Continental Airlines, Inc

Airplane General

WB371

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Introduction

The 777 is designed for ETOPS (extended range operations with two-engine airplanes). It is for medium and long range flights. The 777 size is between a 767-300 and a 747-400.

Features

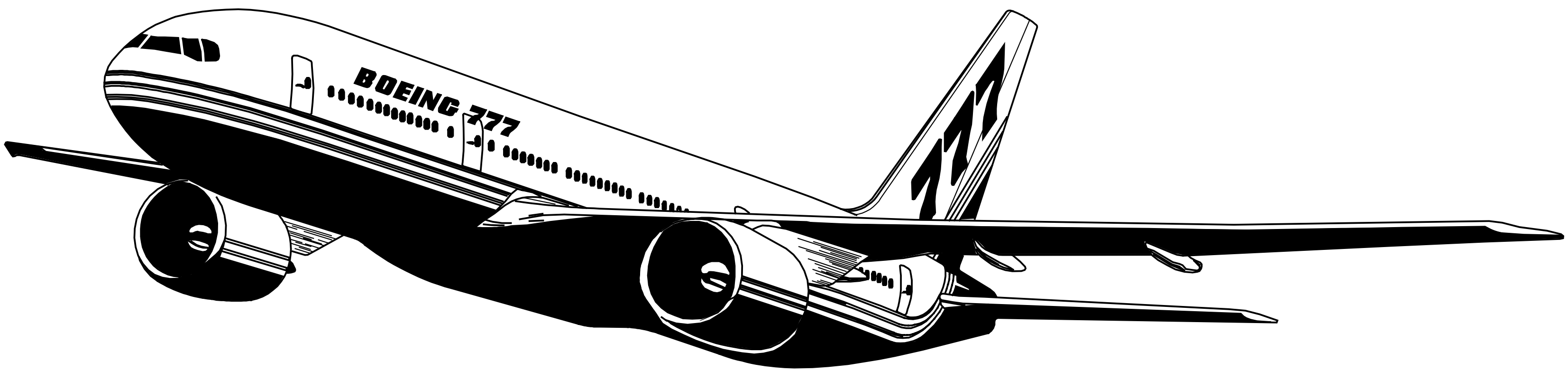
These are the major features of the 777:

- Two-crew flight deck
- Digital avionics
- Flat panel liquid crystal displays
- Fly-by-wire technology
- ARINC 629 data buses
- Ultrasonic fuel quantity measurement
- Six-wheel landing gear trucks with steering
- A combined air data inertial reference system
- Fiber optic technology
- Cabin management system
- Airplane information management system (AIMS) which combines many avionics functions.

Abbreviations and Acronyms

ACMP - AC motor pump
ACP - audio control panel
ADF - automatic direction finder
ADP - air-driven pump
ADIRS - air data inertial reference system
ADIRU - air data inertial reference unit
AFDS - autopilot flight director system
AIMS - airplane information management system
APU - auxiliary power unit
ARINC - Aeronautical Radio, Inc.
ASG - ARINC signal gateway
ATC - air traffic control
BPS - bits per second
BSU - bypass switch unit
CACP - cabin area control panel
CAH - cabin attendant handset
CCD - cursor control device
CDU - control display unit
CIS - cabin interphone system
CMCS - central maintenance computing system
CMS - cabin management system
CSCP - cabin system control panel
DME - distance measuring equipment
EDP - engine-driven pump
EFIS - electronic flight instrument system
EICAS - engine indication and crew alerting system
EPAS - emergency power assist system
ESDS - electrostatic discharge sensitive
ETOPS - extended range operations with two-engine airplanes
FCR - flight crew rest
FDH - flight deck handset
GPS - global positioning system
HF - high frequency

HLCS	-	high lift control system
IDG	-	integrated drive generator
IGW	-	increased gross weight
ILS	-	instrument landing system
KBPS	-	kilobits per second
LAN	-	local area network
LRU	-	line replaceable unit
MAT	-	maintenance access terminal
MBPS	-	megabits per second
MEC	-	main equipment center
mic	-	microphone
OLAN	-	onboard local area network
OPAS	-	overhead panel ARINC 629 system
OPBC	-	overhead panel bus controller
OPCF	-	overhead panel card file
PAX TEL	-	passenger telephone
PDCU	-	panel data concentrator unit
PES	-	passenger entertainment system
PFCS	-	primary flight control system
PMAT	-	portable MAT
RA	-	radio altitude
RAT	-	ram air turbine
RS	-	recommended standard
RTP	-	radio tuning panel
SAARU	-	secondary attitude air data reference unit
SATCOM	-	satellite communication
SCF	-	system card file
TAC	-	thrust asymetry compensation
TCAS	-	traffic alert and collision avoidance system
VHF	-	very high frequency
VOR	-	VHF omni range
WPS	-	words per second



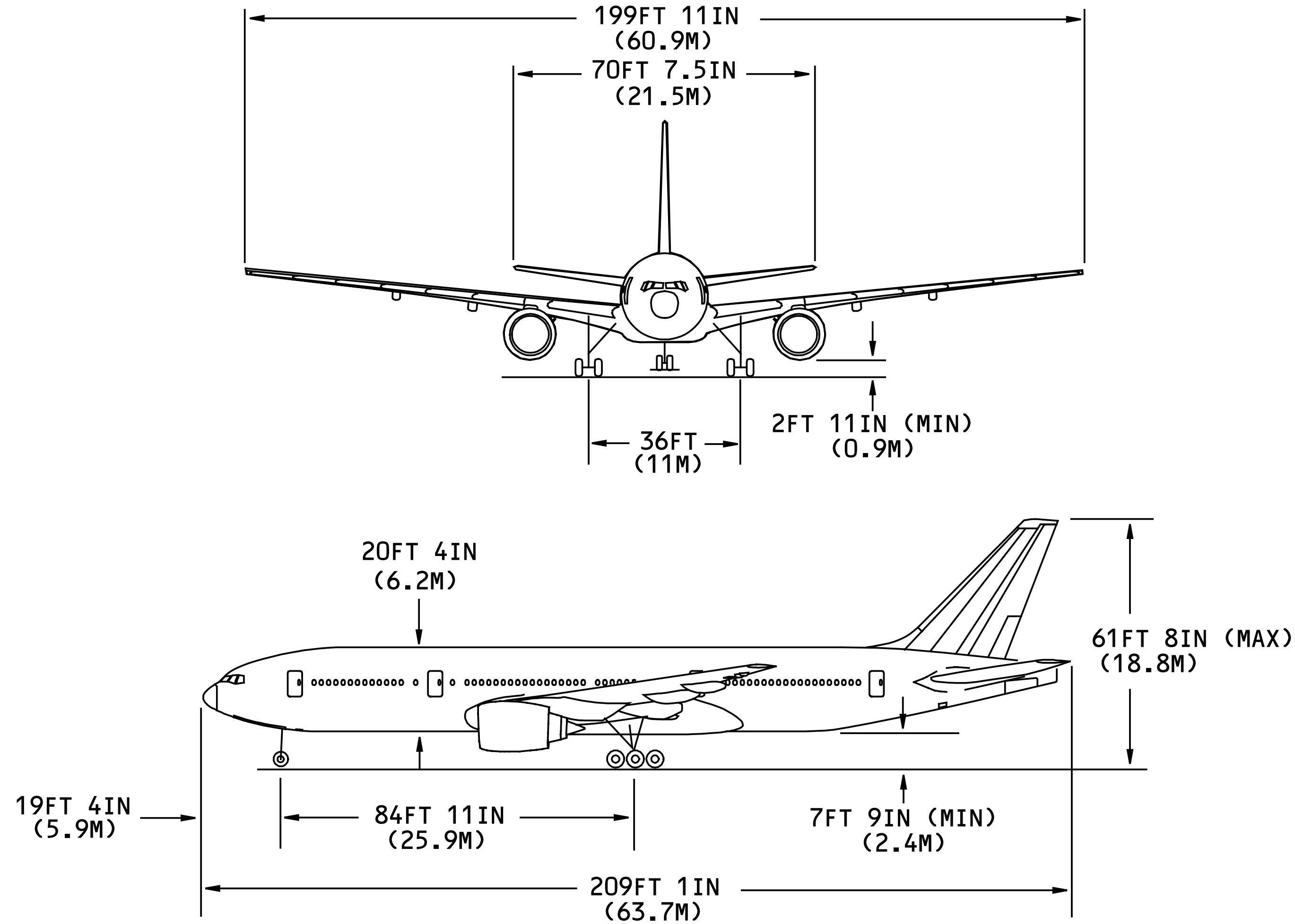
00-00-00-001 Rev 5

777 GENERAL - INTRODUCTION

777 GENERAL - PRINCIPAL DIMENSIONS

777 Principal Dimensions

These are the principal dimensions of the 777-200 increased gross weight (IGW) airplane on a front and side view.



777 GENERAL - PRINCIPAL DIMENSIONS

General Arrangement

The fuselage has these six manufacturing sections:

- Section 41
- Section 43
- Section 44
- Section 46
- Section 47
- Section 48

Section 41 (STA 92.5 - 655)

Section 41 contains these:

- Flight deck
- Radome
- Forward pressure bulkhead
- Forward equipment center
- Nose gear wheel well
- Main equipment center
- Forward entry doors (2)
- Forward cargo compartment.

Section 43 (STA 655 - 1035)

Section 43 contains these:

- Aft part of the forward cargo compartment
- Main entry doors (2).

Section 44 (STA1035 - 1434)

Section 44 is the center portion of the fuselage. It contains these:

- Keel beam
- Main gear wheel wells (2).

Section 46 (STA 1434 - 1832)

Section 46 contains these:

- Main entry doors (2)
- Aft cargo compartment.

Section 47 (STA 1832 - 2150)

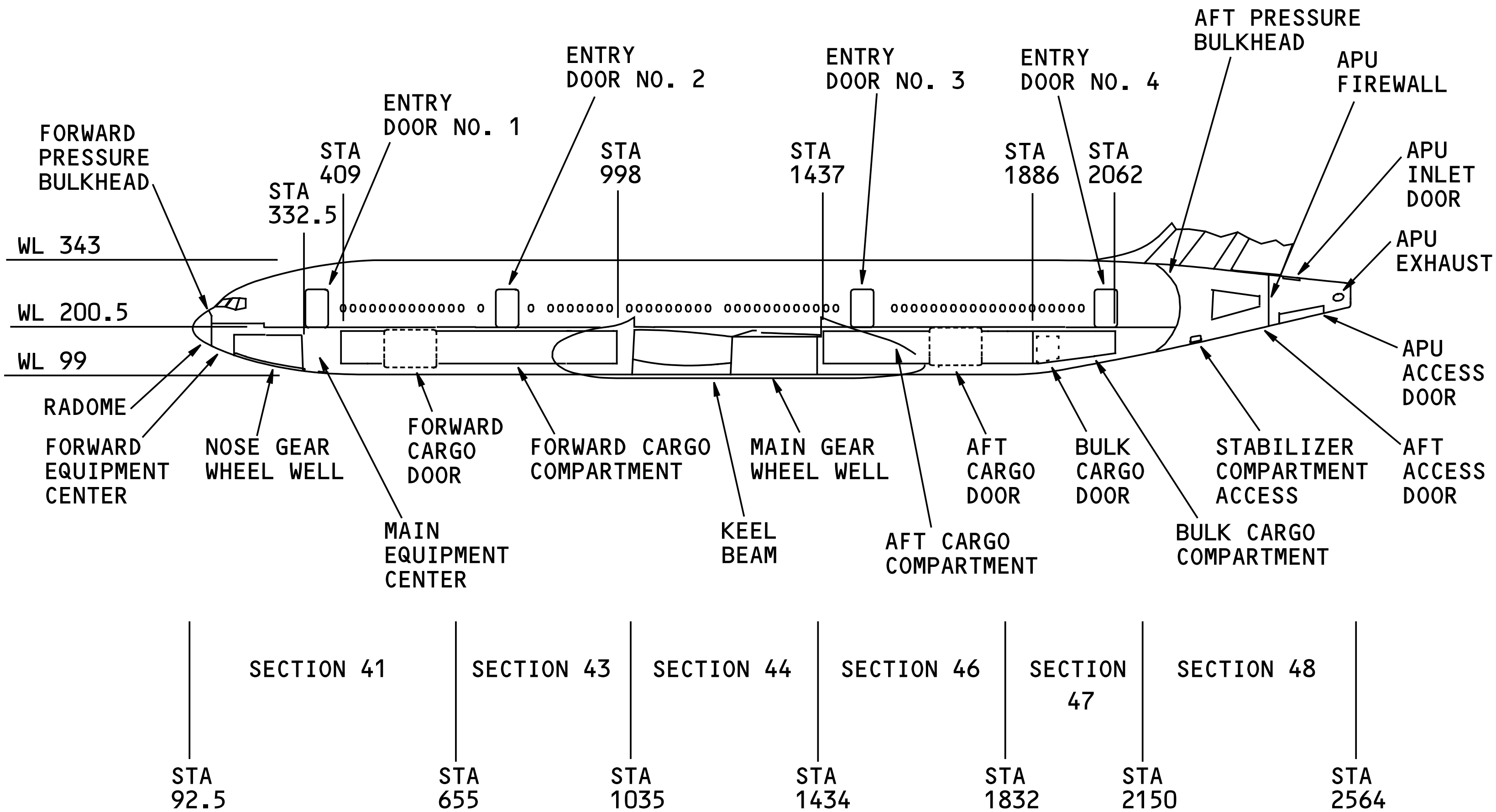
Section 47 contains these:

- Aft entry doors (2)
- Bulk cargo compartment.

Section 48 (STA 2150 - 2564)

Section 48 contains these:

- Aft pressure bulkhead
- Stabilizer compartment access door
- Auxiliary power unit (APU) firewall
- APU inlet and exhaust
- APU access doors
- Aft access door.



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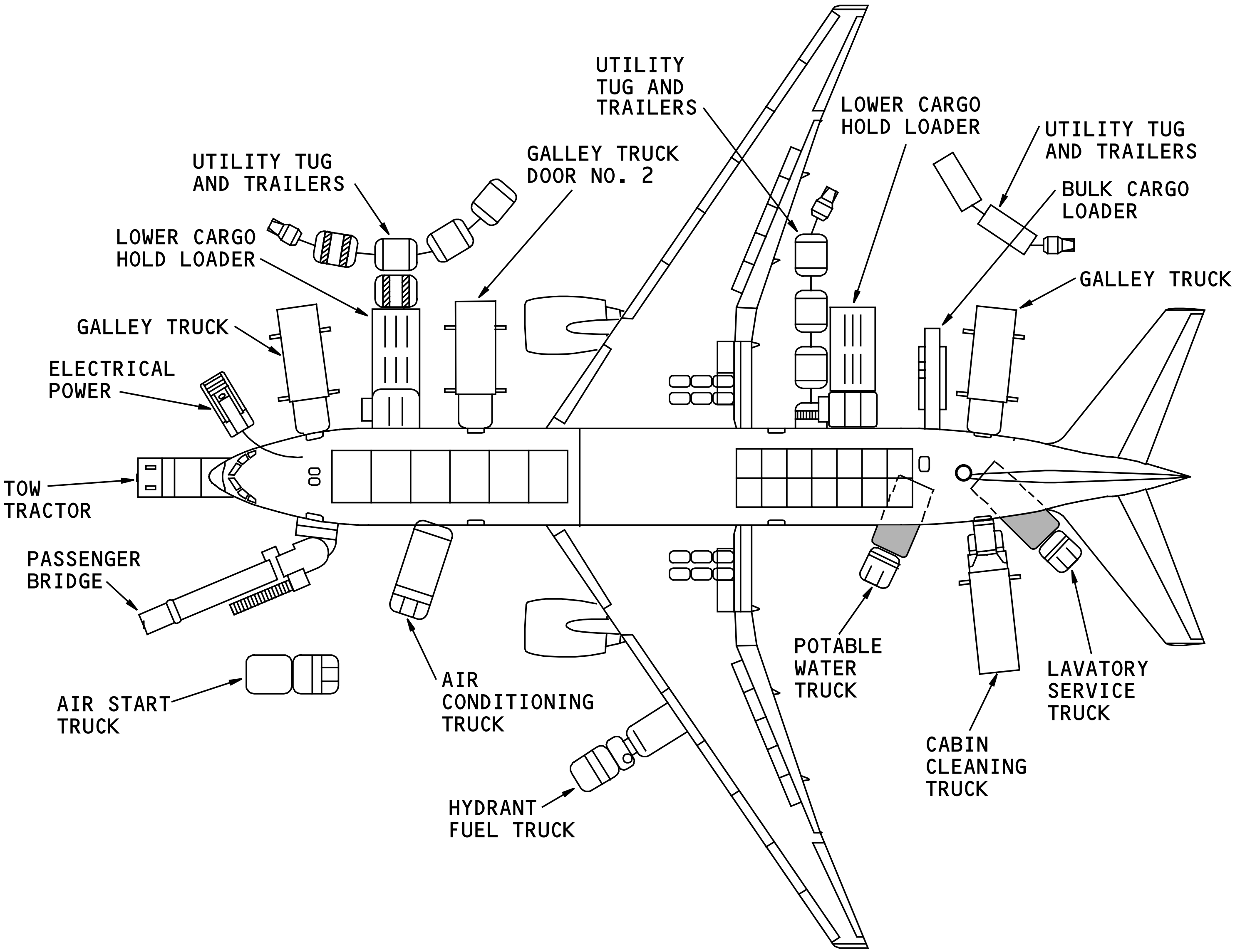
777 GENERAL - GENERAL ARRANGEMENT

General

The locations of doors, service connections, and access panels make it possible to do servicing of many systems at the same time.



777 GENERAL - AIRPLANE SERVICING

777 GENERAL - FLIGHT CONTROL SURFACES

General

There are two flight controls systems. They are the primary flight control system and the high lift control system.

Primary Flight Control System (PFCS)

The control surfaces of the PFCS are:

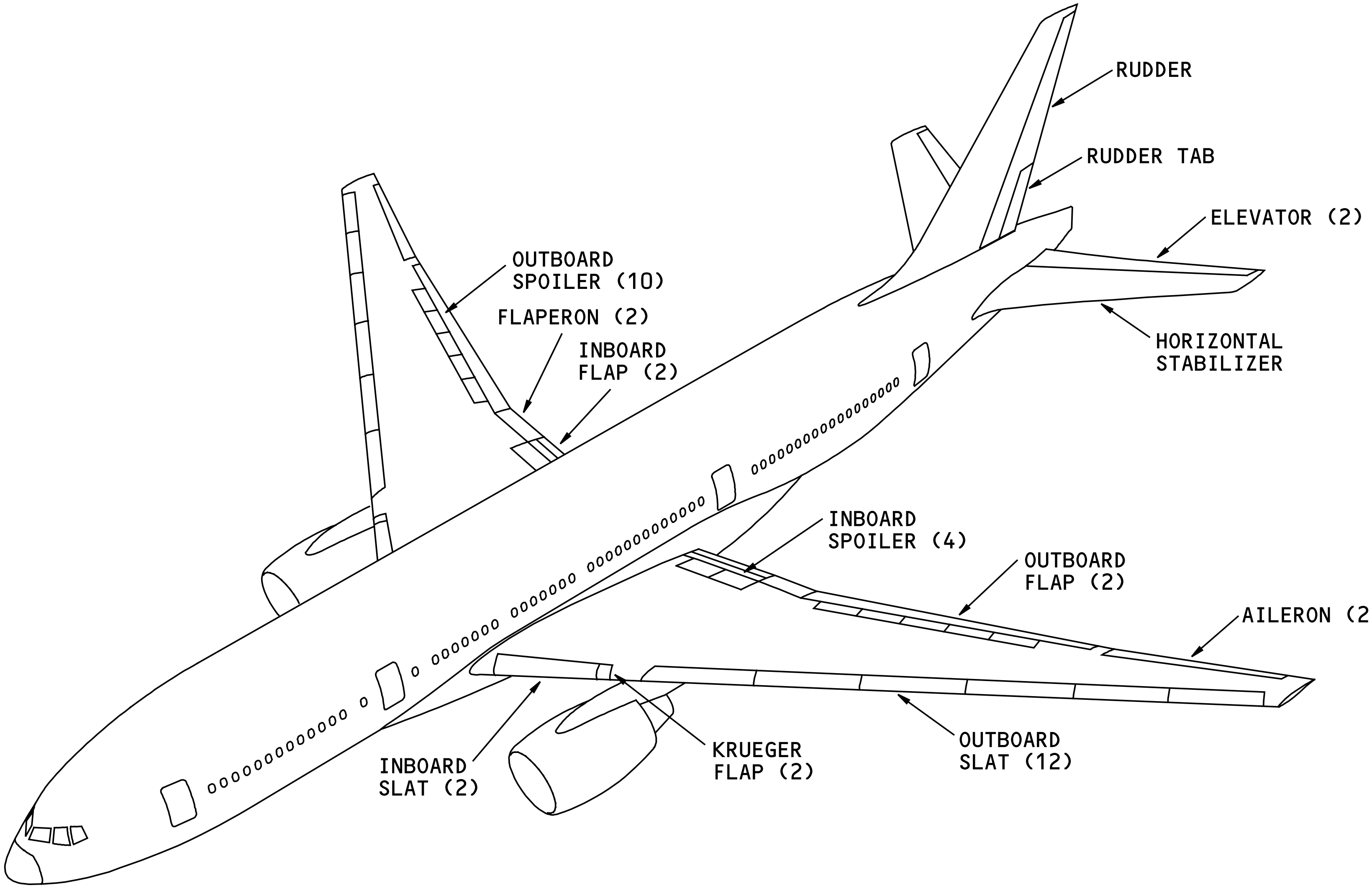
- One aileron on each wing
- One flaperon on each wing
- Seven spoilers on each wing
- One horizontal stabilizer
- One elevator on each side of the horizontal stabilizer
- One rudder (with tab).

High Lift Control System (HLCS)

The high lift devices of the HLCS are:

- Seven leading edge slats on each wing
- One Krueger flap on each wing
- One outboard flap on each wing
- One inboard flap on each wing.

Operation of the HLCS also causes the ailerons and the flaperons to move. They droop on both wings when the high lift devices extend.



00-00-00-005 Rev 1

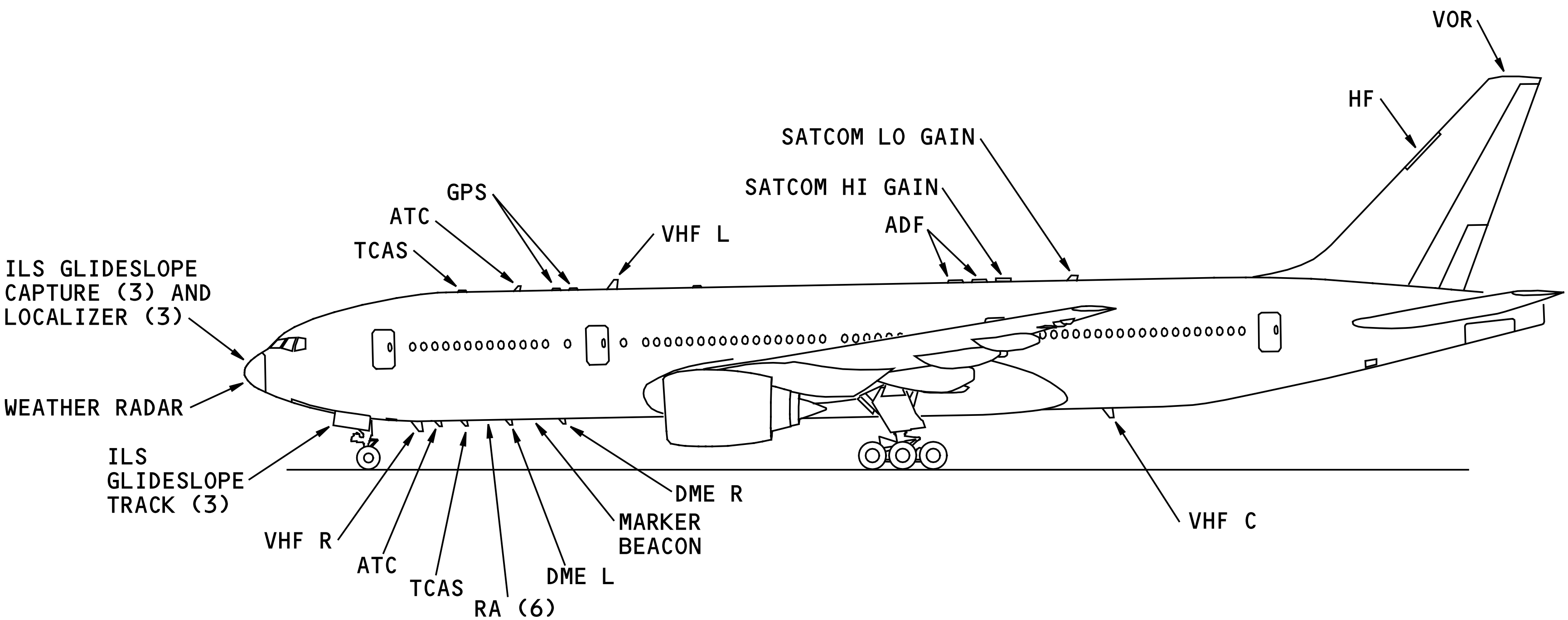
777 GENERAL - FLIGHT CONTROL SURFACES

777 GENERAL - ANTENNA LOCATIONS

Antenna Locations

These are the communication and navigation system antennas:

- Weather Radar
- TCAS (traffic alert and collision avoidance system)
- ATC (air traffic control)
- GPS (global positioning system)
- VHF (very high frequency) communication
- SATCOM (satellite communication)
- ADF (automatic direction finder)
- HF (high frequency) communication
- VOR (VHF omni range)
- Marker beacon
- RA (radar altimeter)
- DME (distance measuring equipment)
- ILS (instrument landing system).



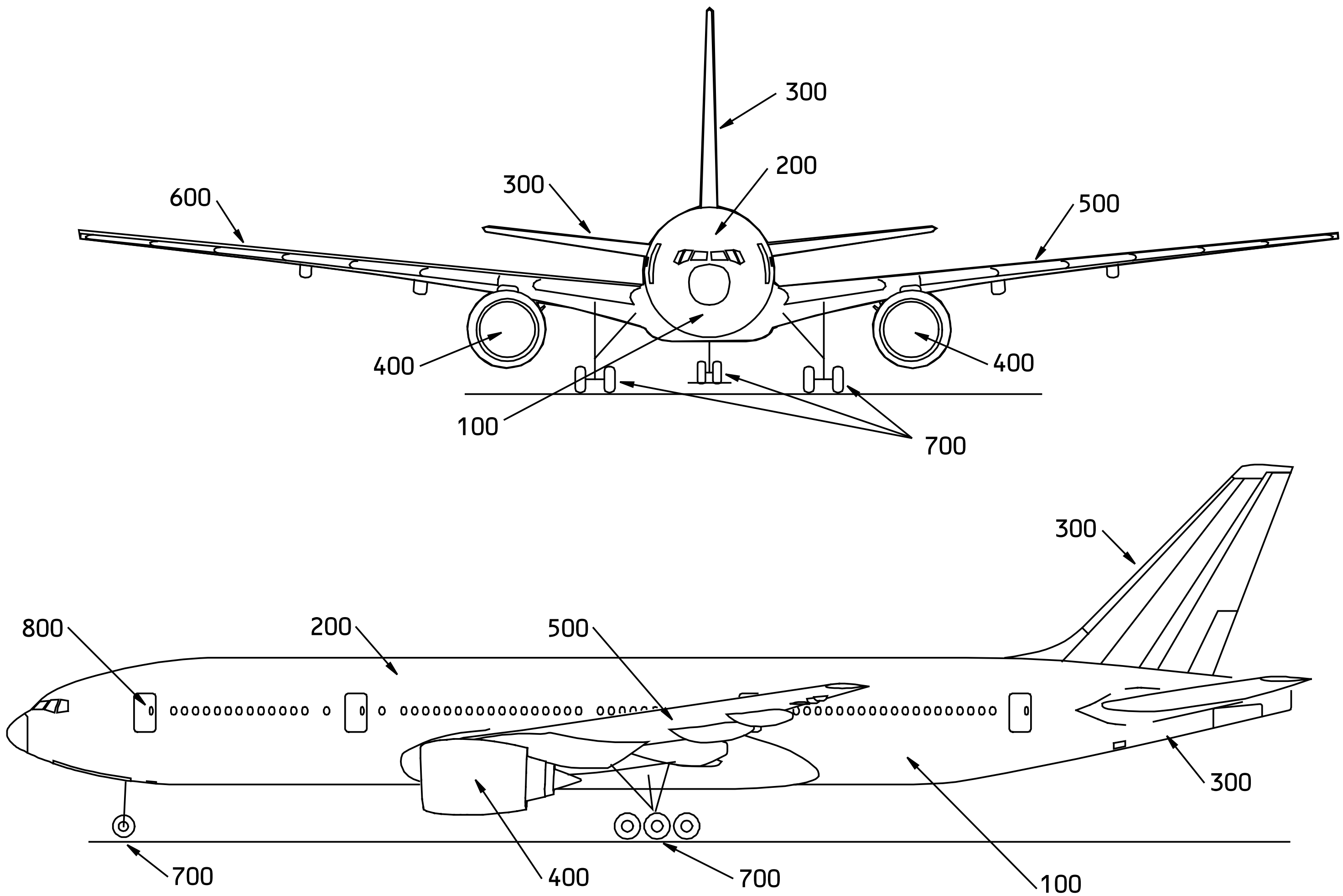
777 GENERAL - ANTENNA LOCATIONS

777 GENERAL - ZONE DIAGRAMS - AIRPLANE MAJOR ZONES

General

The 777 airplane has 8 major zones to help you find and identify airplane components and parts. These are the major zones:

- 100 - lower half of the fuselage
- 200 - upper half of the fuselage
- 300 - empennage and body section 48
- 400 - power plants and nacelle struts
- 500 - left wing
- 600 - right wing
- 700 - landing gear and landing gear doors
- 800 - passenger and cargo compartment doors.



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777 GENERAL - ZONE DIAGRAMS - AIRPLANE MAJOR ZONES

777 GENERAL - ZONE DIAGRAMS - SUBZONES AND ZONES

General

The eight major zones have subzones and the subzones have zones. A three-digit number shows the major zone, subzones, and zones this way:

- Major zone - the first digit is a number from 1 to 8 with two zeros after
- Subzone - the first digit is the major zone number, the second digit is a number from 1 to 9, and the third digit is zero
- Zone - the first two digits are the subzone number and the third digit shows a component or group of components in the subzone.

This is the number sequence for the zones and subzones:

- Wings - inboard to outboard and front to back
- Horizontal stabilizer and elevator - inboard to outboard and front to back
- Vertical stabilizer and rudder - root to tip of vertical stabilizer
- Fuselage - front to back and away from the floor line.

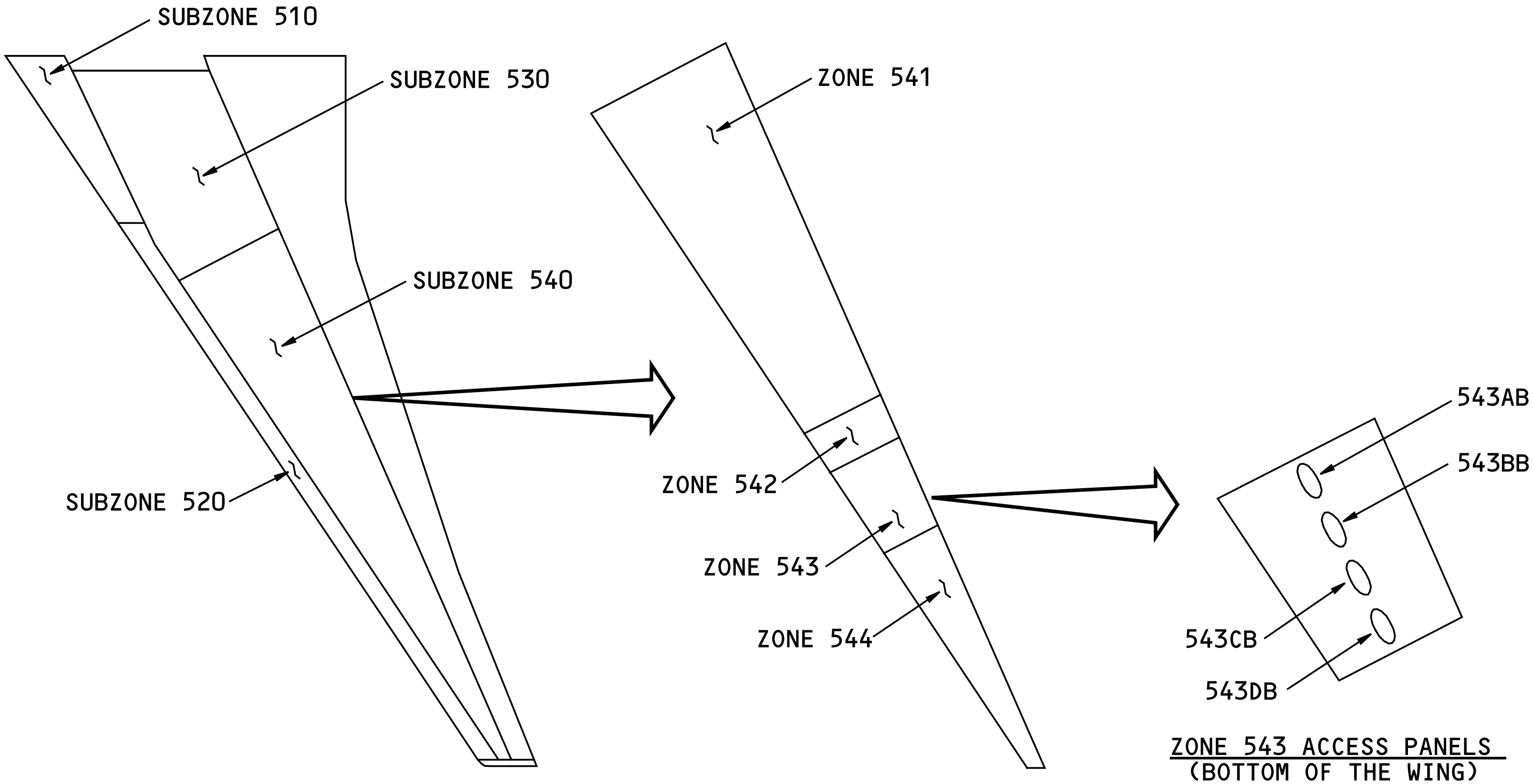
Access Panel Identification

Access doors or panel have five digit alpha-numeric codes. The codes have these parts:

- First three digits: airplane zone
- Fourth digit: a letter that identifies each access door or panel in a zone. If there are more than one access panels in a zone, they have letters (A, B, C, etc.). The letters increase inboard to outboard, bottom to top, and forward to aft.
- Fifth digit: a letter that gives additional location information if the access door or panel is on the top (T), bottom (B), left (L), right (R), internal (Z), ceiling (C), floor panels (F), floor panels (use G when F sequence designation is used), sloping sidewall (S), sidewall (W).

Training Information Point

A small number of access doors or panels have six digit codes. This occurs when a panel is added later in production. In this condition, the first three digits are the zone number. The fourth and fifth digits (letters) designate the panel. The sixth digit gives the additional location information.



SUBZONES OF MAJOR ZONE 500 - LEFT WING

ZONES OF SUBZONE 540

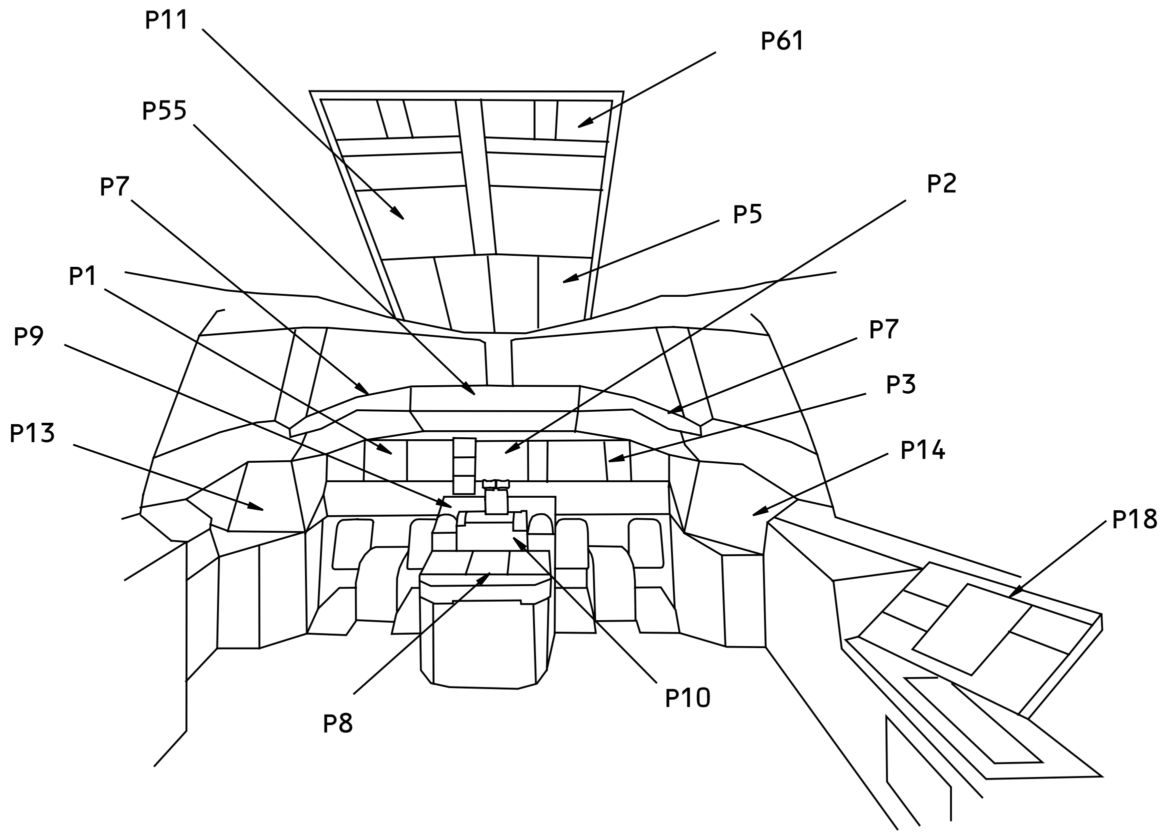
00-00-00-008 Rev 2 09/24/96

777 GENERAL - ZONE DIAGRAMS - SUBZONES AND ZONES

Flight Deck Major Panels

These are the major panels in the flight deck:

- P1 left forward panel
- P2 center forward panel
- P3 right forward panel
- P5 overhead panel
- P7 glareshield panel
- P8 aft aisle stand panel
- P9 forward aisle stand panel
- P10 control stand
- P11 overhead circuit breaker panel
- P13 left sidewall panel
- P14 right sidewall panel
- P18 MAT/second observer panel
- P55 glareshield center panel
- P61 overhead maintenance panel.



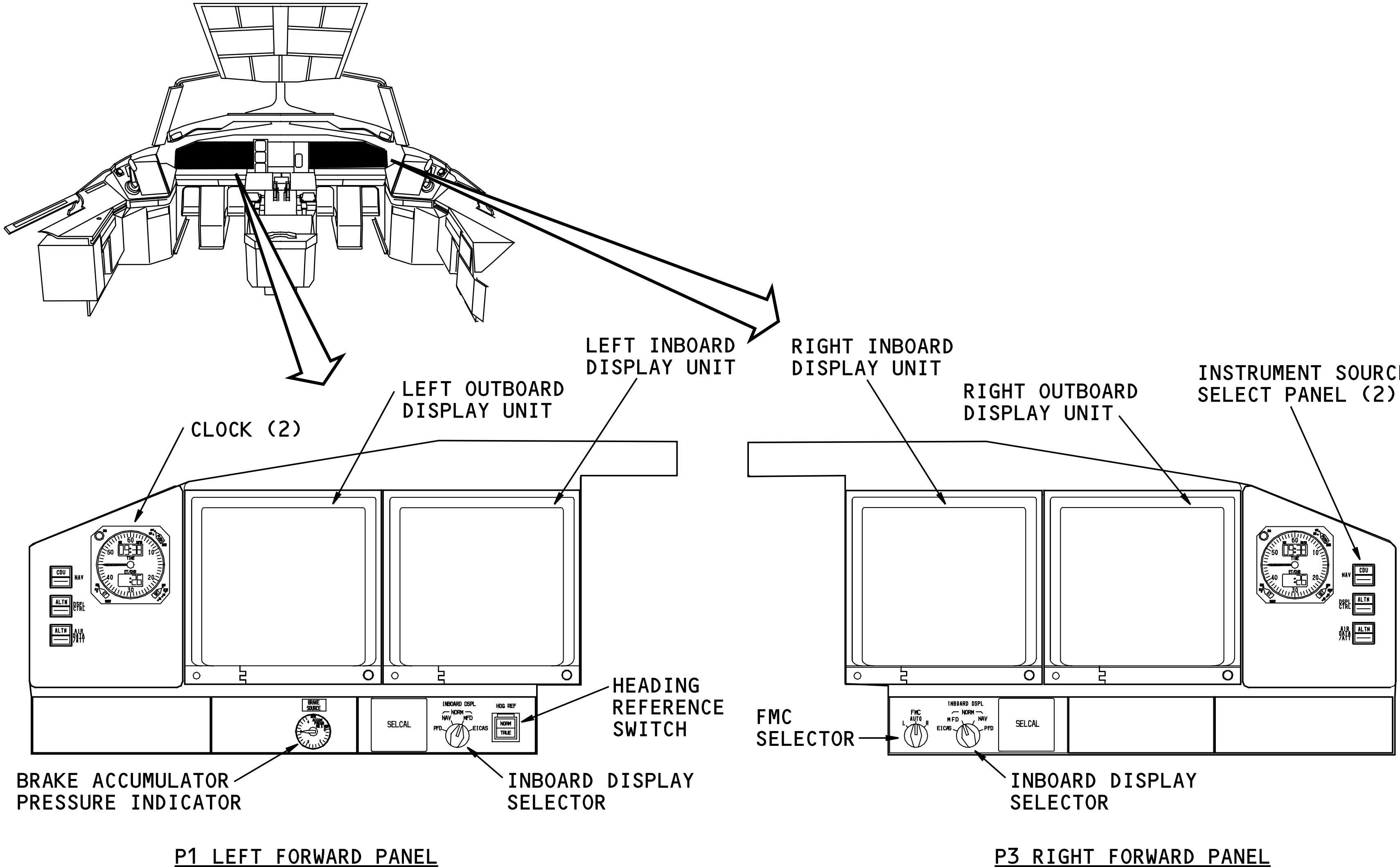
777 GENERAL - FLIGHT DECK

777 GENERAL - MAIN INSTRUMENT PANELS

General

The main instrument panels (P1 and P3) have these displays and controls:

- Display units (4)
- Instrument source select panels (2)
- Clocks (2)
- Inboard display selectors (2)
- FMC selector
- Heading reference switch
- Brake accumulator pressure indicator.



00-00-00-010 Rev 1 12/12/95

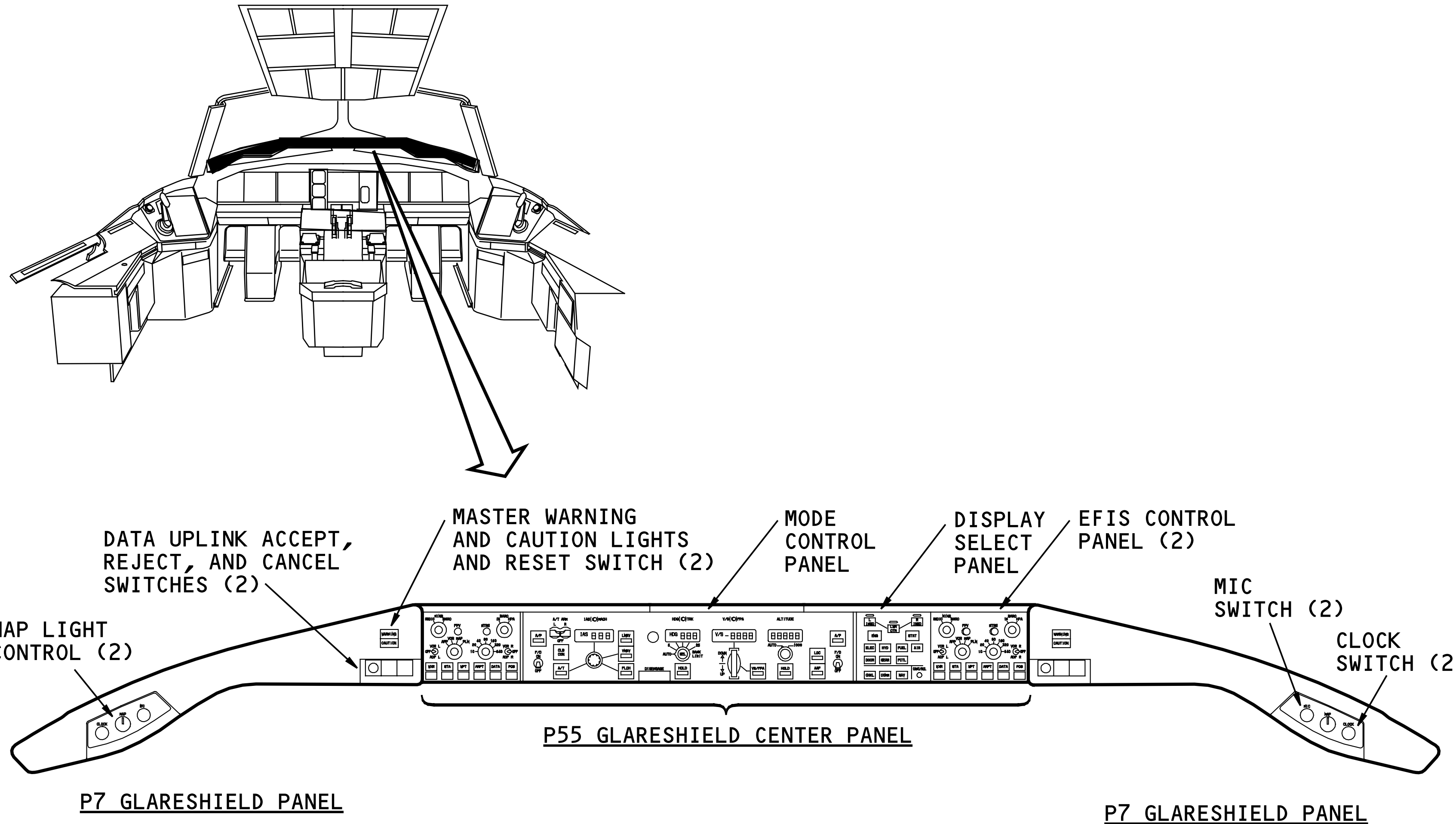
777 GENERAL - MAIN INSTRUMENT PANELS

777 GENERAL - GLARESHIELD PANELS

General

The glareshield panels have these controls:

- Master warning and caution lights (2)
- Master warning and caution reset switches (2)
- Mode control panel
- EFIS control panels (2)
- Display select panel
- Data uplink switches (2)
- Map light controls (2)
- MIC switches (2)
- Clock switches (2).



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777 GENERAL - GLARESHIELD PANELS

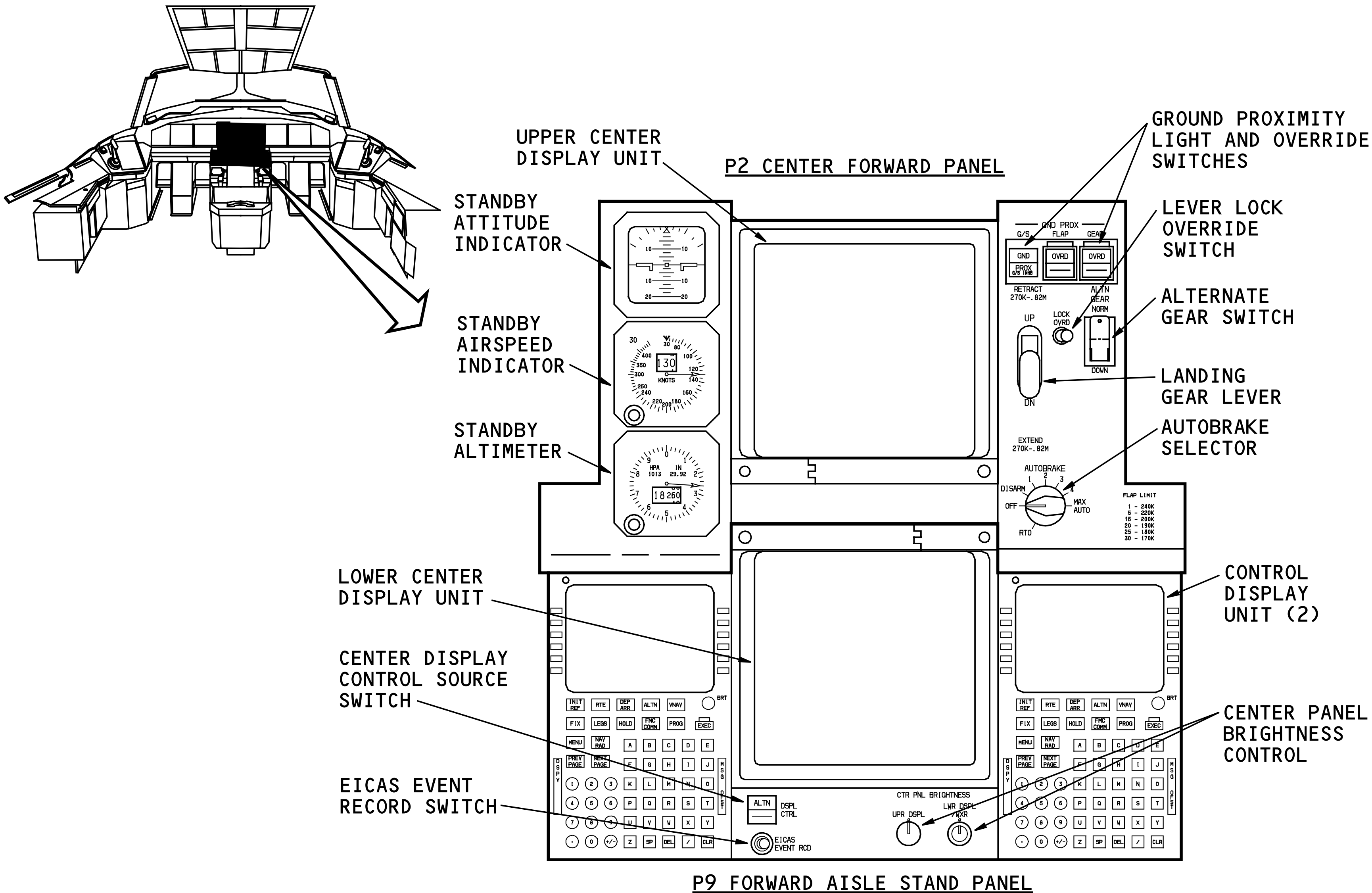
777 GENERAL - P2 CENTER FORWARD AND P9 FORWARD AISLE STAND PANELS

General

The P2 center forward and P9 forward aisle stand panels have these controls:

- Standby instruments (3)
- Display units (2)
- Ground proximity light and override switches
- Landing gear lever
- Autobrake selector
- Control display units (2)
- Center panel brightness control
- EICAS event record switch
- Center display control source switch.

Note that the lower center display unit is reversed (top to bottom) from the other five display units.



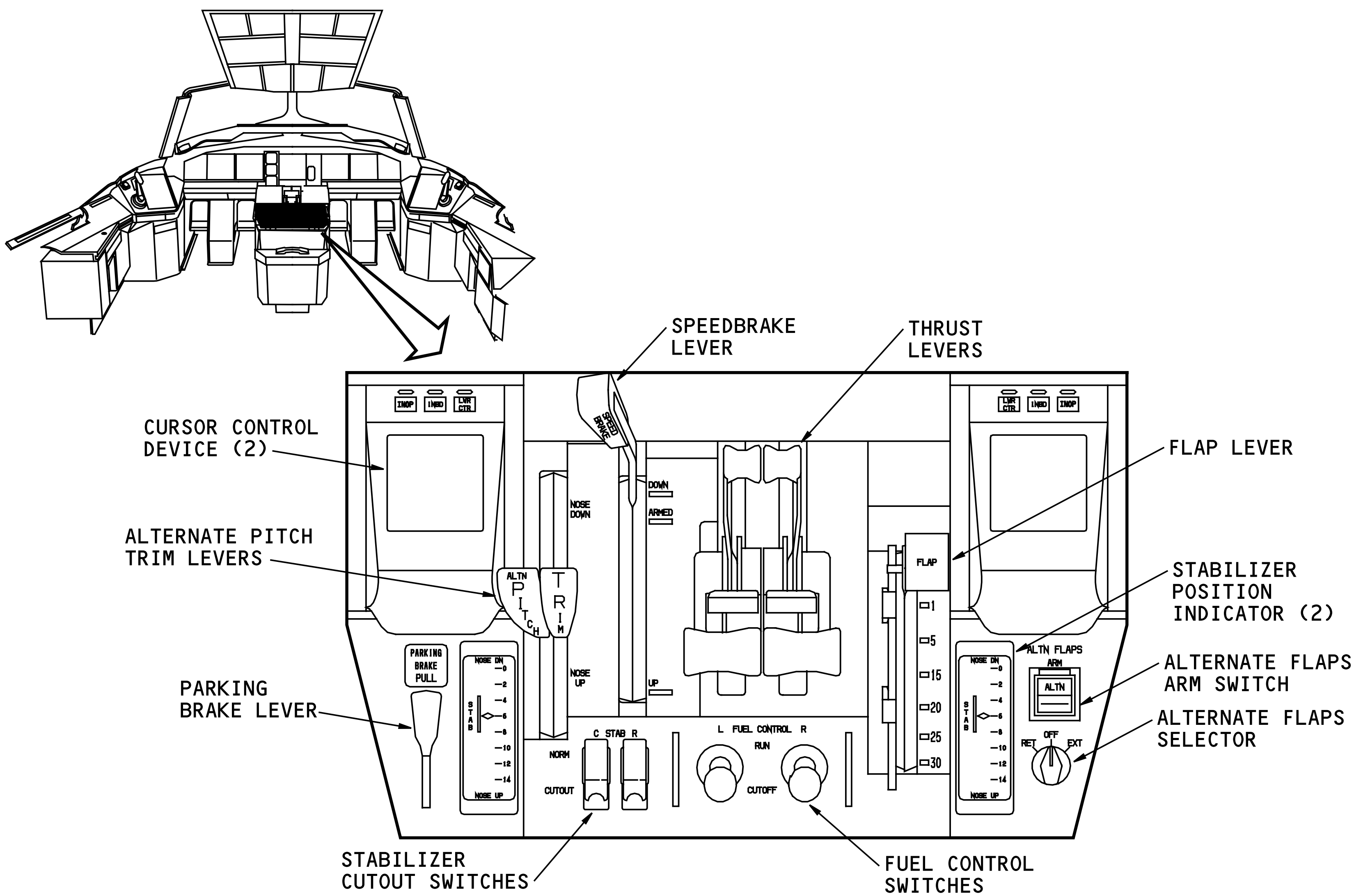
777 GENERAL - P2 CENTER FORWARD AND P9 FORWARD AISLE STAND PANELS

777 GENERAL - P10 CONTROL STAND

General

The P10 control stand has these controls and indications:

- Speedbrake lever
- Thrust levers(2)
- Stabilizer position indicators (2)
- Alternate flaps arm switch
- Alternate flaps selector
- Fuel control switches (2)
- Stabilizer cutout switches (2)
- Parking brake lever
- Alternate pitch trim levers
- Cursor control devices (2)
- Flap lever.



P10 CONTROL STAND

777 GENERAL - P10 CONTROL STAND

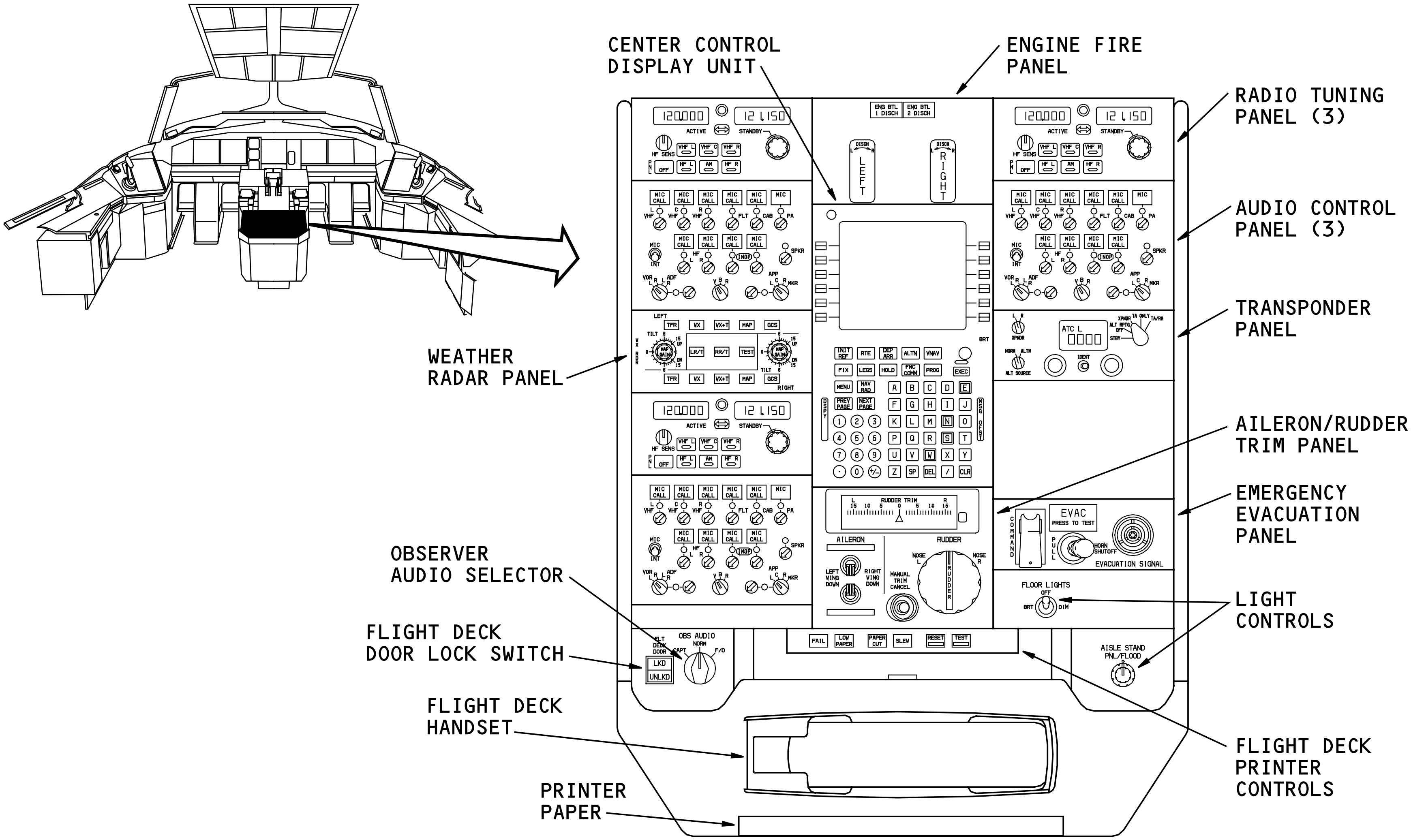
00-00-00-013 Rev 2 10/02/96

777 GENERAL - P8 AFT AISLE STAND PANEL

General

The P8 aft aisle stand panel has these controls:

- Control display unit
- Engine fire panel
- Radio tuning panels (3)
- Audio control panels (3)
- Transponder panel
- Aileron/rudder trim panel
- Light controls
- Flight deck printer
- Flight deck handset
- Observer audio selector
- Flight deck door lock switch
- Weather radar panel.



P8 AFT AISLE STAND PANEL

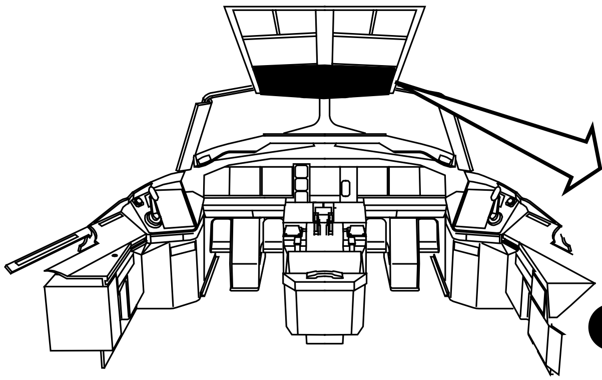
777 GENERAL - P8 AFT AISLE STAND PANEL

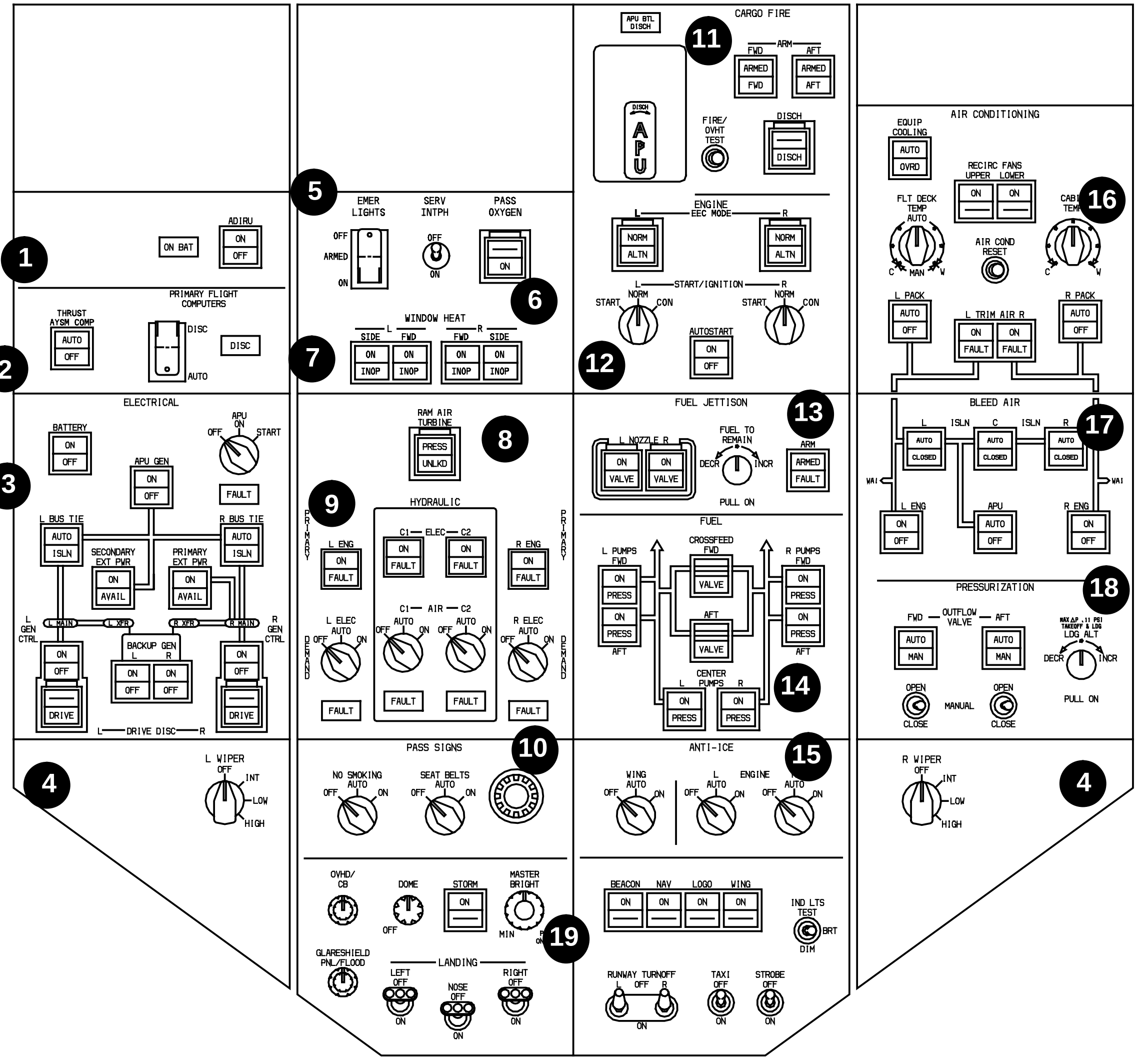
777 GENERAL - P5 OVERHEAD PANEL

General

The P5 overhead panel has controls for these functions (reference numbers on graphic):

- 1. Air data inertial reference system (ADIRS)
- 2. Primary flight computers
- 3. Electrical system/APU
- 4. Wiper control
- 5. Emergency lighting
- 6. Passenger oxygen
- 7. Window heat
- 8. Ram air turbine
- 9. Hydraulic system
- 10. Passenger signs
- 11. APU and cargo fire
- 12. Engine start
- 13. Fuel jettison
- 14. Fuel management
- 15. Anti-ice system
- 16. Air conditioning
- 17. Bleed air system
- 18. Pressurization control
- 19. Lighting





P5 OVERHEAD PANEL

777 GENERAL - P5 OVERHEAD PANEL

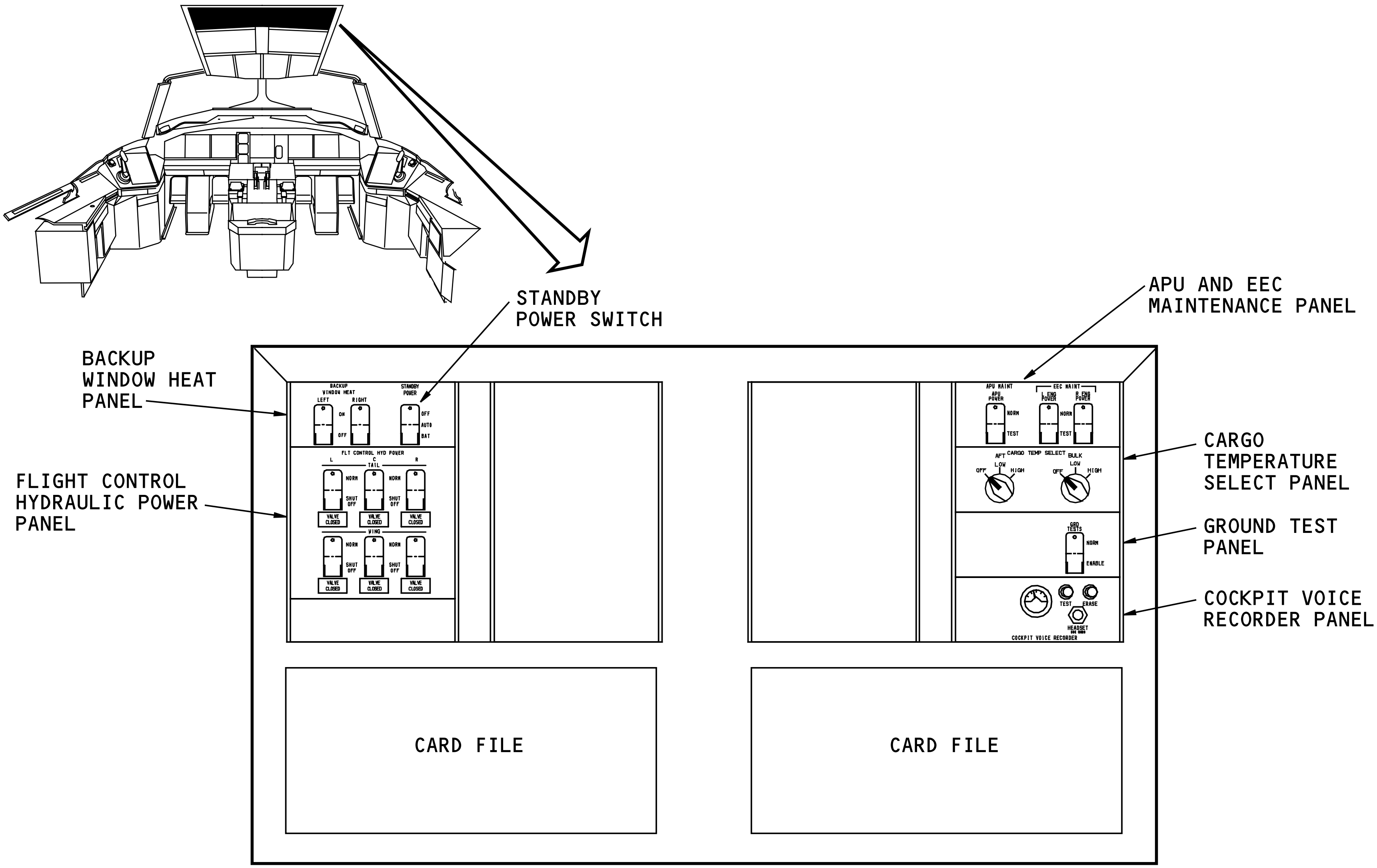
777 GENERAL - P61 OVERHEAD MAINTENANCE PANEL

General

The P61 overhead maintenance panel has control functions used normally only by maintenance personnel. The P61 overhead maintenance panel has these controls:

- Backup window heat switches
- Standby power switch
- Flight control shutoff switches
- APU and EEC maintenance panel
- Cargo temperature select panel
- Ground test switch
- Cockpit voice recorder panel.

The P61 panel also has the card files which contain the multiplexers for the overhead panel ARINC 629 system (OPAS).



P61 OVERHEAD MAINTENANCE PANEL

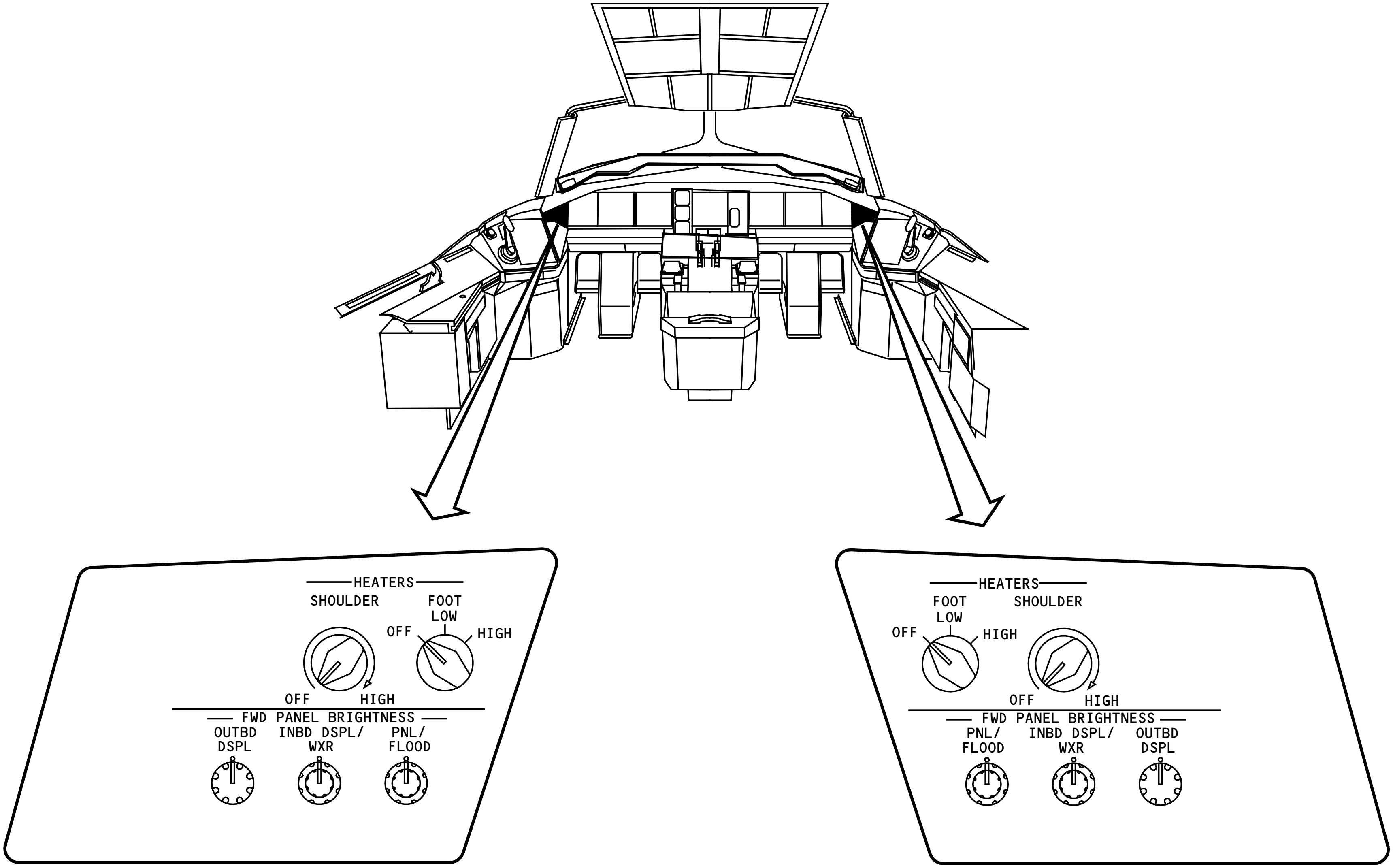
777 GENERAL – P61 OVERHEAD MAINTENANCE PANEL

777 GENERAL - P13 AND P14 SIDEWALL PANELS

General

The sidewall panels have these controls:

- Shoulder heater (2)
- Foot heater (2)
- Outboard display brightness (2)
- Inboard display weather radar (2)
- Panel flood light (2).



P13 LEFT SIDEWALL PANEL

P14 RIGHT SIDEWALL PANEL

777 GENERAL - P13 AND P14 SIDEWALL PANELS

00-00-00-061 Rev 2 05/30/96

777 GENERAL - P18 MAT/SECOND OBSERVER PANEL

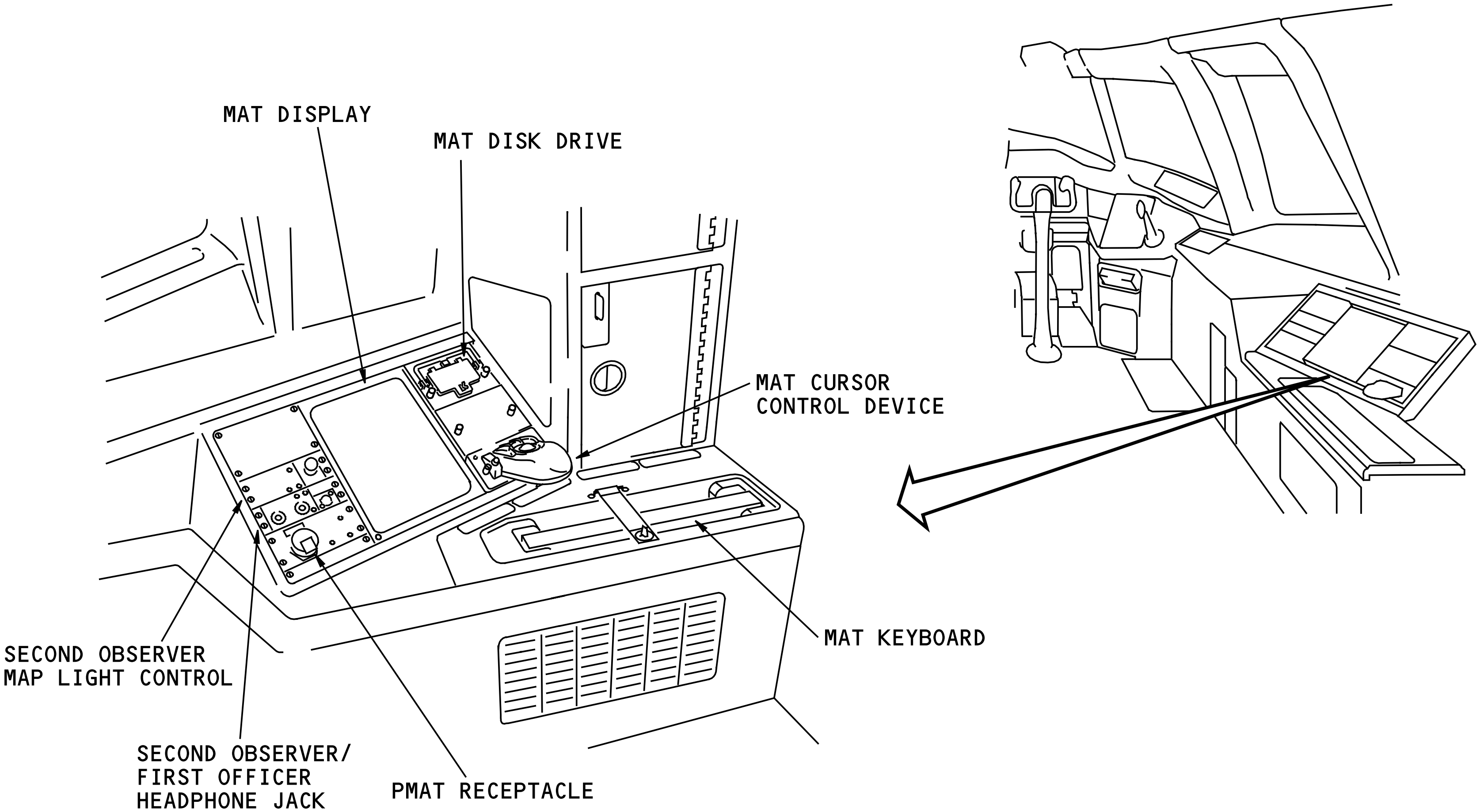
General

The MAT/second observer panel has these maintenance access terminal (MAT) items:

- MAT display
- MAT disk drive
- MAT cursor control device (CCD)
- MAT keyboard
- Portable MAT (PMAT) receptacle.

The panel also has these second observer controls:

- Map light control
- Headphone jack.



00-00-00-017 Rev 1

777 GENERAL - P18 MAT/SECOND OBSERVER PANEL

777 GENERAL - EQUIPMENT CENTER AND RACKS - INTRODUCTION

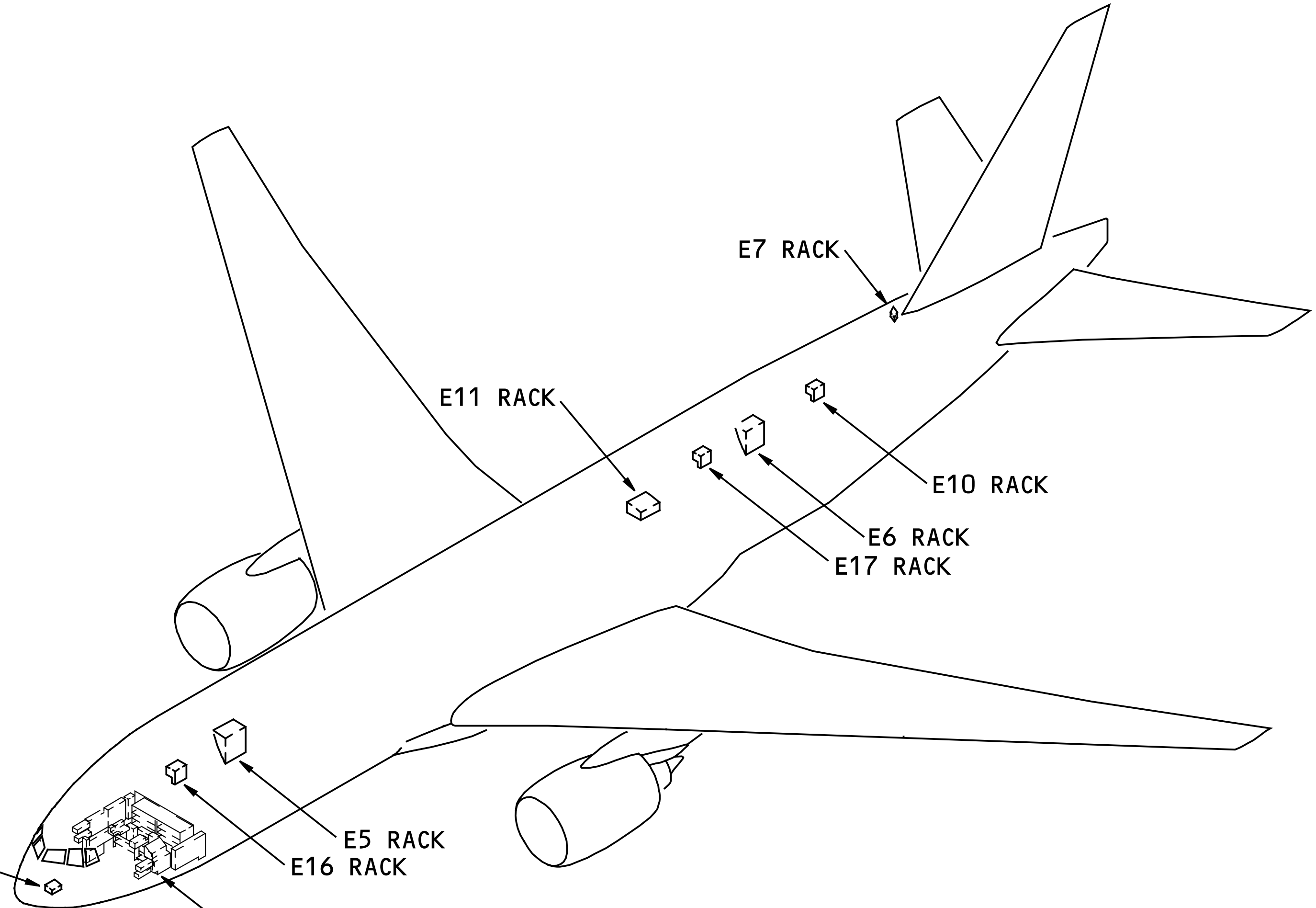
Equipment Centers

The main equipment center is aft of the nose wheel well. The forward equipment center is forward of the nose wheel well.

The E16 rack is forward and the E5 rack is aft of the forward cargo door. The E17 rack is forward and the E6 rack is aft of the aft cargo door.

The E11 and E7 racks are overhead in the passenger compartment.

The E10 rack is in the bulk cargo compartment aft of the bulk cargo door.



777 GENERAL - EQUIPMENT CENTER AND RACKS - INTRODUCTION

Main Equipment Center Electronics

The main equipment center (MEC) contains most of the electronics equipment on the airplane. The electronics equipment in the MEC is on the E1, E2, E3, and E4 racks. The equipment in the MEC includes electronics for these functions:

- Information management
- Generator control
- Transformer rectifier
- Flight control and autopilot
- Environmental control
- Recording
- Navigation
- Communication
- Cabin management
- Weight and balance
- Air data
- Inertial data
- Warning
- Proximity sensing
- Engine control.

Power Management

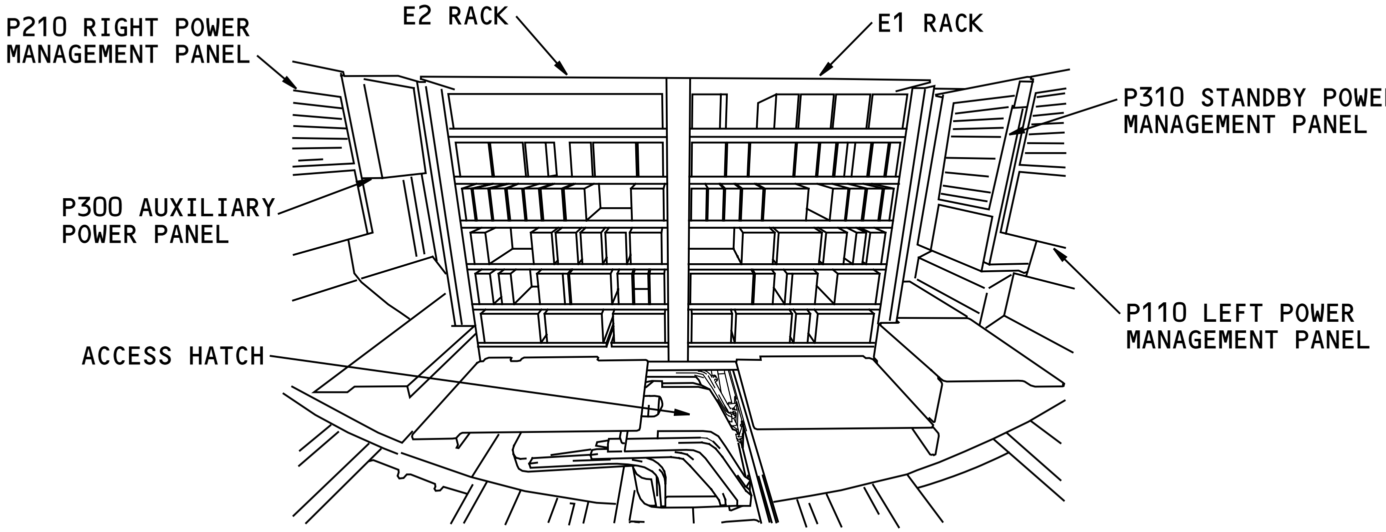
The MEC also contains these components for the electrical loads management system (ELMS):

- Power panels
- Power management panels.

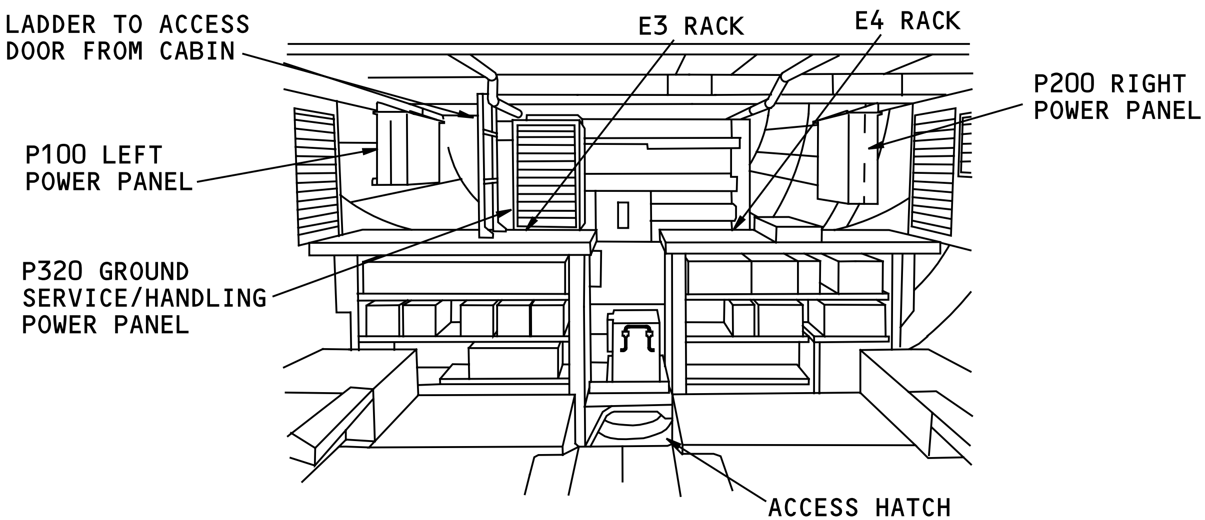
Access to the Main Equipment Center

Access to the MEC is through these:

- Access hatch in the bottom of the airplane
- Access hatch in the passenger compartment
- Door from the forward cargo compartment.



LOOKING AFT



LOOKING FORWARD

777 GENERAL - MAIN EQUIPMENT CENTER - 1

777 GENERAL - MAIN EQUIPMENT CENTER - 2

General

The systems card files hold interface cards for systems that use ARINC 429 buses.

These are the two systems card files in the main equipment center:

- P85 left systems card file (LSCF)
- P84 right systems card file (RSCF).

P85 Left Systems Card File

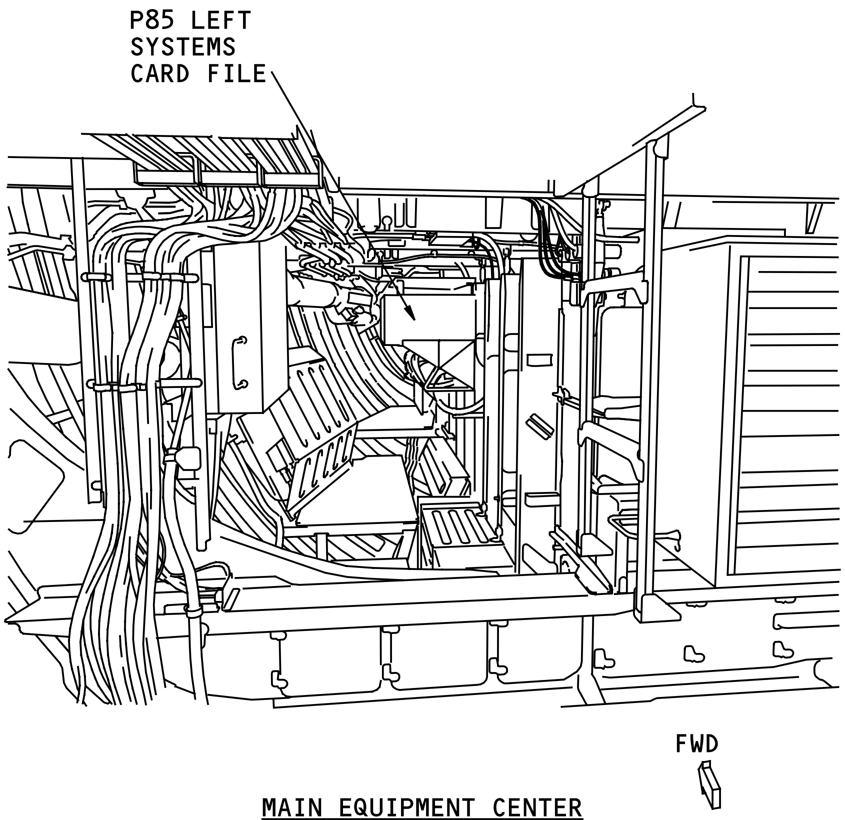
The LSCF has cards for these systems:

- Power supply units (PSUs)
- Hydraulic interface modules (HYDIMs)
- Duct leak and overheat detection system (DLODS)
- Airfoil and cowl ice protection system (ACIPS)
- APU fire/overheat detection
- Left engine fire/overheat detection
- ARINC 629 signal gateway (ASG)
- Environmental control system (ECS)
- Weight on wheels (WOW).

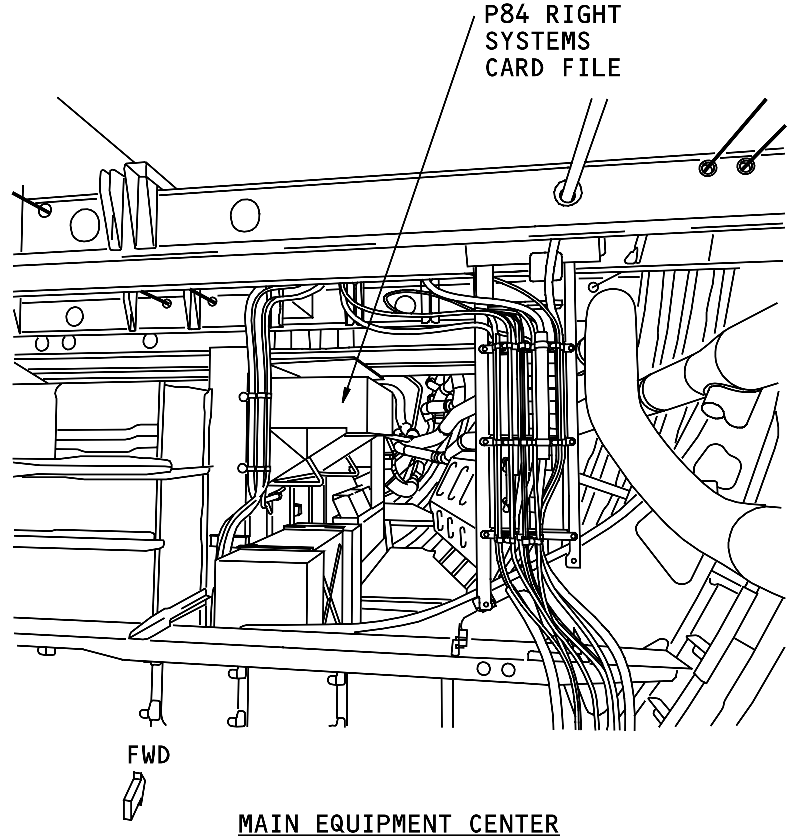
P84 Right Systems Card File

The RSCF has cards for these systems:

- Power supply units (PSUs)
- Hydraulic interface modules (HYDIMs)
- Duct leak and overheat detection system (DLODS)
- Airfoil and cowl ice protection system (ACIPS)
- Right engine fire/overheat detection
- ARINC 629 signal gateway (ASG)
- Environmental control system (ECS)
- Weight on wheels (WOW).



MAIN EQUIPMENT CENTER
(LEFT SIDE, LOOKING FORWARD)



MAIN EQUIPMENT CENTER
(RIGHT SIDE, LOOKING FORWARD)

00-00-00-020 Rev 3 02/22/95

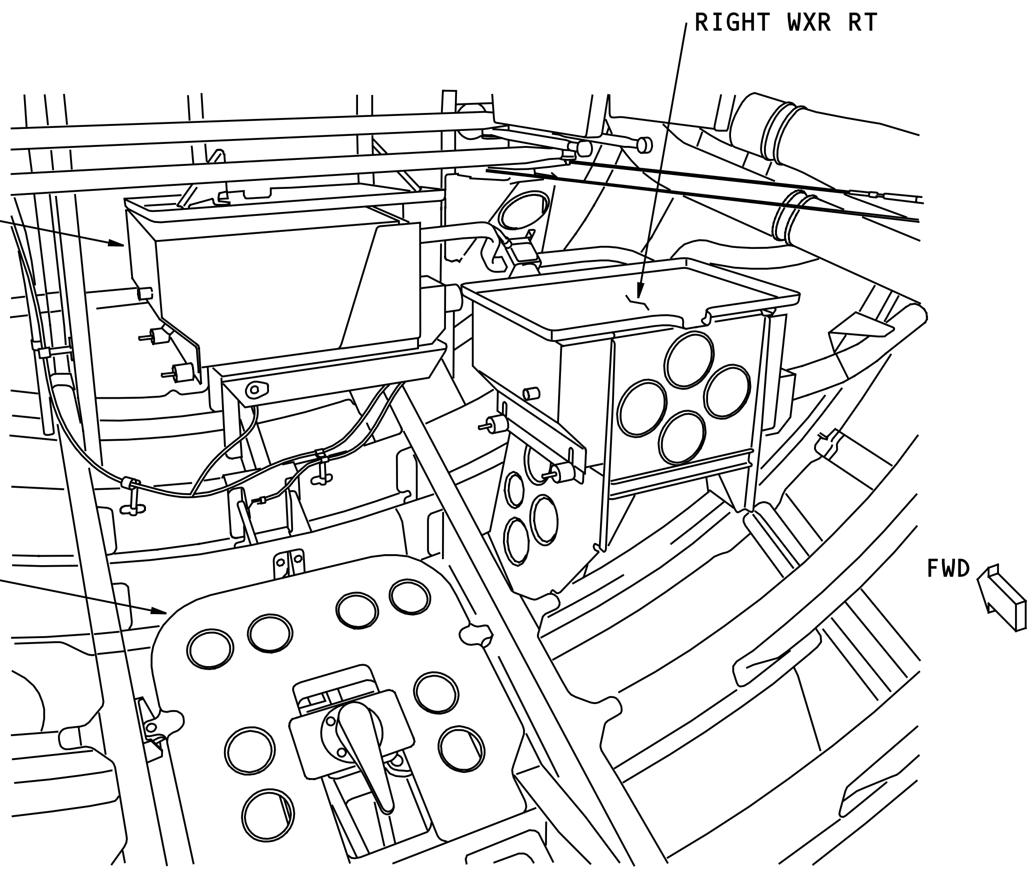
777 GENERAL - MAIN EQUIPMENT CENTER - 2

Forward Equipment Center Electronics

The forward equipment center contains the two weather radar receiver/transmitters.

Access to the Forward Equipment Center

Access to the forward equipment center is through the access door forward of the nose landing gear.



FORWARD EQUIPMENT CENTER
(LOOKING FORWARD)

777 GENERAL - FORWARD EQUIPMENT CENTER

777 GENERAL - CARGO DOOR EQUIPMENT RACKS

General

These four equipment racks are adjacent to the cargo doors:

- E16 rack and E5 rack (forward cargo door)
- E17 rack and E6 rack (aft cargo door).

E16 Rack

The E16 rack is at the forward cargo door at station 501. It contains components for these functions:

- Primary flight control
- Cargo handling.

E5 Rack

The E5 rack is at the forward cargo door at station 613. It contains components for these functions:

- Primary flight control power
- Actuator control electronics
- Radio altitude
- Fuel quantity.

E17 Rack

The E17 rack is at the aft cargo door at station 1678. It contains components for cargo handling.

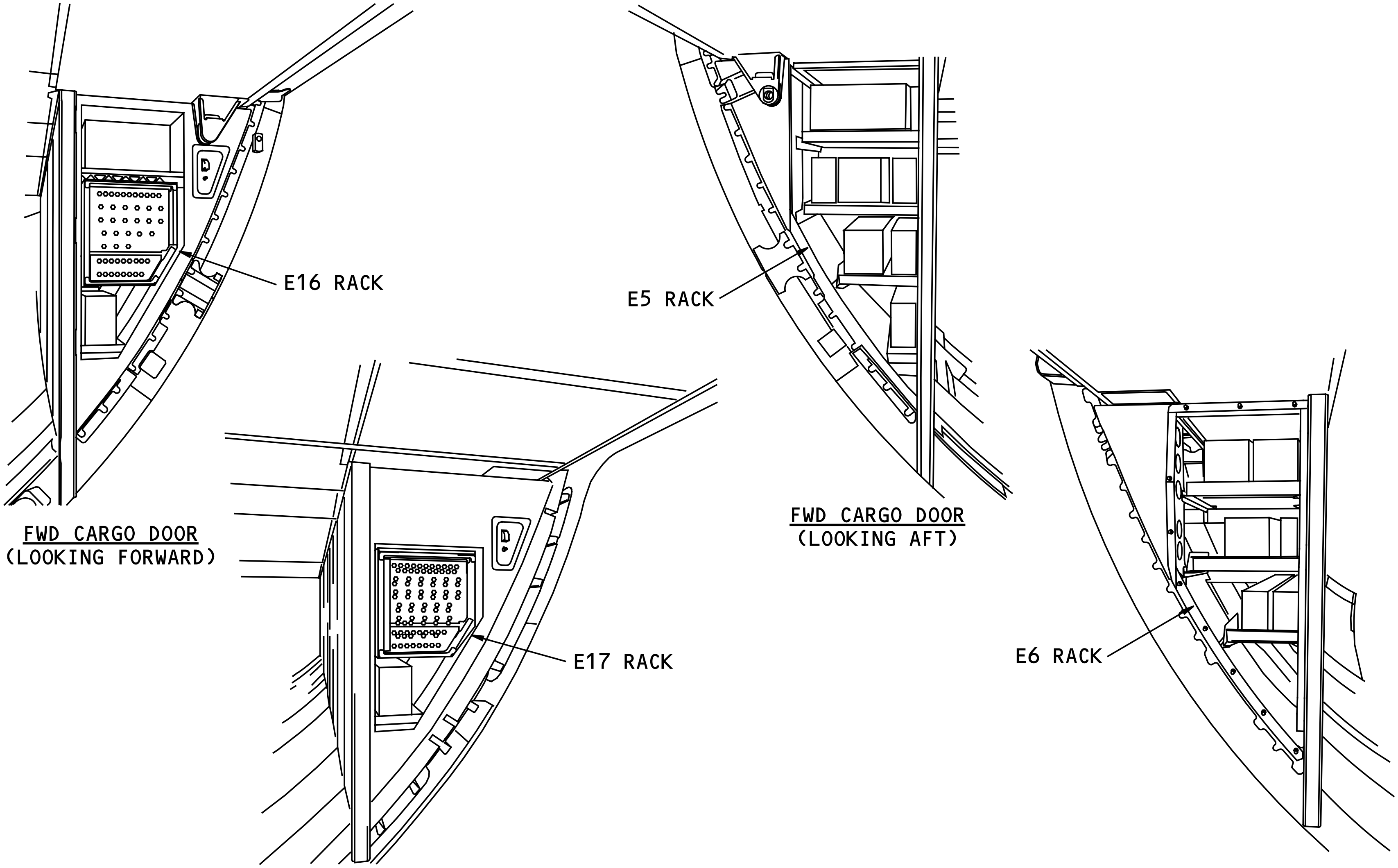
E6 Rack

The E6 rack is at the aft cargo door at station 1754. It contains components for these functions:

- HF communication
- Brake and tire system
- Main gear steering.

Access for Cargo Door Equipment Racks

Access for these equipment racks is at the cargo doors. You must open the cargo door to get access to the equipment rack. You then release and open a protective cover to get to the equipment on the rack.



FWD CARGO DOOR
(LOOKING FORWARD)

FWD CARGO DOOR
(LOOKING AFT)

AFT CARGO DOOR
(LOOKING FORWARD)

AFT CARGO DOOR
(LOOKING AFT)

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777 GENERAL - CARGO DOOR EQUIPMENT RACKS

777 GENERAL - OTHER EQUIPMENT RACKS

General

In addition to the equipment racks in the main equipment center and at the forward and aft cargo doors, there are these other equipment racks in the airplane:

- E11 rack
- E7 rack
- E10 rack

E11 Rack

The E11 rack is in the passenger compartment above the door 3 cross-aisle at station 1530. It is on the left of airplane center. Access is through a ceiling panel.

The E11 rack contains satellite communication (SATCOM) equipment.

E7 Rack

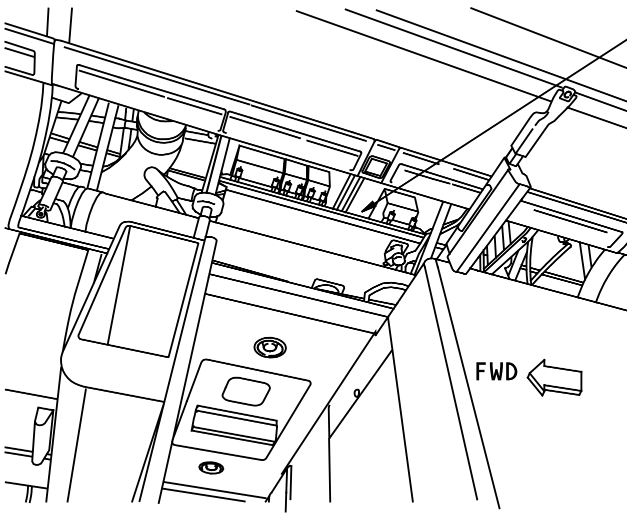
The E7 rack is in the passenger compartment above the aft galley at station 2100. It is on the right side of the airplane. Access is through a ceiling panel.

The E7 rack contains recorder equipment and the APU controller.

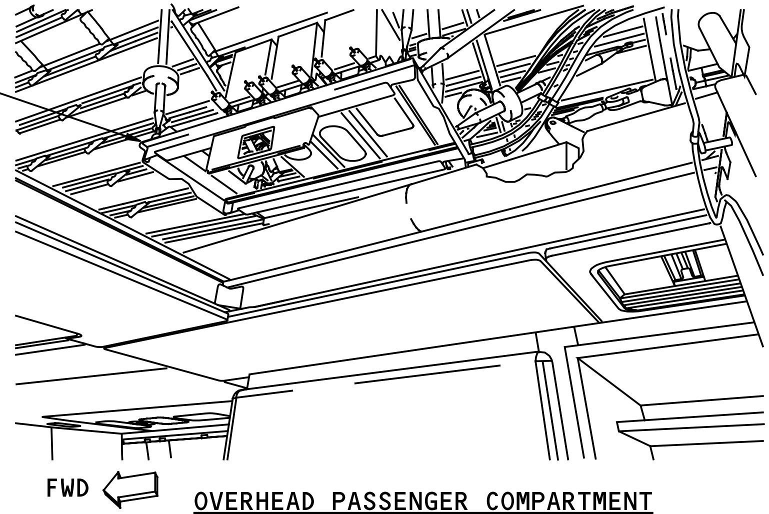
E10 Rack

The E10 rack is aft of the bulk cargo door on the right side of the lower lobe at station 1937. Access is through a door that faces inboard.

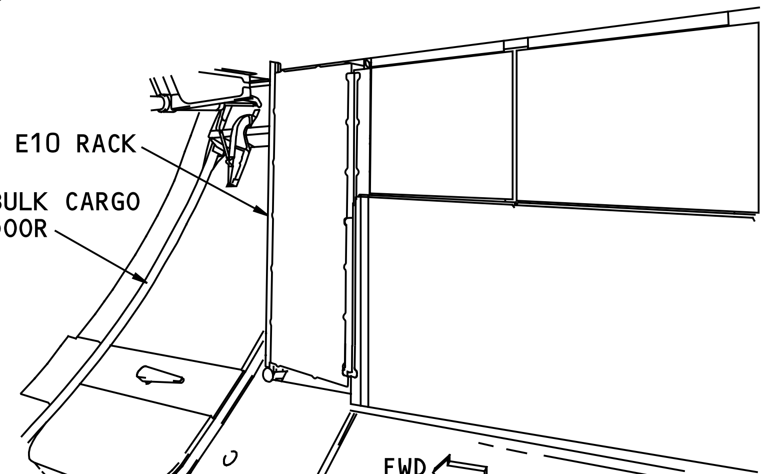
The E10 rack contains the APU battery and charger.



OVERHEAD PASSENGER COMPARTMENT
(LEFT SIDE LOOKING INBOARD)



OVERHEAD PASSENGER COMPARTMENT
(RIGHT SIDE LOOKING OUTBOARD)



BULK CARGO COMPARTMENT
(RIGHT SIDE LOOKING OUTBOARD)

777 GENERAL - OTHER EQUIPMENT RACKS

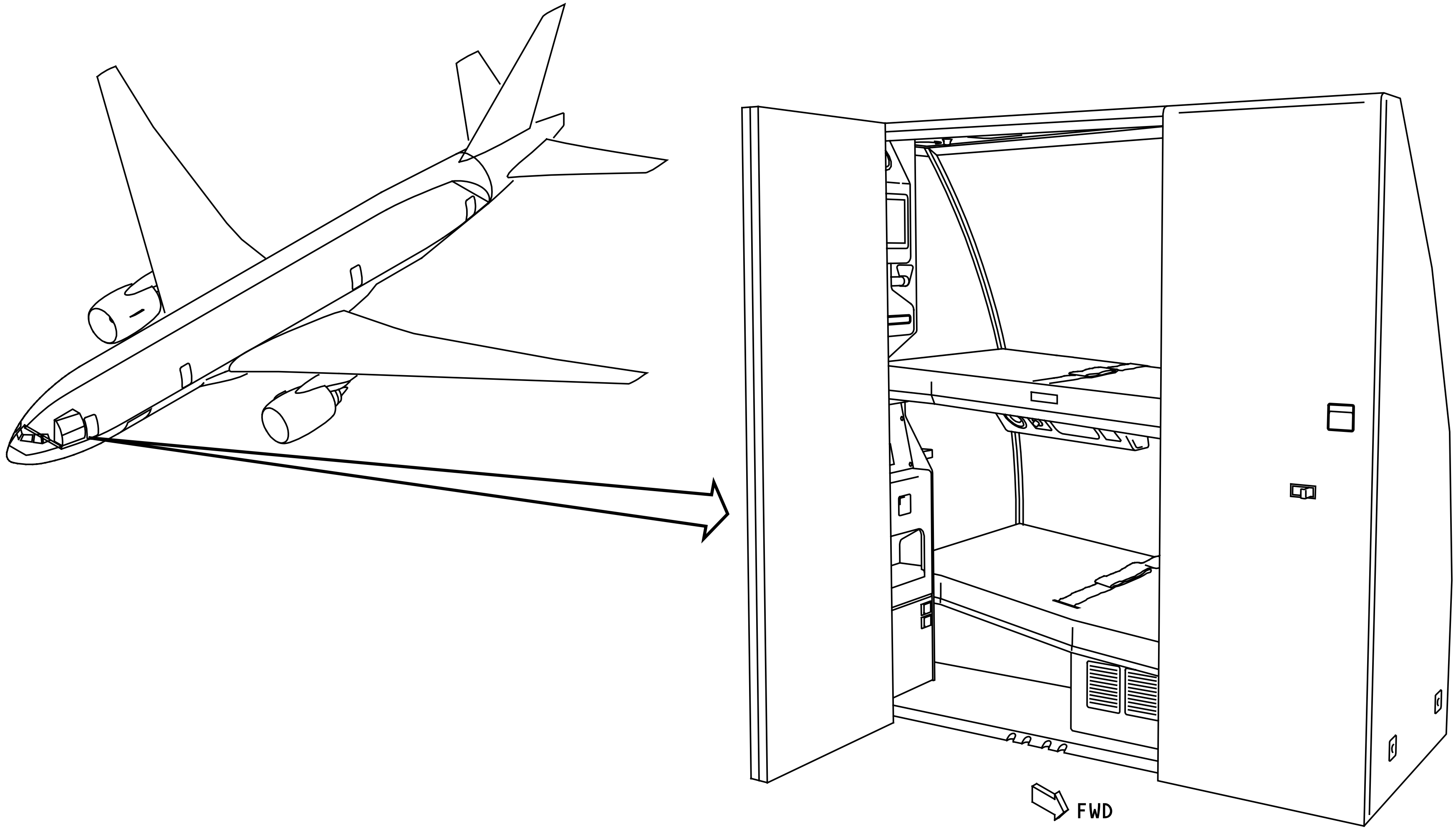
Flight Crew Rest (FCR) Module

The FCR module contains sleeping bunks for two crew members and storage compartments (not shown) for their belongings. The FCR module has these functions (not shown):

- Ventilation and heating
- Aural and visual fire/smoke indication
- Cabin interphone
- Passenger address
- Lighting
- Audio entertainment
- Attendant call
- Supplemental oxygen.

Access to Flight Crew Rest Module

Two doors give access to the FCR module. The primary access door latches open to block the adjacent aisle. This isolates the flight crew rest from the passenger compartment. The secondary access door gives access to the bunks. You can close and latch the two doors from the top or the bottom bunk. A step and handle (not shown) provide access the upper bunk.



FLIGHT CREW REST MODULE

00-00-00-064 Rev 5 02/24/1997

777 GENERAL - CREW REST MODULE(S)

777 GENERAL - ENGINE HAZARD AREAS

General

The hazards around jet engines in operation include:

- Inlet suction
- Heat
- Thrust
- Noise.

Inlet Suction

Suction at the inlet of an engine can pull objects, including a person, into the engine. At idle power, the hazard area is an 8 ft (2.4m) radius around the inlet. At takeoff thrust, the hazard area is a 16 ft (5m) radius around the inlet.

WARNING: IF SURFACE WIND IS GREATER THAN 25 KNOTS, INCREASE THE INLET HAZARD AREA BY 20%.

Engine damage can result when loose objects go into the inlet cowl. You must attach or remove any loose objects before you work around the engine.

Heat

High temperatures exist several hundred feet from the exhaust nozzle depending on wind conditions and thrust settings.

Thrust

The engine thrust makes high speed exhaust gases that can cause injury.

Noise

Engine noise can cause hearing loss. You must wear cup-type ear protection near an engine in operation.

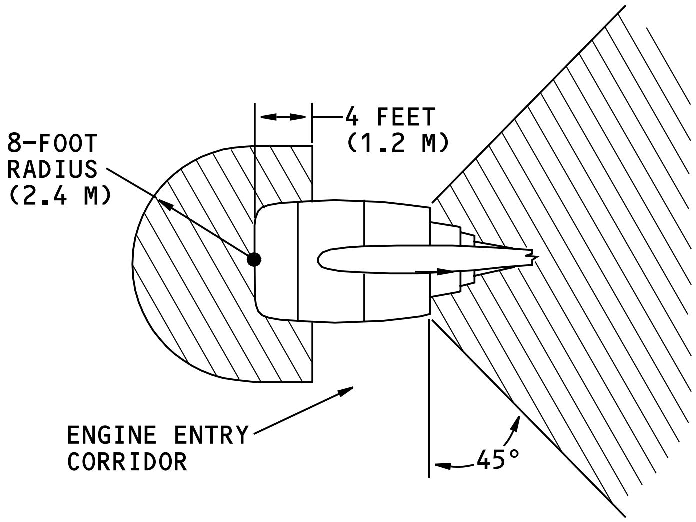
WARNING: LONG EXPOSURES TO JET ENGINE NOISE CAN CAUSE HEARING DAMAGE; EVEN WHEN YOU WEAR HEARING PROTECTION.

Engine Entry Corridors

Engine entry corridors are between the inlet hazard areas and the exhaust hazard areas. You should go near an engine in operation only when:

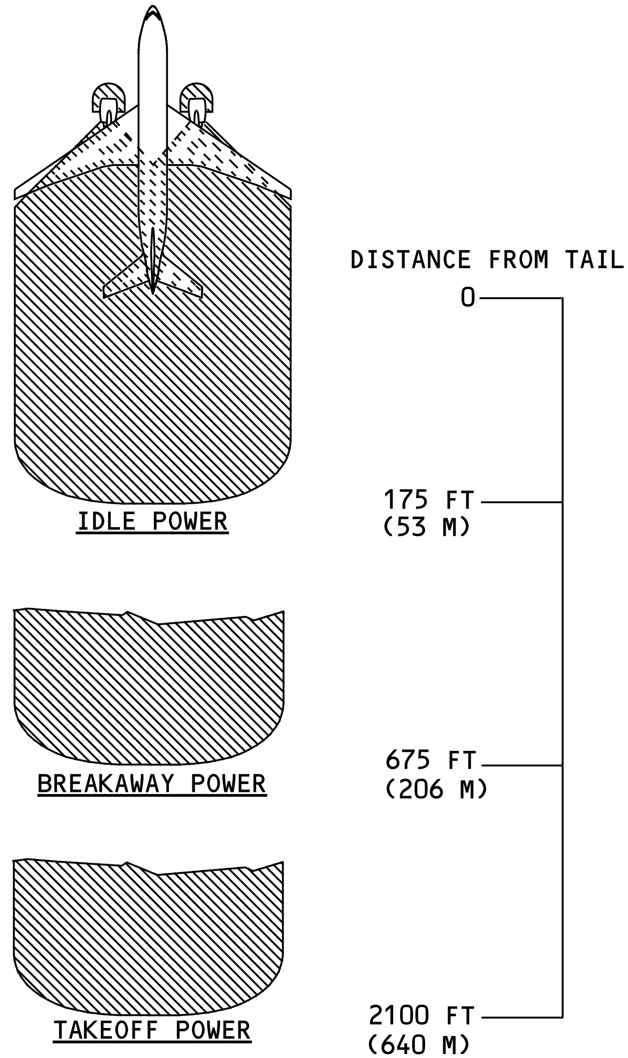
- The engine is at idle (forward thrust only)
- You have communication with the flight deck.

INLET HAZARD AREAS



IDLE POWER HAZARD AREA

EXHAUST HAZARD AREAS



00-00-00-036 Rev 3 12/12/95

777 GENERAL - ENGINE HAZARD AREAS

777 GENERAL - AIRPLANE TOWING

General

You can push or tow the airplane from the nose or main landing gear.

There is a forward tow fitting for a tow bar on the nose gear.

There is a forward and an aft (not shown) tow bar fitting on each main gear truck.

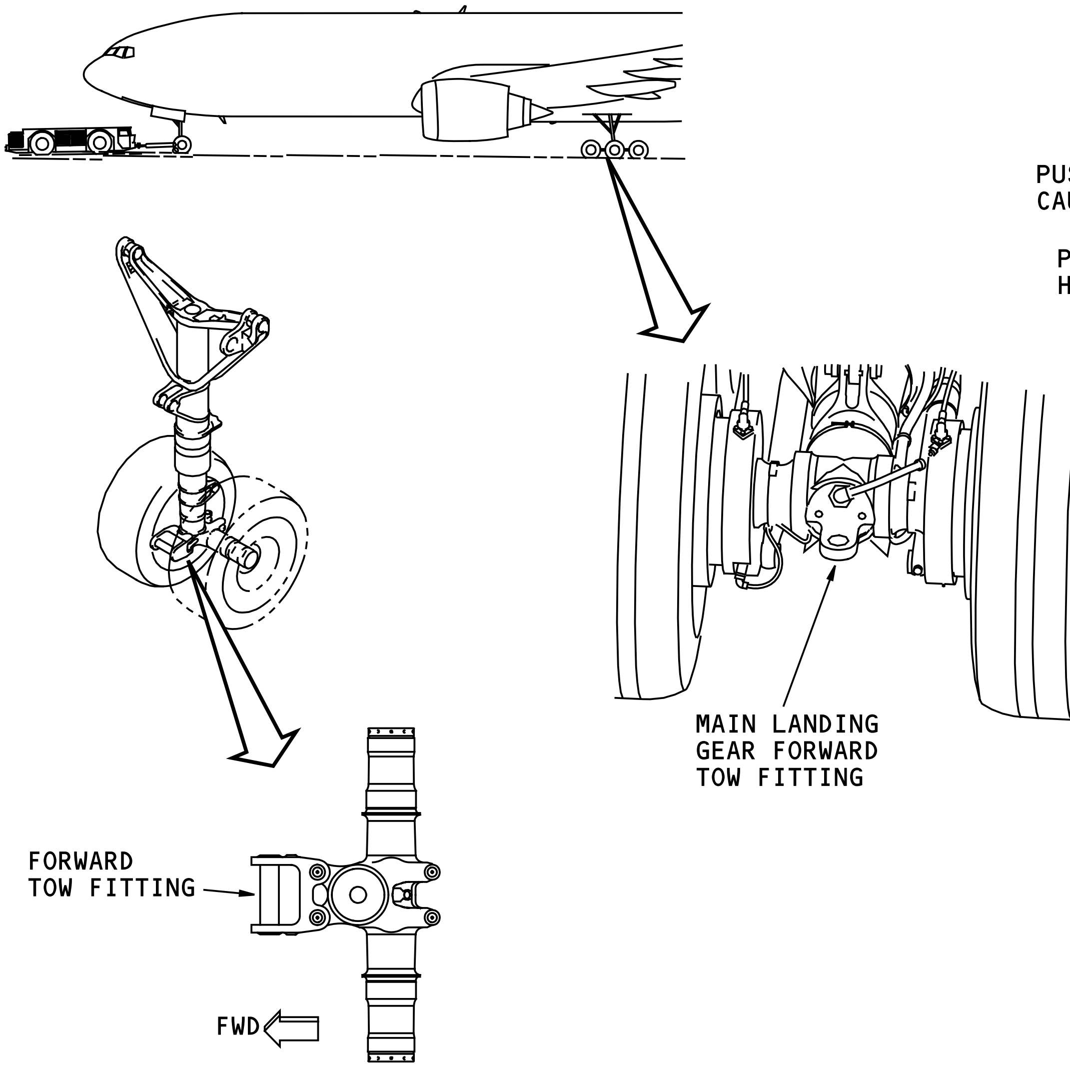
You can use towbarless equipment to push or pull the airplane.

For a fully loaded airplane, the minimum fuselage ground clearance is approximately 86 inches.

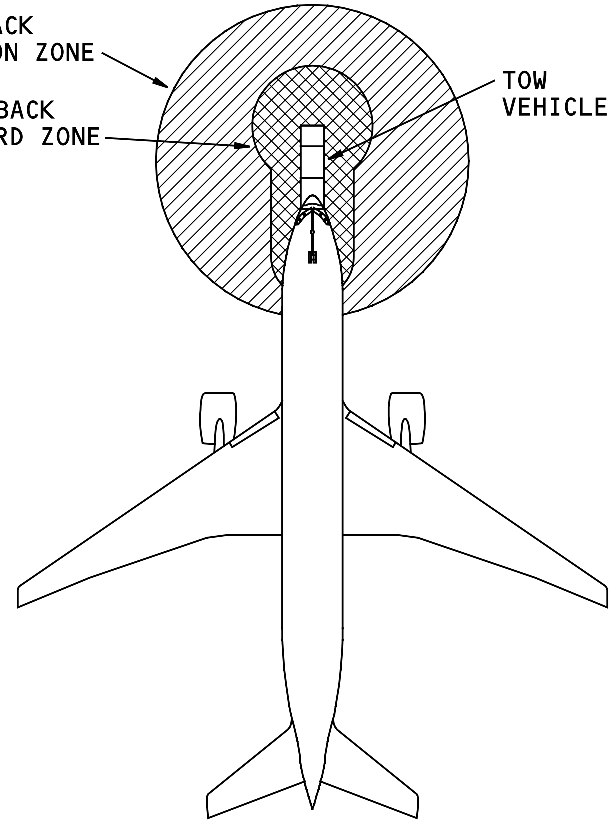
WARNING: WHEN YOU TOW THE AIRPLANE, ALL PERSONS MUST STAY OUT OF THE DANGEROUS AREAS AROUND THE TOW VEHICLE, TOW BAR, AND NOSE WHEELS. PERSONNEL ON THE GROUND MUST BE AWARE OF THE POSSIBILITY OF BEING RUN OVER BY THE NOSE WHEELS. THE TOW VEHICLE, TOW BAR, AND AIRPLANE WILL CHANGE POSITION DURING PUSHBACK AND TOWING. MAINTAIN A MINIMUM OF 10 FEET SEPARATION BETWEEN PERSONS ON THE GROUND AND THE EQUIPMENT THAT MOVES. A FATAL INJURY COULD OCCUR.

Training Information Point

You can tow the airplane when it has flat tires. Keep these operations to a minimum because flat tires can put too much load on the inflated tires.



NOSE GEAR TOW FITTINGS
(TOP VIEW)



TOWING HAZARD ZONES

00-00-00-037 Rev 2 03/01/96

777 GENERAL - AIRPLANE LEVELING

General

For some maintenance procedures, the airplane must be level. To do a check of the airplane attitude, the airplane has these components:

- Longitudinal inclinometer
- Lateral inclinometer
- Plumb bob fitting
- Plumb bob scale.

You can use either the inclinometers or the plumb bob scale to find the airplane pitch and roll attitudes.

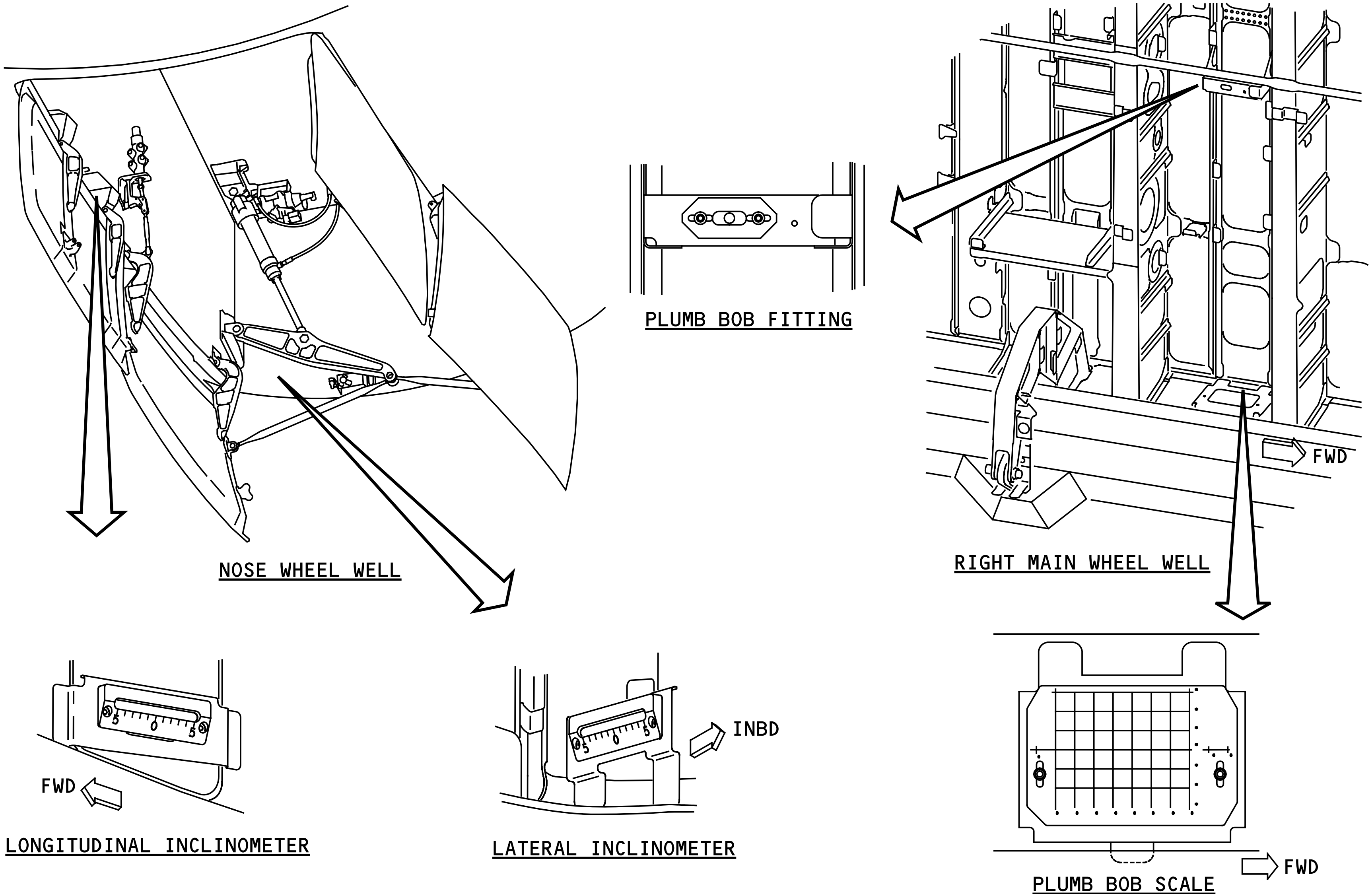
The longitudinal inclinometer tells you the pitch attitude of the airplane. The lateral inclinometer tells you the roll attitude.

You can hang a plumb bob on the plumb bob fitting. You then can read both the pitch and roll attitudes on the plumb bob scale.

Location

The inclinometers are in the nose wheel well.

The plumb bob fitting and plumb bob scale are in the right main wheel well.



777 GENERAL - AIRPLANE LEVELING

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General

You can lift all of the airplane on jacks, or lift only the airplane nose. You can also jack the airplane axles.

To lift the airplane, there are three primary jack points. There are five auxiliary jack points to make the airplane stable after the airplane is at the necessary height.

The airplane has seven axle jack points.

Airplane Jack Points, Pads, and Adapters

The three primary jack points are: A, B, and C. These jack points have jack pads which are part of the airplane body.

The auxiliary jack points are: D, E, F, G, and H. You must install adapters at these points before you put a jack there. You must remove bolts from the airplane body before you install the jack adapter at point D.

Airplane Jacking

Before you jack the airplane, you must make sure that the airplane gross weight and center of gravity are within specified limits.

Also, the loads on the jacks must be within limits. These loads are a function of airplane gross weight.

When you jack the airplane, the airplane must remain level within specified limits. One person must stay in the nose wheel well to monitor the airplane inclinometers.

Nose Jacking

You use jack point D to jack only the airplane nose.

CAUTION: DO NOT LIFT THE NOSE OF THE AIRPLANE TO MORE THAN SIX INCHES OF TIRE CLEARANCE. IF YOU LIFT THE NOSE HIGHER, SIDE LOADS THAT ARE MORE THAN DESIGN LOAD LIMITS CAN OCCUR. THIS CAN CAUSE DAMAGE TO THE JACK RAM AND JACK ADAPTER BECAUSE THEY WILL MOVE IN AN ARC.

Axle Jacking

There are three axle jack points on each main gear (not shown). There is one axle jack point on the nose gear. The pads of the axle jack points are all part of the landing gear.

You can lift the airplane on one axle or a combination of axles. If you use a jack on one axle, you can jack the airplane in winds up to 35 knots. When you use two or more axle jacks, you can jack the airplane in winds up to only 25 knots.

If you have two flat tires on an axle, you can use axle jacking bars to lift the axle enough to install the axle jack.

777 GENERAL - AIRPLANE JACKING

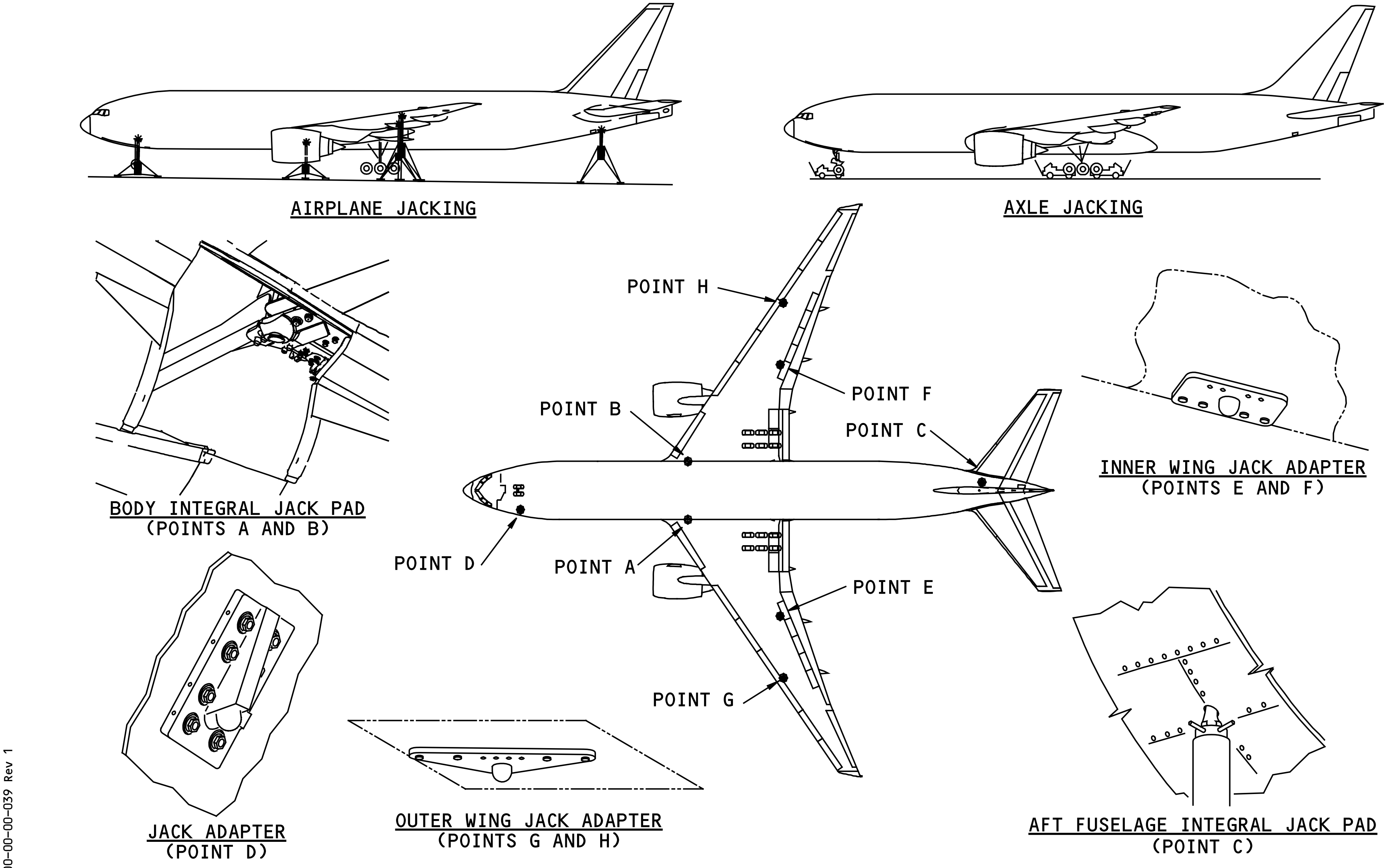
Training Information Point

If you supply electrical power to the airplane while it is on jacks, obey this warning:

WARNING: DO THE DEACTIVATION PROCEDURE FOR THE AIR MODE SIMULATION (AMM 32-09-01) BEFORE YOU LIFT THE AIRPLANE. IF YOU DO NOT OBEY THESE INSTRUCTIONS, INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: DO NOT LIFT THE AIRPLANE ON JACKS IN WINDS MORE THAN 35 KNOTS. IF YOU DO NOT OBEY THESE INSTRUCTIONS, DAMAGE TO THE AIRPLANE CAN OCCUR.

NOTE: If you use jacks that have general specifications but are not designed for the 777, be careful. It is possible that the maximum wind speed limit (35 knots) will have to be decreased.



777 GENERAL - AIRPLANE JACKING

777 GENERAL - FLIGHT INTERPHONE SYSTEM - FLIGHT DECK COMPONENT LOCATIONS - 2

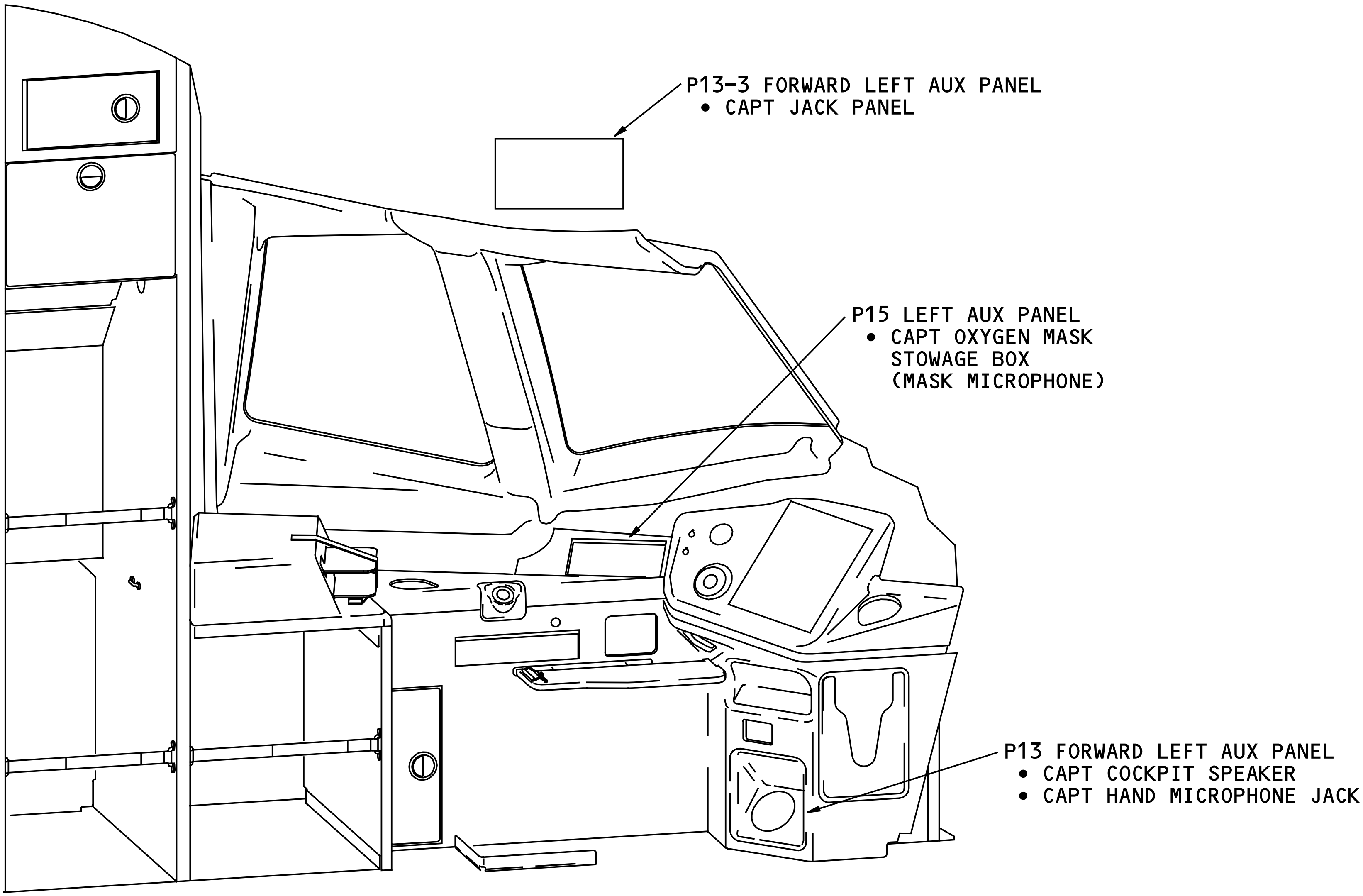
Flight Interphone Component Locations

The flight interphone system components on the left side of the flight deck include:

- Captain's jack panel
- Captain's cockpit speaker
- Captain's hand microphone jack.

Component locations on the right side of the flight deck are almost the same.

The captain's oxygen mask microphone connects with the flight interphone system.



00-00-00-045 Rev 0

777 GENERAL - FLIGHT INTERPHONE SYSTEM - FLIGHT DECK COMPONENT LOCATIONS - 2

777 GENERAL - ELECTROSTATIC DISCHARGE SENSITIVE (ESDS) DEVICES

General

Many electronic line replaceable units (LRUs) contain micro-circuits and other devices that electrostatic discharges can damage. These LRUs are electrostatic discharge sensitive (ESDS). There are placards on ESDS LRUs.

There are precautions that you must take when you touch ESDS LRUs. Some precautions apply only to ESDS printed circuit boards, and some precautions apply only to ESDS metal encased units.

ESDS Printed Circuit Boards

On the outer area of card files, there are placards that show which boards are ESDS printed circuit boards.

You must use a wrist strap when you touch one of the ESDS boards. The wrist strap is on the plenum between the E1 and E2 racks. Connect the wrist strap into an electrostatic ground jack. There are placards that show the jack locations.

Use the extractors on the card to remove it. Put the card in an ESDS conductive bag, and close the bag with ESDS or 100 percent cotton twine.

ESDS Metal Encased Units

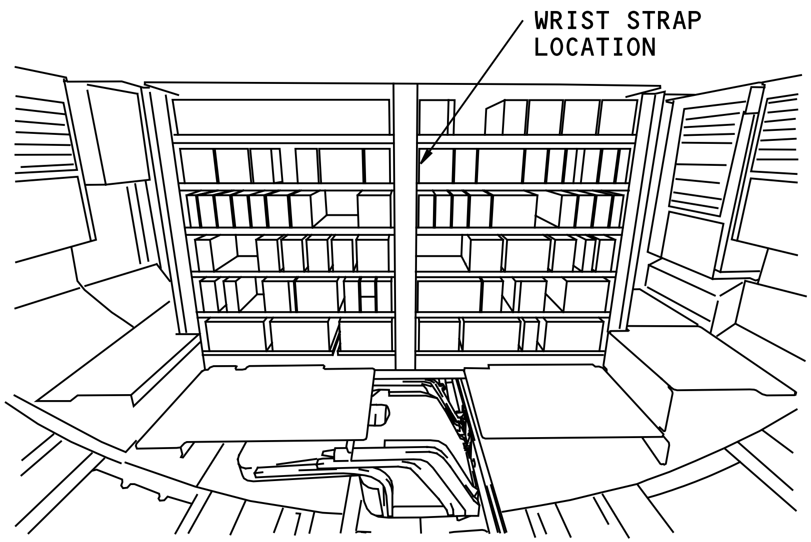
On the equipment racks, there are ESDS placards and placards that show the procedure for the removal and installation of ESDS metal encased units.

Training Information Point

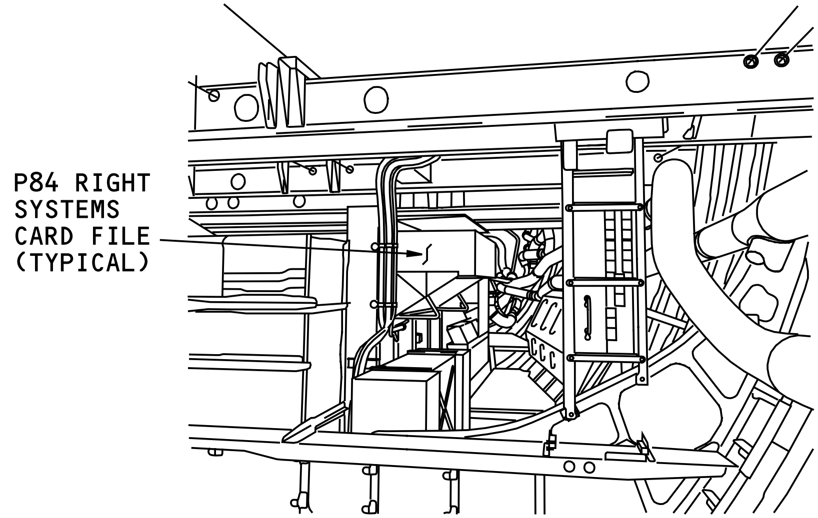
When you remove a unit, do not touch the pins in the electrical connectors. Install a conductive dust cover on the connectors.

NOTE: The conductive dust caps and the connector covers are black.

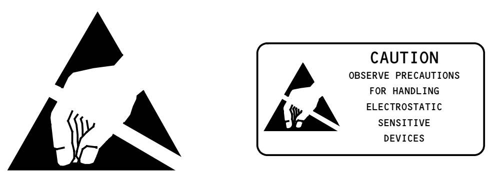
NOTE: You can use the conductive dust caps and the connector covers from the unit you install on the unit you remove.



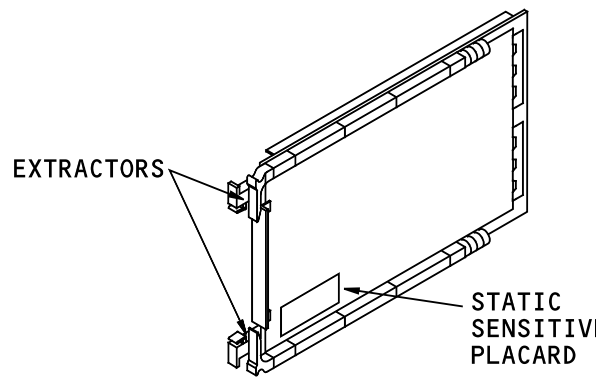
E1 AND E2 RACKS
(LOOKING AFT)



MAIN EQUIPMENT CENTER
(LOOKING FORWARD)



ESDS SYMBOL AND PLACARD (TYPICAL)



ESDS PRINTED CIRCUIT
BOARD (TYPICAL)

00-00-00-049 Rev 1

777 GENERAL - ELECTROSTATIC DISCHARGE SENSITIVE (ESDS) DEVICES

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General

The 777 line replaceable units (LRUs) and line replaceable modules (LRMs) use different data buses.

An LRU/LRM may use one or more of these types of data buses:

- ARINC 629
- ARINC 429
- ARINC 453
- ARINC 717
- ARINC 618
- RS-422
- RS-232
- 10 base T
- RS-485
- 10 base 2
- ARINC 636.

LRUs/LRMs send data to their data bus(es) at different speeds.

ARINC 629

The ARINC 629 data bus is an unshielded, twisted pair of wires continuously bonded and terminated at both ends. Many LRU/LRMs connect to an ARINC 629 data bus with current mode couplers. The LRU/LRMs send data to the ARINC 629 data bus one at a time. All connected LRU/LRMs can receive data from the ARINC 629 data bus at the same time. Some LRU/LRMs only receive ARINC 629 data.

An ARINC 629 LRU/LRM sends and receives data on the ARINC 629 data bus at 2 megabits per second (MBPS).

ARINC 429, 453, 717, 618, and RS-422

The ARINC 429, 453, 717, 618, and RS-422 data buses are one-way buses that send data on a twisted, shielded pair of wires.

Each bus has only one transmitter that sends data to one or more receivers.

An ARINC 429 LRU/LRM sends and receives data at low and high speeds on the ARINC 429 data bus. Low speed data rate is between 12 kilobits per second (KBPS) and 14 KBPS. High speed data rate is 100 KBPS.

An ARINC 453 LRU/LRM sends data to the ARINC 453 data bus at 1 MBPS.

An ARINC 717 LRU/LRM sends and receives data on the ARINC 717 data bus at 128 words per second (WPS).

An ARINC 618 LRU/LRM sends and receives data on the ARINC 618 data bus at up to 2400 BPS.

An RS-422 LRU/LRM sends and receives data on the RS-422 data bus at 9600 BPS.

RS-232

The RS-232 data bus is a one-way bus that sends data on a coaxial wire.

An RS-232 LRU/LRM sends and receives data on the RS-232 data bus up to 20 KBPS.

10 Base T

The 10 base T data bus is a two-way bus that sends data on two twisted, shielded pairs of wires. One pair transmits and the other pair receives signals. The 10 base T bus operates between two LRU/LRMs only.

A 10 base T LRU/LRM sends and receives data at 10 MBPS on the 10 base T data bus.

RS-485

The RS-485 data bus is a two-way bus that sends data on a twisted, shielded pair of wires. The RS-485 bus operates between two LRU/LRMs only.

An RS-485 LRU/LRM sends and receives data at 10 MBPS on the RS-485 data bus.

10 Base 2

The 10 base 2 data bus is a two-way bus that uses a single coaxial wire connected to each LRU/LRM on the bus. The operation of the bus is similar to ARINC 629 but the LRU/LRMs connect to the 10 base 2 bus internally.

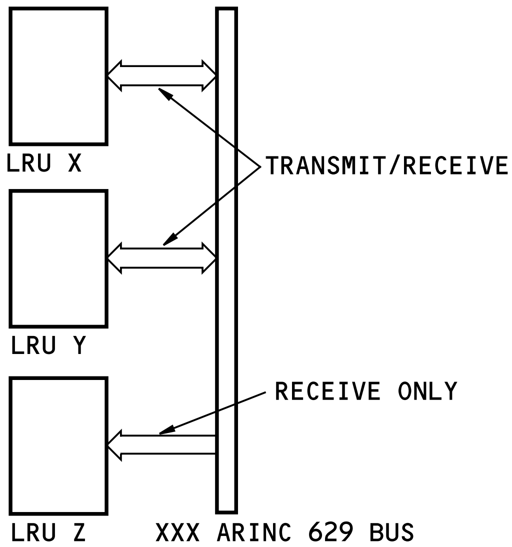
A 10 base 2 LRU/LRM sends and receives data at 10 MBPS on the 10 base 2 data bus.

ARINC 636

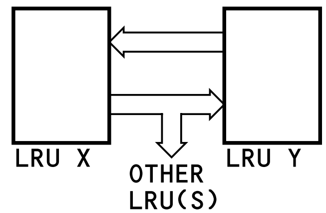
The ARINC 636 is a fiber optic data bus. One strand of optical fiber per bus. Two strands of optical fiber provide a primary (PRI) and secondary (SEC) bus.

The ARINC 636 fiber optic data bus connects to many LRU/LRMs. LRU/LRMs send and receive data in series on the ARINC 636 fiber optic data bus.

An ARINC 629 LRU/LRM sends and receives data at 100 MBPS on the ARINC 636 data bus.

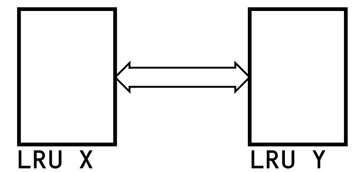


ARINC 629



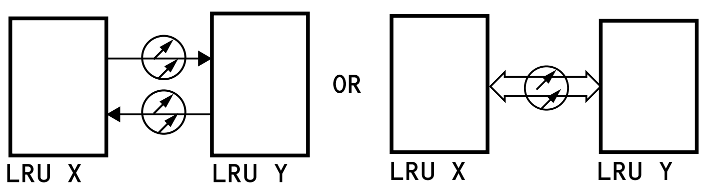
ONE-WAY DATA BUSES

ARINC 429
ARINC 453
ARINC 717
ARINC 618
RS-422
RS-232

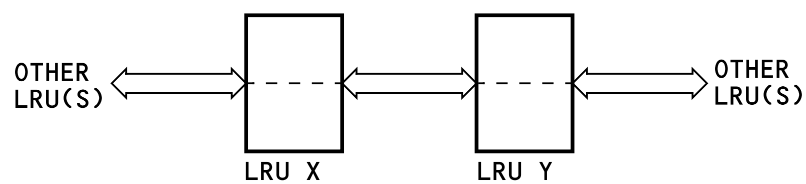


TWO-WAY DATA BUSES

10 BASE T
RS-485



ARINC 636 DATA BUS



10 BASE 2 DATA BUS

00-00-00-062 Rev 0 03/01/96

777 GENERAL - DATA BUSES

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General

An ARINC 629 data bus is an electronic data movement system that connects many line replaceable units (LRUs) in a single communication loop. Data from any ARINC 629 LRU is available to all other LRUs on the ARINC 629 bus.

An ARINC 629 data bus is a twisted pair of wires with termination resistors at each end. As many as 120 LRUs can use one ARINC 629 data bus. On the 777 airplane, the maximum number of LRUs on one bus is 46.

Components

The ARINC 629 data bus system has these parts:

- Data bus cable
- Current-mode couplers
- Stub cables.

The ARINC 629 system also includes these components in the LRUs:

- Serial interface modules
- Terminal controllers.

Physical Description

The ARINC 629 data bus system has these characteristics:

- Many LRUs send data one at a time in sequence
- Many LRUs receive data at the same time
- Communication on ARINC 629 is bi-directional; LRUs may transmit and receive data on the same bus
- One LRU may connect to more than one data bus through separate couplers on each bus
- All data on the bus is available to all the LRUs on that bus.

ARINC 629 Data Buses Configuration

There are eleven ARINC 629 data buses. They are:

- Three flight controls buses
- Four systems buses
- Four airplane information management systems (AIMS) intercabinet buses.

The flight controls buses connect LRUs that have flight control functions.

The systems buses connect LRUs that have other airplane system functions. These buses work independently from the flight controls buses. The systems buses move data between these five areas:

- Avionics
- Propulsion
- Electrical
- Electro-mechanical
- Environmental control.

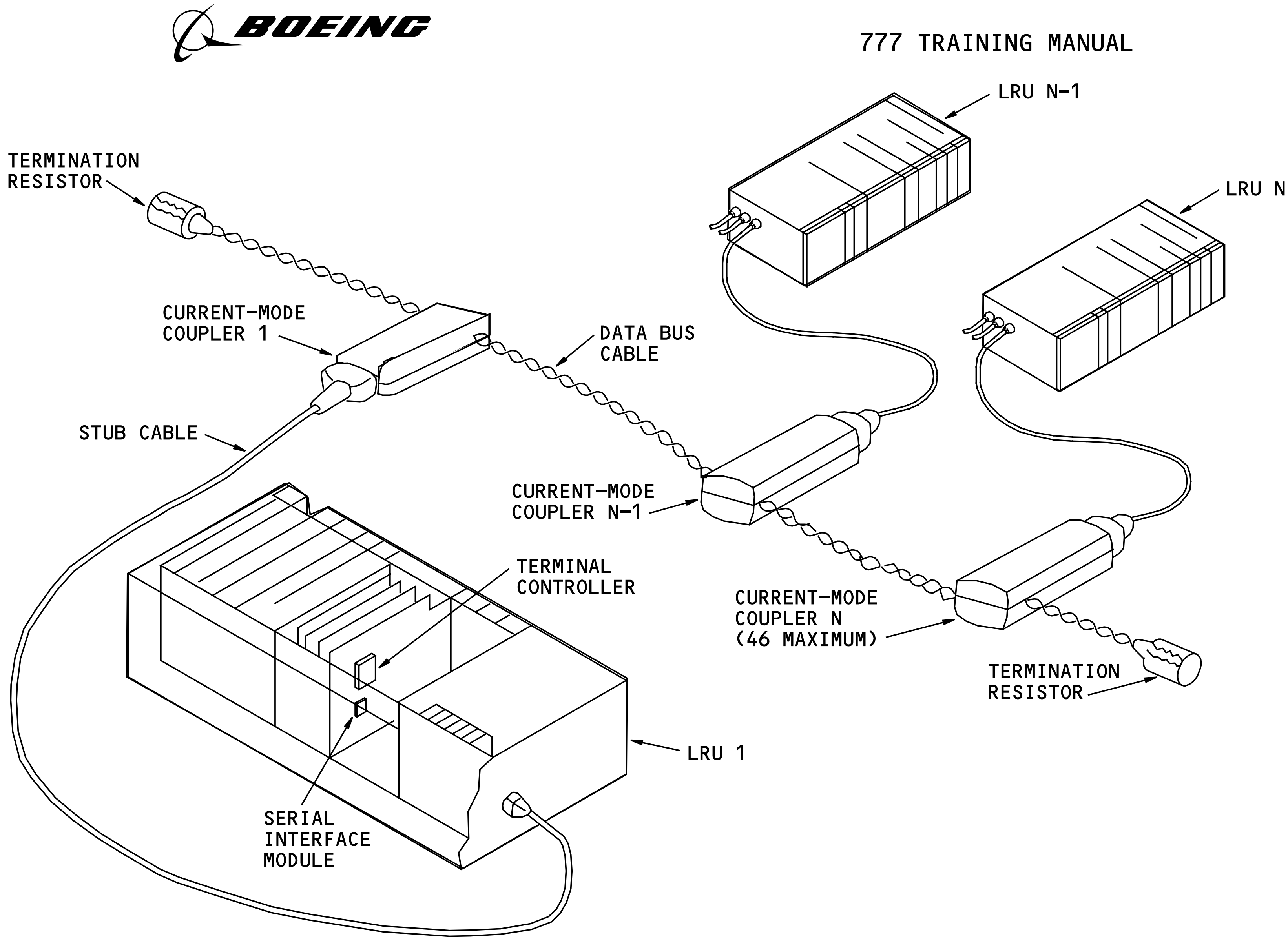
777 GENERAL - ARINC 629 - GENERAL DESCRIPTION

Four AIMS intercabinet buses move data between the two AIMS cabinets and the three control display units (CDUs).

Functional Description

Each LRU uses one or more current-mode couplers to connect to data buses.

A current mode coupler and its terminal (terminal controller and serial interface module) move data to and from the bus. Only one terminal on a bus transmits at a time. Each terminal listens to the bus and waits for a stop in data movement on the bus from other LRUs before it transmits.



777 GENERAL - ARINC 629 - GENERAL DESCRIPTION

777 GENERAL - ARINC 629 - MEC COMPONENT LOCATIONS

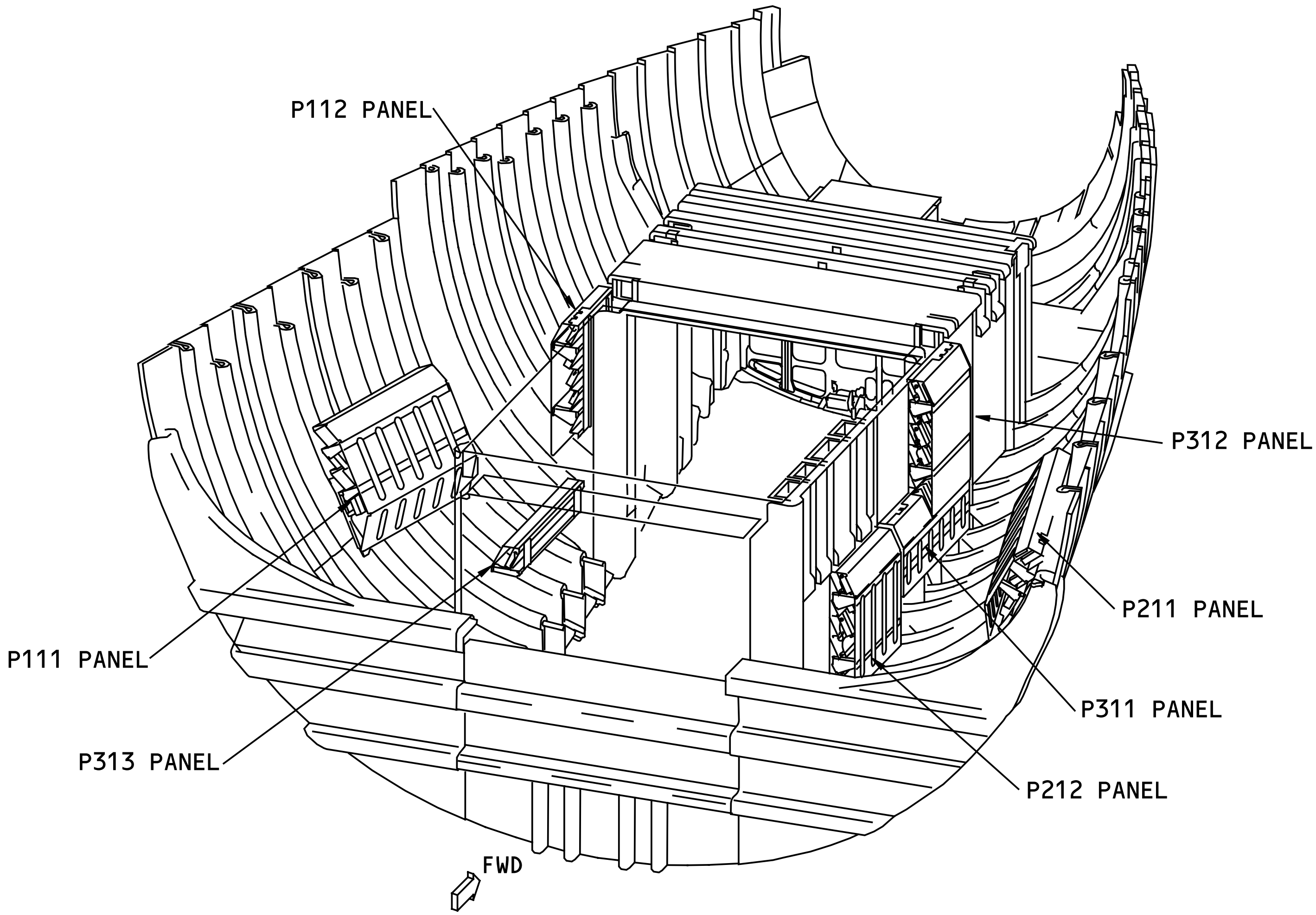
General

There are seven bus panels in the MEC on the left and right sides of the nose wheel well. Each bus panel contains the current-mode couplers and ARINC 629 buses.

Current-Mode Coupler Panels

These are the seven ARINC 629 bus panels:

- P111 (contains the AIMS intercabinet ARINC 629 bus 1 and the forward section of the left systems ARINC 629 bus)
- P112 (contains the left flight controls ARINC 629 bus)
- P211 (contains the AIMS intercabinet ARINC 629 bus 3 and the forward section of the right systems ARINC 629 bus)
- P212 (contains the right flight controls ARINC 629 bus)
- P311 (contains the AIMS intercabinet ARINC 629 bus 2, the AIMS intercabinet ARINC 629 bus 4 and the center 1 systems ARINC 629 bus)
- P312 (contains the center flight controls ARINC 629 bus)
- P313 (contains the center 2 systems ARINC 629 bus).



777 GENERAL - ARINC 629 - MEC COMPONENT LOCATIONS

777 GENERAL - ARINC 629 - BULK CARGO COMPARTMENT COMPONENT LOCATIONS

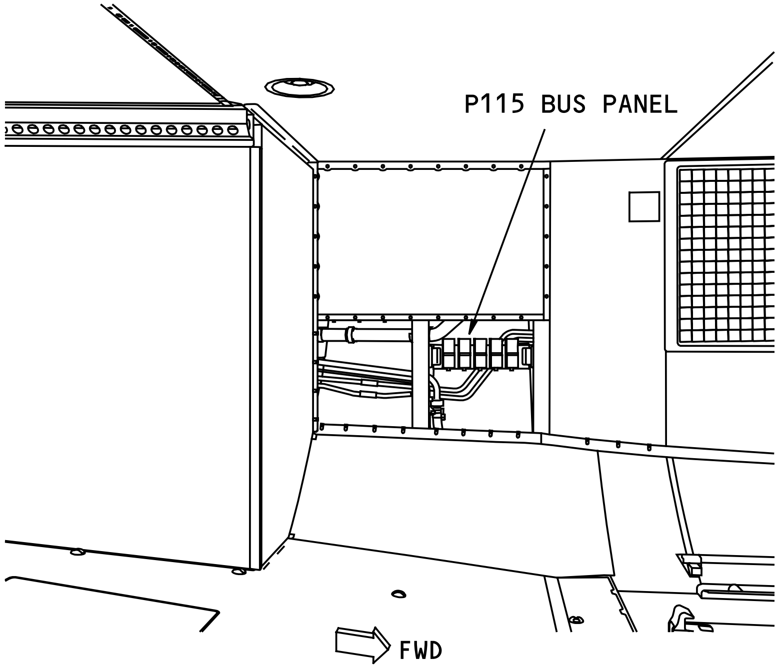
General

There are two bus panels in the aft section. Each panel contains current-mode couplers and ARINC 629 buses.

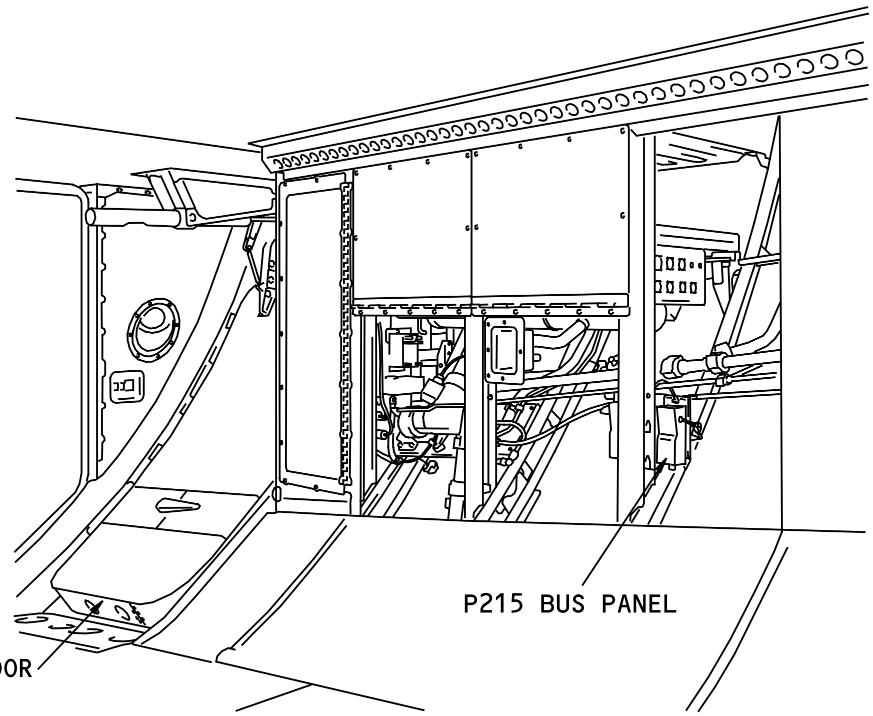
Current-Mode Coupler Panels

These are the bus panels in the aft sections:

- P115 (contains the aft section of the left systems ARINC 629 bus)
- P215 (contains the aft section of the right systems ARINC 629 bus).



VIEW OPPOSITE BULK CARGO DOOR



VIEW LOOKING FORWARD

00-00-00-052 Rev 2

777 GENERAL - ARINC 629 - BULK CARGO COMPARTMENT COMPONENT LOCATIONS

777 GENERAL - ARINC 629 - CURRENT MODE COUPLER

Purpose

The current-mode coupler connects the data bus cable to the stub cable.

Physical Description

The current-mode coupler has these characteristics:

- Two part assembly for fast installation
- Cover with the electronics and the receptacle for the stub cable
- Base designed for easy installation on panel
- Waterproof housing
- Protective wire guide to install the data bus cable.

There are different suppliers for current-mode couplers. They all function in the same way. They are interchangeable.

E-Core Assembly

An E-core assembly is a part of the coupler base. E-core assemblies are electromagnetic components that couple the signals in the data bus cable in and out of the coupler. The wire guides are grooves that give a controlled routing and protection for the wires of the data bus cable as they go through the E-core assembly.

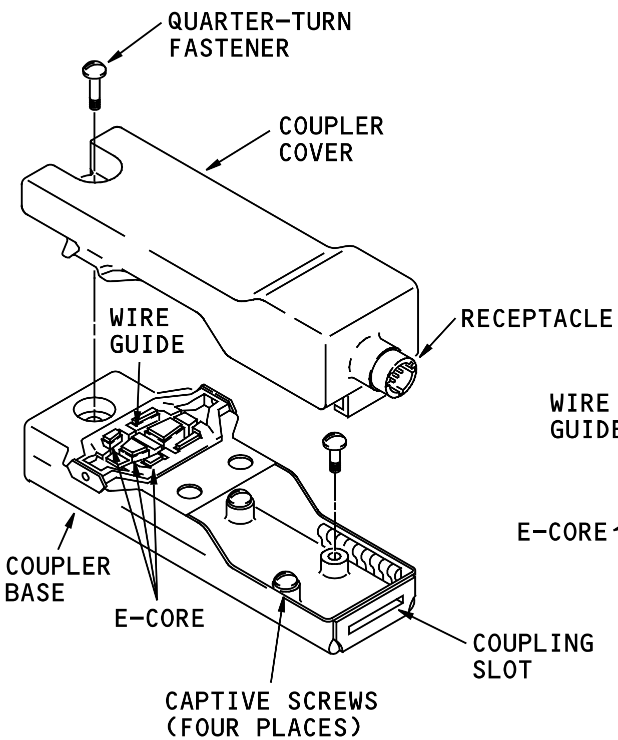
Location

All the current-mode couplers are on the current-mode coupler panels.

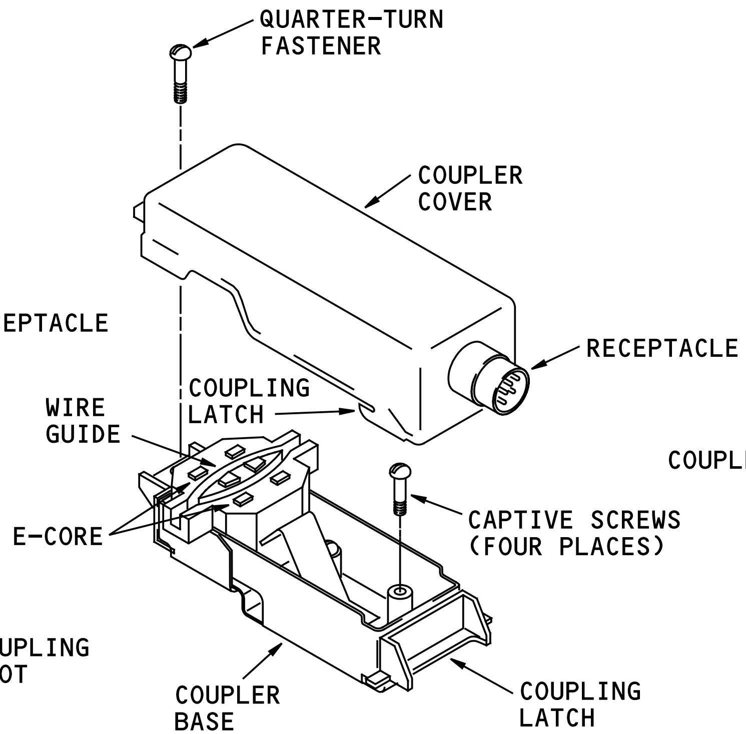
Training Information Point

Couplers are interchangeable units. Covers and bases from different suppliers are not interchangeable.

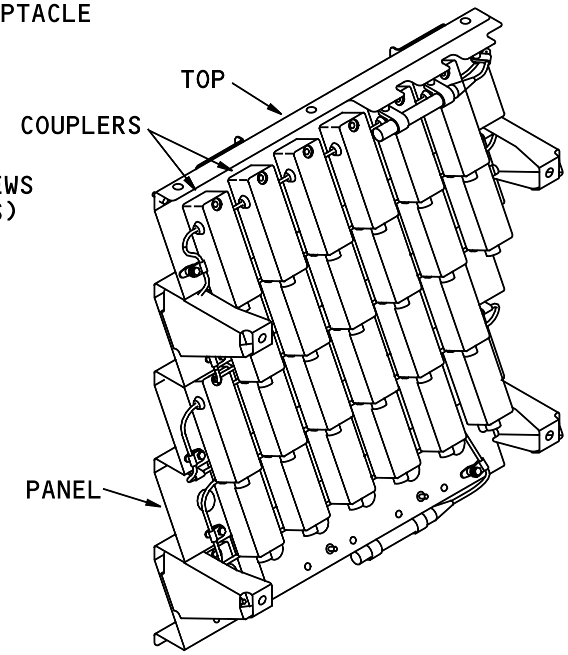
Remove power from the LRU before you replace couplers for that LRU.



COUPLER-AMPHENOL (TYPICAL)



COUPLER-SCI (TYPICAL)



BUS PANEL (COVER REMOVED)
(TYPICAL)

777 GENERAL - ARINC 629 - DATA BUS CABLE

Purpose

The data bus cable moves data between LRUs. A current-mode coupler and a stub cable attach each LRU terminal to the data bus cable.

Physical Description

A data bus cable is a pair of twisted wires with a termination resistor at each end.

The left and right systems ARINC 629 bus cables have production breaks with splices in the middle. The parts of the systems ARINC 629 bus cable that are external to the coupler panels have shielding.

A data bus cable in the 777 may be as long as 180 feet (47.5 m).

A data bus cable in the 777 connects as many as 46 current-mode couplers.

Location

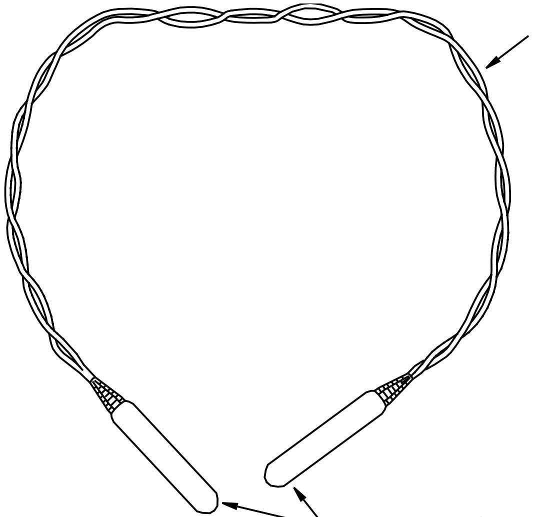
All the data bus cables are fully inside the current-mode coupler panels except the left and right systems bus cables. The left systems ARINC 629 bus connects the P111 forward current-mode coupler panel to the P115 aft current-mode coupler panel. There is a production break in the bus between the panels.

The right systems ARINC 629 bus connects the P211 forward current-mode coupler panel to the P215 aft current-mode coupler panel. There is a production break in the bus between the panels.

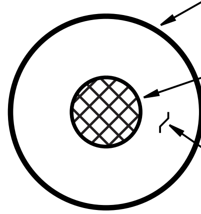
Training Information Point

Be careful when you install the data bus cable on a panel. Do not cut or cause damage to the teflon skin of the data bus cable. Damage to the teflon skin can cause corrosion on the conductor or failure of the system.

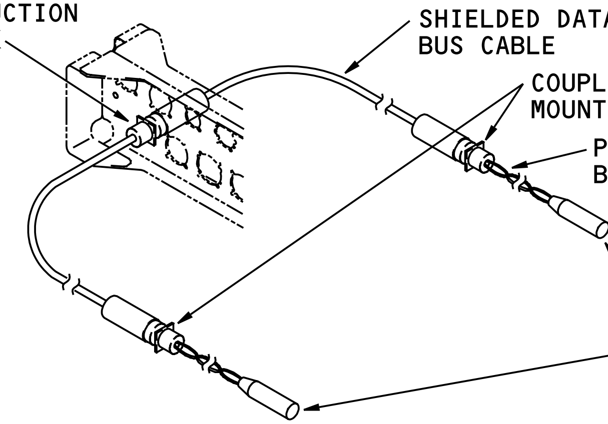
There is a special wire separator tool for data bus cable installation on the coupler. The use of unapproved tools can cause damage to the data bus.



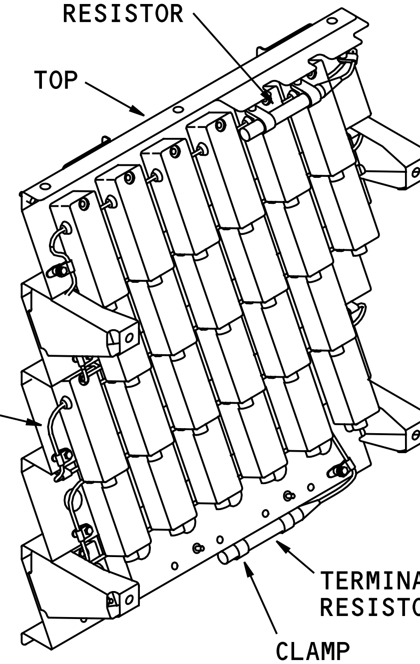
PANEL DATA BUS CABLE
(TYPICAL)



CROSS-SECTION OF A WIRE
OF A DATA BUS CABLE
(TYPICAL)



SYSTEMS DATA BUS CABLE WITH PRODUCTION BREAK
(TYPICAL)



BUS PANEL (COVER REMOVED)
(TYPICAL)

00-00-00-054 Rev 4

777 GENERAL - ARINC 629 - DATA BUS CABLE

777 GENERAL - ARINC 629 - STUB CABLE

Purpose

The stub cables are for bi-directional data movement between the LRU and the current-mode coupler. The stub cables also supply power from the LRUs to the current-mode couplers.

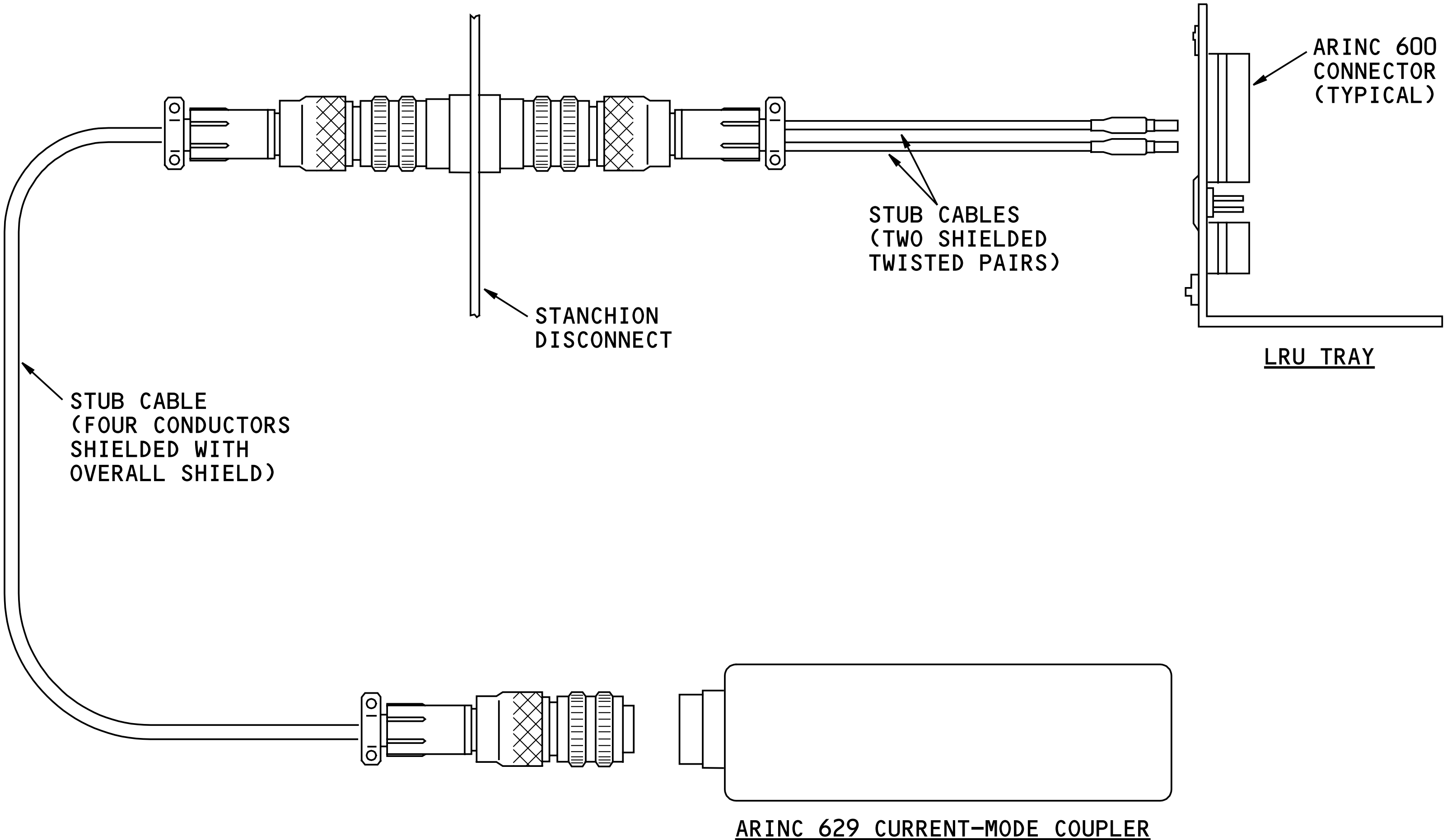
Physical Description

A stub cable has four wires, two to transmit and two to receive.

Stub cables can be as long as 57 feet for transmit and receive couplers and 75 feet for receive only couplers.

Location

The stub cables are in the airplane wiring bundles.



00-00-00-055 Rev 0

777 GENERAL - ARINC 629 - STUB CABLE

777 GENERAL - OVERHEAD PANEL ARINC 629 SYSTEM (OPAS)

General

The overhead panel ARINC 629 system (OPAS) moves data between many flight deck switches and lights and the ARINC 629 systems buses.

The OPAS moves data through overhead panel card files (OPCFs) and through panel data concentrator units (PDCUs).

The OPCFs send switch position data and signals to the lights on the P5 overhead panel and the P61 overhead maintenance panel.

The PDCUs send switch position data and signals to the lights on these panels:

- P1
- P3
- P7
- P8
- P9
- P10
- P55.

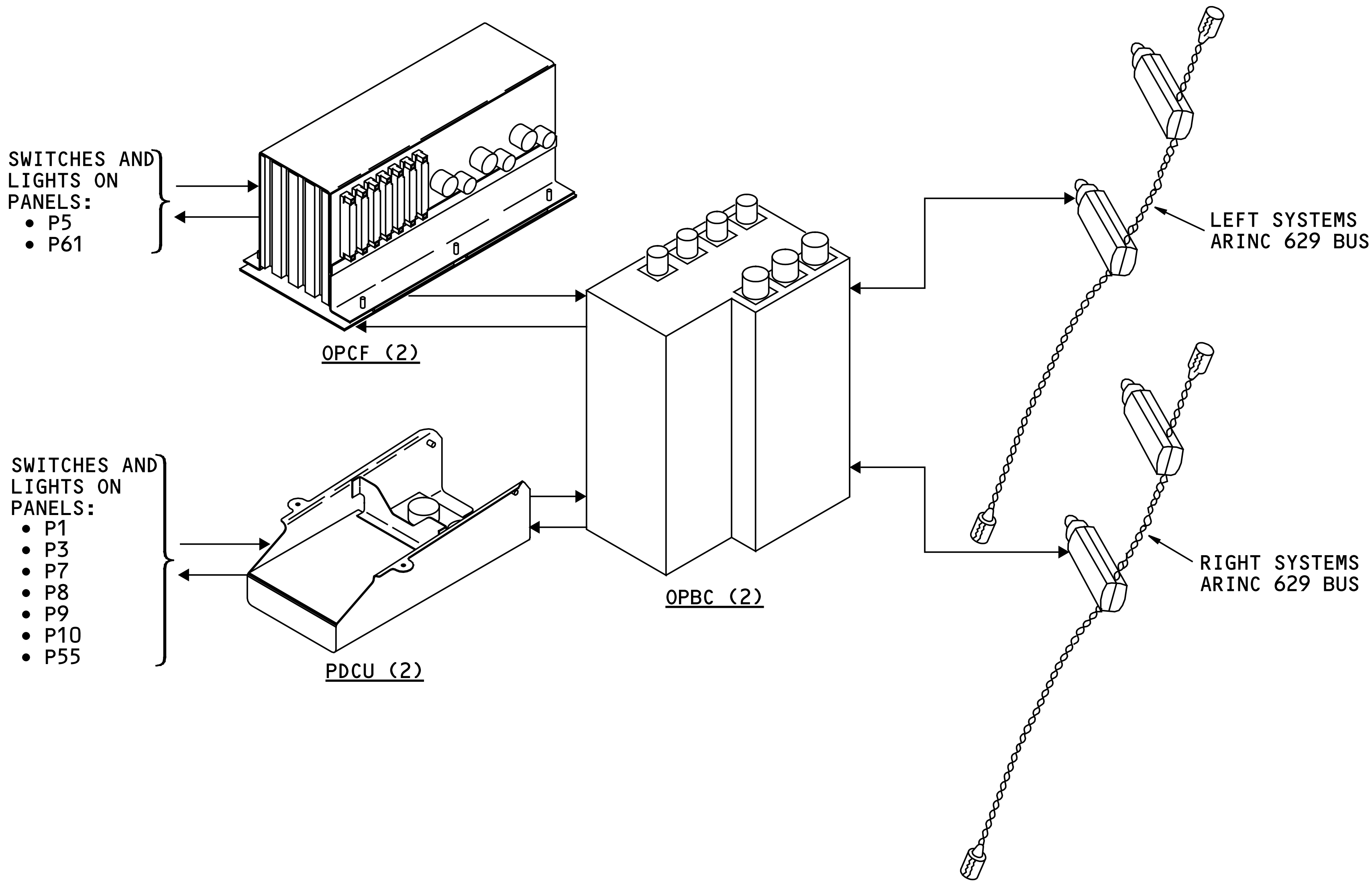
Two overhead panel bus controllers (OPBCs) are the interface units for the ARINC 629 buses.

The OPAS operates automatically. It continuously monitors switches, lights and ARINC 629 system buses. It sends system fault information to the central maintenance computing system (CMCS).

Physical Description

The OPAS has six parts:

- Left and right OPCFs
- Left and right PDCUs
- Left and right OPBCs.



00-00-00-056 Rev 1 11/06/95

777 GENERAL - OVERHEAD PANEL ARINC 629 SYSTEM (OPAS)

777 GENERAL - ARINC 629 SIGNAL GATEWAY (ASG) CARDS

General

The ARINC 629 signal gateway (ASG) cards change data format from ARINC 429 to ARINC 629, and from ARINC 629 to ARINC 429.

The cards move data between the interface cards in the systems card files and ARINC 629 system buses. The ASG cards also move data between the cargo smoke detection system and ARINC 629 system buses.

Components

These are the four ASG cards in two systems card files:

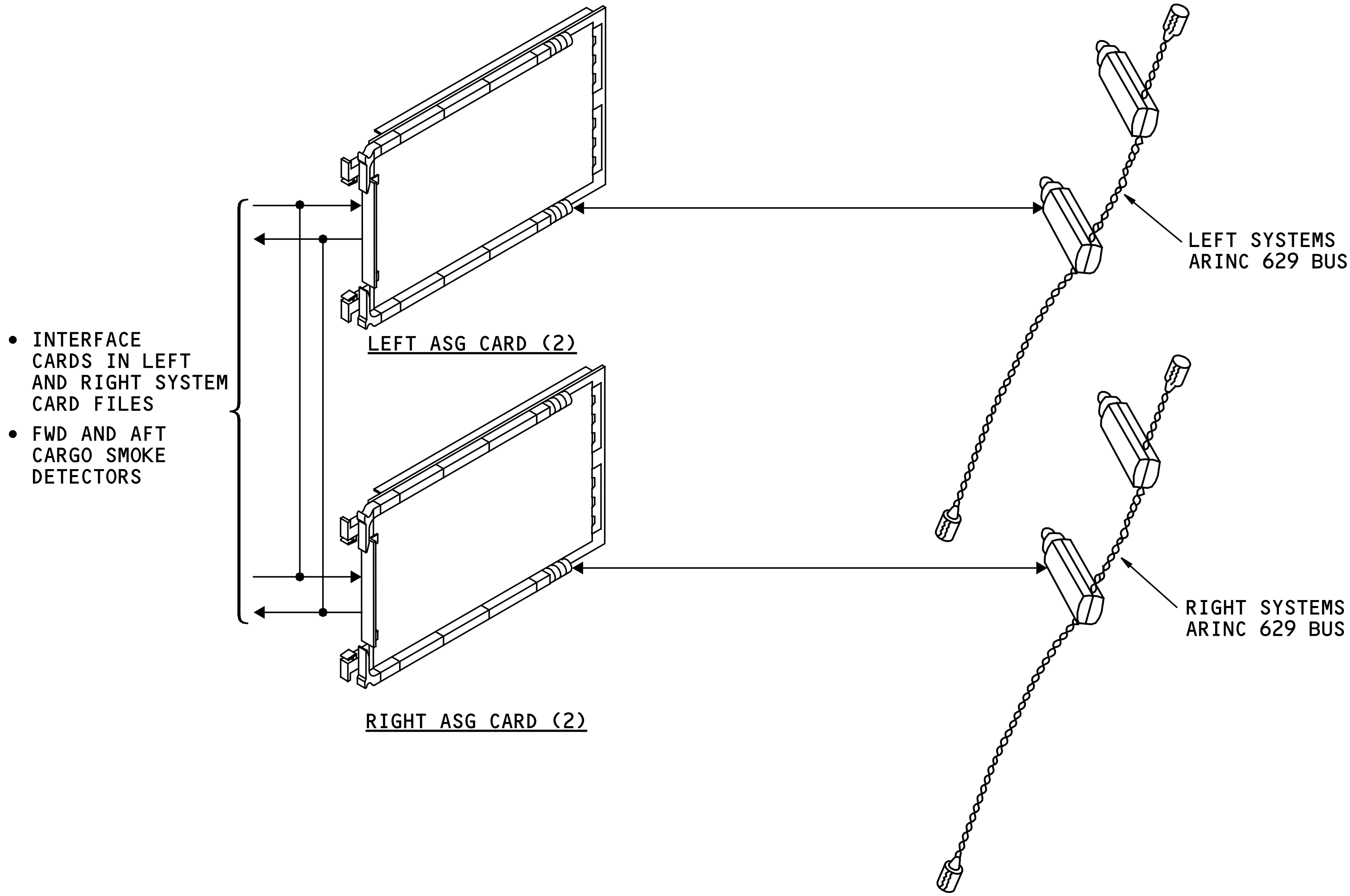
- Right ASG card in the P84 right systems card file (RSCF)
- Left ASG card in the RSCF
- Right ASG card in the P85 left systems card file (LSCF)
- Left ASG card in the LSCF.

Interfaces

The interface cards in a systems card file connect to both the right and left ASG cards in that card file.

Each of the cargo smoke detectors connects to the right and left ASG cards in one of the systems card files.

The left ASG cards connect to the left systems ARINC 629 bus and the right ASG cards connect to the right systems ARINC 629 bus.



777 GENERAL - ARINC 629 SIGNAL GATEWAY (ASG) CARDS

777 GENERAL - ONBOARD LOCAL AREA NETWORK (OLAN) - GENERAL DESCRIPTION

Purpose

The onboard local area network (OLAN) is a fiber optic communications network. It moves digital data between line replaceable units (LRUs). Fiber optic networks have these qualities:

- They are faster than wire
- They weigh less than wire buses
- Electromagnetic radiation has no effect on the data.

Physical Description

The LAN has these parts:

- A primary ring (PRI)
- A secondary ring (SEC)
- Two bypass switch units (BSUs).

The bypass switch units (BSUs) connect the primary and secondary rings with the LRUs. Line replaceable units (LRUs) connect to both rings of a LAN through a BSU.

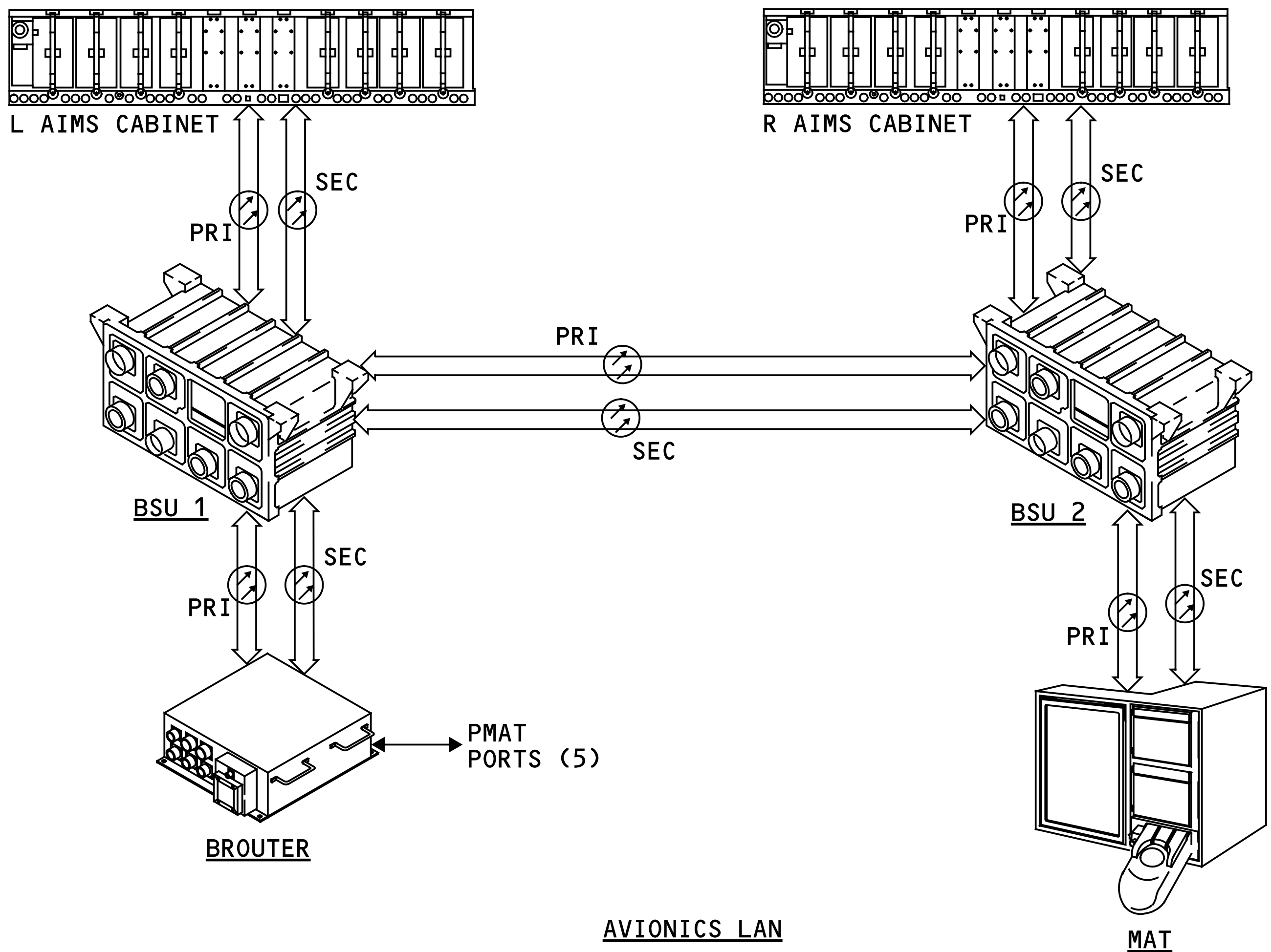
Avionics LAN

The avionics LAN connects these LRUs:

- Right AIMS cabinet
- Left AIMS cabinet
- Maintenance access terminal (MAT)
- Brouter.

The brouter gets fiber optic signals from the LRUs in the avionics LAN. It also sends fiber optic signals to the LRUs. The brouter controls the routing of the signals through the LAN.

The avionics LAN connects the portable maintenance access terminals (PMATs) to the AIMS cabinets through the brouter.



777 GENERAL - ONBOARD LOCAL AREA NETWORK (OLAN) - GENERAL DESCRIPTION

777 GENERAL - OLAN - FIBER OPTIC CABLE

General

Each cable has these items:

- Optical fiber strands
- Two filler strands
- Separator tape
- Aramid yarn strength member
- An outer jacket.

The cable is about 0.2 inches in diameter.

Optical Fiber Strands

The optical fiber strands are glass. Each optical fiber strand is .0055 inches (140 microns) in diameter.

A primary and secondary buffer covers each fiber strand. The primary buffer protects the glass fiber during manufacture.

The secondary buffer adds strength and increases the diameter of the fiber. The secondary buffers of the five optical fiber strands are these five colors:

- Blue
- Red
- Green
- Yellow
- White.

The colors permit you to identify the individual fiber strands at each end of the cable.

Each optical fiber strand with its buffers is .035 inches (900 microns) in diameter.

Cables have three or five optical fiber strands. Cables with three strands use two more filler strands. The example shows a cable with five optical fiber strands.

Filler Strands

The black filler strands are polyester and are .035 inches in diameter.

Separator Tape

A polyester separator tape covers the group of seven strands. The tape is low-friction polyester. It makes the cable more flexible.

Aramid Yarn

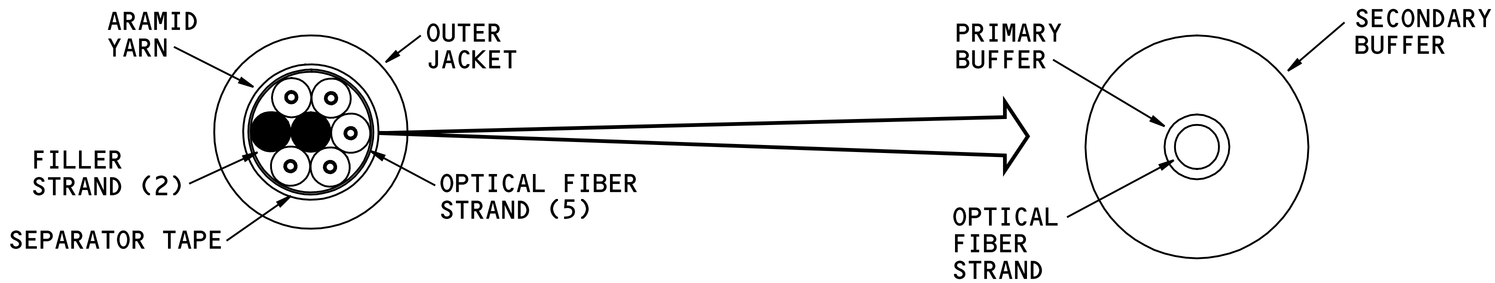
A strength member of woven Aramid (Kevlar) yarn protects the optical fibers from damage.

Outer Jacket

The outer jacket of the cable is purple thermoplastic.

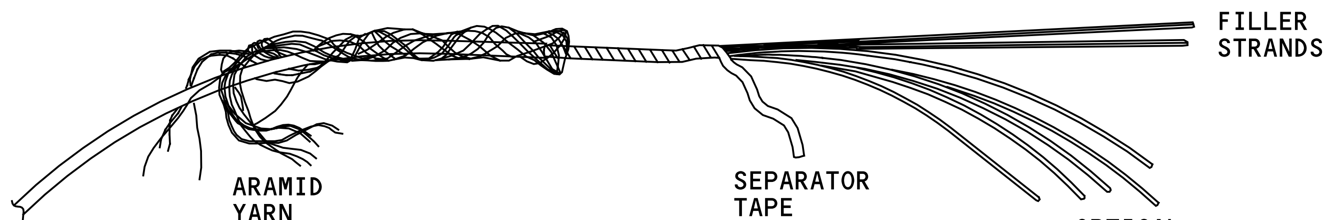
Training Information Point

The optical fiber strands may break if the cable bend radius is less than 1.5 inches.



FIBER OPTIC CABLE
(END VIEW)

OPTICAL FIBER STRAND
(END VIEW)



FIBER OPTIC CABLE

00-00-00-059 Rev 1 05/18/95

777 GENERAL - OLAN - FIBER OPTIC CABLE

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777 GENERAL - OLAN - CONNECTORS

General

OLAN uses two types of connectors: a type-A connector and a type-B connector.

The connectors have these parts:

- Alignment keys and grooves
- Guide pins and cavities
- Color bands
- Three start threads.

Type-A Connector

The type-A connector is for production breaks that are not regularly connected and disconnected.

The type-A connector is a multi-channel, in-line (butt-type) connector. This connector has very low light loss between optical fiber components.

The type-A connector has three fiber optic cables or five fiber optic cables.

Type-B Connector

The Type-B connector attaches a fiber optic cable to a line replaceable unit (LRU). The type-B connector is more frequently connected and disconnected than the type-A connector.

The type-B connector is a multi-channel, expanded beam (ball lens) connector. Light loss across this connector is low but not as low as in the type-A connector.

Alignment Keys and Grooves

Each connector has alignment keys on the plug and alignment grooves on the receptacle. These accurately align the connector optical components.

Guide Pins and Cavities

Guide pins in the plug fit into cavities in the receptacle when the plug and receptacle connect. The pins of the plug touch the bottom of the cavities in the receptacle. You can not overtighten the connector.

Color Bands

The coupling nut on the plug barrel has a yellow band. The receptacle barrel has a red and a yellow band. When the red band on the receptacle is at least 50 percent covered by the coupling nut, this shows a correct connection. With a correct connection, the optical fibers in the plug align end-to-end with the fibers in the receptacle.

Start Threads

Three start threads on the plug and receptacle make sure of a straight start when they join.

Type-A Connector/Fiber Optic Interface

The type-A plug and receptacle have ceramic contacts that touch when connected. The light signal goes through holes in the end of the ceramic contacts when they are in direct physical contact with each other.

Type-B Connector/Fiber Optic Interface

The connector has miniature ball lenses behind a protective window. Each lens is at the end of a fiber. The ball lenses expand and focus the light signal from the fiber. The light goes through the protective windows of the plug and receptacle to another ball lens. This ball lens narrows the light and sends it into a fiber.

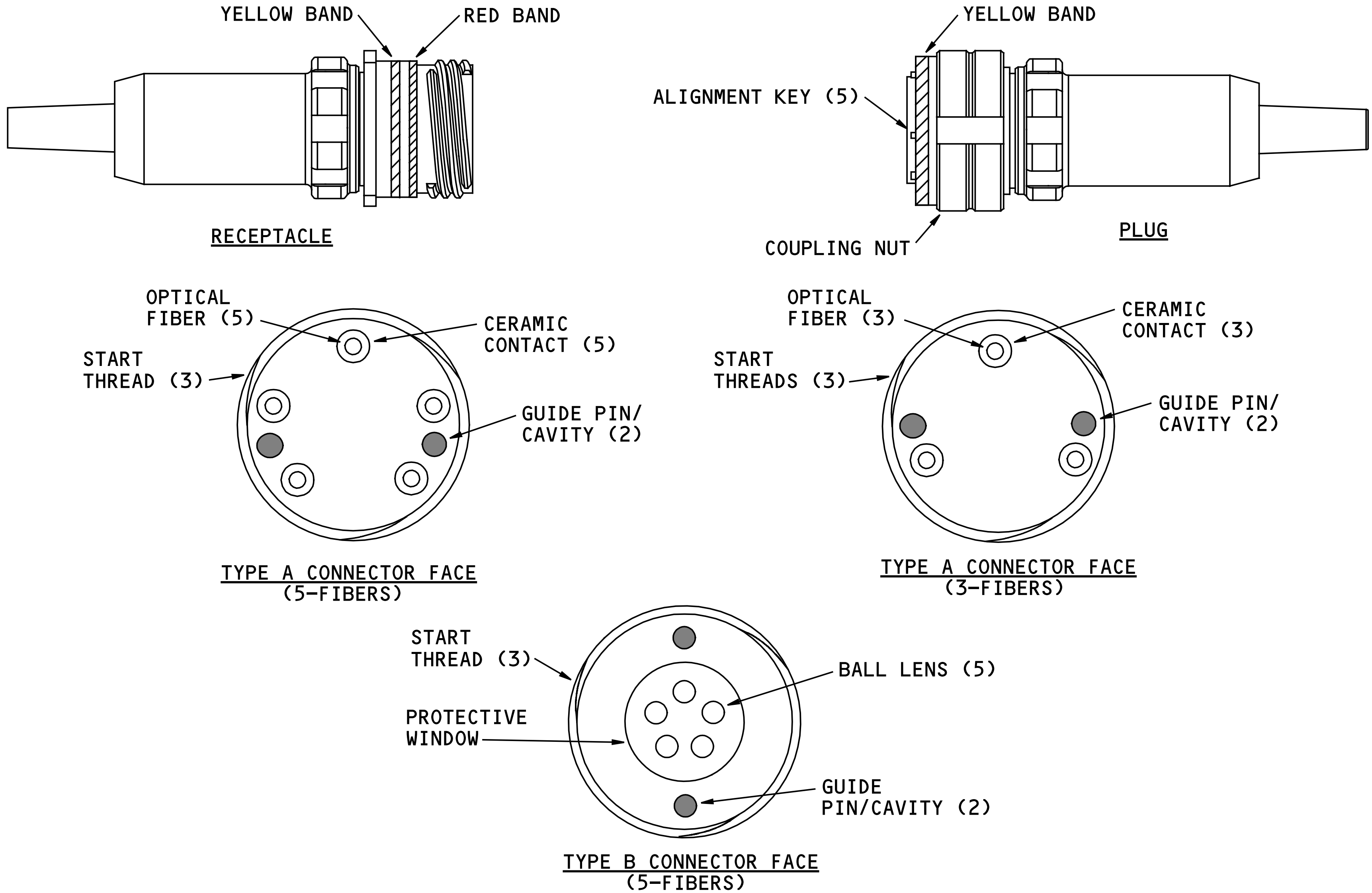
Training Information Point

This training information point refers to both the type-A and type-B connectors.

WARNING: BEFORE YOU EXAMINE THE CONNECTOR FACE OR THE CERAMIC CONTACTS, DISCONNECT THE CABLE FROM THE EQUIPMENT AT BOTH ENDS OR SET THE EQUIPMENT TO OFF. THE LIGHT FROM THE OPTICAL FIBER THAT ATTACHES TO THE AVIONICS EQUIPMENT IS INVISIBLE AND CAN BE INTENSE ENOUGH TO CAUSE DAMAGE TO YOUR EYES.

Before you install a connector, examine it to make sure it is clean.

Use only approved procedures to clean the connectors and the fiber optic lenses.



777 GENERAL - OLAN - CONNECTORS

Continental Airlines, Inc

ARINC 629

WB371

TABLE OF CONTENTS

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ARINC 629 - INTRODUCTION

General

An ARINC 629 data bus is an electronic data movement system that connects many line replaceable units (LRUs) in a single communication loop. Data from any ARINC 629 LRU is available to all other LRUs on the same ARINC 629 bus.

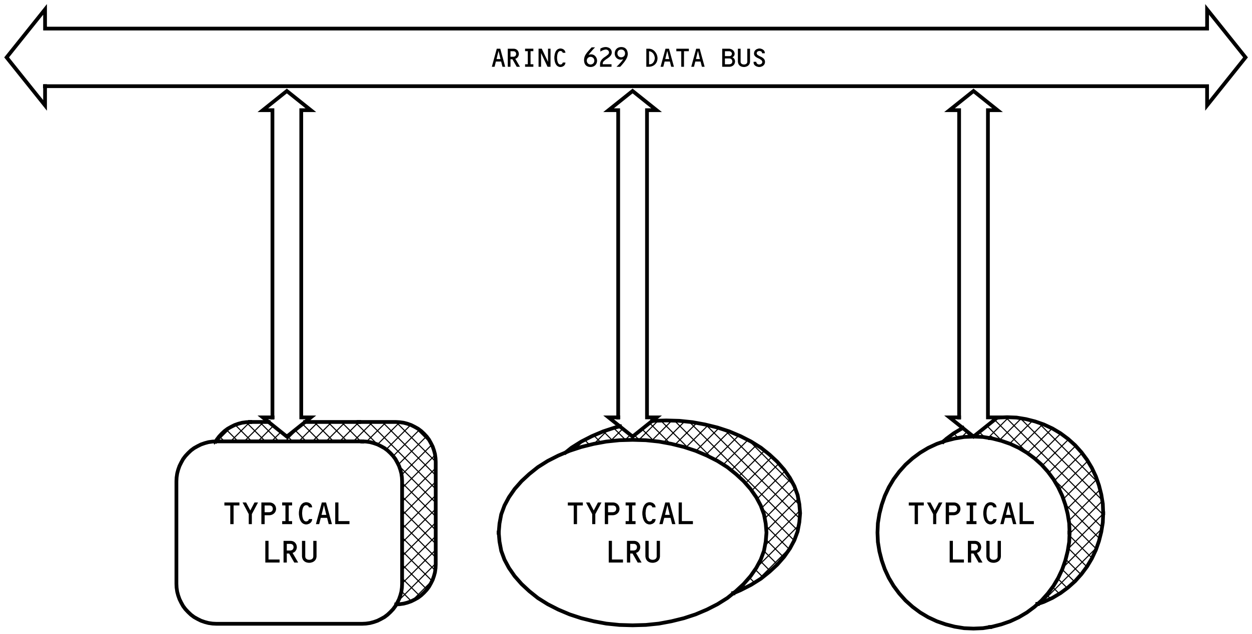
Communication on an ARINC 629 data bus is bidirectional; data to and from the LRUs moves on the same bus.

The ARINC 629 bus permits greater volume and speed of data movement than other data buses now in use.

There are eleven ARINC 629 data buses in the 777 airplane.

Abbreviations and Acronym

AIMS	- airplane information management systems
ARINC	- Aeronautical Radio, Inc.
BPCU	- bus power control unit
CDU	- control display unit
CSMA	- carrier-sense multiple access
I/O	- input/output
IC	- integrated circuit
LRM	- line replaceable module
LRU	- line replaceable unit
mA	- milliampere
MPP	- multiple personality PROM
PPSSP	- pre-pre-sync sync pulse
PROM	- programmable read only memory
PSSP	- pre-sync sync pulse
ROM	- read only memory
RPP	- receive personality PROM
RXI	- receive input line 1
RXN	- receive input line 2
SG	- sync gap (ARINC 629)
SIM	- serial interface module (ARINC 629)
TG	- terminal gap (ARINC 629)
TI	- transmit interval (ARINC 629)
TXN	- transmit output line 2
TXO	- transmit output line 1
XPP	- transmit personality PROM



23-91-00-001 Rev 2

ARINC 629 - INTRODUCTION

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ARINC 629 - GENERAL DESCRIPTION

General

An ARINC 629 data bus is a twisted pair of wires with termination resistors at each end. As many as 120 LRUs can use one ARINC 629 data bus. In 777 airplanes the maximum number of current-mode couplers per bus is 46.

Components

The ARINC 629 data bus system has these parts:

- Data bus cable
- Current-mode couplers
- Stub cables.

The ARINC 629 system also includes these components in the LRUs:

- Serial interface modules
- Terminal controllers.

Characteristics

The ARINC 629 data bus system has these characteristics:

- The LRUs send data one at a time in sequence
- The LRUs receive data at the same time
- Communication on ARINC 629 is bi-directional; LRUs may transmit and receive data on the same bus
- One LRU may connect to more than one data bus through separate couplers on each bus
- All data on the bus is available to all the LRUs on that bus.

ARINC 629 Data Bus Configuration

These are the eleven ARINC 629 data buses:

- Three flight control buses
- Four system buses
- Four airplane information management systems (AIMS) intercabinet buses.

The flight control buses connect LRUs that have flight control functions.

The system buses connect LRUs that have airplane system functions. These buses work independently from the flight control buses. The systems buses move data between these five areas:

- Avionics
- Propulsion
- Electrical
- Electro-mechanical
- Environmental control.

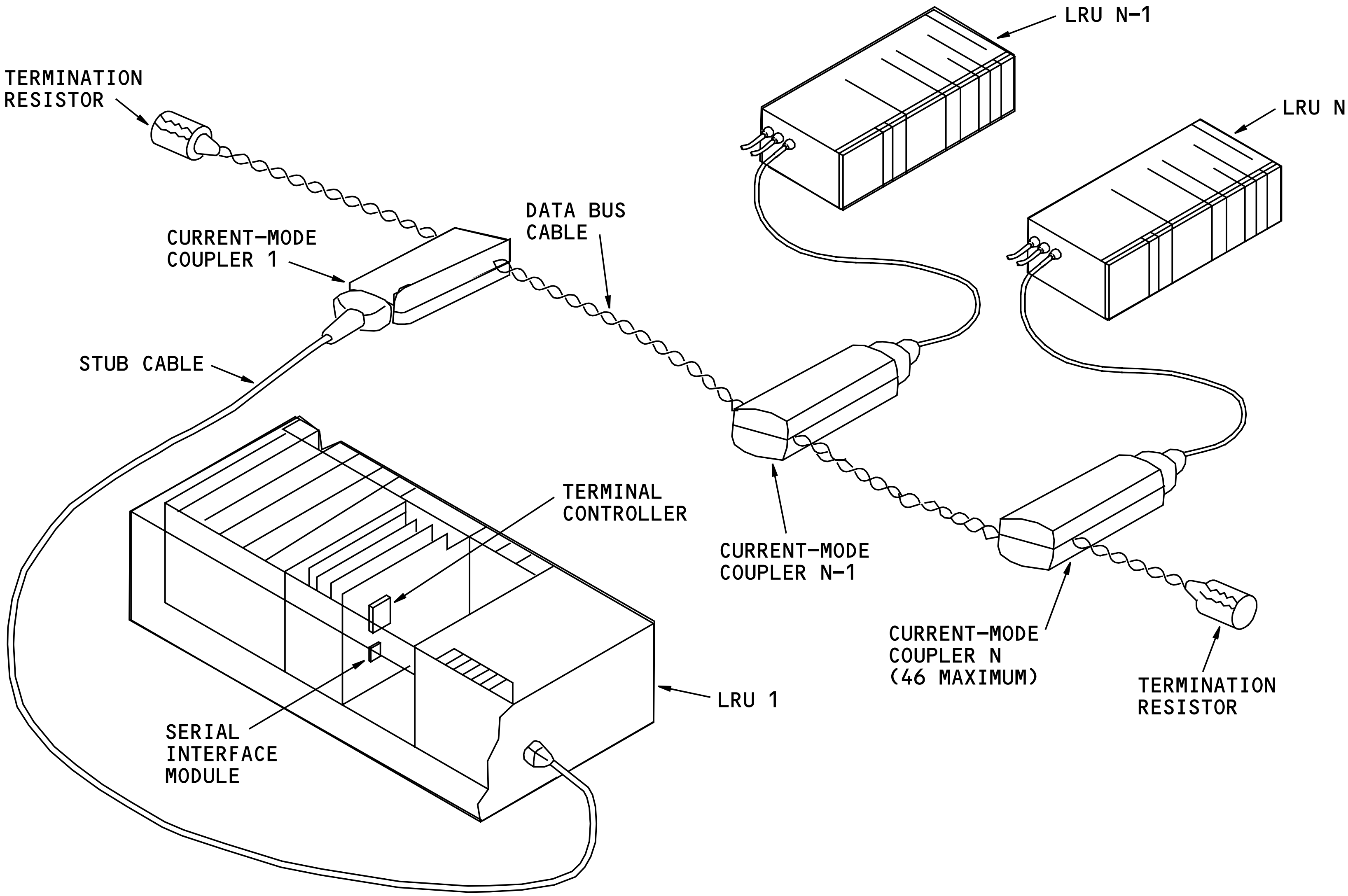
Four AIMS intercabinet buses move data between the two AIMS cabinets and the three control display units (CDUs).

ARINC 629 - GENERAL DESCRIPTION

Functional Description

Each LRU uses one or more current mode couplers to connect to data buses.

A current mode coupler and its terminal (terminal controller and serial interface module) move data to and from the bus. Only one terminal on a bus transmits at a time. Each terminal listens to the bus and waits for a stop in data movement on the bus from other LRUs before it transmits.



23-91-00-002 Rev 3 08/08/96

ARINC 629 - GENERAL DESCRIPTION

ARINC 629 - FORWARD COMPONENT LOCATIONS

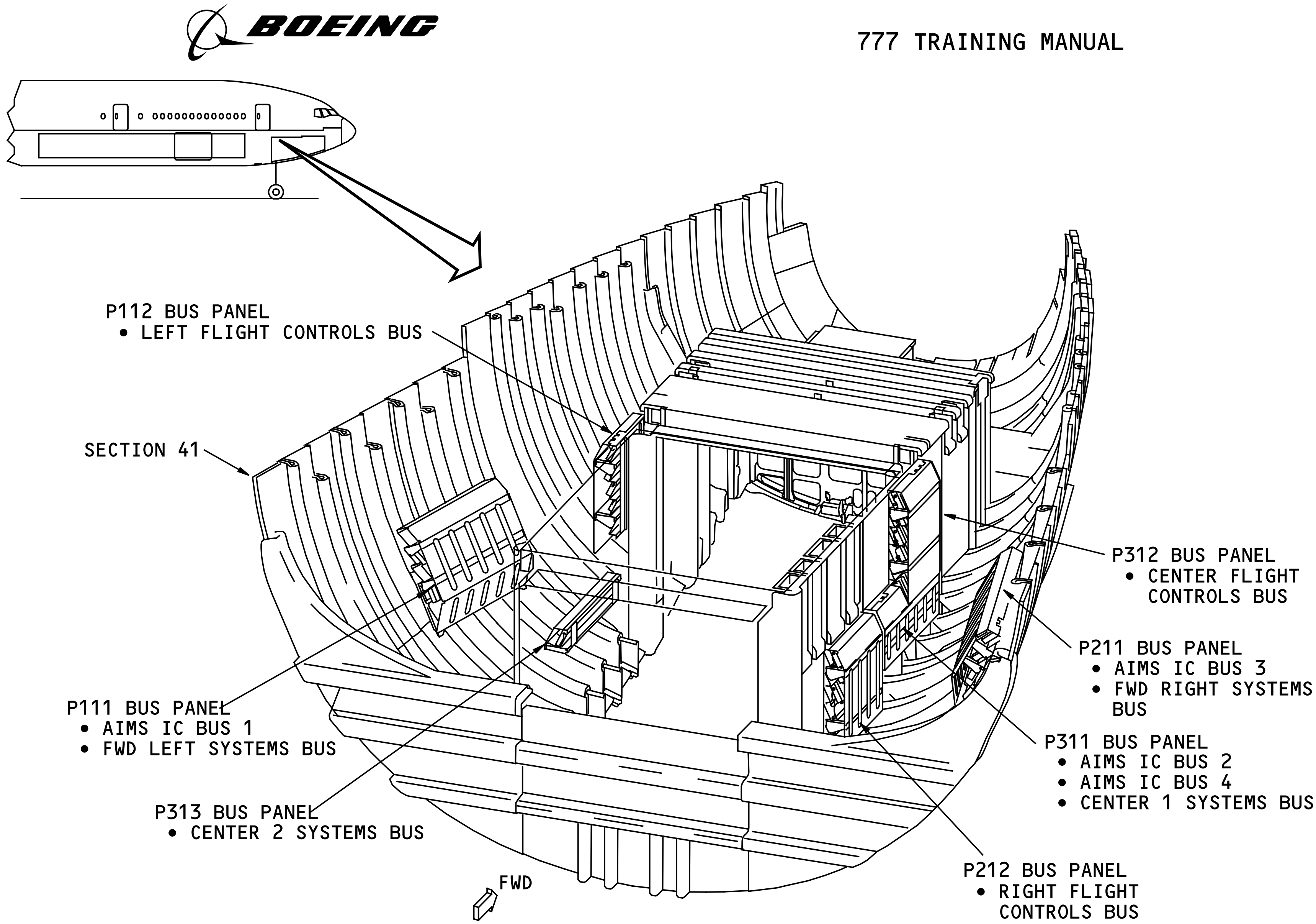
General

There are seven bus panels in the forward section on the left and right sides of the nose wheel well. Each panel contains the current-mode couplers and ARINC 629 buses.

Bus Panels

These are the seven bus panels in the forward section:

- P111 - AIMS intercabinet ARINC 629 bus 1; forward section of left systems ARINC 629 bus
- P112 - Left flight controls ARINC 629 bus
- P211 - AIMS intercabinet ARINC 629 bus 3; forward section of right systems ARINC 629 bus
- P212 - Right flight controls ARINC 629 bus
- P311 - AIMS intercabinet ARINC 629 bus 2; AIMS intercabinet ARINC 629 bus 4; center 1 systems ARINC 629 bus
- P312 - Center flight controls ARINC 629 bus
- P313 - Center 2 systems ARINC 629 bus.



23-91-00-003 Rev 3

ARINC 629 - FORWARD COMPONENT LOCATIONS

ARINC 629 - AFT COMPONENT LOCATIONS

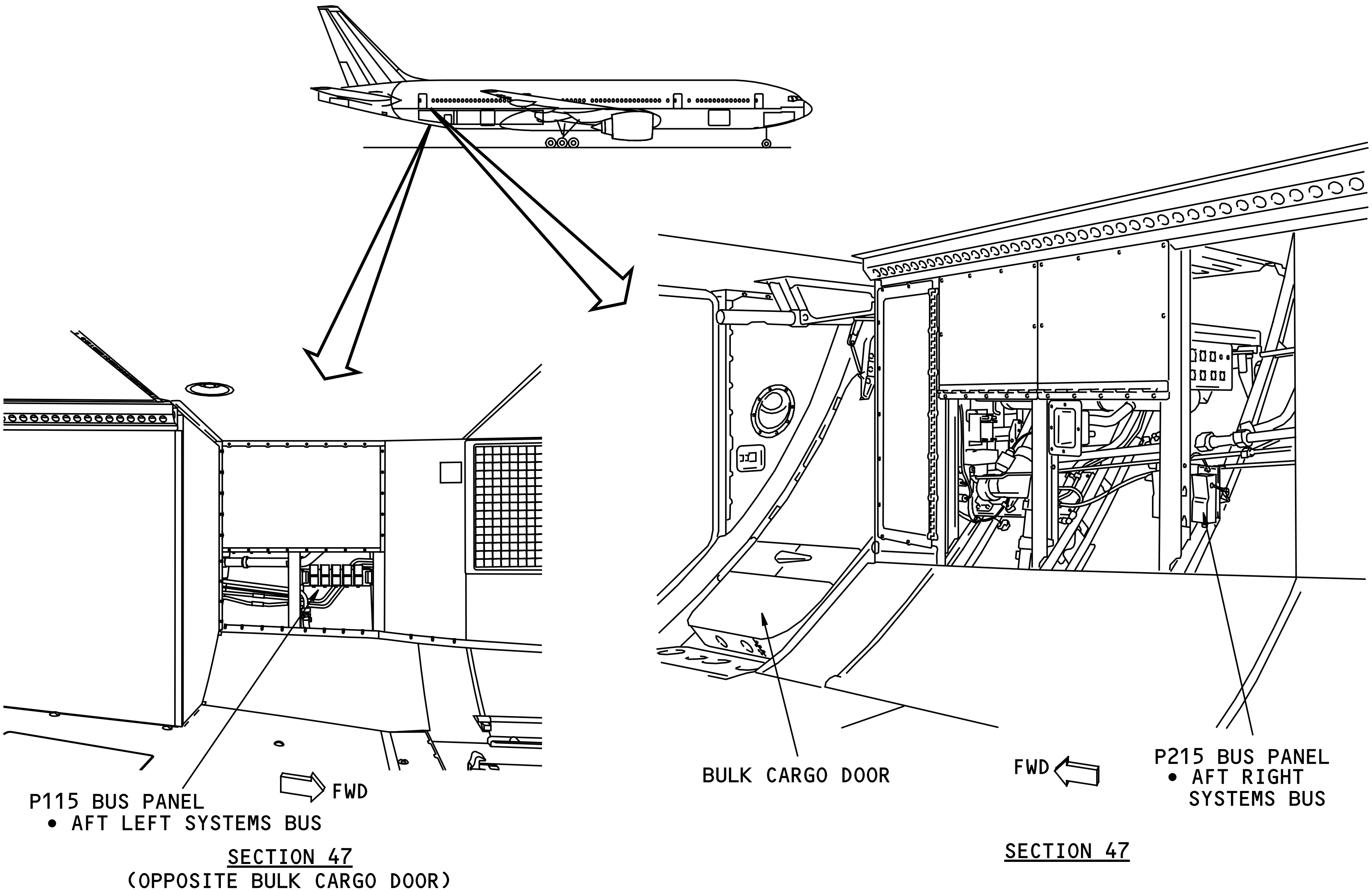
General

There are two bus panels in the aft section of the airplane. Each panel contains current-mode couplers and ARINC 629 buses.

Bus Panels

These are the bus panels in the aft section:

- P115 has the aft section of the left systems bus
- P215 has the aft section of the right systems bus.



23-91-00-004 Rev 2

ARINC 629 - AFT COMPONENT LOCATIONS

ARINC 629 - SYSTEMS BUS PRODUCTION BREAKS

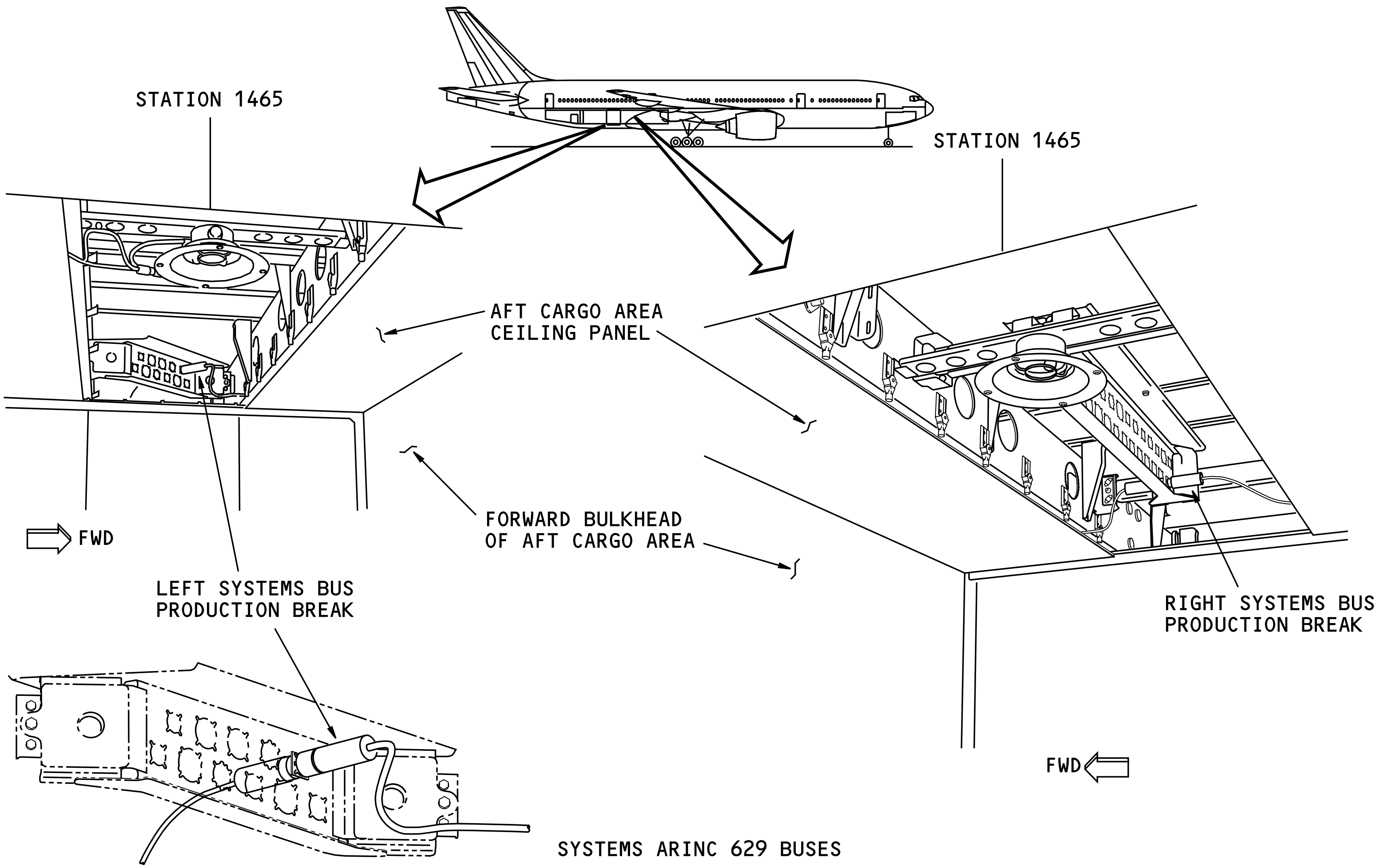
General

There is a production break in the left systems ARINC 629 bus and in the right systems ARINC 629 bus. The break divides the bus in two parts to help in removal and installation.

Production Breaks

The production breaks are above ceiling panels in the aft cargo compartment near the forward bulkhead.

The right systems bus production break is on the right side of the compartment. The left systems bus production break is on the left.



ARINC 629 - SYSTEMS BUS PRODUCTION BREAKS

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ARINC 629 - SYSTEMS BUS INTERFACES

General

These are the four systems ARINC 629 buses:

- Left systems bus
- Center 1 systems bus
- Center 2 systems bus
- Right systems bus.

left Systems ARINC 629 Bus

These LRUs transmit and receive on the left systems bus:

- Bus power control unit (BPCU)
- Generator control unit (GCU)
- Backup (BU) converter
- Left system card file (LSCF)
- Right system card file (RSCF)
- Electrical load management system (ELMS)
- Proximity switch electronics unit (PSEU)
- Fuel quantity indicating system (FQIS)
- Auxiliary power unit (APU)
- Airborne vibration monitor (AVM)
- Flap slat electronics unit (FSEU)
- Air supply control and cabin pressure controllers (ASCPC)
- Cabin temperature controllers (CTC)
- Overhead panel ARINC 629 system (OPAS)
- Audio management unit (AMU)
- Main wheel steering control unit (MWSCU)
- Brake temperature monitor unit (BTMU)
- Tire pressure monitor unit (TPMU)
- Brake system control unit (BSCU)
- Warning electronic system - left (WES-L)
- Autopilot flight director computer (AFDC)
- Engine data interface unit (EDIU)
- Passenger address/cabin interphone (PA/CI) controller
- Control display unit (CDU)
- Airplane information management system (AIMS).

One LRU also has a receive-only connection to the left systems bus:

- Warning electronic system - left (WES-L CH 2).

Center1 Systems ARINC 629 Bus

These LRUs transmit and receive on the center1 systems bus:

- Flap slat electronics unit (FSEU)
- Warning electronic system (WES)
- Autopilot flight director computer (AFDC)
- Engine data interface unit (EDIU)
- Airplane information management system (AIMS).

These LRUs also have a receive-only connection to the center1 systems bus:

- Flap slat electronics unit - 1 (FSEU-1)
- Flap slat electronics unit - 2 (FSEU-2)
- Warning electronic system - right channel 1 (WES-R CH 1).

ARINC 629 - SYSTEMS BUS INTERFACES

Center 2 Systems ARINC 629 Bus

These LRUs transmit and receive on the center 2 systems bus:

- Engine data interface unit (EDIU)
- Airplane information management system (AIMS).

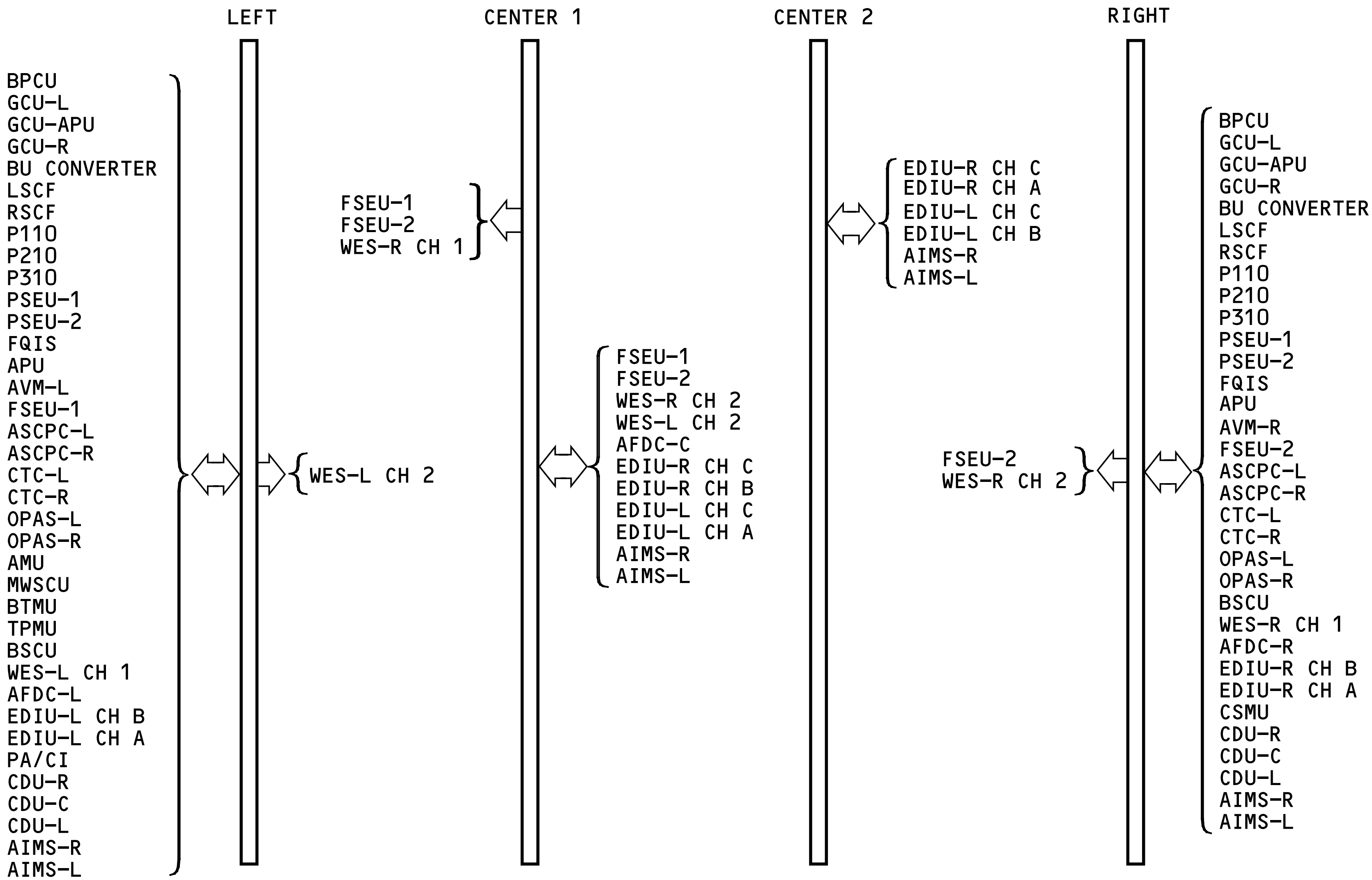
Right Systems ARINC 629 Bus

These LRUs transmit and receive on the right systems bus:

- Bus power control unit (BPCU)
- Generator control unit (GCU)
- Backup (BU) converter
- Left system card file (LSCF)
- Right system card file (RSCF)
- Electrical load management system (ELMS)
- Proximity switch electronics unit (PSEU)
- Fuel quantity indicating system (FQIS)
- Auxiliary power unit (APU)
- Airborne vibration monitor (AVM)
- Flap slat electronics unit (FSEU)
- Air supply control and cabin pressure controllers (ASCPC)
- Cabin temperature controllers (CTC)
- Overhead panel ARINC 629 system (OPAS)
- Brake system control unit (BSCU)
- Warning electronic system (WES)
- Autopilot flight director computer (AFDC)
- Engine data interface unit (EDIU)
- Cabin system management unit (CSMU)
- Control display unit (CDU)
- Airplane information management system (AIMS).

These LRUs also have a receive-only connection to the right systems bus:

- Flap slat electronics unit - 2 (FSEU-2)
- Warning electronic system - RIGHT (WES-R CH 2).



SYSTEMS ARINC 629 BUSES

ARINC 629 - SYSTEMS BUS INTERFACES

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ARINC 629 - FLIGHT CONTROLS BUS INTERFACES

General

These are the three flight controls ARINC 629 buses:

- Left flight controls bus
- Center flight controls bus
- Right flight controls bus.

Left Flight Controls ARINC 629 Bus

These LRUs transmit and receive on the left flight controls bus:

- Air data inertial reference unit (ADIRU)
- Airplane information management system (AIMS)
- Air data module total pressure (ADM TP)
- Air data module static pressure (ADM SP)
- Autopilot flight director computer (AFDC)
- Power supply assembly (PSA)
- Primary flight computer (PFC)
- Actuator control electronics (ACE).

These LRUs also have a receive-only connection to the left flight controls bus:

- Secondary attitude air data reference unit (SAARU)
- Control display unit (CDU)
- Autopilot flight director computer (AFDC)
- Primary flight computer (PFC)
- Actuator control electronics (ACE).

Center Flight Controls ARINC 629 Bus

These LRUs transmit and receive on the center flight controls bus:

- Secondary attitude air data reference unit (SAARU)
- Air data module total pressure (ADM TP)
- Air data module static pressure (ADM SP)
- Autopilot flight director computer (AFDC)
- Power supply assembly (PSA)
- Primary flight computer (PFC)
- Actuator control electronics (ACE)
- Airplane information management system (AIMS).

These LRUs also have a receive-only connection to the center flight controls bus:

- Air data inertial reference unit (ADIRU)
- Autopilot flight director computer (AFDC)
- Primary flight computer (PFC)
- Actuator control electronics (ACE).

Right Flight Controls ARINC 629 Bus

These LRUs transmit and receive on the right flight controls bus:

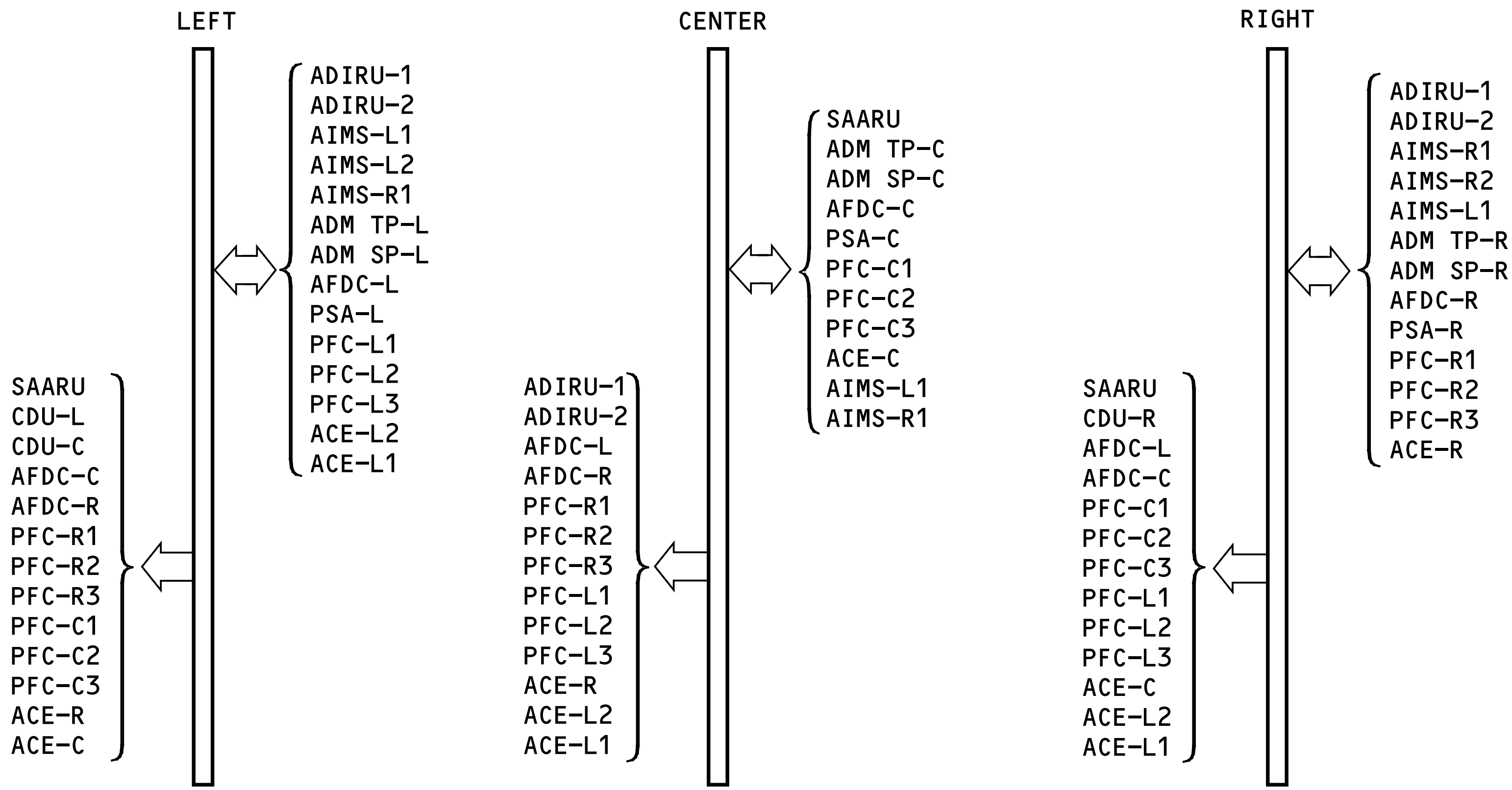
- Air data inertial reference unit (ADIRU)
- Air data module total pressure (ADM TP)
- Air data module static pressure (ADM SP)
- Autopilot flight director computer (AFDC)
- Power supply assembly (PSA)
- Primary flight computer (PFC)

ARINC 629 - FLIGHT CONTROLS BUS INTERFACES

- Actuator control electronics (ACE).

These LRUs also have a receive-only connection to the right flight controls bus:

- Secondary attitude air data reference unit (SAARU)
- Airplane information management system (AIMS)
- Control display unit (CDU)
- Autopilot flight director computer (AFDC)
- Primary flight computer (PFC)
- Actuator control electronics (ACE).



23-91-00-007 Rev 4 02/23/96

ARINC 629 - FLIGHT CONTROLS BUS INTERFACES

ARINC 629 - AIMS INTERCABINET BUS INTERFACES

General

The AIMS intercabinet ARINC 629 buses move data between LRUs of the AIMS.

There are four AIMS ARINC 629 intercabinet buses:

- Airplane information management system (AIMS) intercabinet bus 1
- AIMS intercabinet bus 2
- AIMS intercabinet bus 3
- AIMS intercabinet bus 4.

AIMS Intercabinet Bus 1

These LRUs transmit and receive on the AIMS intercabinet bus 1:

- AIMS left
- AIMS right.

AIMS Intercabinet Bus 2

These LRUs transmit and receive on the AIMS intercabinet bus 2:

- AIMS left
- AIMS right
- Control display unit (CDU) center
- CDU right
- CDU left.

AIMS Intercabinet Bus 3

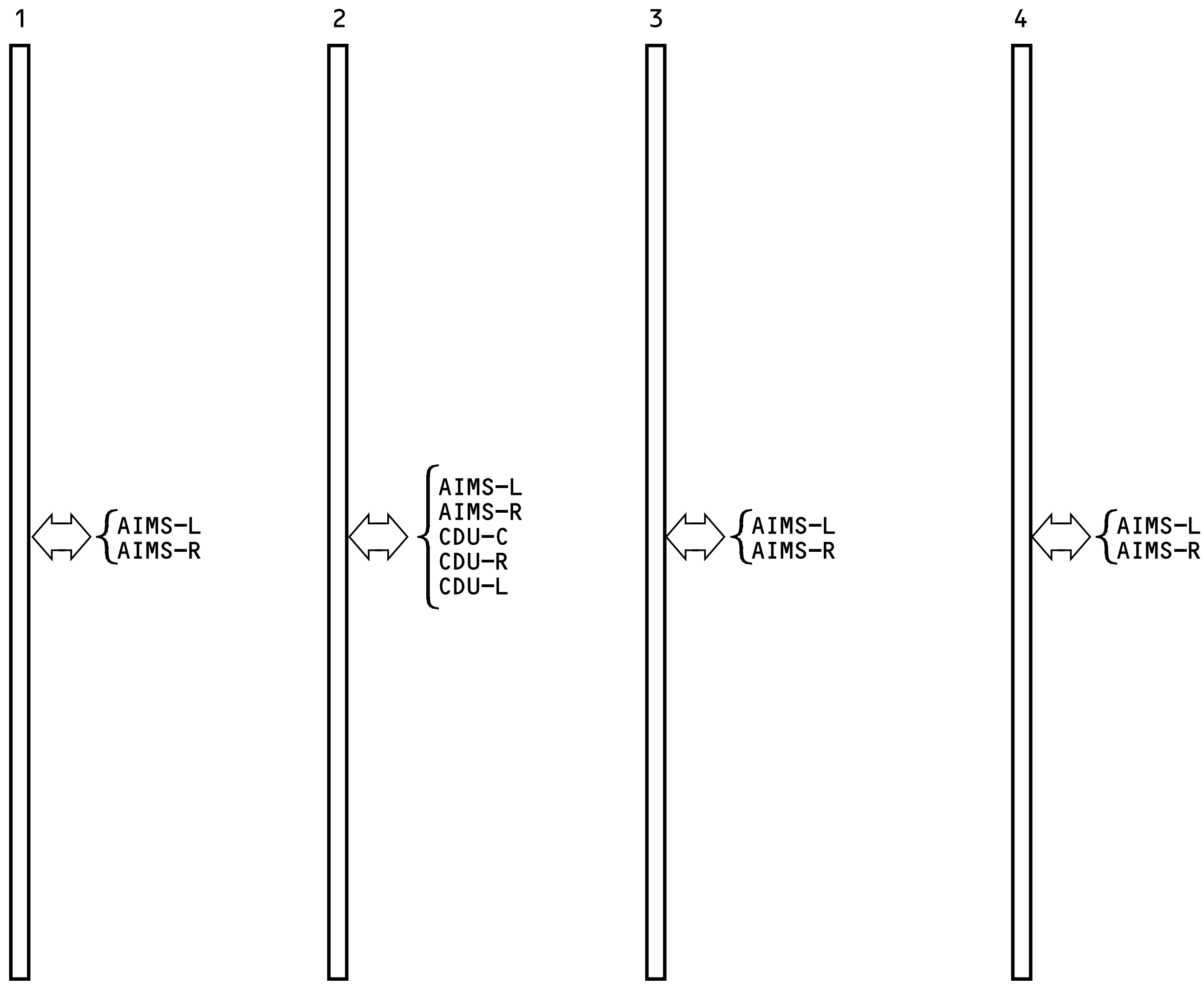
These LRUs transmit and receive on the AIMS intercabinet bus 3:

- AIMS left
- AIMS right.

AIMS Intercabinet Bus 4

These LRUs transmit and receive on the AIMS intercabinet bus 4:

- AIMS left
- AIMS right.



AIMS INTERCABINET ARINC 629 BUSES

ARINC 629 - AIMS INTERCABINET BUS INTERFACES

23-91-00-008 Rev 1

ARINC 629 - CURRENT-MODE COUPLER

Purpose

The current-mode coupler connects the bus cable to the stub cable.

Physical Description

These are the physical characteristics of the current-mode coupler:

- It is a two part assembly for fast installation
- It has a cover with the electronics and the receptacle for the stub cable
- It has a base designed for easy installation on the panel
- It has a waterproof housing
- It has protective wire guides to install the data bus cable.

There are different suppliers for current-mode couplers. They all function in the same way. They are interchangeable.

E-Core Assembly

An E-core assembly is a part of the coupler base. E-core assemblies are electromagnetic components that couple the signals in the data bus cable in and out of the coupler. The wire guides are grooves that give a controlled routing and protection for the wires of the data bus cable as they go through the E-core assembly.

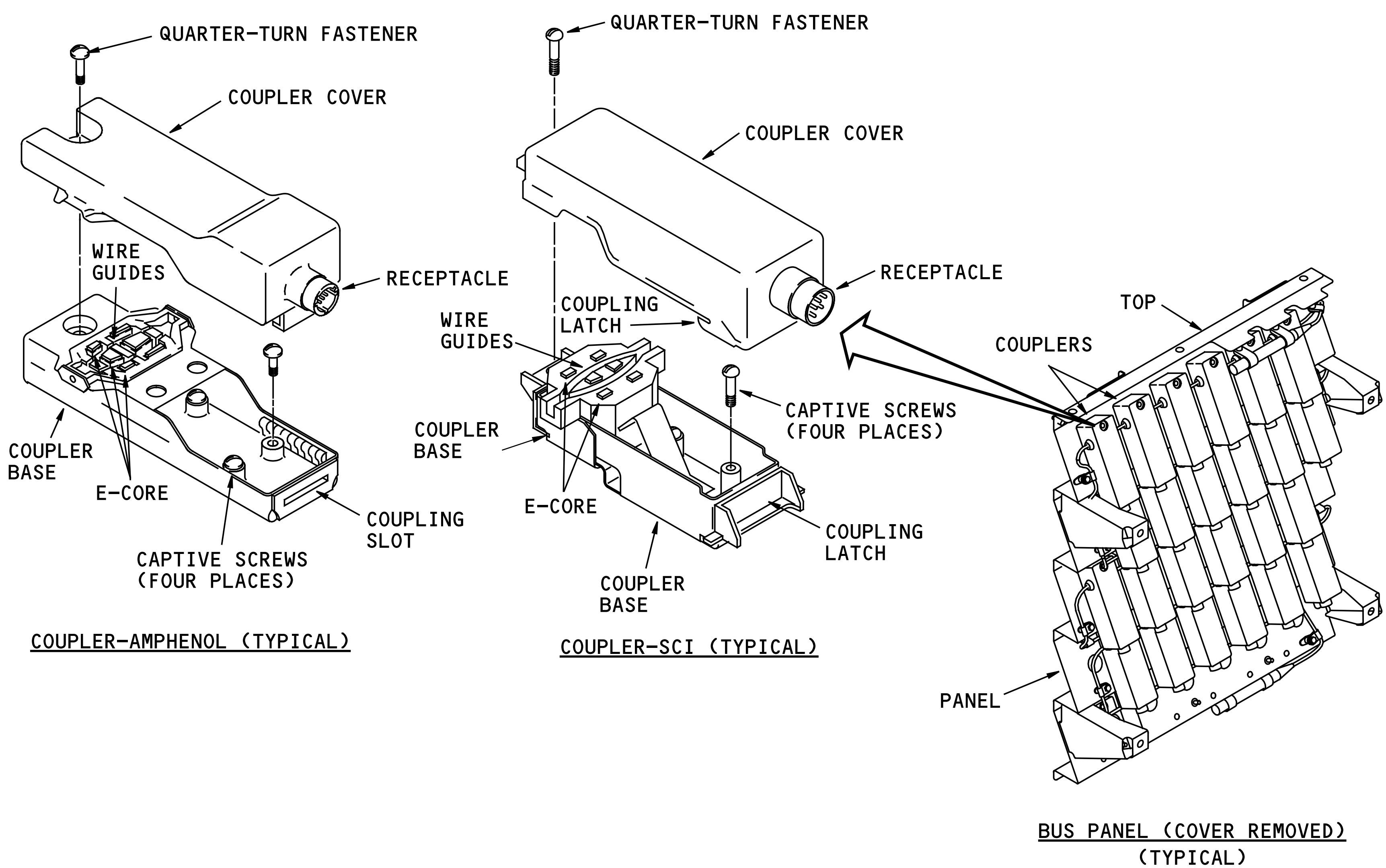
Location

All the current-mode couplers are on the bus panels.

Training Information Point

Couplers are interchangeable units. Covers and bases from different suppliers are not interchangeable.

Remove power from the LRU before you replace the coupler for that LRU.



23-91-00-009 Rev 3 12/06/1995

ARINC 629 - CURRENT-MODE COUPLER

ARINC 629 - BUS CABLE AND BUS PANEL

Purpose

The bus cable moves data between LRUs. A current-mode coupler and a stub cable attach each LRU terminal to the data bus cable.

Physical Description

A bus cable is a pair of twisted wires with a termination resistor at each end. Each resistor has a value of about 130 ohms.

The left and right systems bus cables have production break connectors in the middle for easy replacement. The parts of the system bus cable that are external to the coupler panels have shielding outside.

A bus cable in the 777 may be as long as 180 feet. It connects as many as 46 current-mode couplers.

The cable has a center conductor covered by a layer of foam. A Teflon skin covers the foam.

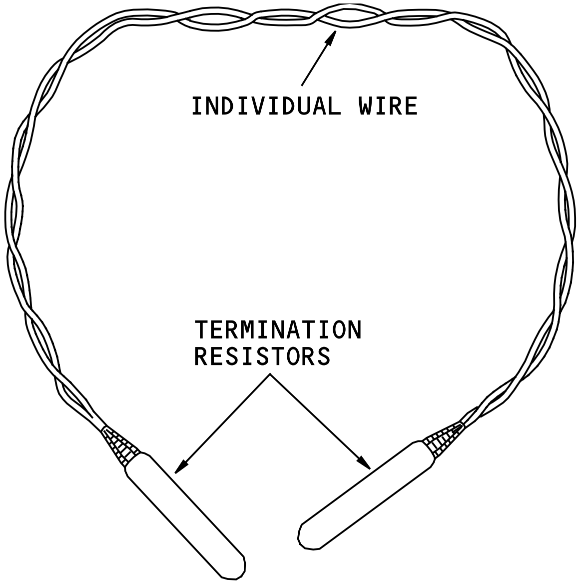
Location

All the bus cables except the left and right systems bus cables are fully inside the bus panels. The left system bus connects the forward bus panel (P111) to the aft bus panel (P115) with a production break in between. The right systems bus connects the forward bus panel (P211) to the aft bus panel (P215) with a production break in between.

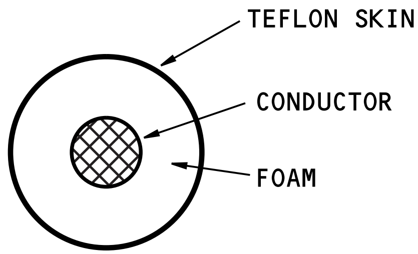
Training Information Point

Be careful when you install the bus cable on a panel. Do not cut or cause damage to the Teflon skin of the bus cable. Damage to the Teflon skin can cause corrosion on the conductor or failure of the system.

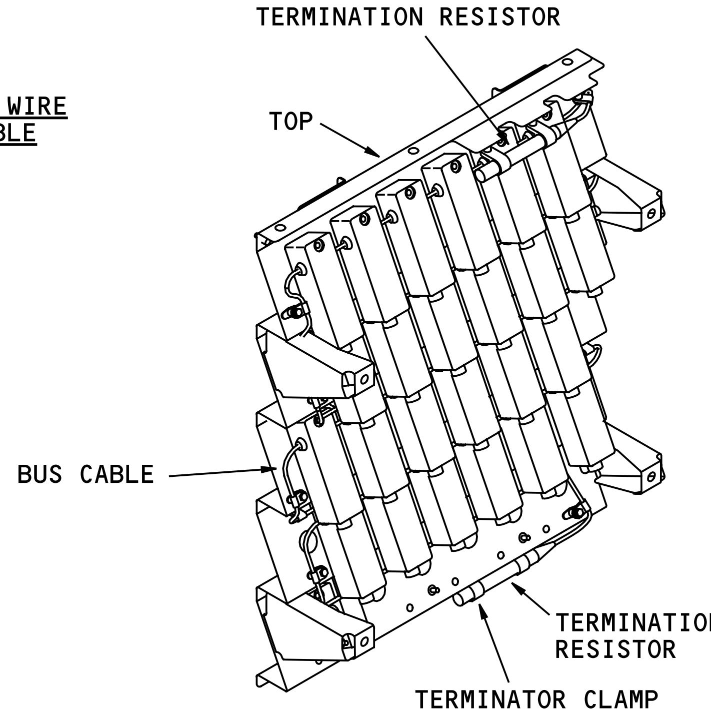
There is a special wire separator tool (WST8139) for bus cable installation on the coupler. The use of unapproved tools can cause damage to the bus.



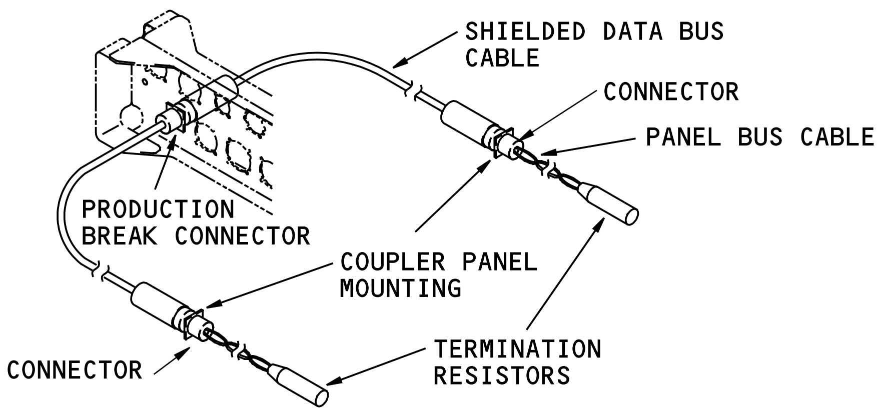
PANEL BUS CABLE
(TYPICAL)



CROSS-SECTION OF A WIRE
OF A DATA BUS CABLE
(TYPICAL)



BUS PANEL (COVER REMOVED)
(TYPICAL)



SYSTEMS ARINC 629 BUS CABLE WITH PRODUCTION BREAK
(TYPICAL)

23-91-00-010 Rev 4

ARINC 629 - BUS CABLE AND BUS PANEL

ARINC 629 - STUB CABLE

Purpose

The stub cables are for bi-directional data movement between the LRU and the current-mode coupler. The stub cables also supply power from the LRUs to the current-mode couplers.

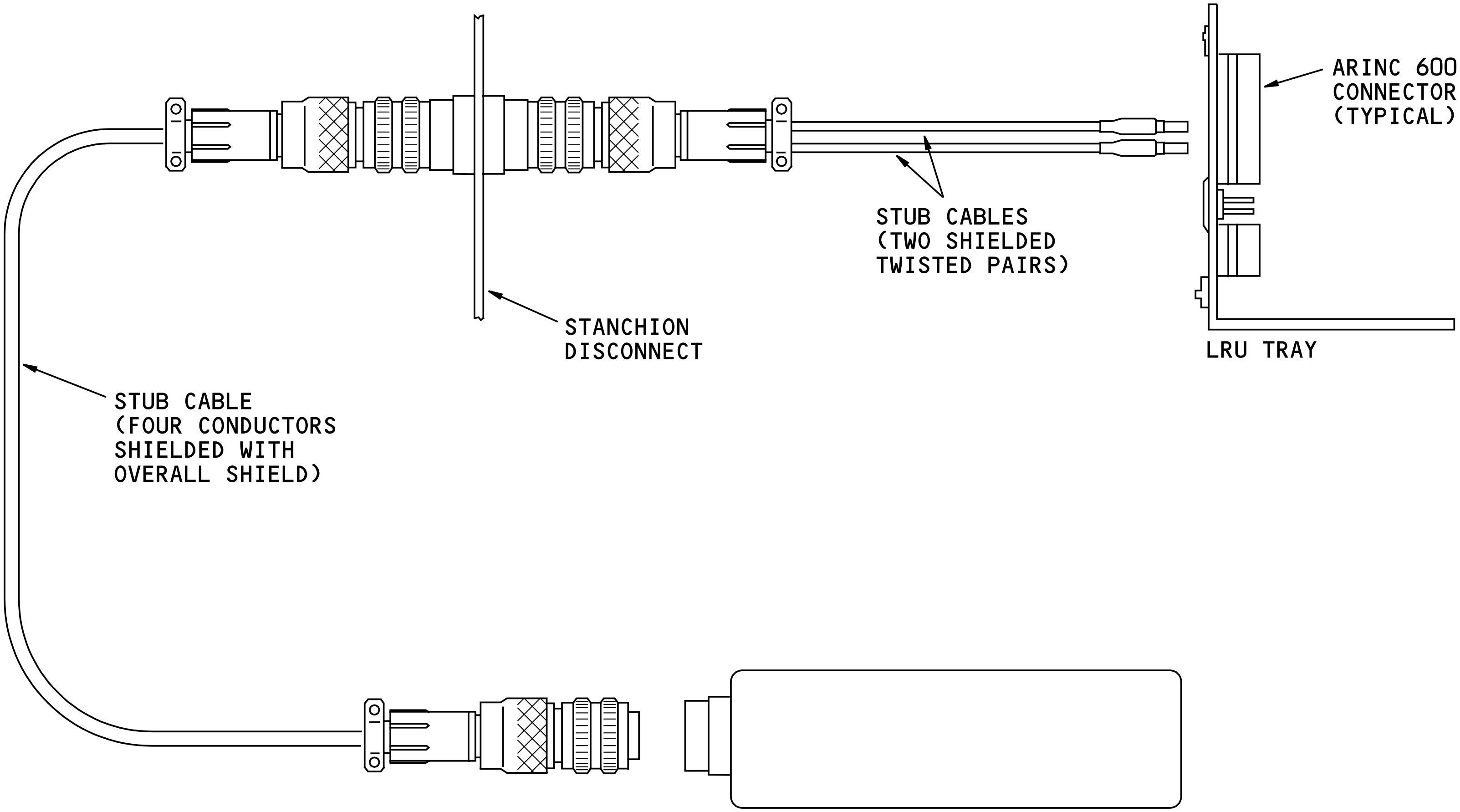
Physical Description

A stub cable has four wires; two to transmit and the other two to receive.

Stub cables can be as long as 57 feet for transmit/receive couplers and 75 feet for receive-only couplers couplers.

Location

The stub cables are in the airplane wiring bundles.



23-91-00-011 Rev 1

ARINC 629 - STUB CABLE

ARINC 629 - CURRENT-MODE COUPLER FUNCTIONAL DESCRIPTION

General

A current-mode coupler, together with a serial interface module (SIM) supplies the interface between the ARINC 629 data bus cable and an ARINC 629 terminal in the LRU. The current-mode coupler is a dual channel device in both transmit and receive operations. It has two transmit drivers and two receivers. The SIM makes the transmit and receive channel selection.

Normal Transmit Mode Operation

The current mode coupler transmit drivers put signals on the data bus. The current mode coupler receives the voltage signals from the SIM over the transmit stub of the stub cable. The current mode coupler puts the signals onto the data bus. Thus it changes voltage signals from the SIM to the current signals on the bus.

Normal Receive Mode Operation

The current mode coupler receives current mode signals from the bus. It changes them to voltage signals which go to the SIM over the receive stub of the stub cable.

Transmit Inhibit Mode Operation

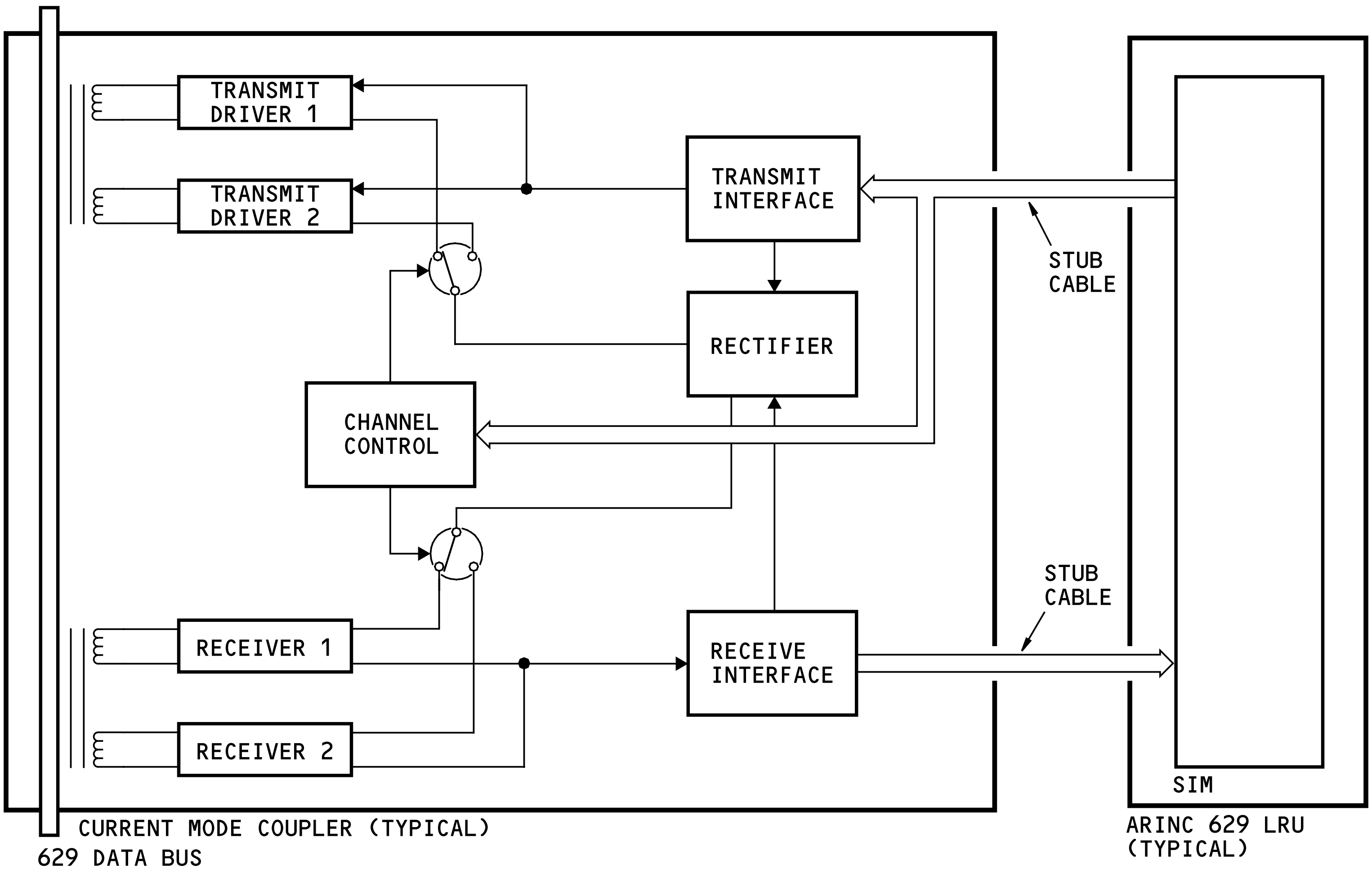
The SIM monitors the quality of the transmit signal from the LRU. If the signal is unsatisfactory, the SIM stops transmit operation. The LRU continues to receive data during the transmit inhibit mode of operation.

Power

The coupler rectifier receives power from the SIM through the transmit and receive interfaces.

Control

The SIM selects the active transmit driver and receiver for transmit and receive operations. The channel control logic selects the switch position in the coupler for the correct transmit driver and receiver.



23-91-00-012 Rev 1

ARINC 629 - CURRENT-MODE COUPLER FUNCTIONAL DESCRIPTION

ARINC 629 - LRU FUNCTIONAL DESCRIPTION

General

An ARINC 629 LRU contains a serial interface module (SIM) and a terminal controller. These move data between the LRU and the current-mode coupler. Each LRU has a personality that identifies its purpose and operation. The personality data is in two parts:

- Transmit personality PROM (XPP)
- Receive personality PROM (RPP).

The terminal controller uses the personality proms to control the flow of data between the LRU and the data bus.

SIM Functions

The SIM together with the current-mode coupler supplies the interface between the ARINC 629 data bus cable and the terminal controller in an LRU.

In transmit mode, the SIM changes transmit signals from the terminal controller into analog voltage signals. It moves these to the current-mode coupler over the transmit stub of the stub cable.

In receive mode, the SIM receives the voltage signals from the current-mode coupler after the current-mode coupler changes the current-mode signals to voltage signals. The SIM changes the received voltage signals into transition signals and moves them to the terminal controller.

The SIM monitors the quality of its own transmit signal and tells the terminal controller about any problem.

It does a check of the signal put on the data bus by the current-mode coupler. The SIM tells the terminal controller if the signal is not satisfactory.

The SIM also monitors the quality of signals received from other LRUs.

Terminal Controller Functions

The ARINC 629 terminal controller moves data to and from the LRU subsystem memory through the subsystem interface. The LRU transmit personality PROM (XPP) and receive personality PROM (RPP) control the flow of data.

The terminal controller gets its protocol access values from the XPP or the RPP.

Bus Protocol

The ARINC 629 uses a procedure to control access to the data bus. This procedure is the bus protocol.

Each LRU has a time period in which it may transmit.

After an LRU transmits, the control function measures the time and makes sure that it does not transmit again until all the other LRUs on the bus have an option to transmit.

ARINC 629 - LRU FUNCTIONAL DESCRIPTION

Transmitter Operation

In an ARINC 629 LRU, the terminal controller controls the schedule of messages on the data bus based on personality data stored in the transmit personality PROM (XPP).

The transmitter uses the XPP to put these details in each message on the data bus:

- Labels in the message
- Number of words in each word string in the message.

The transmitter gets transmit data from the subsystem memory. The protocol logic of the terminal controller monitors the operations and permits the transmitter to transmit. The transmitter sends one complete message each time it transmits.

Receiver Operation

In an LRU, the SIM receiver circuit gets the messages from the data bus through the coupler. It uses the received data based on personality data in the receive personality PROM (RPP).

The receive circuit monitors all signals on the data bus.

When it finds a message label on the bus, it knows if the message is good or is not based on the message structure. If it is good, the receiver uses the message.

Fault Monitor and Control Function

The fault monitor in the ARINC 629 system prevents faults that cause the bus to fail or that degrade the data on the bus. An ARINC 629 LRU monitors all signals on the bus including its own.

ARINC 629 messages contain data words. All received words must pass a receive data test which examines the word structure.

The SIM monitors the received word strings to make sure they are correct.

When a terminal transmits a message on the bus, the terminal receiver reads the message and the monitor circuit makes sure it is correct.

When in the monitor mode, the receiver uses the RPP based on the transmitted label in the same way as in the receive mode.

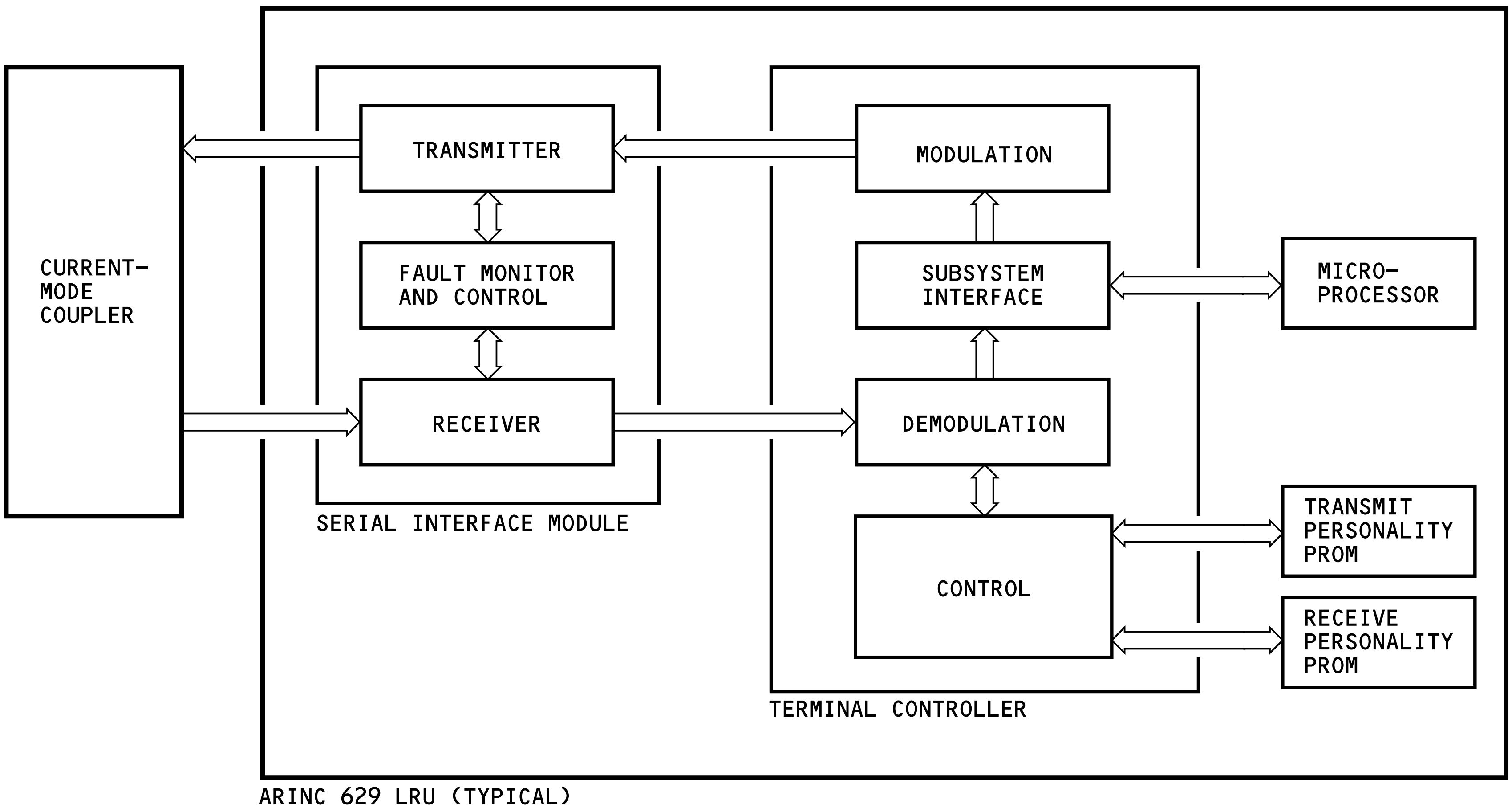
The receiver goes into the monitor mode when any of the following occurs:

- The transmitter gives a signal to the coupler when it starts to transmit
- The receiver finds a label that the terminal has authority to transmit.

ARINC 629 - LRU FUNCTIONAL DESCRIPTION

The transmitter stops operation if there are repeated transmit signal errors. You must reset power to the LRU to continue transmit operation.

If the monitor function does not operate, the transmitter will stop. This occurs if the LRU transmits but the monitor does not receive data.



23-91-00-013 Rev 2

ARINC 629 - LRU FUNCTIONAL DESCRIPTION

ARINC 629 - MESSAGE STRUCTURE FUNCTIONAL DESCRIPTION

General

Data in the ARINC 629 system moves through the data bus cable and other components as messages. Between each message is a terminal gap. A message is a group of word-strings. Each word string has a label word followed by data words. Each message has a special structure. The structure allows the LRUs to select and read the message.

Message Structure

A message has up to 31 word strings. There is a 4-bit time gap between each word string.

A word string begins with a label word. A word string has up to 256 data words. There is no gap between words in a word-string.

The minimum length message has 1 label and no data words. The maximum length message has 31 labels with 256 data words following each label, and 30 time gaps of 4 bits each.

Label Word Structure

A label word is a 20-bit word. It has:

- A 12-bit label field
- A 4-bit label extension field
- A single parity bit
- A 3-bit time hi lo sync pulse.

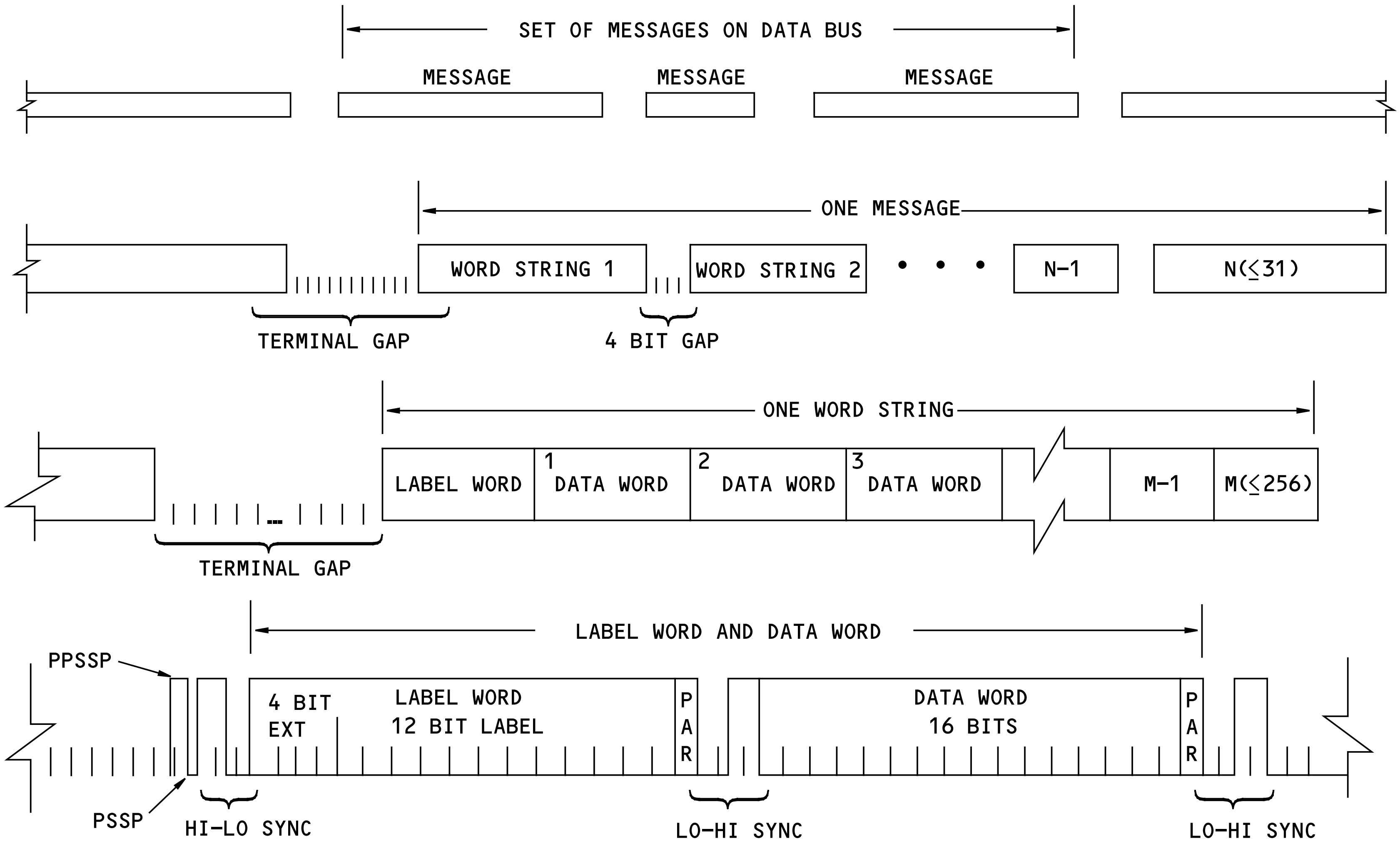
A pulse of one half-bit time, called the pre-sync sync pulse (PSSP), comes before the first label word of a message. An approximately one half-bit time pre-pre-sync sync pulse (PPSSP) comes before the PSSP.

The PPSSP and the PSSP occur prior to the 3-bit time hi lo sync pulse

Data Word Structure

A data word is also a 20-bit word. It has:

- A 16 bit data field
- A single parity bit
- A 3-bit time lo hi sync pulse.



23-91-00-014 Rev 1

ARINC 629 - MESSAGE STRUCTURE FUNCTIONAL DESCRIPTION

ARINC 629 - TIMING FUNCTIONAL DESCRIPTION

General

Because of the quantity of data that may be on the bus, ARINC 629 uses a time procedure to prevent accidental signal mixture. ARINC 629 uses three timers:

- Transmit interval (TI) timer
- Synchronization gap (SG) timer
- Terminal gap (TG) timer.

The timers are part of the LRU personality. Each LRU uses all three timers to isolate data messages.

Transmit Interval (TI)

The TI for any LRU begins the moment the terminal starts to transmit. After the terminal transmits a message, it must wait the length of time equal to TI before it transmits again.

All LRUs on a bus have the same TI.

Synchronization Gap (SG)

After the TI, the SG is the longest timer. The SG begins when there is no signal on the bus. The SG is the same for all LRUs. It has a value larger than the value of the longest terminal gap used on a given bus.

If a signal comes on the bus before the SG completes, the SG stops. When the SG completes, it stays reset until the LRU transmits again.

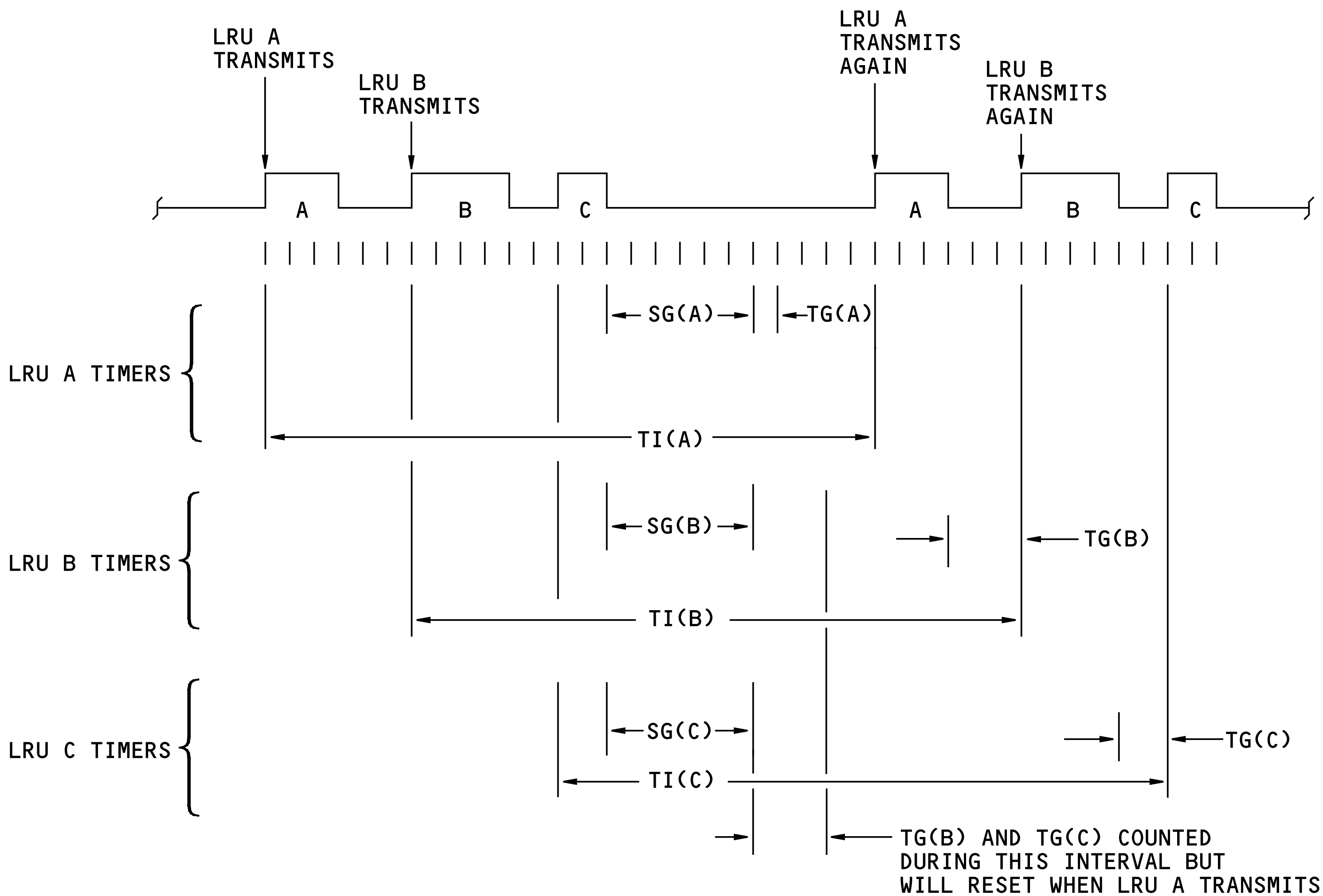
Terminal Gap (TG)

Each LRU on the bus has a special TG.

The TG begins after the SG is complete and no signal is on the bus.

If there is a signal on the bus before the TG completes, the TG stops. It starts again when there is no signal on the bus.

The TG and SG cannot overlap in time. They must occur in sequence.



23-91-00-015 Rev 1

ARINC 629 - TIMING FUNCTIONAL DESCRIPTION

ARINC 629 - PERIODIC MODE TIMING FUNCTIONAL DESCRIPTION

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ARINC 629 - PERIODIC MODE TIMING FUNCTIONAL DESCRIPTION

General

The ARINC 629 uses these three timers:

- Transmit interval (TI)
- Synchronization gap (SG)
- Terminal gap (TG).

The three timers operate in these two ways:

- Periodic mode
- Aperiodic mode.

The periodic mode makes sure that an LRU transmits at a regular time sequence, in their power-up order.

If an LRU message length increases because of a non-normal condition, the system changes to aperiodic operation. In aperiodic operation, the LRU transmits in a different time sequence. In the aperiodic mode, the LRUs transmit in order of shortest TG to longest TG.

Periodic Mode

The periodic mode is the normal mode of operation.

In the periodic mode, an LRU transmits one time every TI.

The examples show the timing diagram for three LRUs in the periodic mode.

At event 1, all three timers (TI, SG & TG) for LRU 1 are complete and LRU 1 starts to transmit a message (M). LRUs 2 and 3 stop their TGs when LRU 1 starts to transmit.

At event 2, LRU 1 no longer transmits, and LRU 2 and 3 start their TG timers.

At event 3, the TG timer for LRU 3 is complete, however TI still continues. LRU 3 does not transmit. The TG timer for LRU 2 continues.

At event 4, the TG timer for LRU 2 is complete. All three timers for LRU 2 (TI, SG and TG) are complete and the LRU starts to transmit a message, while LRU 3 waits for its TI to complete. LRU 3 stops its TG when LRU 2 starts to transmit.

At event 5, LRU 2 stops transmission and LRU 2 starts its TG timer.

At event 6, the TG timer for LRU 3 completes. For LRU 3, all three timers (TI, SG and TG) are complete and it starts to transmit a message.

At event 7, LRU 3 no longer transmits, and all three LRUs start their SG timers.

At event 8, all three SG timers are complete and the TG timers start.

At event 9, the TG for LRU 1 completes, TI continues, so it does not transmit.

ARINC 629 - PERIODIC MODE TIMING FUNCTIONAL DESCRIPTION

At event 10, TG for LRU 3 is complete, the TI continues, so the LRU does not transmit.

At event 11, the TG for LRU 2 completes, the TI continues, so the LRU does not transmit.

Back at event 1 when all three timers (TI, SG and TG) for LRU 1 are complete and it starts to transmit a message. LRU 2 and 3 stop their TGs when LRU 1 starts to transmit.

Aperiodic Mode

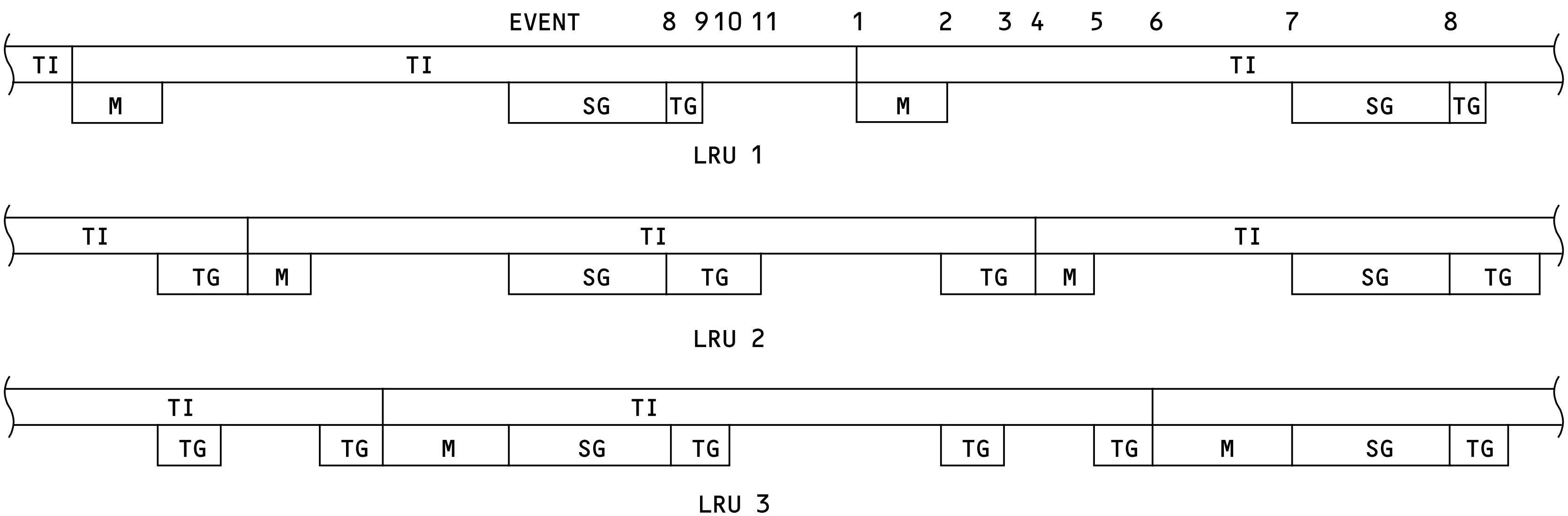
Aperiodic data is a direct result of a discrete event. It is data that is asynchronous and updated at a non-uniform rate. For example, aperiodic data can be a position report in landing gear systems.

Aperiodic data transfers data on events important to airplane operation. This data is in two classes:

- Data to control tasks such as landing gear sensors and flight deck switches
- Data for status information.

Aperiodic data also transmits large blocks of data for these functions:

- Data base loads
- Operational software
- BITE information.



NOTE: NOT TO SCALE

23-91-00-016 Rev 1

ARINC 629 - PERIODIC MODE TIMING FUNCTIONAL DESCRIPTION

ARINC 629 - TEST

Tests

You use the maintenance access terminal (MAT) to do the ARINC 629 coupler replacement test.

This test does not do a check of the AIMS intercabinet buses.

The central maintenance computing function (CMCF) does not have a specified ARINC 629 system test to check the entire system.

ARINC 629 Coupler Replacement Test

For this operational test, you do a check of the configuration of a system that connects to each of the buses. The data you see on the MAT tells you if the bus is operational.

Training Information Point

Use the ARINC 629 system test procedure if you can not do the operational test. This test does not use the MAT. You use an ARINC 629 data bus analyzer.

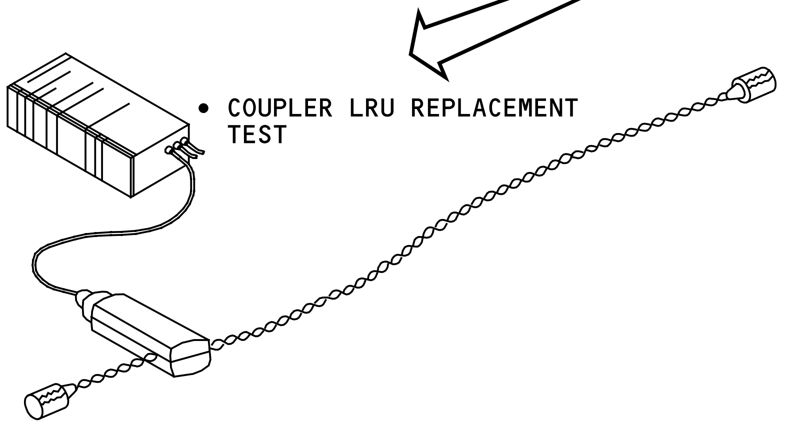
Use the standard wiring practices manual when you replace ARINC 629 stub or system cables.

LINE MAINTENANCE	EXTENDED MAINTENANCE	OTHER FUNCTIONS	HELP	REPORT

- INBOUND FLIGHT DECK EFFECTS
- EXISTING FLIGHT DECK EFFECTS
- GROUND TESTS
- SYSTEM CONFIGURATION
- EXIT MAINTENANCE

ONBOARD MAINTENANCE

Left Central Maintenance Computing Function (CMCF)



- COUPLER LRU REPLACEMENT TEST

ARINC 629 - TEST

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ARINC 629 - OVERALL INTERFACE DIAGRAM

Interface

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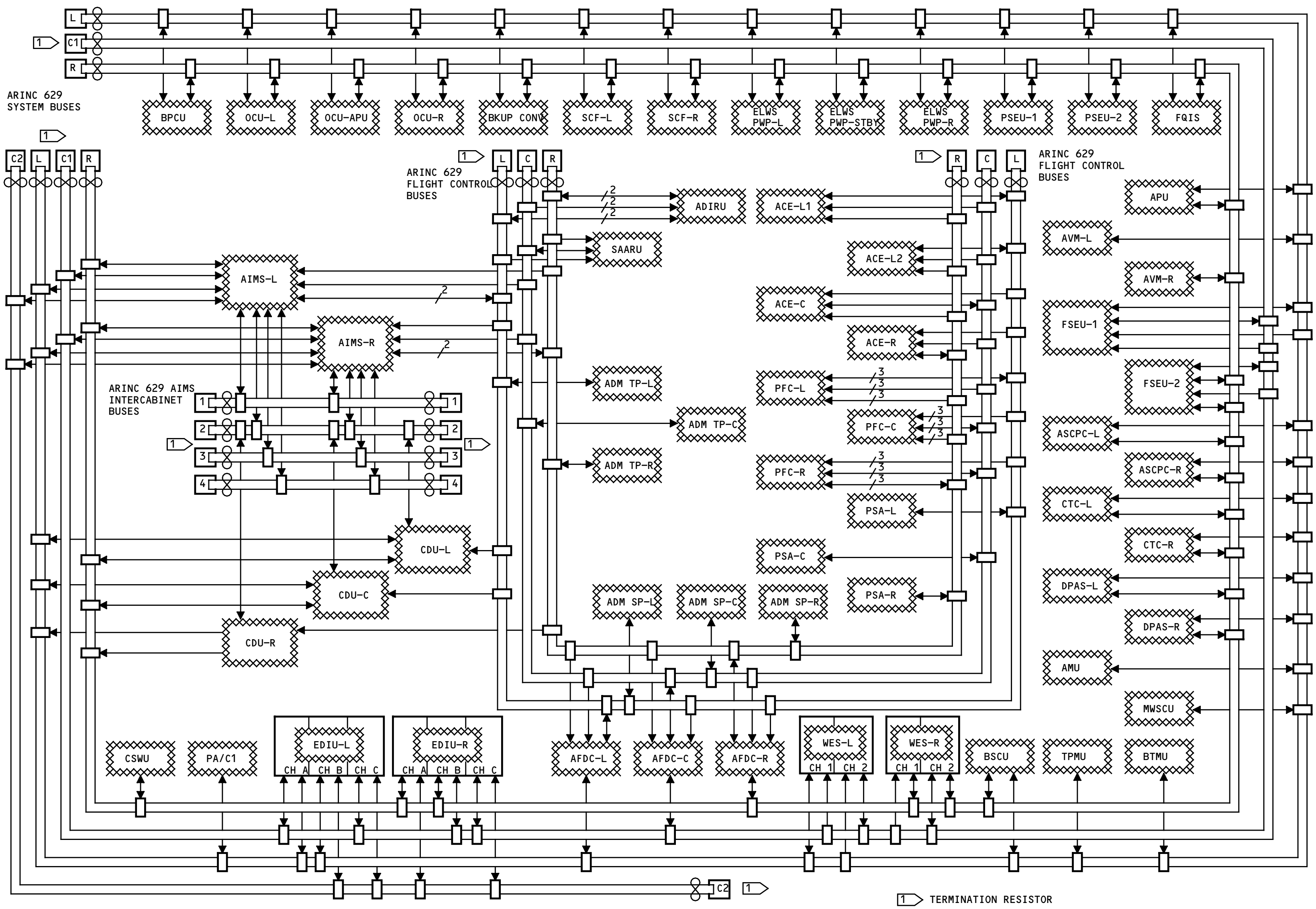

ARINC 629 - OVERALL INTERFACE DIAGRAM

ARINC 629 - OVERALL FUNCTIONAL DESCRIPTION DIAGRAM

Functional Description

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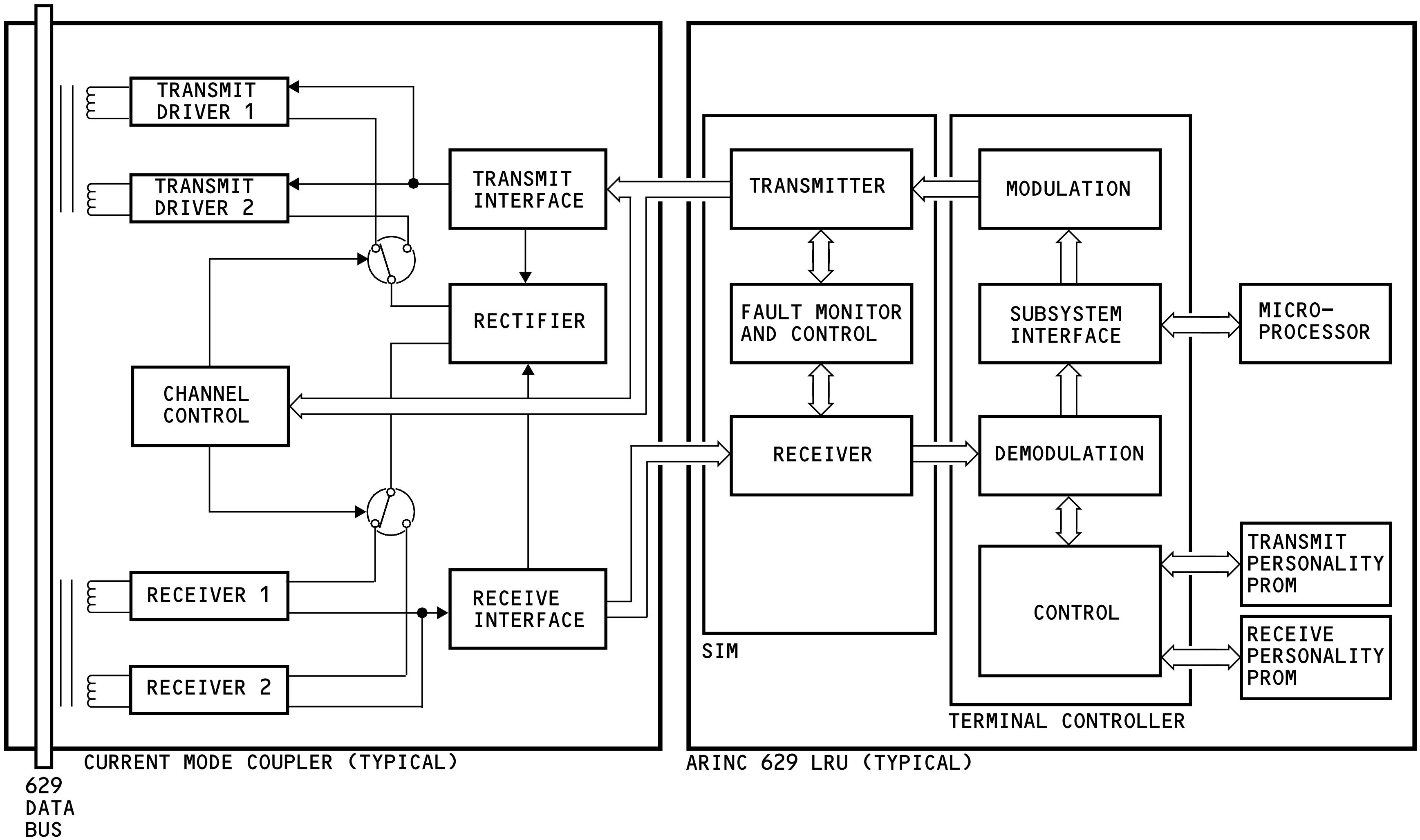

23-91-00-019 Rev 1

ARINC 629 - OVERALL FUNCTIONAL DESCRIPTION DIAGRAM

Continental Airlines, Inc

Overhead Panel ARINC 629 System

WB371

TABLE OF CONTENTS

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OVERHEAD PANEL ARINC 629 SYSTEM - INTRODUCTION

General

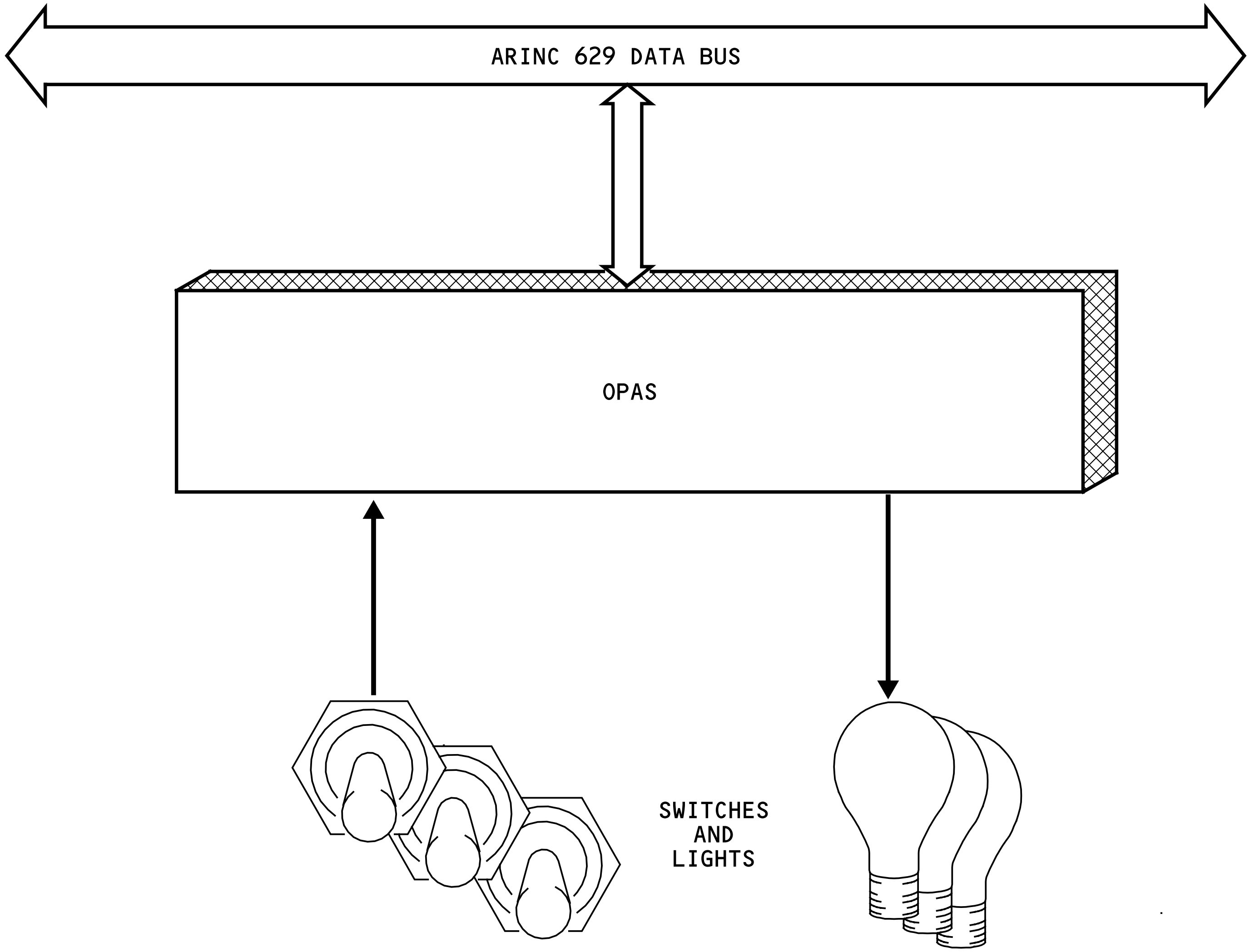
The overhead panel ARINC 629 system (OPAS) sends flight deck switch position data to the ARINC 629 systems buses. It also gets data from the ARINC 629 systems buses to turn on and off some flight deck panel lights.

The OPAS helps decrease the weight of the airplane. It uses less wires than direct connections between these units:

- Switches
- Lights
- Line replaceable units (LRUs)
- Line replaceable modules (LRMs).

Abbreviations and Acronyms

ARINC	- Aeronautical Radio, Inc.
CMCS	- central maintenance computer system
EICAS	- engine indication and crew alerting system
LED	- light emitting diode
LRM	- line replaceable module
LRU	- line replaceable unit
MAT	- maintenance access terminal
MD&T	- master dim and test
OPAS	- overhead panel ARINC 629 system
OPBC	- overhead panel bus controller
OPCF	- overhead panel card file
OPIC	- overhead panel interface card
PDCU	- panel data concentrator unit



23-93-00-001 Rev 0

OVERHEAD PANEL ARINC 629 SYSTEM - INTRODUCTION

OPAS - GENERAL DESCRIPTION

General

The OPAS moves flight deck switch and light data through the overhead panel card files (OPCFs) and panel data concentrator units (PDCUs).

The overhead panel bus controllers (OPBCs) are the interface units for the ARINC 629 buses.

Components

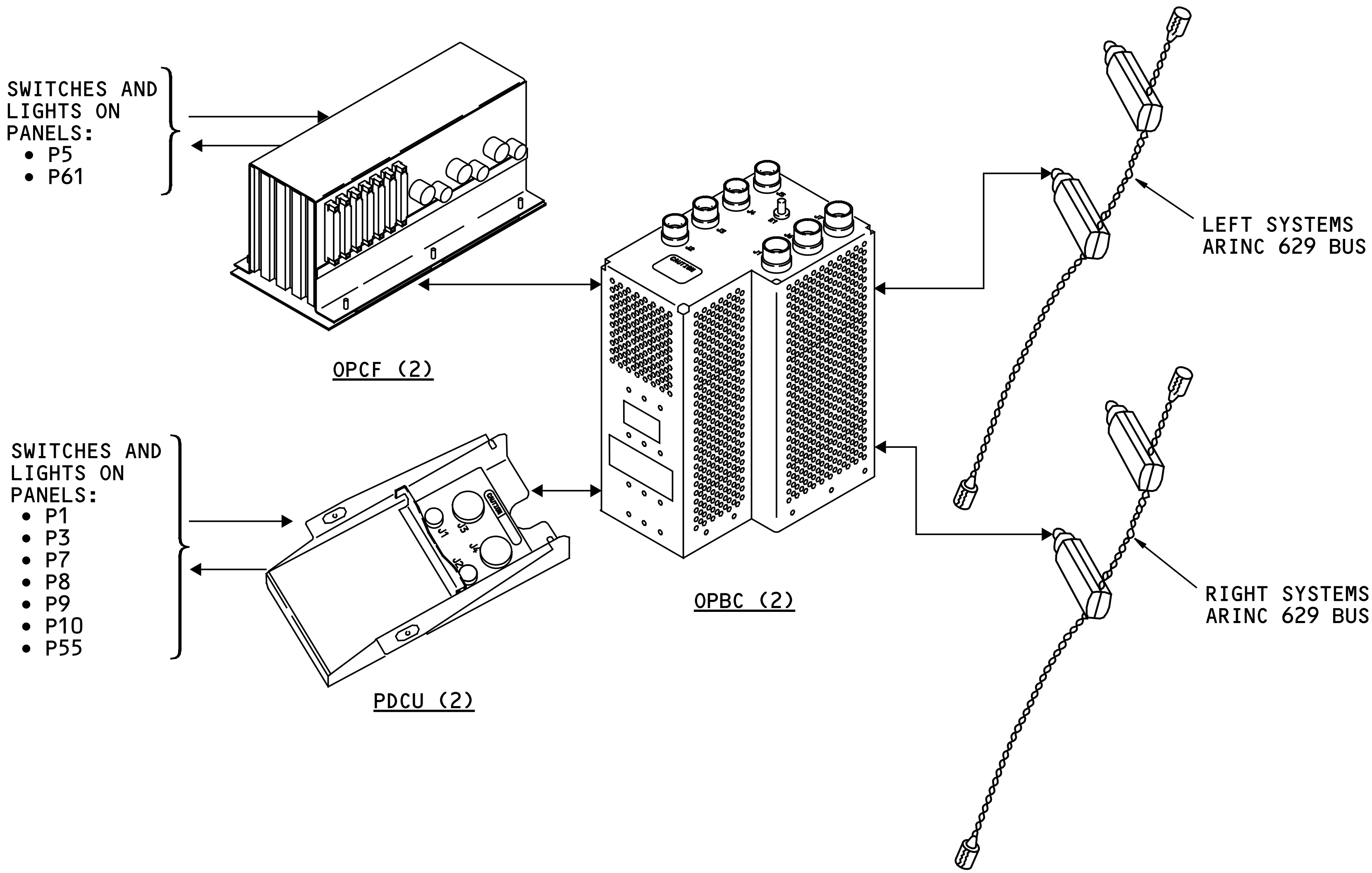
The OPAS has these six components:

- Left and right OPCFs
- Left and right PDCUs
- Left and right OPBCs.

Operation

These are the functions of OPAS:

- It sends flight deck switch position data to the systems ARINC 629 buses
- It gets data from the systems ARINC 629 buses to turn some flight deck panel lights on and off
- It reports system faults to the central maintenance computer system (CMCS)
- It reports OPAS failures to the flight crew by an EICAS status message.



23-93-00-002 Rev 0

OPAS - GENERAL DESCRIPTION

OPAS - COMPONENT LOCATIONS

General

These are the OPAS components in the flight deck:

- Left and right overhead panel card files (OPCFs)
- Left and right panel data concentrator units (PDCUs)
- Left and right overhead panel bus controllers (OPBCs).

Each OPCF has right and left overhead panel interface cards (OPICs).

Overhead Panel Card Files

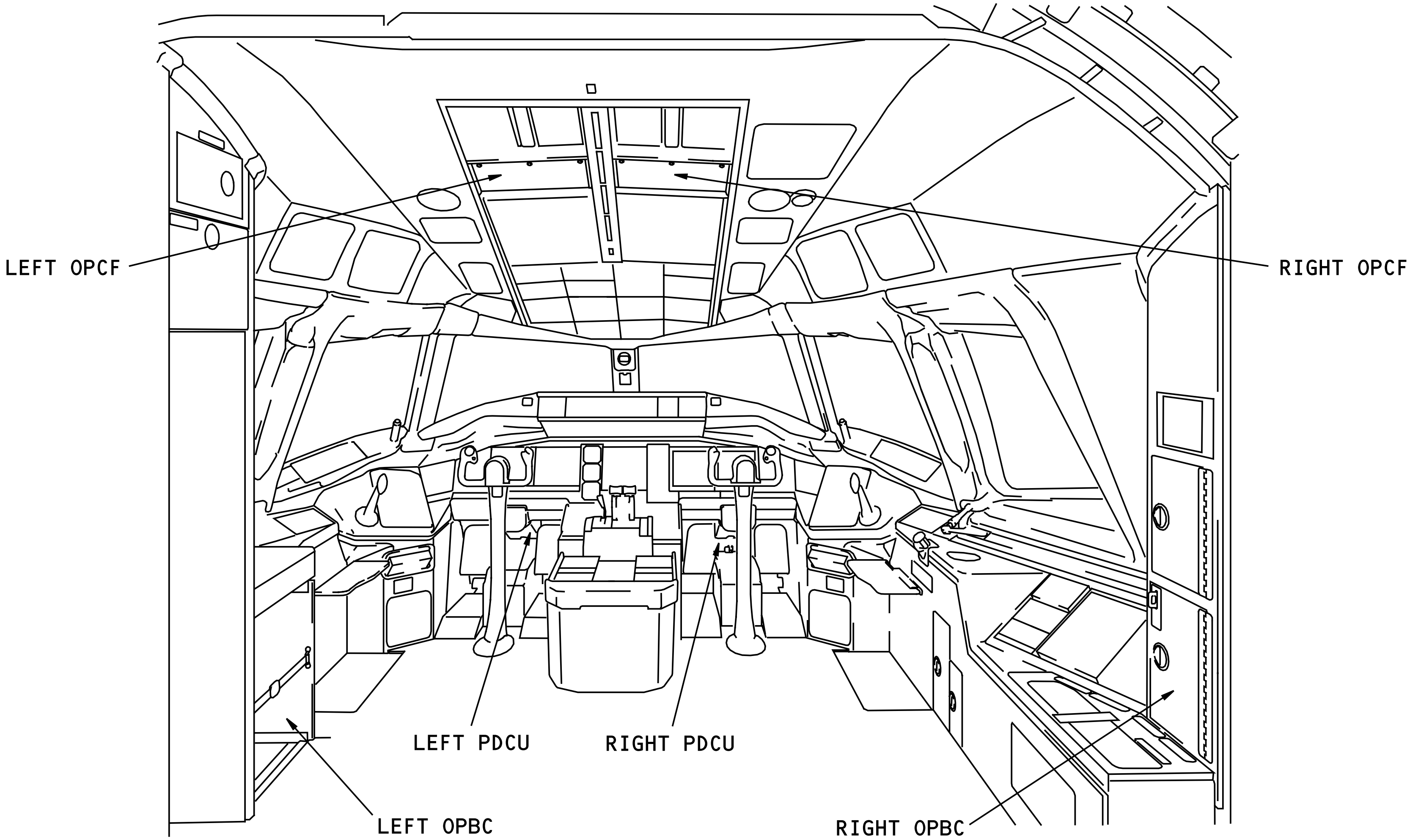
The OPCFs are in the P61 overhead maintenance panel. The left OPCF is in the left side of the panel. The right OPCF is in the right side of the panel.

Panel Data Concentrator Units

The PDCUs are near the floor in the forward part of the flight deck. The left PDCU is on the left side, forward of the captain's seat. The right PDCU is on the right side, forward the first officer's seat.

Overhead Panel Bus Controllers

The left OPBC is in the back of the storage area adjacent to the captain's seat. The right OPBC is in the storage area adjacent to the maintenance access terminal (MAT).



23-93-00-003 Rev 0

OPAS - COMPONENT LOCATIONS

OPAS - OVERHEAD PANEL CARD FILES INTERFACES

General

There are two overhead panel card files (OPCFs). Each OPCF has two interchangeable overhead panel interface cards (OPICs); A1 and A2.

The OPICs send data to the right and left overhead panel bus controllers (OPBCs) on RS 485 buses. Each RS 485 bus has a twisted shielded pair of wires. Data is moved at 10 mega-bits per second on the RS 485 bus. The OPBCs connect to the left and right systems ARINC 629 buses.

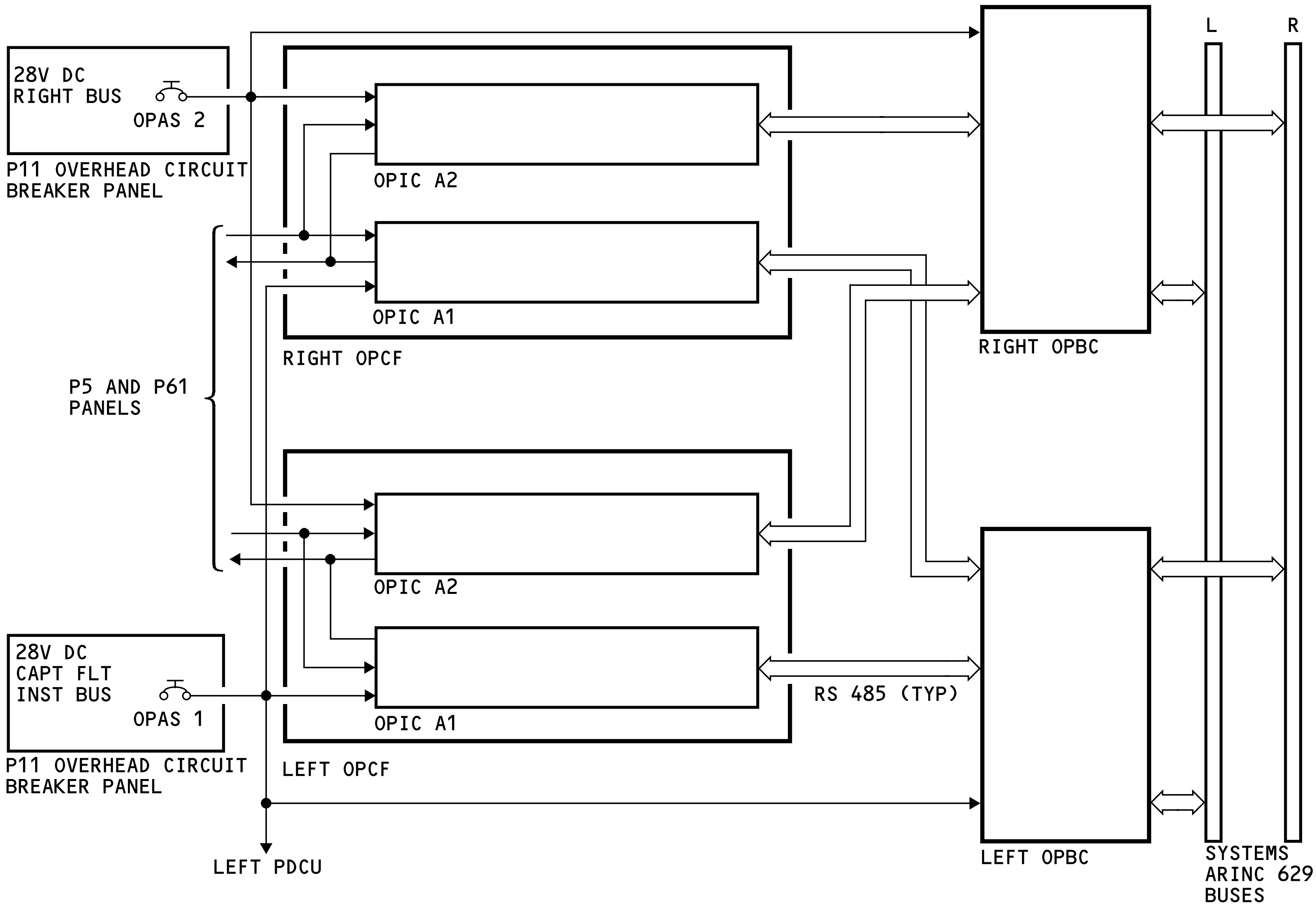
Power Interfaces

The OPAS 2 circuit breaker connects 28v dc to the OPIC A2 in each OPCF and to the right OPBC.

The OPAS 1 circuit breaker connects 28v dc to the OPIC A1 in each OPCF and to the left OPBC.

Right and Left OPCFs

Many switches and lights on the P5 and P61 panels connect to the OPICs in the right and left OPCFs. The OPIC A2s in both card files connect to the right OPBC. Both OPIC A1s connect to the left OPBC.



23-93-00-004 Rev 4 01/26/1998

OPAS - OVERHEAD PANEL CARD FILES INTERFACES

OPAS - PANEL DATA CONCENTRATOR UNITS INTERFACES

General

Switches and lights in the flight deck connect to right and left panel data concentrator units (PDCUs).

The PDCUs connect to the right and left overhead panel bus controllers (OPBCs). The OPBCs connect to the left and right systems ARINC 629 buses.

Power Interfaces

The OPAS 3 circuit breaker connects 28v dc to the right PDCU.

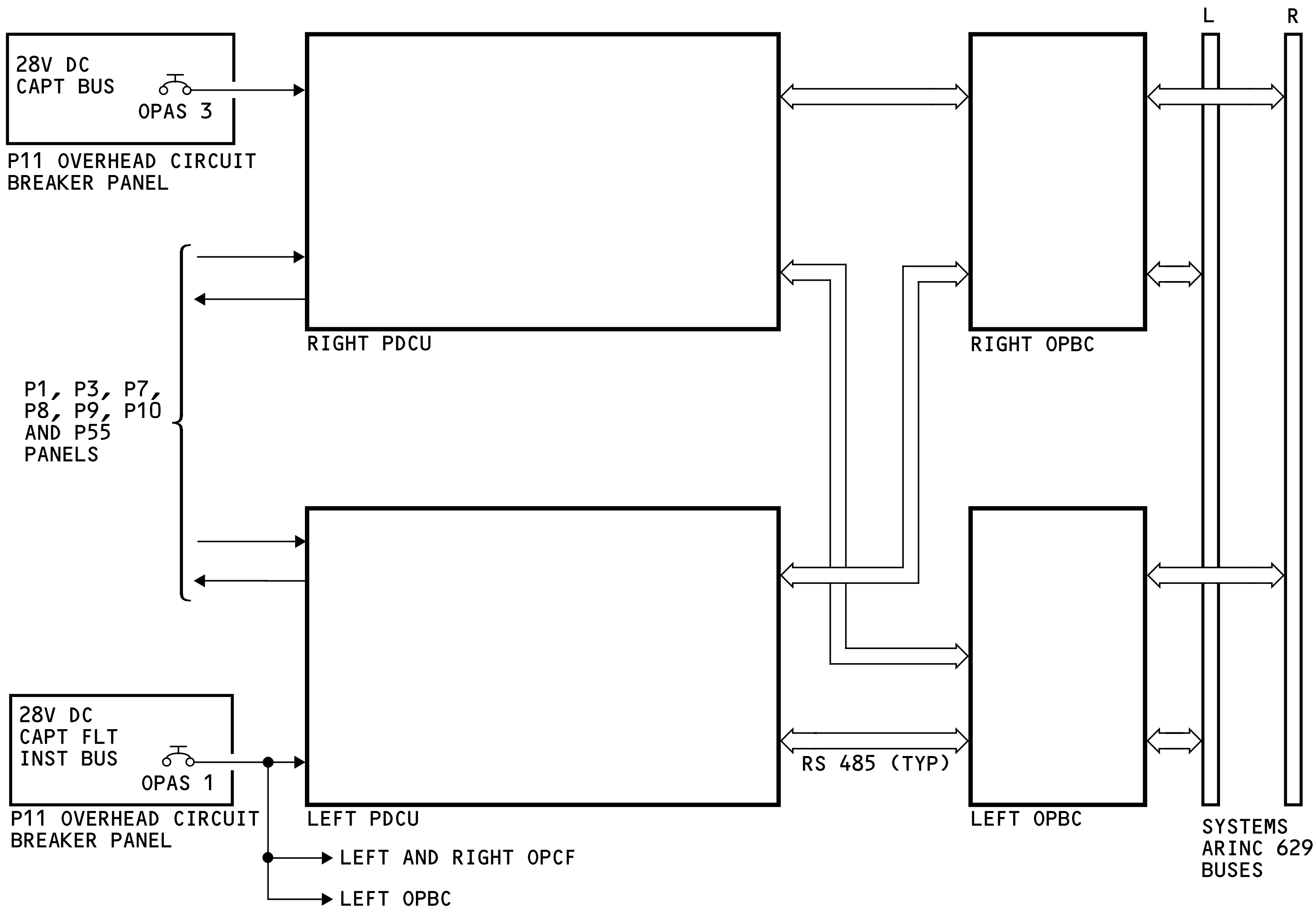
The OPAS 1 circuit breaker connects 28v dc to the left PDCU.

Right and Left PDCUs

Many switches and lights on these flight deck panels connect to the PDCUs:

- P1 left forward panel
- P3 right forward panel
- P7 glareshield panel
- P8 aft aisle stand panel
- P9 forward aisle stand panel
- P10 control stand
- P55 glareshield center panel.

The right and left PDCUs connect to both right and left OPBCs.



OPAS - PANEL DATA CONCENTRATOR UNITS INTERFACES

OPAS - OVERHEAD PANEL CARD FILES

Purpose

The overhead panel card files (OPCFs) send switch position data from the P5 and P61 panels to the overhead panel bus controllers (OPBCs). They also get data from the OPBCs to control some lights in the P5 and P61 panels.

Physical Description

Each OPCF has these parts:

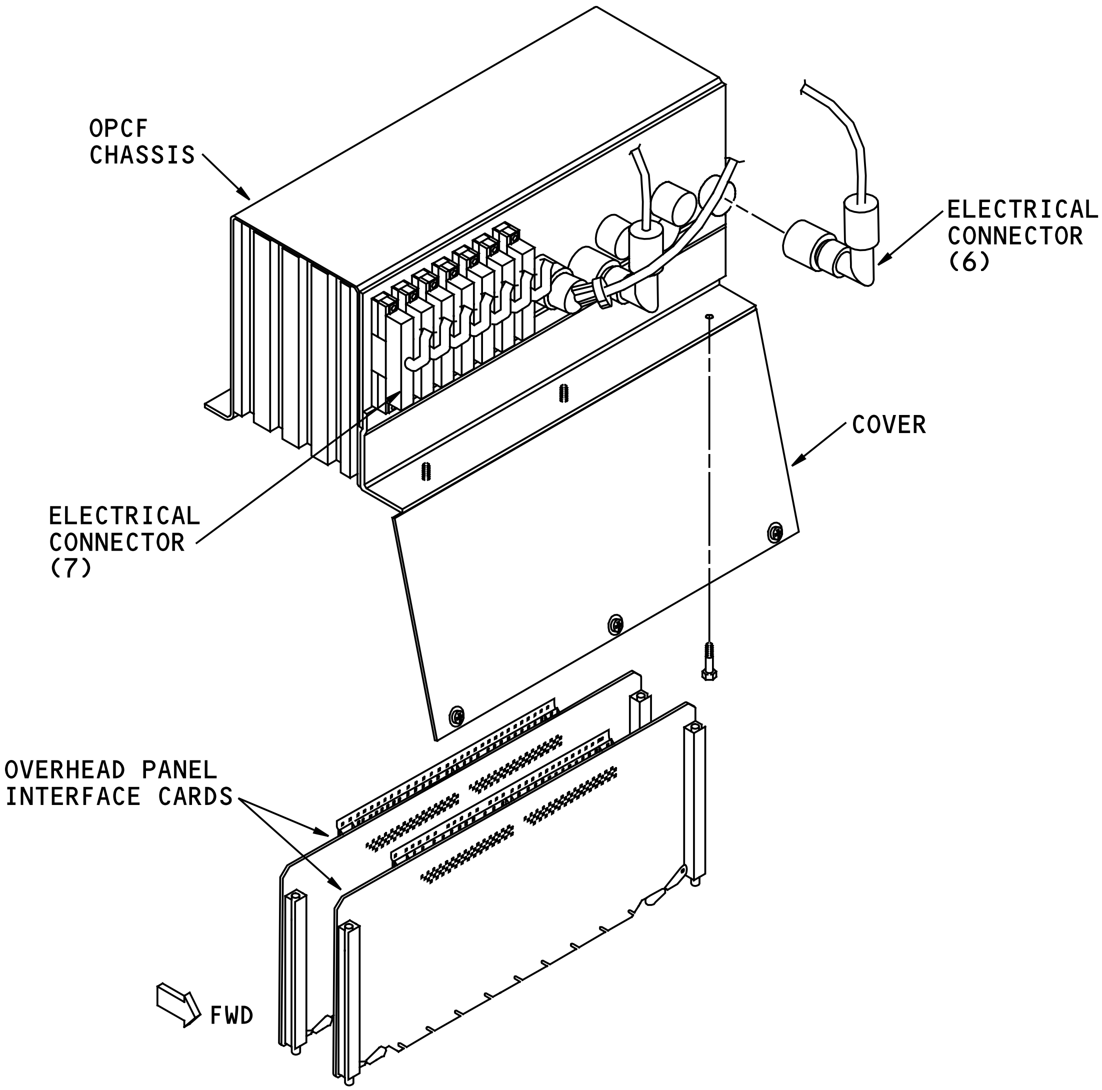
- A chassis
- A connector board
- A backplane board
- Two overhead panel interface cards (OPICs).

An OPCF with both OPICs weighs 9 pounds. Its dimensions are:

- Length - 13 inches
- Width - 6 inches
- Height - 4.5 inches.

Training Information Point

The OPCFs are interchangeable. The OPICs in each OPCF are also interchangeable.



23-93-00-006 Rev 3 04/29/95

OPAS - OVERHEAD PANEL CARD FILES

OPAS - OVERHEAD PANEL CARD FILES FUNCTIONAL DESCRIPTION

General

Each overhead panel card file (OPCF) has two overhead panel interface cards (OPICs); A1 and A2. The positions of many switches in the P5 and P61 panels go to the OPICs. The OPICs send the switch position data to the overhead panel bus controllers (OPBCs) on a serial bus.

The OPICs also get data from the OPBCs to turn on and off indicator lights on the P5 and P61 panels.

OPCF Description

Each OPCF has two OPICs. An OPCF contains connections to the OPICs for these signals:

- Switch inputs
- Light outputs
- Serial data inputs and outputs
- Channel identifications.

OPIC Description

Each OPIC has these circuits:

- A multiplexer for as many as 160 inputs
- A demultiplexer for as many as 36 light outputs
- A microprocessor
- A fault monitor
- One serial port communication bus
- A channel identification interface for program pins.

OPIC Operation

The multiplexer receives inputs from the panel switches. It selects a signal from one switch at a time and sends it to the microprocessor.

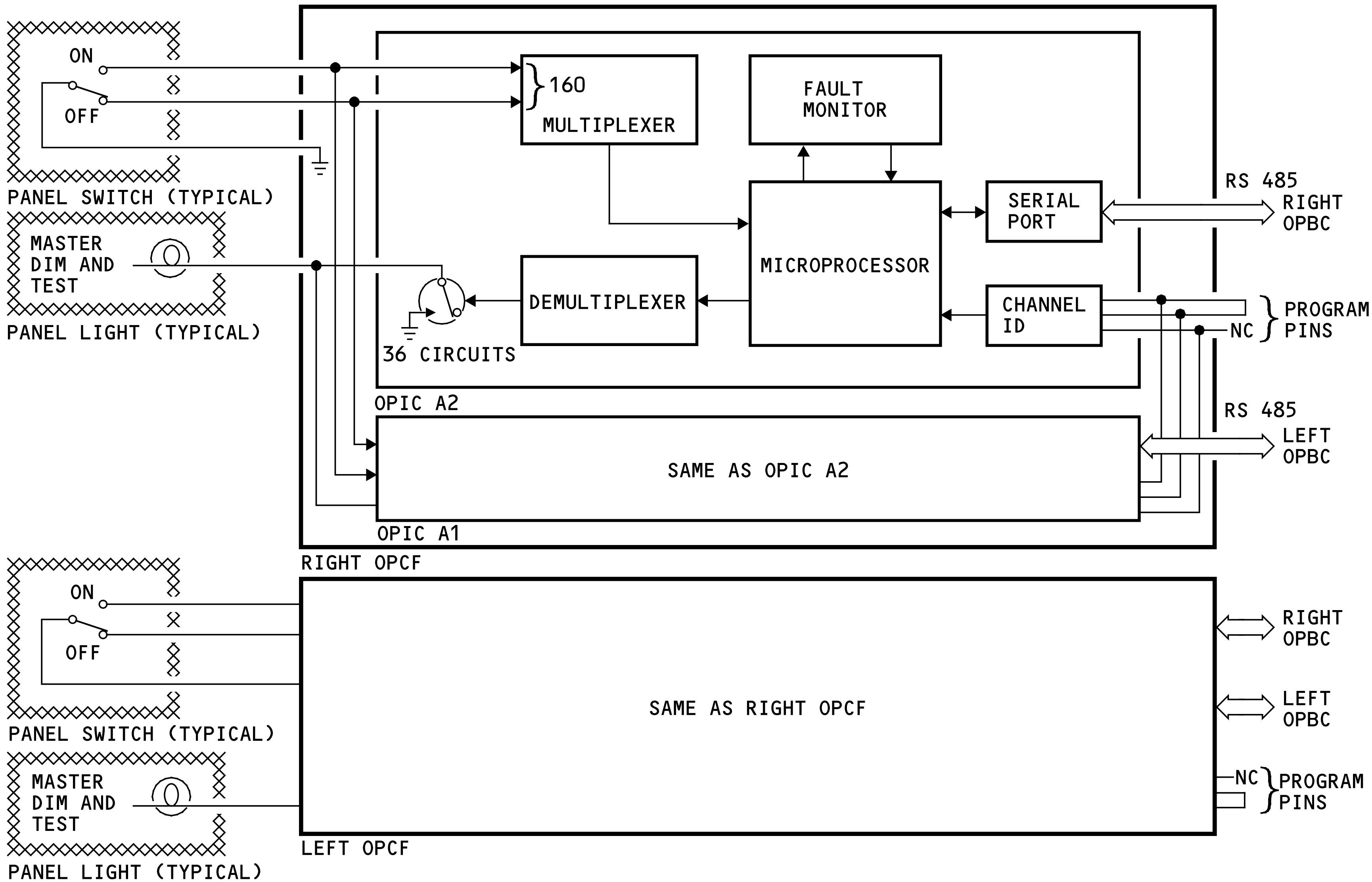
The microprocessor sends the switch position data to the serial port. The microprocessor also receives data from the serial port to control lights. It sends this data to the demultiplexer.

The demultiplexer controls the output to the lights.

The fault monitor circuit identifies OPAS faults to the microprocessor. The microprocessor sends the fault data to the OPBC. The OPBC then sends this data to the central maintenance computer system (CMCS).

The serial port permits the OPIC to send and get switch and light data from the OPBC.

The program pins connect to the channel identification circuit to tell the OPIC its location and functions.



23-93-00-007 Rev 3 01/26/1998

OPAS - OVERHEAD PANEL CARD FILES FUNCTIONAL DESCRIPTION

OPAS - PANEL DATA CONCENTRATOR UNIT

Purpose

The panel data concentrator units (PDCUs) send switch position data from some flight deck panels to the overhead panel bus controllers (OPBCs). They also get data from the OPBCs to turn on and off some panel lights.

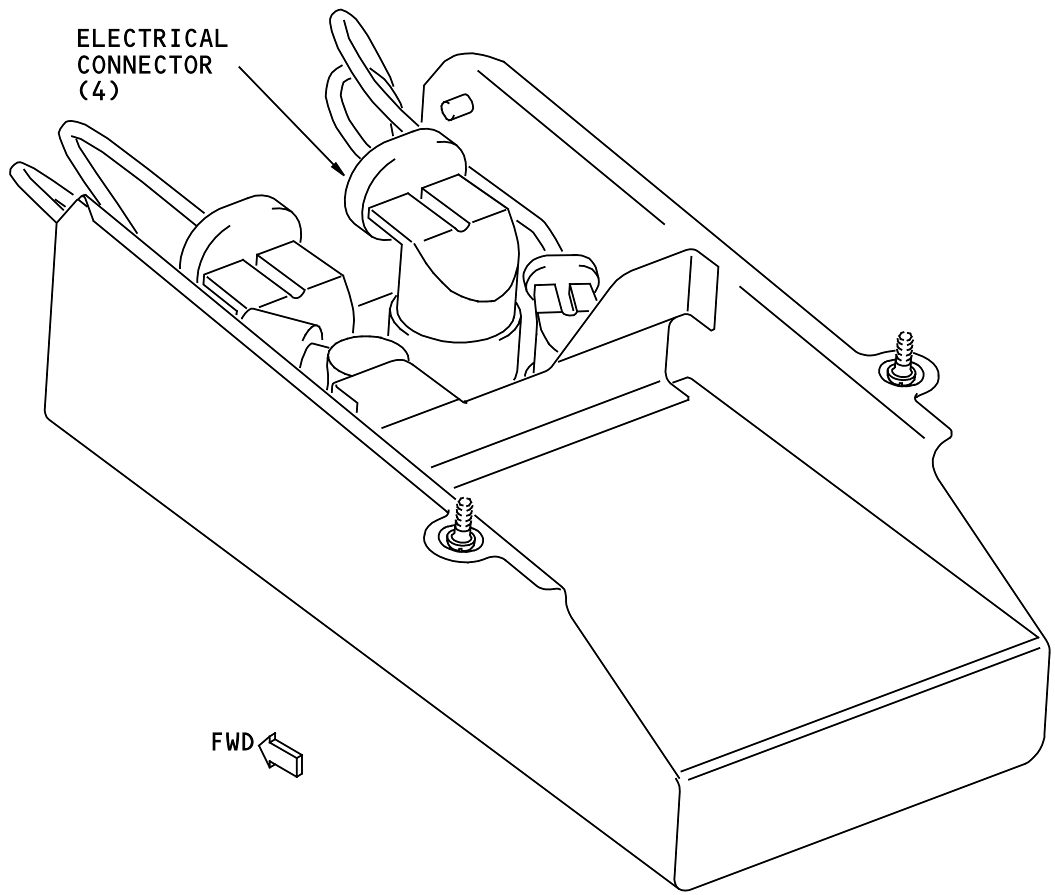
Physical Description

A PDCU weighs 3.5 pounds. Its dimensions are:

- Length - 14 inches
- Width - 8 inches
- Height - 3.5 inches.

Training Information Point

The PDCUs are interchangeable.



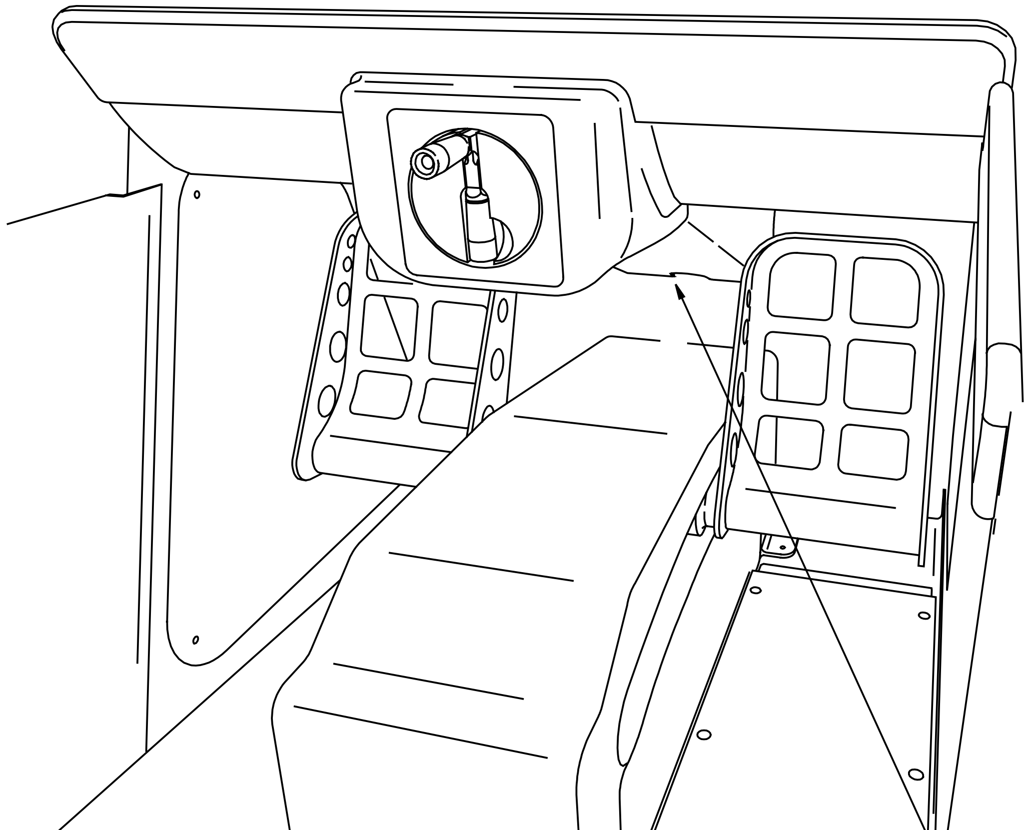
23-93-00-008 Rev 1 04/29/95

OPAS - PANEL DATA CONCENTRATOR UNIT

OPAS - PANEL DATA CONCENTRATOR UNIT INSTALLATION

General

The left panel data concentrator unit (PDCU) is in the flight deck, near the floor between the captain's rudder pedals. The right PDCU is in the same location between the first officer's rudder pedals.



CAPTAIN'S RUDDER PEDAL AREA

23-93-00-009 Rev 0

OPAS - PANEL DATA CONCENTRATOR UNIT INSTALLATION

OPAS - PANEL DATA CONCENTRATOR UNITS FUNCTIONAL DESCRIPTION

General

The panel data concentrator units (PDCUs) send serial switch position data to the overhead panel bus controllers (OPBCs). The PDCUs also get data from the OPBCs to turn on and off some panel lights.

PDCUs Functions

Each PDCU has these circuits:

- A multiplexer for 80 inputs
- A demultiplexer for 18 light outputs
- Two serial ports.

PDCUs Operation

Each PDCU gets inputs from switches on these panels:

- P1 left forward panel
- P3 right forward panel
- P7 glareshield panel
- P8 aft aisle stand panel
- P9 forward aisle stand panel
- P10 control stand
- P55 glareshield center panel.

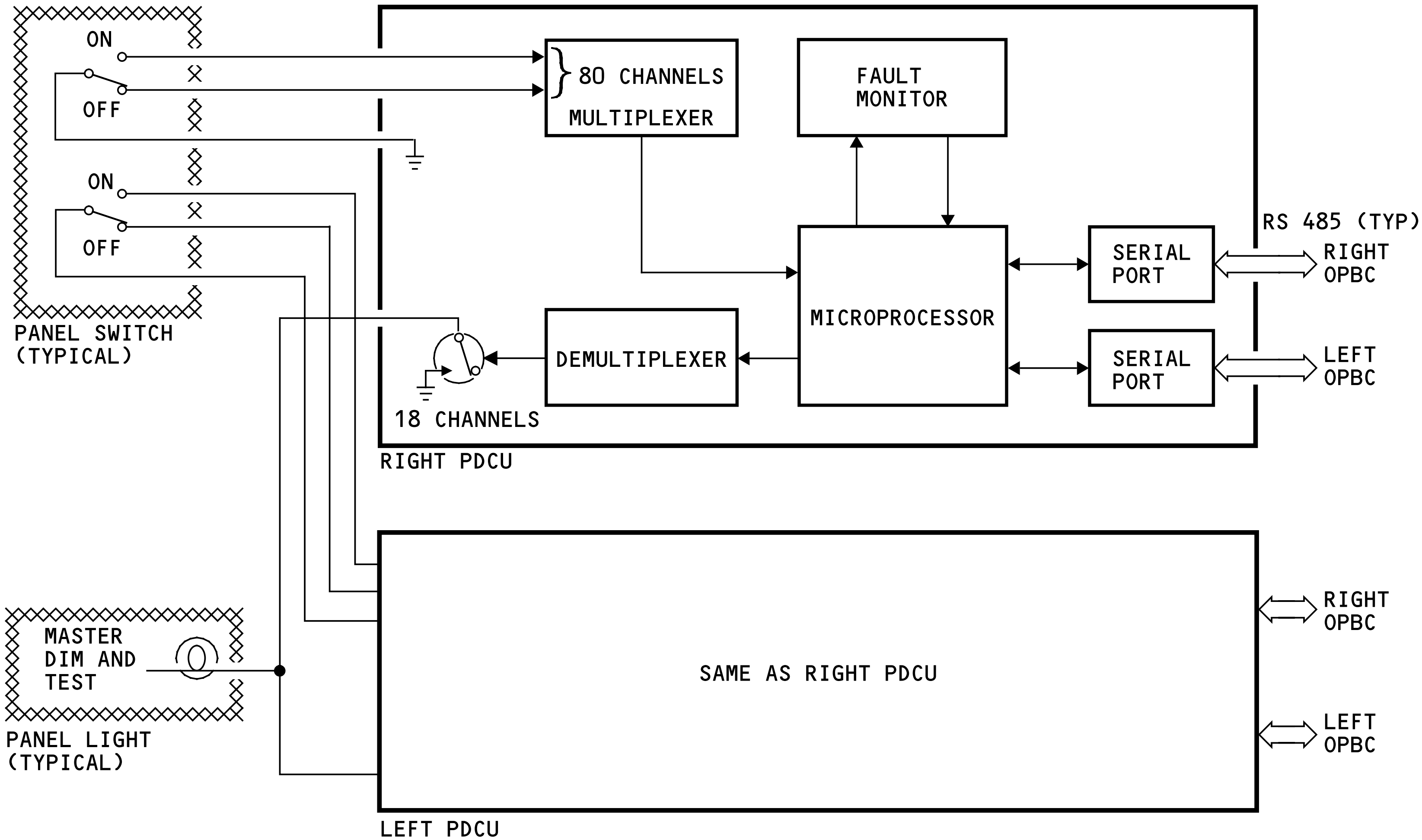
The multiplexer receives inputs from the panel switches. It selects a signal from one switch at a time and sends it to the microprocessor.

The microprocessor sends the condition of the switch to the serial ports. The microprocessor receives data from the serial ports to control lights. It also sends data to the demultiplexer.

The demultiplexer controls the output to the lights.

The fault monitor circuit identifies OPAS faults to the microprocessor. The microprocessor sends the fault data to the central maintenance computer system (CMCS).

The serial ports permit the PDCUs to send and get switch and light data from the OBPCs.



23-93-00-010 Rev 3 01/26/1998

OPAS - PANEL DATA CONCENTRATOR UNITS FUNCTIONAL DESCRIPTION

OPAS - OVERHEAD PANEL BUS CONTROLLERS

Purpose

Two overhead panel bus controllers (OPBCs) are the OPAS interface with the ARINC 629 system buses.

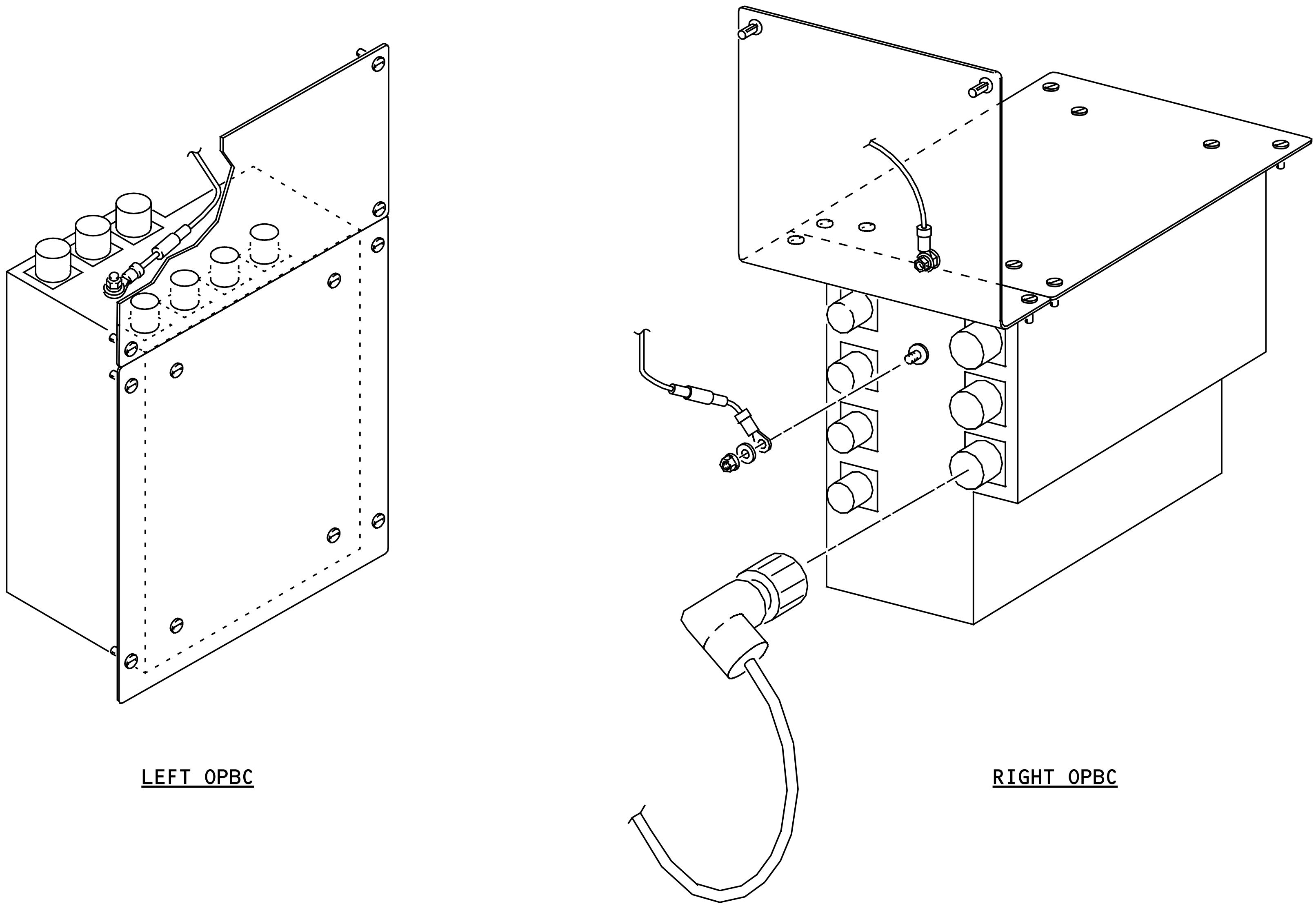
Physical Description

An OPBC weighs 6.6 pounds. The dimensions are:

- Length - 10 inches
- Width - 7.6 inches
- Height - 4.9 inches.

Training Information Point

The left and right OPBCs are interchangeable.



LEFT OPBC

RIGHT OPBC

23-93-00-011 Rev 1

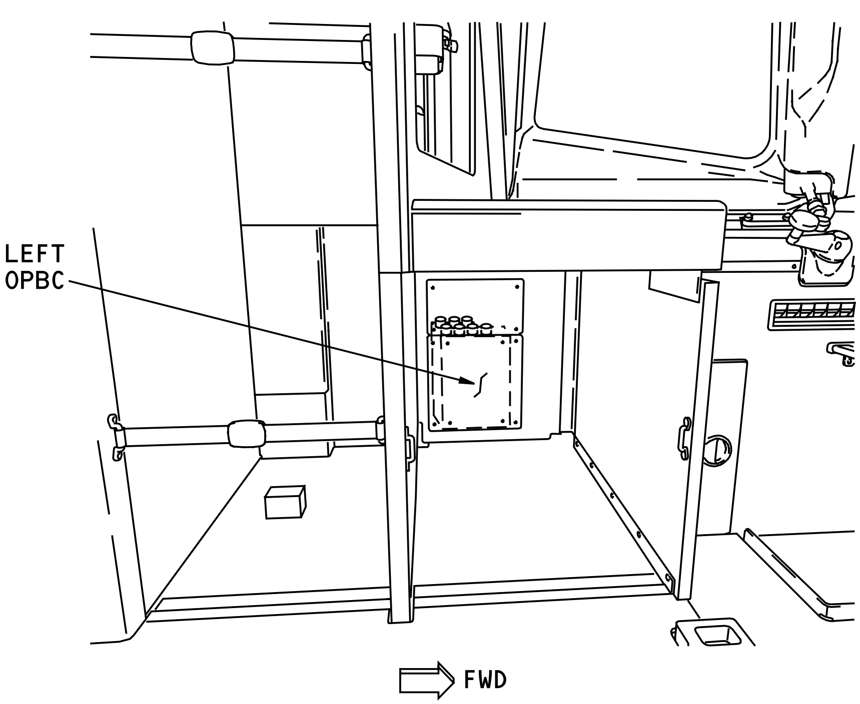
OPAS - OVERHEAD PANEL BUS CONTROLLER INSTALLATION

Left OPBC

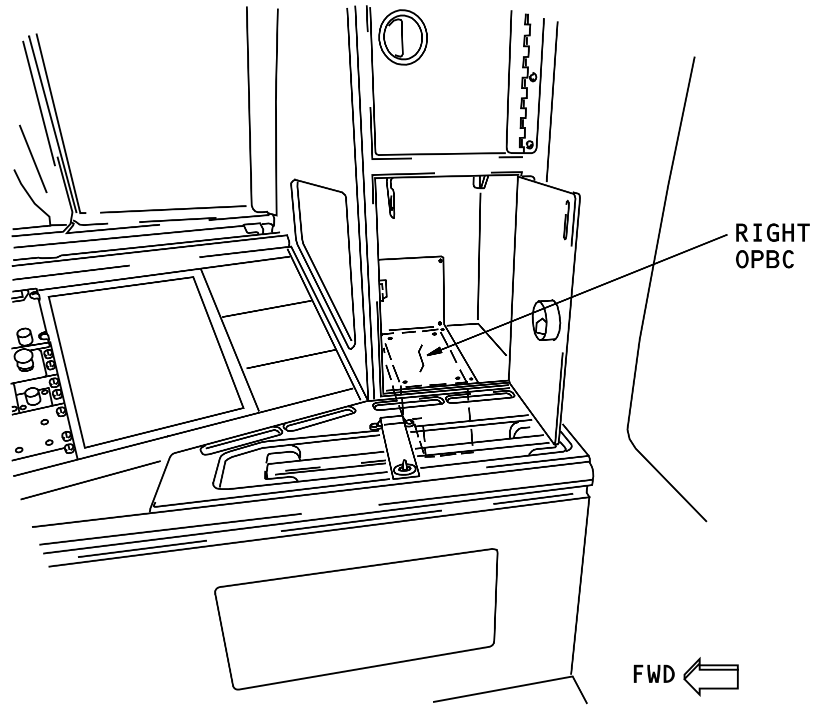
The left overhead panel bus controller (OPBC) is behind a panel at the back of the captain's storage cabinet.

Right OPBC

The right OPBC is under a panel in the storage cabinet adjacent to the MAT.



FLIGHT DECK
(LEFT SIDE, LOOKING OUTBOARD)



FLIGHT DECK
(RIGHT SIDE, LOOKING OUTBOARD)

23-93-00-012 Rev 1 04/29/95

OPAS - OVERHEAD PANEL BUS CONTROLLER INSTALLATION

OPAS - OVERHEAD PANEL BUS CONTROLLER FUNCTIONAL DESCRIPTION

General

There are two overhead panel bus controllers (OPBCs), one on each side of the flight deck. Each OPBC has these components:

- Four serial interface controllers
- Microprocessor
- Fault monitor
- Two ARINC 629 terminal controllers
- A channel identification interface for program pins.

Overhead Panel Bus Controller Functions

Each OPBC has these functions:

- It transmits flight deck switch position data to the ARINC 629 system buses
- It receives data for flight deck lights and LEDs from the ARINC 629 system buses
- It does a fault check of data.

Serial Interface Controllers

The microprocessor uses the serial interface controllers to send and get data through the overhead panel interface cards (OPICs) and panel data concentrator units (PDCUs).

Fault Monitor

The fault monitor circuit identifies OPAS faults to the microprocessor. The microprocessor sends the fault data to the central maintenance computer system (CMCS).

Microprocessor

The microprocessor sends data to and receives data from the ARINC 629 system buses, PDCUs, and OPICs.

It isolates and controls data inputs and outputs to prevent signal mixture.

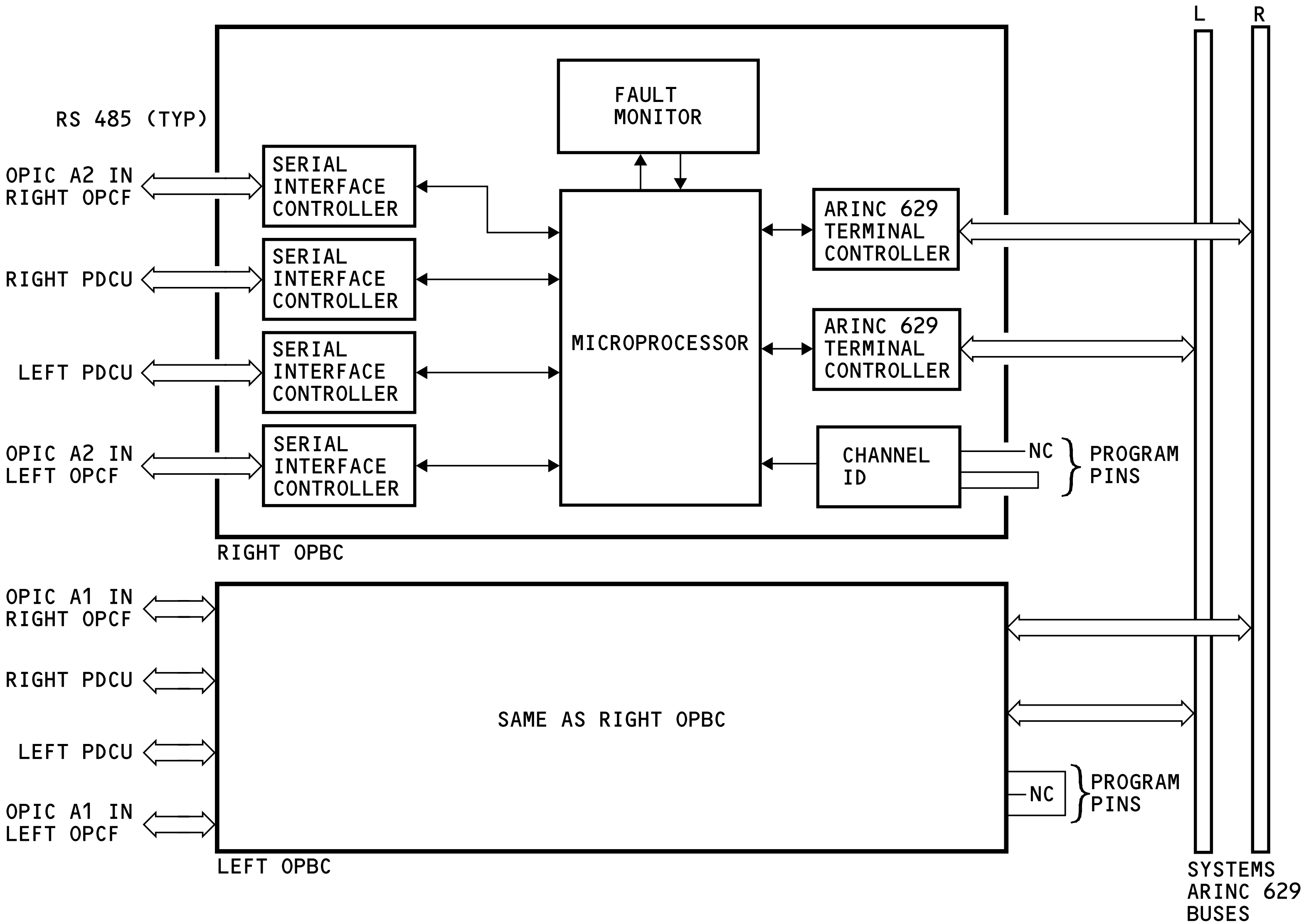
ARINC 629 Terminal Controllers

The ARINC 629 terminal controllers are the interfaces between the OPBCs and the ARINC 629 system buses.

The ARINC 629 terminal controllers monitor the data they transmit. If they find faults in the data, they stop operation.

Channel Identification

The program pins connect to the channel identification circuit to tell the OPBC its location and functions.



OPAS - OVERHEAD PANEL BUS CONTROLLER FUNCTIONAL DESCRIPTION

OPAS - TEST

General

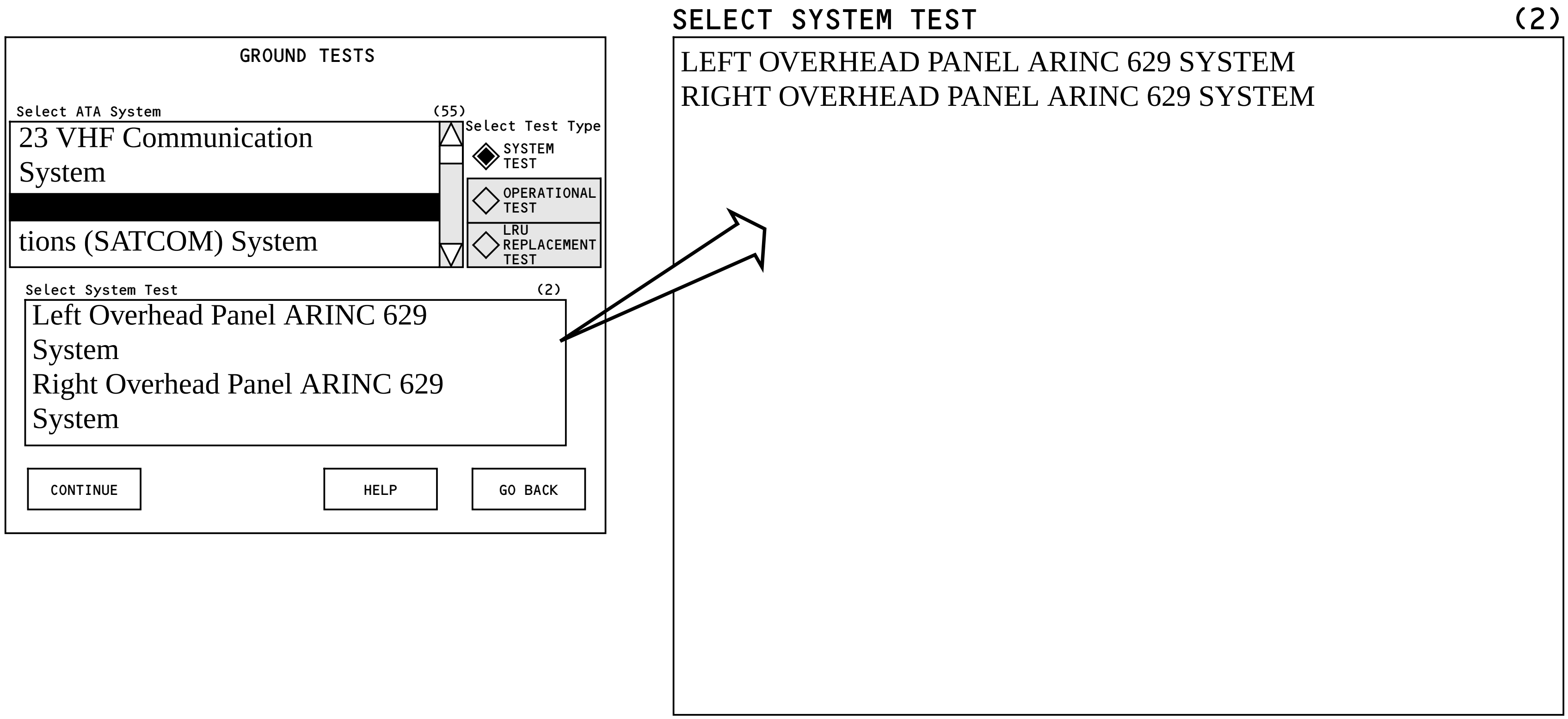
These are the system tests for the OPAS:

- Left overhead panel ARINC 629 system
- Right overhead panel ARINC 629 system

OPAS System Test

Each system test makes sure the operation of that channel is fully functional.

Do both system tests to completely make sure the operation of the OPAS is correct.



CMCS GROUND TEST SELECTION DIALOG BOX

23-93-00-014 Rev 3 01/03/95

OPAS - OVERALL INTERFACES

Interfaces

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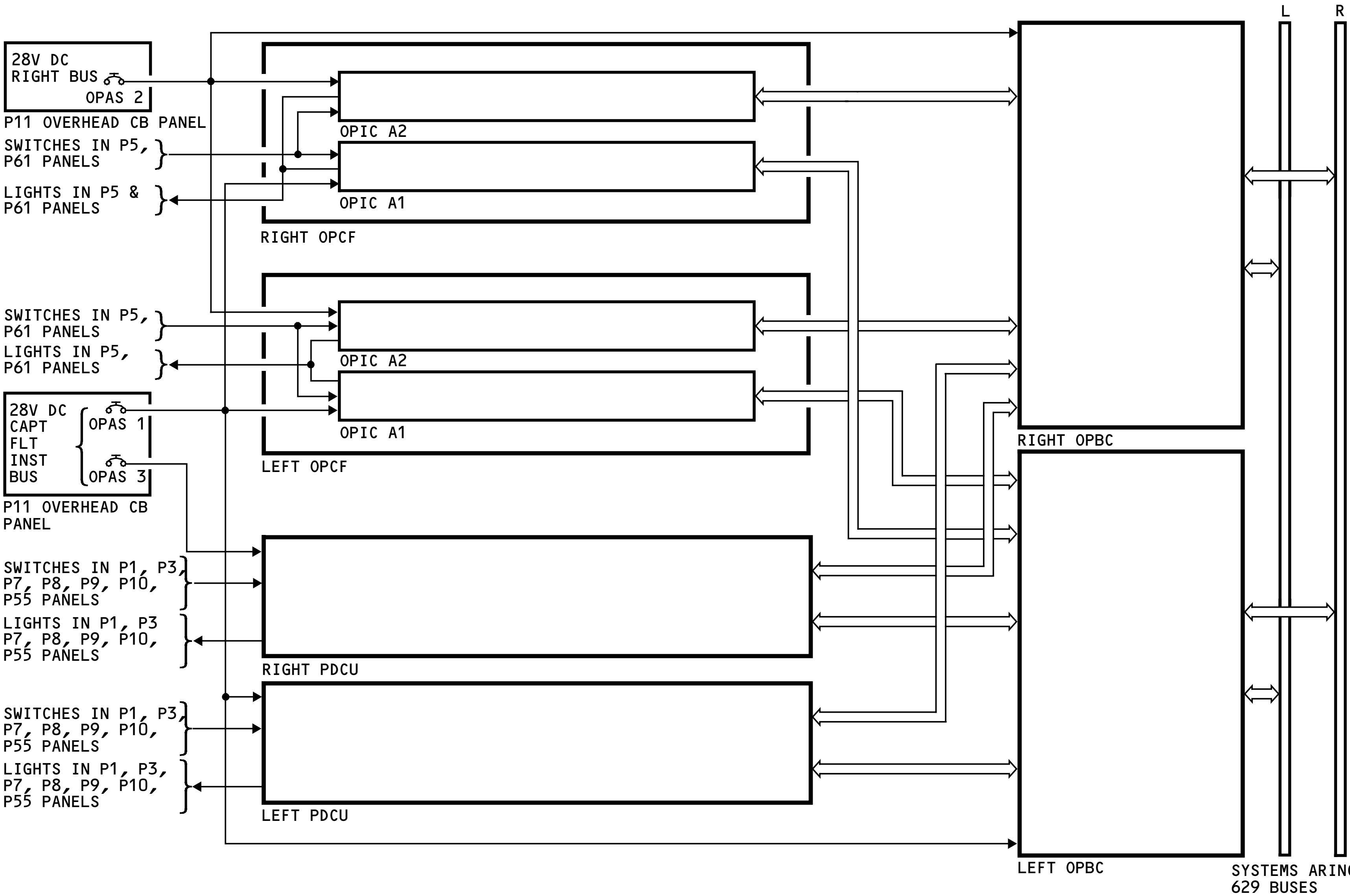

OPAS - OVERALL INTERFACES

OPAS - OVERALL FUNCTIONAL DESCRIPTION

Functional Description

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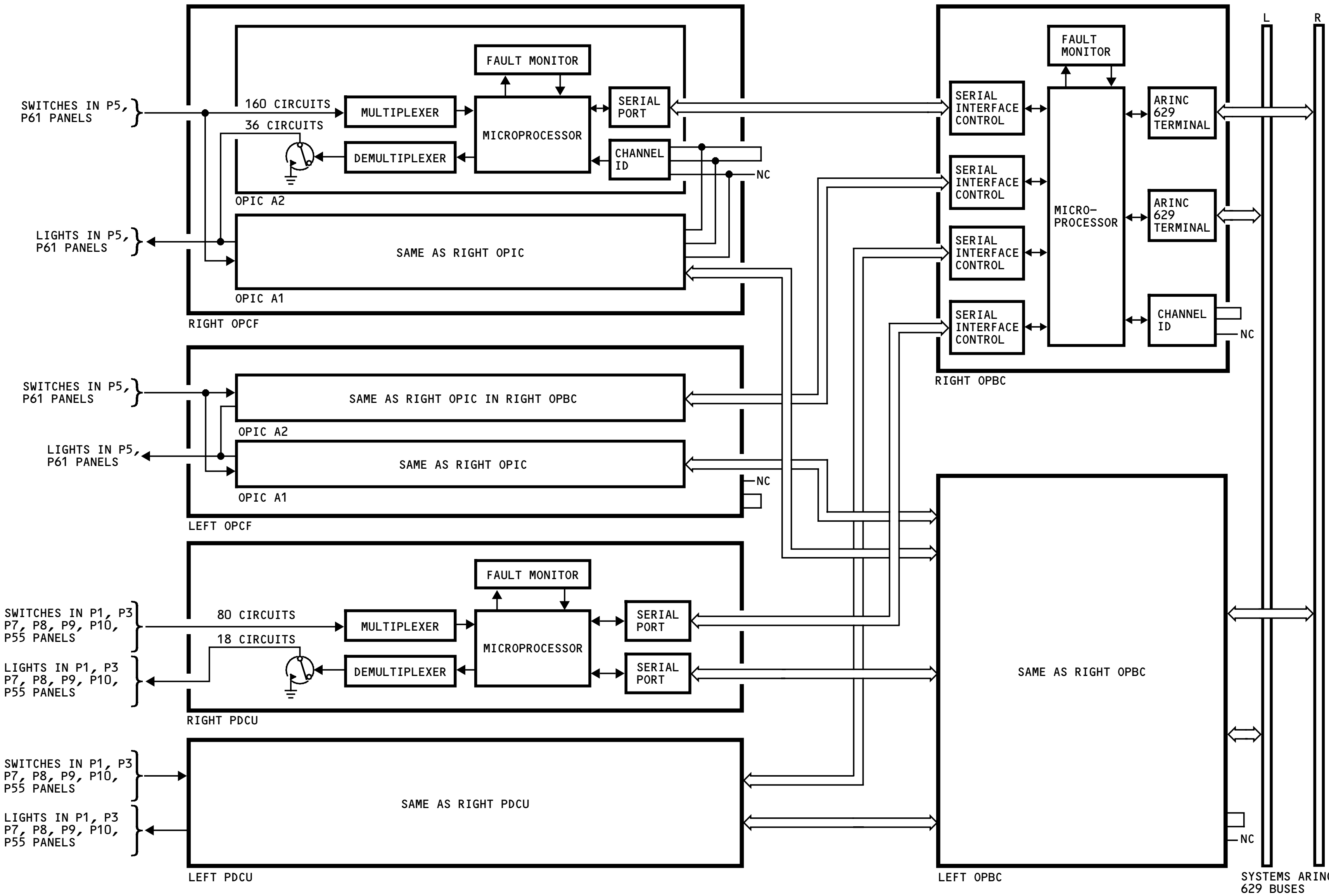

OPAS - OVERALL FUNCTIONAL DESCRIPTION

23-93-00-016 Rev 2 01/26/1998

Continental Airlines, Inc

Onboard Local Area Network

WB371

TABLE OF CONTENTS

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ONBOARD LOCAL AREA NETWORK - INTRODUCTION

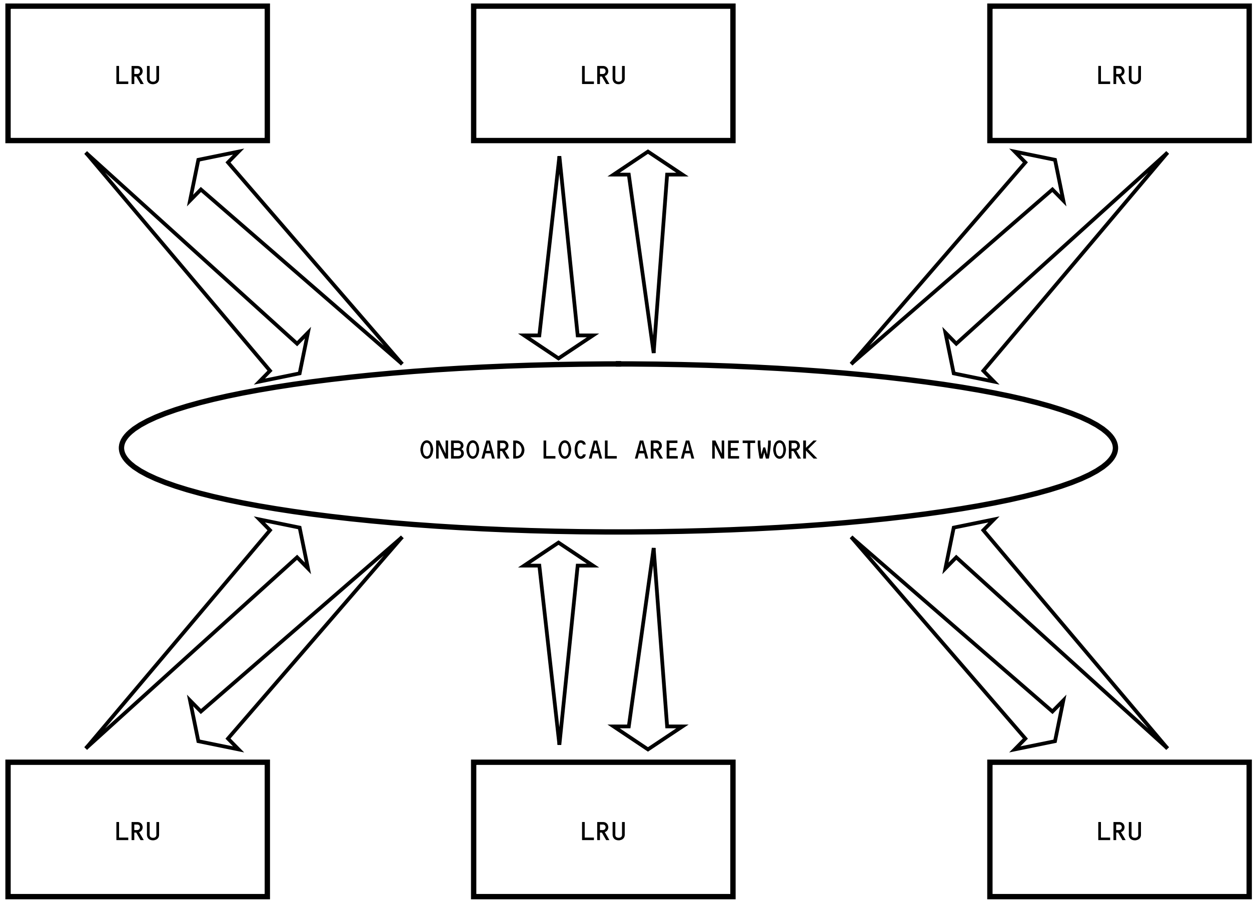
Purpose

The onboard local area network (OLAN) is a fiber optic communications network. It moves digital data between line replaceable units (LRUs). Fiber optic networks have these qualities:

- They carry more data than wire buses
- They weigh less than wire buses
- Electromagnetic radiation has no effect on the data.

Abbreviations and Acronyms

AIMS	- airplane information management system
BSU	- bypass switch unit
LAN	- local area network
LRU	- line replaceable unit
MAT	- maintenance access terminal
OLAN	- onboard local area network
PMAT	- portable maintenance access terminal
pri	- primary
rcvr	- receiver
sec	- secondary
xmtr	- transmitter
ZMU	- zone management unit



23-94-00-001 Rev 2

ONBOARD LOCAL AREA NETWORK - INTRODUCTION

ONBOARD LOCAL AREA NETWORK - GENERAL DESCRIPTION

General

The OLAN has the avionics local area network (LAN). The LAN has these parts:

- A primary ring (PRI)
- A secondary ring (SEC)
- Two bypass switch units (BSUs).

Line replaceable units (LRUs) connect to both rings of a LAN through a BSU.

Avionics LAN

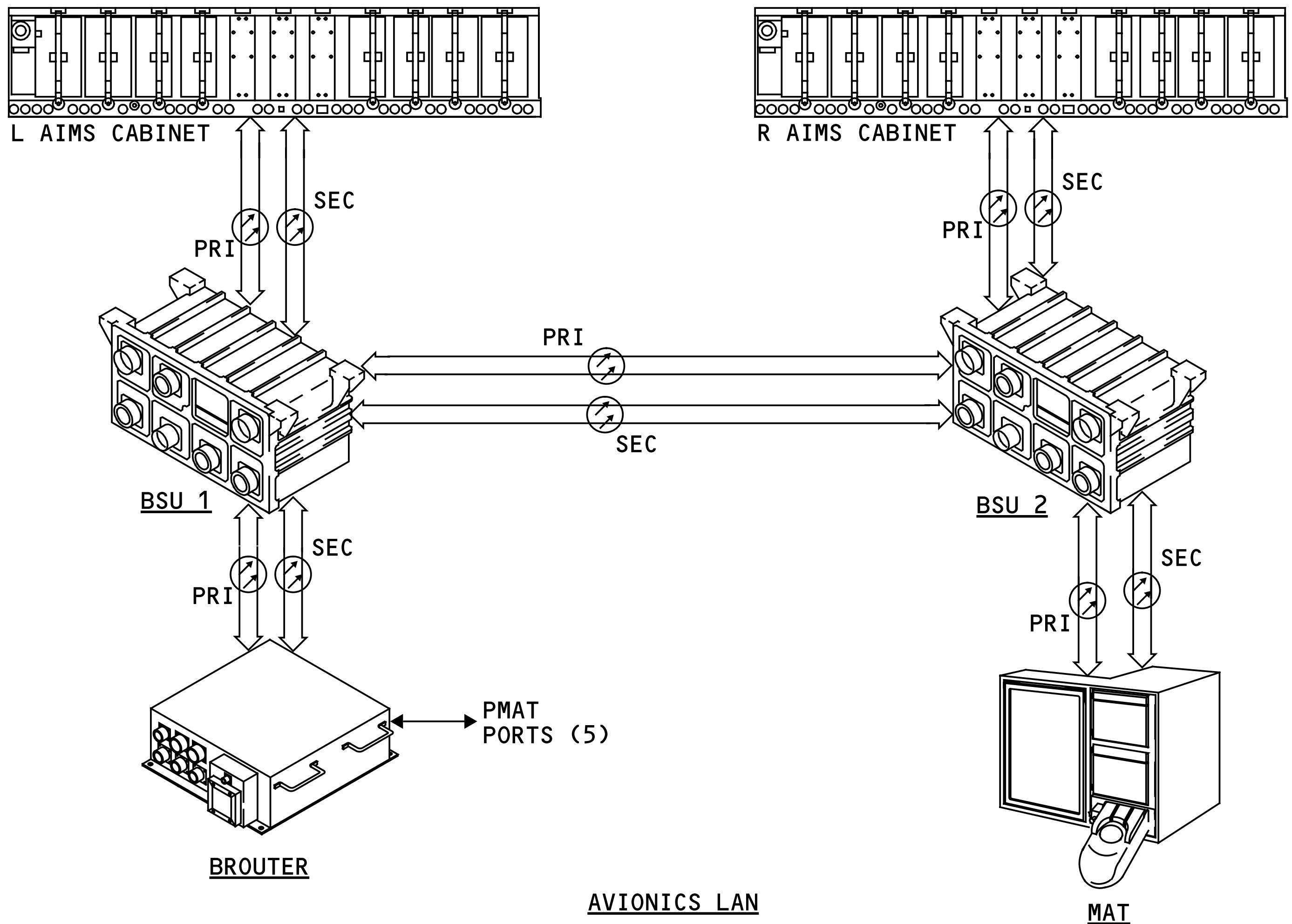
The avionics LAN connects these LRUs:

- Right AIMS cabinet
- Left AIMS cabinet
- Maintenance access terminal (MAT)
- Brouter.

These interfaces permit these functions:

- Data load
- Tests
- Fault isolation.

The avionics LAN connects the portable maintenance access terminals (PMATs) to the AIMS cabinets through the brouter.



AVIONICS LAN

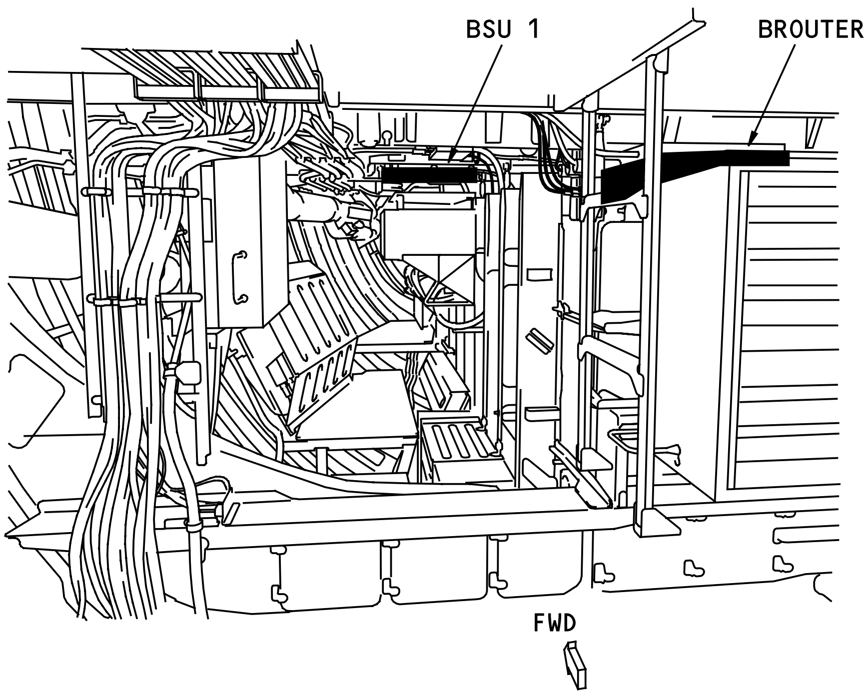
ONBOARD LOCAL AREA NETWORK - GENERAL DESCRIPTION

ONBOARD LOCAL AREA NETWORK - COMPONENT LOCATION 1

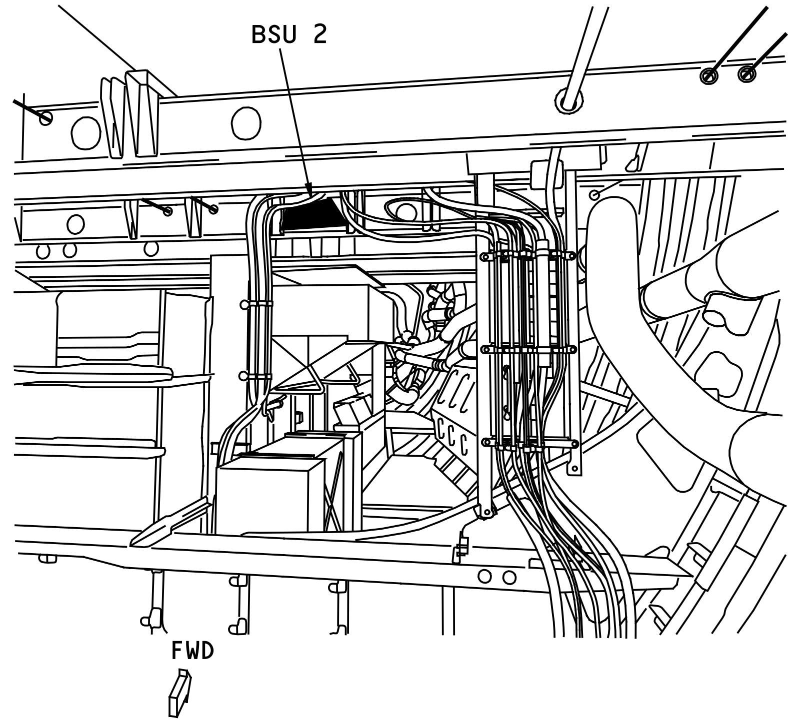
General

The brouter and bypass switch unit (BSU) 1 are in the main equipment center on the left side.

BSU 2 is in the main equipment center on the right side.



MAIN EQUIPMENT CENTER
(LEFT SIDE, LOOKING FORWARD)



MAIN EQUIPMENT CENTER
(RIGHT SIDE, LOOKING FORWARD)

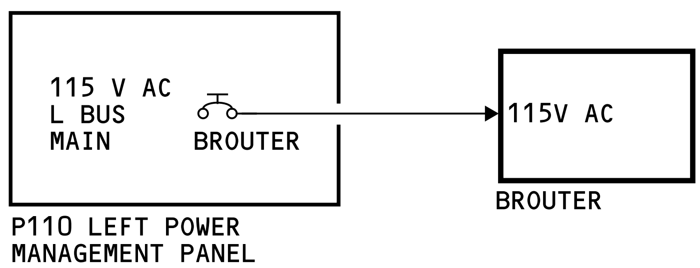
23-94-00-003 Rev 1 03/02/95

ONBOARD LOCAL AREA NETWORK - COMPONENT LOCATION 1

ONBOARD LOCAL AREA NETWORK - POWER INTERFACE

General

Power for the brouter comes through the P110 left power management panel.



23-94-00-005 Rev 1

ONBOARD LOCAL AREA NETWORK - POWER INTERFACE

ONBOARD LOCAL AREA NETWORK - AVIONICS LAN - INTERFACES

General

The avionics LAN connects these LRUs:

- Left AIMS cabinet
- Right AIMS cabinet
- Brouter
- Maintenance access terminal (MAT).

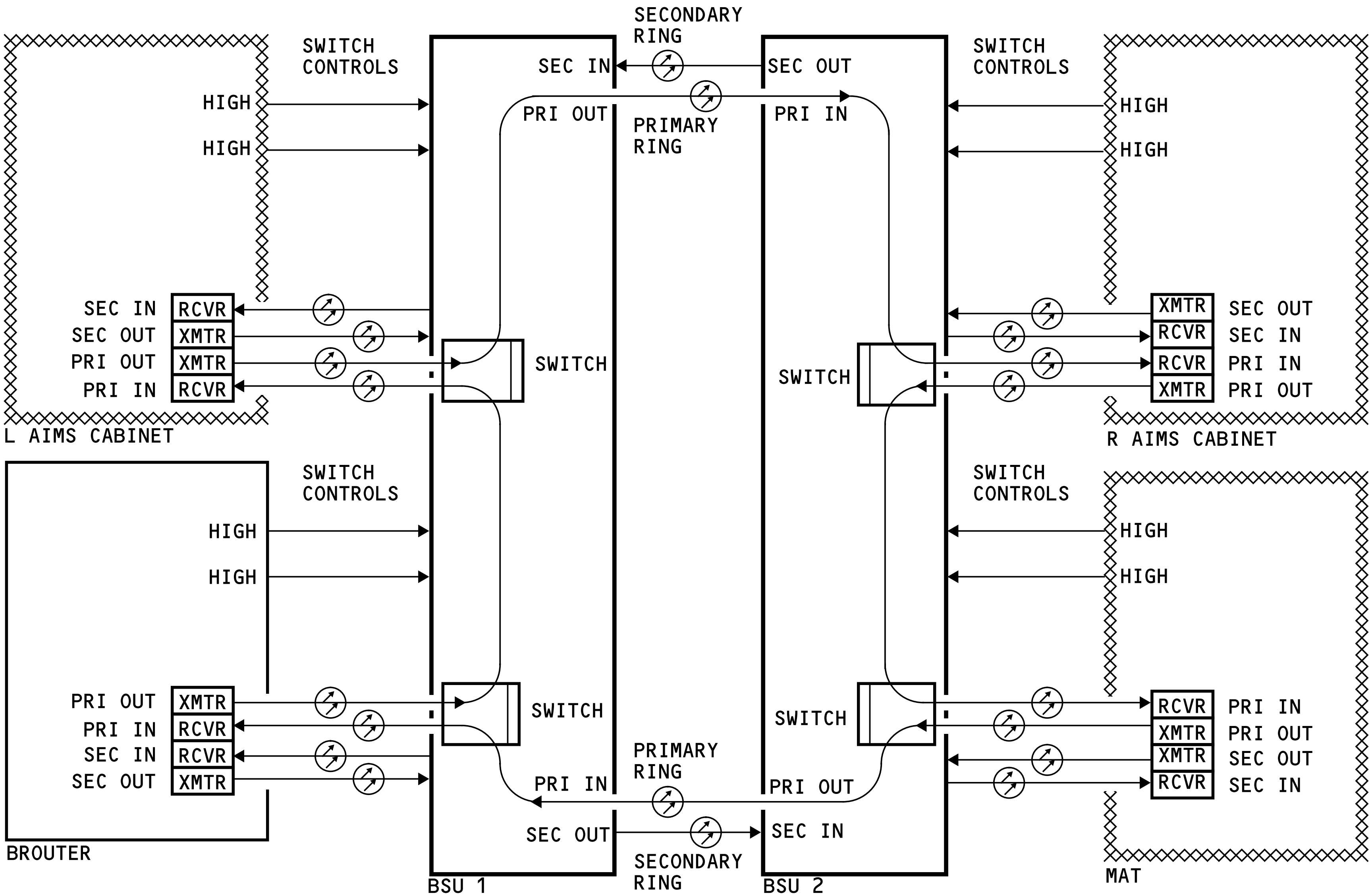
Line Replaceable Unit

Each LRU has two optical receivers and two optical transmitters. The LRUs change electronic data to optical data and transmit it on the primary and secondary rings. They also receive optical data from each ring and change it to electronic data.

Each LRU controls the position of two optical switches in a bypass switch unit (BSU). Electrical return and high signals supply this control.

Bypass Switch Unit

BSUs are the interfaces between the rings of the avionics LAN and the LRUs. Each BSU switch connects a ring to an LRU or bypasses the LRU. Each LRU controls primary and secondary BSU switches at the same time. The example shows the primary ring. The secondary ring operates in the same way.



23-94-00-006 Rev 3 05/30/96

ONBOARD LOCAL AREA NETWORK - AVIONICS LAN - INTERFACES

ONBOARD LOCAL AREA NETWORK - BROUTER

General

The brouter is a local area network (LAN) communication device. It is also a router of data between the avionics LAN components.

The brouter changes data between these formats:

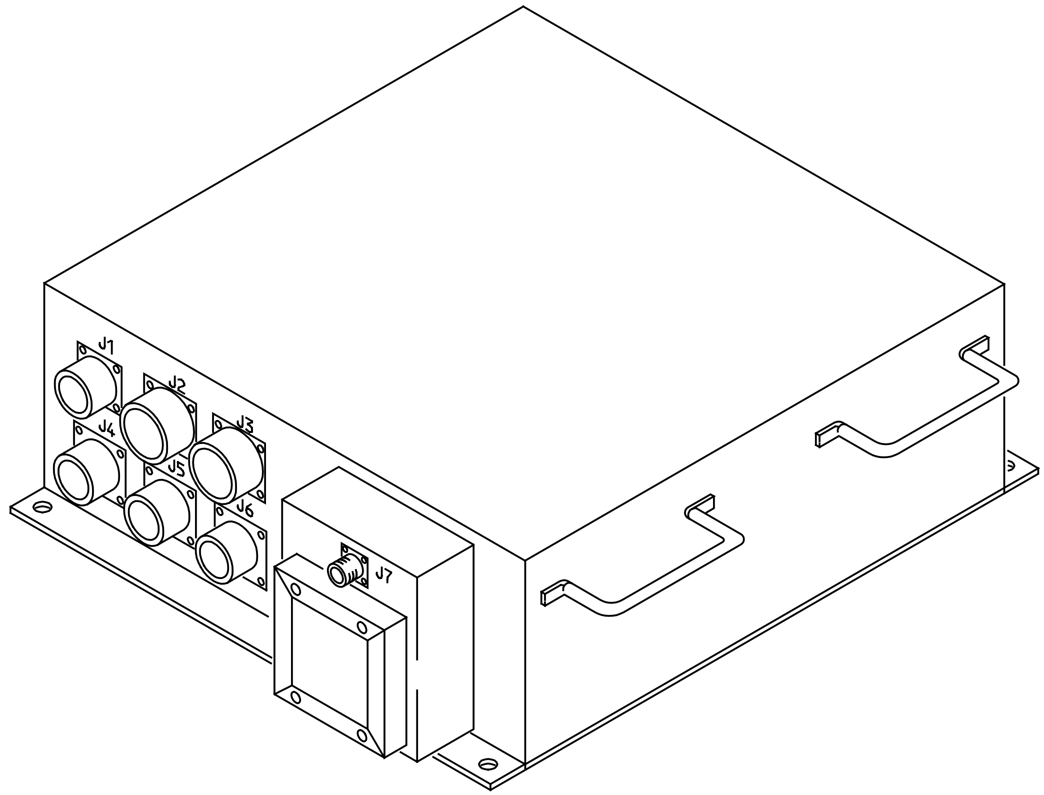
- Fiber optic data
- 10 Base T data.

The brouter sends data to and gets data from the portable maintenance access terminals (PMATs).

Physical Description

The brouter has these physical dimensions:

- Height - 5.5 inches
- Length - 11.6 inches
- Width - 6.2 inches.



23-94-00-008 Rev 1

ONBOARD LOCAL AREA NETWORK - BROUTER

ONBOARD LOCAL AREA NETWORK - BYPASS SWITCH UNIT

General

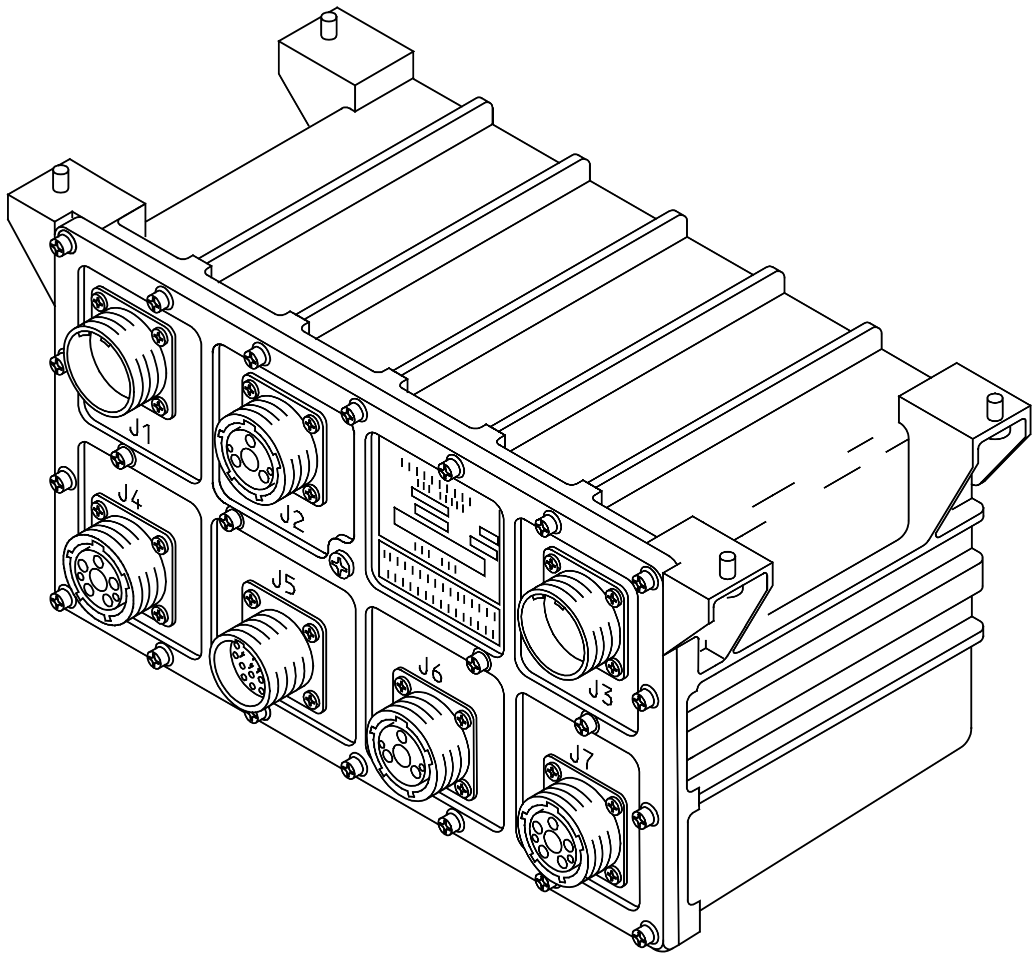
The bypass switch unit (BSU) connects the fiber optic rings to the LRUs. The BSUs receive control signals from the connected LRUs.

Each BSU has one switch for each LRU. Each switch connects an LRU to both fiber optic rings.

Physical Dimensions

The BSU has these properties:

- Length - 6.0 inches
- Width - 11.5 inches
- Height - 5.5 inches.



ONBOARD LOCAL AREA NETWORK - BYPASS SWITCH UNIT

ONBOARD LOCAL AREA NETWORK - FIBER OPTIC CABLE

Fiber Optic Cable Description

Each cable has these items:

- Five optical fibers
- Two filler strands
- Separator tape
- Aramid yarn strength member
- An outer jacket.

The cable is about 0.2 inches in diameter.

Optical Fiber

The optical fiber strands are glass. Each optical fiber strand is .0055 inches (140 microns) in diameter.

A primary and secondary buffer covers each fiber strand. The primary buffer protects the glass fiber during manufacture.

The secondary buffer adds strength and increases the diameter of the fiber. The secondary buffers of the five optical fiber strands are these five colors:

- Blue
- Red
- Green
- Yellow
- White.

The colors permit you to identify the individual fiber strands at each end of the cable.

Each optical fiber strand with its buffers is .035 inches (900 microns) in diameter.

Cables have three or five optical fibers. Cables with three fibers use two more filler strands. The example shows a cable with five optical fiber strands.

Filler Strands

The black filler strands are polyester and are .035 inches in diameter.

Separator Tape

A polyester separator tape covers the group of seven strands. The tape is low-friction polyester. It makes the cable more flexible.

Aramid Yarn

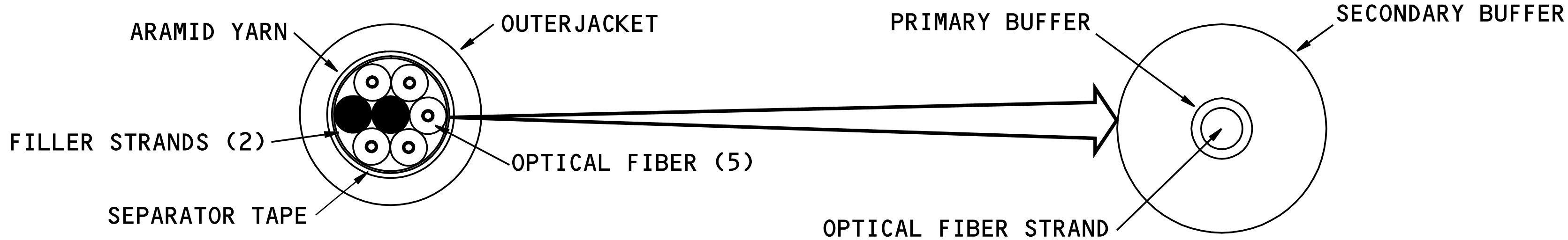
A strength member of woven Aramid (Kevlar) yarn protects the optical fibers from damage.

Outer Jacket

The outer jacket of the cable is purple thermoplastic.

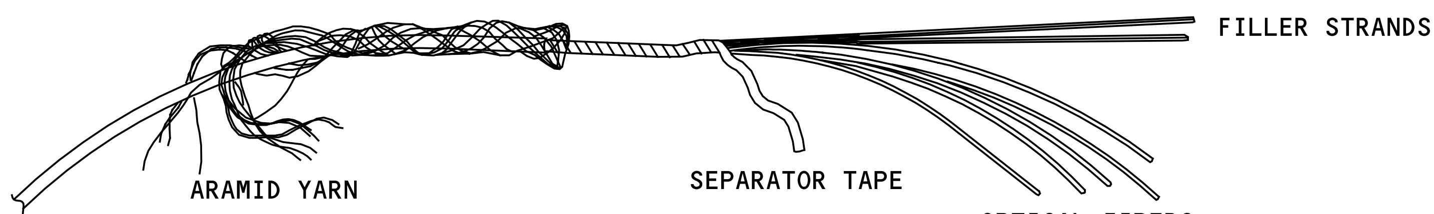
Training Information Point

The optical fiber strands may break if the cable bend radius is less than 1.5 inches.

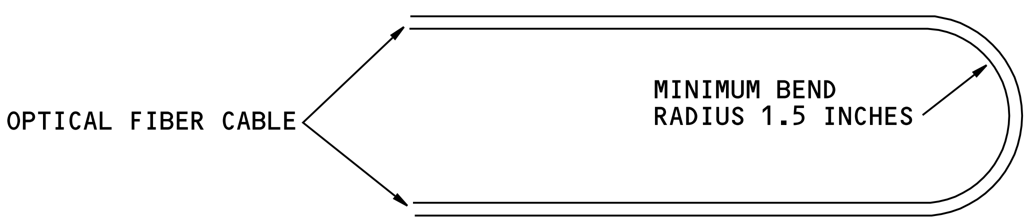


FIBER OPTIC CABLE (END VIEW)
(TYPICAL)

OPTICAL FIBER (END VIEW)



FIBER OPTIC CABLE



23-94-00-010 Rev 2

ONBOARD LOCAL AREA NETWORK - FIBER OPTIC CABLE

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ONBOARD LOCAL AREA NETWORK - CONNECTORS

General

OLAN uses two types of connectors, a type-A connector and a type-B connector.

The connectors have these parts:

- Alignment keys and grooves
- Guide pins and cavities
- Color bands
- Three start threads.

Alignment Keys and Grooves

Each connector has alignment keys on the plug and alignment grooves on the receptacle. These accurately align the connector optical components.

Guide Pins and Cavities

Guide pins in the plug fit into cavities in the receptacle when the plug and receptacle connect. The pins of the plug touch the bottom of the cavities in the receptacle. You can not over tighten the connector.

Color Bands

The coupling nut on the plug barrel has a yellow band. The receptacle barrel has a red and a yellow band. When the red band on the receptacle is at least 50 percent covered by the coupling nut, this shows a correct connection. With a correct connection, the optical fibers in the plug align end-to-end with the fibers in the receptacle.

Start Threads

Three start threads on the plug and receptacle make sure of a straight start when they join. The recessed receptacle components prevent damage from the plug if it strikes the receptacle at an angle.

The plug and receptacle seal to prevent moisture or dust in the connector.

Type-A Connector

The type-A connector is for production breaks that are not regularly connected and disconnected.

The type-A connector is a multi-channel, in-line (butt-type) connector. This connector has very low light loss between optical fiber components.

The type-A connector has three fiber optic cables or five fiber optic cables.

Type-A Connector/Fiber Optic Interface

The plug and receptacle have ceramic contacts that touch when connected. The light signal goes through holes in the end of the ceramic contacts when they are in direct physical contact with each other.

ONBOARD LOCAL AREA NETWORK - CONNECTORS

Type-B Connector

The type-B connector attaches a fiber optic cable to a line replaceable unit (LRU). The type-B connector is more frequently connected and disconnected than the type-A connector.

The type-B connector is a multi-channel, expanded beam (ball lens) connector. Light loss across this connector is low but not as low as in the type-A connector.

Type-B Connector/Fiber Optic Interface

The connector has miniature ball lenses behind a protective window. Each lens is at the end of a fiber. The ball lenses expand and focus the light signal from the fiber. The light goes through the protective windows of the plug and receptacle to another ball lens. This ball lens narrows the light and sends it into a fiber.

Training Information Point

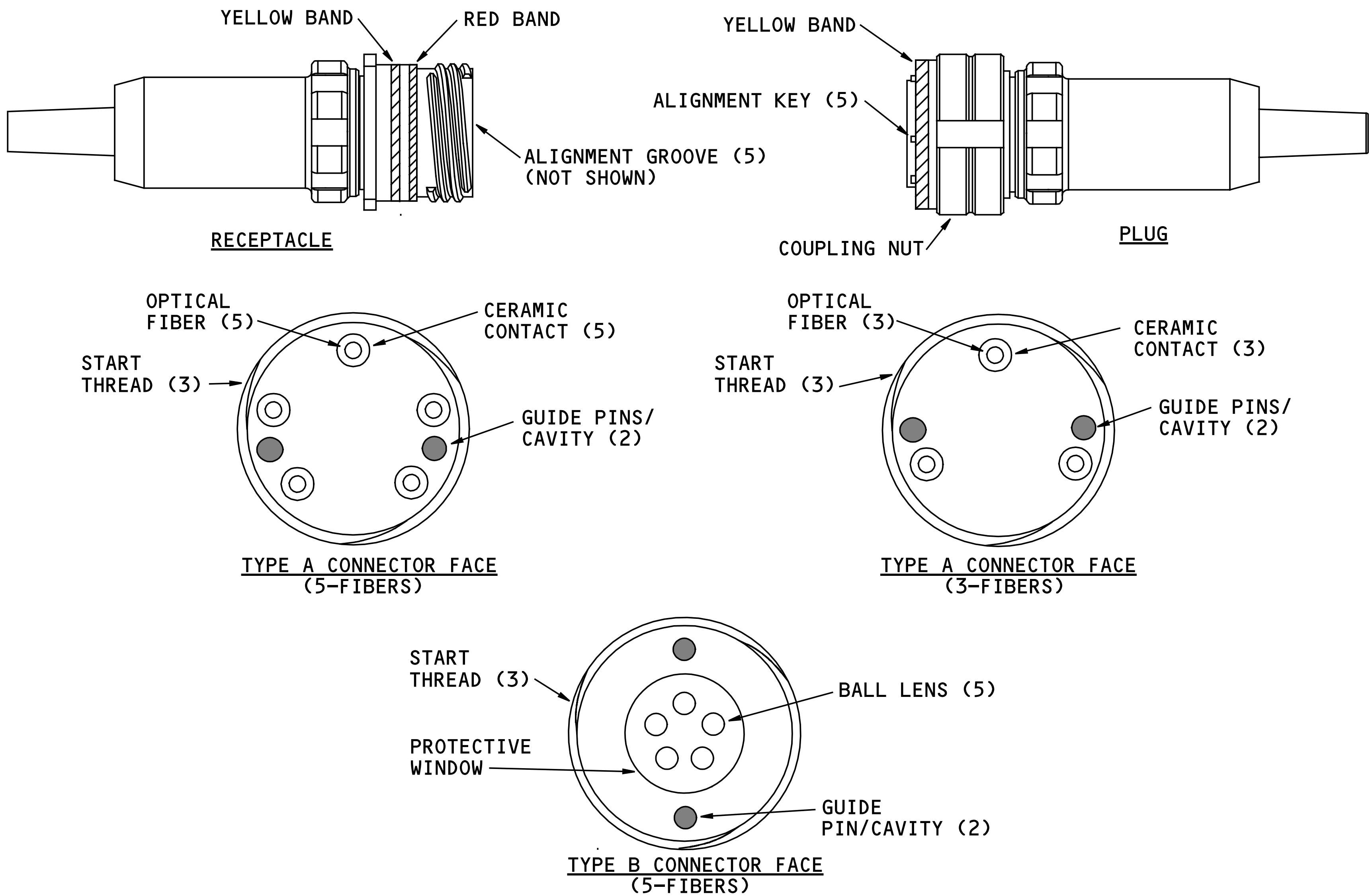
This training information point refers to both the type-A and type-B connectors.

WARNING: BEFORE YOU EXAMINE THE CONNECTOR FACE OR THE CERAMIC CONTACTS, DISCONNECT THE CABLE FROM THE EQUIPMENT AT BOTH ENDS OR SET THE EQUIPMENT TO OFF. THE LIGHT FROM THE OPTICAL FIBER THAT ATTACHES TO THE AVIONICS EQUIPMENT IS INVISIBLE AND CAN BE INTENSE ENOUGH TO CAUSE DAMAGE TO YOUR EYES.

Before you install a connector, examine it to make sure it is clean.

Use only approved procedures to clean the connectors and the fiber optic lenses.

Do not disconnect the connectors unless absolutely necessary.



23-94-00-011 Rev 2

ONBOARD LOCAL AREA NETWORK - CONNECTORS

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ONBOARD LOCAL AREA NETWORK - BROUTER - FUNCTIONAL DESCRIPTION

General

The brouter gets fiber optic signals from the LRUs in the avionics local area network (LAN). It also sends fiber optic signals to these LRUs. The brouter controls the routing of the signals through the avionics LAN.

Brouter Circuits

The brouter has these circuits:

- Bypass switch controller
- Fiber optic interface
- Router processor
- Ethernet control unit
- 10 Base T processors 1 and 2
- 10 Base T interfaces.

Bypass Switch Controller

The bypass switch controller uses bypass switch unit (BSU) control signals to control the BSU internal switches. The router processor sends control signals to the bypass switch controller.

The BSU control signals are:

- PRI HI
- PRI RTN
- SEC HI
- SEC RTN

A logic high on PRI HI or SEC HI connects the BSU to the fiber optic ring. A logic low on PRI HI or SEC HI disconnects the BSU from the fiber optic ring. The PRI RTN and SEC RTN control signals are grounds to the BSU switch relays.

Fiber Optic Interface

The fiber optic interface changes BSU fiber optic signals to electronic signals and electronic signals to BSU fiber optic signals. The router processor controls the fiber optic interface.

Router Processor

The router processor uses internal brouter buses to control all operations of the brouter.

Ethernet Control Unit

The Ethernet control unit controls the 10 base T processors 1 and 2.

The Ethernet control unit sends signals between these circuits:

- Router processor
- 10 Base T processors 1 and 2.

10 Base T Processors 1 and 2

The 10 base T processors control the 10 base T interfaces. They also sends and receive data from the

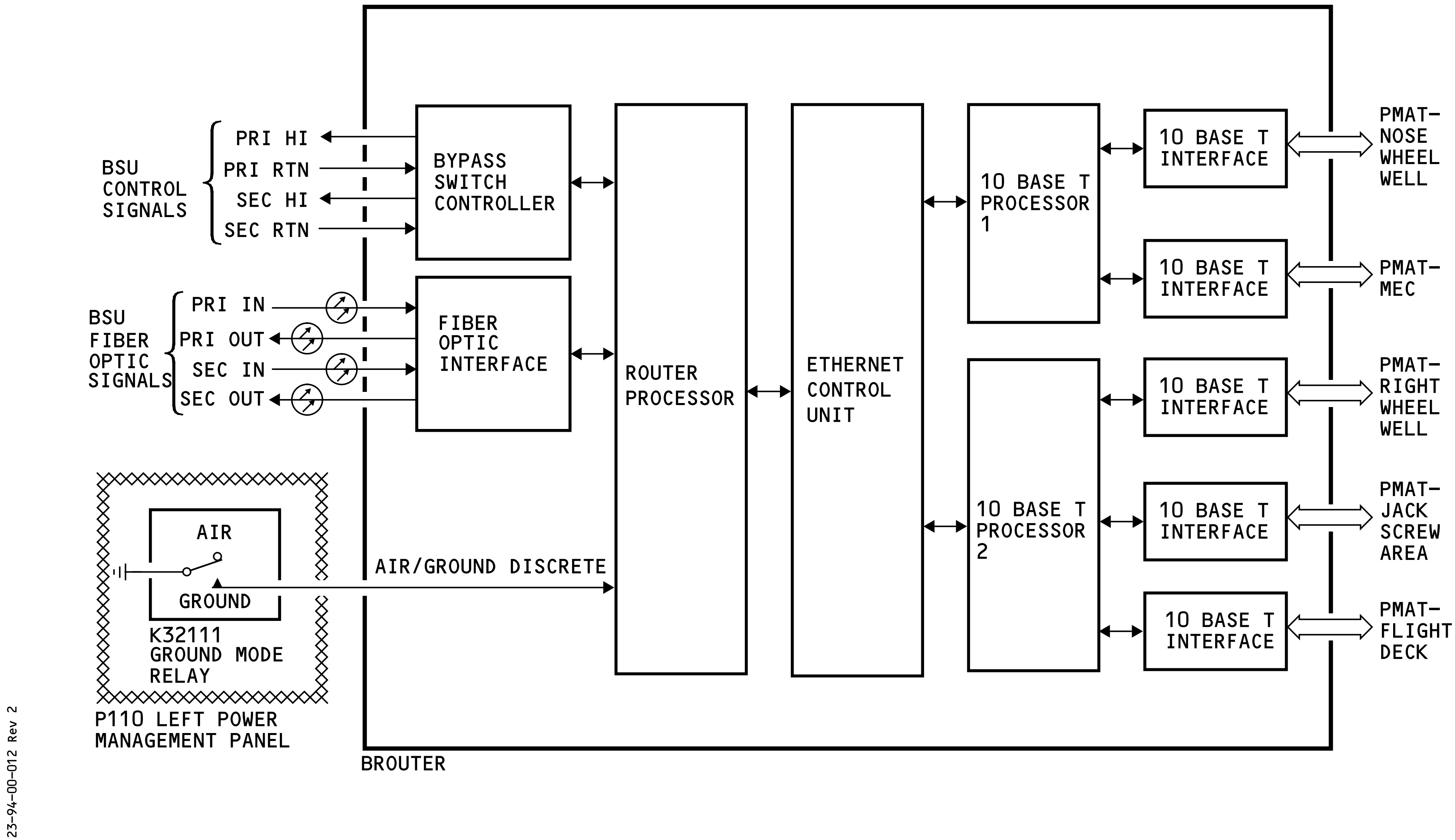
Ethernet control unit. The processors connect the portable maintenance access terminal (PMAT) ports to the Ethernet control unit.

10 Base T Interfaces

The brouter has a 10 base T interface with the PMAT ports to send and get MAT data. The 10 base T interfaces connect with the 10 base T processors 1 and 2.

Air/Ground Discrete

The ground mode relay in the P110 left power management panel sends an air/ground discrete to the brouter. In the air, an open signal from this relay goes to the brouter. This inhibits data loads and manually initiated tests of LRUs.



ONBOARD LOCAL AREA NETWORK - BROUTER - FUNCTIONAL DESCRIPTION

ONBOARD LOCAL AREA NETWORK - BYPASS SWITCH UNIT - FUNCTIONAL DESCRIPTION

General

The bypass switch units (BSUs) connect the primary and secondary rings with the LRUs. None of the components inside the BSU are line replaceable.

Switch Control

Each LRU controls one switch in a BSU. The switch connects the LRU to the primary and secondary rings. The logic high and return for each switch comes from the LRU.

Each BSU switch contains two mirrors and two solenoids. A logic high signal from an LRU causes both solenoids to energize. This moves the mirrors to the ring-connect position. The mirrors move to the bypass position when the LRU de-energizes the solenoids.

Ring-connect Position

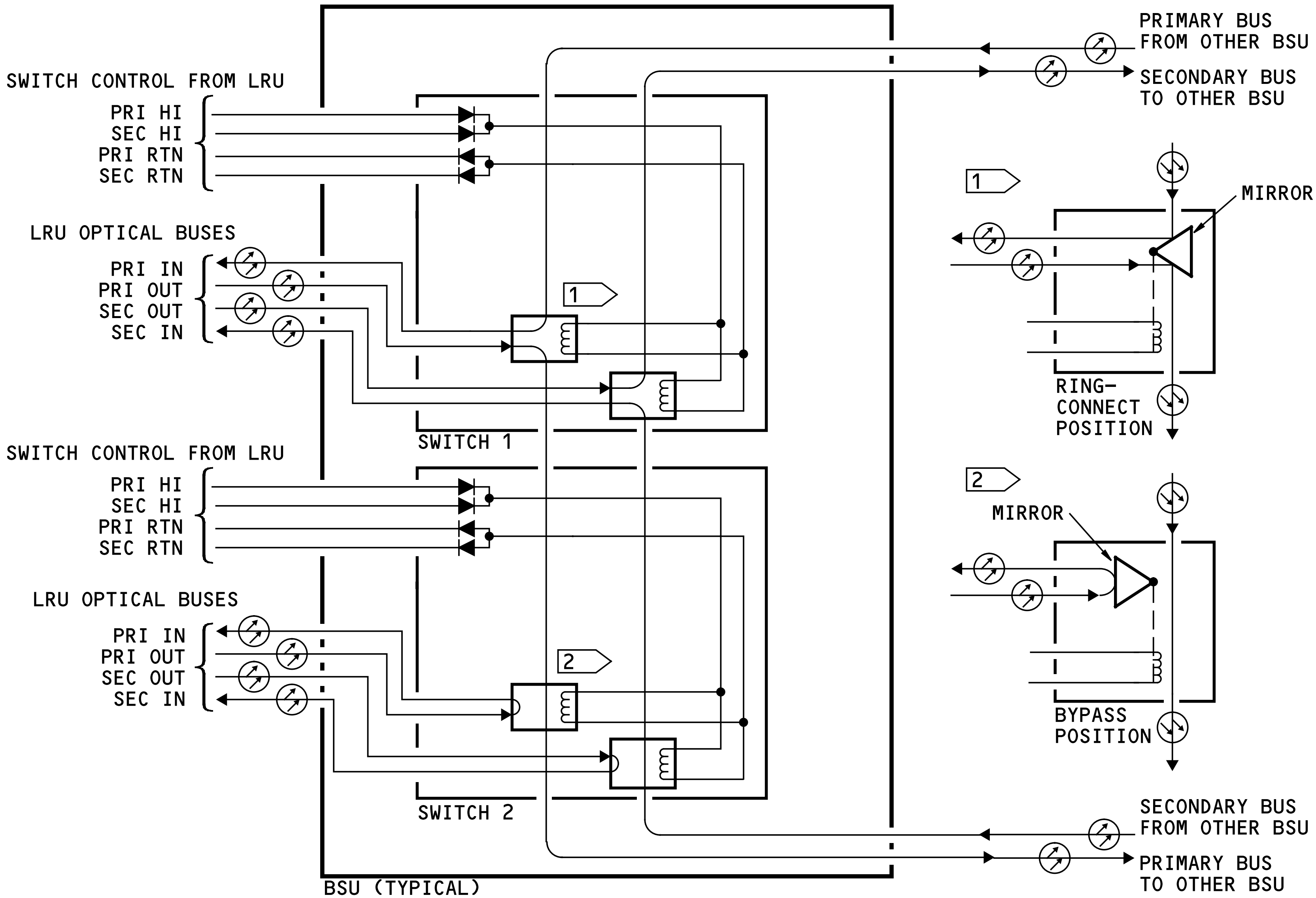
In the ring-connect position, each mirror sends the light from its ring into the LRU. The LRU re-transmits the light back to the BSU. The mirrors send the light to the next switch or to the next BSU.

Bypass Position

In the bypass position, the mirrors reflect light from the LRU back to the LRU. Light from the rings passes through the switch and goes to the next switch or to the next BSU.

LRU Pre-connect Test

Before an LRU transmits data to the rings, it runs a pre-connect test. The LRU commands the BSU switch to the bypass position and transmits test data. The BSU returns the data. If the returned data is good, the LRU commands the BSU switch to the ring-connect position. All LRUs do this pre-connect test before they transmit on a ring.



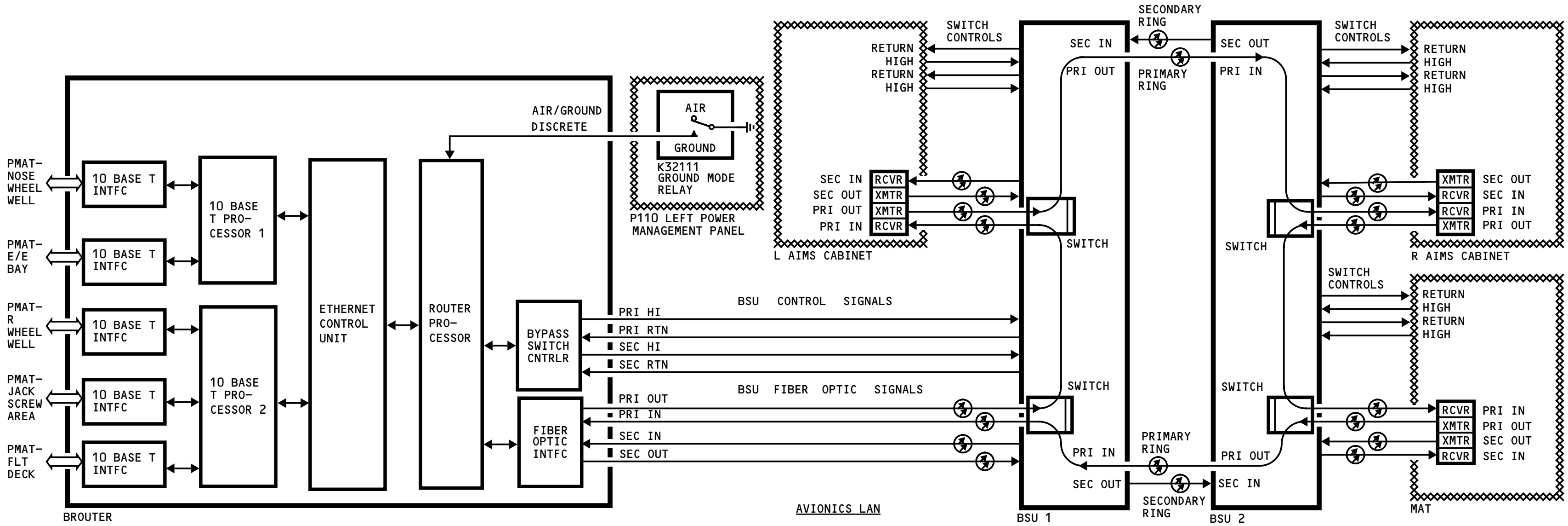
23-94-00-013 Rev 0

ONBOARD LOCAL AREA NETWORK - BYPASS SWITCH UNIT - FUNCTIONAL DESCRIPTION

ONBOARD LOCAL AREA NETWORK - SCHEMATIC

Schematic

This schematic is for reference purposes.



23-94-00-014 Rev 5 05/30/96

ONBOARD LOCAL AREA NETWORK - SCHEMATIC

Continental Airlines, Inc

System Card Files

WB371

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SYSTEMS CARD FILES - INTRODUCTION

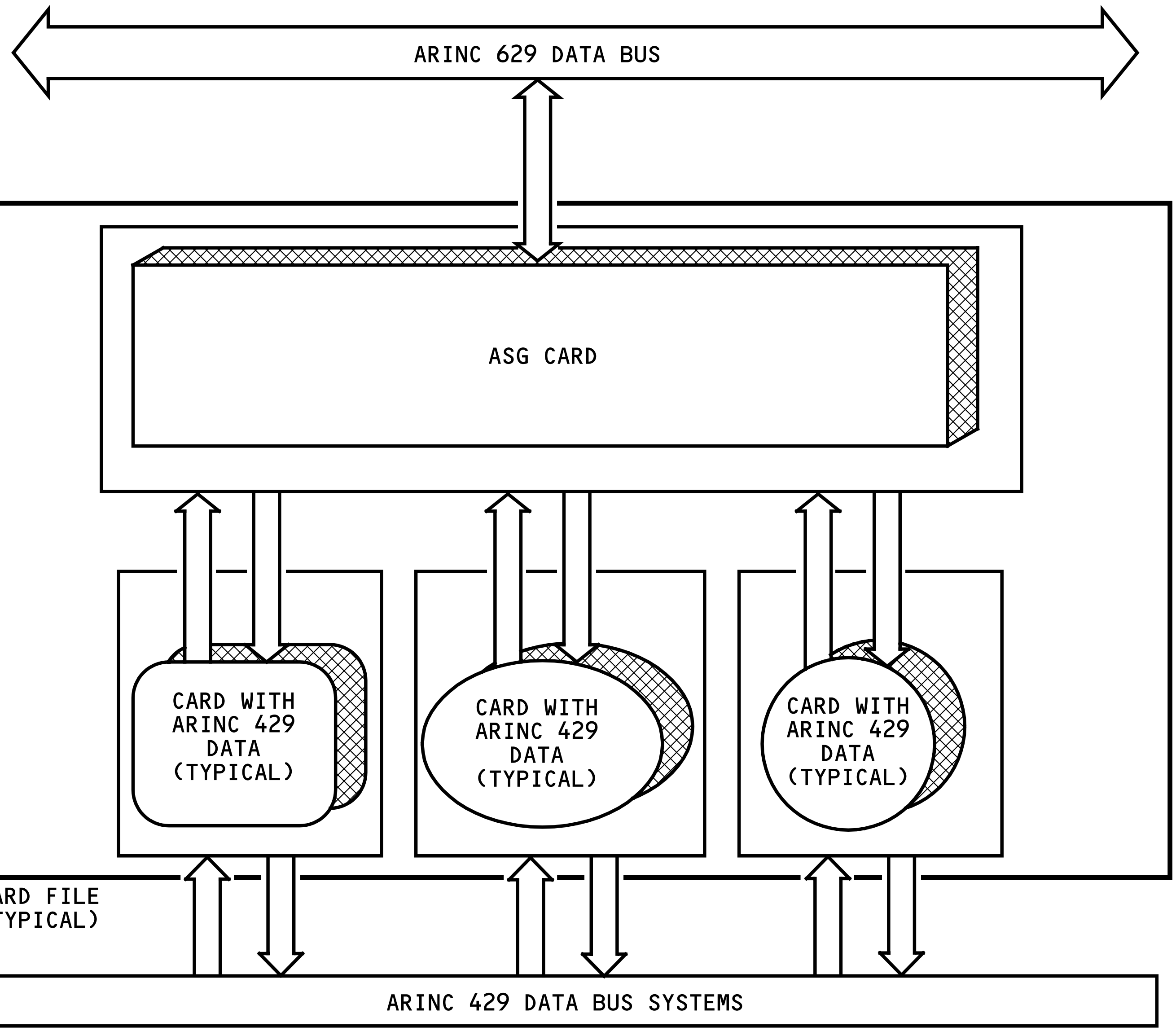
Purpose

The systems card files hold the ARINC 429 bus interface cards for essential systems.

They also hold the ARINC signal gateway (ASG) cards. The ASG cards change data formats between ARINC 429 and ARINC 629. They supply the interface between the interface cards and the systems ARINC 629 buses.

Abbreviations and Acronyms

ACIPS	- airfoil and cowl ice protection system
APU	- auxiliary power unit
ARINC	- aeronautical Radio, Inc.
ASG	- ARINC 629 signal gateway
CFPS	- card file power supply
CH	- channel
CSDS	- cargo smoke detection system
det	- detection
DLODS	- duct leak and overheat detection system
ECS	- environmental control systems
ESDS	- electrostatic discharge sensitive
FODC	- fire/overheat detection card
HYDIM	- hydraulics interface module
intfc	- interface
LH	- left hand
LRU	- line replaceable unit
LSCF	- left systems card file
ovht	- overheat
PSU	- power supply unit
rcvr	- receiver
RH	- right hand
RSCF	- right systems card file
WOW	- weight on wheels
xmtr	- transmitter



SYSTEMS CARD FILES - INTRODUCTION

31-09-00-001 Rev 2 09/21/95

SYSTEMS CARD FILES - GENERAL DESCRIPTION

General

The systems card files hold cards for ARINC 429 systems. These cards calculate data for their systems.

Data moves between the cards in the card files and the left and right ARINC 629 systems buses. Two ARINC signal gateway (ASG) cards in each card file supply the interface to and from the 629 data buses.

Components

There are two systems card files in the airplane, left and right. The system card files contain:

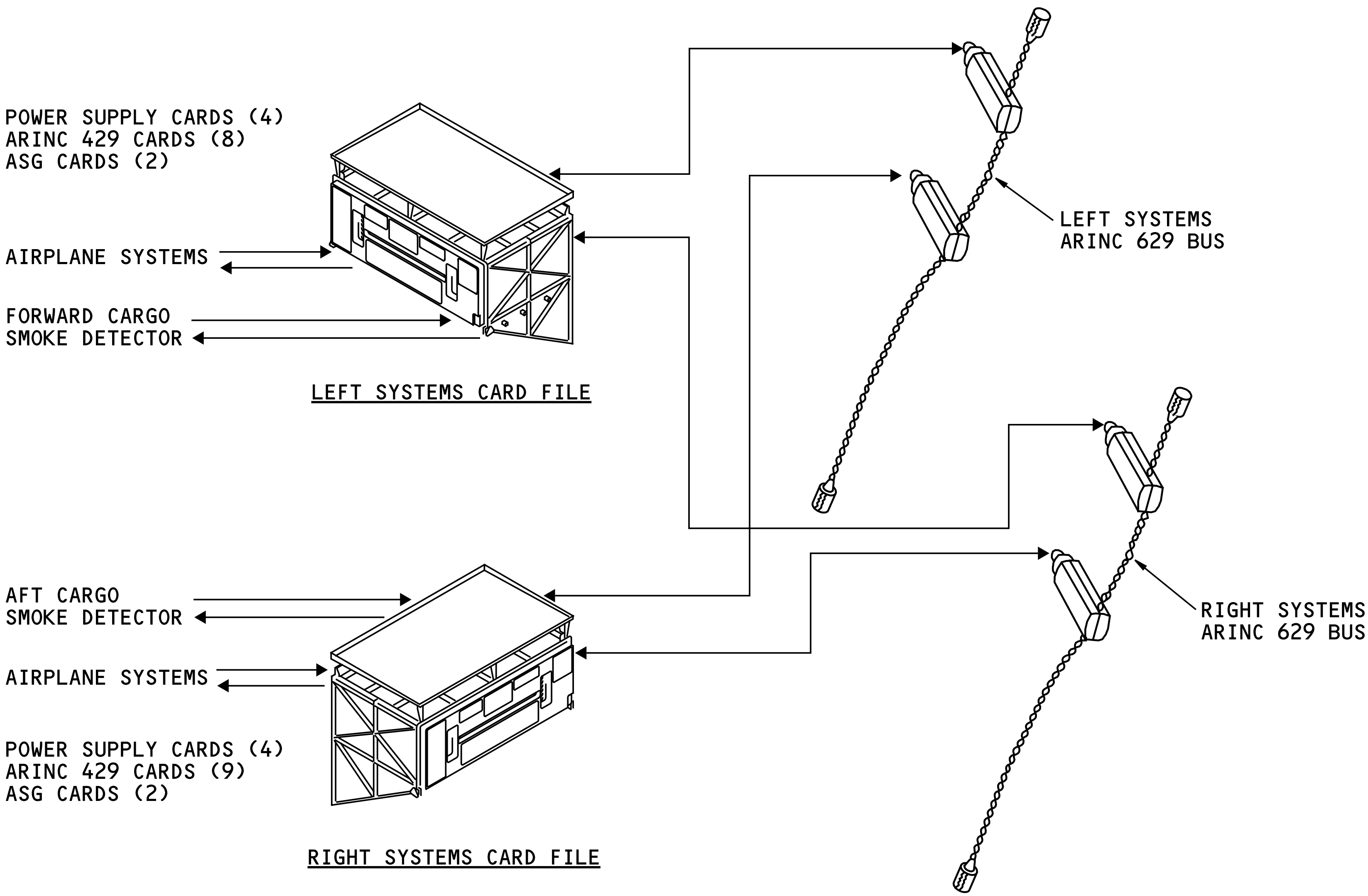
- Power supply cards (4 in each)
- ARINC signal gateway (ASG) cards (2 in each)
- ARINC 429 system cards (8 in Left)
- ARINC 429 system cards (9 in Right).

Interfaces

The eight ARINC 429 cards in the left system card file (LSCF) connect to their systems and to the ASG cards. The forward cargo smoke detector connects directly to the ASG cards in the LSCF.

The nine ARINC 429 cards in the right system card file (RSCF) connect to their systems and to the ASG cards. The aft cargo smoke detector connects directly to the ASG cards in the RSCF.

The left and right ASG cards in each card file connect to the left and right systems ARINC 629 buses.



31-09-00-002 Rev 3 09/21/95

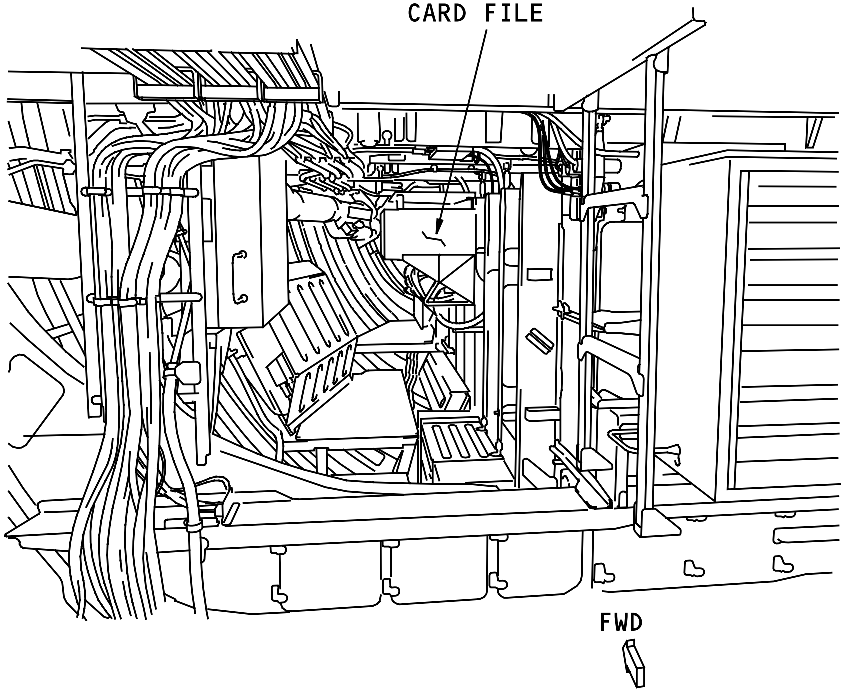
SYSTEMS CARD FILES - GENERAL DESCRIPTION

SYSTEMS CARD FILES - COMPONENT LOCATION - MAIN EQUIPMENT CENTER

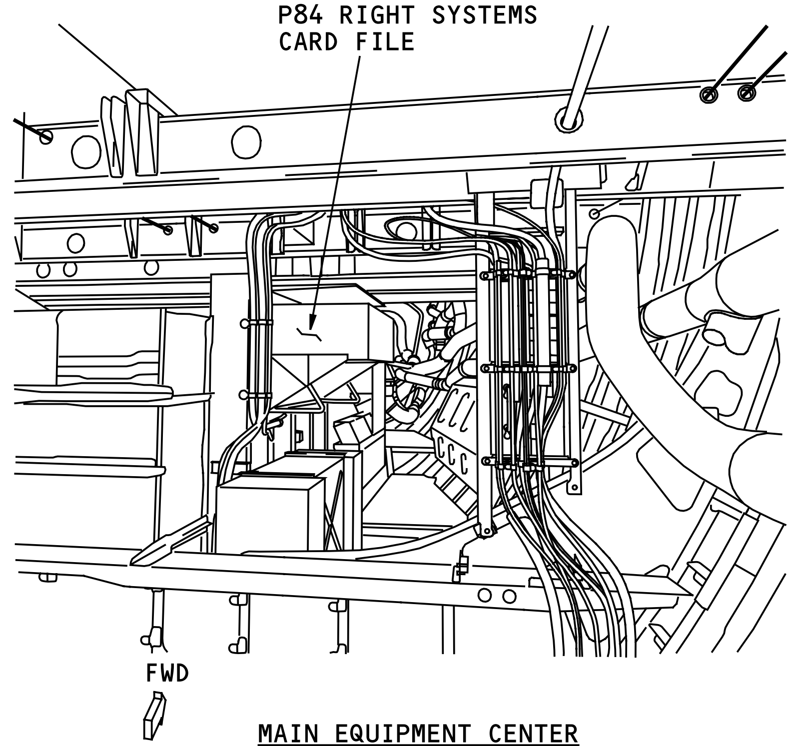
General

These two systems card files are in the main equipment center:

- P85 Left systems card file (LSCF)
- P84 Right systems card file (RSCF).



MAIN EQUIPMENT CENTER
(LEFT SIDE, LOOKING FORWARD)



MAIN EQUIPMENT CENTER
(RIGHT SIDE, LOOKING FORWARD)

31-09-00-003 Rev 1 03/02/95

SYSTEMS CARD FILES - COMPONENT LOCATION - MAIN EQUIPMENT CENTER

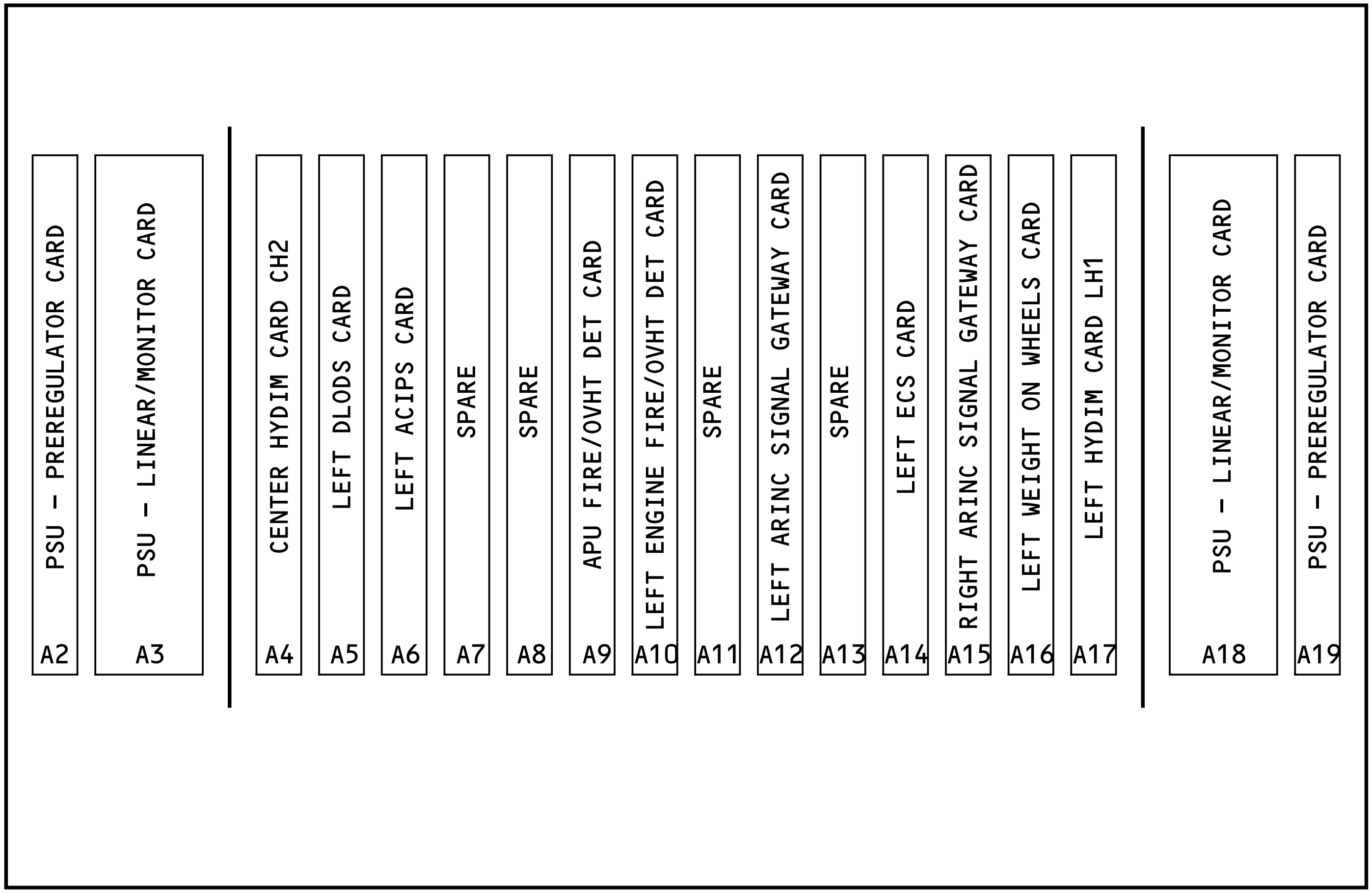
SYSTEMS CARD FILES - COMPONENT LOCATION - LSCF CARDS

General

The left systems card file (LSCF) in the P85 panel has 18 slots, A2 through A19. It contains the following interface cards:

- A2 - PSU - preregulator card
- A3 - PSU - linear/monitor card
- A4 - center HYDIM card CH2
- A5 - left DLODS card
- A6 - left ACIPS card
- A9 - APU fire/overheat detection card
- A10 - left engine fire/overheat detection card
- A12 - left ARINC 629 signal gateway card
- A14 - left ECS card
- A15 - right ARINC 629 signal gateway card
- A16 - left weight on wheels card
- A17 - left HYDIM card LH1
- A18 - PSU - Linear/monitor card
- A19 - PSU - Preregulator card.

A7, A8, A11 and A13 are empty slots.



LEFT SYSTEMS CARD FILE (P85)

31-09-00-004 Rev 2

SYSTEMS CARD FILES - COMPONENT LOCATION - LSCF CARDS

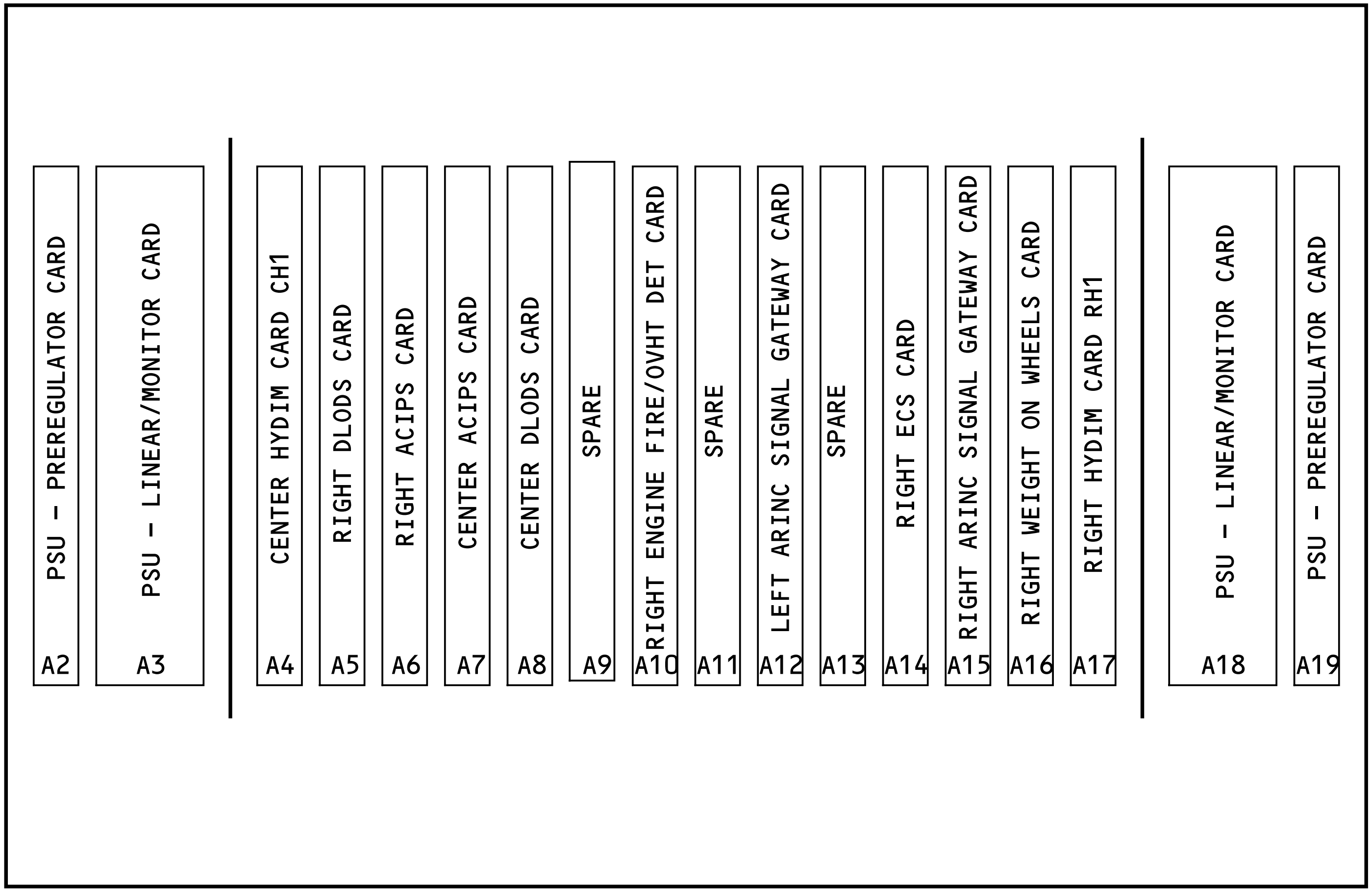
SYSTEMS CARD FILES - COMPONENT LOCATION - RSCF CARDS

General

The right systems card file (RSCF) in the P84 panel has 18 slots, A2 through A19. It contains the following interface cards:

- A2 - PSU - preregulator card
- A3 - PSU - linear/monitor card
- A4 - center HYDIM card CH1
- A5 - right DLODS card
- A6 - right ACIPS card
- A7 - center ACIPS card
- A8 - center DLODS card
- A10 - right engine fire/overheat detection card
- A12 - left ARINC 629 signal gateway card
- A14 - right ECS card
- A15 - right ARINC 629 signal gateway card
- A16 - right weight on wheels card
- A17 - right HYDIM card RH1
- A18 - PSU - linear/monitor card
- A19 - PSU - preregulator card.

A9, A11 and A13 are empty slots.



RIGHT SYSTEMS CARD FILE (P84)

31-09-00-005 Rev 2

SYSTEMS CARD FILES - COMPONENT LOCATION - RSCF CARDS

SYSTEMS CARD FILES - POWER INTERFACES

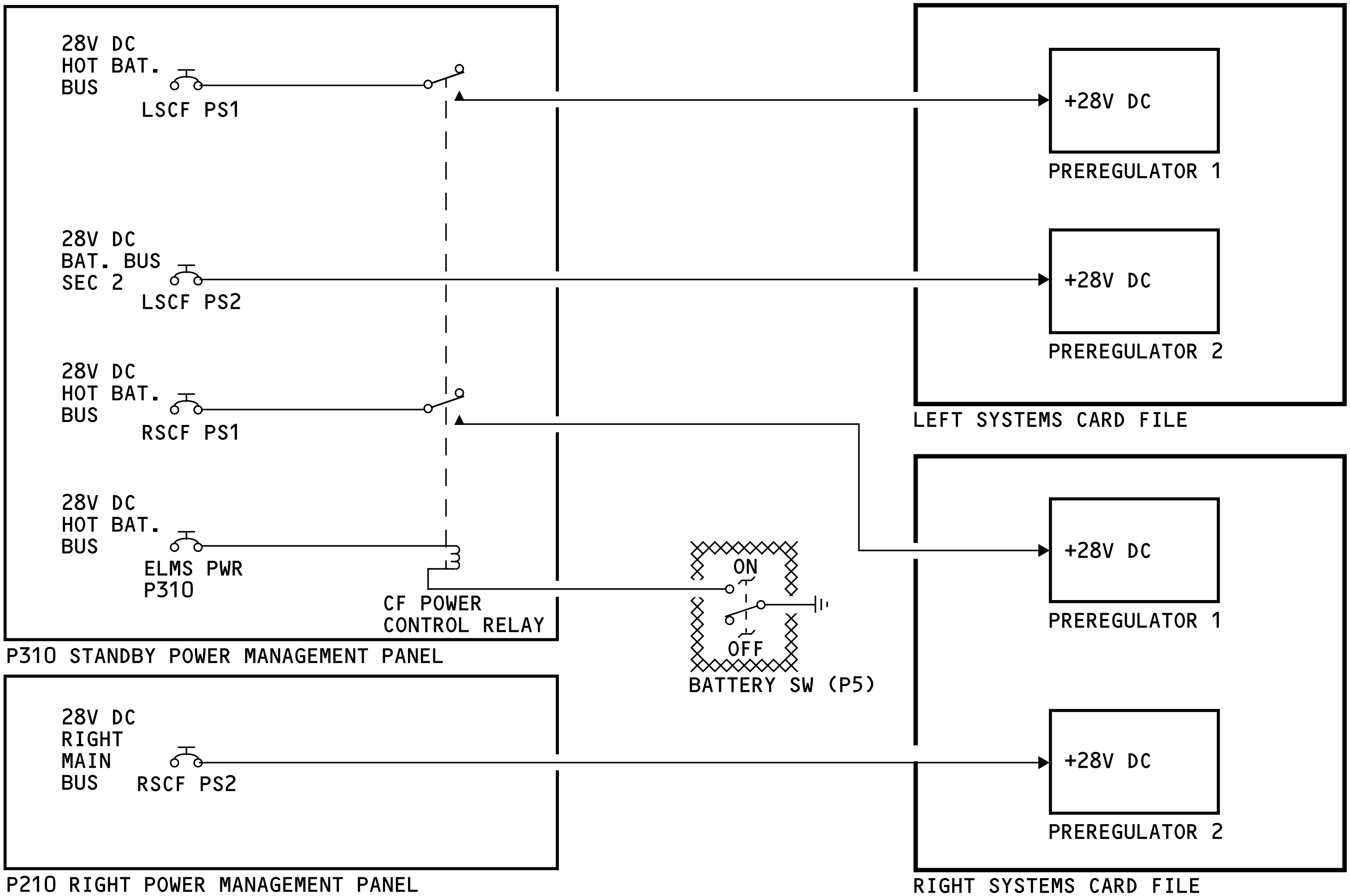
General

The LSCF PS1 circuit breaker in the P310 standby power management panel connects 28v dc to the preregulator 1 card in the LSCF. The LSCF PS2 circuit breaker connects 28v dc to the preregulator 2 card in the LSCF.

The RSCF PS1 circuit breaker in the P310 standby power management panel connects 28v dc to the preregulator 1 card in the RSCF.

The RSCF PS2 circuit breaker in the P210 left power management panel connects 28v dc to the preregulator 2 card in the RSCF.

The battery switch controls the 28v dc that goes to the PS1 power supplies in the left and right system card files.



31-09-00-006 Rev 2

SYSTEMS CARD FILES - POWER INTERFACES

SYSTEMS CARD FILES - LSCF POWER INTERFACES

General

The left system card file (LSCF) has two power supplies. Each power supply has these two cards:

- Preregulator
- linear monitor.

Preregulator Cards

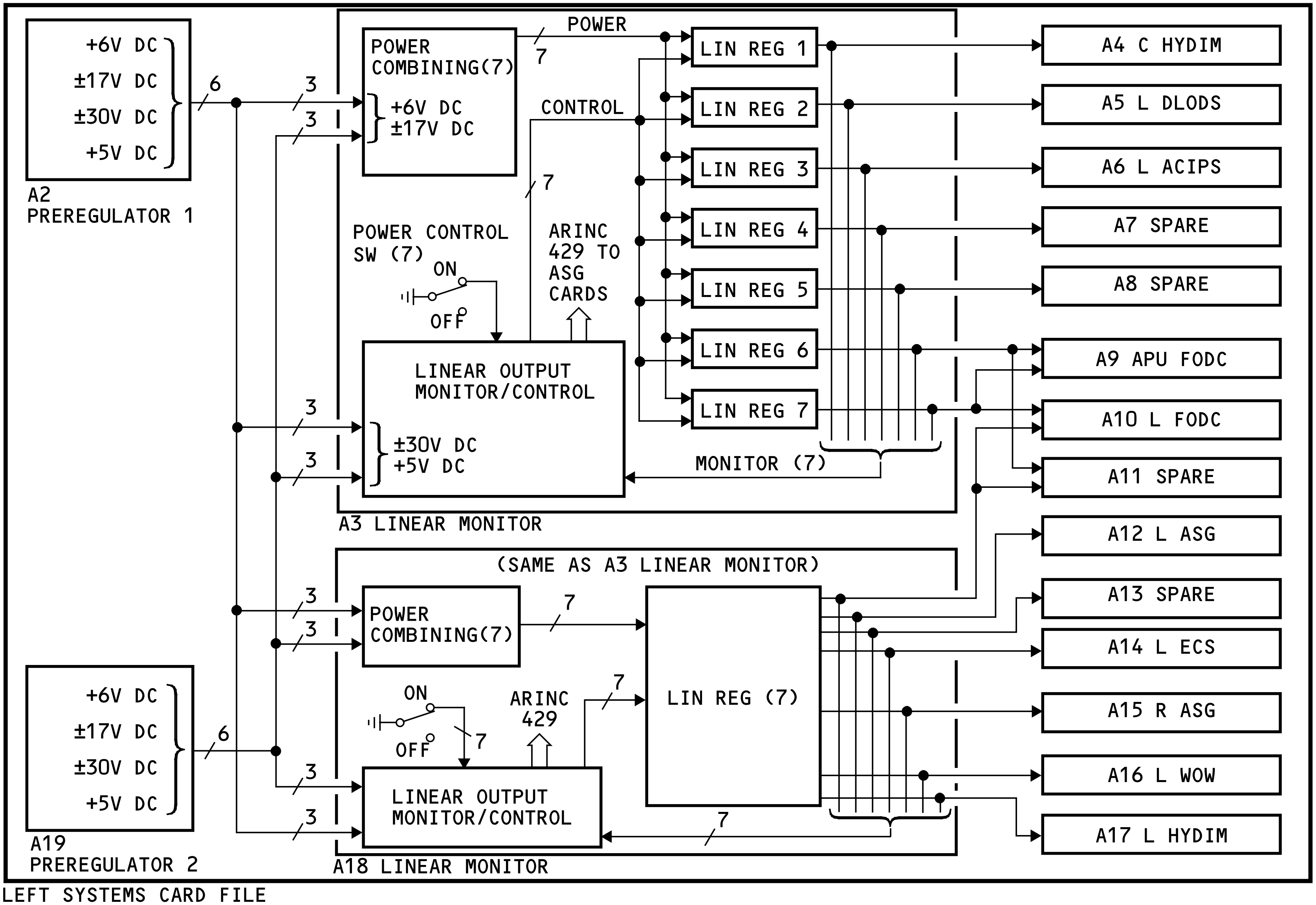
Each preregulator card supplies power to both linear monitor cards. Both linear monitor cards use the power from the preregulator 2 card. Preregulator 1 supplies backup power.

Linear Monitor Cards

Each linear monitor card sends power to seven linear regulators. The linear regulators are isolated from each other and send power to each member system card. The APU and left fire and overheat detection cards (FODC) receive two power inputs each.

The linear output monitor/control monitors the input and output power of the linear monitor. It sends power supply status to the ARINC signal gateway cards (ASG) on an ARINC 429 bus.

The linear output monitor/control also receives inputs from the power control switches. These switch inputs cause the linear regulators to be on or off.



SYSTEMS CARD FILES - LSCF POWER INTERFACES

31-09-00-007 Rev 2

SYSTEMS CARD FILES - RSCF POWER INTERFACES

General

The right system card file (RSCF) has two power supplies. Each power supply has these two cards:

- Preregulator
- linear monitor.

Preregulator Cards

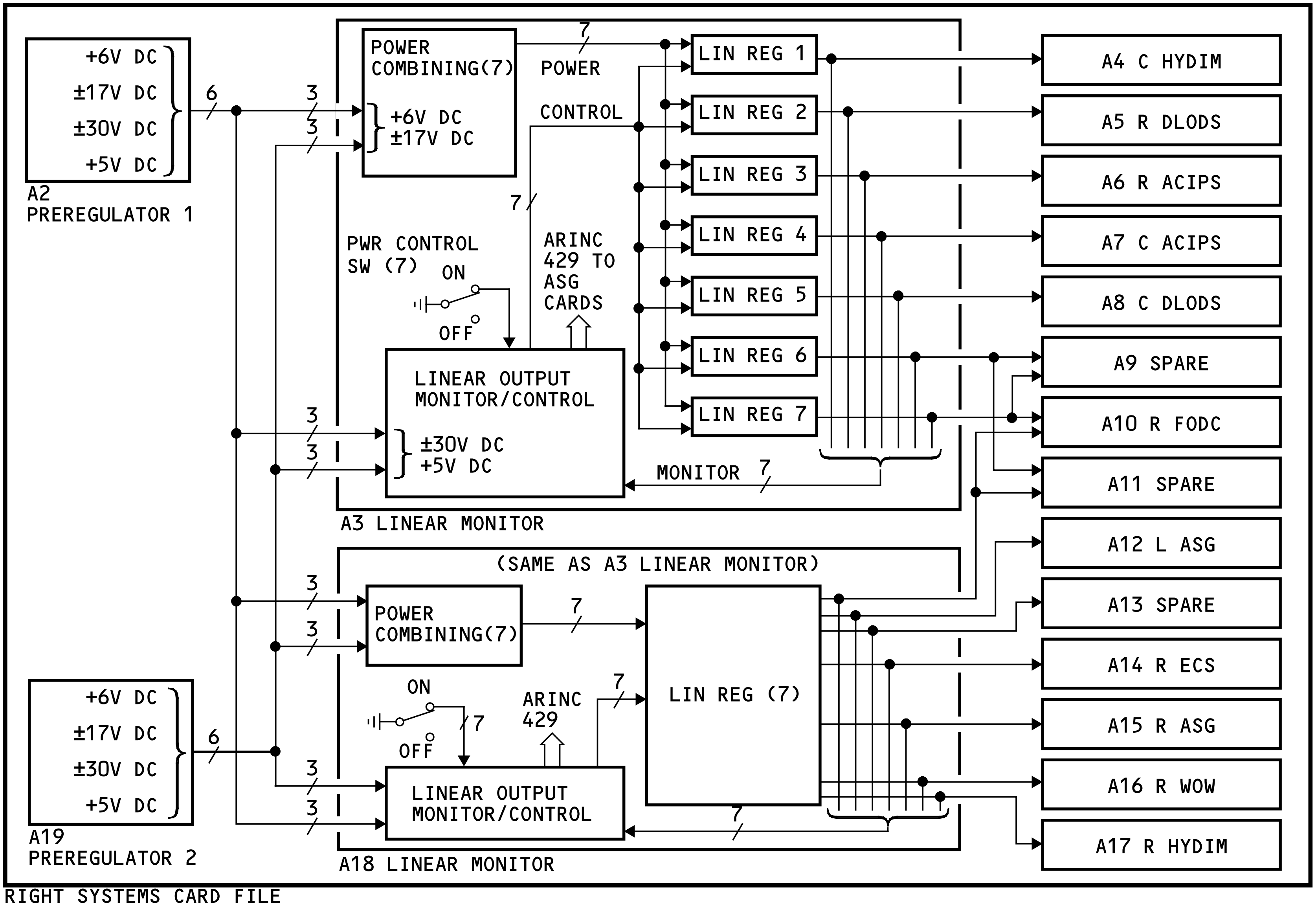
Each preregulator card supplies power to both linear monitor cards. Both linear monitor cards use the power from the preregulator 2 card. Preregulator 1 supplies backup power.

Linear Monitor Cards

Each linear monitor card sends power to seven linear regulators. The linear regulators are isolated from each other and send power to each member system card. The right fire and overheat detection card (FODC) receives two power inputs.

The linear output monitor/control monitors the input and output power of the linear monitor. It sends power supply status to the ARINC signal gateway cards (ASG) on an ARINC 429 bus.

The linear output monitor/control also receives switch inputs from the card file front panel. These switch inputs cause the linear regulators to be on or off.



SYSTEMS CARD FILES - RSCF POWER INTERFACES

SYSTEMS CARD FILES - ARINC 429 AND 629 INTERFACES

General

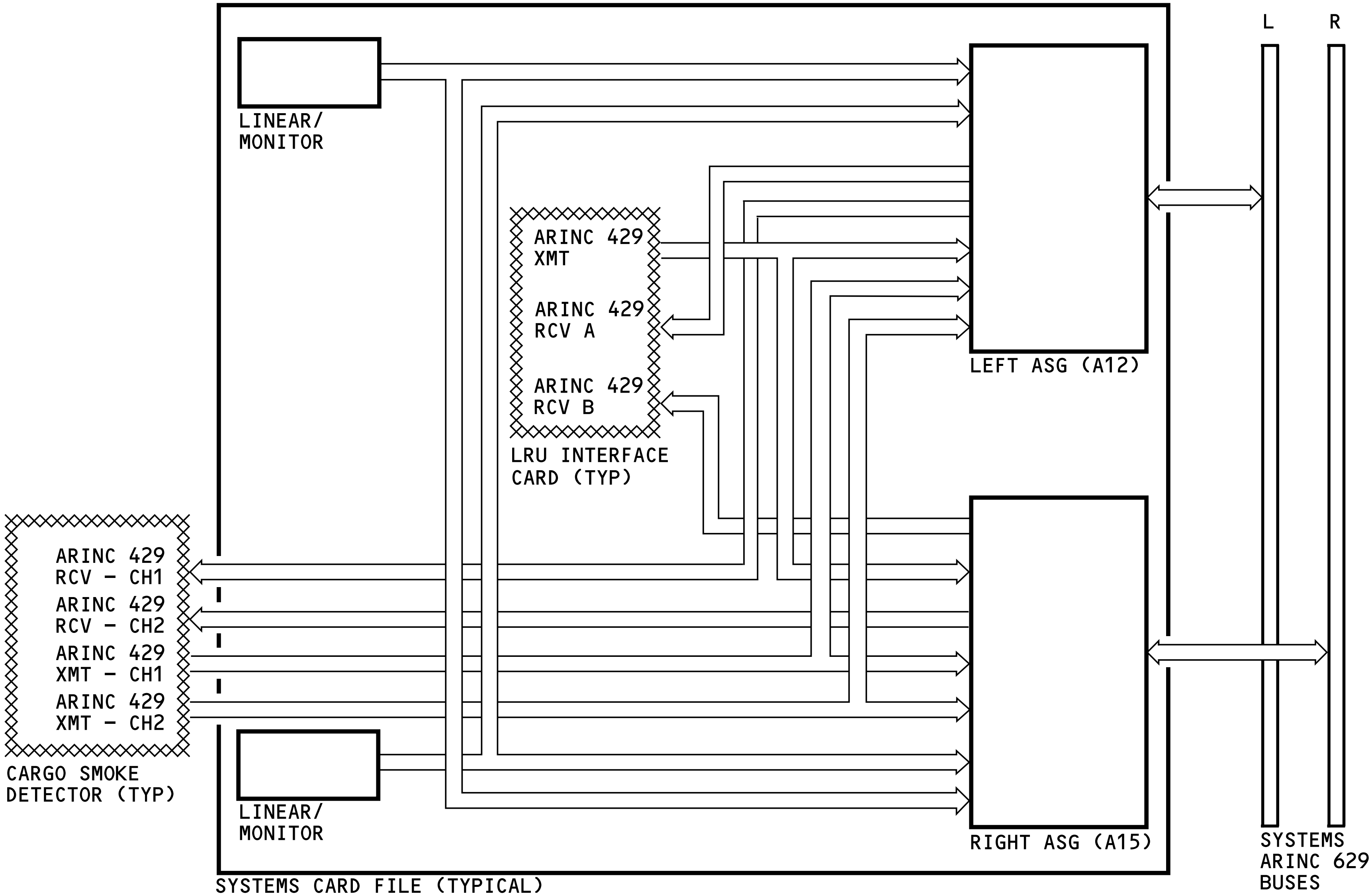
The interface cards in the system card files interface with their systems. They send and receive this type of information:

- ARINC 429 digital data
- Analog
- Analog discretes.

The interface cards also interface with other airplane systems. They send ARINC 429 data to and receive ARINC 429 data from the ASG cards.

The cargo smoke detectors also interface with other airplane systems. They send ARINC 429 data to and receive ARINC 429 data from the ASG cards. The cargo smoke detectors are not located in the system card files.

The ASG cards convert ARINC 429 data to ARINC 629 data and send it to the left and right systems ARINC 629 buses. They also receive ARINC 629 data from the left and right systems ARINC 629 buses. They convert this data to ARINC 429 data and send it to the interface cards and the cargo smoke detectors.



SYSTEMS CARD FILES - ARINC 429 AND 629 INTERFACES

SYSTEMS CARD FILES

Purpose

The left systems card file (LSCF) and right systems card file (RSCF) hold interface cards for the member systems LRUs. Each systems card file gives ARINC 429/629 and ARINC 629/429 communications and power supply connections.

Physical Description

The systems card files chassis have machined and sheetmetal parts.

A typical card file has these dimensions:

- Length 26.4 inches
- Height 17.85 inches
- Width 13.6 inches

Maximum weight of the systems cardfile chassis is 40 pounds.

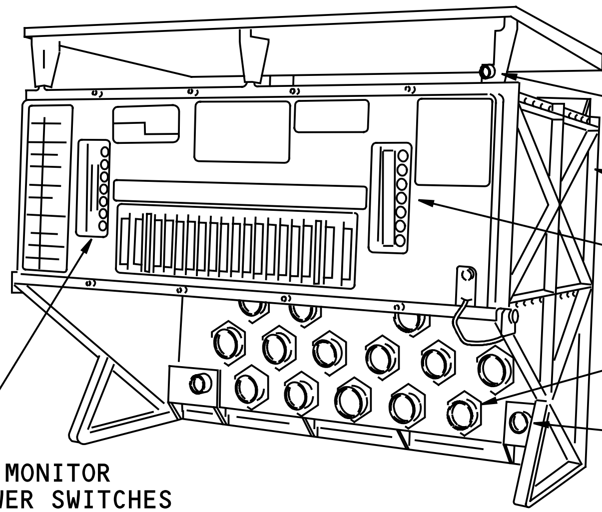
There are eighteen positions for interface cards in each of the two systems card files. Centralized power takes four of these positions in each systems card file.

The power switches on the A3 and A18 linear/monitor cards extend through the card file cover.

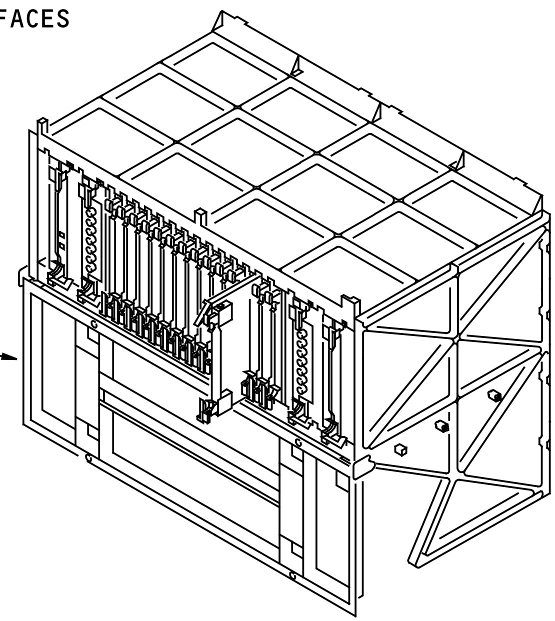
Training Information Point

The RSCF chassis is the same as the LSCF chassis except that it holds right airplane electrical systems or one channel of a dual redundant system. The RSCF chassis has a different part number than the LSCF chassis and different member system LRU slot assignments.

There is an ESDS jack located above each systems card file chassis.



SYSTEMS CARD FILE (TYPICAL)



SYSTEMS CARD FILE WITH COVER OPEN (TYPICAL)

31-09-00-008 Rev 2 09/21/95

SYSTEMS CARD FILES

SYSTEMS CARD FILES - ASG CARDS

Purpose

ARINC 629 signal gateway (ASG) cards change data format between ARINC 429 and ARINC 629. The ASG cards move data between the LRU interface cards in the left and right systems card files and the left and right systems ARINC 629 buses. The ASG cards also move data between the forward and aft cargo smoke detectors and the left and right systems ARINC 629 buses.

Physical Description

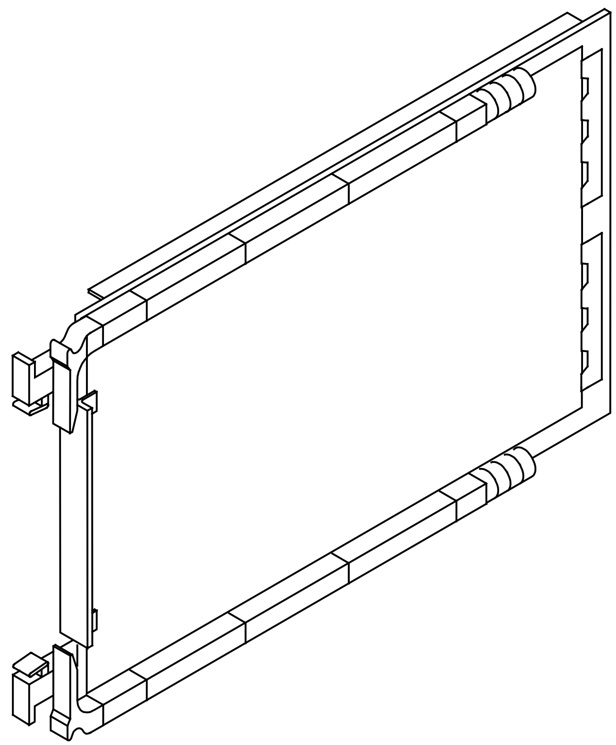
A typical card has these dimensions:

- Length 12 inches
- Height 7.43 inches
- Width 0.6 inch maximum with component protrusion

Maximum weight 1.9 pounds.

Training Information Point

The ASG cards are interchangeable.



ARINC 629 SIGNAL GATEWAY (ASG) CARD (TYPICAL)

31-09-00-009 Rev 1

SYSTEMS CARD FILES - ASG CARDS

SYSTEMS CARD FILES - ASG CARD FUNCTIONAL DESCRIPTION

General

An ARINC 629 signal gateway (ASG) card changes ARINC 429 data from LRU interface cards and cargo smoke detectors to ARINC 629 data. It sends this data to an ARINC 629 system bus.

The ASG card also gets data from an ARINC 629 system bus. It changes this data to ARINC 429 data and sends it to LRU interface cards and cargo smoke detectors.

Each ARINC 629 signal gateway (ASG) card has these components:

- ARINC 429 receiver
- ARINC 429 to ARINC 629 converter
- ARINC 629 terminal
- ARINC 629 to ARINC 429 converter
- ARINC 429 transmitter.

ARINC 429 Receiver

The ASG card receives ARINC 429 data at the ARINC 429 receiver from the LRU interface cards in the systems card files and the forward and aft cargo smoke detectors.

ARINC 429 to ARINC 629 Converter

The ARINC 429 to ARINC 629 converter in an ASG card changes the data from ARINC 429 to ARINC 629 format.

ARINC 629 Terminal

The ARINC 629 terminal transmits the data to an ARINC 629 systems bus.

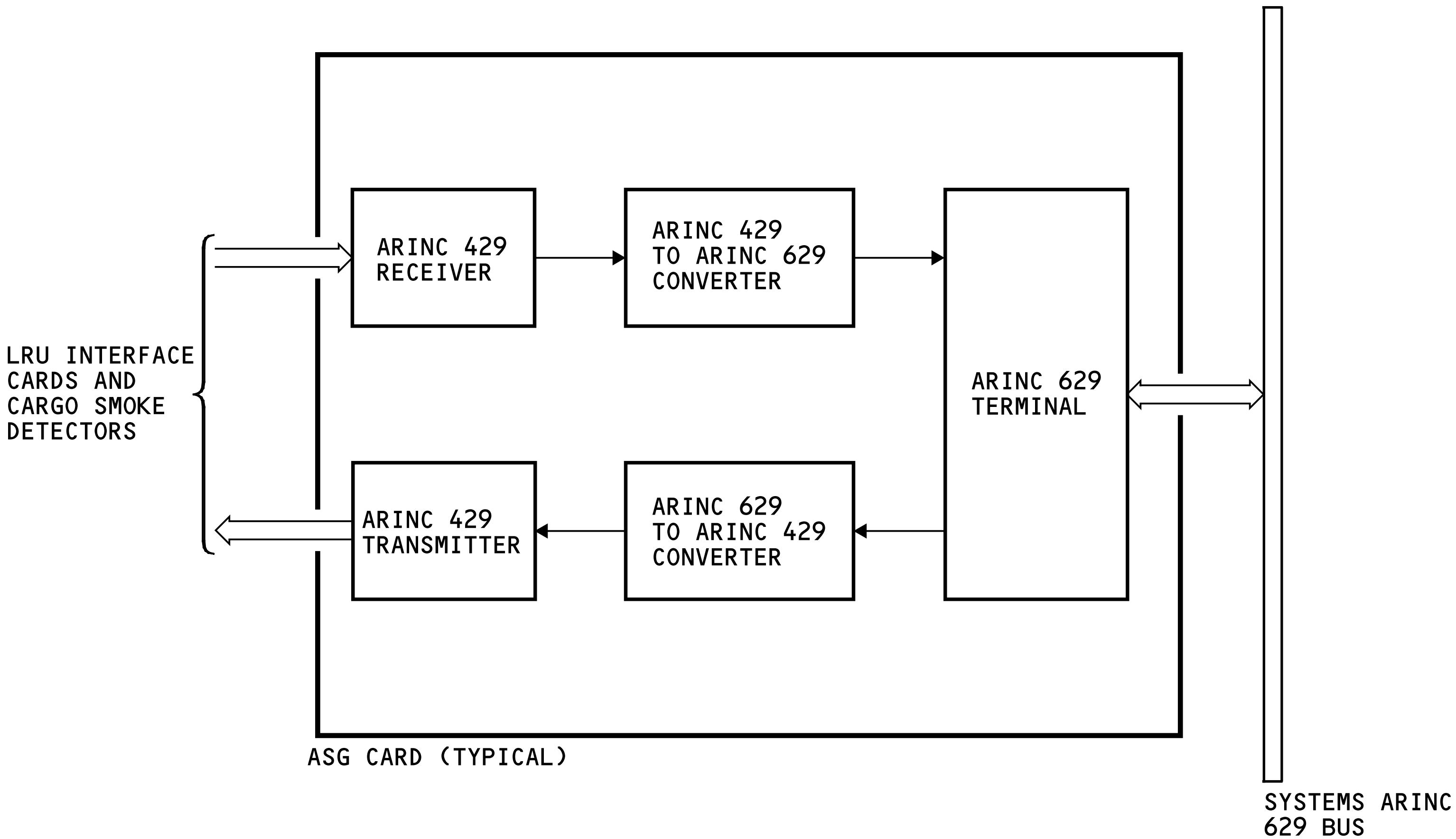
The ARINC 629 terminal receives data from an ARINC 629 systems bus.

ARINC 629 to ARINC 429 Converter

The ARINC 629 to ARINC 429 converter changes the data from the ARINC 629 systems bus to ARINC 429.

ARINC 429 Transmitter

The ARINC 429 transmitter sends the data to the LRU interface cards in the systems card files and the forward and aft smoke detectors.



31-09-00-014 Rev 0

SYSTEMS CARD FILES - ASG CARD FUNCTIONAL DESCRIPTION

Continental Airlines, Inc

Airplane Information Management System

WB371

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Continental Airlines, Inc

Airplane Information Management System

WB371

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AIRPLANE INFORMATION MANAGEMENT SYSTEM - INTRODUCTION

Purpose

The airplane information management system (AIMS) collects and calculates large quantities of data. The AIMS manages this data for several integrated avionics systems. These systems are the:

- Primary display system (PDS)
- Central maintenance computing system (CMCS)
- Airplane condition monitoring system (ACMS)
- Flight data recorder system (FDRS)
- Data communication management system (DCMS)
- Flight management computing system (FMCS)
- Thrust management computing system (TMCS).

The AIMS has software functions that do the calculation for each of these avionics systems.

The AIMS supplies one other software function that many airplane systems use. It is the data conversion gateway function (DCGF).

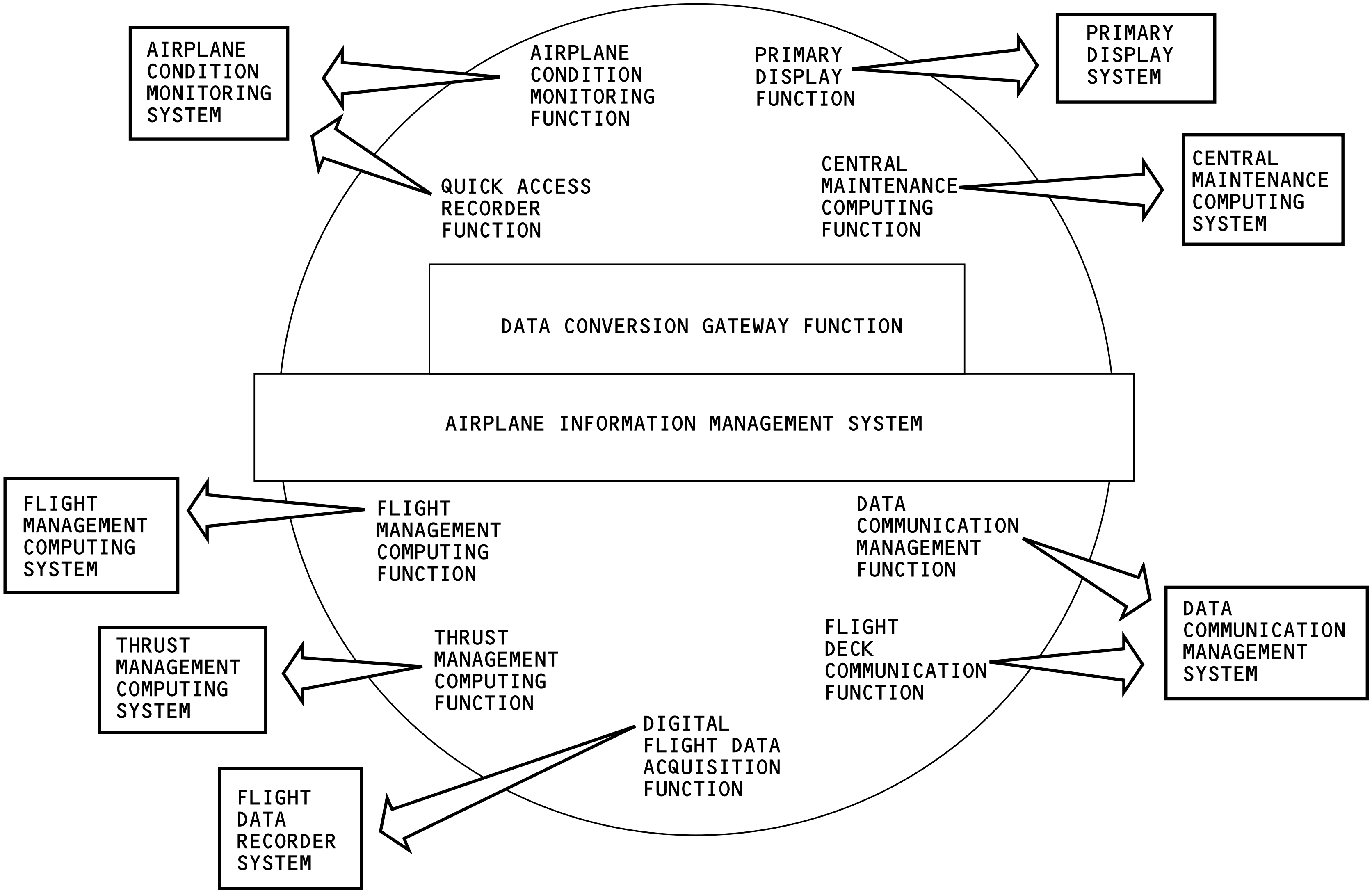
Abbreviations and Acronyms

ACARS	- aircraft communications addressing and reporting system
ACE	- actuator control electronics
ACMF	- airplane condition monitoring function
ACMS	- airplane condition monitoring system
ADF	- automatic direction finder
ADIRS	- air data inertial reference system
ADIRU	- air data inertial reference unit
ADM	- air data module
AFDC	- autopilot flight director computer
AFDS	- autopilot flight director system
AIMS	- airplane information management system
ALDB	- airline loadable database
AMI	- airline modifiable information
AMU	- audio management unit
APUC	- auxiliary power unit controller
ARINC	- Aeronautical Radio, Inc.
arpt	- airport
ASCPC	- air supply cabin pressure controller
ASG	- ARINC 629 signal gateway
ASM	- autothrottle servo motor
AVLAN	- avionics local area network
BIPM	- backplane interface/power monitor
BPCU	- bus power control unit
BPFC	- backup power frequency converter
BSCU	- brake system control unit
BSU	- bypass switch unit
BTMU	- brake temperature monitor unit
capt	- captain
CAS	- calibrated airspeed
CCA	- circuit card assembly
CCD	- cursor control device
CDU	- control display unit
CMCF	- central maintenance computing function
CMCS	- central maintenance computing system
comm	- communication
CPM	- core processor module

CPM/ACMF	- core processor module/airplane condition monitoring function
CPM/Basic	- core processor module/basic
CPM/Comm	- core processor module/communications
CPM/GG	- core processor module/graphics generator
CSMU	- cabin system management unit
CTC	- cabin temperature controller
ctr	- center
ctrl	- control
DCGF	- data conversion gateway function
DCMF	- data communication management function
DCMS	- data communication management system
DFDAF	- digital flight data acquisition function
DH	- decision height
DLGF	- data load gateway function
DME	- distance measuring equipment
DSP	- display select panel
dspl	- display
DU	- display unit
ECS	- environmental control system
EDIU	- engine data interface unit
EEC	- electronic engine control
EEPROM	- electrically erasable programmable read only memory
EFIS CP	- electronic flight instrument system control panel
EICAS	- engine indication and crew alerting system
ELEC	- electrical
ELMS	- electrical load management system
eng	- engine
EPCS	- electronic propulsion control system
ESI	- engine start inhibit
FCPSA	- flight control power supply assembly
fctl	- flight control
FD	- flight director
F/D	- flight director
FDCF	- flight deck communication function
FDR	- flight data recorder
FDRS	- flight data recorder system
flt	- flight
FMCF	- flight management computing function
FMCS	- flight management computing system
F/O	- first officer
FQPU	- fuel quantity processor unit
freq	- frequency
FSEU	- flap slat electronics unit
GCU	- generator control unit
GPS	- global positioning system
GPSSU	- global positioning system sensor unit
GPWC	- ground proximity warning computer
GPWS	- ground proximity warning system
IC	- intercabinet
IDG	- integrated drive generator
IGW	- increased gross weight
ILS	- instrument landing system
IMM	- intermodule memory
I/O	- input/output

IOC - input/output controller
IOM - input/output module
IRS - inertial reference system
ISSP - instrument source select panel
LRM - line replaceable module
LRU - line replaceable unit
MAT - maintenance access terminal
MB - marker beacon
MCP - mode control panel
MEC - main equipment center
MFD - multi-function display
MGSCU - main gear steering control unit
MTF - maintenance terminal function
nav - navigation
ND - navigation display
NVM - non-volatile memory
OPAS - overhead panel ARINC 629 system
OPBC - overhead panel bus controller
OPC - operational program configuration file
OPS - operational program software
PA/CI - passenger address/cabin interphone
PDF - primary display function
PDS - primary display system
PFC - primary flight computer
PFD - primary flight display
PMAT - portable maintenance access terminal
PMP - power management panel
pos - position
PSEU - proximity sensor electronics unit
RA - radio altitude
ref - reference
RLS - remote light sensor
RT - receiver-transmitter
SAARU - secondary attitude air data reference unit
SATCOM - satellite communications
SDU - satellite data unit
SELCAL - selective calling
SPD - speed
SRAM - static random access memory
std - standard
TAI - thermal anti-ice
TAS - true airspeed
TCAS - traffic alert and collision avoidance system
temp - temperature
TMCF - thrust management computing function
TMCS - thrust management computing system
TO/GA - takeoff/go-around
TPMU - tire pressure monitor unit
UTC - universal time (coordinated)
UTCF - universal time (coordinated) function
VHF - very high frequency
vib - vibration
VOR - VHF omnidirectional ranging
WAI - wing anti-ice
WES - warning electronic system
WEU - warning electronic unit

WOW	- weight-on-wheels
WXR	- weather radar
xmsm	- transmission
xmtr	- transmitter



31-41-00-001 Rev 9 04/26/95

AIRPLANE INFORMATION MANAGEMENT SYSTEM - INTRODUCTION

AIMS - GENERAL DESCRIPTION - 1

AIMS Cabinets

The AIMS has two cabinets which do the calculations for other avionic systems. To do these calculations, each AIMS cabinet has these:

- A cabinet chassis
- Four Input/output modules (IOM)
- Four Core processor modules (CPM).

The IOMs and the CPMs are in the cabinet chassis. The chassis also has a backplane data bus and a backplane power bus to distribute data and power to the IOMs and CPMs.

The input/output module (IOM) transfers data between the software functions in the AIMS CPMs and external signal sources.

The CPMs supply the software and hardware to do the calculations for several avionic systems. The software is called functions. To keep a necessary separation between the functions, each function is partitioned. The partitions permit multiple functions to use the same hardware and be in the same CPM.

These are the four types of CPMs:

- CPM/Communication (CPM/Comm)
- CPM/Airplane condition monitoring function (CPM/ACMF) (left AIMS cabinet only)
- CPM/Basic (right AIMS cabinet only)
- CPM/Graphics generator (CPM/GG).

CPM Functions

These are the software functions in the CPM/Comm:

- Data conversion gateway function (DCGF)
- Central maintenance computing function (CMCF)
- Data communication management function (DCMF)
- Flight deck communication function (FDCF)
- Quick access recorder function (QARF)
- Digital flight data acquisition function (DFDAF).

These are the software functions in the CPM/ACMF:

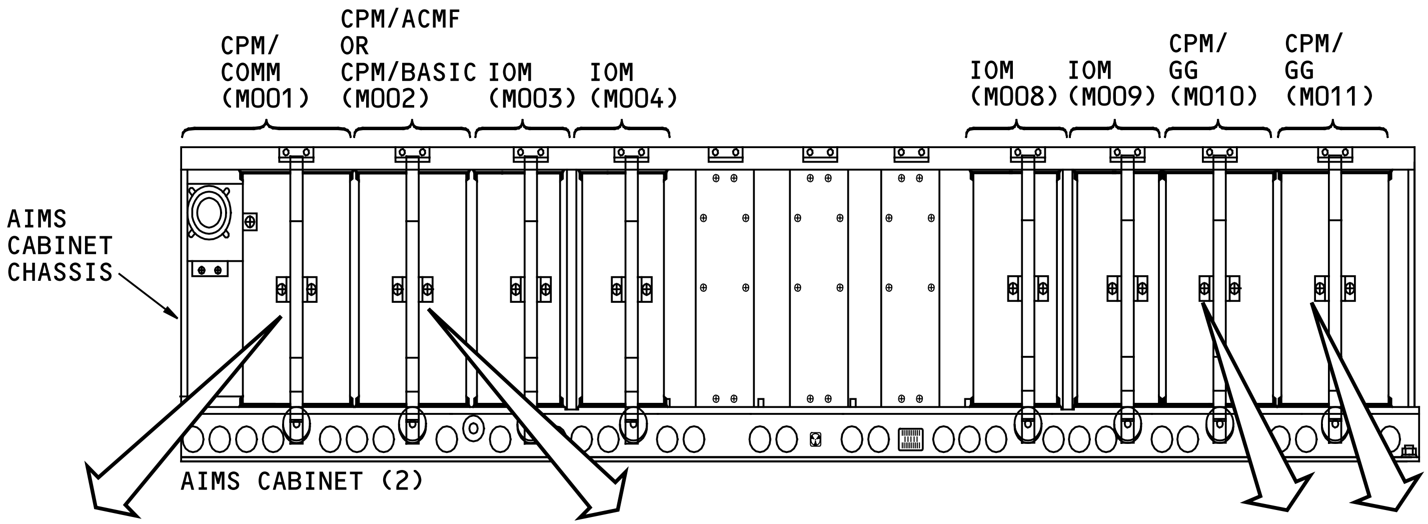
- Data conversion gateway function (DCGF)
- Flight management computing function (FMCF)
- Thrust management computing function (TMCF)
- Airplane condition monitoring function (ACMF).

These are the software functions in the CPM/Basic:

- Data conversion gateway function (DCGF)
- Flight management computing function (FMCF)
- Thrust management computing function (TMCF).

These are the software functions in the CPM/GG:

- Data conversion gateway function (DCGF)
- Primary display function (PDF).



- DATA CONVERSION GATEWAY FUNCTION
- CENTRAL MAINTENANCE COMPUTING FUNCTION
- DATA COMMUNICATION MANAGEMENT FUNCTION
- FLIGHT DECK COMM FUNCTION
- QAR FUNCTION
- DIGITAL FLIGHT DATA ACQUISITION FUNCTION

- AIMS
- CMCS
- DCMS
- ACMS
- FDRS

- DATA CONVERSION GATEWAY FUNCTION
- FLIGHT MANAGEMENT COMPUTING FUNCTION
- THRUST MANAGEMENT COMPUTING FUNCTION
- AIRPLANE CONDITION MONITORING FUNCTION (LEFT AIMS CABINET)

- AIMS
- FMCS
- TMCS
- ACMS

- DATA CONVERSION GATEWAY FUNCTION
- PRIMARY DISPLAY FUNCTION

- AIMS
- PDS

AIMS - GENERAL DESCRIPTION - 1

AIMS - GENERAL DESCRIPTION - 2

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AIMS - GENERAL DESCRIPTION - 2

Avionics Systems Supported by AIMS

The AIMS cabinets do the calculations for several avionic systems. Because the cabinets do the calculations for these systems the systems are considered to be integrated. The systems are:

- Primary display system (PDS)
- Central maintenance computing system (CMCS)
- Airplane condition monitoring system (ACMS)
- Digital flight data recorder system (DFDRS)
- Data communication management system (DCMS)
- Flight management computing system (FMCS)
- Thrust management computing system (TMCS).

The system includes the software function in the AIMS cabinets plus their components that have an interface.

Primary Display System

The components of the primary display system are:

- Primary display function (PDF)
- Display unit (DU) (6)
- Display select panel (DSP)
- Cursor control device (CCD) (2)
- Captain display switching panel
- First officer display switching panel
- Center display control panel
- Instrument source select panel (2)
- EFIS control panel (EFIS CP) (2)
- Remote light sensor (RLS) (2).

Central Maintenance Computing System

These are the components of the central maintenance computing system:

- Central maintenance computing function (CMCF)
- Maintenance access terminal (MAT)
- Portable maintenance access terminal (PMAT).

Airplane Condition Monitoring System

These are the components of the airplane condition monitoring system:

- Airplane condition monitoring function (ACMF)
- Quick access recorder function (QARF).

Flight Data Recorder System

These are the components of the flight data recorder system:

- Digital flight data acquisition function (DFDAF)
- Flight data recorder (FDR).

Data Communication Management System

These are the components of the data communication management system:

- Data communication management function (DCMF)
- Flight deck communication function (FDCF)
- Accept/Cancel/Reject switches (2).

AIMS - GENERAL DESCRIPTION - 2

Flight Management Computing System

These are the components of the flight management computing system:

- Flight management computing function (FMCF)
- Control display unit (CDU) (3).

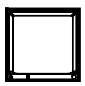
Thrust Management Computing System

These are the components of the thrust management computing system:

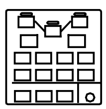
- Thrust management computing function (TMCF)
- Autothrottle servo motor (ASM) (2)
- TO/GA switch (2)
- Autothrottle disconnect switch (2).

PRIMARY DISPLAY SYSTEM (31-61)

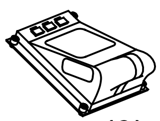
PRIMARY DISPLAY FUNCTION



DU (6)



DSP

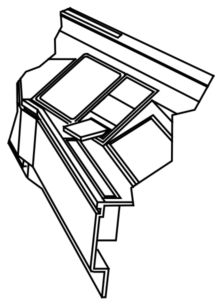


CCD (2)

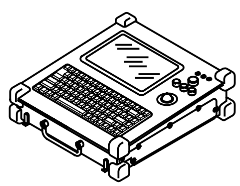
- DISPLAY SWITCHING PANELS
- CENTER DISPLAY CONTROL PANEL
- ISSP
- EFIS CONTROL PANELS

CENTRAL MAINTENANCE COMPUTING SYSTEM (45-10)

CENTRAL MAINTENANCE COMPUTING FUNCTION



MAT



PMAT

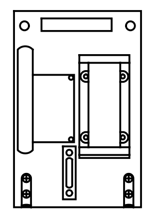
AIRPLANE CONDITION MONITORING SYSTEM (31-35)

AIRPLANE CONDITION MONITORING FUNCTION

QUICK ACCESS RECORDER FUNCTION

FLIGHT DATA RECORDER SYSTEM (31-31)

DIGITAL FLIGHT DATA ACQUISITION FUNCTION

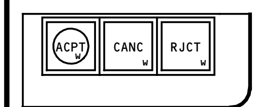


FDR

DATA COMMUNICATION MANAGEMENT SYSTEM (23-27)

DATA COMMUNICATION MANAGEMENT FUNCTION

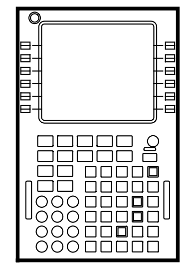
FLIGHT DECK COMMUNICATION FUNCTION



ACCEPT/CANCEL/REJECT SWITCHES

FLIGHT MANAGEMENT COMPUTING SYSTEM (34-61)

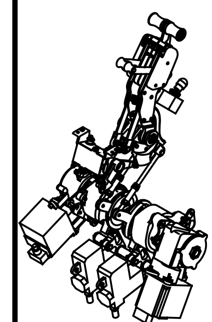
FLIGHT MANAGEMENT COMPUTING FUNCTION



CDU (3)

THRUST MANAGEMENT COMPUTING SYSTEM (22-31)

THRUST MANAGEMENT COMPUTING FUNCTION



ASM (2)
TO/GA (2)
A/T DISC (2)

NOTE: THE QUICK ACCESS RECORDER FUNCTION IS NOT USED WHEN THERE IS NO QUICK ACCESS RECORDER.

AIMS - GENERAL DESCRIPTION - 2

AIMS - GENERAL DESCRIPTION - 3

General Interfaces

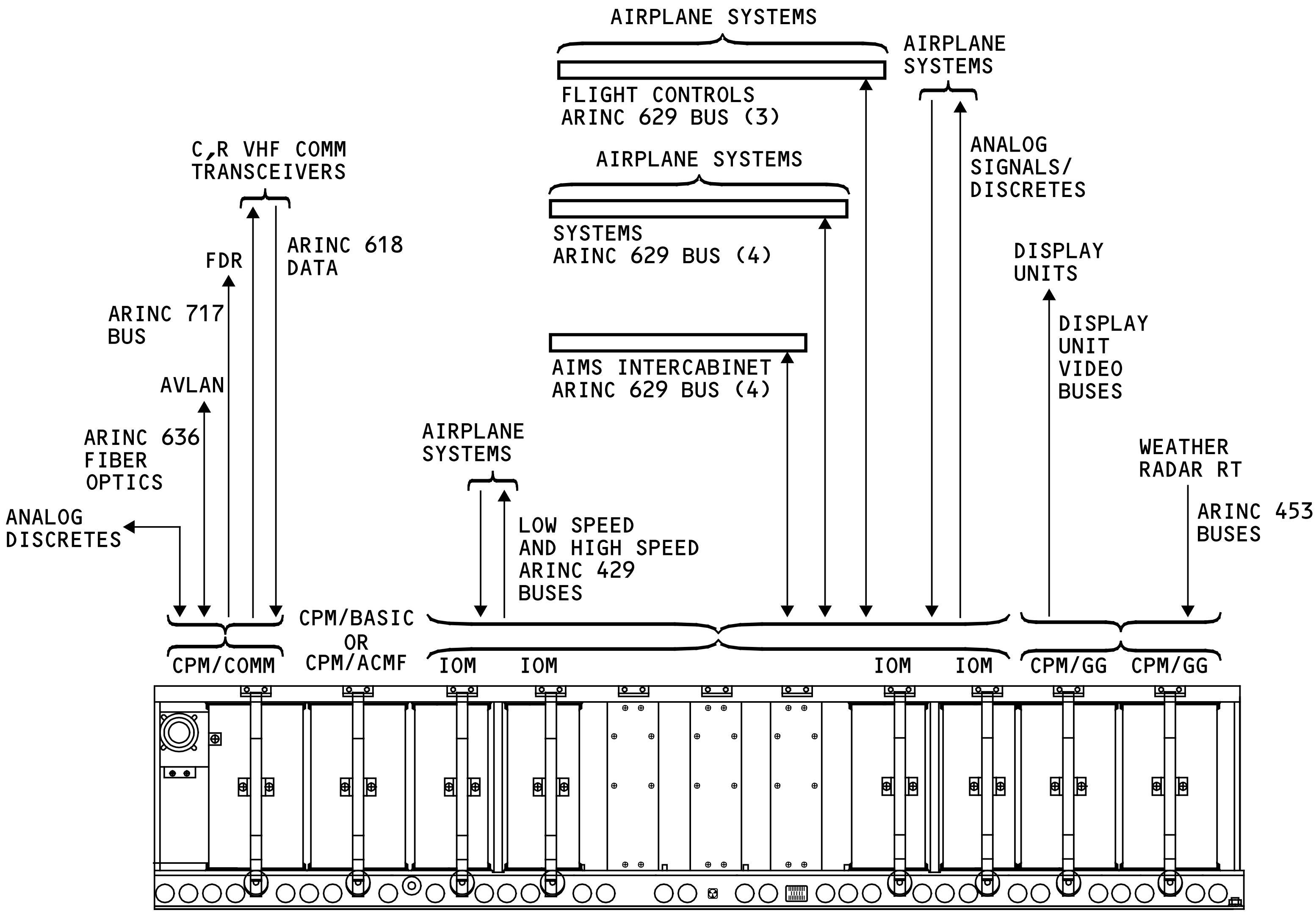
The AIMS has interface with all types of data communication formats. The two AIMS cabinets send data to and receive data from many:

- LRUs
- Sensors
- Switches
- Indicators.

These are the types of interfaces with the AIMS cabinets:

- Flight controls ARINC 629 buses (3)
- Systems ARINC 629 buses (4)
- AIMS intercabinet ARINC 629 buses (4)
- Low speed and high speed ARINC 429 data buses
- ARINC 453 buses
- ARINC 717 bus
- ARINC 618 data
- ARINC 636 Fiber optics
- Display units video buses
- Analog discretes
- Analogs.

The large quantity of interfaces lets the AIMS integrate information from a majority of the airplane systems.



AIMS - GENERAL DESCRIPTION - 3

AIMS - FLIGHT DECK COMPONENT LOCATIONS-1

Integrated Systems Component Locations

These are the integrated systems that have components in the flight deck:

- Primary display system (PDS)
- Data Communication management system (DCMS)
- Flight management computing system (FMCS)
- Thrust management computing system (TMCS).

These PDS components are on the P1, P2, and P3 panels:

- Left instrument source select panel (ISSP)
- Left outboard display unit (DU)
- Left inboard DU
- Captain display switching panel
- Center upper DU
- Right inboard DU
- Right outboard DU
- Right instrument source select panel (ISSP)
- First officer display switching panel.

These PDS components are on the P55 and P7 panels:

- Left EFIS control panel (CP)
- Display select panel (DSP)
- Right EFIS CP
- Left Remote Light Sensor (RLS)
- Right RLS.

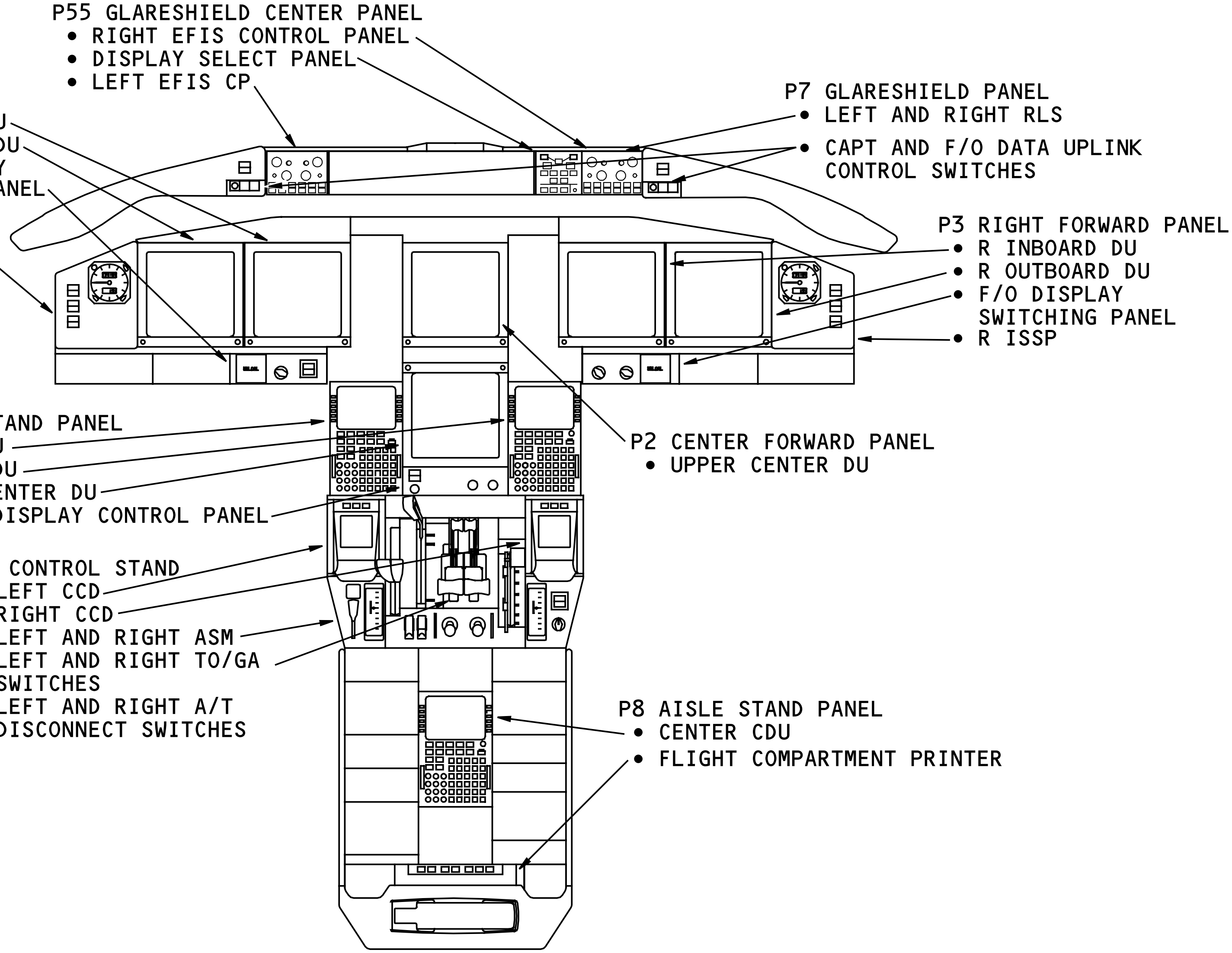
These PDS components are on the P9 and P10 panels:

- Lower center DU
- Center display control panel
- Left cursor control device (CCD)
- Right CCD.

The DCMS components on the P7 panel are the data uplink control switches. The DCMS controls the flight compartment printer on the P8 panel.

These FMCS and TMCS components are on the P8 and P10 panels:

- Left control display unit (CDU)
- Right CDU
- Center CDU
- Left autothrottle servo motor (ASM)
- Right ASM
- Left TO/GA switch
- Right TO/GA switch
- Left autothrottle disconnect switch
- Right autothrottle disconnect switch.



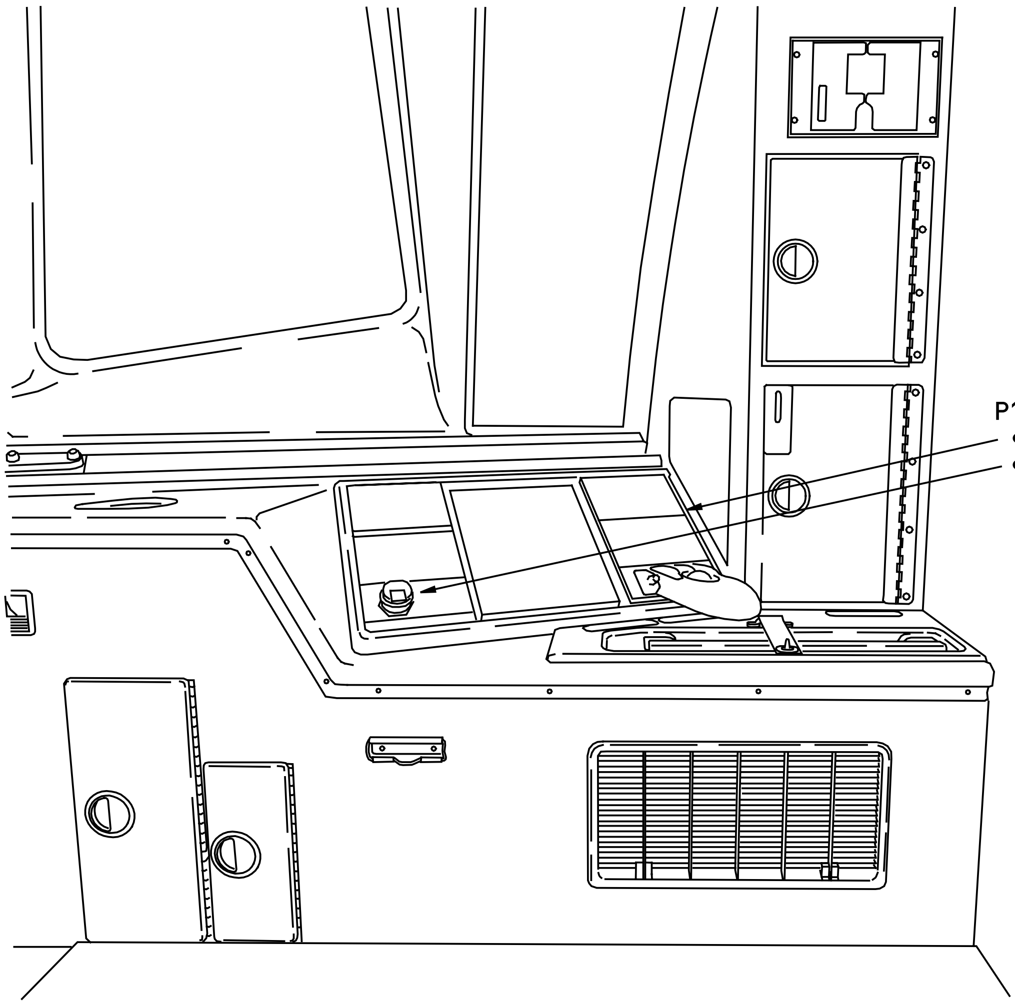
31-41-00-005 Rev 3

AIMS - FLIGHT DECK COMPONENT LOCATIONS-1

AIMS - FLIGHT DECK COMPONENT LOCATIONS - 2

Integrated System Component Locations

The CMCS maintenance access terminal (MAT) and a PMAT receptacle are on the P18 panel.



AIMS - FLIGHT DECK COMPONENT LOCATIONS - 2

31-41-00-037 Rev 2 05/30/96

AIMS - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

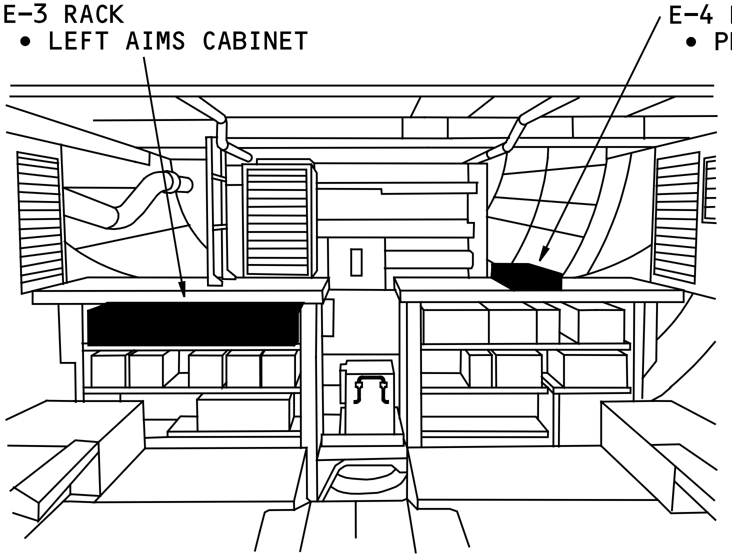
AIMS Components Locations

The AIMS components in the main equipment center (MEC) are the:

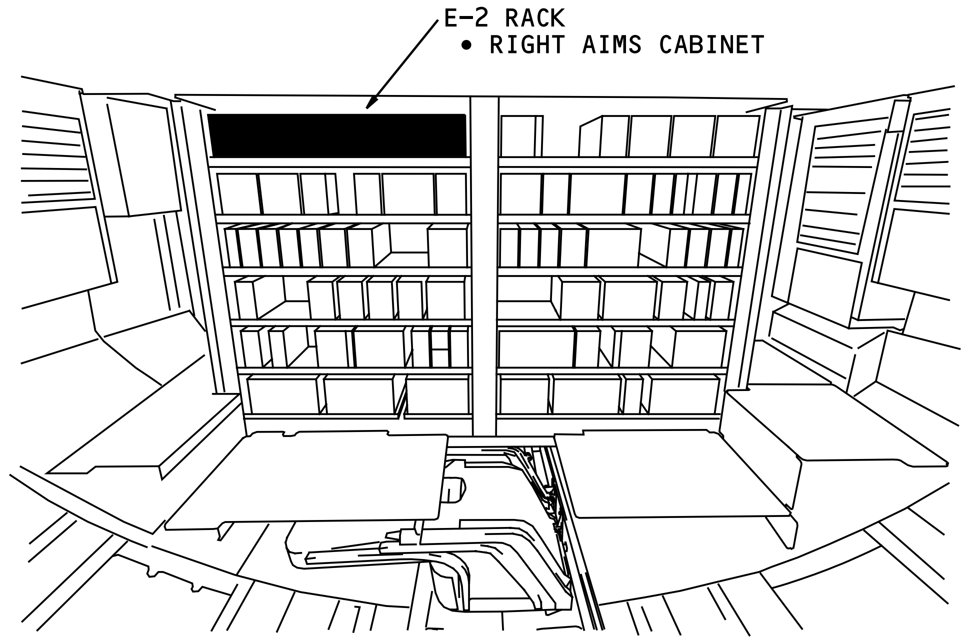
- Left AIMS cabinet
- Right AIMS cabinet.

Integrated Systems Components Locations

The CMCS component in the MEC is the portable maintenance access terminal (PMAT).



MAIN EQUIPMENT CENTER
(LOOKING FORWARD)



MAIN EQUIPMENT CENTER
(LOOKING AFT)

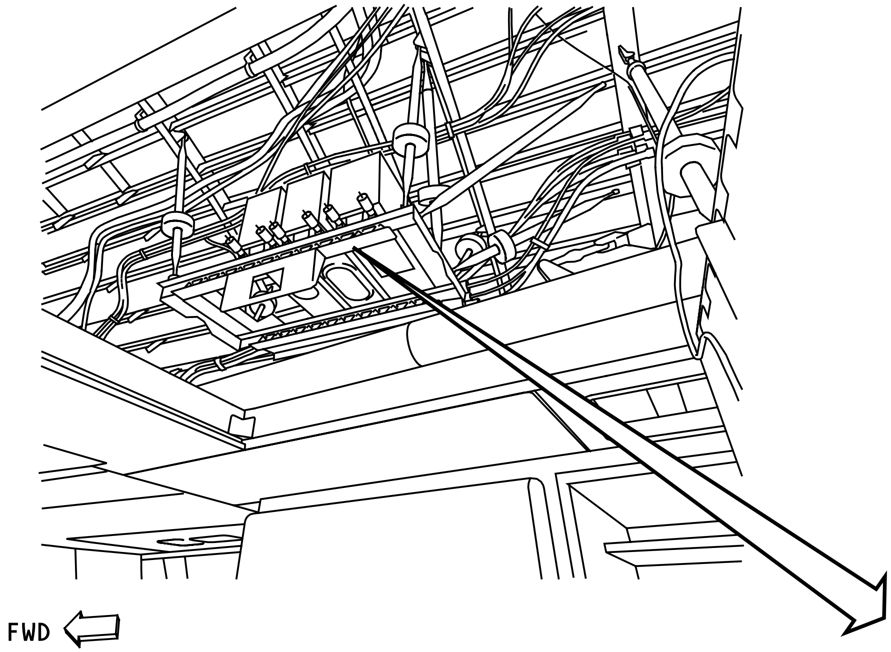
31-41-00-006 Rev 3 01/15/1997

AIMS - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

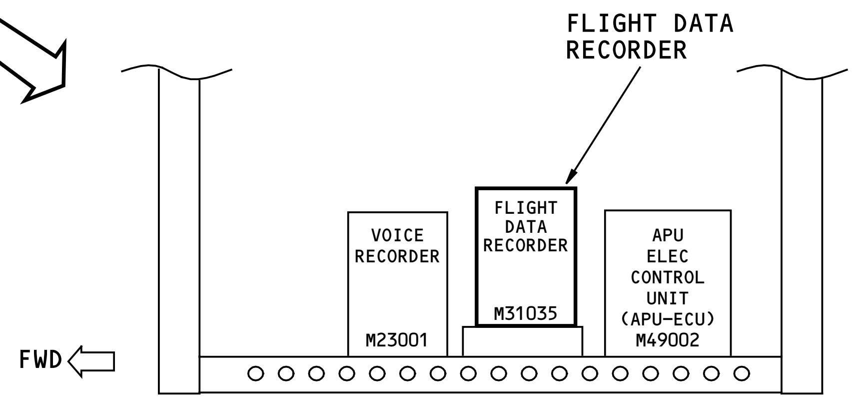
AIMS - MISCELLANEOUS RACKS COMPONENT LOCATIONS

Integrated System Component Locations

The FDRS component in the E7 rack is the flight data recorder (FDR).



OVERHEAD PASSENGER COMPARTMENT
(RIGHT SIDE LOOKING OUTBOARD)



E7 RACK

31-41-00-038 Rev 1

AIMS - MISCELLANEOUS RACKS COMPONENT LOCATIONS

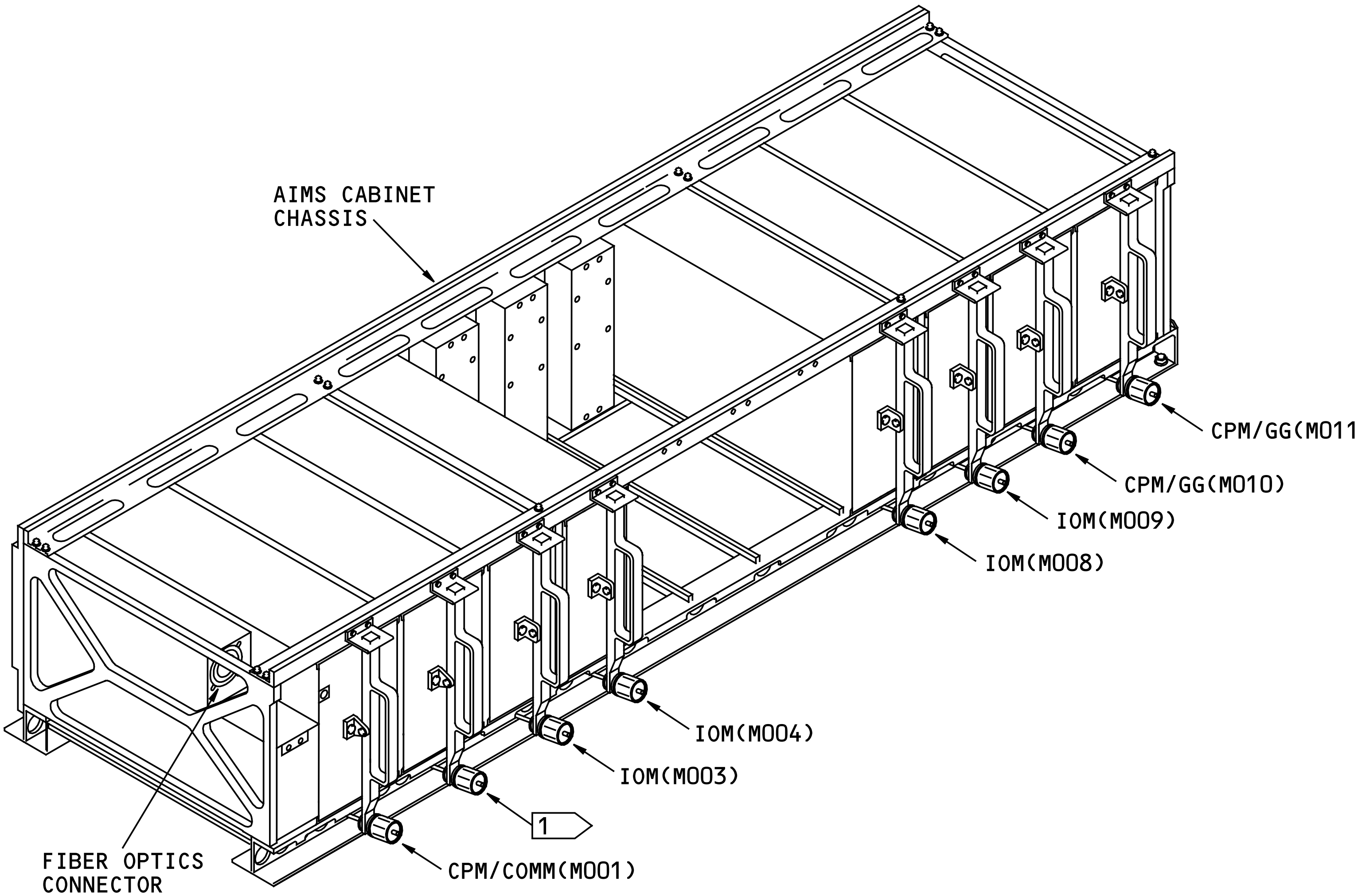
AIMS - AIMS CABINET COMPONENT LOCATIONS

AIMS Component Locations

An AIMS cabinet includes eight LRMs and an AIMS cabinet chassis. The left AIMS cabinet components are:

- Cabinet chassis
- Core processor module/communication (CPM/Comm)
- CPM/airplane condition monitoring function (CPM/ACMF)
- CPM/graphics generator (CPM/GG) (2)
- Input/output module (IOM) (4).

The right AIMS cabinet components are the same except there is a CPM/Basic in place of a CPM/ACMF.



1 CPM/ACMF(M002) IN THE LEFT CABINET
CPM/BASIC(M002) IN THE RIGHT CABINET

31-41-00-007 Rev 0

AIMS - AIMS CABINET COMPONENT LOCATIONS

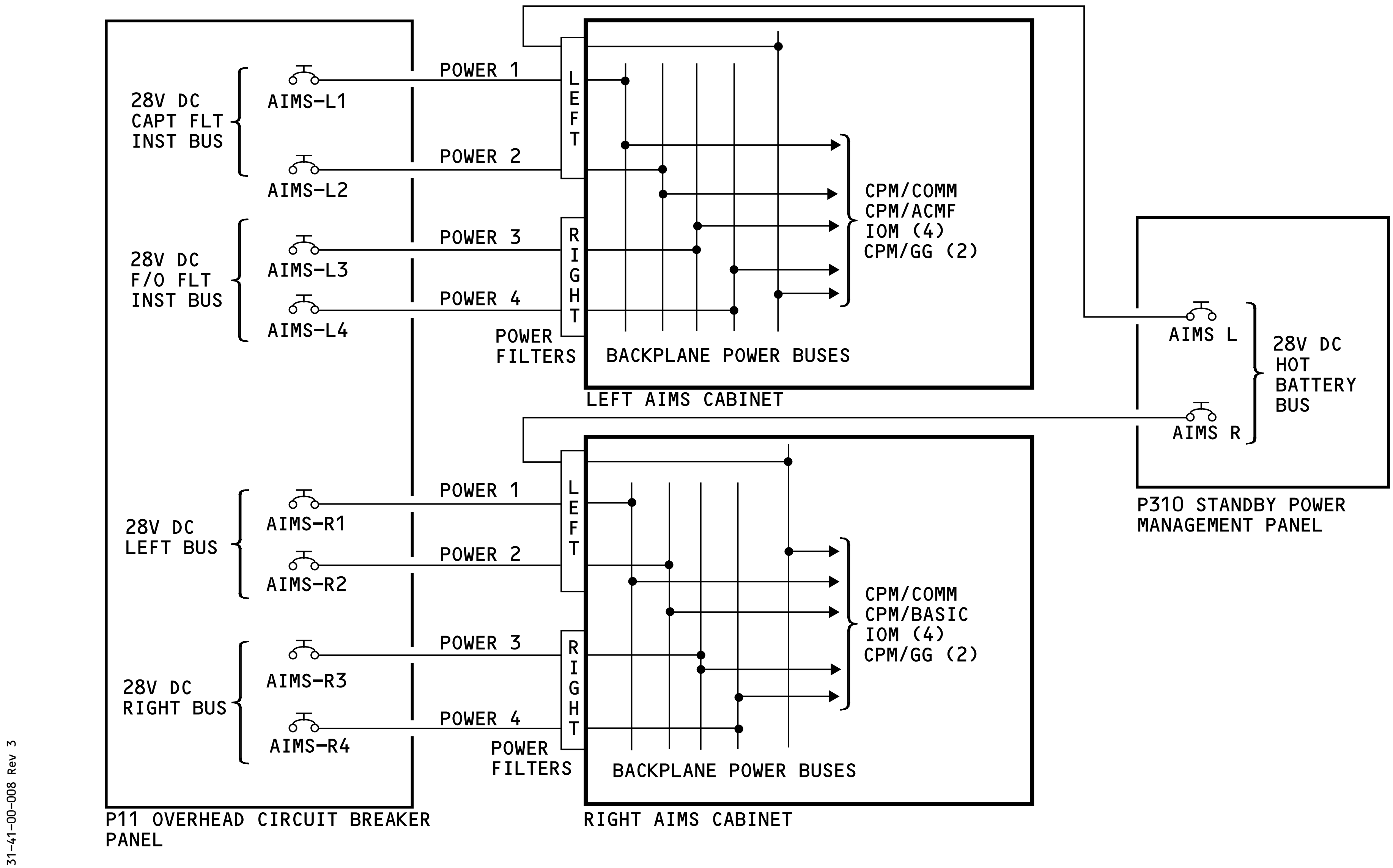
AIMS - INPUT POWER INTERFACES

General

Each AIMS cabinet receives power through four circuit breakers in the overhead circuit breaker panel. Each AIMS cabinet also receives power through one hot battery bus circuit breaker in the standby power management panel.

The left AIMS cabinet gets electrical power from the 28v dc capt flight instrument bus, the 28v dc f/o flight instrument bus, and the hot battery bus. The right AIMS cabinet gets electrical power from the 28v dc left bus, the 28v dc right bus and the hot battery bus.

The electrical power goes through a power filter on the back of the AIMS cabinet and then goes to the backplane power bus. The backplane power bus supplies power to the eight LRMs in the cabinet.



AIMS - INPUT POWER INTERFACES

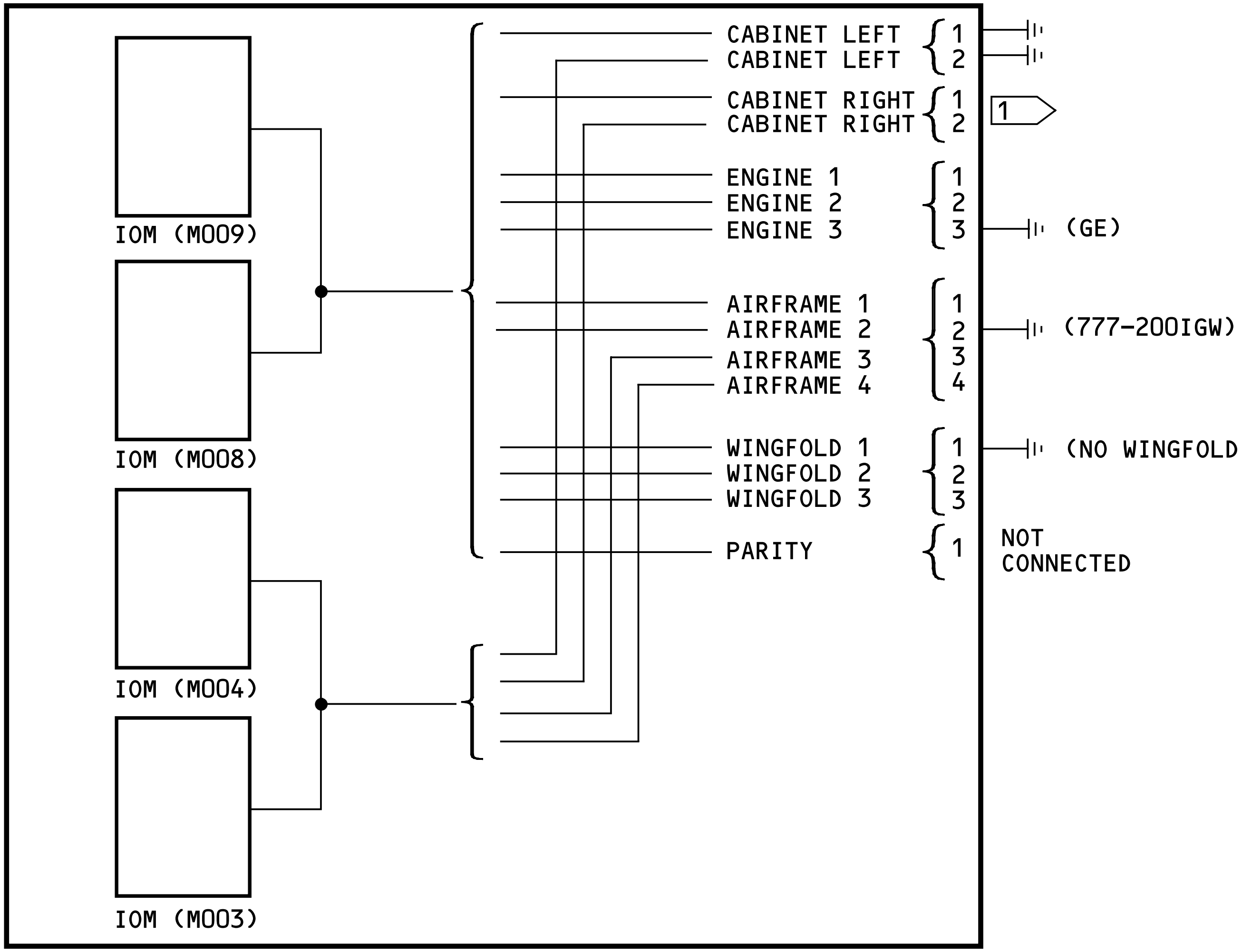
AIMS - CONFIGURATION PIN INTERFACES

Configuration Pins

The left and right AIMS cabinets have program pins that set the configuration of the:

- Cabinet position
- Engine manufacturer
- Airframe type
- Wingfold configuration
- Parity for the program pins.

The parity pin is grounded when an even number of program pins are grounded.



LEFT AIMS CABINET

1 THE RIGHT CABINET HAS THESE PINS GROUNDED AND THE LEFT CABINET PINS ARE NOT CONNECTED

AIMS - CONFIGURATION PIN INTERFACES

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AIMS - FLIGHT CONTROLS ARINC 629 BUSES INTERFACES

General

The AIMS cabinets receive data on all three of the flight controls ARINC 629 buses and transmit data on the left and right buses. The AIMS cabinets also transmit data on the center flight controls ARINC 629 bus when the airplane is on the ground. The AIMS cabinets transmit data loading information and maintenance data on the center flight controls ARINC 629 bus.

The LRUs that have an interface with the AIMS cabinets on the flight controls ARINC 629 buses are the:

- Air data inertial reference unit (ADIRU)
- Secondary attitude air data reference unit (SAARU)
- Air data module (ADM), static (3)
- Air data module (ADM), pitot (3)
- Primary flight computer (PFC) (3)
- Actuator control electronics (ACE) (4)
- Flight control power supply assembly (FCPSA) (3).

The control display units (CDUs) and the autopilot flight director computers (AFDCs) connect to the flight controls ARINC 629 buses. However, the CDUs and AFDCs do not communicate with the AIMS cabinets on the flight controls ARINC 629 buses.

ADIRU

The AIMS cabinets receive inertial reference data and air data from the ADIRU on the left and right flight controls ARINC 629 buses. The AIMS cabinets transmit data to the ADIRU on the left and right flight controls ARINC 629 buses.

SAARU

The AIMS cabinets receive inertial reference data and air data from the SAARU on the center flight controls ARINC 629 bus. The AIMS cabinets transmit data to the SAARU on the left and right flight controls ARINC 629 buses.

ADM

The AIMS cabinets receive static pressure and total pressure data from the six ADMs on the three flight controls ARINC 629 data buses. The AIMS cabinets transmit data to the six ADMs on the left and right flight controls ARINC 629 data buses.

PFC

The AIMS cabinets receive flight control position data from the left, right and center PFCs on the left, center and right flight controls ARINC 629 buses. The AIMS cabinets transmit data to each PFC on the left and right flight controls ARINC 629 buses.

ACE

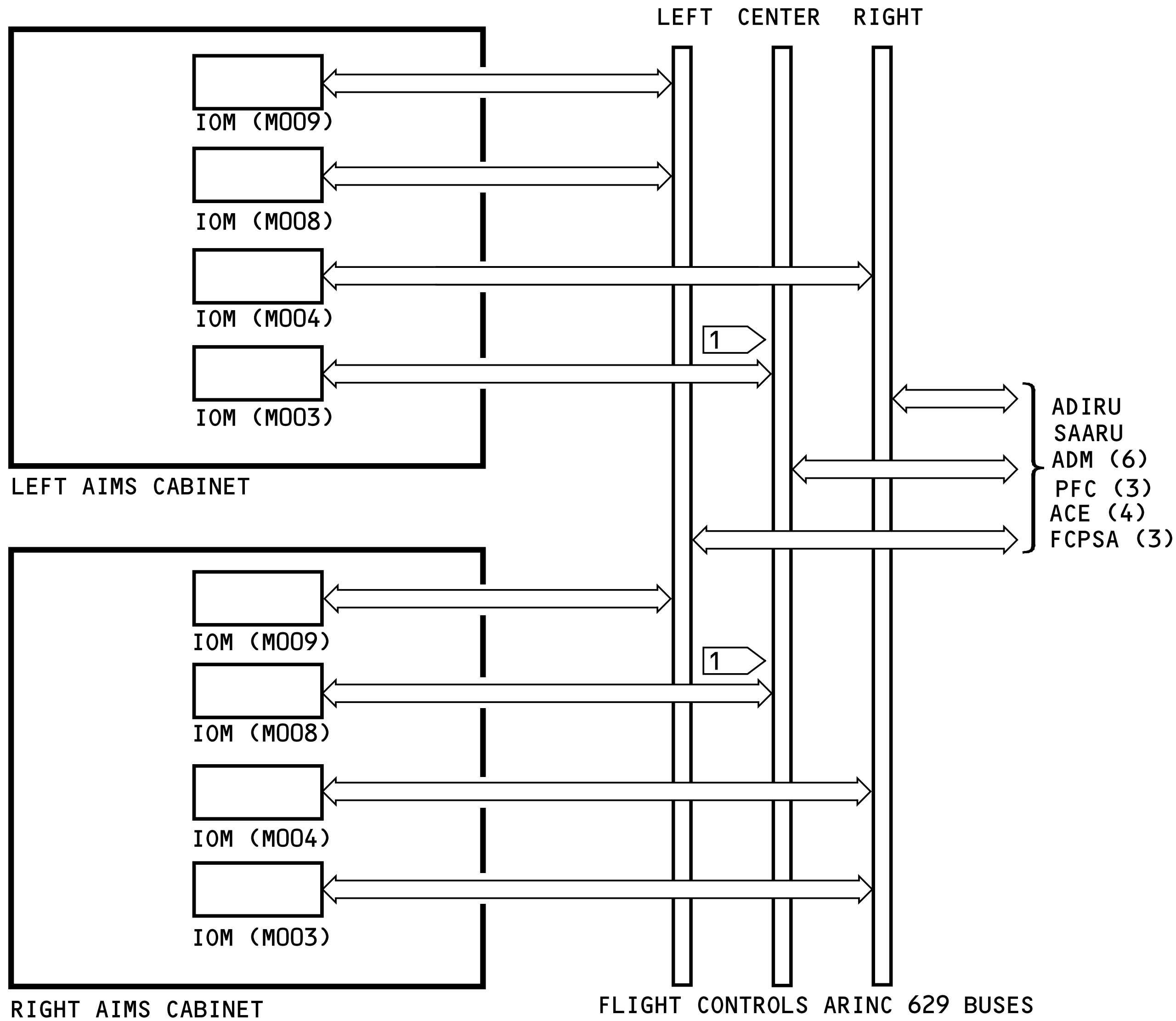
The AIMS cabinets receive power control unit data and position data from the four ACEs on the left, right, and center flight controls ARINC 629 buses. The AIMS

AIMS - FLIGHT CONTROLS ARINC 629 BUSES INTERFACES

cabinets do not transmit data to the ACEs. The AIMS cabinets receive ACE status data from the PFCs.

FCPSA

The AIMS cabinets receive voltage measurement data from the three FCPSAs on the three flight controls ARINC 629 buses. The AIMS cabinets transmit data to the FCPSAs on the left and right flight controls ARINC 629 buses.



1 THE AIMS CABINETS TRANSMIT TO THE CENTER FLIGHT CONTROLS ARINC 629 BUS ONLY WHEN THE AIRPLANE IS ON THE GROUND.

31-41-00-010 Rev 3 08/21/96

AIMS - FLIGHT CONTROLS ARINC 629 BUSES INTERFACES

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AIMS - SYSTEMS ARINC 629 BUSES INTERFACES

General

The AIMS cabinets receive and transmit data on all four of the systems ARINC 629 buses. These LRUs have an interface with the AIMS cabinets on the systems ARINC 629 buses:

- ARINC signal gateway card (ASG)
- Warning electronic unit (WEU)
- Backup generator converter (BU gen conv)
- Proximity sensor electronics unit (PSEU)
- Bus power control unit (BPCU)
- Generator control unit (GCU)
- ELMS power management panel (ELMS pwr mgmt pnl)
- Passenger address/cabin interphone controller (PA/CI CONT)
- Cabin system management unit (CSMU)
- Overhead panel bus controller (OPBC)
- Flap slat electronics unit (FSEU)
- Brake system control unit (BSCU)
- Brake temperature monitor unit (BTMU)
- Main gear steering control unit (MGSCU)
- Tire pressure monitor unit (TPMU)
- Cabin temperature controller (CTC)
- Air supply-cabin pressure controller (ASCPC)
- Airborne vibration monitor signal conditioner (AVM signal conditioner)
- Engine data interface unit (EDIU)
- APU controller
- Fuel quantity processor unit (FQPU)
- Audio management unit (AMU)
- Control display unit (CDU)
- Autopilot flight director computer (AFDC).

ASG Card- System CardFile

A left and right system cardfile integrate many systems cards. The systems cardfiles have many data inputs and outputs. The left and right system cardfiles communicate on the left and right systems ARINC 629 buses.

Both systems cardfiles have two ARINC signal gateway (ASG) cards. One ASG card in each cardfile connects to the left ARINC 629 bus and one card in each cardfile connects to the right ARINC bus.

The other cards in the systems cardfiles are the:

- Engine fire detection card (2)
- Engine overheat detection card (2)
- APU fire detection card
- Airfoil and cowl ice protection system card (3)
- ECS card (2)
- HYDIM card (4)
- Weight on wheels (WOW) card (2)
- Duct leak overheat detection card (3)
- Cardfile power supply unit, monitor card (4).

The AIMS cabinets receive fire detection and fire handle position data from the:

- Left engine fire detection card
- Right engine fire detection card
- APU fire detection card.

AIMS - SYSTEMS ARINC 629 BUSES INTERFACES

The AIMS cabinets receive overheat detection data from the left engine overheat detection card and right engine overheat detection card.

The AIMS cabinets receive duct leak data from the left, right and center duct leak overheat detection cards.

The AIMS cabinets receive environmental system status data from the left and right ECS cards.

The AIMS cabinets receive hydraulic system status data from the HYDIM cards in each cardfile.

The AIMS cabinets receive weight on wheels data from the left and right WOW cards.

The AIMS cabinets receive wing and cowl TAI data, and ice detector status from the left, right and center airfoil and cowl ice protection system cards.

The AIMS cabinets receive cardfile power-supply-unit cards status-data from the monitor card in each of the cardfile power supply units. There are 2 cardfile power supply units in each of the systems cardfiles.

<u>WEU</u>

The AIMS cabinets receive warning system data from the left and right WEUs on the left, right and center 1 systems ARINC 629 buses. The left WEU communicates on the left and center 1 buses and the right WEU communicates on the right and center 1 buses.

The AIMS cabinets transmit data to the WEUs on the left, right and center 1 systems ARINC 629 buses.

<u>BU Generator Converter</u>

The AIMS cabinets receive backup electrical power system data from the BU generator convertor on the left and right systems ARINC 629 buses.

The AIMS cabinets transmit data to the BU generator convertor on the left and right systems ARINC 629 buses.

<u>PSEU</u>

The AIMS cabinets receive proximity sensor data from the left and right PSEUs on the left and right systems ARINC 629 buses.

The AIMS cabinets transmit data to each PSEU on the left and right systems ARINC 629 buses.

<u>BPCU</u>

The AIMS cabinets receive electrical power system data from the BPCU on the left and right systems ARINC 629 buses.

The AIMS cabinets transmit data to the BPCU on the left and right systems ARINC 629 buses.

AIMS - SYSTEMS ARINC 629 BUSES INTERFACES

GCU

The AIMS cabinets receive electrical power system data from the left GCU, right GCU and APU GCU on the left and right systems ARINC 629 buses.

The AIMS cabinets transmit data to the GCUs on the left and right systems ARINC 629 buses.

ELMS

The AIMS cabinets receive electrical power system data from the ELMS left power management panel, right power management panel, and standby power management panel on the left and right systems ARINC 629 buses.

The AIMS cabinets transmit data to the ELMS power management panels on the left and right systems ARINC 629 buses.

PA/CI CONT

The AIMS cabinets receive PA/CI CONT status data from the PA/CI CONT on the left systems ARINC 629 bus.

The AIMS cabinets transmit data to the PA/CI CONT on the left systems ARINC 629 bus.

CSMU

The AIMS cabinets receive cabin management system status data from the CSMU on the right systems ARINC 629 bus.

The AIMS cabinets transmit data to the CSMU on the right systems ARINC 629 bus.

OPBC

The AIMS cabinets receive switch position data from the overhead panel switches and other flight deck switches via the left and right OPBC on the left and right systems ARINC 629 buses.

The AIMS cabinets transmit flight deck indicator states data to the OPBCs on the left and right systems ARINC 629 buses.

FSEU

The AIMS cabinets receive flap position data and slat position data from the left and right FSEU on the left, right and center 1 systems ARINC 629 buses.

The left FSEU has two interfaces on the left bus and two interfaces on the center 1 bus. The right FSEU has two interfaces on the right bus and two interfaces on the center 1 bus.

The AIMS cabinets transmit data to the left and right FSEU on the left, right and center 1 systems ARINC 629 buses.

AIMS - SYSTEMS ARINC 629 BUSES INTERFACES

BSCU

The AIMS cabinets receive brake system control data, from the BSCU on the left and right systems ARINC 629 buses.

The AIMS cabinets transmit data to the BSCU on the left and right systems ARINC 629 buses.

BTMU

The AIMS cabinets receive brake temperature data from the BTMU on the left systems ARINC 629 bus.

The AIMS cabinets transmit data to the BTMU on the left systems ARINC 629 bus.

MGSCU

The AIMS cabinets receive aft axle steering locked status from the MGSCU on the left systems ARINC 629 bus.

The AIMS cabinets transmit data to the MGSCU on the left systems ARINC 629 bus.

TPMU

The AIMS cabinets receive tire pressure data from the TPMU on the left systems ARINC 629 bus.

The AIMS cabinets transmit data to the TPMU on the left systems ARINC 629 bus.

CTC

The AIMS cabinets receive air conditioning data and system status data from the left and right CTCs on the left and right systems ARINC 629 buses.

The AIMS cabinets transmit data to the CTCs on the left and right systems ARINC 629 buses.

ASCPC

The AIMS cabinets receive air supply data and cabin pressure data from the left and right ASCPCs on the left and right systems ARINC 629 buses.

The AIMS cabinets transmit data to the ASCPCs on the left and right systems ARINC 629 buses.

AVM Signal Conditioner

The AIMS cabinets receive engine vibration data and system status message data from the left and right AVM signal conditioners on the left and right systems ARINC 629 buses.

The AIMS cabinets transmit data to the AVM signal conditioners on the left and right systems ARINC 629 buses.

EDIU

The EDIUs receive ARINC 429 data from the A and B channels of the left and right electronic engine controls (EECs). The EDIUs convert the data to an ARINC 629 format. The left and right EDIUs transmit the ARINC 629 formatted data to the AIMS cabinets.

The AIMS cabinets receive engine data and system status message data from the channel A, the channel B, and the channel C EDIU interface cards in each EDIU. The EDIU channel interface cards and the systems ARINC 629 buses that connect to each are as follows:

- Channel A - left EDIU, left and C1 buses
- Channel B - left EDIU, left and C2 buses
- Channel C - left EDIU, C1 and C2 buses
- Channel A - right EDIU, right and C2 buses
- Channel B - right EDIU, right and C1 buses
- Channel C - right EDIU, C1 and C2 buses.

The AIMS cabinets transmit data to the channel A, the channel B, and the channel C EDIU interface cards, in each EDIU.

The AIMS cabinets transmit data to the EDIUs on the same systems ARINC 629 buses that they receive data from. The EDIUs then transmit the data received from the AIMS cabinets to the left and right EECs.

APU Controller

The AIMS cabinets receive APU data from the APUC controller on the left and right systems ARINC 629 buses.

The AIMS cabinets transmit data to the APU controller on the left and right systems ARINC 629 buses.

FQPU

The AIMS cabinets receive fuel data and system status data from the FQPU on the left and right systems ARINC 629 buses.

The AIMS cabinets transmit data to the FQPU on the left and right systems ARINC 629 buses.

AMU

The AIMS cabinets receive digital audio system status data from the AMU on the left systems ARINC 629 bus.

The AIMS cabinets transmit data to the AMU on the left systems ARINC 629 bus.

CDU

The AIMS cabinets receive keyboard selection data and map data from the left, right and center CDUs on the left and right systems ARINC 629 buses.

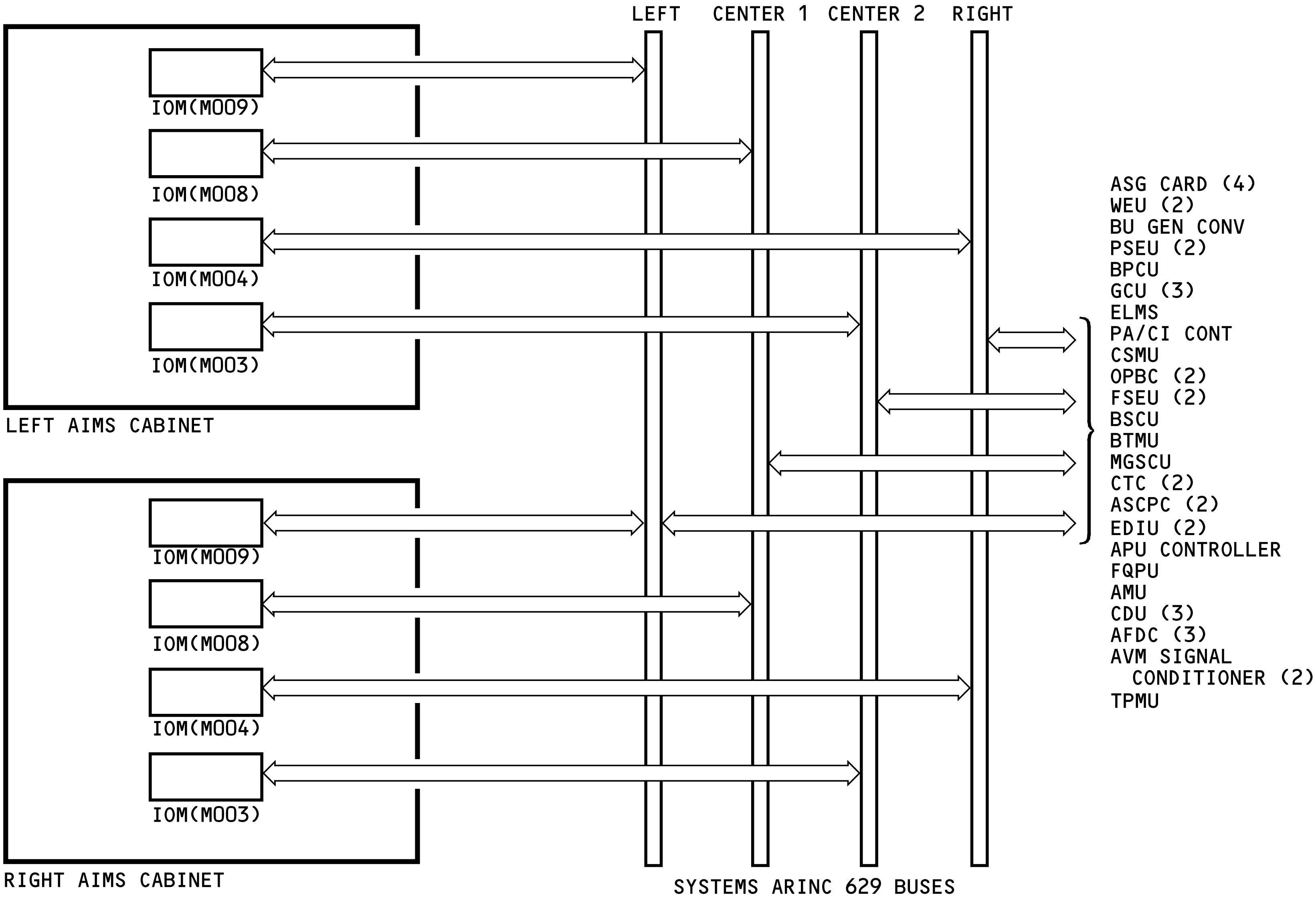
The AIMS cabinets transmit data to the CDUs on the left and right systems ARINC 629 buses.

AIMS - SYSTEMS ARINC 629 BUSES INTERFACES

AFDC

The AIMS cabinets receive autopilot status and guidance data from the left, right and center AFDCs on the left, right and center 1 systems ARINC 629 data buses.

The AIMS cabinets transmit data to the AFDCs on the left, right and center 1 systems ARINC 629 buses.



31-41-00-011 Rev 5

AIMS - SYSTEMS ARINC 629 BUSES INTERFACES

AIMS - AIMS INTERCABINET ARINC 629 BUSES INTERFACES

General

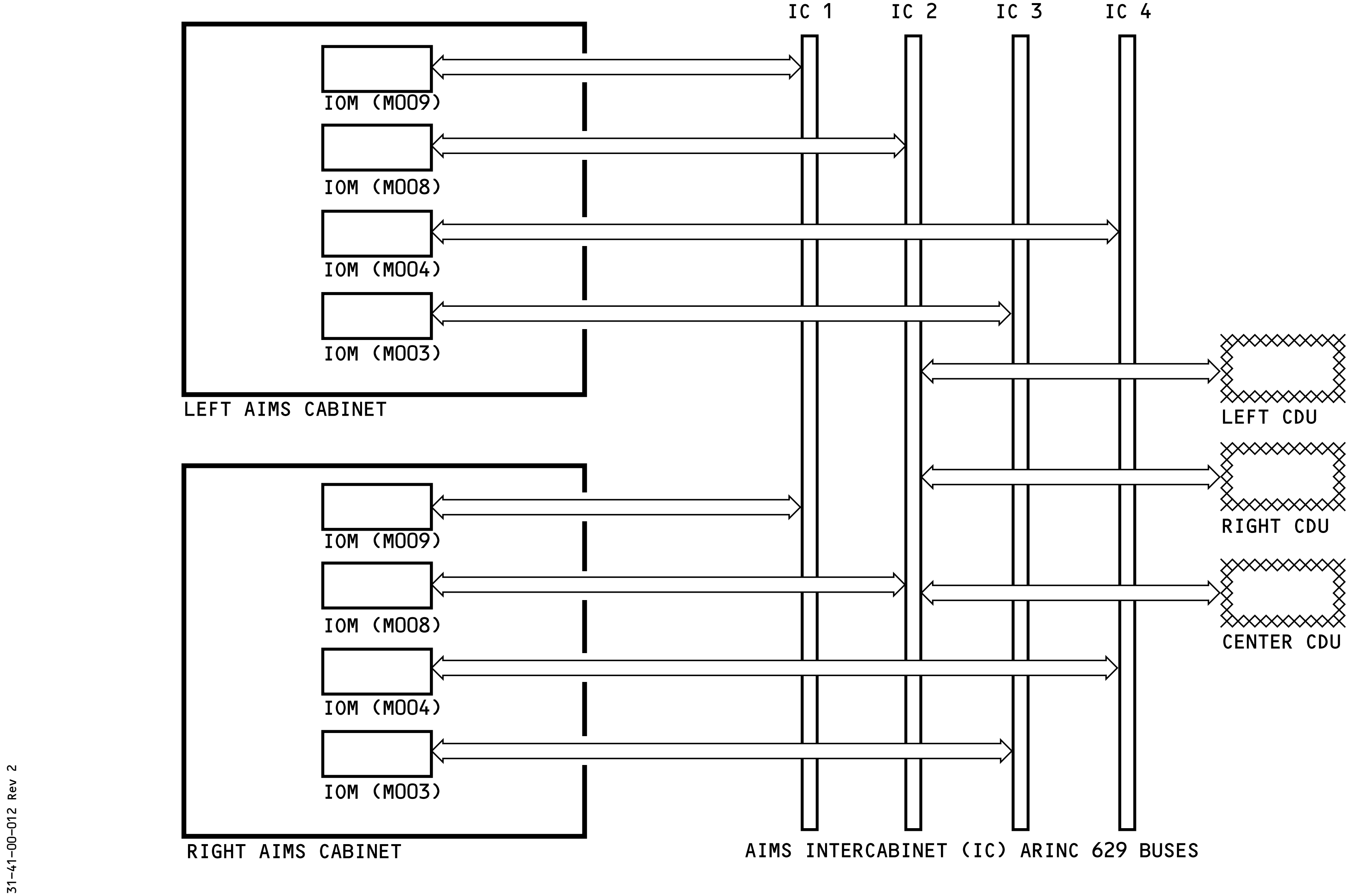
The left and right AIMS cabinets transmit and receive data on all four of the AIMS intercabinet (IC) buses. The CDUs communicate with the AIMS cabinets on the AIMS intercabinet (IC) 2 bus.

AIMS Cabinets

Data that goes between the two AIMS cabinets includes intra-function active-nonactive data and inter-function communication data.

CDU

If the systems ARINC 629 buses fail, the CDUs use the AIMS IC 2 bus. The AIMS cabinets receive keyboard selection data and map data from the left, right and center CDUs on the IC 2 bus.



AIMS - AIMS INTERCABINET ARINC 629 BUSES INTERFACES

AIMS - ARINC 429 INPUTS INTERFACES

General

These are the four ways the ARINC 429 input buses go to the input/output modules:

- ARINC 429 bus goes directly to one IOM
- ARINC 429 bus goes to two IOMs in the same AIMS cabinet
- ARINC 429 bus goes to one IOM in each AIMS cabinet.
- ARINC 429 bus goes to two IOMs in each AIMS cabinets.

More critical systems usually send their data to more that one IOM.

The ARINC 429 buses may be either low speed or high speed buses.

ARINC 429 inputs

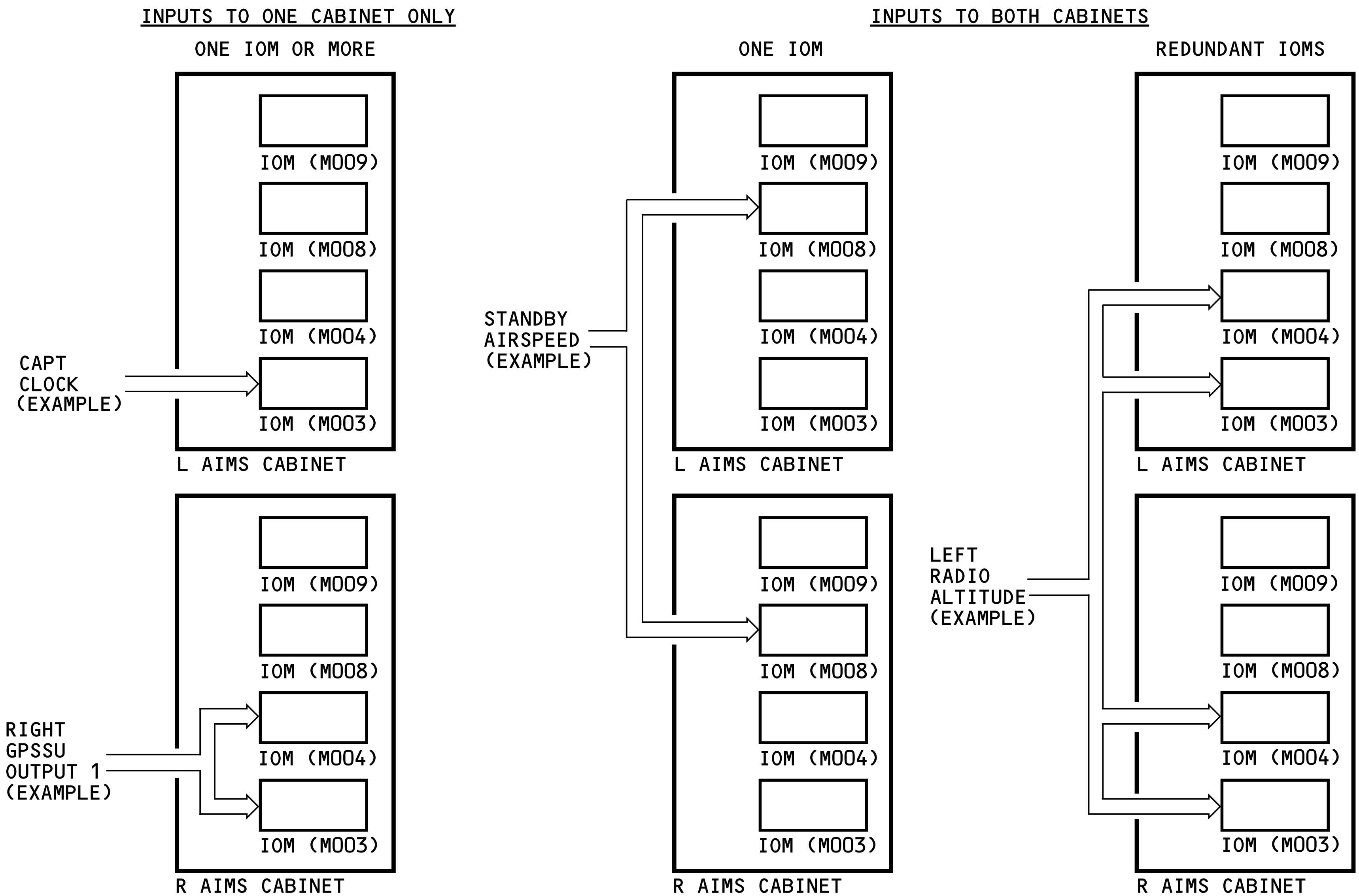
These LRUs send data to the AIMS cabinet on ARINC 429 buses:

- Autothrottle servo motors
- Mode control panel
- VHF communication transcievers
- HF communication transceivers
- Radio tuning panels
- Satellite data unit
- Clocks
- Cursor control devices (Capt and F/O)
- Display units
- EFIS control Panels
- Window heat control units
- Radio altimeter transcievers
- Weather radar receiver/transceivers
- TCAS computers
- ILS receivers
- VOR/MB receivers
- ADF receivers
- DME interrogators
- Global position system sensor units
- Cabin telecommunications unit
- Standby airspeed indication
- Standby altimeter
- Ground proximity warning computer
- Air traffic control mode S transponders.

Some of these LRUs have more than one ARINC 429 bus that go to the AIMS cabinet. Each bus sends different types of data.

Training Information Point

For details on the exact interfaces between the LRUs and the IOMs, refer to the wiring diagram manual.



AIMS - ARINC 429 INPUTS INTERFACES

31-41-00-013 Rev 3 04/29/95

AIMS - ARINC 429 OUTPUTS INTERFACES

General

The left and right AIMS cabinets transmit low speed and high speed ARINC 429 outputs in these three ways:

- There is a direct output
- There are two IOM sources in the same AIMS cabinet. A relay controls the output from one source.
- There is one IOM source in each AIMS cabinet. A relay controls the output from one source.

The different AIMS functions control the relays. For example, the FMCF controls the center nav tuning bus.

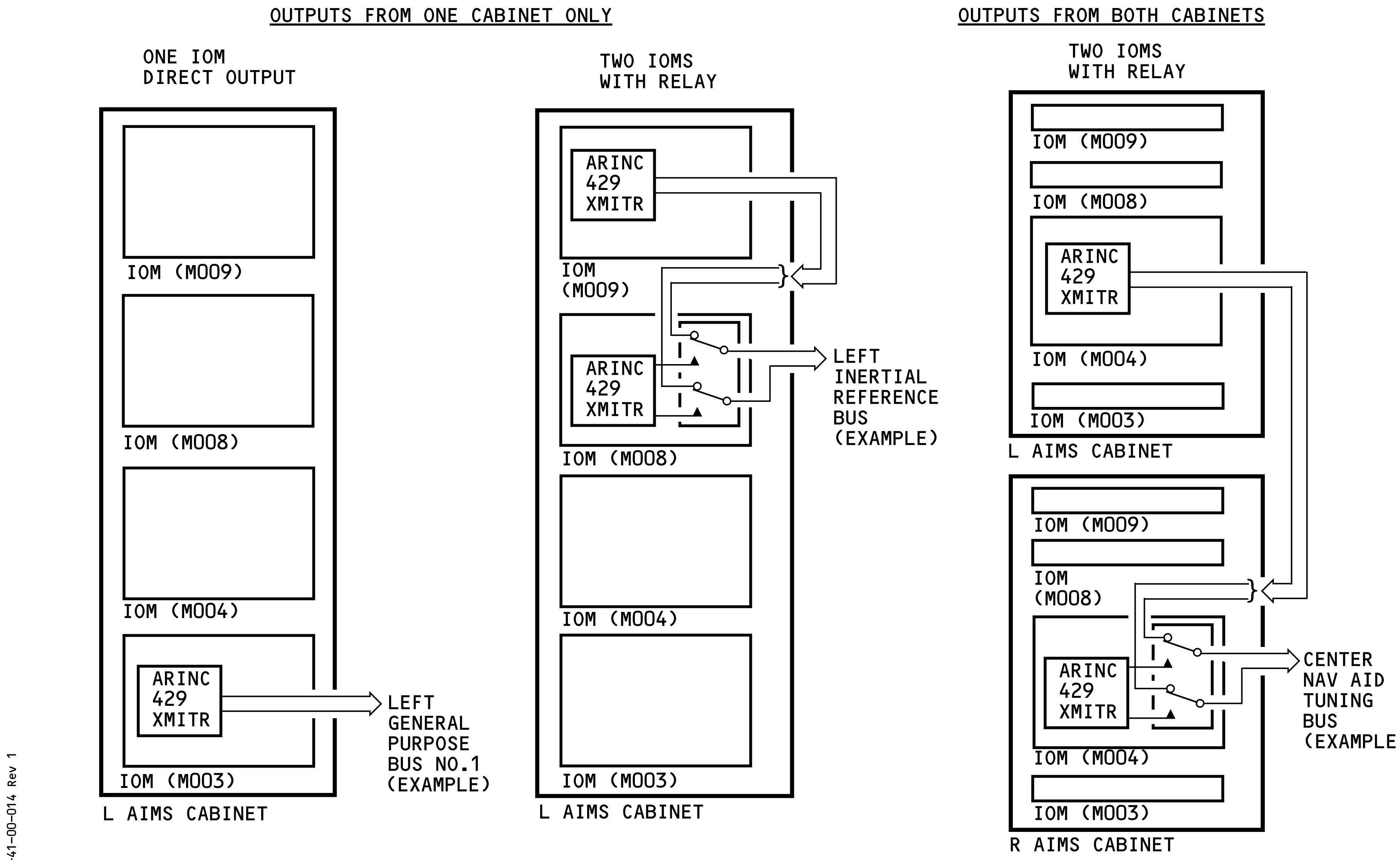
ARINC 429 outputs

There are eighteen 429 output buses. Each 429 bus transmits different types of data. These are the ARINC 429 output buses:

- Left general purpose bus #1
- Right general purpose bus #1
- Left general purpose bus #2
- Right general purpose bus #2
- Left general purpose bus #3
- Right general purpose bus #3
- Left DCMF data bus
- Right DCMF data bus
- Left inertial reference bus
- Right inertial reference bus
- Center nav tuning bus
- Left nav tuning bus
- Right nav tuning bus
- Center CMCF bus
- Left CMCF bus
- Right CMCF bus
- Left data load bus
- Right data load bus.

Training Information Point

For details on the exact interfaces between the IOMs and the LRUs, refer to the wiring diagram manual.



AIMS - ARINC 429 OUTPUTS INTERFACES

AIMS - ARINC 717 BUS INTERFACES

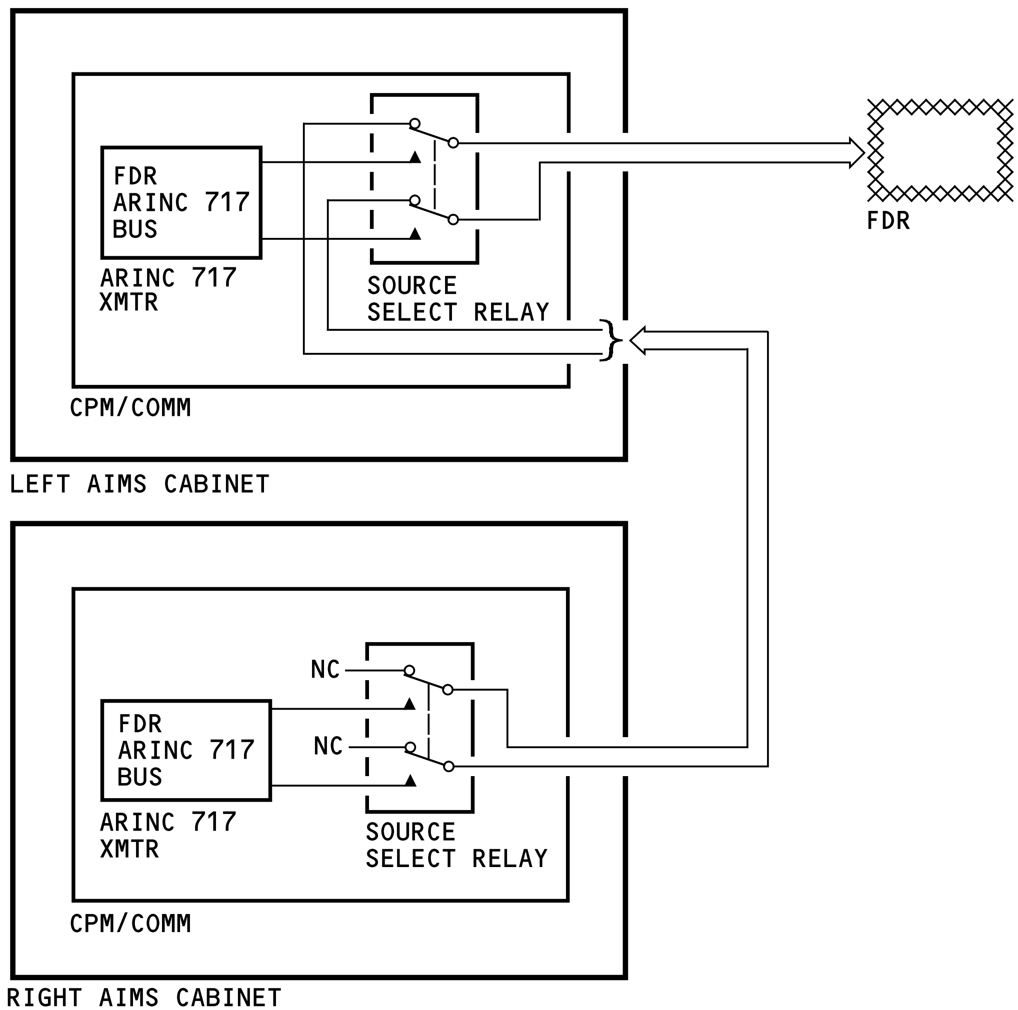
General

The CPM/Comm in the left and right AIMS cabinets supplies an ARINC 717 bus interface to the flight data recorder (FDR).

FDR ARINC 717 Buses

The CPM/Comm sends data to the flight data recorder (FDR) on an ARINC 717 bus. Each of the AIMS cabinets has an ARINC 717 transmitter and an ARINC 717 output bus for the FDR. The ARINC 717 transmitter receives data from the DFDAF and sends the data to the FDR.

The FDR ARINC 717 output from the right AIMS cabinet goes to a relay in the left AIMS cabinet. The relay sends the output from the left AIMS cabinet ARINC 717 transmitter or the right AIMS cabinet ARINC 717 transmitter to the FDR. The DFDAF in the left AIMS cabinet controls the state of the source select relay.



31-41-00-015 Rev 2

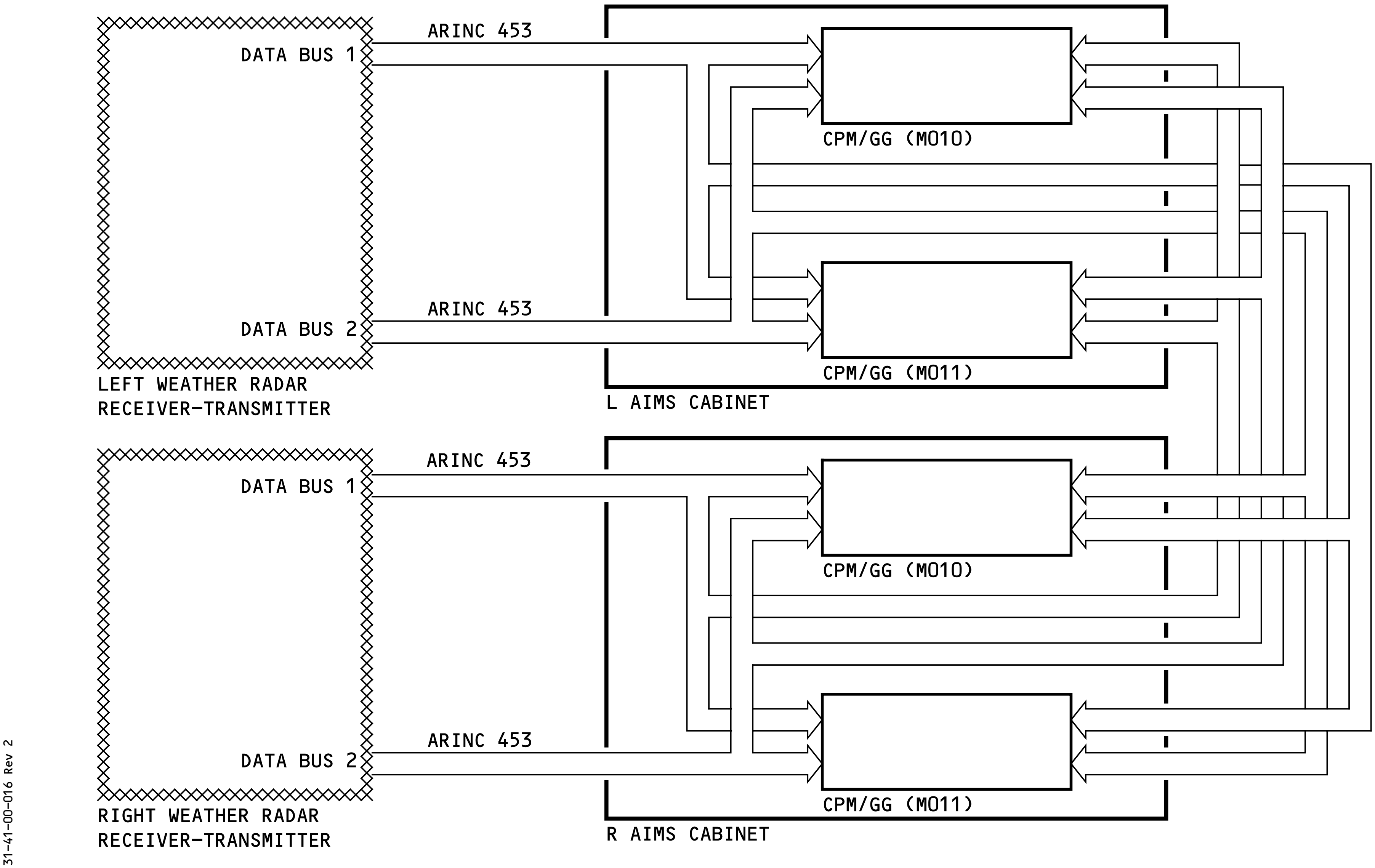
AIMS - ARINC 717 BUS INTERFACES

AIMS - WEATHER RADAR BUSES ARINC 453 INTERFACES

ARINC 453 Buses

The left and right weather radar receiver-transmitters (WXR RT) send weather data to both AIMS cabinets on high speed ARINC 453 buses. Each WXR RT transmits the data over two ARINC 453 buses. Each AIMS cabinet also sends the ARINC 453 weather radar bus inputs to the other AIMS cabinet.

Two load resistors terminate the ARINC 453 weather radar bus inputs at the rear connector in each AIMS cabinet.



AIMS - WEATHER RADAR BUSES ARINC 453 INTERFACES

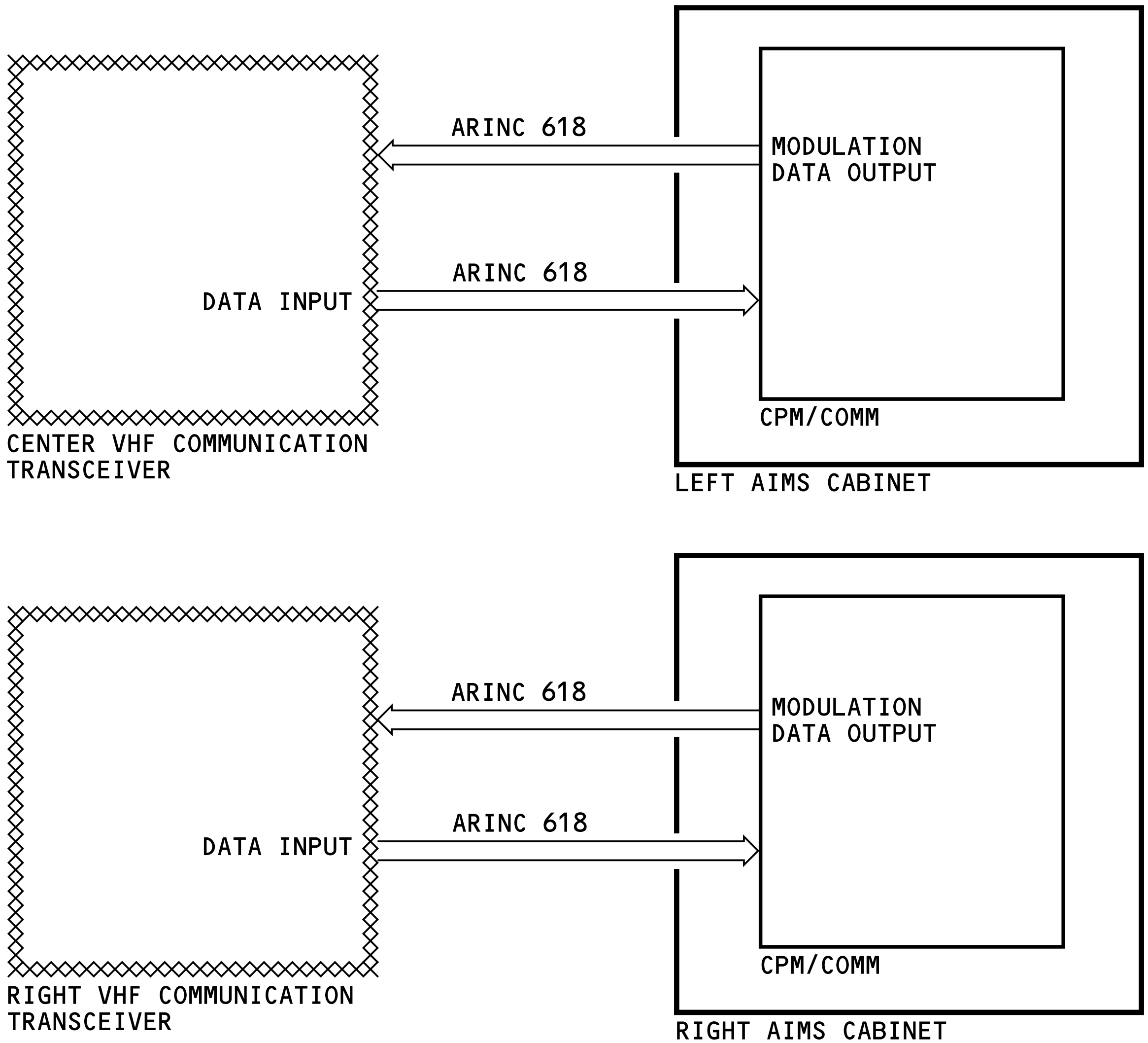
AIMS - DATALINK ARINC 618 INTERFACES

ARINC 618

Each AIMS cabinet receives uplink ARINC 618 signals from its VHF communication transceiver.

Each AIMS cabinet transmits downlink ARINC 618 signals to its VHF communication transceiver.

The CPM/Comm in each AIMS cabinet has a modem interface to receive and transmit the signals.



31-41-00-017 Rev 2 04/26/95

AIMS - DATALINK ARINC 618 INTERFACES

AIMS - AVIONICS LOCAL AREA NETWORK ARINC 636 INTERFACES

Avionics Local Area Network

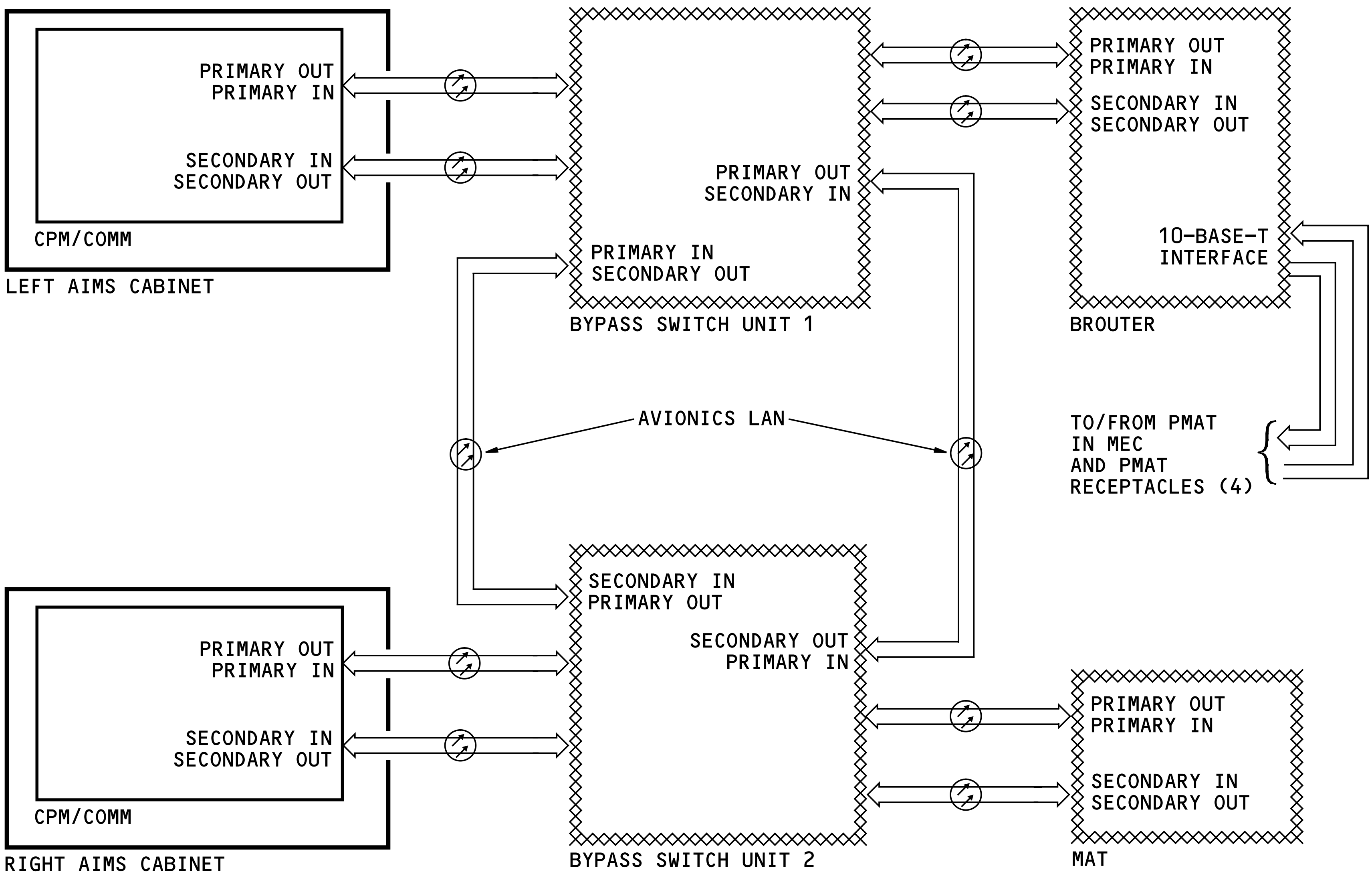
The CPM/Comm in both AIMS cabinets has the fiber optics interface that supplies the connections to an avionics local area network (AVLAN). The AVLAN supplies a high speed communication path to the:

- Maintenance access terminal (MAT)
- Portable maintenance access terminal (PMAT)
- Four portable maintenance access terminal (PMAT) receptacles.

The AVLAN connects the AIMS cabinets to the MAT and a brouter through a bypass switch unit. The brouter supplies the connection to the PMAT and PMAT receptacles with a ten base T bus.

The DCMF in the CPM/Comm has the communication protocols that permit the AIMS functions to communicate with the AVLAN.

The CMCF and ACMF send their data to the DCMF to be formatted with the correct data format. The DCMF then transmits this data on the AVLAN.



31-41-00-018 Rev 3 05/30/96

AIMS - AVIONICS LOCAL AREA NETWORK ARINC 636 INTERFACES

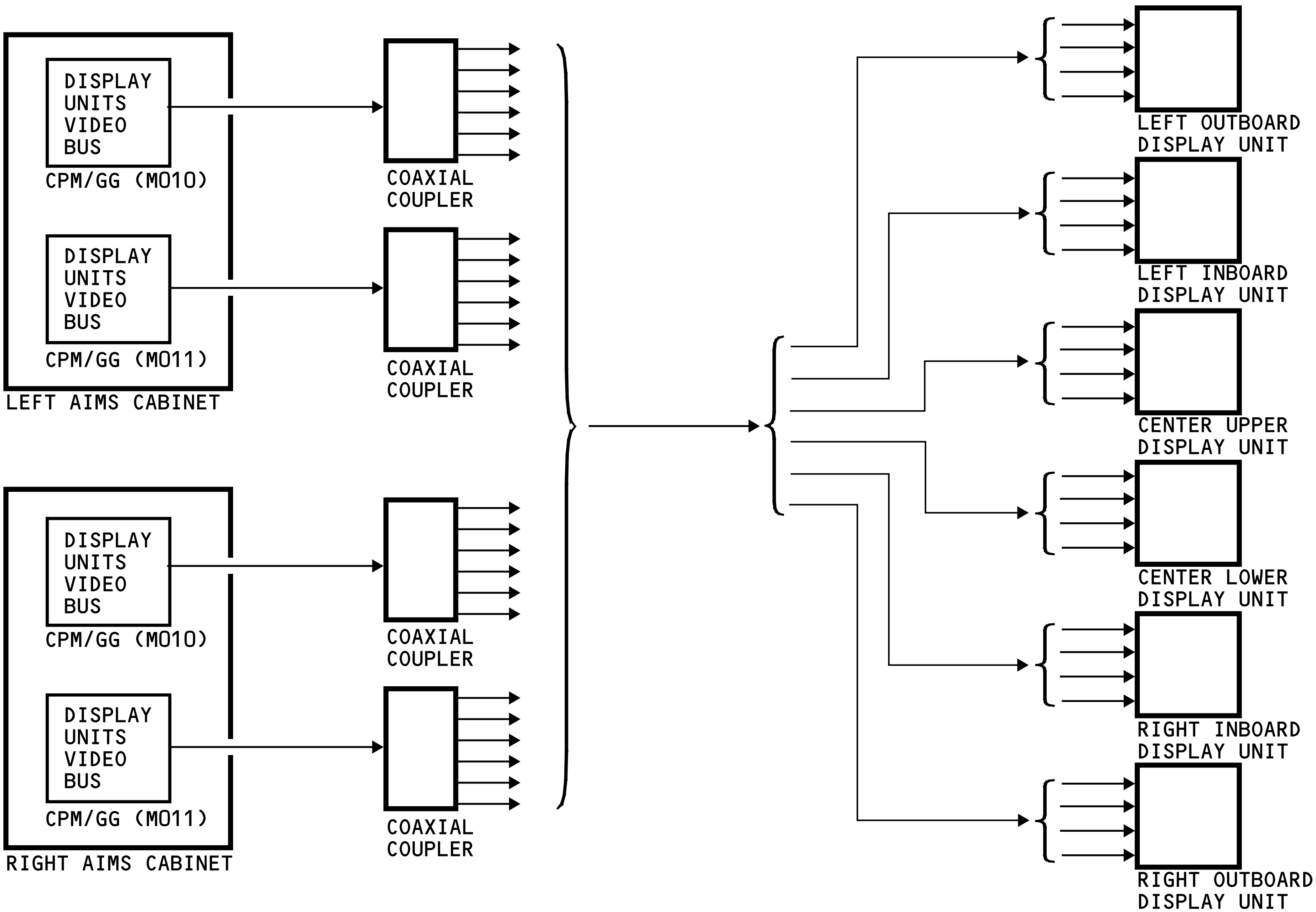
EFFECTIVITY
WB371

AIMS - DISPLAY UNITS VIDEO BUSES INTERFACES

Display Units Video Buses

The two core processor module/graphics generators (CPM/GG) in both AIMS cabinets transmit video signals to the six display units. Each CPM/GG transmits on a dedicated display units video bus.

The display units video buses are coaxial cables that transfer high speed digitized compressed video signals. Each of the video buses is split by a coaxial coupler into six signals. The six signal then go to the six display units.



31-41-00-019 Rev 0

AIMS - DISPLAY UNITS VIDEO BUSES INTERFACES

AIMS - ANALOG DISCRETE INPUTS INTERFACES

General

There are two ways analog discrete inputs go to the input/output modules:

- The analog discrete input goes to two IOMs in the one AIMS cabinet
- The analog discrete input goes to two IOMs in both AIMS cabinets.

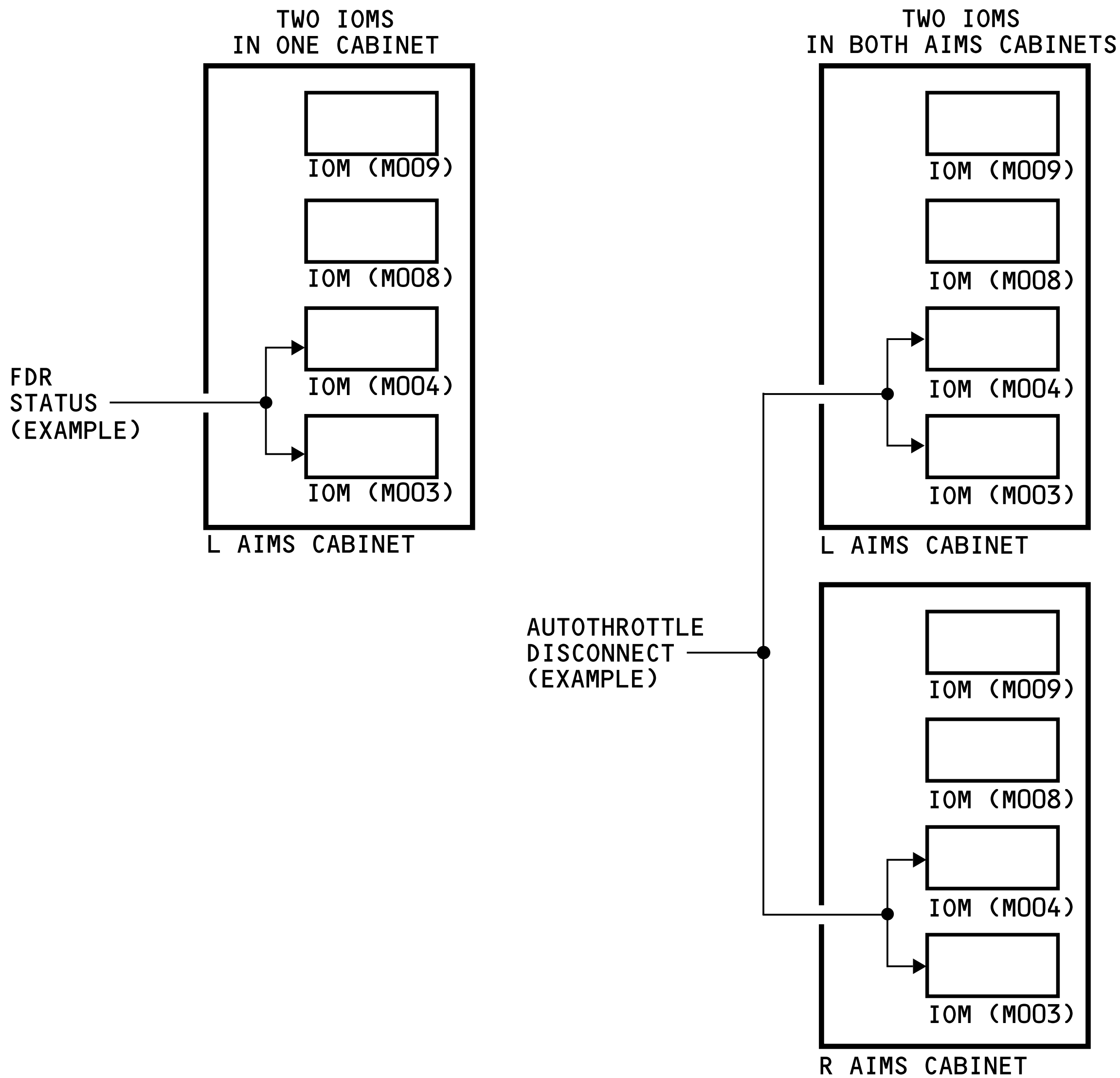
Analog Discrete Inputs

The AIMS cabinets receive these analog discretes:

- Autothrottle disconnect
- Autothrottle disconnect reset
- Takeoff go around
- Master caution warning light reset
- Key event from the VHF radios
- Program pins
- Air ground status from ELMS
- Maintenance/software load enable
- Trucks not tilted from the PSEU
- Flight data recorder status
- Flight data recorder maintenance status
- Fuel lever at cutoff position
- EEC GND test switch in ON position
- ACE in direct mode
- ACE power supply valid
- Alternate pitch trim - arm active
- Alternate pitch trim - arm down
- Alternate pitch trim - arm up
- Alternate pitch trim - control active
- Alternate pitch trim - control down
- Alternate pitch trim - control up
- Auto speed brake switch
- Thrust reverser interlock feedback
- Parking brake handle
- Parking brake valve close relay
- Brake source pressure indication
- APU fire alarm
- Left engine fire alarm
- Right engine fire alarm
- APU bottle pressure low
- Engine bottle pressure low
- ASCPC L/R bleed off message
- Cabin alert message
- Cabin call message
- Cabin ready message
- Cargo call message
- Ground call message
- Autopilot disconnect warning battery 2
- Girt bar armed - door X
- Left engine start continuous ignition
- Right engine start continuous ignition.

Training Information Point

For details of the exact interfaces between the LRUs and the IOMs, refer to the wiring diagram manual.



31-41-00-020 Rev 2

AIMS - ANALOG DISCRETE INPUTS INTERFACES

AIMS - ANALOG DISCRETES OUTPUTS INTERFACES

General

The AIMS cabinets transmit analog discretes in these three ways:

- The analog discrete output comes from one IOM in one AIMS cabinet
- The analog discrete comes from the outputs of two IOMs in the same AIMS cabinet. The outputs are wired together in that AIMS cabinet
- The analog discrete comes from the outputs of two IOMs in both AIMS cabinets. The outputs are wired together in each AIMS cabinet and in the airplane wiring outside the cabinet.

The CPM/Comm also has analog discrete outputs. They are all direct outputs.

Analog Discrete Outputs

The IOMs send these analog discretes:

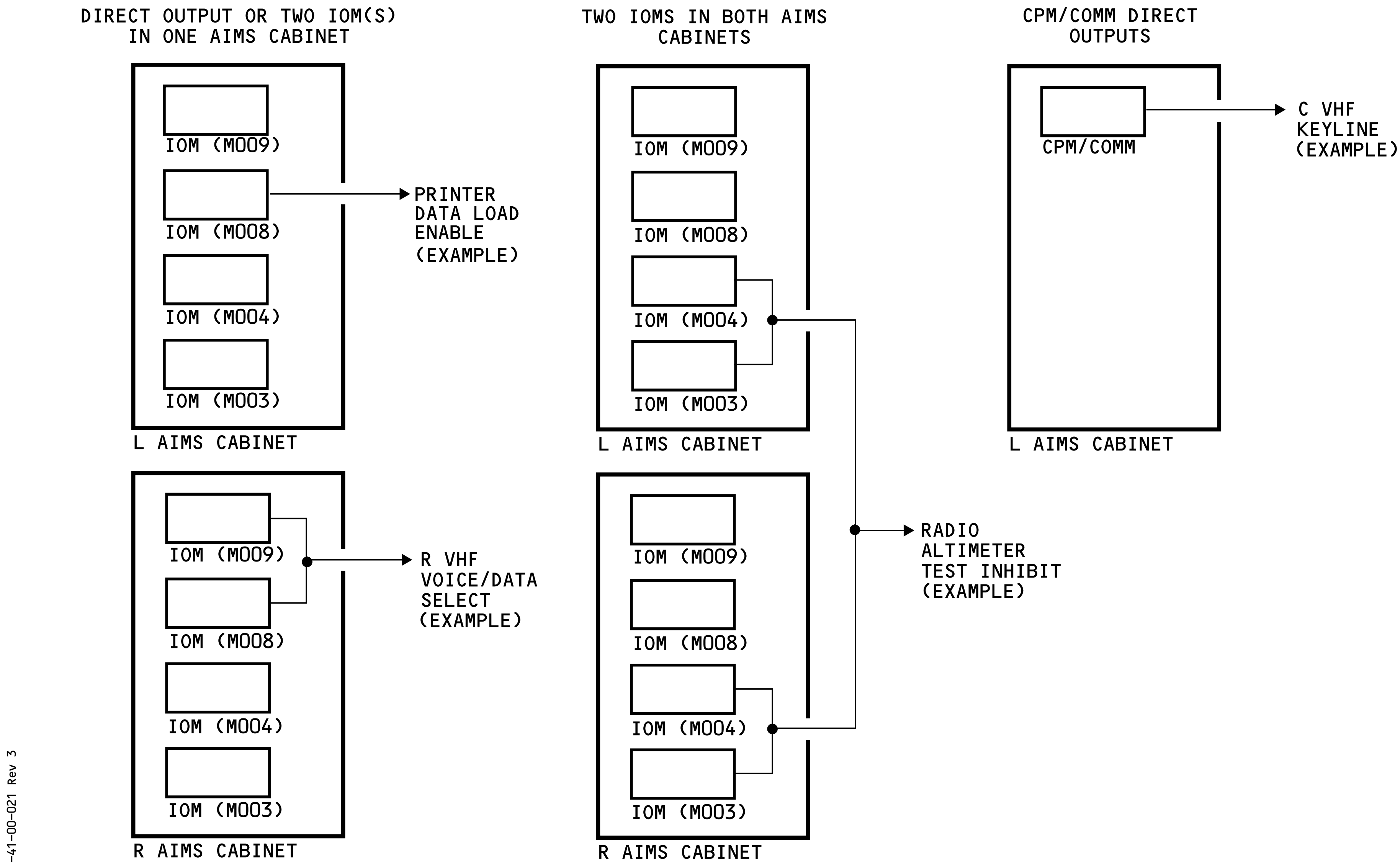
- Autothrottle servo inhibit
- Master caution lamp drive
- VHF voice data select
- VHF bite inhibit
- SDU data load enable
- Printer data load enable
- TCAS data load enable
- GPS data load enable
- ASCPC engine running
- Engine start solenoid
- PFC disconnect
- Radio altimeter test inhibit
- IRS 429 bus invalid
- WXR control on
- TCAS RA display status.

The CPM/Comm sends these analog discretes:

- VHF data keyline
- Bypass switch unit bypass control.

Training Information Point

For details of the exact interfaces between the IOMs or CPMs and the LRUs, refer to the wiring diagram manual.



AIMS - ANALOG DISCRETES OUTPUTS INTERFACES

AIMS - ANALOG INTERFACES

General

The input/output modules receive analog inputs in these three ways:

- The analog input goes to one IOM
- The analog input goes to two IOMs in the same AIMS cabinet
- The analog discrete input goes to two IOMs in each AIMS cabinets.

The input/output modules transmit analog outputs in these two ways:

- One IOM supplies the analog output
- One IOM in each AIMS cabinet supplies the analog output. The airplane wiring splices together the outputs.

Analog Inputs

The IOMs receive this analog data:

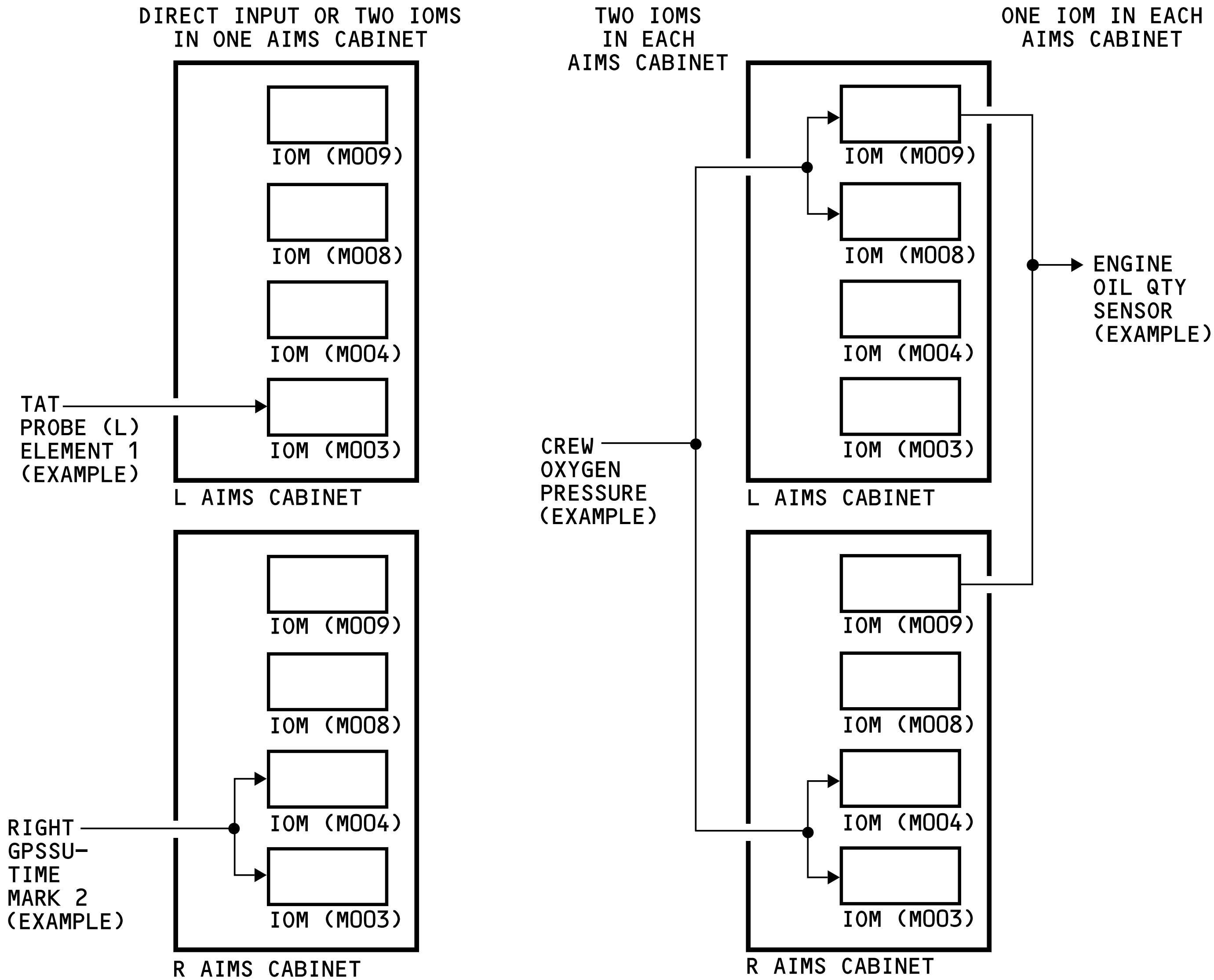
- Total air temperature
- Angle of attack
- Global positioning system time mark
- Crew oxygen pressure
- Passenger oxygen pressure
- Cabin pressure sensor
- N1 Tach
- N2 Tach
- Engine oil quantity sense.

Analog Outputs

IOMs send analog data to the engine oil quantity sensor. The AIMS cabinet sends a 6v dc oil quantity excitation voltage to the engine oil quantity sensor unit.

Training Information Point

For details of the exact interfaces between the IOMs and the LRUs, refer to the wiring diagram manual.



31-41-00-022 Rev 1

AIMS - ANALOG INTERFACES

AIMS - CABINET CHASSIS - 1

General

Each cabinet chassis is a rack enclosure. It can hold up to 11 LRMs. Currently, there are eight LRMs installed in the cabinet and three spare slots.

A printed wiring board called the backplane runs the width of the cabinet chassis. This backplane transfers the power and data to each LRMs.

Physical Description

The cabinet chassis has these dimensions:

- Width = 48 inches
- Depth = 24 inches
- Height = 12 inches.

The cabinet chassis weighs approximately 45 pounds.

With the eight LRMs installed, the AIMS cabinet weighs 146.4 pounds.

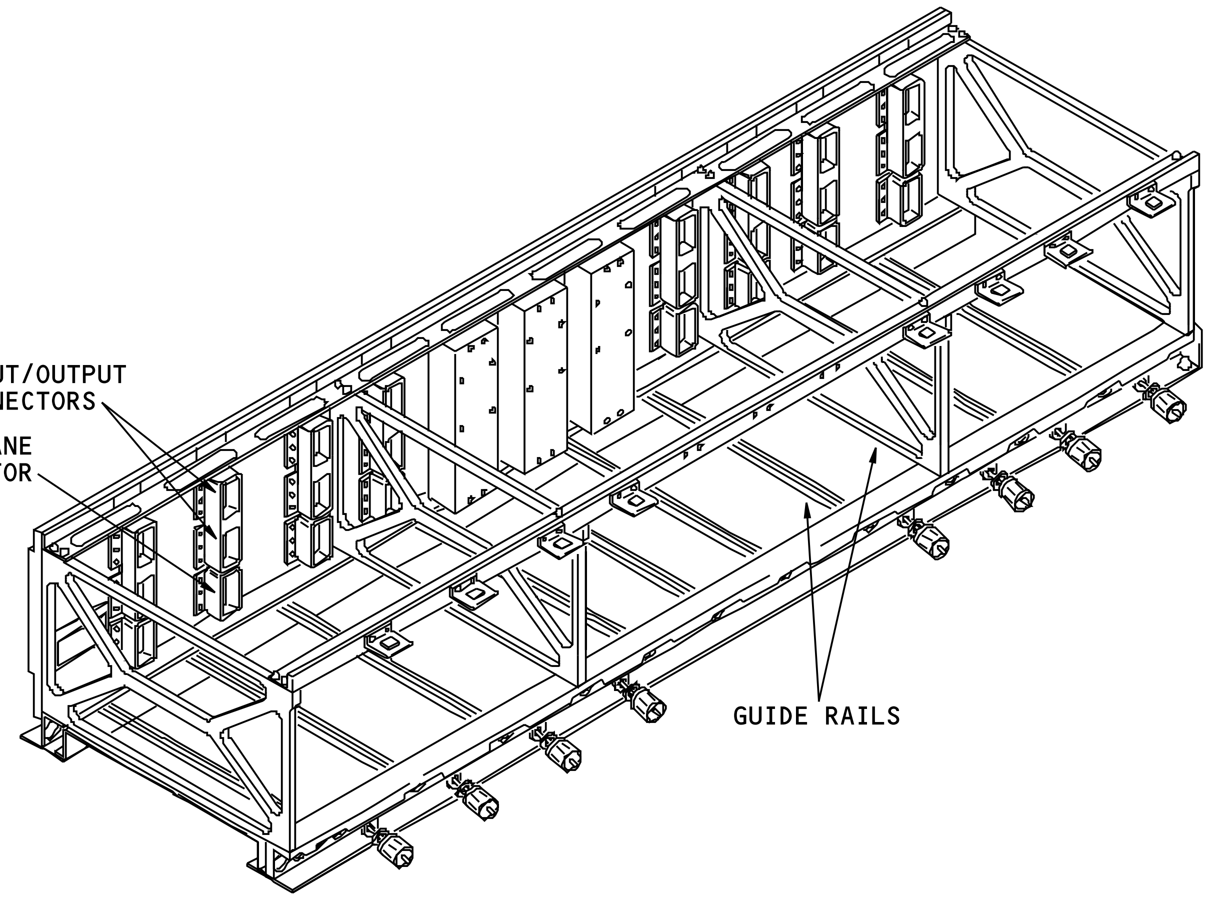
The Back of the Cabinet Chassis

In the back of the cabinet chassis, there are three ARINC 650 connectors for each slot. The top two connectors, A and B, are for input and output data. The bottom connector C, is for the interface to the backplane.

In the empty slot, there are load plugs on the bottom connector.

Installation

The cabinet has guide rails on the bottom surface and guide pins at the top and bottom of the rear connector to align the LRMs.



31-41-00-040 Rev 1

AIMS - CABINET CHASSIS - 1

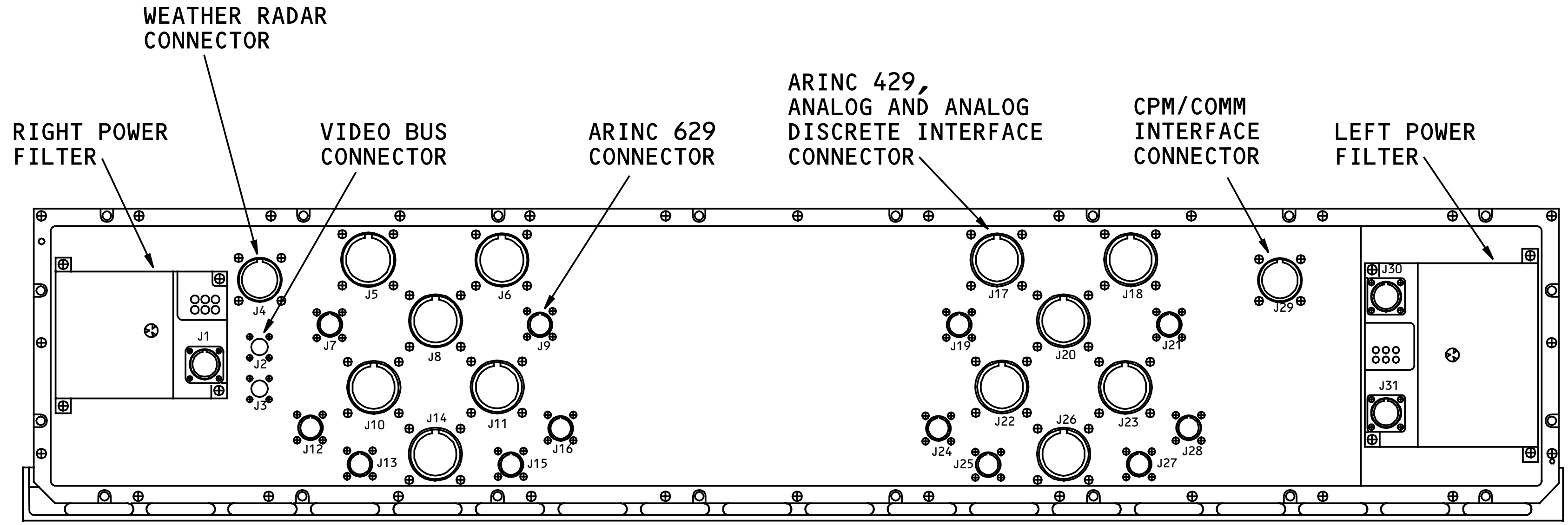
AIMS - CABINET CHASSIS - 2

The Rear of the Cabinet Chassis

These are the interface connectors on the rear of the cabinet:

- 12 connectors for ARINC 629 interface
- 2 connectors for video bus data output
- 12 connectors for ARINC 429, analog and analog discrete interface
- 3 connectors for power interface
- 1 connector for CPM/COMM interface
- 1 connector for ARINC 453, weather radar interface.

The airplane power comes into two power supply filters. These filter the power and distribute it on the backplane.



AIMS CABINET CHASSIS - REAR VIEW

31-41-00-023 Rev 4

AIMS - CABINET CHASSIS - 2

AIMS - INPUT/OUTPUT MODULE

General

The input/output module (IOM) supplies the interface between the software functions in the AIMS cabinet and external signal sources. The four IOMs supply most of the standard and shared interfaces necessary to operate the CPMs. The CPM/COMM and the CPM/GG supply some unique input and output interfaces.

Input/Output Modules

The IOM supplies these types of interfaces:

- 76 analog discrete inputs
- 16 analog discrete outputs
- 32 ARINC 429 data bus inputs
- 5 ARINC 429 data bus outputs
- 3 ARINC 629 data buses
- 12 analog inputs
- 2 analog outputs.

The IOMs also interface with the backplane data bus, and the backplane power bus to communicate with the software functions in the cabinet.

Physical Description

These are the dimensions of an IOM:

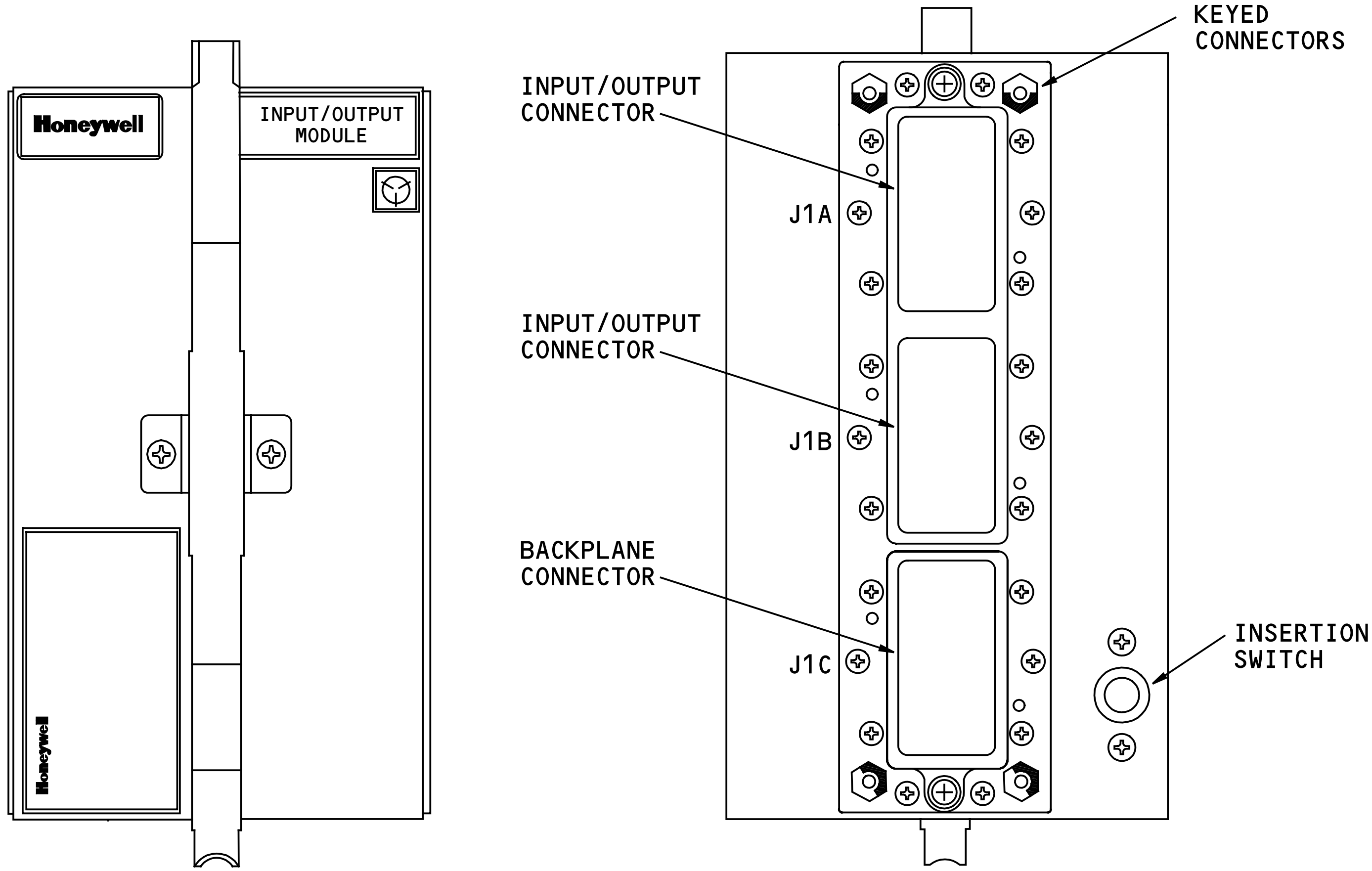
- 3.41 inches wide
- 15 inches deep (includes the handle assembly)
- 7.2 inches high.

The weight of an IOM is 10.6 pounds.

Installation

The IOMs have a hot insertion switch on the rear surface. This insertion switch keeps the cabinet +28v dc from the IOM until it makes positive contact between the IOM ARINC 650 connector and the backplane pins of the cabinet.

The four IOMs have the same keyed connectors. This makes the IOMs interchangeable.



INPUT/OUTPUT MODULE
(FRONT VIEW)

INPUT/OUTPUT MODULE
(REAR VIEW)

31-41-00-024 Rev 2

AIMS - INPUT/OUTPUT MODULE

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AIMS - CORE PROCESSOR MODULES

General

The core processor modules (CPM) supplies the hardware and software for the AIMS functions. These are the four different CPMs:

- CPM/Communications (CPM/Comm)
- CPM/Basic
- CPM/Airplane condition monitoring function (CPM/ACMF)
- CPM/Graphics generator (CPM/GG).

Core Processor Modules

The CPM has internal slots for up to 7 circuit card assemblies (CCAs). The CPMs all have five basic CCAs. The remaining internal slots for CCAs contain unique CCAs to make each CPM different.

These are the five basic CCAs:

- Power supply CCA
- Backplane interface/power monitor (BIPM) CCA
- Processor CCA
- Instruction Memory CCA
- Data memory CCA.

The CPM/Comm has a sixth and a seventh CCA. These are the multifunction CCA and the fiber optics CCA. The purpose of the multifunction CCA is to:

- Transmit ARINC 717 formatted data
- Transmit and receive datalink data for the center and right VHF communication transceivers.

The fiber optics CCA transmits and receives data for the onboard local area network.

The CPM/Basic does not have any additional CCAs. It only has the 5 basic CCAs.

The CPM/ACMF has a sixth CCA. This CCA is the ACMF memory CCA. It supplies the static random access memory (SRAM) for the ACMF.

The CPM/GG has a sixth CCA. This CCA is the graphics generator CCA. This CCA has the weather radar and high speed coax interfaces necessary to support the displays.

Physical Description

The dimensions of the CPM/GG, CPM/Basic, and CPM/ACMF are:

- 4.18 inches wide
- 15 inches deep (includes the handle assembly)
- 7.2 inches high.

The CPM/Comm dimensions are the same except it is 6 inches wide. It is wider than the other CPM because it has the fiber optics connector.

The weight of the four CPM types is:

AIMS - CORE PROCESSOR MODULES

- CPM/Comm - 15.7 pounds
- CPM/ACMF - 13.5 pounds
- CPM/Basic - 12.3 pounds
- CPM/GG - 13.4 pounds.

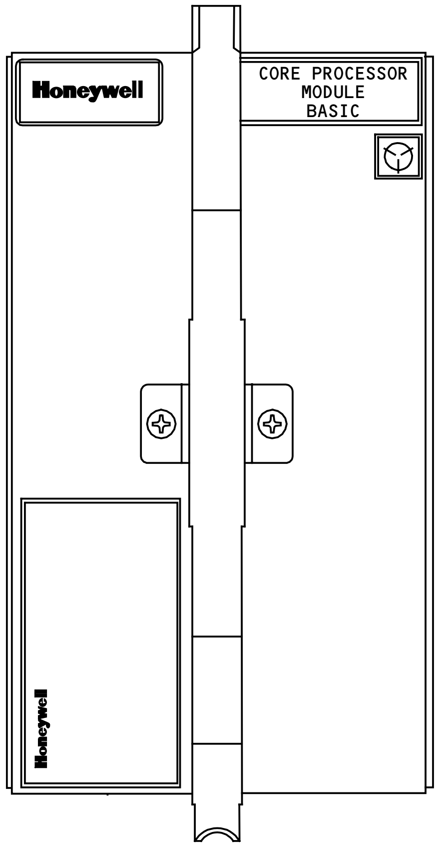
Installation

The CPMs have a hot insertion switch on the rear surface. This insertion switch keeps the cabinet +28v dc from the CPM until it makes positive contact between the CPM ARINC 650 connector and the backplane pins of the cabinet.

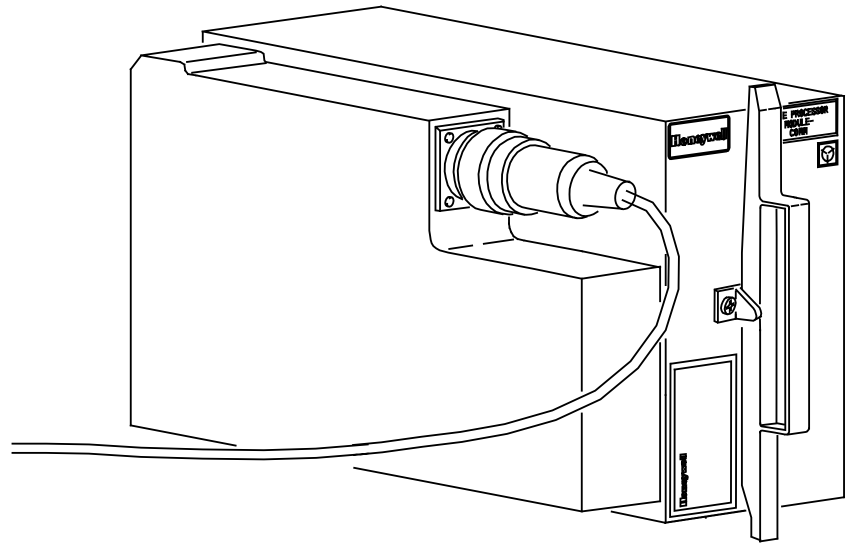
Each CPM has a unique keyed connector, except for the CPM/basic and CPM/ACMF. Because the CPM/basic and CPM/ACMF are in the same cabinet position they have the same keyed connector. This allows the left and right cabinet to have the same part number.

Training Information Point

Although the CPM/Basic and CPM/ACMF have the same keyed connector, do not install a CPM/Basic in the left cabinet chassis. If you install the CPM/Basic in the left cabinet with the proper software, the CPM reports a hardware and software incompatibility to the central maintenance computing function.



CORE PROCESSOR MODULE/BASIC
CORE PROCESSOR MODULE/GG
CORE PROCESSOR MODULE/ACMF



CORE PROCESSOR MODULE/COMM

31-41-00-025 Rev 3

AIMS - CORE PROCESSOR MODULES

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AIMS - CABINET CHASSIS POWER DISTRIBUTION FUNCTIONAL DESCRIPTION

General

A signal distribution area goes along the full width of the rear of the cabinet chassis. This area has a backplane power bus for power distribution.

Four power sources and the hot battery bus power source connect to an AIMS cabinet. The backplane power bus distributes the power inputs to each LRM. Power contacts on the LRM connector connect directly to the power backplane.

The steady state load is 700 W.

Input Power

Each cabinet receives four 28v dc inputs. The sources of 28v dc for the left AIMS cabinet are the 28v dc capt flight instrument bus and the 28v dc F/O flight instrument bus. The sources of 28v dc for the right AIMS cabinet are the 28v dc left bus and 28v dc right bus.

The four 28v dc bus inputs are power 1 through power 4. Power 1 and power 2 enter the cabinet through a connector on the left side of the cabinet. Therefore, power 1 and power 2 are left power.

Power 3 and power 4 enter the cabinet through a connector on the right side of the cabinet. Therefore, power 3 and power 4 are right power.

Each LRM receives power from four sources, two for main power and two for monitor power. The main circuitry uses the main power. Special circuits that monitor the condition of the power supply in the LRM use the monitor power. The two main and two monitor sources of power for each LRM come from different power sources.

Each LRM must have at least one main and one monitor power input to operate.

The loss of any one of the four power buses to the backplane power bus or to any one LRM has no effect on the function of the LRMs.

The loss of two power inputs from the same side of the cabinet, left or right, has no effect on the function of the LRMs. The loss of one power input from the left side and one power input from the right side results in the loss of function in four LRMs.

The loss of three or four of the power buses to the cabinet chassis power backplane results in the loss of function of all the LRMs.

Training Information Point

The status message AIMS shows when one or more of the power inputs has failed for one second.

Hot Battery Bus

Each LRM also receives one 28v dv power source from the hot battery bus.

AIMS - CABINET CHASSIS POWER DISTRIBUTION FUNCTIONAL DESCRIPTION

The connection to the hot battery bus keeps the LRMs internal memories active. The hot battery bus also makes the AIMS cabinet less likely to have faults due to power transients. The LRMs shut down after 500 msec of hot battery bus power operation.

Training Information Point

The hot battery bus holds the static random access memory (SRAM) with no other power on the airplane. If you remove the battery, you lose some data from the LRMs. The data you lose includes:

- ACMF report data stored on the ACMF CCA
- Fault history data collected by the CMCF.

Power Distribution

Each LRM changes the 28v dc from the backplane power buses into:

- Voltages required by the LRM
- 5v dc transceiver voltage
- 2v dc termination voltage.

Each LRM sends a 5v dc transceiver voltage to one of the four transceiver power backplanes. This power is used by the transceivers in the LRMs.

Each LRM sends a 2v dc termination voltage to one of the four termination power backplanes. Terminators on the ends of the backplane data buses use the power from the 2v termination power backplanes.

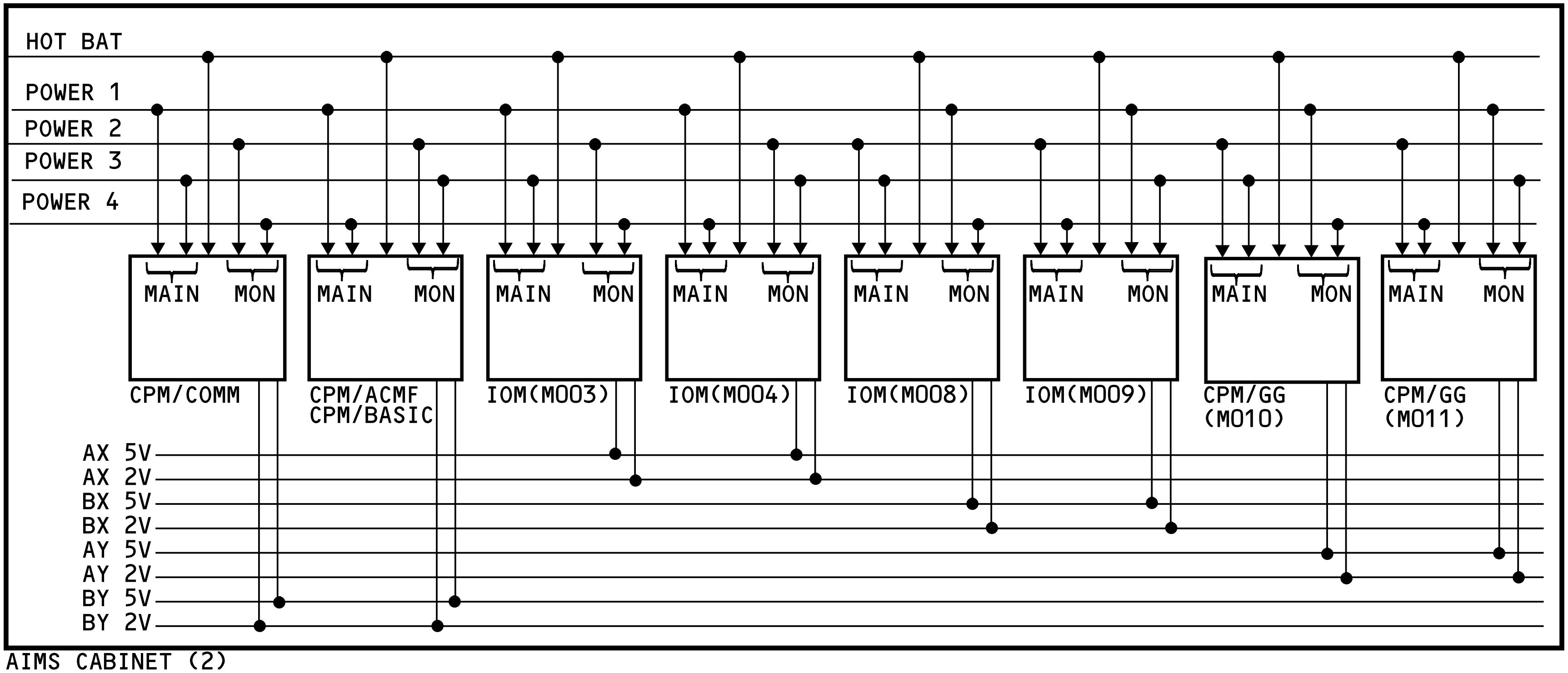
Training Information Point

Each LRM has a hot insertion switch. The switch makes sure that the LRM does not get power until it has positive contact between its connector pins and the backplane pins.

When you install an LRM into the cabinet, this sequence occurs:

- The ground, power, and signal pins in the connector make contact with the backplane ground, power, and signal pins
- The hot insertion switch engages. This lets the power from the backplane go to the power in the LRM.

When you remove an LRM from the cabinet, the reverse sequence occurs.



LOSS OF POWER INPUTS							
POWER 1 AND 3		POWER 2 AND 4		POWER 1 AND 4		POWER 2 AND 3	
MAIN	MONITOR	MAIN	MONITOR	MAIN	MONITOR	MAIN	MONITOR
CPM/COMM IOM(M003)	CPM/GG(M011) IOM(M009)	CPM/GG(M011) IOM(M009)	CPM/COMM IOM(M003)	CPM/ACMFORBASIC IOM(M004)	CPM/GG(M010) IOM(M008)	CPM/GG (M010) IOM(M008)	CPM/ACMFORBASIC IOM(M004)

NOTE: AN LRM MUST HAVE AT LEAST ONE MAIN AND ONE MONITOR POWER INPUT TO OPERATE. LOSS OF TWO POWER INPUTS, ONE FROM EACH SIDE (LEFT AND RIGHT) RESULTS IN THE LOSS OF LRMS ACCORDING TO ABOVE TABLES.

AIMS - CABINET CHASSIS POWER DISTRIBUTION FUNCTIONAL DESCRIPTION

31-41-00-026 Rev 5 03/28/95

AIMS - CABINET CHASSIS BACKPLANE DATA BUSES FUNCTIONAL DESCRIPTION

General

A signal distribution area goes along the entire width of the rear of the cabinet chassis. This area has four serial backplane data buses. These data buses distribute data between the LRMs.

The data on the backplane buses transfers at a rate of 60 million bits per second (Mbps).

Data Distribution

The serial buses are AX, BX, AY and BY. The buses all transmit the same information. The two serial buses AX and BX come from the X bus interface in the LRM, and are a bus pair. The two serial buses AY and BY come from the Y bus interface in the LRM and are a bus pair. With the dual redundant buses, the LRM can isolate failures in the module.

A serial bus consists of three signal lines. Two of the signal lines are data lines and the third signal line is a clock line. A terminator at each end of a serial bus terminates the three signal lines. The terminator gets power from the termination power backplane bus.

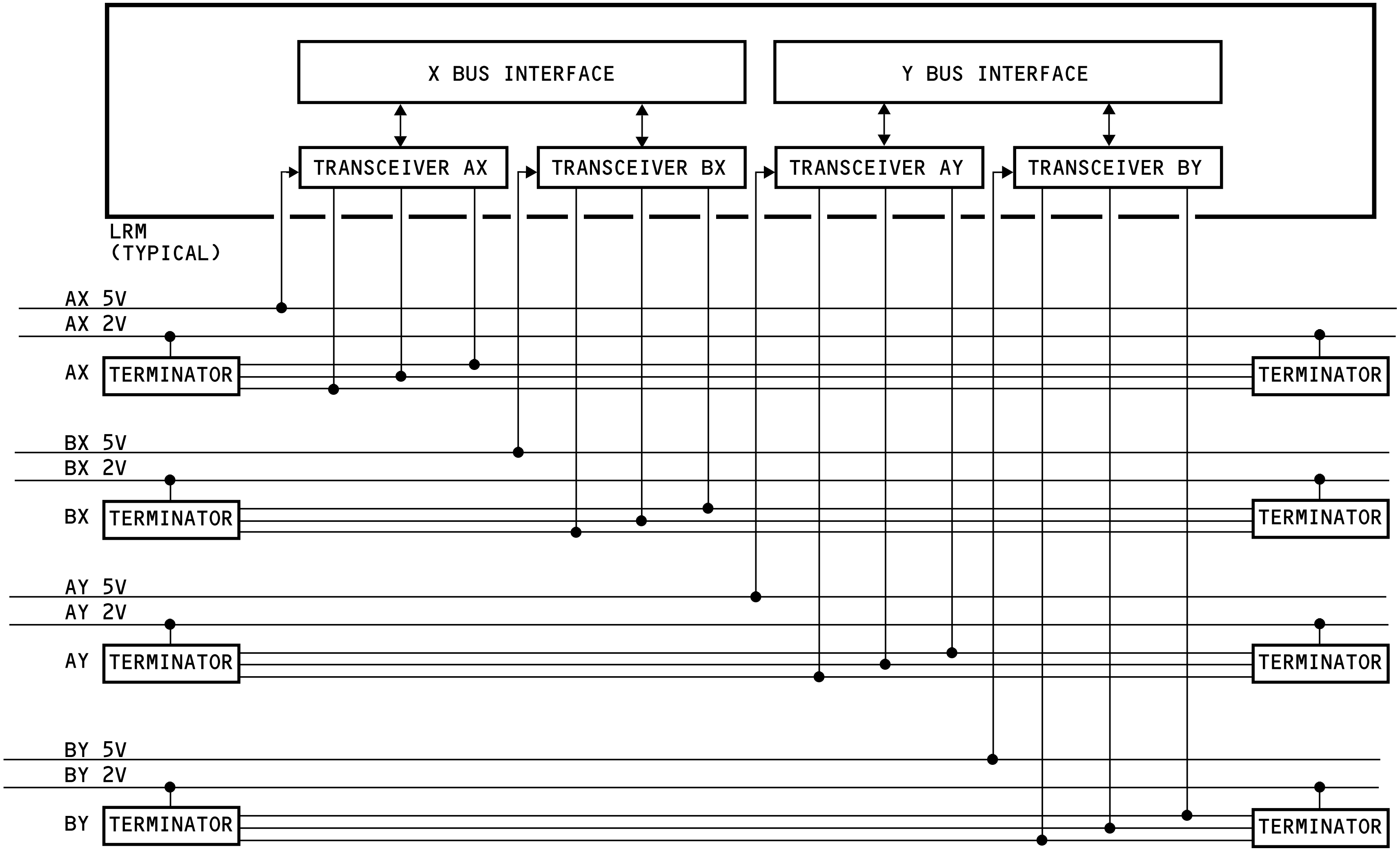
Transceivers in each LRM transmit data to and receive data from the backplane data buses. The LRM transmits data on all four of the serial buses at the same time. The transceivers get power from the transceiver power backplane bus.

The LRM compares the data it transmits on serial buses AX and BX with the data it transmits on serial buses AY and BY.

The duplicate bus pairs supply bit-for-bit identical information. The duplication supplies error detection, isolation, and containment.

Training Information Point

The status message AIMS shows when one or more of the serial backplane data buses fail for one second. All communication can be lost over a serial bus if a transceiver shorts out the serial bus or if power to the terminators fails.



31-41-00-027 Rev 5 07/10/95

AIMS - CABINET CHASSIS BACKPLANE DATA BUSES FUNCTIONAL DESCRIPTION

AIMS - INPUT/OUTPUT MODULE FUNCTIONAL DESCRIPTION

General

The input/output module (IOM) supplies the interface between the software functions in the AIMS cabinet and external signal sources. The four IOMs supply most of the standard and shared input and output interfaces necessary to operate the CPMs. Some unique input and output interfaces are supplied by the CPM/Comm and the CPM/GG.

The IOM does not monitor or interrogate any data that passes through it. The IOM is only a high-speed data mover.

IOM Hardware

The IOM has these four circuit card assemblies (CCAs):

- Power supply CCA
- Input/output controller/ backplane interface/power monitor (IOC/BIPM) CCA
- ARINC 629/429 CCA
- Analog and discrete/ARINC 629 CCA.

Power Supply CCA

The power supply CCA receives 28v dc from five sources on the power backplane. The power supply CCA supplies power for:

- IOM CCAs
- 5v dc transceiver power backplane
- 2v dc termination power backplane
- Different I/O interfaces.

I/O Controller/Backplane Interface/Power Monitor CCA

The I/O controller/backplane interface/power monitor (IOC/BIPM) CCA has:

- One single thread interface
- Two I/O controllers (IOC)
- Two backplane interface/power monitors (BIPM)
- Four transceivers.

The single thread interface receives data from the input and output interfaces and sends the data to the X IOC and the Y IOC. The single thread interface also receives data from the X IOC and sends the data to the input and output interfaces.

The I/O controllers (IOC) control the operation of the different IOM input and output interfaces. The IOCs receive data from the single thread interface and transmit the data to the BIPMs. Each IOC receives data from a BIPM and compares the data with the other IOC. IF the data is the same, the X IOC sends the data to the single thread interface.

The IOC also supplies the BITE for the IOM. The IOC BITE supplies an IOM BITE history log and an IOM fault history log. The IOC communicates with the four core processing modules to supply IOM BITE data. The functions in the CPMs use the BITE data to check for I/O interface faults.

AIMS - INPUT/OUTPUT MODULE FUNCTIONAL DESCRIPTION

The IOCs operate in a dual, self-monitoring configuration. The IOCs are identical. The self-monitoring operation allows both IOCs to execute the same instructions on a clock-for-clock basis. The IOCs cross-compare all signals during normal operation. This is called lock-step operation. If the data in each IOC is the same, the X IOC sends the data to the single thread interface. If the data in each IOC is different, the IOCs will not send any more data to the I/O interfaces.

The X BIPM sends data to and receives data from the AX and BX transceivers. The X BIPM also sends data to and receives data from the X IOC. The Y BIPM sends data to and receives data from the AY and BY transceivers. The Y BIPM also sends data to and receives data from the Y IOC.

The BIPM has an intermodule memory (IMM) array for data storage. The IMM array holds the data to be passed from one LRM to another LRM in the cabinet. The IMM array, in combination with the data bus interface, supplies an orderly flow of the data.

For input and output data, the functions in the CPMs need to know what place in the array in the IMM to write to for output data and what place in the array IMM to read from for input data.

The BIPMs also monitor power for the IOM. The BIPMs detect over voltage and under voltage conditions. The BIPMs prevent IOM operation during these conditions.

The monitor circuits use a different power source than the rest of the IOM for operation.

The four transceivers supply the interface between the backplane data buses and the BIPM. The four transceivers receive 5v dc from the transceiver power backplane.

ARINC 629 And ARINC 429 CCA

The ARINC 629 and ARINC 429 CCA supplies the interface between the IOC/BIPM CCA and the ARINC 629 and ARINC 429 buses.

The ARINC 629 interface transmits data to and receives data from the ARINC 629 buses. There are two ARINC 629 terminals in this CCA. There is another ARINC 629 terminal in the analog and discrete/ARINC 629 CCA. Each ARINC 629 terminal has one transmit bus and one receive bus.

The ARINC 429 interface transmits data to and receives data from the ARINC 429 buses. An IOM has 27 ARINC 429 receivers and five ARINC 429 transmitters. Each transmitter has a wrap around receiver that monitors the transmitted data. The five wrap around receivers make the total number of receivers equal to 32.

Two of the ARINC 429 transmit channels are sent out through relays. The other input into each relay is from the other AIMS cabinet or from another IOM in the same AIMS cabinet. The AIMS functions in the CPMs supply the relay control. The functions that supply the ARINC 429 source select logic are:

- Flight management computing function
- Central maintenance computing function
- Data conversion gateway function
- Data communication management function.

Analog and Discrete/ARINC 629 CCA

The analog and discrete/ARINC 629 CCA supplies the interface between the IOC/BIPM and the analog inputs and outputs, the discrete inputs and outputs and one ARINC 629 channel.

The analog and discrete interface supplies 76 discrete inputs. Sixteen of the inputs are wrap around discretes. The total number of discrete inputs available for other inputs is 60. The analog and discrete interface converts the discrete inputs to a digital format. The IOC/BIPM CCA transmits the digital data on the backplane data bus to the CPMs.

The analog and discrete interface supplies sixteen discrete outputs. Wrap around discrete inputs monitor the discrete outputs. The analog and discrete interface coverts the digital data from the IOC/BIPM CCA and sets the analog discrete outputs.

The analog and discrete interface supplies 11 analog inputs and converts the analog inputs to a digital format. The IOC/BIPM CCA transmits the digital data on the backplane data bus to the CPMs.

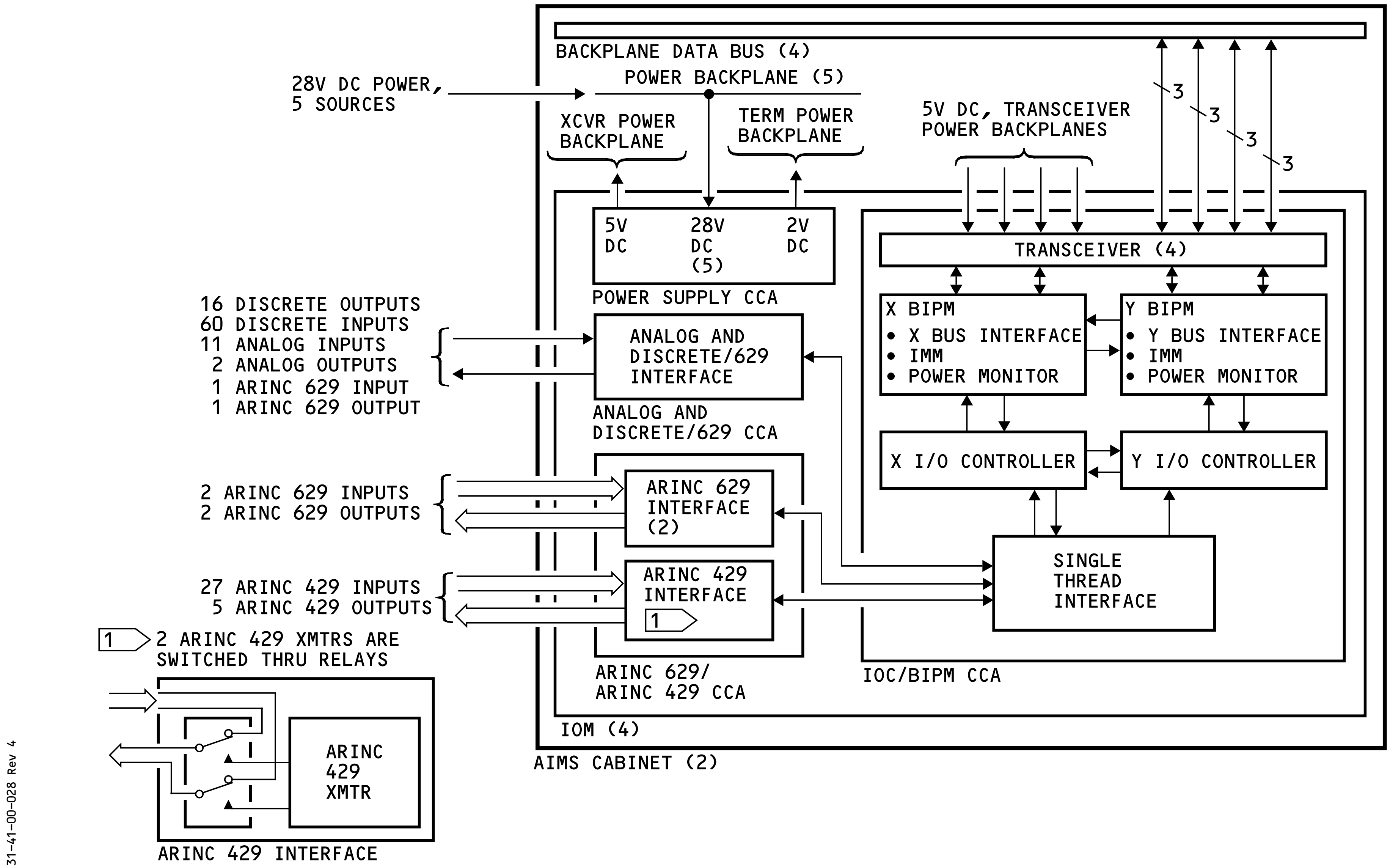
The analog and discrete interface supplies two analog outputs. It converts the digital data from the IOC/BIPM CCA and supplies the analog discrete outputs.

IOM Slot Position

The IOMs all have the same hardware and software. The IOM gets its slot identity from a ground that the cabinet supplies.

Training Information Point

At power up, the IOMs go through an initialization phase where they read their slot identity and configure themselves to the slot they are in. If you remove and install an IOM, when you reapply power to the cabinet, the IOM will go through the initialization phase.



AIMS - INPUT/OUTPUT MODULE FUNCTIONAL DESCRIPTION

AIMS - CORE PROCESSOR MODULE/BASIC FUNCTIONAL DESCRIPTION

General

These are the four types of core processor modules:

- CPM/Basic
- CPM/Graphics generator (CPM/GG)
- CPM/Airplane condition monitoring function (CPM/ACMF)
- CPM/Communication (CPM/Comm).

Each CPM has the same basic hardware and some unique hardware. Each of the CPMs have the same hardware as the CPM/Basic and then some unique hardware to make it different.

The CPM/Basic does the calculations for these systems:

- Flight management computing system
- Thrust management computing system.

CPM Hardware

The core processor modules have:

- lockstep processors
- Memory devices
- Application specific integrated circuits
- Support hardware.

All of this is mounted on circuit card assemblies in the CPM.

Circuit Card Assemblies

The CPMs have internal slots for up to 7 circuit card assemblies (CCAs). The CPMs all have five basic CCAs. The remaining internal slots for CCAs contain unique CCAs to make each CPM different.

These are the five basic CCAs:

- Power supply CCA
- Backplane interface/power monitor (BIPM) CCA
- Processor CCA
- Instruction Memory CCA
- Data memory CCA.

The sixth and seventh slots have a unique CCA in some CPMs. This makes each of the four types of CPMs different.

The CPM/Basic only has the five basic CCAs. The CPM/Basic is described here.

Power Supply CCA

The power supply CCA receives 28v dc from five sources on the power backplane. The power supply CCA supplies power for these functions:

- The other CCAs
- 5v dc transceiver power backplane
- 2v dc termination power backplane.

AIMS - CORE PROCESSOR MODULE/BASIC FUNCTIONAL DESCRIPTION

Backplane Interface/Power Monitor CCA

The backplane interface/power monitor (BIPM) CCA has two backplane interface/power monitors (BIPM) interface circuits and four transceivers.

The CPM uses the BIPMs for communication to the other CPMs and to the IOMs on the backplane data bus. The BIPM CCA also monitors the CPM power.

The X BIPM sends data to and receives data from the AX and BX transceivers. The Y BIPM sends data to and receives data from the AY and BY transceivers. The X BIPM and Y BIPM also sends data to and receives data from the processor CCA.

The BIPM has an intermodule memory (IMM) array for data storage. The IMM array holds the data to be passed from one LRM to another LRM in the cabinet. The IMM array, in combination with the bus interface, supplies an orderly flow of the data.

The BIPMs detect over voltage and under voltage conditions. The BIPMs prevent IOM operation during these conditions. The monitor circuits use a different power source than the rest of the CPM for operation.

The four transceivers supply the interface between the backplane buses and the backplane data bus/IMM interface circuits. The transceivers receive 5v dc from the transceiver power backplanes.

Processor CCA

There are two identical microprocessors on the processor CCA. The microprocessors do the same operations and use the same software from memory. The processor CCA has bus comparison circuits to compare the data and control the buses of the two microprocessors. The bus comparison circuits check that the microprocessors generate and receive identical information. The bus comparison circuits report a fault to BITE if the data is not identical.

Instruction Memory and Data Memory CCAs

The microprocessors access instruction memory from the instruction memory CCA through the bus comparison circuits. The microprocessors also access data memory from the data memory CCA through the bus comparison circuits. Both memories are software loadable. The memories use electrically erasable programmable read only memory (EEPROM) devices and battery-backed static random access memory (SRAM) devices.

The instruction memory stores operational (OPS) software. It includes this software:

- Core software
- BITE software
- Operational software for the AIMS functions.

Each microprocessor accesses this instruction software and does the instructions directly out of the instruction memory.

AIMS - CORE PROCESSOR MODULE/BASIC FUNCTIONAL DESCRIPTION

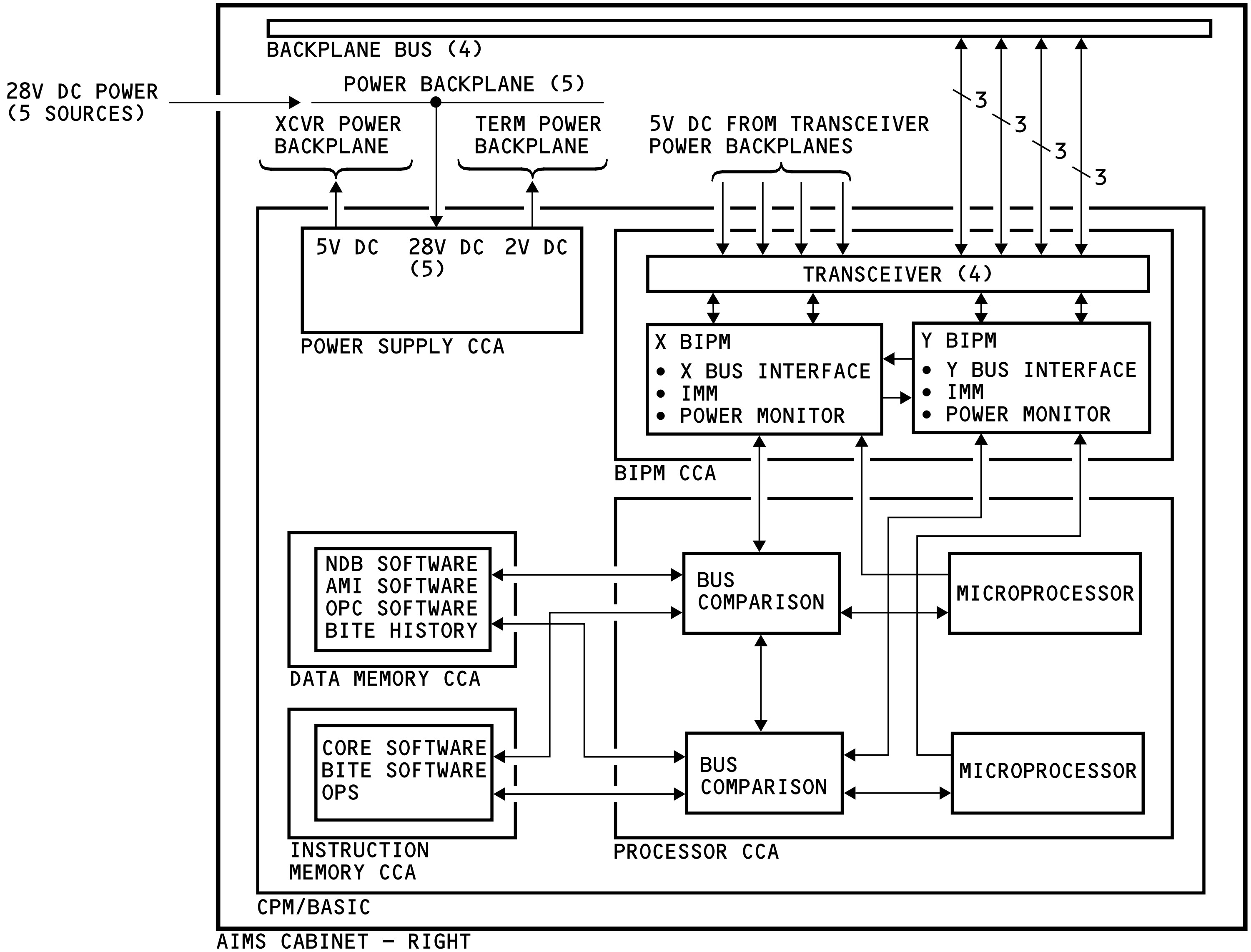
The data memory stores databases and program variables.

These are the databases:

- Navigation database (NDB) software
- Airline modifiable information (AMI) software
- Operational program configuration file (OPC) software
- BITE history data.

These are the program variables:

- FMCF CDU entered data
- CMCF existing faults
- CMCF fault histories.



AIMS - CORE PROCESSOR MODULE/BASIC FUNCTIONAL DESCRIPTION

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AIMS - CORE PROCESSOR MODULE/AIRPLANE CONDITION MONITORING FUNCTION FUNCTIONAL DESCRIPTION

General

The core processor module/airplane condition monitoring function (CPM/ACMF) uses the same hardware as the CPM/Basic and additional hardware to supply memory to store reports and variables for the airplane condition monitoring system.

The CPM/ACMF does computations for these systems:

- Flight management computing system
- Thrust management computing system
- Airplane condition monitoring system.

CPM/ACMF Hardware

In addition to the five standard CCAs, the CPM/ACMF has a sixth CCA. The sixth CCA is the ACMF memory CCA. The ACMF memory CCA has 6 Mbytes of battery backed static random access memory (SRAM).

ACMF Memory CCA

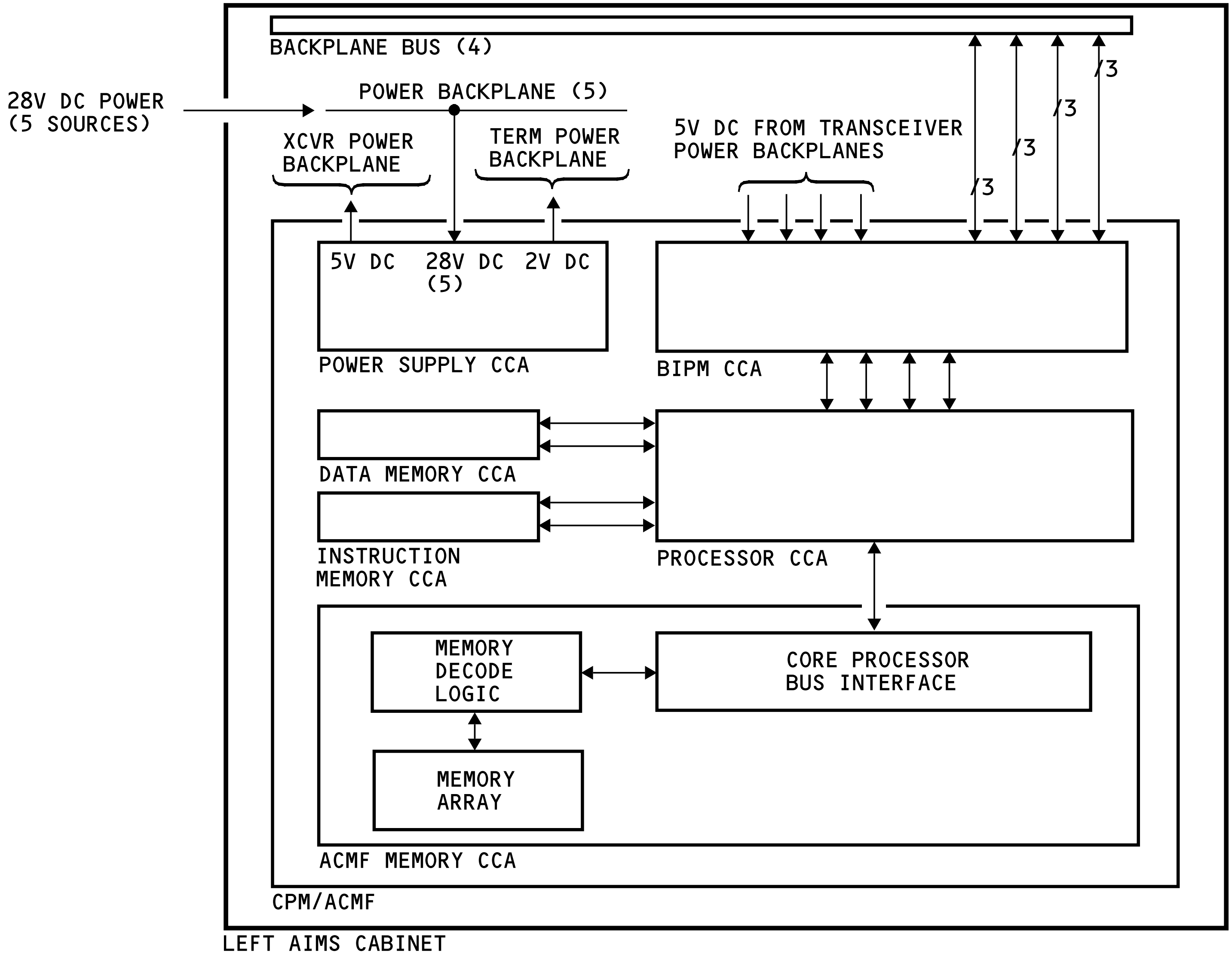
The ACMF memory CCA includes the:

- Core processor bus interface
- Memory array
- Memory decode logic.

The core processor bus interface communicates with the processor CCA. It supplies the protocol for the data transfers between the ACMF memory CCA and the processor CCA.

The memory array is 6 Mbytes of SRAM. The memory array stores reports and variables.

The memory decode logic supplies the control signals to the memory array. It is the interface between the core processor bus interface and the memory array.



31-41-00-030 Rev 2

AIMS - CORE PROCESSOR MODULE/AIRPLANE CONDITION MONITORING FUNCTION FUNCTIONAL DESCRIPTION

AIMS - CORE PROCESSOR MODULE/GRAPHICS GENERATOR FUNCTIONAL DESCRIPTION

General

The core processor module/graphics generator (CPM/GG) uses the same hardware as the CPM/Basic and additional hardware to generate image data for the six display units.

The CPM/GGs do the calculations for the primary display system.

CPM/GG Hardware

In addition to the five standard CCAs, the CPM/GG has a sixth CCA. This sixth CCA is the graphics generator (GG) CCA. The graphics generator CCA generates display formats and transmits this information to the display units.

GG CCA

The GG CCA includes these functions:

- Core processor bus interface
- Vector generation logic
- Weather radar logic
- Data compression/transmission.

The core processor bus interface communicates with the processor CCA. It supplies the protocol for the data transfers between the GG CCA and the processor CCA.

The vector generation logic creates these display functions:

- Lines
- Arcs
- Characters
- Background shading colors.

The vector generation logic receives graphics instructions from the core processor bus interface. The vector generation logic supplies the display format data to the data compression/transmission logic.

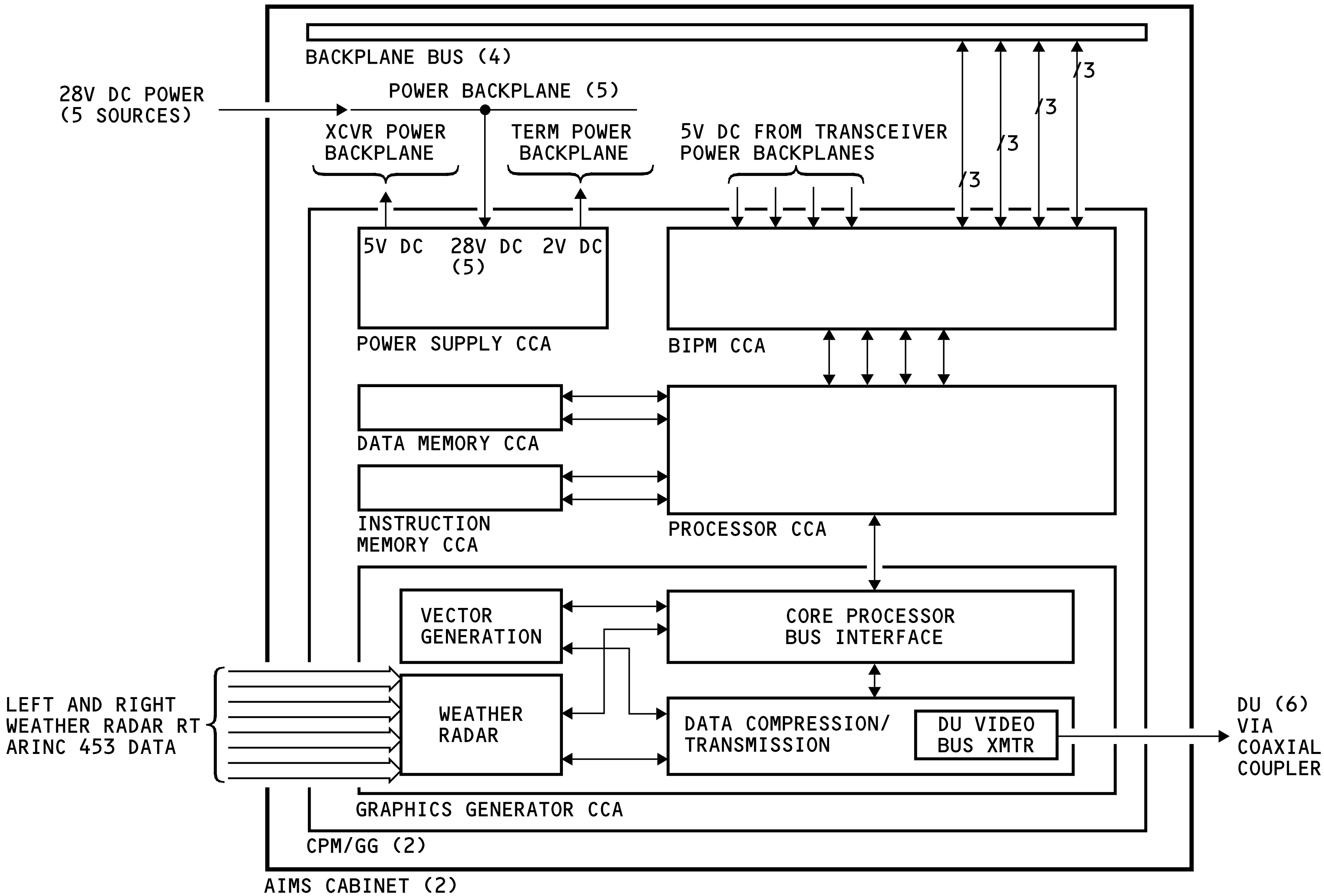
The weather radar logic does these functions:

- Receives weather radar ARINC 453 data from the left and right weather radar receiver-transmitters
- Creates raster type map image for display
- Calculates and adjusts the radar data to correct for airplane motion
- Supplies the weather radar data to the data compression/transmission logic.

The data compression/transmission logic:

- Combines data from the vector generation logic and the weather radar logic
- Compresses the data
- Transmits the data to the display units.

The data compression/transmission logic has a display unit video bus transmitter. The transmitter sends image data to the display units at a 125 Mbit per second rate. The data compression/transmission logic receives transmission instructions from the core processor bus interface.



AIMS - CORE PROCESSOR MODULE/GRAPHICS GENERATOR FUNCTIONAL DESCRIPTION

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AIMS - CORE PROCESSOR MODULE/COMMUNICATIONS FUNCTIONAL DESCRIPTION

General

The core processor module/communications (CPM/Comm) uses the same hardware as the CPM/Basic and additional hardware to supply unique interfaces not supplied by the IOMs.

The CPM/Comm does the calculations for these systems:

- Flight data recorder system
- Central maintenance computing system
- Data communication management system.

CPM/Comm Hardware

In addition to the five standard CCAs, the CPM/Comm has two additional CCAs. The two CCAs are the multifunction CCA and the fiber optics CCA.

Multi-Function CCA

The multifunction CCA has these interfaces:

- Core processor bus interface
- Datalink ARINC 618 interface
- FDR ARINC 717 interface
- QAR ARINC 717 interface
- QAR RS422 interface.

The core processor bus interface supplies the protocol for the data transfers between the processor CCA and the:

- Datalink ARINC 618 interface
- FDR ARINC 717 interface
- QAR ARINC 717 interface
- QAR RS422 interface
- Fiber optics interface in the fiber optics CCA.

The datalink ARINC 618 interface does these functions:

- Receives data modulated on tones from the center or right VHF communication transceiver
- Demodulates the tones and determines the message data
- Transmits the message data to the DCMF.

The datalink ARINC 618 interface also does these functions:

- Receives message data from the DCMF
- Modulates audio tones with the message data
- Transmits the data modulated on the audio tones to the center or right VHF radio.

The datalink ARINC 618 interface also transmits faults to the DCMF.

The center VHF communication transceiver interfaces with the CPM/Comm in the left AIMS cabinet. The right VHF communication transceiver interfaces with the CPM/Comm in the right AIMS cabinet.

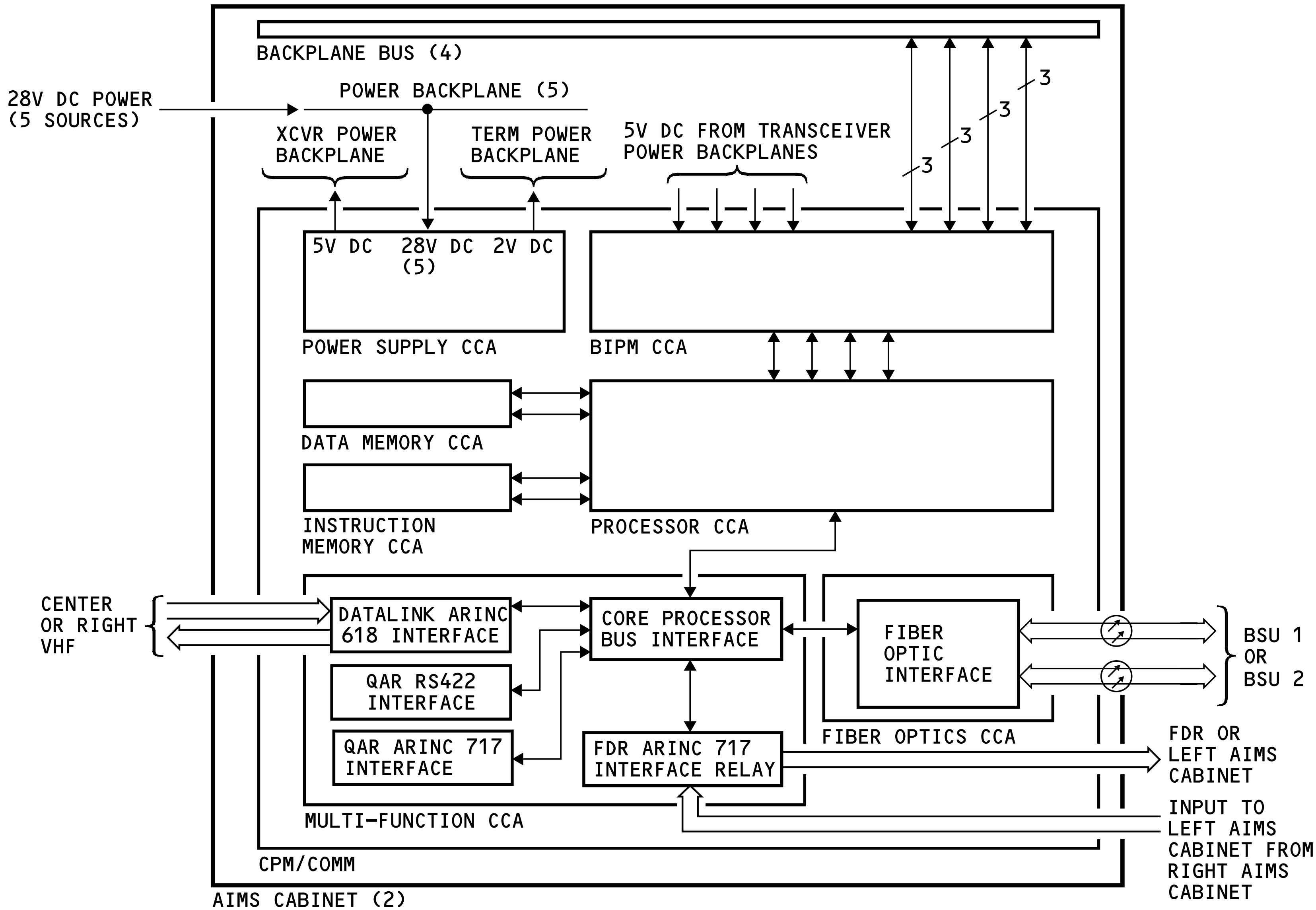
The FDR ARINC 717 interface receives data from the DFDAF software. The FDR ARINC 717 interface in the right AIMS cabinet transmits the data to a relay in the left AIMS cabinet. The DFDAF software in the left AIMS cabinet controls the relay and selects between the data received from the DFDAF in the left AIMS cabinet and the data received from the right AIMS cabinet. The FDR ARINC 717 interface in the left AIMS cabinet transmits the selected source of data from this relay to the FDR.

The FDR ARINC 717 interface also transmits faults to the DFDAF.

The QAR ARINC 717 and RS422 interface are not used.

Fiber Optics CCA

The fiber optics CCA contains two optic transmitters and receivers. These transmitters and receivers are the interface to the avionics local area network bypass switch units. The left AIMS cabinet communicates with BSU 1. The right AIMS cabinet communicates with BSU 2. The DCMF software in the CPM/Comm transfers data to and receives data from the fiber optics.



AIMS - CORE PROCESSOR MODULE/COMMUNICATIONS FUNCTIONAL DESCRIPTION

31-41-00-032 Rev 5 07/07/95

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AIMS - AIRLINE MODIFIABLE INFORMATION OVERVIEW

General

The airplane information management system (AIMS) must have several types of software loads. These are the types of software:

- Operational program software (OPS) in all CPMs and IOMs
- Operational configuration files (OPC) in all CPMs
- Navigation Data Base (NDB) software for the FMCF function
- Airline modifiable information (AMI) software for related functions.

The design of the 777 airplane gives the option to permit airlines to customize the operation of some of the functions in AIMS.

AMI software supplies this flexibility. Baseline AMI software and default values provides basic functionality for the related AIMS systems.

If you make the decision to modify or customize the basic functionality, you use the ground based software tool (GBST to develop the new AMI. You must have a Sun workstation to operate the software for the GBST.

Baseline AMIs

Baseline AMIs supply an initial level of functionality for several AIMS functions.These are the functions that use baseline AMIs:

- Airplane condition monitoring function (ACMF)
- Flight deck communication function (FDCF)
- Electronic checklist (ECL) portion of the primary display function (PDF)
- Central maintenance computing function (CMCF).

You load baseline AMIs software into the AIMS cabinet from a separate diskette. This software is in addition to the other software for the core processor module (CPM) that has the related function. A new or modified AMI load will replace any existing AMI software for that particular function.

Default Values

Default values also supply an initial level of functionality for several AIMS functions. These are the functions that use default values:

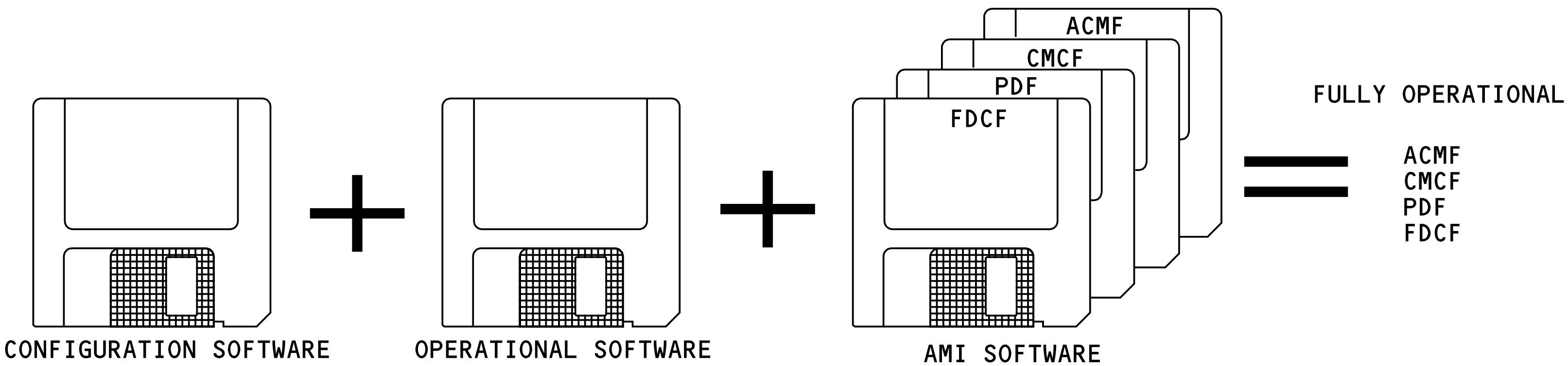
- Data communication management function (DCMF)
- Flight management computer function (FMCF).

Default values are hardcoded (non-modifiable) values found in the operational software of the CPM for the related functions. To cause the function to operate with new values you must develop a customized AMI and load that software into the CPM from a new diskette. These new values do not replace the default values but are used instead of the default values. If the AMI fails, the functions go back to the default values.

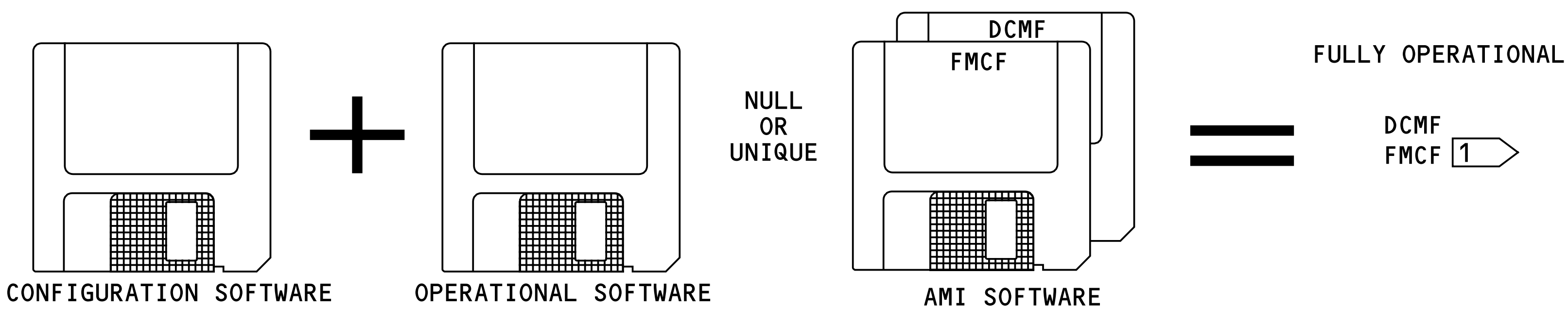
AIMS - AIRLINE MODIFIABLE INFORMATION OVERVIEW

Boeing initially installs a null AMI. A null AMI is a blank AMI that causes the related function to use the default values.

SYSTEMS WITH BASELINE AMI



SYSTEMS WITH DEFAULT VALUES



31-41-00-041 Rev 2 06/02/95

1 ALSO REQUIRES NAVIGATION DATA BASE SOFTWARE

AIMS - AIRLINE MODIFIABLE INFORMATION OVERVIEW

AIMS - SOFTWARE FUNCTIONAL DESCRIPTION

General

These are the four different types of software in the AIMS cabinet:

- Operational program software (OPS)
- Operational configuration files (OPC)
- Airline modifiable information (AMI)
- Database.

These are the two different types of data stored by the LRMs:

- Bite history data
- Run-time data.

These are the three different types of memory that the LRMs use to store the software and the data:

- Flash which is nonvolatile
- EEPROM which is nonvolatile
- SRAM which is volatile.

Operation Program Software

The OPS is the core software and the application software for the avionic functions. There is a unique software part number for each type of LRM. Modules that are the same, like all the IOMs and the two CPM/GGs, have the same part number.

The OPS is stored in flash memory which is nonvolatile memory. If you remove the module from the cabinet, you do not lose the OPS software. The OPS software can be loaded into the module either in the shop or when it is installed on the airplane.

Operation Program Configuration Files

The OPCs set the configuration of the airplane. The OPCs replace hardware program pins used on older model airplanes. There is only one OPC part number for the cabinet. This one part number includes the OPCs for several avionic functions.

The OPCs are in flash memory.

Training Information Point

There is only one OPC software part number for the cabinet. When you remove and replace one LRM, you can load the OPC into that LRM. When you load the OPC into the LRM, it will do a check to make sure it is the same OPC software that is in the other LRMs in the cabinet. This is to make sure that you can not load an OPC with a different part number into any LRM.

If the OPC software part number changes, you need to load the new OPC into all the LRMs in the cabinet. During a data load, you will get a dialog box that shows that the software is incompatible with the old OPC part number in the other LRMs. You can override and force the software to load into the LRM.

Airline Modifiable Information

The AMIs set the configuration of the airplane. This software, developed with the ground based software tool, gives the airlines more flexibility to define their configuration. Several avionic functions have an AMI. There is a separate software part number for each AMI.

The AMIs are in flash memory.

Database

There is one database for AIMS, the navigation database. The flight management computing function uses this database. There is only one part number for this database.

The database is in flash memory.

BITE History Data

Each LRM stores BITE history in EEPROM. EEPROM is nonvolatile memory. If you remove the LRM this BITE history is saved.

Run-Time Data

The run-time data is data that is generated by the operation of the cabinet. This run-time data is in SRAM. If you remove the module you will lose this data.

The hot battery bus power holds the data in SRAM, so that when you power down the airplane you do not lose this data.

Training Information Point

If you remove the LRM or if you remove the battery without primary power, you lose this run time data. Specific data that you lose includes:

- ACMF report data stored in the ACMF CCA
- Fault history data collected by the CMCF.

LRMs software

This is the software loaded into the CPM/Comm:

- CPM/Comm OPS (includes core software and DCGF, CMCF, DCMF, DFDAF, FDCF, QARF)
- AIMS OPC
- AMI for CMCF
- AMI for DCMF
- AMI for FDCF.

This is the software loaded into the CPM/ACMF:

- CPM/ACMF OPS (includes core software and DCGF, ACMF, FMCF, TMCF, and performance database)
- AIMS OPC
- AMI for FMCF
- AMI for ACMF
- Nav database.

AIMS - SOFTWARE FUNCTIONAL DESCRIPTION

This is the software loaded into the CPM/Basic:

- CPM/Basic OPS (includes core software and DCGF, FMCF, TMCF, and performance database.)
- AIMS OPC
- AMI for FMCF
- Nav database.

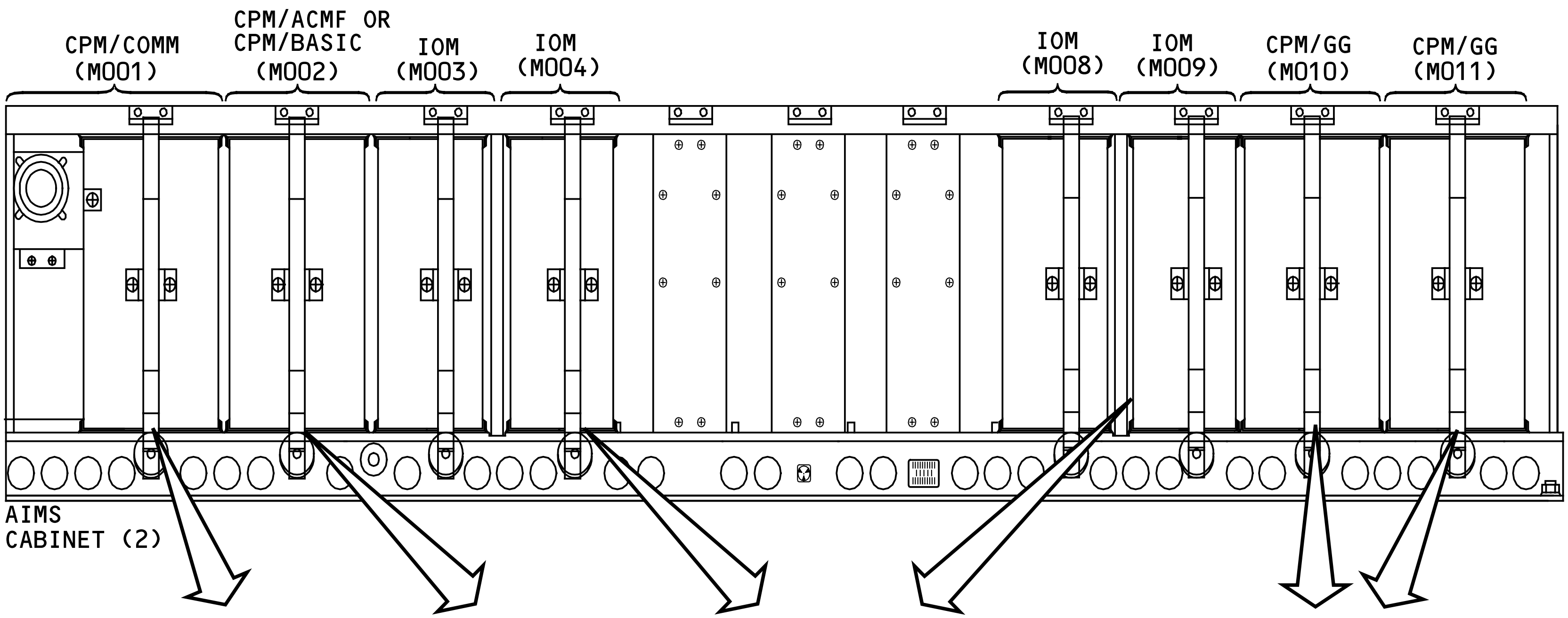
This is the software loaded into the CPM/GGs:

- CPM/GG OPS (includes core software, DCGF and PDF)
- AMI for PDF
- AIMS OPC.

The software loaded into the IOMs is IOM OPS (includes core software).

<u>Training Information Point</u>

The status message AIMS shows when there is a difference between the OPCs or program pins of the left and right AIMS cabinets. This is monitored at power up or when this software is loaded.



<u>CPM/COMM</u>

CPM/COMM OPS
AIMS OPC
AMI FOR CMCF
AMI FOR DCMF
AMI FOR FDCF

<u>CPM/BASIC</u>

CPM/BASIC OPS
AIMS OPC
AMI FOR FMCF
NAV DATABASE

<u>CPM/ACMF</u>

CPM/ACMF OPS
AIMS OPC
AMI FOR FMCF
AMI FOR ACMF
NAV DATABASE

<u>IOM</u>

IOM OPS

<u>CPM/GG</u>

CPM/GG OPS
AIMS OPC
AMI FOR PDF

AIMS - SOFTWARE FUNCTIONAL DESCRIPTION

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AIMS - DATA CONVERSION GATEWAY FUNCTION FUNCTIONAL DESCRIPTION

General

The data conversion gateway function (DCGF) has these five primary purposes:

- Transfer data between the flight control ARINC 629 buses and analog, analog discrete and ARINC 429 buses
- Transfer data between the systems ARINC 629 buses and analog, analog discrete and ARINC 429 buses
- Transfer data between the systems ARINC 629 buses and the flight control ARINC 629 buses
- Isolate transfer of engine data between the flight control ARINC 629 buses and the systems ARINC 629 buses
- Isolate transfer of engine data between the systems ARINC 629 buses and analog, analog discrete and ARINC 429 buses.

All DCGF data transfers follow the same basic data flow. The IOMs receive the data. The data then moves to the CPMs over the backplane data bus. The CPMs reformat the data and send the data back to the IOMs. The IOMs then transmit the data.

DCGF Types

There are seven different types of data transfer.

DCGF Type 1: The AIMS cabinets receive ARINC 429, analog discrete signals, and analog signals and transmit the data to the flight controls ARINC 629 buses.

DCGF Type 2: The AIMS cabinets receive ARINC 429 and analog discrete signals and transmit the data to the systems ARINC 629 buses.

DCGF Type 3: The AIMS cabinets receive data from the flight controls ARINC 629 buses and transmit the data to the systems ARINC 629 buses.

DCGF Type 4: The AIMS cabinets receive data from the systems ARINC 629 buses and transmit the data to the flight controls ARINC 629 buses.

DCGF Type 5: The AIMS cabinets receive data from the flight controls ARINC 629 buses and transmit ARINC 429 data and analog discrete signals.

DCGF Type 6: The AIMS cabinets receive data from the systems ARINC 629 buses and transmit ARINC 429 data and analog discrete signals.

DCGF Type 7: The AIMS cabinets receive data from a systems ARINC 629 bus and transmit the data to another systems ARINC 629 bus.

DCGF Software

Each AIMS cabinet has two DCGFs. Each DCGF has a master and a shadow. The master is in control unless the CPM fails. Then the shadow takes over. DCGF1 is in the two CPM/GGs. CPM/GG M0010 is the master and CPM/GG M0011 is the shadow. DCGF2 is in the CPM/COMM and the CPM/Basic or CPM/ACMF. The CPM/Basic or CPM/ACMF is the master

AIMS - DATA CONVERSION GATEWAY FUNCTION FUNCTIONAL DESCRIPTION

and the CPM/COMM is the shadow. DCGF1 and DCGF2 operate independently.

DCGF1 processes left engine data, data transfers and AOA and TAT calculations. DCGF2 processes right engine data and data transfers.

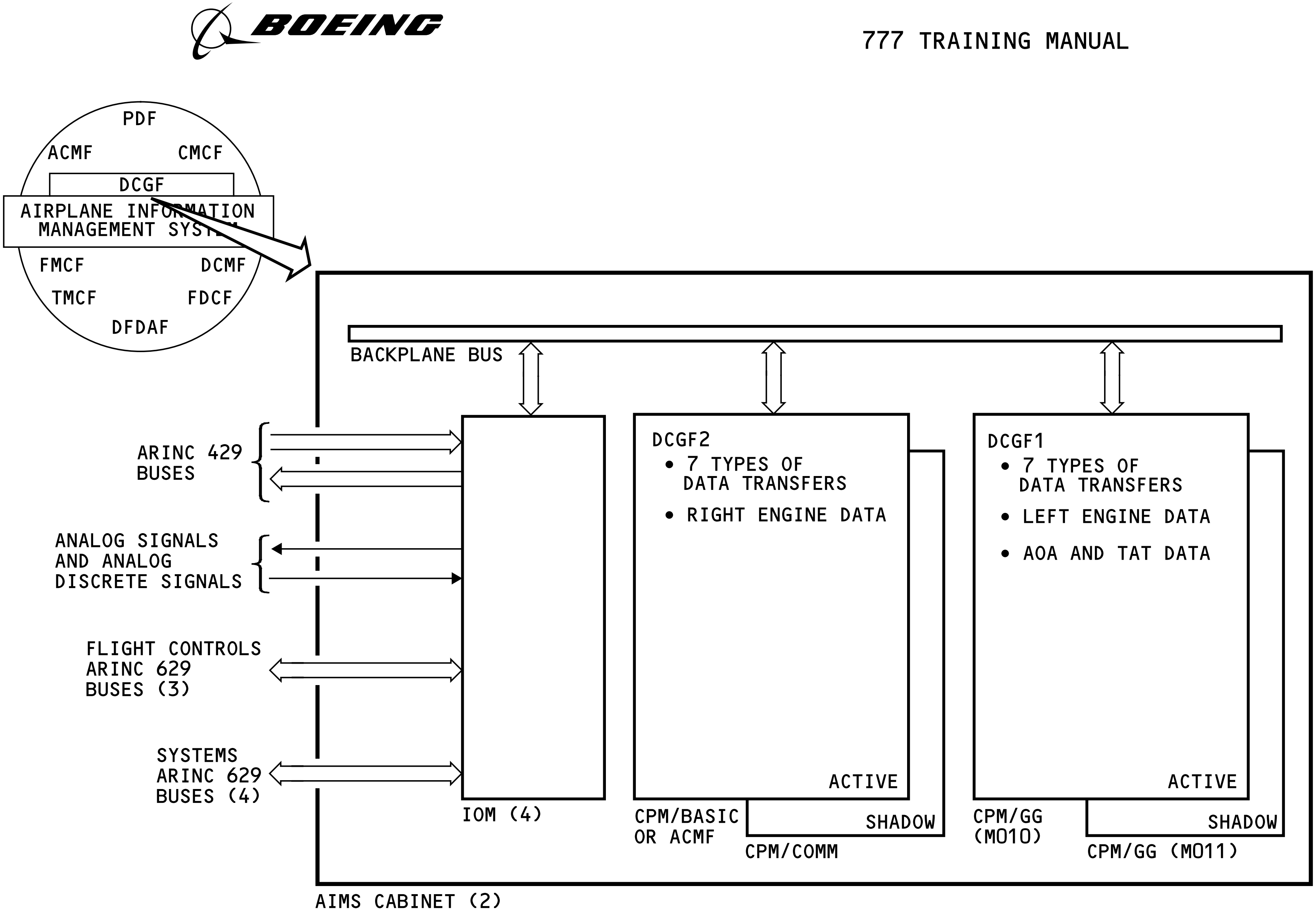
The engine data is data that goes to and from both engines for control and indication. This data goes to the EECs via the engine data interface units:

- ADIRU and SAARU data
- Autothrottle trim commands
- Condition of various engine related flight deck controls and switches.

Training Information Point

The status message AIMS shows when the DCGF fails in more than one of the CPMs or there is insufficient input/output resources for more than one second.

When only one of the DCGFs fail, a scheduled maintenance task (SMT) message AIMS CABINET LRM shows. It is a requirement that you do a check for this SMT message every 30 days. If the SMT message shows, you must do the corrective action for the DCGF. The SMT messages are on the maintenance task maintenance page.



31-41-00-034 Rev 3 04/26/95

AIMS - DATA CONVERSION GATEWAY FUNCTION FUNCTIONAL DESCRIPTION

AIMS - UNIVERSAL TIME (COORDINATED) FUNCTION FUNCTIONAL DESCRIPTION

General

The core processor modules (CPMs) each perform the universal time (coordinated) function (UTCF) in addition to their other major functions.

Each CPM has a UTCF that supplies universal time (coordinated) (UTC) and date to all the functions in that CPM. One of the CPMs in each cabinet also sends UTC and date to the other airplane systems.

Time and Date Calculation

The AIMS cabinets receive time and date data from the global positioning system sensor units (GPSSUs). The GPSSUs also send an analog time mark once per second. The UTCF uses the time mark signal and the time data to calculate the UTC.

CPM Interface

The UTCF in each CPM computes the UTC and provides the UTC and date to the functions on that CPM. The UTCF uses the left GPSSU data if it is valid. Otherwise, the UTCF uses the right GPSSU data.

If GPSSU data is not available, the UTCF maintains the UTC and the date. It does this based on the last valid data received from the GPSSU and its own internal clock.

The hot battery bus power permits the CPM clocks to continue to keep time when no other sources of power is available to the CPMs.

User System Interface

Each AIMS cabinet transmits UTC and date data to other airplane systems on these ARINC 429 data buses:

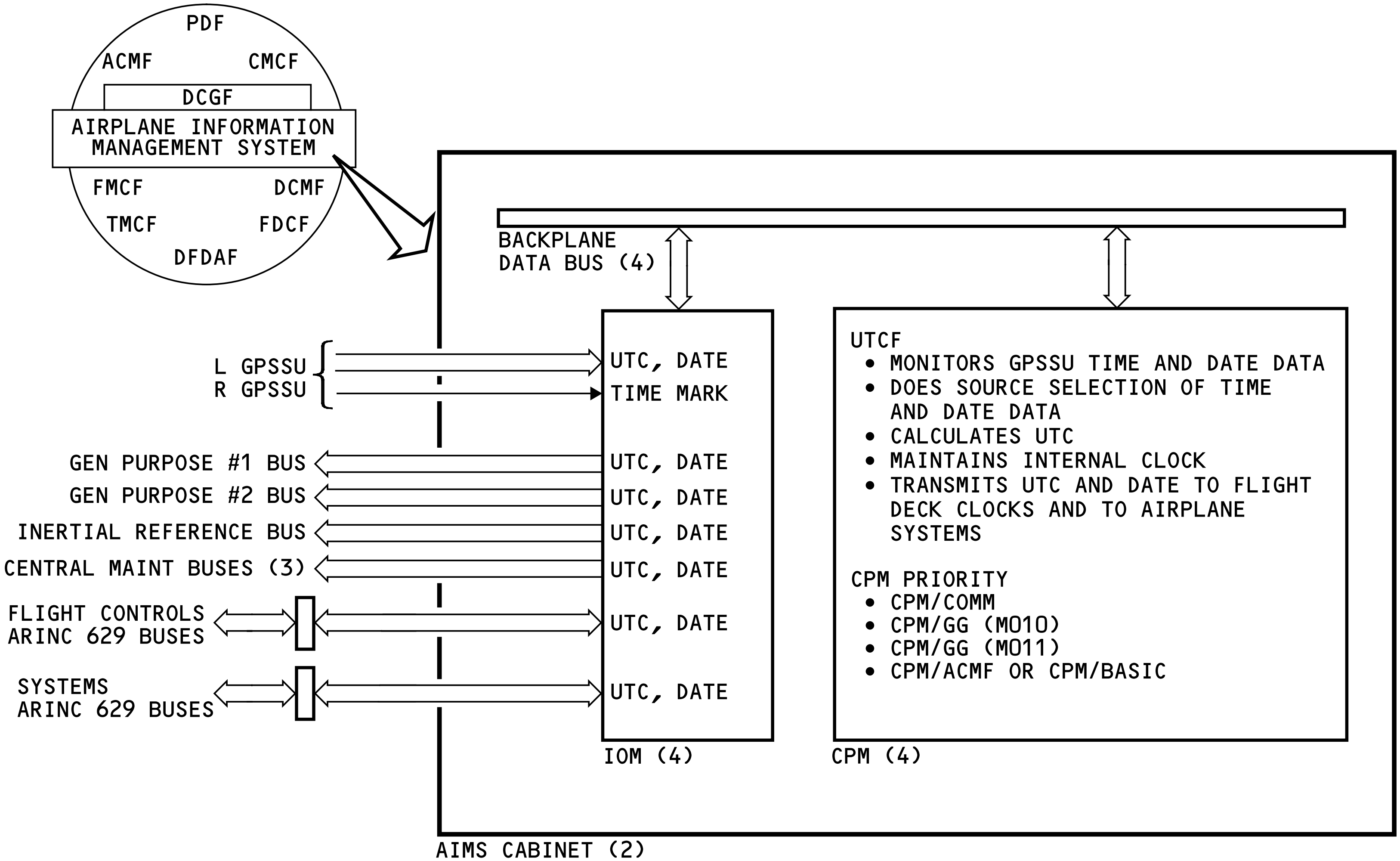
- General purpose #1 bus
- General purpose #2 bus
- Inertial reference bus
- Central maintenance buses (L/C/R).

Each AIMS cabinet transmits UTC and date data to other airplane systems on these ARINC 629 data buses:

- Flight controls buses
- Systems buses.

Only one of the four CPMs in a cabinet sends time and date data to other airplane systems. The priority for the CPM that sends the data is:

- CPM/Comm
- CPM/GG (M010)
- CPM/GG (M011)
- CPM/ACMF or CPM/Basic.



31-41-00-035 Rev 2 06/22/95

AIMS - UNIVERSAL TIME (COORDINATED) FUNCTION FUNCTIONAL DESCRIPTION

AIMS - SYSTEM GROUND TESTS

General

These are the two different types of systems tests:

- IOM module reset test
- CPM reset test.

IOM Module Reset Test

Each of the four IOMs have an individual module reset test.

This test makes sure that the IOM operates correctly. The approximate time to run the test is less than one minute. After the test starts, you can not stop it.

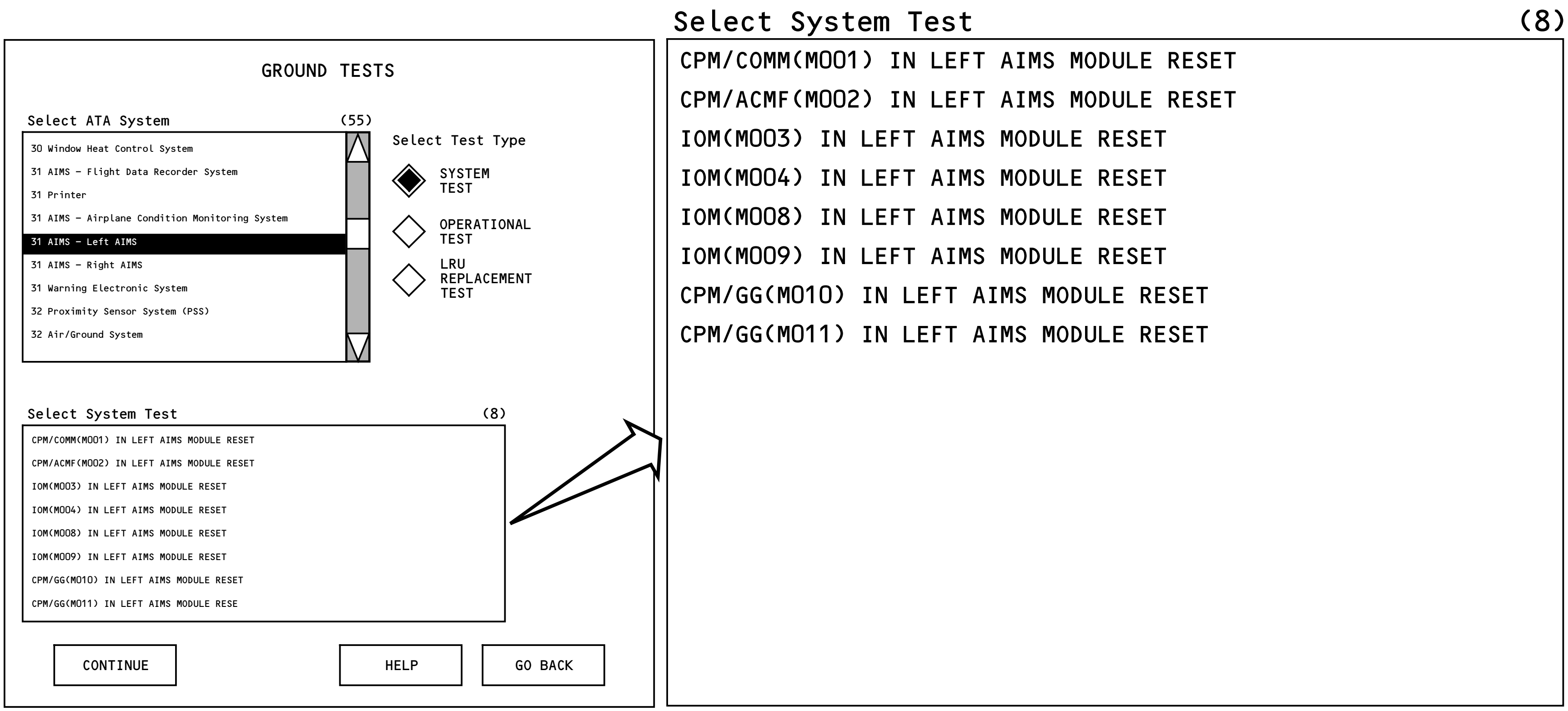
This test may show failures of fault tolerant components which may not have an effect on airworthiness. Use EICAS messages with the proper documentation to find airworthiness.

CPM Module Reset Test

Each of the four CPMs have an individual module reset test.

This test makes sure that the CPM operates correctly. The approximate time to run the test is less than one minute. After the test starts, you can not stop it.

This test may show failures of fault tolerant components which may not have an effect on airworthiness. Use EICAS messages with the proper documentation to find airworthiness.



31-41-00-036 Rev 2 05/12/1995

AIMS - SYSTEM GROUND TESTS

AIMS - OPERATIONAL TESTS

General

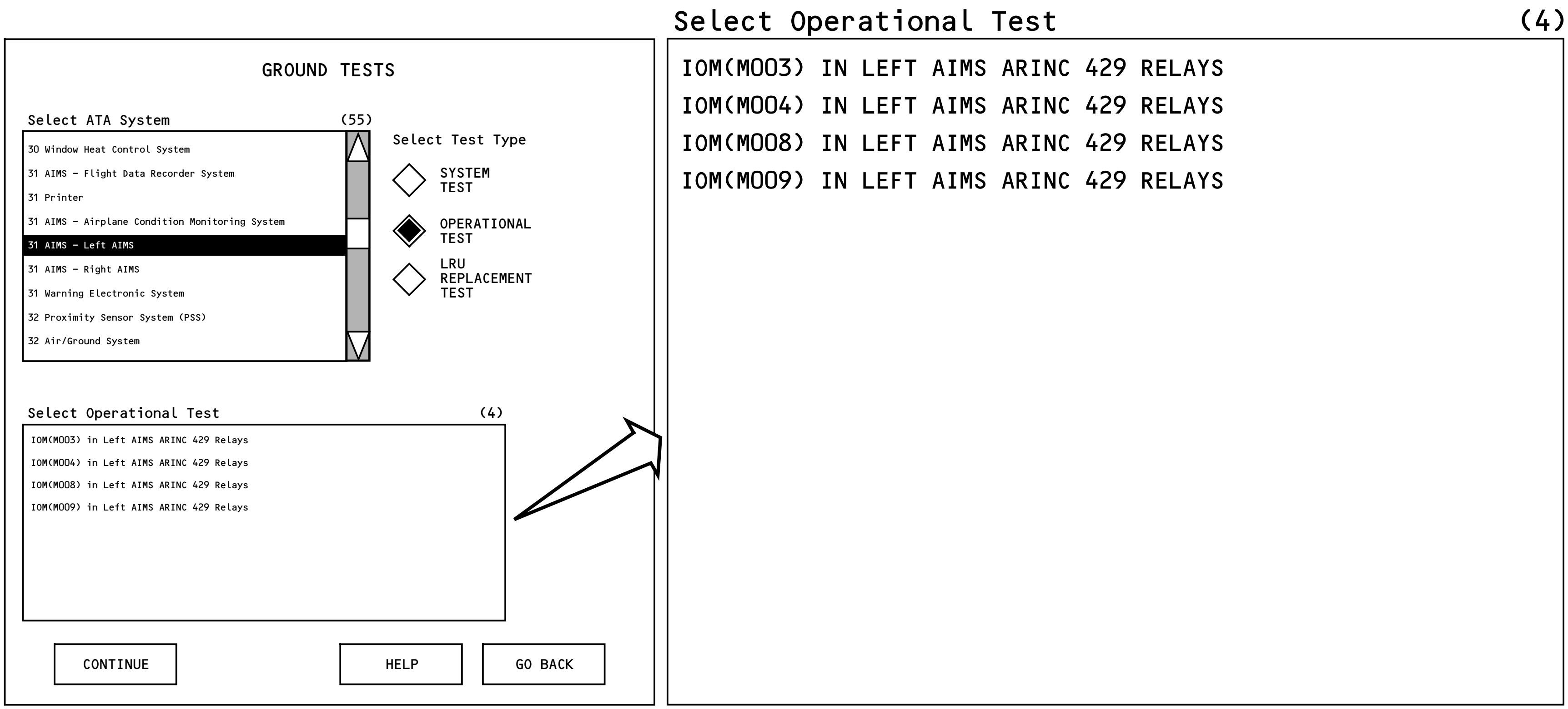
You can do AIMS operational tests from the MAT. Use the operational test to do a check of the ARINC 429 relays in each IOM.

Operational Tests

Each of the four IOMs has an operational test.

This test makes sure that the ARINC 429 relays in the IOM operate correctly. The approximate time to run the test is less than one minute. After this test starts, you can not stop it.

This test may show failures of fault tolerant components which may not have an effect on airworthiness. Use EICAS messages and proper documentation to find airworthiness.



31-41-00-042 Rev 2 03/31/1998

AIMS - OPERATIONAL TESTS

AIMS - LRU REPLACEMENT TESTS

General

These are the two LRU replacement tests:

- IOM module reset test
- CPM reset test.

IOM Module Reset Test

Each of the four IOMs has an individual module reset test.

This test makes sure that the IOM operates correctly. The approximate time to run the test is less than one minute. After the test starts, you can not stop it.

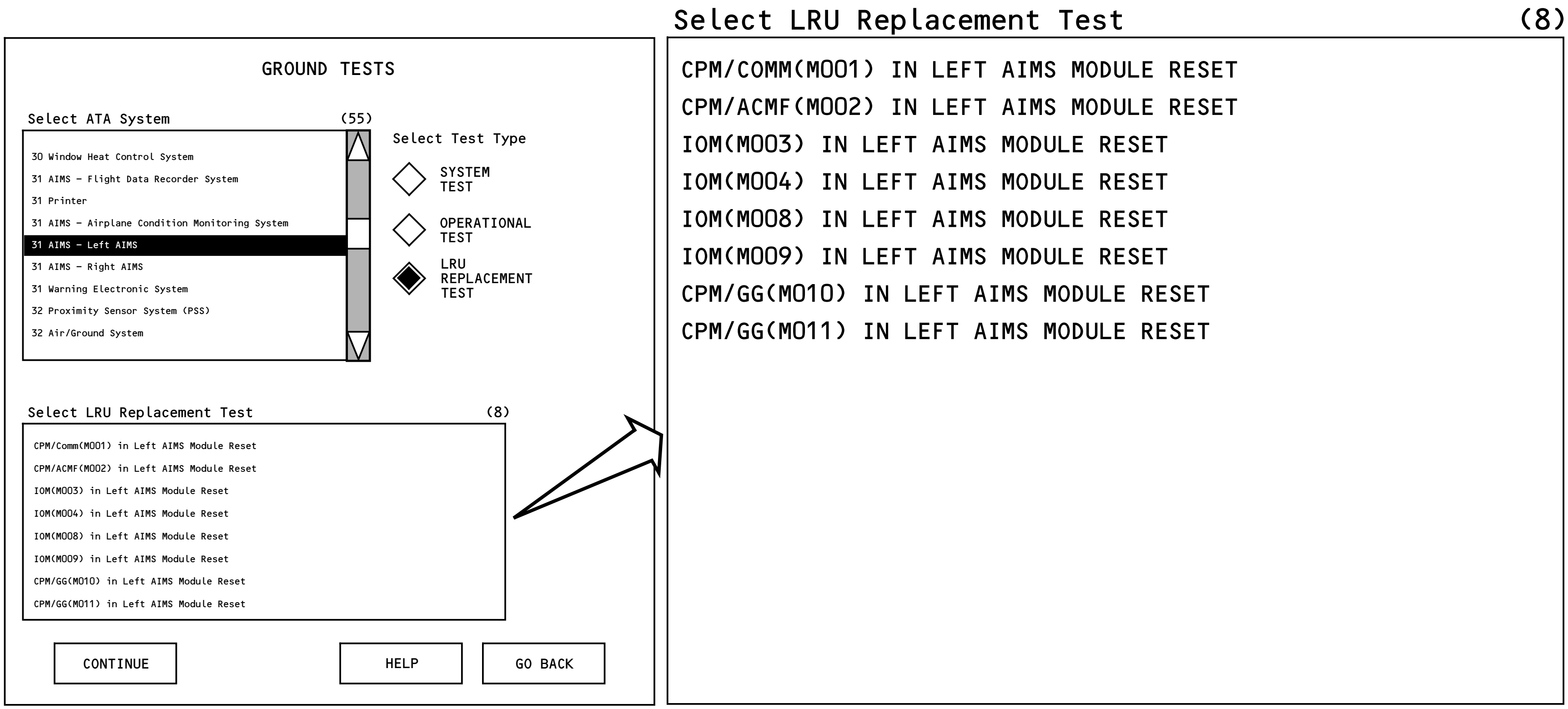
This test may show failures of fault tolerant components which may not have an effect on airworthiness. Use EICAS messages and proper documentation to find airworthiness.

CPM Module Reset Test

Each of the four CPMs has an individual module reset test.

This test makes sure that the CPM operates correctly. The approximate time to run the test is less than one minute. After the test starts, you can not stop it.

This test may show failures of fault tolerant components which may not have an effect on airworthiness. Use EICAS messages and proper documentation to find airworthiness.



31-41-00-043 Rev 2 03/31/1998

AIMS - LRU REPLACEMENT TESTS

Continental Airlines, Inc

Primary Display System

WB371

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Continental Airlines, Inc
Primary Display System
WB371

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Continental Airlines, Inc
Primary Display System
WB371

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PRIMARY DISPLAY SYSTEM - INTRODUCTION

General

The primary display system (PDS) is part of the airplane information management system (AIMS). The PDS shows information in many different formats on six display units (DUs) in the flight deck. The information includes:

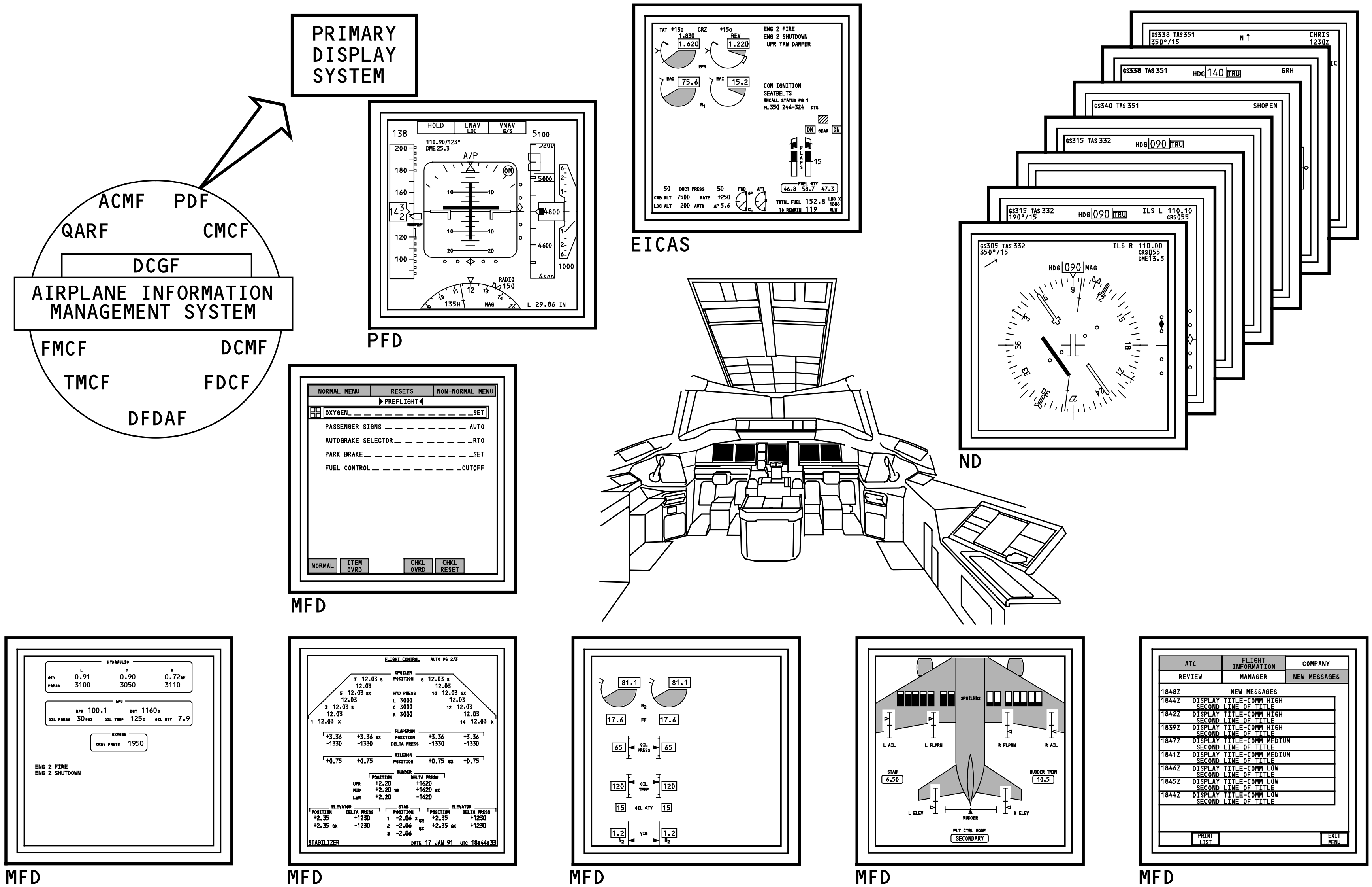
- Airplane status
- Navigation data
- Flight plan data
- Engine indicating and crew alerting data
- Communication data
- Checklists
- Maintenance data.

Abbreviations and Acronyms

ACARS	- aircraft communications addressing and reporting system
ACE	- actuator control electronics
acpt	- accept
ADIRS	- air data inertial reference system
ADIRU	- air data inertial reference unit
AFDS	- autopilot flight director system
ail	- aileron
AIMS	- airplane information management system
ALDB	- airline loadable database
alt	- altitude
altn	- alternate
app	- approach
ARINC	- Aeronautical Radio, Inc.
arpt	- airport
att	- attitude
baro	- barometric
BLS	- bezel light sensor
brks	- brakes
canc	- cancel
capt	- captain
CAS	- calibrated airspeed
CCD	- cursor control device
CDU	- control display unit
chkl	- checklist
CMCF	- central maintenance computing function
comm	- communication
CPM/GG	- core processor module/graphics generator
crz	- cruise
DH	- decision height
DSP	- display select panel
dspl	- display
DU	- display unit
EFIS CP	- electronic flight instrument system control panel
EGT	- exhaust gas temperature
EICAS	- engine indication and crew alerting system
elev	- elevator
eng	- engine
EPCS	- electronic propulsion control system
ESI	- engine start inhibit

excd - exceedance
ext - external
fctl - flight control
F/D - flight director
FDCF - flight deck communication function
FF - fuel flow
flprn - flaperon
flt - flight
FMA - flight mode annunciation
FMCF - flight management computing function
FMCS - flight management computing system
F/O - first officer
FPV - flight path vector
FPA - flight path angle
FSEU - flap slat electronics unit
fwd - forward
GPWS - ground proximity warning system
GS - glide slope
G/S - ground speed
hdg - heading
hPa - hectopascal
hyd - hydraulic
IDG - integrated drive generator
ILS - instrument landing system
IM - inner marker
inbd - inboard
IOM - input/output module
isln - isolation
ISSP - instrument source select panel
lim - limit
LNAV - lateral navigation
lo - low
loc - localizer
LRU - line replaceable unit
LRM - line replaceable module
LSK - line select key
mag - magnetic
MAT - maintenance access terminal
MCP - mode control panel
MDA - minimum descent altitude
MFD - multi-function display
MINS - minimums
MLW - maximum landing weight
MM - middle marker
MMEL - master minimum equipment list
MMO - maximum operating mach number
MTRS - meters
nav - navigation
NCD - no computed data
ND - navigation display
NVM - nonvolatile memory
N1 - low pressure rotor speed
N2 - high pressure compressor RPM
OF - overfull
OM - outer marker
OPAS - overhead panel ARINC 629 system
outbd - outboard
ovht - overheat

PDS	- primary display system
PFD	- primary flight display
pln	- plan
pos	- position
QFE	- altimeter setting to indicate height above reference airfield
QNH	- altimeter setting to indicate height above mean sea level
QRH	- quick reference handbook
RA	- radio altitude
RA	- resolution advisory
rcd	- record
rcl	- recall
ref	- reference
rev	- reverser
RF	- refill
rjct	- reject
RLS	- remote light sensor
RTO	- rejected takeoff
SAI	- system analysis item
SATCOM	- satellite communications
SMT	- scheduled maintenance task
SPD	- speed
stat	- status
std	- standard
TA	- traffic advisory
TAI	- thermal anti-ice
TAS	- true airspeed
TCAS	- traffic alert and collision avoidance system
TCW	- time critical warning
temp	- temperature
tfc	- traffic
trk	- track
upr	- upper
UTC	- universal time (coordinated)
vert	- vertical
vib	- vibration
vlv	- valve
VMO	- maximum operating limit speed
VNAV	- vertical navigation
VR	- rotation speed
VREF	- landing reference speed
VSI	- vertical speed indicator
VS	- stall speed
VTK	- vertical track
VTO	- volumetric topoff
V1	- takeoff decision speed
V2	- takeoff safety speed
WAI	- wing anti-ice
WES	- warning electronics system
wpt	- waypoint
WXR	- weather radar
X-BLD	- cross bleed



PRIMARY DISPLAY SYSTEM - INTRODUCTION

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PRIMARY DISPLAY SYSTEM - GENERAL DESCRIPTION

General

The AIMS PDS provides dynamic and static information to the flight and ground crews. The PDS also provides crew interface with other avionics systems. These are the major components of the AIMS PDS:

- Six display units (DUs)
- Two EFIS control panels (EFIS CPs)
- Display select panel (DSP)
- Two cursor control devices (CCDs)
- Two remote light sensors (RLSs)
- Two instrument source select panels (ISSPs)
- Two display switching panels
- Center display control panel.

Three control display units (CDU) give alternate EFIS CP functions and alternate DSP functions.

Overhead Panel ARINC 629 System (OPAS) Interface

These are the control panels that interface with the OPAS:

- DSP
- Two CCDs
- Two ISSPs
- Two display switching panels
- Center display control panel.

OPAS multiplexes the signals and sends the data to the systems ARINC 629 data buses.

OPAS also sends control information to each control panel.

AIMS Cabinet Interfaces

The AIMS cabinets get airplane information on the ARINC 629 flight controls and system buses and the ARINC 429 buses. The AIMS cabinets also get analog and analog discrete data.

The AIMS cabinets get control information from the two EFIS CPs and the two CCDs on ARINC 429 data buses. Additional control information comes from the three CDUs on the systems ARINC 629 buses.

The AIMS cabinets send information to the display units on high speed coax lines through four coax couplers.

Two remote light sensors supply inputs to the two outboard display units. Other flight deck controls supply additional brightness and contrast controls for the display units.

Each display unit sends information to the AIMS cabinets on ARINC 429 data buses. This data is for fault reporting and brightness controls.

DU Location and Formats

Location determines which types of display format shows. These are the display locations:

- Left outboard DU

PRIMARY DISPLAY SYSTEM - GENERAL DESCRIPTION

- Left inboard DU
- Upper center DU
- Lower center DU
- Right inboard DU
- Right outboard DU.

The format that each DU shows depends on its location. DU status, location, and switch inputs determine the format a DU shows. These are the formats a DU can show:

- Primary flight display (PFD)
- Navigation display (ND)
- EICAS
- Multifunction display (MFD).

The left and right outboard DUs show only a PFD format.

The left and right inboard DUs normally show the ND format. They can show these formats:

- PFD
- EICAS
- MFD.

The upper center DU shows only the EICAS format. The lower center DU normally shows the MFD format. It can show these formats:

- EICAS
- ND
- MFD.

Each format has one or more modes. Flight deck control inputs and other system inputs determine which mode shows.

The PFD has only one mode.

The ND has these seven modes:

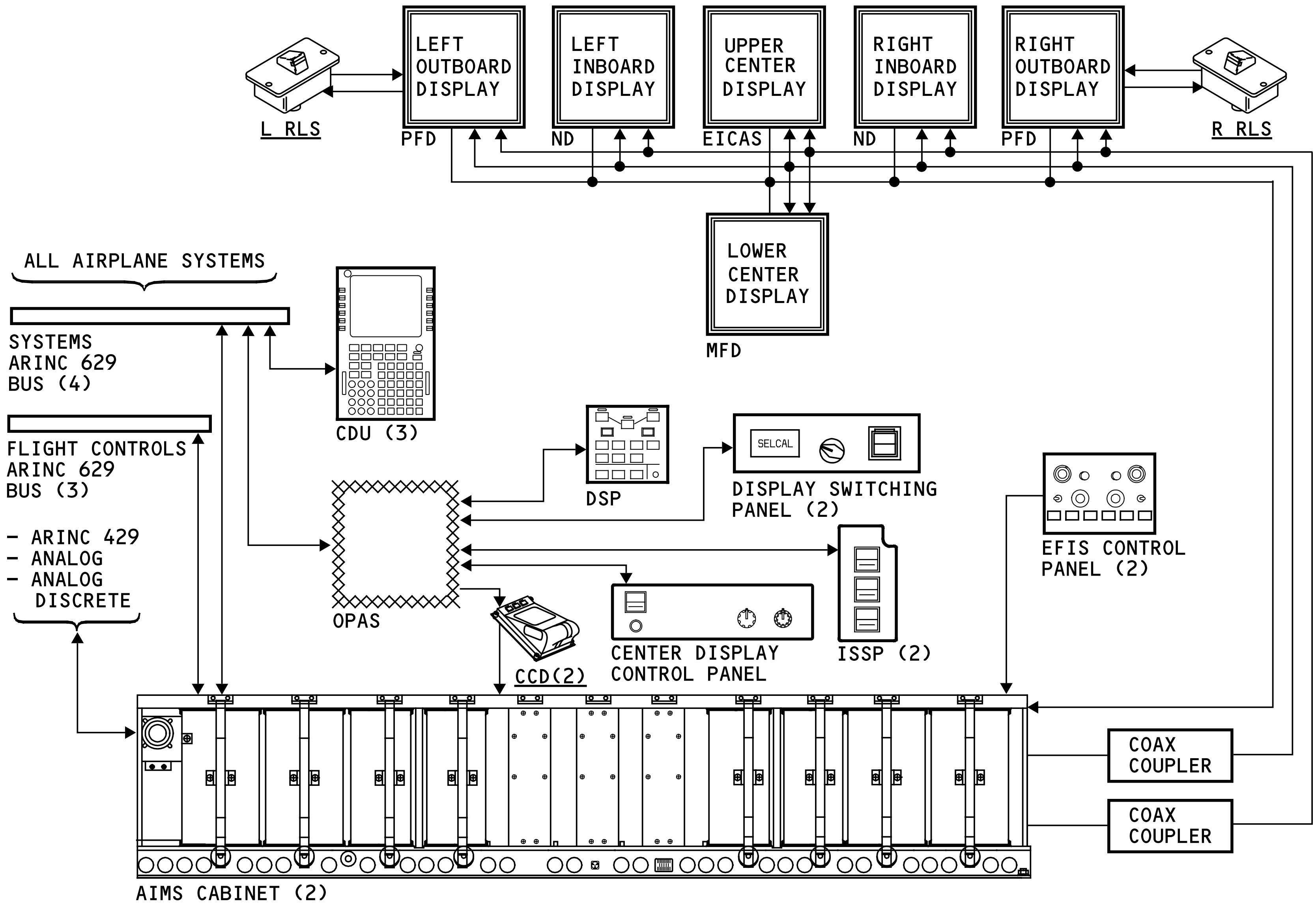
- Centered approach mode
- Expanded approach mode
- Centered VOR mode
- Expanded VOR mode
- Centered map mode
- Expanded map mode
- Plan mode.

The EICAS display can show the normal display or a compacted format.

The MFD can show these formats:

- Secondary engine display
- Status display
- Synoptic display (7)
- Maintenance page (19)
- Checklists display
- Communication display.

The PFD, EICAS and secondary engine formats are critical formats. The ND and other MFD formats are essential formats.



PRIMARY DISPLAY SYSTEM - GENERAL DESCRIPTION

PRIMARY DISPLAY SYSTEM - COMPONENT LOCATIONS - 1

Major Components

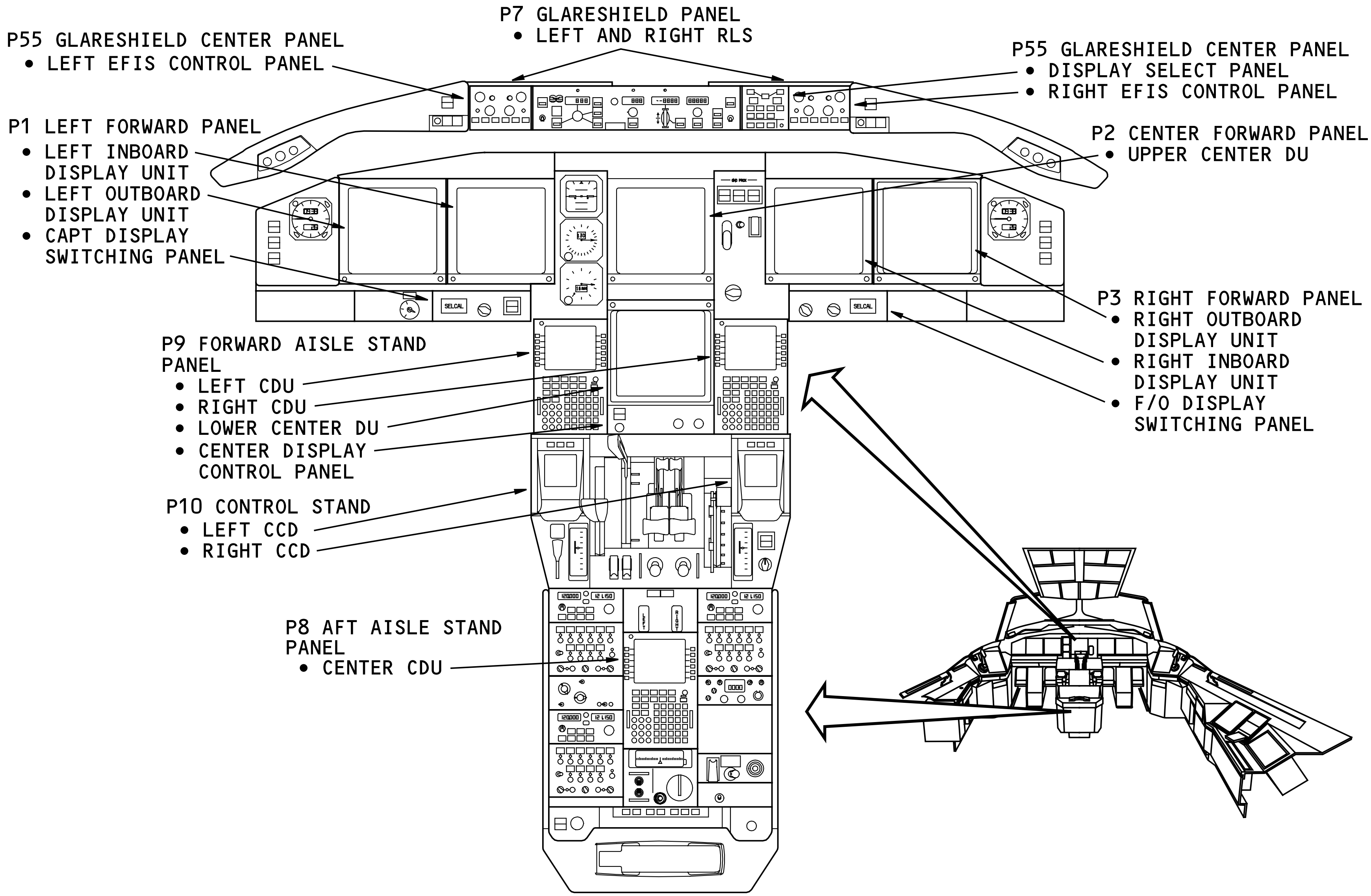
The primary display system major components in the flight deck are:

- Left outboard display unit (DU)
- Left inboard DU
- Right outboard DU
- Right inboard DU
- Upper center DU
- Lower center DU
- Left EFIS control panel (CP)
- Right EFIS CP
- Display select panel
- Left cursor control device (CCD)
- Right CCD
- Left Remote Light Sensor (RLS)
- Right RLS
- Captain's display switching panel
- F/O display switching panel
- Center display control panel.

Miscellaneous Components

Other controls and switches in the flight deck are:

- Left control display unit (CDU)
- Right CDU
- Center CDU.



PRIMARY DISPLAY SYSTEM - COMPONENT LOCATIONS - 1

31-61-00-003 Rev 2

PRIMARY DISPLAY SYSTEM - COMPONENT LOCATIONS - 2

Miscellaneous Components

There are these control panels and switches in the flight deck:

- Left instrument source select panel (ISSP)
- Right ISSP
- Captain's data uplink control switches
- F/O data uplink control switches
- Captain's master warning and caution light
- F/O master warning and caution light
- Captain's forward panel brightness controls
- F/O forward panel brightness controls.

These are the data uplink control switches:

- Accept switch
- Cancel switch
- Reject switch.

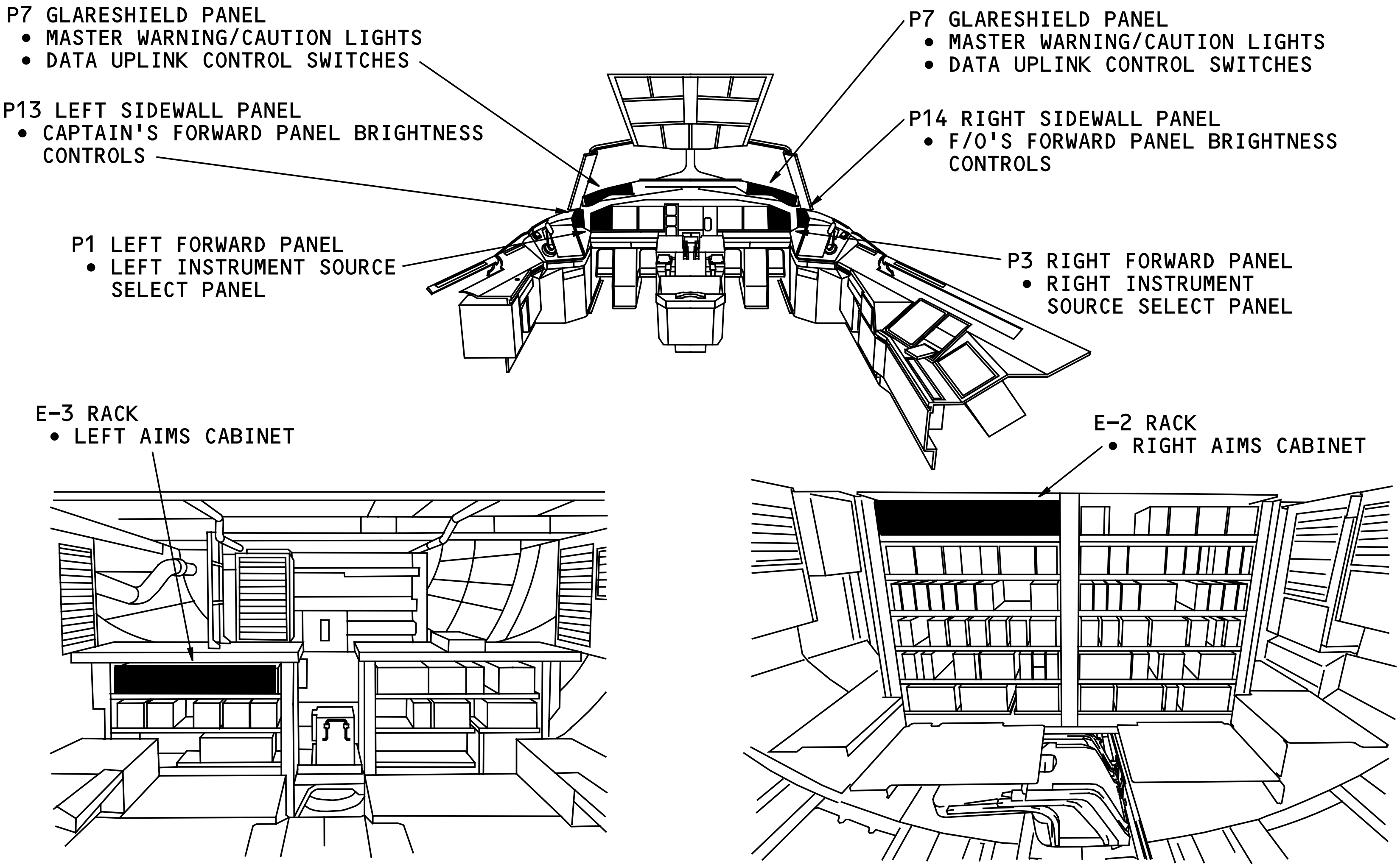
These are the forward panel brightness controls:

- Outboard display brightness control
- Inboard display brightness control
- Inboard display weather radar brightness control.

PDS Components

The left AIMS cabinet is on the E3-1 rack in the main equipment center.

The right aims cabinet is on the E2-1 rack in the main equipment center.



MAIN EQUIPMENT CENTER
(LOOKING FORWARD)

MAIN EQUIPMENT CENTER
(LOOKING AFT)

31-61-00-004 Rev 1

PRIMARY DISPLAY SYSTEM - COMPONENT LOCATIONS - 2

PRIMARY DISPLAY SYSTEM - SYSTEM INTERFACE

OPAS Interface

The overhead panel ARINC 629 system (OPAS) receives control panel and switch input data from the flight deck. OPAS multiplexes the analog and discrete data and sends it to AIMS on the systems ARINC 629 bus. OPAS sends control signals to each of the control panels. These components interface with OPAS:

- Display select panel (DSP)
- Two cursor control devices (CCD)
- Two display switching panels
- Two instrument source select panels (ISSP)
- Center display control panel.

Primary Display Function (PDF) of AIMS Interface

The PDF of AIMS gets control information from the two EFIS CPs and the two CCDs on ARINC 429 data buses and from the overhead panel ARINC system (OPAS) on the systems ARINC 629 data buses. Additional control information comes from the three CDUs on the systems ARINC 629 buses.

The PDF of AIMS gets airplane information on these buses for display:

- Flight controls ARINC 629 buses (3)
- Systems ARINC 629 buses (4)
- ARINC 429 buses.

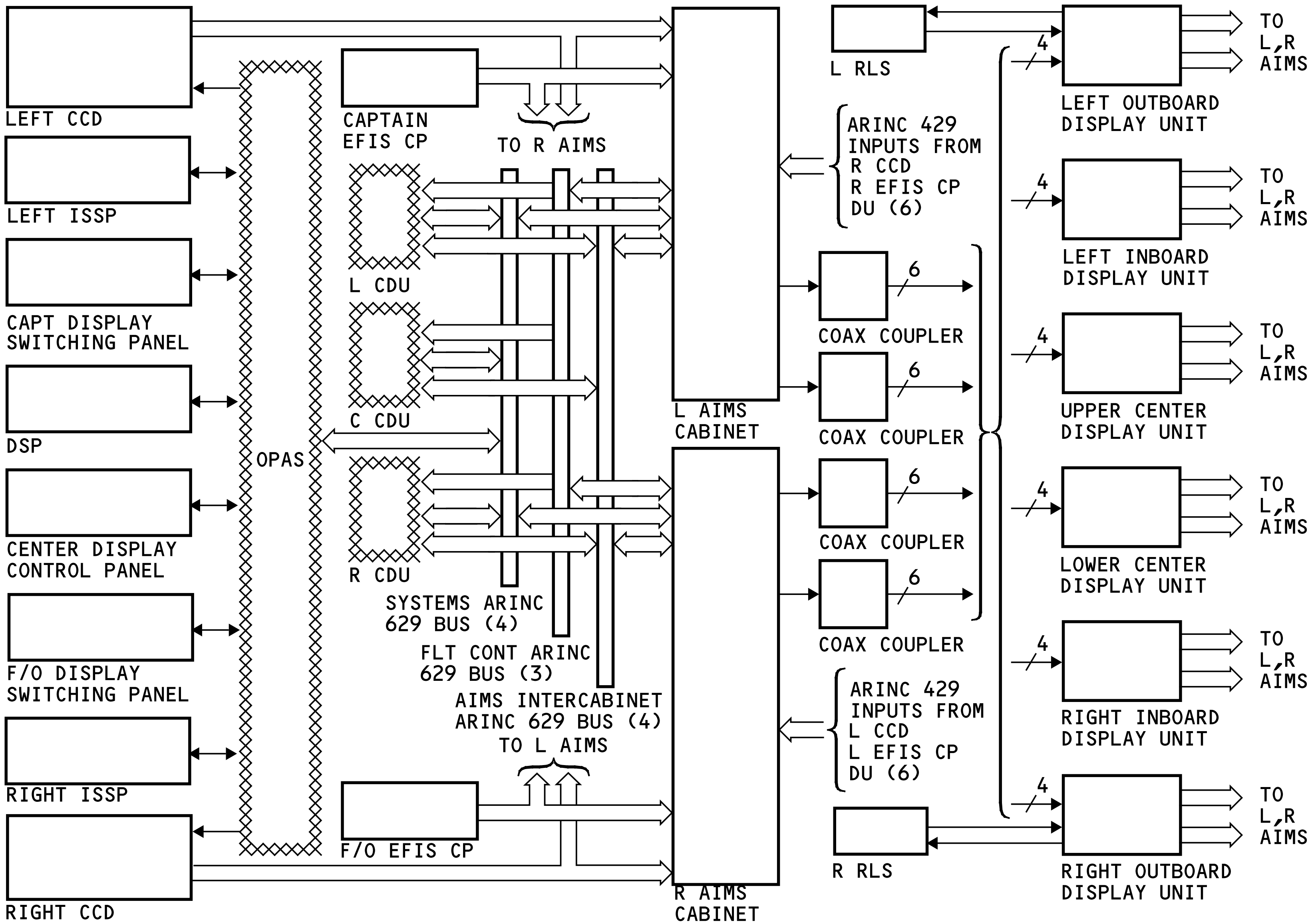
The interface between the two AIMS cabinets is on four ARINC 629 intercabinet buses. The PDF of AIMS shares data for redundancy and configuration management.

Display Unit (DU) Interface

The AIMS cabinets send information to the DUs on high speed coaxial-lines through four coaxial couplers. Each coaxial coupler sends data to each DU.

Two remote light sensors (RLS) supply inputs to the two outboard DUs, left RLS to left inboard DU and right RLS to right outboard DU. Other flight deck controls supply additional brightness and contrast controls for the display units.

Each display unit sends information to the AIMS cabinets on ARINC 429 data buses. This data is for fault reporting.



PRIMARY DISPLAY SYSTEM - SYSTEM INTERFACE

31-61-00-005 Rev 1

PRIMARY DISPLAY SYSTEM - POWER INTERFACES

Power

The captain's flight instrument 28v dc bus supplies power to these components:

- Left outboard display unit
- Left inboard display unit
- Upper center display unit
- Left cursor control device
- Left EFIS control panel.

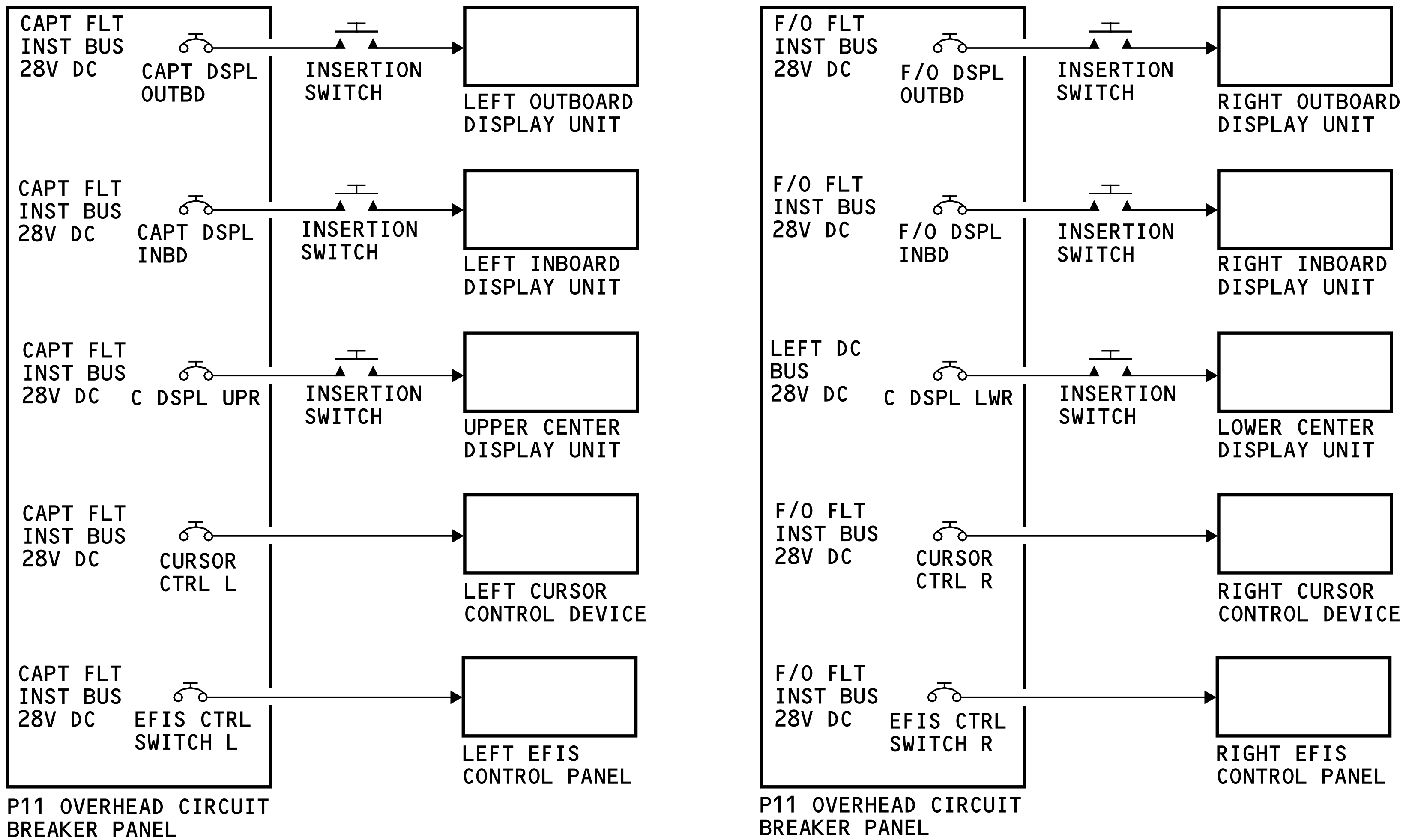
The first officers's flight instrument 28v dc bus supplies these components:

- Right outboard display unit
- Right inboard display unit
- Right cursor control device
- Right EFIS control panel.

The left dc bus supplies the lower center display unit with 28v dc.

Switches

An insertion switch is on the inside of each display unit (DU) rack. As the technician installs the DU, the switch closes and completes the circuit for the power input.



31-61-00-006 Rev 2

PRIMARY DISPLAY SYSTEM - POWER INTERFACES

PRIMARY DISPLAY SYSTEM - BRIGHTNESS CONTROL INTERFACES

General

The display units (DUs) get brightness control inputs manually and automatically. Each display unit has a built-in bezel light sensor (BLS) for automatic brightness control. A remote light sensor (RLS) on the glareshield also supplies automatic brightness control to the onside outboard DU. The passenger sign module also sends automatic brightness control inputs to the outboard DUs.

Control panels in the flight deck have individual manual brightness controls for each display unit. Additional manual brightness controls are available for the display units (DUs) that show weather radar (WXR).

Automatic Brightness Control

Each display unit has a BLS on the front of the unit that measures ambient light. The automatic brightness control calculation uses two BLSs and an RLS input to adjust the DU brightness of the six DUs.

The brightness of a DU pair changes automatically based on the calculation of the brightest value the pair gets from their BLSs.

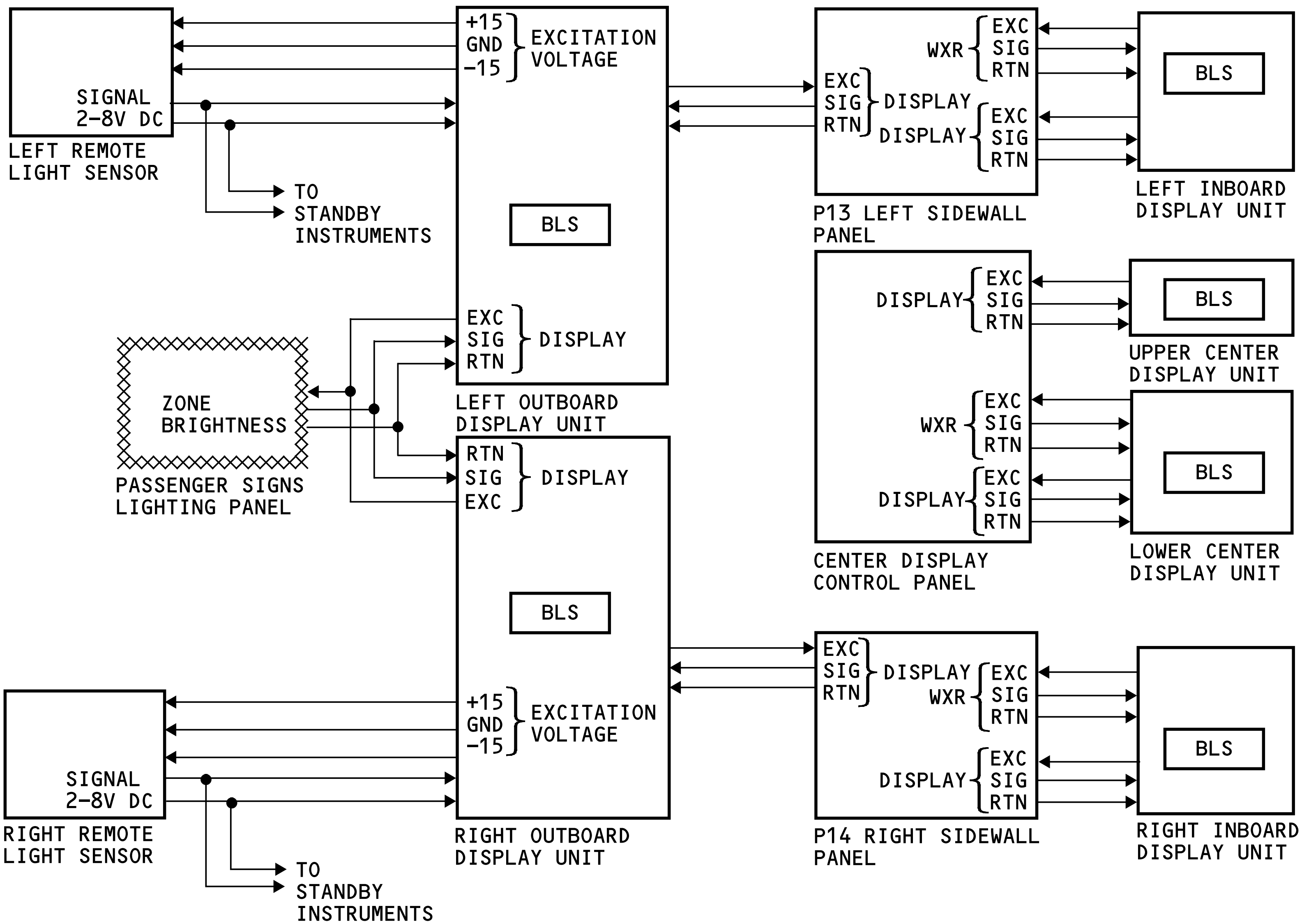
Each outboard DU sends an excitation voltage to its respective RLS. The RLS sends a signal back to its DU. The signal changes with the amount of light in the forward part of the flight deck.

Manual Brightness Control

The master brightness control on the passenger sign module sends a zone brightness input to the left and right outboard display units.

The captain's and first officer's forward panel brightness controls have controls for their outboard and inboard display units. These controls are on the sidewall panels. There is a single control for the outboard display units. There is a dual control knob for the inboard display units. The outer knob controls display brightness and the inner knob controls WXR brightness.

The center display control panel has a single knob to control the brightness of the upper center display unit. There is a dual control knob for the lower center display unit. The outer knob controls display brightness and the inner knob controls weather radar brightness when weather radar information shows on the lower center display unit.



PRIMARY DISPLAY SYSTEM - BRIGHTNESS CONTROL INTERFACES

31-61-00-007 Rev 3 05/30/96

PRIMARY DISPLAY SYSTEM - ARINC 429 DATA BUS INTERFACES

General

These components send data to the input/output modules (IOMs) in the two AIMS cabinets on ARINC 429 data buses:

- Six display units
- Two EFIS control panels
- Two cursor control devices (CCDs).

Display Unit Interface

The display units send:

- Fault monitoring data
- Brightness sensor values
- Remote light sensor values
- Manual brightness values.

EFIS Control Panel Interface

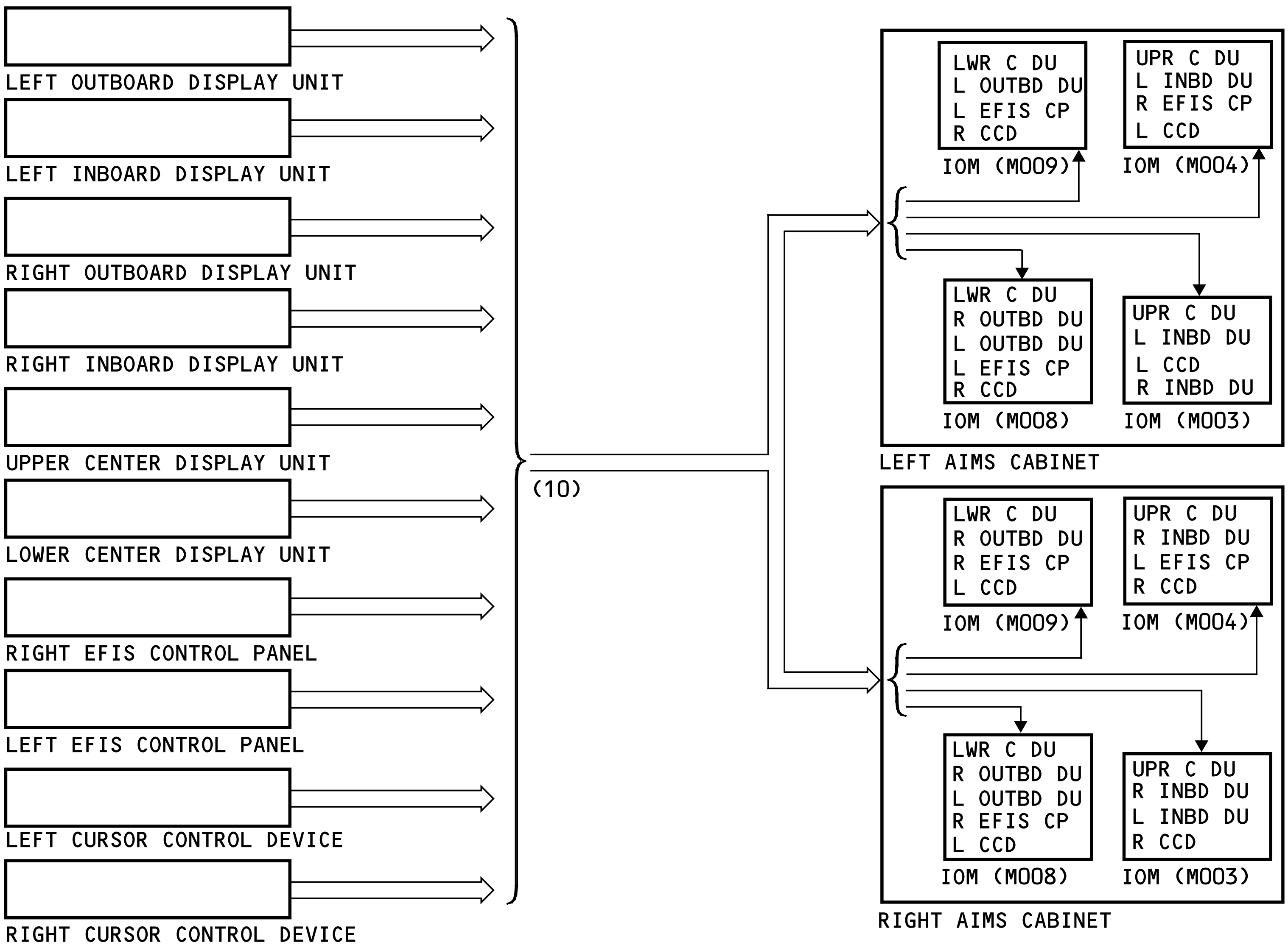
The EFIS control panels send switch position data to control the operation of the related primary flight display and navigation display.

Cursor Control Device Interface

The cursor control devices send:

- Cursor position data
- Display cursor position switch discretes
- Cursor activation switch discrete
- CCD status
- Program pin data
- CCD version number.

The inputs go to multiple IOMs in both cabinets. The multiple inputs provide for redundancy.



31-61-00-008 Rev 5 05/30/96

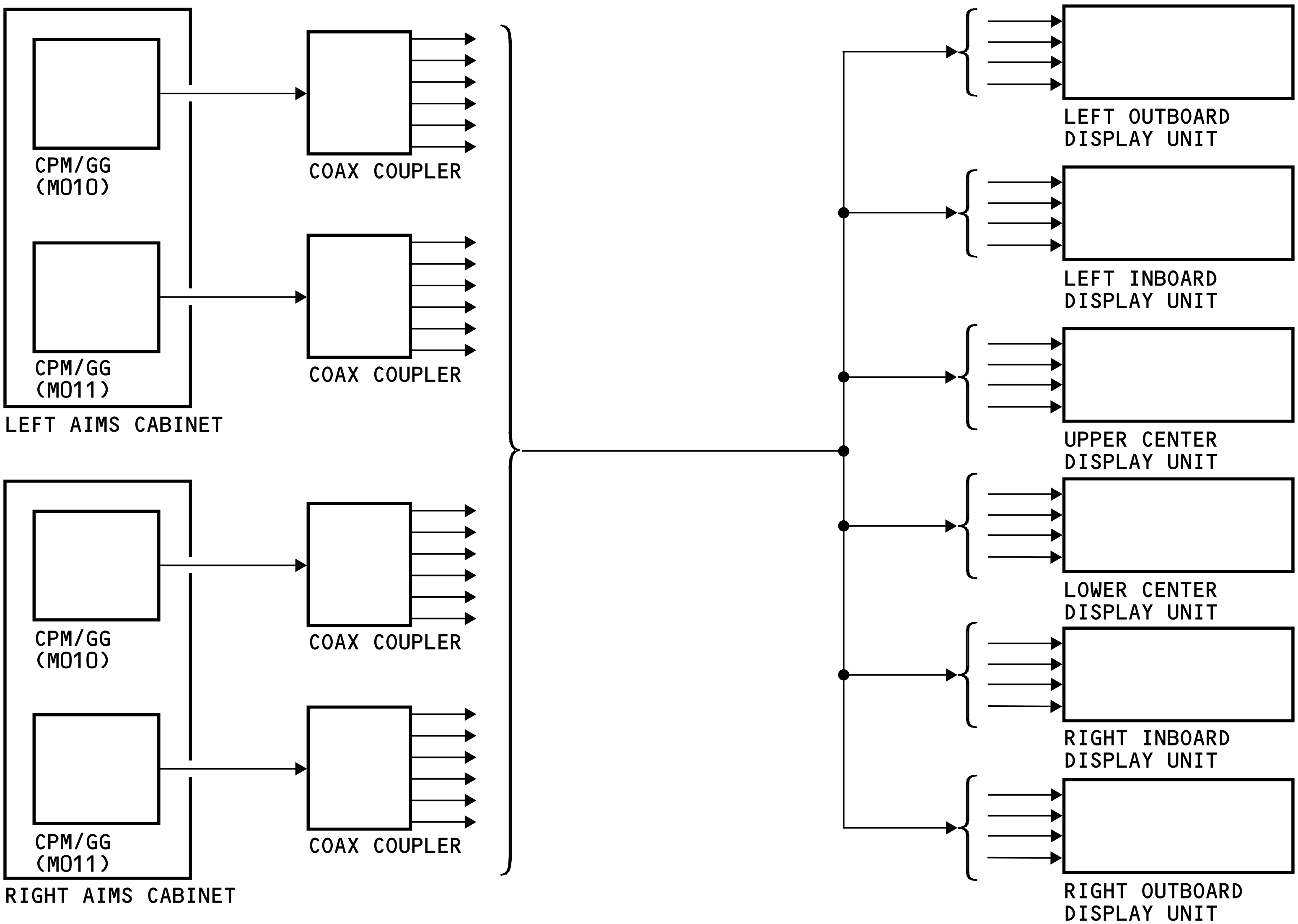
PRIMARY DISPLAY SYSTEM - ARINC 429 DATA BUS INTERFACES

PRIMARY DISPLAY SYSTEM - DISPLAY UNIT COAX INTERFACES

General

The display units get data from the AIMS graphic generators through coax buses. Each AIMS cabinet has two graphics generators, each with a bus output. Each bus output is split six ways and goes to each DU.

The data from the graphics generators contains instructions that make the symbols on the DUs.



31-61-00-009 Rev 1 01/06/1998

PRIMARY DISPLAY SYSTEM - DISPLAY UNIT COAX INTERFACES

PRIMARY DISPLAY SYSTEM - OPAS INTERFACE

General

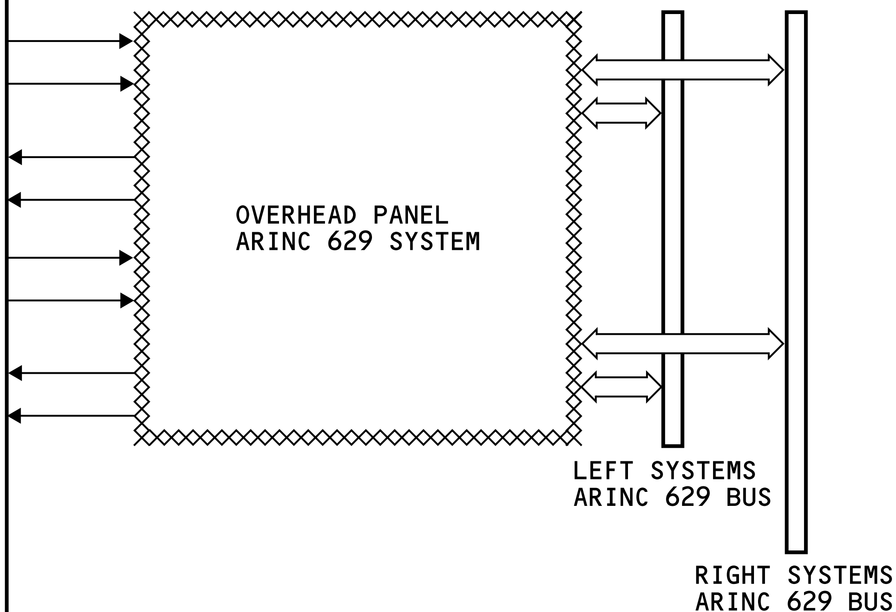
The overhead panel ARINC 629 system (OPAS) continuously receives and monitors flight deck switches and lights, processes and formats the data, and transmits the data. OPAS uses the left and right systems ARINC 629 data buses. OPAS supplies two outputs to each of the primary display functions of AIMS.

Primary Display System OPAS Interface

OPAS monitors these panels and switches of the primary display system. They include:

- All the switches on the CAPT and F/O instrument source select panels
- CAPT display switching panel
- F/O display switching panel
- CAPT and F/O accept/reject switches
- EICAS display select panel
- Center display control panel
- CCDs.

PANEL	SWITCH	DISCRETE
CAPT & F/O INST SOURCE SELECT PANELS	NAV DISPL CONT AIR DATA/ATT	AUTO/CDU AUTO/ALTN AUTO/ALTN
CAPT DISPLAY SWITCH PANEL	HDG REF INBOARD DSPL	TRUE/NORM PFD/NORM/NAV MFD/EICAS
F/O DISPLAY SWITCH PANEL	INBOARD DSPL	EICAS/NORM/ NAV/MFD/PFD
CAPT & F/O ACCEPT/CANCEL/ REJECT SWITCHES	ACCEPT/CANCEL/ REJECT	ACCEPT/ REJECT/ CANCEL
DISPLAY SELECT PANEL	S1/S2/S3 ENG STAT ELEC HYD FUEL AIR DOOR GEAR FCTL CHKL COMM NAV CANC RCL	LITES ON/OFF ENG STAT ELEC HYD FUEL AIR DOOR GEAR FCTL CHKL COMM NAV CANC RCL
CENTER DISPLAY CONTROL PANEL	EVENT RECORD DISPL CONT	RECORD AUTO/ALTN
L & R CCD		LITE ON/OFF LWR CTR, INBD



PRIMARY DISPLAY SYSTEM FLIGHT DECK PANEL (TYPICAL)

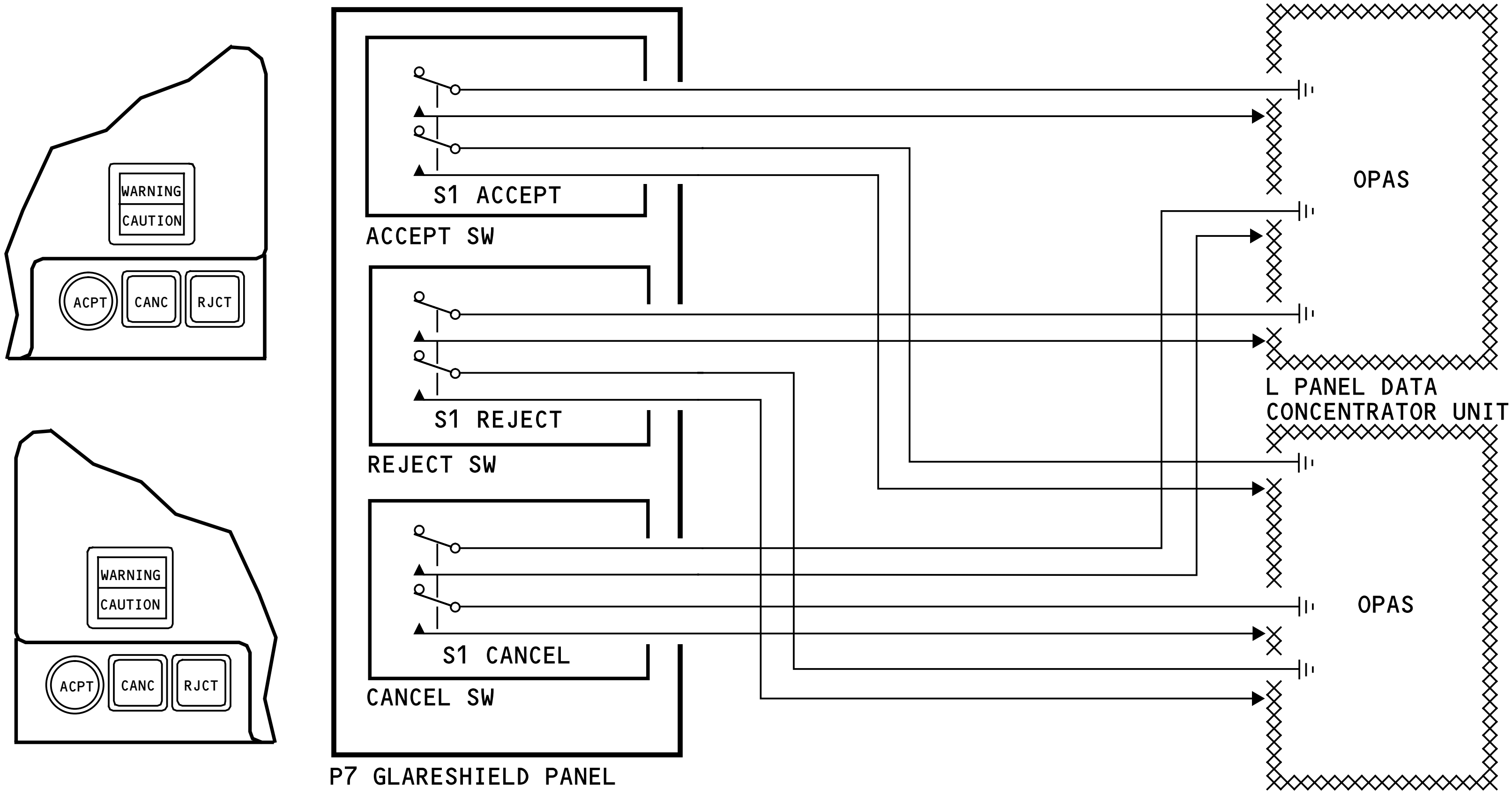
PRIMARY DISPLAY SYSTEM - OPAS INTERFACE

31-61-00-010 Rev 6 03/26/1998

PRIMARY DISPLAY SYSTEM - ACCEPT, REJECT AND CANCEL SWITCH INTERFACE

General

The ACCEPT/REJECT/CANCEL switches on the captain's and first officer's glareshields give the flight crew control of uplink and downlink messages. The OPAS panel data concentrator units (PDCUs) receive requests as analog discretes and process them.



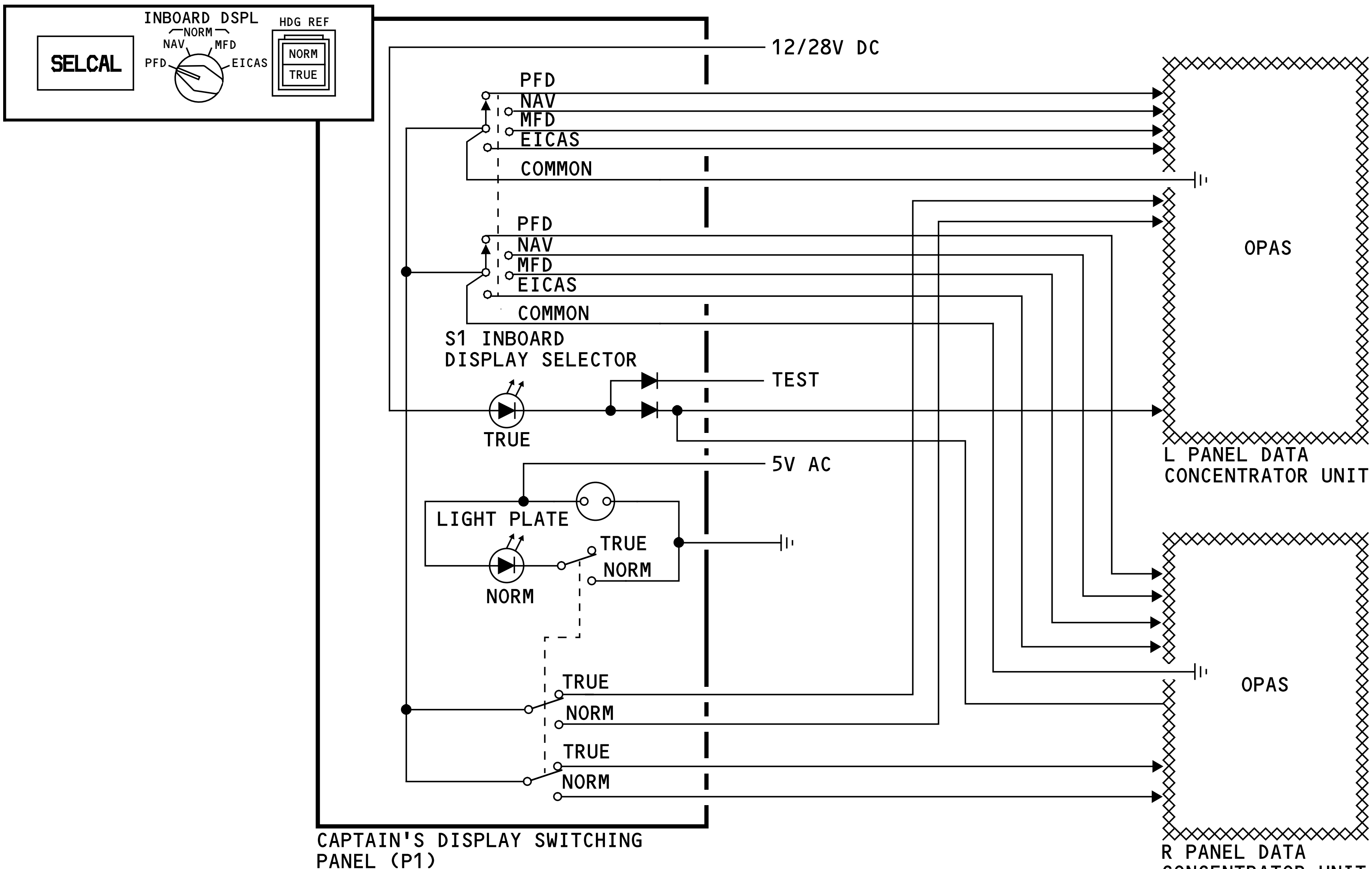
31-61-00-011 Rev 0

PRIMARY DISPLAY SYSTEM - ACCEPT, REJECT AND CANCEL SWITCH INTERFACE

PRIMARY DISPLAY SYSTEM - CAPTAIN DISPLAY SWITCHING PANEL INTERFACES

General

An inboard display (INBOARD DSPL) selector and a heading reference (HDG REF) switch send analog discretes to the OPAS panel data concentrator units (PDCUs). The inboard display selector gives the flight crew control of the inboard display format. The heading reference switch gives the flight crew control of the compass heading reference on both the captain's and first officer's displays.



31-61-00-012 Rev 2 03/28/95

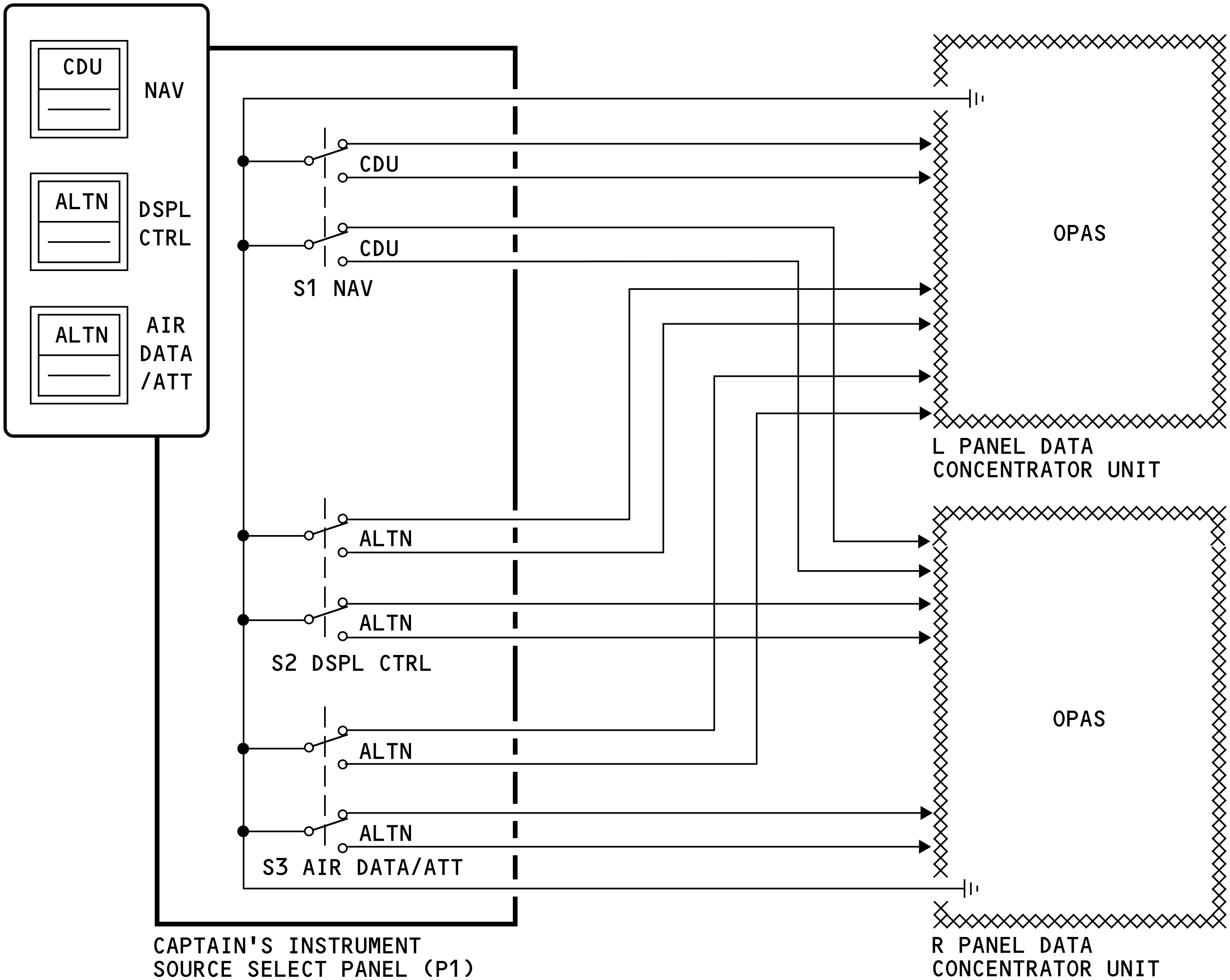
PRIMARY DISPLAY SYSTEM - CAPTAIN DISPLAY SWITCHING PANEL INTERFACES

PRIMARY DISPLAY SYSTEM - INSTRUMENT SOURCE SELECT PANELS INTERFACE

General

The captain's and first officer's instrument source select panels (ISSPs) send analog discretes to the OPAS panel data concentrator units (PDCUs) to process. Each ISSP switch gives onside flight crew control for an alternate source display.

The PDS has automatic control when the ISSP switches are in the normal position.



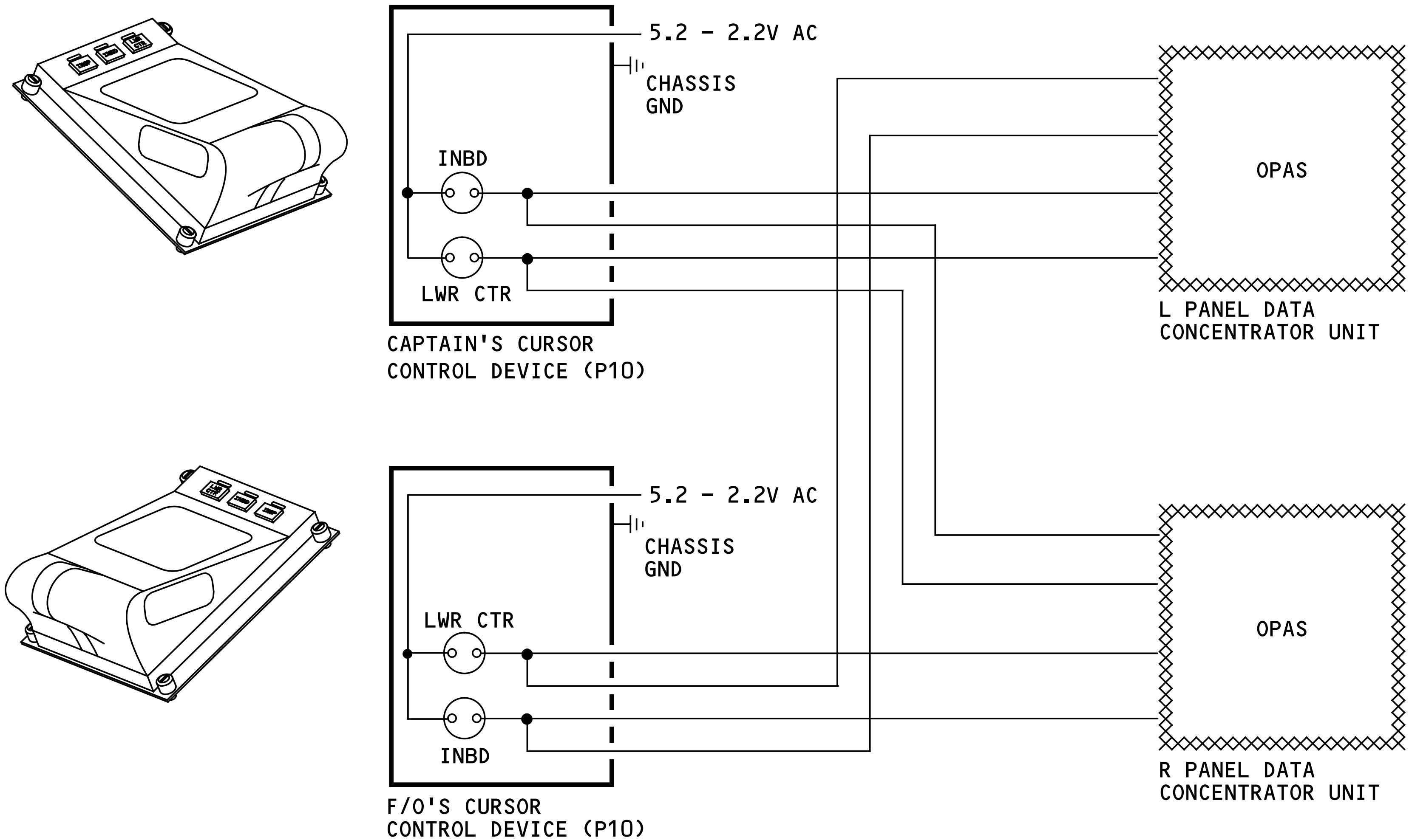
31-61-00-013 Rev 0

PRIMARY DISPLAY SYSTEM - INSTRUMENT SOURCE SELECT PANELS INTERFACE

PRIMARY DISPLAY SYSTEM - CURSOR CONTROL DEVICE INTERFACES

General

The cursor control devise (CCD) gets grounds from the panel data concentrator units. The grounds turn on lights to indicate which display the operator selected.



31-61-00-014 Rev 2 05/30/96

PRIMARY DISPLAY SYSTEM - CURSOR CONTROL DEVICE INTERFACES

PRIMARY DISPLAY SYSTEM - DISPLAY SELECT PANEL INTERFACES

General

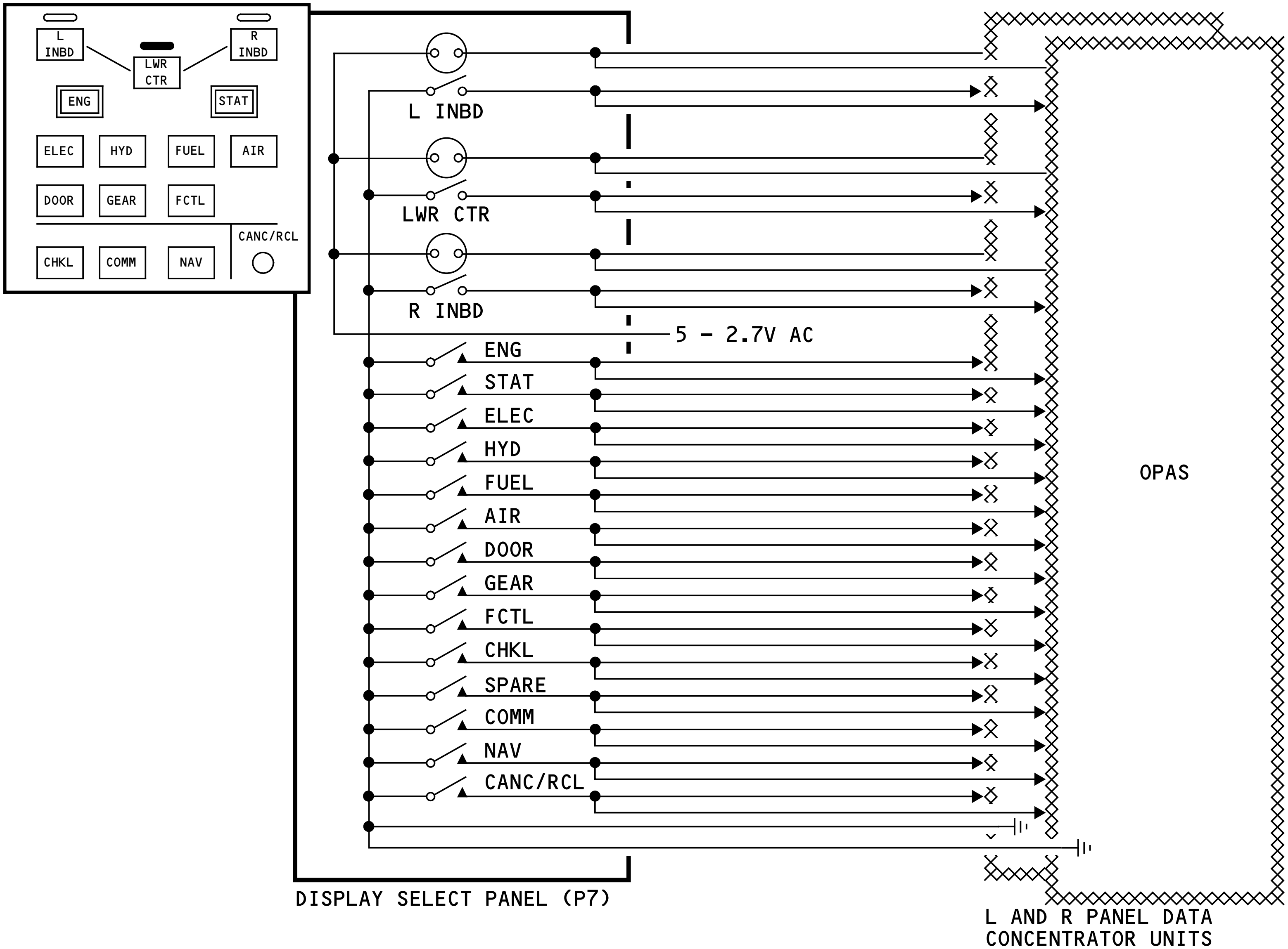
The display select panel (DSP) receives analog discrete data from the overhead panel ARINC 629 system (OPAS). The DSP sends analog discrete data to OPAS.

Inputs

The DSP receives a ground analog discrete from each OPAS panel data concentrator unit (PDCU). The DSP receives power from -2.7 to 5 vac.

Outputs

The DSP sends an analog discrete(s) to each OPAS PDCU when you make a mode and/or a display request.



PRIMARY DISPLAY SYSTEM - DISPLAY SELECT PANEL INTERFACES

31-61-00-015 Rev 4 01/16/1998

PRIMARY DISPLAY SYSTEM - CENTER DISPLAY CONTROL PANEL INTERFACES

General

The center display control panel receives analog discretes from and sends analog discretes to OPAS.

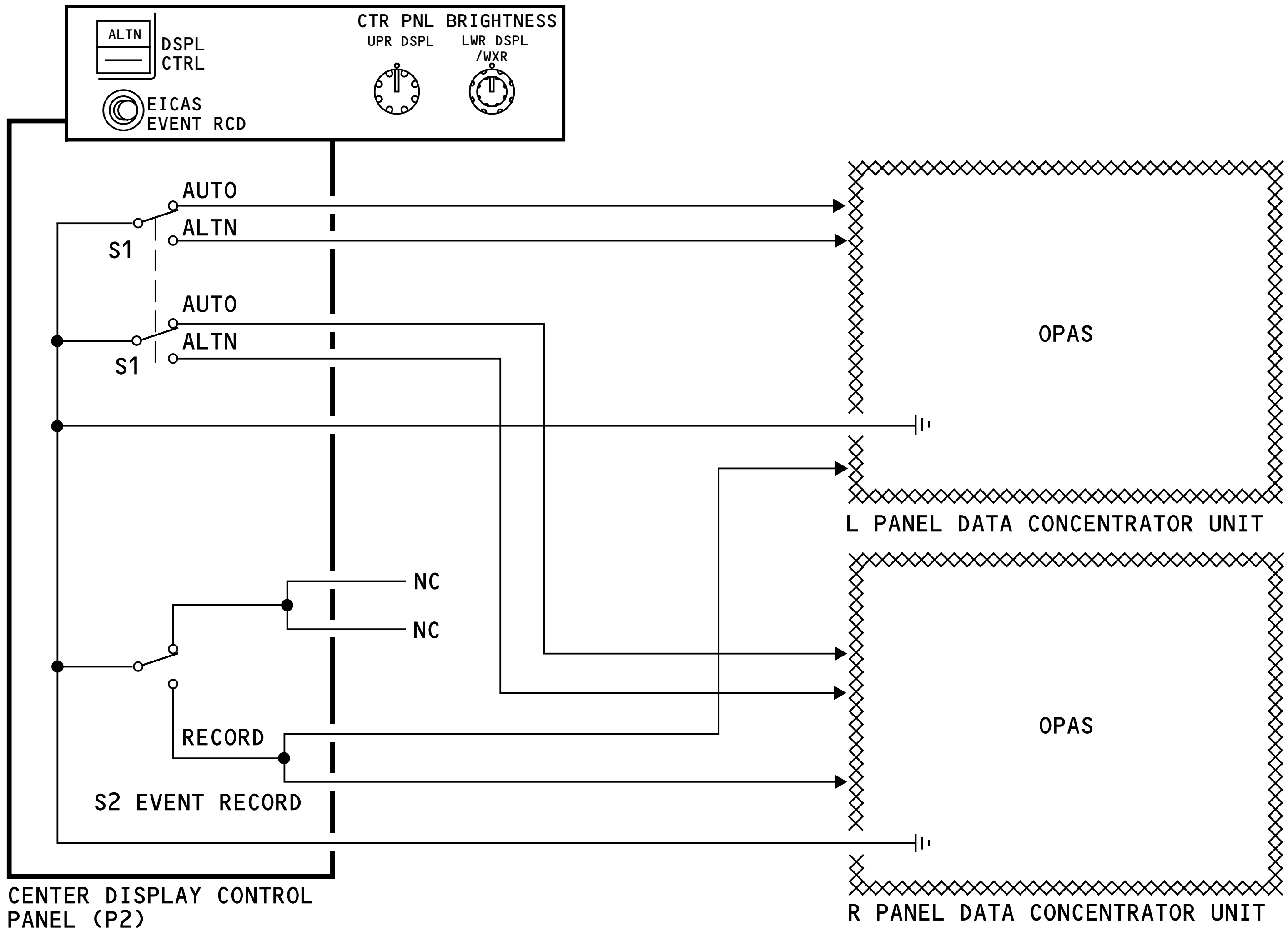
Inputs

OPAS sends two analog discrete grounds to the center display control panel.

Outputs

The center display control panel sends an analog discrete when the DSPL CTRL switch is in the AUTO and ALTN position to OPAS.

The center display control panel also sends an analog discrete to OPAS when the operator uses the event record switch.



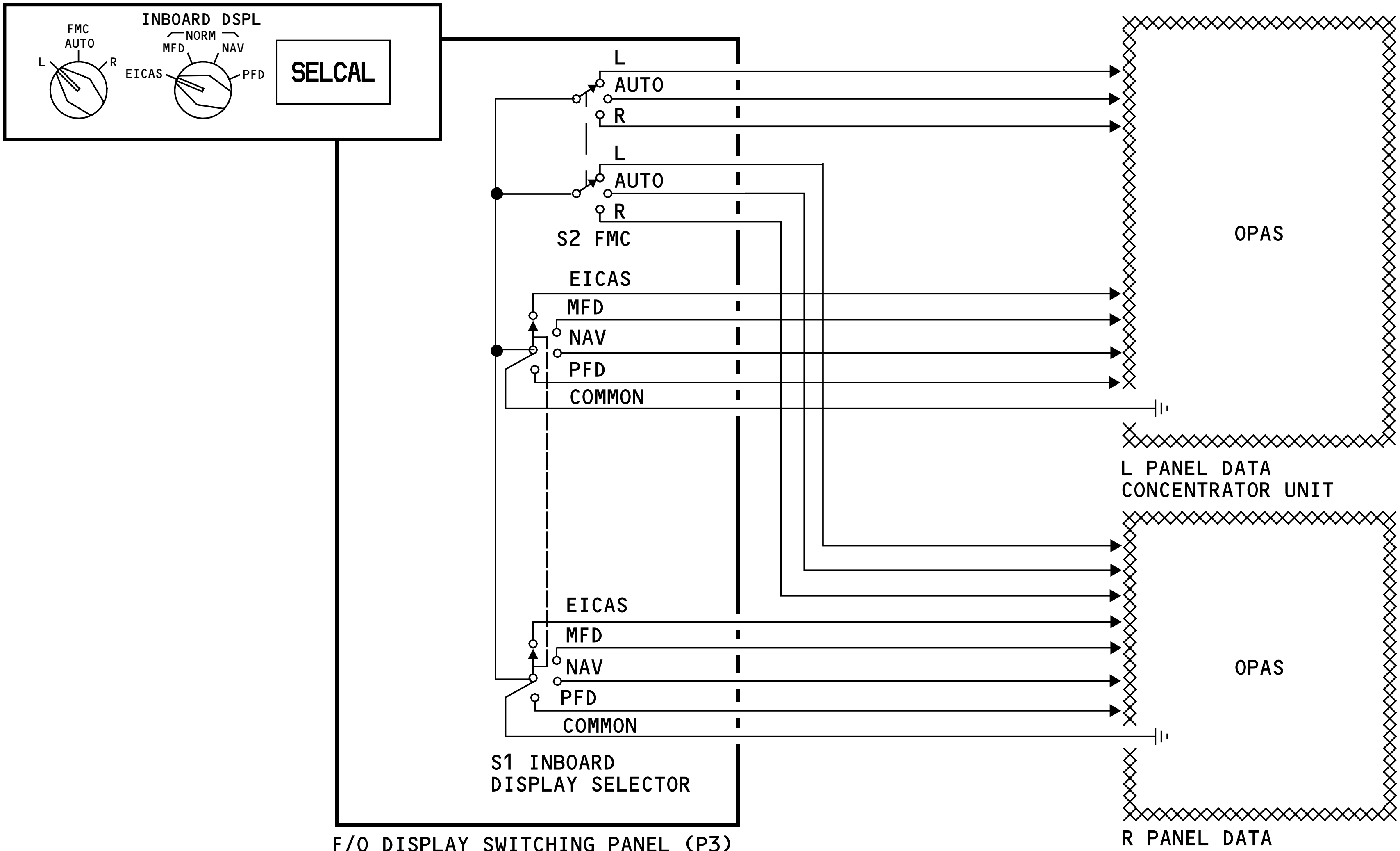
31-61-00-016 Rev 1

PRIMARY DISPLAY SYSTEM - CENTER DISPLAY CONTROL PANEL INTERFACES

PRIMARY DISPLAY SYSTEM - F/O DISPLAY SWITCHING PANEL INTERFACES

General

An inboard display (INBOARD DSPL) selector and an FMC selector send analog discretes to the OPAS panel data concentrator units (PDCUs). The display selector gives the flight crew control of the inboard display format. The FMC selector gives the flight crew manual or automatic control of the FMCF source on both the captain and first officer's displays.



31-61-00-017 Rev 1

PRIMARY DISPLAY SYSTEM - F/O DISPLAY SWITCHING PANEL INTERFACES

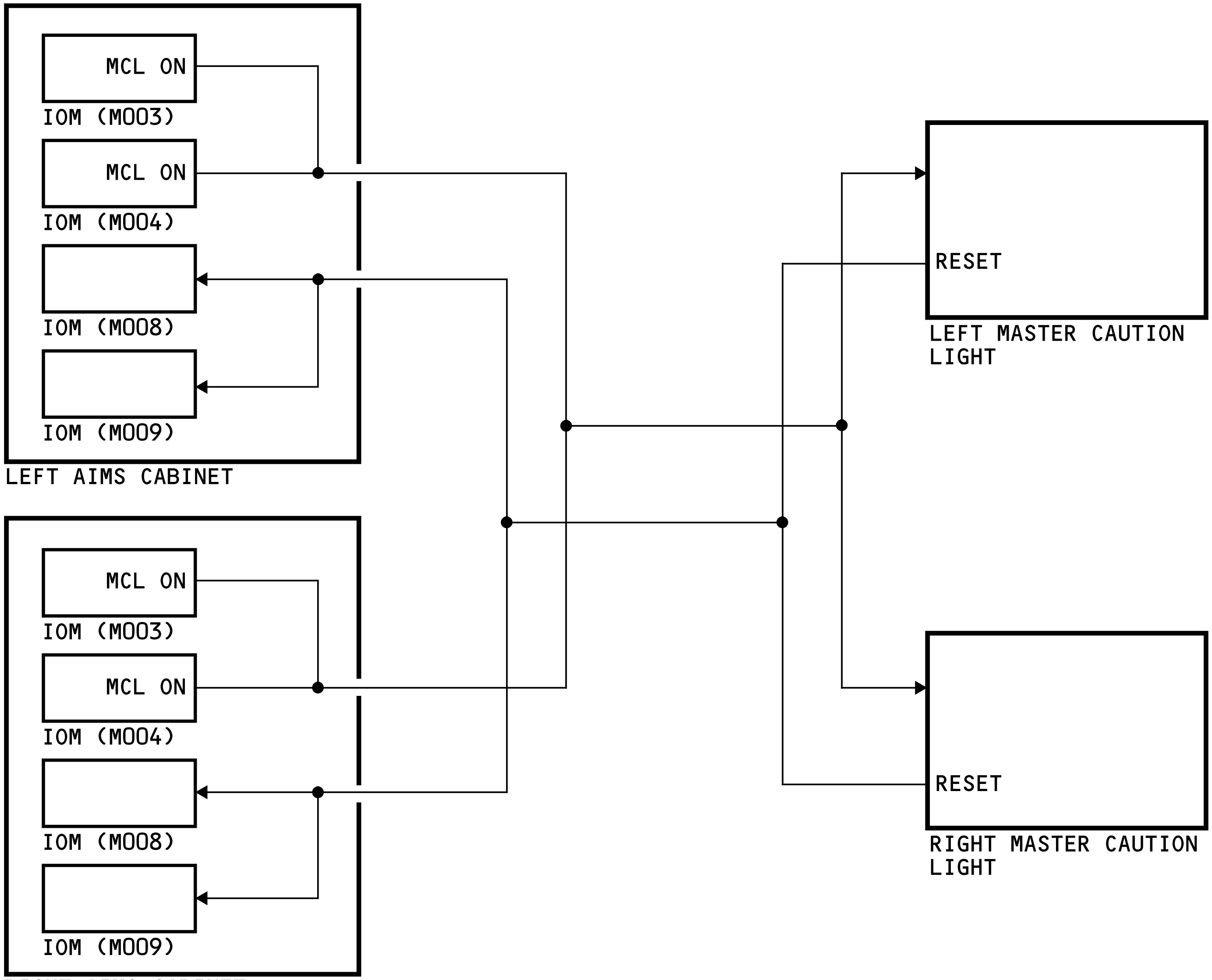
PRIMARY DISPLAY SYSTEM - MASTER CAUTION LIGHTS INTERFACES

Master Caution Light On Signal

IOMs M004 and M003 in each AIMS cabinet supply a master caution light on signal to both master caution lights.

Reset

When you push a master caution light, IOMs M008 and M009 in each AIMS cabinet receive a master caution light reset signal. This makes both master caution lights go out.



31-61-00-132 Rev 0 03/07/96

PRIMARY DISPLAY SYSTEM - MASTER CAUTION LIGHTS INTERFACES

PRIMARY DISPLAY SYSTEM - DISPLAY UNIT

Purpose

The primary display system uses six identical ARINC D flat panel liquid crystal display (LCD) units. These display units (DUs) show:

- Primary flight information
- Navigation information
- Engine information
- Crew alerting information
- Airplane systems data.

Physical Description

The DUs are in a rack. The DUs are 8 inches by 8 inches and are 8.75 inches deep. Each DU weighs 18 pounds.

There is a bezel light sensor (BLS) at the bottom edge of the face plate.

Operation

The DUs have two internal temperature detectors. The power supply has a detector that causes the DU to shutdown when the internal temperature reaches 110 degrees centigrade. The backlight assembly has a detector that causes the DU to shutdown when the internal temperature reaches 95 degrees centigrade. The detectors automatically turn the DUs off during an overtemperature condition. The DUs come on when the temperature returns to normal. The DUs use forced air cooling.

Training Information Point

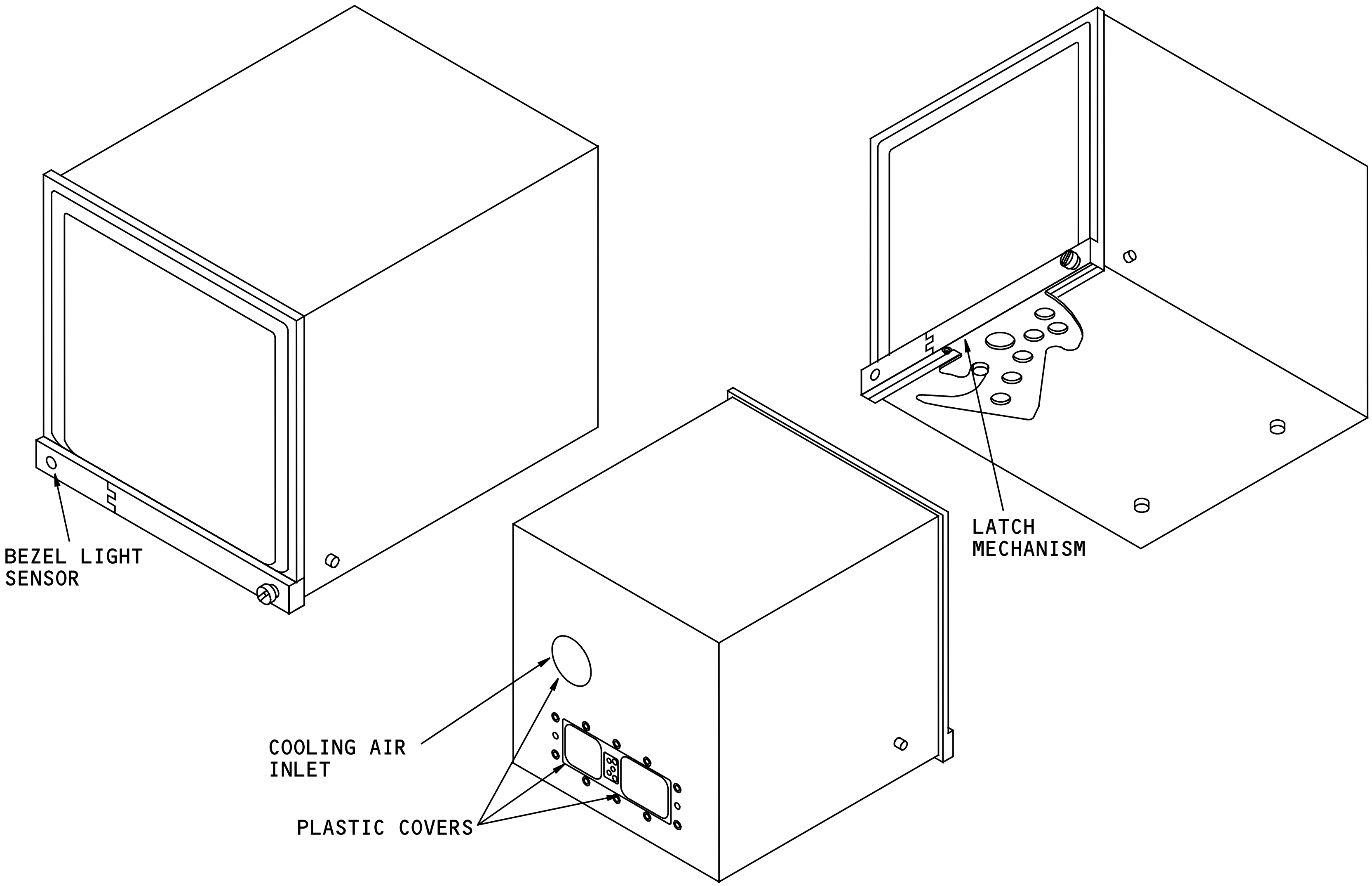
The six DUs are interchangeable. Due to the viewing angle limitations of LCD technology, the installation of the lower center DU is 180 degrees (handle at the top) from the other DUs. For the lower center DU, the handle is opposite to the handle of the other DUs.

Training Information Point

During the removal or installation of the inboard and outboard DUs, you must move the control column.

CAUTION: MOVEMENT OF THE CONTROL COLUMN MAY CAUSE FLIGHT SURFACE MOVEMENT.

NOTE: Remove plastic covers from the connectors before you install a DU.



31-61-00-018 Rev 3

PRIMARY DISPLAY SYSTEM - DISPLAY UNIT

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PRIMARY DISPLAY SYSTEM - EFIS CONTROL PANEL

Purpose

Two identical EFIS control panels (EFIS CP) control data on the PFD and ND formats.

Description

The EFIS CP is 4.8 inches by 3.45 inches and 6 inches deep. The panel weighs approximately 4 pounds.

PFD Controls

Use these controls to manage data on the PFD:

- Minimums reference selector
- Flight path vector (FPV) switch
- Meters (MTRS) switch
- Barometric (BARO) reference selector.

The minimums reference selector selects and sets altitude minimums. The minimums reference outer selector selects either RADIO or BARO minimums. The inner selector sets the altitude. The reset (RST) push-button switch cancels the RADIO or BARO alert annunciation.

The FPV switch enables or disables the display of the FPV vector symbol.

The meters (MTRS) switch is an alternate action switch that controls the display of actual and selected altitude in meters. This is in addition to the display of these parameters in feet.

The barometric reference selector selects and sets the barometric reference. This selector has three controls, outer, middle, and inner. The baro reference outer selector selects either inches of mercury (IN) or hectopascals (hPa) as the barometric reference on the related PFD. The barometric middle selector sets the barometric correction. The inner push-button switch selects the standard baro setting 29.92 inches of Hg or 1013 hpa.

ND Controls

The ND mode selector enables either the approach (APP), VOR, MAP, or PLAN modes. Use the center (CTR) push-button to toggle between an expanded display that covers 90 degrees and a centered display that covers 360 degrees in all modes except PLAN.

The ND range selector controls the map range or display range in the MAP or PLAN mode. This selector also controls weather radar range and TCAS intruder symbol range in the expanded APP mode, expanded VOR mode and MAP modes.

The traffic switch selects or cancels TCAS traffic data.

The VOR/ADF switches show radio navigation aid data in all modes except PLAN. The OFF position causes the VOR and ADF information to go out of view. Bearing information shows on the compass rose when you set either switch to VOR or ADF. VOR/ADF identification or frequency data also shows in the lower corner or the display. Co-located DME distance shows when the switches are in the VOR position.

These ND map switches cause data to show on the NDs or cause data on the NDs to go out of view:

- Weather radar (WXR)
- Station (STA)
- Waypoint (WPT)
- Airport (ARPT)
- DATA
- Position (POS).

The weather map switch causes weather radar (WXR) data to show.

The station map switch causes navigation aids not in the flight plan to show.

The waypoint map switch causes waypoints and ground reference points to show.

The airport map switch causes airports not in the flight plan to show.

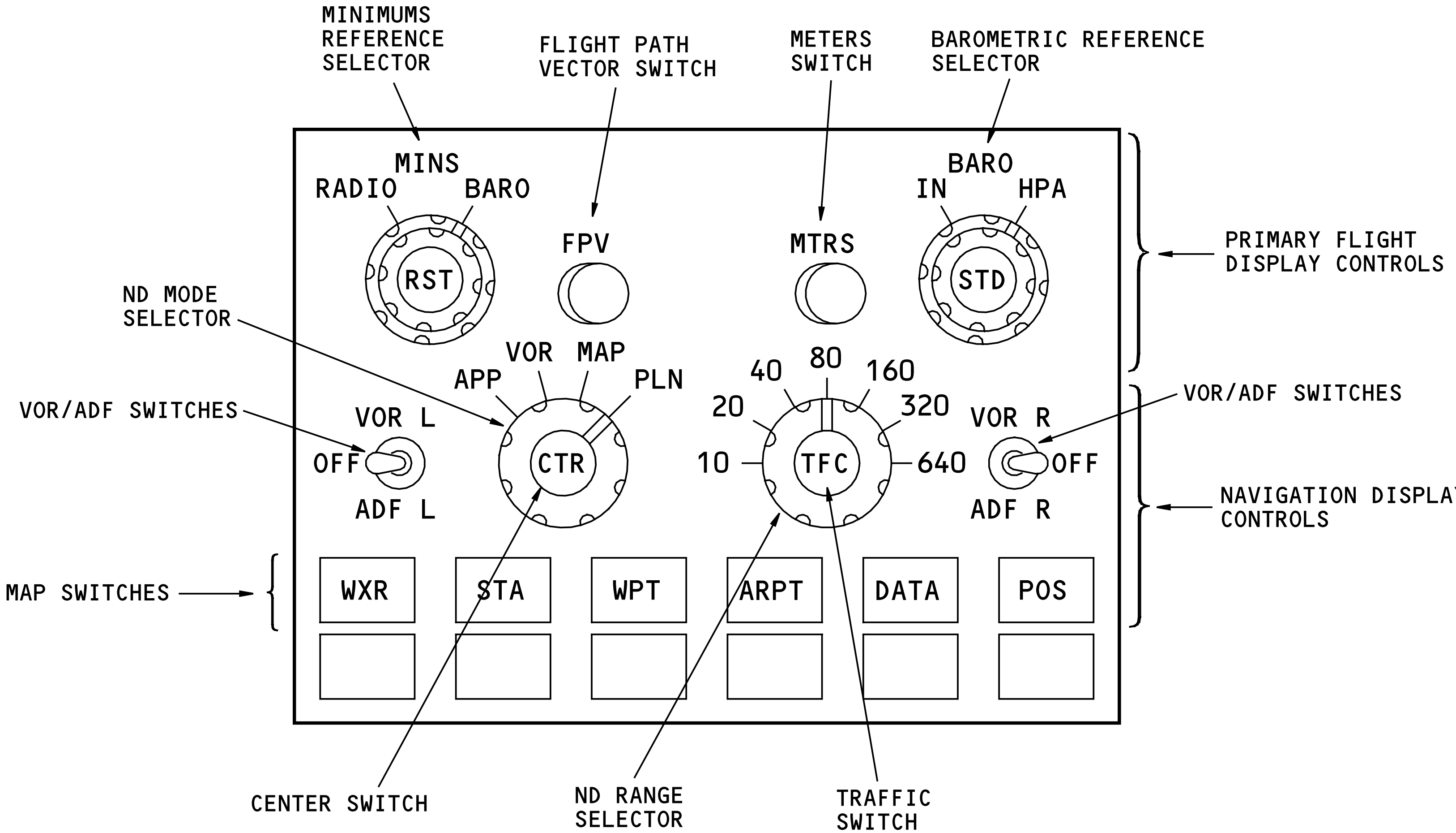
The DATA map switch causes route data to show.

The STA, WPT, ARPT and DATA switches affect the map background display.

The position map switch causes VOR/DME and air data inertial reference system (ADIRS) position data to show on the map display.

Alternate Control Panel Functions

The left and right control display units (CDUs) provide alternative EFIS CP functions. CDU menu selections enable the alternate EFIS CP functions.



31-61-00-019 Rev 1

PRIMARY DISPLAY SYSTEM - EFIS CONTROL PANEL

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PRIMARY DISPLAY SYSTEM - DISPLAY SELECT PANEL

Purpose

The display select panel (DSP) controls the formats on the two inboard and the center lower display units.

Physical Description

The DSP is 3.5 inches by 3.45 inches and 3 inches deep. It weighs 4 pounds.

DU Selection Controls

There are three switches at the top of the panel. The labels on the switches are L INBD, R INBD, and LWR CTR. Each switch has a light that comes on when you set the switch. The switches select which display unit (left inboard, right inboard, or lower center) responds to the mode select switches. The three select switches are latched electronically, only one switch is active at a time.

Mode Controls

The mode select switches are alternate action switches that control the display of these formats:

- ENG: Engine secondary
- STAT: Status page
- ELEC: Electrical synoptic
- HYD: Hydraulic synoptic
- FUEL: Fuel synoptic
- AIR: Air synoptic
- DOOR: Door synoptic
- GEAR: Gear synoptic
- FCTL: Flight controls synoptic
- CHKL: Checklists
- COMM: Communication function
- NAV: Navigation display.

On an inboard DU, if you select the same display that shows, the navigation display format will show. On the lower center DU, if you select the same display that shows, the DU blanks.

The status format is an exception. When the status format shows and you select the STAT switch, the next status page shows. When the last page shows and you select the STAT switch, the inboard DU shows the navigation display format and the lower center DU blanks.

The ENG, FUEL, and AIR switches also control information on the EICAS and compacted engine displays when EICAS is in the limited mode.

Cancel/Recall Switch

The cancel/recall (CANC/RCL) switch cancels and recalls EICAS caution and advisory messages.

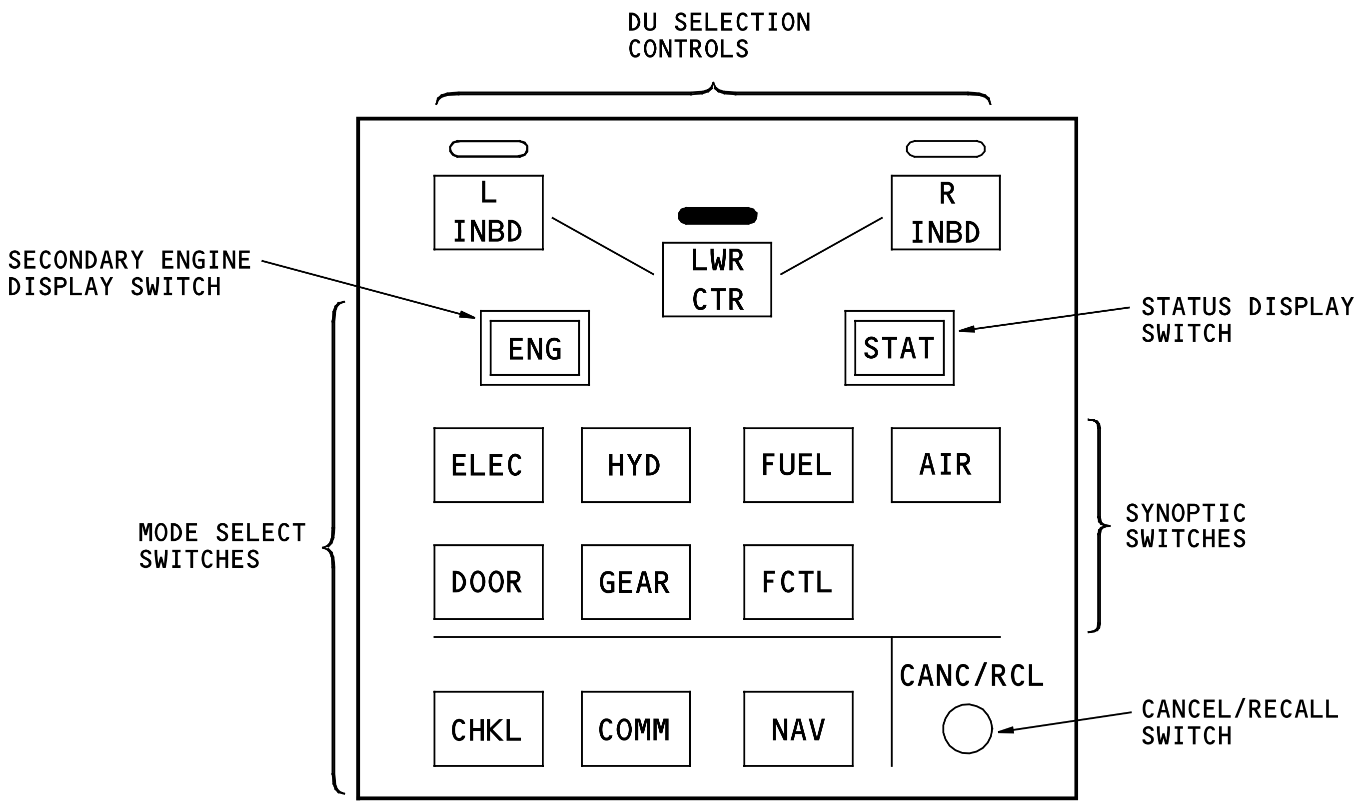
When caution and advisory messages show, selection of this switch causes the first page of messages to go out of view and causes the next page of messages to show if additional pages exist. Warning, memo, and COMM messages remain. This switch also cancels red latched exceedance boxes.

PRIMARY DISPLAY SYSTEM - DISPLAY SELECT PANEL

You can recall caution and advisory messages when you select the CANC/RCL switch again. Previous messages return if the conditions that cause them to show still exist. Red exceedance boxes that you cancelled also show.

Alternate DSP Functions

The three control display units (CDU) supply an alternate way to select the DSP functions. CDU menu selections enable the DSP functions.



31-61-00-020 Rev 5 05/19/1997

PRIMARY DISPLAY SYSTEM - DISPLAY SELECT PANEL

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PRIMARY DISPLAY SYSTEM - CONTROL DISPLAY UNIT MENUS

Purpose

The control display units (CDUs) provide menu selections for:

- Maintenance page selections
- Alternate EFIS control panel functions
- Alternate display select panel (DSP) functions

Maintenance Page Selection

Use Line select key (LSK) five right (5R) on the CDU MENU page to show the maintenance page menu on the selected display unit. Then use the cursor control device to make other selections.

The maintenance page selection is available on all three CDUs.

You can select and see maintenance pages any time the airplane is on the ground or any time the airplane is above ten thousand feet.

EFIS Control Panel Functions

The onside CDU provides a menu selection for the EFIS control panel. The selection of the EFIS function on a CDU disables the onside EFIS control panel.

The center CDU is a backup for the left or right CDU for the EFIS control panel functions. IF both CDUs fail, the center CDU is a backup for the CDU that fails first.

The CDU remembers the last valid settings of the EFIS CPs.

Use LSK 1R on the CDU MENU page, then LSK 2R to show the EFIS CONTROL page.

Use the OPTIONS key (LSK 6R) on the EFIS CONTROL page to show the EFIS OPTIONS page.

Use the CONTROL key (LSK 6R) on the EFIS OPTIONS page to show the EFIS CONTROL page.

These two pages supply most of the functions of the EFIS CP.

Display Select Panel Functions

The DSP menu selection is available on all three CDUs.

The CDU remembers the last valid DSP selection.

The selection of the DSP function on a CDU disables the DSP and the DSP lights go out. It also disables the DSP menu selections on the other two CDUs.

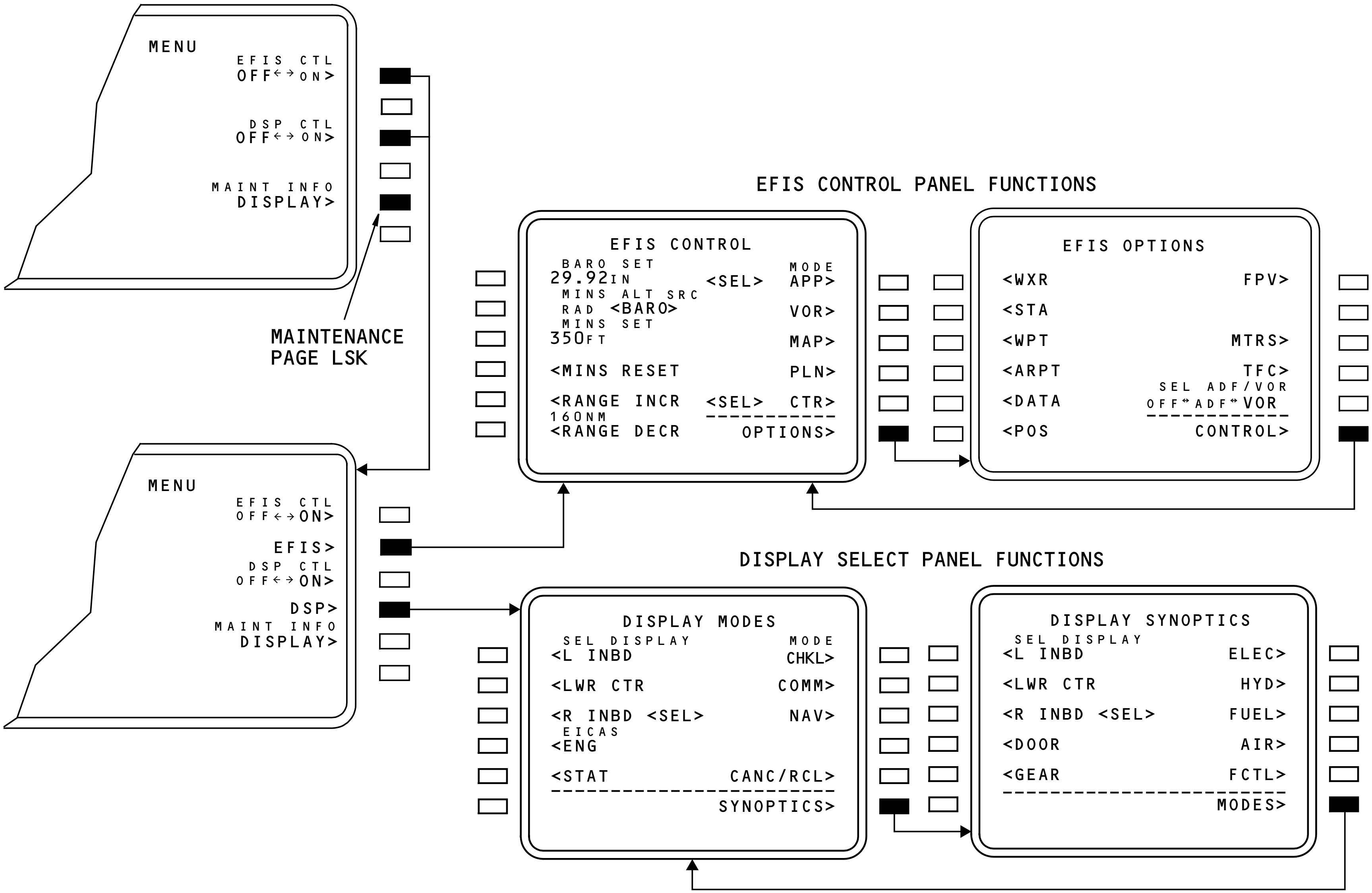
Use DSP CTL (LSK 3R), then DSP (LSK 4R) to show the DSP DISPLAY MODES page.

Use the SYNOPTICS key (LSK 6R) on the DISPLAY MODES page to show the DISPLAY SYNOPTICS page.

Use the MODES key (LSK 6R) on the DISPLAY SYNOPTICS page to show the DISPLAY MODES page.

PRIMARY DISPLAY SYSTEM - CONTROL DISPLAY UNIT MENUS

The CDU keys for the DSP functions operate the same as the switches on the DSP. The two pages supply all the functions of the DSP.



31-61-00-021 Rev 5 05/19/1997

PRIMARY DISPLAY SYSTEM - CONTROL DISPLAY UNIT MENUS

PRIMARY DISPLAY SYSTEM - CURSOR CONTROL DEVICES

Purpose

Flight crews and maintenance personnel use the cursor control devices (CCD) for the data communication management function and to control the maintenance page format selections.

You also use the CCDs to control the electronic checklists.

Description

The CCD weighs four pounds. The CCD has its own power supply. The CCD has two electrical connectors, one for power and one for control. The CCD has three control switches and a touch pad.

Controls

The CCD has two momentary cursor location switches for display selection, one cursor select switch on the side for selection, and a touch pad.

The cursor location switches are:

- LWR CTR: This switch connects the CCD to the lower center display
- INBD: This switch connects the CCD to the inboard display.

Each cursor location switch has a cursor location light (green LED) that comes on when you select the switch.

Use the cursor select switch to make a selection when the cursor on the display is in an active area. You operate the switch with the thumb. This switch gives a tactile feedback.

Touch Pad

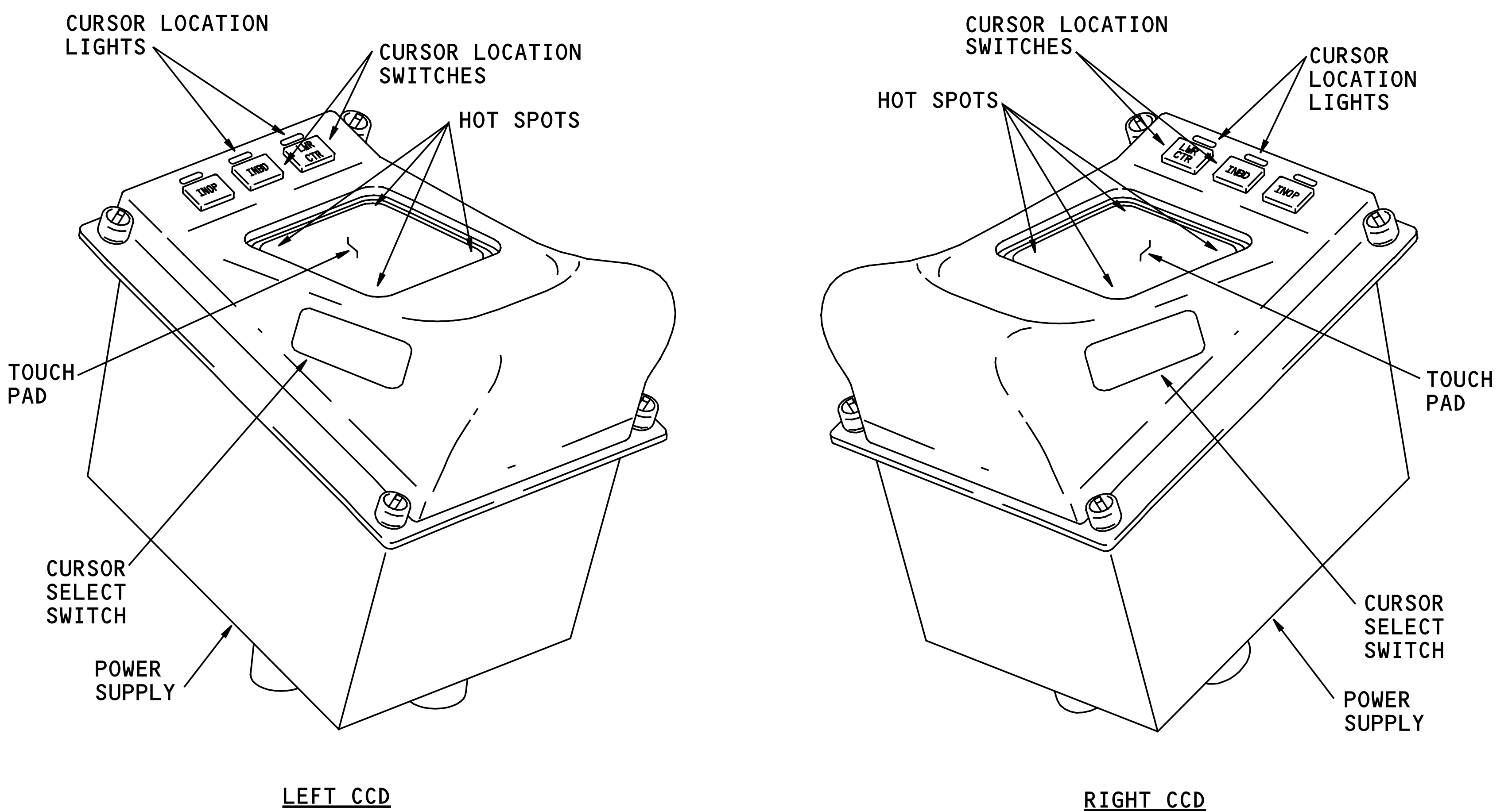
The cursor follows your finger on the display when you move a finger across the touch pad. Each touch pad has hot spots. These hot spots are at each corner of the touch pad. The cursor goes to the corner of the active display when you touch a corner of the touch pad. This gives the operator quick access to frequently used menu selections. In some instances, the cursor automatically moves to the next selection.

Training Information Point

The two CCDs are not interchangeable because the cursor select and cursor location switches are not in the same position.

The manufacturer seals the CCD touch pad to prevent damage from liquid spills.

A glass faceplate over the touch pad prevents damage to the touch pad. The touch pads are impact resistant up to a force of 5 pounds.



31-61-00-022 Rev 4 05/30/96

PRIMARY DISPLAY SYSTEM - CURSOR CONTROL DEVICES

PRIMARY DISPLAY SYSTEM - REMOTE LIGHT SENSOR

Purpose

Two remote light sensors (RLSs) are on the forward part of the glareshield. The sensors face forward. The RLSs measure ambient light with a photodiode sensor and supply an analog signal proportional to the ambient light. The left and right RLS sends data to the respective outboard display unit. The display units use the analog signals for automatic brightness control.

Description

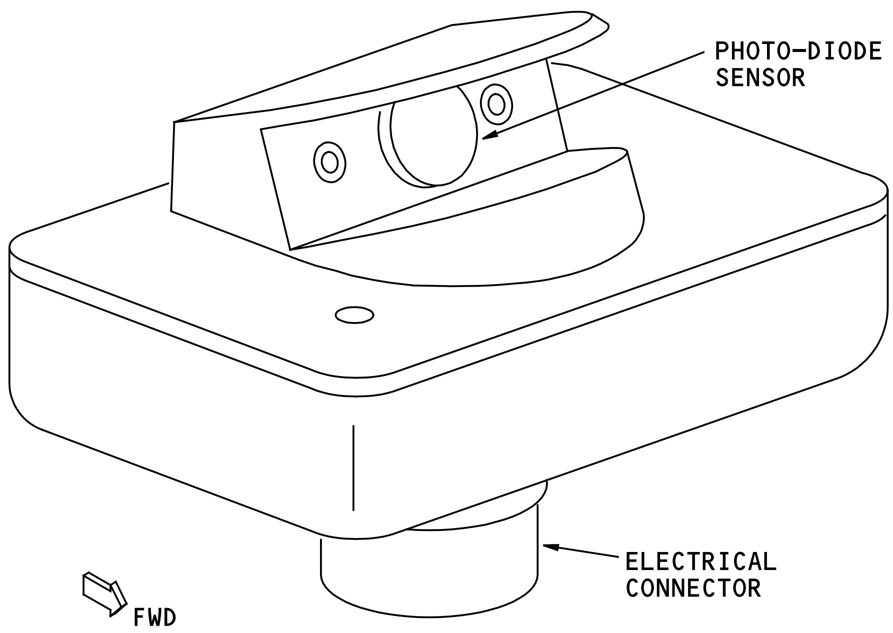
Each sensor weighs less than 1/2 pound. Each has a cable that has all the wires required for electrical power and signal interface. The cable is 84 inches long.

Each RLS has a field-of-view of 60 degrees left, 60 degrees right, 35 degrees up, and 35 degrees down.

Each RLS gets ±15v dc from the onside display unit.

Training Information Point

The remote light sensors are interchangeable.



REMOTE LIGHT SENSOR

31-61-00-023 Rev 1

PRIMARY DISPLAY SYSTEM - REMOTE LIGHT SENSOR

PRIMARY DISPLAY SYSTEM - BRIGHTNESS CONTROLS

Purpose

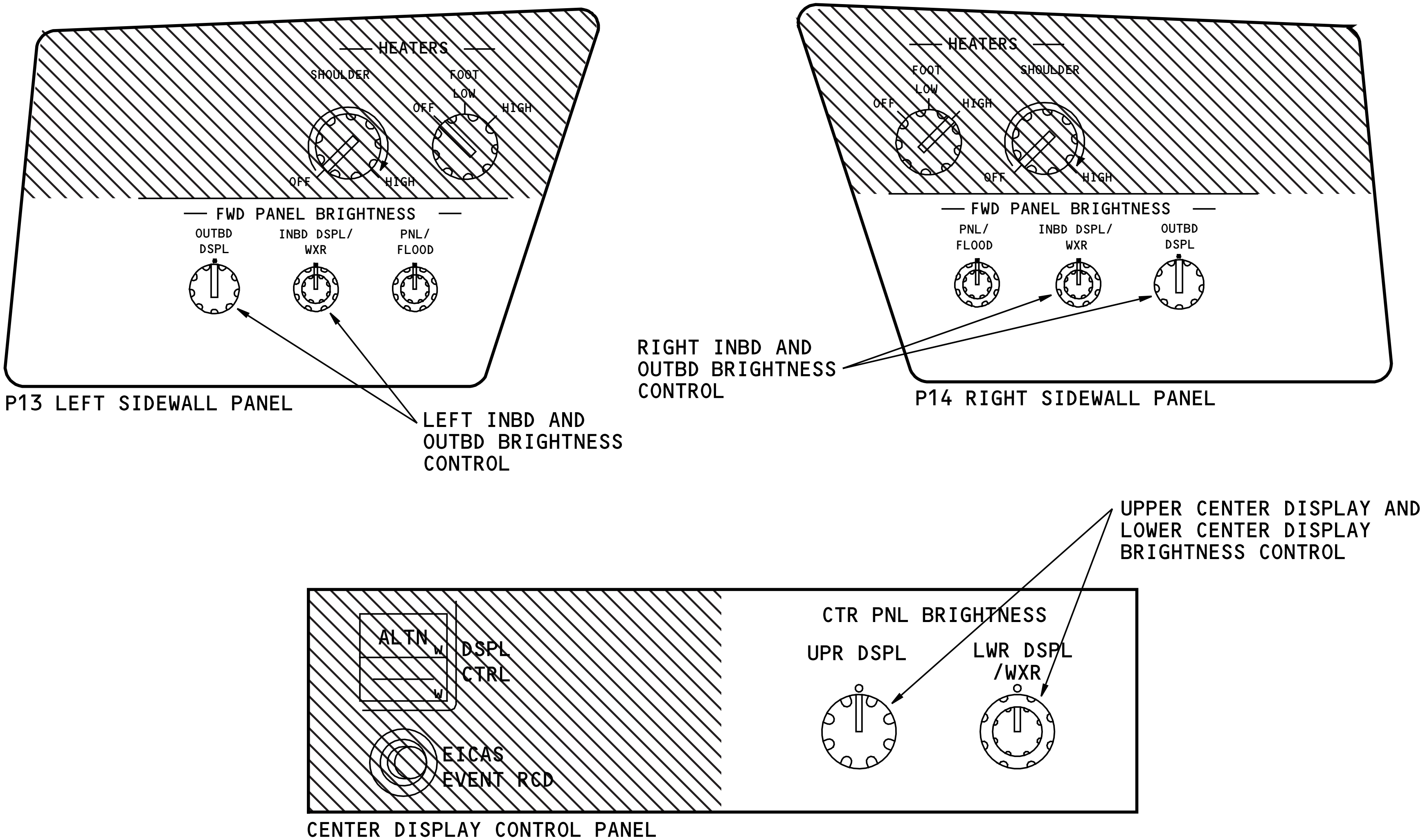
The brightness controls permit manual brightness control by the flight crew for the display units.

Forward Panel Brightness/Heater Controls

The flight crew forward panel brightness controls, control the brightness on the inboard and outboard DUs. There is a single control for the outboard display units. There are two controls for the inboard display units. The outer knob controls brightness and the inner knob controls the weather radar brightness.

Center Display Control Panel

The center display control panel has two brightness controls. The UPR DSPL control adjusts the brightness of the upper center display unit. The LWR DSPL/WXR has an outer knob and an inner knob. The outer knob adjusts the brightness of the center lower display. The inner knob adjusts the weather radar brightness.



31-61-00-024 Rev 3 08/08/96

PRIMARY DISPLAY SYSTEM - BRIGHTNESS CONTROLS

PRIMARY DISPLAY SYSTEM - DISPLAY SWITCHING PANELS

Purpose

Use the display switching panels to select alternate positions for display formats.

Operation

The NORM position has two selections. The MFD position causes the inboard DU to respond to the selections of the display select panel (DSP). The NAV position forces the inboard DU to show the ND format. In the NAV position, the inboard DU does not respond to DSP inputs.

The PFD position causes the inboard DU to show the PFD format.

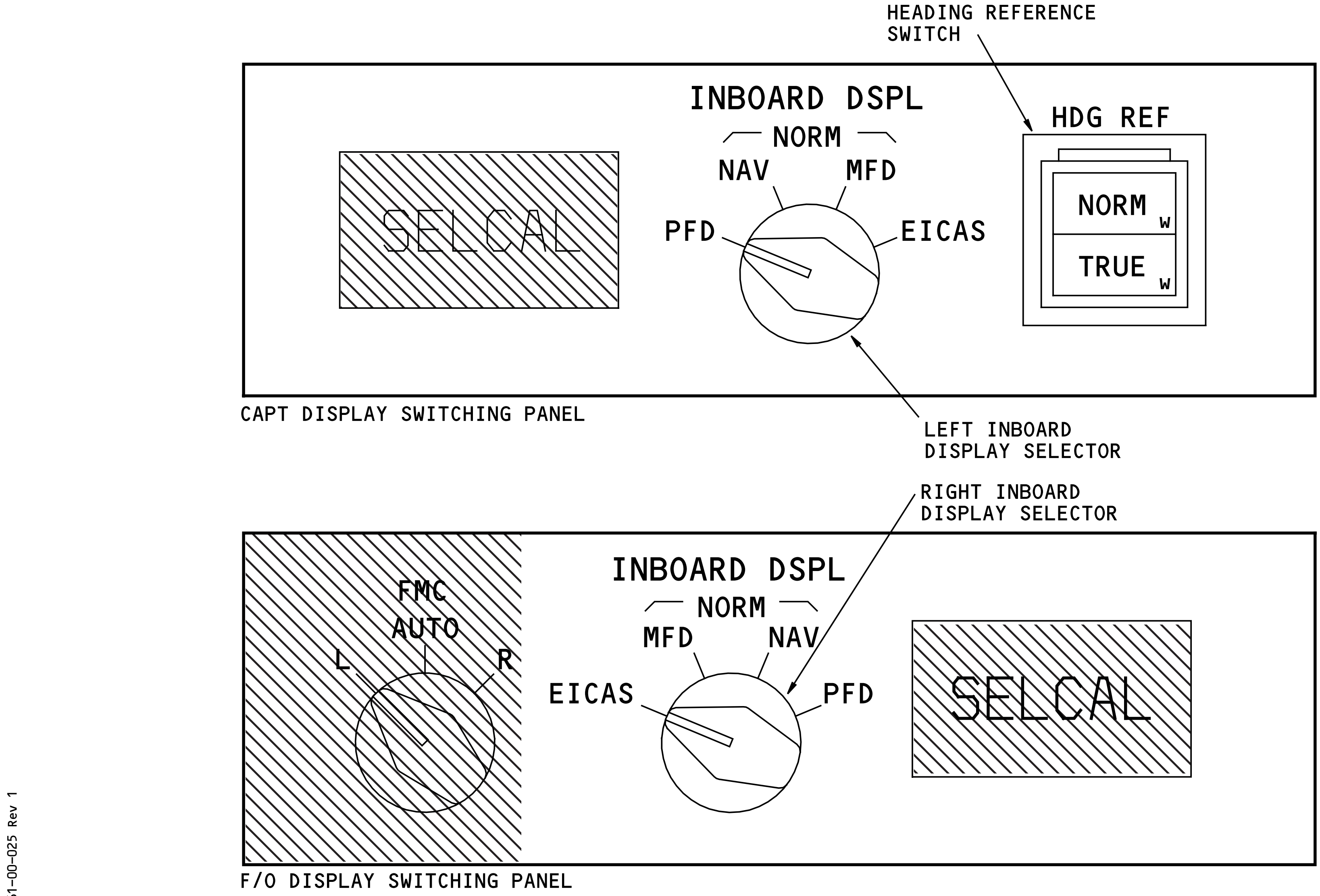
The EICAS position causes the inboard DU to show the EICAS display format.

The INBD DSPL switch has no effect on the inboard display unit(s) (DU) when the associated outboard DU finds a failure and the PFD switches automatically to the inboard DU. You cannot use the display selector for manual display selection.

Heading Reference Switch

The heading reference switch sets the reference for the PFD and ND formats. The NORM position sets the reference to magnetic heading and turns the NORM light on. The TRUE position sets the reference to true heading and turns the TRUE light on.

The switch has a plastic guard.



PRIMARY DISPLAY SYSTEM - DISPLAY SWITCHING PANELS

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PRIMARY DISPLAY SYSTEM - MISCELLANEOUS CONTROLS - 1

General

The left and right instrument source select panels (ISSPs) and the center display control panel supply additional controls for the primary display system. Each source switch permits alternate display source for the flight crew member. These are the alternate source display control switches:

- Navigation source switch
- Display control source switch
- Air data/attitude source switch
- Center display control source switch
- Event record switch.

The three display source control (DSPL CTRL) switches in the flight deck supply manual control for the display channel outputs from the two graphics generators in each AIMS cabinet.

Instrument Source Select Panel (ISSP) Switches

The captain and first officer use the ISSP switches to select an alternate display source.

Use the navigation source switch (NAV) to select the CDU as an alternate map source.

Use the display control source switch (DSPL CTRL) on the ISSP to control the display channels source for the respective inboard and outboard display units. During normal operation, the captain's DUs use graphics generator M010 in the left AIMS cabinet and the first officer's DUs use graphics generator M011 in the right AIMS cabinet.

Use the air data/attitude source switch (AIR DATA/ATT) to select an alternate attitude and other ADIRU source inputs.

The center display control source switch (DSPL CTRL) is on the center display control panel. This switch controls the display source for the two center display units. During normal operation, these DUs use graphics generator M011 in the Left AIMS cabinet.

In the normal configuration, the switches are in the out position and no legend shows. A failure of a display channel causes the DUs to automatically switch to an alternate source. No legend shows in this case.

The selection of any of the switches, causes the display system to assume a failure and automatically change display channels. The NAV switch legend shows CDU when you select the NAV switch for alternate navigation source. In this case, the onside CDU or closest valid CDU. All other switches show ALTN when you select them.

If the display system has lost input sources, you can not cause the entire system to fail through the selection of manual overrides. The system ignores the switch(es) with only one display channel left.

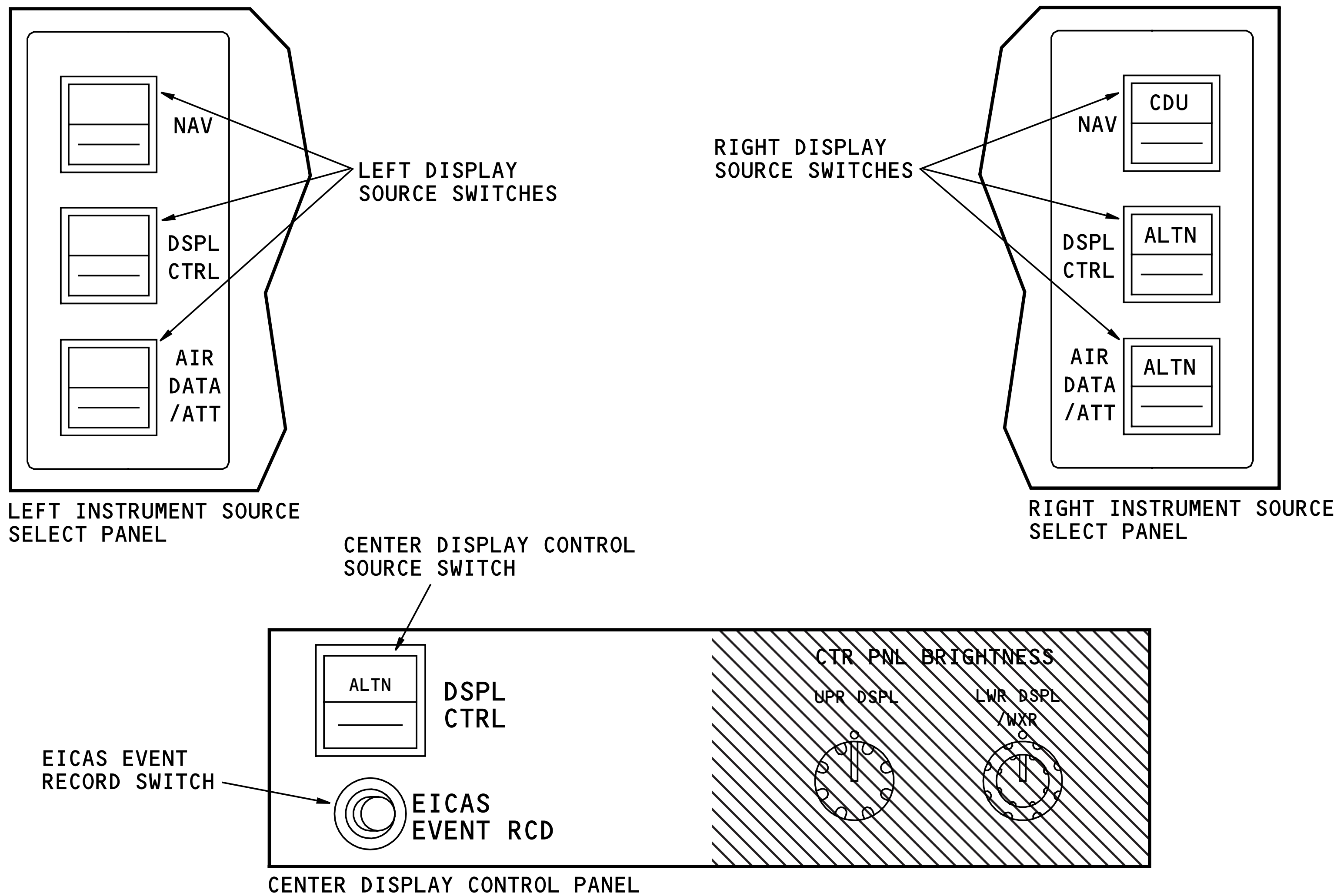
PRIMARY DISPLAY SYSTEM - MISCELLANEOUS CONTROLS - 1

EICAS Event Record Switch

The EICAS event record switch is an additional primary display system control on the center display control panel. Push the this switch to store a snapshot for each maintenance page.

Training Information Point

All display control source switches are line replaceable.



31-61-00-026 Rev 3

PRIMARY DISPLAY SYSTEM - MISCELLANEOUS CONTROLS - 1

PRIMARY DISPLAY SYSTEM - MISCELLANEOUS CONTROLS - 2

Purpose

The master caution lights alert the flight crew visually of a condition(s) that require crew awareness. You use the master warning/caution reset switch to reset the caution annunciation.

The master caution lights come on when a caution message shows on the EICAS display.

Training Information Point

When the master caution lights come on and there is a caution message on the EICAS display, you also hear a caution aural. The warning electronic system (WES) makes the caution aural. For all caution messages except ALTITUDE ALERT and SPEEDBRAKES EXT, AIMS sends a digital request to the WES to make the caution aural. WES makes the aural request for the caution messages ALTITUDE ALERT and SPEEDBRAKES EXT.

Master Caution Lights and Master Warning/Caution Reset Switch

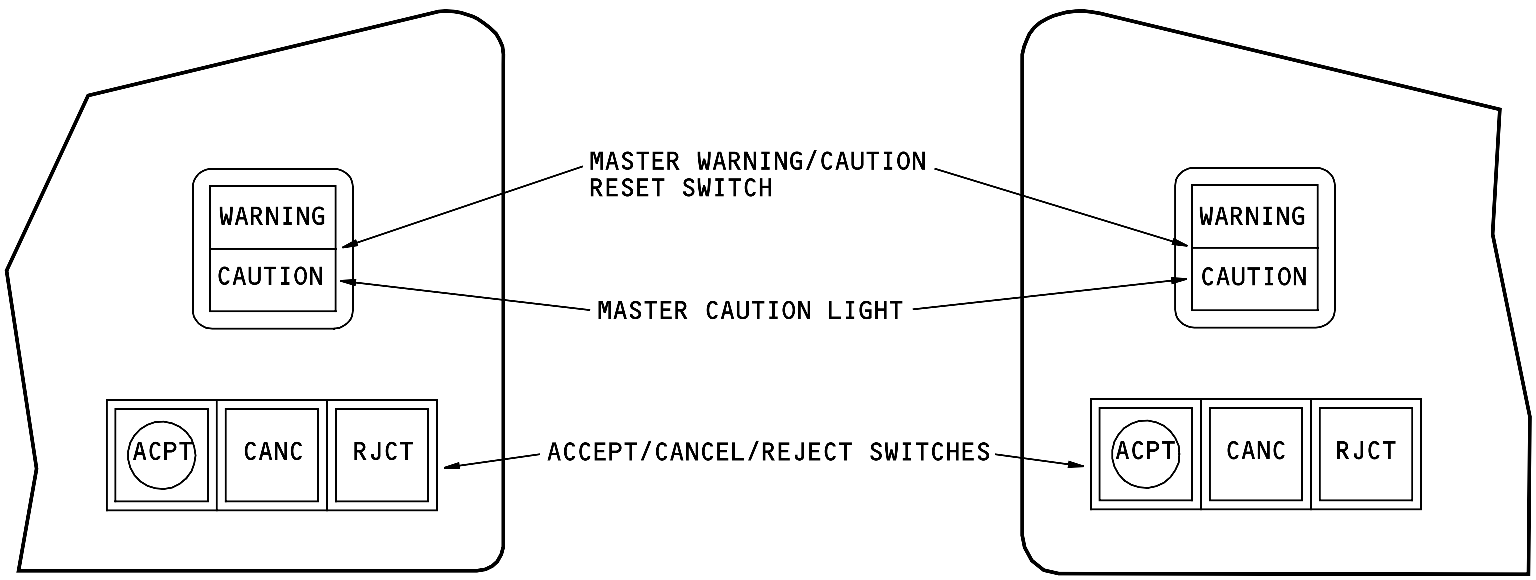
The master caution lights come on whenever the system finds a new active caution message. The lights go out when you push the switch or when the condition that caused the message goes away. The master caution lights are amber.

Training Information Point

The master warning lights are part of the warning electronic system (WES). WES controls the master warning lights. The master warning lights are red. The master warning lights come on when there is a warning message on the EICAS display. The master warning lights also come on when there is a time critical warning (TCW) message on the PFD.

Accept (ACPT), Cancel (CANC), and Reject (RJCT) Switches

You use these switches with the flight deck communication function when you receive uplink messages.



31-61-00-027 Rev 4 03/07/96

PRIMARY DISPLAY SYSTEM - MISCELLANEOUS CONTROLS - 2

PRIMARY DISPLAY SYSTEM - PRIMARY FLIGHT DISPLAY OVERVIEW

Purpose

The primary flight display (PFD) gives the crew this information:

- Attitude
- Critical parameters cross comparison
- Airspeed
- Altitude
- Marker beacon
- Vertical speed
- Heading
- Localizer and glide slope deviation
- Autopilot and autothrottle mode annunciations
- Autopilot status annunciations
- Radio altitude and decision height
- Time critical warning (TCW) messages.

Attitude

The attitude area supplies the flight crew with pitch and roll information from the air data inertial reference system (ADIRS). This data shows as sky/ground shading, a horizon line and a fixed airplane symbol. Additional information in this area includes this:

- Flight director (F/D) bars
- Flight path vector (FPV)
- Flight path angle (FPA)
- TCAS commands
- Slip/skid information
- Pitch limit indications.

Critical Parameter Cross Comparison

Each PFD graphic generator compares this data with the data for the other PFD:

- Track
- Heading
- Pitch attitude
- Roll attitude.

When the difference between pitch or roll attitude exceeds three degrees, heading exceeds four degrees, or track exceeds six degrees, the system makes an EICAS ATTITUDE message.

Airspeed

The airspeed indication is to the left of the attitude area. Digital readouts show computed air speed (CAS) and MACH values. Reference speeds, maximum and minimum limit speeds, and speed trend data also show.

Altitude

The barometric altitude indication shows as a digital readout and a moving tape to the right of the attitude area.

Marker beacon

The marker beacon indication shows in the upper right area of the attitude display. Inner marker (IM) white, middle marker (MM) amber, or outer marker (OM) blue, show as the airplane flies over a marker beacon.

Vertical Speed

The vertical speed indication shows on a fixed scale with a pointer. It is to the right of the barometric altitude indication.

Heading

Heading and track data show on a partial compass rose at the bottom of the PFD.

ILS Data

ILS data shows when the ILS receiver tunes to a valid frequency. This data includes:

- localizer and glide slope deviation
- ILS frequency
- ILS identifier
- DME distance and
- Selected runway course.

The identifier and selected runway course show at the upper left corner of the attitude area. Co-located DME distance shows just below the identifier.

Localizer and glide slope deviation show as pointers against fixed scales at the bottom and right sides of the attitude area. The scales go away when the ILS receivers are not tuned or invalid.

Flight Mode Annunciations

Autopilot and autothrottle flight mode annunciations show at the top of the PFD. The top lines show autothrottle, AFDS roll, and AFDS pitch active modes in large green letters. The lower line shows AFDS roll and pitch armed modes in the center and right areas in small white letters.

AFDS Status

The AFDS status shows at the top center of the attitude area. These annunciations show for a flight director (F/D) only or an autopilot and F/D engaged:

- FLT DIR - F/D only
- A/P - autopilot only or autopilot and F/D.

These are the autoland status annunciations:

- NO AUTOLAND
- >LAND 2<
- LAND 3.

Radio Altitude and Minimums

Radio altitude shows as a digital readout in the bottom center portion of the attitude area when the radio altitude is at or below 2500 feet. A highlight box shows for ten seconds as the altitude goes below 2500 feet.

PRIMARY DISPLAY SYSTEM - PRIMARY FLIGHT DISPLAY OVERVIEW

Radio minimums (decision height-DH) shows as a digital readout near the lower left side of the altitude tape. The operator sets the RADIO value on the onside EFIS control panel. An amber alert shows as the radio altitude goes below the RADIO value.

Time Critical Warning (TCW) Messages

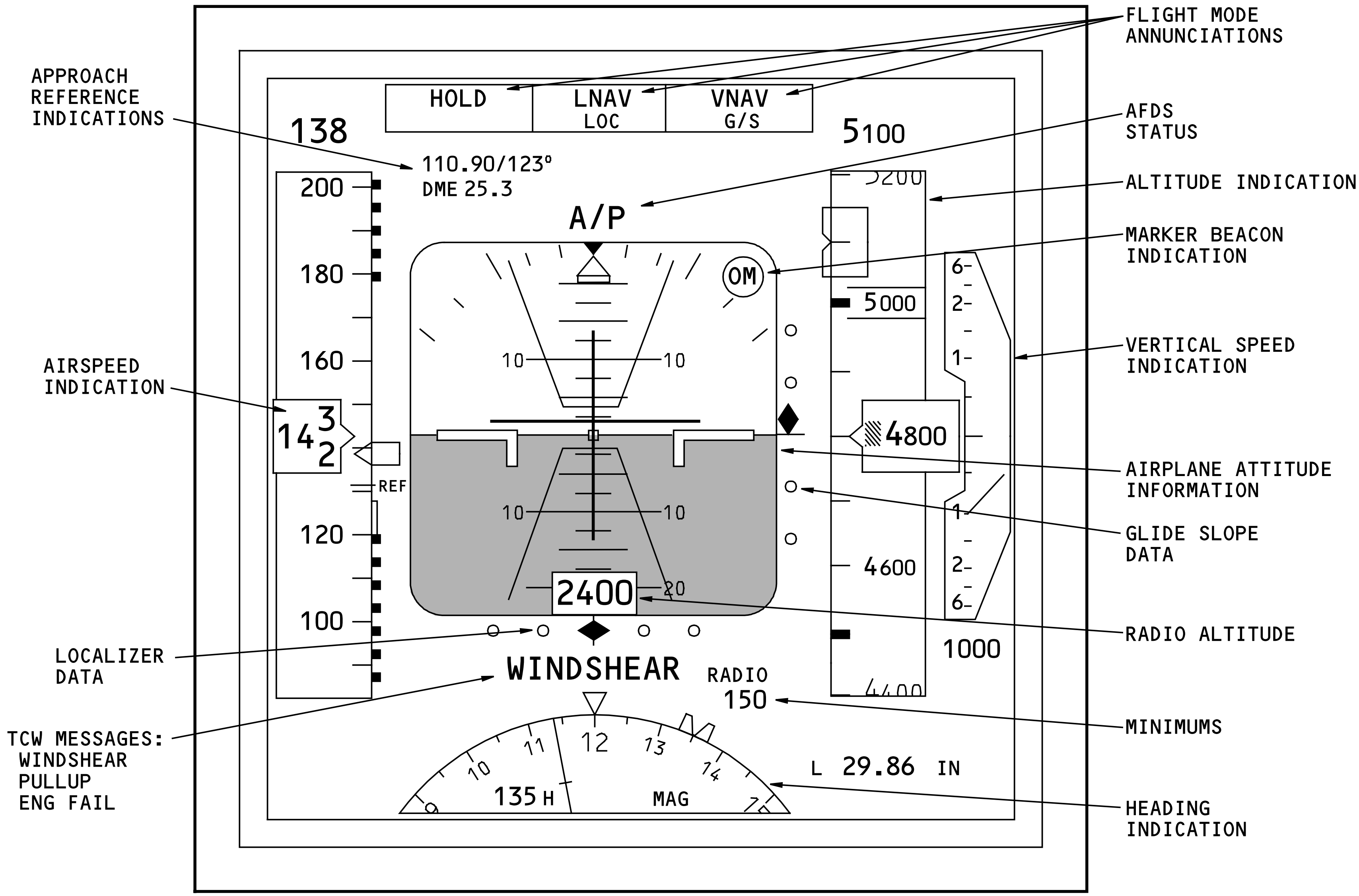
There are three time-critical warning messages. The two ground proximity warning system (GPWS) and one engine messages show on the PFD at the bottom center of the attitude area. These messages are the highest priority messages in the flight deck. Immediate flight crew intervention must follow to keep the airplane in a safe operating environment.

The GPWS message WINDSHEAR shows red during a windshear alert condition.

The GPWS message PULL UP shows red during a pull up alert condition.

The message ENG FAIL shows red during a failed engine condition.

If more than one condition exists, only one message shows in the priority above.



PRIMARY DISPLAY SYSTEM - PRIMARY FLIGHT DISPLAY OVERVIEW

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PRIMARY DISPLAY SYSTEM - PFD ATTITUDE AREA

General

The attitude area has a pitch scale with a horizon line, bank pointer and scale, sky and ground shading, and a fixed airplane symbol. The dynamic symbols of the display move in response to the air data inertial reference system (ADIRS) pitch and roll outputs.

Roll Attitude

The bank pointer moves to show roll against the fixed bank scale. The bank scale shows ±60 degrees of bank and the indices are at 10, 20, 30, 45, and 60 degrees. The bank pointer and slip/skid indicator turn amber when the bank is equal to or greater than ±35 degrees.

Pitch Attitude

The pitch scale moves against the fixed airplane symbol. The pitch lines are every 2.5 degrees from -90 degrees to +90 degrees. The sky/ground shading shows airplane attitude at a quick glance.

Flight Director Bars

Flight director bars show in the sky/ground area as a cross-pointer. The pitch command is a horizontal magenta bar. The roll command is the vertical magenta bar. The two bars move independently.

Flight Path Vector (FPV) and Flight Path Angle (FPA)

The FPV symbol shows the flight path angle and drift angle. The FPA is relative to the horizon line. Drift angle is the difference between airplane track and airplane heading. You use the FPV switch on the onside EFIS control panel to show the symbol. The symbol shows when there are valid pitch and bank commands from the AFDS, and valid pitch and roll information from the ADIRS.

The selected flight path angle shows the FPA selected on the mode control panel (MCP).

Traffic Alert and Collision Avoidance System (TCAS) Resolution Advisory Commands

TCAS resolution advisory commands show on the attitude display as three red bands. This makes a symbol similar to a rising runway. Pilots must avoid this area(s) inside the lines during a traffic encounter.

Slip/Skid Indication

The slip/skid indication shows the lateral acceleration of the airplane by the displacement of the lower portion of the bank pointer. With no lateral acceleration, the pointer and rectangular section align.

PRIMARY DISPLAY SYSTEM - PFD ATTITUDE AREA

Pitch Limit Indication

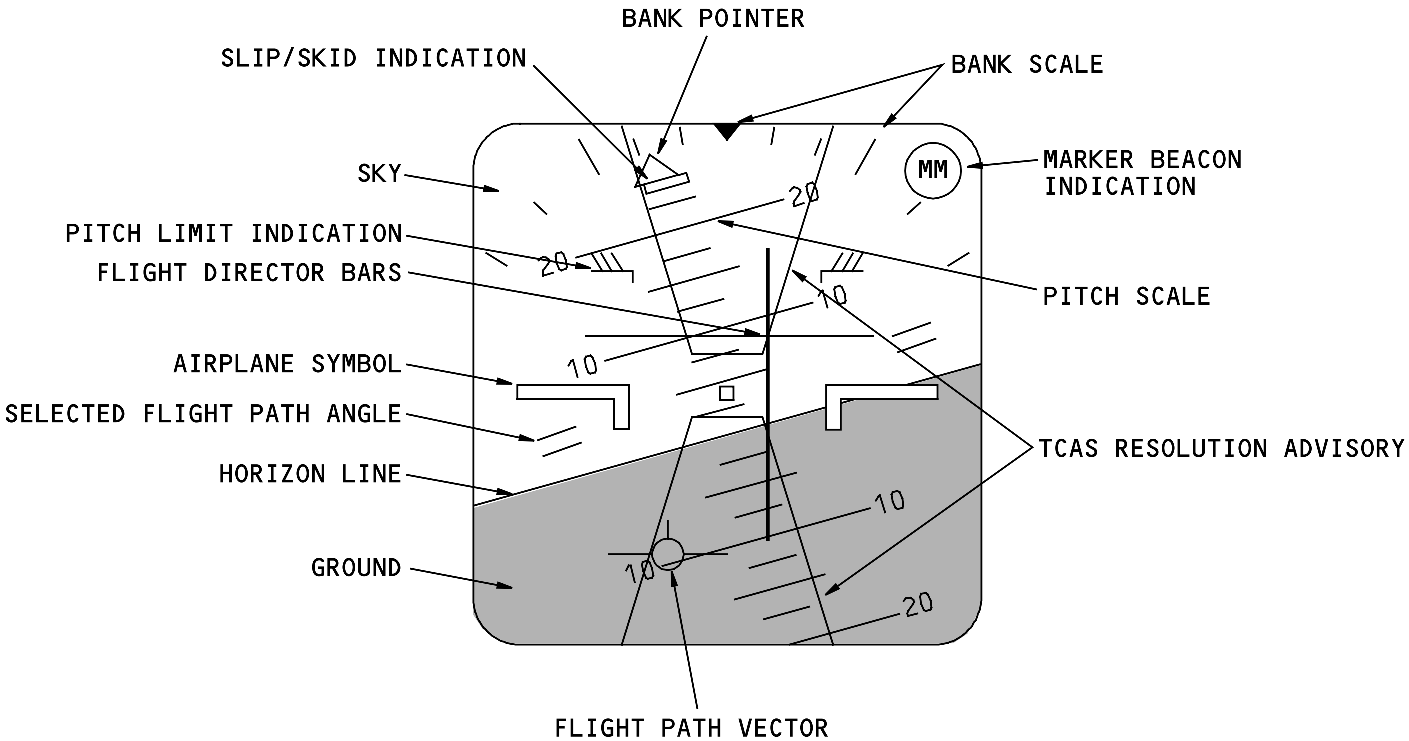
The pitch limit indication shows the remaining pitch angle to stick shaker activation for the current conditions. They show as amber eyelash symbols. They show during flap extension.

Marker Beacon Indication

The marker beacon indication shows in the upper right area of the attitude display. These are the indications that may show:

- IM (inner marker) white
- MM (middle marker) amber
- OM (outer marker) blue.

The indication shows as the airplane flies over a marker beacon. During a marker beacon functional test, the symbol FT shows. A circle encloses the symbols. The beacon displays flash at the rate normal for each beacon, IM-high, MM-medium, or OM-low.



31-61-00-029 Rev 3 10/28/1996

PRIMARY DISPLAY SYSTEM - PFD ATTITUDE AREA

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General

The airspeed indication is a display that moves against a fixed pointer. The indication has a visible range of 121 knots. Lines show at 10 knot intervals from 30 knots to 990 knots. Numbers show every 20 knots from 40 knots to 980 knots. Airspeed indication limits cause the display to show 30 knots for computed airspeed inputs of 30 knots or less (airspeed NCD).

Airspeed and MACH Number

A digital readout in the center of the tape shows the current computed airspeed (CAS) from the ADIRS. As the value changes, the digits move to simulate a drum type readout. The tape moves so that the current CAS shows by the point of the readout box. Current MACH shows below the speed tape for MACH values greater than 0.4. The information goes away when MACH goes below 0.38 or when MACH fails.

Selected Speed

Selected speed or MACH show as a pointer against the speed tape. The pointer is magenta and is rectangular with a point on one end that shows the selected speed. A numeric readout of the selected speed or MACH shows above the airspeed indication.

Takeoff Reference Speeds

The takeoff reference speeds have of three symbols that show against the speed tape before and during takeoff roll. The bugs show as a green dash followed by V1, VR, or V2. V1 is the decision speed for takeoff abort. VR is the recommended rotation speed. V2 is the takeoff safety speed. The FMCF calculates these speeds. The pilots use the CDU to accept or change the speeds. V1 and VR go away after lift-off. V2 goes away after lift-off when the flaps begin to raise. VR changes to R when GS is less than four knots.

Landing reference speed shows as a green dash and the letters REF.

Flap Maneuver Speeds

Two flap maneuver speeds show. The speeds agree with the current flap selection and the next retracted flap selection. The speeds show as tick marks on the airspeed tape with labels for the flap selections.

Limit Speeds

Maximum speed shows as a red and black barber pole that extends from the top of the speed tape. The barber pole extends to either VMO, MMO, flap placard or gear placard, whichever is smaller. The maneuver margin shows as a hollow amber bar that extends down from the bottom of the maximum speed barber pole. It represents the highest speed before the start of high speed buffet.

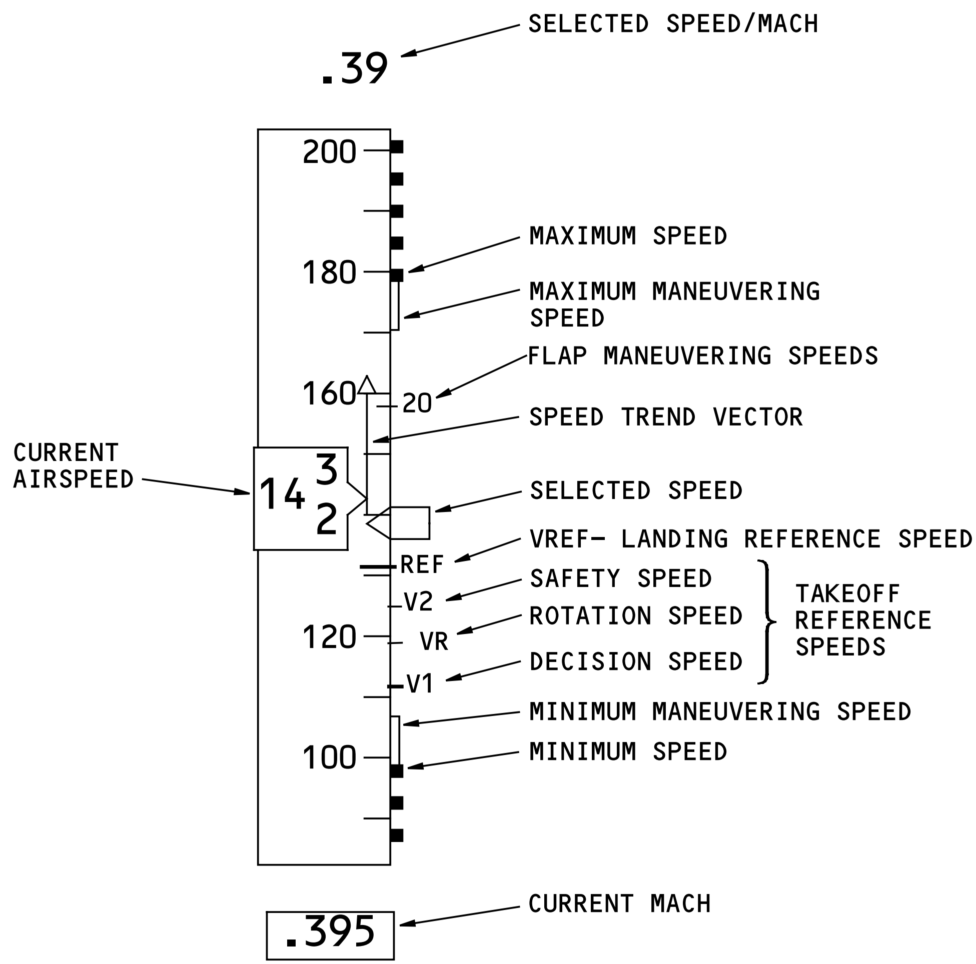
Minimum speed shows as a red and black barber pole that extends from the bottom of the speed tape to the Minimum speed.

PRIMARY DISPLAY SYSTEM - PFD AIRSPEED INDICATION

The maneuver margin shows as a hollow amber bar above the minimum speed barber pole. It shows the minimum maneuvering speed of the aircraft. This speed depends on flap/slat settings.

Speed Trend Vector

The length and direction of the green speed trend vector shows the airspeed in ten second intervals based on current acceleration.



31-61-00-030 Rev 2

PRIMARY DISPLAY SYSTEM - PFD AIRSPEED INDICATION

PRIMARY DISPLAY SYSTEM - BAROMETRIC ALTITUDE AND VERTICAL SPEED

General

Barometric altitude shows as a digital readout on a moving tape. As altitude changes, the tape moves against a fixed readout box that contains a drum type readout. The baro altitude tape goes from a -9900 feet to 99900 feet. Lines show every 100 feet with numbers every 200 feet.

Selected Altitude

A selected altitude bug shows the selected altitude from the mode control panel (MCP). The bug rests at the top or the bottom of the scale with only half the bug visible when the selected/target altitude is off the scale. The meters (MTRS) switch on the onside EFIS control panel adds the actual altitude and selected altitude show in meters.

Baro Minimums (MDA)

The baro minimums show as a pointer and a digital readout. A knob on the EFIS CP lets the operator set the value. Baro minimums or MDA has a range that starts at -1000 feet. For values less than -1000 feet, the pointer and readout go away.

Barometric Reference

Barometric reference data includes:

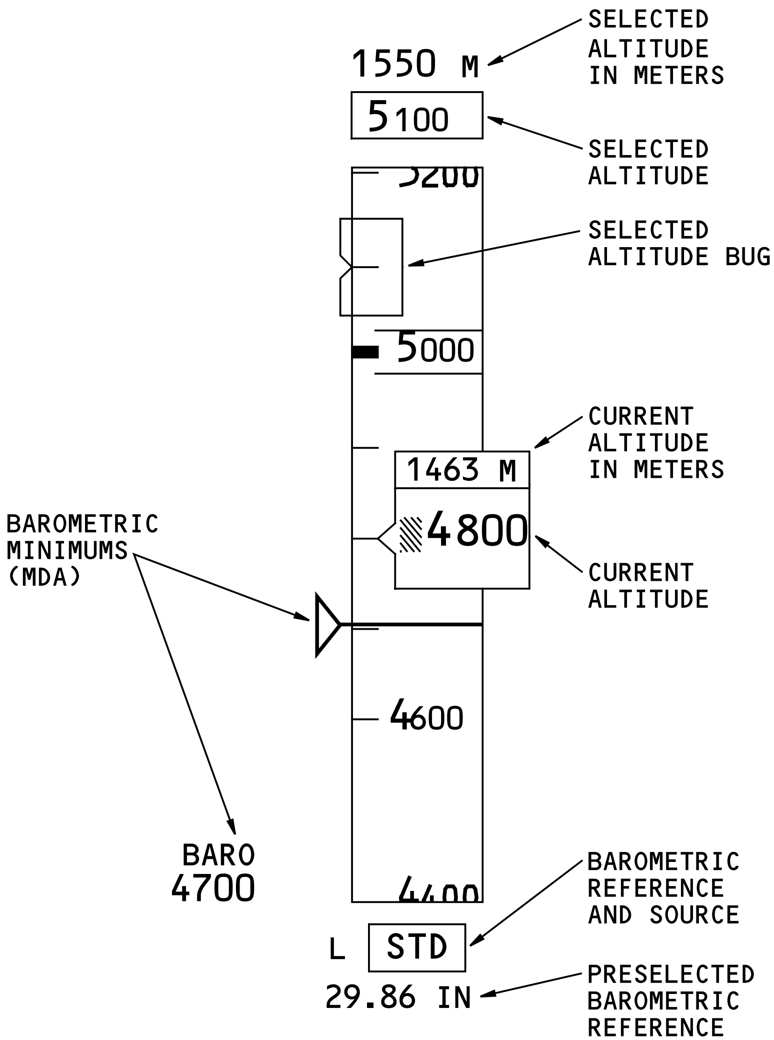
- Actual barometric reference
- Barometric reference source (L or R)
- Preselected barometric reference
- Barometric correction reference (QNH or QFE).

An amber box shows around the reference readout for a barometric transfer warning.

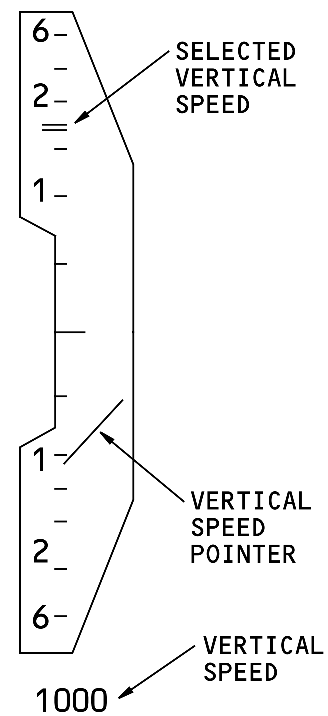
Vertical Speed (V/S)

Vertical speed shows as amoving pointer against a fixed scale. The display range of the scale is ± 6000 feet/minute. The top half of the scale shows a positive V/S and the bottom half shows a negative V/S. A V/S in excess of 400 feet per minute causes a digital readout to show. With a positive rate of climb, a digital readout shows at the top of the VS scale. With a negative rate of climb, a digital readout shows at the bottom of the VS scale.

Selected V/S shows as a magenta double line against the numerical scale. You can select the V/S value from the MCP.



ALTITUDE INDICATION



VERTICAL SPEED INDICATION

PRIMARY DISPLAY SYSTEM - BAROMETRIC ALTITUDE AND VERTICAL SPEED

PRIMARY DISPLAY SYSTEM - PFD HEADING AND TRACK

General

A partial compass rose of approximately 80 degrees shows at the bottom of the PFD. The compass rose shows this data:

- Heading and track
- Heading reference
- Selected heading or track.

Heading and Track

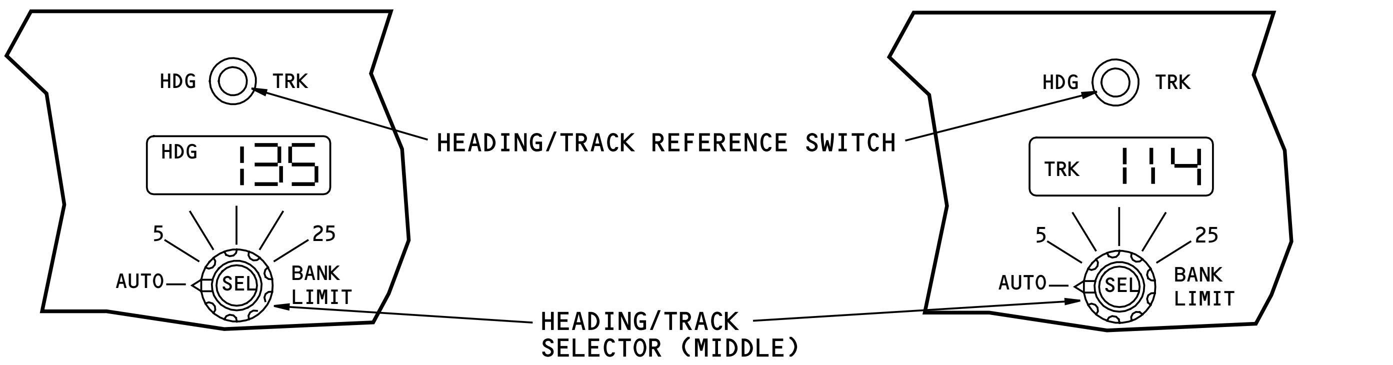
The current heading shows as a white (W) triangular pointer above the compass rose. The track line shows as a white (W) line that extends up from the center of the compass rose (off screen) and moves in response to track data.

Heading Reference

The heading reference shows automatic or manual selections in the bottom right part of the compass rose. MAG in green (G) shows when the heading reference switch is in the NORM position. TRU (G) shows in a white box when the switch is in the TRUE position. When the reference switches from TRUE to MAG, a green highlight box appears around MAG for 10 seconds.

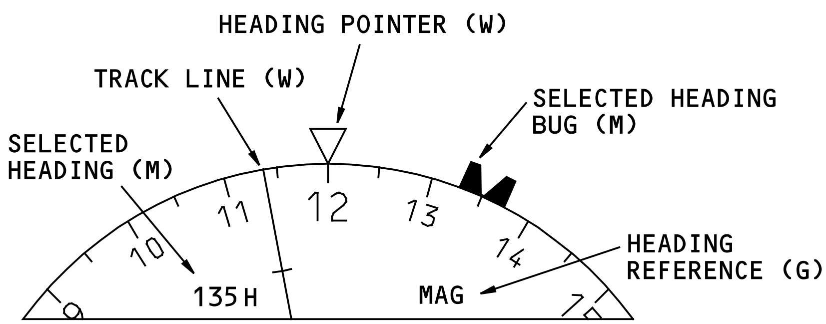
Selected Heading or Track

A selected heading or selected track shows magenta (M) both digitally and by a bug that shows the value on the compass rose. The digital readout shows in the lower portion just left of center. An H follows the value for selected heading and a T follows the value for selected track. The selected heading bug is in the shape of an M (bow tie). The bug is on the outer portion of the compass rose. The selected track bug is in the shape of a V and is in the inner portion of the compass rose. Use the heading/track selector on the mode control panel (MCP) to select a heading or track.

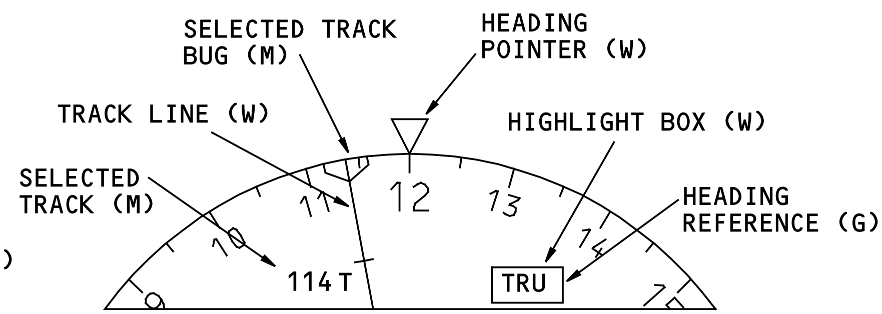


MODE CONTROL PANEL - HDG SELECTED

MODE CONTROL PANEL - TRK SELECTED



COMPASS ROSE WITH NORM SELECTED



COMPASS ROSE WITH TRU SELECTED

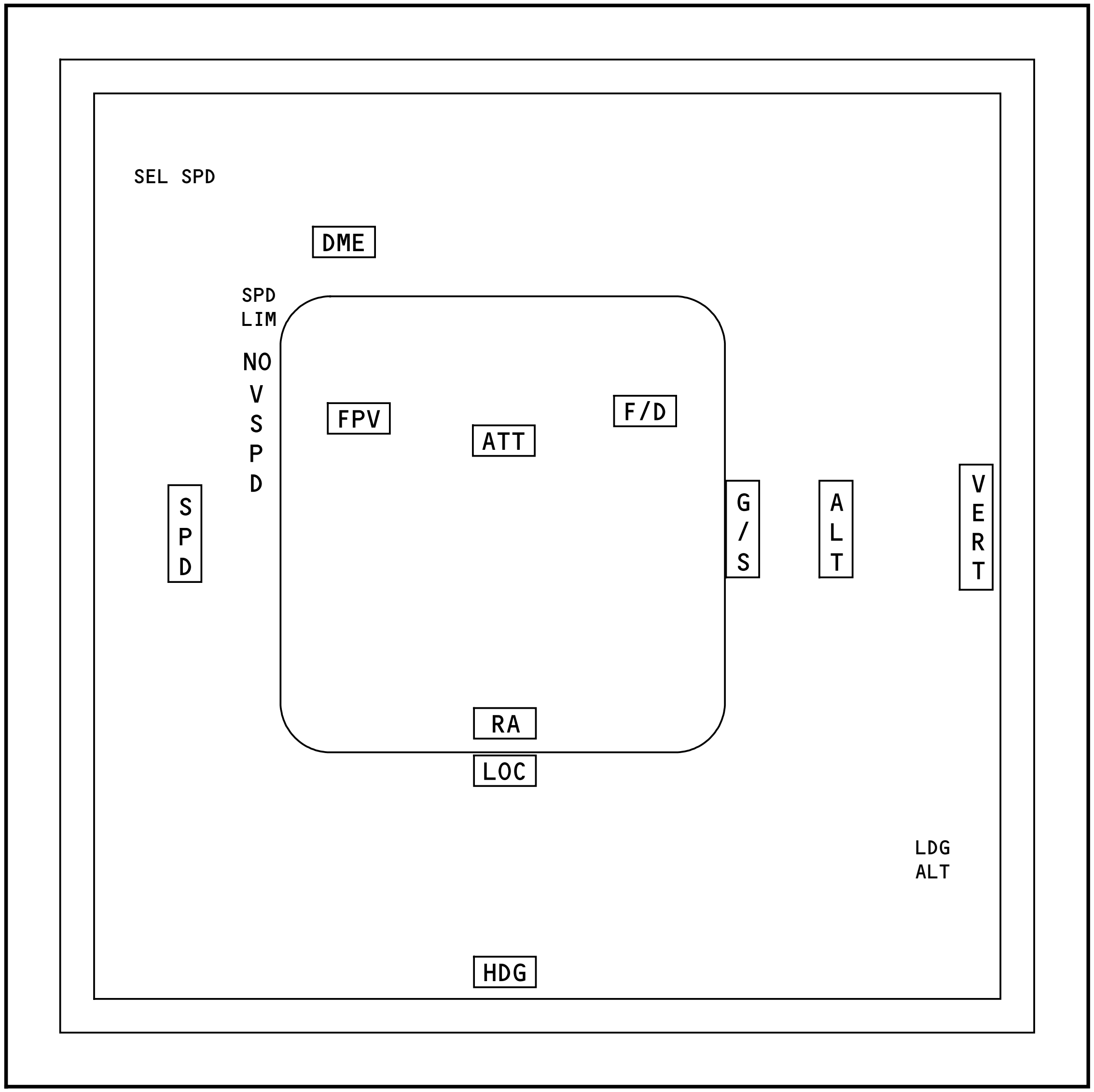
31-61-00-032 Rev 1

PRIMARY DISPLAY SYSTEM - PFD HEADING AND TRACK

PRIMARY DISPLAY SYSTEM - PFD FAULT ANNUNCIATIONS

General

The primary flight display shows data from many systems. The validity of the data determines what shows on the display. A no computed data (NCD) condition removes data from the display. An invalid condition removes the data and the display shows a failure flag.



31-61-00-033 Rev 1

PRIMARY DISPLAY SYSTEM - PFD FAULT ANNUNCIATIONS

PRIMARY DISPLAY SYSTEM - PFD NCD AND FAIL CONDITIONS -1

General

The display function in the AIMS cabinets evaluates inputs from the airplane systems.

A no computed data (NCD) status causes information on the display to go away.

A fail status causes information on the display to go away and a fail flag to show.

NCD and Failed Conditions

The chart shows the conditions for:

- Instrument landing system (ILS)
- Co-located DME
- Radio altimeter (RA) system
- Decision height (DH)
- Flight mode annunciations (FMA).

PARAMETER	CONDITION	RESULT	REMARKS
GLIDE SLOPE DEVIATION	NCD	GLIDE SLOPE POINTER GOES AWAY	NCD STATUS FROM ALL GLIDE SLOPE SOURCES INDEPENDENTLY OF LOCALIZER DATA
GLIDE SLOPE DEVIATION	FAIL	GLIDE SLOPE POINTER AND SCALE GO AWAY - AMBER G/S FLAG	FAIL FROM ALL GLIDE SLOPE SOURCES INDEPENDENTLY OF LOCALIZER DATA
LOCALIZER DEVIATION	NCD	LOCALIZER POINTER GOES AWAY	NCD STATUS FROM ALL LOCALIZER SOURCES INDEPENDENTLY OF GLIDE SLOPE DATA
LOCALIZER DEVIATION	FAIL	LOCALIZER POINTER AND SCALE GO AWAY - AMBER LOC FLAG	FAIL STATUS FROM ALL LOCALIZER SOURCES INDEPENDENTLY OF GLIDE SLOPE DATA
DME DISTANCE	NCD	DME WITH DASHES SHOWS - - - -	ONSIDE DME CO-LOCATED WITH ILS IS NCD
DME DISTANCE	FAIL	AN AMBER DME FLAG SHOWS	ONSIDE DME CO-LOCATED WITH ILS FAILS
RADIO ALTITUDE	NCD	RA DATA GOES AWAY	NCD STATUS FROM ALL RA SOURCES
RADIO ALTITUDE	FAIL	RA DATA GOES AWAY, AMBER RA FLAG	FAIL STATUS FROM ALL RA SOURCES
DECISION HEIGHT	NCD	NUMERICS AND CHARACTERS GO AWAY	NCD STATUS FROM ONSIDE EFIS CP
DECISION HEIGHT	FAIL	NUMERICS AND CHARACTERS GO AWAY	FAIL STATUS FROM ONSIDE EFIS CP
FLIGHT MODE ANNUNCIATIONS	NCD	CHARACTERS GO AWAY	NCD STATUS FROM ONSIDE AFDC
FLIGHT MODE ANNUNCIATIONS	FAIL	FMA SHOWS WITH AMBER LINE THROUGH CHARACTERS - ~~LNAV~~	FAIL STATUS FROM AFDC

31-61-00-034 Rev 0

PRIMARY DISPLAY SYSTEM - PFD NCD AND FAIL CONDITIONS -1

PRIMARY DISPLAY SYSTEM - PFD NCD AND FAIL CONDITIONS -2

General

The display function in the AIMS cabinets evaluates inputs from the airplane systems.

A no computed data (NCD) status causes information on the display to go away.

A fail status causes information on the display to go away and a fail flag to show.

NCD and Failed Attitude Conditions

The chart shows the conditions for the attitude area on the PFD.

PARAMETER	CONDITION	RESULT	REMARKS
ATTITUDE	NCD	HORIZON, PITCH LINES, ROLL POINTER, SKY/GROUND, SLIP/ SKID INDICATORS GO AWAY	NCD PITCH AND/OR ROLL DATA FROM ADIRS OR PITCH EXCEEDS 90 DEGREES
ATTITUDE	FAIL	HORIZON, PITCH LINES, ROLL POINTER, SKY/GROUND, SLIP/ SKID INDICATORS GO AWAY - AMBER ATT FLAG SHOWS	FAILED PITCH AND/OR ROLL DATA FROM ADIRS
FLIGHT DIRECTOR	NCD	FD BAR OR BARS REMOVED	NCD PITCH AND/OR ROLL FD COMMANDS FROM AFDC. PITCH AND ROLL BARS OPERATE INDEPENDENTLY.
FLIGHT DIRECTOR	FAIL	FD BARS REMOVED - AMBER FD FLAG SHOWS	FAILED PITCH AND/OR ROLL FD COMMANDS FROM AFDC
FLIGHT PATH VECTOR	NCD	FPV SYMBOL GOES AWAY	EFIS CP SWITCH ON AND ADIRS PITCH OR ROLL OR HEADING OR TRACK OR FPA IS NCD
FLIGHT PATH VECTOR	FAIL	FPV SYMBOL GOES AWAY - AMBER FPV FLAG SHOWS	EFIS CP SWITCH ON AND ADIRS PITCH OR ROLL OR HEADING OR TRACK OR FPA FAILS OR PITCH EXCEEDS 90 DEGREES

31-61-00-035 Rev 0

PRIMARY DISPLAY SYSTEM - PFD NCD AND FAIL CONDITIONS -2

PRIMARY DISPLAY SYSTEM - PFD NCD AND FAIL CONDITIONS -3

General

The display function in the AIMS cabinets evaluates inputs from the airplane systems.

A no computed data (NCD) status causes information on the display to go away.

A fail status causes information on the display to go away and a fail flag to show.

NCD and Failed Airspeed Conditions

The chart shows the conditions for the airspeed indication.

PARAMETER	CONDITION	RESULT	REMARKS
COMPUTED AIR SPEED	NCD	TAPE WITH POINTER AT 30 KNOTS SHOWS	NCD CAS FROM ADIRS
COMPUTED AIR SPEED	FAIL	ALL SPEED TAPE SYMBOLOGY GOES AWAY AND AMBER S P D FLAG SHOWS	FAILED CAS FROM ADIRS
SELECTED SPEED	NCD OR FAILED MCP SEL MACH OR SEL SPD	AMBER SEL SPD FLAG SHOWS AND SELECTED SPEED BUG GOES AWAY	SELECTED MACH OR SELECTED AIRSPEED FROM THE MCP ARE NCD OR FAILED
SELECTED SPEED	FAIL	THREE DASHES - - - SHOW	FMC MACH TARGET, CAS TARGET OR VNAV PITCH COMMAND FAILED
V1, V2, VR	FAIL	BUGS AND READOUTS GO AWAY	FAILED ADIRS CAS
V1, V2, VR	FAIL	BUGS AND READOUTS GO AWAY AND AMBER NO V SPD SHOWS	CAS<50 KNOTS OR CAS NCD AND V1, OR V2, OR VR FAIL
V1, V2, VR	FAIL	V2 GOES AWAY, VR AND V1 STAY	V2 FAILS
SPEED LIMIT	NCD	BARBER POLE GOES AWAY	ADIRS CAS NCD OR CAS < 40 KNOTS AND STICK SHAKER SPEED NCD OR ADIRS CAS FAIL
SPEED LIMIT	FAIL	BARBER POLE GOES AWAY AND AMBER SPD LIM SHOWS	ADIRS FAIL AND WES MAX OP SPEED NCD OR FAIL OR STICK SHAKER SPEED NCD OR FAIL
MACH	MACH NCD OR FAIL	AREA BLANKS	MACH IS NCD OR LESS THAN.4 OR FAILED

31-61-00-036 Rev 1 01/23/96

PRIMARY DISPLAY SYSTEM - PFD NCD AND FAIL CONDITIONS -3

PRIMARY DISPLAY SYSTEM - PFD NCD AND FAIL CONDITIONS -4

General

The display function in the AIMS cabinets evaluates inputs from the airplane systems.

A no computed data (NCD) status causes information on the display to go away.

A fail status causes information on the display to go away and a fail flag to show.

NCD and Failed Conditions

The charts shows the conditions for:

- Altitude indication
- Vertical speed indication
- Heading indication.

PARAMETER	CONDITION	RESULT	REMARKS
BAROMETRIC ALTITUDE	FAIL	THE TAPE AND SYMBOLOGY GO AWAY AND AN AMBER ALT FLAG SHOWS	BARO CORRECTED ALTITUDE FROM THE ADIRS FAILS

BAROMETRIC ALTITUDE INDICATION

PARAMETER	CONDITION	RESULT	REMARKS
VERTICAL SPEED	NCD	POINTER AND DIGITAL READOUT GO AWAY	NCD ADIRS VERTICAL SPEED
VERTICAL SPEED	FAIL	SCALE, POINTER, AND DIGITAL READOUT GO AWAY AND AN AMBER VERT FLAG SHOWS	ADIRS VERTICAL SPEED FAILS

VERTICAL SPEED INDICATION

PARAMETER	CONDITION	RESULT	REMARKS
HEADING	NCD	TAPE NUMERICS GO AWAY	NCD MCP HEADING
HEADING	FAIL	TAPE NUMERICS, TICKS, AND HEADING INDEX GO AWAY. AN AMBER HDG FLAG SHOWS	FAILED MCP HEADING

HEADING INDICATION

31-61-00-037 Rev 0

PRIMARY DISPLAY SYSTEM - PFD NCD AND FAIL CONDITIONS -4

PRIMARY DISPLAY SYSTEM - NAVIGATION DISPLAY OVERVIEW

General

The navigation display (ND) has seven modes of operation. The modes are:

- Expanded approach mode
- Centered Approach mode
- Expanded VOR mode
- Centered VOR mode
- Expanded map mode
- Centered map mode
- Plan mode.

Flight planning, different flight phases, and flight changes require the use the various modes.

The plan mode has a north-up orientation.

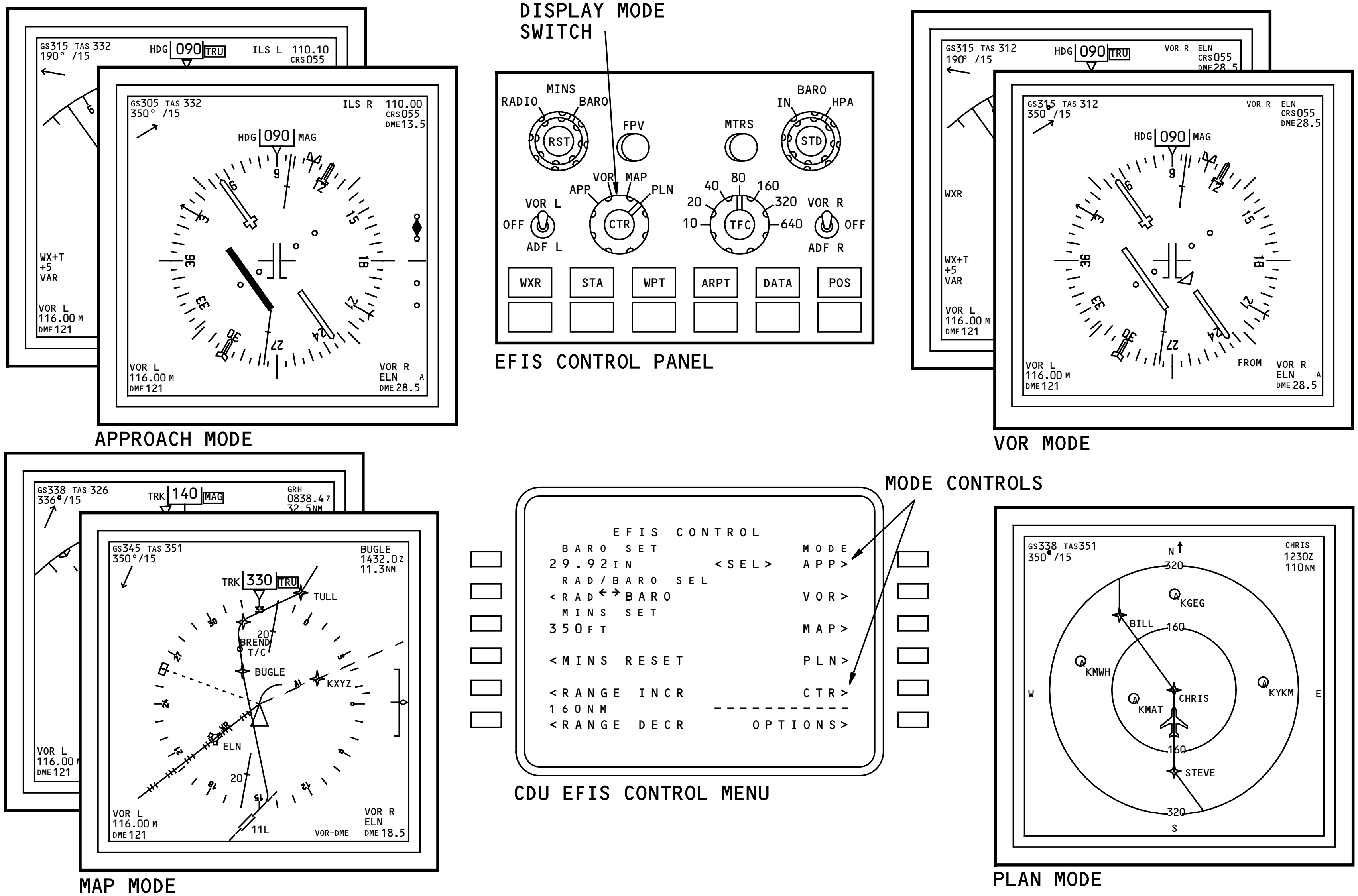
The centered modes show 360 degrees of the compass rose. The expanded modes show 90 degrees of the compass rose.

Use the EFIS control panel (CP) to change the modes of operation.

Controls

Use the onside EFIS CP or the onside CDU to control the mode of operation.

Use the CTR push-button on the EFIS CP or the CTR selection on the CDU EFIS page to toggle the ND between the centered and the expanded display in the approach, VOR and MAP modes.



31-61-00-038 Rev 1

PRIMARY DISPLAY SYSTEM - NAVIGATION DISPLAY OVERVIEW

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PRIMARY DISPLAY SYSTEM - CENTERED APPROACH MODE

General

The centered approach mode display shows ILS course deviation, and navigation information over a full 360 degree compass rose. The centered approach mode is a heading-up display. The airplane symbol in the center of the display shows the airplane position along the flight path.

Display Data

The heading box at the upper center of the display shows digital heading in 1 degree increments. The compass rose also rotates to show airplane heading. The digital heading readout is green. MAG or TRU annunciation shows in green to indicate the heading reference.

A white track pointer on the compass rose shows track angle.

Selected course shows as a magenta pointer that rotates around the fixed airplane symbol. The selected course also shows digitally in the upper right corner of the display.

The localizer deviation indication contains a deviation bar on a dot scale. The localizer deviation indicator rotates around the airplane symbol with the pointer.

Glide slope deviation shows as a deviation bar on a vertical dot scale on the right side of the display.

This data shows in the upper right corner for a tuned ILS station when the receiver gets a valid identifier from the ground station:

- Frequency
- Station (STA) identifier
- DME distance.

With no valid identifier, the tuned frequency shows. Below the frequency/identifier field is the selected course. DME distance to a co-located DME station shows below the selected course when available.

The ILS radio source shows at the upper right, near the frequency or STA identifier.

VOR or ADF bearing pointers show on the compass rose. VOR and ADF pointers move clockwise. The VOR pointer movement equals the difference between the received omni-bearing signal and the airplane heading. VOR pointers are green and ADF pointers are cyan. The left pointer is thin and the right pointer is thick for both radios. ADF pointer movement from the airplane heading is the received ADF bearing.

Use the VOR/ADF switches on the EFIS CP to show the applicable data in the lower left and/or right corners of the display. The switch position shows as well as the identifier/frequency of the tuned navigation aids. ADF data shows in cyan and VOR data shows in green. DME distance shows below the frequency/identifier for VOR stations with a co-located DME.

PRIMARY DISPLAY SYSTEM - CENTERED APPROACH MODE

Selected heading shows as M shaped box on the outer edge of the compass rose. When selected heading and actual heading are equal, the box fits around the heading pointer. Selected track shows as a cursor on the inner edge of the compass rose.

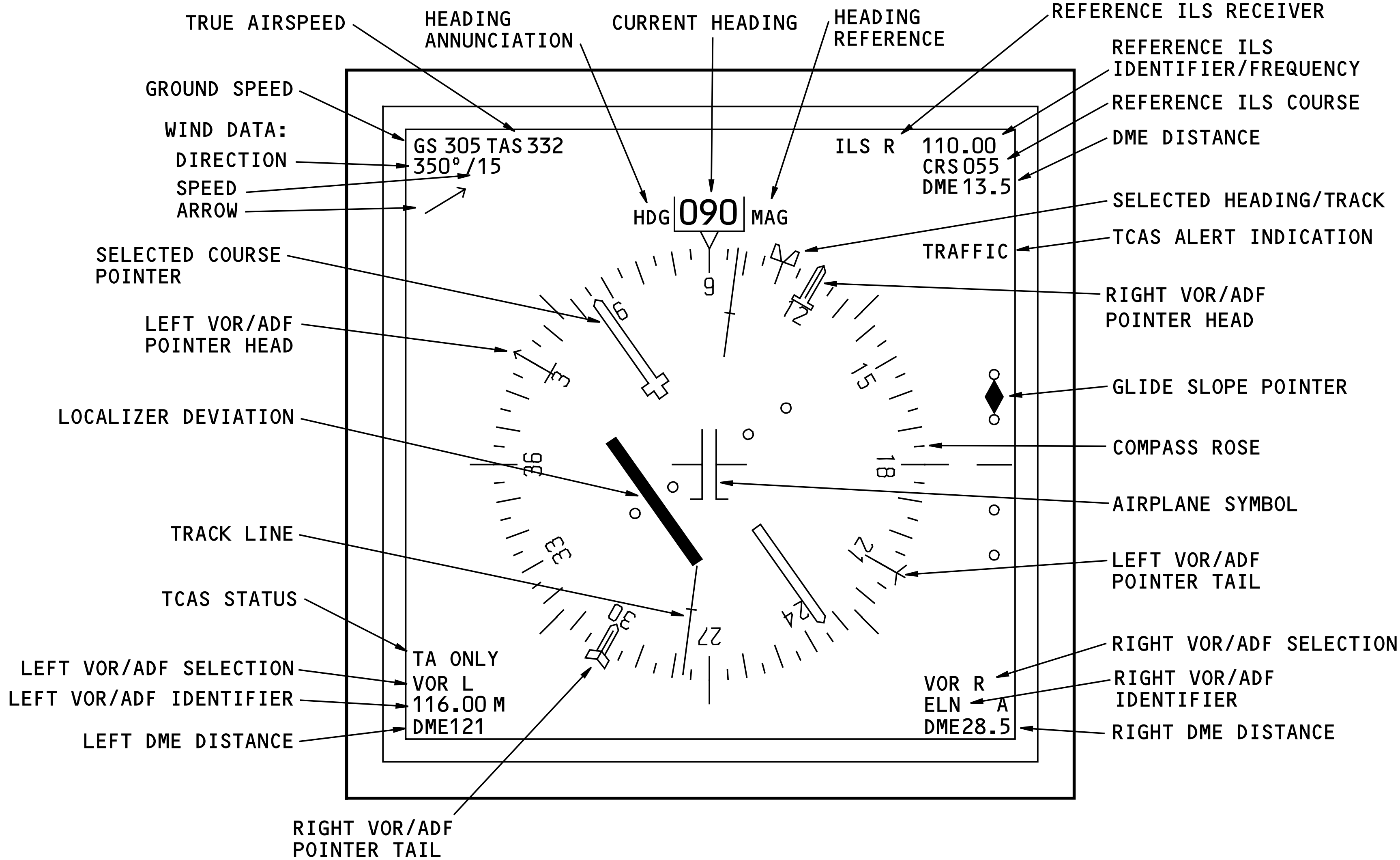
This data shows in the upper left corner:

- Ground speed
- True airspeed
- Wind data.

Ground speed and true airspeed shows as digital readouts. Wind data shows as digital readouts and a rotating arrow.

TCAS information shows as a message below the DME distance in the upper right corner.

TCAS status information shows below the WXR data field to indicate TCAS selection, TA ONLY (TCAS is not computing RAs) or TCAS TEST (TCAS is in the test mode).



PRIMARY DISPLAY SYSTEM - CENTERED APPROACH MODE

PRIMARY DISPLAY SYSTEM - EXPANDED APPROACH MODE

General

The expanded approach mode shows ILS course and course deviation and navigation information. The display shows 90 degrees of the compass rose. The airplane symbol is at the bottom of the display and the point of the symbol represents the present position of the airplane along the flight path.

Display Data

The expanded approach mode shows data that does not show or is different on the full rose approach mode.

Heading and track, the airplane heading shows as digits on top of a 90 degree arc and is the same as the full approach mode. The track line extends from the tip of the airplane symbol to the compass rose.

Selected runway course shows as a magenta pointer.

Localizer and glide slope deviation scales and symbology are slightly different in appearance. The function is the same as the centered approach mode.

VOR/ADF bearing pointers head or the tail of the applicable pointer shows.

Selected heading or track show as a magenta dashed line that extends from the selected heading or track pointer to the apex of the airplane symbol.

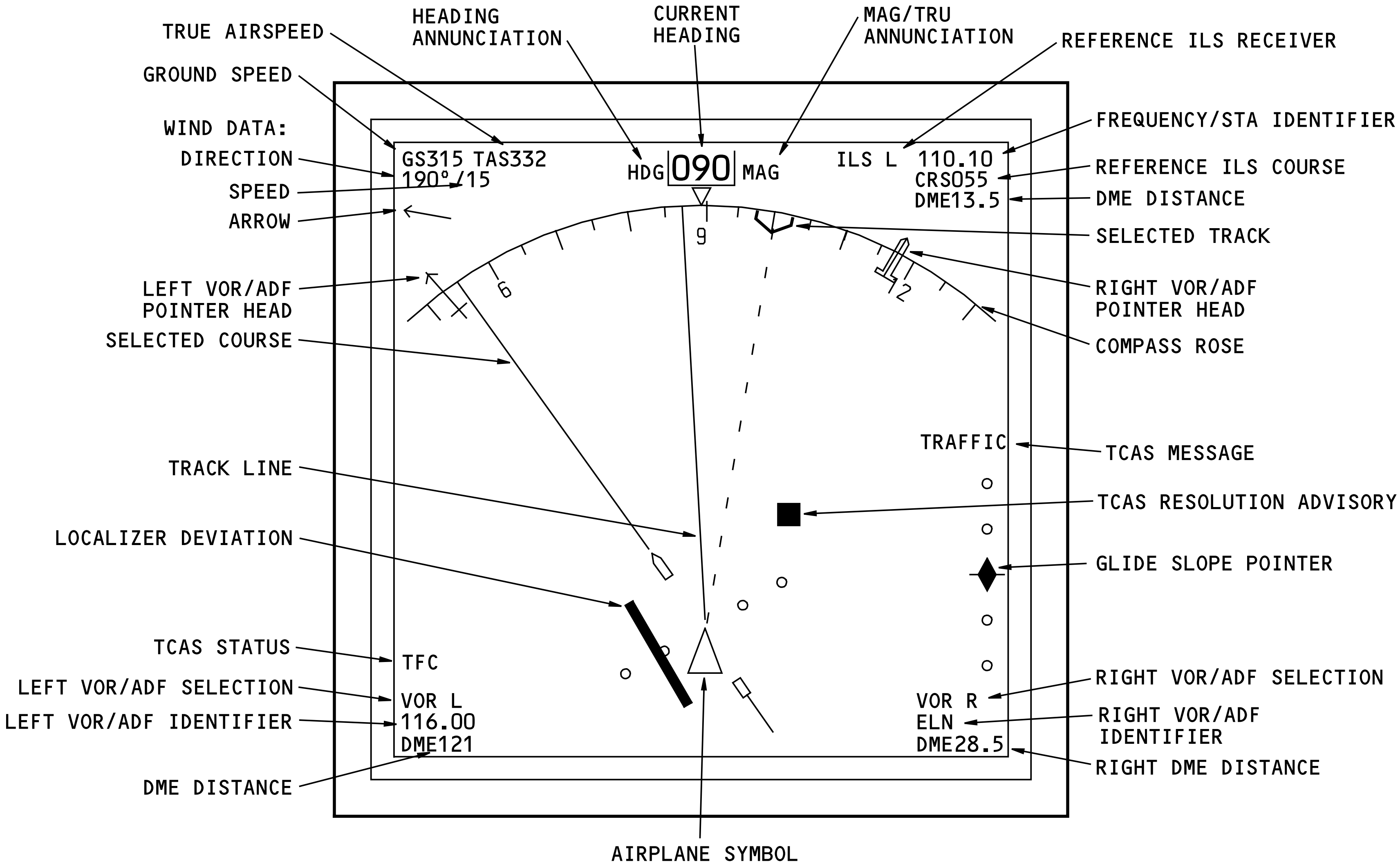
TCAS information shows as messages in the right center of the display and as symbols.

TCAS status and mode information shows below the WXR data field to show this TCAS selection (TFC) and mode data:

- TA ONLY (TCAS is not computing RAs)
- TCAS TEST (TCAS is in the test mode)
- TCAS OFF
- TCAS FAIL (a fault exist in TCAS).

Data that does not change includes:

- Identifier, frequency and DME distance
- The radio source
- ADF/VOR switch position, frequency and DME distance
- Ground speed, wind data and true airspeed.



31-61-00-040 Rev 1

PRIMARY DISPLAY SYSTEM - EXPANDED APPROACH MODE

PRIMARY DISPLAY SYSTEM - APPROACH MODE FAILURE FLAGS

General

Failures of input sources cause data to go away from the display and failure flags to show.

All the flags are amber.

The captain's and first officer's NDs operate independently.

Failure Flags

A heading (HDG) input failure to the ND causes HDG to show.

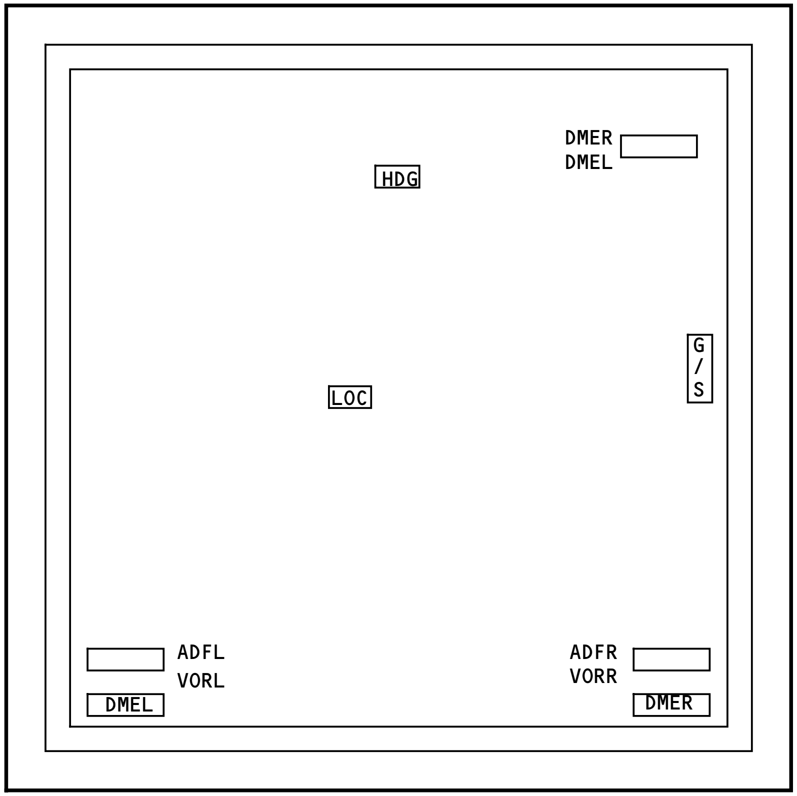
The DME co-located with the ILS, or left or right VOR failure causes DMEL or DMER to show on the ND. To see the flag for DMEs co-located with the VOR stations, put the applicable VOR switch on the EFIS CP in the VOR position.

The localizer (LOC) input failure causes the LOC to show on the ND. The localizer flag is independent of the glideslope flag.

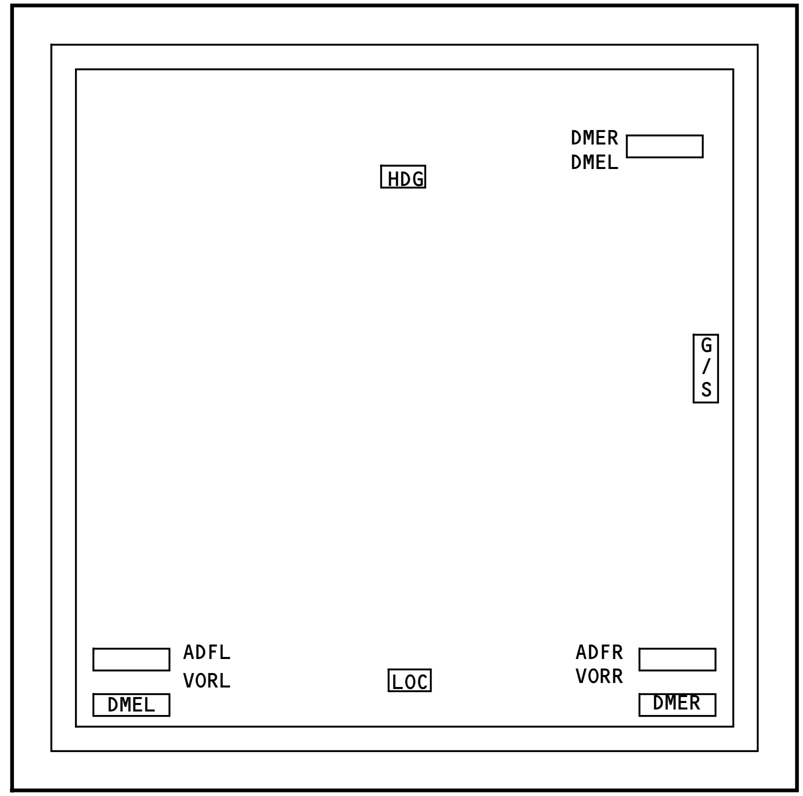
A glide slope (G/S) failure causes G/S to show on the ND. The glide slope flag is independent of the localizer flag.

A left or right ADF failure causes ADFL or ADFR to show on the ND. To see the flag, put the applicable switch on the EFIS control panel in the ADF position.

A left or right VOR failure causes VORL or VORR to show on the ND. To see the flag, put the applicable switch on the EFIS control panel in the VOR position.



CENTERED MODE



EXPANDED MODE

31-61-00-041 Rev 0

PRIMARY DISPLAY SYSTEM - APPROACH MODE FAILURE FLAGS

PRIMARY DISPLAY SYSTEM - APPROACH MODE NCD AND FAIL CONDITIONS

General

The display function in the AIMS cabinets evaluates inputs from the airplane systems.

A no computed data (NCD) status causes information on the display to go away.

A fail status causes information on the display to go away and a fail flag to show.

Approach Mode NCD and Fail Conditions

The chart below shows the NCD and fail conditions for the approach mode.

PARAMETER	CONDITION	RESULT	REMARKS
GLIDE SLOPE DEVIATION	NCD	GLIDE SLOPE POINTER GOES AWAY	NCD STATUS FOR ALL GLIDE SLOPE SOURCES INDEPENDENT OF LOCALIZER DATA
GLIDE SLOPE DEVIATION	FAIL	GLIDE SLOPE POINTER AND SCALE GO AWAY. AMBER G/S FLAG.	FAIL STATUS FOR ALL GLIDE SLOPE SOURCES INDEPENDENT OF LOCALIZER DATA
LOCALIZER DEVIATION	NCD	LOCALIZER POINTER GOES AWAY	NCD STATUS FOR ALL LOCALIZER SOURCES INDEPENDENT OF GLIDE SLOPE DATA
LOCALIZER DEVIATION	FAIL	LOCALIZER POINTER AND SCALE GO AWAY. AMBER LOC FLAG.	FAIL STATUS FOR ALL LOCALIZER SOURCES INDEPENDENT OF GLIDE SLOPE DATA
ADF FREQ/IDENT	NCD OR FAIL	IF IDENT INVALID, FREQ SHOWS. IF FREQ INVALID DISPLAY BLANKS	EFIS CP VOR/ADF SWITCHES ON
DME DISTANCE	NCD	DME WITH DASHES SHOWS - - - -	ON-SIDE DME CO-LOCATED WITH VOR IS NCD
DME DISTANCE	FAIL	AN AMBER DME FLAG SHOWS	ON-SIDE DME CO-LOCATED WITH VOR FAILS
HEADING	NCD	TAPE NUMERICS GO AWAY	NCD HEADING
HEADING	FAIL	TAPE NUMERICS, TICKS, AND HEADING INDEX GO AWAY. AN AMBER HDG FLAG SHOWS	FAILED HEADING

31-61-00-042 Rev 0

PRIMARY DISPLAY SYSTEM - APPROACH MODE NCD AND FAIL CONDITIONS

PRIMARY DISPLAY SYSTEM - CENTERED VOR MODE

General

The centered VOR mode shows selected VOR course and course deviation. The display shows the full 360 degrees of the compass rose. The centered VOR mode has a heading up display.

Display Data

There is some data that is the same as the data on the centered approach mode. Other data is unique to the VOR mode.

Heading and track is the same as the approach mode.

Selected VOR course shows as a magenta pointer that rotates around a fixed airplane symbol. The selected VOR course also shows digitally in the upper right corner.

VOR course deviation shows as a deviation bar on a dot scale. The dot scale rotates around the airplane symbol.

TO shows airplane direction to the tuned station. FROM shows airplane direction from the tuned station. A pointer and the TO or FROM indication shows this data.

The decoded VOR station identifier shows in the upper right corner for a tuned VOR station when the receiver gets a valid identifier from the ground station. With no valid identifier, the tuned frequency shows. Below the frequency/identifier field is the selected course.

DME distance to the co-located DME station shows below the selected VOR course.

The radio source shows at the upper right between the heading readout and the frequency/identifier.

ADF/VOR bearing information is the same as the approach mode.

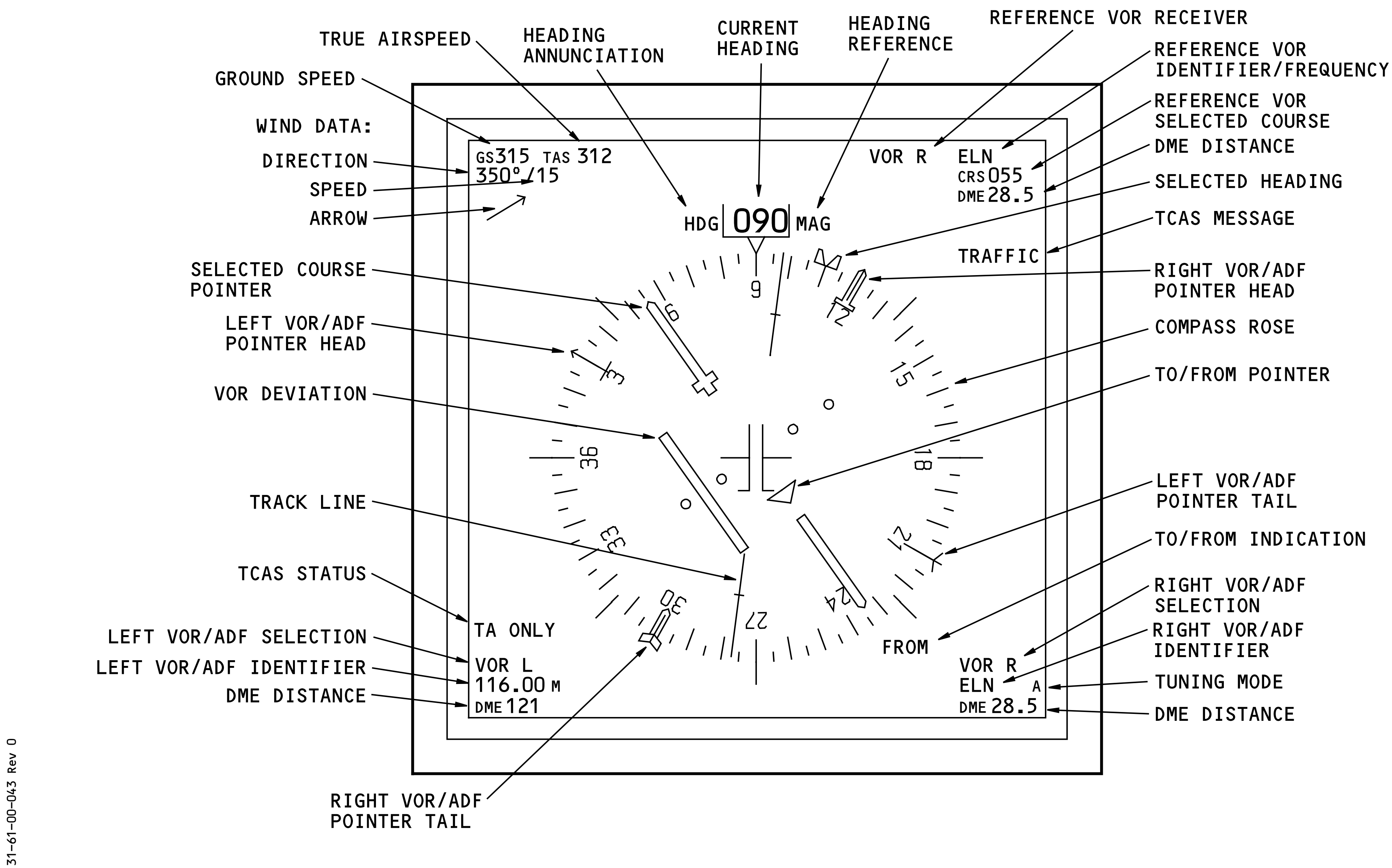
ADF/VOR switch position, frequency, and DME distance is the same as the approach mode.

Selected heading or track is the same as the approach mode.

Ground speed, wind data and true airspeed is the same as the approach mode.

TCAS information shows as a message below the DME distance in the upper right corner. Set the TFC switch on the EFIS CP to see the data.

TCAS status information shows below the WXR data field to indicate TCAS selection; TA ONLY (TCAS is not computing RA) or TCAS TEST (TCAS is in the test mode).



PRIMARY DISPLAY SYSTEM - CENTERED VOR MODE

PRIMARY DISPLAY SYSTEM - EXPANDED VOR MODE

General

The expanded VOR mode shows the selected VOR course and course deviation. The display shows 90 degrees of the compass rose. The airplane symbol is at the bottom of the display and the apex of the symbol represents the present position of the airplane.

Display Data

The expanded VOR mode shows data that does not show or is different on the centered VOR mode.

The airplane heading shows as digits on top of a 90 degree arc and is the same as the centered VOR mode. The track line extends from the tip of the airplane symbol to the compass rose.

Selected course shows as a magenta line.

VOR course deviation scales and symbols look slightly different. They function the same as the centered VOR mode.

Only the head or the tail of the VOR/ADF bearing pointers shows.

Selected heading or track shows as a magenta dashed line that extends from the apex of the airplane symbol to the selected heading or track pointer.

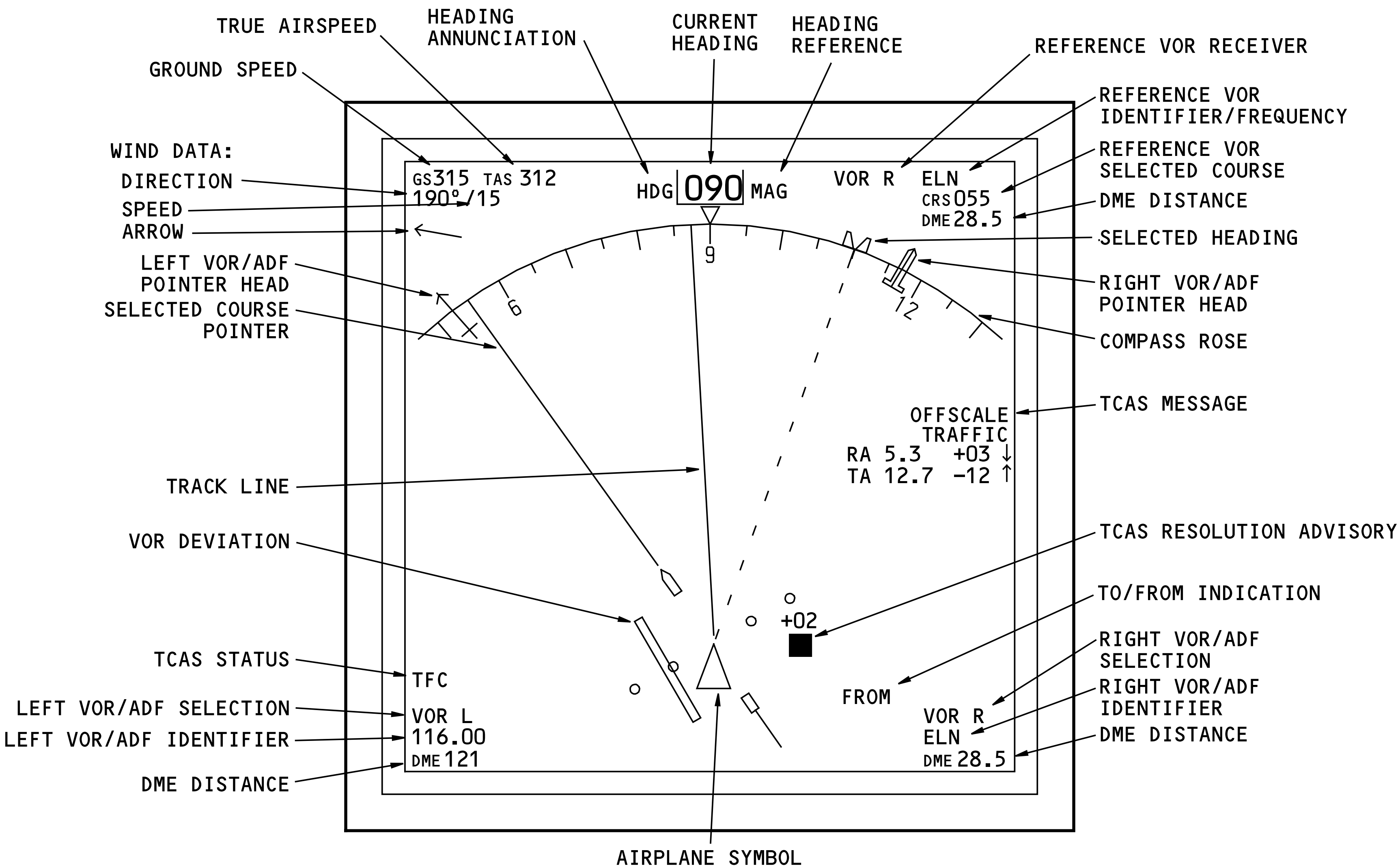
TCAS information shows as messages in the right center of the display and as symbols on the display. Set the TFC switch on the EFIS CP to see the information.

TCAS status and mode information shows below the WXR data field to show:

- TCAS selection
- TFC and mode data
- TA ONLY (TCAS is not computing RA)
- TCAS TEST (TCAS is in the test mode)
- TCAS OFF
- TCAS FAIL (a fault exist in TCAS).

Data that does not change includes:

- Identifier, frequency and DME distance
- The radio source
- ADF/VOR switch position, frequency and DME distance
- Ground speed, wind data and true airspeed.



31-61-00-044 Rev 1

PRIMARY DISPLAY SYSTEM - EXPANDED VOR MODE

PRIMARY DISPLAY SYSTEM - VOR MODE FAILURE FLAGS

General

Failures of input sources cause data to go away from the display and failure flags to show.

All the flags are amber in color.

The captain's and first officer's NDs operate independently.

Failure Flags

The heading (HDG) flag shows when the input to the applicable ND fails

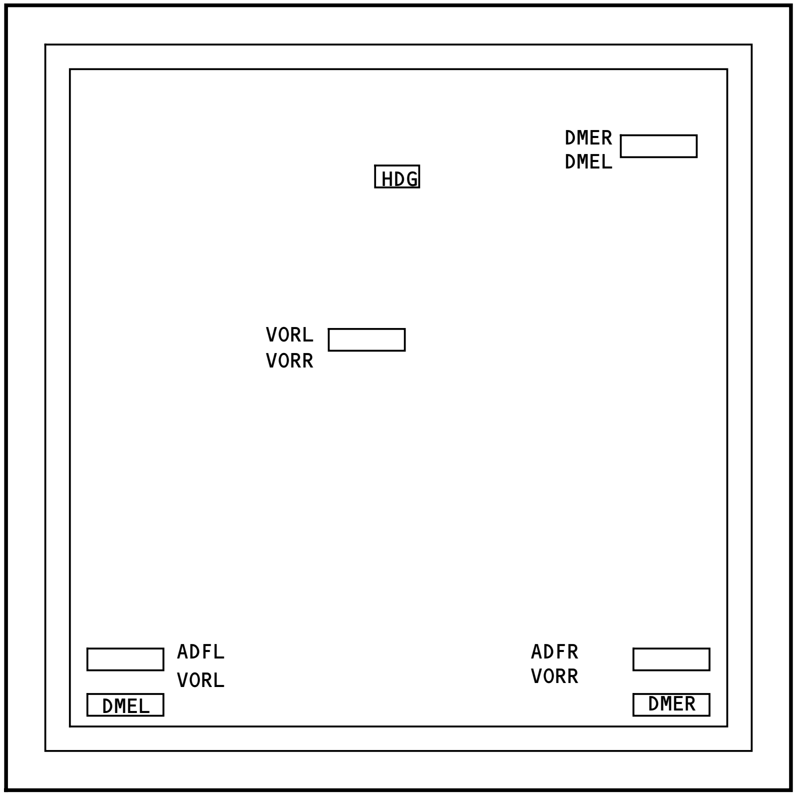
DMEL or DMER (top corner information) flag shows when the DME co-located with the left or right VOR input fails to the ND

VORL or VORR (mode information) flag shows when the left or right VOR input fails to the ND

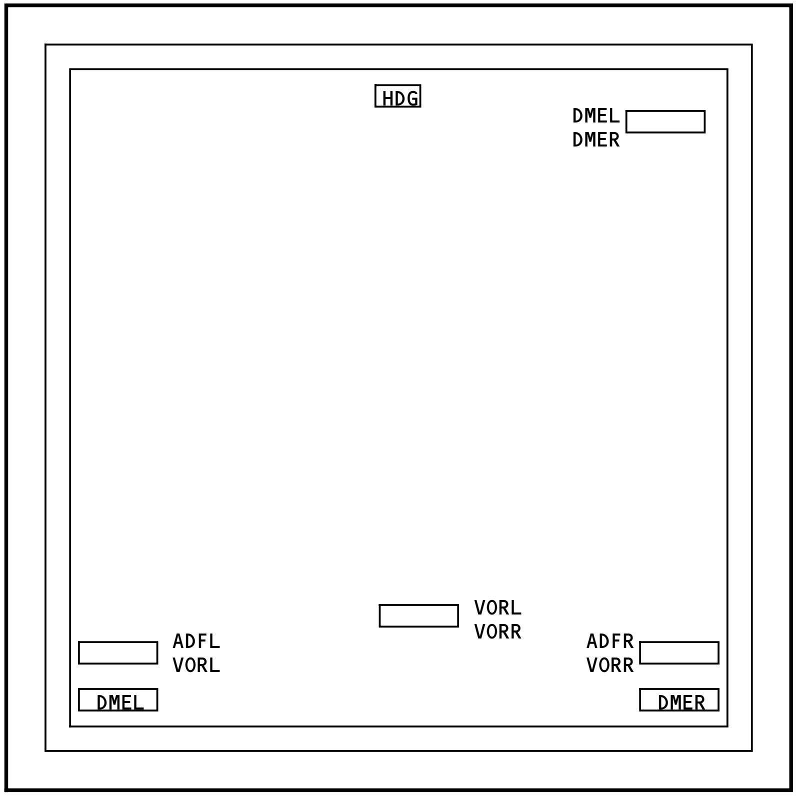
DMEL or DMER (bottom corner information) shows when the DME co-located with the left or right VOR input fails to the ND. To see the flag, put the applicable VOR switch on the EFIS CP in the VOR position.

VORL or VORR (bottom corner information) shows when the left or right VOR input fails to the ND. To see the flag, put the applicable switch on the EFIS control panel in the VOR position.

ADFL or ADFR shows when the left or right ADF input fails to the ND. To see the flag, put the applicable switch on the EFIS control panel in the ADF position.



CENTERED MODE



EXPANDED MODE

31-61-00-045 Rev 0

PRIMARY DISPLAY SYSTEM - VOR MODE FAILURE FLAGS

PRIMARY DISPLAY SYSTEM - VOR MODE NCD AND FAIL CONDITIONS

General

The display function in the AIMS cabinets evaluates inputs from the airplane systems.

A no computed data (NCD) status causes information on the display to go away.

A fail status causes information on the display to go away and a fail flag to show.

VOR Mode NCD and Failure Conditions

The chart shows the NCD and fail conditions for the VOR mode and for the VOR, DME, and ADF data available through the VOR/ADF switches on the EFIS CPs.

PARAMETER	CONDITION	RESULT	REMARKS
VOR FREQ/IDENT	NCD OR FAIL	IF IDENT INVALID, FREQ SHOWS. IF FREQ INVALID DASHES SHOW	CAPT AND F/O VOR
VOR COURSE	NCD	DEVIATION BAR GOES AWAY	CAPT AND F/O VOR
VOR COURSE	FAIL	SCALE AND BAR GO AWAY	CAPT AND F/O VOR
VOR OMNIBEARING	NCD	POINTERS GO AWAY	EFIS CP VOR/ADF SWITCHES ON
VOR OMNIBEARING	FAIL	ALL VOR SYMBOLOGY GOES AWAY. VOR FLAG SHOWS	CAPT AND F/O VOR
ADF FREQ/IDENT	NCD OR FAIL	IF IDENT INVALID, FREQ SHOWS. IF FREQ INVALID DISPLAY BLANKS	EFIS CP VOR/ADF SWITCHES ON
DME DISTANCE	NCD	DME WITH DASHES SHOWS - - - -	ON-SIDE DME CO-LOCATED WITH VOR IS NCD
DME DISTANCE	FAIL	AN AMBER DME FLAG SHOWS	ON-SIDE DME CO-LOCATED WITH VOR FAILS
HEADING	NCD	TAPE NUMERICS,TICKS, AND HEADING INDEX GO AWAY	NCD HEADING
HEADING	FAIL	TAPE NUMERICS, TICKS, AND HEADING INDEX GO AWAY. AN AMBER HDG FLAG SHOWS	FAILED HEADING

31-61-00-046 Rev 1

PRIMARY DISPLAY SYSTEM - VOR MODE NCD AND FAIL CONDITIONS

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PRIMARY DISPLAY SYSTEM - CENTERED MAP MODE

General

The centered map mode shows the airplane flight plan on a full 360 degree display. The centered map mode has a track up reference. The point of the airplane symbol (a triangle) is the present position of the airplane.

The same basic data shows in both the centered and the expanded map modes.

Display Data

The current track value shows digitally in the readout box. The compass rose rotates and the readout changes in one degree increments. TRK shows on the left and MAG or TRU shows on the right. A track line shows from the bottom of the display through the tip of the airplane symbol to the readout box. Current heading shows as a triangular pointer on the outer edge of the compass rose.

Selected heading shows as a magenta (M) cursor (bow tie) on the outer edge of the compass rose. The selected heading cursor and the heading cursor (W) fit together when their values are equal. A dotted magenta vector shows full time except when the AFDS roll mode is LOC, ROLLOUT or LNAV. For these modes, the vector shows for ten seconds after selected heading changes, then goes away. Selected track shows as a magenta cursor on the inner edge of the compass rose. The vector is the same as the selected heading vector.

VOR/ADF bearing information is the same as approach and VOR modes.

VOR/ADF selection is the same as approach and VOR modes.

Ground speed, wind data, and true airspeed are the same as approach and VOR modes.

A curved position trend vector (W) shows from the tip of the airplane symbol. The vector shows the airplanes predicted position in 30, 60, or 90 second intervals. The map range controls the number of segments. The tip of each segment shows the future airplane position in 30 seconds. The ground speed determines the length of the line. Cross track acceleration from the ADIRU controls the curve.

This data shows in the upper right corner:

- Active waypoint identifier
- Estimated time of arrival (ETA) to the waypoint
- Distance to the waypoint.

The active (next) waypoint on the flight path is magenta.

The FMCF navigation mode shows in the lower right corner next to the navigation aid information. The update method shows as:

- VOR-DME
- DME-DME

PRIMARY DISPLAY SYSTEM - CENTERED MAP MODE

- GPS
- LOC
- INERTIAL.

TCAS traffic messages and TCAS traffic symbols show in the centered map mode.

TCAS status and mode information shows below the WXR data field to indicate TCAS selection (TFC) and mode data; TA ONLY (TCAS is not computing RA), TCAS TEST (TCAS is in the test mode), TCAS OFF, or TCAS FAIL (a fault exist in TCAS).

Vertical deviation from the FMCF flight plan descent path shows on the VNAV path scale. The information shows when the descent phase becomes active. Deviation greater than 420 feet above the path causes a numerical readout to show above the vertical scale. Deviation greater than 420 feet below the path causes a numerical readout to show below the vertical scale.

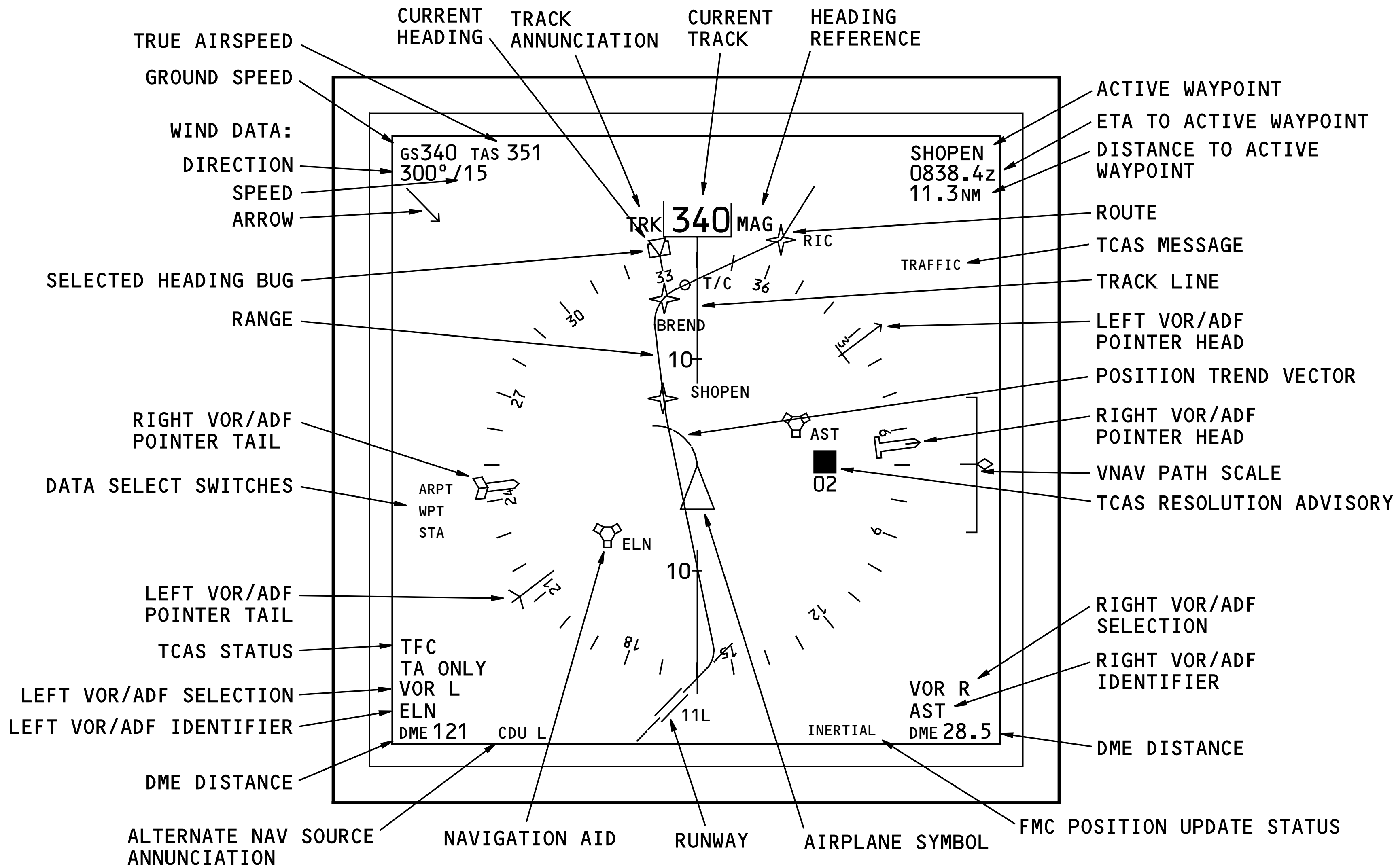
Weather radar shows in this mode when the crew turns weather radar on.

Map background data contains many types of symbols and data. This data includes:

- Active, inactive and modified flight plans
- Flight plan waypoints
- Holding patterns
- Airports
- Runways
- Navigation aids
- Airway segments
- Radio navigation aid raw data.

The ND data select switches on the EFIS control panels control much of the data.

The alternate navigation source shows if the FMCF fails in the lower left corner next to the navigation aid information. For CDU map changes, the CDU can only do straight or direct to calculations.



PRIMARY DISPLAY SYSTEM - CENTERED MAP MODE

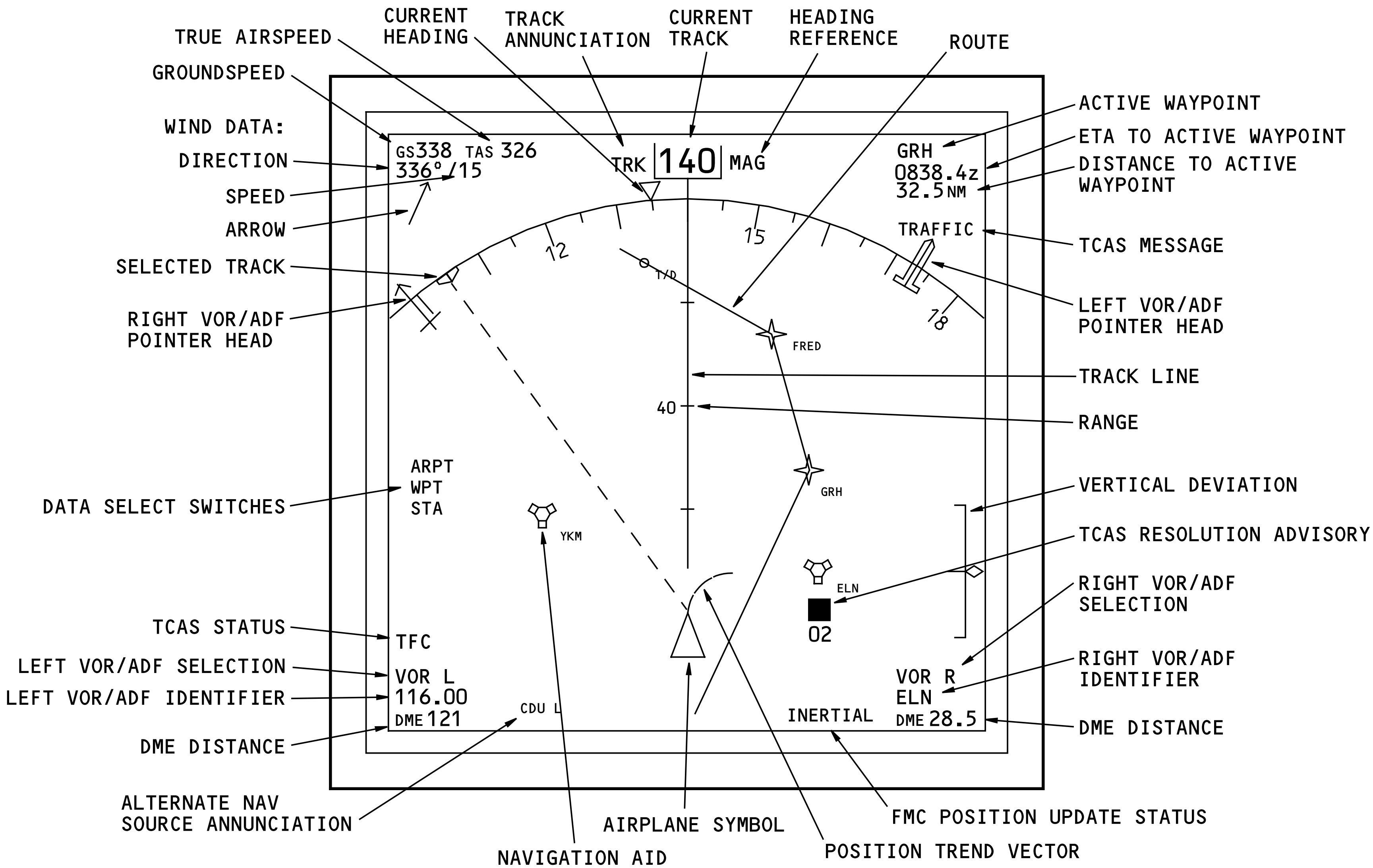
31-61-00-047 Rev 1

PRIMARY DISPLAY SYSTEM - EXPANDED MAP MODE

General

The expanded map mode shows the same basic data as the centered map mode. The airplane symbol is identical. The top of the symbol shows the present position of the airplane.

The single range numeric shows one half of the full scale map range from the range control on the EFIS control panel or the CDU.



PRIMARY DISPLAY SYSTEM - EXPANDED MAP MODE

31-61-00-048 Rev 1

PRIMARY DISPLAY SYSTEM - MAP MODE FAILURE FLAGS

General

Failures of input sources cause data to go away from the display and failure flags to show.

All the flags are amber in color.

The captain's and first officer's NDs operate independently.

Failure Flags

The TRK flag shows when the ADIRU track input fails.

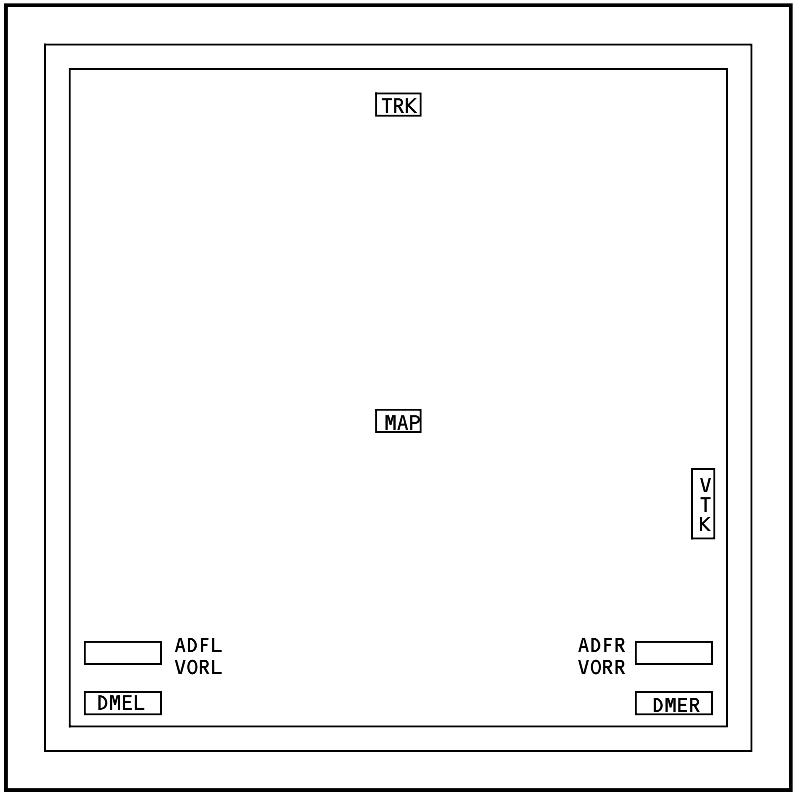
The MAP flag shows when the FMCF latitude or longitude is invalid or when the MAP dynamic or background data is invalid.

The VTK (vertical track) flag shows if the map dynamic or background data is invalid or the FMC altitude error rate is invalid.

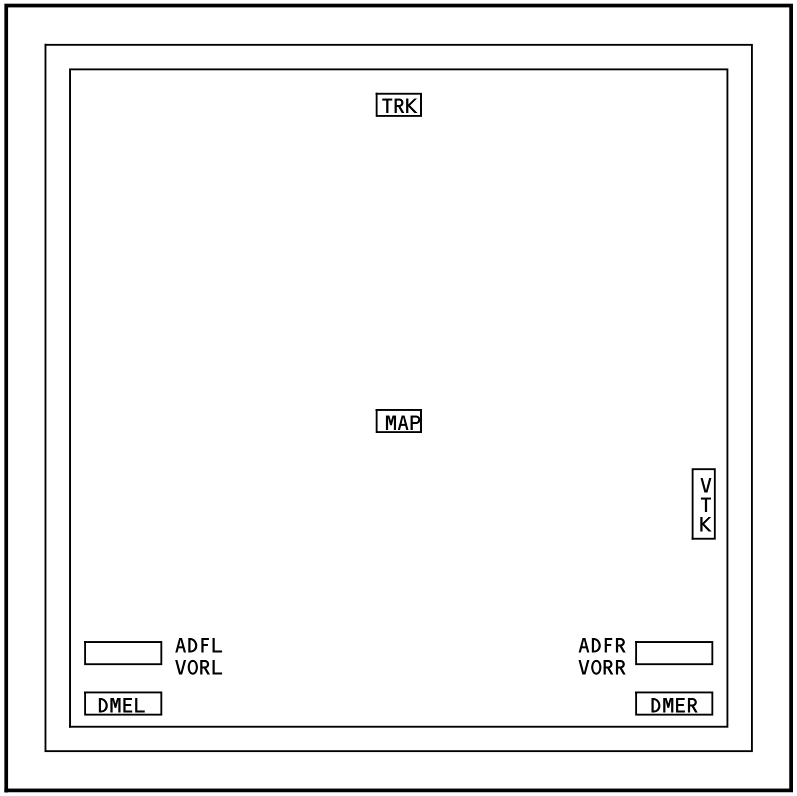
The VORL or VORR flag shows when the left or right VOR input fails. To see the flag, put the applicable switch on the EFIS control panel in the VOR position.

The ADFL or ADFR flag shows when the left or right ADF fails. To see the flag, put the applicable switch on the EFIS control panel in the ADF position.

The DMEL or DMER flag shows when the DME co-located with the ILS, or left or right VOR fails. To see the flag for DMEs co-located with the VOR stations, put the applicable VOR switch on the EFIS CP must in the VOR position.



CENTERED MODE



EXPANDED MODE

31-61-00-049 Rev 1

PRIMARY DISPLAY SYSTEM - MAP MODE FAILURE FLAGS

PRIMARY DISPLAY SYSTEM - MAP MODES NCD AND FAIL CONDITIONS

General

The display function in the AIMS cabinets evaluates inputs from the airplane systems.

A no computed data (NCD) status causes information on the display to go away.

A fail status causes information on the display to go away and a fail flag to show.

MAP Modes NCD and Failure Conditions

The chart shows the NCD and fail conditions for the MAP modes.

PARAMETER	CONDITION	RESULT	REMARKS
TRACK	NCD	TAPE NUMERICS GO AWAY, CURVED TREND VECTOR GOES AWAY	NCD TRACK
TRACK	FAIL	TAPE NUMERICS, TICKS, AND TRACK INDEX GO AWAY. CURVED TREND VECTOR GOES AWAY, AN AMBER TRK FLAG SHOWS	FAILED TRACK
MAP BACKGROUND	FAIL	ALL MAP DISPLAY DATA GOES AWAY AND AN AMBER MAP FLAG SHOWS	INVALID MAP DATA FROM FMCF
VERTICAL DEVIATION	NCD	VERTICAL DEVIATION SCALE GOES AWAY. AMBER VTK SHOWS	MAP BACKGROUND NCD OR FMC ALTITUDE ERROR RATE NCD
VERTICAL DEVIATION	FAIL	VERTICAL DEVIATION SCALE GOES AWAY	MAP BACKGROUND NCD OR FMC ALTITUDE ERROR RATE NCD

31-61-00-050 Rev 1

PRIMARY DISPLAY SYSTEM - MAP MODES NCD AND FAIL CONDITIONS

PRIMARY DISPLAY SYSTEM - ND MAP SYMBOLOGY - 1

General

The ND map has dynamic and background data and may include a combination of the symbols or data in the chart. Dynamic data changes as a function of time. Background data is stationary data that does not move as a function of time.

The latitude and longitude of the symbol determines its location on the map display.

The EFIS control panel STA, WPT, ARPT, DATA and POS switches control some data.

The flight management computer function (FMCF) of AIMS supplies the map flight plan data.

The mode control panel (MCP) supplies selected heading (HDG) and track (TRK) data.

These symbology colors show on the ND:

- Green (G) - shows an engaged mode condition, dynamic conditions
- White (W) - shows present status, scales, armed flight mode displays
- Magenta (M) - shows command information, pointers, symbols, fly to condition
- Cyan (B) - shows nonactive or background information
- Red (R) - shows warnings
- Amber (A)- shows caution information, faults, flags.

SYMBOL	NAME	MODE(S)	REMARKS
1. GS310	GROUND SPEED INDICATION (W)	ALL	CURRENT GROUND SPEED
2. TAS312	TRUE AIRSPEED INDICATION (W)	ALL	CURRENT TRUE AIRSPEED SHOWS ABOVE 100 KTS
3. 350° /15 ↙	WIND BEARING/SPEED (W) DIRECTION (W)	ALL	WIND DATA SHOWS IN RESPECT TO DISPLAY ORIENTATION AND HDG/TRK REFERENCE. ARROW DOES NOT SHOW IN THE PLAN MODE.
4. AAAAA	ACTIVE WAYPOINT IDENTIFIER	MAP, MAP CTR AND PLAN	SHOWS THE GO TO WAYPOINT IN THE ACTIVE FLIGHT PLAN.
5. VOR L,R ILS L,C,R	RECEIVER REFERENCE (G)	VOR, VOR CTR APP, APP CTR	SHOWS RECEIVER REFERENCE FOR THE DISPLAY.
6. 116.80 OR SEA	ILS (W)/VOR (G) FREQUENCY OR IDENTIFIER DISPLAY	VOR, VOR CTR APP, APP CTR	FREQUENCY SHOWS BEFORE THE IDENT IS DECODED. DECODED IDENT REPLACES THE FREQUENCY. MED FONT VOR, SMALL FONT DME ONLY.
7. 124NM	DISTANCE DISPLAY (W)	MAP, MAP CTR AND PLAN	SHOWS DISTANCE TO THE ACTIVE WAYPOINT.
8. DME 24.6	DME DISTANCE DISPLAY (W)	VOR, VOR CTR APP, APP CTR	SHOWS DME DISTANCE TO THE REFERENCE NAVAID.
9. 0835.4Z	ETA DISPLAY (W)	MAP, MAP CTR AND PLAN	SHOWS FMCF CALCULATED ETA FOR THE ACTIVE WAYPOINT.
10. CRS135	COURSE DISPLAY (W)	VOR, VOR CTR APP, APP CTR	SHOWS VOR COURSE OR LOCALIZER COURSE.

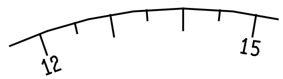
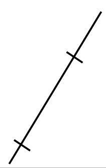
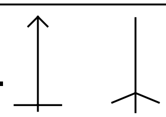
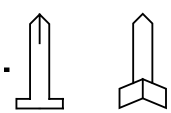
31-61-00-051 Rev 1

PRIMARY DISPLAY SYSTEM - ND MAP SYMBOLOGY - 1

PRIMARY DISPLAY SYSTEM - ND MAP SYMBOLOGY - 2

General

Additional ND map symbology is shown in the graphic.

SYMBOL	NAME	MODE(S)	REMARKS
11. 	EXPANDED COMPASS (W)	MAP, APP, VOR AND PLAN MAP CTR, VOR CTR, AND APP CTR	90 DEGREES SHOW IN THE EXPANDED MODE. 360 DEGREES SHOW WHEN THE CENTERED MODE IS SELECTED.
12. ▽	HEADING POINTER (W)	MAP, MAP CTR	SHOWS AIRPLANE HEADING ON THE COMPASS ROSE.
13. HDG | 263 | MAG ▽	HEADING: ORIENTATION (G) READOUT (W) REFERENCE (G) POINTER (W)	VOR, VOR CTR APP, APP CTR	BOX DISPLAYS CURRENT HEADING. POINTER SHOWS HEADING ON THE COMPASS ROSE.
14 	TRACK POINTER WITH RANGE (W)	ALL EXCEPT PLAN	SHOWS AIRPLANE TRACK AND LOCATION ON THE COMPASS ROSE. RANGE SHOWS NEXT TO THE MIDDLE RANGE MARK.
15. MAG or TRU	HEADING/TRACK REFERENCE (G) BOX (W) IN TRU	ALL EXCEPT PLAN	SHOWS HEADING/TRACK TO MAGNETIC NORTH OR TRUE NORTH. SWITCHING FROM TRU TO MAG SHOWS A BOX AROUND THE MAG FOR 10 SECONDS.
16. 	LEFT: VOR (G) OR ADF (B) BEARING	ALL EXCEPT PLAN	SHOWS BEARING TO (HEAD) OR FROM (TAIL) A TUNED STATION, IF A RADIO IS SELECTED ON THE EFIS CONTROL PANEL.
17. 	RIGHT: VOR (G) OR ADF (B) BEARING		
18. TRK | 062 | MAG	TRACK: ORIENTATION (G) READOUT (W) REFERENCE (G)	MAP, MAP CTR	BOX SHOWS CURRENT TRACK.

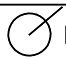
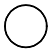
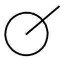
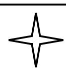
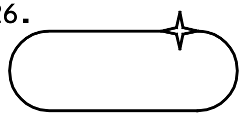
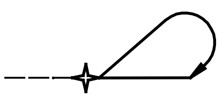
31-61-00-052 Rev 0

PRIMARY DISPLAY SYSTEM - ND MAP SYMBOLOGY - 2

PRIMARY DISPLAY SYSTEM - ND MAP SYMBOLOGY - 3

General

Additional ND map symbology is shown in the graphic.

SYMBOL	NAME	MODE(S)	REMARKS
19.  KABC 22L	AIRPORT IDENTIFIER AND RUNWAY (W)	MAP, MAP CTR AND PLAN	THE ORIGIN OR AIRPORT SHOWS WHEN THE ND RANGE IS 80, 160, 320, OR 640 AND AN AIRPORT ENTRY.
20.  KTEB	AIRPORT (B)	MAP, MAP CTR	AIRPORTS WITHIN THE MAP AREA SHOW WITH A SELECTION OF THE ARPT SWITCH ON THE EFIS CONTROL PANEL.
21. 	AIRPORT AND RUNWAY (W)	MAP, MAP CTR AND PLAN	THE ORIGIN OR AIRPORT SHOWS WHEN THE ND RANGE IS 10, 20, OR 40 NM. RUNWAY DASHES EXTEND 14.2 NM.
22. 	WAYPOINT: ACTIVE (M) INACTIVE (W)	MAP, MAP CTR AND PLAN	ACTIVE - THE NEXT GO TO WAYPOINT. INACTIVE - OTHER WAYPOINTS ON THE ACVTIVE ROUTE.
23.  MLF	OFF ROUTE WAYPOINT (B)	MAP, MAP CTR	SHOWS WITH A SELECTION OF THE MAP SWITCH ON THE EFIS CONTROL PANEL AND ND RANGES OF 10, 20, OR 40.
24.  AMBOY KILMR PARBY	FLIGHT PLAN ROUTE: ACTIVE (M) MODIFIED (W) INACTIVE (B)	MAP, MAP CTR AND PLAN	ACTIVE - THE ACTIVE ROUTE SHOWS MAGENTA WITH A CONTINUOUS LINE BETWEEN WAYPOINTS. MODIFIED - ACTIVE ROUTE MODIFICATIONS SHOW WITH SHORT DASHES (W) BETWEEN WAYPOINTS. INACTIVE - INACTIVE ROUTES SHOW WITH LONG DASHES (B) BETWEEN WAYPOINTS.
25.  KILMER 12000 0835Z	ROUTE DATA: ACTIVE WPT (M) INACTIVE WWPT (W)	MAP, MAP CTR	THE ENTERED OR PROCEDURAL ALTITUDE AND ETA FOR ROUTE WAYPOINTS SHOW WITH A SELECTION OF THE EFIS CONTROL PANEL DATA SWITH.
26. 	HOLDING PATTERN: ACTIVE ROUTE (M) MODIFIED ROUTE (W) INACTIVE ROUTE (B)	MAP, MAP CTR AND PLAN	A HOLDING PATTERN SHOWS WHEN IN THE FLIGHT PLAN. THE PATTERN INCREASES TO CORRECT SIZE FOR HOLDING.
27. 	PROCEDURE TURN: ACTIVE ROUTE (M) MODIFIED ROUTE (W) INACTIVE ROUTE (B)		A PROCEDURE TURN SHOWS WHEN IN THE FLIGHT PLAN. THE PATTERN INCREASES TO CORRECT SIZE FOR HOLDING.

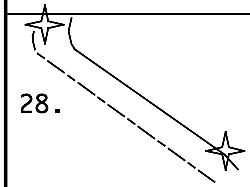
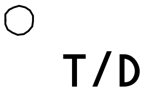
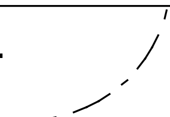
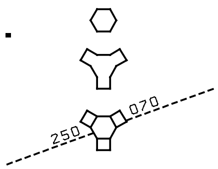
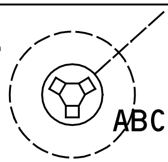
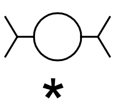
PRIMARY DISPLAY SYSTEM - ND MAP SYMBOLOGY - 3

31-61-00-053 Rev 0

PRIMARY DISPLAY SYSTEM - ND MAP SYMBOLOGY - 4

General

Additional ND map symbology is shown in the graphic.

SYMBOL	NAME	MODE(S)	REMARKS
28. 	OFFSET PATH AND IDENTIFIER: ACTIVE ROUTE (M) MODIFIED ROUTE (W)	MAP, MAP CTR AND PLAN	A PARALLEL OFFSET LINE WITH DASHES SHOWS FROM THE ACTIVE OR MODIFIED ROUTE. THIS OCCURS WHEN AN ENTRY IS MADE FROM THE FMCS-CDU ROUTE PAGE AND THE AIRPLANE IS IN THE AIR.
29. 	ALTITUDE RANGE ARC (G)	MAP, MAP CTR	SHOWS THE LOCATION ON THE FLIGHT WHEN THE AIRPLANE REACHES THE MCP ALTITUDE. THE CAPTURE POINT IS BASED ON VERTICAL SPEED AND GROUND SPEED.
30. 	ALTITUDE PROFILE POINT AND IDENTIFIER (G)	MAP, MAP CTR	SHOWS THE FMCF CALCULATED T/C (TOP OF CLIMB), T/D (TOP OF DESCENT), S/C (STEP CLIMB), AND E/D (END OF DESCENT). DECELERATION AND PREDICTED ALTITUDE/ETA POINTS HAVE NO IDENTIFIER.
31. 	ENERGY MANAGEMENT CIRCLES (B, W)	MAP, MAP CTR	SHOWS CLEAN (B) AND SPEEDBRAKE (W) ENERGY MANAGEMENT CIRCLES AS DEFINED ON OFFPATH DES PAGE.
32. 	VOR (B, G), DME/TACAN (B, G) VORTAC (B, G)	MAP, MAP CTR	NAVAIDS (B) THAT RELATE TO STATIONS SHOW WHEN THE STA SWITCH ON THE EFIS CONTROL PANEL IS ON. TUNED NAVAIDS ALWAYS SHOW IN GREEN (G). A MANUALLY TUNED NAVAID SHOWS THE SELECTED COURSE AND ITS RECIPROCAL.
33. 	SELECTED REFERENCE POINT AND BEARING DISTANCE INFORMATION (G)	MAP, MAP CTR AND PLAN	SHOWS THE REFERENCE POINT SELECTED ON THE FMCS-CDU FIX PAGE. BEARING AND/OR DISTANCE FROM THE FIX SHOW WITH GREEN DASHES.
34. 	GPS POSITION (W) ADIRU POSITION (W)	MAP, MAP CTR	THE PRIMARY UPDATE MODE SHOWS WHEN THE POS SWITCH OF THE EFIS CONTROL PANEL IS SELECTED ON, INDICATES ADIRU/GPS POSITION RELATIVE TO THE FMCS POSITION.

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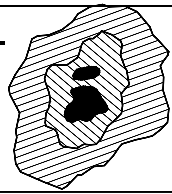
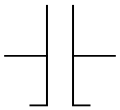
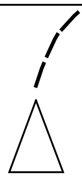
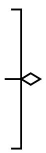
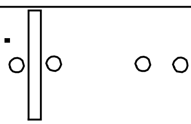
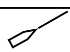
PRIMARY DISPLAY SYSTEM - ND MAP SYMBOLOGY - 4

PRIMARY DISPLAY SYSTEM - ND MAP SYMBOLOGY - 5

General

Additional ND map symbology is shown in the graphic.

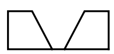
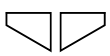
SYMBOL	NAME	MODE(S)	REMARKS
35. 	WEATHER RADAR RETURNS (R, A, G, M)	MAP, MAP CTR VOR, APP	WEATHER RADAR RETURNS SHOW WHEN THE WXR SWITCH OF THE EFIS CONTROL PANEL IS ON. INTENSE WXR RETURNS SHOW IN RED (R). MEDIUM INTENSITY SHOW IN AMBER (A). LOW INTENSITY SHOW IN GREEN (G). TURBULENCE SHOWS IN MAGENTA.
36. 	AIRPLANE SYMBOL (W)	MAP, MAP CTR VOR, APP	CURRENT AIRPLANE POSITION IS AT THE POINT OF THE AIRPLANE SYMBOL.
37. 	AIRPLANE SYMBOL (W)	VOR CTR, APP CTR	CURRENT AIRPLANE POSITION IS AT THE TOP CENTER OF THE AIRPLANE SYMBOL.
38. 	TREND VECTOR (W), DASH(S)	MAP, MAP CTR	SHOWS AIRPLANE PREDICTED POSITION AT THE END OF 30, 60, AND 90 SECOND INTERVALS. EACH SEGMENT SHOWS 30 SECONDS AND IS BASED ON BANK ANGLE AND GROUND SPEED.
39. 	VERTICAL DEVIATION POINTER (M) AND SCALE (W)	MAP, MAP CTR	VERTICAL DEVIATION FROM THE CALCULATED VERTICAL PROFILE (POINTER) SHOWS AT THE TOP OF DESCENT (T/D) AND DURING DESCENT ONLY. SCALE INDICATES +/- 400 FEET DEVIATION. A DIGITAL READOUT SHOWS WHEN THE POINTER IS OVER +/- 400 FEET.
40. 	COURSE DEVIATION POINTER (M) AND SCALE (W)	VOR, VOR CTR APP, APP CTR	SHOWS VOR OR LOC DEVIATION. DEVIATION POINTER SHOWS THE DIRECTION OF THE VOR OR ILS (LOC) SELECTED COURSE FROM THE FMCS-CDU.
41.  	SELECTED COURSE POINTER (W) AND LINE (M)	VOR, VOR CTR APP, APP CTR	SHOWS VOR OR LOC SELECTED COURSE FROM THE FMCS-CDU.
42. 	GLIDE SLOPE DEVIATION POINTER (M) AND SCALE (W)	APP, APP CTR	SHOWS GLIDE SLOPE DEVIATION. DEVIATION POINTER SHOWS THE DIRECTION OF THE GLIDE SLOPE CENTERLINE.

PRIMARY DISPLAY SYSTEM - ND MAP SYMBOLOGY - 5

PRIMARY DISPLAY SYSTEM - ND MAP SYMBOLOGY - 6

General

Additional ND map symbology is shown in the graphic.

SYMBOL	NAME	MODE(S)	REMARKS
43. △	TO/FROM INDICATOR (W)	VOR CTR	SHOWS NEAR AIRPLANE SYMBOL. SHOWS VOR TO/FROM INDICATION.
44. TO FROM	TO/FROM DISPLAY (W)	VOR, VOR CTR	SHOWS VOR TO/FROM INDICATION.
45. CDU L, C, OR R	MAP SOURCE ANNUNCIATION (G)	MAP, MAP CTR	SHOWS ND MAP SOUCE WHEN THE NAV SOURCE SWITCH IS THE CDU POSITION. THE NAV SOURCE SWITCH IN THE NORMAL POSITION SHOWS THE ND MAP SOURCE FOR A SELECTED FMCF OR FMCFS FAILURE.
46. 	SELECTED HEADING CURSOR (M)	ALL, EXCEPT PLAN	SHOWS THE HEADING SET ON THE MCP. A DASH LINE (M) EXTENDS FROM THE CURSOR TO THE POINT OR TOP OF THE AIRPLANE SYMBOL. THE MAGENTA (DASH) LINE GOES AWAY WHEN A ROLL MODE OTHER THAN HEADING IS ACTIVE.
47. 	SLECTED TRACK CURSOR(M)	ALL, EXCEPT PLAN	SHOWS THE TRACK SET ON THE MCP. A DASH LINE (M) EXTENDS FDROM THE CURSOR TO THE POINT OR TOP OF THE AIRPLANE SYMBOL. THE MAGENTA (DASH) LINE GOES AWAY WHEN A ROLL MODE OTHER THAN HEADING IS ACTIVE.
48. A KGEG	FMC SELECTED ALTERNATE AIRPORTS (B)	MAP, MAP CTR PLAN	ND SHOWS FMCF SELECTED ENROUTE ALTERNATE AIRPORTS WHEN EFIS CP APRT SWITCH IS SELECTED. PLAN SHOWS FMCF ENROUTE ALTERNATE AIRPORTS AT ALL TIMES.
49. N ↑	NORTH POINTER (G)	PLAN	SHOWS MAP BACKGROUND IS ORIENTED AND REFERENCED TO TRUE NORTH.

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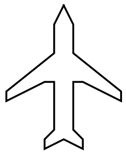
PRIMARY DISPLAY SYSTEM - ND MAP SYMBOLOGY - 6

PRIMARY DISPLAY SYSTEM - ND MAP SYMBOLOGY - 7

General

Additional ND map symbology is shown in the graphic.

SYMBOL	NAME	MODE(S)	REMARKS
50. 	MINIATURE AIRPLANE (W)	PLAN	SHOWS ACTUAL POSITION AND TRACK ALONG ROUTE IN THE PLAN MODE ONLY.
51. GPS	FMCF UPDATE STATUS (G)	MAP, MAP CTR	GLOBAL POSITIONING SYSTEM
LOC			LOCALIZER
DME-DME VOR-DME			RADIOS
INERTIAL			INERTIAL ONLY
52. ■ ↑ -03	TCAS RESOLUTION ADVISORY (RA) OR RELATIVE ALTITUDE (R)	MAP, MAP CTR APP, VOR	RA PITCH COMMANDS SHOW ON THE PFD. SEE NOTE BELOW.
53. +02 ● ↓	TCAS TRAFFIC ADVISORY OR TA (A) RELATIVE ALTITUDE		SEE NOTE BELOW. 1
54. ◆ ↓ -05	TCAS PROXIMATE TRAFFIC (W) RELATIVE ALTITUDE		SEE NOTE BELOW. 1
55. +09 ◇ ↑	TCAS OTHER TRAFFIC (W) RELATIVE ALTITUDE		SEE NOTE BELOW. 1
56. ● ↑ 128	TCAS TA ABSOLUTE ALTITUDE		SEE NOTE BELOW. 1
57. RA 5.3 +03 ↑ TA 8.9 -12 ↑	TCAS NO BEARING MESSAGE (RA-R, TA-A)		MESSAGE SHOWS TRAFFIC TYPE, RANGE IN NMS, ALTITUDE AND VERTICAL DIRECTION.

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PRIMARY DISPLAY SYSTEM - ND MAP SYMBOLOGY - 7

PRIMARY DISPLAY SYSTEM - ND MAP SYMBOLOGY - 8

General

Additional ND map symbology is shown in the graphic.

SYMBOL	NAME	MODE(S)	REMARKS
58. TRAFFIC	TCAS TRAFFIC ALERT MESSAGE (RA-R, TA-A)	ALL	SHOWS TCAS RA OR TA IS ACTIVE WITH OR WITHOUT THE TFC SWITCH SELECTED.
59. OFFSCALE	TCAS OFFSCALE MESSAGE (RA-R, TA-A)	MAP, MAP CTR APP, VOR	SHOWS RA OR TA TRAFFIC IS OUTSIDE THE TRAFFIC AREA OF THE ND RANGE. TFC SWITCH NEEDS TO BE ON.
60. TFC	TCAS MODE (B)		SHOWS TRAFFIC MODE IS ON.
61. TA ONLY	TCAS MODE (B)	ALL	SHOWS WHEN TCAS COMPUTER IS NOT COMPUTING RAS.
62. TCAS TEST			TCAS COMPUTER IS OPERATING IN THE TEST MODE. TFC IS ON (EFIS CP).
63. TCAS OFF	TCAS MODE (A)	MAP, MAP CTR APP, VOR	SHOWS A TCAS CONDITION EXISTS WHEN TFC IS ON FROM THE EFIS CP.
64. TCAS FAIL			SHOWS A FAULT IS PRESENT IN TCAS DATA WHEN TFC IS ON FROM THE EFIS CP.

1 THE TCAS SYMBOLS ABOVE THE ARROW SHOWS THAT THE TRAFFIC IS CLIMBING OR DESCENDING; NO ARROW INDICATES ALTITUDE OF TRAFFIC IN HUNDREDS OF FEET RELATIVE TO AIRPLANE POSITION. FOR ABSOLUTE ALTITUDE SYMBOLS, THE NUMERICS SHOW ALTITUDE OF TRAFFIC IN HUNDREDS AND THOUSANDS OF FEET. RELATIVE VERSUS ABSOLUTE ALTITUDE DISPLAY IS SELECTED BY A SWITCH ON THE TCAS CONTROL PANEL. FOR BOTH RELATIVE AND ABSOLUTE ALTITUDE, THE NUMERIC SHOWS BELOW THE TRAFFIC SYMBOL WHEN THE TRAFFIC IS BELOW THE AIRPLANE AND ABOVE THE TRAFFIC SYMBOL WHEN THE TRAFFIC IS ABOVE THE AIRPLANE. NO NUMERICS IN BOTH CASES SHOW ALTITUDE IS UNKNOWN. TCAS DATA SHOWS WHEN TRAFFIC (TFC) IS SELECTED ON THE EFIS CP.

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PRIMARY DISPLAY SYSTEM - ND MAP SYMBOLOGY - 8

PRIMARY DISPLAY SYSTEM - PLAN MODE

General

The flight crew uses the plan mode for flight planning purposes.

The plan mode is a north-up presentation. The plan mode shows the entered route from the FMCS.

Range information shows as circles around the reference point in the middle of the display.

An airplane symbol shows current position and track, if the airplane is within the range and portion of the flight plan shown.

Display Data

Ground speed, wind data, and true airspeed is the same as approach, VOR and map modes except that the wind direction arrow does not show.

This data shows in the upper right corner:

- Active waypoint identifier
- Estimated time of arrival (ETA) to the waypoint
- Distance to the waypoint.

The active waypoint on the route is magenta.

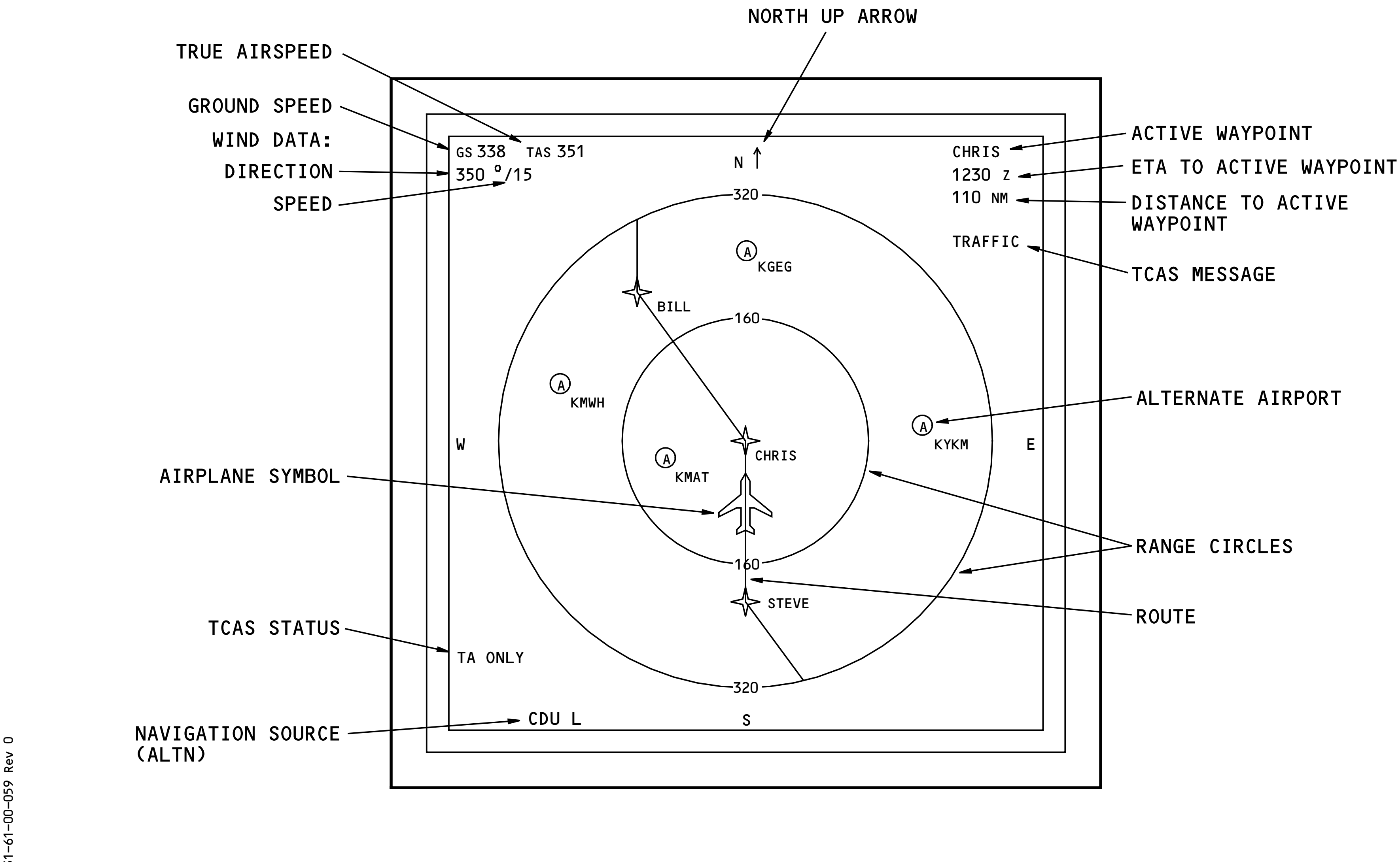
Only TCAS traffic data messages show in the plan mode.

TCAS status information shows below the WXR data field to indicate TCAS selection. Information is TA ONLY (TCAS is not computing RA) or TCAS TEST (TCAS is in the test mode).

The alternate navigation source, CDU L, CDU C, or CDU R shows if the active FMCF(s) fail(s) in the lower left corner next to the navigation aid information

Alternate airports for the origin and destination airports on the flight plan show as a circle around the letter A.

The MAP fail flag shows in the plan mode when the FMCS fails. TCAS status is the same as the map mode.



PRIMARY DISPLAY SYSTEM - PLAN MODE

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PRIMARY DISPLAY SYSTEM - PFD AND ND DISPLAY FUNCTIONAL DESCRIPTION

General

Each AIMS cabinet has four input/output modules (IOMs) and two core processor/graphic generators (CPM/GGs). Each graphic generator has an output to the display units (DUs). The PFD and ND functions in the CPM/GGs independently process their formats. The PFD function has these sub-functions:

- Display format processing
- Display resource management
- PFD display generator
- Graphics generator.

The ND function shares the display format processing and display resource management sub-function. The ND function has these sub-functions:

- ND generator
- Graphics generator.

Both functions send data to the graphic generator sub-function. The graphic generator reformats and sends this data to the DUs.

IOM

Each IOM does these functions:

- Presence and validity checks
- Source select and filtering.

The IOM modules do presence and validity checks on all display input parameters. Data updates ensure that the information the flight crew sees is current.

Each IOM removes bad data, replaces it with a good source, and filters the change from bad to a good data source. For critical data, the IOM sends messages to alert the flight crew of a failure. The IOMs send the valid and message data to the EICAS and MFD functions through the backplane bus.

CPM/GG

Each CPM/GG also has a PFD and ND function with sub-functions. Each AIMS cabinet has a redundant pair (CPM/GGs) for a total of four on the aircraft. Each CPM/GG can drive any three display units or three out of four display formats (PFD, ND, EICAS, or MFD). The EICAS and MFD functions configure and format the EICAS and MFD displays. The outboard DU location is for PFD display only. This redundant system supplies fail operational capability and allows deferred airplane maintenance.

The sub-functions in the CPM/GGs decode switch inputs and make the appropriate displays. Additional switch positions determine format location. If the outboard DU fails, the inboard DU automatically changes to the outboard format. The IOMs send display and switch input data to the display processing sub-function for the PFD and ND functions.

PRIMARY DISPLAY SYSTEM - PFD AND ND DISPLAY FUNCTIONAL DESCRIPTION

PFD/ND Function- Display Format Processing

The display format processing sub-function receives display and switch input data from the IOMs. It receives status data from the display system resource management sub-function for CPM/GG redundancy management. The display format processing sub-function formats the data and sends PFD and ND format data to the PFD and ND generator sub-functions. It also sends status data to the other CPM/GGs.

PFD/ND Function- PFD and ND Generators

The PFD and ND display generator sub-functions reformat the display data for the graphics generator.

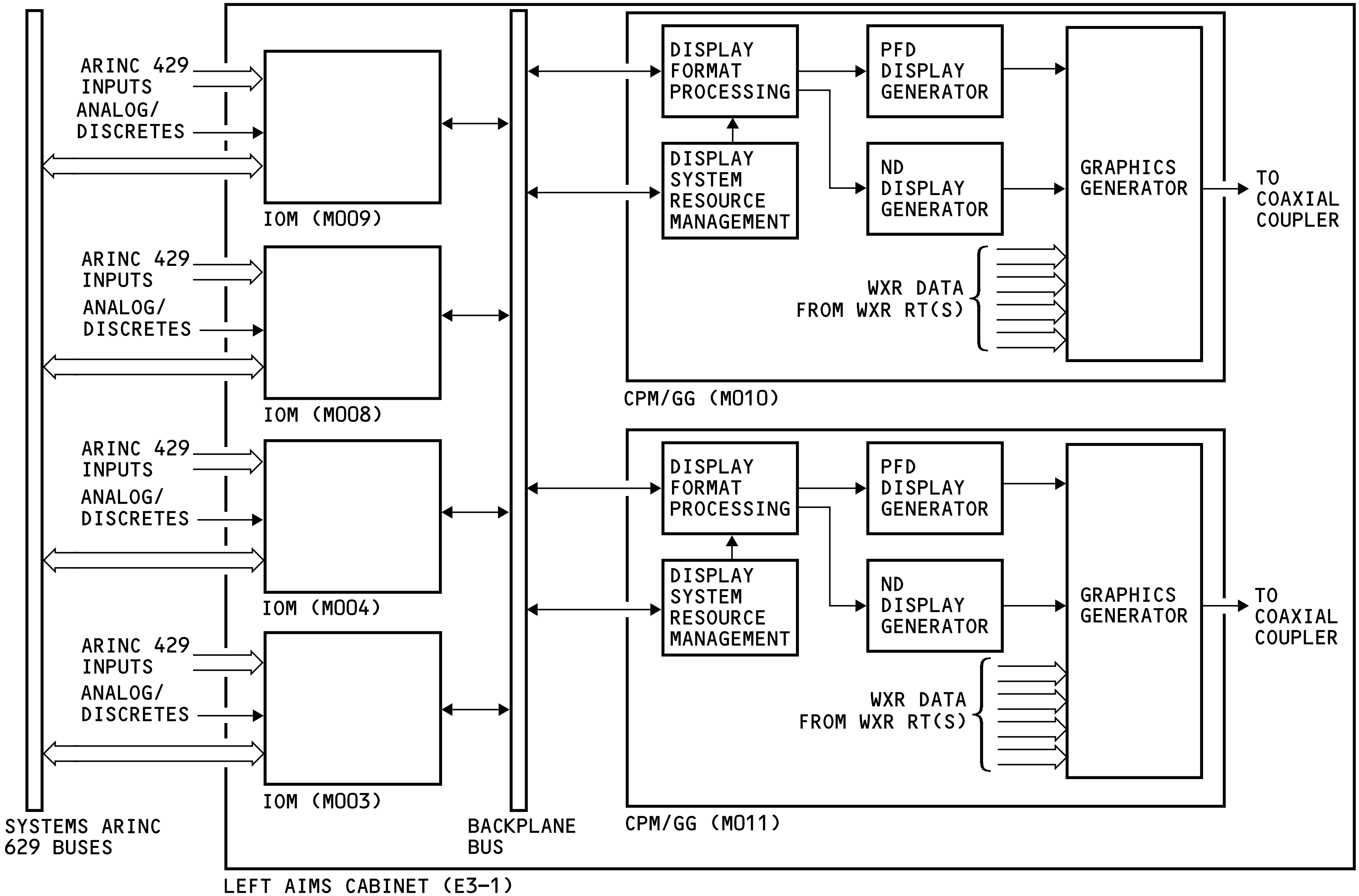
PFD/ND Function- Graphics Generator

The graphics generator sub-functions use switch inputs and output device selection data to determine display location and correct format. The PFD has one format. The ND has these seven formats

- Approach (2)
- VOR (2)
- Map (2)
- Plan.

The switch inputs permit automatic switch over of the PFD (outboard) to the ND (inboard) location in case of a PFD failure. The switch inputs also permit a ND in two locations.

The graphics generator receives the PFD and ND reformatted data from the PFD and ND generators. It converts this data to a video format and sends it to the DUs through a coaxial cable.



PRIMARY DISPLAY SYSTEM - PFD AND ND DISPLAY FUNCTIONAL DESCRIPTION

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PRIMARY DISPLAY SYSTEM - DU FUNCTIONAL DESCRIPTION

General

Each display unit (DU) receives this from the AIMS cabinets:

- Graphics data
- Display format commands.

AIMS data goes to the DUs through coaxial cables. The DUs also receive brightness control data from internal and external sources. The DUs use this data to show flight information and status data to the flight crews during normal and non-normal conditions.

The input/output (I/O) controller also gets DU address information from five identification pins.

Input/Output Controller

The I/O controller receives, converts, and transmits data to the AIMS cabinet and the DU functions. The I/O controller sends graphics data to the beamformer and brightness control data to brightness control circuit. It sends command and BITE data to the DU controller.

A ground on an identification pin is a logic one. Address numbers on each DU set the standard configuration.

DU Controller

The DU controller uses a dedicated bus to receive and send data to the I/O controller. The DU controller is a programmable logic device. The DU controller has built in test (BITE) and fault logic circuits. BITE and fault circuits collect status data from the functions in the DU. The DU controller formats the data and sends it to the I/O controller. The DU controller also sends a DU reset signal and processes the DU identification (ID).

Beamformer

The beamformer receives the digital data and changes it to a CRT-like image. The beamformer splits the image data and sends it to the liquid crystal display (LCD). The beamformer also responds to BITE.

LCD Interface Register and LCD

The LCD interface register changes the two data images from the beamformer into a single image and loads the values into the LCD source drivers. The LCD interface register applies voltages to compensate for data that changes. This improves LCD response times. The interface also supplies timing and control signals to the LCD drivers. The LCD circuit responds to BITE.

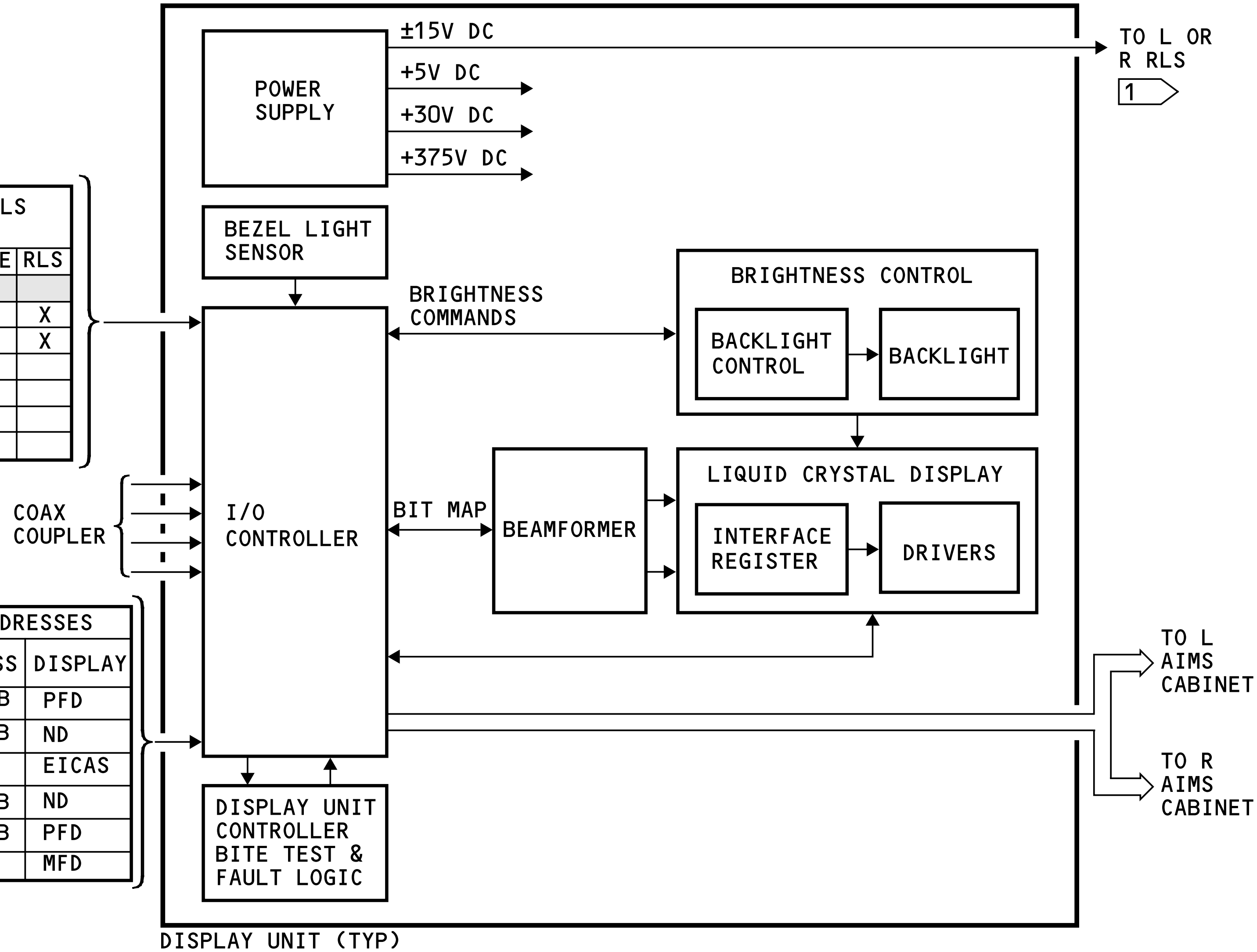
Brightness Control

The brightness control circuit uses a combination of these inputs to adjust the LCD brightness:

- Bezel light sensor (BLS), internal
- Paired DUs, WXR, and RLS from the brightness controls and sensors table, external.

The brightness control circuit responds to the BITE.

BRIGHTNESS CONTROLS AND SENSORS				
INPUT	UNIT	WXR	ZONE	RLS
DU				
L OUTBD	X		X	X
R OUTBD	X		X	X
L INBD	X	X		
R INBD	X	X		
UPPER	X			
LOWER	X	X		



DU LOCATION PIN ADDRESSES			
ADDRESS CODE MSB-LSB-PARITY		ADDRESS	DISPLAY
0 0 0 1	1	1-LOB	PFD
0 0 1 0	1	2-LIB	ND
0 0 1 1	0	3-CU	EICAS
0 1 0 0	1	4-RIB	ND
0 1 0 1	0	5-ROB	PFD
0 1 1 0	0	6-CL	MFD

1 OUTBOARD DU'S ONLY

PRIMARY DISPLAY SYSTEM - DU FUNCTIONAL DESCRIPTION

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PRIMARY DISPLAY SYSTEM - EICAS DISPLAY FORMAT

General

The EICAS display normally shows on the upper center display unit (DU). When the upper center DU fails, the display automatically shows on the lower center DU. The display shows primary engine parameters and other data which require continuous display for flight safety. The EICAS display shows:

- Total air temperature (TAT) and assumed temperature
- Thrust reference mode
- Thrust reverser indication
- Primary engine parameters
- Anti-ice indication
- Pressurization indications
- Alerting and other annunciation messages
- Engine in-flight start envelope
- Gear position
- Flap position
- Fuel data.

TAT and Assumed Temperature

TAT shows above the N1 scales in white. Assumed temperature shows above the N1 scale in green when a request is made from the CDU thrust limit page. Assumed temperature is for reduced thrust takeoffs.

Thrust Limit Mode Annunciations

The thrust limit mode annunciation shows in green above and between the N1 scales.

Thrust Reverser Indication

REV shows above each engine N1 actual readout when the thrust reverser is in transit or the extended position. The indication temporarily overrides the primary thrust reference readout. The REV readout is amber when the thrust reverser is in transit and is green when the thrust reverser is fully extended.

Engine Parameters

The engine parameters show in a round dial format in a vertical column. N1 shows first, then EGT. Each parameter has a digital readout and an analog round dial.

N1

The N1 scale starts at an N1 minimum (3 o'clock position). N1 maximum shows at the 210 degree position. A pointer and the gray shading behind the pointer shows the actual N1. An amber bar at the upper end of the scale shows N1 maximum. Digital readouts for N1 show above the round dials. N1 command shows as a white sector that moves around the N1 scale. The reference N1 shows as a green digital readout above the actual N1 box.

Anti-Ice Indication

A green engine anti-ice (EAI) indication shows next to the N1 scale when the engine anti-ice valve is open. The wing anti-ice (WAI) indication shows near the bottom of the N1 scale when the wing anti-ice valve is open.

EGT

EGT also shows in a round dial format. A pointer and a gray scale show the actual values. Redline limits, amber band and amber band limits show on the scales. Digital readouts for EGT show above the analog dial.

When an engine exceedance occurs, this data changes from white to red or amber:

- Scale
- Digital readout
- Digital readout box
- Fill area.

For redline exceedances, the box around the digital readout stays red after the exceedance goes away.

The CANC/RCL switch removes or shows the exceedance indication.

The engine exceedance maintenance page shows the exceedance information and controls the data. Both N1 and EGT show exceedances when they occur.

ATC Datalink Message Field

An ATC message shows in the communication message field at the bottom left corner of EICAS when there is an ATC uplink.

If ECS information shows the ATC text shows above it.

If the EICAS display is not in the compacted format, ATC message text shows in the ATC datalink message field.

The ATC datalink message field has a maximum of 30 characters across. It also has:

- A maximum of 5 lines of text
- 1 line for accept, reject, cancel, and time information.

Pressurization Indications

Pressurization indications show below the EGT scales when an associated crew alert message shows or a parameter exceedance occurs. The data shows for the length of the condition when no AIR synoptic shows. The data includes:

- Duct pressure
- Cabin altitude
- Cabin rate
- Cabin differential pressure
- Outflow valves
- Landing altitude.

Any non-normal condition shows in red or amber.

Alerting and Other Annunciation Messages

These crew alerting and annunciation messages show on the right side of the display:

- Warning
- Caution
- Advisory
- Communication
- Memo.

The messages show by priority and in chronological order. The message field shows eleven messages. When more than eleven messages exist, a white page number shows.

A small box shows adjacent to these messages when there is a non-normal checklist with the message:

- Warning
- Caution
- Advisory.

The small box goes away when electronic checklists are on and the checklist for the message is complete.

STATUS Cue and RECALL Annunciation

The STATUS cue shows when the PDS makes a new status message and the status page is not showing. The STATUS cue goes away when the operator selects the status page or when the condition that causes the status message goes away. The STATUS cue is cyan.

The RECALL annunciation shows for one second each time the operator uses the recall switch. The RECALL annunciation is white.

In-flight Start Envelope

The range of airspeed for an in-flight start shows below the crew alerting message field. This occurs during flight if any engine is shut down and its fire switch is on.

The flight level shows in hundreds of feet and is to the nearest 1,000 feet of actual airplane altitude. If the airplane is above the maximum flight level for in-flight start, the maximum and current flight level show.

Gear Position Indication

A single landing gear indication shows the condition of the nose, left, and right main gear during normal operation. A white UP shows when all gear are up and locked. A green DOWN shows when all gear are down and locked. When the gear are in transit, a series of white diagonal lines show. The gear display goes blank after the gear UP shows for ten seconds.

During non-normal conditions, a multiple gear indication shows all individual gear positions.

Flap Position Indication

During normal flap operation, a single thermometer style indicator shows for all flap segments. The indicator shows the flap lever detents of 0, 1, 5, 10, 20, 25, and 30 degrees along the scale. Zero is at the top. A horizontal bar and a digital readout show the commanded flap position. The digital readout shows when the flap handle is in detent. The bar and readout are green when the flaps/slats are in the commanded position. Otherwise they are magenta.

The flap position indication goes blank ten seconds after the commanded flap position is 0 and both the flap handle and the flaps are in the 0 detent.

During non-normal conditions, a multiple flap indication shows. The multiple indication shows all individual flap/slat segments for each wing.

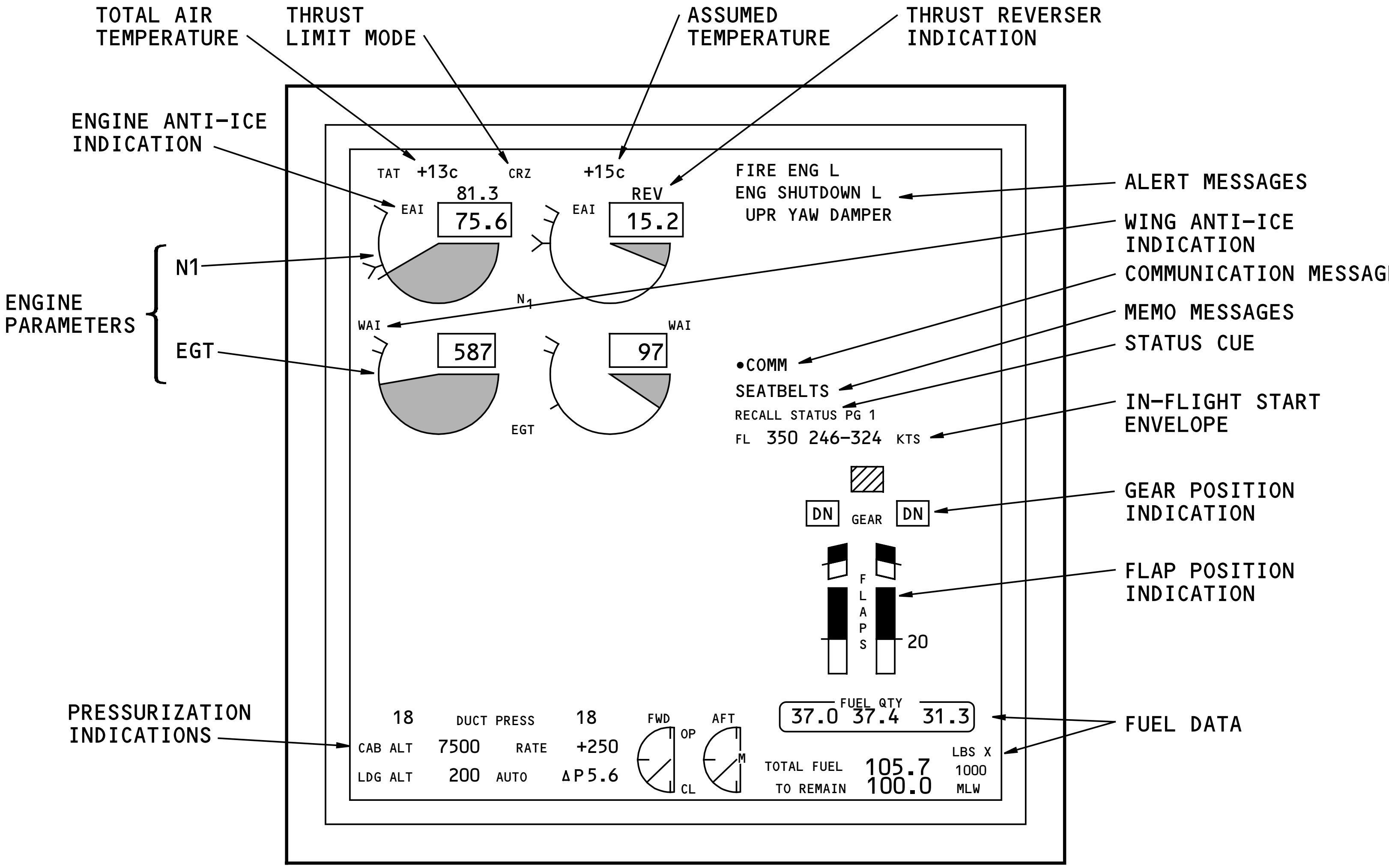
Fuel Data

Total fuel quantity and fuel temperature show as white numerical readouts in the lower right corner of the display. TOTAL FUEL and TEMP show in cyan.

During a fuel imbalance condition, a fuel quantity block shows to help the crew balance the fuel in the main tanks.

A low fuel temperature condition causes the fuel temperature readout to change to amber.

During fuel jettison, the fuel temperature readout changes to fuel-to-remain indication.



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PRIMARY DISPLAY SYSTEM - EICAS DISPLAY FORMAT

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PRIMARY DISPLAY SYSTEM - SECONDARY ENGINE DISPLAY FORMAT

General

The secondary engine display format shows on the center lower display unit (DU) at power-up. The format shows secondary engine parameters not required for continuous display. The ENG switch on the EICAS display select panel controls the display.

The display shows this information:

- High pressure rotor speed (N2)
- Fuel flow
- Oil pressure
- Oil temperature
- Oil quantity
- Engine vibration
- In-flight start data.

N2

N2 shows as a digital readout and a round analog scale. The display units are percent RPM. Red lines and color code for exceedance are the same as the N1 display on the EICAS display format.

Fuel Flow

A digital readout shows fuel flow in units of thousands of pounds per hour for each engine just below the N2 scale. There are no exceedance indications for fuel flow.

Oil Pressure, Temperature, Quantity

Oil pressure shows as a digital readout and filled, moving pointers on a vertical analog scale. Oil pressure has a lower red line limit and an upper and lower amber band limit.

Oil temperature shows as a digital readout in degrees C and filled, moving pointers on a vertical analog scale. Oil temperature has an upper and lower red line limit and a high and low amber band limit.

For both oil pressure and oil temperature, these change colors (white to amber to red) as the parameter exceeds applicable high or low limits:

- Digital readouts
- Readout boxes
- Pointers.

Oil quantity shows as a digital readout in quarts. For a low oil quantity condition, the digital readout changes to reverse video and a LO message shows next to the readout.

Engine Vibration

Engine vibration shows at the bottom of the page as a digital readout and a moving pointer on an analog scale. Vibration shows in normalized units from zero to five. The scale is white. A message shows below each digital readout. The message shows the rotor with the highest vibration level. The messages are N1, N2, or BB

PRIMARY DISPLAY SYSTEM - SECONDARY ENGINE DISPLAY FORMAT

(broadband). During a high vibration condition, the vibration indication goes to reverse video.

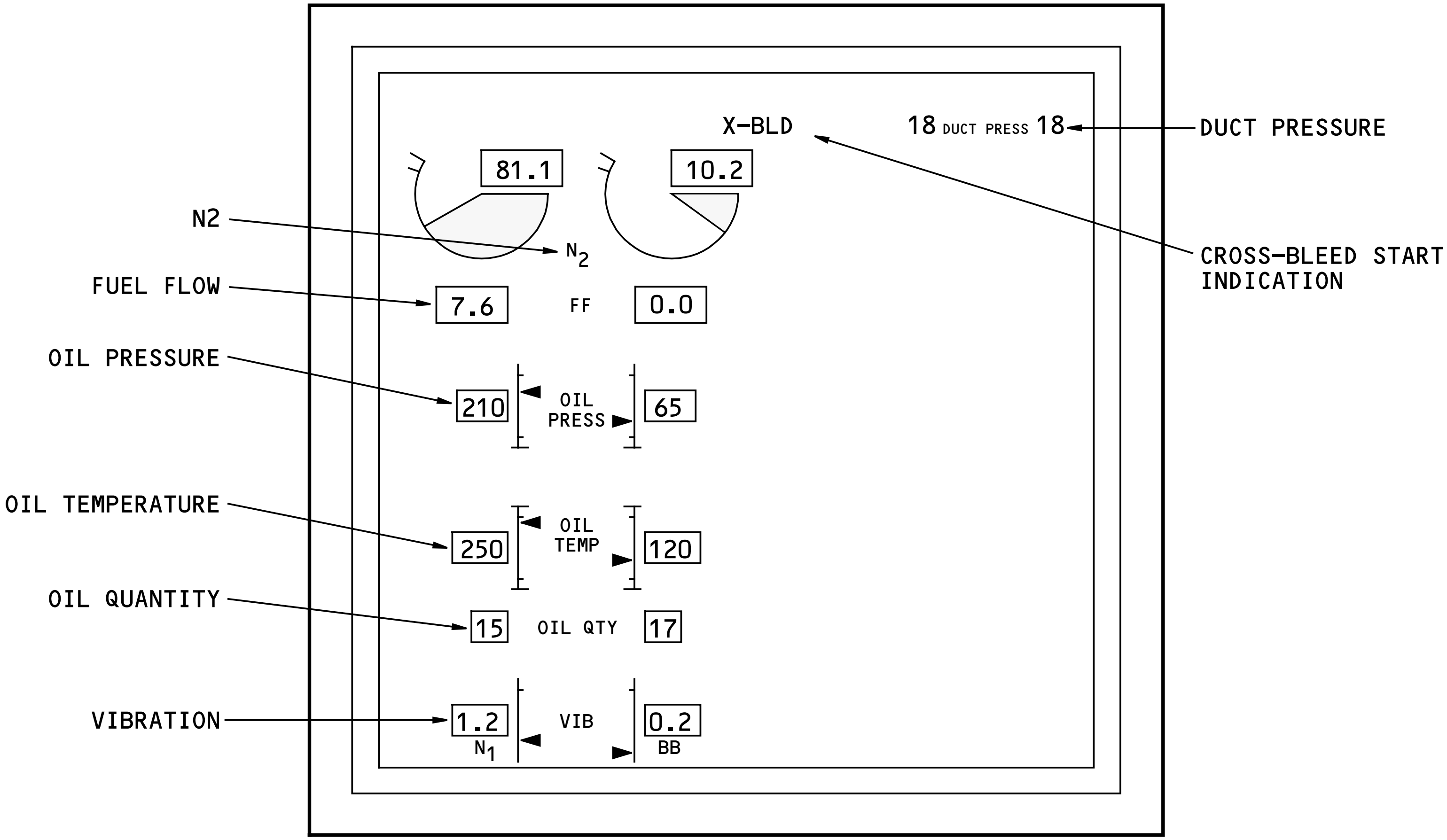
In-Flight Start Data

During in-flight start conditions, if airspeed and altitude conditions require cross-bleed, then a X-BLD message shows. A fuel-on line shows the RPM level where the crew applies fuel. The message and indication are magenta. The fuel-on line shows when an engine shuts down in the air.

During an in-flight engine shutdown, the secondary engine display format automatically shows.

Duct Pressure

The duct pressure legend and readout show when one of the engines is not running and the fire handle is not pulled.



31-61-00-063 Rev 4 09/26/1995

PRIMARY DISPLAY SYSTEM - SECONDARY ENGINE DISPLAY FORMAT

PRIMARY DISPLAY SYSTEM - EICAS ENGINE COMPACTED DISPLAY FORMAT

General

When either the upper center or lower center is not available for engine data, engine parameters from the EICAS display and secondary engine display formats show in a compacted format. With only one DU available, EICAS is in the limited mode of operation.

When the above conditions exist, the ENG switch on the display select panel (DSP) controls the compacted format. The ENG switch changes the compacted format to the EICAS display format or the EICAS display format to the engine compacted format.

The FUEL switch controls the display of the fuel data block when EICAS is in the limited mode of operation.

The AIR switch controls the display of the ECS data block when EICAS is in the limited mode of operation.

The compacted format also shows when a maintenance page shows on the lower center DU.

Compacted Format Features

N1 and EGT are the same as the EICAS display format.

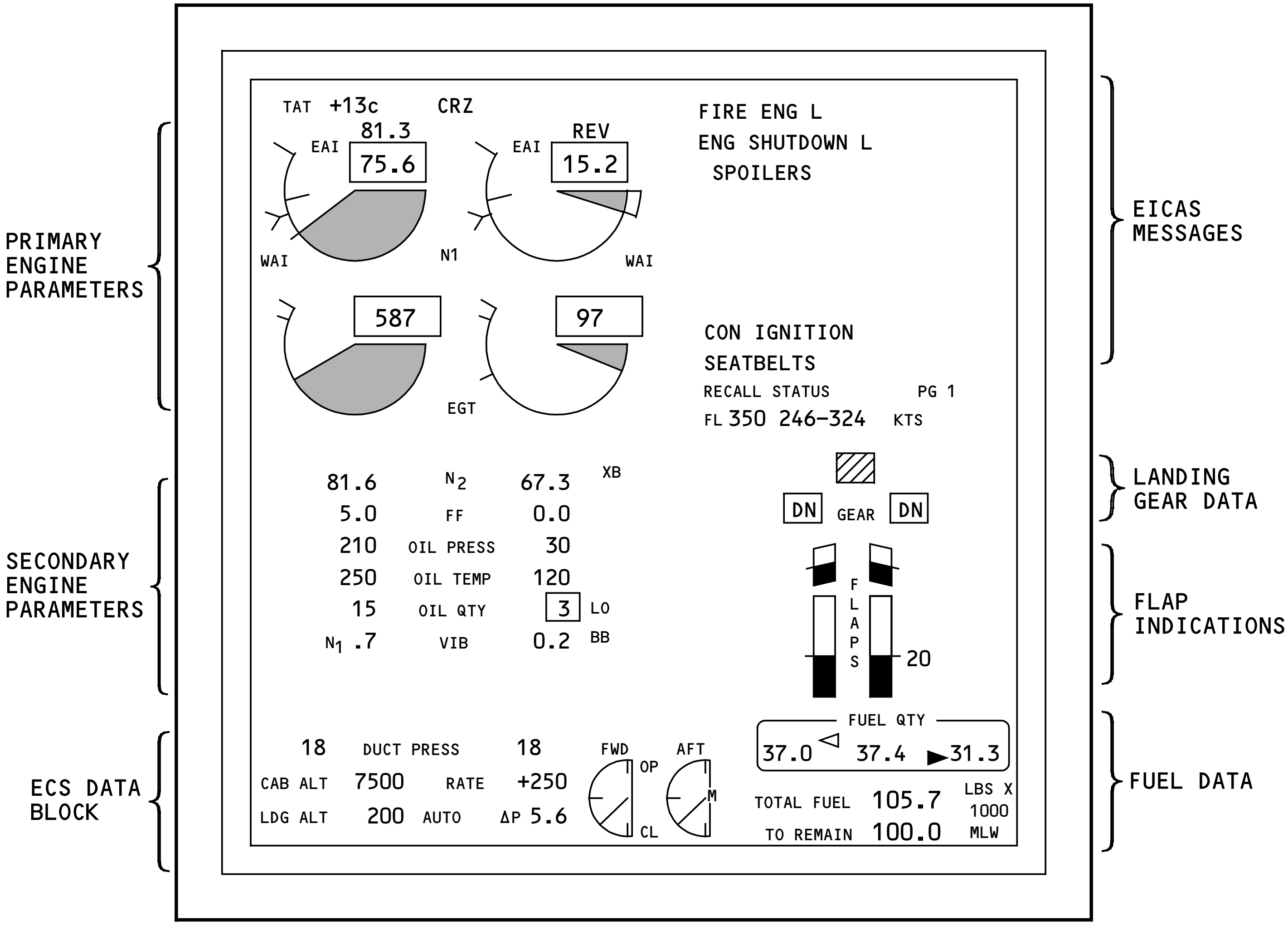
N2 shows as a numerical readout only. Cross-bleed (XB) shows next to N2.

Fuel flow and oil quantity are the same as the secondary engine display format except that the readout box goes away.

Oil pressure, oil temperature, and vibration show digitally only. The readout box and the analog scale go away.

This data shows in the same way as the EICAS display format:

- Alert and annunciation messages
- Gear information
- Flap/slat information
- Cabin pressure data
- Fuel quantity and temperature.



PRIMARY DISPLAY SYSTEM - EICAS ENGINE COMPACTED DISPLAY FORMAT

PRIMARY DISPLAY SYSTEM - CREW ALERT MESSAGES

General

The EICAS display and engine compacted formats show these types of messages:

- Warnings
- Cautions
- Advisory
- Comm
- Memo
- In-flight start.

Warning, caution, and advisory messages are crew alerting messages. Comm messages tell the crew of communication requests. Memo messages are crew reminders of the current state of manually selected normal conditions.

The most important messages in sequence are:

- Warnings
- Cautions
- Advisory
- Comm and FMC medium
- Comm low
- Memo.

Warning, caution, and advisory messages show from the top down with the most recent message at the top of its category.

Comm and memo messages start on line eleven and work up. The most recent message shows at the bottom of its group.

There are eleven messages available on each page. The CANCEL/RECALL switch controls message paging when an overflow condition exists. A page number shows when an overflow condition exists. A bullet next to a message identifies a comm message.

Warning Messages

Warning messages have a relation to operational or airplane system conditions that require immediate crew action. Warning messages are red and have an associated aural and dedicated master warning lights.

The most recent warning message shows at the top of the message field. You cannot cancel warning messages with the cancel/recall switch.

The master warning light reset switch cancels aurals and master warning light indications. The message stays on the display until the condition that caused the message goes away.

Warning messages are left justified and have a maximum of 20 characters.

Caution Messages

Caution messages have a relation to an operational or airplane condition that requires immediate crew awareness and possible action. Caution messages are amber and have an associated aural and dedicated master caution lights.

The most recent caution message shows at the top of the caution messages and below any existing warning messages.

The first push of the cancel/recall switch removes caution messages from the display. The second push returns the messages to the display if they are still active.

The master caution light reset switch cancels the master caution light and the caution aural. The message remains on the display until the condition that caused the message goes away.

Caution messages are left justified and have a maximum of 20 characters.

<u>Advisory Messages</u>

Advisory messages have a relation to an operational or airplane condition that requires crew awareness. Advisory messages are amber.

The most recent advisory message shows at the top of any advisory messages and below any existing warning or caution messages.

The first push of the cancel/recall switch removes advisory messages from the display. The second push returns the messages to the display if they are still active.

Advisory messages are left justified with the first space blank. They have a maximum of 19 characters.

<u>Comm Messages</u>

Comm messages alert the flight crew to new messages. The messages may affect the FMCS functions and advise the crew to check the CDU scratch pad. They may also affect the flight deck communication function (FDCF) and alert the crew to check the FDCF displays. Comm messages may also affect the cabin management system (CMS).

There are two levels of comm messages:

- Comm medium
- Comm low.

Comm medium messages identify an incoming communication request which requires immediate crew awareness and prompt crew acknowledgment. Comm medium messages are white and are associated with a hi-lo chime.

Comm medium messages are left justified, 20 characters long and the first character is a bullet.

Comm low messages identify an incoming communication request which requires timely crew awareness and timely crew acknowledgment. Comm low messages are white.

PRIMARY DISPLAY SYSTEM - CREW ALERT MESSAGES

Comm low messages are left justified, 19 characters long and the first character is blank. The second character is a bullet.

To cancel a comm or FMC message, use the accept switch on the glareshield panel. Or use the appropriate datalink page of the CDU or MFD to accept the uplink.

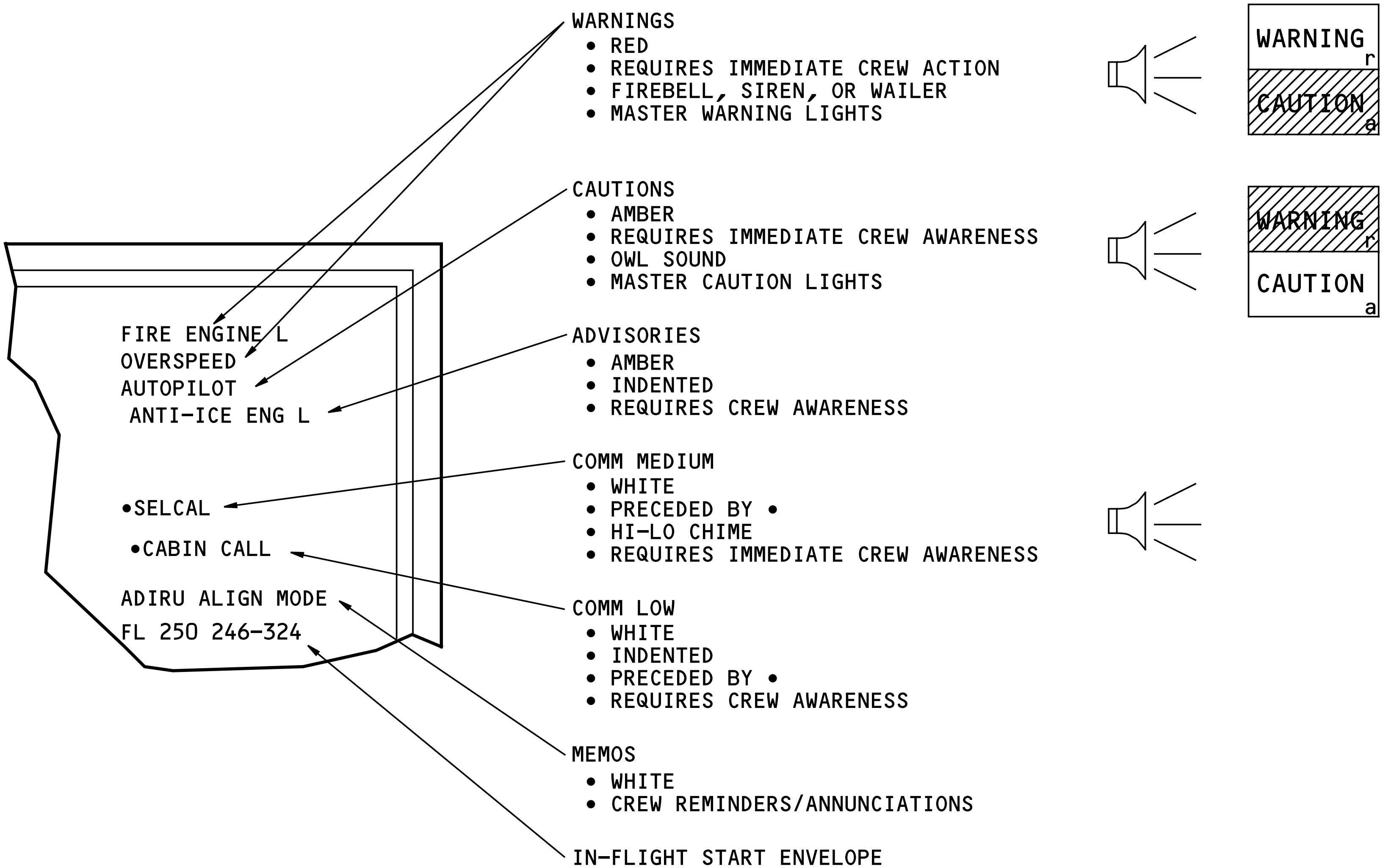
Memo Messages

Memo messages remind the crew of certain manually selected normal conditions. Memo messages are white.

Memo messages are left justified and 20 characters long.

To cancel a memo message remove the condition to cause it to show.

The highest priority memo message shows at the bottom of the display below any existing comm messages.



31-61-00-065 Rev 5 02/08/1997

PRIMARY DISPLAY SYSTEM - CREW ALERT MESSAGES

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PRIMARY DISPLAY SYSTEM - EICAS INHIBITS SUMMARY

General

EICAS inhibits remove invalid messages and also remove the caution visuals and aural tones during the maintenance period and during certain airplane and flight conditions.

Message Inhibits

These are the six types of EICAS message and caution inhibits:

- Engine start inhibit (ESI)
- Starter cutout inhibit
- Message inhibit
- General inhibit
- Flight phase inhibits
- Master caution and caution aural tone inhibits.

Engine Start Inhibit

The engine start inhibit prevents some of these messages and alerts during an engine start sequence:

- Caution
- Advisory
- Memo
- Status.

The engine start inhibit prevents automatic electrical bus load shedding and bus transient annunciations that may occur due to generator switching during an engine start.

Starter Cutout Inhibit

When a starter cutout condition occurs, the STARTER CUTOUT caution message replaces these existing messages:

- Caution
- Advisory
- Comm
- Memo.

During the inhibit, message processing continues but the messages do not show.

The starter cutout inhibit stops when one of these happens:

- The starter cutout condition goes away
- A new caution message occurs that is not subject to ESI inhibits
- 20 seconds after it starts
- You push the CANCL/RCL switch.

Message Inhibit

Some messages cause other messages not to show. As an example, the caution message ENG R SHUTDOWN inhibits the advisory message ENG CONTROL R.

PRIMARY DISPLAY SYSTEM - EICAS INHIBITS SUMMARY

General Inhibit

Some airplane conditions cause certain messages not to show. As an example, airplane-on-the-ground inhibits the advisory message ICING WING.

Flight Phase Inhibits

There are several flight phase inhibits.

The advisory message takeoff inhibit prevents the display of all advisory messages during takeoff.

The comm message takeoff inhibit prevents the display of comm messages during takeoff except CABIN ALERT.

The status cue inhibit prevents the display from first engine start to top of climb or 30 minutes after liftoff.

The comm message landing inhibit prevents the display of comm messages during landing except CABIN ALERT.

The caution/advisory landing inhibit prevents the display of caution and advisory messages during landing. These are the exceptions:

- AUTOPILOT
- NO AUTOLAND
- SPEEDBRAKE EXTENDED
- AUTOTHROTTLE DISC.

Master Caution Light and Caution Aural Tone Inhibits

There are two master caution lights and aural tone inhibits. They are the:

- Airplane takeoff inhibit
- All engine shutdown inhibit.

The airplane takeoff inhibit prevents the lights and tone during takeoff. The inhibit starts as the airplane accelerates through 80 knots and ends when one of these happens:

- The airplane reaches 400 feet of radio altitude
- 20 seconds after it starts
- The airplane slows to less than 75 knots.

The all engine shutdown inhibit prevents the lights and tones when the airplane is on the ground and both engines are shut down.

INHIBIT	RESULTS	CONDITIONS
ENGINE START INHIBIT	CERTAIN CAUTION, ADVISORY, MEMO, STATUS & ASSOCIATED ALERTS	EITHER ENGINE STARTER VALVE OPEN TO ENGINE IDLE RPM OR FUEL SWITCH IN CUTOFF
STARTER CUTOUT INHIBIT	CAUTION, ADVISORY, COMM, MEMO PROCESSED BUT DO NOT SHOW. REPLACES WITH STARTER CUTOUT CAUTION MESSAGE	AIRPLANE ON THE GROUND AND L OR R STARTER PROBLEM. ENDS WHEN ABOVE NOT TRUE OR 20 SECONDS OR NEW CAUTION OR CANCEL/RECALL PRESSED.
ADVISORY MESSAGE TAKEOFF INHIBIT	NO ADVISORY MESSAGES SHOW	STARTS WITH AIRPLANE ON GROUND AND TRANSITION FROM BELOW TO ABOVE 80 KNOTS. ENDS AT CLIMB THROUGH 400 FT RA OR 20 SECONDS OR ON GROUND AND TAKEOFF THRUST NOT SELECTED ON BOTH ENGINES.
COMM MESSAGE TAKEOFF INHIBIT	CERTAIN COMM MESSAGES DO NOT SHOW	STARTS WHEN T/O THRUST ON EITHER ENGINE AND AIRPLANE ON THE GROUND. ENDS AT CLIMB THROUGH 400 FT RA OR 20 SEC AFTER ROTATION OR T/O THRUST NOT SELECTED ON BOTH ENGINES
STATUS CUE INHIBIT	STATUS CUE DISPLAY DOES NOT SHOW	STARTS WITH FIRST ENGINE START. ENDS AT TOP OF CLIMB OR 30 MINUTES AFTER LIFTOFF.
COMM MESSAGE LANDING INHIBIT	CERTAIN COMM MESSAGES DO NOT SHOW	STARTS AT DESCENT THROUGH 800 FT RA. ENDS AT TRANSITION FROM AIR TO GROUND AND GS<80 KNOTS OR LOSS OF RA OR CLIMB THROUGH 800 FEET RA.
CAUTION/ADVISORY LANDING INHIBIT	CERTAIN CAUTION/ADVISORY MESSAGES NOT DISPLAYABLE. MASTER CAUTION LIGHT AND CAUTION AURAL TONE INHIBITED	STARTS AT DESCENT THROUGH 800 FT RA. ENDS AT TRANSITION FROM AIR TO GROUND AND GS<75 KNOTS OR 40 SEC OR ASCENT THROUGH 800 FEET RA.
AIRPLANE TAKEOFF INHIBIT	MASTER CAUTION LIGHT AND CAUTION AURAL TONE INHIBITED	STARTS WHEN CAS>80 KNOTS AND CAS NOT PREVIOUSLY >80 KNOTS. ENDS WHEN RA > 400 FT OR 20 SEC OR CAS<75 KNOTS
ALL ENGINE SHUTDOWN INHIBIT	MASTER CAUTION LIGHT AND CAUTION AURAL TONE INHIBITED	ENABLED WHEN AIRPLANE IS ON THE GROUND AND BOTH ENGINES SHUT DOWN

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PRIMARY DISPLAY SYSTEM - EICAS INHIBITS SUMMARY

PRIMARY DISPLAY SYSTEM - EICAS MESSAGE PROCESSING

General

EICAS shows messages when certain conditions are met. Each type of message goes through several possible conditions before it shows on the display. Each message condition needs certain logic to be true.

Crew Alert Messages

Crew alert messages have these three possible conditions:

- ENABLED
- ACTIVE
- DISPLAYABLE.

A message is ENABLED when the logic is true and configuration requirements are true.

A message is ACTIVE when it is ENABLED and there are no inhibits.

A message is DISPLAYABLE when it is ACTIVE and it is not cancelled.

ACTIVE crew alerting messages that are inhibited by the starter cutout inhibit or that go away because of an overflow condition are DISPLAYABLE. Use the CNCL/RCL switch on the display select panel (DSP) to review the starter cutout inhibit messages. Also use the CNCL/RCL switch to go to the next page to review the overflow messages.

Status Messages

Status messages have these four possible conditions:

- ENABLED
- CURRENT
- ACTIVE
- DISPLAYABLE.

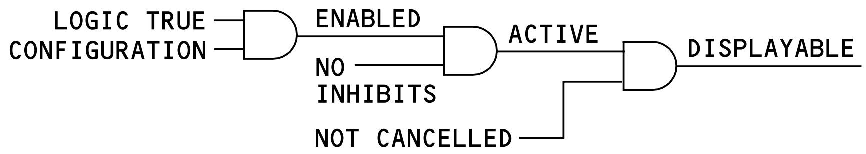
A message is ENABLED when the logic is true and configuration requirements are true.

A message is CURRENT when it is ENABLED and there are no inhibits. (ESI must be false or ESI became true after the message was ACTIVE.)

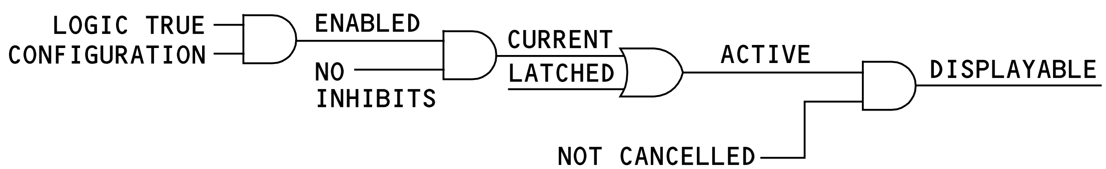
A message is ACTIVE when it becomes current or when it is latched.

A message is DISPLAYABLE when it is ACTIVE and it is not cancelled.

ACTIVE status messages that go away because of an overflow condition are DISPLAYABLE. Use the STAT switch on the DSP to go to the next page of messages.



CREW ALERT MESSAGE CONDITIONS



STATUS MESSAGE CONDITIONS

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PRIMARY DISPLAY SYSTEM - EICAS MESSAGE PROCESSING

PRIMARY DISPLAY SYSTEM - STATUS PAGE FORMAT

General

The status display shows information that helps the technician make a decision on the dispatch status of the airplane.

The status display shows:

- Hydraulic system information
- APU information
- Crew oxygen information
- Status messages.

You use the status display switch on the display select panel (DSP) to select the status display on the multifunction display (MFD).

Hydraulic System Information

Digital display of hydraulic fluid quantity shows as a percentage; 1.00 equals full. Hydraulic fluid pressure shows for each of the three hydraulic systems.

These messages show next to the quantity readouts when the condition exists:

- LO (low)
- RF (refill)
- OF (overfill).

The LO message is amber and the RF and OF messages are white.

APU Information

APU information shows below the hydraulic information. The APU information includes:

- APU exhaust gas temperature (EGT), in centigrade
- APU rotor speed
- APU oil quantity
- APU oil pressure
- APU oil temperature.

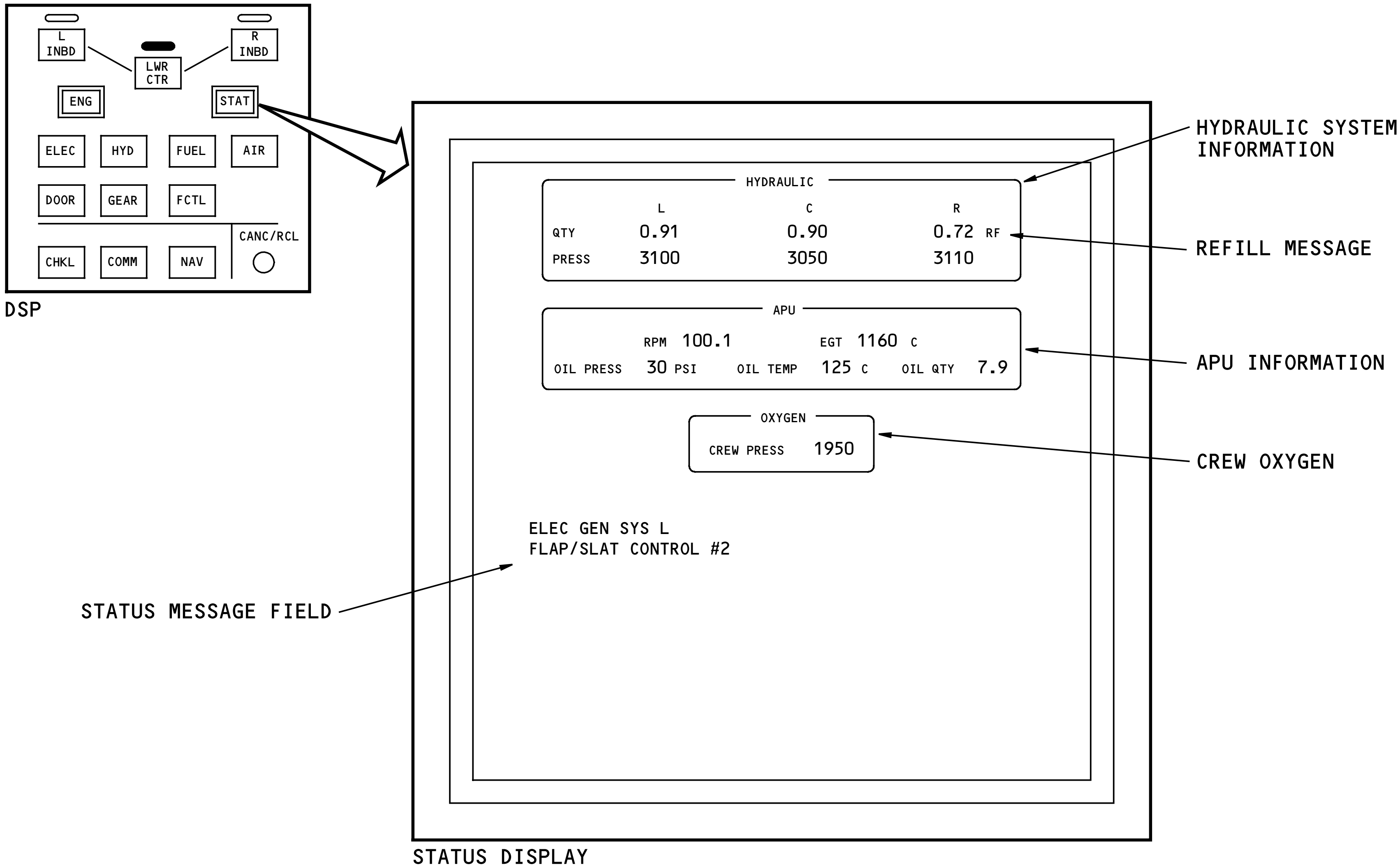
Crew Oxygen

Crew oxygen status shows below the APU information.

Status Messages

Status messages have a relation to conditions that affect dispatch. The technician uses applicable publications to make a decision on the dispatch status of the airplane.

The status message field holds eleven messages on each page. Use the status display switch on the DSP to page through multiple pages of status messages. When the last page of status messages shows, a push of the status display switch causes the display to go away.



31-61-00-068 Rev 4 05/19/1997

PRIMARY DISPLAY SYSTEM - STATUS PAGE FORMAT

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PRIMARY DISPLAY SYSTEM - STATUS MESSAGE FIELD AND STATUS CUE

General

The status message field shows in the lower left corner on the status display (MFD). Status messages show the dispatch status of the airplane in the status message field. A status message is based on the requirements of the master minimum equipment list (MMEL). The most recent message shows at the top of the list.

The STATUS cue field shows on the EICAS display when the status display does not show and a new status message occurs. The STATUS cue shows below the memo message field.

These are the two types of status messages:

- Non-latched
- Latched.

Non-Latched

Non-latched status messages show on the status display when some malfunctions occur in the systems monitored by AIMS. The newest message shows first. When the condition that causes the message goes away, the message on the status page format goes away.

If more than eleven messages exist, they overflow to additional pages and a page number shows below the status message field. Use the status display switch on the display select panel (DSP) to page through multiple pages of status messages. When the last page of status messages shows, a push of the status display switch causes the display to go away.

Latched

Latched status messages also show on the status display when malfunctions occur in systems monitored by AIMS. They have the same priority as non-latched status messages. The most recent message of either type shows at the top of the list.

These are the three types of latched status messages:

- Ground only
- Air only
- Either air or ground.

AIMS stores latched status messages in memory. The messages go to the central maintenance computing function (CMCF) for flight deck effect correlation.

Latched messages allow the maintenance technicians to look at failures that occur in specific flight phases and may not be present or active all the time.

Latched status messages do not go away when the condition that causes the message goes away. Some latched status messages require the technician to do the necessary repair and then use the ERASE function on the MAINTENANCE TASK maintenance page to erase the messages. Other latched status messages require the technician to do the necessary repair and then do a ground test of the system to erase the message.

PRIMARY DISPLAY SYSTEM - STATUS MESSAGE FIELD AND STATUS CUE

Status Cue

A STATUS cue shows on the EICAS display any time a new status message becomes current and the status page format does not show. The STATUS cue is cyan.

There is a fifteen second time delay before the STATUS cue shows. This prevents transient messages.

The STATUS cue goes away when one of these occurs:

- The status page format shows
- The condition that causes the status message goes away.

Status Cue Inhibit

A status cue inhibit does not let the STATUS cue show. During takeoff, the inhibit starts when both of these occur:

- The airplane is on the ground
- First engine start.

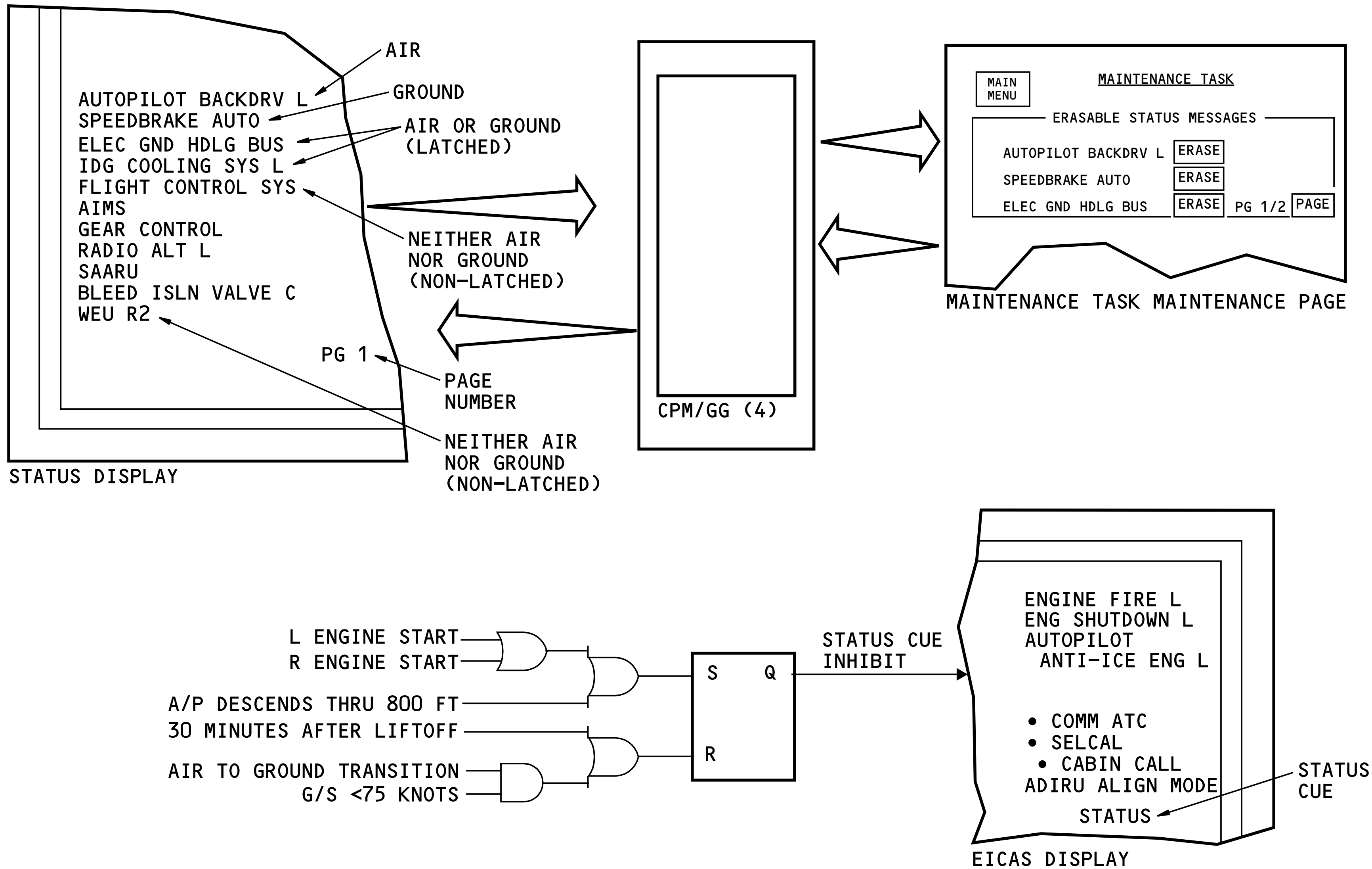
During landing, the inhibit starts when the airplane descends through 800 feet of altitude.

The inhibit stops 30 minutes after liftoff.

After landing, the inhibit stops when the airplane ground speed is less than 75 knots.

If a STATUS cue shows before the start of the inhibit, it continues to show.

If a status message becomes active during the inhibit and is still active when the inhibit ends, the STATUS cue shows.



PRIMARY DISPLAY SYSTEM - STATUS MESSAGE FIELD AND STATUS CUE

31-61-00-069 Rev 7 11/15/95

PRIMARY DISPLAY SYSTEM - SYNOPTIC FORMATS OVERVIEW

General

Synoptic formats give a graphic representation of airplane systems. The word SYNOPTIC combines the words synopsis (summary) and optic (visual). Synoptics are dynamic displays in color of real-time data. The synoptic displays are available for these systems:

- Flight controls (FCTL)
- Landing gear (GEAR)
- Doors (DOOR)
- Environmental control system (AIR)
- Fuel (FUEL)
- Hydraulic (HYD)
- Electrical (ELEC).

Push the applicable switch on the display select panel (DSP) to show a synoptic. Push the same switch a second time and the display goes away.

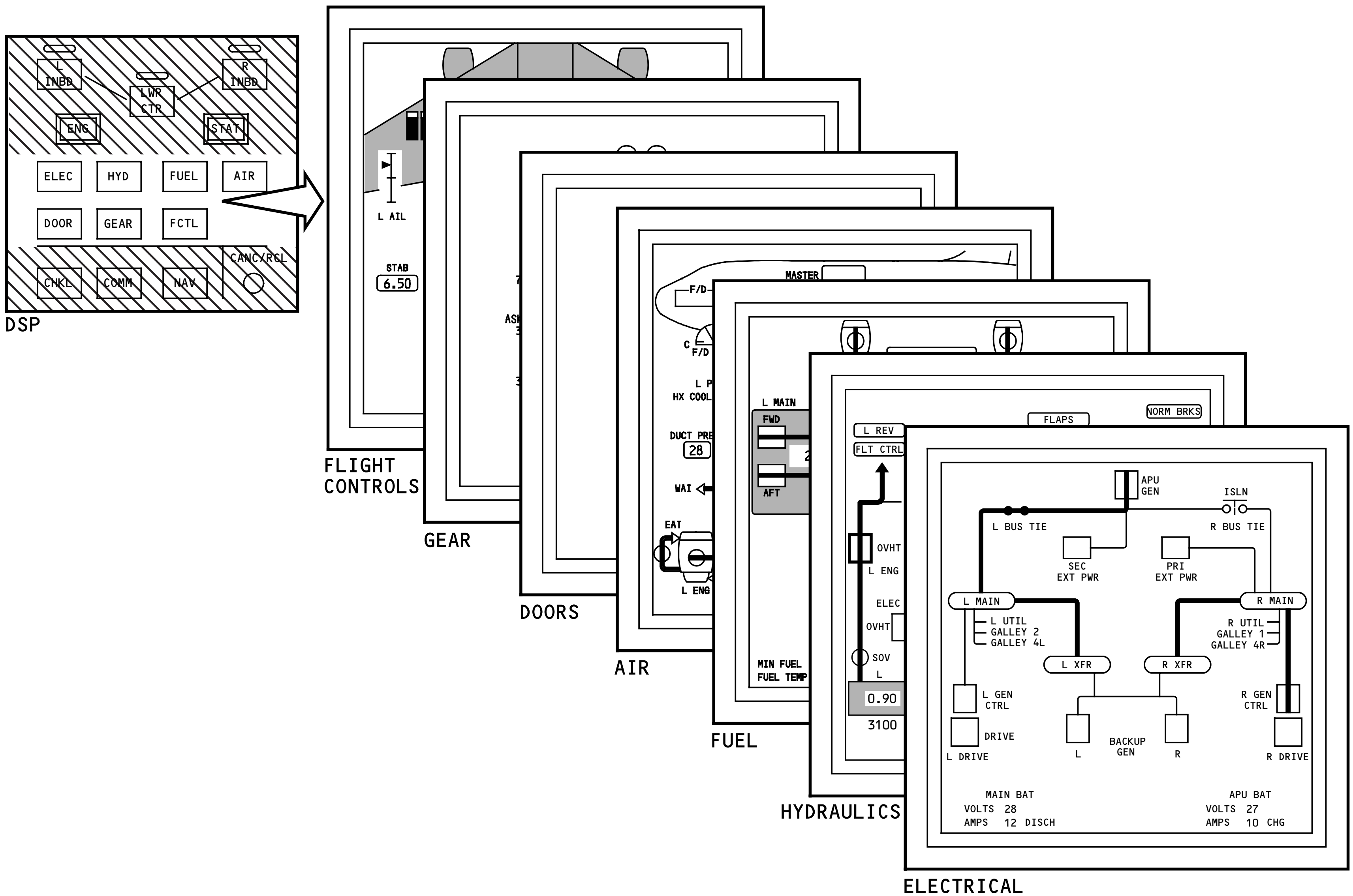
Synoptic formats can show as a multi functional display (MFD) on any or all of these DUs:

- Lower center DU
- Left inboard DU
- Right inboard DU.

Colors

Colors show on synoptic pages to help identify conditions and states. These colors show on the synoptic pages:

- Red, warning/limit/exceedance
- Amber, caution/limit/exceedance/failed
- Magenta, commands/targets
- Cyan, arm state
- Green, on/flow
- Grey, actual airplane condition
- White, off/invalid data.



PRIMARY DISPLAY SYSTEM - SYNOPTIC FORMATS OVERVIEW

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PRIMARY DISPLAY SYSTEM - FLIGHT CONTROLS SYNOPTIC

General

The flight controls synoptic display shows the status of the external flight control surfaces on an airplane outline.

The synoptic shows this information:

- Spoiler position
- Flaperon position
- Aileron position
- Elevator position
- Stabilizer position
- Rudder trim position
- Rudder position
- Flight control mode
- Hydraulic system status
- Actuator control electronics (ACE) status.

Spoiler Position

Spoiler positions show as a thermometer. The full up position shows as a filled thermometer and the full down position has no fill. For invalid conditions the spoiler symbol goes away. For fail conditions an amber X shows.

Flaperon, Aileron, and Elevator Position

The flaperon, aileron and elevator surface position shows as a pointer that moves along a vertical scale. The ends of the scales show full range deflection and the tick mark at the center shows zero deflection. For invalid conditions, the triangular pointer goes away. For fail conditions, an amber X shows.

Stabilizer Position

Stabilizer position shows as a digital readout in units of trim. For invalid conditions, the digital readout goes away. For fail conditions, an amber X shows.

Rudder Trim Position

Rudder trim position shows as a digital readout in units of trim. The letters L or R show trim direction. For invalid conditions, the digital readout and the L and R goes away. For fail conditions, an amber X shows.

Rudder Position

The rudder position shows as a pointer that moves along a horizontal scale. The ends of the scales show full range deflection and the tick mark at the center shows zero deflection. For invalid conditions, the triangular pointer goes away. For fail conditions, an amber X shows.

Flight Control Mode

NORMAL, SECONDARY, or DIRECT shows for the applicable flight control mode. NORMAL is white and SECONDARY and DIRECT are amber. The box and message goes away when no data is available.

PRIMARY DISPLAY SYSTEM - FLIGHT CONTROLS SYNOPTIC

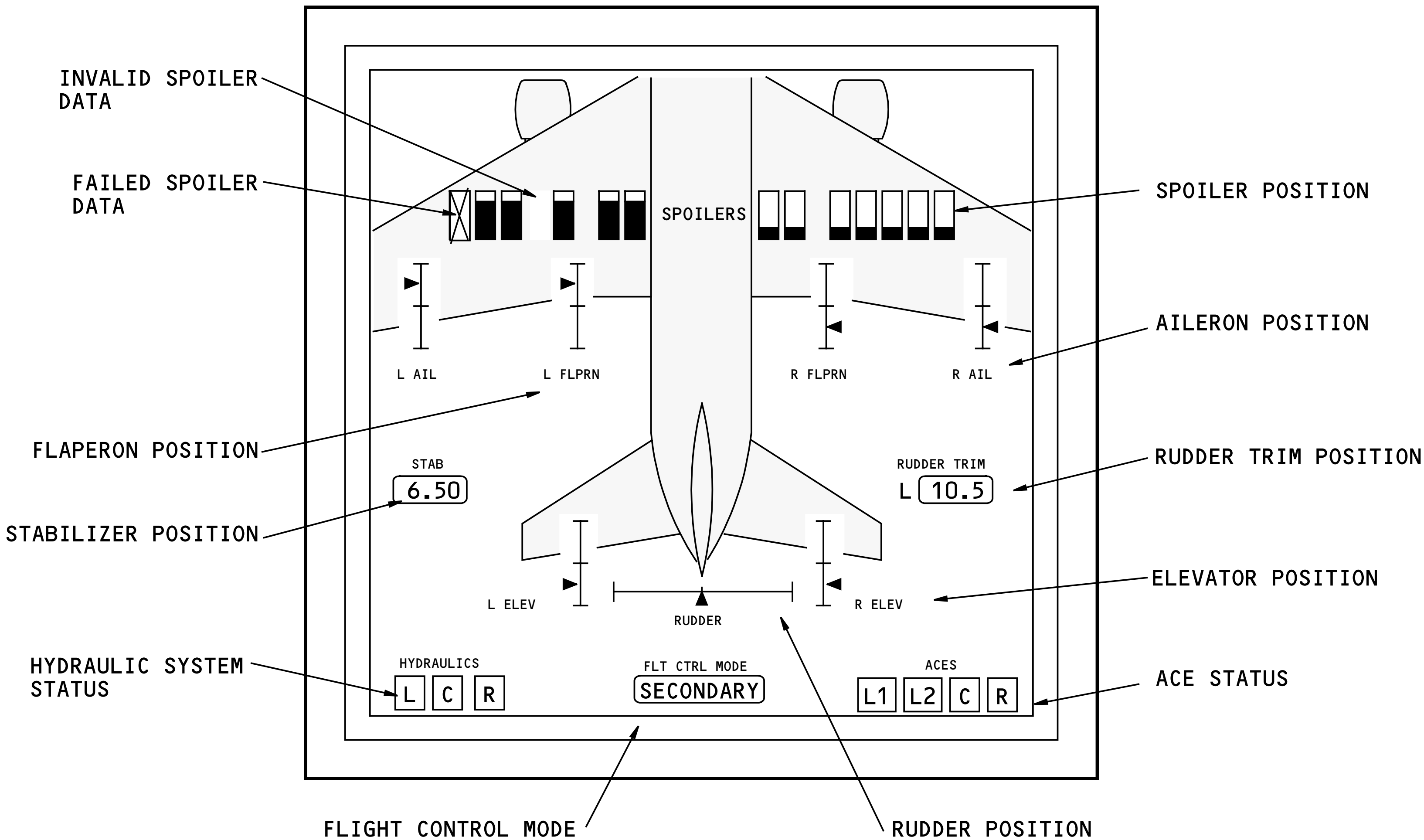
Hydraulic System Status

The hydraulic system status blocks show when there is low pressure in any of the three systems. L, C or R show for the applicable system. The system with low pressure shows as an amber letter and box. The normal systems show as green letters and boxes.

When all three systems are normal, the display goes away.

Actuator Control Electronics (ACE) Status

The ACE status blocks show when there is a failure. L1, L2, C, or R show for the applicable system. The box and label for the failed system shows in amber. The normal systems show as green letters and boxes.



PRIMARY DISPLAY SYSTEM - FLIGHT CONTROLS SYNOPTIC

PRIMARY DISPLAY SYSTEM - GEAR SYNOPTIC

General

The Gear synoptic shows this information:

- Tire pressure
- Gear door information
- Brake temperature
- Brake symbols
- Brake deactivation/antiskid status.

Tire Pressure

Tire pressure shows in each tire symbol. Normal pressures show in white. Non-normal tire pressure shows in amber. Invalid tire pressure information shows blank.

Gear Doors

The message CLOSED shows in the door symbol when the nose gear doors or the main landing gear doors close. When the doors are in transit, diagonal lines show in the door symbol. For invalid conditions, the door symbols go away.

Brake Temperature

Brake temperature shows as a digital readout next to the wheel symbol. Temperatures show as numbers on a scale that relates to actual brake temperatures. Normal temperatures are white readouts. Non-normal temperatures are amber readouts. Invalid brake temperature information shows blank.

Brake Status and Symbols

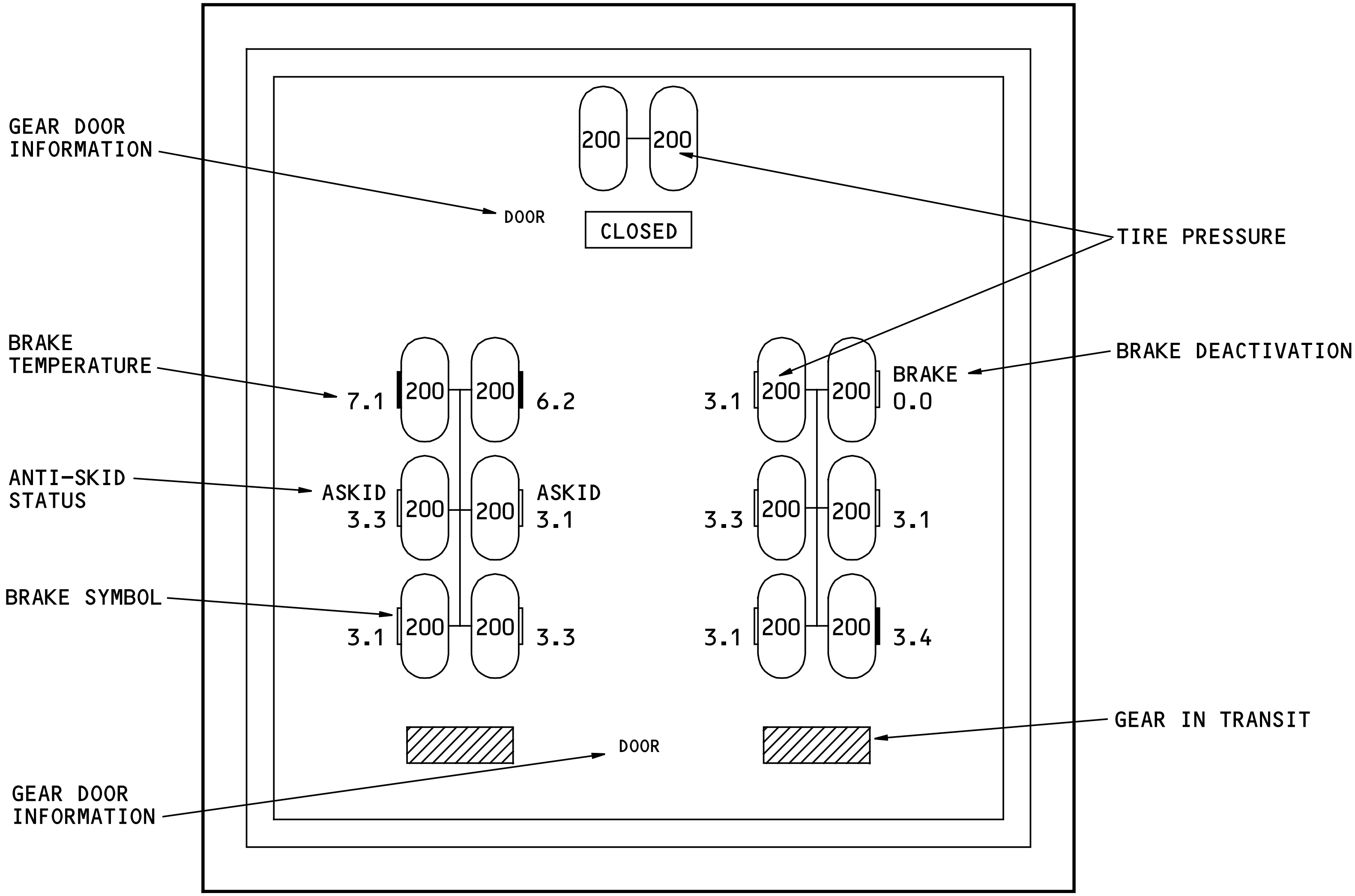
The brake symbol is a vertical bar next to the wheel symbol.

These are the four conditions and displays for the brakes:

- Brake invalid - a white symbol and blank digital temperature readout
- Brake normal - a white brake symbol and digital temperature readout
- Brake hottest - a solid white brake symbol shows on each truck for the hottest brake. The temperature readout remains white
- Brake overheat - the brake symbol and digital temperature readout change to amber. This cancels the brake hottest indication for that truck.

Brake Deactivation/Antiskid

The message BRAKE or ASKID shows next to the applicable wheel when there is a brake deactivation or an antiskid condition.



31-61-00-072 Rev 2

PRIMARY DISPLAY SYSTEM - GEAR SYNOPTIC

PRIMARY DISPLAY SYSTEM - DOOR SYNOPTIC

General

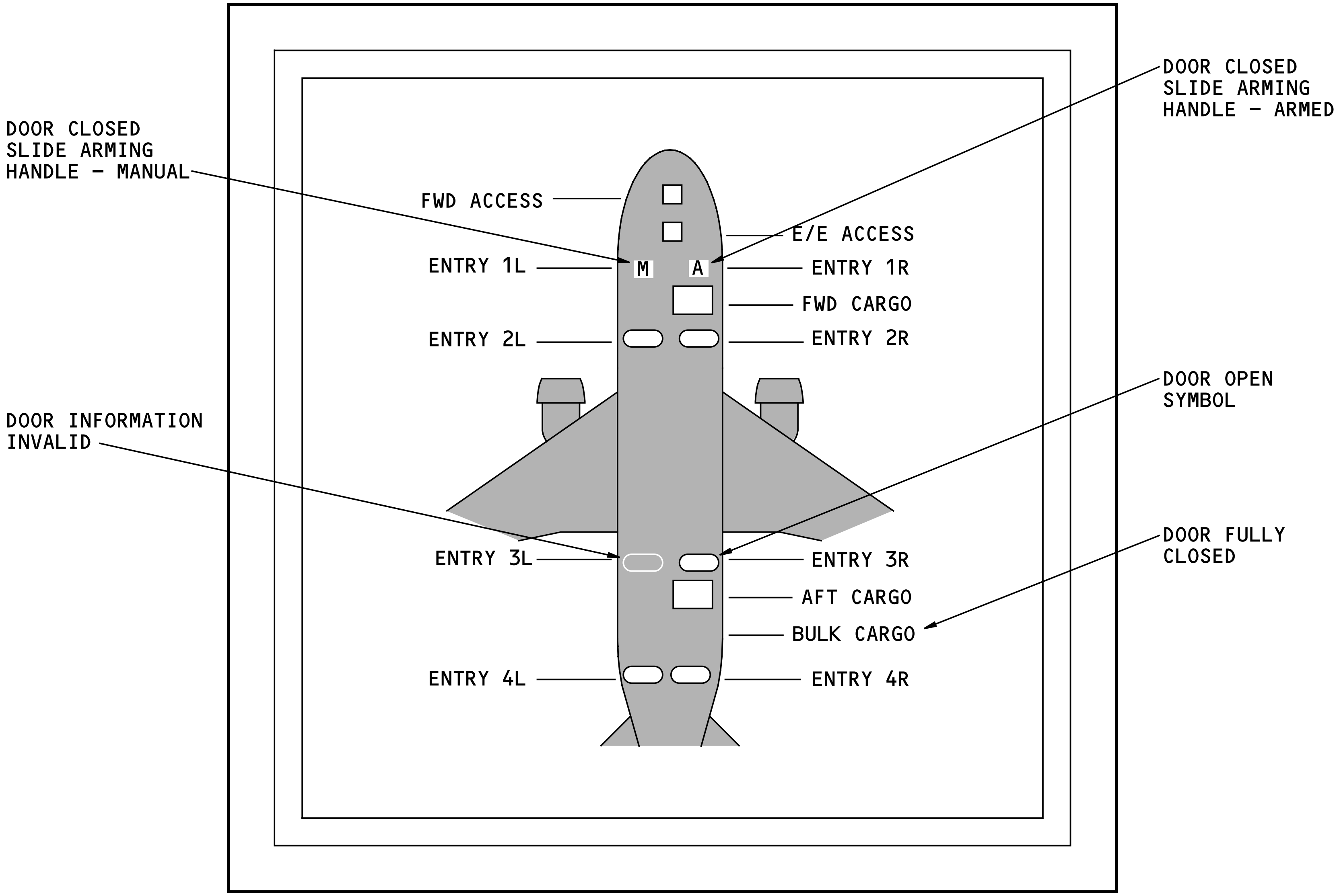
The door synoptic shows the status of these doors:

- Access doors
- Passenger entry doors
- Cargo doors.

The names of the doors always show. An amber symbol shows when a door is open or not completely closed. Cargo and access doors show nothing when they are fully closed. Invalid door information shows a white door symbol outline.

The slide arming handle position shows when the entry doors are fully closed. The symbol shows:

- A - for handle armed
- M - for handle in manual.



PRIMARY DISPLAY SYSTEM - DOOR SYNOPTIC

31-61-00-073 Rev 3 03/03/1998

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PRIMARY DISPLAY SYSTEM - FUEL SYNOPTIC

General

The fuel synoptic shows APU and ENG normal and non-normal pump status. The fuel synoptic also shows other ENG normal and non-normal fuel data. The fuel synoptic shows:

- APU pump status
- ENG pump status
- Total fuel
- Fuel quantity
- Fuel temperature and minimum fuel temperature
- Cross feed valve position
- Flow indications
- Fuel jettison.

APU Pump Status

The APU dc pump status shows as:

- Pump on (green)
- Pump off (white)
- Pump invalid (white).

ENG Pumps Status

The ENG ac pumps status show as:

- Pump on (green)
- Pump off (white)
- Pump invalid (white)
- Pump failed (amber with an X).

Total Fuel, Fuel Quantities, and Fuel Temperatures

The fuel synoptic shows this fuel information in the same way as the information on the EICAS display.

The legends are cyan and the readouts are white. For invalid or fail conditions, the readouts go away.

Fuel Balanced Message

A FUEL BALANCED message shows below total fuel when the left and right tanks disagree.

Cross Feed Valve Position

The valves show as one of these conditions:

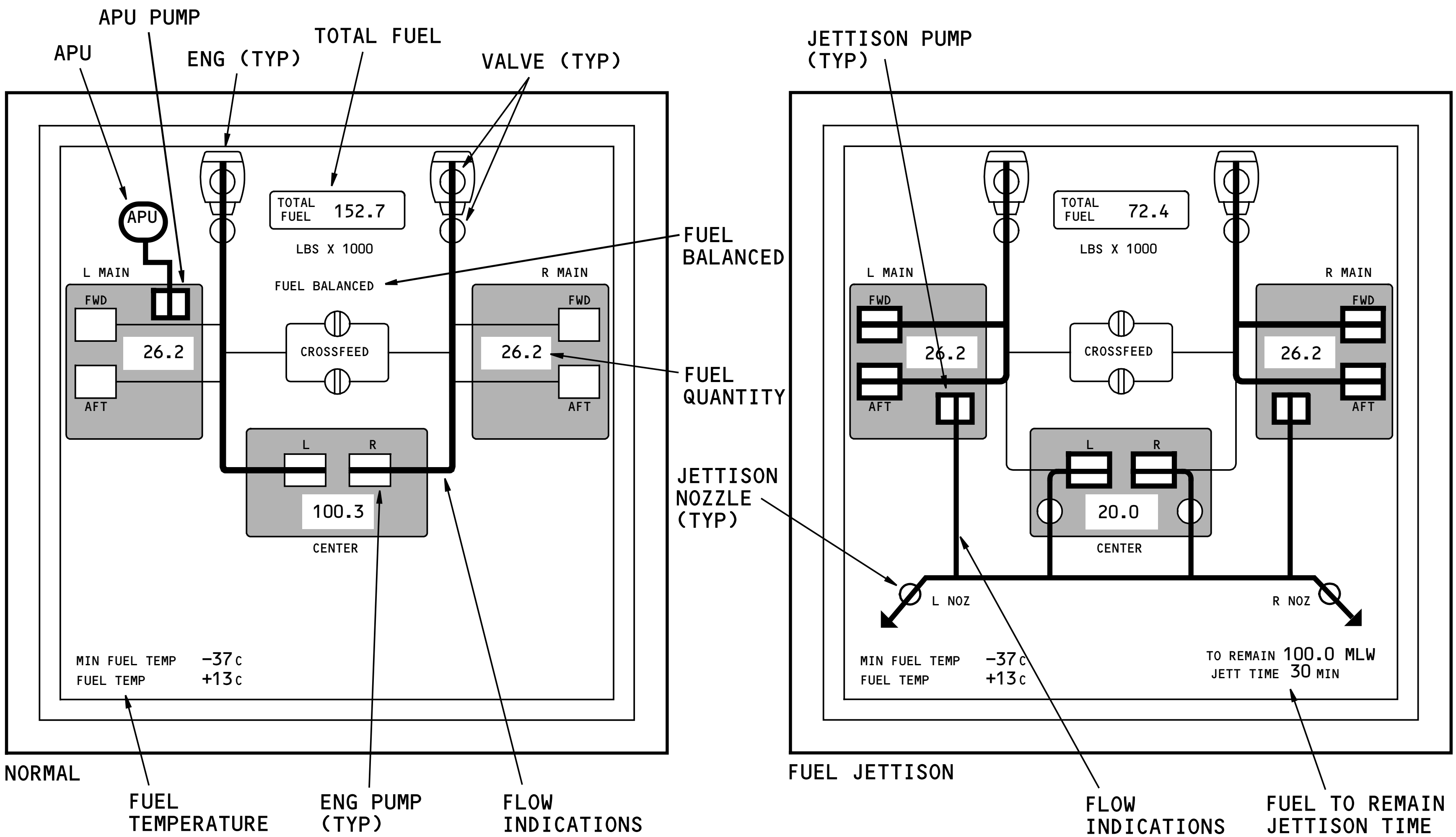
- Open
- Closed
- Failed open
- Failed closed
- Invalid.

Flow Indications

Automatic overrides and pressures cause fuel flow segments to show. Normal flow indications are green. When the engines use fuel with the pumps off, the flow indications are amber.

Fuel Jettison

During a fuel jettison condition, the fuel synoptic shows more information. The flow indications are magenta. The jettison pumps show. Fuel to remain and fuel jettison time also show.



31-61-00-074 Rev 1

PRIMARY DISPLAY SYSTEM - FUEL SYNOPTIC

PRIMARY DISPLAY SYSTEM - AIR SYNOPTIC

General

The air synoptic shows this information:

- Master temperature
- Zone temperature
- Flight deck trim valve position
- Bleed isolation valve status
- Anti-ice valve positions
- APU isolation valve status
- Engine bleed valve status
- Engine start valve status
- Pack status
- Duct pressure and ground air supply
- APU running status
- Air flow indications.

Temperatures

The master temperature shows as a magenta digital readout. Zone temperatures, target and actual, also show as magenta and white digital readouts.

Target and actual zone temperatures show for these areas:

- Flight deck
- Zones A through F
- Aft cargo
- Bulk cargo.

The target temperature is magenta. The actual temperature is white.

Valves

The trim valves show in several possible conditions.

An open valve is green with a horizontal bar. A closed valve is white with a vertical bar.

A failed open valve is amber with an X. A failed closed valve is amber with an X.

Pack Status

Pack status shows as a symbol. The symbol is green for a pack on condition. The symbol is white for a pack off or invalid condition. The symbol is amber with an X for a failed pack condition.

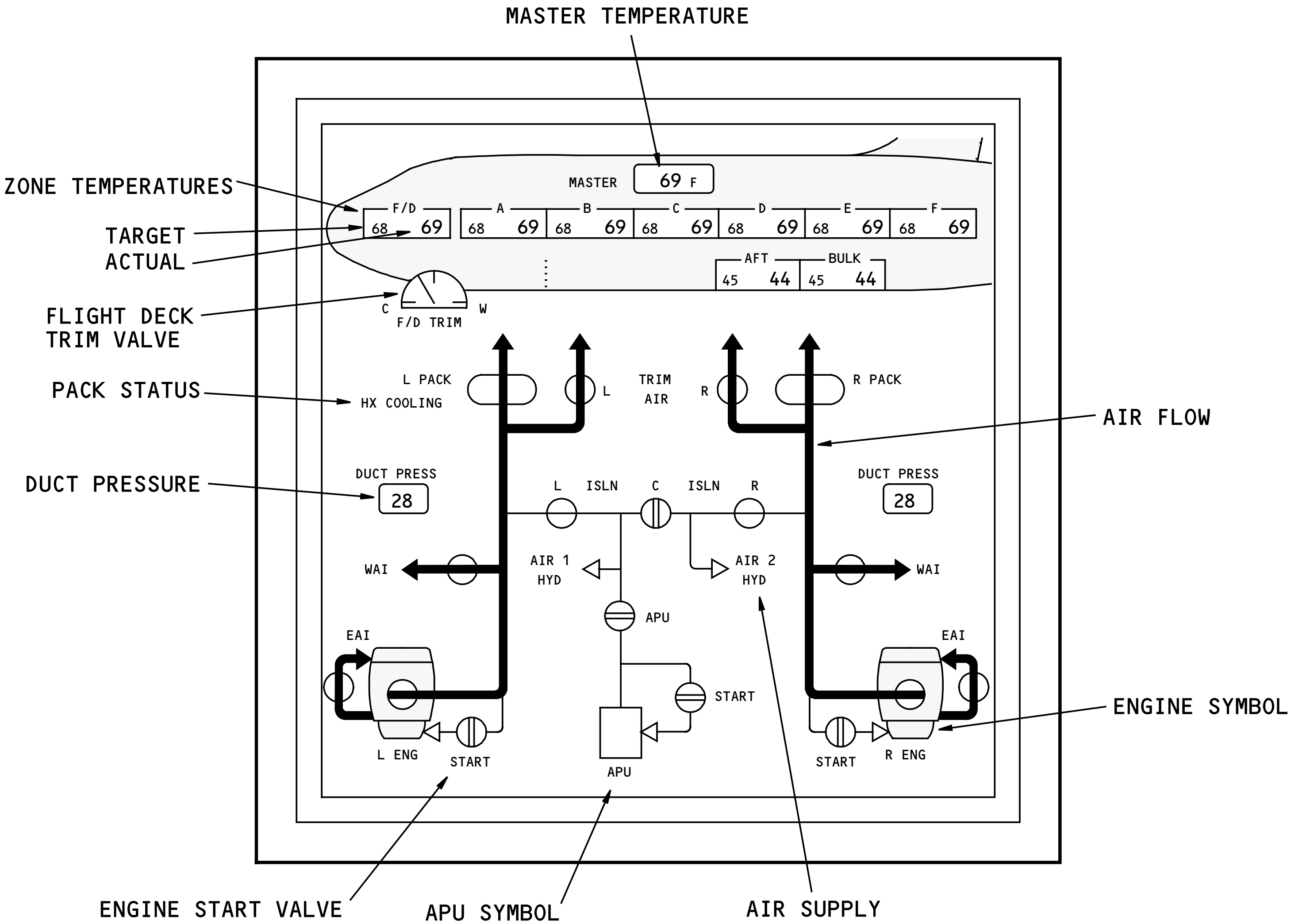
Duct Pressure and Ground Air Supply

Duct pressure shows as a digital readout.

The air source, either ground-air or an air-driven pump, shows as a cyan message.

APU Status

The APU symbol is green when the APU is running. The APU symbol is white when the APU is not running.



PRIMARY DISPLAY SYSTEM - AIR SYNOPTIC

31-61-00-075 Rev 1

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PRIMARY DISPLAY SYSTEM - HYDRAULIC SYNOPTIC

General

The hydraulic synoptic shows this information:

- User systems
- Flow indications
- Pump status
- Valve information
- Reservoir quantity and status
- System pressure.

User Systems

The systems that use hydraulic power show at the top of the display.

Flow Segments

Flow segments are green. Pressure causes a segment to show.

Pump Status

A pump on symbol is green. A pump off symbol is white. A pump invalid symbol is white. A pump failed symbol is amber with an X.

An overheat message (OVHT) shows for the primary engine pump, primary electrical pump, demand electrical pump, and the demand air pump.

Valve Information

The shutoff valve and reserve supply valve have four possible conditions. A valve open symbol is green with a vertical line. A valve closed symbol is white with a horizontal line. A valve invalid symbol is white with no line. A valve failed symbol is amber with an X.

The reserve isolation valve has four possible conditions. A valve normal symbol is green with a horizontal line. A valve isolation symbol is white with a wedge shaped horizontal line. A valve invalid symbol is white with no line. A valve failed symbol is amber with an X.

The nose gear and steering isolation valve has four possible conditions. A valve normal symbol is green with a horizontal line. A valve isolation symbol is white with a horizontal line. A valve invalid symbol is white with no line. A valve failed symbol is amber with an X.

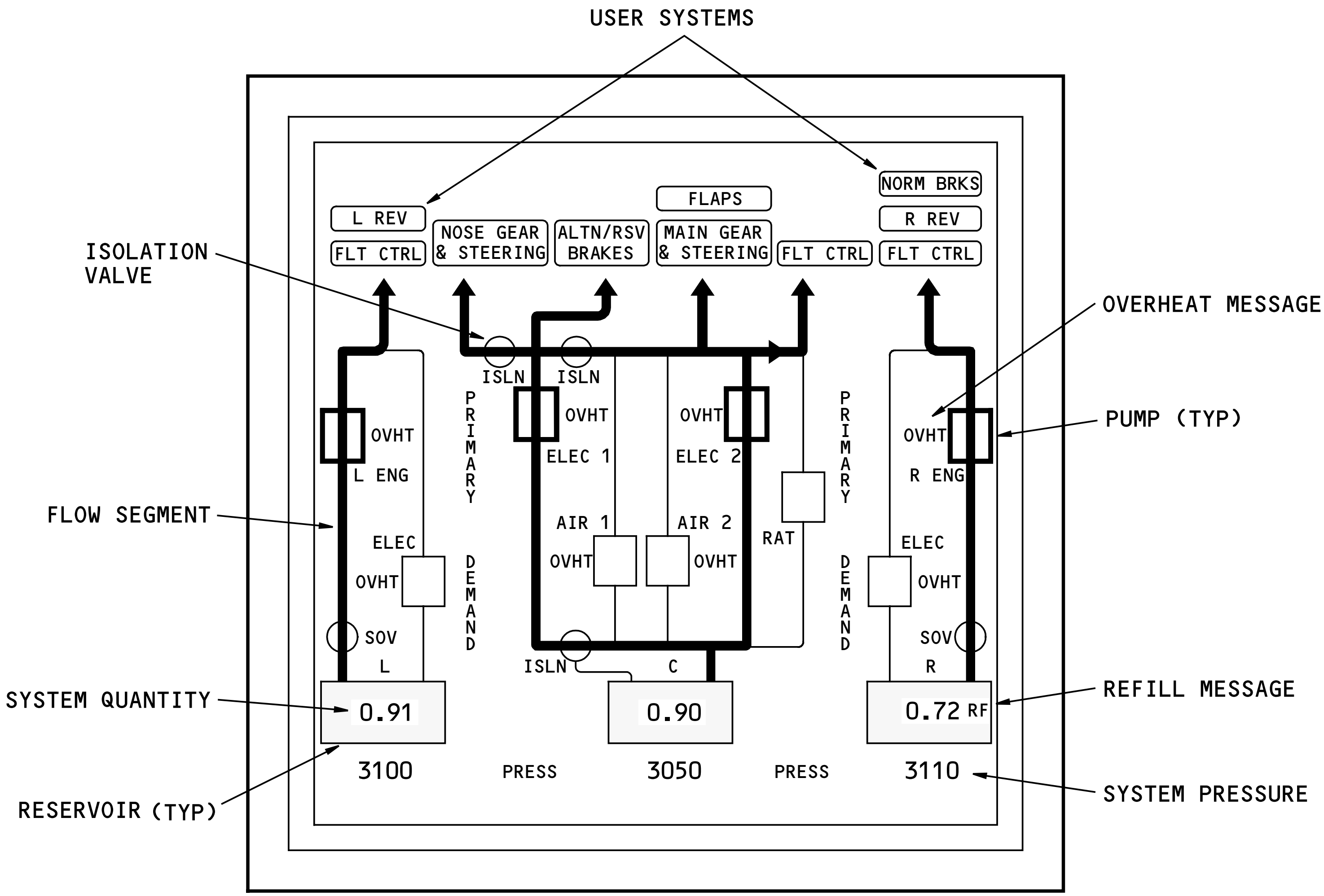
Reservoir Quantity and Status

Reservoir quantity for each tank shows as a digital readout. The readout values go from 0.0 to 1.20. A readout of 1.0 means the reservoir is full. When the airplane is on the ground, messages show for low quantity (LO), overfill (OF) or refill (RF). The quantity readout is normally white. The OF and RF messages are white. During a low condition, both the quantity readout and the LO message are amber.

PRIMARY DISPLAY SYSTEM - HYDRAULIC SYNOPTIC

System Pressure

System pressures show as digital readouts at the bottom the display.



31-61-00-076 Rev 1

PRIMARY DISPLAY SYSTEM - HYDRAULIC SYNOPTIC

PRIMARY DISPLAY SYSTEM - ELECTRICAL SYNOPTIC

General

The electrical synoptic shows:

- Bus information
- Bus tie breakers position
- Power flow
- Generator drive status and control
- Backup generator status
- Battery information.

Bus information

Buses show as a legend in an oval symbol. For invalid conditions, the symbols and legends are white. For unpowered conditions, the symbols and legends are amber. With power applied, the symbols and legends are green.

Bus Tie Breakers

The bus tie breaker symbol is circuit breaker with two circular contacts. During normal operation the symbol is white when the breaker is open and green when the breaker is closed. When the breaker is isolated and the bus tie is commanded closed or tripped, the symbol is amber. During these conditions an amber isolation message (ISLN) shows also.

Power Flow

Power flow shows as green segments.

Power sources show as green boxes when power is available and as white boxes when power is not available. Logic equations determine which flow segments show.

Generator Drive and Control

The generator symbols have four conditions. The drive on symbol is a green box. The drive off and drive invalid symbols are white boxes. The drive failed symbol is an amber box with an X.

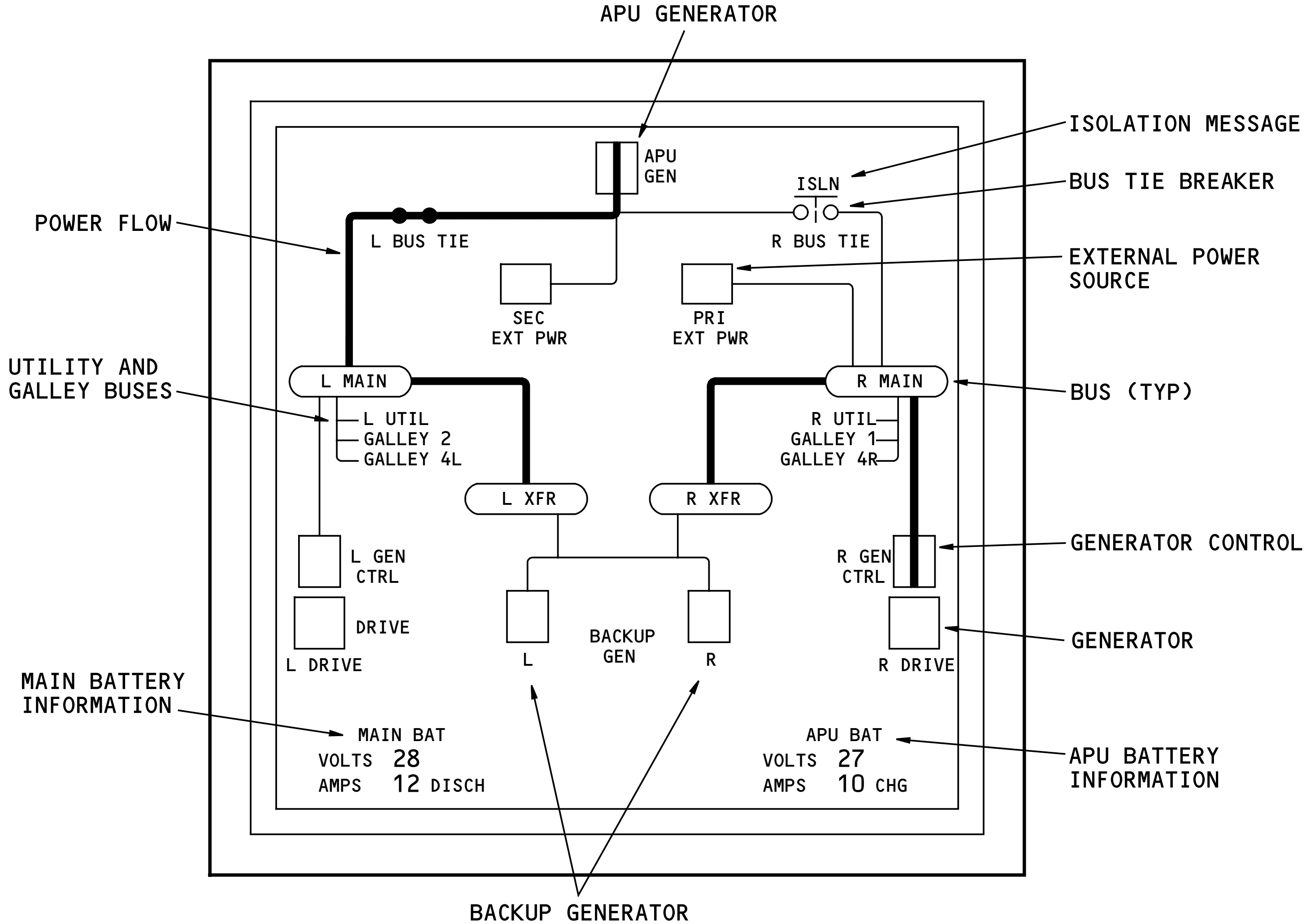
The generator control symbols have four conditions. The generator control breaker open and breaker invalid symbols are white boxes. The breaker closed symbol is a green box. The breaker failed symbol is an amber box with an X.

Backup Generator

The symbols for the backup generators are the same as the left and right generators.

Battery Information

Voltage, current, and battery charge status show for the main battery, and the APU battery.



31-61-00-077 Rev 0

PRIMARY DISPLAY SYSTEM - ELECTRICAL SYNOPTIC

PRIMARY DISPLAY SYSTEM - MAINTENANCE PAGES OVERVIEW

General

There are 18 system maintenance pages. The maintenance pages supply information that is useful in the analysis and repair of airplane systems.

You can select and see maintenance pages any time the airplane is on the ground or any time the airplane is above ten thousand feet.

The information shows in real time or as a snapshot (manual event or auto event). Snapshots occur automatically when individual systems exceed established parameters. The operator can print or downlink the maintenance pages to ground stations.

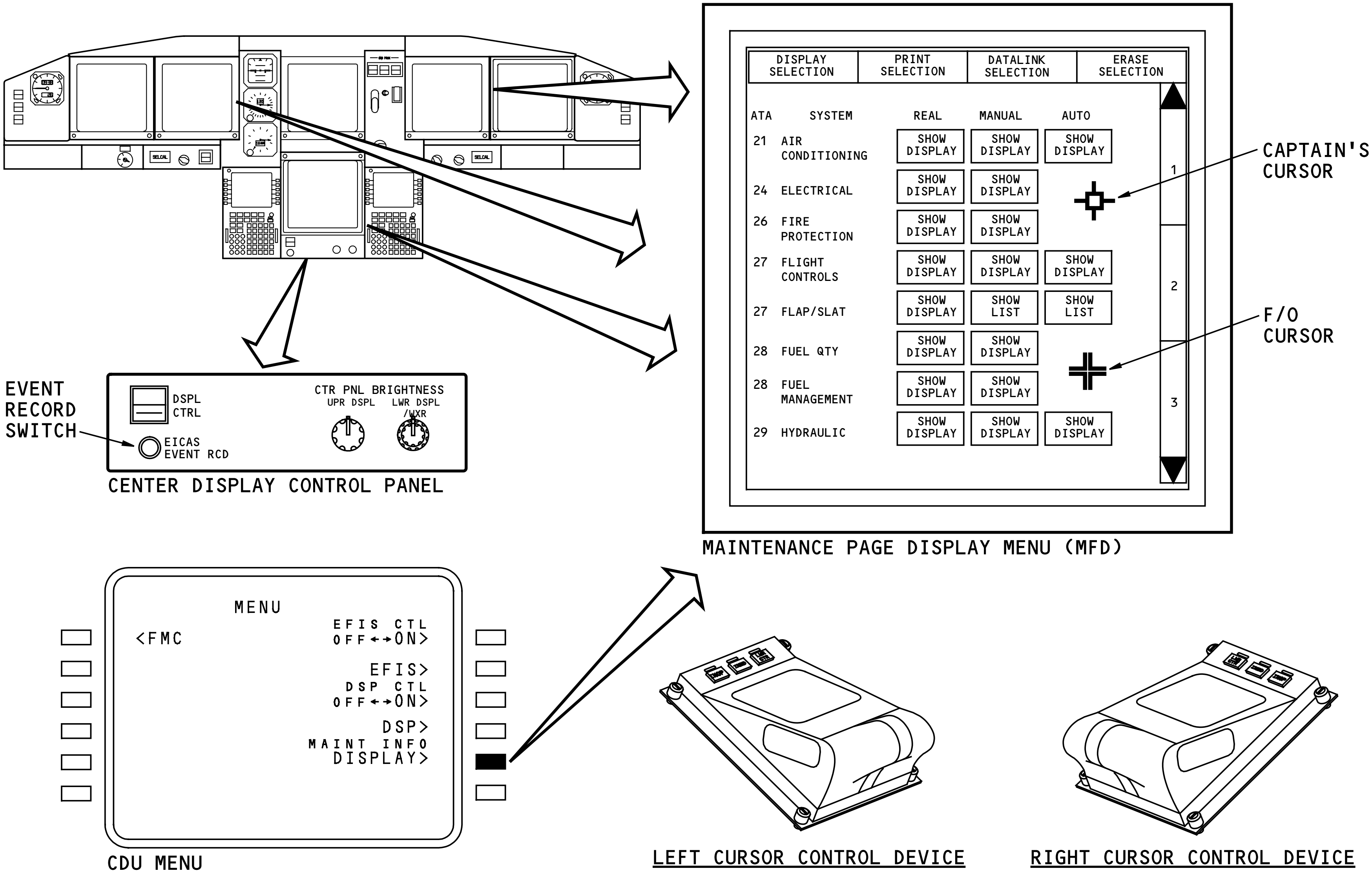
You can also take a manual snapshot of all the maintenance pages or of individual maintenance pages.

Maintenance Page Controls

The MAINT INFO prompt on the left, center, or right CDU gives access to the maintenance pages on the multifunction display (MFD). You use the display select panel and the display switching panels to show the maintenance page display selection menu on the lower center, left inboard, or right inboard display units.

The EICAS event record switch on the center display control panel lets the operator take a manual snapshot of all the applicable maintenance pages at the same time. A snapshot is a picture of a maintenance page frozen in time.

You use the cursor control device to control more menu selections. Move your finger on the CCD touchpad to move the cursor symbol on the display. When the cursor is over the desired selection, use the cursor activation switch to make the selection. Each corner of the CCD touchpad has a "hot spot". This causes the cursor to go the related corner of the display. This gives you quick access to frequently used menu selections.



PRIMARY DISPLAY SYSTEM - MAINTENANCE PAGES OVERVIEW

31-61-00-078 Rev 5 03/31/95

PRIMARY DISPLAY SYSTEM - MAINTENANCE PAGE MAIN MENU BAR SELECTIONS

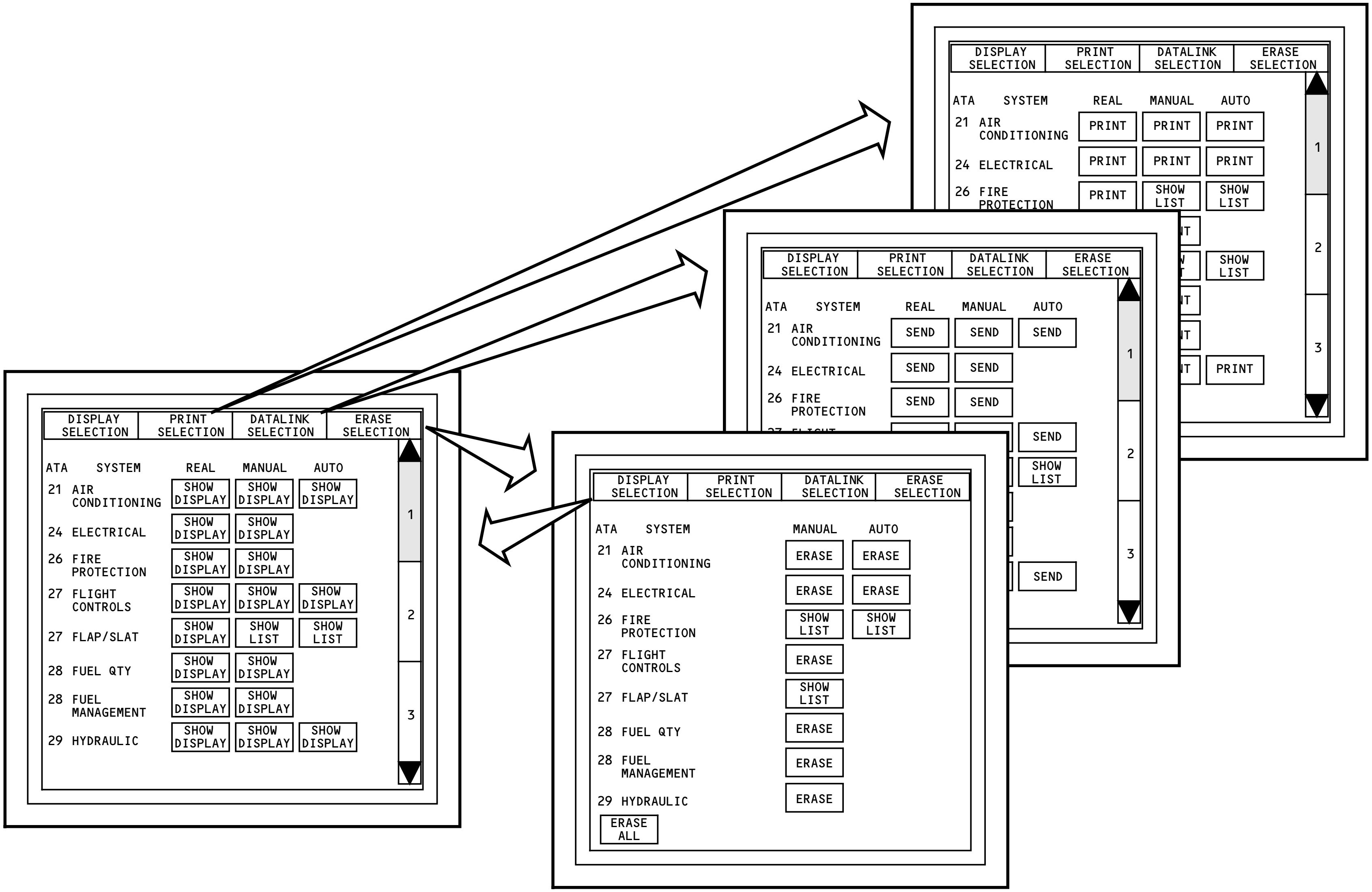
General

The main menu bar lets the operator choose a specific function and move from one function to another. The functions available are:

- DISPLAY SELECTION - This prompt lets the operator show real time or existing, manual snapshots, or auto snapshots of maintenance pages.
- PRINT SELECTION - This prompt lets the operator print real time or existing, manual snapshots, or auto snapshots of maintenance pages.
- DATA LINK SELECTION - This prompt lets the operator downlink real time or existing, manual snapshots, or auto snapshots of maintenance pages.
- ERASE SELECTION - This prompt lets the operator erase manual or auto snapshots of maintenance pages.

After a selection, the main menu function highlights.

The maintenance pages are in ATA sequence on all the menu pages. For the ERASE function, only those ATAs with manual or auto snapshots in memory show.



31-61-00-079 Rev 1 02/25/95

PRIMARY DISPLAY SYSTEM - MAINTENANCE PAGE MAIN MENU BAR SELECTIONS

PRIMARY DISPLAY SYSTEM - MAINTENANCE PAGE DISPLAY SELECTION MENUS

General

The DISPLAY menu gives access when you select a maintenance page to real time information, auto snapshots, and manual snapshots. These are the display selections:

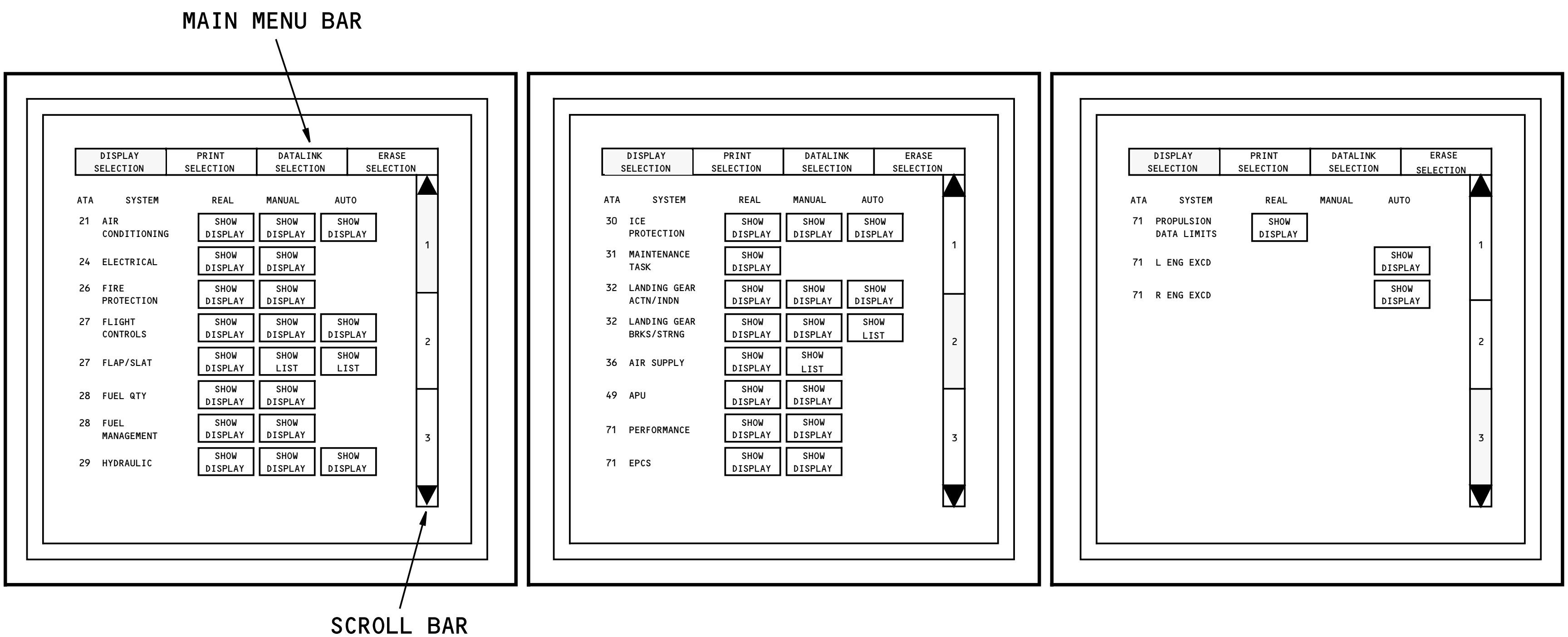
- SHOW DISPLAY - This selection shows the real time display of the maintenance page. It also shows a single auto or manual snapshot in memory
- SHOW LIST - This selection shows if there is more than one auto or manual snapshot in memory.

A blank area next to any selection means there are no selections for that maintenance page.

Maintenance Page Selections

There are three pages of maintenance page selections. They show in ATA sequence. A scroll bar at the right of the display lets the operator select the appropriate menu page. A highlight shows around the applicable page number. These are the selections:

- 21 AIR CONDITIONING
- 24 ELECTRICAL
- 26 FIRE PROTECTION
- 27 FLIGHT CONTROLS
- 27 FLAP/SLAT
- 28 FUEL QUANTITY
- 28 FUEL MANAGEMENT
- 29 HYDRAULIC
- 30 ICE PROTECTION
- 31 MAINTENANCE TASK
- 32 LANDING GEAR ACTUATION/INDICATION
- 32 LANDING GEAR BRAKES/STEERING
- 36 AIR SUPPLY
- 49 APU
- 71 PERFORMANCE
- 71 EPCS
- 71 PROPULSION DATA LIMITS
- 71 LEFT ENGINE EXCEEDANCE
- 71 RIGHT ENGINE EXCEEDANCE.



31-61-00-080 Rev 0

PRIMARY DISPLAY SYSTEM - MAINTENANCE PAGE DISPLAY SELECTION MENUS

PRIMARY DISPLAY SYSTEM - MAINTENANCE PAGE AUTO AND MANUAL EVENT MENU PAGES

General

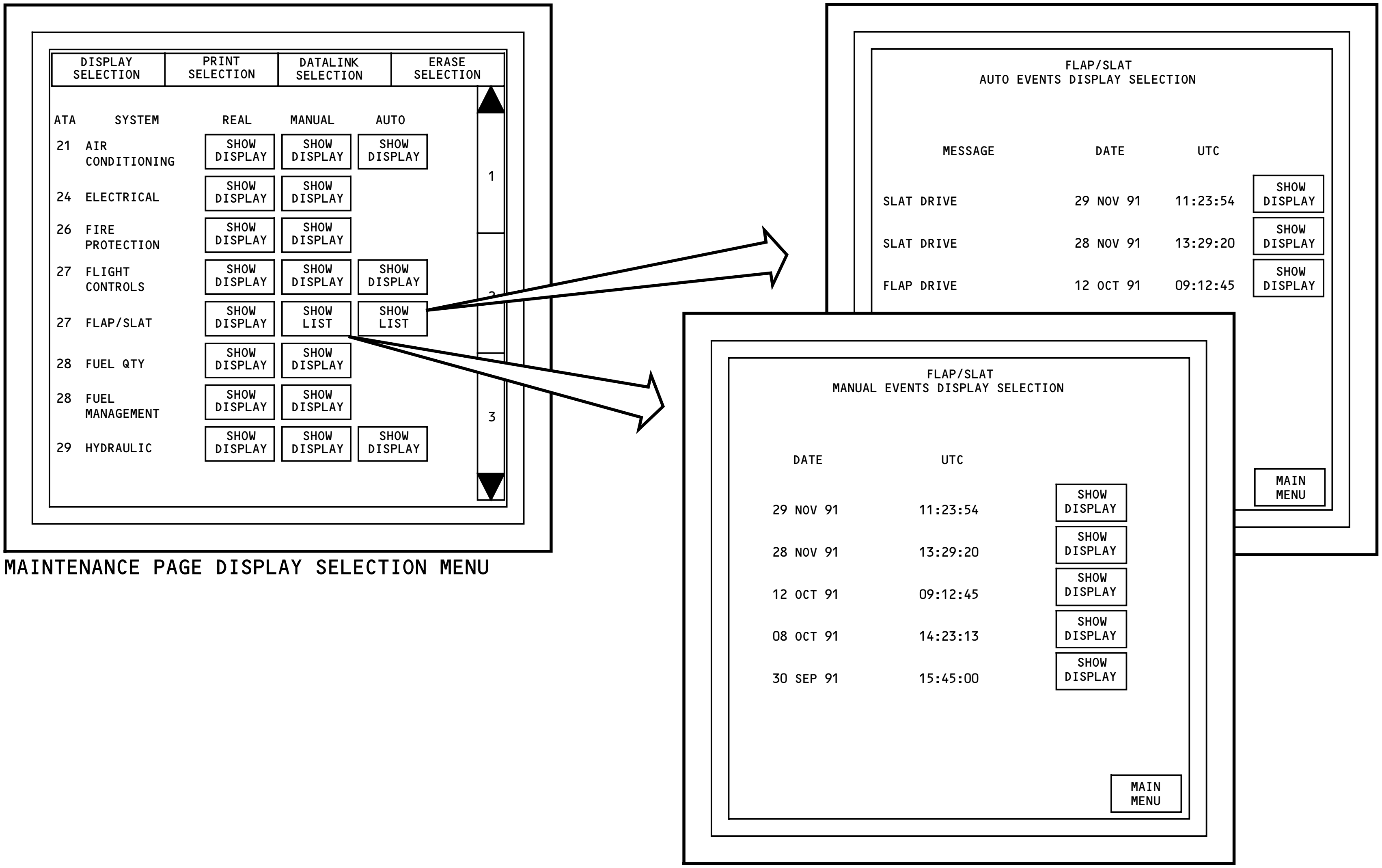
The SHOW DISPLAY prompt shows next to the maintenance page in the applicable column when one manual or auto snapshot is in memory.

The SHOW LIST prompt shows next to the maintenance page when there is more than one manual or auto snapshots for that system.

The selection of the SHOW LIST prompt causes a menu to show that lists the snapshots that are in memory. AIMS stores up to five manual snapshots and five auto snapshots for each system. The menu page shows the maintenance page category at the top and the date and time of each snapshot. The auto event menu page also shows the associated auto event message.

The SHOW DISPLAY prompt causes the maintenance page in memory to show on the display unit.

The MAIN MENU prompt at the bottom-right returns the operator to the DISPLAY SELECTION menu.



31-61-00-081 Rev 2 03/31/95

PRIMARY DISPLAY SYSTEM - MAINTENANCE PAGE AUTO AND MANUAL EVENT MENU PAGES

PRIMARY DISPLAY SYSTEM - MAINTENANCE PAGE PRINT MENUS

General

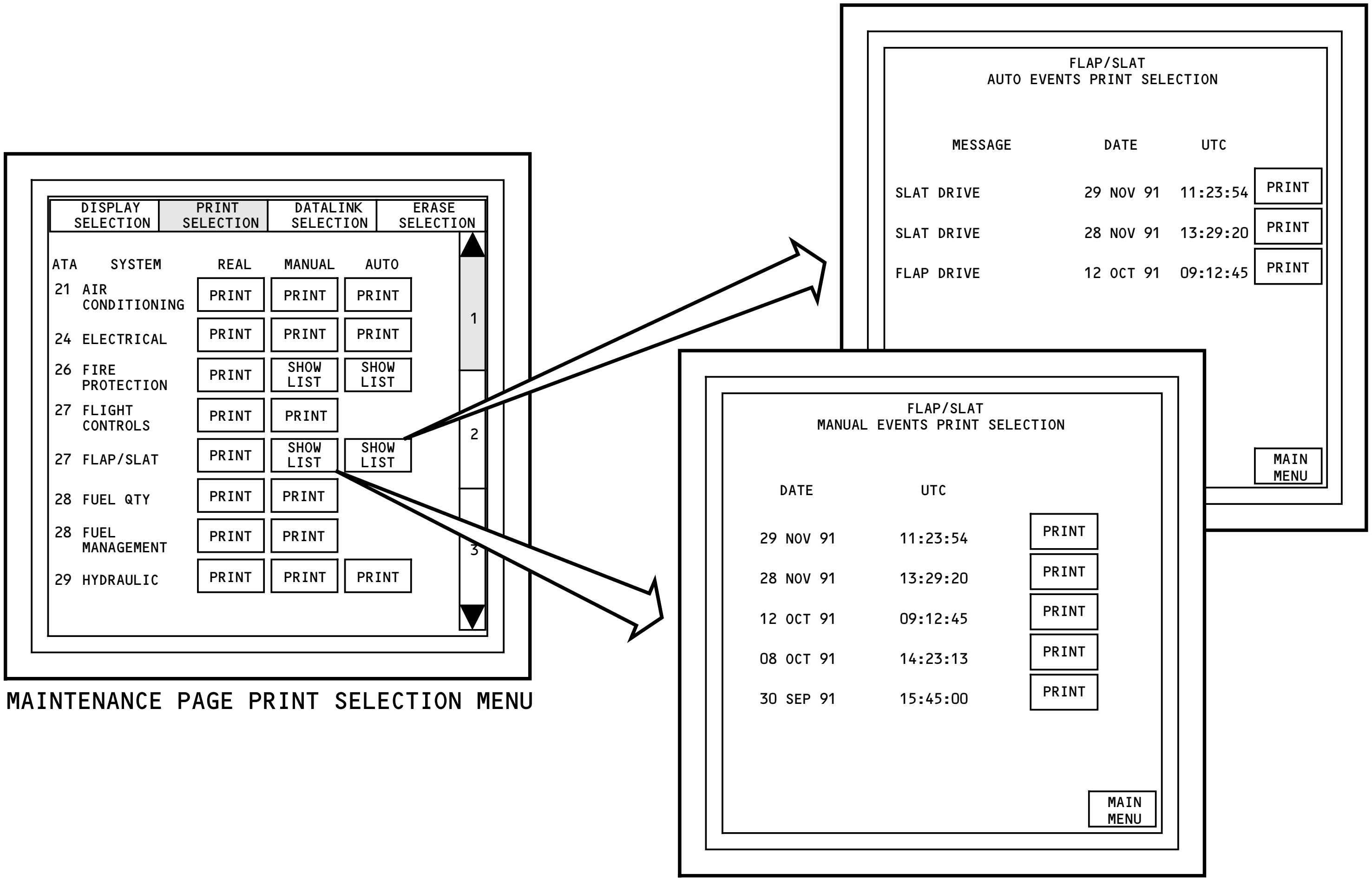
The PRINT SELECTION menu lets the operator print real time displays, manual snapshots, or auto snapshots of the maintenance pages.

A PRINT prompt shows for the real time displays. A PRINT prompt also shows for manual or auto snapshots when one snapshot is in memory.

A SHOW LIST prompt shows when more than one auto or manual snapshot is in memory.

Selection of the SHOW LIST prompt causes a menu page to show that lists the maintenance pages in memory. The PRINT prompt lets the operator print the individual pages.

The MAIN MENU prompt returns the operator to the PRINT SELECTION menu page.



MAINTENANCE PAGE PRINT SELECTION MENU

31-61-00-082 Rev 1 09/22/1995

PRIMARY DISPLAY SYSTEM - MAINTENANCE PAGE PRINT MENUS

PRIMARY DISPLAY SYSTEM - MAINTENANCE PAGE DATALINK MENUS

General

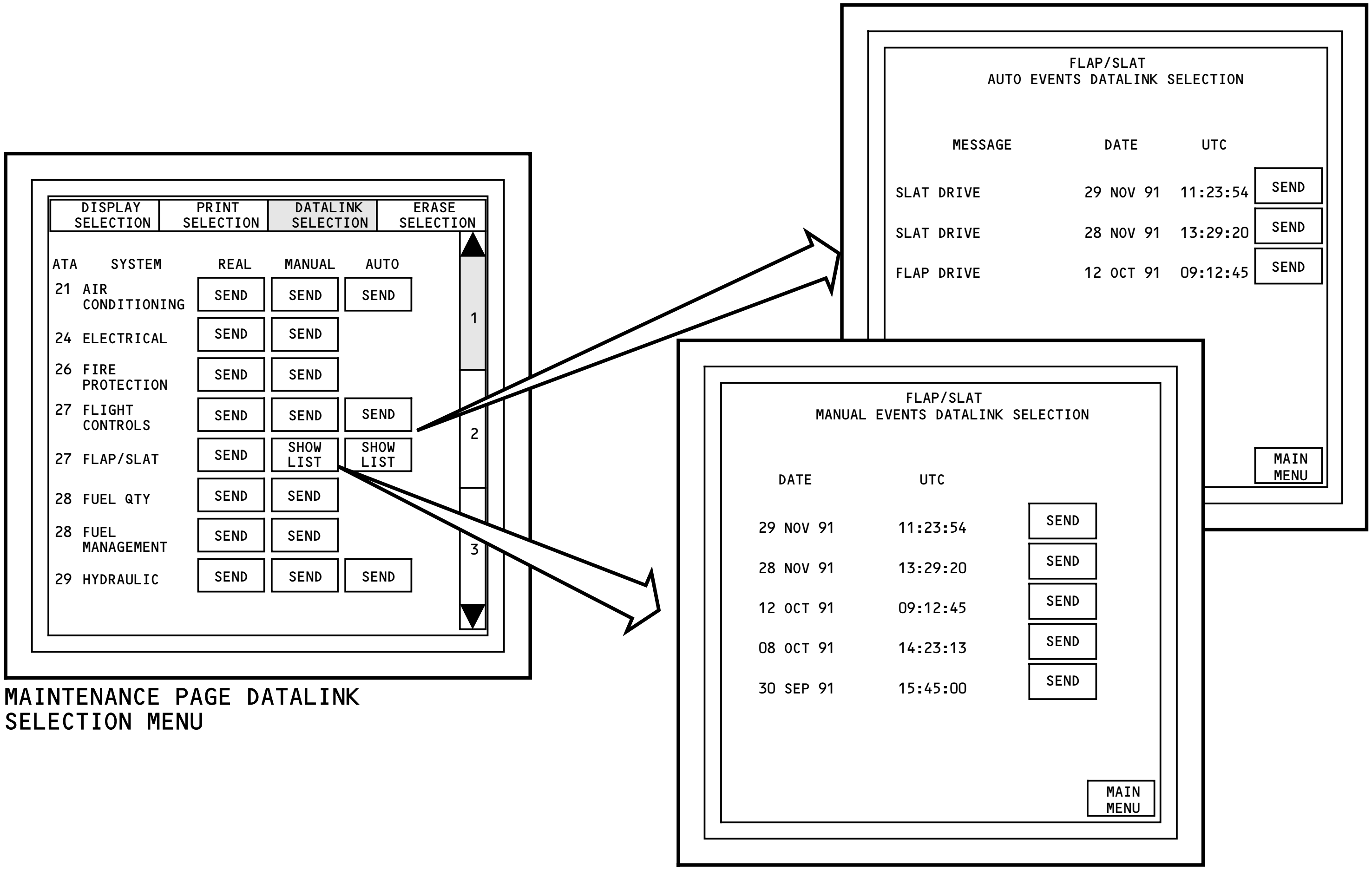
The DATALINK SELECTION menu lets the operator downlink real time displays, manual snapshots or auto snapshots of the maintenance pages.

A SEND prompt shows for the real time displays. A SEND prompt also shows for manual or auto snapshots when one snapshot is in memory.

A SHOW LIST prompt shows when more than one auto or manual snapshot is in memory.

Selection of the SHOW LIST prompt causes a menu page to show that lists the maintenance pages in memory. The SEND prompt lets the operator downlink the individual pages.

The MAIN MENU prompt returns the operator to the DATALINK SELECTION menu page.



31-61-00-083 Rev 1 09/22/1995

PRIMARY DISPLAY SYSTEM - MAINTENANCE PAGE DATALINK MENUS

PRIMARY DISPLAY SYSTEM - MAINTENANCE PAGE ERASE MENUS

General

The ERASE SELECTION menu lets the operator erase manual and auto snapshots of the maintenance pages. You cannot erase snapshots when the airplane is in the air.

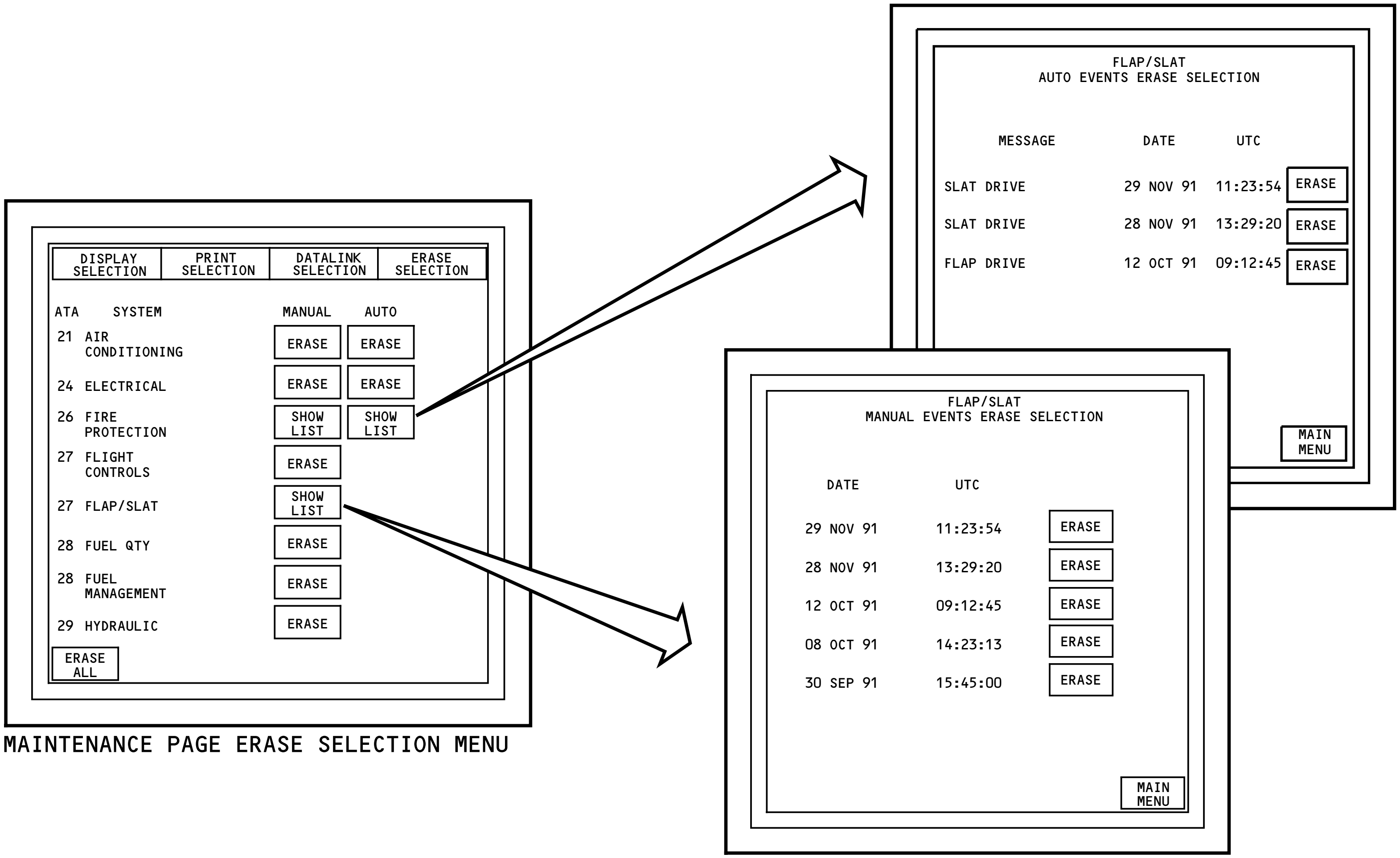
An ERASE prompt shows for maintenance pages when only one manual or one auto snapshot is in memory.

A SHOW LIST prompt shows when more than one auto or manual snapshot is in memory.

Selection of the ERASE ALL prompt erases all manual and auto events (snapshots) stored in non volatile memory.

Selection of the SHOW LIST prompt causes a menu page to show that lists the maintenance pages in memory. The ERASE prompt lets the operator erase the individual pages.

The MAIN MENU prompt returns the operator to the ERASE SELECTION menu page.



31-61-00-084 Rev 3 10/23/95

PRIMARY DISPLAY SYSTEM - MAINTENANCE PAGE ERASE MENUS

PRIMARY DISPLAY SYSTEM - INDIVIDUAL MAINTENANCE PAGE MENUS

General

Each maintenance page format except for the maintenance task maintenance page has several possible menu selections. The SHOW PG MENU or the CANCEL PAGE MENU shows in the top left corner of each maintenance page.

The SHOW PG MENU causes several menu selections to show across the bottom of the maintenance page and causes the CANCEL PAGE MENU selection to show at the top left of the display.

The CANCEL PAGE MENU causes the menu selections across the bottom of the maintenance page to go away and causes the SHOW PG MENU selection to show at the top left of the display.

The menu functions are available for real time, auto, or manual snapshot displays.

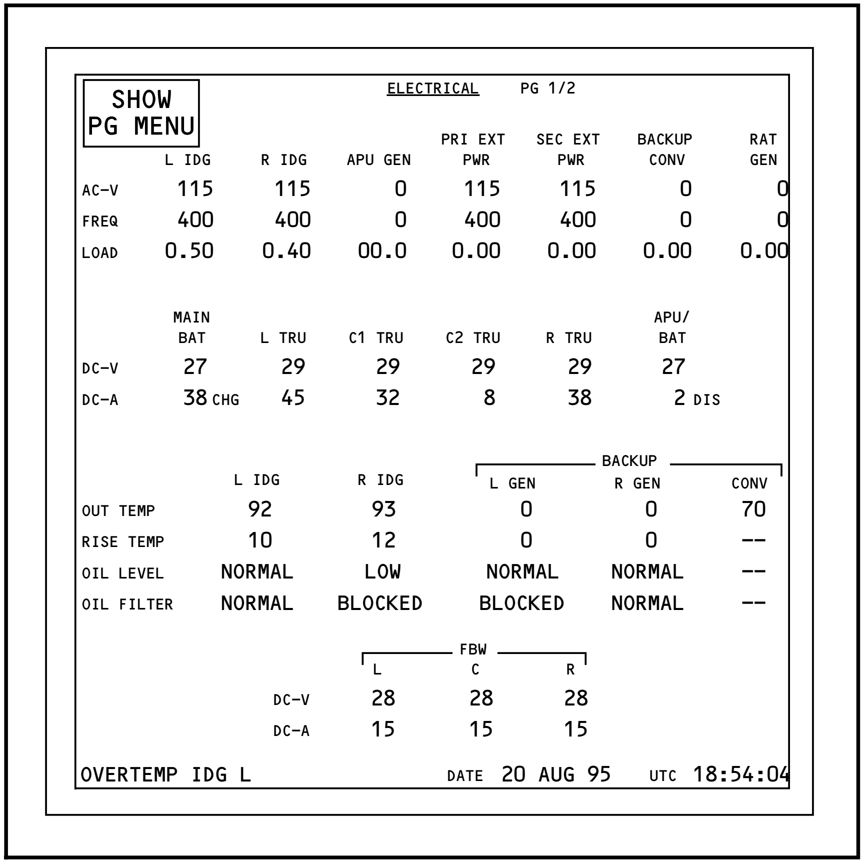
These are the commands that show across the bottom of the display:

- SEND - This selection lets the operator downlink the maintenance page that shows
- PRINT - This selection lets the operator print the maintenance page that shows
- ERASE - This selection lets the operator erase the manual or auto event for maintenance page that shows. This selection does not show for a real time format
- RECORD - This selection lets the operator take a manual snapshot of the maintenance page that shows (real time only)
- NEXT PAGE and PREV PAGE - This selection lets the operator page through a sequence of pages for systems that have more than one page format
- PREV MENU - This selection lets the operator return to MANUAL (AUTO) EVENT SELECTION page for the maintenance page that shows if they were accessed by the MANUAL (AUTO) EVENT SELECTION menu pages
- MAIN MENU - The selection lets the operator return to the DISPLAY SELECTION menu page. This selection is available on the maintenance task maintenance page.

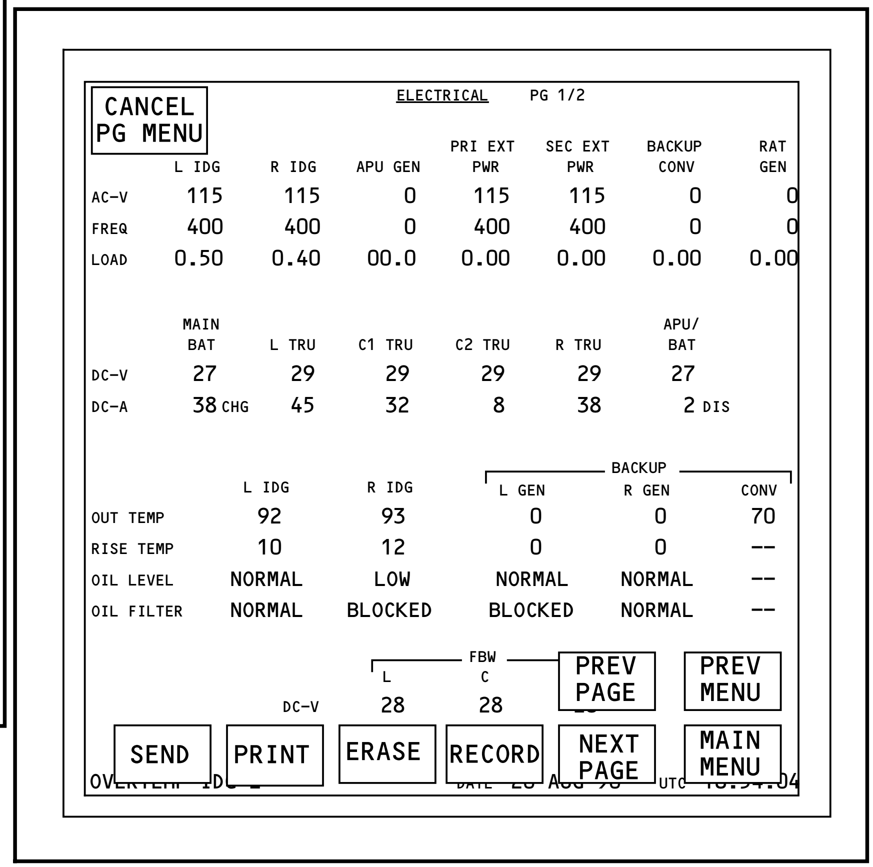
Training Information Point

The ATA that shows can have more than one page. These command buttons will cause the selected action on all pages of the ATA:

- SEND
- PRINT
- ERASE
- RECORD.



CANCEL PG MENU SELECTED



SHOW PG MENU SELECTED

31-61-00-085 Rev 1

PRIMARY DISPLAY SYSTEM - INDIVIDUAL MAINTENANCE PAGE MENUS

PRIMARY DISPLAY SYSTEM - AIR CONDITIONING MAINTENANCE PAGE

General

The air conditioning maintenance page is available in these three display modes:

- Real time
- Manual event
- Auto event.

Title

The title shows the display mode. The title shows as:

- AIR CONDITIONING for the real time mode
- AIR CONDITIONING MAN for the manual event mode
- AIR CONDITIONING AUTO for the auto event mode.

Auto Event Message

In the real time mode, the auto event message shows for the most recent auto event in memory. If there are no auto events in memory, the message field is blank.

In the auto event mode, the message for the incident shows.

There is no message in the manual event mode.

Date and Time

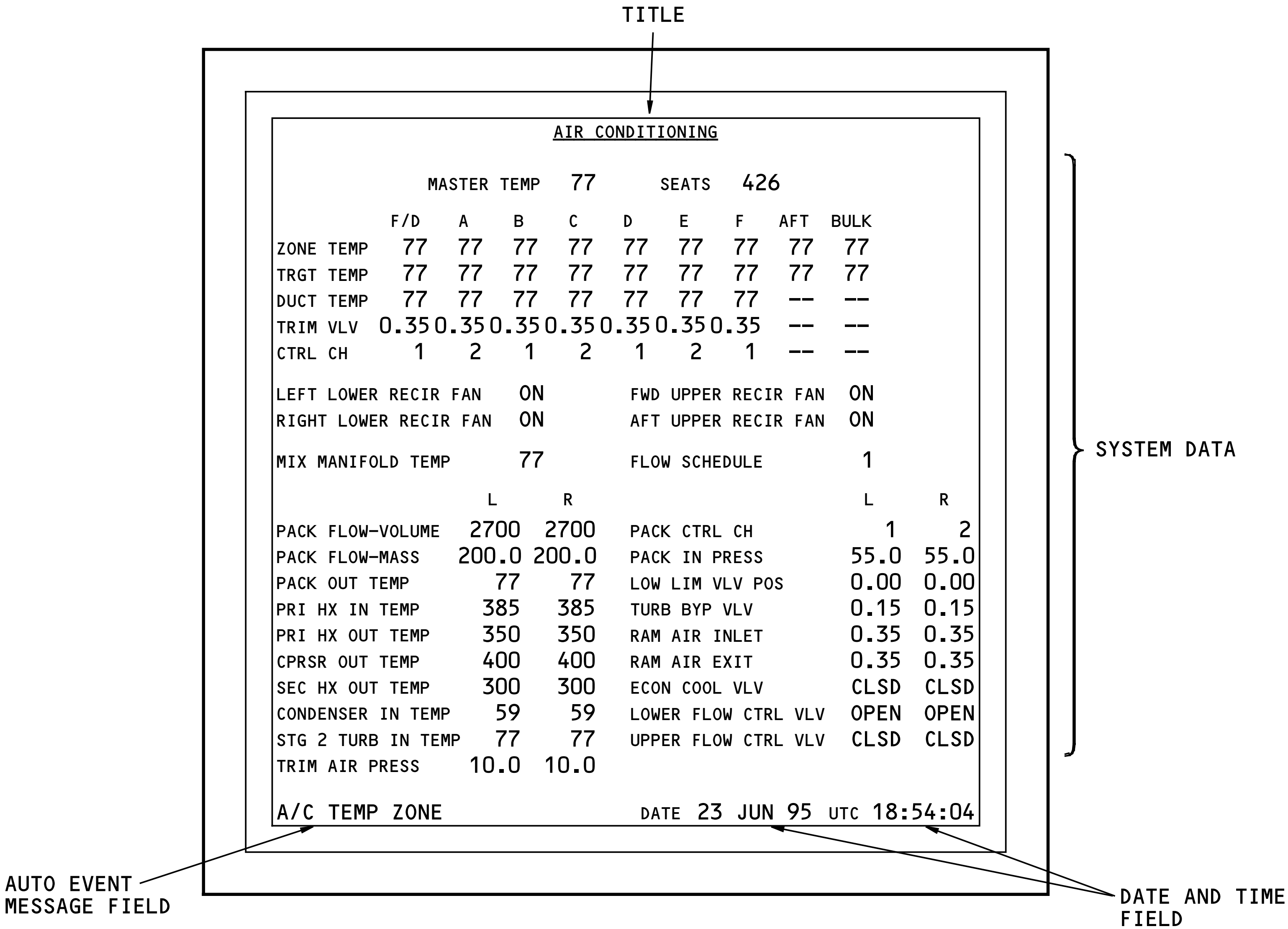
In the real time mode, the date field shows the current date and universal coordinated time (UTC).

In the manual event mode and the auto event mode, the date field shows the date and UTC of the incident.

System Data

The air conditioning maintenance page shows environmental control system information. The information includes:

- Zone temperature
- Target temperature
- Duct temperature
- Trim valve position
- Recirculation fan status
- Trim air pressure
- Pack outlet temperature
- Pack flow
- Turbine bypass valve position
- Ram air inlet/exit positions
- Compressor outlet temperature
- Cabin temperature controller channel in control.



31-61-00-086 Rev 1

PRIMARY DISPLAY SYSTEM - AIR CONDITIONING MAINTENANCE PAGE

PRIMARY DISPLAY SYSTEM - ELECTRICAL MAINTENANCE PAGES

General

There are two electrical maintenance pages. They are available in these three display modes:

- Real time
- Manual event
- Auto event.

Title

The titles show the display mode and page number. The titles show as:

- ELECTRICAL PG 1/2 for the real time mode
- ELECTRICAL PG 2/2 for the real time mode
- ELECTRICAL MAN 1/2 for the manual event mode
- ELECTRICAL MAN 2/2 for the manual event mode
- ELECTRICAL AUTO 1/2 for the auto event mode
- ELECTRICAL AUTO 2/2 for the auto event mode.

Auto Event Message

In the real time mode, the auto event message shows for the most recent auto event in memory. If there are no auto events in memory, the message field is blank. The message shows on both pages.

In the auto event mode, the message for the incident shows. The message shows on both pages.

There is no message in the manual event mode.

Date and Time

In the real time mode, the date field shows the current date and universal coordinated time (UTC).

In the manual event mode and the auto event mode, the date field shows the date and UTC of the incident.

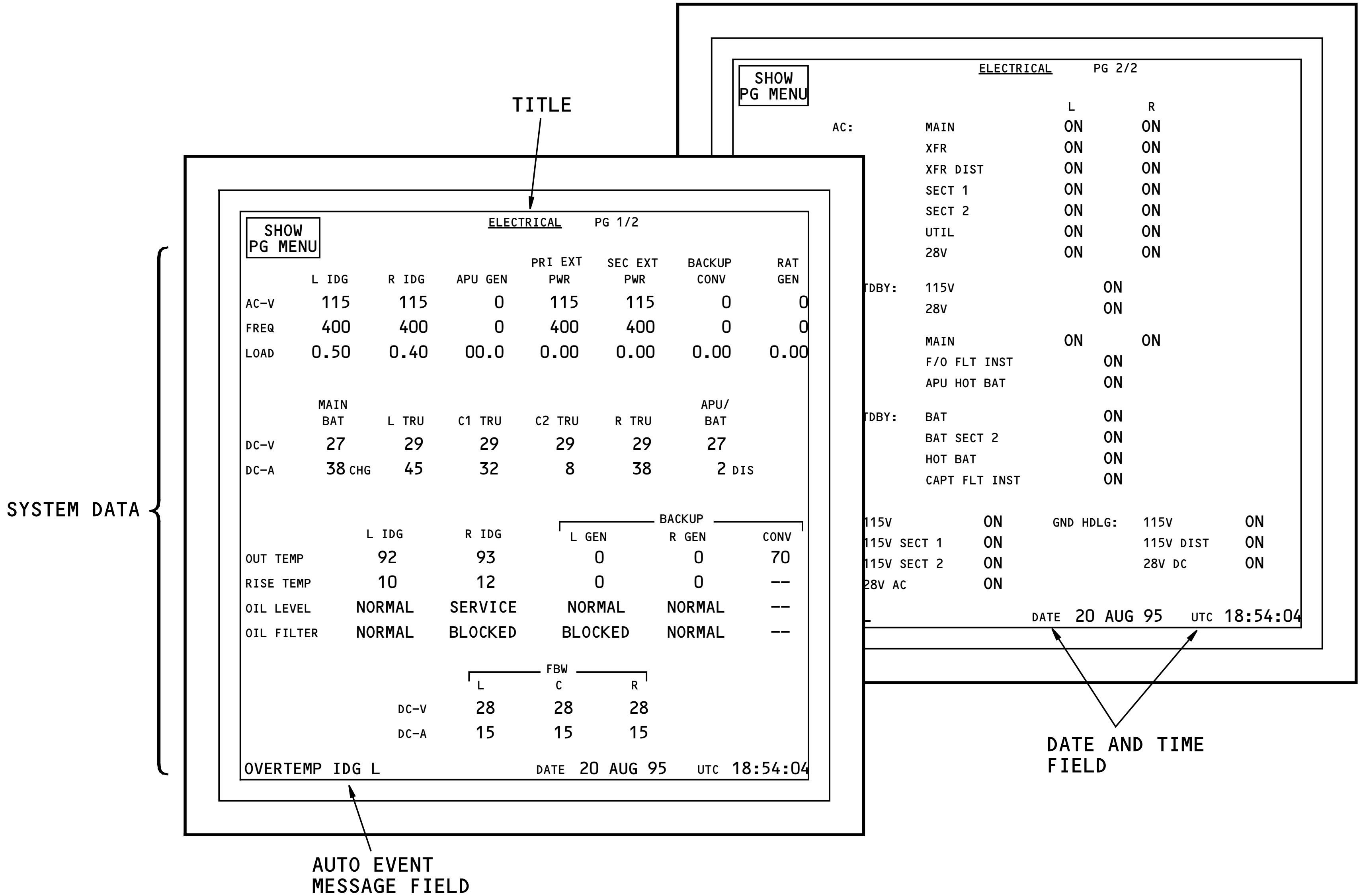
System Data

The information on electrical maintenance page 1/2 includes:

- AC voltage
- AC frequency
- AC load
- DC voltage
- DC amperage
- IDG outlet/rise temperature
- IDG oil and oil filter information
- Fly by wire (FBW) DC system information.

The electrical maintenance page 2/2 has bus status information for the:

- AC buses
- AC standby bus
- DC buses
- DC standby bus
- Ground service bus
- Ground handling bus.



31-61-00-087 Rev 1 01/07/1998

PRIMARY DISPLAY SYSTEM - ELECTRICAL MAINTENANCE PAGES

PRIMARY DISPLAY SYSTEM - FIRE PROTECTION MAINTENANCE PAGE

General

The fire protection maintenance page is available in these three display modes:

- Real time
- Manual event
- Auto event.

Title

The title shows the display mode. The title shows as:

- FIRE PROTECTION for the real time mode
- FIRE PROTECTION MAN for the manual event mode
- FIRE PROTECTION AUTO for the auto event mode.

Auto Event Message

In the real time mode, the auto event message shows for the most recent auto event in memory. If there are no auto events in memory, the message field is blank.

In the auto event mode, the message for the incident shows.

There is no message in the manual event mode.

Date and Time

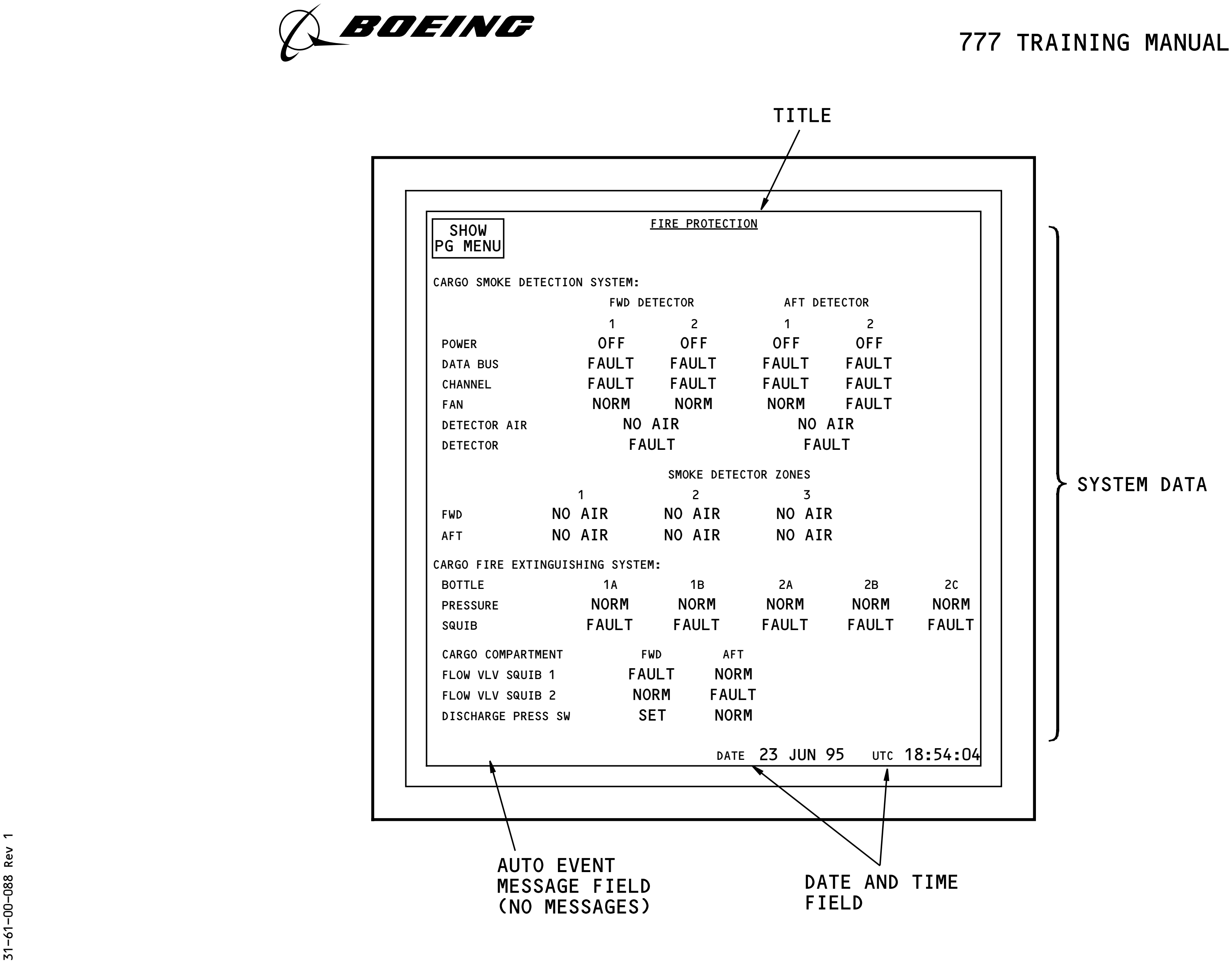
In the real time mode, the date field shows the current date and universal coordinated time (UTC).

In the manual event mode and the auto event mode, the date field shows the date and UTC of the incident.

System Data

The fire protection maintenance page shows cargo smoke detection and fire system information. The information includes:

- Forward cargo smoke detection system information
- Aft cargo smoke detection system information
- Smoke detector zones
- Cargo fire system information.



PRIMARY DISPLAY SYSTEM - FIRE PROTECTION MAINTENANCE PAGE

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PRIMARY DISPLAY SYSTEM - FLIGHT CONTROLS MAINTENANCE PAGES

General

There are three flight control maintenance pages. They are available in three display modes. They are:

- Real time
- Manual event
- Auto event.

Title

The titles show the display mode and page number. The titles show as:

- FLIGHT CONTROL PG 1/3 for the real time mode
- FLIGHT CONTROL PG 2/3 for the real time mode
- FLIGHT CONTROL PG 3/3 for the real time mode
- FLIGHT CONTROL MAN PG 1/3 for the manual event mode
- FLIGHT CONTROL MAN PG 2/3 for the manual event mode
- FLIGHT CONTROL MAN PG 3/3 for the manual event mode
- FLIGHT CONTROL AUTO 1/3 for the auto event mode
- FLIGHT CONTROL AUTO 2/3 for the auto event mode
- FLIGHT CONTROL AUTO 3/3 for the auto event mode.

Auto Event Message

In the real time mode, the auto event message shows for the most recent auto event in memory. If there are no auto events in memory, the message field is blank. The message shows on all pages.

In the auto event mode, the message for the incident shows. The message shows on all pages.

There is no message in the manual event mode.

Date and Time

In the real time mode, the date field shows the current date and universal coordinated time (UTC).

In the manual event mode and the auto event mode, the date field shows the date and UTC of the incident.

System Data

The information on the flight controls maintenance page 1/3 includes:

- Airplane state information (roll, pitch, yaw etc.)
- Column information
- Wheel information
- Pedal information
- Speed brake handle information
- Rudder trim position data
- Column feel data
- Gust suppression data
- Flight mode information.

The information on the flight controls maintenance page 2/3 includes:

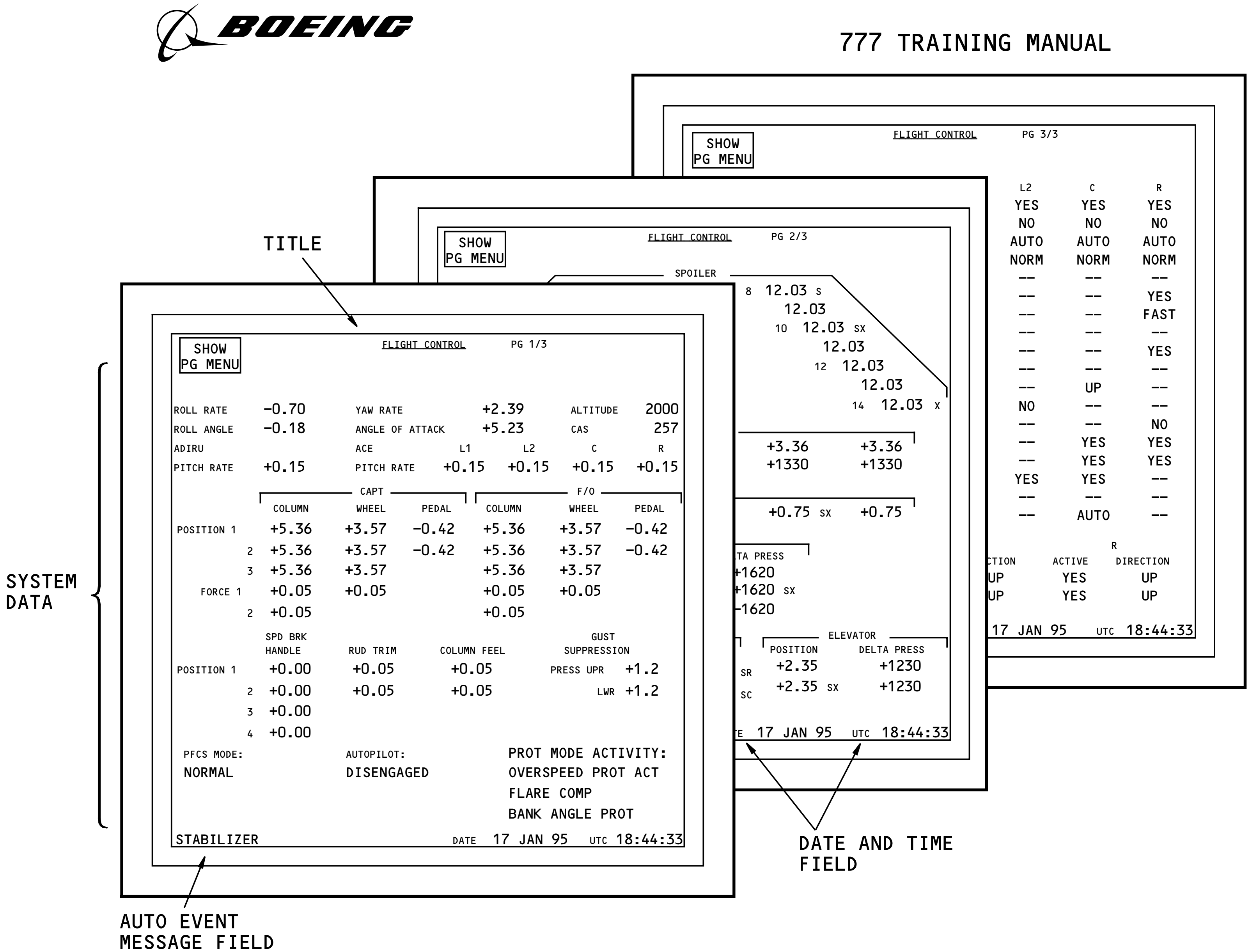
- Spoiler position data
- Hydraulic pressure data

PRIMARY DISPLAY SYSTEM - FLIGHT CONTROLS MAINTENANCE PAGES

- Flaperon position data
- Aileron position data
- Rudder position data
- Elevator position data
- Stab position data.

The information on the flight controls maintenance page 3/3 includes:

- ACE analog discrete data
- AIMS analog discrete data.



PRIMARY DISPLAY SYSTEM - FLIGHT CONTROLS MAINTENANCE PAGES

31-61-00-089 Rev 1 03/05/96

PRIMARY DISPLAY SYSTEM - FLAP/SLAT MAINTENANCE PAGE

General

The flap/slat maintenance page is available in three display modes. They are:

- Real time
- Manual event
- Auto event.

Title

The title shows the display mode. The title shows as:

- FLAP/SLAT for the real time mode
- FLAP/SLAT MAN for the manual event mode
- FLAP/SLAT AUTO for the auto event mode.

Auto Event Message

In the real time mode, the auto event message shows for the most recent auto event in memory. If there are no auto events in memory, the message field is blank.

In the auto event mode, the message for the incident shows.

There is no message in the manual event mode.

Date and Time

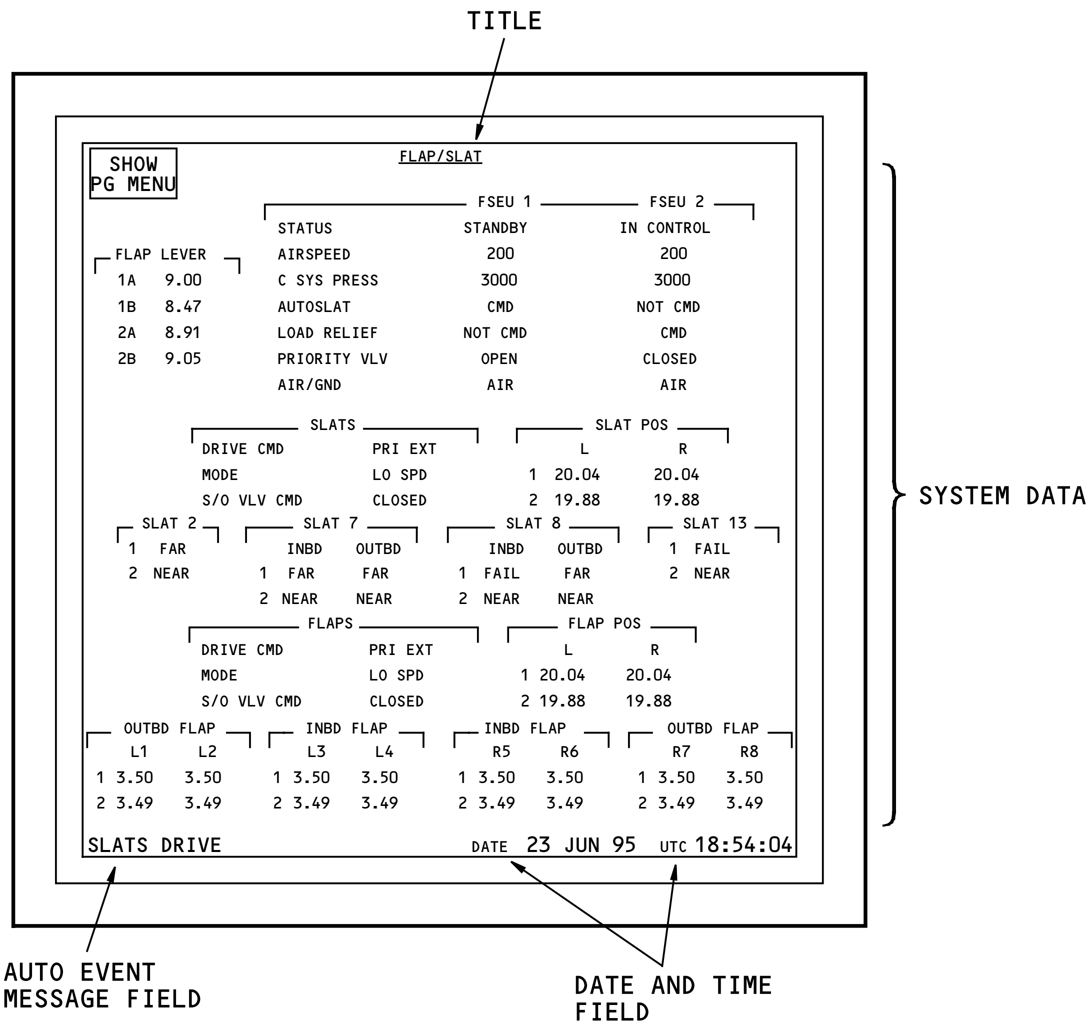
In the real time mode, the date field shows the current date and universal coordinated time (UTC).

In the manual event mode and the auto event mode, the date field shows the date and UTC of the incident.

System Data

The flap/slat maintenance page shows flight control system information. The information includes:

- FSEU status information
- Flap lever position
- Slat position
- Flap position
- Slat mode and command data
- Flap/slat skew data.



31-61-00-090 Rev 0

PRIMARY DISPLAY SYSTEM - FLAP/SLAT MAINTENANCE PAGE

PRIMARY DISPLAY SYSTEM - FUEL QUANTITY MAINTENANCE PAGES

General

There are two fuel quantity maintenance pages. They are available in these three display modes:

- Real time
- Manual event
- Auto event.

Title

The titles show the display mode and page number. The titles show as:

- FUEL QTY PG 1/2 for the real time mode
- FUEL QTY PG 2/2 for the real time mode
- FUEL QTY MAN 1/2 for the manual event mode
- FUEL QTY MAN 2/2 for the manual event mode
- FUEL QTY AUTO 1/2 for the auto event mode
- FUEL QTY AUTO 2/2 for the auto event mode.

Auto Event Message

In the real time mode, the auto event message shows for the most recent auto event in memory. If there are no auto events in memory, the message field is blank. The message shows on both pages.

In the auto event mode, the message for the incident shows. The message shows on both pages.

There is no message in the manual event mode.

Date and Time

In the real time mode, the date field shows the current date and universal coordinated time (UTC).

In the manual event mode and the auto event mode, the date field shows the date and UTC of the incident.

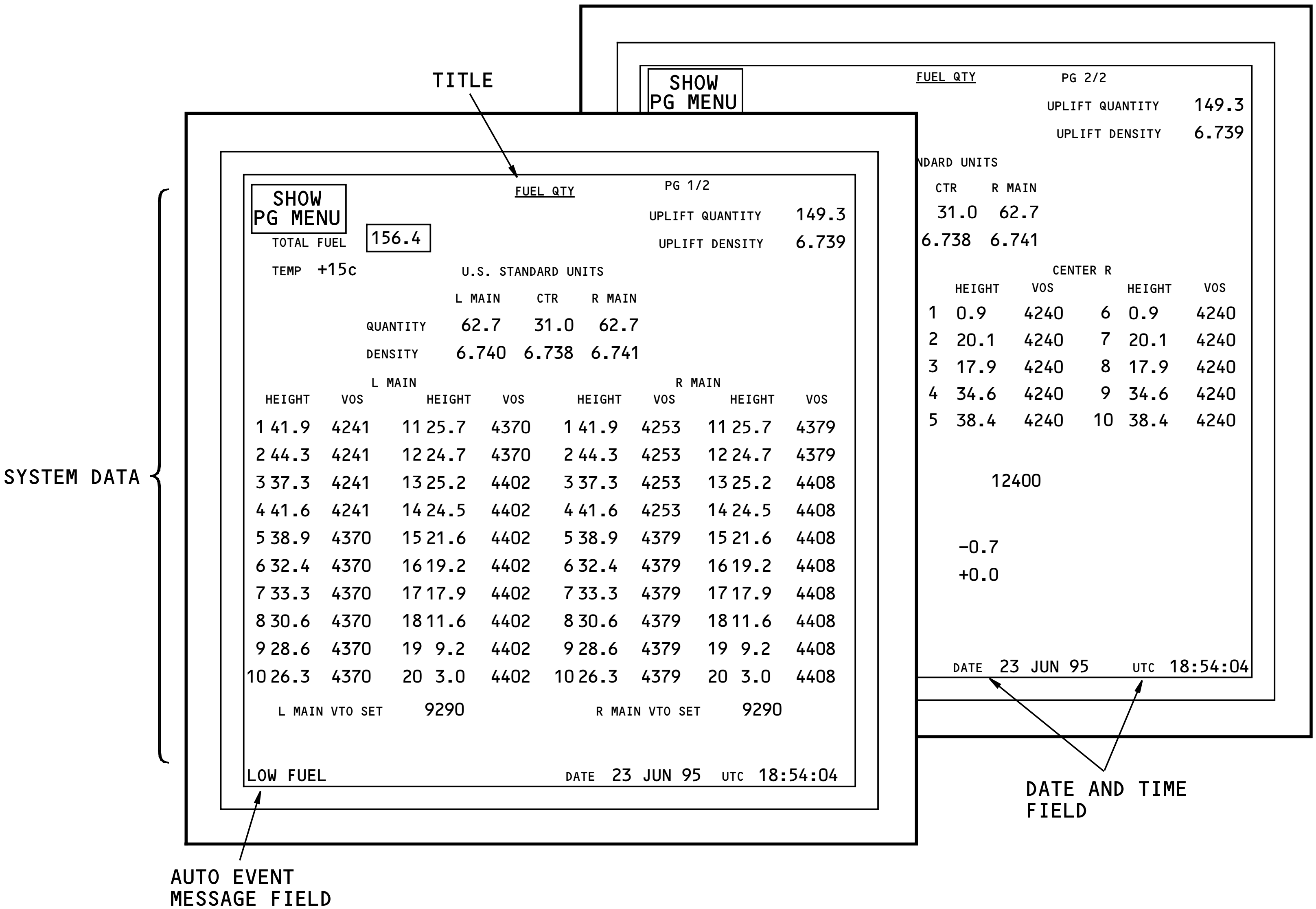
System Data

The information on fuel quantity maintenance page 1/2 includes:

- Total fuel quantity
- Total fuel density
- Main tank ultrasonic probe velocity of sound
- Main tank fuel height
- Main tank volume top-off data.

The information on fuel quantity maintenance page 2/2 includes:

- Total fuel quantity
- Total fuel density
- Center tank ultrasonic probe velocity of sound
- Center tank fuel height
- Center tank volume top-off data
- Pitch and roll data.



PRIMARY DISPLAY SYSTEM – FUEL QUANTITY MAINTENANCE PAGES

PRIMARY DISPLAY SYSTEM - FUEL MANAGEMENT MAINTENANCE PAGE

General

The fuel management maintenance page is available in these three display modes:

- Real time
- Manual event
- Auto event.

Title

The title shows the display mode. The title shows as:

- FUEL MANAGEMENT for the real time mode
- FUEL MANAGEMENT MAN for the manual event mode
- FUEL MANAGEMENT AUTO for the auto event mode.

Auto Event Message

In the real time mode, the auto event message shows for the most recent auto event in memory. If there are no auto events in memory, the message field is blank.

In the auto event mode, the message for the incident shows.

There is no message in the manual event mode.

Date and Time

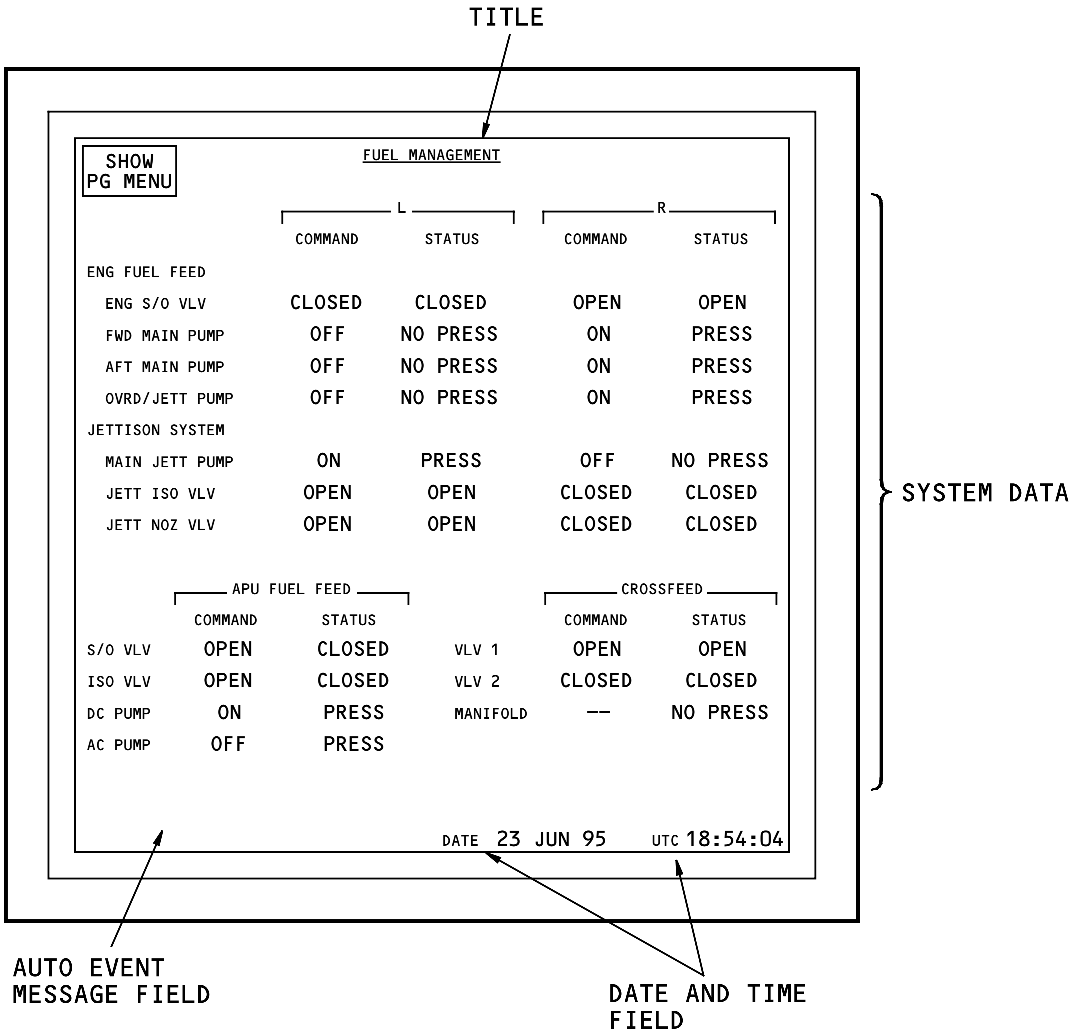
In the real time mode, the date field shows the current date and universal coordinated time (UTC).

In the manual event mode and the auto event mode, the date field shows the date and UTC of the incident.

System Data

The fuel management maintenance page shows fuel system information. The information includes:

- Actual and commanded positions for engine fuel feed components
- Actual and commanded positions for jettison system components
- Actual and commanded positions for APU fuel feed components
- Actual and commanded positions for crossfeed components.



31-61-00-092 Rev 0

PRIMARY DISPLAY SYSTEM - FUEL MANAGEMENT MAINTENANCE PAGE

PRIMARY DISPLAY SYSTEM - HYDRAULIC MAINTENANCE PAGE

General

The hydraulic maintenance page is available in these three display modes:

- Real time
- Manual event
- Auto event.

Title

The title shows the display mode. The title shows as:

- HYDRAULIC for the real time mode
- HYDRAULIC MAN for the manual event mode
- HYDRAULIC AUTO for the auto event mode.

Auto Event Message

In the real time mode, the auto event message shows for the most recent auto event in memory. If there are no auto events in memory, the message field is blank.

In the auto event mode, the message for the incident shows.

There is no message in the manual event mode.

Date and Time

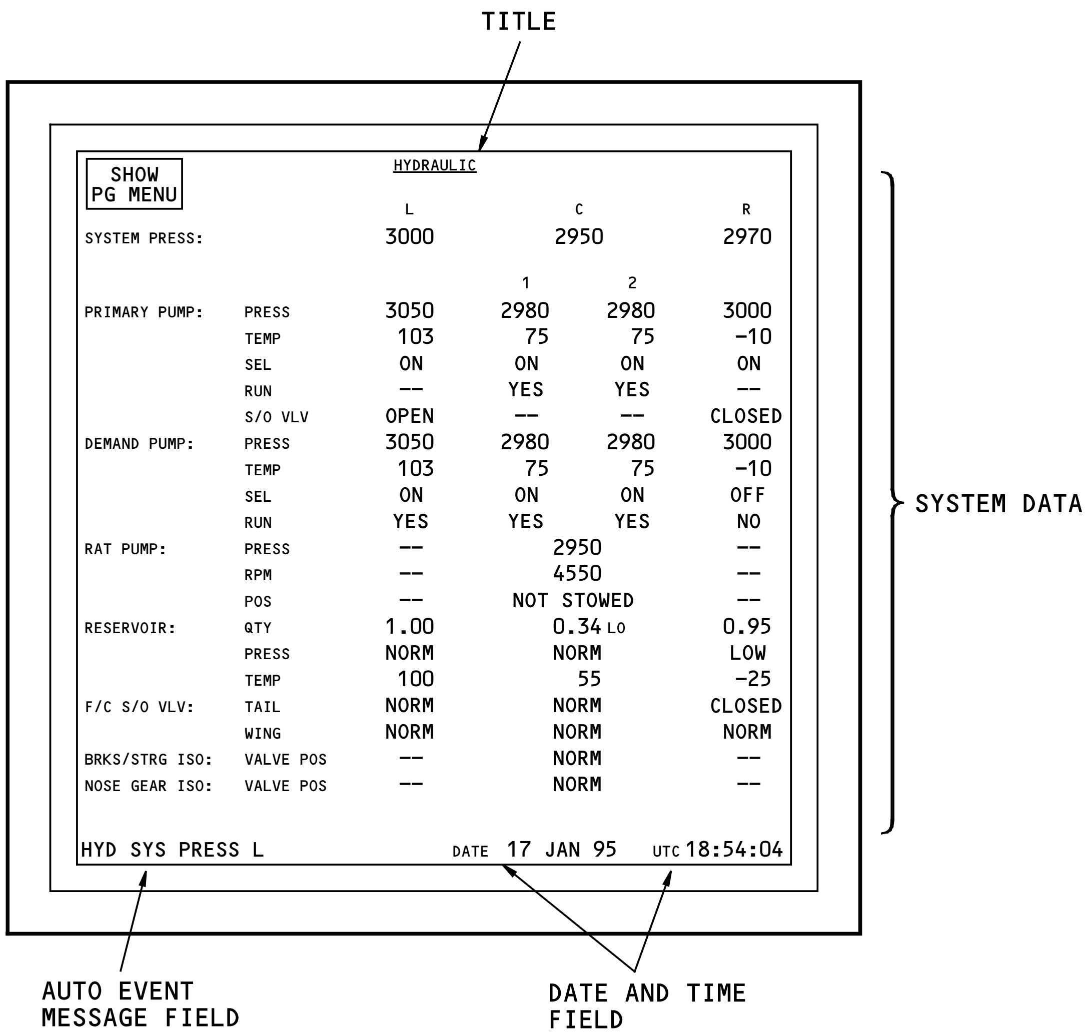
In the real time mode, the date field shows the current date and universal coordinated time (UTC).

In the manual event mode and the auto event mode, the date field shows the date and UTC of the incident.

System Data

The hydraulic maintenance page includes:

- Hydraulic system quantity
- Hydraulic system pressure
- Primary pump pressure, temperature, and status
- Demand pump pressure, temperature, and status
- Rat pump pressure, temperature, and status
- Isolation valve position.



31-61-00-093 Rev 2

PRIMARY DISPLAY SYSTEM - HYDRAULIC MAINTENANCE PAGE

PRIMARY DISPLAY SYSTEM - ICE PROTECTION MAINTENANCE PAGE

General

The ice protection maintenance page is available in three display modes. They are:

- Real time
- Manual event
- Auto event.

Title

The title shows the display mode. The title shows as:

- ICE PROTECTION for the real time mode
- ICE PROTECTION MAN for the manual event mode
- ICE PROTECTION AUTO for the auto event mode.

Auto Event Message

In the real time mode, the auto event message shows for the most recent auto event in memory. If there are no auto events in memory, the message field is blank.

In the auto event mode, the message for the incident shows.

There is no message in the manual event mode.

Date and Time

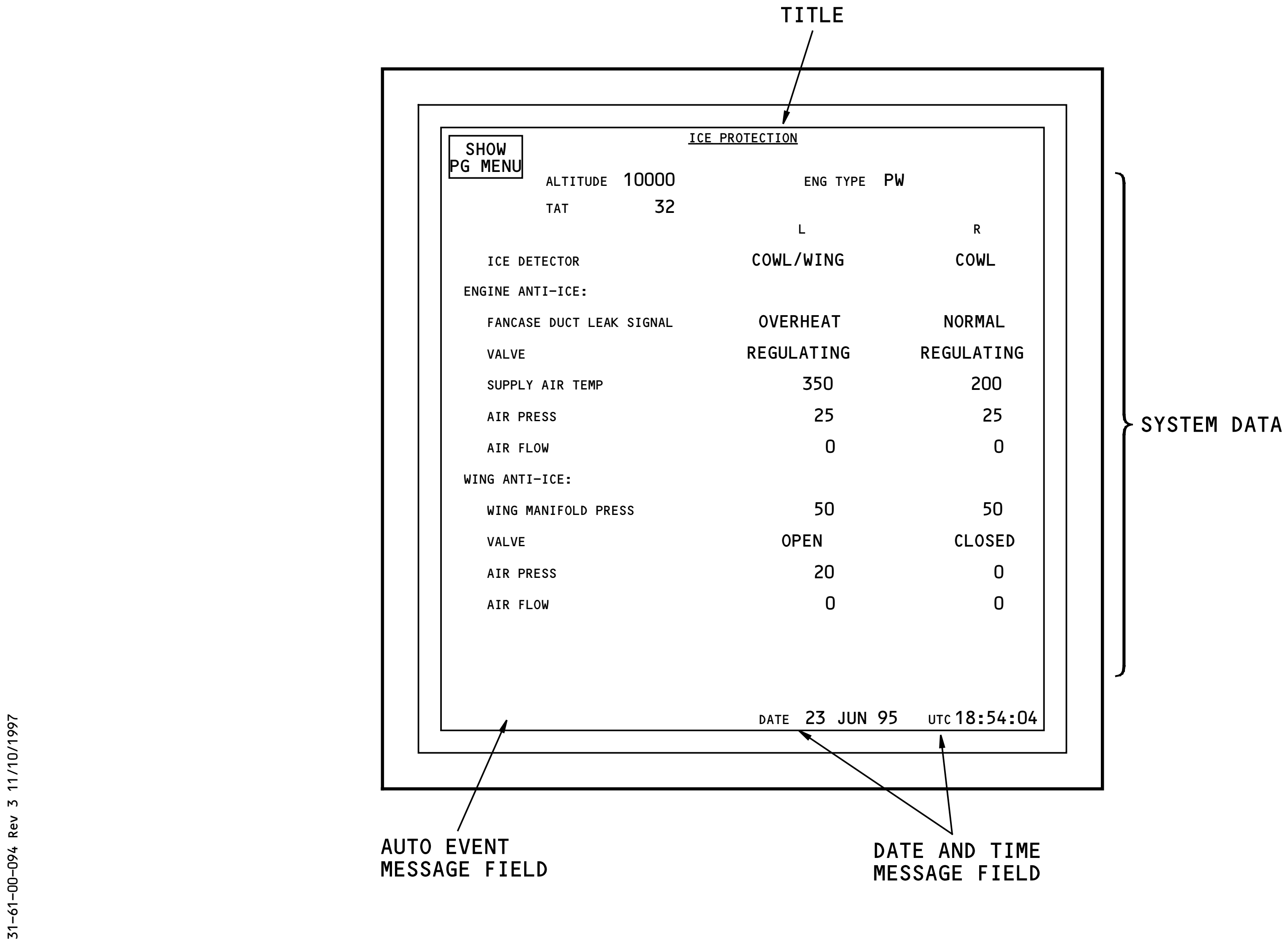
In the real time mode, the date field shows the current date and universal coordinated time (UTC).

In the manual event mode and the auto event mode, the date field shows the date and UTC of the incident.

System Data

The ice protection maintenance page shows engine and wing anti-ice system information. The information includes:

- Airplane altitude
- Total air temperature
- Engine type
- Engine anti-ice system valve positions, pressure, and flow
- Wing anti-ice system valve positions, pressure, and flow.



PRIMARY DISPLAY SYSTEM - ICE PROTECTION MAINTENANCE PAGE

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PRIMARY DISPLAY SYSTEM - MAINTENANCE TASK MAINTENANCE PAGE

General

The maintenance task maintenance page is unique. The page has these functions:

- Erase latched status messages
- View and erase scheduled maintenance task (SMT) messages
- Control the electronic checklist.

Use the cursor control device to clear, enable or disable any of the functions.

The MAIN MENU command at the top left causes the maintenance page DISPLAY SELECTION menu to show.

Erasable Latched Status Messages

This window shows status messages whose activation conditions are no longer true but are latched in AIMS nonvolatile memory (NVM). The messages show in the order in which they were latched in NVM. The window shows a maximum of three messages. When three messages or less show, the page number shows 1/1. When more than one page of messages exist, the PAGE command shows. The page number then shows the total number of pages. Use the PAGE command to get to the other pages of messages. The messages page in a circular way. When you return to the first page of messages from the last pages of messages, the messages update and the page number updates. The initial selection of this maintenance page always causes the first page of messages to show.

The ERASE command clears the message from NVM and removes the message from the display.

The ERASE function does not operate when the airplane is in the air.

SMT Message Functions

This window shows the active SMT messages whose activation conditions are true or are latched in NVM. The messages show in the order they were latched in NVM. The window shows a maximum of three messages. Use the PAGE command when more than three messages exist. (PAGE operation identical to latched status message function).

The ERASE command shows to the right of messages latched in NVM. Activation of the command clears the message from NVM and removes the message from the display. Not all SMT messages latch in NVM.

The ERASE function does not operate when the airplane is in the air.

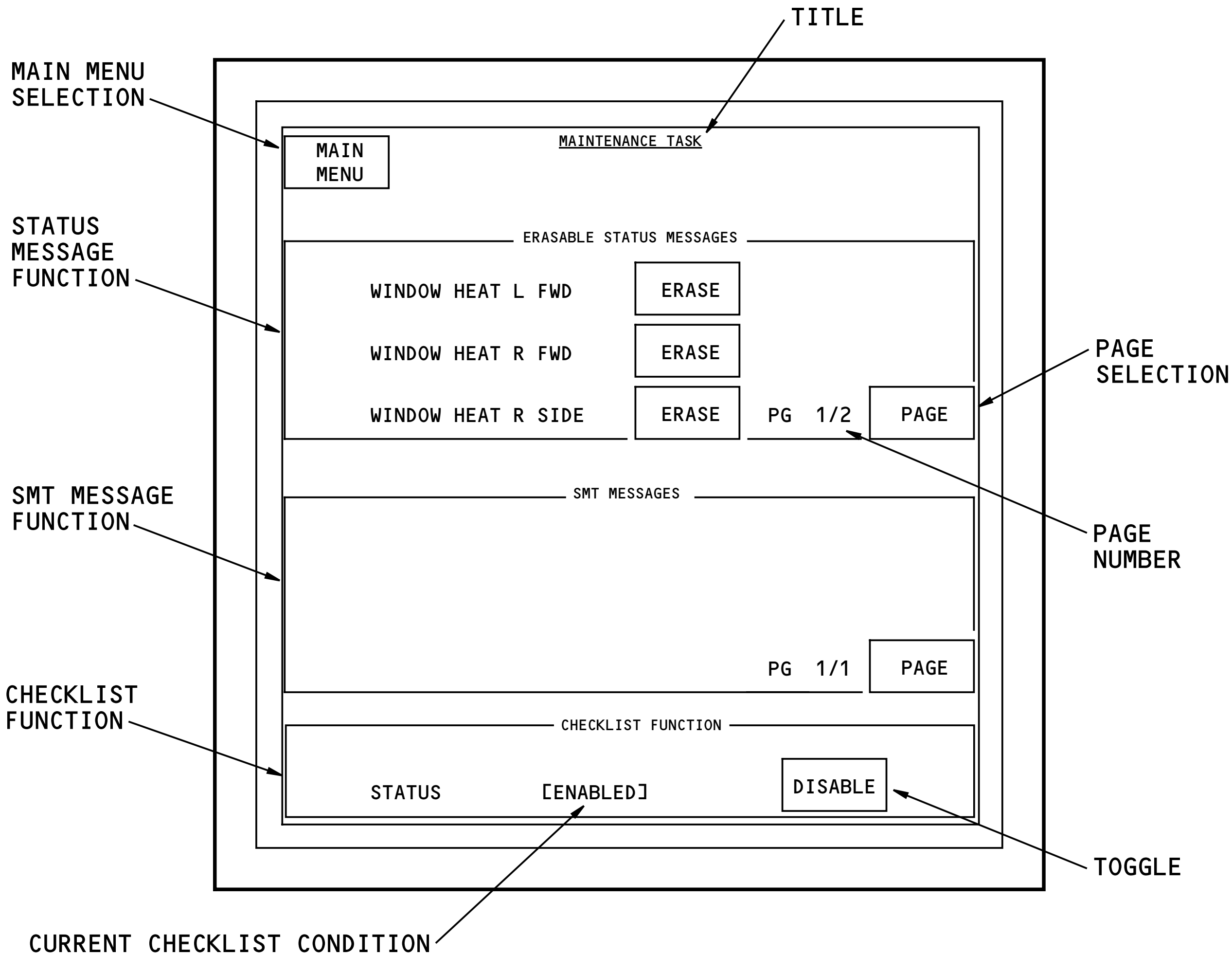
Checklist Function

Each selection of the ENABLE/DISABLE button causes the message to toggle between [ENABLE] and [DISABLE]. This selection enables or disables the electronic checklist function. The current checklist condition shows next to the STATUS prompt. The system stores the message in non-volatile memory so that the condition remains when you put power back on the airplane.

PRIMARY DISPLAY SYSTEM - MAINTENANCE TASK MAINTENANCE PAGE

The initial software load in the graphics generators cause the function to be ENABLED.

The toggle does not operate when the airplane is in the air.



31-61-00-095 Rev 6 01/23/96

PRIMARY DISPLAY SYSTEM - MAINTENANCE TASK MAINTENANCE PAGE

PRIMARY DISPLAY SYSTEM - LANDING GEAR ACTUATION MAINTENANCE PAGE

General

The landing gear actuation maintenance page is available in these three display modes:

- Real time
- Manual event
- Auto event.

Title

The title shows the display mode. The title shows as:

- LANDING GEAR ACTN/INDN for the real time mode
- LANDING GEAR ACTN/INDN MAN for the manual event mode
- LANDING GEAR ACTN/INDN AUTO for the auto event mode.

Auto Event Message

In the real time mode, the auto event message shows for the most recent auto event in memory. If there are no auto events in memory, the message field is blank.

In the auto event mode, the message for the incident shows.

There is no message in the manual event mode.

Date and Time

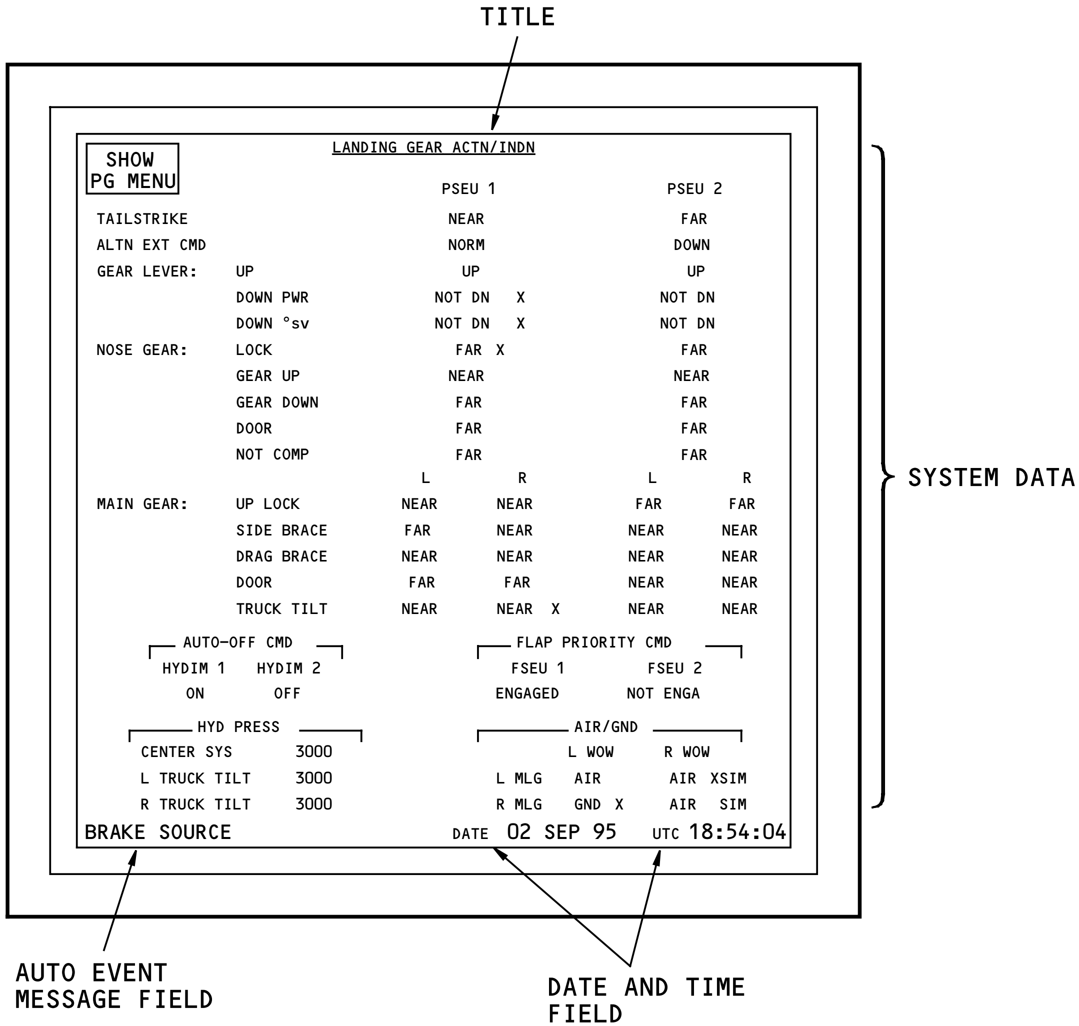
In the real time mode, the date field shows the current date and universal coordinated time (UTC).

In the manual event mode and the auto event mode, the date field shows the date and UTC of the incident.

System Data

The landing gear actuation maintenance page shows:

- Tailstrike, alternate extend command, and gear lever data
- Nose gear data
- Main gear data
- Hydraulic and flap/slat data
- Hydraulic pressure data
- Air/ground data.



31-61-00-096 Rev 0

PRIMARY DISPLAY SYSTEM - LANDING GEAR ACTUATION MAINTENANCE PAGE

PRIMARY DISPLAY SYSTEM - LANDING GEAR BRAKE/STEERING MAINTENANCE PAGE

General

The landing gear brake/steering maintenance page is available in these three display modes:

- Real time
- Manual event
- Auto event.

Title

The title shows the display mode. The title shows as:

- LANDING GEAR BRKS/STRNG for the real time mode
- LANDING GEAR BRKS/STRNG MAN for the manual event mode
- LANDING GEAR BRKS/STRNG AUTO for the auto event mode.

Auto Event Message

In the real time mode, the auto event message shows for the most recent auto event in memory. If there are no auto events in memory, the message field is blank.

In the auto event mode, the message for the incident shows.

There is no message in the manual event mode.

Date and Time

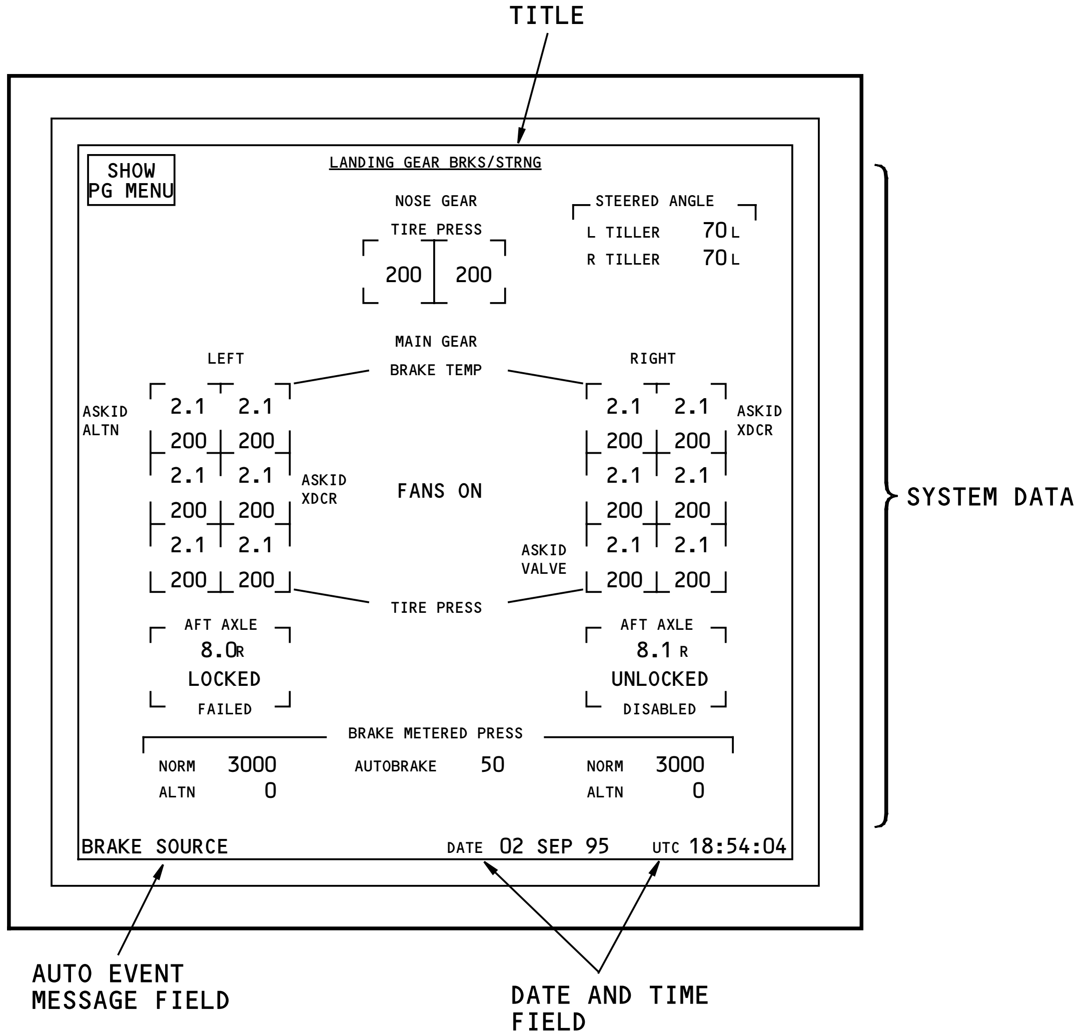
In the real time mode, the date field shows the current date and universal coordinated time (UTC).

In the manual event mode and the auto event mode, the date field shows the date and UTC of the incident.

System Data

The landing gear brake/steering maintenance page shows:

- Nose gear data
- Main gear steering data
- Main gear tire pressure data
- Main gear brake data
- Brake temperature
- Brake metered pressure.



31-61-00-097 Rev 1

PRIMARY DISPLAY SYSTEM - LANDING GEAR BRAKE/STEERING MAINTENANCE PAGE

PRIMARY DISPLAY SYSTEM - AIR SUPPLY MAINTENANCE PAGE

General

The air supply maintenance page is available in these three display modes:

- Real time
- Manual event
- Auto event.

Title

The title shows the display mode. The title shows as:

- AIR SUPPLY for the real time mode
- AIR SUPPLY MAN for the manual event mode
- AIR SUPPLY AUTO for the auto event mode.

Auto Event Message

In the real time mode, the auto event message shows for the most recent auto event in memory. If there are no auto events in memory, the message field is blank.

In the auto event mode, the message for the incident shows.

There is no message in the manual event mode.

Date and Time

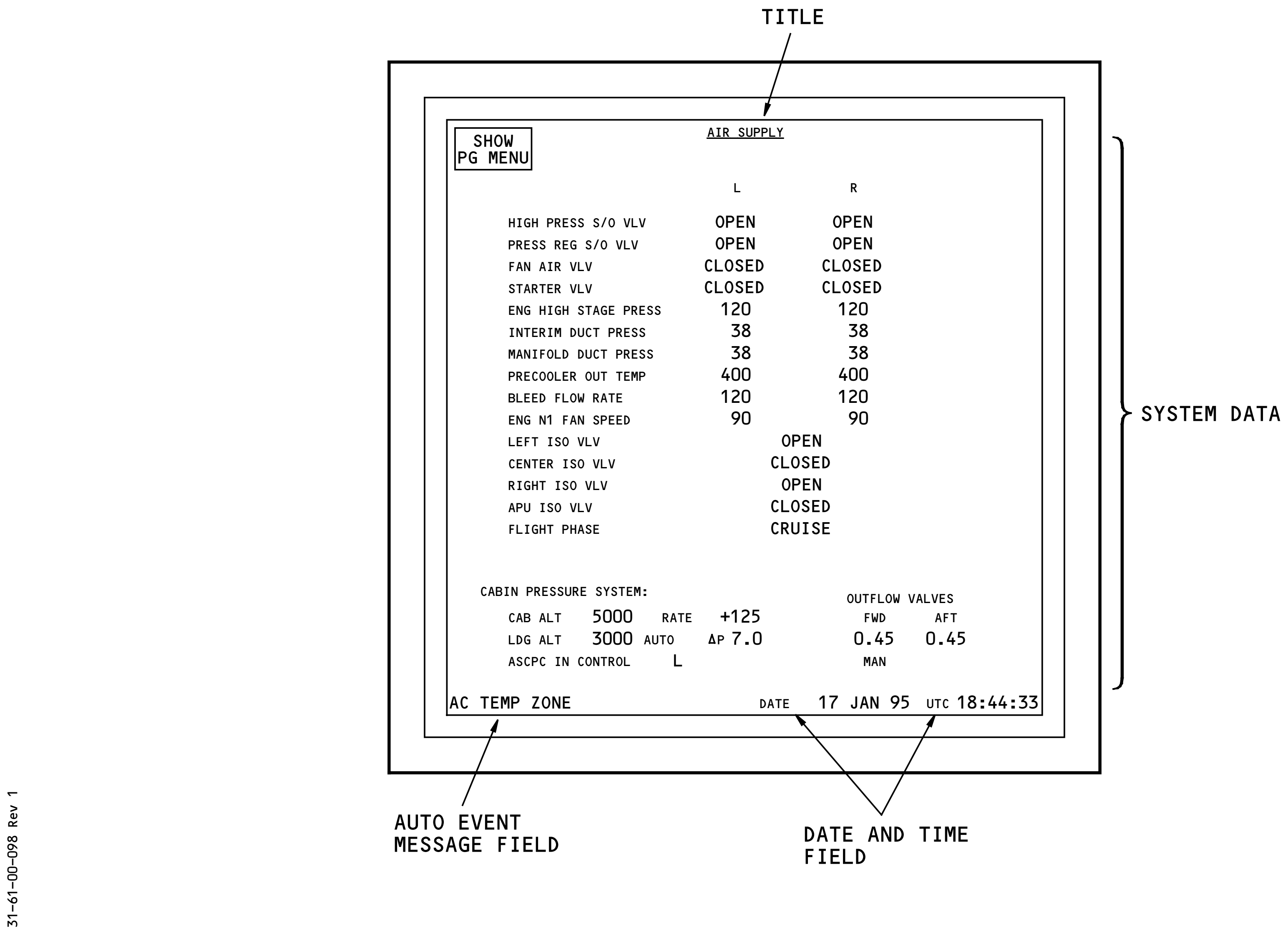
In the real time mode, the date field shows the current date and universal coordinated time (UTC).

In the manual event mode and the auto event mode, the date field shows the date and UTC of the incident.

System Data

The air supply maintenance page shows environmental control system information. The information includes:

- Air supply valve positions
- Air supply miscellaneous data
- Flight phase
- Cabin pressure system data
- Outflow valve data
- Cabin pressure controller channel in control.



PRIMARY DISPLAY SYSTEM - AIR SUPPLY MAINTENANCE PAGE

PRIMARY DISPLAY SYSTEM - APU MAINTENANCE PAGE

General

The APU maintenance page is available in these three display modes:

- Real time
- Manual event
- Auto event.

Title

The title shows the display mode. The title shows as:

- APU for the real time mode
- APU MAN for the manual event mode
- APU AUTO for the auto event mode.

Auto Event Message

In the real time mode, the auto event message shows for the most recent auto event in memory. If there are no auto events in memory, the message field is blank.

In the auto event mode, the message for the incident shows.

There is no message in the manual event mode.

Date and Time

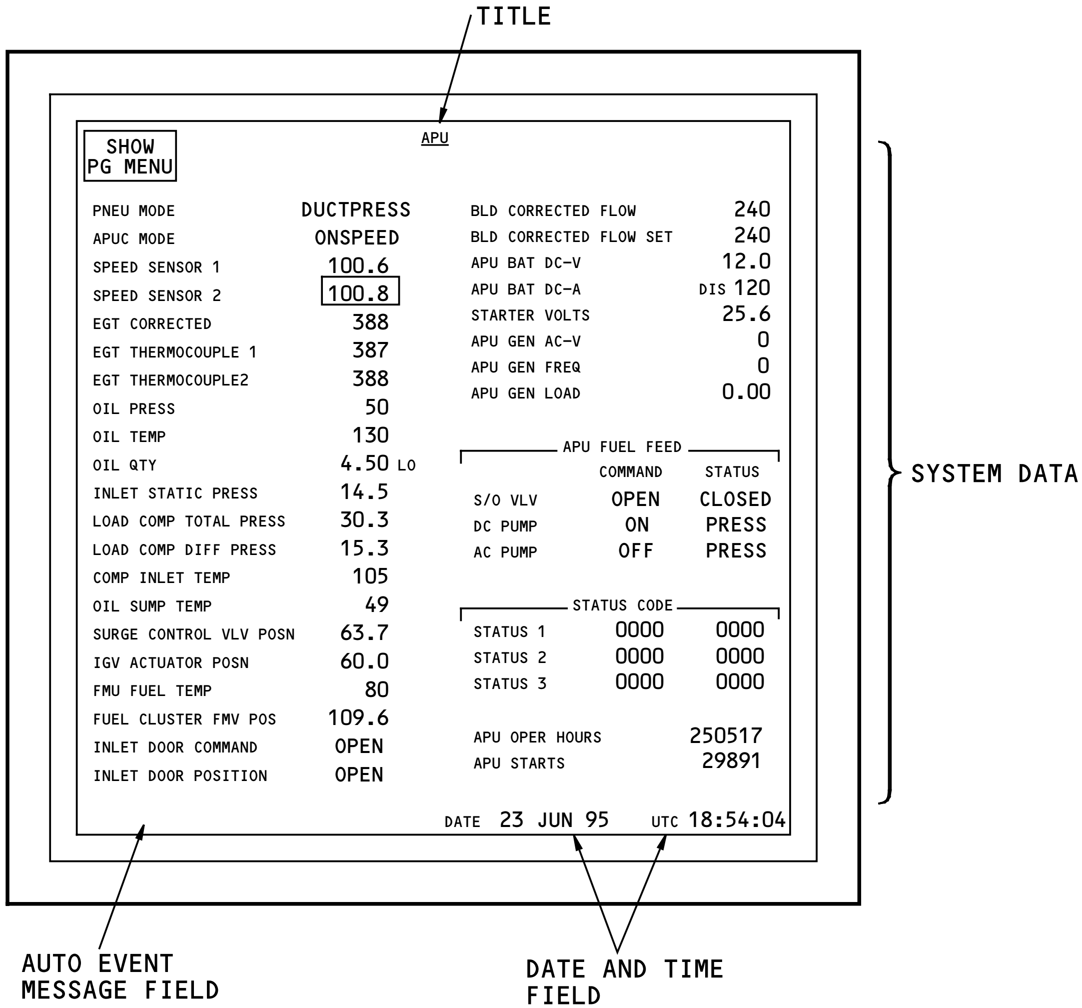
In the real time mode, the date field shows the current date and universal coordinated time (UTC).

In the manual event mode and the auto event mode, the date field shows the date and UTC of the incident.

System Data

The APU maintenance page shows:

- APU mode
- Rotor speed
- EGT
- Oil information
- Starter voltage
- Pressure data
- Valve positions
- Door positions
- Battery, starter, and generator status
- Status code, APU unique maintenance codes (six maximum), hexadecimal
- APU operating hours and starts
- Other APU status data.



31-61-00-099 Rev 1 12/12/95

PRIMARY DISPLAY SYSTEM - APU MAINTENANCE PAGE

PRIMARY DISPLAY SYSTEM - PERFORMANCE MAINTENANCE PAGE

General

The performance maintenance page is available in these three display modes:

- Real time
- Manual event
- Auto event.

Title

The title shows the display mode. The title shows as:

- PERFORMANCE for the real time mode
- PERFORMANCE MAN for the manual event mode
- PERFORMANCE AUTO for the auto event mode.

Auto Event Message

In the real time mode, the auto event message shows for the most recent auto event in memory. If there are no auto events in memory, the message field is blank.

In the auto event mode, the message for the incident shows.

There is no message in the manual event mode.

Date and Time

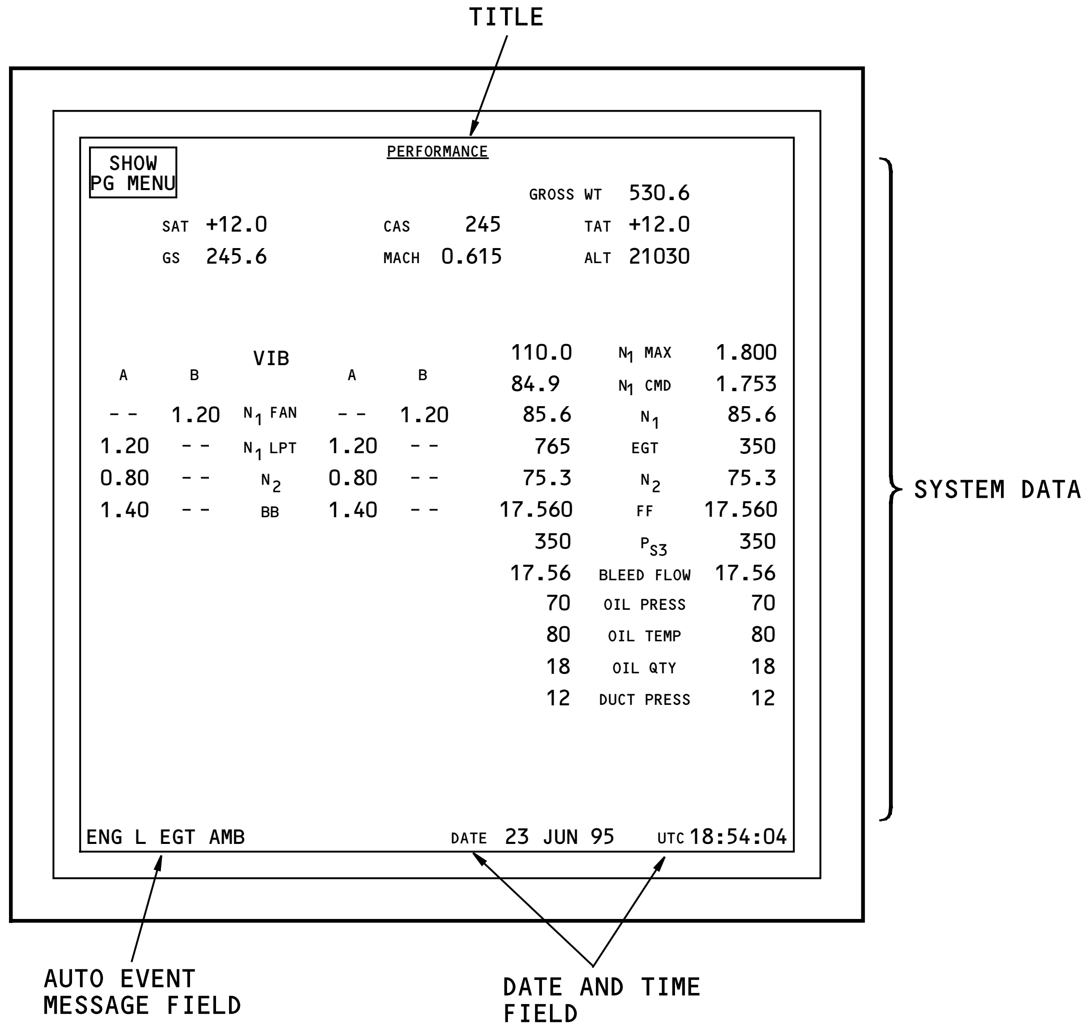
In the real time mode, the date field shows the current date and universal coordinated time (UTC).

In the manual event mode and the auto event mode, the date field shows the date and UTC of the incident.

System Data

The performance maintenance page shows:

- Airplane state data
- Engine parameters
- Engine vibration
- Engine oil parameters.



31-61-00-100 Rev 3 09/18/96

PRIMARY DISPLAY SYSTEM - PERFORMANCE MAINTENANCE PAGE

PRIMARY DISPLAY SYSTEM - EPCS MAINTENANCE PAGES

General

There are two electronic propulsion control system (EPCS) maintenance pages. They are available in these three display modes:

- Real time
- Manual event
- Auto event.

Title

The titles show the display mode and page number. The titles show as:

- EPCS PG 1/2 for the real time mode
- EPCS PG 2/2 for the real time mode
- EPCS MAN 1/2 for the manual event mode
- EPCS MAN 2/2 for the manual event mode
- EPCS AUTO 1/2 for the auto event mode
- EPCS AUTO 2/2 for the auto event mode.

Auto Event Message

In the real time mode, the auto event message shows for the most recent auto event in memory. If there are no auto events in memory, the message field is blank. The message shows on both pages.

In the auto event mode, the message for the incident shows. The message shows on both pages.

There is no message in the manual event mode.

Date and Time

In the real time mode, the date field shows the current date and universal coordinated time (UTC).

In the manual event mode and the auto event mode, the date field shows the date and UTC of the incident.

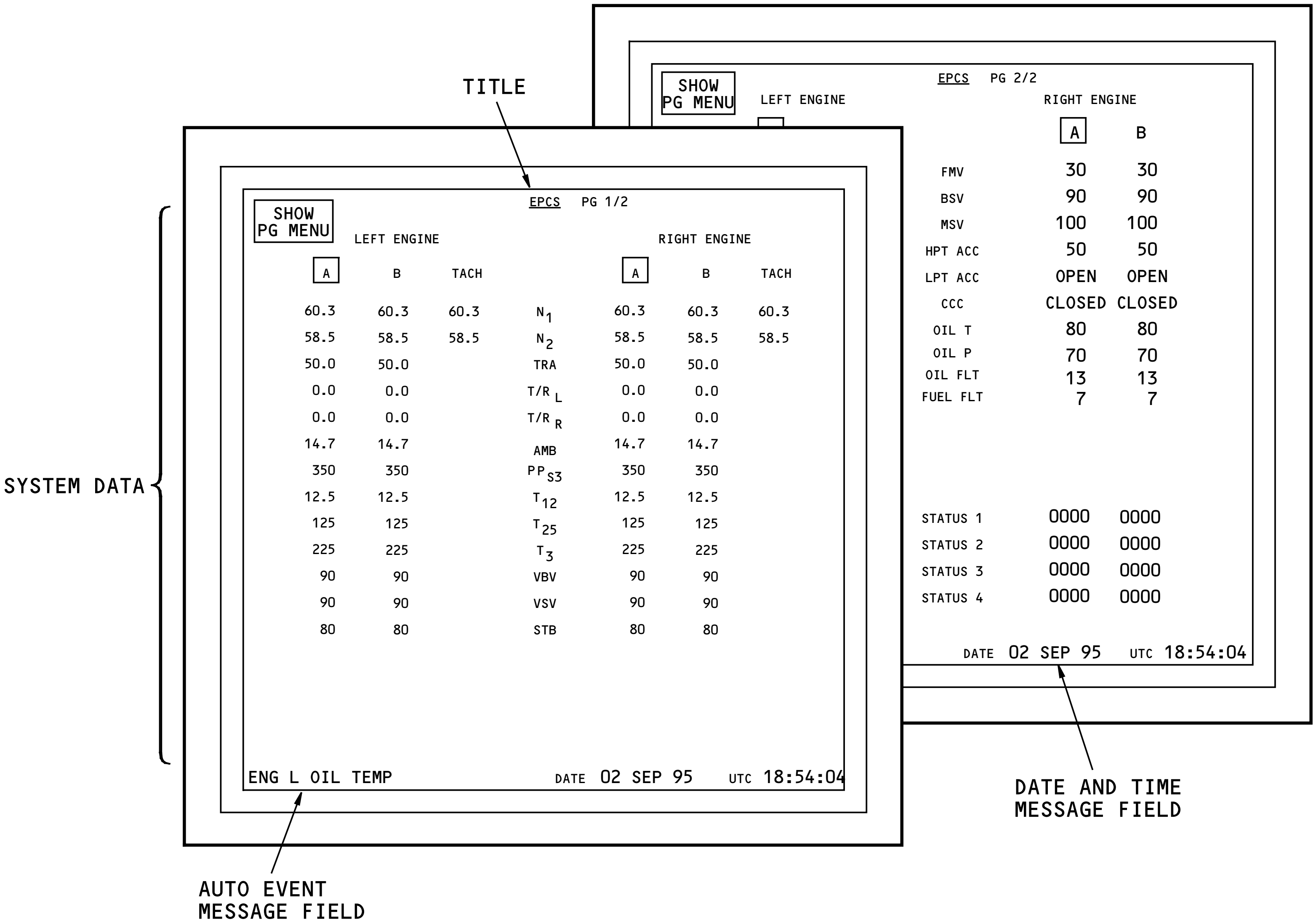
System Data

The information on EPCS maintenance page 1/2 includes:

- Channel in control
- Rotor speed information
- Thrust reverser information
- Engine temperature and pressure data.

The information on EPCS maintenance page 2/2 includes:

- Channel in control
- Oil pressure and temperature
- Status message codes (hexadecimal).



PRIMARY DISPLAY SYSTEM - EPCS MAINTENANCE PAGES

31-61-00-101 Rev 2

PRIMARY DISPLAY SYSTEM - PROPULSION DATA LIMITS MAINTENANCE PAGES

General

There are two maintenance pages for propulsion data limits. They are available in the real time display mode only.

Title

The title shows the page. The titles show as:

- PROPULSION DATA LIMITS PG 1/2
- PROPULSION DATA LIMITS PG 2/2.

System Data

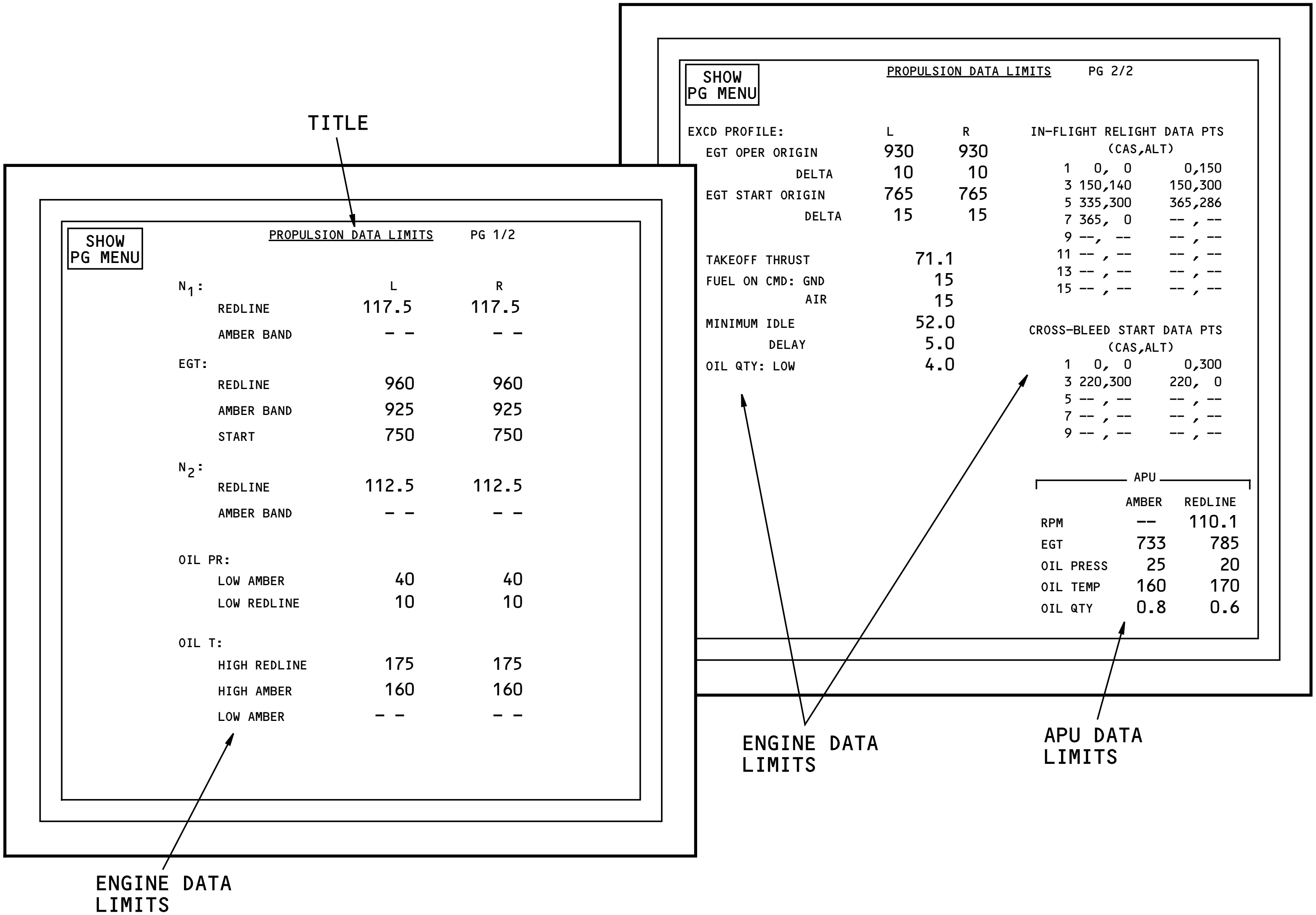
The propulsion data limits maintenance pages show engine red-line and amber-line exceedance limits. The information shows on two pages.

The information on the limits maintenance page 1/2 for propulsion data includes:

- Rotor speeds
- EGT
- Oil pressure
- Oil temperature
- Oil pressure data points.

The information on the limits maintenance page 2/2 for propulsion data includes:

- Takeoff thrust
- Fuel on command
- Minimum idle
- Oil quantity
- Engine vibration
- Exceedance profile
- In-flight relight data points
- Cross-bleed start data points
- APU data limits.



31-61-00-102 Rev 2

PRIMARY DISPLAY SYSTEM - PROPULSION DATA LIMITS MAINTENANCE PAGES

PRIMARY DISPLAY SYSTEM - ENGINE EXCEEDANCE MAINTENANCE PAGES

General

There are two separate engine exceedance maintenance pages, one for the left engine and one for the right engine. They are available in the auto event display mode only.

Title

The title shows the engine. The titles show as:

- L ENG EXCD
- R ENG EXCD.

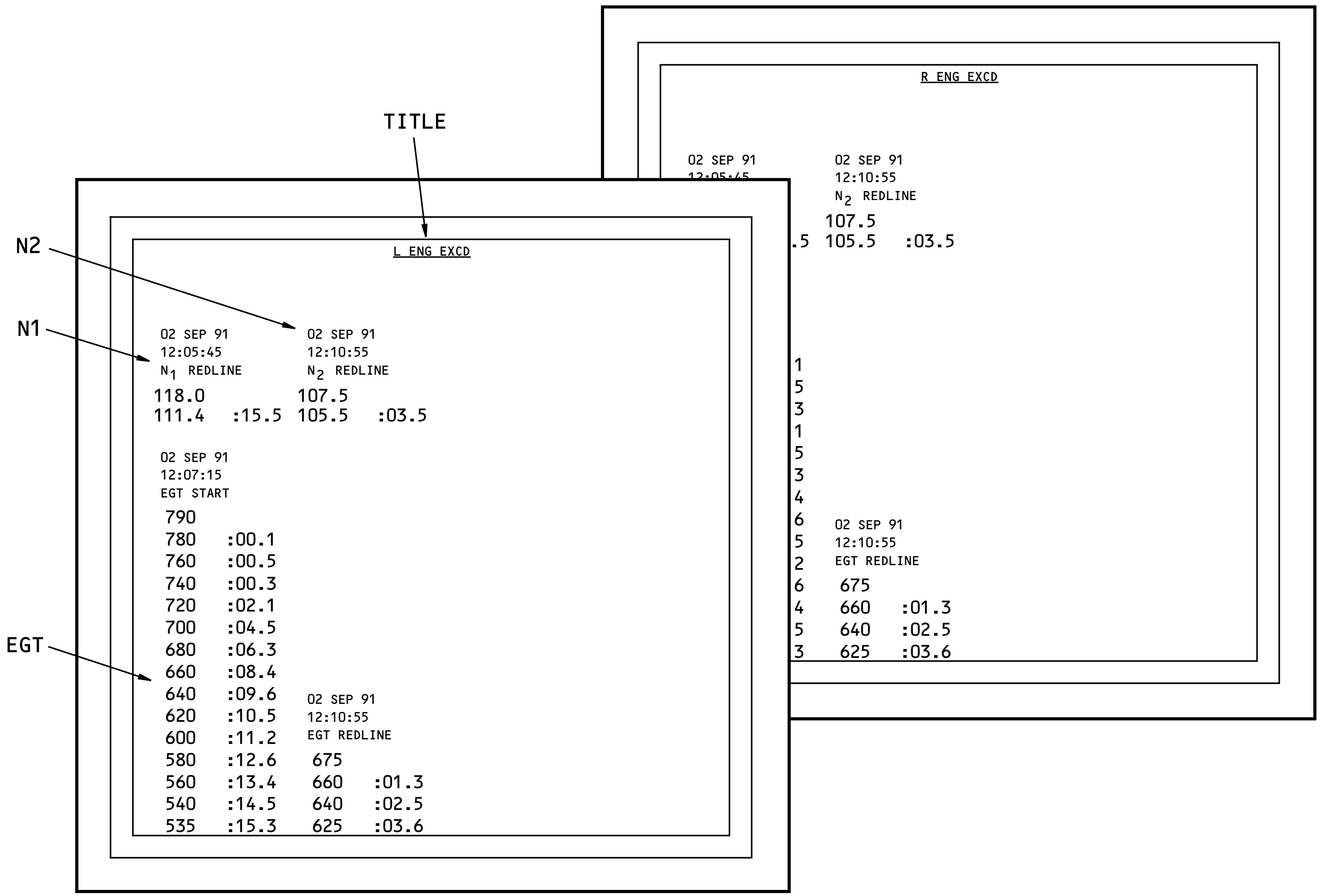
System Data

The engine exceedance maintenance pages show engine red line and amber line exceedance profiles. Profiles show for:

- N1 amber band/red line exceedance mini-profile
- N2 amber band/red line exceedance mini-profile
- EGT start limit exceedance profile
- EGT amber band/red line exceedance profile.

Each profile area stores up to four exceedances in nonvolatile memory (NVM). The date and time of each exceedance shows at the top of the profile. The parameter message follows the date. The profile data follows the message.

The exceedances show in order of occurrence with the most recent exceedance in the right hand column.



31-61-00-103 Rev 1

PRIMARY DISPLAY SYSTEM - ENGINE EXCEEDANCE MAINTENANCE PAGES

PRIMARY DISPLAY SYSTEM - MAINTENANCE PAGES SUMMARY

General

These are the four main selection pages:

- Display selection page
- Print selection page
- Datalink selection page
- Erase selection page.

These are the eight sub-page selections:

- Manual events display selection sub-page
- Auto events display selection sub-page
- Manual events print selection sub-page
- Auto events print selection sub-page
- Manual events datalink selection sub-page
- Auto events datalink selection sub-page
- Manual events erase selection sub-page
- Auto events erase selection sub-page.

Also, individual menu selections show on each maintenance page.

Each maintenance page shows the available menu selections.

These menu selections for the maintenance pages show in the summary chart:

- Real time
- Manual event
- Auto event
- Number of pages.

ATA	TITLE	REAL TIME	MANUAL EVENT	AUTO EVENT	NUMBER OF PAGES
21	AIR CONDITIONING	YES	YES	YES	1
24	ELECTRICAL	YES	YES	YES	2
26	FIRE PROTECTION	YES	YES	YES	1
27	FLIGHT CONTROLS	YES	YES	YES	3
27	FLAP/SLAT	YES	YES	YES	1
28	FUEL QUANTITY	YES	YES	YES	1
28	FUEL MANAGEMENT	YES	YES	YES	1
29	HYDRAULIC	YES	YES	YES	1
30	ICE PROTECTION	YES	YES	YES	1
31	MAINTENANCE TASK	YES	NO	NO	1
32	LANDING GEAR ACTUATION/INDICATION	YES	YES	YES	1
32	LANDING GEAR BRAKES/STEERING	YES	YES	YES	1
36	AIR SUPPLY	YES	YES	YES	1
49	APU	YES	YES	YES	1
71	PERFORMANCE	YES	YES	YES	1
71	EPCS	YES	YES	YES	2
71	PROPULSION DATA LIMITS	YES	NO	NO	2
71	LEFT ENGINE EXCEEDANCE	NO	NO	YES	1
71	RIGHT ENGINE EXCEEDANCE	NO	NO	YES	1

31-61-00-104 Rev 1

PRIMARY DISPLAY SYSTEM - MAINTENANCE PAGES SUMMARY

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PRIMARY DISPLAY SYSTEM - DISPLAY CONTROL FUNCTIONAL DESCRIPTION

General

There are four display channels in the primary display system. Each channel has a graphics generator, a coax coupler, and six coax cables.

Each AIMS cabinet has a left (M010) and a right (M011) graphics generator (GG). During normal operation, three of the GGs each send data to two DUs. The fourth GG is a spare. The GGs normally drive the displays at a 20 Hz rate.

Display control (DSPL CTRL) switches on the left instrument source select panel (L ISSP), center display control panel (CDCP), and right instrument source select panel (R ISSP) change the source of display data for the six display units (DUs).

Each switch has two positions, AUTO and alternate (ALTN). Normally, the switches are in the AUTO position. With the switches in the AUTO position, the AIMS cabinets automatically switch sources when a GG fails.

System software determines the switching sequence. For example, if the left GG in the left AIMS cabinet fails, the right GG in the left AIMS cabinet takes over.

Each graphics generator has the capability to drive a maximum of two critical formats and one essential format. The critical formats are the PFD, EICAS and secondary engine displays. The essential formats are the ND and the other MFD formats.

AUTO Position Operation

The AUTO position of the DSPL CTRL switch on the L ISSP causes the CPM/GG (M010) in the left AIMS cabinet to send data to the left outboard DU and left inboard DU.

The AUTO position of the DSPL CTRL switch on the CDCP causes the CPM/GG (M011) in the left AIMS cabinet to send data to the upper center DU and the lower center DU.

the AUTO position of the DSPL CTRL switch on the R ISSP causes the CPM/GG (M011) in the right AIMS cabinet to send data to the right outboard DU and right inboard DU.

The CPM/GG (M010) in the right AIMS cabinet is the spare.

ALTN Switch Operation or One Channel Failure

The ALTN position of the switches changes the source of display data.

With the display control switches in AUTO, failures also cause the source of display data to change.

When you put the DSPL CTRL switch on the L ISSP in the ALTN position, or the CPM/GG (M010) in the left AIMS cabinet fails, the CPM/GG (M011) in the left AIMS cabinet sends data to the captain DUs.

PRIMARY DISPLAY SYSTEM - DISPLAY CONTROL FUNCTIONAL DESCRIPTION

When you put the DSPL CTRL switch on the CDCP in the ALTN position, or CPM/GG M011 in the left AIMS cabinet fails, the CPM/GG (M010) in the right AIMS cabinet sends data to the upper center and lower center DUs.

When you put the DSPL CTRL switch on the R ISSP in the ALTN position, or the CPM/GG (M0011) in the right AIMS cabinet fails, CPM/GG M010 in the left AIMS cabinet sends data to the first officer's DUs.

For any of the above conditions all display functions are available and there is no reduction in system capability and functionality. There are no flight deck effects set.

ALTN Switch Operation and One Channel Failure

Alternate switch operation and one channel failure together cause the display system to go to a limited format operation. The total display system has the capability to show four critical and two essential formats.

With all other conditions normal, the outboard display units will show PFDs. The inboard display units will show NDs. The upper center DU will show EICAS and the lower center DU will show the secondary engine display.

If the CPM/GG (M010) in the left AIMS cabinet fails and the captain display control switch is in the alternate position, CPM/GG (M010)in the right AIMS cabinet sends data to the left outboard (LOB), left inboard (LIB), and upper center DUs. CPM/GG (M011) in the right AIMS cabinet sends data to the right outboard (ROB), right inboard (RIB) and lower center DUs. This causes the display system to go to the limited format mode. For this condition there are no flight deck effects and no dispatch limitations.

If the CPM/GG (M011) in the left AIMS cabinet fails and the center display control switch is in the alternate position, CPM/GG (M010)in the left AIMS cabinet sends data to the LOB, LIB, and upper center DUs. CPM/GG (M011) in the right AIMS cabinet sends data to the ROB, RIB and lower center DUs. This causes the display system to go to the limited format mode. For this condition there are no flight deck effects and no dispatch limitations.

If the CPM/GG (M010) in the right AIMS cabinet fails and the first officer display control switch is in the alternate position, CPM/GG (M010)in the left AIMS cabinet sends data to the LOB, LIB, and upper center DUs. CPM/GG (M011) in the left AIMS cabinet sends data to the ROB, RIB and lower center DUs. This causes the display system to go to the limited format mode. For this condition there are no flight deck effects and no dispatch limitations.

If the CPM/GG (M011) in the right AIMS cabinet fails and the first officer display control switch is in the alternate position, CPM/GG (M010)in the left AIMS cabinet sends data to the LOB, LIB, and upper center DUs. CPM/GG (M011) in the left AIMS cabinet sends data to the ROB, RIB and lower center DUs. This causes the display system to go to the limited format mode. For this condition there are no flight deck effects and no dispatch limitations.

Two Display Channel Failures

Two failures cause the display system to go limited format operation. The total display system has the capability to show four critical and two essential formats.

With two failures, the system has the capability for:

- Separate captain and first officer PFDs.
- EICAS and secondary engine displays
- At least one ND to be controlled by either pilot
- Crew warnings, alerts, and cautions
- MFD availability (not required full time)
- Displays at a 10 Hz rate.

Two failures also cause the status message DISPLAY RESOURCES to show. There is no master minimum equipment list (MMEL) relief for this condition.

Three Display Channel Failures

If three failures occur, the last channel can fully support three display units.

This channel can send data to all display formats. In this condition, the GG sends data to three displays and then echoes or duplicates displays on other DUs.

After the third channel failure, the system has the capability for:

- Single PFD and single ND generation
- EICAS and secondary engine displays with warnings and alerts on EICAS (compacted EICAS)
- MFD availability in place of the ND.

This condition causes the status message DISPLAY PROCESSING and the caution message SGL SOURCE DISPLAYS to show. There is no MMEL relief for this condition.

Graphics Generator to Display Unit Interfaces Summary

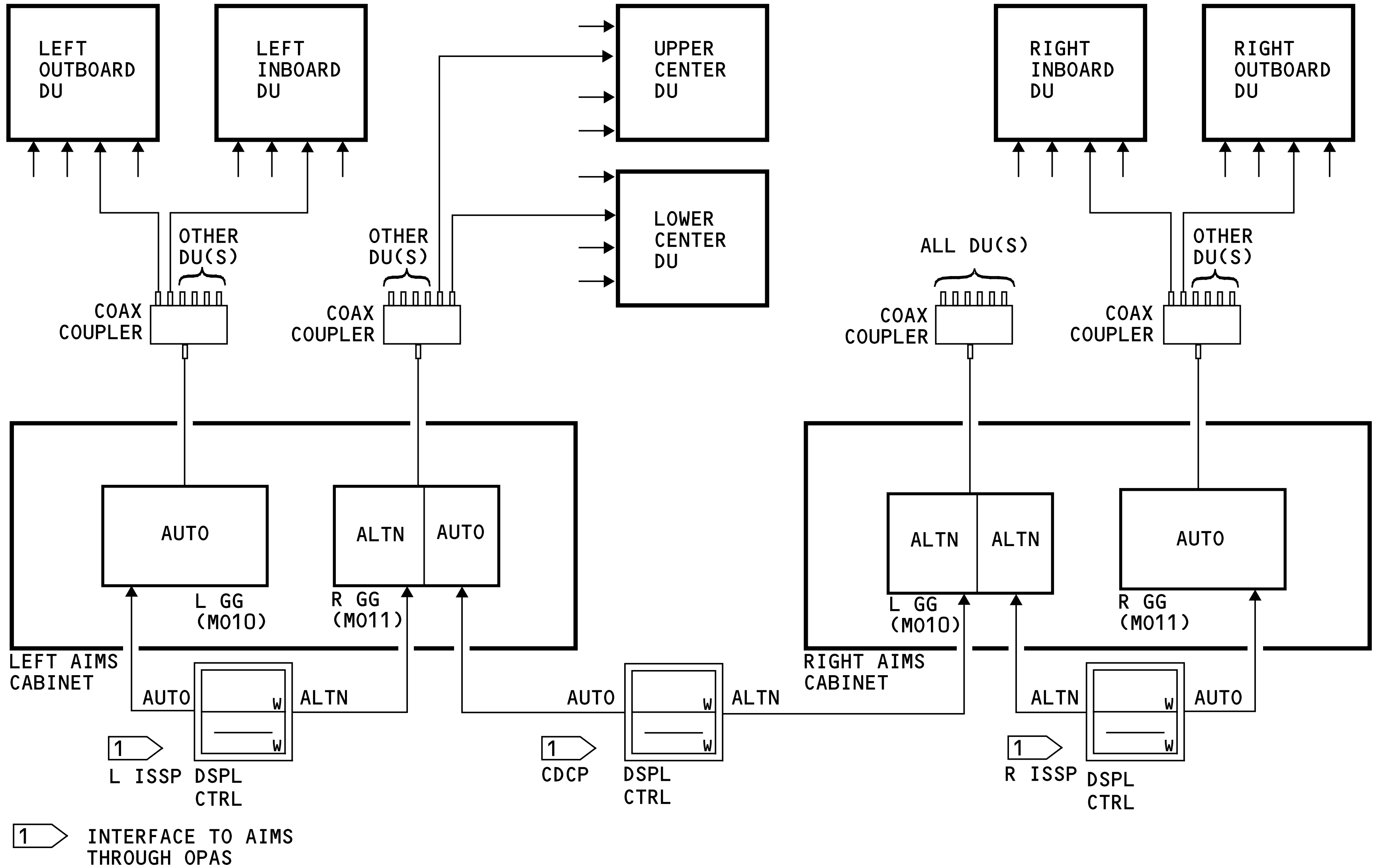
There are many possible combinations of display channel failures and switch positions. The above text and chart that follows summarizes several of these conditions.

CONDITION	LOB DU	LIB DU	CU DU	CL DU	RIB DU	ROB DU
NORMAL GGs	L10	L10	L11	L11	R11	R11
CAPT ALTN	L11	L11	R10	R10	R11	R11
CDCP ALTN	L10	L10	R10	R10	R11	R11
F/O ALTN	L10	L10	L11	L11	R10	R10
L 10 BAD	L11	L11	R10	R10	R11	R11
L 11 BAD	L10	L10	R10	R10	R11	R11
R 10 BAD	L10	L10	L11	L11	R11	R11
R 11 BAD	L10	L10	L11	L11	R10	R10
L10 BAD CAPT ALTN	R10	R10	R10	R11	R11	R11
L11 BAD CTR ALTN	L10	L10	L10	R11	R11	R11
R10 BAD F/O ALTN	L10	L10	L10	L11	L11	L11
R11 BAD F/O ALTN	L10	L10	L10	L11	L11	L11
L10L11 BAD	R10	R10	R10	R11	R11	R11
R10R11 BAD	L10	L10	L10	L11	L11	L11
L10R10 BAD	L11	L11	L11	R11	R11	R11
L10R11 BAD	L11	L11	L11	R10	R10	R10
L11R10 BAD	L10	L10	L10	R11	R11	R11
L11R11 BAD	L10	L10	L10	R10	R10	R10
ANY 3 FAIL	C PFD	C ND	EICAS	BLANK	C ND	C PFD
	C = Captain					

Training Information Point

On the ground, the display system will try to switch back to a previously failed graphics generator. This will cause the display unit to blink on and off. This condition lets the maintenance personnel troubleshoot an intermittent GG or wiring problem. There is no limit to the number of times the display system will try to switch.

In the air, the display system will try to switch back to a bad GG up to four times. After four tries, redundancy logic takes effect and the blinking stops.



31-61-00-120 Rev 10 10/07/1997

PRIMARY DISPLAY SYSTEM - DISPLAY CONTROL FUNCTIONAL DESCRIPTION

PRIMARY DISPLAY SYSTEM - ELECTRONIC CHECKLIST OVERVIEW

General

Checklists contain data necessary for the flight crew to operate the airplane in normal conditions and to help with non-normal conditions.

The flight crew completes the electronic checklist item by item on a READ and DO basis. These are the three types of checklists:

- Normal checklists (for example, PREFLIGHT and BEFORE START)
- Non-normal checklists related to an EICAS message (for example, ENG FAIL L and FIRE APU)
- Non-normal checklists not related to an EICAS message (for example, GEAR LEVER LOCKED DN and VOLCANIC ASH).

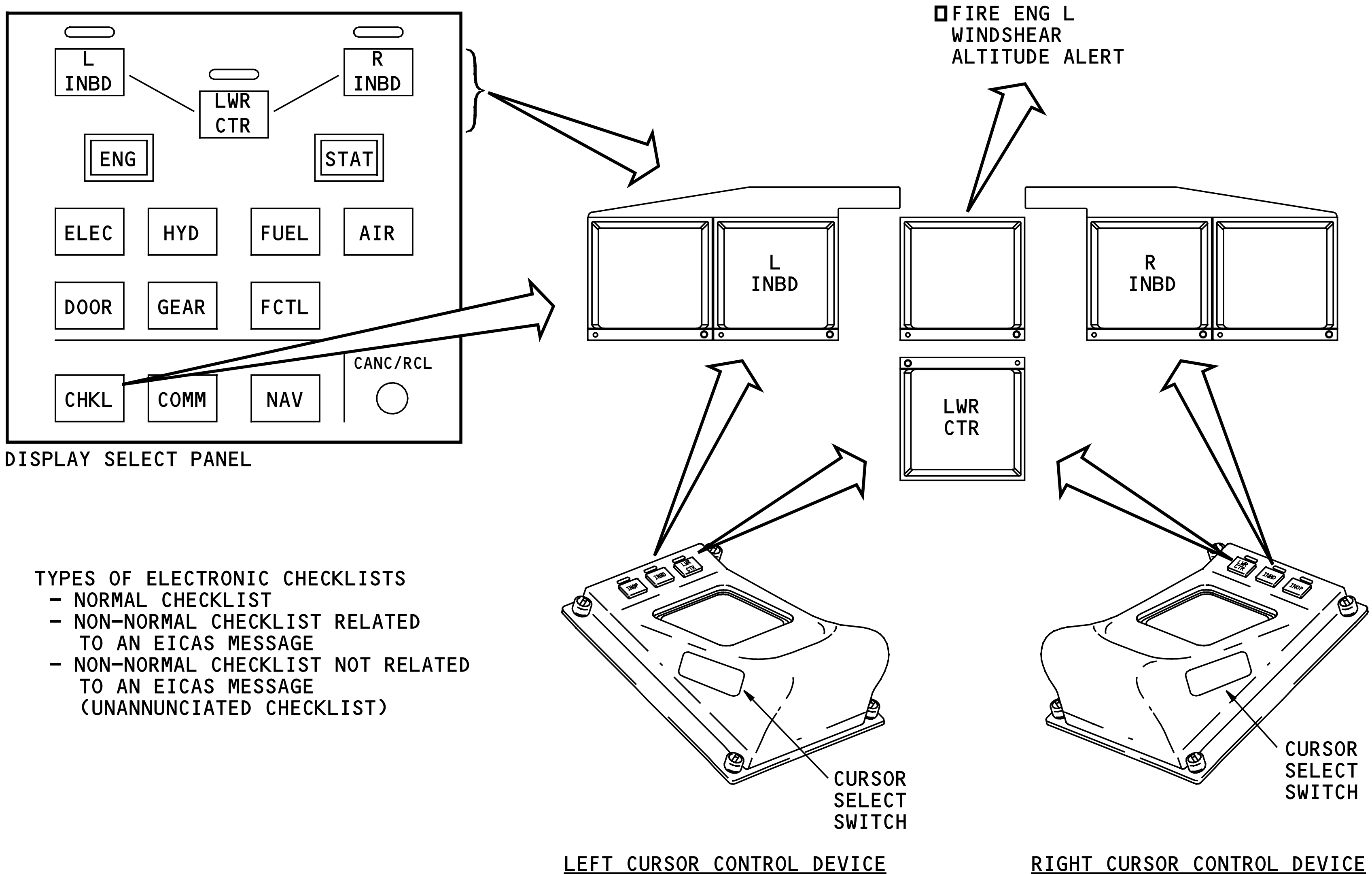
Normal checklist are organized by phase of flight. The flight crew uses them to verify that important procedural steps have been done.

Non-normal checklists contain steps to correct a condition. A square box shows in front of an EICAS message when the message is related to a non-normal checklist and the checklist is not complete. There are also non-normal checklists not related to an EICAS message. These are called unannunciated checklists.

Electronic Checklist Operation

Normal and non-normal electronic checklists show on any multifunction display (MFD). Push the CHKL switch on the display select panel (DSP) to show a checklist.

Only one checklist shows at a time. This checklist can show on more than one display unit, but only one cursor control device (CCD) can control the checklist.



TYPES OF ELECTRONIC CHECKLISTS
- NORMAL CHECKLIST
- NON-NORMAL CHECKLIST RELATED TO AN EICAS MESSAGE
- NON-NORMAL CHECKLIST NOT RELATED TO AN EICAS MESSAGE (UNANNUNCIATED CHECKLIST)

PRIMARY DISPLAY SYSTEM - ELECTRONIC CHECKLIST OVERVIEW

PRIMARY DISPLAY SYSTEM - CHECKLIST DISPLAY PRIORITY

Automatic Display of Checklists

Push the CHKL switch on the display select panel (DSP) to show a checklist on the selected MFD. The primary display system monitors the air/ground phase and EICAS message level and makes an automatic checklist selection.

When the airplane is in the ground phase (on the ground and engines off), this is the checklist priority:

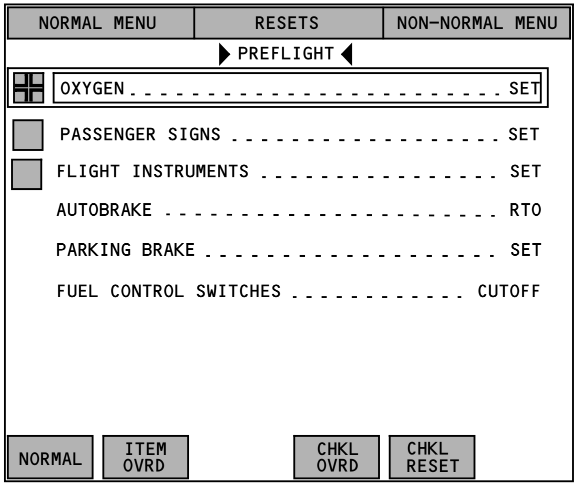
- Warning message checklist (not completed or not accessed)
- Normal checklist (not completed or not accessed)
- Caution message checklist (not completed or not accessed)
- Advisory message checklist (not completed or not accessed)
- Unannunciated checklist (not completed).

When the airplane is in the air phase (engines running), this is the priority:

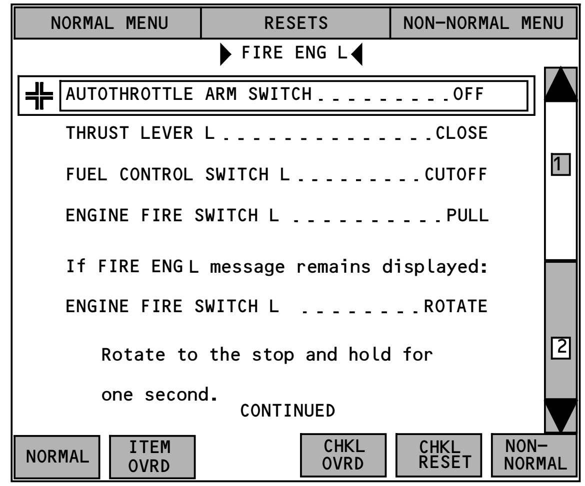
- Warning message checklist (not completed or not accessed)
- Caution message checklist (not completed or not accessed)
- Advisory message checklist (not completed or not accessed)
- Unannunciated checklist (not completed)
- Normal checklist (not completed or not accessed).

Manual Display of Checklists

Push the CHKL switch on the DSP to show a checklist. If the primary display system makes a decision that no checklists needs to show (all checklists are complete), only the menu bar at the top of the display shows. This permits selection of the normal and non-normal menus. These menus show a list of all the normal and non-normal checklists available for manual selection.

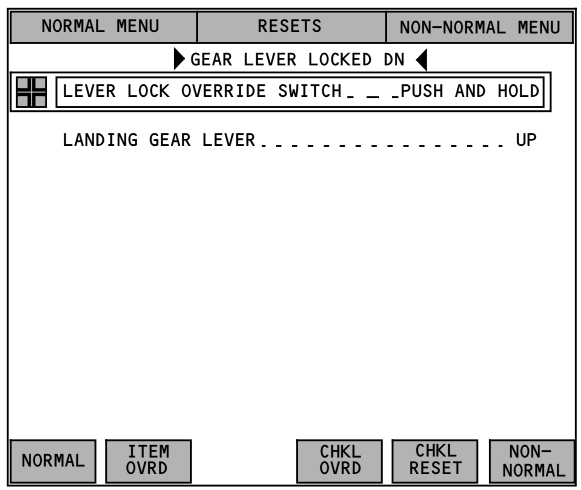


NORMAL CHECKLIST



NON-NORMAL CHECKLIST CONNECTED TO AN EICAS MESSAGE

DISPLAY PRIORITY – GROUND PHASE
- WARNING MESSAGE CHECKLISTS
- NORMAL CHECKLISTS
- CAUTION MESSAGE CHECKLISTS
- ADVISORY MESSAGE CHECKLISTS
- UNANNUNCIATED CHECKLISTS



NON-NORMAL CHECKLIST NOT CONNECTED TO AN EICAS MESSAGE

DISPLAY PRIORITY – AIR PHASE
- WARNING MESSAGE CHECKLISTS
- CAUTION MESSAGE CHECKLISTS
- ADVISORY MESSAGE CHECKLISTS
- UNANNUNCIATED CHECKLISTS
- NORMAL CHECKLISTS

31-61-00-122 Rev 1 11/15/1995

PRIMARY DISPLAY SYSTEM – CHECKLIST DISPLAY PRIORITY

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PRIMARY DISPLAY SYSTEM - CHECKLIST CONTROL

General

Use the active cursor control device (CCD) to control the checklist.

Checklist Menu Bar

Use the NORMAL and NON-NORMAL menu selection on the checklist menu bar to show a list of all normal or non-normal checklists.

Use the RESETS menu selection to show a list of checklist reset options and the airline modifiable information (AMI) software part numbers.

Command Keys

These are the six command keys that control the checklists:

- NORMAL shows the next normal checklist
- ITEM OVRD overrides the highlighted checklist item. An overridden item changes color to cyan
- NOTES key shows if the checklist has more information for the flight crew
- CHKL OVRD allows the flight crew to override the current checklist so they can go on to the next one
- CHKL RESET resets the current checklist
- NON-NORMAL shows the next non-normal checklist.

Closed Loop and Open Loop Items

The checklist function monitors the position of switches, controls and other data in the flight deck. Checklist items that are monitored by the checklist function are called closed loop items. Checklist items that are not monitored are called open loop items.

Closed loop (monitored) items are checklist items that automatically show complete when the boolean state of the applicable line item goes true. Closed loop items show as checkmarks with no gray checkboxes.

Open loop (not monitored) items show as a gray checkbox. Use the CCD cursor activation switch to set open loop items complete.

Line Item and Active Area Highlight Boxes

After the flight crew makes a checklist selection, a line item highlight box shows on the first line item that is not complete. The line item highlight box has a thin line width which goes around the text of the checklist line item. When the cursor is on a line item, an active area highlight box goes around the line item highlight box and open loop check box. When line items are marked complete, the cursor and the line item highlight box move to the next line item.

Cursor Movement

The flight crew moves the cursor as necessary. When all checklist items on a page are complete, the cursor moves to the next page selection on the scroll bar (the scroll bar shows if the checklist has more than one page).

Completed Line Items and Checklists

Checklist line items show in white and change color to green when the flight crew does the required action. When the flight crew completes all items (green) or overrides all items (cyan), one of these messages show at the bottom of the checklist:

- CHECKLIST COMPLETE
- CHECKLIST COMPLETE EXCEPT DEFERRED ITEMS
- CHECKLIST OVERRIDDEN.

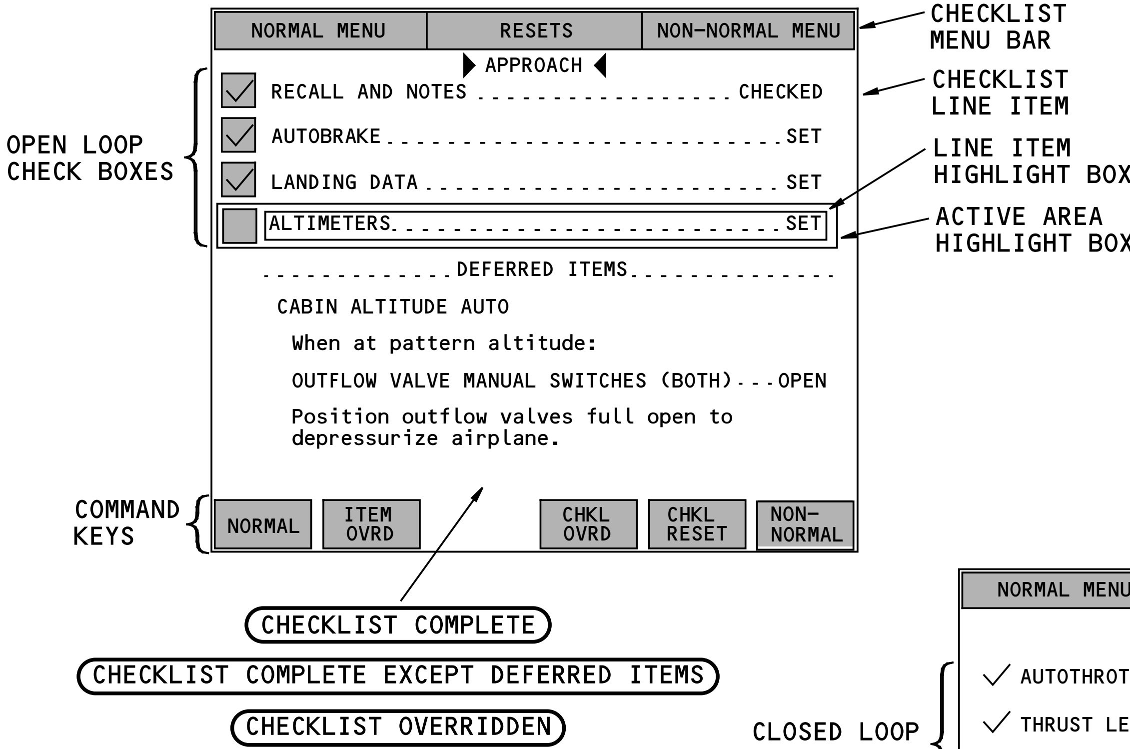
If the flight crew does not complete one checklist before they go to another, the NORMAL or NON-NORMAL command key changes color to amber to show that one or more checklists are not complete. Selection of the amber command key returns the system to the first line item not complete in the first incomplete checklist.

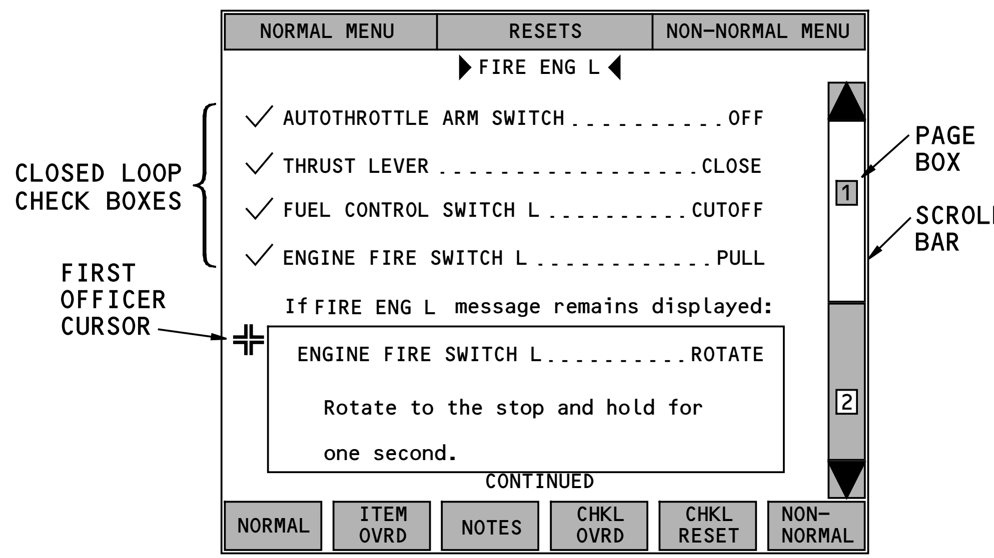
Scroll Bar

Checklists with more than one page have a scroll bar to give access to different pages. A page box and highlight indicates the page that shows on the display unit. Each page box shows the status of that page:

- White - At least one line item is not complete, or the page has not been accessed
- Green - All line items on the page are complete.

A page indicator shows a maximum of nine page numbers. Selection of a page number shows that page. A down arrow symbol replaces page number nine if the checklist is larger than nine pages. Selection of this arrow shows a page indicator that starts with an up arrow. Immediately below the up arrow is the selection of page nine and subsequent pages. This allows for a maximum of 99 pages in a checklist.





31-61-00-123 Rev 1 11/15/1995

PRIMARY DISPLAY SYSTEM - CHECKLIST CONTROL

PRIMARY DISPLAY SYSTEM - NORMAL CHECKLIST OPERATION

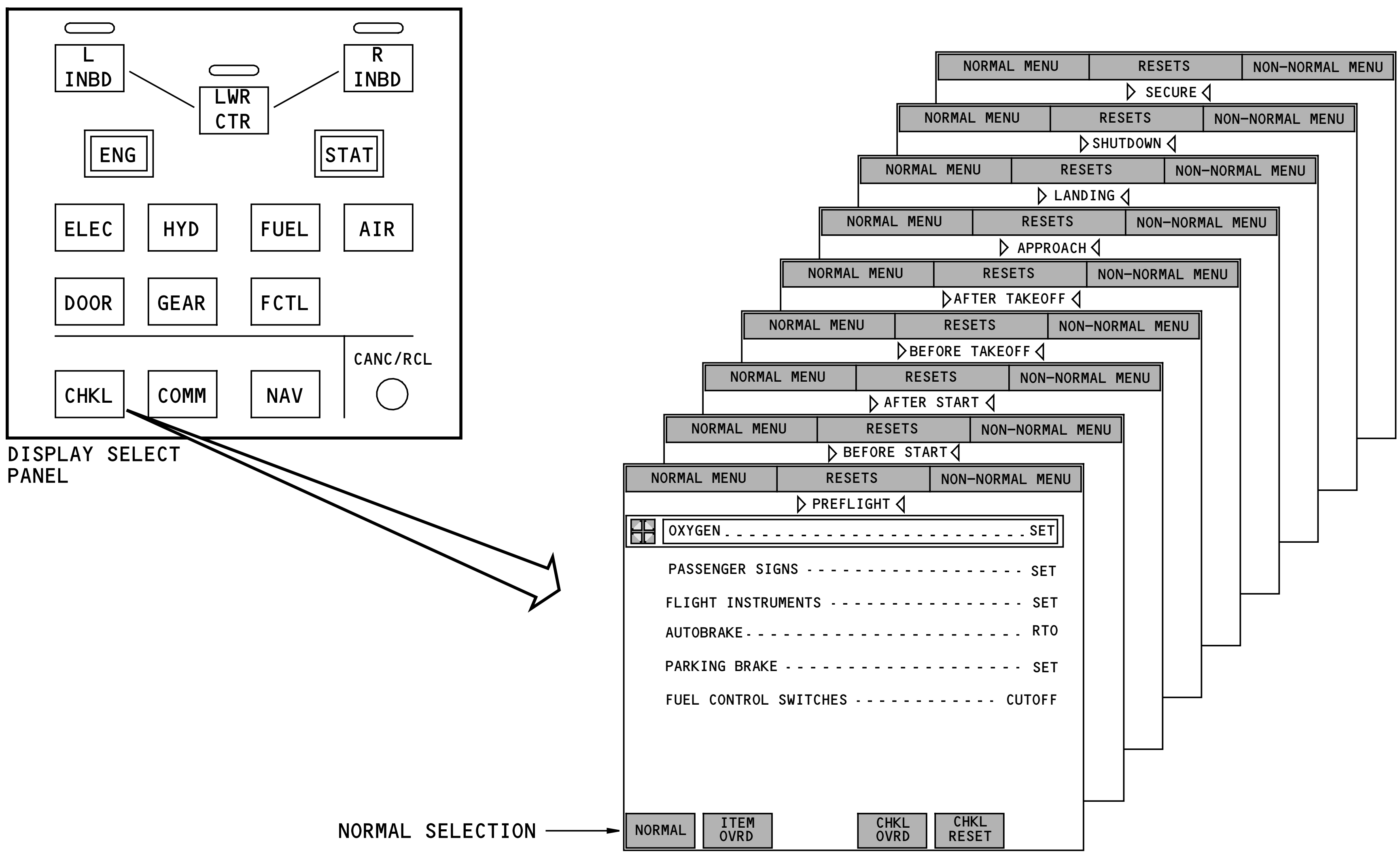
Checklist Access

To show a normal checklist, push the CHKL button on the display select panel (DSP). The first normal checklist that is not complete shows (unless a checklist with a higher priority exists). The normal checklist order directly relates to the different flight phases. The checklist changes after each flight phase. At the end of each normal checklist, select CHKL on the DSP or NORMAL in the lower left corner of the display to show the next checklist in order.

This is the order of the normal checklists:

- PREFLIGHT
- BEFORE START
- AFTER START
- BEFORE TAKEOFF
- AFTER TAKEOFF
- APPROACH
- LANDING
- SHUTDOWN
- SECURE.

To remove the checklist from the display unit (after all checklists are complete), push CHKL on the DSP a second time.



31-61-00-124 Rev 1 05/19/1997

PRIMARY DISPLAY SYSTEM - NORMAL CHECKLIST OPERATION

PRIMARY DISPLAY SYSTEM - NON-NORMAL CHECKLIST OPERATION

Checklist Access

To show a non-normal checklist, push the CHKL button on the display select panel (DSP). The first non-normal checklist that is not complete shows (unless a checklist with a higher priority exists).

If an EICAS message shows with a white empty box next to it, select CHKL to access the non-normal checklist for that condition. If more than one EICAS message shows, a CHKL selection causes a list box of non-normal checklists to show.

List Box

The list box shows non-normal checklists in this order:

- Warning message checklists
- Caution message checklists
- Advisory message checklists
- Unannunciated checklists.

The list box contains a list of incomplete checklists that have a relation to an EICAS message. Use the cursor control device to select a checklist from the list box. When the checklist is complete, the checklist title goes away from the list box. If there are more than nine non-normal checklists, a scroll bar shows adjacent to the list box.

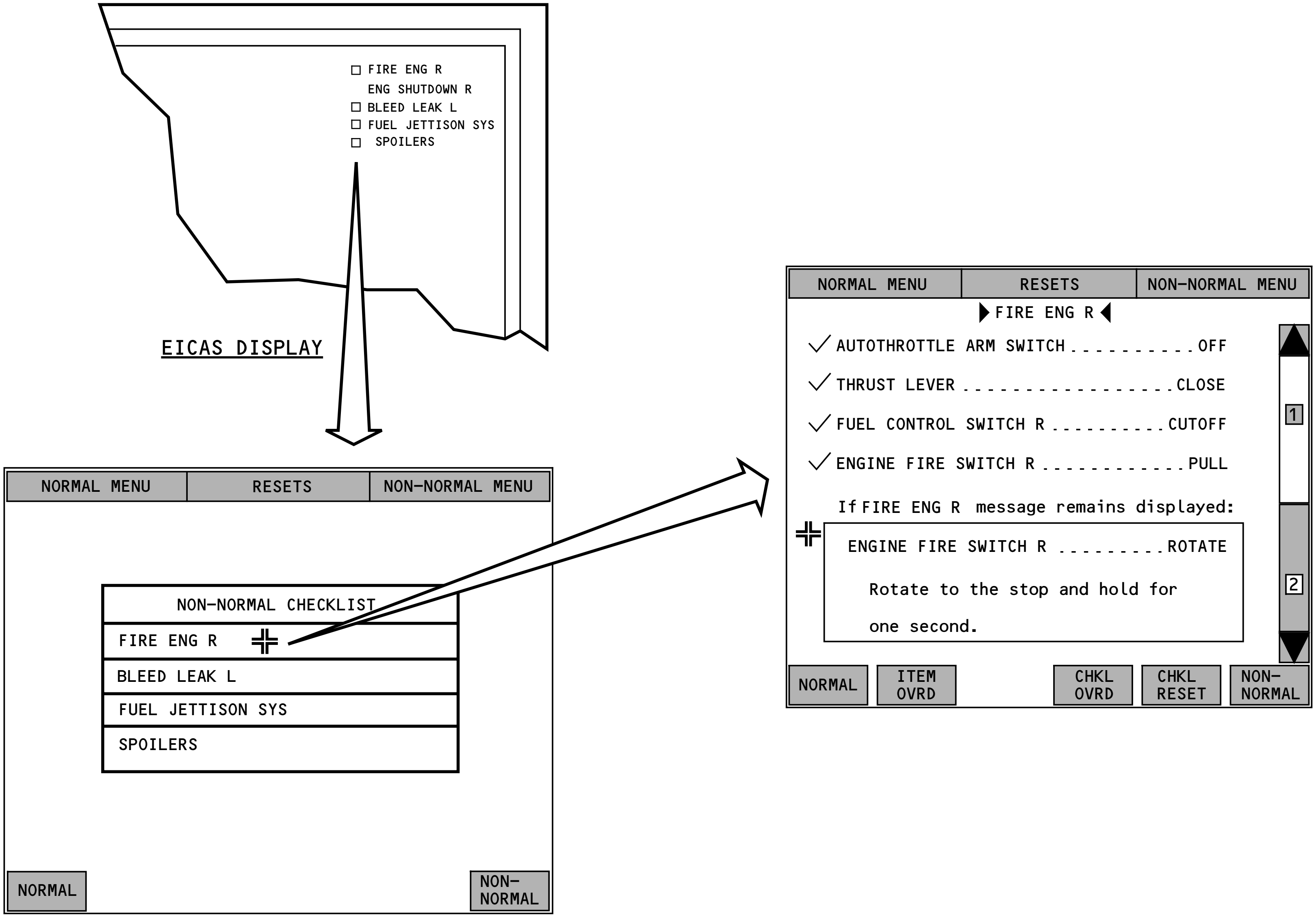
Un-annunciated Non-normal Checklists

Non-normal checklists that do not have a relation with an EICAS message are called unannunciated checklists. Select the NON-NORMAL MENU to show the non-normal checklist menu. Unannunciated checklists are the first sub-menu under the non-normal menu.

Non-normal Checklist Status Indicator

The condition of a non-normal checklist that has a relation to an EICAS message shows on the display unit (engine primary format) as a box adjacent to the related EICAS message. The checklist status shows as one of these:

- White empty box - The checklist for the message has not been accessed or the checklist has been accessed but not complete
- No box - The checklist for the message is complete or no checklist procedure exists for the message.



31-61-00-125 Rev 2 11/15/1995

PRIMARY DISPLAY SYSTEM - NON-NORMAL CHECKLIST OPERATION

PRIMARY DISPLAY SYSTEM - CHECKLIST OPERATIONAL NOTES

General

Operational notes give information about the effects of failures that occur during the flight. Operational notes include:

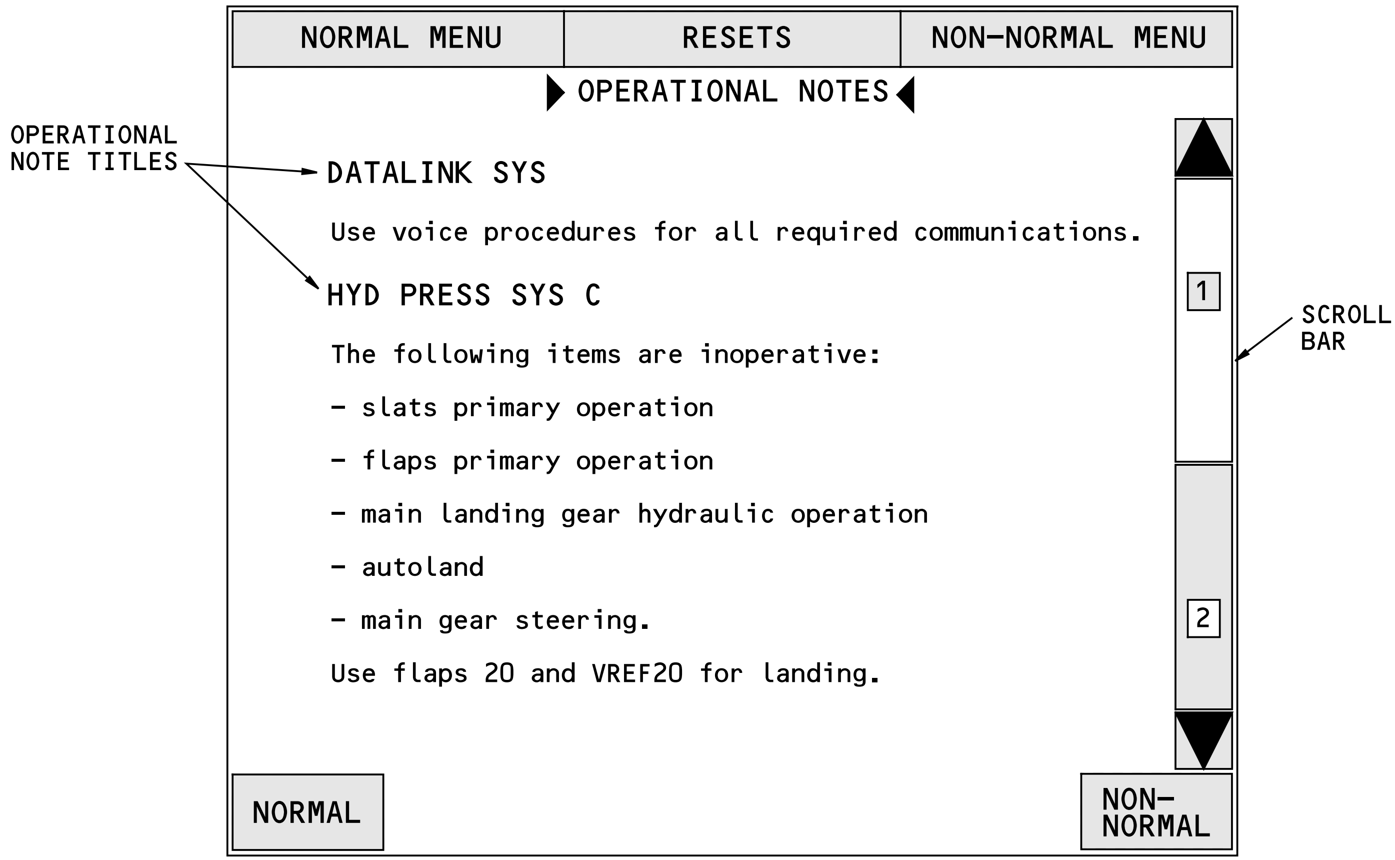
- Inoperative equipment
- Limitations
- Notes.

To access operational notes, select the NOTES command key. The NOTES selection shows on the lower part of the display unit when information that has a relation to a non-normal condition is important. Operational notes are available throughout the rest of that flight.

Each operational note includes a title which is the same as the EICAS message.

A paging panel shows if the operational notes have more than one page.

Operational notes latch to the state of the non-normal condition. When the condition and EICAS message goes away, the operational note goes away.



31-61-00-126 Rev 0

PRIMARY DISPLAY SYSTEM - CHECKLIST OPERATIONAL NOTES

PRIMARY DISPLAY SYSTEM - CHECKLIST LANDING PREPARATION FEATURE

Landing Preparation Functions

Many non-normal checklists contain landing preparation line items also known as deferred line items. These items have a relation to the approach and landing phases of flight. The landing preparation information includes:

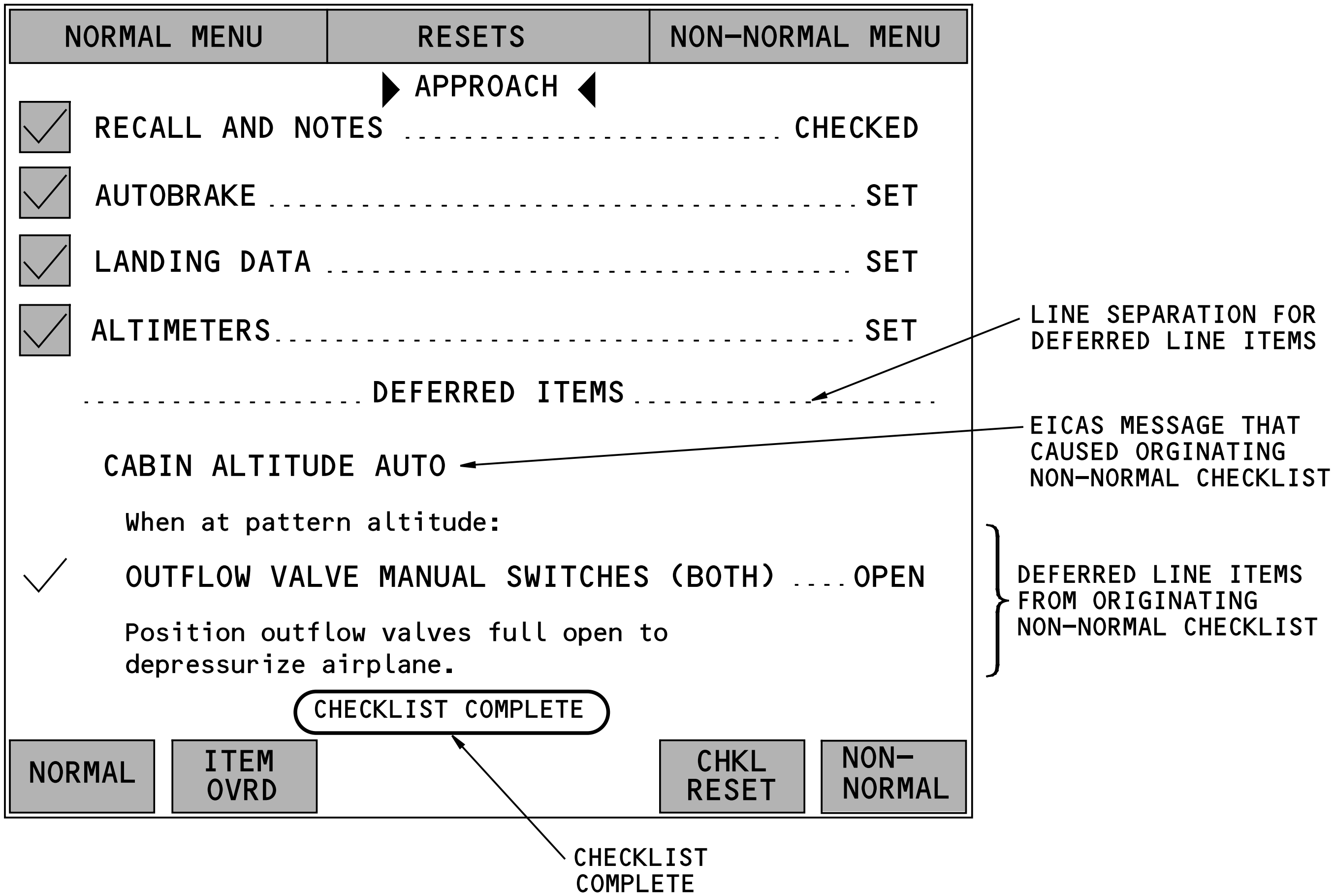
- Inoperative equipment
- Limitations
- Landing preparation procedures
- Conditional statements
- Notes.

If a non-normal checklist has deferred items, they show on a subsequent normal checklist.

A non-normal checklist that contains deferred items is complete when all line items before the deferred items are complete. The message CHECKLIST COMPLETE EXCEPT DEFERRED ITEMS shows on the bottom of the checklist.

On the normal checklists, each set of deferred items refers to the EICAS message that caused the original non-normal checklist. A line makes a separation of the deferred items from both the originating non-normal checklist and the approach or landing normal checklist.

If a non-normal condition occurs after the normal checklist is complete, the non-normal checklist is not complete until all items including the deferred items are complete.



31-61-00-127 Rev 2 03/02/95

PRIMARY DISPLAY SYSTEM - CHECKLIST LANDING PREPARATION FEATURE

PRIMARY DISPLAY SYSTEM - NON-NORMAL CHECKLIST CONDITIONAL STATEMENTS

General

These are the two different types of conditional statements for non-normal checklists:

- Closed loop (automatic switch and system input)
- Open loop (manual input from the pilot).

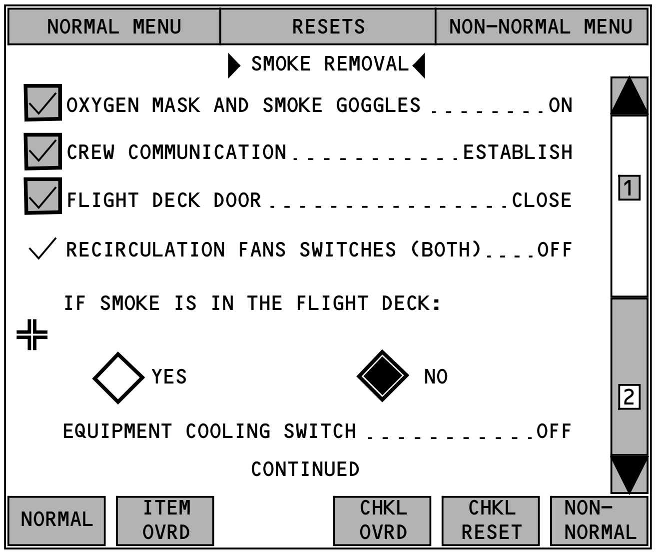
Conditional statements have an IF-THEN structure.

Open Loop If Statement

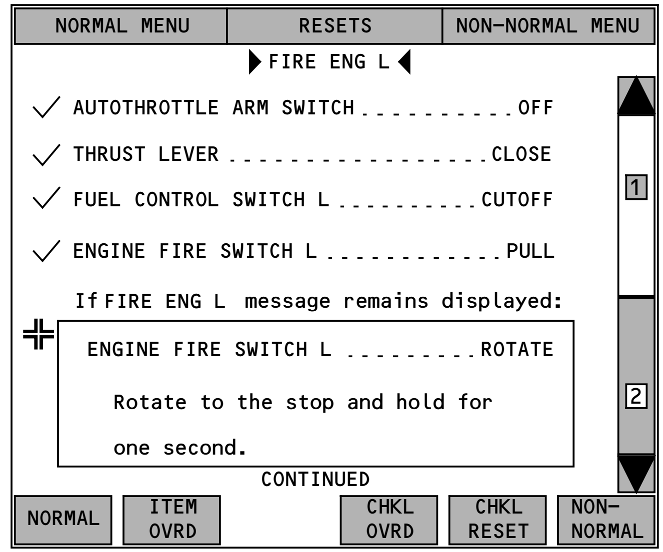
Open loop IF statements include the selections YES and NO. Use the CCD to place the cursor adjacent to the YES/NO line and make a selection to answer the statement. If the answer to the IF statement is yes, the cursor moves to the first line item within the IF statement to be completed. If the answer to the IF statement is no, the line item turns cyan to show that the item is not applicable.

Closed Loop If Statement

Closed loop IF statements are similar to open loop IF statements with one difference. In closed loop IF statements, the YES and NO decision is made automatically by the checklist function which monitors airplane system status. If the condition is yes, the cursor moves to the first line item within the IF statement to be completed. If the condition is no, the IF statement is satisfied and turns cyan to show that the item is not applicable.



OPEN LOOP IF STATEMENT



CLOSED LOOP IF STATEMENT

31-61-00-128 Rev 1 11/15/1995

PRIMARY DISPLAY SYSTEM - NON-NORMAL CHECKLIST CONDITIONAL STATEMENTS

PRIMARY DISPLAY SYSTEM - CHECKLIST OVERRIDE FUNCTION/CHECKLIST TIMERS

General

These are the two types of override functions:

- Checklist item overrides
- Checklist overrides.

Checklist Item Override

The ITEM OVRD selection is available on all checklists. Selection of the ITEM OVRD command key turns the highlighted step to cyan. This shows that the step has been overridden. Both closed loop and open loop steps can be overridden.

A checklist is complete if all steps, except landing preparation steps, are green or cyan.

Conditional statements (both closed and open loop) cannot be overridden. Steps within conditional statements can be overridden.

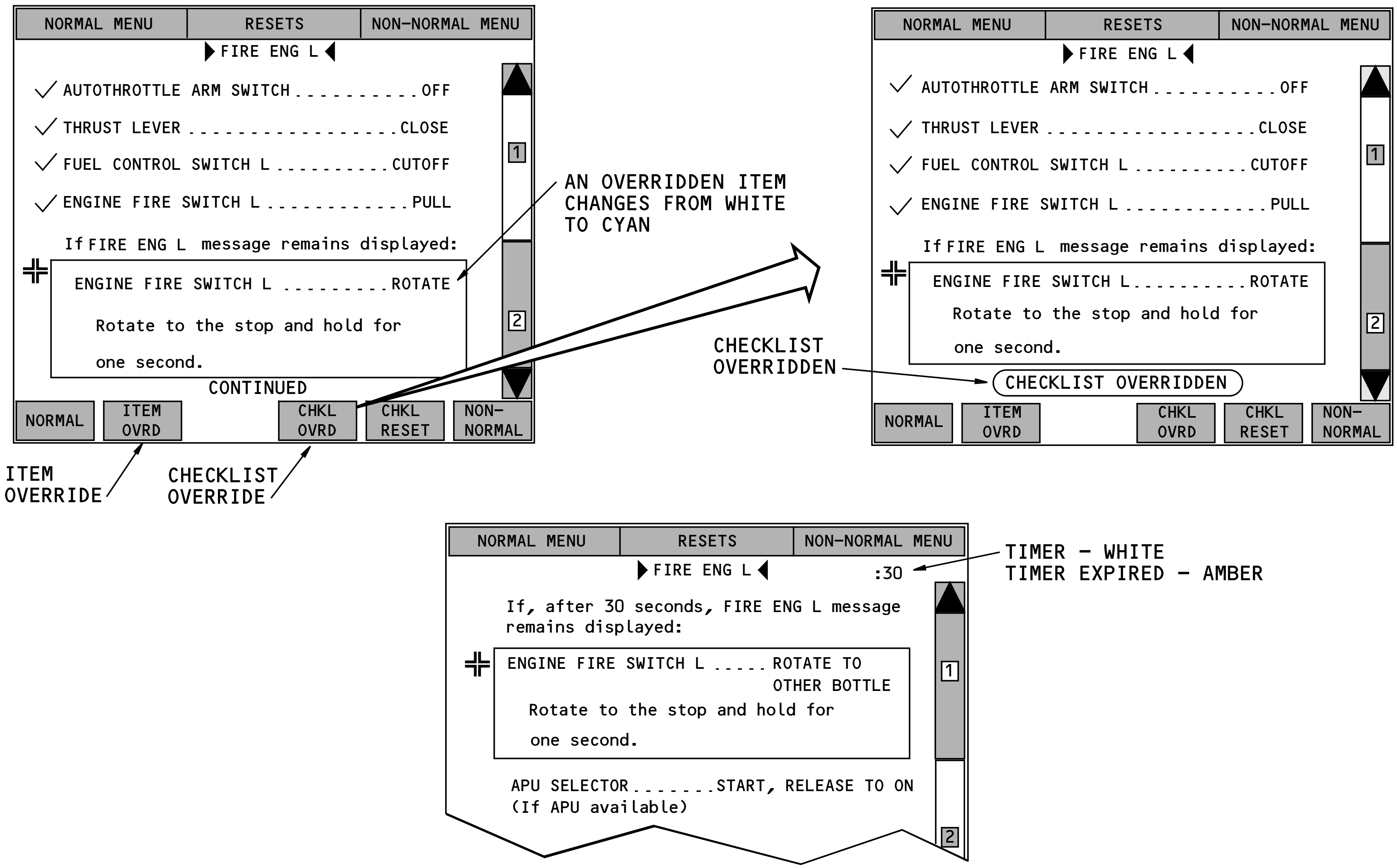
Checklist Override

Full checklists can be overridden. Select the CHKL OVRD command key to override a checklist. The checklist turns cyan when it is overridden. All related operational notes and landing preparation items go away and conditional statements cancel. The message CHECKLIST OVERRIDDEN shows at the bottom of the page.

Checklist Timers

Where necessary, an automatic timer shows in the upper right corner of the checklist. This helps complete checklist items where time delays are necessary. Maximum time is 99 minutes and 59 seconds. All timers are countdown timers. Timers usually go with conditional IF statements. When the line item highlight box shows on a line item, the timer starts to count down.

Timers continue to operate when the checklist does not show. This lets the flight crew do other tasks and then return to the checklist. Timers show in white. An expired timer shows :00 and the color is amber. As soon as the operator completes the next line item, the expired timer goes away.



PRIMARY DISPLAY SYSTEM - CHECKLIST OVERRIDE FUNCTION/CHECKLIST TIMERS

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PRIMARY DISPLAY SYSTEM - CHECKLIST RESETS

General

When a checklist is complete, to do the checklist again, the checklist must be reset. Some conditions require resets to prepare the checklist for the next phase of flight.

There are manual resets and automatic resets.

The resets menu page also has the software part numbers for the checklist databases.

Normal Checklist - Manual Reset Conditions

These are the normal manual checklist reset conditions:

- RESETS FUNCTION. The flight crew selects the RESETS function from the menu bar and then selects RESET NORMAL. This resets all normal checklists. If the flight crew selects RESET ALL, then all normal and non-normal checklists are reset.
- INDIVIDUAL CHECKLIST RESET. Select the CHKL RESET command key to reset any displayed checklist.

Normal Checklist - Automatic Reset Conditions

These are the automatic normal checklist reset conditions:

- GO-AROUND. If the airplane is in the air, the landing gear is not up, and TO/GA is selected, or takeoff thrust is set on either engine, then all specified normal checklists automatically reset.
- TOUCH AND GO. If the airplane changes from air to ground, and takeoff thrust is set with groundspeed greater than 80 KIAS, and the thrust reversers not deployed, then all specified normal checklists are reset.
- RESET ALL. The airplane changes from air to ground, and both engines are shut down, and at least one passenger door is open (conditions must be set for 10 minutes). All normal checklists are reset.
- If a completed checklist is selected from the menu, it is automatically reset.

Non-Normal Checklist Manual Reset Conditions

These are the non-normal manual checklist reset conditions:

- RESETS FUNCTION. During preflight, the flight crew selects the RESETS menu and then selects RESET NON-NORMAL. This resets all non-normal checklists. If the flight crew selects RESET ALL, then all normal and non-normal checklists are reset.
- INDIVIDUAL CHECKLIST RESET. Select the CHKL RESET command key to reset any displayed checklist.

Non-Normal Checklist - Automatic Reset Conditions

These are the automatic non-normal checklist reset conditions:

- The non-normal conditions no longer exist.

PRIMARY DISPLAY SYSTEM - CHECKLIST RESETS

- RESET ALL. The airplane changes from air to ground, and both engines are shut down, and at least one passenger door is open (conditions must be set for 10 minutes). All checklists are reset.

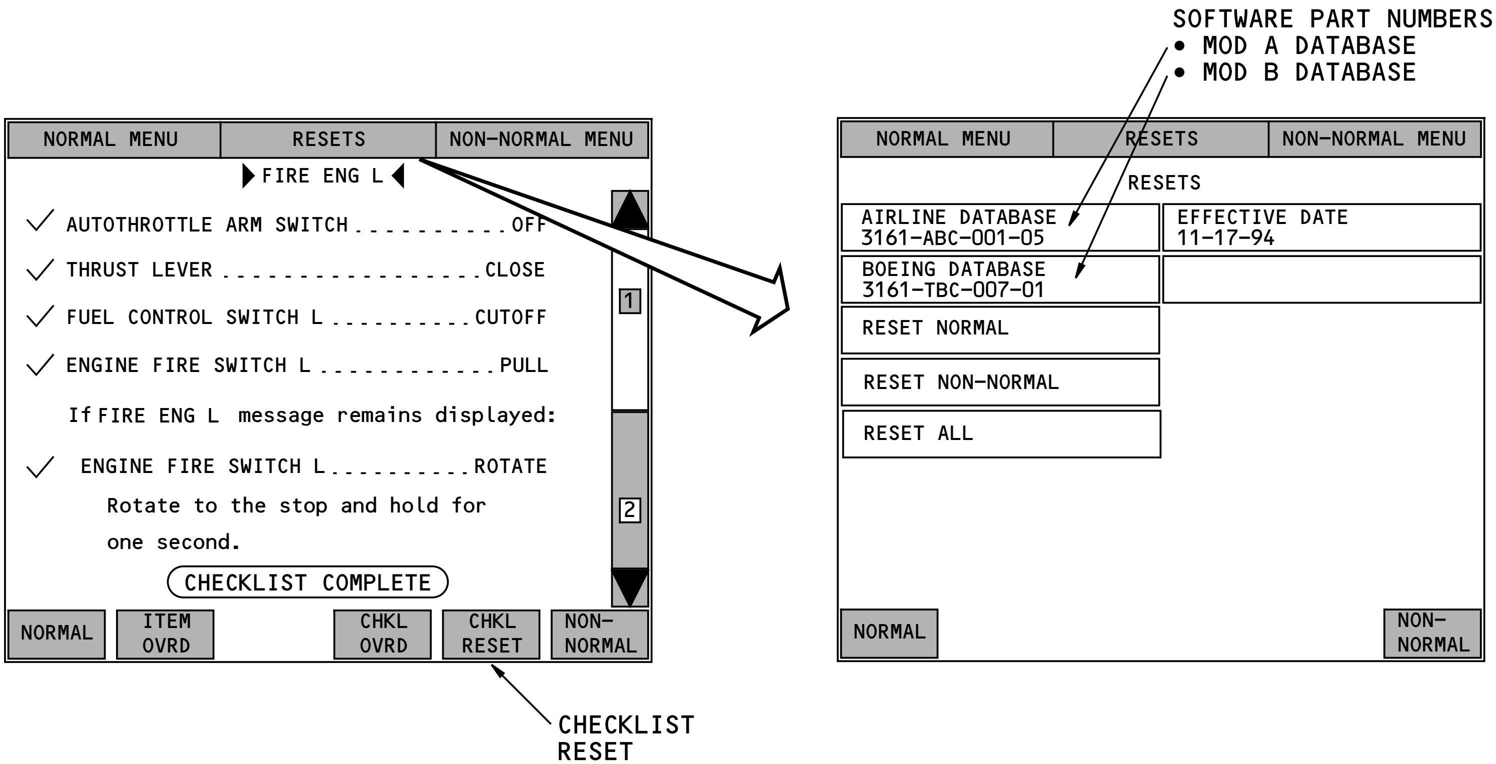
Checklist Databases

The checklist database has two parts, the MOD B database and the MOD A database.

The MOD B database has the Boeing baseline checklist and the specific rules and global rule flags for the particular airplane configuration.

The MOD A database has the Boeing baseline checklist (without the specific rules) and all the airline modifications (AMI).

Together, the two databases make an operational checklist.



31-61-00-130 Rev 1 11/15/1995

PRIMARY DISPLAY SYSTEM - CHECKLIST RESETS

PRIMARY DISPLAY SYSTEM - AIRLINE MODIFIABLE INFORMATION

General

Boeing provides an initial customized normal and non-normal checklist for each airline.

Boeing will also provide electronic checklist revision information along with operations manual updates.

The airline may use the ground based software tool to make any other desired changes to the baseline AMI.

BASELINE AMI	MODIFIABLE INFORMATION
CUSTOMIZED NORMAL AND NON-NORMAL CHECKLIST	ANY ELEMENT OF THE CHECKLIST THAT THE AIRLINE FINDS TO BE NECESSARY

31-61-00-131 Rev 1 03/02/95

PRIMARY DISPLAY SYSTEM - AIRLINE MODIFIABLE INFORMATION

PRIMARY DISPLAY SYSTEM - EICAS AND MFD FUNCTIONAL DESCRIPTION

General

Each AIMS cabinet has four input/output modules (IOMs) and two core processor/graphic generators (CPM/GGs). Each graphic generator has an output to the display units (DUs). The EICAS and MFD functions in the CPM/GGs independently process their formats. The EICAS function has these sub-functions:

- Solution logic
- EICAS display generator.

The MFD function has these sub-functions:

- System fault reports
- Determine dispatch status
- MFD display generator.

Both functions send data to the graphic generator sub-function. The graphic generator reformats and sends this data to the DUs.

IOMs

Each IOM does these functions:

- Presence and validity checks
- Source select and filtering.

The IOM modules do presence and validity checks on all display input parameters. Data updates at specified frequencies make sure that the information the flight crews see is current.

Each IOM removes bad data, replaces it with a good source, and filters the change from bad to a good data source. The IOM sends, in critical cases, messages to alert the flight crew of a failure. The IOMs send the valid and message data to the EICAS and MFD functions through the backplane bus.

CPM/GGs

Each CPM/GG also has an EICAS and MFD function with sub-functions. Each AIMS cabinet has two CPM/GGs for a total of four on the aircraft. Each CPM/GG can drive any three display units or three out of four display formats (EICAS, MFD, PFD, or ND). The PFD and ND functions configure and format the PFD and ND displays. The outboard DU location is for PFD display only. This redundant system supplies fail operational capability and allows deferred airplane maintenance.

The sub-functions in the CPM/GGs decode switch inputs and make the appropriate displays. Additional switch positions determine format location. If the upper center DU fails, the lower center DU changes to the upper center DU format.

EICAS Function- Solution logic

The solution logic sub-function receives display and switch input data from the IOMs. The solution logic sub-function determines which of these formats to select:

- EICAS display

- Compacted engine
- Secondary engine.

The solution logic use the DSP DU and ENGINE push-button selection along with DU failure status to change between the EICAS display and compacted engine formats. A second push of the DSP ENGINE switch causes the MFD to show the secondary engine format.

The solution logic sub-function sends the display data to the EICAS display function. A failure of the lower DU also causes the solution logic to send compacted engine set logic along with display outputs to the EICAS display sub-function.

EICAS Function- EICAS Display

The EICAS display sub-function use the solution logic inputs and display data to select the correct format(s) and display data. The EICAS and/or secondary formats go to the EICAS display generation block.

EICAS Function- EICAS Display Generation

The EICAS display generation sub-function reformats the display data for the graphics generator.

EICAS/ Function - MFD Graphics Generator

The graphics generator sub-function changes the EICAS display data to graphics on a vector format and sends it to the displays through a coaxial-cable. DU switch inputs from the display switching panels determine when an EICAS display shows in more than one location.

MFD Function - System Fault Reports

The system fault reports sub-function receive faults, sort and order the faults by time of occurrence. It sends this data to the determine dispatch status sub-function.

MFD Function - Determine Dispatch Status

The determine dispatch status sub-function use the fault report data and an airworthiness table to determine the airplane dispatch status. It sends this data to the MFD display generator.

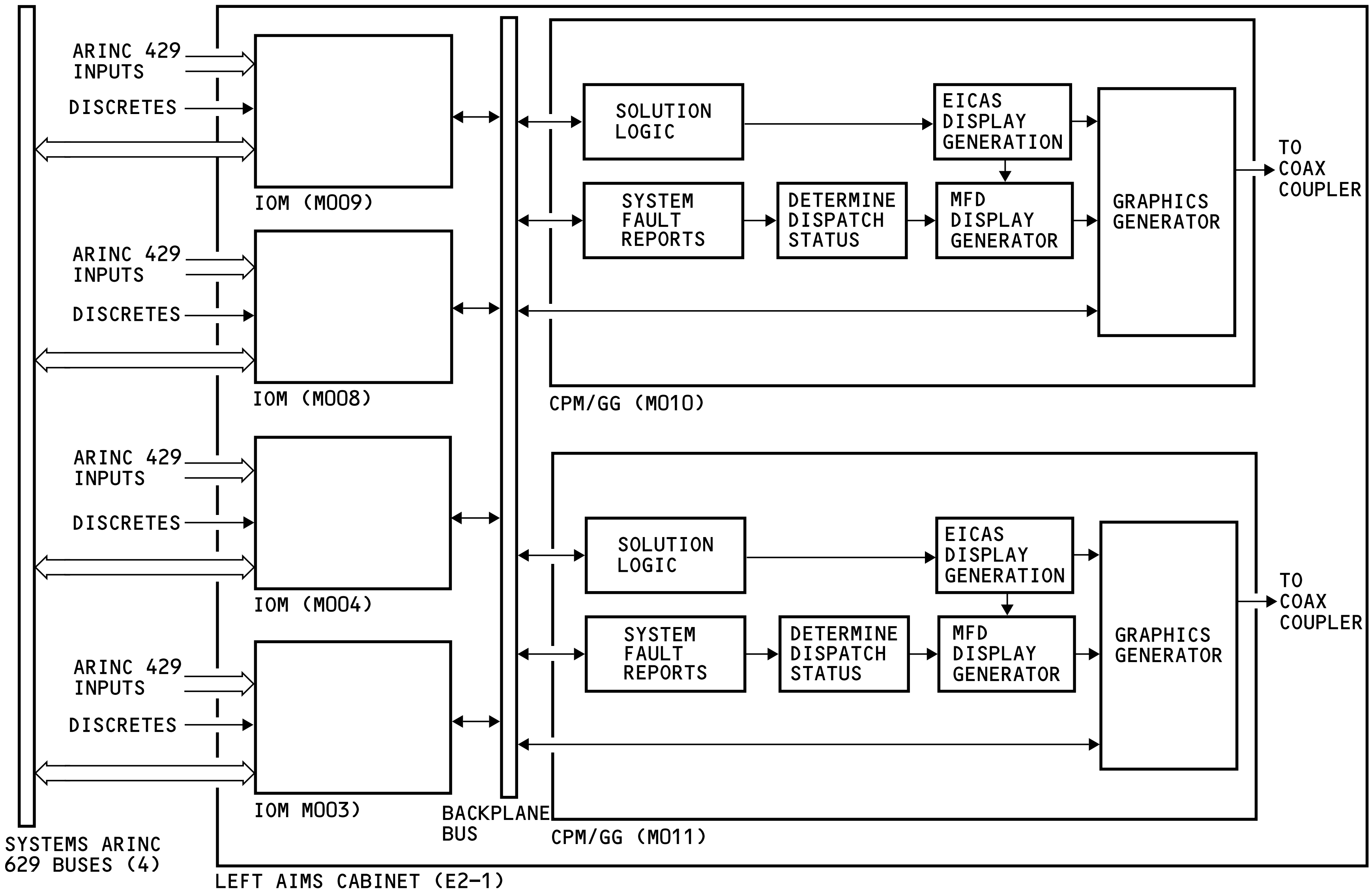
MFD Function - MFD Display Generator

The MFD display generator sub-function use the airplane status data, display selection, and real time status inputs to properly format displays. The display generator use this data along with the maintenance page control and output device selection inputs for proper page display and correct DU location. These inputs permit the MFD display to show synoptics and maintenance formats.

It also use the switch data for automatic lower DU selection to an EICAS format in case the upper DU fails.

PRIMARY DISPLAY SYSTEM - EICAS AND MFD FUNCTIONAL DESCRIPTION

The graphics generator sub-function changes the display data to a video format and sends it to the DUs through a coaxial-cable. DU switch inputs from the display switching panels determine when a MFD display shows in more than one location.



31-61-00-105 Rev 1

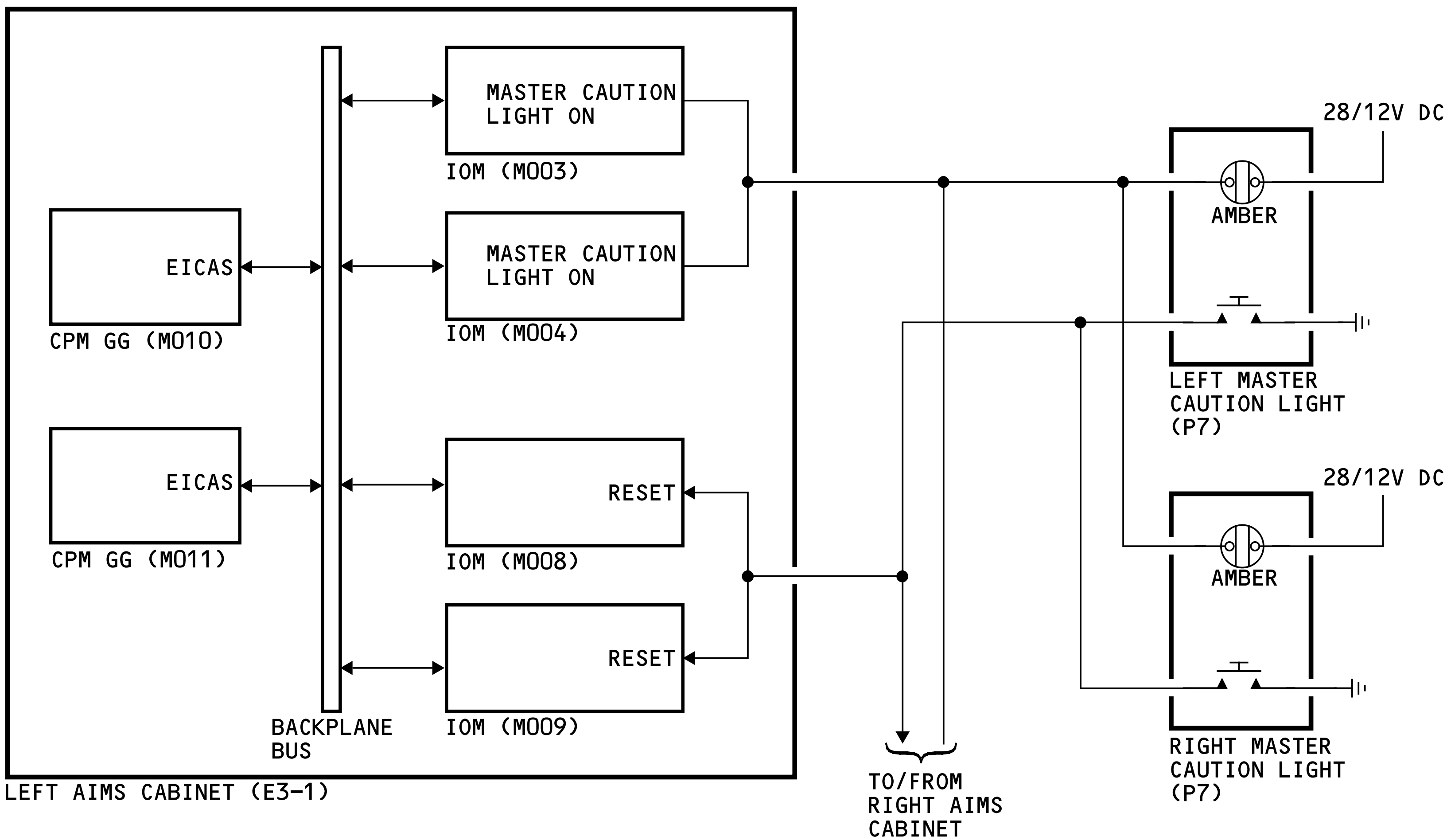
PRIMARY DISPLAY SYSTEM - EICAS AND MFD FUNCTIONAL DESCRIPTION

PRIMARY DISPLAY SYSTEM - MASTER CAUTION LIGHTS FUNCTIONAL DESCRIPTION

General

When a caution message shows on the EICAS display, the EICAS function in the CPM GGs make master caution light on signals. The IOMs supply the master caution light on signals to the master caution lights. The master caution lights come on.

When you push the master caution lights, a momentary reset signal goes to the IOMs. The IOMs send the reset signal to the EICAS function in the CPM GGs. The EICAS function then makes the master caution lights go out.



31-61-00-133 Rev 0 03/07/96

PRIMARY DISPLAY SYSTEM - MASTER CAUTION LIGHTS FUNCTIONAL DESCRIPTION

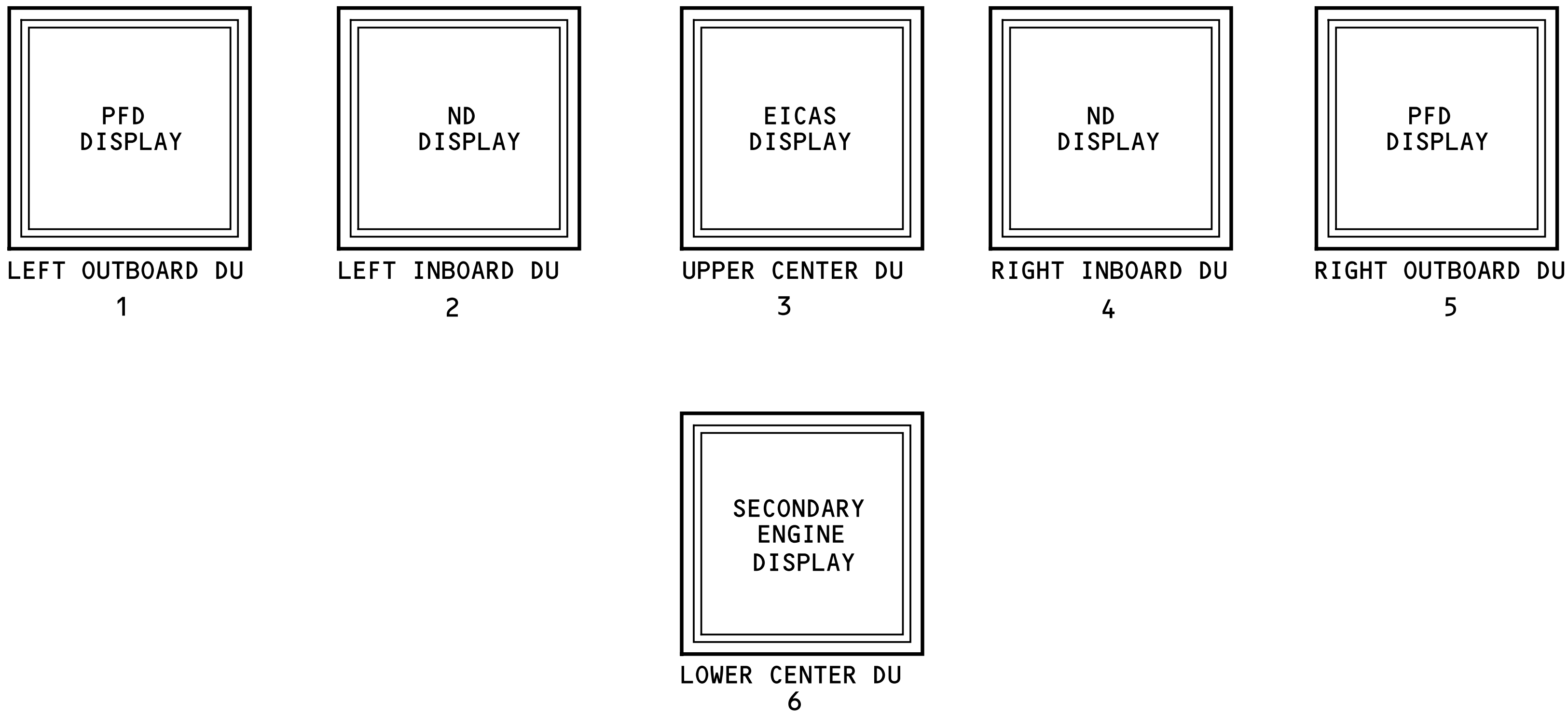
PRIMARY DISPLAY SYSTEM - DISPLAY FORMAT ALLOCATIONS - 1

General

Hardware position pins for display units (DU) determine normal display configuration. A position number identifies each DU location and its normal format. These are the position numbers, normal display format, and location:

- Position 1 - Captain's PFD (left outboard)
- Position 2 - Captain's ND (left inboard)
- Position 3 - EICAS display (upper center)
- Position 4 - First officer's ND (right inboard)
- Position 5 - First officer's PFD (right outboard)
- Position 6 - Secondary engine (lower center).

Each DU reports its operational status at power-up on the ground or at power-up after a long term power interrupt (5 seconds). The display function latches the configuration in memory. Subsequent in-flight failures of a position pin configuration does not cause format changes or failure indications.



31-61-00-106 Rev 1

PRIMARY DISPLAY SYSTEM - DISPLAY FORMAT ALLOCATIONS - 1

PRIMARY DISPLAY SYSTEM - DISPLAY FORMAT ALLOCATIONS - 2

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PRIMARY DISPLAY SYSTEM - DISPLAY FORMAT ALLOCATIONS - 2

General

Display unit failures or unique requirements cause the need to move displays to alternate DU locations. Some displays move automatically. Controls on the display select panel and the display switching panels enable the operator to move displays manually.

Display Unit Display Format Allocations

Each DU location has the capability to show specific formats.

The left outboard DU shows the captain PFD format only.

The right outboard DU shows the first officer PFD format only.

The center upper DU shows the EICAS display or compacted engine formats.

The left inboard DU shows these displays:

- Captain ND
- Captain PFD
- EICAS display
- Compacted engine display
- MFD formats.

The right inboard DU shows these displays:

- First officer ND
- First officer PFD
- EICAS display
- MFD formats.

The center lower DU shows these displays:

- MFD formats
- EICAS display
- Captain ND display
- First officer ND display.

The left, right inboard and lower center DUs can show the MFD formats. The MFD formats are:

- Secondary engine display
- Status display
- Synoptic displays
- Maintenance pages
- Checklists
- Communication displays.

Inboard Display Selectors

The inboard display selectors control onside movement of display formats to and from the inboard DUs.

The NORM position of the selector has two settings. The ND position causes the inboard DU to show the ND format. The MFD position works with the display select panel (DSP) L or R INBD switch and the other DSP display switches to show one of these displays on an inboard DU:

- Secondary engine display

PRIMARY DISPLAY SYSTEM - DISPLAY FORMAT ALLOCATIONS - 2

- Status display
- Synoptic displays
- Flight deck communication function display.

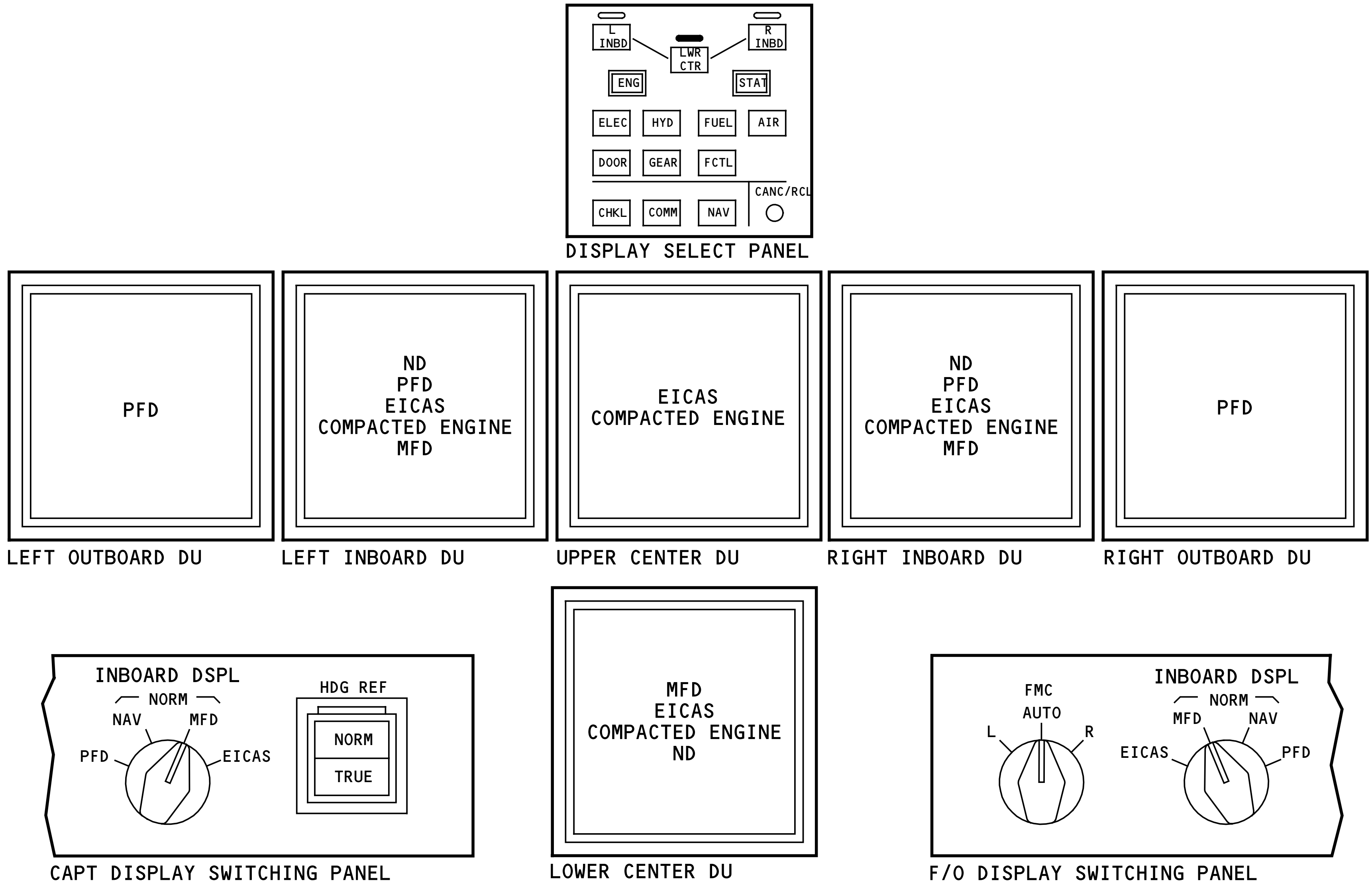
The L or R INBD switch on the DSP and the MFD position of the selector cause maintenance pages to show on an inboard DU after selection on a CDU.

PFD position causes the PFD display to show on the inboard DU.

The EICAS position causes the EICAS display to show in the normal mode or the compacted engine display to show in the limited mode. The limited mode exists when only one DU is available for EICAS display and secondary engine display.

Movement of the inboard display selector from the PFD position or from the EICAS position to the NORM position (ND or MFD) causes the ND format to show on the inboard DU.

A failure of the inboard display selector causes the display format that shows to latch.



PRIMARY DISPLAY SYSTEM – DISPLAY FORMAT ALLOCATIONS – 2

31-61-00-107 Rev 5 10/20/1997

PRIMARY DISPLAY SYSTEM - AUTOMATIC DISPLAY SWITCHING

General

The PFD display on the outboard DUs and the EICAS display on the upper center DU automatically move to alternate locations when a DU failure occurs.

When only one DU shows the EICAS display, EICAS is in the limited mode. In the limited mode, only these three switches on the DSP have a function:

- ENG switch
- AIR switch
- FUEL switch.

Outboard DU Failures

The PFD display automatically moves to the onside inboard location when a detected failure of the outboard DU occurs.

After the PFD display moves automatically, the inboard display selector on the display switching panel has no effect on the inboard DU.

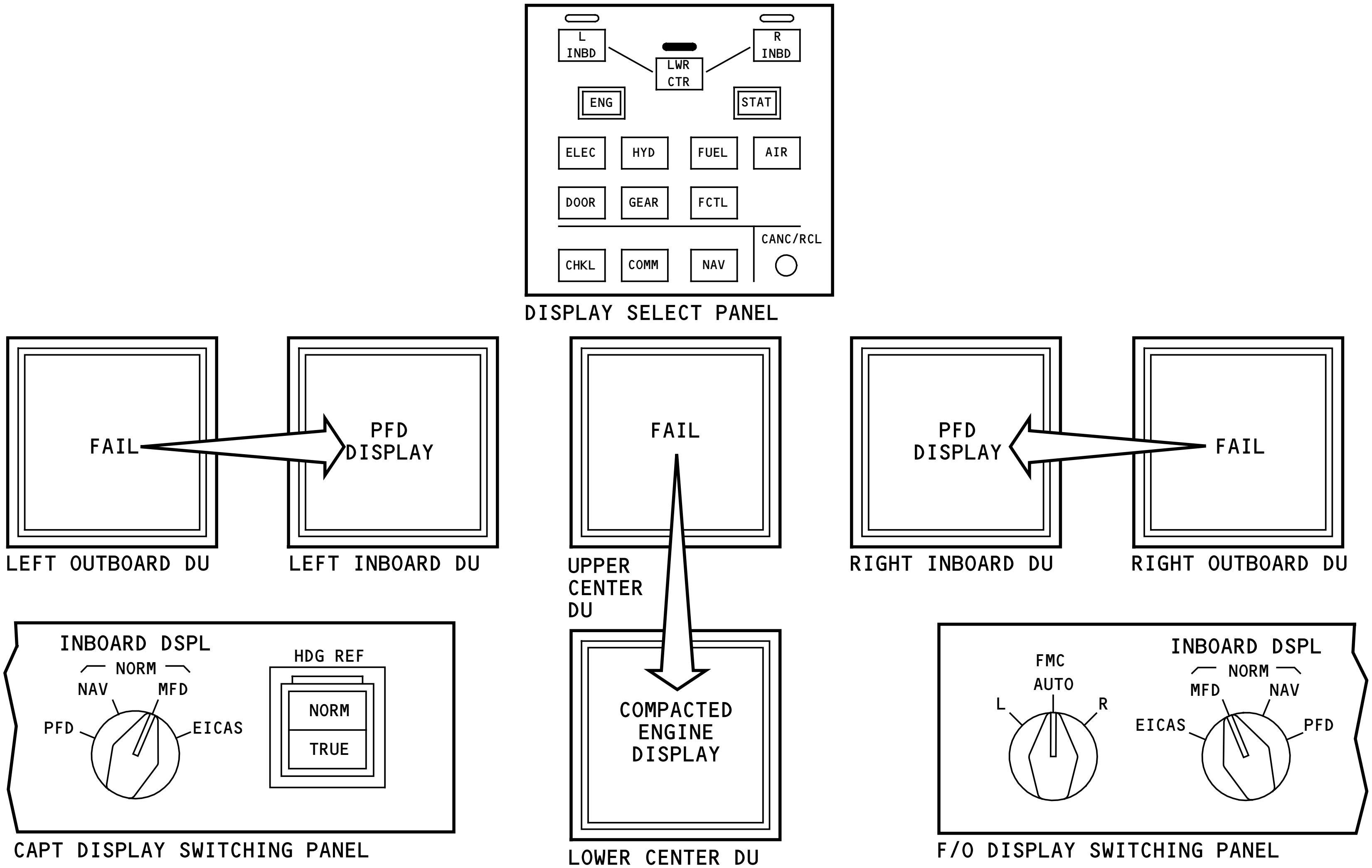
Upper Center DU failures

The EICAS display automatically moves to the lower center DU when a detected failure of the center upper DU occurs. The lower DU then shows the compacted engine display.

The ENG switch on the DSP causes the display to change between EICAS display and compacted engine display.

The AIR switch controls the ECS data block.

The FUEL switch controls the fuel quantity and fuel imbalance display.



31-61-00-108 Rev 2 05/19/1997

PRIMARY DISPLAY SYSTEM - AUTOMATIC DISPLAY SWITCHING

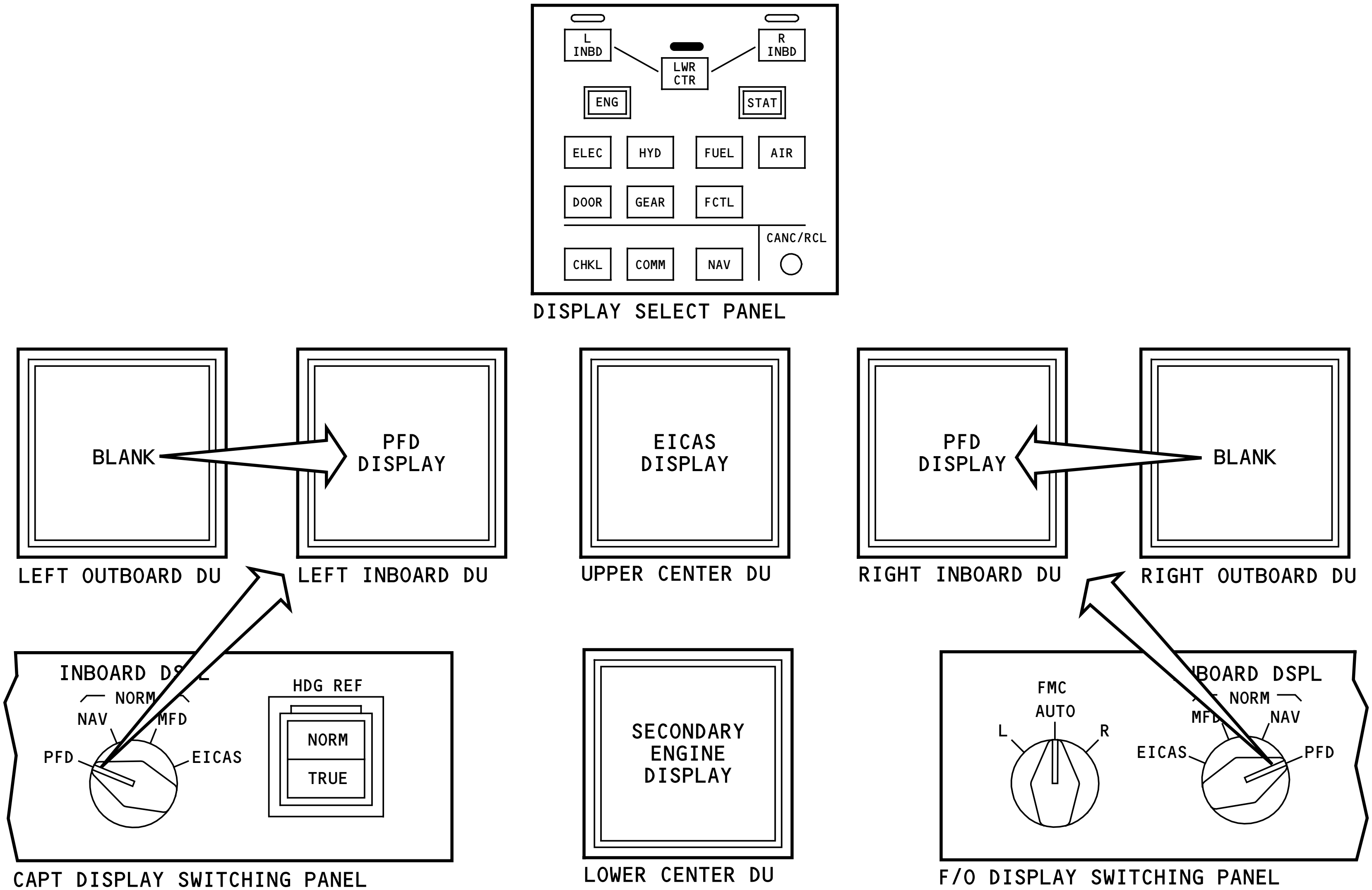
PRIMARY DISPLAY SYSTEM - PFD MANUAL SWITCHING

General

The PFD position of the inboard display selector on the display switching panel lets the operator move the PFD format to the inboard DU.

The outboard DU blanks when the selector is in the PFD position.

Return the inboard display selector to NORM (ND or MFD) to cause the PFD to show on the outboard DU and to cause the ND format to show on the inboard DU.



PRIMARY DISPLAY SYSTEM - PFD MANUAL SWITCHING

31-61-00-109 Rev 1 05/19/1997

PRIMARY DISPLAY SYSTEM - MANUAL EICAS SWITCHING

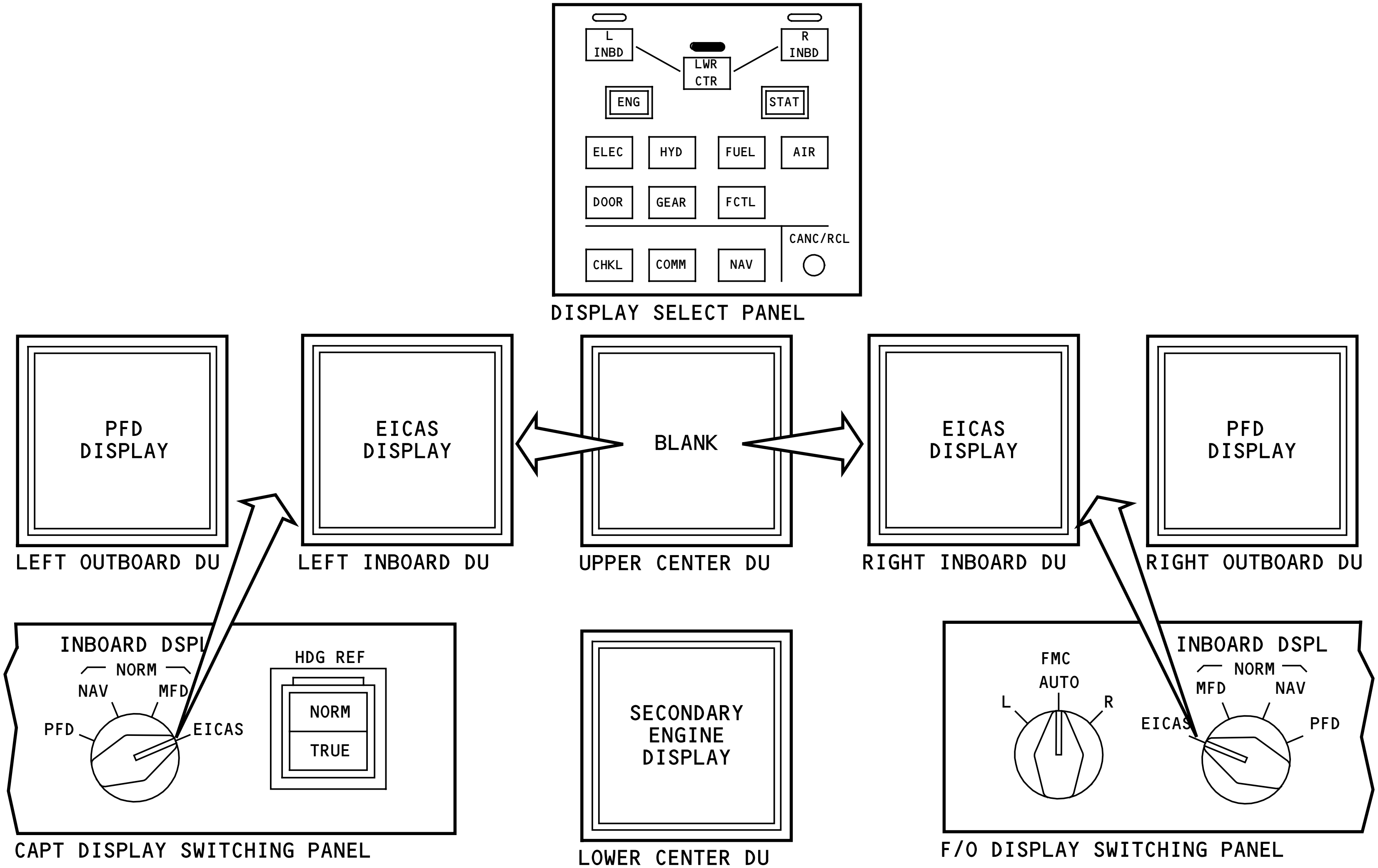
General

The EICAS position of the inboard display selector on the display switching panel lets the operator move the EICAS display format to the inboard DU.

Both inboard DUs can show the EICAS display format at the same time. Both displays will be identical. One DU cannot show EICAS display and the other show compacted engine.

The upper center DU blanks when the inboard display selector is in the EICAS position.

Return the inboard display selector to NORM (ND or MFD) to cause the engine EICAS display to show on the upper center DU and to cause the ND format to show on the inboard DU.



PRIMARY DISPLAY SYSTEM - MANUAL EICAS SWITCHING

PRIMARY DISPLAY SYSTEM - MULTIPLE DU FAILURES

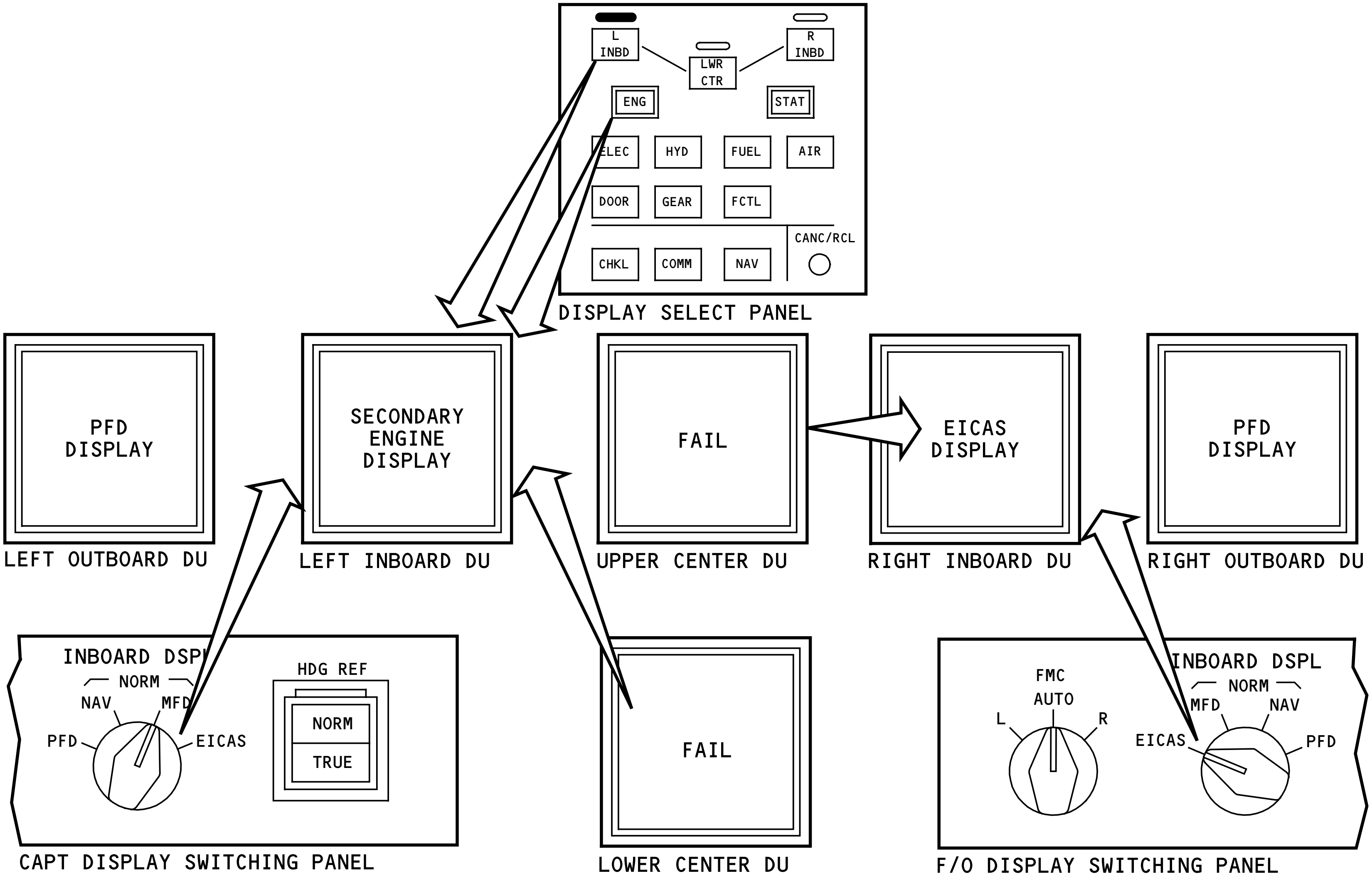
General

The display select panel (DSP) switches and the inboard display selectors on the display switching panel provide system redundancy when multiple DU failures occur.

The EICAS position of the inboard display selector causes the EICAS display format to show on an inboard DU.

The L INBD or R INBD switch on the DSP causes other EICAS formats to show on an inboard DU. The inboard display selector must be in the MFD position before the DSP L INBD or R INBD switch will have effect.

The L INBD or R INBD switch also has no effect if an outboard DU fails and the PFD automatically switches to an inboard DU.



31-61-00-111 Rev 1 05/19/1997

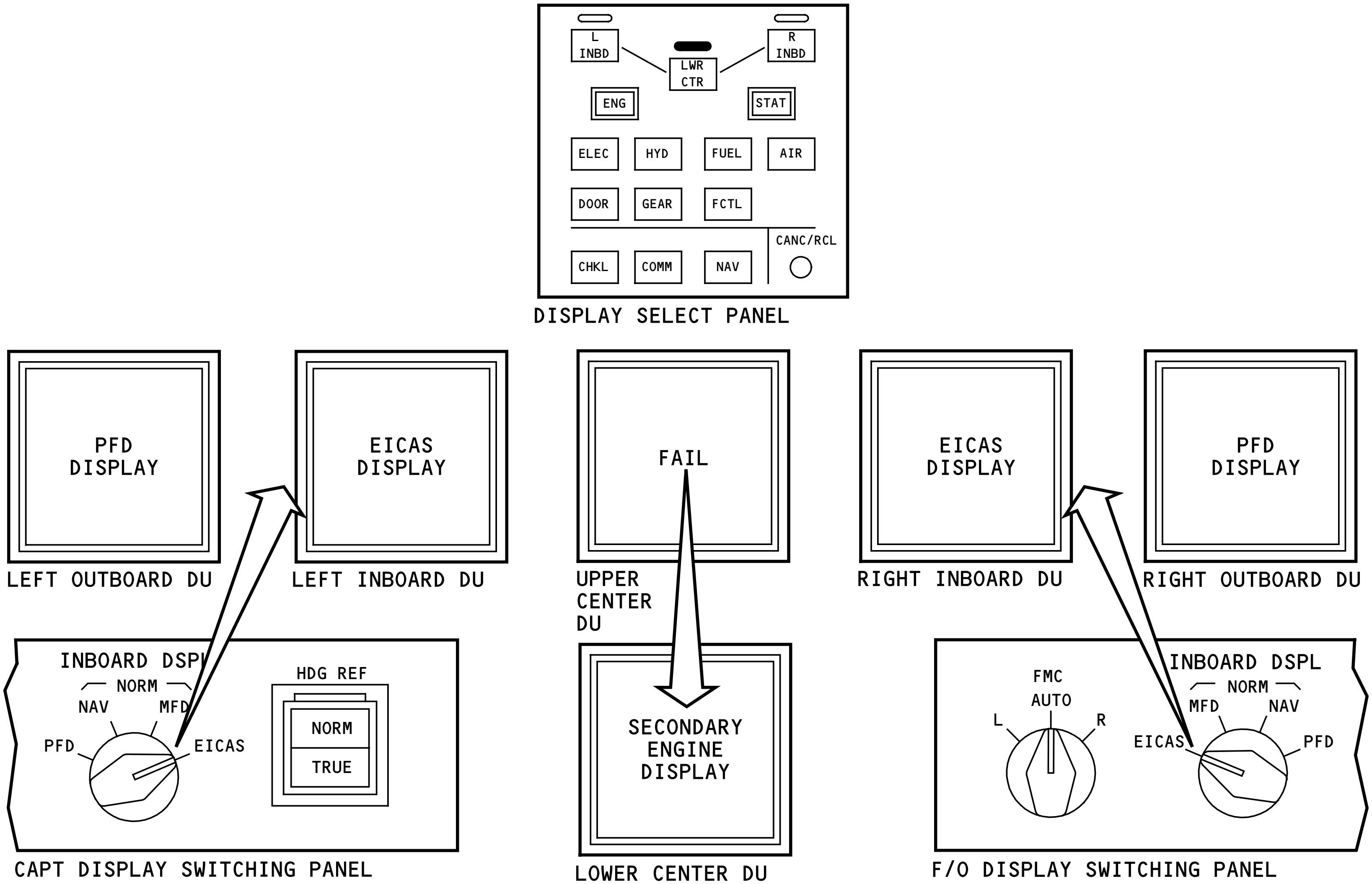
PRIMARY DISPLAY SYSTEM - MULTIPLE DU FAILURES

PRIMARY DISPLAY SYSTEM - EICAS LIMITED MODE RECOVERY

General

After the EICAS display automatically switches, the selection of EICAS on either inboard display selector causes the lower center DU to show the secondary engine format. The EICAS display shows on the inboard DU.

The EICAS display shows on both inboard DUs when the inboard display selectors are in the EICAS position.



31-61-00-112 Rev 2 05/19/1997

PRIMARY DISPLAY SYSTEM - EICAS LIMITED MODE RECOVERY

PRIMARY DISPLAY SYSTEM - MULTIPLE DISPLAY FORMATS

General

The primary display system has the capability to show multiple formats at the same time. To do this, the DSP works with the inboard display selectors on the display switching panels. The system has the capability to show any combination of display formats.

As an example, to show the AIR synoptic on the F/O's inboard DU, do this:

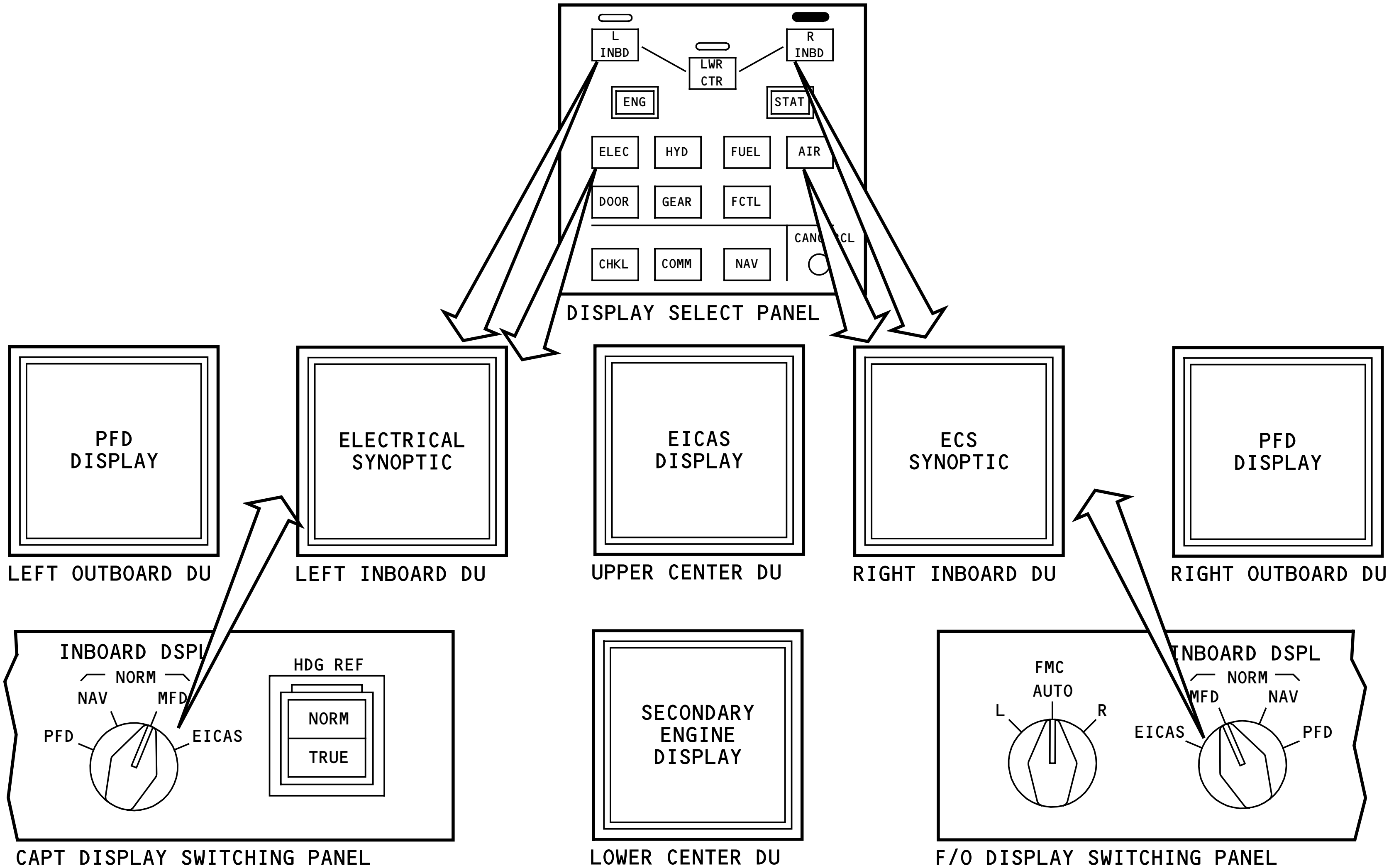
- Put the right inboard display selector in the MFD position
- Select R INBD on the DSP
- Select AIR on the DSP.

To show the electrical synoptic on the captain's inboard DU, do this:

- Put the left inboard display selector in the MFD position
- Select L INBD on the DSP
- Select ELEC on the DSP.

The inboard DUs return to the ND display when you put the inboard display selector in the ND position or when you select the NAV switch on the DSP.

The inboard DU also returns to the ND display when you select a synoptic that already shows on that ND.



PRIMARY DISPLAY SYSTEM - MULTIPLE DISPLAY FORMATS

31-61-00-113 Rev 3 05/19/1997

PRIMARY DISPLAY SYSTEM - NAVIGATION DISPLAY PRIORITIES

Center Lower DU

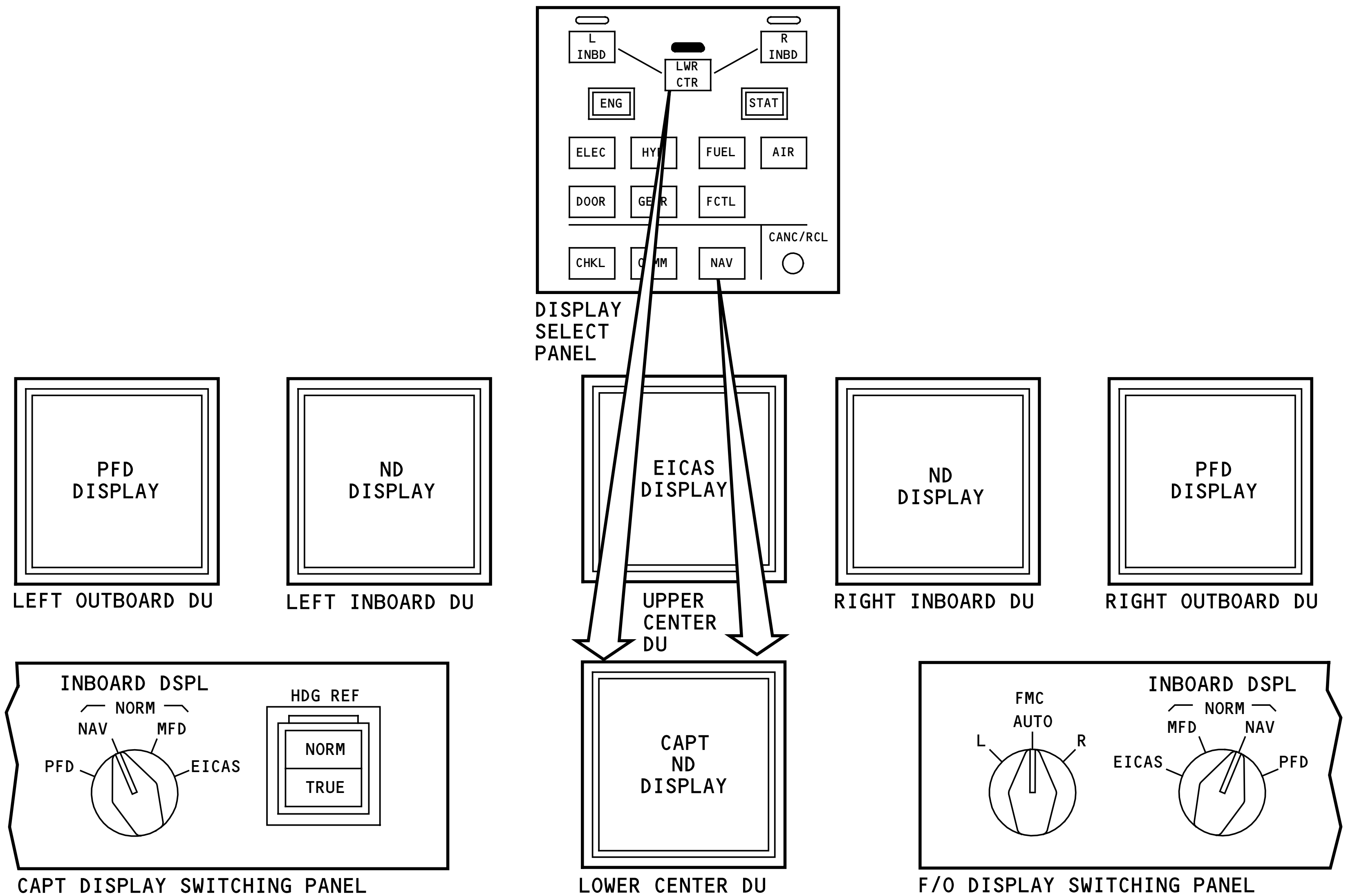
Select the NAV switch and the LWR CRT switch on the DSP to cause an ND display to show on the lower center DU.

If only one ND (capt or F/O) shows on an inboard DU, the other ND (capt or F/O) shows on the lower center DU.

If both the captain's and the F/O's inboard DUs show the ND display or neither show the ND display, the lower center DU shows the captain's ND.

Inboard DU

If the left or right inboard display selector on the display switching panels is in the NAV or MFD position and the NAV switch on the DSP is set, the left or right inboard DU shows the associated captain's or first officer's ND display unless that ND display already shows, then the inboard DU blanks.



PRIMARY DISPLAY SYSTEM - NAVIGATION DISPLAY PRIORITIES

PRIMARY DISPLAY SYSTEM - SECONDARY ENGINE EXCEEDANCE

General

The EICAS display format and MFD show different formats when a secondary exceedance latches or an exceedance clear occurs. This occurs during normal and limited operation.

Secondary Engine Exceedance Latches

When a secondary engine exceedance latches in memory, the upper center DU and lower center DU change formats. The new formats depend on the formats that show before the exceedance occurs.

During normal operation one of these will occur:

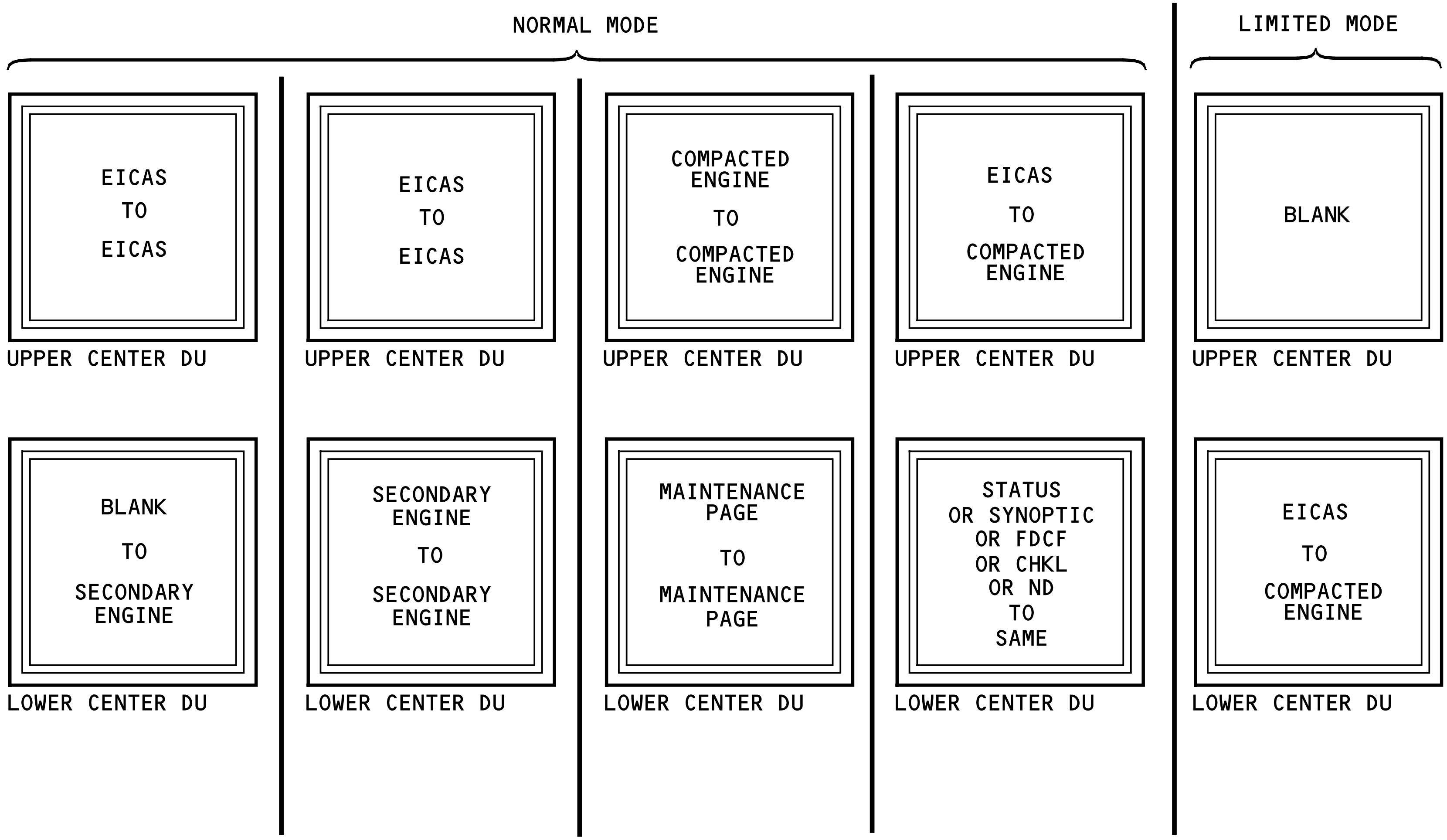
- If the lower center DU is blank, then it shows the secondary engine format and the upper center DU shows the EICAS display format.
- If the lower center DU shows the secondary engine format, it remains the same and the upper center DU shows the EICAS display format.
- If the lower center DU shows a maintenance page while the airplane is on the ground, it remains the same and the upper center DU shows the compacted engine format.
- If the lower center DU shows a status page format, a synoptic, flight deck communication function format, checklist format or a navigation display, it remains the same and the upper center DU shows the compacted engine format.

During limited operation, if the upper center DU is blank and the lower center DU shows the EICAS display format, the lower center DU shows the compacted engine format.

Secondary Engine Exceedance Clears

During normal operation, when the secondary engine exceedance clears, the upper center DU shows the EICAS display format for all conditions except when the lower center DU shows a maintenance page while the airplane is on the ground, then the upper center DU shows the compacted engine format. The center lower DU remains the same.

During limited operation, when the exceedance clears, the lower center DU remains the same.



31-61-00-115 Rev 1 03/20/95

PRIMARY DISPLAY SYSTEM - SECONDARY ENGINE EXCEEDANCE

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PRIMARY DISPLAY SYSTEM - SPECIAL FUNCTIONS

General

The AIMS primary display system (PDS) special functions make sure the interfaces of the displays to their hardware are correct. PDS hardware includes:

- CPM/GGs
- Display units (DU)
- Coaxial couplers
- Control panels and switches
- Remote light sensors
- Cursor control devices (CCD).

These are the special functions for PDS hardware:

- Display Switches
- Display screens (5)
- CPM/GG to WXR interface checks (4)
- Brightness control and display units
- CPM/GG to DU interface checks (4).

Display Switches

The display unit special functions supports functional testing of interfaces and verifies correct operation. The DUs show a test format to do this.

Display Screens (5)

Select the display screen special functions on the MAT. Examine the DU liquid crystal display (LCD). The DU BITE circuits do not monitor the DU LCD and electronic driver circuits. These are the failures to look for:

- Line defects
- Element defects
- Full-field gray scale characteristics.

For the full red screen test (the red, blue, and green screen tests are similar), all six DUs show a solid red screen. Use the MAT to cycle through the seven red gray scales. All six DUs show the same red gray scale level. This occurs with the brightness controls on all six DUs set to maximum and all six DUs should appear equal. A DU with a weak backlight or electronic driver failure stands out from the other DUs at one or more of the gray scale levels.

For the full white/black screen test, all DUs show a solid white screen. Use the MAT to cycle through the seven gray scales plus black. This test detects intermittent dot failures and hard failures. A DU with a weak backlight or electronic driver failure stands out from the other DUs at one or more of the gray scale levels.

For the striped pattern test, all six DUs show a screen with diagonal white and black stripes. This format allows detection of electrically floating line failures. These lines may not be visible on a solid color screen.

CPM/GG to WXR Interface Check (4)

The CPM/GG to WXR interface check verifies the validity to the WXR ARINC 453 inputs to the GGs in each AIMS cabinet.

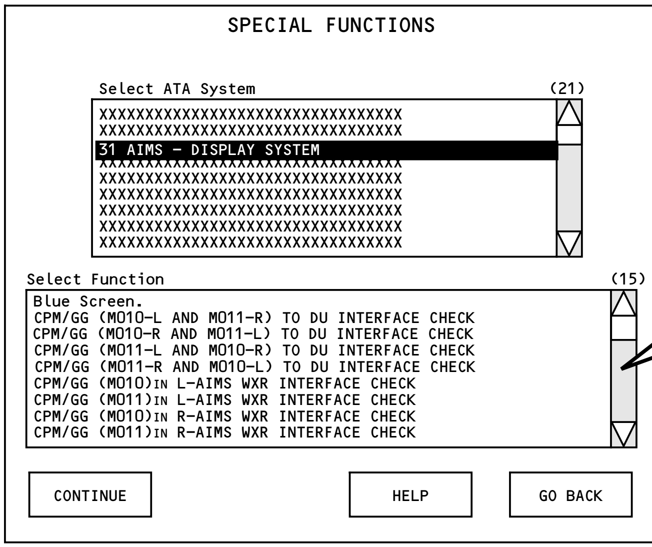
PRIMARY DISPLAY SYSTEM - SPECIAL FUNCTIONS

Brightness Control and Display Units

This special function supports functional tests of hardware interfaces and makes sure operation is correct. The six DUs show a test display to do this.

CPM/GG to DU Interface Checks (4)

The graphic generator special functions supports functional tests of airplane interfaces and verifies correct interface of the CPM/GGs to the DUs. The CPM/GGs do a test one at a time. The DUs are grouped in two sets of three for this test. All four combinations of CPM/GG to DU groups are tested. The DUs show the test format to make sure that each DU receives each CPM/GG input.



Select Function (15)

BLUE SCREEN
BRIGHTNESS CONTROLS AND DISPLAY UNITS
CPM/GG (M010)IN L-AIMS WXR INTERFACE CHECK
CPM/GG (M011)IN L-AIMS WXR INTERFACE CHECK
CPM/GG (M010)IN R-AIMS WXR INTERFACE CHECK
CPM/GG (M011)IN R-AIMS WXR INTERFACE CHECK
CPM/GG (M010-L AND M011-R) TO DU INTERFACE CHECK
CPM/GG (M010-R AND M011-L) TO DU INTERFACE CHECK
CPM/GG (M011-L AND M010-R) TO DU INTERFACE CHECK
CPM/GG (M011-R AND M010-L) TO DU INTERFACE CHECK
DISPLAY SWITCHES
GREEN SCREEN
RED SCREEN
STRIPE SCREEN
WHITE SCREEN

31-61-00-116 Rev 4

PRIMARY DISPLAY SYSTEM - SPECIAL FUNCTIONS

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PRIMARY DISPLAY SYSTEM - BRIGHTNESS CONTROLS AND DISPLAY UNITS TEST DISPLAY

General

The brightness controls and display units test is a special purpose test that does a test of the primary display system hardware. You use the MAT or PMAT to start the test and the test display shows on all six DUs.

The test display shows these:

- DU location
- ARINC 429 loop
- Graphic generator (GG) source
- DU input activity
- Status of brightness inputs.

The background of the test format is black. Text titles are cyan. Test values are white except for FAIL, N (for no) and BAD which are red. PASS and Y (for yes) are green.

DU Location

The DU location information shows the location ID pins of the DU that the GG is addressing. The readouts show as:

- RIB - right inboard DU
- ROB - right outboard DU
- CU - center upper DU
- CL - center lower DU
- LIB - left inboard DU
- LOB - left outboard DU.

An invalid DU location ID shows as BAD.

ARINC 429 Loop

The ARINC 429 loop shows the status of the ARINC 429 bus from the DUs to the AIMS cabinets.

A PASS or FAIL indication shows on the DU.

GG Source

The GG source shows the GG that is driving the display. The readouts show as:

- L10 for the left GG in the left AIMS cabinet
- L11 for the right GG in the Left AIMS cabinet
- R10 for the left GG in the right AIMS cabinet
- R11 for the right GG in the right AIMS cabinet.

Input Activity

The input activity area shows the status of the four DU coaxial cable inputs. The specific input for each DU shows with a white highlight box.

A Y or N shows for each of the four coaxial inputs.

Brightness Inputs

The value of both automatic and manual brightness control inputs show as a percentage of maximum value.

PRIMARY DISPLAY SYSTEM - BRIGHTNESS CONTROLS AND DISPLAY UNITS TEST DISPLAY

The range of each of the inputs is from 0 to 100. BAD shows if the input is bad. These are the inputs for automatic brightness controls:

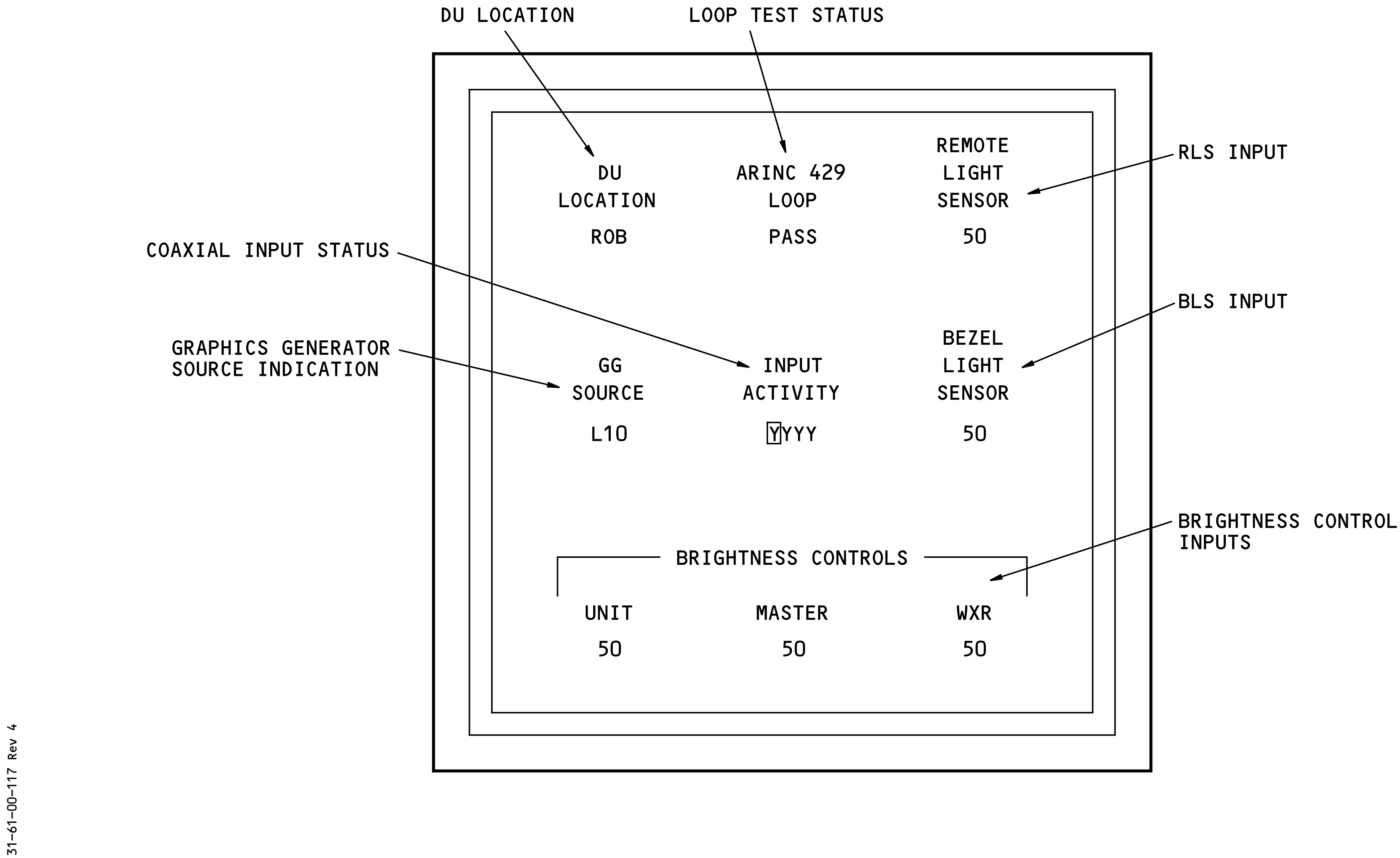
- Remote light sensor (RLS)
- Bezel light sensor (BLS).

During the test, automatic brightness control of the DUs is disabled.

These are the manual inputs:

- Unit brightness from the individual brightness control knob
- Master brightness from the zone brightness control
- WXR from the shading brightness control knob.

As you adjust a knob, the value on the DU should change.



PRIMARY DISPLAY SYSTEM - BRIGHTNESS CONTROLS AND DISPLAY UNITS TEST DISPLAY

PRIMARY DISPLAY SYSTEM - DISPLAY SWITCHES TEST DISPLAY

General

The display switches test display is a special purpose test that shows the status of switches that effect the primary display system. You use the MAT or the PMAT to select the test and a test display shows on all six DUs. As you change the position of any of the switches, the display changes.

The display shows the condition of these switches:

- Display select panel (DSP) switches
- Accept (ACPT), cancel (CANC), reject (RJCT) switches.

The display also shows the position of switches and selectors on the:

- Instrument source select panels (ISSPs)
- Display switching panels
- CDCP.

DSP Switches

There is an indication for all the switches on the DSP. A filled white box shows when you select a switch. The fill goes away when you deselect the switch.

Accept, Cancel, Reject Switches

A filled white box shows when you select a switch. The fill goes away when you deselect the switch.

ISSPs

The position of each of the switches on the captain's and first officer's ISSPs show.

The display control (DSPL CTRL) switch positions show as AUTO or ALT.

The navigation source switch positions show as AUTO or CDU.

The air data/attitude source switch positions show as NORM or ALT.

Display Switching Panels

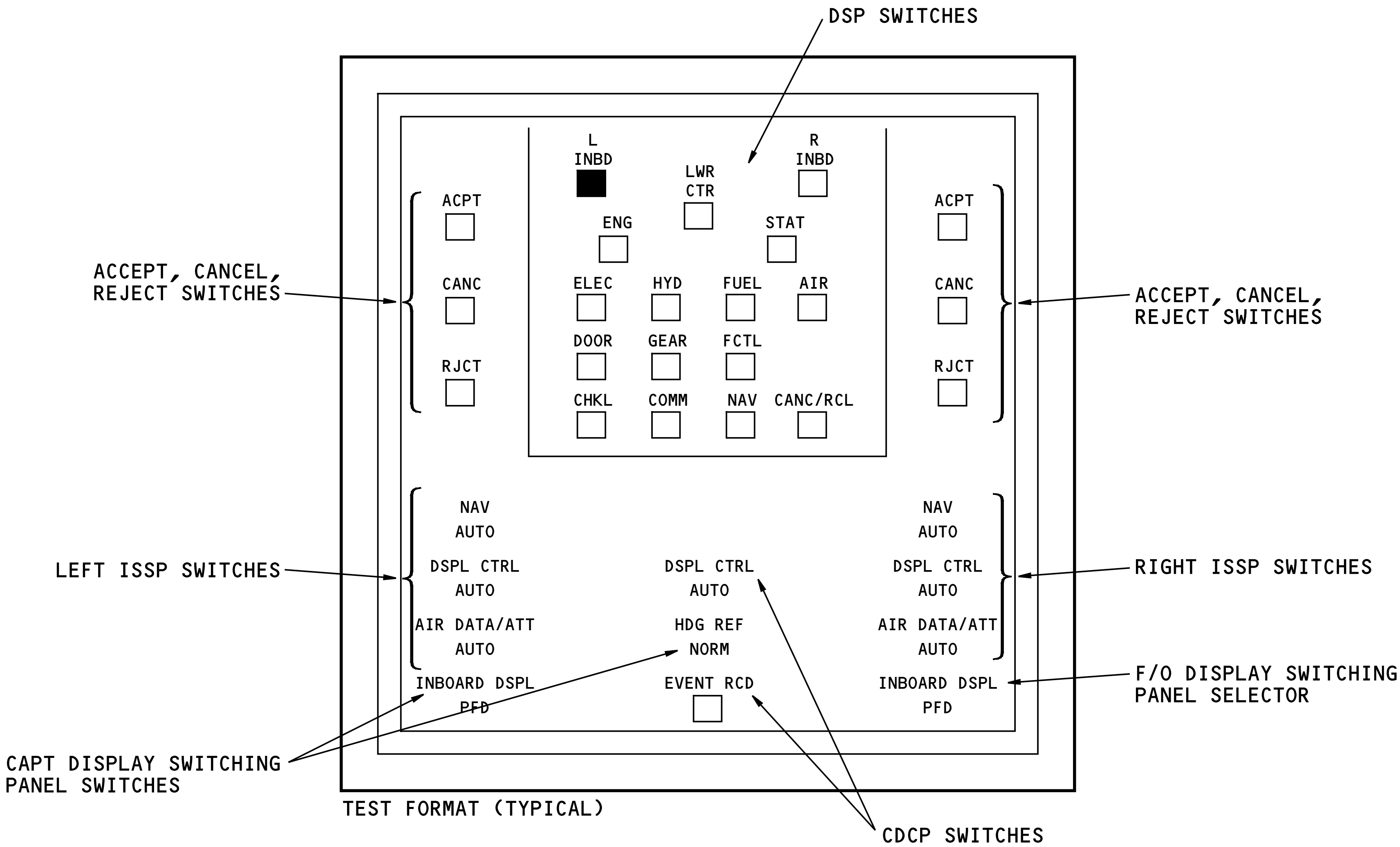
The captain's and first officer's inboard display selector positions show as PFD, ND, MFD or EICAS.

The heading reference switch position shows as NORM or MAG.

CDCP

The display control (DSPL CTRL) switch position shows as AUTO or ALT.

The event record switch shows a white box shows when you select the switch. The white box goes away when you deselect the switch.



31-61-00-118 Rev 1 01/16/1998

PRIMARY DISPLAY SYSTEM - DISPLAY SWITCHES TEST DISPLAY

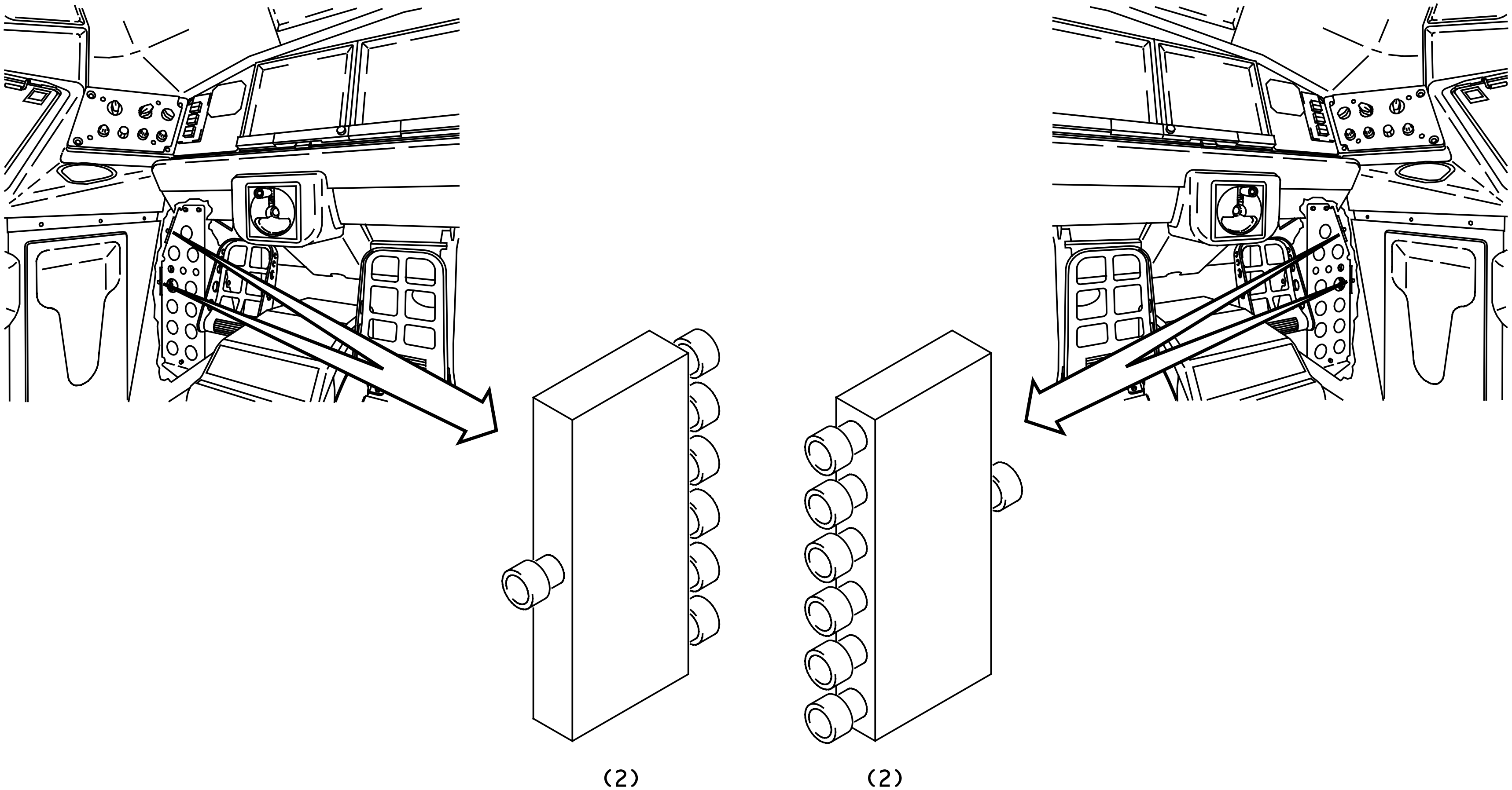
PRIMARY DISPLAY SYSTEM - COAXIAL COUPLER

General

There are four coaxial couplers on the airplane. Each graphics generator sends a video output to a coaxial coupler. The coaxial coupler splits the signal and sends an output to each of the six display units.

Location

The coaxial couplers are on disconnect brackets outboard of the captain's and first officer's outboard rudder pedals. There are two coaxial couplers on the outboard side of each disconnect bracket.



31-61-00-119 Rev 1

PRIMARY DISPLAY SYSTEM - COAXIAL COUPLER

Continental Airlines, Inc

Central Maintenance Computing System

WB371

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Continental Airlines, Inc

Central Maintenance Computing System

WB371

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General

The central maintenance computing system (CMCS) collects and stores maintenance data for most of the airplane systems. The maintenance access terminal (MAT) or portable maintenance access terminal (PMAT) shows the data. Menu selections on the MAT give access to maintenance functions based on type of task. The CMCS primary functions include:

- Fault processing
- Testing
- Data loading.

The CMCS also does these functions:

- Fault history
- Input monitoring
- Configuration reporting
- Shop faults
- Engine balancing
- PSEU and air/ground rigging
- Report generation.

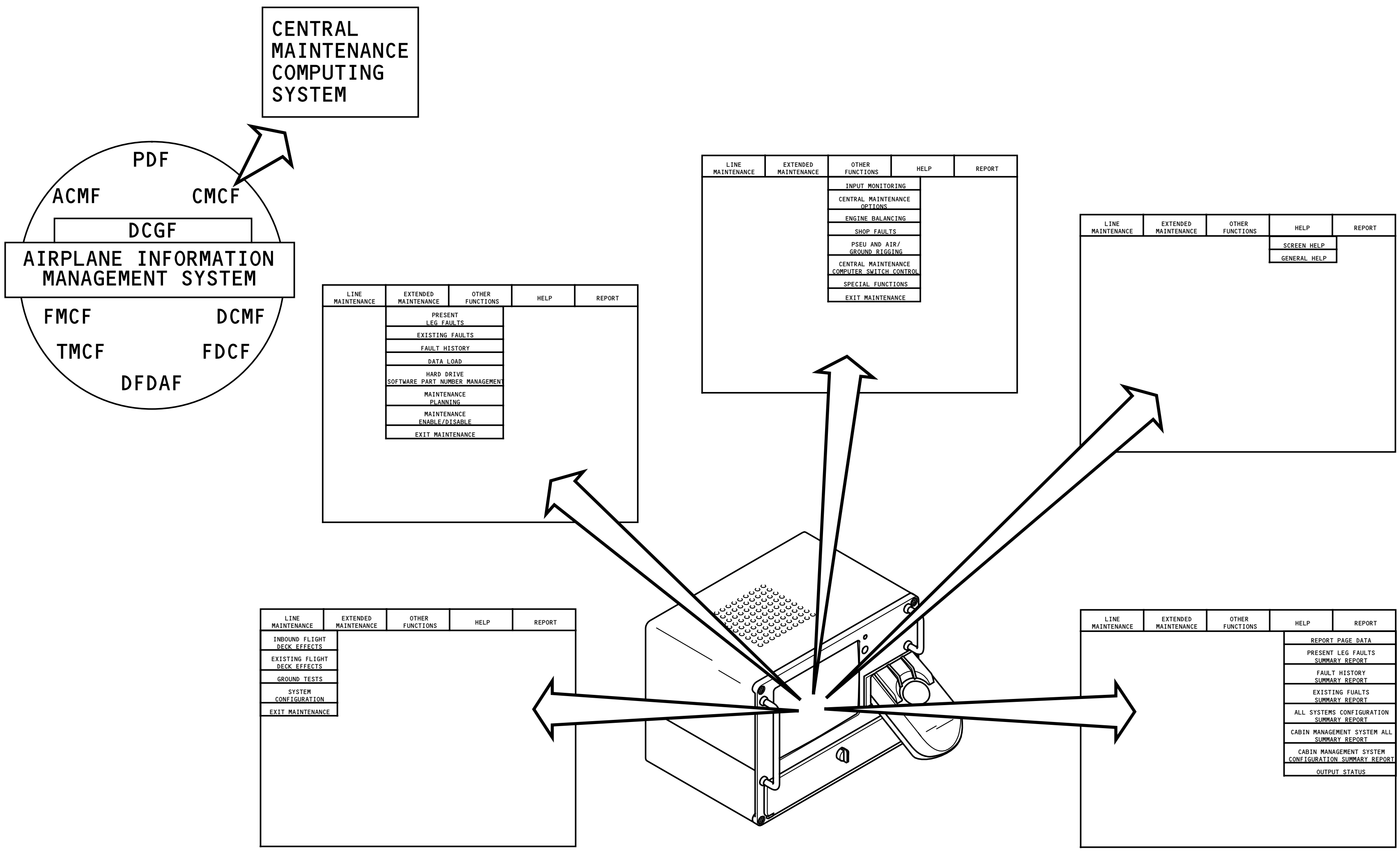
The MAT also supplies access to on-line help.

Abbreviations and Acronyms

ACARS	- aircraft communications addressing and reporting system
ACIPS	- airfoil and cowl ice protection system
ACMF	- airplane condition monitoring function
ACMS	- airplane condition monitoring system
ADF	- automatic direction finder
ADIRU	- air data inertial reference unit
ADM	- air data module
AFDC	- autopilot flight director computer
AIMS	- airplane information management system
AMI	- airline modifiable information
AMM	- airplane maintenance manual
APU	- auxiliary power unit
APUC	- auxiliary power unit controller
ARINC	- Aeronautical Radio, Inc.
ASCPC	- air supply cabin pressure controller
ASG	- ARINC 629 signal gateway
ATC	- air traffic control
AVLAN	- avionics local area network
AVM	- airborne vibration monitoring
BPCU	- bus power control unit
BEPS	- backup electrical power system
BSCU	- brake system control unit
BS	- bypass switch
BSU	- bypass switch unit
CCD	- cursor control device
CMCF	- central maintenance computing function
CMCS	- central maintenance computing system
CMR	- certification maintenance requirement
comm	- communication
CPM	- core processor module
CTC	- cabin temperature controller
CTU	- cabin telecommunication unit
DCGF	- data conversion gateway function

DCMF - data communication management function
DFDAF - digital flight data acquisition function
DTD - data terminal display
EEC - electronic engine control
EICAS - engine indication and crew alerting system
ELMS - electrical load management system
FDCF - flight deck communication function
FDE - flight deck effect
FIM - fault isolation manual
FMCF - flight management computing function
FSEU - flap/ slat electronics unit
GBST - ground based software tool
GCU - generator control unit
GPSSU - global positioning system sensor unit
GPWC - ground proximity warning computer
HYDIM - hydraulic interface module
ICAO - international civil aviation organization
IMM - intermodule memory
IOM - input/output module
ISO - International Standards Organization
LAN - local area network
LCD - liquid crystal display
LDI - loadable diagnostic information
LPT - low pressure turbine
LRM - line replaceable module
LRU - line replaceable unit
MAT - maintenance access terminal
MEC - main equipment center
MFD - multi-function display
MO - maintenance memo
MPS - maintenance page snapshot
MTF - maintenance terminal function
ND - navigation display
NVM - non-volatile memory
OEBS - onboard engine balancing system
OLAN - onboard local area network
OMS - onboard maintenance system
OPC - operational program configuration
OPS - operational program software
PDF - primary display function
PDS - primary display system
PFC - primary flight computer
PFD - primary flight display
PMAT - portable maintenance access terminal
PSEU - proximity sensor electronics unit
RAM - random access memory
RMM - ramp maintenance manual
SAARU - secondary attitude air data reference unit
SCSI - small computer system interface
SD - side display
SDI - source destination indicator
SDU - satellite data unit
SMT - scheduled maintenance task
TCAS - traffic alert and collision avoidance system

TMCF	- thrust management computing function
UTC	- universal time (coordinated)
UTCF	- universal time (coordinated) function
WHCU	- window heat control unit
WXR	- weather radar



MAINTENANCE ACCESS TERMINAL

CENTRAL MAINTENANCE COMPUTING SYSTEM - INTRODUCTION

CMCS - FAULT PROCESSING CONCEPT

General

The central maintenance computing system (CMCS) does these things:

- Monitors airplane systems for faults
- Processes fault information
- Supplies maintenance messages.

The CMCS also monitors flight deck effect (FDE) activity. The CMCS matches, or correlates, applicable FDEs and maintenance messages.

Flight deck effects (FDEs) tell the flight and ground crews of conditions related to safe operation. The ground crew must find the cause of an FDE to find the corrective action. You use this information along with these manuals to isolate airplane faults

- Fault isolation manual (FIM)
- Airplane maintenance manual (AMM)
- Ramp maintenance manual (RMM).

Flight Deck Effects

The airplane systems monitor conditions related to loss of a system or function. If a condition exists that requires repair or deferral, the airplane system sends FDE data to the AIMS primary display system (PDS). The PDS shows the FDE.

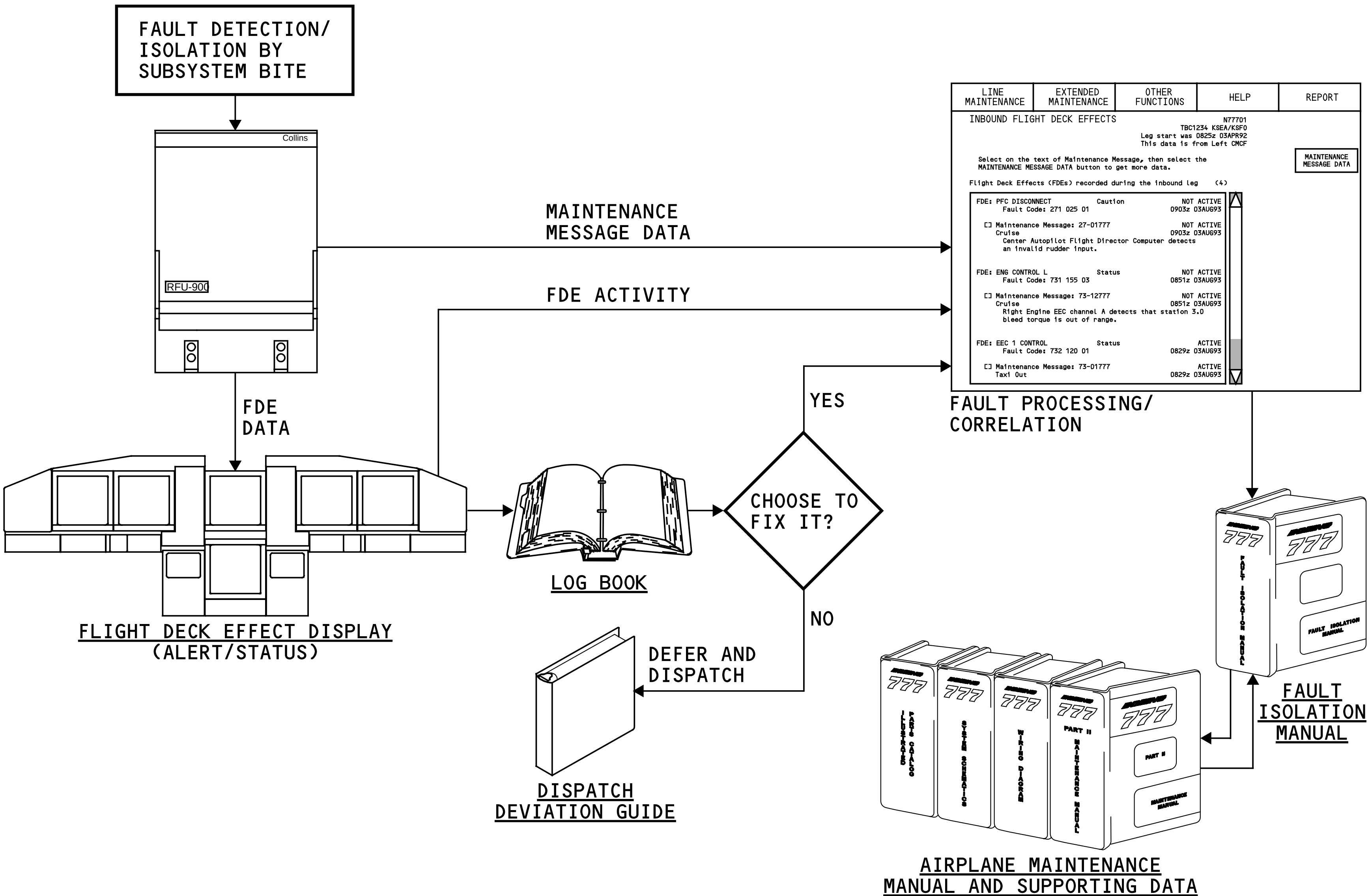
Many flight log entries have an FDE. The ground crew examines and makes an analysis of additional FDEs before they release the airplane.

Maintenance Messages

Maintenance messages supply the ground crew with detailed fault information to help in troubleshooting. Airplane systems monitor for system faults. If an airplane system finds a fault, it sends maintenance message data to the CMCS. The CMCS processes the data and shows a maintenance message so the maintenance crew can examine it and find a corrective action.

FDE/Maintenance Message Correlation

The CMCS has logic that makes a relation between maintenance messages and FDEs. When an FDE occurs and the CMCS receives a maintenance message that has a relation to the FDE, the CMCS correlates the FDE to the message.



CMCS - FAULT PROCESSING CONCEPT

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CMCS - GENERAL DESCRIPTION

General

The central maintenance computing system (CMCS) supports both line maintenance and extended maintenance functions through menu selections on the maintenance access terminal (MAT). Other menu selections support special maintenance functions, supply on-line help, and make reports.

There is a central maintenance computing function (CMCF) in each AIMS cabinet. Only one CMCF operates at a time, the other is a backup.

CMCS Components

The components of the CMCS are the:

- Central maintenance computing function (CMCF) in the AIMS cabinets
- MAT
- MAT keyboard
- Portable maintenance access terminal (PMAT) in the main equipment center (MEC)
- PMAT receptacles (4)
- Ground test switch.

Use the MAT in the flight deck or a PMAT to operate the CMCS.

The PMAT receptacles permit the use of another PMAT. These are the four other locations on the airplane that have PMAT receptacles:

- On the right side of the P40 panel at the nose wheel well
- On the P56 main wheel well electrical service panel
- Inside of the stabilizer jack screw service access door
- On the P18 panel in the flight deck.

Fiber Optic Interfaces

The MAT communicates with the CMCF in the AIMS cabinets through two fiber optic interfaces. The fiber optics interfaces supply a dual connection to the avionics local area network (AVLAN). These interfaces and the AVLAN are part of the onboard local area network (OLAN). The MAT connects directly to the AVLAN. The PMAT and the PMAT receptacles connect to a brouter. The brouter performs a network bridging function.

Primary Display System Interface

The CMCF gets fault reports from systems and records this information in a fault history. The primary display system (PDS) shows failure conditions in the form of flight deck effects (FDEs). The primary display function in the AIMS cabinets sends FDEs to the CMCF. The CMCF correlates faults to PDS failure indications.

These are the types of FDEs:

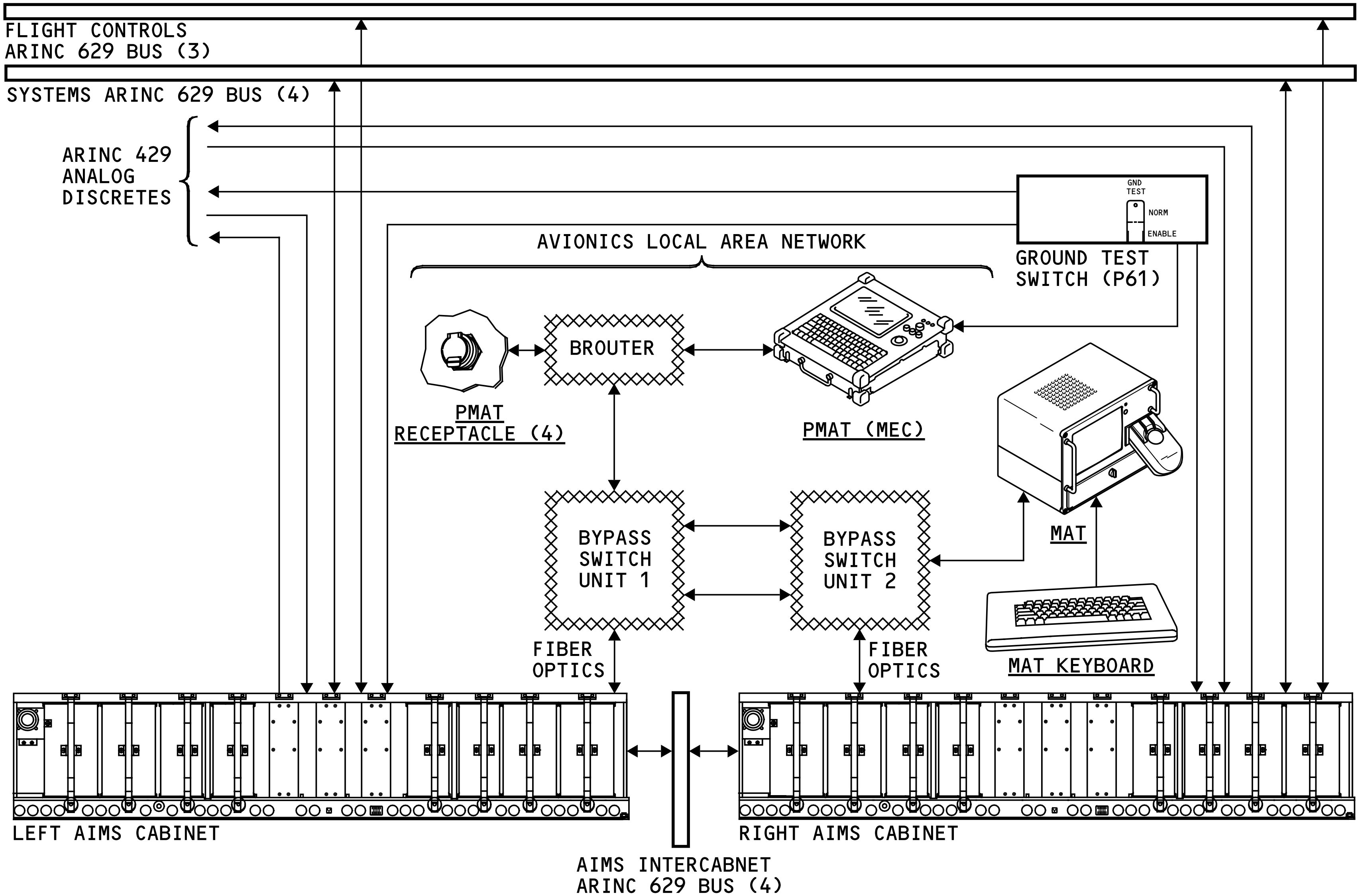
- EICAS messages
- PFD flags
- ND flags

- EIICAS snapshots
- Scheduled maintenance tasks
- Other display features.

The CMCS lets the maintenance personnel look at faults and correlated FDEs based on flight phases and flight legs.

<u>Ground Test Switch Interface</u>

The GROUND TEST switch on the ground test panel permits certain CMCS ground tests, data loads and special functions. It also provides power to the PMAT in the MEC.



45-10-00-003 Rev 3 11/06/1997

CMCS - GENERAL DESCRIPTION

CMCS - COMPONENT LOCATIONS

Flight Deck

The maintenance access terminal (MAT) is on the P18 panel.

The MAT keyboard is on the P18 panel in front of the MAT.

The portable maintenance access terminaL (PMAT) receptacle is on the left side of the MAT on the P18 panel.

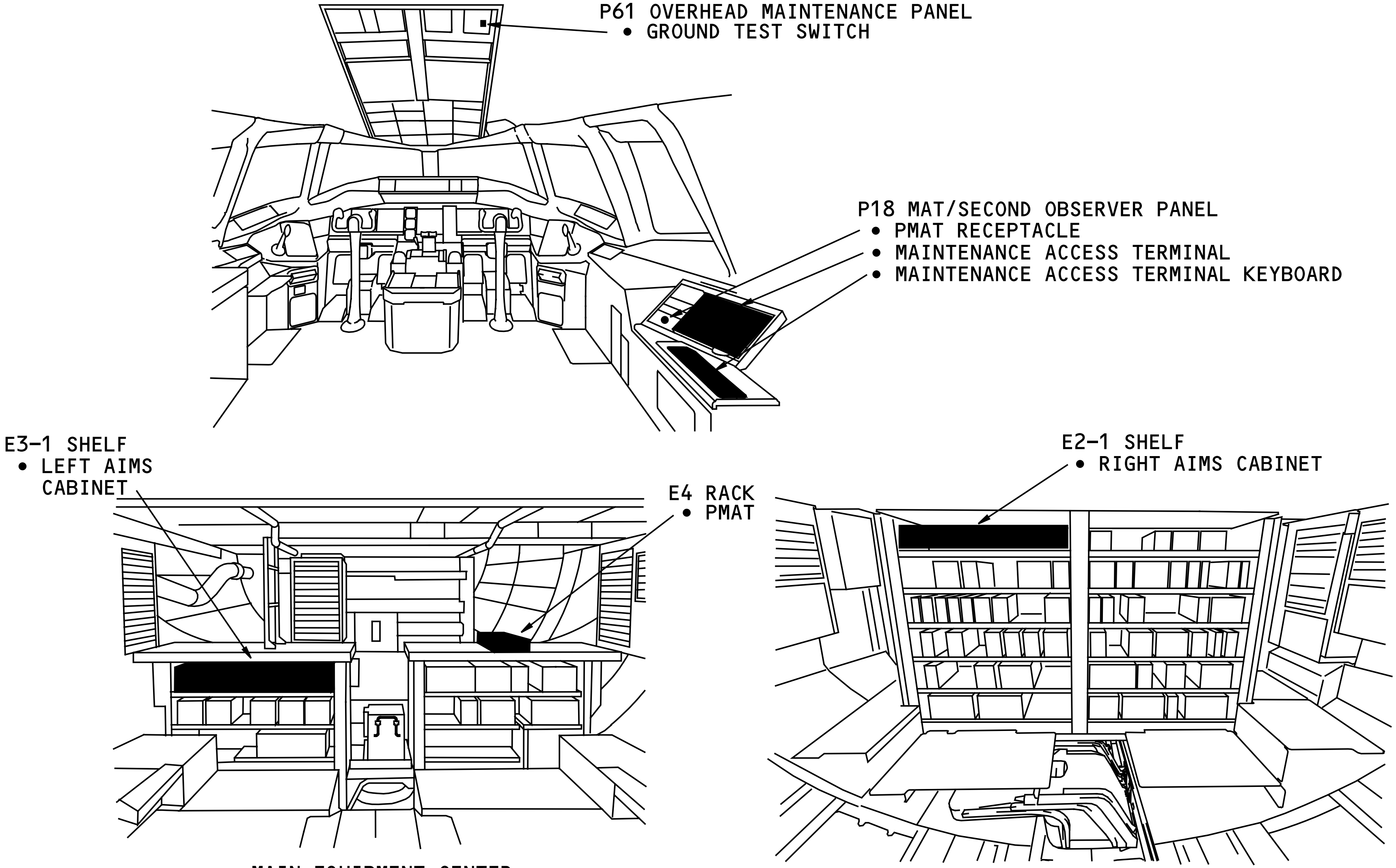
The GROUND TEST switch is on the P61 overhead maintenance panel.

Main Equipment Center

The left AIMS cabinet is on the E3-1 shelf. The right AIMS cabinet is on the E2-1 shelf.

The PMAT is on top of the E-4 rack.

The PMAT receptacle is between the E-3 and E-4 racks.



MAIN EQUIPMENT CENTER
(LOOKING FORWARD)

MAIN EQUIPMENT CENTER
(LOOKING AFT)

CMCS - COMPONENT LOCATIONS

45-10-00-004 Rev 2 05/30/96

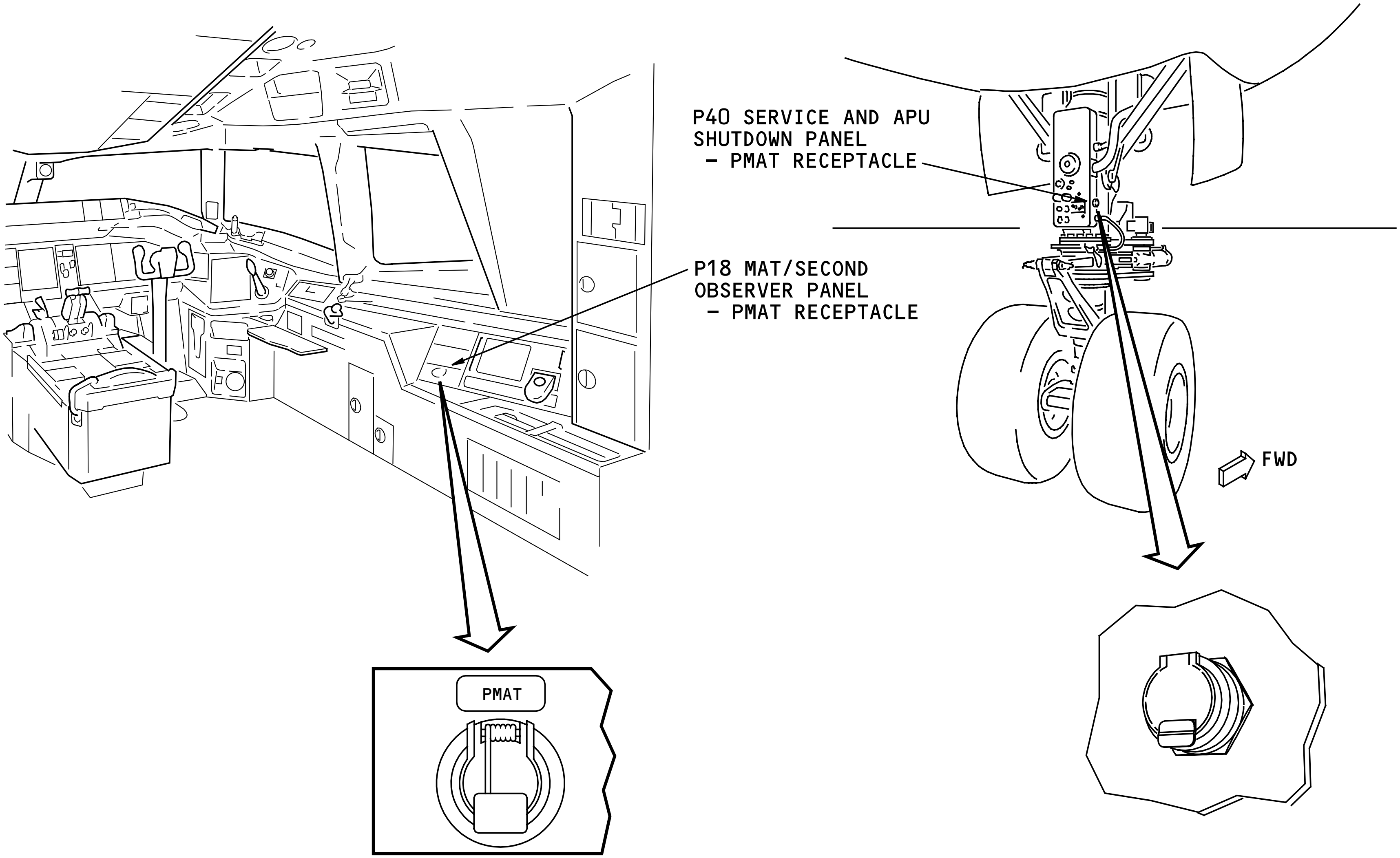
CMCS - PMAT RECEPTACLE LOCATIONS - 1

Flight Deck

A PMAT receptacle is on the left side of the MAT on the P18 MAT/second observer panel.

Nose Wheel Well

A PMAT receptacle is on the right side of the P40 service and APU shutdown panel.



CMCS - PMAT RECEPTACLE LOCATIONS - 1

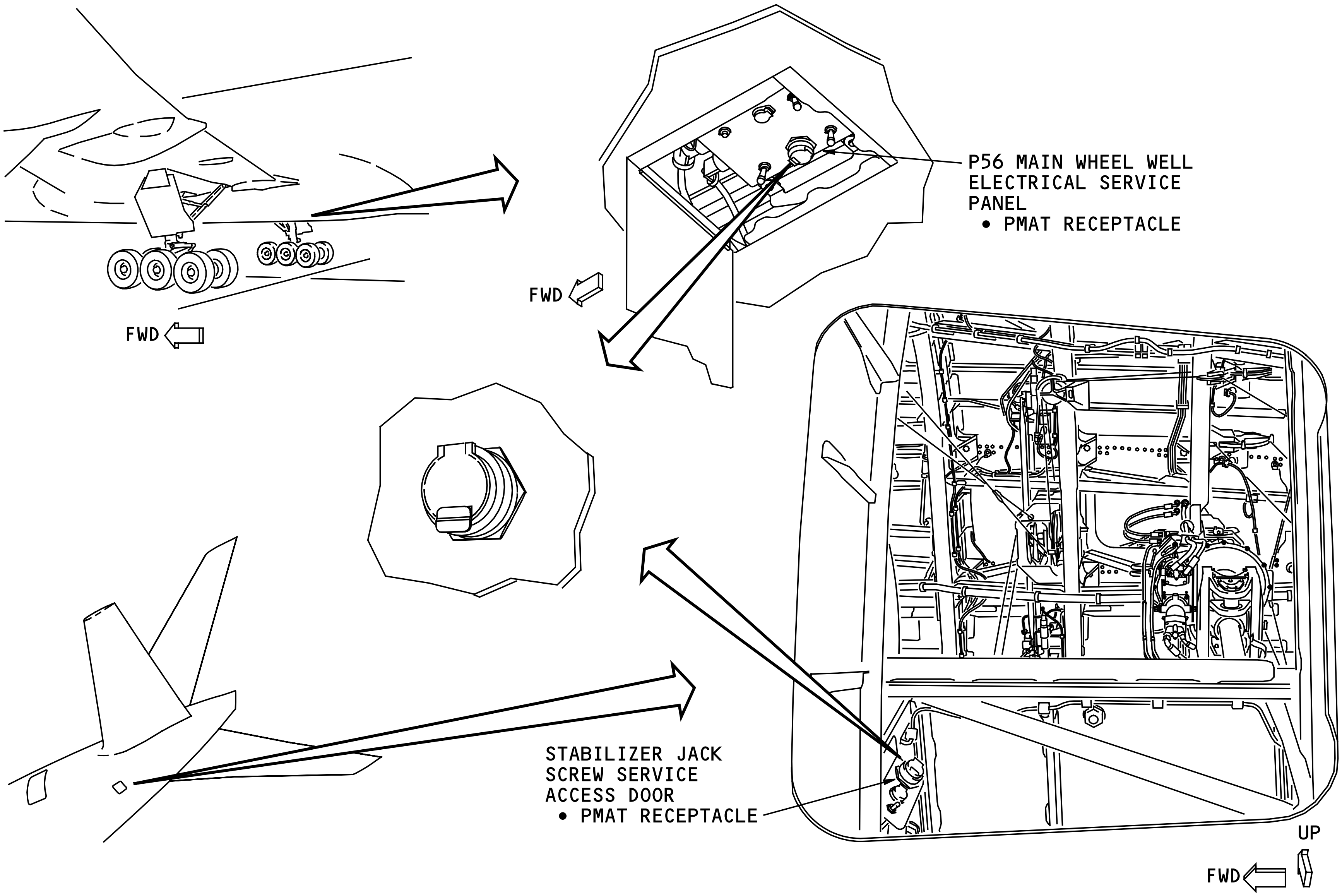
CMCS - PMAT RECEPTACLE LOCATIONS - 2

Main Wheel Well

A PMAT receptacle is on the P56 main wheel well electrical service panel.

Stabilizer Jack Screw Access Door

A PMAT receptacle is inside of the stabilizer jack screw access door.



CMCS - PMAT RECEPTACLE LOCATIONS - 2

CMCS - MAT INTERFACES

Power

The MAT receives 115v ac from the MAINT ACCESS TERM circuit breaker on the P11 overhead circuit breaker panel. The MAT cursor control power supply module receives the 115v ac and sends the power to the other components in the MAT.

Air Ground Discrete

A ground mode relay in the right power management panel supplies an air ground discrete to the MAT display module. The maintenance terminal function in the MAT display module uses the air ground discrete.

MAT Keyboard

The MAT keyboard transmits data to and receives data from the MAT display module. Certain pages that show on the MAT require entries from the keyboard.

Bypass Switch Unit

The MAT has a fiber optics interface which connects the MAT to the avionics local area network (AVLAN). The interface and the avionics LAN are parts of the onboard local area network (OLAN). The AVLAN supplies a high speed communication path with the:

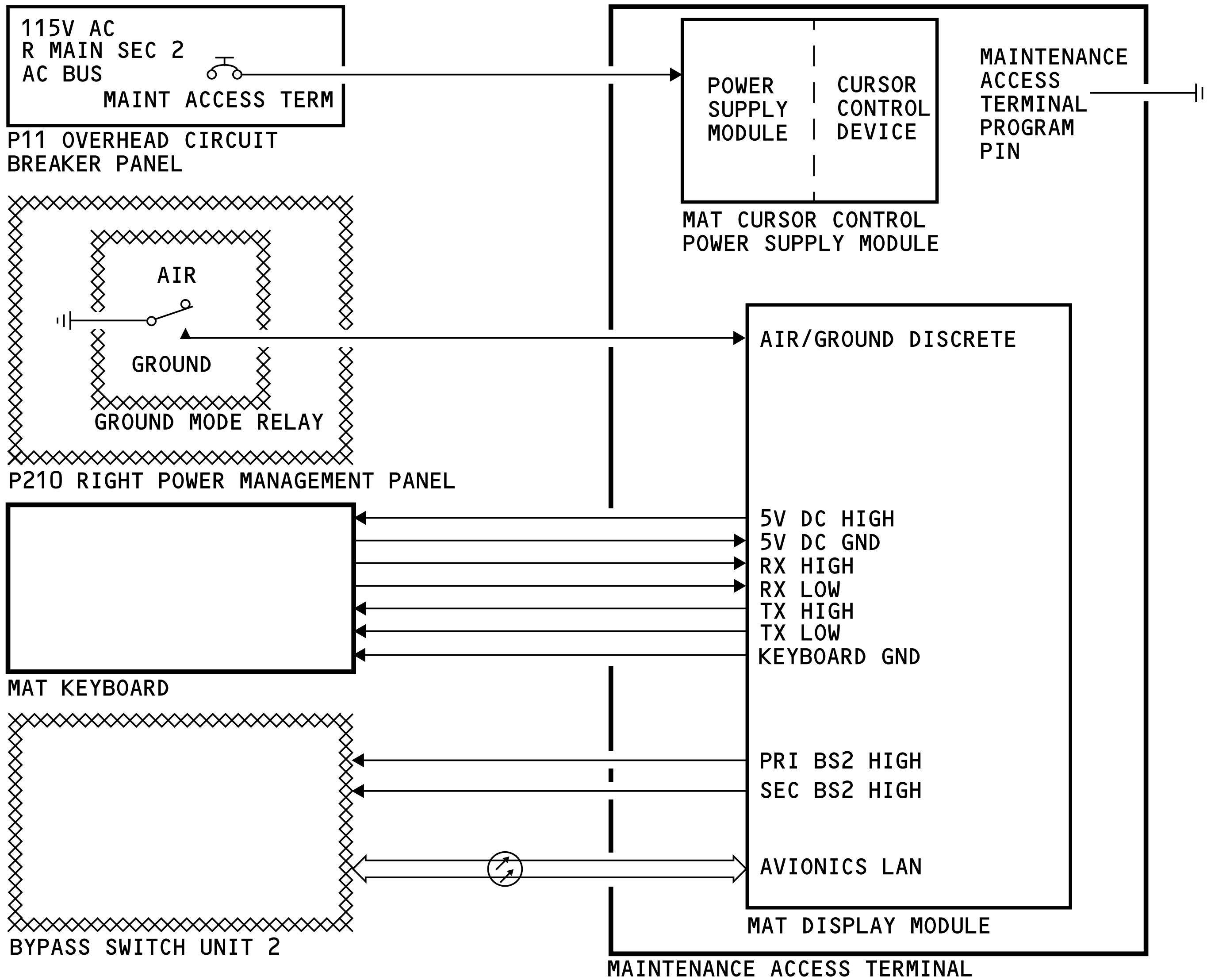
- AIMS cabinets
- MAT
- PMAT
- PMAT receptacles.

The MAT receives data from and transmits data to the avionics LAN through bypass switch unit (BSU) 2.

The MAT controls switches in the BSU to connect the MAT to the avionics LAN. The bypass switch control in the MAT display module sends two discretes to the BSU.

Program Pin

A program pin identifies this unit as the maintenance access terminal.



CMCS - MAT INTERFACES

CMCS - MAT INTERNAL INTERFACES

Power

The MAT cursor control power supply module receives 115v ac power from the R MAIN SEC 2 AC BUS. The MAT cursor control power supply module supplies 115v ac power to the:

- MAT dual disk drive module
- MAT display module.

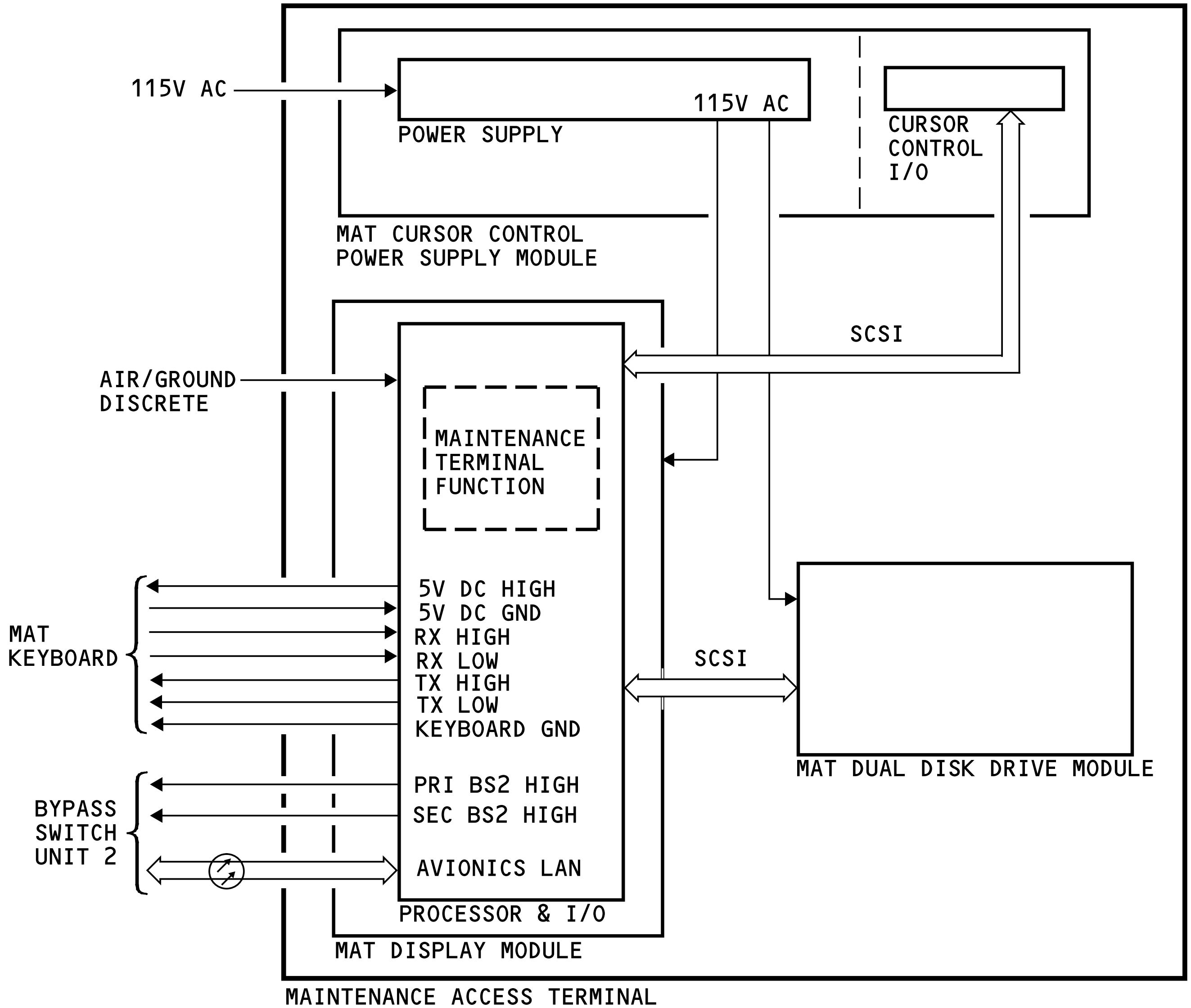
Small Computer System Interface

The MAT display module supplies a small computer system interface (SCSI) connection to the:

- MAT cursor control power supply module
- MAT dual disk drive module.

Maintenance Terminal Function

The MAT display module contains the maintenance terminal function (MTF) software that operates the MAT. You can load the MTF software.



45-10-00-006 Rev 1 07/27/1995

CMCS - MAT INTERNAL INTERFACES

CMCS - GROUND TEST SWITCH INTERFACE

General

The ground test switch:

- Permits some ground tests to run
- Permits some software to load into some LRUs
- Provides power to the portable maintenance access terminal (PMAT) in the main equipment center.

The ground test switch sends discrete signals to the:

- Left and right AIMS cabinets
- PSEU 1 and 2
- Left and right systems card files.

PMAT Interface

The ground test switch sends 115v ac from the left power management panel to the portable maintenance access terminal in the main equipment center.

AIMS Interface

The ground test switch discrete signals go to IOM (M004) and IOM (M003) in both the left and right AIMS cabinets.

The AIMS uses the data conversion gateway function (DCGF) and converts the switch discretes to ARINC 629 formatted signals. The DCGF puts the signals on the systems ARINC 629 buses and the flight controls ARINC 629 buses.

LRUs that connect to the ARINC 629 buses use the data to permit critical tests.

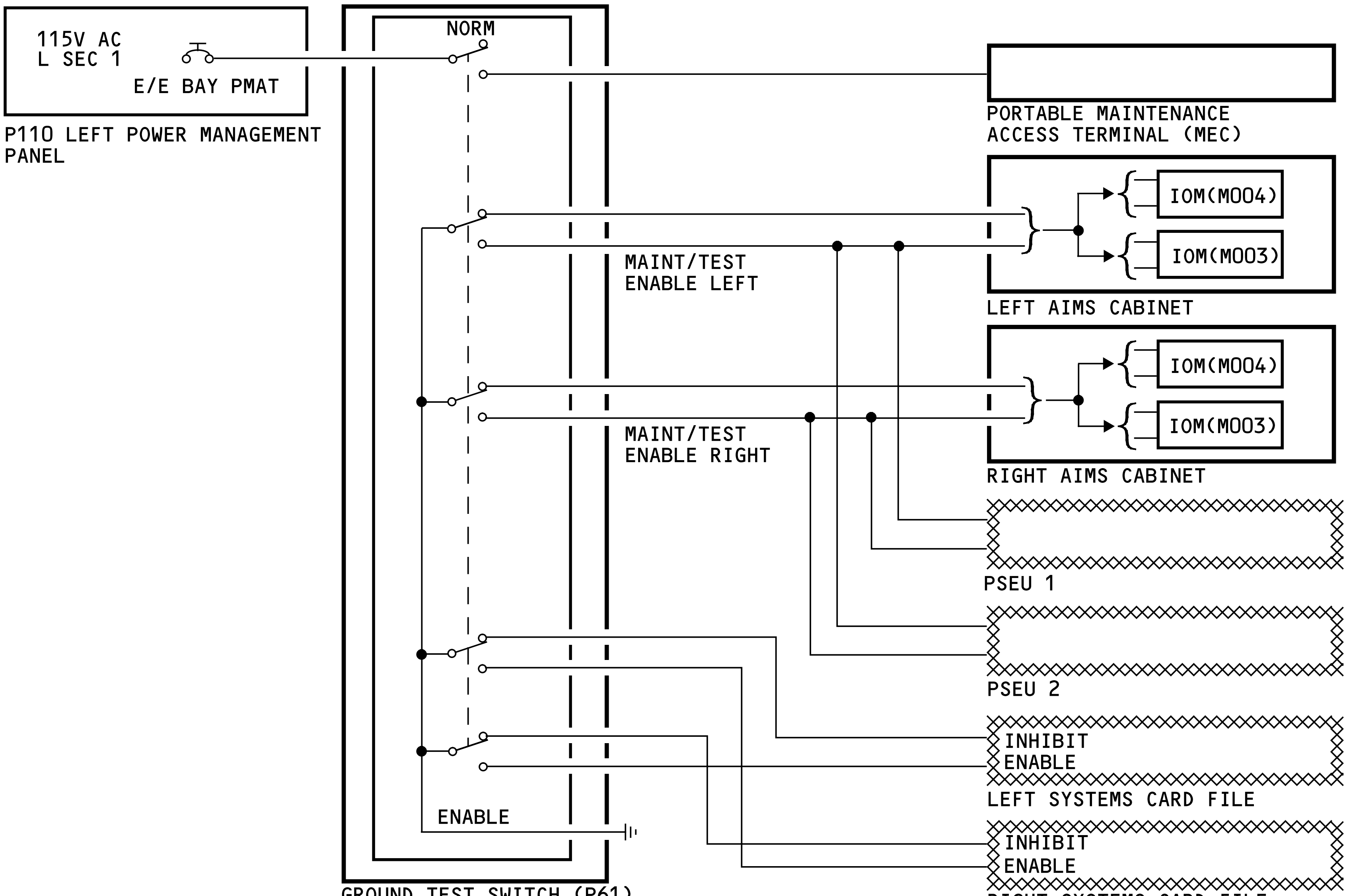
PSEU Interface

The proximity sensor electronics units (PSEU) get a direct input from the switch. The PSEUs use the signal for ground test control.

Systems Card File Interface

The left and right systems card files get switch discretes that show the position of the ground test switch. These are the systems that use the signal to permit ground tests:

- Fire/overheat detection system
- Airfoil and cowl ice protection system
- Duct leak detection system
- Air/ground system
- Hydraulic system
- Environmental control system
- Cargo smoke detection system.



CMCS - GROUND TEST SWITCH INTERFACE

CMCS - PMAT INTERFACES

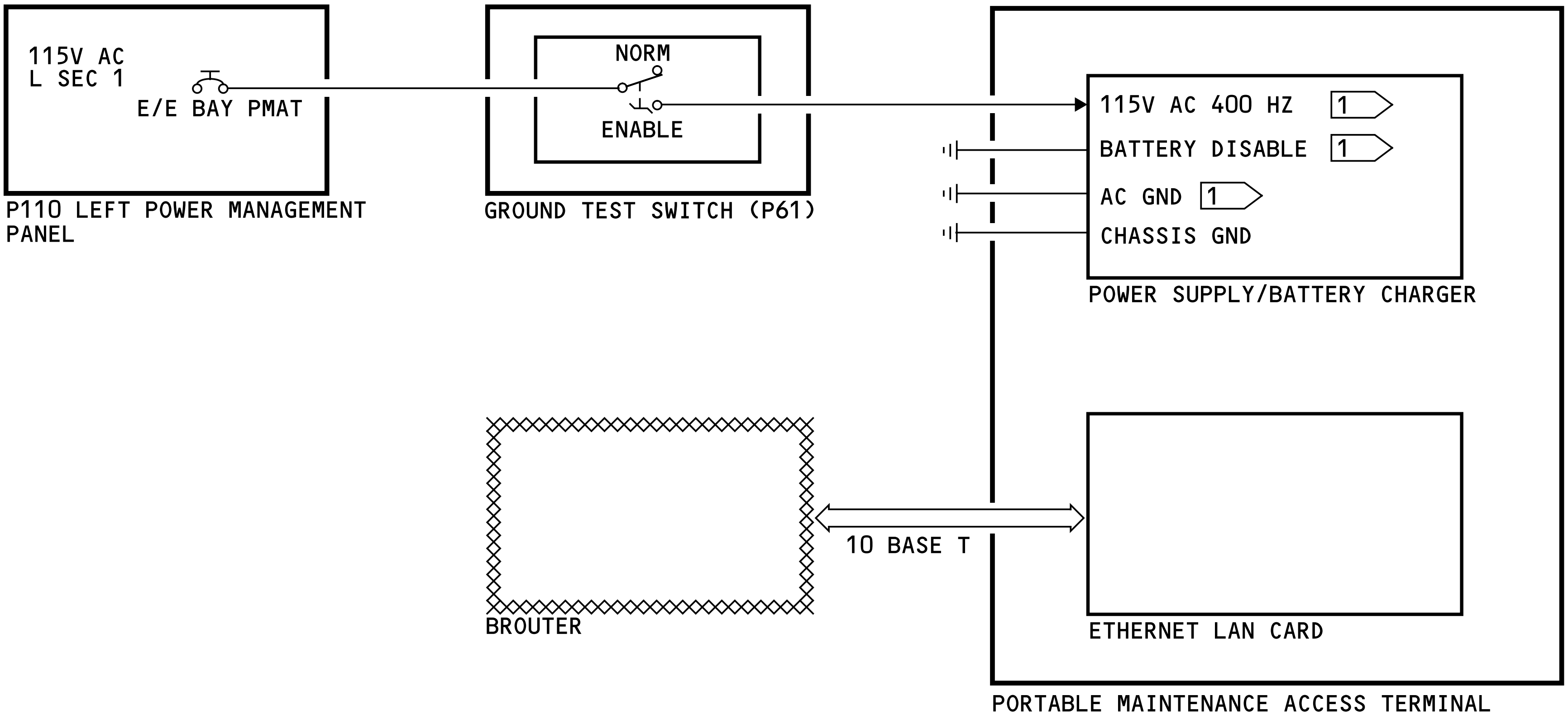
Power

The portable maintenance access terminal (PMAT) in the main equipment center (MEC) receives 115v ac 400 hz from the E/E BAY PMAT circuit breaker on the P110 left power management panel. The PMAT receives power when the ground test switch is in the enable position.

The PMAT in the MEC has a battery disable discrete to disable the battery.

Brouter

The brouter transmits data to and receives data from the ethernet local area network card in all PMATs. The PMATs use a 10 base T interface.



45-10-00-129 Rev 0

1 MAIN EQUIPMENT CENTER PMAT ONLY

CMCS - PMAT INTERFACES

CMCS - FIBER OPTICS INTERFACE

Avionics Local Area Network

The left and right AIMS cabinets have a fiber optics interface which supplies two connections to an avionics local area network (AVLAN). The MAT and a brouter also have fiber optics connections to the avionics LAN. The avionics LAN is part of an onboard local area network (OLAN). The AVLAN supplies a high speed communication path between the AIMS cabinets and the:

- Maintenance access terminal (MAT)
- Portable maintenance access terminal (PMAT)
- Four portable maintenance access terminal (PMAT) receptacles.

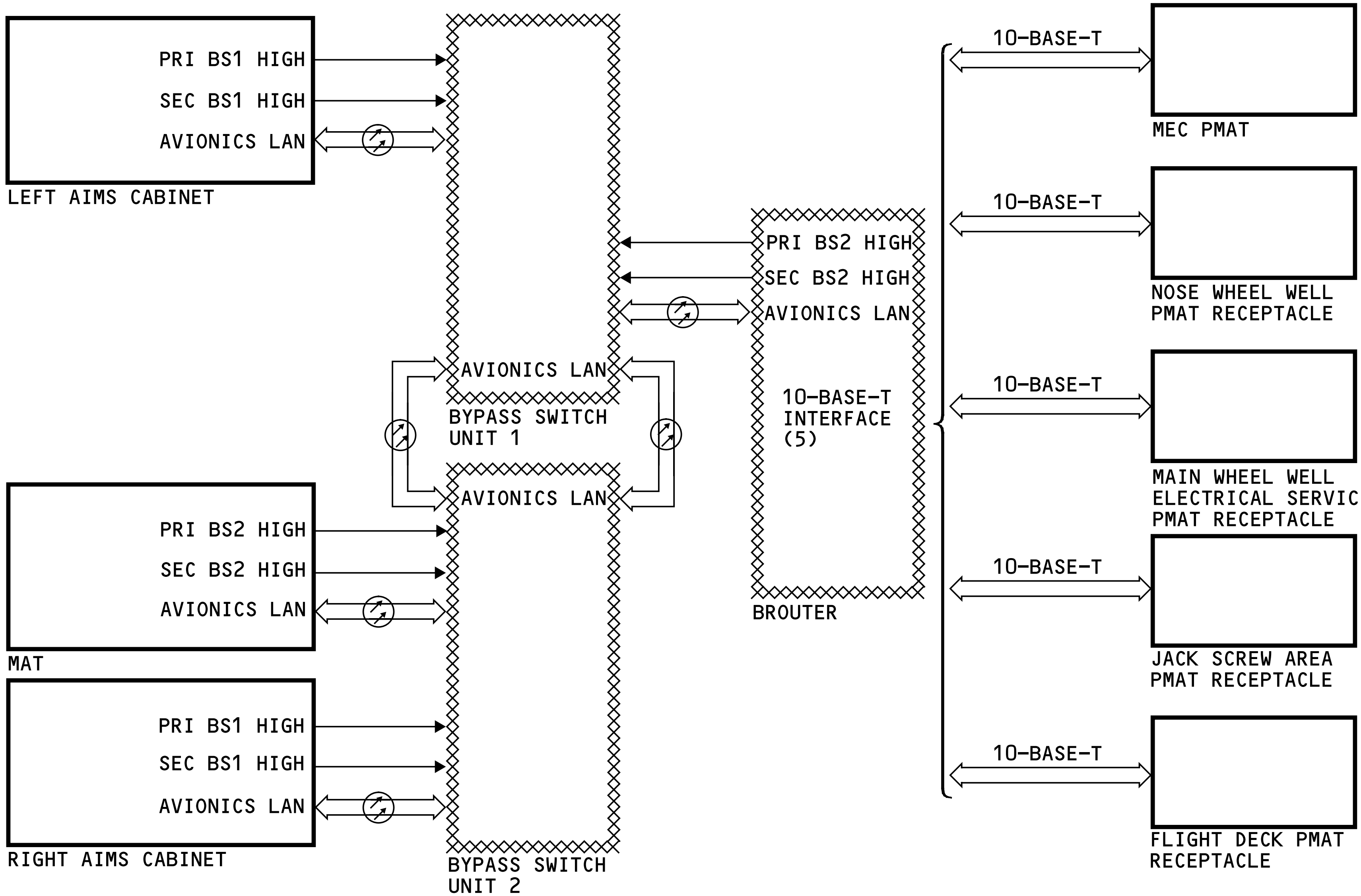
The MAT receives data from and transmits data to the avionics LAN through a bypass switch unit (BSU). The MAT controls switches in BSU 2 to connect the MAT to the AVLAN. The MAT uses two discretes, primary bypass switch (BS) 2 high and secondary BS 2 high, to control the switches in BSU 2.

A brouter supplies the connection to the PMAT and PMAT receptacles. The brouter has a network bridging function. The network bridging function supplies the brouter connection to the avionics LAN. The brouter also uses two discretes, primary bypass switch (BS) 2 high and secondary BS 2 high, to control the switches in BSU 1.

The data communication management function (DCMF) in the left and right AIMS cabinets has the communication protocols that permit the AIMS functions to communicate with the OLAN.

The AIMS functions that use the DCMF communication services are the:

- CMCF for software data loading from the MAT and PMAT
- CMCF and ACMF for communications with the maintenance terminal function (MTF) in the MAT and PMAT
- CMCF to record OLAN faults.



CMCS - FIBER OPTICS INTERFACE

45-10-00-008 Rev 4 05/30/96

CMCS - ARINC 429 DATA LOAD INTERFACE

General

The central maintenance computing function (CMCF) in the AIMS cabinets supplies data load display formats that appear on the MAT display unit. The data load display formats let the maintenance crew select the source of the data and the destination of the data.

The source of the data is a data file on the hard drive or on a disk in the disk drive. The destination is one of these:

- An ARINC 429 LRU
- An LRU on a systems ARINC 629 bus
- An LRU on a flight controls ARINC 629 bus
- An LRM in the AIMS cabinet.

When the crew selects the source and the destination, the MAT sends the data through the fiber optics interface to the CPM/COMM in the AIMS cabinets. The CMCF sends the data to the correct LRU or LRM on a designated data load port through an IOM.

ARINC 429

The data goes out on the ARINC 429 data load bus.

Along with the data, load enable discretes go to the ARINC 429 LRUs.

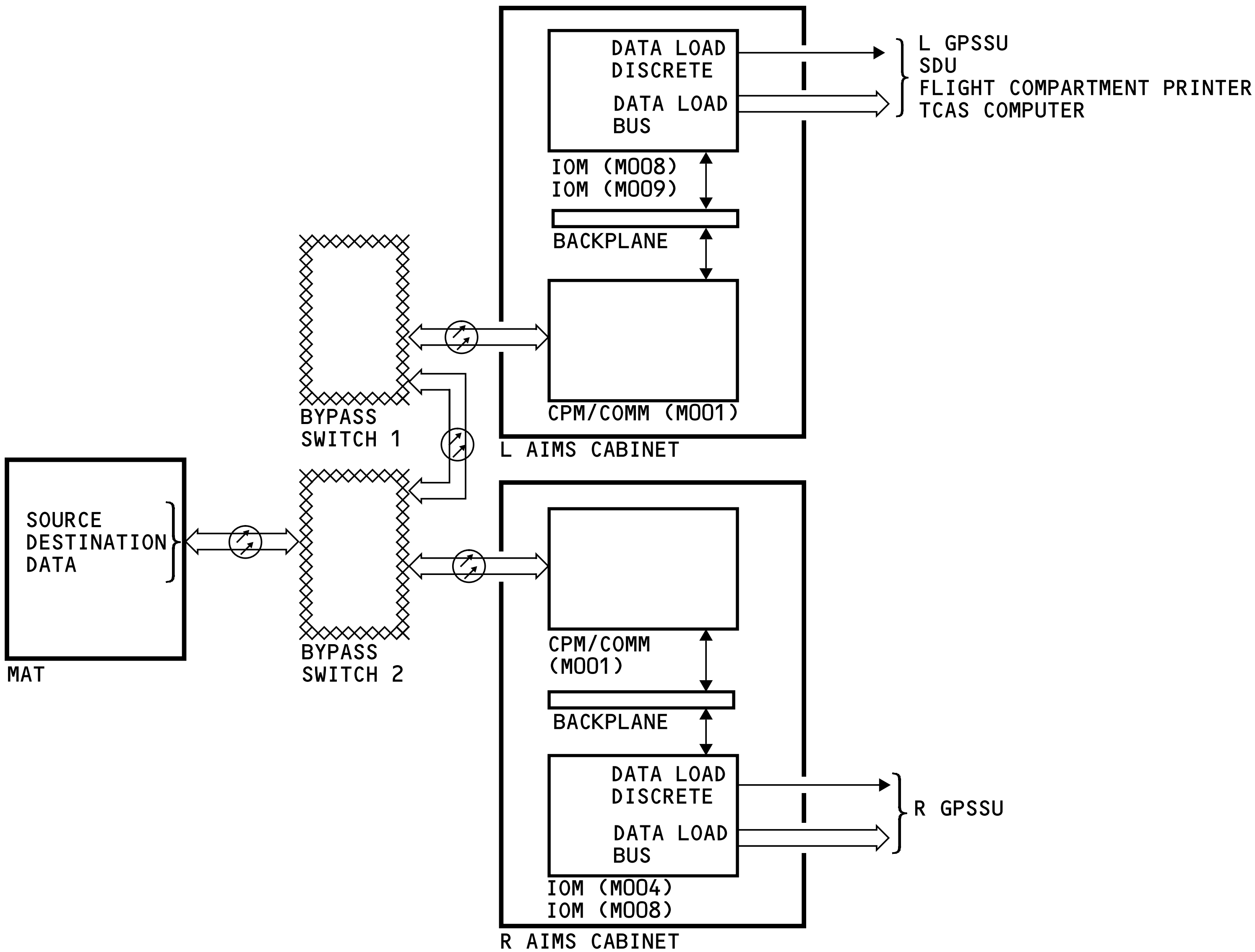
Data and status information comes in from the ARINC 429 LRUs on the 429 data input buses.

Training Information Point

These are the times when you must switch the active CMCF to do a data load:

- To load some LRUs on the flight controls ARINC 629 buses
- To load a 429 LRU connected to the right AIMS cabinet when the left CMCF is active.
- To load a 429 LRU connected to the left AIMS cabinet when the right CMCF is active.

Use the central maintenance computer switch control from the other functions menu to switch the active CMCF.

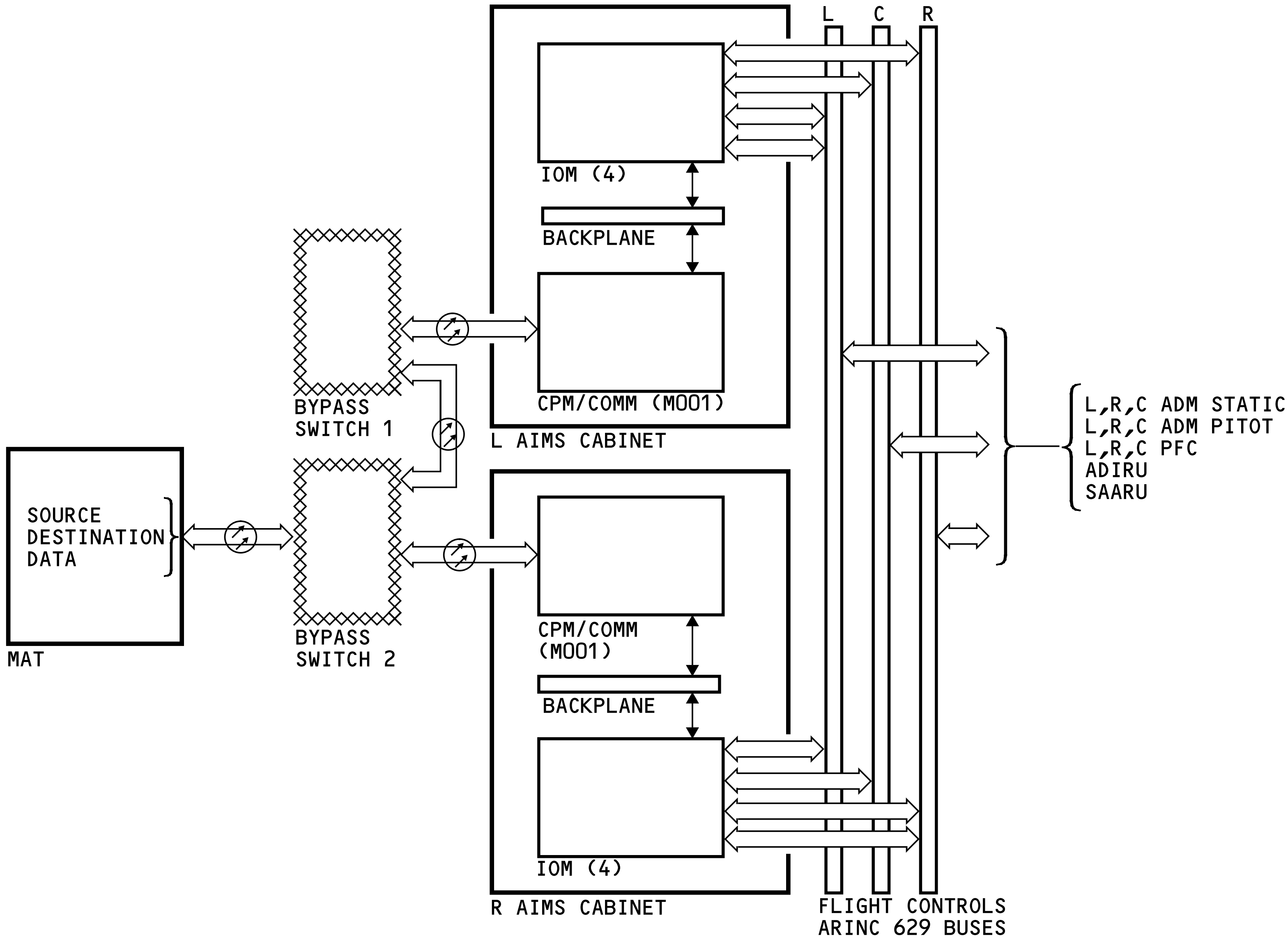


CMCS - ARINC 429 DATA LOAD INTERFACE

CMCS - FLIGHT CONTROLS ARINC 629 BUS DATA LOAD INTERFACE

Flight Controls ARINC 629 Data Buses

The data load information goes to the flight controls system LRUs on the left, center, or right flight controls ARINC 629 data buses.

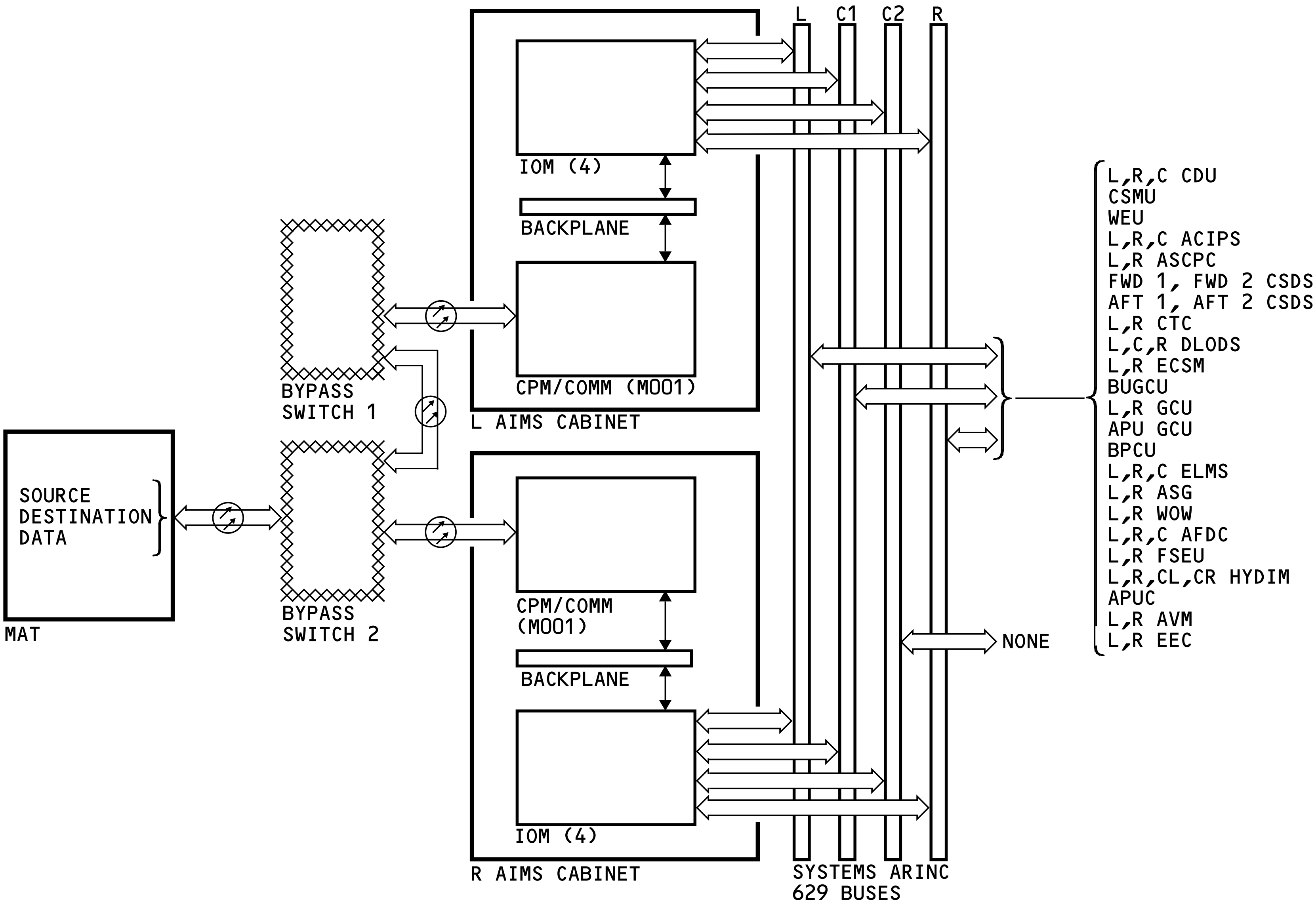


CMCS - FLIGHT CONTROLS ARINC 629 BUS DATA LOAD INTERFACE

CMCS - SYSTEMS ARINC 629 BUS DATA LOAD INTERFACE

Systems ARINC 629 Buses

The data goes to the airplane system LRUs on the left, center 1, or right systems ARINC 629 data bus. No data goes out on the center 2 systems ARINC 629 data bus.



CMCS - SYSTEMS ARINC 629 BUS DATA LOAD INTERFACE

45-10-00-011 Rev 2

CMCS - ARINC 429 INTERFACES

CMCS ARINC 429 Bus Control

The central maintenance computing system (CMCS) buses connect the left and right AIMS cabinets with LRUs that use the ARINC 429 standard for digital data transfer. The CMCF supplies data to three low speed ARINC 429 transmitters in each AIMS cabinet. Three source select relays in the left AIMS cabinet select between the left and right AIMS cabinets as the data source to the LRUs.

The left CMCF controls the source select relays. If the left CMCF is the primary CMCF, the relays are energized and the left CMCF supplies the outputs on the CMCS buses.

If an IOM fails in the left AIMS cabinet, the relay relaxes in that IOM and the data comes from the right CMCF.

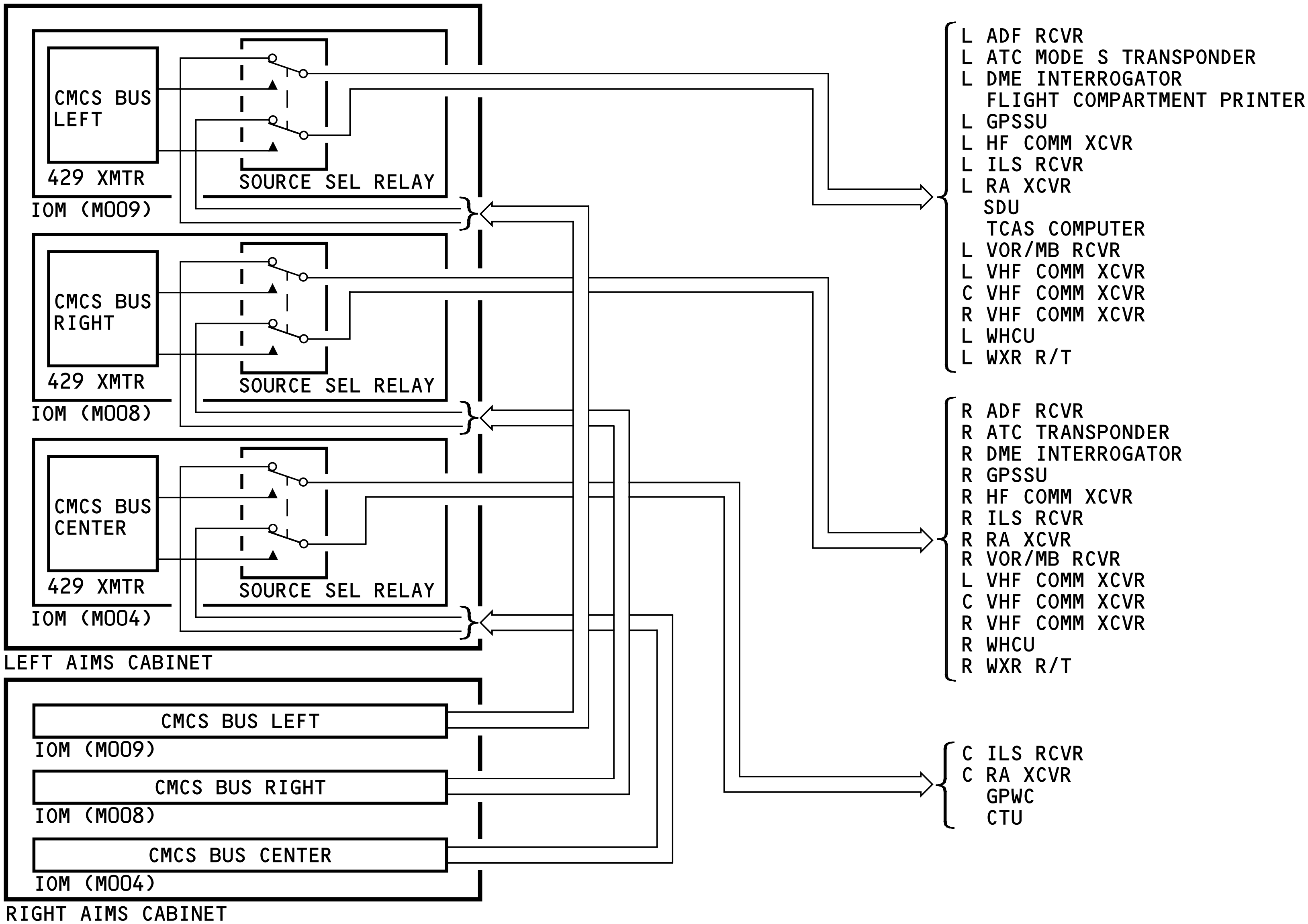
If the left CMCF fails, all three relays relax and the data on the CMCS buses comes from the right CMCF.

CMCS ARINC 429 Outputs

The LRUs that receive data on the CMCS buses are the:

- ATC mode S transponder; left and right
- ADF receiver; left and right
- Cabin telecommunications unit (CTU)
- DME interrogator; left and right
- Flight compartment printer
- GPSSU; left and right
- GPWC
- HF communication transceiver; left and right
- ILS receiver; left, right and center
- Radio altimeter receiver/transmitter; left, right and center
- Satellite data unit
- TCAS computer
- VHF communication transceiver; left, right and center
- VOR/MB receiver; left and right
- Weather radar receiver/transmitter; left and right
- Window heat control unit; left and right.

The CMCS data includes maintenance test command data and flight phase data.



CMCS - ARINC 429 INTERFACES

CMCS - MAINTENANCE ACCESS TERMINAL

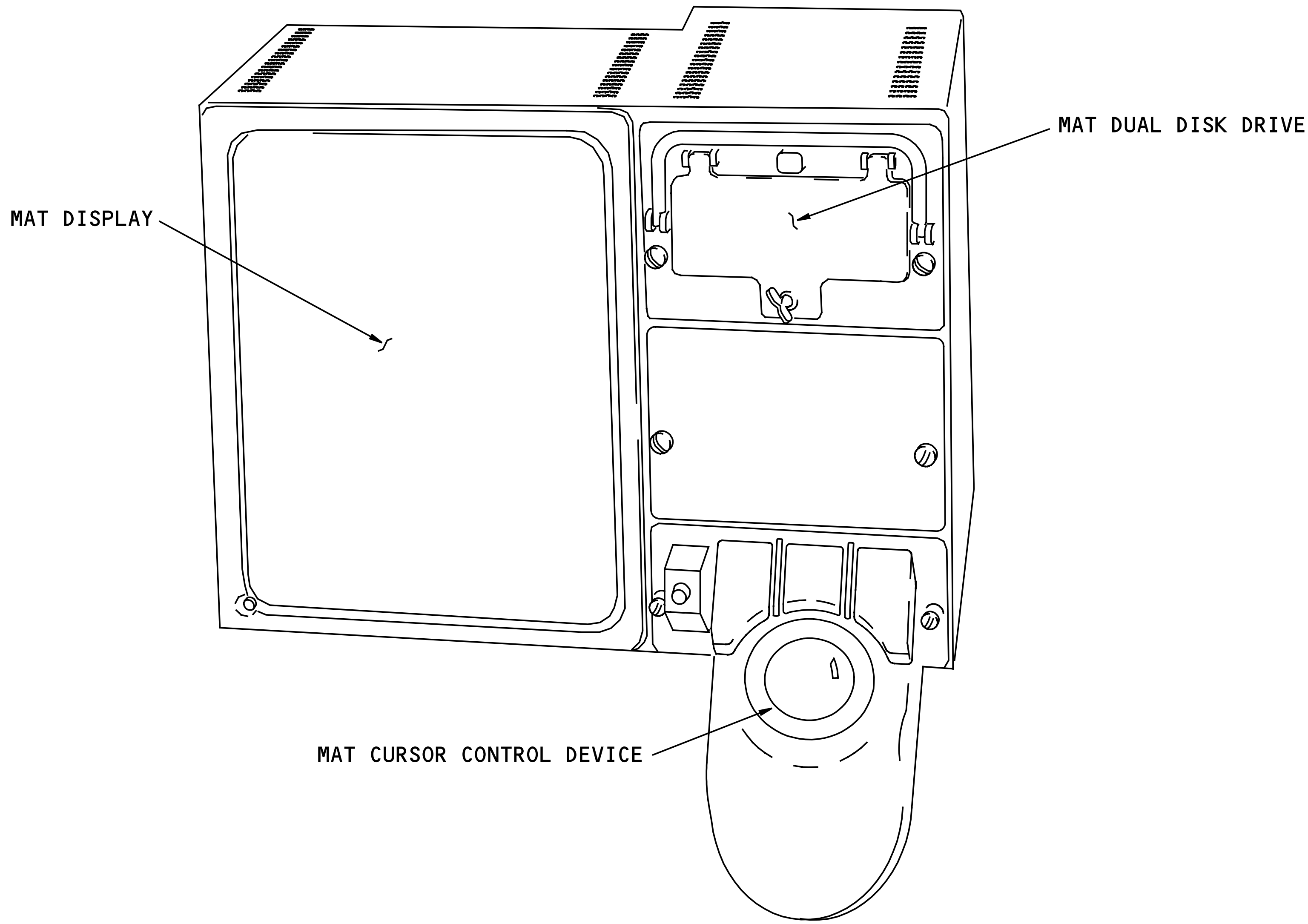
Purpose

The maintenance access terminal (MAT) gives access to the central maintenance computing system (CMCS) and the airplane condition monitoring system (ACMS).

General Description

The MAT has these four line replaceable units (LRUs):

- MAT chassis
- MAT display
- MAT dual disk drive module
- MAT cursor control device.



CMCS - MAINTENANCE ACCESS TERMINAL

CMCS - MAINTENANCE ACCESS TERMINAL KEYBOARD

Purpose

The MAT keyboard supplies:

- Standard keyboard functions
- Alternate cursor control capability.

Physical Description

The keyboard is 15 inches wide, 5.7 inches deep, and 2 inches high.

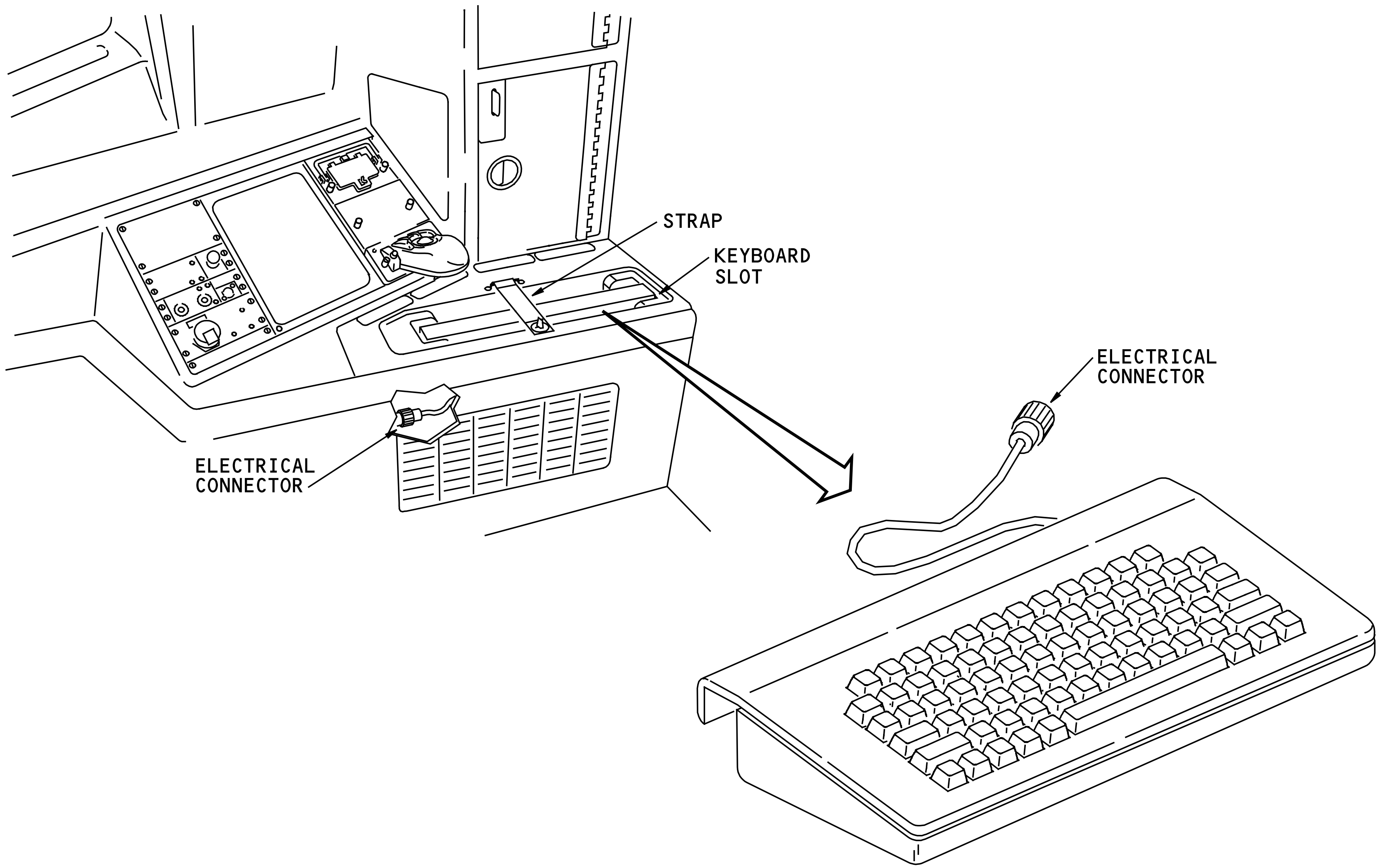
The MAT keyboard weighs approximately 4.5 pounds.

The keyboard stows on edge in the built-in stowage slot.

The keyboard has a non-removable cable at the back that connects to airplane wiring inside the keyboard slot. The keyboard cable is 48 inches long.

Training Information Point

Store the keyboard so the keyboard cable does not touch the keyboard keys. If the keyboard cable, or anything else, pushes the keyboard keys, the MAT may not operate.



CMCS - MAINTENANCE ACCESS TERMINAL KEYBOARD

CMCS - PORTABLE MAINTENANCE ACCESS TERMINAL

Purpose

The portable maintenance access terminal (PMAT) lets the operator access the CMCS and the airplane condition monitoring system (ACMS) from various locations on the airplane. All functions available on the maintenance access terminal are available on the PMAT. The locations are:

- Flight deck
- Main equipment center
- Nose wheel well
- Right main wheel well
- Jack screw area.

The PMAT in the main equipment center is permanently mounted on top of the E4 rack.

Physical Description

The PMAT is 14.00 inches wide, 14.70 inches deep, and 4.75 inches high.

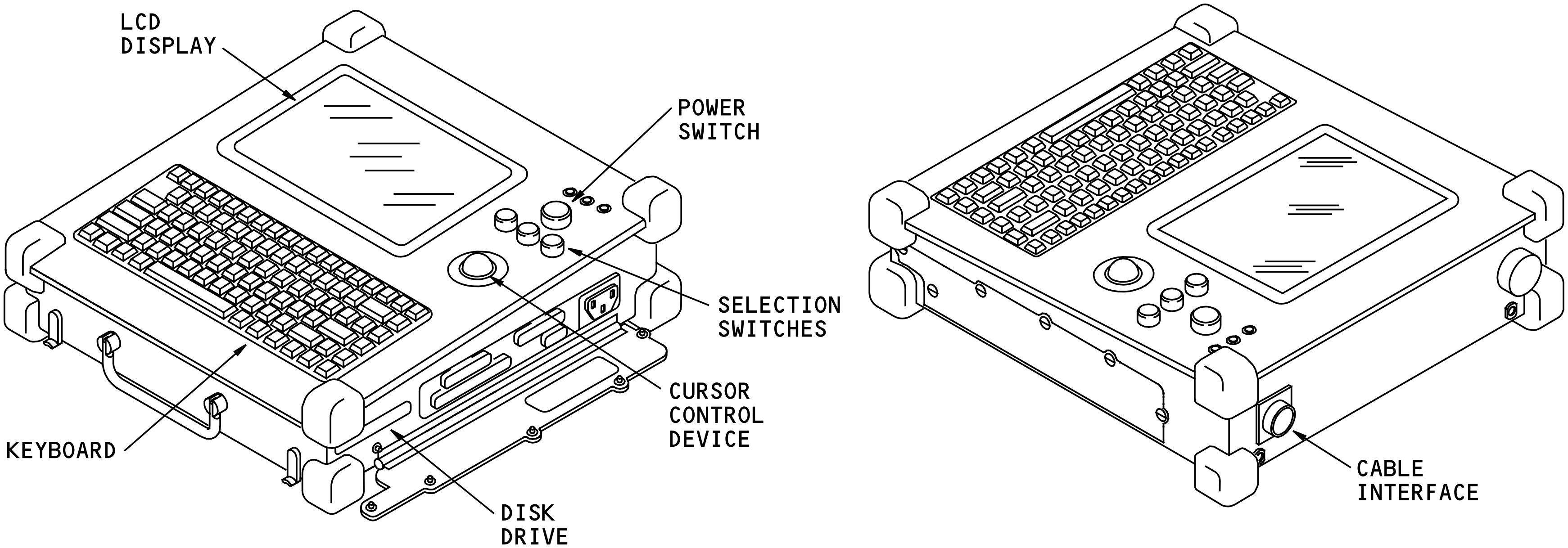
The PMAT weighs approximately 16 pounds.

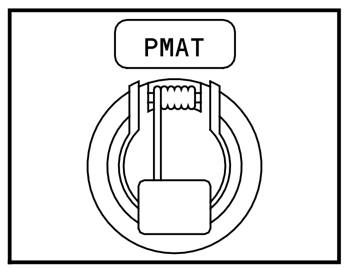
An interface cable connects to the back of the PMAT and supplies and interface to the airplane.

The PMAT receptacle has a dust cover for protection against dust and fluids.

PMAT Receptacle

The PMAT receptacle supplies an interface between a PMAT and the avionics local area network (AVLAN). The PMAT receptacle in the main equipment center also supplies power to the PMAT.





PMAT RECEPTACLE

45-10-00-019 Rev 1

CMCS - PORTABLE MAINTENANCE ACCESS TERMINAL

CMCS - FUNCTIONAL DESCRIPTION

General

The CMCF is software in the CPM/Comm that does many operations. The CMCF divides the software into many sub-functions. The software sub-functions supply these:

- Redundancy management
- BITE
- Power-up configuration checks
- Power-up hardware failure detection
- Fault data processing
- Fault and FDE correlation
- Data tables
- Flight leg and flight phase calculations
- Ground tests
- Input monitoring
- Special functions
- PSEU and air/ground rigging/calibration
- On-board engine balancing
- System configuration
- Software controlled options
- Shop faults processing
- Airline database
- Report generation
- Data load gateway
- Interface protocol.

There is CMCF software in each CPM/Comm.

Redundancy Management

Each CMCF supplies a redundancy management sub-function which does:

- Dual CMCF configuration checks
- CMCF fault history database synchronization
- Central maintenance source switching
- Offside CMCF data access.

After power-up, if both the CMCFs are operational then the primary CMCF is the left CMCF. The secondary CMCF is the right CMCF. The primary CMCF controls all the CMCF outputs to the airplane systems. The right CMCF becomes the primary CMCF if the left CMCF fails or if changed by the central maintenance source switching selection on the MAT.

The CMCFs do configuration checks continuously after a power-up. During dual operation, the CMCFs do configuration checks for these:

- Operational program configuration files (OPC)
- Operational program software (OPS)
- Airline modifiable information (AMI)
- Fault history databases
- Manual flight leg enabled/disabled condition.

In case of a configuration check difference between the two CMCFs, the CMCF shows a warning dialog box on the MAT.

For different AMIs between the two CMCFs, the CMCFs:

- Record a shop fault message
- Generate a fault report
- Continue to operate normally.

CMCS - FUNCTIONAL DESCRIPTION

The primary CMCF automatically cross loads the flight leg enabled/disabled condition to the secondary CMCF when the two CMCFs manual flight leg enable/disable conditions are different.

The CMCF supplies an automatic way to maintain an identical fault history database in both CMCFs at all times. The primary CMCF cross loads the fault history database to the secondary CMCF automatically whenever the two databases are different. The primary CMCF cross loads the fault history database in 1 minute.

The primary CMCF can be switched from one CMCF to the other CMCF. The MAT supplies the central maintenance source switching operation. The central maintenance source switching is inhibited during these conditions:

- Ground tests operation
- Data load operation
- One CMCF failure
- Onboard engine balancing system operation.

Each CMCF gets data from the other CMCF for input monitoring and reports from the AIMS intercabinet buses.

CMCF BITE

Each CMCF has BITE which detects any CMCF software partition failures. A CMCF fails if the CMCF BITE detects one of these:

- Bad data tables
- Loss of maintenance message correlation to flight deck effects (FDEs)
- Bad stored fault history database
- Loss of MAT and PMAT communications.

The CMCF BITE records a shop fault message when a failure occurs. After a CMCF failure, the failed CMCF if in control, loses control to the offside CMCF. The offside CMCF becomes the primary CMCF.

Single CMCF Power-up Configuration Checks

Each CMCF does configuration checks during power-up or after the software load of an OPS, OPC, data table, or airline database. The CMCF does configuration checks for an:

- Invalid or missing OPC
- Invalid or missing OPS
- OPC that is incompatible with the OPS
- Invalid or missing AMI
- AMI that is incompatible with the OPS.

If a configuration check finds a failure the CMCF records a shop fault message. The CMCF also shows a warning dialog box for each failure.

Single and Dual Hardware Power-up Failures

The CMCFs check for hardware failures at power-up. A failure indication, R CMCF or L CMCF Initialization Failed, shows on the MAT if one of the CMCFs has a hardware failure at power-up. The CMCF also records a shop fault message. The CMCF with no failures is the primary CMCF and supplies the CMCF outputs.

If both CMCFs have hardware failures at power up, Initialization Failed shows on the MAT. The CMCFs record a shop fault message.

Fault Data Processing

The CMCF fault processing sub-function:

- Processes inputs
- Inhibits invalid fault reports
- Creates limited fault reports
- Removes cascaded effects of failures
- Correlates FDEs and maintenance messages
- Stores FDEs and maintenance messages.

Loadable Diagnostic Information

The CMCF requests data from the loadable diagnostic information (LDI) to operate. The LDI contains:

- Fault data
- FDEs data
- MOs data
- Maintenance page snapshots (MPSs) data
- Fault correlation algorithms
- LRUs that the CMCF has access to for shop faults information
- Options
- LRU/LRM installation data.

Flight Leg and Flight Phase Calculations

The CMCF calculates the airplane flight legs. The flight legs are calculated as:

- Present leg = leg 0
- Last leg = leg -1
- Previous legs = legs -2, -3, -4, etc. to -99.

The CMCF calculates the airplane flight phases, which are:

- Power on
- Engine start
- Taxi out
- Takeoff roll
- Initial climb
- Climb
- Cruise
- Descent
- Approach
- Go around
- Flare
- Rollout
- Taxi in
- Shutdown
- Maintenance.

Ground Tests

The CMCF controls ground tests for the airplane systems. These are the three types of ground tests:

- System test
- Operational test
- LRU replacement test.

System tests make sure the system meets all tolerances and specifications for in-service use.

Operational tests are short tests that find if the system is operational.

LRU replacement tests make sure that you installed an LRU correctly and it does a check of airplane system interfaces.

Some of the grounds tests are interactive tests. Interactive tests require interaction on the MAT to complete the test.

The CMCF transmits test commands and receives test replies from the airplane systems on the:

- ARINC 629 buses
- ARINC 429 buses
- Onboard local area network (OLAN).

System Configuration

The CMCF supplies equipment and software identification (ID) data from many LRUs and LRMs to show on the MAT. The CMCF transmits ID data to and receives system configuration data from LRUs and LRMs connected to the:

- ARINC 629 buses
- ARINC 429 buses
- OLAN.

Input Monitoring

The CMCF has an input monitoring sub-function which receives input signals and supplies the signals for display on the MAT. The CMCF monitors these five signal input types:

- ARINC 629
- ARINC 429
- Analog variable
- Analog discrete
- AIMS intermodule memory (IMM).

Onboard Engine Balancing

The CMCF, with the left and right airborne vibration monitoring units, supplies the onboard engine balancing system (OEBS). The airbone vibration monitoring units transmit data to the CMCF for the OEBS.

The CMCF starts and controls the engine balancing procedure. The CMCF also supplies the displays for the engine balancing procedure.

PSEU and Air/Ground Rigging/Calibration

Rigging is a procedure where a mechanic uses information shown on the PSEU and air/ground rigging/ calibration display to make sure a sensor installation is correct. The manual mechanical rerigging of a sensor installation is also possible with the information shown on the display.

Rigging calibration permits the mechanic to change the sensor operation range from the MAT. This feature permits compensation for small differences in sensor installations.

The PSEU and air/ground rigging/calibration sub-function receives data from the:

- Left proximity sensor electronics unit (PSEU)
- Right PSEU
- Left weight on wheels (WOW) card
- Right WOW card.

You can rig or calibrate only one sensor at a time per PSEU or WOW card.

The CMCF supplies rigging and rigging calibration information for:

- Air/ground sensors
- Nose gear sensors
- Left and right main gear sensors
- Tail strike sensors
- Left and right thrust reversers indication sensors
- Forward and aft cargo doors control sensors
- Forward and aft cargo doors indication sensors
- Passenger entry doors flight lock sensors
- Passenger doors indication sensors
- Forward access door sensor
- Electrical/electronic access door sensor.

Special Functions

The CMCF supplies special functions for certain LRUs and LRMs. The protocols for special functions is the same as the protocols for ground tests. The CMCF transmits data to and receives data from the LRUs and the LRMs to show special function displays on the MAT.

Data Load Gateway

The data load gateway sub-function supplies the transfer of data between a data loader and an LRU or LRM. The data load gateway sub-function permits only one software data loading or recording session at a time.

The data load gateway sub-function moves the data between a source and a destination. The sources and destinations are LRUs and LRMs.

The sources of data for data loading are the:

- MAT
- PMAT.

The data load gateway sub-function can update a destination software configuration or record data from an LRU.

The data load gateway sub-function permits data transfers when weight is on the wheels for 5 minutes and computed airspeed is less than 40 knots.

The data load gateway sub-function supplies data to show that a destination LRU is being loaded by the data load gateway sub-function. This permits the fault processing sub-function not to show that the destination LRU has failed due to lack of response or incorrect output due to the load process. The data load gateway sub-function sends control and status data, and receives control and status data from the:

- ARINC 629 buses
- ARINC 429 buses
- Avionics local area network (AVLAN).

Software Controlled Options

The CMCF identifies software controlled options by the:

- Operational program configuration (OPC) file
- Airline modifiable information (AMI)
- CMCF options display on the MAT
- Fault table software inhibits in the data tables.

Shop Faults

The CMCF shop faults sub-function supplies a way for maintenance personnel to show and to report shop fault data stored in LRUs and LRMs, including the AIMS functions.

Shop fault data is a combination of LRU maintenance information and failure information that the LRU detects by BITE. The LRU stores the maintenance and failure information in non-volatile memory (NVM) for use during shop maintenance.

The CMCF supplies access to the shop faults data on the MAT.

Airline Modifiable Information

These are the types of data which the airline modifiable information (AMI) supplies for the CMCF:

- Notes text for maintenance messages, ground test displays, and configuration displays
- Help text for CMCF dialog boxes and displays
- The types of reports available
- Event triggers for automatically generated reports
- Tail number cross reference table which gets the specific tail number associated with the received international civil aviation organization (ICAO) number from the ATC transponder.

Report Generation

The CMCF report generation sub-function processes requests for CMCF reports from:

- The MAT dialog boxes or displays
- The PMAT dialog boxes or displays
- A ground station via datalink
- The flight deck communication function (FDCF)
- The MAT disk drive.

The CMCF also generates event triggered reports. The CMCF generates reports of the requested data and transmits the data to:

- The flight compartment printer
- A ground station
- The MAT disk drive
- The PMAT disk drive.

The print driver sub-function in the data communication management function (DCMF) receives the CMCF report data for the flight deck printer. The ACARS datalink sub-function in the DCMF receives the CMCF report data for transmission to a ground station. The OLAN sub-function in the DCMF receives the CMCF report data for transmission to the MAT and PMAT over the AVLAN.

The CMCF supplies one report at a time. The CMCF generates reports automatically at selected CMCF flight events. The flight events are program selectable and deselectable on the GBST. The CMCF transmits the flight event data to ground stations via datalink.

CMCF Interface Protocol

The CMCF interface protocol supplies the communications with the:

- DCMF
- PDF EICAS sub-function
- FMCF
- ARINC 629 buses
- ARINC 429 buses
- AVLAN.

The CMCF transmits data to and receives data from the DCMF. The data is used for:

- Downlink and uplink communications
- AVLAN communications
- Flight deck printer communications.

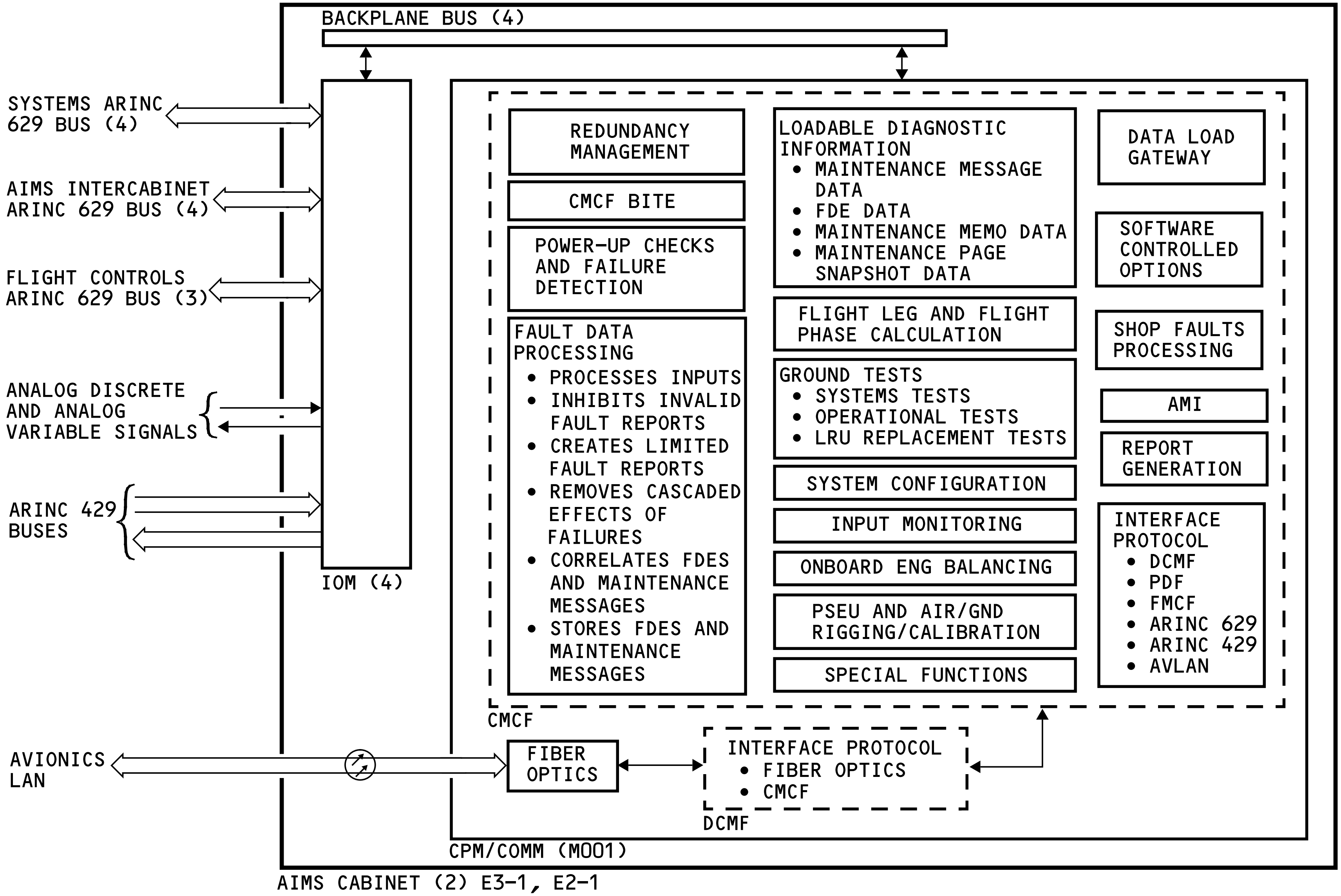
The PDF EICAS sub-function supplies FDE status data to the CMCF, which indicates the active, inactive and latched states of the FDEs.

The FMCF transmits data to the CMCF. The CMCF receives:

- Flight phase
- Flight number
- City pair
- Top of descent.

The CMCF transmits data to and receives data from many LRUs and LRMs. The CMCF supplies three interface protocols for communications with the LRUs and LRMs:

- ARINC 629 protocol
- ARINC 429 protocol
- AVLAN protocol.



CMCS - FUNCTIONAL DESCRIPTION

CMCS - AIRLINE MODIFIABLE INFORMATION

General

The design of the 777 airplane lets the airlines customize certain functions in the central maintenance computing system (CMCS). You customize these functions through airline modifiable information (AMI). You use the ground based software tool (GBST) to make the modifications.

The CMCS system comes with a baseline AMI. The baseline AMI for this system has HELP pages only.

The total memory available for the CMCS AMI is one megabyte. This total includes the baseline AMI and any modifications you make using the GBST.

You use the GBST to modify these:

- Notes
- Help
- Reports selections
- Tail number cross reference table.

Baseline Help

The baseline AMI provides help screens for displays and dialog boxes.

Modifiable Functions

You can use the GBST to specify notes for any maintenance message, ground test, or system configuration. When you select them, notes show in dialog boxes.

You can modify the baseline AMI and show help for most displays and most dialog boxes.

You can use the GBST to specify a selection for an automatic downlink of CMCF reports. You can specify these:

- Type of report to downlink
- Trigger for the report
- Destination (VHF or SATCOM)
- Downlink label and sublabel.

You can have a table to define the airplane tail identification. This table correlates to the ICAO addresses with tail numbers to allow proper identification for downlinked messages. This table has all the tail numbers for the airplanes in your 777 fleet.

Training Information Point

The CMCS AMI supplies the airplane tail identification to the data communication management system (DCMS). The DCMS aircraft communication addressing and reporting system (ACARS) sub-function must have this information to operate.

BASELINE AMI
HELP PAGES

MODIFIABLE FUNCTIONS
NOTES
HELP PAGES
REPORTS SELECTION
TAIL NUMBER CROSS REFERENCE TABLE

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CMCS - AIRLINE MODIFIABLE INFORMATION

CMCS - FLIGHT LEG LOGIC

General

You can review fault data on the MAT by flight legs. The CMCF computes the flight legs.

The flight leg logic defines the flight leg period. There are no time gaps between flight legs. When one flight leg ends, the next flight leg begins.

Flight Leg Transition Logic

The CMCF transitions or increments the flight leg when all of these conditions are true:

- The airplane is on the ground
- Either one of the engines is running after both have been shut down or one or both engines are running and the last door transitions from open to closed
- The flight leg transition is enabled.

Flight Leg Enable Logic

The flight leg enable logic prevents nuisance flight legs because of engine starts and shutdowns or doors open and closed.

A flight leg enable occurs when either of these are true:

- You manually enable the flight leg on the MAT
- The CMCF detects parking brakes off, engine at takeoff thrust, and a ground speed of more than 80 knots.

After the enable occurs, The CMCF stores it until the next flight leg transition logic becomes true.

When the CMCF uses the enable, a new flight leg enable must occur before the next flight leg can transition.

When the flight leg transition occurs, the CMCF generates a transition inhibit. This inhibit resets the enable logic. You can also manually set the transition inhibit on the MAT.

The next flight leg enable causes the inhibit to go away.

Flight Leg Calculations

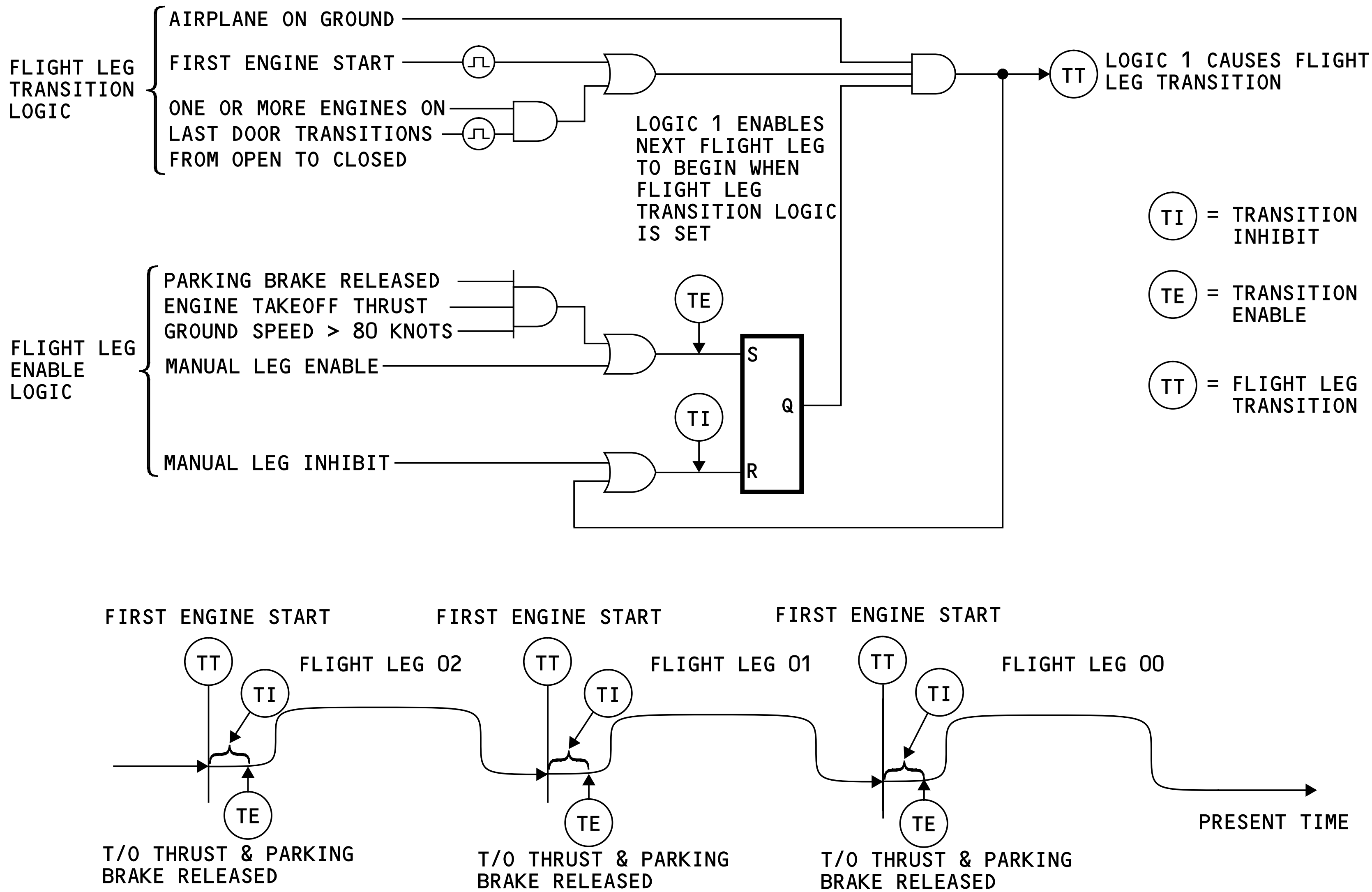
The current flight leg shows as flight leg 00.

The previous flight leg shows as flight leg 01.

Other flight legs show as 02, 03, 04,...99. The CMCF stores the most recent 100 flight legs.

Flight legs help identify faults stored for these:

- Inbound flight deck effects
- Present leg faults
- Fault history.



CMCS - FLIGHT LEG LOGIC

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CMCS - FLIGHT PHASES - 1

Flight Phase Logic

The CMCF in AIMS calculates flight phases. A flight leg has several flight phases. The CMCF uses specific logic for these calculations. The logic includes:

- Only one flight phase is active at any time
- A flight phase remains active until conditions for a new flight phase exist
- The maintenance (MT) flight phase has priority over all other flight phases
- The engine start (ES) flight phase has priority over all flight phases except MT
- The shutdown (SD) flight phase has priority over all flight phases except ES and MT
- The go around (GA) flight phase has priority over all flight phases except MT, ES, SD and climb (CL)
- The approach (AP) and flare (FL) flight phases have priority over descent (DC).

Flight Phase Calculations

The CMCF uses specific inputs to calculate and transition flight phases. There are fifteen flight phases.

Flight phases show on various CMCS displays to show the part of the flight that a fault first becomes active.

Power On (PO) Flight Phase

PO is the CMCF default flight phase. The CMCF transitions to PO when both of these are true:

- There is power on the airplane
- No other flight phase conditions are true.

Engine Start (ES) Flight Phase

The CMCF transitions to ES when these are true:

- The airplane is on the ground
- An engine's starter air valve transitions from closed to open.
- The engines fuel switch is in the RUN position
- N2 is less than idle.

Taxi Out (TA) Flight Phase

The CMCF transitions to TA when all of these are true:

- At least one engine has N2 equal to or greater than idle
- The airplane is on the ground
- The airplanes ground speed (GS) is less than 80 knots
- The flight leg transition is disabled.

Takeoff Roll (TO) Flight Phase

The CMCF transitions to TO when all of these are true:

- Both engines are running
- The airplane is on the ground
- The throttle resolver angle (TRA) for both engines is at takeoff
- Flaps/slats are set for takeoff

- GS is greater than 80 knots.

Initial Climb (IC) Flight Phase

The CMCF transitions to IC when all of these are true:

- The airplane is in the air
- Flaps/slats are set for takeoff
- Mode control panel (MCP) altitude is above the airplane's current altitude.

Climb (CL) Flight Phase

The availability of FMCF flight phase data determines how the CMCF transitions to CL.

When FMCF flight phase data is available, the CMCF transitions to CL when the FMCF flight phase transitions to CL.

When FMCF flight phase data is not available, the CMCF transitions to CL when all of these are true:

- The airplane is in the air
- The airplane climbs at more than 400 feet per minute.
- Radio altitude (RA) data shows that RA is greater than 1500 feet or RA data is not available and IC or go around (GA) has been active for two minutes.

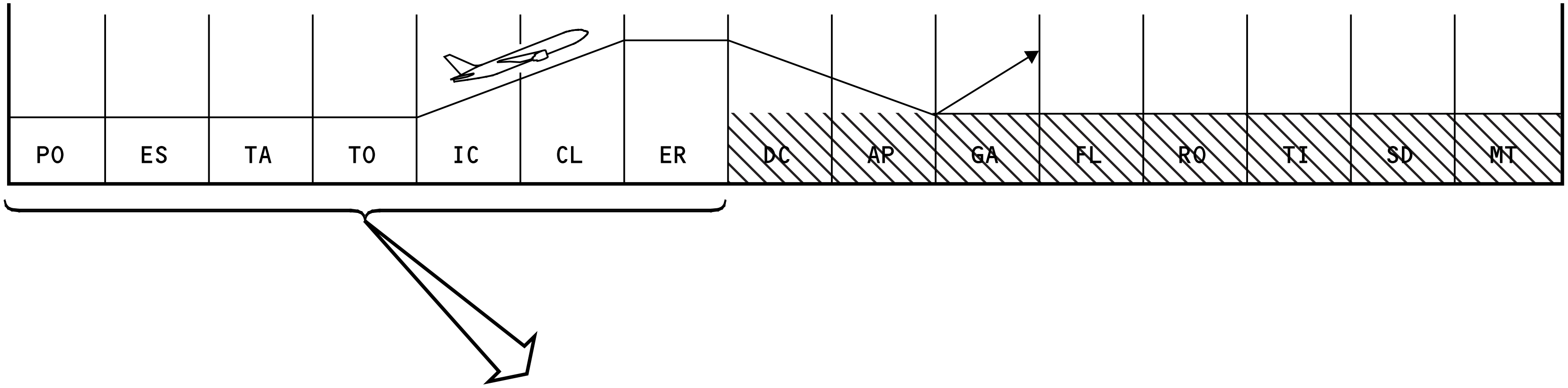
Cruise (ER) Flight Phase

The availability of FMCF flight phase data determines how the CMCF transitions to ER.

When FMCF flight phase data is available, the CMCF transitions to ER when the FMCF flight phase transitions to cruise.

When FMCF flight phase data is not available, the CMCF transitions to ER when both of these are true:

- The airplane is in the air
- The airplane either climbs or descends at a rate less than 400 feet per minute.



FLIGHT PHASE	CONDITION
PO (POWER ON)	POWER TO AIRPLANE AND NO OTHER FLIGHT PHASE
ES (ENGINE START)	AIRPLANE ON GROUND AND STARTER VALVE FROM CLOSED TO OPEN AND FUEL SWITCH IN RUN AND N2 IS LESS THAN IDLE
TA (TAXI OUT)	ONE ENGINE RUNNING (N2 > IDLE) AND AIRPLANE ON GROUND AND GS < 80 KNOTS AND FLIGHT LEG TRANSITION DISABLED
TO (TAKEOFF ROLL)	BOTH ENGINES RUNNING AND AIRPLANE ON GROUND AND TRA SET TO TAKEOFF AND FLAPS/SLATS IN TAKEOFF AND GS > 80 KNOTS
IC (INITIAL CLIMB)	AIRPLANE IN AIR AND FLAPS/SLATS AT TAKEOFF AND MCP ALTITUDE IS ABOVE CURRENT ALTITUDE
CL (CLIMB)	FMCF FLIGHT PHASE TRANSITIONS TO CLIMB OR FMCF FLIGHT PHASE DATA NOT AVAILABLE AND AIRPLANE IN AIR AND AIRPLANE CLIMBS AT MORE THAN 400 FEET/MINUTE AND RA > 1500 FEET OR IC OR GA FOR TWO MINUTES
ER (CRUISE)	FMCF FLIGHT PHASE DATA AVAILABLE AND FMCF TRANSITIONS TO CRUISE OR FMCF FLIGHT PHASE DATA NOT AVAILABLE AND AIRPLANE IN AIR AND AIRPLANE CLIMBS OR DESCENDS AT A RATE LESS THAN 400 PER MINUTE.

CMCS - FLIGHT PHASES - 1

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CMCS - FLIGHT PHASES - 2

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CMCS - FLIGHT PHASES - 2

Descent (DC) Flight Phase

The availability of FMCF flight phase data determines how the CMCF changes to DC.

With FMCF flight phase data available, the CMCF changes to DC when the FMCF flight phase changes to descent.

With FMCF flight phase data not available, the CMCF changes to DC when both of these conditions are true:

- The airplane is in the air
- The airplane descends at more than 400 feet per minute.

Approach (AP) Flight Phase

The CMCF changes to AP when all of these are true:

- The airplane is in the air
- The flaps are set for landing
- The landing gear is down.

Go-Around (GA) Flight Phase

There are two conditions that cause the CMCF to change to GA.

For the first condition, the CMCF changes to GA when both of these are true:

- The airplane is in the air
- The TOGA switch is set.

For the second condition, the CMCF changes to GA when all these are true:

- The airplane is in the air
- The flaps have changed from landing to takeoff
- The TRA for both engines is set for takeoff.

Flare (FL) Flight Phase

The CMCF changes to FL when all of these are true:

- The airplane is in the air
- The flaps are set for landing
- Radio altitude is less than 50 feet.

Rollout (RO) Flight Phase

The CMCF changes to RO when all of these are true:

- The airplane is on the ground
- Ground speed is more than 80 knots.

Taxi In (TI) Flight Phase

The CMCF changes to TI when all of these are true:

- The airplane is on the ground
- At least one engine is running
- Ground speed is less than 80 knots
- The flight leg transition is enabled.

CMCS - FLIGHT PHASES - 2

Shutdown (SD) Flight Phase

The CMCF changes to SD when all of these are true:

- The airplane is on the ground
- The starter air valve is closed
- Either engine fuel switch changes from RUN to CUTOFF and the EEC is active.

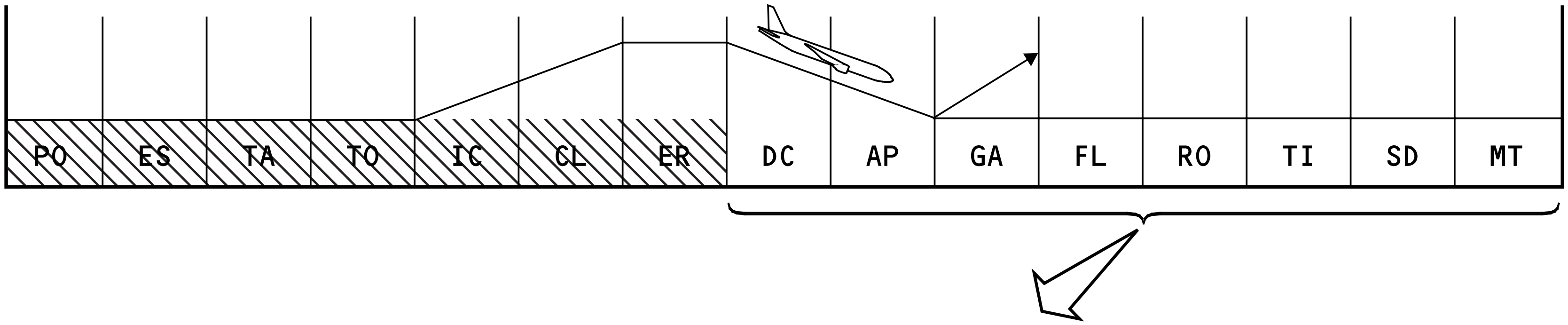
Maintenance (MT) Flight Phase

There are two conditions that cause the CMCF to change to MT.

For the first condition, the CMCF changes to MT when both of these are true:

- Aircraft vibration monitoring (AVM) onboard engine balancing system (OEBS) on the MAT is in test
- The airplane is on the ground.

For the second condition, the CMCF changes to MT when the maintenance phase is selected on the maintenance enable/disable dialog box on the MAT.



FLIGHT PHASE	CONDITION
DC (DESCENT)	FMCF FLIGHT PHASE CHANGES TO DESCENT OR FMCF FLIGHT PHASE DATA NOT AVAILABLE AND AIRPLANE IN AIR AND AIRPLANE DESCENDS AT MORE THAN 400 FEET/MINUTE
AP (APPROACH)	AIRPLANE IN AIR AND FLAPS SET FOR LANDING AND LANDING GEAR DOWN
GA (GO AROUND)	AIRPLANE IN AIR AND TOGA SWITCH IS ENABLED OR AIRPLANE IN AIR AND FLAPS SET FOR LANDING AND TRA SET TO TAKEOFF
FL (FLARE)	AIRPLANE IN AIR AND FLAPS SET FOR LANDING AND RADIO ALTITUDE < 50 FT
RO (ROLLOUT)	AIRPLANE ON GROUND AND GROUND SPEED > 80 KNOTS
TI (TAXI IN)	AIRPLANE ON GROUND AND AT LEAST ONE ENGINE RUNNING AND GROUND SPEED < 80 KNOTS AND FLIGHT LEG TRANSITION ENABLED
SD (SHUTDOWN)	AIRPLANE ON GROUND AND THE STARTER AIR VALVE CLOSED AND EITHER FUEL SWITCH CHANGES FROM RUN TO CUTOFF/EEC ACTIVE
MT (MAINTENANCE)	AVM OEBS SELECTED ON MAT AND AIRPLANE ON GROUND OR MAINTENANCE ENABLE MODE IS SELECTED ON MAT

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CMCS - FLIGHT PHASES - 2

CMCS - CMCF CORRELATION

General

The central maintenance computing function (CMCF) in the AIMS cabinets monitors systems for failures and reports these failures as maintenance messages.

The primary display function (PDF) in the AIMS cabinets also monitors systems for faults that show on these displays:

- PFD
- ND
- EICAS
- MFD.

These faults show as failure flags, messages, or non-normal displays. The PDF groups these indications and calls them flight deck effects (FDEs). The flight crews report these FDEs as log book entries. The PDF sends the FDEs to the CMCF.

The CMCF correlates or associates these maintenance messages with an FDE and makes displays that show on the MAT.

Correlated maintenance messages also relate to and cause maintenance memos.

The CMCF also generates non-correlated maintenance messages. These messages do not relate to an FDE but provide useful maintenance data.

Correlated Maintenance Messages

Correlated maintenance messages are those messages that are directly linked to a FDE or a maintenance memo (MO). These are the requirements to correlate a message to an FDE:

- They must both be active or latched at the same time
- The FDE and maintenance message must match on a CMCS correlation list.

Flight Deck Effects

These are the nine categories of flight deck effects:

- EICAS warning messages
- EICAS caution messages
- EICAS advisory messages
- EICAS status messages
- PFD flags
- ND flags
- EICAS snapshots
- Displays (exceedances, etc.)
- Scheduled maintenance tasks.

The primary display function (PDF) sends the flight deck effects to the CMCF. The CMCF then correlates the FDE to a maintenance message.

CMCS - CMCF CORRELATION

Scheduled Maintenance Tasks

Scheduled maintenance task messages relate to certification maintenance requirement items (CMR) or maintenance review board (MRB) items with time exposure limits.

These messages relate to those that show on the maintenance task maintenance page on the MFD.

These messages are available in the maintenance planning function as:

- Inbound scheduled maintenance tasks (from maintenance planning menu)
- Existing scheduled maintenance tasks (from maintenance planning menu).

One or more correlated maintenance messages cause a scheduled maintenance task. There is no requirement to check these messages prior to flight.

Maintenance Memos

Maintenance memos (MO) are a special category of CMCS messages. The purpose of these messages is to report failures in fault tolerant parts of systems. If another failure in that system occurs, it may affect function of the system. They let maintenance organizations plan appropriate actions before a system or component becomes not airworthy.

These messages are available in the maintenance planning function as:

- Inbound maintenance memos (from maintenance planning menu)
- Existing maintenance memos (from maintenance planning menu).

One or more correlated maintenance messages cause a maintenance memo. There is no requirement to check these messages prior to flight.

Maintenance Message Storage

The CMCF stores maintenance messages differently for the different flight phases. This is called flight phase screening. If the maintenance message occurred during a storable flight phase, it is kept in static random access memory (SRAM). The maintenance messages may show on one of these:

- Inbound flight deck effects
- Present leg faults
- Fault history
- Inbound scheduled maintenance tasks (from maintenance planning menu)
- Inbound maintenance memos (from maintenance planning menu).

Maintenance messages that do not occur during a storable flight phase are also kept in SRAM. But, these messages are erased when they become not active or unlatched. They show on these:

CMCS - CMCF CORRELATION

- Existing flight deck effects
- Existing faults
- Existing scheduled maintenance tasks (from maintenance planning menu)
- Existing maintenance memos (from maintenance planning menu).

Training Information Point

More than one maintenance message may correlate to an FDE or MO. Find the corrective action for the maintenance message nearest in time to the FDE or MO. If the display does not show the time of the maintenance message, find the corrective action for the maintenance message that shows first below the FDE or MO.

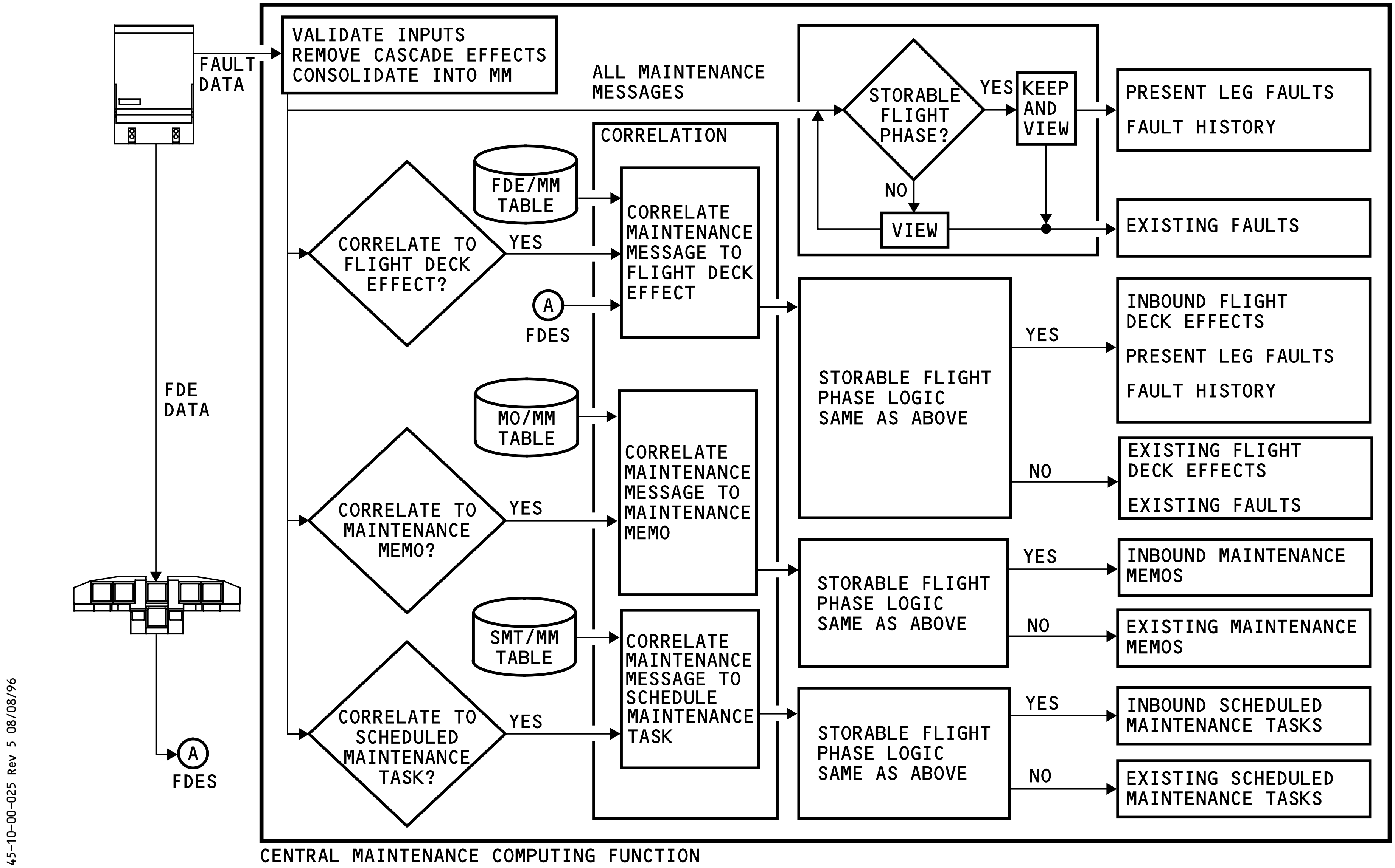
The CPM/COMM SRAM is kept by the hot battery bus. Use the move fault history function from the fault history summary display to move the fault history to diskettes if you are going to disconnect the hot battery bus.

Non-Correlated Maintenance Messages

Non-correlated maintenance messages are those messages that do not relate to a FDE but provide useful diagnostic information. The MAT reports these messages as non-FDE messages.

These messages show in these areas:

- Present leg faults
- Existing faults
- Fault history.



CMCS - CMCF CORRELATION

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CMCS - CMCF FLIGHT PHASE SCREENING

General

The CMCF uses the flight phase to make a decision about where to store maintenance messages and where to show them on the MAT. This is called flight phase screening.

Flight phase screening prevents the CMCF from storing nuisance or false maintenance messages. Every maintenance message is storable during some flight phases.

Maintenance Message Correlation

The CMCF receives active or latched fault data and changes it to a maintenance message. The CMCF may correlate a maintenance message to one or more of these flight deck effects (FDEs):

- EICAS warning message
- EICAS caution message
- EICAS advisory message
- EICAS status message
- PFD Flag
- ND FLag
- EICAS auto snapshot
- Display (exceedance, etc.)
- Scheduled maintenance task (SMT).

The CMCF may also correlate a maintenance message to a maintenance memo (MO).

Storable Flight Phase Logic

The CMCF stores the active or latched maintenance message and correlation in temporary memory. The CMCF calculates the flight phase. If the maintenance message is active or latched during a storable flight phase, the CMCF also stores the maintenance message and correlation in fault history memory.

Maintenance Message Display - Temporary Memory

The CMCF will always show an active or latched maintenance message on the MAT. This chart shows which MAT displays show the maintenance message when it is active or latched and stored in temporary memory:

Maintenance message is active or latched and correlates to:	Shows on display(s):
None	Existing Faults
FDE	Existing Flight Deck Effects
	Existing Faults
Maintenance Memo (MO)	Existing Maintenance Memos
	Existing Faults
Scheduled Maintenance Task (SMT)	Existing Scheduled Maintenance Tasks
	Existing Faults

If a maintenance message becomes not active, the CMCF removes the maintenance message and correlation from temporary memory. It no longer shows on the above displays.

Maintenance Message Display - Fault History Memory

If the maintenance message is active or latched during a storable flight phase, the maintenance message and correlation is also in fault history memory. The maintenance message and correlation shows on the above displays when it is active or latched. This chart shows which other MAT displays show the maintenance message when it is stored in fault history memory:

Maintenance message is active or latched during a storable flight phase and correlates to:	Shows on display(s):
None	Present Leg Faults
	Fault History
FDE	Inbound Flight Deck Effects
	Fault History
Maintenance Memo	Inbound Maintenance Memos
	Present Leg Faults
	Fault History
Scheduled Maintenance Task	Inbound Scheduled Maintenance Tasks
	Present Leg Faults
	Fault History

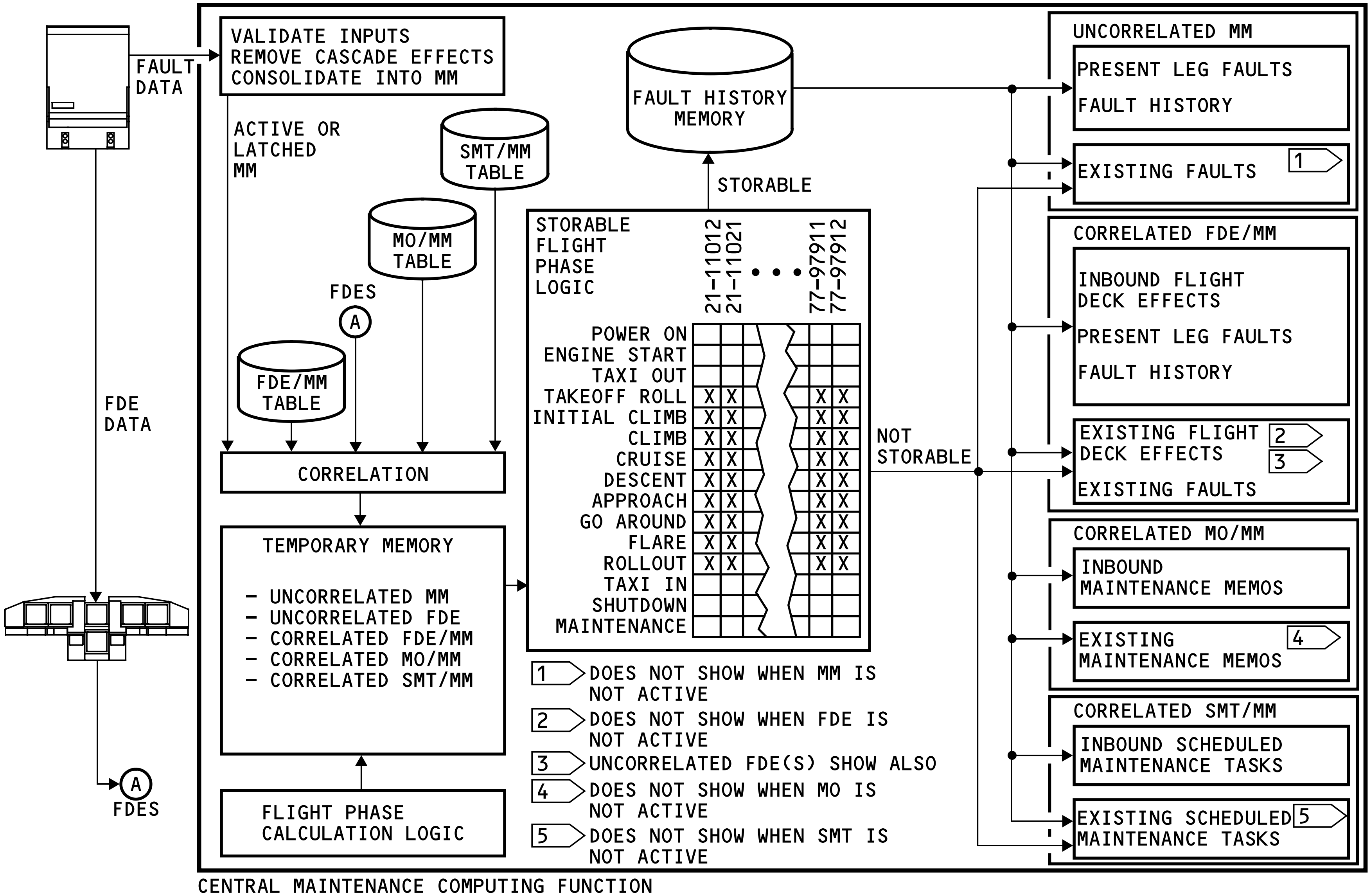
If a maintenance message becomes not active, the CMCF keeps the maintenance message and correlation in fault history memory. It changes the maintenance message activity to not active.

Training Information Point

Some FDEs with no correlated maintenance messages show on the existing flight deck effects display. Normal conditions on the ground, such as engine shutdown, usually cause these FDEs.

Latched EICAS status messages stay on the inbound and existing flight deck effects display after the correlated maintenance message becomes not active. When you erase the status message from the maintenance task maintenance page:

- The CMCF changes the status message activity to not active on the inbound flight deck effects display.
- The CMCF removes the status message from the existing flight deck effects display.



CMCS - CMCF FLIGHT PHASE SCREENING

CMCS - FAULT DISPLAY SUMMARY

General

You can see flight deck effects (FDEs) and maintenance message (fault) data on many different CMCS displays.

You use the different displays for different work on the airplane. You use the fault isolation manual (FIM) to find the cause of maintenance messages.

These displays show FDEs and their correlated maintenance messages:

- Inbound flight deck effects
- Existing flight deck effects.

These displays show maintenance messages and their correlated FDEs:

- Present leg faults
- Existing faults
- Fault history.

These displays show maintenance memos (MOs) and their correlated maintenance messages:

- Inbound maintenance memos
- Existing maintenance memos.

These displays show scheduled maintenance tasks (SMTs) and their correlated maintenance messages:

- Inbound scheduled maintenance tasks
- Existing scheduled maintenance tasks.

Ground test displays show maintenance messages when a ground test fails.

Inbound Flight Deck Effects Display

The inbound flight deck effects display shows the flight deck effects and correlated maintenance messages from the last flight. Flight phase screening occurs, so maintenance messages must have been active or latched during a storable flight phase to show on this display. The CMCF shows the FDEs by time. The most recent FDE shows first.

Existing Flight Deck Effects Display

The existing flight deck effects display shows all active and latched flight deck effects. There is no flight phase screening. Flight deck effects that show because of airplane system problems have correlated maintenance messages. Some EICAS messages which are not failure related or which show a pilot selected condition do not have correlated maintenance messages. Many EICAS messages which are not failure related show when the airplane is parked on the ground. These are examples of EICAS messages which are not failure related:

- FUEL PUMP R AFT
- HYD PRESS SYS C
- ENG SHUTDOWN
- ICING WING.

CMCS - FAULT DISPLAY SUMMARY

These are examples of EICAS messages which show a pilot selected condition:

- PARKING BRAKE SET
- APU RUNNING
- AUTOBRAKE 3.

The CMCF shows the FDEs by time. The most recent FDE shows first.

Present Leg Faults Display

The present leg faults display shows the maintenance messages from the last flight. Flight phase screening occurs so maintenance messages must have been active or latched during a storable flight phase to show on this display. Maintenance messages with correlated flight deck effects show on the display. Maintenance messages which are not correlated to flight deck effects show in a separate group on the display. These are for airplane system problems which are not critical. These are called non-correlated maintenance messages.

The CMCF shows the maintenance messages and correlated FDEs by time. The maintenance message with the most recent FDE shows first. The group of non-correlated maintenance messages shows last. In this group, the most recent non-correlated maintenance message shows first. You can also select the maintenance messages by ATA chapter.

Existing Faults Display

The existing faults display shows active and latched maintenance messages. There is no flight phase screening. You select the maintenance messages by ATA chapter. You can also show the maintenance messages and FDEs by time. The maintenance message with the most recent FDE shows first. The group of non-correlated maintenance messages shows last. In this group, the most recent non-correlated maintenance message shows first.

Fault History Display

The fault history display shows the maintenance messages from the last 100 flight legs. Flight phase screening occurs so maintenance messages must have been active or latched during a storable flight phase to show on this display. You select the maintenance messages by ATA chapter. You can also show the maintenance messages and FDEs by flight leg. The maintenance message with the most recent FDE of the flight leg shows first. The group of non-correlated maintenance messages shows last. In this group, the most recent non-correlated maintenance message shows first.

Inbound Maintenance Memos Display

The inbound maintenance memo display shows the maintenance memos and correlated maintenance messages from the last flight. Maintenance memos and their correlated maintenance messages give data about the condition of redundant LRUs and systems. Flight phase screening occurs so maintenance messages must have been active or latched during a storable flight phase to show on this display. The CMCF shows the maintenance memos by time. The most recent maintenance memo shows first.

Existing Maintenance Memos Display

The existing maintenance memos display shows all active and latched maintenance memos. There is no flight phase screening. Maintenance memos and their correlated maintenance messages give data about the conditions of redundant LRUs and systems. The CMCF shows the maintenance memos by time. The most recent maintenance memo shows first.

Inbound Scheduled Maintenance Tasks Display

The inbound scheduled maintenance tasks display shows the scheduled maintenance tasks and correlated maintenance messages from the last flight. Scheduled maintenance tasks and their correlated maintenance messages relate to certification maintenance requirement (CMR) items or maintenance review board (MRB) items. These items have time exposure limits. Flight phase screening occurs so maintenance messages must have been active or latched during a storable flight phase to show on this display. Some inbound scheduled maintenance tasks which are not failure related do not have correlated maintenance messages. The CMCF shows the scheduled maintenance tasks by time. The most recent scheduled maintenance task shows first.

Existing Scheduled Maintenance Tasks Display

The existing scheduled maintenance tasks display shows all active scheduled maintenance tasks. There are no latched scheduled maintenance tasks. There is no flight phase screening. Scheduled maintenance tasks and their correlated maintenance messages relate to certification maintenance requirement (CMR) items or maintenance review board (MRB) items with time exposure limits. Some existing scheduled maintenance tasks which are not failure related do not have correlated maintenance messages. The CMCF sorts the scheduled maintenance tasks by time. The most recent scheduled maintenance task shows first.

Ground Tests Display

Maintenance messages that cause a ground test to fail show on the ground test tests display. The CMCF shows the maintenance messages by ATA chapter.

FUNCTION	FLIGHT PHASE SCREENING	CORRELATED MAINTENANCE MESSAGES	NON-CORRELATED MAINTENANCE MESSAGES	NON-CORRELATED FDES (MO OR SMT)	SORT BY FDE (MO OR SMT)	SORT BY ATA	SORT BY FLIGHT LEG
INBOUND FDES	YES	YES	NO	NO	YES	NO	NO
EXISTING FDES	NO	YES	NO	YES	YES	NO	NO
PRESENT LEG FAULTS	YES	YES	YES	NO	YES [1]	YES	NO
EXISTING FAULTS	NO	YES	YES	NO	YES	YES [1]	NO
FAULT HISTORY	YES	YES	YES	NO	YES	YES [1]	YES
INBOUND MAINTENANCE MEMOS	YES	YES	NO	NO	YES	NO	NO
EXISTING MAINTENANCE MEMOS	NO	YES	NO	NO	YES	NO	NO
INBOUND SCHEDULED MAINTENANCE TASKS	YES	YES	NO	YES	YES	NO	NO
EXISTING SCHEDULED MAINTENANCE TASKS	NO	YES	NO	YES	YES	NO	NO
GROUND TESTS	NO	YES	YES	NO	NO	YES	NO

[1] SEQUENCE THAT SHOWS FIRST

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CMCS - FAULT DISPLAY SUMMARY

CMCS - MAT MAIN MENU DISPLAY

Initial Power-Up

At initial power-up of the airplane, the maintenance access terminal (MAT) shows a MAT main menu display. The MAT main menu display supplies access to these functions:

- Central maintenance computing system (CMCS)
- Airplane conditioning monitoring system (ACMS)
- MAT status
- Self load.

Software Requirements

The operational software for the MAT supplies the displays on the MAT display module. It is in the memory of the MAT display module. This software is called the maintenance terminal function (MTF). Select SELF LOAD from the MAT main menu display to load the MTF.

The operational software for the central maintenance computing function (CMCF) is in memory in the AIMS cabinets.

Screen Saver

The MAT has a screen saver. If you do not use the MAT for 30 minutes, the MAT display becomes dim. Use one of these controls to make the MAT display bright again:

- MAT cursor control device
- MAT keyboard
- MAT brightness control.

The master brightness control does not make the MAT display bright again.

Buttons

Select ONBOARD MAINTENANCE to send a request for CMCS information from the CMCF in the AIMS cabinets. The CMCF sends the data to the MAT and the CMCF main menu shows.

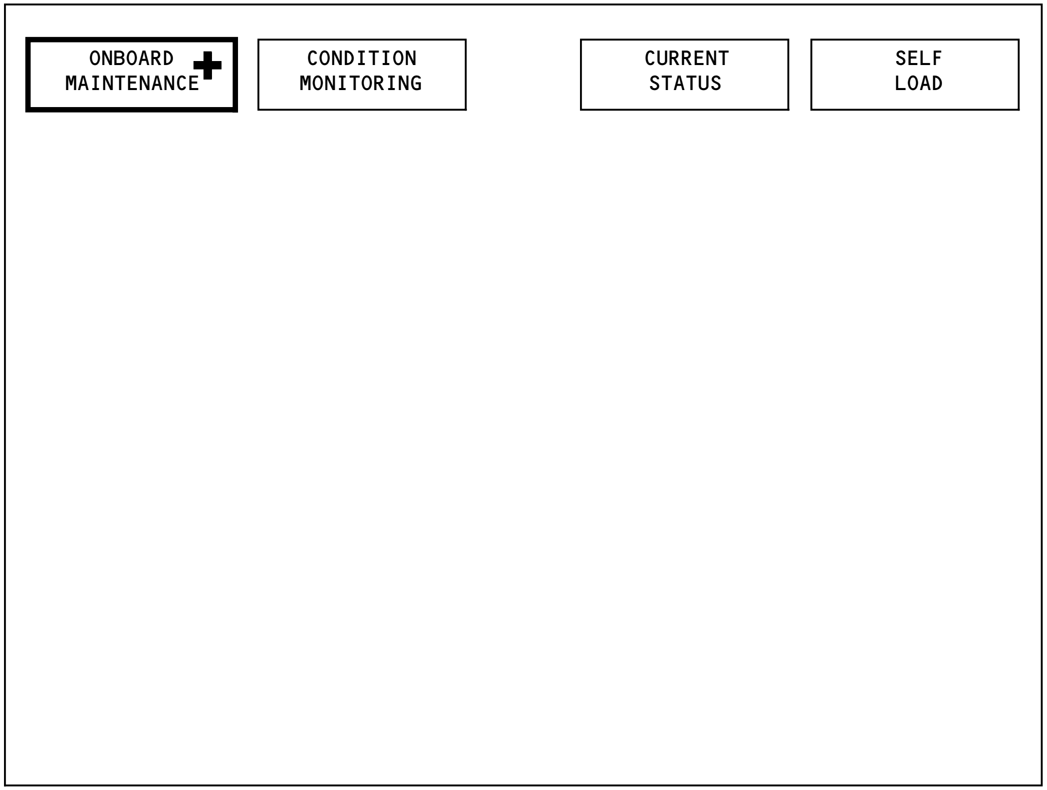
Select CONDITION MONITORING to send a request for ACMS data from the airplane condition monitoring function (ACMF) in the left AIMS cabinet. The ACMF sends the data to the MAT and the ACMF main menu shows.

Select CURRENT STATUS to see the condition of the MAT. A dialog box shows any hardware or software failures.

Select SELF LOAD to load the MTF into the MAT. Use the MAT disk drive or MAT hard drive as the source of the software.

Training Information Point

As many as three technicians can use the CMCS at the same time. Only one technician can use the ACMS at a time. You can also use a portable maintenance access terminal (PMAT) to use the CMCS and ACMS.



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CMCS - MAT MAIN MENU DISPLAY

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CMCS - MAIN MENU SELECTIONS

General

The CMCF menus supply access to functions that are task oriented. The menus also supply access to functions based on when and how often technicians do certain tasks. As many as three technicians can use the CMCS at the same time.

Main Menu Bar

Select ONBOARD MAINTENANCE from the MAT main menu display to cause the CMCS main menu bar to show at the top of the MAT display. ONBOARD MAINTENANCE and the CMCF in control shows in the center of the MAT. All the menu items are available for selection except when a dialog box shows on the display.

You can use the CMCS from three maintenance access terminals at the same time. These are the maintenance access terminals:

- the maintenance access terminal in the flight compartment
- the portable maintenance access terminal (PMAT) in the main equipment center
- a PMAT at one of the PMAT receptacles.

These are the main menu selections:

- LINE MAINTENANCE
- EXTENDED MAINTENANCE
- OTHER FUNCTIONS
- HELP
- REPORT.

LINE MAINTENANCE Selection

Select LINE MAINTENANCE to get access to maintenance functions generally done during quick turnarounds at the gate.

Select LINE MAINTENANCE to cause another menu to show. These are the selections available on this menu:

- INBOUND FLIGHT DECK EFFECTS
- EXISTING FLIGHT DECK EFFECTS
- GROUND TESTS
- SYSTEM CONFIGURATION
- EXIT MAINTENANCE.

INBOUND FLIGHT DECK EFFECTS gives a summary of the faults correlated to flight deck effects (FDEs) for the present flight leg (0). The CMCF shows the FDEs in the reverse order of occurrence.

EXISTING FLIGHT DECK EFFECTS shows all currently active and latched FDEs. The CMCF shows the FDEs in the reverse order of when the FDEs occurred.

GROUND TESTS supplies access to:

- System tests
- Operational tests
- LRU replacement tests.

CMCS - MAIN MENU SELECTIONS

SYSTEM CONFIGURATION gives access to configuration data for system LRUs. This data includes hardware and software part numbers.

EXIT MAINTENANCE ends the CMCF session on the MAT and shows the MAT main menu display.

EXTENDED MAINTENANCE Selection

The EXTENDED MAINTENANCE selection supplies access to functions performed when more time is needed such as during overnight maintenance.

Select EXTENDED MAINTENANCE to cause another menu to show. These are the selections available on this menu:

- PRESENT LEG FAULTS
- EXISTING FAULTS
- FAULT HISTORY
- DATA LOAD
- HARD DRIVE SOFTWARE PART NUMBER MANAGEMENT
- MAINTENANCE PLANNING
- MAINTENANCE ENABLE/DISABLE
- EXIT MAINTENANCE.

PRESENT LEG FAULTS shows maintenance messages for the current flight leg. These maintenance messages are grouped by FDE and the most recent maintenance messages shows first. Non-correlated maintenance messages show at the end of the FDEs. The present leg faults display also shows the faults by ATA chapter number and ATA name.

EXISTING FAULTS show maintenance messages for each ATA chapter that has active and latched faults in memory. The user can also group the faults by FDE.

FAULT HISTORY supplies access to faults by ATA chapter or by flight leg. Also, you can use FAULT HISTORY to erase single faults, all faults for an ATA or all faults from the fault history database.

Use DATA LOAD to load LRU software. Menu selections permit the selection of the source of the software and the destination LRU.

HARD DRIVE SOFTWARE PART NUMBER MANAGEMENT lets you change, examine, and do a check of LRU software on the maintenance access terminal hard drive.

MAINTENANCE PLANNING supplies access to inbound maintenance memos, existing maintenance memos, inbound scheduled maintenance tasks (SMT), and existing scheduled maintenance task messages.

MAINTENANCE ENABLE/DISABLE permits the selections to enable or to disable the flight leg or the maintenance phase.

EXIT MAINTENANCE ends the CMCF session on the MAT and shows the MAT main menu display.

OTHER FUNCTIONS Selection

The OTHER FUNCTIONS selection supplies access to more complex maintenance functions. Special training is necessary to do these complex functions.

Select OTHER FUNCTIONS to cause another menu to show. These are the selections available on this menu:

- INPUT MONITORING
- CENTRAL MAINTENANCE OPTIONS
- ENGINE BALANCING
- SHOP FAULTS
- PSEU AND AIR/GROUND RIGGING
- CENTRAL MAINTENANCE COMPUTER SWITCH CONTROL
- SPECIAL FUNCTIONS
- EXIT MAINTENANCE.

INPUT MONITORING lets you analyze specific interface signals. The types of signals available for analysis include analog discretes, analog variables, ARINC 429 words and ARINC 629 words.

CENTRAL MAINTENANCE OPTIONS supplies access to user interface controlled options. The central maintenance options display permits the selections to activate or to deactivate up to fifty CMCF options.

ENGINE BALANCING supplies access to the onboard engine balancing system (OEBS) menus. Use the OEBS menus to do in-depth engine maintenance and to show engine data stored in memory.

Use SHOP FAULTS to show internal LRU faults. Data is available by ATA and by LRU.

Use PSEU AND AIR/GROUND RIGGING to rig and to calibrate sensors for the PSEU and air/ground functions.

Use CENTRAL MAINTENANCE COMPUTER SWITCH CONTROL to set the control source of CMCF data.

SPECIAL FUNCTIONS supplies access to unique functions within certain ATA chapters. Use special functions to set conditions that aid in specific maintenance tasks.

EXIT MAINTENANCE ends the CMCF session on the MAT and shows the MAT main menu display.

HELP Selection

The HELP selection supplies access to SCREEN HELP or GENERAL HELP. The help that is available is defined in the airline modifiable information (AMI) using the ground based software tool (GBST).

REPORT Selection

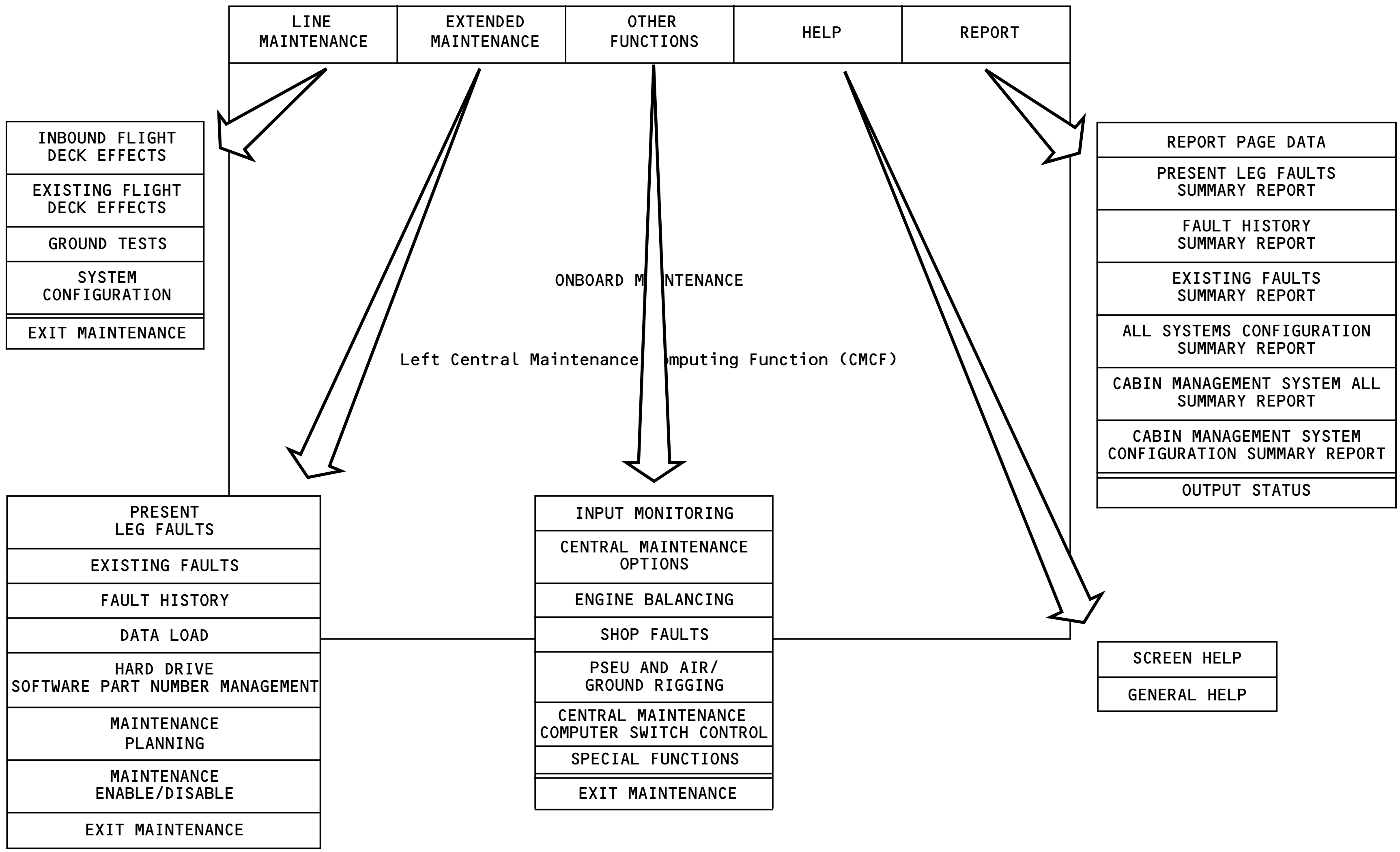
The REPORT selection lets the user send predefined reports to the printer, to the disk drive, or by datalink to a ground station.

These are the selections available on the REPORT menu:

- REPORT PAGE DATA
- PRESENT LEG FAULTS SUMMARY REPORT

CMCS - MAIN MENU SELECTIONS

- FAULT HISTORY SUMMARY REPORT
- EXISTING FAULTS SUMMARY REPORT
- ALL SYSTEMS CONFIGURATION SUMMARY REPORT
- CABIN MANAGEMENT SYSTEM ALL SUMMARY REPORT
- CABIN MANAGEMENT SYSTEM CONFIGURATION SUMMARY REPORT
- OUTPUT STATUS.



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CMCS - MAIN MENU SELECTIONS

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General

To do specific functions, several categories of controls show on the MAT. These categories are:

- MAT menu functions
- Cursor functions
- Dialog boxes
- Buttons
- Selection options
- Scroll bar.

Basic MAT Menu Functions

All the text on the displays is white. When the cursor is in an area, a white solid border highlights the area. Other colors, such as blue and green show on the MAT displays.

The main menu bar normally shows on the display at all times. In some cases, a dialog box can hide it. The selection of an item on the main menu bar causes a pull-down menu to show. This pull-down menu supplies additional selections within the main menu category.

The selection of an item on the pull-down menu causes a new display to appear. If the new display is a dialog box, the dialog box shows on top of the display. Portions of the original display remain visible but the data does not update.

Make main menu selections at any time except when dialog boxes show. Dialog box functions must be completed before access to the main menu returns.

When the dialog box goes away, the data on the original display continues to update.

Cursor Functions

The cursor on the display shows as one of three symbols. The symbols are:

- A plus (+) symbol for the normal cursor
- A wrist watch symbol for the wait cursor
- An I-beam symbol for the text entry cursor.

Cursor control device selections and keyboard selections have no effect when the wait cursor is active.

To highlight or make a selection, use the cursor control device. Place the cursor over any part of a message or command selection and select using any of the activation switches on top of the cursor control device. This highlights a message or chooses the command.

Dialog Boxes

There are several types of dialog boxes. In general, dialog boxes supply additional instructions or information about the current function. Dialog boxes show on top of the previous display.

The list box is a special type of dialog box. It is a list of scrollable items in a text box. Use the cursor control device to select an item. When you select an item, it highlights.

If a dialog box has only one possible choice, that choice is automatically made.

Command Buttons

Select a command button (button) to start a process or change a display or dialog box on the MAT. Most buttons are located at the bottom of displays and dialog boxes. A button dims when selection is not possible. Deactivated buttons do not highlight when the cursor goes over them.

Selection Options

Selection options show as a group of possible label selections. These selections are exclusive or non-exclusive.

Exclusive selections have a diamond symbol that comes before the selections.

Non-exclusive selections have a square symbol that comes before the selections.

When a selection is made, the square or diamond shows the selected state. You can select only one exclusive selection at a time. You can select none, one, or more than one non-exclusive selection at a time.

A crosshatch covers selections that are not active. Deactivated selections do not highlight as the cursor passes over them.

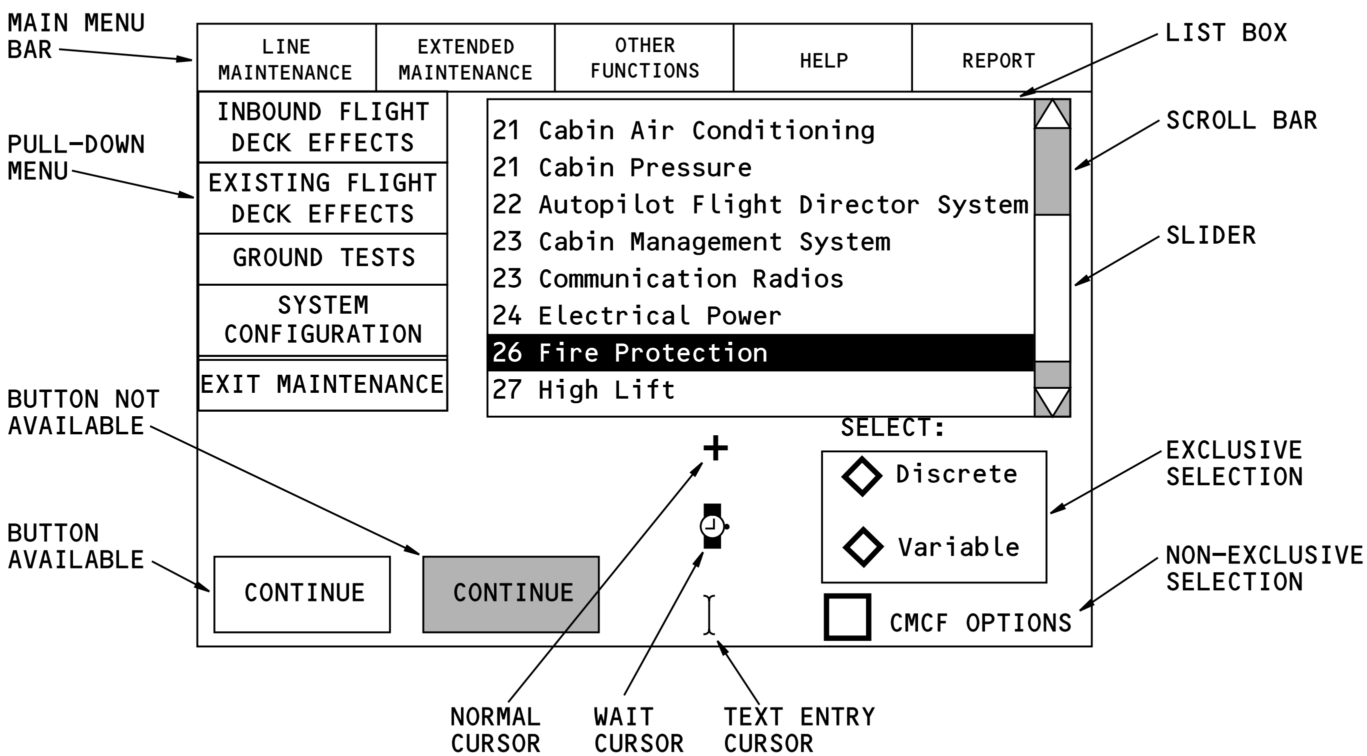
Scroll Bar

The scroll bar has a triangle that represents an arrow that points away from the center of the scroll bar.

The activation of the cursor over the triangle causes the visible area to move one increment in the direction of the arrow.

The slider is a variable length box that shows on the scroll bar. The position of the slider represents the position of the visible area in the entire data field. The length of the slider represents how much of the text is visible in the text box.

The slider moves along the scroll bar. The activation of the cursor in the scroll bar above the slider causes the visible area to move up one length of the visible area. The activation of the cursor in the scroll bar below the slider causes the visible area to move down one length of the visible area.



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CMCS - GENERAL FEATURES AND CONTROLS

CMCS - NOTES AND HELP DIALOG BOXES

Notes Dialog Box

The notes dialog box is available for these functions:

- Maintenance messages
- Ground tests
- Configuration.

The central maintenance computing function (CMCF) airline modifiable information (AMI) must be loaded with the notes. If the CMCF AMI is not loaded in the CMCF, the notes selection does not show.

A scroll bar shows on the notes dialog box if there is more text than can fit in the visible area.

Notes Buttons

Select GO BACK to remove the dialog box and return to the previous page.

Select REPORT DATA to show the report dialog box.

Select HELP to show the help dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Help Dialog Box

The help dialog box is available from the main menu at the top of the MAT display or from HELP buttons on these dialog boxes or displays:

- Notes dialog box
- ATA chapter selection dialog box
- Ground test selection dialog box
- Test inhibit dialog box
- Test interference dialog box
- Precondition dialog box
- Configuration selection dialog box
- System configuration dialog box
- Existing faults dialog box
- Fault history erase dialog box
- Fault history erase confirmation dialog box
- Fault history ATA dialog box
- Fault history leg dialog box
- Move fault history dialog box
- Source selection dialog box
- Destination selection dialog box
- Load message dialog box
- Destination LRU not enabled dialog box
- Change diskette dialog box
- Wrong diskette in disk drive dialog box
- Diskette access error dialog box
- Load in progress activity indication dialog box
- Destination LRU incompatibility dialog box
- Data storage error dialog box
- Data transfer completion dialog box
- Data load completion and verification dialog box
- Are you sure dialog box
- Data load function not enabled dialog box
- Check disk dialog box
- Data load function already in use dialog box
- Hard drive main menu
- Cannot get disk drive connection
- Hard drive in air

- No hard drive
- Hard drive partially updated
- Hard drive unknown configuration
- Hard drive part number removed
- Need good disk
- Hard drive source selection
- Adding part number
- Hard drive change disk
- Checking part number
- Done adding passed
- Done adding failed
- Stop are you sure
- Not added
- Part number already there
- Not enough room
- Hard drive wrong disk
- Disk problem
- Hard drive faulted
- Remove part number
- Remove are you sure
- Removing part number
- Show part numbers
- Hard drive change name
- Check part number
- Checking part number
- Stop checking are you sure
- Hard drive check passed
- Hard drive check failed
- Maintenance planning dialog box
- Maintenance enable/disable dialog box
- Input monitoring main menu dialog box
- Input monitoring signals dialog box
- Input monitoring ARINC 429 dialog box
- Input monitoring ARINC 629 dialog box
- Input monitoring analog dialog box
- Input monitoring AIMS IMM dialog box
- Input monitoring units dialog box
- Input monitoring alias pages dialog box
- Invalid entry dialog box
- Shop faults selection dialog box
- Shop faults contents dialog box
- Shop faults LRU configuration dialog box
- CMCF options dialog box
- Status dialog box
- PSEU and air/ground rigging/calibration menu dialog box
- PSEU and air/ground rigging/calibration dialog box
- OEBS main menu dialog box
- Edit dialog box
- Calibration condition dialog
- Edit error dialog box
- Ground run dialog box
- Keep coefficients dialog box
- Exit approval dialog box
- Menu abort dialog box
- Special functions selection dialog box
- Special functions interactive dialog box
- Report output device dialog box.

A scroll bar shows on the help dialog box if there is more text than can fit in the visible area.

Help text for a subject must exist in the CMCF AMI for the HELP button to show on a dialog box.

CMCS - NOTES AND HELP DIALOG BOXES

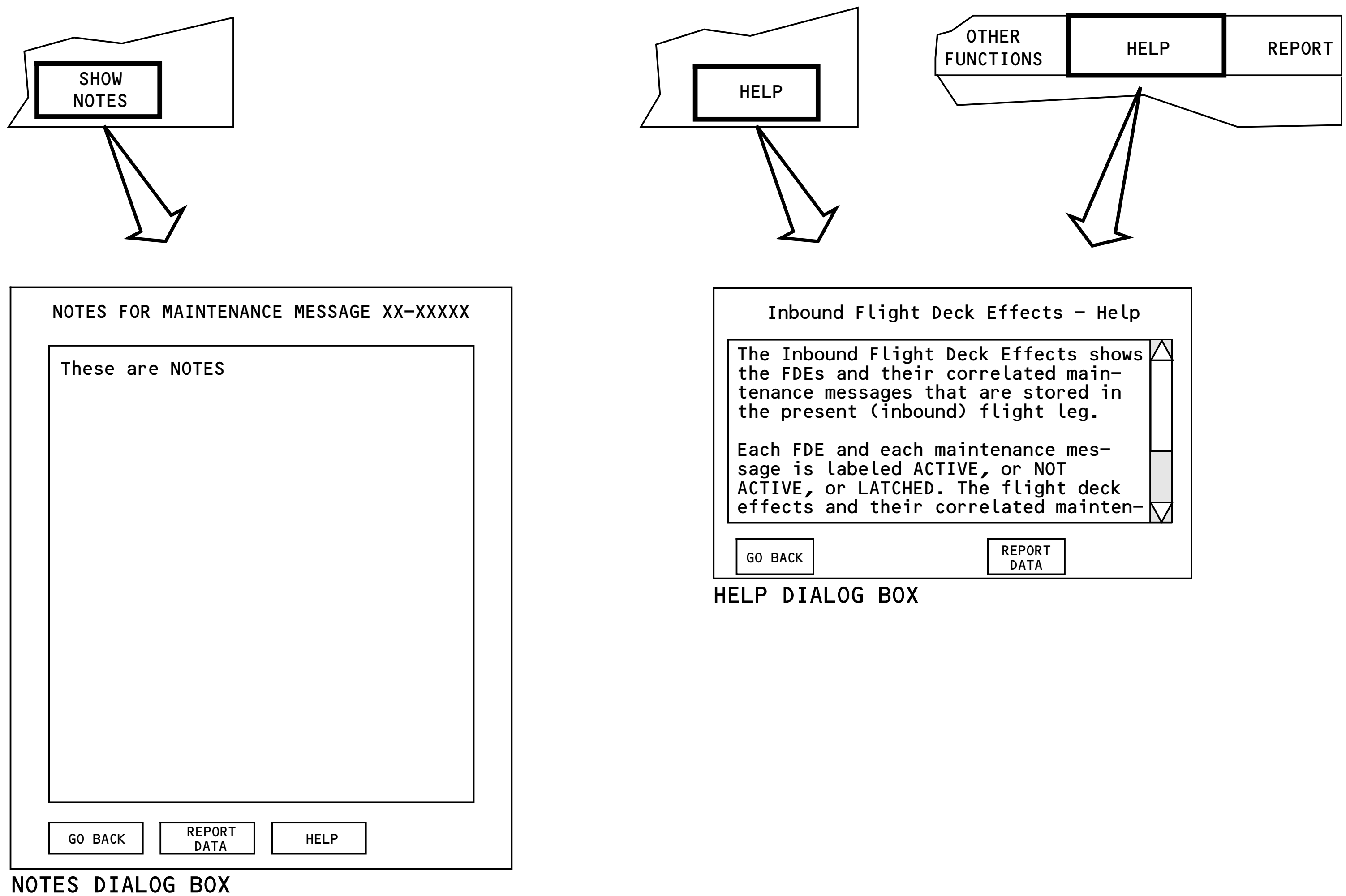
Help Buttons

Select REPORT DATA to show the report dialog box.

Select GO BACK to remove the dialog box and return to the previous page.

Main Menu Help Selection

The main menu HELP selection will be discussed later.



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CMCS - NOTES AND HELP DIALOG BOXES

CMCS - NOTES AND HELP DIALOG BOXES

Notes Dialog Box

The notes dialog box is available for these functions:

- Maintenance messages
- Ground tests
- Configuration.

The central maintenance computing function (CMCF) airline modifiable information (AMI) must be loaded with the notes. If the CMCF AMI is not loaded in the CMCF, the notes selection does not show.

A scroll bar shows on the notes dialog box if there is more text than can fit in the visible area.

Notes Buttons

Select GO BACK to remove the dialog box and return to the previous page.

Select REPORT DATA to show the report dialog box.

Select HELP to show the help dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Help Dialog Box

The help dialog box is available from the main menu at the top of the MAT display or from HELP buttons on these dialog boxes or displays:

- Notes dialog box
- ATA chapter selection dialog box
- Ground test selection dialog box
- Test inhibit dialog box
- Test interference dialog box
- Precondition dialog box
- Configuration selection dialog box
- System configuration dialog box
- Existing faults dialog box
- Fault history erase dialog box
- Fault history erase confirmation dialog box
- Fault history ATA dialog box
- Fault history leg dialog box
- Move fault history dialog box
- Source selection dialog box
- Destination selection dialog box
- Load message dialog box
- Destination LRU not enabled dialog box
- Change diskette dialog box
- Wrong diskette in disk drive dialog box
- Diskette access error dialog box
- Load in progress activity indication dialog box
- Destination LRU incompatibility dialog box
- Data storage error dialog box
- Data transfer completion dialog box
- Data load completion and verification dialog box
- Are you sure dialog box
- Data load function not enabled dialog box
- Check disk dialog box
- Data load function already in use dialog box
- Hard drive main menu
- Cannot get disk drive connection
- Hard drive in air

CMCS - NOTES AND HELP DIALOG BOXES

- No hard drive
- Hard drive partially updated
- Hard drive unknown configuration
- Hard drive part number removed
- Need good disk
- Hard drive source selection
- Adding part number
- Hard drive change disk
- Checking part number
- Done adding passed
- Done adding failed
- Stop are you sure
- Not added
- Part number already there
- Not enough room
- Hard drive wrong disk
- Disk problem
- Hard drive faulted
- Remove part number
- Remove are you sure
- Removing part number
- Show part numbers
- Hard drive change name
- Check part number
- Checking part number
- Stop checking are you sure
- Hard drive check passed
- Hard drive check failed
- Maintenance planning dialog box
- Maintenance enable/disable dialog box
- Input monitoring main menu dialog box
- Input monitoring signals dialog box
- Input monitoring ARINC 429 dialog box
- Input monitoring ARINC 629 dialog box
- Input monitoring analog dialog box
- Input monitoring AIMS IMM dialog box
- Input monitoring units dialog box
- Input monitoring alias pages dialog box
- Invalid entry dialog box
- Shop faults selection dialog box
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- Edit error dialog box
- Ground run dialog box
- Keep coefficients dialog box
- Exit approval dialog box
- Menu abort dialog box
- Special functions selection dialog box
- Special functions interactive dialog box
- Report output device dialog box.

A scroll bar shows on the help dialog box if there is more text than can fit in the visible area.

Help text for a subject must exist in the CMCF AMI for the HELP button to show on a dialog box.

CMCS - NOTES AND HELP DIALOG BOXES

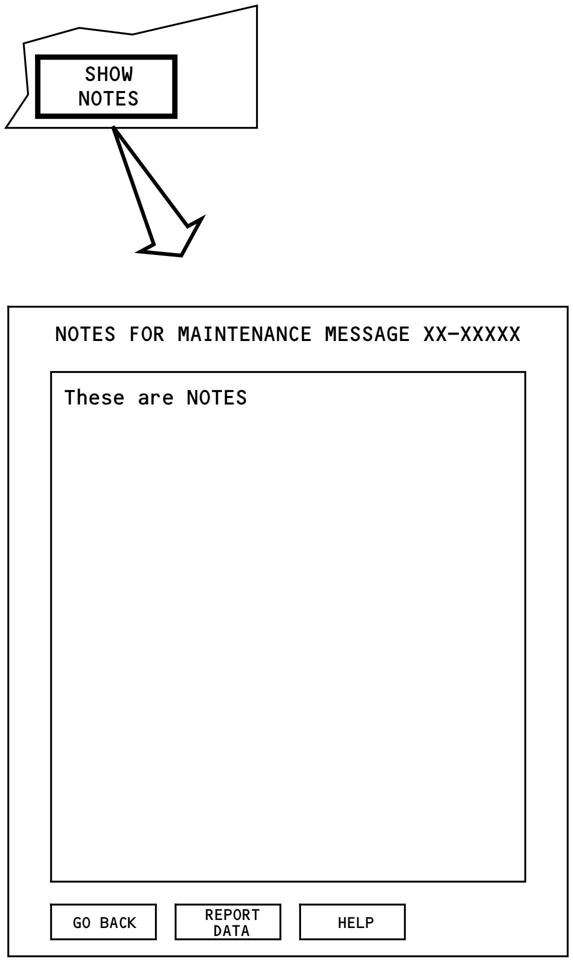
Help Buttons

Select REPORT DATA to show the report dialog box.

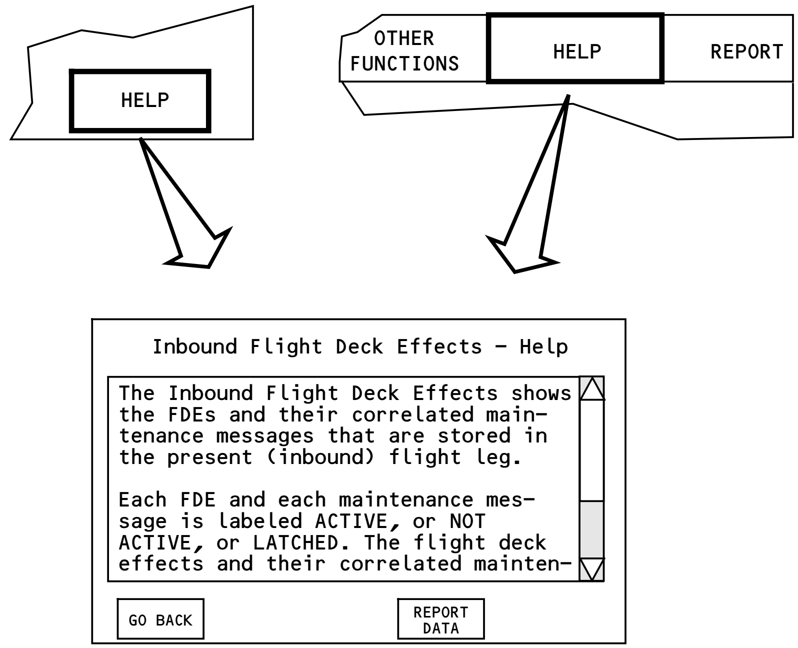
Select GO BACK to remove the dialog box and return to the previous page.

Main Menu Help Selection

The main menu HELP selection will be discussed later.



NOTES DIALOG BOX



HELP DIALOG BOX

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CMCS - NOTES AND HELP DIALOG BOXES

CMCS - ATA CHAPTER SELECTION DIALOG BOX

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CMCS - ATA CHAPTER SELECTION DIALOG BOX

General

The ATA CHAPTER selection dialog box permits the selection of an ATA system. Select the ATA system to show the maintenance message summary groups or system configuration information for that system.

The ATA chapter selection dialog box is available from these displays:

- Present leg faults
- Existing faults
- Fault history.

The ATA chapter selection dialog box also shows when you make these CMCS main menu selections:

- System configuration
- Existing faults
- Fault history.

The ATA chapter selection dialog box shows:

- Dialog box title
- List box
- Number of items
- Buttons.

Dialog Box Title

The dialog box title shows the main display title of the display that the SORT BY ATA command selection was made from.

List Box

The list box shows the ATA systems that have faults in memory when you select these displays:

- Present leg faults
- Existing faults
- Fault history.

The list box shows the ATA systems that can show hardware and software part numbers when you select system configuration.

Number of Items

The number of items that show in the list box shows at the top of the list box.

Buttons

Select an ATA system and then select CONTINUE to show fault information about that system.

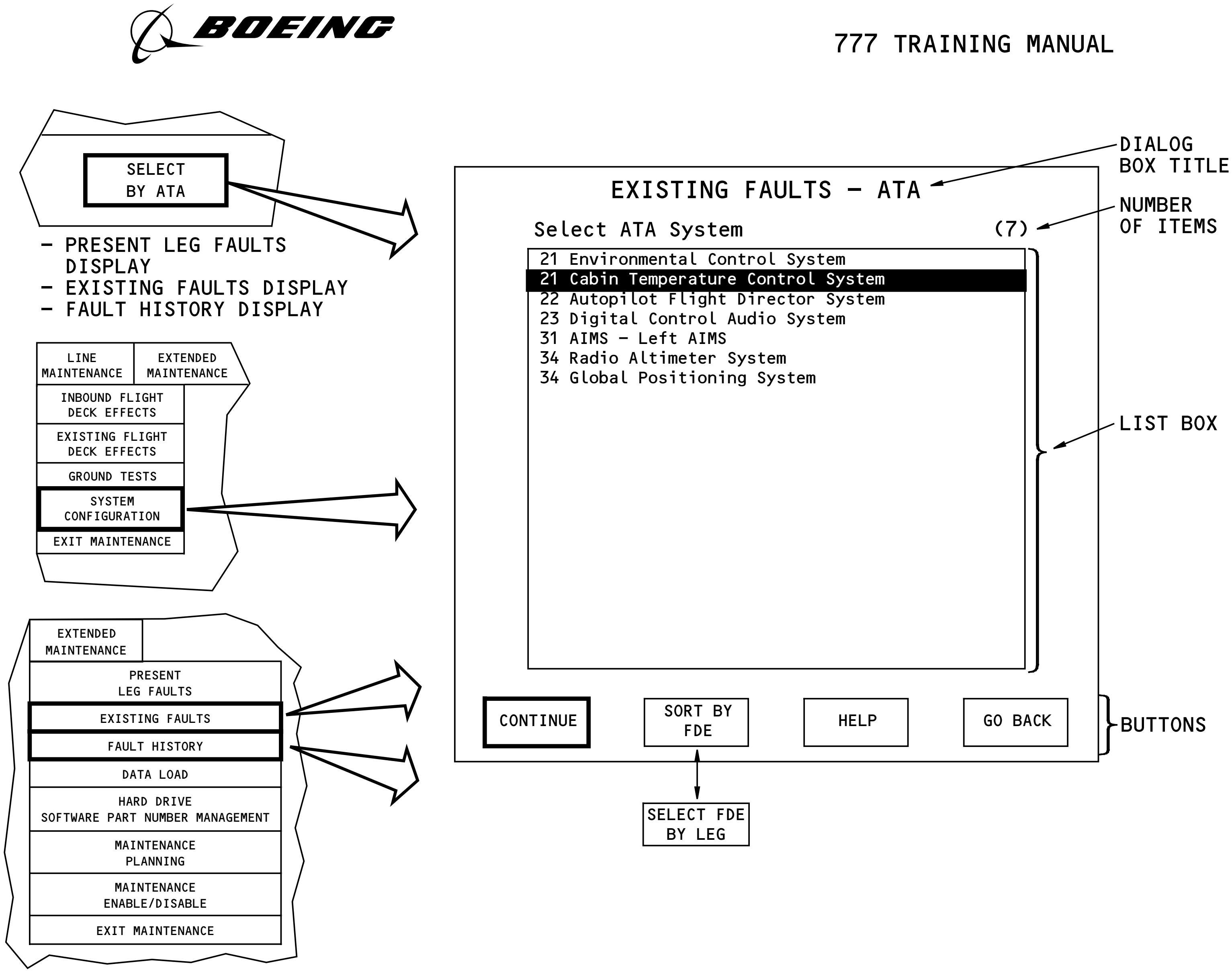
Select SORT BY FDE to show all selected faults by FDE summary groups and maintenance message summary groups. This button shows when you select present leg faults or existing faults.

Select SELECT FDE BY LEG to show all selected faults by FDE summary groups and maintenance message summary groups for one leg from fault history. This button shows when you select fault history.

CMCS - ATA CHAPTER SELECTION DIALOG BOX

Select HELP to show the HELP dialog box for the ATA CHAPTER selection dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select GO BACK to remove the ATA CHAPTER selection dialog box and return to the previous display.



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CMCS - ATA CHAPTER SELECTION DIALOG BOX

CMCS - INBOUND FLIGHT DECK EFFECTS DISPLAY

General

The purpose of inbound flight deck effects is to help the line maintenance technician repair the airplane during quick turnarounds at the gate.

Use inbound flight deck effects (FDEs) to look at FDEs and their correlated maintenance messages for the current flight leg (0).

The CMCF sorts the FDEs and any correlated maintenance messages by time. The most recent FDE shows first.

Use the maintenance message data button to show the single maintenance message display for a maintenance message summary group.

This shows on the inbound flight deck effects summary display:

- Header information
- Instructions field
- Fault summary field title
- Number of items
- Fault summary field
- Buttons.

Header Information

This data shows under the main menu bar on the right side:

- Tail identification
- Flight number from the FMCF
- Leg ID, departure airport and arrival airport identifiers from the FMCF
- Leg start time and date from the CMCF
- CMCF source field.

Fault Summary Field Title

The number of flight deck effects in the fault summary field shows at the top of the scroll bar.

The fault summary field has the FDE summary groups.

Each FDE summary group includes this data:

- Flight deck effect
- FDE and maintenance message activity
- Fault code
- FDE time and date
- Maintenance message summary groups.

FDE and Maintenance Message Activity

The activity of an FDE shows as one of these:

- Active
- Latched
- Not Active.

An active FDE is an FDE that currently shows in the flight deck.

A latched FDE can only be a status message or a scheduled maintenance task. Scheduled maintenance tasks are discussed elsewhere in this section.

A failure that causes a status message may impact dispatch and may be intermittent or detectable only under certain conditions. The PDS holds a status message to make sure that you see it on the ground. You must do a task to clear a latched FDE.

An FDE is not active if it can not currently show on the flight deck.

The activity of a maintenance message also shows as one of these:

- Active
- Latched
- Not Active.

A maintenance message is active if a system can continuously monitor for a fault condition, and the fault exists.

A maintenance message is latched for these reasons:

- If a system detects a fault and no longer uses the related equipment as part of its operational function
- To ensure correlation with an FDE
- If a system can not always detect if the fault exists.

You must do something to clear a latched maintenance message.

A maintenance message is not active if a system can continuously monitor for a fault condition, and the fault does not exist.

Maintenance Message Summary Groups

Each maintenance message summary group includes this data:

- Maintenance message number
- Maintenance message activity
- Flight phase
- Fault time and date
- Maintenance message symptom.

One or more maintenance messages may be correlated to each FDE and shows with an FDE summary group.

Button

Highlight and select a maintenance message summary group. Next, select MAINTENANCE MESSAGE DATA to show the single maintenance message display.

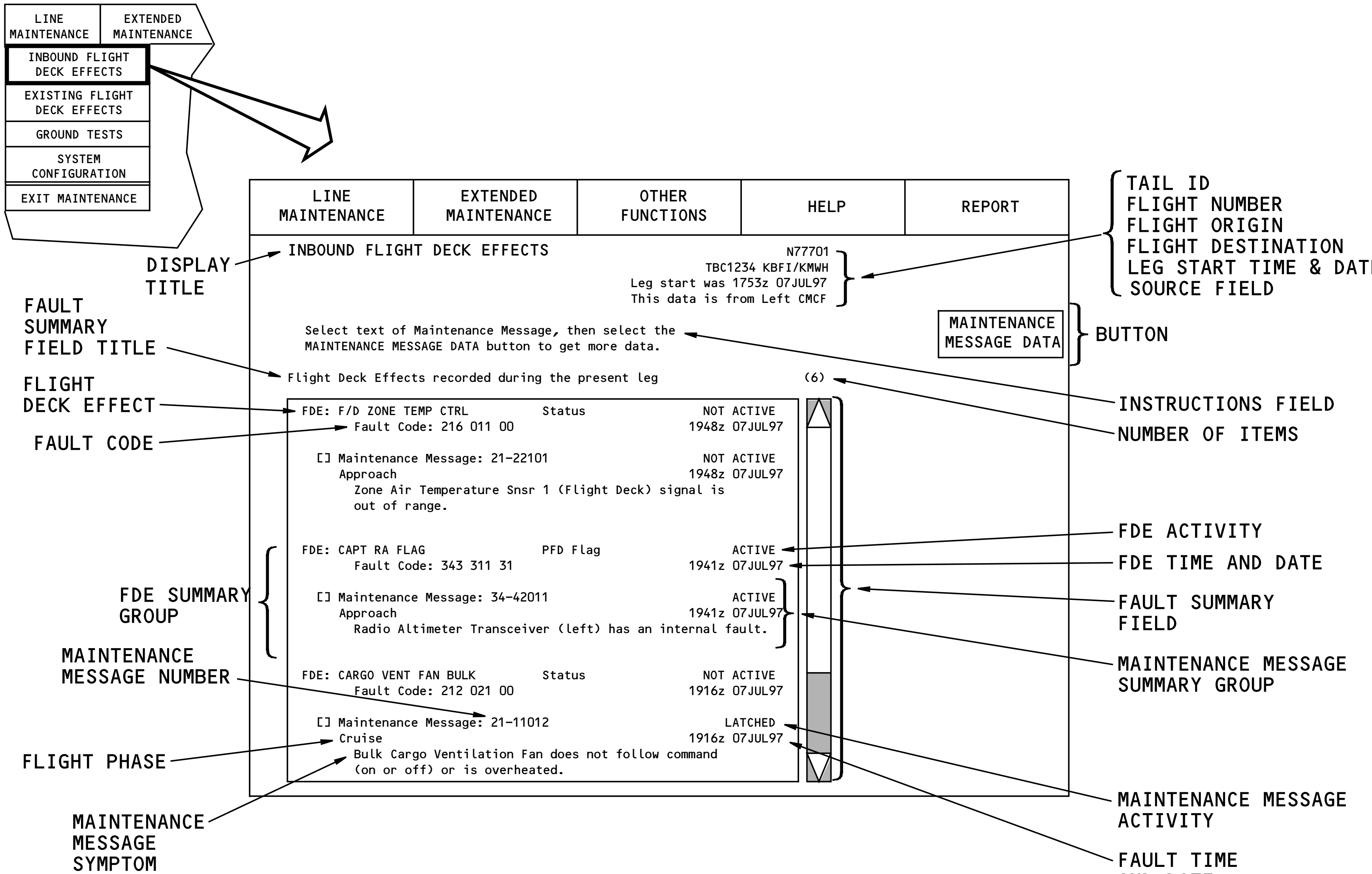
Training Information Point

If a flight leg transition occurs while the inbound flight deck effect display shows, this happens:

- If a fault summary field shows, it goes away

CMCS - INBOUND FLIGHT DECK EFFECTS DISPLAY

- A text dialog box shows with Flight Leg Has Changed. To See Data from Before, Go to Fault History Leg-1.
- Select CONTINUE on the text box to remove the text box and to show the Inbound Flight Deck Effects display again.



CMCS - INBOUND FLIGHT DECK EFFECTS DISPLAY

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CMCS - SINGLE MAINTENANCE MESSAGE DATA DISPLAY

General

The single maintenance message data display shows this data on one page:

- Title
- Fault information
- Maintenance message information
- Activity
- Occurrence field
- Leg information
- Recommended maintenance actions
- Correlated flight deck effects
- Buttons.

The single maintenance message data display is available from one of these displays:

- Inbound flight deck effects display
- Existing flight deck effects display
- Ground tests display
- Present leg faults display
- Existing faults display
- Fault history display
- Maintenance planning displays.

Within these displays, the single maintenance message data display supplies data for a maintenance message summary group from a one of these:

- FDE summary group
- Maintenance message summary group
- Non-FDE summary group.

Title

The title shows the original source of the message and previous display title of the page that showed the maintenance message.

Fault Information

The fault information field shows specific fault data and shows the source of the data.

Maintenance Message Information

The maintenance message number field contains the unique number associated with that specific maintenance message.

FDE, Maintenance Message, or Maintenance Memo Activity

The CMCF receives LRU fault information for display on the single maintenance message display that refers to these:

- FDEs
- Maintenance messages
- Maintenance memos.

The CMCF stores the information in the fault database.

The condition of an FDE shows as one of these:

- Active
- Latched

- Not Active.

An active FDE is an FDE that currently shows in the flight deck.

A latched FDE can only be a status message or a scheduled maintenance task. A failure that causes a status message may impact dispatch and may be intermittent or detectable only under certain conditions. The PDS holds a status message to make sure that you can see it on the ground.

An FDE is not active if it can not currently show on the flight deck

The activity of a maintenance message and maintenance memo also shows as one of these:

- Active
- Latched
- Not Active.

A maintenance message or maintenance memo is active if a system can continuously monitor for a fault condition, and the fault exists.

A maintenance message or maintenance memo is latched for one of these reasons:

- If a system detects a fault and no longer uses the related equipment as part of its operational function
- To ensure correlation with an FDE (maintenance message only)
- If a system can not always detect if the fault exists.

You must do something to clear a latched maintenance message.

A maintenance message or maintenance memo is not active if a system can continuously monitor for a fault condition, and the fault does not exist.

Occurrence Field

The occurrence field tells where the fault occurred, the time of the occurrence and the flight phase.

The occurrence field also tells if the fault is one of these:

- Hard
- Intermittent
- Message is ACTIVE only during operational mode shown in FIM.

A fault shows as hard if a system can currently monitor the fault condition, the fault exists, and it has not become not active.

A fault shows intermittent if a system can currently monitor the fault condition and the fault condition has gone away at least once. The fault condition may or may not currently exist. The number of times the fault has become active also appears.

A fault shows as "Message is ACTIVE only during operational mode shown in FIM" if the system has modes in which it can not tell if the fault is active. Use the initial evaluation paragraph of the fault isolation task in the FIM to see if it is active.

The occurrence field only shows when you select the maintenance message display from one of these displays:

- Inbound flight deck effects display
- Present leg faults display
- Fault history display.

Leg Information

The leg field shows information about the message and tells if the message occurred in a previous leg.

Recommended Maintenance Action Field

The recommended maintenance action field shows possible causes for the maintenance message.

The cause number shows in the order of probability. Causes with the same number have the same probability.

Training Information Point

The fault isolation manual (FIM) may show the fault isolation steps in a different order than the items in the recommended maintenance action field. The FIM considers ease of access and cost of component replacement in addition to probability.

Correlated Flight Deck Effects Field

The correlated flight deck effects field shows all the FDEs correlated to the message. This field updates as FDEs change.

Buttons

Select NEXT MESSAGE to show the next maintenance message in the FDE summary group. NEXT MESSAGE shows when viewing a maintenance messages selected from an FDE summary group.

Select PREVIOUS MESSAGE to show the previous maintenance message in the FDE summary group. PREVIOUS MESSAGE shows when viewing a maintenance messages selected from an FDE summary group.

FAULT HISTORY shows only when you access the single maintenance message display through one of these displays:

- INBOUND FLIGHT DECK EFFECTS
- PRESENT LEG FAULTS
- INBOUND MAINTENANCE MEMOS
- INBOUND SCHEDULED MAINTENANCE TASKS.

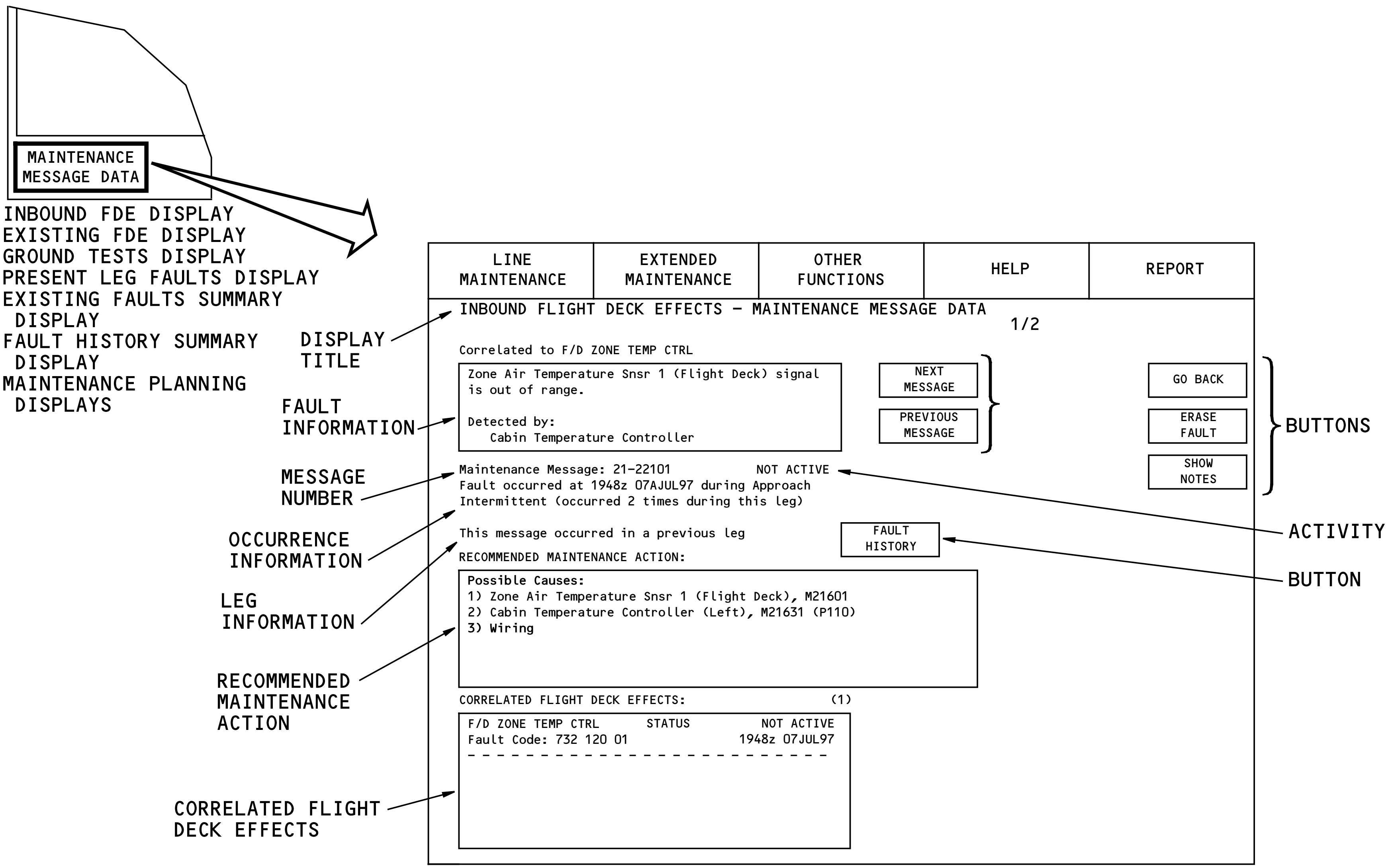
Select FAULT HISTORY to show the fault history summary display for the applicable maintenance message.

CMCS - SINGLE MAINTENANCE MESSAGE DATA DISPLAY

Select GO BACK to return to the page from which the single maintenance message display was selected.

ERASE FAULT shows only when you access the single maintenance message page through fault history. Select ERASE FAULT to show the fault history erase confirmation dialog box.

Select SHOW NOTES to show the notes dialog box.



CMCS - SINGLE MAINTENANCE MESSAGE DATA DISPLAY

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CMCS - EXISTING FLIGHT DECK EFFECTS DISPLAY

General

The purpose of the existing flight deck effects display is to help the line maintenance technician repair the airplane during quick turnarounds at the gate.

Use the existing flight deck effects display to get access to any existing FDEs and their correlated maintenance messages. The FDEs may be active or latched.

The CMCF sorts the FDEs and any correlated maintenance messages by time and the most recent FDE shows first.

The user has the option to show the single maintenance message display.

The existing flight deck effects display shows this data:

- Header information
- Instructions field
- Fault summary field title
- Number of items
- Fault summary field
- Buttons.

Header Information

The data under the main menu bar on the right side shows this data:

- Tail identification
- Time and date from the CMCF
- CMCF source field.

Fault Summary Field

The number of flight deck effects in the fault summary field shows at the top of the scroll bar.

The fault summary field has the FDE summary groups.

Each FDE summary group includes this data:

- Flight deck effect
- Flight deck effect activity
- Fault code
- Maintenance message summary groups.

FDE and Maintenance Message Activity

The CMCF receives LRU fault information for display on the existing flight deck effects display that refers to:

- FDEs
- Maintenance messages.

The CMCF stores the information in the fault database. The information shows in FDE summary groups.

The condition of an FDE shows as one of these:

- Active
- Latched.

CMCS - EXISTING FLIGHT DECK EFFECTS DISPLAY

An active FDE is an FDE that currently shows in the flight deck.

A latched FDE can only be a status message or a scheduled maintenance task. A failure that caused a status message may impact dispatch and may be intermittent or detectable only under certain conditions. The PDS holds a status message to make sure it can be seen on the ground.

The condition of a maintenance message shows as one of these:

- Active
- Latched
- Not Active.

A maintenance message is active if a system can continuously monitor for a fault condition, and the fault exists.

A maintenance message is latched for one of these reasons:

- If a system detects a fault and no longer uses the related equipment as part of its operational function
- To ensure correlation with an FDE
- If a system can not always detect if the fault exists.

You must do something to clear a latched maintenance message.

A maintenance message is not active if a system can continuously monitor for a fault condition, and the fault does not exist.

Maintenance Message Summary Group

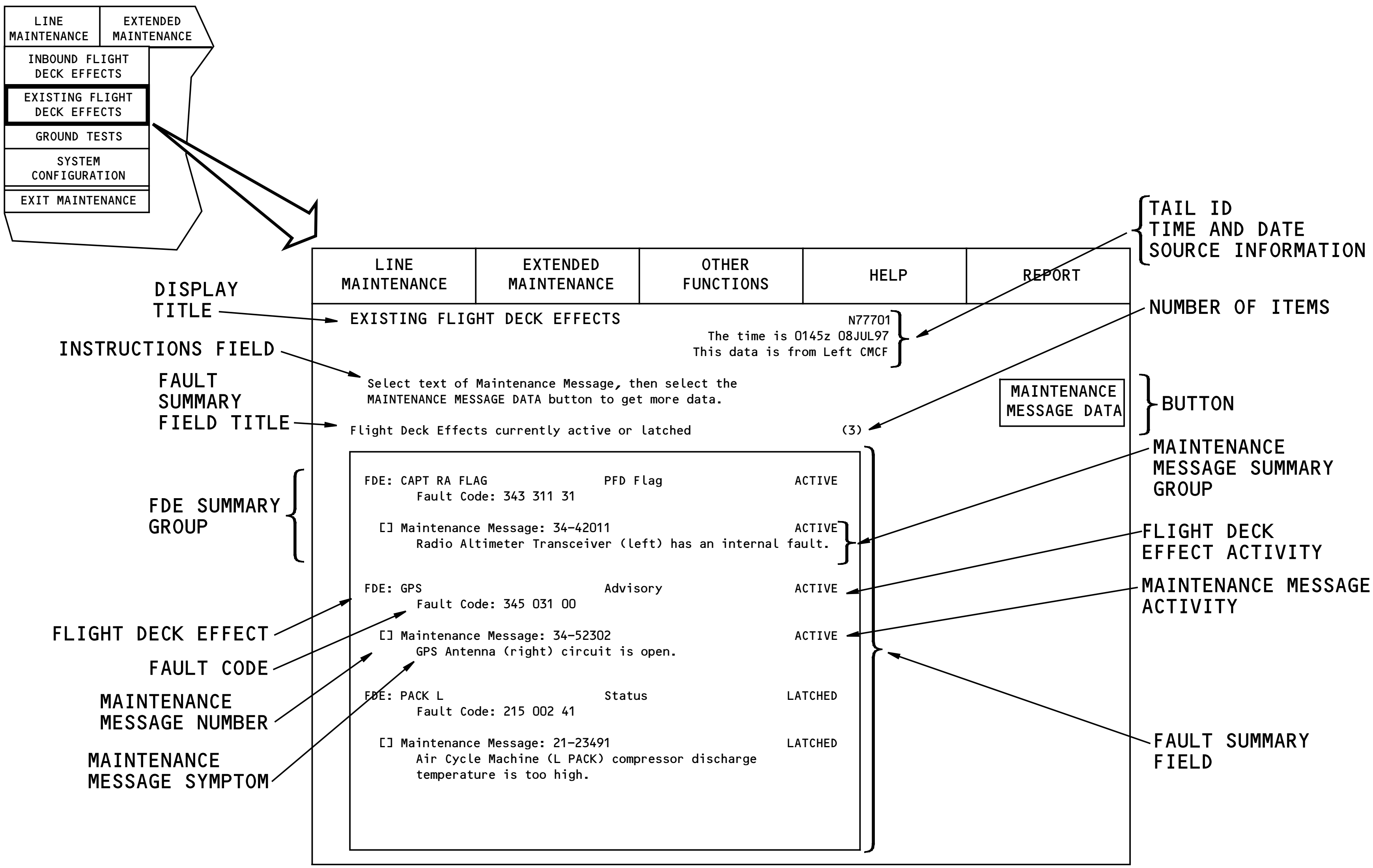
Each maintenance message summary group includes:

- Maintenance message symptom
- Maintenance message number
- Maintenance message activity.

One or more maintenance messages may be correlated to each FDE.

Button

Select MAINTENANCE MESSAGE DATA to show the single maintenance message display for the selected maintenance message.



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CMCS - EXISTING FLIGHT DECK EFFECTS DISPLAY

CMCS - GROUND TESTS SELECTION DIALOG BOX

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CMCS - GROUND TESTS SELECTION DIALOG BOX

General

The GROUND TESTS selection supplies access to airplane systems with ground tests. In this ground test selection dialog box, you select this data:

- ATA system
- Type of test
- LRU in that system.

Many ATA systems and LRU have unique requirements that cause additional dialog boxes to show before the test actually starts. The types of dialog boxes include these:

- Precondition dialog boxes
- Inhibit dialog boxes
- Interference dialog boxes
- Interactive dialog boxes
- Menu abort dialog boxes.

When all requirements are met, the ground tests display shows the status and instructions for the test.

Buttons on the ground tests display and the dialog boxes supply:

- Specific instructions
- Help
- Report capability
- Access to the single maintenance message page.

The ground test selection dialog box shows this data:

- Dialog box title
- List box titles
- ATA system list box
- Test type exclusive selections
- Test list box
- Buttons.

ATA System List Box

The ATA System list box lists the airplane systems in ATA order. Select an ATA system first. This highlights the selection. This selection causes the test types for that ATA to become available. Those test types that are not available show dim or gray.

Test Type Exclusive Selections

These are the test types that are exclusive selections:

- SYSTEM TEST
- OPERATIONAL TEST
- LRU REPLACEMENT TEST.

A system test contains all adjustment specifications and tolerances to maintain systems or units at maximum efficiency. It is self-contained and may duplicate other tests.

An operational test determines only that a system or unit is operational. These tests require no special test equipment.

CMCS - GROUND TESTS SELECTION DIALOG BOX

An LRU replacement test determines only that the interfaces to the LRU are operational.

The selection of a test type causes the test list box to show.

Test List Box

The title of the test list box matches the test type. The test list box shows all LRUs in the ATA that have the appropriate test available. The selection of an LRU in the test list box causes that LRU to highlight.

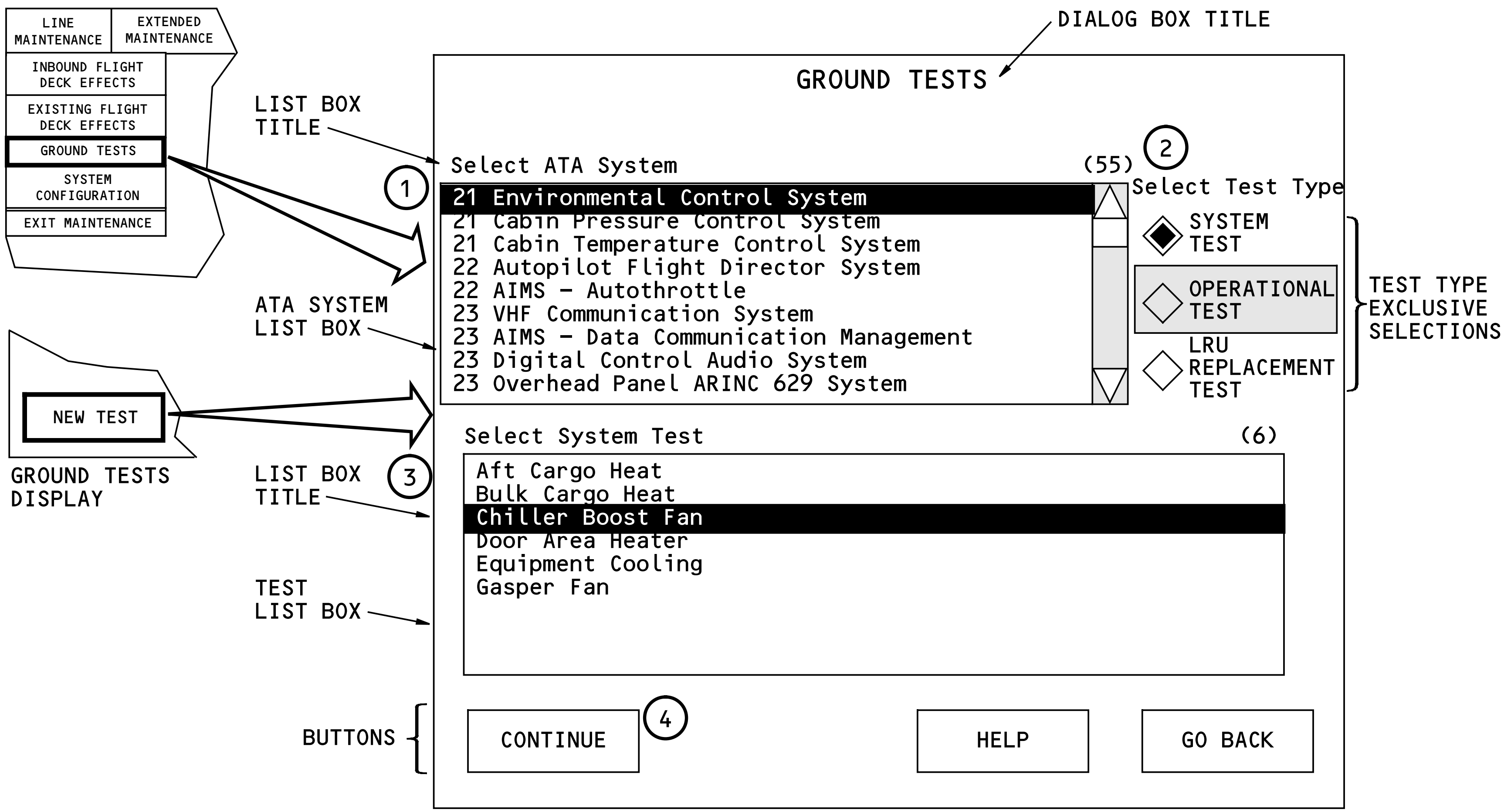
The selection of the LRU also makes the CONTINUE command available.

Buttons

Select CONTINUE to show the precondition dialog box on top of the ground test selection dialog box for the selected test.

Select HELP to show the help dialog box for the ground tests selection dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select GO BACK to remove the ground test selection dialog box and to show the previous display.



1 - 4 TEST SELECTION SEQUENCE

45-10-00-034 Rev 2

CMCS - GROUND TESTS SELECTION DIALOG BOX

CMCS - GROUND TESTS PRECONDITION DIALOG BOX

General

The precondition dialog box has a description for each test and special instructions for each test (if required).

The precondition dialog box shows this data:

- Display title
- Test title
- Test description
- Precondition list
- Buttons.

Test Title

The test title shows the test name from the selection you make on the ground test selection dialog box.

Test Description

The test description briefly tells you about the test.

Precondition List

The precondition list gives instructions for you to follow before the test is run.

The precondition display database stores the test description and the precondition list.

Buttons

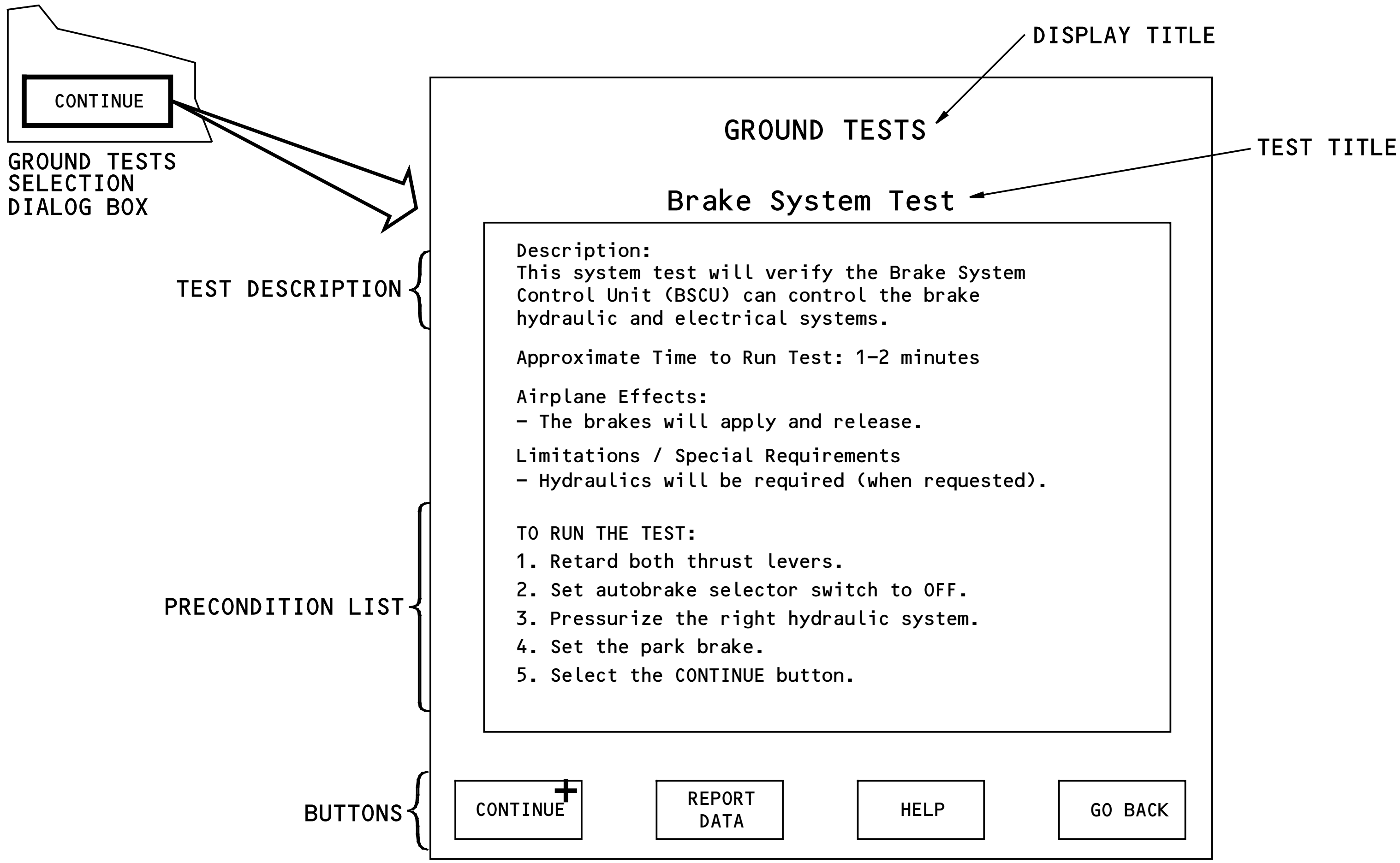
The precondition dialog box shows four buttons.

Select CONTINUE to close the ground test selection dialog box (if open), to close the precondition dialog box, and to cause the test display to show.

Select REPORT DATA to show the report dialog box.

Select HELP to show the help dialog box for the precondition dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select GO BACK to remove the precondition dialog box to show the previous display.



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CMCS - GROUND TESTS PRECONDITION DIALOG BOX

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45-10-00-036 Rev 4

CMCS - GROUND TESTS TEST DISPLAY

General

The ground tests test display supplies status information and control for ground tests.

The ground tests test display shows:

- Display title
- ATA chapter and name
- Test type title
- Test title
- Test condition messages
- Test control buttons
- Text field
- Text field title
- Buttons.

ATA Chapter and Name

This field shows the ATA chapter and system name from the initial selection on the ground tests selection dialog box.

Test Type Title

This field shows the test type title from the initial selection on the ground tests selection dialog box.

Test Title

This field shows the test title from the initial selection on the ground tests selection dialog box.

Test Condition Messages and Test Control Buttons

The TEST CONDITION messages field can show these messages:

- READY
- INHIBITED
- CAN NOT OPERATE
- OPERATING
- PASSED
- FAILED
- STOPPED.

These are the possible test control buttons:

- START TEST
- STOP TEST
- OPERATE TEST AGAIN
- TO TEST.

READY shows when no inhibit conditions or no interference conditions exist. START TEST shows next to the READY message.

START TEST causes the CMCF to begin the test. OPERATING shows as the message.

When OPERATING shows, the button changes to STOP TEST.

The selection of STOP TEST causes the message STOPPED to show.

At the completion of the test, PASSED or FAILED shows.

CMCS - GROUND TESTS TEST DISPLAY

With STOPPED, PASSED or FAILED as the message, OPERATE TEST AGAIN shows as the button.

OPERATE TEST AGAIN causes the precondition to show.

INHIBITED shows when a test inhibit condition exists. The TO TEST control selection shows next to the message. Select TO TEST to show the test inhibit dialog box.

CAN NOT OPERATE shows as the message if a test interference condition exists. The TO TEST control selection shows next to the message. Select TO TEST to show the test interference dialog box.

Text Field

The text field shows the maintenance message summary group and reported test results when a test fails.

If the message STOPPED shows in the test condition field, and you stop the test, or the system in test stops the test, then the text field shows one of these messages:

- Test stopped due to user request
- Test stopped due to member system request.

Text Field Title

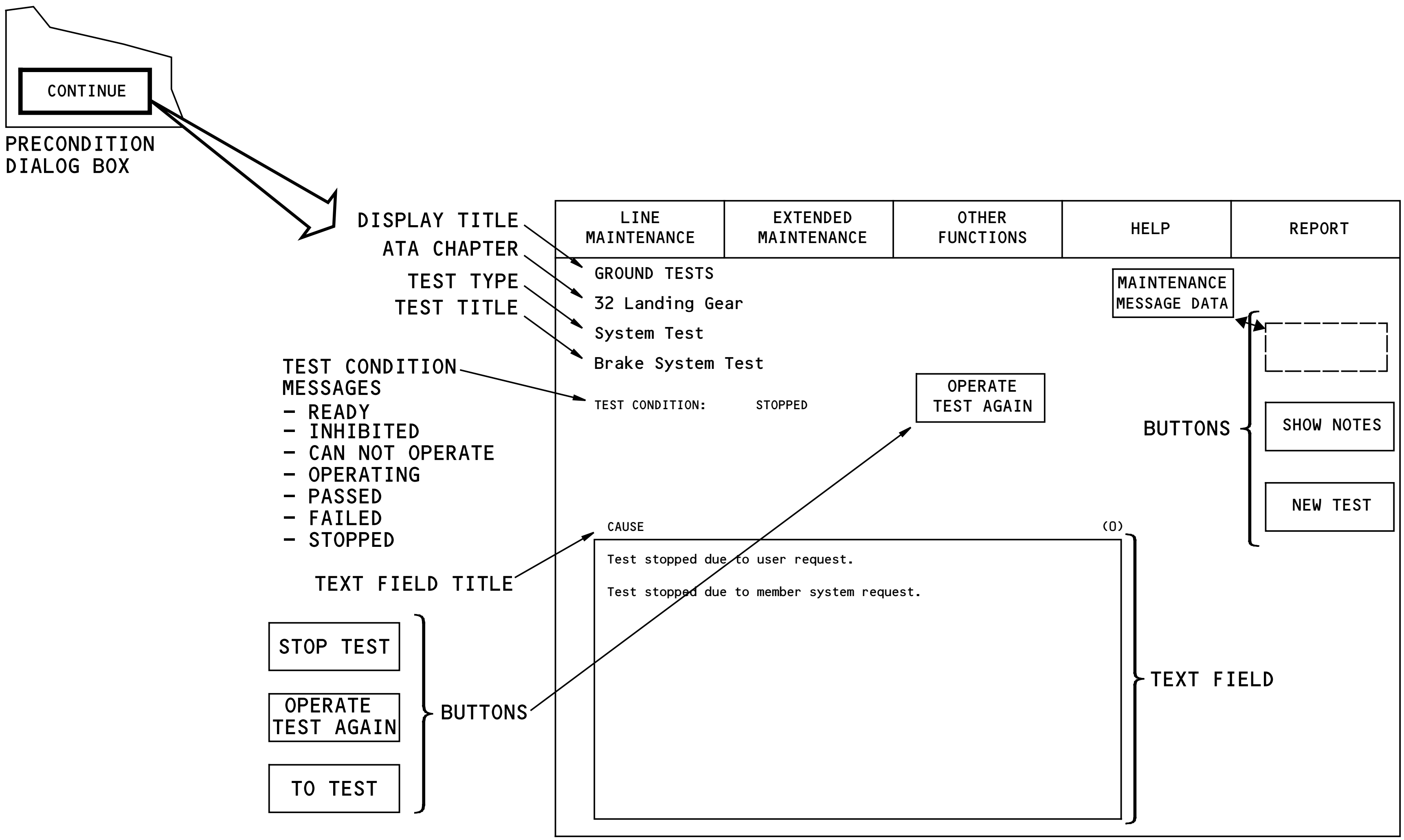
When FAILED or STOPPED shows in the test condition field, the title of the text field is CAUSE.

Buttons

The MAINTENANCE MESSAGE DATA button is available when a maintenance message summary group shows for a failed test.

Select SHOW NOTES to show the notes dialog box selected ground test. Notes text for the dialog box must be in the CMCF AMI for SHOW NOTES to show.

Select NEW TEST to show the ground tests selection dialog box.



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CMCS - GROUND TESTS TEST DISPLAY

CMCS - GROUND TESTS DISPLAYS - 2

General

The test condition messages and the test control button show the current status of the test and give the next control selection.

These are the two possible displays that show:

- Test failed display
- Test stopped display.

Test Failed Display

The test failed display shows the test condition message FAILED and gives the operator the control command to OPERATE TEST AGAIN.

The title of the variable text field is CAUSE and the variable text field shows the maintenance message groups or messages associated with the failure.

The MAINTENANCE MESSAGE DATA button lets you see a single maintenance message after the selection of that maintenance message.

NEW TEST and SHOW NOTES functions remain the same.

Test Stopped Display

After a tests starts, the test condition message changes to OPERATING and the control command changes to STOP TEST.

The test can be stopped by you or by the system.

When you stop the test, the test condition message changes to STOPPED and the button changes to OPERATE TEST AGAIN. The variable text field title is CAUSE and the variable text field shows the message:

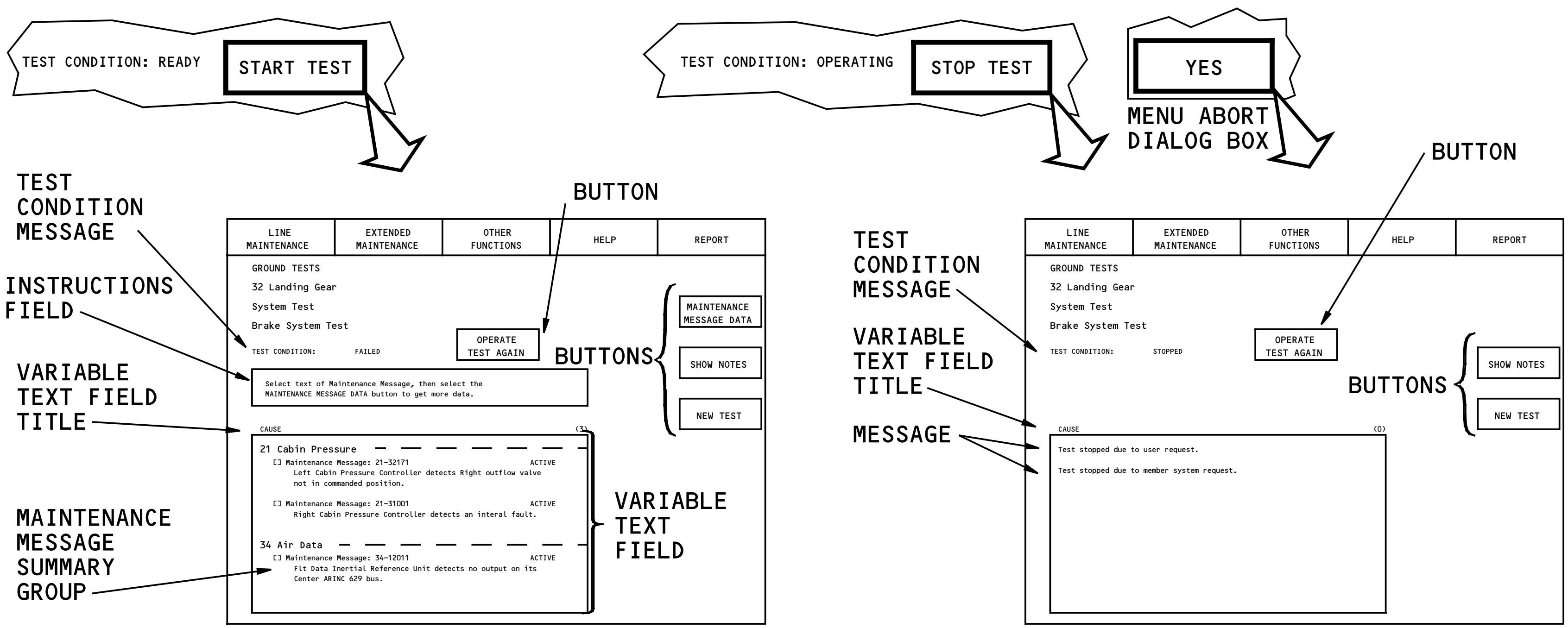
- Test stopped due to user request.

When the system stops the test, the test condition message changes to STOPPED and the button changes to OPERATE TEST AGAIN. The variable text field title is CAUSE and the variable text field shows the message:

- Test stopped due to member system request.

The MAINTENANCE MESSAGE DATA button is not available from this display.

NEW TEST and SHOW NOTES functions remain the same.



GROUND TEST DISPLAY WITH TEST FAILED

GROUND TEST DISPLAY WITH TEST STOPPED

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CMCS - GROUND TESTS DISPLAYS - 2

CMCS - GROUND TEST INTERACTIVE DIALOG BOX

General

The ground test interactive dialog boxes show only if your interaction is necessary to complete the test.

The member systems control the interactive displays. LRUs in the member systems send a control signal that tells the CMCF to show the interactive displays as necessary. When the CMCF gets the control signal, it removes the current interactive display that shows.

Each interactive dialog box shows:

- Dialog box title
- Test title
- Messages
- Exclusive selections
- Buttons.

Test Title

The test title shows the title of the test from the initial selection on the Ground Tests selection dialog box.

Messages

The messages area shows directions to successfully run and complete the test.

The message area also shows any warnings for the test.

If there is more text to show than can fit in the message area, a scroll bar shows.

Exclusive Selections

The member systems define the exclusive selections. The selections permit communication between you and the LRU under test.

Each interactive dialog box can show a maximum of ten exclusive selections.

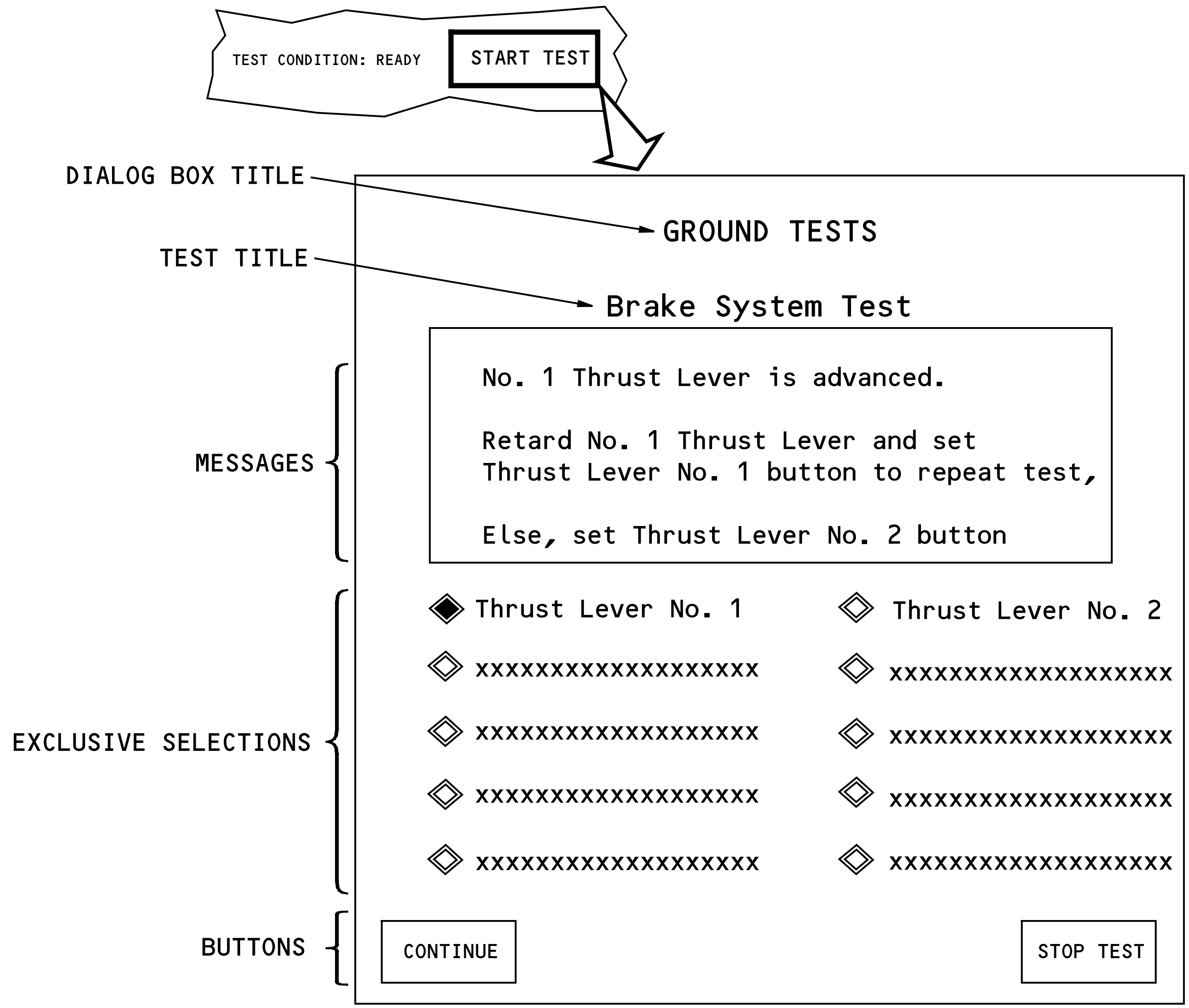
Only the required number of exclusive selections show for each test. The ground test interactive dialog box grows to fit the buttons.

Buttons

The CONTINUE button shows dim or is not available if exclusive selections are not available or until you make an exclusive selection.

After you make an exclusive selection, select CONTINUE to cause that selection to go to the LRU. The CMCF removes the interactive dialog box. The CMCF then starts the test.

Select STOP TEST to remove the interactive dialog box and cause the TEST CONDITION message on the system test screen to show STOPPED. The control selection shows OPERATE TEST AGAIN.



45-10-00-038 Rev 0

CMCS - GROUND TEST INTERACTIVE DIALOG BOX

CMCS - GROUND TESTS INHIBIT AND INTERFERENCE DIALOG BOXES

Test Inhibit Dialog Box

When the TEST CONDITION message shows INHIBITED, the control button changes to TO TEST.

Select TO TEST to show the ground tests test inhibit dialog box.

The ground tests test inhibit dialog box shows:

- Dialog box title
- Test title
- Instructions to continue the test
- Buttons.

The test title shows the title from the original selection on the ground test selection dialog box.

The instructions tell why the test is inhibited and how to enable the test.

After the inhibit condition goes away, select CONTINUE to remove the dialog box and permit the test to continue.

Select REPORT DATA to show the report dialog box.

Select HELP to show the help dialog box for the dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select GO BACK to remove the test inhibit dialog box.

Test Interference Dialog Box

When the TEST CONDITION message shows CAN NOT OPERATE, the control button changes to TO TEST.

Select TO TEST to show the ground tests test interference dialog box.

The ground tests test interference dialog box shows:

- Dialog Box title
- Test title
- Test interference information
- Buttons.

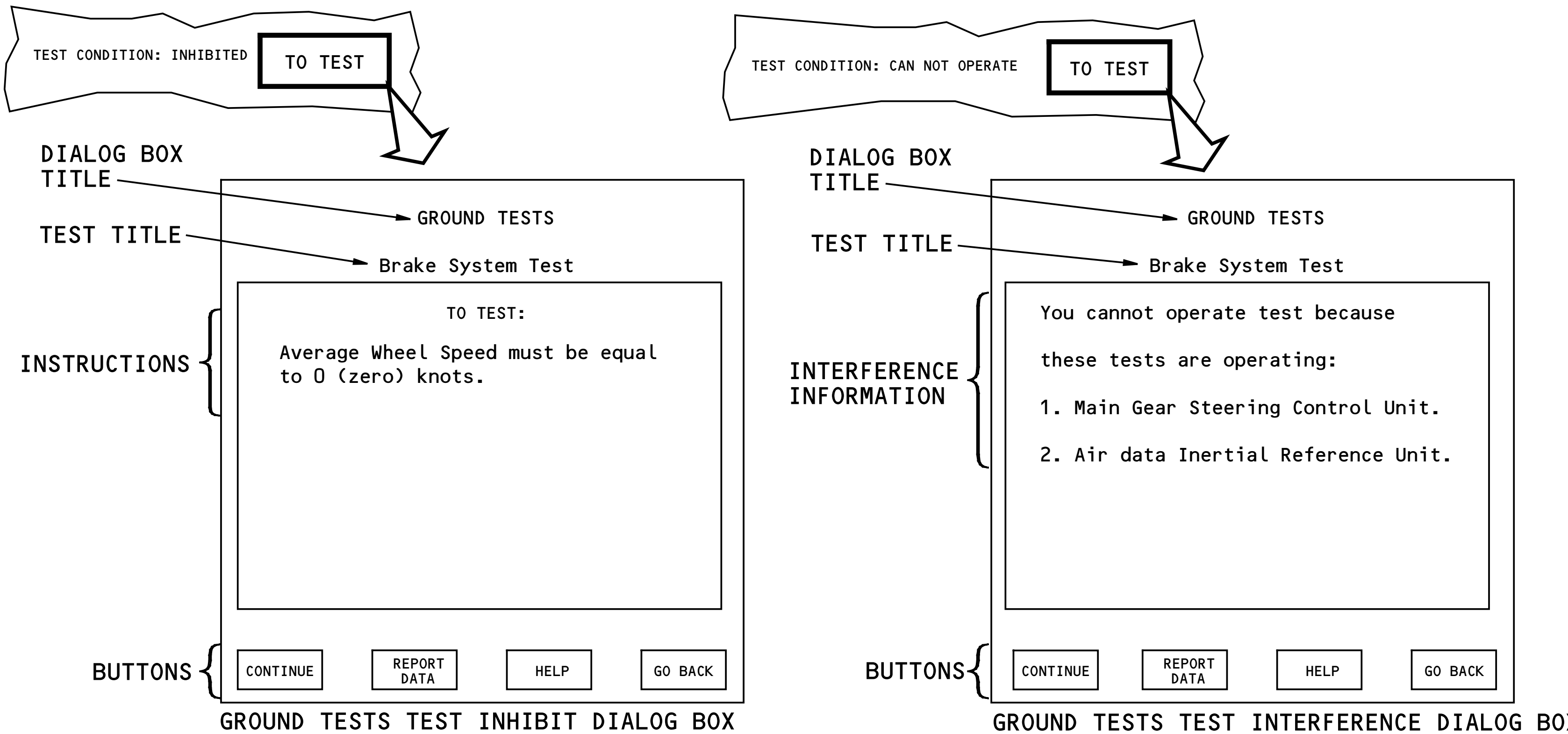
The test title shows the title from the original selection on the ground test selection dialog box.

The test interference information has the header "You cannot operate this test because these tests are operating" and a numbered list of the causes of the interference. After the interference condition goes away, select CONTINUE to remove the dialog box and permit the test to continue.

Select REPORT DATA to show the report dialog box.

Select HELP to show the help dialog box for the dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select GO BACK to close the test interference dialog box.



45-10-00-039 Rev 1

CMCS - GROUND TESTS INHIBIT AND INTERFERENCE DIALOG BOXES

CMCS - GROUND TESTS MENU ABORT AND NO TEST ABORT DIALOG BOXES

Ground Tests Menu Abort Dialog Box

The ground tests menu abort dialog box shows when a selection other than HELP is made from the main menu bar or the user selects NEW TEST with a test in progress.

The menu abort dialog box shows:

- Dialog box title
- Message text
- Buttons.

The message text shows:

- Do you wish to STOP the Test?

Select YES to do these:

- Stop the test
- Remove the menu abort dialog box
- Show the main menu bar selection or the NEW TEST button.

Select GO BACK to remove the menu abort dialog box.

Ground Tests No Menu Abort Dialog Box

The ground tests no menu abort dialog box shows when a selection other than help is made from the main menu bar or the user selects NEW TEST with a test in progress.

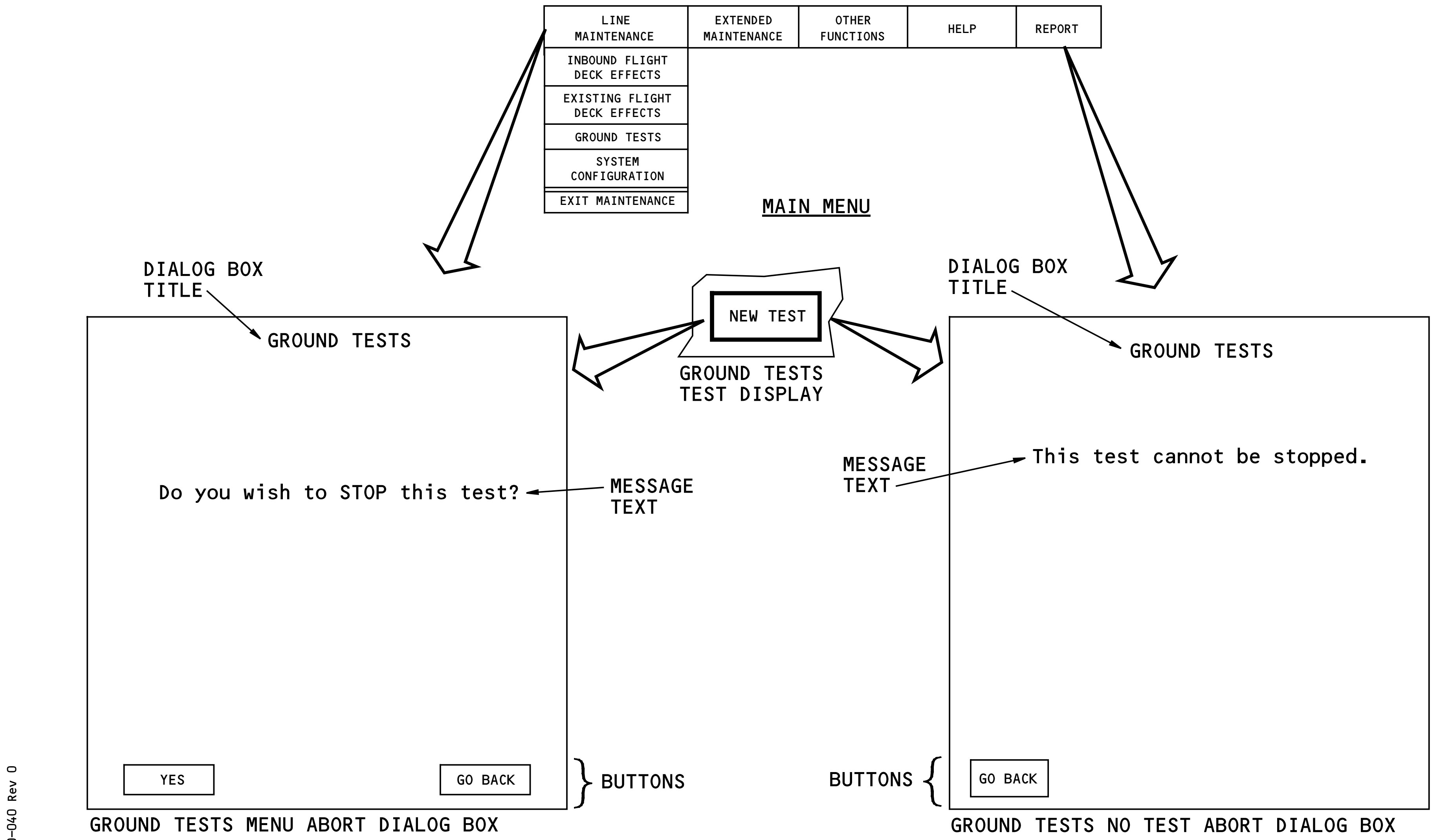
The no menu abort dialog box has:

- Dialog box title
- Message text
- Buttons.

The message text shows:

- This test cannot be stopped.

Select GO BACK to remove the no menu abort dialog box and return to the previous display.



CMCS - GROUND TESTS MENU ABORT AND NO TEST ABORT DIALOG BOXES

CMCS - SYSTEM CONFIGURATION SELECTION DIALOG BOX

General

The system configuration selection dialog box shows ATA chapters and ATA system names for access to hardware and software configuration information for different LRUs and LRMs in the ATA systems.

The system configuration selection dialog box shows:

- Dialog box title
- List box title
- Number of items
- List box
- Buttons.

The list box shows a list of ATA chapter numbers and ATA chapter names. The list box shows the ATA systems sorted in order of ATA chapter number.

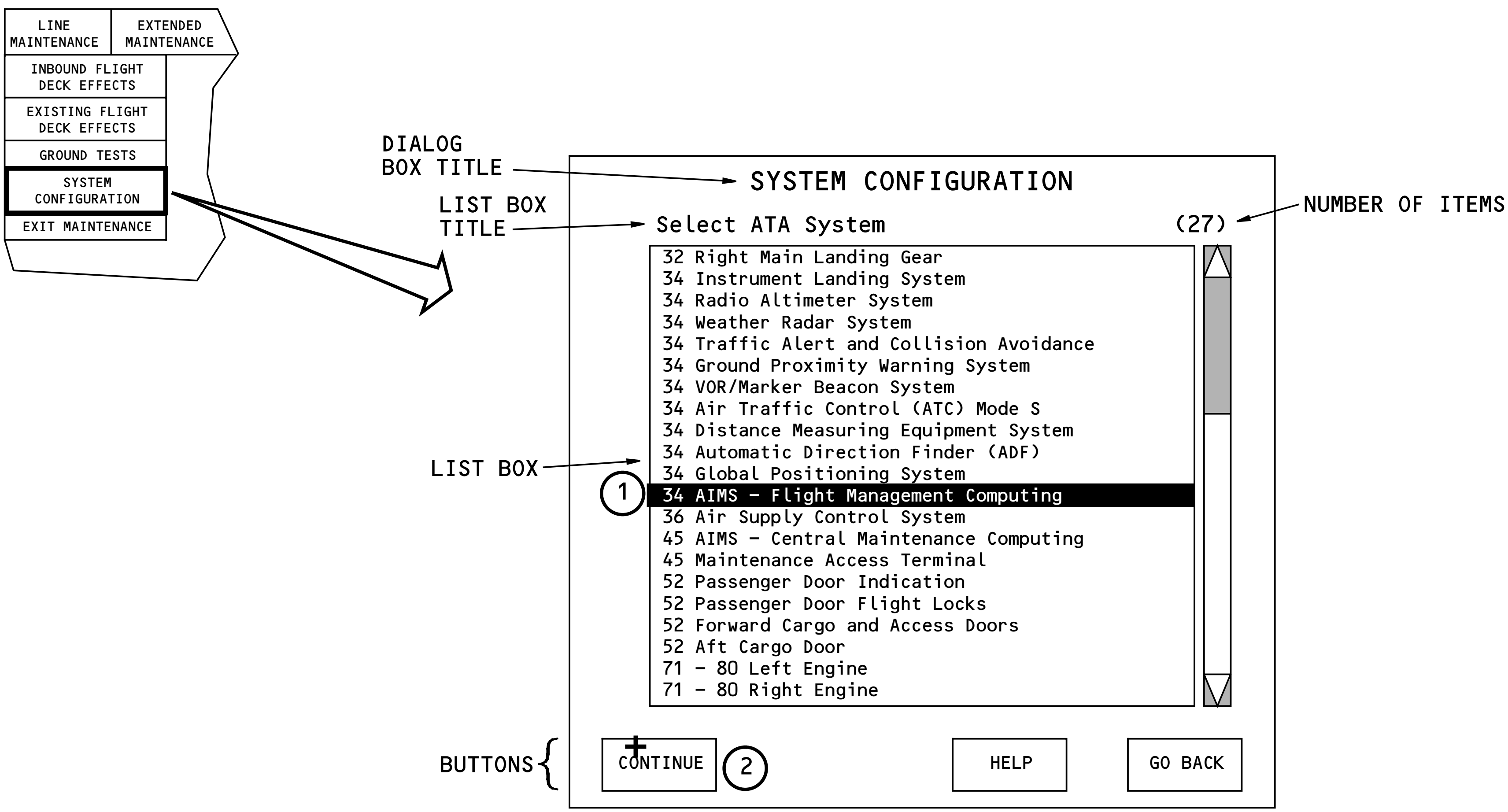
The selected item highlights. The total number of ATA chapter numbers and systems items shows at the top of the list box.

Buttons

Select CONTINUE to remove the system configuration selection dialog box and show the system configuration dialog box. The CONTINUE selection is not available until an ATA system is highlighted.

Select GO BACK to close the system configuration selection dialog box and return to the previous display.

Select HELP to show the help dialog box for the system configuration selection dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.



SYSTEM CONFIGURATION SELECTION DIALOG BOX

1 - 2 SELECTION SEQUENCE

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CMCS - SYSTEM CONFIGURATION SELECTION DIALOG BOX

CMCS - SYSTEM CONFIGURATION DIALOG BOX

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CMCS - SYSTEM CONFIGURATION DIALOG BOX

General

The system configuration dialog box shows hardware and software configuration information for different ATA systems.

The system configuration dialog box shows:

- Dialog box title
- List box title
- Number of items
- List box
- Buttons.

The title of the list box is the ATA chapter number and system selected from the system configuration selection dialog box.

The total number of LRM/LRU items shows at the top of the list box.

List Box

The list box shows the:

- System identifiers
- LRU/LRM identifiers for the system
- Configuration data identifiers
- Configuration data
- Configuration data not available text.

The system identifiers and the LRU/LRM identifiers show for the ATA chapter number and system that shows on top of the list box.

Configuration Data

The configuration data identifiers are:

- Hardware Part Number
- Software #n Part Number
- LRU Part Number
- Serial Number
- Options
- Other Item.

Configuration data shows to the right of the configuration data identifiers.

If an LRU/LRM cannot supply configuration data to the CMCF, the configuration data identifiers and configuration data do not show. The list box shows one of four text blocks in the place of the configuration data identifiers and configuration data.

If there is no response from an LRU/LRM the text block shows:

- CONFIGURATION DATA NOT AVAILABLE.
  CANNOT CONNECT TO THIS SYSTEM. THIS SYSTEM DOES NOT GIVE A REPLY.

CMCS - SYSTEM CONFIGURATION DIALOG BOX

If the CMCF receives data from an LRU/LRM, but no configuration information is in the data received, the text block shows:

- CONFIGURATION DATA NOT AVAILABLE.

If an LRU/LRM is inactive, the text block shows:

- CONFIGURATION DATA NOT AVAILABLE. CANNOT CONNECT TO THIS SYSTEM. THIS SYSTEM IS INACTIVE/FAULTED.

An LRU/LRM can only do one system configuration request at a time. If the CMCF receives a second request to show a system configuration dialog box for the same LRU/LRM the text block shows:

- CONFIGURATION DATA NOT AVAILABLE. CANNOT CONNECT TO XXXX. SYSTEM CONFIGURATION IS ALREADY CONNECTED TO XXXX.

The XXXX is the LRU/LRM that system configuration information was requested for. For example:

- CONFIGURATION DATA NOT AVAILABLE. CANNOT CONNECT TO AIR DATA SYSTEM. SYSTEM CONFIGURATION IS ALREADY CONNECTED TO AIR DATA SYSTEM.

Buttons

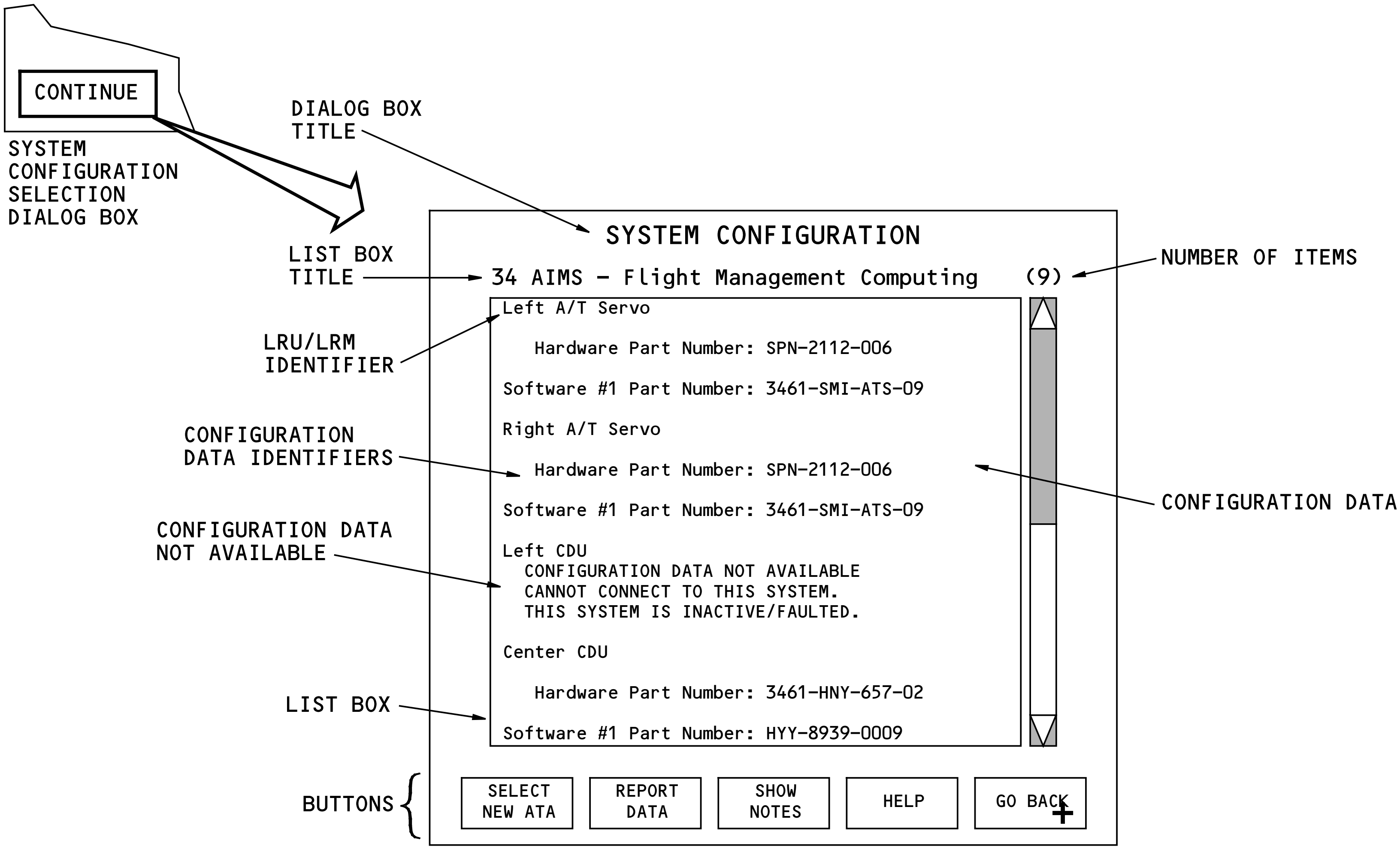
Select SELECT NEW ATA to show the system configuration selection dialog box on top of the system configuration dialog box. The configuration data that shows on the system configuration dialog box remains the same and shows below the system configuration selection dialog box.

Select REPORT DATA to show the report dialog box.

Select SHOW NOTES to show the notes dialog box for the system configuration dialog box. Notes text for the dialog box must be in the CMCF AMI for SHOW NOTES to show.

Select HELP to show the help dialog box for the system configuration dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select GO BACK to remove the system configuration dialog box and show the previous display.



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CMCS - SYSTEM CONFIGURATION DIALOG BOX

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CMCS - PRESENT LEG FAULTS DISPLAY

General

The present leg faults display shows FDE and non-FDE summary groups. The FDE summary group shows FDEs and their correlated maintenance message summary groups which the CMCF stores in fault history leg 0. The non-FDE summary group shows non-correlated maintenance message summary groups which the CMCF stores in fault history leg 0.

FDEs and their correlated maintenance message summary groups show in time order of occurrence, with the most recent FDE and correlated maintenance message summary groups at the top of the list. The non-FDE summary groups show at the bottom of the list.

The present leg faults display also shows maintenance message summary groups for a single ATA chapter, which the CMCF stores in fault history leg 0.

The present leg faults display shows:

- Header Information
- Instructions field
- Fault summary field title
- Number of items
- Fault summary field
- Buttons.

Header Information

The data under the main menu bar on the right side shows:

- Tail identification
- Flight number from the FMCF
- Leg ID, departure airport and arrival airport identifiers from the FMCF
- Leg start time and date from the CMCF
- CMCF source field.

Fault Summary Field Title

The fault summary field title shows above the fault summary field on the left side. The fault summary title shows:

- Data Recorded During the Present Leg - shows when the present leg faults display shows FDE and non-FDE summary groups
- Maintenance Messages Recorded During the Present Leg for XXXXX; (XXXXX is the ATA system that has faults) - shows when the present leg faults display shows maintenance message summary groups sorted by a single ATA chapter.

Number of Items

The number of items shows above the fault summary field on the right side. The number in the parentheses shows the total number of:

- FDE summary groups plus one for the non-FDE summary group, when the fault summary field shows FDE and non-FDE summary groups

CMCS - PRESENT LEG FAULTS DISPLAY

- Maintenance message summary groups, when the fault summary field shows maintenance message summary groups for a single ATA chapter.

Fault Summary Field

A fault summary field has:

- FDE summary groups
- Non-FDE summary group
- Maintenance message summary groups for a single ATA chapter.

The summary groups are faults and FDEs which the CMCF stores in the current leg. The fault summary field border highlights when the cursor is within the area of the fault summary field and there is one or more summary groups within the field.

Select the cursor control device button while the cursor is within the area of the fault summary field to highlight the text of a maintenance message summary group or the text of a FDE summary group header. Select a button to show more data for the highlighted maintenance message summary group or the highlighted FDE summary group header.

FDE Summary Group

A FDE summary group shows the:

- Flight deck effect EICAS message and level
- Flight deck effect activity
- Fault code for the FDE
- Time and date the FDE occurred
- One or more maintenance message summary groups.

FDE and Maintenance Message Activity

The activity of an FDE shows as one of these:

- Active
- Latched
- Not Active.

An active FDE is an FDE that currently shows in the flight deck.

A latched FDE can only be a status message or a scheduled maintenance task. Scheduled maintenance tasks are discussed elsewhere in this section.

A failure that caused a status message may impact dispatch and may be intermittent or detectable only under certain conditions. The PDS holds a status message to make sure you can see it on the ground. You must do something to clear a latched FDE.

An FDE is not active if it can not currently be seen on the flight deck.

The activity of a maintenance message also shows as one of these:

- Active
- Latched

- Not Active.

A maintenance message is active if a system can continuously monitor for a fault condition, and the fault exists.

A maintenance message is latched for one of these reasons:

- If a system detected a fault and is no longer using the related equipment as part of its operational function
- To ensure correlation with an FDE
- If a system can not always detect if the fault exists.

You must do something to clear a latched maintenance message.

A maintenance message is not active if a system can continuously monitor for a fault condition, and the fault does not exist.

Maintenance Message Summary Groups

Each maintenance message summary group includes:

- Maintenance message number
- Maintenance message activity
- Flight phase
- Fault time and date
- Maintenance message symptom.

One or more maintenance messages may be correlated to each FDE and shows with an FDE summary group.

Buttons

Select MAINTENANCE MESSAGE DATA to show the single maintenance message display for the highlighted maintenance message.

Select SELECT BY ATA to show the ATA chapter selection dialog box. If the fault summary field shows maintenance message summary groups for a single ATA chapter, then the button shows SORT BY FDE.

Select SORT BY FDE to show all the present leg, leg 0, FDE and non-FDE summary groups. If the fault summary field shows FDE and non-FDE summary groups, then the button shows SELECT BY ATA.

Select SELECT NEW ATA to show the ATA chapter selection dialog box. The SELECT NEW ATA button shows only if the fault summary field shows maintenance message summary groups for a single ATA chapter.

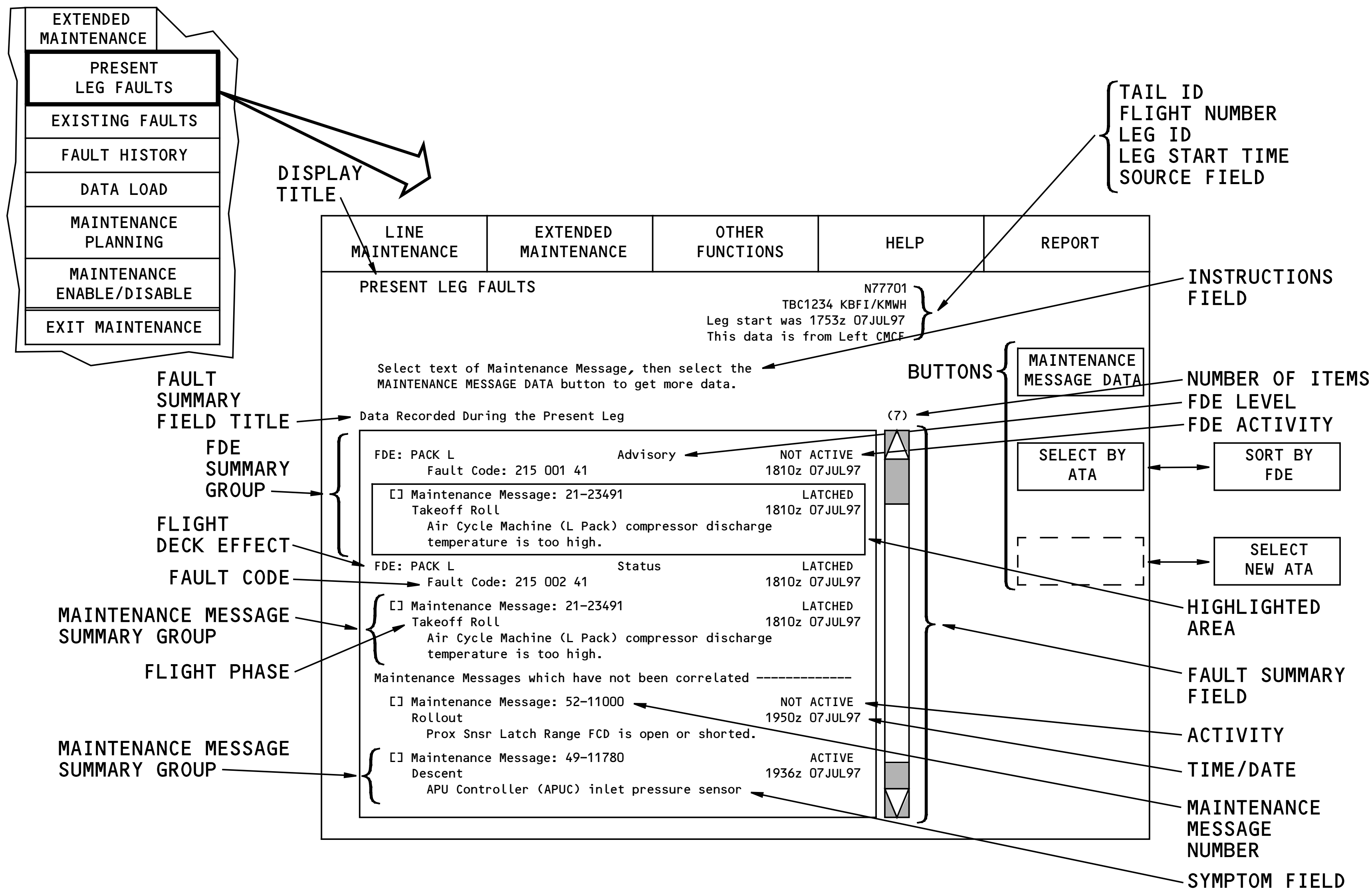
Training Information Point

If a flight leg transition occurs while any present leg faults display or dialog box shows this happens:

- The dialog box goes away
- The fault summary field goes away

CMCS - PRESENT LEG FAULTS DISPLAY

- A dialog box shows with the text: Flight Leg Has Changed. To See Data from Before, Go to Fault History Leg-1.
- Cancel the text dialog box to show the Present Leg Faults ATA chapter selection dialog box.



CMCS - PRESENT LEG FAULTS DISPLAY

CMCS - EXISTING FAULTS DIALOG BOX

General

The existing faults dialog box lets you select an ATA system that currently has faults. Select an ATA system to show the maintenance message summary groups for that system on the existing faults summary display.

The existing faults dialog box shows:

- Dialog box title
- Number of items
- List box
- Buttons.

The list box shows all the ATA systems that have active or latched maintenance messages.

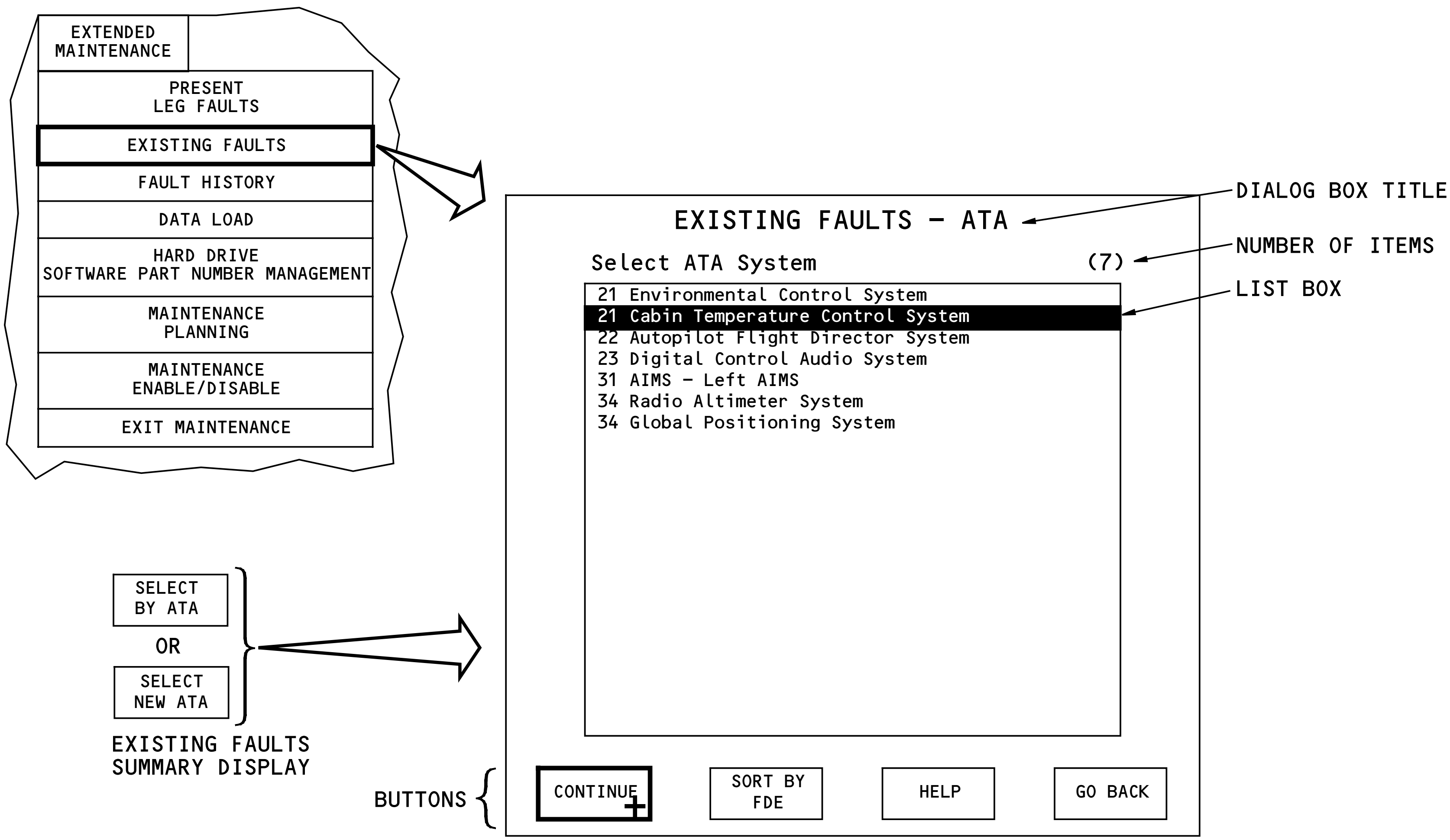
Buttons

Select an ATA system and then select CONTINUE to show the maintenance message summary groups for that ATA system on the existing faults summary display.

Select SORT BY FDE to show the existing faults summary display with all of the FDE and non-FDE summary groups which have active and latched maintenance messages.

Select the HELP button to show the help dialog box for the existing faults dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select the GO BACK button to close the existing faults dialog box and return to the previous display.



45-10-00-044 Rev 4 11/06/1997

CMCS - EXISTING FAULTS DIALOG BOX

CMCS - EXISTING FAULTS SUMMARY DISPLAY

General

The existing faults summary display shows maintenance message summary groups of all active and latched maintenance messages for a single ATA system. Maintenance message summary groups show in time order of occurrence with the newest at the top.

The existing faults summary display also shows FDE and non-FDE summary groups. A FDE summary group shows the currently active or latched FDE, and the active or latched maintenance message summary groups correlated to the FDE. The non-FDE summary group shows the currently active and latched non-correlated maintenance message summary groups.

FDEs and their correlated maintenance message summary groups show in time order of occurrence, with the most recent FDE and correlated maintenance message summary groups at the top of the list. The non-FDE summary groups show at the bottom of the list.

The existing faults summary display shows:

- Header Information
- Instructions field
- Fault summary field title
- Number of items
- Fault summary field
- Buttons.

Header Information

The data under the main menu bar on the right side shows:

- Tail identification
- Time and date from the CMCF
- CMCF source field.

Fault Summary Field Title

The fault summary field title shows above the fault summary field on the left side. The fault summary title shows:

- ATA ZZZZZ; shown when the existing faults summary display shows maintenance message summary groups for a single ATA system. (ZZZZZ is the ATA system that has faults)
- Faults Active or Latched; shown when the existing faults summary display shows FDE and non-FDE summary groups.

Number of Items

The number of items shows above the fault summary field on the right side. The number in the parentheses shows the total number of:

- Maintenance message summary groups, when the fault summary field shows maintenance message summary groups for a single ATA chapter

- FDE summary groups plus one for the non-FDE summary group, when the fault summary field shows FDE and non-FDE summary groups.

Fault Summary Field

The fault summary field has:

- Maintenance message summary groups for a single ATA chapter
- FDE summary groups
- Non-FDE summary group.

The fault summary field border highlights when the cursor is in the area of the fault summary field and there is one or more summary groups within the field.

FDE Summary Group

A FDE summary group shows the:

- FDE EICAS message and level
- FDE activity
- Fault code for the FDE
- Time and date the FDE occurred
- One or more maintenance message summary groups.

A non-FDE summary group shows a description field followed by one or more maintenance message summary groups. The description field shows the text:

- Maintenance Messages which have not been correlated.

Select the cursor control device button while the cursor is in the area of the fault summary field to highlight the text of a maintenance message summary group or the text of a FDE summary group header. Select the MAINTENANCE MESSAGE DATA button to show more data for the highlighted maintenance message summary group.

Maintenance Message Summary Group

A maintenance message summary group shows:

- Maintenance message number
- Maintenance message activity
- Symptom field.

FDE and Maintenance Message Activity

The activity of an FDE shows as one of these:

- Active
- Latched.

An active FDE is an FDE that currently shows in the flight deck.

A latched FDE can only be a status message or a scheduled maintenance task. Scheduled maintenance tasks are discussed in another section.

A failure that caused a status message may impact dispatch and may be intermittent or detectable only under certain conditions. The PDS holds a status

CMCS - EXISTING FAULTS SUMMARY DISPLAY

message to make sure you can see it on the ground. You must do something to clear a latched FDE.

The activity of a maintenance message also shows as one of these:

- Active
- Latched
- Not Active.

A maintenance message is active if a system can continuously monitor for a fault condition, and the fault exists.

A maintenance message is latched for one of these reasons:

- If a system detected a fault and is no longer using the related equipment as part of its operational function
- To ensure correlation with an FDE
- If a system can not always detect if the fault exists.

You must do something to clear a latched maintenance message.

A maintenance message is not active if a system can continuously monitor for a fault condition, and the fault does not exist.

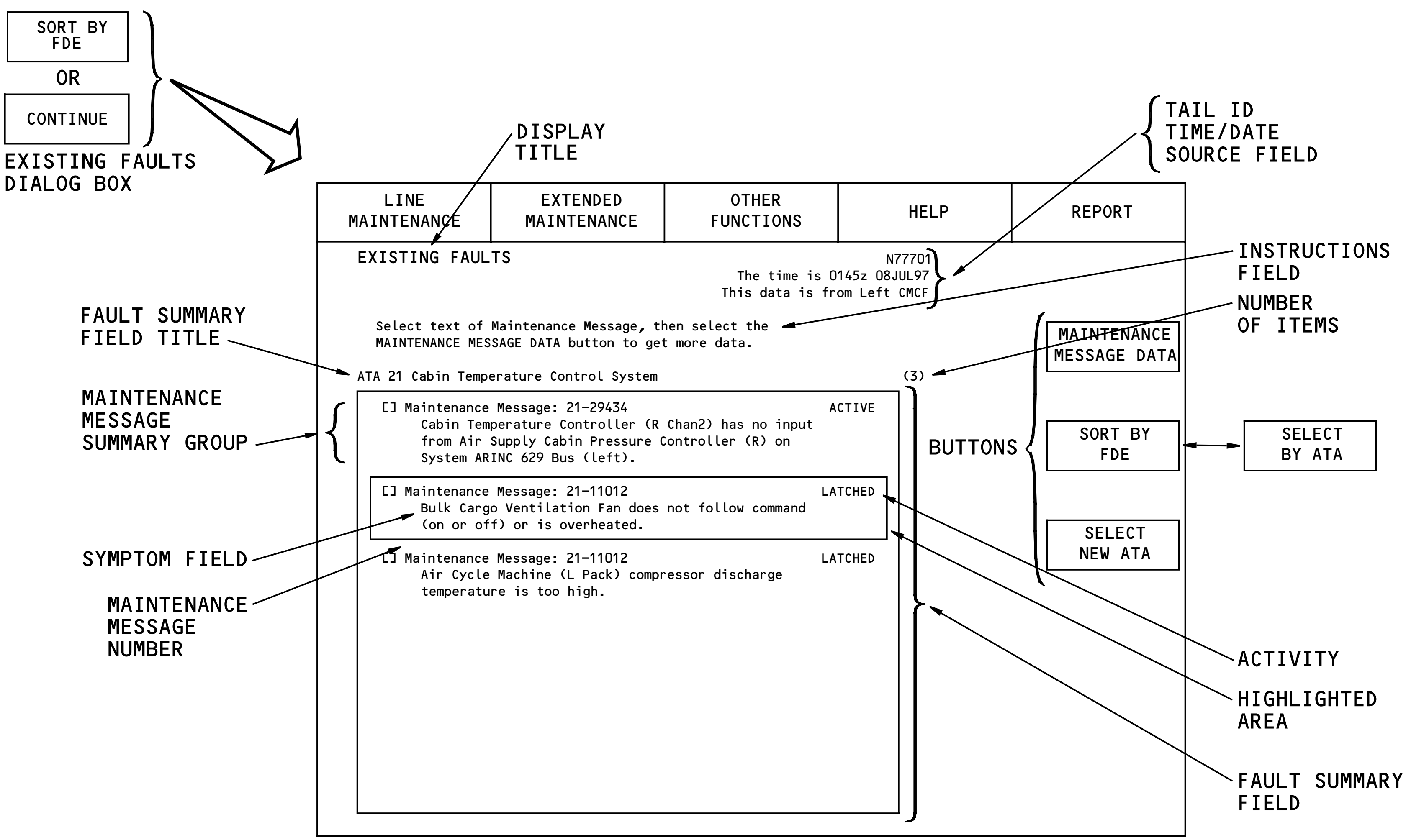
<u>Buttons</u>

Select MAINTENANCE MESSAGE DATA to show the single maintenance message display for the highlighted maintenance message.

Select SELECT BY ATA to show the existing faults dialog box. If the fault summary field shows maintenance message summary groups for a single ATA chapter, then the button shows SORT BY FDE.

Select SORT BY FDE to show all the existing FDE and non-FDE summary groups. If the fault summary field shows FDE and non-FDE summary groups, then the button shows SELECT BY ATA.

Select SELECT NEW ATA to show the existing faults dialog box. The SELECT NEW ATA button shows only if the fault summary field shows maintenance message summary groups for a single ATA chapter.



45-10-00-045 Rev 4 11/06/1997

CMCS - EXISTING FAULTS SUMMARY DISPLAY

CMCS - FAULT HISTORY - ATA DIALOG BOX

General

The fault history-ATA dialog box permits the selection of an ATA chapter that has failures in the CMCF fault history memory. Select an ATA chapter to show the fault summary groups of the failures in the CMCF fault history memory. They show on the fault history summary display.

If there are no failures in the CMCF fault history memory, the selection of FAULT HISTORY on the menu title bar shows the fault history summary display.

The fault history ATA dialog box shows:

- Dialog box title
- Number of items
- List box
- Buttons.

The list box shows all the ATA chapters that have failures in the CMCF fault history memory.

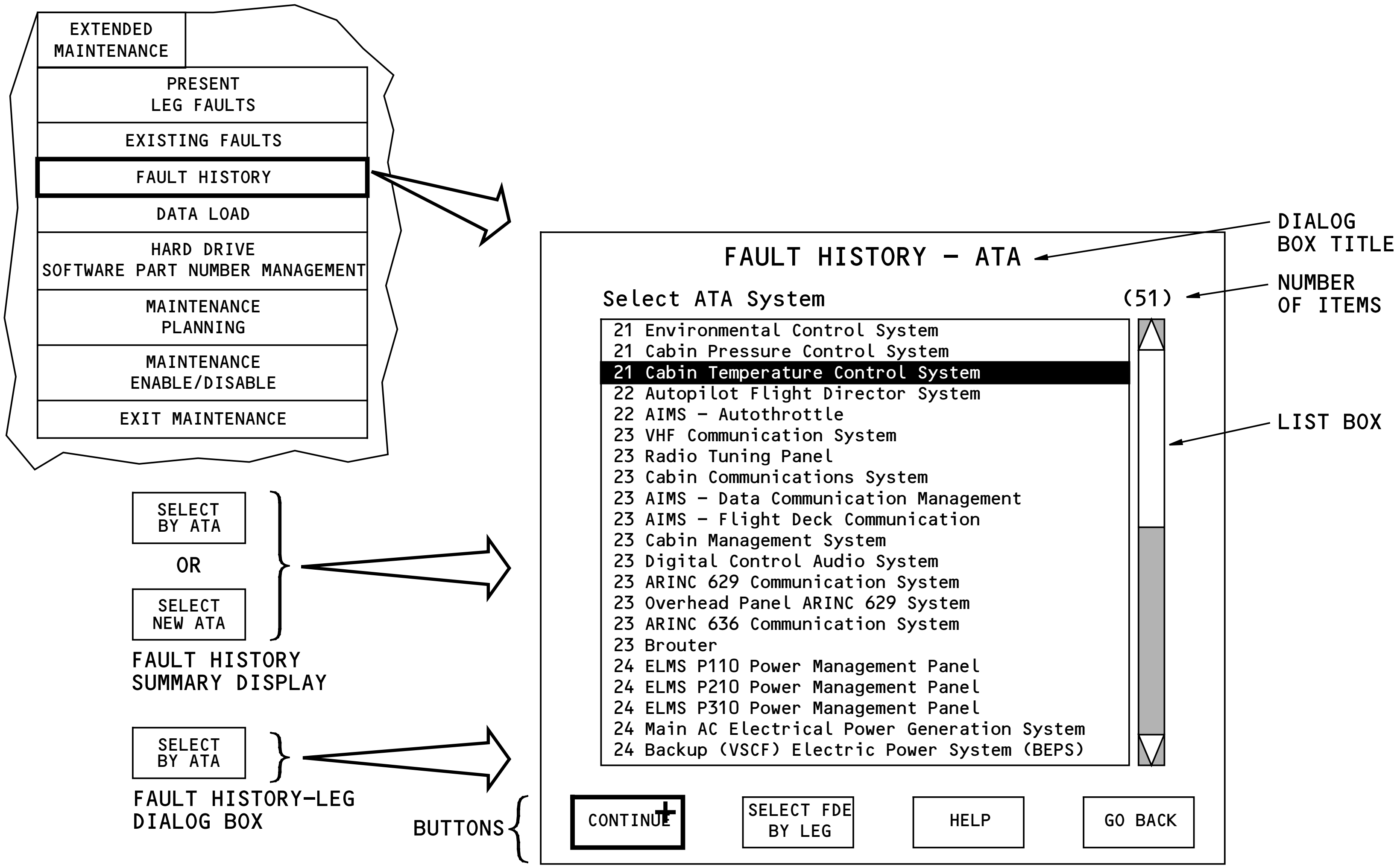
Buttons

Select an ATA system and then select CONTINUE to show the fault summary groups for that ATA system on the fault history summary display.

Select SELECT FDE BY LEG to show the fault history-Leg dialog box.

Select HELP to show the help dialog box for the fault history-ATA dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select the GO BACK button to remove the fault history-ATA dialog box and return to the previous display.



45-10-00-046 Rev 4 11/06/1997

CMCS - FAULT HISTORY - ATA DIALOG BOX

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CMCS - FAULT HISTORY SUMMARY DISPLAY

General

The fault history summary display shows the failures in the CMCF fault history memory. The fault history summary display shows failures for a single ATA chapter or sorted by FDE summary groups for a specific flight leg.

The fault history summary display shows:

- Header information
- Instructions field
- Fault summary field title
- Number of items
- Fault summary field
- Buttons.

Header Information

The header information shows:

- Display title
- Tail identification
- Flight number, only when fault history for a specific flight leg shows
- Leg ID, only when fault history for a specific flight leg shows
- Leg start time, only when fault history for a specific flight leg shows
- Current time and date from the universal time (coordinated) function (UTCF), when fault history does not show a specific flight leg
- CMCF source field.

Fault Summary Field Title

The fault summary field title shows above the fault summary field on the left side. The fault summary title shows:

- Faults recorded during leg NN; shown when fault history for a specific flight leg shows. (NN is the flight leg)
- Fault History for ATA ZZZZZ; shown when the Fault History Summary display shows fault history summary groups for a single ATA chapter. (ZZZZZ is the ATA chapter that has faults)
- Fault History for Maintenance Message XX; shown when fault history for a single maintenance message shows. (XX is the maintenance message number).

Number of Items

The number of items shows above the fault summary field on the right side. The number in the parentheses shows the total number of:

- Fault summary groups, when the fault summary field shows fault summary groups for a single ATA chapter
- FDE summary groups plus one for the non-FDE summary group, when the fault summary field shows FDE and non-FDE summary groups.

CMCS - FAULT HISTORY SUMMARY DISPLAY

Fault Summary Field for a Specific ATA Chapter

The fault summary field shows fault summary groups for a specific ATA chapter. The fault summary groups show all the failures for a specific ATA chapter. The fault summary groups show:

- Maintenance message symptom
- Maintenance message number
- One or more fault occurrence records.

A fault occurrence record shows the leg that had a failure. Each fault occurrence record has a:

- Leg number
- Flight phase
- Time and date
- Hard or intermittent if the CMCS can always monitor for a fault.

Fault Summary Field for a Specific Leg

The fault summary field also shows FDE summary groups and a non-FDE summary group for a specific leg. The FDE summary groups and the non-FDE summary group show all the failures for a specific leg.

A FDE summary group shows the:

- Flight deck effect EICAS message and level
- Flight deck effect activity
- Fault code for the FDE
- Time and date the FDE occurred
- One or more maintenance message summary groups.

A non-FDE summary group shows a description field followed by one or more maintenance message summary groups. The description field shows the text:

- Maintenance Messages which have not been correlated.

A maintenance message summary group shows:

- Maintenance message number
- Maintenance message activity
- Symptom field.

Fault Summary Field for a Single Maintenance Message

The fault summary field also shows the fault summary group for a single maintenance message. Select FAULT HISTORY from the single maintenance message display to show the fault summary group for a single maintenance message.

The fault summary group shows:

- Maintenance message symptom
- Maintenance message number
- One or more fault occurrence records.

A fault occurrence record shows the leg in which a specific failure occurred. Each fault occurrence record has a:

CMCS - FAULT HISTORY SUMMARY DISPLAY

- Leg number
- Flight phase
- Time and date
- Hard or intermittent indication.

Fault Summary Field Control

The fault summary field border highlights when the cursor is in the area of the fault summary field and there is one or more summary groups in the field.

Select the cursor control device switch while the cursor is in the area of the fault summary field to highlight the text of a maintenance message summary group or the text of a FDE summary group header. Selection of a button shows more data for the highlighted maintenance message summary group or the highlighted FDE summary group header.

Select the cursor control device switch while the cursor is in the area of the fault summary field to highlight the text of a fault occurrence record. Selection of a command selection shows more data for the highlighted fault occurrence record.

Buttons

Select GO BACK to close the fault history summary page and return to the single maintenance message display from which FAULT HISTORY was selected. The GO BACK button shows only if the you select the FAULT HISTORY button from the single maintenance message display.

Select MAINTENANCE MESSAGE DATA to show the single maintenance message display for the highlighted maintenance message summary group or the highlighted fault occurrence record.

Select SELECT FDE BY LEG to show the fault history-leg dialog box. The SELECT FDE BY LEG button shows when the fault summary field shows fault summary groups.

Select SELECT BY ATA to show the fault history-ATA dialog box. The SELECT BY ATA button shows when the fault summary field shows FDE summary groups.

Select SELECT NEW ATA to show the fault history-ATA dialog box. The SELECT NEW ATA button shows when the fault summary field shows fault summary groups.

Select SELECT NEW LEG to show the fault history-Leg dialog box. The SELECT NEW LEG button shows when the fault summary field shows FDE summary groups.

Select ERASE BY ATA to show the fault history-erase dialog box.

Select MOVE FAULT HISTORY to show the fault history-move dialog box.

Some of the buttons do not show when the fault history summary page is selected from the FAULT HISTORY button on the single maintenance message page. The buttons that do not show are:

- MAINTENANCE MESSAGE DATA

CMCS - FAULT HISTORY SUMMARY DISPLAY

- SELECT FDE BY LEG
- SELECT BY ATA
- SELECT NEW ATA
- SELECT NEW LEG
- ERASE BY ATA
- MOVE FAULT HISTORY.

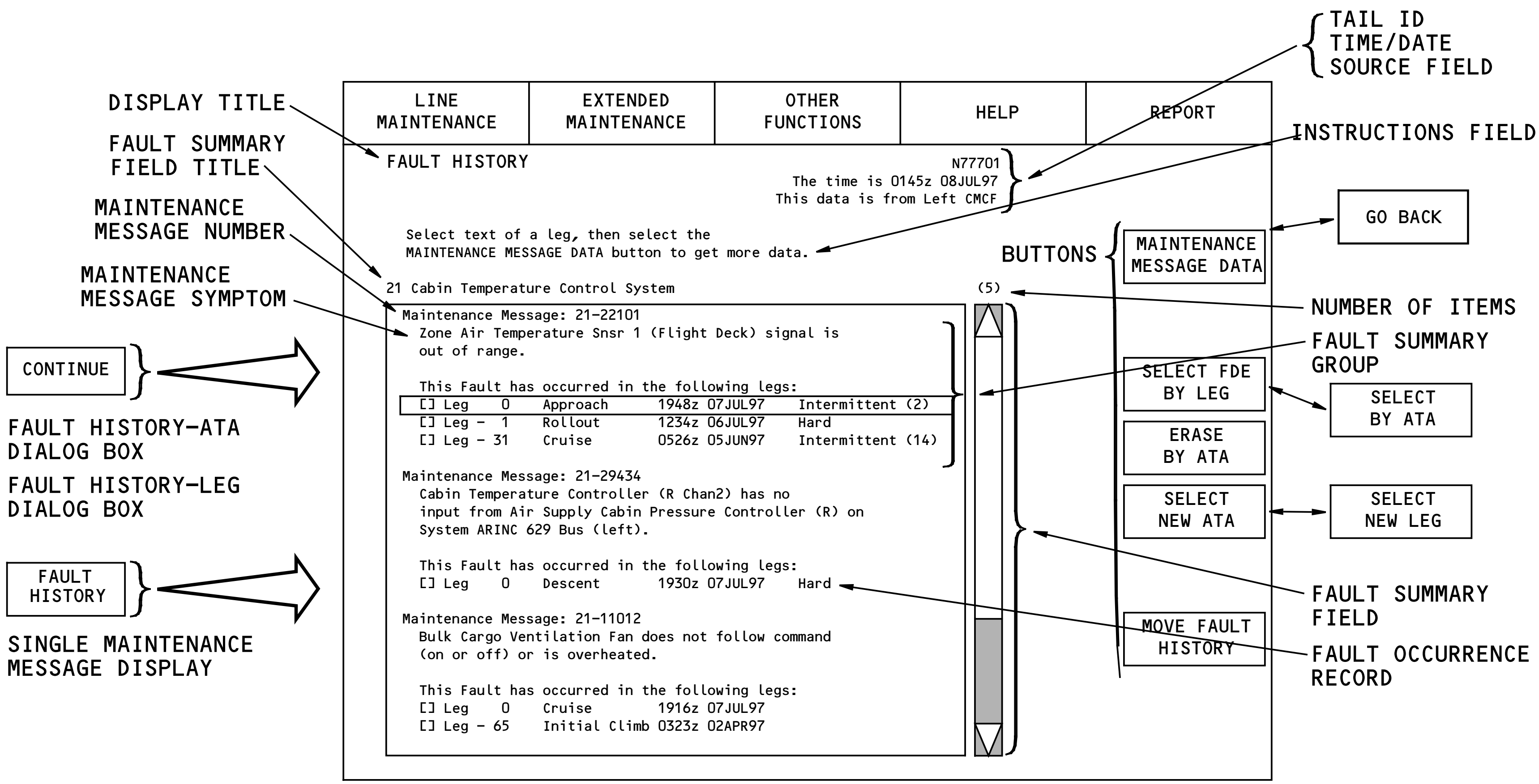
Training Information Point

If a flight leg transition occurs while any fault history display that is sorted by flight leg shows:

- Any open dialog boxes go away
- The fault summary field, if shown, blanks
- A text dialog box shows: Flight Leg has Changed. To See Data from before, Go to Fault History Leg-1.
- Cancel the text dialog box to show the Fault History-Leg dialog box which shows selections based on the new flight leg data.

If a flight leg transition occurs while any fault history display that is sorted by ATA chapter shows:

- Any open dialog box is removed
- The fault summary field, if shown, blanks
- A text dialog box shows: The Flight Leg has Changed. All Flight Leg Numbers are Increased by-1.
- Cancel the text dialog box to show the Fault History-ATA dialog box which shows selections based on the new flight leg data.



45-10-00-047 Rev 7 11/06/1997

CMCS - FAULT HISTORY SUMMARY DISPLAY

CMCS - FAULT HISTORY - LEG DIALOG BOX

General

The fault history-leg dialog box permits the selection of a flight leg that has failures in the CMCF fault history memory. Select a flight leg to show the FDE summary groups and the non-FDE summary group, of the maintenance messages that have failures in the CMCF fault history memory, on the fault history summary display.

The fault history-leg dialog box shows:

- Dialog box title
- Number of items
- List box
- Buttons.

The list box shows all the flight legs that have failures in the CMCF fault history memory.

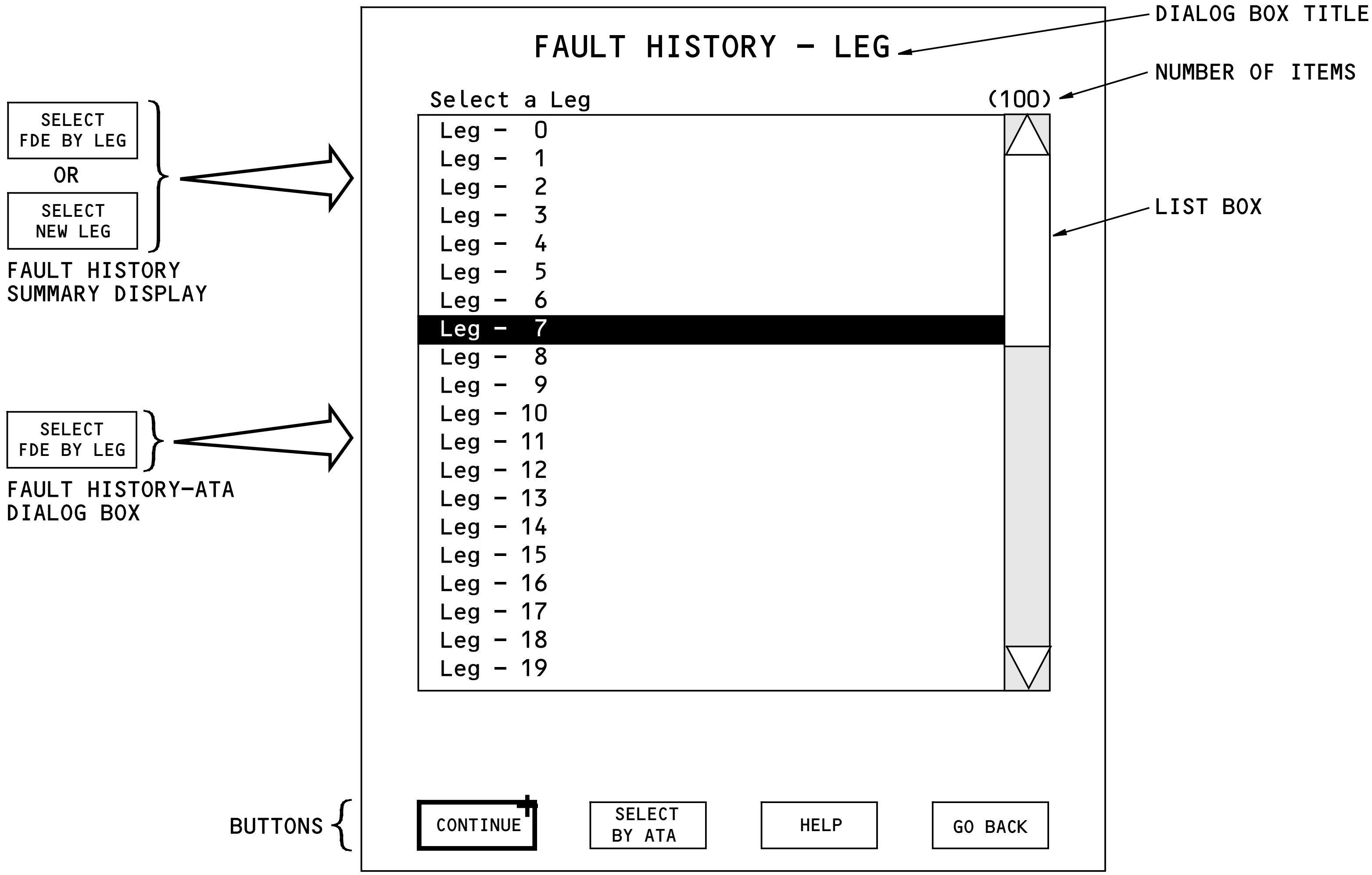
Buttons

Select a flight leg and then select CONTINUE to show the FDE summary groups and the non-FDE summary group for that flight leg on the fault history summary display.

Select SELECT BY ATA to show the fault history-ATA dialog box.

Select HELP to show the help dialog box for the fault history-leg dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select GO BACK to remove the fault history-Leg dialog box and return to the previous display.



45-10-00-048 Rev 2

CMCS - FAULT HISTORY - LEG DIALOG BOX

CMCS - FAULT HISTORY - ERASE DIALOG BOX

General

Fault history erase selections permit the removal of failures from the CMCF fault history memory. Fault history erase selections permit the removal of these:

- All occurrences of a single failure
- All failures for an ATA chapter
- All failures in the CMCF fault history memory.

The fault history-erase dialog box shows these:

- Dialog box title
- Number of items
- List box
- All Fault History selection
- Buttons.

The list box shows all the ATA chapters that have failures in the CMCF fault history memory.

Erase All Occurrences of a Single Failure

Select MAINTENANCE MESSAGE DATA on the fault history summary display to show the single maintenance message display. Select ERASE FAULT on the single maintenance message display to erase all occurrences of the single maintenance message. Then select ERASE on the fault history-erase confirmation dialog box.

Erase All Failures for an ATA Chapter

Use the fault history-erase dialog box to erase all maintenance messages from an ATA chapter. Select an ATA chapter that has failures in the CMCF fault history memory and select ERASE to erase the failures. Then select ERASE on the fault history-erase confirmation dialog box.

Erase All Failures

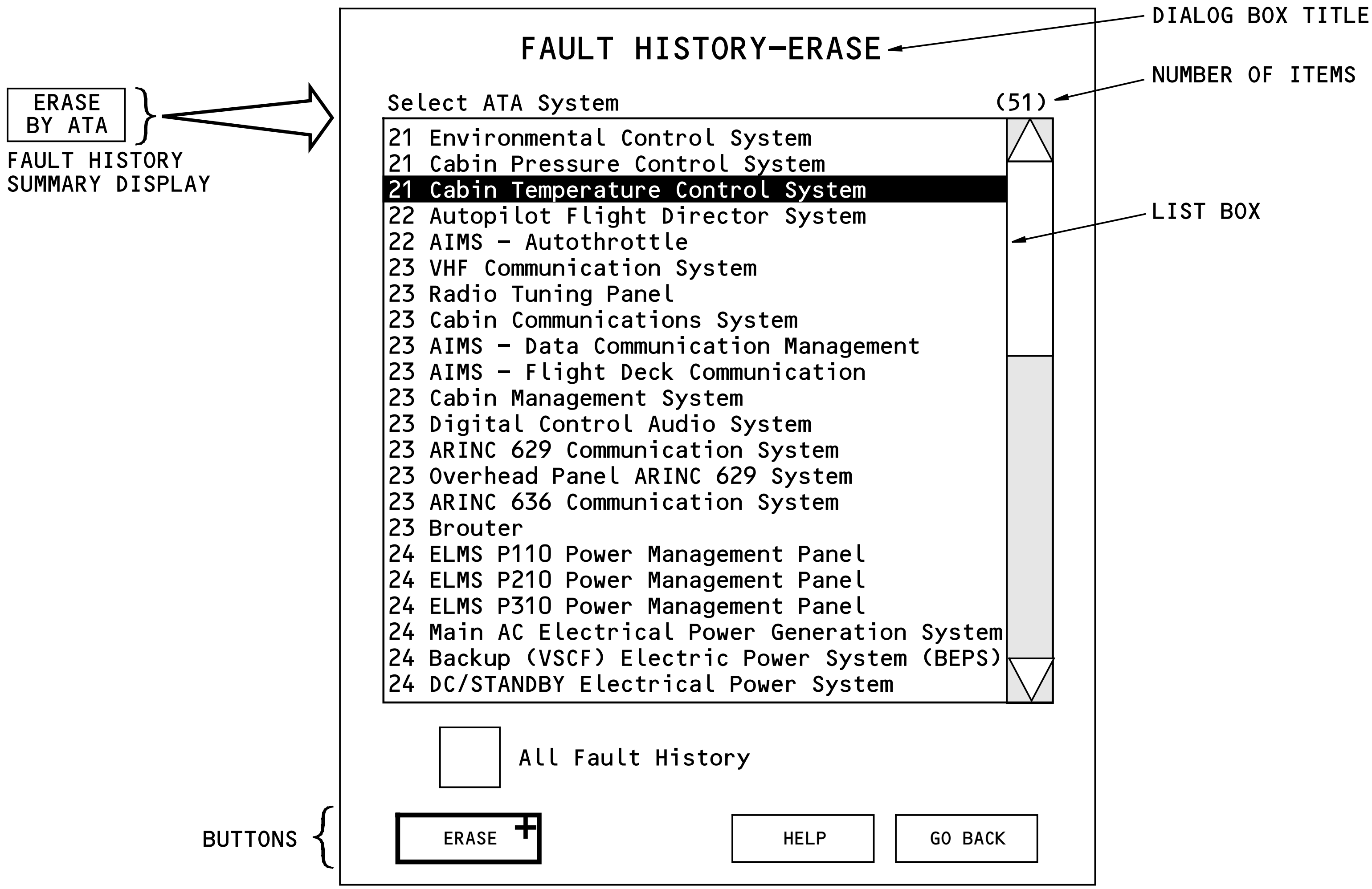
Use the fault history-erase dialog box to erase all maintenance messages in fault history. Select the All Fault History selection to indicate that all maintenances messages in the fault history should be erased. Then select ERASE to show the fault history-erase confirmation dialog box. Then select ERASE on the fault history-erase confirmation dialog box.

Buttons

Select an ATA system and then select ERASE to show the fault history-erase confirmation dialog box.

Select HELP to show the help dialog box for the fault history-erase dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select GO BACK to remove the fault history-erase dialog box and return to the previous display.



45-10-00-049 Rev 3

CMCS - FAULT HISTORY - ERASE DIALOG BOX

CMCS - FAULT HISTORY - ERASE CONFIRMATION DIALOG BOX

General

The fault history-erase confirmation dialog box permits the confirmation or cancellation to erase maintenance messages from fault history.

The text in the fault history-erase confirmation dialog box shows:

- If you select the ERASE button, xx Maintenance Message Occurrences will be erased from the Fault History database. Are you sure that you want to permanently remove these maintenance messages?

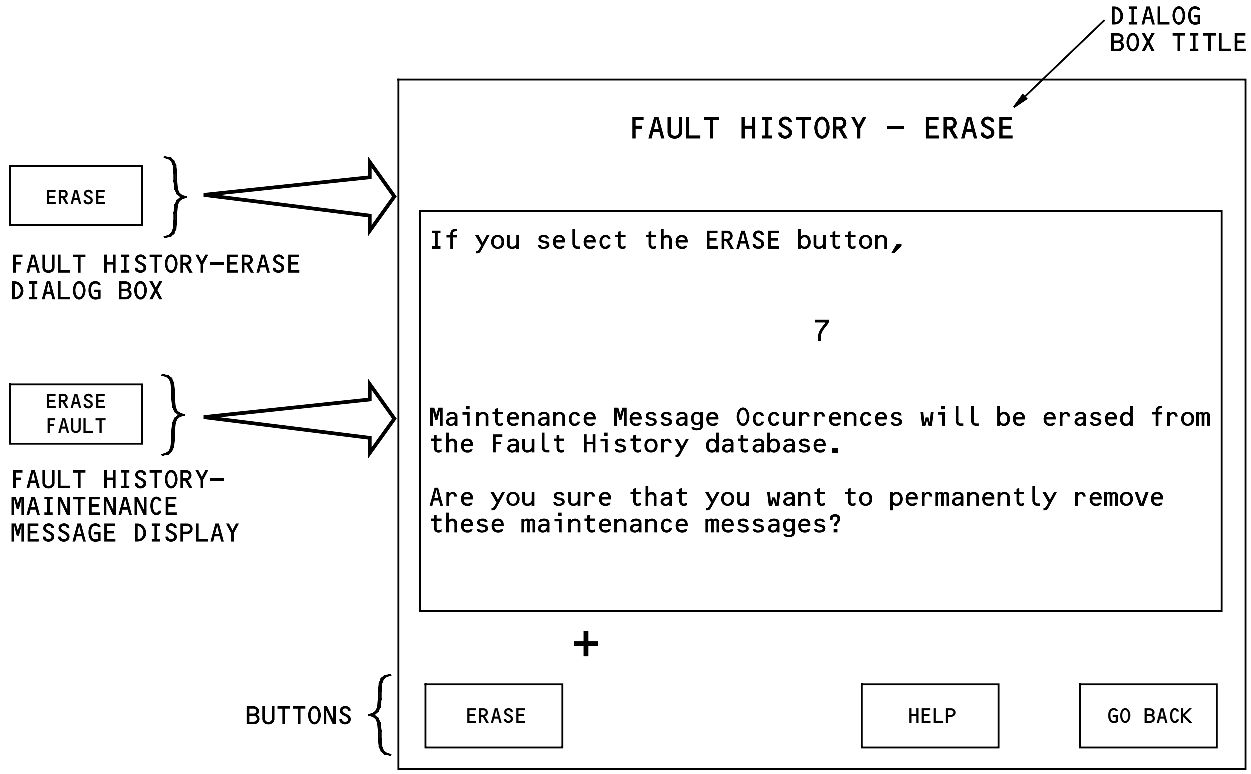
XX is the number of maintenance messages that will erase.

Buttons

Select ERASE to remove the maintenance messages from the CMCF fault history memory. The selection of ERASE removes the fault history-erase confirmation dialog box. The selection of ERASE also removes the fault history-erase dialog box. If the fault history-erase confirmation dialog box shows from the single maintenance message display, then the selection of ERASE removes the single maintenance message display, and the fault history summary display shows.

Select HELP to show the help dialog box for the fault history-erase confirmation dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select GO BACK to close the fault history-erase confirmation dialog box and return to the previous display.



45-10-00-050 Rev 2 07/20/95

CMCS - FAULT HISTORY - ERASE CONFIRMATION DIALOG BOX

CMCS - FAULT HISTORY - MOVE DIALOG BOX

General

The fault history-move dialog box permits an upload of the fault history data from the disk drive. The fault history-move dialog box also permits a download of the fault history data to the disk drive.

The fault history-move dialog box shows:

- Dialog box title
- Exclusive selections
- Buttons.

Training Information Point

Move the fault history data to diskettes before you disconnect the main battery. When there is no other power on the airplane, the hot battery bus provides power to the static random access memory (SRAM) that holds the fault history data.

Exclusive Selections

These are the two exclusive selections:

- Load from Disk Drive
- Report to Disk Drive.

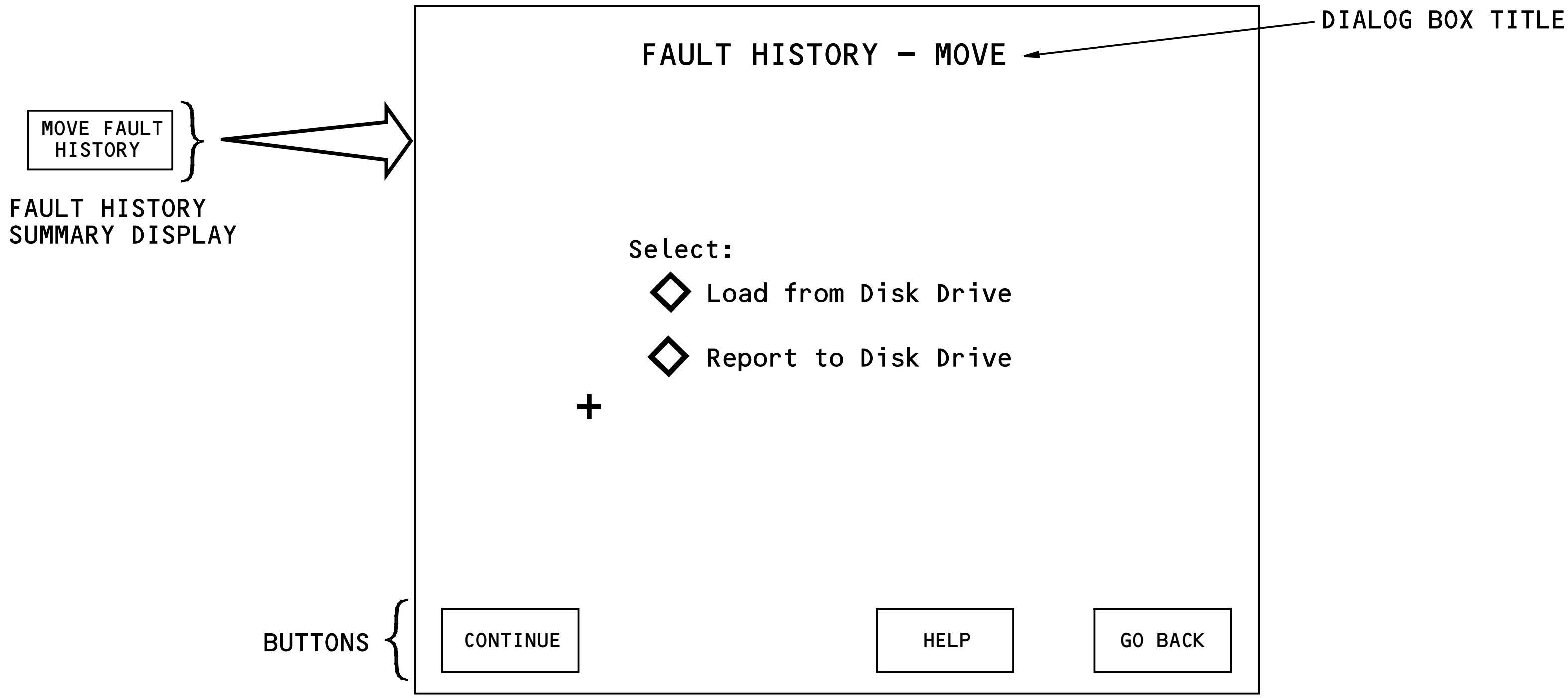
Select Load from Disk Drive and then select CONTINUE to upload a fault history.

Select Report to Disk Drive and then select CONTINUE to download the fault history. Select CONTINUE to remove the fault history-move dialog box.

Buttons

Select HELP to show the help dialog box for the fault history-move dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select GO BACK to close the fault history-move dialog box and return to the previous display.



45-10-00-051 Rev 3

CMCS - FAULT HISTORY - MOVE DIALOG BOX

CMCS - FAULT HISTORY UPLOAD DIALOG BOXES - 1

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CMCS - FAULT HISTORY UPLOAD DIALOG BOXES - 1

General

The fault history upload procedure permits an upload of a fault history database from a diskette into the selected CMCF. This procedure overwrites the fault history database currently in the CMCF.

Certain dialog boxes show as a normal part of the upload procedure. Other dialog boxes show non-normal conditions and require other steps to complete the upload procedure.

The fault history upload dialog boxes are:

- Text
- In-progress
- Fault history advisory
- Load completion
- Next disk
- Loading error
- Incompatibility.

Each dialog box has these:

- Title
- Message field
- Buttons.

The message field shows messages or directions for each type of dialog box.

There is a maximum of four buttons at the bottom of each dialog box. The buttons may be different for each type of dialog box.

Text Dialog Box

If the tail identification of a diskette is the same as the tail ID of the CMCF fault history database, a text dialog box shows that says If continue is selected, the fault history database will be replaced.

Select CONTINUE to upload the fault history database on the diskette into the selected CMCF.

The selection of CONTINUE on the text dialog box also does these:

- Causes a fault history advisory dialog box to show on the MAT and PMATs that show fault history information, except on the MAT or PMAT that starts the fault history upload procedure
- Causes an in-progress dialog box to show on the MAT or PMAT that starts the fault history upload procedure
- Closes the text dialog box.

Select GO BACK to remove the text dialog box and to show the fault history-move dialog box.

In-Progress Dialog Box

The in-progress dialog box shows the progress of the fault history database upload procedure. The in-progress dialog box shows what percent of the fault history database has been transferred to the CMCF.

Select STOP to end the fault history database upload and to close the in-progress dialog box.

Select HELP to show the help dialog box.

Fault History Advisory Dialog Box

The fault history advisory dialog box shows that the fault history database is about to change on the MAT or PMATS that show fault history information, except on the MAT or PMAT that starts the fault history upload procedure.

Select CONTINUE to show the new summary groups based on the new fault history database.

Select HELP to show the help dialog box for the fault history advisory dialog box. Help text for the dialog box must be in the CMCF AMI for help to show.

Next Disk Dialog Box

The next disk dialog box shows that the part of the fault history database on the diskette in the disk drive was loaded. Remove the diskette and install the diskette with the next part of the fault history database.

Install the next diskette to remove the dialog box.

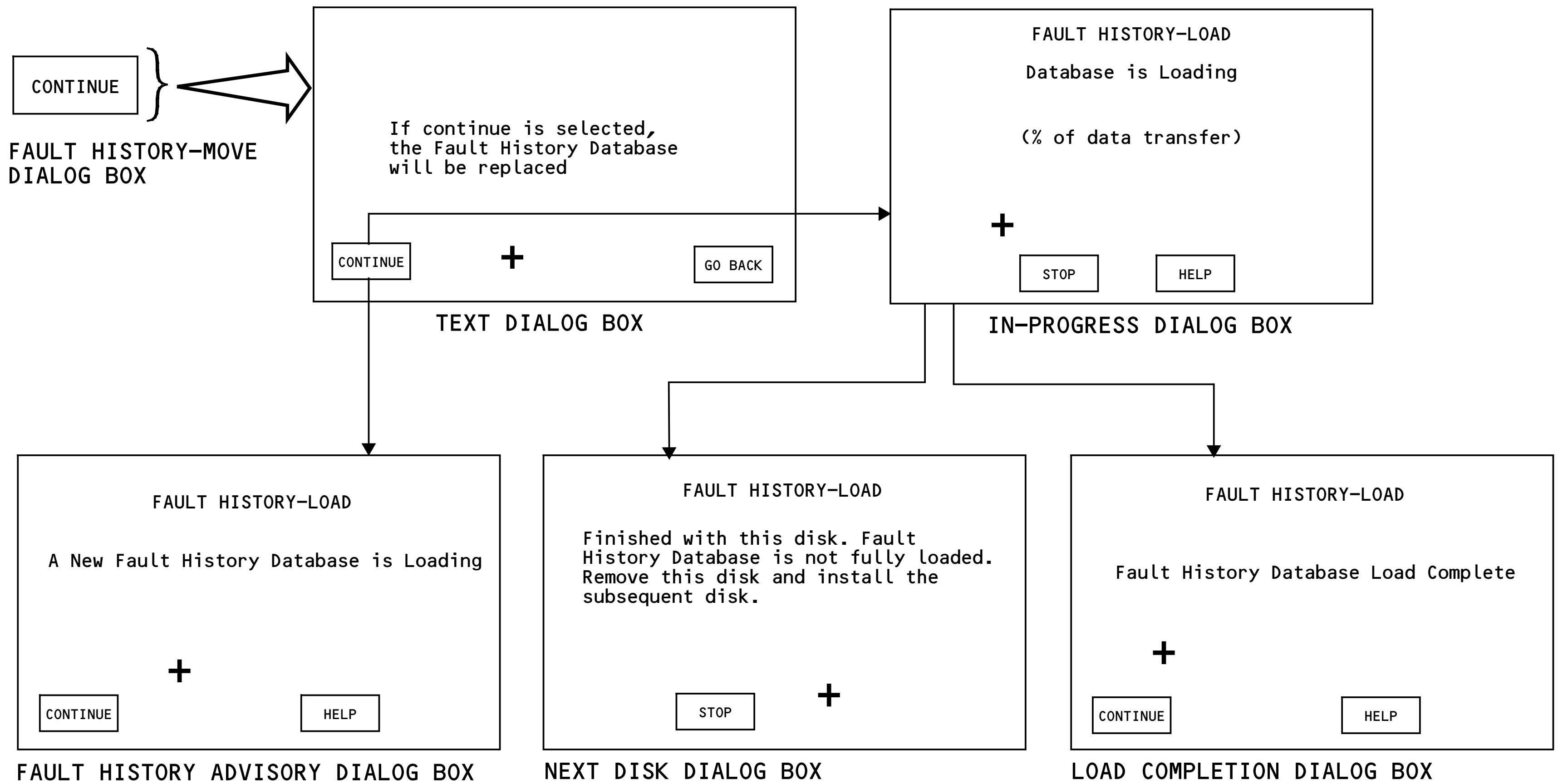
Select STOP to end the fault history database upload and to close the next disk dialog box.

Load Completion Dialog Box

The load completion dialog box shows that the fault history database upload procedure was successful.

Select CONTINUE to remove the dialog box.

Select HELP to show the help dialog box for the Load Completion dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.



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CMCS - FAULT HISTORY UPLOAD DIALOG BOXES - 1

CMCS - FAULT HISTORY UPLOAD DIALOG BOXES - 2

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CMCS - FAULT HISTORY UPLOAD DIALOG BOXES - 2

General

The fault history upload procedure permits an upload of a fault history database from diskettes into the selected CMCF. This procedure overwrites the fault history database currently in the CMCF.

Certain dialog boxes show as a normal part of the upload procedure. Other dialog boxes show non-normal conditions and require other steps to complete the upload procedure.

The fault history upload dialog boxes are:

- Text dialog box
- In-progress dialog box
- Fault history advisory dialog box
- Load completion dialog box
- Next disk dialog box
- Loading error dialog box
- Incompatibility dialog box.

Each dialog box has these:

- Title
- Message field
- Buttons.

The message field shows messages or directions for each type of dialog box.

There are a maximum of four buttons at the bottom of each dialog box. The selections may be different for each type of dialog box.

Loading Error Dialog Box

If a data transfer error occurs while the fault history database is being uploaded, then the fault history database upload procedure stops and the loading error dialog box shows. The CMCF clears any partially loaded fault history database.

Select STOP to remove the loading error dialog box.

Select HELP to show the help dialog box for the Loading Error dialog box. Help text for the dialog box must be in the CMCF AMI for help to show.

Incompatibility Dialog Box

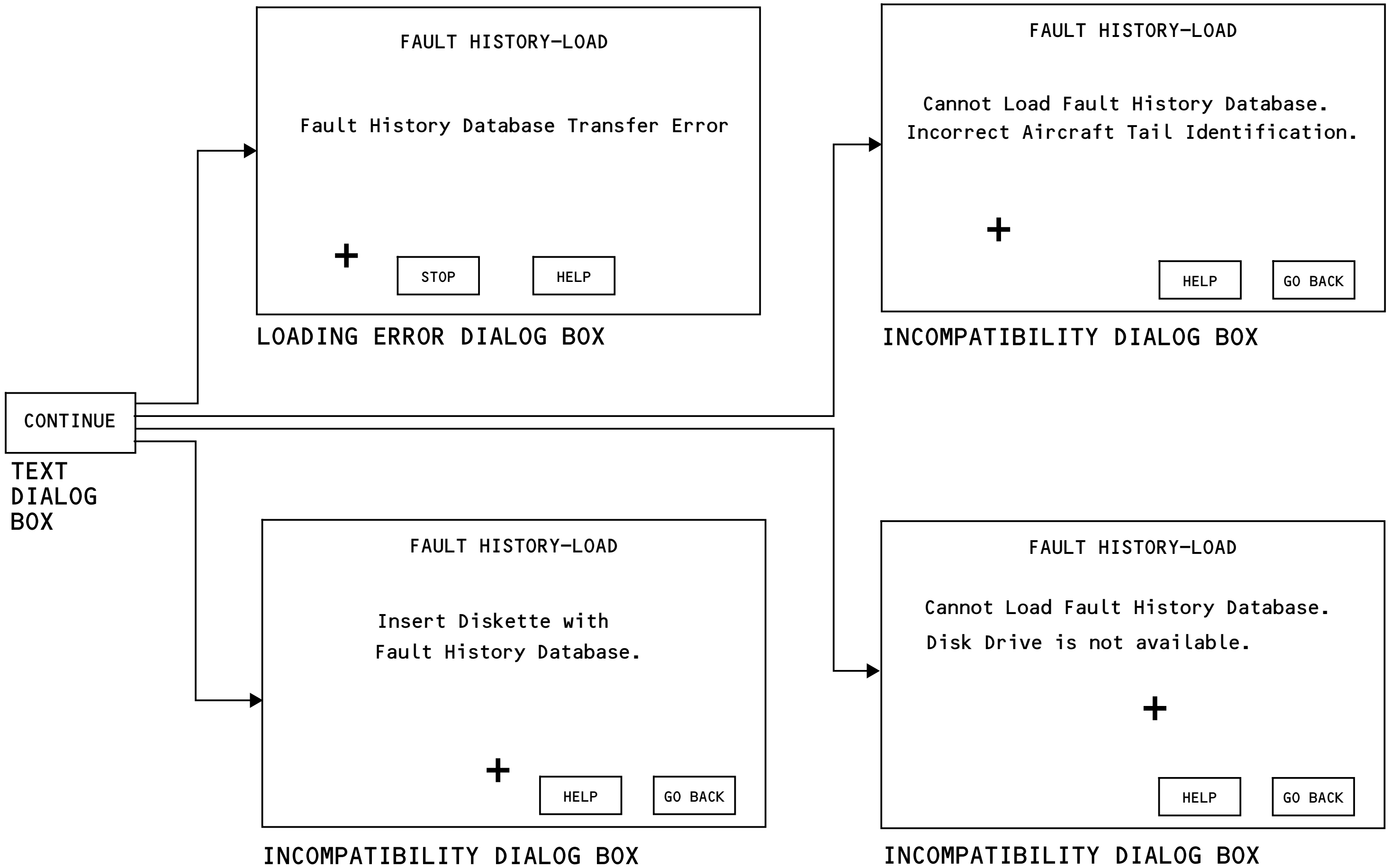
The fault history database on the diskette does not load into the CMCF and an incompatibility dialog box shows if one of these occurs:

- Tail ID of the database on the diskette is different than the tail ID of the CMCF fault history database
- CMCF cannot read the diskette
- Disk drive is not available.

Select GO BACK to remove the incompatibility dialog box and show the fault history-move dialog box.

CMCS - FAULT HISTORY UPLOAD DIALOG BOXES - 2

Select HELP to show the help dialog box for the Incompatibility dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.



45-10-00-053 Rev 1

CMCS - FAULT HISTORY UPLOAD DIALOG BOXES - 2

CMCS - FAULT HISTORY DOWNLOAD DIALOG BOXES - 1

General

The fault history download procedure permits the transfer of the CMCF fault history to diskettes.

Certain dialog boxes show as a normal part of the download procedure. Other dialog boxes show non-normal conditions and show other steps to complete the download procedure.

These are the fault history download dialog boxes:

- Download in-progress dialog box
- Download completion dialog box
- Download interference dialog boxes
- Downloading error dialog box.

Each dialog box has these:

- Title
- Message field
- Buttons.

The message field shows messages or directions for each type of dialog box.

There is a maximum of four buttons at the bottom of each dialog box. The selections may be different for each type of dialog box.

Download In-Progress Dialog Box

The download in-progress dialog box shows the progress of the fault history database download procedure. The download in-progress dialog box shows what percent of the CMCF fault history database has been transferred to the diskette.

Select STOP to end the CMCF fault history database download procedure and to remove the download in-progress dialog box.

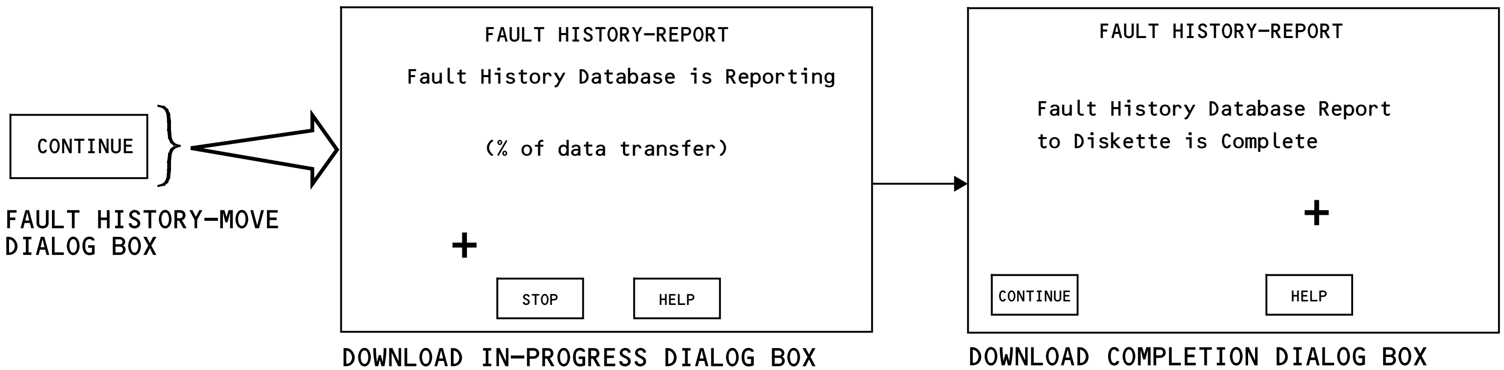
Select HELP to show the help dialog box for the Download In-Progress. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Download Completion Dialog Box

The download completion dialog box shows that the fault history database download procedure successfully completed.

Select CONTINUE to remove the download completion dialog box.

Select HELP to show the help dialog box for the download completion dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.



45-10-00-054 Rev 1

CMCS - FAULT HISTORY DOWNLOAD DIALOG BOXES - 1

CMCS - FAULT HISTORY DOWNLOAD DIALOG BOXES - 2

General

The fault history download procedure lets the transfer of the CMCF fault history to diskettes.

Certain dialog boxes show as a normal part of the download procedure. Other dialog boxes show non-normal conditions and show other steps to complete the download procedure.

These are the fault history download dialog boxes:

- Download in-progress dialog box
- Download completion dialog box
- Download interference dialog boxes
- Downloading error dialog box.

Each dialog box has these:

- Title
- Message field
- Buttons.

The message field shows messages or directions for each type of dialog box.

There are a maximum of four buttons at the bottom of each dialog box. The selections may be different for each type of dialog box.

Download Interference Dialog Boxes

The download interference dialog boxes show that the CMCF fault history database cannot be transferred to a disk. A download interference dialog box shows if the:

- Disk drive is not available
- Disk drive does not have a diskette in it
- Diskette is write protected
- Diskette does not have sufficient memory space or runs out of memory space.

Select GO BACK to remove the download interference dialog box and show the Fault History-Move dialog box.

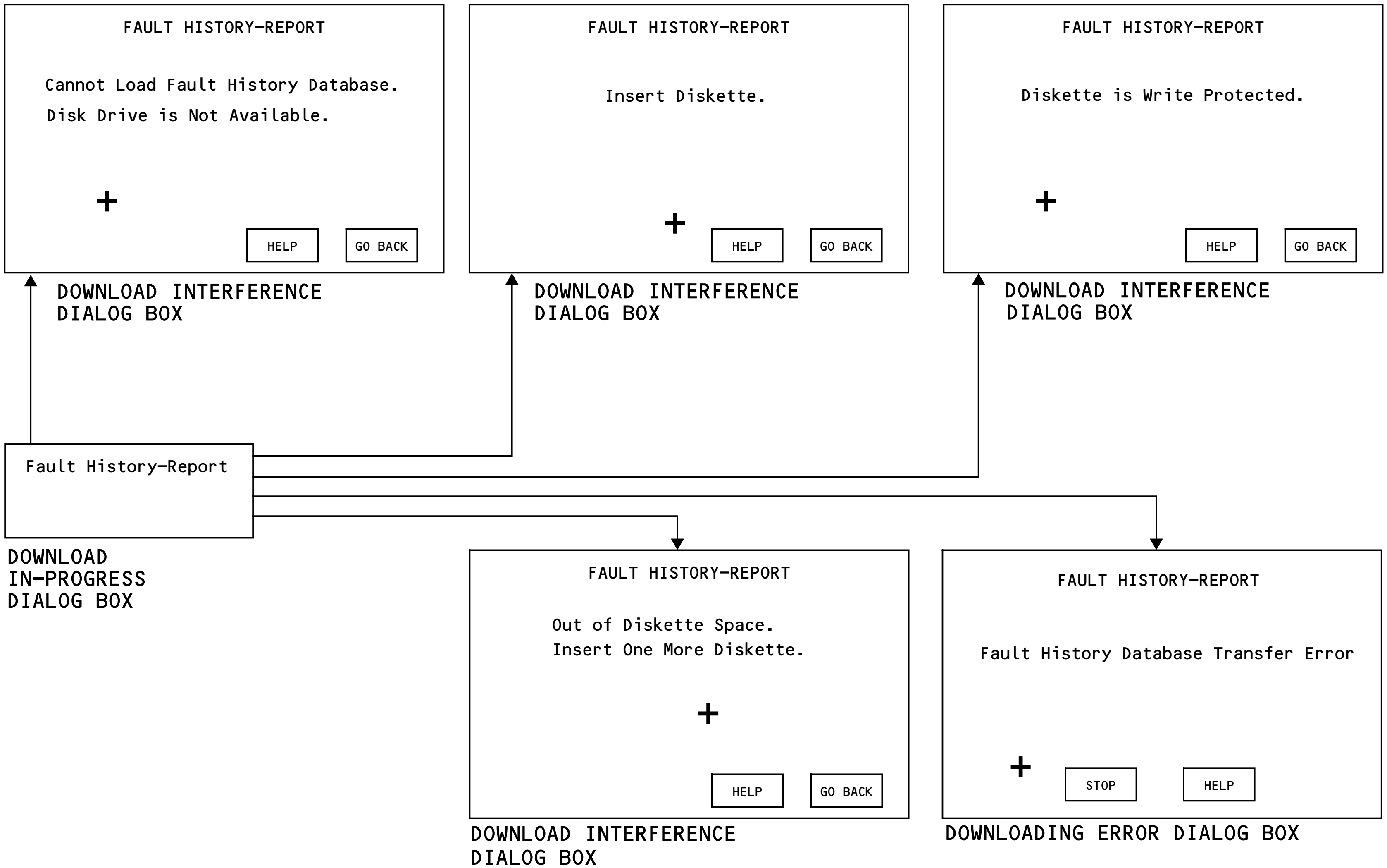
Select HELP to show the help dialog box for the download interference dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Downloading Error Dialog Box

If a data transfer error occurs while the CMCF fault history database is being downloaded, then the CMCF fault history database download procedure stops and the downloading error dialog box shows.

Select STOP to remove the downloading error dialog box.

Select HELP to show the help dialog box for the Downloading Error dialog box Help text for the dialog box must be in the CMCF AMI for HELP to show.



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CMCS - FAULT HISTORY DOWNLOAD DIALOG BOXES - 2

CMCS - DATA LOAD MAIN DISPLAY

General

The data load main display format lets you start and monitor the data load process.

The data load main display shows this information:

- Header data
- Source indication field
- Destination indication field
- Data load Status field
- System configuration list box
- Buttons.

Header Data

The header data includes the:

- Title
- Tail ID
- Time field.

The tail ID field has the airplane tail ID.

The time field shows the current time in UTC. The format is: DDMMMYY HHMMz.

Source Indication Field

The source indication field has two labels and two data fields.

The first label is Data Source. The associated data field shows the data source from the source selection dialog box.

The other label is Load Part Number. The related data field shows the load part number from the source selection dialog box.

With no selection, the labels and data fields are blank.

Destination Indication Field

The destination indication field has one label and one data field.

The label is Data Destination. The associated data field shows the LRU/LRM identifier from the destination selection dialog box.

With no selection, the label and data field is blank.

Data Load Status Field

The data load status field is a message field.

The message field shows the status of the data load process. The message field shows these messages:

- Select the SOURCE or the DESTINATION
- Select the DESTINATION
- Select the SOURCE.

CMCS - DATA LOAD MAIN DISPLAY

- The data loader is prepared for operation. Select START.
- The data load is in progress.
- The data load is stopped.
- The data load is complete.

Select the DESTINATION shows when both the source indication and destination data fields are blank.

Select the SOURCE shows when the source indication and data field is blank.

When the data load process is ready to start, this shows:

- The data loader is prepared for operation. Select START.

When data transfer starts between the CMCF and the destination LRU/LRM, this shows:

- The data load is in progress.

When the data load process stops, this shows:

- The data load is stopped.

When the data load process is successful, this shows:

- The data load is complete. Select another source or another destination.

System Configuration List Box

The system configuration list box and box title shows information based on the system selection on the destination selection dialog box. The box shows:

- LRU/LRM identifier
- Hardware part number
- LRU serial number
- Software part number(s).

When the destination indication field is empty, the system configuration list box is empty.

Buttons

These are the three buttons that show on the data load main display:

- SELECT SOURCE
- SELECT DESTINATION
- START.

SELECT SOURCE shows next to the source indication field.

Select SELECT SOURCE to show the source selection dialog box.

The selection is not available during the data load process.

CMCS - DATA LOAD MAIN DISPLAY

SELECT DESTINATION shows next to the destination indication data field.

Select SELECT DESTINATION to show the destination selection dialog box.

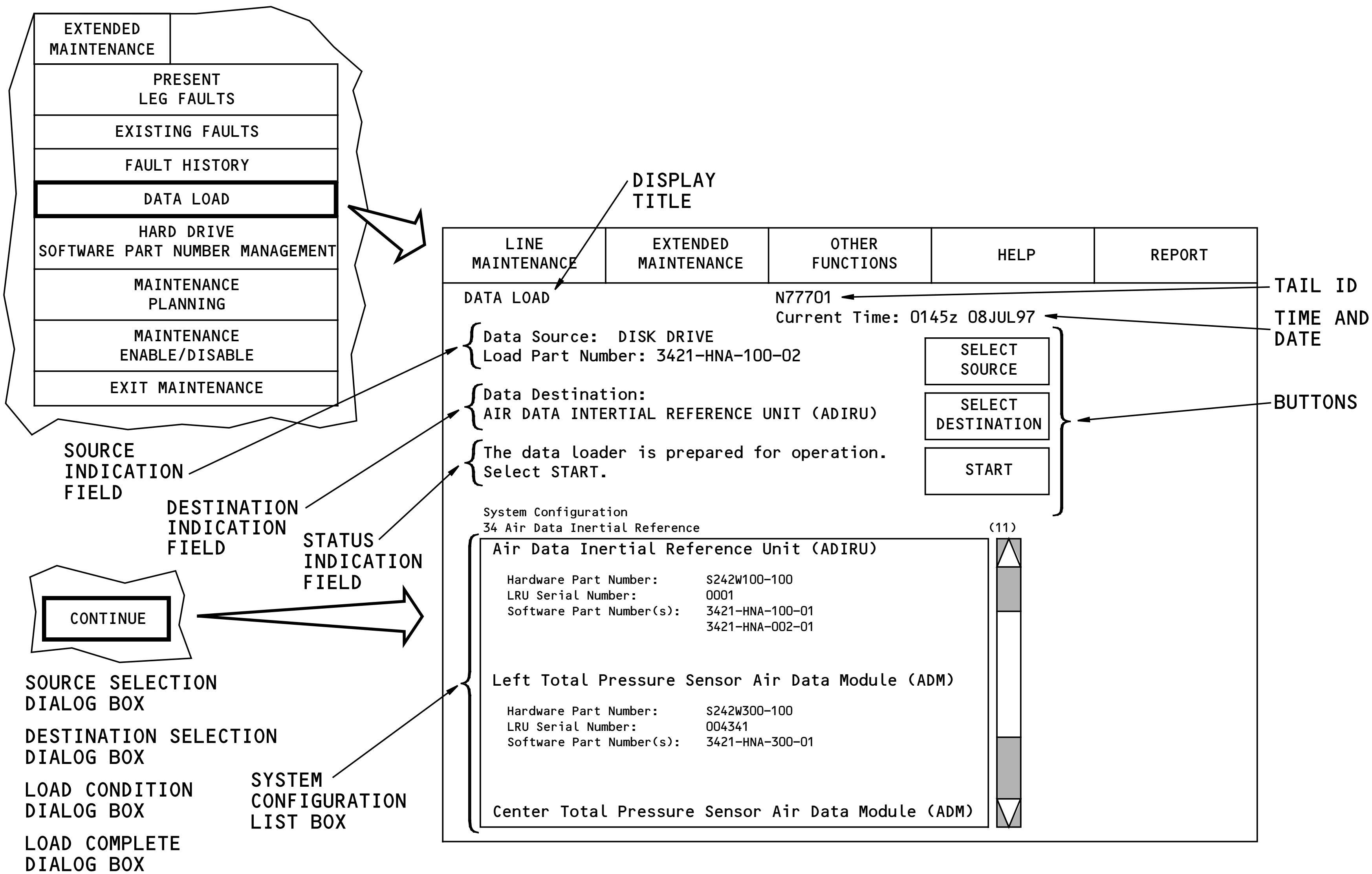
The selection is not available during the data load process.

START shows next to the data load status field.

Select START to begin the data load process.

At initial power-up, the START selection is not available. The START selection becomes available when this load status indication shows:

- The data loader is prepared for operation. Select START.



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CMCS - DATA LOAD MAIN DISPLAY

CMCS - DATA LOAD SOURCE SELECTION DIALOG BOX

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CMCS - DATA LOAD SOURCE SELECTION DIALOG BOX

General

The source selection dialog box lets you select a specific data source and a load part number for software data loading.

The source selection dialog box shows:

- Title
- Source selection list box
- Load part number list box
- Buttons.

Title

The first line of the title always shows DATA LOAD. The second line of the title shows Set Source.

Source Selection List Box

The title of the source selection list box is Select the Data Source.

The source selection list box shows the list of sources for the software. The source is one of these:

- MAT hard drive
- MAT disk drive
- PMAT disk drive.

Select the source first. Data does not show in the load part number list box until a selection is made.

The selection of a source causes that source to show on the data load main display in the source indication field.

Load Part Number List Box

The title of the load part number list box is Select the Load Part Number.

The load part number list box shows the list of software part numbers as they appear in the directory of the source.

If the source does not have any valid software numbers, the message No Software Load Part Numbers shows.

The list shows all software part numbers in the source or software for a specified LRU/LRM.

Buttons

The buttons that show at the bottom of the dialog box are:

- CONTINUE
- HELP
- SHOW MORE DATA/SHOW LESS DATA
- GO BACK.

CONTINUE is not available for selection until you make a selection for both a source and a software part number.

CMCS - DATA LOAD SOURCE SELECTION DIALOG BOX

Select CONTINUE to:

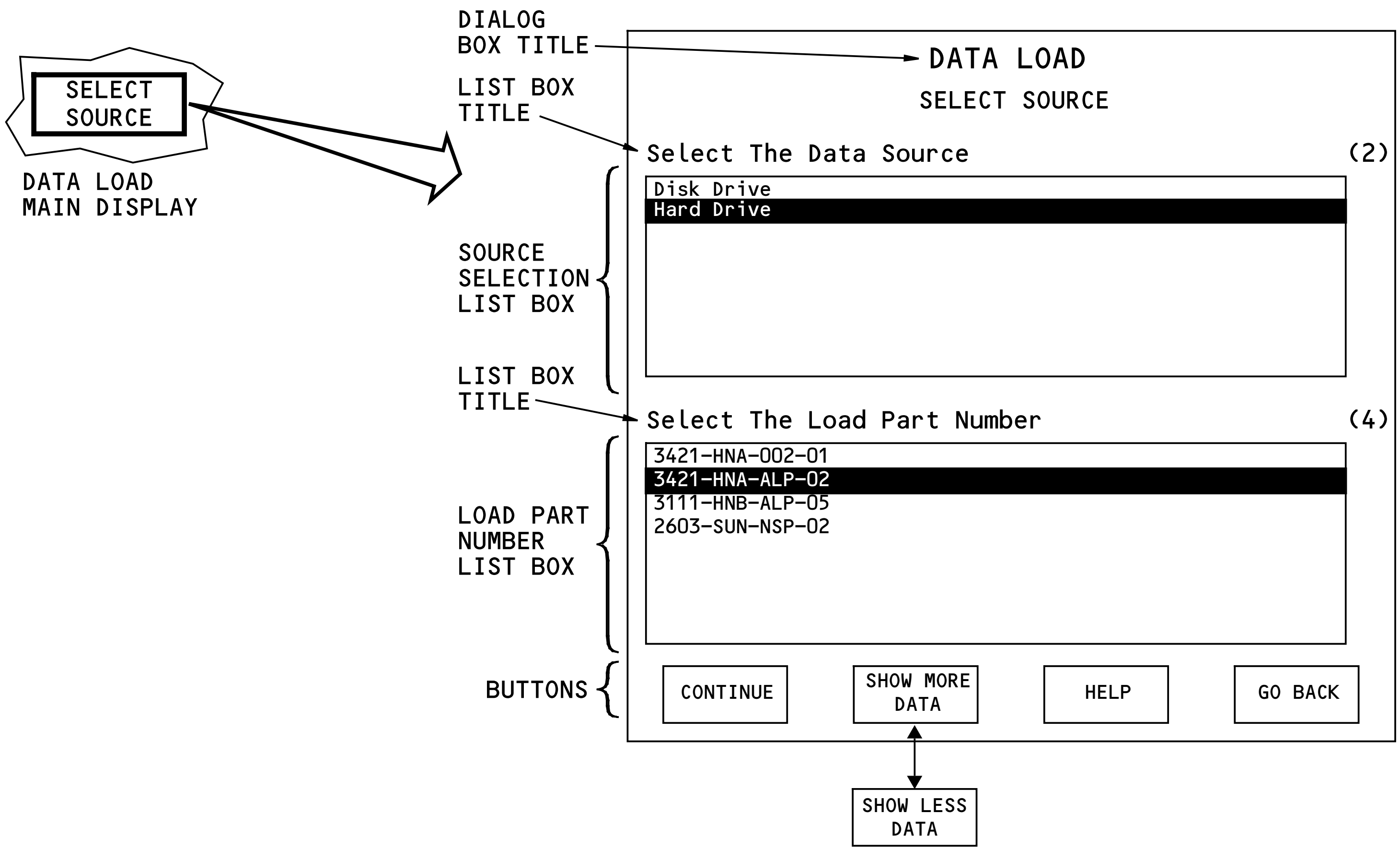
- Choose the source
- Choose the software part number
- Close the dialog box and return the user to the data load main display.

Select HELP to show the help dialog box for the source selection dialog box. Help text for the dialog box must exist in the CMCF AMI for HELP to show.

SHOW MORE DATA/SHOW LESS DATA are toggles. When the user chooses either a source or a destination, SHOW MORE DATA becomes available and a limit is applied to the destination selections and the software part number selections. This limits the number of possible choices to those choices that are compatible with the selected software or those choices that are compatible with the selected ATA and LRU.

Select SHOW MORE DATA to remove the limit. This selection causes all possible destination choices and software choices to show. The command selection toggles to SHOW LESS DATA.

Select GO BACK to remove the dialog box and return to the data load main display. The GO BACK selection does not affect any source selections already made.



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CMCS - DATA LOAD SOURCE SELECTION DIALOG BOX

CMCS - DATA LOAD DESTINATION SELECTION DIALOG BOX

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CMCS - DATA LOAD DESTINATION SELECTION DIALOG BOX

General

The destination selection dialog box lets you select a specific destination for software data loading.

The destination selection dialog box shows this:

- Title
- System selection list box
- LRU/LRM selection list box
- Buttons.

Title

The first line of the title always shows DATA LOAD. The second line of the title always shows Set Destination.

System Selection List Box

The title of the system selection list box is Select the ATA System.

The system selection list box shows the list of ATA system choices. The number of choices depends on the state of the SHOW MORE DATA/SHOW LESS DATA command selection.

Select the system first. The selected system becomes the title of the LRU/LRM selection list box.

If only one choice is available, that selection is automatically made.

LRU/LRM Selection List Box

The LRU/LRM selection list box shows the list of identifiers based on the ATA system selection.

The number of choices depends on the state of the SHOW MORE DATA/SHOW LESS DATA command selection.

If no ATA system choice is made, the list box is blank.

Buttons

These are the buttons that show at the bottom of the dialog box:

- CONTINUE
- HELP
- SHOW MORE DATA/SHOW LESS DATA
- GO BACK.

If you go to the destination selection dialog box before you select the source, CONTINUE is available for selection when the selection for both a system and a LRU/LRM is made.

Select CONTINUE to do this:

- Choose the destination
- Close the dialog box and return the user to the data load main display.

If you go to the destination selection dialog box after the source selection dialog box and a source selection

CMCS - DATA LOAD DESTINATION SELECTION DIALOG BOX

and a software part number selection is made, then the CONTINUE button is available.

The CONTINUE button does this:

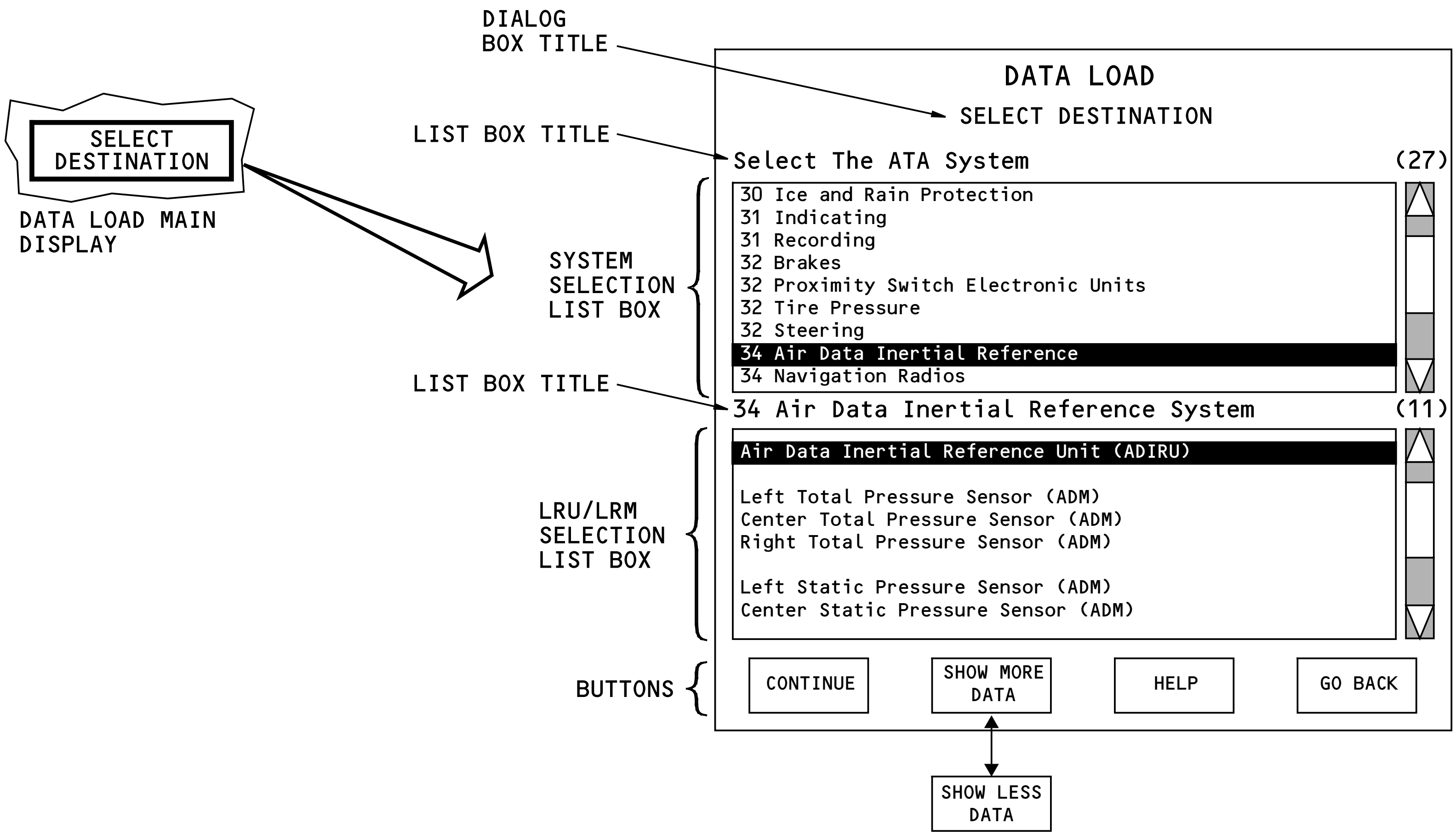
- Chooses the ATA system
- Chooses the LRU for data load
- Closes the dialog box and returns the user to the data load main display.

Select HELP to show the help dialog box for the destination selection dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

SHOW MORE DATA/SHOW LESS DATA are toggles. When you choose either a source or a destination, SHOW MORE DATA becomes available and a limit is applied to the destination selections and the software part number selections. This limits the number of possible choices to those choices that are compatible with the selected software or those choices that are compatible with the selected ATA and LRU/LRM.

Select SHOW MORE DATA to remove the limit. This selection causes all possible destination choices and software choices to show. The command selection toggles to SHOW LESS DATA.

Select GO BACK to remove the dialog box and return to the data load main display. The GO BACK selection does not affect any destination selections already made.



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CMCS - DATA LOAD MESSAGE DIALOG BOXES - 1

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CMCS - DATA LOAD MESSAGE DIALOG BOXES - 1

General

Message dialog boxes show as overlays on the data load main display. The dialog boxes are in a position that lets the source indication field and the destination indication field show.

Certain message dialog boxes show as a normal part of the data load process. Other message dialog boxes show non-normal conditions and require user involvement to complete the data load process.

Each dialog box has:

- Title
- Message field
- Buttons.

The title of each message dialog box changes to indicate the purpose of the dialog box.

The message field shows messages or directions for each type of dialog box. If the message exceeds the size of the dialog box, a scroll bar shows to allow the user to access the entire text field.

There is a maximum of four buttons at the bottom of each dialog box. The buttons may be different for each type of dialog box.

The types of message dialog boxes are:

- Load condition
- Destination LRU not enabled
- Change diskette
- Wrong diskette in disk drive
- Diskette access error
- Load in progress activity indication
- Destination LRU incompatibility
- Data transfer error
- Data storage error
- Data transfer completion
- Data load completion and configuration verification
- Are you sure?
- Data load function not enabled
- Check disk
- Data load function already in use
- Switch source CMCF
- Data loader not working.

Load Condition Dialog Box

The load condition dialog box gives indications of conditions that have to exist in member systems before the load process can begin.

The message shows:

- Put the airplane in this configuration

It is followed by specific instructions that relate to the LRU/LRM.

The buttons are:

CMCS - DATA LOAD MESSAGE DIALOG BOXES - 1

- CONTINUE
- REPORT DATA
- HELP
- GO BACK.

Select CONTINUE to close the dialog box and return to the data load main display.

Select REPORT DATA to show the report dialog box. This enables the user to get a hard copy of the dialog box.

Select HELP to show the help dialog box for the Load Condition dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select GO BACK to close the dialog box and return to the previous display.

<u>Destination LRU Not Enabled Dialog Box</u>

The destination LRU not enabled dialog box shows when the destination LRU/LRM is not available or when the CMCF cannot communicate with the destination LRU/LRM.

The message shows:

- The destination LRU cannot receive the data load.

The message also shows:

- The airplane configuration is not correct; or
- No signal came back from the destination LRU.

The buttons are:

- HELP
- GO BACK.

Select HELP to show the help dialog box for the destination LRU not available dialog box. Help must exist in the CMCF AMI for the HELP selection to show.

Select GO BACK to close the dialog box and return to the previous display.

<u>Change Diskette Dialog Box</u>

The change diskette dialog box instructs the user to insert a specific disk into the disk drive.

The message shows:

- Change the disk.

The message also shows:

- Put disk sequence number x of disk set number NNNNNNNNNNNNNNN into the disk drive.

The letter x stands for the specific disk sequence number of the disk set and NNNNNNNNNNNNNNN is the 15 character disk set part number.

The buttons are:

- STOP

CMCS - DATA LOAD MESSAGE DIALOG BOXES - 1

- HELP
- GO BACK.

Select STOP to end the data load process, close the dialog box and return to the data load main display.

The STOP selection is only available during data transfer.

Select HELP to show the help dialog box for the Change Diskette dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select GO BACK to close the dialog box and return to the previous display.

GO BACK is not available for selection during data transfer.

Wrong Diskette in Disk Drive Dialog Box

The wrong diskette in disk drive dialog box shows after the change diskette dialog box when the user inserts the wrong disk in the disk drive.

The message field shows:

- The incorrect disk in the disk drive.

The message also shows:

- Put disk sequence number x of disk set number NNNNNNNNNNNNNNN into the disk drive.

The letter x stands for the specific disk sequence number of the disk set and NNNNNNNNNNNNNNN is the 15 character disk set part number.

The buttons are:

- STOP
- HELP
- GO BACK.

Select STOP to end the data load process, close the dialog box and return to the data load main display.

The STOP selection is only available during data transfer.

Select HELP to show the help dialog box for the Wrong Diskette in disk drive dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select GO BACK to close the dialog box and return to the previous display.

GO BACK is not available for selection during data transfer.

Diskette Access Error Dialog Box

The diskette access error dialog box tells you that the CMCF is not receiving data from the disk drive.

The message shows:

CMCS - DATA LOAD MESSAGE DIALOG BOXES - 1

- The data loader cannot read the disk drive.
- If there is no disk in the disk drive, you must put the disk in the disk drive.
- If there is a disk in the disk drive, you must make sure it is put in the disk drive correctly, and the disk must have a valid load part number.

The command selections are:

- STOP
- HELP
- GO BACK.

Select STOP to end the data load process, close the dialog box and return to the data load main display.

The STOP selection is only available during data transfer.

Select HELP to show the help dialog box for the diskette access error dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select GO BACK to close the dialog box and return to the previous display.

GO BACK is not available for selection during data transfer.

Load in Progress Activity Indication Dialog Box

The Load In Progress Activity Indication dialog box shows the of the data load transfer process.

The message field shows:

- Load in Progress
- Wait...
- The percent of data that has transferred.

The buttons are:

- STOP
- HELP.

Select STOP to end the data load process, close the dialog box and return to the data load main display.

Select HELP to show the help dialog box for the load in progress activity indication dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

DATA LOAD

Put the airplane in this configuration:

1. Engines are not running

CONTINUE | REPORT DATA | HELP | GO BACK

LOAD CONDITION DIALOG BOX

DATA LOAD

The destination LRU cannot receive the data load.

The airplane configuration is not correct.

GO BACK | HELP

DESTINATION LRU NOT ENABLED DIALOG BOX

DATA LOAD

Change the disk.

Put disk sequence number x of disk set number NNNNNNNNNNNNNNN into the disk drive.

STOP | HELP | GO BACK

CHANGE DISKETTE DIALOG BOX

DATA LOAD

The incorrect disk is in the disk drive.

Put disk sequence number x of disk set number NNNNNNNNNNNNNNN into the disk drive.

STOP | HELP | GO BACK

WRONG DISKETTE IN DISK DRIVE DIALOG BOX

DATA LOAD

The data loader cannot read the disk drive.

If there is no disk in the disk drive, you must put the disk in the disk drive.

If there is a disk in the disk drive, you must make sure it is put in the disk drive correctly, and the disk must have a valid load part number.

STOP | HELP | GO BACK

DISKETTE ACCESS ERROR DIALOG BOX

Load in Progress

Wait...

(% of data transfer)

STOP | HELP

LOAD IN PROGRESS ACTIVITY INDICATION DIALOG BOX

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CMCS - DATA LOAD MESSAGE DIALOG BOXES - 2

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CMCS - DATA LOAD MESSAGE DIALOG BOXES - 2

Destination LRU Incompatibility Dialog Box

The destination LRU incompatibility dialog box shows when the destination LRU/LRM detects an incompatibility with the current data load. The text also shows the override capabilities for the incompatibility.

If the destination does not allow the software load, but can be overwritten, this message shows:

- The destination LRU does not allow this load part number, but you may continue.

If the destination does not allow the software load, and can not be overwritten, this message shows:

- The destination LRU does not allow this load part number.

If the LRU tells the CMCF the software is not compatible with other software loaded in the LRU, the message shows:

- The load part number is not compatible with the software of the destination LRU.

If the LRU tells the CMCF the software is not compatible with other LRU software in the system, the message shows:

- The load part number is not compatible with software loaded in the other LRUs in this system.

If the LRU tells the CMCF the software is not compatible with LRU, the message shows:

- The load part number is not compatible with the hardware of the destination LRU.

If the LRU tells the CMCF the software is not compatible with airplane, the message shows:

- The load part number is not compatible with the airplane.

The buttons are:

- OVERRIDE
- STOP
- HELP

The OVERRIDE selection shows if an override capability exists. Select OVERRIDE to continue the load process.

Select STOP to end the data load process, close the dialog box and return to the data load main display.

Select HELP to show the help dialog box for the destination LRU incompatibility dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Data Transfer Error Dialog Box

The data transfer error dialog box shows when the load transfer process ends because of a data transfer error.

CMCS - DATA LOAD MESSAGE DIALOG BOXES - 2

The message field shows:

- The data load stopped.
- The signal became incorrect.
- Usually, the destination LRU cannot operate.

The buttons show:

- STOP
- HELP.

Select STOP to close the dialog box and return to the data load main display.

Select HELP to show the help dialog box for the data transfer error dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Data Storage Error Dialog Box

The data storage error dialog box shows when the destination LRU/LRM cannot validate the data load.

The message field shows:

- The destination cannot make sure the new load part number is loaded correctly.
- If this is the first time that the data load has stopped, select TRY AGAIN.
- If this is the second time the data load has stopped, select CHECK DISK. The select TRY AGAIN if the load part number is good.

The command selections are:

- TRY AGAIN
- STOP
- HELP
- CHECK DISK.

Select TRY AGAIN to start the full load process for the same source and destination selections.

Select STOP to close the dialog box and return to the data load main display.

Select HELP to show the help dialog box for the data storage error dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select CHECK DISK to start the disk validation procedure.

Data Transfer Completion Dialog Box

The data transfer completion dialog box shows that the transfer of data is complete for the current load process.

The message field shows:

- Wait for the destination LRU to start.
- If you wait more than fifteen minutes, select STOP.

The buttons are:

CMCS - DATA LOAD MESSAGE DIALOG BOXES - 2

- STOP
- HELP.

Initially, the STOP selection does not show. The STOP selection shows if the destination LRU/LRM does not respond within ten minutes.

Select STOP to close the dialog box and return to the data load main display.

Select HELP to show the help dialog box for the data transfer completion dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Data Load Completion and Configuration Verification

The data load completion and configuration verification dialog box shows that the load process is complete and successful.

The message field has several items. These items are:

- The data load is complete. The current LRU configuration is shown below.
- LRU Part Number:
- Hardware Part Number:
- Serial Number:

If necessary, a scroll bar may show to enable the user to scroll through the text.

The buttons are:

- CONTINUE
- HELP.

Select CONTINUE to close the dialog box and return to the data load main display.

Select HELP to show the help dialog box for the data load completion and configuration verification dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Are You Sure? Dialog Box

The Are You Sure? dialog box shows when you select a button which you can not undo. The dialog box gives the user a chance to undo the selection.

There is no dialog box title.

The message text shows:

- If you stop now, usually the destination LRU cannot operate.
- You must complete a data load to make the destination LRU serviceable with the new load part number.

The buttons are:

- STOP
- HELP
- GO BACK.

CMCS - DATA LOAD MESSAGE DIALOG BOXES - 2

Select STOP to continue with the previous command selection and close the dialog box.

Select HELP to show the help dialog box for the are you sure? dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select GO BACK to undo the previous command selection and close the dialog box.

DATA LOAD

The destination LRU does not allow this load part number, but you may continue.

The load part number is not compatible with the software of the destination LRU.

OVERRIDE | STOP | HELP

DESTINATION LRU INCOMPATIBILITY DIALOG BOX

DATA LOAD

The data load stopped.

The signal became incorrect.

Usually, the destination LRU cannot operate.

STOP | HELP

DATA TRANSFER ERROR DIALOG BOX

DATA LOAD

The destination cannot make sure the new load part number is loaded correctly.

If this is the first time the data load has stopped, select TRY AGAIN.

If this is the second time the data load has stopped, select CHECK DISK. Then select TRY AGAIN if the load part number is good.

TRY AGAIN | STOP | HELP | CHECK DISK

DATA STORAGE ERROR DIALOG BOX

DATA LOAD

Wait for the destination LRU to start.

If you wait more than fifteen minutes, select STOP.

STOP | HELP

DATA TRANSFER COMPLETION DIALOG BOX

DATA LOAD

The data load is complete. The current LRU configuration is shown below.

LRU Part Number:
Hardware Part Number:
Serial Number:

CONTINUE | HELP

DATA LOAD COMPLETION AND CONFIGURATION VERIFICATION DIALOG BOX

DATA LOAD

If you stop now, usually the destination LRU cannot operate.

You must complete a data load to make the destination LRU serviceable with the new load part number.

STOP | HELP | GO BACK

ARE YOU SURE? DIALOG BOX

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CMCS - DATA LOAD MESSAGE DIALOG BOXES - 2

CMCS - DATA LOAD MESSAGE DIALOG BOXES - 3

Data Load Function Not Enabled Dialog Box

The data load function not enabled dialog box shows when the use of the CMCF is not available because the enable logic is not set.

If this dialog box shows after you start a data load the message shows:

- The data loader cannot start.

If the data load cannot finish, the message shows:

- The data loader has stopped.
- Usually the destination LRU cannot operate.

This message also shows:

- To start and complete a data load, you must make sure the airplane is in this configuration:
- 1. Airplane is on the ground
- 2. Engines are off.

The buttons are:

- GO BACK
- STOP
- HELP.

Select GO BACK to remove the dialog box and return to the previous display.

Select STOP to end the data load and remove the dialog box.

Select HELP to show the help dialog box for the data load not enabled dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Check Disk Dialog Box

The check disk dialog box shows when the CMCF does a load integrity check.

The check disk dialog box follows the selection of the CHECK DISK command selection on the data storage error dialog box.

The message field shows:

- The data loader will make sure load part number AACC-MMM-SSS-SS is serviceable.
- Wait...

If the load part number is valid, the message shows:

- Load part number AACC-MMM-SSS-SS is serviceable.

If the load part number is not valid, the message shows:

- Load part number AACC-MMM-SSS-SS is not serviceable.

CMCS - DATA LOAD MESSAGE DIALOG BOXES - 3

You must get a serviceable disk to complete the data load of this load part number.

The buttons are:

- CONTINUE
- STOP
- HELP.

CONTINUE is not available for selection while the CMCF is verifying the disk.

Select CONTINUE to close the dialog box.

STOP is not available while the message field shows Usable or Not Usable.

Select STOP to end the CMCF disk verification and to remove the dialog box.

Select HELP to show the help dialog box for the check disk dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Data Load Function Already in Use Dialog Box

The data load function already in use dialog box shows that the data load sub-function of the CMCF is already in use.

The message field shows:

- The data loader is already in use.
- Only one person can use the data loader at a time.

The buttons are:

- GO BACK
- HELP.

Select GO BACK to remove the dialog box and return to the previous display.

Select HELP to show the help dialog box for the data load function already in use dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Switch Source CMCF Dialog Box

The switch source CMCF dialog box shows when there is no data bus connection in the AIMS cabinet with the active CMCF to the destination LRU. This will occur with some 429 destination LRUs.

The message field shows:

- The Data Loader cannot data load the destination from the current Central Maintenance Computing Function source.
- You must switch to the other Central Maintenance Computing Function to complete this data load. Do the following steps:
- 1. Select GO BACK
- 2. Select the OTHER FUNCTIONS menu and CENTRAL MAINTENACE SOURCE SWITCHING

CMCS - DATA LOAD MESSAGE DIALOG BOXES - 3

- 3. After you switch source, select DATA LOAD and start again.

The buttons are:

- GO BACK
- HELP.

Select GO BACK to remove the dialog box and return to the previous display.

Select HELP to show the help dialog box for the switch source CMCF dialog box dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Data Loader Not Working Dialog Box

The data loader not working dialog box shows when the CMCF detects a fault with the data load gateway sub-function.

The message field shows:

- The data loader finds and internal failure and cannot operate.
- You may select CONTINUE to data load the AIMS CMCF/Comm destination LRU. This may make the data loader serviceable.
- NOTE: If you select CONTINUE, all functions of the connected Central Maintenance Computing Function will stop.
- If a new load is necessary in the CPM/Comm, select CONTINUE.

The buttons are:

- CONTINUE
- HELP
- GO BACK.

Select CONTINUE to start a data load of the CPM/Comm LRM.

Select HELP to show the help dialog box for the data loader not working dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select GO BACK to remove the dialog box and return to the previous display.

DATA LOAD

The data loader cannot start.

To start and complete a data load, you must make sure the airplane is in this configuration:

1. Airplane is on the ground
2. Engines are off.

GO BACK | STOP | HELP

DATA LOAD FUNCTION NOT ENABLED DIALOG BOX

DATA LOAD

The data loader will make sure load part number AACC-MMM-SS-SS is serviceable.

Wait...

CONTINUE | STOP | HELP

CHECK DISK DIALOG BOX

DATA LOAD

The data loader is already in use.

Only one person can use the data loader at one time.

GO BACK | HELP

DATA LOAD FUNCTION ALREADY IN USE DIALOG BOX

DATA LOAD

The Data Loader cannot data load the destination from the current Central Maintenance Computing Function source.

You must switch to the other Central Maintenance Computing Function to complete this data load. Do the following steps:

1. Select GO BACK
2. Select OTHER FUNCTIONS menu and CENTRAL MAINTENANCE SOURCE SWITCHING
3. After you switch source, select DATA LOAD and start again.

GO BACK | HELP

SWITCH SOURCE CMCF DIALOG BOX

DATA LOAD

The data loader finds an internal failure and cannot operate.

You may select CONTINUE to data load the AIMS CPM/COMM destination LRU. This may make the data loader serviceable.

NOTE: If you select CONTINUE, all functions of the connected Central Maintenance Computing Function will stop.

If a new load is necessary in the CPM/COMM, select CONTINUE.

CONTINUE | HELP | GO BACK

DATA LOADER NOT WORKING DIALOG BOX

45-10-00-061 Rev 2

CMCS - DATA LOAD MESSAGE DIALOG BOXES - 3

CMCS - HARD DRIVE MAIN MENU DIALOG BOX

General

The hard drive main menu dialog box gives access to functions that let you do these:

- Add a new part number to the hard drive
- Remove an existing part number from the hard drive
- Show stored part numbers
- Check a part number.

The software part numbers are on the maintenance access terminal (MAT) hard drive.

The hard drive main menu dialog box shows:

- Exclusive selectors
- Buttons.

Exclusive Selections

These are the four exclusive selections:

- ADD A NEW PART NUMBER TO THE HARD DRIVE
- REMOVE AN EXISTING PART NUMBER FROM THE HARD DRIVE
- SHOW STORED PART NUMBERS
- CHECK PART NUMBER.

Select ADD A NEW PART NUMBER TO THE HARD DRIVE to add LRU software part numbers to the hard drive.

Select REMOVE AN EXISTING PART NUMBER FROM THE HARD DRIVE to show the remove part number dialog box. Select the LRU software part number you want to remove from the remove part number dialog box.

Select SHOW STORED PART NUMBERS to show the show part numbers dialog box. The show part numbers dialog box shows:

- Hard drive configuration name
- Hard drive configuration index
- Hard drive capacity
- LRU software part numbers on the hard drive.

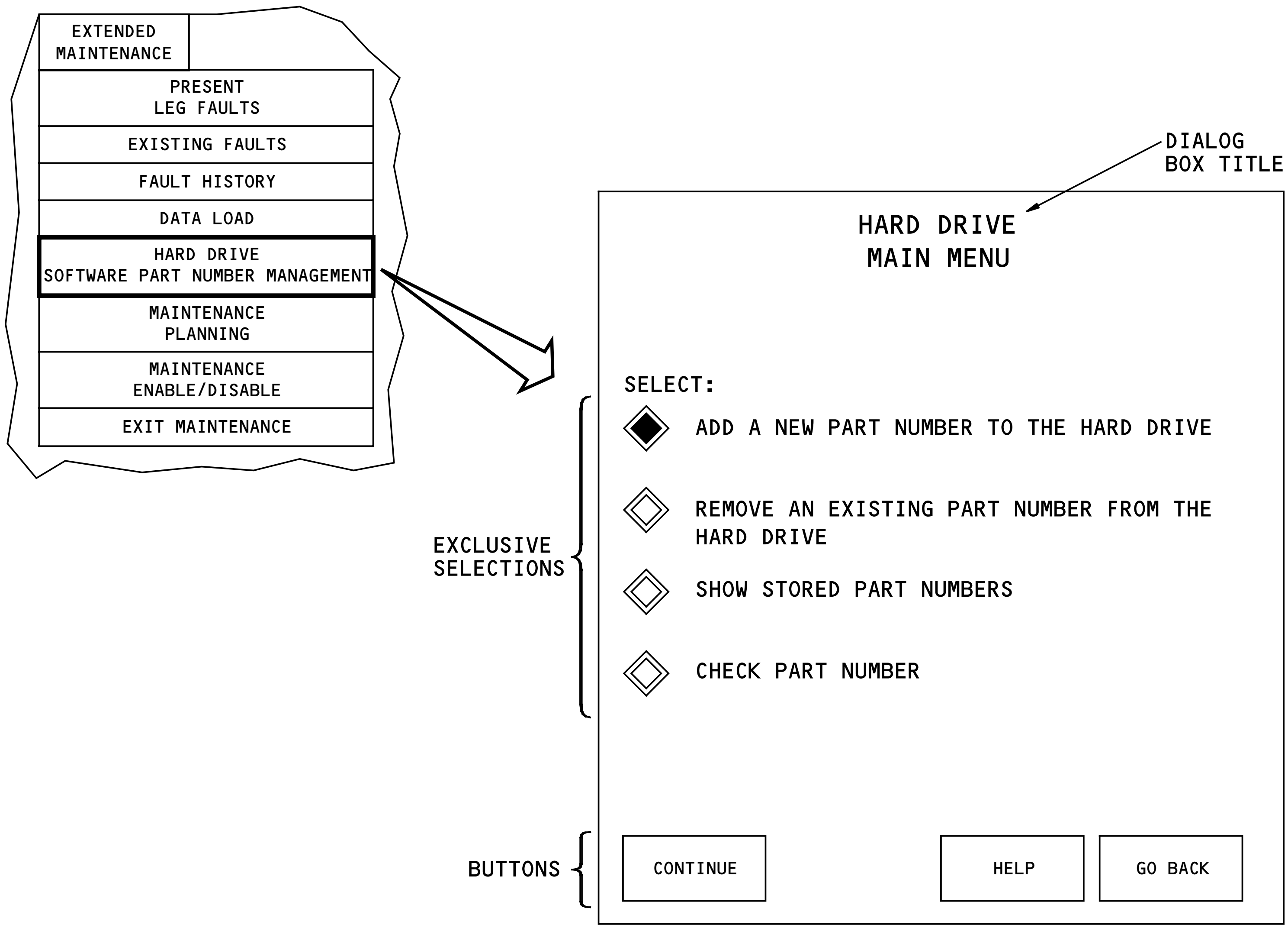
Select CHECK PART NUMBER to show the check part number dialog box. The check part number function checks that an LRU software part number is stored correctly on the hard disk. Select the LRU software part number you want to check from this dialog box.

Buttons

When you select an exclusive selection, the CONTINUE button is available. Select CONTINUE to go to one of the four hard drive software part number management functions.

Select HELP to show the help for this dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select GO BACK to remove the dialog box and return to the previous display.



45-10-00-134 Rev 0 07/27/1995

CMCS - HARD DRIVE MAIN MENU DIALOG BOX

CMCS - MAINTENANCE PLANNING DIALOG BOX

General

The maintenance planning dialog box gives access to information that the airline maintenance organizations can use to plan maintenance.

The information available is in the form of maintenance memo messages and scheduled maintenance tasks.

Maintenance memos relate to faults in fault tolerant systems. These memos let the maintenance organizations monitor the deterioration of a component/system. They also let the maintenance organizations plan the appropriate maintenance actions before a system or component becomes not airworthy. Maintenance memos correlate to maintenance messages.

Scheduled maintenance task messages relate to certification maintenance requirement items (CMR) or maintenance review board (MRB) items with time exposure limits. They are stored and reported by the airplane systems and correlate to maintenance messages.

The maintenance planning dialog box shows:

- Exclusive selections
- Buttons.

Exclusive Selections

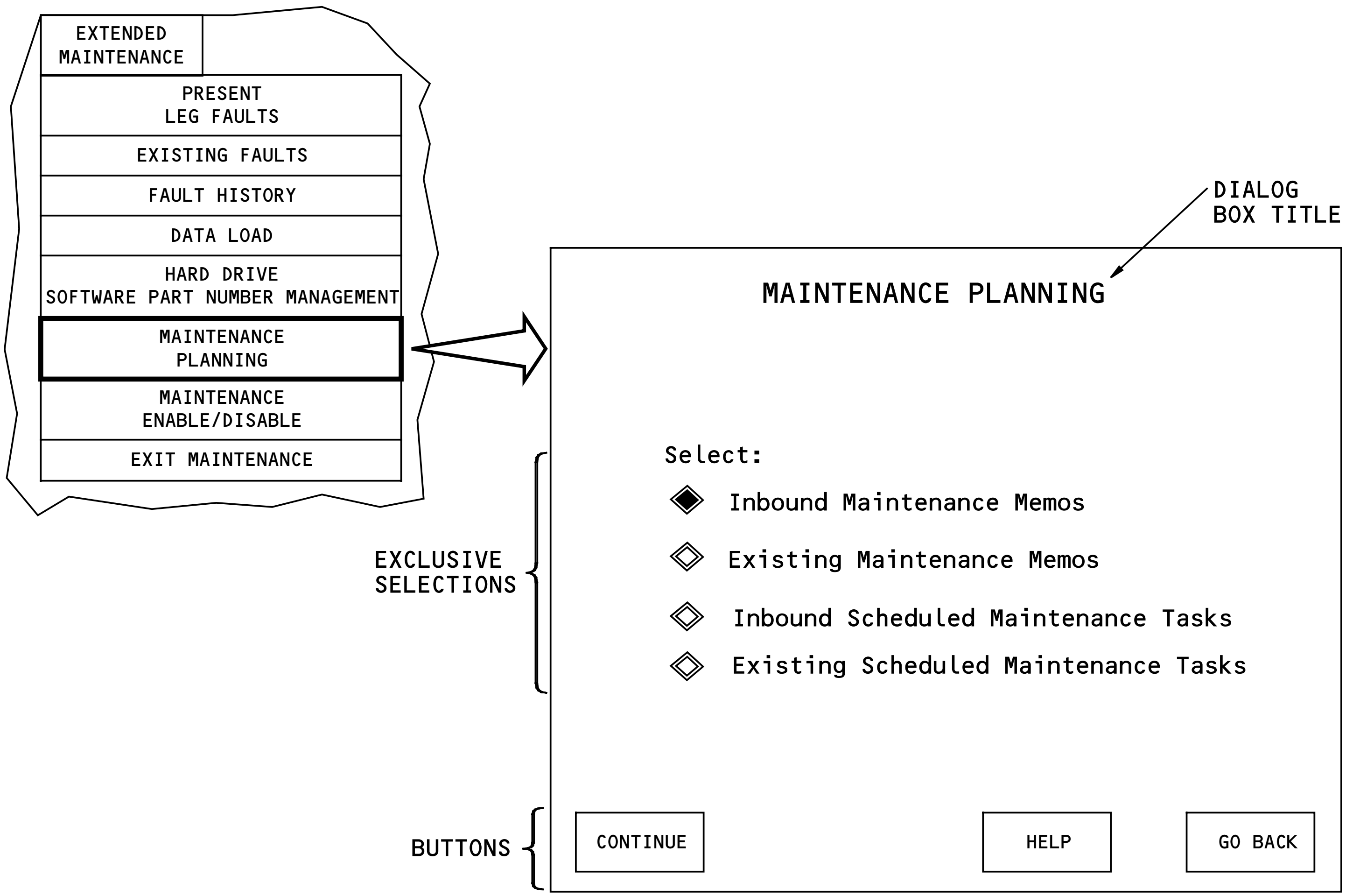
These are the four exclusive selections:

- Inbound Maintenance Memos
- Existing Maintenance Memos
- Inbound Scheduled Maintenance Tasks
- Existing Scheduled Maintenance Tasks.

Select one of the exclusive selections and CONTINUE to show that display.

Select HELP to show the help dialog box for the maintenance planning dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select GO BACK to remove the dialog box and return to the previous display.



45-10-00-062 Rev 4 07/27/1995

CMCS - MAINTENANCE PLANNING DIALOG BOX

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CMCS - MAINTENANCE PLANNING - INBOUND MAINTENANCE MEMO SUMMARY DISPLAY

General

The inbound maintenance memo summary display shows all maintenance messages that are correlated to maintenance memos that occurred in present flight leg.

Maintenance memos are a group of maintenance messages that give information about the condition of redundant LRU/systems.

These memos let the maintenance organizations monitor the deterioration of a component/system. They also let the maintenance organizations plan the appropriate maintenance actions before a system or component becomes not airworthy.

A maintenance memo normally shows one fault away from a fault that will cause a status message.

Maintenance memos are either active, latched, or not active. Latched messages are those that occur in a particular flight phase and are in the memory of the LRU.

Maintenance memos are correlated to one or more maintenance messages.

The inbound maintenance memo summary display shows the maintenance memos by time (the newest memo shows first) or by ATA.

The inbound maintenance memo summary display shows this:

- Header information
- Fault summary field
- Buttons.

Header Information

The header information includes:

- Display title
- Instructions to access the single maintenance message summary display
- Tail identification
- Flight leg ID with origin and destination airports
- Flight leg start time and date
- Source of information.

Fault Summary Field

The fault summary field includes:

- Fault summary field title
- Number of items
- Maintenance memo summary groups.

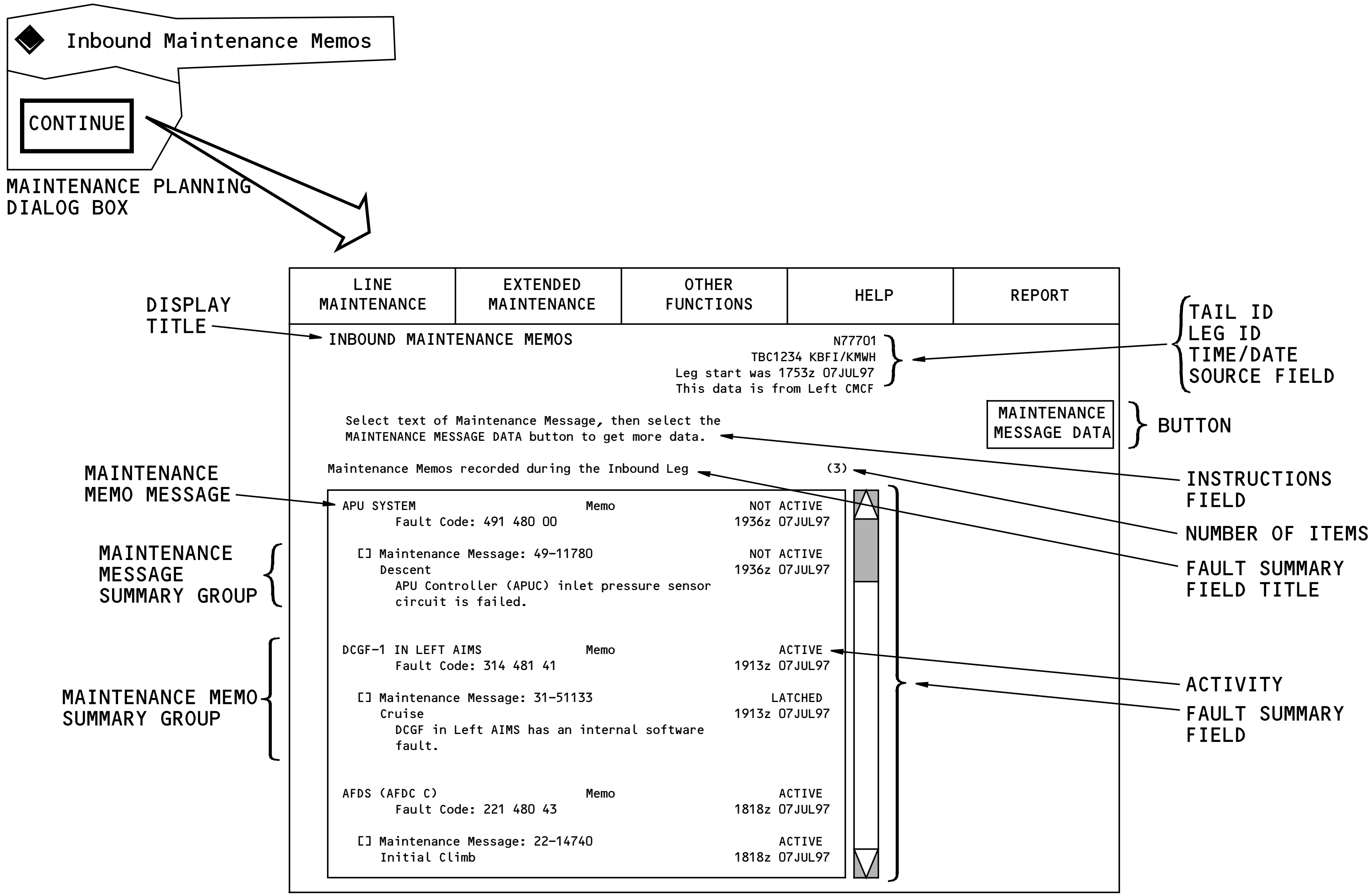
The fault summary field title shows above the fault summary on the left side. The title is Maintenance Memos recorded during the Inbound Leg.

The number of items shows above the scroll bar. The number shows the total number of memo summary groups.

CMCS - MAINTENANCE PLANNING - INBOUND MAINTENANCE MEMO SUMMARY DISPLAY

Buttons

Select MAINTENANCE MESSAGE DATA to show the single maintenance message display.



CMCS - MAINTENANCE PLANNING - INBOUND MAINTENANCE MEMO SUMMARY DISPLAY

45-10-00-063 Rev 5 11/06/1997

CMCS - MAINTENANCE PLANNING - EXISTING MAINTENANCE MEMO SUMMARY DISPLAY

General

The existing maintenance memo summary display shows all maintenance memos that are currently active or latched.

Maintenance memos are a group of maintenance messages that give information about the condition of redundant LRU/systems.

These memos let the maintenance organizations monitor the deterioration of a component/system. They also let the maintenance organizations plan the appropriate maintenance actions before a system or component becomes not airworthy.

A maintenance memo normally shows one fault away from a fault that will cause a status message.

Maintenance memos are either active or latched. Latched messages are those that occur in a particular flight phase and are in the memory of the LRU.

Maintenance memos are correlated to one or more maintenance messages.

The existing maintenance memo summary display shows the maintenance memos by time (the newest memo shows first) or by ATA.

The existing maintenance memo summary display shows:

- Header information
- Fault summary field
- Buttons.

Header Information

The header information includes:

- Display title
- Instructions to access the single maintenance message summary display
- Tail identification
- Time and date
- Source of information.

Fault Summary Field

The fault summary field includes:

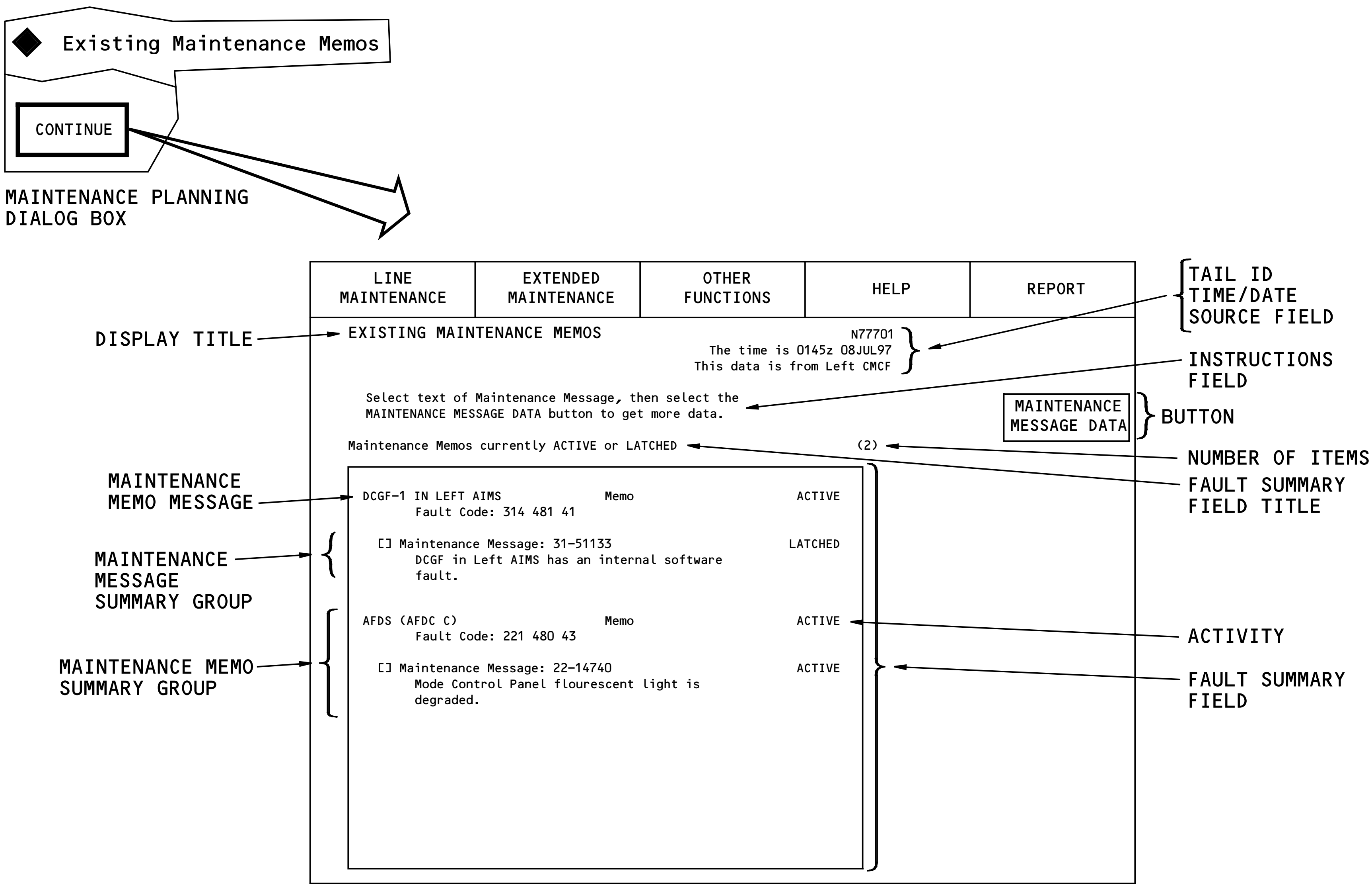
- Fault summary field title
- Number of items
- Maintenance memo summary groups

The fault summary field title shows above the fault summary on the left side. The title is Maintenance Memos currently ACTIVE or LATCHED.

The number of items shows above the scroll bar. The number shows the total number of memo summary groups.

Buttons

Select MAINTENANCE MESSAGE DATA to show the single maintenance message display.



45-10-00-064 Rev 5 11/06/1997

CMCS - MAINTENANCE PLANNING - EXISTING MAINTENANCE MEMO SUMMARY DISPLAY

CMCS - MAINTENANCE PLANNING - INBOUND SCHEDULED MAINTENANCE TASKS MESSAGE SUMMARY DISPLAY

General

The inbound scheduled maintenance tasks message summary display shows all maintenance messages that are correlated to scheduled maintenance task messages that occurred in present flight leg.

Scheduled maintenance task messages relate to certification maintenance requirement items (CMR) or maintenance review board (MRB) items with time exposure limits.

These messages relate to those that show on the maintenance task maintenance page on the MFD.

There is no requirement to check these messages prior to flight.

The inbound scheduled maintenance task message summary display shows:

- Header information
- Fault summary field
- Buttons.

Header Information

The header information includes:

- Display title
- Instructions to access the single maintenance message summary display
- Tail identification
- Flight leg ID with origin and destination airports
- Flight leg start time and date
- Source of information.

Fault Summary Field

The fault summary field includes:

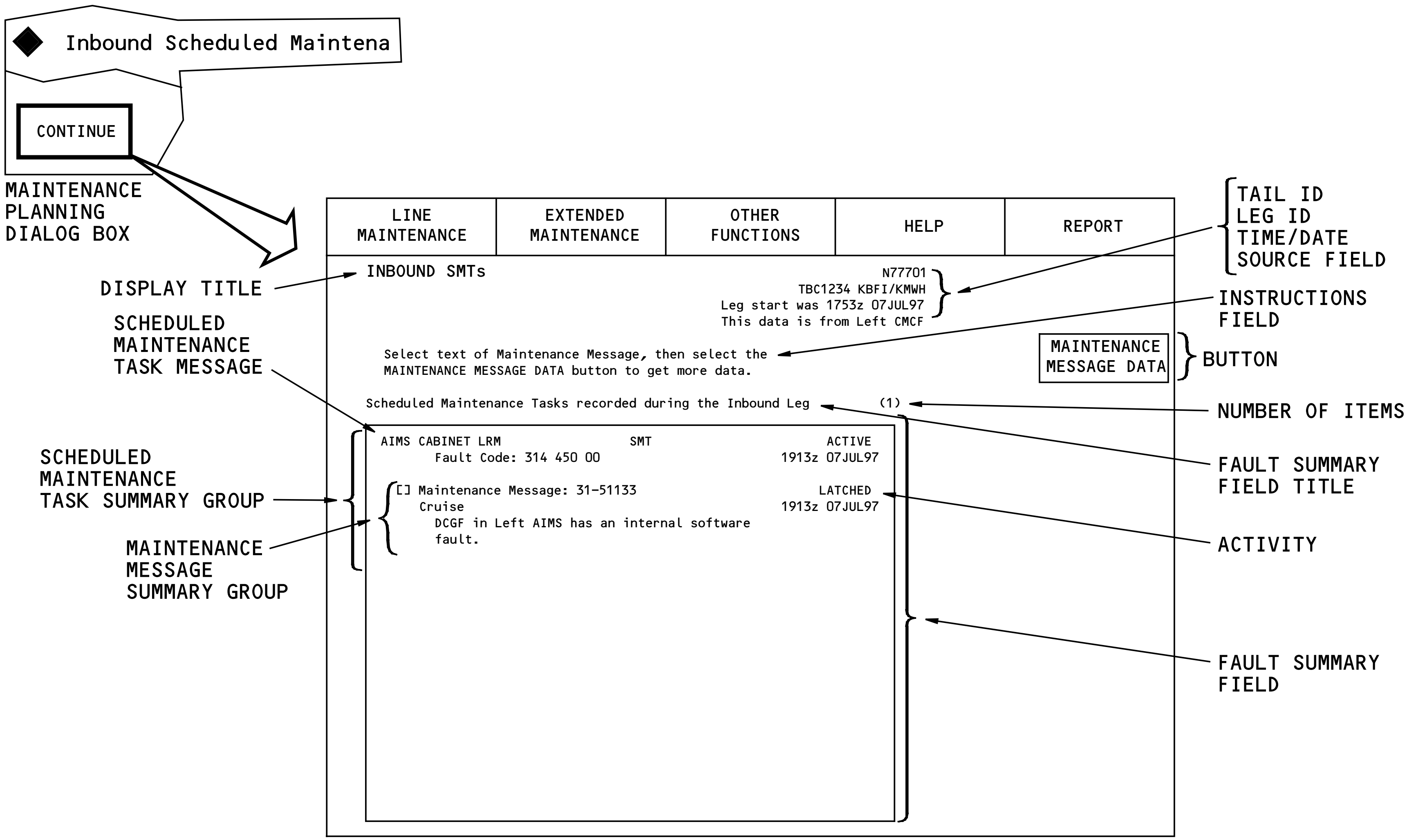
- Fault summary field title
- Number of items
- Scheduled maintenance task summary groups.

The fault summary field title shows above the fault summary on the left side. The title is Scheduled Maintenance Tasks recorded during the Inbound Leg.

The number of items shows above the scroll bar. The number shows the total number of scheduled maintenance task message summary groups.

Buttons

Select MAINTENANCE MESSAGE DATA to show the single maintenance message display.



45-10-00-065 Rev 6 11/06/1997

CMCS - MAINTENANCE PLANNING - INBOUND SCHEDULED MAINTENANCE TASKS MESSAGE SUMMARY DISPLAY

CMCS - MAINTENANCE PLANNING - EXISTING SCHEDULED MAINTENANCE TASKS MESSAGE SUMMARY DISPLAY

General

The existing scheduled maintenance tasks message summary display shows all maintenance messages that are correlated to scheduled maintenance task messages.

Scheduled maintenance task messages relate to certification maintenance requirement items (CMR) or maintenance review board (MRB) items with time exposure limits.

These messages relate to those that show on the maintenance task maintenance page on the MFD.

There is no requirement to check these messages prior to flight.

The existing scheduled maintenance task message summary shows:

- Header information
- Fault summary field
- Buttons.

Header Information

The header information includes:

- Display title
- Instructions to access the single maintenance message summary display
- Tail identification
- Time and date
- Source of information.

Fault Summary Field

The fault summary field includes:

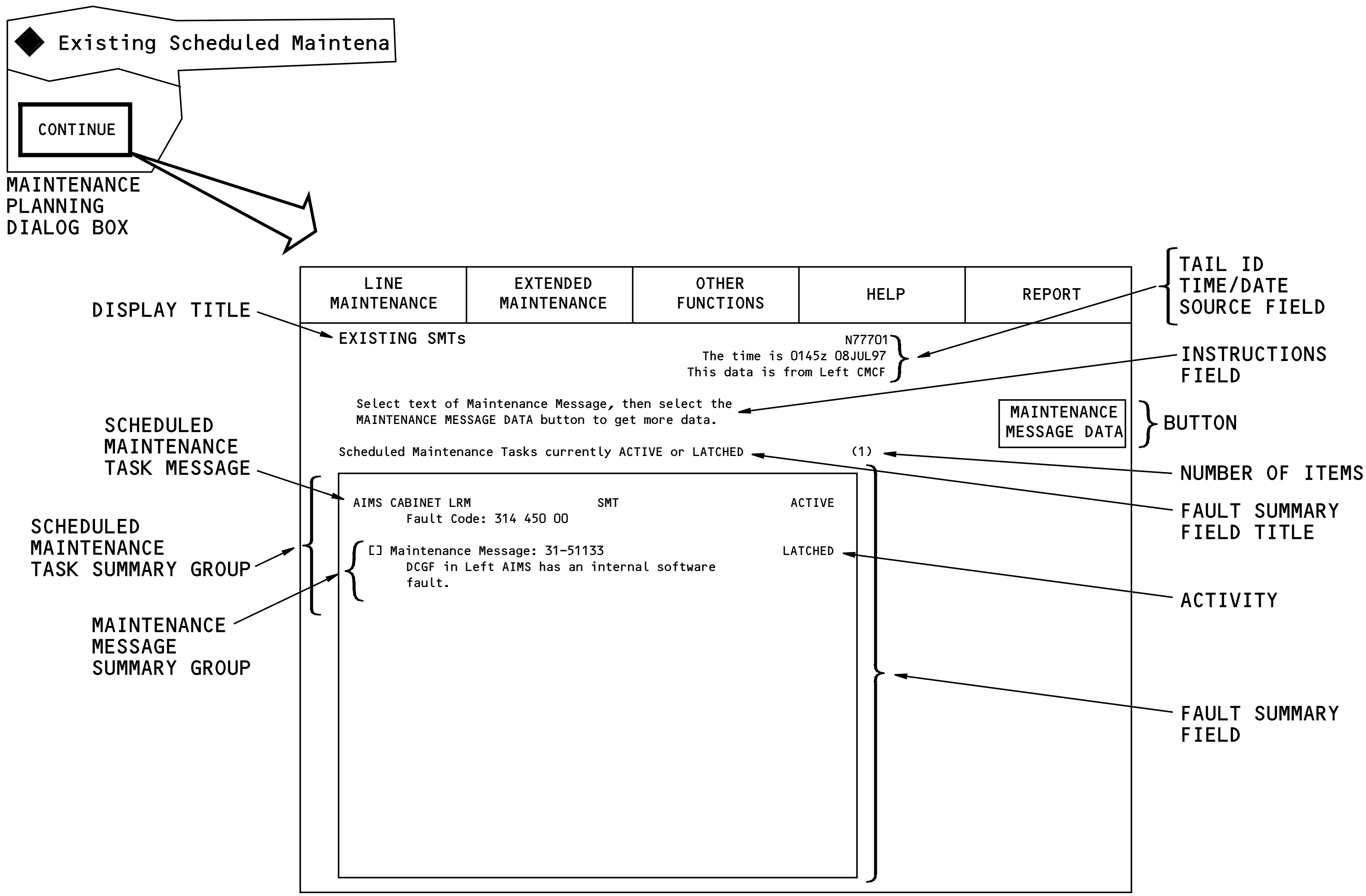
- Fault summary field title
- Number of items
- Scheduled maintenance task summary groups.

The fault summary field title shows above the fault summary on the left side. The title is Scheduled Maintenance Task currently ACTIVE or LATCHED.

The number of items shows above the scroll bar. The number shows the total number of scheduled maintenance task message summary groups.

Buttons

Select MAINTENANCE MESSAGE DATA to show the single maintenance message display.



45-10-00-066 Rev 6 11/06/1997

CMCS - MAINTENANCE PLANNING - EXISTING SCHEDULED MAINTENANCE TASKS MESSAGE SUMMARY DISPLAY

CMCS - MAINTENANCE ENABLE/DISABLE DIALOG BOX

General

The maintenance enable/disable dialog box lets the user enable or disable flight legs and the maintenance phase.

The maintenance enable/disable dialog box shows:

- Dialog box title
- Text box titles
- Two text boxes
- buttons.

Text Box Titles

The title of the upper text box is FLIGHT LEG TRANSITION ENABLE/DISABLE.

The title of the lower test box is MAINTENANCE PHASE ENABLE/DISABLE.

Text Boxes

The upper text box shows the status of the flight leg transition. Two possible messages show in the box.

The lower text box shows the status of the maintenance phase. This text box has two messages.

Buttons

Two buttons control the status of the flight leg transition.

Select LEG ENABLE to enable the flight leg transition. This selection is available only when the flight leg transition is disabled.

Select LEG DISABLE to disable the flight leg transition. This selection is available only when the flight leg transition is enabled.

Two buttons control the status of the maintenance phase.

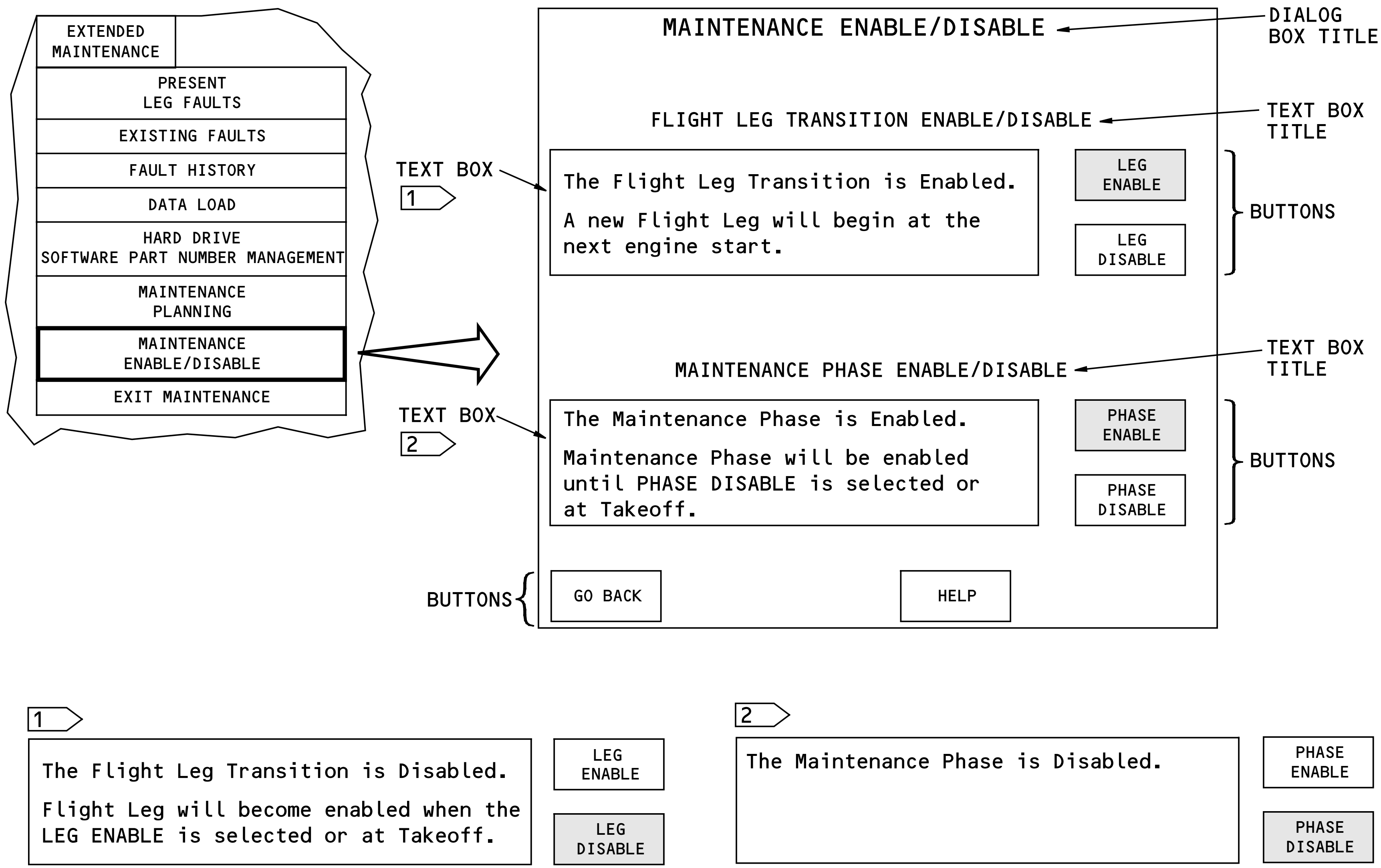
Select PHASE ENABLE to enable the maintenance phase. This selection is available only when the maintenance phase is disabled.

Select PHASE DISABLE to disable the maintenance phase. This selection is available only when the maintenance phase is enabled.

Two buttons show at the bottom of the dialog box.

Select GO BACK to remove the dialog box and return to the previous screen.

Select HELP to show the help dialog box for the maintenance enable/disable dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.



45-10-00-067 Rev 2 07/27/1995

CMCS - MAINTENANCE ENABLE/DISABLE DIALOG BOX

CMCS - INPUT MONITORING MAIN MENU DIALOG BOX

General

Input monitoring is a tool which specially trained personnel use to check signals to the AIMS cabinets. These signals are:

- 32 bit ARINC 429 word
- 16 bit or 32 bit ARINC 629 word
- Hard wired AIMS analog variable input
- Hard wired AIMS analog discrete input
- AIMS partition IMM signal of one, two, or four bytes.

The CMCF shows these two types of input monitoring displays on the MAT:

- General input displays
- Special input displays.

You use the general input displays to select and monitor up to eight input signals.

You use these special input displays to select four types of input monitoring displays:

- Analog discrete display
- Analog variable display
- ARINC 629 full word string display
- Input monitoring aliases display.

Input Monitoring Main Menu Dialog Box

The INPUT MONITORING MAIN MENU dialog box has:

- Dialog box title
- Exclusive selections
- Buttons.

Exclusive Selections

Use an exclusive selection and the CONTINUE command selection to monitor one of these signal types:

- General inputs
- Analog discretes
- Analog variables
- ARINC 629 full word strings.

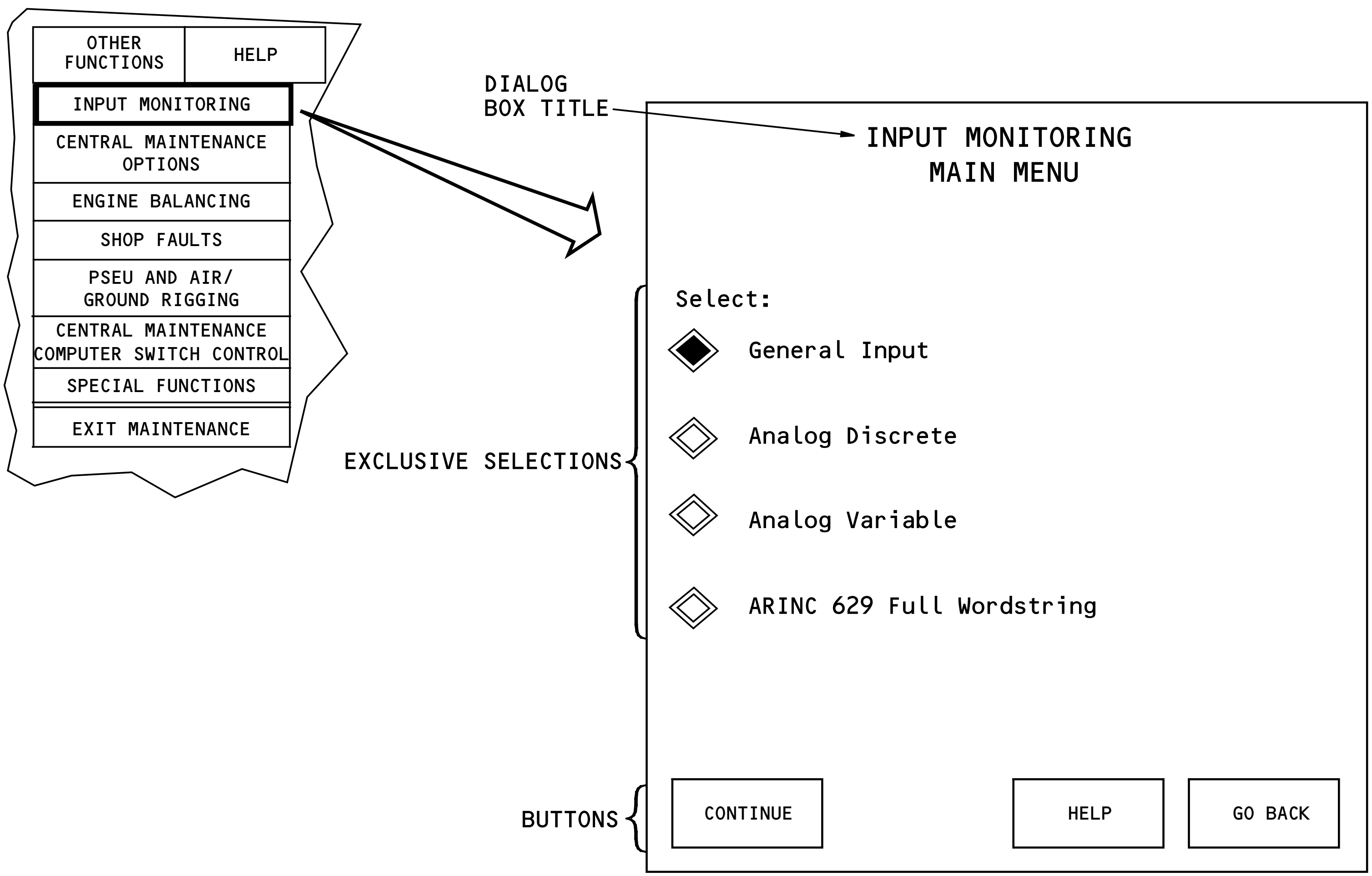
Buttons

The CONTINUE button becomes available when you make an exclusive selection.

Select CONTINUE to show the display for the exclusive selection.

Select GO BACK to remove the dialog box and return to the previous display.

Select HELP to show the help dialog box for the INPUT MONITORING MAIN MENU dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.



45-10-00-068 Rev 1

CMCS - INPUT MONITORING MAIN MENU DIALOG BOX

CMCS - CENTRAL MAINTENANCE COMPUTER SWITCH CONTROL DIALOG BOX

General

The central maintenance computer switch control dialog box lets the user switch the source of CMCF data to the left or right CMCF.

Display Characteristics

The dialog box has:

- Title
- Message field
- Buttons.

Message Field

The CMCF shows these messages that identifies the CMCF currently in control.

Buttons

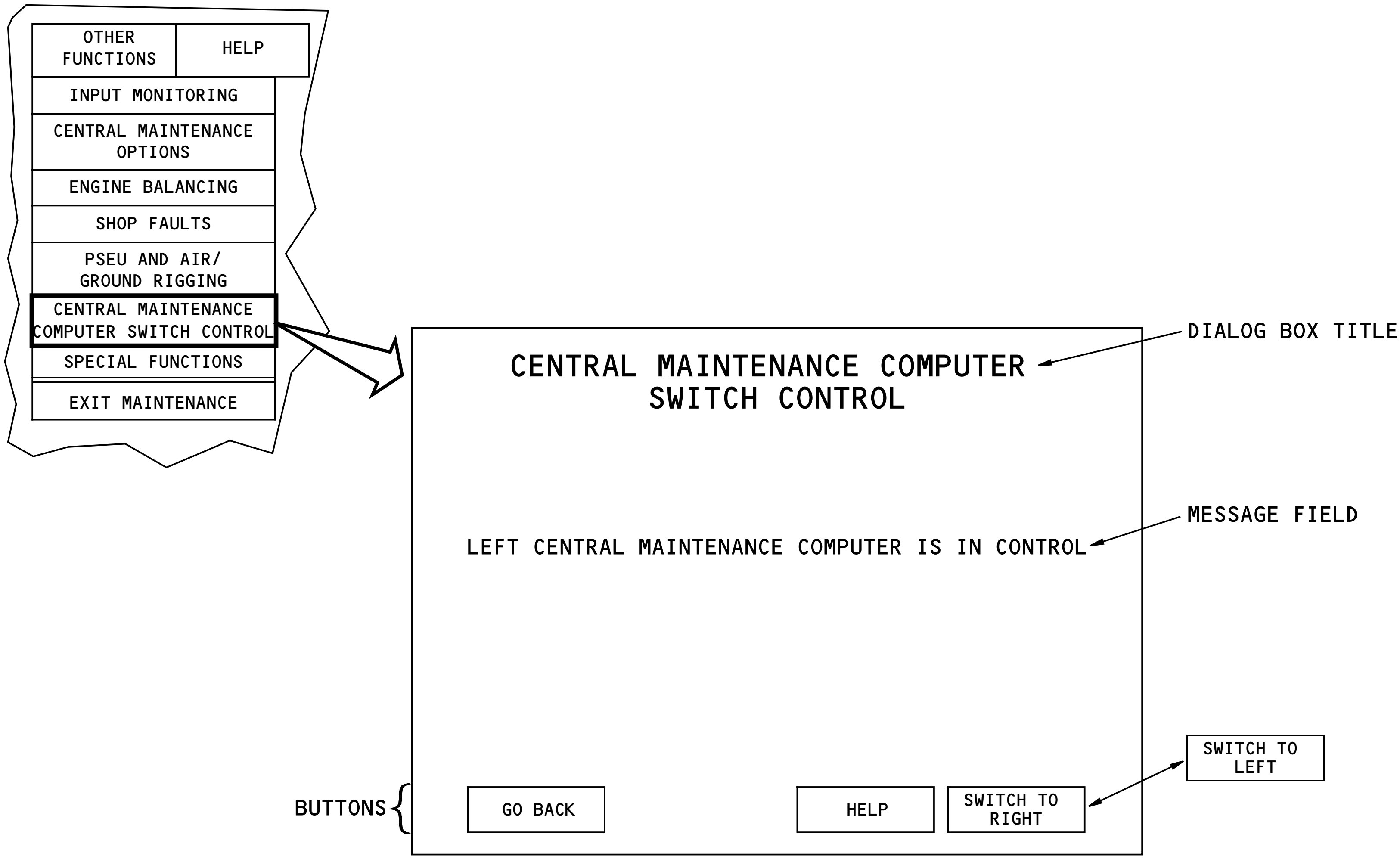
Select HELP to show the help dialog box for the shop faults shop faults status dialog box. Help must exist in the CMCF AMI for the HELP selection to show.

Select GO BACK to show all messages except Request Is In Progress. Select GO BACK to remove the shop faults status dialog box and to return to the previous screen.

SWITCH TO LEFT and SWITCH TO RIGHT are toggles. If the left CMCF is in control then the button shows SWITCH TO RIGHT.

If the right CMCF is in control then the button shows SWITCH TO LEFT.

Select SWITCH TO LEFT or SWITCH TO RIGHT to remove the dialog box and to show an inhibit dialog box or a confirmation dialog box.



45-10-00-111 Rev 0

CMCS - CENTRAL MAINTENANCE COMPUTER SWITCH CONTROL DIALOG BOX

CMCS - CENTRAL MAINTENANCE COMPUTER SWITCH CONTROL INHIBIT DIALOG BOX

General

The central maintenance computer switch control inhibit dialog box shows if a condition exists that affects the ability of the CMCF to switch sources.

Display Characteristics

The dialog box has:

- Title
- Message field
- Buttons.

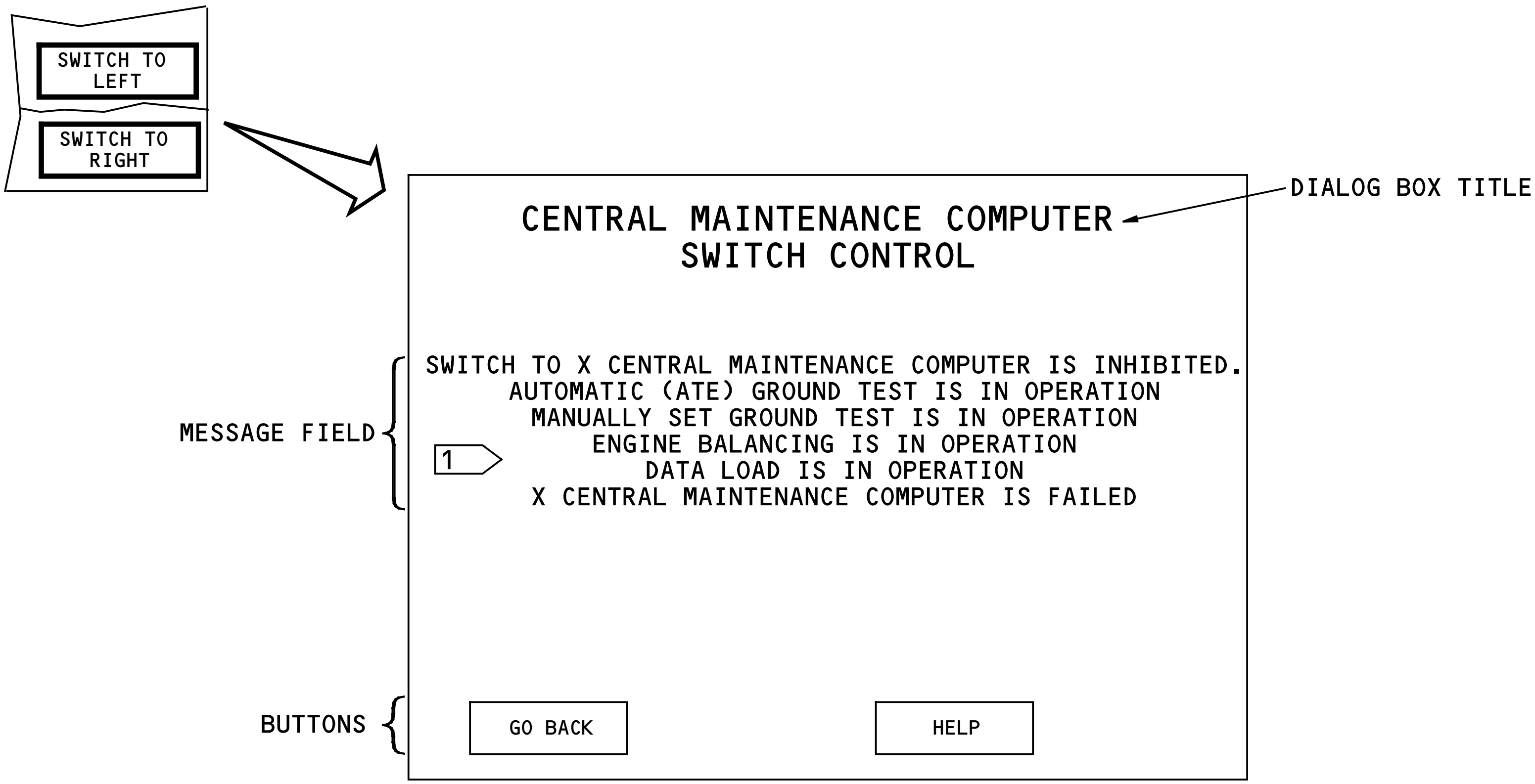
Message Field

The CMCF shows one or more messages that identify the specific inhibits.

Buttons

Select HELP to show the help dialog box for the central maintenance computer switch control dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select GO BACK to remove the dialog box to return to the previous display.



1 X = LEFT OR RIGHT

45-10-00-112 Rev 1

CMCS - CENTRAL MAINTENANCE COMPUTER SWITCH CONTROL INHIBIT DIALOG BOX

CMCS - CENTRAL MAINTENANCE COMPUTER SWITCH CONTROL CONFIRMATION DIALOG BOXES

General

If there are no inhibits, the selection of SWITCH TO LEFT or SWITCH TO RIGHT causes a confirmation dialog box to show.

A YES selection on the confirmation dialog box causes another dialog box to show while the CMCF switches sources.

Dialog Box Characteristics

Each dialog box has:

- Title
- Message Field
- Buttons.

Message Field

The message field on each dialog identifies the current condition of the CMCF and provides instructions.

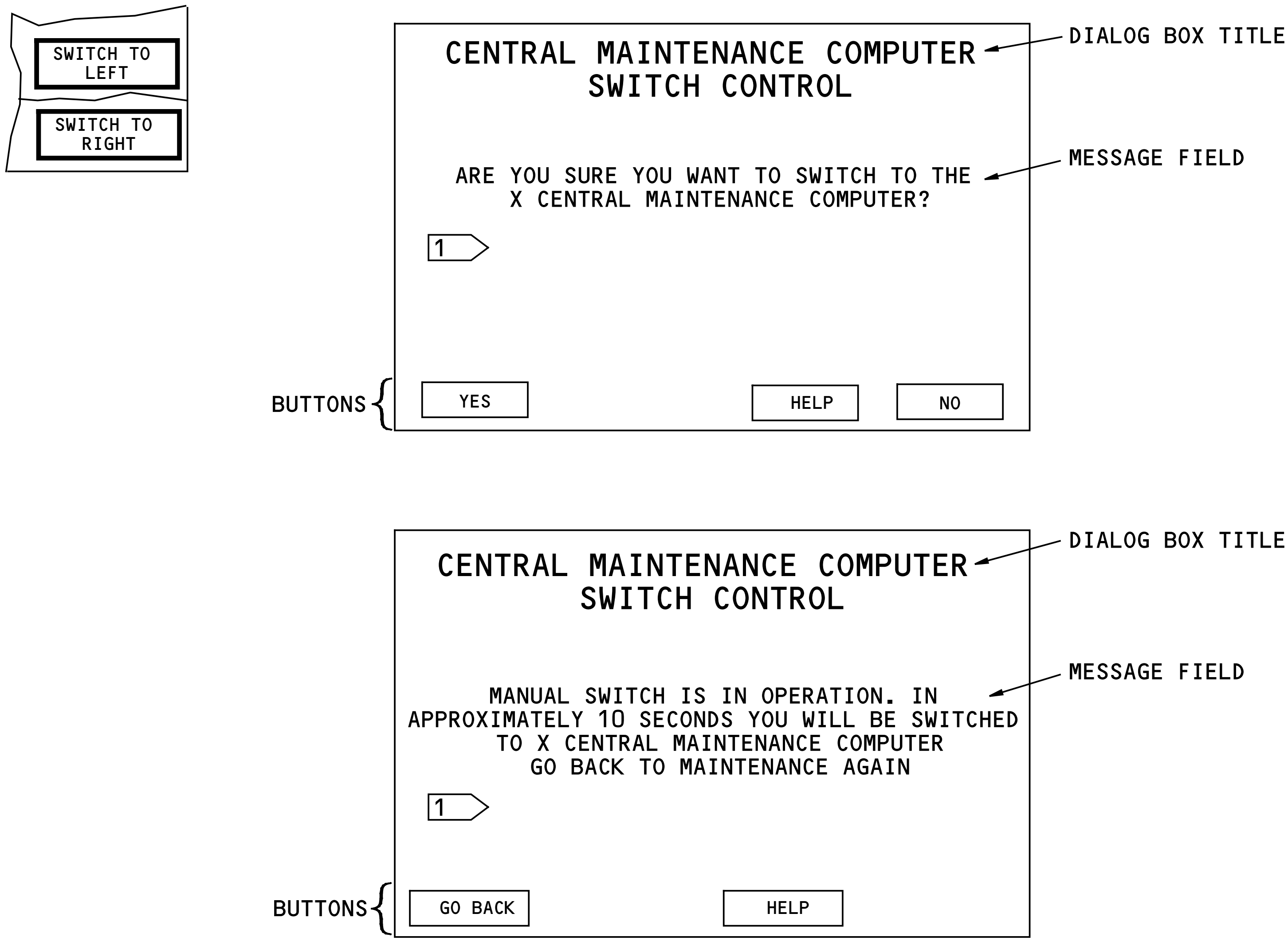
Buttons

The first dialog box has three buttons.

Select YES to show the second dialog box.

Select HELP on both to show the help dialog box for the central maintenance computer switch control dialog box. Help must exist in the CMCF AMI for the HELP selection to show.

Select GO BACK on the dialog box to remove all dialog boxes and to return to the previous display.



1 X = LEFT OR RIGHT

45-10-00-113 Rev 0

CMCS - CENTRAL MAINTENANCE COMPUTER SWITCH CONTROL CONFIRMATION DIALOG BOXES

CMCS - SPECIAL FUNCTIONS DIALOG BOX

General

The SPECIAL FUNCTIONS selection supplies you with access to airplane systems that have unique maintenance functions.

Many ATA systems and LRUs have unique requirements that cause additional dialog boxes to show before the function starts. The types of dialog boxes include:

- Precondition dialog box
- Inhibit dialog box
- Interference dialog box
- Interactive dialog box
- Menu abort dialog box.

When you meet all unique requirements, the special function display shows with status and instructions for the special function.

Special Functions Selection Dialog Box

The special functions selection dialog box has:

- Title
- Select ATA list box
- Select function list box
- Button area.

Select ATA List Box

The select ATA list box shows the airplane systems in ATA order. You must choose an ATA system first. This selection causes the functions for that ATA to become available.

Select Function List Box

The select function area list box has all the LRUs in the ATA that have a special function available.

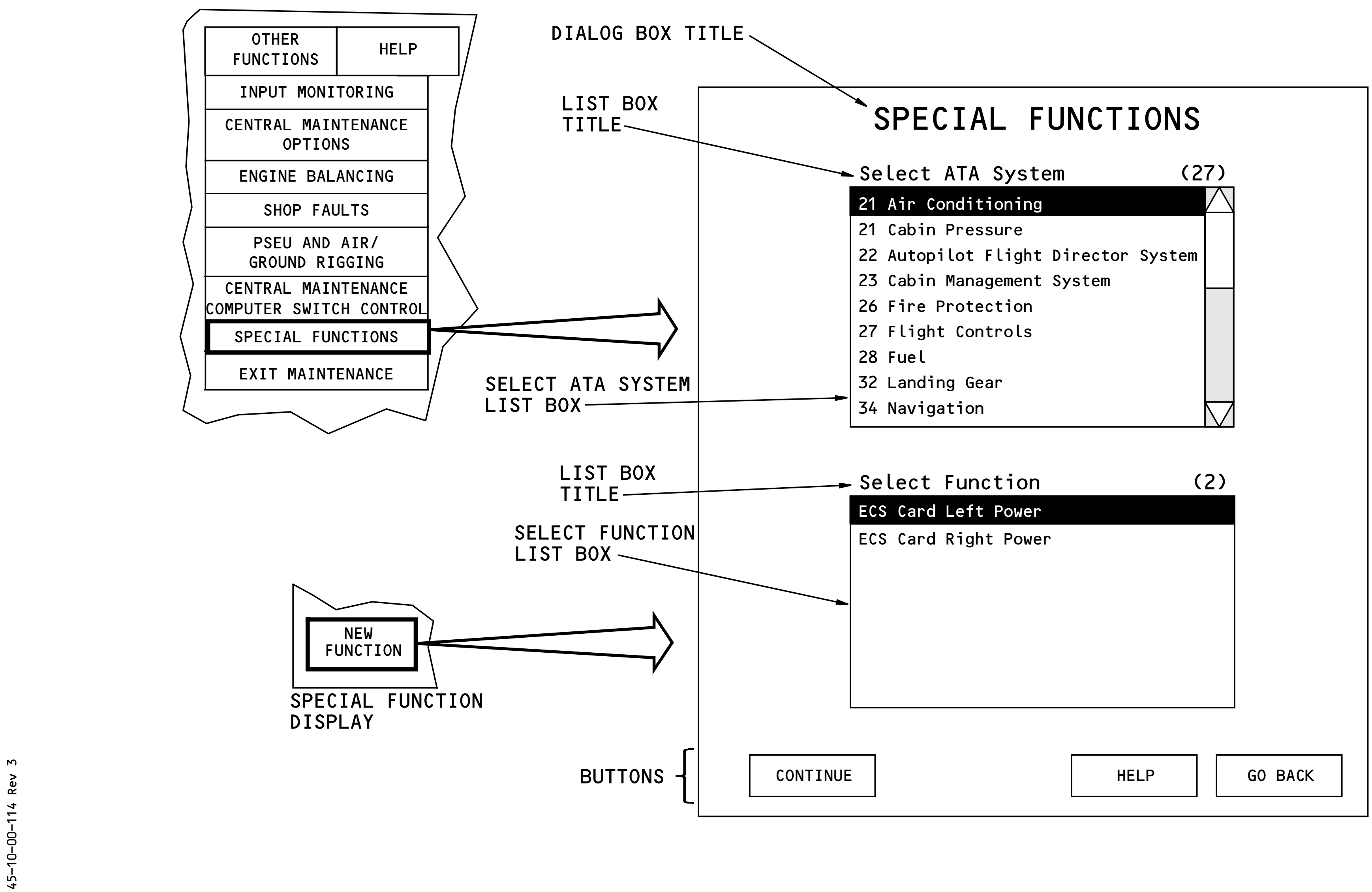
The selection of the LRU with a special function makes the CONTINUE command available.

Button

Select CONTINUE to show the precondition dialog box on top of the ground test selection dialog box for the selected special function.

Select HELP to show the help dialog box for the special function dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select GO BACK to remove the special function selection dialog box and to return to the previous display.



CMCS - SPECIAL FUNCTIONS DIALOG BOX

CMCS - SPECIAL FUNCTIONS PRECONDITION DIALOG BOX

General

The special functions precondition dialog box is similar to the ground test precondition dialog box. The special functions precondition dialog box contains:

- Title
- Special function title
- Special function description
- Precondition list
- Buttons.

Special Function Title

The special function title shows the name from the selection made on the special function selection dialog box.

Special Function Description

The test description is a brief description about the special function.

Precondition List

The precondition list gives instructions to follow before you run the special function.

The precondition display database stores the special function description and the precondition list.

Buttons

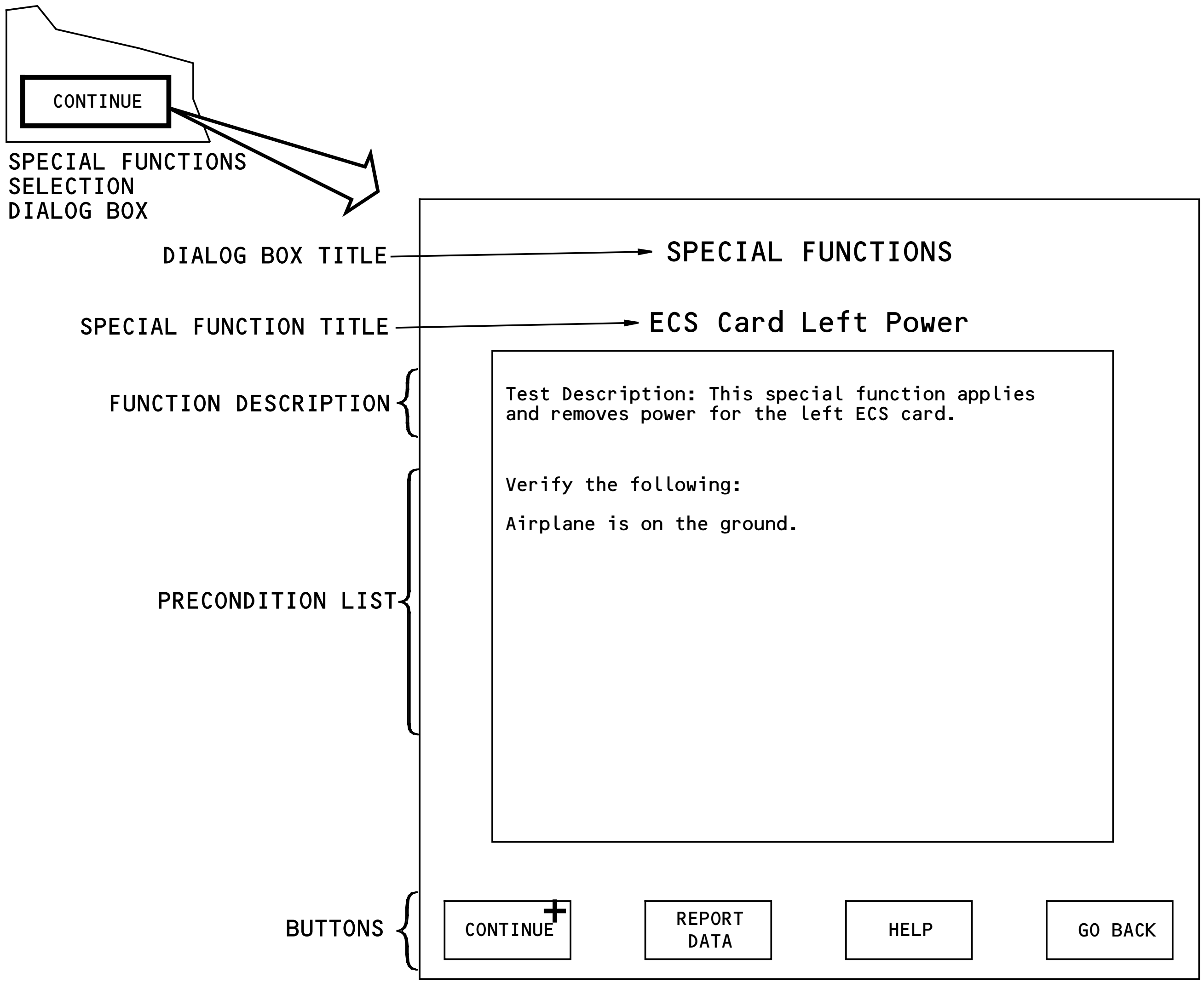
The precondition dialog box shows four buttons.

Select CONTINUE to close the special function selection dialog box (if open), the precondition dialog box, and to show the special function display.

Select REPORT DATA to show the report dialog box.

Select HELP to show the help dialog box for the special function precondition dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select GO BACK to remove the precondition dialog box and to return to the previous display.



45-10-00-115 Rev 1

CMCS - SPECIAL FUNCTIONS PRECONDITION DIALOG BOX

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CMCS - SPECIAL FUNCTION MAIN DISPLAY

General

The SPECIAL FUNCTION main display supplies status information and control for the special functions.

The SPECIAL FUNCTION display shows:

- Display title
- ATA chapter and name
- Special function title
- FUNCTION CONDITION messages
- Function control selections
- Text field
- Text field title
- Buttons.

ATA Chapter and Name

This field shows the ATA chapter and system name from the initial selection on the special functions selection dialog box.

Special Function Title

This field shows the system function title from the initial selection on the special function selection dialog box.

Function Condition Messages and Control Selections

The function condition messages field can show these messages:

- READY
- INHIBITED
- CAN NOT OPERATE
- OPERATING
- STOPPED
- COMPLETE.

The possible function control buttons are:

- START FUNCTION
- STOP FUNCTION
- OPERATE FUNCTION AGAIN
- TO START FUNCTION.

READY shows when no inhibits or no interference conditions exist. The START FUNCTION button shows next to the READY message.

Select START FUNCTION to begin the function. OPERATING shows as the message.

When OPERATING shows, the button changes to STOP FUNCTION.

Select STOP FUNCTION to stop the function and show the STOPPED message.

At the completion of the function, COMPLETE shows.

With STOPPED, or COMPLETE as the message, OPERATE FUNCTION AGAIN shows as the button.

CMCS - SPECIAL FUNCTION MAIN DISPLAY

Select OPERATE FUNCTION AGAIN to show the precondition dialog box.

INHIBITED shows when a test inhibit condition exists. The TO START FUNCTION control selection shows next to the message.

The TO START FUNCTION selection in this case causes the function inhibit dialog box to show.

CAN NOT OPERATE shows as the message if a function interference condition exists. The TO START FUNCTION control selection shows next to the message.

The TO START FUNCTION selection in this case causes the function interference dialog box to show.

If the LRU stops the special function, STOPPED shows as the message and TO START FUNCTION shows as the control selection.

<u>Text Field</u>

If the message STOPPED shows in the function condition field, and the user stops the function, or the member system stops the function, then the text field shows one of these messages:

- User Stopped the Function
- Member System Stopped the Function.

<u>Text Field Title</u>

When STOPPED shows in the function condition field, the title of the text field is CAUSE.

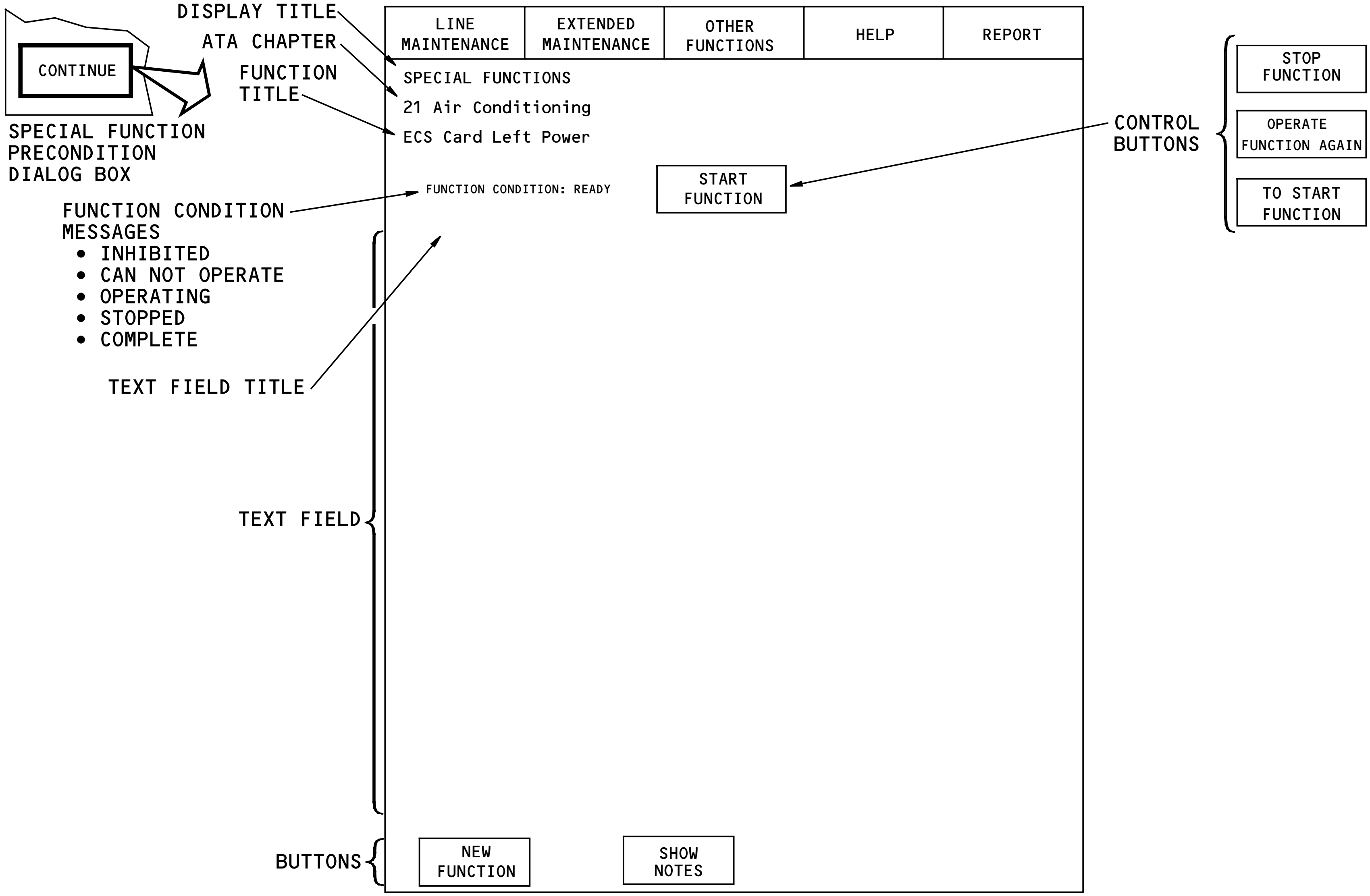
<u>Buttons</u>

Select NEW FUNCTION to show the special function selection dialog box.

Select SHOW NOTES to show the notes dialog box for the selected special function. Notes text for the dialog box must be in the CMCF AMI for SHOW NOTES to show.

<u>Button</u>

Select NEW FUNCTION to show the special function selection dialog box.



45-10-00-116 Rev 2 12/08/95

CMCS - SPECIAL FUNCTION MAIN DISPLAY

CMCS - SPECIAL FUNCTION INTERACTIVE DIALOG BOX

General

Interactive dialog boxes show when interaction by the user is necessary to complete the function.

The member systems control the interactive displays. LRUs in the member systems send a control signal that tells the CMCF to show the interactive displays as necessary. When the CMCF gets the control signal, any existing interactive displays close.

Each interactive dialog box has:

- Dialog box title
- Function title
- Messages
- Buttons

Function Title

The function title shows the title of the function from the initial selection on the special functions selection dialog box.

Messages

The messages area shows directions to complete the function.

The message area also shows any warnings associated with the function.

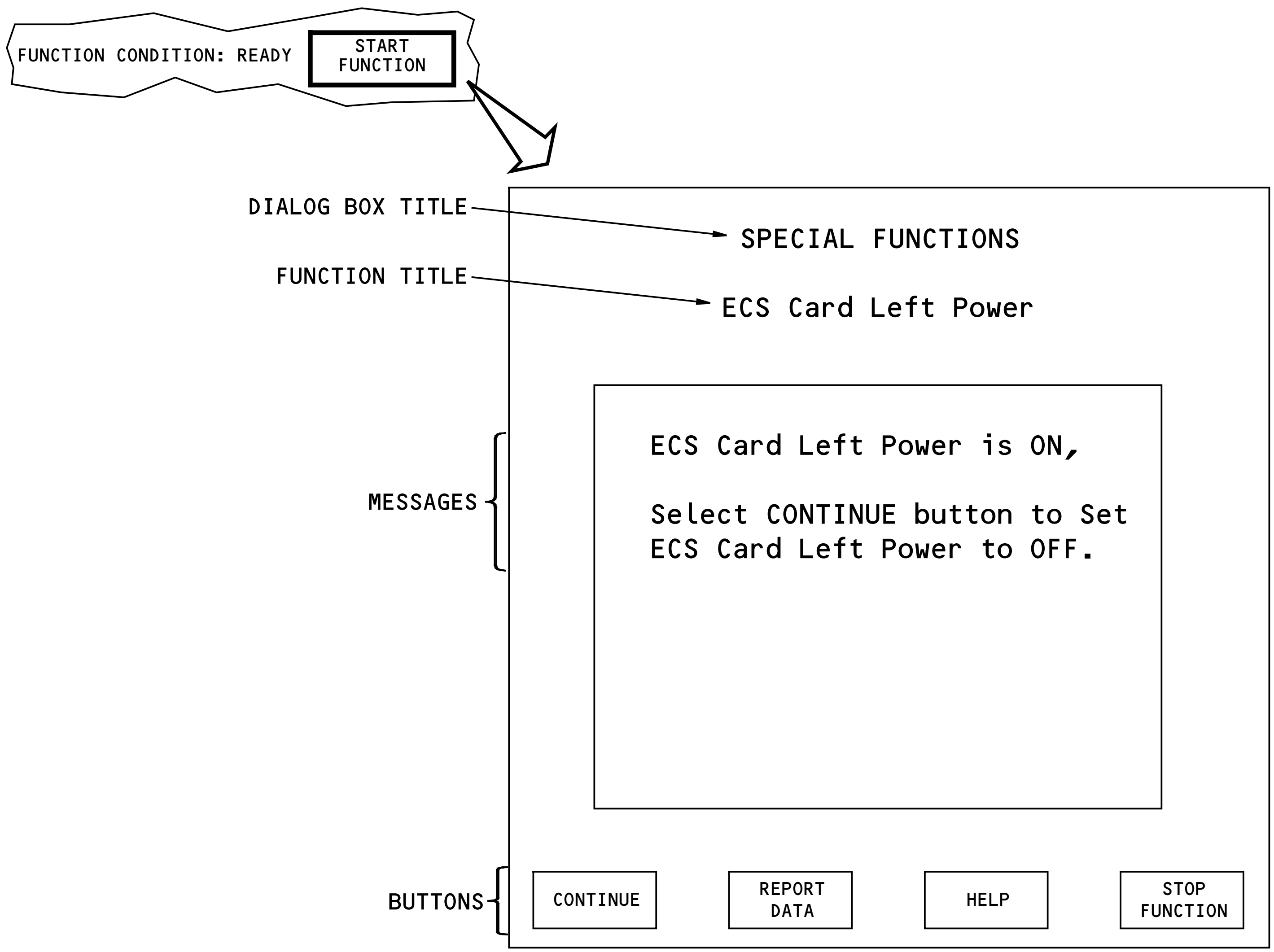
Buttons

Select CONTINUE to remove the interactive dialog box and the to start the function.

Select STOP FUNCTION to remove the interactive dialog box and to show STOPPED as the FUNCTION CONDITION message on the special function display. The control selection shows OPERATE FUNCTION AGAIN.

Select REPORT DATA to show the report dialog box.

Select HELP to show the help dialog box for the interactive dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.



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CMCS - SPECIAL FUNCTION INTERACTIVE DIALOG BOX

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CMCS - SPECIAL FUNCTION INHIBIT AND INTERFERENCE DIALOG BOXES

Function Inhibit Dialog Box

When the FUNCTION CONDITION message shows INHIBITED, the control command changes to TO START FUNCTION.

Select TO START FUNCTION to show the function inhibit dialog box.

The dialog box has:

- Box title
- Function title
- Instructions to continue the function
- Buttons.

The function title shows the title from the original selection on the special function selection dialog box.

The instructions tell why the function is inhibited and how to enable the function.

After the inhibit condition goes away, select CONTINUE to remove the dialog box to enable the function to continue.

Select REPORT DATA to show the report dialog box.

Select HELP to show the help dialog box for the function inhibit dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select GO BACK to remove the function inhibit dialog box and to return to the previous display.

Function Interference Dialog Box

When the FUNCTION CONDITION message shows CAN NOT OPERATE, the control command changes to TO START FUNCTION.

Select TO START FUNCTION to show the function interference dialog box .

The dialog box has:

- Box title
- Function title
- Function interference information
- Buttons.

The box title always shows SPECIAL FUNCTIONS.

The function title shows the title from the original selection on the special function selection dialog box.

The function interference information has the header (You cannot operate this function because these functions are operating) and a numbered list of the tests that cause the interference.

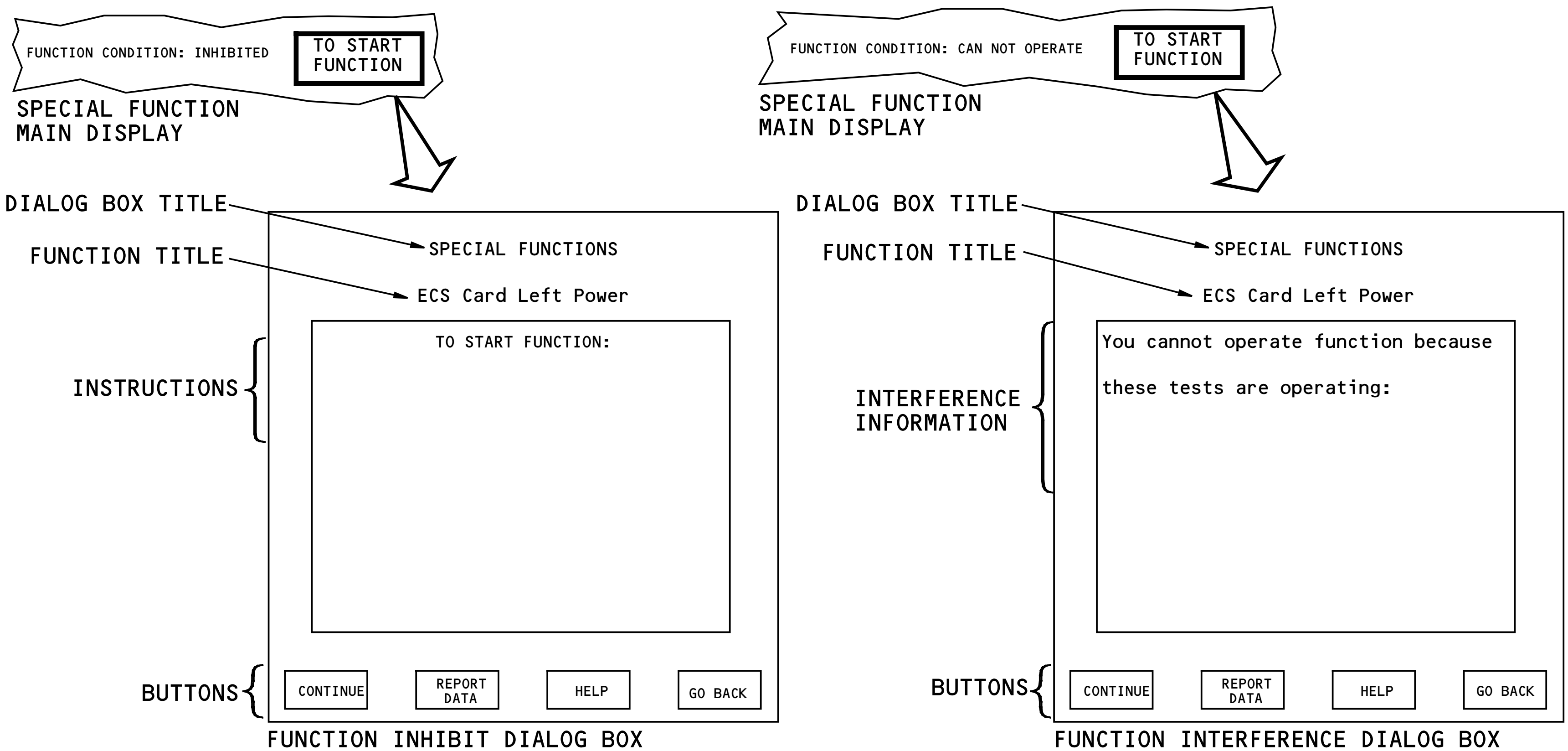
After the interference condition goes away, select CONTINUE to remove the dialog box to enable the function to continue.

Select REPORT DATA to show the report dialog box.

CMCS - SPECIAL FUNCTION INHIBIT AND INTERFERENCE DIALOG BOXES

Select HELP to show the help dialog box help for the interference dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select GO BACK to remove the function interference dialog box and to return to the previous display.



45-10-00-118 Rev 1

CMCS - SPECIAL FUNCTION INHIBIT AND INTERFERENCE DIALOG BOXES

CMCS - SPECIAL FUNCTION MENU ABORT DIALOG BOX

General

The menu abort dialog box shows when a selection other than HELP is made from the main menu title bar or the user selects NEW FUNCTION and a function is in progress.

The dialog box has:

- Dialog box title
- Message text
- Buttons.

Message Field

The message text provides instructions to stop or continue the function.

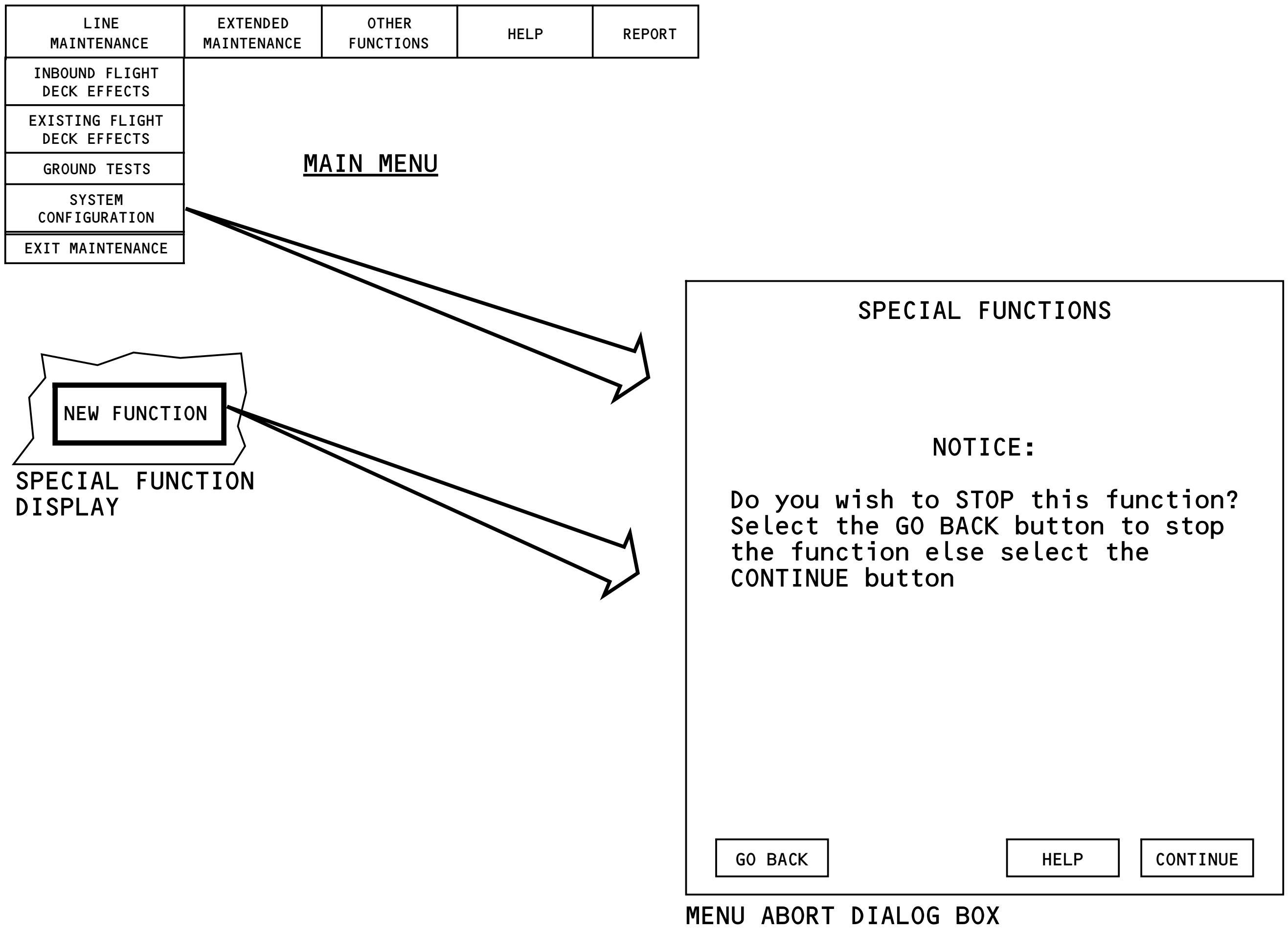
Buttons

Select GO BACK to do this:

- Stop the function
- Close the menu abort dialog box
- Process the main menu selection or the NEW FUNCTION selection.

Select HELP to show the help dialog box for menu abort dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select CONTINUE to remove the menu abort dialog box.



45-10-00-119 Rev 1

CMCS - SPECIAL FUNCTION MENU ABORT DIALOG BOX

CMCS - HELP FUNCTION

General

The main menu HELP selection is available on every CMCF display. The selection of HELP causes the menu with SCREEN HELP and GENERAL HELP to show.

A HELP button also shows on many of the CMCF dialog boxes.

The information on the help dialog boxes comes from data in the CMCF airline modifiable information (AMI).

SCREEN HELP

Select SCREEN HELP to get information about the present display.

If the CMCF does not have AMI data, this message shows:

- NO HELP, Maintenance Airline Modifiable Information (AMI) is not loaded.

If the AMIis loaded but no help is available for the present screen, this message shows:

- NO HELP, help is not assigned in the Maintenance Airline Modifiable Information (AMI).

If there is help data, a dialog box with a display title and a scrollable text field shows with the specific help for the present display.

Each dialog box has two command selections. Select REPORT DATA to show the report dialog box. Select GO BACK to remove the dialog box and return to the previous display.

GENERAL HELP

Select GENERAL HELP to get general help information in the CMCF AMI. If there is no CMCF AMI or if general help is not available, the dialog boxes with the applicable message show.

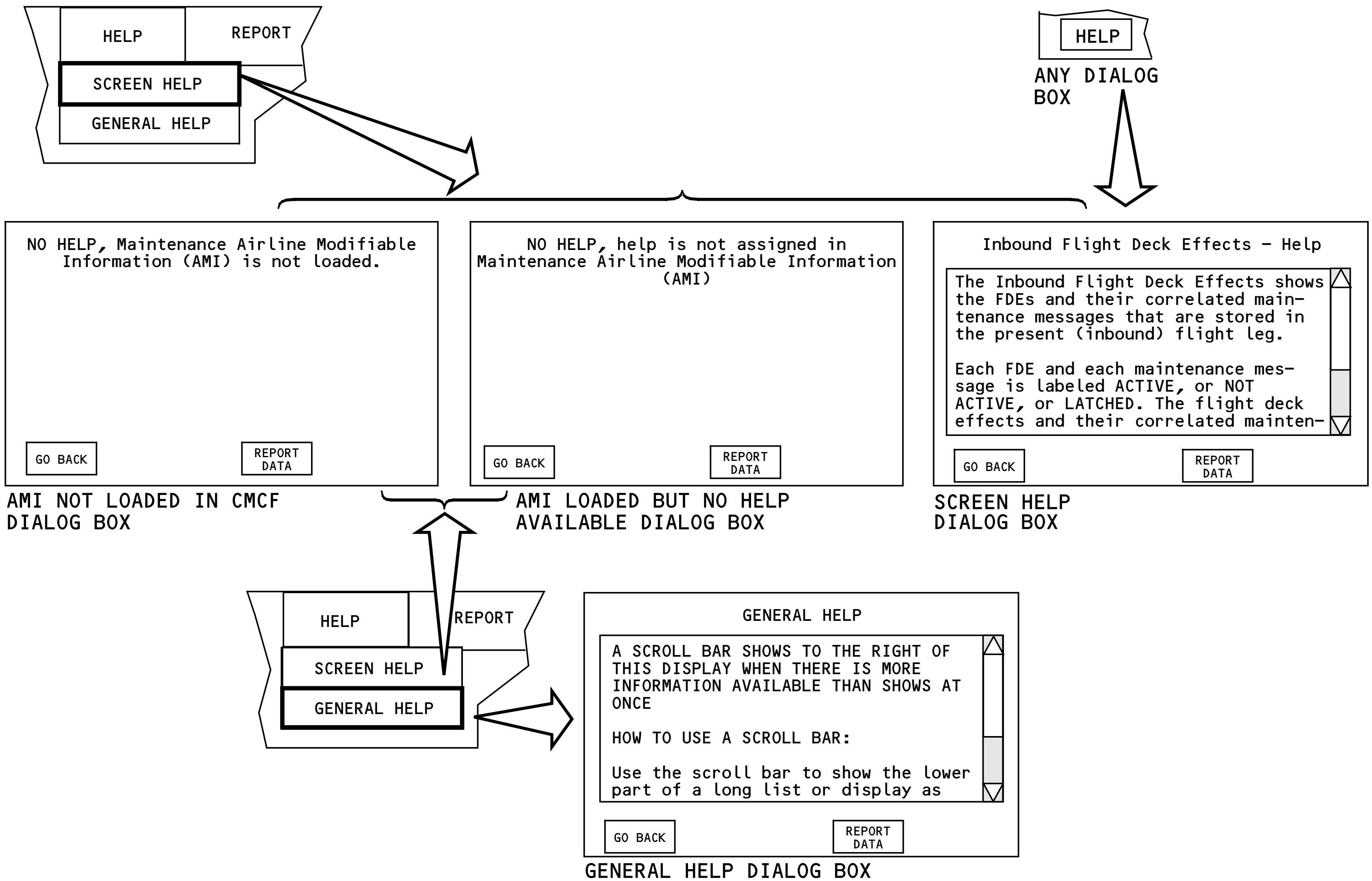
If general help is available, a scrollable dialog box shows and has the title GENERAL HELP.

The GENERAL HELP dialog box has the same two command selections as the screen help dialog box.

Dialog Box Help

If help for specific dialog boxes is available, the HELP command selection on that dialog box shows.

Select HELP on the dialog box to show the help dialog box. The dialog box has a display title and a scrollable text field with the help information for the present display.



45-10-00-120 Rev 1 06/02/1995

CMCS - HELP FUNCTION

CMCS - REPORT OUTPUT DEVICE DIALOG BOX

General

The CMCF can generate reports from user inputs, from a ground station request or when events cause an automatic report.

The CMCF sends a print image of the reports to the flight compartment printer and the disk drive. The CMCF sends reports to a ground station are in a compressed format.

The CMCF can complete one report at a time. You may send another report after the CMCF completes the first report.

Automatic CMCF Event Triggered Reports

The CMCF can automatically generate reports at certain flight events. Use the ground based software tool (GBST) to select the flight events. When selected, the events that trigger an automatic report are:

- Top of descent
- Roll out
- Engine shutdown
- Present flight leg flight deck effects, maintenance page snapshots, and maintenance messages.

Ground Station Report Requests

The CMCF can respond to ground station requests for these reports:

- Inbound flight deck effects summary
- Present leg fault summary
- Fault history summary
- Existing faults summary
- Airplane configuration summary
- Cabin management fault summary
- Maintenance planning summary.

Report Menu Selections

When you select any item on the report menu bar or select REPORT DATA on any dialog box, the output device dialog box shows.

Select REPORT PAGE DATA to cause a report to go to the output device for the information that shows on the display.

Dialog Box Characteristics

The dialog box has:

- Title
- Exclusive source selections
- Printer output device selection
- Disk drive output device selection
- Data link output device selection
- Buttons.

Title

The title shows REPORT: followed by the item from the menu selection or the dialog box.

CMCS - REPORT OUTPUT DEVICE DIALOG BOX

Printer Output Device Selection

The printer area has:

- Title
- Buttons
- Text area.

The buttons are SEND and STOP. When you select SEND the CMCF sends the report to that device. The SEND button is not available during these times:

- When the output device is not available
- During the transmission of a report to that device
- After the selection of OUTPUT STATUS on the menu bar.

Select STOP to abort the report in progress.

The text area shows the status of the transmission to the printer. These are the possible messages:

- Transmission in Operation
- Door Open/Printer out of Paper
- Printer Busy
- Cannot Connect to the Printer. The Printer is Inactive/Faulted
- Cannot Connect to the Printer. The Printer Does not Give a Reply
- Transmission Completed.

Disk Drive Output Device Selection

The disk drive area has:

- Title
- Buttons
- Text area.

The buttons are SEND and STOP. Their function here is the same as the printer area.

The text area shows the status of the transmission sent to the disk drive. These are the possible messages:

- Transmission in Progress
- Insert Disk
- Change Disk
- Disk Write Protected
- Cannot Connect to the Disk Drive. The Disk Drive is Inactive/Faulty
- Cannot Connect to the Disk Drive. The Disk Drive Does not Give a Reply
- Transmission Completed to Disk Drive.

Datalink Output Device Selection

The datalink area has:

- Title
- Buttons
- Text area.

CMCS - REPORT OUTPUT DEVICE DIALOG BOX

The buttons are SEND and STOP. Their function here is the same as the printer area.

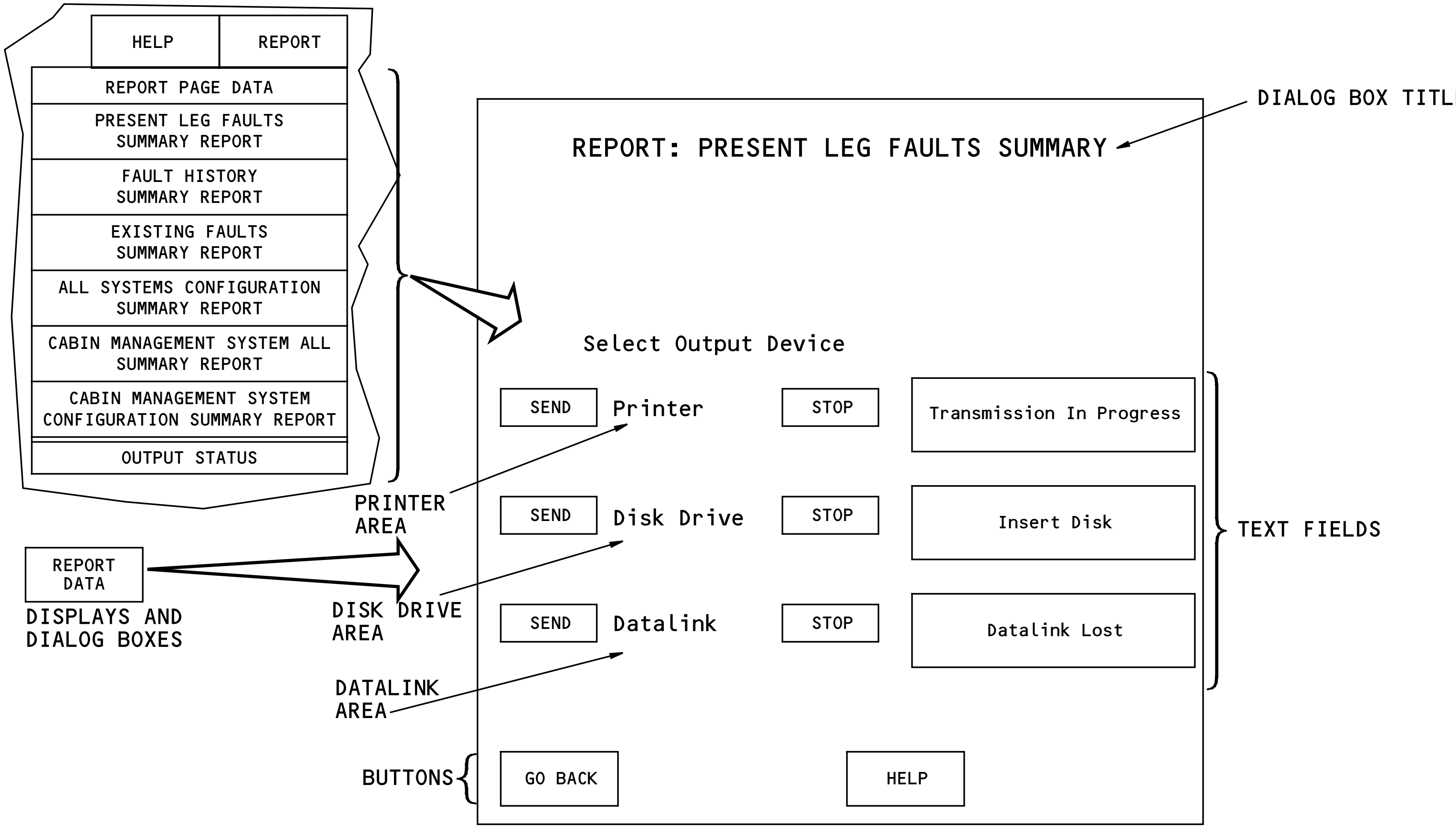
The text area shows the status of the transmission sent to datalink. These are the possible messages:

- Transmission in Progress
- Datalink SYS Faulted
- Datalink Lost
- Disk Write Protected
- Transmission Completed to Ground.

<u>Buttons</u>

Select HELP to show the help dialog box for the report output device dialog box. Help text for the dialog box must be in the CMCF AMI for HELP to show.

Select GO BACK to remove the dialog box and return to the previous display.



45-10-00-121 Rev 3 02/12/96

CMCS - REPORT OUTPUT DEVICE DIALOG BOX

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General

Datalink reports are changed into short codes to lower the cost of using a satellite or ground station.

The reports have header information and can show data for FDE summary groups and maintenance message summary groups. Correlated FDEs and maintenance messages also show.

Report Header

Each report has header information that describes:

- Report type
- Report number
- Date and time sent
- Airplane tail number
- Flight number
- Flight origin and destination
- CPM/COMM OPS part number
- Active CMCF.

These are the codes for report type:

- IFDE: Inbound FDE summary report
- EFDE; Existing FDE summary report
- TEST; Ground test report
- CFG; System configuration summary report
- PLF; Present leg fault summary report
- EF; Existing faults summary report
- DL; Data load reports
- IMM; Inbound maintenance memo summary report
- EMM; Existing maintenance memo summary report
- ISMT; Inbound scheduled maintenance task summary report
- ESMT; Existing scheduled maintenance task summary report
- IMON; Input monitoring report
- OPT; Central maintenance options report
- ENG; Engine balancing report
- SFLIST; Shop fault list of contents report
- SFDATA; Shop fault data report
- PSEU; PSEU rigging/calibration report
- AGRIG; Air/ground rigging report
- SPEC; Special function report
- MSG; Single maintenance message report
- NOTES; Notes report
- HELP; Help report.

The report number is the number of reports sent to the ground during the present flight leg.

The active CMCF shows as L for left and R for right.

FDE Summary Groups

Flight deck effect (FDE) summary groups start with the code FDE. They also have the:

- Fault code
- FDE activity
- Time and date the FDE first occurred.

The codes for FDE activity are:

- A; active
- I; not active
- L; latched
- N; no activity.

Maintenance Message Summary Groups

Maintenance message summary groups start with the code MSG. They also have the:

- Maintenance message number
- Maintenance message activity
- Time and date the maintenance message first occurred
- Flight phase
- Intermittence
- Intermittence number
- Previous leg identifier
- Detected by identifier.

The codes for maintenance message activity are the same as for FDE activity.

These are the codes for flight phase activity:

- PO; Power on
- ES; Engine start
- TA; Taxi out
- TO; Take off
- IC; Initial climb
- CL; Climb
- ER; Cruise
- DC; Descent
- AP; Approach
- GA; Go around
- FL; Flare
- RO; Rollout
- TI; Taxi in
- SD; Shutdown
- MT; Maintenance.

These are the codes for intermittence:

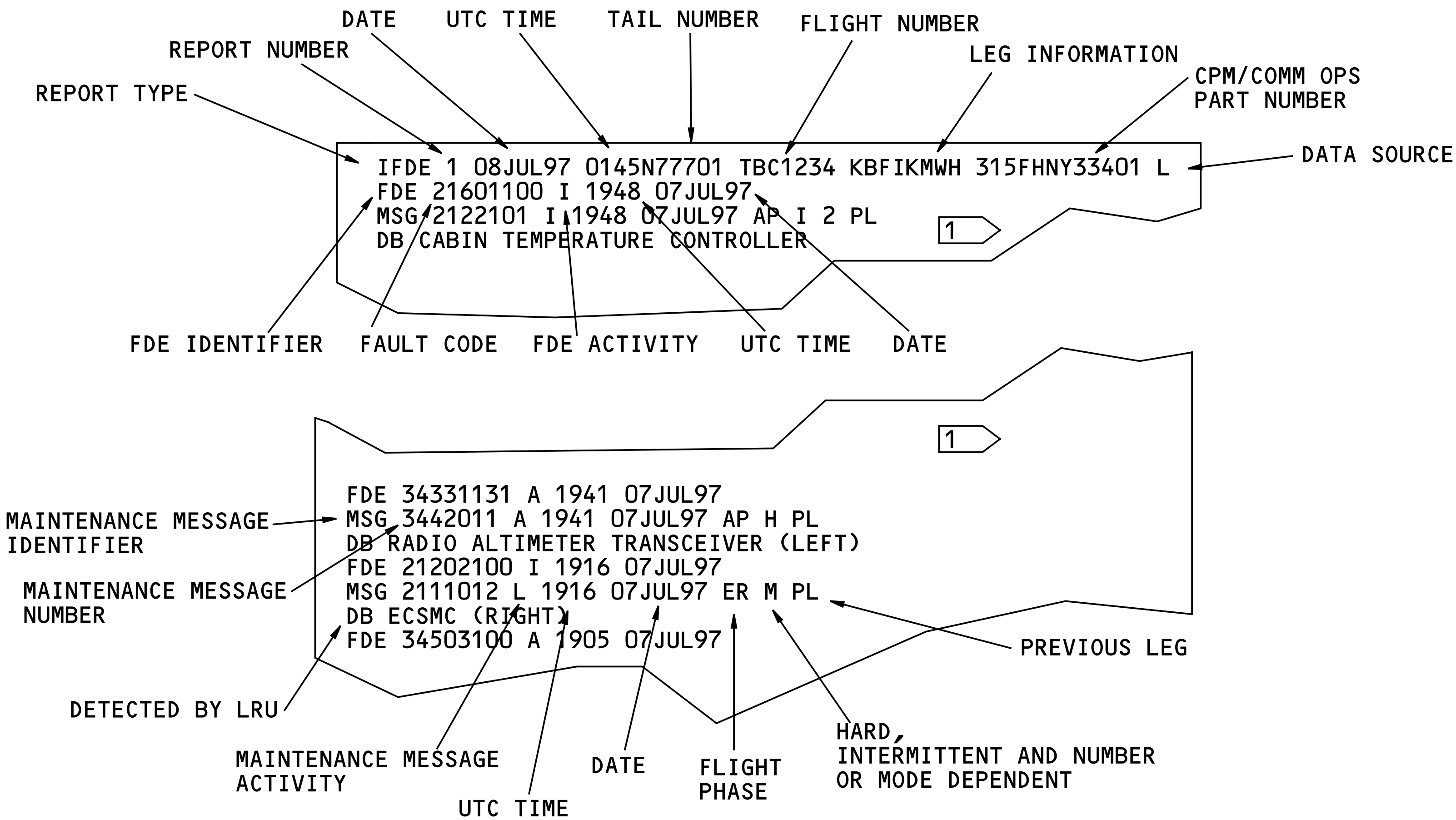
- H; Hard
- I; Intermittent
- M; Mode dependent.

If the fault occurred in a previous leg, PL will show.

The LRU that detects the fault shows after the code DB.

Correlated FDEs and Maintenance Messages

The summary groups for maintenance messages correlated to FDEs show after the FDE summary groups.



45-10-00-122 Rev 1

1 EXAMPLE OF INBOUND FLIGHT DECK EFFECTS DATALINK REPORT

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CMCS - MAINTENANCE ACCESS TERMINAL - SYSTEM TESTS

General

These are the six system tests for the maintenance access terminal (MAT):

- MAT Display Unit System Test
- MAT Display Brightness System Test
- MAT Display Unit Graphical Pattern System Test
- MAT Cursor Control Unit System Test
- MAT Standard Disk Drive System Test
- MAT AVLAN System Test.

MAT Display Unit System Test

This test makes sure the power-on self-tests run correctly. The approximate time to run the test is one to three minutes.

You must do this test from a portable maintenance access terminal.

MAT Display Brightness System Test

This test makes sure the brightness control analog inputs operate correctly. The approximate time to do the test changes based on the operator.

You must do this test from a portable maintenance access terminal.

MAT Display Unit Graphical Pattern System Test

This test makes sure the graphics capability of the display operates correctly. The approximate time to do the test changes based on the operator.

You must do this test from a portable maintenance access terminal.

MAT Cursor Control Unit System Test

This test makes sure the maintenance access terminal cursor controller operates correctly. The approximate time to do the test changes based on the operator.

For this test, you will move the cursor control and look at the results on the display.

MAT Standard Disk Drive System Test

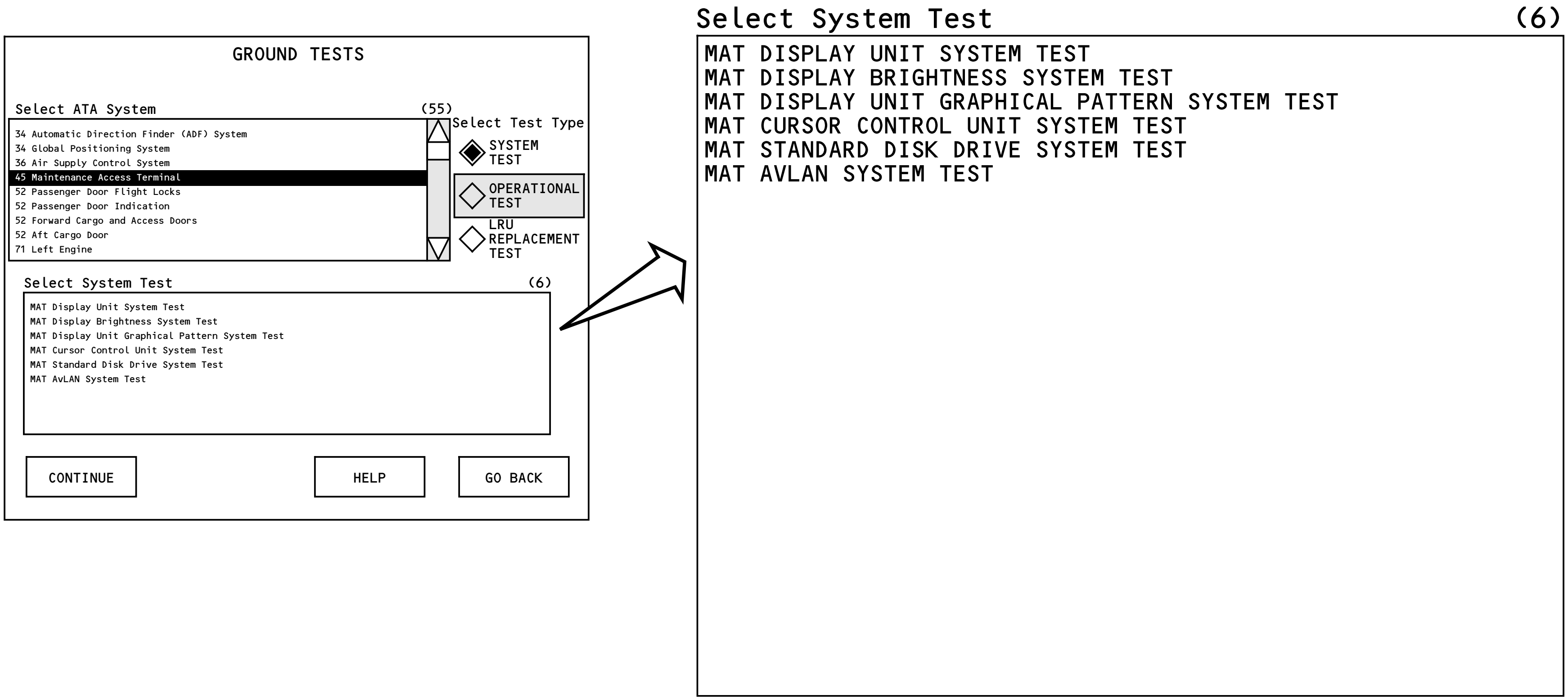
This test makes sure the standard disk drive operates correctly by writing to a diskette and reading back the results. The approximate time to do the test is less than one minute.

For this test, you will insert a formatted, writable diskette into the standard disk drive.

MAT AVLAN System Test

This test makes sure the avionics local area network (AVLAN) interface to the MAT display unit functions correctly. The approximate time to do the test is less than one minute.

You must do this test from a portable maintenance access terminal.



45-10-00-123 Rev 4 07/27/1995

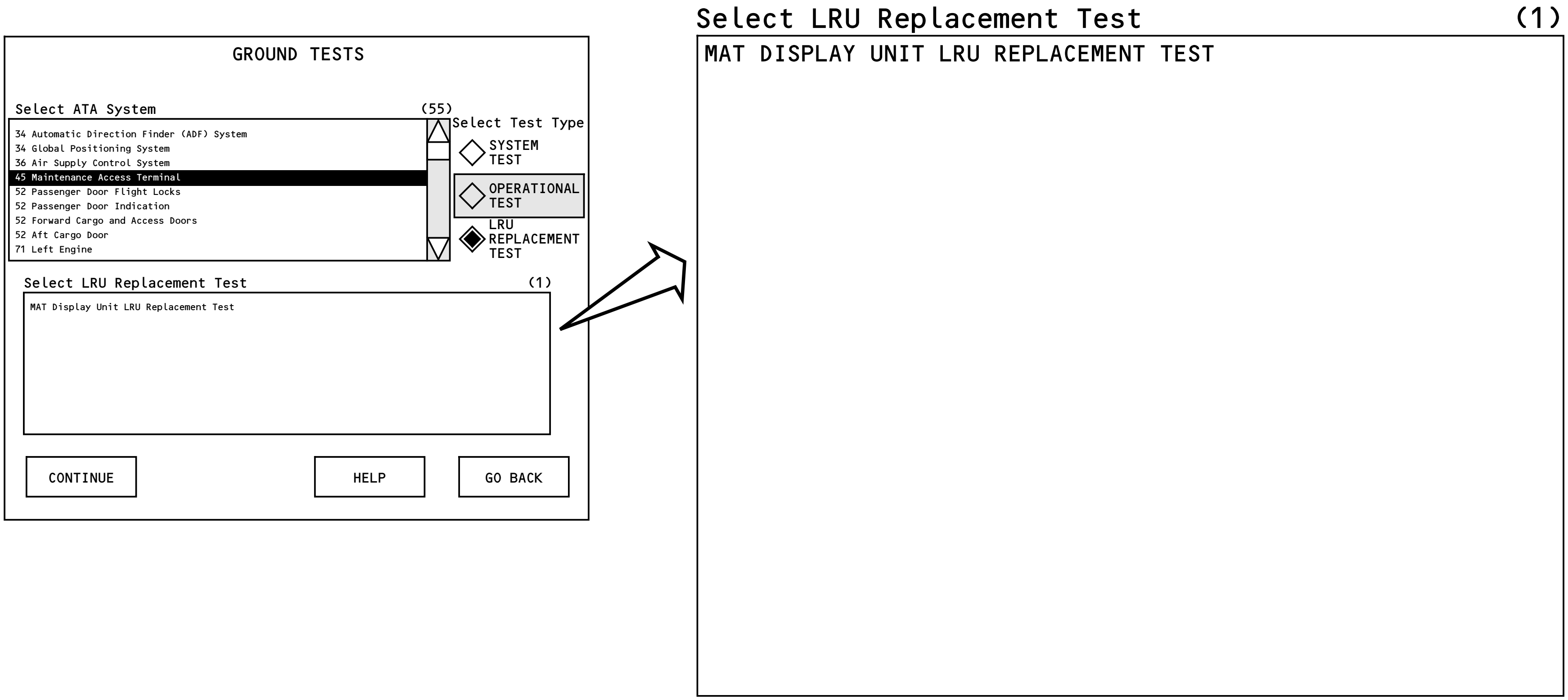
CMCS - MAINTENANCE ACCESS TERMINAL - SYSTEM TESTS

General

There is one LRU replacement test for the maintenance access terminal (MAT). It is the MAT display unit LRU replacement test.

MAT Display Unit LRU Replacement Test

The MAT display unit LRU replacement test does a check of the fiber optics interface between the display unit and the avionics local area network (AVLAN). It also does a check of the interface between the display unit and other MAT functions.



45-10-00-124 Rev 3 07/27/1995

CMCS - MAINTENANCE ACCESS TERMINAL - LRU REPLACEMENT TESTS

Continental Airlines, Inc

777 Manuals

WB371

TABLE OF CONTENTS

777 MAINTENANCE DOCUMENTS - INTRODUCTION

General

The maintenance documents for the 777 supply help for all maintenance activities. You use many different documents to do scheduled and unscheduled maintenance.

Scheduled Maintenance

These are examples of scheduled maintenance work:

- Through stop checks
- Airplane turn around
- Daily checks
- Planned checks.

You use these documents to do scheduled maintenance:

- Maintenance Planning Data (MPD) Document
- Airplane Maintenance Manual (AMM).

Unscheduled Maintenance

These are examples of unscheduled maintenance work:

- Flight faults
- Ground faults
- Service problems
- Structural damage.

You use these documents to do unscheduled maintenance:

- Fault Reporting Manual (FRM)
- Maintenance Tips
- Fault Isolation Manual (FIM)
- Structural Repair Manual (SRM)
- Dispatch Deviations Guide (DDG)
- Airplane Maintenance Manual.

Supporting data

These documents supply supporting data to do scheduled and unscheduled maintenance:

- System Schematics Manual (SSM)
- Wiring Diagram Manual (WDM)
- Illustrated Parts Catalog (IPC)
- Standard Wiring Practices Manual.

Maintenance Planning Data (MPD) Document

The MPD defines the tasks for each type of scheduled maintenance check. Most airlines use the MPD to make a set of task cards that the technician uses during the checks.

Airplane Maintenance Manual (AMM)

The AMM has two parts. Part I is the Systems Description Section (SDS). This section replaces the Description And Operation (D and O) section of airplane models before the 777. Part II is maintenance practices and procedures.

The practices and procedures has data related to these functions:

- Removal and installation of components
- Component Location
- Maintenance practices
- Servicing
- Adjustment/test
- Inspection/check
- Cleaning/painting
- Repair.

Fault Reporting Manual (FRM)

The flight crew uses the FRM to improve communication with maintenance personnel. The flight crew uses the FRM to get fault codes for airplane faults. These faults can be flight deck effects or other faults. The FRM has standard log book write-ups for each fault code.

The flight crew can send the fault code to ground personnel. This permits faster maintenance when the airplane lands.

FRM fault codes refer you to the FIM.

Maintenance Tips

Maintenance tips give information that help the mechanic with specified procedures. The information is short and simple so it is easy to understand. The maintenance tip gives mechanics information to make repairs quickly and easily. It has these sections:

- Subject
- Applicability
- Condition
- Recommended action
- Background (optional)
- Maintenance manual action.

Fault Isolation Manual (FIM)

You use the FIM to repair airplane faults. You start the fault isolation process with FRM fault codes or other fault data. You use the fault data and the FIM to identify the maintenance action(s) to correct the fault.

Structural Repair Manual (SRM)

The SRM supplies data and specific instructions to help in field repair of airplane structure. The SRM is not customized. It has data related to these areas:

- Allowable damage evaluation
- Typical repairs
- Material identification
- Material substitution
- Fastener installation
- Alignment check
- Planning.

Dispatch Deviation Guide (DDG)

The DDG supplies Boeing's recommended minimum equipment necessary for dispatch in the master minimum equipment list (MMEL). It also supplies the procedures and references to AMM procedures to dispatch the airplane with a fault.

The DDG also has an EICAS message section that has a relation to the MMEL.

System Schematics Manual (SSM)

The SSM gives the user an understanding of system operation and helps in the fault isolation process. It supplies the interconnection of all LRUs of a system or subsystem. It also supplies data for a general knowledge about system operation.

Wiring Diagram Manual (WDM)

The WDM supplies details of the point-to-point wiring on the airplane.

Illustrated Parts Catalog (IPC)

The IPC supplies part replacement data. This data includes:

- Hardware and software part number replacement
- Part illustrations
- Supplier data
- Specification numbers
- Recommended spares
- Service bulletin activity.

Standard Wiring Practices Manual

The Standard Wiring Practices Manual has instructions for maintenance and repair of the wiring of all Boeing airplanes. It is not customized.

Training Information Point

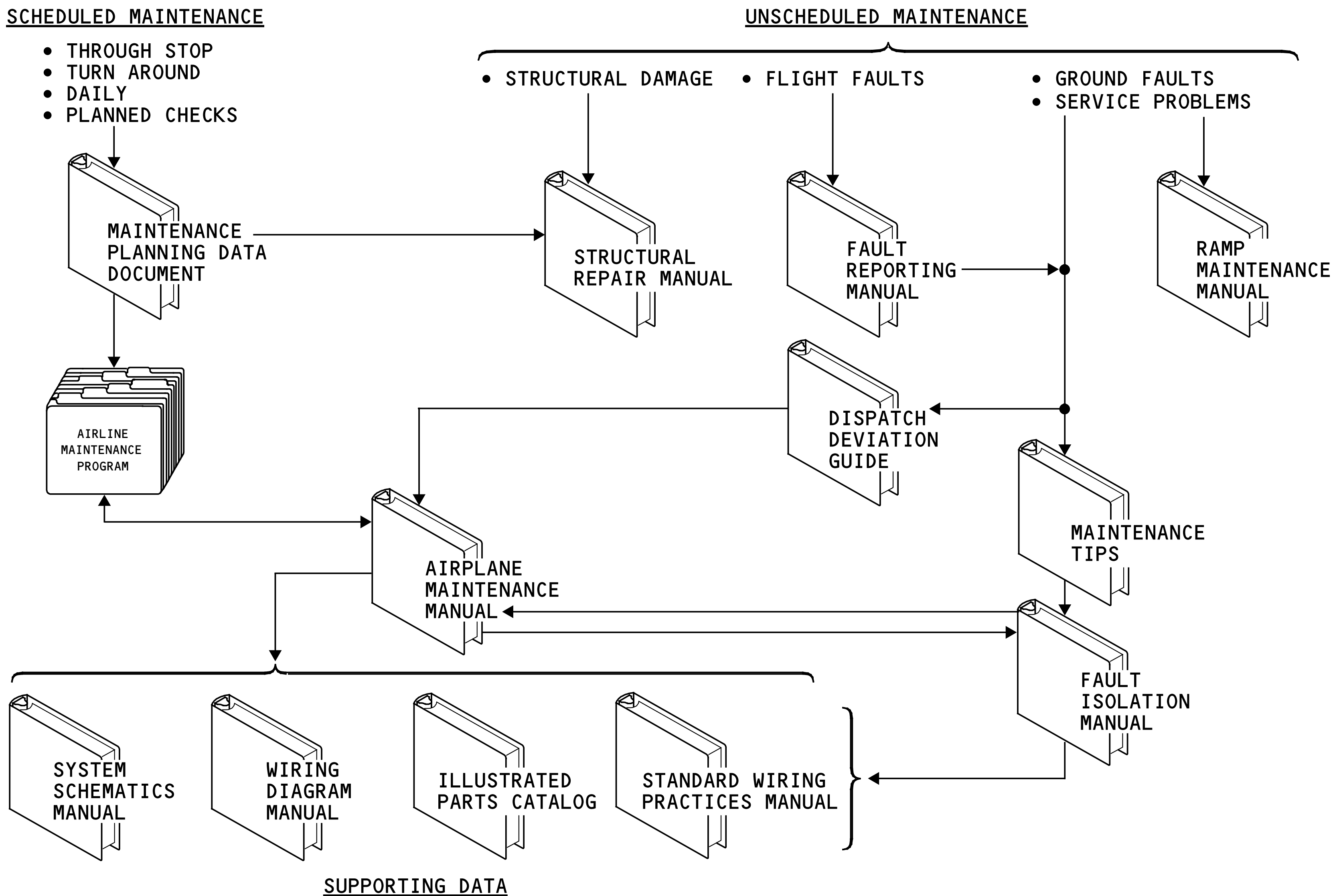
Each maintenance document has an introduction to show you how to use that document.

Abbreviations and Acronyms

AMM	- Airplane Maintenance Manual
AR	- airplane repair
ASN	- assigned subject number
A/T	- adjustment/test
ATA	- Air Transport Association
CL	- component location
CMCS	- central maintenance computing system
C/P	- cleaning/painting
DDG	- Dispatch Deviation Guide
FIM	- Fault Isolation Manual
FRM	- Fault Reporting Manual
I/C	- inspection/check
IPC	- Illustrated Parts Catalog
LRU	- line replaceable unit
MAT	- maintenance access terminal
MMEL	- Master Minimum Equipment List
MP	- maintenance practices
MPD	- Maintenance Planning Data

777 MAINTENANCE DOCUMENTS - INTRODUCTION

R/I	- removal/installation
SDS	- Systems Description Section
SRM	- Structural Repair Manual
svce	- service
SSM	- System Schematics Manual
WDM	- Wiring Diagram Manual



777 MAINTENANCE DOCUMENTS - INTRODUCTION

General

The airplane maintenance manual (AMM) Part I is the first of the two parts of the 777 AMM. It is called the systems description section (SDS). This section replaces the description and operation (D and O) section of earlier model Boeing airplanes. Both Part I and Part II of the AMM show the configuration of the airplanes in an operator's fleet. They have frequent revisions for improvements and for configuration changes.

Purpose

The SDS gives descriptions of the interfaces, function, and operation of the airplane systems and subsystems. You use these descriptions to become familiar with the airplane systems so that you can do fault isolation and system maintenance.

The SDS content and format is such that it can be a training manual.

Organization

The SDS uses text/graphic paravisuals (pagesets). Each graphic has one or more pages of text that describe the information on the graphic. The graphic has the primary information and the associated text page(s) have the support information or explanations.

The SDS uses a horizontal (sometimes called landscape) format. All pages (graphic and text) are 8-1/2 by 11 inches. The graphic page is always on the bottom (odd numbered page) of the text/graphic paravisual. The text pages have a double galley (two column) format.

Divisions

The SDS organization is by ATA chapter (system) or chapter/section (subsystem). Each ATA chapter/section usually defines an airplane system or subsystem. Several volumes (or binders) are used to cover all the airplane systems.

Each subject of the SDS has this information:

- Purpose/introduction
- General description
- Component location
- Interface
- Operation
- Functional description
- Training information points (TIPs).

TEXT PAGE

BOEING 777-200

MAINTENANCE MANUAL

777 AIR CONDITIONING - PACK FLOW CONTROL - OPERATION

Operation

When the pack switch on the P5 overhead panel is in the AUTO position, the CTC automatically controls the pack.

The CTC controls the operation of the two flow control and shutoff valves for the related pack. When the pack switch is in the OFF position, the CTC closes both valves. In this position, the OFF light on the pack switch comes on.

Functional Description

The CTC and air supply-cabin pressure controller (ASCPC) control the flow of air to the pack by adjustment of the flow control and shutoff valves. The ASCPC controls the valves for system shutdown and emergency flow control if the CTC loses electrical power.

The CTC closes the upper valve to permit flow through the lower valve and ozone converter at higher altitudes. The CTC closes the lower valve to permit flow through the upper valve and bypass the ozone converter at lower altitudes.

These sensors supply related inputs to the CTC:

- Flow sensor
- Primary heat exchanger inlet temperature sensor.

The flow sensor also supplies an input directly to AIMS.

These conditions cause the flow control and shutoff valves to adjust air flow to the packs:

- Cabin pressure
- Altitude
- Airplane operation
- Faults.

EFFECTIVITY
All

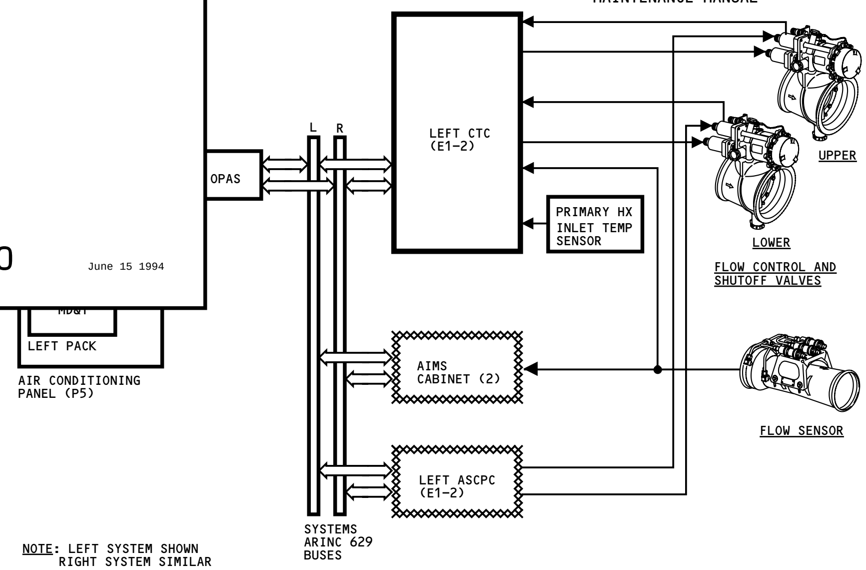
-2-

21-51-00

June 15 1994

GRAPHIC PAGE

MAINTENANCE MANUAL



NOTE: LEFT SYSTEM SHOWN
RIGHT SYSTEM SIMILAR

777 AIR CONDITIONING - PACK FLOW CONTROL - OPERATION

EFFECTIVITY
All

-3-

21-51-00

June 15 1994

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777 MAINTENANCE DOCUMENTS - AMM PART II - INTRODUCTION

General

Part II of the AMM has the maintenances practices and procedures to do maintenance on the airplane.

Chapter Numbering System

The manual has a tab section for each ATA chapter. Within each tab section, the manual has more divisions that use the assigned subject number (ASN) list number XX-YY-ZZ, where:

- XX is the ATA chapter
- YY is the subsystem or sub-subsystem
- ZZ is the unit (component).

The table of contents for each chapter lists the maintenance procedures in numerical order for each subsystem and sub-subsystem. For each subsystem or sub-subsystem, the maintenance tasks are in alphabetical order based on the page numbers described below.

Page Numbering System

Each page has two numbers in the lower right corner: the ASN and a topic page number. Each topic is made up of a page block. Each page block is for a special type of information. These are the page blocks:

Type of Information	Page Block
COMPONENT LOCATION (CL)	101-199
MAINTENANCE PRACTICES (MP)	201-299
SERVICING (SRV)	301-399
REMOVAL/INSTALLATION (R/I)	401-499
ADJUSTMENT/TEST (A/T)	501-599
INSPECTION/CHECK (I/C)	601-699
CLEANING/PAINTING (C/P)	701-799
REPAIRS (AR)	801-899
DISPATCH DEVIATIONS GUIDE (DDG)	901-999

The dispatch deviations guide page block is new with the 777. It has procedures with maintenance tasks that prepare the airplane for flight with certain systems/ components inoperative. It also has tasks that put the airplane back to its usual condition.

If all the topics for an ATA chapter, subsystem, or sub-subsystem are brief, all the topics are in a single MAINTENANCE PRACTICES page block.

Component Locations

The COMPONENT LOCATION topic has a component index and component location illustrations.

The component index is an alphabetical list of all components for the system, subsystem, or sub-subsystem. There is a reference to the figure and sheet for each component.

777 MAINTENANCE DOCUMENTS - AMM PART II - INTRODUCTION

Components from different systems that have an operational relationship to the system, are also in the index. These components have a cross-reference to the chapter to which they are assigned.

Circuit breakers and other electrical components that do not have specific maintenance manual procedures have references to the wiring diagram manual (WDM).

Training Information Point

Each chapter of part II of the AMM has a list of effective pages at the beginning of each chapter.

Chapter 12 of the AMM has the title SERVICING. This chapter has procedures to fill and drain items such as:

- Fuel
- Oil
- Hydraulic fluid
- Water
- Tire pressure.

BOEING 777
MAINTENANCE MANUAL

Chapter 21 - AIR CONDITIONING
Part II

TABLE OF CONTENTS

21-CONTENTS PART II

Page 1
D633W101-TBC Mar 15/94

CHAPTER TABLE OF CONTENTS (TYPICAL)

BOEING 777
MAINTENANCE MANUAL

EQUIPMENT COOLING SYSTEM

COMPONENT	FIG	QTY	ACCESS/AREA	AMM REF
CHECK VALVE -				
CONV SUPPL CLG (VSCF)	105	1	MAIN EQUIP CTR, R	21-27-06
SATCOM BACKUP CLG	113	1	AREA ABOVE PASS COMPT CEILG, L - SECTION 46	21-27-31
CONTROLLER -				
L EQUIP CLG, M21104	101	1	MAIN EQUIP CTR, L	21-27-01
R EQUIP CLG, M21207	102	1	MAIN EQUIP CTR, R	21-27-01
FAN -				
EQUIP CLG VENT, B21583	109	1	FWD CGO COMPT, R	21-27-21
L EQUIP CLG SUPPLY, B21581	104	1	FWD CARGO COMPT, L	21-27-03
R EQUIP CLG SUPPLY, B21582	104	1	FWD CARGO COMPT, L	21-27-03
SATCOM BACKUP CLG, B21265	112	1	AREA ABOVE PASS COMPT CEILG, L - SECTION 46	21-27-30
FILTER -				
EQUIP CLG AIR	103	1	FWD CARGO COMPT, L	21-27-02
LOW FLOW SENSOR -				
EE BAY, M21582	106	1	AREA BLW FWD CGO COMPT, R	21-27-07
FLT DK, M21583	107	1	MAIN EQUIP CTR, R	21-27-07
PRESSURE SENSOR -				
E4 RACK DUCT, M21586	108	1	MAIN EQUIP CTR, R	21-27-08
E5 RACK DUCT, M21584	108	1	FWD CGO COMPT, R	21-27-08
FLT DECK DUCT, M21587	108	1	AREA FWD OF NOSE LDG GEAR WHEEL WELL	21-27-08
VSCF DUCT, M21585	108	1	FWD CGO COMPT, R	21-27-08
VALVE -				
EQUIP CLG OVRD, V21585	105	1	FWD CARGO COMPT, L	21-27-04
EQUIP CLG VENT, V21584	110	1	AREA BLW FWD CGO COMPT, L	21-27-21
FWD CARGO HEAT, V21583	111	1	AREA BLW FWD CGO COMPT, L	21-27-22

Equipment Cooling System - Component Index
Table 101

EFFECTIVITY
ALL

21-27-00 ASN

Page 101
D633W101-TBC Mar 15/94
PAGE BLOCK

COMPONENT INDEX (TYPICAL)

01-00-00-003 Rev 5

777 MAINTENANCE DOCUMENTS - AMM PART II - INTRODUCTION

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777 MAINTENANCE DOCUMENTS - AMM PART II - MAINTENANCE TASK STRUCTURE

General

The maintenance tasks are procedures for specific maintenance requirements. For example, R/I page blocks normally contain two tasks: removal of the LRU and installation of the LRU.

Each procedure has some or all of these paragraphs:

- General
- Access
- Prepare for removal
- Equipment
- Consumable materials
- References.

General Paragraph

The general paragraph is an introduction that gives the purpose and limitations of the task. There may be a general paragraph for the page block, or for each task.

References Paragraph

The references paragraph is a list that supplies all references. References may be made to other AMM procedures or other manuals.

Access Paragraph

The access paragraph is a summary of all location zones and access panel information to do the task. See chapter six of the maintenance manual for more information on the zone and access panel numbering systems.

Prepare for Removal Paragraph (Not Shown)

The prepare for removal paragraph is for tasks in the R/I page block. The paragraph gives all the things you must do before you start the task. This includes any doors, panels, or circuit breakers that you must open.

Equipment Paragraph

The equipment paragraph is a summary of all tools and test equipment to do the task. Each piece of equipment also has its part number.

Consumable Materials Paragraph

The consumable materials paragraph is a summary of all consumable materials necessary to complete the task. The Boeing Spares Department gives each airline a list of all consumable materials that you need to do all the tasks in the maintenance manual.

Procedure Paragraph

The procedure paragraph has the steps to complete the task.

Training Information Point

Each page has a section that gives the effectivity of the page. It may say ALL or it may give specified airplane identification numbers.

BOEING 777
MAINTENANCE MANUAL

POWER DOOR OPENING SYSTEM (PDOS) - SERVICING

GENERAL PARAGRAPH

1. General
   A. This procedure has one task:
      (1) Fill the power door opening system (PDOS) pump (referred to as the PDOS pump) with oil.

   TASK 12-12-02-610-801

2. Fill the PDOS Pump with Oil (Fig. 301)
   A. General
      (1) The PDOS pump is installed in the brackets on the fan cowl support assembly. The fan cowl support assemble is on the forward side of the strut. You must remove the No. 1 forward fairing from the strut to get access to the PDOS pump.
      (2) You need to use the fall arrest lifeline procedure or other safety equipment to do this task.
      (3) After the oil servicing, you must do a bleed air check on the PDOS system.

REFERENCES PARAGRAPH

   B. References
      (1) AMM TASK 27-81-00-040-801 p201, Leading Edge Slat Deactivation
      (2) AMM TASK 27-81-00-440-801 p201, Leading Edge Slat Reactivation
      (3) AMM TASK 27-81-00-860-805 p201, Retract the Leading Edge Slats
      (4) AMM TASK 54-52-00-971-804 p201, Fall Arrest Lifeline Procedure
      (5) AMM TASK 54-52-01-000-802 p401, Fan Cowl Support Beam Fairings Removal
      (6) AMM TASK 54-52-01-400-802 p401, Fan Cowl Support Beam Fairings Installation
      (7) AMM TASK 70-41-00-910-801-G00 p201, Lockwire Installation
   C. Consumable Materials
      (1) D00109 Oil, Aircraft turbine engine, synthetic base - MIL-L-7808
      (2) D00523 Oil, Aircraft turbine engine, synthetic base - MIL-L-23699

CONSUMABLE MATERIALS PARAGRAPH

ACCESS PARAGRAPH

   D. Access
      (1) Location Zones
         (a) 431 Forward Strut Fairing - Left Nacelle Strut
         (b) 441 Forward Strut Fairing - Right Nacelle Strut

PROCEDURE

   E. Procedure

      SUBTASK 480-002

   WARNING: USE THE FALL ARREST LIFELINE PROCEDURE IF YOU DO NOT USE OTHER SAFETY EQUIPMENT. IF YOU DO NOT, YOU COULD FALL AND CAUSE INJURY OR DEATH.

      (1) If you do not use other safety equipment, do the (strut-mounted) Fall Arrest Lifeline Procedure (AMM TASK 54-52-00-910-803 p201)

      SUBTASK 010-003
      (2) Remove the No. fairing on the applicable strut (AMM TASK 54-52-01-000-806 p401):
         (a) No. 2 Forward Fairing, 431CT

EFFECTIVITY
ALL

12-12-02

D633W101-TBC

Page 301
Mar 15/94

777 MAINTENANCE DOCUMENTS - AMM PART II - MAINTENANCE TASK STRUCTURE

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777 MAINTENANCE DOCUMENTS - MAINTENANCE TIPS

General

The maintenance tip gives information that helps the mechanic in a procedure. The information is short and simple so it is easy to understand. It is published and mailed within 10 days by Boeing Service Engineering. The maintenance tip gives mechanics information to make repairs quickly and easily. It has these sections:

- Number
- Release date
- Subject
- Applicability
- Condition
- Recommended Action
- Background (optional)
- Maintenance Manual Action
- Reason For Cancellation (optional)
- Reference Message Number (#) (optional).

Number

The maintenance tip number has five digits. The first two digits are the ATA chapter. The last three digits are the sequence number for the ATA.

Release Date

This is the publication date for the maintenance tip.

Subject

The subject shows the topic of the procedure.

Applicability

The applicability gives line numbers, airplanes, or part numbers and software if necessary.

Condition

The condition section gives a brief description of the condition.

Recommended Action

This section gives the actions necessary to dispatch the airplane. This section may include a sketch if applicable.

Background (optional)

The background section gives the probable cause of the condition. It may tell how to prevent the condition.

Maintenance Manual Action

This section shows which manuals have updates.

Reason For Cancellation (optional)

This section shows why this maintenance tip is no longer in effect. CANCELLED also shows across the first page of the maintenance tip.

Reference Message Number (#) (optional)

This section has the central maintenance computing system maintenance messages shown in this tip.

BOEING 777

MAINTENANCE TIP

Customer Services Division

SERVICE ENGINEERING BOEING COMMERCIAL AIRPLANE GROUP P.O. BOX 3707 SEATTLE WASHINGTON 98124-2207

NUMBER

777 MT 34-0002

RELEASE DATE

21 JUNE 1996

SUBJECT

SUBJECT GPS STATUS MESSAGES

APPLICABILITY

APPLICABILITY All 777-200 airplanes equipped with P/NS242T104-201 (XYZ Corp P/N XG2021GP01) Global Positioning System (GPS) sensor units.

CONDITION

CONDITION "GPS L" or "GPS R" status message displayed.

RECOMMENDED ACTION

RECOMMENDED ACTION If the status message "GPS L" or "GPS R" is displayed after a flight, accomplish the following:

1. View the PRESENT LEG FAULT information for the flight where the "GPS L,R" status message was displayed.
2. Check for the following maintenance messages:

   34-52801 = GPS sensor unit (left) has no output on any bus
   34-52802 = GPS sensor unit (right) has no output on any bus

3. If either of these maintenance messages are correlated to the "GPS L" or "GPS R" status message, then cycle the circuit breaker for the applicable GPS sensor unit:

GRID LOCATION	NOMENCLATURE	
11G5	GLOBAL POS L	for left GPS sensor unit
11G18	GLOBAL POS R	for right GPS sensor unit

If cycling power to the GPS sensor unit does not clear the status message, then the GPS sensor unit should be replaced.

BACKGROUND

BACKGROUND Boeing is currently investigating a condition experienced during flight where the XYZ Corp. GPS sensor unit detects a critical fault and shuts down. The result is display of the "GPS L" or "GPS R" status message. Cycling electrical power to the GPS sensor clears the status message and restores normal operation of the sensor unit. Subsequent shop testing of GPS sensor units removed from the airplane due to this condition results in the unit testing ok with no faults found. Since this is a potential nuisance message condition, this maintenance tip is being issued to advise maintenance crews to first cycle power to the GPS sensor unit when the aforementioned maintenance messages are displayed.

MAINTENANCE MANUAL ACTION

MAINTENANCE MANUAL ACTION The 5 September 1996 revision to the 777 Fault Isolation Manual will include the troubleshooting information in this maintenance tip.

REFERENCE MAINTENANCE MESSAGE NUMBER

REFERENCE MSG # 34-52801
34-52802

777 MAINTENANCE DOCUMENTS - MAINTENANCE TIPS

01-00-00-023 Rev 0 11/04/1996

777 MAINTENANCE DOCUMENTS - SYSTEM SCHEMATICS MANUAL (SSM)

Purpose

The system schematics manual gives the user an understanding of system operation and helps in the fault isolation process. To do this, the manual includes this kind of information on the schematics:

- Component locations
- Component identification (drawings)
- Controls
- Displays
- Logic for system/subsystem operation
- Logic for messages.

Organization

The system schematics manual organization is by ATA chapter, then chapter/section (subsystem). Each ATA chapter/section usually defines an airplane system or subsystem. Within an ATA chapter, the schematics show in increasing depth or complexity.

The schematic numbers follow this order:

- ATA chapter/section (four-digit number)
- Schematic number (two-digit number)
- Page number
- Sheet number.

Page numbers (Page 101, 102, etc.) show configurations of a schematic for different airplanes in a customer's fleet.

There is a sheet number only if the schematic cannot show on one sheet.

General Chapter

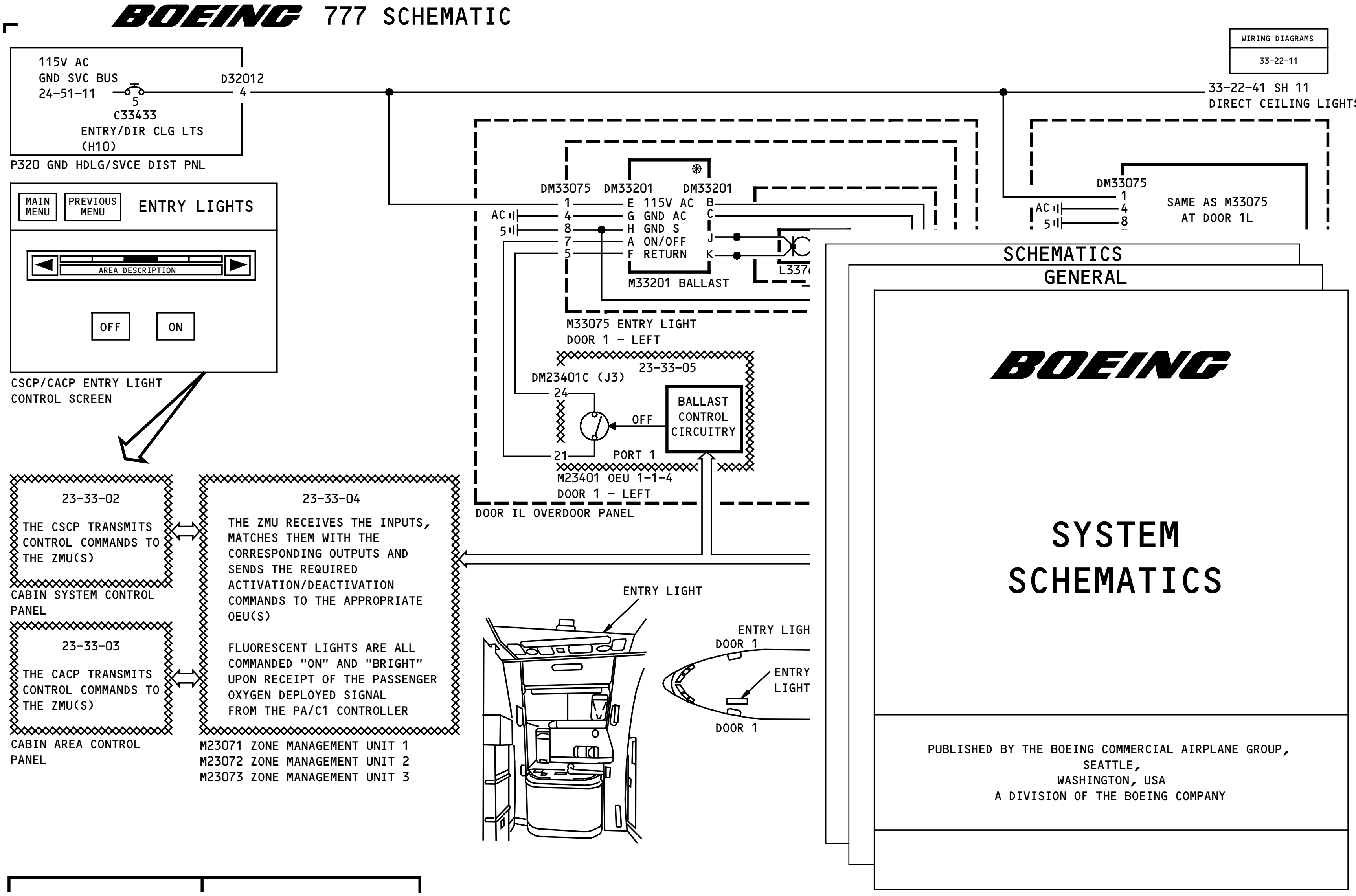
There is a general chapter. It has chapter number 00. The general chapter has this customized data:

- 00-00-00-00; Airplane principal dimensions
- 00-00-00-10; Ground service access panels
- 00-00-00-20; Airplane stations
- 00-00-00-30; Panel locations (including circuit breaker panel configurations)
- 00-00-00-40; Equipment center locations and configurations.

Training Information Point

Schematics and wiring diagrams show two important improvements that affect the maintenance technician. First, the equipment number of an LRU on the 777 has the ATA chapter of the LRU as the first two numbers. These numbers are after the letter that shows the kind of LRU (M, K, L, etc.).

Second, the connector numbers for an LRU are the same as the equipment numbers with the letter "D" in front. For example, the connector for the M33075 entry light is DM33075. The exception to this is for connectors on power panels which have numerous connectors. In this case, the connector number has the panel number and a two-digit connector number. For example, a connector on the P320 panel is D32012.



01-00-00-005 Rev 2

777 MAINTENANCE DOCUMENTS - SYSTEM SCHEMATICS MANUAL (SSM)

777 MAINTENANCE DOCUMENTS - WIRING DIAGRAM MANUAL (WDM)

Purpose

The wiring diagram manual gives details of the point-to-point wiring on the airplane. It shows all connectors including breakout and shelf connectors.

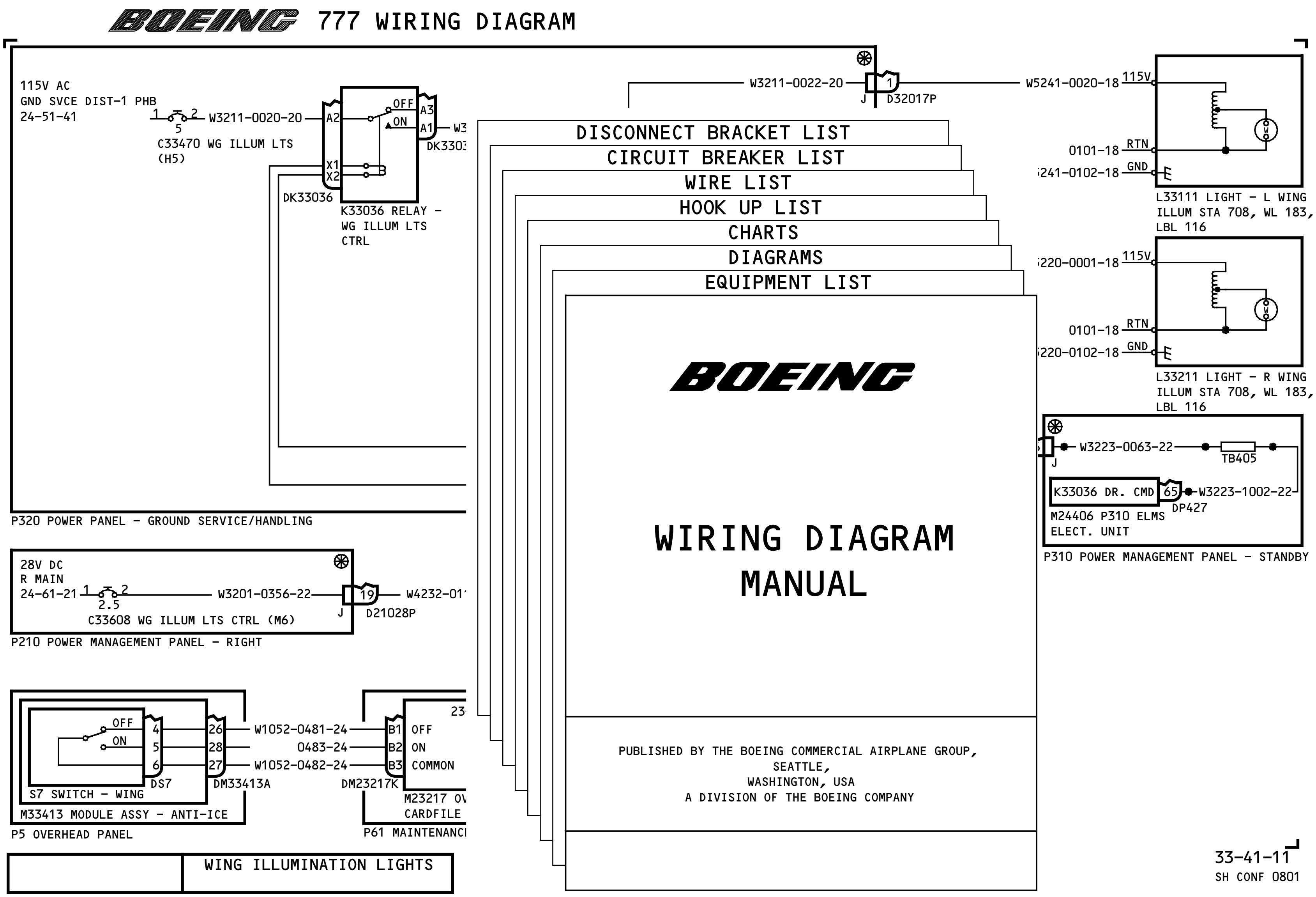
The wiring diagram shows simple internal components of LRUs so the user may better understand the signal flow and purpose of the wiring. Internal components do not show if they are complex or if the signal(s) comes from or goes to software.

Organization

The organization of the wiring diagram manual is similar to the system schematic manual. It uses the ATA chapter/section organization.

These are the sections of the wiring diagram manual:

- Equipment list
- Diagrams
- Charts
- Hook up list
- Wire list
- Circuit breaker list
- Disconnect bracket list.



777 MAINTENANCE DOCUMENTS - WIRING DIAGRAM MANUAL (WDM)

General

The dispatch deviations guide (DDG) helps the airline operations and maintenance organizations. It helps these organizations develop the procedures to operate their airplane in non-standard configurations. This manual shows the Federal Aviation Administration's (FAA) permitted non-standard configurations. It has these sections:

- Introduction
- EICAS Messages
- Minimum Equipment List Items
- Configuration Deviation List Items
- Ferry Items
- Miscellaneous Items.

Introduction

The introduction section gives the purpose, background, contents, and organization of the DDG.

EICAS Messages

The DDG has an EICAS message list with a cross reference to the minimum equipment list items. Use the EICAS message list to find the minimum equipment list (MEL) item for possible dispatch relief. The EICAS message is in alphabetical order by EICAS message text.

The EICAS message list has these parts:

- Message text
- Level
- Notes
- Condition
- MMEL item.

The message text shows the text of the EICAS message as it shows on the airplane.

These are the EICAS message levels:

- Warning
- Caution
- Advisory
- Comm
- Memo
- Status.

The notes show if the EICAS message is basic, optional, or provisional.

The condition gives a description of what causes this EICAS message.

Use the MEL item to find the necessary procedures to operate the aircraft in a non-standard configuration.

Minimum Equipment List Items

The FAA publishes a master minimum equipment list (MMEL). The operator can add to the MMEL. Then it is the MEL. The MEL has the minimum equipment and the procedures necessary to operate the aircraft. The company MEL cannot be less restrictive than the master minimum equipment list.

The MEL has an ATA index of MEL items and a list of definitions.

The MEL items are in ATA sequence. There is a general system schematic at the start of each ATA chapter.

These are the parts of the minimum equipment list items:

- Item
- Repair Interval
- Number Installed
- Number Required For Dispatch
- Remarks Or Exceptions
- EICAS Status Messages
- Placard
- Maintenance Procedure (optional)
- Operations Procedure (optional).

The Item is the equipment, system, or function installed in the airplane.

The Repair Interval shows when you must repair the item. Repair intervals are specified in the front section of the MEL. These letter codes show the time interval:

- A; as shown in the remarks or exceptions column
- B; within 3 consecutive calendar days
- C; within 10 consecutive calendar days
- D; within 120 consecutive calendar days.

The Number Installed is the quantity usually installed in the airplane. A dash "-" shows if the quantity can change.

The Number Required For Dispatch is the minimum quantity necessary for operation if you meet the conditions in the remarks of exceptions column. The MMEL may show a dash "-" in this column. The MEL must show actual quantity required.

The Remarks Or Exceptions column shows what you must do to release the airplane. It may also show operations notes and limits.

The EICAS Status Message section lists the EICAS status messages that show when this item does not operate.

The Placard section shows the placard and where you must put it when this item does not operate.

Some MEL items have a Maintenance Procedure that you must do to release the airplane. The maintenance procedure is listed in the MEL if it is simple. A reference to the procedure in the 900 page block of the airplane maintenance manual (AMM) is listed if the procedure is more complex.

Some MEL items have an Operations Procedure. The flight crew must do this procedure if your airline operates the airplane when this item does not operate.

Configuration Deviation List Items

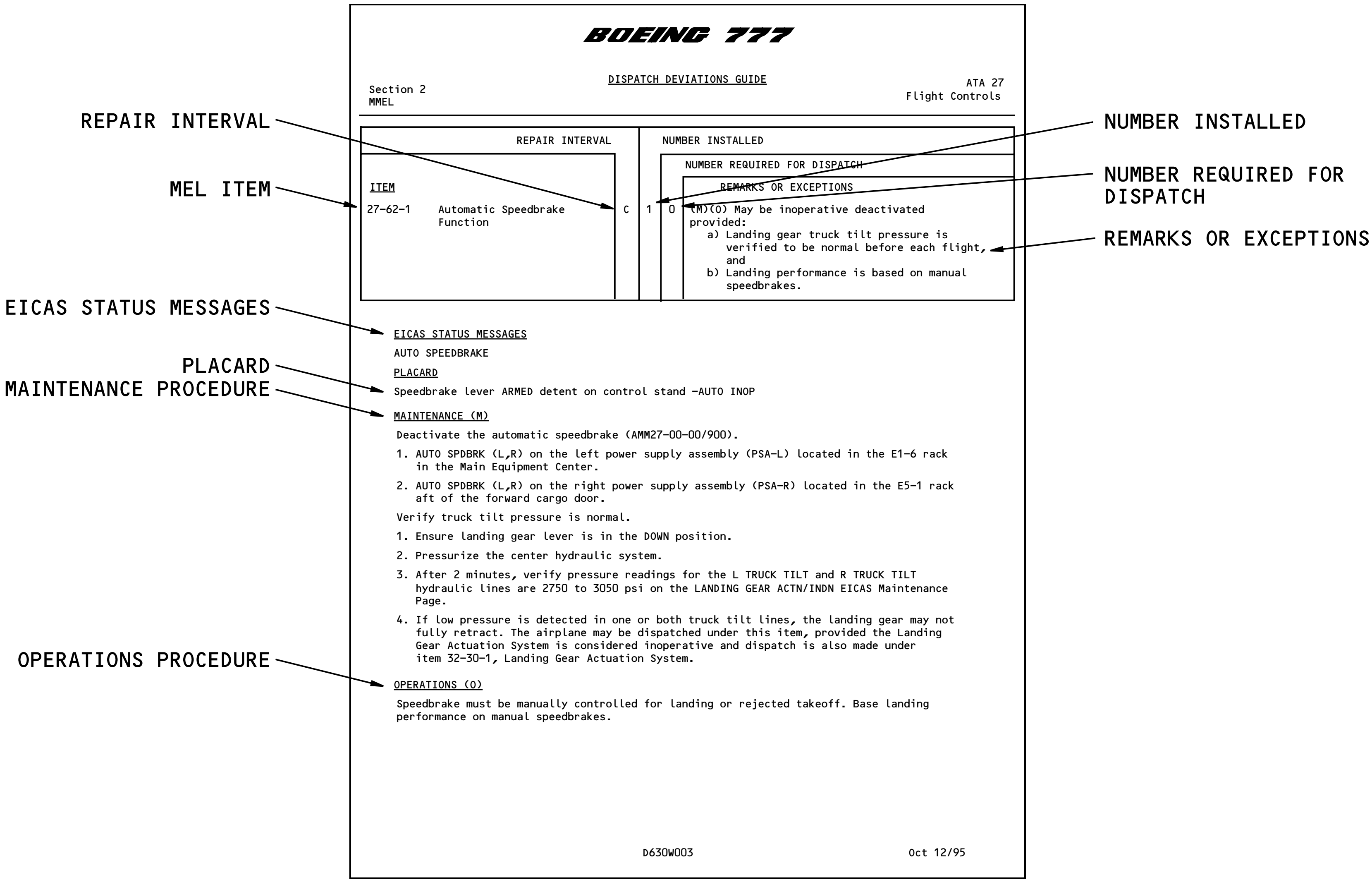
The Configuration Deviation List (CDL) is an appendix to the FAA approved aircraft flight manual (AFM). It includes secondary airframe and engine parts which you do not have to have for dispatch.

Ferry Items

A ferry flight occurs when it is necessary to fly the aircraft back to a maintenance base for repairs. Your airline makes a ferry flight when the MMEL or the CDL does not permit dispatch with revenue passengers. The Ferry Items section contains information you must have for dispatch with a configuration deviation for a ferry flight.

Miscellaneous Items

The Miscellaneous Items section contains a list of items that are unique and do fit in the other deviation lists.



BOEING 777

Section 2
MMEL

DISPATCH DEVIATIONS GUIDE

ATA 27
Flight Controls

ITEM		REPAIR INTERVAL	NUMBER INSTALLED	NUMBER REQUIRED FOR DISPATCH	REMARKS OR EXCEPTIONS
27-62-1	Automatic Speedbrake Function	C	1	0	(M)(O) May be inoperative deactivated provided: a) Landing gear truck tilt pressure is verified to be normal before each flight, and b) Landing performance is based on manual speedbrakes.

EICAS STATUS MESSAGES

AUTO SPEEDBRAKE

PLACARD

Speedbrake lever ARMED detent on control stand -AUTO INOP

MAINTENANCE (M)

Deactivate the automatic speedbrake (AMM27-00-00/900).

1. AUTO SPDBRK (L,R) on the left power supply assembly (PSA-L) located in the E1-6 rack in the Main Equipment Center.
2. AUTO SPDBRK (L,R) on the right power supply assembly (PSA-R) located in the E5-1 rack aft of the forward cargo door.

Verify truck tilt pressure is normal.

1. Ensure landing gear lever is in the DOWN position.
2. Pressurize the center hydraulic system.
3. After 2 minutes, verify pressure readings for the L TRUCK TILT and R TRUCK TILT hydraulic lines are 2750 to 3050 psi on the LANDING GEAR ACTN/INDN EICAS Maintenance Page.
4. If low pressure is detected in one or both truck tilt lines, the landing gear may not fully retract. The airplane may be dispatched under this item, provided the Landing Gear Actuation System is considered inoperative and dispatch is also made under item 32-30-1, Landing Gear Actuation System.

OPERATIONS (O)

Speedbrake must be manually controlled for landing or rejected takeoff. Base landing performance on manual speedbrakes.

D630W003 Oct 12/95

DISPATCH DEVIATION GUIDE - MINIMUM EQUIPMENT LIST ITEM

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General

The fault reporting manual (FRM) gives the flight crew a simple list of fault descriptions. Each fault description has a fault code.

When the flight crew finds a problem on the airplane, they look for the description of the fault indication in the FRM. They write the fault description and the fault code in the log book. They can also send the information to a ground station so maintenance personnel can prepare before the airplane arrives.

The FRM has these sections:

- EICAS alert messages
- Observed faults
- EICAS status messages
- Cabin faults.

EICAS Alert Messages

The EICAS ALERT MESSAGES section is an alphabetical list of all EICAS warning, caution, and advisory messages. With each message is the message level (warning, caution, or advisory) and a fault code.

This information is the same as the information in the fault isolation manual (FIM). The FIM also has a brief description of the message. See the section on the FIM for more information.

Observed Faults

The OBSERVED FAULTS section is an alphabetical list of fault descriptions for malfunctions that the flight crew or ground service crew can see. These are some examples of observed faults:

- Flap lever difficult to operate
- Tire number 6 is worn.

This information is also in the FIM. The FIM also has a FIM task number. See the section on the FIM for more information.

EICAS Status Messages

The EICAS STATUS MESSAGES section is an alphabetical list of all EICAS status messages. Status messages are in a separate section because it is not necessary for the flight crew to monitor status messages during flight.

With each message is a brief description and a fault code.

This information is also in the FIM. See the section on the FIM for more information.

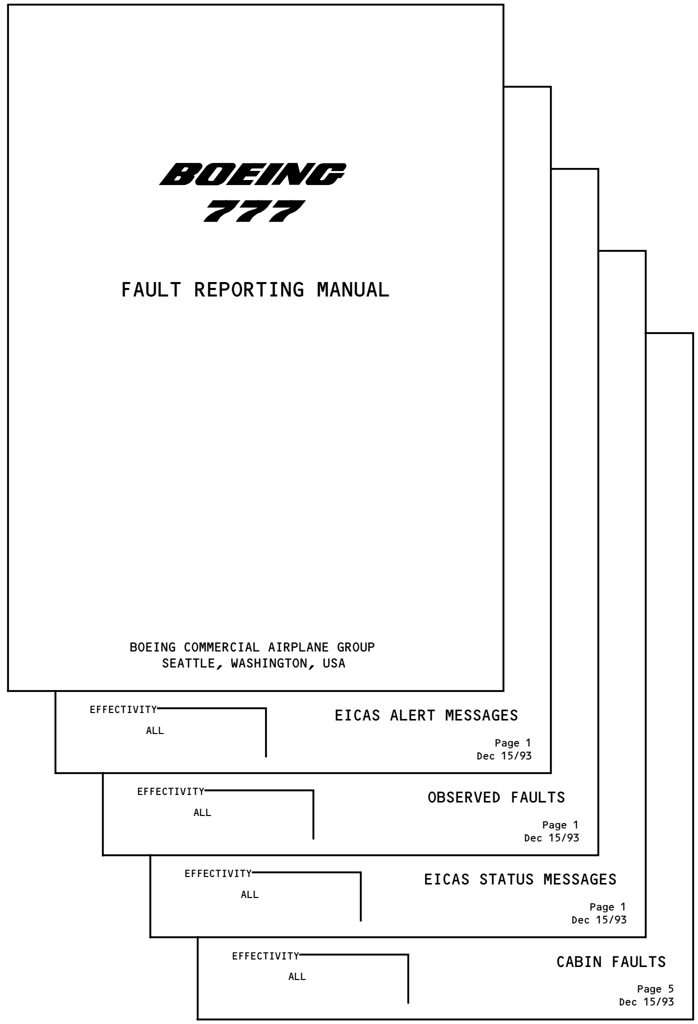
Cabin Faults

The CABIN FAULTS section is a list of fault descriptions for malfunctions that the cabin crew can see. The faults are in groups based on system function.

777 MAINTENANCE DOCUMENTS - FAULT REPORTING MANUAL (FRM)

With each description is a fault code. An example of a cabin fault is: GALLEYS - OVEN - DOES NOT HEAT.

This information is the same as the information in the FIM. The FIM also has a FIM task number. See the section on the FIM for more information.



777 MAINTENANCE DOCUMENTS - FAULT REPORTING MANUAL (FRM)

General

You use the fault isolation manual (FIM) to isolate and correct airplane faults.

To isolate a fault, you must get a FIM task number. You use different sections of the FIM along with airplane data to identify the correct task number.

The FIM has front subjects and chapter subjects.

FIM Front Subjects

You use the front subjects to find a fault code or a task number. With the fault code, you can find which tasks in the FIM you must do to correct the fault. These are the front subjects:

- EICAS message list
- Observed fault list
- Cabin fault list
- Cabin fault code index.

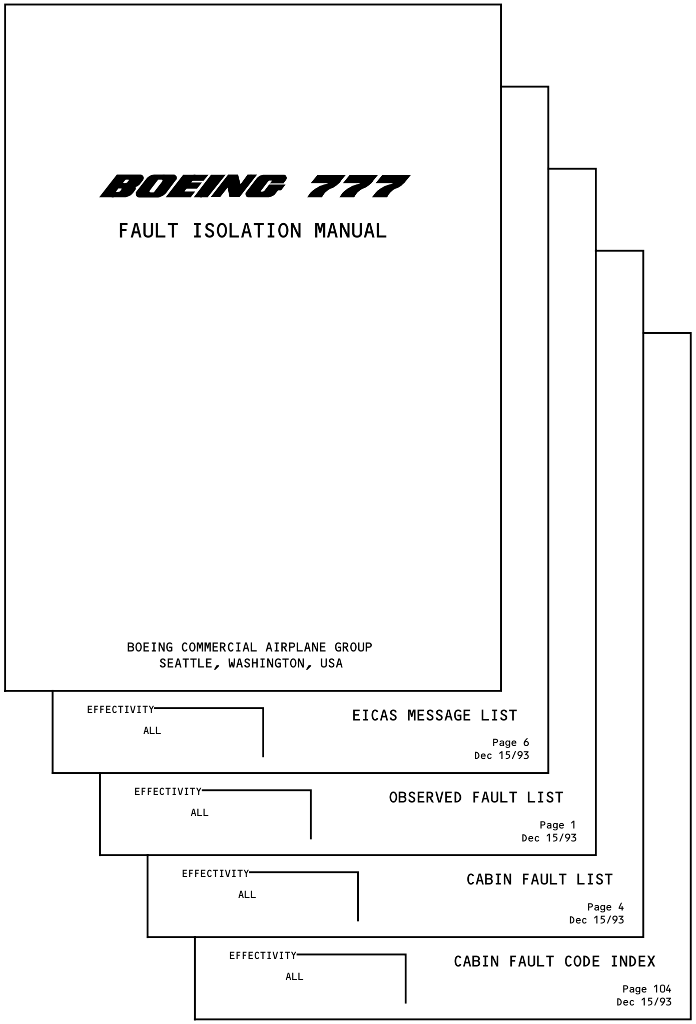
FIM Chapter Subjects

The chapter subjects have two types of information. The subjects have the fault isolation tasks. They also have information that help you identify the correct task. These are the chapter subjects:

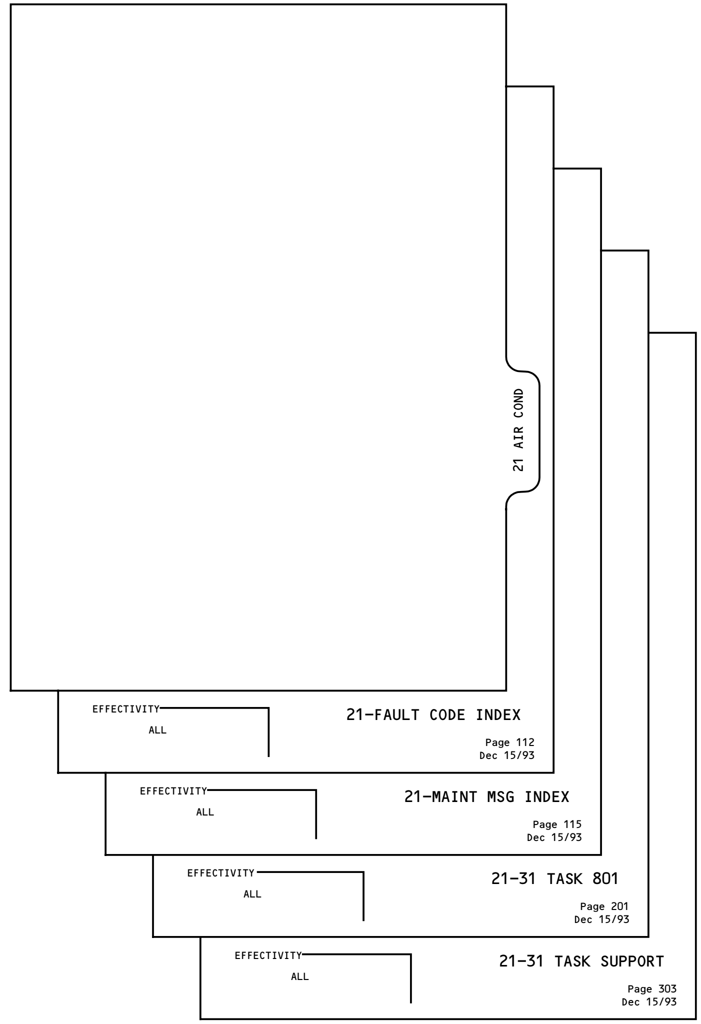
- Fault code index
- Maintenance message index
- Fault isolation tasks
- Task support pages.

Training Information Point

If the flight crew does not supply a fault code, you can use the front subjects of the FIM to find the fault code.



FIM FRONT SUBJECTS



FIM CHAPTER SUBJECTS

01-00-00-008 Rev 1

777 MAINTENANCE DOCUMENTS - FIM - INTRODUCTION

777 MAINTENANCE DOCUMENTS - FIM - EICAS MESSAGE LIST

General

The EICAS MESSAGE LIST is an alphabetical list of all EICAS messages. Each message in the list has this information:

- Message level (warning, caution, advisory, status, communication, or memo)
- Brief description of the problem that causes the message
- Fault code.

See the primary display system section for information on EICAS message levels (AMM PART I 31-61).

Training Information Point

See the section on the FAULT CODE INDEX for information on the meaning of the digits of the fault code.

BOEING 777
FAULT ISOLATION MANUAL

EICAS MESSAGE (LEVEL)	DESCRIPTION	FAULT CODE
CABIN ALTITUDE (WARNING)	Cabin altitude is greater than or equal to 10K feet and selected landing altitude is less than 9.65K feet.	213 144 00
CABIN ALTITUDE AUTO (CAUTION)	Complete automatic control failure or manual control selected.	213 146 00
CABIN INTERPHONE (STATUS)	Selected cabin interphone is failed, or other cabin interphone failure exists.	232 004 00
CABIN PRESS LEFT (STATUS)	Loss of left air supply and cabin pressure controller function. Failure of both left ASCPC channels.	213 145 41
CABIN PRESS RIGHT (STATUS)	Loss of right air supply and cabin pressure controller function. Failure of both right ASCPC channels.	213 145 42

EICAS MESSAGE

FAULT CODE

CABIN ALTITUDE (WARNING)	CABIN ALTITUDE IS GREATER THAN OR EQUAL TO 10K FEET AND SELECTED LANDING ALTITUDE IS LESS THAN 9.65K FEET	213 144 00

MESSAGE LEVEL

EICAS MESSAGE DATA (TYPICAL)

(ADVISORY)	compartment due to failure of both aft controller channels or failure of both aft smoke detector fans.	
DET FIRE CARGO FWD (ADVISORY)	Loss of smoke detection in fwd cargo compartment due to failure of both fwd controller channels or failure of both fwd smoke detector fans.	261 611 44

MESSAGE DESCRIPTION

EFFECTIVITY
ALL

EICAS MESSAGE LIST

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777 MAINTENANCE DOCUMENTS - FIM - EICAS MESSAGE LIST

777 MAINTENANCE DOCUMENTS - FIM - OBSERVED FAULT LIST

General

The OBSERVED FAULT LIST is an alphabetical list of fault descriptions for malfunctions that the flight crew or ground service crew can see.

These are the items in the list:

- Fault description
- Fault code
- FIM task number.

Training Information Point

When you use the list, select the fault that best describes the malfunction.

The same fault may have more than one description. For example, the fault code is the same for these descriptions:

- Glareshield panel light(s) do not come on
- Light(s), glareshield panel, do not come on.

BOEING 777
FAULT ISOLATION MANUAL

FAULT DESCRIPTION	FAULT CODE	GO TO FIM TASK
ACARS item selections (left CDU) do not respond to to line item selection keys	232 652 43	23-99 TASK 801
ACARS item selections (left CDU) do not respond to line item selection keys	232 652 41	23-99 TASK 801
ACARS item selections (right CDU) do not respond to line item selection keys	232 652 42	23-99 TASK 801
ACARS menu pages (center CDU) do not show when ACARS menu key selected..........................	232 651 43	23-99 TASK 801
ACARS menu pages (left CDU) do not show when ACARS menu key selected.........................	232 651 41	23-99 TASK 801
ACARS menu pages (right CDU) do not show when ACARS menu key selected.........................	232 651 42	23-99 TASK 801
ADF (left) audio problem.........................	345 643 41	34-99 TASK 801
ADF (left) indication blank on both NDs...........	345 641 48	34-99 TASK 801
ADF (left) indication blank on both ND (Capt)	345 836 42	34-52 TASK 801
ADF ident/audio not received at Capt's station ...	345 833 31	34-52 TASK 801
ADF ident/audio not received at F/O's station	345 833 32	34-52 TASK 801
Aft cargo door failed to close	326 804 00	34-61 TASK 801
Aft cargo door failed to open	526 803 00	34-61 TASK 801
Aileron control wheel binding/jammed	271 813 00	34-18 TASK 801
Aileron position indicator error	271 809 00	34-18 TASK 801
Air conditioning - General fault not listed	210 000 00	21-21 TASK 801
Air conditioning - Distribution fault not listed	212 000 00	21-21 TASK 802
Air conditioning - Pressurization fault not listed	213 000 00	21-31 TASK 801
Air conditioning - Heating fault not listed	214 000 00	21-41 TASK 801
Air conditioning - Cooling fault not listed	215 000 00	21-51 TASK 801
Air conditioning - Temp control fault not listed	216 000 00	21-61 TASK 801
Air conditioning - Humidification fault not		

FAULT DESCRIPTION	FAULT CODE	GO TO FIM TASK
ADF (LEFT) INDICATION BLANK ON BOTH ND(S).............	345 641 48	34-99 TASK 801

OBSERVED FAULT (TYPICAL)

EFFECTIVITY
ALL

OBSERVED FAULT LIST
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777 MAINTENANCE DOCUMENTS - FIM - OBSERVED FAULT LIST

General

The CABIN FAULT LIST is a list of fault descriptions for malfunctions that the cabin crew finds. The faults are in groups based on system function.

These are the items in the list:

- Fault description
- Fault code
- FIM task number.

Cabin Fault Code Structure

Each cabin fault code starts with a letter. This tells you that the fault is not in a flight-related system. It shows the general cabin function. For example, G is the letter for galley faults.

The second and third digits show the type of component. For example, 01 is the code for a galley.

The fourth and fifth digits show the type of problem. For example, 33 is the code for an inoperative component.

The last three digits are not specified. The cabin crew uses these digits to enter a location identifier such as a seat number or galley location.

Training Information Point

When you use the cabin fault from the list, select the fault that best describes the malfunction.

Digits three, four, and five of the fault code are described in air transport association (ATA) specification 100.

BOEING 777
FAULT ISOLATION MANUAL

FAULT DESCRIPTION	FAULT CODE (location ---)	GO TO FIM TASK
GALLEYS (cont.)		
Chiller - inoperative	G01 33 ---	25-31 TASK 802
Chiller - intermittent	G01 34 ---	25-31 TASK 802
Chiller - shuts off	G01 52 ---	25-31 TASK 802
Coffee maker - does not heat	G02 75 ---	AIRLINE METHOD
Coffee maker - leaking	G02 36 ---	AIRLINE METHOD
Coffee maker - overflows	G02 44 ---	AIRLINE METHOD
Drain - loose	G06 37 ---	AIRLINE METHOD
Drain - plugged/blocked	G06 47 ---	38-31 TASK 801
Oven - dirty	G05 17 ---	AIRLINE METHOD
Oven - does not heat	G05 75 ---	25-31 TASK 801
Oven - does not close	G05 71 ---	AIRLINE METHOD
Oven - does not open	G05 77 ---	AIRLINE METHOD
Oven - overheats	G05 46 ---	25-31 TASK 801
Oven - smells bad	G05 54 ---	AIRLINE METHOD
Serving cart - hard to operate	G51 29 ---	AIRLINE METHOD
Spigot - does not heat	G07 75 ---	38-13 TASK 805
Spigot - no water	G07 43 ---	38-15 TASK 802
Spigot - weak	G07 66 ---	38-15 TASK 802
LAVATORIES/TOILETS		

FAULT DESCRIPTION	FAULT CODE (LOCATION...)	GO TO FIM TASK
GALLEYS (CONT.)		
CHILLER - INOPERATIVE.........................	G01 33 ---	25-31 TASK 802

SYSTEM FUNCTION

CABIN FAULT (TYPICAL)

EFFECTIVITY
ALL

CABIN FAULT LIST

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777 MAINTENANCE DOCUMENTS - FIM - CABIN FAULT LIST

777 MAINTENANCE DOCUMENTS - FIM - CABIN FAULT CODE INDEX

General

The CABIN FAULT CODE INDEX is an alphabetical list of fault codes for malfunctions that the cabin crew can see. You use the index when you have a cabin fault code.

The index has these items:

- Fault code
- Brief description
- FIM task number.

Training Information Point

The CABIN FAULT CODE INDEX has the same information as the CABIN FAULT LIST. The only difference is the faults are in alpha-numerical order of the fault codes. They are not grouped by system function.

BOEING 777
FAULT ISOLATION MANUAL

FAULT CODE	FAULT DESCRIPTION	GO TO FIM TASK
L06 34 ---	Lights - passenger reading: intermittent.	33-23 TASK 802
L06 83 ---	Lights - passenger reading: does not turn off.	33-23 TASK 801
L06 84 ---	Lights - passenger reading: does not turn on.	33-23 TASK 801
L07 83 ---	Lights - sidewall: does not turn off.	33-21 TASK 801
L07 84 ---	Lights - sidewall: does not turn on.	33-21 TASK 801
L08 83 ---	Lights - entry/threshold: do not turn off.	33-22 TASK 801
	Seats - jumpseat: loose.	AIRLINE METHOD

FAULT CODE	FAULT DESCRIPTION	GO TO FIM TASK
L06 34 ---	LIGHTS - PASSENGER READING: INTERMITTENT	33-23 TASK 802

CABIN FAULT CODE (TYPICAL)

EFFECTIVITY
ALL

CABIN FAULT CODE INDEX

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777 MAINTENANCE DOCUMENTS - FIM - CABIN FAULT CODE INDEX

777 MAINTENANCE DOCUMENTS - FIM - FAULT CODE INDEX

General

The FAULT CODE INDEX is a numerical list of all fault codes for a chapter. With each fault code, there is a fault description and a minimum of one FIM task number.

If the fault description is an EICAS message, a list of maintenance messages shows next to the description. Each maintenance message has a specific task number reference on the same line. You must use the maintenance access terminal (MAT) to find the unique maintenance message for the fault.

See the central maintenance computing system section for more information on the MAT (AMM PART I 45-10).

Fault codes that are not for EICAS messages have one task number.

Fault Code Structure

All fault codes have eight digits. The codes have two blank spaces to make them easier to read.

The first three digits of the fault code are the ATA chapter plus the subsystem. For example, 213 is chapter 21 (air conditioning), subsystem 30 (pressurization).

The middle three digits are a unique number for the fault.

The last two digits are a location identifier, or an engine identifier. These location identifiers are described in air transport association (ATA) specification 100.

BOEING 777
FAULT ISOLATION MANUAL

FAULT CODE	FAULT DESCRIPTION	MAINT MESSAGE	GO TO FIM TASK
213 144 00	CABIN ALTITUDE (EICAS WARNING)	21-01345 21-01346 21-01348 21-01350 24-17543 24-17544	21-31 TASK 820 21-31 TASK 820 21-31 TASK 824 21-31 TASK 824 24-11 TASK 838 24-11 TASK 839
213 145 41	CABIN PRESS LEFT (EICAS STATUS)	21-01345 21-01347 21-01348	21-31 TASK 820 21-31 TASK 823 21-31 TASK 824

FAULT CODE	FAULT DESCRIPTION	MAINT MESSAGE	GO TO FIM TASK
213 147 42	PRESS RELIEF VLV R (EICAS ADVISORY)	21-01391 21-01393 21-01402 21-01451	21-31 TASK 803 21-31 TASK 804 21-31 TASK 809 21-31 TASK 899

	ground during climb.		
213 802 00	Cabin pressure MAN CONT INOP light illuminated.		21-31 TASK 851

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21-FAULT CODE INDEX

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777 MAINTENANCE DOCUMENTS - FIM - FAULT CODE INDEX

777 MAINTENANCE DOCUMENTS - FIM - MAINTENANCE MESSAGE INDEX

General

The MAINTENANCE MESSAGE INDEX is a list in numerical order of maintenance message numbers for a chapter. With each message number is the symptom text for the message and a FIM task number.

You get maintenance messages from the MAT and the cabin system control panel (CSCP).

See the cabin services system section for more information on the CSCP (AMM PART I 23-39).

The maintenance message index has the task number references for all maintenance messages, even for messages which do not correlate to EICAS messages.

Each maintenance message has the problem that causes the message (MESSAGE SYMPTOM) and the FIM task number for the message.

Maintenance Message Structure

All maintenance messages have seven digits. The codes have a dash to make them easier to read.

The first two digits of the fault code are the ATA chapter.

The last five digits are a unique number for the fault.

BOEING 777
FAULT ISOLATION MANUAL

MAINT MESSAGE	MESSAGE SYMPTOM	GO TO FIM SECTION
21-01345	Cabin Pressure Controller A Fail	21-31-TASK 820
21-01346	Cabin Pressure Controller B Fail	21-31-TASK 820
21-01347	Cabin Pressure Controller A DC Power Fail	21-31-TASK 823
21-01348	Cabin Pressure Controller A AC Power Fail	21-31-TASK 824
21-01349	Cabin Pressure Controller B DC Power Fail	21-31-TASK 823
21-01350	Cabin Pressure Controller B AC Power Fail	21-31-TASK 824

MAINT MESSAGE	MESSAGE SYMPTOM	GO TO FIM TASK
21-01360	OUTFLOW VALVE RIGHT OPEN LOCK FAIL	21-31 TASK 838

21-01360	Outflow Valve Right Open Lock Fail	21-31-TASK 838
21-01361	CPC-A > Outflow Valve Left Interface Fail	21-31-TASK 855
21-01362	CPC-B > Outflow Valve Left Interface Fail	21-31-TASK 855
21-01363	CPC-A > Outflow Valve Right Interface Fail	21-31-TASK 855
21-01364	CPC-B > Outflow Valve Right Interface Fail	21-31-TASK 855

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ALL

21-MAINT MSG INDEX

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777 MAINTENANCE DOCUMENTS - FIM - MAINTENANCE MESSAGE INDEX

777 MAINTENANCE DOCUMENTS - FIM - FIM TASKS

General

FIM tasks have the procedures to find and correct faults. The tasks are grouped at the sub-subsystem level. For example, all sub-subsystem 27-31 tasks are in a group. These tasks are in numerical order by task number.

The task identifier is the sub-subsystem number, the word TASK, and a three digit number.

Each FIM task assumes that the cause of the fault is a single component failure.

FIM Task Structure

Each FIM task has these parts:

- Task number and description
- Maintenance message
- Initial evaluation
- Fault isolation steps.

These are the assumed conditions at the start of the task:

- External electrical power is on
- Hydraulic power and pneumatic power are off
- Engines are shut down
- Circuit breakers for the system are closed.

The task has an initial evaluation paragraph that tells you if the fault is intermittent.

After the initial evaluation paragraph, the task has several steps. The steps may use several different paths. When you are at the end of a path, that task says that you corrected the fault.

Training Information Point

When a step in a FIM task says to do a wiring check, these are the types of checks you must do for the specified pins:

- Continuity from contact to contact
- Shorts between the contacts
- Shorts from each contact to ground.

A step in a FIM task may ask you to do a task in the AMM. After you do the AMM task, you must go back to the FIM and complete the FIM task.

BOEING 777
FAULT ISOLATION MANUAL

TASK NUMBER AND DESCRIPTION

805. Left Column Position Transducer 1 Problems - Fault Isolation

MAINTENANCE MESSAGE

A. This task is for maintenance message: 27-12000.

INITIAL EVALUATION PARAGRAPH

B. Initial Evaluation
   (1) If the MAT shows ACTIVE with the maintenance message, then do the Fault Isolation Procedure below.
   (2) If the MAT shows LATCHED with the maintenance message, then do the 27-Primary Flight Controls, Column Position Transducer test on the MAT.
   (3) If the MAT shows PASSED, then no corrective action is necessary.
   (4) If the MAT shows FAILED, do the Fault Isolation Procedure below.

FAULT ISOLATION STEPS

C. Fault Isolation Procedure
   (1) Make sure that the control column is at the neutral position.
   (2) Disconnect connector DM27134 from the left 1 column position transducer, M27134.
   (3) Do a check for 7 VAC between pins 8 and 9 of connector DM27134.
   (4) If there is 7 VAC between pins 8 and 9 of DM27134, do this check:
      (a) Measure the resistances between these pairs of pins of the connector on the transducer, M27134:
         1) Pin 1 to pin 5, specified resistance AA-BB ohms
         2) Pin 1 to pin 6, specified resistance CC-DD ohms
         3) Pin 8 to pin 9, specified resistance EE-FF ohms
      (b) If the resistance is not in the range specified for each pair of pins, replace the left 1 column position transducer, M27134 (AMM 27-31-04/401).
      (c) If the resistance is in the range specified for each pair of pins, do this check:
         1) Open these circuit breakers on the left PSA, M24101:
            a) A1 ACE PWR
            b) A3 AIL PCU
            c) A5 FLPRN PCU
            d) A7 ELEV PCU
            e) A9 RUD PCU
            f) B2 STAB TRIM
            g) B4 AUTOSPDBRK (L, R)
            h) B6 ELEV FEEL C
            i) B8 RUD TRIM ACTR (L)
         2) Remove the left 1 ACE, M27121 from the E1-5 shelf.
         3) Do a continuity check between these pins of connector DM27134 at the E1-5 shelf and connector D4474J at the E1-5 shelf (WDM 27-31-11):

WIRING CHECK

DM27134		D4474J
pin 1	-------------------------	pin 12
pin 5	-------------------------	pin 10
pin 6	-------------------------	pin 11

         4) If you find a problem in the wiring, do these steps:

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27-31 TASK 805

TASK NUMBER

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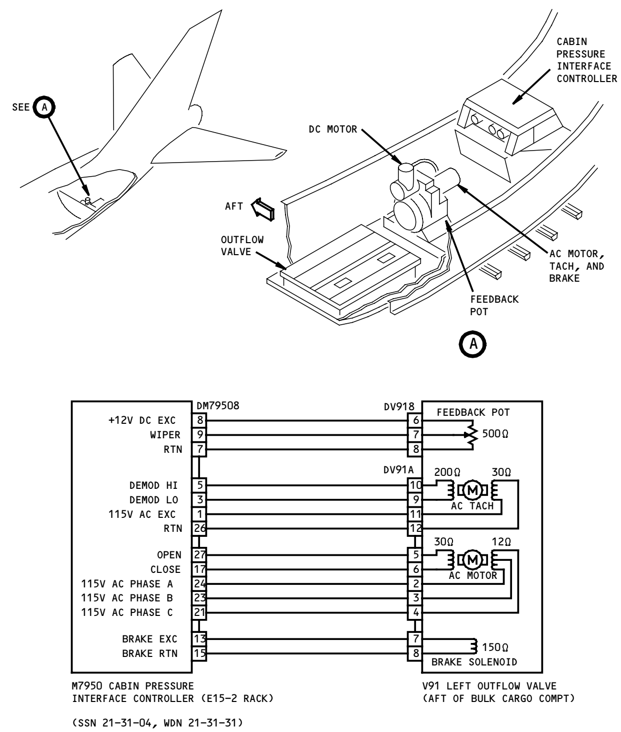
777 MAINTENANCE DOCUMENTS - FIM - TASK SUPPORT PAGES

General

For each sub-subsystem, some tasks have TASK SUPPORT pages. These pages have data to help you do the FIM tasks. This data may include simplified wiring diagrams, or component access illustrations.

BOEING 777
FAULT ISOLATION MANUAL



Outflow Valve Interface Check Diagram
Figure 304

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21-31 FAULT ISOLATION

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General

The FIM has an introduction section that gives you the procedure to do fault isolation. The introduction has these four figures:

- Figure one: basic fault isolation process
- Figure two: getting information from the MAT
- Figure three: find the fault isolation task in the FIM
- Figure four: Doing the fault isolation task.

Figure One: Basic Fault Isolation Process

The basic fault isolation process starts with some fault data that you have. Figure one tells you that after you get the fault data, you follow this sequence of steps:

- If necessary, use the MAT to get more information
- Go to the FIM task
- Do the FIM task.

Figure Two: Getting Information from the MAT

There are many locations in the MAT to get fault data. Figure two has a process to make sure you get the necessary data to complete the basic fault isolation process.

Figure Three: Find the Fault Isolation Task in the FIM

There are many locations in the FIM that help you find the FIM task number. For example, you can use the OBSERVED FAULT LIST or the MAINTENANCE MESSAGE INDEX to find a FIM task number. Figure three tells you where to find the task number if you have any of this data:

- Fault code
- EICAS message
- Observed or cabin fault description
- Maintenance message number (with no correlated EICAS message).

Figure Four: Doing the Fault Isolation Task.

Figure four tells you about the information that is in each FIM task. It also tells you how to do some of the steps in the task, such as a wiring check.

BOEING 777
FAULT ISOLATION MANUAL

YOU FIND A FAULT WITH AN AIRPLANE SYSTEM

These are the possible types of faults:
1. EICAS Message
2. Observed Fault
3. Cabin Fault
4. Non-Correlated Maintenance Mes

USE THE MAT TO GET MORE INFORMATION

If you have an EICAS to the MAT to find and the correspondin message numbers.
For details, see Fig

GO TO THE FAULT ISOLATION TASK IN THE FIM

Use the fault code to find the task in tasks in the FIM are Ramp Maintenance Man You can look in the you have it with you
For details, see Fig

FOLLOW THE STEPS OF THE FAULT ISOLATION TASK

The fault isolation how to find the caus When the task says the fault" you know is gone.
For details, see Fig

Basic Fault Isolation Process
Figure 1

EFFECTIVITY
ALL
D633W103-UAL
INT

FIGURE 1

BOEING 777
FAULT ISOLATION MANUAL

Start with an EICAS message or other flight deck effect (FDE) that you saw on the displays or in the log book.

Go to the MAT. Select LINE MAINTENANCE, INBOUND FLIGHT DECK EFFECTS and look for the FDE. Do you find the FDE? — YES → Get the fault code and the maintenance me from the MAT a FIM (see Figur

NO

Select LINE MAINTENANCE, EXISTING FLIGHT DECK EFFECTS and look for the FDE. Do you find the FDE? — YES → Get the fault maintenance me from the MAT a FIM (see Figur

NO

Find the FDE in the EICAS Message List at the front of the FIM and get the fault code. Then find the fault code in the FIM Fault Code Index and make a note of the maintenance message numbers given with the fault code.

Select EXTENDED MAINTENANCE, PRESENT LEG FAULTS on the MAT and look at the non-correlated maintenance messages. Do you find any of the maintenance message numbers that you saw in the FIM? — YES → Get the mainte number from th to the FIM (se

NO

Select EXTENDED MAINTENANCE, EXISTING FAULTS. Do you find any of the maintenance message numbers that you saw in the FIM? — YES → Get the mainte number from th to the FIM (se

NO

Select EXTENDED MAINTENANCE, FAULT HISTORY, leg -01, and look for any of the maintenance message numbers that you saw in the FIM. → Get the mainte number from th to the FIM (se

Getting Fault Information from the MAT
Figure 2

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INT

FIGURE 2

BOEING 777
FAULT ISOLATION MANUAL

IF YOU HAVE:	THEN DO THIS TO FIND THE TASK IN THE FIM:
FAULT CODE with maintenance message number (if applicable)	1. The first two digits of the fault code are the FIM chapter that you need. Go to the Fault Code Index in that chapter and find the fault code. I code starts with a letter, then go to th Code Index at the front of the FIM. 2. Find the maintenance message number (if to the right of the fault code. 3. Find the task number on the same line as maintenance message number. Go to the t FIM and do the steps in the task (see Fi
EICAS MESSAGE TEXT with no fault code	1. Go to the MAT. Find the fault code and correlated maintenance message number (s Then do the FAULT CODE procedure above.
OBSERVED FAULT DESCRIPTION or cabin fault description	1. Go to the Observed Fault List or Cabin F the front of the FIM and find the best d for the fault. 2. Find the task number on the same line as description. Go to the task in the FIM steps of the task (see Figure 4).
MAINTENANCE MESSAGE NUMBER with no correlated EICAS message	1. The first two digits of the maintenance number are the FIM chapter you need. Go Maintenance Message Index in the chapter the maintenance message number. 2. Find the task number on the same line as maintenance message number. Go to the t FIM and do the steps in the task (see Fi

Finding the Fault Isolation Task in the FIM
Figure 3

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INTRO

FIGURE 3

BOEING 777
FAULT ISOLATION MANUAL

NOTE: Each task assumes that a single component failure caused the fault.

ASSUMED CONDITIONS AT START OF TASK
1. External electrical power is ON
2. Hydraulic power and pneumatic power are OFF
3. Engines are shut down
4. Circuit breakers for the system are closed
5. No equipment in the system is deactivated

INITIAL EVALUATION PARAGRAPH

The Initial Evaluation paragraph at the start of the task helps you determine whether you can detect the fault right now.

If you cannot detect the fault right now, then the task cannot isolate the fault and the Initial Evaluation paragraph will say that there was intermittent fault.

If you have an intermittent fault, you must use your judgement (and follow your airline's policy) to decide which components to replace. Then monitor the airplane to see if the fault happens again on subsequent flights.

FAULT ISOLATION STEPS

Follow the steps of the task in the order given. The "If...then" statements that you see will guide you along the correct path.

When you are at the endpoint of the path, the task says "You corrected the fault." Complete the step you are in and exit the procedure.

WIRING CHECKS

When a step says "Do a wiring check", do these three types of electrical checks for the specified contacts (pins):
- continuity from contact to contact
- shorts between the contacts
- shorts from each contact to ground

Doing the Fault Isolation Task
Figure 4

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FIGURE 4

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General

You use the FIM, the other maintenance documents, and the MAT to isolate and correct faults. Because you can start fault isolation with different types of failure data, there are different paths to find the correct FIM task. As shown in figure one of the FIM introduction, you can start to isolate a fault with any of this data:

- EICAS message
- Observed fault
- Cabin fault
- Non-correlated maintenance message.

Start with an EICAS message

If you have an EICAS message, use the MAT to find the fault code and the maintenance message. You must do this because it is possible to have more than one maintenance message for an EICAS message. The MAT will tell you which maintenance message applies to the message.

If you have the fault code and a maintenance message, do these steps:

- Go to the fault code index for the applicable ATA chapter
- Find the fault code
- Record the FIM task that is next to the applicable maintenance message
- Go to the FIM task section for that ATA chapter
- Find the task.

Start with an Observed Fault

An observed fault is a fault that is not in the cabin and does not have an EICAS message. If you start with an observed fault, do these steps:

- Go to the observed fault list section
- Find the best match that describes the fault condition
- Record the FIM task
- Go to the FIM task section for the ATA chapter
- Find the task.

Start With A Cabin Fault

The cabin fault list has cabin faults in groups based on system function. The cabin fault code index has cabin faults in fault code order. Do these steps after you have the cabin fault code:

- Go to the cabin fault code index
- Find the fault code
- Record the FIM task
- Go to the FIM task section for the ATA chapter
- Find the task.

Start with a Non-Correlated Maintenance Message

A non-correlated maintenance message is a maintenance message that has no related EICAS message. If you start with a non-correlated maintenance message, do these steps:

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- Go to the maintenance message index section
- Find the maintenance message
- Record the FIM task
- Go to the FIM Task section for the ATA chapter
- Find the task.

The FIM also has task support pages. These pages have information to help you do specified fault isolation tasks. This may include simplified wiring diagrams or component access illustrations.

YOU FIND A FAULT WITH AN AIRPLANE SYSTEM

1. EICAS MESSAGE
2. OBSERVED FAULT
3. CABIN FAULT
4. NON-CORRELATED MAINTENANCE MESSAGE

USE THE MAT TO GET MORE INFORMATION

LINE MAINTENANCE | EXTENDED MAINTENANCE

INBOUND FLIGHT DECK EFFECTS

EXISTING FLIGHT DECK EFFECTS

GROUND TESTS

```
FDE: PFC DISCONNECT         Caution              NOT ACTIVE
       Fault Code: 271 025 01                  0903z 03AUG93

  [] Maintenance Message: 27-01777               NOT ACTIVE
     Cruise                                    0903z 03AUG93
       Center Autopilot Flight Director Computer detects
       an invalid rudder input.
```

GO TO THE FAULT ISOLATION TASK IN THE FIM

EICAS MESSAGE LIST

OBSERVED FAULT LIST

CABIN FAULT LIST

CABIN FAULT CODE INDEX

XX - FAULT CODE INDEX

XX - MAINT MSG INDEX

XX - XX TASK YYY

XX - XX TASK SUPPORT

FOLLOW THE STEPS OF THE FAULT ISOLATION TASK

1. ASSUMED CONDITIONS AT START OF TASK
2. INITIAL EVALUATION PARAGRAPH
3. FAULT ISOLATION STEPS

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777 MAINTENANCE DOCUMENTS - AMM PART II - AMTOSS NUMBERS

General

All maintenance tasks and sub-tasks have an aircraft maintenance task oriented support system (AMTOSS) number. These are the reference numbers that you use to find a specified task. AMTOSS numbers show before each task and sub-task in the aircraft maintenance manual (AMM). These are examples of AMTOSS task numbers:

- TASK 29-11-05-000-801
- TASK 31-61-00-800-806
- TASK 71-11-04-010-804-G00.

These are examples of AMTOSS sub-task numbers:

- SUBTASK 870-001-002
- SUBTASK 710-001.

AMTOSS task numbers can have as many as six parts:

- ATA chapter
- ATA section
- ATA subject
- Function code
- Sequence number
- Configuration.

This is an example of the parts of an AMTOSS task:

AMTOSS TASK 71-11-04-010-804-N00	
71	ATA chapter
11	ATA section
04	ATA subject
010	Function code
804	Sequence number
G00	Configuration

ATA Chapter, Section, and Subject

These parts identify the airplane part for this task. Each has two digits.

Sub-Task Numbers

AMTOSS sub-task numbers can have as many as three parts:

- Function code
- Sequence number
- Configuration.

This is an example of the parts of the AMTOSS sub-task:

SUBTASK 870-001-002	
870	Function code
001	Sequence number
002	Configuration

Function Code

The function code defines the maintenance task. It has three alpha-numeric digits. The full definition of the function codes is in ATA Specification 100. The first two digits define the type of task. The third digit is not used by Boeing and is always zero. This is a list of the first two digits of the function codes:

Function Codes 0x0: Removal	
010	Remove, open for access
020	Remove, disconnect, loosen, remove unit, component, or item
040	Deactivate
070	Erase/delete software or data
080	Remove test or support equipment

Function Codes 1x0: Cleaning	
110	Chemical
120	Abrasive
130	Ultrasonic
140	Mechanical
150	Stripping
160	Miscellaneous cleaning
170	Flushing

Function Codes 2x0: Inspection, Checks	
210	General visual
220	Detailed dimensional
230	Penetrant
240	Magnetic
250	Eddy current
260	X-ray holographic
270	Ultrasonic
280	Special or specific
290	Borescope

Function Codes 3x0: Repair	
310	Welding or brazing
320	Machining, reaming, or blending
330	Composite
340	Fiberglass, plastic, honeycomb, or epoxy
350	Miscellaneous repair
360	Leakage repair
370	Painting
380	Plating
390	Sealing

Function Codes 4x0: Installation	
410	Install, close items removed, opened for access
420	Install, reconnect unit, tighten safety component or item
440	Reactivate
470	Install/load data or software
480	Install test or support equipment

Function Codes 5x0: Material and Aircraft Handling	
510	Shipping
520	Receiving
530	Packing
540	Unpacking
550	Storage or return to service
560	Marshaling or positioning
570	Engine ferry or pod maintenance
580	Aircraft handling

Function Codes 6x0: Servicing, Preserving, and Lubricating	
610	Servicing
620	Preserving
630	De-preserving
640	Lubricating
650	Fueling or defueling
660	Deicing or anti-icing
670	Disinfect or sanitize
680	Drain fluid

Function Codes 7x0: Testing and Checking	
710	Operational
720	Functional
730	System
740	BITE
750	Special
760	Electrical
780	Pressure
790	Leak

Function Codes 8x0 and 9x0: Miscellaneous	
810	Fault isolation
820	Adjusting, aligning, calibrating, or rigging
840	Preparing for maintenance or restoring to normal
850	Operator modification incorporation
860	Aircraft or system configuration
870	Bleeding
880	Heating or cooling
890	Airline maintenance program
900	Change (remove and install)
910	Standard practices
930	Marking
940	Job set up or close up
950	Masking
960	Replace
970	Data recording or calculating
980	Manual operation or positioning
990	Illustrations or tables

Sequence Number

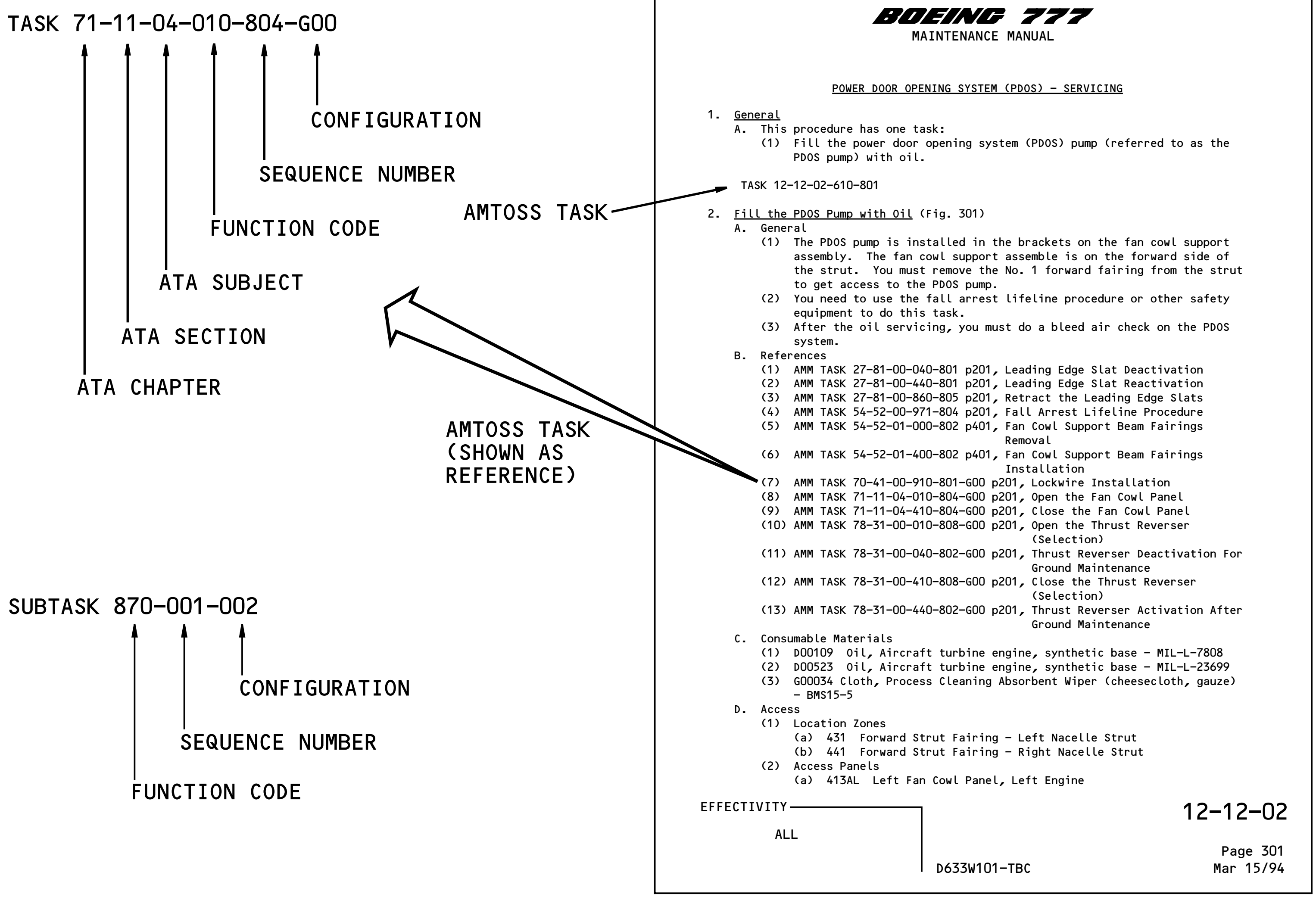
The sequence number makes sure there is a unique number for all tasks and sub-tasks which have the same ATA and function code. Tasks are numbered 801 through 999. If all task numbers are used, the third digit uses alphabetic characters. Sub-tasks are numbered 001 through 800.

Configuration

The configuration is a three digit alpha-numeric code that identifies the maintenance task for these items:

- Configuration
- Methods or techniques
- Variations of standard practices.

This data is blank or has zeroes if there is no data.



BOEING 777
MAINTENANCE MANUAL

POWER DOOR OPENING SYSTEM (PDOS) - SERVICING

1. General
   A. This procedure has one task:
      (1) Fill the power door opening system (PDOS) pump (referred to as the PDOS pump) with oil.

TASK 12-12-02-610-801

2. Fill the PDOS Pump with Oil (Fig. 301)
   A. General
      (1) The PDOS pump is installed in the brackets on the fan cowl support assembly. The fan cowl support assemble is on the forward side of the strut. You must remove the No. 1 forward fairing from the strut to get access to the PDOS pump.
      (2) You need to use the fall arrest lifeline procedure or other safety equipment to do this task.
      (3) After the oil servicing, you must do a bleed air check on the PDOS system.
   B. References
      (1) AMM TASK 27-81-00-040-801 p201, Leading Edge Slat Deactivation
      (2) AMM TASK 27-81-00-440-801 p201, Leading Edge Slat Reactivation
      (3) AMM TASK 27-81-00-860-805 p201, Retract the Leading Edge Slats
      (4) AMM TASK 54-52-00-971-804 p201, Fall Arrest Lifeline Procedure
      (5) AMM TASK 54-52-01-000-802 p401, Fan Cowl Support Beam Fairings Removal
      (6) AMM TASK 54-52-01-400-802 p401, Fan Cowl Support Beam Fairings Installation
      (7) AMM TASK 70-41-00-910-801-G00 p201, Lockwire Installation
      (8) AMM TASK 71-11-04-010-804-G00 p201, Open the Fan Cowl Panel
      (9) AMM TASK 71-11-04-410-804-G00 p201, Close the Fan Cowl Panel
      (10) AMM TASK 78-31-00-010-808-G00 p201, Open the Thrust Reverser (Selection)
      (11) AMM TASK 78-31-00-040-802-G00 p201, Thrust Reverser Deactivation For Ground Maintenance
      (12) AMM TASK 78-31-00-410-808-G00 p201, Close the Thrust Reverser (Selection)
      (13) AMM TASK 78-31-00-440-802-G00 p201, Thrust Reverser Activation After Ground Maintenance
   C. Consumable Materials
      (1) D00109 Oil, Aircraft turbine engine, synthetic base - MIL-L-7808
      (2) D00523 Oil, Aircraft turbine engine, synthetic base - MIL-L-23699
      (3) G00034 Cloth, Process Cleaning Absorbent Wiper (cheesecloth, gauze) - BMS15-5
   D. Access
      (1) Location Zones
         (a) 431 Forward Strut Fairing - Left Nacelle Strut
         (b) 441 Forward Strut Fairing - Right Nacelle Strut
      (2) Access Panels
         (a) 413AL Left Fan Cowl Panel, Left Engine

EFFECTIVITY
ALL

12-12-02

D633W101-TBC

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Mar 15/94

01-00-00-021 Rev 0 11/04/1996

777 MAINTENANCE DOCUMENTS - AMM PART II - AMTOSS NUMBERS

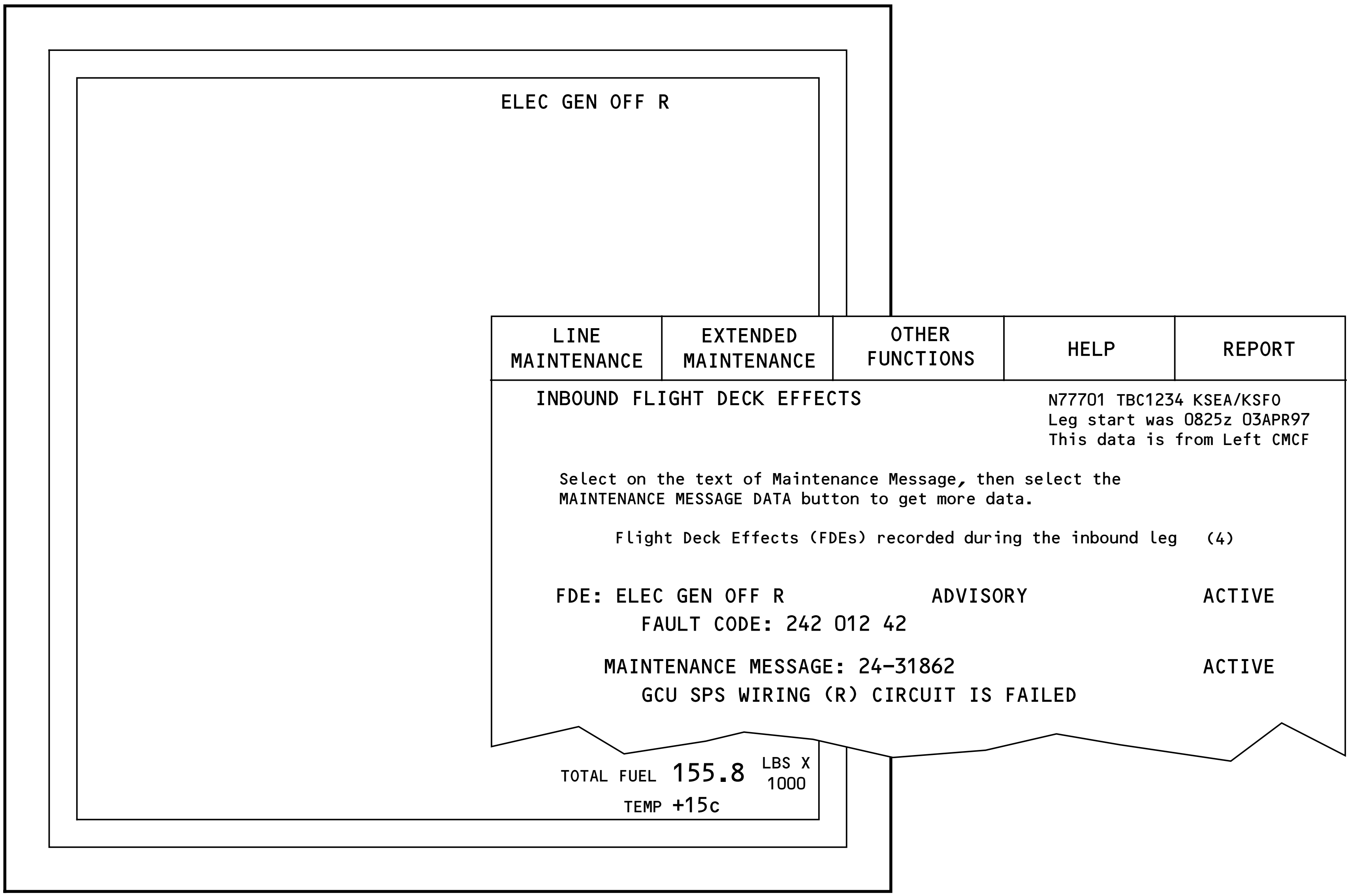
777 MAINTENANCE DOCUMENTS - FAULT ISOLATION PRACTICE - 1

General

Each fault isolation practice example starts with different fault data. This example starts with these data:

- ELEC GEN OFF R advisory message
- Inbound FDE data from the MAT.

You must use the fault isolation manual to find the corrective action.



01-00-00-019 Rev 1 06/09/1995

777 MAINTENANCE DOCUMENTS - FAULT ISOLATION PRACTICE - 1

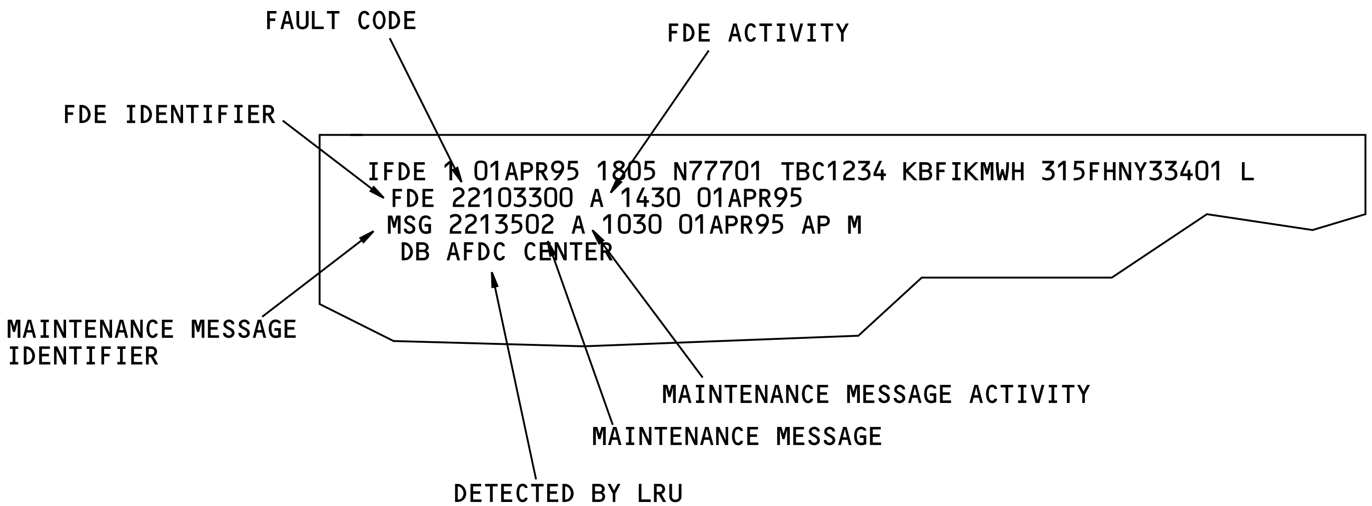
777 MAINTENANCE DOCUMENTS - FAULT ISOLATION PRACTICE - 2

General

Each fault isolation practice example starts with different fault data. This example starts with the downlink report to a ground station (shown below).

You must use the fault isolation manual to find the corrective action for this active fault.

See the central maintenance computing system section for more information on downlink reports (AMM PART I 45-10).



EXAMPLE OF INBOUND FLIGHT DECK EFFECTS DOWNLINK REPORT

Continental Airlines, Inc

Airplane Condition Monitoring System

WB371

TABLE OF CONTENTS

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AIRPLANE CONDITION MONITORING SYSTEM - INTRODUCTION

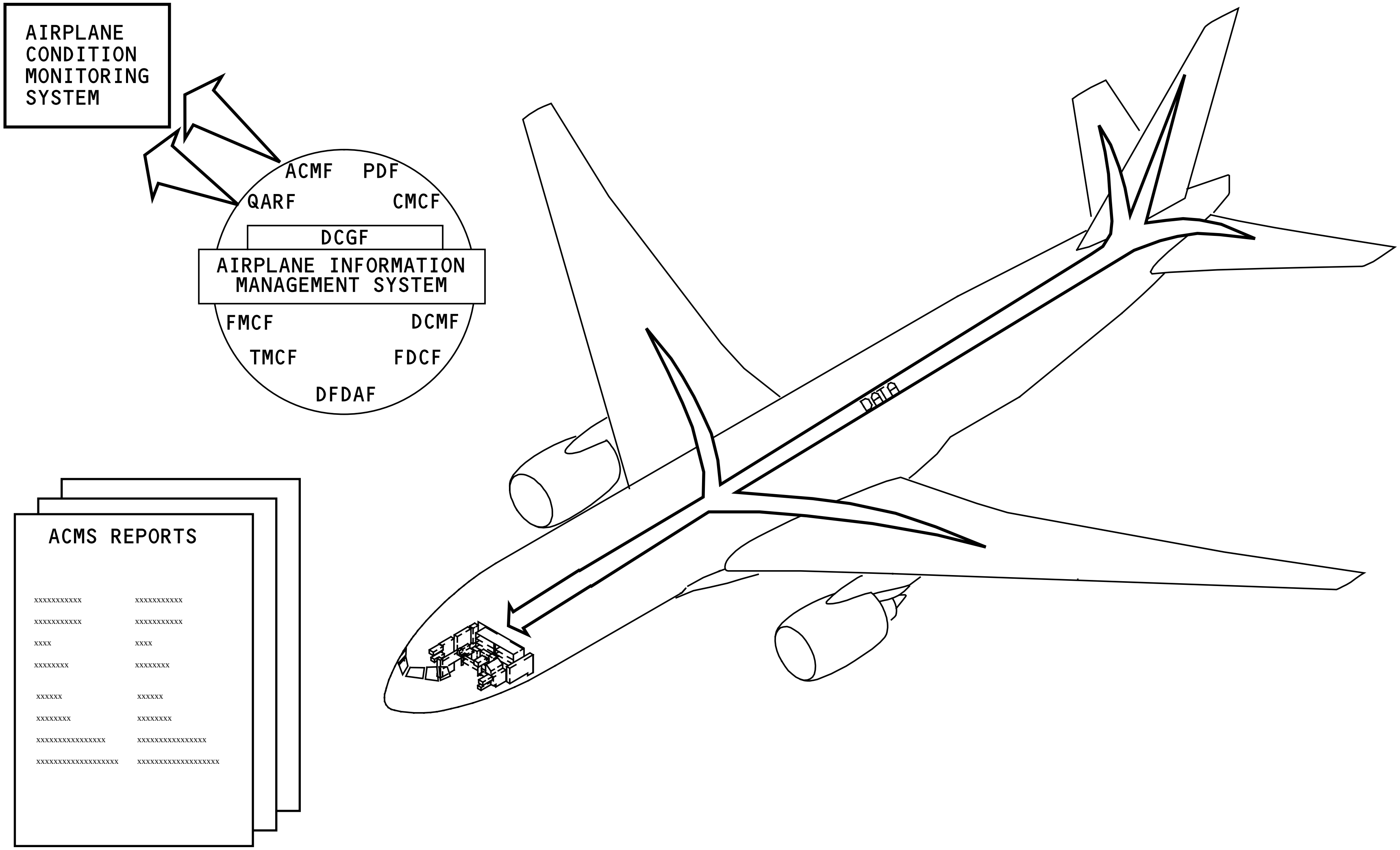
General

The airplane condition monitoring system (ACMS) collects, monitors, and records data from airplane systems. This data causes reports. The purpose of the reports are to:

- Analyze airplane performance
- Analyze trends
- Report significant events
- Troubleshoot faults.

Abbreviations and Acronyms

ACMF - airplane condition monitoring function
ACMS - airplane condition monitoring system
AIMS - airplane information management system
AMI - airline modifiable information
ARINC - Aeronautical Radio, Inc.
ATE - automatic test equipment
CPM/Comm - core processor module/communications
CPM/ACMF - core processor module/airplane condition monitoring function
CPU - central processing unit
DCMF - data communication management function
EEPROM - electrically erasable programmable read only memory
GBST - ground based software tool
IOM - input/output module
MAT - maintenance access terminal
OPC - operational program configuration
OPS - operational program software
SDU - satellite data unit
SRAM - static random access memory
VHF - very high frequency



31-35-00-001 Rev 5 02/12/1996

AIRPLANE CONDITION MONITORING SYSTEM - INTRODUCTION

ACMS - GENERAL DESCRIPTION

General

The ACMS has the airplane condition monitoring function (ACMF) in the left AIMS cabinet.

ACMS user interface is through formats on the maintenance access terminal (MAT) or portable maintenance access terminal (PMAT) displays.

The airline uses a ground based software tool (GBST) to program the ACMS with custom features.

ACMF

The ACMF is only in the left cabinet. The ACMF is a combination of standard and custom software. The software that the airline customizes sets these functions:

- Report format
- Report content
- Triggers.

Triggers are logic equations that detect conditions and cause data to record. An example of a trigger is an engine exceedance or a flight phase.

The ACMF sends the data to the:

- MAT
- PMAT
- MAT or PMAT disk drive to record on a diskette
- Data communication management function (DCMF).

The DCMF controls the interface to:

- The printer
- The satellite data unit (SDU)
- The VHF transceivers.

MAT

The ACMS main menu shows on the MAT. The standard ACMS menu lets the user do these:

- Modify constants
- Set triggers for manual reports
- See reports
- Set the destination for reports
- See real-time data.

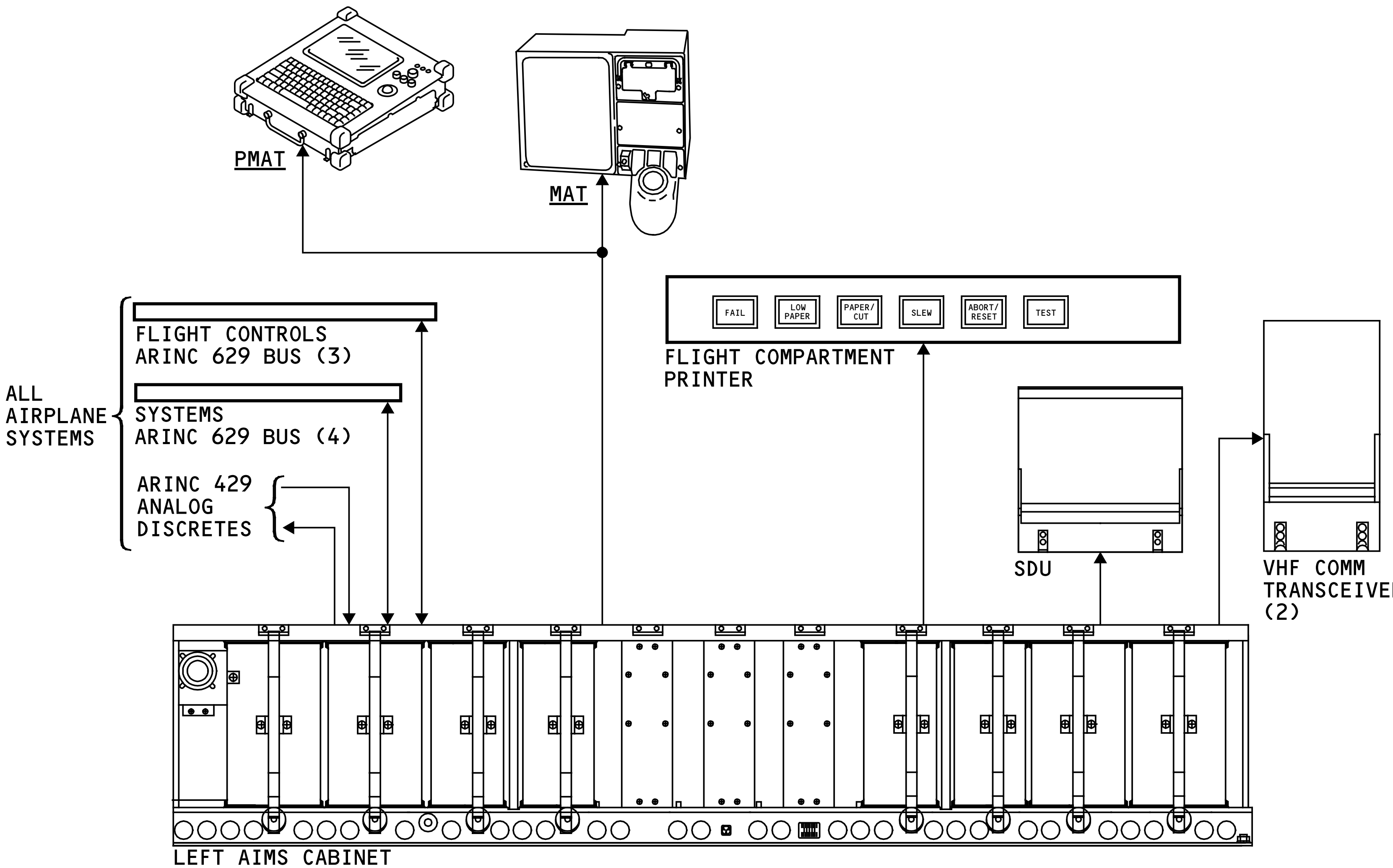
There are five ACMS menus that the airline can customize with the GBST.

Ground Based Software Tool

The airline uses the GBST to do these:

- Create custom MAT menus and displays
- Create specific reports
- Set triggers
- Set report types.

To load information from a diskette into the ACMF memory, use the disk drive on the MAT.



ACMS - GENERAL DESCRIPTION

31-35-00-002 Rev 17 03/11/1998

ACMS - COMPONENT LOCATIONS

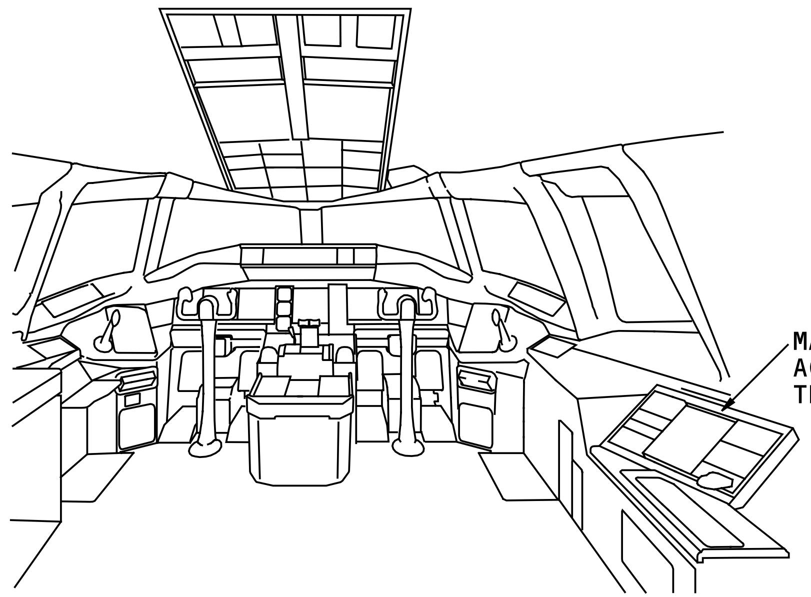
ACMS Component Locations

The airplane condition monitoring function (ACMF) is in the left AIMS cabinet.

Other System Component Locations

The user interface for the ACMS menus is through a maintenance access terminal (MAT) or portable maintenance access terminal (PMAT).

MAIN EQUIPMENT CENTER
(LOOKING FORWARD)



31-35-00-003 Rev 6 01/15/1997

ACMS - COMPONENT LOCATIONS

ACMS - INTERFACES

General

The ACMS collects data to record and sends reports to many output devices. The MAT and PMATs let you see ACMS data and control ACMS functions.

Data Collection

Airplane systems send data into the left AIMS cabinet input/output modules (IOMs) on:

- Flight controls ARINC 629 buses
- Systems ARINC 629 buses
- ARINC 429 buses
- Analog inputs
- Discrete inputs.

Some airplane system data only goes to the right AIMS cabinet. The data comes from the:

- Right angle of attack vane
- Left total air temperature probe, element two.

The data conversion gateway function in the right AIMS cabinet converts this data to ARINC 629. It then transmits the data to the left AIMS cabinet over the right flight controls ARINC 629 bus.

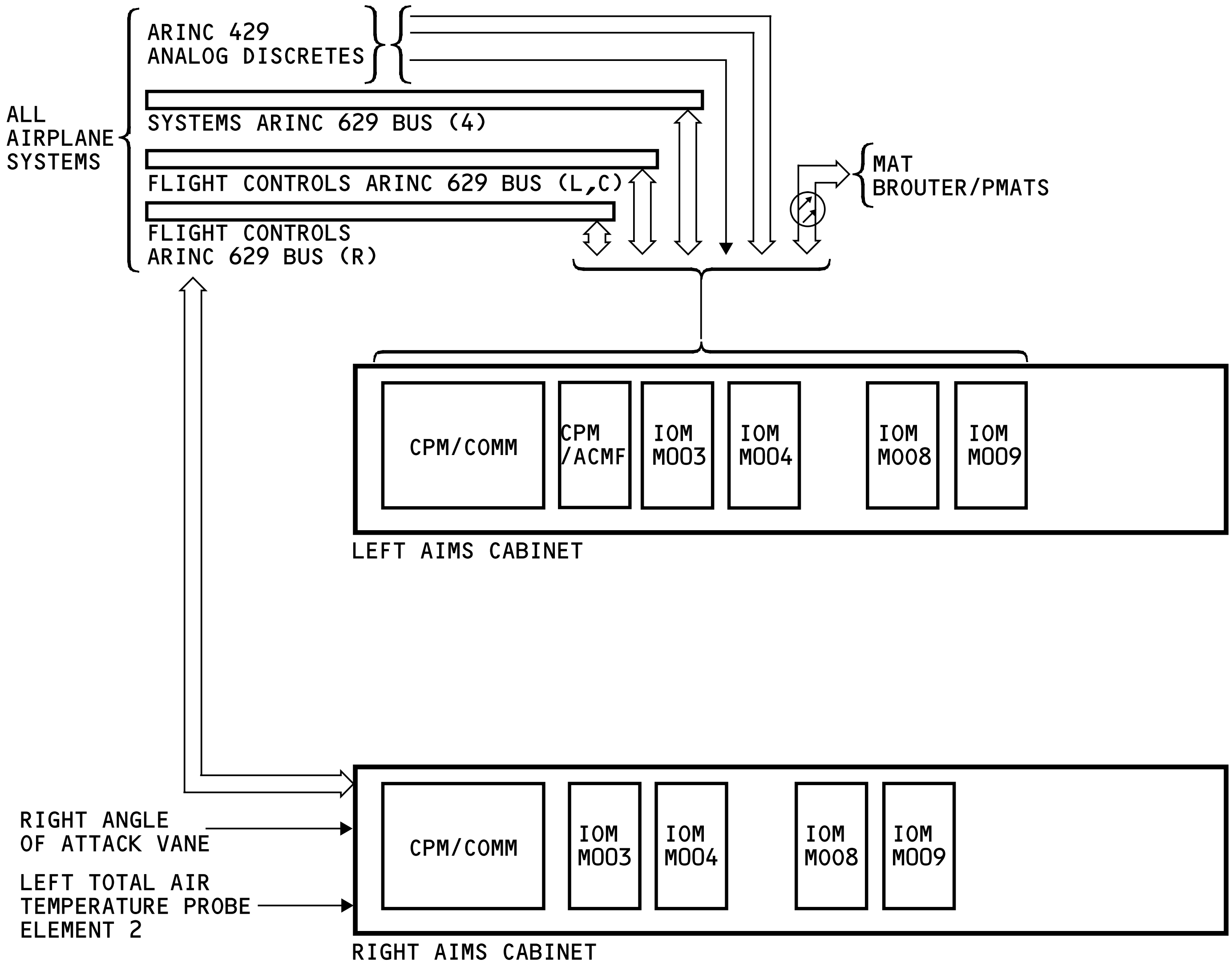
Control

The user requests information with the MAT or PMAT. The MAT/PMAT has ACMS menus and display formats. Also, ACMF airline modifiable information loads from the disk drive on the MAT or PMAT.

Output

ACMS reports can go to these:

- Data communication management system to transmit to a ground station
- Printer to print
- MAT or PMATs to see on the display or to record on a floppy disk.



ACMS - INTERFACES

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ACMS - ACMF FUNCTIONAL DESCRIPTION

General

The ACMF gets airplane system data, records the data, and creates reports.

Data Collection

The ACMF can process:

- ARINC 429 or ARINC 629 data received by the left AIMS cabinet
- ARINC 429 data received by only the right AIMS cabinet
- Analog and discrete input data to the left and right AIMS cabinets
- Data that communicates between the AIMS software partitions
- Data that goes from the left AIMS cabinet to ARINC 429 buses and ARINC 629 buses.

From the four IOMs or the other CPMs, this data transmits through the backplane bus to the ACMF.

CPM/ACMF

Only the left AIMS cabinet has a CPM/ACMF. The CPM/ACMF has 6 megabytes of volatile RAM to store reports.

The CPM/ACMF contains the ACMF software. There are different parts of the software. The parts include these:

- ACMF operational program software (OPS)
- AIMS operational program configuration file (OPC)
- ACMF airline modifiable information (AMI).

The ACMF operational program software is standard and the airlines can not customize it. It does these things:

- Evaluates the triggers
- Gets the data
- Compresses the data
- Prepares the reports.

The ACMF AMI sets the:

- Report formats
- Triggers to record data
- Customized menus, display formats, and MAT ACMS features.

The ACMF AMI also contains the onboard signal database. This database has all the available signals to the ACMF.

CPM/Comm

The ACMF sends data to these functions in the CPM/Comm:

- Data communication management function (DCMF)
- Central maintenance computing function (CMCF).

The DCMF controls these interfaces:

- Onboard local area netework (OLAN) for MAT/PMAT

ACMS - ACMF FUNCTIONAL DESCRIPTION

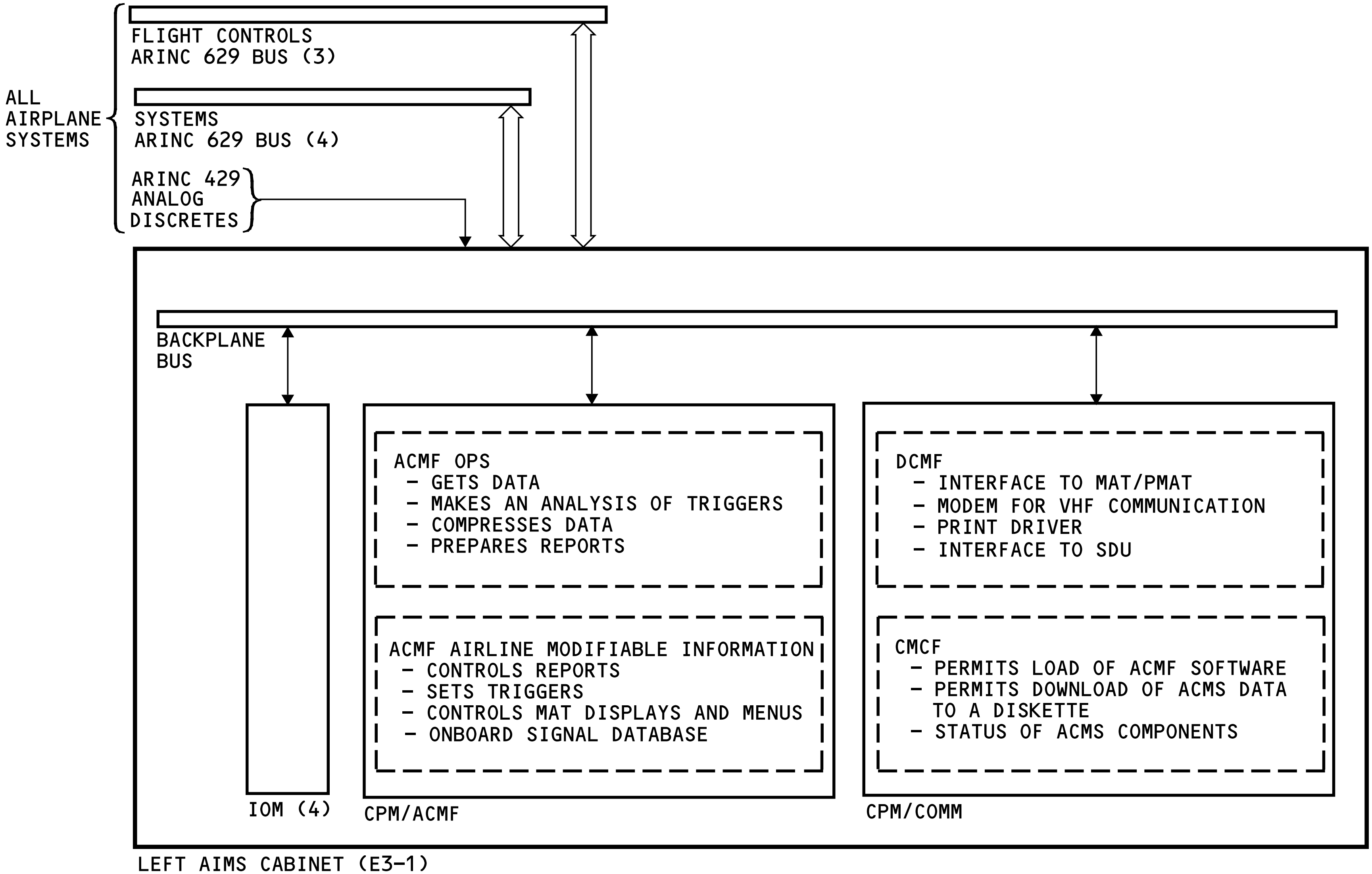
- Printer
- Satellite communications system (SATCOM)
- VHF communication system.

The CMCF records and shows the status of ACMS components. It also lets you load this software:

- The ACMF AMI
- The AIMS OPC
- The ACMF OPS.

<u>Training Information Point</u>

When you load a new OPS or AMI, the ACMS data that is stored in the CPM/ACMF memory goes away. If you need data for a report, be sure that you download the data to the flight compartment printer or to a diskette before you load the new OPS or AMI. When you load an OPC, the ACMS data that is stored in the CPM/ACMF memory does not go away.



31-35-00-005 Rev 8 10/07/1997

ACMS - ACMF FUNCTIONAL DESCRIPTION

ACMS - AIRLINE MODIFIABLE INFORMATION

General

The design of the 777 airplane lets the airlines customize certain functions in the airplane condition monitoring system (ACMS). You customize these functions through airline modifiable information (AMI). You use the ground based software tool (GBST) to make the modifications.

The ACMS system comes with a baseline AMI. This baseline AMI provides functionality to meet most airline requirements. The baseline AMI for the ACMS system has these types of reports and controls:

- Engine
- Airplane
- APU
- Environmental control system (ECS)
- Autoland
- Other report controls.

You use the GBST to modify:

- Report features
- ACMF features on the MAT
- Onboard parameter databases.

Engine Reports

The engine stable report collects data during stable cruise periods. It has these submenu items:

- REPORT SUMMARY
- MANNUALLY ITITIATED.

The engine takeoff report collects key data for EGT parameters and takeoff derate data.

The engine climb report collects EGT data and climb derate data.

The normal engine start report collects key data during engine start. It has these submenu items:

- LEFT ENGINE
- RIGHT ENGINE.

The abnormal engine start report collects historical and real time data when an engine start is aborted or a fault condition occurs in the start sequence. It has these submenu items:

- LEFT ENGINE
- RIGHT ENGINE.

The engine oil monitoring report collects oil quantity during taxi in and taxi out. This report also computes oil consumption for each flight leg and keeps oil consumption information for the last ten flight legs.

The EGT divergence report computes EGT divergence between the left and right engine during stable cruise conditions and generates a report when the divergence exceeds a specified delta value.

ACMS - AIRLINE MODIFIABLE INFORMATION

The engine data report collects information during engine runup and engine operation. It has these submenu items:

- REPORT SUMMARY
- MANUALLY ITITIATED.

The engine exceedance report collects historical and real time data during engine exceedances. It has these submenu items:

- LIMIT
- HISTORY-LEFT A
- HISTORY-LEFT B
- HISTORY-RIGHT A
- HISTORY-RIGHT B.

Airplane Reports

The airplane performance monitoring report collects airplane and engine data for the Boeing performance group for input into the Boeing supplied airplane performance analysis program. It has these submenu items:

- REPORT SUMMARY
- MANUALLY INITIATED.

APU Reports

The APU report collects airplane, engine, and APU data when an auto shutdown of the APU occurs. It also collects airplane, engine, and APU data at APU start, main engine start, defined duct pressure conditions, and at ECS demand limits. It has these submenu items:

- APU AUTO SHUTDOWN
- APU PERFORMANCE
- ALL APU REPORTS.

ECS Report

The ECS performance report collects airplane, engine, and ECS data at APU start, main engine start, defined duct pressure conditions, and at ECS demand limits.

Autoland Report

The autoland report collects aircraft systems data about an automatic landing sequence.

Other Report Controls

The all reports selection gives you access to these items:

- BASELINE
- ENGINE
- CURRENT FLIGHT LEG.

Modifiable Parameters

You can use the GBST to change the control logic that defines data collection. You can also change the content and format of reports.

ACMS - AIRLINE MODIFIABLE INFORMATION

You can change the structure and display formats of the ACMS screens on the MAT. You can also add security features to control access to the ACMS functions on the MAT.

You can also modify the onboard data bases in the ACMS memory.

BASELINE AMI
ENGINE STABLE
ENGINE TAKEOFF
ENGINE CLIMB
NORMAL ENGINE START
ABNORMAL ENGINE START
ENGINE OIL MONITORING
EGT DIVERGENCE
ENGINE DATA
ENGINE EXCEEDANCE
AIRPLANE PERFORMANCE MONITORING
APU
ECS
AUTOLAND

MODIFIABLE FUNCTIONS
CONTROL LOGIC
REPORT SPECIFICATIONS
MAT MENU STRUCTURE
MAT DISPLAY FORMATS
SECURITY ACCESS
ON-BOARD PARAMETER DATABASE

31-35-00-022 Rev 2 11/13/95

ACMS - AIRLINE MODIFIABLE INFORMATION

ACMS - OPERATION - ENGINE REPORTS MENU

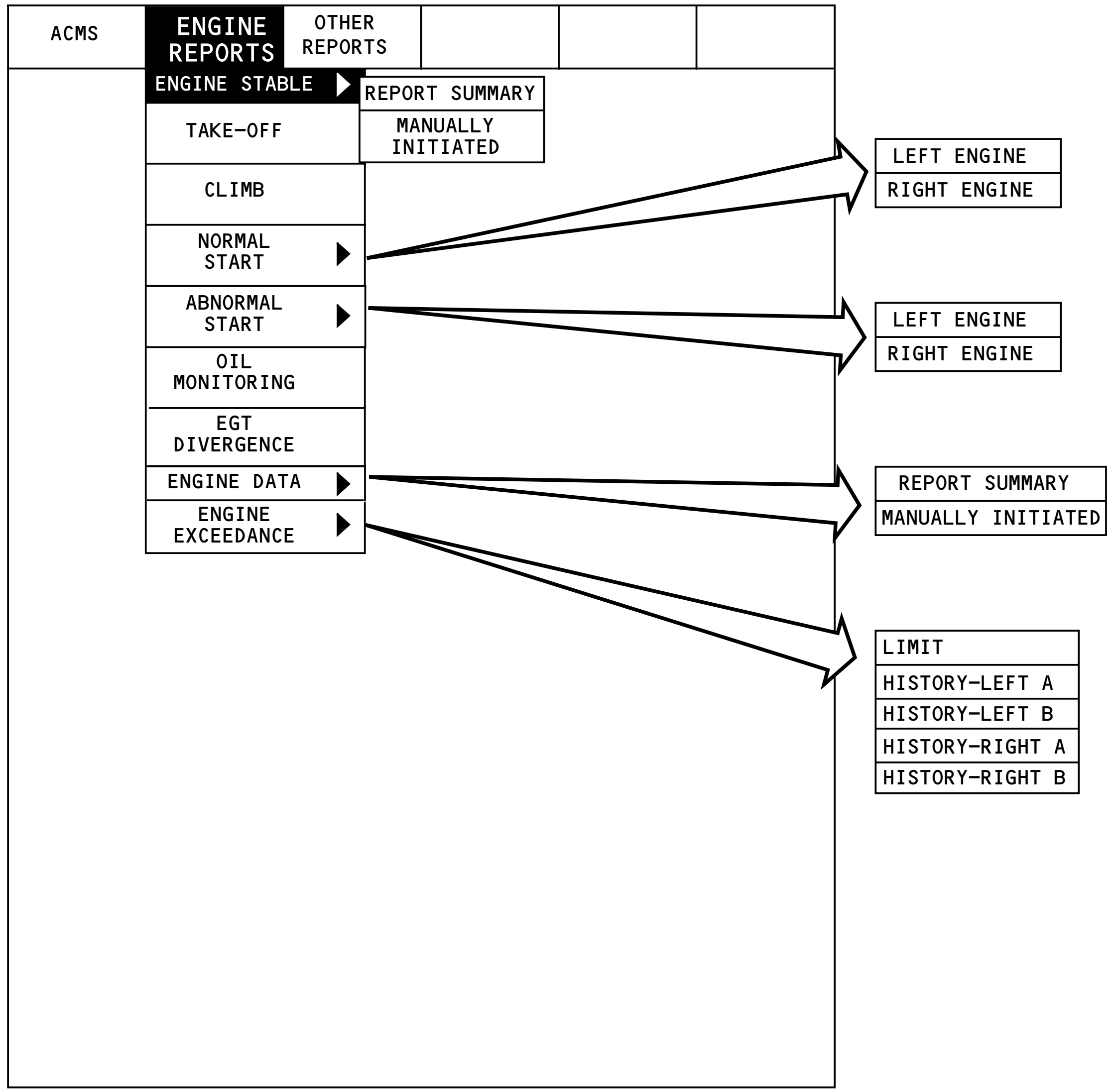
General

You get access to the ACMS main menu through the MAT main menu. Select ENGINE REPORTS to show the list of available engine reports.

Engine Reports Menu

The engine reports menu provides access to these menu items:

- ENGINE STABLE
- TAKE-OFF
- CLIMB
- NORMAL START
- ABNORMAL START
- OIL MONITORING
- EGT DIVERGENCE
- ENGINE DATA
- ENGINE EXCEEDANCE.



ENGINE REPORTS MENU

ACMS - OPERATION - ENGINE REPORTS MENU

ACMS - OPERATION - OTHER REPORTS MENU

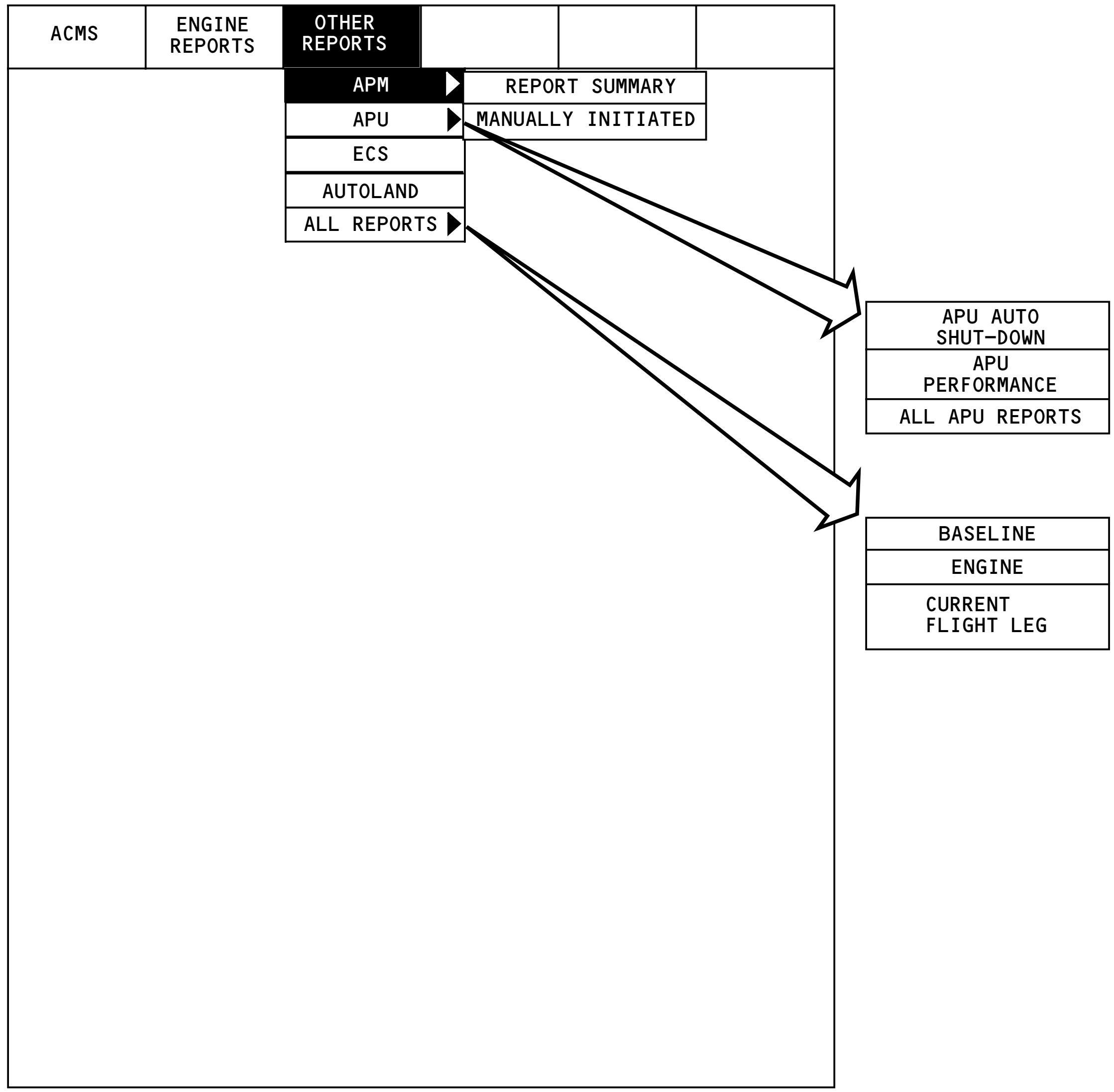
General

You get access to the ACMS main menu through the MAT main menu. Select OTHER REPORTS to show the available reports.

Other Reports Menu

The OTHER REPORTS menu provides access to these menu items:

- APM
- APU
- ECS
- AUTOLAND
- ALL REPORTS.



OTHER REPORTS MENU

ACMS - OPERATION - OTHER REPORTS MENU

ACMS - OPERATION - MAIN MENU

General

You get access to the ACMS main menu through the MAT main menu. Select ACMS to show the ACMS title display.

Menu Bar

The menu bar has the ACMS standard menu and five user defined menus. Airline modifiable information (AMI) software provides two of the user defined menus, engine reports and other reports.This manual does not describe the other three user-defined menus.

ACMS Standard Menu

The ACMS standard menu provides access to these menu items:

- PASSWORD
- TITLE SCREEN
- MNEMONIC DATA
- MODIFIABLE CONSTANTS
- PROGRAMMABLE REPORT 1
- PROGRAMMABLE REPORT 2
- PROGRAMMABLE REPORT 3
- QUICK REPORT
- TRACE LOG
- EXIT ACMS.

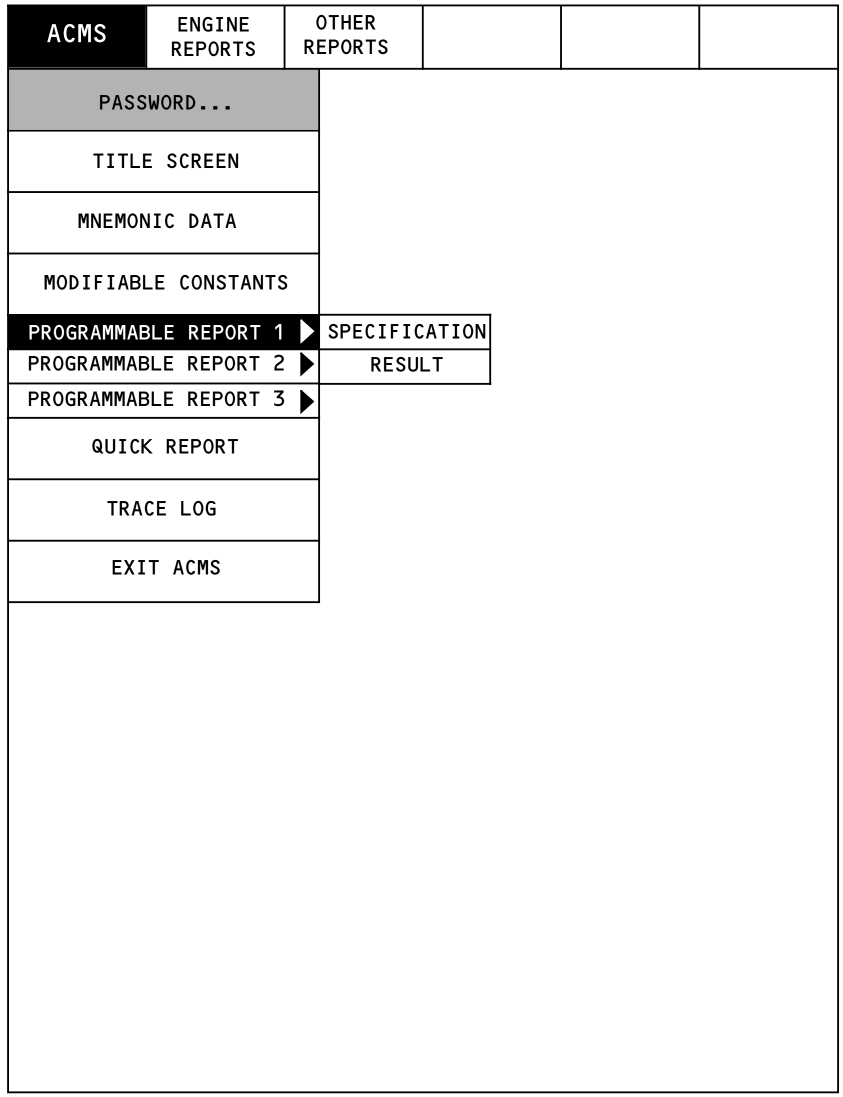
Programmable Reports

Each programmable report menu item supplies access to these cascaded menu options:

- SPECIFICATION
- RESULT.

Exit ACMS

The Exit ACMS menu item permits the user to return to the MAT main menu.



MAIN MENU

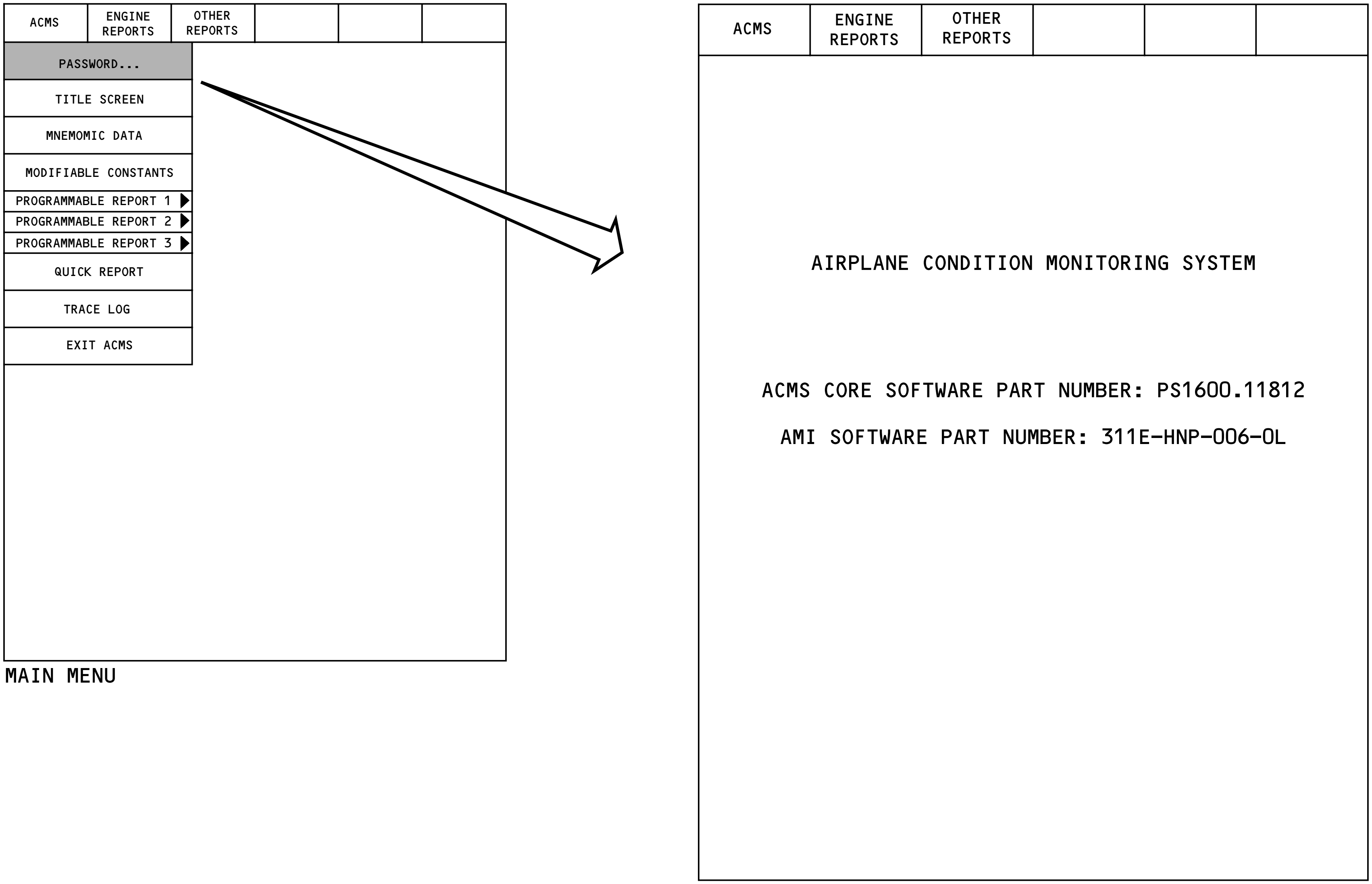
ACMS - OPERATION - MAIN MENU

ACMS - OPERATION - TITLE SCREEN

Title Screen

The ACMS menu has a title screen menu item. You select this menu item to show the title screen page.

The title screen page shows the ACMS core and airline modifiable information (AMI) software part numbers.



MAIN MENU

TITLE SCREEN PAGE

31-35-00-007 Rev 1 02/22/95

ACMS - OPERATION - TITLE SCREEN

ACMS - OPERATION - MNEMONICS

General

The mnemonic data page shows real time data. You use this page to monitor a specific signal parameter for troubleshooting.

The mnemonic data page shows this information for each mnemonic:

- Source LRU
- If applicable, left, center or right position
- Parameter value
- Engineering units of measure.

The mnemonic data page has command buttons at the bottom of the display.

Search Parameter

To show a parameter, select SEARCH PARAMETER and the parameter search dialog box shows.

Delete Parameter

To delete a parameter, select the parameter then select DELETE PARAMETER.

Start and Stop

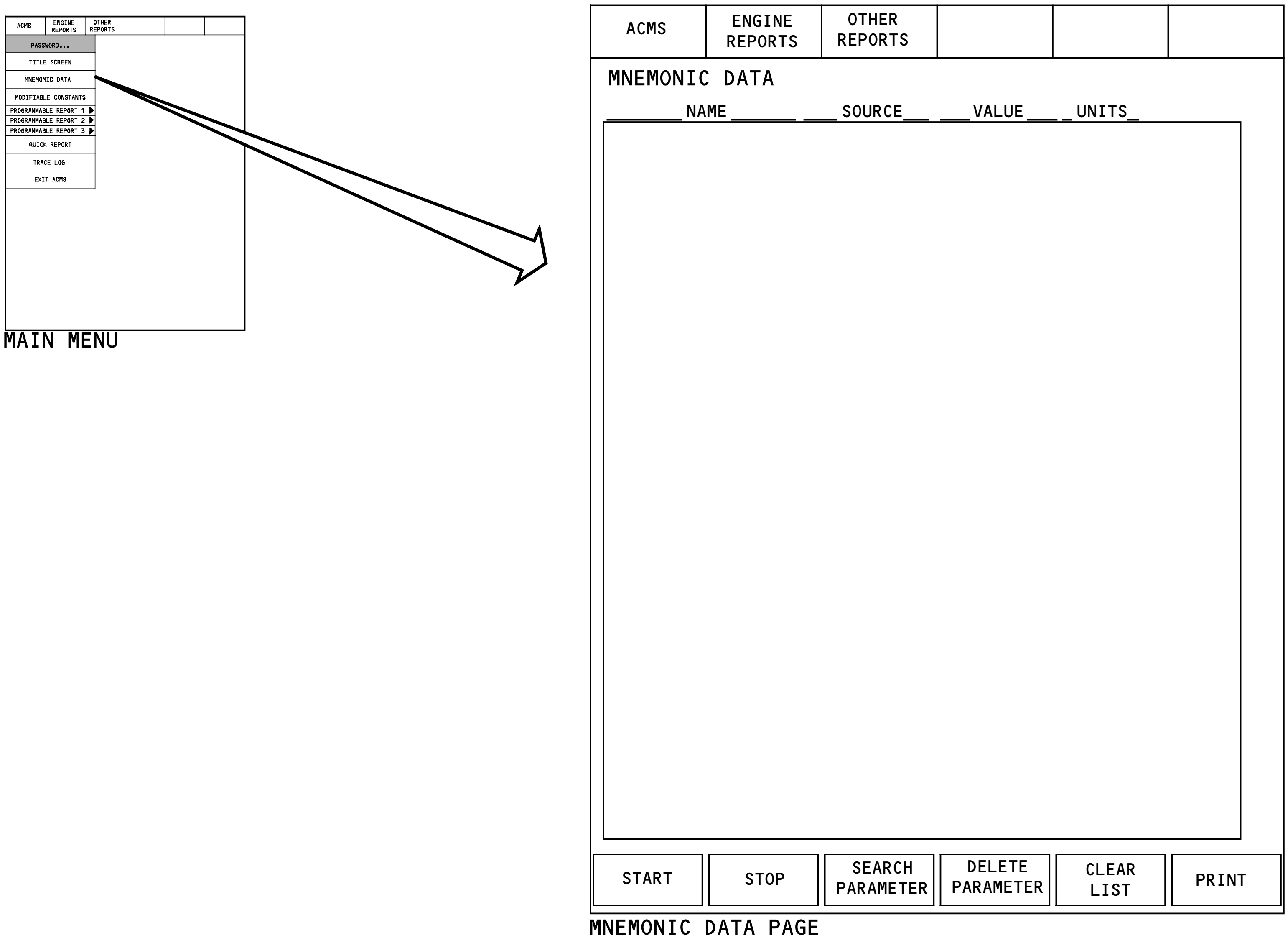
Select START and the mnemonic data page updates the parameters at a 1Hz rate. Select STOP and the parameters do not update.

Clear List

Select CLEAR LIST and the mnemonic list on the mnemonic data page goes away.

Print

The PRINT selection causes the list to go to the printer.



ACMS - OPERATION - MNEMONICS

31-35-00-008 Rev 1 01/06/95

ACMS - OPERATION - SIGNAL SOURCE DIALOG BOX

General

The mnemonic data page uses the parameter search dialog box. The parameter search dialog box finds any signal in the ACMS database. You enter a signal name in the SIGNAL NAME field and/or enter an LRU in the SOURCE field. You can use an asterisk (*) as a wild card in the SIGNAL NAME field.

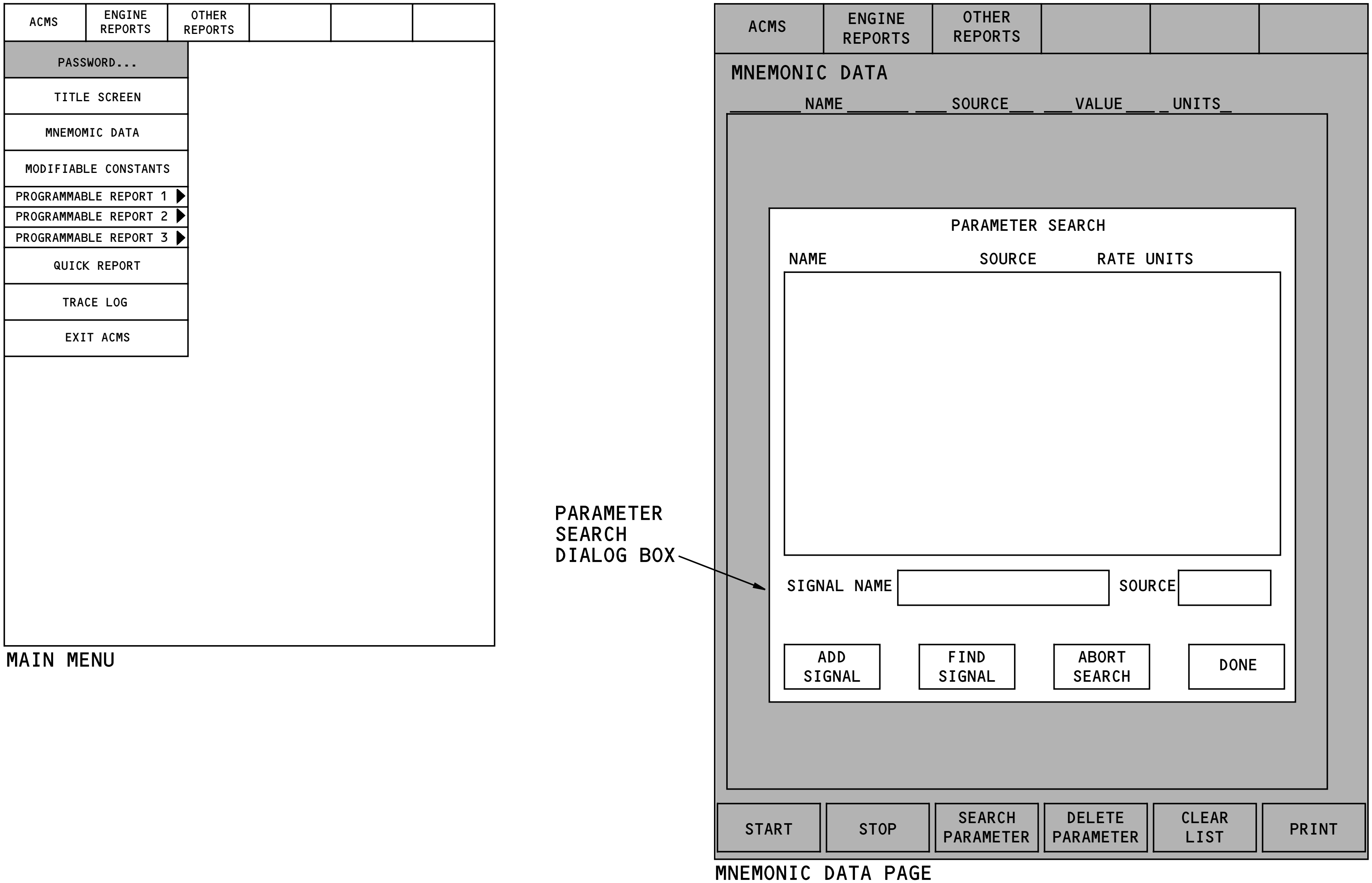
Select FIND SIGNAL to show a list of signals in the dialog box window.

Select the desired signal from the list and then select ADD SIGNAL.

Select DONE to close the parameter search dialog box. The selected signal then shows on the mnemonic data page.

Select ABORT SEARCH to stop a search.

The programmable report specification page also uses this dialog box.



ACMS – OPERATION – SIGNAL SOURCE DIALOG BOX

31-35-00-009 Rev 1 02/22/95

ACMS - OPERATION - MODIFIABLE CONSTANTS

General

The modifiable constants function lets you change a constant with the MAT rather than with the GBST.

The modifiable constants show on the modifiable constants page. Scroll through the display to view all the modifiable constants.

For each modifiable constant, the page shows this information:

- Name
- Default value
- Current value.

Two command buttons show at the bottom of the display.

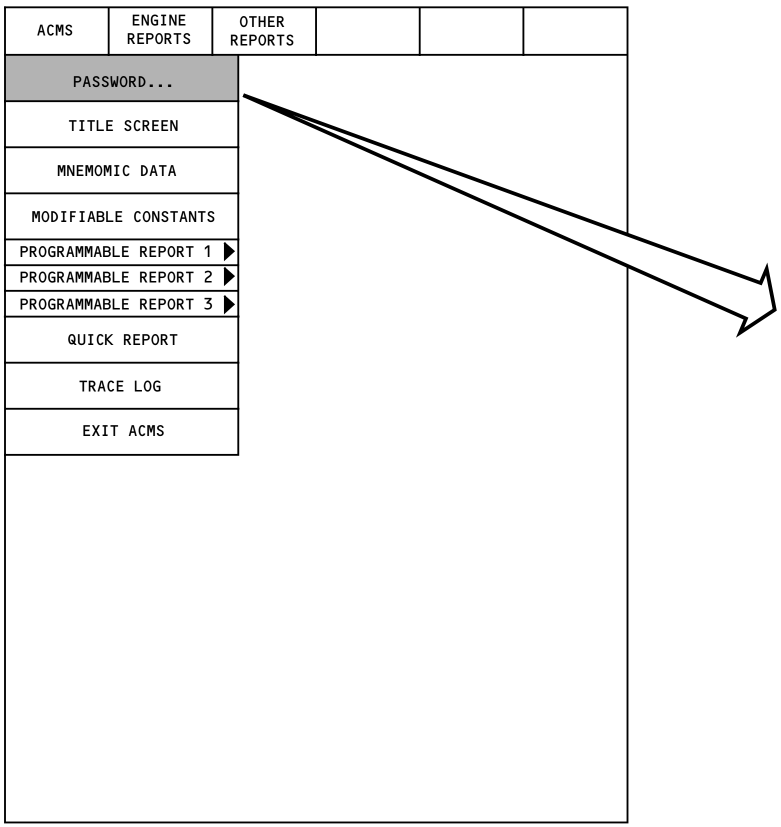
Modify Constant

To change a modifiable constant, select MODIFY CONSTANT and the modify value dialog box shows.

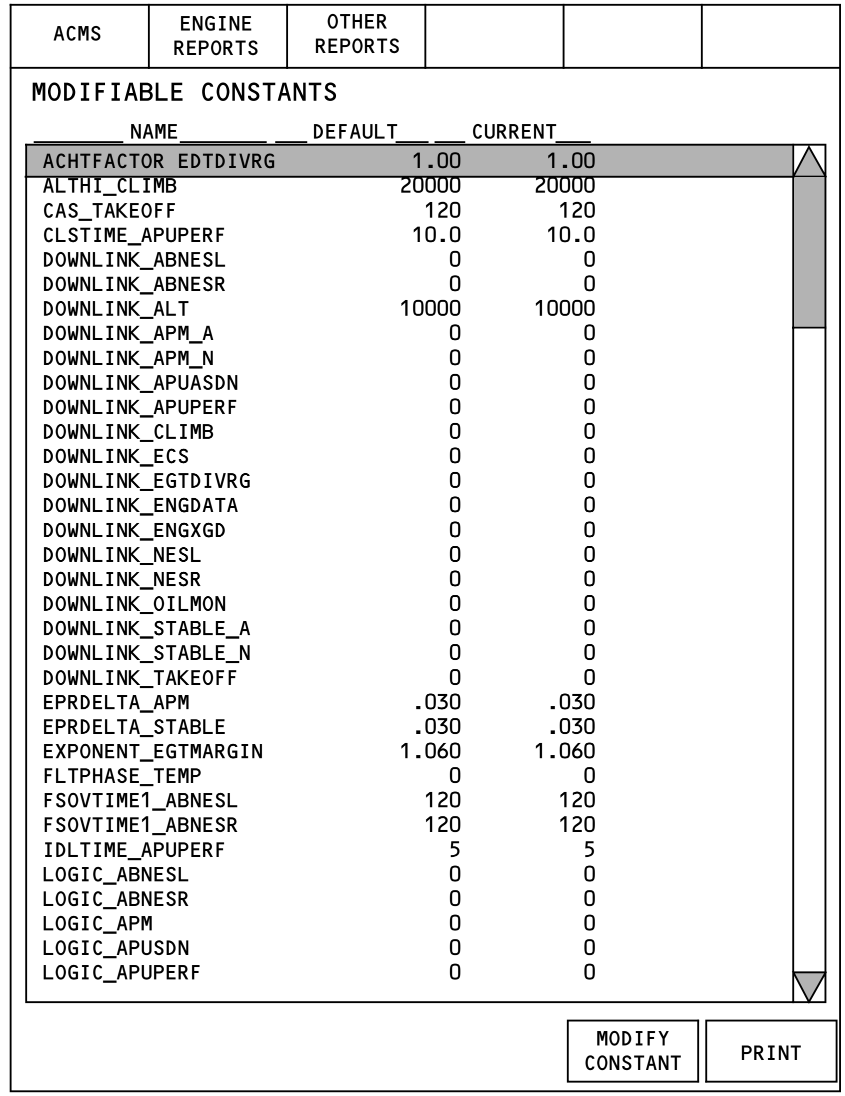
Print

Select PRINT, and a minimum of the last twenty modified constants show on the report. The printout contains these fields:

- Modified constant name
- Previous value
- New value
- Default value
- Time of change
- Date of change.



MAIN MENU



MODIFIABLE CONSTANTS PAGE (TYPICAL)

31-35-00-010 Rev 1 02/22/95

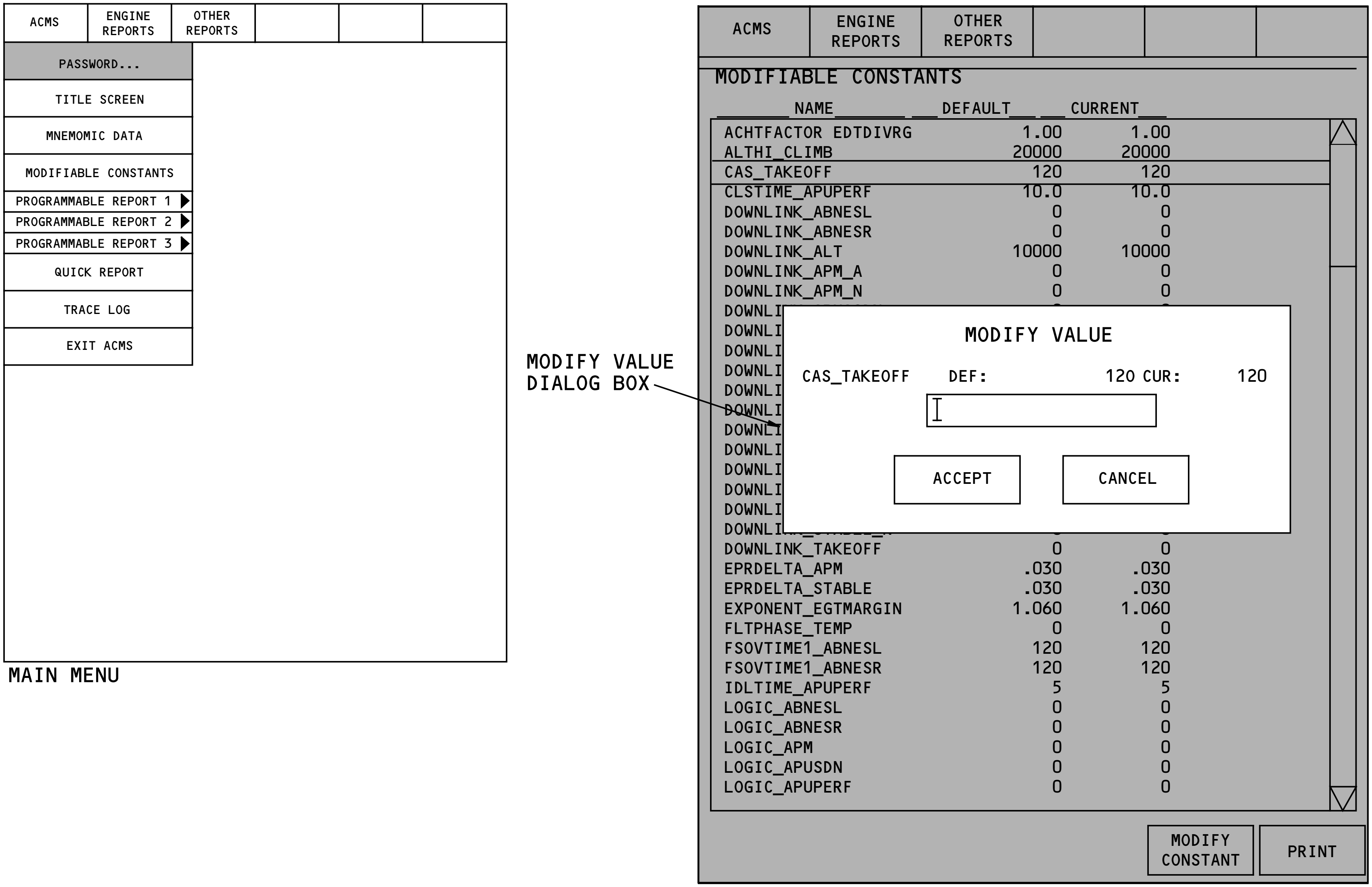
ACMS - OPERATION - MODIFIABLE CONSTANTS

ACMS - OPERATION - MODIFY VALUE DIALOG BOX

General

The modifiable constants page uses the modify value dialog box. The modify value dialog box lets you enter a new value in the value field. Select ACCEPT to return to the modifiable constants page. The new value then shows on the modifiable constants page.

The programmable reports specification page also uses this dialog box.



MAIN MENU

MODIFIABLE CONSTANTS PAGE

ACMS - OPERATION - MODIFY VALUE DIALOG BOX

ACMS - OPERATION - PROGRAMMABLE REPORT - SPECIFICATION

General

The ACMS menu has three programmable report menu items. The programmable reports let you create a limited logic unit and record airplane parameters onboard the airplane. Each programmable report menu item cascades into two selections, SPECIFICATION or RESULT. Select SPECIFICATION to see the report specification page. Select RESULT to see the report results page.

Report Specification Page

The report specification page lets you select these:

- A report title
- The report trigger parameters
- The data collection specifications
- Automatic datalink
- The report collection parameters.

You use text fields, selection boxes and cascading menu selections to define and control the report trigger parameters.

Select SEARCH PARAMETER and the parameter search dialog box shows. Use this to choose the collection parameters.

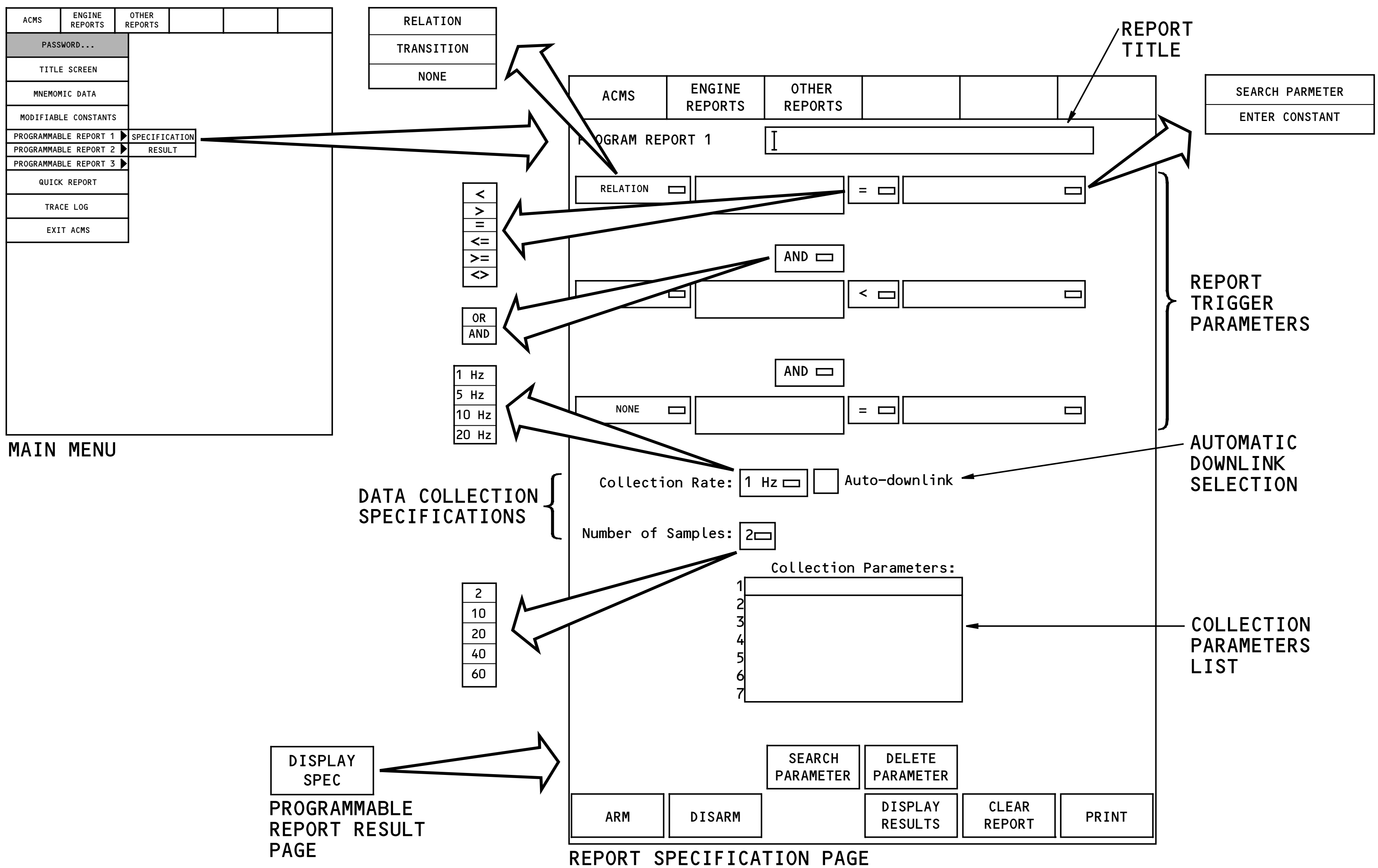
Select DELETE PARAMETER to remove a collection parameter from the list.

Select ARM to enable the report. The defined report trigger then causes collection of the report data. Select DISARM to disable the report.

Select DISPLAY RESULTS to see the report results page.

Select CLEAR REPORT to clear the current report specifications.

Select PRINT to print a copy of the programmable report specification page.



31-35-00-012 Rev 1 02/22/95

ACMS - OPERATION - PROGRAMMABLE REPORT - SPECIFICATION

ACMS - OPERATION - PROGRAMMABLE REPORT - RESULTS

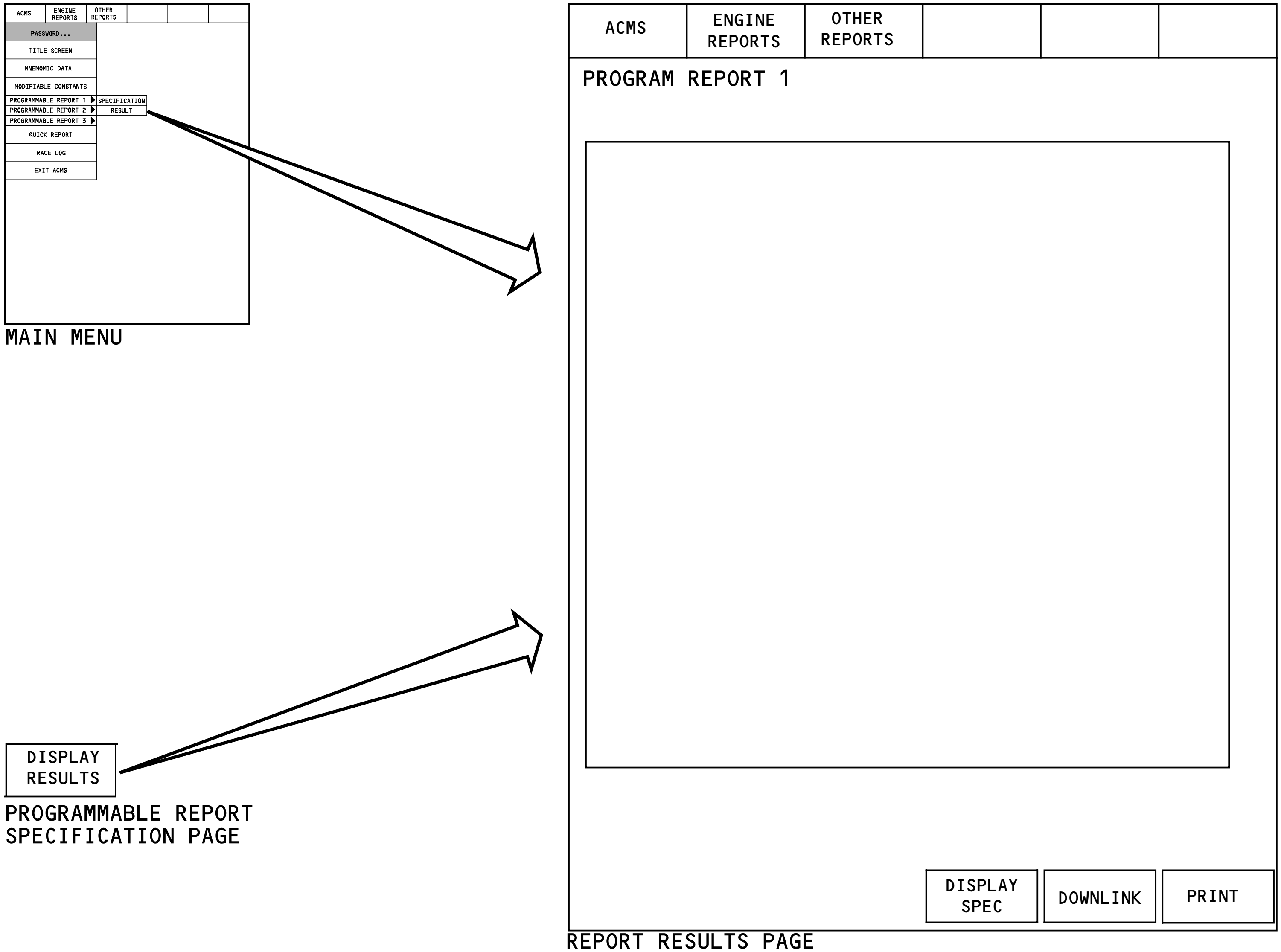
General

The programmable report result page shows the data for a report specification. Each report has header information that contains all the information captured in the report specification.

Select DISPLAY SPEC to return to the programmable report specification page.

Select DOWNLINK to transmit the report to a ground station.

Select PRINT to send the report to the flight compartment printer.



ACMS - OPERATION - PROGRAMMABLE REPORT - RESULTS

31-35-00-013 Rev 1 01/06/95

ACMS - OPERATION - QUICK REPORTS

General

The quick report page gives you a time history for a group of signals. The quick report results show on the MAT during data collection.

You can select the:

- Report title
- Signal collection rate
- Collection signals.

You can identify up to seven collection signals for data collection.

The date and time will show when the report results are displayed.

Command buttons show at the bottom of the display.

Start and Stop

Select START to start the quick report data collection. The report collects and shows 60 values for each collection signal. Select STOP to stop the data collection before all 60 values are collected.

Search and Delete Parameters

Select SEARCH PARAMETER to add a collection signal to the list.

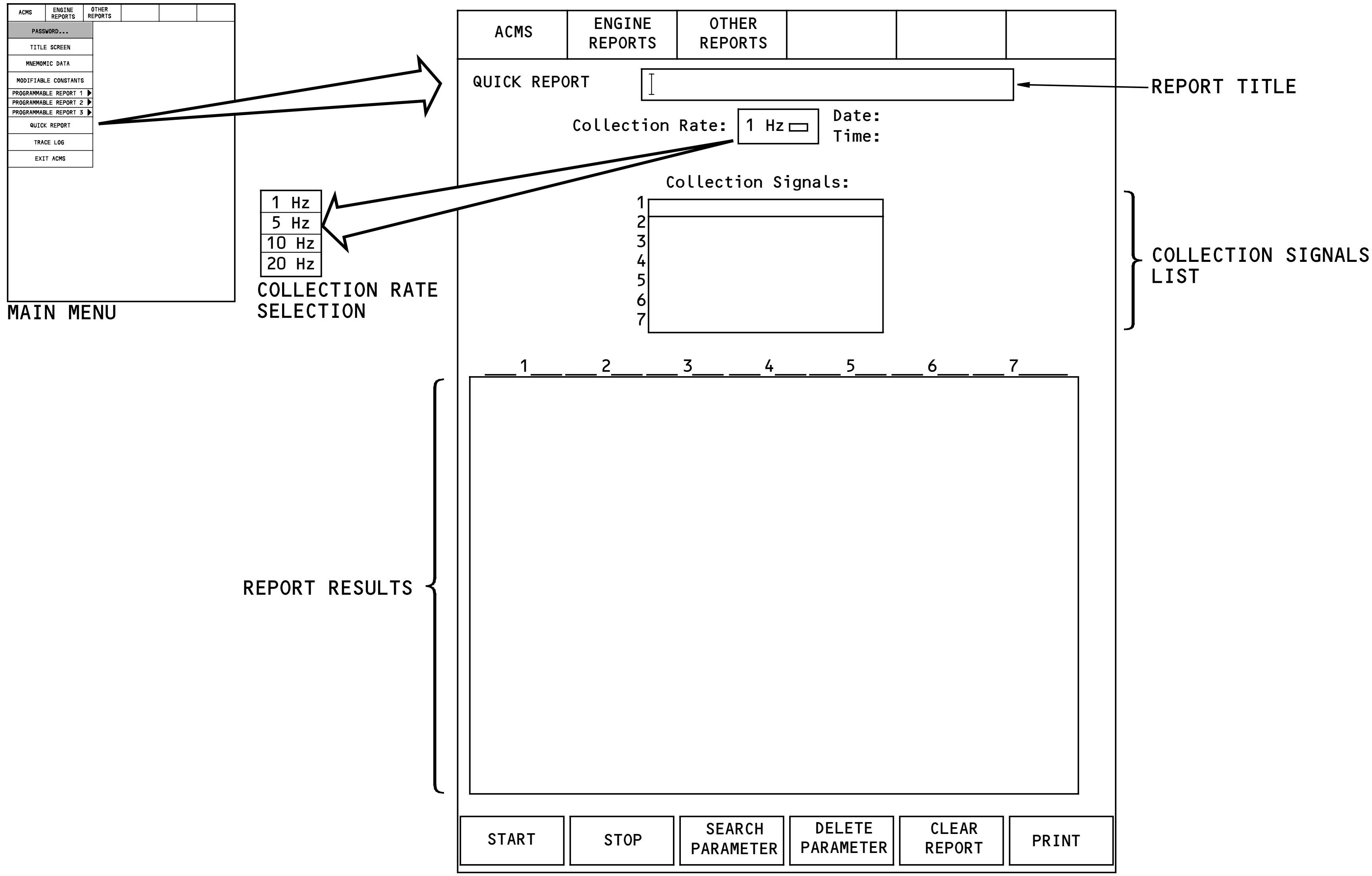
Select DELETE PARAMETER to delete a collection signal from the list.

Clear report

Select CLEAR REPORT to clear the current quick report specifications.

Print

Select PRINT to send the quick report to the flight compartment printer.

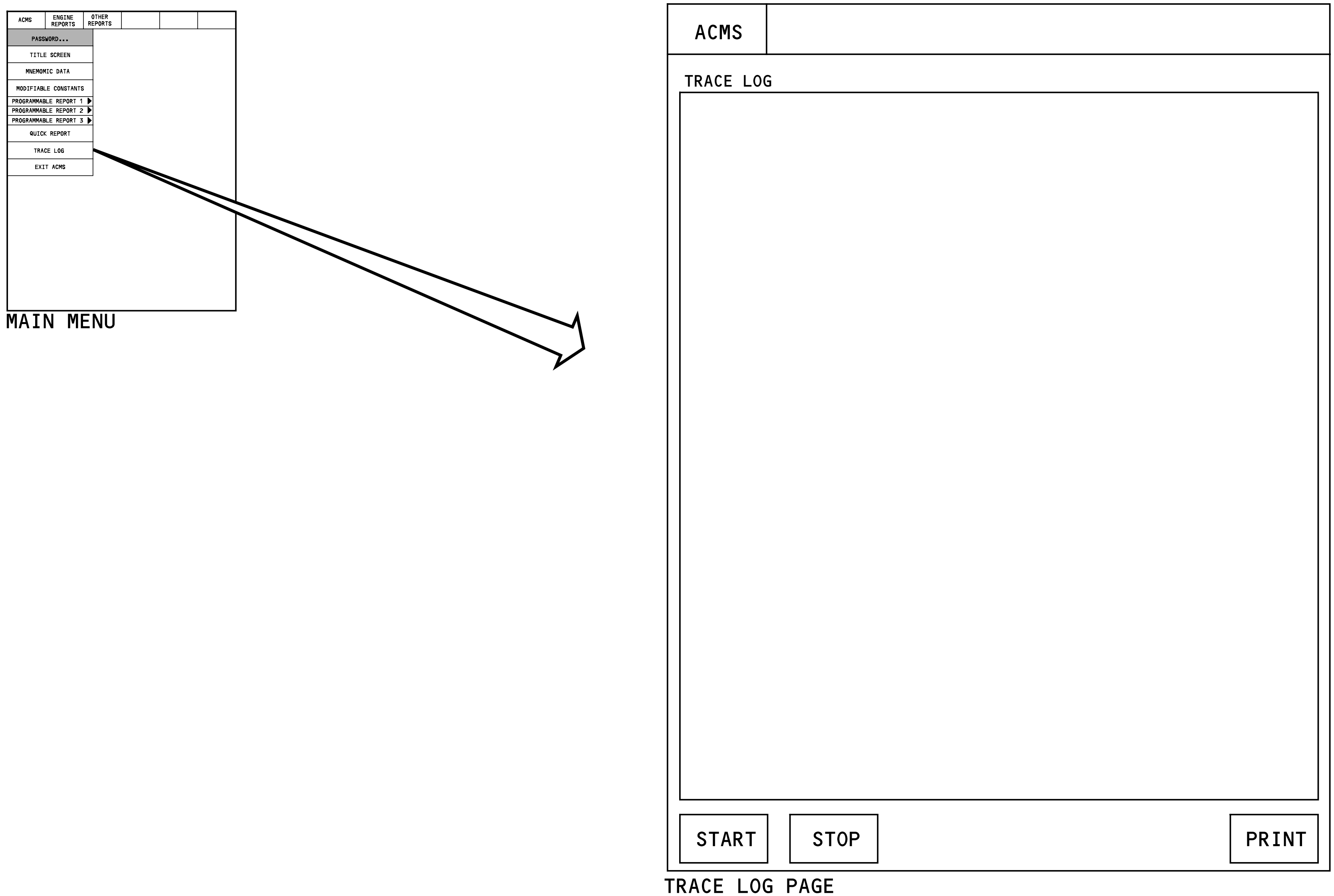


ACMS - OPERATION - QUICK REPORTS

ACMS - OPERATION - TRACE LOG

Trace Log

Software engineers use the trace log page to make sure the AMI software operates correctly.



31-35-00-015 Rev 1

ACMS - OPERATION - TRACE LOG

ACMS - SYSTEM TEST

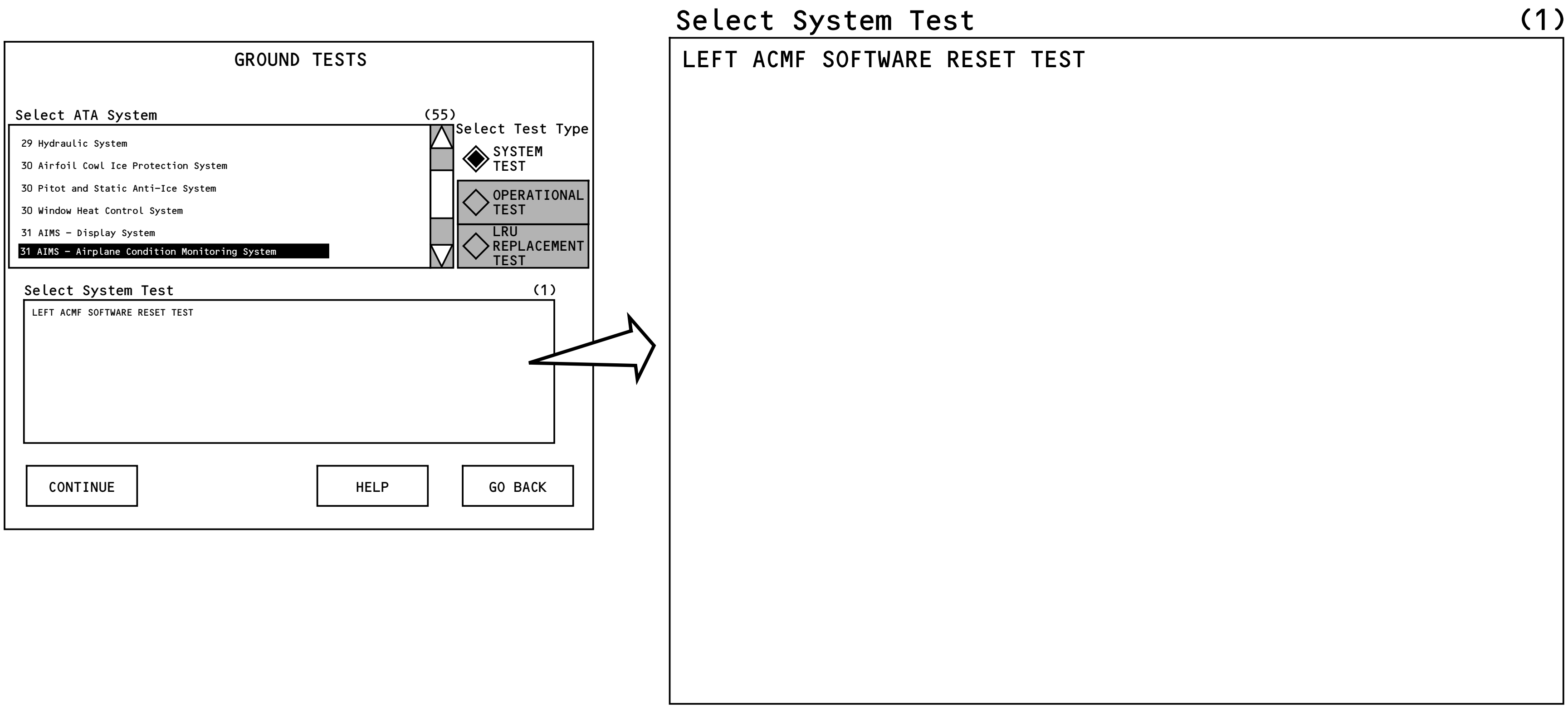
General

There is one system test for the ACMS. It is the left ACMF software reset test.

Left ACMF Software Reset Test

This test makes sure that the ACMF software in the CPM/ ACMF operates correctly. The test erases all ACMF reports. This test may reveal failures of fault tolerant components which may not impact airworthiness. EICAS message indications are the final determinant.

The test takes about one minute.



31-35-00-016 Rev 4 03/31/1998

ACMS - SYSTEM TEST

Continental Airlines, Inc

Electrical Power

WB371

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ELECTRICAL POWER - INTRODUCTION

General

The electrical power system makes, supplies, and controls electrical power to the airplane. The system has these subsystem:

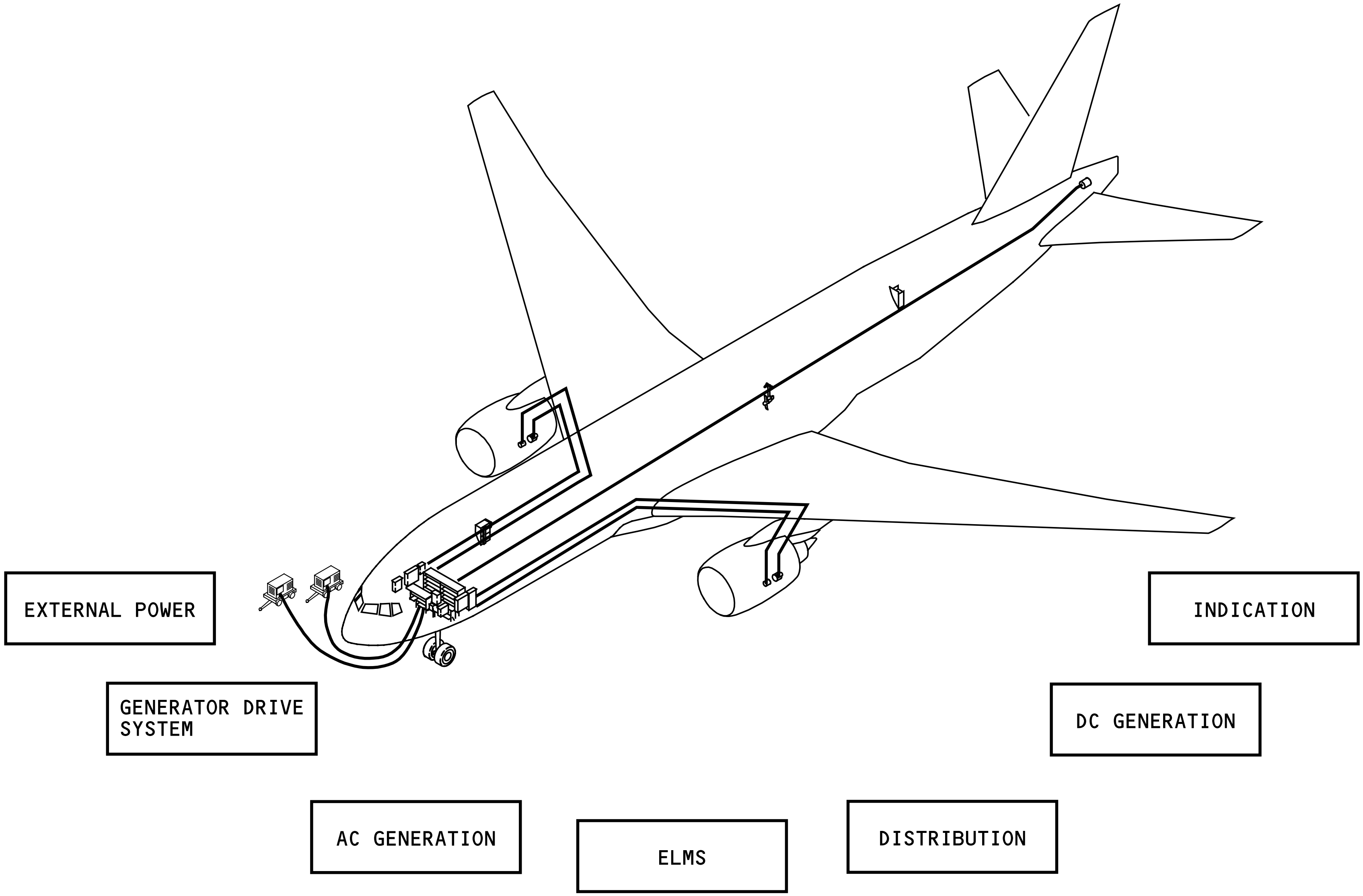
- External power
- Generator drive system
- AC generation
- ELMS
- Distribution
- DC generation
- Indication.

Abbreviations and Acronyms

AFDC	- automatic flight director computer
AFDS	- automatic flight director system
APB	- auxiliary power breaker
AUTO	- automatic
AVAIL	- available
BAT	- battery
BPCU	- bus power control unit
BTB	- bus tie breaker
BU	- backup
CCB	- converter circuit breaker
CONV	- converter
CPT	- captain
CPU	- central processing unit
CSD	- constant speed drive
CTRL	- control
DISC	- disconnect
EDIU	- engine data interface unit
EEC	- electronic engine control
EEU	- ELMS electronic unit
ELCU	- electrical load control unit
ELMS	- electrical load management system
EMI	- electro-magnetic interference
EP	- external power
EPC	- external power contactor
ESDS	- electro-static discharge sensitive
ETOPS	- extended twin operations
FBW	- fly by wire
FCDC	- flight controls dc
FLT	- flight
FNC	- fiber nickel cadmium
F/O	- first officer
GCB	- generator circuit breaker
GCR	- generator control relay
GCU	- generator control unit
GEN	- generator
GH	- ground handling
GHR	- ground handling relay
GND	- ground
GSSR	- ground service select relay
GSTR	- ground service transfer relay
HDLG	- handling
IDG	- integrated drive generator
ILS	- instrument landing system
INST	- instrument

ELECTRICAL POWER - INTRODUCTION

I/O	- input/output
ISLN	- isolation
LRM	- line replaceable module
LRU	- line replaceable unit
PEPC	- primary external power contactor
PFC	- primary flight computer
PMG	- permanent magnet generator
POR	- point of regulation
PRI	- primary
PSA	- power supply assembly
PSU	- power supply unit
PWR	- power
QAD	- quick attach/detach
RAT	- ram air turbine
RLY	- relay
SCM	- signal conditioning module
SEC	- secondary
SEPC	- secondary external power contactor
STBY	- standby
SVC	- service
TBB	- transfer bus breaker
TRU	- transformer rectifier unit
UB	- utility bus
UTIL	- utility
XFR	- transfer



ELECTRICAL POWER - INTRODUCTION

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ELECTRICAL POWER - GENERAL DESCRIPTION - POWER & CONTROL

Power Sources

The electrical power system has five main power sources, two backup power sources, and two standby power sources. These are the main power sources and their continuous supply capacity:

- Left integrated drive generator (IDG) (120 kva)
- Right IDG (120 kva)
- APU generator (120 kva)
- Primary external power (90 kva)
- Secondary external power (90 kva).

The backup power sources are the two backup generators. Each backup generator can continuously supply 20 kva. The standby power sources are the ram air turbine (RAT) generator and the main battery. The RAT generator can continuously supply 7.5 kva. The battery is a 47 amp-hour battery.

Control

These six electronic units control the ac power sources:

- Left generator control unit (GCU) - left IDG power
- Right GCU - right IDG power
- Backup generator converter - backup generator power
- APU GCU - APU generator power
- Bus power control unit (BPCU) - external power
- RAT GCU - RAT generator power.

The electrical load management system (ELMS) controls the main battery power.

ELMS

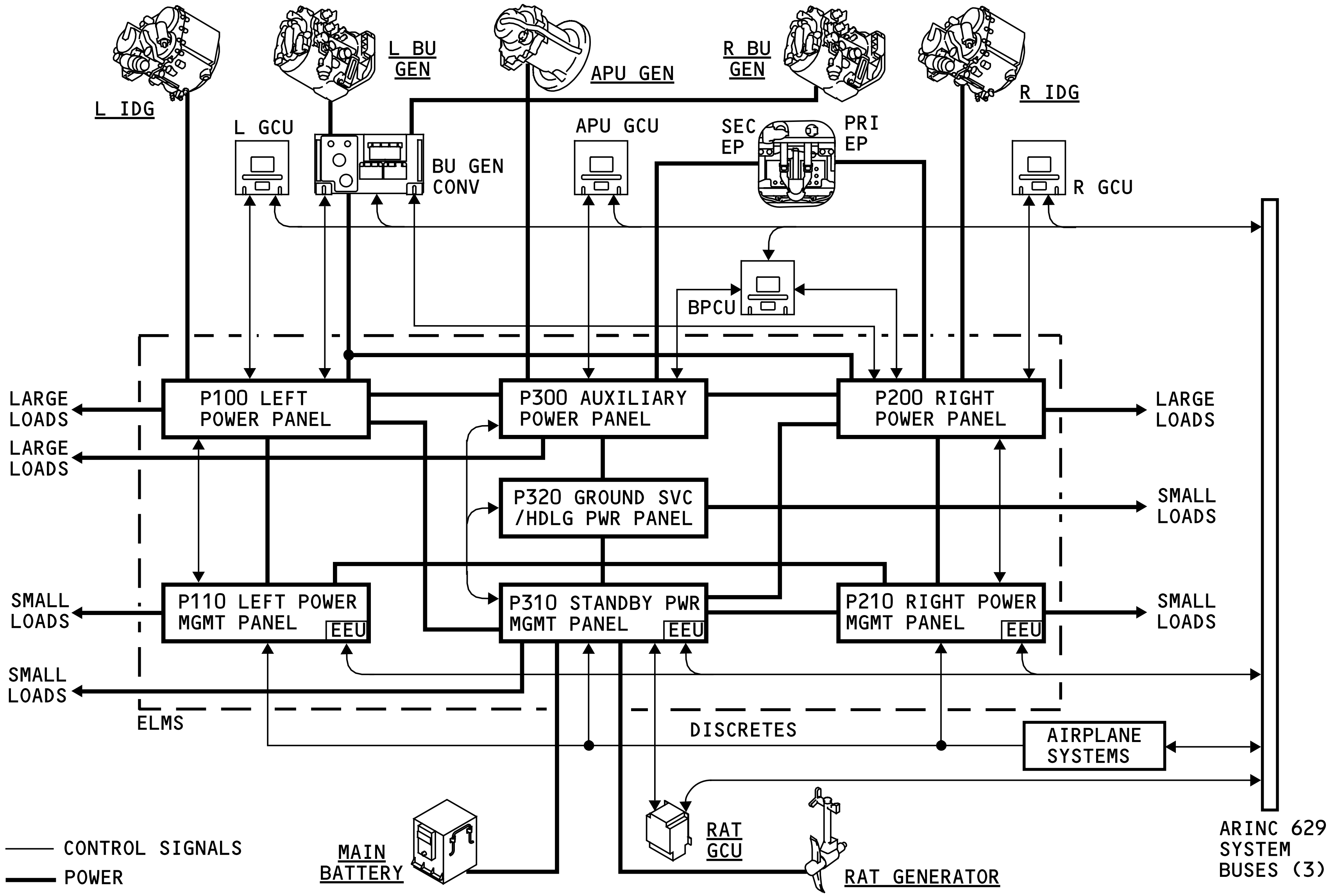
All airplane electrical power goes through the ELMS panels for distribution. The ELMS panels contain the load-switching devices that distribute this power. The ELMS also controls most of the devices. These are the ELMS panels:

- P100 Left power panel
- P200 Right power panel
- P300 Auxiliary power panel
- P110 Left power management panel
- P210 Right power management panel
- P310 Standby power management panel
- P320 Ground service/handling power panel.

Main and backup power go to the left, right, or auxiliary power panels. These power panels supply power to large loads (25 amps or more). They also supply power to the power management panels and the ground service/handling power panel. From these panels, electrical power goes to small loads (less than 25 amps).

The ELMS power management panels contain electronic units. These control and monitor the load-switching devices in their related ELMS panels. However, the ELMS electronic units (EEU) do not control all of the large load-switching devices in the power panels. The GCUs, BPCU, and backup generator converter directly control some of the large load-switching devices.

The EEUs get data from the other electrical power control units and airplane systems either directly or from the ARINC 629 system buses. They use this data to manage the loads of the electrical power system.



ELECTRICAL POWER - GENERAL DESCRIPTION - POWER & CONTROL

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ELECTRICAL POWER - GENERAL DESCRIPTION - DISTRIBUTION

General

The electrical power system normally operates as two independent power channels: left and right. These buses are on the left channel:

- Left main ac
- Left utility
- Left transfer
- Left dc
- Standby ac
- Captain's flight instrument
- Battery
- Battery #2.

The left channel also supplies power to the left and center flight controls dc power supply assemblies (FCDC PSA).

These buses are on the right channel:

- Right main ac
- Right utility
- Right transfer
- Right dc
- First officer's flight instrument
- Ground service
- APU battery
- Hot battery.

The right channel also supplies power to the right FCDC PSA.

Power Configurations

The buses may connect to different power sources and to each other. This depends upon which power sources are available, the flight phase of the airplane, and the configuration of the flight deck electrical panel. Breakers, contactors, and relays connect the buses to the power sources and to each other.

Ground Power

Primary external power automatically supplies power to the ground handling buses. You can also use a switch to connect primary external power to the ground service bus. When you turn primary external power on at the electrical panel, the power connects to the right main ac bus. From there, it supplies power to the rest of the electrical system.

If you need more ground power capacity, connect the secondary external power. The right bus tie breaker (BTB) opens so that the secondary external power supplies power to the left side of the electrical system while the primary supplies power to the right side.

APU Power

The APU generator can supply power to the airplane on the ground or in flight. On the ground, it can supply power to the ground handling bus. The APU generator can also supply all of the airplane power or share the load with an IDG, backup generator, or the primary external power source.

IDG Power

The IDGs normally supply the electrical power when the engines are operating. They each supply power to one side of the electrical system. If an IDG fails, the APU generator can supply power to the failed side.

Backup Generator Power

The backup generators are a variable-speed, variable-frequency type. They operate when the engines are running. They connect to the backup generator converter. The converter makes the backup generator output into satisfactory ac power. A backup generator supplies power to a transfer bus under non-normal conditions and during autoland.

Each backup generator also contains permanent magnet generators (PMGs). Two of these PMGs in each backup generator are the primary power sources for the FCDC PSAs.

Standby Power

If all normal power is lost, the RAT generator can supply the flight instrument buses with power. It does this through the two center transformer rectifier units (TRU). The captain's flight instrument bus then supplies power to the battery and standby ac buses.

If the RAT generator does not operate, the main battery supplies power to the battery buses, captain's flight instrument bus, and the standby ac bus.

Battery Power

The electrical system has these four battery buses:

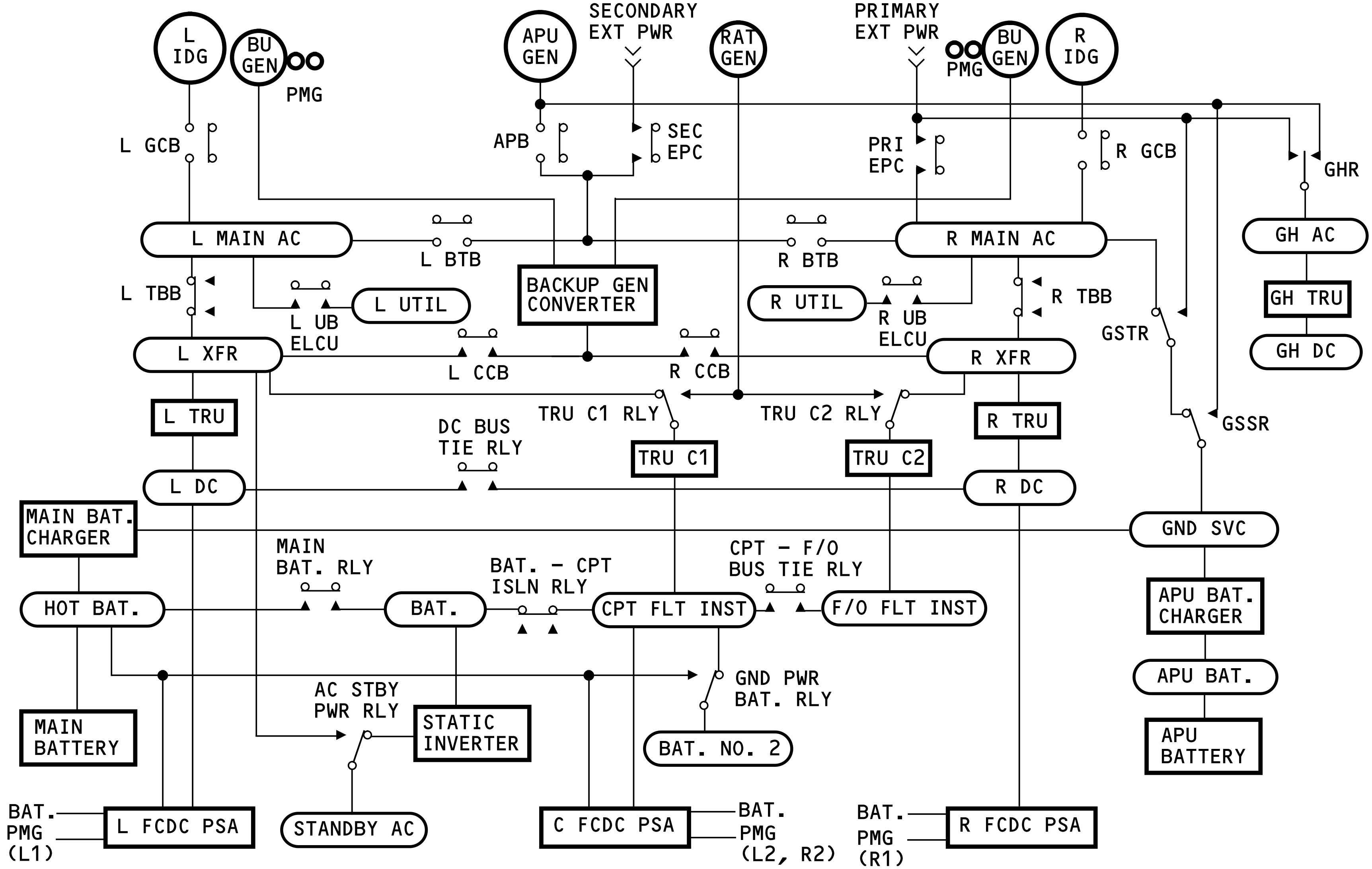
- Hot battery
- Battery
- Battery #2
- APU battery.

The ground service bus normally supplies power to the hot battery and APU battery buses through their related battery chargers.

The captain's flight instrument bus normally supplies power to the battery and battery #2 buses.

Flight Control Power

Three FCDC PSAs supply power to the flight control system. The PSAs have more than one power source. Each PSA has a small battery to prevent power interruptions during power transfers.



ELECTRICAL POWER - GENERAL DESCRIPTION - DISTRIBUTION

ELECTRICAL POWER - COMPONENT LOCATIONS - AIRPLANE

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ELECTRICAL POWER - COMPONENT LOCATIONS - AIRPLANE

General

There are electrical power components in these areas:

- Flight deck
- E5 rack
- Wing-to-body fairing
- APU gearbox
- E10 rack
- Engine accessory gearbox
- Engine fan hub/compressor case
- Door 2 left
- Main equipment center
- Right-forward fuselage.

Flight Deck

The electrical power system control switches are on the P5 overhead panel and the P61 overhead maintenance panel.

E5 Rack

Some of the FCDC components are in the E5 rack just aft of the forward cargo door.

Wing-to-Body Fairing

The RAT generator is in the wing-to-body fairing aft of the right main gear.

APU Gearbox

The APU generator attaches to the APU gearbox.

E10 Rack

The APU battery and battery charger are in the E10 rack just aft of the bulk cargo door.

Engine Accessory Gearbox

A backup generator attaches to the forward side of the main gearbox on each engine. The IDG attaches to the aft side.

The IDG fuel/oil heat exchanger attaches to the right forward side of the accessory gearbox. a

Engine Fan Hub / Compressor Case

The oil/oil heat exchanger is on the fan hub frame. The backup generator/IDG air/oil heat exchanger attaches to the high compressor case.

Door 2 Left

The ground service switch is on the flight attendant's panel by door 2 left.

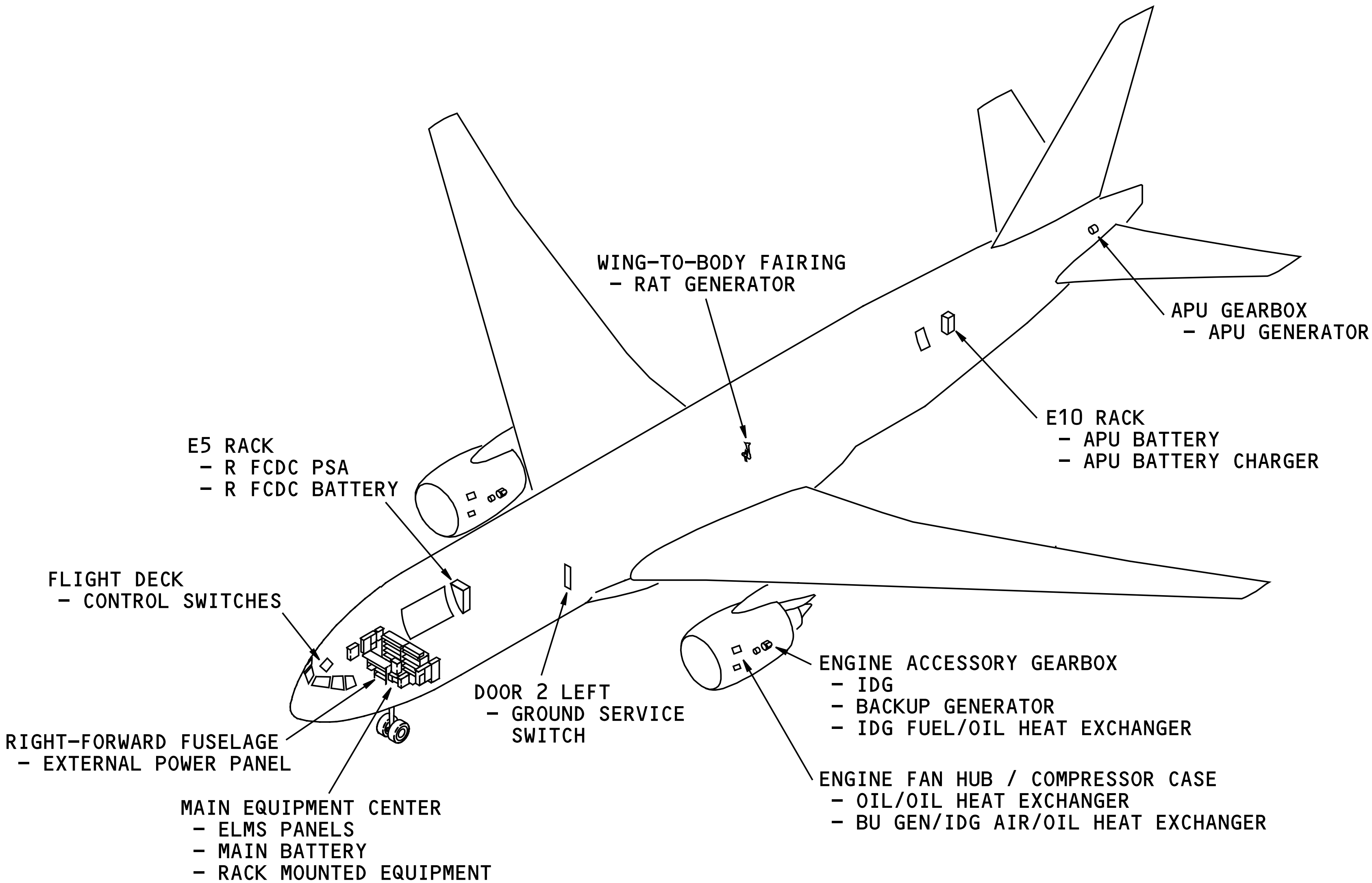
ELECTRICAL POWER - COMPONENT LOCATIONS - AIRPLANE

Main Equipment Center

Most of the electrical system components are in the main equipment center. The main battery is there. The rest are in equipment racks or the ELMS panels.

Right-Forward Fuselage

The external power panel is to the right of the main equipment center access door.



24-00-00-004 Rev 5 04/15/1997

ELECTRICAL POWER - COMPONENT LOCATIONS - AIRPLANE

ELECTRICAL POWER - GENERAL COMPONENT LOCATIONS - MAIN EQUIPMENT CENTER

General

Most of the electrical system components are in equipment racks or the ELMS panels.

The specific locations of components are in their related sections.

The ELMS section shows the specific location of components inside the ELMS panels.

Panels

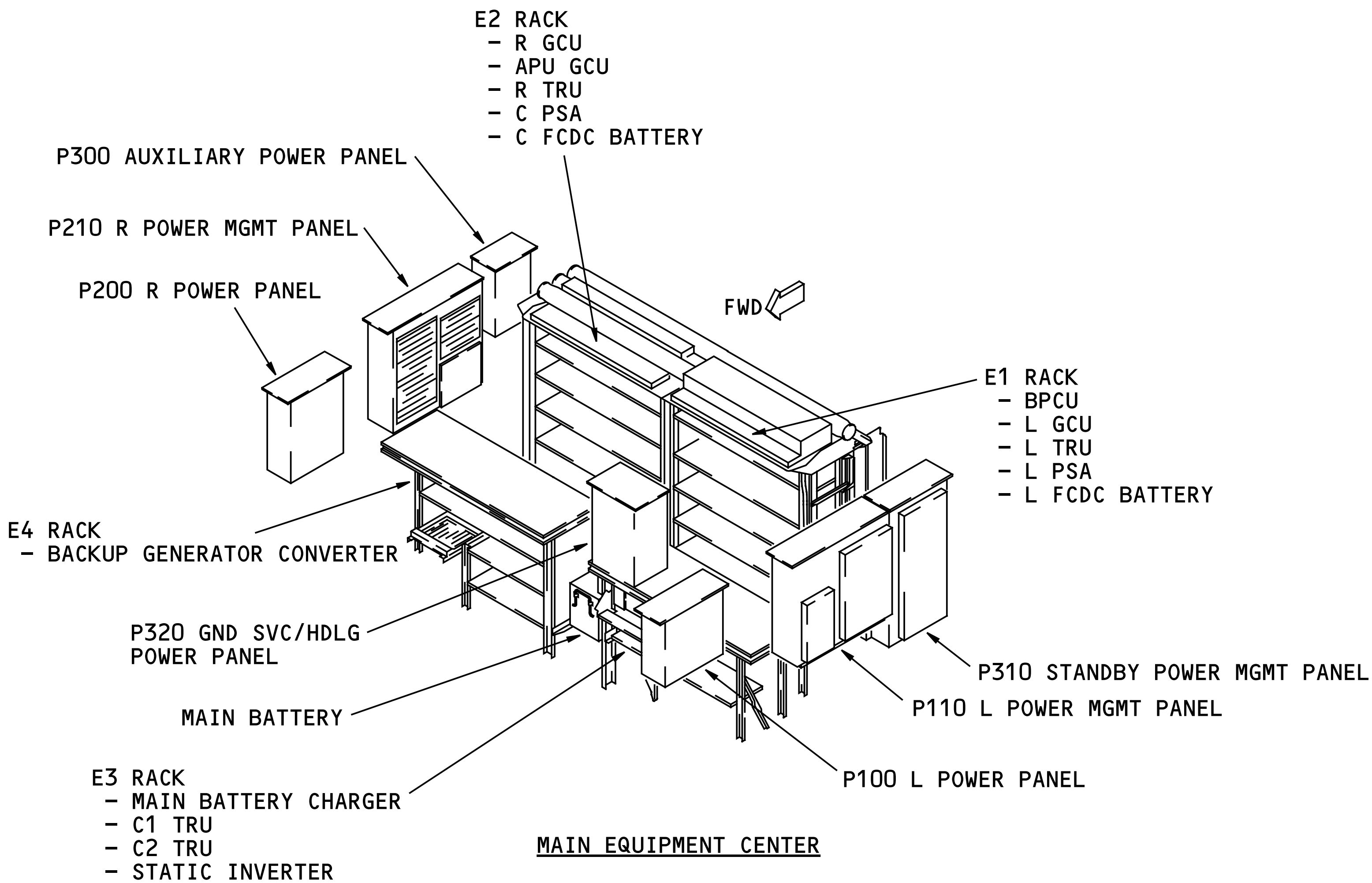
All the ELMS panels contain electrical system components. These are the ELMS panels:

- P200 right power panel
- P210 right power management panel
- P300 auxiliary power panel
- P100 left power panel
- P110 left power management panel
- P310 standby power management panel
- P320 ground service/handling power panel.

Racks

These main equipment center racks contain electrical system components:

- E1
- E2
- E3
- E4.



MAIN EQUIPMENT CENTER

24-00-00-005 Rev 3 04/15/1997

ELECTRICAL POWER - GENERAL COMPONENT LOCATIONS - MAIN EQUIPMENT CENTER

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General

The electrical panel is on the P5 overhead panel. The panel has four momentary-action switches and eight alternate-action switches. You use these to operate most of the electrical system. These are the momentary-action switches:

- External power (2)
- Drive disconnect (2).

These are the alternate-action switches:

- Battery
- APU generator
- Bus tie (2)
- Generator control (2)
- Backup generator (2).

The standby power switch is on the P61 overhead maintenance panel. It is a guarded, toggle switch. You use it to manually control standby power.

Battery Switch

The battery switch connects the hot battery bus to the battery #2 bus. ON is a mechanical indication that shows the switch is in its latched-in position. OFF is an amber light that shows when the switch is out and the airplane has ac power.

APU Generator Switch

The APU generator switch arms the APU GCU to automatically control APU generator electrical power. ON is a mechanical indication that shows the switch is in its latched-in position. OFF is an amber light that shows when the switch is out. If the APU is running, the light also comes on when the auxiliary power breaker (APB) opens for any reason other than when you apply secondary external power to the airplane. The switch is normally left on.

Bus Tie Switches

Each bus tie switch controls the operation of its related BTB. AUTO is a mechanical indication that shows the switch is in its latched-in position. ISLN is an amber light that shows when the switch is out and the BTB is open. The isolation (ISLN) light also comes on if the switch is in AUTO and the GCU opens the BTB for a fault. The switches are normally left in AUTO.

External Power Switches

Each external power switch controls the operation of its related external power contactor (EPC). AVAIL is a white light that shows good power quality at the ground power source. ON is a white light that shows a closed EPC. The available (AVAIL) light goes out when the EPC closes.

Generator Control Switches

Each generator control switch arms its GCU to automatically control IDG electrical power. ON is a mechanical indication that shows the switch is in its latched-in position. OFF is an amber light that shows when the related generator circuit breaker (GCB) is open. The switches are normally left on.

Backup Generator Switches

Each backup generator control switch arms the backup generator converter to control backup electrical power. ON is a mechanical indication that shows the switch is in its latched-in position. OFF is an amber light that comes on for these conditions:

- Generator control relay (GCR) opens for a fault
- Engine is shut down
- Related engine fire switch is pulled out
- Switch is out.

The switches are normally left on.

Drive Disconnect Switches

The drive disconnect (DISC) switch removes engine gearbox power from the IDG. When you press the switch, the two-piece IDG input shaft moves apart. DRIVE is an amber light that shows that the related IDG has low oil pressure. Plastic guards cover the drive disconnect switches to prevent accidental operation.

Standby Power Switch

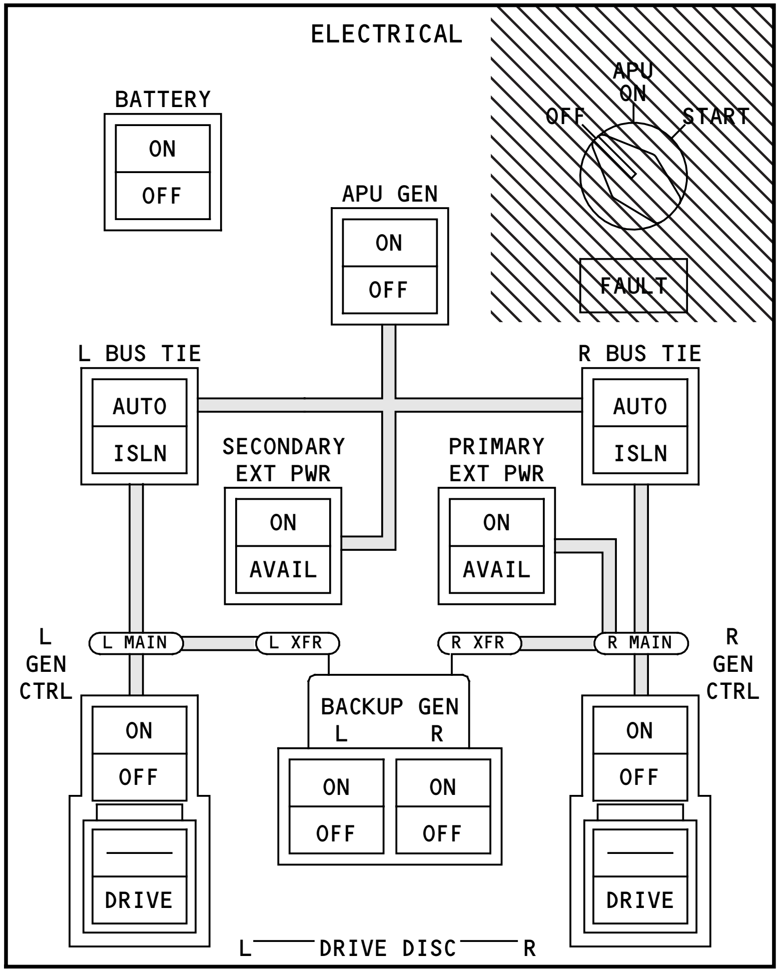
The standby power switch has these three positions:

- OFF
- AUTO
- BAT (momentary).

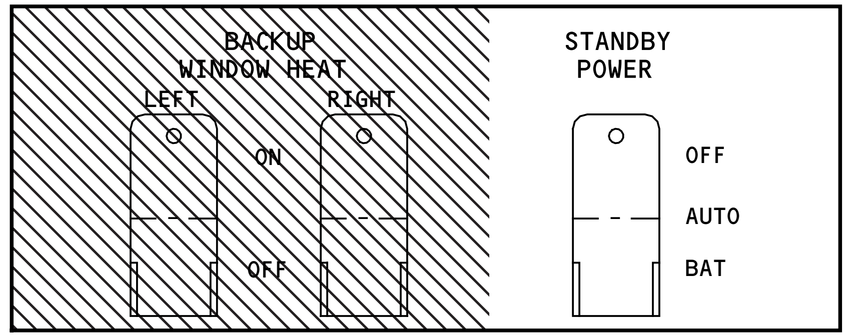
On the ground, the off position makes the static inverter stay off. In the air, the off position has no effect.

The automatic (AUTO) position puts the standby electrical power system under the ELMS control. A guard over the switch moves it to AUTO. The switch is normally left in AUTO.

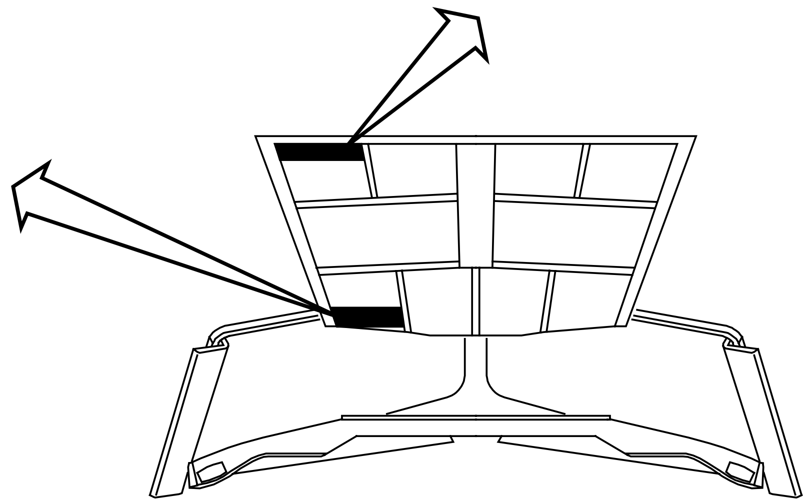
To use the battery position (BAT), you must first push the battery switch on. With no ac power on the airplane, the switch in BAT turns the static inverter on and makes it power the standby ac bus. With ac power on the airplane, the switch in BAT starts a dc/standby self check test.



ELECTRICAL PANEL (P5)



OVERHEAD MAINTENANCE PANEL (P61)



FLIGHT DECK OVERHEAD PANELS

24-00-00-006 Rev 6 05/16/95

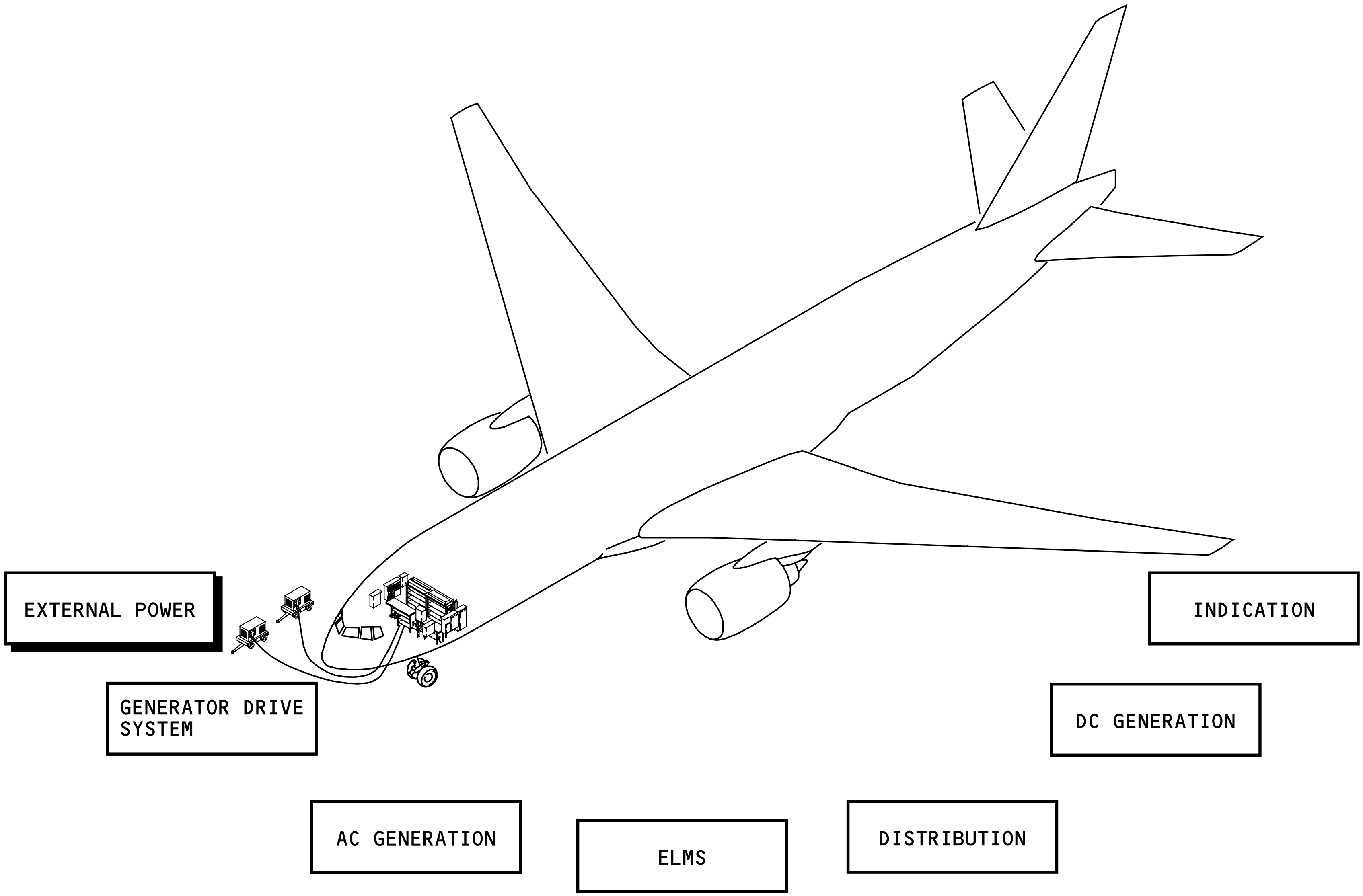
ELECTRICAL POWER - OPERATION - GENERAL

EXTERNAL POWER - INTRODUCTION

General

The external power system controls the electrical power on the airplane from ground power sources. The external power system has these electrical power system functions:

- Bus power control
- Ground handling power
- Ground service power
- Primary external power
- Secondary external power.



24-40-00-001 Rev 0

EXTERNAL POWER - INTRODUCTION

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EXTERNAL POWER - GENERAL DESCRIPTION

General

You use external power to supply the airplane with electrical power from a ground power source. You can supply the power directly to these electrical buses:

- Ground Handling
- Ground Service
- Main ac.

External Power Panel

The external power panel has two external power receptacles that have a continuous supply capacity of 90 kva each. The forward receptacle is for primary external power. The aft receptacle is for secondary external power.

Control

The BPCU controls these electrical switching devices that connect external power to the airplane:

- Secondary EPC
- Primary EPC
- Ground handling relay
- Ground service transfer relay
- Ground service select relay.

The GCUs control the BTBs to connect power between the main ac buses.

Ground Handling Power

When you supply power to the primary external power receptacle, the BPCU energizes the ground handling relay. This connects primary external power to the ground handling ac bus. The ground handling TRU supplies dc power to the ground handling dc bus.

The APU generator can also supply power to the ground handling ac bus, but secondary external power cannot. If both primary external power and the APU generator are available, the BPCU selects primary external power for the ground handling ac bus.

Ground Service Power

The BPCU selects the power source for the ground service bus in this order:

- Right main ac bus
- Primary external
- APU generator.

If the right main ac bus has no power, you can use the ground service switch. When you push the switch, the BPCU connects primary external power or APU generator power directly to the ground service bus.

Primary External Power

When you push the primary external power switch, you connect primary external power to the main ac buses.

EXTERNAL POWER - GENERAL DESCRIPTION

The BPCU closes the primary EPC and the GCUs close the BTBs to connect the power.

Secondary External Power

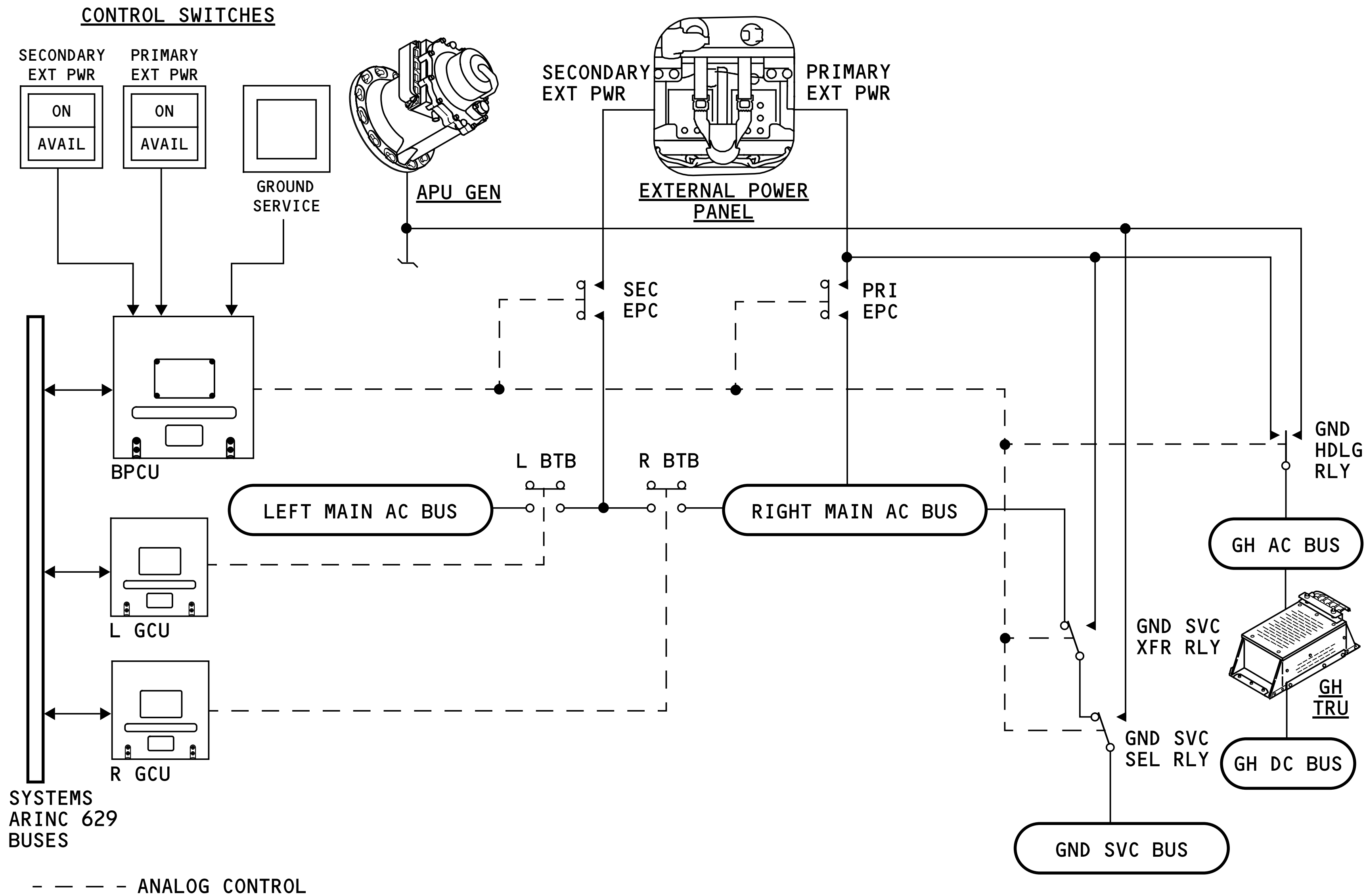
When you push the secondary external power switch, you connect secondary external power to the main ac buses. The BPCU closes the secondary EPC and the GCUs close the BTBs to connect the power. If primary external power was on the right main ac bus, the right GCU opens the right BTB first to perform a break-power transfer.

No-Break Power Transfers

The BPCU coordinates power transfers between the external power sources and the IDGs or APU generator. The BPCU and GCUs communicate on the systems ARINC 629 buses.

When the ac system changes from an external power source to another power source, it does no-break power transfers. The system momentarily connects the two power sources to one bus so there is no interruption in power. A GCU electronically adjusts an IDG speed to match the power of the external power source to do a no-break power transfer. For transfers between external power and the APU, the APU controller adjusts the APU speed to do the no-break power transfer.

The BPCU always does a break-power transfer between primary external power and secondary external power.



EXTERNAL POWER - GENERAL DESCRIPTION

24-40-00-002 Rev 4 08/08/96

EXTERNAL POWER - COMPONENT LOCATIONS

General

These are the components of the external power system:

- Primary EPC
- Ground service transfer relay
- Secondary EPC
- Ground service select relay
- Ground handling relay
- BPCU
- Ground handling TRU.

Main Equipment Center

Most of the external power components are in the ELMS panels in the main equipment center. See the electrical load management system section for more information on component locations (AMM PART I 24-09).

These are the components in the P200 right power panel:

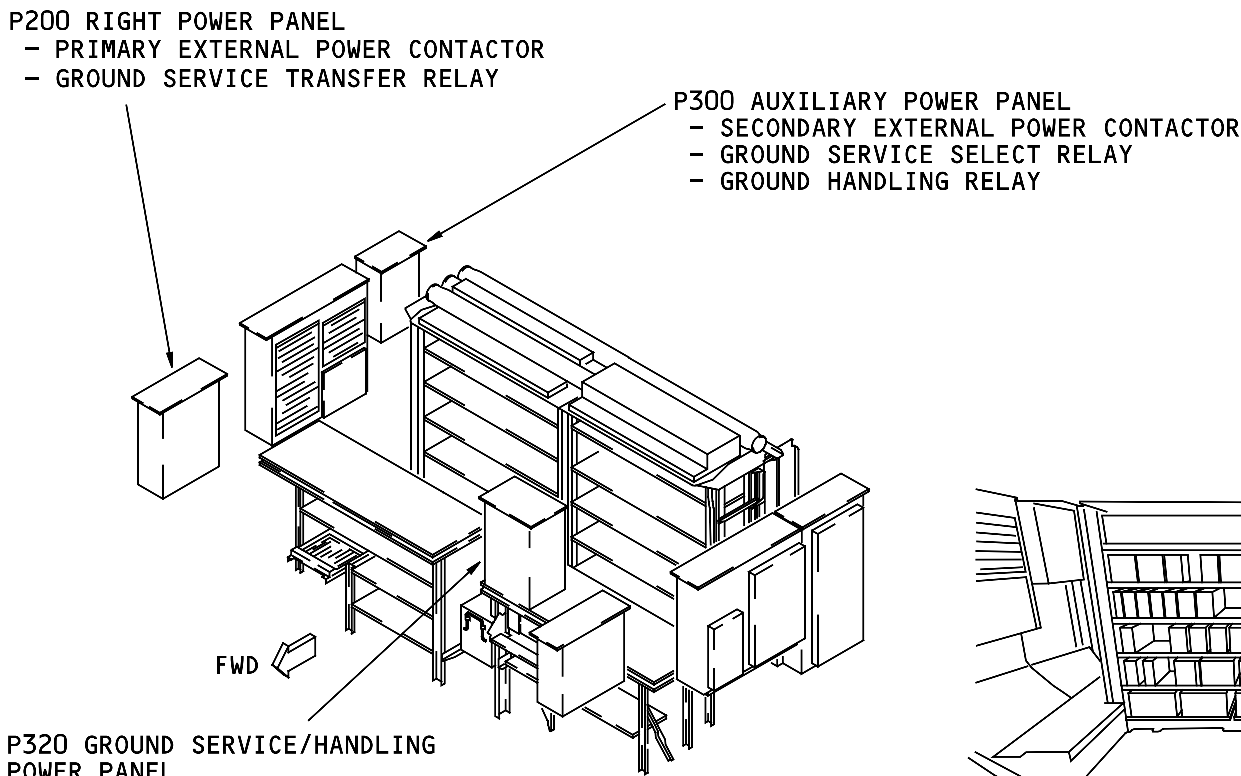
- Primary EPC
- Ground service transfer relay.

These are the components in the P300 auxiliary power panel:

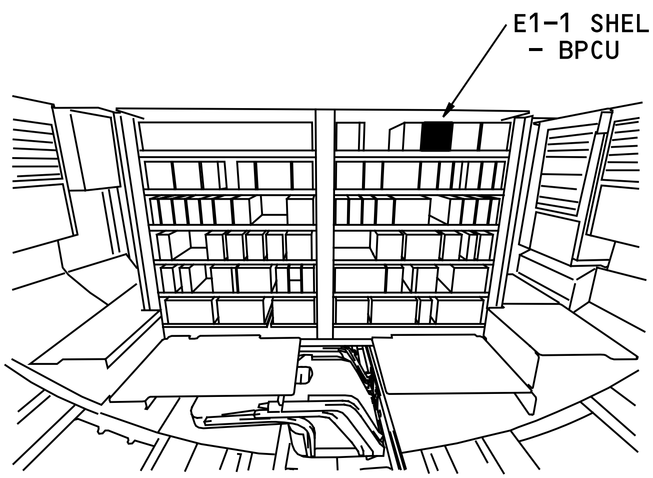
- Secondary EPC
- Ground service select relay
- Ground handling relay.

The ground handling TRU is in the P320 ground service/ handling power panel.

The BPCU is on the E1-1 shelf.



MAIN EQUIPMENT CENTER



MAIN EQUIPMENT CENTER
(LOOKING AFT)

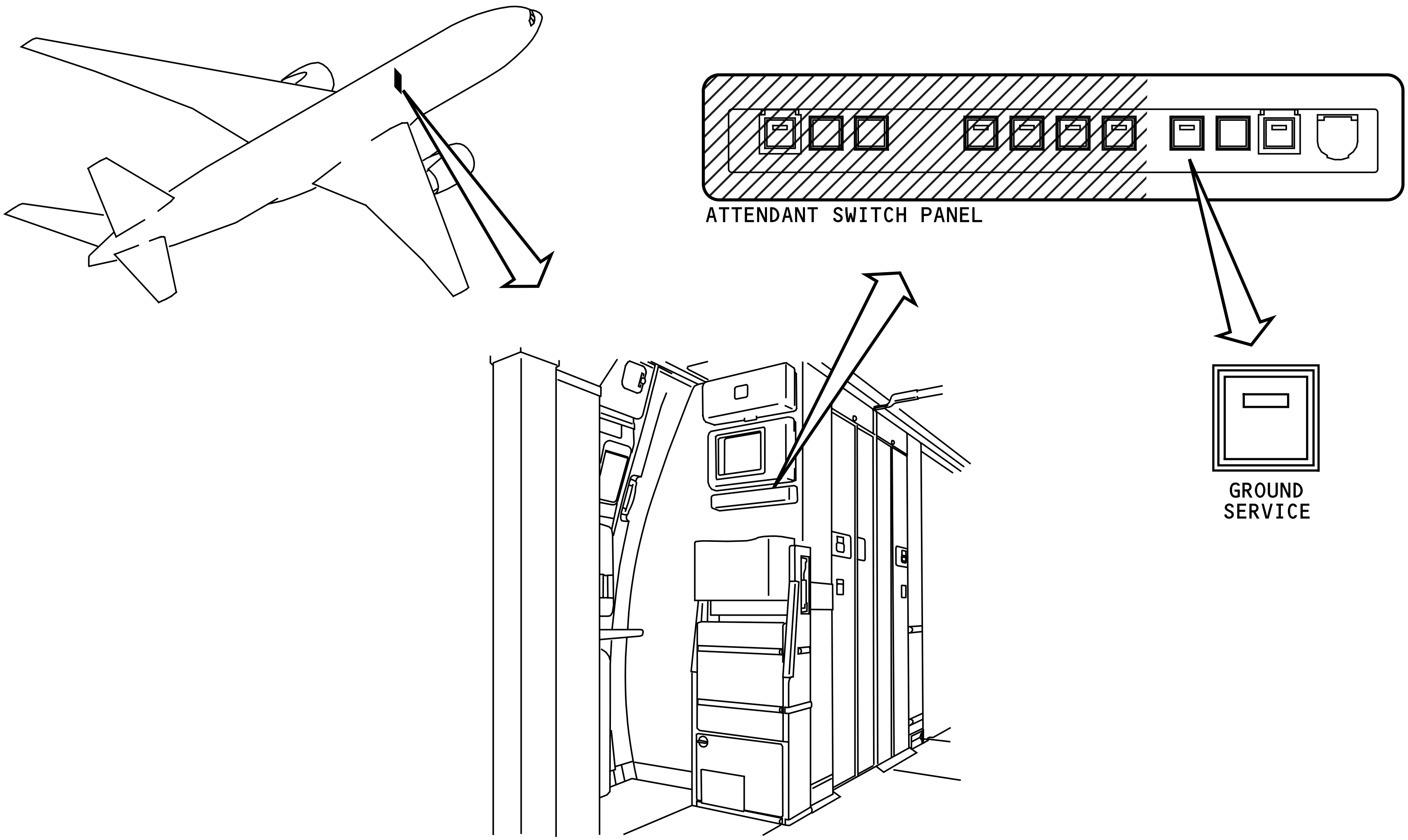
24-40-00-003 Rev 3 04/15/1997

EXTERNAL POWER - COMPONENT LOCATIONS

EXTERNAL POWER - GROUND SERVICE SWITCH

General

The ground service switch arms the BPCU to connect either primary external power or the APU generator directly to the ground service bus. The switch is on the right side of the attendant switch panel at door 2 left.



ATTENDANT SWITCH PANEL - DOOR 2L
(LOOKING FWD)

EXTERNAL POWER - GROUND SERVICE SWITCH

24-40-00-004 Rev 4 04/26/96

EXTERNAL POWER - EXTERNAL POWER PANEL

General

You use the external power panel to connect ground power sources to the airplane electrical system. The panel is immediately to the right of the main equipment center access door approximately 10 ft (3 m) above the ground.

Physical Description

The panel contains two power receptacles and their related power cord restraining straps. The forward receptacle is for primary power. The aft receptacle is for secondary power.

Each receptacle has four large pins for ac power and two small ones for the interlock. Above each receptacle are two indication lights; CONNECTED and NOT IN USE.

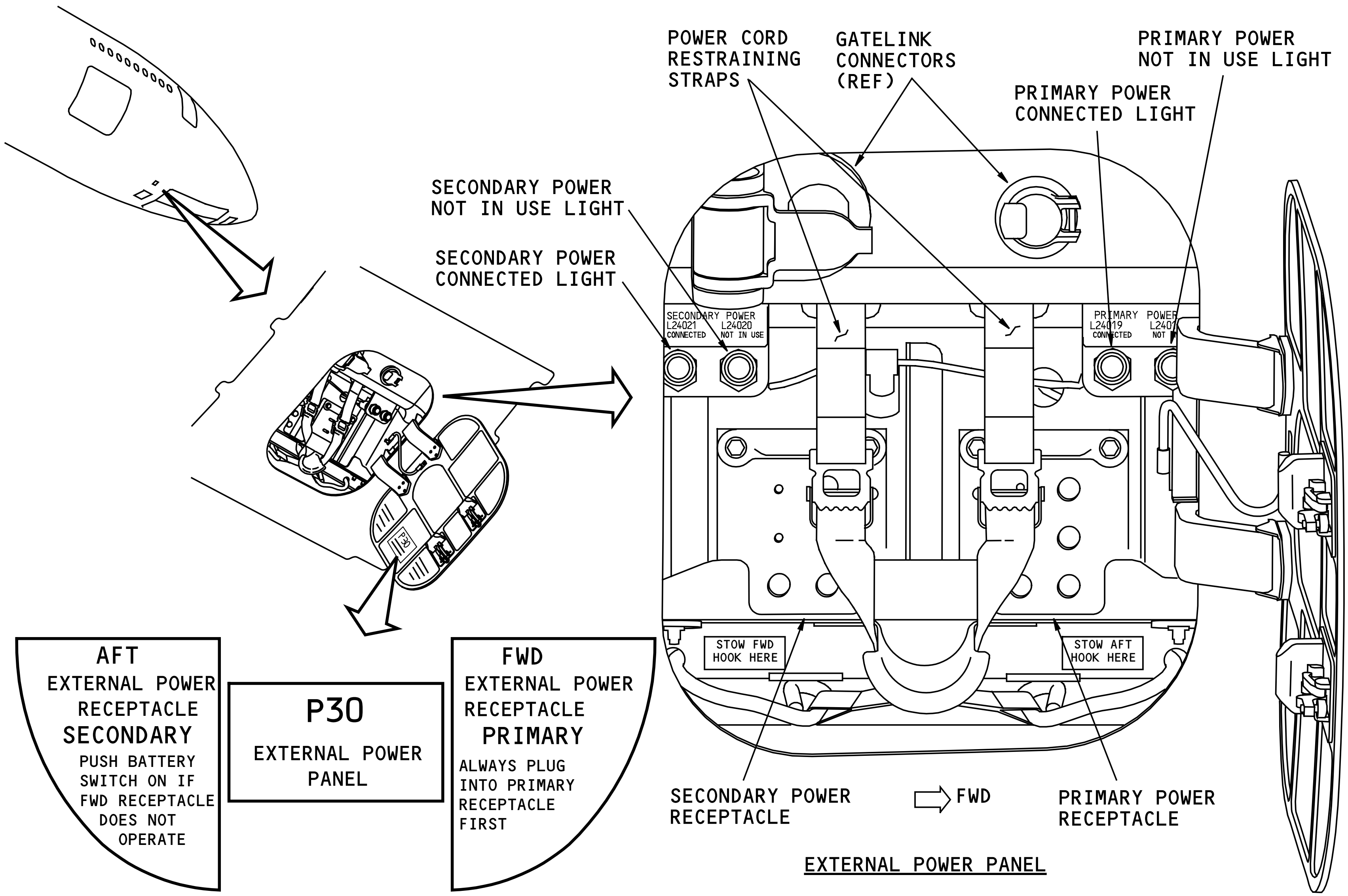
Above the lights are gatelink connectors. You find details on the gatelink connectors in chapter 23.

The power cord restraining straps are hook-type with adjustable straps. They hold the weight of the power cords to keep the plugs connected to the receptacles. The aft hook, which stows forward, is for the aft receptacle. The forward hook, which stows aft, is for the forward receptacle.

Placards inside the panel access door list specific information about connecting external power.

Training Information Point

When you stow the hooks, make sure the straps are tight.



EXTERNAL POWER - EXTERNAL POWER PANEL

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EXTERNAL POWER - FUNCTIONAL DESCRIPTION - BPCU

General

The BPCU controls external power on the airplane. It also controls ground handling and ground service power.

The BPCU sends data to the GCUs and the ELMS across the ARINC 629 systems data buses for power management. It also sends data to the AIMS for indications.

Switch Controls

These three switches supply control signals to the BPCU:

- Primary external power
- Secondary external power
- Ground service.

The BPCU supplies power to the switches and controls the lights in the switches.

Contactor and Relay Control

The BPCU controls these five electrical switching devices:

- Primary external power contactor (EPC)
- Secondary EPC
- Ground handling relay
- Ground service transfer relay
- Ground service select relay.

Power Transfer Control

The BPCU controls bus transfers between power sources. A reference frequency circuit in the BPCU permits no-break-power-transfers (NBPT) between external, APU, and IDG power sources on the ground. A NBPT is when two power sources momentarily parallel during a transfer. The power transfer circuit prevents any paralleling in the air and during takeoff and landing.

Protection

The BPCU protects the airplane electrical system from these external power problems:

- Over/under-voltage
- Over/under-frequency
- Over-current
- Unbalanced current
- Open phase
- Sustained parallel source (SPS)
- BPCU processor failure.

BPCU Power

The BPCU has these three power sources:

- Primary external power
- Battery bus #2
- Right dc bus.

A rectifier in the BPCU power supply changes the primary external ac power to dc. Battery bus #2 power

EXTERNAL POWER - FUNCTIONAL DESCRIPTION - BPCU

connects to the BPCU when you push the battery switch on.

Power Quality

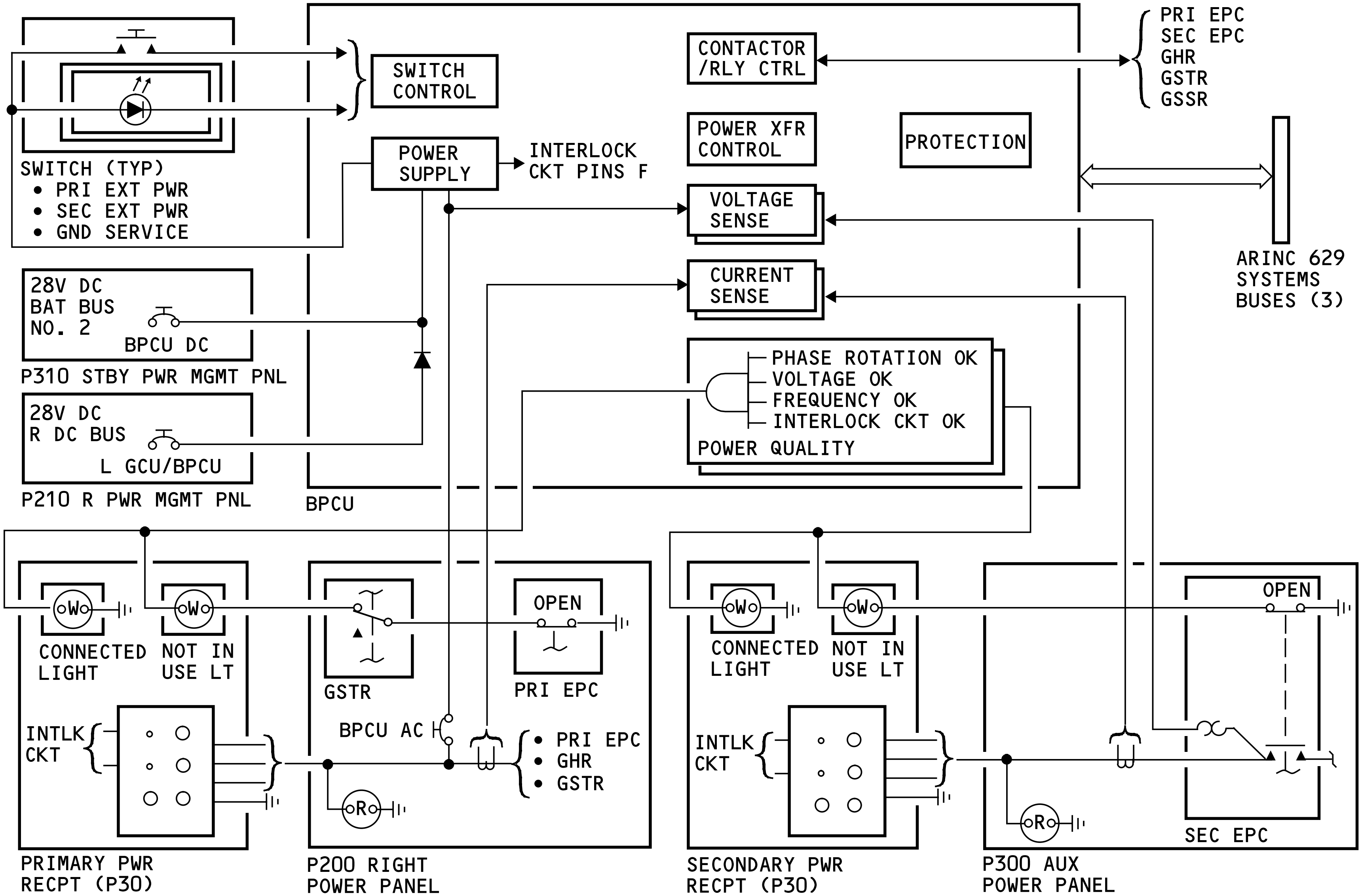
The BPCU checks the quality of the external power sources for:

- Phase rotation
- Voltage
- Frequency
- Interlock circuit.

If the power is good, the BPCU supplies power to turn on the related CONNECTED and NOT IN USE lights. When you select primary external power or ground service power, the primary NOT IN USE light goes off. When you select secondary external power, the secondary NOT IN USE light goes off.

Training Information Point

The secondary external power source does not supply power to the BPCU. To use secondary external power, you must connect the primary external power or push the battery switch on.



EXTERNAL POWER - FUNCTIONAL DESCRIPTION - BPCU

EXTERNAL POWER - GROUND HANDLING/GROUND SERVICE POWER - FUNCTIONAL DESCRIPTION

General

The BPCU controls the power to the ground handling bus and the ground service bus. Ground handling power is available only on the ground. Ground service power is available on the ground and in flight.

Ground Handling Power

When you apply good power to the primary power receptacle, the BPCU energizes one coil of the ground handling relay. This connects the primary external power to the ground handling bus.

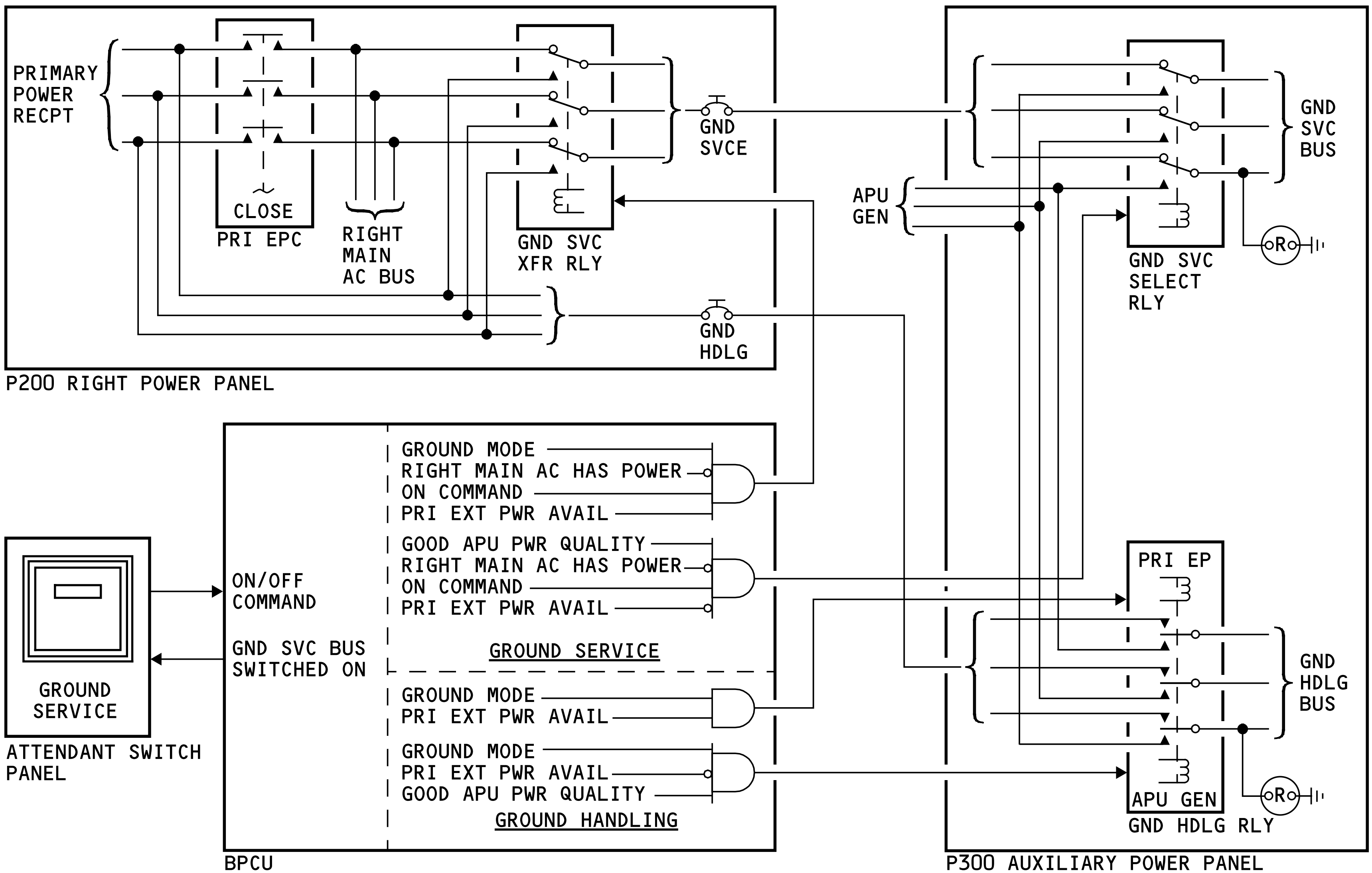
If no primary external power is available, but the APU generator power quality is good, the BPCU energizes the other coil of the ground handling relay. This connects the APU generator to the ground handling bus.

Ground Service Power

When you apply good power to the primary power receptacle, power is available at the ground service transfer relay. When you push the ground service switch, the BPCU energizes the ground service transfer relay. This connects primary external power to the ground service bus. With primary external power on the ground service bus, the BPCU turns on the light in the ground service switch.

When you push the ground service switch with no primary external power available, but the APU generator power quality is good, the BPCU energizes the ground service select relay. This connects the APU generator to the ground service bus. With APU power on the ground service bus, the BPCU turns on the light in the ground service switch.

When the right main ac bus has power, it automatically supplies the power to the ground service bus. In this case, the ground service switch has no effect on the ground service bus. The light in the switch does not come on or it goes out if it was on.



EXTERNAL POWER - GROUND HANDLING/GROUND SERVICE POWER - FUNCTIONAL DESCRIPTION

EXTERNAL POWER - FUNCTIONAL DESCRIPTION - PRIMARY/SECONDARY POWER

General

The BPCU controls external power on the airplane. You use the external power switches on the electrical panel to supply command signals to the BPCU.

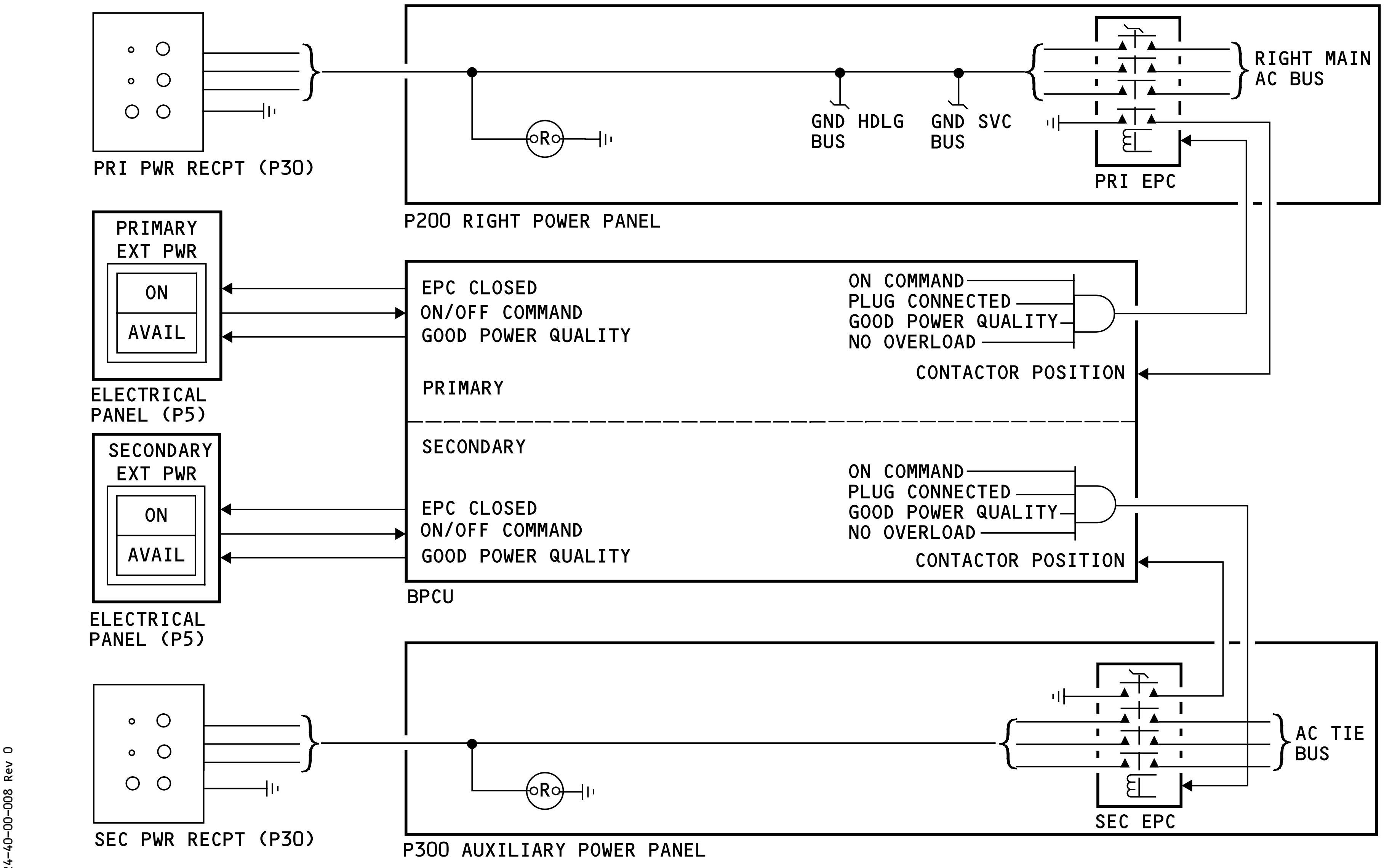
Primary External Power

When you apply power to the primary power receptacle, power is available at the primary EPC. With good power quality, the BPCU turns on the AVAIL light in the primary external power switch. When you push the primary external power switch, the BPCU energizes the primary EPC. This connects primary external power to the right main ac bus. When the EPC closes, the BPCU turns off the AVAIL light and turns on the ON light.

The BPCU must keep control power on the EPC to keep it closed. If you push the primary external power switch again, the on command in the BPCU goes away. This removes power to the EPC and it opens. The ON light goes off and the AVAIL light comes on again.

Secondary External Power

Secondary external power works the same as primary external power except the secondary external power connects to the ac tie bus through the secondary EPC.



EXTERNAL POWER - FUNCTIONAL DESCRIPTION - PRIMARY/SECONDARY POWER

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EXTERNAL POWER - OPERATION

General

To apply external power to the airplane electrical system, do these steps:

- Connect ground power plugs
- Observe indications
- Operate control switches.

Placards inside the external power panel access door give specific information about connecting external power.

Connect Ground Power Plugs

To connect to the power receptacles, you must loosen the restraining straps and remove the hooks from their stow points.

You should always use the primary receptacle. If you need more power, you can use the secondary receptacle.

Insert the ground power plug. Place the correct hook around the power cord behind the plug and tighten the restraining strap. Turn on power at the power source.

Observe Indications

If the quality of the power to the primary receptacle is good, the two lights above the receptacle come on. When the lights above the primary receptacle are on, the ground handling buses have power.

When you supply power to the secondary receptacle, the two lights above the receptacle come on if the power quality is good and one of these conditions exist:

- The primary receptacle has power
- The battery switch is on.

Operate Control Switches

You push the ground service switch to apply power to the ground service bus. The light in the switch comes on when the ground service bus has power. The NOT IN USE light above the primary receptacle goes out when the ground service bus gets power.

The AVAIL light in the primary external power switch comes on if the power quality is good.

The AVAIL light in the secondary external power switch comes on if the power quality is good and one of these conditions exist:

- The primary receptacle has power
- The battery switch is on.

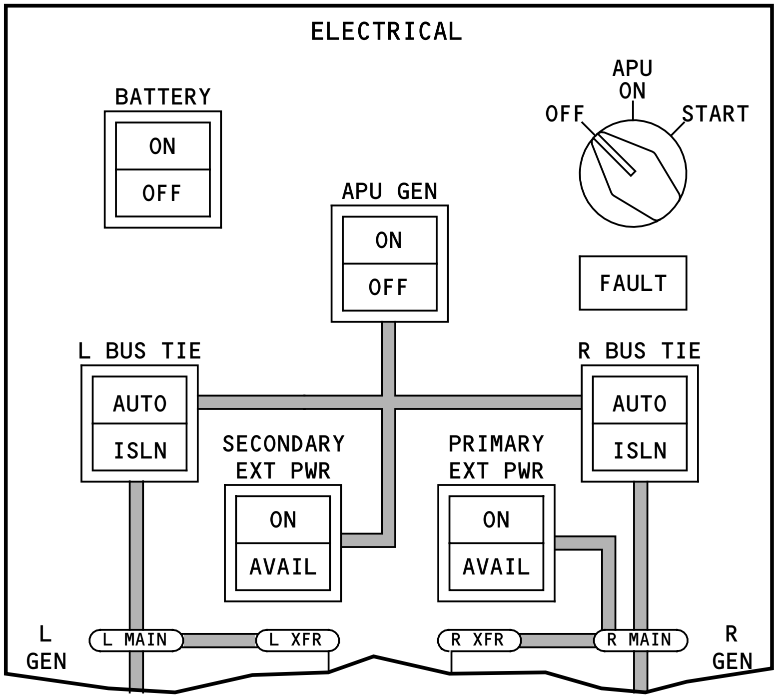
Push the battery switch on. Push the primary external power switch to apply primary ground power to the airplane electrical system. Push the secondary external power switch to apply secondary ground power to the airplane electrical system. When you supply power, the AVAIL lights go off and the ON lights come on.

EXTERNAL POWER - OPERATION

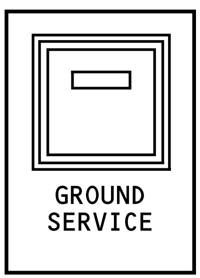
If the airplane will be left unattended, push the battery switch off. This prevents the automatic operation of the standby power system if you lose all ground power to the airplane.

Training Information Point

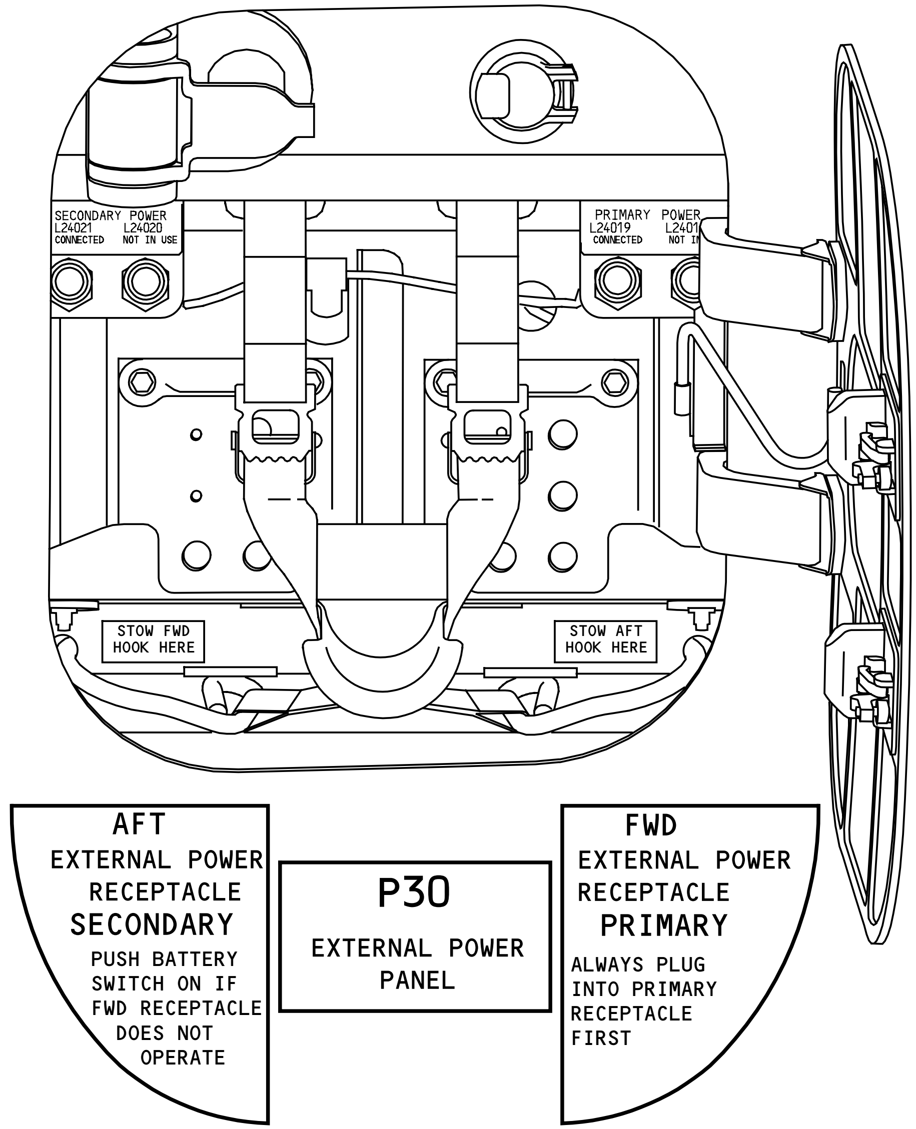
For each power receptacle, you should only use external power sources that have a power capacity of 90 kva or more. If you do not, it is possible that the ELMS will shed all the loads it controls or the BPCU will open the external power contactor(s). See the electrical load management system section for more information on load shedding (AMM PART I 24-09).



ELECTRICAL PANEL (P5)



ATTENDANT'S PANEL



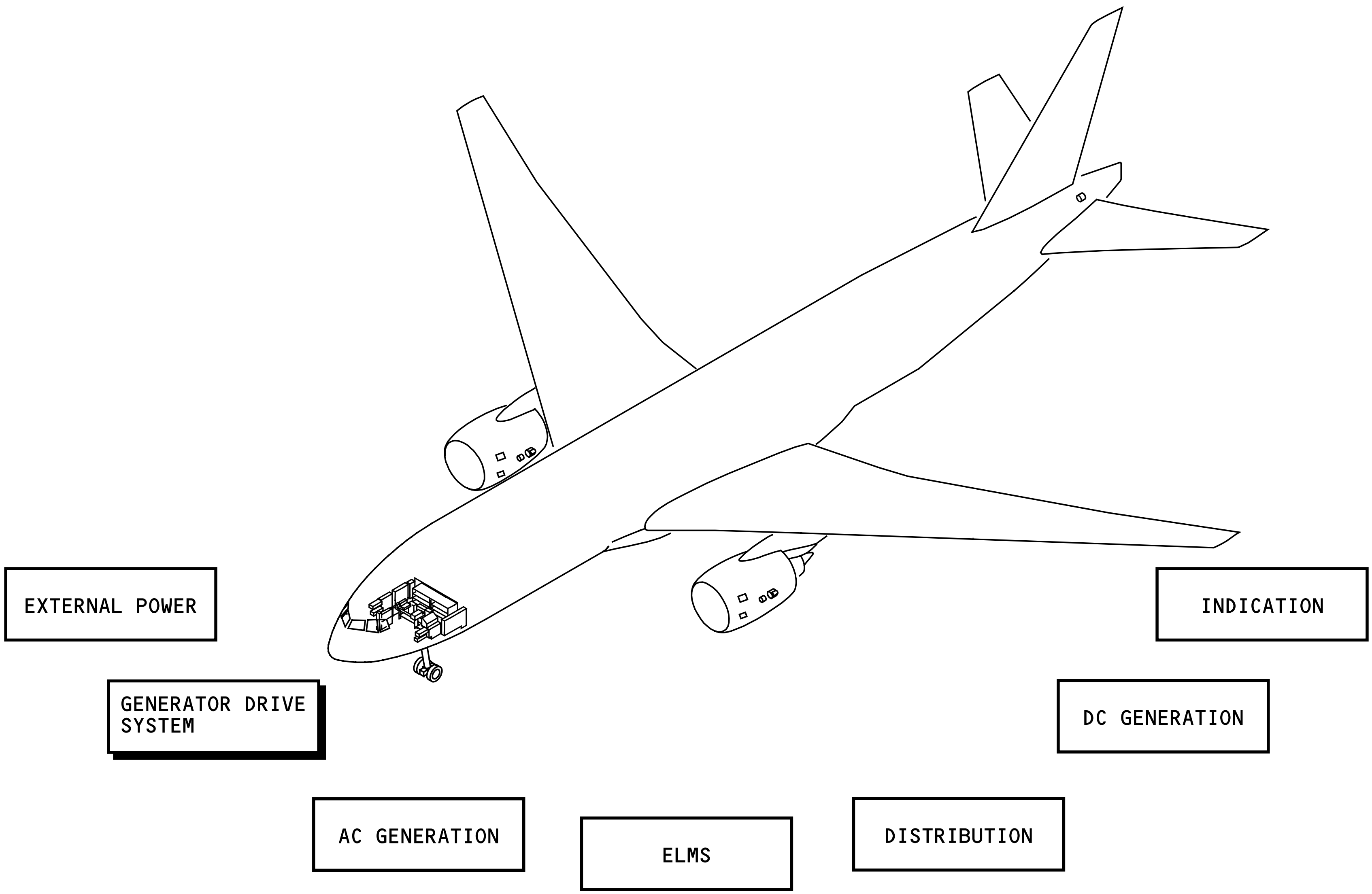
24-40-00-009 Rev 8 04/30/96

EXTERNAL POWER - OPERATION

GENERATOR DRIVE - INTRODUCTION

General

The generator drive system normally supplies electrical power to all of the electrical loads while the engines operate. The integrated drive generators (IDGs) are the primary sources of electrical power. The APU generator and the backup generators are secondary sources of electrical power.



GENERATOR DRIVE - INTRODUCTION

GENERATOR DRIVE - GENERAL DESCRIPTION

General

Two IDGs are primary power sources. The APU generator, and two backup generators are secondary power sources.

Heat exchangers remove heat from the generators.

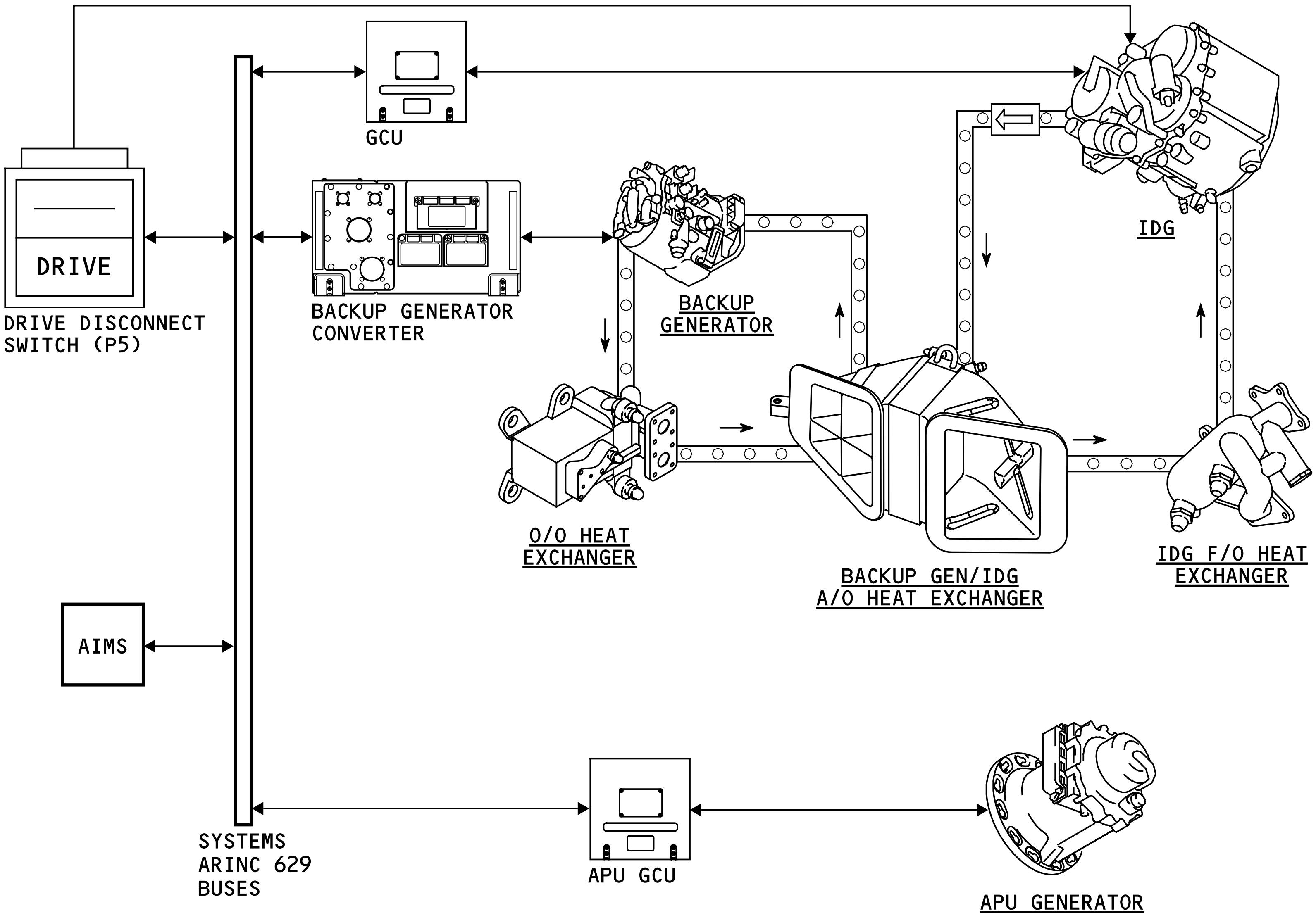
Electrical Interfaces

Switches on the electrical panel control the IDG disconnect operations. GCUs control the IDGs and the APU generator. One backup generator convertor controls the two backup generators. Lights on the electrical panel and EICAS messages show generator drive system information.

Mechanical Interfaces

Each engine mechanically turns an IDG and a backup generator. The IDGs change the mechanical power to constant-frequency ac electrical power. The backup generators change the mechanical power to variable-frequency ac electrical power. The backup generator converter changes the variable-frequency ac power to constant frequency ac power.

A continuous flow of fuel through the IDG fuel/oil heat exchanger cools the IDG oil. A continuous flow of fan air through the backup generator/IDG air/oil heat exchanger cools the oil for the backup generator and the IDG. The oil/oil heat exchanger heats the backup generator oil with engine oil.



GENERATOR DRIVE - GENERAL DESCRIPTION

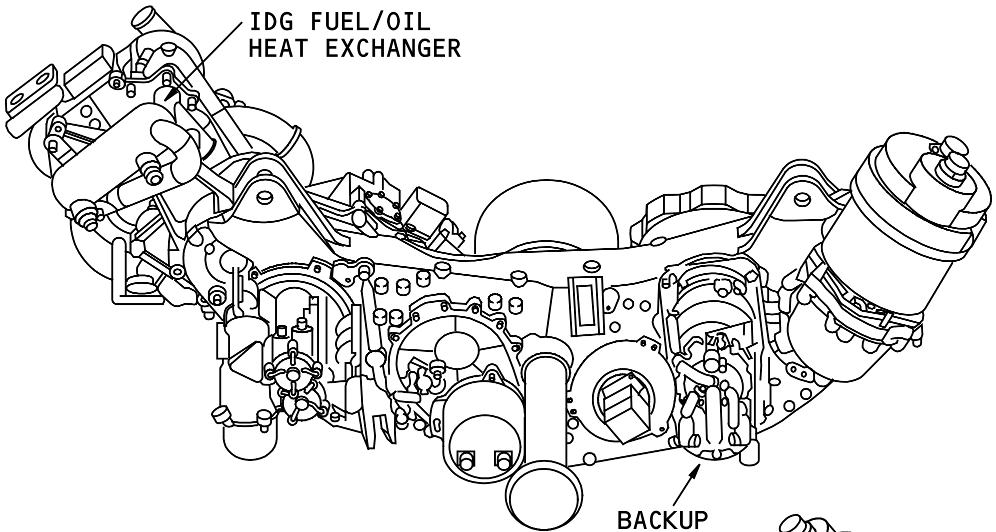
GENERATOR DRIVE - COMPONENT LOCATIONS - GEARBOX

General

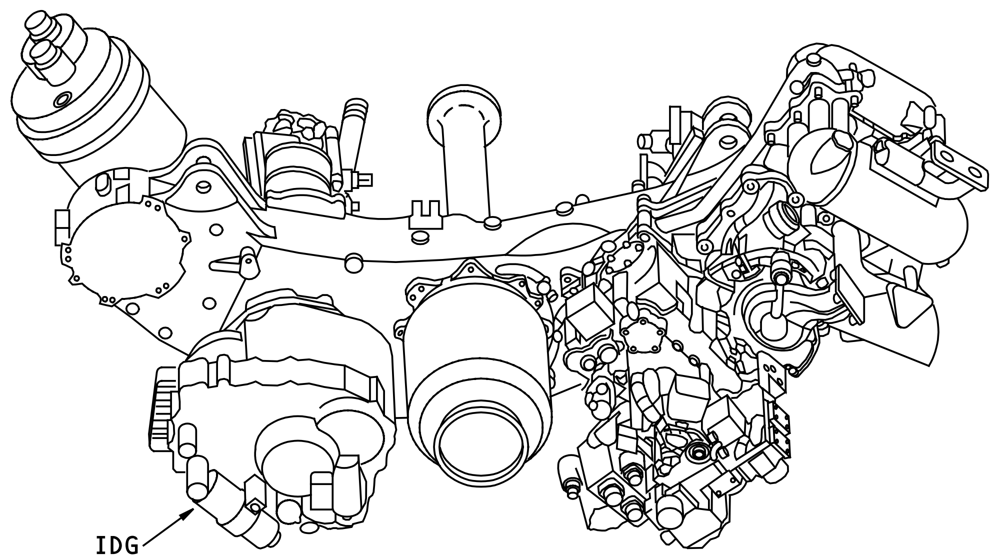
These are the generator drive components that attach to the accessory gearbox of each engine:

- IDG fuel/oil heat exchanger
- Backup generator
- IDG.

The IDG fuel/oil heat exchanger attaches to the front of the gearbox at the 4:30 position. The backup generator attaches to the front of the gearbox at the 6:30 position. The IDG attaches to the aft side of the gearbox at the 6:30 position.



ACCESSORY GEARBOX
(LOOKING AFT)



ACCESSORY GEARBOX
(LOOKING FORWARD)

GENERATOR DRIVE - COMPONENT LOCATIONS - GEARBOX

GENERATOR DRIVE - COMPONENT LOCATIONS - ENGINE

General

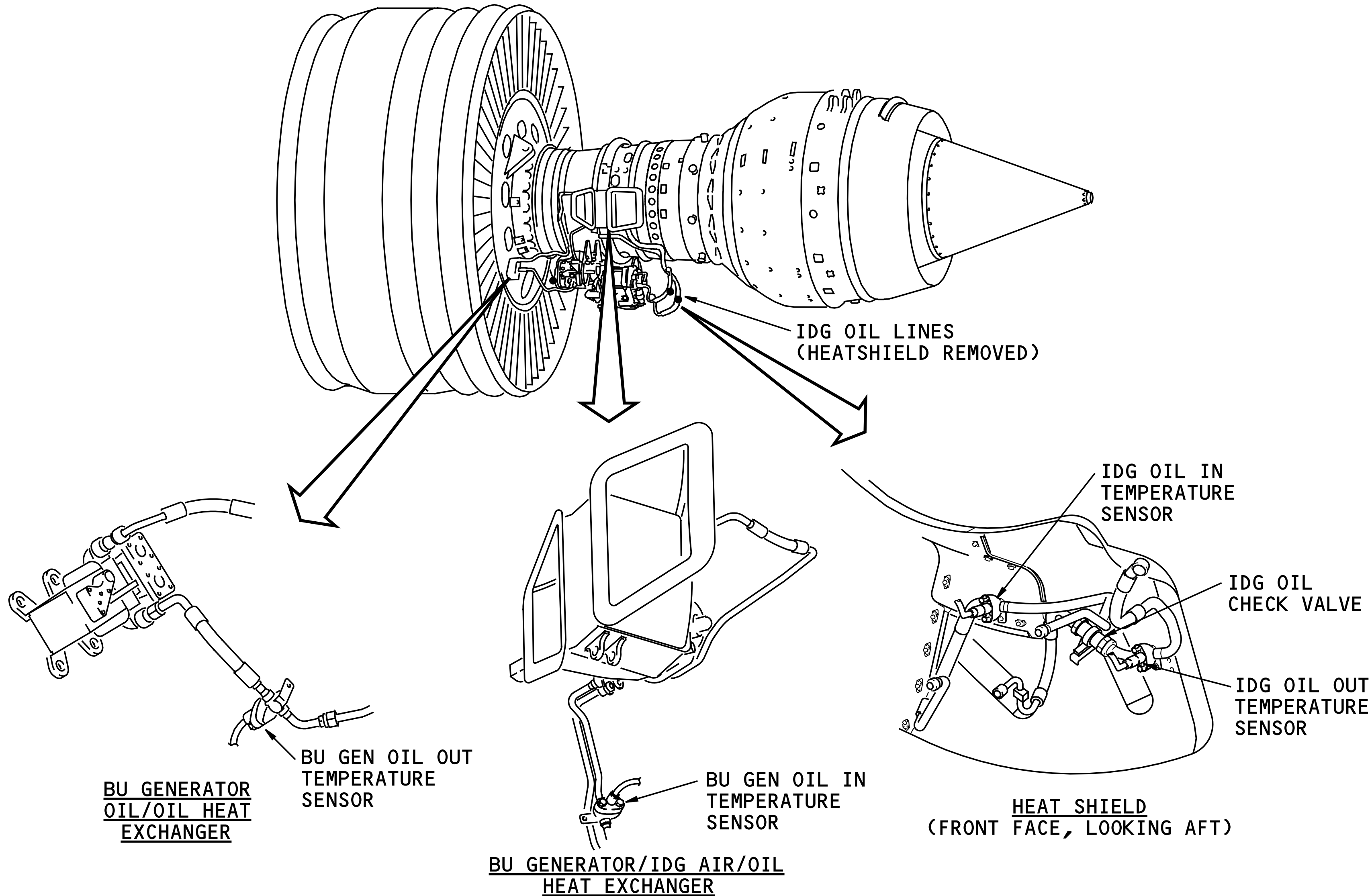
Each engine has these generator system components:

- Backup generator oil/oil heat exchanger
- Backup generator oil in and oil out temperature sensors
- Backup generator/IDG air/oil heat exchanger
- IDG oil in and oil out temperature sensors.

Component Locations

The backup generator oil/oil heat exchanger attaches to the fan hub frame at the 7:30 position. The backup generator oil out temperature sensor is in an oil line to the right of the oil/oil heat exchanger in the fan hub frame area. It is just in front of the BU generator (not shown). The oil in sensor is in an oil line forward and below the air/oil heat exchanger. It is just above and behind the left variable stator vane actuator (not shown).

The backup generator/IDG air/oil heat exchanger attaches to the high pressure compressor case at the 9:00 position. The IDG oil temperature sensors and the IDG oil check valve are aft of the IDG on the front face of the heat shield.



GENERATOR DRIVE - COMPONENT LOCATIONS - ENGINE

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GENERATOR DRIVE - INTEGRATED DRIVE GENERATOR

General

The IDG supplies electrical power to the airplane. It is a combination of a constant speed drive (CSD) and an ac generator. The CSD turns the generator at a constant speed to make constant frequency electrical power. Oil lubricates the IDG and makes it cool.

Electrical Connections

These are the four electrical connections on the IDG:

- Terminal block
- Electrical connector A
- Electrical connector B
- Electrical connector C.

The terminal block connects the power feeder cables to the IDG. The other connectors transmit control and monitoring inputs and outputs. They also transmit the PMG output.

Mechanical Items

You can get access to these mechanical items on the IDG:

- Input shaft (with aneroid valve)
- Aspirator
- Check valve
- Disconnect solenoid with thermal plug
- Case relief valve
- Oil out port
- Oil filter
- Oil in port
- Case drain
- Charge relief valve.

The aneroid valve, aspirator, and check valve keep a positive pressure inside the IDG when it operates. The aspirator pulls air in through the check valve. The air goes out through the aneroid valve. This prevents the collection of moisture in the IDG.

The case relief valve prevents the rupture of the IDG case if the IDG fuel/oil heat exchanger leaks.

The charge relief valve regulates the oil pressure of the IDG.

Maintenance Items

You use these items to maintain the IDG:

- Disconnect reset ring
- Oil level sightglass
- Overfill drain port
- Pressure fill port.

The disconnect reset ring lets you reset the drive disconnect mechanism. A solenoid operates the disconnect mechanism. You pull on the ring while the engine is shutdown to connect the drive shaft halves.

GENERATOR DRIVE - INTEGRATED DRIVE GENERATOR

NOTE: The IDG can automatically disconnect if the IDG oil gets too hot. A thermal plug melts and operates the disconnect mechanism. If the IDG disconnects automatically with the thermal plug, the reset ring cannot connect the drive shaft halves. The IDG must be reset at the repair shop.

You use the sightglass, fill port, and drain port to service the IDG oil.

Indication Items

These items supply data you use to make a check of the operational status of the IDG:

- Differential pressure switch (internal)
- Differential pressure indicator
- Remote oil level sensor
- Charge pressure switch (internal).

The differential pressure switch monitors the oil pressure upstream and downstream of the oil filter. The switch sends a signal that tells if the oil filter is clogged.

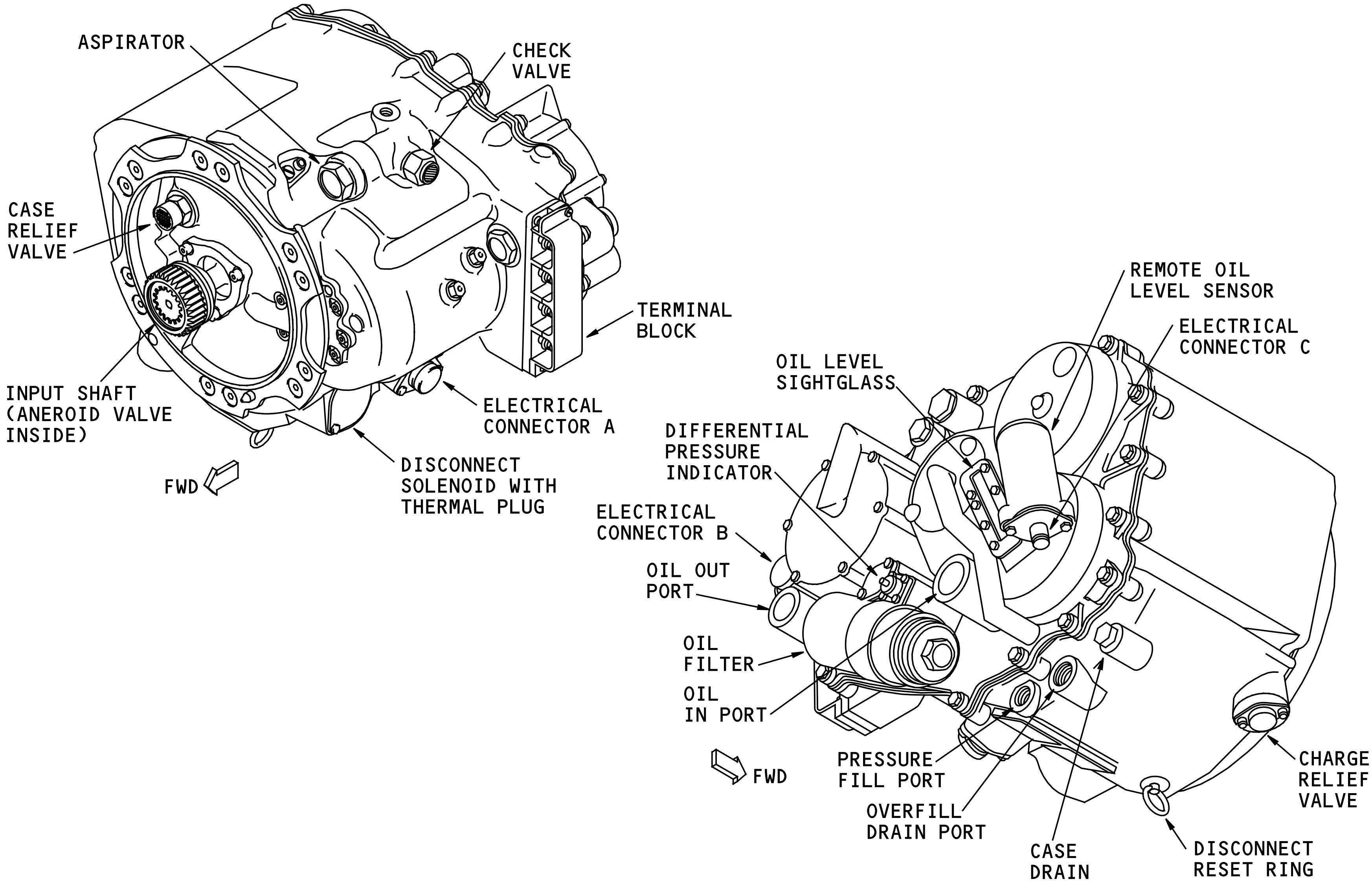
The differential pressure indicator has a red button. The red button moves out when the oil filter is clogged.

The remote oil level sensor sends the IDG oil level status to the GCU. The GCU supplies the primary display system with this data.

The charge pressure switch connects to the GCU. The switch monitors the oil pressure inside the IDG.

Training Information Point

The only LRMs on the IDG are the oil filter and the remote oil level sensor.



GENERATOR DRIVE - INTEGRATED DRIVE GENERATOR

GENERATOR DRIVE - IDG QAD COUPLING

General

The QAD coupling attaches the IDG to the gearbox. It has an adapter plate, a ring, index marks, and a tension bolt. You turn the tension bolt to turn the ring. When the ring releases the IDG, the ring index mark aligns with the adapter plate index mark and the IDG index mark.

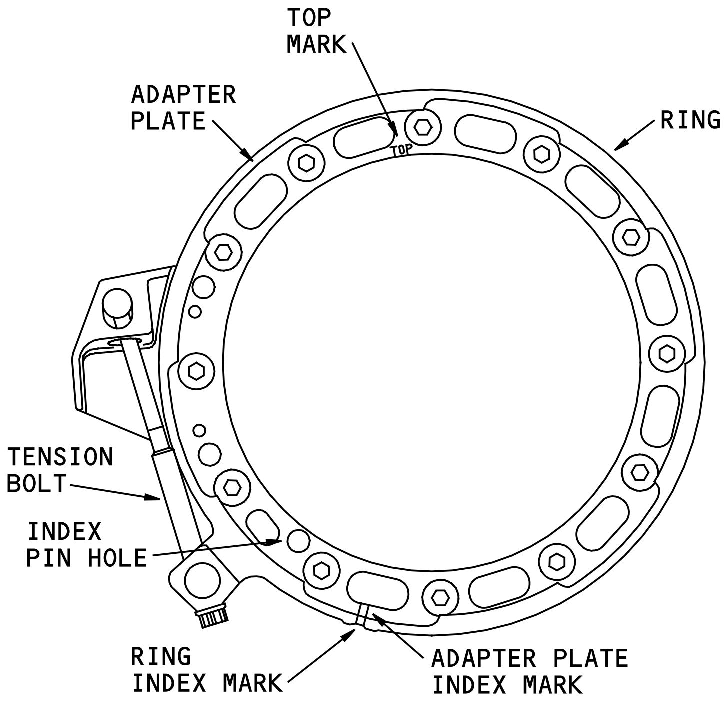
Training Information Point

There is a TOP mark that shows you how to put a new QAD coupling on the gearbox. You put the TOP mark at the 12:00 position.

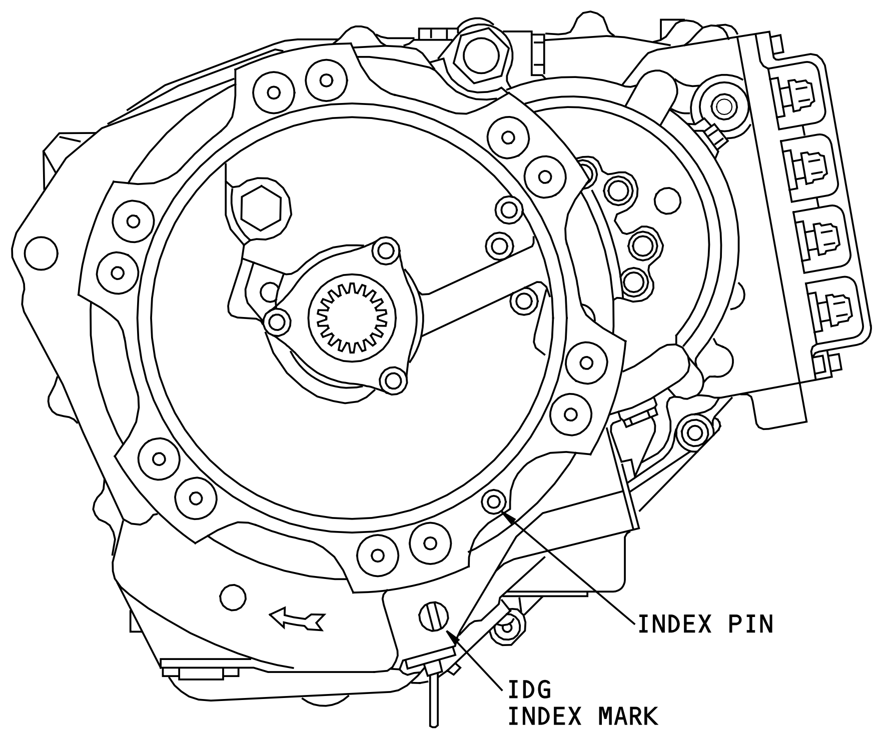
When you install a new QAD coupling, align the ring index mark and the adapter index mark so the IDG can go in. When you install an IDG, turn it so that the IDG index mark aligns with the ring index mark. This should align the IDG index pin with the QAD coupling index pin hole.

The IDG is very heavy. It weighs approximately 140 lbs (63 kgs). You must get the correct torque on the ring to prevent damage to the mating surfaces of the QAD coupling and the IDG.

At regular times, you must make a check of the QAD coupling. You must make sure that the IDG is locked in the QAD ring. You must make sure the tension bolt torque is correct. If the IDG is loose in the QAD coupling, vibration can cause damage to the QAD ring, the IDG mounting flange, and the IDG input seal.



QAD COUPLING
(LOOKING FORWARD)



IDG
(LOOKING AFT)

24-10-00-006 Rev 2

GENERATOR DRIVE - IDG QAD COUPLING

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GENERATOR DRIVE - IDG - FUNCTIONAL DESCRIPTION

General

The GCU and the drive disconnect switch control the IDG. The GCU sends information about the IDG to the systems ARINC 629 buses. The EEC sends oil temperature and oil filter data to the systems ARINC 629 buses. This permits the AIMS to show EICAS messages and maintenance data.

Generator Drive Light

The GCU controls the DRIVE light in the disconnect switch. The GCU sends a signal that causes the DRIVE light to come on when the IDG charge pressure is low. If the engine is running, the low oil pressure also causes the ELEC GEN DRIVE advisory message to show. When you see the ELEC GEN DRIVE message, you should immediately disconnect the IDG. This protects the IDG from damage. The drive disconnect switch on the P5 panel controls the IDG drive disconnect solenoid.

Drive Disconnect

The EEC reset/IDG disconnect relay arms the disconnect switch while the related engine fuel cutoff switch is in the RUN position. If the disconnect switch is in, the IDG disconnect solenoid energizes. This causes the spring-loaded disconnect mechanism to disconnect the IDG from the drive shaft.

The IDG can automatically disconnect if the IDG oil gets too hot. A thermal plug in the disconnect mechanism melts. This causes the spring-loaded disconnect mechanism to disconnect the IDG from the drive shaft.

Oil Level Sensing

The remote oil level sensor sends an oil level signal to the GCU. The sensor sends data only when the IDG charge pressure is low (IDG is shutdown). The electrical maintenance page shows the oil level data of the IDG. The oil level data shows two dashes when the IDG operates.

If oil does not cover the underfill sensor for the related IDG, the IDG oil level is too low. The maintenance page will show SERVICE when the IDG is shutdown.

If oil covers the underfill sensor, but not the overfill sensor, the IDG has sufficient oil. The maintenance page will show NORMAL when the IDG is shutdown.

If oil covers the overfill sensor and the related underfill sensor, the IDG oil level is too high. The maintenance page will show SERVICE when the IDG is shutdown.

Frequency Trim Control

The GCU controls the trim coil to increase or reduce the speed of the IDG drive. The speed change changes the frequency of the power output. The GCU uses the trim coil to match the IDG power frequency to the

GENERATOR DRIVE - IDG - FUNCTIONAL DESCRIPTION

frequency of an other power source during no-break power transfers.

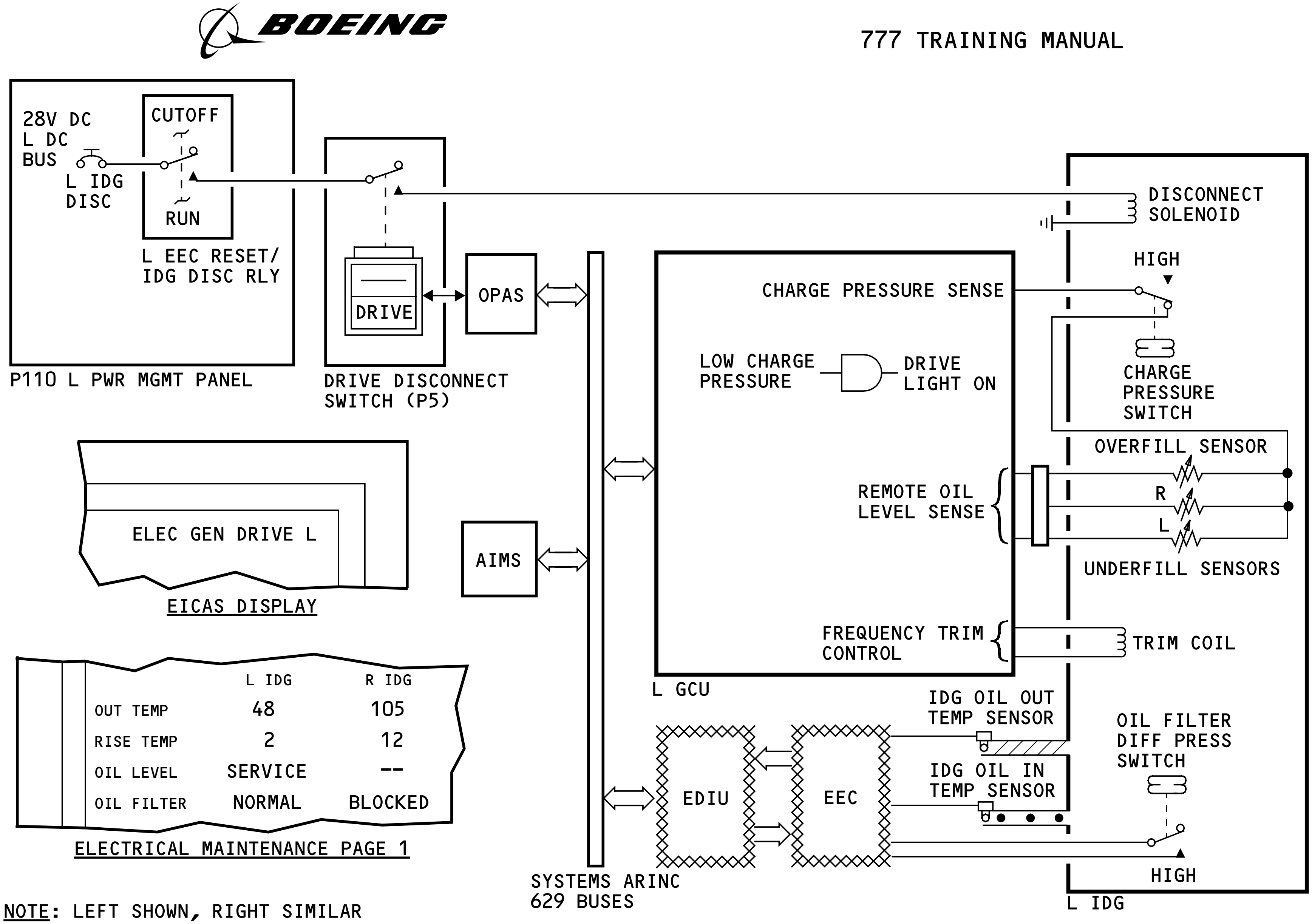
Oil Filter Status

The differential pressure switch monitors the difference between the pressures upstream and downstream of the oil filter. The switch sends a filter status signal through the EEC and the systems ARINC 629 buses to the GCU. The GCU causes the electrical maintenance page to show the status of the oil filter. The usual status on the maintenance page is NORMAL.

When the oil filter is clogged, the differential pressure switch closes. The GCU causes the electrical maintenance page to change the filter status to BLOCKED. The GCU inhibits the filter status signal when the oil out temperature is colder than 145F (62C).

Temperature Data

Oil temperature sensors in the inlet and outlet tubing send data to the EEC. The EEC sends the data to AIMS. The electrical maintenance page shows OUT TEMP, the temperature of the oil at the IDG outlet. And, it shows RISE TEMP, the difference between the inlet and the outlet temperatures. The data are in degrees C.



NOTE: LEFT SHOWN, RIGHT SIMILAR

GENERATOR DRIVE - IDG - FUNCTIONAL DESCRIPTION

GENERATOR DRIVE - IDG - OIL SERVICING

Oil Level Indication

The signal from the remote oil level sensor causes the IDG oil level data to show on the electrical maintenance page. The maintenance page shows the oil level data as NORMAL or SERVICE.

The IDG sightglass shows the oil level. You must open the left thrust reverser cowl to see the sightglass.

If the oil level is in the silver area of the sightglass, the IDG oil level is satisfactory. The black zone at the bottom of the sightglass is the low oil zone. The low oil zone is different for the left and right engine. You must add oil to the IDG if the oil level is in the low oil zone.

Add Oil to the IDG

You can add oil to the IDG through the IDG pressure fill valve. It is above an access door in the thrust reverser at the 6:00 position.

When you add oil, you must attach a drain hose to the IDG overflow drain valve. Add oil until at least one quart (liter) of oil comes out of the drain valve hose then stop. When the flow out of the overflow hose is within limits, disconnect the pressure fill hose and the drain valve hose.

CAUTION: MAKE SURE THE DRAIN VALVE HOSE IS CONNECTED TO LET THE OIL DRAIN TO THE CORRECT LEVEL IN THE IDG. TOO MUCH HEAT CAN OCCUR IF THE IDG IS FILLED WITH TOO MUCH OIL.

Training Information Point

The sightglass indication of the IDG oil level is not accurate until the engine is cold (a minimum of 30 minutes after engine shutdown).

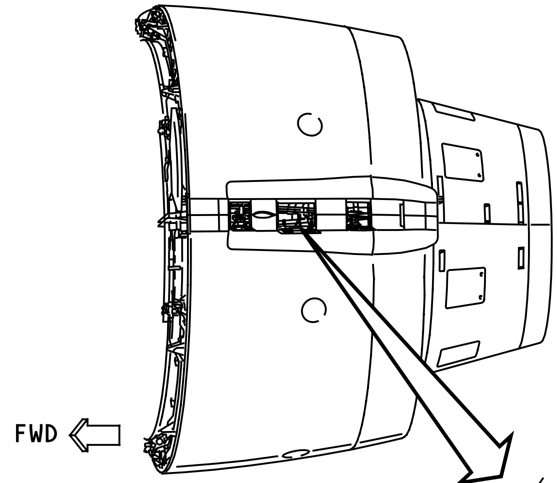
When the IDG operates, the electrical maintenance page does not get new oil level data. The oil level data shows as two dashes.

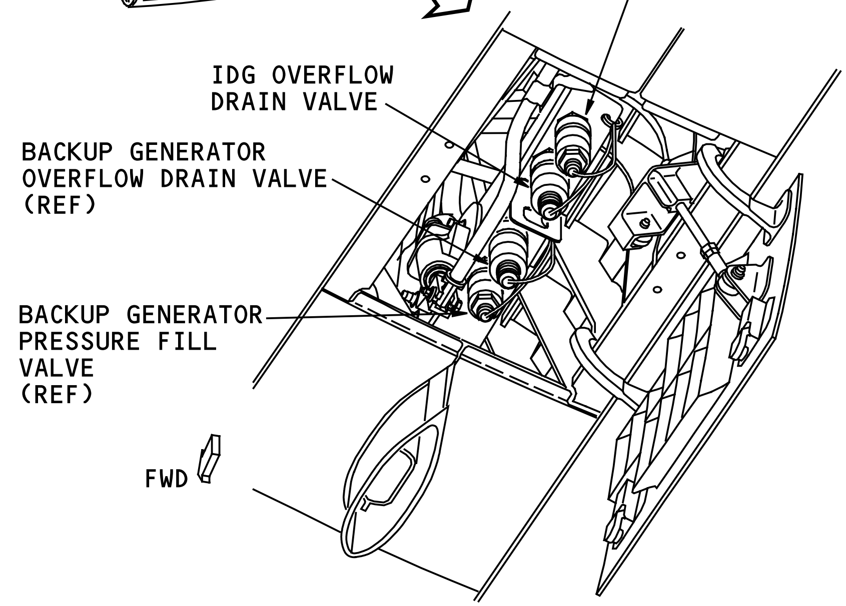
The oil level data is blank for any of these conditions:

- Engine shutdown (blank for approximately 10 minutes)
- Initial GCU power-up (blank for approximately 10 minutes)
- Data is invalid due to a fault.

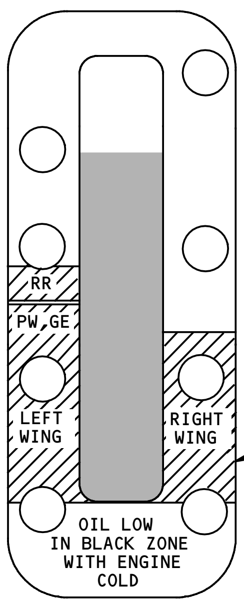
	L IDG	R IDG
OUT TEMP	48	105
RISE TEMP	2	12
OIL LEVEL	SERVICE	--
OIL FILTER	NORMAL	BLOCKED

ELECTRICAL MAINTENANCE PAGE 1

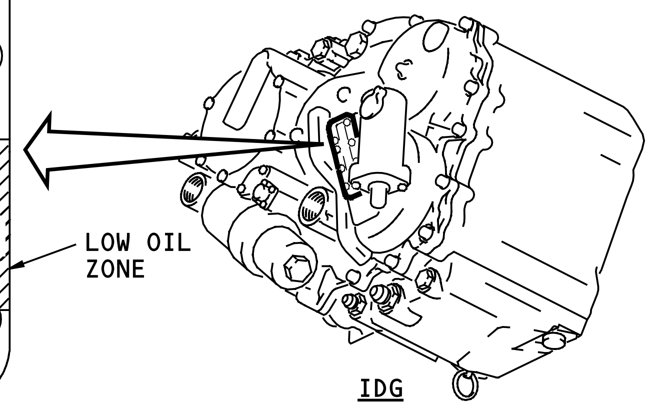




GENERATOR SERVICE DOOR



OIL LEVEL
SIGHTGLASS



IDG

GENERATOR DRIVE - IDG - OIL SERVICING

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GENERATOR DRIVE - BACKUP GENERATOR

General

The backup generator is an alternative power source. It can supply 115v ac, 400 Hz, electrical power to the transfer buses.

The backup generator also has permanent magnet generators (PMGs). One PMG supplies the field power for the backup generator. Two PMGs are power sources for the flight control power supply assemblies (PSAs).

Electrical Connections

These are the four electrical connections on the backup generator:

- Terminal block
- Electrical connector J1
- Electrical connector J2
- Electrical connector J3.

The terminal block connects the power feeder cables to the backup generator. Electrical connector J1 transmits the control inputs and the data outputs of the backup generator. Electrical connectors J2 and J3 connect the backup generator PMG power to the PSAs.

Mechanical Items

You can get access to these mechanical items on the backup generator:

- Oil in port
- Oil out port
- Overtemperature dump valve port
- Case drain plug
- Oil filter.

The overtemperature dump valve opens when the generator gets too hot. Generator oil drains through the open valve to the accessory drain.

Maintenance Items

You use these items to maintain the backup generator:

- Oil level sightglass
- Overfill drain port
- Pressure fill port.

Indication Items

These items supply data you use to make a check of the operational status of the backup generator:

- Differential pressure indicator
- Differential pressure switch (internal)
- Charge pressure switch (internal)
- Remote oil level sensor (internal).

The differential pressure indicator has a red button. The red button moves out when the filter is clogged.

The differential pressure switch monitors the oil pressure upstream and downstream of the oil filter. The

GENERATOR DRIVE - BACKUP GENERATOR

switch sends a signal that tells if the oil filter is clogged.

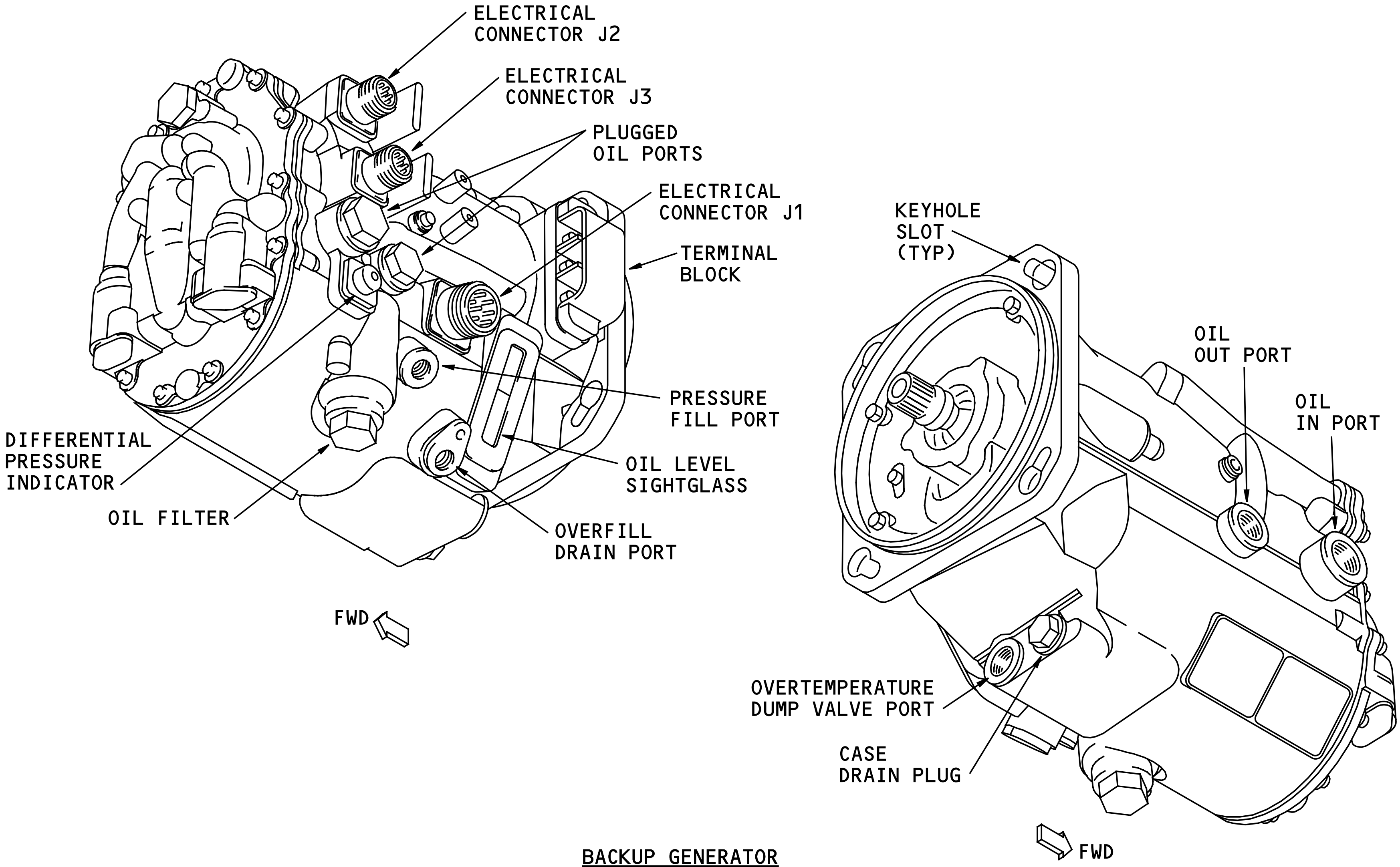
The charge pressure switch connects to the backup generator converter. The switch monitors the oil pressure inside the backup generator.

Two probes in the remote oil level sensor send the backup generator oil level status to the backup generator converter. The electrical maintenance page shows the oil level status from the remote oil level sensor.

Training Information Point

The generator has keyhole mounting holes in its mounting flange. This lets you leave the nuts and washers on the mounting bolts while you remove or install a generator.

The only LRM on the backup generator is the oil filter.



BACKUP GENERATOR

24-10-00-010 Rev 6

GENERATOR DRIVE - BACKUP GENERATOR

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GENERATOR DRIVE - BACKUP GENERATOR - FUNCTIONAL DESCRIPTION

General

The backup generator converter sends data from backup generator components to the systems ARINC 629 buses. The EEC puts oil temperature and oil filter data on the systems ARINC 629 buses. This permits AIMS to show EICAS messages and maintenance data.

Charge Pressure Switch

If the backup generator has low oil pressure, the charge pressure switch closes. If the charge pressure switch closes while the related engine is running and the backup generator oil temperature is above 20C, the backup converter trips the generator field. This causes the BACKUP GEN OFF light to come on. Low oil pressure also causes the ELEC BACKUP GEN message.

Oil Level Sensing

The remote oil level sensors send an oil level signal to the backup generator converter. The sensors send data only when the oil pressure is low (generator is shutdown). The electrical maintenance page shows the oil level data of the backup generator. The oil level data shows two dashes when the backup generator operates.

If oil does not cover the underfill sensor, the backup generator oil level is too low. The maintenance page will show SERVICE when the backup generator is shutdown.

If oil covers the underfill sensor, but not the overfill sensor, the backup generator has sufficient oil. The maintenance page will show NORMAL when the backup generator is shutdown.

If oil covers the two oil level sensors, the backup generator oil level is too high. The maintenance page will show SERVICE when the backup generator is shutdown.

The oil level data is blank for any of these conditions:

- Engine shutdown (blank for approximately 10 minutes)
- Initial converter power-up (blank for approximately 10 minutes)
- Data is invalid due to a fault.

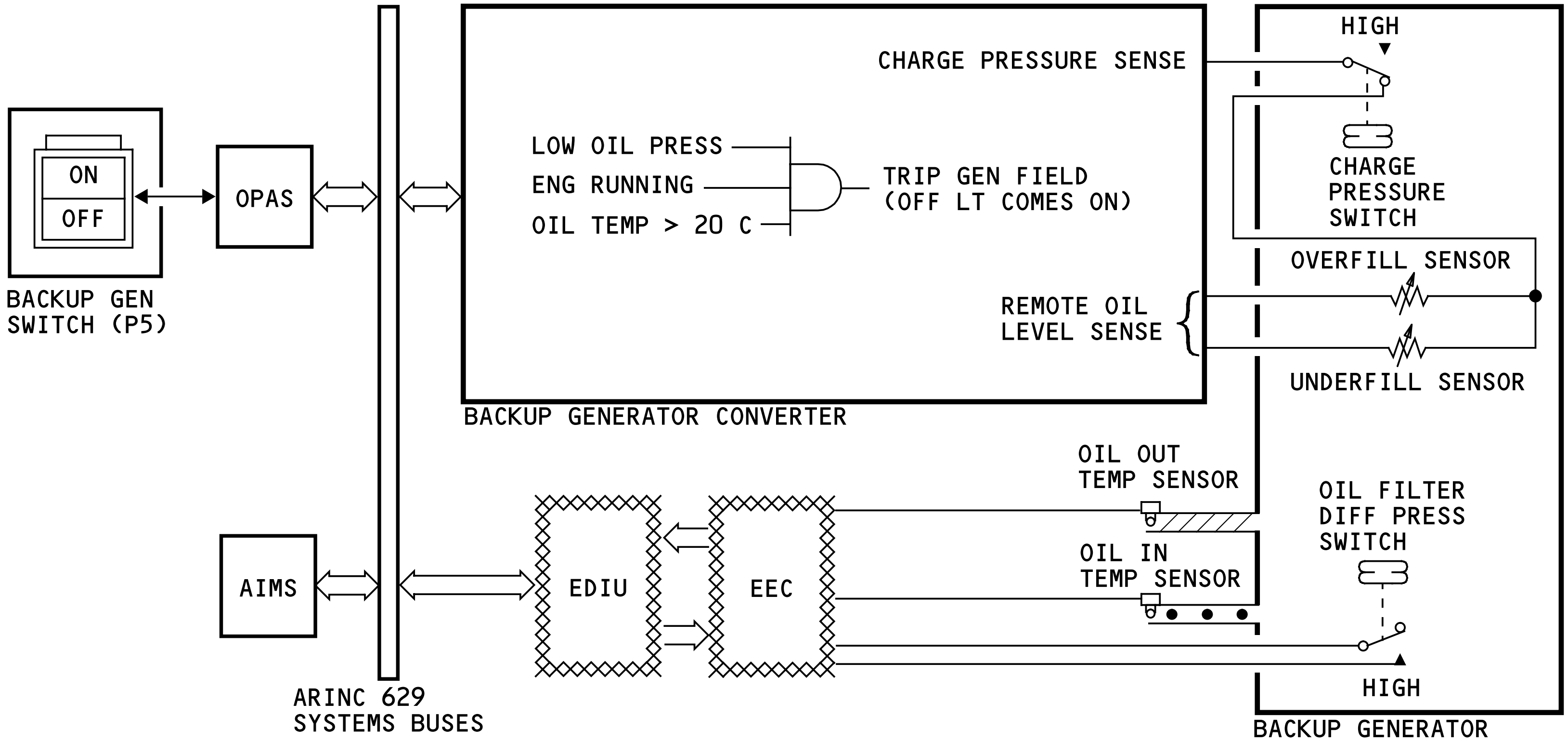
Oil Filter Status

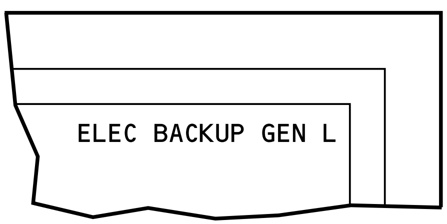
The differential pressure switch monitors the difference between the pressures upstream and downstream of the oil filter. The switch sends a filter status signal through the EEC and the systems ARINC 629 buses to the backup generator converter. The backup generator converter causes the electrical maintenance page to show the status of the oil filter. The usual status on the maintenance page is NORMAL.

When the oil filter is clogged, the differential pressure switch closes. The backup generator converter causes the electrical maintenance page to change the filter status to BLOCKED. The backup generator converter inhibits the filter status signal when the oil out temperature is less than 145F (62C).

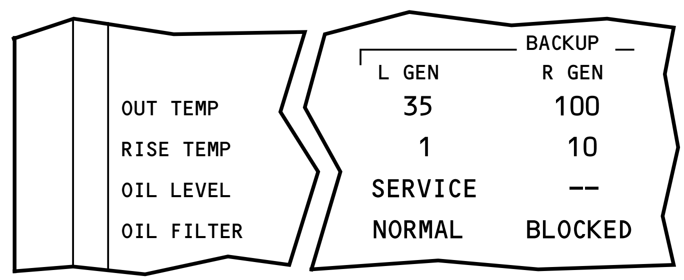
Temperature Data

Oil temperature sensors in the inlet and outlet tubing send data to the EEC. The EEC sends the data to AIMS. The electrical maintenance page shows OUT TEMP, the temperature of the oil at the backup generator outlet. It also shows RISE TEMP, the difference between the inlet and the outlet temperatures.





EICAS DISPLAY



ELECTRICAL MAINTENANCE PAGE 1

24-10-00-012 Rev 7 03/21/96

GENERATOR DRIVE - BACKUP GENERATOR - FUNCTIONAL DESCRIPTION

GENERATOR DRIVE - BACKUP GENERATOR - OIL SERVICING

Oil Level Indication

The signal from the remote oil level sensor causes the electrical maintenance page to show the backup generator oil level data. The maintenance page shows the oil level data as NORMAL or SERVICE.

The sightglass on the backup generator shows the oil level also. You must open the left thrust reverser cowl to see the sightglass.

The sightglass has two sets of oil level zones. You use one set when the generator is on the left engine. You use the other set when the generator is on the right engine.

The related center area of the sightglass is the normal zone. If the oil level is in the normal zone, the backup generator oil quantity is satisfactory. The related black zone at the top of the sightglass is the overfull zone. You must drain some oil from the generator if the level is in the overfull zone. The black zone at the bottom of the sightglass is the low oil zone. You must add oil to the generator if the oil level is in the low oil zone.

Add Oil to the Generator

You add oil to the generator through the backup generator pressure fill valve. It is above an access door in the thrust reverser at the 6:00 position.

When you add oil, you must attach a drain hose to the backup generator overflow drain valve. Add oil until at least one quart (liter) of oil comes out of the drain valve hose, then stop. When the flow out of the overflow hose is within limits, disconnect the pressure fill hose and the drain valve hose.

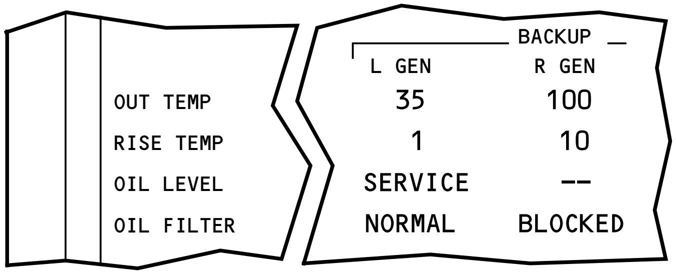
CAUTION: MAKE SURE THE DRAIN VALVE HOSE IS CONNECTED TO LET THE OIL DRAIN TO THE CORRECT LEVEL IN THE BACKUP GENERATOR. TOO MUCH HEAT CAN OCCUR IF THE BACKUP GENERATOR IS FILLED WITH TOO MUCH OIL.

Training Information Point

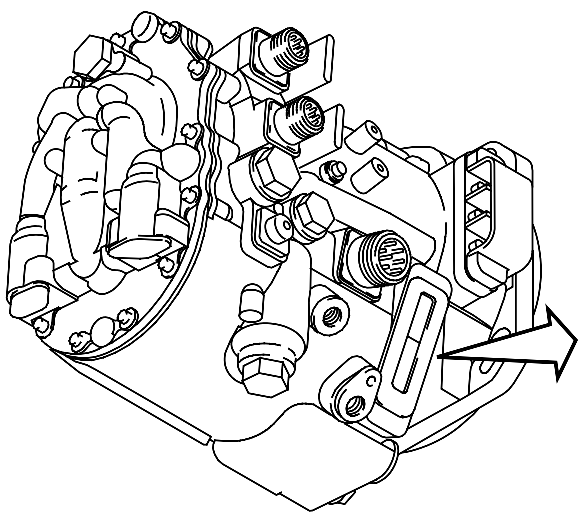
When the backup generator operates, the maintenance page does not get new oil level data. The oil level data shows as two dashes.

The oil level data shows blank for any of these conditions:

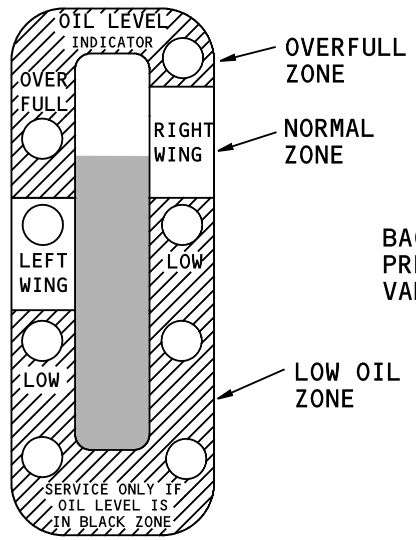
- Engine shutdown (blank for approximately 10 minutes)
- Initial converter power-up (blank for approximately 10 minutes)
- Data is invalid due to a fault.



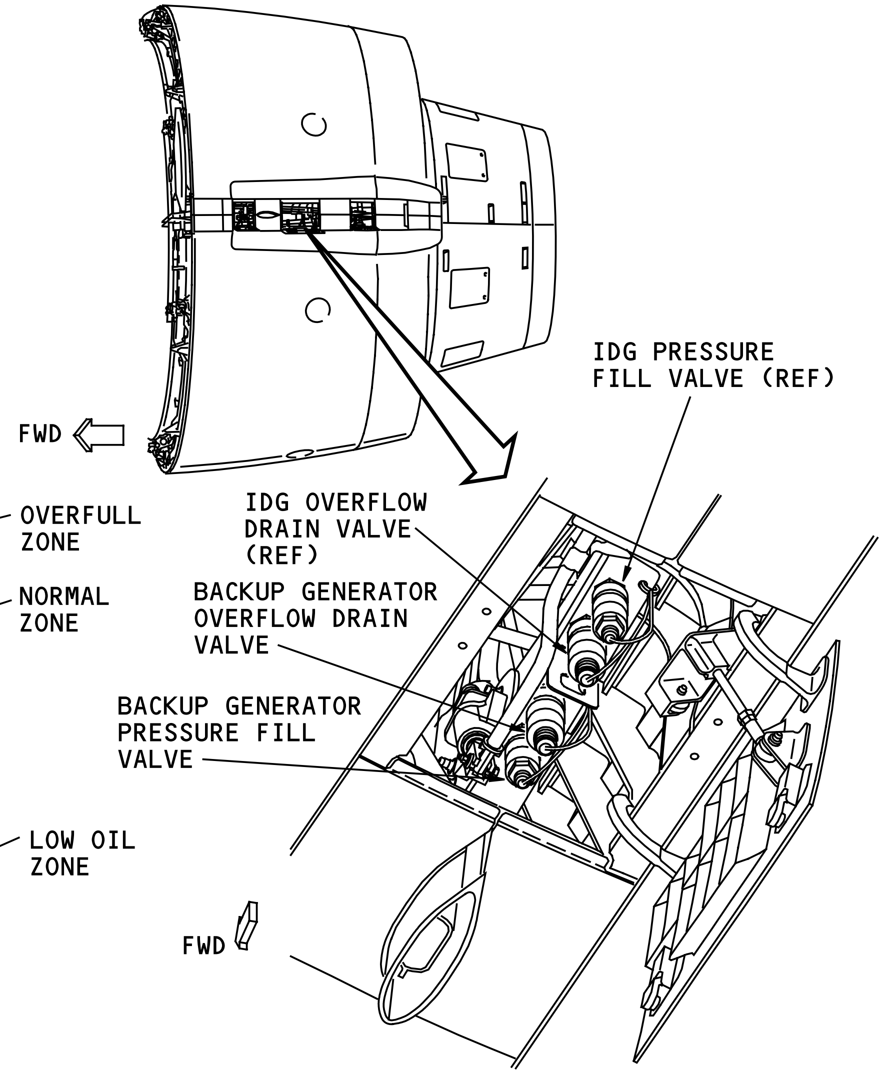
ELECTRICAL MAINTENANCE PAGE 1



BACKUP GENERATOR



OIL LEVEL
SIGHTGLASS



GENERATOR SERVICE DOOR

GENERATOR DRIVE - BACKUP GENERATOR - OIL SERVICING

24-10-00-013 Rev 11 04/10/1997

GENERATOR DRIVE - APU GENERATOR

Purpose

The APU generator is a secondary source of electrical power for airplane systems. It can supply electrical power when the airplane is on the ground or during flight. It can supply 120 kva of ac power.

Location

The APU generator is in the APU compartment. It attaches to the accessory pad of the APU gearbox. A seal plate is between the APU generator and the APU gearbox.

Interfaces

The APU GCU controls the APU generator.

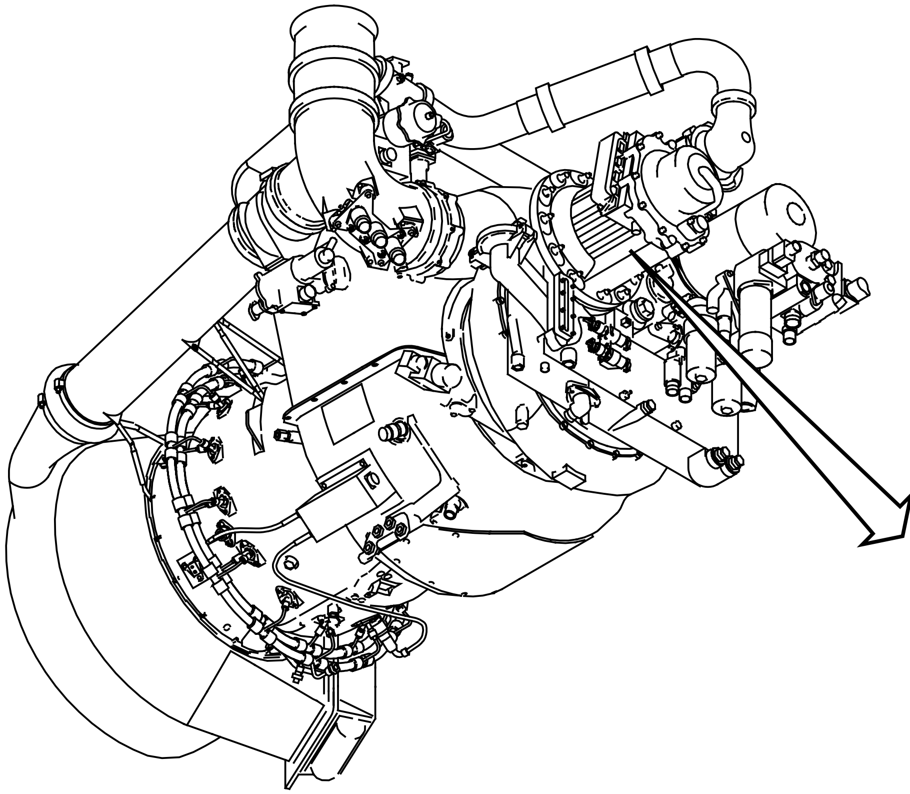
The APU gearbox turns the APU generator. The APU oil system lubricates the APU generator and keeps it cool.

The APU generator has a terminal block and two electrical connectors. The oil ports are part of the mounting flange to the accessory pad. The seal plate prevents oil leakage at the mounting flange.

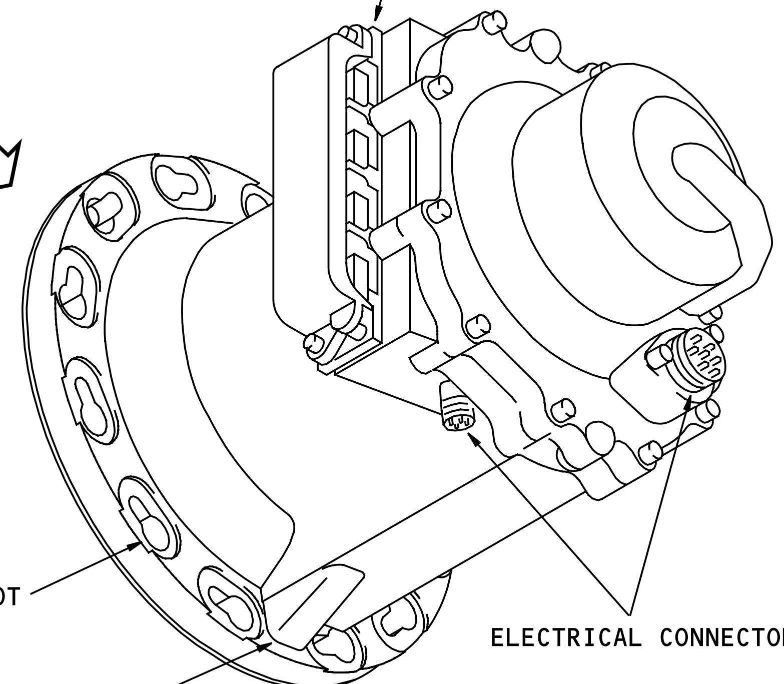
Training Information Point

The APU generator has keyhole slots in the mounting flange. You do not remove the fasteners to remove or replace the generator.

An indexing pin (not shown) on the APU generator helps you align it with the APU gearbox when you install it.



APU



APU GENERATOR

24-10-00-014 Rev 1

GENERATOR DRIVE - APU GENERATOR

GENERATOR DRIVE - FUNCTIONAL DESCRIPTION

General

The gearbox of each engine turns an IDG and a backup generator. The related GCU controls the IDG. The backup generator converter controls the backup generators on both engines. Oil goes through the generators to make them cool. Heat exchangers take the heat from the oil. The IDG oil subsystem operates independently of the backup generator oil subsystem.

IDG Operation

The GCU causes the flight deck effects for the IDG. If the IDG has low pressure during operation, the GCU turns on the DRIVE light and makes an EICAS message. The drive disconnect switch on the electrical panel controls the disconnect solenoid.

The pumps in the IDG move the IDG oil. The oil filter removes unwanted particles from the oil. The differential pressure indicator and the MFD electrical maintenance page tell you if the filter is clogged. The GCU causes the maintenance page to show the oil level status.

Backup Generator Operation

The backup generator converter causes the flight deck effects for the backup generator. The supply pump in the backup generator moves the backup generator oil. The oil filter removes unwanted particles from the oil. The differential pressure indicator and the MFD electrical maintenance page tell you if the filter is clogged. The backup generator converter causes the maintenance page to show the oil level status.

APU Generator Operation

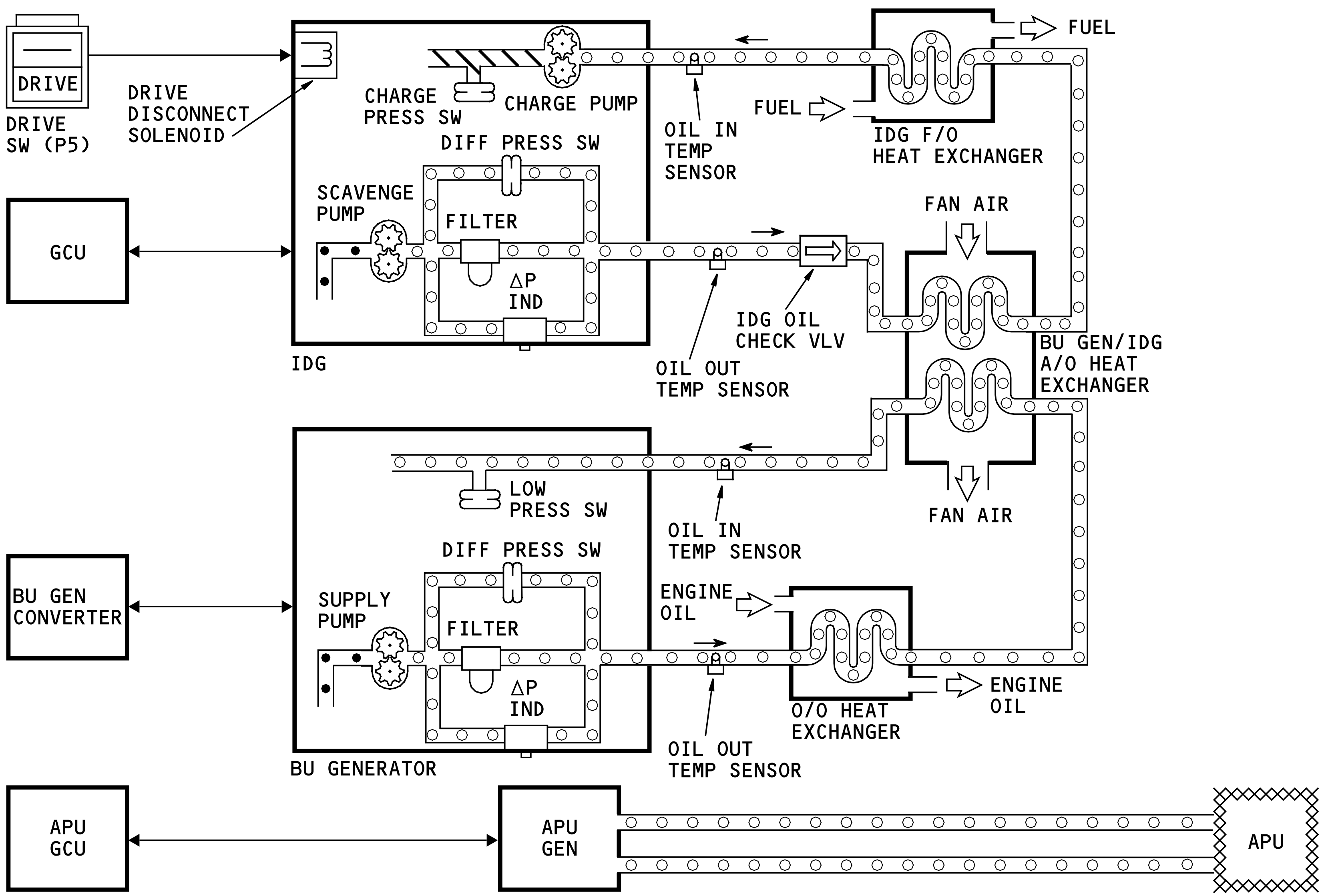
The APU gearbox turns the APU generator. The APU GCU controls and monitors the operation of the APU generator.

Generator Cooling

The IDG oil goes through the backup generator/IDG air/oil heat exchanger first. Then it goes through the IDG fuel/oil heat exchanger.

The backup generator oil goes through the oil/oil heat exchanger first. Then it goes through the backup generator/IDG air/oil heat exchanger.

The APU oil cools the APU generator. See the APU and generator lubrication system section for more information (AMM PART I 49-27).



GENERATOR DRIVE - FUNCTIONAL DESCRIPTION

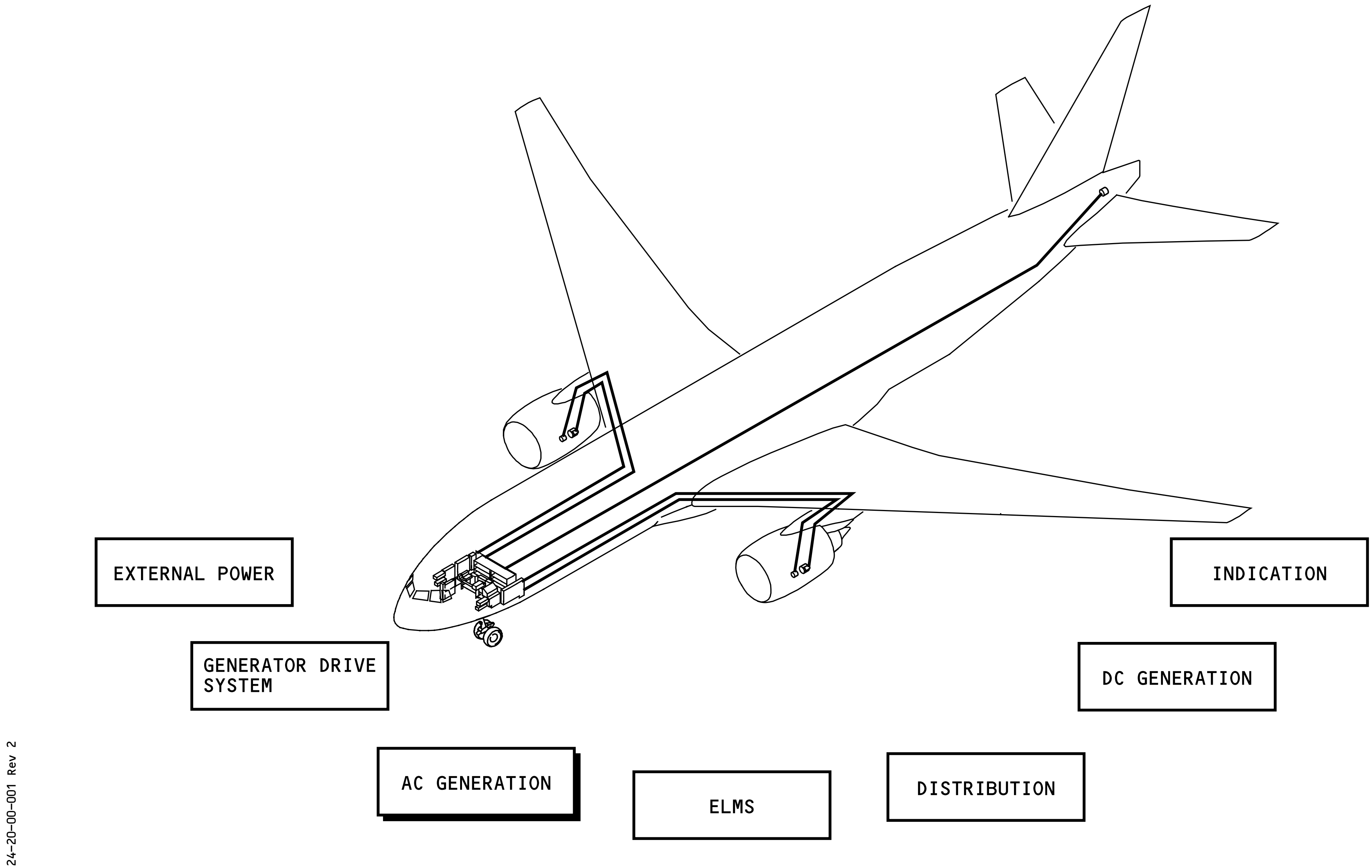
24-10-00-015 Rev 4

AC GENERATION - INTRODUCTION

General

The AC generation system supplies 115v ac power to the airplane. The ac generation system has these sub-systems:

- IDG power
- APU generator power
- Backup generator power.



AC GENERATION - INTRODUCTION

AC GENERATION - APU GENERATOR AND IDG POWER SYSTEMS - GENERAL DESCRIPTION

General

The IDGs and APU generator supply 115v ac, 400 Hz power to the left and right main ac buses. See the generator drive section for more inforation about the APU generator and the IDGs (AMM PART I 24-10).

APU Power

The APU generator supplies power through the APB to the tie bus. Power goes from the tie bus, through the BTBs, to one or both main ac buses.

The APU generator supplies power through the GSSR to the ground service bus. The APU generator also supplies power through the GHR to the ground handling bus.

The APU generator has a GCU that controls, monitors, and protects the APU power system. The APU GCU gets an input from the APU generator (APU GEN) switch. When the switch is in, the GCU automatically controls the APB. When the switch is out, the GCU opens the APB and trips the field of the generator. The OFF light comes on when the switch is out, or when the APB is open because of a fault.

IDG Power

The left IDG supplies power to the left main ac bus. The right IDG supplies power to the right main ac bus. Power goes through the GCBs.

There is a GCU for each IDG. The left and right GCUs control, monitor, and protect the IDG power system. Each GCU gets inputs from a generator control (GEN CTRL) switch and a BUS TIE switch.

When the GEN CTRL switch is in, the GCU automatically controls the GCB. When the switch is out, the GCU opens the GCB and trips the field of the generator.

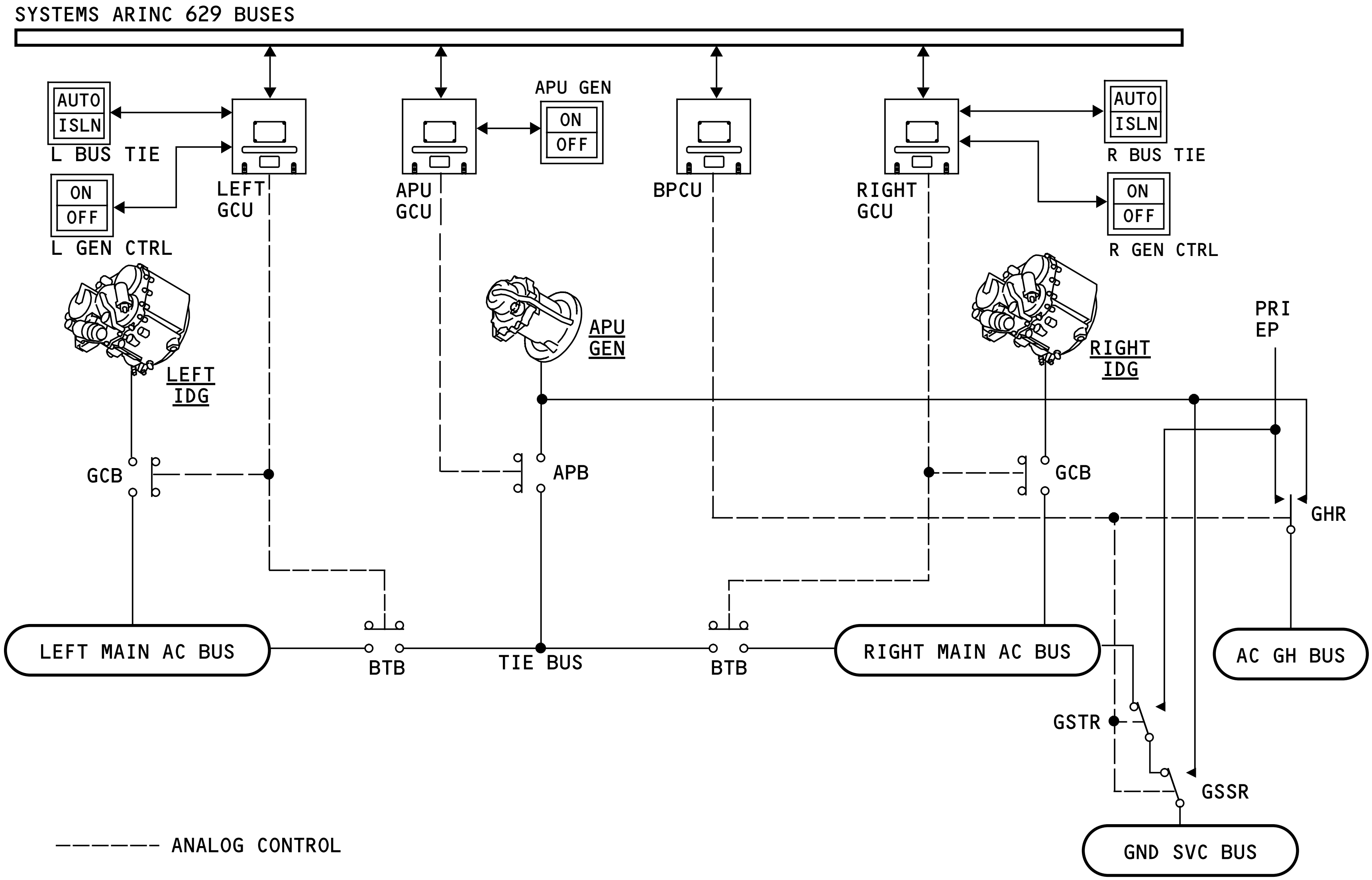
When the BUS TIE switch is in, the GCU automatically controls the BTB. When the switch is out, the GCU opens the BTB.

The GCU turns the switch light (ISLN or OFF) on for each switch when the switch is out, or the breaker is open because of a fault.

No-Break Power Transfers

The BPCU coordinates power transfers between the APU generator and IDGs. The BPCU and GCUs communicate on the systems ARINC 629 buses.

When the ac system changes from one power source to another in the air, it does break power transfers. On the ground, it does no-break power transfers. The system momentarily connects two power sources to one bus so there is no interruption in power. A GCU electronically adjusts an IDG speed to match the power of the two sources to do a no-break power transfer. For transfers between external power and the APU, the APU controller adjusts the APU speed to do the no-break power transfer.



24-20-00-002 Rev 6 03/11/1997

AC GENERATION - APU GENERATOR AND IDG POWER SYSTEMS - GENERAL DESCRIPTION

AC GENERATION - BACKUP GENERATOR POWER SYSTEM - GENERAL DESCRIPTION

General

The backup power system supplies 115v ac, 400 Hz power to the left, right, or both transfer buses. The transfer buses usually get power from the main ac buses. If a main ac bus loses power, the backup power system supplies power to the related transfer bus.

The backup power system also supplies power during autoland operations.

The backup power system has two backup generators and a backup generator converter. The system is independent of other airplane systems. There is no time limit for backup power system operation.

Backup Generator Power

The backup generators supply variable frequency ac power to the backup generator converter. The converter changes the variable frequency power to 115v, 400 Hz ac power and sends it to the transfer buses. Power goes through the converter circuit breakers (CCB).

Only one backup generator supplies power at a time. Normally, the left backup generator supplies power to the left transfer bus and the right backup generator supplies power to the right transfer bus. If the left and right transfer buses need power, the right backup generator supplies the power if it is available.

The backup generator converter also controls, monitors, and protects the backup power system. The converter gets an input from each backup generator (BACKUP GEN) switch. When the switch is in, the converter controls the related CCB and transfer bus breaker (TBB) automatically. When the switch is out, the converter opens the CCB, closes the TBB, and trips the field of the generator. The converter causes the OFF light to come on for each switch for any of these conditions:

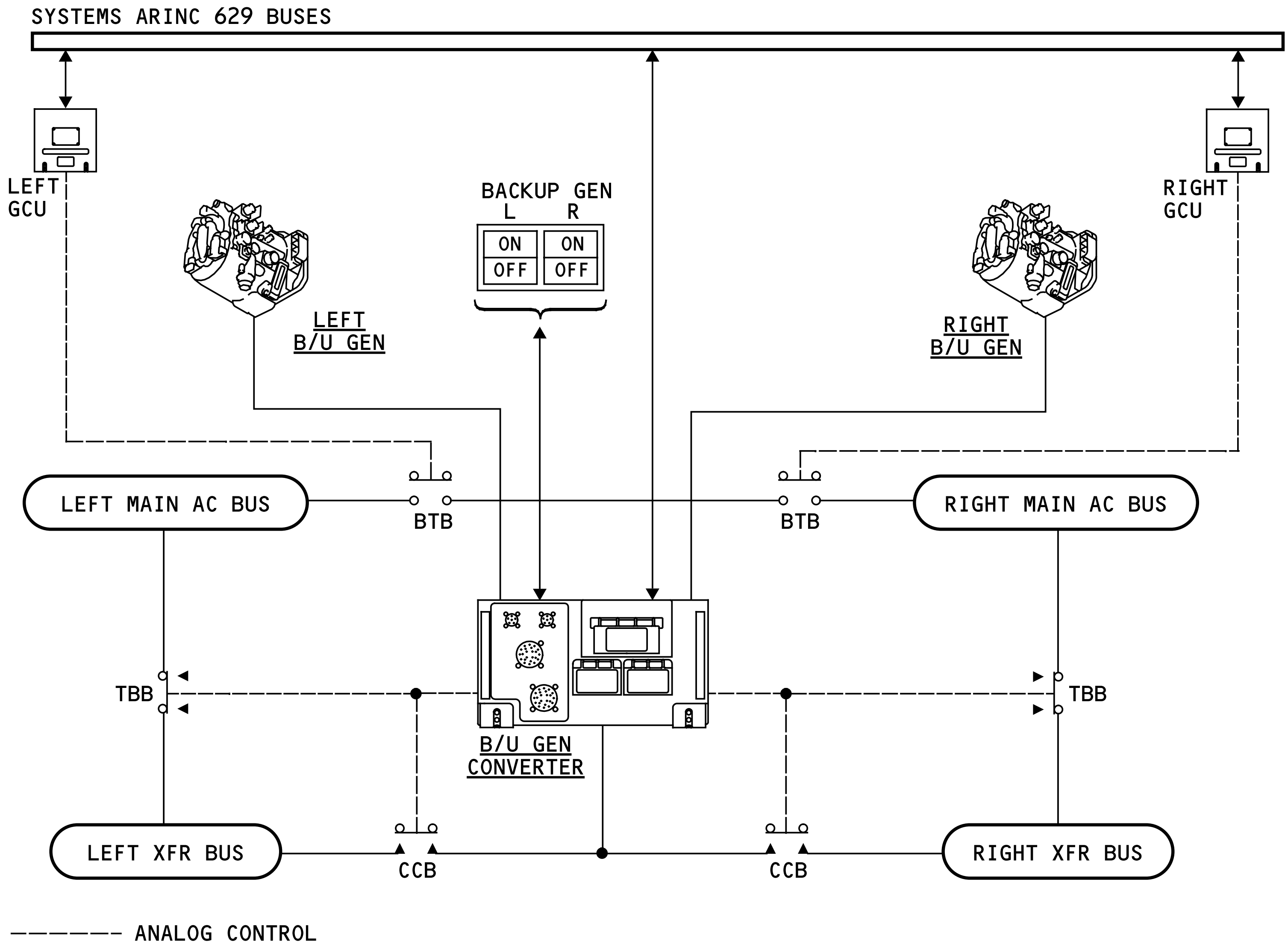
- Switch is out
- Backup generator field relay opens because of a fault
- Engine fire switch is pulled out
- Engine is shutdown.

No-Break Power Transfers

The backup generator converter controls the CCB and TBB to do no-break power transfers to the transfer buses. When a main ac bus loses power, the BTBs close to permit the opposite main ac bus to supply power to the main ac bus that lost power and its related transfer bus. The backup generator power system then momentarily connects the main ac bus power and the backup generator converter power on the transfer bus so there is no interruption in power. The backup generator converter electronically matches the power on the transfer bus to do a no-break power transfer.

Engine Start Test

After an engine starts, the backup generator supplies power to its transfer bus for approximately 15 seconds. This makes sure the system operates before each flight.



24-20-00-003 Rev 5

AC GENERATION - BACKUP GENERATOR POWER SYSTEM - GENERAL DESCRIPTION

AC GENERATION - COMPONENT LOCATIONS - GENERATORS

General

The ac generation system has these five generators:

- IDG (2)
- Backup generator (2)
- APU generator.

IDG

There is one IDG on each engine. The IDG attaches to the aft face of the gearbox.

Each IDG supplies a maximum of 120 kva of power.

Backup Generator

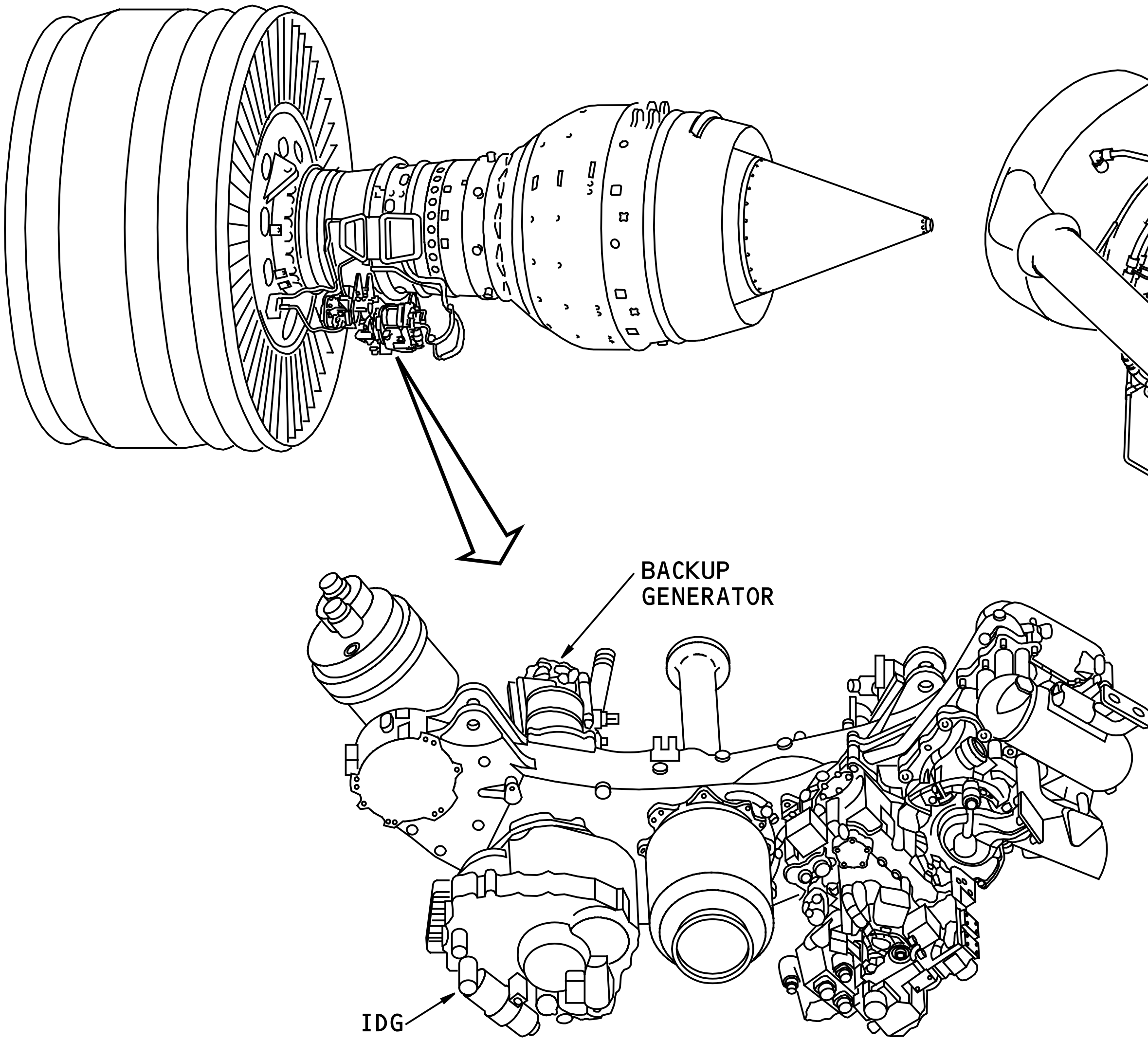
There is one backup generator on each engine. The backup generator attaches to the forward face of the gearbox.

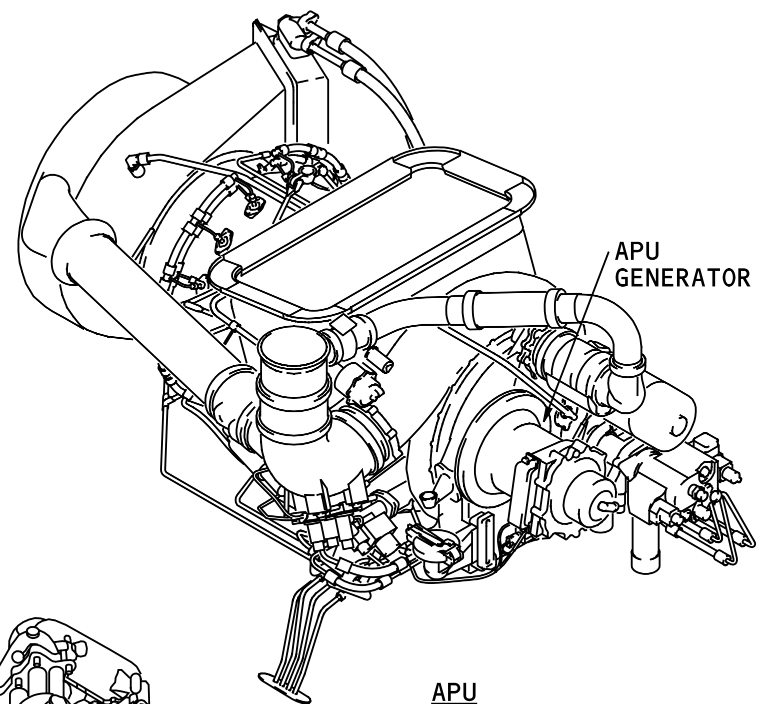
Each backup generator supplies a maximum of 20 kva of power.

APU Generator

The APU generator is in the APU compartment. It attaches to the APU gearbox.

The APU generator supplies a maximum of 120 kva of power.





24-20-00-004 Rev 5 07/15/96

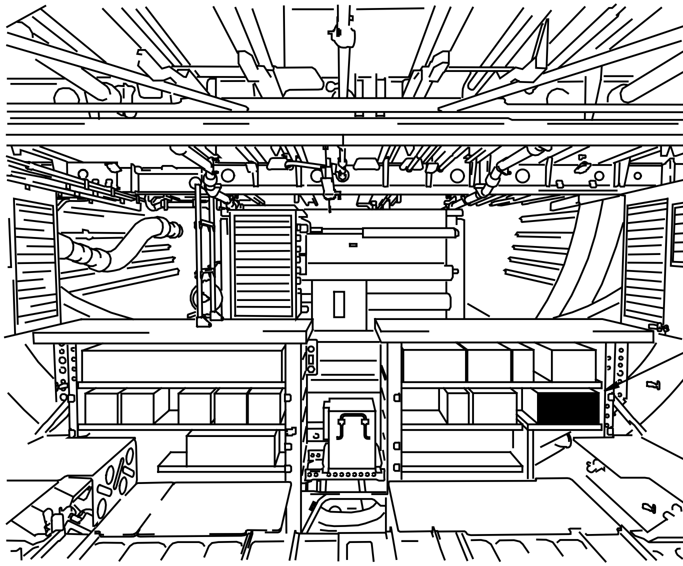
AC GENERATION - COMPONENT LOCATIONS - GENERATORS

AC GENERATION - MAIN EQUIPMENT CENTER - COMPONENT LOCATIONS

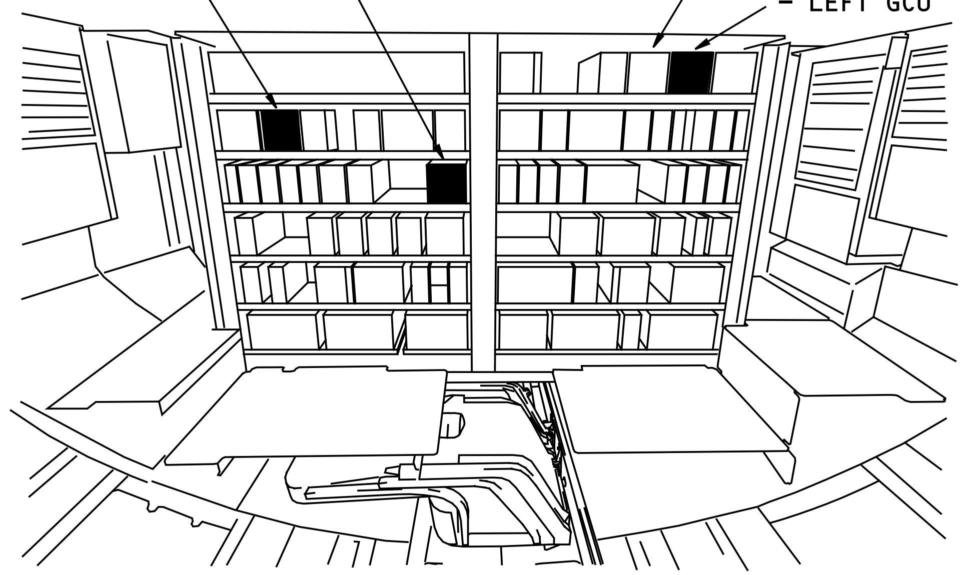
General

These ac generation system components are in the main equipment center:

- Backup generator converter
- Right GCU
- APU GCU
- Left GCU.



MAIN EQUIPMENT CENTER
(LOOKING FORWARD)



MAIN EQUIPMENT CENTER
(LOOKING AFT)

24-20-00-005 Rev 3 04/15/1997

AC GENERATION - MAIN EQUIPMENT CENTER - COMPONENT LOCATIONS

AC GENERATION - ELECTRICAL PANELS - COMPONENT LOCATIONS

General

The ac generation system has components in these ELMS panels:

- P100 left power panel
- P200 right power panel
- P300 auxiliary power panel.

See the electrical load management system section for more information on the location, removal, and installation of panel components (AMM PART I 24-09).

P100 Left Power Panel

These are the components in the left power panel:

- L GCB
- L BTB
- L TBB
- L CCB.

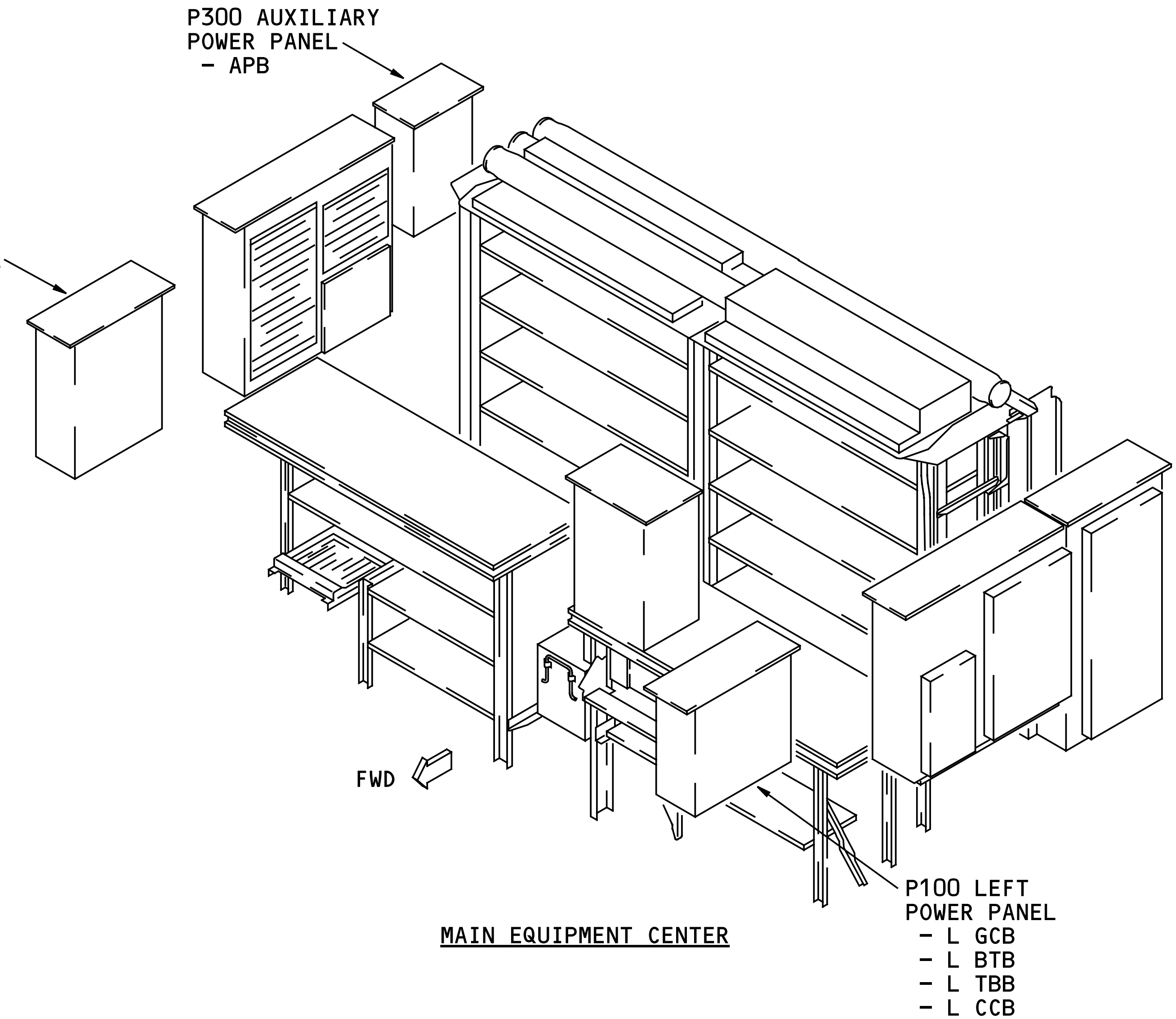
P200 Right Power Panel

These are the components in the right power panel:

- R GCB
- R BTB
- R TBB
- R CCB.

P300 Auxiliary Power Panel

The APB is in the auxiliary power panel

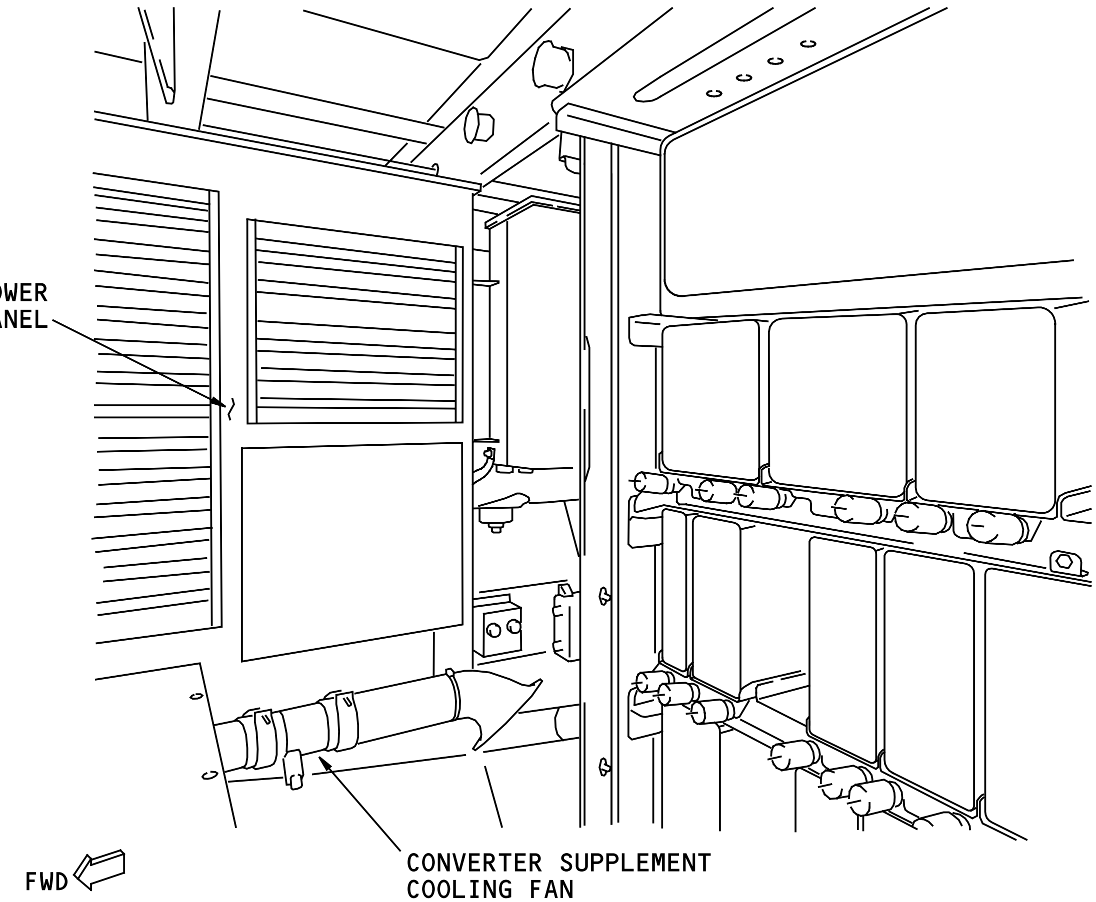


AC GENERATION - ELECTRICAL PANELS - COMPONENT LOCATIONS

AC GENERATION - CONVERTER SUPPLEMENT COOLING FAN - COMPONENT LOCATION

Converter Supplement Cooling Fan

The converter supplement cooling fan is on the right side of the MEC below the P210 right power management panel.



MAIN EQUIPMENT CENTER
(LOOKING OUTBOARD)

24-20-00-007 Rev 1

AC GENERATION - CONVERTER SUPPLEMENT COOLING FAN - COMPONENT LOCATION

AC GENERATION - BACKUP POWER - BACKUP GENERATOR CONVERTER & SUPPLEMENT COOLING FAN

Backup Generator Converter

The backup generator converter gets variable frequency ac power from both backup generators. It changes the variable frequency power into 115v, 400 hz, ac power. The converter supplies power to one or both transfer buses.

The converter also controls, monitors, and protects the backup electrical power system. The converter does an automatic test of the backup system immediately after an engine start. These are some of the protective functions of the converter:

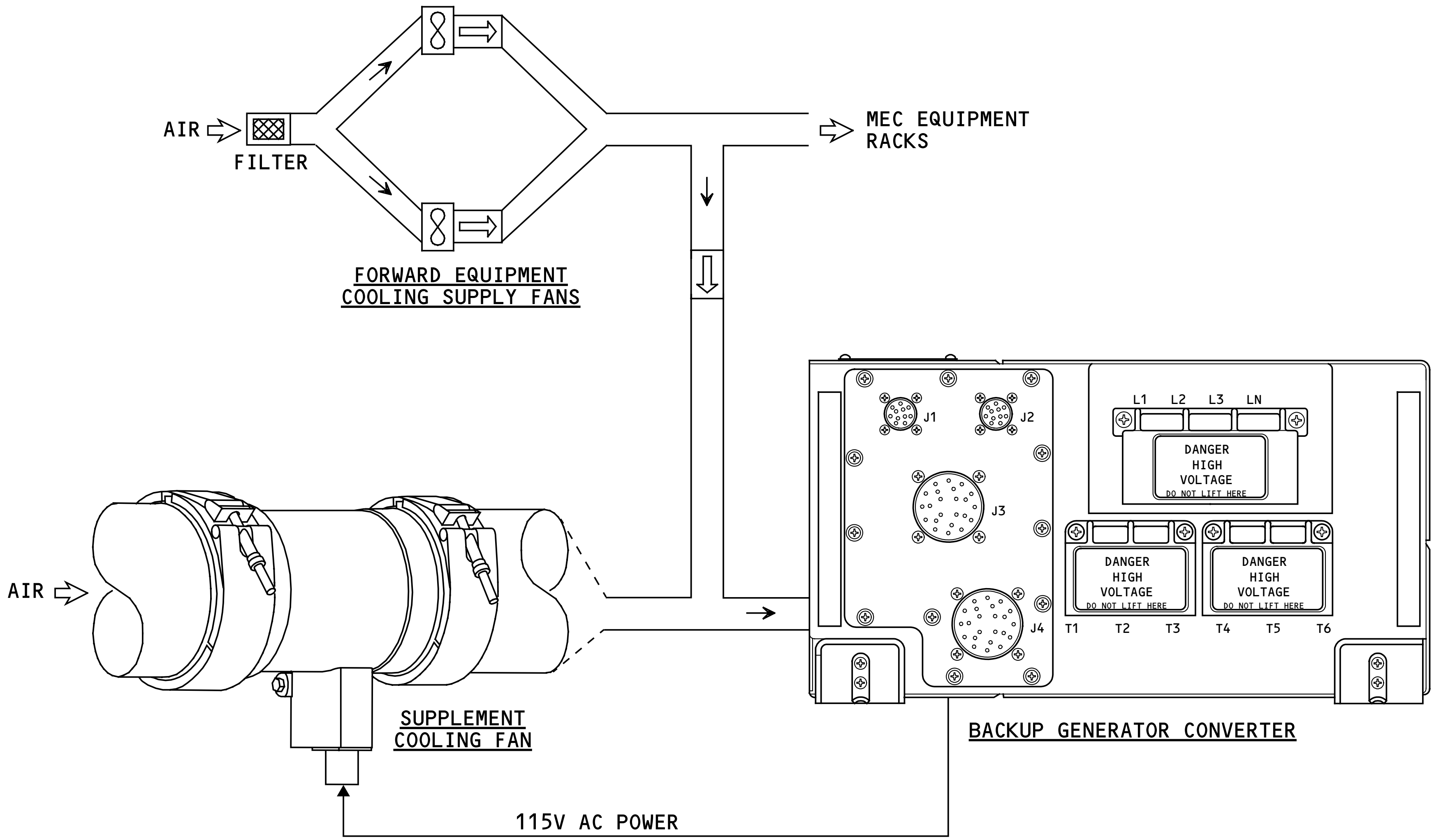
- Over/undervoltage
- Over/underfrequency
- Overcurrent
- Differential protection
- Converter fault.

Supplement Cooling Fan

The backup generator converter gets cooling air from the forward equipment cooling supply fans. It also gets cooling air from the supplement cooling fan.

The supplement cooling fan is an axial flow blower with an integral discharge check valve. The backup generator converter turns the fan on when it supplies it with 115v ac power during these conditions:

- Backup system test after an engine start
- Backup system supplies power to both transfer buses
- High temperature difference across the converter
- Inlet air temperature is greater than 40 degrees C and the backup system supplies power to one transfer bus
- Forward equipment cooling failure.



24-20-00-008 Rev 1

AC GENERATION - BACKUP POWER - BACKUP GENERATOR CONVERTER & SUPPLEMENT COOLING FAN

AC GENERATION - APU GENERATOR POWER - GENERATOR CONTROL

General

The APU GCU controls, protects, and monitors the APU power.

The forward equipment cooling system actively cools the GCU.

GCU Power

The APU GCU power supply gets power from two different sources. One source is the PMG in the APU generator. The other source is the captain's flight instrument bus.

Generator Excitation

The voltage regulator controls the power level to the exciter field in the generator. The voltage regulator rectifies ac power from the PMG to make dc current for the exciter field. Power to the voltage regulator goes through the generator control relay (GCR).

The generator uses the exciter field current to make the ac current in the power feeders. The feeder cables go to the APB, the ground handling relay, and the ground service select relay in the auxiliary power panel.

The voltage regulator monitors the generator output voltage. This is called the point-of-regulation (POR) voltage. POR voltage is on the generator side of the APB. The voltage regulator adjusts the dc current to the exciter field to keep the POR voltage at 115 volts.

Protection

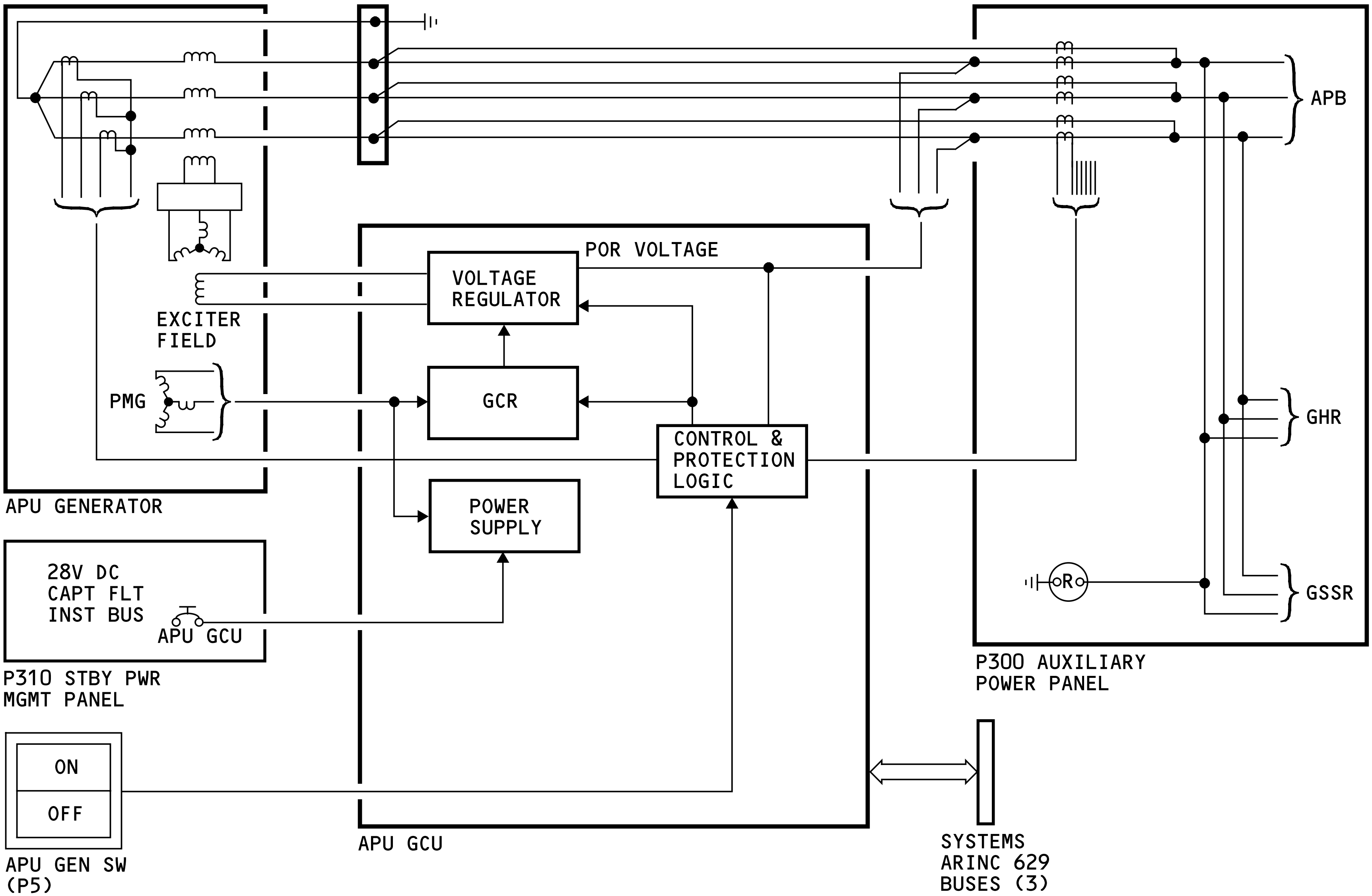
The GCU monitors the APU generator power and control inputs. It opens the GCR for any of these causes:

- Control switch off
- Fire switch pulled
- Over/under voltage
- Over/under frequency
- Differential fault
- Open phase
- Generator diode failure
- Parallel feeder open
- Unbalanced current
- Computer failure.

A protective trip is reset when you push the control switch off and then on.

Power Feeders

Copper feeders go from the APU to a terminal block at the aft stabilizer pivot bulkhead. From there, double-wire aluminum feeders go to the auxiliary power panel. The feeders reconnect in the power panel.



24-20-00-009 Rev 3

AC GENERATION - APU GENERATOR POWER - GENERATOR CONTROL

AC GENERATION - APU GENERATOR POWER - APB CONTROL

APB Control

The APU GCU controls the automatic operation of the APB. The GCU gets a switch position signal from the APU generator (APU GEN) switch.

When the switch is in, the GCU operates the APB automatically. The GCU uses power transfer logic to make a decision when to close the APB. In the air, with a single IDG operating, the APB closes if the APU is running (a break-power transfer). On the ground, the APB closes for no-break power transfers.

The GCU opens the APB for any these conditions:

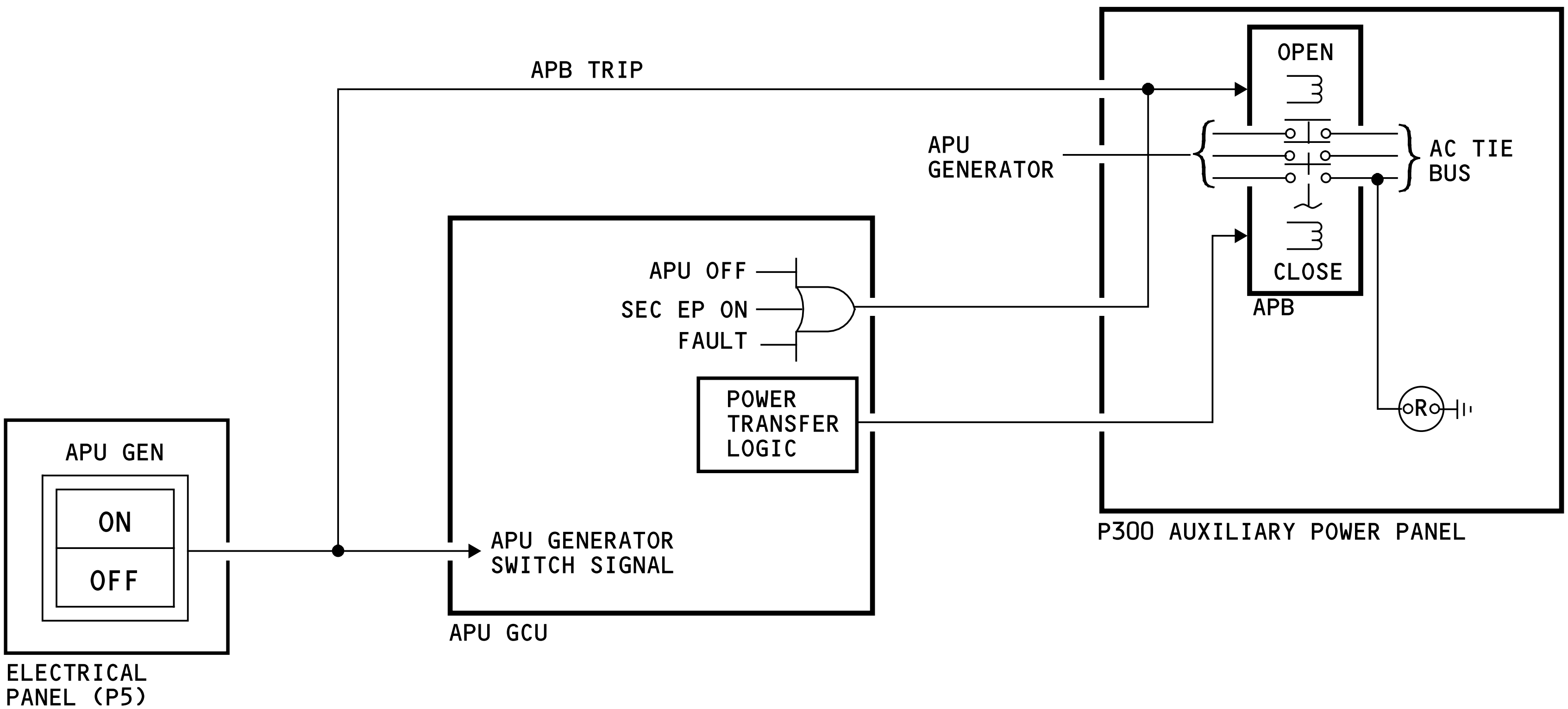
- The APU is off
- Secondary external power is on
- An APU power system fault occurs.

When the switch is out, a direct wire to the APB supplies power to open the breaker.

Switch Light

The OFF light on the APU GEN switch comes on for any of these conditions:

- The switch is out and the APB is open
- The APU is running and the GCU opens the APB because of a fault.



24-20-00-010 Rev 2 01/09/95

AC GENERATION - APU GENERATOR POWER - APB CONTROL

AC GENERATION - IDG POWER - GENERATOR CONTROL

General

The IDG GCU controls, protects, and monitors the IDG power.

The forward equipment cooling system actively cools the GCU.

GCU Power

The GCU gets power for control, protection, and BITE functions from these sources:

- IDG PMG
- Battery bus #2
- Right dc bus.

Generator Excitation

The voltage regulator controls the power level to the exciter field in the IDG. The voltage regulator rectifies ac power from the PMG to make dc current for the exciter field. Power to the voltage regulator goes through the generator control relay (GCR).

The generator uses the exciter field current to make the ac current in the power feeders. The power feeders go to the GCB in the power panel.

Point-of-Regulation (POR) Voltage

The voltage regulator monitors the voltage at the POR. POR is on the generator side of the GCB. The voltage regulator adjusts the dc current to the exciter field to keep the POR voltage at 115 volts.

Protection

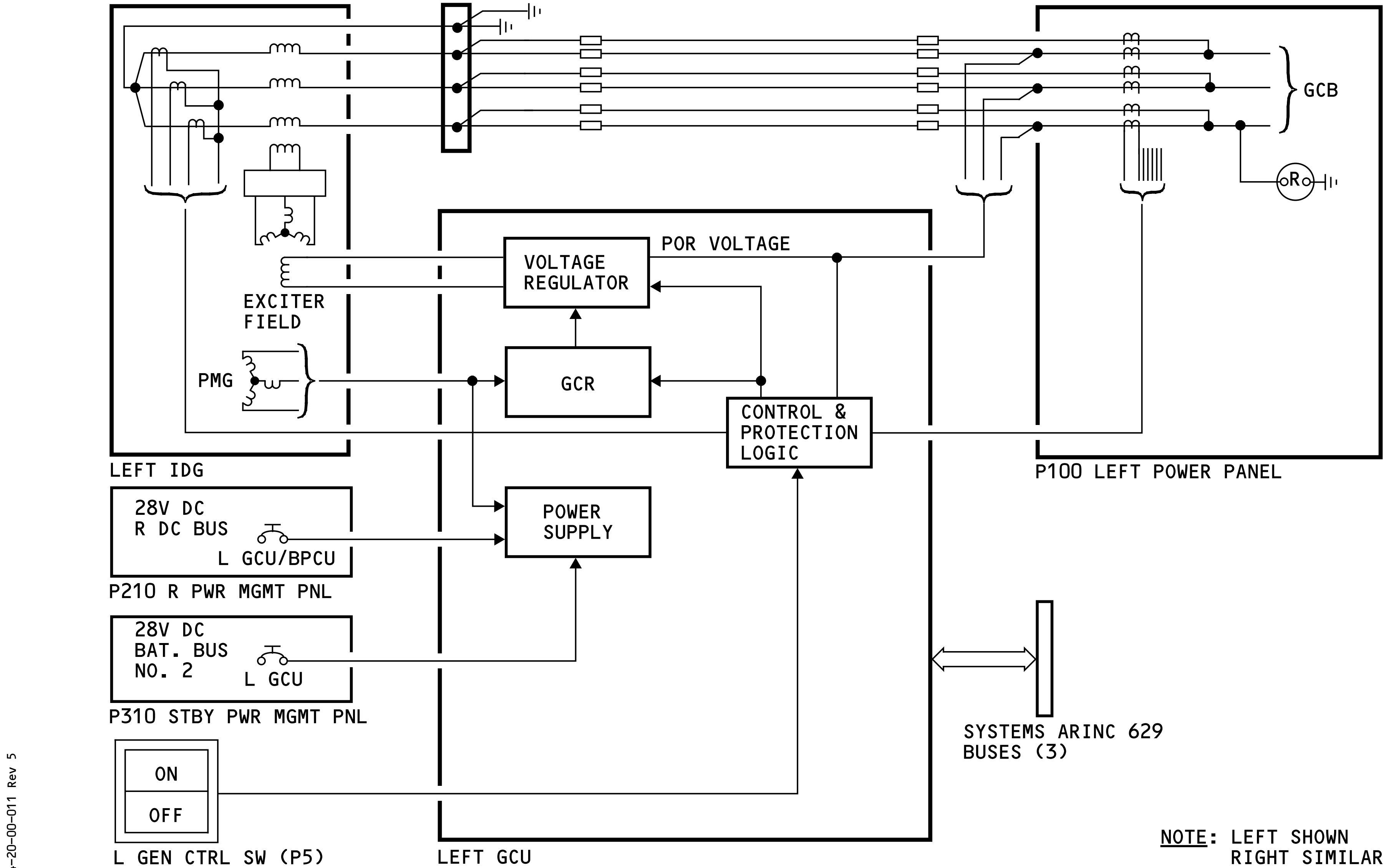
The GCU monitors the IDG generator power and control inputs. It opens the GCR for any of these causes:

- Control switch off
- Fire switch pulled
- IDG disconnect switch pushed
- Over/under voltage
- Over/under frequency
- Differential fault
- Open phase
- Generator diode failure
- Parallel feeder open
- Unbalanced current
- Computer failure.

A protective trip is reset when you push the control switch off and then on.

Power Feeders

Copper feeders go from the IDG to a terminal block under the strut. From there, double-wire copper feeders go through the strut to a splice in the wing leading edge. At the splice, the feeders change from copper to aluminum. Another splice is at the wing-to-body join. The feeders reconnect in the power panel.



AC GENERATION - IDG POWER - GENERATOR CONTROL

AC GENERATION - IDG POWER - BREAKER CONTROL

General

The GCU controls the GCB and BTB. When the GCB closes, the IDG connects to the main ac bus. When the BTB closes, the tie bus connects to the main ac bus.

The GCU gets switch position signals from the generator control (GEN CTRL) and BUS TIE switches.

GCB Control

When the GEN CTRL switch is in, the GCU operates the GCB automatically. The GCU closes the GCB when the IDG is available. This permits the left main ac bus to get power from the IDG. The GCU opens the GCB for any of these conditions:

- Secondary external power is on
- A fault occurs
- The IDG is not available.

When the GEN CTRL switch is out, a direct wire to the GCB open coil supplies power to open the GCB.

The OFF light on the GEN CTRL switch comes on when the GCB is open.

BTB Control

When the BUS TIE switch is in, the GCU operates the BTB automatically. The GCU closes the BTB to permit either of these conditions:

- The main ac bus gets power from the tie bus
- The main ac bus supplies power to the tie bus.

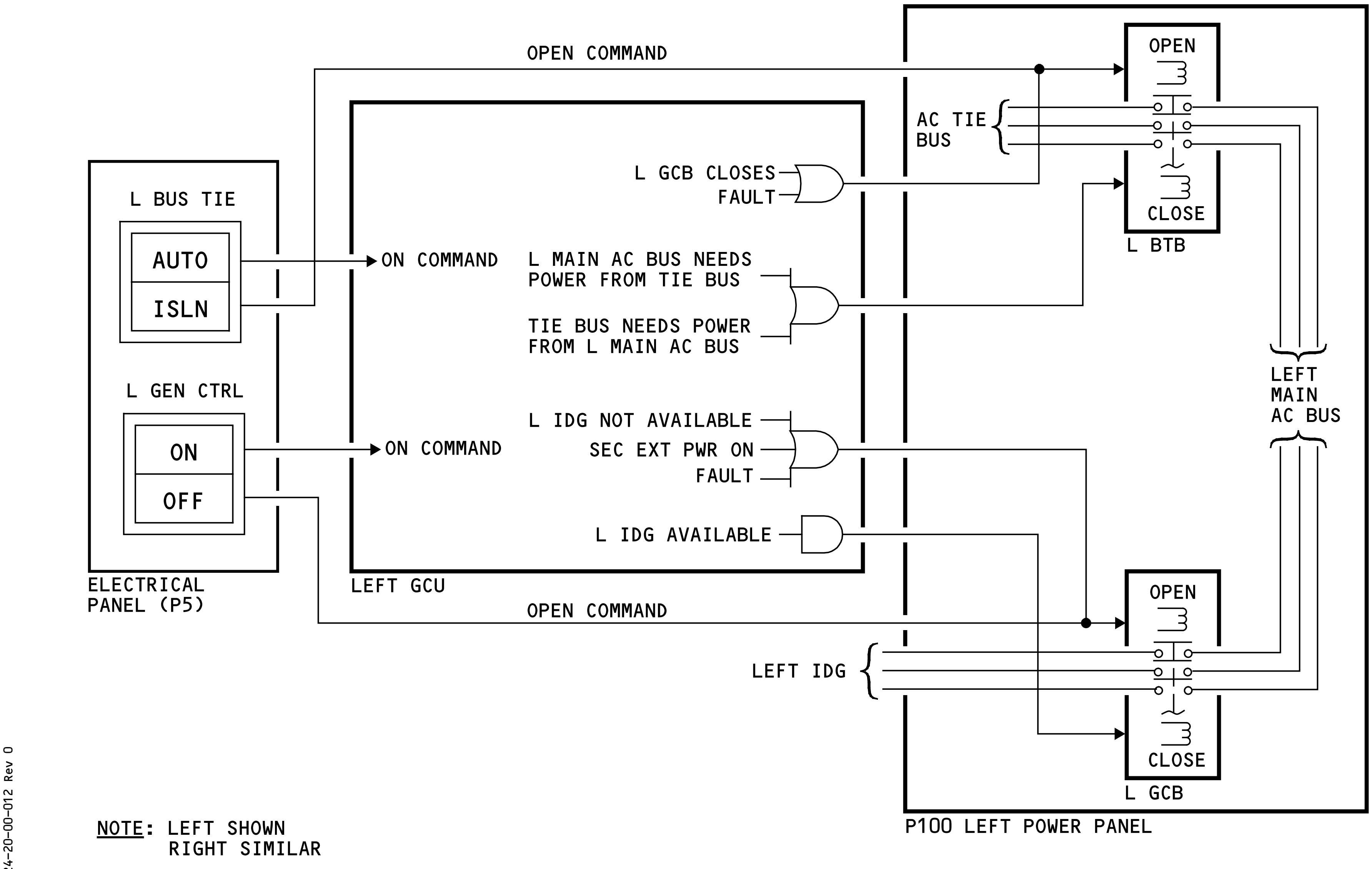
The GCU opens the BTB for either one of these conditions:

- The left GCB closes
- A fault occurs.

When the BUS TIE switch is out, a direct wire to the BTB open coil supplies power to open the BTB.

The ISLN light on the BUS TIE switch comes on for either of these conditions:

- The switch is out and the BTB is open
- The GCU opens the BTB because of a fault.



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AC GENERATION - IDG POWER - BREAKER CONTROL

Converter Power

The converter power supply gets power from a PMG in the backup generator or from the captain's flight instrument bus.

Generator Excitation

The voltage regulator controls power to the exciter field in the backup generator. The voltage regulator rectifies ac power from the PMG to make dc power for the exciter field. It sends power through the GCR to the exciter field. The generator uses the exciter field current to make variable frequency ac power. The generator sends variable frequency ac power to the converter.

Main Feeder Power

The rectifier changes the variable frequency ac power to dc power. The inverter changes dc power to constant frequency 115v ac power. The inverter sends the 115v ac power through the power feeders to the CCB.

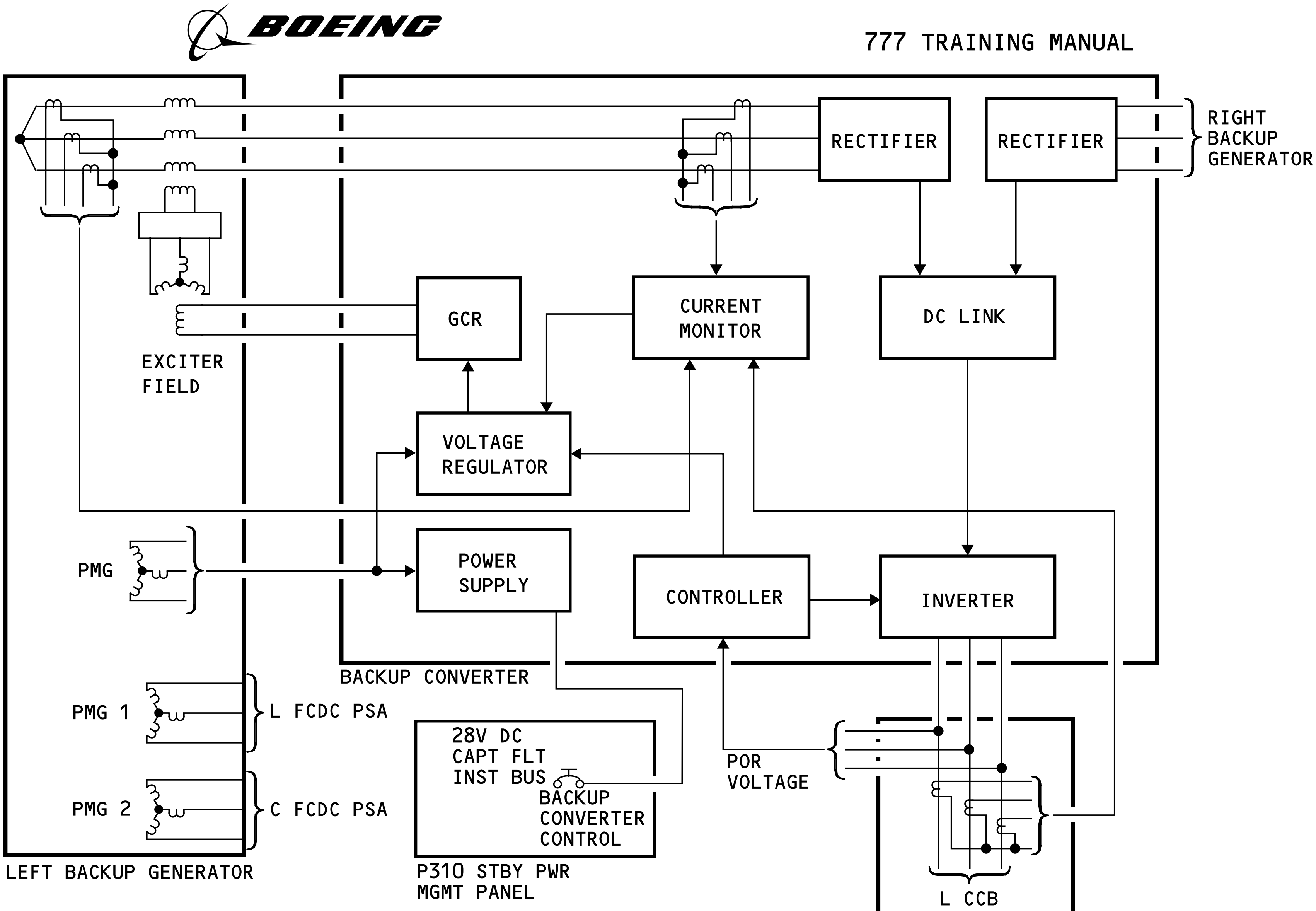
The controller monitors the POR voltage. The POR is on the generator side of the CCB. The controller adjusts the output from the inverter to keep the POR voltage at 115v.

Protection

The backup generator converter monitors the backup generator power and control inputs. It opens the GCR for the related backup generator for any of these causes:

- Control switch off
- Fire switch pulled
- Over/under-voltage
- Over/under-frequency
- Differential fault
- Computer failure
- Converter fault
- Generator over-temperature
- Low oil pressure
- DC link over-voltage
- Converter harmonic output distortion
- DC content out of range
- Converter over-current.

Under certain conditions the converter over-current fault does not trip the GCR.



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AC GENERATION - BACKUP POWER - GENERATOR CONTROL

24-20-00-013 Rev 3 03/19/96

AC GENERATION - BACKUP POWER - BREAKER CONTROL

TBB and CCB Control

The backup generator converter controls the automatic operation of the TBB and CCB. The converter gets a switch position signal from the backup generator (BACKUP GEN) switch.

When the switch is in, the converter controls the TBB and CCB. The TBB and CCB are normally not energized. A spring holds the TBB closed when it is not energized. A spring holds the CCB open when it is not energized.

The converter energizes the TBB and CCB to permit the backup system to supply power to the transfer buses. The TBB opens when it energizes. The CCB closes when it energizes.

When the switch is out, the TBB and CCB are relaxed.

Power Transfer

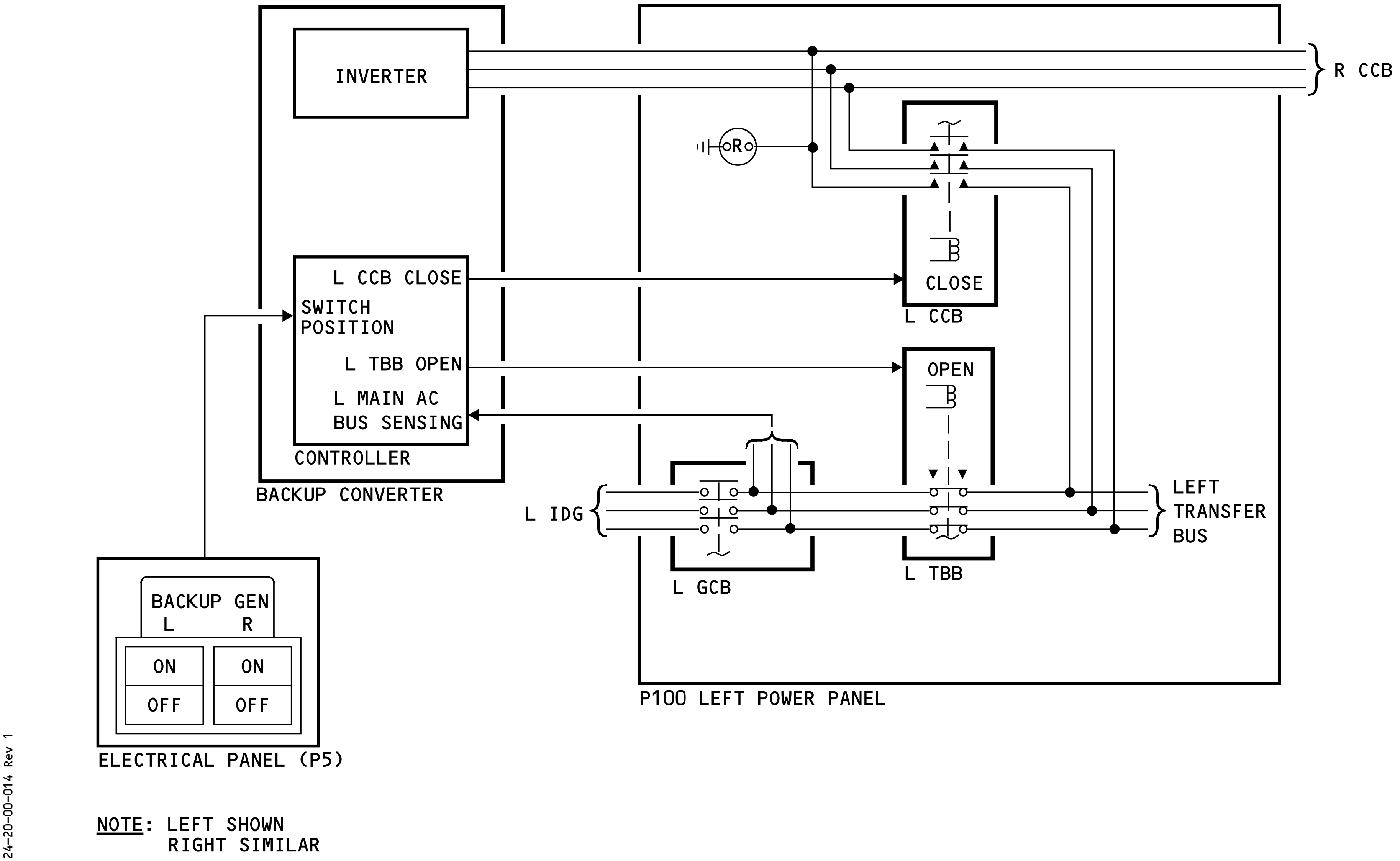
The left transfer bus normally gets power from the left IDG, through the left GCB and left TBB. When the converter senses no power at the left main ac bus, it opens the left TBB and closes the left CCB. This permits power to go from the converter to the left transfer bus.

If necessary, the converter supplies power to the right transfer bus through the right CCB.

Indication

The OFF light on the BACKUP GEN switch comes on for these conditions:

- Switch is out
- Backup generator field relay opens because of a fault
- Engine fire switch is pulled out
- Engine is shutdown.



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AC GENERATION - BACKUP POWER - BREAKER CONTROL

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AC GENERATION - FUNCTIONAL DESCRIPTION

General

The BPCU and GCUs automatically control the power source selection for each main ac bus. The power sources for a main ac bus have this priority:

- Related IDG
- APU generator
- Opposite IDG.

External power has priority over other sources when you manually choose it with the external power switch.

APB Control

When the APU is running, the APU GCU closes the APB. This permits the APU to supply power to the tie bus. If the left main ac bus has no power, the left GCU closes the left BTB. This connects the tie bus to the left main ac bus.

If the right main ac bus has no power, the right GCU closes the right BTB. This connects the tie bus to the right main ac bus.

GCB Control

When the left IDG operates, the left GCU closes the left GCB. This permits the IDG to supply power to the left main ac bus.

When the right IDG operates, the right GCU closes the right GCB. This permits the IDG to supply power to the right main ac bus.

BTB Control

One IDG can supply power to both main ac buses at the same time. For example, if the right IDG fails, the right GCU opens the right GCB and closes the right BTB. The left GCU closes the left BTB. This connects the left main ac bus to the right main ac bus.

Ground Service and Ground Handling Buses

When the right main ac bus has power, it supplies power to the ground service bus. When the right main ac bus has no power, the BPCU selects primary external power or the APU generator as the power source.

Primary external power or the APU generator also supply power to the ground handling bus through the ground handling relay.

If both the APU generator and primary external power are available, primary external power has priority.

Backup Generator Power

The backup power system supplies power to one or both transfer buses during these conditions:

- Loss of all main ac power
- Single main generator operation

AC GENERATION - FUNCTIONAL DESCRIPTION

- Autoland
- Backup system test after engine start.

The backup generator converter controls the TBBs and CCBs. For example, if the left main ac bus has no power, the converter opens the left TBB and closes the left CCB. This permits the converter to supply power to the left transfer bus.

BITE

The GCUs and backup converter protect and monitor the ac power systems for faults. They perform three kinds of tests:

- Continuous
- Power-up/manually-initiated
- Fault-initiated.

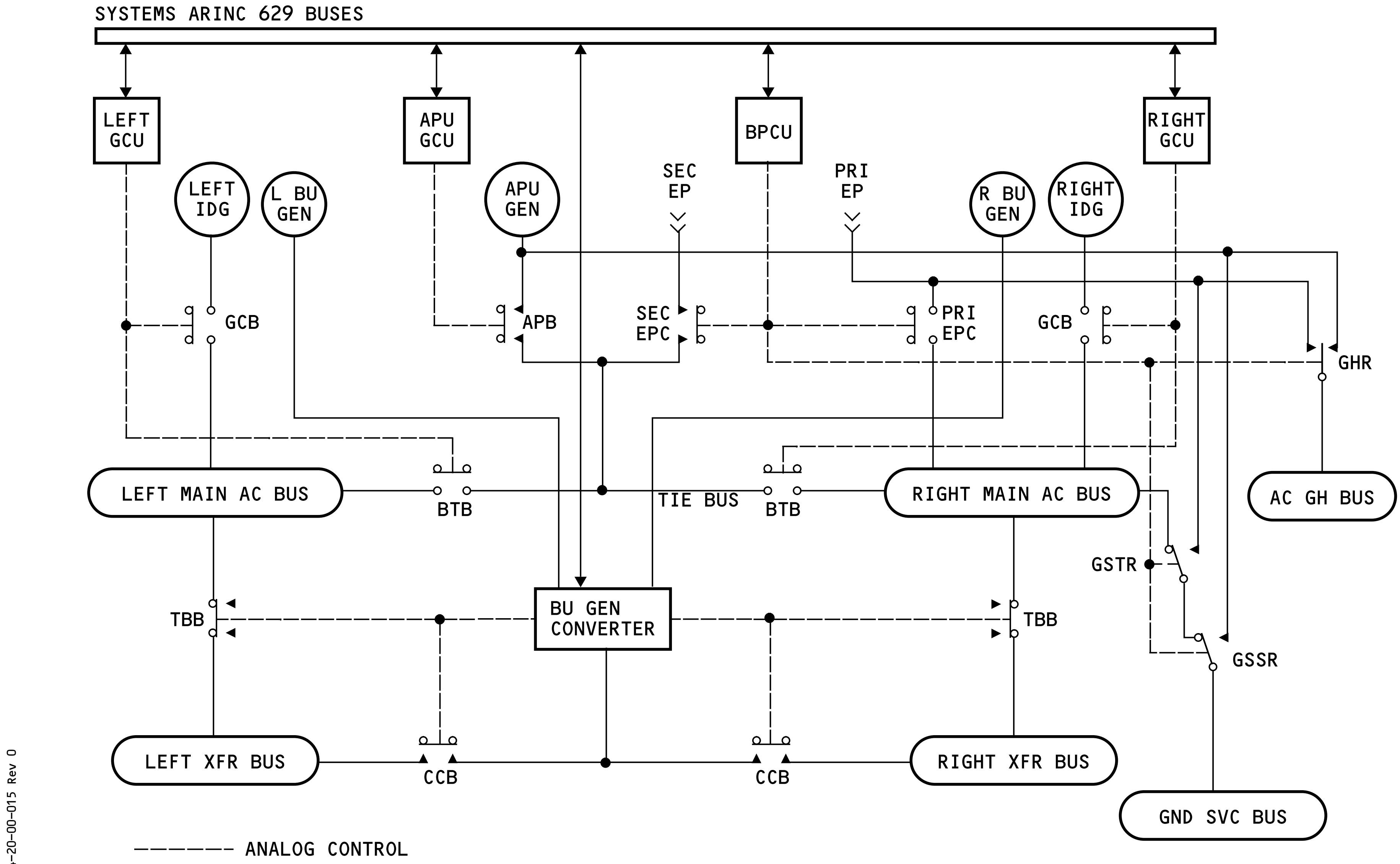
The GCUs and the converter send the test fault data to the AIMS.

Training Information Point

There is a short time delay between when the engine reaches idle and when the IDG starts to supply power. The length of the time delay depends on engine idle speed data from the engine data interface unit (EDIU).

On the ground, if the GCU gets a satisfactory engine idle speed signal from the EDIU, the IDG starts to supply power in 6 seconds. If there is not a satisfactory engine idle speed signal from the EDIU, the GCU gets a different engine speed signal from its own PMG. In this case, the IDG starts to supply power in 16 seconds.

In the air, if the GCU gets a satisfactory engine idle speed signal from the EDIU, the IDG starts to supply power in 10 seconds. If it must get an engine speed signal from the PMG, the IDG starts to supply power in 20 seconds.



AC GENERATION - FUNCTIONAL DESCRIPTION

AC GENERATION - IDG AND APU POWER CMCS GROUND TESTS

General

There are three operational tests for the main ac electrical power generation system:

- Unlatch Sustained Parallel Fault (AGCU)
- Unlatch Sustained Parallel Fault (LGCU)
- Unlatch Sustained Parallel Fault (RGCU).

There are four replacement tests for the main ac electrical power generation system:

- Auxiliary Generator Control Unit
- Bus Power Control Unit
- Left Generator Control Unit
- Right Generator Control Unit.

Unlatch Sustained Parallel Fault (AGCU)

When the APU generator control unit detects a fault in its sustained-parallel-source protection circuits, it latches a related fault message. You run this test to clear the latched fault message.

Unlatch Sustained Parallel Fault (LGCU)

When the left generator control unit detects a fault in its sustained-parallel-source protection circuits, it latches a related fault message. You run this test to clear the latched fault message.

Unlatch Sustained Parallel Fault (RGCU)

When the right generator control unit detects a fault in its sustained-parallel-source protection circuits, it latches a related fault message. You run this test to clear the latched fault message.

Auxiliary Generator Control Unit

This test makes the APU GCU do a BITE test of its internal circuits. The test is almost equivalent to the power-up test of the APU GCU.

Bus Power Control Unit

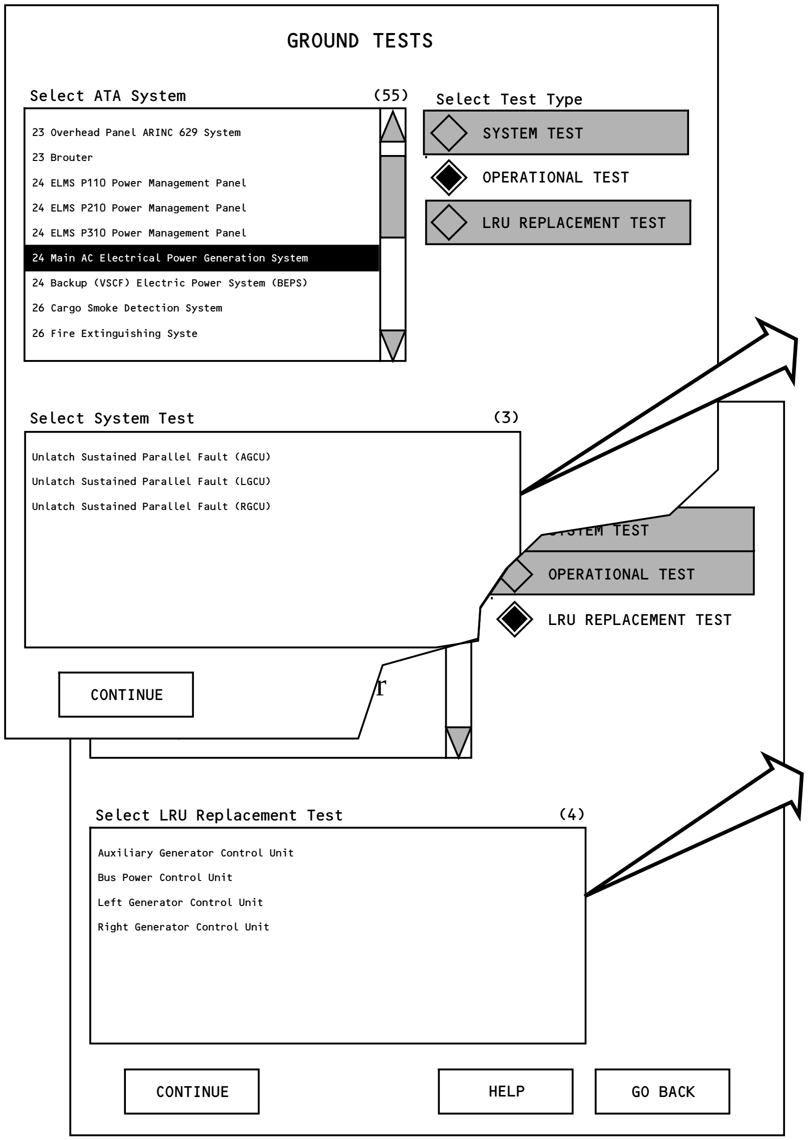
This test makes the BPCU do a BITE test of its internal circuits. The test is almost equivalent to the power-up test of the BPCU.

Left Generator Control Unit

This test makes the left GCU do a BITE test of its internal circuits. The test is almost equivalent to the power-up test of the left GCU.

Right Generator Control Unit

This test makes the right GCU do a BITE test of its internal circuits. The test is almost equivalent to the power-up test of the right GCU.



Select Operational Test (3)

UNLATCH SUSTAINED PARALLEL FAULT (AGCU)
UNLATCH SUSTAINED PARALLEL FAULT (LGCU)
UNLATCH SUSTAINED PARALLEL FAULT (RGCU)

Select LRU Replacement Test (4)

AUXILIARY GENERATOR CONTROL UNIT
BUS POWER CONTROL UNIT
LEFT GENERATOR CONTROL UNIT
RIGHT GENERATOR CONTROL UNIT

24-20-00-016 Rev 1 06/06/95

AC GENERATION - IDG AND APU POWER CMCS GROUND TESTS

AC GENERATION - BACKUP POWER CMCS GROUND TESTS

General

There is one operational test for the backup electrical power system. It is the Engine Start Test.

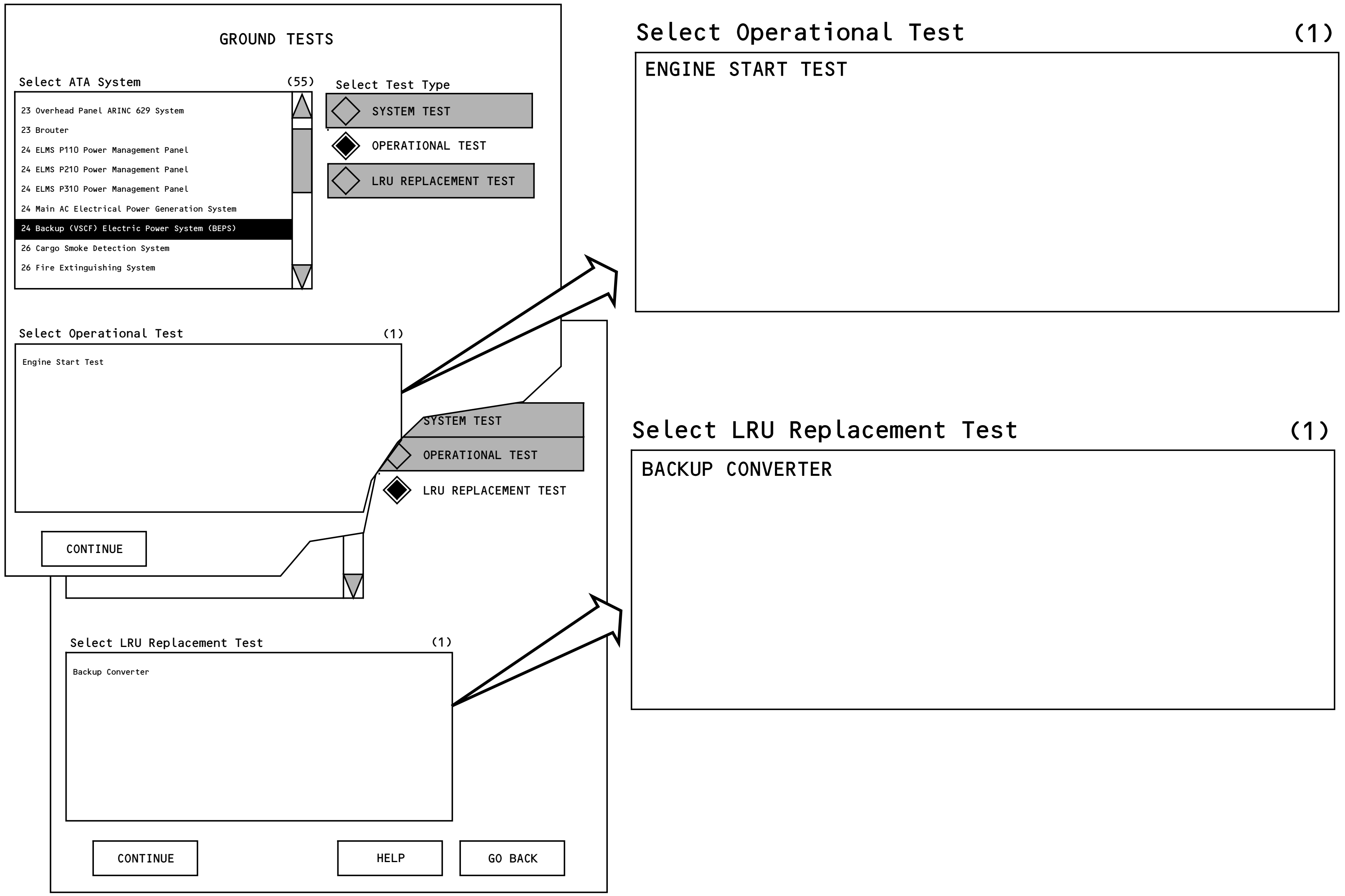
There is one LRU replacement test for the backup electrical power system. It is the Backup Converter Test.

Engine Start Test

To do this test, you must operate the engine for the backup generator you want to test. The test makes the backup converter do the engine start test that normally occurs after each engine start.

Backup Converter

This test makes the backup converter do a BITE test of its internal circuits. The test is almost equivalent to the power-up test of the backup converter.



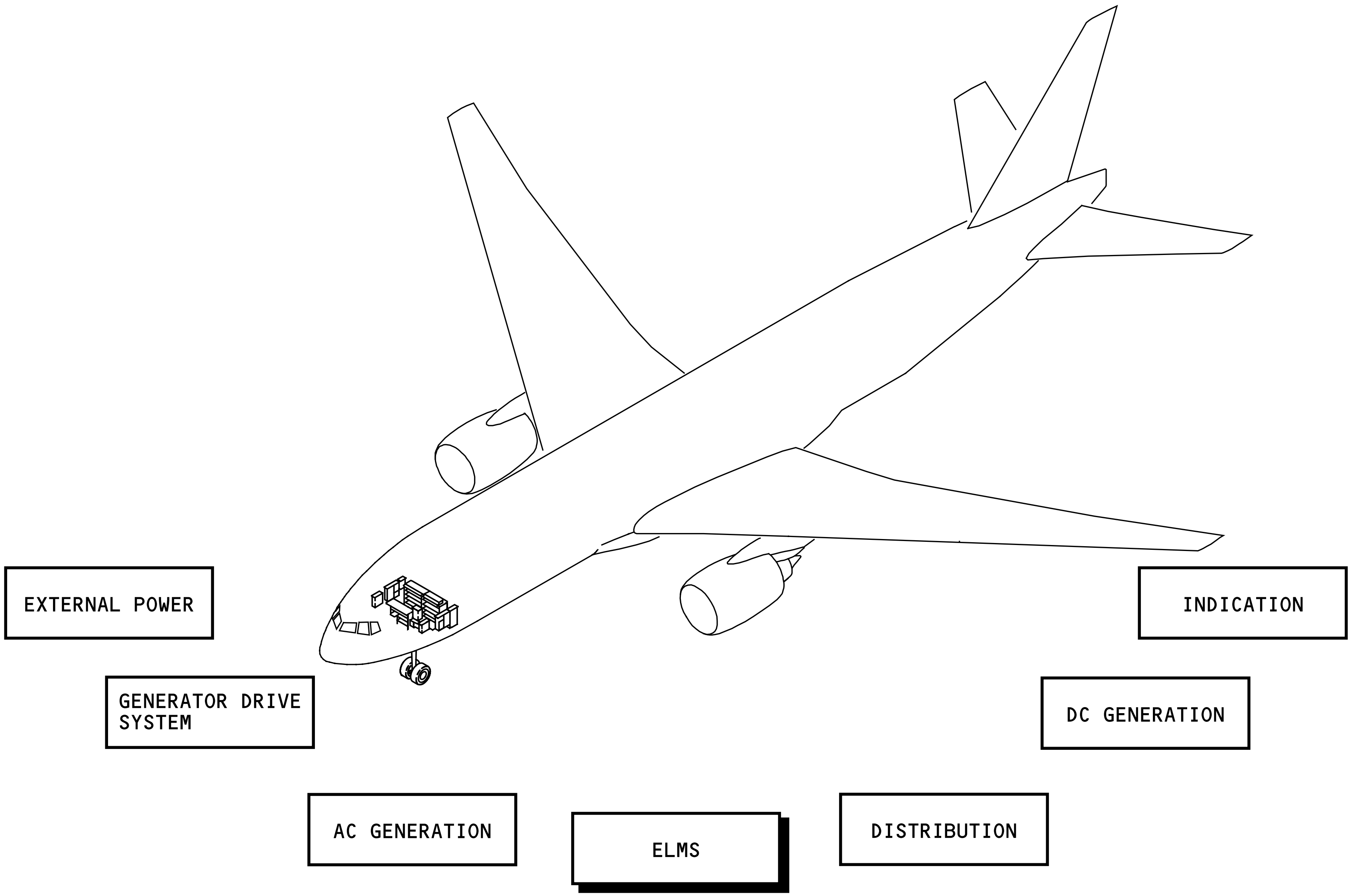
24-20-00-017 Rev 1 06/06/95

AC GENERATION - BACKUP POWER CMCS GROUND TESTS

ELMS - INTRODUCTION

General

The electrical load management system (ELMS) has two basic functions that are independent of each other. First, the ELMS is a physical container for electrical equipment that it may or may not control. Second, the ELMS is a control system for many electrical components.



ELMS - INTRODUCTION

ELMS - GENERAL DESCRIPTION

General

The ELMS has seven panels that contain components to distribute electrical power. The ELMS also protects the electrical power system and controls many load-switching devices.

Distribution

All airplane electrical power goes through the ELMS panels for distribution. These are the ELMS panels:

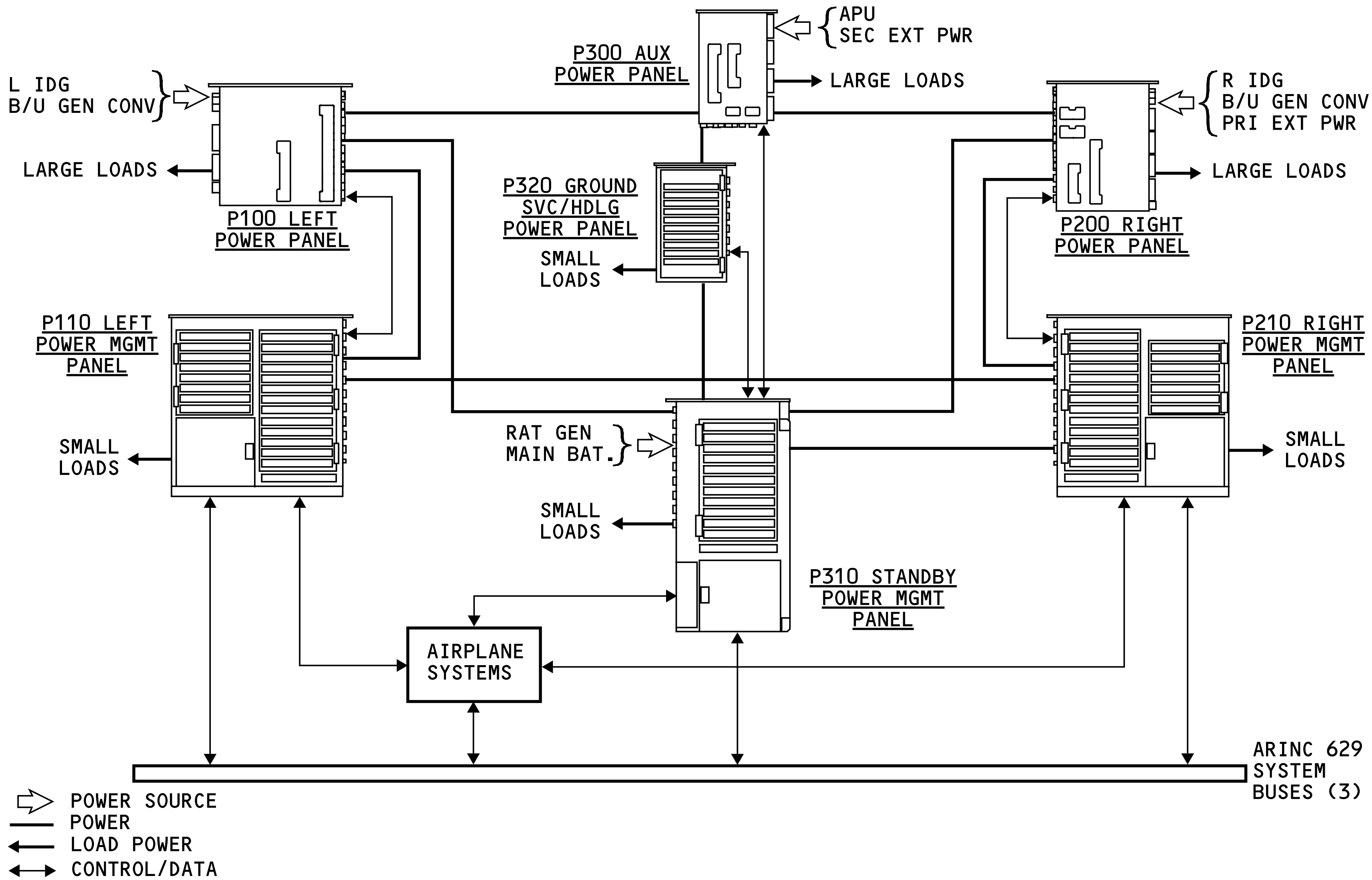
- P100 Left power panel
- P200 Right power panel
- P300 Auxiliary power panel
- P320 Ground service/handling power panel
- P110 Left power management panel
- P210 Right power management panel
- P310 Standby power management panel.

Main and backup power go to the left, right, or auxiliary power panels. These power panels supply power to large loads (usually 25 amps or more). They also supply power to the power management panels and the ground service/handling power panel. The power management panels and the ground service/handling power panel supply power to small loads (usually less than 25 amps).

Load Switching

The power management panels contain ELMS electronic units (EEU). The EEUs control and monitor load-switching devices in their related ELMS panels. However, the EEUs do not control all of the load-switching devices. The GCUs, BPCU, and backup generator converter directly control some of the large load-switching devices in the power panels. Airplane systems directly control some load switching in the power management panels.

The EEUs get data from the other electrical power control units and airplane systems. This data comes directly or from the ARINC 629 system buses. The EEUs use this data to manage the loads of the electrical power system.



24-09-00-002 Rev 2 12/04/1996

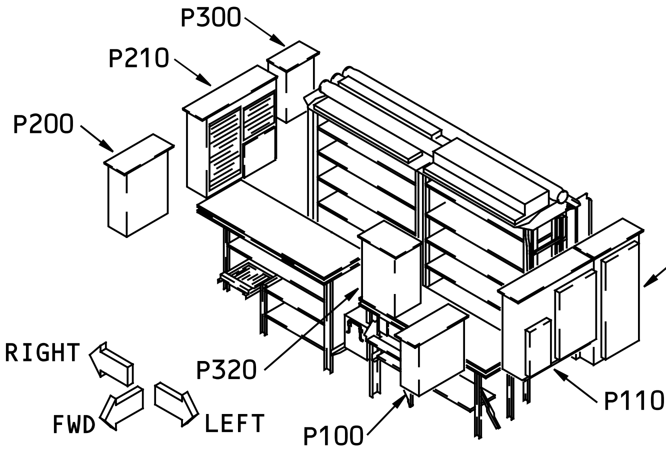
ELMS - GENERAL DESCRIPTION

ELMS - COMPONENT LOCATIONS

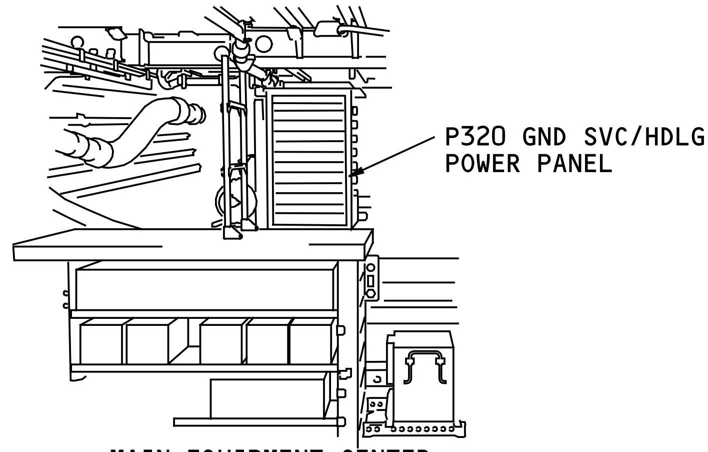
Component Locations

All of the ELMS panels are in the main equipment center. Other ELMS components are in these panels. These are the seven ELMS panels:

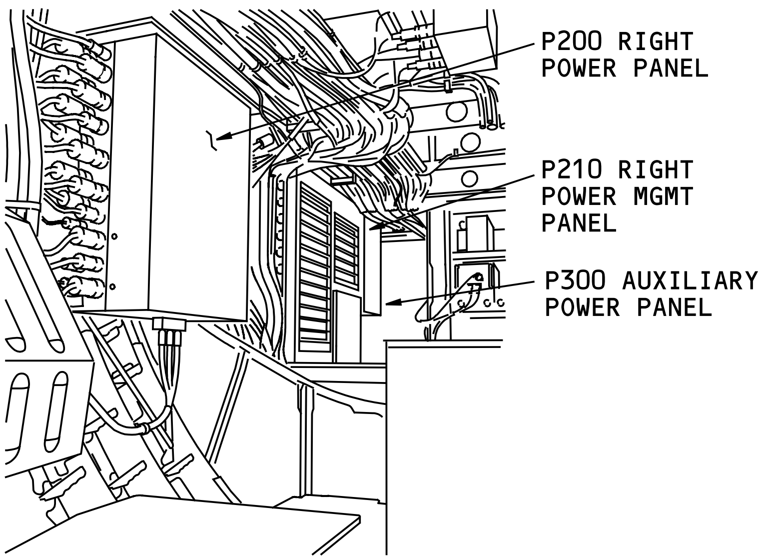
- P320 Ground service/handling power panel
- P200 Right power panel
- P210 Right power management panel
- P300 Auxiliary power panel
- P100 Left power panel
- P110 Left power management panel
- P310 Standby power management panel.



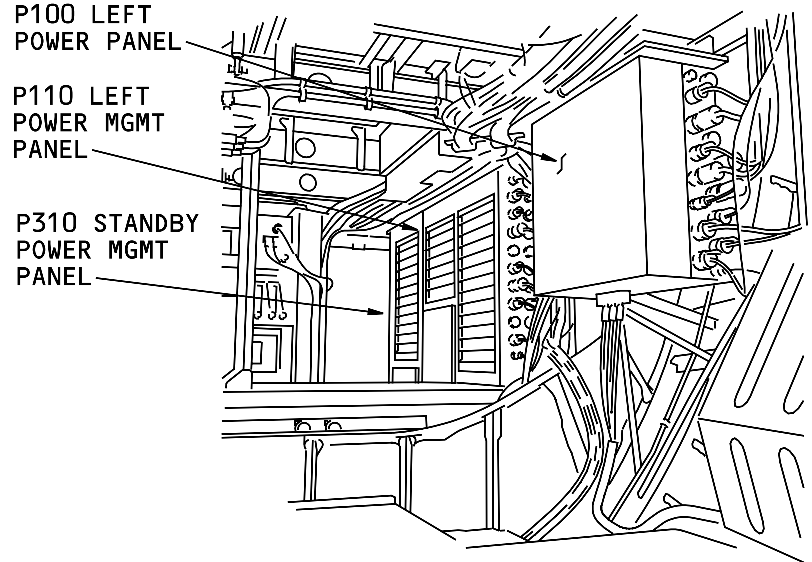
MAIN EQUIPMENT CENTER



MAIN EQUIPMENT CENTER
(LEFT, LOOKING FORWARD)



MAIN EQUIPMENT CENTER
(RIGHT, LOOKING AFT)



MAIN EQUIPMENT CENTER
(LEFT, LOOKING AFT)

24-09-00-003 Rev 0

ELMS - COMPONENT LOCATIONS

ELMS - P100/P200 POWER PANELS

P100 Left Power Panel

P100 contains switching devices and circuit breakers for large electrical loads. You remove the panel cover to get access to these components in P100:

- Electrical load control units (ELCUs)
- L GCB
- L BTB
- L TBB
- L CCB
- Circuit breakers.

Holes in the panel cover permit access to the circuit breakers. Labels on the cover identify the circuit breakers.

There are bus power lights on the lower-left side of the panel. The red lights have numbers on them. A placard on the side of the panel identifies the lights by number.

Stud connectors for the large power cables are on the aft side of the panel. Electrical connectors for smaller circuits are on the forward side of the panel.

P200 Right Power Panel

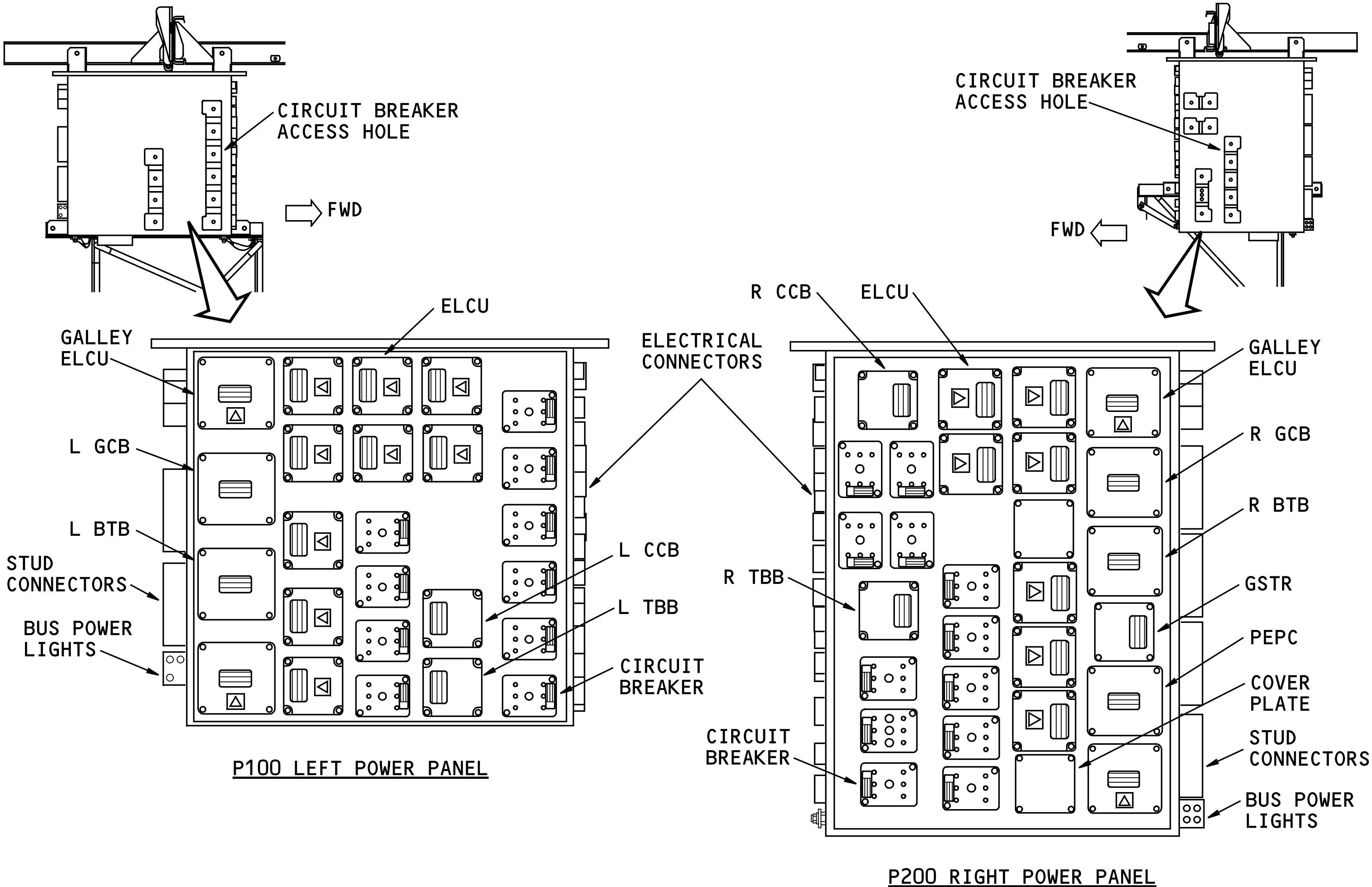
P200 contains switching devices and circuit breakers for large electrical loads. You remove the panel cover to get access to these components in P200:

- R CCB
- ELCUs
- R GCB
- R BTB
- GSTR
- Primary external power contactor (PEPC)
- Circuit breakers
- R TBB.

Holes in the panel cover permit access to the circuit breakers. Labels on the cover identify the circuit breakers.

There are bus power lights on the lower-right side of the panel. The red lights have numbers on them. A placard on the side of the panel identifies the lights by number.

Stud connectors for the large power cables are on the aft side of the panel. Electrical connectors for smaller circuits are on the forward side of the panel.



24-09-00-004 Rev 0

ELMS - P100/P200 POWER PANELS

ELMS - P300/P320 AUXILIARY AND GROUND SERVICE/HANDLING POWER PANELS

P300 Auxiliary Power Panel

P300 contains switching devices and circuit breakers for large electrical loads. You remove the panel cover to get access to these components in P300:

- APB
- GHR
- GSSR
- Secondary external power contactor (SEPC)
- Circuit breakers.

Holes in the panel cover permit access to the circuit breakers. Labels on the cover identify the circuit breakers.

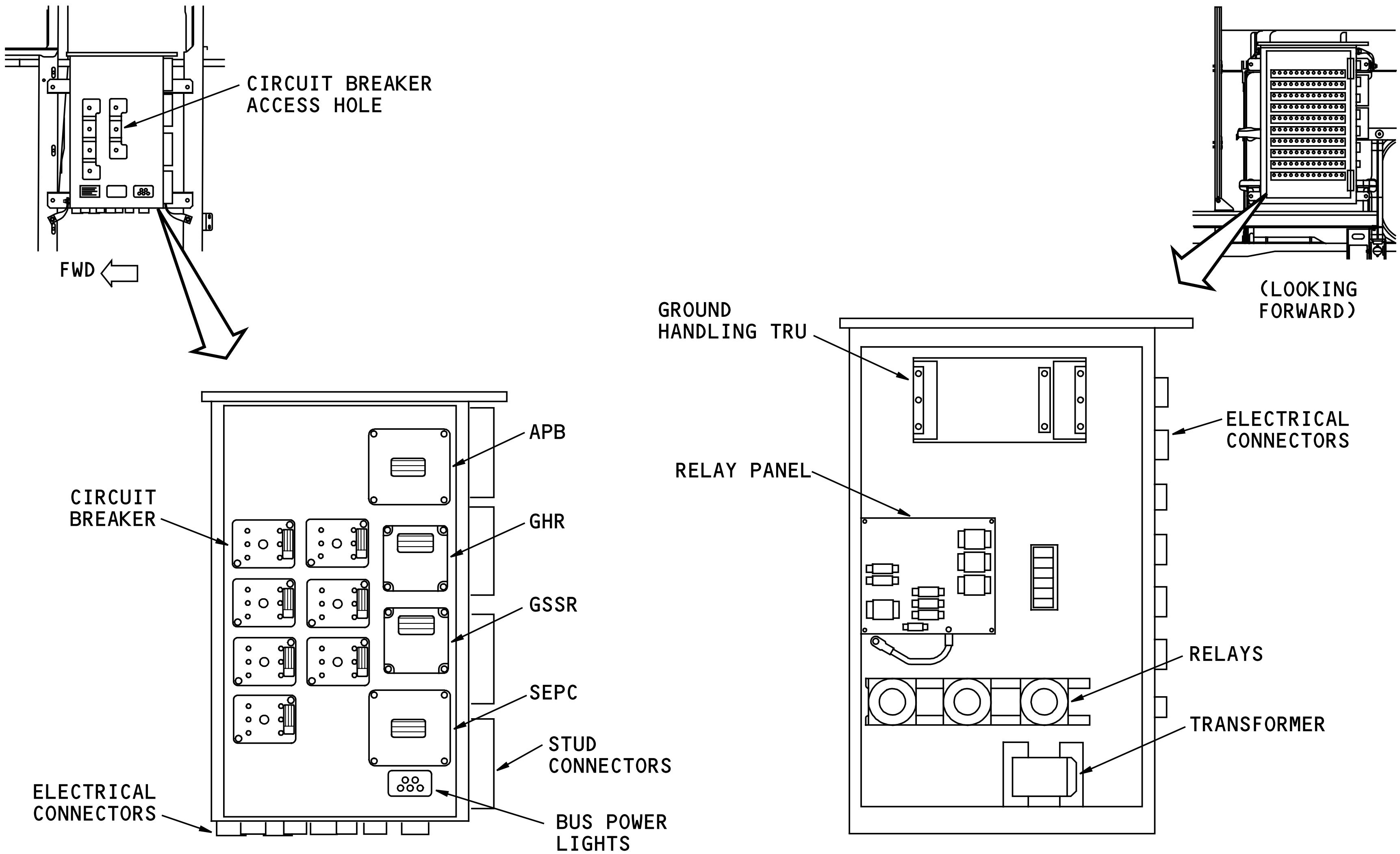
There are bus power lights on the lower, right side of the panel. The red lights have numbers on them. A placard on the front of the panel identifies the lights by number.

Stud connectors for the large power cables are on the aft side of the panel. Electrical connectors for smaller circuits are on the bottom of the panel.

P320 Ground Service/Handling Power Panel

P320 contains switching devices and circuit breakers for smaller electrical loads. You open the panel door to get access to these components in P320:

- Ground handling TRU
- Relay panel
- Relays
- Transformer.



P300 AUXILIARY POWER PANEL

P320 GROUND SERVICE/HANDLING POWER PANEL

ELMS - P300/P320 AUXILIARY AND GROUND SERVICE/HANDLING POWER PANELS

ELMS - P110 LEFT POWER MANAGEMENT PANEL

General

The P110 left power management panel contains switching devices and circuit breakers for smaller electrical loads. An EEU is also in P110.

Physical Description

You open the panel doors to get access to these components in the P110:

- Relays
- Relay panels
- EEU
- Signal conditioning modules (SCM).

Circuit breakers are in the doors of the panel.

A special section of P110 contains the EEU. This section shields the EEU circuit cards from electro-magnetic interference (EMI). You open the EEU cover door to get access to these EEU circuit cards:

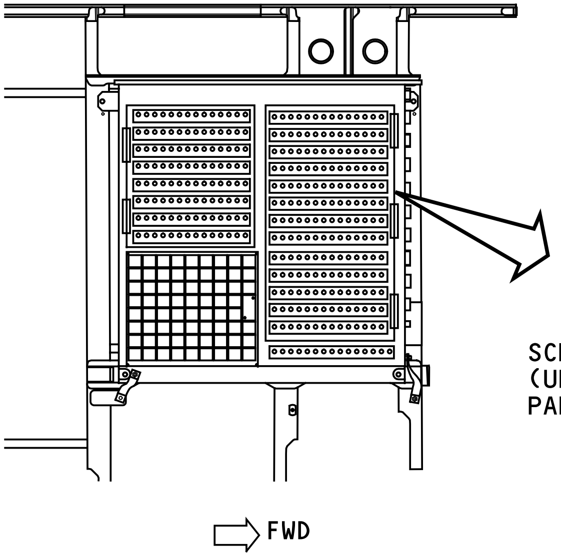
- Power supply unit (PSU) (2)
- ARINC 629 (2)
- I/O (6)
- CPU (2)
- Filter (3).

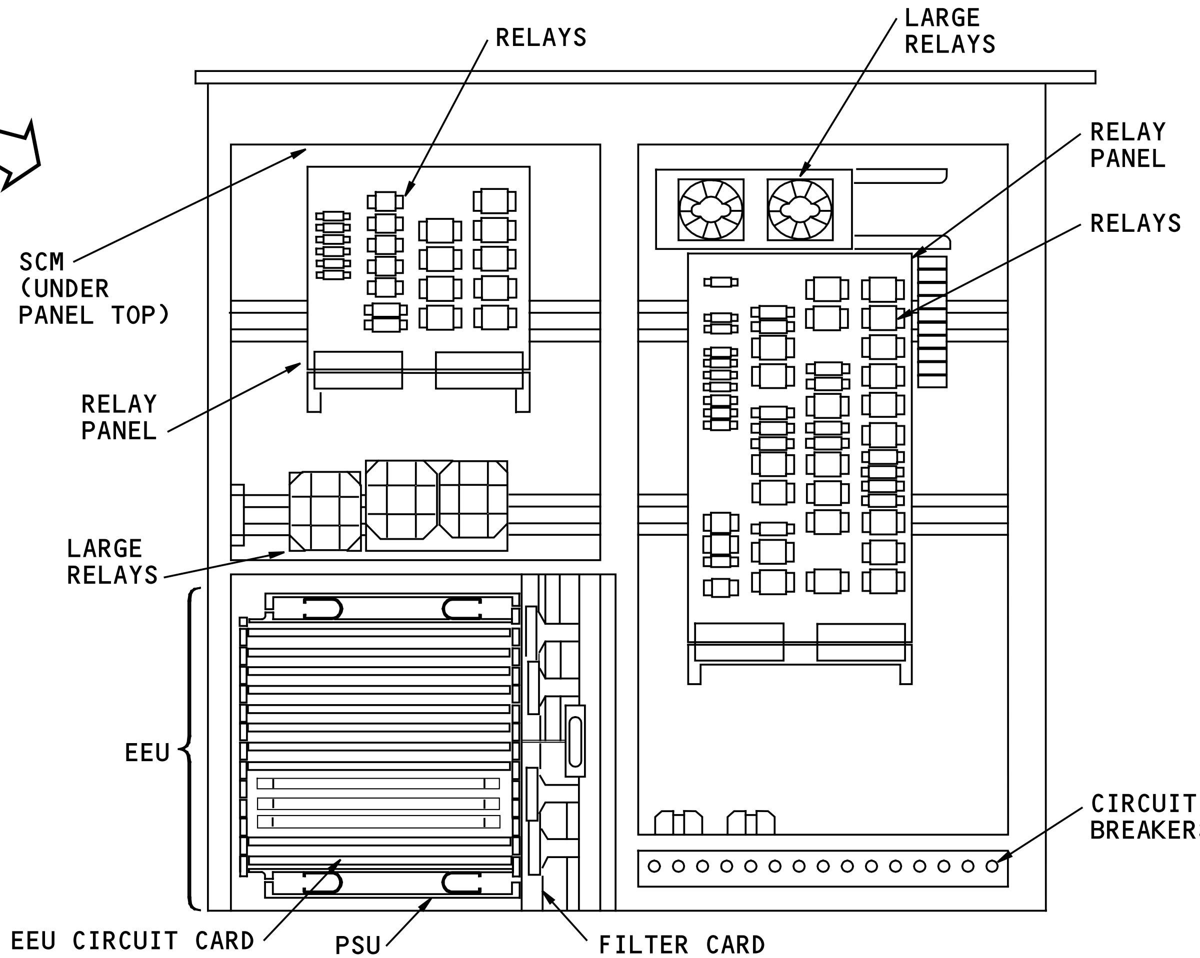
Labels on the ends of the EEU circuit cards identify them.

Training Information Point

You can remove the EEU circuit cards. Exposed connector pins make the cards electrostatic discharge sensitive (ESDS) components.

The CPU cards have software that is data-loadable.





P110 LEFT POWER MANAGEMENT PANEL

24-09-00-006 Rev 2

ELMS - P110 LEFT POWER MANAGEMENT PANEL

ELMS - P210 RIGHT POWER MANAGEMENT PANEL

General

The P210 right power management panel contains switching devices and circuit breakers for smaller electrical loads. An EEU is also in P210.

Physical Description

You open the panel doors to get access to these components in P210:

- Transformer
- SCMs
- Relays
- Relay panels
- EEU
- DC tie relay.

Circuit breakers are in the doors of the panel.

A special section of P210 contains the EEU. This section shields the EEU circuit cards from EMI. You open the EEU cover door to get access to these EEU circuit cards:

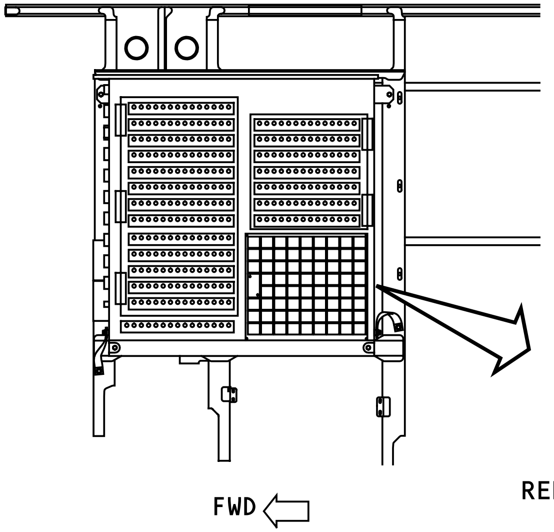
- PSUs (2)
- ARINC 629 (2)
- I/O (6)
- CPU (2)
- Filter (3).

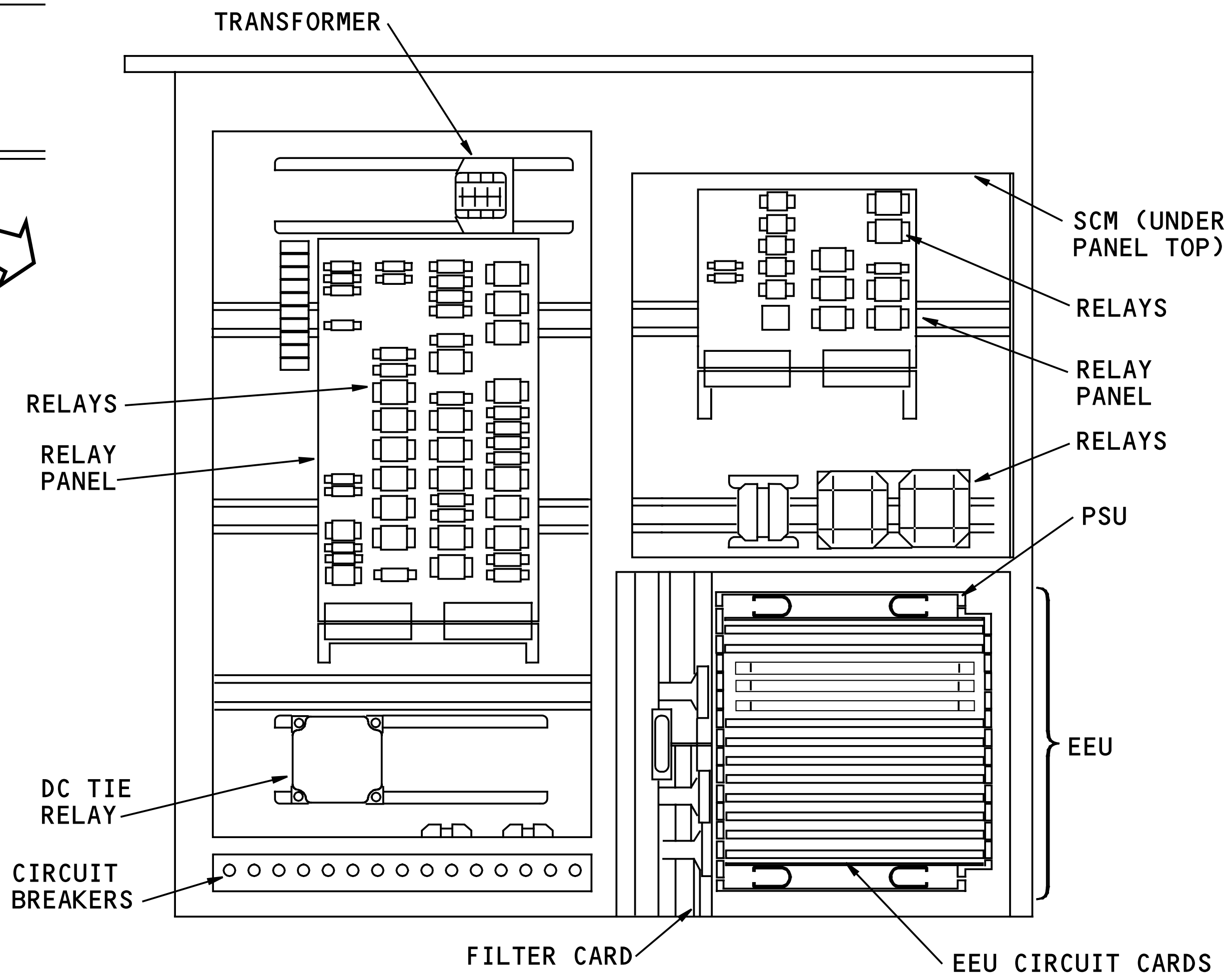
Labels on the ends of the EEU circuit cards identify them.

Training Information Point

You can remove the EEU circuit cards. Exposed connector pins make the cards ESDS components.

The CPU cards have software that is data-loadable.





P210 RIGHT POWER MANAGEMENT PANEL

ELMS - P210 RIGHT POWER MANAGEMENT PANEL

ELMS - P310 STANDBY POWER MANAGEMENT PANEL

General

The P310 standby power management panel contains switching devices and circuit breakers for smaller electrical loads. An EEU is also in P310.

Physical Description

You open the panel door to get access to these components in P310:

- SCMs
- Relay panel
- Relays
- EEU.

A special section of P310 contains the EEU. This section shields the EEU circuit cards from EMI. You open the EEU cover door to get access to these EEU circuit cards:

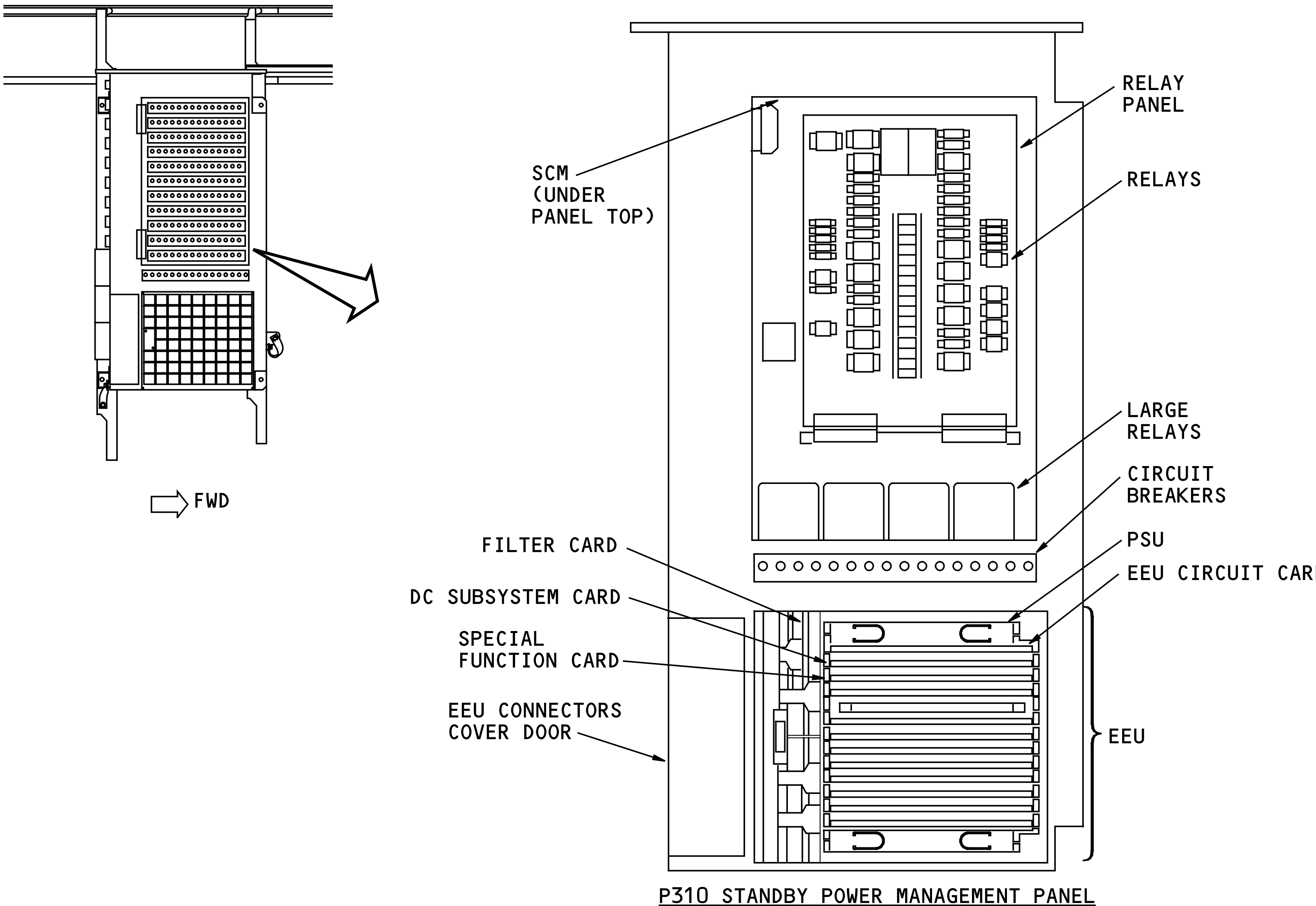
- PSUs (2)
- ARINC 629 (2)
- I/O (6)
- CPU (2)
- Filter (4)
- DC subsystem
- Special function.

Labels on the ends of the EEU circuit cards identify them.

Training Information Point

You can remove the EEU circuit cards. Exposed connector pins make the cards ESDS components.

The CPU cards have software that is data-loadable. The dc subsystem card is for dc power control and cannot be programmed. The special function card is for unusual input/output data handling and cannot be programmed.



24-09-00-008 Rev 3

ELMS - P310 STANDBY POWER MANAGEMENT PANEL

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ELMS - FUNCTIONAL DESCRIPTION - PANELS

General

Each of the ELMS panels has self-contained wiring. All of the airplane wiring connects to the panels with external connectors. Line replaceable modules (LRMs) are inside the ELMS panels.

Power Panels

The power panels contain the large electrical load switching devices. One side of each panel has connecting studs for the large power cables. The other side has electrical connectors for smaller circuits. Bus power lights show when buses in the panel have power.

Inside each power panel is a backplane. Panel wiring and current transformers are behind the backplane. LRM mounting bases are part of the backplane. No wire connections are in front of the backplane.

LRMs plug into the mounting bases. The LRM power contacts are spring-loaded to ensure good contact with the mounting bases. Screws hold the LRMs in position. Plates cover any mounting bases that are not used.

Power Management Panels

The power management panels contain the smaller electrical load switching devices and the EEUs. These LRMs are in the panels:

- SCMs
- Current monitors
- Relays
- Circuit breakers
- EEU circuit cards
- Breaker.

The SCMs change input signals into a type that is satisfactory for the EEUs.

Relays are inside the panels. Smaller relays attach to relay panels that rotate down to expose the back of the relay panel. Larger relays attach to rails.

Circuit breakers are in the doors of the panels. Those monitored by the ELMS have a small circuit card attached to their base on the back of the panel door. One row of high ampere dc circuit breakers attach to the bottom face of the panels.

The EEU circuit cards are in a special section of the power management panels. You open a door to get access to the cards. Labels on the cards identify them.

Training Information Point

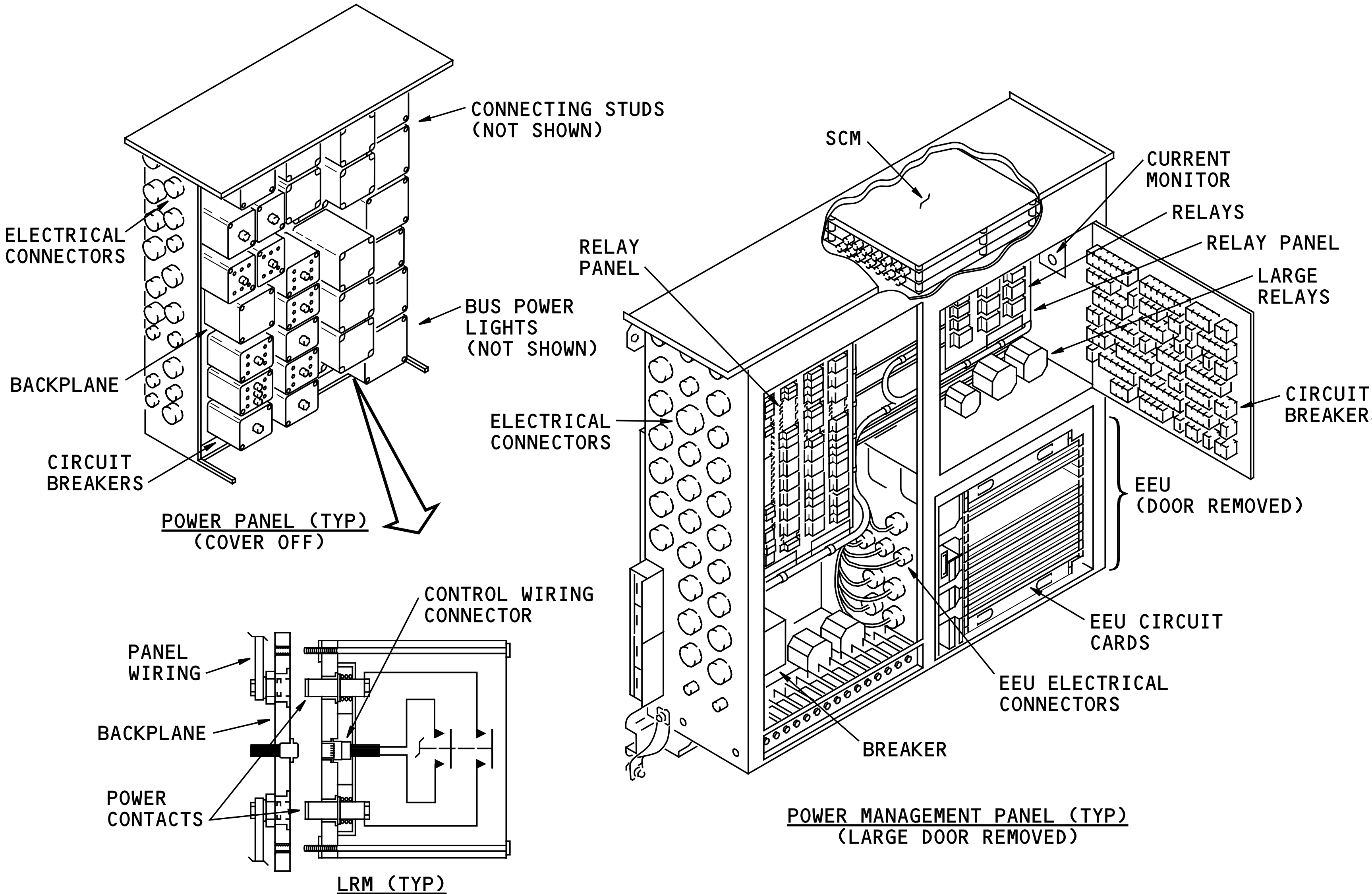
The screws of the power panel LRMs are captive (stay with the LRM).

Exposed connector pins on the EEU circuit cards make them ESDS components.

Circuit breakers for the ELMS panels are below the surface of the panel cover or are in a recess in the

ELMS - FUNCTIONAL DESCRIPTION - PANELS

panel doors. This prevents accidental damage to the circuit breakers, but you cannot easily see when a circuit breaker is open. Attach circuit breaker clips when you manually pull a circuit breaker to clearly show that it is open. Also supply power through the circuit breaker after you reset it to make sure it stays in.



24-09-00-009 Rev 3

ELMS - FUNCTIONAL DESCRIPTION - PANELS

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ELMS - FUNCTIONAL DESCRIPTION - EEU

General

The power management panels contain ELMS electronic units (EEU). The EEUs are two-channel computers that control and monitor load-switching devices in their related ELMS panels. Each EEU is an LRU that contains several circuit cards that are line replaceable modules (LRM). These are the circuit cards in the P310 EEU:

- Power supply
- CPU
- ARINC 629
- DC subsystem
- Special function
- I/O-1
- Filters A, B, and C.

P110 and P210 do not contain a dc subsystem, special function, or filter B circuit card. They also use an I/O-2 card instead of an I/O-1 card.

Physical Description

The EEU is in a special section of the power management panel that is shielded against EMI. You can remove the EEU from the panel. To remove the EEU from the panel, you have to disconnect the electrical connectors on the side of the EEU and remove it from the panel.

The circuit cards are in slots in the EEU. All of the cards, except the filter cards, are color-coded and labeled on the front of the card. There is also a label on the door of the EEU that shows the equipment number for each card slot. Card locks hold the cards in place. To remove a card, you loosen two card locks to release the card. To remove a filter card, you must first disconnect the electrical connector on the front of the card.

NOTE: The orientation of the P110 EEU is 180 degrees different from P210 and P310 (channel A is on top and the filter cards are to the right as you face the unit).

Power Supply

There are two power supply cards in each EEU. One is for channel A and the other for channel B. The power supplies convert the airplane dc power into acceptable power for the EEU LRMs. The power supply cards are brown.

CPU

There are two central processing unit (CPU) cards in each EEU. One is for channel A and the other for channel B. The CPUs contain the software that controls and monitors the ELMS functions. The CPU cards have a red removal handle.

The CPU channel that is the most healthy is the channel in control. The circuitry that decides which channel is the most healthy is split evenly between the two CPUs. If both CPUs have the same health, the channel that was in control when power to the EEU was removed, is the channel in control. The channel in control changes when the engines are shutdown at the end of a flight leg.

The channel in control can receive and transmit data to the ARINC 629, I/O, dc subsystem, and special function cards. The other channel is in a standby mode and can only receive data from the cards.

ARINC 629

There are two ARINC 629 cards in each EEU. The ARINC 629 cards transmit and receive data across the airplane systems ARINC 629 buses. One card is for the left systems bus and the other for the right systems bus. The ARINC 629 cards have a blue removal handle.

DC Subsystem

There is one dc subsystem card. It is in the P310 EEU. The dc subsystem card controls and monitors the airplane dc system. The dc subsystem card has a green removal handle.

Special Function

There is one special function card. It is in the P310 EEU. The special function card controls the interface between special external signals and the CPUs such as the battery and TRU current sensors and the cabin pressure sensor. The special function card has a black removal handle.

Input/Output (I/O)

There are six I/O cards in each EEU. There are expansion slots for additional I/O cards if they become necessary. P310 uses I/O-1 cards. P110 and P210 use I/O-2 cards. The I/O cards control the interface between external signals and the CPUs. The I/O-2 cards have a special loadshed function for the hydraulic ac motor pumps that the I/O-1 cards do not. All the I/O cards have yellow removal handles.

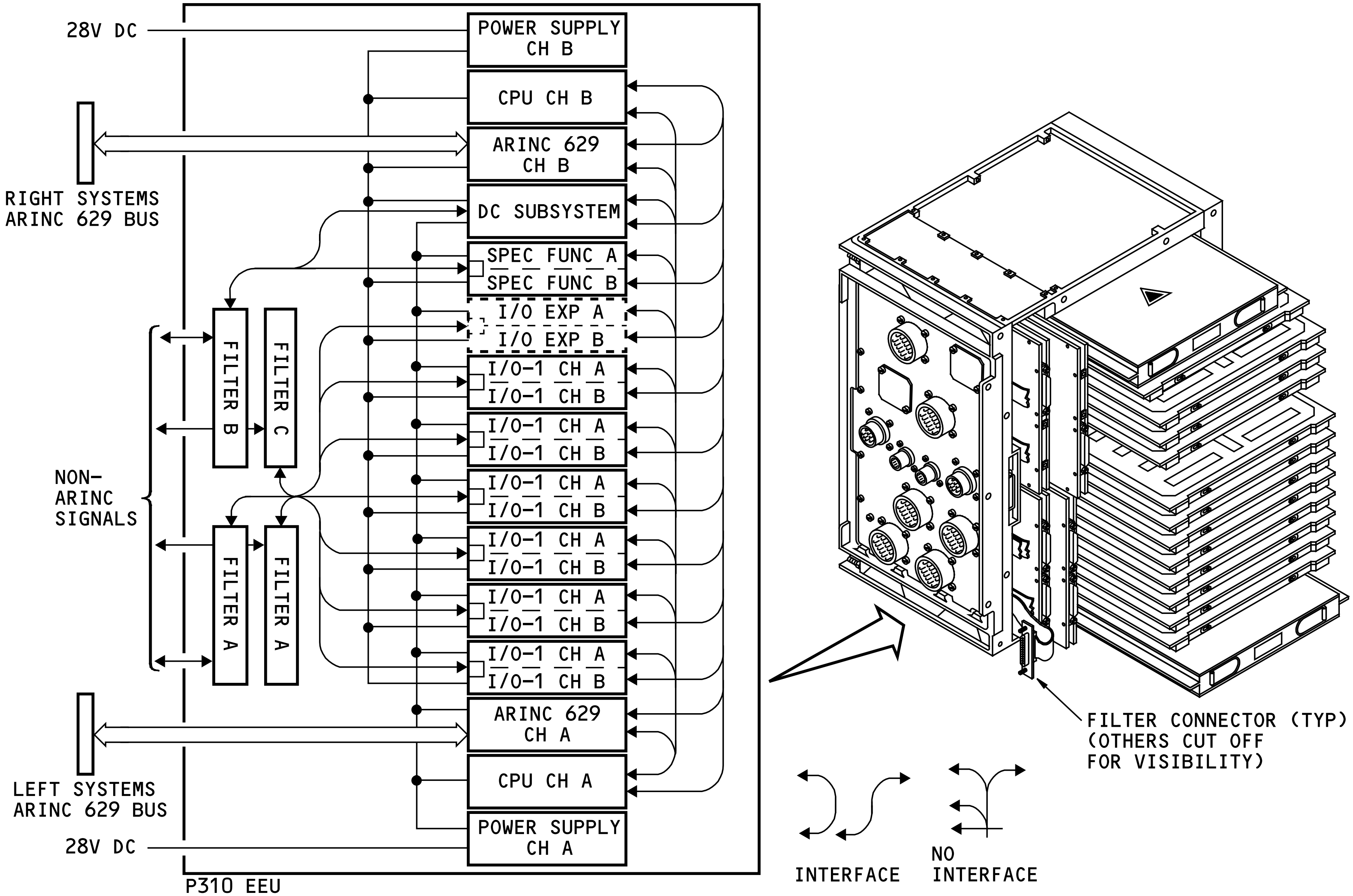
Filters

There are three filter cards in each EEU; filter A (2) and filter C. P310 has an additional fourth card; filter B. The filter cards remove noise from the signals to and from the EEU circuit cards. The filter cards have no colored removal handle.

The filter A and filter C cards remove noise from the signals to and from the I/O cards. The filter B card removes noise from the signals to and from the dc subsystem and special function cards.

Training Information Point

The EEU and its circuit cards are ESDS components. You must use a wrist strap to remove an EEU or any of its circuit cards.



ELMS - FUNCTIONAL DESCRIPTION - EEU

ELMS - FUNCTIONAL DESCRIPTION - EEU POWER

General

The ELMS power management panels operate with 28v dc power. Each power management panel has two power supply units (PSU) to control the power. The PSUs are circuit cards in the EEU. Two different dc power sources supply power to each PSU.

P110

The left power management panel gets power from the left and right dc buses.

P210

The right power management panel gets power from the left and right dc buses.

P310

The standby power management panel gets power from the battery #2 bus and the hot battery bus. The hot battery bus can supply power to P310 when any of these conditions occur:

- Battery switch is on
- Airplane is in the air
- RAT is deployed
- Refuel panel door is open.

The hot battery bus supplies control power to all of the relays that connect hot battery bus power to the P310 EEU.

Start Power Control

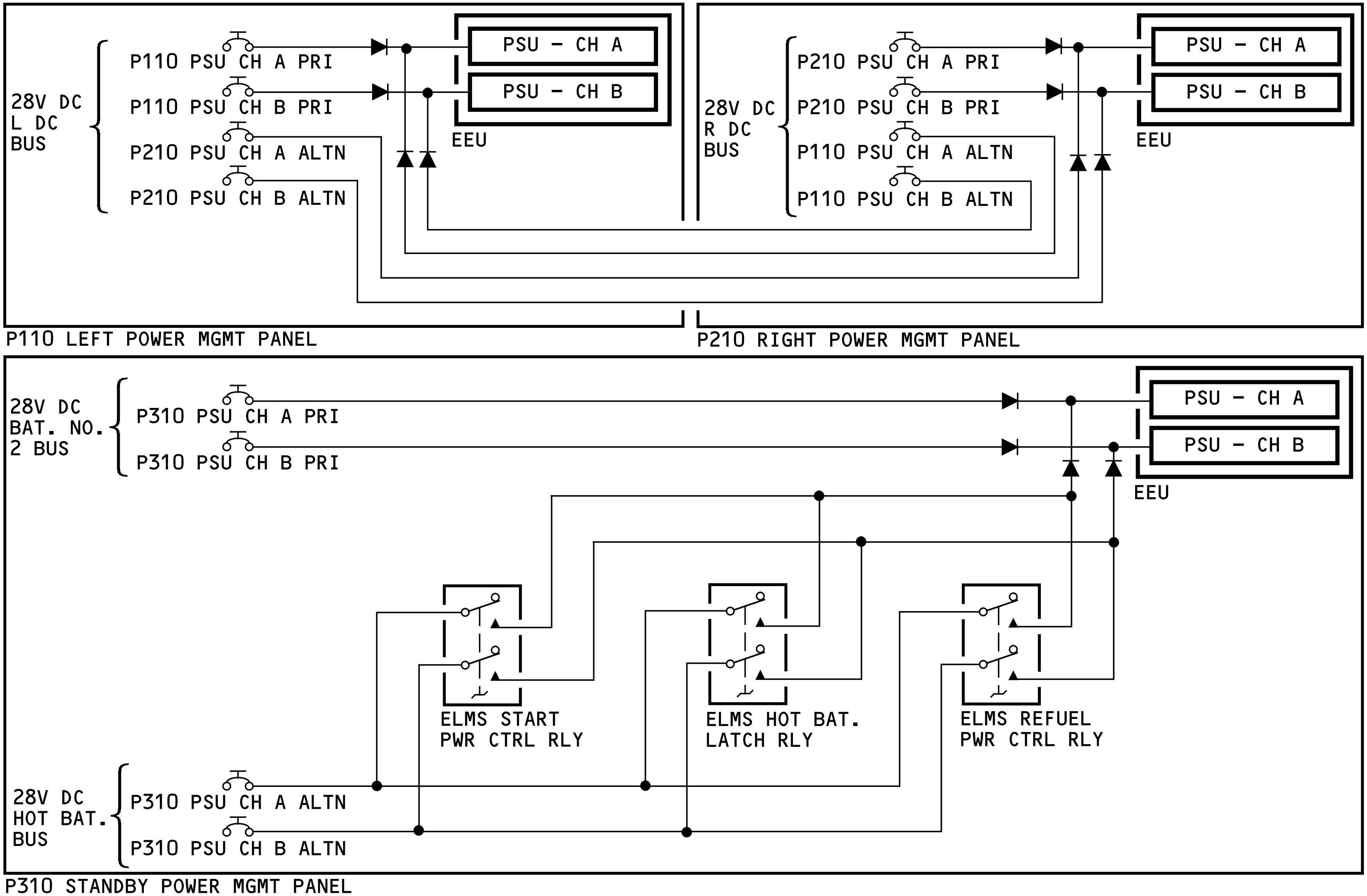
When the airplane has no power and you push the battery switch on, the ELMS start power control relay energizes. This supplies power to the P310 EEU so that it can energize the ground power battery relay. The ground power battery relay connects the hot battery bus to the battery No. 2 bus.

Hot Battery Latch

When the airplane is in the air or the RAT deploys, the hot battery latch relay energizes. This makes sure that the P310 EEU has power to control standby power operations even if the battery switch receives damage.

Refuel Power Control

When the integrated refuel panel door is open, the refuel power control relay energizes. This supplies power to the P310 EEU so that it can control the refuel valves.



ELMS - FUNCTIONAL DESCRIPTION - EEU POWER

ELMS - FUNCTIONAL DESCRIPTION - CONTROL

General

In addition to the distribution of electrical power, the ELMS also controls the switching of many electrical loads.

Control

Switching devices control the flow of electrical power to electrical loads. The ELMS controls these devices in one of these three ways:

- EEU control
- External control
- Remote control.

For EEU control, the EEUs receive control signal inputs. EEU software decides when the switching device should operate. The EEUs then directly control the power switching device.

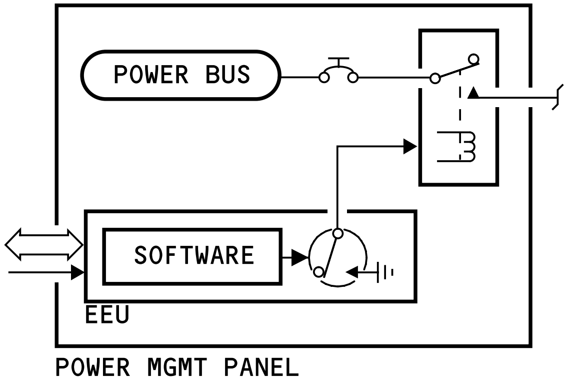
Other systems, external to the ELMS, also control switching devices in the ELMS panels. In these cases the ELMS has no control over the switching device.

For remote control, the EEUs control switching devices that are not in the power management panels. The EEUs supply a control signal that is either a ground for a remote relay or a logic discrete for a control unit.

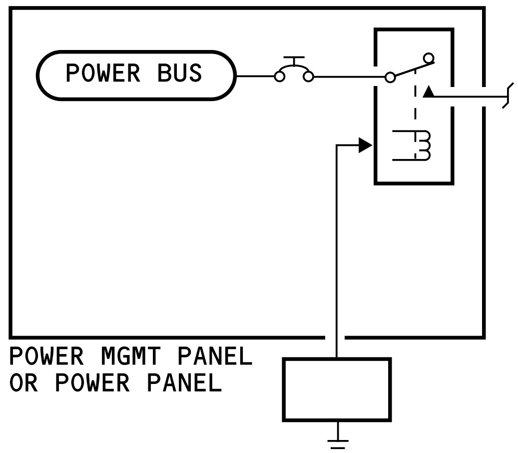
Software

The EEU control software for a switching device can be simple or complex. For some devices, the software just repeats a command input with no processing. For other devices, the software requires many inputs and does much processing.

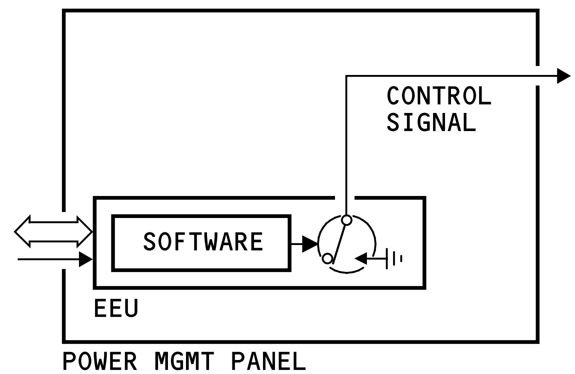
The software of the EEUs is data loadable.



EEU CONTROL



EXTERNAL CONTROL



REMOTE CONTROL

24-09-00-011 Rev 2 03/18/96

ELMS - FUNCTIONAL DESCRIPTION - CONTROL

ELMS - FUNCTIONAL DESCRIPTION - MONITORING

General

In addition to the distribution of electrical power, the ELMS also monitors the status of the power to many electrical loads for control purposes.

Monitor

The EEUs monitor electrical loads in several different ways. The EEUs can use different combinations of these ways to monitor the electrical loads:

- Bus voltage
- Circuit breaker position
- Relay position by voltage (option A)
- Relay position by ground (option B)
- Load current
- Analog discrete signal.

The EEUs use this load data to control the loads and to report faults. The EEUs also supply external control units with load data.

Bus Status

The EEUs monitor the power on buses by sensing the bus voltage. This is done with a voltage sensor (V SEN).

Bus/CB Status

The EEUs monitor the position of circuit breakers by sensing the voltage downstream of the circuit breaker. This is done with a circuit breaker monitor (CB MON).

Bus/CB/Relay Status - Opt A

Additionally, the EEUs can monitor the position of relays by sensing the voltage downstream of the relay contact. The signal conditioning module (SCM) makes the signal satisfactory for the EEU.

Bus/CB/Relay Status - Opt B

The EEUs sometime use an alternative to option A by sensing a ground (or power) through one contact of the relay. The SCM makes the signal satisfactory for the EEU.

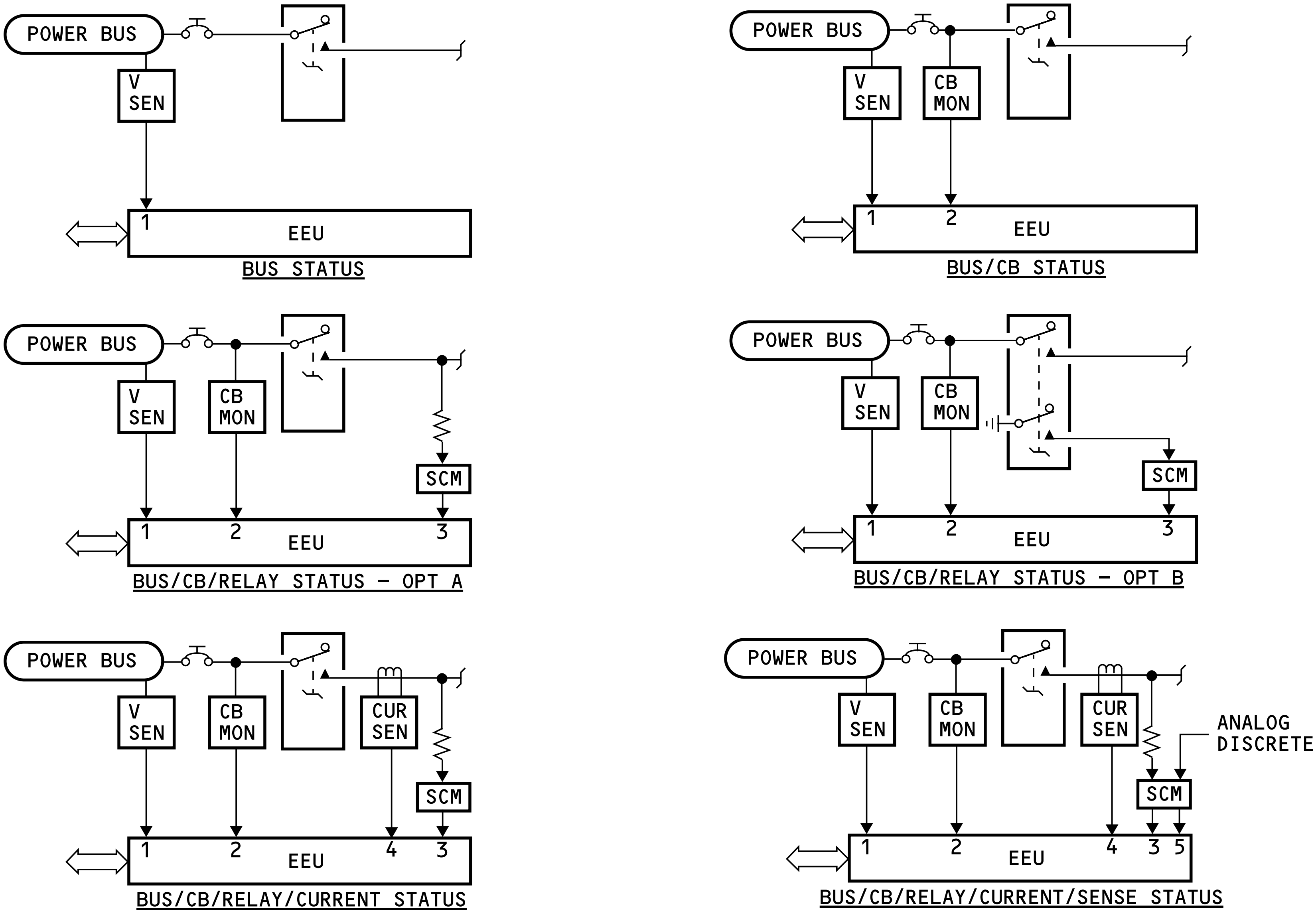
Bus/CB/Relay/Current Status

The EEUs can also monitor load current with a current sensor (CUR SEN).

Bus/CB/Relay/Current/Sense Status

In addition to the above, the EEUs can monitor load status with an analog discrete supplied by the load. The SCM makes the signal satisfactory for the EEU.

NOTE: These are examples. They only show, in increasing complexity, ways the ELMS can monitor electrical loads. The ELMS may not use some of these combinations.



ELMS - FUNCTIONAL DESCRIPTION - MONITORING

ELMS - FUNCTIONAL DESCRIPTION - LOAD SHEDDING - 1

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ELMS - FUNCTIONAL DESCRIPTION - LOAD SHEDDING - 1

General

The ELMS protects the electrical power system. It sheds (disconnects) electrical loads to keep the load levels below the power supply levels.

Power Sources

The ELMs monitors the status of these five power sources for load shed control:

- Left IDG (120 kva)
- APU generator (120 kva)
- Secondary external power (90 kva)
- Primary external power (90 kva)
- Right IDG (120 kva).

The ELMS does not monitor the backup generators for load shed control.

The GCUs and the BPCU digitally supply the ELMS with the power source status information. The ELMS also monitors the status of the power sources with hard-wired signals (configuration load shed signals). These signals come from circuits that go through the auxiliary contacts of the breakers and contactors in the power panels.

Load Shed Control

The EEUs in the P110 left power management panel and the P210 right power management panel control load shedding. P110 and P210 can shed loads independently or operate together (interpanel operation). If two power sources supply power to the airplane, the panels operate independently. If only one power source supplies power to the airplane, the panels operate together.

Independent Operation

If two power sources supply power to the airplane, P110 controls left side load shedding, and P210 controls right side load shedding. These are the loads that the ELMS can shed and the general sequence it sheds them:

- Galley loads
- Utility buses
- Equipment cooling vent fan
- Galley chillers
- Recirculation fans
- Lavatory/galley fans
- Electronic seat equipment
- Hydraulic pumps.

During independent operation, more important loads on one side can be shed while less important loads on the other side remain.

When you use external power, the ELMS reverses the load shed sequence for hydraulic pumps and electronic seat equipment.

ELMS - FUNCTIONAL DESCRIPTION - LOAD SHEDDING - 1

Interpanel Operation

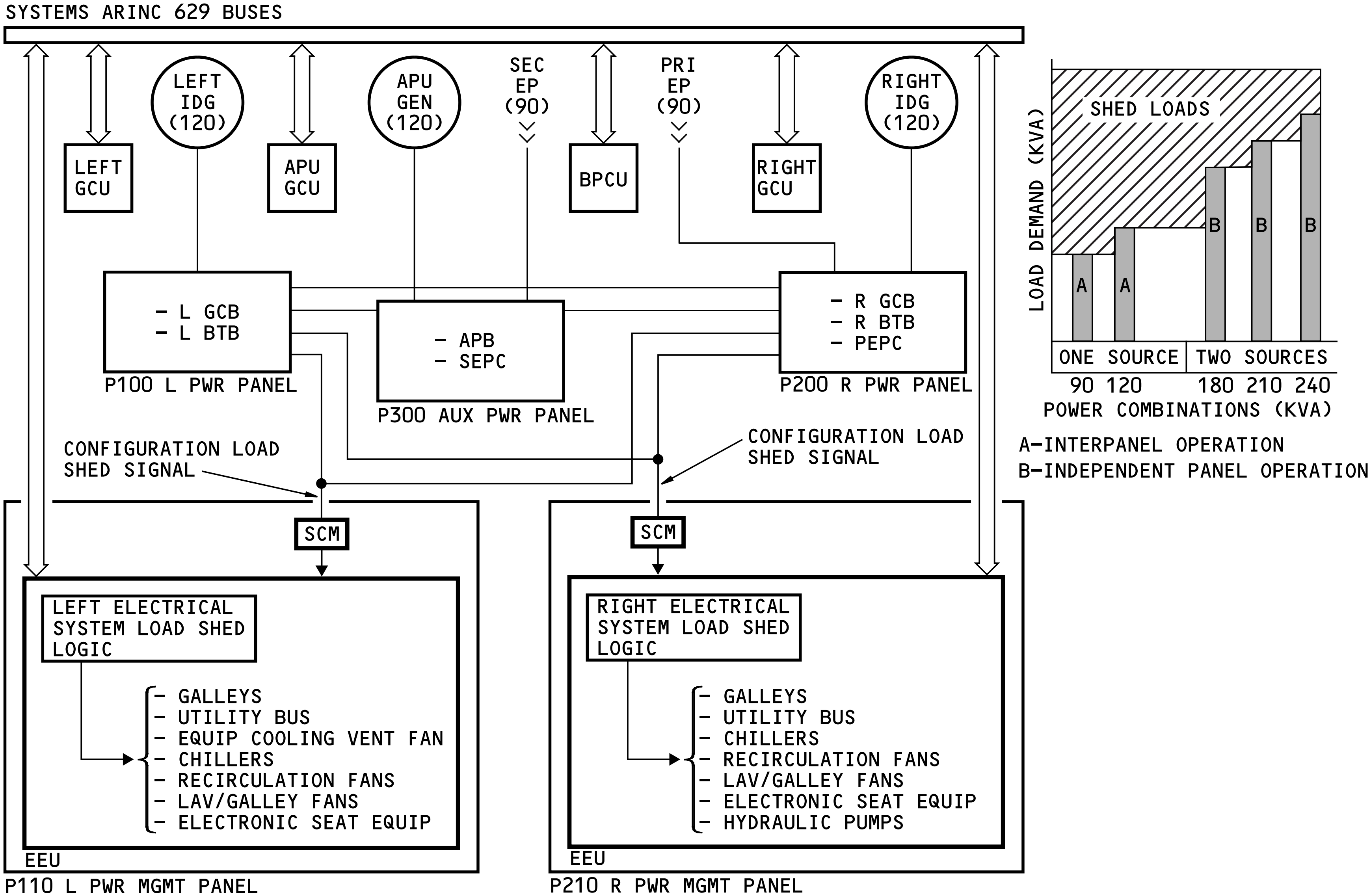
If only one power source supplies power to the airplane, P110 and P210 control load shedding together. They use a combined load shed sequence so that all the less important loads shed first and all the most important loads shed last.

Load Shed Limits

Since the power sources can supply different levels of power, there are several load shed limits. These are the conditions that define the load shed limits:

- Power source configuration
- Value of the overload
- Sustained time of the overload.

The ELMS gets load level data from the GCUs and BPCU across the systems ARINC 629 data buses.



ELMS - FUNCTIONAL DESCRIPTION - LOAD SHEDDING - 1

ELMS - FUNCTIONAL DESCRIPTION - LOAD SHEDDING - 2

Configuration Load Shed

A change in the source(s) of power for the airplane is called a change in the power source configuration. If the configuration change will result in a lower power supply capacity, the ELMS quickly sheds specified loads. This protects the new power source from overloading. The normal computer processing time does not occur fast enough to adequately do this function. Configuration load shed logic uses a hard-wired signal from the power management panel through auxiliary contacts in the BTBs, GCBs, APB, and EPCs to quickly detect a power source configuration change.

Configuration load shed logic sheds loads in groups. If the ELMS needs to shed more loads, it uses its normal computer processing.

Sequential Load Shed

If there is a large overload not due to a power source change , the ELMS sheds loads in groups like a configuration load shed.

If an overload is not large, the ELMS sheds individual loads until the electrical load demand level is below the available power supply level.

The ELMS sheds all loads on a main bus for these conditions:

- There is no power on the bus for over 2.5 seconds
- A failure of interpanel operations
- Loss of load level data from the GCUs and BPCU.

Load Restoration

After a load shed occurs, the ELMS adds loads in the reverse sequence they were shed. The ELMS continues to add loads until the electrical load demand level would exceed the available power supply level.

The ELMS staggers the starting of the hydraulic ac motor pumps.

After a configuration load shed, loads do not come back on for approximately 3 seconds.

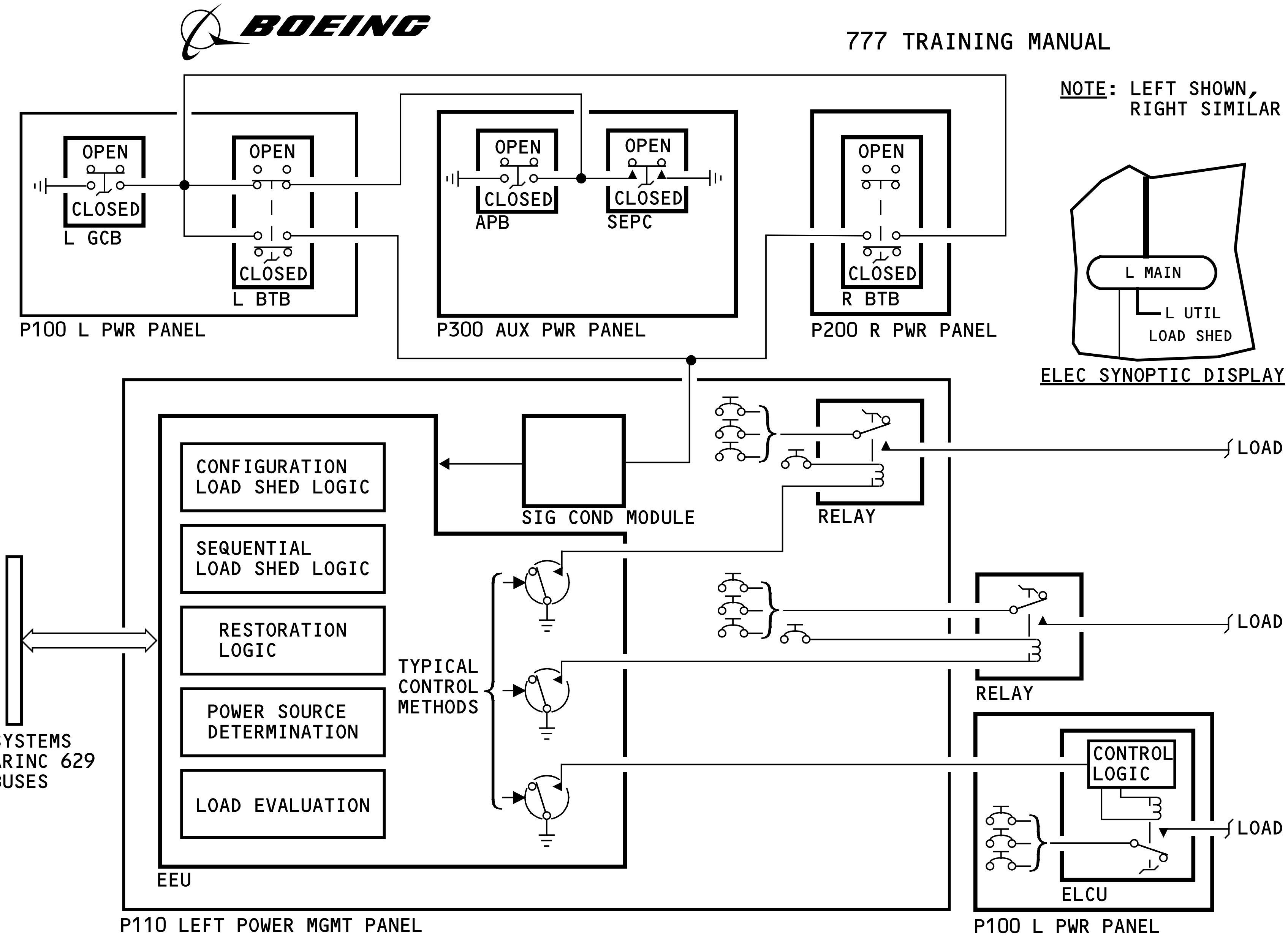
Failure of interpanel operations, prevents any load restoration.

Indication

When the ELMS does a load shed, the message LOAD SHED shows on the electrical power synoptic display below the utility bus indication for the related channel.

Training Information Point

If you use an external power source with less than a 90 kva capacity at an external power receptacle, the ELMS can possibly shed and restore all loads four times in about one minute. It then sheds all loads until you supply more power to the airplane.



ELMS - FUNCTIONAL DESCRIPTION - LOAD SHEDDING - 2

ELMS - SPECIAL FUNCTION TESTS

General

There is one special function test for each power management panel. These are the special function tests:

- Initiate P110 EU self test
- Initiate P210 EU self test
- Initiate P310 EU self test.

Initiate P110 EU Self Test

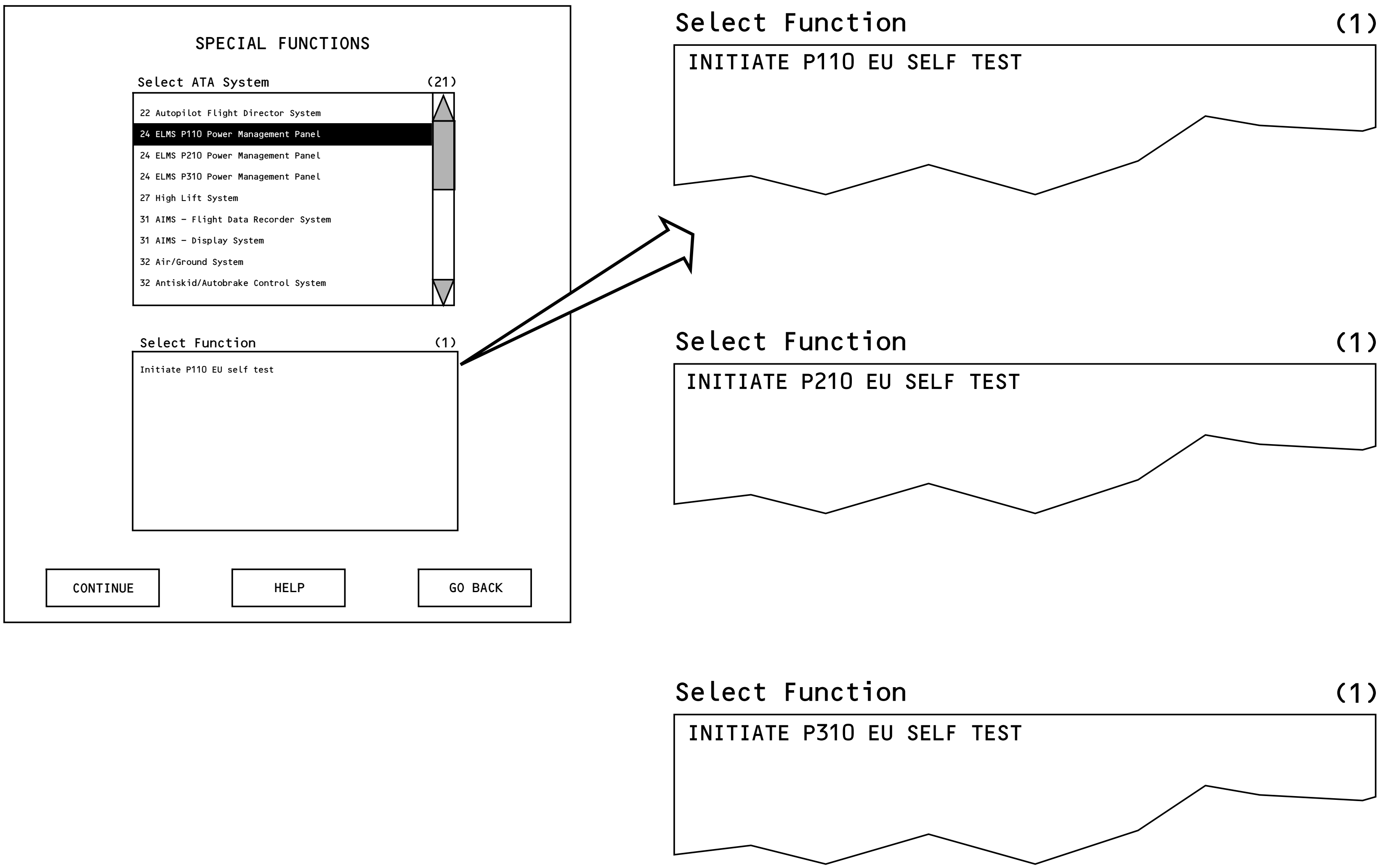
This test makes sure that all circuit cards in the P110 electronics unit operate correctly.

Initiate P210 EU Self Test

This test makes sure that all circuit cards in the P210 electronics unit operate correctly.

Initiate P310 EU Self Test

This test makes sure that all circuit cards in the P310 electronics unit operate correctly.



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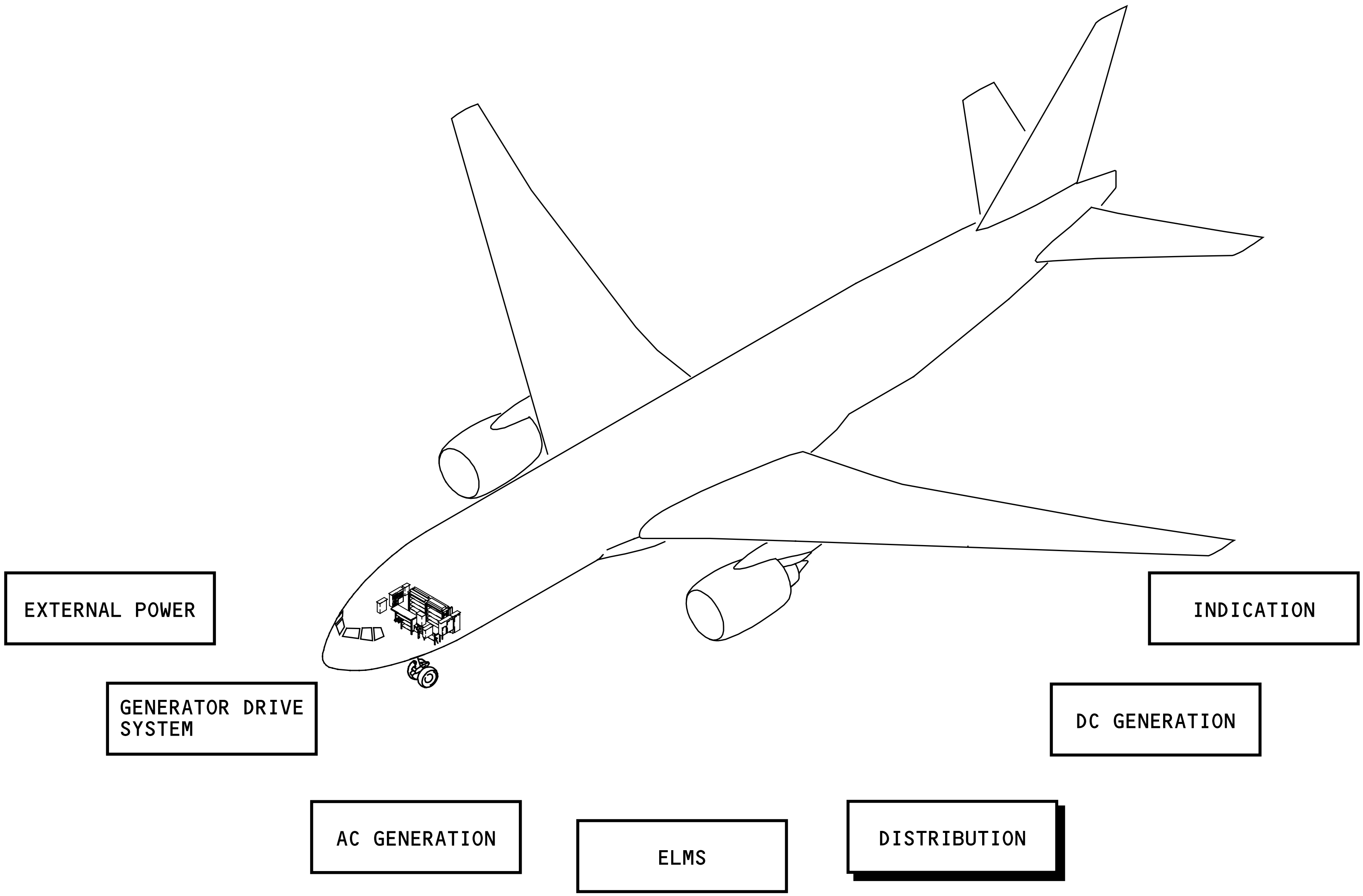
ELMS - SPECIAL FUNCTION TESTS

AC DISTRIBUTION - INTRODUCTION

General

The distribution section of electrical power includes both ac and dc power distribution.



AC DISTRIBUTION - INTRODUCTION

AC DISTRIBUTION - GENERAL DESCRIPTION

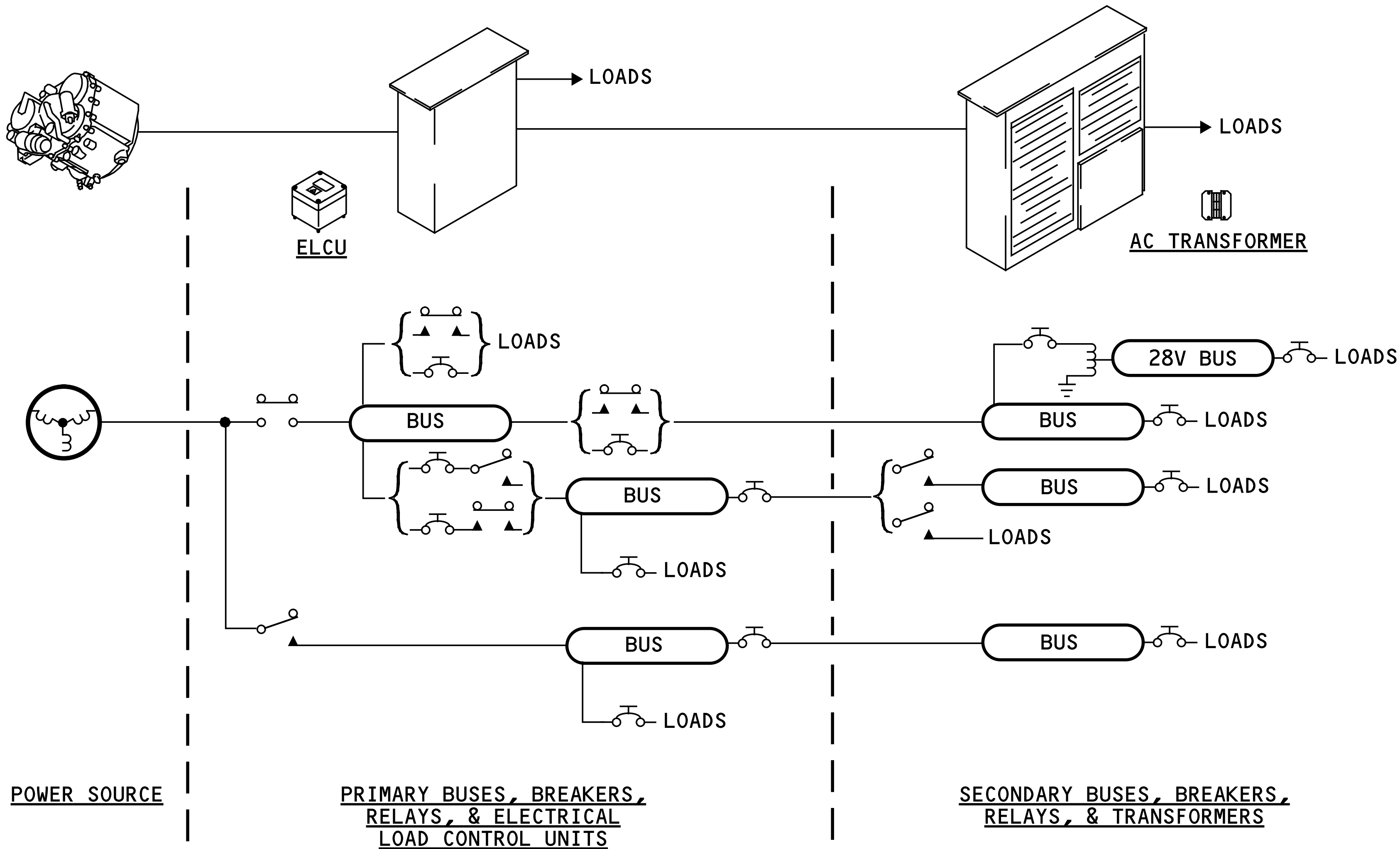
General

The ac distribution system divides the electrical power ac buses into sections. This permits better control over small groups of electrical loads. It also protects against a severe loss of power due to a single electrical power failure.

These are the only components in the ac distribution system:

- Electrical load control units (ELCU)
- 28v ac transformers.

A primary function of the ac distribution system is autoland bus isolation.



24-50-00-002 Rev 1

AC DISTRIBUTION - GENERAL DESCRIPTION

AC DISTRIBUTION - ELECTRICAL LOAD CONTROL UNIT

General

The ELCUs control and protect the electrical power supplied to large ac loads. There are several ELCUs in the P100 and P200 power panels.

Physical Description

The ELCUs are LRMs of the ELMS power panels. The ELCUs contain these parts:

- Current transformers
- Contactor
- Power supply
- Control logic.

The ELCUs are ESDS components because of the wiring connections to the control logic.

Control

The ELCUs use these things to control their contactors:

- Current transformers
- Rating jumper
- Input command.

The ELCU current transformers supply signals to the control logic for overcurrent and differential fault protection. The load current transformer signal supplies the second current signal necessary for differential fault protection. The control logic does not use the differential fault protection function if there is no load current transformer connected to the ELCU.

A rating jumper (external wiring) across pins of galley ELCU power panel wiring connectors sets the current capacity of the ELCUs.

A control signal to the ELCU causes it to open or close. The control signal comes from the ELMS or other airplane systems.

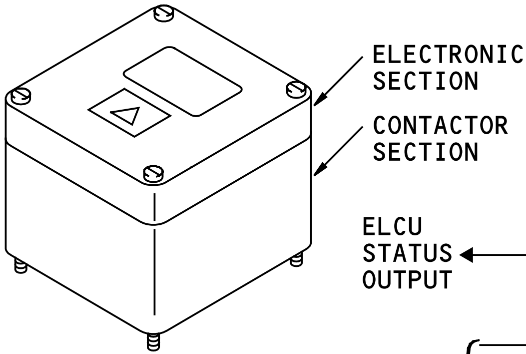
Operation

The ELCU contactor connects ac power to the load when the control inputs satisfy the control logic.

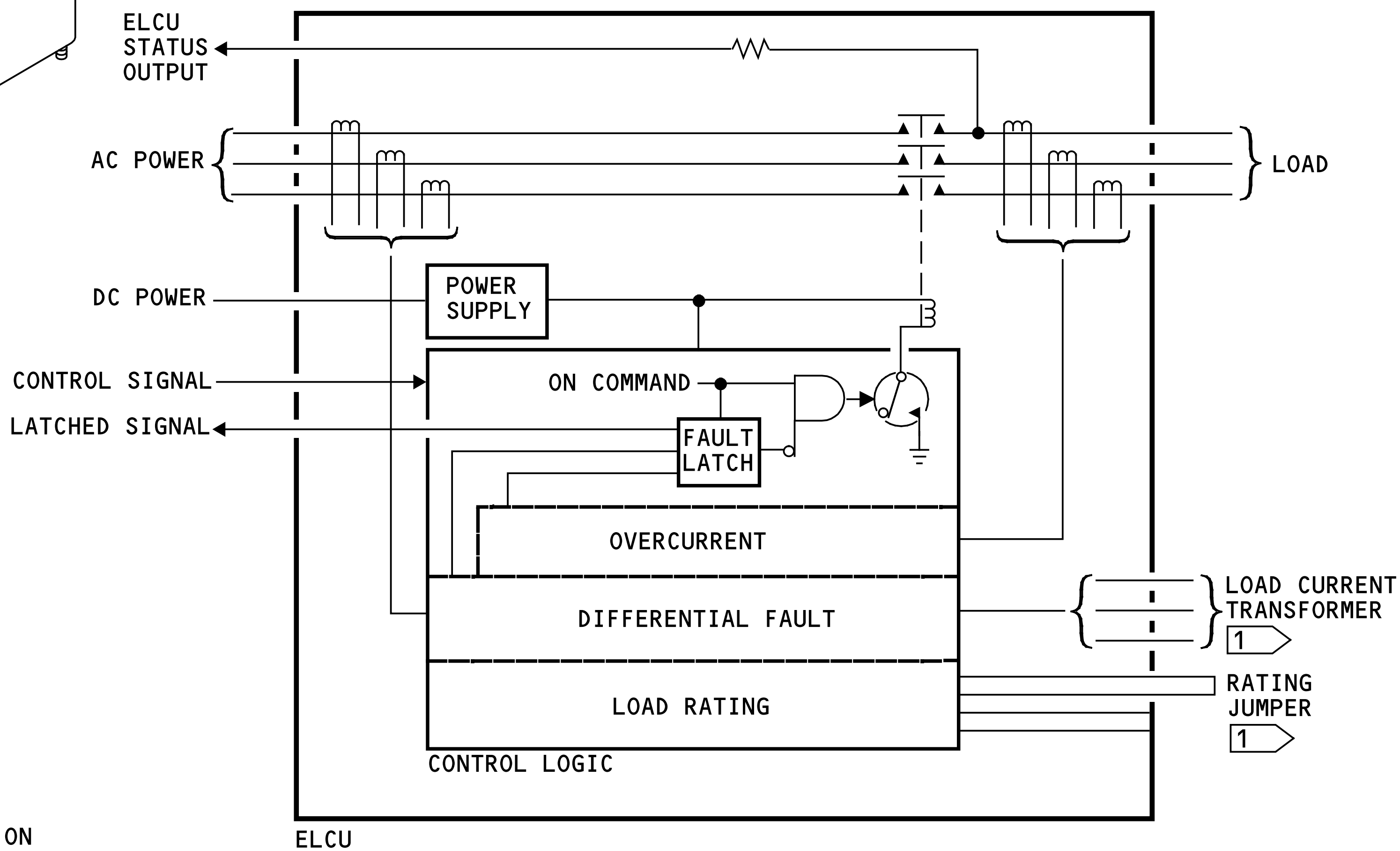
When the ELCU closes, a voltage signal goes to the ELMS for ELCU status monitoring. If the ELCU opens due to a fault, it latches open and sends a latched open signal to the ELMS. The ELCU is reset when the control signal goes off and then back on or when you remove dc power to the ELCU.

Training Information Point

Each ELCU is a two-piece unit. Do not disassemble it. The mounting screws are captive, but can be unscrewed from the ELCU housing. With the screws removed the electronic section can move apart from the contactor section for shop repair.



ELCU



1 NOT USED ON ALL ELCUS

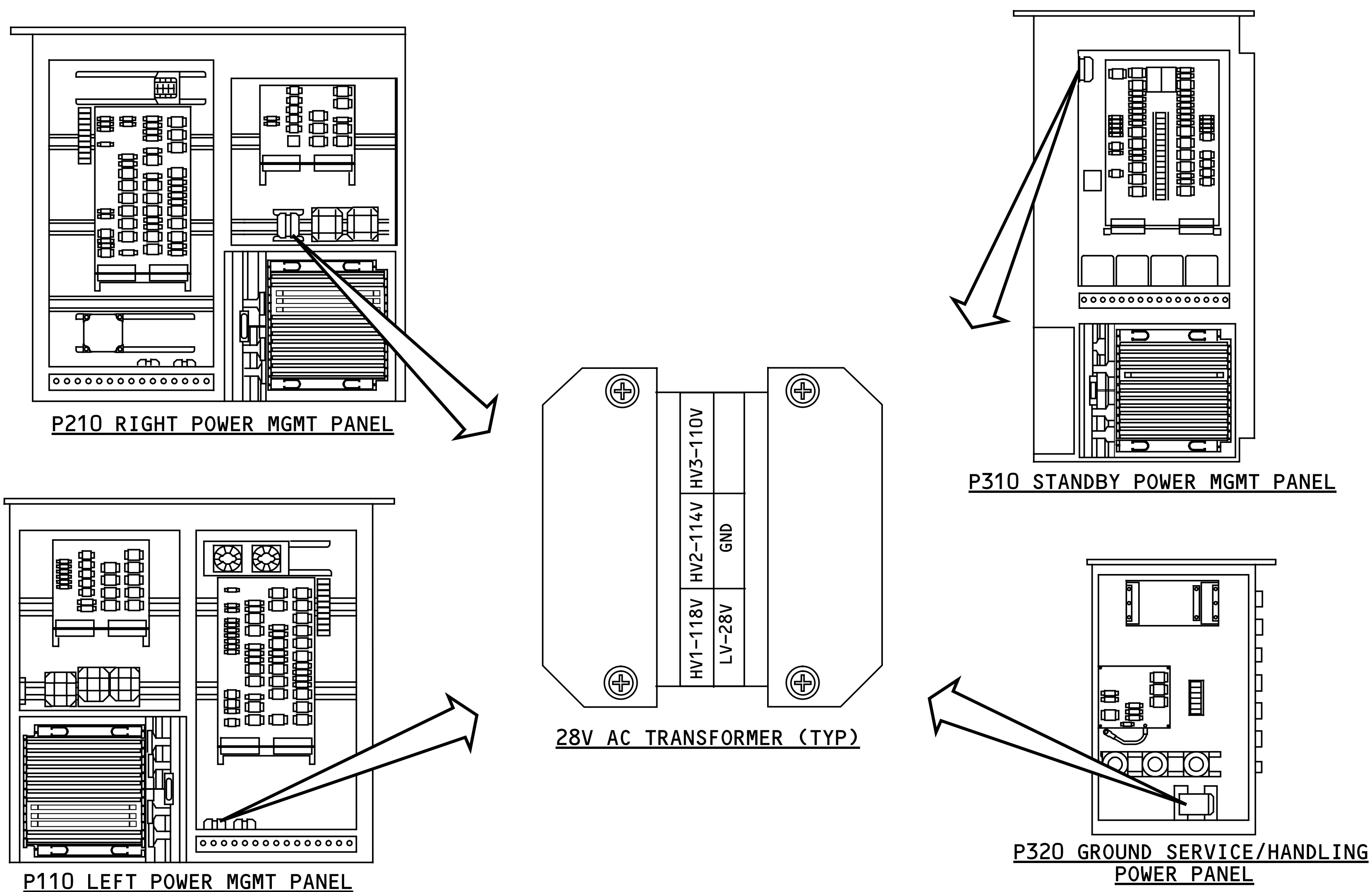
AC DISTRIBUTION - ELECTRICAL LOAD CONTROL UNIT

AC DISTRIBUTION - 28V AC TRANSFORMERS

General

The 28v ac transformers convert 115v ac power into 28v ac power. There are four transformers. They are in the ELMS power management panels and ground service/ handling power panel. These are typical loads for the 28v ac power:

- Signal conditioning card power supply
- Resolver excitation
- Sensor excitation
- Service lights.



24-50-00-004 Rev 1

AC DISTRIBUTION - 28V AC TRANSFORMERS

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AC DISTRIBUTION - FUNCTIONAL DESCRIPTION - POWER DISTRIBUTION

General

The ac distribution divides the electrical power buses into sections. The primary buses are in the ELMS power panels P100, P200, and P300. These are the primary buses of the electrical power ac system:

- Left main ac
- Left transfer
- Right main ac
- Right transfer
- Ground handling ac
- Ground service.

Left Main AC Bus

The left main ac bus divides into these buses:

- Left transfer
- Left utility
- Left section 1
- Left section 2.

The left section 1 bus supplies power to an ac transformer for the left 28v ac bus. The left section 2 bus is a P11 power source.

Left Transfer Bus

The left transfer bus divides into these:

- P11 supply
- Left transfer distribution bus
- Standby ac bus.

The standby ac bus supplies power to an ac transformer for the 28v ac standby bus.

Right Main AC Bus

The right main ac bus divides into these buses:

- Right transfer
- Right utility
- Right section 1
- Right section 2.

The right section 1 bus supplies power to an ac transformer for the right 28v ac bus. The right section 2 bus is a P11 power source.

Right Transfer Bus

The right transfer bus divides into these:

- P11 supply
- Right transfer distribution bus.

Ground Handling AC Bus

The ground handling ac bus supplies power to the ground handling distribution bus.

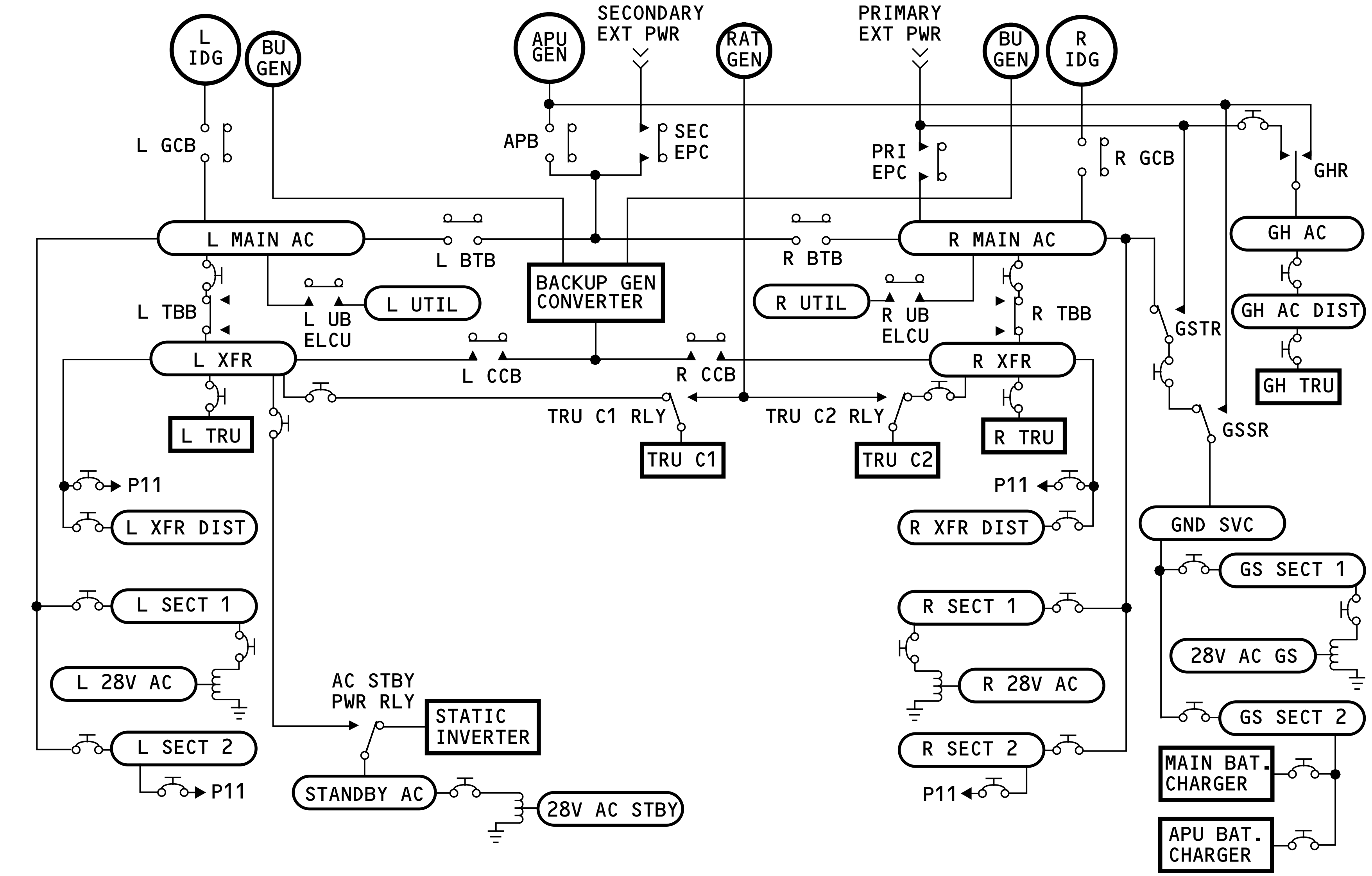
Ground Service Bus

The ground service bus divides into these buses:

AC DISTRIBUTION - FUNCTIONAL DESCRIPTION - POWER DISTRIBUTION

- Ground service section 1
- Ground service section 2.

The ground service section 1 bus supplies power to an ac transformer for the 28v ac ground service bus.



AC DISTRIBUTION - FUNCTIONAL DESCRIPTION - POWER DISTRIBUTION

AC DISTRIBUTION - FUNCTIONAL DESCRIPTION - AUTOLAND BUS ISOLATION INTERFACES

General

Autoland is an automatic flight director system (AFDS) mode. In this mode, the AFDS automatically lands the airplane.

During autoland, the electrical system divides into three different channels (bus isolation). This is to ensure that a single electrical power problem does not endanger the automatic landing.

Bus Isolation Process

The automatic flight director computers (AFDC) get an autoland request from pilot input. They send a bus isolation request signal on the systems ARINC 629 buses to these electrical power system components:

- ELMS
- BU generator converter
- GCUs.

Under normal conditions, the ELMS and the B/U generator converter divide the electrical system. The ELMS operates these components:

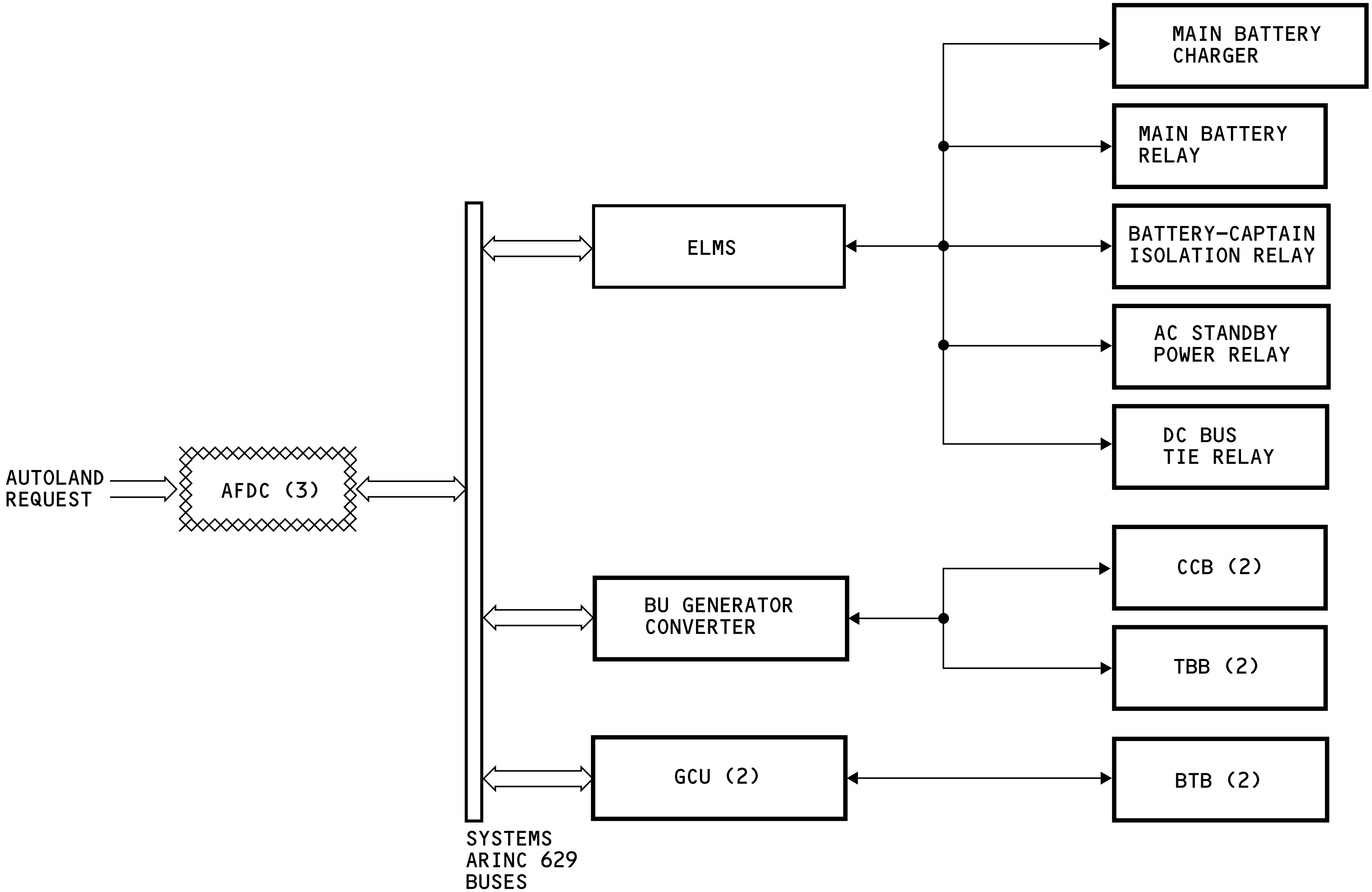
- Main battery charger
- Main battery relay
- Battery-captain isolation relay
- AC standby power relay
- DC bus tie relay.

The B/U generator converter operates the CCBs and TBBs.

When the bus isolation is complete, the B/U converter and the ELMS send autoland confirm signals to the AFDCs.

If the electrical power system is in a non-normal configuration before an autoland, other power configurations support the bus isolation. The GCUs then control part of the bus isolation.

If the electrical system cannot divide to support an autoland, the electrical control components send cannot-support-autoland signals to the AFDCs. The primary display system then shows a NO LAND 3 advisory message.



24-50-00-006 Rev 1

AC DISTRIBUTION - FUNCTIONAL DESCRIPTION - AUTOLAND BUS ISOLATION INTERFACES

AC DISTRIBUTION - FUNCTIONAL DESCRIPTION - NORMAL AUTOLAND BUS ISOLATION

General

When the electrical power system receives a bus isolation request signal from the AFDS, it divides into three different channels. This is to supply power to critical autoland components from different power sources. For normal autoland operations, these are the power sources for the three electrical power channels:

- Left IDG
- Right B/U generator
- Right IDG.

B/U Generator Converter Control

The B/U generator converter closes the right CCB to perform a no-break power transfer between the right B/U generator and the right transfer bus. The converter then opens the right TBB. The converter also prevents any operation of the left TBB and left CCB during autoland.

ELMS Control

The ELMS does these operations:

- Sends a signal to put the main battery charger into a TRU mode
- Closes the main battery relay
- Opens the battery-captain isolation relay
- De-energizes the ac standby power relay to connect the standby ac bus to the static inverter
- Prevents operation of the dc bus tie relay.

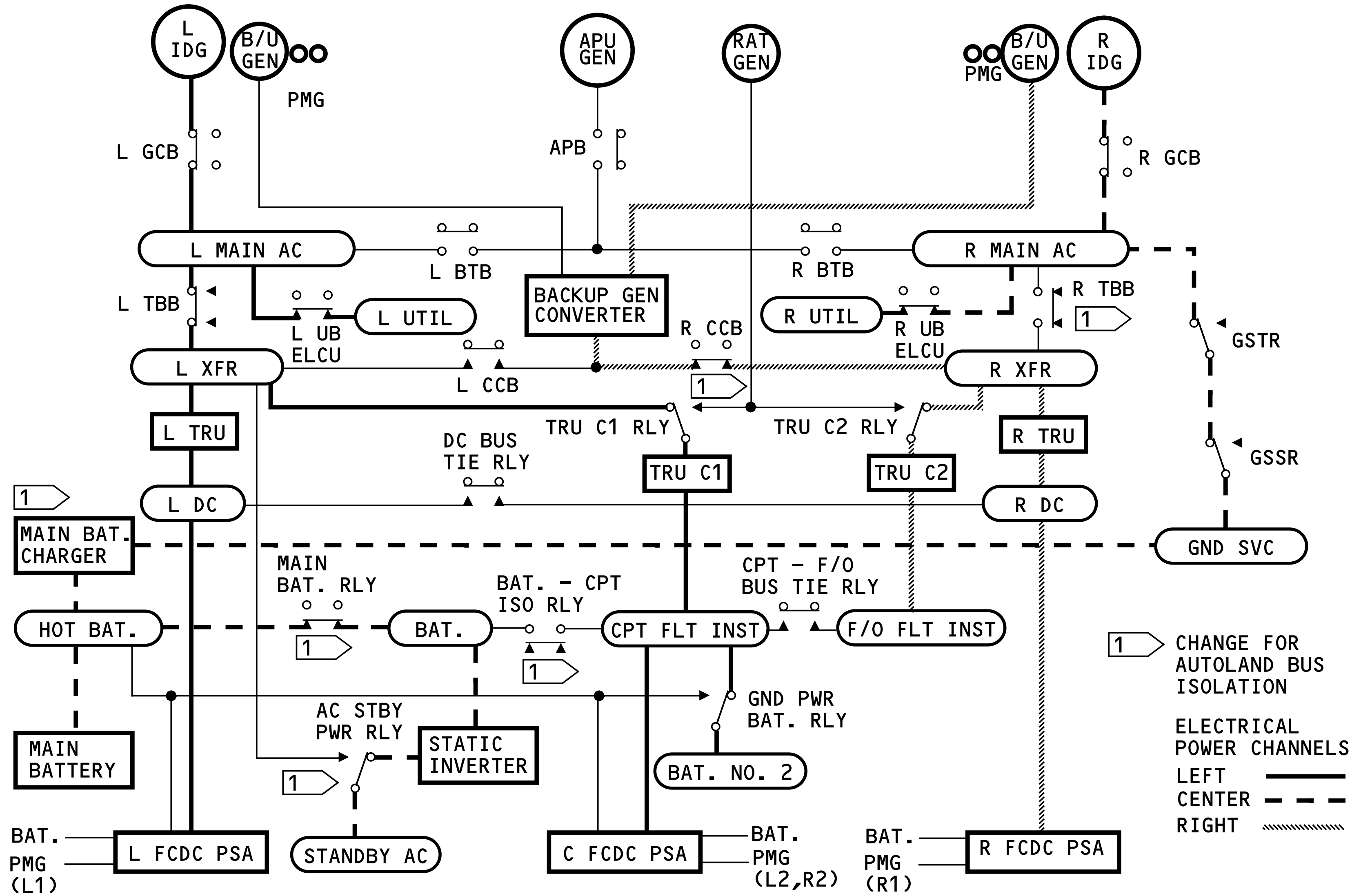
Autoland Components

There are three sets of critical autoland components; left, center, and right. These are the components in each set and their power requirements:

- Instrument landing system (ILS) (115v ac)
- Radio altimeter (115v ac)
- AFDC (28v dc)
- ILS antenna switch (28v dc).

During autoland bus isolation, the left set gets power from the left transfer bus and the left dc bus. The center gets power from the standby ac bus and the battery bus. The right set gets power from the right transfer bus and the right dc bus.

For more details on autoland, go to chapter 22.



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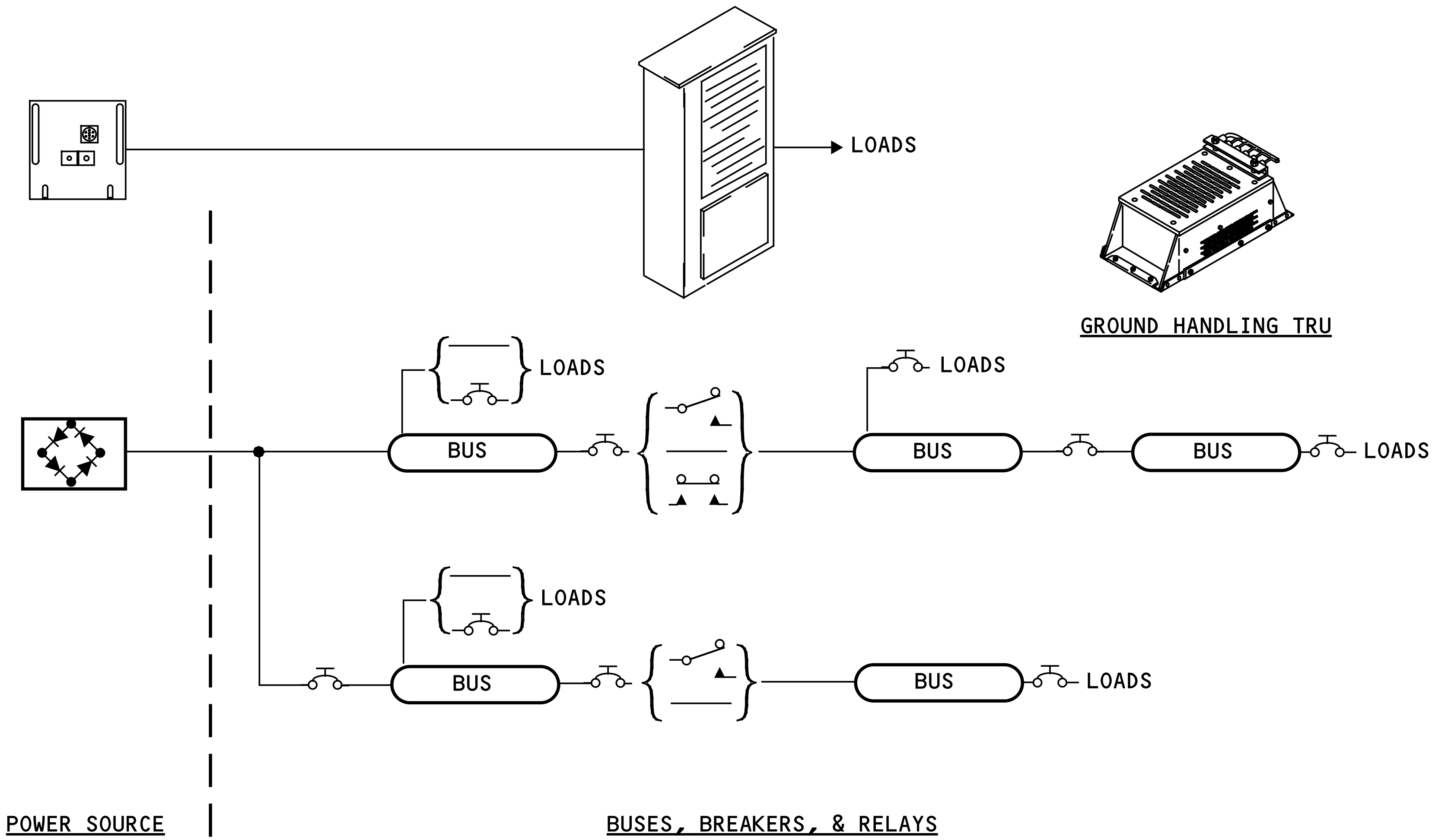
AC DISTRIBUTION - FUNCTIONAL DESCRIPTION - NORMAL AUTOLAND BUS ISOLATION

DC DISTRIBUTION - GENERAL DESCRIPTION

General

The dc distribution system divides the electrical power dc buses into sections. This permits better control over small groups of electrical loads. It also protects against a severe loss of power due to a single electrical power failure.

The ground handling TRU is the only component in the dc distribution system.



24-60-00-001 Rev 1

DC DISTRIBUTION - GENERAL DESCRIPTION

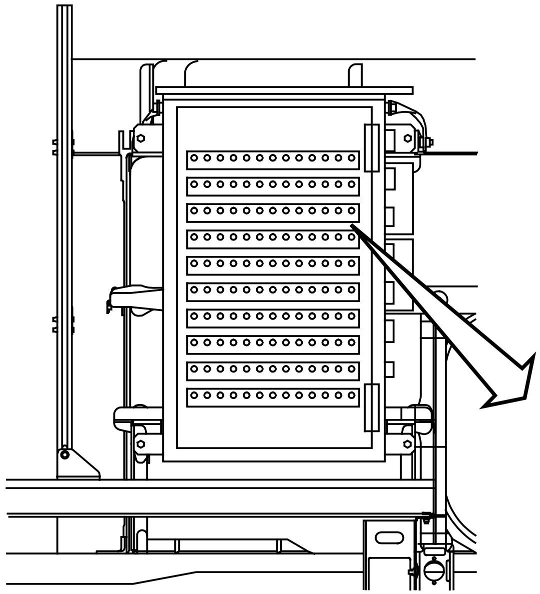
DC DISTRIBUTION - GROUND HANDLING TRU

General

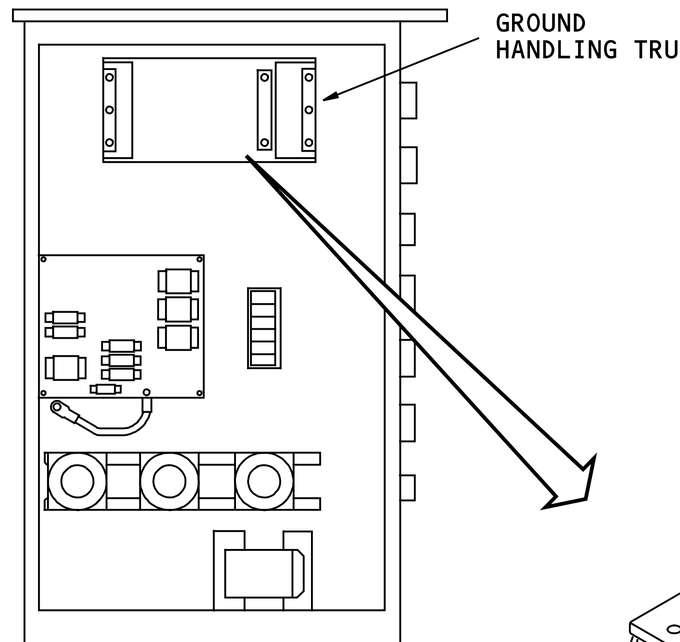
The ground handling TRU is in the P320 ground service/ handling power panel. It converts ac power into 28v dc power. These are typical loads for the ground handling 28v dc power:

- Cargo handling
- Refuel valves
- Refuel quantity control/indication
- Service interphone
- Powered door opening system (engine cowls).

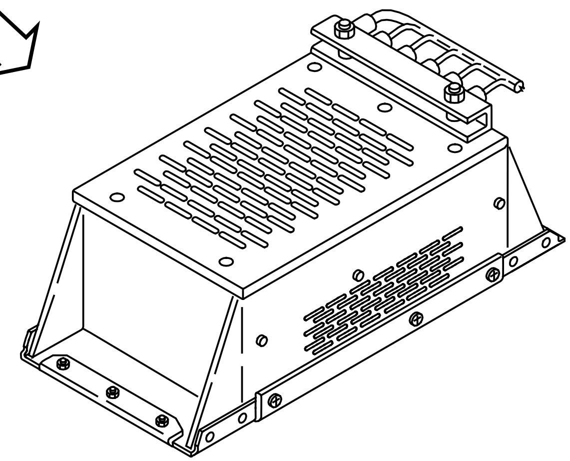
24-60-00-002 Rev 1 12/18/1995



(LOOKING FORWARD)



P320 GROUND SERVICE/HANDLING
POWER PANEL



GROUND HANDLING TRU

24-60-00-002 Rev 1

DC DISTRIBUTION - GROUND HANDLING TRU

DC DISTRIBUTION - FUNCTIONAL DESCRIPTION - POWER DISTRIBUTION

General

The dc distribution divides the electrical power dc buses into sections. The primary buses are in the ELMS power management panels P110, P210, and P310. These are the primary buses of the electrical power dc system:

- Hot battery
- Left dc
- Right dc
- Captain's flight instrument
- First officer's flight instrument.

The ground handling bus is in the P320 ground service/handling power panel. The APU battery bus is in the P49 APU panel.

Hot Battery Bus

The hot battery bus divides into these:

- P11 supply
- Hot battery distribution bus.

Left and Right DC Buses

The left and right dc buses do not divide. They do supply power to P11.

Captain's Flight Instrument Bus

The captain's flight instrument bus divides into these buses:

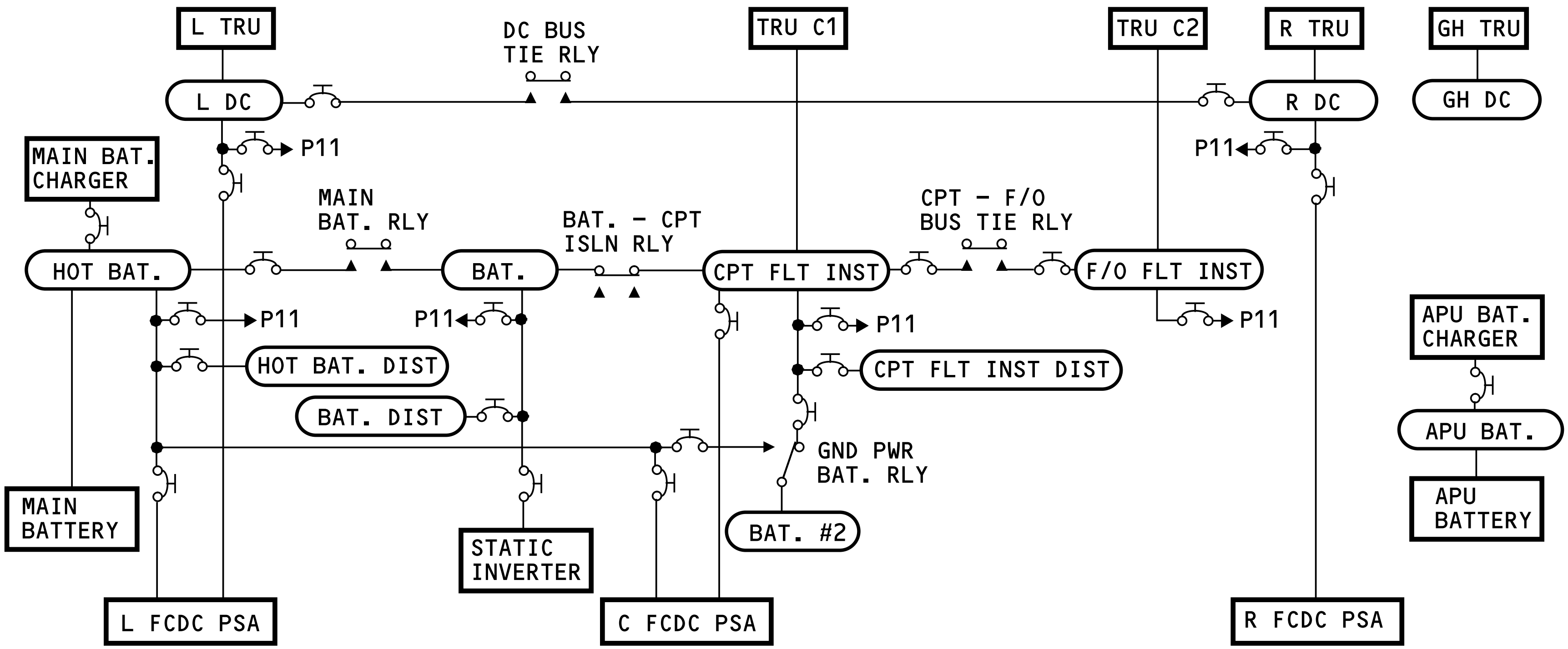
- Battery bus
- P11 supply
- Captain's flight instrument distribution bus
- Battery #2 bus.

The battery bus further divides into these:

- P11 supply
- Battery distribution bus.

First Officer's Flight Instrument Bus

The first officer's flight instrument bus does not divide. It does supply power to the P11.



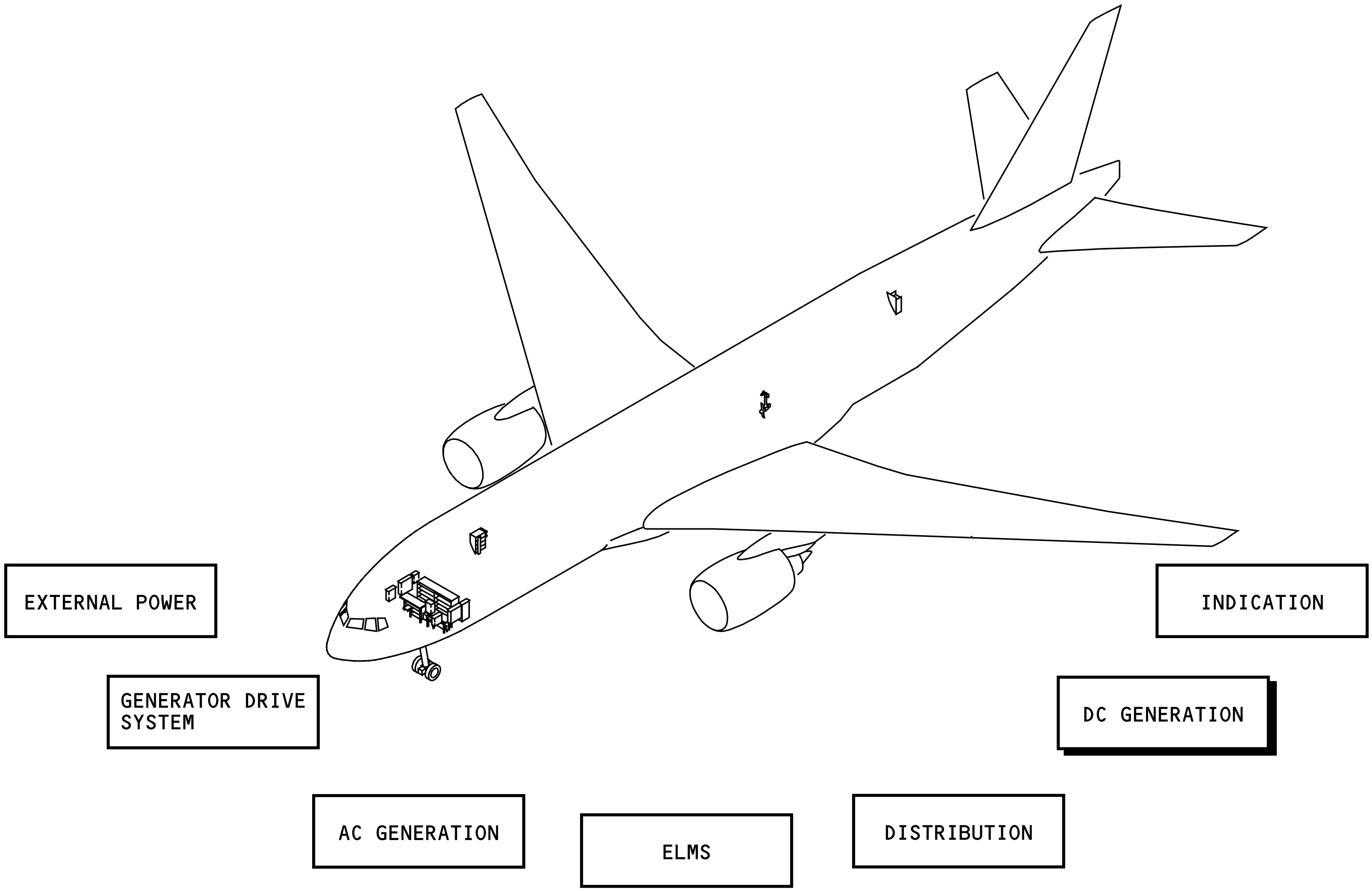
24-60-00-003 Rev 1 04/10/1997

DC DISTRIBUTION – FUNCTIONAL DESCRIPTION – POWER DISTRIBUTION

DC GENERATION - INTRODUCTION

General

The dc generation system changes ac power from the generators into dc power. It supplies power for dc loads and to charge the batteries. The batteries are an alternative power source for some loads when the generators do not operate.



DC GENERATION - INTRODUCTION

DC GENERATION - SUBSYSTEMS INTRODUCTION

General

The dc power system has these subsystems:

- Transformer rectifier units (TRUs)
- Batteries
- Standby power
- Flight controls dc (FCDC) power.

Transformer Rectifier Units (TRUs)

TRUs change ac power to dc power. There are four TRUs in the dc power system:

- Left
- Center 1 (C1)
- Center 2 (C2)
- Right.

Batteries

Batteries supply dc power to loads that require power when no ac power source is available.

Standby Power

Standby power supplies ac power and dc power to important systems when all normal ac power is lost. The RAT generator and the main battery are the sources of standby power.

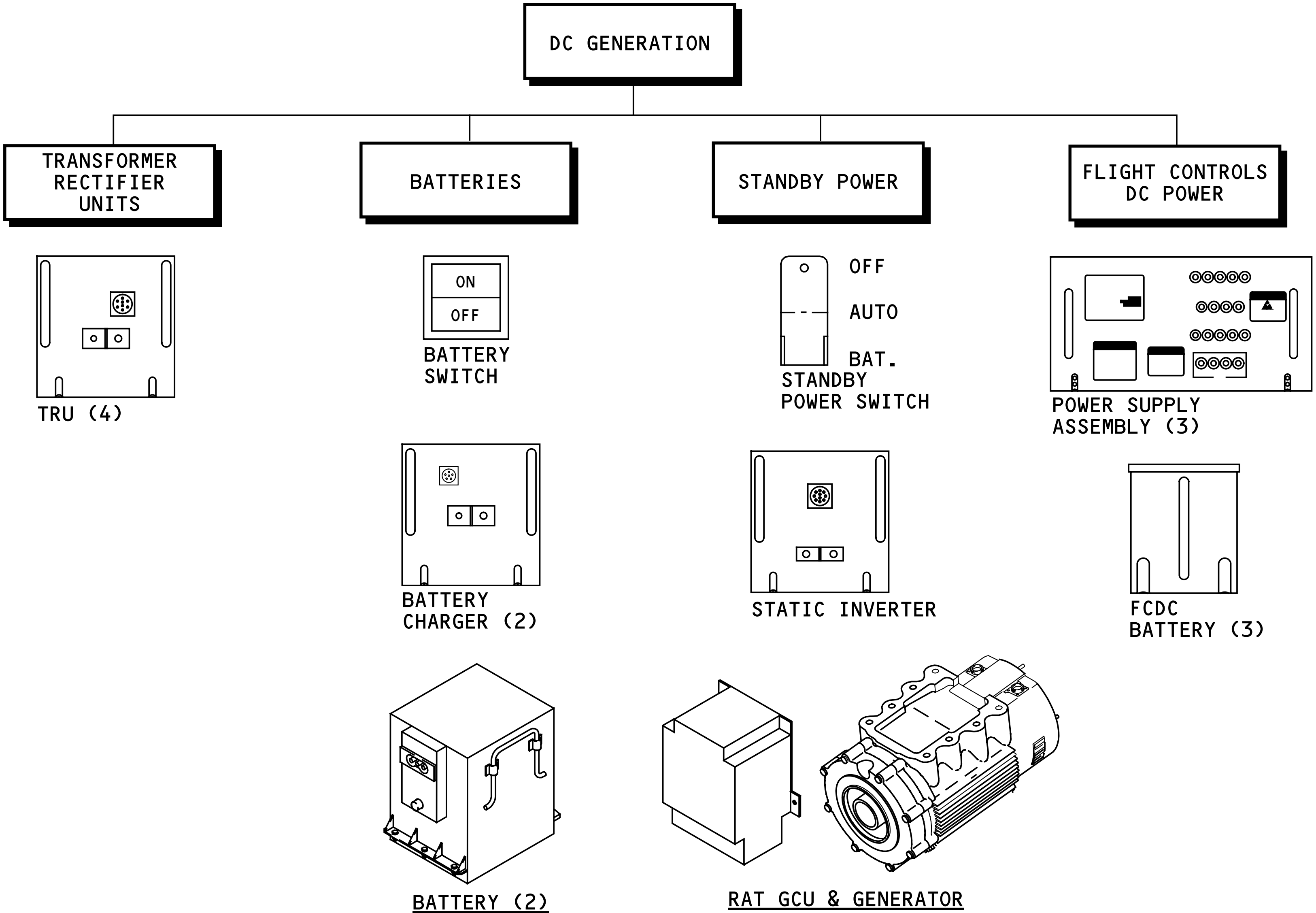
TRUs change the RAT ac power to dc power. The static inverter changes dc power to ac power.

Flight Controls DC (FCDC) Power

Power supply assemblies (PSAs) supply power to the flight controls system. The related FCDC battery protects the PSA from power interruptions during power transfers.

Training Information Point

The external power system also has a TRU. The ground handling TRU supplies power to the ground handling bus. See the external power system section for more information (AMM PART I 24-40).



DC GENERATION - SUBSYSTEMS INTRODUCTION

24-30-00-002 Rev 8 05/16/95

DC GENERATION - COMPONENT LOCATIONS - FORWARD MEC

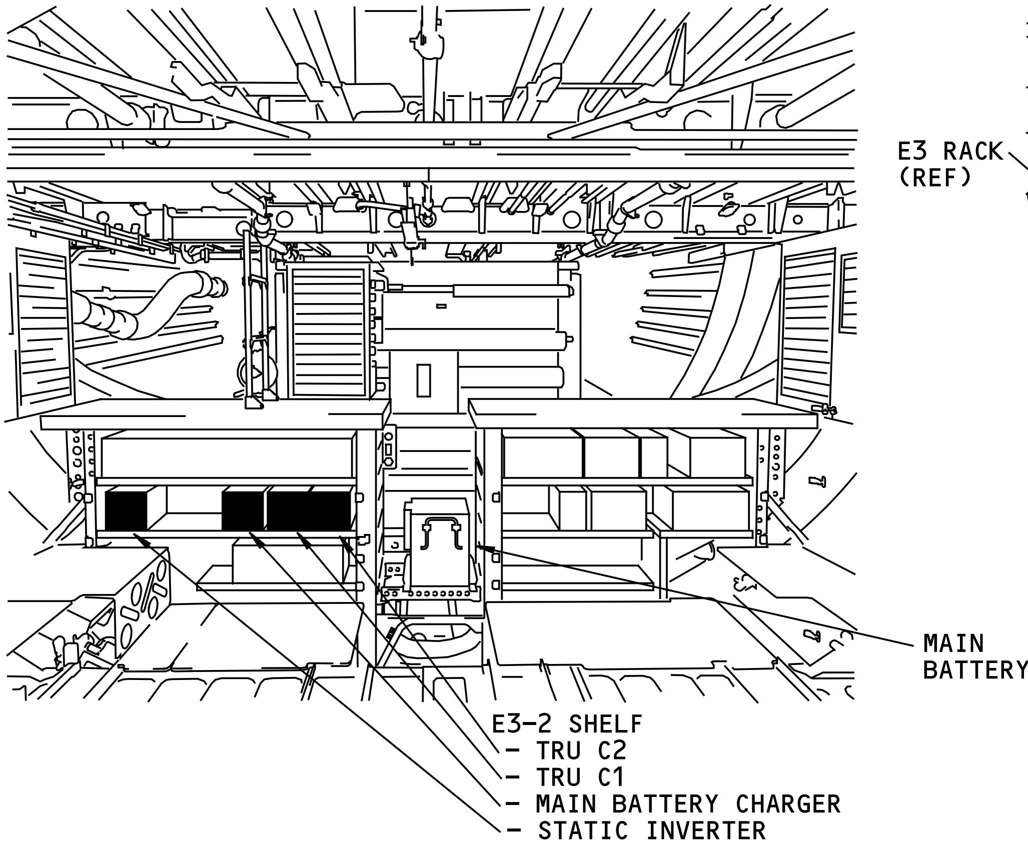
E3 Rack

These components are in the E3-2 shelf of the MEC:

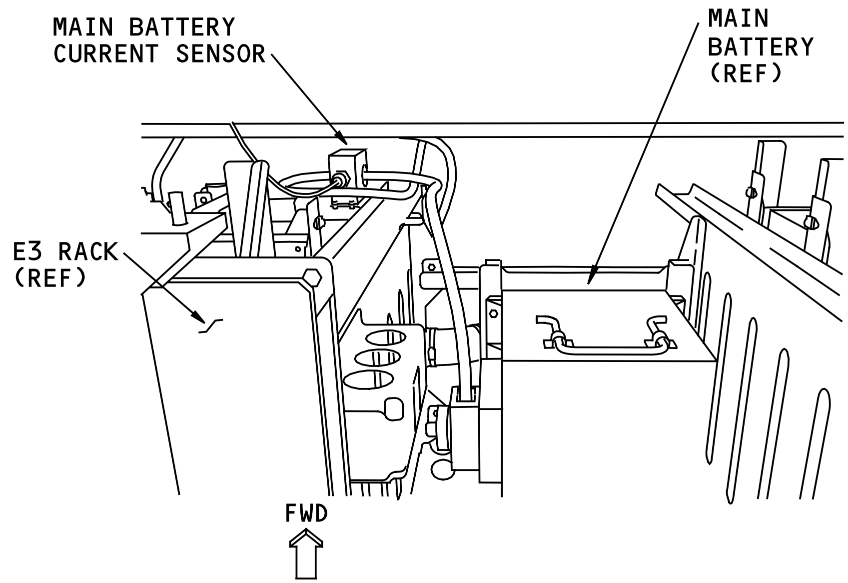
- TRU C2
- TRU C1
- Main battery charger
- Static inverter.

Main Battery Equipment

The main battery is on the floor between the E3 and the E4 racks. The main battery current sensor is forward of the right side of the E3 rack.



MAIN EQUIPMENT CENTER
(LOOKING FORWARD)



MAIN EQUIPMENT CENTER
(LOOKING DOWN)

DC GENERATION - COMPONENT LOCATIONS - FORWARD MEC

DC GENERATION - COMPONENT LOCATIONS - AFT MEC

Right Power Management Panel

The DC tie relay is in the P210 power management panel.

E2 Rack

The right TRU is on the E2-2 shelf. The center FCDC battery is on the E2-5 shelf. The center PSA is on the E2-6 shelf.

E1 Rack

The left TRU is on the E1-1 shelf. The left FCDC battery and the left PSA are on the E1-6 shelf.

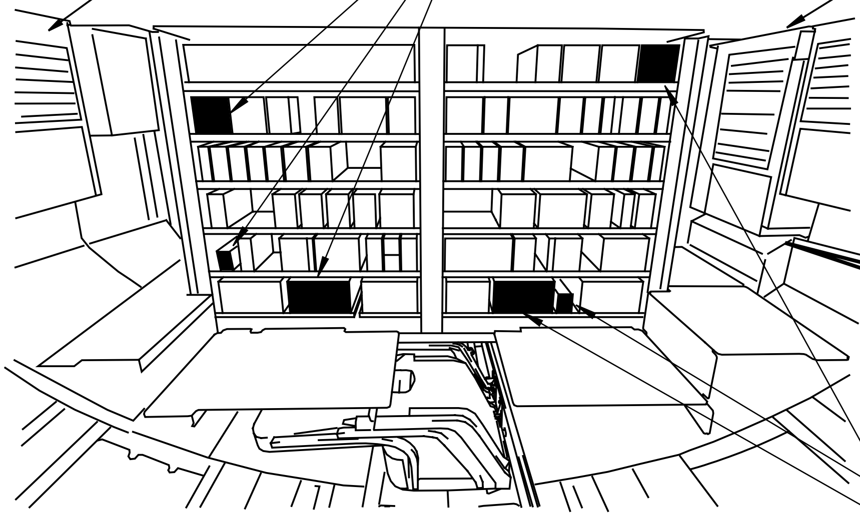
Standby Power Management Panel

These relays are in the P310 standby power management panel:

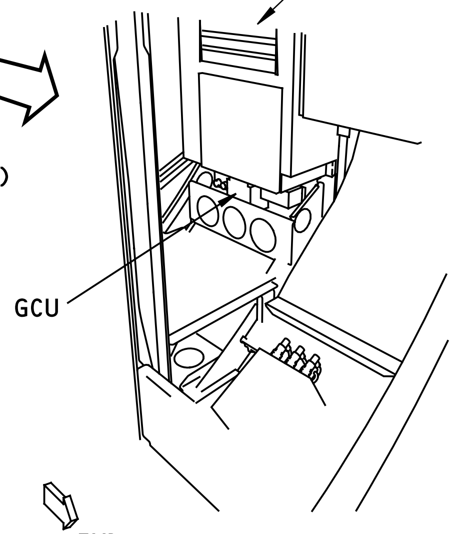
- TRU C1 relay
- TRU C2 relay
- Capt-F/O bus tie relay
- Main battery relay
- Bat-capt isolation relay
- Ground power relay
- AC standby control relay
- AC standby power relay
- RAT deploy relay.

RAT GCU

The RAT GCU is below the P310 standby power management panel.



<u>MAIN EQUIPMENT CENTER</u>
(LOOKING AFT)



24-30-00-004 Rev 2 04/15/1997

DC GENERATION - COMPONENT LOCATIONS - AFT MEC

DC GENERATION - COMPONENT LOCATIONS - CARGO COMPARTMENT RACKS

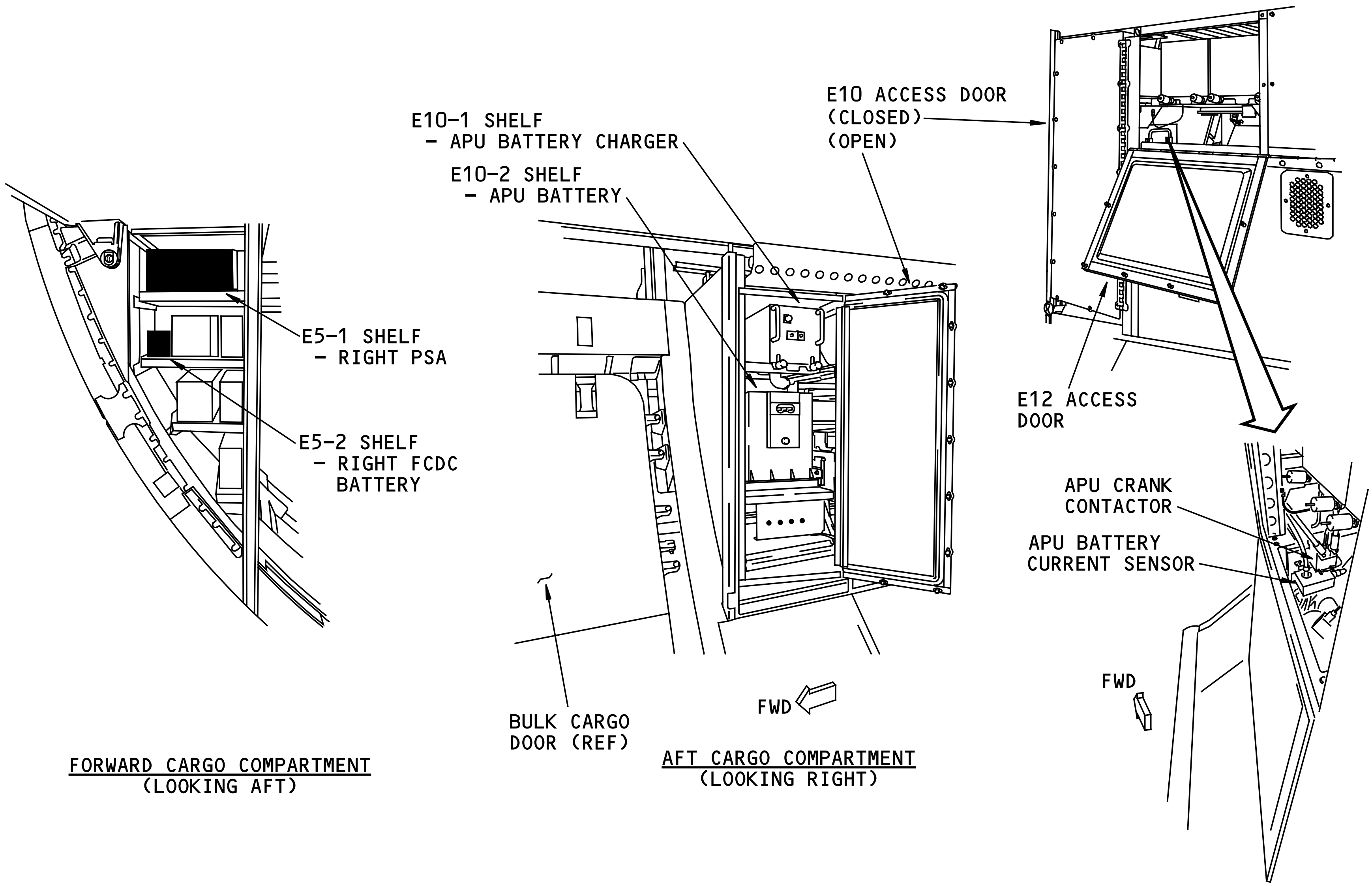
E5 RACK

The right PSA is on the E5-1 shelf. The right FCDC battery is on the E5-2 shelf.

E10 RACK

The APU battery charger is on the E10-1 shelf. The APU battery is on the E10-2 shelf.

The APU crank contactor and the APU battery current sensor attach to the aft side of the E10-2 shelf. But, you gain access to these components through the E12 access door.



24-30-00-005 Rev 4 04/15/1997

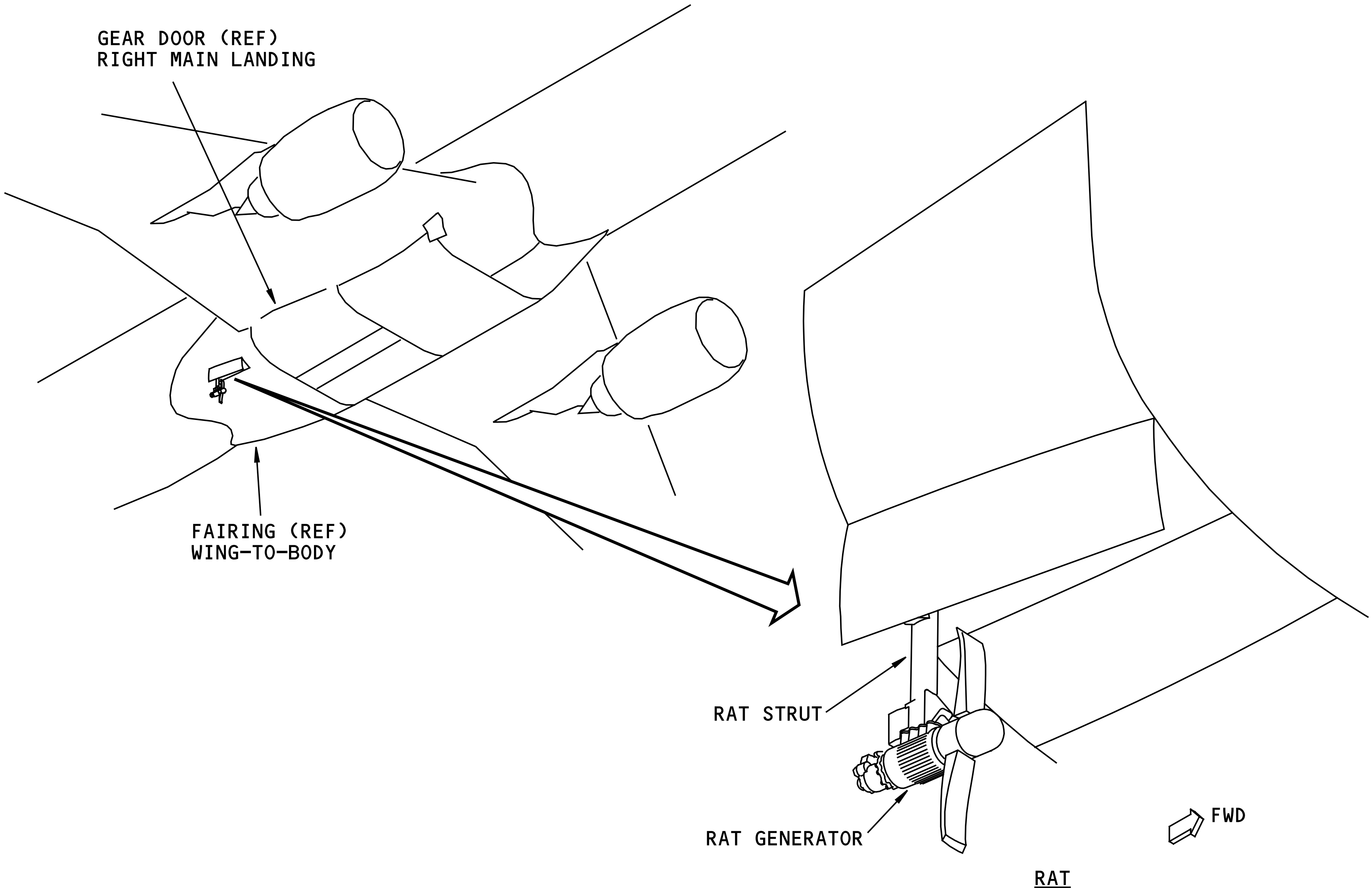
DC GENERATION - COMPONENT LOCATIONS - CARGO COMPARTMENT RACKS

DC GENERATION - COMPONENT LOCATIONS - RAT

Component Locations

The RAT is in the wing-to-body fairing aft of the right main landing gear door. The RAT generator attaches to the RAT strut.

See the ac generation section for more information about the RAT (AMM PART I 24-20).



DC GENERATION - COMPONENT LOCATIONS - RAT

TRU - GENERAL DESCRIPTION

General

Four TRUs change 115v ac power into 28v dc power to supply the main dc buses. The TRUs normally get power from the transfer buses. If the transfer buses have no power, the RAT generator supplies power to the two center TRUs.

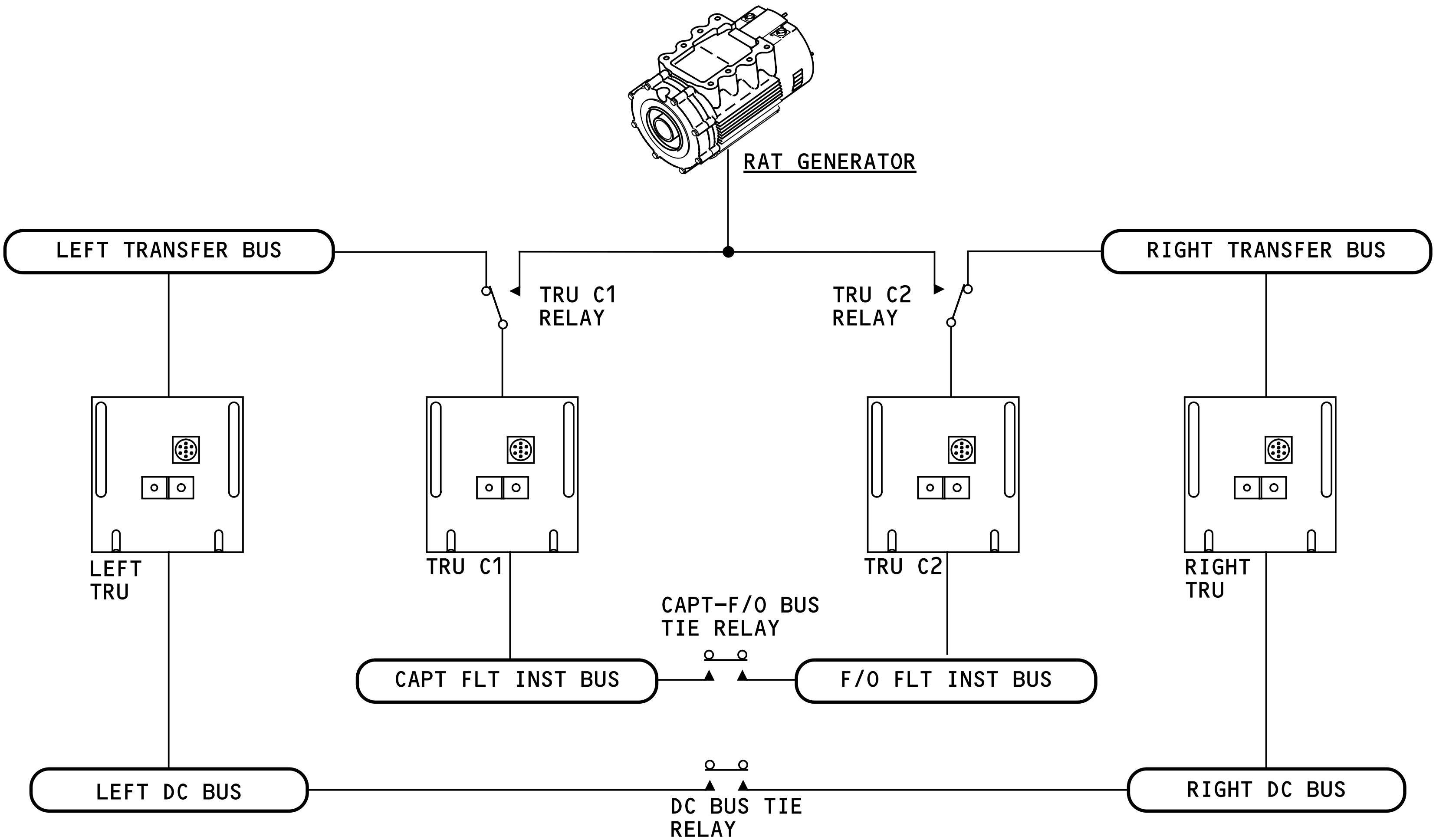
The dc subsystem card controls all the relays. The card is in the EEU in the P310 standby power management panel.

General Description - Left and Right DC Buses

During normal operation, the left TRU supplies power to the left dc bus, and the right TRU supplies power to the right dc bus. If a TRU fails, the dc bus tie relay closes to let the other TRU supply power to the two buses.

General Description - Flight Instrument DC Buses

During normal operation, TRU C1 supplies power to the captain's flight instrument bus, and TRU C2 supplies power to the first officer's flight instrument bus. If a TRU fails, the capt-F/O bus tie relay closes to let the other TRU supply power to the two buses.



24-32-00-001 Rev 1 03/21/96

TRU - GENERAL DESCRIPTION

TRU - FUNCTIONAL DESCRIPTION - LEFT AND RIGHT DC BUS

General

Normally the right TRU supplies power to the right dc bus, and the left TRU supplies power to the left dc bus. If one TRU does not operate, the other TRU can supply power to both buses through the dc tie relay.

The EEU in the standby power management panel has a dc subsystem card that controls the dc tie relay. The card gets voltage inputs from the left and right dc buses. The card also monitors the output current from each TRU.

DC Tie Relay - Normal Control

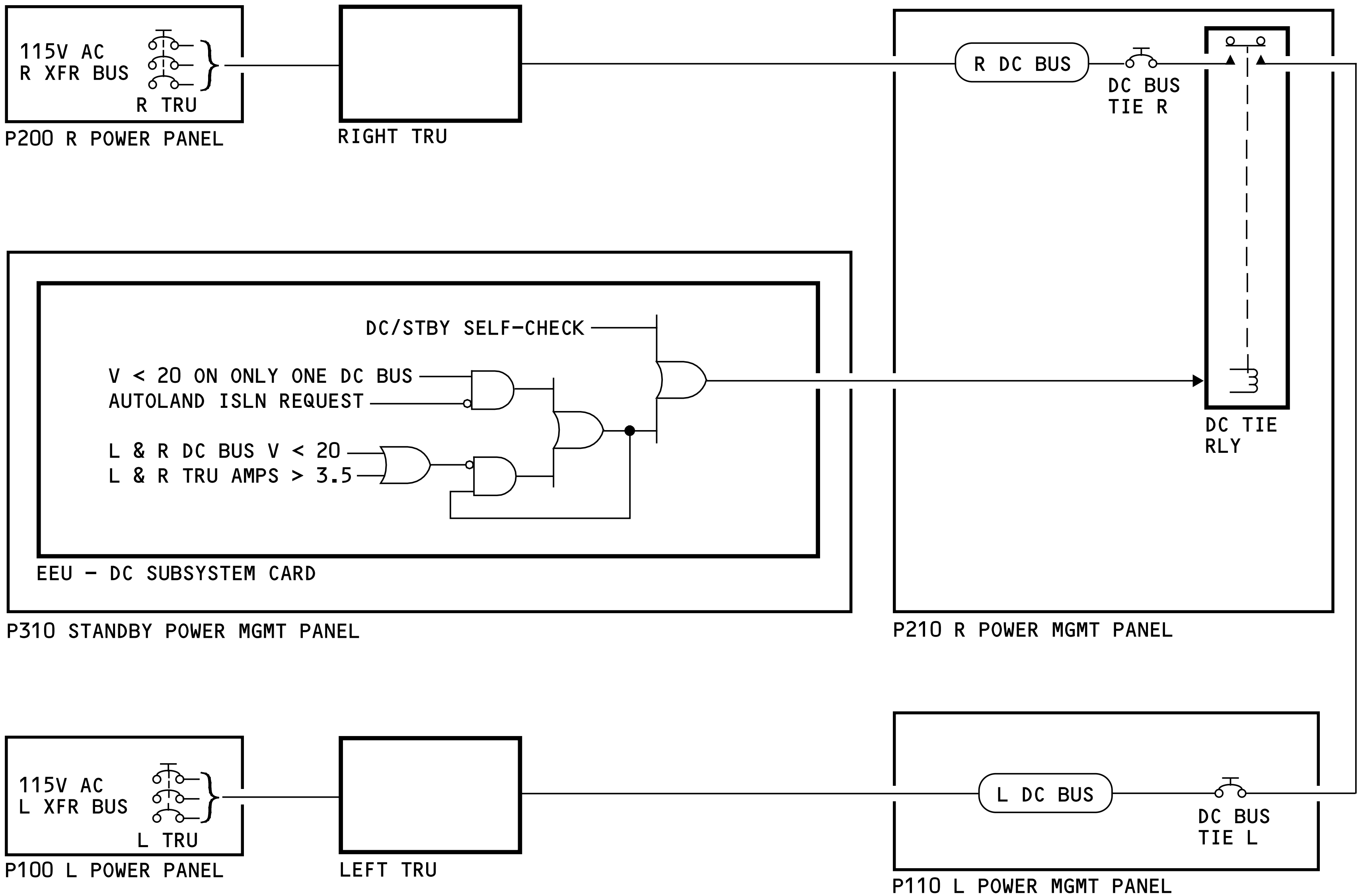
The dc tie relay is normally open to isolate the left and right dc buses. If one of the two dc buses has low voltage, the dc subsystem card closes the dc tie relay. This connects the left and right dc buses. The dc tie relay stays closed until the card senses output current from both TRUs.

If the tie relay closes and the card senses low voltage on the two dc buses, the card opens the relay. This is typical of a bus fault.

DC Tie Relay - Autoland Control

When the dc tie relay is open during autoland, the dc subsystem card keeps it open. This continues to isolate the left and right dc buses.

If the relay is closed before autoland, it stays closed. ELMS rejects the autoland request to isolate the buses.



TRU - FUNCTIONAL DESCRIPTION - LEFT AND RIGHT DC BUS

TRU - FUNCTIONAL DESCRIPTION - CAPT & F/O FLIGHT INSTRUMENT DC BUSES

General

Normally the TRU C1 supplies power to the captain's flight instrument bus, and the TRU C2 supplies power to the first officer's flight instrument bus. If TRU C1 does not operate, TRU C2 supplies power to the two buses through the captain-F/O bus tie relay. If TRU C2 does not operate, TRU C1 supplies power to the two buses through the captain-F/O bus tie relay.

During standby power operation, the RAT generator supplies power to the two flight instrument buses through the TRU C1 and C2 relays.

The EEU in the standby power management panel has a dc subsystem card that controls the captain-F/O bus tie and TRU C2 relays. The card and the RAT GCU control the TRU C1 relay.

Standby Power Control

When the RAT deploys, the RAT GCU sends a RAT power ready signal to the dc subsystem card. The RAT GCU also energizes the TRU C1 relay. This permits the RAT generator to supply power to the captain's flight instrument bus through the TRU C1. The dc subsystem card supplies a backup signal to energize the TRU C1 relay.

If the right transfer bus has no power the card energizes the TRU C2 relay. This permits the RAT generator to supply power to the F/O flight instrument bus through the TRU C2. Energizing the TRU C2 relay also causes the dc subsystem card to energize the captain-F/O bus tie relay.

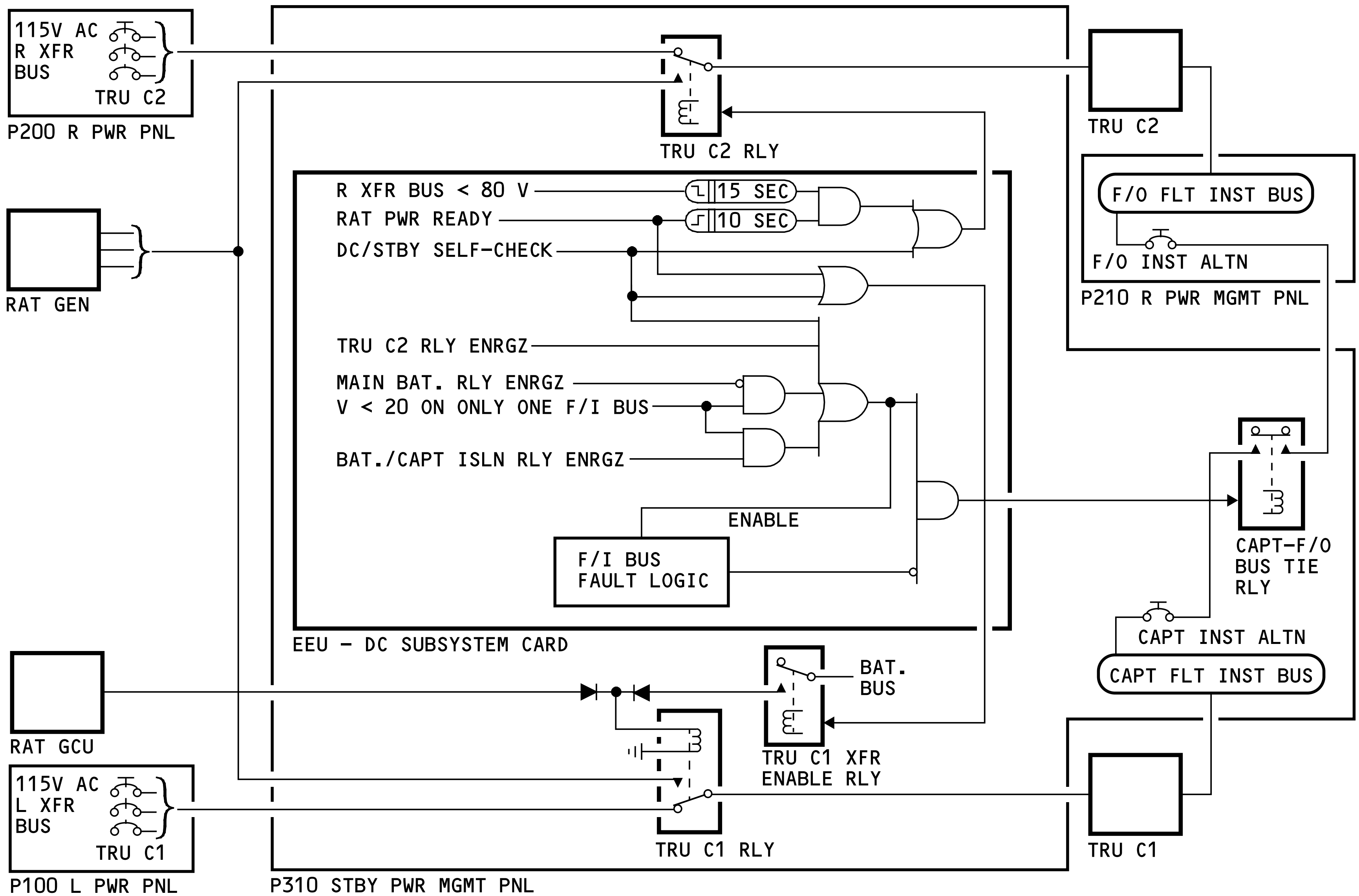
Captain-F/O Bus Tie Relay Control

The captain-F/O bus tie relay is normally open to isolate the captain's and first officer's flight instrument buses. If one of the flight instrument buses has no power and the main battery relay is not energized, the dc subsystem card energizes the captain-F/O bus tie relay. If one of the flight instrument buses has no power, the card also energizes the relay during autoland when the battery/captain isolation relay energizes. The relay connects the two flight instrument buses.

The control outputs of these two conditions latch to keep the relay energized. The latch releases if any of these occur:

- The left and right transfer buses lose power
- TRU C1 & C2 supply power
- The two flight instrument buses lose power.

All of the conditions that energize the captain-F/O bus tie relay also enable the flight instrument bus fault logic. The dc subsystem card monitors TRU current and bus voltage to detect a bus fault. If the card detects a fault, the relay is de-energized and the fault logic latches. The logic is reset at system power-up or with the MAT special function test: INITIATE P310 EU SELF TEST.



TRU - FUNCTIONAL DESCRIPTION - CAPT & F/O FLIGHT INSTRUMENT DC BUSES

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BATTERIES - GENERAL DESCRIPTION

General

There are two equivalent sets of battery equipment for main battery power and APU battery power. Each set has these components:

- Battery
- Battery charger
- Current sensor.

The main battery components supply dc power to important equipment when other power sources are not available.

The APU battery components supply power to start the APU.

The battery switch on the electrical panel supplies a control signal to ELMS. This permits you to supply main battery power to the battery #2 bus when the airplane is on the ground and has no ac power.

Batteries

The main battery supplies power to these buses:

- Hot battery bus
- Battery bus
- Captain's flight instrument bus
- Battery bus #2.

These relays select the buses to get power from the main battery:

- Main battery relay
- Battery-captain's bus isolation relay
- Ground power battery relay.

The APU battery supplies power directly to the APU battery bus. The APU battery bus supplies power to the APU electric starter through the APU crank contactor. The ELMS energizes the APU crank contactor when the APU controller starts the APU.

The APU battery bus is also an alternate power source for the APU controller and the RAT deploy relay.

Battery Chargers

The battery chargers do these functions:

- Change the ac power to dc power for the related dc buses
- Charge the batteries
- Send fault signals to the ELMS.

The ground service bus supplies 115v ac power to the main battery charger and the APU battery charger. The main battery charger charges the main battery through the hot battery bus. The APU battery charger charges the APU battery through the APU battery bus.

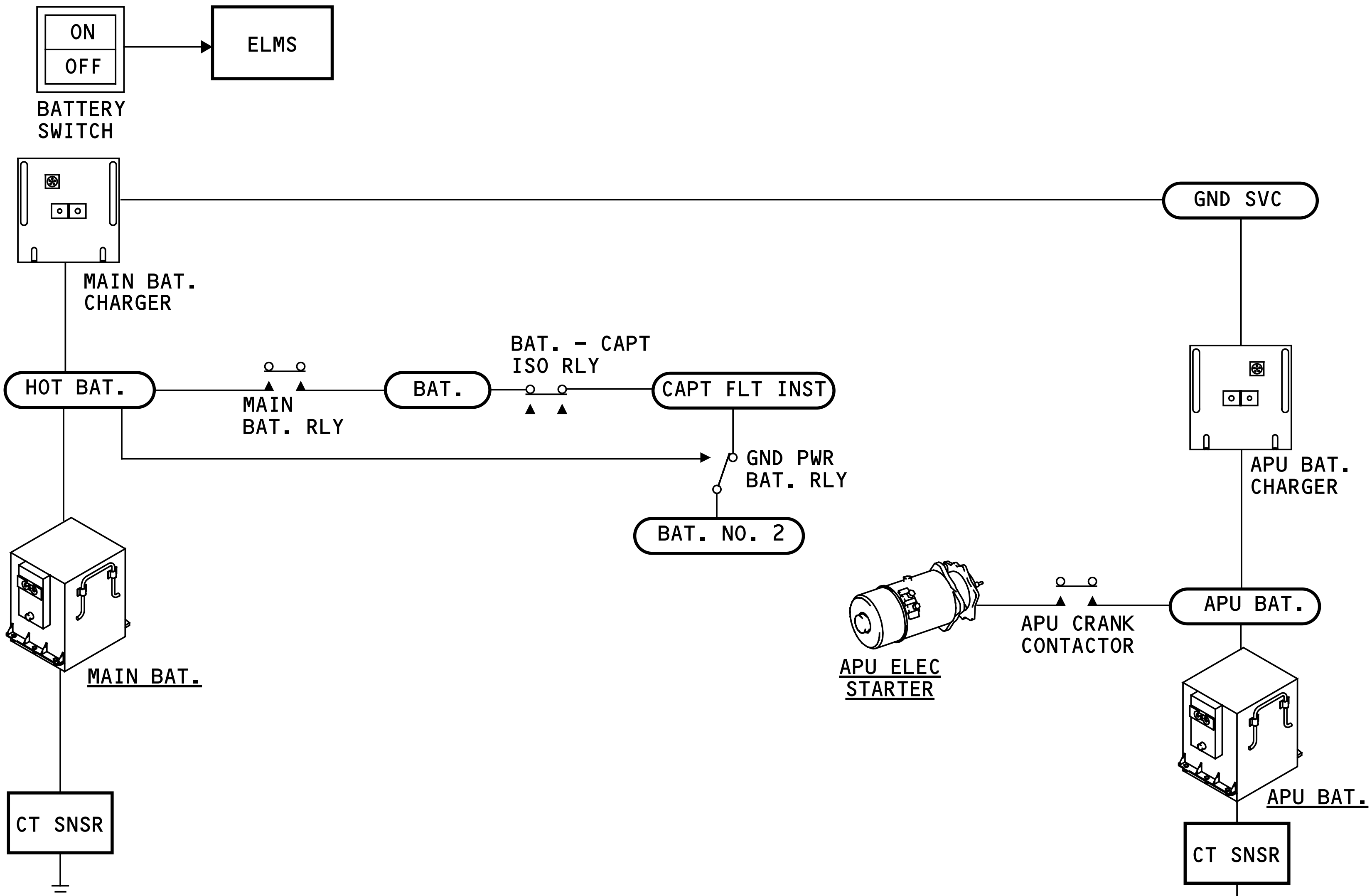
Current Sensors

Current sensors measure the current through the related battery. The ELMS EEU uses the current sensor output to calculate these data:

BATTERIES - GENERAL DESCRIPTION

- Amount of current
- Direction of current (charge or discharge).

The battery current data shows on page 1 of the MFD electrical maintenance page.



24-31-00-001 Rev 2

BATTERIES - GENERAL DESCRIPTION

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BATTERIES - MAIN AND APU BATTERIES

Purpose

When ac power is not available, the main battery does these functions:

- Supplies power to dc loads that are necessary for ground operation
- Supplies power to all the components that deploy the RAT
- Supplies standby system power until the RAT generator starts to supply power.

The main battery can supply standby system power for at least five minutes.

The APU battery supplies electrical power to start the APU.

Physical Description

The main battery and the APU batteries are rechargeable. They are fiber nickel-cadmium (FNC) batteries. Each battery weighs 106 lb (48 kg).

Each battery has two sets of ten FNC cells. The battery case is green. The case has two mounting flanges and two lifting handles. Bolts attach the mounting flanges to the airplane. The lifting handles help you connect ground support equipment (GSE) to the battery when you move it.

The battery has a terminal block and an electrical connector. The terminal block connects the high power output. The electrical connector connects control and status signals.

The battery has a temperature sensor and an overheat switch (not shown).

Training Information Point

WARNING: BE CAREFUL WHEN YOU MOVE THE BATTERY. BECAUSE THE BATTERY WEIGHS 106 POUNDS (48 KG), INJURY TO PERSONS CAN OCCUR.

Use ground support equipment to lift the main battery. You install a rack and pulley between the floor beams above the battery to help you lift it.

The APU battery attaches to a tray that you can pull out to easily remove and install the battery. Once you push the tray in, there are two captive screws you must tighten to prevent the tray from moving.

CAUTION: DO NOT CHARGE THIS BATTERY WITH BATTERY CHARGERS WHICH ARE NOT APPROVED FOR THIS TYPE OF FNC BATTERY. OVER-CHARGING CAN OCCUR AND SERIOUSLY DAMAGE OR DESTROY BATTERY CELLS.

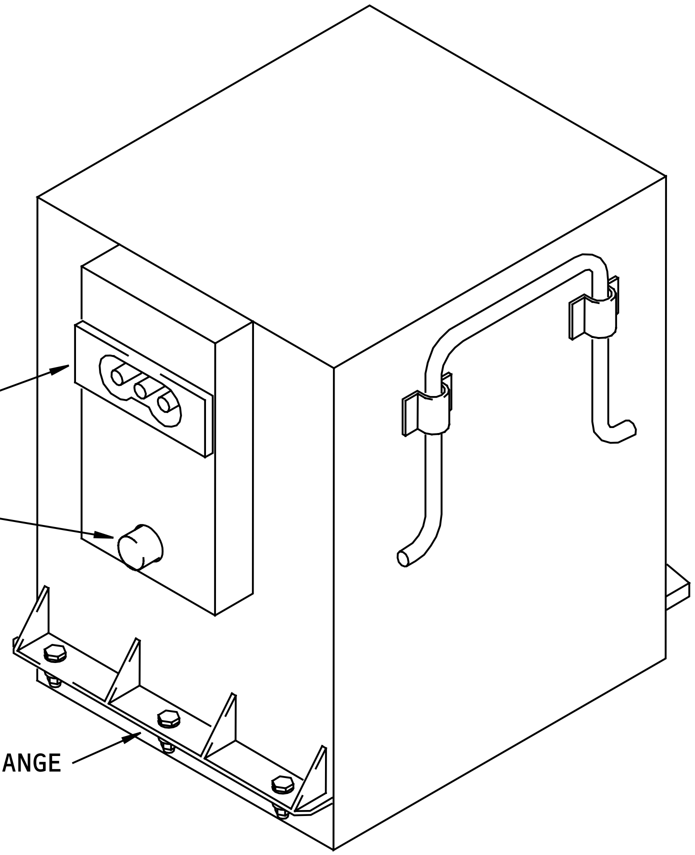
The capacity of each battery is 47 amp-hours. The main battery can supply the hot battery bus loads for 10 days.

The main battery and the APU battery are interchangeable.

BATTERIES - MAIN AND APU BATTERIES

No maintenance is necessary for FNC batteries.

When no other power is on the airplane, the hot battery bus supplies power to the static random access memory (SRAM) of the AIMS. If you disconnect the main battery with no power to the AIMS cabinets, you lose some data. See the AIMS section for more information (AMM PART I 31-41).



BATTERY
(TYPICAL)

24-31-00-002 Rev 3

BATTERIES - MAIN AND APU BATTERIES

BATTERIES - MAIN AND APU BATTERY CHARGERS

Purpose

The battery chargers change ac power to dc power for the related dc buses. The battery chargers keep the related batteries charged.

Physical Description

The battery chargers are ARINC 600-style LRUs. Each battery charger has these components on the front cover:

- Terminal block
- Electrical connector
- Handles.

The terminal block connects the high power output. The electrical connector connects ac power, control signals, and status signals to the battery charger.

Functional Description

The input power to each battery charger is 3-phase, 115v ac, 400 Hz. power.

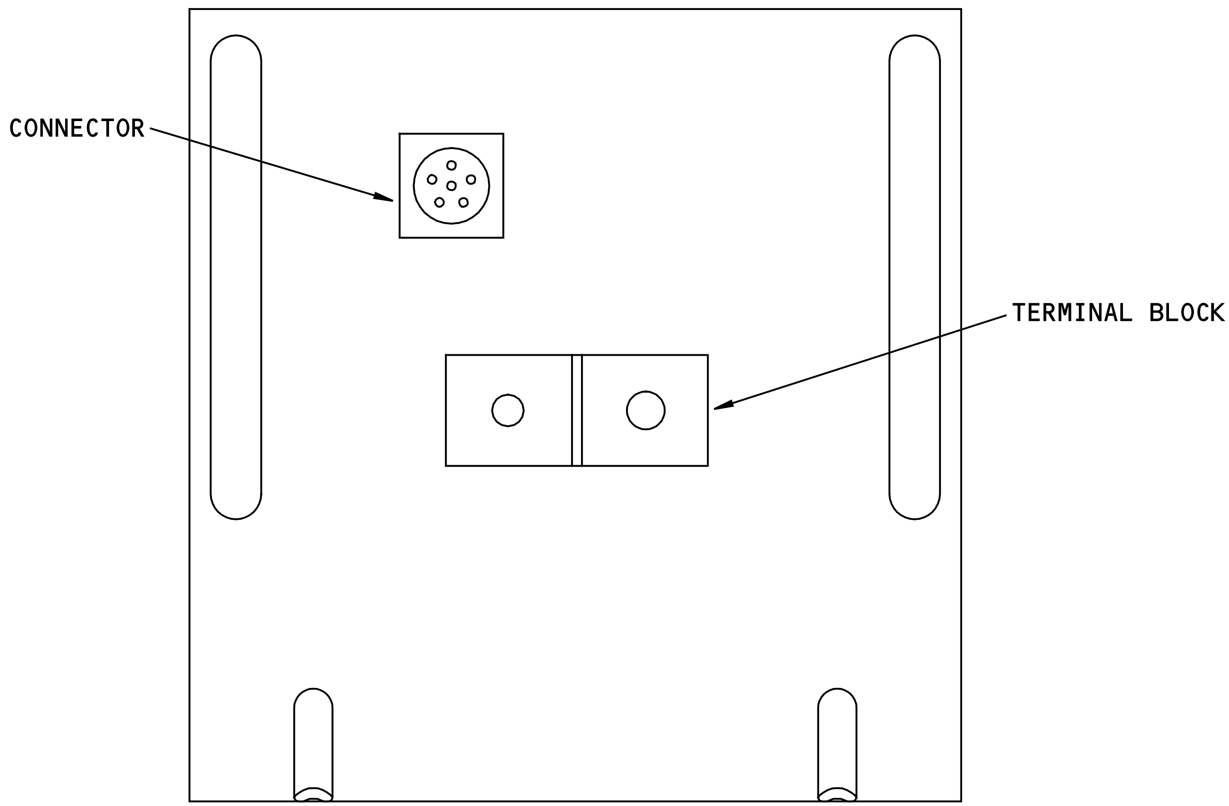
The battery charger has four modes of operation. Three of these are charge modes; the other is transformer-rectifier (TR) mode.

In the TR mode, the battery charger supplies dc power up to 65 amps. The voltage of this power is very tightly regulated.

Training Information Point

The main battery charger and the APU battery charger are interchangeable.

CAUTION: DO NOT TOUCH THE BATTERY CHARGER BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE BATTERY CHARGER.



BATTERY CHARGER

24-31-00-003 Rev 1

BATTERIES - MAIN AND APU BATTERY CHARGERS

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BATTERIES - FUNCTIONAL DESCRIPTION

General

This is how the main battery subsystem works. The APU subsystem is similar.

The battery charger supplies power to dc buses and keeps the battery charged. It operates in four modes:

- Main
- Topping
- Float
- TR.

Main Mode

The battery charger starts main mode operation when one of these conditions occurs:

- Power turns on the battery charger
- Battery has low voltage during float mode
- Battery charger stops TR mode operation.

Main mode is the fastest charge mode. The battery charger uses the increase in battery temperature to make a decision that the battery is almost fully charged. The temperature sensor in the battery gives the temperature data to the battery charger. The charger stops main mode when the battery temperature increases approximately 7F (4C).

Topping Mode

The battery charger automatically starts topping mode at the end of main mode. Topping mode supplies less current than main mode. The battery charger uses topping mode to make sure that the battery is fully charged. The battery charger operates in topping mode for 11 minutes.

Float Mode

The battery charger automatically starts float mode at the end of topping mode. The battery charger operates in float mode when the battery is fully charged. It can supply 65 amperes to the dc bus while it is in float mode.

Usually, the battery charger continues to operate in float mode.

TR Mode

In TR mode, the battery charger operates as a TRU and can supply up to 65 amperes to the dc bus. The output voltage of the TR mode is more closely regulated than the output voltage of the float mode.

The battery charger goes into the TR mode when there is a hot battery condition, or when it receives a TR mode signal from the ELMS. The TR mode overrides all other modes. The hot battery condition occurs when the battery is 145F (63C) or hotter. The ELMS supplies the TR mode signal when any of these conditions occur:

BATTERIES - FUNCTIONAL DESCRIPTION

- Main battery relay energizes
- Ground power battery relay energizes
- Autoland system sends an isolation request.

There is no ELMS TR mode signal for the APU battery charger.

Fault Protection

The battery charger monitors the battery for these conditions:

- Overheat switch closed (154F (68C))
- Colder than -40F (-40C)
- Cell imbalance
- Temperature sensor failure.

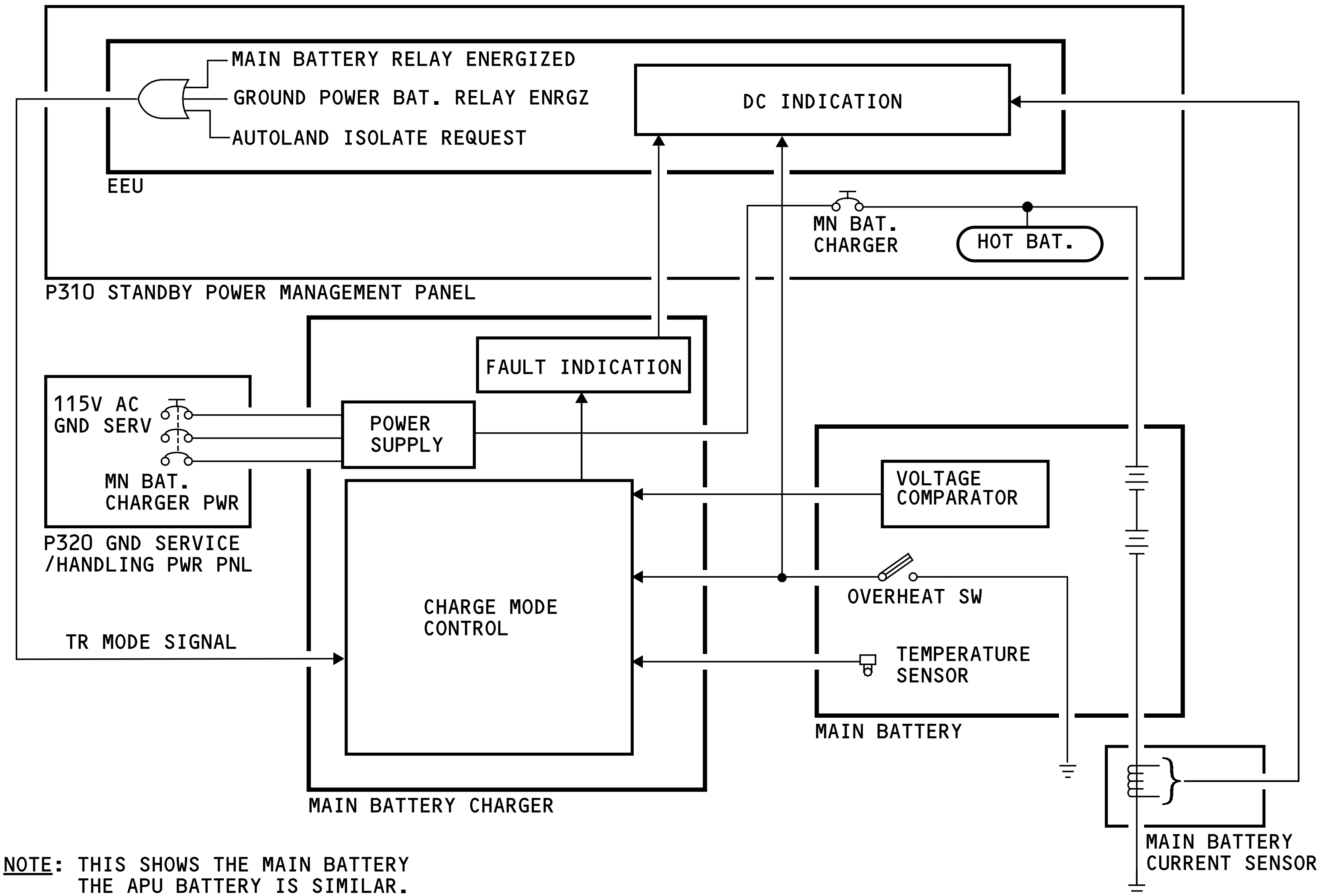
The cell imbalance condition occurs when the voltage of the first 10 battery cells is different from one half of the battery voltage. The battery charger monitors the voltage comparator in the battery to find this condition.

If the battery charger finds a fault, it turns off and sends a fault signal to the ELMS.

Current Indication

The current sensor sends current data to the EEU in the P310 panel.

The ELMS sends indication data to the AIMS.



NOTE: THIS SHOWS THE MAIN BATTERY
THE APU BATTERY IS SIMILAR.

24-31-00-004 Rev 4

BATTERIES - FUNCTIONAL DESCRIPTION

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STANDBY POWER - GENERAL DESCRIPTION

General

The standby power system operates when the normal electrical power sources do not supply power to the left and right transfer buses. Standby power goes to these buses:

- Captain's flight instrument bus
- First officer's flight instrument bus
- Battery bus
- Battery bus #2
- Hot battery bus
- AC standby bus.

Standby power comes from either the RAT generator or the main battery. ELMS controls the standby system relays. The battery switch and the standby power switch send control signals to the ELMS.

Rat Generator

The RAT generator supplies 7.5 kva of ac power to the two center TRUs. The RAT GCU monitors and controls the output of the RAT. The TRUs change the ac power into 28v dc power and supply it to the captain's and first officer's flight instrument buses.

The captain's flight instrument bus supplies power to the battery bus and battery bus #2.

The battery bus supplies power to the hot battery bus and the ac standby bus. Power to the ac standby bus goes through the static inverter. The static inverter changes 28v dc power into one phase of 115v, 400 Hz, ac power.

Main Battery

The main battery supplies 28v dc power to the standby system if the RAT generator does not.

To supply power to the standby system, the main battery supplies power to the hot battery bus. The hot battery bus supplies power to the battery bus.

The battery bus supplies power to the captain's flight instrument bus. The captain's flight instrument bus supplies power to battery bus #2.

The battery bus supplies power to the static inverter, so that the ac standby bus has power.

Operation

The standby power switch on the P61 overhead maintenance panel has three positions:

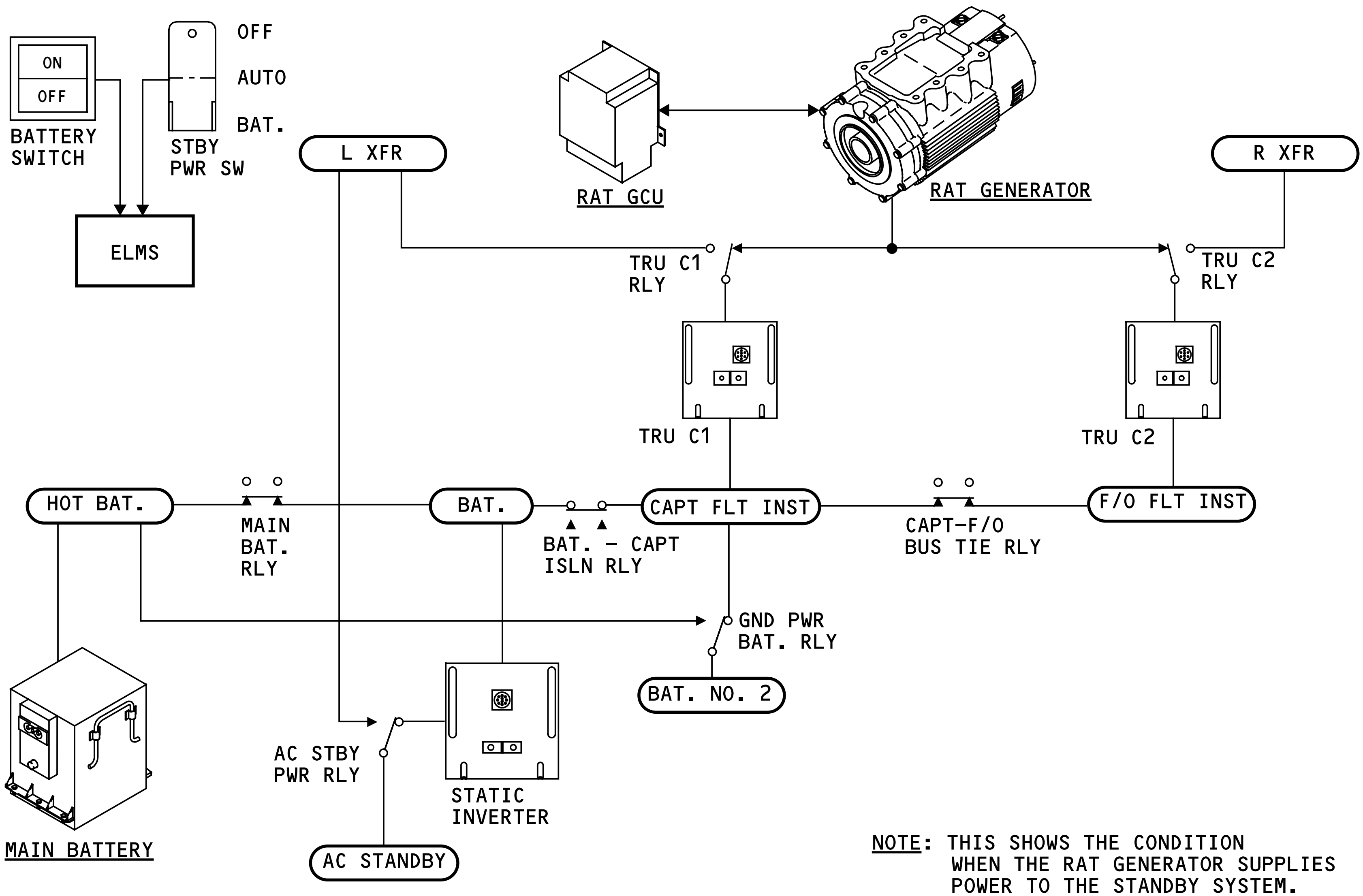
- OFF
- AUTO
- BAT.

The BAT position is a momentary position. The standby power switch permits you to do these functions on the ground only:

- De-energize the ac standby bus (OFF position)

STANDBY POWER - GENERAL DESCRIPTION

- Arm the standby system for automatic operation (AUTO position)
- Energize the standby buses when ac power is not available (BAT position, when the battery switch is in the ON position)
- Start a self-check of the dc/standby system (BAT position, when ac power is available).



STANDBY POWER - GENERAL DESCRIPTION

STANDBY POWER - RAT GENERATOR

General

The RAT generator supplies ac power when normal power sources are not available. The RAT generator supplies power to TRU C1 and TRU C2 for the standby system buses.

Physical Description

The generator capacity is 7.5 kva. It has two electrical connectors. One connector carries RAT GCU signals and power. The other carries the generator output to TRU C1 and TRU C2.

The generator contains these parts:

- Permanent magnet generator (2)
- Exciter
- Main generator
- Heater (2).

The main generator makes three-phase ac power. The voltage is 115 volts. The frequency is the result of the rotational speed of the of the RAT propeller/ governor unit. The frequency range is from 392 Hz to 510 Hz.

There are two heaters in the RAT generator that prevent ice. The hydraulic interface module (HYDIM) cards control the heaters through the ELMS. See the ram air turbine system section for more information on the heaters (AMM PART I 29-20).

Location

Eight bolts attach the RAT generator to the RAT strut. The RAT propeller/governor unit attaches to the front side of the generator. The hydraulic pump attaches to the aft side of the generator. See the ram air turbine system section for more information on the RAT (AMM PART I 29-20).

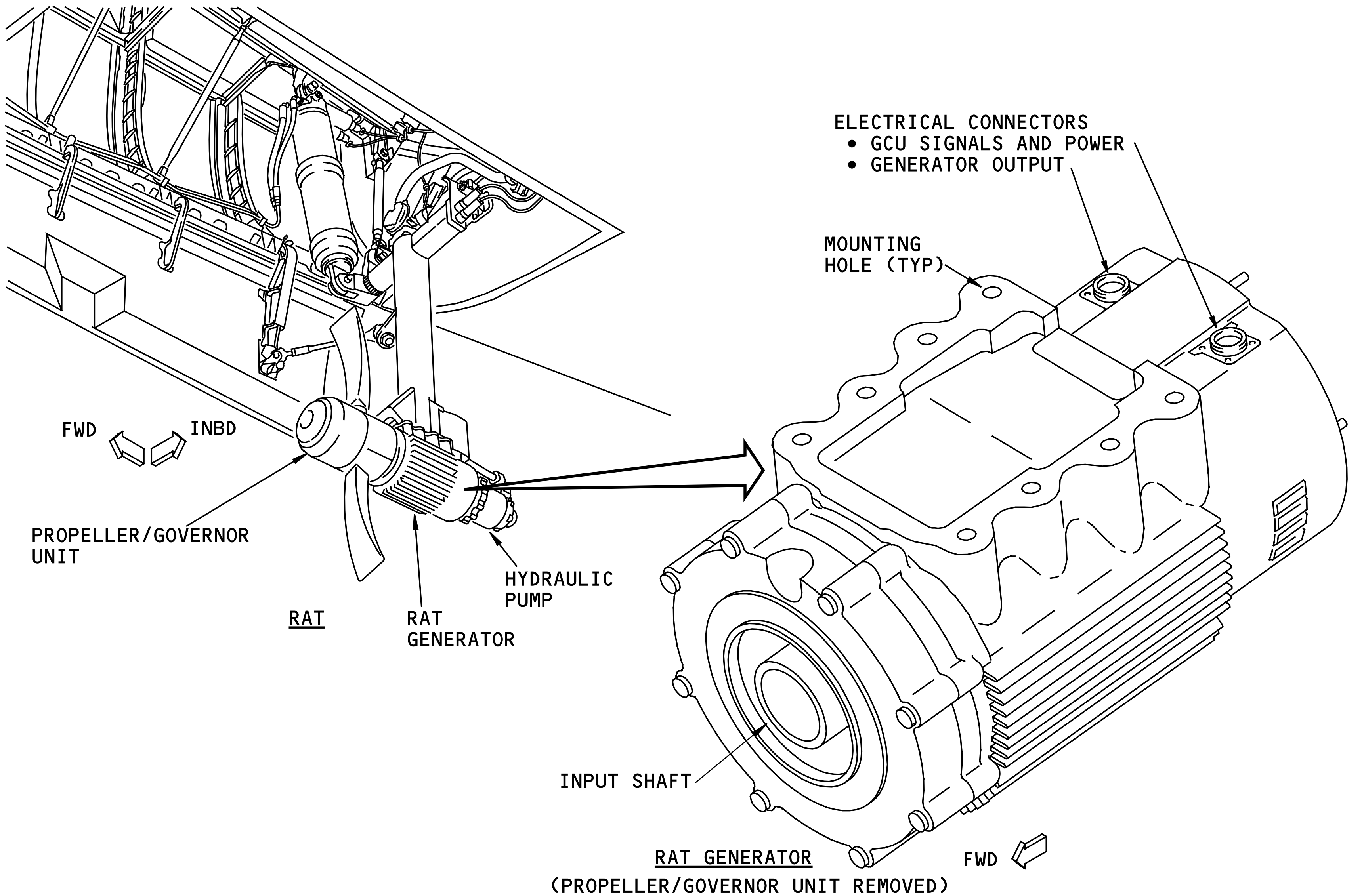
Functional Description

When the RAT deploys, the propeller/governor unit turns the input shaft of the generator and hydraulic pump. The generator changes the energy of the turning shaft into ac power.

Training Information Point

You remove and install the RAT generator and propeller/ governor unit as an assembly. More work on the assembly must be done in a shop.

You must do a test of the RAT at specified times. See the ram air turbine system section for more information on the test (AMM PART I 29-20).



STANDBY POWER - RAT GENERATOR

STANDBY POWER - FUNCTIONAL DESCRIPTION - AC CONTROL

General

The ac standby bus uses single phase, 115v ac power. The left transfer bus is the usual power source for the ac standby bus. The static inverter is an alternative power source for the ac standby bus. These components control power switching to the ac standby bus:

- AC standby power relay
- AC standby control relay
- Static inverter
- P310 EEU.

Power to energize the ac standby bus goes through the ac standby power relay. The ac standby control relay controls the ac standby power relay. The EEU controls the ac standby control relay.

Standby Power Control

The left transfer bus normally supplies power to the ac standby bus. The static inverter supplies the power when any of these conditions are true:

- Left transfer bus voltage is below 80 volts
- There is an autoland bus isolation request
- There is a dc/standby self-check in progress.

Static Inverter

The static inverter gets 28v dc power from the battery bus. The static inverter has a converter that increases the dc voltage, and an inverter that changes the dc power into single phase, 115v ac power.

The static inverter turns off for either of these conditions:

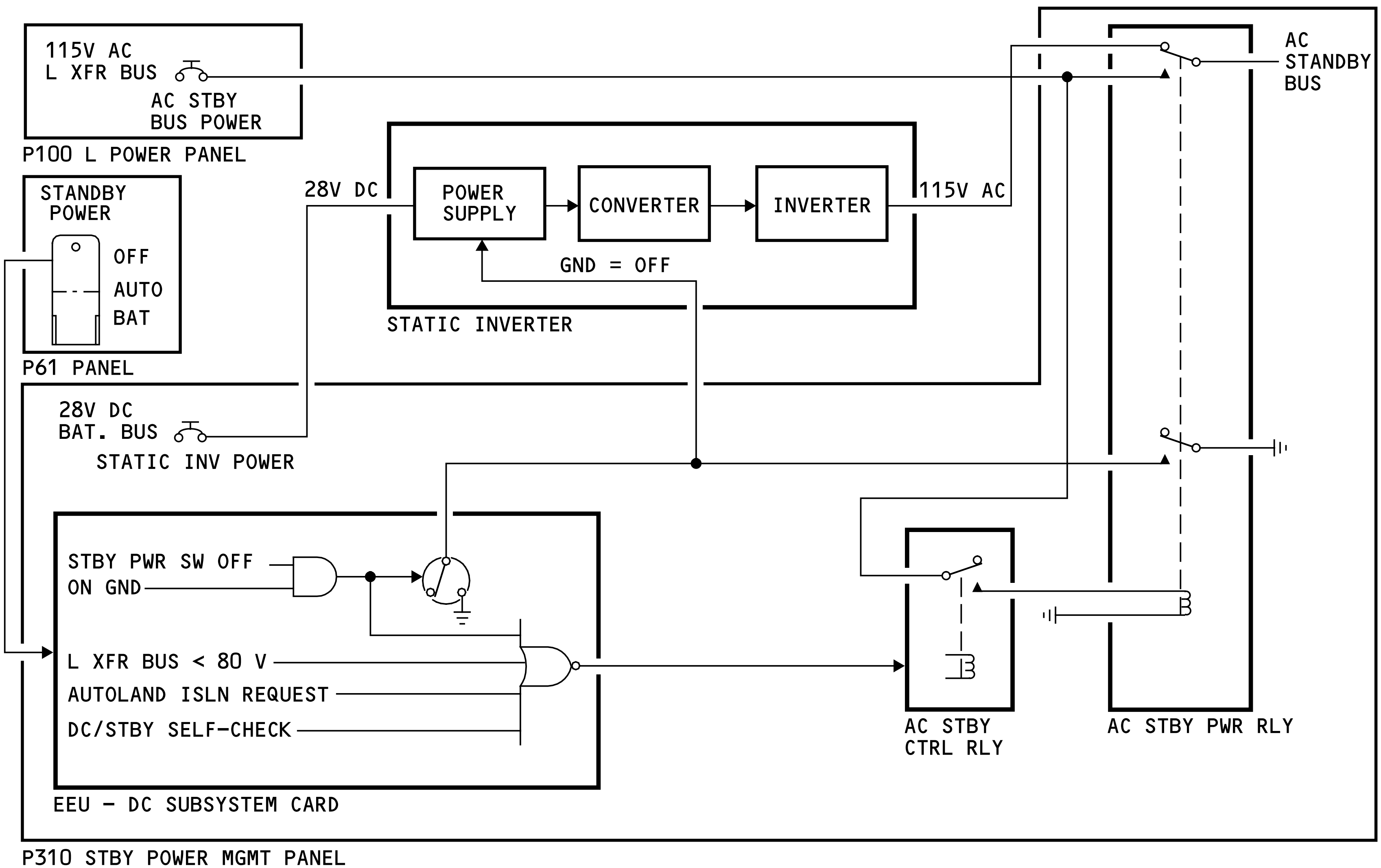
- Standby power switch is in the OFF position and the airplane is on the ground
- AC standby power relay is energized.

DC/Standby Self-Check

The dc subsystem card does a test of the dc system with a dc/standby self-check.

The self-check can start either manually or automatically. You manually start the self-check when you set these conditions:

- The airplane is on the ground
- Left and right ac transfer buses have power
- The battery switch is in the ON position
- The standby power switch is in the BAT position (momentary).



24-33-00-003 Rev 4

STANDBY POWER - FUNCTIONAL DESCRIPTION - AC CONTROL

STANDBY POWER - FUNCTIONAL DESCRIPTION - RAT GENERATOR CONTROL

General

The RAT deploys manually or automatically. The RAT switch controls manual deployment of the RAT. The P310 EEU and the hydraulic interface modules (HYDIM) (not shown) control the automatic deployment of the RAT. When one or two RAT actuator solenoids energize, the RAT deploys. Then, the RAT GCU controls and monitors the RAT generator power.

RAT Deployment

To deploy the RAT manually, you put the RAT manual switch in the DEPLOY position. This energizes the two RAT actuator solenoids.

The P310 EEU can deploy the RAT automatically. When the airplane is in the air and the two transfer buses do not have power for more than 15 seconds, the EEU energizes the RAT deploy relay for five seconds. The energized RAT deploy relay supplies power to the M29002 RAT actuator solenoid.

See the ram air turbine system section for more information on the hydraulic interface module card control of the M29001 RAT actuator solenoid (AMM PART I 29-20).

Power

The RAT GCU gets power from a PMG in the RAT generator. The PMG also supplies power to the voltage regulator.

The voltage regulator rectifies the power to make dc current for the exciter field.

The generator uses the exciter field current to make ac current. The ac current goes through two relays to the two center TRUs.

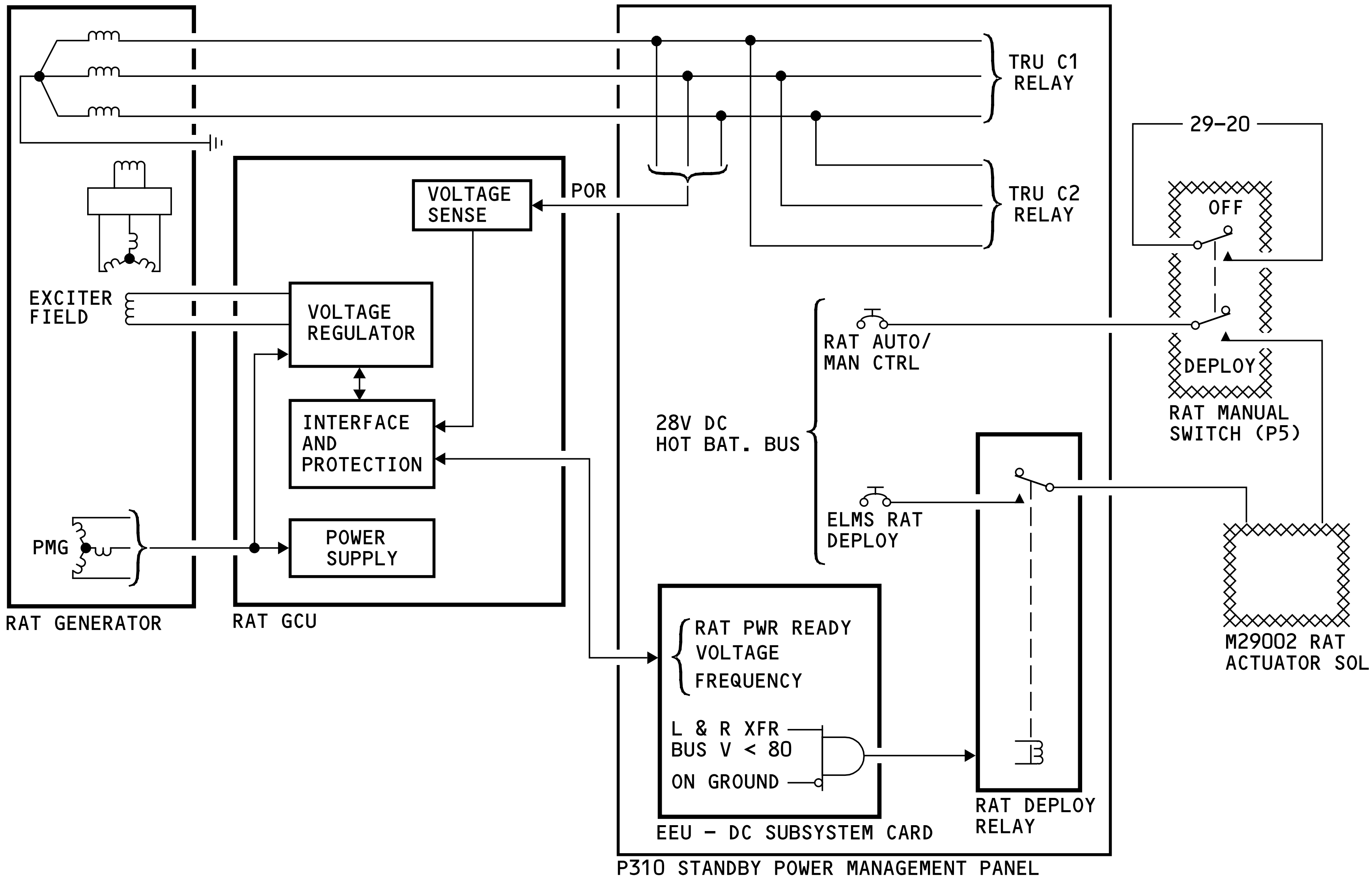
Control

The GCU monitors the voltage at the point of regulation (POR). The POR is between the generator and the TRU relays. The voltage regulator adjusts the dc current to the exciter field to keep the POR voltage at 115 volts.

The GCU sends these signals to the EEU in the standby power management panel:

- RAT generator power ready signal
- RAT generator voltage
- RAT generator frequency.

The ELMS uses the power ready signal for control logic. The voltage and frequency signals are for indication.



24-33-00-004 Rev 5

STANDBY POWER - FUNCTIONAL DESCRIPTION - RAT GENERATOR CONTROL

STANDBY POWER - FUNCTIONAL DESCRIPTION - DC CONTROL

General

The standby power system operates to control power from the hot battery bus to these buses:

- Battery bus
- Captain's flight instrument bus
- Battery bus #2.

The EEU controls these relays to control power from the hot battery bus:

- Main battery relay
- Battery-captain isolation relay
- Ground power battery relay.

Main Battery Relay

When the main battery relay energizes, the hot battery bus can supply power to the battery bus. In general, the main battery relay energizes for these conditions:

- Transfer bus power was available, but was lost (in the air, the EEU keeps the relay energized)
- You manually select standby power on
- The two center TRUs fail
- TRU C1 fails and the captain-F/O bus tie relay energizes to restore power
- Autoland bus isolation request
- DC/standby self-check.

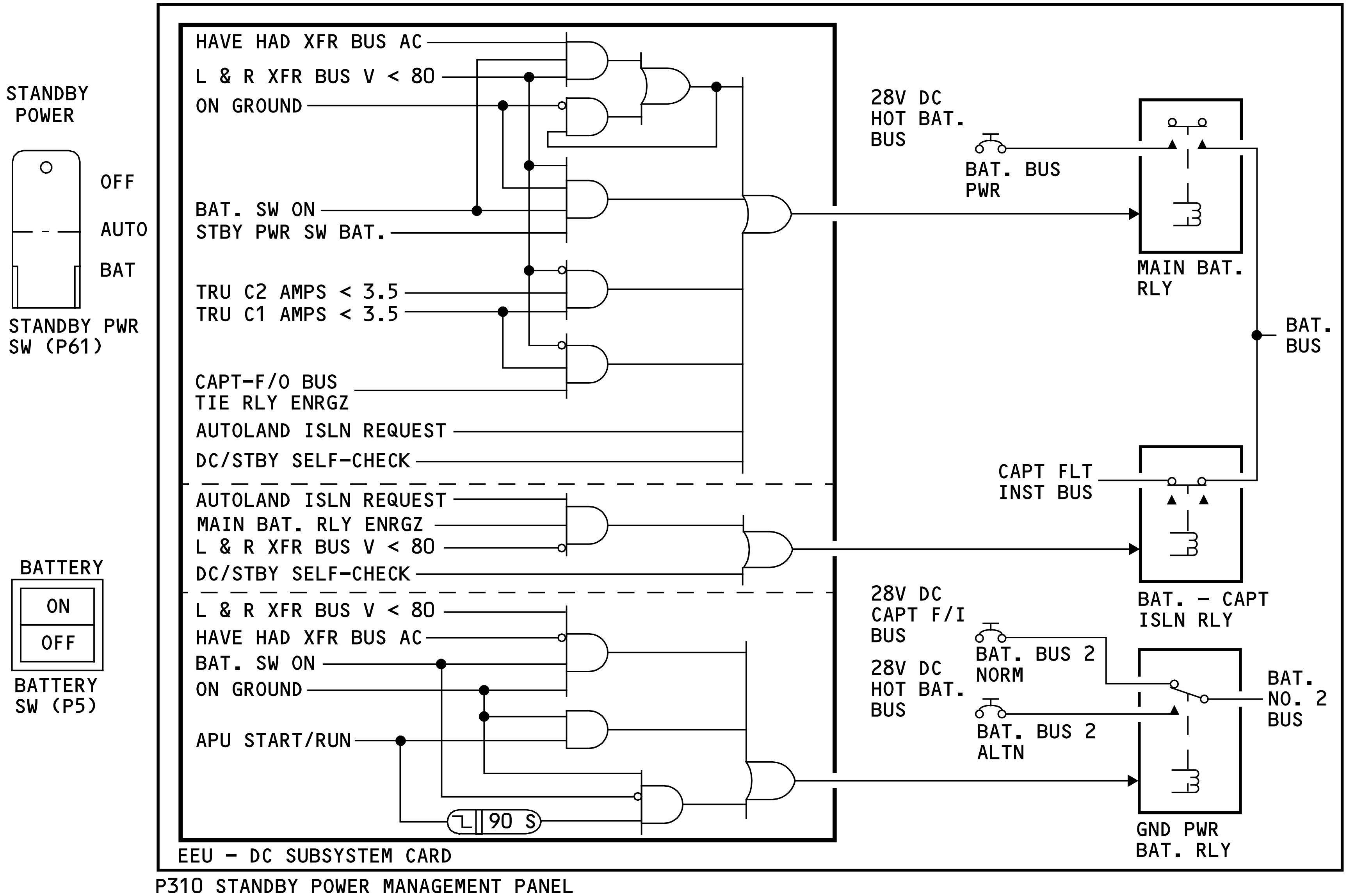
Battery-Captain Isolation Relay

The battery-captain isolation relay energizes to isolate the captain's flight instrument bus from the hot battery bus (through the battery bus). This occurs when there is an autoland bus isolation request or for a dc/standby self-check.

Ground Power Battery Relay

When the ground power battery relay energizes, the hot battery bus can supply power to the battery bus #2. The ground power battery relay energizes for these conditions:

- You push the battery switch on as part of initial power application
- APU starting/running on the ground
- When APU shuts down and the battery switch is off, the relay stays energized for 90 seconds. This makes sure the battery bus #2 has power to close the APU inlet door.



STANDBY POWER - FUNCTIONAL DESCRIPTION - DC CONTROL

24-33-00-005 Rev 3

FLIGHT CONTROLS DC POWER - GENERAL DESCRIPTION

Purpose

The flight controls dc (FCDC) power system supplies power to the flight controls system.

General Description

There are three FCDC power supply assemblies (PSA):

- Left
- Center
- Right.

These PSAs supply power to their related flight control buses.

Power Sources

Each PSA gets power from many different sources. The PSA automatically selects which power source to use. Each PSA has a battery to supply power during power interruptions.

The left PSA gets power from these sources:

- PMG L1
- Left dc bus
- Hot battery bus.

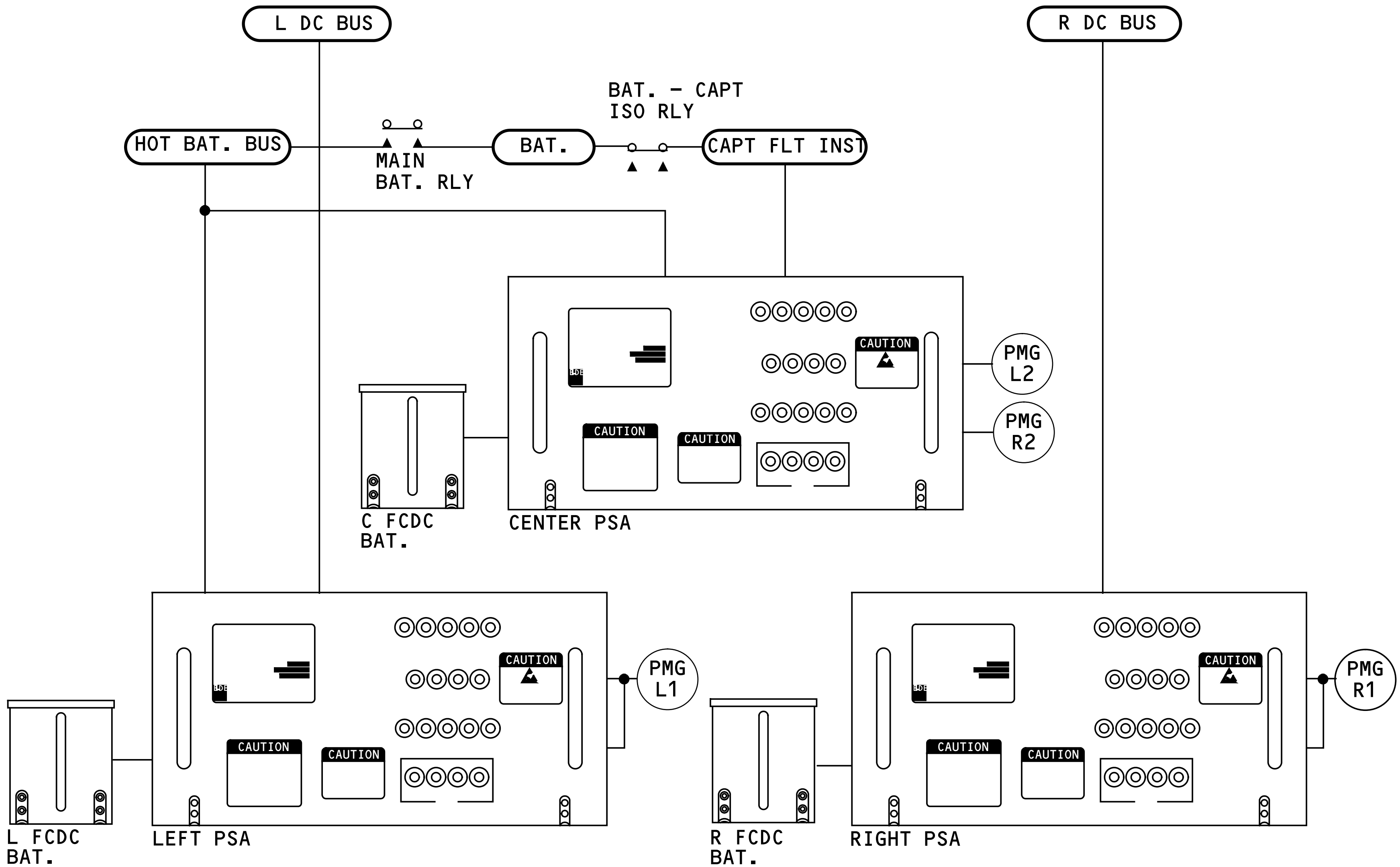
The center PSA gets power from these sources:

- PMG L2
- PMG R2
- Captain's flight instrument bus
- Hot battery bus.

The right PSA gets power from these sources:

- PMG R1
- Right dc bus.

The PMGs are permanent magnet generators in the backup generator housing. Each backup generator has two PMGs that supply power to the PSAs. The PSA changes variable frequency ac power from the PMGs into 28v dc power.



24-35-00-001 Rev 3

FLIGHT CONTROLS DC POWER - GENERAL DESCRIPTION

FLIGHT CONTROLS DC POWER - POWER SUPPLY ASSEMBLY

General

The PSA supplies power to the flight control systems.

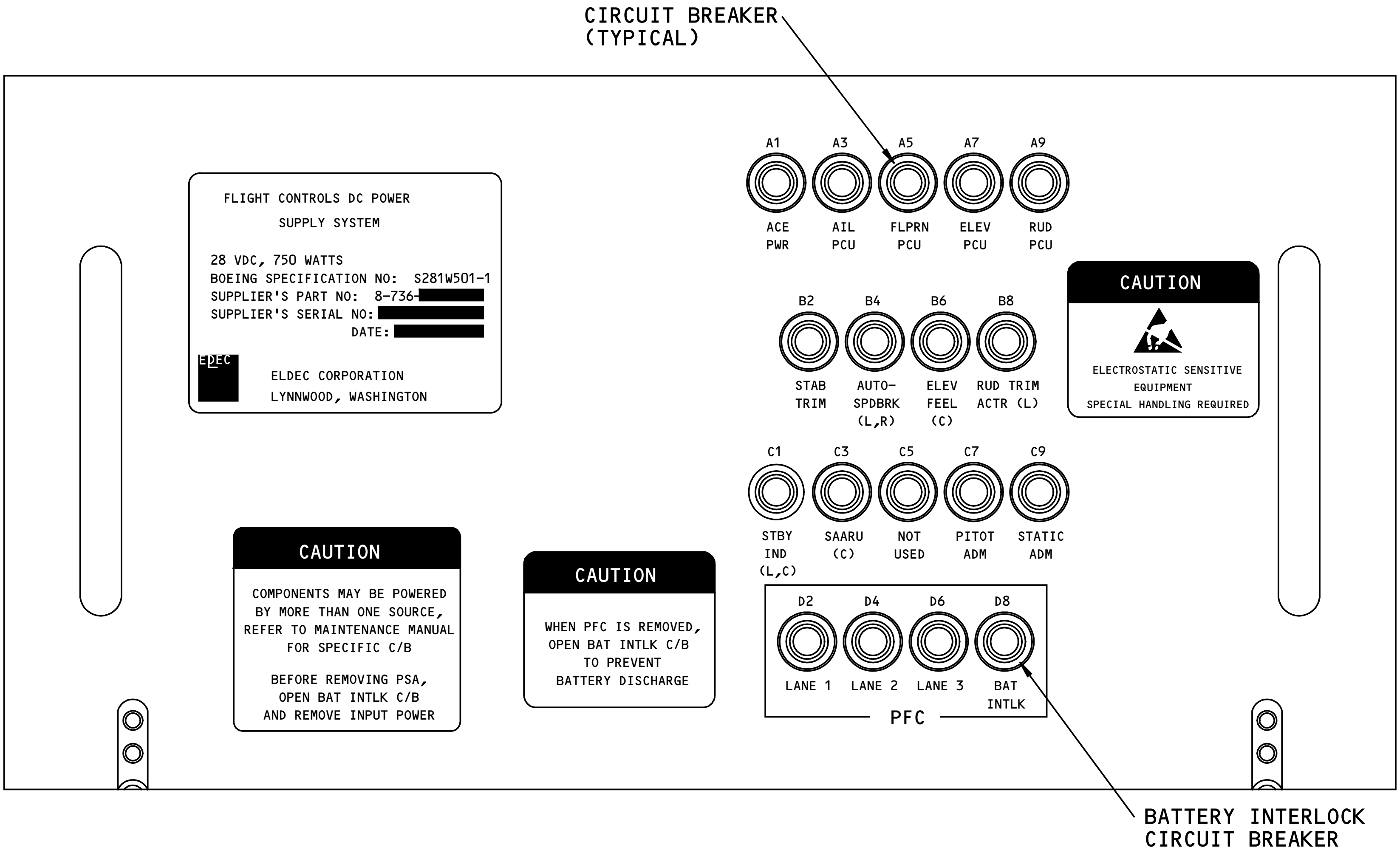
The PSA contains the FCDC bus. The FCDC bus supplies power to flight control LRUs. Power to each LRU goes through circuit breakers on the front of the PSA. You can remove power from an LRU when you open its related circuit breakers.

Training Information Point

Be sure to obey all of the cautions on the front of the PSA.

The left, center, and right PSAs are interchangeable.

The parentheses below a circuit breaker tells the PSA position in which that circuit breaker is active. For example, circuit breaker AUTO-SPDBRK (L,R) is only active when the PSA is in the left or right position.



24-35-00-002 Rev 2

FLIGHT CONTROLS DC POWER - POWER SUPPLY ASSEMBLY

FLIGHT CONTROLS DC POWER - FUNCTIONAL DESCRIPTION

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FLIGHT CONTROLS DC POWER - FUNCTIONAL DESCRIPTION

General

The center PSA can get power from these sources:

- PMG L2
- PMG R2
- Captain's flight instrument bus
- Hot battery bus.

The PSA has a controller that selects which power source to use. The controller supplies grounds to relays in the PSA to select the different power sources.

PSA Operation Modes

The PSA has three modes of operation:

- Primary
- Secondary
- Backup.

Primary mode is the normal mode when the engines are running. The PSA uses power from one or both PMGs when it is in primary mode. The PMGs send ac power to a power converter. The power converter changes the ac power to 28v dc power.

When there is no power from either PMG, the PSA goes into secondary mode. Secondary mode is the normal mode when the airplane is on the ground and the engines are off. The K2 relay relaxes when the PSA is in secondary mode. This permits the PSA to use power from the captain's flight instrument bus.

When there is no power from either PMG or from the captain's flight instrument bus, the PSA goes into backup mode. The K1 relay energizes when the PSA is in backup mode. This permits the PSA to use power from the hot battery bus.

NOTE: The right PSA does not use backup mode because it does not connect to the hot battery bus.

FCDC Battery

Normally, the controller energizes the K3 relay to connect the FCDC battery to the FCDC bus. A diode prevents uncontrolled charging of the battery from the bus. When the bus loses power, the battery supplies power until the controller connects another power source.

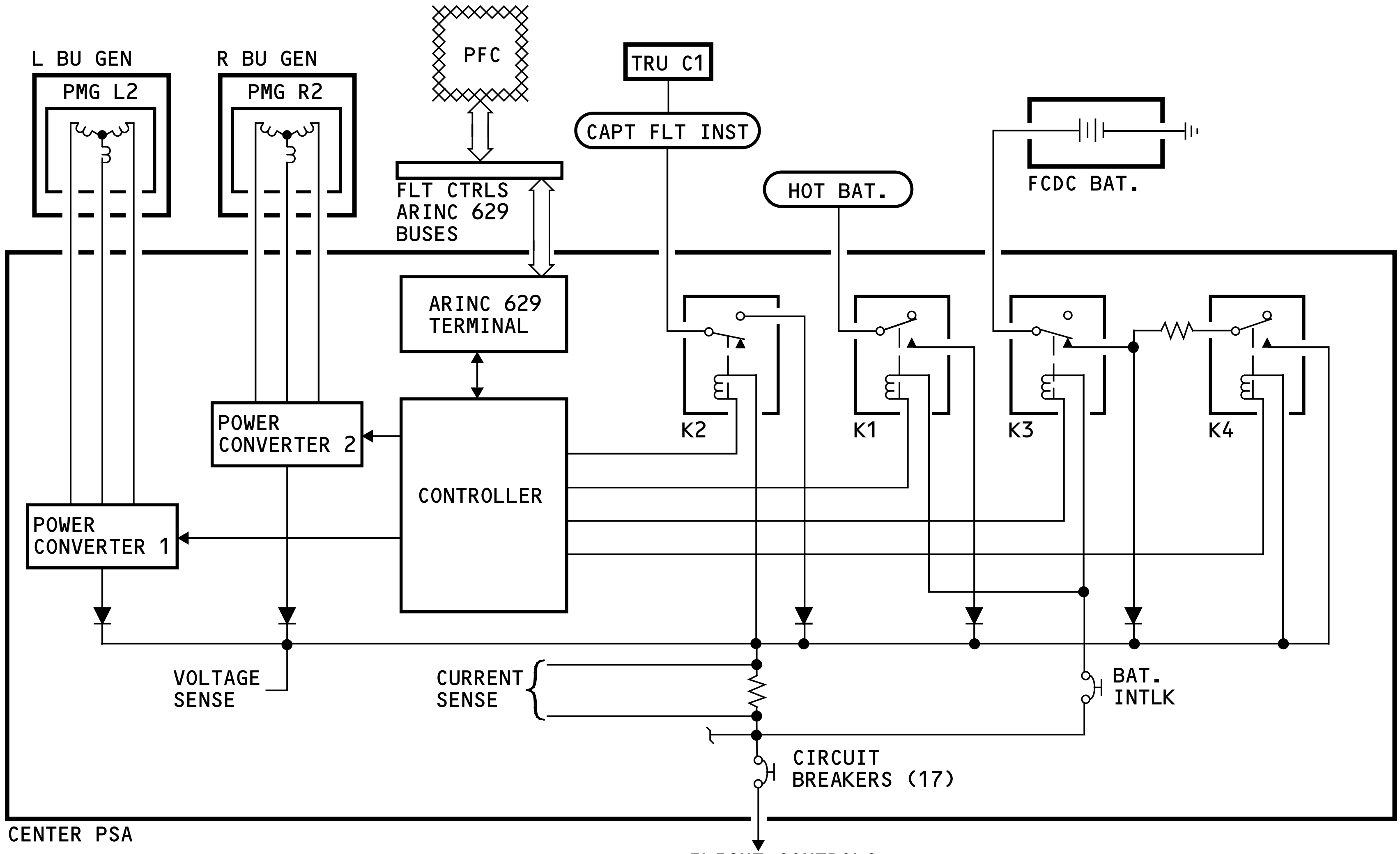
The PSA monitors the voltage of the FCDC battery. When the battery voltage is below 25 volts, the PSA energizes the K4 relay. This permits the FCDC bus to charge the battery. The battery charge cycle lasts for 300 minutes.

The PSA will not charge the battery if the battery voltage is below 21 volts or if the PSA is in backup mode.

FLIGHT CONTROLS DC POWER - FUNCTIONAL DESCRIPTION

Training Information Point

If you replace a primary flight computer (PFC), you must open the battery interlock circuit breaker of the related PSA before you remove power from the airplane. The battery interlock circuit breaker removes power from the K1 and the K3 relays. This prevents the FCDC loads from draining the main battery and the related FCDC battery. But, the PSA does automatically open K1 and K3 if the FCDC bus voltage drops below 17.5.



NOTE: CENTER PSA SHOWN WITH ENGINES RUNNING - LEFT AND RIGHT SIMILAR

24-35-00-003 Rev 3

FLIGHT CONTROLS DC POWER - FUNCTIONAL DESCRIPTION

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DC GENERATION - FUNCTIONAL DESCRIPTION

Normal Power

The dc generation system normally receives power from these ac power sources:

- Left transfer bus
- Right transfer bus
- Ground service bus
- Backup generator PMGs.

Four TRUs change the ac power from the transfer buses to dc power. Most of the dc loads on the airplane use this power.

The standby ac bus uses power directly from the left transfer bus.

Two battery chargers change the ac power from the ground service bus to dc power. This dc power charges the main and APU batteries. It also supplies power to the hot battery bus loads.

Three PSAs change the ac power from the backup generator PMGs to dc power. Flight control components use this dc power.

Standby Power

When all ac power is lost, the main battery supplies power to the standby loads of the dc generation system until the RAT deploys (except those on the first officer's flight instrument bus). The standby loads are on these buses:

- Hot battery
- Battery
- Battery No. 2
- Captain's flight instrument
- First officer's flight instrument
- Standby ac.

After the RAT deploys, its generator supplies all of the power for the standby loads through the two center TRUs.

Control

The ELMS controls all the dc power system relays. (The RAT GCU can also control the TRU C1 relay.) The battery switch and the standby power switch supply manual control inputs to the ELMS.

The ELMS decreases the effect of faults in the dc generation system by normally keeping dc buses isolated. But, if there is a power loss to a dc bus, the ELMS can supply power to that bus from another dc bus. It does this by connecting the two buses. The ELMS uses these relays to connect dc buses:

- DC bus tie
- Main battery
- Battery-captain's isolation
- Captain's-first officer's bus tie
- Ground power battery.

DC GENERATION - FUNCTIONAL DESCRIPTION

Fault Isolation - DC/Standby Self-Check

The dc subsystem card does a check of the dc system. This is called a dc/standby self-check. It does these tests:

- Makes sure all dc/standby system relays operate correctly
- Makes sure the ac standby bus has power (this does a check of the static inverter).

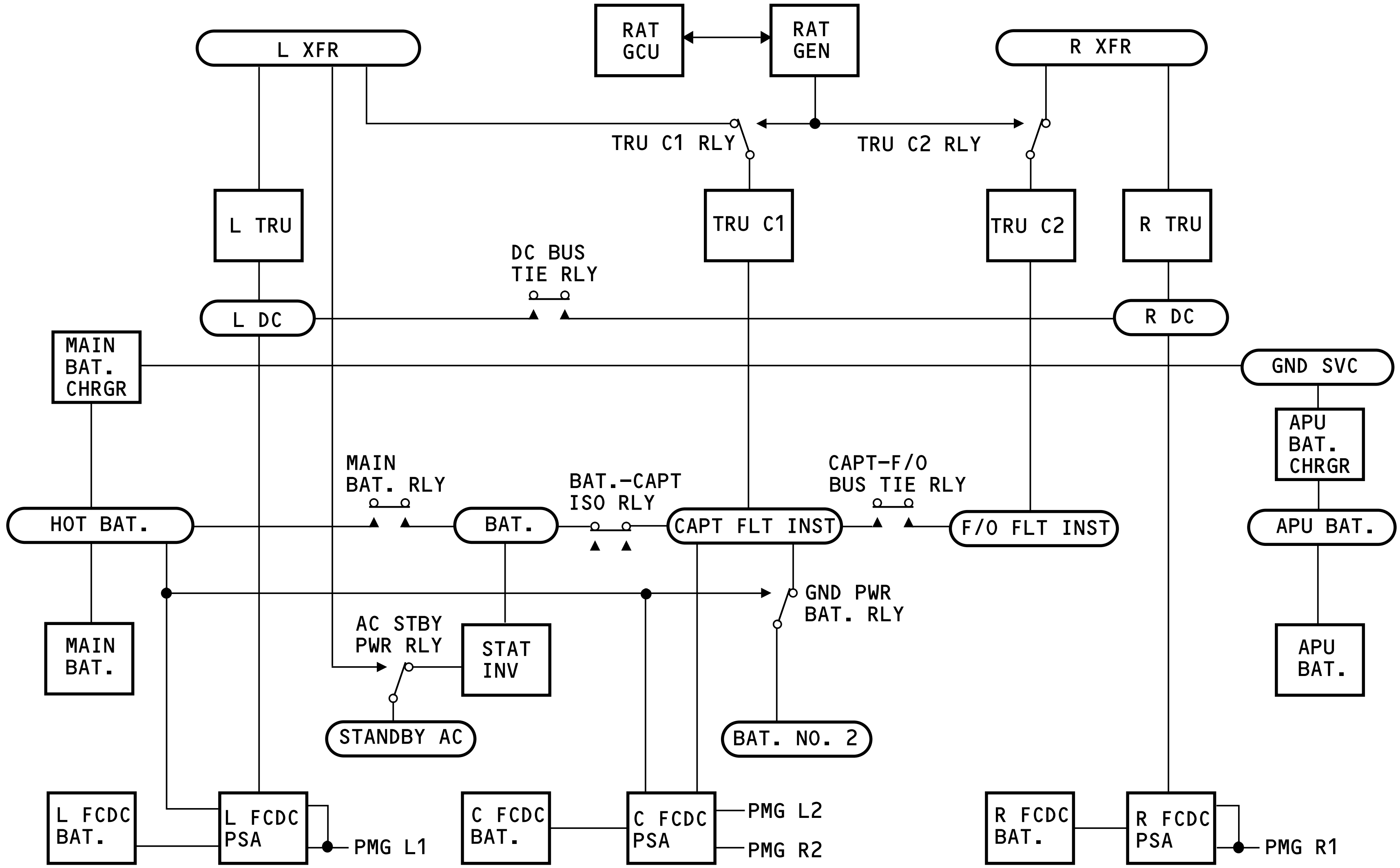
A dc/standby self-check can start either manually or automatically. You manually start the self-check when you set these conditions:

- The airplane is on the ground
- Left and right ac transfer buses have power
- The battery switch is in the ON position
- The standby power switch is in the BAT position (momentary).

The self-check starts automatically when these conditions occur:

- There are more than 72 hours since the last dc system test occurred
- The airplane is on the ground
- Left and right ac transfer buses have power.

The test takes less than ten seconds. If the system passes the test, no message shows on the EICAS display. If the system fails the test, the advisory message ELEC STANDBY SYS shows.



NOTE: ELMS CONTROLS ALL RELAYS SHOWN.
RAT GCU ALSO CONTROLS TRU C1 RELAY.

24-30-00-007 Rev 2 01/09/95

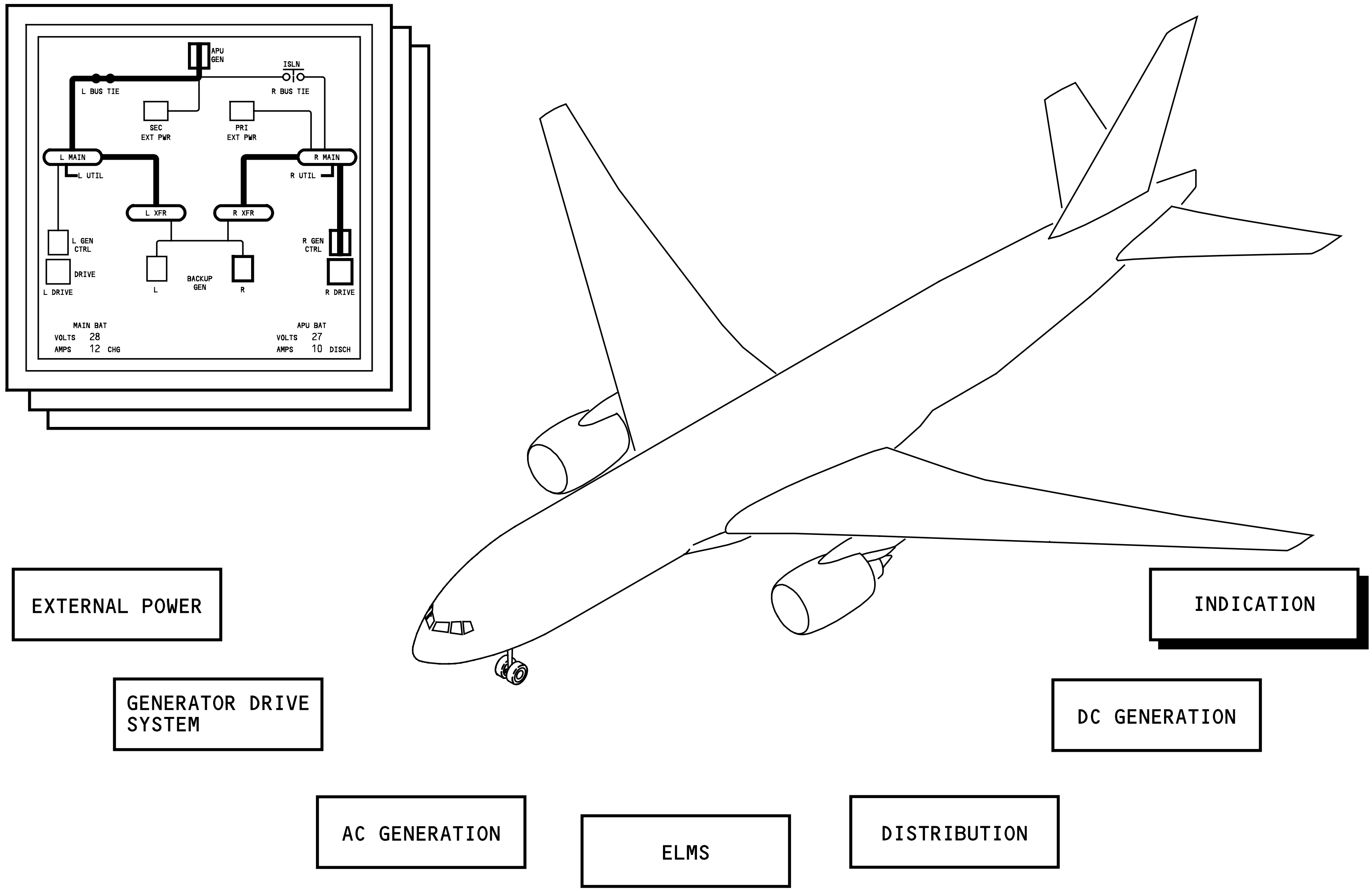
DC GENERATION - FUNCTIONAL DESCRIPTION

ELECTRICAL POWER - INDICATION - INTRODUCTION

General

The EICAS shows electrical power system indications on these formats:

- Electrical synoptic
- Electrical maintenance page 1
- Electrical maintenance page 2.



ELECTRICAL POWER - INDICATION - INTRODUCTION

ELECTRICAL POWER - INDICATION - ELECTRICAL SYNOPTIC DISPLAY

General

The electrical synoptic display is a simplified schematic of the electrical system. It shows the system configuration for these parts of the ac and dc generation systems:

- Power sources
- Buses
- BTBs
- Generator drives
- Main and APU batteries.

Green flow segments show electrical power flow from power sources to buses.

Power Sources

The electrical synoptic shows power flow from these power sources:

- IDG
- APU generator
- Backup generator
- Primary and secondary external power.

It also shows the position of the breakers for the power sources.

A white box shows when the power source is off or the breaker is open. A green box shows when the power source is on or the breaker is closed. In general, an amber box and X show when there is a fault with the power source or a fault with the breaker.

Buses

The electrical synoptic shows when these buses receive power:

- Main ac buses
- Transfer buses
- Utility buses.

When the ELMS does a load shed, the message LOAD SHED shows below the utility bus indication for the related channel.

BTB Status

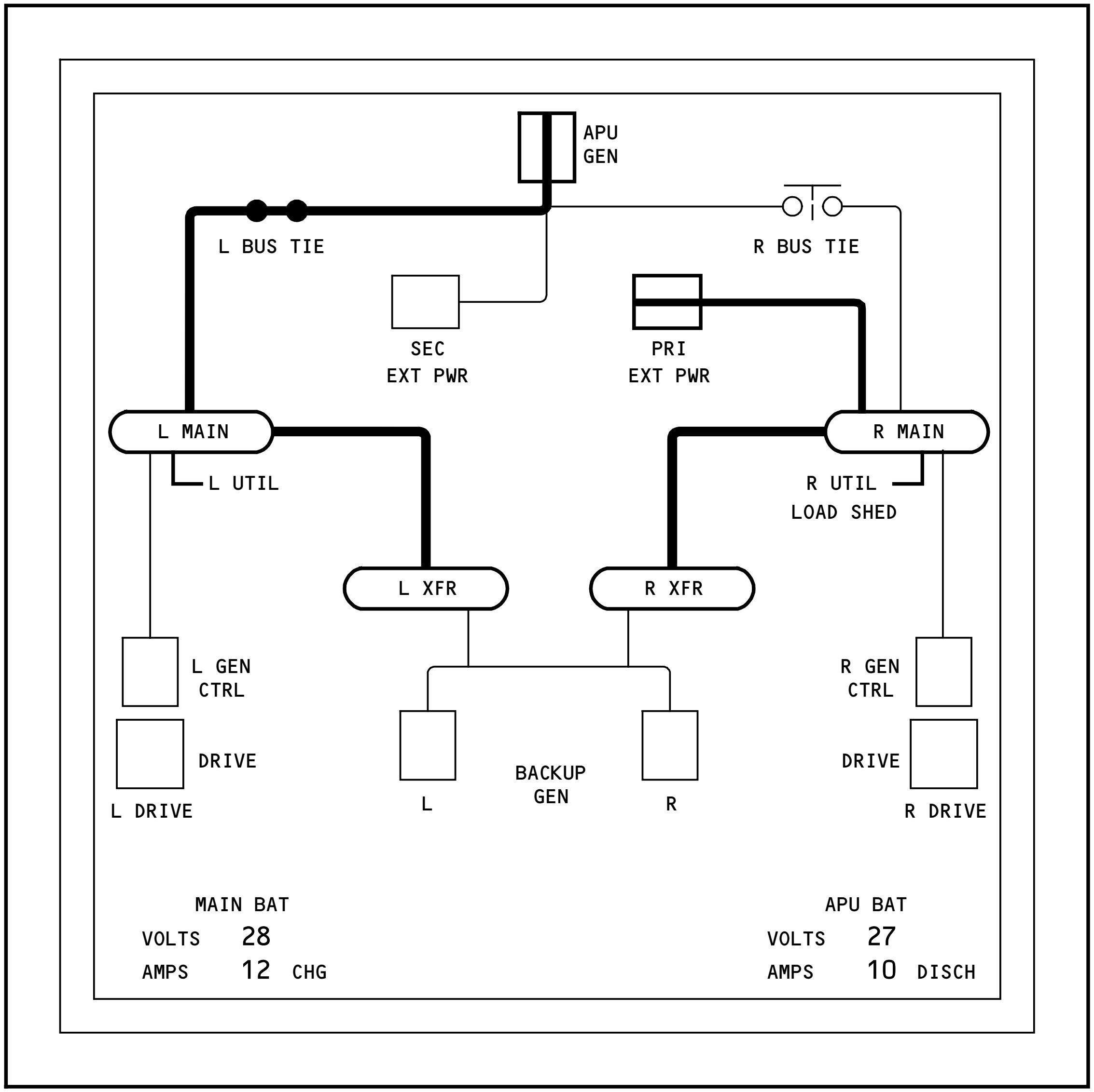
The electrical synoptic shows the BTB positions. An amber ISLN shows when a BTB is open because of a fault.

Drive Status

The electrical synoptic shows the IDG drive condition. The amber word DRIVE shows when the IDG has low oil pressure. An amber box and X show if the IDG is disconnected and the engine is running.

Main and APU Battery Output

The electrical synoptic shows the voltage and amperage output for the main and APU batteries. It also shows when a battery is charging or discharging.



ELECTRICAL POWER - INDICATION - ELECTRICAL SYNOPTIC DISPLAY

ELECTRICAL POWER - INDICATION - ELECTRICAL MAINTENANCE PAGE 1

General

The electrical system has two maintenance pages. Page 1 has information on these items:

- AC generation
- DC generation
- Generator oil information
- Fly-by-wire (FBW) output
- Auto-event messages.

AC Generation

The maintenance page shows these indications for the ac generation system power sources:

- Voltage
- Frequency
- Load.

The load is a percent of maximum output.

DC Generation

The maintenance page shows the voltage, and the load in amps, for the dc generation system power sources. Charge (CHG) and discharge (DIS) also show for the batteries.

Generator Oil Information

The maintenance page shows these indications for the IDGs and backup generators:

- Oil outlet temperature
- Oil rise temperature
- Oil level
- Oil filter message.

See the generator drive section for more information about generator oil indications (AMM PART I 24-10).

FBW Output

The maintenance page shows the voltage, and load in amps, for the FCDC buses.

SHOW PG MENU

ELECTRICAL PAGE 1/2

	L IDG	R IDG	APU GEN	PRI EXT PWR	SEC EXT PWR	BACKUP CONV	RAT GEN
AC-V	0	115	115	0	0	115	0
FREQ	0	400	400	0	0	400	0
LOAD	0.00	0.50	0.50	0.00	0.00	0.00	0.00

	MAIN BAT	L TRU	C1 TRU	C2 TRU	R TRU	APU/ BAT
DC-V	28	28	28	28	28	27
DC-A	2 CHG	25	12	11	30	10 CHG

	L IDG	R IDG	BACKUP L GEN	BACKUP R GEN	BACKUP CONV
OUT TEMP	48	105	35	100	22
RISE TEMP	2	12	1	10	--
OIL LEVEL	SERVICE	--	NORMAL	--	--
OIL FILTER	NORMAL	NORMAL	NORMAL	BLOCKED	--

	FBW L	FBW C	FBW R
DC-V	28	28	28
DC-A	14	15	15

DATE 20 AUG 96 UTC 18:54:04

ELECTRICAL POWER - INDICATION - ELECTRICAL MAINTENANCE PAGE 1

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ELECTRICAL POWER - INDICATION - ELECTRICAL MAINTENANCE PAGE 2

General

The electrical system has two maintenance pages. Page 2 is shown below. This page shows which buses are receiving power.

An ON next to the name of the bus means that it is receiving power. An OFF means that it is not receiving power.

SHOW PG MENU

ELECTRICAL PG 2/2

		L	R
AC:	MAIN	ON	ON
	XFR	ON	ON
	XFR DIST	ON	ON
	SECT 1	ON	ON
	SECT 2	ON	ON
	UTIL	ON	ON
	28V	ON	ON
AC STDBY:	115V	ON	
	28V	ON	
DC:	MAIN	ON	ON
	F/O FLT INST	ON	
	APU HOT BAT	ON	
DC STDBY:	BAT	ON	
	BAT SECT 2	ON	
	HOT BAT	ON	
	CAPT FLT INST	ON	

GND SVC:	115V	ON	GND HDLG:	115V	ON
	115V SECT 1	ON		115V DIST	ON
	115V SECT 2	ON		28V DC	ON
	28V AC	ON			

DATE 20 AUG 96 UTC 18:54:04

ELECTRICAL POWER - INDICATION - ELECTRICAL MAINTENANCE PAGE 2

Continental Airlines, Inc

Flight Data Recorder System

WB371

TABLE OF CONTENTS

FLIGHT DATA RECORDER SYSTEM - INTRODUCTION

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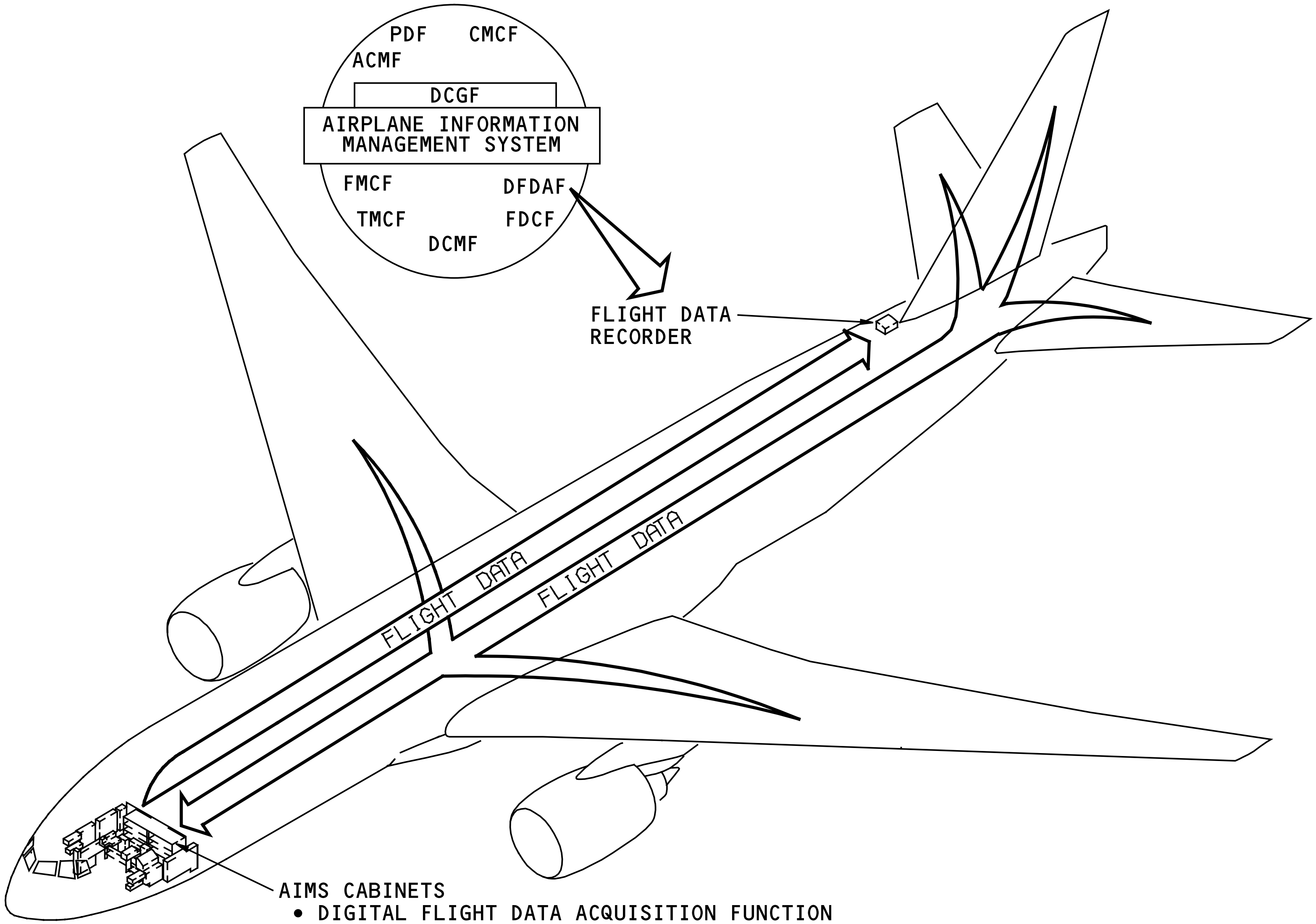
FLIGHT DATA RECORDER SYSTEM - INTRODUCTION

Purpose

The flight data recorder system (FDRS) stores airplane parameters and system data in a protected solid state memory. These parameters provide data on flight conditions and airplane systems operation. Airline personnel use the data to analyze system performance during airplane maintenance.

Glossary

ac - alternating current
ACE - actuator control electronics
AIMS - airplane information management system
AOA - angle of attack
ARINC - aeronautical radio, inc.
ATE - automatic test equipment
CMCF - central maintenance computing function
CMM - communication management module
comm - communication
CPM - core processor module
ctrl - control
dc - direct current
DFDAF - digital flight data acquisition function
EEC - electronic engine control
EICAS - engine indication and crew alerting system
ELM - electrical load management
FDR - flight data recorder
FDRS - flight data recorder system
flt - flight
gnd - ground
HF - high frequency
IOM - input/output module
L - left
LAN - local area network
lat - latitude
long - longitude
LRU - line replaceable unit
maint - maintenance
MAT - maintenance access terminal
nav - navigation
PDF - primary display function
PMA - permanent magnet alternator
pwr - power
R - right
rec - recorder
rly - relay
RPM - revolutions per minute
rtn - return
TAT - total air temperature
ULD - underwater locating device
V - volt
VHF - very high frequency
wps - words per second
xdcr - transducer
xfr - transfer
xmtr - transmitter



FLIGHT DATA RECORDER SYSTEM - INTRODUCTION

FDRS - GENERAL DESCRIPTION

General

The flight data recorder (FDR) receives and stores selected airplane parameters from various airplane systems and sensors in a crash-protected solid state memory. The digital flight data acquisition function (DFDAF) of the airplane information management system (AIMS) receives all the flight recorder data. The DFDAF then processes the data and sends it to the FDR, where it is stored. The DFDAF is in the CPM/Comm module of both AIMS cabinets.

The flight data recorder system (FDRS) operates during any engine start, while any engine is running, during test or when the airplane is in the air.

The FDR records the most recent 25 hours of flight.

In addition to the data recording function, the FDR also has monitor circuits which send fault data to the DFDAF within AIMS.

DFDAF

The DFDAF receives all flight parameters to record. The DFDAF converts these parameters to a digital format and sends them to the FDR.

Analog Signals and Analog Discretes

The DFDAF processes and the FDR stores analog signals and analog discretes.

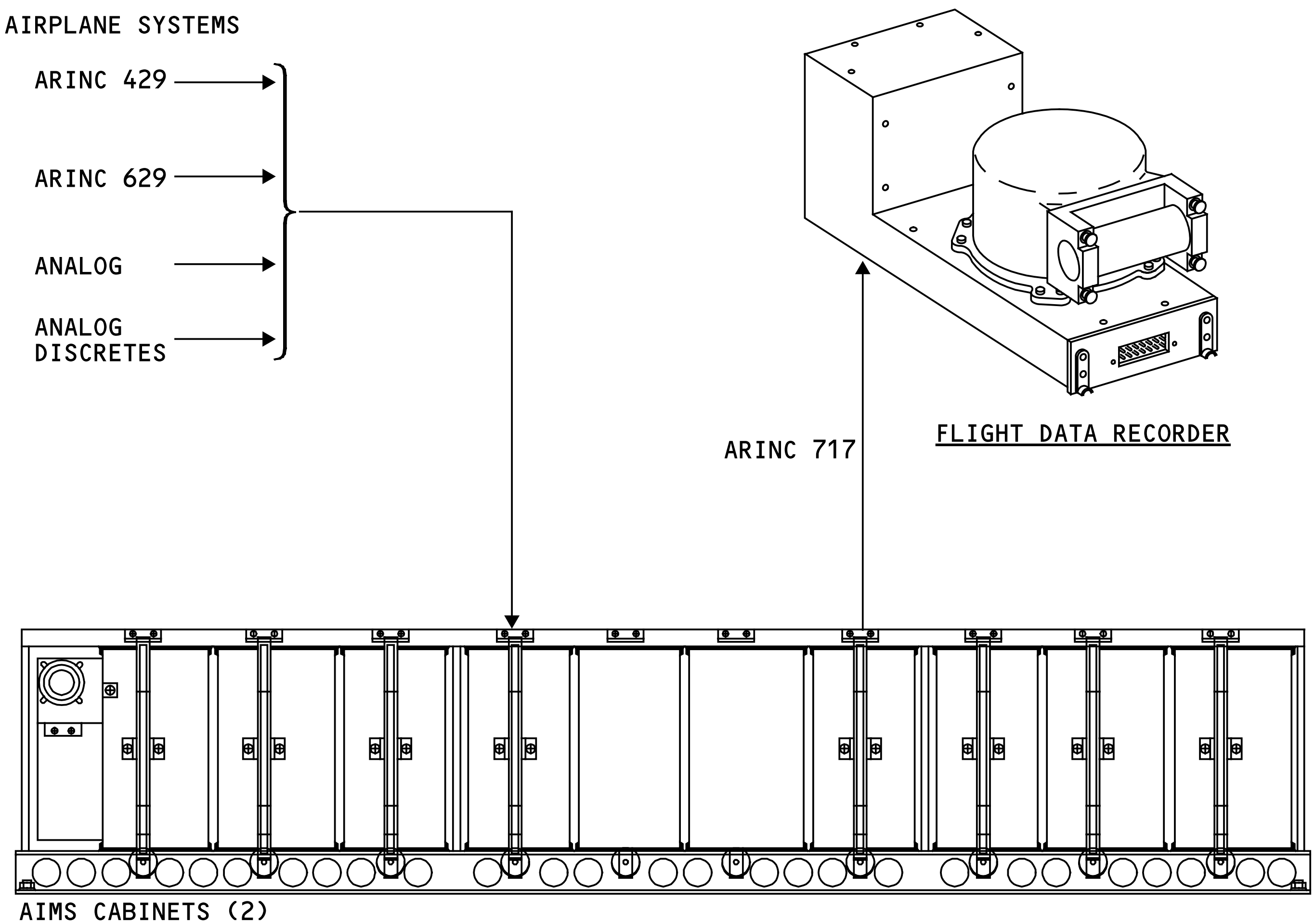
The FDR sends discrete signals to the DFDAF. The discretes show fault status.

Data Bus Interfaces

AIMS gets power control data from several airplane systems. Power goes to the FDR when the logic is valid. The power control data includes:

- Engine start
- Engine running
- Air/ground logic
- Test.

The FDR gets airplane parameters from the DFDAF in AIMS. Data goes on ARINC 717 buses. Each ARINC 717 bus has a shielded twisted pair of wires.



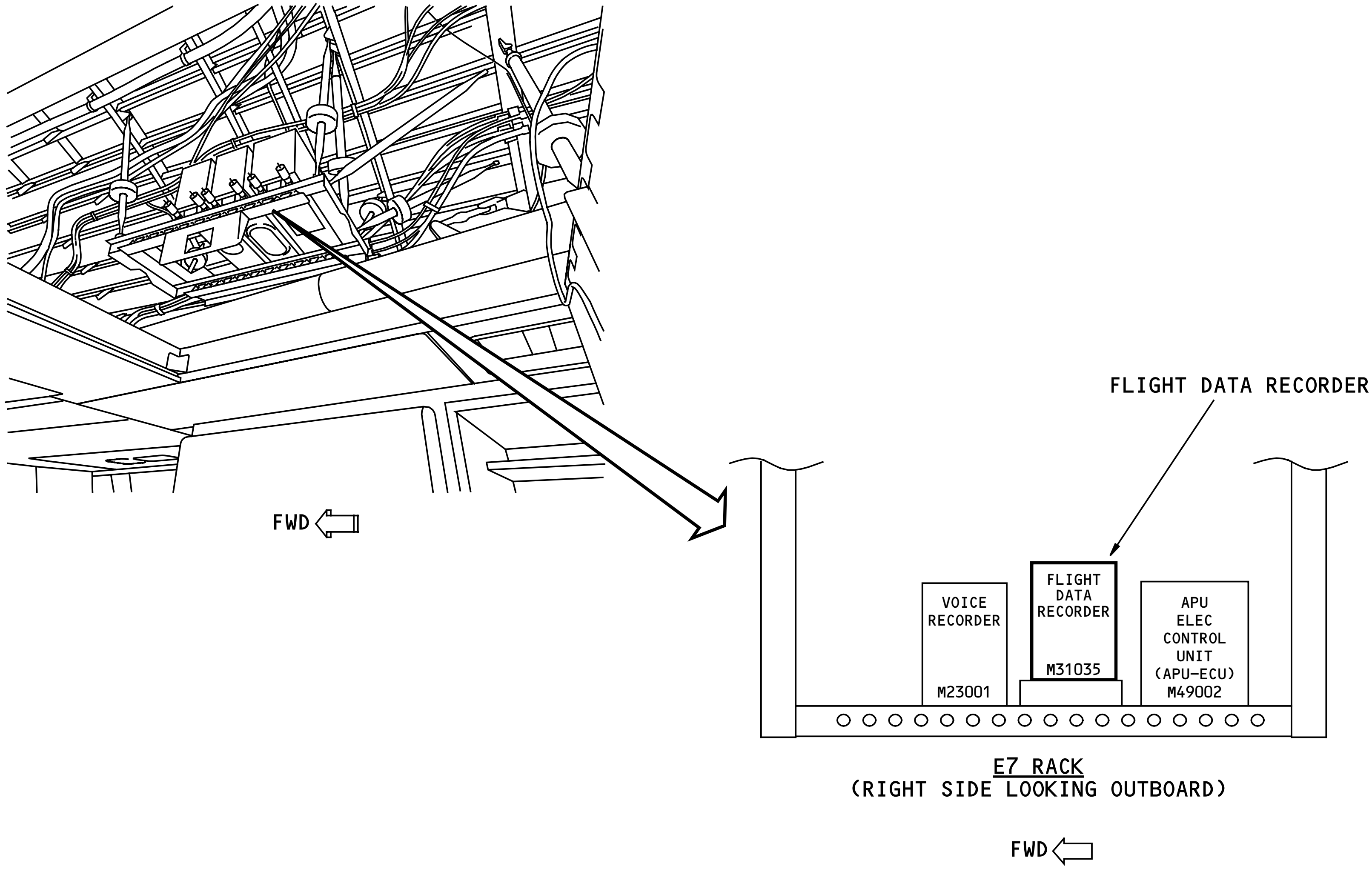
31-31-00-002 Rev 5 03/17/1998

FDRS - GENERAL DESCRIPTION

FDRS - COMPONENT LOCATIONS - 1

Aft Equipment Center

The flight data recorder (FDR) is in the E7 aft equipment rack. Access is through a ceiling panel that is forward of the aft galley.



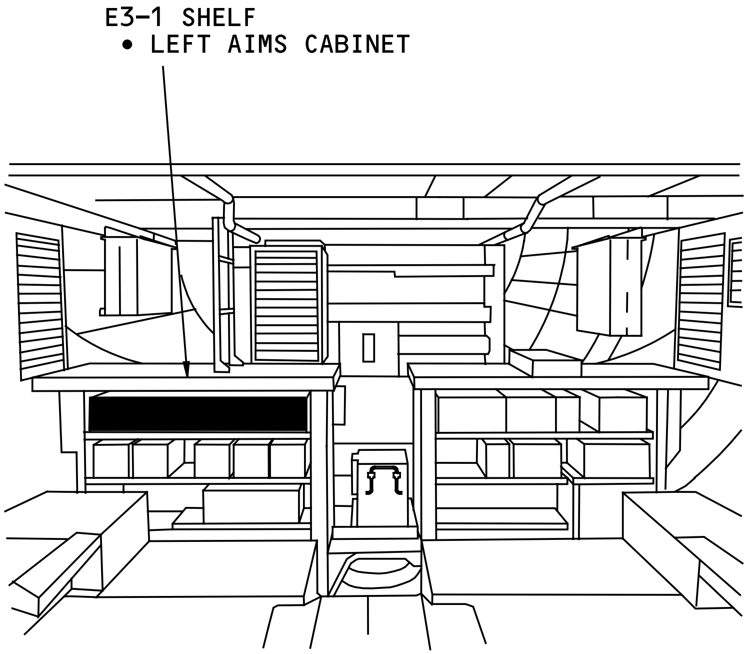
31-31-00-003 Rev 1

FDRS - COMPONENT LOCATIONS - 1

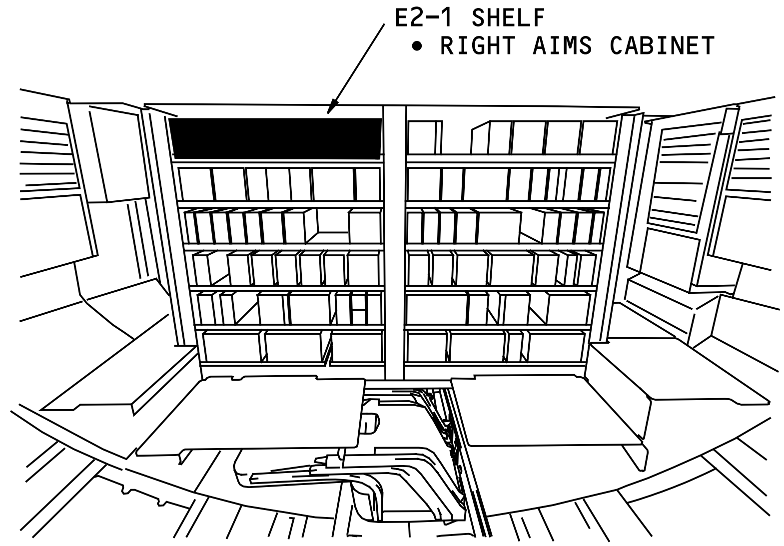
FDRS - COMPONENT LOCATIONS - 2

Main Equipment Center

The digital flight data acquisition function (DFDAF) is part of the airplane information management system (AIMS). The DFDAF is in the CPM/Comm LRM. The right AIMS cabinet is in the E2-1 shelf. The left AIMS cabinet is in the E3-1 shelf.



MAIN EQUIPMENT CENTER
(LOOKING FORWARD)



MAIN EQUIPMENT CENTER
(LOOKING AFT)

31-31-00-004 Rev 1

FDRS - COMPONENT LOCATIONS - 2

FDRS - SYSTEM INTERFACE

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FDRS - SYSTEM INTERFACE

General

The flight data recorder system (FDRS) gets digital data and digital discrete data on ARINC 629 and ARINC 429 data buses. The FDRS also receives analog inputs from some of the airplane systems and sensors. The FDR receives power from the power management panel. The FDR sends analog data to the digital flight data acquisition functions (DFDAF) of AIMS.

The left AIMS cabinet sends DFDAF data on an ARINC 717 data bus to the FDR. If the left AIMS cabinet DFDAF fails, the right AIMS cabinet sends DFDAF data to the FDR. The DFDAF sends fault data, status and test result data to the CMCF and the display system functions within the AIMS cabinets.

Power

The FDR receives power from the P210 right power management panel. DFDAF uses engine, air/ground, and ground test logic to determine when to turn on the FDR.

Analog Data

The DFDAFs receive status and maintenance flag data from the FDR. The DFDAFs receive key events from the VHF and HF LRUs and variable analog data from TAT, AOA and engine RPM sensors.

Digital Data

The systems ARINC 629 buses provides engine, airframe data, and air/ground logic. This is the engine data:

- Engine parameters, normal and exceedances
- Commands
- Actual thrust.

This is the airframe data:

- Flight deck switch position
- Flight controls positions
- Mode selections on control panels in the flight deck.

The DFDRS receives status from the engine and airframe sensors. The DFDRS also receives data and status from the electrical power system.

The flight controls ARINC 629 buses provide flight data and navigation data. This is the flight data:

- Flight control position
- Commands
- Status.

This is the navigation data from the ADIRU and SAARU:

- Pitch, roll and yaw attitude
- Acceleration data
- Status.

FDRS - SYSTEM INTERFACE

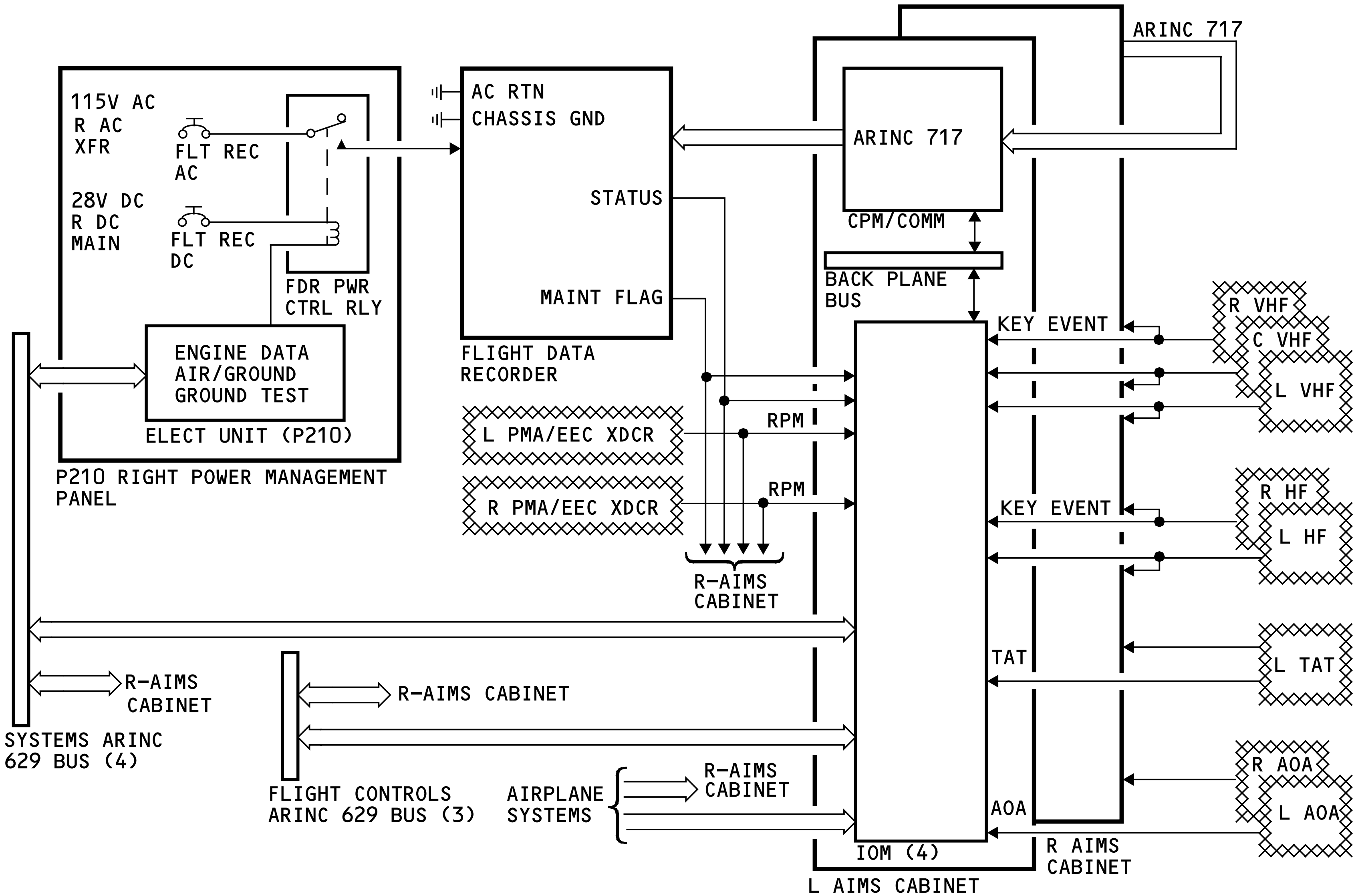
ARINC 429 provides navigation (NAV) radio/NAV data and communication (COMM) radio data. This is the NAV radio data:

- Radio frequencies
- Mode
- Parameters
- Status.

NAV data is aircraft position (LAT/LONG) and sensor status. COMM data is radio control panel frequencies and sensor status.

The left AIMS cabinet sends left or right DFDAF data on an ARINC 717 bus to the FDR.

The DFDAF sends fault data, status data and ground test results to the CMCF.



FDRS - SYSTEM INTERFACE

31-31-00-005 Rev 4 10/31/1997

FDRS - FLIGHT DATA RECORDER

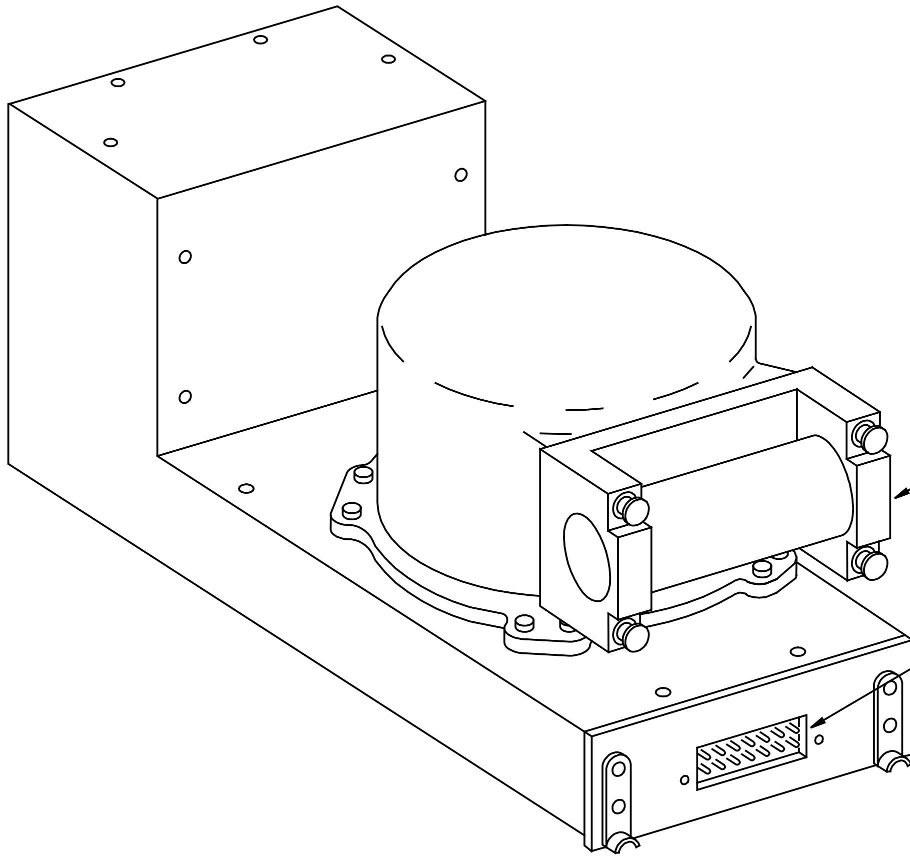
Purpose

The flight data recorder (FDR) records flight data in a protected solid-state memory.

Physical Description

The FDR is made of stainless steel. It weighs approximately 18 pounds. The memory storage assembly in the FDR is crush-proof up to 5000 pounds. The FDR case also supplies protection for up to 3400 g's of impact, deep sea pressures to 20,000 feet, and fire protection up to a temperature of 1100C for 1/2 hour.

An underwater locating device (ULD) is on the front panel. An automatic test equipment (ATE) connector is on the front of the unit.



31-31-00-006 Rev 3 03/17/1998

FDRS - FLIGHT DATA RECORDER

FDRS - UNDERWATER LOCATING DEVICE

Purpose

The underwater locating device (ULD) is an ultrasonic beacon. It makes the flight data recorder (FDR) easier to find if it is underwater.

Physical Description

The ULD is a line replaceable unit that is 1.3 inches in diameter and 4 inches long. It weighs less than 12 ounces.

Power

The ULD receives power from a 9.6 volt DUKANE model DK100 battery.

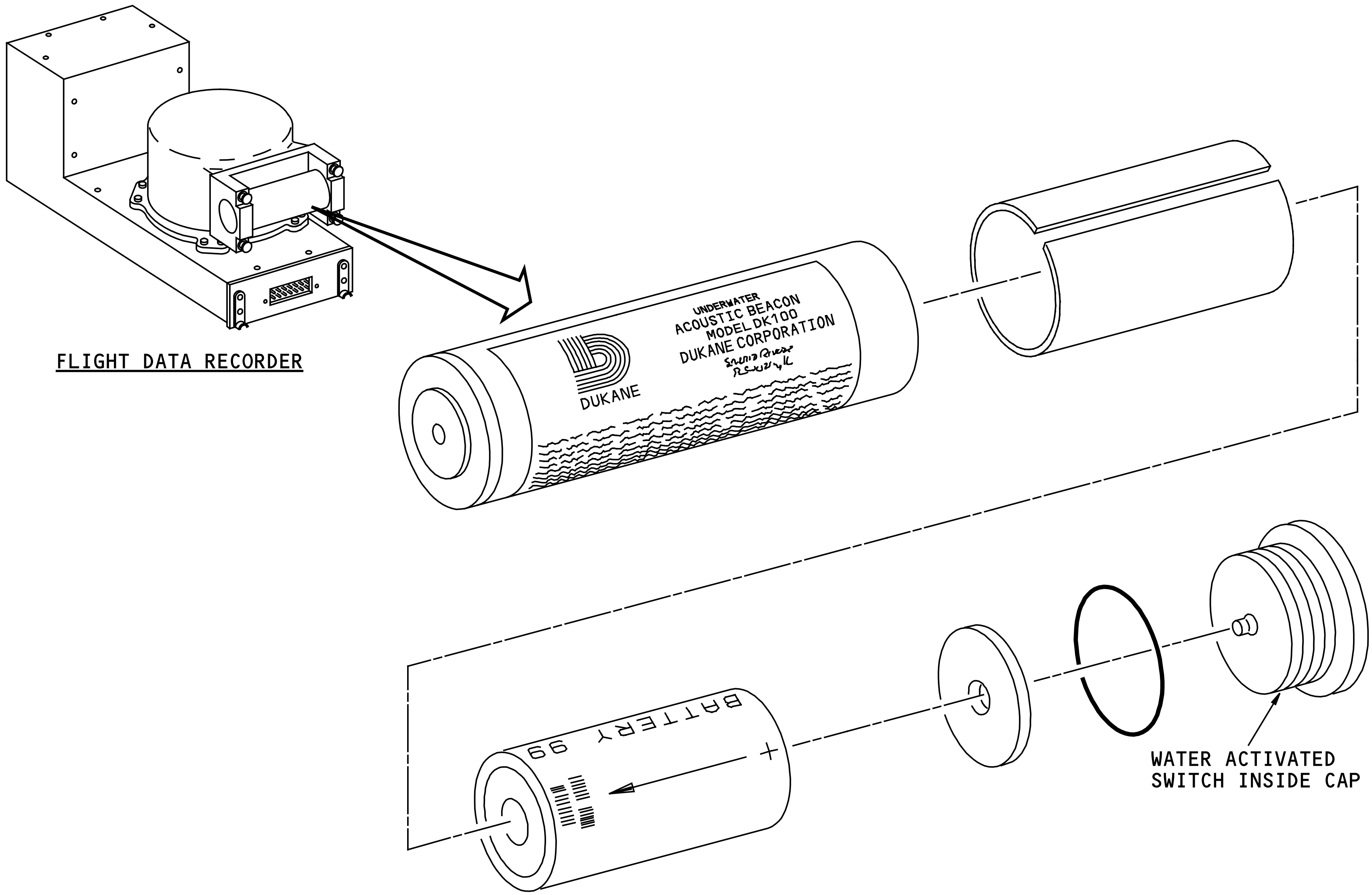
Functional Description

The ULD has these operational characteristics:

- Operates when it is put into water
- Operates to a maximum depth of 20,000 feet
- Has a detection range of 7,000 to 12,000 feet
- Has an operational life of 30 days underwater
- Sends out an acoustic pulse tone of 37.5 kHz at a rate of one pulse-per-second.

Training Information Point

The DK100 ULD uses a lithium battery. If not activated, it has a life of six years. It is important to keep the water switch contacts clean. The battery is not a line replaceable unit.



FDRS - UNDERWATER LOCATING DEVICE

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General

The digital flight data acquisition function (DFDAF) is software in each AIMS cabinet. The DFDAF collects data from:

- ARINC 629 buses
- ARINC 429 buses
- Analog discrete inputs
- Analog inputs.

The DFDAF reformats, organizes, and transmits this data to the FDR.

The DFDAF controls power to the FDR. The FDR records and monitors the fault status of the FDR system when it receives power. The FDR sends fault information to the central maintenance computing function (CMCF) and the primary display function (PDF) in AIMS.

ARINC 717 Interfaces

The AIMS core processor module/communication module (CPM/Comm) supplies ARINC 717 interfaces to the DFDAF. The AIMS DFDAF interfaces with the FDR via ARINC 717. Each of the AIMS cabinets has an ARINC 717 transmitter and a ARINC 717 bus for the FDR.

The output from the right AIMS cabinet goes to a source select relay in the left AIMS cabinet. The source select relay uses the output from the left or right DFDAF for the FDR. Software in the left AIMS cabinet controls the position of the source select relay. When the source select relay energizes, the left AIMS cabinet ARINC 717 output goes to the FDR.

DFDAF

Normal operation of the FDRS is automatic. The DFDAF is in both the left and right AIMS cabinets. The normal source of the data sent to the FDR is from the DFDAF in the left AIMS cabinet. If the left DFDAF fails, the DFDAF in the right AIMS cabinet automatically sends data to the FDR. In this case, the source select relay de-energizes. The DFDAF automatically collects, reformats and transmits data to the FDR shortly after the AIMS cabinets receive power.

The DFDAF continuously monitors airplane status to determine when to turn on the FDR and when to transmit data to the FDR. The DFDAF turns on the FDR when any one of these occur:

- Any engine is in start mode (starter air valve switch in START position or fuel cutoff lever not in CUTOFF position)
- Any engine is in the RUN mode (N1 RPM>20% or N2 RPM>20%)
- The airplane is airborne (from weight on wheels card in systems cardfile).

To supply power to the FDR, the DFDAF sends a digital discrete to the electrical load management system (ELMS) power management panel. The power management panel sends a ground to energize a relay in the panel and pass power to the FDR.

FDRS - DFDAF FUNCTIONAL DESCRIPTION

The DFDAF receives these two discrete inputs from the FDR:

- Maintenance flag
- System status flag.

The maintenance flag discrete shows a FDR internal failure. A system status flag shows a system level failure such as:

- No FDR power
- No data input to the FDR
- A power control relay failure in the power management panel.

The DFDAF reports system status to the CMCF within the AIMS cabinet.

CMCF

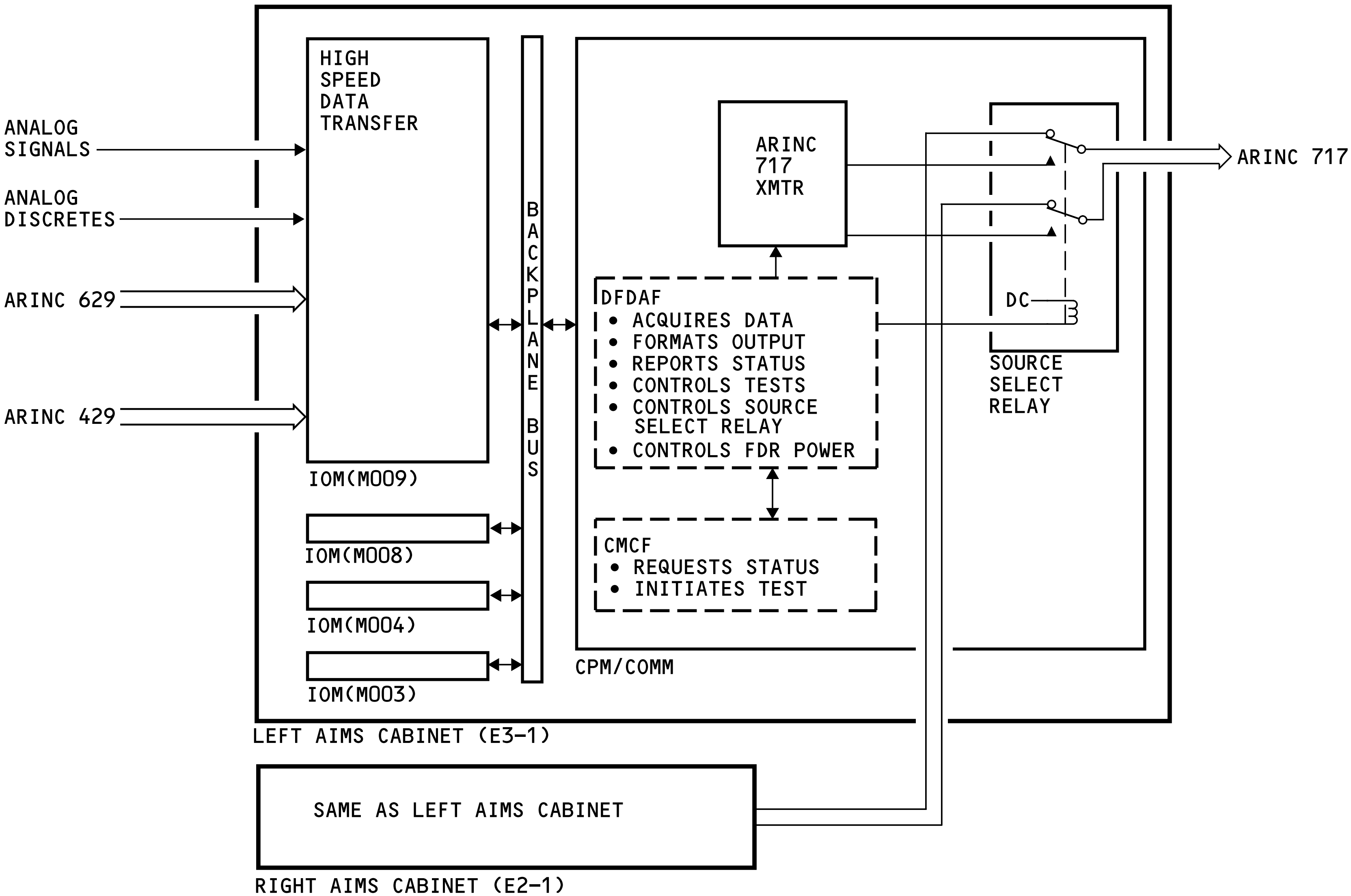
The DFDAF receives fault and status information from the FDR. DFDAF sends fault reports and status data to the CMCF. The CMCF determines pass/fail. For each fault message sent to the CMCF, the DFDAF records this information:

- Which message was sent
- The specified data
- Diagnostic data
- Date, time, and flight number
- Software part number.

Use the MAT to request the DFDAF to start the FDRS ground test. The MAT interfaces with the CMCF which sends the test command to the DFDAF. The DFDAF transmits two frames of data to the FDR to verify the operational status of the FDRS and responds back to the CMCF with a pass/fail message. You see the test results and fault status on the MAT and the EICAS display format.

The DFDAF in the right AIMS cabinet sends data to the FDR first during the ground test. After the ground test for the DFDAF in the right AIMS cabinet, the DFDAF in the left AIMS cabinet sends data to the FDR to do the second half of the ground test.

A manual POWER ON command causes the FDR to transfer data to an ARINC 615 portable data loader. A manual POWER OFF command is available from the MAT to remove power to the FDR. The FDRS normal mode of operation inhibits the manual commands.



31-31-00-008 Rev 2

FDRS - DFDAF FUNCTIONAL DESCRIPTION

FDRS - FDR FUNCTIONAL DESCRIPTION

General

The flight data recorder (FDR) receives and records the last 25 hours of data. The FDR receives the data from the DFDAF. The FDR records the data in a solid-state memory. The memory is in a crash-proof, fire-resistant container. The FDR also monitors and sends fault data to the DFDAF.

Recording Data

The AIMS digital flight data acquisition function (DFDAF) sends data on a high speed data bus (ARINC 717) to the FDR. In the FDR, the receiver processes and sends the data to the microprocessor. The microprocessor receives, processes and stores the data in a crash survival solid-state memory. Data is recorded at 128 words/second.

Data Downloading

The front mounted automatic test equipment (ATE) connector on the FDR provides a connection for:

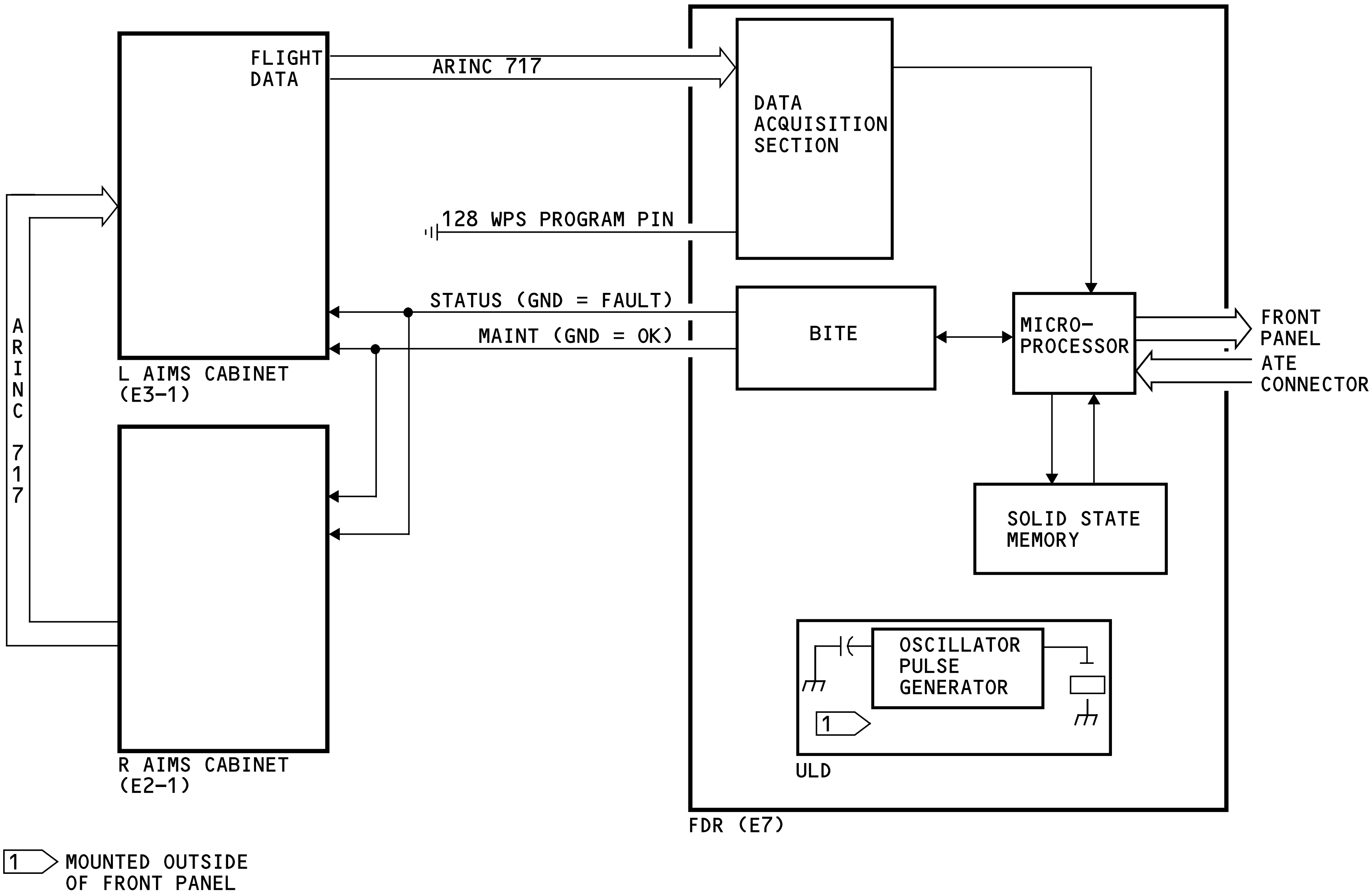
- ATE or ramp test equipment for recorder checkouts on or off the aircraft
- Data download to a portable data unit while on or off the airplane.

Non-normal Conditions

The FDR microprocessor sends these two discretes to the AIMS DFDAF:

- System status flag
- Maintenance flag.

The system status flag discrete causes a system level alert. A maintenance flag discrete causes a FDR internal failure. When a FDR fails, the FDR sends both discretes. When the AIMS DFDAF receives either discrete, EICAS (PDF) shows a FLT RCDR SYS status message. The AIMS DFDAF also sends the fault data to the AIMS CMCF.



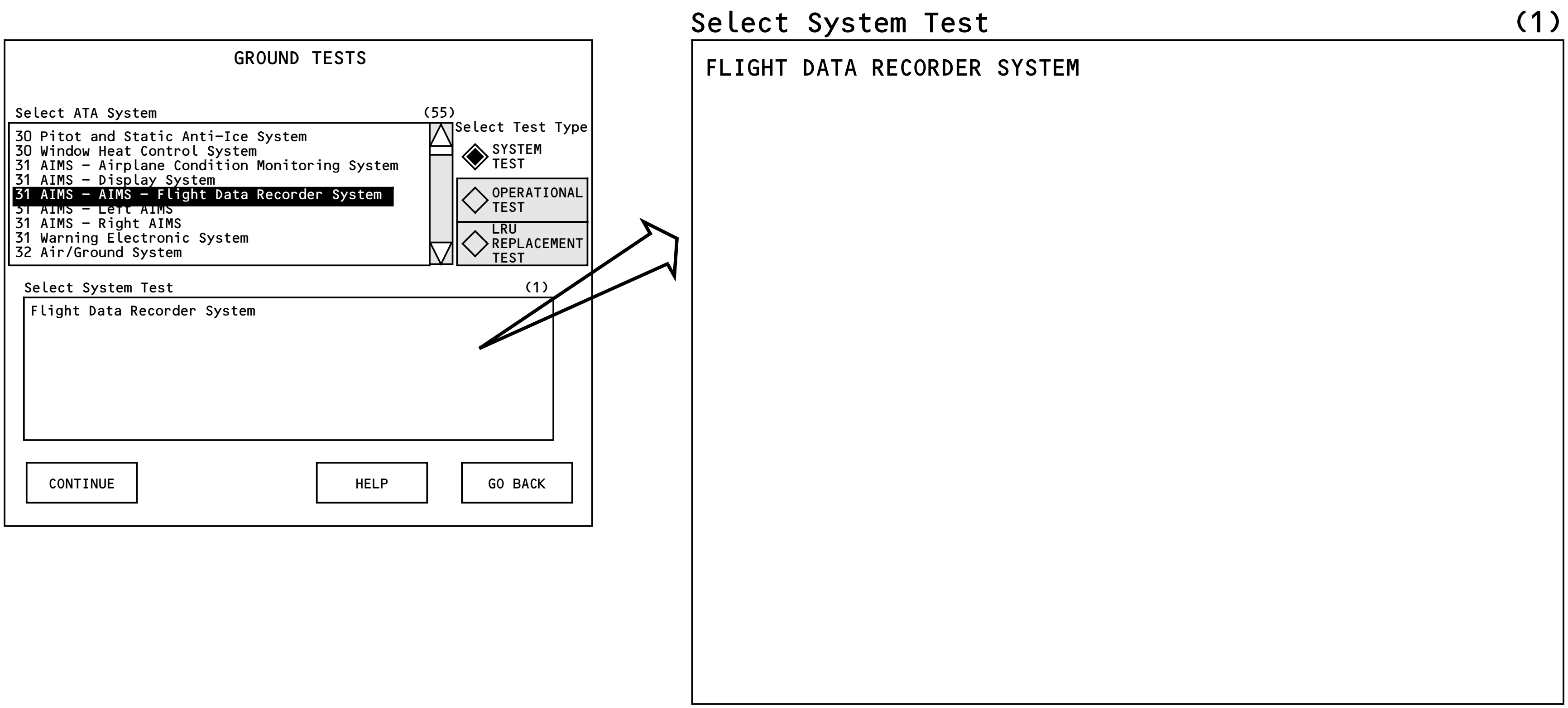
31-31-00-009 Rev 1

FDRS - FDR FUNCTIONAL DESCRIPTION

FDRS - SYSTEM TESTS

General

You can do the FDRS system test to verify correct system interfaces and internal operation of the FDR. You do the test from the MAT.


GROUND TESTS
Select ATA System
(55)
30 Pitot and Static Anti-Ice System
30 Window Heat Control System
31 AIMS - Airplane Condition Monitoring System
31 AIMS - Display System
31 AIMS - AIMS - Flight Data Recorder System
31 AIMS - Left AIMS
31 AIMS - Right AIMS
31 Warning Electronic System
32 Air/Ground System
Select Test Type
SYSTEM TEST
OPERATIONAL TEST
LRU REPLACEMENT TEST
Select System Test
(1)
Flight Data Recorder System
CONTINUE
HELP
GO BACK
Select System Test
(1)
FLIGHT DATA RECORDER SYSTEM

FDRS - SPECIAL FUNCTIONS

General

These are the special functions for the flight data recorder system:

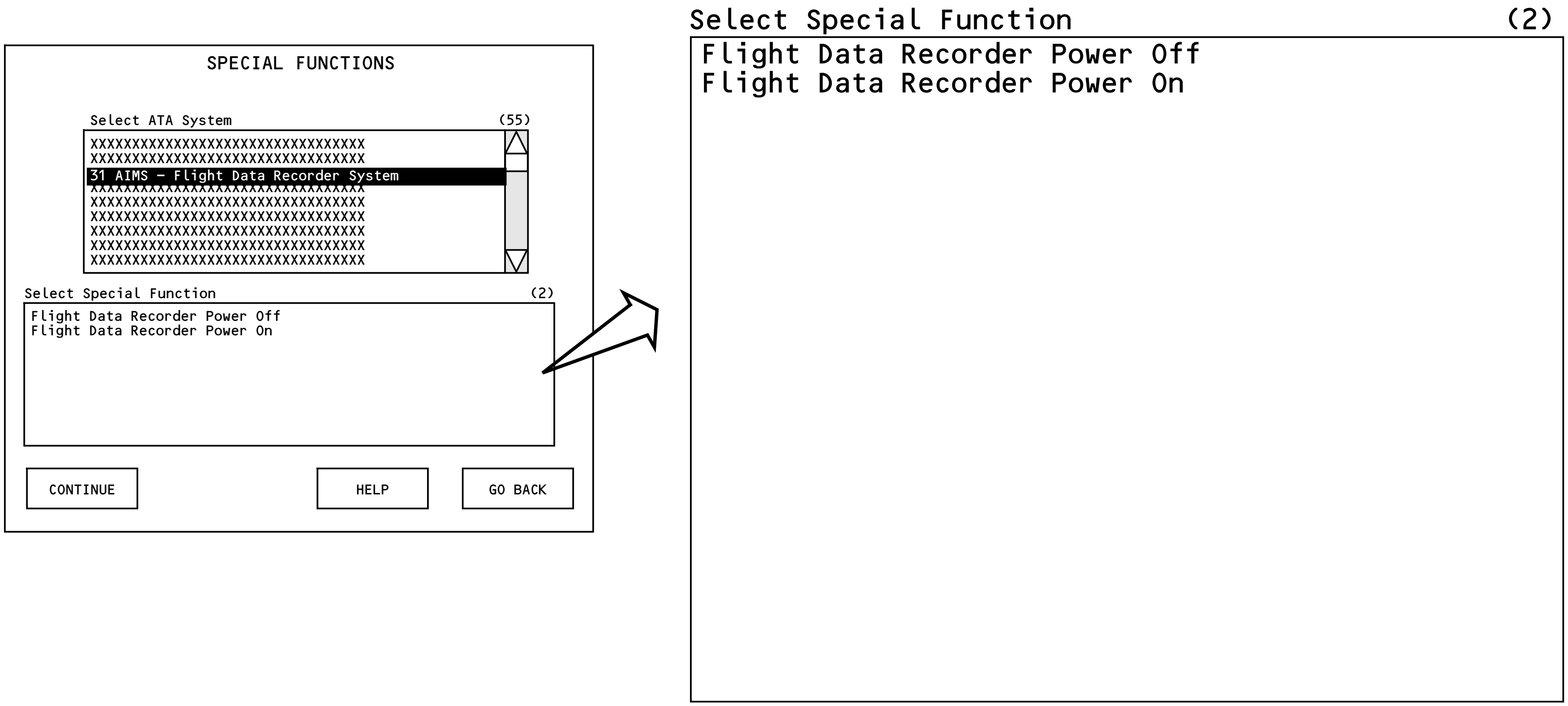
- Flight Data Recorder Power Off
- Flight Data Recorder Power On.

Flight Data Recorder Power Off

A manual POWER OFF command is available from the MAT to remove power to the FDR. The FDRS normal mode of operation inhibits the manual commands.

Flight Data Recorder Power On

A manual POWER ON command causes the FDR to transfer data to an ARINC 615 portable data loader.



31-31-00-012 Rev 1

FDRS - SPECIAL FUNCTIONS

FDRS - SYSTEM SCHEMATIC

Schematic

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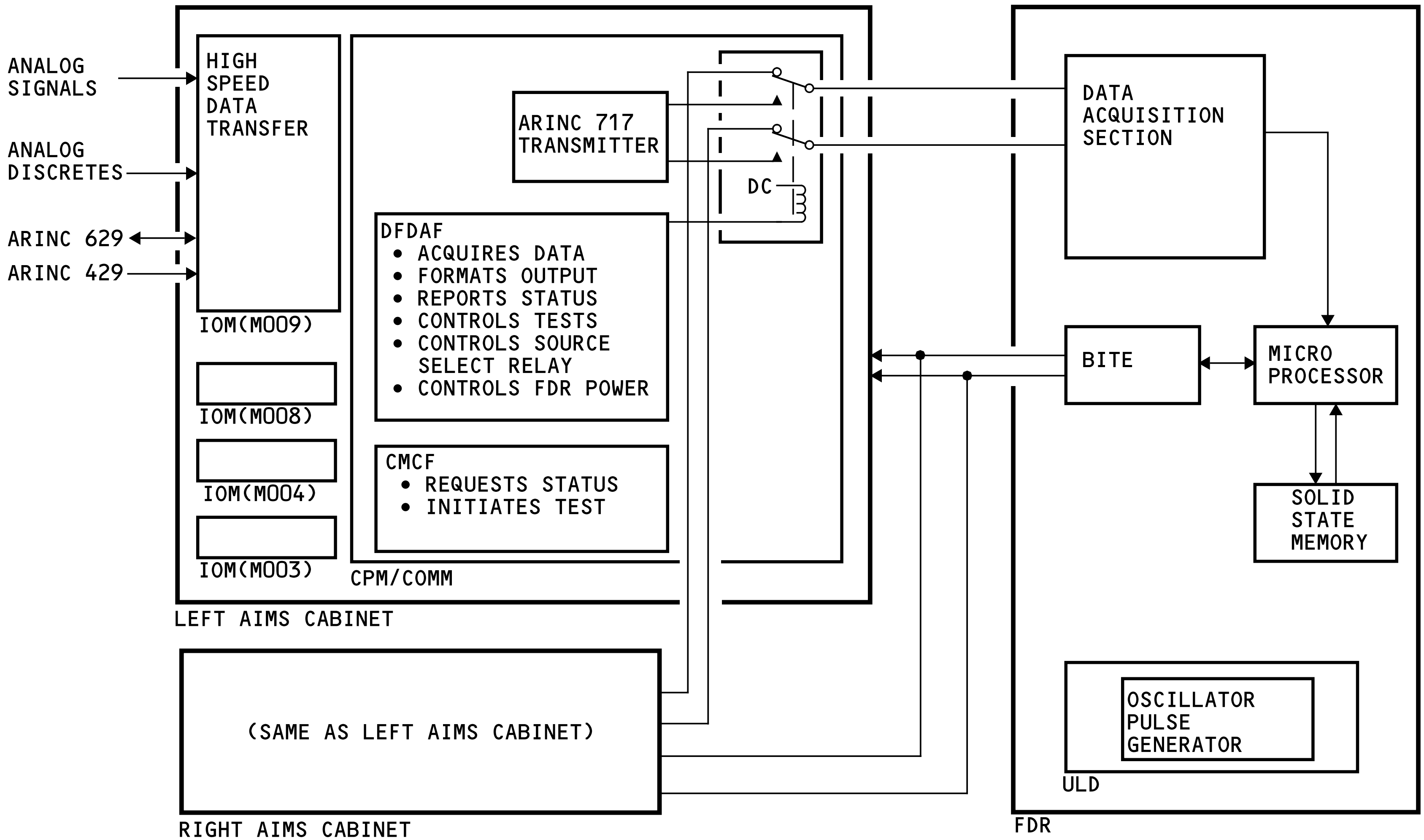


31-31-00-011 Rev 1

FDRS - SYSTEM SCHEMATIC

Continental Airlines, Inc

Data Communication Management System

WB371

TABLE OF CONTENTS

DATA COMMUNICATION MANAGEMENT SYSTEM - INTRODUCTION

General

The data communications management system (DCMS) supplies a common interface for AIMS functions and other systems that need to exchange data. The DCMS has these functions:

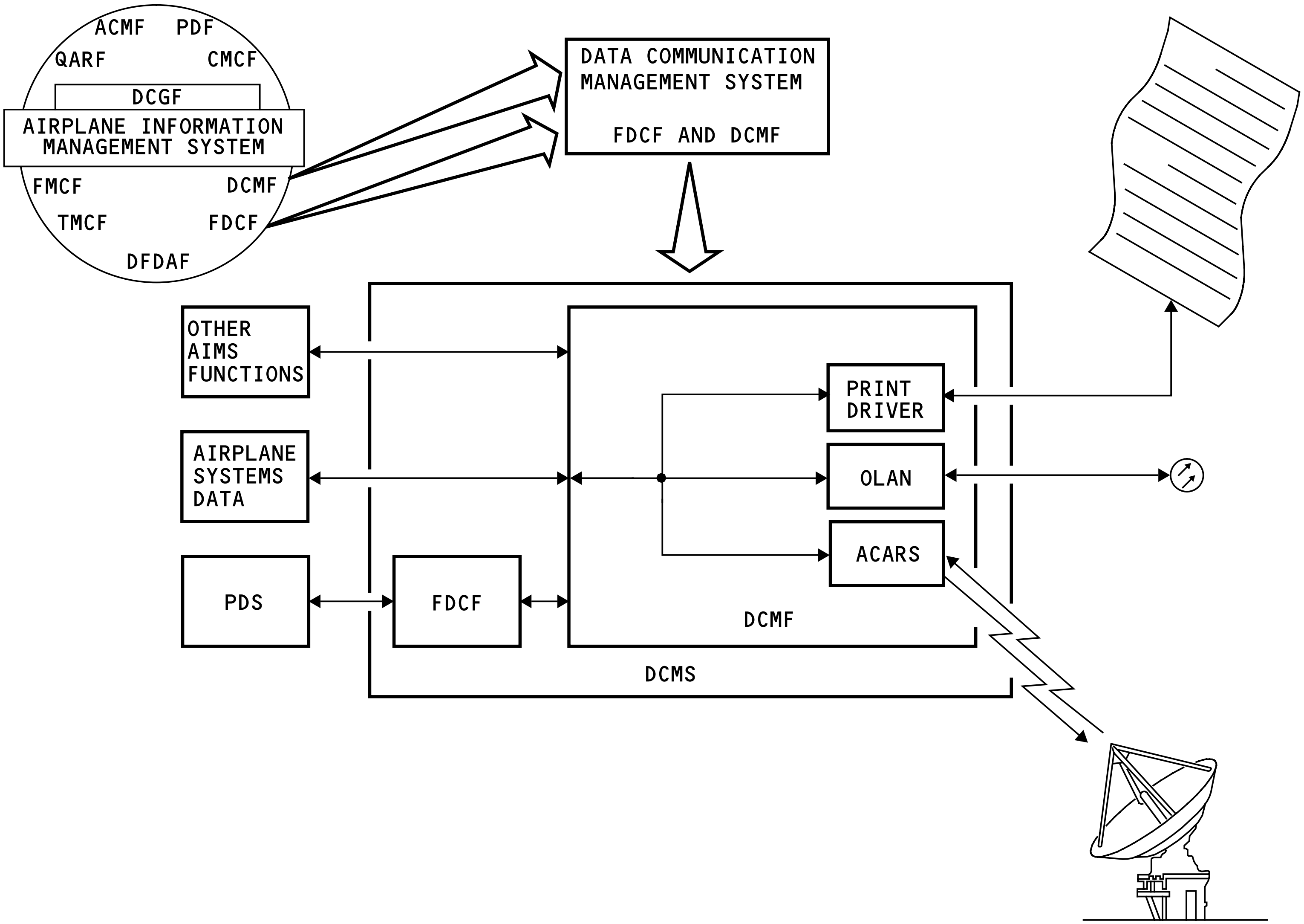
- Data communications management function (DCMF)
- Flight deck communication function (FDCF).

Abbreviations and Acronyms

ACARS	- aircraft communications addressing and reporting system
ACMF	- airplane condition monitoring function
AIMS	- airplane information management system
AMI	- airline modifiable information
APL	- airplane
ARINC	- Aeronautical Radio, Inc.
ATC	- air traffic control
ATIS	- airline traffic information system
auto	- automatic
AVLAN	- avionics local area network
BITE	- built-in test equipment
BSU	- bypass switch unit
CCD	- cursor control device
CDU	- control display unit
CMCF	- central maintenance computing function
COMM	- communication
CPI	- communication program interface
CPM	- core processor module
DCMF	- data communication management function
DCMS	- data communication management system
DFDAF	- digital flight data acquisition function
DLGF	- data load gateway function
DSP	- display select panel
EICAS	- engine indication and crew alerting system
ETA	- estimated time of arrival
FDCF	- flight deck communication function
FDDI	- fiber digital data interface
FMCF	- flight management computing function
GBST	- ground base software tool
GSP	- ground service provider
info	- information
I/O	- input/output
IOM	- input/output module
ISO	- International Standards Organization
LAN	- local area network
LRU	- line replaceable unit
MAT	- maintenance access terminal
MCP	- mode control panel
MFD	- multi-function display
MTF	- maintenance terminal function
NOTAMS	- notice to airmen
OLAN	- onboard local area network
OPC	- operational program configuration
OPS	- operational program software
OSI	- open systems interconnection
PDF	- primary display function

DATA COMMUNICATION MANAGEMENT SYSTEM - INTRODUCTION

PDS	- primary display system
PIIC	- passenger inflight information computer
PMAT	- portable maintenance access terminal
pri	- primary
PROC	- processor
RTP	- radio tuning panel
SATCOM	- satellite communication
sec	- secondary
sw	- switch
SDU	- satellite data unit
VHF	- very high frequency
xcvr	- transceiver
xpdr	- transponder



DATA COMMUNICATION MANAGEMENT SYSTEM - INTRODUCTION

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DCMS - GENERAL DESCRIPTION

General

The data communication management system (DCMS) manages analog and digital data in many different formats. It divides the work into these two functions:

- Data communication management function (DCMF)
- Flight deck communication function (FDCF).

The DCMF manages the radio hardware interfaces and internal processing. The FDCF controls the flight deck interface and passes it on to the DCMF.

DCMF

The DCMF supplies the protocols and manages data for these sub-functions:

- ACARS datalink sub-function
- Onboard local area network (OLAN) interface sub-function
- Print driver sub-function.

The aircraft communications addressing and reporting system (ACARS) datalink sub-function manages flight plan and maintenance data between the airplane and the ground service provider (GSP). The ACARS datalink sub-function connects to these components of other systems:

- Satellite data unit (SDU)
- Center and right VHF communication transceivers
- Left, center and right radio tuning panels (RTPs).

The OLAN interface sub-function manages the data exchange between the DCMF and the components on the avionics local area network (AVLAN). The AVLAN is part of the OLAN. The AVLAN includes these components:

- Maintenance access terminal (MAT)
- Brouter.

The brouter connects to the portable maintenance access terminals (PMATs).

The print driver sub-function manages all print requests for the DCMS. It sends data from the DCMS to the flight compartment printer, and sends print job status and any fault data back to the DCMS.

FDCF

The FDCF supplies an operator interface for the DCMS. You use these components to make inputs to the FDCF:

- The display select panel (DSP)
- The multi-function display (MFD)
- The control display units (CDU)
- The cursor control devices (CCD)
- Accept/reject/cancel switches.

The DSP controls which display unit shows the MFD. You use the DSP to select the COMM MFD display.

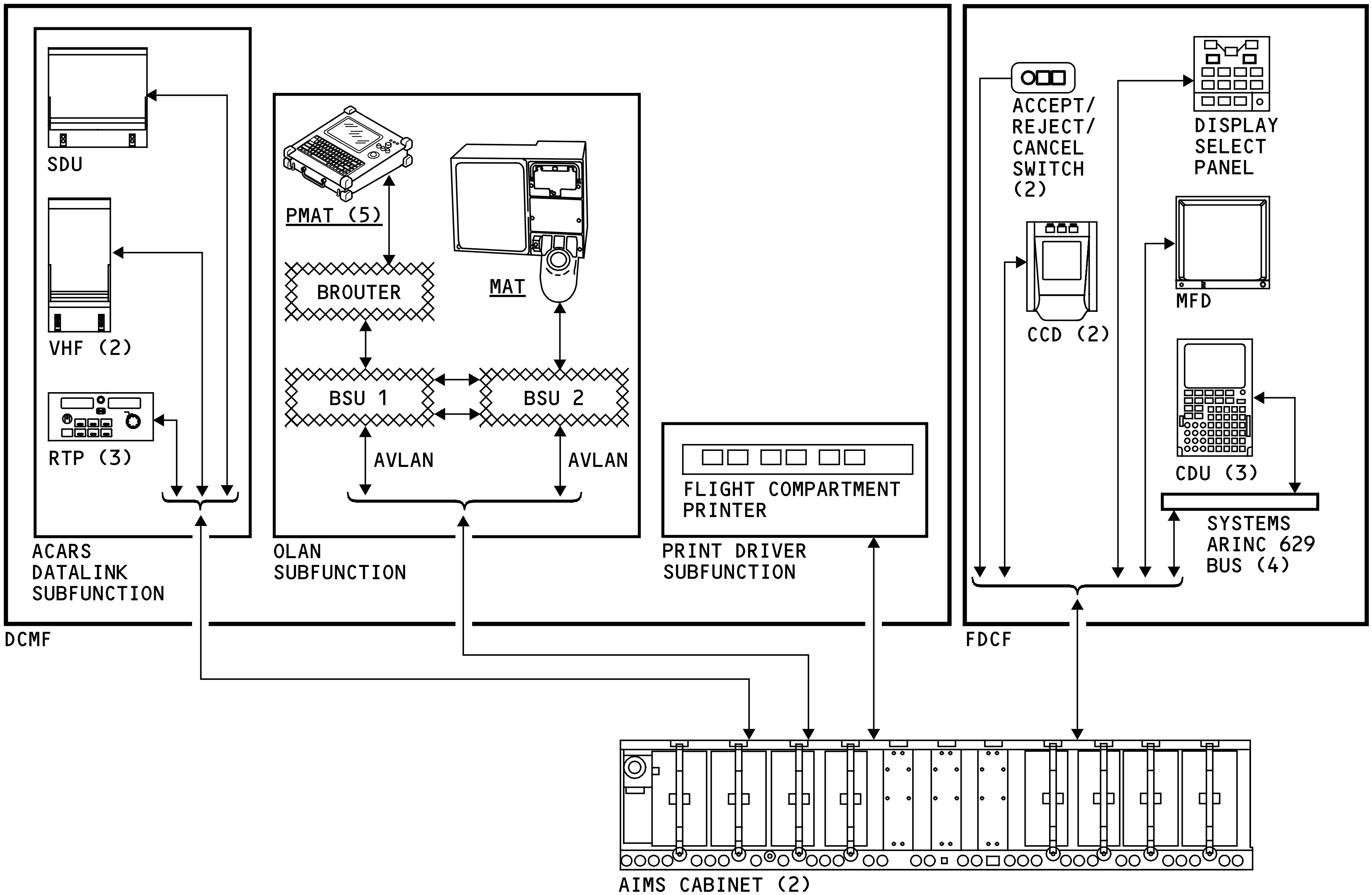
When you select the COMM display on the DSP, the MFD shows the FDCF main menu.

DCMS - GENERAL DESCRIPTION

You use the CDUs to enter text to the FDCF displays. After you type text in the CDU scratch pad you use the CCD select switch to move it to the FDCF display.

You also use the CCDs to select menu items, buttons, and text boxes on the FDCF displays.

You use the accept/reject/cancel switches to accept, reject, or cancel messages that show on the FDCF displays.



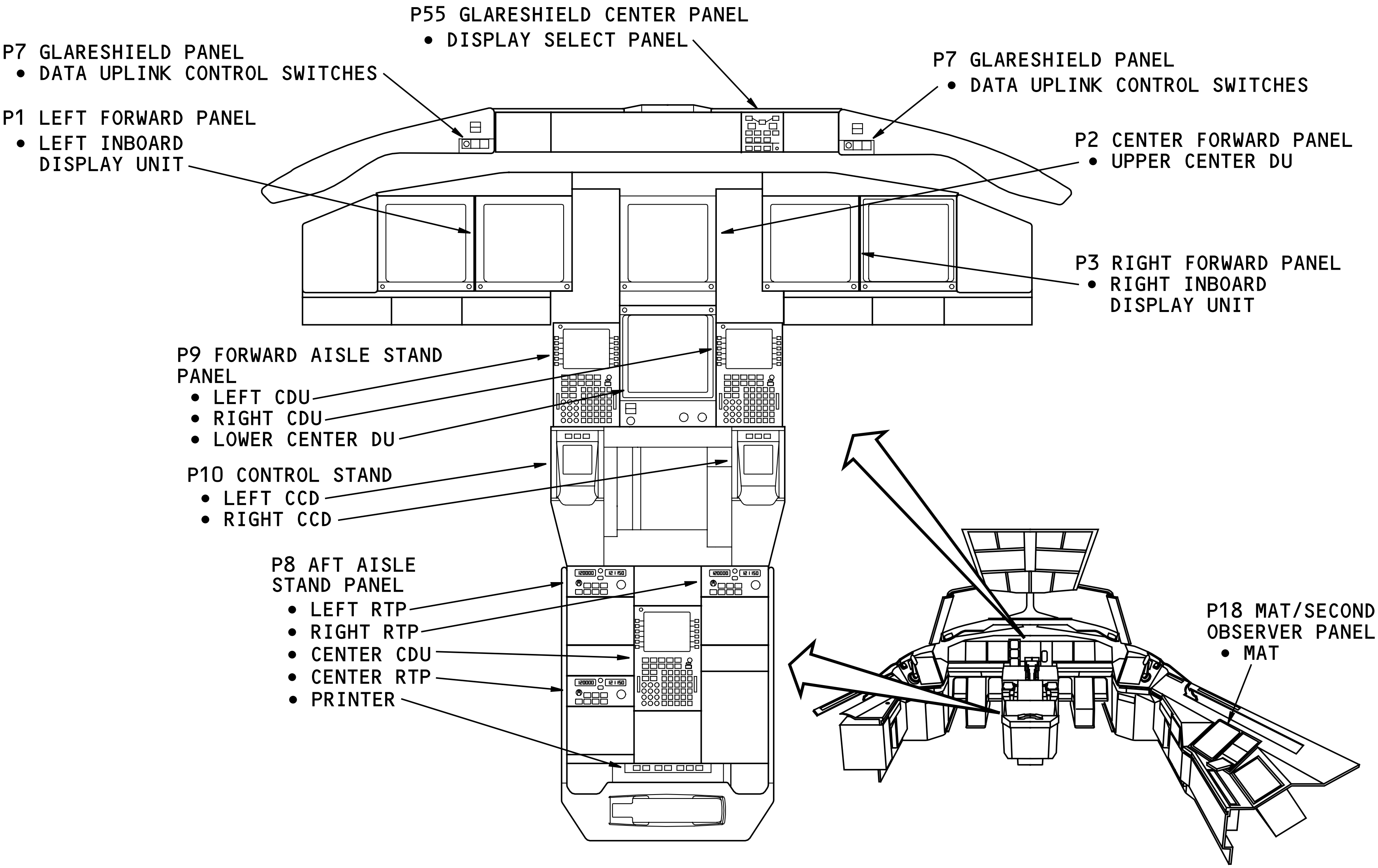
DCMS - GENERAL DESCRIPTION

DCMS - COMPONENT LOCATIONS - FLIGHT DECK

Flight Deck Components

These are the DCMS related components in the flight deck:

- Left data uplink control switches
- Right data uplink control switches
- Left inboard display unit (DU), (MFD)
- Right inboard DU (MFD)
- Upper center DU
- Lower center DU (MFD)
- Display select panel
- Left cursor control device (CCD)
- Right CCD
- Left control display unit (CDU)
- Right CDU
- Center CDU
- Left radio tuning panel (RTP)
- Right RTP
- Center RTP
- Maintenance access terminal (MAT).



23-27-00-003 Rev 4 05/30/96

DCMS - COMPONENT LOCATIONS - FLIGHT DECK

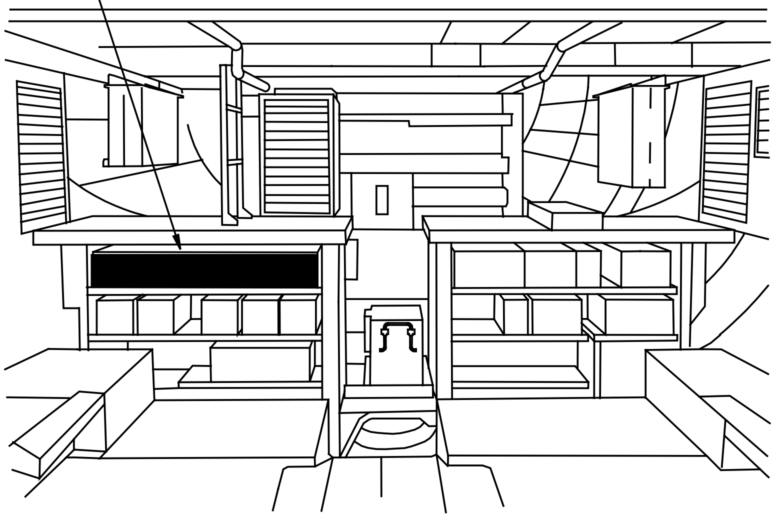
DCMS - COMPONENT LOCATIONS - MAIN EQUIPMENT CENTER

DCMS Component Locations

The DCMS components in the main equipment center are the data communication management function (DCMF) and flight deck communication function (FDCF) software in the AIMS cabinets.

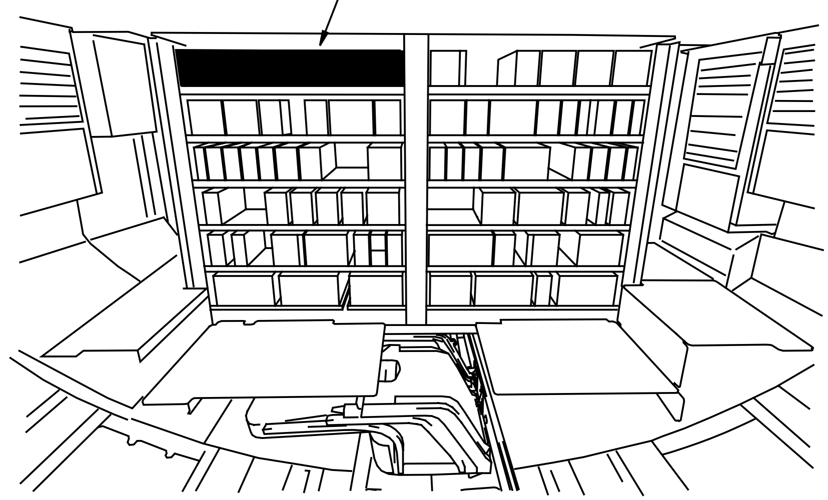
The DCMF and FDCF are in the AIMS core processor module/communications (CPM/Comm) in both the left and right AIMS cabinets.

E3-1 SHELF
• LEFT AIMS CABINET



E3 RACK
(LOOKING FORWARD)

E2-1 SHELF
• RIGHT AIMS CABINET



E2 RACK
(LOOKING AFT)

23-27-00-004 Rev 1

DCMS - COMPONENT LOCATIONS - MAIN EQUIPMENT CENTER

DCMS - ARINC 429 INPUTS AND ARINC 618 INTERFACES

General

The data communication management function (DCMF) receives data on low speed and high speed ARINC 429 buses. It also receives and sends data on ARINC 618 buses.

Input Components

These components exchange data with the DCMF:

- Satellite data unit (SDU)
- Flight deck printer
- Inflight entertainment system
- left, center, and right radio tuning panels (RTP)
- Center and right VHF communication transceivers (VHF).

Satellite Data Unit

The SDU sends ground service provider (GSP) data to the DCMF on a high speed ARINC 429 bus.

The SDU data goes to IOM (M003) and IOM (M004) in the left AIMS cabinet, and IOM (M008) and IOM (M009) in the right AIMS cabinet.

Flight Compartment Printer

The flight compartment printer sends status and error data to the DCMF on a high speed ARINC 429 bus.

Printer data goes to IOM (M009) in both AIMS cabinets.

Inflight Entertainment System

The inflight entertainment system sends data to the DCMF on a high speed ARINC 429 bus. The DCMF sends this data to the GSP. The data is downlink data.

Inflight entertainment system data goes to IOM (M009) in both AIMS cabinets.

Radio Tuning Panels

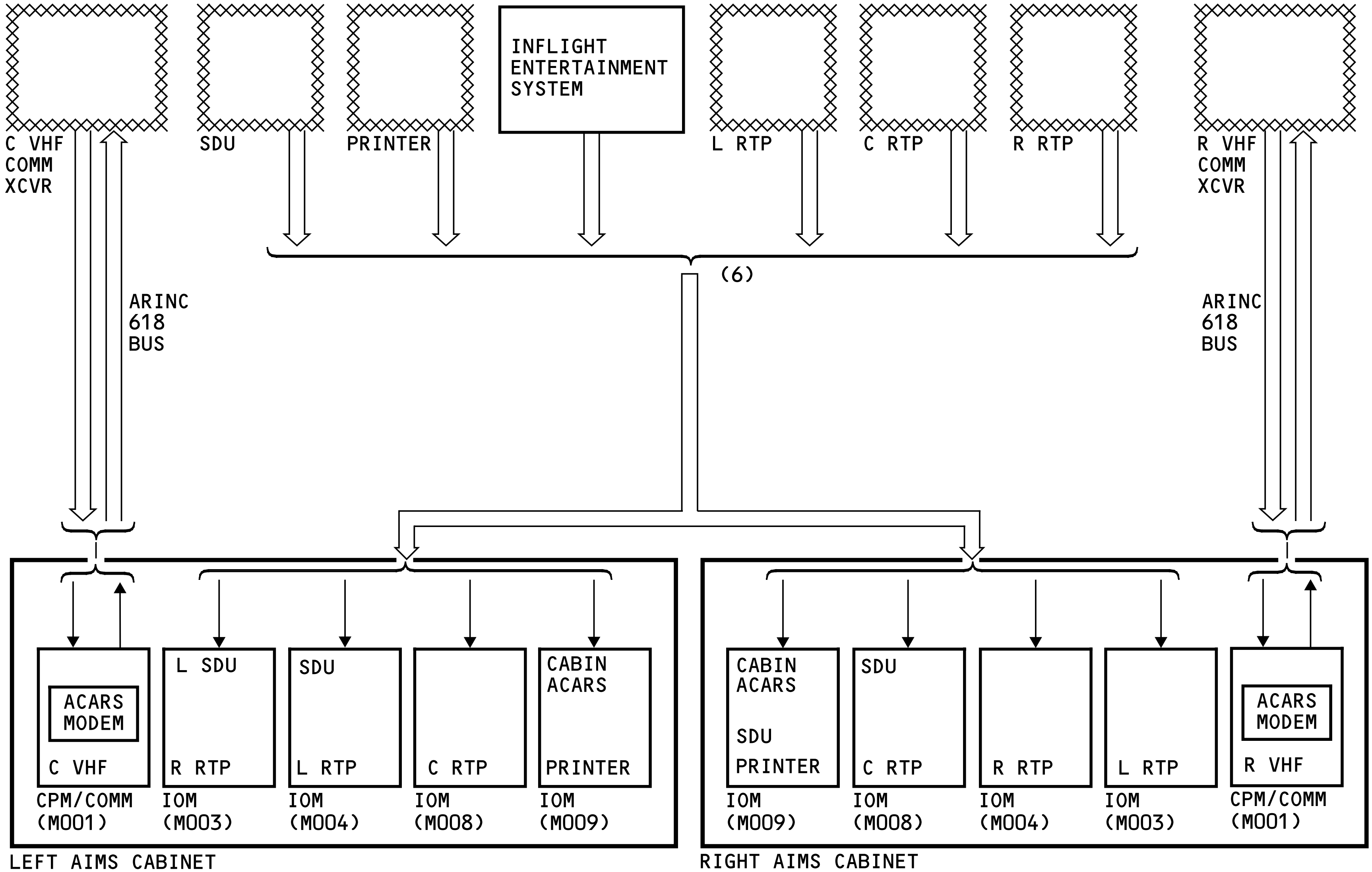
The RTPs send tuning data and broadcast status data to the DCMF and the flight deck communication (FDCF) on low speed ARINC 429 buses.

Left RTP data goes to IOM (M004) in the left AIMS cabinet and IOM (M003) in the right AIMS cabinet. Center RTP data goes to IOM (M008) in both cabinets. Right RTP data goes to IOM (M003) in the left AIMS cabinet and IOM (M004) in the right AIMS cabinet.

VHF Communication Transceivers

The DCMF receives and sends GSP data to the VHF transceivers on ARINC 618 data buses.

The center VHF exchanges data with the ACARS modem in the left CPM/Comm. The right VHF exchanges data with the ACARS modem in the right CPM/Comm. The DCMF does not interface with the left VHF transceiver.



DCMS - ARINC 429 INPUTS AND ARINC 618 INTERFACES

DCMS - ARINC 429 INTERFACES - OUTPUTS

General

The data communication management function (DCMF) uses the DCMF bus and the general purpose bus 2 to send data.

Each bus takes data from one of two IOMs in each cabinet. Each bus uses a source select relay to get data from one of two IOMs in each cabinet if necessary.

DCMF Bus

The source select relay for the DCMF bus energizes when the DCMF sends a signal. This causes data to come from IOM (M009). When the DCMF causes the source select relay to relax, data comes from IOM (M003).

The DCMF bus is a high speed ARINC 429 bus. It sends data from the left and right AIMS cabinets to the:

- Satellite data unit (SDU)
- Inflight entertainment system
- Flight compartment printer.

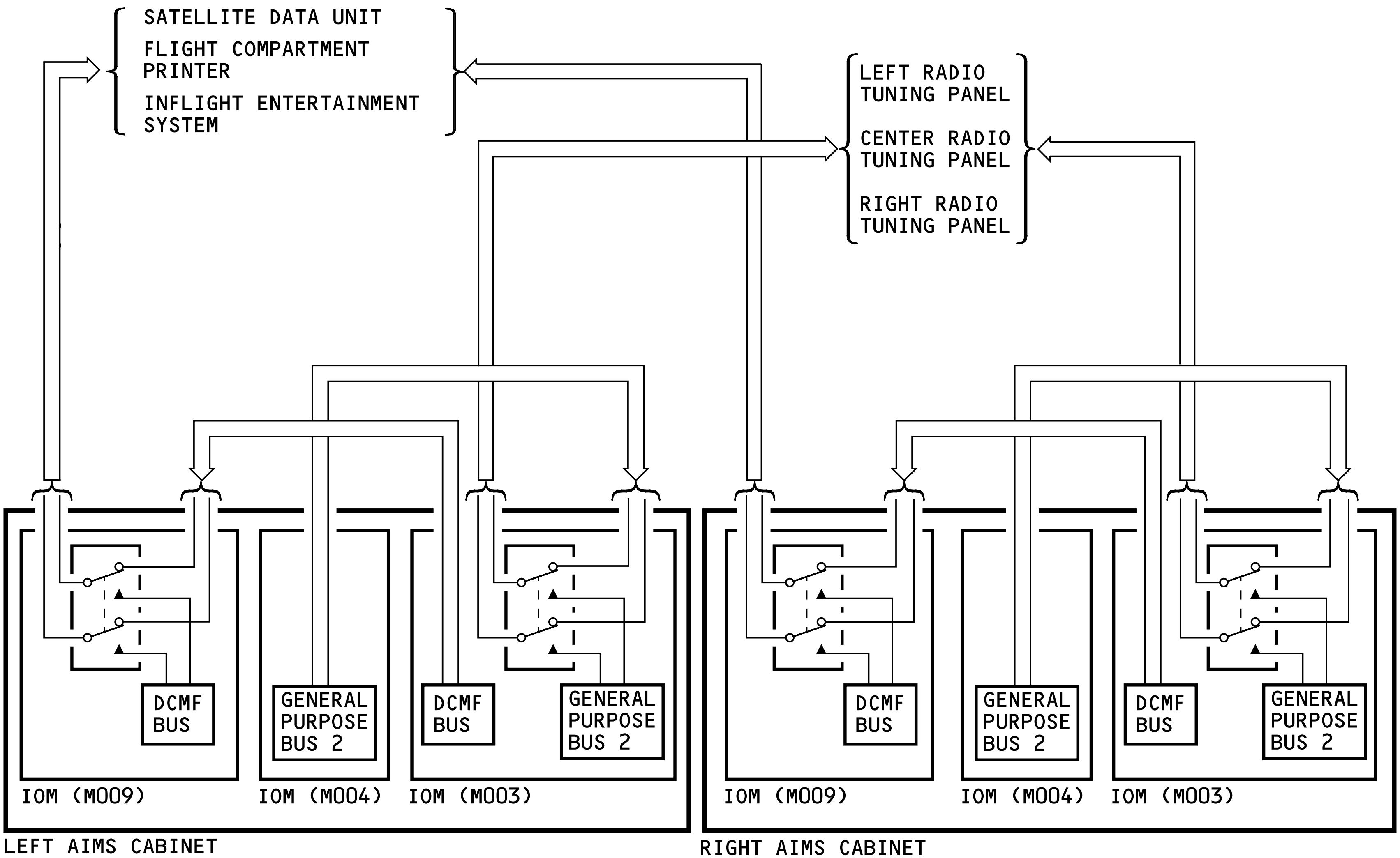
The DCMF sends downlink data through the SDU to the ground service provider (GSP).

The DCMF controls the print requests it receives from other AIMS functions. It sends print controls and data to the printer.

General Purpose Bus 2

Fault detection and switch logic in IOM (M003) energizes the source select relay. This causes the source select relay to use general purpose bus 2 data from IOM (M003). When the fault detection and switch logic causes the source select relay to relax, data comes from IOM (M004).

The general purpose bus 2 is a low speed ARINC 429 bus. It sends tuning data and broadcast status data to the RTPs.



23-27-00-006 Rev 6 02/24/1997

DCMS - ARINC 429 INTERFACES - OUTPUTS

DCMS - INTERCABINET ARINC 629 INTERFACES

Intercabinet Interface

The DCMFs and FDCF exchange data across AIMS intercabinet ARINC 629 buses. The DCMFs use buses 3 and 4. The FDCFs use buses 1 and 2.

The DCMF data includes the:

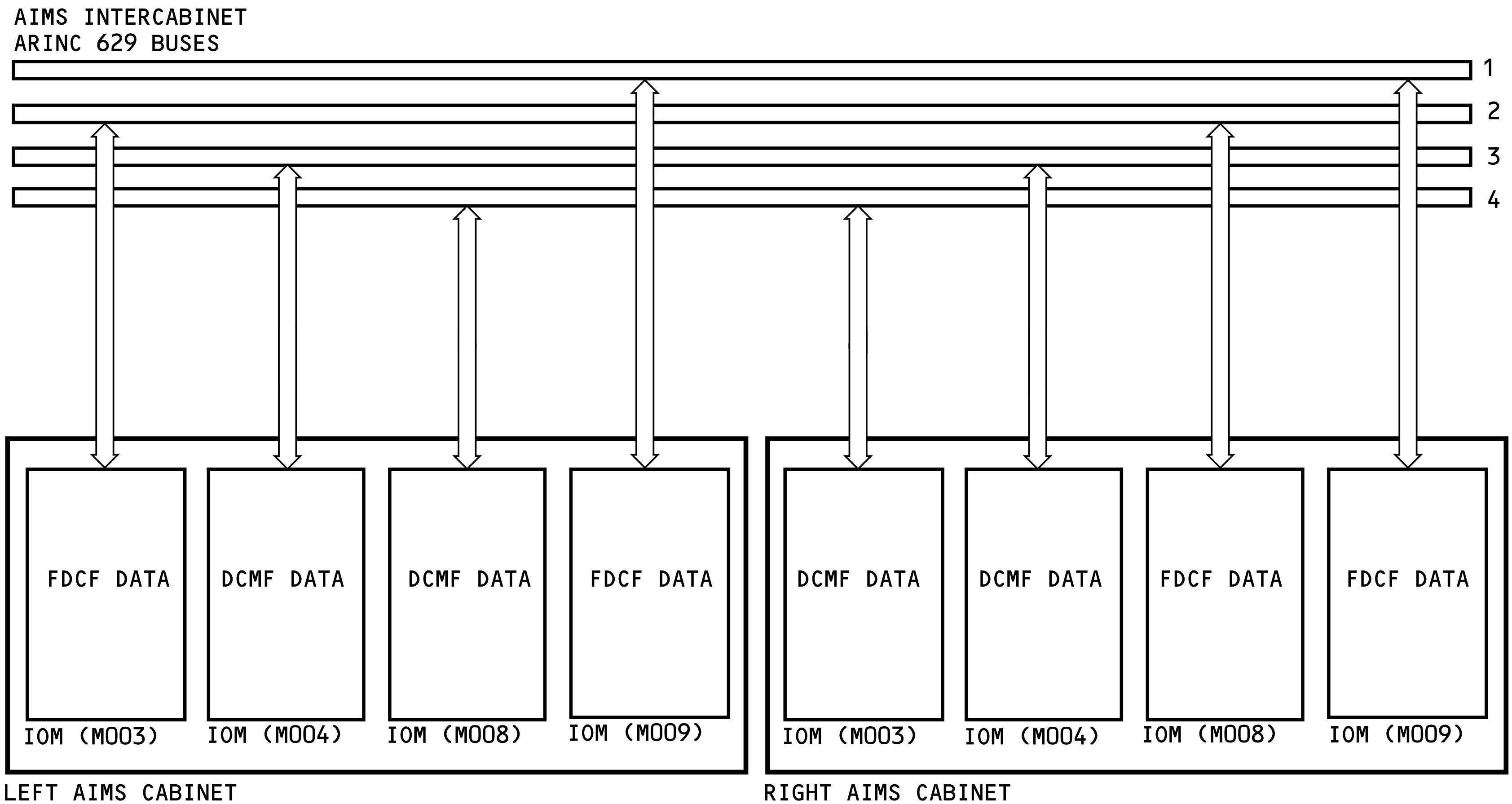
- Inputs to each DCMF
- Status and control information from each DCMF.

The DCMFs use this data to keep synchronized and to monitor their operation.

The FDCF data includes:

- FDCF-related display information
- FDCF-related central maintenance information
- FDCF-related DCMF information
- FDCF-redundancy information.

The FDCFs use this data to keep synchronized and to monitor their operation.



23-27-00-007 Rev 1

DCMS - INTERCABINET ARINC 629 INTERFACES

DCMS - OLAN AND DISCRETE INTERFACES

OLAN Interfaces

The avionics local area network (AVLAN) is part of the onboard local area network (OLAN) fiber distributed data interface (FDDI). The AVLAN uses a primary (PRI) network loop with a secondary (SEC) network loop as an alternative. The avionics LAN uses the ARINC 636 standard. The DCMF supplies the communications protocols that permit AIMS to exchange data with the:

- Maintenance access terminal (MAT)
- Brouter.

The brouter supplies the interface to the PMATs.

PRI BS1 is a 15v dc power discrete. It causes the bypass switch unit (BSU) to connect the left or right AIMS cabinet to the primary loop of the avionics LAN.

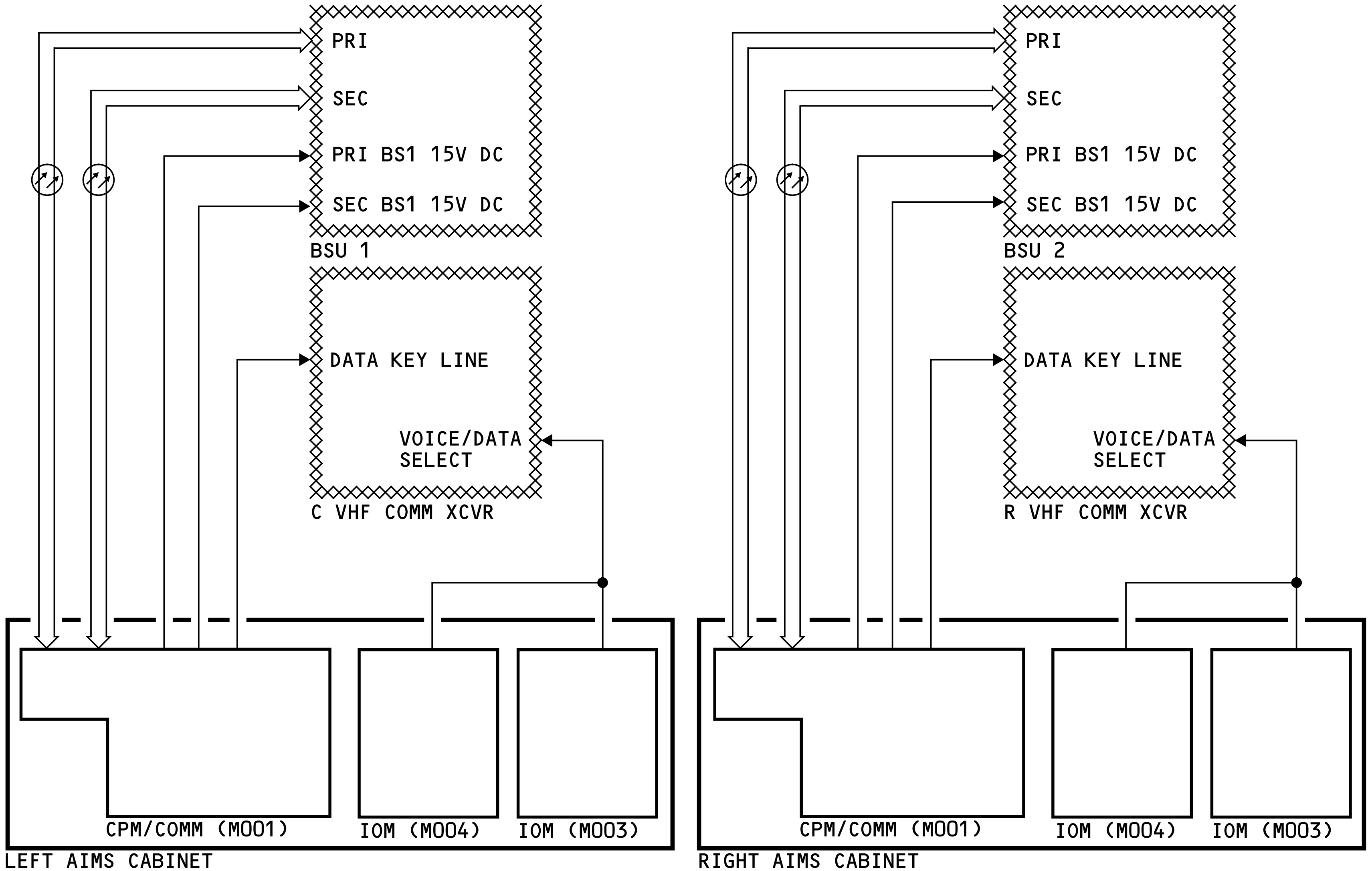
SEC BS1 is also a 15v dc power discrete. It causes the BSU to connect the left or right AIMS cabinet to the secondary loop of the avionics LAN.

Discrete Interfaces

The DCMF uses the data key line to key the VHF communication transceiver. When the DCMF keys the transceiver, the DCMF sends the downlink message to the VHF communication transceiver.

The DCMF uses the voice/data select to set the VHF communication transceiver to the data signal mode. At power-up, the DCMF sets the center VHF communication transceiver to the data signal mode. If the center VHF communication transceiver fails the DCMF selects satcom for data transmissions. If satcom fails, the DCMF selects the right VHF communication transceiver for data transmissions.

The left VHF communication transceiver is voice only.



23-27-00-008 Rev 5

DCMS - OLAN AND DISCRETE INTERFACES

DCMS - FDCF DISPLAY OVERVIEW

General

The FDCF displays show on a multifunction display (MFD). The FDCF receives messages from the airline's ground station and sends them to the PDS to show on the MFD. The flight crew can also send messages to the airline's ground station.

To show the FDCF main menu bar, select COMM on the display select panel (DSP).

These are the six menu selections that show on the FDCF main menu bar:

- ATC
- FLIGHT INFORMATION
- COMPANY
- REVIEW
- MANAGER
- NEW MESSAGES.

Buttons show at the bottom of the display to give the flight crew control.

ATC

The air traffic control (ATC) menu shows all of the displays the flight crew uses to communicate with the ATC system.

Flight Information

The FLIGHT INFORMATION selection is not available now. There is no response when the crew puts the CCD cursor in this menu selection.

COMPANY

The COMPANY menu shows all customer configured downlink messages.

REVIEW

The flight crew uses the REVIEW menu to look at uplink or downlink messages. Uplink messages show here after the crew accepts or rejects them. Messages that do not require an accept or reject also show here.

MANAGER

The MANAGER menu shows status information and supplies controls for flight deck communication external support devices. In the MANAGER menu, pages show for:

- The radios
- The flight compartment printer
- Message configuration
- Datalink configuration.

NEW MESSAGES

The NEW MESSAGES menu shows the new messages that require flight crew review. The new messages usually come from the airline ground station. They may also be messages that the flight crew enters.

Buttons

The flight crew uses the buttons to control the flight deck communication function (FDCF) displays. Each FDCF display causes different buttons to show.

The ACCEPT, REJECT, and CANCEL buttons on the FDCF display do the same functions as the ACCEPT, REJECT, and CANCEL switches on the P7 glareshield panel.

These buttons can show on the FDCF displays:

- ACCEPT
- SEND
- LOAD FMC
- PRINT
- PRINT LIST
- RESET
- STANDBY
- RETURN
- APPEND
- REJECT REASONS
- REJECT
- CANCEL
- EXIT
- EXIT MENU.

The ACCEPT button shows when a received message requires an accept or reject response and all pages of the message have been displayed.

The SEND button shows when all required data for the message has been entered and all pages have been displayed.

The LOAD FMC button shows when the air traffic control (ATC) system sends a flight plan modification. The flight crew uses this button to send the modified flight plan to the flight management computing function (FMCF).

The PRINT button shows when a page has the capability to be printed and the printer is available.

The PRINT LIST button is available for the REVIEW or NEW MESSAGES pages when a list shows. This lets the flight crew print multiple messages.

The RESET button shows when a downlink message is displayed. This clears the message text.

The STANDBY button lets the flight crew tell the ATC that the ATC message is in review.

The RETURN button shows when a review message page, a downlink message page, or a manager page shows. This returns you to the previous list box page or menu.

The APPEND button shows if the received message has the capability for the crew to add information and downlink a response message. The APPEND button shows only if all pages have been shown.

DCMS - FDCF DISPLAY OVERVIEW

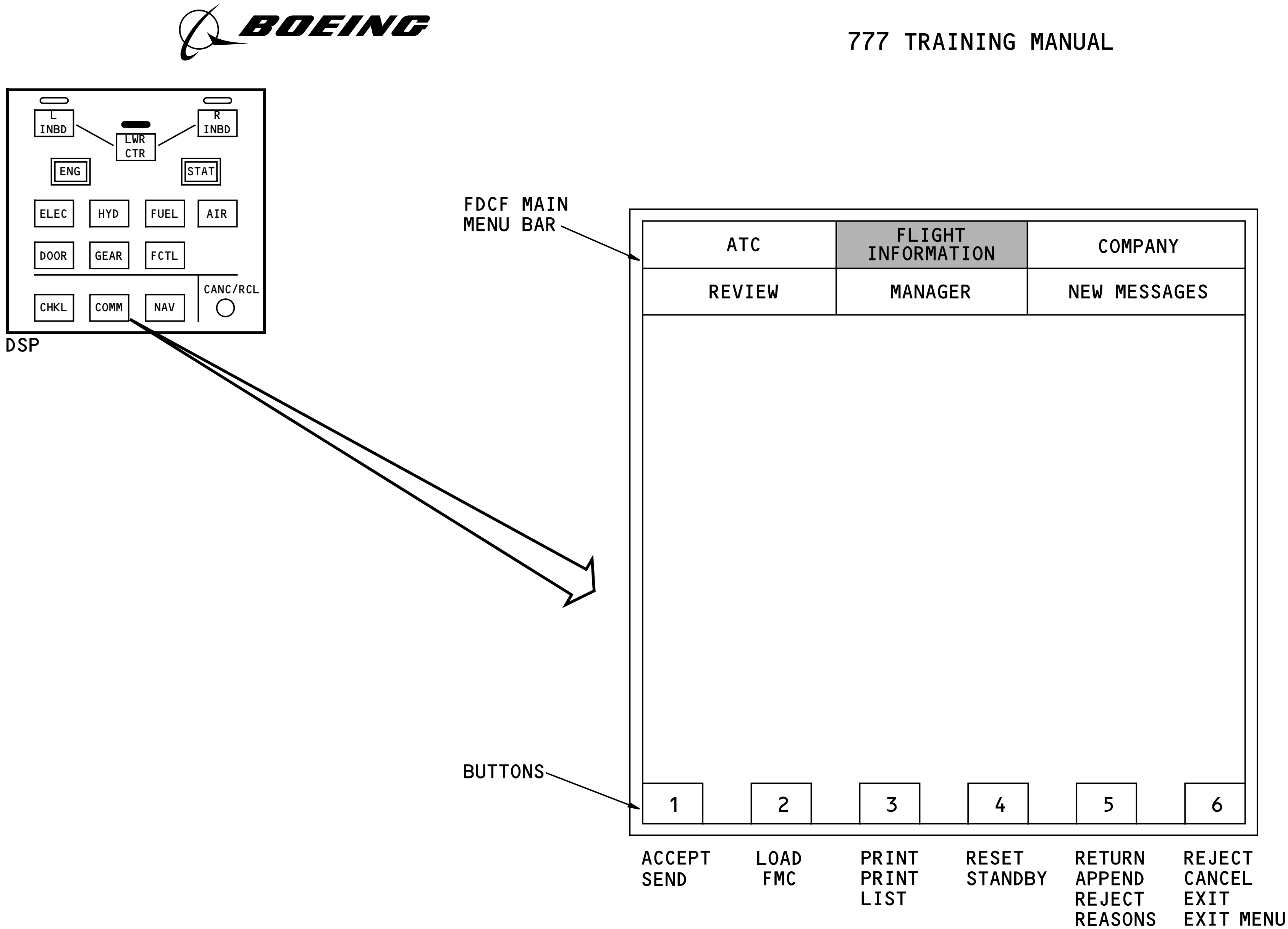
The REJECT REASONS button shows when a received message requires an accept or reject response and all pages of the message have been shown. A list of reject reasons shows when you select this button.

The REJECT button shows when a received message requires an accept or reject response and all pages of the message have been shown. The message is rejected when the flight crew selects this button.

The CANCEL button shows when a received message does not require a response or the received message has been accepted or rejected.

The EXIT button shows when the downlink page or manager page shows.

The EXIT MENU button shows when a menu shows. The EXIT MENU button takes you back to the FDCF main menu screen.



DCMS - FDCF DISPLAY OVERVIEW

23-27-00-009 Rev 3 08/21/1997

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DCMS - FDCF INFORMATION MESSAGES

General

During the uplink or downlink mode, information messages show on the display. The information box and the button show at the bottom of the display and hides other data. Information messages show in the box as the flight crew looks at the uplink or downlink message text. Information messages occur either as a result of flight crew action or automatically.

Uplink Information Messages

When you select the ACCEPT button on the MFD or the glareshield, one of these information messages show:

- ACCEPTING
- ACCEPTED
- NO ACCEPT.

ACCEPTING shows after crew selects ACCEPT and until the ACCEPT uplink is successful or the flight crew selects EXIT INFO.

ACCEPTED shows that the uplink is successful and shows when the flight crew selects EXIT INFO.

NO ACCEPT shows when the uplink queue is full or the crew selects EXIT INFO.

When you select the REJECT button on the MFD or the glareshield, one these information messages show:

- REJECTING
- REJECTED
- NO REJECT.

REJECTING shows after the crew selects REJECT and until the REJECT uplink is successful or the flight crew selects EXIT INFO.

REJECTED shows that the uplink is successful and shows when the flight crew selects EXIT INFO.

NO REJECT shows when the uplink queue is full or the crew selects EXIT INFO.

When you select the PRINT button on the MFD, one of these information messages show:

- MESSAGE TO PRINTER 1
- NO PRINT.

MESSAGE TO PRINTER 1 shows when the print format goes to the primary flight compartment printer. It shows until the flight crew selects EXIT INFO or until NO PRINT occurs.

NO PRINT shows when the print format cannot be sent to the flight compartment printer. It shows until the flight crew selects EXIT INFO.

INVALID DATA shows when the uplink has invalid data.

DATALINK LOST FOR THIS MESSAGE tells the flight crew that the datalink to respond to this message is not available. This type of information message requires a flight crew response. It shows until the flight crew makes a response. EXIT INFO then causes the message to go away.

INCOMPLETE MESSAGE shows when the flight crew receives an uplink with mandatory data fields blank. The message shows until the flight crew selects EXIT INFO.

Downlink Information Messages

When you select the PRINT button on the MFD, one of these information messages show:

- MESSAGE TO PRINTER 1
- NO PRINT.

MESSAGE TO PRINTER 1 shows when the print format goes to the flight compartment printer. It shows until the flight crew selects EXIT INFO or NO PRINT occurs.

NO PRINT shows when the print format cannot be sent to the flight compartment printer. It shows until the flight crew selects EXIT INFO.

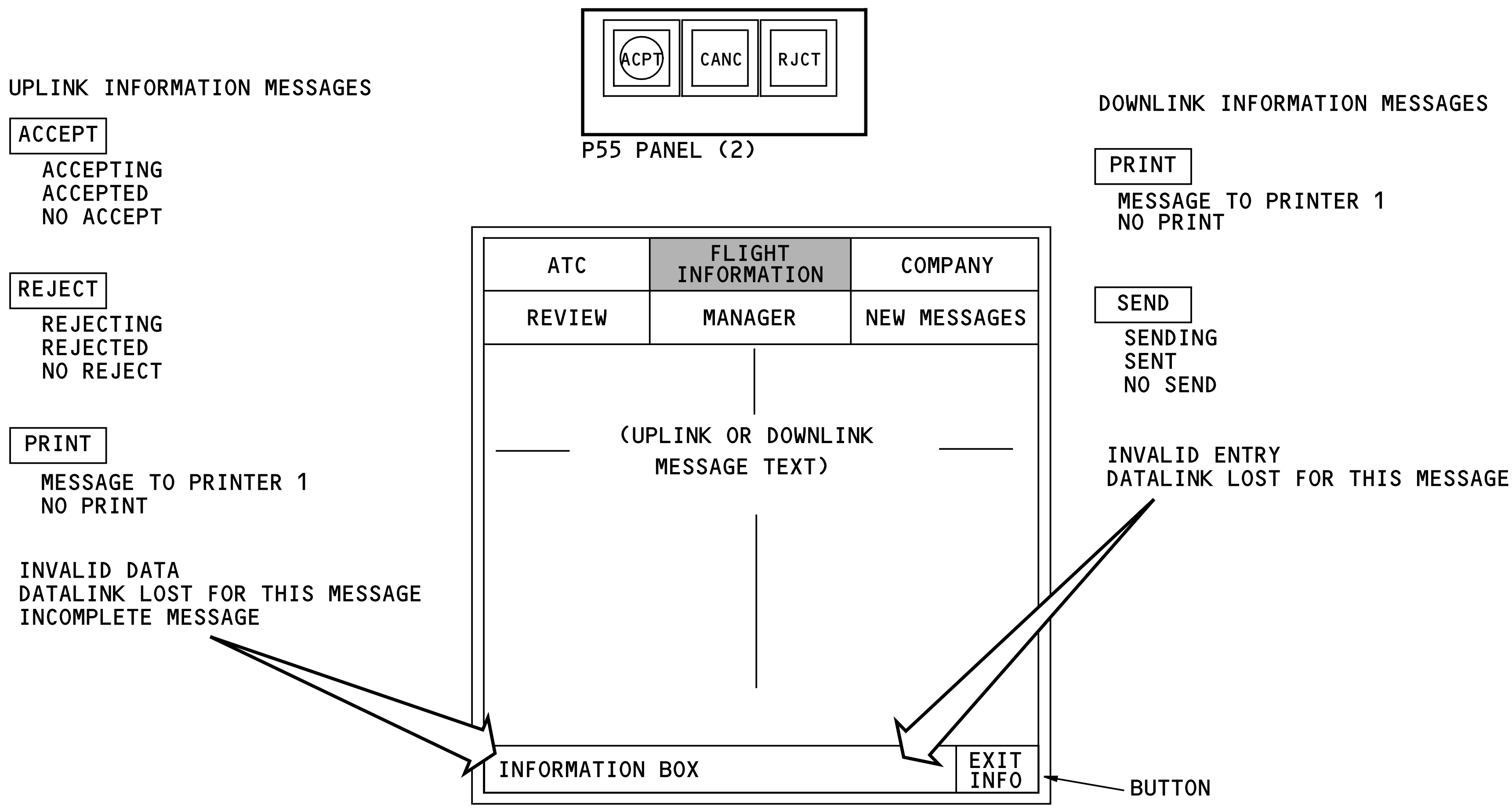
When you select the SEND button on the MFD, one of these information messages show:

- SENDING
- SENT
- NO SEND.

SENDING shows until the downlink is successful or the flight crew removes the response from the downlink list or the flight crew selects EXIT INFO.

SENT shows that the downlink is successful. It shows until the flight crew selects EXIT INFO.

NO SEND shows when the flight crew deletes the response from the downlink list. It shows until the crew selects EXIT INFO.



23-27-00-010 Rev 2 03/05/96

DCMS - FDCF INFORMATION MESSAGES

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DCMS - FDCF COMPANY MENU

General

The COMPANY menu gives you access to company format displays and sub-menus to downlink. You can transmit messages and data from a display. you can select the company menu anytime.

These are the displays you can select from the company menu:

- Flight initialization
- Diversion
- Estimated time of arrival (ETA)
- Flight times
- Departure report
- Position report
- Arrival report
- Message to ground
- Voice contact request
- Weather requests
- Maintenance report
- Miscellaneous codes
- Situation.

These are the sub-menus you can select from the company menu:

- Delay reports
- Crew requests.

Use the cursor control device to highlight and select a display or sub-menu.

Flight Initialization Display

The flight crew can initialize flight plan data from a single location on this display.

Diversion Report Display

The flight crew uses the diversion report display to tell the airline the ETA at the diversion destination.

Estimated Time of Arrival Display

The flight crew uses the estimated time of arrival display to tell the airline the planned ETA at the destination airport.

Flight Times Display

The flight crew uses the flight times display to show the OUT, OFF, ON, and IN times. This shows the fuel on board and boarded fuel for the current and previous flights.

Departure Report Display

The flight crew uses the departure report display to send information that shows on the flight times display and additional information that relates to a departure.

Position Report Display

The flight crew uses the position report display to send this information:

DCMS - FDCF COMPANY MENU

- Position information
- Current position
- Flight level
- Next position
- Other performance data.

Arrival Report Display

The flight crew uses the arrival report display to send information that shows on the flight times display and additional information that relates to an arrival.

Message To Ground Display

The flight crew uses the message to ground display to send free text messages to a selected ground station.

Voice Contact Request Display

The flight crew uses the voice contact request display to start voice contact with a selected ground station.

Weather Requests Display

The flight crew uses the weather request display to request weather information from the airline host or ground service provider.

Maintenance Report Display

The flight crew uses the maintenance report display to enter codes and/or free text about maintenance problems for transmissions to the ground.

Miscellaneous Codes Display

The airline uses the miscellaneous codes display to support new display functions.

Situation Display

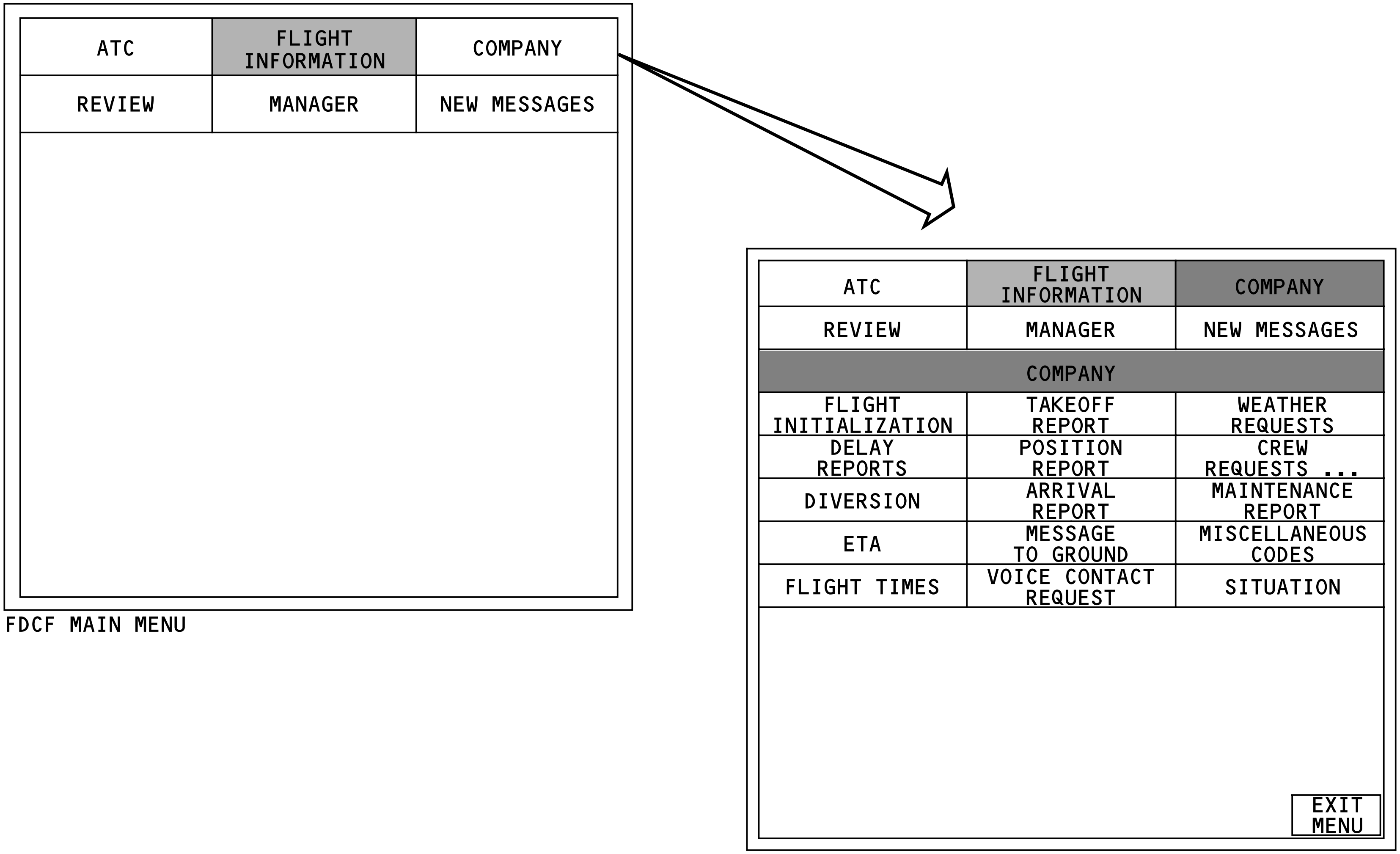
The flight crew uses the situation display to tell the ground station of an emergency situation.

Delay Reports Sub-menu

The flight crew uses the delay reports sub-menu to tell the airline of a departure, takeoff, or enroute delay.

Crew Requests Sub-Menu

When you select the crew requests box, the crew requests sub-menu shows. The crew requests sub-menu shows more display selections.



FDCF MAIN MENU

FDCF COMPANY MENU

23-27-00-013 Rev 2 03/05/96

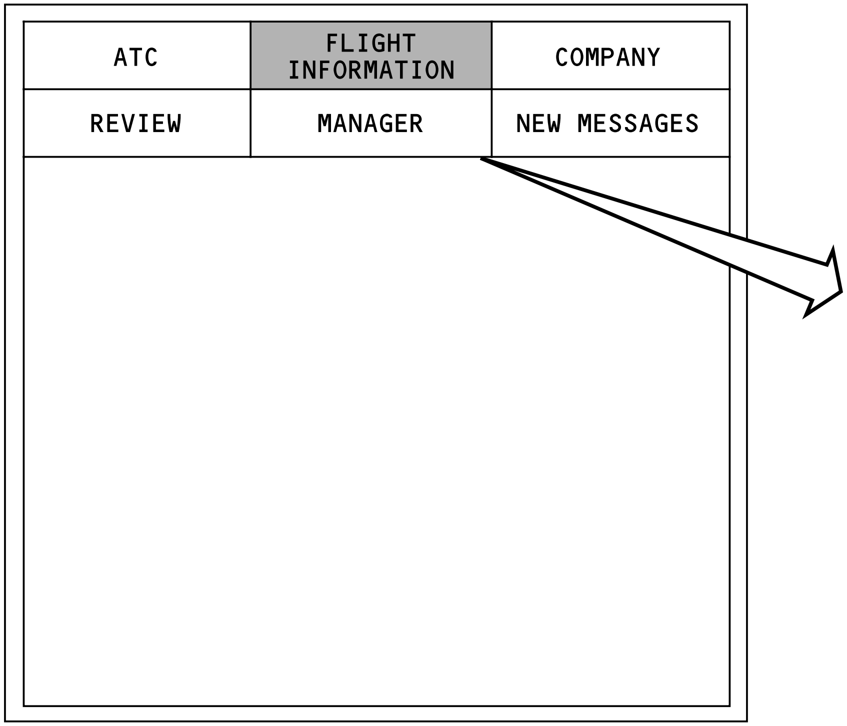
DCMS - FDCF COMPANY MENU

DCMS - FDCF MANAGER MENU

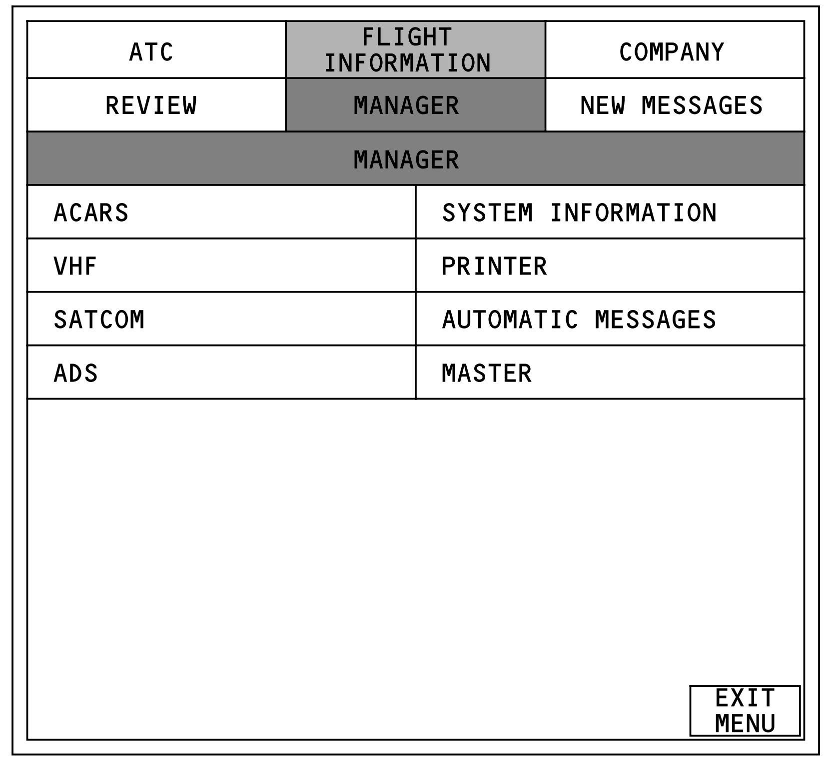
General

The MANAGER menu selection gives the flight crew access to these manager sub-menus:

- ACARS
- VHF
- SATCOM
- Automatic dependent surveillance (ADS)
- System information
- Printer
- Automatic messages
- Master.



FDCF MAIN MENU



FDCF MANAGER MENU

23-27-00-017 Rev 3 03/07/96

DCMS - FDCF MANAGER MENU

DCMS - FDCF ACARS SUB-MENU

ACARS Sub-menu Page One

Page one of the ACARS sub-menu lets the flight crew select the ACARS frequency and scan rate. It also lets the flight crew set the secondary frequency. To do this, type the frequency into the CDU scratch pad. Use the cursor control device (CCD) to highlight the box prompts. Use the CCD cursor select switch to select the secondary frequency.

The RETURN and EXIT buttons show on the display.

ACARS Sub-menu Page Two

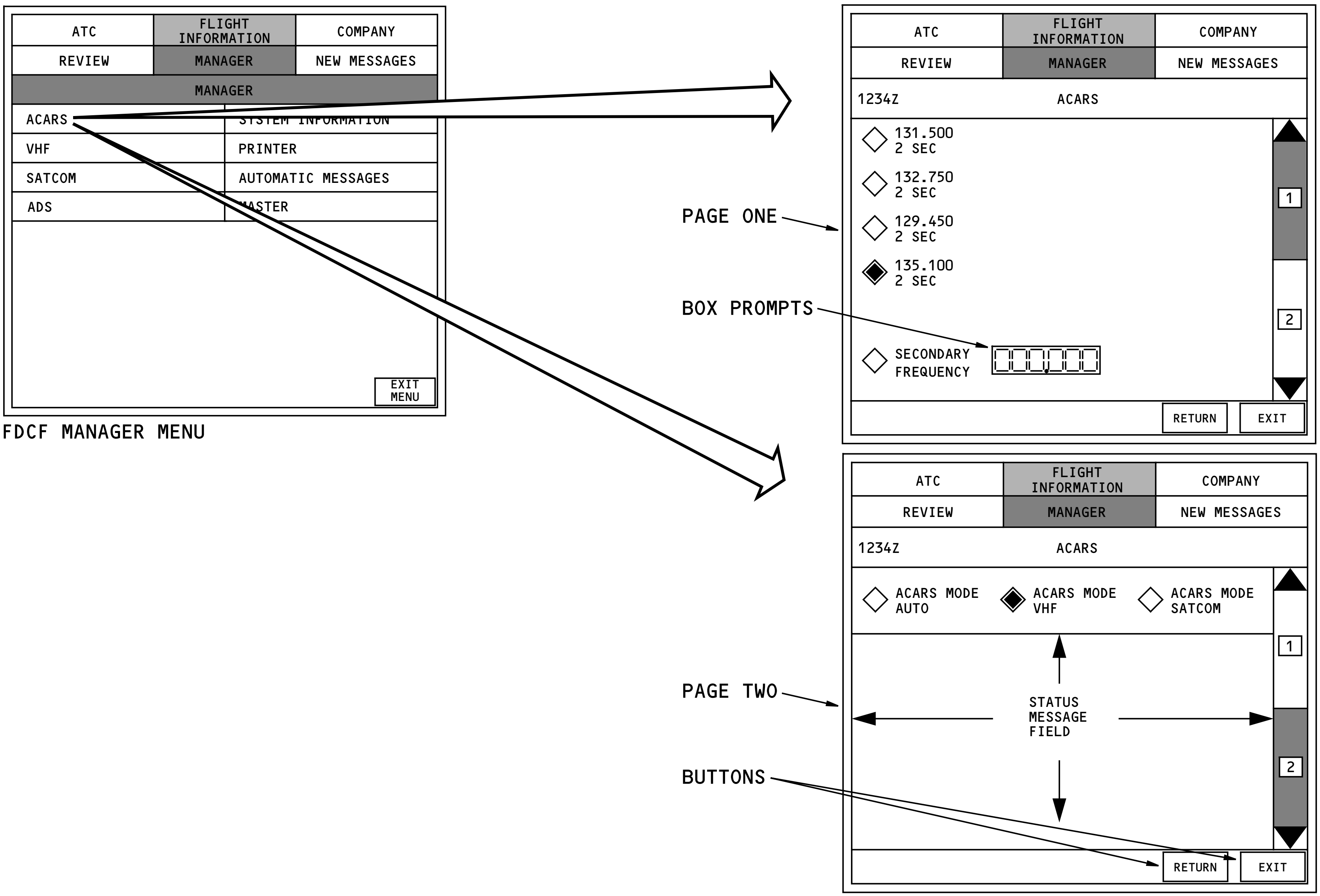
Page two of the ACARS sub-menu lets the flight crew select the ACARS mode of transmission. The selections are:

- AUTO
- SATCOM mode only
- VHF mode only.

Page two of the ACARS sub-menu also shows ACARS status messages. The status message field holds the 25 most recent messages. The newest messages show first. The possible ACARS messages are:

- NO ACARS LINK
- ACARS SATCOM MODE
- ACARS LINK ESTABLISHED
- ACARS VHF MODE.

The RETURN and EXIT buttons show on the display.



DCMS - FDCF ACARS SUB-MENU

DCMS - FDCF COMMUNICATION SUB-MENUS

SATCOM Sub-menu

The SATCOM sub-menu lets the flight crew see the SATCOM STATUS messages. The status message field holds the 25 most recent messages. The newest messages show first. These are the possible SATCOM messages:

- NO SATCOM LINK
- SATCOM LINK ESTABLISHED
- SATCOM FAILURE
- SATCOM NORMAL.

The RETURN and EXIT buttons show on the display.

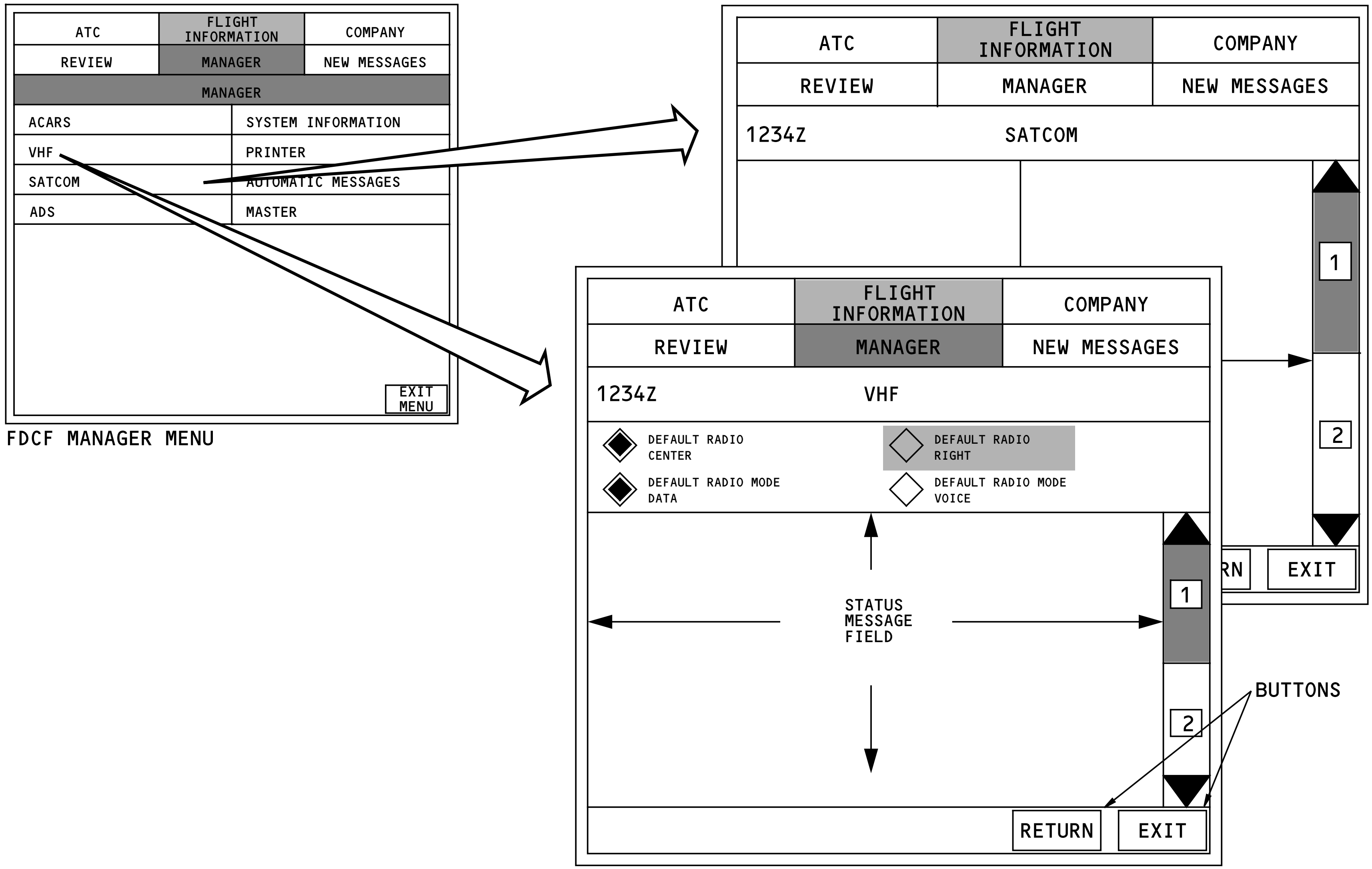
VHF Sub-menu

The VHF sub-menu lets the flight crew set the radio transmission mode and select the VHF radio as the default data radio (right or center only). The graphic shows the power up default selections.

The sub-menu also shows VHF status messages. The status message field holds the 25 most recent messages. The newest messages show first. These are the possible VHF messages:

- NO VHF LINK
- VHF LINK ESTABLISHED
- VHF RADIO FAILURE
- VHF RADIO NORMAL.

The RETURN and EXIT buttons show on the display.



23-27-00-019 Rev 4 08/08/96

DCMS - FDCF COMMUNICATION SUB-MENUS

DCMS - DCMF FUNCTIONAL DESCRIPTION

General

The DCMF manages the internal and external communication of data. It supplies the many communication protocols and it routes data that AIMS needs to process data messages. Communication protocols are the rules and standards that the DCMF use for data communications.

The primary sub-functions of the DCMF are:

- ACARS datalink
- OLAN interface
- Print driver.

Other sub-functions of the DCMF are:

- Communications program interface (CPI)
- Initialization
- BITE
- Redundancy management.

ACARS Datalink Sub-function

The aircraft communications and reporting system (ACARS) permits communication of data between airplane systems and ground systems. The ACARS has airborne subsystems and ground station networks. The ground network is made up of subscriber airlines, aviation authorities, and other users.

The DCMF supplies the airplane part of ACARS. The ACARS sub-function controls air/ground file transfers and onboard message routing. The message routing process supplies uplink message routing to onboard systems. It downlinks message routing to the ACARS ground service providers (GSP) through VHF or SATCOM. The ACARS datalink sub-function uses information within each uplink to send the message to the applicable system. The ACARS datalink sub-function also routes downlinks to the path set by the flight deck crew and airplane systems.

The flight crew sets the datalink path through the MANAGER menu of the AIMS flight deck communications function (FDCF). The path preferences are:

- VHF
- SATCOM
- Auto.

The power-up default selection is auto. When the auto path is set, the ACARS sub-function uses a preference table for internal downlink routing to select a communications transceiver.

OLAN Interface Sub-function

The OLAN interface sub-function supplies the communications protocols that permit AIMS functions to send data to and receive data from member systems on the avionics local area network (AVLAN). AVLAN systems include the:

- Left and right AIMS cabinets
- Maintenance access terminal (MAT)

- Brouter.

These AIMS functions use the DCMF to exchange data through the AVLAN:

- Central maintenance computing function (CMCF)
- Maintenance terminal function (MTF).

The DCMF has redundancy management that sends data to the CMCFs in both AIMS cabinets. The CMCF also gives data load access and control to install LRU/LRM software for DCMF normal operation.

MTF provides communications between CMCF or ACMF and the AVLAN systems.

The BITE for AVLAN systems also uses the DCMF to report faults to the CMCF.

Print Driver Sub-function

The print driver sub-function transfers AIMS data to the flight compartment printer. The print driver sub-function sends data to and receives data from AIMS functions to:

- Spool a print job
- Send data to the flight compartment printer
- Send printer and job status and fault data back to the AIMS function.

Communications Program Interface (CPI) Sub-function

The communications program interface sub-function of the DCMF supplies a common interface for data communications between other AIMS functions and these DCMF sub-functions:

- ACARS datalink
- OLAN interface
- Printer driver.

The CPI supplies a common protocol across the AIMS backplane bus for data transfer.

Initialization Sub-function

The initialization sub-function of the DCMF has these two parts:

- Software installation checks
- Power interrupt processing.

The initialization sub-function does software installation checks on the DCMF software components during initialization. These components are the:

- Operational program configuration (OPC)
- Operational program software (OPS)
- Airline modifiable information (AMI).

Power interrupt processing reacts to primary power system interrupts in different ways. The reaction depends on the length of the interrupt and if the airplane is on the ground or in the air. The power interrupt groups are:

- Short term power interrupt (<500 ms)
- Warm start (>= 500 ms and < 5 s)
- Cold start (>= 5 s and airplane in air)
- Complete power loss.

BITE Sub-function

The DCMF BITE sub-function monitors the DCMF in the left and right CPM/Comm and the related hardware units use that the DCMFs use. The related hardware units that the DCMFs use are, the OLAN circuit card assembly (CCA) and the VHF modem in each CPM/Comm module. When the system first gets power, the power-up BITE test makes sure that the DCMF works correctly. During normal operation, the BITE continuously monitors the condition of the DCMF for redundancy management.

Redundancy Management Sub-function

The redundancy management sub-function of the DCMF does these four things:

- DCMF selection as primary at power-up
- Primary to secondary DCMF transfer
- External hardware monitors
- Datalink monitors.

The redundancy management function makes sure that one of the two DCMFs is primary and one is secondary. The primary DCMF does:

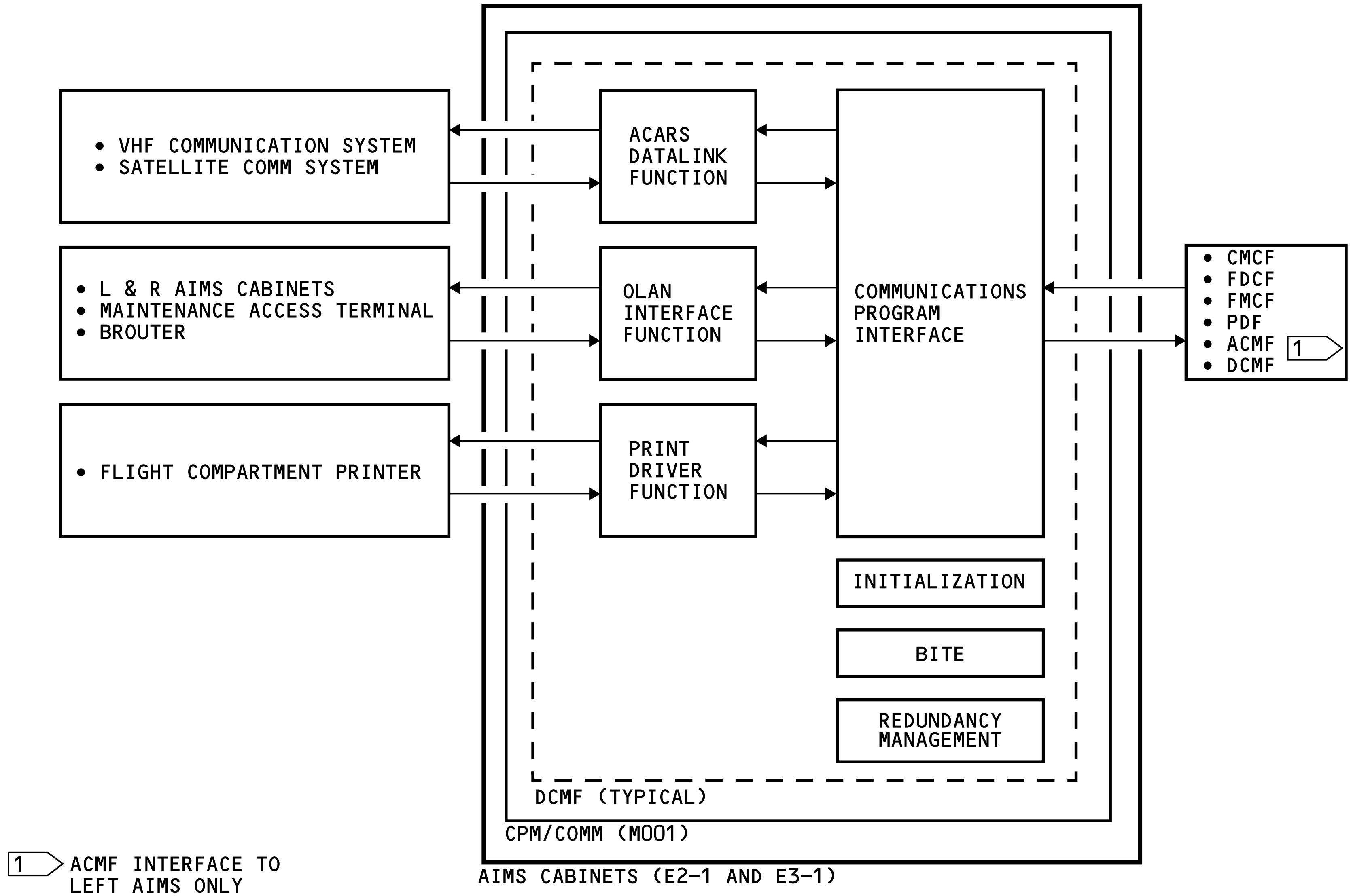
- All air/ground communications
- Maintenance of AVLAN connections to AIMS functions within its cabinet
- Monitors condition and status of the secondary DCMF.

The secondary DCMF does the same functions as the primary, but it does not handle air/ground communications.

The secondary DCMF takes over for the primary DCMF if it fails or if the flight crew changes the default VHF communications transceiver. The secondary DCMF monitors the intercabinet status messages from the primary DCMF. The primary DCMF uses the results of the monitors and other conditions to change to the secondary DCMF. The DCMF monitors this hardware for correct operation:

- Left, center, and right RTPs
- Center and right VHF comm xcvrs
- The SDU
- Flight compartment printer.

The DCMF monitors the condition of the VHF and SATCOM datalinks. The DCMF sends messages to the PDF for flight crew notification when the condition of the VHF or SATCOM systems change.



23-27-00-022 Rev 4 05/30/96

DCMS - DCMF FUNCTIONAL DESCRIPTION

DCMS - FDCF FUNCTIONAL DESCRIPTION

General

The flight deck communication function (FDCF) gives the flight crew access to data communication menus and their displays. The FDCF uses instructions in software and hardware to do this. The flight crew uses the menus and displays to do these tasks:

- Downlink messages
- Uplink messages
- Review messages
- Select a medium to transmit/receive and print messages.

The FDCF has inputs, outputs, and these sub-functions to give the flight crew access to the FDCF menus and to control the displays:

- Inputs
- Display/switch interface
- FDCF main sub-functions
- Redundancy management
- BITE
- Airline modifiable information (AMI)
- Communications program interface (CPI) input/ output (I/O).

Inputs

The FDCF uses inputs and the DCMF interfaces to do the FDCF sub-functions. These components send input data:

- CDU'S
- DSP
- CCD'S
- ACCEPT switch
- REJECT switch
- CANCEL switch
- RTP'S.

Display/Switch Interfaces

The display/switch interfaces convert the inputs to a format that the FDCF can use. Inputs show in order of time. The new format goes to the main FDCF sub-functions.

Main FDCF

The main FDCF lets the flight crew make menu selections. These are the main FDCF sub-functions:

- Main menus
- Sub-menus
- Up/downlink displays on a multifunctional display (MFD)
- Decode uplink and downlink messages
- Logic units
- Communication alerts.

The main menus sub-function uses the DSP COMM selection to show the FDCF main menu. This gives access to the sub-menus. The FDCF main menu has four sub-menus:

- Review
- Manager

- Company
- New messages.

The sub-menus sub-function uses the CCD selection to show a sub-menu. This gives access to a display for flight crew control and entry.

The up/downlink sub-function gives the flight crew control to receive, send messages, and make entries on a display. The flight crew uses the CCD to make selections on a display. To make an entry on a display, the flight crew uses the CDU scratch pad to type the message. They use the CCD to transfer the scratch pad data to a data field in the selected MFD. Data transfer occurs when you select box prompts or a line with dashes on the the MFD.

The decoding sub-function decodes the uplink messages and codes the downlink messages. This process is necessary to support these display features:

- Buttons that show in the display
- Data fields for entry
- Information that shows in the information display box.

The logic unit sub-function uses CDU, panel, and switch inputs to support display formats. It also uses the decoding sub-function to make sure that certain buttons and fields are active or not active on a display.

The communications alerts sub-function receives inputs from the decoding sub-function. It uses a look up table to send communication alerts to the PDF for visual and aural flight deck alerts.

<u>Redundancy Management</u>

The redundancy management of the FDCF does these tasks:

- Selects a primary FDCF at power-up
- Transfers a primary FDCF to secondary
- Monitors the datalink interface.

The redundancy management makes sure that one of the two FDCFs is primary and one is secondary at power-up. To do this, the primary FDCF:

- Remembers which FDCF was primary at last power-on
- Monitors the condition and status of the secondary FDCF.

The secondary FDCF does the same functions as the primary.

The primary-to-secondary FDCF transfer occurs when the primary FDCF fails. The secondary FDCF monitors the intercabinet status messages from the primary FDCF during normal operation. The primary FDCF uses the results of the monitors and power conditions to change to the secondary FDCF.

The secondary FDCF also takes over when a datalink interface is lost.

DCMS - FDCF FUNCTIONAL DESCRIPTION

BITE

The FDCF BITE monitors the hardware and software of the FDCF in the left and right CPM/Comm. When the system first gets power, the power up BITE test makes sure that the FDCF works correctly. During normal operation, the BITE monitors the condition of the FDCF for redundancy management.

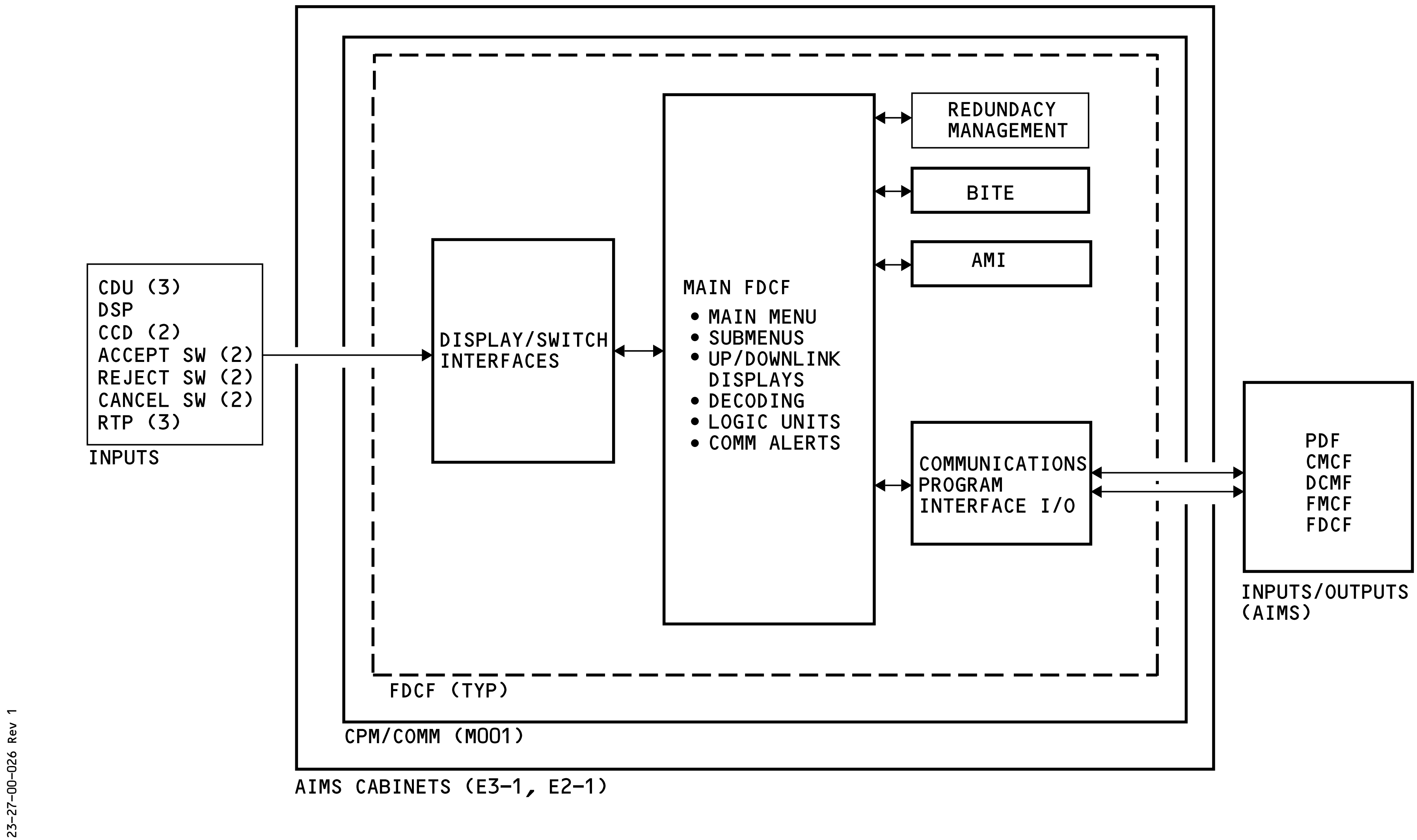
Airline Modifiable Information (AMI)

The airline can use a ground base software tool (GBST) to re-configure the FDCFs.

Communications Program Interfaces (CPI) I/O

The communications program interfaces of the FDCF supplies a common interface for data communications in the AIMS cabinets. To do this, the CPI supplies a common protocol for the AIMS backplane bus for data transfer. This supports the FDCF intracabinet data exchanges.

The CPI I/O of the FDCF supplies a common interface for data communications to the other AIMS cabinet. The primary and secondary FDCFs exchange data for redundancy management. To do this, the CPI supplies a common protocol for the intercabinet buses 1 and 2.



DCMS - FDCF FUNCTIONAL DESCRIPTION

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DCMS - DCMF AND FDCF AIRLINE MODIFIABLE INFORMATION

General

The data communication management system (DCMS) has a data communication management function (DCMF) and a flight deck communication function (FDCF). Together the two make up the functionality of ACARS. The design of the 777 airplane lets the airlines customize certain functions in the DCMS. You customize these functions through airline modifiable information (AMI). You use the ground based software tool (GBST) to make the modifications.

The DCMF comes with a default values AMI. The default values AMI has values that determine these:

- VHF data frequencies
- ACARS reject message formats
- Uplink message routing.

The FDCF comes with a baseline AMI. The baseline AMI defines these:

- Baseline flight deck communication display formats
- Basic screen reports
- Downlink messages and formats
- Uplink messages and formats
- Logic units and parameter definitions.

DCMF VHF Data Frequency Selection Tables

The default VHF data frequency selection table includes this information:

- Frequencies
- Scan times
- A prekey length
- An enable/disable trigger.

These are the default frequencies:

- 131.550 (ARINC and Australia)
- 131.725 (SITA)
- 131.475 (Canada)
- 131.450 (Japan).

You can enter up to 15 total frequencies in the table. The valid frequency range is 118.000 to 136.975 megahertz.

The default scan time for all frequencies is 126 seconds. You can change the scan time to any rate between 10 and 600 seconds.

The default prekey length is 75 milliseconds. The valid prekey lengths are 53 to 190 milliseconds in increments of one millisecond.

The default setting for the trigger is enable. You can set this to disable.

ACARS Reject Message

The ACARS reject message format has 69 characters and an HX label that identifies the reject message. Characters 1-10 contain a standard header. Character 11 has the slash character. Characters 12-18 contain the

DCMS - DCMF AND FDCF AIRLINE MODIFIABLE INFORMATION

ATA/IATA address. Character 19 has a period. You can not modify these characters.

Characters 20-69 contain the first 50 characters of the uplink message and label HX identifies the downlink as a reject. You can modify these characters.

DCMF Uplink Routing Tables

The default values are a table of predefined labels and sublabels that control the destination of uplink messages. These are the valid destinations:

- FDCF
- CMCF
- ACMF
- FMCF.

The DCMF routes the message according to the default table. This table is not modifiable. An uplink message routes to a destination defined in the modifiable AMI file only if it is not already defined by the hardcoded table.

This is the hardcoded table:

Label/Sublabel	Destination
51/none	FDCF
52/none	FDCF
54/none	FDCF
C1/none	FDCF
H1/CF	CMCF
H1/HF	ACMF
H1/W0	FMCF
H1/W1	FMCF
H1/W2	FMCF
A1/none	FDCF
A7/none	FDCF
RA/-1	FDCF
RA/-2	FDCF
RA/-3	FDCF
RA/-4	FDCF
RA/-5	FDCF
RA/-6	FDCF
RA/-7	FDCF

FDCF Display Formats

The FDCF baseline AMI provides a generic display menu structure. This structure meets the needs of most airlines. You can modify the basic structure or develop a custom AMI to meet specific needs.

DCMS - DCMF AND FDCF AIRLINE MODIFIABLE INFORMATION

FDCF Screen Reports

The FDCF baseline AMI provides generic screen reports. These reports meet the needs of most airlines. You can modify the basic screen reports or develop a custom AMI to meet specific needs.

Downlink Messages and Formats

The baseline AMI contains the Company Menu which you use to select the downlink formats. This section provides the downlink display, encoding, and print format definitions required to show, send, and print specific messages.

These are the downlink messages available in the baseline AMI:

- Flight initialization display
- Flight auto-Initialization request display and downlink message
- Delay report display and downlink message
- Diversion report display and downlink message
- Estimated time of arrival display and downlink message
- Departure report display and downlink message
- Position report display and downlink message
- Arrival report display and downlink message
- Message to ground display and downlink message
- Voice contact request display and downlink message
- Weather request display and downlink message
- Weight and balance request display and downlink message
- Clearance request display and downlink message
- Re-clearance request display and downlink message
- Flight plan request display and downlink message
- Flight release request display and downlink message
- Gate assignment request display and downlink message
- ATIS request display and downlink message
- NOTAMS request display and downlink message
- Maintenance deport display and downlink message
- Miscellaneous codes report display and downlink message
- Situation report display and downlink message
- Invalid reject message
- Unable to process reject message
- Unknown reject message
- Flight times display (OOOI).

You can modify the AMI to add or delete existing messages.

FDCF Uplink Messages and Formats

These are the uplink messages and formats available with the baseline AMI:

- Flight initialization uplink
- Free text uplink
- Crew advisory uplink
- Weather report uplink
- Weight and balance uplink
- Clearance uplink
- Re-clearance uplink

DCMS - DCMF AND FDCF AIRLINE MODIFIABLE INFORMATION

- Flight plan uplink
- Flight release uplink
- Gate assignment uplink
- VHF voice contact uplink
- Display command uplink
- Standard printer with Alert uplink
- Command/response uplink
- Acknowledgment of rejected uplink message.

You can modify the AMI to add or delete existing messages.

FDCF Logic Units and Airplane Parameters

The baseline AMI provides these logic units:

- OOOI initialization and state logic
- OUT event
- OFF event
- ON event
- IN event
- Return to gate event
- Diversion report logic
- End of flight.

Also, there is a list of airplane parameters available in the baseline AMI. The baseline AMI makes use of only a few of these parameters. You can modify the logic units and the airplane parameters.

DCMS DEFAULT VALUES AND BASELINE AMI	
DCMF DEFAULT VALUES	FDCF BASELINE AMI
VHF DATA FREQUENCY SELECTION TABLE	GENERIC MENU STRUCTURE
ACARS REJECT MESSAGE FORMAT	SCREEN REPORTS
HARDCODED UPLINK ROUTER TABLE	DOWNLINK MESSAGES AND FORMATS
	UPLINK MESSAGES AND FORMATS

DCMS MODIFIABLE FUNCTIONS	
DCMF MODIFIABLE FUNCTIONS	FDCF MODIFIABLE FUNCTIONS
FREQUENCY SELECTION TABLE	UPLINK DECODING DEFINITIONS
ACARS REJECT MESSAGE FORMAT	UPLINK DISPLAY DEFINITIONS
HARDCODED UPLINK ROUTER TABLE	DOWNLINK ENCODING DEFINITIONS
	DOWNLINK DISPLAY DEFINITIONS
	DOWNLINK QUEUE STRUCTURE
	PRINT FORMAT DEFINITIONS
	REPORT TRIGGERS
	PARAMETER DEFINITIONS

23-27-00-028 Rev 1 06/02/95

DCMS - DCMF AND FDCF AIRLINE MODIFIABLE INFORMATION

DCMS - DCMF OPERATIONAL TESTS

General

You can do DCMF operational tests from the MAT. These are the operational tests for the DCMF:

- Left DCMF - FDDI (fiber digital data interface) LAN reset
- Left DCMF - modem reset
- Right DCMF - FDDI LAN reset
- Right DCMF - modem reset.

Left DCMF - FDDI LAN Reset

This test makes sure that the left AIMS cabinet can exchange data on the avionic local area network (AVLAN). The time for this test is about one minute.

Left DCMF - Modem Reset

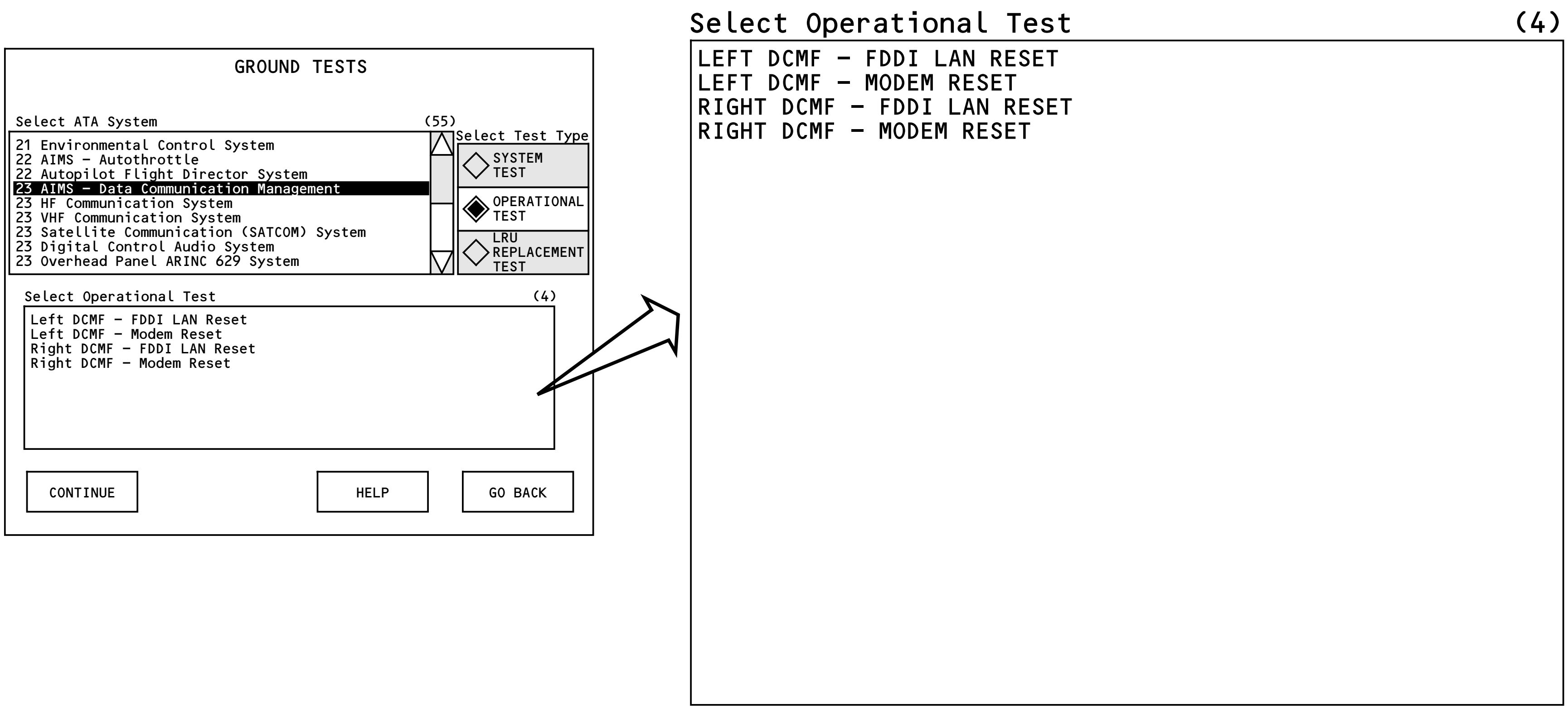
This test makes sure that the DCMF modem in the left AIMS cabinet operates correctly. The test stops ACARS communication. The time for this test is about one minute.

Right DCMF - FDDI LAN Reset

This test makes sure that the right AIMS cabinet can exchange data on the AVLAN. The time for this test is about one minute.

Right DCMF - Modem Reset

This test makes sure that the DCMF modem in the right AIMS cabinet operates correctly. The test stops ACARS communication. The time for this test is about one minute.



23-27-00-027 Rev 2

DCMS - DCMF OPERATIONAL TESTS

Continental Airlines, Inc

Printing System

WB371

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FLIGHT COMPARTMENT PRINTING SYSTEM - GENERAL DESCRIPTION

General

The flight compartment printer supplies high-speed hard copy of text for these systems:

- Primary display system (PDS)
- Airplane condition monitoring system (ACMS)
- Central maintenance computing system (CMCS).

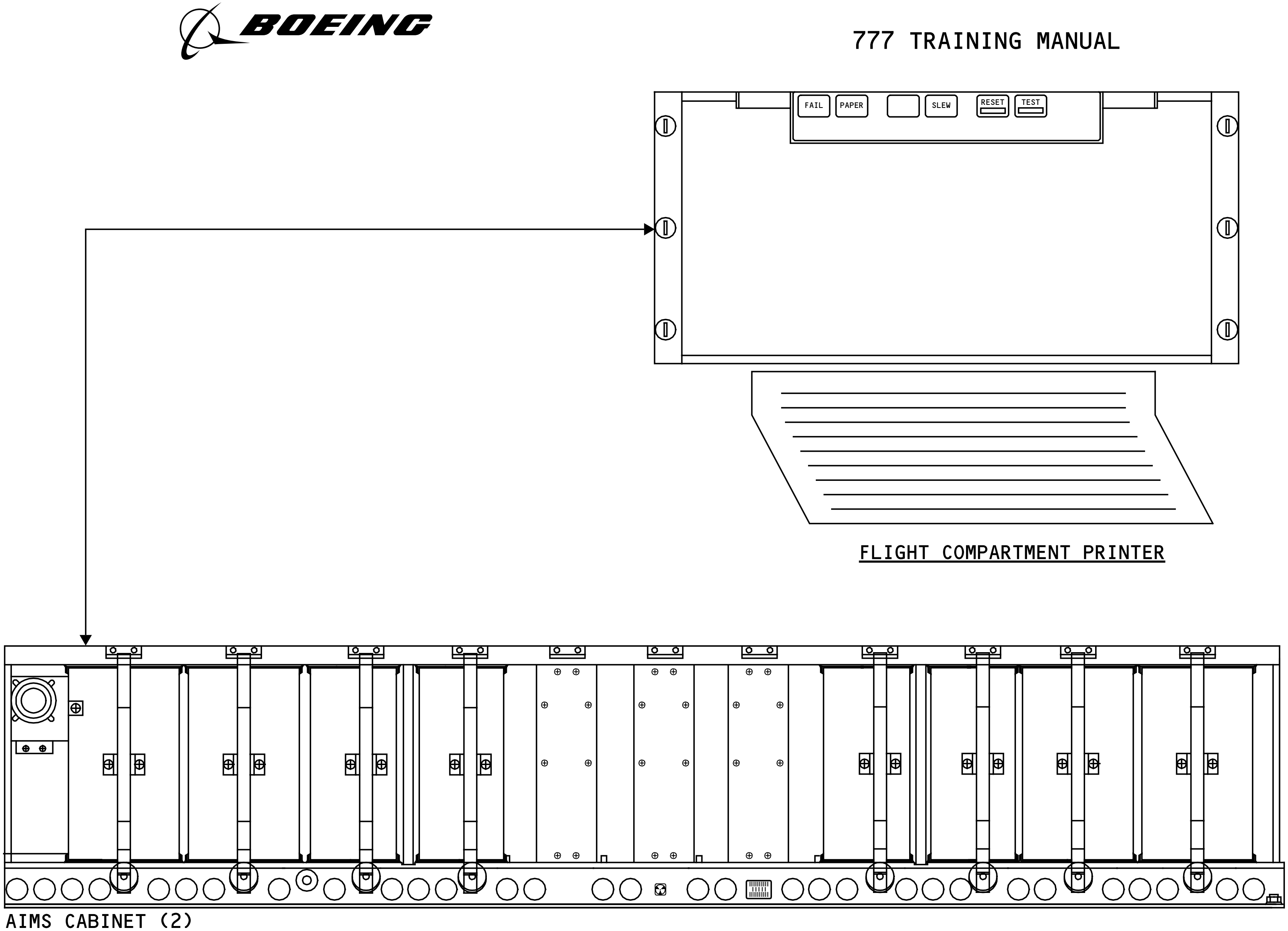
The flight compartment printer receives data from the print driver partition of the data communication management function (DCMF). The DCMF is part of the airplane information management system (AIMS). The printer sends status and error information back to the DCMF.

The DCMF prioritizes data sent to the printer in this order:

- Flight deck communication function (FDCF) of the DCMS
- Central maintenance computing function of the CMCS
- Airplane condition monitoring function of the ACMS
- Multifunction display (MFD).

Abbreviations and Acronyms

ac	- alternating current
ACMS	- airplane condition monitoring system
AIMS	- airplane information management system
CMCS	- central maintenance computing system
CPM	- core processor module
DCMF	- data communication management function
DCMS	- data communication management system
FDCF	- flight deck communication function
LAN	- local area network
MFD	- multifunction display
OPC	- operational program configuration file
OPS	- operational program software
PDF	- primary display function
PDS	- primary display system

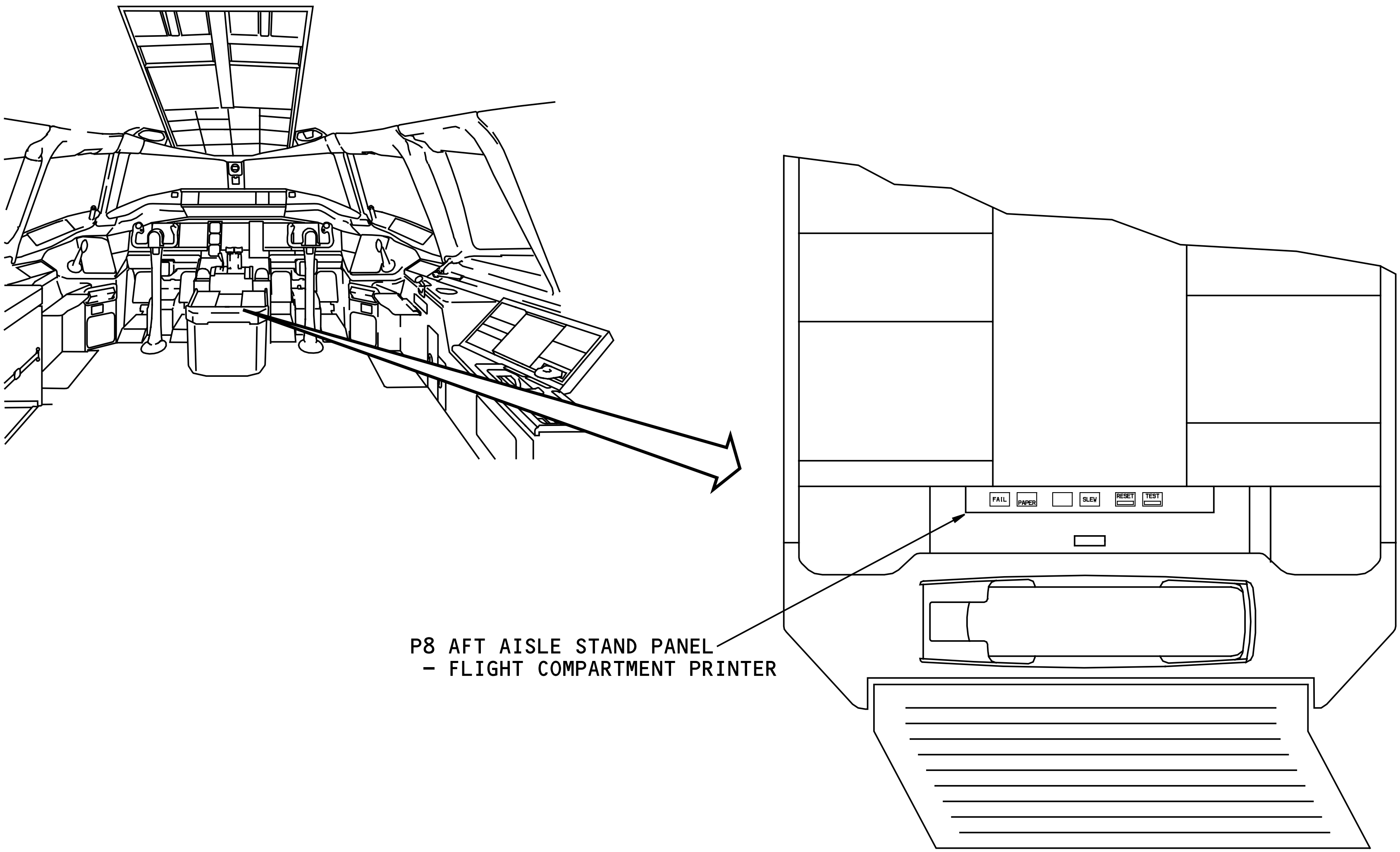


FLIGHT COMPARTMENT PRINTING SYSTEM - GENERAL DESCRIPTION

FLIGHT COMPARTMENT PRINTING SYSTEM - COMPONENT LOCATIONS - FLIGHT COMPARTMENT

Flight Compartment Component locations

The flight compartment printer is on the P8 aft aisle stand panel. It is in front of the cabin interphone handset.



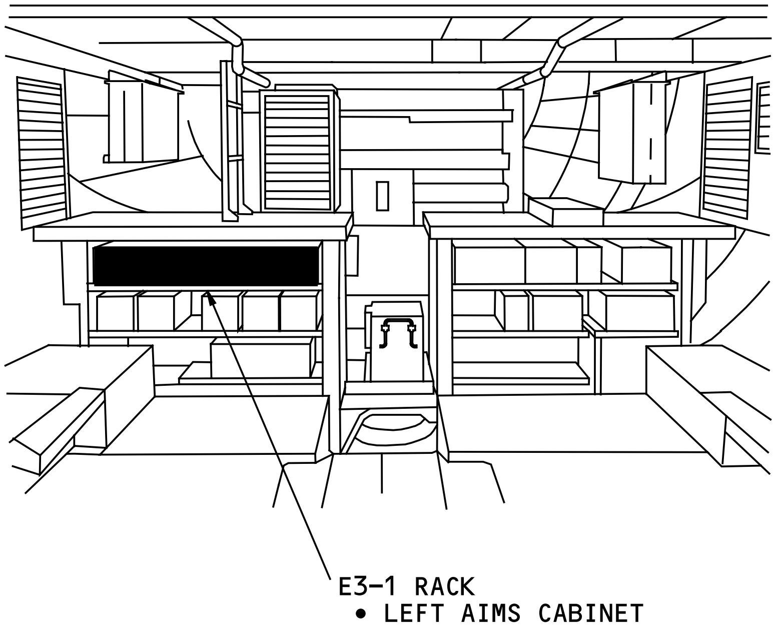
31-33-00-002 Rev 2 03/02/1998

FLIGHT COMPARTMENT PRINTING SYSTEM - COMPONENT LOCATIONS - FLIGHT COMPARTMENT

FLIGHT COMPARTMENT PRINTING SYSTEM - COMPONENT LOCATIONS - MEC

Other System Component Locations

The print driver is a software partition in the data communication management function (DCMF). The DCMF is in the AIMS core processor module/communications (CPM/Comm) in both the left and right AIMS cabinets. Both AIMS cabinets are in the main equipment center.



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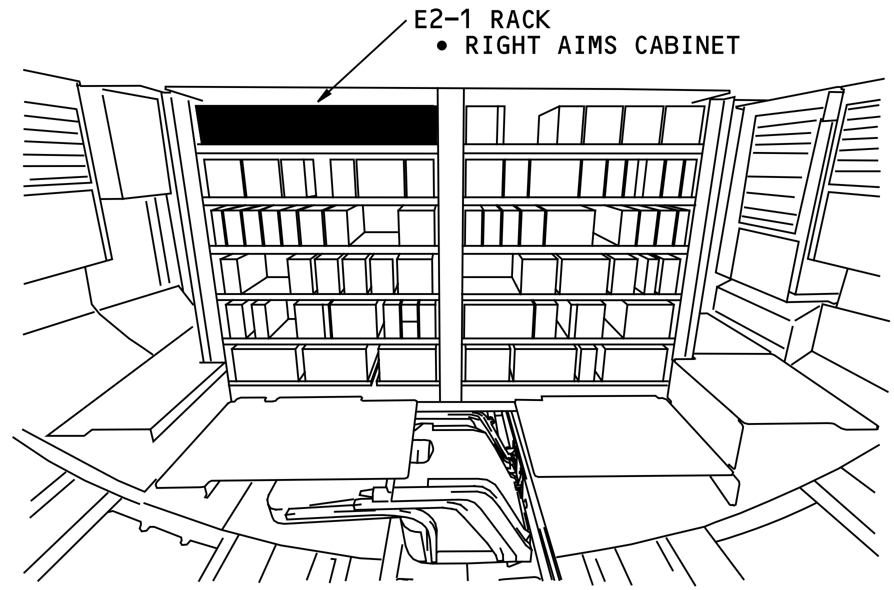

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FLIGHT COMPARTMENT PRINTING SYSTEM - COMPONENT LOCATIONS - MEC

31-33-00-003 Rev 1

FLIGHT COMPARTMENT PRINTING SYSTEM - INTERFACES

Power

The right main ac bus supplies power to the flight compartment printer.

Discretes

The left AIMS cabinet sends an enable discrete before it sends the printer data load.

ARINC 429

The flight compartment printer receives new operational program software (OPS) on the data load bus from the left AIMS cabinet.

The DCMF in both AIMS cabinets sends print data to the printer on the DCMF data bus.

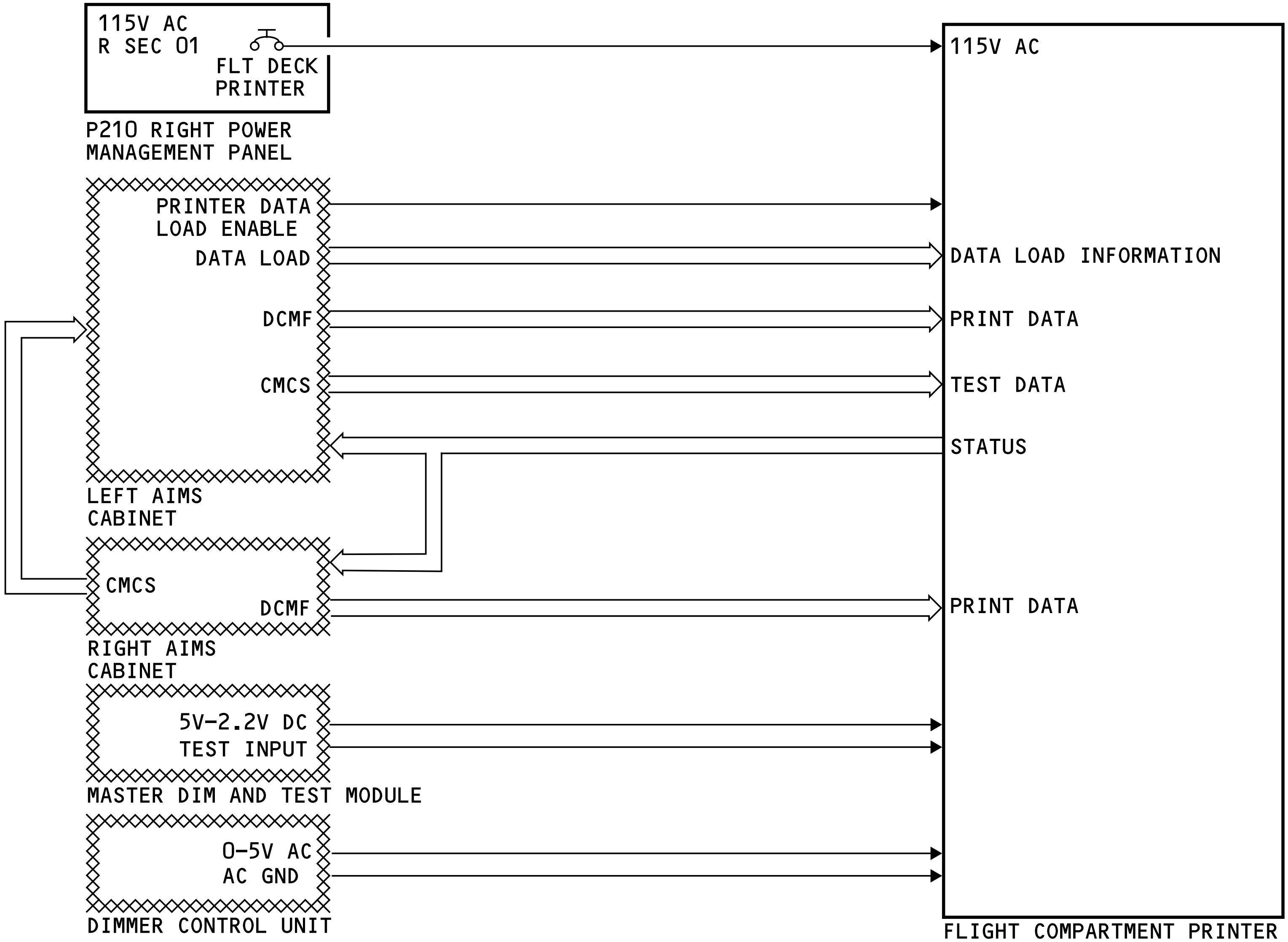
The central maintenance computing system (CMCS) in the left AIMS cabinet sends test data to the printer on the CMCS bus. If the left AIMS cannot send CMCS information, it will send the information from the right AIMS cabinet.

The flight compartment printer sends status and error messages to the DCMS in both AIMS cabinets over the status bus.

Analog

The master dim and test module supplies the power for the indication lights on the front panel. The master dim and test module also sends a test input to the printer.

The dimmer control unit sends lighting control for the integral lighting for the printer.



31-33-00-004 Rev 2 03/05/96

FLIGHT COMPARTMENT PRINTING SYSTEM - INTERFACES

FLIGHT COMPARTMENT PRINTING SYSTEM - FLIGHT COMPARTMENT PRINTER

General

The printer can print an 8.5 inch page. The printer resolution is 300 dots per inch. You can load a full paper roll of 125 linear feet into the printer. The printer uses the U.S. standard 8.5 inch roll or the A4 European Air standard paper.

Physical Description

The printer weighs approximately 12.2 lbs without a paper roll.

These are the dimensions of the printer:

- 5 inches high
- 10.75 inches wide
- 10.25 inches deep.

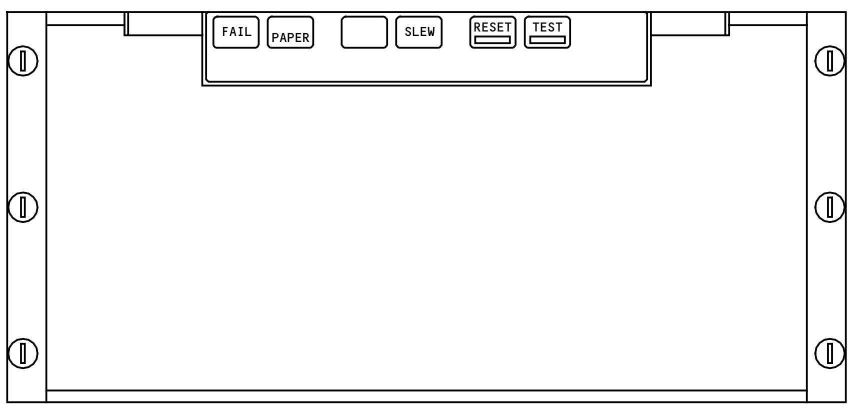
The printer contains all the mechanical components and electronics necessary for printer operation.

The mechanical components include:

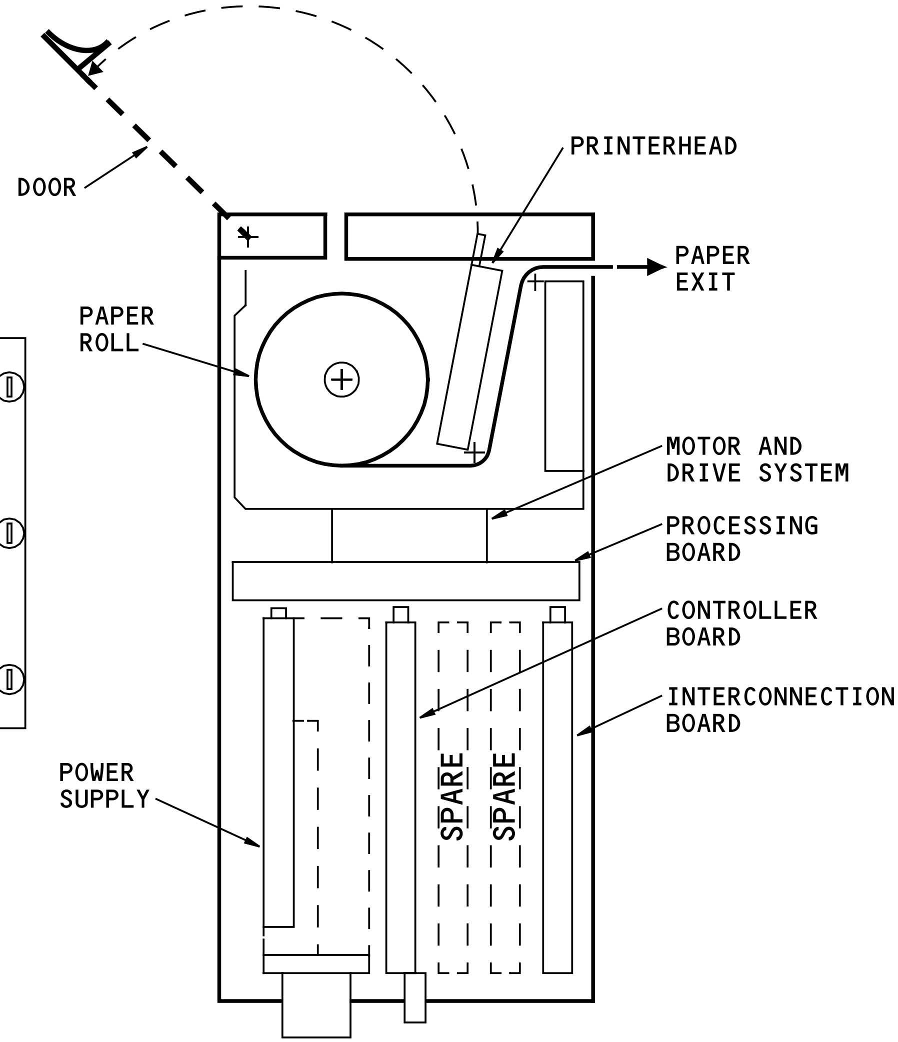
- Printer head
- Rollers to move the paper
- Motor and drive system.

The electronic components include:

- Power supply
- Processor board
- Controller board
- Interconnection board
- 2 connectors.



TOP VIEW



SIDE VIEW

31-33-00-005 Rev 1 03/02/1998

FLIGHT COMPARTMENT PRINTING SYSTEM - FLIGHT COMPARTMENT PRINTER

FLIGHT COMPARTMENT PRINTING SYSTEM - OPERATION

General

There are five functional buttons on the printer. Two of the push buttons show printer status. Three of the push buttons control the printer.

Indications

The amber FAIL light comes on when a failure occurs that you can not repair on the line.

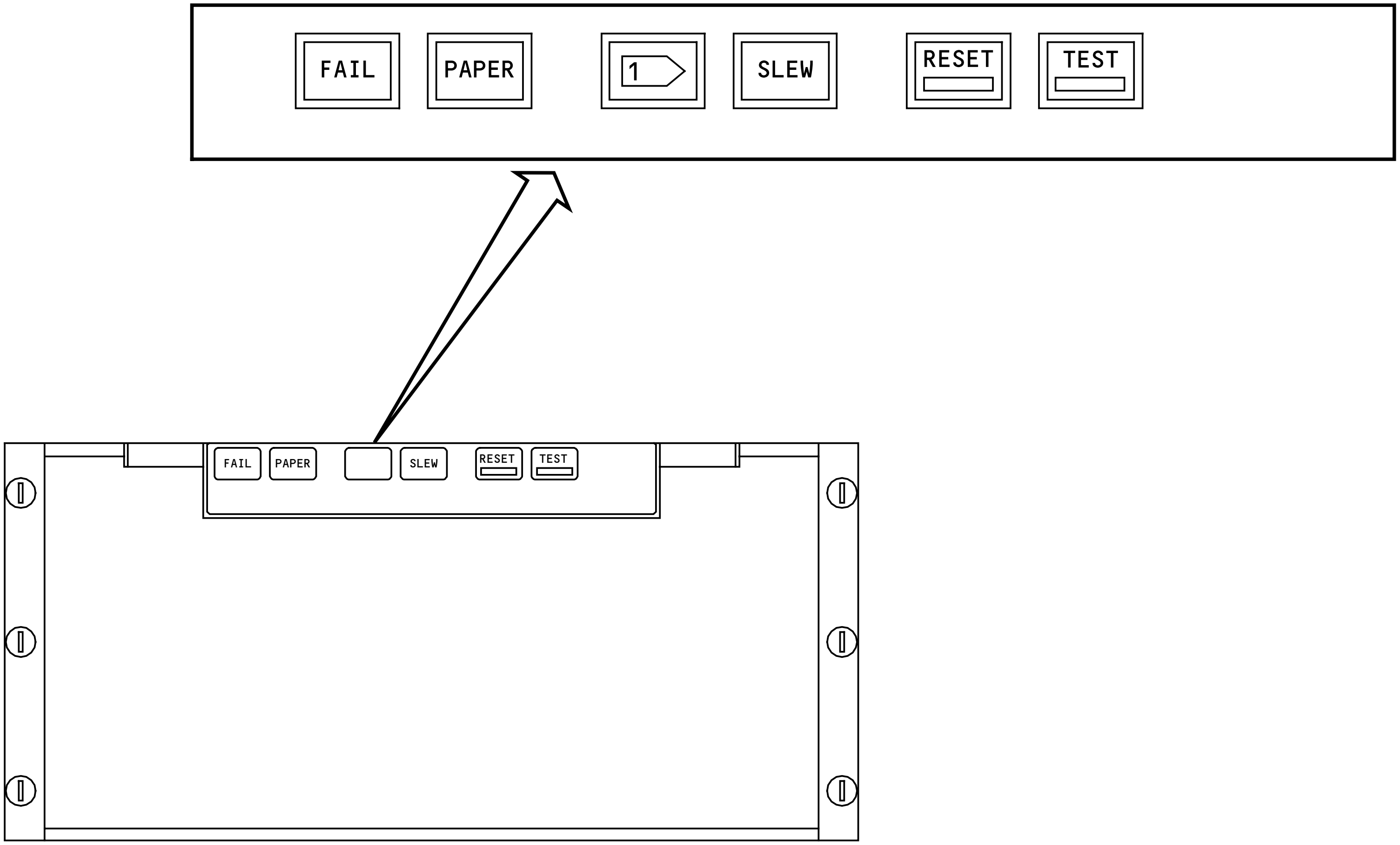
The amber PAPER light comes on when the printer is out of paper and when there is a paper jam.

Controls

Push the SLEW switch to move the paper out of the printer. Release the SLEW switch to stop the paper.

Push the RESET switch to cause a power-up reset of the electronic circuitry of the printer. Printing will stop. Messages in the printer memory are kept in memory. A green bar on the switch shows during the reset.

Push the TEST switch to do a test of the printer. During the test, a test pattern for text prints. The test pattern shows all the text characters the printer can print. A 300 dots per inch test pattern for graphics follows the test pattern for text. A green bar on the switch shows during the printer test.



1 THIS BUTTON NOT CONNECTED

FLIGHT COMPARTMENT PRINTING SYSTEM - OPERATION

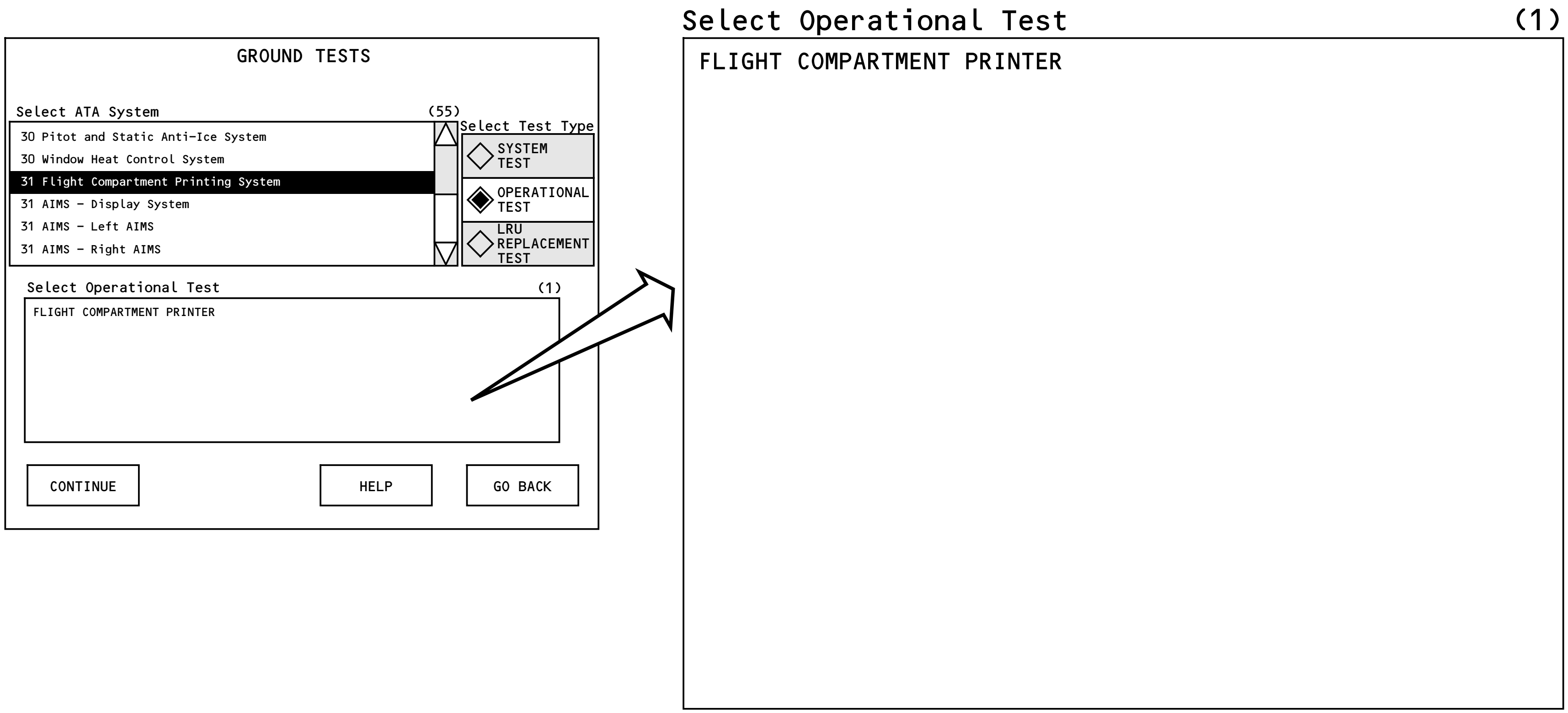
FLIGHT COMPARTMENT PRINTING SYSTEM - OPERATIONAL GROUND TESTS

General

You can do a test of the flight compartment printer with the MAT. The MAT has one test for the printer, it is an operational ground test.

Flight Compartment Printer

During this test, the printer does an internal test. If the printer has no problem, it makes a printout of a page of characters. The lights on the printer come on during the test.



31-33-00-008 Rev 2 03/31/1998

FLIGHT COMPARTMENT PRINTING SYSTEM - OPERATIONAL GROUND TESTS

Continental Airlines, Inc

Flight Management Computing System

WB371

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FLIGHT MANAGEMENT COMPUTING SYSTEM - INTRODUCTION

General

The purpose of the FMCS is to supply these functions:

- Flight plan control data
- Navigation calculations
- Display information.

The flight crew can use the FMCS data to manually or automatically fly the airplane.

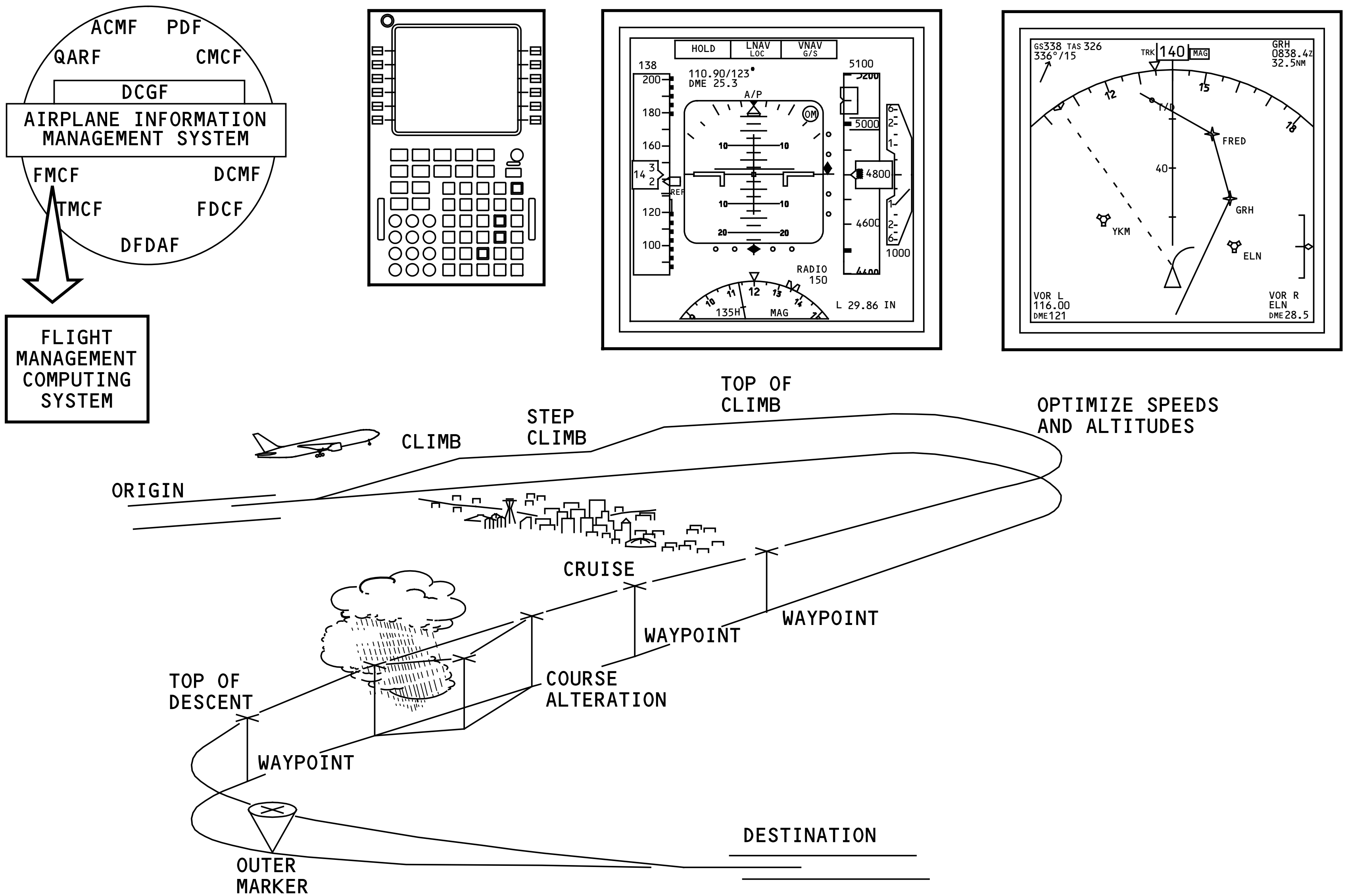
Abbreviations and Acronyms

A	- at or above an altitude
A	- antenna (mode for ADF)
A	- automatic (radio tuning mode)
ABM	- abeam
ACIPS	- airfoil and cowl ice protection system
ACMF	- airplane condition monitoring function
act	- active
A/T	- autothrottle
ADIRS	- air data inertial reference system
AFDC	- autopilot flight director computer
AFDS	- autopilot flight director system
AIMS	- airplane information management system
alt	- altitude
ALTN	- alternate
ALTN NAV	- alternate navigation
AMI	- airline modifiable information
AMU	- audio management unit
appr	- approach
ARINC	- Aeronautical Radio, Incorporated
arr	- arrival
ASCPC	- air supply cabin pressure controller
ASG	- ARINC signal gateway
ATA	- actual time of arrival
ATN	- aeronautical telecommunication network
avail	- available
B	- at or below an altitude
B/A	- bank angle
B/C	- back course
BFO	- beat frequency oscillator
BPCU	- bus power control unit
brg	- bearing
C	- center
C	- celsius
CAM	- crew alertness monitor
CAS	- computed airspeed
CDU	- control display unit
clb	- climb
clr	- clear
CMCF	- central maintenance computing function
cmd	- command
co	- company
con	- continuous
CPM	- core processor module
crs	- course
crz	- cruise
CTC	- cabin temperature controller
ctr	- center

D	- derated
DCMF	- data communication management function
DCGF	- data conversion gateway function
DD	- drift down
DFDAF	- digital flight data acquisition function
del	- delete
dep	- departure
des	- descent
dest	- destination
dev	- deviation
dist	- distance
dspl	- display
DTG	- distance to go
DME	- distance measuring equipment
DSP	- display select panel
DSP	- display switching panel
E	- east
E/O	- engine out
econ	- economy
E/D	- end of descent
EDIU	- engine data interface unit
EEC	- electronic engine control
EFC	- expect further clearance
ELMS	- electrical load management system
eng	- engine
ETA	- estimated time of arrival
ETE	- estimated time enroute
exec	- execute
F	- Fahrenheit
FDCF	- flight deck communication function
FF	- fuel flow
FL	- flight level
FLCH	- flight level change
flt	- flight
FMA	- flight mode annunciation
FMCF	- flight management computing function
FMCS	- flight management computing system
FMF	- flight management function
FPA	- flight path angle
FQPU	- fuel quantity processor unit
FSEU	- flap slat electronics unit
FW	- failure warning
fwd	- forward
G/A	- go around
GBST	- ground based software tool
GPSSU	- global positioning system sensor unit
GPS	- global positioning system
GPWC	- ground proximity warning computer
GRWT	- gross weight
H	- hot
hdg	- heading
ht	- heat
HFOM	- horizontal figure of merit
ICAO	- International Civil Aviation Organization
ICB	- intercabinet bus
ident	- identification
IEI	- imbedded element identifier

IMI	- imbedded message identifier
inbd	- inboard
info	- information
INIT/REF	- initialization reference
intcp	- intercept
ISA	- international standard atmosphere
ISSP	- instrument source select panel
KTS	- nautical miles per hour (knots)
L	- left
lat	- latitude
LED	- light emitting diode
LF	- left front
lim	- limit
LNAV	- lateral navigation
lo	- low
long	- longitude
LRC	- long range cruise
max	- maximum
MCP	- mode control panel
MFD	- multi-function display
MLS	- microwave landing system
MMR	- multi-mode receiver
mod	- modification
msg	- message
m	- meters
N	- north
N1	- low pressure rotor speed
N2	- high pressure rotor speed
nav	- navigation
NAV RAD	- navigation radio
NCD	- no computed data
NDB	- navigation database
NM	- nautical miles
OAT	- outside air temperature
OFST	- offset
OPAS	- overhead panel ARINC 629 system
OPBC	- overhead panel bus controller
OPC	- operational program configuration
opt	- optimum
PA/CI	- passenger address/cabin interphone
PBD	- place bearing distance
PDB	- performance data base
PDF	- primary display function
PDS	- primary display system
perf	- performance
PFC	- primary flight computer
PFCS	- primary flight control system
PIIC	- passenger inflight information computer
pl	- place
pln	- plan
pos	- position
PPOS	- present position
pred	- predicted
preflt	- preflight
proc	- procedure
prof	- profile
PSD	- port select discrete
PSEU	- proximity sensor electronics unit

PTC	- push to center
QAD	- quick attach/detach
QARF	- quick access recorder function
QFE	- altimeter setting to indicate height above reference airfield
QNH	- altimeter setting to indicate altitude above mean sea level
QRH	- quick reference handbook
QUAD	- quadrant
qty	- quantity
R	- right
rad	- radio
ref	- reference
rev	- revise
rte	- route
rwy	- runway
S	- south
S/C	- step climb
SAARU	- secondary attitude air data reference unit
SAT	- static air temperature
SATCOM	- satellite communications
SDU	- satellite data unit
sel	- selector
SID	- standard instrument departure
SPD	- speed
STAR	- standard terminal arrival route
TACAN	- tactical air navigation
TAS	- true airspeed
TAT	- total air temperature
T/C	- top of climb
T/D	- top of descent
tgt	- target
thr	- thrust
thr ref	- thrust reference
TMCF	- thrust management computing function
TMCS	- thrust management computing system
TO/GA	- takeoff/go-around
TRA	- throttle resolver angle
trans	- transition
trk	- track
TTG	- time to go (CDU)
UTC	- universal time (coordinated)
V1	- takeoff decision speed
V2	- takeoff safety speed
v	- volt
VNAV	- vertical navigation
VR	- rotation speed
VREF	- landing reference speed
V/S	- vertical speed
VTK	- vertical track
W	- west
WES	- warning electronic system
WEU	- warning electronic unit
wpt	- waypoint
wt	- weight
XTK	- cross track
ZFW	- zero fuel weight



FLIGHT MANAGEMENT COMPUTING SYSTEM - INTRODUCTION

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FMCS - GENERAL DESCRIPTION

General

The flight management computing system shares data with the:

- Air data inertial reference system
- Global positioning system
- Navigation radios
- Engine sensors
- Fuel sensors
- FMCF internal databases
- Key entries into the control display units (CDUs).

The FMCS uses the data from the airplane systems to do these functions:

- Navigation
- Flight planning
- Performance management
- Guidance and control
- Thrust management
- Display and system control
- Datalink interface.

FMCS Components

The FMCS has these components:

- Flight management computing function (FMCF) (2) one in each AIMS cabinet
- CDUs (3)
- FMC selector
- Instrument source select panel (ISSP) navigation source switches (2).

Also, the mode control panel (MCP) has an interface with the FMCS, but is not an FMCS component.

Flight Management Computing Function

Each FMCF has these two software partitions:

- Flight management function (FMF) partition
- Navigation function partition.

The FMF partition supplies:

- Flight planning
- Lateral navigation (LNAV) guidance commands
- Vertical navigation (VNAV) guidance commands
- Thrust guidance commands
- Performance data
- Display control
- ND MAP display
- Manual, route, and procedure selection of navigation radios
- Required time of arrival (RTA) calculation
- Automatic dependent surveillance function (ADSF)
- BITE and fault monitoring.

The navigation function partition supplies:

- Position calculation
- Navaid selection for radio position calculation
- Navigation radio tuning command outputs.

FMCS - GENERAL DESCRIPTION

The FMCFs use performance and navigation data bases and sensor inputs to calculate guidance commands. When the flight crew uses the MCP to select the LNAV and VNAV modes, the FMCF sends:

- LNAV and VNAV guidance commands to the autopilot flight director computers (AFDCs)
- Thrust guidance commands and thrust limit data to the thrust management computing function (TMCF)
- Display and fault data to the primary display and central maintenance computing functions in the AIMS cabinets.

Automatic Dependent Surveillance Function

The automatic dependent surveillance function (ADSF) is a sub-function of the FMCF. The purpose of the ADSF is to permit air traffic control (ATC) to monitor the airplane in the air.

ATC sends automatic dependent surveillance (ADS) requests from the ground to the airplane. The ADSF in the airplane sends airplane position, heading, airspeed, and other data to the ground. ATC uses this data to manage air traffic. The ADSF is automatic and does not require flight crew action.

CDU - General

There are three CDUs in the flight deck. The CDUs are the primary control and display interface unit for the FMCF. The flight crew uses the left and right CDUs to enter flight plan data and interface with the FMCF and other systems. If the left or right CDU fails, the center CDU is the backup.

All CDUs can select a maintenance page format on a multifunction display (MFD) in the primary display system (PDS).

All CDUs can control the satellite communication (SATCOM) system.

The center CDU is the interface for the passenger address/cabin interphone (PA/CI) controller.

The CDU supplies these functions when the FMCFs fail:

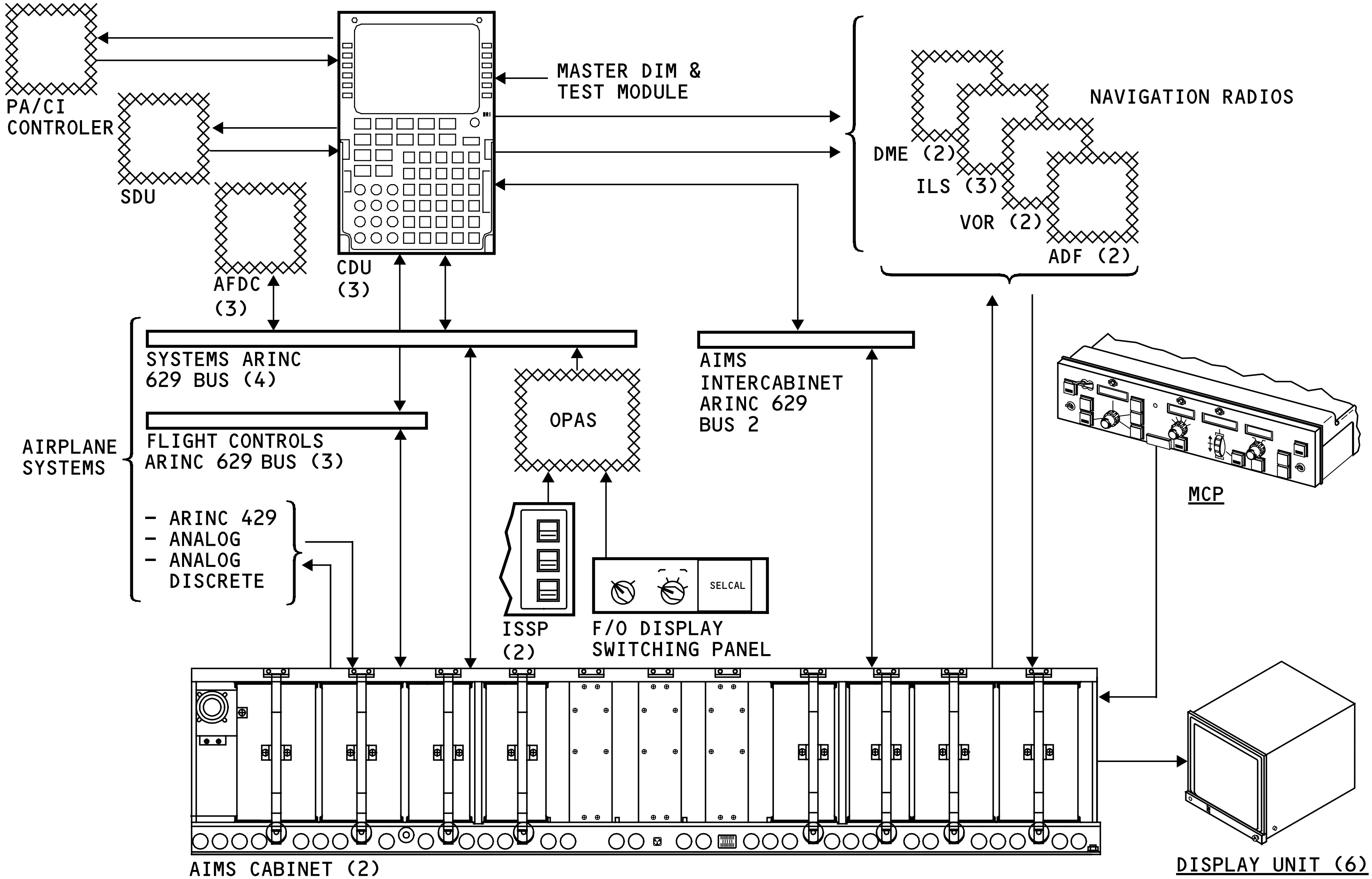
- Backup navigation radio tuning
- Calculates LNAV guidance commands
- Backup map data.

FMC Selector and Instrument Source Select Panel

The FMC selector is on the first officer's display switching panel. It determines the active FMCF.

The FMC selector and ISSP switches supply analog inputs to the overhead panel ARINC 629 system (OPAS). The OPAS converts these inputs and sends them to the AIMS cabinet on the systems ARINC 629 buses.

The NAV ISSP switch determines the source of navigation display data.



FMCS - GENERAL DESCRIPTION

FMCS - FLIGHT DECK COMPONENT LOCATIONS

FMCS Component Locations - P8 and P9 Panels

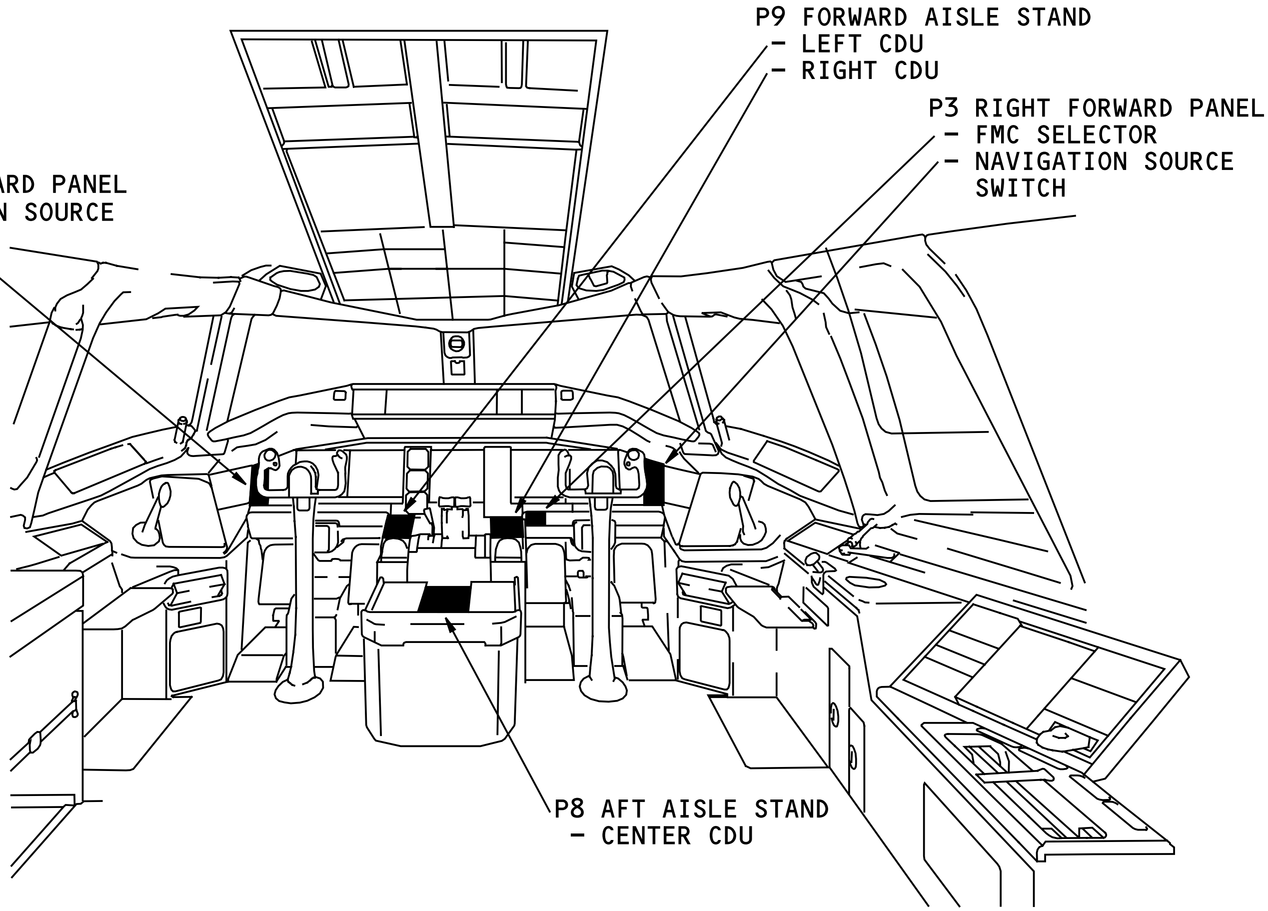
The FMCS components on the P9 forward aisle stand and P8 aft aisle stand panels are:

- Left control display unit (CDU)
- Right CDU
- Center CDU.

FMCS component Locations - P1 and P3 Panels

The FMCS components on the P1 left forward panel and P3 right forward panel are:

- Left and right navigation source switch (P1/P3)
- FMC selector (P3).



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FMCS - FLIGHT DECK COMPONENT LOCATIONS

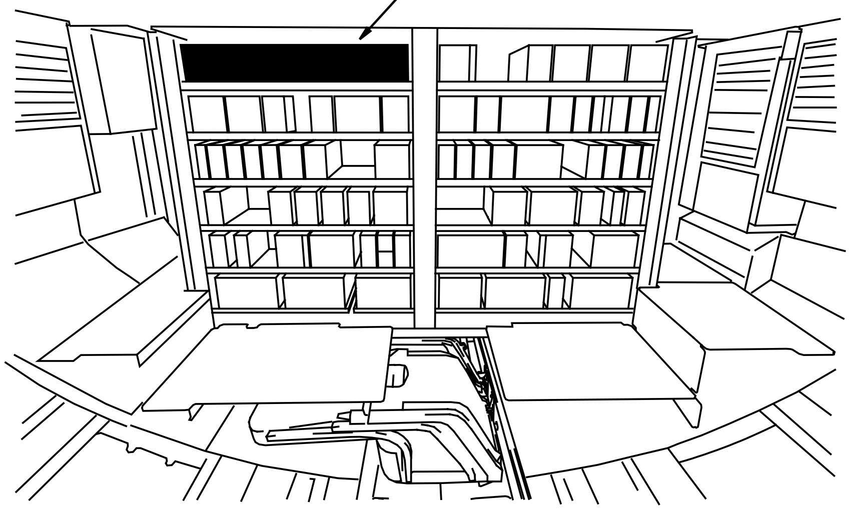
FMCS - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

General

Each AIMS cabinet has an FMCF. The left AIMS cabinet has the FMCF in the core processor module/airplane condition monitoring function (CPM/ACMF). The right AIMS cabinet has the FMCF in the CPM/Basic.

Main Equipment Center Component Location

The left AIMS cabinet is on the E3-1 shelf. The right AIMS cabinet is on the E2-1 shelf.



MAIN EQUIPMENT CENTER
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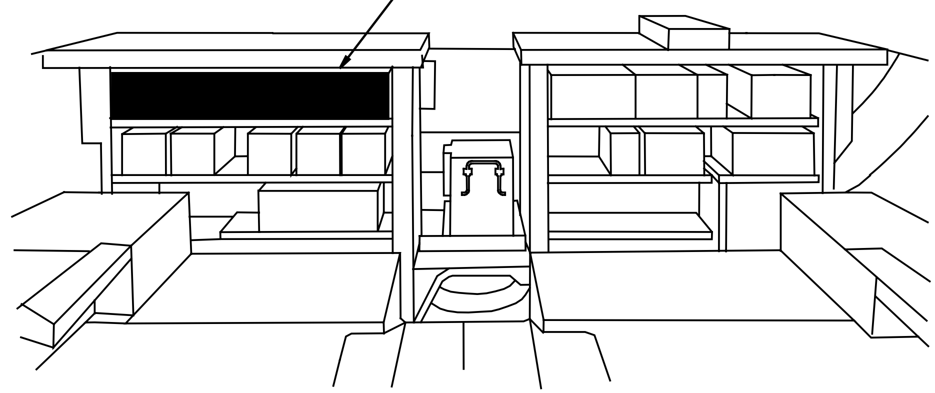


MAIN EQUIPMENT CENTER
(LOOKING FORWARD)

FMCS - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

FMCS - CDU POWER INTERFACE

General

These power buses supply 28v dc power to a CDU through an insertion switch:

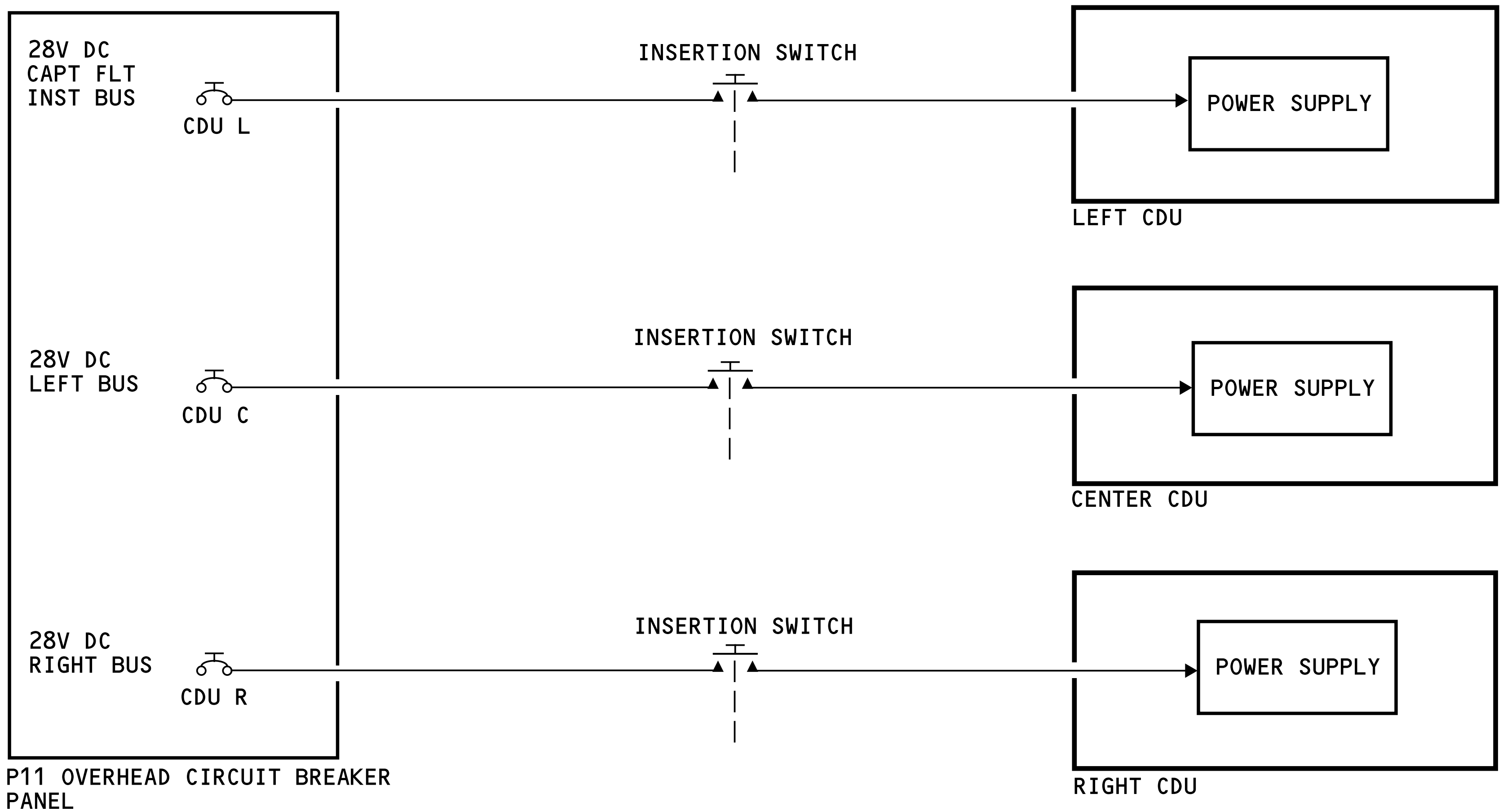
- Captain's flight instrument bus (L CDU)
- Left bus (C CDU)
- Right bus (R CDU).

Insertion Switch

When you remove the CDU from the CDU mount, the insertion switch opens and removes power from the CDU.

When you put the CDU into the CDU mount, the insertion switch closes and supplies power to the CDU.

The insertion switch is a spring loaded switch near the connector on the CDU mount.



34-61-00-005 Rev 3

FMCS - CDU POWER INTERFACE

FMCS - FMCF INTERFACES - 1

General

The FMCF in the AIMS cabinets receives digital and analog discrete inputs from components, sensors, and switches on these buses:

- Flight controls ARINC 629 buses
- Systems ARINC 629 buses
- ARINC 429 buses
- AIMS intercabinet ARINC 629 buses
- Analog discretes.

The FMCF in the AIMS cabinets sends digital data on these buses:

- Flight controls ARINC 629 buses
- Systems ARINC 629 buses
- ARINC 429 buses
- AIMS intercabinet ARINC 629 bus 2.

Input Overview

These are the components that have an interface on the flight controls ARINC 629 buses:

- Primary flight computer (PFC) (3)
- Air data inertial reference unit (ADIRU)
- Secondary attitude air data reference unit (SAARU).

These are the components that have an interface on the systems ARINC 629 buses:

- Autopilot flight director computers (AFDCs) (3)
- Warning electronic unit (WEU) (2)
- Air supply cabin pressure controller (ASCPC (2)
- Cabin temperature controller (CTC) (2)
- Engine data interface units (EDIU) (2)
- Flap slat electronic unit (FSEU) (2)
- Proximity switch electronic units (PSEU) (2)
- Electrical load management system (ELMS) (3)
- Fuel quantity processing unit (FQPU) (2)
- Overhead panel ARINC 629 system (OPAS)
- Audio management unit (AMU)
- Card files (2)
- ARINC signal gateway (ASG).

These are the components that have an interface on the AIMS intercabinet ARINC 629 bus 2:

- L AIMS cabinet
- R AIMS cabinet.

These are the components that have an interface on the ARINC 429 buses:

- Multi-mode receiver (MMR) (2)
- Ground proximity warning computer (GPWC)
- Passenger inflight information computer (PIIC)
- EFIS control panel (2).

The FMCFs receive analog discretes from these:

- VHF communication transceivers (3)
- HF communication transceivers (2)
- TO/GA switches (3).

FMCS - FMCF INTERFACES - 1

Input Details

The FMCFs get data from these interfaces:

- Flight control ARINC 629 buses
- Systems ARINC 629 buses
- AIMS inter-cabinet bus 2
- ARINC 429 buses
- Analog discretes.

PFC Inputs - Flight Control ARINC 629 Bus (L, R, & C)

The PFCs send bank angle protection data to the FMCFs. The FMCFs use this data to calculate the lateral guidance command.

ADIRU Inputs - Flight Control ARINC 629 Bus (L & R)

The ADIRU sends air data and inertial data to the FMCFs. The FMCFs use this data to calculate guidance and display commands.

SAARU Inputs - Flight Control ARINC 629 Bus (C)

The SAARU sends back-up air data and inertial data when the ADIRU fails.

AFDS Inputs - Systems Bus ARINC 629 (L, R, & C1)

The AFDCs send the ILS tune inhibit discrete and the arm/operational mode discretes to the FMCFs. The FMCFs use the ILS discrete to inhibit all ILS tune requests when the AFDS is in the approach mode. The arm/operational mode discretes tell the FMCF when to send its LNAV/VNAV guidance commands to the AFDS.

WEU Inputs - Systems ARINC 629 Bus (L, R, & C1)

The WEUs send this data to the FMCFs:

- Maximum operating speed
- Minimum operating speed
- Maximum placard speed.

The FMCFs use this data to compare with its maximum and minimum speed calculations. The active FMCF sends the safe maximum and minimum speeds to the WEUs for aural annunciations.

ASCPC and CTC Inputs - Systems ARINC 629 Bus (L & R)

The ASCPCs and CTCs send bleed air data to the FMCFs. The FMCFs use this data to calculate thrust and display commands when VNAV engages.

EDIU Inputs - Systems ARINC 629 Bus (L, R, C1, & C2)

The data the EDIUs send to the FMCFs includes this:

- Low speed compressor RPM (N1)
- Fuel flow for each engine.

The FMCFs use this data to calculate thrust commands and thrust limits.

FSEU Inputs - Systems ARINC 629 Bus (L, R, & C1)

The FSEUs send flap position and flap lever position to the FMCFs. The FMCF uses this data in its maximum speed and minimum speed calculations.

PSEU Inputs - Systems Bus ARINC 629 (L & R)

The PSEUs send landing gear position to the FMCFs. The FMCFs use this data to calculate speed limits.

FQPU Inputs - Systems Bus ARINC 629 (L & R)

The FQPUs send total fuel to the FMCFs. The FMCFs use this data to calculate performance data.

OPAS Inputs - Systems ARINC 629 Bus (L & R)

The OPAS send this data to the FMCFs:

- FMC selector position (Left, right or AUTO)
- Navigation source switch position
- Display select panel (DSP) switch position.

Card Files Inputs - Systems ARINC 629 Bus (L & R)

The FMCFs receive air/ground discretes and airfoil and cowl ice protection system (ACIPS) bleed air data from the card files. The FMCFs use the air/ground data to start and stop radio position calculation. The FMCFs use ACIPS data to help calculate performance commands.

FMCF Inputs - AIMS Intercabinet ARINC 629 Bus 2

The active FMCF receives intercabinet data, such as flight plan and map data, from the other FMCF. It does a comparison check with the other data. The active FMCF starts a resync to the other FMCF when the comparison check does not agree.

GPS Inputs - ARINC 429 Bus

The GPS sends this data to the FMCFs:

- Altitude
- Latitude
- Longitude
- East/north/vertical velocities
- Horizontal figure of merit (HFOM).

The FMCFs use GPS altitude, position (LAT and LON), and velocity data with ADIRU and radio data to calculate present position and ground speed. The FMCFs use the HFOM to reject the GPS data when the data is not within the necessary limits.

EFIS Control Panel Inputs - ARINC 429 Bus

The EFIS CPs send map data requests to the active FMCF to process. The active FMCF sends this map data to the PDF for display:

- Map mode
- Map range
- Navaid and waypoint data.

FMCS - FMCF INTERFACES - 1

Analog Discrete Inputs - HF (2), VHF (3) Communication Transceivers, and TO/GA Switches (3)

When the flight crew pushes the microphone switch on the HF or VHF communication transceivers or pushes the TO/GA switches, an analog discrete signal goes to the FMCFs. The FMCFs use the analog discretes with other entry inputs from these components to monitor crew work:

- MCP
- EFIS CP (2)
- DSP (2)
- CDU (3).

If the flight crew does not do any work over a period of time, the FMCF makes these alerts occur in cruise and descent:

- Warning
- Caution
- Advisory.

Output Overview

The active FMCF sends digital data to these components on the flight controls ARINC 629 buses:

- ADIRU
- SAARU.

The active FMCF sends digital data to these components on the system ARINC 629 buses:

- AFDS (3)
- ELMS (3)
- AMU
- ASG (2).

The active FMCF sends digital data to the other AIMS cabinet on the ICB ARINC 629 buses.

The active FMCF sends digital data to these components on the ARINC 429 buses:

- Passenger inflight information computer (PIIC)
- GPWC.

Output Details

The FMCFs send data to these interfaces:

- Flight controls ARINC 629 buses
- Systems ARINC 629 buses
- AIMS intercabinet ARINC 629 bus 2
- ARINC 429 buses.

SAARU/ADIRU Outputs - Flight Controls ARINC 629 Bus (3)

The active FMCF sends CDU heading requests to the SAARU when the SAARU is the active navigation source.

The active FMCF sends CDU LAT and LON entries to the ADIRU for initialization.

FMCS - FMCF INTERFACES - 1

AFDS Outputs - Systems ARINC 629 Bus (L, R, & C1)

The active FMCF sends the AFDS lateral and vertical steering guidance commands after the FMCFs receive an arm/operational mode discrete from the AFDS.

ELMS Outputs - Systems ARINC 629 Bus (L & R)

The active FMCF sends zero fuel weight to the ELMS.

AMU Outputs - Systems ARINC 629 Bus (L)

The FMCF sends a VOR/DME or ILS/DME pair discrete to the AMU. This pair discrete lets you hear the DME audio identifier with the co-located VOR or ILS audio identifier. Selections on the EFIS control panel and the audio control panel defines the audio pair.

ASG Outputs - Systems ARINC 629 Bus (L & R)

The active FMCF sends this data to the ASG:

- Airframe configuration
- Engine configuration
- Wing configuration.

FMCF Outputs - AIMS Intercabinet ARINC 629 Bus 2

The active FMCF sends resync data, such as flight plan and map data, to the other FMCF. This happens when a comparison check of the data between the two FMCFs fails.

Passenger Inflight Information Computer (PIIC) Outputs - ARINC 429 Bus

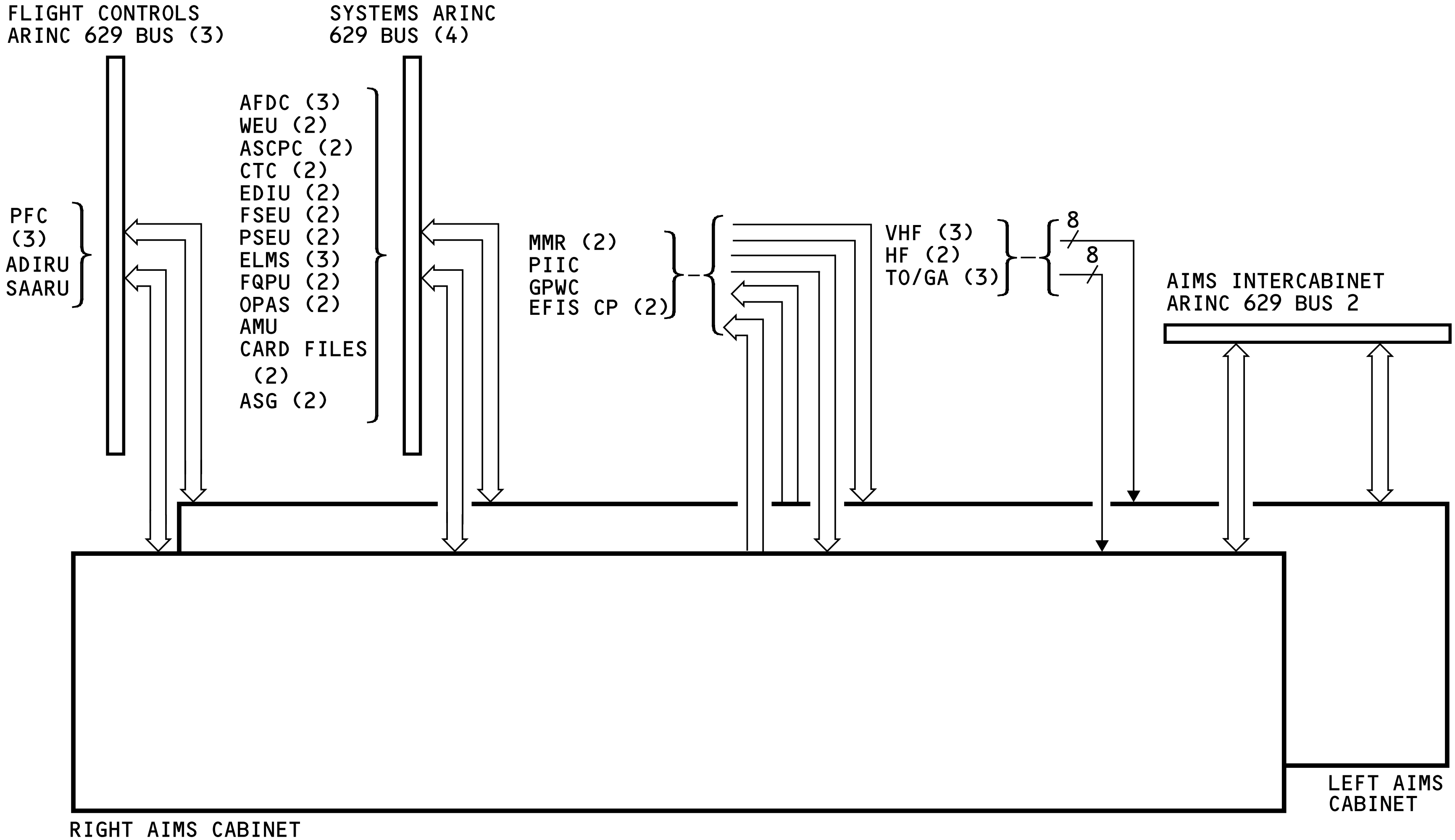
The active FMCF sends this data to the PIIC on a low speed 429 data bus:

- Distance and time to waypoint
- Distance and time to destination.

GPWC Outputs - ARINC 429 Bus

The active FMCF sends this data to the GPWC on a low speed ARINC 429 data bus:

- Air data and inertial data
- Magnetic track angle
- Position (latitude and longitude).



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FMCS - FMCF INTERFACES - 1

FMCS - FMCF INTERFACES - 2

General

The FMCFs receive mode and status data from the mode control panel (MCP).

The FMCFs receive inputs from these navigation radios:

- MMR
- VOR
- DME
- ADF.

The navigation radio inputs go to the input/output modules (IOMs) in the left and right AIMS cabinets.

The FMCFs use DME distance, ILS deviation and VOR bearing for position update.

MCP Inputs - ARINC 429 Bus

The MCP sends this data to the FMCFs on two 429 buses:

- Altitude and altitude intervention
- Speed and speed intervention
- Mach and mach intervention
- LNAV and VNAV mode requests.

Navigation Radio Inputs - ARINC 429 Buses

The multi-mode receivers (MMR) send ILS deviation data to the FMCF navigation partition. The FMCF can use this data to calculate a position. The MMRs also send frequency data to the FMCF navigation partition so the FMCF can verify valid ILS tuning.

The VOR receivers send bearing, frequency, and status data.

The DME interrogators send distance, frequency, and status data.

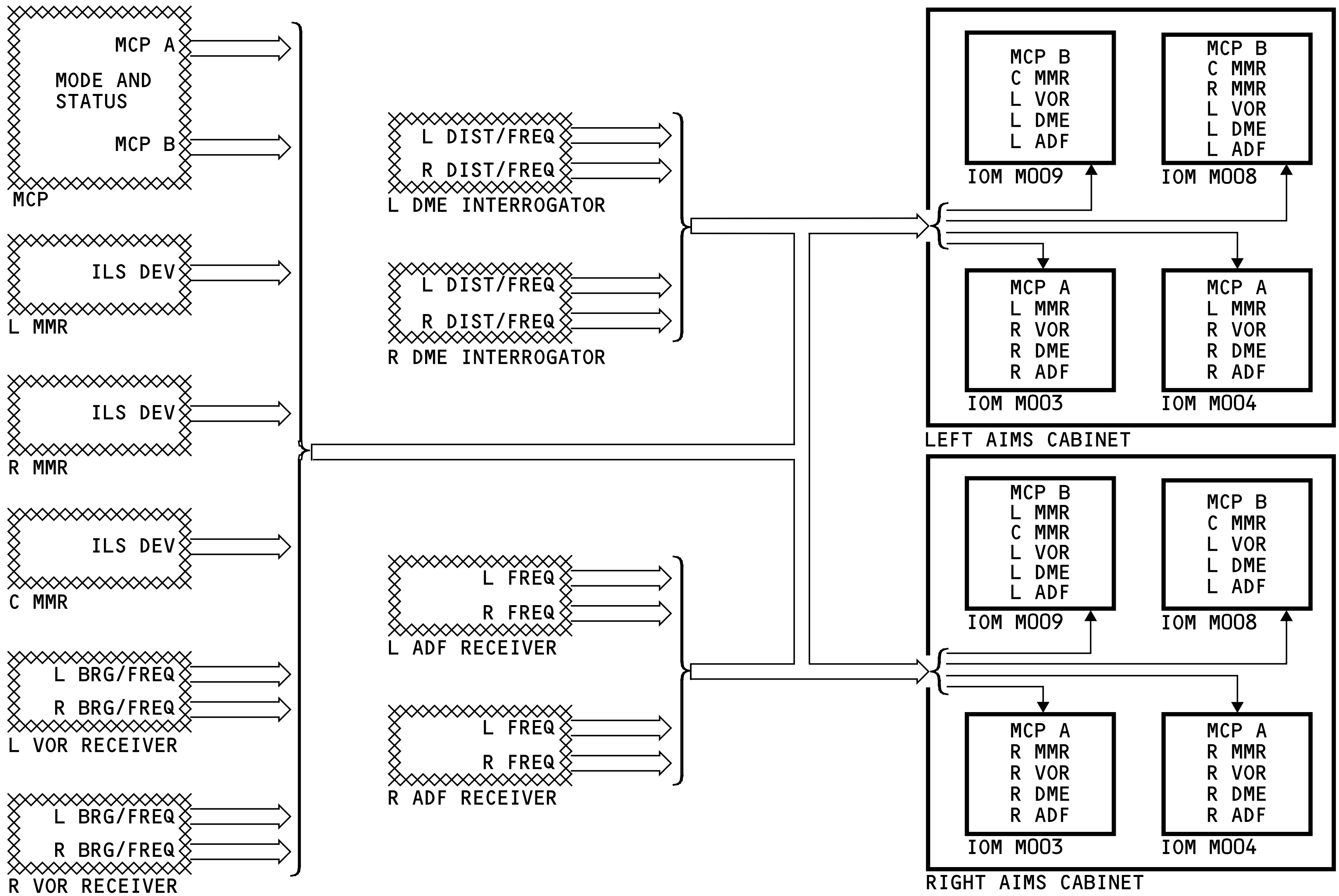
The ADF receivers send frequency and status data.

The navigation radios send the tuned frequencies back to the FMCFs. The FMCFs use these frequencies as a wrap around tests. The FMCFs use status data to blank or show dashes instead of the normal display.

The FMCFs use the navigation radios for position update in this order:

- ILS/DME in approach and ILS active
- DME/DME
- DME/VOR.

The FMCFs do not use ADF bearing in their position calculations.



FMCS - FMCF INTERFACES - 2

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FMCS - FMCF INTERFACES - 3

General

These are the three types of procedures to tune navigation radio:

- Automatic
- Manual
- Alternate.

For the automatic procedure, the FMCFs send tune data to the ILS, VOR and DME navigation radios automatically. The ADF navigation radios are not tuned automatically.

For the manual tune procedure, you use the left or right CDU to manually tune all of the navigation radios through the FMCFs. You use the center CDU to manually tune the navigation radios only when the left or right CDU fails.

When both FMCFs fail, you use the CDUs and the alternate procedure to tune all of the navigation radios. The tune data goes from the on-side CDU directly to the on-side navigation radio. The center multi-mode receiver (MMR) gets the alternate tune data from the left CDU.

FMCF Radio Tune Outputs

Both FMCFs in the AIMS cabinets generate radio tune data. The left AIMS cabinet sends radio tune data to the right AIMS cabinet on ARINC 429 data buses.

The right AIMS FMCF radio tune sub-function normally tunes the navigation radios. The right AIMS cabinet has the radio tune relays. The radio tune relays energize when the right navigation radio tune sub-function and the input/output modules (IOMs) are valid.

Both AIMS FMCF radio tune sub-functions process radio input data and make radio tune output data. When the right radio tune sub-function fails, the right radio tune relays de-energize. This allows the left AIMS radio tune sub-function to tune the radios through the relaxed position of the relays in the right AIMS cabinet.

The right AIMS cabinet IOM M004 sends radio tune data to input port B in these radios:

- Right MMR receiver
- Right VOR receiver
- Right DME interrogator
- Right ADF receiver, manual tune only.

The right AIMS cabinet IOM M009 sends radio tune data to input port B in these radios:

- Left MMR
- Left VOR receiver
- Left DME interrogator
- Left ADF receiver, manual tune only.

The right AIMS cabinet IOM M008 sends radio tune data to input port B in the center ILS receiver.

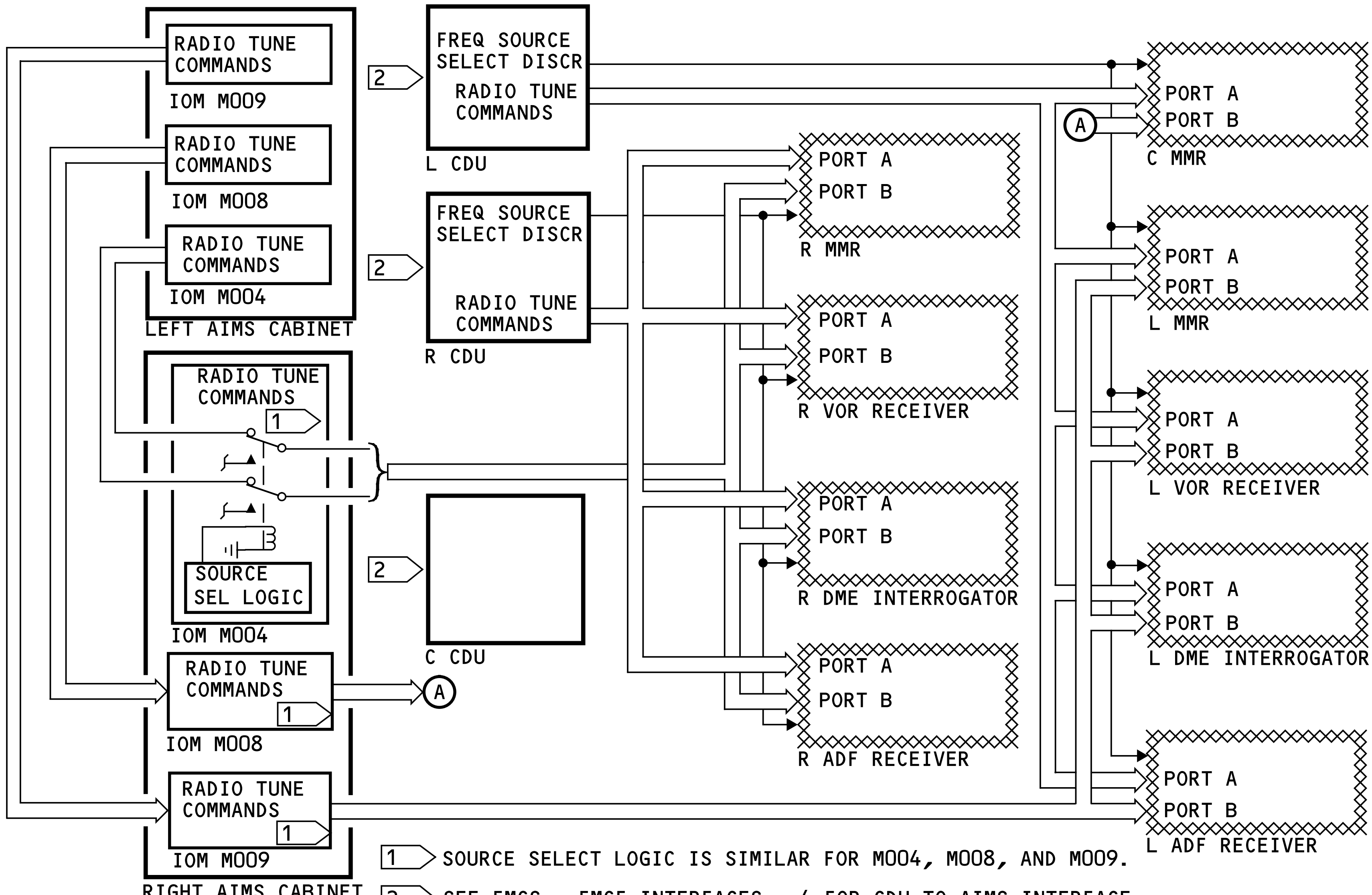
FMCS - FMCF INTERFACES - 3

CDU Navigation Radio Outputs - ARINC 429 Bus

When the FMCFs fail, the CDUs send a frequency source select discrete to the navigation radios. This discrete causes the navigation radios to select the input port A. Input port A receives the tune frequency directly from the ARINC 429 bus of the on-side CDU.

The FMCF or the on-side CDU for the alterenate tune procedure send this data to the NAV radios:

- ILS frequency and runway heading
- DME frequency
- VOR frequency and course
- ADF frequency, tune mode.



1 SOURCE SELECT LOGIC IS SIMILAR FOR M004, M008, AND M009.

2 SEE FMCS - FMCF INTERFACES - 4 FOR CDU TO AIMS INTERFACE

FMCS - FMCF INTERFACES - 3

FMCS - FMCF INTERFACES - 4

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FMCS - FMCF INTERFACES - 4

General

The CDU is the primary interface for the FMCF and other systems. The CDU also processes inputs from external sensors to supply alternate commands when the active FMCF fails. The CDUs receive some of the same inputs as the FMCFs.

The CDU also supplies:

- Alternate lateral navigation steering commands and map display data (LNAV)
- The interface with SATCOM
- The interface with the passenger address/cabin interphone (PA/CI) controller on the center CDU
- Alternate radio tuning (L and R)
- Alternate electronic flight instrument system control panel (EFIS CP)
- Alternate display select panel (DSP) control
- Alternate map display and control
- BITE and fault monitoring
- Maintenance page access.

CDU - Inputs Overview

The CDUs receive air data inertial reference unit (ADIRU) data on the flight controls ARINC 629 buses.

The CDUs receive digital data on the systems ARINC 629 buses from these components:

- Audio management unit (AMU)
- CDU (2)
- ARINC signal gateway (ASG) (2)
- Bus power control unit (BPCU)
- Overhead panel ARINC system (OPAS) (2)
- Autopilot flight director computer (AFDC) (3)
- AIMS Intercabinet ARINC 629 Bus 2
- AIMS FMCF data.

The CDUs receive digital data on the ARINC 429 bus from the satellite communication data unit (SDU).

The center CDU also gets data from the passenger address/cabin interphone (PA/CI) controller.

The CDUs receive analog discretes from the master dim and test module.

The CDUs receive digital flight plan data on the AIMS intercabinet bus (ICB) 2 from the active FMCF.

ADIRU Inputs - Flight Controls ARINC 629 Bus (L and R)

The ADIRU sends inertial data to the CDUs. The CDUs use this data to calculate LNAV commands when the active FMCF fails. The CDUs receive this data from the ADIRU:

- Position, latitude and longitude (lat/long)
- Heading (hdg)
- Roll angle
- Altitude data.

FMCS - FMCF INTERFACES - 4

CDU Inputs - Systems ARINC 629 Buses (L & R)

Each CDU receives flight plan synchronization data and brightness control data from the other CDUs. If both FMCFs failed, the flight plan synchronization data prevents flight plan map shifts when a CDU fails and the next CDU takes over. The brightness control input is fromthe local light sensors from each of the other CDUs (2) and the PDS light sensors.

ASG Inputs - Systems ARINC 629 Bus (L and R)

The ASG function sends weight-on-wheels data to the CDUs. The CDUs use this data for the air/ground logic.

BPCU Inputs - Systems ARINC 629 Bus (L and R)

The BPCU sends a discrete to the CDUs. This is air/ ground status.

OPAS Inputs - Systems ARINC 629 Bus (L and R)

The OPAS send the CDUs the navigation source select switch position (AUTO or CDU).

AFDC Inputs - Systems ARINC 629 Buses (L and R)

The AFDS sends LNAV arm/operate data to the CDUs during the alternate LNAV guidance mode. The AFDS also sends an ILS tune inhibit to the left and right CDUs to stop manual tune requests to the ILS radios in approach.

AIMS Cabinet Inputs - Systems ARINC 629 Bus (L and R)

These functions in AIMS send data to the CDUs on the left and right systems ARINC 629 buses:

- Central maintenance computing function (CMCF)
- Primary display function (PDF)
- Flight deck communication function (FDCF)
- Flight management computing function (FMCF).

The CMCF sends this data to the CDUs:

- Airplane identification
- Flight leg
- Flight phase
- Date and time
- Directed message commands
- Operational software
- Load commands
- Engine switch data for air/ground logic.

The PDF sends this data to the CDUs:

- Brightness command
- Display select panel (DSP) data
- EFIS CP data.

The FDCF sends a command to clear the scratchpad for the multi-functional display (MFD) text entry to the CDUs.

The FMCF sends this data to the left and right CDUs on the left and right system ARINC 629 buses:

FMCS - FMCF INTERFACES - 4

- Flight plan download
- Radio tune download
- Page displays.

The FMCF sends the same data on the left and right system buses to the center CDU when the left or right CDU fails.

SDU Inputs - ARINC 429 Bus

The SDU sends communications data to the CDUs on a high speed ARINC 429 data bus.

PA/CI Controller Inputs - ARINC 429 Bus

The PA/CI controller sends passenger address and cabin interphone data to the center CDU for flight deck and cabin interface.

Analog Inputs

The CDUs receive lamp test and bright/dim inputs from the master/dim and test module.

AIMS Intercabinet ARINC 629 Bus 2 Inputs

The AIMS ICB bus 2 supplies the data from the active FMCF when the left and right system ARINC 629 buses failed.

CDU Outputs Overview

The CDU sends digital and analog data to components and systems on these buses:

- Systems ARINC 629 buses
- ICB 2.

AMU Outputs - Systems ARINC 629 Bus (L)

This discrete causes the DME identifier audio to be paired with either VOR in the EFIS VOR mode or ILS audio in the EFIS approach mode.

AFDS Outputs - Systems ARINC 629 Bus (L and R)

When both FMCFs fail, the left CDU sends LNAV guidance commands to the AFDS. If the left CDU fails then the center CDU supplies the LNAV guidance commands. If the center CDU fails then the right CDU supplies the LNAV guidance data.

AIMS Outputs - Systems ARINC 629 Bus (L and R)

The CDUs send data to these AIMS functions on the left and right system buses:

- CMCF
- Primary display function (PDF)
- FDCF
- FMCF.

FMCS - FMCF INTERFACES - 4

The CDUs send fault reports and directed messages to the CMCF in the AIMS cabinets on the L and R systems ARINC 629 buses.

The CMCF in AIMS receives operational program load status data from the CDUs during data load operation.

The PDF in AIMS receives this data from the CDUs on the L and R systems ARINC 629 buses:

- Map background data
- Dynamic map data
- EFIS CP data
- DSP data
- Maintenance display discrete.

The CDUs supply on-side map display. The center CDU acts as a back-up CDU for the left or right CDU if a CDU failure occurs.

The FMCFs receives scratchpad contents from the CDUs on the L and R system ARINC 629 buses.

The FMCFs get button push and protocol data from the CDUs through the left and right system ARINC 629 buses.

SDU Outputs - ARINC 429 Bus

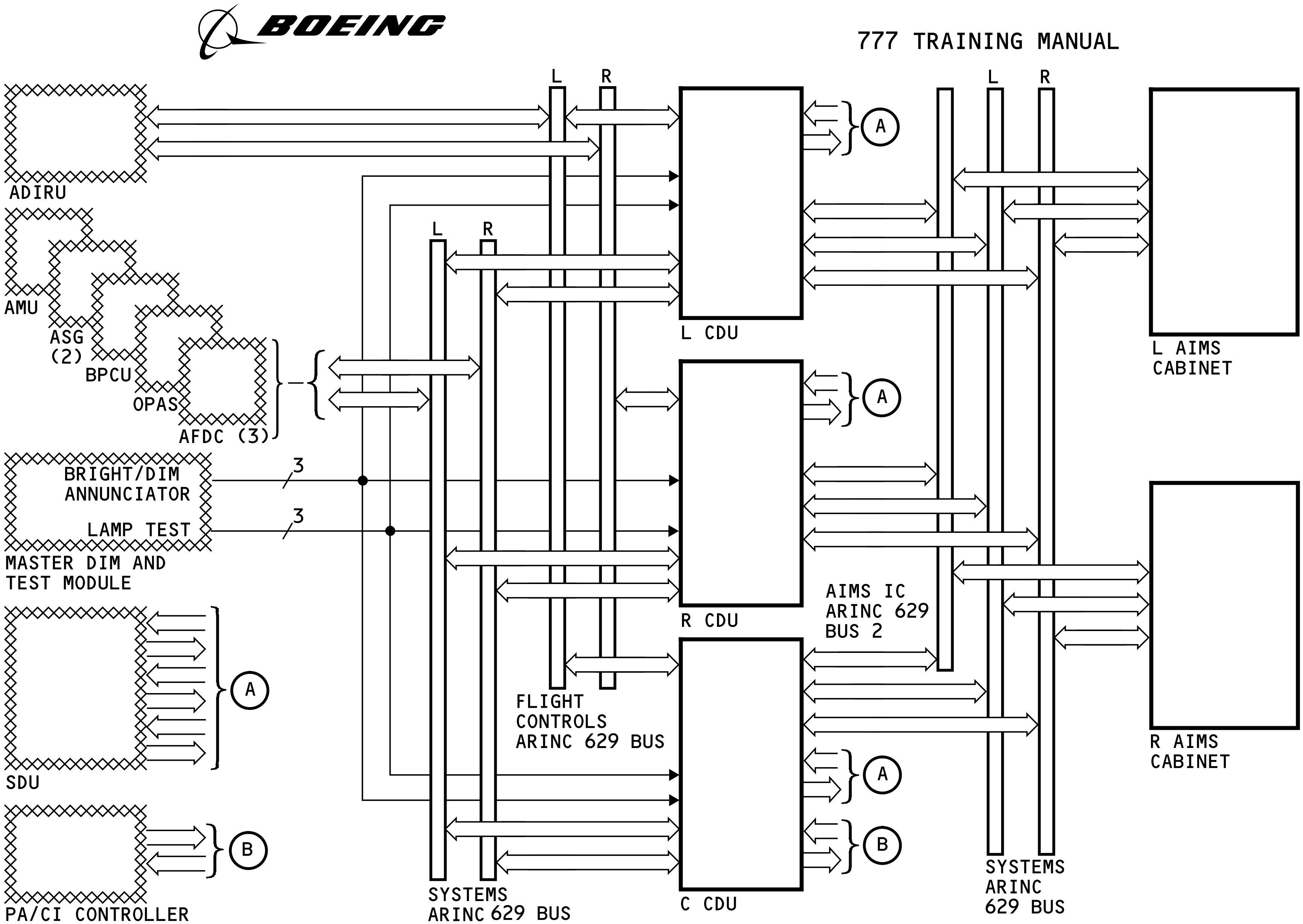
Each CDU sends communication data to the SDU on a high speed ARINC 429 data bus.

PA/CI Controller Outputs - ARINC 429 Bus

The center CDU sends passenger address and cabin interphone data to the PA/CI controller on a high speed ARINC 429 bus.

CDU Outputs - AIMS Intercabinet Bus 2

If the left and right system ARINC 629 buses fail, then the CDUs send data to the FMCFs on the ICB 2.



FMCS - FMCF INTERFACES - 4

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FMCS - CONTROL DISPLAY UNIT

Purpose

The CDU is the primary control and display interface for the FMCF. You use the CDU to enter flight plan data and performance data. Also, you use the CDU to manually tune the navigation radios and access maintenance pages. In the event of a EFIS control panel failure or display select panel (DSP) failure, you use the on-side CDU as a back-up EFIS control panel and any CDU as a back-up DSP.

Physical Features

The CDU weighs approximately 16 pounds. It is 9 inches tall, 10.5 inches deep and 5.75 inches wide. The LCD of the CDU shows the flight modes and data in color. The CDU needs 28v dc input power for normal operation. The CDUs use forced air through inlet and exhaust ports for cooling. The CDU shuts down at temperatures above 77C. It restarts when the temperature is below 77C. The CDU has these physical features:

- LCD
- CDU controls
- Annunciators
- Light sensor
- Manual brightness control.

LCD Display Format

The LCD shows 14 lines of data in various colors. Each line is 24 characters long. The top line is the page title field. The title field shows the function of the page and the current page number and the total number of pages for the page display. Lines 1L to 6L and 1R to 6R have title fields and data fields. The scratchpad area is below line 6L and 6R.

To enter or transfer data use the scratchpad. Alert and advisory messages also show in the scratchpad.

Some data fields can show box prompts or dashes. When the box prompts show, you must enter data into that data field. When the dashes show, data entry into that data field is optional.

Color

The LCD uses different colors to show flight activity and modes. Information shows in these colors:

- Black - background
- White - default color for text
- Magenta - next active waypoint in the flight plan
- Green - multiple state data fields with large font (ON) and VOR tuned navigational aids
- Cyan - ADF tuned navigational aids
- Shaded white - data that modifies the flight plan.

The CDU shows this data in white:

- Text
- Alert and advisory messages
- Multiple state data fields with small font (off)
- Tuned ILS navigational aids
- Line titles

- Dashes, except when the dash is an integral part of the data field
- Slashes, except when the slash has data on both sides.

CDU Controls

These are the primary controls for the CDU:

- Line select keys
- Function keys
- Mode keys
- Alpha-numeric keys
- Special keys.

Line Select Keys

Line select keys 1L to 6L and 1R to 6R, permit the operator to do these things:

- Transfer data from the scratchpad to a data field
- Copy data from a data field to the scratchpad
- Delete data from a data field
- Select an operation. (This occurs when the CDU operates as a control panel in the alternate mode, EFIS or DSP control panel. In this case, the line select key acts as a toggle switch to select between two states (OFF or ON))
- Select another page. This occurs when a caret (prompt) and a page title show next to a line select key.

Not all keys permit all actions. Keys can have different functions on other pages.

Function Keys

These are the three function keys:

- Execute (EXEC)
- NEXT PAGE
- Previous page (PREV PAGE).
- Use the EXEC key to execute (make active) or to modify a page with data entry when the EXEC light comes on.
- Use the NEXT PAGE key to go to the next page when the page count shows more than one page (1/X, 2/X ...).
- Use the PREV PAGE key to go back one page when the page count shows more than one page (1/X, 2/X ...).

Mode Keys

The mode keys select the page for the current airplane condition. These are the mode keys:

- Initialization/reference (INIT/REF)
- Route (RTE) page
- Departure/arrival (DEP/ARR) page
- Alternate (ALTN) page
- Vertical navigation (VNAV) pages
- FIX page
- LEGS page
- HOLD page

- FMC COMM page
- Progress (PROG) pages
- MENU page
- Navigation radio page (NAV/RAD).

Alpha-numeric Keys

The alpha-numeric keys permit the operator to type alpha-numeric data into the scratchpad. The operator can use the line select key to enter scratchpad data into a data field. Some data fields do not let the operator enter data.

Special keys

The keyboard has some special keys in addition to the alpha-numeric keys. These are the special keys:

- Change sign (+/-)
- Space (SP)
- Slash (/)
- Clear (CLR)
- Delete (DEL).

The change sign (+/-), SP keys and slash (/) keys are standard keys on a keyboard.

Use the CLR key to remove a single alpha-numeric character in the scratchpad or an alert or advisory message from the scratchpad with one push. Hold the CLR key down for one second to remove all scratchpad data.

A push of the DEL key puts the word DELETE in the CDU scratchpad and this permits the operator to delete a data field with the line select key next to the data field. The DEL key does not work when the scratchpad contains data. Some data fields do not permit the DEL key function. In this case, the INVALID DELETE message shows in the CDU sratchpad.

Annunciators

The annunciators come on to show status. These are the annunciators:

- Display (DSPY)
- Message (MSG)
- Offset (OFST).

DSPY shows when the current page does not relate to the active flight plan or present active mode or function. The DSPY comes on, as an example, when the route page 2 of 3 (2/3) shows on the LCD and the airplane is at the departure gate.

The MSG annunciator comes on whenever an alert or an advisory message shows in the scratchpad. The CDU or the FMCF can cause this to occur.

The OFST annunciator comes on when the airplane is in the air and an offset route is active. An offset route is a route parallel (left or right) to the active route.

Light Sensor

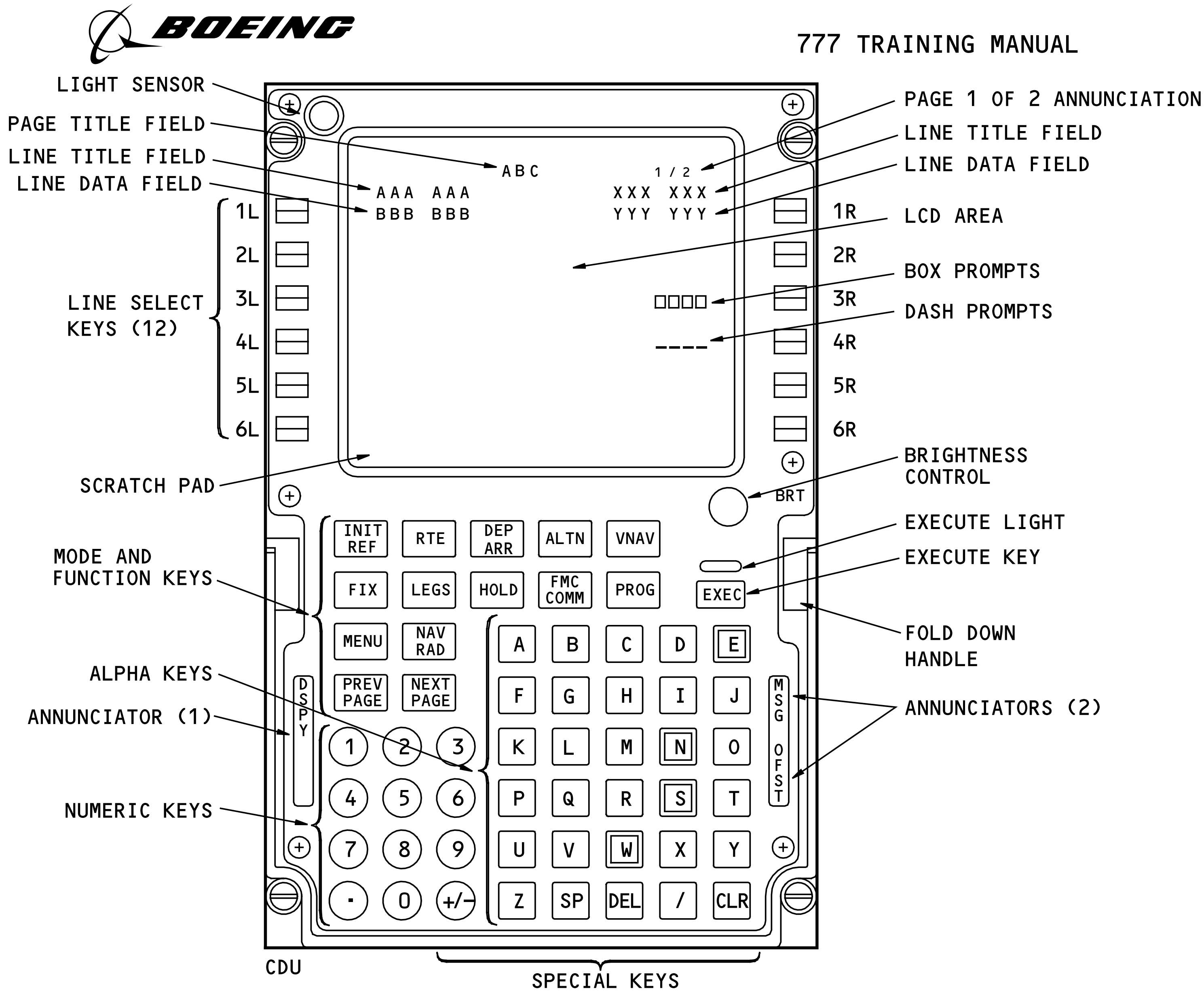
The light sensor on the CDU is one of four light sensor inputs the CDU uses to set the LCD brightness level. The others are the light sensors from the other CDUs and the PDS light sensors.

Manual Brightness Control

The manual brightness control adjusts the brightness level above or below the automatic brightness level set by the CDU. To do this, rotate the manual brightness knob left or right.

Training Information Point

The CDU has no line replaceable parts. The CDU is a line replaceable unit (LRU).



FMCS - CONTROL DISPLAY UNIT

FMCS - INSTRUMENT SOURCE SELECT PANELS AND F/O DISPLAY SWITCHING PANEL

General

The FMCS has an interface with these controls:

- Captain's NAV source switch on the instrument source select panel (ISSP)
- First officer's NAV source switch on the ISSP
- FMC selector on the first officer's display switching panel
- LNAV and VNAV mode switches on the mode control panel (MCP)

Operation - NAV Source Switch

The NAV source switch selects the source of NAV data that shows on the on-side ND and PFD. In the AUTO position, the active FMCF is the source of NAV data for the PFDs and NDs. The on-side CDU supplies map data to the on-side ND when both FMCFs fail and the FMC selector is in the AUTO position. The on-side CDU also supplies map data when the FMC selector is in the left or right FMCF position and the related FMCF fails.

The NAV source switches in the CDU position causes the on-side CDU to supply NAV data to the on-side ND. This position permits the flight and maintenance crews to do a check of the CDU alternate navigation capability. The CDU uses the active FMCF flight plan/map data, reformats it, and sends it to the on-side ND.

Operation - FMC Selector

The FMC selector has these three positions:

- Left (L)
- AUTO
- Right (R).

In the left position, the left FMCF and TMCF are active. If the left FMCF fails, there is no active FMCF.

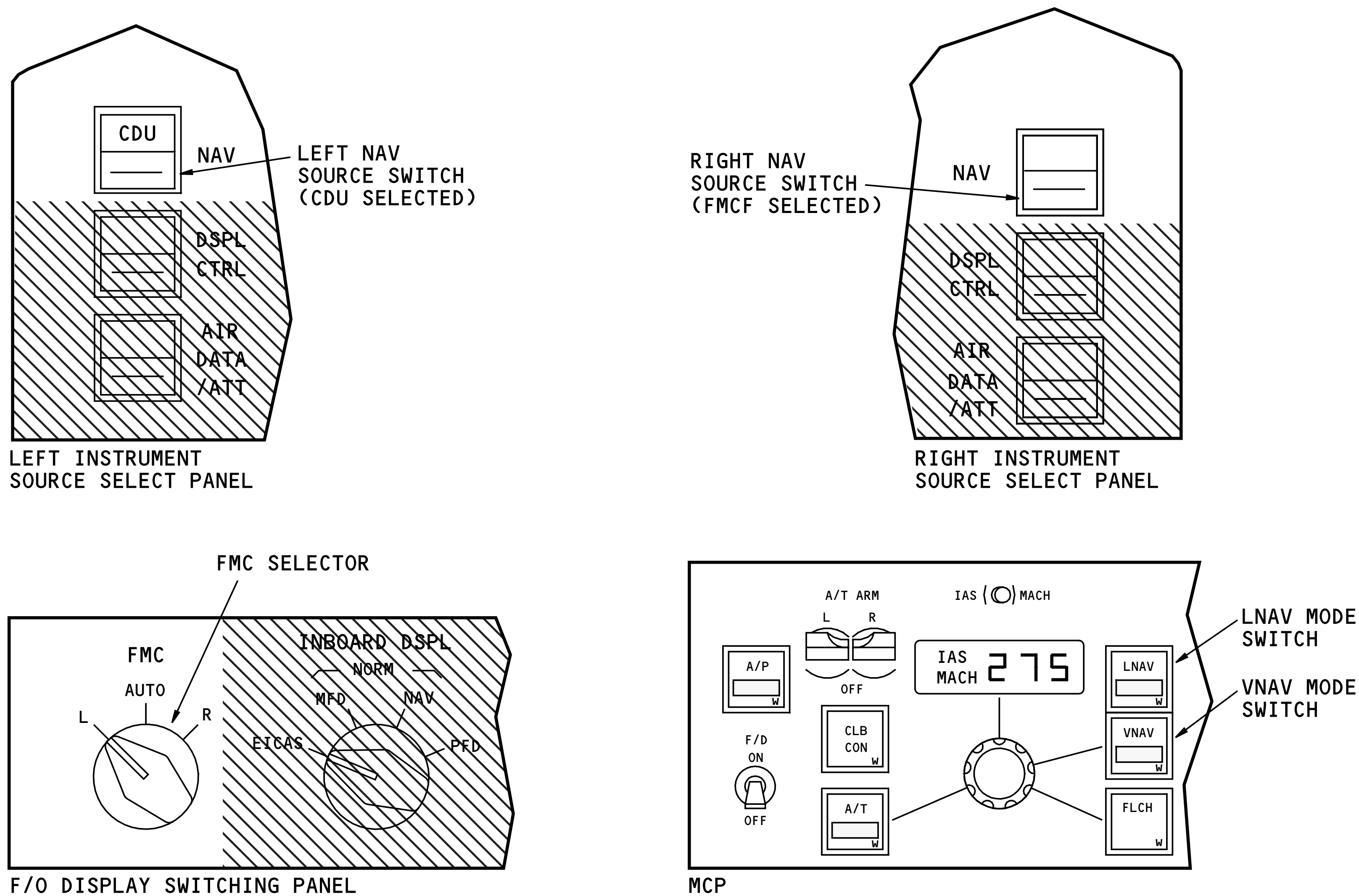
In the AUTO position, a random selection of the active FMCF and TMCF occurs after power is supplied. If the active FMCF fails, the other FMCF becomes active.

In the right position, the right FMCF and TMCF are active. If the right FMCF fails, there is no active FMCF.

Mode Switches (LNAV and VNAV)

The LNAV mode switch on the MCP sends mode requests to the FMCFs and the CDUs. Normally, the active FMCF uses the mode request to send lateral steering commands to the autopilot flight director system (AFDS) when the airplane is in the air. The CDU sends lateral steering commands to the AFDS when both FMCFs fail.

The VNAV mode switch on the MCP sends mode requests to the FMCFs. Normally, the active FMCF uses the mode request to send vertical steering commands to the AFDS when the airplane is in the air. The CDU does not calculate VNAV steering commands.



FMCS - INSTRUMENT SOURCE SELECT PANELS AND F/O DISPLAY SWITCHING PANEL

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FMCS - PRIMARY FLIGHT DISPLAY (PFD)

General

The flight management computing function (FMCF) sends speed and compass data to the primary display system to show on the primary flight display (PFD).

Speed Data

When the flight crew completes the FMCF pre-flight, the active FMCF sends this speed data to the primary display system to show on the PFDs:

- Selected target speed/mach and target cursor
- High SPD buffet
- Takeoff safety speed (V2)
- Rotation speed (VR)
- Takeoff decision speed (V1)
- Landing reference speed (VREF)
- Flap maneuver speed (extend or retract)
- Minimum speed limit (VMIN).

As part of the pre-flight, the flight crew can enter target speed/mach into the FMCF. When the vertical navigation (VNAV) mode is active, the FMCF selected target speed/mach shows above the speed tape on the PFD. Also, the selected target speed cursor points to the same target speed on the speed tape. If VNAV is not active, the MCP selected speed/mach shows.

High speed buffet is the maximum maneuver speed. The high speed buffet shows as a hollow yellow bar. The bar extends from the bottom of the maximum operating speed symbol. The maximum operating speed symbol is the red and black barber pole symbol which comes from the warning electronic system (WES).

V2 is the takeoff safety speed. V2 shows in green next to the climb out speed tick on the airspeed tape. V2 goes away when the flaps begin to retract.

VR is the takeoff rotation speed. VR shows in green next to the rotation speed tick on the airspeed tape. VR goes away after takeoff.

V1 is the takeoff decision speed. V1 shows in green next to the decision speed tick on the airspeed tape. V1 goes away after takeoff.

VREF is the landing approach speed when the flaps are extended. A green REF and a bar shows next to the airspeed tape.

Flap maneuver speeds show the flight crew the necessary flap selection for the current takeoff or cruise/ approach speed. The retract or extend speed shows as a tick mark on the airspeed tape with labels for the flap selections.

VMIN is the minimum speed limit of the airplane when the flaps/slats extend. VMIN shows as a hollow yellow bar that extends up from the top of the stick shaker symbol. The stick shaker symbol is a red and black barber pole symbol. The stick shaker symbol comes from the WES.

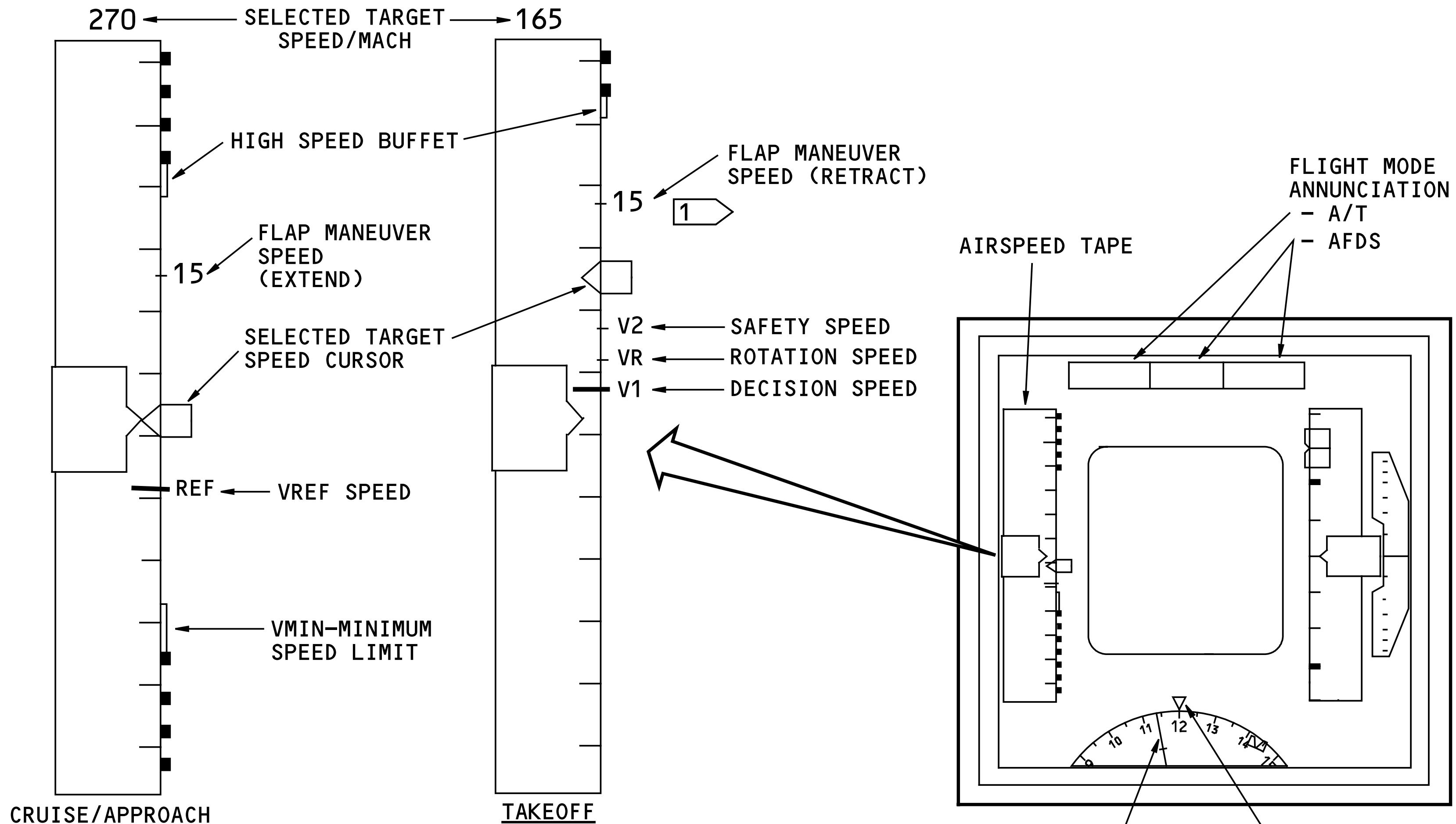
FMCS - PRIMARY FLIGHT DISPLAY (PFD)

Compass Data

The active FMCF sends this compass data to the primary display system to show on the PFD:

- Heading
- Track.

The air data inertial reference unit (ADIRU) sends heading and track data to the PFDs when the active FMCF fails.



1 UP, SHOWS WHEN FLAPS ARE RETRACTED

FMCS - PRIMARY FLIGHT DISPLAY (PFD)

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FMCS - NAVIGATION DISPLAY (ND)

General

The flight management computing function (FMCF) sends navigation display data to the primary display system (PDS) to show on the navigation display (ND).

Display Data

The active FMCF sends navigation data to the NDs for all display modes. If both FMCFs fail, the on-side CDU sends the navigation data.

There are two types of navigation data, dynamic data and background data. Dynamic data changes as a function of time. Background data is stationary data that does not move as a function of time. The active FMCF sends this dynamic data to show on the NDs via the PDF:

- Track (TRK)
- Heading (HDG)
- Ground speed (GS)
- Wind data - direction, speed, and angle. This shows when true airspeed is greater than 100 knots and wind speed is greater than 5 knots
- Active waypoint (magenta). This is the fly to waypoint. When the airplane crosses it, the waypoint color goes to white and the next fly to waypoint becomes magenta
- Altitude range arc. This shows the range to the mode control panel (MCP) altitude
- VNAV path deviation. This shows as a vertical scale and magenta pointer when the airplane goes through the top of descent profile point. The scale range is +/- 420 feet in 50 foot increments to a maximum of 9999 feet
- Estimated time of arrival (ETA) - FMCF or time to go (TTG) - CDU
- Distance to go (DTG). DTG to the active waypoint shows in nautical miles (nm) when greater than 100 nm and in tenths at less than 100 nm
- Altitude profile points. These are along the flight plan to show flight mode or vertical flight path changes, top of climb (T/C), top of descent (T/D), step climb (S/C), end of descent (E/D)
- Route. The route shows magenta when active, cyan when inactive, and white dash lines for modifications
- Airplane position
- FMC position update mode. This shows the data the FMCFs use for position update (GPS, lOC, DME/DME, VOR-DME, INERTIAL)
- Tuning mode. This shows as an A (auto tune) or M (manual tune).

The active FMCF sends this dynamic data in the approach and VOR ND modes via the PDF:

- Track
- Heading
- Ground speed
- Wind data.

FMCS - NAVIGATION DISPLAY (ND)

The air data inertial reference unit (ADIRU) sends wind data, ground speed, track, and heading data to the ND when the active FMCF fails.

If both FMCFs fail, the on-side CDU sends this dynamic data to the ND in the map and plan modes:

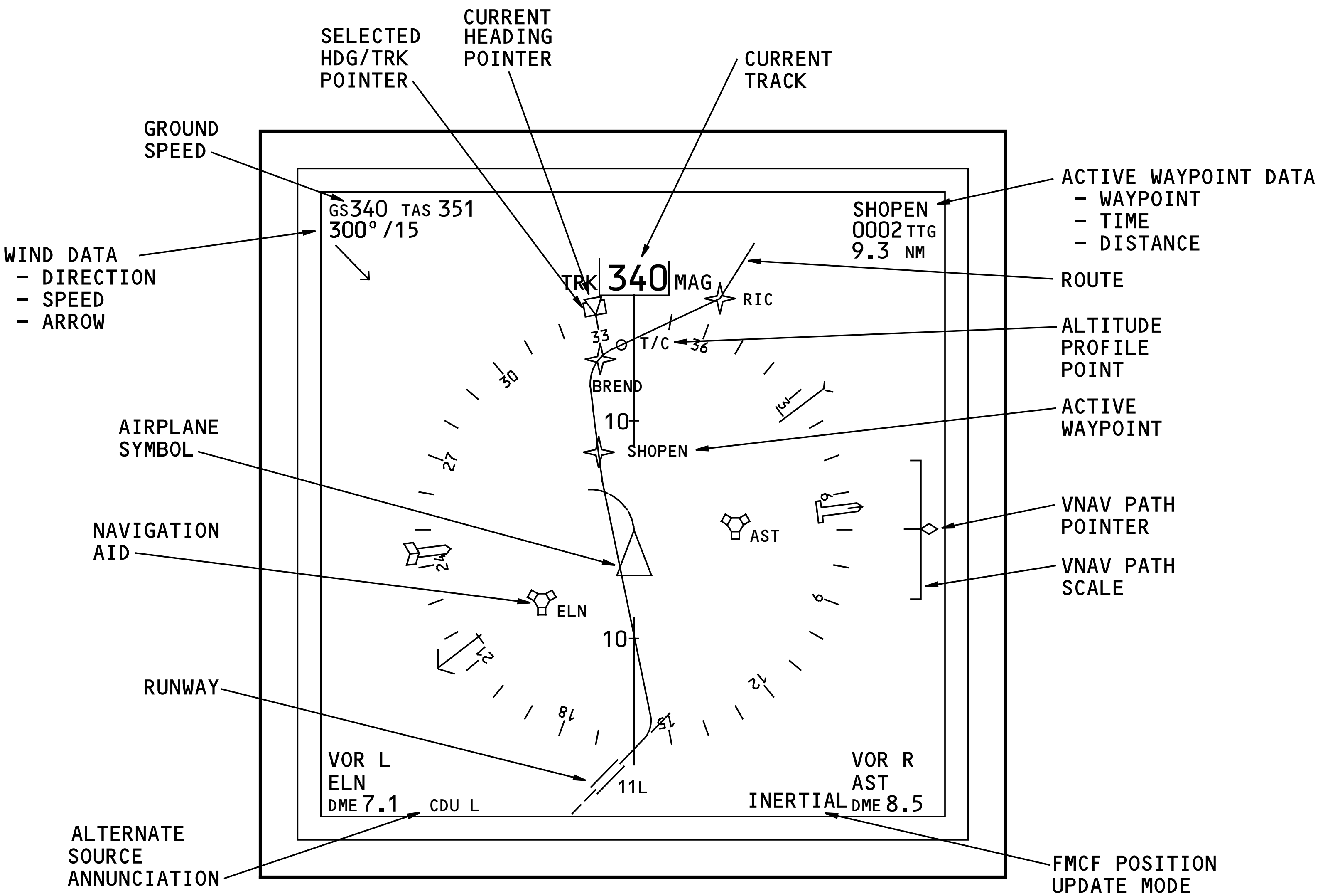
- Active waypoint
- Time to go (TTG)
- Distance to go (DTG)
- Route
- CDU position
- CDU (L, C or R) source for display.

The active FMCF sends this background data to the NDs in the map and plan modes:

- Runways
- Airports
- Waypoints, flight plan and off route waypoints
- Navaids (VOR, DME, etc.)
- Beacons, marker and non-directional
- Procedure turns
- Holding patterns
- Energy management circles.

If both FMCFs fail, the on-side CDU sends this background data to the NDs via the PDF in the back-up navigation mode:

- Waypoints (LAT/LON)
- Navaids (VOR, DME, etc.)
- Beacons, marker and non-directional.



FMCS - NAVIGATION DISPLAY (ND)

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FMCS - FMCF/CDU MESSAGES

General

The FMCS sends messages to the CDUs and the primary display system. The FMCS messages alert and advise the flight crew with:

- Information that relates to airplane system level of operation
- Airplane flight phase of operation
- Entry errors.

The CDUs show the FMCS message content in the scratchpad and the CDU MSG annunciator comes on. The FMCF sends an alert discrete that causes the advisory message (FMC MESAGE) to show on the EICAS display. The alert message content shows in the CDU scratchpad.

The CDUs show messages when they operate as the alternate navigation source.

Message, Priority, and Reset

The CDUs show these three message types in this priority:

- Entry error advisory
- Alert
- Advisory.

The CDUs store messages in stacks with a maximum of ten in each stack. The entry error advisory message has priority over the alert and advisory message that show in the CDU scratchpad. Alert messages have priority over advisory messages.

When a CDU scratchpad message occurs, it goes to the top of the related stack. A new message pushes down any other messages in the stack. A maximum of ten messages may enter a stack. If the stack is full and another message occurs, the message at the bottom of the stack exits the stack.

The CDU scratchpad message clears out of the scratchpad in one of these ways:

- A push of the CLR key - one push removes one message
- A new message occurrs at the same level or higher
- The condition that causes the message resets.

All CDU scratchpad messages are white.

Entry Error Advisory Messages

Entry error advisory messages relate to any crew entries on a CDU. Each CDU responds to entries from its keyboard. These are examples of entry error advisory messages:

- NOT IN DATA BASE
- INVALID ENTRY
- STANDBY ONE
- BUSY.

FMCS - FMCF/CDU MESSAGES

The CDU that is in use for entry shows the entry error advisory message in its scratchpad. The MSG annunciator comes on for all CDUs. The CDUs can supply the entry error advisory messages when the FMCFs fail.

Alert Messages

Alert messages tell the flight crew a flight phase or flight mode limitation. These are examples of alert messages:

- END OF ROUTE
- NO ACTIVE ROUTE
- UNABLE NEXT ALTITUDE
- INSUFFICIENT FUEL.

Alert messages set the CDU output discrete to show the advisory FMC MESSAGE on the EICAS display. The left and right CDU scratchpad shows the alert message.

The CDU annunciator MSG comes on for all CDUs.

Scratchpad display priority does not override the alert message indication on the EICAS display and MSG annunciator on the CDUs.

The approach flight phase and below 500 feet above ground level (AGL) inhibits the display of the alert messages when the arrival runway is part of the active route. The alert messages that occur in this flight phase show at flight completion or after the airplane climbs through 1000 feet AGL.

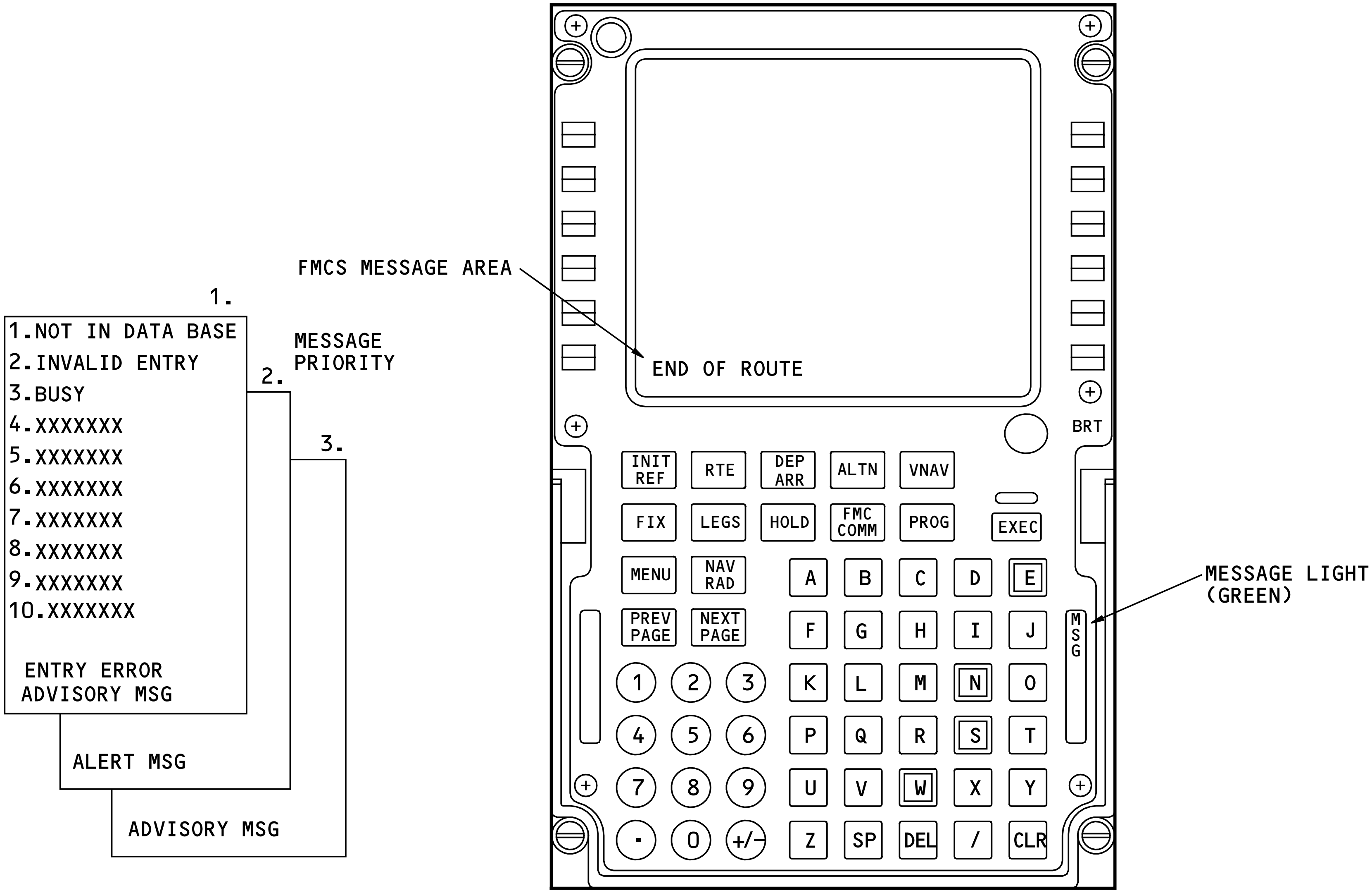
Advisory Messages

Advisory messages tell the crew flight activity they should perform to make their flight go smoothly. These are examples of advisory messages:

- NOT ON INTERCEPT HEADING
- RWY/ILS COURSE ERROR
- TIMEOUT - RESELECT.

The left and right CDU scratchpad shows the advisory message. The CDU annunciator MSG comes on for all CDUs.

The CDUs can supply the advisory messages when the FMCFs fail.



FMCS - FMCF/CDU MESSAGES

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FMCS - MENU PAGE

General

The MENU page gives a list of selections for systems that use the CDU. These are the systems that use the CDU:

- Flight management computing system (FMCS)
- Satellite communication (SATCOM) system
- Cabin services system (CSS)
- Primary display system (PDS).

The CDUs can operate as alternate control panels for the EFIS control panels and the display select panel (DSP).

The CDU has a selection that lets you get access to maintenance pages on an MFD.

Page Access

The MENU page shows at CDU power-up or push the MENU mode key to show the menu page.

Color

All text on the MENU page is white except for the OFF/ ON indications for the alternate EFIS CP and DSP functions. OFF is green when an EFIS CP or DSP has failed and should be selected. ON is green when the EFIS CP or DSP function on the CDU is in use.

Operation

The left line select keys select which system communicates with the CDU. Only one of these systems can control the CDU at a time. <ACT> shows on the MENU page for the system that is active. If a system requests control of the CDU, there is a <REQ> after the system name.

Push 1L <FMC for the FMCF to communicate with the CDU. The INIT/REF INDEX page shows.

Push 2L <SAT for the satellite data unit (SDU) to communicate with the CDU. The associated CDU page shows.

Push 4L <CAB INT for the passenger address/cabin interphone controller to communicate with the CDU. The associated CDU pages show. The <CAB INT prompt is only available on the center CDU.

Push 5R MAINT INFO DISPLAY> to show the PDS maintenance pages CDU on the MFD.

The left and right CDUs normally show the prompts for the alternate on-side EFIS CP function. If the left or right CDU fails, the EFIS CP function shows on the center CDU.

Do this to operate the alternate EFIS controls:

- Push 1R EFIS CTL OFF on> and EFIS> shows on line 2R
- Push 2R to go to the EFIS control selections page.

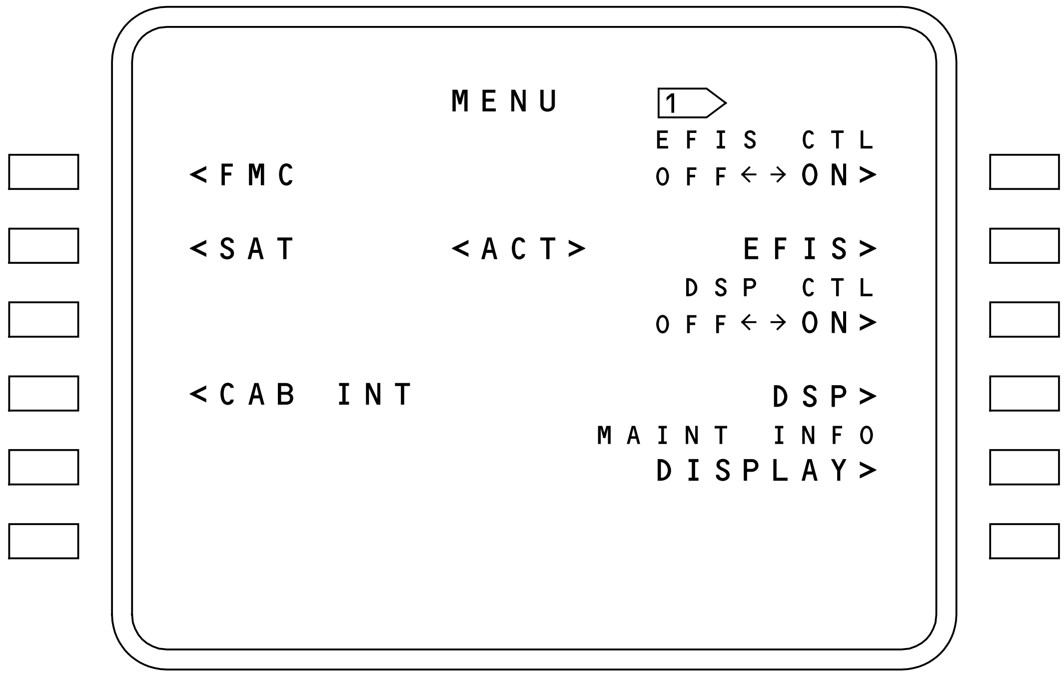
FMCS - MENU PAGE

All three CDUs show the alternate DSP prompt.

Do this to operate the alternate display select panel (DSP) controls:

- Push 3R DSP CTL OFF on> and DSP> shows on line 4R
- Push 4R, DSP> to go to the DSP control selections page.

You must cancel the alternate DSP function from the same CDU you used to enable the alternate DSP function.



C-CDU

1 THE EFIS CTL FUNCTION IS AVAILABLE ON THE C-CDU WHEN IT ACTS AS A LEFT OR RIGHT CDU.

FMCS - MENU PAGE

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FMCS - INIT/REF INDEX PAGE

General

The initialization reference (INIT/REF) INDEX page is a menu of the pre-flight pages. You select these pages to initialize the FMCS and the ADIRU and enter other kinds of reference data.

The INIT/REF INDEX page also shows some inflight pages and the maintenance page prompt.

Page Access

To get access to the INIT REF INDEX page, do one of these steps:

- Push the INIT REF mode key to show a preflight page
- Push 6L <INDEX on a preflight page.

Color

All text on this page is white.

Page Selections

Use the active line select keys on the INIT/REF INDEX page to select additional pages.

Push 1L <IDENT to show the identification page.

Push 2L <POS to show the position initialization page.

Push 3L <PERF to show the performance initialization page.

Push 4L <THRUST LIM to show the thrust limits page.

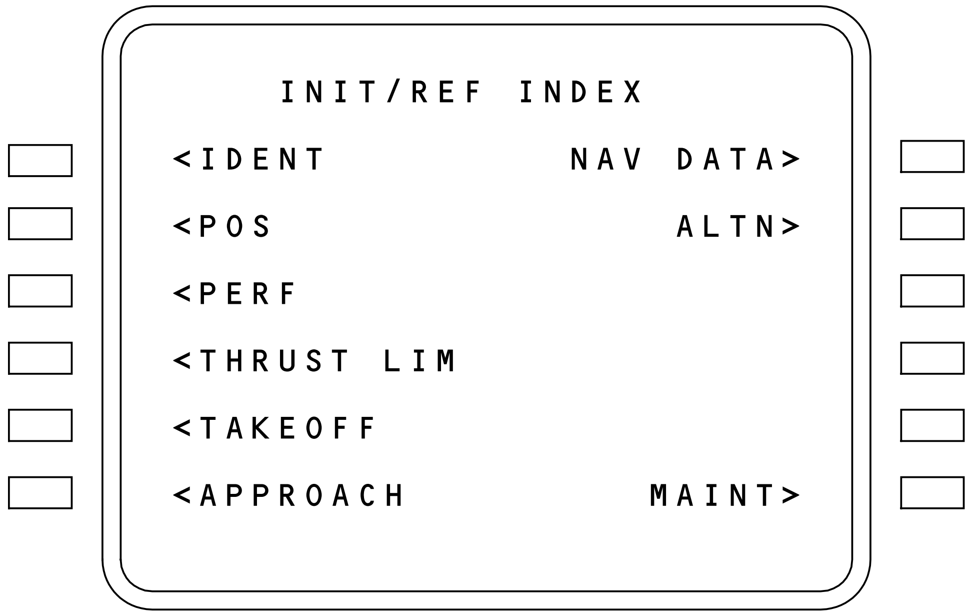
Push 5L <TAKEOFF to show the takeoff reference page.

Push 6L <APPROACH to show the approach reference page.

Push 1R NAV DATA> to show the navigation data reference page.

Push 2R ALTN> and the alternate page shows. The alternate page shows alternate route structures. Fuel and ETA also shows for the alternates route structures.

Push 5R MAINT> to show the maintenance index page. The MAINT> prompt only shows when the airplane is on the ground.



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FMCS - INIT/REF INDEX PAGE

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FMCS - IDENT PAGE

Purpose

The identification (IDENT) page shows this information:

- Airplane model number
- Navigation database configuration
- Operational program
- Engine identification
- Drag factors
- Fuel flow factors.

Page Access

To get access to the IDENT page, select IDENT from the INIT/REF index page.

This page also shows when the self test is not satisfactory at power-up.

Color

All text on this page is white.

Information

Line 1L shows the model number. This number is the aircraft model from the airframe/engine program pins. Blanks show if the program pins do not match the performance database.

Line 2L shows the navigation data base number. Blanks show if there is a bad database load.

Line 4L shows the operational program part number.

Line 1R shows the engine identification. This line shows the engine identification number from the EECs and the airframe/engine program pin. Blanks show if the program pins do not match the performance database.

Line 2R shows the active navigational database.

Line 3R shows the navigational database that is not active.

Line 5R shows the drag factor followed by a fuel flow factor.

Operations

To change the navigation database:

- Push 3R, the inactive navigational database to copy the dates into the scratchpad
- Push 2R to transfer the navigational database that is not active to the active position.

Page Selections

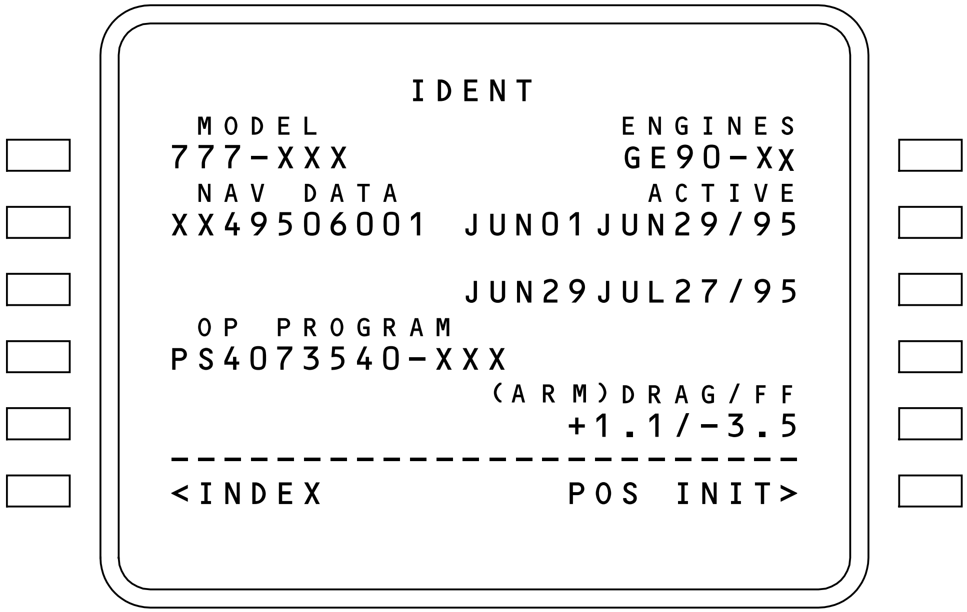
Push 6L <INDEX to show the INIT REF INDEX page.

Push 6R POS INIT> to show the POS INIT page.

FMCS - IDENT PAGE

Training Information Point

Refer to the Flight Operations Manual for more information related to the IDENT page.



34-61-00-017 Rev 2

FMCS - IDENT PAGE

FMCS - POS INIT 1/3 PAGE

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FMCS - POS INIT 1/3 PAGE

Purpose

The position initialization (POS INIT) 1/3 page lets the user enter a reference position for the air data inertial reference unit (ADIRU) alignment. The page also shows the FMCS time reference.

Page Access

To get access to the POS INIT 1/3 page, do one of these steps:

- Push POS INIT from the INIT/REF 1/3 page
- Push POS INIT from the IDENT page
- Push POS INIT from the TAKEOFF REF page
- On the ground with the ADIRU position not initialized, push the INIT/REF mode key.

Color

All text on this page is white.

Information

Line 4L shows the UTC time.

Line 1R shows the FMCF last calculated position. If the FMCF position is not valid, the last valid FMCF position shows.

Line 2R shows the reference airport position. This position shows when an airport identification is in line 2L.

Line 3R shows the reference gate position. This position shows with a gate entry in line 3L.

Line 4R shows the global positioning system (GPS) position.

Entries

This page permits entries of airports and gate identifiers in order to get the latitude and longitude from the navigation database. These latitudes and longitudes are available to initialize the ADIRU.

Do this to get the latitude and longitude of an airport:

- Type a valid airport identifier into the scratchpad
- Enter into 2L
- The latitude and longitude of the airport shows in 2R.

Do this to get the latitude and longitude of a gate at an airport:

- Type a valid gate identifier into the scratchpad
- Enter into 3L
- The latitude and longitude of the gate shows in 3R.

To initialize the ADIRU, there are two steps. First, enter a latitude and longitude into the scratchpad with one of these steps:

FMCS - POS INIT 1/3 PAGE

- Manually type the data with the keypad
- Push 1R, the last position
- Push 2R, the reference airport position
- Push 3R, the reference airport gate position
- Push 4R, the GPS position.

Then line select this data into 5R.

This page also permits the entry of a manual heading.

When the ADIRU has failed and the SAARU navigation parameters are valid, SET HDG shows above line 5L.

Page Selections

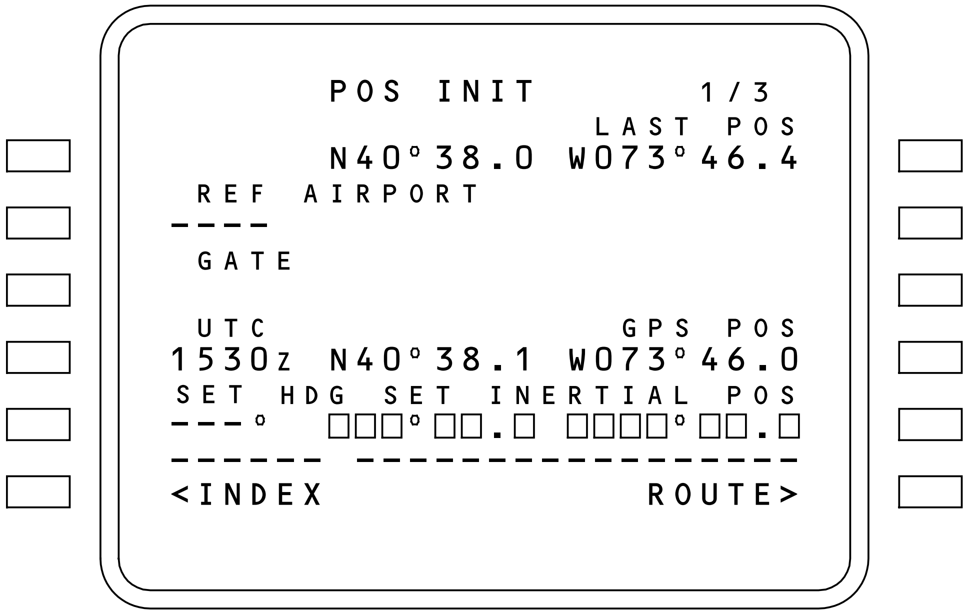
Push 6L <INDEX to show the INIT/REF INDEX.

Push 6R <ROUTE to show the appropriate RTE page.

Push the NEXT PAGE or PREV PAGE mode keys to go to the other POS INIT pages.

Training Information Point

Refer to the Flight Operations Manual for more information related to the this page.



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FMCS - POS INIT 1/3 PAGE

FMCS - POS REF 2/3 and 3/3 PAGES

Purpose - POS REF Page 2/3 and 3/3

There are two additional POS REF pages. The POS REF page 2/3 shows this position information:

- FMCF position calculation
- Inertial position
- Global positioning system (GPS) position
- Radio position.

You can use these pages to update the FMCF position calculation so it to matches either the inertial, GPS, or radio position.

The POS REF page 3/3 shows the left and right GPS positions and the left and right FMCF positions.

This page lets the operator remove the GPS position update from the FMCFs at 5R.

The POS REF pages also permits the flight crew to show the relative bearing and distance from the FMCF position at 6R.

Page 2/3 access

To get access to the POS REF 2/3 page, do one of these steps:

- Push the NEXT PAGE function key while on the POS INIT page
- Push POS REF on the PROGRESS page.

Color - POS REF Page 2/3

All text on this page is white.

Information - POS REF 2/3 Page

Line 1L shows the FMCF position. The header shows if the inertial, GPS or radio is the primary source for update of the current FMCF position. The header shows one of these:

- GPS
- RADIO
- INERTIAL
- LOC-GPS
- LOC-RADIO
- LOC.

Line 2L shows the inertial position from the ADIRU.

Line 3L shows the GPS position.

Line 4L shows the radio position.

Line 5L shows the FMCF required navigation precision (RNP) and the FMCF actual position accuracy in nautical miles (NM). The RNP or actual position accuracy shows to the nearest 1/10NM if the accuracy is more than or equal to 10NM. The RNP or actual position accuracy shows to the nearest 1/100NM if the inaccuracy is less than 10NM. The active FMCF automatically sets the RNP for each flight phase. You can also manually update the RNP.

FMCS - POS REF 2/3 and 3/3 PAGES

Line 5R shows the three or four letter identifiers of the navigation stations that the FMCF uses in the radio navigation solution. The header shows the active radio update mode as one of these:

- DME/DME
- LOC/LOC
- VOR/DME.

Operations - POS REF Page 2/3

To update the computed FMCF position so it matches the inertial, GPS or radio position, first push 1R, ARM>. This arms the FMCF position update function and the line changes to ARMED. Then do one of these:

- Push either 2R, NOW> to update the FMCF position to match the inertial position
- Push 3R, NOW> to update the FMCF position to match the GPS position
- Push 4R, NOW> to update the FMCF position to match the radio position.

Page Selections

Push 6L <INDEX to show the INIT/REF INDEX page.

Page 3/3 Access

To get access to the POS REF 3/3 page, do one of these steps:

- Push 6R BRG/DIST> while on the POS REF page 2/3
- Push NEXT PAGE function key while on the POS REF page 2/3
- Push PREV PAGE function key while on the POS INIT page.

Color - POS REF 3/3 Page

All text on this page is white except the GPS NAV ON/OFF indication. The active condition is green and the not active condition is white.

Information - POS REF 3/3 Page

Line 1l shows the left GPS sensor unit position.

Line 2l shows the right GPS sensor unit position.

Line 3L shows the position from the left FMCF.

Line 4L shows the position from the right FMCF.

Operations - POS REF 3/3 Page

To toggle the GPS position update of the FMCF ON/OFF, do one of these:

- Push 5R when ON shows and the GPS data is inhibited from the FMCF navigation solution
- Push 5R when OFF shows and the GPS data is included in the FMCF navigation solution.

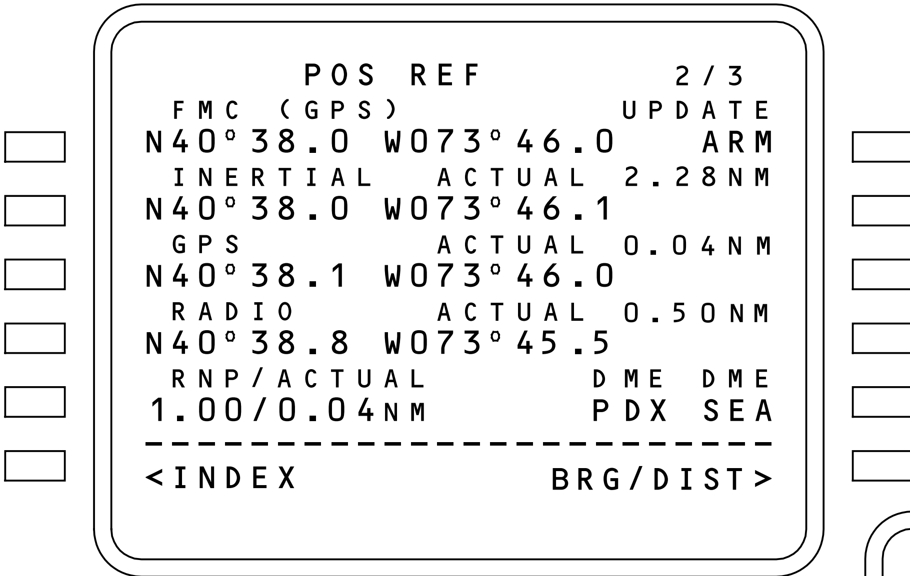
FMCS - POS REF 2/3 and 3/3 PAGES

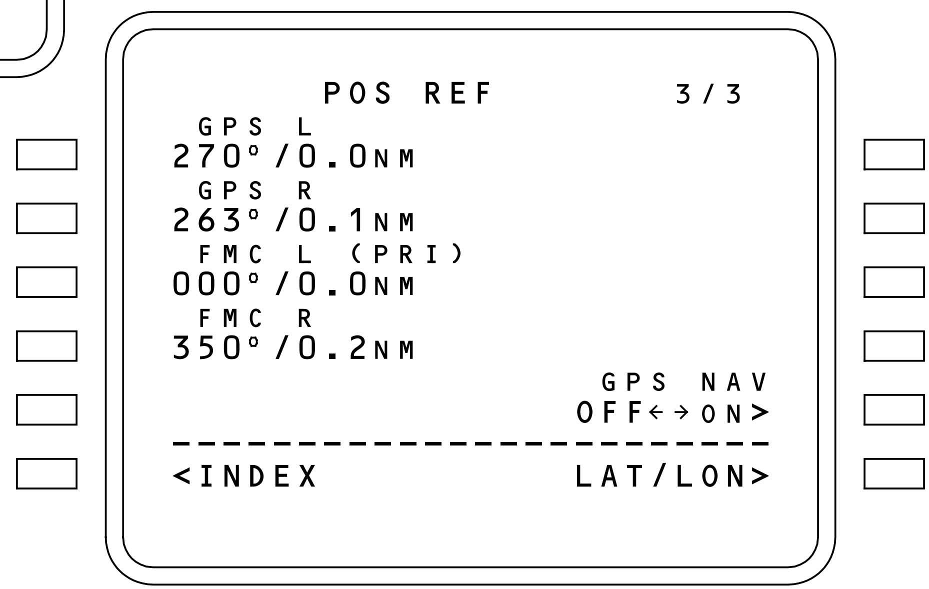
To toggle the display of the GPS and FMCF positions between latitude and longitude format and bearing distance format, do one of these:

- Push 6R, LAT/LON>, to show positions latitude and longitude
- Push 6R, BRG/DIST>, to show positions bearing and distance.

Training Information Point

Refer to the Flight Operations Manual for more information related to this page.





34-61-00-019 Rev 3 07/09/1997

FMCS - POS REF 2/3 and 3/3 PAGES

FMCS - MAINTENANCE INDEX PAGE

Purpose

Use the MAINTENANCE INDEX page to access several pages of data. These pages let maintenance personnel examine and change FMCF policy data and monitor ADIRU inertial position data.

Page Access

To get access to the MAINTENANCE INDEX page the airplane must be on the ground. Select MAINT> from the INIT/REF INDEX page.

Color

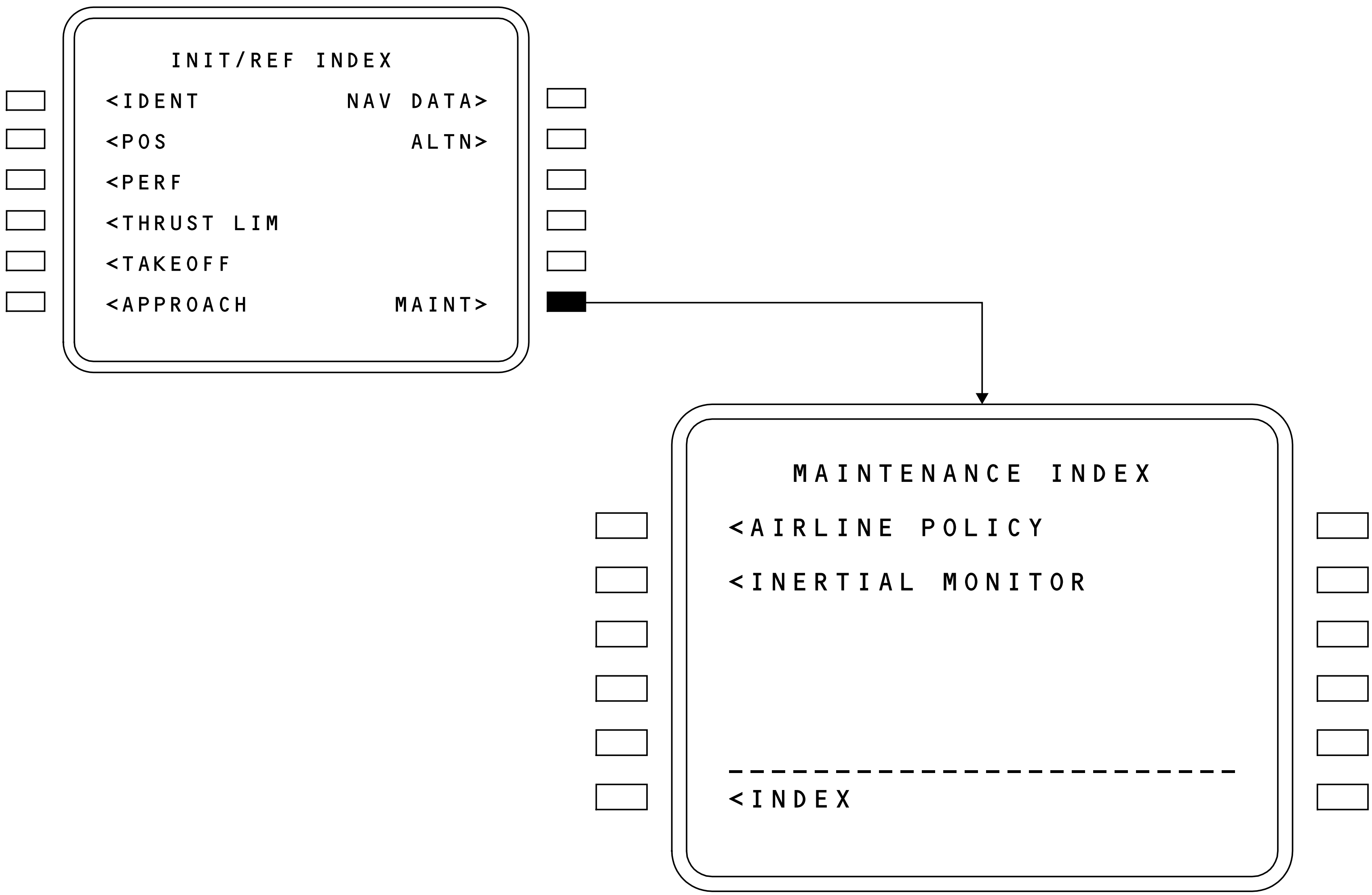
All text on this page is white.

Page Selections

Select 1L, <AIRLINE POLICY, to show the AIRLINE POLICY pages.

Select 2L, <INERTIAL MONITOR, to show the INERTIAL MONITOR page.

Select 6L, <INDEX, to show the INIT/REF INDEX page.



FMCS - MAINTENANCE INDEX PAGE

FMCS - AIRLINE POLICY 1/2 PAGE

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FMCS - AIRLINE POLICY 1/2 PAGE

Purpose

Use the AIRLINE POLICY 1/2 page to see some values from the airline modifiable information (AMI) file and the operational program configuration (OPC) file.

Page Access

To get access to the AIRLINE POLICY 1/2 page, select <AIRLINE POLICY from the MAINTENANCE INDEX page.

Color

All text on this page is white.

Information

Line 3L is the maneuver margin. This number is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows.

Line 4L is the minimum cruise time. This number is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows.

Line 5L is the fuel freeze temperature. This number is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows.

Line 1R is the option code. This option code is from the OPC.

Line 2R is the minimum rate of climb margin in climb. This number is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows.

Line 3R is the default thrust rating in cruise and minimum rate of climb margin in cruise. This number is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows.

Line 4R is the default thrust reduction height or the thrust reduction flap setting. Thrust reduction values show in feet for the altitude or show as FLAPS1 and FLAPS5. This number is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows.

Line 5R is the default all engine acceleration height and the default engine out acceleration height. This number is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows.

Line 6R is the AMI software part number. If no AMI is loaded, the field is blank.

Entries

To enter a takeoff derate percentage:

- Type a number between 0 and 30% and, if you enter two percentages separate them by a /, into the scratchpad
- Enter this into 2L.

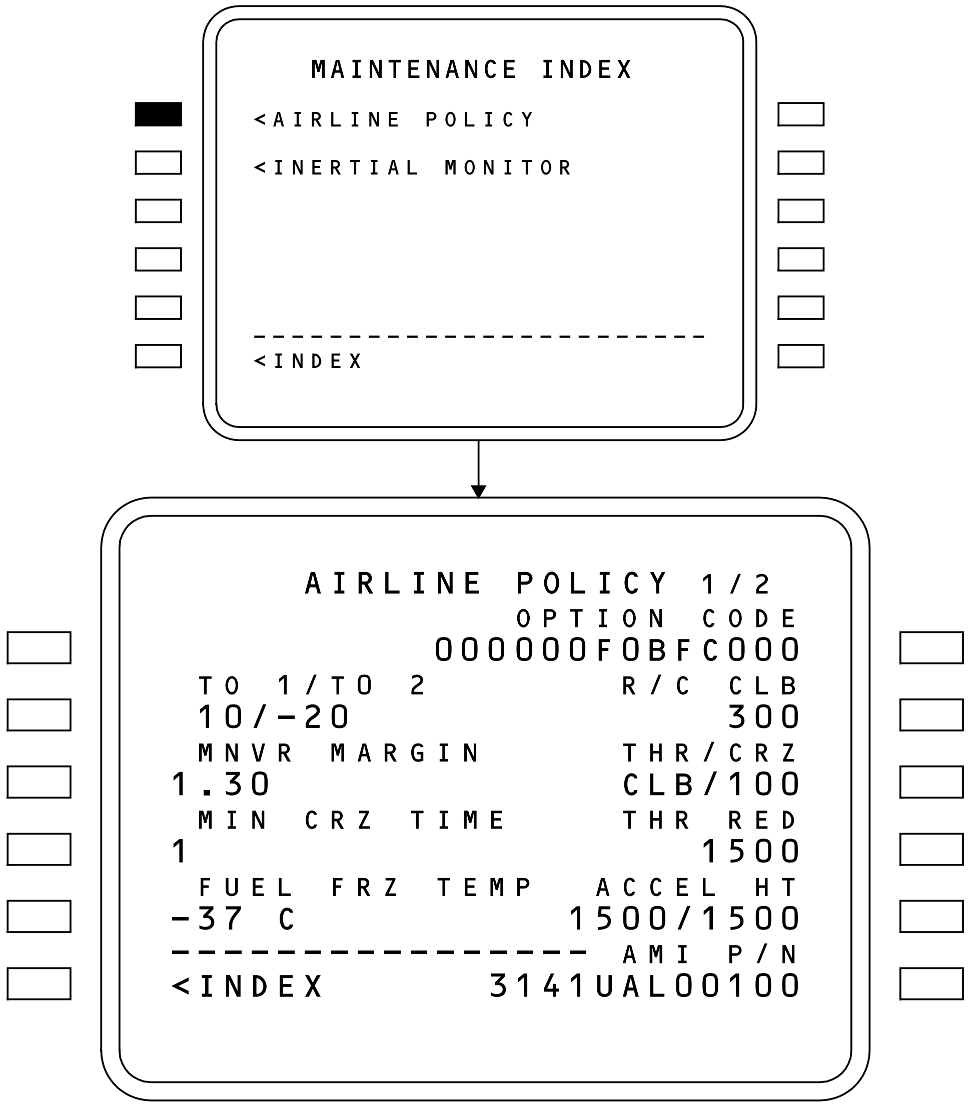
FMCS - AIRLINE POLICY 1/2 PAGE

You can also delete this value. When you delete an entered value, the takeoff derate percentage that shows returns to the FMCF default value.

Page Selections

Select 6L, <INDEX, to show the MAINTENANCE INDEX page.

Select the NEXT PAGE / PREV PAGE mode key to see AIRLINE POLICY page 2/2.



34-61-00-031 Rev 1

FMCS - AIRLINE POLICY 1/2 PAGE

FMCS - AIRLINE POLICY 2/2 PAGE

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FMCS - AIRLINE POLICY 2/2 PAGE

Purpose

Use the AIRLINE POLICY 2/2 page to see values from the airline modifiable information (AMI) file.

Page Access

To get access to the AIRLINE POLICY 2/2 page, do these steps:

- Select <AIRLINE POLICY from the MAINTENANCE INDEX page
- Push the NEXT PAGE function key.

Color

All text on this page is white.

Information

Line 1L is the default speed transition computed airspeed and the default speed transition altitude. The data is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows. The default value is the customer's baseline or delivered configuration without the AMI.

Line 2L is the alternate minimum runway length. The data is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows.

Line 3L is the alternate default speed mode. The data is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows.

Line 4L is the company speed thrust rating. The data is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows.

Line 5L is the company speed. The data is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows.

Line 1R is the default speed restriction computed airspeed and default speed restriction altitude. The data is from the AMI. If there is no AMI loaded, this field is blank.

Line 2R is the alternate altitude. The data is from the AMI. If there is no AMI loaded, this field is blank.

Line 3R is the data link option code. The data is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows.

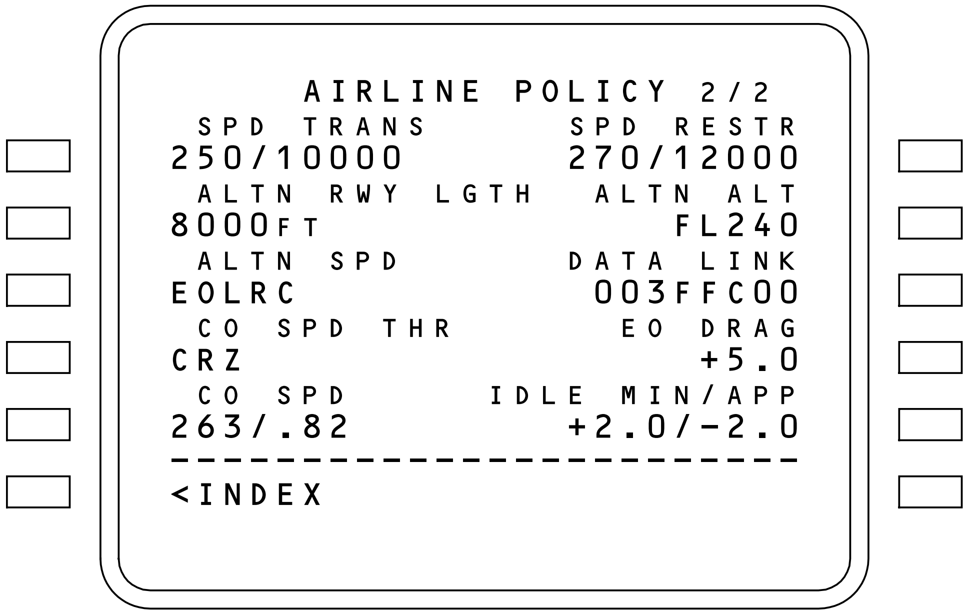
Line 4R is the engine out drag factor. The data is from the Boeing navigation database. If a non-Boeing database is loaded, it is blank.

Line 5R is the minimum idle thrust descent factor and approach idle thrust descent factor. The data is from the Boeing navigation database. If a non-Boeing database is loaded, it is blank.

FMCS - AIRLINE POLICY 2/2 PAGE

Page Selections

Select 6L, <INDEX to show the MAINTENANCE INDEX page.



34-61-00-032 Rev 1

FMCS - AIRLINE POLICY 2/2 PAGE

FMCS - INERTIAL MONITOR PAGE

Purpose

The inertial monitor page shows the position error rate for the ADIRU.

Page Access

To get access to the INERTIAL MONITOR page, select <INERTIAL MONITOR from the MAINTENANCE INDEX page.

Color

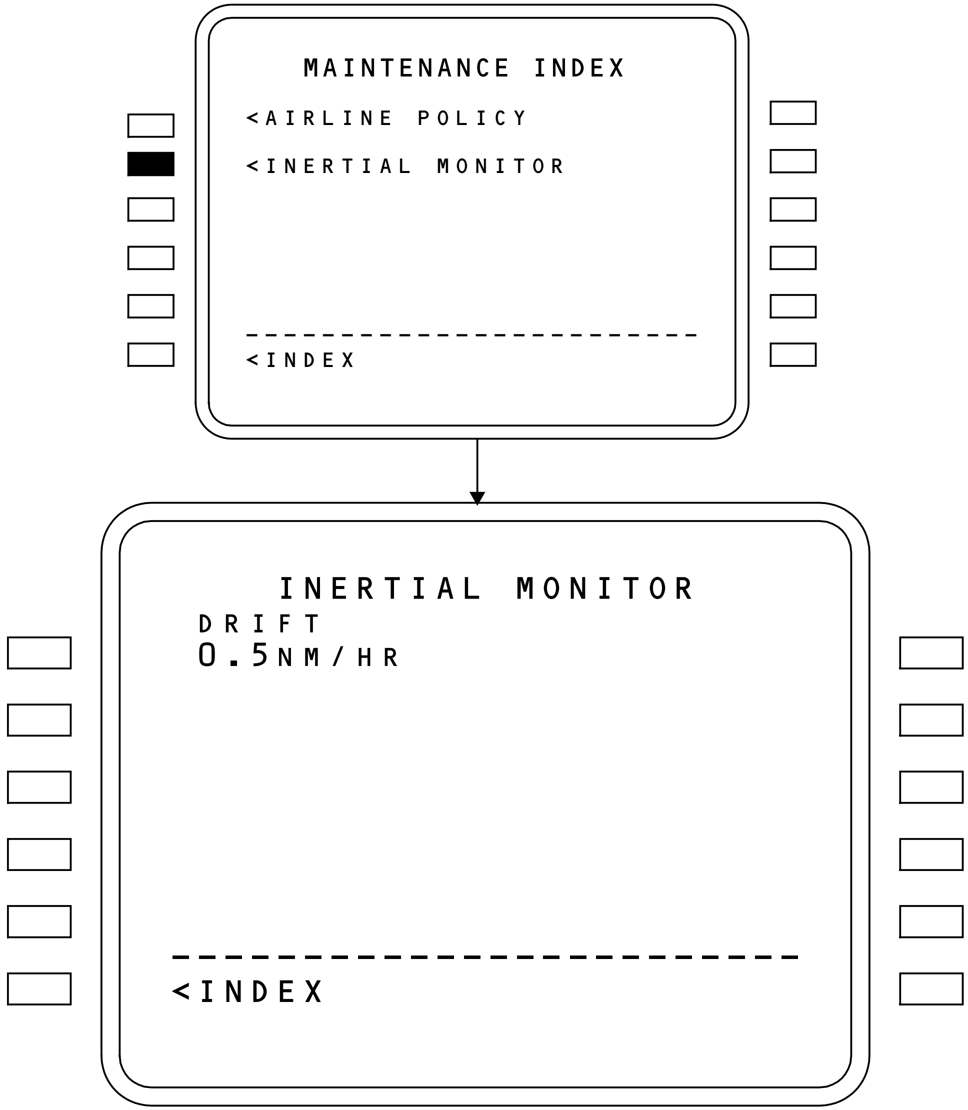
All text on this page is white.

Information

Line 1L is the inertial monitor drift. The drift rate shows for the last completed flight. It cleares at the ground-to-air transition.

Page Selections

Select 6L, <INDEX to show the MAINTENANCE INDEX.



FMCS - INERTIAL MONITOR PAGE

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FMCS - ALTN NAV RADIO PAGE

Purpose

The alternate (back-up) navigation (ALTN NAV) RADIO page gives an alternate means to tune the navigation radios. The left CDU does the alternate tune for the left navigation radios and the center ILS radio. The right CDU does the alternate tune for the right navigation radios.

Page Access

To get access to the ALTN NAV RADIO page, push the NAV RAD mode key when both FMCFs fail.

Color

All text on this page is white except for these indications:

- VOR frequency and course (CRS) entries are green and in large font
- ADF frequency entry is cyan in large font.

Information

Line 1L shows the last FMCF VOR frequency or manual frequency entry for the onside radio. The M shows for both cases.

Line 2L shows the manual CRS entry or dashes with no previous CRS entry. The CRS entry or dashes show when there is a valid frequency in 1L.

Line 3L shows the ADF frequency and tune mode. The tune mode shows next to the ADF frequency, ANT (A) or BFO (B). No show of A or B means that ADF is the active tune mode.

Line 4L shows the ILS title field with L & C for the left CDU and R for the right CDU along with the frequency and course.

Entries and Deletes

Do this to enter a VOR frequency at 1L:

- Type a valid VOR frequency between 108.0 to 117.95 into the scratchpad
- Enter into 1L.

The VOR frequency range does not include the frequencies between 108.0 to 111.95 MHz and frequencies that contain odd tenths. All frequencies from 112 to 117.95 MHz are included.

Line 1L shows dashes with a delete entry.

Line 2L shows dashes with a delete entry.

To enter a VOR course at 2L or 2R when dashes show, do this:

- Type a number between 000 to 360 into the scratchpad
- Enter into 2L.

FMCS - ALTN NAV RADIO PAGE

Dashes show in the VOR course data field and M shows next to the VOR frequency. An entry of 360 shows as 000.

A delete at line 2L with a course present blanks the course data field and dashes show.

Do this to enter an ADF frequency at 3L:

- Type a frequency between 190.0 and 1750 kHz into the scratchpad
- Enter into 3L.

Do this to enter an A (ANT) or B (BFO) ADF tune mode at 3L:

- Type the letter A or B into the scratchpad
- Enter into 3L.

Do this to delete the A or B from an ADF entry at line 3L:

- Push the DEL key. DELETE shows in the scratchpad
- Enter into line 3L.

You can not use the DELETE key to delete an ADF frequency.

Do this to enter an ILS frequency or course at 4L:

- Type an ILS frequency between 108.10 to 111.95 (odd tenths)
- Type a course between 000 to 360 with a leading slash
- Enter into 4L.

A course entry of 360 shows as 000 in the ILS course field at 4L.

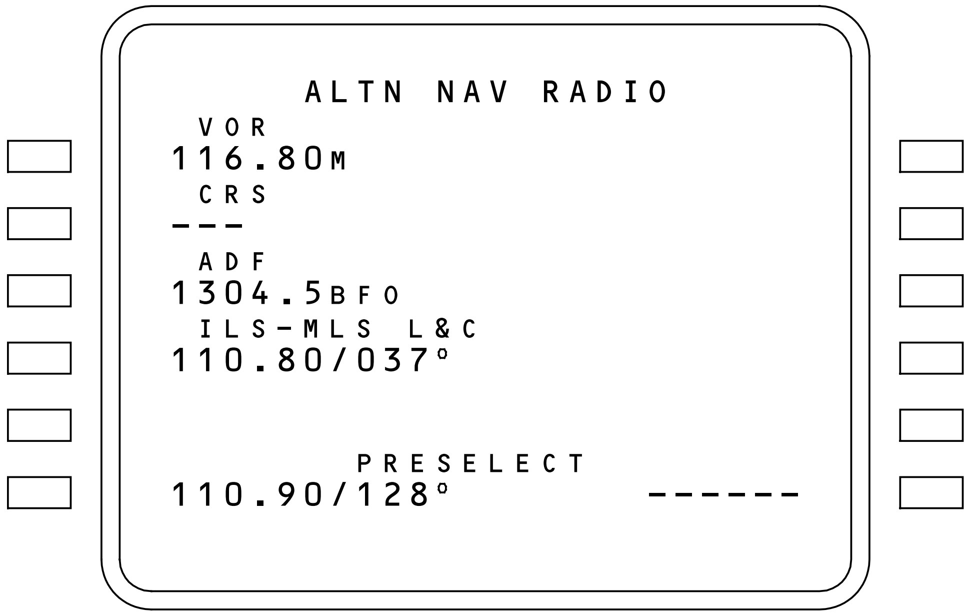
Do this to delete an ILS entry at 4L:

- Push the DEL key
- Enter into 4L.

Line 4L shows dashes with a delete entry.

Line 6L or 6R entries are valid 1L, 2L, 3L, and 4L frequency or course formats.

Line 6L or 6R shows dashes with a delete entry.



34-61-00-049 Rev 2

FMCS - ALTN NAV RADIO PAGE

FMCS - COMM PAGE

Purpose

The FMC communication (COMM) page does these functions:

- Supplies access to FMC CDU pages that have data link information
- Shows which FMC CDU pages have pending uplink information
- Shows the data link status.

Page Access

To see the FMC COMM page, select the FMC COMM mode key.

Color

All text on this page is white.

Information

Line 6R shows the data link status, the possible indications are:

- READY
- NO COMM
- VOICE
- FAIL.

Selections

Push line 1L to access RTE 1 page. If RTE 2 shows on line 1L then you will access the RTE 2 page. The word UPLINK shows in small font above line 1L when there is an uplink pending.

Push line 2L to access the ALTN page. The word UPLINK shows in small font above line 2L when there is an uplink pending.

Push line 3L to access the PERF INIT page. The word UPLINK shows in small font above line 3L when there is an uplink pending.

Push line 4L to access the TAKEOFF REF page 1/2. The word UPLINK shows in small font above line 4L when there is an uplink pending.

Push line 5L to access the ACT RTE X DATA or MOD RTE X DATA. The word UPLINK shows in small font above line 5L when there is an uplink pending.

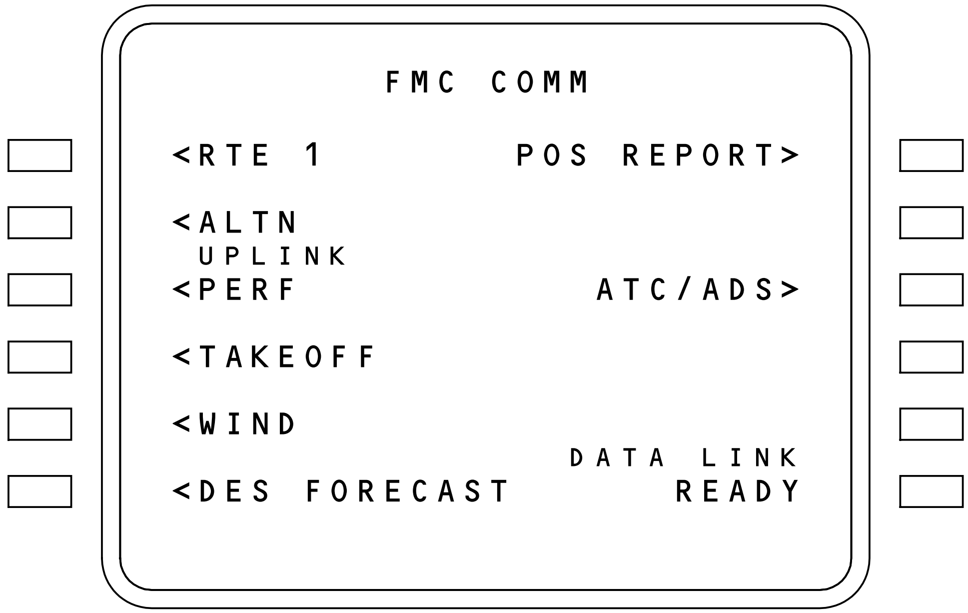
Push line 6L to access the DESCENT FORECAST page. The word UPLINK shows in small font above line 6L when there is an uplink pending.

Push line 1R to access the POS REPORT page.

Push line 3R to access the automatic surveillance/air traffic control (ADS/ATC) status page.

Training Information Point

Refer to the flight operations manual for more information related to this page.



34-61-00-063 Rev 0 03/26/96

FMCS - COMM PAGE

FMCS - FMCF FUNCTIONAL DESCRIPTION - INTRODUCTION

General

There are two FMCFs, one in the CPM/ACMF in the left AIMS cabinet and one in the CPM/Basic in the right AIMS cabinet.

The FMCFs use digital and analog inputs from external sensors and components, flight deck controls, internal AIMS cabinet interfaces, and cross cabinet AIMS interfaces.

Each FMCF has two software partitions. These are:

- Navigation (NAV) partition
- Flight management function (FMF) partition.

The flight management computing function (FMCF) does these sub-functions:

- Lateral navigation (LNAV) - NAV partition
- Nav radio tune - NAV partition
- Vertical nav (VNAV) - FMF partition
- Guidance - FMF partition
- BITE/fault monitoring - FMF partition
- Display control - FMF partition.

The active FMCF sub-function sends this data to these user systems:

- Guidance sub-function sends LNAV and VNAV commands and mode data to the AFDS
- Guidance sub-function sends VNAV thrust commands mode and data to the TMCF
- Radio tune sub-function sends radio tune commands and mode data to the navigation radios
- BITE sub-function sends fault and display data to the PDF and CMCF of AIMS
- Display control sub-function sends page and display data to the CDUs, PDF, and CMCF of AIMS.

NAV - Lateral Navigation Position Calculation

The LNAV sub-function uses these inputs to calculate the current airplane position:

- Air data inertial reference unit (ADIRU) inertial data
- Global position system (GPS) inertial data
- Navigation data base (NDB)
- Nav radio data.

The LNAV sub-function sends these outputs to the VNAV and guidance sub-function for the autopilot flight director system (AFDS):

- Position and velocity data
- Flight path data
- Heading and track data.

NAV - Nav Radio Tune

The nav radio tune sub-function allows autotune and manual tuning of the navigation radios. The FMCF uses the autotuned radios for position update. The flight crew uses the data to verify their position.

The FMCF does not auto tune the ADF radios.

The nav radio tune sub-function receives these inputs to do its calculations:

- Nav radio data
- LNAV data
- NDB
- CDU requests.

The nav radio tune sub-function sends these outputs to the nav radios:

- Tune mode
- Tune frequency
- Identifier
- Course
- ILS course.

FMF - Vertical Navigation

The VNAV sub-function uses these inputs to calculate VNAV (pitch) commands and other display data:

- Airframe and engine performance data from the performance data base (PDB)
- Inertial data from the ADIRU
- LNAV data from the NAV partition
- Engine data from the engine controllers
- Fuel data from the fuel quantity system
- Crew entries from the CDU performance initialization and the takeoff reference page.

The VNAV sub-function sends these outputs to the guidance sub-function for the AFDS and the thrust management computing function (TMCF):

- Altitude
- Vertical track (VTK)
- Cross track (XTK)
- Fuel used
- Thrust limits
- Gross weight
- Takeoff speeds
- Approach speeds.

FMF - Guidance

The guidance sub-function calculates steering and thrust commands. To do this, it looks at inputs from external sensors, components, and internal FMCF interfaces. The guidance sub-function compares the actual position from the LNAV sub-function with the flight plan from the display control sub-function. It compares the VNAV sub-function targets (pitch and thrust) with actual airplane pitch and actual thrust. The guidance sub-function sends roll and pitch steering commands to the AFDS.

The guidance sub-function also supplies these outputs to the AFDS:

- LNAV operate mode
- VNAV operate mode.

It sends this data to the TMCF:

- Thrust commands
- Speed commands
- Thrust limit mode
- Autothrottle mode.

The guidance sub-function also supplies these outputs to the display control sub-function:

- Roll flight path data
- Pitch flight path data.

FMF - BITE/Fault Monitoring

The BITE/fault monitoring sub-function contains hardware monitors, software monitors and fault detection circuits. The BITE/fault monitoring sub-function stores BITE and fault detection information and status for the last ten flight legs in non-volatile memory (NVM). It also records the status of the input source in BITE history. The BITE/fault monitoring sub-function supplies FMCF faults to the display control sub-function.

The BITE/fault monitoring sub-function responds to CMCF test requests when the airplane is on the ground.

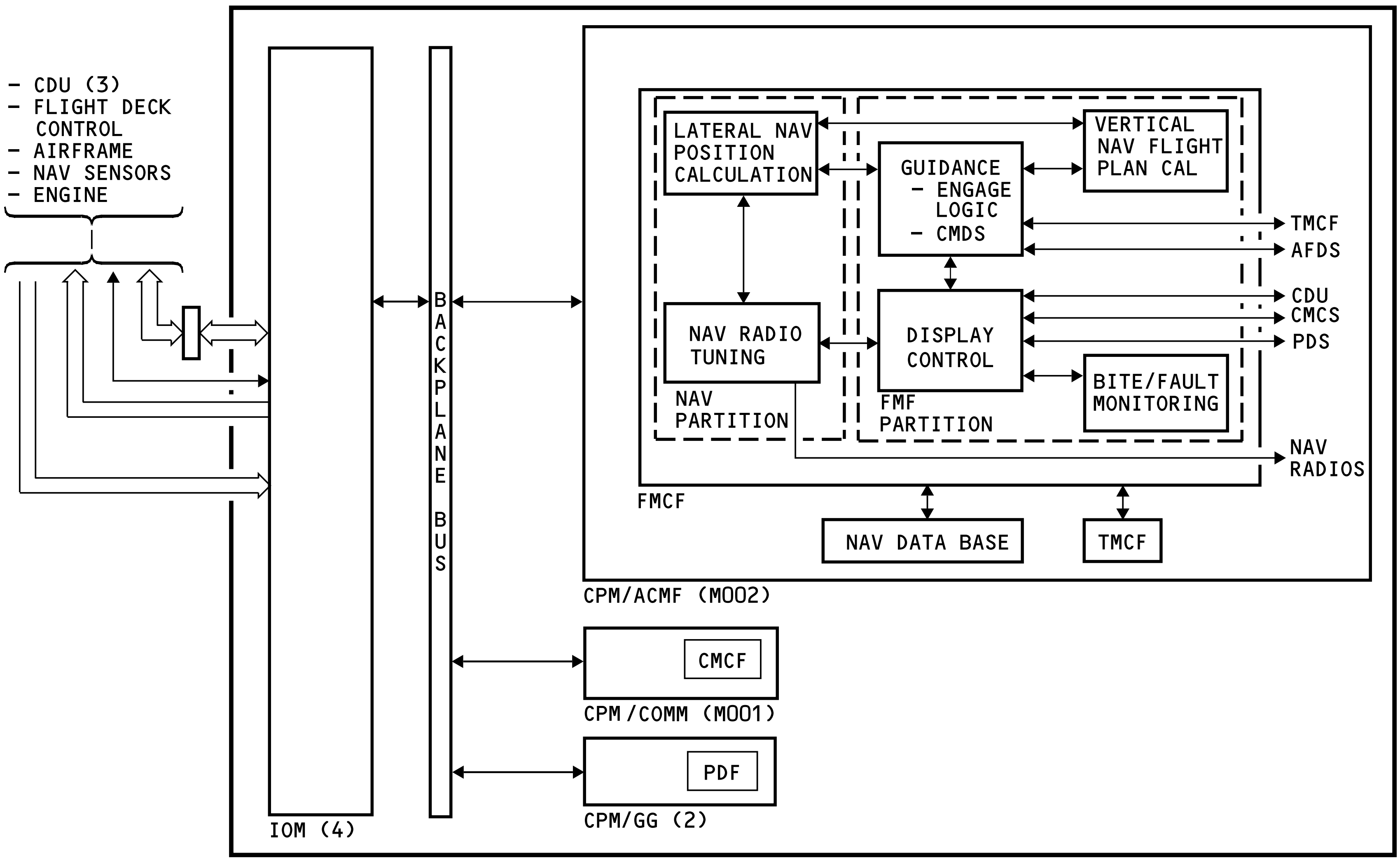
FMF - Display Control

The display control sub-function formats, updates and sends data to the CDU. It sends button push and other flight deck data to the sub-functions. The display control sub-function uses data from the LNAV, VNAV, guidance, and BITE/fault monitoring sub-functions to update and reformat the CDU pages.

The display control sub-function also sends background and dynamic data to the PDF.

The display control sub-function sends alert and advisory messages to the CDU. It also sends the alert message to the PDF for a flight deck annunciation.

The display control sub-function sends fault and display data to the CMCF for display. This occurs during normal FMCF operation and for CMCF test requests.



34-61-00-050 Rev 3 09/22/1997

FMCS - FMCF FUNCTIONAL DESCRIPTION - INTRODUCTION

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FMCS - FMCF FUNCTIONAL DESCRIPTION - LNAV SUB-FUNCTION

General

The FMCF LNAV sub-function uses data from external systems and internal data from AIMS to calculate navigation data for the performance, guidance, and display control sub-function of the FMCF.

The LNAV sub-function supplies this data:

- Navigation update mode
- Position uncertainty
- Velocity vectors
- Wind data.

The active FMCF display control sub-function sends display data to the CDUs and the primary display function (PDF).

Navigation Update Mode

The FMCF has ten navigation update modes. The navigation update mode determines which sensors the FMCF uses to calculate the airplane position and velocity. These are the ten navigation update modes (not in order of priority):

- No nav - There are no valid FMCF sensors (GPS, radios, or ADIRU) necessary
- GPS only - The FMCF uses global positioning system (GPS) data
- ADIRU only - The FMCF uses ADIRU data
- VOR/DME/ADIRU - The FMCF filters VOR, DME, and ADIRU data
- DME/DME/ADIRU - The FMCF filters DME and ADIRU data
- GPS/ADIRU - The FMCF filters ADIRU data with GPS position data
- LOC/ADIRU - The FMCF filters localizer deviation with ADIRU data
- LOC/VOR/DME/ADIRU - The FMCF filters localizer deviation, collocated VOR/DME, and ADIRU data
- LOC/DME/DME/ADIRU - The FMCF filters localizer deviation, DME/DME, and ADIRU data
- LOC/GPS/ADIRU - The FMCF filters localizer deviation, GPS, and ADIRU data.

Position Uncertainty

The FMCF uses mathematical algorithms to calculate a position uncertainty value for each one of the navigation sensors (GPS, radios, ADIRU).

The FMCF selects only one navigation update mode at a time. The FMCF selects the navigation update mode with the least amount of position uncertainty.

Velocity Vector Calculation

The LNAV sub-function uses north, east, and vertical velocity components from the ADIRU and GPS position bias or radio position bias to calculate the velocity vectors. These are the outputs from the total velocity vector calculations:

- Ground speed
- Distance-to-go to next waypoint

- Cross-track error
- True heading
- Magnetic track
- True track
- Flight path angle
- Magnetic heading
- Altitude.

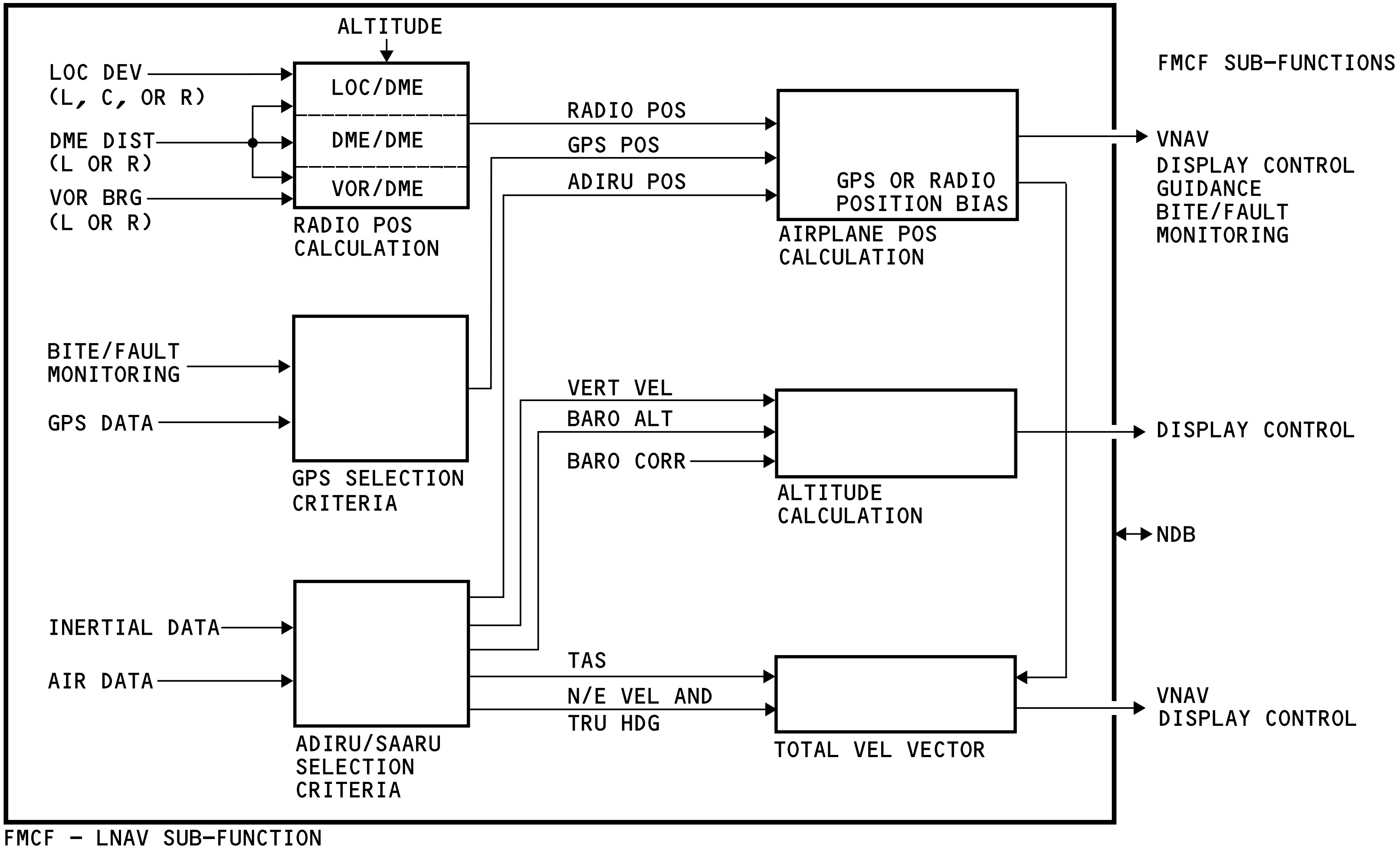
Wind Data Calculation

The LNAV sub-function uses these inputs to calculate wind data:

- Flight path angle
- North and east velocity
- True heading
- ADIRU true airspeed (TAS).

The LNAV sub-function gives wind speed, wind direction, and wind angle. Wind speed is the difference between the track and airplane heading vector.

Wind direction and wind angle is the difference between ground speed and the true airspeed vector.



34-61-00-051 Rev 5 06/20/1997

FMCS - FMCF FUNCTIONAL DESCRIPTION - LNAV SUB-FUNCTION

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FMCS - FMCF FUNCTIONAL DESCRIPTION - RADIO TUNE SUB-FUNCTION

General

Normally, the radio tune commands come from the right FMCF for automatic or manual tune of the navigation radios. If the radio tune sub-function in the right AIMS cabinet fails, the tune commands from the left FMCF are used.

After the FMC autotunes the navigation radios, the radio data goes to the FMCF. If global positioning system (GPS) data in not available, the FMCFs use nav radio data to update the inertial position from the air data inertial reference unit (ADIRU).

Navaid Autotuning

The FMCFs autotune to the best navaids for position updates. The FMCFs autotune to VOR/DME navaids in three different ways. These are the three types and the indications that show on the NAV RADIO page on the CDU:

- The letter P shows for procedure tuning when the FMCF automatically tunes to a navaid that is part of the active departure or arrival procedure.
- The letter R shows for route tuning when the FMCF automatically tunes to a navaid that is the next or last waypoint of the active route.
- Autotune (A) occurs when no procedure (P) or route (R) tune is active. The FMCFs automatically tune to the best navaids.

During autotune (A), the FMCFs use a selection criteria to find the best DME/DME pair to autotune as the navaids. This is the selection criteria:

- Range; the range of navaid station must not be farther than the line-of-sight or closer than 9 nm
- Geometry; the angle between the two stations is between 30 and 150 degrees, with the airplane as the center point
- Raw data availability; when the station is tuned it returns valid data.

The FMCFs make a list of the 20 navaid stations closest to the current FMCF position. The FMCFs update the list every three minutes. The navaid stations are from the navigation data base.

The FMCFs select five navaid stations from the list of 20 to autotune. The FMCFs select the best five navaids that meet the selection criteria. Each DME tunes to those five navaid stations. The FMCFs use two of the five navaid stations for position updates. The FMCFs use two more navaid stations for DME distance display updates in the navigation display. The FMCFs use the last navaid station for co-located ILS/DME distance.

If a DME/DME pair is not available, the FMCFs use the VOR bearing and DME distance from a co-located VOR/DME station.

If the destination runway is a part of the flight plan, the FMCFs autotune to the co-located ILS/DME station for the destination runway. The FMCFs use the ILS localizer deviation and DME slant range distance for FMCF position updates during a landing.

Navaid Manual Tuning

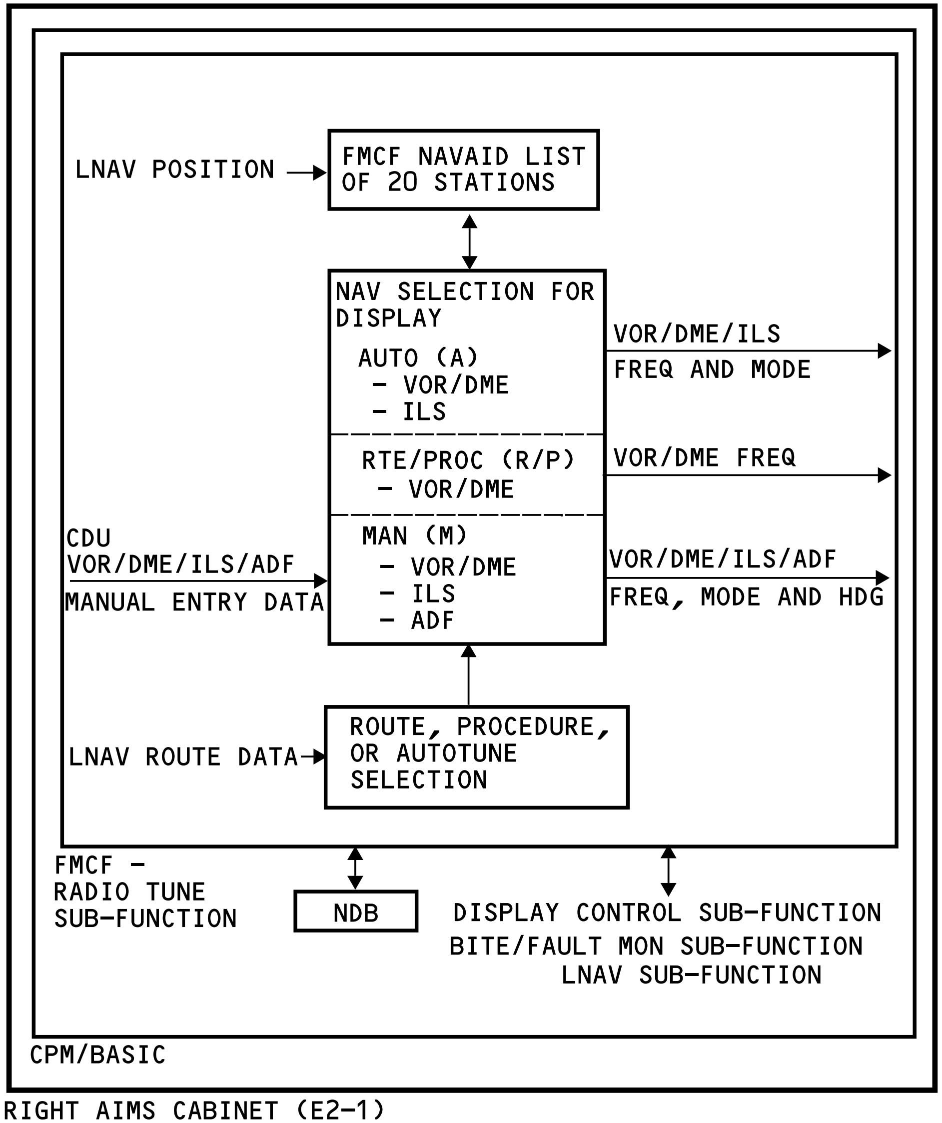
Use the CDU to manually tune the nav radios. To tune to a navaid station, enter a tuning frequency for ILS, VOR, DME or ADF navaids or station identifier for VOR or DME. When you do this, the tuning frequency or identifier goes to the FMCFs. The FMCFs do a check of the validity of the tuning frequency or identifier, and make sure that it is in the navigation data base. If the tuning frequency is valid, the FMCFs send it to the related radio. Then the radio tunes to that station. If you enter a station identifier for VOR or DME, the FMCFs change the station identifier to the related tuning frequency. The FMCFs send the related tuning frequency to the VOR receiver and DME interrogators.

A manual tune entry overrides a P, R, or an A-autotune mode for VOR/DME tuning and an A autotune mode for ILS. This causes the letter M to show between the frequency and identifier on the NAV RADIO page of the CDU. A delete of the manual tune mode causes a P, R or an A to show between the frequency and identifier on the NAV RADIO page.

Navigation Radios Tune Modes

These are the tune modes for the VOR/DME, ILS, and ADF navigation radios:

- VOR/DME - M, P, R, or A
- ILS - M or A, the FMCF auto-tunes the ILS when the airplane is within range of the destination airport and the ILS runway is part of the active flight plan
- ADF - M (manual) tune only.



34-61-00-052 Rev 4 02/11/1998

FMCS - FMCF FUNCTIONAL DESCRIPTION - RADIO TUNE SUB-FUNCTION

FMCS - AUTOMATIC DEPENDENT SURVEILLANCE FUNCTION FUNCTIONAL DESCRIPTION

General

ATC sends automatic dependent surveillance (ADS) requests from the ground to the airplane. The ADSF in the airplane sends airplane data to the ground. ATC uses this data to manage air traffic. The ADSF is automatic and does not require flight crew action.

Functional Description

ATC sends ADS requests from the ground to the airplane. The link between the ground and the airplane is through the ACARS sub-function of the DCMF.

The DCMF sends the request to the ADSF. The ADSF receives inputs from these units and functions:

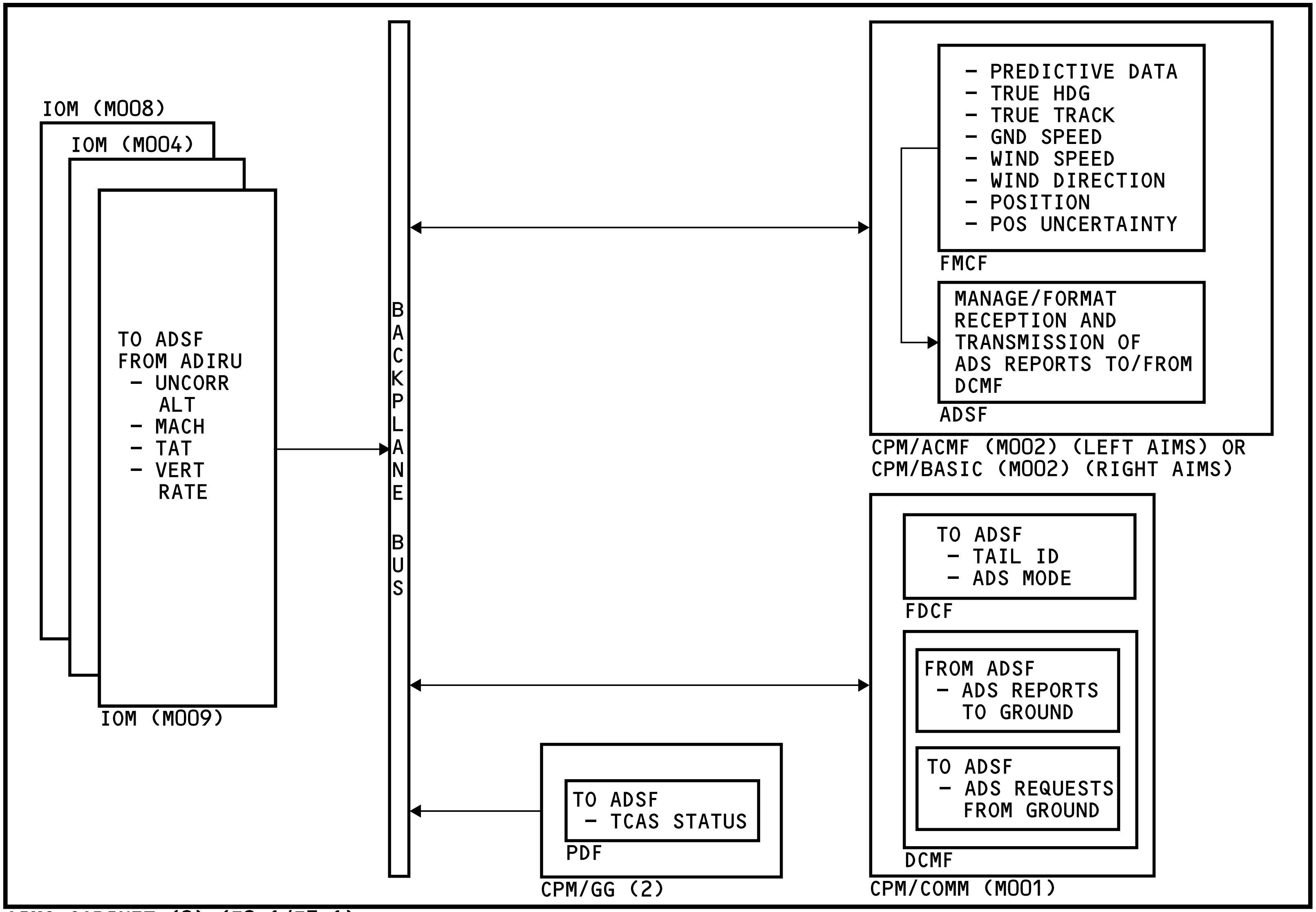
- Air data inertial reference unit (ADIRU)
- Flight management computing function (FMCF)
- Flight deck communication function (FDCF)
- Data communication management function (DCMF)
- Primary display function (PDF).

The ADSF uses these inputs to manage and format the transmission of ADS reports to the ground. The ADSF sends the report to the DCMF. The ACARS sub-function of the DCMF down links the report to the ground.

The reports contain data ATC uses to track the airplane in the air. These are examples of data transmitted to ATC:

- Airplane position
- Flight plan waypoints
- True heading
- True track
- Ground speed
- Wind speed
- Wind direction
- Position uncertainty
- Validity status of the airplane TCAS system
- Aircraft tail identification
- Operational status of the ADSF
- Uncorrected barometric altitude
- Mach number
- Total air temperature (TAT)
- Vertical rate.

The ADS reports occur without any flight crew action.



FMCS - AUTOMATIC DEPENDENT SURVEILLANCE FUNCTION FUNCTIONAL DESCRIPTION

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FMCS - FMCF FUNCTIONAL DESCRIPTION - BITE/FAULT MONITORING SUB-FUNCTION

General

The FMCF BITE and fault monitoring sub-function does software and hardware comparisons, input monitoring, and fault recording. The BITE and fault monitoring sub-function uses both external and internal inputs to do:

- Input monitoring
- Power-up checks
- Cross cabinets checks
- Synchronization monitoring
- Software reset.

The BITE and fault monitoring sub-function sends fault display data to the display control sub-function. It also sends fault data to the central maintenance computing function (CMCF) for fault recording.

Input Monitoring

The FMCFs monitor inputs from the CDUs and all the applicable line replaceable units (LRUs). The FMCFs monitor the input buses to find if the input signals are active, not active, valid or invalid.

Power-Up Checks

The FMCF does compatibility and comparison checks during power-up and internal monitoring during normal operation. Power-up checks are done at power-up and at BITE restarts. These are the checks and comparisons that occur:

- Operational program configuration (OPC) check. The FMCF compares the OPC and the FMCF operational software. If they do not agree, the FMCF fails and a maintenance message occurs on the MAT.
- Performance database (PDB) check. The FMCF monitors the airframe/engine identification program pin input and OPS. If they do not agree, the FMCF fails and a maintenance message occurs on the MAT.
- PDB/electronic engine controller (EEC) comparison. The FMCF compares the engine type and thrust rating in the PDB and the engine type and thrust rating from the EEC. If they do not agree, the FMCF stores the EEC data in non-volatile memory then restarts.
- Airline modifiable information (AMI) comparison. The FMCF compares the AMI file with the OPS and the OPC. If they do not agree, the FMCF uses the AMI default values.

Cross Cabinet Checks

The active FMCF compares its OPS, PDB, and navigation data base (NDB) to the inactive FMCF to make sure they agree. If they do not agree, the inactive FMCF fails. A maintenance message goes to the CMCF for display and storage.

Sychronization Monitoring

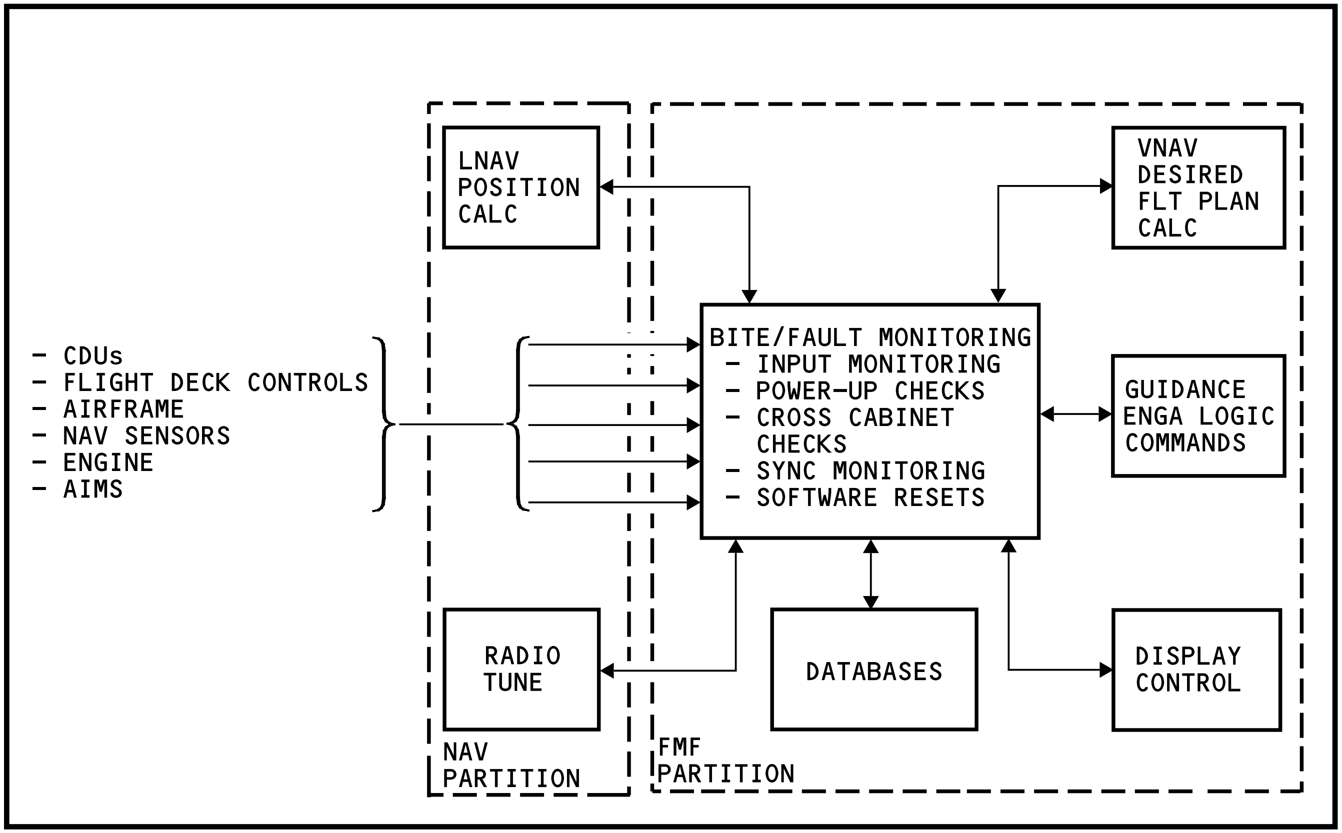
FMCF synchronization monitoring occurs at power-up and during normal operation. The active FMCF sends flight plan data to the inactive FMCF. This occurs so the inactive FMCF can take over if the active FMCF fails. The active FMCF sends its flight plan data to the inactive FMCF for these conditions:

- Long term power-ups
- BITE induced restart
- Flight plan entries and performance data changes.

When the active FMCF fails, a resychronization (resync) occurs. Resyncs take about 1 second for an entire flight plan update. The active FMCF always resyncs the inactive FMCF. The active FMCF selection is a function of the FMC selector position and FMF partition health.

Software Reset

An AIMS software reset from the MAT does a test of the FMCFs and clears memory buffers, flight plans, and user entered data. Fault data stays in memory over the reset.



FMCF - BITE/FAULT MONITORING SUB-FUNCTION

34-61-00-058 Rev 5 09/22/1997

FMCS - FMCF FUNCTIONAL DESCRIPTION - BITE/FAULT MONITORING SUB-FUNCTION

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FMCS - AIRLINE MODIFIABLE INFORMATION

General

The design of the 777 airplane lets the airlines customize certain default values in the flight management computing system. You customize these functions through airline modifiable information (AMI). You use the ground based software tool (GBST) to make the modifications.

These functions have default values:

- Performance, guidance, and takeoff data
- Alternate function parameters
- Crew alertness monitor
- Request uplink imbedded message identifier (IMI) table
- Datalink option codes
- Downlink trigger parameters.

You can modify any of the default values for these functions. In addition, you can create tables or values for these functions:

- Downlink address table
- Airline ground address table.

There are no default values for these tables.

Performance, Guidance and Takeoff Data

The table shows the default values and the valid range for the performance, guidance and takeoff data.

Parameter	Default Value	Valid Range
All Eng Accel ht	1000 feet	400-9999 feet
Eng out accel ht	1000 feet	400-9999 feet
Speed restriction	none	100-400 knots
Speed transition	250 kts/10000 ft	Spd-100-400 kts Alt-0-40000 ft
Maneuver margin	1.2 FAA 1.3 CAA/JAR	1.2-1.3 FAA 1.3-CAA/JAR
Rate of climb margin for climb	100 ft/min	0-500 ft/min
Rate of climb margin for cruise	100 ft/min	0-500 ft/min
Default thrust rating in cruise	Max cruise thrust	Max climb or max cruise thrust
Minimum cruise time	1 minute	1-20 minutes
Thrust reduction height/flap setting	1000 feet	400-9999 feet
Fuel freeze/min operating temp	-37 deg C	-99to-1 deg C
Takeoff Derate 1	10%	0-30%
Takeoff Derate 2	20%	0-30%
Company speed	Defined in NDB	1-400 KTS CAS .1-.99 MACH
Company speed thrust rating	Max climb thrust	Max climb, Max cruise,Max con

Alternate Function Parameters

The table shows the default values and the valid range for the alternate function parameters.

FMCS - AIRLINE MODIFIABLE INFORMATION

Parameter	Default Value	Valid Range
Altitude	FMCF computed	1500-40000 ft
Min runway length	0 feet	0-15000 ft
Speed mode	ECON	ECON, CAS/ MACH, LRC, EOLRC, COSPD
Speed value	None	1-400 KTS CAS .1-.99 MACH

Crew Alertness Monitor Parameters

The table shows the default values and the valid range for the crew alertness monitor parameters.

Parameter	Default Value	Valid Range
Cruise advisory timer	15 min	15-60 min
Cruise caution timer	20 min	15-75 min
Cruise warning timer	25 min	15-75 min
Descent advisory timer	5 min	5-60 min
Descent caution timer	6 min	5-75 min
Descent warning timer	7 min	5-75 min

Additionally, the default settings for the crew alertness warning, caution and advisory annunciations is disable. You can enable any or all of these annunciations.

Request Uplink IMI Table

The table shows the default IMI values and the associated imbedded element identifier (IEI) values for uplink requests.

IMI Description	IMI	Associated IEI
Flight Plan	FPN	RP, FN
Load information	LDI	RR
Performance initialization	PER	PR
Position	POS	POS
Progress (ETA) report	PRG	DT

Datalink Option Codes

You control the datalink option codes by setting a bit in a data word to a logic 1 or a logic 0. Bits 1-10 are for functions that show on a CDU display. The default value for these functions is set to a logic 0 which causes the function to show on the appropriate display. A logic 1 blanks the function. The functions are:

- Bit 1: Flight plan data request inhibit
- Bit 2: Performance Initialize data request inhibit
- Bit 3: Takeoff data request inhibit
- Bit 4: Enroute wind data request inhibit
- Bit 5: Descent forecast data request inhibit
- Bit 6: Company preferred alternate request inhibit
- Bit 7: Alternate flight list data request inhibit
- Bit 8: Alternate weather data request inhibit
- Bit 9: Flight plan data report inhibit

- Bit 10: Position report inhibit.

Bits 11 through 23 control data that may be added to message content or functions that will be added. These items have a default value of logic 0 which excludes the functionality. The items includes:

- Bit 11: Time stamp IEI enable
- Bit 12: Ground address IEI enable
- Bit 13: Company distribution IEI enable
- Bit 14: Scratchpad IEI enable
- Bit 15: Flight number IEI enable
- Bit 16: Flight plan response enable
- Bit 17: Performance initialize response message enable
- Bit 18: Takeoff response message enable
- Bit 19: Wind response message enable
- Bit 20: Pos report trigger response message enable
- Bit 21: ALTN response message enable
- Bit 22: Change in destination airport trigger enable
- Bit 23: Change in arrival runway trigger enable.

Downlink Trigger Parameters

The table shows the default values and the valid range for the downlink trigger parameters.

Parameter	Default Value	Valid Range
Head wind discrepancy	Disable	0-99 knots
Change in destination ETA	Disable	0-999 min
Time to top of descent 1	Disable	0-999 min
Time to top of descent 2	Disable	0-999 min
Time to top of descent 3	Disable	0-999 min
Time to top of descent 4	Disable	0-999 min
Time to top of descent 5	Disable	0-999 min
Time to destination 1	Disable	0-999 min
Time to destination 2	Disable	0-999 min
Time to destination 3	Disable	0-999 min
Time to destination 4	Disable	0-999 min
Time to destination 5	Disable	0-999 min

Downlink Address Table

The downlink address table has the ground addresses and the company distribution for IMIs. There are no default entries for this table. You may enter a maximum of 20 IMIs in the table.

Airline Ground Address Table

The airline ground address table has the ground addresses with the identification of ADS uplinks that originate with the airline. There are no default entries for this table. You may enter a maximum of 5 ground addresses or 5 groups of addresses in the table.

FMCS - AIRLINE MODIFIABLE INFORMATION

Default Values Summary

Default values are non-modifiable values found in the operational software of the CPM/Basic and the CPM/ACMF. To cause the function to operate with new values you must develop a customized AMI and load that software into the CPMs. These new values do not override the default values but are used instead of the default values. If the AMI fails, FMCFs use the default values.

With the FMCF, you can also use the Airline Policy page to modify the AMI values on a short term basis. You can do this between flights. At power down, the system restores the default values values.

FUNCTIONS WITH DEFAULT VALUES

PERFORMANCE, GUIDANCE AND TAKEOFF DATA
ALTERNATE FUNCTION PARAMETERS
CREW ALERTNESS MONITOR
REQUEST UPLINK IMI TABLE
DATALINK OPTION CODES
DOWNLINK TRIGGER PARAMETERS

MODIFIABLE FUNCTIONS

PERFORMANCE, GUIDANCE AND TAKEOFF DATA
ALTERNATE FUNCTION PARAMETERS
CREW ALERTNESS MONITOR
REQUEST UPLINK IMI TABLE
DATALINK OPTION CODES
DOWNLINK TRIGGER PARAMETERS
DOWNLINK ADDRESS TABLE
AIRLINE GROUND ADDRESS TABLE

34-61-00-061 Rev 2 06/02/95

FMCS - AIRLINE MODIFIABLE INFORMATION

FMCS - SYSTEM TESTS

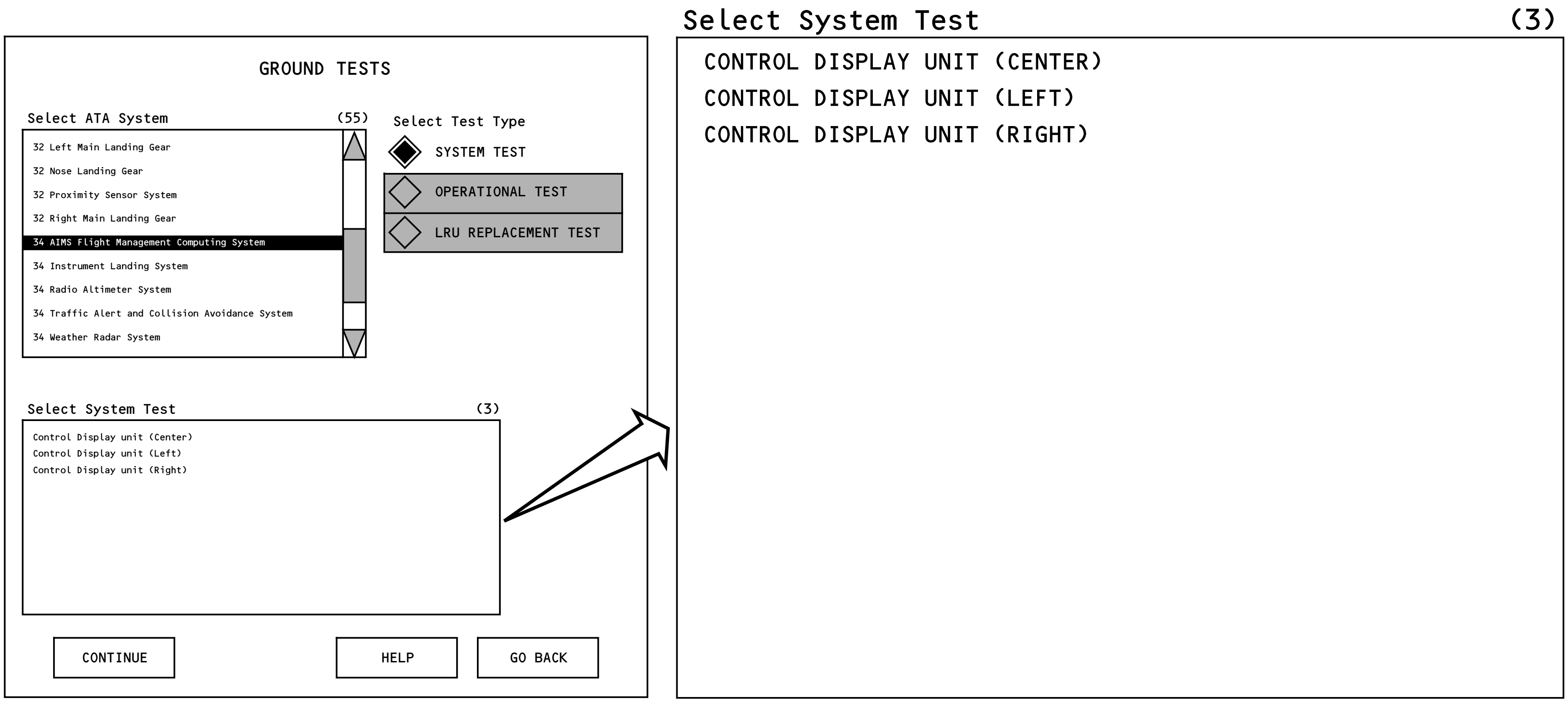
General

These are the system tests for the flight management computing system:

- Control Display Unit (CDU), Center
- Control Display Unit, Left
- Control Display Unit, Right.

CDU System Test

This test makes sure that the center, left, or right CDU operates correctly. The CDU display (screen) goes blank during the test. After you start the test, you can not stop it. This test takes less than one minute.



34-61-00-062 Rev 1 03/02/95

FMCS - SYSTEM TESTS

FMCS - CDU SPECIAL FUNCTIONS

General

The FMCS control display unit (CDU) special function makes sure the internal hardware and software operates correctly. During a special function, the CDU uses it's built in test equipment (BITE) to do a power-up test. The special function also makes a CDU test patterns show on the CDU for operator inspection.

The MAT shows these CDU special function screens/ dialogue boxes:

- Select ATA system
- Select function (left, center, or right CDU)
- CDU center, left, or right special function
- Description (same for all CDUs)
- Special function condition - ready, inhibited, or completed
- Special function instructions - what to look for on the CDU display
- CDU center, left, or right white test pattern
- CDU center, left, or right black test pattern
- CDU center, left, or right checkerboard test pattern.

CDU Display - Special Function Description

The CDU special function permits the operator to look for faults in the CDU LCD glass or drive circuits. Normal operating formats are not on the CDU during this special function.

The approximate time to run a CDU special function is 2-5 minutes.

There are no limitations or special requirements to run a CDU special function.

To do a CDU special function, select a CDU from the MAT select function screen/dialogue box. Next, read and follow the instructions on the MAT screens/dialogue boxes that show.

CDU LCD Test Pattern - White

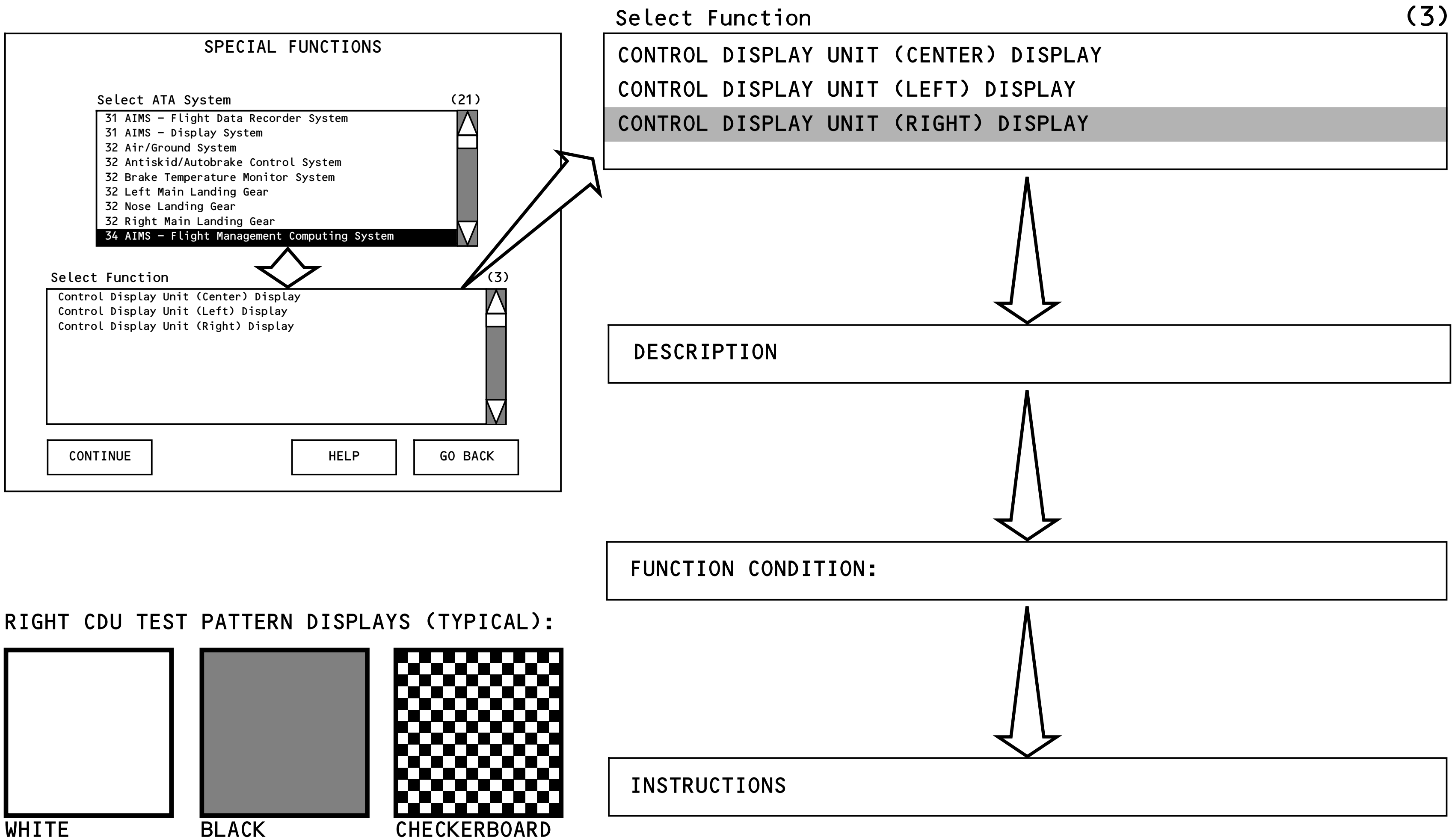
This special function causes the CDU display to show a white test pattern. Look for defects on the display.

CDU LCD Test Pattern - Black

This special function causes the CDU display to show a black test pattern. Look for defects on the display.

CDU LCD Test Pattern - Checkerboard

This special function causes the CDU display to show a checkerboard test pattern. Look for defects on the display.



34-61-00-060 Rev 3

FMCS - CDU SPECIAL FUNCTIONS

Continental Airlines, Inc

Thrust Management Computing System

WB371

TABLE OF CONTENTS

THRUST MANAGEMENT COMPUTING SYSTEM (TMCS) - INTRODUCTION

General

The thrust management computing system (TMCS) is part of the airplane information management system (AIMS). The TMCS controls engine thrust in response to mode requests from the:

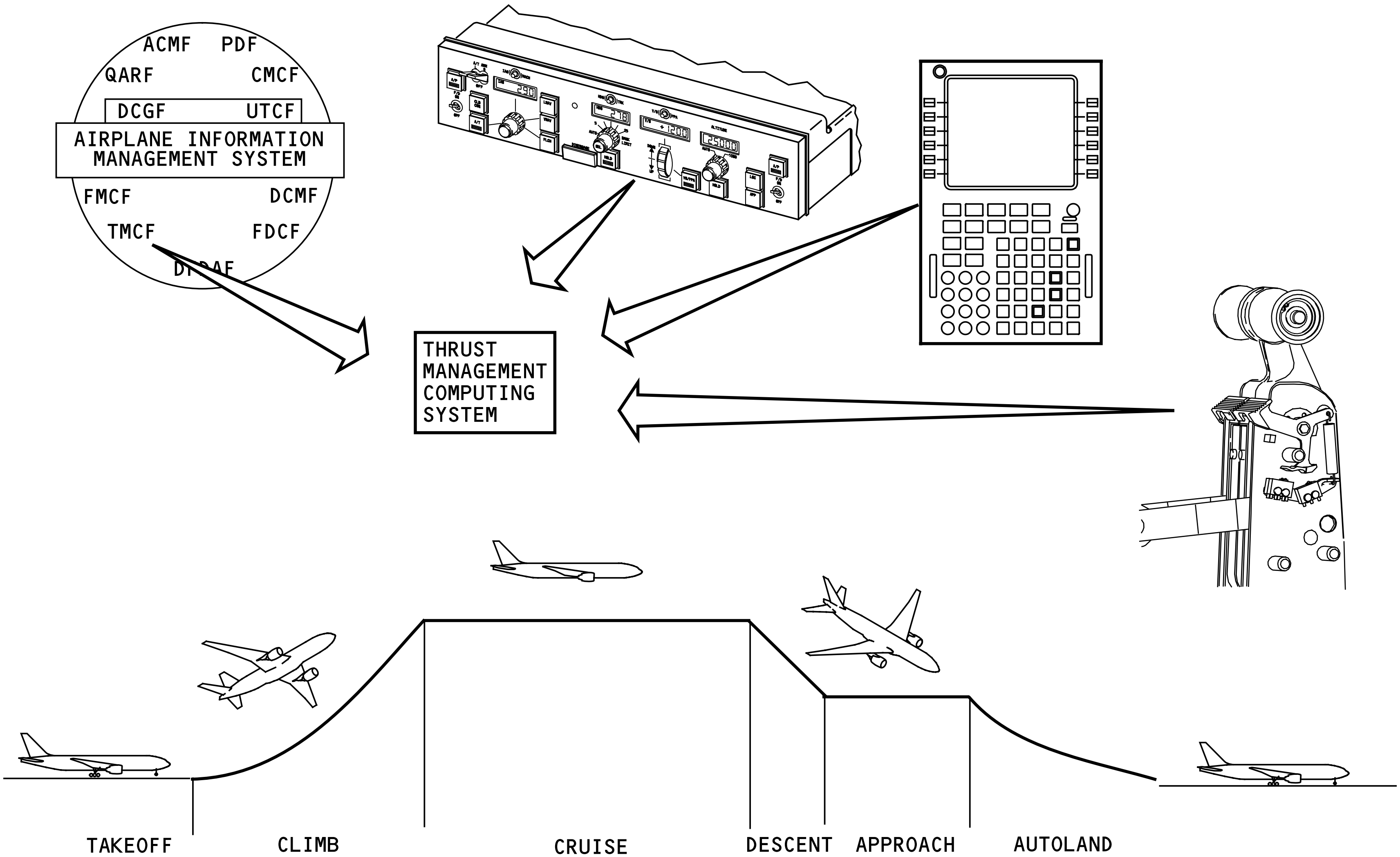
- Mode control panel (MCP)
- Flight management computing function (FMCF)
- Flight deck switches.

The TMCS operates in most flight phases.

Abbreviations and Acronyms

A/P	- autopilot
A/T	- autothrottle
ACMF	- airplane condition monitoring function
ADIRU	- air data inertial reference unit
AFDC	- autopilot flight director computer
AFDS	- autopilot flight director system
AGL	- above ground level
AIMS	- airplane information management system
alt	- altitude
app	- approach
ASCPC	- air supply cabin pressure controller
ASG	- ARINC signal gateway
ASIC	- application specific integrated circuit
ASM	- autothrottle servo motor
BARO	- barometric altitude
clb	- climb
CMCF	- central maintenance computing function
cmd	- command
con	- continuous
CPM	- core processor module
CTC	- cabin temperature controller
D	- derate
des	- descent
DFDAF	- digital flight data acquisition function
disc	- disconnect
DCGF	- data conversion gateway function
DCMF	- data communication management function
ECM	- electronic control module
EEC	- electronic engine control
EDIU	- engine data interface unit
FD	- fire detection
FDCF	- flight deck communication function
F/D	- flight director
FLCH	- flight level change
flt	- flight
FMCF	- flight management computing function
FMCS	- flight management computing system
FPM	- feet per minute
FPS	- feet per second
FSEU	- flap slat electronics unit
G/A	- go around
GG	- graphics generator
GS	- ground speed
GW	- gross weight
IAS	- indicated airspeed

IC	- intercabinet
IOM	- input/output module
KTS	- knots (nautical miles per hour)
L	- left
MAT	- maintenance access terminal
MCP	- mode control panel
Mmo	- maximum operating mach
N1	- low speed compressor RPM
N2	- high speed compresor RPM
OPAS	- overhead panel ARINC system
OPBC	- overhead panel bus controller
OPC	- operational program configuration
OPS	- operational program software
PDF	- primary display function
PFC	- primary flight computer
PTH	- path
PSEU	- proximity sensor electronics unit
PSB	- power switching bridge
PSM	- power switching module
PSU	- power switching unit
PSU	- power supply unit
pwr	- power
QARF	- quick access recorder function
ref	- reference
rqst	- request
R	- right
RA	- radio altimeter
RT	- receiver-transmitter
SAARU	- secondary attitude air data reference unit
SO	- shutoff
SPD	- speed
tach	- tachometer
TAS	- true airspeed
TAT	- total air temperature
T/D	- top of descent
TMCF	- thrust management computing function
thr	- thrust
thr ref	- thrust reference
TLC	- thrust limit calculation
TLDB	- thrust limit data base
TO	- takeoff
TO/GA	- takeoff/go-around
UTCF	- universal time (coordinated) function
Vmo	- maximum operating velocity
VNAV	- vertical navigation
WES	- warning electronic system
WEU	- warning electronic unit



THRUST MANAGEMENT COMPUTING SYSTEM (TMCS) - INTRODUCTION

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TMCS - GENERAL DESCRIPTION

General

The operator interface to the TMCS is through the control display units (CDUs) and the mode control panel (MCP). Several airplane systems and components send and receive TMCS information. TMCS information shows on the primary flight display (PFD) and the EICAS display.

TMCS Components

The TMCS has these components:

- TMCF in AIMS cabinets
- Autothrottle servo motors (ASMs)
- A/T disconnect switches
- Takeoff go-around (TO/GA) switches
- A/T arm and mode switches on the MCP.

There are two TMCFs, one in each AIMS cabinet. Each TMCF receives digital and digital discrete data from airframe and engine components. The TMCF also receives flight deck commands (A/T mode requests) and switch position inputs.

The TMCS does these sub-functions:

- Autothrottle (A/T) control laws
- Thrust limit calculation
- Engine trim calculation
- BITE and fault monitoring
- TMCS annunciations.

The ASMs receive digital commands from the TMCF and analog data from the MCP.

The A/T disconnect and TO/GA switches on the center aisle control stand supply disconnect, TO or GA inputs to the TMCF.

The MCP A/T arm and mode switches send digital control and mode data to the TMCF.

The A/T arm switches on the MCP supply analog arm or inhibit signals to the ASMs. They also supply engine trim enable logic to the engine electronic controllers (EECs).

TMCS Interfaces

The TMCF receives data on the flight controls ARINC 629 data buses from these components:

- Autopilot flight director computer (AFDC) (3)
- Air data inertial reference unit (ADIRU)
- Secondary attitude air data reference unit (SAARU)
- Primary flight computer (PFC) (3).

The TMCF receives data on the systems ARINC 629 data buses from these components:

- Air supply cabin pressure controller (ASCPC) (2)
- Cabin temperature controller (CTC) (2)
- Proximity switch electronic units (PSEU) (2)
- Warning electronic units (WEU) (2)
- Engine data interface units (EDIU) (2)

TMCS - GENERAL DESCRIPTION

- Overhead panel bus controller (OPBC) (2)
- Flap slat electronic unit (FSEU) (2)
- ARINC signal gateway (ASG) (2)
- CDU (3).

The TMCF receives ARINC 429 data from these:

- Mode control panel (MCP)
- Radio altimeter (RA) transceiver (xcvr) (3)
- Autothrottle servo motor (ASM) (2).

The TMCF receives analog inputs from these:

- Engine RPM, N1/N2
- Fuel shutoff switch (2)
- Master caution and warning light switch.

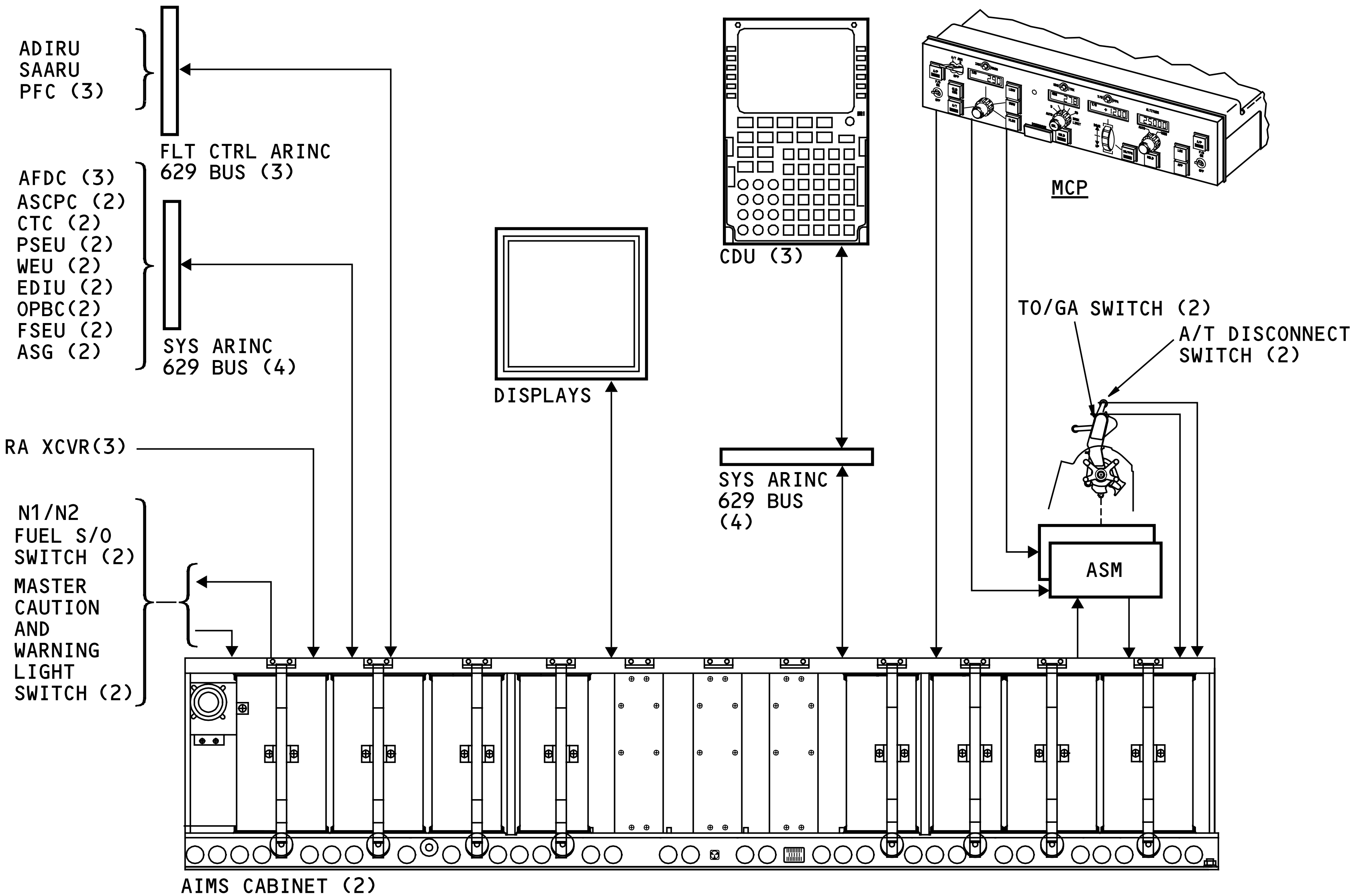
The TMCF also receives analog inputs from these:

- Autothrottle (A/T) disconnect switch (2)
- Takeoff go-around (TO/GA) switch (2)
- Autothrottle servo motor (ASM) (2).

The TMCF sends data to these components and switches:

- WEU (2)
- EDIU (2)
- AFDC (3)
- Primary flight computers (PFC) (3)
- Master caution and warning light switch (2)
- ASM (2).

The TMCF sends display and fault data to the primary display function and the central maintenance computing function in the AIMS cabinets.



TMCS - GENERAL DESCRIPTION

TMCS - FLIGHT DECK COMPONENT LOCATIONS

TMCS Component Locations - P55

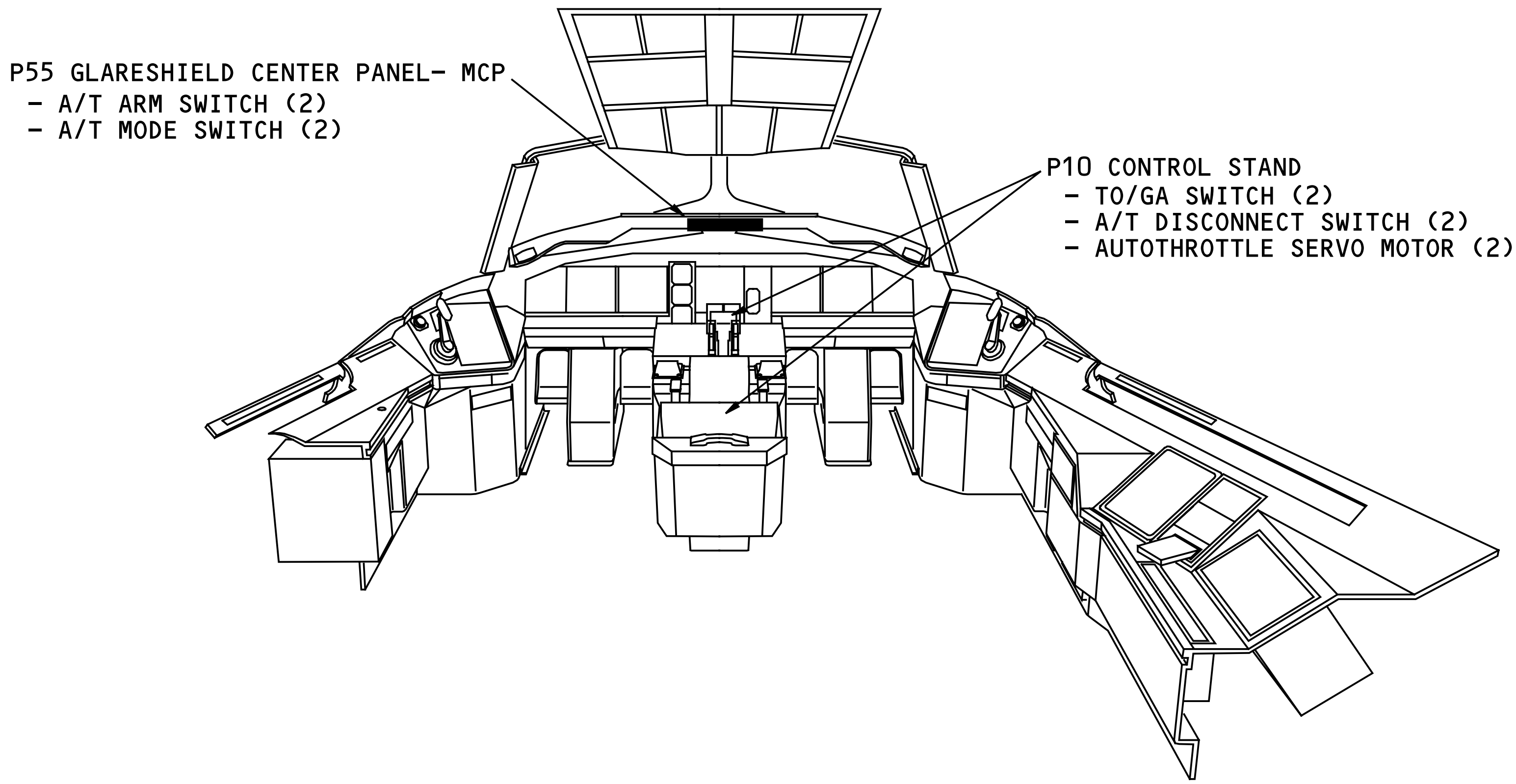
These are the components of the TMCS on the P55 glareshield center panel:

- Autothrottle (A/T) mode switch (2) on mode control panel (MCP)
- A/T arm switch (2) on MCP.

TMCS Component Locations - P10

These are the components of the TMCS on the thrust levers and below the control stand:

- Takeoff go-around (TO/GA) switch (2)
- A/T disconnect switch (2)
- A/T servo motor (ASM) (2), one on each side below the control stand.



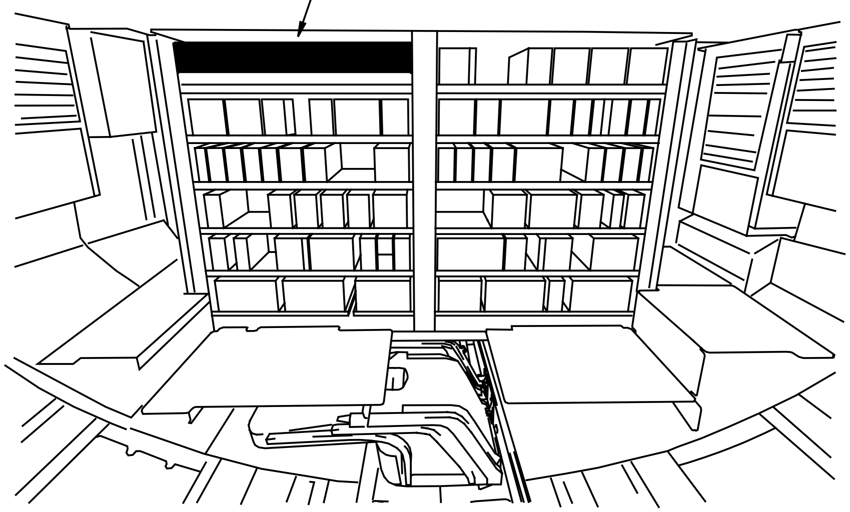
22-31-00-003 Rev 1 09/22/1997

TMCS - FLIGHT DECK COMPONENT LOCATIONS

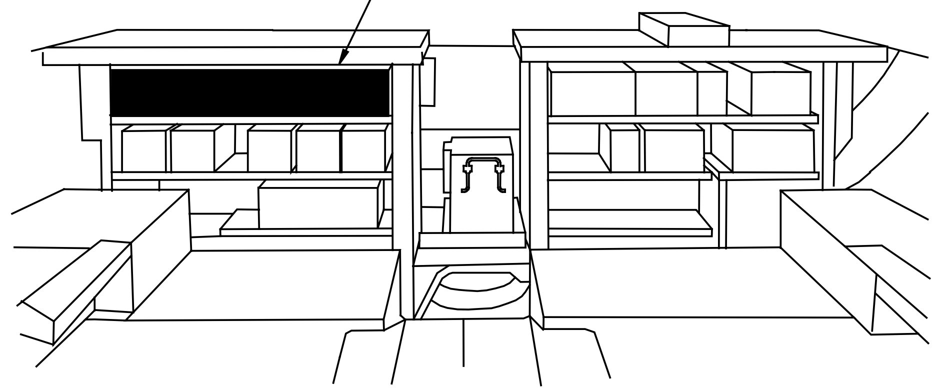
TMCS - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

TMCS Component Locations - MEC

The thrust management computing function (TMCF) is part of the airplane information management system (AIMS). The left AIMS cabinet is on the E3-1 shelf. The right AIMS cabinet is on the E2-1 shelf.



MAIN EQUIPMENT CENTER
(LOOKING AFT)



MAIN EQUIPMENT CENTER
(LOOKING FORWARD)

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TMCS - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

TMCS - INTERFACES - 1

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TMCS - INTERFACES - 1

General

The left and right AIMS cabinets receive inputs from and send outputs to many components, sensors, and switches for the thrust management computing function (TMCF). These interfaces are on the flight controls ARINC 629 data buses, the systems ARINC 629 data buses or analog discrete signals.

The IOMs show the inputs that come directly from TMCF components.

ADIRU Inputs - Flight Control Bus (L & R)

The air data inertial reference unit (ADIRU) sends these parameters and status to the TMCFs:

- Air data
- Temperature
- Ground speed (G/S).

The TMCFs use this data to calculate the A/T modes and thrust limits.

SAARU Inputs - Flight Control Bus (C)

The secondary attitude air data reference unit (SAARU) sends these backup parameters to the TMCFs:

- Air data
- Temperature
- Ground speed (G/S).

The TMCFs use this data to calculate the A/T modes and thrust limits.

PFC Outputs - Flight Control Bus (L, R, & C)

The PFCs receive this data from the TMCFs:

- Left engine idle discrete
- Right engine idle discrete
- Left engine fail
- Right engine fail
- Speed mode
- Go around mode (GA).

AFDC Inputs - Systems Bus (L, R, & C1)

The AFDCs send a flare retard command to the TMCFs when the airplane is in the final land (autoland) configuration. This causes the TMCF to command the throttles to idle at a set A/T rate. The TMCFs also receive AFDCs status.

The AFDCs also send voted TO/GA to the TMCFs. The AFDCs receive a discrete signal from the TO/GA switch. The AFDCs send a digital voted TO/GA signal to the TMCF. The TMCF uses the voted TO/GA signal to engage take off or go-around modes.

AFDC Outputs - Systems Bus (L, R, & C1)

The TMCF sends this data to the AFDCs:

- A/T engage

TMCS - INTERFACES - 1

- Command altitude rate
- Engine fail and operating discretes
- A/T mode discretes.

CDU Inputs - Systems Bus (L & R)

The CDU sends thrust limit mode and derated thrust limit data and status to the TMCFs.

ASCPC Inputs - Systems Bus (L & R)

The air supply cabin pressure controllers (ASCPCs) sends engine bleed data to the TMCFs to calculate the lower thrust operating limit.

CTC Inputs - Systems Bus (L & R)

The cabin temperature controllers (CTCs) send cabin bleed data to the TMCFs to determine the lower thrust operating limit.

PSEU Inputs - Systems Bus (L & R)

The proximity switch electronic units (PSEUs) send air/ground logic to the TMCFs. The in air logic enables A/T mode operation and inhibits takeoff (TO) mode engage in the air. The on ground logic enables TO mode engage and inhibits all other A/T modes of operation.

WEU Inputs - Systems Bus (L, R, & C1)

The TMCFs receive maximum and minimum speed from the warning electronic units (WEUs).

WEU Outputs - Systems Bus (L, R, & C1)

The TMCFs sends an A/T disengage discrete to the (WEUs) for an automatic or manual A/T disengage. This signal causes the WEUs to sound the caution aural, a four-beep tone in the flight deck speakers. The TMCFs also send engine fail and takeoff thrust limit data to the WEUs.

EDIU Inputs - Systems Bus (L, R, C1, & C2)

The engine data interface units (EDIUs) send engine parameters to help the TMCFs calculate the A/T servo motor commands. The TMCFs also receive status from the EDIUs.

EDIU Outputs - Systems Bus (L, R, C1, & C2)

The TMCFs send this data to the EDIUs:

- Thrust data N1 and N2
- Engine trim commands
- Bleed data (configuration codes).

OPBC Inputs - Systems Bus (L & R)

The overhead panel bus controllers (OPBCs) send this data to the TMCFs:

- FMC selector switch position
- Left and right engine fire handle position
- L/R engine anti-ice switch position
- Wing anti-ice switch position
- L/R engine alternate mode.

TMCS - INTERFACES - 1

FSEU Inputs - Systems Bus (L, R, & C1)

The flap slat electronics units (FSEUs) send flap angle data to the TMCFs.

ASG Inputs - Systems Bus (L & R)

The ASG sends this data to the TMCFs:

- Left and right cowl anti-ice valve position
- Left and right engine anti-ice valve position.

RA RT Inputs - ARINC 429

The radio altimeter (RA) receiver transmitters (RTs) send radio altitude and status to the TMCFs in the AIMS cabinets. This provides A/T flare retard engage or inhibit logic just before touchdown.

Engine RPM (N1 & N2) Analog Inputs

The left and right engine RPM sensors send low (N1) and high (N2) engine RPM to the TMCFs.

Fuel Shutoff (SO) Switches Analog Discrete Inputs

The TMCFs receive the left and right fuel SO switch position as analog discretes. This helps the TMCFs determine engine status along with other inputs.

Master Caution Light Analog Discrete Inputs

The master caution and warning light switch supplies an analog discrete to the TMCFs to reset the caution lights. Push a master caution and warning switch light to reset the A/T disconnect function.

Master Caution Analog Discrete Outputs

The TMCFs send an analog discrete to the master caution and warning light switches. This causes the caution light to come on. This occurs when a manual or an automatic A/T disengage occurs.

A/T Disconnect Switch Analog Discrete Inputs

The autothrottle (A/T) disconnect switch supplies a manual A/T disengage analog discrete to the TMCFs to disengage both A/T servo motors. A second push causes the TMCF to reset both the A/T function and the AUTOTHROTTLE DISC caution message on the EICAS display.

TO/GA Switch Analog Discrete Inputs

The takeoff/go around (TO/GA) switch supplies a TO/GA analog discrete to the TMCFs to start the A/T mode. The TO/GA switch supplies logic to the AFDS for the TO/GA mode. The TO/GA switch analog discrete input is a backup to the voted TO/GA input from the AFDCs. On the ground, the thrust limit mode is TO for the TMCS. In the air the thrust limit mode is GA for the TMCS.

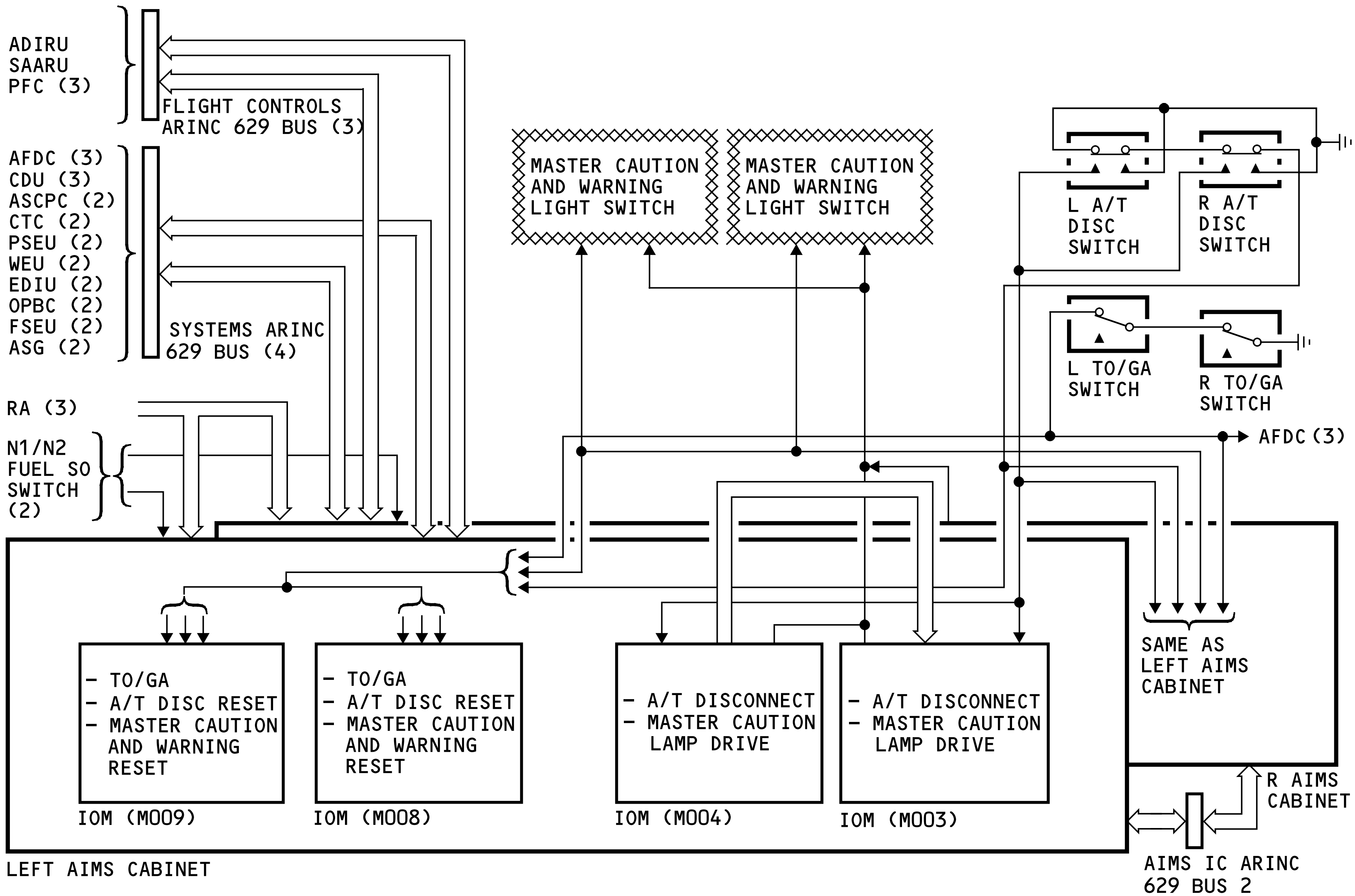
TMCS - INTERFACES - 1

AIMS Intercabinet Bus (ICB) Interfaces

The left and right TMCFs use the ICB to share and compare data.

The left TMCF and right TMCF calculate the same A/T commands. Only one TMCF is active. They compare data bases, input data, sensor status, and BITE results. The active TMCF sends synchronization data to the non-active TMCF at these times:

- When they do not agree
- During power interrupts
- At power up.



TMCS - INTERFACES - 1

22-31-00-005 Rev 6 02/18/1998

TMCS - INTERFACES - 2

General

The active TMCF automatically sets the throttle levers in response to crew or system inputs.

Each autothrottle servo motor (ASM) needs power inputs and control signals from the AIMS cabinets and the mode control panel (MCP).

Power Interface

The P11 overhead circuit breaker panel supplies 28V dc to the left and right ASM for operation. On/off control comes from the mode control panel (MCP). The A/T ARM switches control 28V dc to the ASMs for servo motor operation.

MCP Digital and Analog Discrete Interfaces

The MCP sends this digital discrete data to the TMCFs:

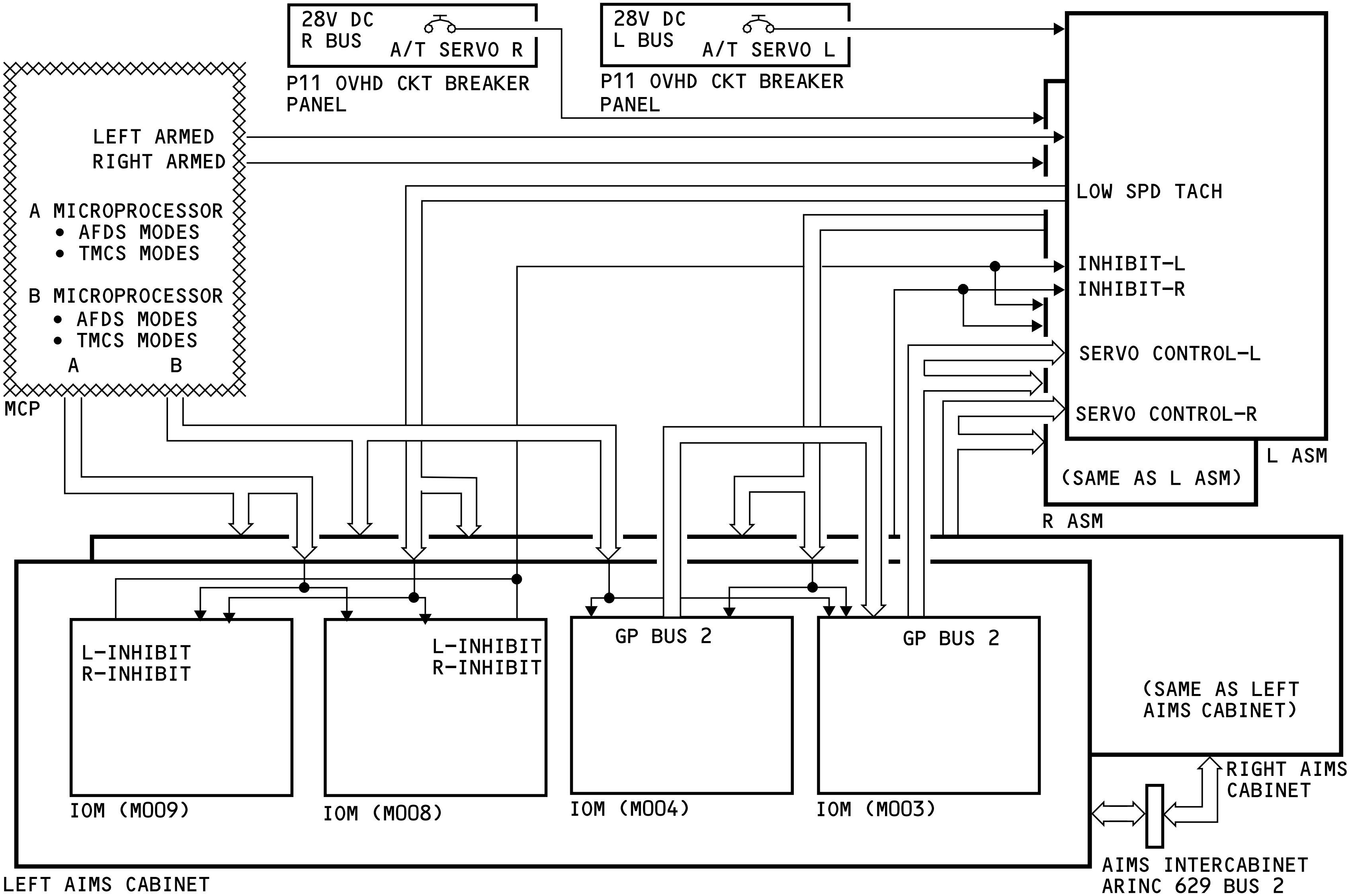
- A/T arm (on/off) - the engine trim function engages when both A/T arm switches are on. Also, single (L or R) or dual (both) autothrottle operation occurs when the appropriate arm switch is in the ARM position
- A/T mode
- AFDS mode
- Parameters for A/T mode logic
- MCP status.

The MCP sends this analog discrete data to the ASMs:

- A/T arm (ON) switch supplies ASM control power in the on position
- A/T arm (OFF) switch removes power (positive disengage) from its ASM in the off position.

ASM Digital Interface

The active TMCF causes the throttles to move forward or aft when it sends the ASMs digital commands. The ASM operation stops with the inhibit input. The A/T servo motors send digital throttle position (low speed tachometer) feedback data to the TMCFs when the servomotor moves. The autothrottle servo motors also send status information to the TMCFs.



22-31-00-006 Rev 3

TMCS - INTERFACES - 2

TMCS - A/T SERVO MOTOR

General

The integrated autothrottle servo motors (ASMs) are below the throttle quadrant (P10). The active TMCF sends servo rate commands to each ASM to move its throttle forward or aft through a separate gear box assembly.

Physical Description

The ASM weighs 1.9 pounds and measures 4.5 inches by 3.26 inches by 4 inches. The electrical power interface is from the bottom of the ASM.

Operation

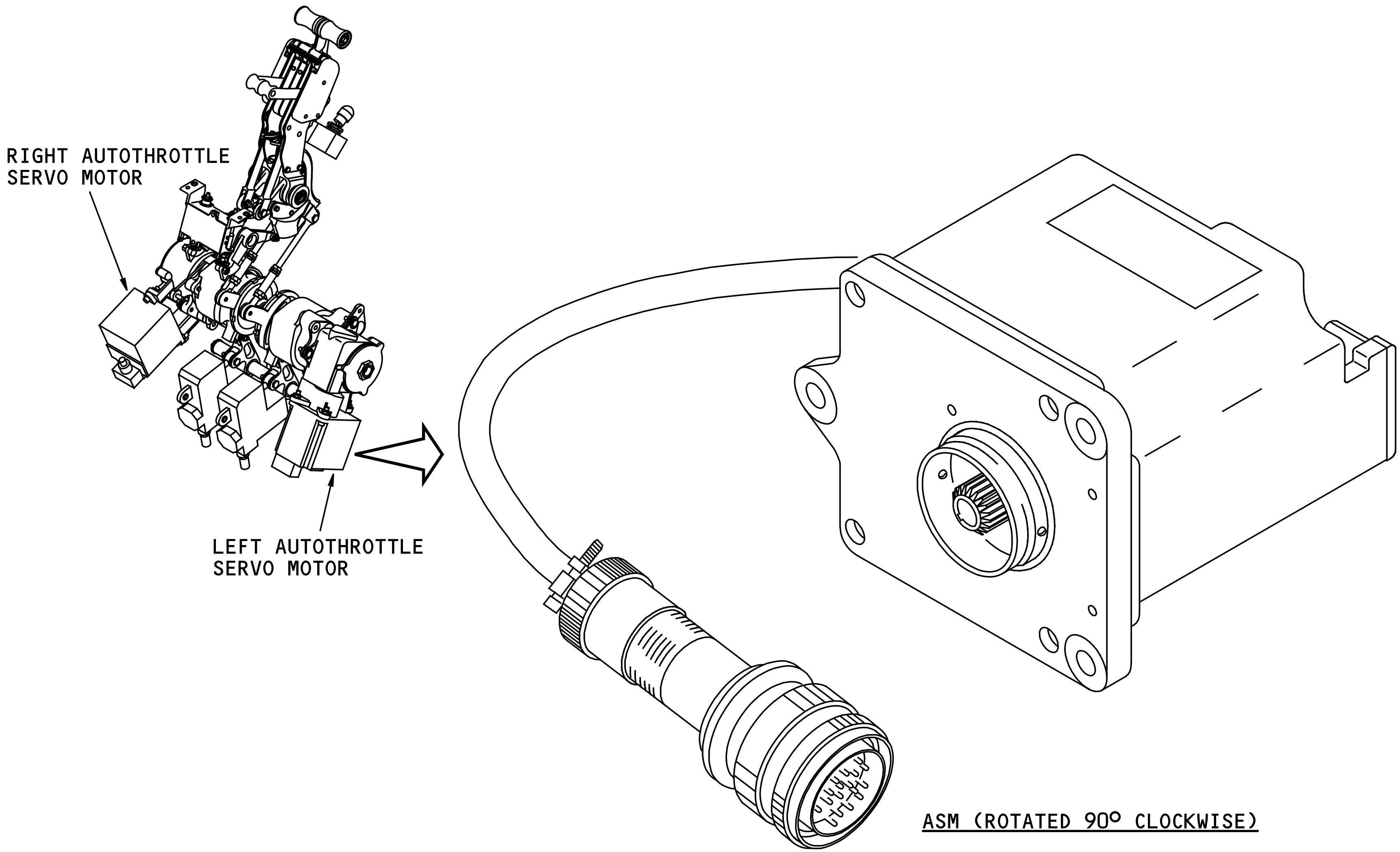
Each ASM consists of these:

- Electronic control module (ECM)
- Power supply unit (PSU)
- Power switching module (PSM)
- Power switching bridge (PSB)
- DC motor with magnetic sensors.

Power to the ASM is 28V dc for excitation and motor control. The ASM pulse modulates and amplifies the digital servo rate commands it receives from the TMCF.

Each ASM receives analog (A/T arm and inhibit L/R) and digital (FMC selector position) discretes to enable its operation. Each ASM sends the TMCF a digital discrete of its state and digital rate feedback.

There are three magnetic pick-off sensors in the DC motor stator that measure rate feedback. These sensors measure the rate between the rotor and stator as the motor moves the throttle forward or aft.



22-31-00-007 Rev 2

TMCS - A/T SERVO MOTOR

TMCS - A/T ARM, A/T MODE AND THROTTLE SWITCHES

General

You use switches on the mode control panel (MCP) and on the thrust levers to arm, select, or disconnect A/T modes.

MCP A/T Arm Switch

The A/T arm switches are on the MCP. You use the A/T arm switches to enable ASM excitation power (28V dc) for operation. The on position (both) also supplies engine trim equalization control from the TMCFs. The off position removes power from that ASM and removes engine trim equalization control.

MCP A/T Mode Switches

The MCP has these A/T mode switches with these functions:

- Climb/continuous (CLB/CON), selects the CLB thrust limit mode in the air or CON thrust limit mode in the air when one engine fails
- A/T, selects the A/T speed (SPD) mode or the thrust reference (THR REF) mode when in the air
- Flight level change (FLCH), gives a thrust command that changes with a small or large altitude change
- Vertical navigation (VNAV), allows the throttles to operate with the autopilot flight director system (AFDS) to control thrust or speed.

To arm the autothrottle, move one or both of the A/T arm switches to the UP position. To engage the A/T, push the A/T switch on the MCP. The autothrottle engages automatically if any of these modes engage:

- VNAV
- FLCH
- TO/GA.

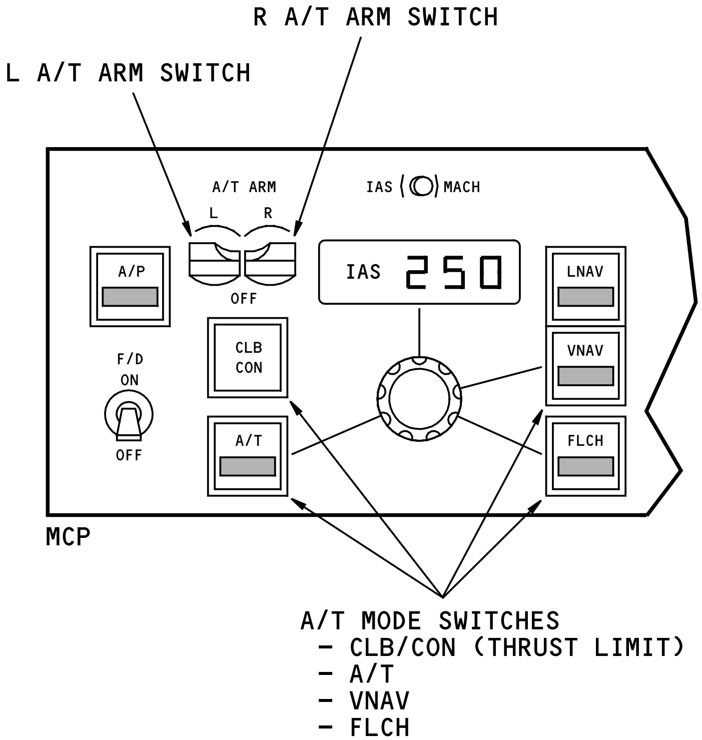
Thrust Lever Switches

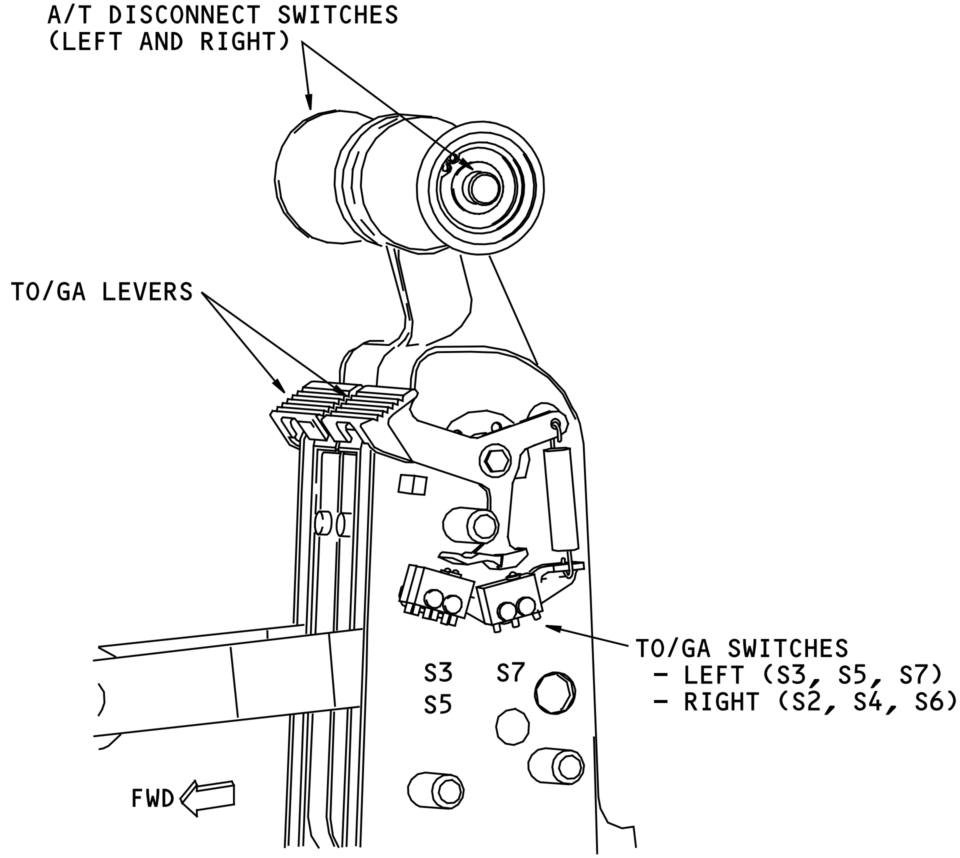
These switches are on the left and right thrust levers:

- Takeoff/go-around (TO/GA), S3, S5 and S7 (left) and S2, S4, and S6 (right)
- A/T disconnect.

Push a TO/GA lever to engage that TO/GA switch. This causes the selected takeoff (TO) thrust mode to operate on the ground. In the air, with a TO/GA request in approach, the go-around (GA) thrust mode operates with less than maximum GA thrust. Push the TO/GA switch twice to move the throttles to the full GA thrust limit when in the air.

An A/T disconnect switch is on the left and right thrust lever. Push an A/T disconnect switch to disconnect the A/T and show the AUTHROTTLE DISC caution message on the EICAS display. To reset the AUTHROTTLE DISC caution message, push the A/T disconnect switch again.





THRUST LEVERS

22-31-00-008 Rev 4 05/14/1997

TMCS - A/T ARM, A/T MODE AND THROTTLE SWITCHES

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TMCS - PRIMARY FLIGHT DISPLAY - OPERATION

General

The autothrottle (A/T) modes show on the primary flight display (PFD) when an A/T mode engages.

A/T Modes

Normal A/T mode annunciation and operation is with both the left and right A/T servo motors (ASM) in operation. A left (L) or right (R) precedes the A/T mode annunciation when only one ASM operates.

These are the A/T modes that show on the PFD:

- Speed (SPD/X SPD)
- Thrust (THR/X THR)
- Thrust reference (THR REF/X THR REF)
- HOLD/X HOLD
- IDLE/X IDLE
- TEST/X TEST.

SPD or X SPD shows when:

- A/T engage conditions are valid and vertical navigation (VNAV) commands the throttles to hold SPD
- VNAV or flight level change (FLCH) mode transitions to another pitch mode, such as vertical speed, altitude hold, capture, or glideslope capture
- The A/T mode on the mode control panel (MCP) is active, the airplane is in the air and the autopilot flight director system (AFDS) is not in a speed mode.

THR or X THR shows when the TMCF receives an A/T mode request and goes into one of these modes:

- VNAV descent
- FLCH
- Go-around (GA) thrust mode.

THR REF or X THR REF shows when the TMCF receives a takeoff (TO) A/T request from the left or right TO/GA switch and the TMCF commands the throttles to full TO thrust. THR REF shows for VNAV CLB or a GA thrust mode.

HOLD or X HOLD shows when the TMCF removes excitation power from the ASMs. HOLD shows in these A/T modes:

- FLCH idle descent (pilot override)
- TO thrust mode when computed air speed (CAS) is more than 80 KTs
- VNAV idle descent.

IDLE or X IDLE show for these A/T modes:

- VNAV descent
- A flare retard idle command from the AFDS.

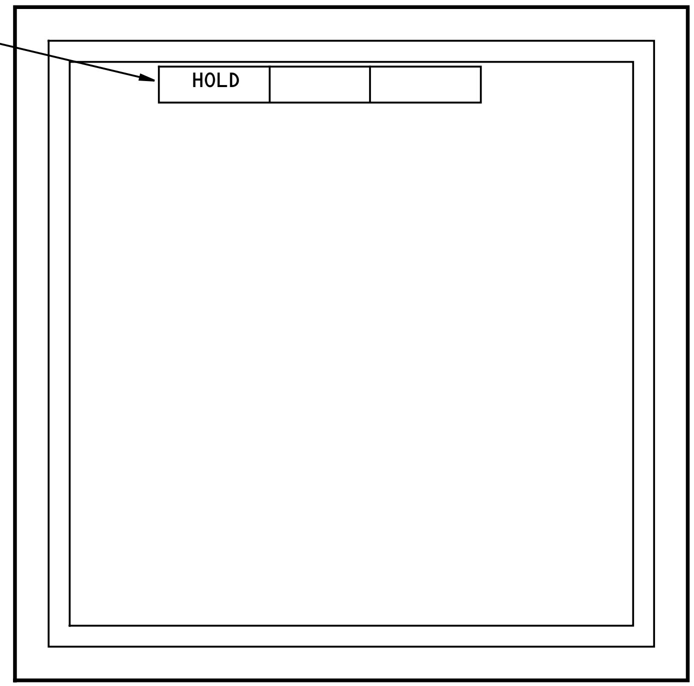
TEST or X TEST shows when a TMCS ground test is active.

The A/T mode annunciation is blank with one of these:

TMCS - PRIMARY FLIGHT DISPLAY - OPERATION

- No A/T mode requests
- The left and right TMCS invalid.

AUTOTHROTTLE MODES:
- THR REF
- HOLD
- THR
- SPD
- IDLE
- TEST
- [1] - X THR REF
- X HOLD
- X THR
- X SPD
- X IDLE
- X TEST
- (BLANK)



PRIMARY FLIGHT DISPLAY

[1] X - LEFT OR RIGHT

22-31-00-009 Rev 1 05/14/1997

TMCS - PRIMARY FLIGHT DISPLAY - OPERATION

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TMCS - EICAS DISPLAY - OPERATION

General

The EICAS display shows this TMCF data that relates to engine/thrust performance:

- Thrust limit mode
- Selected temperature
- Thrust limit
- Target N1
- Maximum thrust limit.

Thrust limit Mode

The takeoff (TO) thrust limit mode shows automatically on the ground at power up. Other thrust limit modes show in the automatically or with a manual selection on the CDU THRUST LIMIT page when in flight. It also shows automatically when in flight and VNAV (vertical navigation) engages.

These are the two ways to derate the engine thrust:

- Enter an assumed temperature
- Select CLB 1 or CLB 2.

A temperature derate occurs with a temperature entry on the CDU THRUST LIMIT page. The TMCF uses this value when it is more than the present temperature in use for TO thrust calculation. D shows in front of the TO thrust limit for a temperature derated thrust.

There are two climb derates, CLB 1 and CLB 2. Climb derates are available on the CDU THRUST LIMIT page. CLB 1 derate level is 10% and CLB 2 derate level is 20% of the climb thrust.

Selected Temperature

The TMCF uses temperature (selected) inputs from the CDU THRUST LIMIT page when the input is more than the TAT. The TMCF uses the selected temperature input to calculate temperature derated thrust limits.

Thrust Limit

The TMCF calculates the thrust limit with inputs from the FMCF and other sensors and components. The digital readout shows on the EICAS display.

Maximum Thrust limit

The TMCF calculates the maximum thrust limit. The engine electronic control (EEC) is secondary for maximum thrust limit calculation.

Target N1

The target thrust cursor shows in green when it shows the N1 limit calculated by the TMCF for the active thrust limit mode. The target thrust cursor shows in green for all autothrottle modes other than THR or THR REF when VNAV is engaged.

The target thrust cursor shows in magenta when the TMCF uses a target N1 that the FMCF calculates. The target

TMCS - EICAS DISPLAY - OPERATION

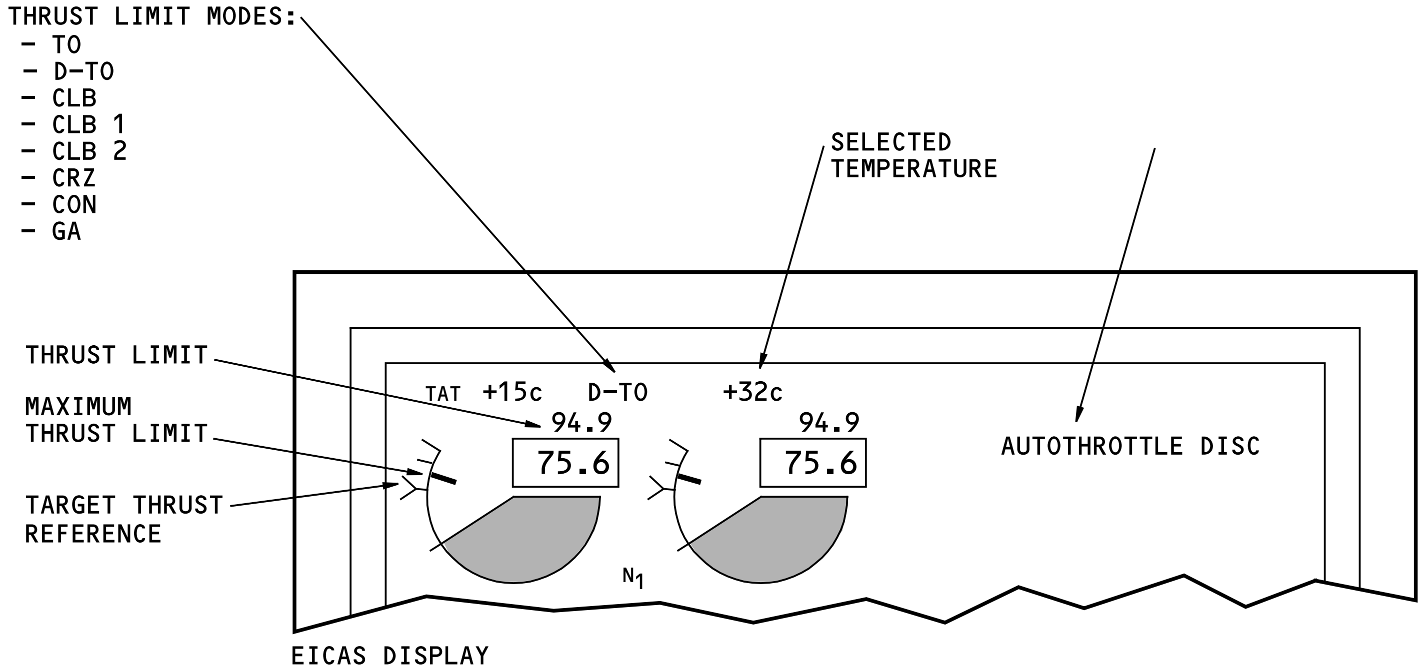
thrust cursor shows in magenta during any of these condtions:

- VNAV is engaged and the autothrottle mode is THR REF. This occurs when VNAV is engaged during climb.
- VNAV is engaged and the autothrottle mode is THR. This occurs when VNAV is engaged during descent and anti-ice is on.
- VNAV is engaged and the autothrottle is off. The pilots can manually set the thrust levers to agreee with the target N1 that shows on EICAS.

Fault Messages

TMCS fault messages show on the EICAS display for these conditions:

- AUTOTHROTTLE DISC, caution occurs when the TMCS detects an automatic or manual disengagement
- AUTOTHROTTLE L and/or AUTOTHROTTLE R, advisory occurs when the TMCS detects an ASM or arm switch failure.



22-31-00-010 Rev 5 10/29/1997

TMCS - EICAS DISPLAY - OPERATION

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TMCS - AUTOTHROTTLE FLIGHT PROFILE

General

During normal flight operations, the flight crew uses the TMCF to perform several routine or normal operations and tasks. These operations or tasks relate to autothrottle modes.

The autothrottle (A/T) modes operate in these flight phases:

- Takeoff (TO)
- Climb (CLB)
- Cruise (CRZ)
- Descent (DES)
- Approach (APP)
- Go-around (GA).

A/T functions that relate to flight phases are flare retard during autoland and A/T disconnect.

A/T thrust mode annunciations relate to pitch mode annunciations on the PFD. Use the MCP to select these modes.

Takeoff

In TO, the A/T controls thrust to the takeoff thrust limit. The A/T mode annunciation on the PFD is thrust reference (THR REF). At 80 knots (KTS) air speed, the A/T mode annunciation changes to HOLD on the PFD.

Climb

These are the three autothrottle mode selections in climb:

- Vertical navigation (VNAV)
- Flight level change (FLCH)
- A/T (MCP) speed mode or thrust mode.

The A/T mode annunciations for these modes are:

- THR REF when VNAV engages
- THR when FLCH engages
- SPD or THR REF when A/T mode engages.

The A/T mode only (MCP) engages when VNAV, FLCH, and TO/GA are not active and the airplane is in the air.

Cruise

These are the two A/T modes in cruise:

- VNAV
- A/T mode only.

These are the A/T mode annunciations in cruise:

- SPD when VNAV engages
- SPD, VNAV is not active.

Descent

These are the three A/T modes in descent:

TMCS - AUTOTHROTTLE FLIGHT PROFILE

- VNAV
- FLCH
- A/T mode only.

These are the A/T mode annunciations in descent:

- IDLE, THR, or HOLD shows for VNAV
- THR, or HOLD shows for FLCH
- SPD.

Approach

SPD is normal mode in approach with glideslope active or in a manual approach.

Go-Around

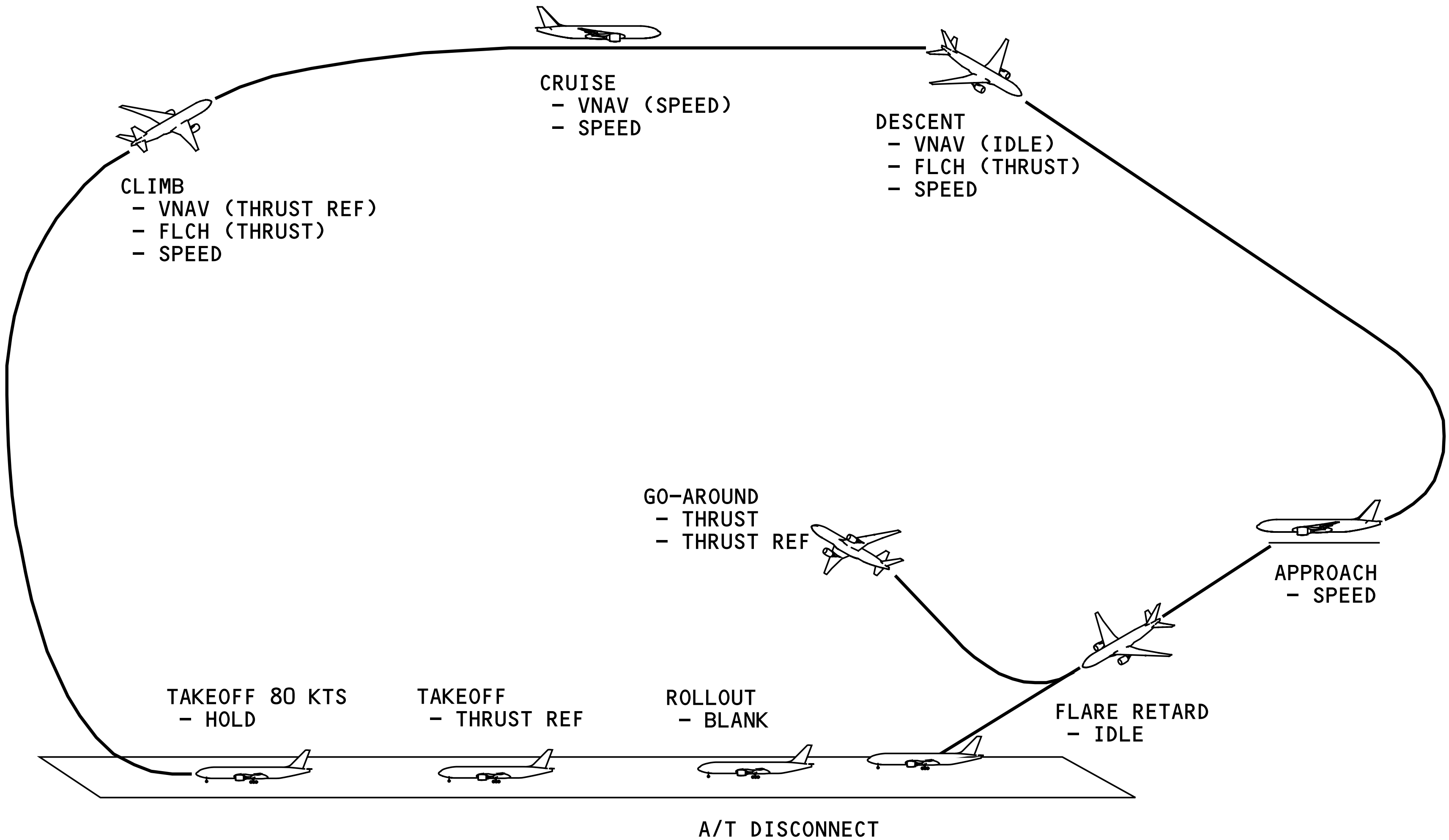
A GA mode request causes the A/T mode to change to THR. A second GA request causes the A/T mode to change to THR REF. You push a TO/GA lever to request GA.

Flare Retard

Flare retard occurs at 25 feet radio altitude during approach with a command from the autopilot flight director system (AFDS). The A/T mode changes to IDLE during a flare retard.

A/T Disconnect

The A/T disconnects with a manual A/T disconnect or with thrust reverser application. This occurs after initial touchdown during rollout.



22-31-00-011 Rev 2 05/14/1997

TMCS - AUTOTHROTTLE FLIGHT PROFILE

TMCS - A/T OPERATION - TAKEOFF

General

To prepare the AFDS and the A/T for the takeoff phase of the flight, use the mode control panel (MCP) to set the necessary parameters. Use the EICAS display and the PFD to see the modes and mode changes.

Before the A/T mode can engage, the system must pass servo motor tests to ensure proper operation.

Mode Selection

The takeoff (TO) mode engages with these conditions:

- Autothrottle (A/T) arm switches on
- Airplane on the ground
- Flap position not zero
- Thrust limit mode takeoff (TO)
- Push a TO/GA lever with less than 50 KTs air speed.

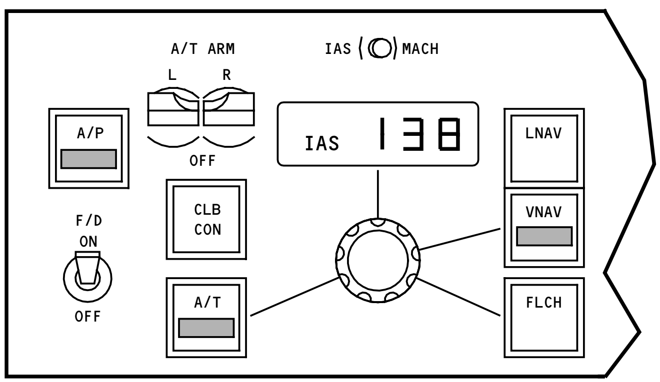
Takeoff Mode Operation

At the start of takeoff, the TMCF does the A/T stopper test. This test does a check for the ability of the TMCF to remove power from the servos.

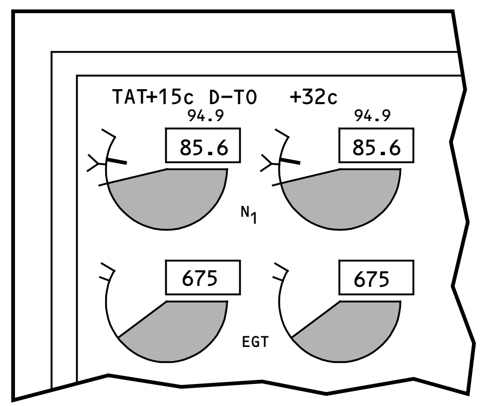
The TMCF sends ASM commands to move the throttles to the TO thrust limit. The throttles move when the TMCF completes and passes the A/T stopper tests. The A/T mode is thrust reference (THR REF) on the PFD. At more than 80 KTs air speed, the A/T mode changes to HOLD.

During normal operation, as the airplane goes above 400 feet AGL, the A/T mode changes to THR REF.

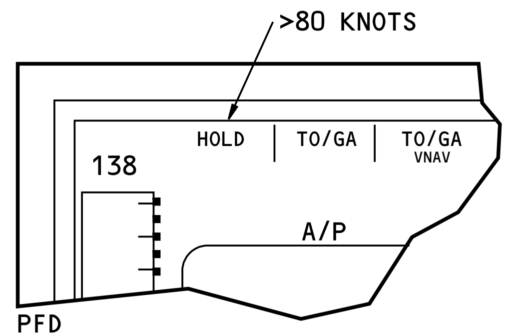
CONDITION:
- ON THE GROUND
- A/T ARMED
- VNAV ARMED
- TO/GA LEVER PUSHED
- < 50 KTS AIR SPEED (A/S)
- THROTTLES AT TO THRUST LIMIT



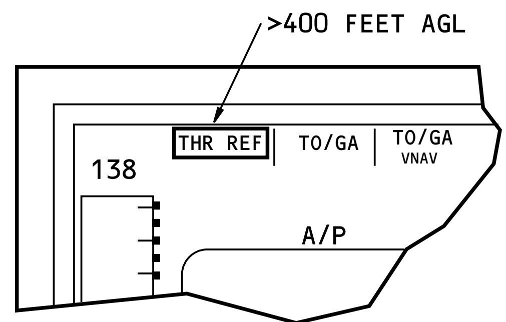
MCP



EICAS DISPLAY



PFD



PFD

MCP:
- VNAV SWITCH LIGHT ON
- A/T SWITCH LIGHT ON
- F/D ACTIVE

EICAS DISPLAY:
- TO THRUST LIMIT
- ENGINES ADVANCE TO TAKEOFF THR LIMIT CURSOR (GREEN)

PFD:
- THE A/T MODE IS THR REF
- 80 KTS (A/S) THE MODE CHANGES TO HOLD
- FLAP SPEED PROTECTION IS AVAILABLE > 400 FEET ABOVE GROUND LEVEL (AGL)

22-31-00-012 Rev 2 05/14/1997

TMCS - A/T OPERATION - TAKEOFF

TMCS - A/T OPERATION - VNAV CLIMB

Mode Selection

The VNAV climb mode engages with these conditions:

- Active route
- Performance page complete
- Vertical navigation (VNAV) armed
- VNAV engages when the airplane is 400 feet above ground level (AGL) barometric (BARO) altitude
- A/T armed
- Flight director or A/P active.

Operation

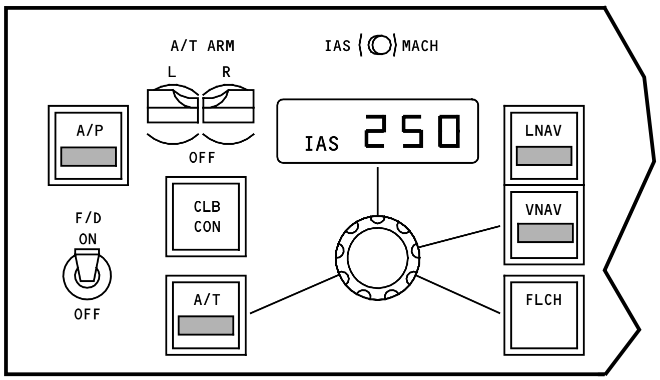
At the thrust reduction altitude, the FMCF sends commands to the TMCF to move the throttles to the climb thrust position. This occurs at or above 400 feet for a flap or an altitude setting. The flap or altitude setting is preset in the airline modifiable information (AMI). Takeoff thrust changes from TO to CLB thrust as the airplane goes through the preset altitude or at a preset flap position. You can change the preset altitude or flap position for a flight on the CDU TAKEOFF REF page 2.

The thrust limit cursor changes from green to magenta on the EICAS display when CLB thrust engages.

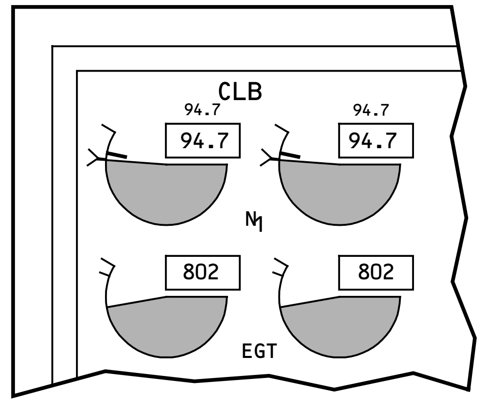
The A/T mode changes from HOLD to THR REF at 400 feet (BARO) when VNAV engages.

The FMCF also sends pitch control commands to the autopilot flight director system (AFDS) to control speed on elevator while in climb.

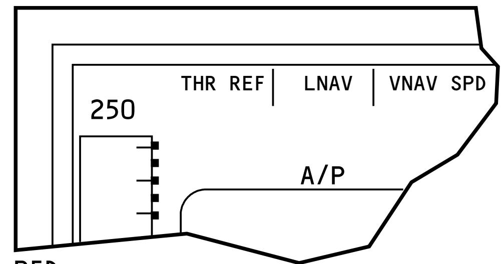
CONDITION:
- IN CLIMB
- > 400 FEET (BARO)
- VNAV ENGAGED



MCP



EICAS DISPLAY



PFD

MCP:
- VNAV ENGAGES > 400 FEET (BARO)
- SPEED WINDOW BLANKS
- F/D ACTIVE

EICAS DISPLAY:
- AT THE THRUST REDUCTION ALTITUDE
  OR
- AT FLAPS 5 OR FLAPS 1
- THE THRUST LIMIT MODE CHANGES FROM TO - CLB AND THE CURSOR CHANGES FROM GREEN TO MAGENTA

PFD:
- A/T MODE IS THR REF

22-31-00-013 Rev 2 05/14/1997

TMCS - A/T OPERATION - VNAV CLIMB

TMCS - A/T OPERATION - VNAV CRUISE

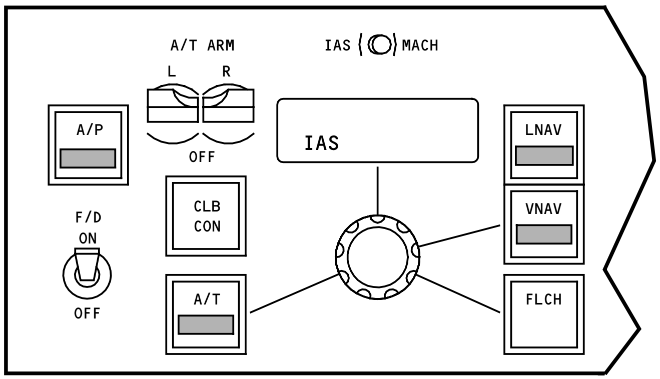
Mode Selection

The VNAV cruise (CRZ) mode engages prior to cruise altitude capture. The change from VNAV CLB to VNAV CRZ is automatic with inputs from the FMCF to the TMCF.

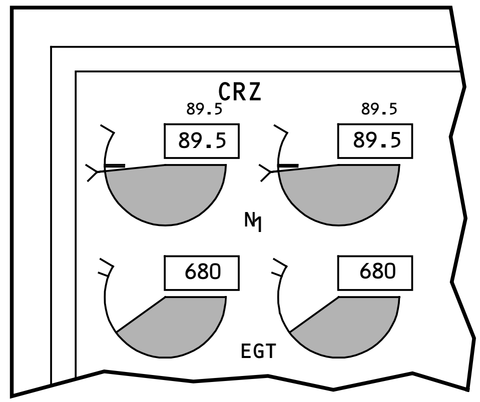
Operation

When the airplane gets to the flight level altitude or MCP altitude, the thrust limit mode changes to CRZ and the A/T mode changes to SPD. The TMCF commands the throttles to move to a speed command with inputs from the FMCF. The magenta thrust limit cursor changes to green on the EICAS display.

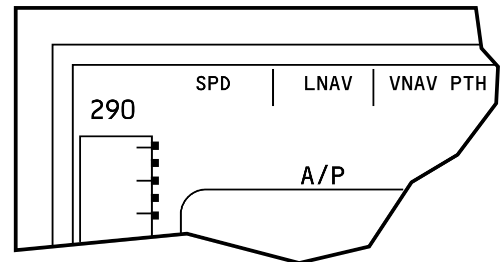
CONDITION:
- AT CRUISE ALTITUDE
- VNAV ENGAGED
- AIRPLANE LEVELS OUT



MCP



EICAS DISPLAY



PFD

MCP:
- NO CHANGES

EICAS DISPLAY:
- THRUST LIMIT MODE GOES TO CRZ
- THRUST CURSOR GOES TO GREEN (MAX CRUISE THR LIMIT)

PFD:
- A/T MODE GOES TO SPD

22-31-00-014 Rev 2 05/14/1997

TMCS - A/T OPERATION - VNAV CRUISE

TMCS - A/T OPERATION - VNAV DESCENT

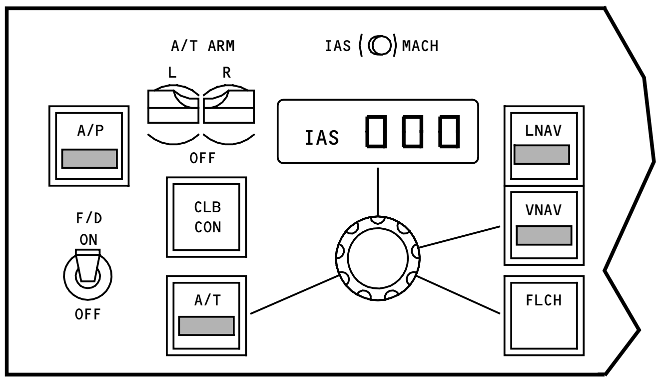
Mode Selection

The VNAV descent (DES) mode engages before the top of descent (T/D). The FMCF causes the A/T to go to the next flight phase, DES. The change from VNAV cruise (CRZ) to VNAV DES is automatic with inputs from the FMCF to the TMCF.

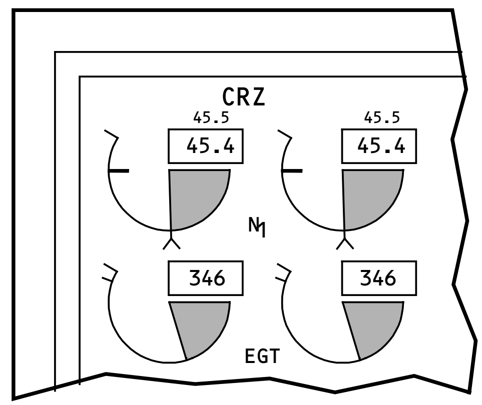
Operation

The TMCF commands the throttles to idle thrust at mode transition. The A/T mode is IDLE or THR in descent. The A/T mode changes to HOLD when a pilot moves the throttles opposite to the throttle command or when the throttles reach the aft mechanical stop.

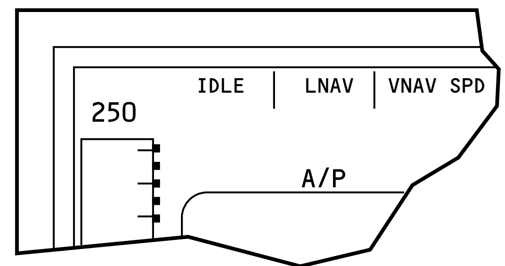
CONDITION:
- AIRPLANE IN DESCENT
- VNAV ENGAGED



MCP



EICAS DISPLAY



PFD

MCP:
- NO CHANGE

EICAS DISPLAY:
- THRUST CURSOR SHOWS CRZ THRUST LIMIT

PFD:
- AT START OF DESCENT, A/T MODE GOES TO IDLE AND THROTTLES MOVE AFT
- AT THE AFT MECHANICAL STOP, THE A/T MODE GOES FROM IDLE TO HOLD

TMCS - A/T OPERATION - VNAV DESCENT

22-31-00-015 Rev 2 05/14/1997

TMCS - A/T OPERATION - FLIGHT LEVEL CHANGE

Mode Selection

The TMCF sends A/T servo motor (ASM) commands to control engine thrust when all these conditions are present:

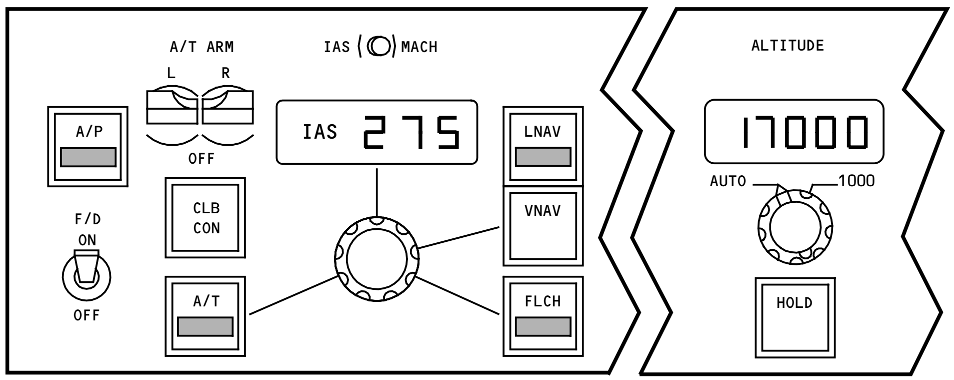
- A/T arm switches are on
- An autopilot (A/P) or flight director (F/D) switch is active
- Flight level change (FLCH) switch is active
- Airplane is in the air.

Operation

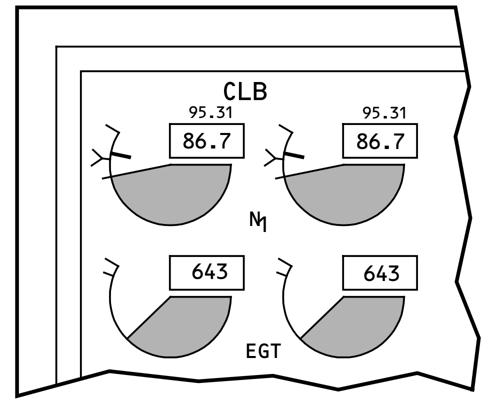
The MCP synchronizes to the current airspeed with a FLCH mode request. The TMCF uses the difference between the present altitude and the MCP altitude to calculate a vertical speed to capture the MCP altitude. The A/T control laws command thrust which produces a vertical speed to complete the altitude change in 125 seconds. The A/T command can not exceed the thrust limit mode.

If an override occurs while in the FLCH mode, the A/T mode goes to HOLD. HOLD shows on the PFD. The thrust limit mode changes to CLB on the engine primary format. An override occurs when throttle position and throttle command differ by more than eight degrees. This may occur when a pilot overrides the throttles. HOLD also shows when the throttle command moves the throttles to the aft mechanical stop and the ASM continues to move.

CONDITION:
- CURRENT ALTITUDE < MCP ALTITUDE
- FLCH ENGAGED



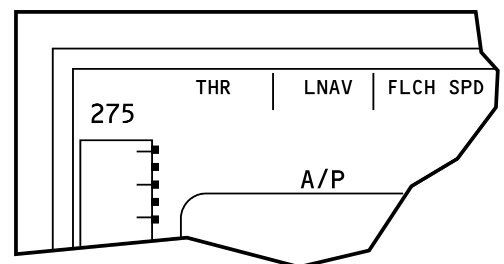
MCP



EICAS DISPLAY

MCP:
- FLCH SWITCH LIGHT IS ON
- F/D ACTIVE

EICAS DISPLAY:
- THRUST LIMIT MODE IS CLB



PFD

PFD:
- A/T MODE GOES TO THR

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TMCS - A/T OPERATION - FLIGHT LEVEL CHANGE

TMCS - A/T OPERATION - SPEED

Mode Selection

The speed (SPD) mode engages when all these conditions are true:

- Autothrottle arm switches on
- Airplane in the air more than 400 feet above ground level (AGL) BARO altitude
- Takeoff (TO) mode not active
- Go-around (GA) mode not active
- VNAV mode active in cruise
- Flight level change (FLCH) not active
- Select the A/T switch on the mode control panel (MCP)
- Default SPD selection (mode change from FLCH or VNAV).

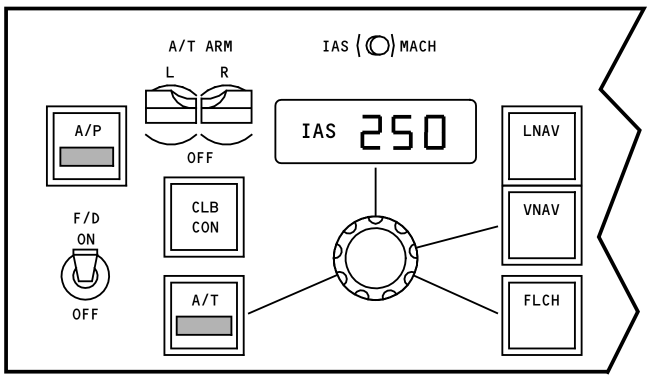
Operation

The TMCF sends the A/T servo motor commands to move the throttles in the SPD mode to control the airplane speed. The control speed shows in the MCP speed window. The TMCF responds to speed window changes. Thrust limit, speed limit (Vmo/Mmo), and flap speed limit protection is active in this mode. The SPD mode can operate with or without an A/P pitch mode.

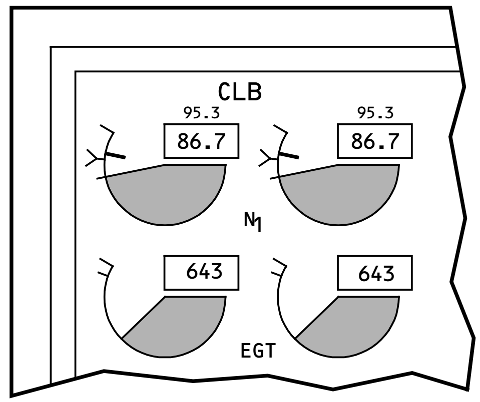
SPD shows as the A/T mode on the primary flight display (PFD).

The thrust limit mode climb (CLB) or continuous (CON) shows on the EICAS display when the airplane is in the air. Push the CLB/CON switch on the MCP to get the CLB thrust limit mode. Push the CLB/CON switch on the MCP to get the CON thrust limit mode when one engine fails.

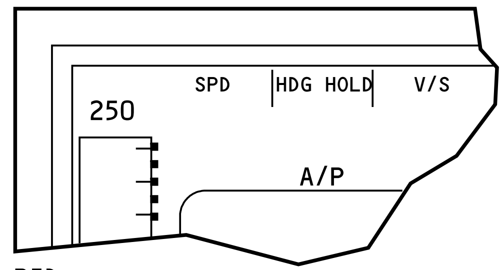
CONDITION:
- MCP A/T SWITCH ACTIVE



MCP



EICAS DISPLAY



PFD

MCP:
- AIRPLANE SPEED SHOWS IN THE IAS DISPLAY
- A/T SWITCH LIGHT ON
- F/D ACTIVE

EICAS DISPLAY:
- THRUST LIMIT MODE IS CLB PUSH THE CLB/CON SWITCH
- THE CURSOR (GREEN) SHOWS THE THRUST LIMIT
- THRUST LIMIT MODE IS CON PUSH THE CLB/CON SWITCH

PFD:
- THE A/T MODE CHANGES TO SPD
- THE TMCF CONTROLS THE AIRPLANE TO THE MCP IAS SPEED DISPLAY

22-31-00-017 Rev 2 05/14/1997

TMCS - A/T OPERATION - SPEED

TMCS - A/T OPERATION - GO-AROUND

Mode selection

The go-around (GA) mode engages when all these conditions are true:

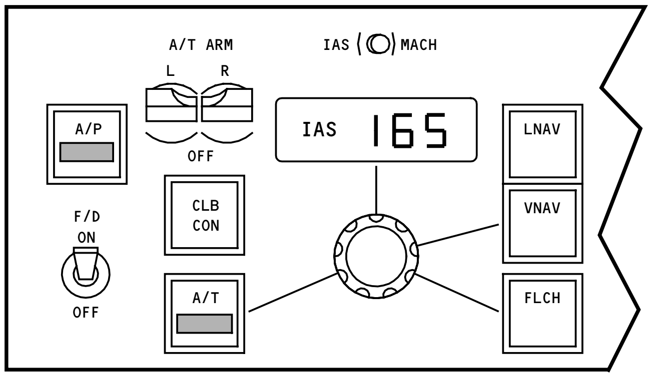
- Autothrottle arm switches on
- Airplane in the air
- Glideslope active (engaged) or flaps not zero
- Thrust limit mode not takeoff (TO)
- Push either TO/GA lever.

Operation

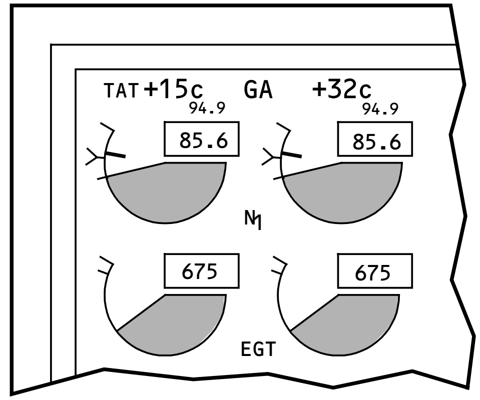
The GA mode arms in approach when the flaps are down or glideslope is active. GA shows as the thrust limit mode on the EICAS display. Push any TO/GA lever to start the GA mode. The A/T mode annunciation goes to thrust (THR).

The TMCF commands the A/T servo motors (ASM) to move the throttles and control the airplane to 2000 feet per minute (FPM) vertical speed. Push any TO/GA lever again to start the full thrust GA mode. The A/T mode changes to thrust reference (THR REF). The TMCF commands the ASMs to move the throttles to the full GA thrust limit that shows on the EICAS display.

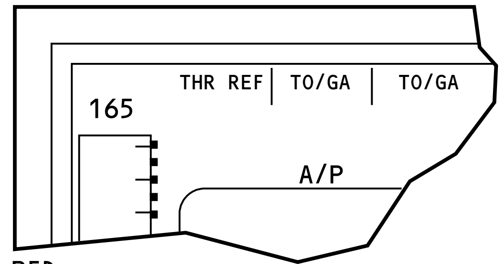
CONDITION:
- IN APPROACH
- TO/GA LEVER PUSHED



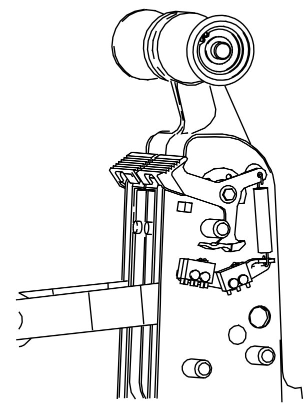
MCP



EICAS DISPLAY



PFD



THROTTLES

MCP:
- F/D SWITCH ON

EICAS DISPLAY:
- IN APPROACH (GA SHOWS-ARMED) FOR GLIDESLOPE ACTIVE OR FLAPS NOT ZERO
- THE GREEN THRUST LIMIT CURSORS IS THE GA THRUST LIMIT (COMMANDED THRUST IS LESS UNTIL GA ENGAGES)

PFD:
- FIRST TO/GA PUSH, THE A/T MODE CHANGES TO THR
- SECOND TO/GA PUSH, THE A/T MODE CHANGES TO THR REF

22-31-00-018 Rev 2 05/14/1997

TMCS - A/T OPERATION - GO-AROUND

TMCS - A/T OPERATION - FLARE RETARD

Mode Selection

The TMCF commands the throttles to move aft when all these conditions are true:

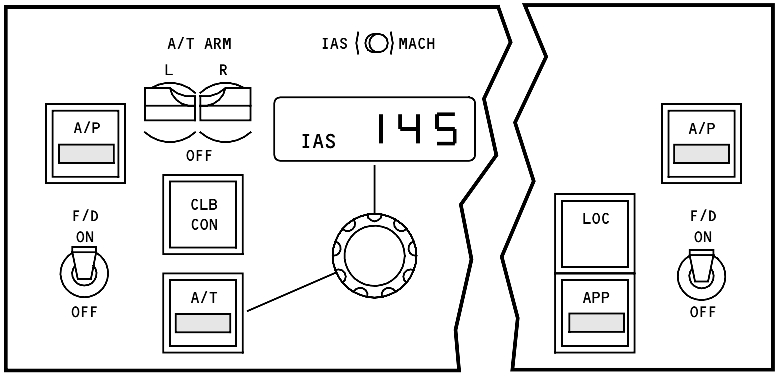
- Flare retard command from the AFDS
- Autothrottle arm switches on
- Less than or equal to 25 feet radio altitude in a land configuration.

Operation

The TMCF sends a throttle rate command to the servo modules to cause the throttles to move aft. This action assists the AFDS flare maneuver in the final landing phase. The throttle retard action starts at 25 feet radio altitude. IDLE shows as the A/T mode on the PFD when flare retard starts.

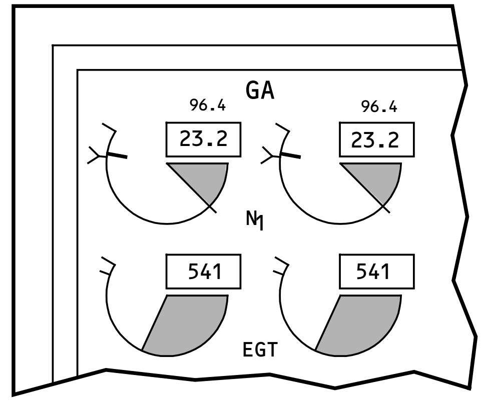
The A/T disconnects when the flight crew applies reverse thrust. The landing phase inhibit logic prevents the display of the AUTHROTTLE DISC caution message on the EICAS display and does not let the caution aural operate.

CONDITION:
- PASSING THRU FLARE HEIGHT

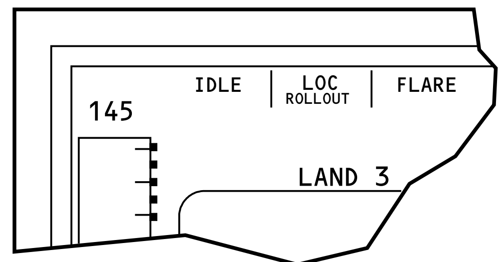


MCP

MCP:
- NO CHANGES ON MCP



EICAS DISPLAY:
- NO CHANGES ON THE ENGINE PRIMARY FORMAT



PFD

PFD:
- THE A/T MODE GOES FROM SPD TO IDLE
- AT TOUCHDOWN WITH REVERSE THRUST ACTIVE, THE A/T DISCONNECTS AND THE A/T MODE DISPLAY GOES BLANK

22-31-00-019 Rev 2 05/14/1997

TMCS - A/T OPERATION - FLARE RETARD

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TMCS - TMCF FUNCTIONAL DESCRIPTION - INTRODUCTION

General

The thrust management computing function (TMCF) controls engine thrust in response to commands from the guidance function of the flight management computing function (FMCF), the mode control panel, and flight deck switches.

The TMCF sub-functions are:

- Thrust limit calculation
- Engine trim equalization
- Autothrottle (A/T)
- BITE and fault monitoring
- TMCF annunciations.

The TMCF uses digital and analog inputs from external sensors, digital and analog inputs from flight deck components, internal AIMS cabinet interface signals, and cross cabinet AIMS interface signals.

Thrust limit Calculation

The TMCF calculates maximum thrust and thrust limits for these thrust limit modes:

- Takeoff (TO) thrust
- Go-around (GA)
- Climb (CLB)
- Continuous (CON)
- Cruise (CRZ)
- Temperature derated TO
- Fixed derated TO and CLB.

The TMCF uses these inputs to calculate thrust limits:

- Temperature
- Barometric altitude
- Barometric pressure
- Engine/airframe data bases
- Thrust model data base
- Flight deck inputs
- Air/ground.

The thrust limits show on the EICAS display.

Engine Trim Equalization

The TMCF calculates engine trim commands to decrease the thrust difference between the engines. The trim function receives actual engine thrust data from each engine to do this. The incremental engine trim command goes to the EECs to change the engine thrust.

Autothrottle (A/T)

The A/T sub-function sets the thrust levers to capture and hold a thrust setting, or to hold a target airspeed.

To calculate the A/T function, the TMCF uses these:

- Engage logic
- Control Laws
- Mode logic.

The A/T uses inputs from these sources:

- External sensor inputs
- Flight deck switches and sensors inputs
- Flight phase logic inputs
- FMCF thrust, mode, and guidance request inputs
- Internal and cross-cabinet AIMS inputs.

The engage logic determines the validity of the control law data and permits the software control laws to operate. The engage logic also sends logic that permits excitation voltage to the A/T servo motor (ASM). This permits the ASM to operate when it receives a command from the TMCF.

The control laws calculate the A/T command. It looks at the desired command and the actual airplane condition for that command. The error from these two is the error command.

The mode logic lets allows manual or automatic selection of the available autothrottle mode, thrust limit mode, and thrust limits. The A/T mode, thrust limit mode, and thrust limits show on the PFD and EICAS display.

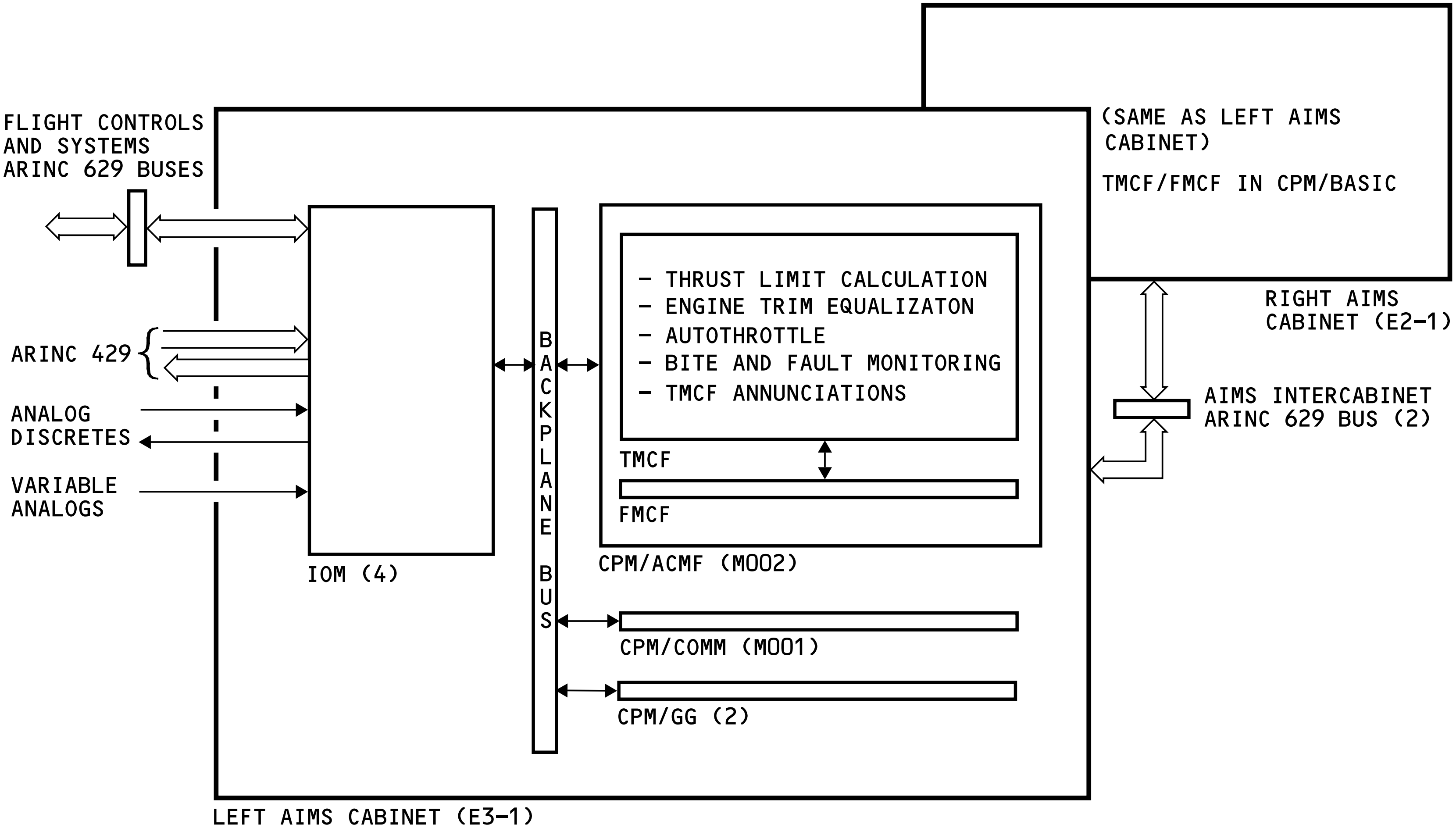
BITE and Fault Monitoring

The TMCF BITE circuits do tests at power-up and throughout the TMCF operation. When the fault monitor circuits receives a test failure from the BITE, it writes the faults in the TMCF memory and sends the faults to the PDF (primary display function) and the central maintenance computing function (CMCF).

TMCF Annunciations

These annunciations go to the primary display function for the PFD and EICAS display:

- A/T modes
- Thrust limits
- Thrust limit modes
- Fault messages.



22-31-00-020 Rev 3 05/14/1997

TMCS - TMCF FUNCTIONAL DESCRIPTION - INTRODUCTION

TMCS - TMCF FUNCTIONAL DESCRIPTION - ENGAGE LOGIC

General

The A/T engage logic process monitors the TMCF parameters for A/T mode engage. The TMCF sends an analog enable discrete to the A/T servo motors (ASM) when conditions are valid. The logic also generates ASM commands and an autothrottle disconnect signal.

Servo Loop Monitor

When the A/T engages, the control law sends rate commands to the ASMs. The ASMs send rate feedback (low speed tachometer data) to the TMCFs. The servo loop monitor compares these two signals and sets the inhibit logic when they do not agree. This causes the ASMs to disconnect. BITE (TMCF and ASM) failures also set the inhibit.

Autothrottle Disconnect

When the A/T disconnects automatically or manually, the AUTHROTTLE DISC caution message shows on the engine primary format display. BITE sets the A/T disconnect. Push an A/T disconnect switch to cause a manual A/T disconnect.

The A/T also disconnects on the ground when the flight crew applies reverse thrust. In this case, there is no A/T disconnect message or caution aural.

The AUTHROTTLE DISC is a caution message that causes the master caution lights to come on and an aural four beep alert to sound in the flight deck.

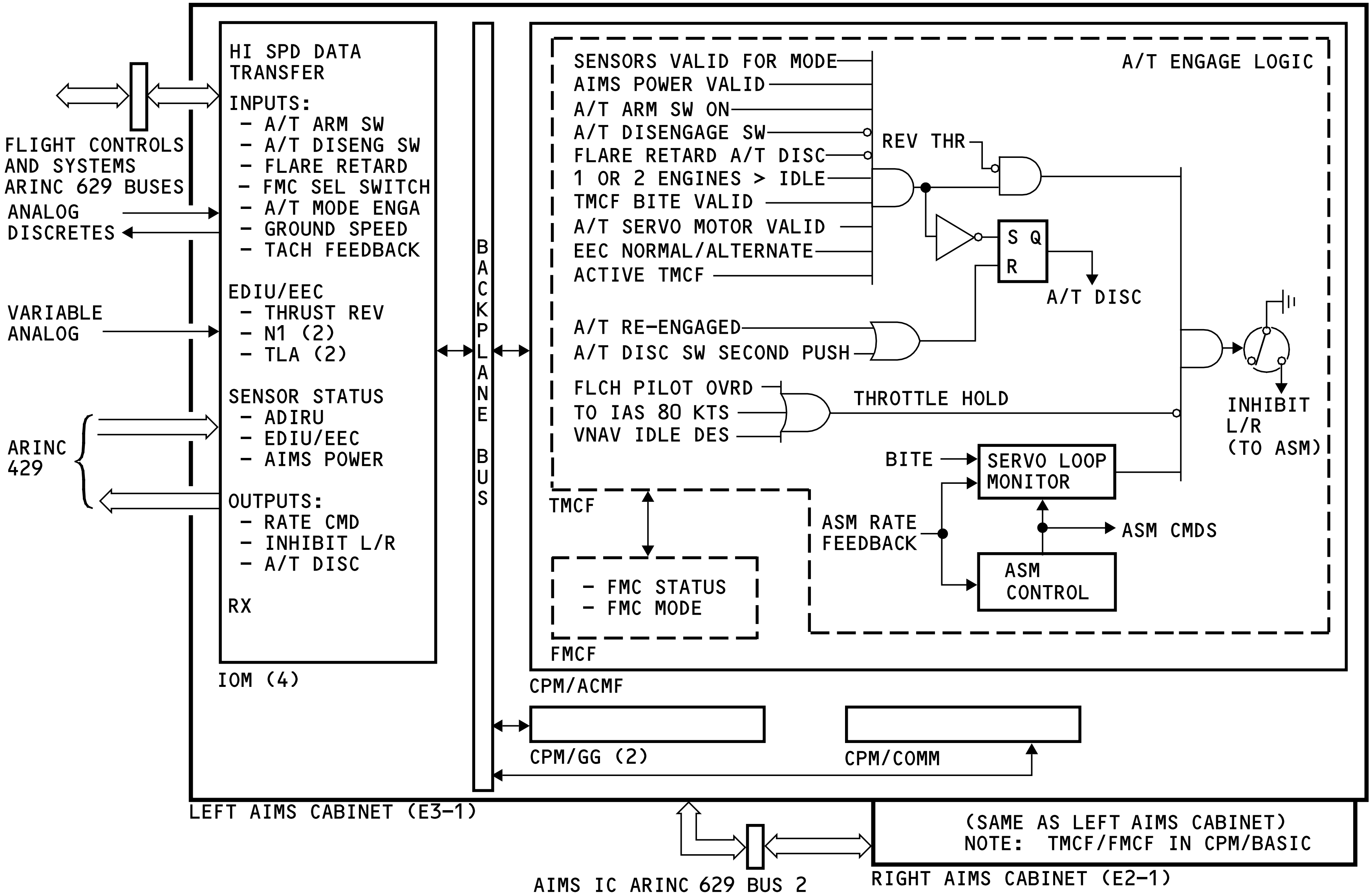
Inhibit L/R

The active TMCF causes the ASMs to disconnect when it sets the left and right inhibit switches.

TMCF Selection

The TMCF selection is similar to the FMCF selection. Use the FMC selector to make the left or right TMCF active.

The FMC selector is a three position switch, LEFT, AUTO and RIGHT. In the LEFT position, the left TMCF and FMCF are active. If the left TMCF fails, then there is no active TMCF. In the AUTO position, a random selection of the active TMCF and FMCF occurs after power is supplied. If the active TMCF fails, then the other TMCF becomes active. In the RIGHT position, the right TMCF and FMCF are active. If the right TMCF fails, then there is no active TMCF.



TMCS - TMCF FUNCTIONAL DESCRIPTION - ENGAGE LOGIC

TMCS - FUNCTIONAL DESCRIPTION - A/T SERVO MOTOR

General

These are the functions of the autothrottle servo motor (ASM):

- ARINC 429 rate command decoding
- Tachometer and power feedback decoding
- Enable/disable logic
- Inner loop servo motor rate control.

The (ASM) has these components:

- Power supply unit (PSU)
- Power Switching Module (PSM)
- Electronic control module (ECM)
- DC motor.

Power Supply Unit

The PSU provides internal power for the ECM and the PSM.

Power Switching Module

The PSM has a series of enable switches that send an output to a power switching bridge. These switch inputs are based on these inputs to the input controller:

- Left and right arm from the MCP
- Left TMCF and right TMCF inhibit
- Left, right or auto from the FMC selector.

The output to the power switching bridge lets the bridge process the drive signals.

The enable switches also send an output to the ECM.

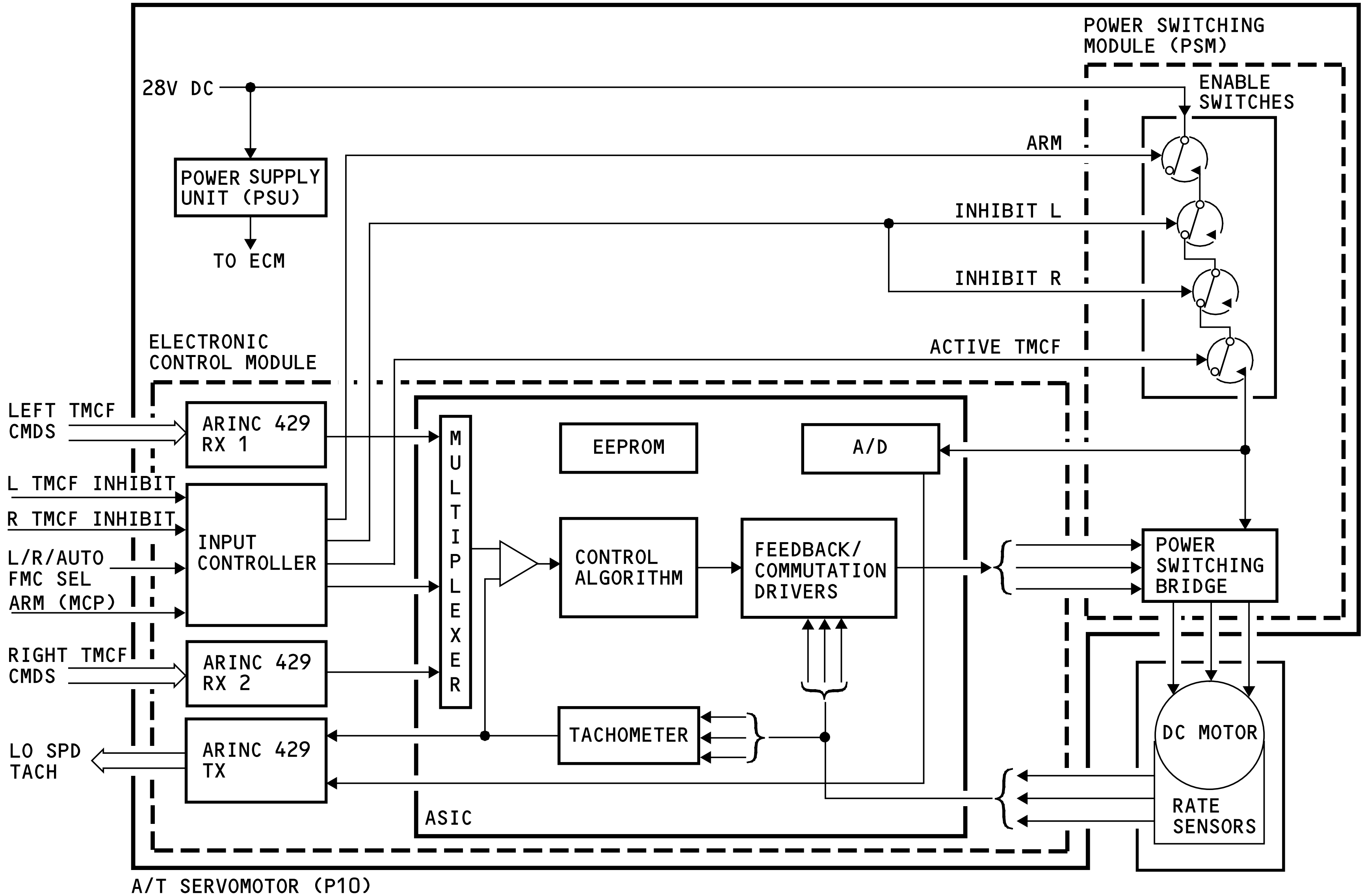
Electronic Control Module

The ECM contains the circuitry to calculate the drive commands for the DC motor. The ECM gets inputs through the ARINC 429 receivers and the input controller and gets feedback signals from the rate sensors of the DC motor.

DC Motor

The DC motor is a 28 VDC brushless motor. The output shaft of the motor connects to a gearbox. The gearbox connects to the throttle lever assembly.

The motor also has a friction brake/clutch assembly that lets a pilot manually override the throttle lever.



TMCS - FUNCTIONAL DESCRIPTION - A/T SERVO MOTOR

22-31-00-024 Rev 4 07/09/1997

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TMCS - TMCF FUNCTIONAL DESCRIPTION - BITE AND FAULT MONITORING

General

The TMCF has internal and external fault monitors. The TMCF records BITE faults into TMCF memory. It sends faults to the central maintenance computing function (CMCF) and causes fault messages to show on the EICAS display. BITE logic removes the A/T and thrust limit modes when TMCF BITE detects an internal or external failure.

Internal Fault Monitors

The TMCF does these checks:

- Compatibility
- Miscomparisons
- Active TMCF selection
- Cross cabinet synchronization checks.

The TMCF does these checks when the core processor module (CPM) and cabinet level BITE is valid, the back plane bus is valid, and the input/output (I/O) modules are valid.

The TMCF does these compatibility checks:

- Operational program software (OPS)/hardware
- Engine/airframe
- Operational program configuration (OPC)/OPS
- Engines/ratings
- Ratings/thrust limit data base (TLDB)
- Left and right engine ratings disagree.

The TMCF stores BITE disagree data into BITE history. With a BITE disagree, the TMCF causes all outputs to go invalid and prevents thrust limit calculation (TLC) and autothrottle engage.

At power up, the TMCF does these cross-cabinet miscomparison checks:

- OPS
- Engine/airframe data bases
- OPC
- TLC database.

When a disagree occurs, the TMCF BITE stores each miscompare in BITE history and the TMCF operation shuts down.

AIMS Cross-Cabinet Synchronization

Continuous cross-cabinet synchronization occurs between the active and inactive TMCF. This ensures common modes of operation, A/T commands, and engine trim commands do not change when there is a master TMCF transfer.

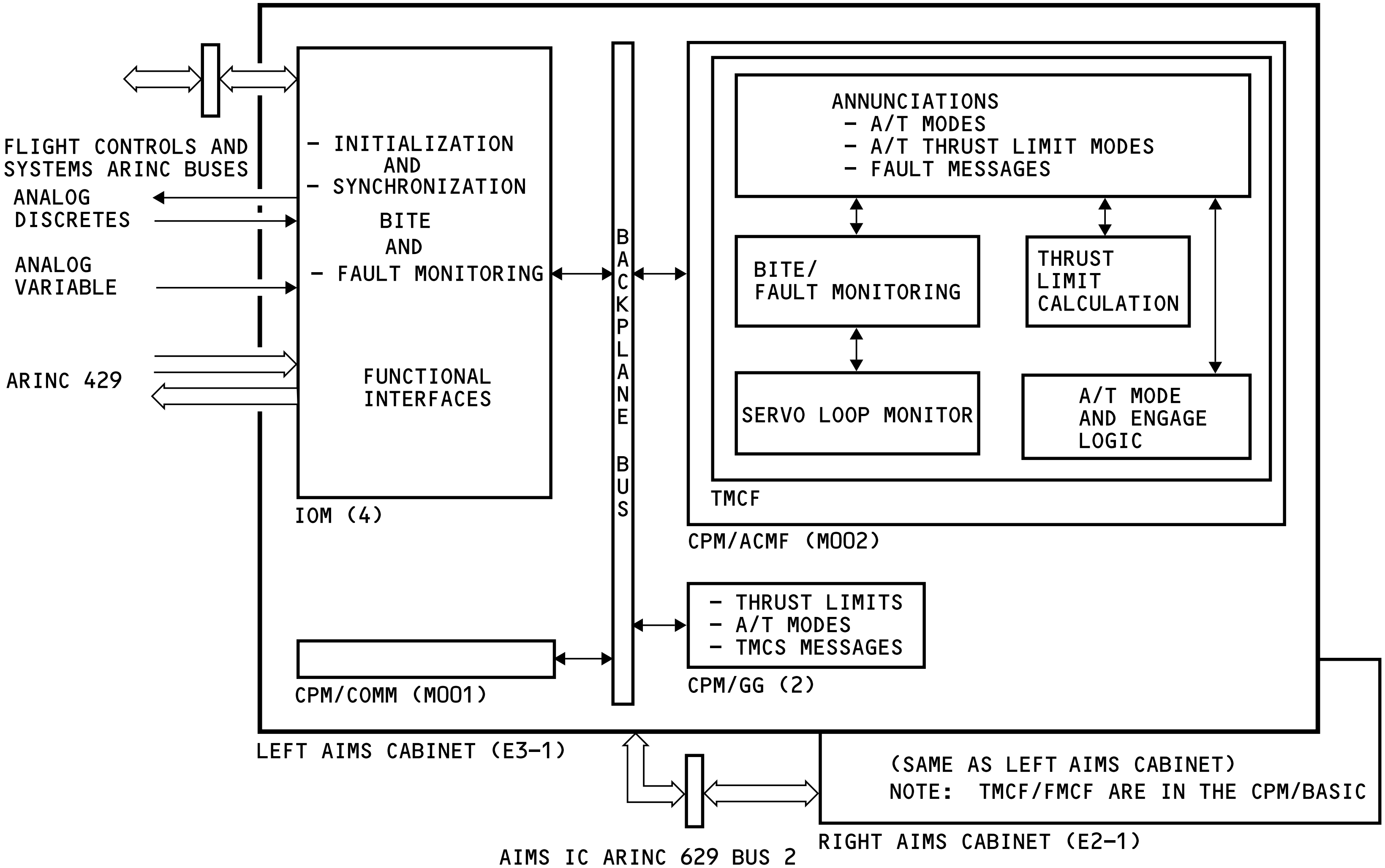
External Fault Monitors

The TMCF also monitors these external interfaces for the autothrottle ASMs:

- Servo
- Power removal or no power
- Tachometer feedback, scheduled or zero
- Servo rate within 2 degrees/second

TMCS - TMCF FUNCTIONAL DESCRIPTION - BITE AND FAULT MONITORING

- Stopper, detects inability to remove power from servo during takeoff less than 50 knots.



TMCS - TMCF FUNCTIONAL DESCRIPTION - BITE AND FAULT MONITORING

TMCS - SYSTEM TESTS

General

These are the servo loop system tests for the left and right TMCF:

- Left cabinet servo loop test
- Right cabinet servo loop test.

Servo Loop Test

The servo loop test makes sure that the TMCF in the left and right AIMS and the autothrottle servomotors operate correctly.

The thrust levers on the P10 control stand move during the test.

This test examines the integrity of each autothrottle servomotor's rate drive. It also tests the ability of the TMCF to remove power from the servos.

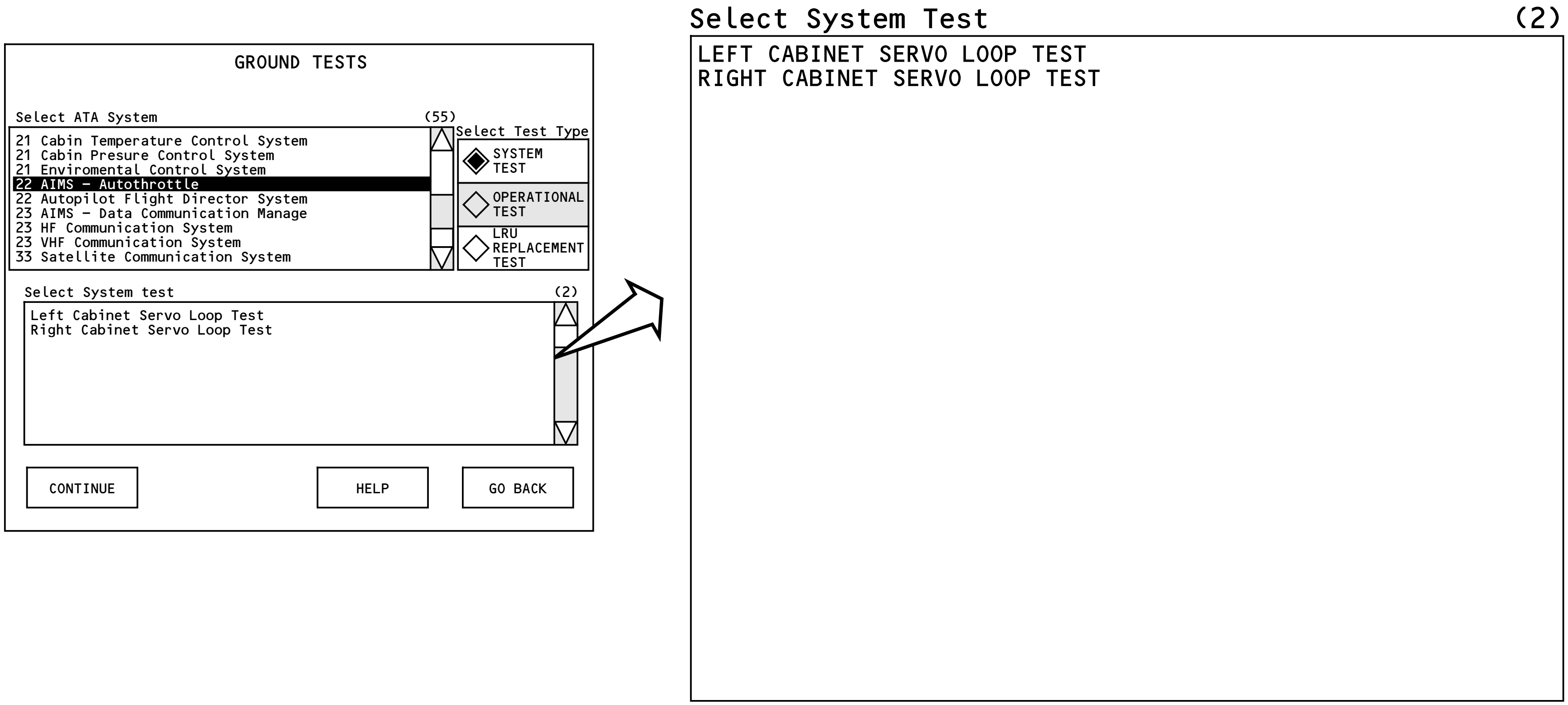
The test has four steps. The first step is the initial command. The initial command has a TLA rate of -8 degrees/second for 7 seconds and brings the throttles aft to the mechanical stop. There is no pass/fail.

The second step is the throttle stopper test. This test runs the throttle stopper to verify that the TMCF can remove power from the servos and that the servos do not drive as determined by the tach feedback.

The third step is the forward command. This test has a TLA rate of 8 degrees/second for 5 seconds. During the throttle movement, the average tach feedback for both must be between 6 and 10 degrees/second.

The fourth step is the reverse command. This test has a TLA rate of -8 degrees/second for 5 seconds. During the throttle movement, the average tach feedback for both must be between -6 and -10 degrees/second.

The TMCF provides pass/fail information for each servo to show on the MAT.



22-31-00-026 Rev 3 02/11/1998

TMCS - SYSTEM TESTS

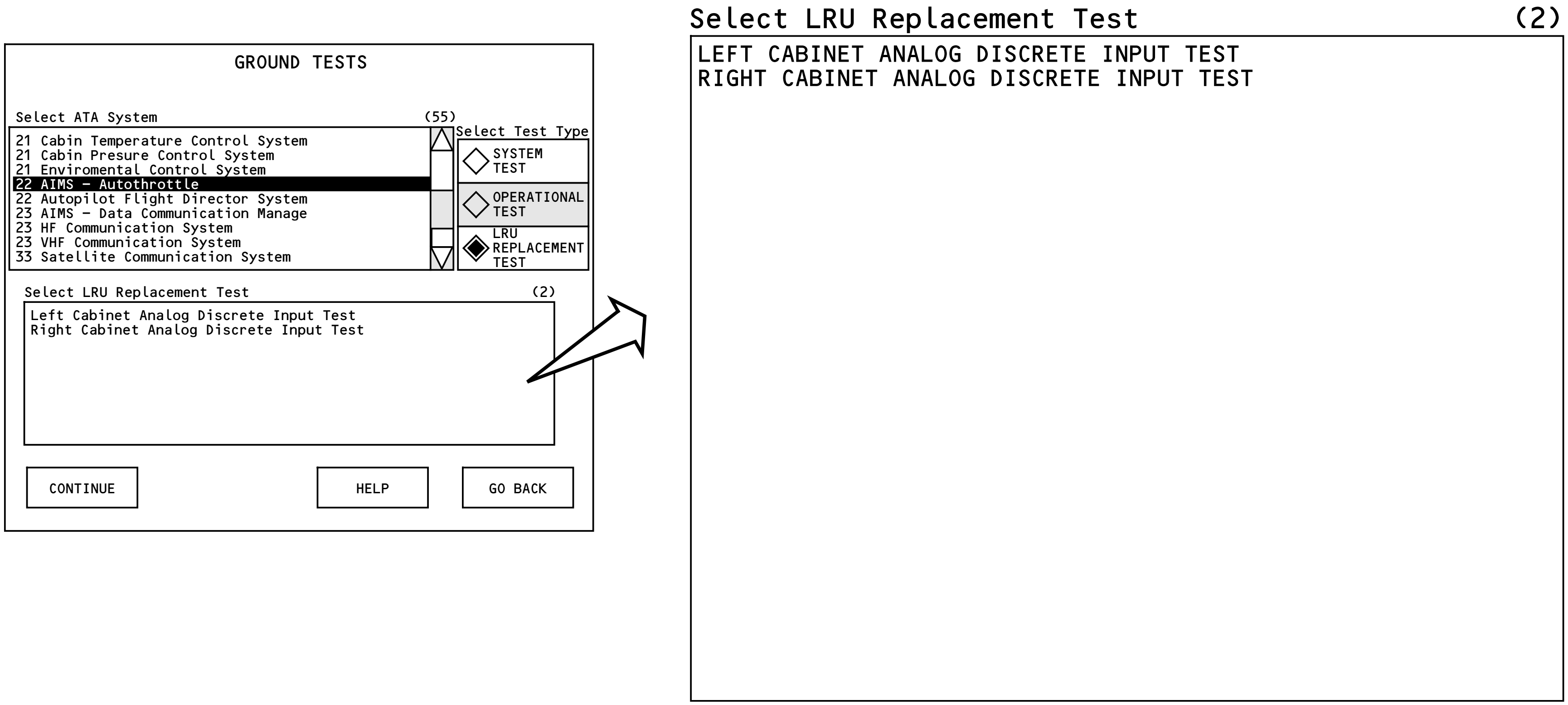
TMCS - LRU REPLACEMENT TESTS

General

The LRU Replacement tests for the TMCS are the left and right cabinet analog discrete input tests.

Analog Input Discrete Test

This test makes sure that the TMCF in the AIMS and the takeoff/go-around switches, the autothrottle disconnect switches, and the autothrottle arm switches operate correctly.



22-31-00-027 Rev 2

TMCS - LRU REPLACEMENT TESTS

Continental Airlines, Inc

Flight Controls - Introduction

WB371

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FLIGHT CONTROLS - INTRODUCTION

General

The flight controls keep the airplane at the desired attitude during flight. They consist of movable surfaces on the wing and the empennage. The flight controls change the lift of the wing and the empennage.

There are two types of flight controls: the primary flight control system and the high lift control system.

Primary Flight Control System

The primary flight control system (PFCS) uses a fly-by-wire control system with digital and analog electronic equipment. It receives commands from the flight crew and the autopilot and causes the control surfaces to move.

The PFCS controls the attitude of the airplane during flight. The control surfaces operated by the PFCS are:

- One aileron on each wing
- One flaperon on each wing
- Seven spoilers on each wing
- One horizontal stabilizer
- One elevator on each side of the horizontal stabilizer
- One tabbed rudder.

High Lift Control System

The high lift control system (HLCS) uses a fly-by-wire control system with digital electronic equipment. It receives commands from the flight crew and causes the flaps and slats to move.

Operation of the HLCS increases the wing lift so the airplane can takeoff and land at lower speed and higher weight. The high lift devices operated by the HLCS are:

- Seven leading edge slats on each wing
- One Krueger flap on each wing
- One single slotted outboard flap on each wing
- One double slotted inboard flap on each wing.

Operation of the HLCS also causes the ailerons and the flaperons to move. They droop on both wings when the high lift devices extend.

Benefits of the Fly-By-Wire System

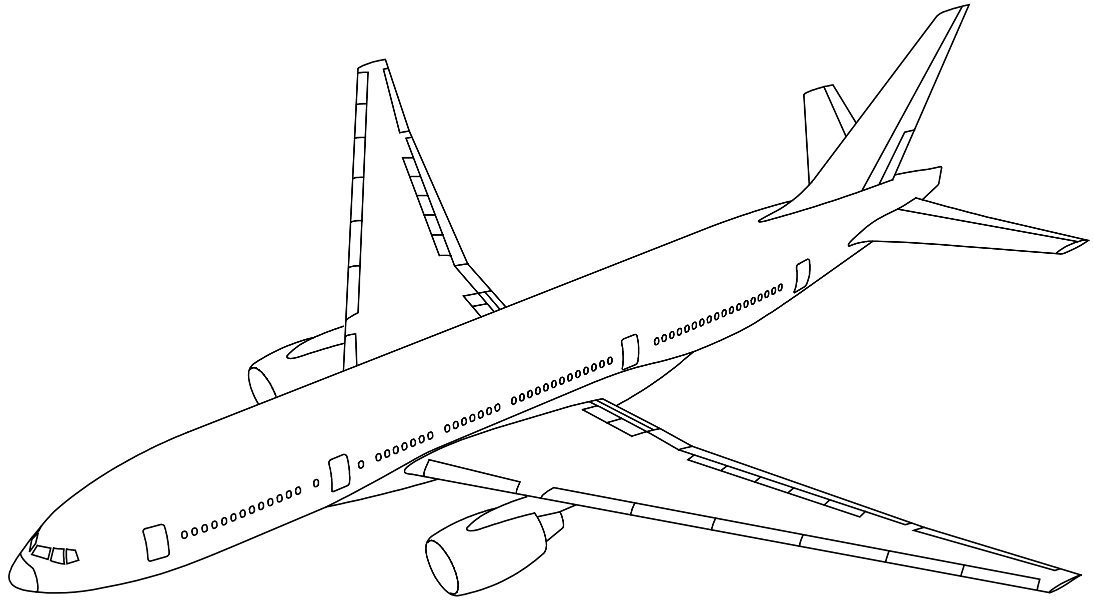
The fly-by-wire design of the flight controls permits:

- A more efficient structure design
- Increased fuel economy
- A smaller vertical fin
- A smaller horizontal stabilizer
- Reduced weight
- Improved controls and protections.

Abbreviations and Acronyms

ACE	- actuator control electronics
ACMS	- airplane condition monitoring system
ADIRS	- air data inertial reference system
ADIRU	- air data inertial reference unit

ADM	- air data module
AFDC	- autopilot flight director computer
AFDS	- autopilot flight director system
AIMS	- airplane information management system
ARINC	- Aeronautical Radio, Inc.
BAP	- bank angle protection
B/D	- backdrive
CMCS	- central maintenance computing system
CPU	- central processing unit
EDIU	- engine data interface unit
EHS	- electrohydraulic servo valve
EICAS	- engine indication and crew alerting system
FCDC	- flight controls direct current
FMCS	- flight management computer system
FSEU	- flap/slat electronics unit
HLCS	- high lift control system
LIB	- left inboard
LOB	- left outboard
LVDT	- linear variable differential transformer
MCP	- mode control panel
MFD	- multi functional display
PCU	- power control unit
PDU	- power drive unit
PFC	- primary flight computer
PFCS	- primary flight control system
PMG	- permanent magnet generator
PSA	- power supply assembly
PSEU	- proximity sensor electronic unit
RIB	- right inboard
ROB	- right outboard
RVDT	- rotary variable differential transformer
SAARU	- secondary attitude air data reference unit
SOL	- solenoid
SOV	- shutoff valve
STCM	- stabilizer trim control module
TAC	- thrust asymmetry compensation
WEU	- warning electronic unit
WOW	- weight on wheels



FLIGHT CONTROLS

PRIMARY FLIGHT CONTROL SYSTEM

- AILERONS AND FLAPERONS
- SPOILERS AND SPEEDBRAKES
- ELEVATORS
- HORIZONTAL STABILIZER
- RUDDER

HIGH LIFT CONTROL SYSTEM

- TRAILING EDGE FLAPS
- LEADING EDGE SLATS
- KRUEGER FLAPS

27-00-00-001 Rev 2

FLIGHT CONTROLS - INTRODUCTION

PRIMARY FLIGHT CONTROL SYSTEM - INTRODUCTION

Purpose

The primary flight control system (PFCS) controls the airplane flight attitude in relation to the three basic axes:

- Longitudinal
- Lateral
- Vertical.

Roll Control

The roll control uses the ailerons, flaperons, and spoilers to control the airplane attitude about the longitudinal axis. During a bank of the airplane, the aileron and flaperon on one wing move in an opposite direction from the aileron and flaperon on the other wing. The spoilers move up only on the down wing and do not move on the up wing.

Pitch Control

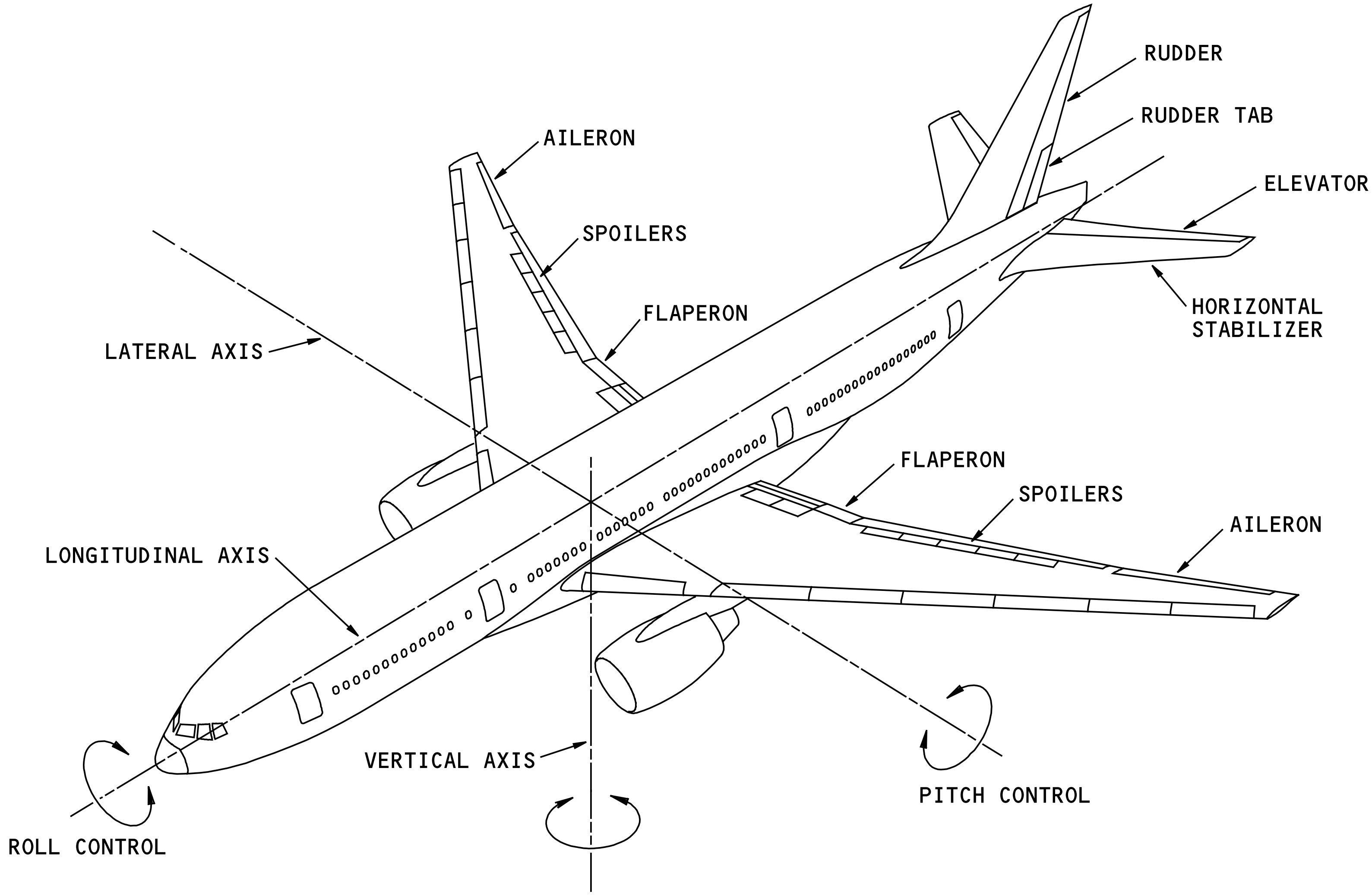
The pitch control uses the horizontal stabilizer and the elevator to control the airplane attitude about the lateral axis. The stabilizer controls long term pitch changes. The elevator supplies short term pitch control.

Yaw Control

The yaw control uses the rudder to control the airplane attitude about the vertical axis. The rudder has a tab which moves to increase the effectiveness of the rudder.

Speedbrakes

The PFCS also includes the speedbrakes. In addition to roll control, the spoilers also act as speedbrakes in the air and on the ground. They deploy on both wings to increase drag and to decrease the amount of lift the wings supply.



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PRIMARY FLIGHT CONTROL SYSTEM - INTRODUCTION

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PFCS - GENERAL DESCRIPTION

General

The pilots or the autopilot commands control the PFCS. The pilots can override the autopilot.

Manual Operation

Position transducers change the pilots' manual commands of the control wheel, the control columns, the rudder pedals, and the speedbrake lever to analog electrical signals. These signals go to the four actuator control electronics (ACEs). The ACEs change the signals to digital format and send them to the three primary flight computers (PFCs).

The PFCs have interfaces with the airplane systems through the three flight controls ARINC 629 buses. In addition to command signals from the ACEs, the PFCs also receive data from:

- The airplane information management system (AIMS)
- The air data inertial reference unit (ADIRU)
- The secondary attitude air data reference unit (SAARU).

The PFCs calculate the flight control commands based on control laws and flight envelope protection functions. The control laws supply stability augmentation in the pitch and yaw axes and flight envelope protections in all three axes. The digital command signals from the PFCs go to the ACEs.

The ACEs change these command signals to analog format and send them to the power control units (PCUs) and the stabilizer trim control modules (STCMs). The ACEs and the PCUs form control loops which control the surfaces based on the PFCs commands.

One, two or three PCUs operate each control surface. One PCU controls each spoiler, two PCUs control each aileron, flaperon, and elevator, and three PCUs control the rudder. The PCUs contain a hydraulic actuator, an electrohydraulic servo valve, and a position feedback transducer.

When commanded, the servo valve causes the hydraulic actuator to move the control surface. The position transducer sends a position feedback signal to the ACEs. The ACEs then stop the PCU command when the position feedback signal equals the commanded position.

Two STCMs control hydraulic power to the motors and brakes of the horizontal stabilizer.

Autopilot Operation

The PFCs receive autopilot commands from all three autopilot flight director computers (AFDCs). The PFCs use the autopilot commands in the same manner as the pilots' manual commands. In addition, the PFCs supply the backdrive signals to the backdrive actuators through the AFDCs. The backdrive actuators move the control wheels, control columns, and rudder pedals in synchronization with the autopilot commands. The movement of the flight deck controls supplies visual indications to the flight crew.

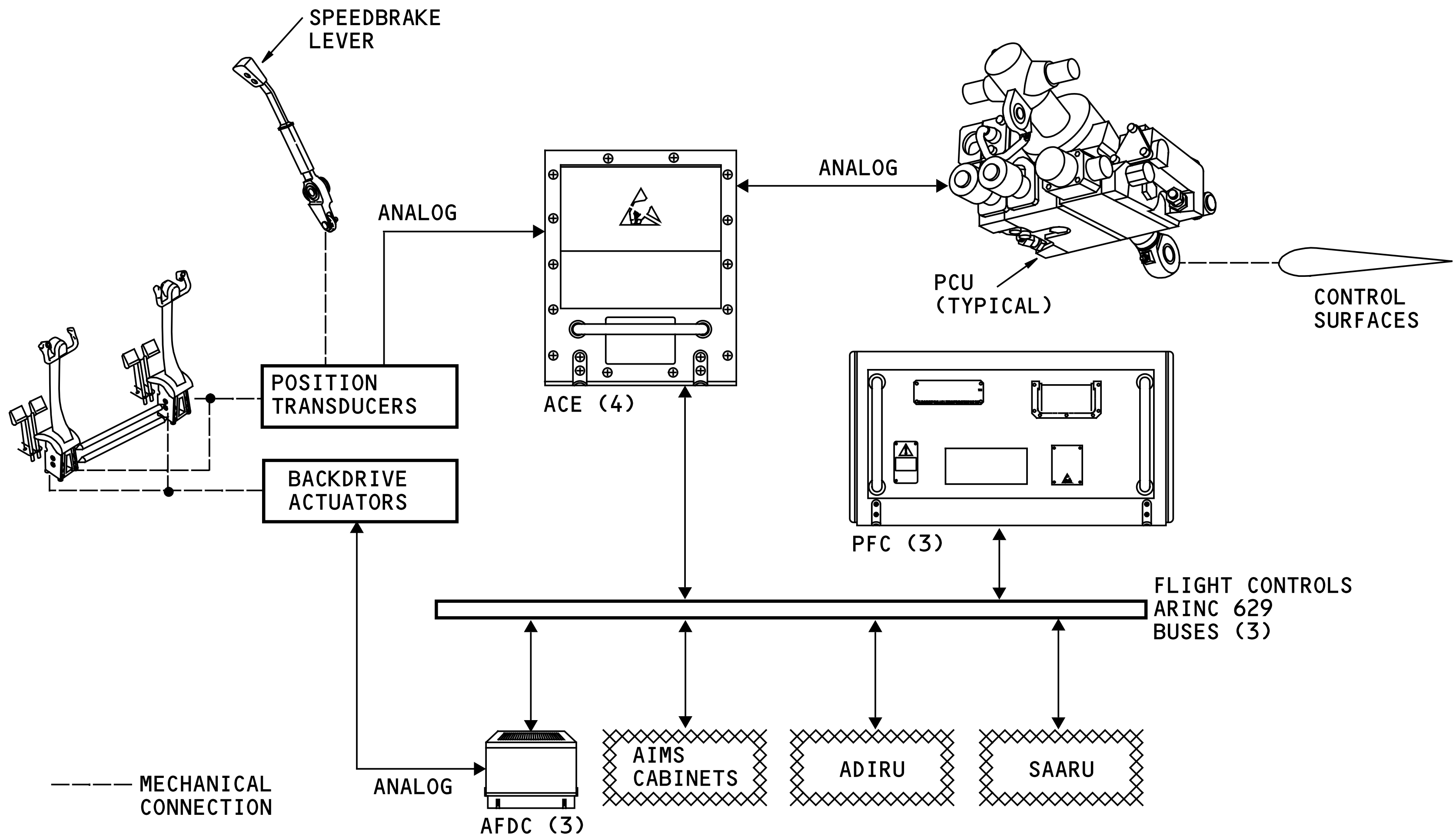
PFCS Modes of Operation

The PFCS has three modes of operation: normal, secondary, and direct.

Normal mode operates when the necessary data are available for the PFCs and the ACEs. All the control laws, protection functions, and the AFDCs operate.

When the PFCS detects the loss of important air and attitude data, the PFCS operation changes to secondary mode. The PFCs and the ACEs operate but the PFC control laws and protection functions downgrade. The autopilot cannot operate in secondary mode.

In direct mode, the PFCs are not used. The ACEs set the position of the control surfaces in direct response to analog pilot control inputs.



27-02-00-002 Rev 4

PFCS - GENERAL DESCRIPTION

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PFCS - PFC CONTROL LAWS - FUNCTIONAL DESCRIPTION

General

The PFCs software includes the flight control laws. They calculate the control surface commands to set the desired airplane stability and control. The calculation uses data inputs from the pilots, the autopilot, and other data from the air and inertial sensing systems.

The PFCs calculate control commands for:

- The ailerons, flaperons and spoilers for roll control
- The ailerons and some spoilers for lockout during cruise
- The ailerons and flaperons for droop control during flap extension
- The spoilers during speedbrake control in flight and on the ground
- The elevators for pitch control
- The elevator feel actuator
- The stabilizer for elevator offload (long term pitch trim), column cutout, and stabilizer auto shutdown
- The rudder for yaw control, yaw damping, rudder ratio, and wheel-rudder cross-tie
- The rudder trim actuator.

The control laws also include stability augmentation and protection functions.

Stability Augmentation

There is a stability augmentation function for the pitch and yaw control. Stability augmentation controls the airplane attitude to simulate the natural reaction of the airplane that the pilots expect.

The control laws calculate yaw damping and turn coordination commands. A gust suppression function makes the ride quality better and reduces the pilots' work load.

In pitch stability augmentation, the PFCs use the control laws to calculate the elevator control commands for speed stability and flare compensation.

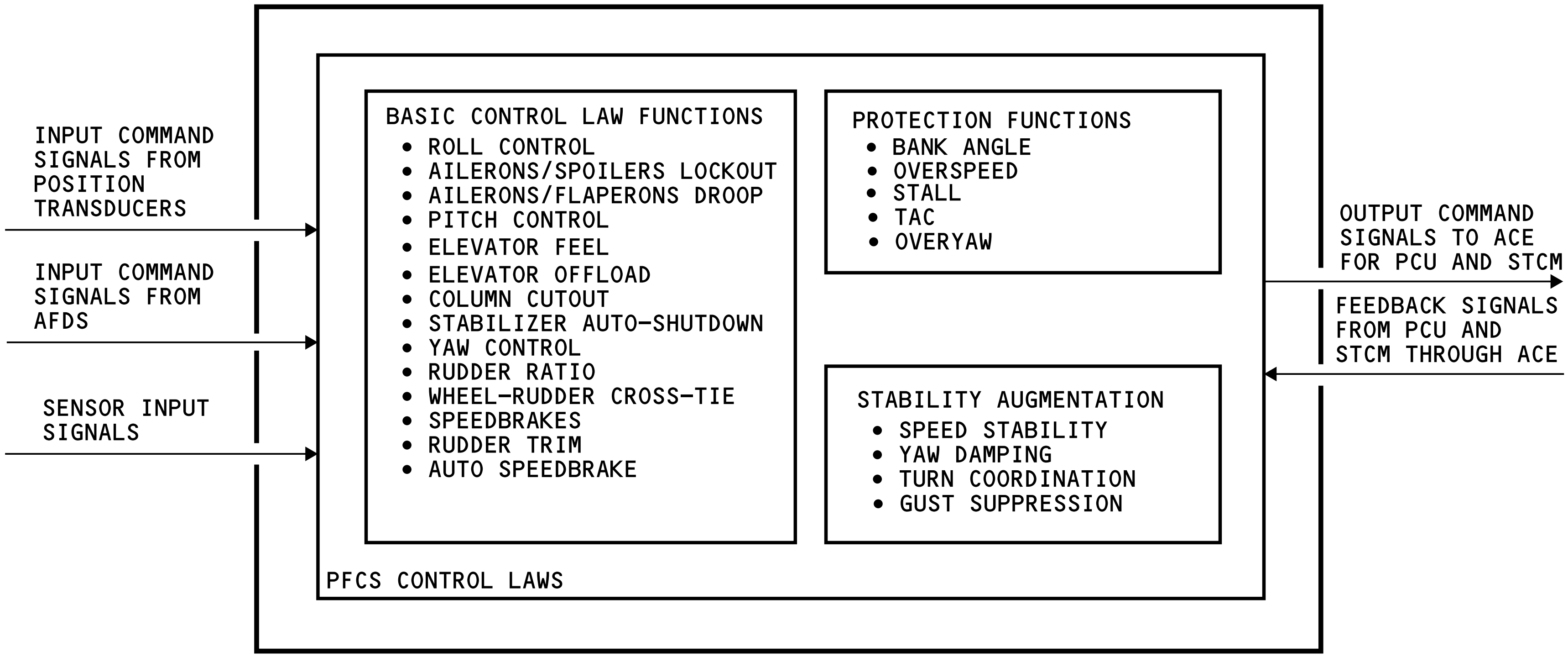
Protection Functions

The control laws contain several different limits to supply flight envelope protection in the three axes of control. The PFCs calculate protection functions for:

- Bank angle
- Overspeed
- Stall
- Thrust asymmetry compensation
- Overyaw.

The bank angle protection supplies a roll command opposite to the bank. The overspeed protection supplies a pitch up command when the speed is more than the maximum. The stall protection supplies a pitch down command. The thrust asymmetry compensation (TAC) automatically controls the rudder movement to make allowance for asymmetrical thrust from the engines. The overyaw protection operates through the wheel-rudder cross-tie function to decrease the yaw command.

The bank angle and the stall protections supply more resistive force to the controls. The pilots can override the protection functions when they move the controls more than the limit. There is no increased force on the controls for the other protection functions.



PRIMARY FLIGHT COMPUTER (TYPICAL)

27-02-00-013 Rev 4

PFCS - PFC CONTROL LAWS - FUNCTIONAL DESCRIPTION

PFCS - OPERATIONAL MODES - FUNCTIONAL DESCRIPTION

General

These are the three modes of PFCS operation:

- Normal
- Secondary
- Direct.

During the PFCS normal and secondary mode operation, both the PFCs and the ACEs are in operation. In the secondary mode, the PFC's operation downgrades. During the direct mode, only the ACEs operate in response to direct analog inputs.

The PFCS selects the mode of operation. On the ground with ground speed less than 40 knots, the PFCs automatically select the highest mode available based on the inputs from the ADIRU and SAARU. In flight, the pilots cycle the PFC disconnect switch on the P5 panel, or move it back to the AUTO position to cause the selection of the highest mode available.

During PFCS mode changes, there is a smooth change to the new commands.

Normal Mode

The PFCS selects the normal mode when all these conditions are met:

- The PFC disconnect switch, on the P5 panel, is in the AUTO position
- The needed input data is available
- At least one PFC and three ACEs are in normal mode.

All the control laws, the protection functions, and the stability augmentation of the PFCs are active in the normal mode. The autopilot operates only in normal mode.

Secondary Mode

The PFCS selects the secondary mode when it detects the loss of important air and attitude sensor data from both the ADIRU and the SAARU. The PFCS also selects the secondary mode when two ACEs are in direct mode.

A simplified set of control laws operate the PFCS in secondary mode. The protection functions are not available. Gain schedules and limits are a function of flap data discretes from the ACEs. Pitch stability augmentation uses pitch rate data from the ACEs. Yaw damper augmentation uses inertial data from the ADIRU and the SAARU if available.

Direct Mode

The PFCS selects the direct mode when there are failures that make the normal and secondary modes unreliable. If three ACEs are in direct mode, the PFCS switches the last ACE to the direct mode. The PFC disconnect switch also causes the selection of the direct mode.

The PFCs do not control the surfaces in the direct mode. Position transducer signals from the control wheels, columns and pedals go directly to the ACEs which use them to control the PCUs. The protection functions are not available.

When the PFCS is in direct mode, whether automatically or manually, the DISC amber light shows next to the PFC disconnect switch.

Manual Switching

The PFCS goes to the direct mode of operation when the pilots move the PFC disconnect switch to the DISC position.

If the pilots cycle the PFC disconnect switch or move it again to the AUTO position, the PFCS goes from the direct mode to the highest mode available. The PFCS selects the mode based on the validity of available data.

If the PFCS is in the secondary or direct modes and the normal mode becomes available, the PFCS may select the normal mode. To do this in the air, you must cycle the PFC disconnect switch. If the airplane is on the ground and ground speed is less than 40 knots, then the PFCS selects the normal mode automatically.

Indications

The EICAS caution message FLIGHT CONTROL MODE shows when the PFCS is in secondary mode.

The EICAS caution message PRI FLIGHT COMPUTERS shows when all ACEs under power are in direct mode and the PFC is not in the hydraulic OFF self-test mode.

On the status display, the status message FLIGHT CONTROL SYS shows when the PFCS does not operate at minimum dispatch requirement levels. This message shows because of one or more of these faults:

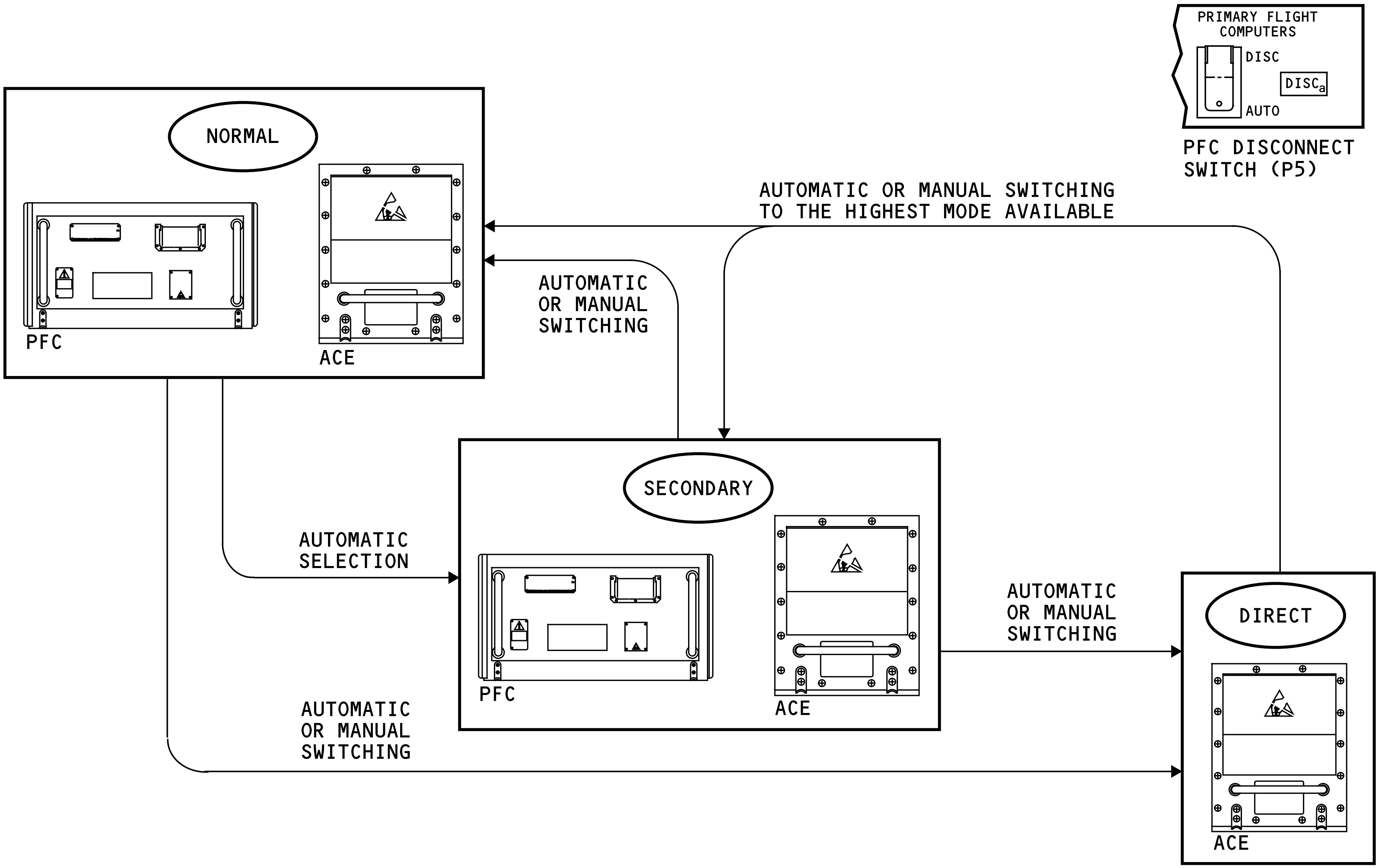
- Failure of a column, wheel, pedal, or speedbrake lever position transducer
- Failure of a rudder, elevator, aileron, flaperon, or spoiler PCU
- Failure of a STCM
- Failure of an elevator feel actuator
- Failure of a PFC and at least one lane in another PFC
- Failure of an ACE or at least one ACE is in direct mode
- Failure of the stabilizer control
- Failure of the actuator confidence test
- Failure of a PSA, a flight controls ARINC 629 bus, or a WES channel.

The EICAS caution message FLIGHT CONTROLS shows when the flight control system has lost substantial capabilities. Any one of these faults causes the message to show:

- The stabilizer is not operative
- Two elevator PCUs and one stabilizer path are not operative

PFCS - OPERATIONAL MODES - FUNCTIONAL DESCRIPTION

- The wheel, column, or pedal position transducers for the captain and first officer disagree by more than 15 percent of full range with the airplane on the ground
- The elevator force fight equalization function is defective.



27-02-00-015 Rev 7 08/18/95

PFCS - OPERATIONAL MODES - FUNCTIONAL DESCRIPTION

Continental Airlines, Inc

Autopilot Flight Director System

WB371

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AUTOPILOT FLIGHT DIRECTOR SYSTEM - INTRODUCTION

General

The autopilot flight director system (AFDS) has two purposes. These purposes are:

- To automatically control the airplane attitude
- To supply indications so the flight crew can manually control the airplane attitude.

The flight crew uses the mode control panel (MCP) to select a mode of operation.

Autopilot

The autopilot controls the airplane attitude through:

- Takeoff (flight director only)
- Climb
- Cruise
- Descent
- Approach
- Go-around
- Autoland.

The autopilot commands go to the primary flight computers (PFCs) to operate the flight control surfaces.

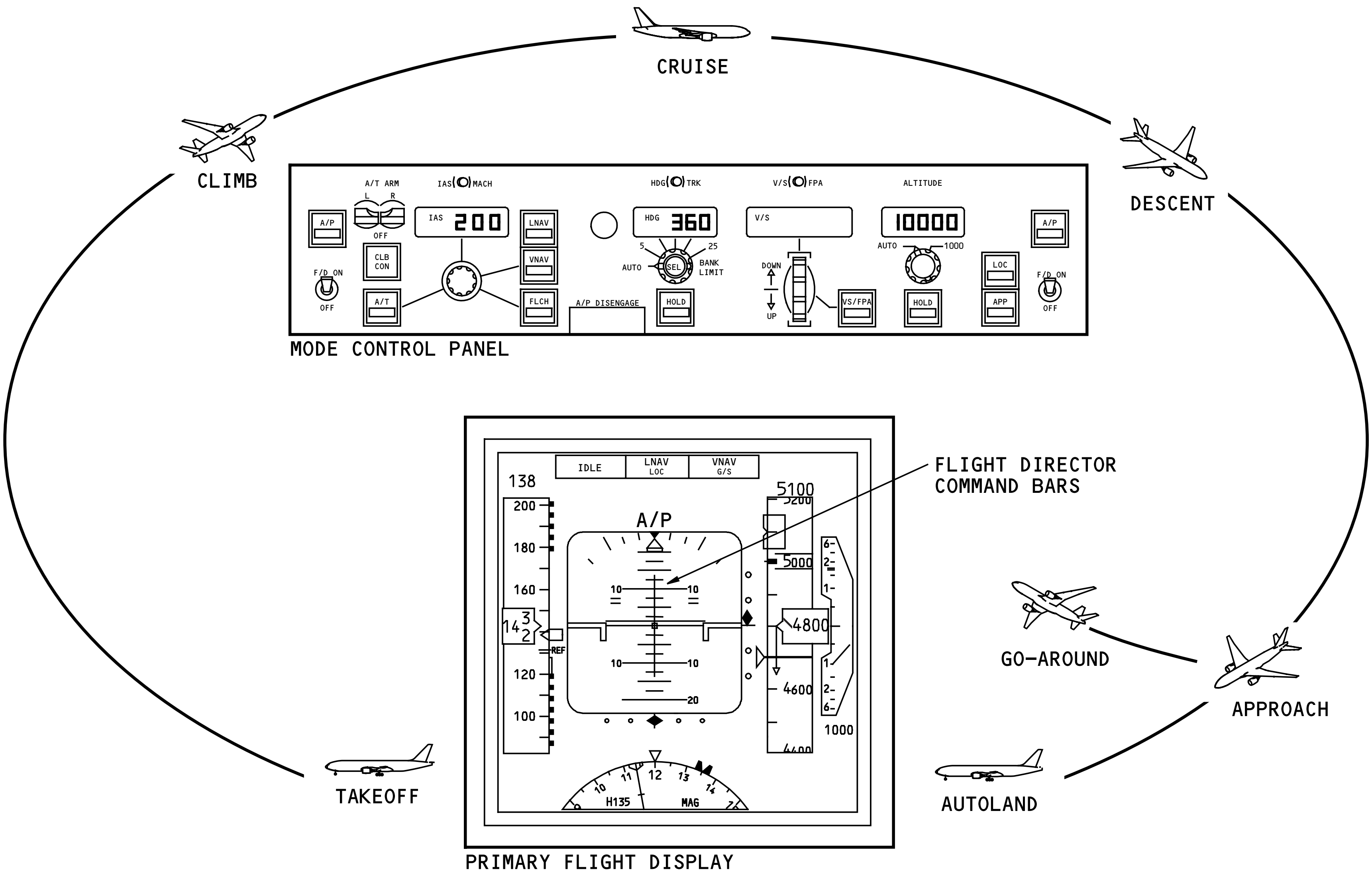
Flight Director

When the flight director switches are on, the flight director command bars show on the primary flight displays (PFDs). The flight crew uses the flight director bars as guides to control the attitude of the airplane.

Abbreviations and Acronyms

A/P	- autopilot
ACE	- actuator control electronics
ADIRU	- air data inertial reference unit
AFDC	- autopilot flight director computer
AFDS	- autopilot flight director system
AGS	- air/ground system
AIMS	- airplane information management system
alt	- altitude
ASCPC	- air supply-cabin pressure controller
BAP	- bank angle protect
bkdrv	- backdrive
CDU	- control display unit
clb	- climb
CMCF	- central maintenance computing function
DLGF	- data load gateway function
EICAS	- engine indication and crew alerting system
F/D	- flight director
FMCF	- flight management computing function
FMCS	- flight management computing system
FPA	- flight path angle
FSEU	- flap/slat electronics unit
G/A	- go-around
G/S	- glideslope
GCU	- generator control unit

hdg	- heading
HYDIM	- hydraulic interface module
LCD	- liquid crystal display
LED	- light emitting diode
LNAV	- lateral navigation
loc	- localizer
MCP	- mode control panel
MFD	- multi-function display
ND	- navigation display
OPAS	- overhead panel ARINC 629 system
PCU	- power control unit
PFC	- primary flight computer
PFD	- primary flight display
PSEU	- proximity sensor electronics unit
pth	- path
SAARU	- secondary attitude air data reference unit
SPD	- speed
TMCF	- thrust management computing function
TO/GA	- takeoff/go-around
trk	- track
V2	- takeoff safety speed
V/S	- vertical speed
VNAV	- vertical navigation
WOW	- weight-on-wheels
X-CH	- cross channel



AUTOPILOT FLIGHT DIRECTOR SYSTEM - INTRODUCTION

AFDS - GENERAL DESCRIPTION

Pilot Interface

The mode control panel (MCP) is the primary interface between the pilot and the autopilot flight director computers (AFDCs).

Other pilot inputs to the AFDCs are the disconnect switches and the go-around (GA) switches.

Sensors

Sensors supply the AFDCs with this information:

- Transducer positions
- Inertial data
- Atmospheric data
- Ground reference data
- Airplane accelerations
- Velocities
- Attitudes.

These are the types of sensors:

- Airplane sensors
- Navigation sensors
- Air data sensors (ADIRU and SAARU).

Aircraft Information Management System (AIMS) Interface

The flight management computer function (FMCF) sends LNAV and VNAV data to the AFDCs.

The thrust management computer function (TMCF) sends autothrottle data to the AFDCs.

The primary display function receives AFDS display data.

Primary Flight Control System (PFCS)

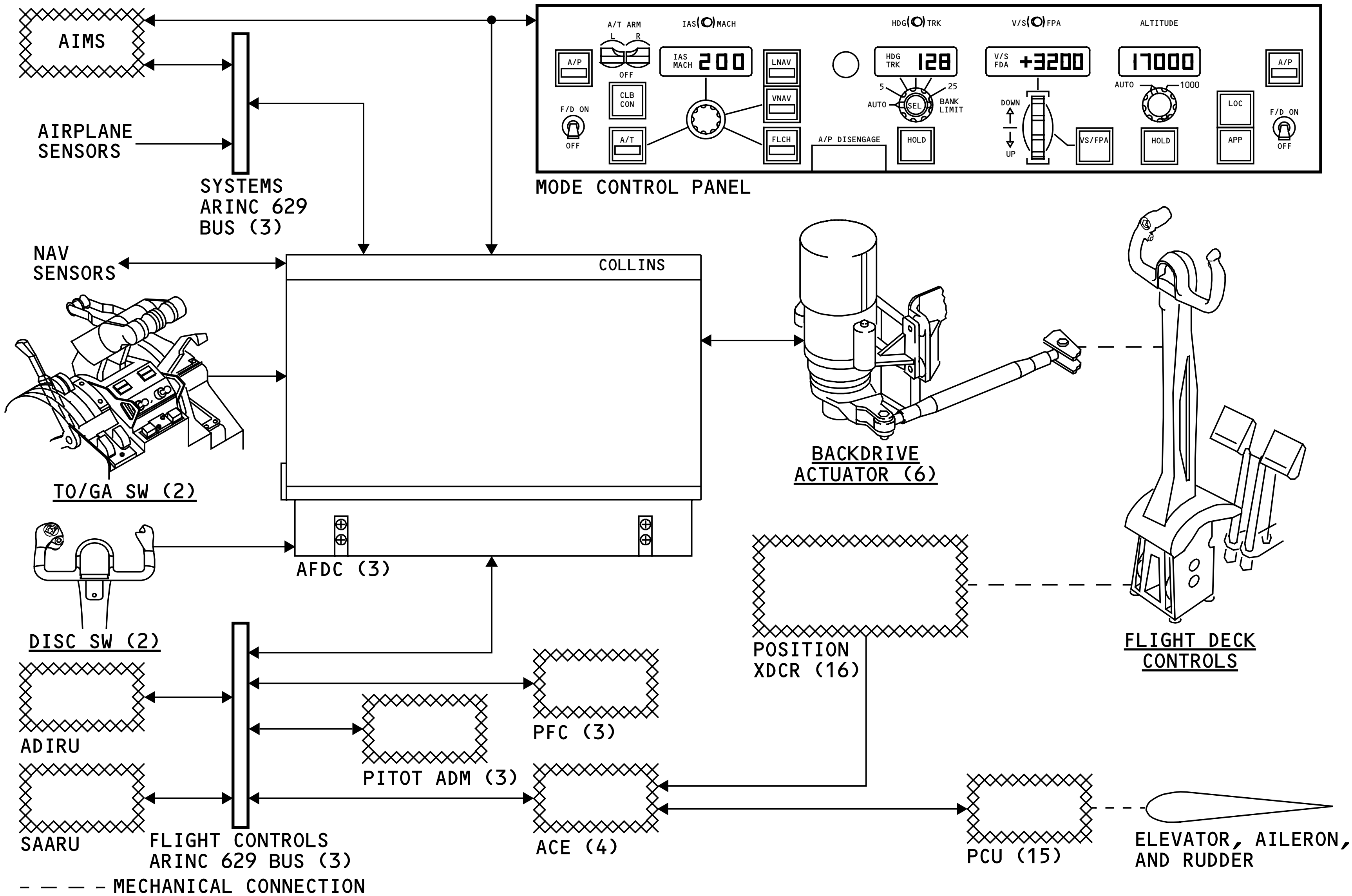
The primary flight computers (PFCs) receive commands from the AFDCs. The PFCs calculate and send surface position commands to the actuator control electronics (ACE).

The ACEs receive surface position commands from the PFCs. The ACEs send commands to the surface power control units (PCU). The PCUs move the surface.

The PFCs also calculate and send backdrive commands to the AFDCs.

Backdrive Actuators

The AFDCs receive backdrive actuator commands from the PFCs. The AFDCs send backdrive commands to the backdrive actuators. The actuators cause the control wheels, control columns, and rudder pedals to move.



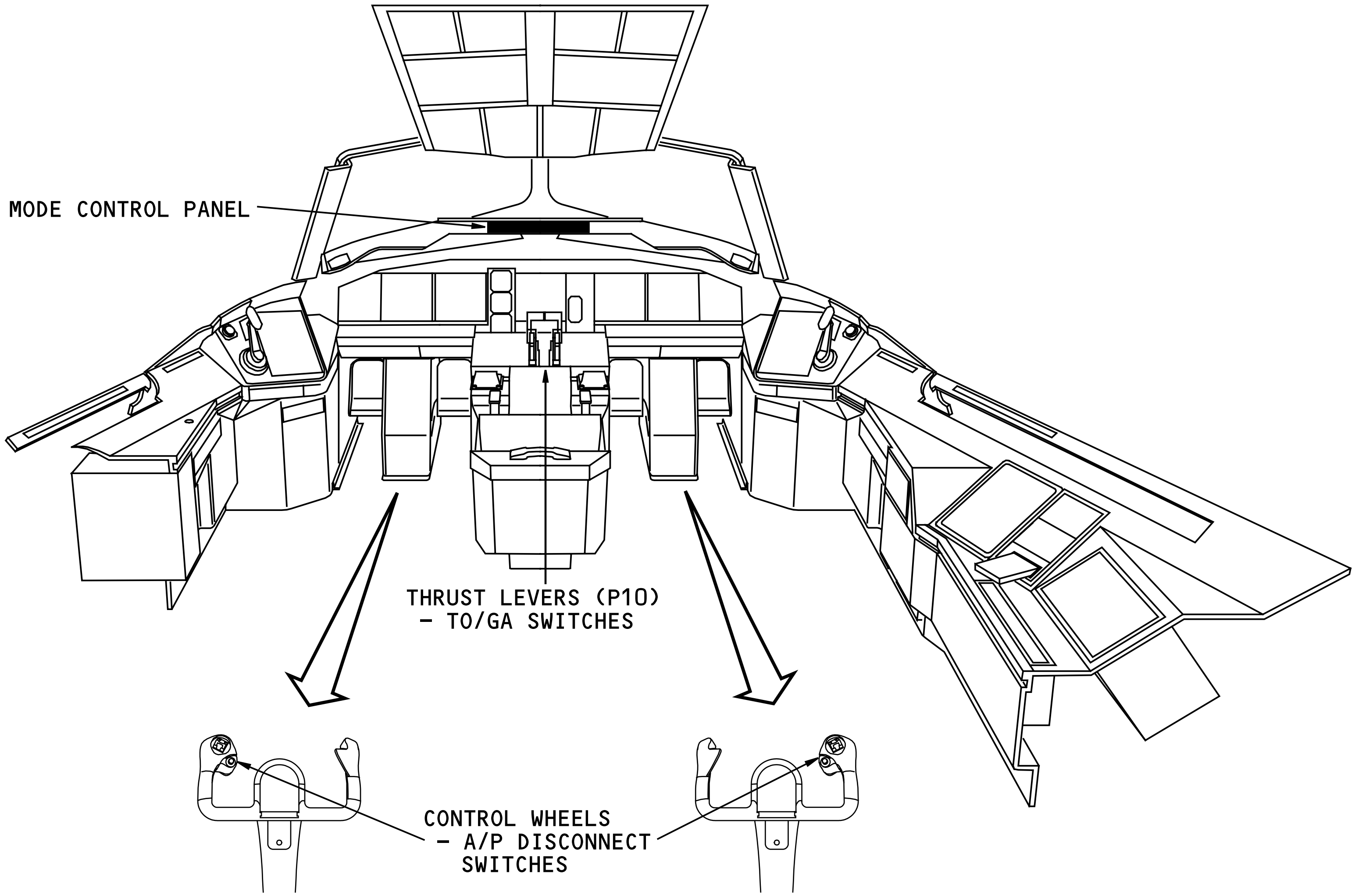
AFDS - GENERAL DESCRIPTION

AFDS - FLIGHT DECK COMPONENT LOCATIONS

AFDS Component Locations In The Flight Deck

The AFDS components in the flight deck are:

- The mode control panel (MCP)
- The takeoff/go-around (TO/GA) switches
- The autopilot disconnect switches.



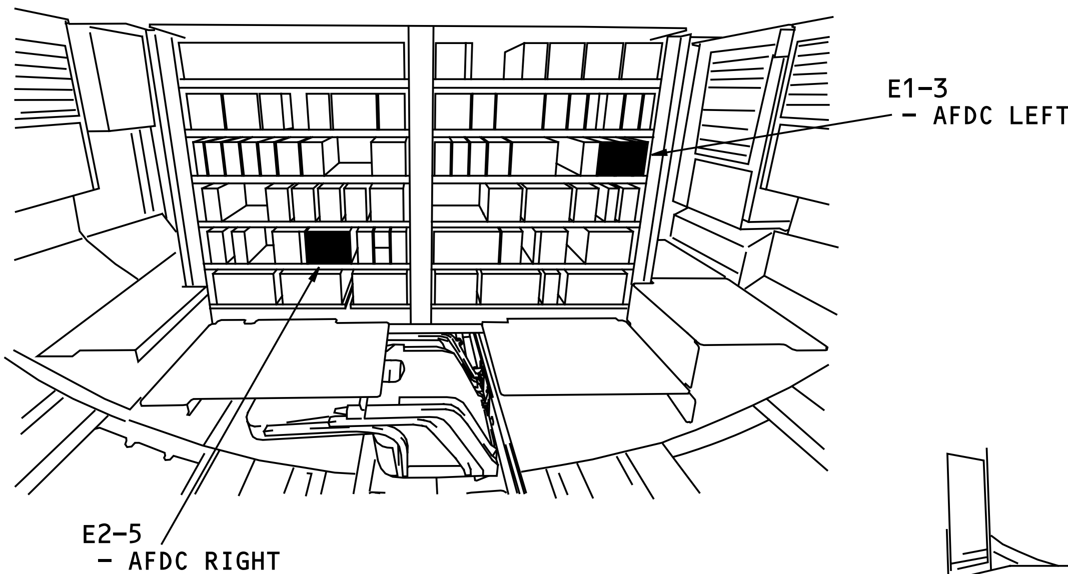
22-11-00-003 Rev 2 09/22/1997

AFDS - FLIGHT DECK COMPONENT LOCATIONS

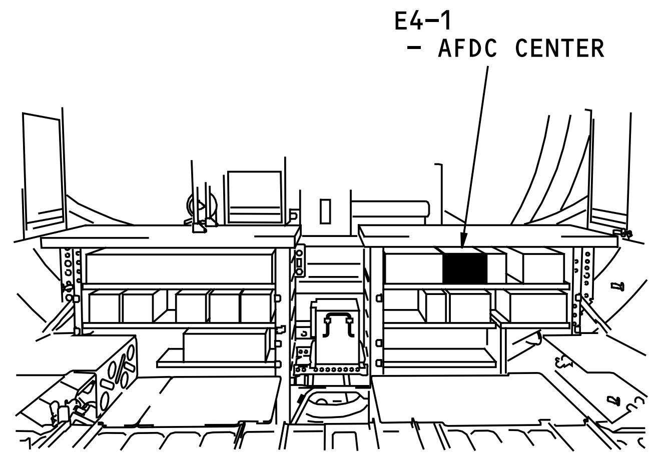
AFDS - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

AFDS Component Locations

The AFDCs are on the E1, E2 and E4 racks in the main equipment center.



MAIN EQUIPMENT CENTER
(LOOKING AFT)



MAIN EQUIPMENT CENTER
(LOOKING FWD)

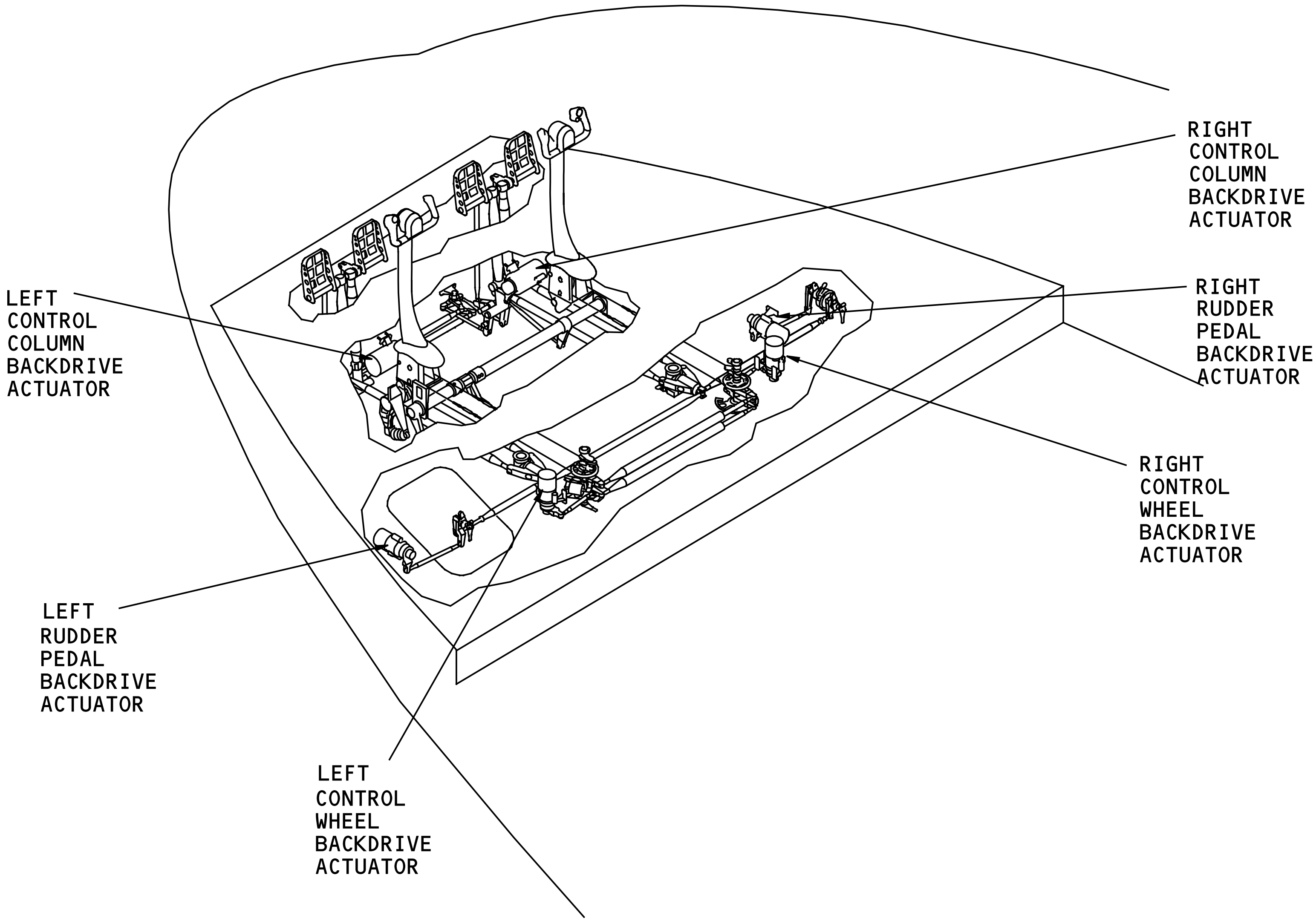
22-11-00-004 Rev 1 09/22/1997

AFDS - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

AFDS - BELOW FLIGHT DECK COMPONENT LOCATIONS

AFDS Component Locations

The backdrive actuators and their mechanical connections are under the flight deck floor.



22-11-00-005 Rev 1

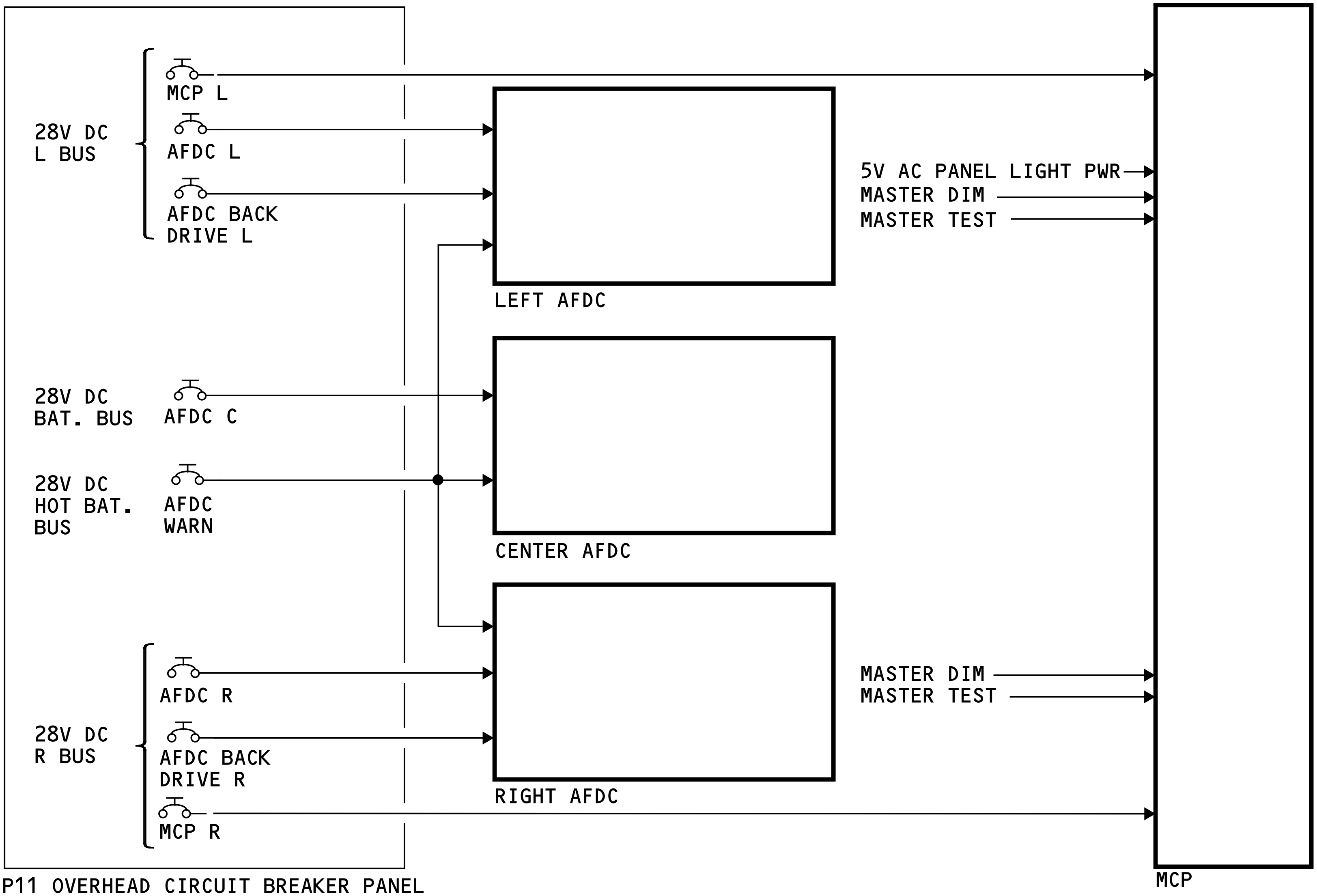
AFDS - BELOW FLIGHT DECK COMPONENT LOCATIONS

AFDS - POWER INTERFACE

AFDS - Power Distribution

The left and right 28V DC buses supply AFDC and backdrive power to their onside AFDCs and the MCP. The 28V DC battery bus supplies AFDC power to the center AFDC. The hot battery bus supplies a second source of power to the warning function of each AFDC.

The MCP lights receive 5 VAC panel light power. Signals from the master dim and test system control the brightness of the panel lights.



AFDS - POWER INTERFACE

AFDS - SYSTEMS ARINC 629 BUS INTERFACE

Systems ARINC 629 Buses

Each AFDC uses the onside systems bus to transmit and receive data.

AIMS Information

Each AIMS cabinet transmits vertical navigation (VNAV) and lateral navigation (LNAV) data to all three buses.

Each control display unit (CDU) transmits and receives LNAV data from the left and right buses.

Flap Slat Electronics Unit (FSEU)

The FSEUs send flap position and slat position data to the AFDCs. The left FSEU transmits to the left and center buses, the right FSEU transmits to the center and right buses.

Proximity Sensor Electronics Unit (PSEU)

The PSEUs send nose gear and nose gear door position information to the AFDCs. The left PSEU transmits to the left and center buses, the right PSEU transmits to the center and right buses.

Weight-on-Wheels (WOW) Cards

The WOW cards are part of the air/ground system (AGS). They transmit WOW data to the left and right buses. The center AFDC receives WOW data from the AFDC cross channel data buses.

Overhead Panel ARINC 629 System (OPAS)

The OPAS sends heading reference switch data to the AFDCs. The left OPAS controller transmits on the left and right buses. The right OPAS controller transmits on the left and right buses.

Electrical Power System

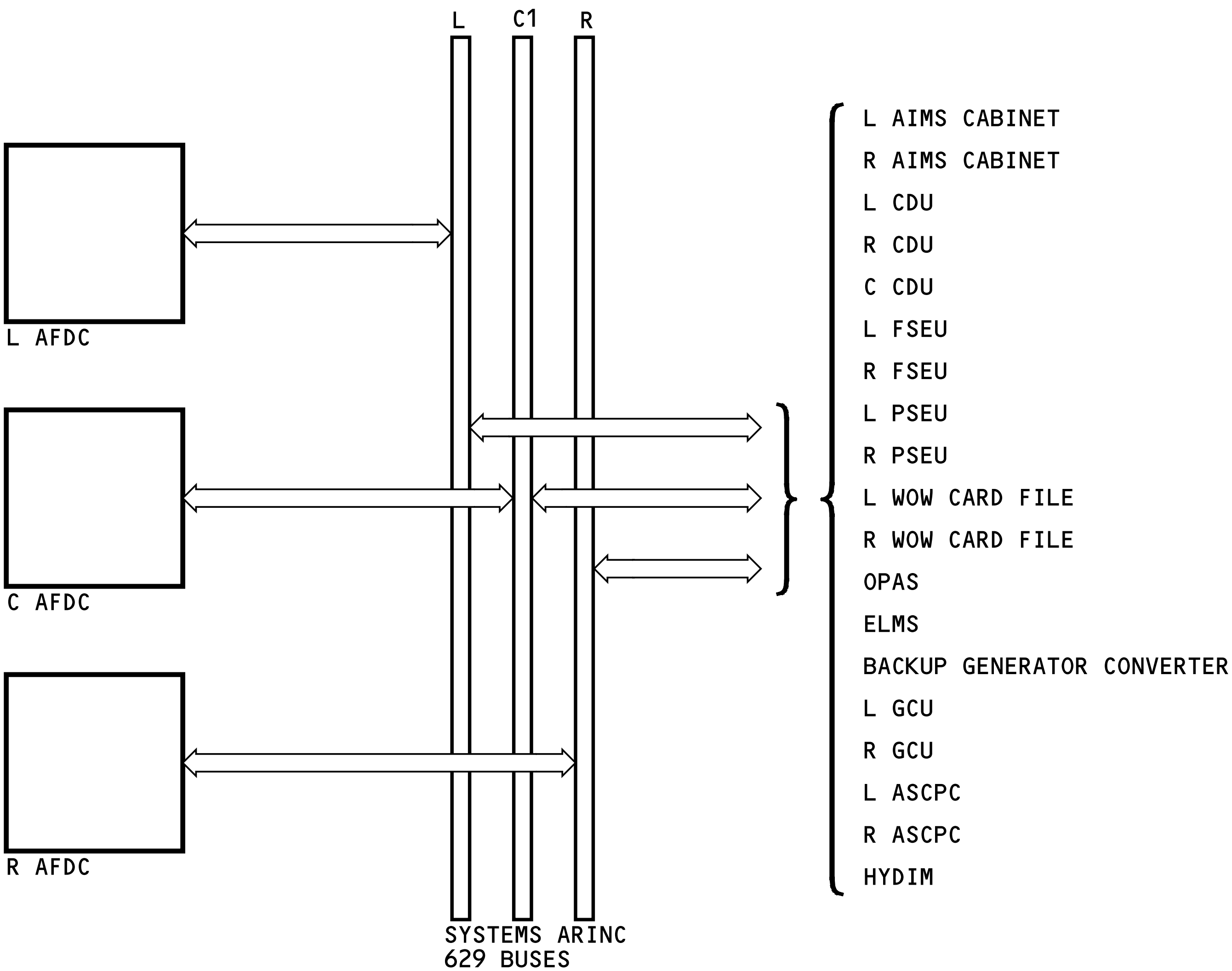
The electrical load management system (ELMS), backup generator converter, and generator control units (GCU) send electrical system status to the left and right AFDCs. They transmit the data to the left and right buses. The center AFDC receives electrical system status from the cross channel data buses. Each AFDC sends bus isolation request to its on-side bus.

Air Supply and Cabin Pressurization Controllers (ASCPC)

Each ASCPC receives AFDC mode status data from the left and right buses.

Hydraulic Interface Modules (HYDIMs)

The HYDIMs send hydraulic system status to the left and right AFDCs. All four HYDIMS transmit to left and right buses. The left and right AFDCs receive the four HYDIMs data on their on-side bus. The center AFDC receives hydraulic status data from the cross channel data buses.



22-11-00-007 Rev 3 08/24/1995

AFDS - SYSTEMS ARINC 629 BUS INTERFACE

AFDC - FLIGHT CONTROLS ARINC 629 BUSES INTERFACE

AFDC

Each AFDC uses the on-side flight controls bus to transmit data. Each AFDC receives data from all three buses.

Primary Flight Control Computers

Each PFC uses the on-side flight controls bus to transmit data. Each PFC receives data from all three buses. Each AFDC receives data from all three PFCs.

The AFDCs send engage requests and autopilot commands to the PFCs. The AFDCs receive backdrive commands, flight deck control input positions, and engagement status.

Air Data Modules (ADMs)

Each ADM receives air/ground and engine running status from their on-side AFDCs.

Air Data Inertial Reference Unit (ADIRU)

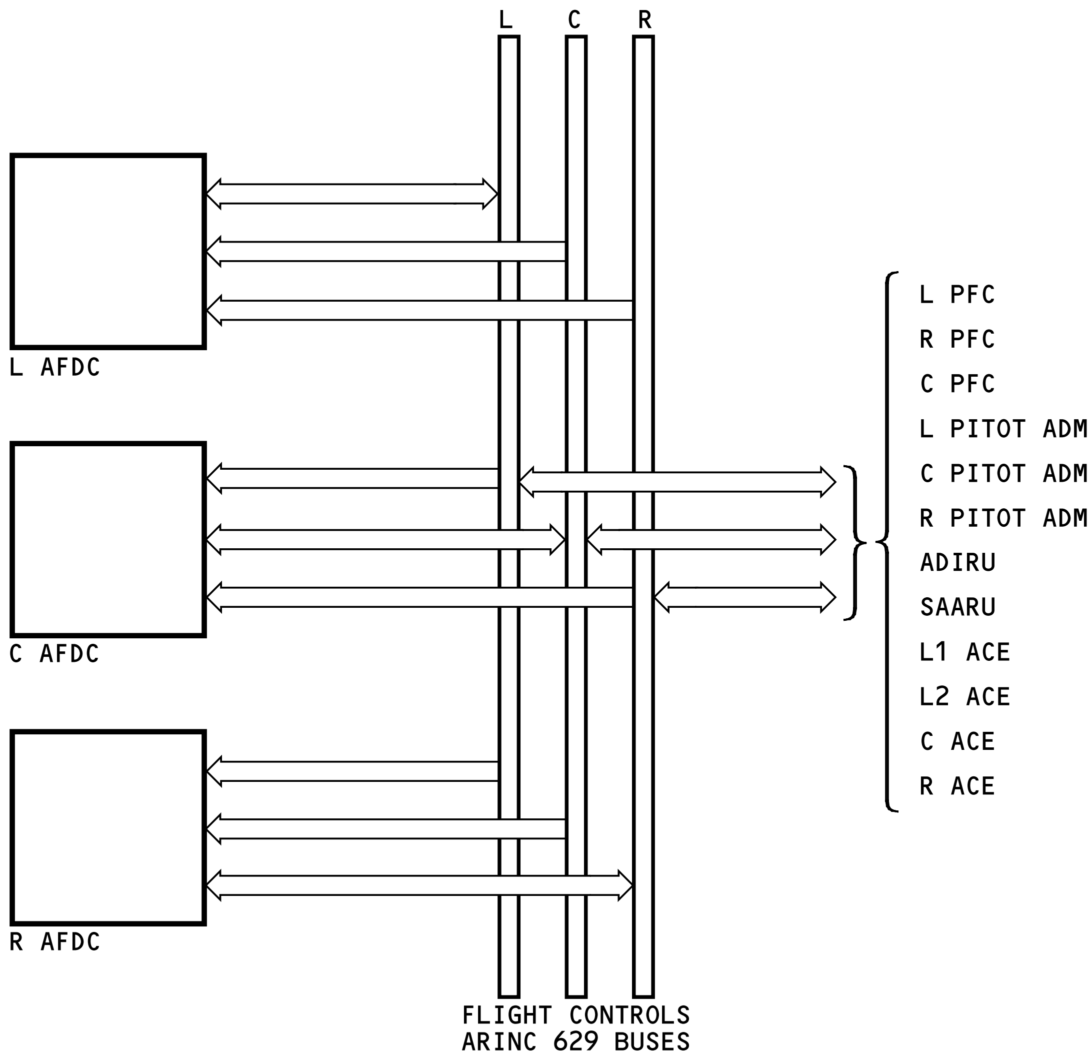
Each AFDC receives attitude and air data from ADIRU on the left and right buses.

Secondary Attitude Air Data Reference Unit (SAARU)

Each AFDC receives attitude and air data from the secondary attitude air data reference unit (SAARU) on the center bus.

Actuator Control Electronics (ACEs)

Each ACE receives flight surface control data from the flight controls bus. Each ACE sends position transducer data from the pilot controls (wheels, columns, pedals) to the PFCS. Each ACE also sends power control unit (PCU) position feedback data to the PFCs.



22-11-00-008 Rev 2 08/24/1995

AFDC - FLIGHT CONTROLS ARINC 629 BUSES INTERFACE

AFDS - ARINC 429 DATA BUS INTERFACE

Mode Control Panel

The mode control panel (MCP) has three 429 input data buses and two 429 output data buses.

The MCP receives mode requests and target values from the three AFDCs on separate data buses.

The MCP sends this information to the three AFDCs:

- Engage requests
- Mode requests
- Target values
- Maintenance data.

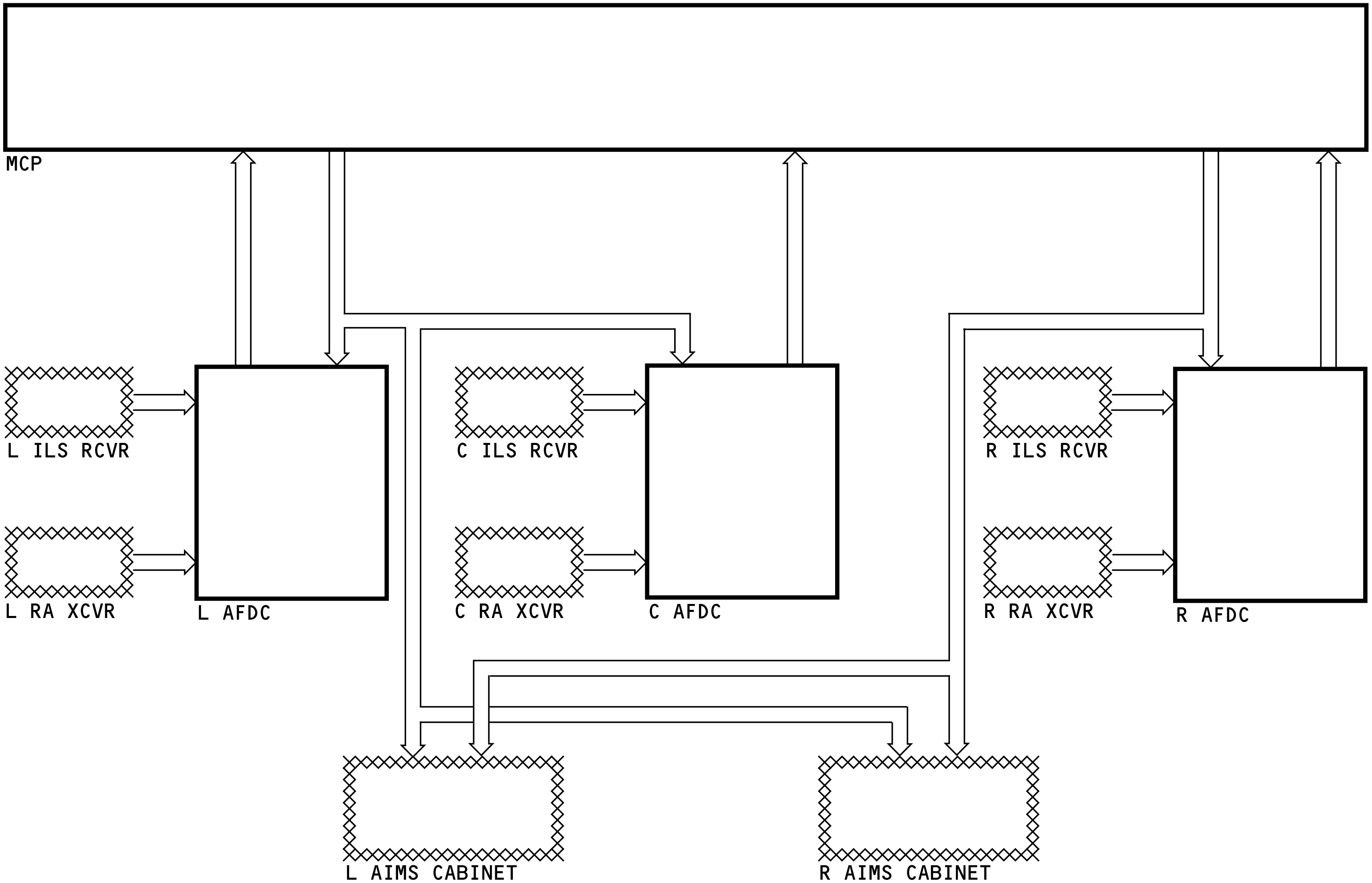
The MCP sends LNAV and VNAV mode requests and maintenance data to the AIMS cabinets.

Instrument Landing System (ILS)

Each ILS receiver sends data to the onside AFDC.

Radio Altimeter Transceiver

Each radio altimeter transceiver sends data to the onside AFDC.



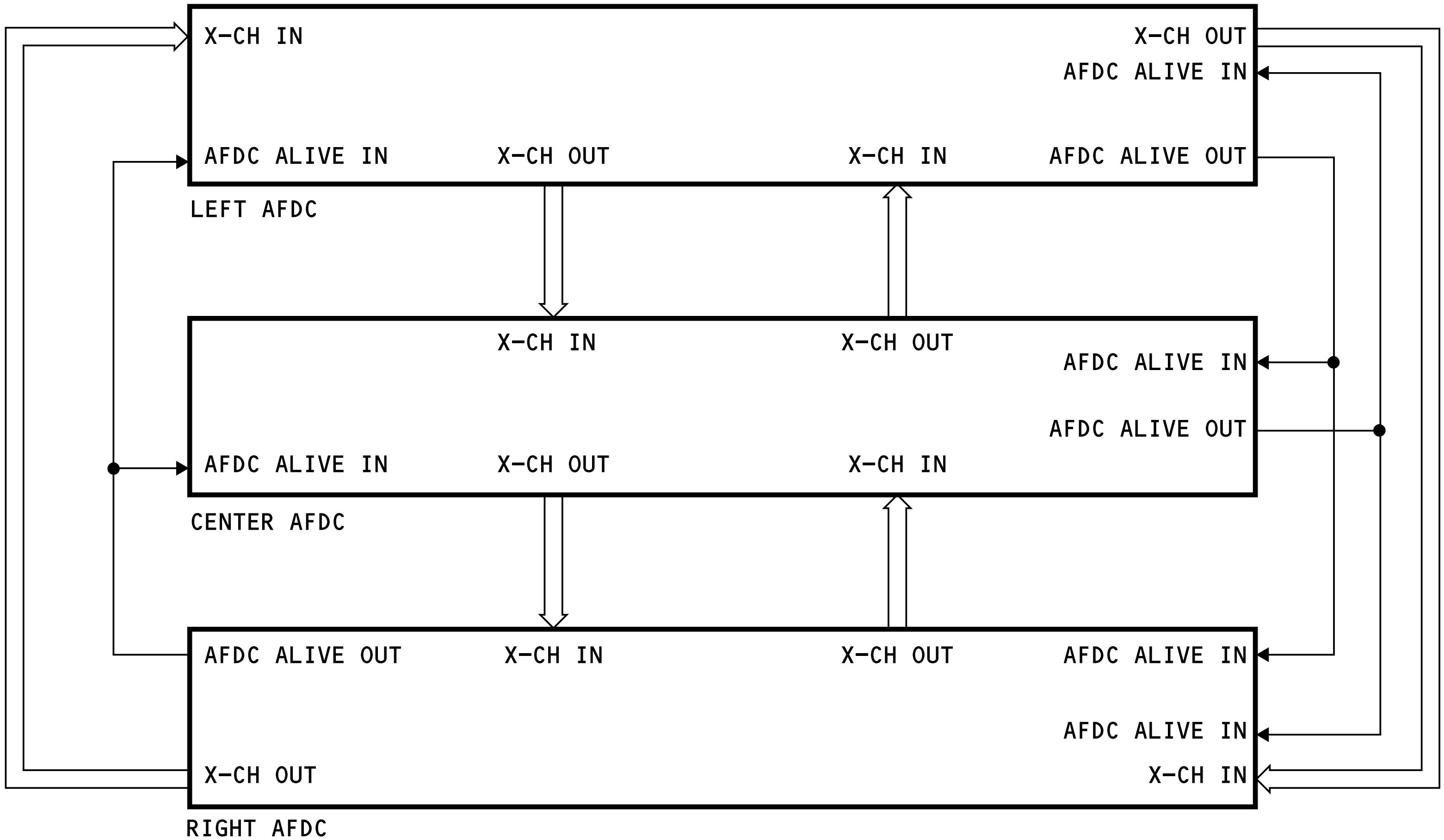
AFDS - ARINC 429 DATA BUS INTERFACE

AFDS - CROSS-CHANNEL DATA INTERFACE

Cross Channel Bus and Discrete Information

Each AFDC receives digital data on cross-channel buses for monitor, signal selection and synchronization functions.

Each AFDC continuously sends an AFDC ALIVE discrete to the other AFDCs if it does not detect any internal faults.



22-11-00-010 Rev 2 08/24/1995

AFDS - CROSS-CHANNEL DATA INTERFACE

AFDS - MISCELLANEOUS ANALOG DISCRETES INTERFACE

General

These discrete inputs to the AFDC are from the:

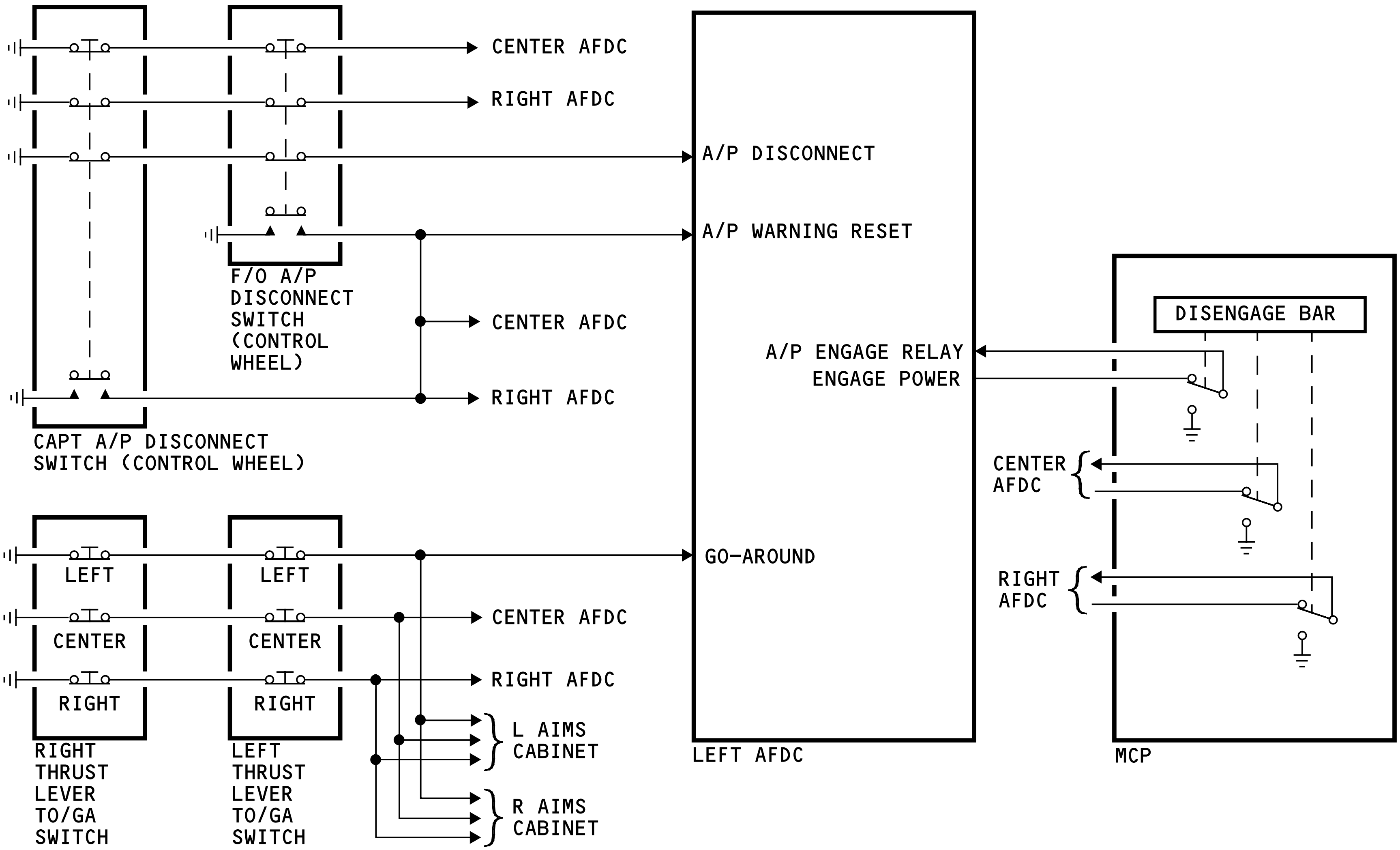
- Autopilot disconnect switches
- Takeoff/go-around (TO/GA) switches
- Autopilot disengage bar.

Interface

Each control wheel has an autopilot disconnect switch. These switches supply the A/P disengage and A/P warning reset discretes to each AFDC.

Two takeoff go-around (TO/GA) switches on the left and right thrust levers supply a discrete to each AFDC. This discrete also goes to both AIMS cabinets.

The disengage bar on the MCP supplies a secondary method to disengage the AFDCs. When the bar is in the up position, the disengage switches supply power to the engage relay in the AFDCs. When the bar is in the down position, the disengage switches supply a ground to this relay.



22-11-00-011 Rev 3 01/14/1998

AFDS - MISCELLANEOUS ANALOG DISCRETES INTERFACE

AFDS - WARNING ANALOG DISCRETES INTERFACE

Warning Electronic System

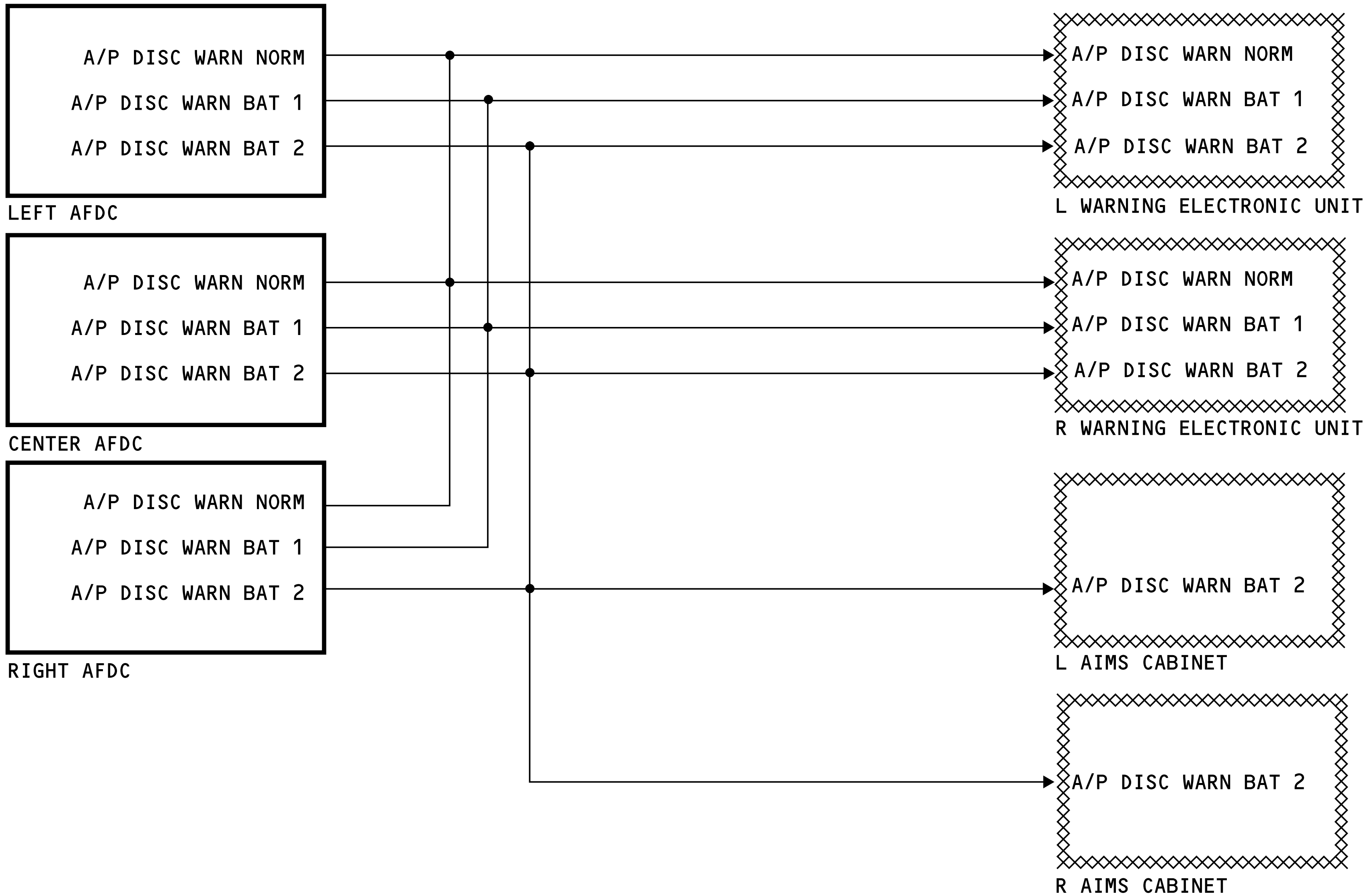
These signals go to the warning electronic units (WEUs) when there is an autopilot disconnect:

- Autopilot disconnect warning normal (A/P DISC WARN NORM)
- Autopilot disconnect warning battery 1 (A/P DISC WARN BAT 1)
- Autopilot disconnect warning battery 2 (A/P DISC WARN BAT 2)

When the WEUs receive at least two of the three warning signals, they make the master warning lights show and the siren sounds.

AIMS

The A/P DISCONNECT WARN BAT 2 discretes are connected together outside of the AFDCs and go to the two AIMS cabinets. The primary display function of AIMS shows a warning message on EICAS.



22-11-00-012 Rev 2 09/22/1997

AFDS - WARNING ANALOG DISCRETES INTERFACE

AFDS - ILS ANALOG DISCRETES INTERFACE

Tune Inhibit Discrete

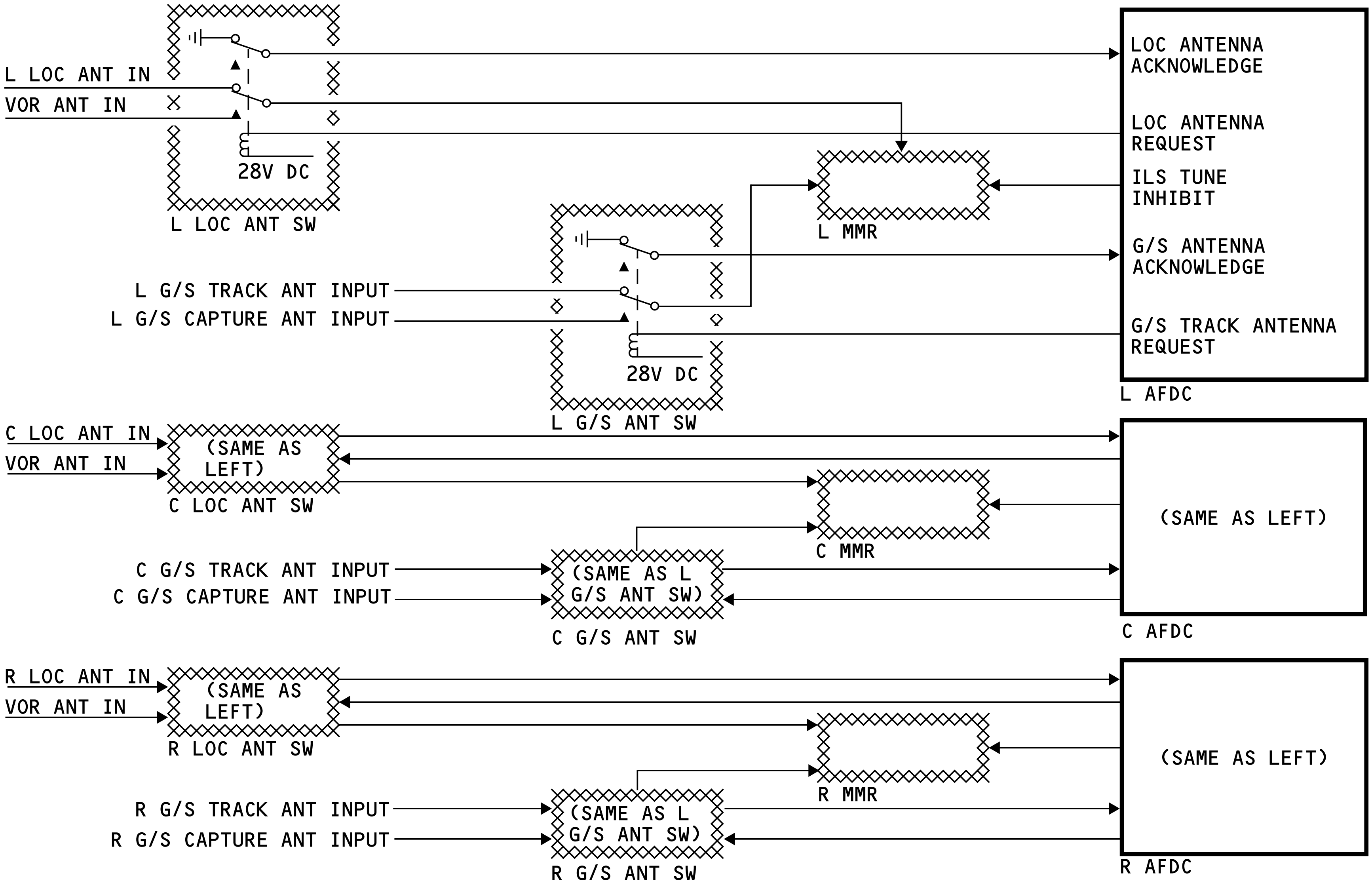
During an approach with the flight director or autopilot engaged, the AFDCs send tune inhibit discretes to the multi-mode receivers (MMRs). The tune inhibit discrete inhibits flight crew from tuning the ILS receivers.

Antenna Switch Interface

Each AFDC controls its antenna switches for the LOC and G/S antennas.

The LOC antenna request discrete signal controls a localizer antenna switch that connects the LOC antenna to the multi-mode receiver (MMR). One set of switch contacts sends feedback to the AFDC to show the position of the relay.

The G/S capture antenna request discrete signal controls a glideslope antenna switch that connects the G/S track antenna to the multi-mode receiver (MMR). One set of switch contacts sends feedback to the AFDC to show the position of the relay.



AFDS - ILS ANALOG DISCRETES INTERFACE

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AFDS - MODE CONTROL PANEL - FUNCTIONAL DESCRIPTION

General

The major components of the MCP are:

- Power supplies (A and B)
- Microprocessors (A and B)
- Fluorescent tube control
- LCDs and encoders
- Push-button and toggle switches.

Power Supplies A and B

Power supplies A and B receive 28v dc from the left and right 28v dc buses. The MCP functions with either source of 28v dc.

Power supplies A and B supply +12v dc, -12v dc and +5v dc to their microprocessors and logic circuits. Power supplies A and B also supply +14v dc to power supply C which is part of the fluorescent tube control.

Microprocessor A and B

The MCP contains two separate microprocessor channels.

Microprocessor A receives data from the Left and center AFDC. Microprocessor B receives data from the right and center AFDC.

Microprocessor A sends data to the left and center AFDCs. Microprocessor B sends data to the right AFDC.

To make sure all three AFDCs use data from one MCP processor, all AFDCs use the microprocessor data sent to the master AFDC.

When the left AFDC is master, microprocessor A writes to the LCD displays. The right and center AFDCs receive microprocessor A data through the AFDC cross-channel buses.

When the right AFDC is master, microprocessor B writes to the LCD displays. The left and center AFDCs receive microprocessor B data through the AFDC cross-channel buses.

Training Information Point

If a microprocessor fails or if its interface to the AFDC fails, the MCP sends a request to the CMCF to make an EICAS status message show. The status message is MCP CTRL PANEL LANE.

Fluorescent Tube Control

The fluorescent tube control circuit supplies current to drive the tube filament and the tube heater.

A heater coil is around the fluorescent tube. A temperature sensor next to the tube operates the heater when the sensor detects a temperature below 40F.

AFDS - MODE CONTROL PANEL - FUNCTIONAL DESCRIPTION

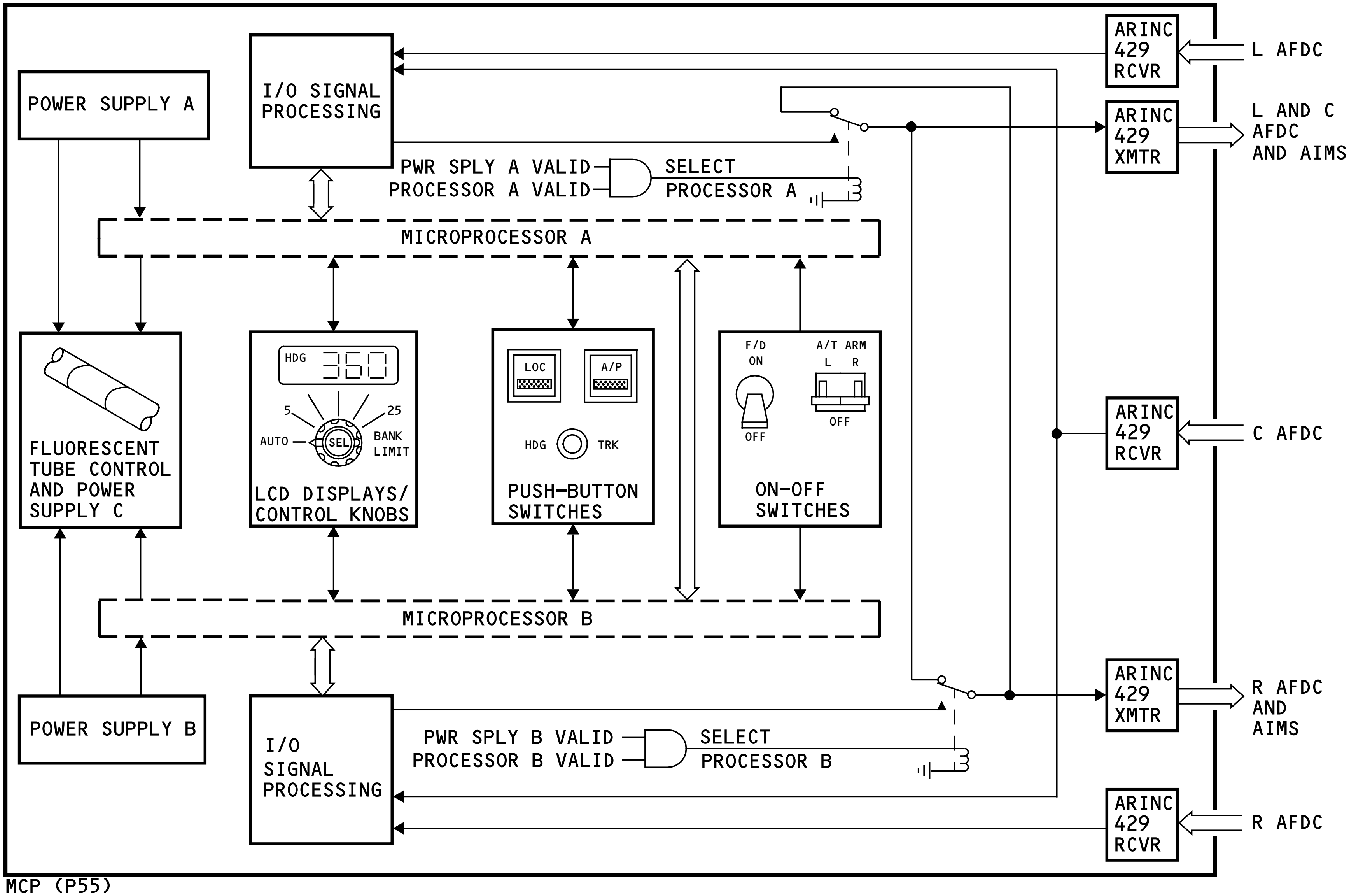
Liquid Crystal Displays (LCD) And Control Knob Encoders

There are four LCDs. They display mode reference values. The values change when you rotate the selector or when the AFDCs command a new reference value.

Microprocessor A and B drive each LCD. Each selector connects to two encoders. Each encoder sends data to the onside microprocessor.

Push-Button And Toggle Switches

Each push-button and toggle switch has two sets of contacts. One set connects to microprocessor A and one set connects to microprocessor B. The LED annunciators in the push-button switches also connect to each microprocessor.



AFDS - MODE CONTROL PANEL - FUNCTIONAL DESCRIPTION

AFDS - MODE CONTROL PANEL - CONTROLS AND DISPLAYS

Autopilot (A/P) Engage Switches

Push either switch to engage all available A/P channels. The LEDs in both switches come on.

Autothrottle (A/T) Arm Switches

The switches arm the A/T and digital trimmer control for each engine. Both switches are normally left in the ARM position. When you set the switches to the OFF position, the A/T disconnects.

IAS/MACH Reference Switch

This switch controls the reference the IAS/MACH window shows.

IAS/MACH Window

The window shows indicated airspeed (IAS) or MACH number. IAS shows from 100 to 399 knots in one knot increments. Mach number shows from 0.400 to 0.900 MACH in increments of 0.001 MACH.

At AFDC power up, the window shows 200 knots. The window is normally blank when VNAV is active. If VNAV is not active, the window shows the current target airspeed/mach.

Mode Switches (8)

These switches request A/P, F/D, and A/T modes.

Light Sensor

A photo diode light sensor on the MCP front panel monitors ambient lighting. It controls the brightness of the LCDs.

Heading/Track (HDG/TRK) Reference Switch

This switch controls the reference for the Heading/ Track window.

Heading/Track Window

The window shows heading or track angle in increments of one degree. The window range is from 001 to 360 degrees.

At AFDC power-up, the window shows 360 degrees. Runway heading shows at localizer capture.

Vertical Speed/Flight Path Angle (V/S/FPA) Reference Switch

This switch controls the reference for the vertical speed/flight path angle window.

Vertical Speed/Flight Path Angle Window

The vertical speed range is +6000 FPM to -8000 FPM. The flight path angle range is +9.9 degrees to -9.9 degrees.

AFDS - MODE CONTROL PANEL - CONTROLS AND DISPLAYS

The window shows four dashes when vertical speed and flight path angle modes are not active.

Altitude Window

The altitude range is from 0 to 50000 feet. The increment is variable.

The altitude in the window is also the altitude alert value for the caution and warning system. At AFDC power-up the display shows 10000 feet.

Flight Director (F/D) Switches

The F/D switches make the F/D displays show on the primary flight displays (PFDs). When the airplane is on the ground and you move a switch to the ON position, the F/D takeoff (TO) mode indications show on the associated PFD.

Altitude Increment Selector (Outer) and Altitude Selector (Inner)

The control has two concentric selectors.

The inner selector changes the reference altitude in the window. If you push the selector while in VNAV, you activate altitude intervention.

The outer selector changes the window increment. With the outer selector in the 1000 position, the inner selector changes the window at 1000 feet/detent.

With the outer selector in the AUTO position, the window change rate is 100 feet/detent. The altitude window also shows the barometric minimums you selected on both EFIS control panels.

For example, you select barometric minimum values of 290 feet on the left EFIS control panel, and 330 feet on the right EFIS control panel. As you rotate the outer selector, the altitude on the window changes as follows:

- 100
- 200
- 290
- 300
- 330
- 400
- 500, etc.

If you select the same barometric minimums value on both EFIS control panels, the MCP shows the value only once.

Once the values from the EFIS control panels show on the MCP, they stay on the MCP even if you change the EFIS control panel barometric minimums.

The MCP rounds up to the next 10 feet. So if you select a barometric minimums value of 181 feet, the MCP shows 190 feet.

AFDS - MODE CONTROL PANEL - CONTROLS AND DISPLAYS

Vertical Speed/Flight Path Angle Selector

Rotate the selector up to decrease the value. Rotate the selector down to increase the value.

Bank Limit Selector (Outer), Heading/Track Selector (Middle), and Heading/Track Select Switch (Inner)

The control has two concentric selectors and one push-button.

The bank limit selector (outer) selects the bank angle limit used in the heading/track select mode.

The heading/track selector (middle) changes the value the window shows.

The heading/track select switch (inner) is a push-button switch. Push this switch to request the heading select or track select mode.

Autopilot Disengage Bar

The bar connects to three toggle switches. The bar is normally in the up position. Push the bar down to disengage all AFDCs.

IAS/MACH Selector

When not in VNAV, the IAS/MACH window shows the current target airspeed. Turn the IAS/MACH selector to change the target airspeed.

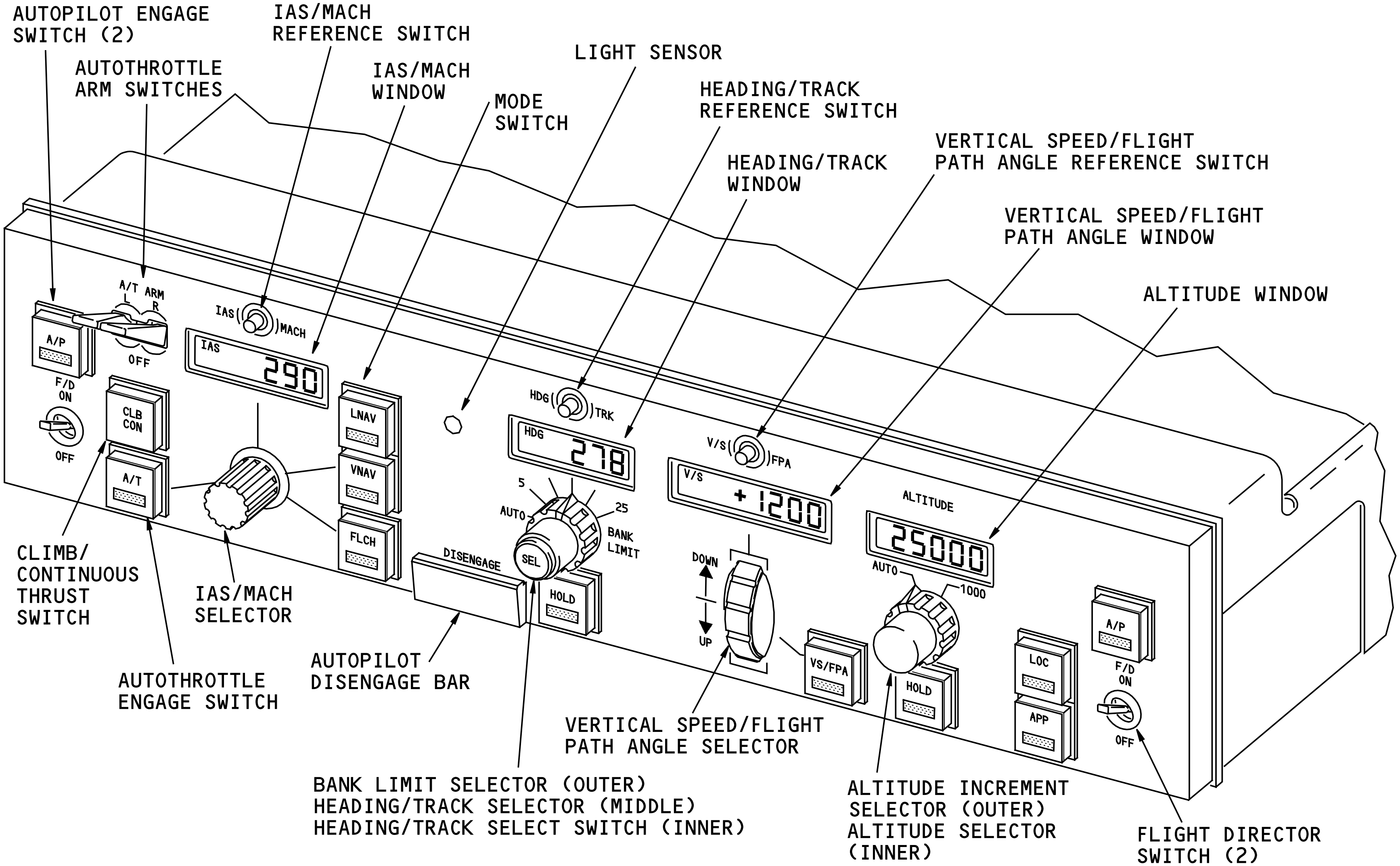
In VNAV, the IAS/MACH window is normally blank. If you push the selector, the window unblanks to show the current FMCF target airspeed. You can then turn the IAS/MACH selector to change the target airspeed. This is speed intervention.

Autothrottle (A/T) Engage Switch

This switch engages the autothrottle.

Climb/Continuous (CLB/CON) Thrust Switch

When two engines are in operation, this switch changes the autothrottle thrust reference to climb (CLB). When only one engine is in operation, it changes the thrust reference to maximum continuous (CON).



22-11-00-017 Rev 4 03/24/1998

AFDS - MODE CONTROL PANEL - CONTROLS AND DISPLAYS

AFDS - AUTOPILOT FLIGHT DIRECTOR COMPUTER

Purpose

The autopilot flight director computer (AFDC) calculates:

- Flight director (F/D) commands
- Autopilot commands
- Backdrive actuator commands.

Physical Description

The AFDC has modules, sub-assemblies, and a chassis assembly in an ARINC 600 8 MCU box. The top and bottom covers let cooling air to flow from the bottom to the top. The AFDC is a line replaceable unit (LRU). AFDC internal components are not LRUs.

Software Loading

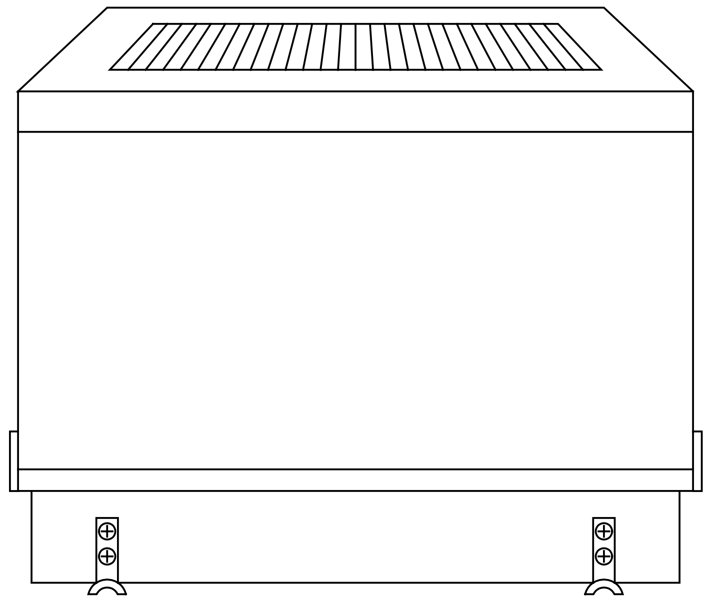
The AFDCs must have operational software loaded in them. Shop personnel can load the software, or you can use the MAT to do a software load.

System Configuration

Use the MAT to monitor the AFDS configuration. You can monitor:

- A/P hardware part number
- A/P software number
- A/P serial number
- A/P configuration pins
- A/P compatibility pins
- A/P interlock pins
- A/P options list.

This information shows for each AFDC.



22-11-00-018 Rev 1

AFDS - AUTOPILOT FLIGHT DIRECTOR COMPUTER

AFDS - AUTOPILOT FLIGHT DIRECTOR COMPUTER - FUNCTIONAL BLOCK DIAGRAM

General

This is a block diagram of the autopilot flight director computer (AFDC).

Input Signal Selection

Each ARINC and discrete input/output (I/O) section monitors and selects input signals. Each I/O section monitors the signal validity first. If the validity check is good, the I/O section selects the signal by one of these methods:

- Mid-value selection which uses the middle value of the three signals. Radio altitude (RA) and instrument landing system (ILS) are examples of signals selected by mid-value.
- Priority selection for signals with two sources (left, right). For example, the air data inertial reference unit (ADIRU) is the normal source of air and inertial reference data. If the ADIRU fails, the AFDC selects the secondary attitude air data reference unit (SAARU).
- Forced selection for airplane information management system (AIMS) data. AIMS tells the AFDC which signal to use.

AFDC Processors

The AFDC has three processors. Processors A and B receive digital backdrive commands from the primary flight computers (PFCs). They convert the digital backdrive commands into analog. Processor C calculates the autopilot and flight director control laws. Processor C also does these functions:

- Test and data load.
- Engage/disengage logic
- Failure detection/fault response monitor

Power Supplies

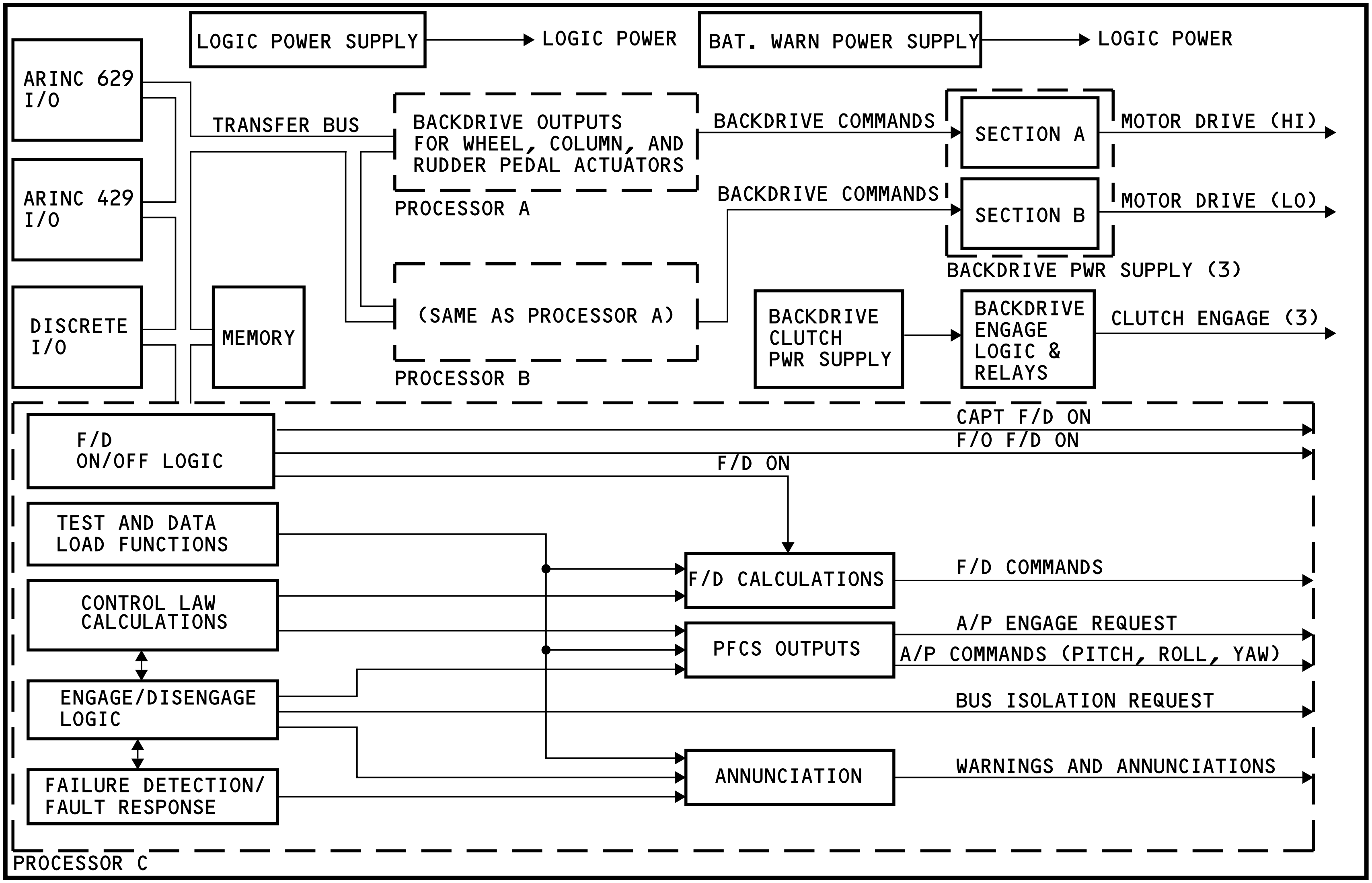
The logic power supply sends +5v dc, +15v dc, -15v dc, and +28v dc to internal components of the AFDC. It also sends +28v dc disengage power to the mode control panel (MCP).

The backdrive clutch power supply sends +28v dc to the backdrive clutch engage logic and relays.

Three backdrive power supplies send drive signals to the wheel, column, and rudder pedal backdrive actuators. Each power supply is a variable voltage push-pull power supply that sends +/-50v dc to each backdrive actuator. Commands from the A and B processors control the variable output of the power supplies.

The center AFDC does not connect to backdrive actuators and does not use its backdrive power supplies.

The battery warning power supply sends +28v dc to the battery warning logic.



AFDC (TYPICAL)

22-11-00-019 Rev 4 04/26/96

AFDS - AUTOPILOT FLIGHT DIRECTOR COMPUTER - FUNCTIONAL BLOCK DIAGRAM

AFDS - BACKDRIVE ACTUATOR INSTALLATION - 1

Purpose

The backdrive actuators are variable torque motors. They move the control columns, control wheels, and rudder pedals during autopilot operation. This movement gives the flight crew an indication of the autopilot commands that go to the primary flight computers (PFCs).

A control wheel backdrive actuator also operates when the bank angle protection (BAP) function operates. The actuator supplies a variable torque to the roll control system if the airplane bank angle exceeds 35 degrees. BAP is available with the autopilot engaged or disengaged.

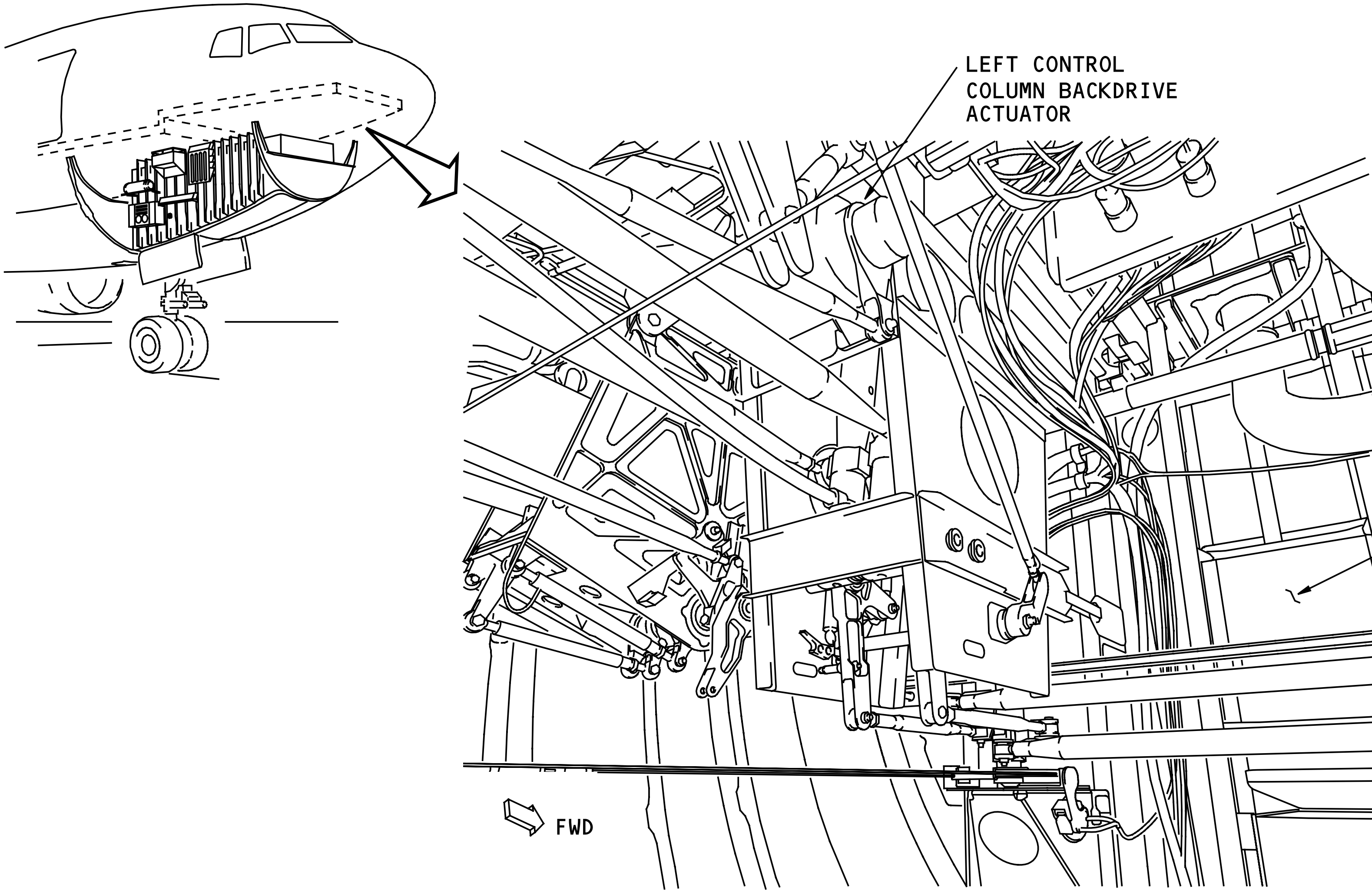
There are two backdrive actuators for each of the control columns, control wheels, and rudder pedals. The backdrive actuators are interchangeable.

Location

The six backdrive actuators are below the floor in the 41 section. Access to the control wheel and rudder pedal backdrive actuators is by the main equipment center access door. Access to the control column backdrive actuators is through the forward equipment center access door.

Physical Description

Each actuator weighs about 8 lbs (3.6 kg) and attaches to the airplane structure with four bolts.



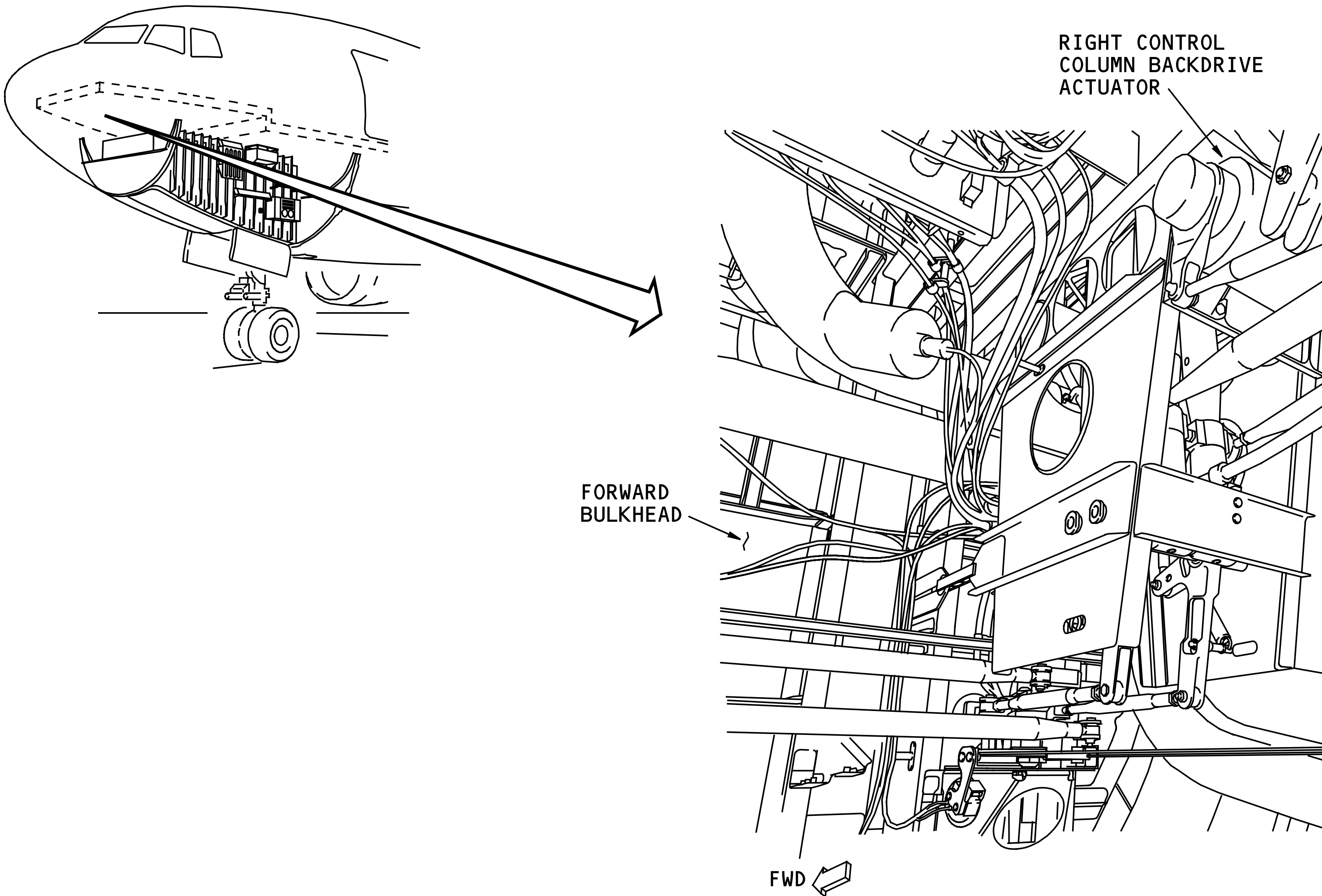
FORWARD EQUIPMENT CENTER BELOW FLIGHT DECK FLOOR

AFDS - BACKDRIVE ACTUATOR INSTALLATION - 1

AFDS - BACKDRIVE ACTUATOR INSTALLATION - 2

General

The right control column backdrive actuator is below the flight deck floor. Access is through the forward equipment center.



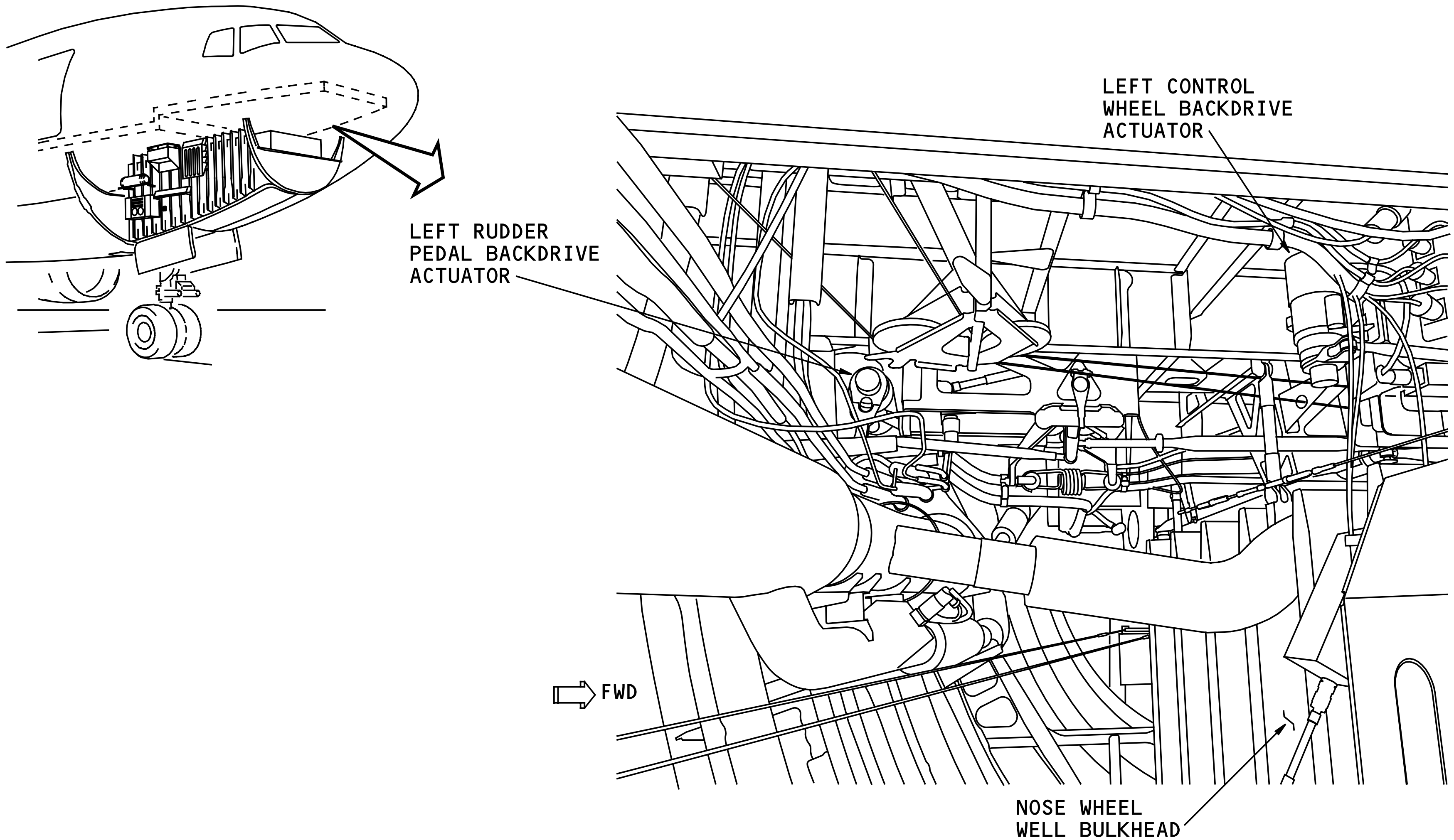
AFDS - BACKDRIVE ACTUATOR INSTALLATION - 2

AFDS - BACKDRIVE ACTUATOR INSTALLATION - 3

General

The left control wheel backdrive actuator and the left rudder pedal backdrive actuator are below the flight deck floor.

Access is through the left side of the main equipment center.



BETWEEN FORWARD EQUIPMENT CENTER AND MAIN EQUIPMENT CENTER BELOW FLIGHT DECK FLOOR

22-11-00-023 Rev 2

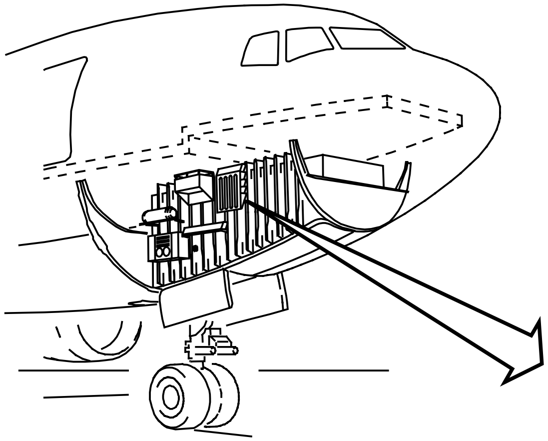
AFDS - BACKDRIVE ACTUATOR INSTALLATION - 3

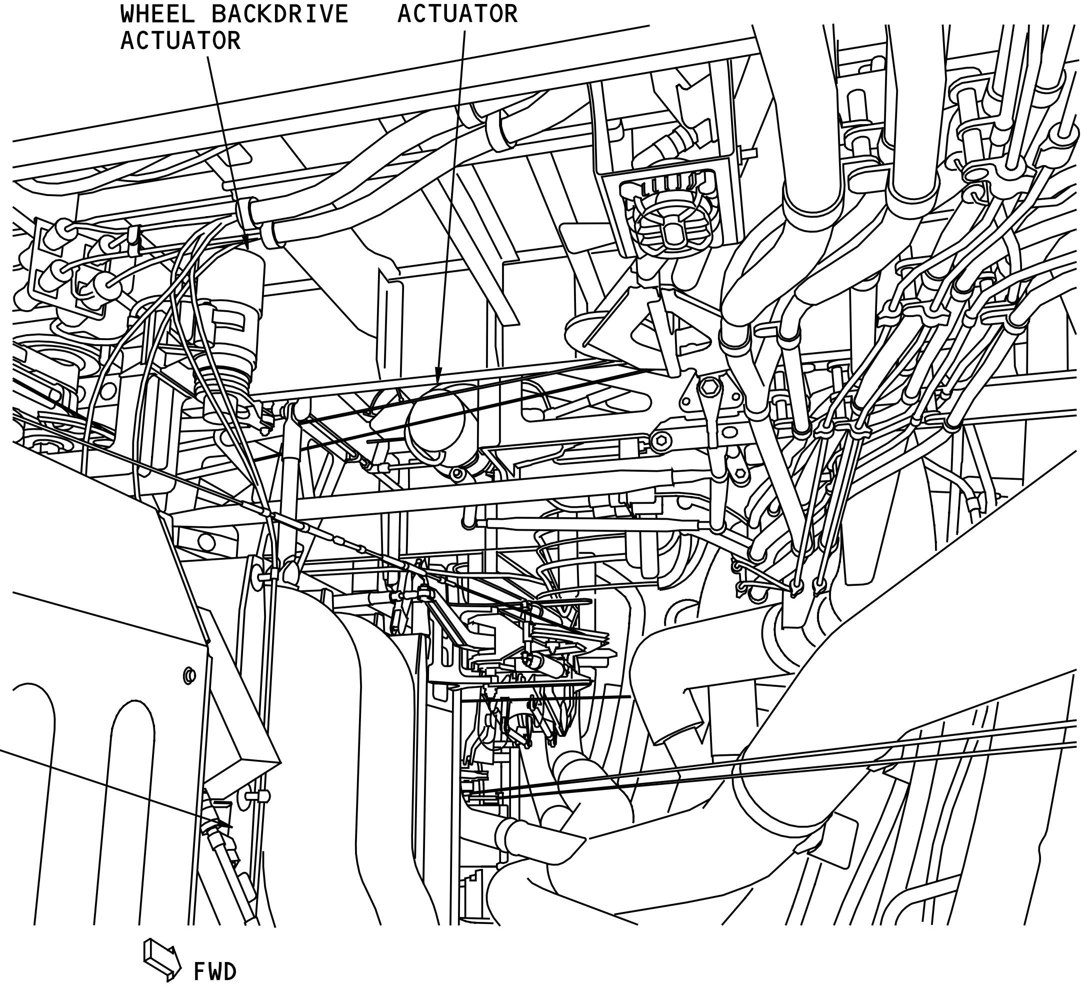
AFDS - BACKDRIVE ACTUATOR INSTALLATION - 4

General

The right control wheel backdrive actuator and the right rudder pedal backdrive actuator are below the flight deck floor.

Access is through the right side of the main equipment center.





BETWEEN FORWARD EQUIPMENT CENTER AND MAIN EQUIPMENT CENTER BELOW FLIGHT DECK FLOOR

AFDS - BACKDRIVE ACTUATOR INSTALLATION - 4

22-11-00-024 Rev 2

AFDS - BACKDRIVE ACTUATOR - FUNCTIONAL DESCRIPTION

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AFDS - BACKDRIVE ACTUATOR - FUNCTIONAL DESCRIPTION

General

Each backdrive actuator contains:

- Two tachometers
- A DC motor
- An engage clutch
- An override slip clutch.

Tachometers

The two tachometers supply motor rate feedback to the AFDC processors. Tachometer A feedback goes to processor A. Tachometer B feedback goes to processor B.

DC Motor

The AFDC supplies a variable dc current to the motor. The current to the motor limits the motor torque.

Engage Clutch

The AFDC supplies 28v dc to operate the engage clutch. The clutch connects the output crank to the motor and gear train. With the clutch not engaged, the output crank is free to move with the flight controls.

Override Slip Clutch

The override slip clutch lets the pilot override the backdrive actuator if it jams.

Actuator Authority

The AFDC controls the motor current to each backdrive actuator. This limits the force that a backdrive actuator applies to the columns, wheels, and rudder pedals. This force is sufficient for the actuator to overcome the feel and friction forces in the control system. The force is limited so that the pilot can override the backdrive, feel, and centering forces. The autopilot disengages if the pilot overrides the backdrive, feel, and centering forces.

The AFDS engages one control column and one control wheel backdrive actuator in cruise. The override forces necessary to make the autopilot disengage are approximately:

- 50 lbs for the control column
- 27 lbs for the control wheel.

The override forces that show are the sum of the backdrive force and the feel and centering forces from the flight controls system.

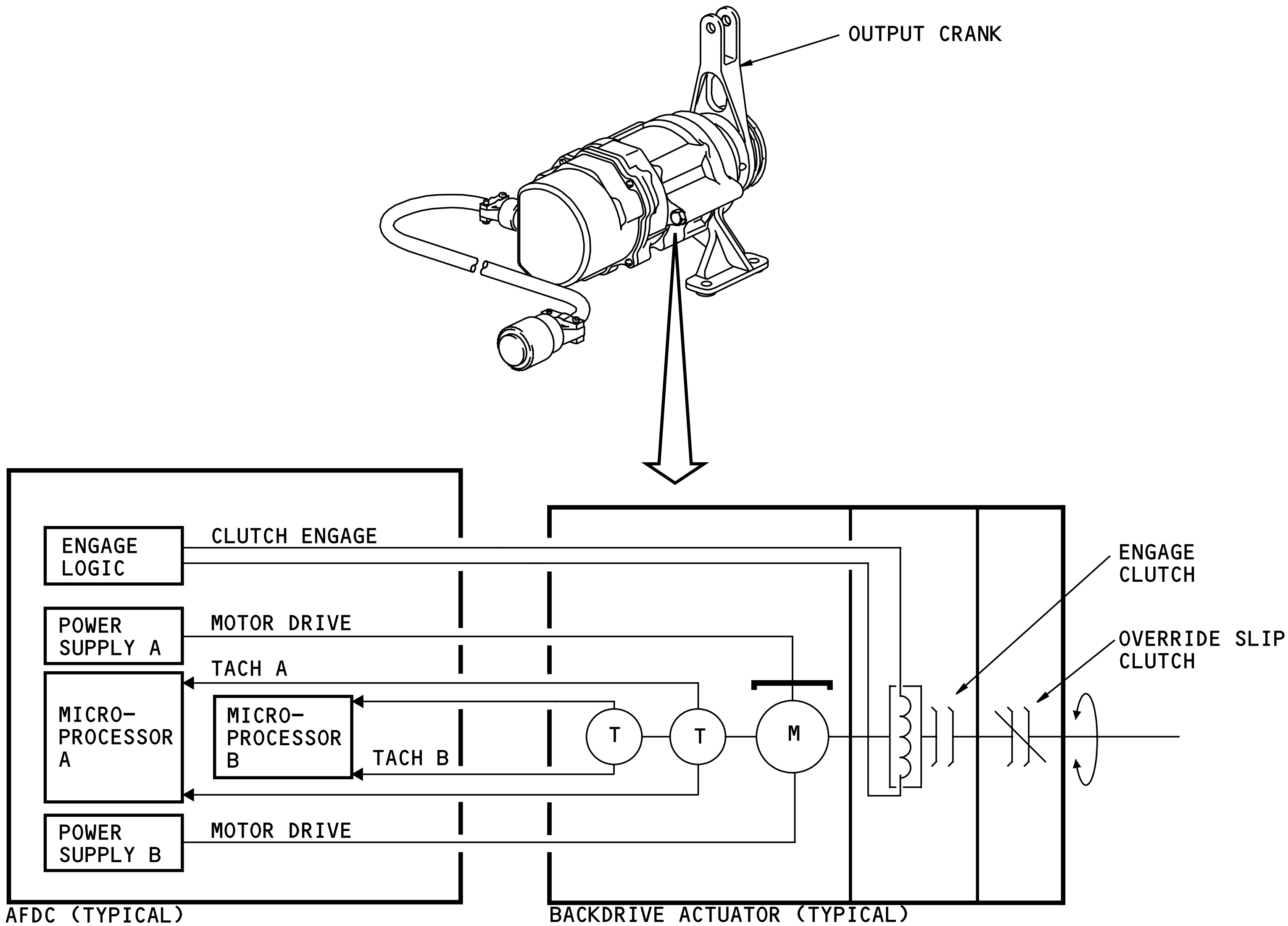
The AFDS engages all six backdrive actuators in autoland. The backdrive forces for this condition are approximately two times the force for a single actuator. The override forces are approximately:

- 81 lbs for the control column
- 49 lbs for the control wheel
- 186 lbs for the rudder pedals.

AFDS - BACKDRIVE ACTUATOR - FUNCTIONAL DESCRIPTION

If one control column actuator fails during autoland, the force limit of the remaining column actuator is two times as high. This makes sure there is enough force to prevent accidental column movement by the pilot during autoland.

If a control wheel or rudder pedal actuator fails during autoland, the force limit of the remaining actuator does not increase.



AFDS - BACKDRIVE ACTUATOR - FUNCTIONAL DESCRIPTION

22-11-00-025 Rev 2

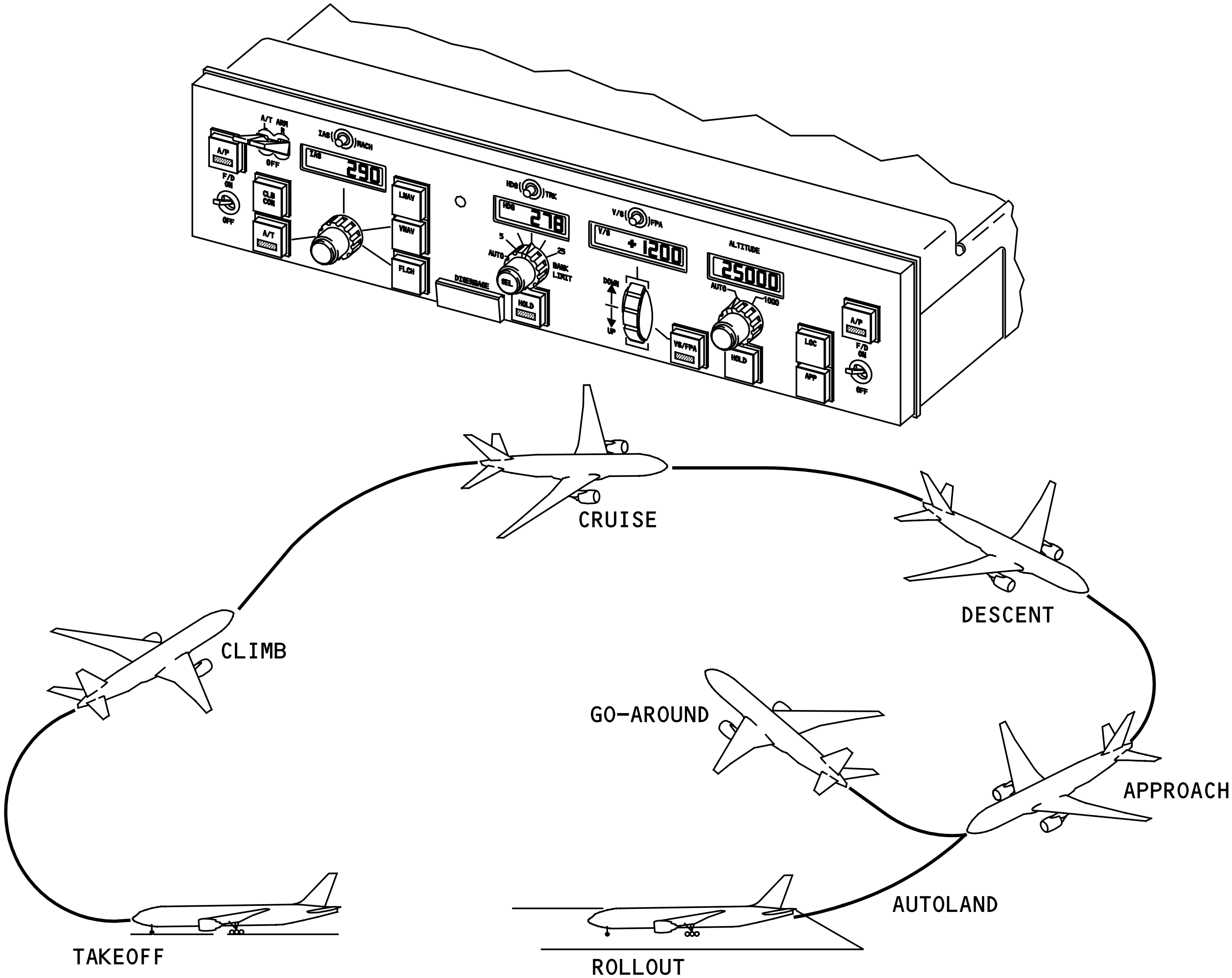
AFDS - OPERATION - OVERVIEW

General

The autopilot flight director system (AFDS) operates on the ground and in flight.

The AFDS calculates commands for these flight sequences:

- Takeoff
- Climb
- Cruise
- Descent
- Approach
- Autoland
- Rollout
- Go-Around.



AFDS - OPERATION - OVERVIEW

22-11-00-026 Rev 0

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AFDS - OPERATION - TAKEOFF

General

The F/D display supplies the pilot with roll and pitch commands during takeoff. After the airplane is off the ground, the pilot can stay in the F/D takeoff mode, or after the airplane passes 50 feet of radio altitude, the pilot can engage the autopilot to the takeoff mode.

Both F/D switches must be set to the OFF position to remove the takeoff mode.

The takeoff mode has this sequence:

- Before takeoff
- Takeoff start
- Lift-off/in air
- Climbout.

Before Takeoff

All of these conditions must be true to put the F/D in the takeoff mode (TO/GA):

- The captain's and/or the first officer's F/D switches are in the ON position
- The autopilot is not engaged
- The airplane is on the ground.

The PFD shows:

- FLT DIR as the AFDS status
- TO/GA as the pitch and roll mode
- The F/D pitch bar shows eight degrees
- The F/D roll bar shows wings level.

The pilot sets an engine-out climb speed (V2) and a clearance altitude on the MCP. The autothrottle (A/T) arm switches are on.

Takeoff Start

The pilot pushes a TO/GA switch on the thrust levers. The autothrottle engages in the takeoff thrust mode and the throttles move forward until the engines reach takeoff thrust. THR REF shows on the PFDs as the active autothrottle mode.

In takeoff, the flight director shows on the PFDs automatically even if the flight director switches are in the OFF position. This is called "auto pop up". It occurs when all these conditions are true:

- A flight director switch is in the OFF position
- The pilot pushes a TO/GA switch
- The trailing edge flaps are not up.

The TMCF removes power from the autothrottle servo motors at 80 knots. Throttle hold (HOLD) shows on the PFDs.

Lift-Off/In Air

For a normal lift-off, the pitch command holds:

- Target airspeed
- Combination of airspeed and pitch attitude

AFDS - OPERATION - TAKEOFF

- Pitch attitude.

If the climb rate is below 600 FPM, the pitch command is to hold attitude. For rates between 600 FPM and 1200 FPM, the pitch command holds a mix of airspeed and attitude. For climb rates above 1200 FPM, the pitch command holds a target airspeed.

If an engine fails during takeoff, the pitch axis command is a mix of airspeed and attitude for climb rates below 1200 FPM. For climb rates above 1200 FPM, the pitch axis holds a target airspeed.

The target airspeed for a normal takeoff is the larger of these two:

- V2 plus 15 knots
- The airspeed at lift-off plus 15 knots.

If the airspeed is more than the target for five seconds, the target airspeed becomes the smaller of the current airspeed or V2 + 25.

This mix of speed and attitude commands gives wind shear protection during takeoff and go-around. The F/D pitch command also keeps the airplane in these limits:

- Flap placard speeds
- Maximum operating velocity and Mach (VMO/MMO)
- Minimum speed.

At five feet radio altitude, the roll command changes to track hold.

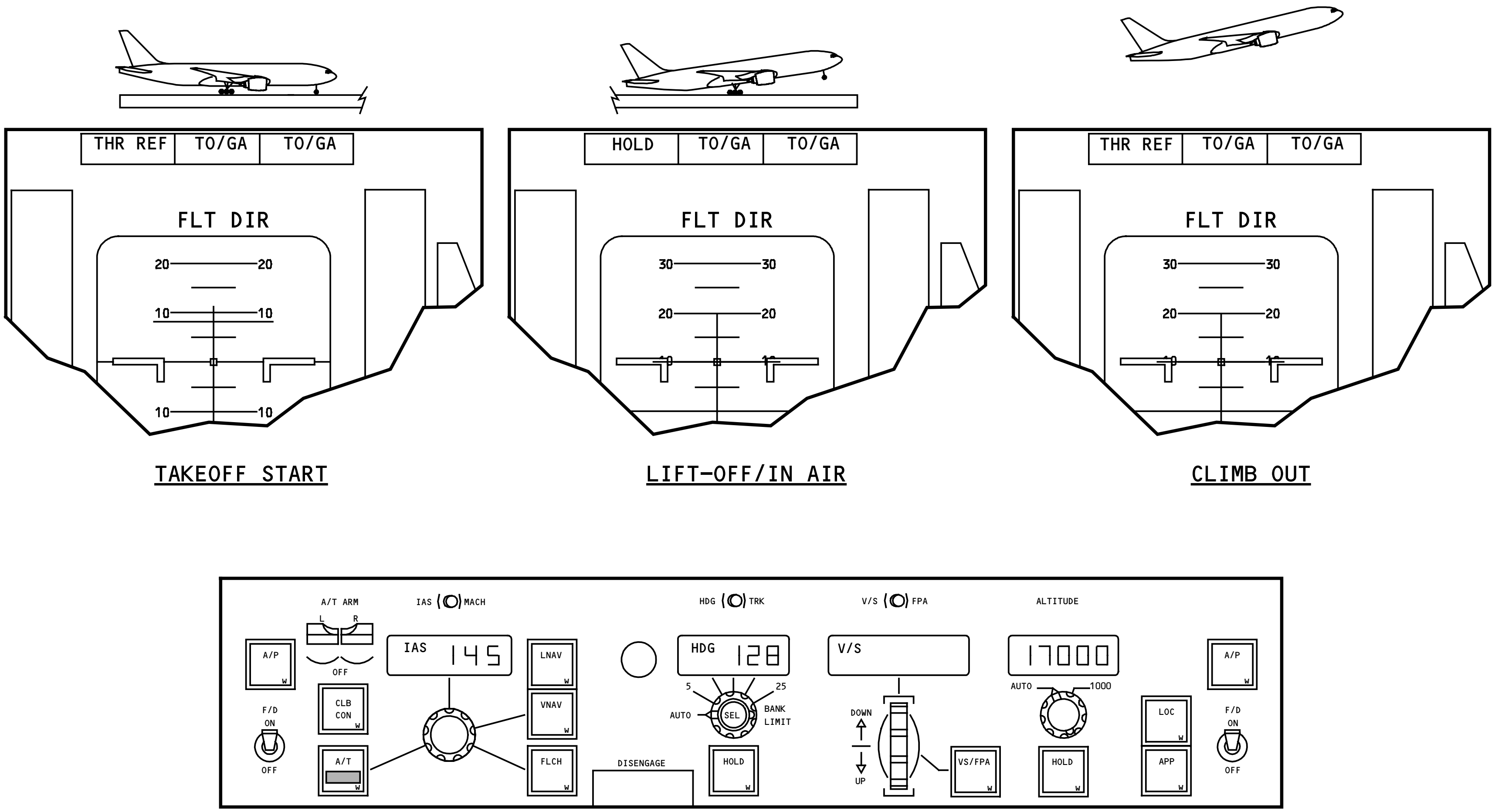
The autothrottle stays in HOLD.

FLT DIR remains the active AFDS status until the pilot engages the autopilot.

The pitch and roll modes remain in TO/GA until the pilot selects another pitch or roll mode.

Climb Out

The roll command continues to hold track. The pitch command continues to hold speed, attitude, or a mix of speed and attitude.



MCP

22-11-00-027 Rev 4 04/26/96

AFDS - OPERATION - TAKEOFF

AFDS - OPERATION - AUTOPILOT ENGAGE

General

Autopilot engagement occurs when the pilot pushes an autopilot (A/P) switch on the MCP. At that time, this happens:

- All available AFDCs and one control wheel and one column backdrive actuator engage
- A/P status shows on the PFDs.

F/D status (on or off) sets the roll and pitch mode selection.

Engage Autopilot With Flight Director On

The AFDS roll and pitch modes stay the same except in these conditions:

- With the LOC mode active, LOC changes to arm and localizer must capture again. The active roll mode is HDG or TRK hold until LOC is captured
- With the G/S mode active, G/S changes to arm and glideslope must capture again. The active pitch mode is V/S or FPA until G/S is captured.

The autopilot will engage in the takeoff mode when all these conditions are true:

- The airplane is on the ground
- A flight director is on
- The mode selected is TO/GA.

Engage Autopilot With Flight Director Off

The active pitch mode is vertical speed or flight path angle.

If the airplane is in a bank of 5 degrees or less, the autopilot commands wings level. When the airplane bank is at 3 degrees or less, the airplane holds the heading or track that is present. The active roll mode is heading or track hold.

The PFDs show the applicable pitch and roll modes and A/P status. The applicable mode select switch LED on the MCP is also on.

Autopilot Engage Inhibit

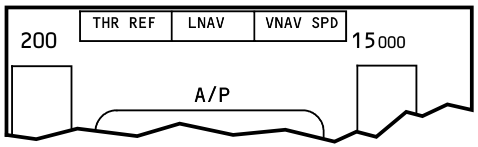
The AFDCs have an inhibit that prevents the engagement of the autopilot during the takeoff roll and immediately after it. You cannot engage the autopilot when all these conditions are true:

- The ground speed is more than 80 knots
- The radio altitude is less 50 feet.

This engage inhibit function does not operate if the airplane takes off with the autopilot already engaged.

Training Information Point

The airplane is not certified for takeoff with the autopilot engaged.

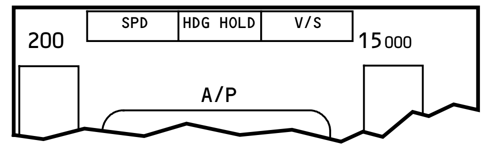


PFD

F/D ON

A/P MODE IS SAME AS
F/D MODE OR:

- HDG HOLD (OR TRK HOLD) IF F/D IN LOC
- V/S (OR FPA) IF F/D IN G/S



PFD

F/D OFF

A/P MODE IS HDG HLD (OR TRK HOLD) AND V/S (OR FPA) IF THE BANK ANGLE IS 5 DEGREES OR LESS:

- A/P COMMAND IS WINGS LEVEL
- AIRPLANE HOLDS HEADING (OR TRACK) WHEN THE BANK IS 3 DEGREES OR LESS

22-11-00-028 Rev 4 04/10/1997

AFDS - OPERATION - AUTOPILOT ENGAGE

AFDS - ROLL ATTITUDE HOLD

General

In this mode, the airplane holds a roll attitude until the pilot selects another roll mode.

Bank Angle More Than Five Degrees

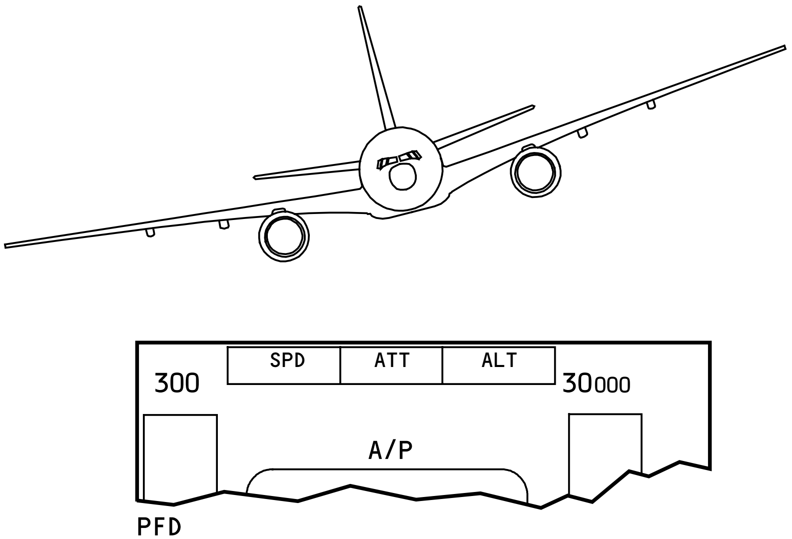
If the pilot engages the autopilot when the bank angle is more than five degrees and the flight director is off, the airplane holds the roll attitude present at that time.

ATT stays as the active roll mode until the pilot selects another roll mode. The PFD shows ATT (roll attitude) for the active roll mode.

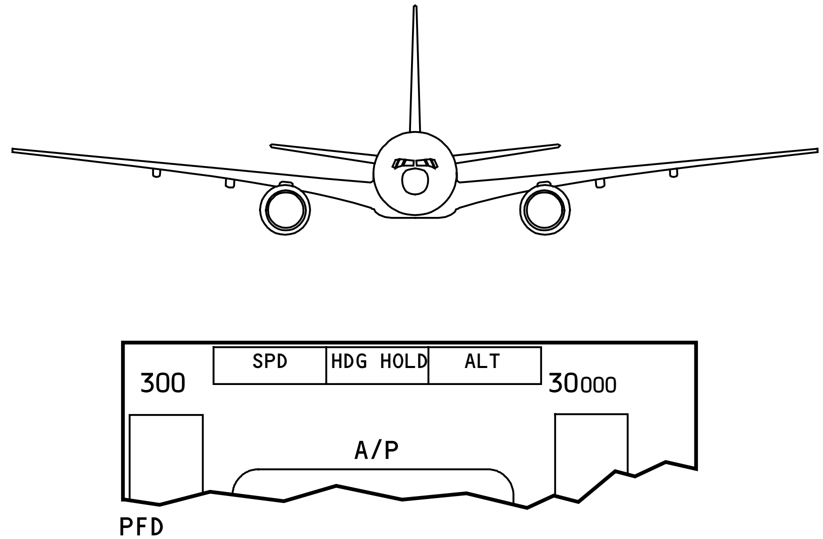
Bank Angle Five Degrees or Less

If the pilot engages the autopilot when the bank angle is five degrees or less and the flight director is off, the airplane will roll to wings level. The active roll mode is heading hold or track hold.

The PFD shows HDG HOLD or TRK HOLD as the active roll mode.



PILOT ENGAGES AUTOPILOT
WITH AIRPLANE IN A BANK
OF MORE THAN FIVE DEGREES AND F/D OFF
- AIRPLANE STAYS ON ROLL ATTITUDE PRESENT
- PFD SHOWS ATT



PILOT ENGAGES AUTOPILOT
WITH AIRPLANE IN A BANK
OF FIVE DEGREES OR LESS AND F/D OFF
- HEADING/TRACK HOLD LIGHT ON
- AIRPLANE HOLDS HEADING
- PFD SHOWS HDG HOLD

22-11-00-060 Rev 2 02/13/1998

AFDS - ROLL ATTITUDE HOLD

AFDS - OPERATION - ROLL INTRODUCTION

General

These AFDS modes are available during climb, cruise and descent:

- Lateral navigation (LNAV)
- Heading hold (HDG HOLD)
- Track hold (TRK HOLD)
- Heading select (HDG SEL)
- Track select (TRK SEL).

LNAV

The commands come from the active FMCF when there is a valid navigation data base and an active flight plan. The CDUs can send LNAV steering commands when there is no active FMCF. The AFDS use this priority to select a CDU command:

- Left if valid
- Center if left not valid
- Right if left and center are not valid.

Heading/Track Hold

In this mode, the airplane holds either heading (HDG) or track (TRK).

If the HDG/TRK display on the MCP shows TRK, the airplane holds track.

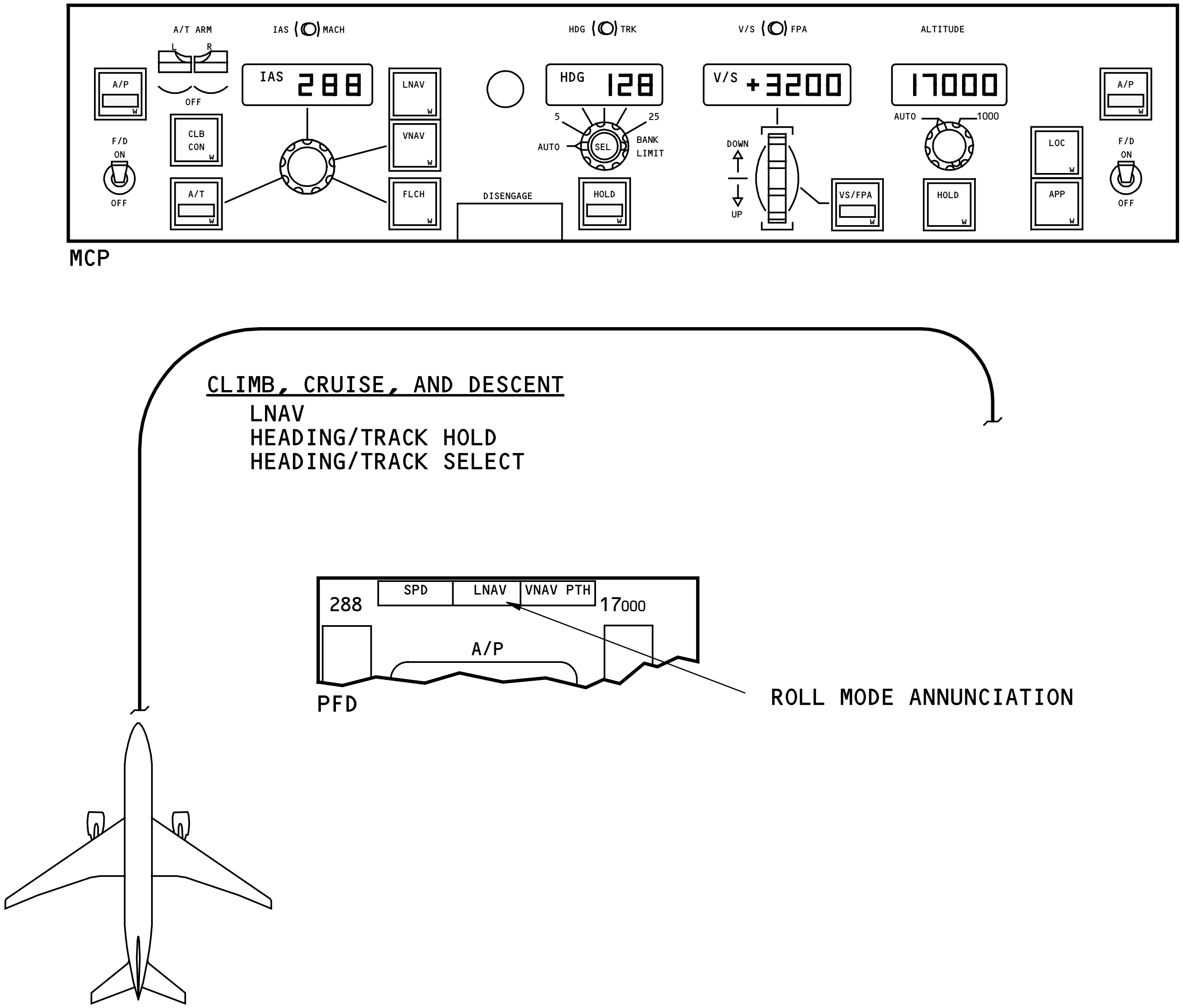
If the HDG/TRK display on the MCP shows HDG, the airplane holds heading.

Heading/Track Select

In this mode, the airplane turns to the heading or track that shows in the heading/track window.

If the HDG/TRK display shows HDG, the airplane goes to and holds the heading that shows in the heading/track window.

If the HDG/TRK display shows TRK, the airplane goes to and holds the track that shows in the heading/track window.



22-11-00-029 Rev 3 08/31/1995

AFDS - OPERATION - ROLL INTRODUCTION

AFDS - OPERATION - LNAV

General

LNAV has two sub modes:

- LNAV arm
- LNAV active.

LNAV Arm

Push the LNAV switch on the MCP to arm LNAV. To remove the LNAV arm status, push the LNAV switch again before LNAV captures or select another roll mode.

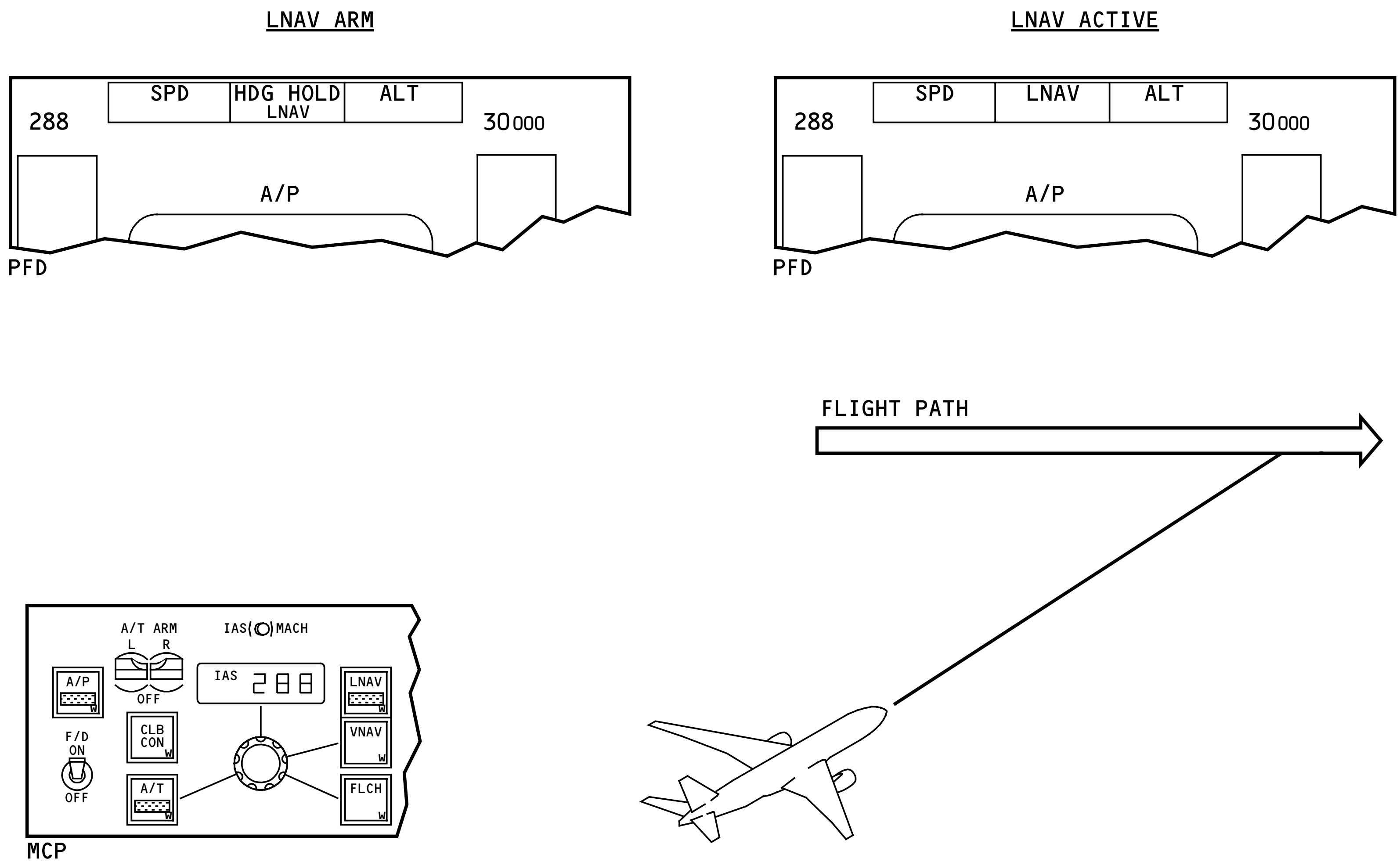
The PFD shows LNAV in white. The LNAV light is on.

You can arm LNAV before takeoff. Also, you can arm LNAV in flight if the LOC mode is not active.

LNAV Active

When active, LNAV on the PFD changes to green. This occurs when all these are true:

- The lateral flight plan is active
- The airplane is greater than 50 feet above the ground
- Data to calculate the lateral guidance command is valid
- Aircraft position is satisfactory for capture.



22-11-00-030 Rev 1

AFDS - OPERATION - LNAV

AFDS - OPERATION - HEADING/TRACK SELECT

General

The pilot uses the HDG/TRK select mode to change the airplane heading.

The select switch (SEL) on the MCP does not have a LED in the switch.

This example shows operation with HDG selected on the heading/track display. Operation with TRK selected is the same except for the display on the PFDs.

There are two ways to use the mode:

- Set heading before the mode is selected
- Select the mode before the heading is set.

Set Heading Before Mode

Set a heading in the heading/track display and push the heading select switch. These things happen:

- HDG SEL shows on the PFD
- The airplane turns in the direction for minimum heading change
- The airplane captures and holds the heading set on the MCP.

Select Mode Before Heading

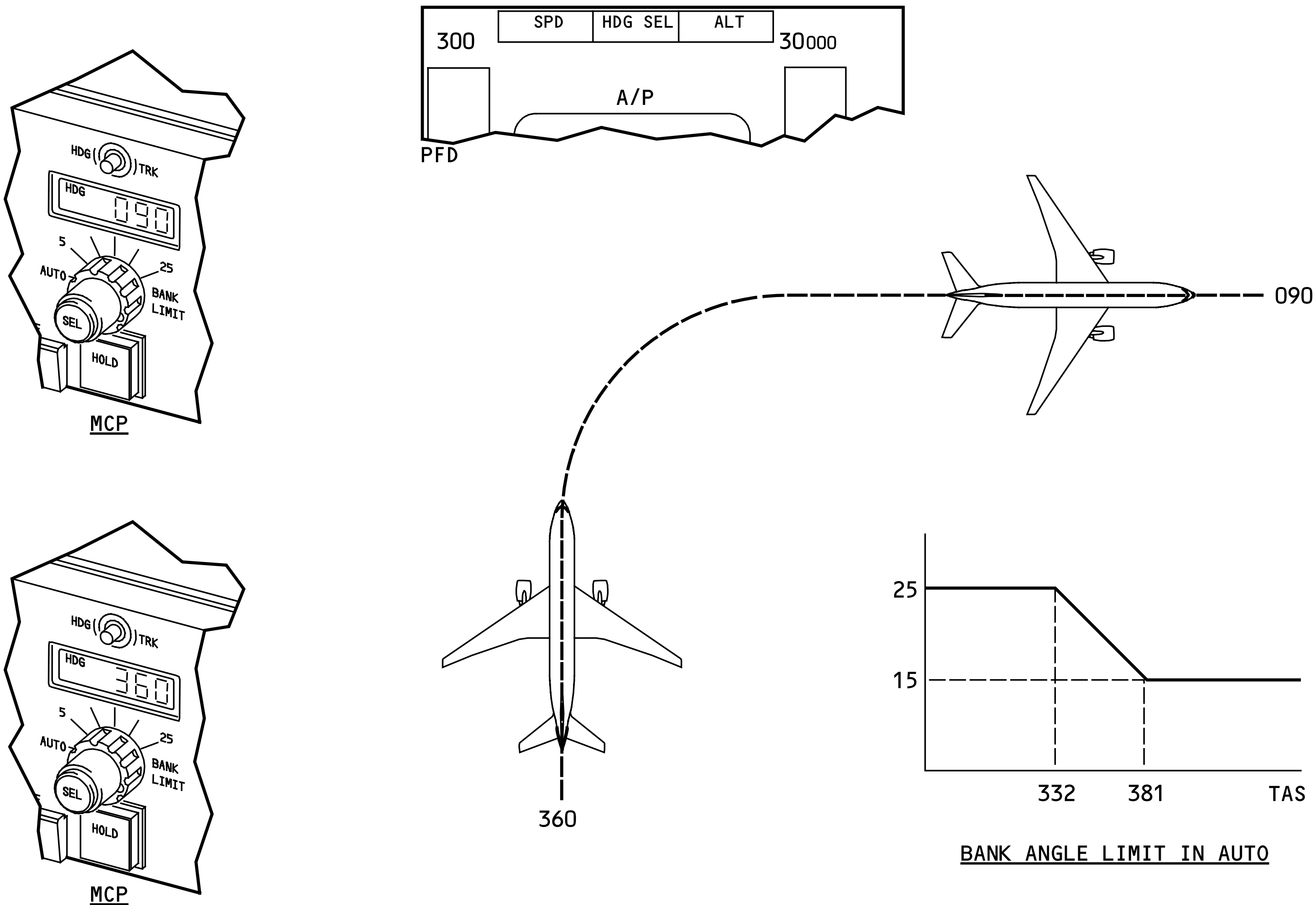
Push the heading select switch and set a heading in the heading/track display. These things happen:

- HDG SEL shows on the PFD
- When the pilot turns the heading knob clockwise, the airplane banks to the right
- When the pilot turns the heading knob counterclockwise, the airplane banks to the left
- The airplane captures and holds the heading set on the MCP.

Heading/Track Select Bank Angle Limit

The pilot uses the bank limit selector on the MCP to limit the airplane bank angle. In the AUTO position, the bank angle limit changes with true airspeed.

Below 200 feet, the bank angle limit is eight degrees.



22-11-00-031 Rev 1

AFDS - OPERATION - HEADING/TRACK SELECT

AFDS - OPERATION - HEADING/TRACK HOLD

General

In this mode the airplane holds a heading or a track angle. The pilot can set a heading or a track in the MCP displays before the mode is set.

This example shows operation with HDG selected. Operation with TRK selected is the same except for the display on the PFDs and MCP.

Airplane In A Bank

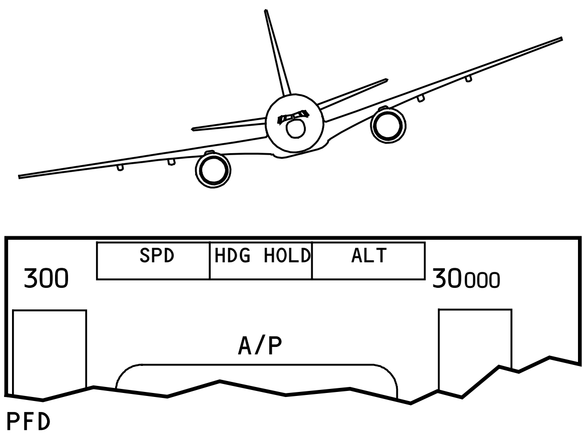
When the pilot pushes the heading/track hold switch:

- The heading/track hold light on the MCP comes on
- The airplane rolls wings level
- HDG HOLD is shown on the PFDs
- The airplane holds the heading present when the bank angle is less than three degrees for two seconds.

Airplane Wings Level

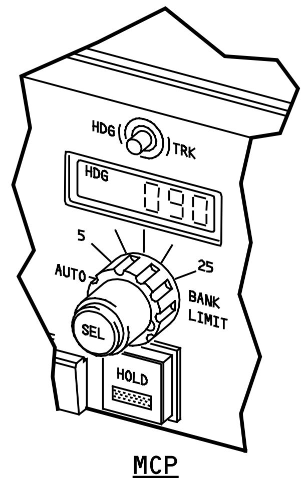
When the pilot pushes the heading/track hold switch:

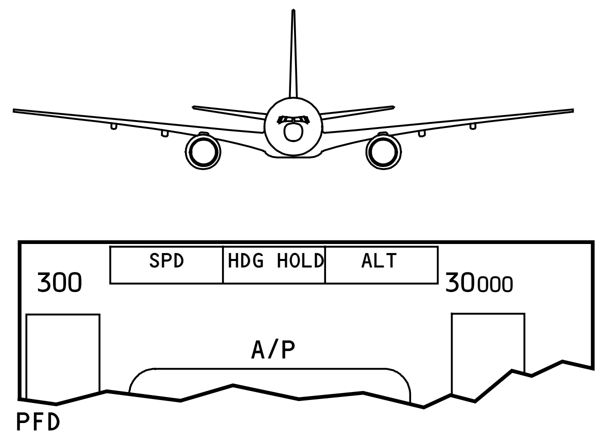
- The heading/track hold light on the MCP comes on
- HDG HOLD shows on the PFDs
- The airplane holds the present heading.



HEADING HOLD SELECTED WITH AIRPLANE IN BANK

- HEADING/TRACK HOLD LIGHT ON
- AIRPLANE ROLLS TO WINGS LEVEL
- PFD SHOWS HDG HOLD
- AIRPLANE HOLDS HEADING WHEN ROLL ATTITUDE LESS THAN 3° FOR 2 SECONDS





HEADING HOLD SELECTED WITH WINGS LEVEL

- HEADING/TRACK HOLD LIGHT ON
- PFD SHOWS HDG HOLD
- AIRPLANE HOLDS HEADING

22-11-00-032 Rev 2 09/22/1997

AFDS - OPERATION - HEADING/TRACK HOLD

AFDS - OPERATION - PITCH INTRODUCTION

General

These AFDS pitch modes are available during climb, cruise and descent:

- Vertical navigation (VNAV)
- Vertical speed (V/S)
- Flight path angle (FPA)
- Flight level change (FLCH)
- Altitude hold (ALT).

VNAV

The VNAV mode is a mix of throttle and elevator commands that control the vertical flight path.

The FMCF vertical steering commands come from the active FMCF based on the navigation data and the active flight plan.

Vertical Speed/Flight Path Angle

The vertical speed or flight path angle command is an elevator command. The pilot uses this mode to change flight levels. The pilot must set the engine thrust necessary to hold the vertical speed or flight path angle command.

When the V/S/FPA display shows V/S, the airplane goes to and holds the vertical speed that shows on the vertical speed/flight path angle window.

When the VS/FPA display shows FPA, the airplane goes to and holds the flight path angle that shows on the vertical speed/flight path angle window.

FLCH

The FLCH command is a mix of thrust and elevator commands to change flight levels.

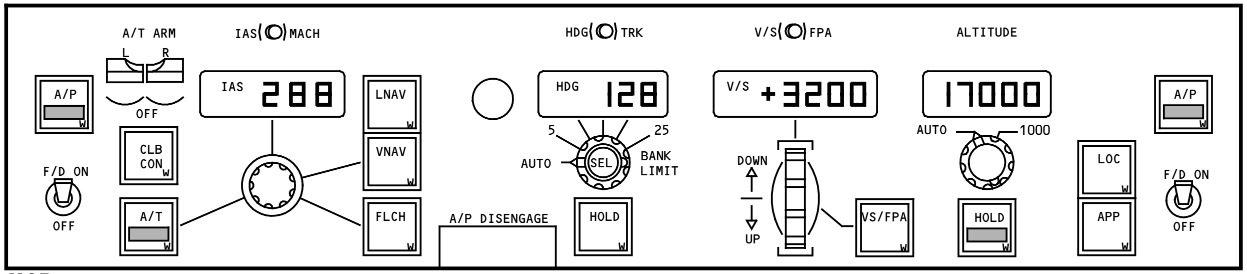
When the IAS/mach display shows IAS, the elevator command holds the speed that shows on the IAS/mach window.

When the IAS/mach display shows MACH, the elevator command holds the mach that shows on the IAS/mach window.

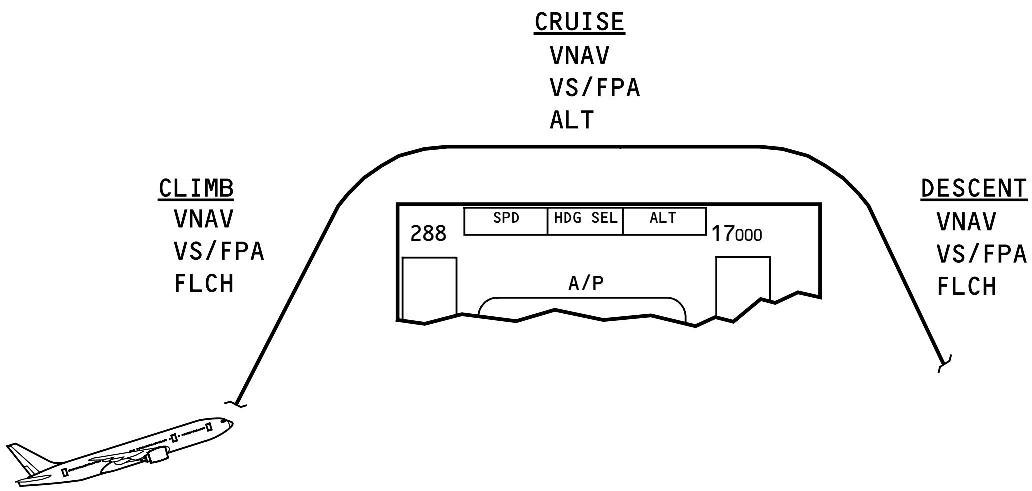
The TMCF supplies the engine thrust commands.

Altitude Hold

In this mode, the airplane holds the barometric altitude present when the pilot pushes the altitude HOLD switch.



MCP



22-11-00-033 Rev 1

AFDS - OPERATION - PITCH INTRODUCTION

AFDS - OPERATION - VNAV

General

Push the VNAV mode select switch to arm VNAV. The PFD shows VNAV in white and the switch LED is on. Push the switch again to remove the arm status.

VNAV can arm before takeoff. Also VNAV can arm in flight with the glideslope mode not active.

When active, VNAV on the PFD changes to green. This occurs when all these conditions are true:

- VNAV flight plan is active
- The airplane is greater than 400 feet above the ground
- Data required to calculate the vertical guidance command is valid.

VNAV active has these three sub-modes:

- VNAV SPD (speed)
- VNAV PTH (path)
- VNAV ALT (altitude).

VNAV SPD

The VNAV SPD mode controls the elevator to hold the FMCF target speed. The mode is active in:

- Climb
- Cruise or descent when the airplane exceeds an FMCF target speed by 5 knots.

VNAV PTH

In climb, VNAV SPD changes to VNAV PTH to capture the FMCF target altitude. In the VNAV PTH mode, the airplane holds the FMCF altitude.

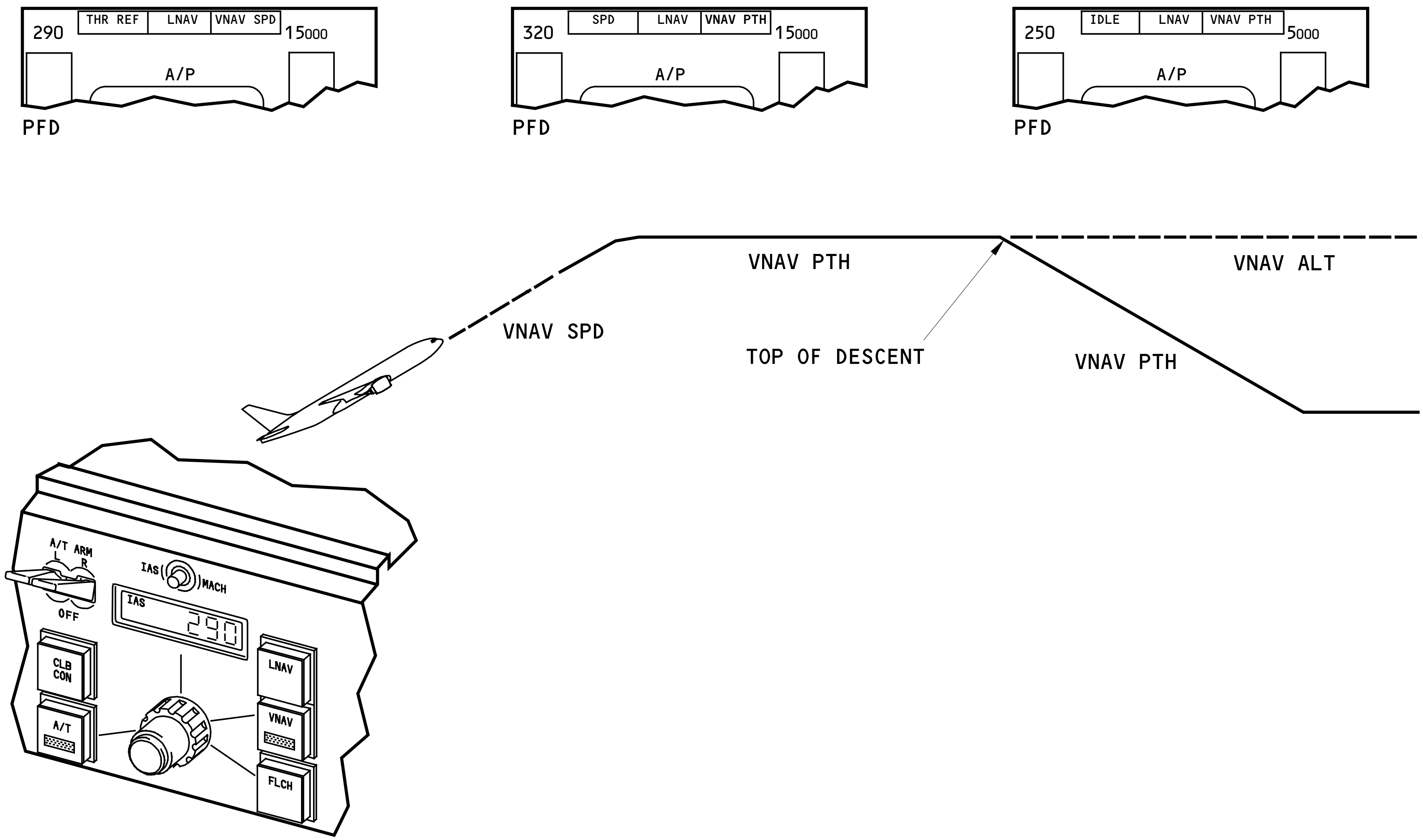
Before descent, the pilot sets an approach altitude on the MCP. At the top of descent, the throttle retards and the PFDs show IDLE. The pitch mode remains in VNAV PTH and the airplane descends.

The VNAV PTH mode continues in descent until the airplane is near the approach altitude. The autothrottle mode returns to SPD. VNAV PTH remains active and holds the approach altitude.

VNAV ALT

The VNAV ALT (altitude) mode occurs when one of these conditions is true:

- When in VNAV SPD and the airplane captures the MCP selected altitude before the FMCF target altitude
- When in VNAV PTH (descent) and the airplane captures the MCP altitude before the FMCF altitude.



22-11-00-034 Rev 1

AFDS - OPERATION - VNAV

AFDS - OPERATION - VERTICAL SPEED/FLIGHT PATH ANGLE

General

The pilot uses the VS/FPA mode to climb or descend to the altitude set in the MCP.

This example shows FPA operation. VS mode operation is the same except for the display on the PFDs.

Climb

These occur when the pilot sets a positive FPA on the MCP and pushes the VS/FPA mode select switch:

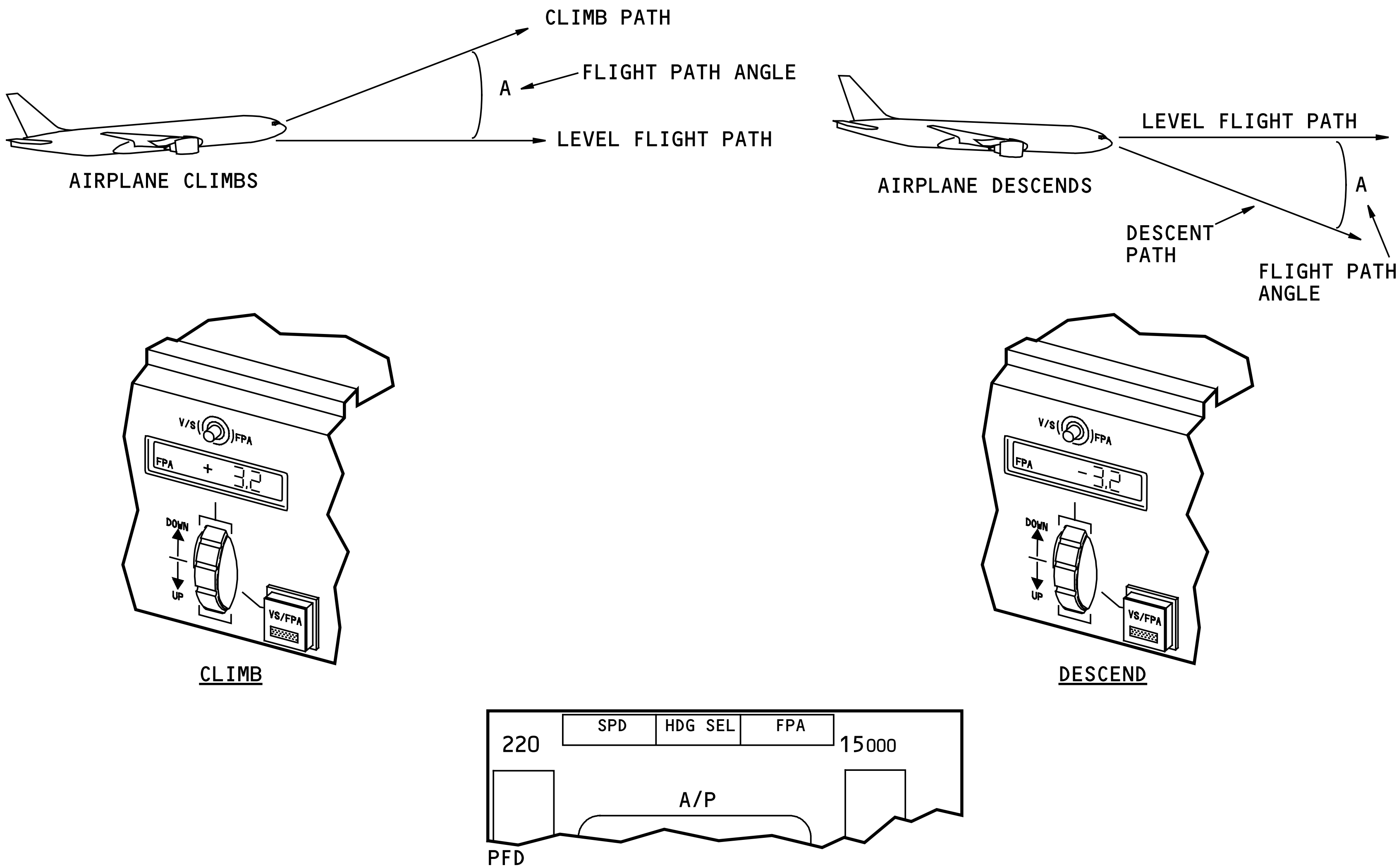
- FPA shows on the PFD
- The switch LED is on
- The airplane holds the selected FPA.

Descend

These occur when the pilot sets a negative FPA on the MCP and pushes the VS/FPA mode select switch:

- FPA shows on the PFD
- The switch LED is on
- The airplane holds the selected FPA.

The AFDS mode changes from FPA to altitude hold (ALT) when the airplane reaches the altitude set on the MCP.



AFDS - OPERATION - VERTICAL SPEED/FLIGHT PATH ANGLE

AFDS - OPERATION - ALTITUDE HOLD

General

Altitude hold is active in any of these conditions:

- Push the altitude hold switch on the MCP
- Select a V/S of 0000 in the V/S mode
- Capture and hold the altitude set on the MCP.

Altitude Hold Switch

These occur when the pilot pushes the altitude hold switch on the MCP:

- The AFDS holds the present barometric altitude
- The altitude hold light is on
- The PFDs show ALT.

Set V/S To 0000

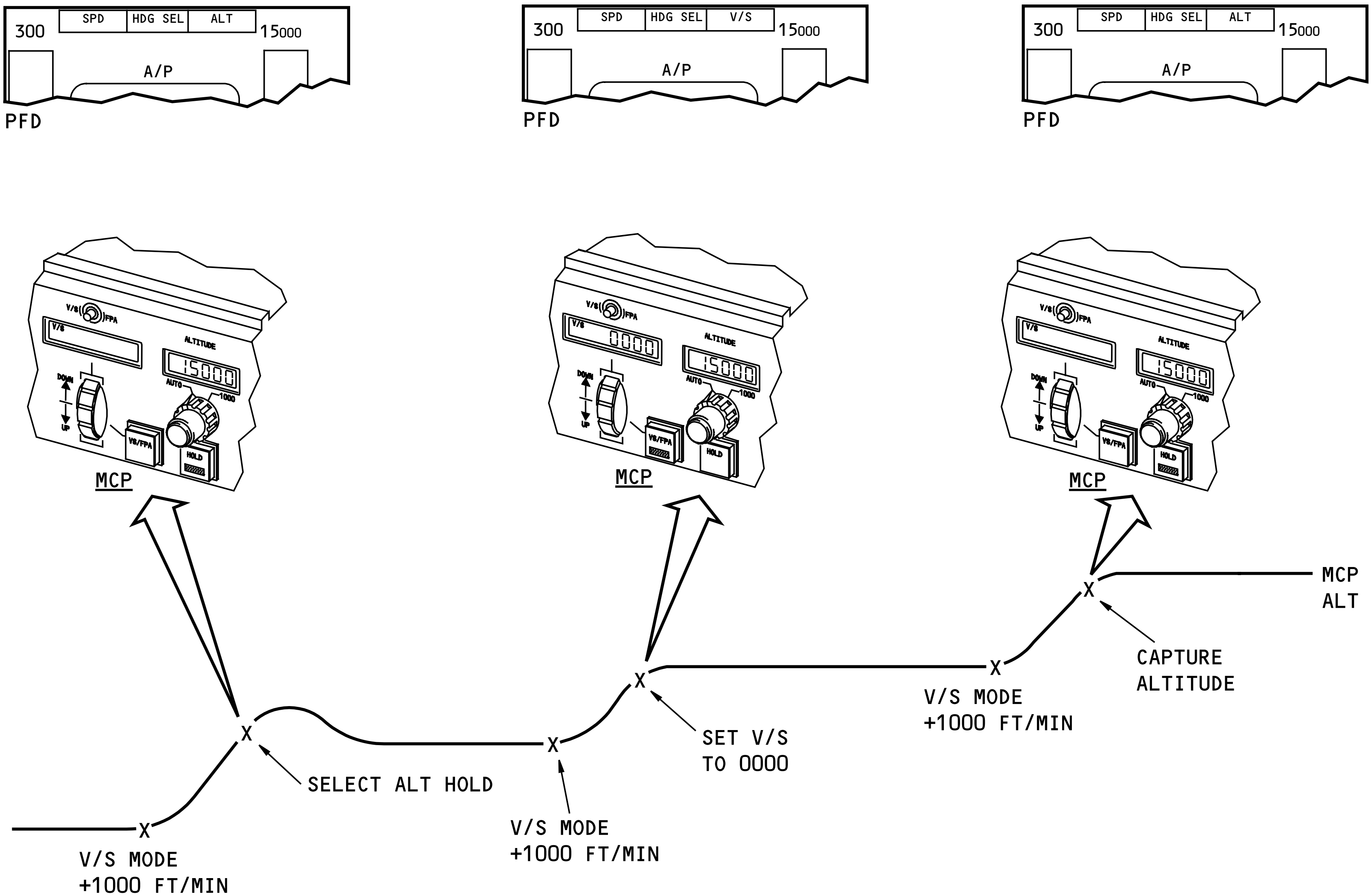
These occur when the pilot sets a vertical speed of 0000:

- The airplane levels and holds the present barometric altitude
- The V/S mode remains active
- The PFDs show V/S.

Capture Altitude

Altitude capture starts as the airplane approaches the MCP selected altitude:

- The PFDs show ALT in green
- The airplane holds the altitude set on the MCP.



22-11-00-036 Rev 1

AFDS - OPERATION - ALTITUDE HOLD

AFDS - OPERATION - FLIGHT LEVEL CHANGE

General

The FLCH mode permits the pilot to change flight levels with the AFDS and the TMCF. The autothrottle controls thrust. The AFDS controls airspeed with the elevator.

FLCH Selection

The pilot must set a target altitude on the MCP before the FLCH mode can be set.

With the FLCH mode active, the flight level change light is on. FLCH SPD is the pitch mode and THR is the autothrottle mode on the PFDs.

If the pilot pushes the FLCH switch with VNAV as the active mode, the MCP IAS/mach window shows the FMCF target speed. The AFDS controls to this speed until the pilot sets a new speed in the window.

When TO/GA is the active pitch mode and the pilot pushes the FLCH switch, the IAS/mach window shows the higher of these:

- Present airspeed
- Speed set in the MCP.

If you push the FLCH switch when the IAS/mach window shows a speed or mach number and the active pitch mode is not TO/GA, the MCP IAS/mach window does not change.

In all cases, the AFDS controls to the speed on the MCP IAS/mach window until the pilot sets a new speed in the window.

The airplane speed stays within these limits:

- Flap placard speeds
- Maximum operating velocity and Mach (VMO/MMO)
- Minimum speed.

Altitude Capture

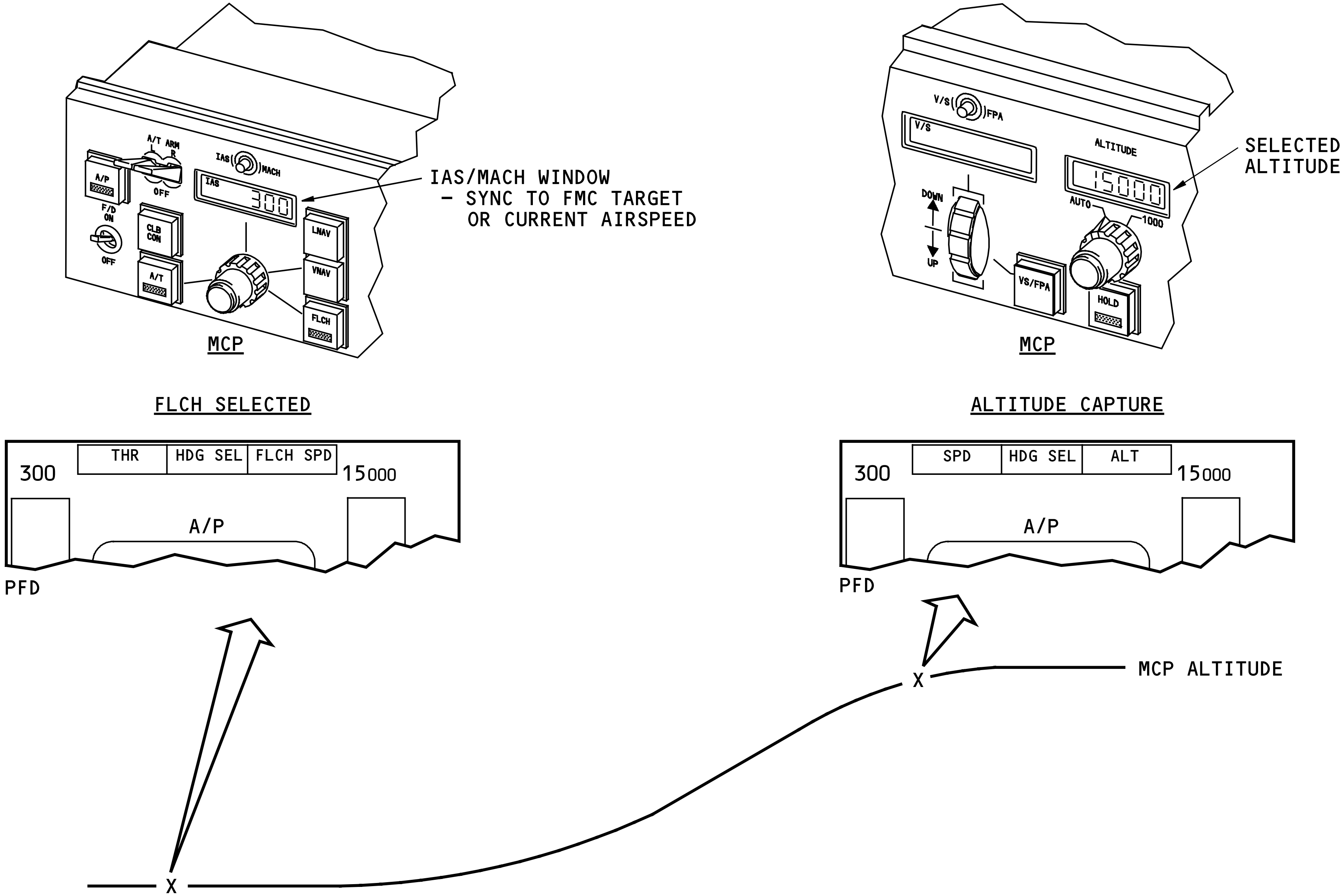
When the airplane is at the altitude set on the MCP, the AFDS pitch mode changes to ALT. The autothrottle mode changes to SPD.

If there is not enough engine thrust to capture the altitude and hold airspeed, the AFDS stays in the speed mode and does not go to the ALT mode.

A/T Modes

These A/T modes can show during FLCH:

- THR
- HOLD
- IDLE.



AFDS - OPERATION - FLIGHT LEVEL CHANGE

AFDS - OPERATION - APPROACH/AUTOLAND INTRODUCTION

General

These AFDS functions are available for landing:

- Localizer (LOC)
- Glideslope (G/S)
- Flare (FLARE)
- Runway Alignment
- Rollout (ROLLOUT)
- Go-Around (TO/GA).

The flight crew pushes the APP switch on the MCP to arm the LOC and G/S modes.

Localizer

The LOC mode captures and holds the airplane to a localizer flight path.

Glideslope

The G/S mode captures and holds the airplane to a vertical descent flight path.

Flare

The flare mode controls the airplane to a smooth touchdown at a point past the glideslope antenna. This is a computed command and is not part of the glideslope mode.

Runway Alignment

In crosswind conditions, the runway alignment mode supplies roll and yaw control to decrease the airplane crab angle for touchdown. The runway alignment mode also includes roll and yaw control for an engine failure in approach during autoland.

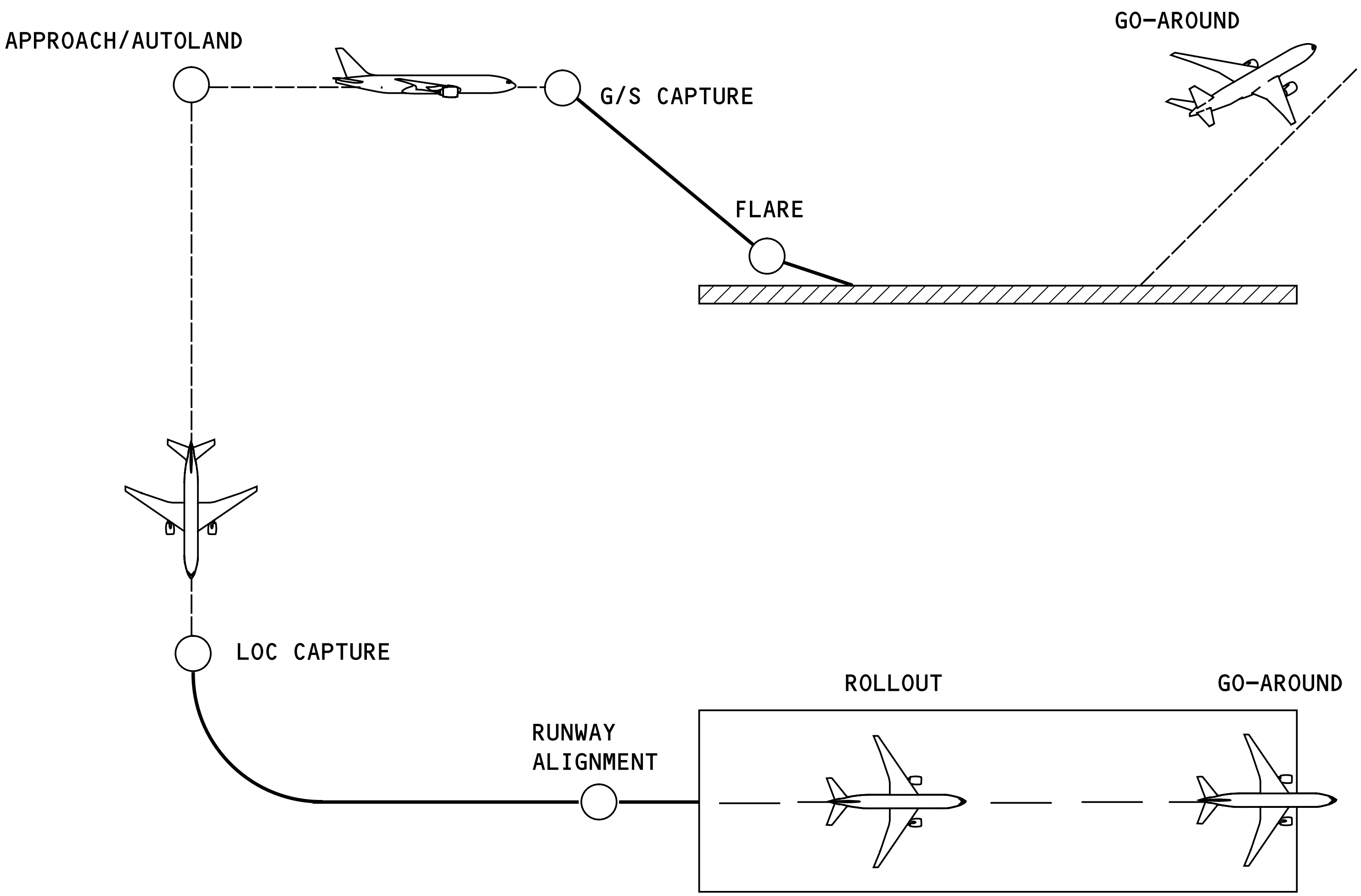
There is no annunciation on the PFD for this mode.

Rollout

After touchdown, the rollout mode controls the airplane to the runway center line. Airplane deviation from the localizer center line supplies rudder and nose wheel steering signals.

Go-Around

The go-around mode controls roll and pitch after an aborted approach. Also, the TMCF controls thrust during go-around.



22-11-00-038 Rev 0

AFDS - OPERATION - APPROACH/AUTOLAND INTRODUCTION

AFDS - OPERATION - LOCALIZER

General

The flight crew uses the localizer switch on the MCP, to select a localizer only approach.

The flight crew uses the localizer only approach when glideslope is not available or uses a different vertical path for descent.

An ILS frequency and course must be set into the FMCF.

The flight crew can use another roll mode to fly the airplane to the localizer. In this example, the flight crew uses the heading select mode.

The LOC mode has these two sub-modes:

- Localizer arm
- Localizer active.

Localizer Arm

The LOC switch on the MCP arms only the localizer mode. The PFD shows LOC in white. The LOC switch light comes on.

To remove the arm status, push the LOC switch again before the localizer captures or select another roll mode.

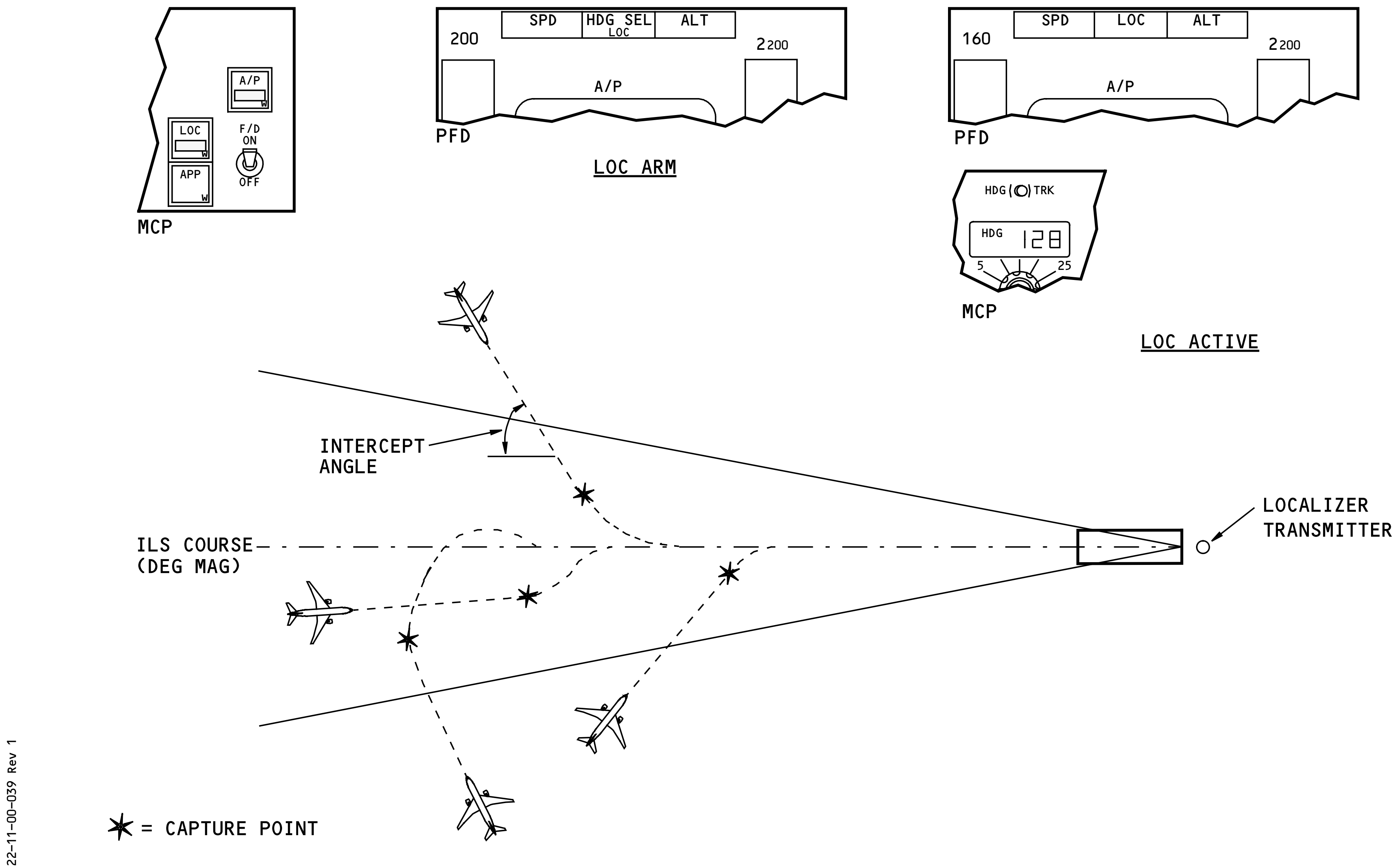
Localizer Active

At LOC capture, the active roll mode changes to LOC. The MCP heading/track window changes to the ILS course.

The localizer capture point is not fixed. The AFDS calculates the localizer capture point as a function of:

- Ground speed
- Localizer deviation
- Intercept angle (must be less than 120 degrees from the selected ILS course).

The AFDS uses the previous data to put the airplane on the localizer beam without large bank angles.



AFDS - OPERATION - LOCALIZER

AFDS - OPERATION - APPROACH

General

In approach (APP), the airplane automatically captures and tracks the localizer and glideslope beams. If an autopilot approach continues, the airplane lands automatically.

The flight crew or the FMCF sets the ILS frequency and the ILS course.

The two sub-modes of APP are:

- LOC and G/S arm
- LOC and G/S capture.

Autoland Status

If the autopilot is engaged in the approach mode below 1500 feet radio altitude, the autoland status shows on the PFD. The autoland status shows LAND 3, LAND 2, or NO AUTOLAND. The autoland status is the level of redundancy in the autoland system.

LAND 3 shows when there are no failures in any part of the autoland system. LAND 2 shows when any part of the autoland system is one failure away from NO AUTOLAND. NO AUTOLAND shows when the autoland system is not available.

There are more than 30 conditions that can cause a change from LAND 3 to LAND 2 or NO AUTOLAND. Refer to the airplane system schematics for a full list of the conditions that change the autoland status to LAND 2 or NO AUTOLAND.

These are some failures that cause a change from LAND 3 to LAND 2:

- Single AFDC failure
- Single backdrive actuator failure
- Single radio altimeter failure
- Single ILS receiver failure
- ADIRU status message.

These are some failures that cause a change from LAND 3 to NO AUTOLAND:

- Two AFDCs fail
- Approach mode not active at 600 feet
- Two radio altimeters fail
- Two ILS receivers fail
- ADIRU failure.

Approach Arm

These occur when the flight crew pushes the approach (APP) switch on the MCP:

- The approach light on the MCP comes on
- LOC and G/S show white on the PFD
- A bus isolation request goes to the electrical power system.

Bus isolation stays active during an autoland until the autopilot disengages or the airplane climbs above 400 feet radio altitude after a go-around starts.

If bus isolation fails, the autoland status changes from LAND 3 to LAND 2.

If you push the APP switch while both LOC and G/S are armed, the approach mode will disarm.

LOC And G/S Capture

The localizer capture point is not fixed. The AFDS calculates the localizer capture point as a function of these data:

- Ground speed
- Localizer deviation
- Intercept angle (must be less than 120 degrees from the selected runway heading).

The glideslope capture point is not fixed. Glideslope capture is a function of these data:

- The airplane distance from the center of the glideslope beam
- Glideslope deviation.

Glide slope capture does not occur until after localizer capture.

At LOC capture, the active roll mode changes to LOC. The MCP heading/track window changes to the ILS course.

At G/S capture, the active pitch mode changes to G/S.

The AFDS supplies an ILS tune inhibit signal when G/S and LOC are active with the autopilot system engaged.

The AFDS also supplies an ILS tune inhibit signal when the autopilot is not engaged and all of these conditions are true:

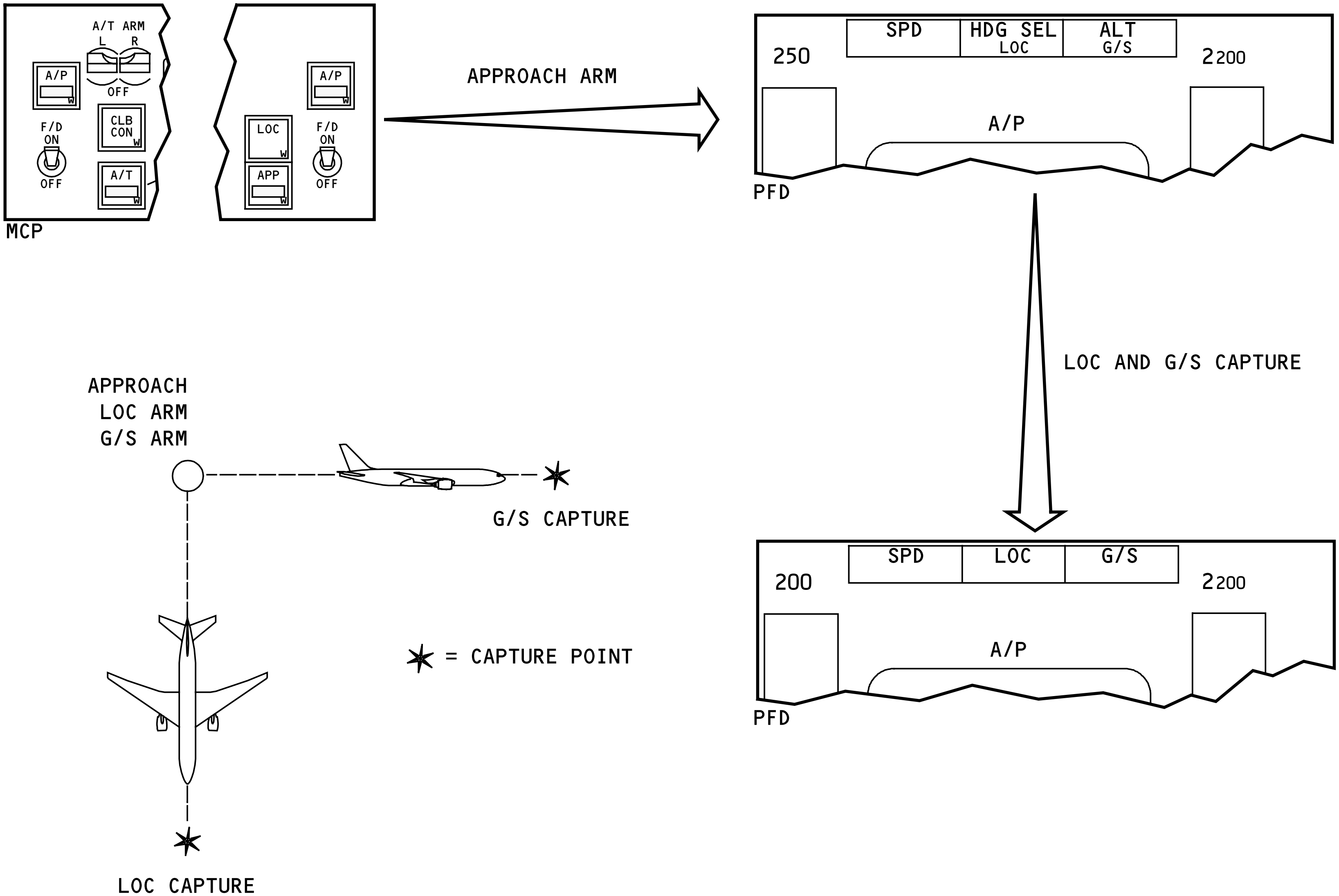
- A flight director is on
- G/S and LOC are active
- The airplane is below 500 feet of radio altitude.

If the autopilot is not engaged and pilot tunes the ILS when the radio altitude is 500 feet or more, the flight director displays go out of view.

With LOC and/or G/S captured, the APP mode goes away by one of these methods:

- Select another pitch mode if only G/S is active
- Select another roll mode including LOC, if only LOC is active
- Push either TO/GA switch if G/S is active, or the trailing edge flaps are not up
- Disengage the autopilot and put the F/D switches in the off position
- Push the APP switch if the airplane is above 1500 feet and both LOC and G/S are active.

The last method lets the flight crew disconnect the APP mode if air traffic control sends the airplane to another runway. The flight crew sets a new ILS frequency and ILS course and pushes the APP switch to arm LOC and G/S again.



22-11-00-040 Rev 3

AFDS - OPERATION - APPROACH

AFDS - OPERATION - AUTOLAND PITCH

General

In autoland, the AFDS controls the elevator for these functions:

- Glideslope (G/S)
- Flare
- Touchdown.

The flare mode and touchdown sub-mode occur when the autopilot is engaged and at least two AFDCs operate.

Glideslope

With the G/S mode active, the AFDS keeps the airplane on the vertical descent flight path.

With the autopilot engaged and G/S and LOC modes active, these events occur as the airplane descends below 1500 feet:

- The other control column and wheel backdrive actuators and both rudder pedal actuators engage. All available backdrive actuators engage.
- LAND 3, LAND 2 or NO AUTOLAND shows on the PFD as the active autoland status
- ROLLOUT and FLARE modes arm and show on the PFD.
- The runway alignment sub-mode is active. There is no added annunciation for runway alignment on the PFD.

Flare/Touchdown

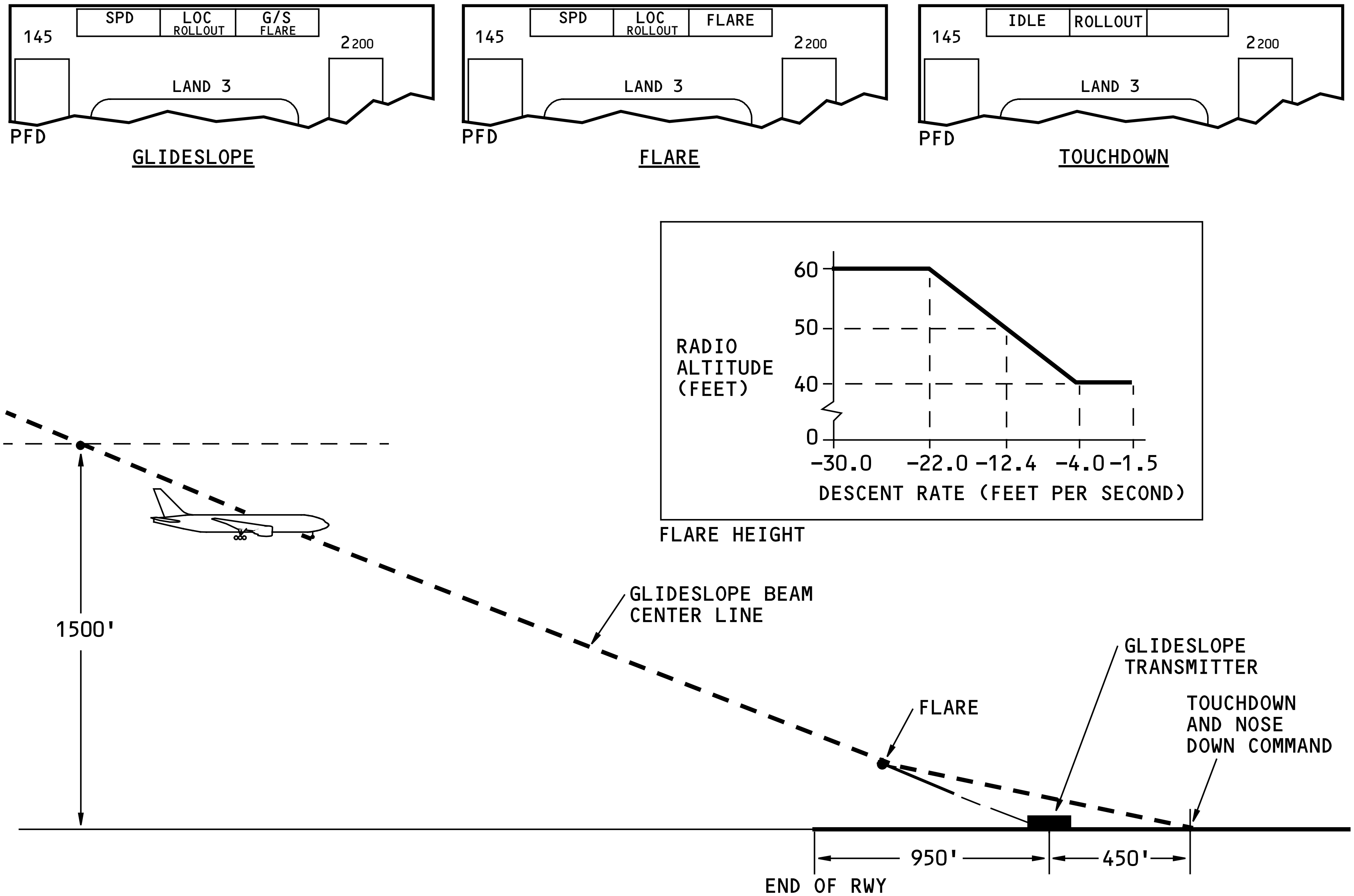
FLARE replaces G/S as the active mode on the PFD.

During flare, airplane touchdown occurs 450 feet past the glideslope transmitter at a descent rate of 1.5 feet/second.

The altitude at which the flare mode becomes active is flare height. The descent rate of the airplane sets this height. An adjustable flare height gives constant touchdown performance for a wide range of approach speeds.

The AFDS sends a throttle idle command to the TMCF at 25 feet radio altitude.

An airplane nose down command brings the nose wheel in contact with the runway. This occurs when the radio altitude is below five feet and the pitch attitude of the airplane is less than two degrees. At this time, the pitch mode goes blank on the PFD.



AFDS - OPERATION - AUTOLAND PITCH

AFDS - OPERATION - AUTOLAND ROLL AND YAW

General

The runway alignment function corrects for engine out and crosswind conditions during an autoland. This is to make sure the wings are level or the upwind wing is low for all possible wind and engine out combinations. The AFDS does this with rudder and aileron commands (sideslip).

At landing, the rollout mode controls rudder and nosewheel steering to keep the airplane on the center line of the runway.

Runway Alignment

Engine out runway alignment occurs at 1300 feet. The speed and the direction of the crosswind sets the amount of sideslip.

Crosswind control occurs at 500 feet or 200 feet.

With a crab angle of more than ten degrees (high crosswinds), the alignment occurs at 500 feet. The AFDS command decreases the crab angle by five degrees.

With a crab angle between five and ten degrees (medium crosswinds), alignment occurs at 500 feet. Another alignment occurs at 200 feet. The total crab angle reduction for both alignments is five degrees.

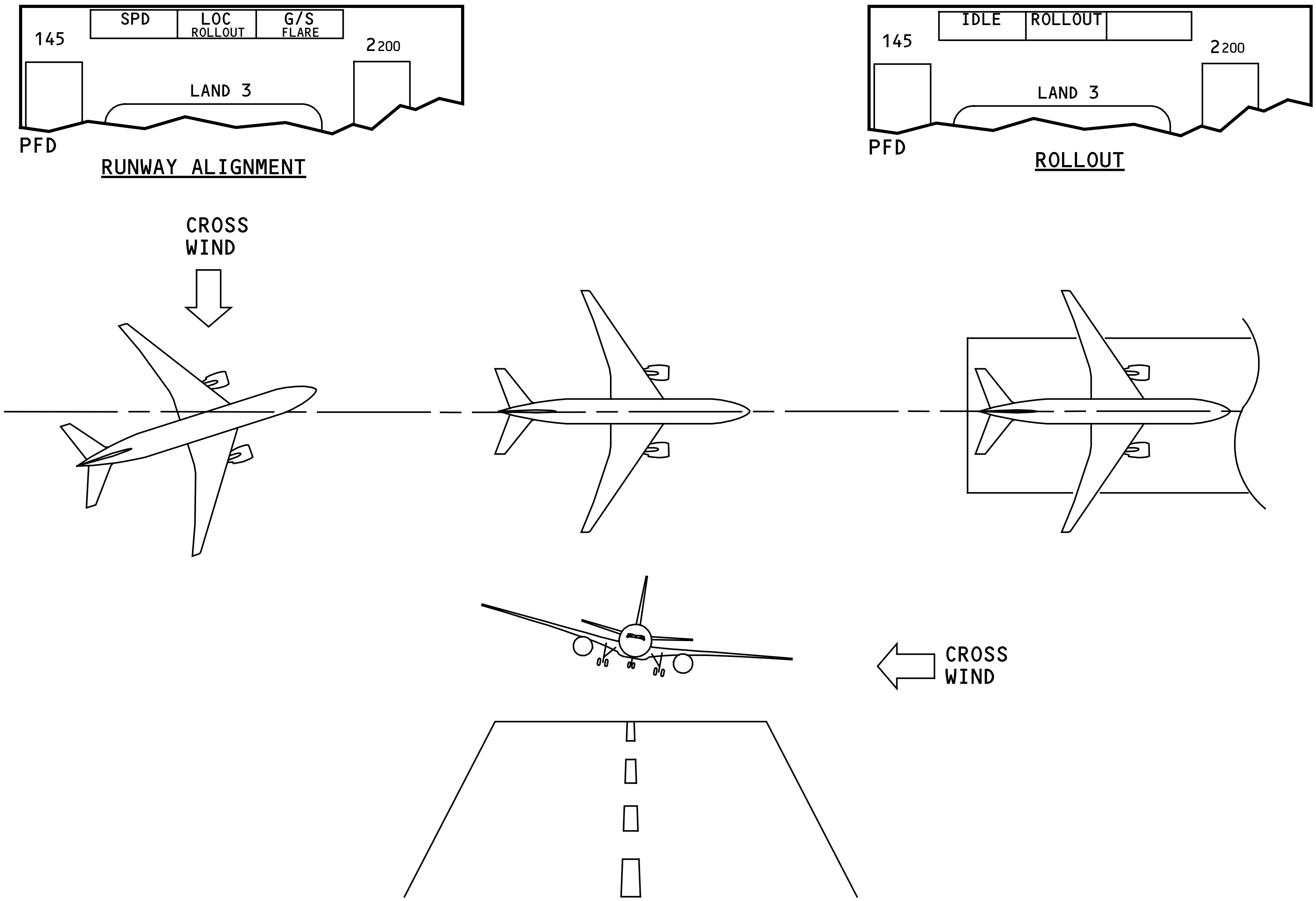
With a crab angle less than five degrees (light crosswinds), alignment occurs at 200 feet. The AFDS removes the crab angle.

Rollout

The rollout mode arms at 1500 feet during an autoland.

As the airplane descends below two feet of radio altitude, the mode is active and ROLLOUT replaces LOC as the active mode on the PFD.

Rollout guidance continues until the flight crew disengages the autopilot and sets the flight director switches to off.



22-11-00-042 Rev 2

AFDS - OPERATION - AUTOLAND ROLL AND YAW

AFDS - OPERATION - GO-AROUND

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AFDS - OPERATION - GO-AROUND

General

Go-around is a combined AFDS and TMCF mode. The pilot uses the mode in these conditions:

- An aborted approach
- Windshear during takeoff or landing.

The pitch command keeps the airplane in these limits:

- Flap placard speeds
- Maximum operating velocity and Mach (VMO/MMO)
- Minimum speed.

The roll command holds the present track of the airplane over the ground.

In go-around, the flight director display on the PFDs automatically comes on even if the flight director switches are off. This is called "auto pop up". It occurs when all these conditions are true:

- A flight director switch is off
- The trailing edge flaps are not up
- The pilot pushes a TO/GA switch.

Go-Around Arm

Go-around arms when the airplane is in the air and, one of these conditions is true:

- Glideslope mode is active
- The trailing edge flaps are not up.

The PFD and MCP continue to show the approach modes.

Go-Around Active

The go-around mode starts when the pilot pushes either TO/GA switch. With one push of the TO/GA switch, the autothrottle controls to a 2000 ft/min climb. With a second push, the autothrottle controls to full go-around thrust.

TO/GA shows on the PFD as the active mode for roll and pitch. The autothrottle mode is thrust (THR).

The AFDS supplies an initial pitch up command to make sure the airplane clears any obstacles. After the pitch up command, the AFDS commands one of these:

- Target airspeed
- A combination of target airspeed and pitch attitude
- Pitch attitude.

If the climb rate is below 600 FPM, the pitch command is to hold attitude. For rates between 600 FPM and 1200 FPM, the pitch axis holds a mixture of airspeed and attitude. For climb rates above 1200 FPM, the pitch axis holds a target airspeed.

For go-around with an engine out, the pitch axis command is a mixture of airspeed and attitude below 1200 FPM. Above 1200 FPM, the pitch axis holds a target airspeed.

AFDS - OPERATION - GO-AROUND

This mix of speed and attitude command gives windshear protection during go-around.

Go-Around Off

Below 400 feet, the AFDS stays in go-around unless the pilot disengages the autopilot and sets the flight director switches to off.

Above 400 feet, the pilot can select another roll or pitch mode.

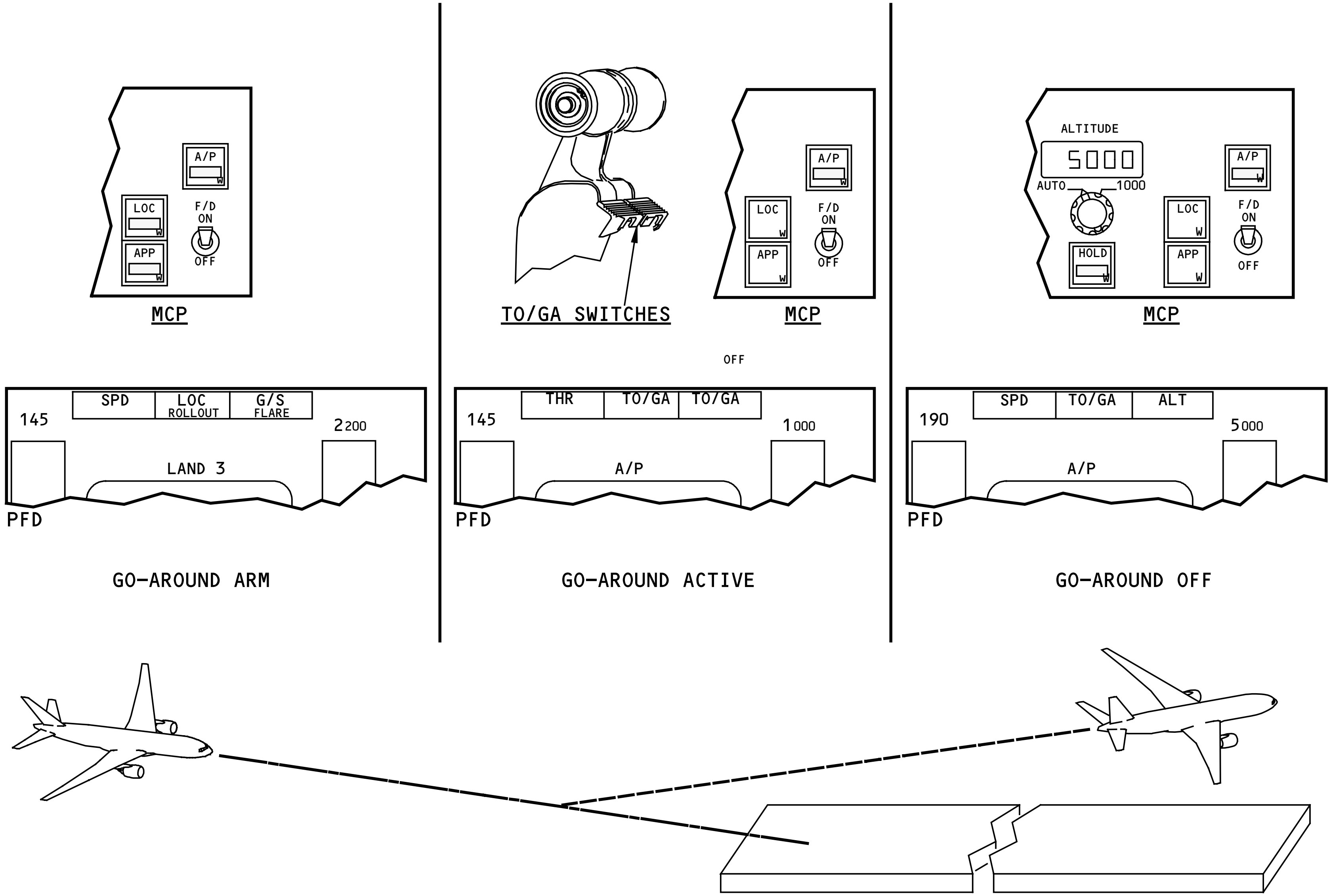
In this example, the AFDS captures the MCP altitude. The PFDs show ALT and the airplane levels off at 5000 feet.

Go-around stays as the active roll mode until the pilot selects another roll mode.

The pitch mode change from TO/GA to ALT makes the autothrottle change to SPD mode at the speed set on the MCP.

When a go-around occurs below 1500 feet during an autoland, all six backdrive actuators remain engaged until a different roll or pitch mode, other than TO/GA, is selected.

When a go-around occurs below 1500 feet during an autoland, bus-isolation remains active until the airplane is above 400 feet.



AFDS - OPERATION - GO-AROUND

AFDS - FUNCTIONAL DESCRIPTION - ENGAGE INTERLOCKS INTRODUCTION

Purpose

The autopilot engage interlock circuits in the AFDCs and PFCs monitor the operation, power, and components of the AFDS and PFCS. With normal conditions, the circuits let the autopilot engage. If conditions are not normal, the autopilot disengages or the autopilot does not engage.

Mode Control Panel

The autopilot engage switches are on the MCP. The flight crew pushes either switch to engage the autopilot.

Usually, all three AFDCs engage when the flight crew pushes either A/P engage switch. If there are faults, it is possible to engage one or two AFDCs. Autoland requires two or three AFDCs engaged.

The disengage bar on the MCP lets the flight crew disengage the autopilot from the MCP. The autopilot cannot engage unless the bar is in the up position.

AFDC

The AFDCs process the engage request from the MCP and send it to the PFCs.

The engage logic and backdrive engage relays in the AFDCs monitor these components, systems, and sensors:

- MCP
- Autopilot disengage switches
- AFDC cross channel data
- PFCS
- ADIRU
- SAARU
- ILS
- RA
- Backdrive actuators.

PFCs

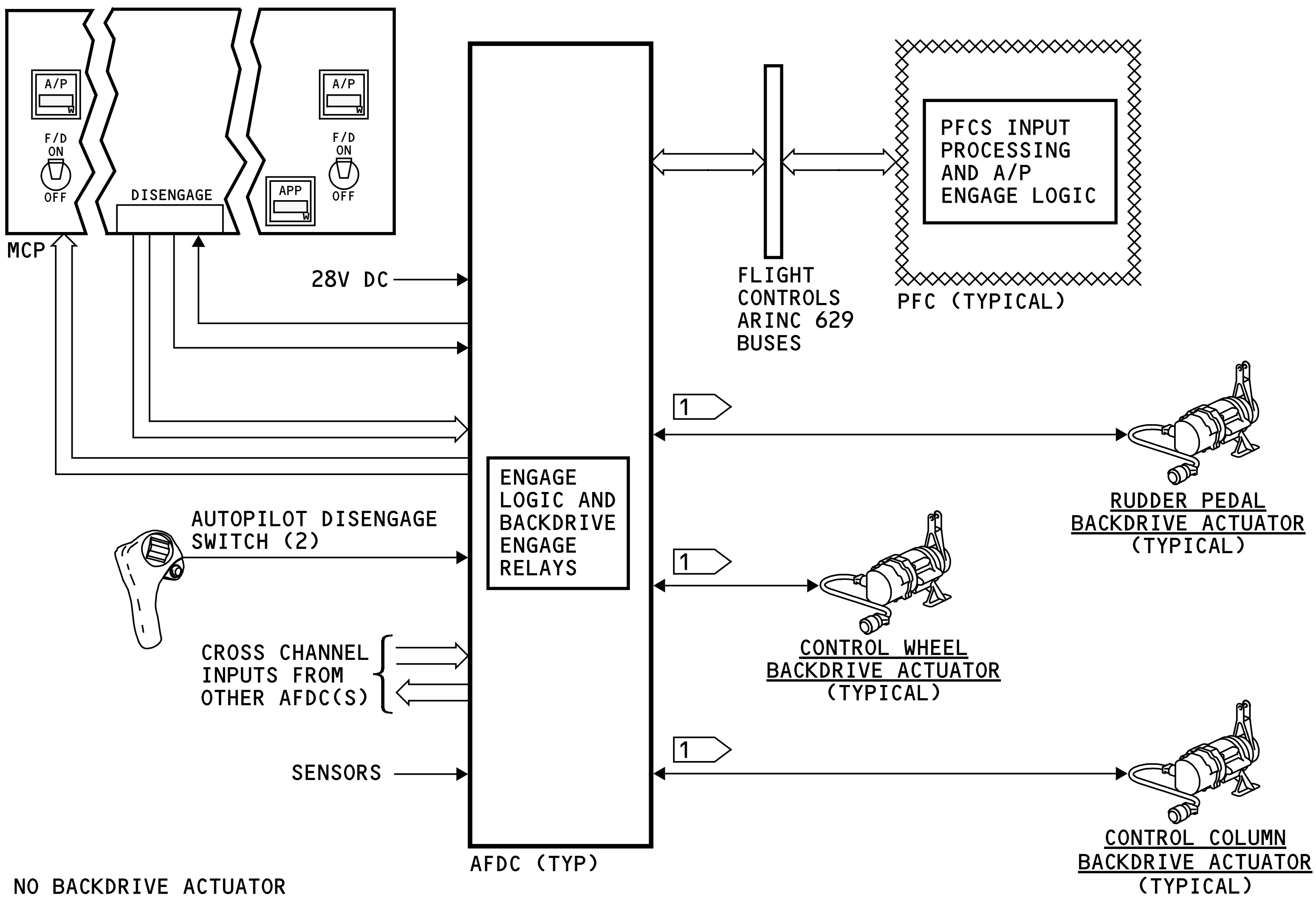
The PFCS controls the elevator, aileron, and rudder. When the PFCs receive valid engage requests from the AFDCs, the PFCs change control of these surfaces from the flight crew to the autopilot. The PFCs also command the AFDCs to engage the backdrive actuators.

Backdrive Actuators

The left and right AFDCs have rudder pedal, control wheel, and control column backdrive actuators. The center AFDC does not control backdrive. For this reason, the autopilot does not engage with only the center AFDC.

The engage relays for the backdrive actuators are in the AFDCs.

Logic in the AFDCs monitor the electrical components in the backdrive actuators.



1 NO BACKDRIVE ACTUATOR CONNECTIONS FOR CENTER AFDC.

AFDS - FUNCTIONAL DESCRIPTION - ENGAGE INTERLOCKS INTRODUCTION

AFDS - FUNCTIONAL DESCRIPTION - ENGAGE INTERLOCKS MASTER/SLAVE SELECTION

General

The AFDCs operate as master or slave when the autopilot engages in cruise. Two or three AFDCs must engage before the master/slave selection occurs.

Only the left or right AFDCs can be master. This is because they operate the backdrive actuators. Any of the three AFDCs can operate as slave.

The master selection changes between the left and right AFDC to:

- Apply equal wear between the backdrive actuators
- Automatically select a good AFDC for master after a failure disengages the autopilot.

The AFDS does not use the master/slave function in autoland.

Selection Process

The AFDCs use these methods to select the master AFDC:

- Random selection of the right or left AFDC when power is applied to the AFDS
- The master AFDC changes each time the autopilot engages.

Master AFDC Function

The master AFDC performs these functions:

- Column and wheel backdrive actuator selection and control in cruise
- Wheel backdrive actuator selection during BAP
- Control of AFDS modes
- Sends AFDS mode data to the slave AFDCs
- Calculate pitch, roll and yaw commands.

If the master AFDC cannot do these functions, the autopilot disengages. You can engage the autopilot again with a different AFDC as the master.

The MCP microprocessor in control follows the master AFDC selection when:

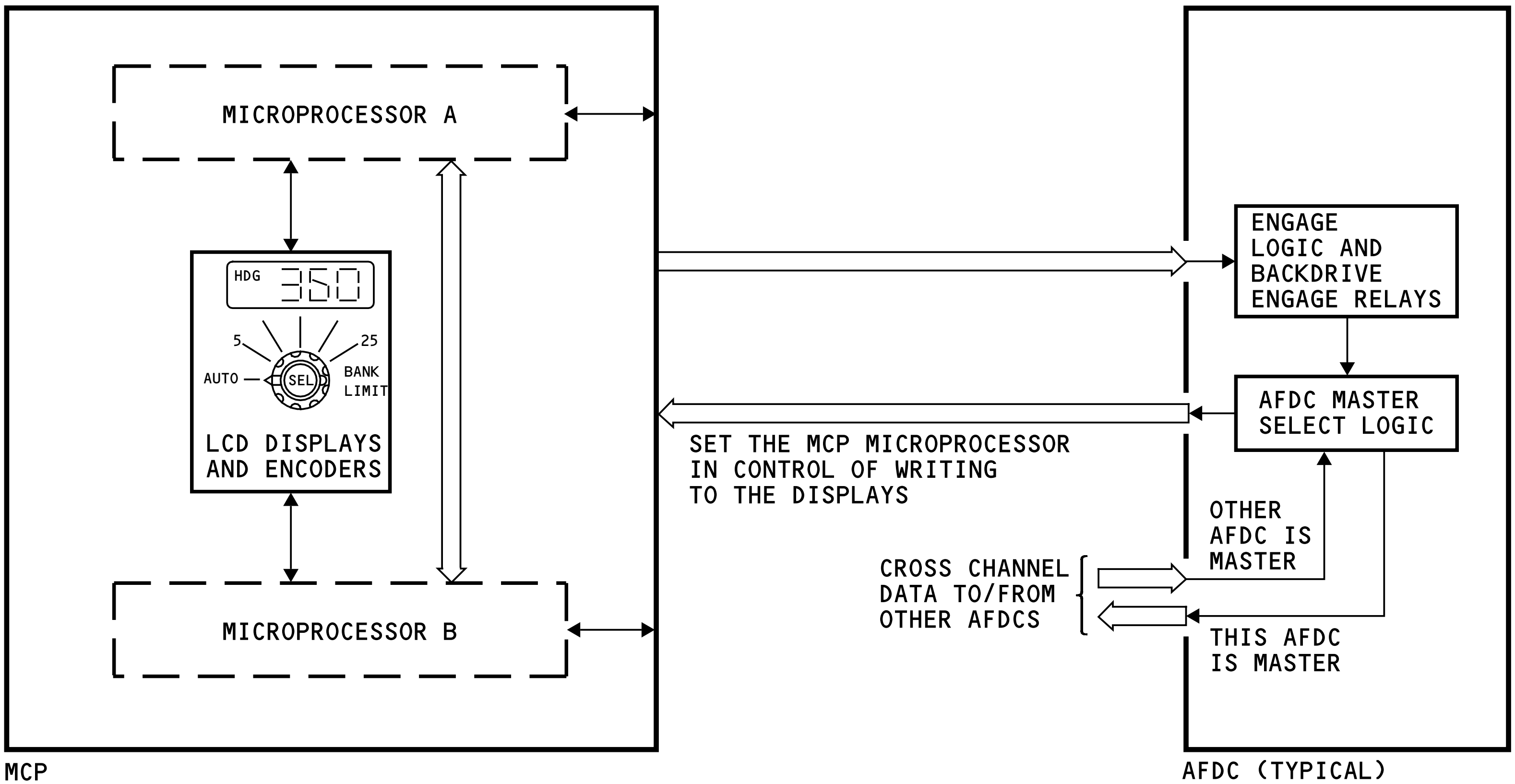
- The left AFDC is the master, MCP microprocessor A writes to all the MCP displays
- The right AFDC is the master, MCP microprocessor B writes to all the MCP displays.

Slave AFDC Function

The slave AFDC does these functions:

- Calculate pitch, roll and yaw commands
- Receives AFDS mode data from the master AFDC
- Limits the AFDS pitch and roll commands to safe values.

If a slave AFDC cannot do its functions, the PFCs do not use autopilot commands from that AFDC.



22-11-00-053 Rev 2

AFDS - FUNCTIONAL DESCRIPTION - ENGAGE INTERLOCKS MASTER/SLAVE SELECTION

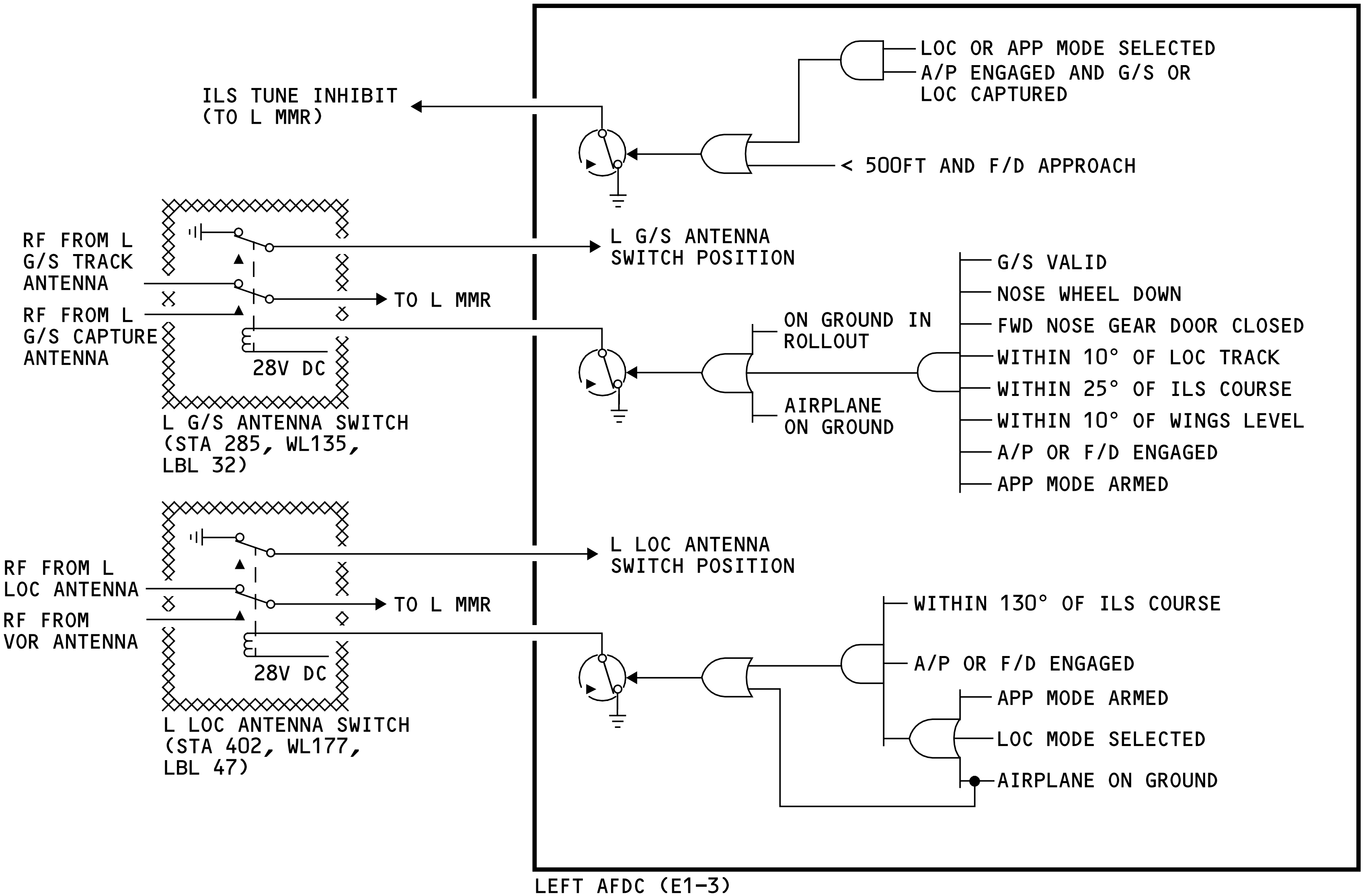
AFDS - ILS ANTENNA SWITCHING LOGIC

ILS Antenna Switching

The autopilot flight director computers (AFDCs) select the position of their onside localizer and glideslope antenna switches.

ILS Tune Inhibit

The AFDCs prevent tuning of the multi-mode receivers (MMRs) when the airplane makes an autopilot engaged approach. The AFDCs also prevent tuning of the MMRs when the pilot makes a flight director only approach and the airplane is below 500 feet of radio altitude.



22-11-00-061 Rev 3 01/14/1998

AFDS - ILS ANTENNA SWITCHING LOGIC

AFDS - FUNCTIONAL DESCRIPTION - WARNING AND ANNUNCIATION INTRODUCTION

General

The AFDCs warning and annunciation functions send normal and non-normal indications of AFDS performance to:

- The AIMS cabinets
- The warning electronic system (WES).

Description

Each AFDC sends this normal data to the AIMS cabinets:

- Mode
- Status
- Flight director commands
- Autoland status.

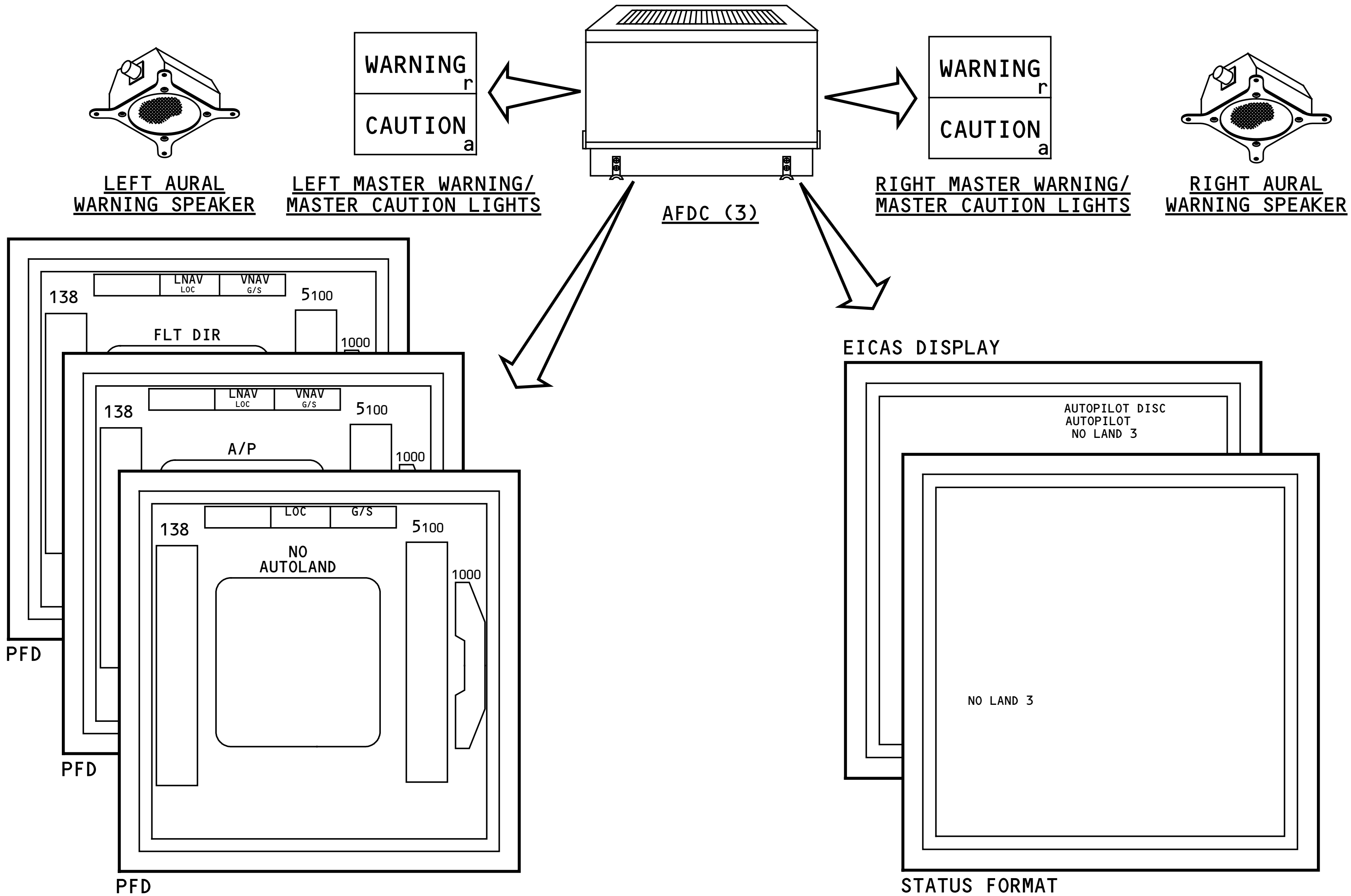
AIMS shows this data on the primary flight displays (PFDs).

Each AFDC sends this non-normal data to AIMS:

- Autopilot disconnect warning
- Autopilot caution
- Autoland status
- Mode fail
- Flight director (F/D) fail.

Each AFDC sends the disconnect warning discrete to the WES. This causes the master warning lights and the siren to come on.

The AIMS also turns on the master caution light and causes the WES to make the caution aural.



22-11-00-054 Rev 3 04/10/1997

AFDS - FUNCTIONAL DESCRIPTION - WARNING AND ANNUNCIATION INTRODUCTION

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AFDS - FUNCTIONAL DESCRIPTION - WARNING AND ANNUNCIATION - PFD AND ND DISPLAYS

General

The primary flight displays (PFDs) show AFDS modes, status messages, and flight director (F/D) information. The PFD also shows selected mode control panel (MCP) data.

Display Priority

The AIMS uses the validity of the three AFDCs and the MCP A and B processors to determine the priority for the displays.

This is the AFDC priority for the captain's PFD:

- left AFDC if valid
- Center AFDC if left AFDC is not valid
- Right AFDC if left and center AFDCs are not valid.

This is the AFDC priority for the first officer's PFD:

- Right AFDC if valid
- Center AFDC if right AFDC is not valid
- Left AFDC if right and center AFDCs are not valid.

This is the MCP priority for both PFDs:

- The A microprocessor if valid
- The B microprocessor if the A microprocessor is not valid.

AFDS Modes

The top of the PFD shows the AFDS modes of operation. This is the flight mode annunciator (FMA). Active and arm pitch and roll modes show.

The failure of sensor data necessary for the active pitch or roll mode causes a yellow bar to show through the mode on the FMA. This bar indicates a mode failure. An arm mode will not show the mode fail bar.

Flight Director Commands

Flight director commands show on the PFD as pitch and roll F/D bars. A mode fail will cause the appropriate F/D bar to go out of view.

When the AIMS does not receive any valid F/D data from the AFDCs and either of the F/D switches is on, a F/D failure flag shows on the PFD.

AFDS Engage and Autoland Status Annunciation

The AIMS shows this AFDS status:

- FLT DIR; when in flight director only operation
- A/P; when in autopilot operation
- LAND 3, LAND 2, NO AUTOLAND; when in approach and below 1500 feet radio altitude
- Test; if any AFDC is in test.

This is the autoland status display priority:

- NO AUTOLAND
- LAND 2
- LAND 3.

MCP Selected Data

The AIMS shows this data from the MCP:

- Selected speed
- Selected mach
- Selected altitude
- Selected vertical speed
- Selected flight path angle
- Selected heading
- Selected track.

Selected Flight Path Angle

Selected flight path angle (FPA) shows on the PFD when you select FPA on the MCP. The selected FPA is a target for the flight path vector (FPV) symbol, it is not a target for the flight director pitch bar. If you select FPA on the MCP before you select the FPV on the EFIS control panel, the FPV will show automatically on the PFD.

Navigation Display (ND)

The ND shows the selected track or heading cursors. The AIMS uses the validity of the MCP A and B processors for the priority of the display.

This is the MCP priority for both NDs:

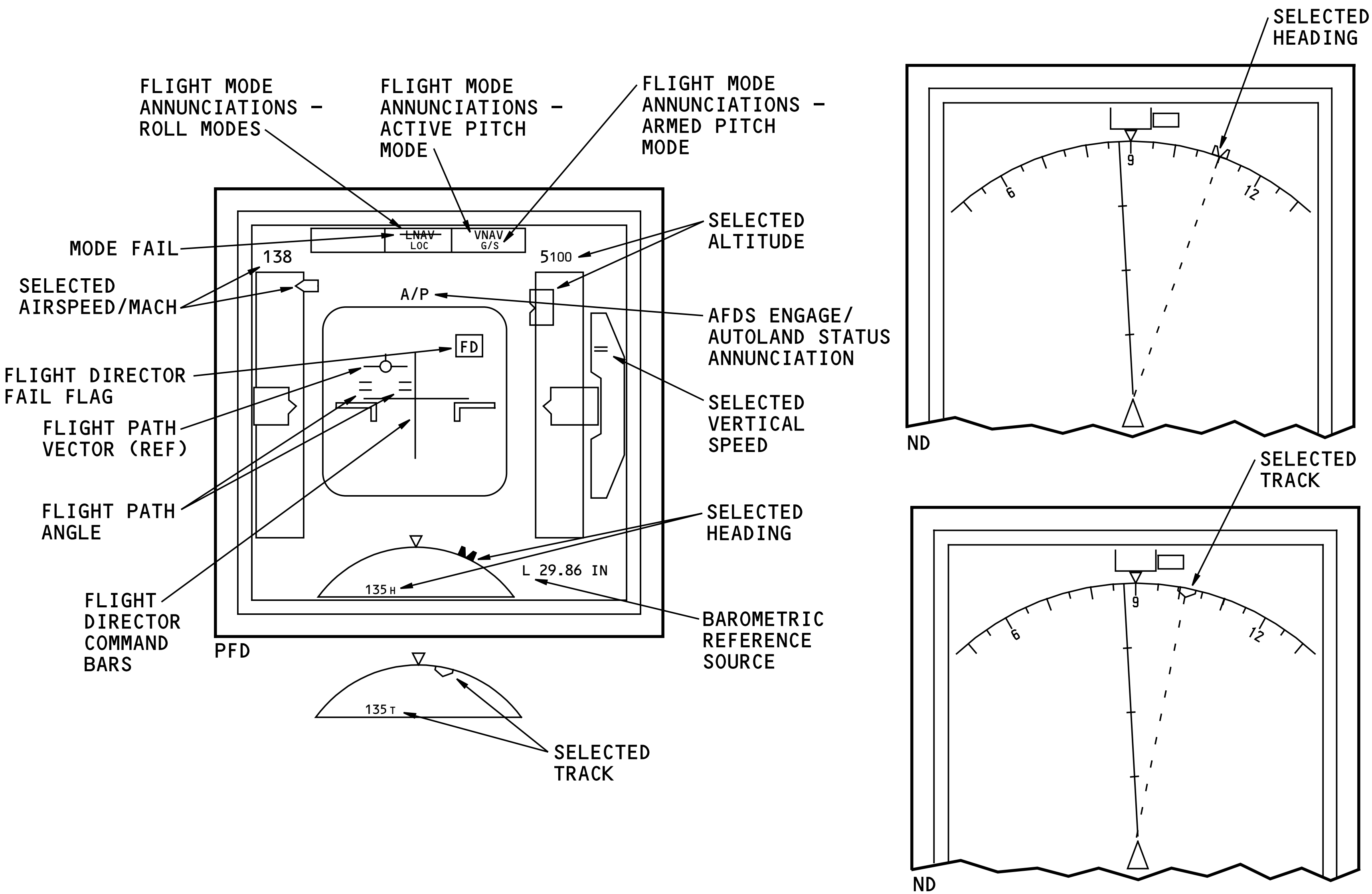
- The A processor
- The B processor.

Barometric Reference Source

The barometric reference source shows which barometric (baro) correction the AFDCs use. An L shows the AFDCs use the captain's baro correction value. An R shows the AFDCs use the first officer's baro correction value. Both PFDs show the same baro reference source.

With no autopilot engagement and with flight director selection only, the AFDCs use the captain's barometric correction when the left flight director switch is on, and both PFDs show the letter L. If you select the ON position for only the right flight director switch, the AFDCs use the first officer's barometric correction and both PFDs show the letter R. If both flight director switches are on, the AFDCs use the captain's barometric correction, and both PFDs show the letter L.

When you engage the autopilot with the left autopilot engage switch, the AFDCs use the captain's baro correction value and both PFDs show the letter L. When you engage the autopilot with the right autopilot engage switch, the AFDCs use the first officer's baro correction value and both PFDs show the letter R.



22-11-00-055 Rev 6 04/26/96

AFDS - FUNCTIONAL DESCRIPTION - WARNING AND ANNUNCIATION - PFD AND ND DISPLAYS

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AFDS - FUNCTIONAL DESCRIPTION - WARNING AND ANNUNCIATIONS - EICAS DISPLAYS

General

The EICAS and MFD displays show messages, warnings, and autoland capability for the autopilot system. The warning electronic units (WEUs) make the master warning lights come on when a warning message shows on the EICAS display. The AIMS makes the master caution lights come on when a caution message shows on the EICAS display.

The AFDCs send data that causes these types of messages to show on the EICAS display and the MFD:

- Warning on the EICAS display
- Caution on the EICAS display
- Advisory on the EICAS display
- Status on the status display.

Warning

The AFDCs send the AUTOPILOT DISC warning message request to the AIMS when either of these happens:

- The flight crew disconnects all engaged AFDCs
- All engaged AFDCs automatically disconnect.

The wheel disconnect switch resets the AUTOPILOT DISCONNECT warning.

The wheel disconnect switch tests the AUTOPILOT DISCONNECT warning if the autopilot is not engaged. The warning resets when the flight crew releases the switch.

Caution

The AFDCs send these autopilot caution messages requests to the AIMS:

- AUTOPILOT, when an autopilot mode fail occurs
- NO LAND 3, when autoland capability degrades while in approach after LAND 3 shows. This only occurs above 200 feet radio altitude
- NO AUTOLAND, when all autoland capability is lost during approach after LAND 2 or LAND 3 has shown. This also occurs during approach if LAND 2 or LAND 3 is not active by 600 feet radio altitude.

Advisory

The AFDCs send these advisory message requests to the AIMS:

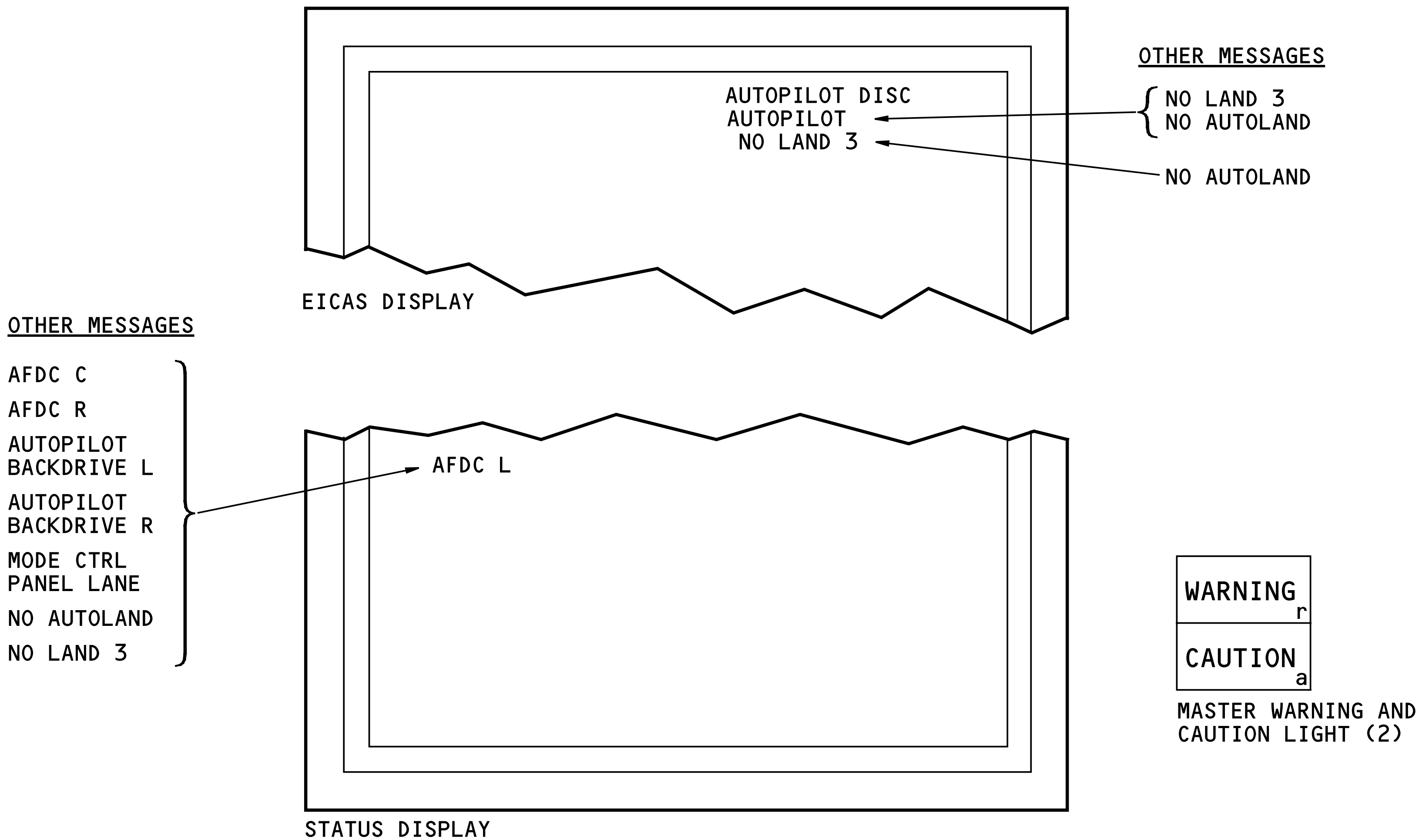
- NO LAND 3, when autoland capability degrades before the LAND 3 autoland status annunciation shows
- NO AUTOLAND, when loss of all autoland capability occurs before the LAND 3 or LAND 2 autoland status annunciation shows.

Status

The AFDCs send these autopilot status message requests to the AIMS:

- AFDC L, R, or C; when an AFDC does not operate

- AUTOPILOT BACKDRIVE L or R, when the left or right backdrive system does not operate
- MODE CTRL PANEL LANE, when one of the two lanes in the AFDS MCP or its interface to the AFDC fails
- NO AUTOLAND, when loss of all autoland capability occurs
- NO LAND 3, when the NO LAND 3 caution or advisory message shows
- NO LAND 3, autoland capability degrades during approach when the airplane is below 200 feet radio altitude. There is no caution or advisory message.



22-11-00-056 Rev 3

AFDS - FUNCTIONAL DESCRIPTION - WARNING AND ANNUNCIATIONS - EICAS DISPLAYS

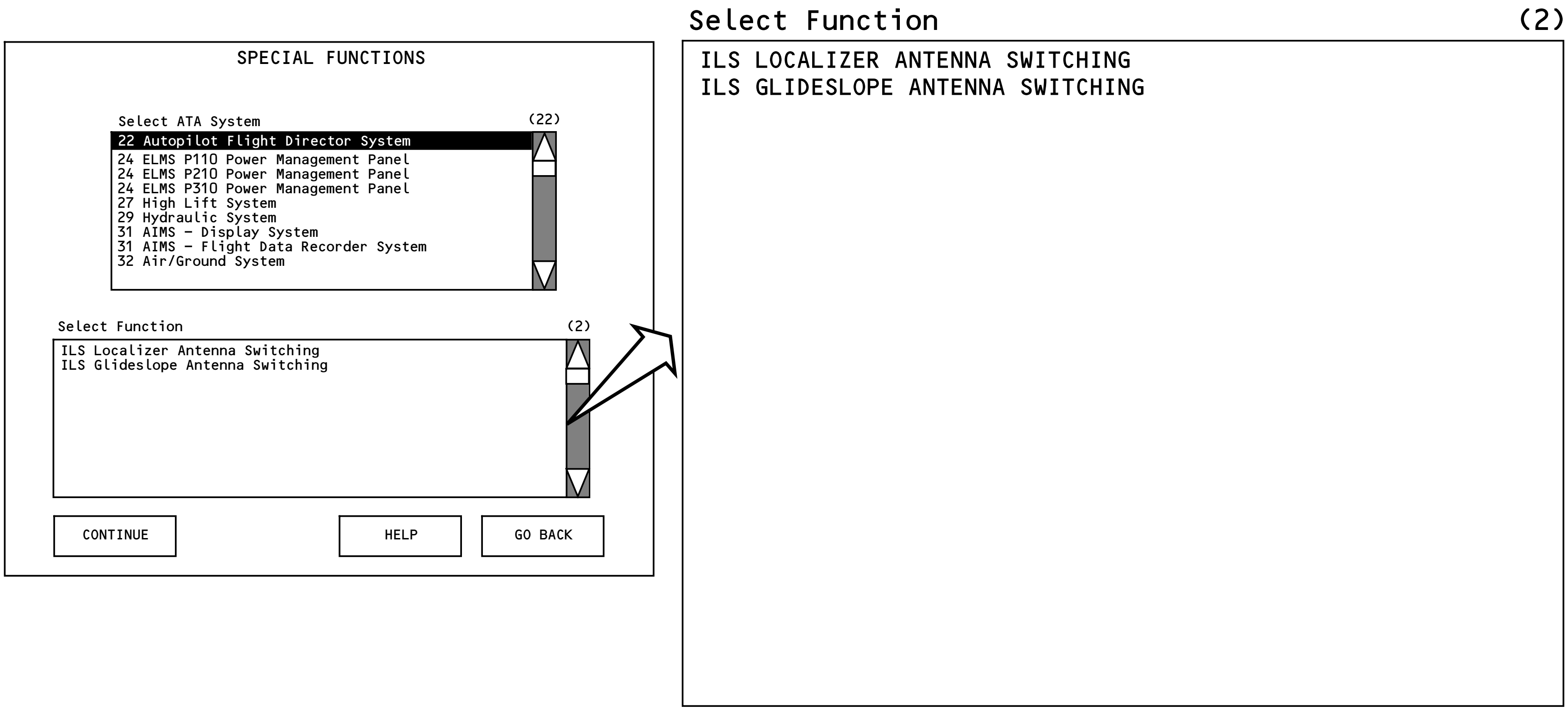
AFDS - SPECIAL FUNCTIONS

General

You can select these two special functions on the MAT:

- Localizer antenna switching
- Glideslope antenna switching.

The AFDS special functions make the localizer and glideslope switches change position. You use these special functions during ILS system troubleshooting.



22-11-00-057 Rev 1

AFDS - SPECIAL FUNCTIONS

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AFDS - LRU TESTS

General

The LRU replacement tests verify the correct installation of an LRU.

Autopilot Disconnect Switch LRU Replacement Test

The autopilot disconnect switch LRU replacement test makes sure all contacts of the captain's and first officer's disconnect switches operate correctly.

During the test, the MAT tells you to operate the captain's and first officer's disconnect switches one at a time. The test makes sure all AFDCs receive the correct results.

The autopilot disconnect switch LRU replacement test isolates faults to:

- The AFDC (left, center, or right)
- The captain's disconnect switch
- The first officer's disconnect switch.

AFDC LRU Replacement Tests

The left, right, or center AFDC LRU replacement test causes the AFDC self-test and interface test to start. At the end of the test, the MAT shows AFDC internal and interface faults.

Backdrive Actuator LRU Replacement Tests

All backdrive actuator LRU replacement tests make sure the backdrive electrical signal wires are good. They also make sure the flight deck controls move to the correct position at the correct rate. The left or right AFDC:

- Calculates the backdrive command
- Engages its backdrive actuator
- Drives its backdrive actuator.

The backdrive actuator LRU replacement tests isolate faults to:

- The AFDC (left or right)
- Tachometer A
- Tachometer B
- The engage clutch
- The motor.

Mode Control Panel LRU Replacement Test

The mode control panel LRU replacement test isolates faults to the:

- AFDC (left, center, or right)
- MCP
- MCP/AFDC interface.

AFDS - LRU TESTS

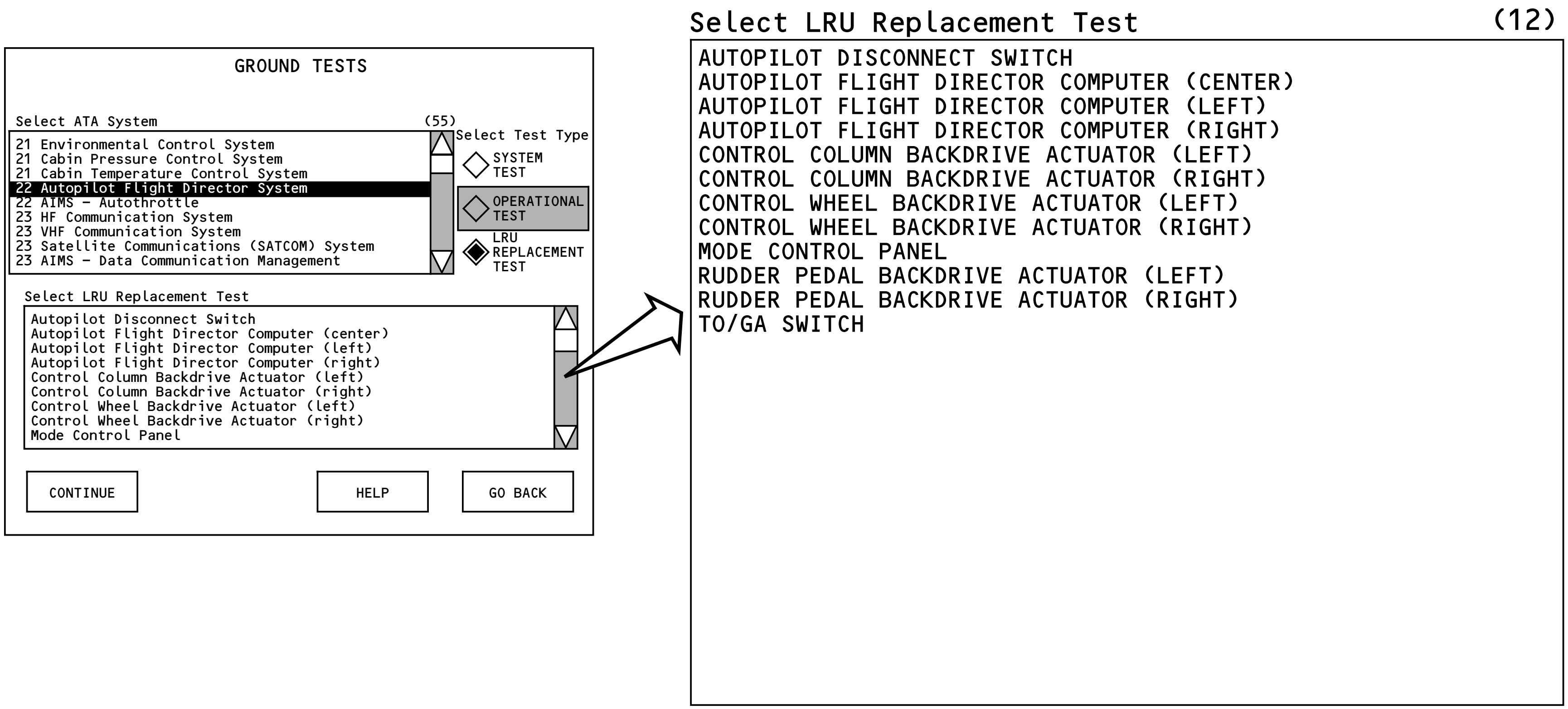
TO/GA Switch LRU Replacement Test

The TO/GA switch LRU replacement test makes sure all contacts of both TO/GA switches operate correctly. The TO/GA switches interface with all AFDCs and AIMS cabinets.

During the test, the MAT tells you to operate the left and right go-around switches one at a time. The test makes sure all AFDCs and AIMS cabinets receive the correct results.

The TO/GA switch LRU replacement test isolates faults to the:

- AFDC (left, center, or right)
- TO/GA switch
- TO/GA switch analog interface with all AFDCs and AIMS cabinets.



22-11-00-058 Rev 1

AFDS - LRU TESTS

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AFDS - SYSTEM TESTS

General

The AFDS system tests verify the correct functionality of the AFDS.

Autopilot Disconnect Warning System Test

The autopilot disconnect warning system test makes sure these functions are correct:

- Installation and operation of the A/P disengage switches
- 28v dc battery power input to the AFDCs
- A/P analog cross-channel discretes
- AFDS-WES analog interfaces
- AFDS-AIMS cabinet analog interfaces
- AFDC disengage warning monitors.

During the test, the MAT tells you to operate the captain's and first officer's disengage switches. You then make sure these functions operate correctly:

- The aural warning
- The master warning lights
- The EICAS messages.

AFDCs System Test

The test program for the AFDCs system test causes all three AFDCs to do a self-test and interface test. This test detects these:

- AFDC internal failures
- Analog signals that are not in their normal state when the airplane is on the ground and is not moving
- ARINC 629 input bus inactivity
- ARINC 429 input bus inactivity
- Incorrect ILS or RA to AFDC connections. For example, left ILS receiver or radio altimeter transceiver not connected to the left AFDC.

Backdrive Actuator System Tests

These tests operate like the LRU replacement tests for the control column, control wheel, or rudder pedal actuators. The tests also do a check of dual backdrive functions.

This test isolates the same faults as the backdrive actuator LRU replacement tests and these:

- Actuator polarity faults
- Single actuator drive faults
- Dual actuator drive faults
- AFDC backdrive monitor faults.

ILS Interface System Test

The ILS interface system test makes sure these functions are correct for all three AFDCs:

- Localizer antenna switches
- Glideslope antenna switches
- ILS tune inhibit.

AFDS - SYSTEM TESTS

During the test, the AFDCs operate these functions to make sure all signal wires are correct:

- Tune inhibit discrete
- Localizer antenna switches
- Glideslope antenna switches.

Mode Control Panel System Test

The MCP system test makes sure these functions are correct:

- All MCP switches, selectors and displays
- MCP panel variable lighting
- MCP configuration pins
- Autothrottle switch discrete output to AIMS
- ARINC 429 bus output to AIMS and the AFDCs
- ARINC 429 inputs from the AFDCs
- Disengage bar discrete outputs to the AFDCs
- Disengage bar discrete inputs from the AFDCs
- Input activity for all buses
- AFDC MCP flight fault monitors.

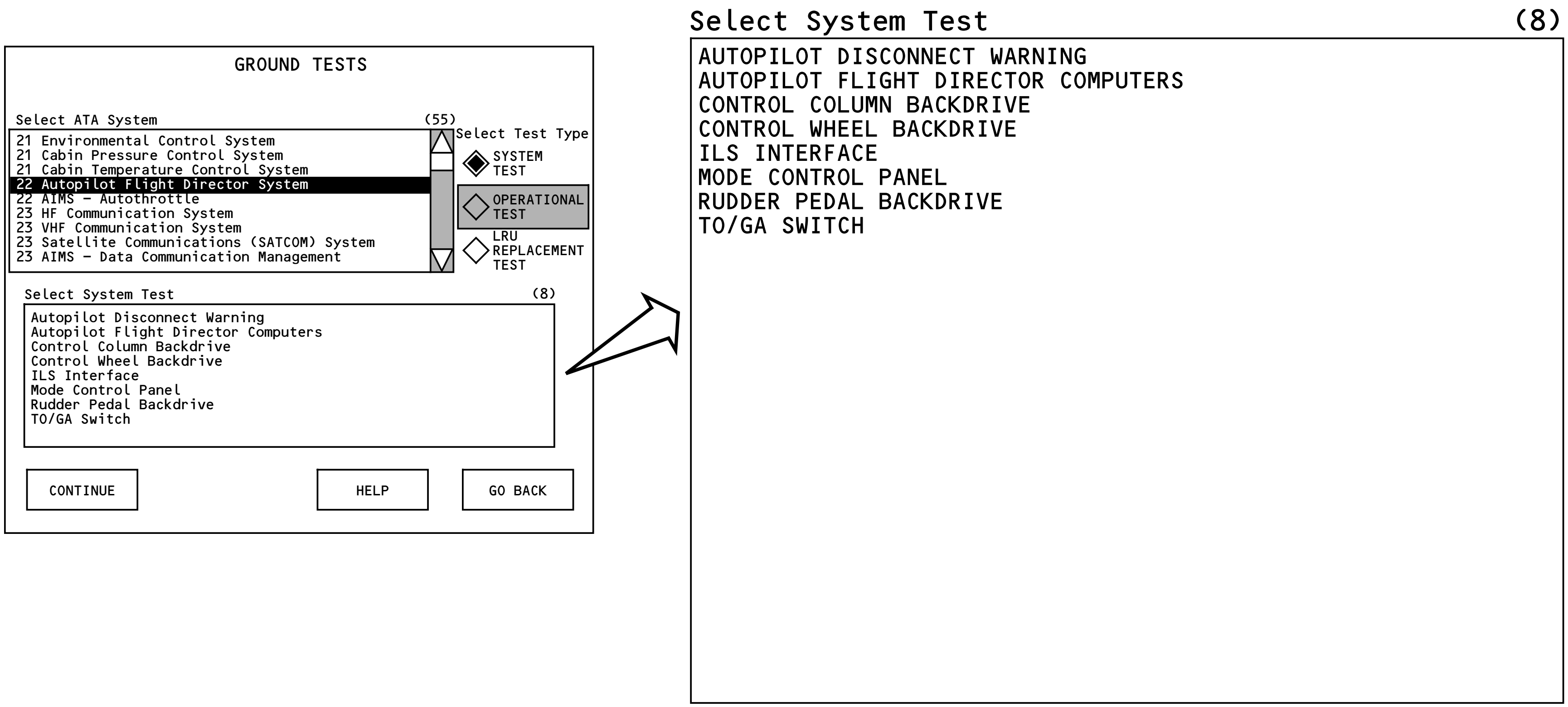
During the test, the MAT tells you to operate all switches and selectors applicable to the MCP. You also visually monitor the displays on the MCP for correct results.

This MCP system test isolates the same faults as the MCP LRU replacement test and these:

- MCP switch, selector, lights, and display faults
- MCP program pin faults
- MCP/AFDC discrete interface faults
- MCP/AIMS discrete interface faults
- ARINC 429 output bus faults
- Internal MCP monitor faults
- Internal MCP redundant and parallel data path faults.

TO/GA Switch System Test

The TO/GA switch system test is the same as the TO/GA switch LRU replacement test.



22-11-00-059 Rev 1

AFDS - SYSTEM TESTS

Continental Airlines, Inc

Pitot Static/Air Data Standby Instruments

WB371

TABLE OF CONTENTS

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PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - INTRODUCTION

Pitot-Static System

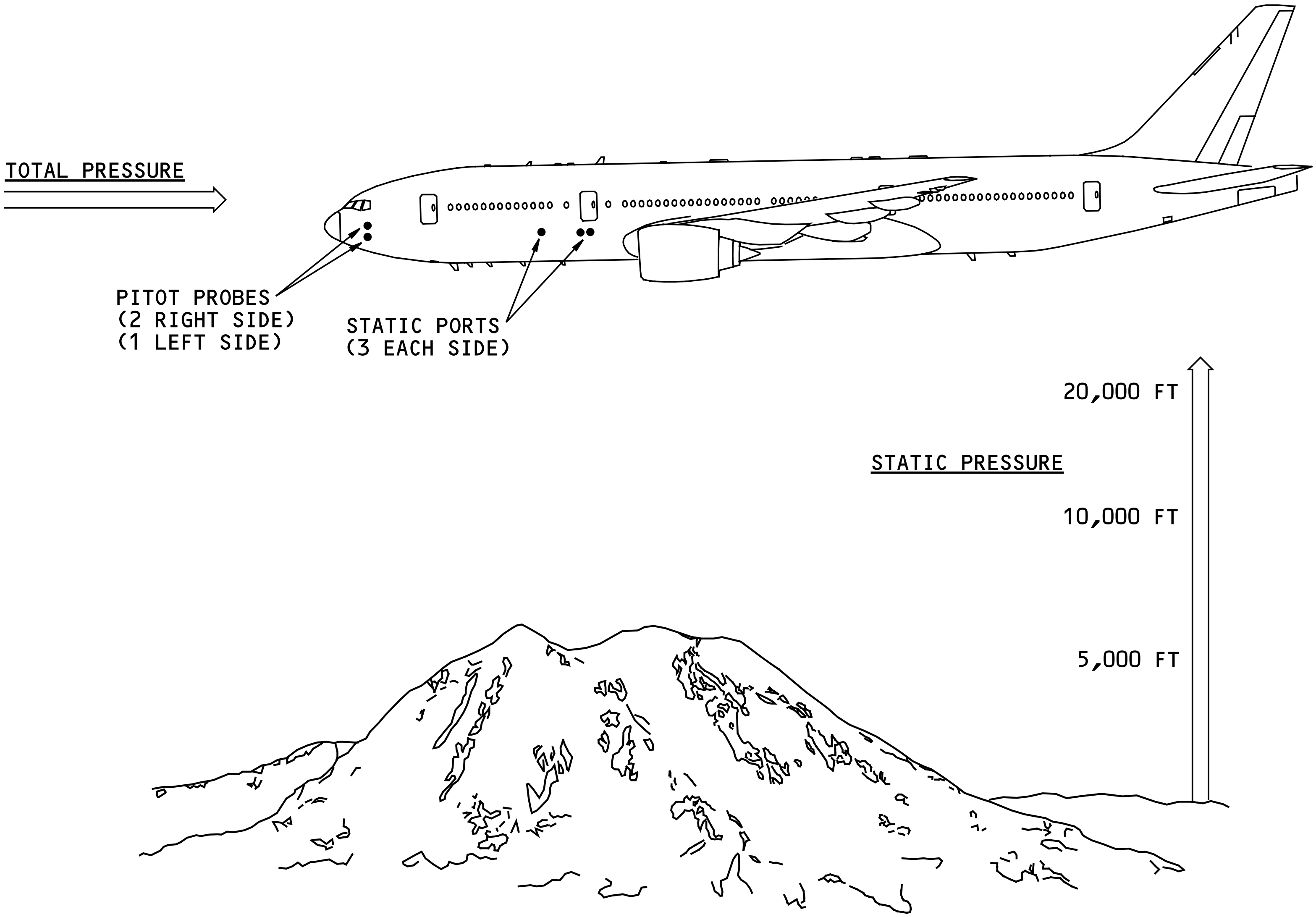
The pitot-static system uses pitot probes and flush static ports to sense total and static air pressures. These pressures go to the air data inertial reference system (ADIRS) to calculate flight parameters such as air speed and altitude.

Air Data Standby Instruments

The air data standby instruments supply the flight crew alternate indications of the airplane altitude and indicated airspeed (IAS).

Abbreviations and Acronyms

ADIRU	- air data inertial reference unit
ADM	- air data module
ALT	- altitude
BITE	- built-in test equipment
CAS	- calibrated air speed
ELMS	- electrical load management system
LCD	- liquid crystal display
IAS	- indicated air speed
SAARU	- secondary attitude air data reference unit
SADM	- standby air data module
SAI	- standby attitude indicator
SALT	- standby altimeter
SASI	- standby airspeed indicator
TYP	- typical



PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - INTRODUCTION

PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - GENERAL DESCRIPTION

Pitot-Static System

The pitot-static system gets air pressure inputs from three pitot probes and six flush static ports on the airplane fuselage.

These are the two types of air pressure:

- Static air pressure. This is the ambient air pressure around the airplane
- Pitot air pressure. This is the air pressure on the pitot tube as a result of the forward motion of the airplane.

The pitot-static system has:

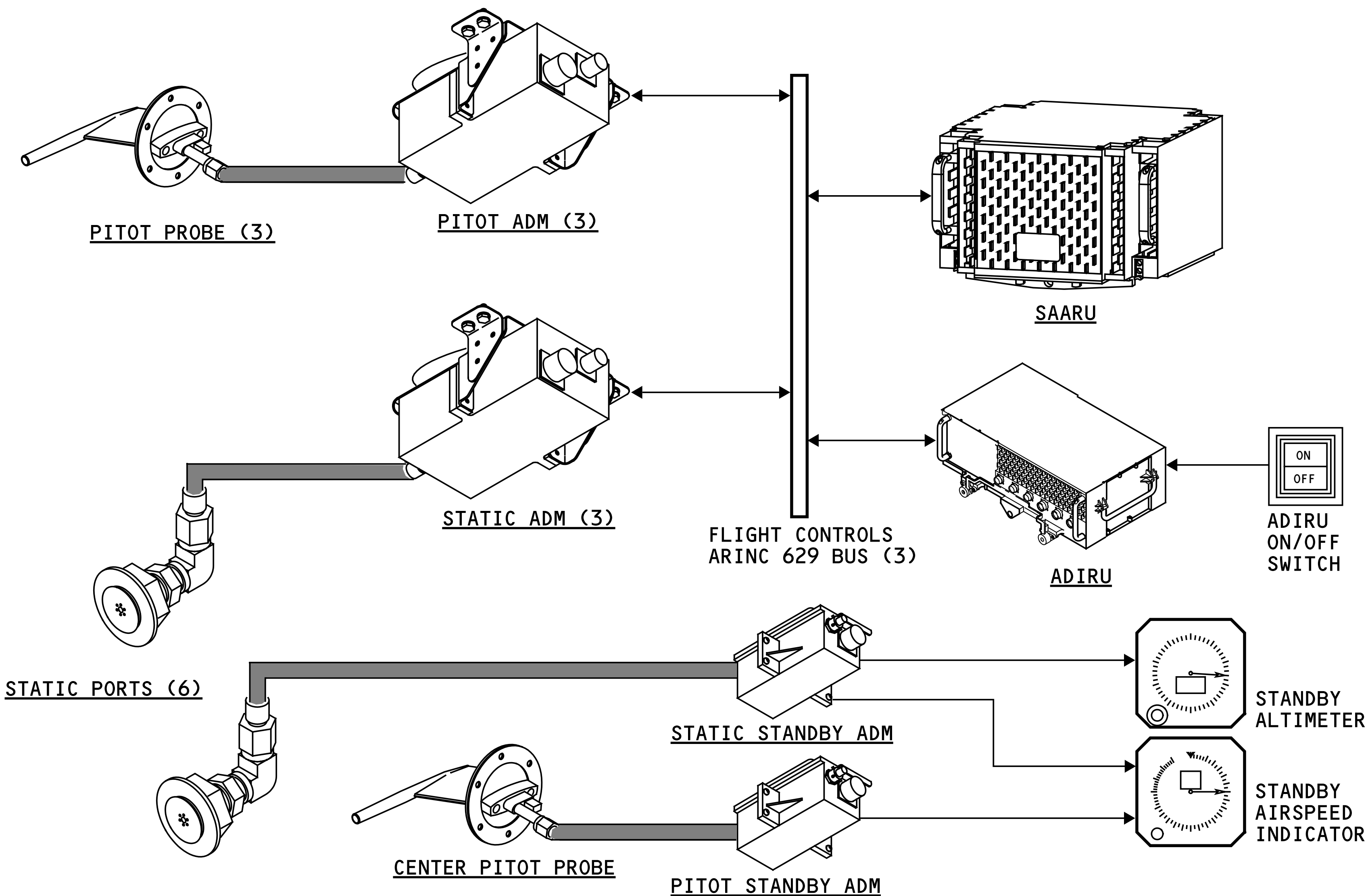
- 3 pitot probes
- 6 flush static ports
- Pneumatic lines.
- 6 air data modules (ADMs)
- 2 standby air data modules (SADMs).

The 777 has short flexible hoses that connect pitot probes to the pitot ADMs and pitot SADM. There is cross-fuselage hard tubing that connects pairs of static ports with the static ADMs and static SADM. The static ADMs and static SADM are in the center of the airplane and tubing runs. This reduces the amount of pressure lines and possible leaks from connections that occur in long tubing runs.

The pitot probes and static ports send the air pressures through lines to the ADMs and SADMs. The ADMs change the air pressures to electrical signals and send them to the air data inertial reference unit (ADIRU) and secondary attitude air data reference unit (SAARU) on the flight controls ARINC 629 data buses.

The ADIRU and SAARU use static air pressure and pitot air pressure to calculate airplane altitude and airspeed.

The standby airspeed indicator and standby altimeter get information directly from the SADMs on ARINC 429 data buses.



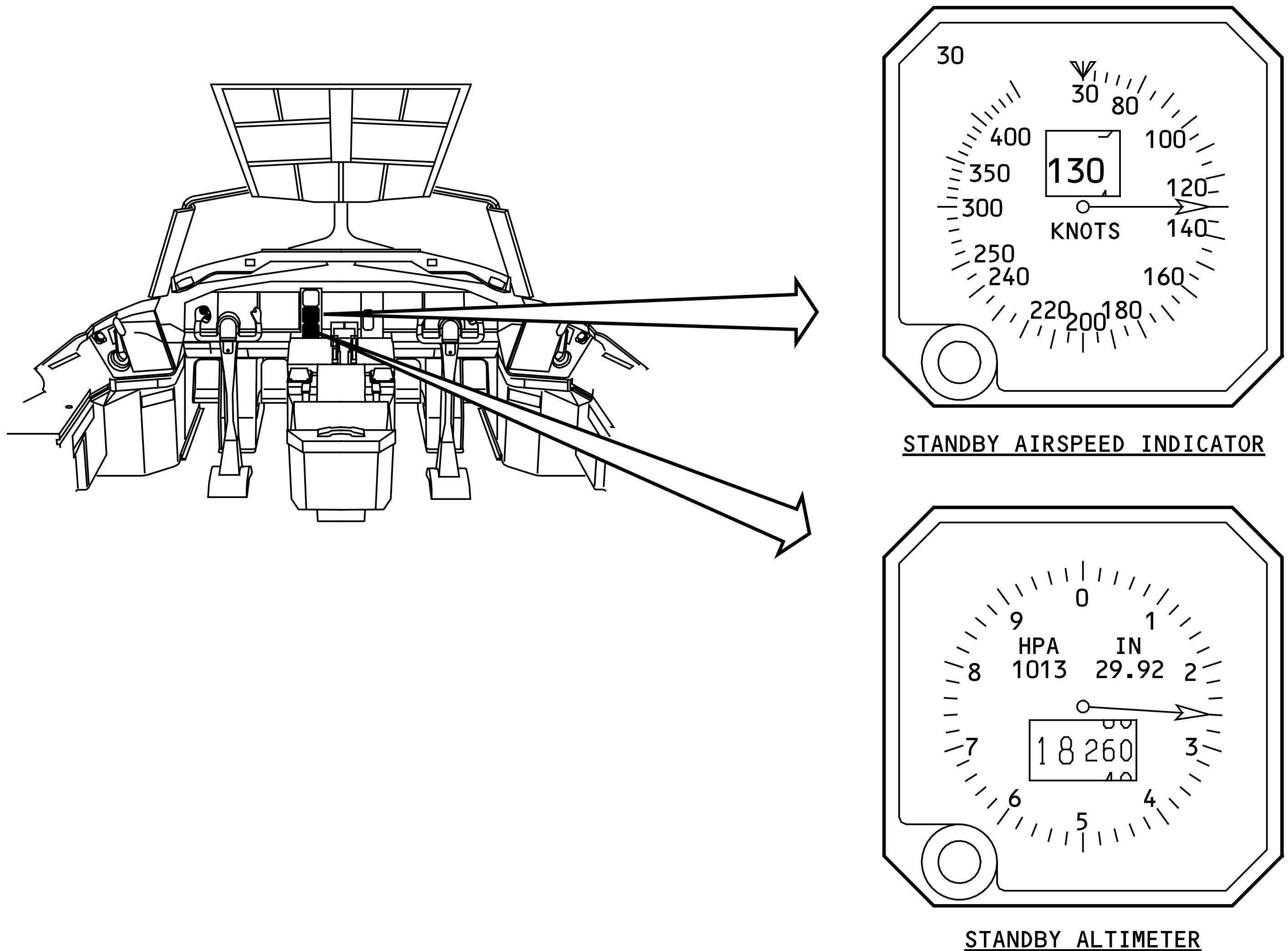
34-11-00-002 Rev 2 10/10/96

PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - GENERAL DESCRIPTION

PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - FLIGHT DECK COMPONENT LOCATION

Air Data Standby Instruments

The standby airspeed indicator and standby altimeter are in the flight deck. They are flat panel liquid crystal displays (LCD).



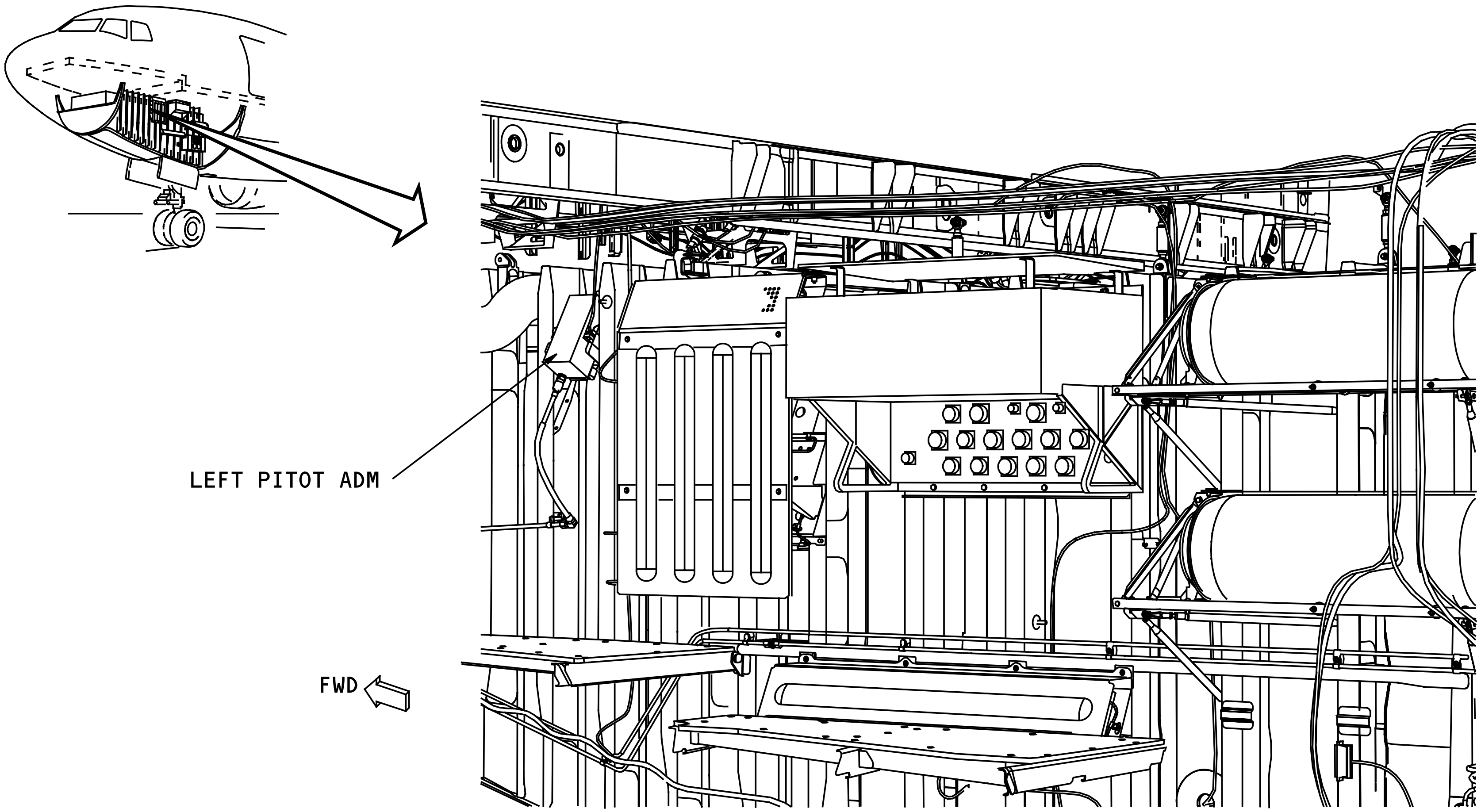
34-11-00-003 Rev 1

PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - FLIGHT DECK COMPONENT LOCATION

PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - MEC COMPONENT LOCATIONS - 1

Left Pitot ADM

The left pitot ADM is in the MEC, in the forward section to the left of the nose wheel well.



FORWARD SECTION - LEFT OF NOSE WHEEL WELL

34-11-00-004 Rev 1

PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - MEC COMPONENT LOCATIONS - 1

PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - MEC COMPONENT LOCATIONS - 2

Right Pitot ADM

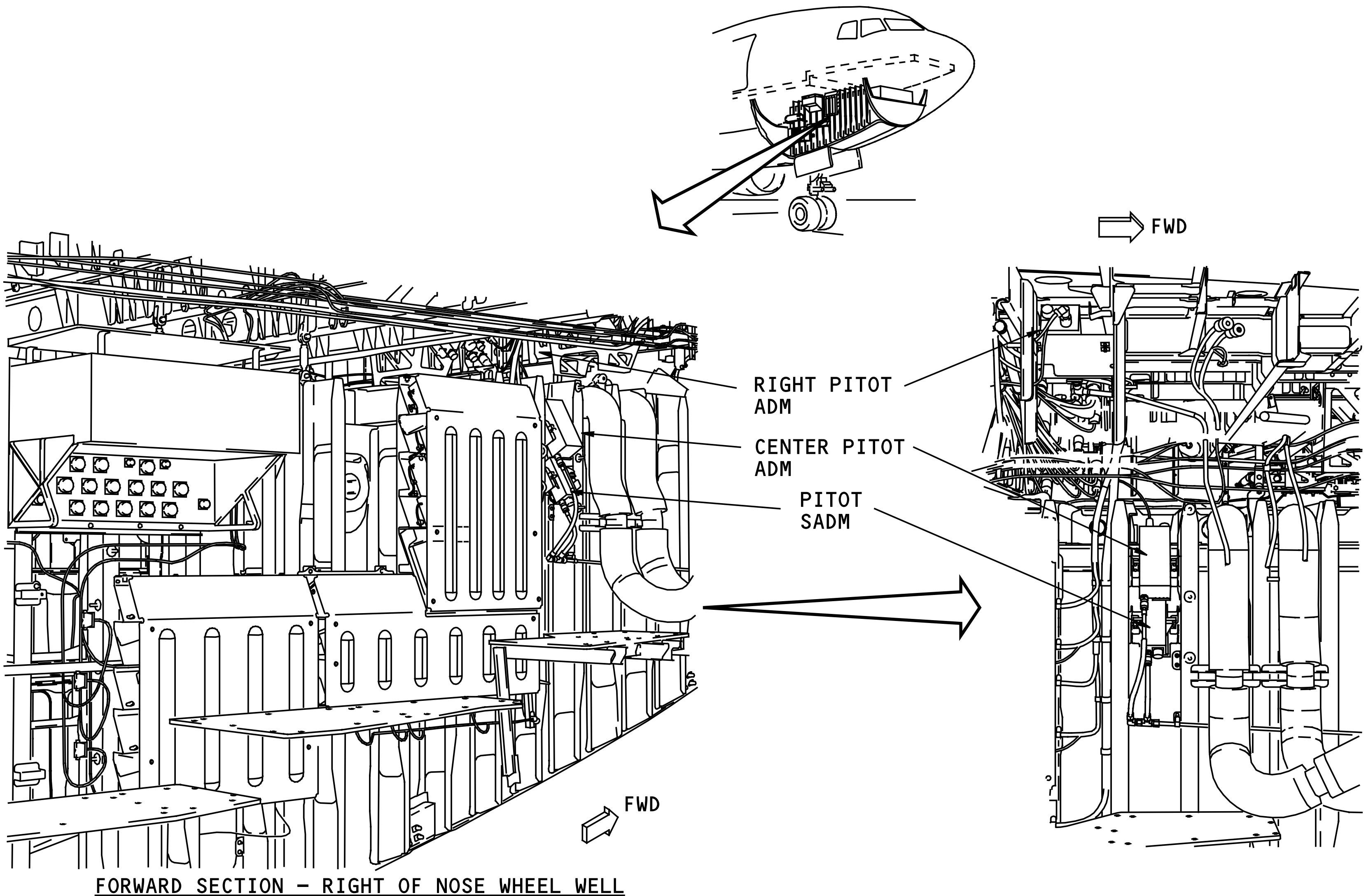
The right pitot ADM is in the MEC, in the forward section to the right of the nose wheel well.

Center Pitot ADM

The center pitot ADM is below the right pitot ADM in the MEC, in the forward section to right of the nose wheel well.

Pitot SADM

The pitot SADM is below the center pitot ADM in the MEC, in the forward section to the right of the nose wheel well.

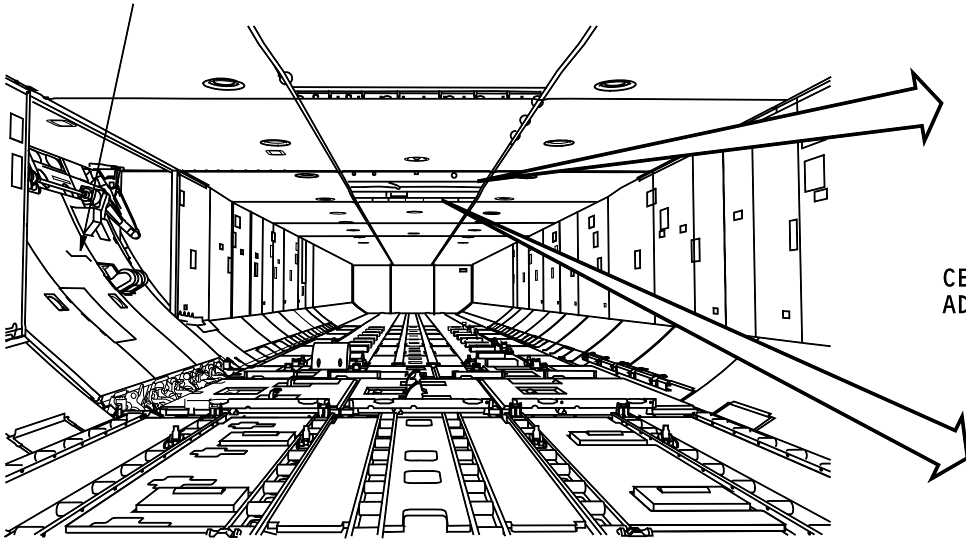


PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - MEC COMPONENT LOCATIONS - 2

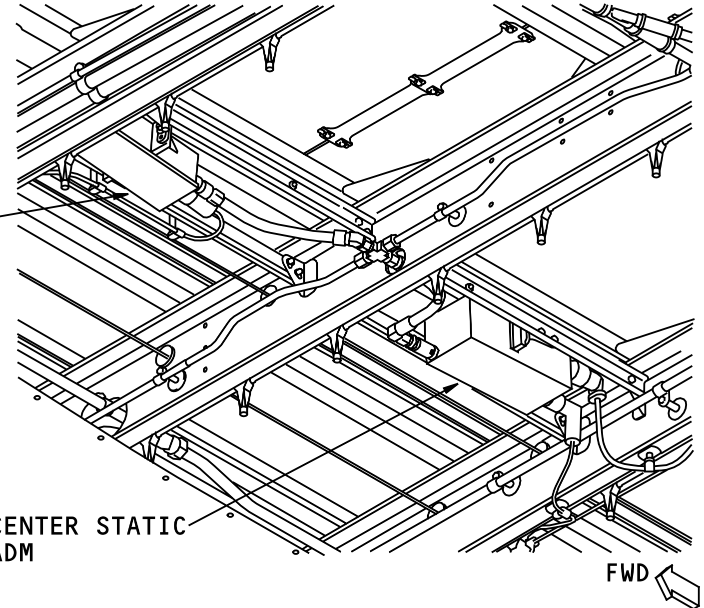
PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - FWD CARGO COMPARTMENT COMPONENT LOCATIONS

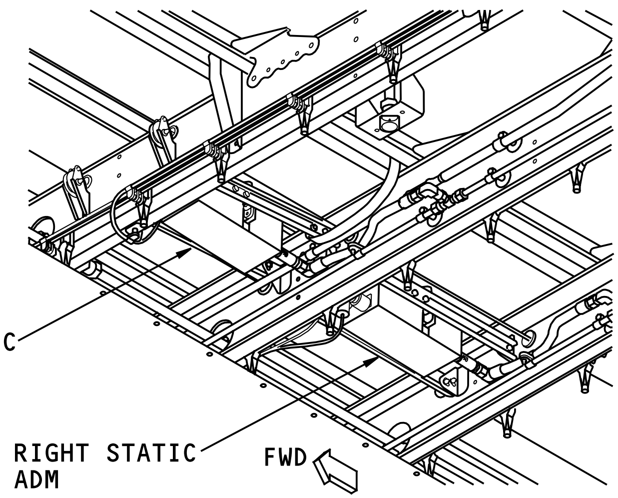
Static SADM and Static ADMs

The static SADM and the three static ADMs are in the forward cargo compartment ceiling, above the cargo liner.



FWD CARGO COMPARTMENT (LOOKING AFT)





PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - FWD CARGO COMPARTMENT COMPONENT LOCATIONS

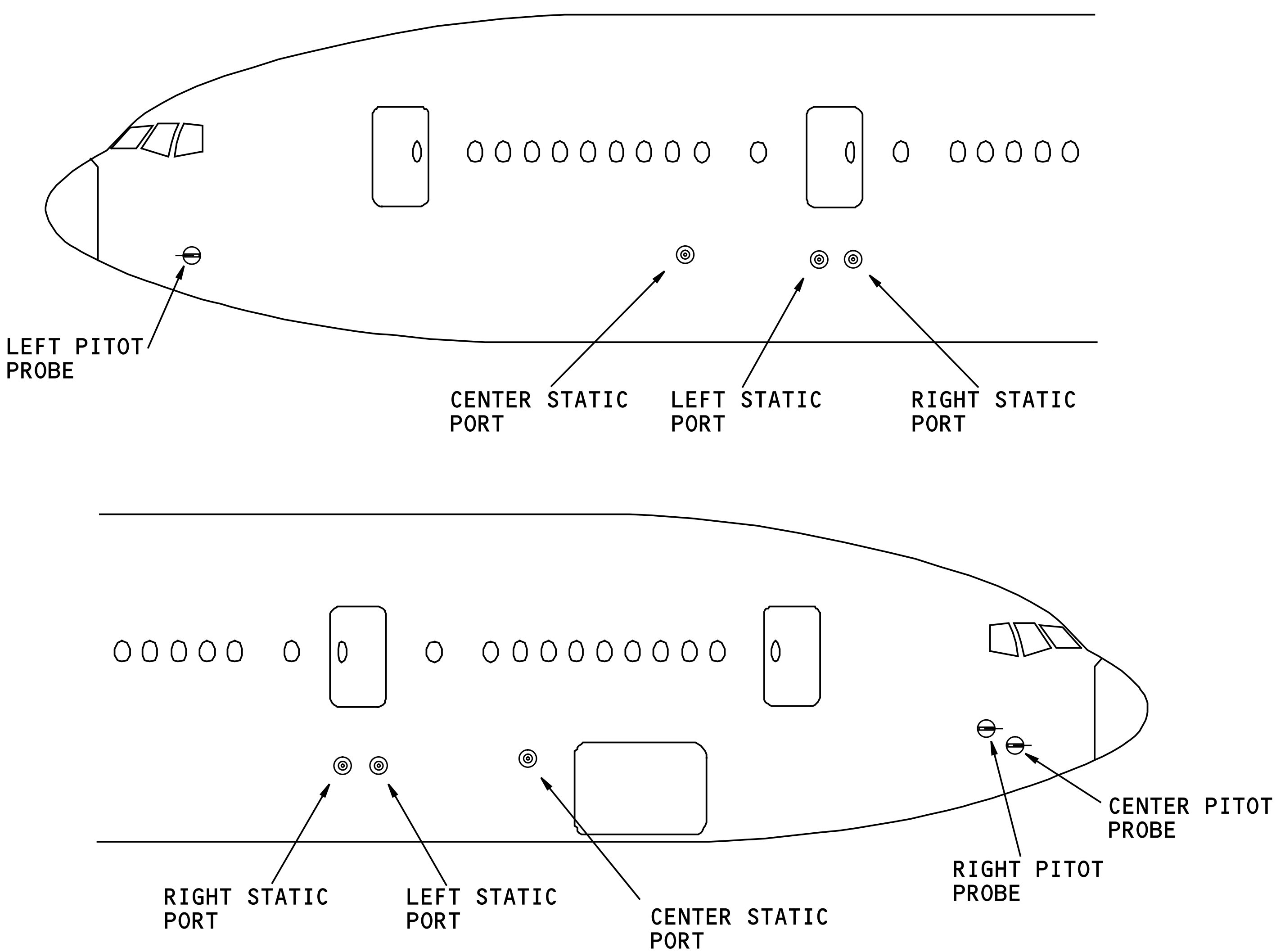
PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - EXTERNAL COMPONENT LOCATION

Pitot Probes Location

There are 3 pitot probes on the airplane. The left pitot probe is on the left side of the airplane. The right and center pitot probes are on the right side of the airplane.

Static Ports Location

There are six static ports on the airplane. There is a left, center, and right static port on each side of the airplane.



PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - EXTERNAL COMPONENT LOCATION

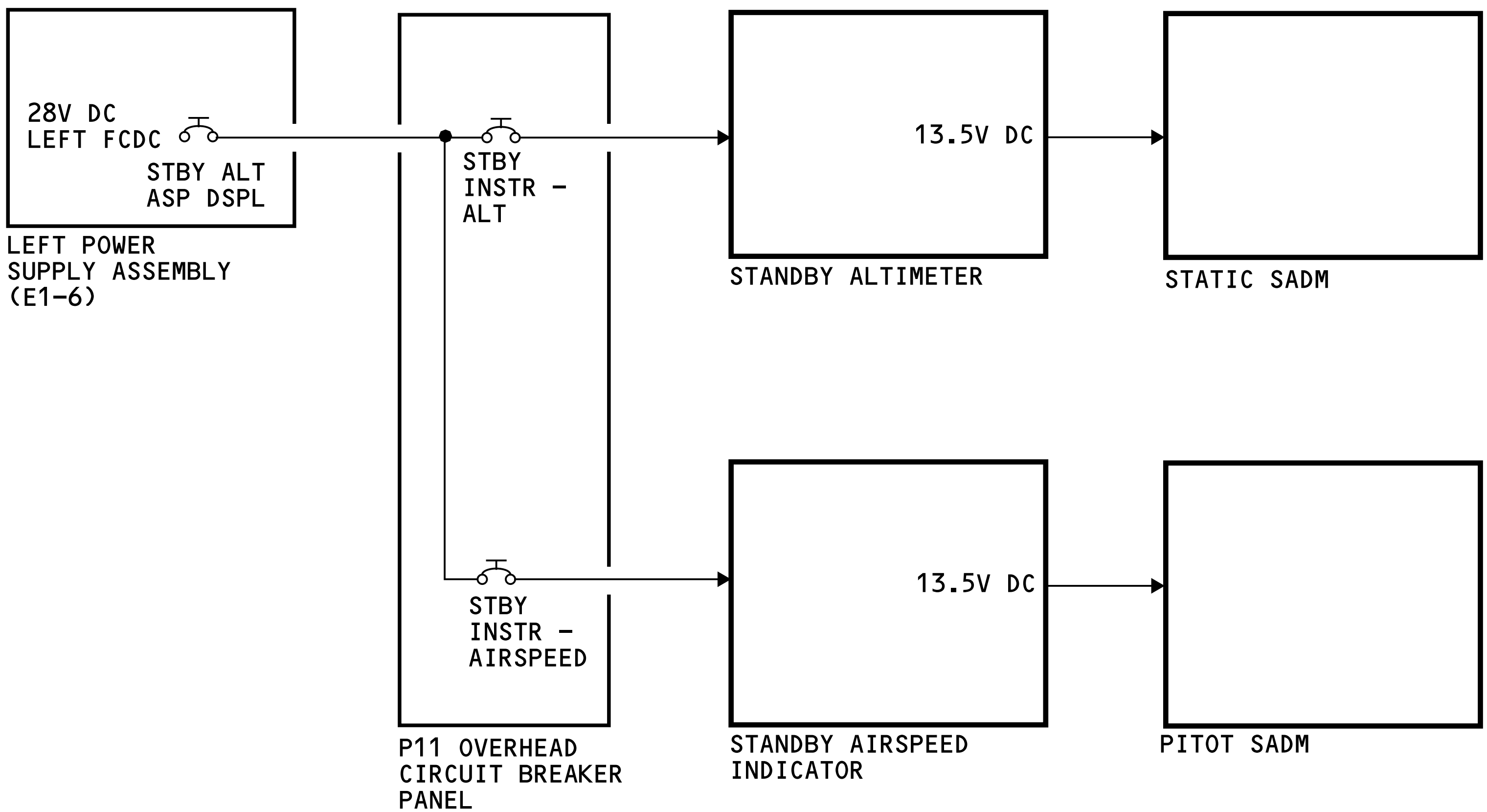
34-11-00-007 Rev 3 08/31/95

PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - POWER

Power

28 VDC power comes from the STBY INSTR - ALT and STBY INSTR - AIRSPEED circuit breakers on the P11 panel. Power goes to the air data standby instruments, then to the SADMs.

See the air data inertial reference system section for more information on ADM power (AMM PART I 34-20).



34-11-00-008 Rev 3 08/31/1995

PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - POWER

PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - INTERFACE

629 Interfaces

The pitot probes and static ports send air pressure through pressure lines to the ADMs. The ADMs convert the air pressures into ARINC 629 data. The data goes on the flight controls ARINC 629 buses to the ADIRU and SAARU.

The ADMs have interface only with the onside flight control ARINC 629 bus.

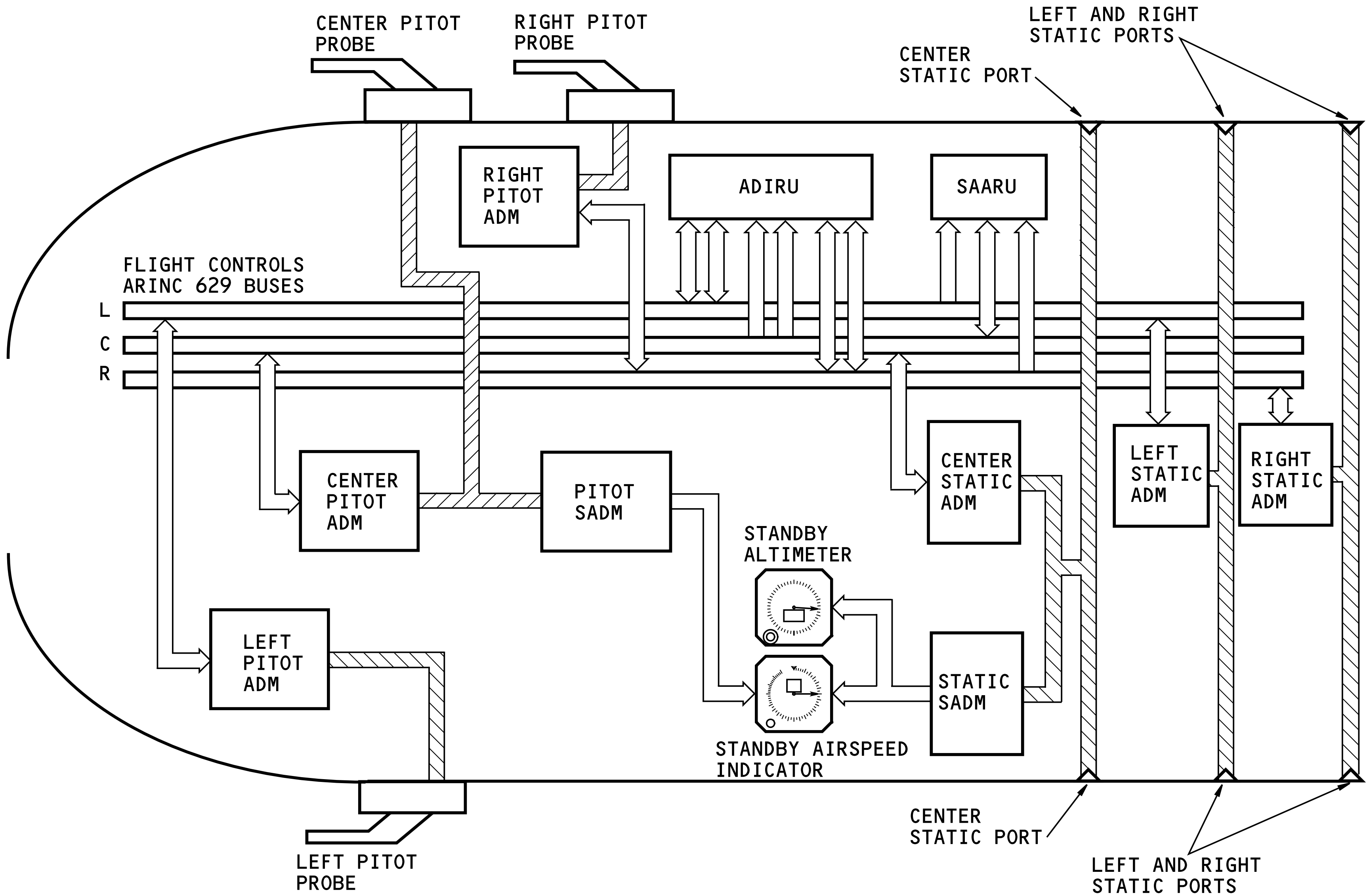
429 Interfaces

The center pitot probe sends pitot pressure to the pitot SADM. The pitot SADM sends the pitot pressure to the standby airspeed indicator on an ARINC 429 bus.

The center static ports send static pressure to the static SADM. The static SADM sends the static pressure to the standby altimeter and the standby airspeed indicator on an ARINC 429 bus.

Pressure lines

The pressure lines go from the pitot tubes and static ports to the ADMs. The static lines average approximately 24 feet long and the pitot lines average approximately 74 inches.



PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - INTERFACE

PITOT-STATIC/AIR DATA INSTRUMENTS - PITOT PROBES AND STATIC PORTS

Static Ports

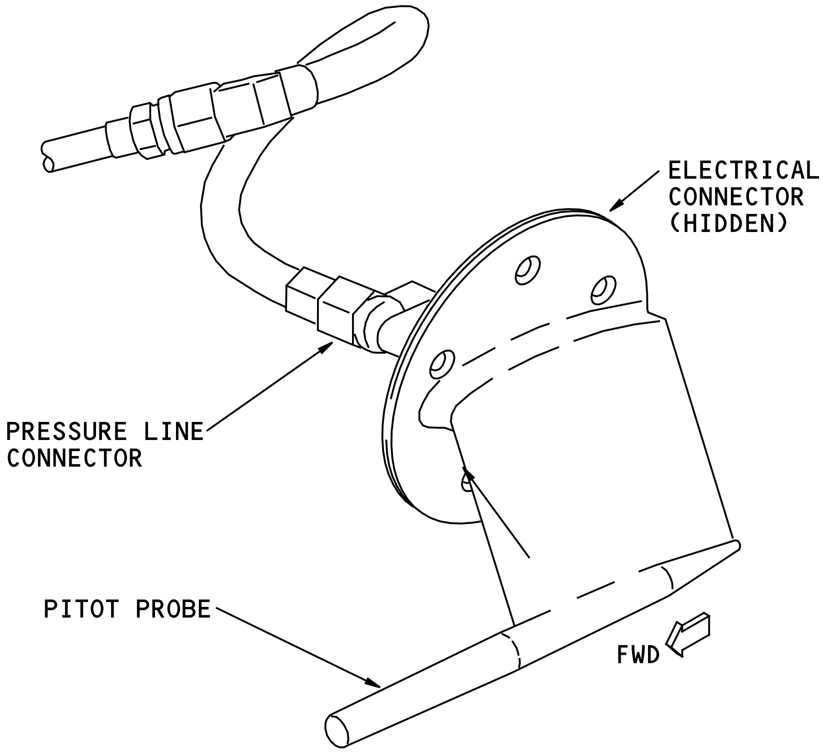
The static ports supply static pressure to the static air data modules (ADMs).

Pitot Probes

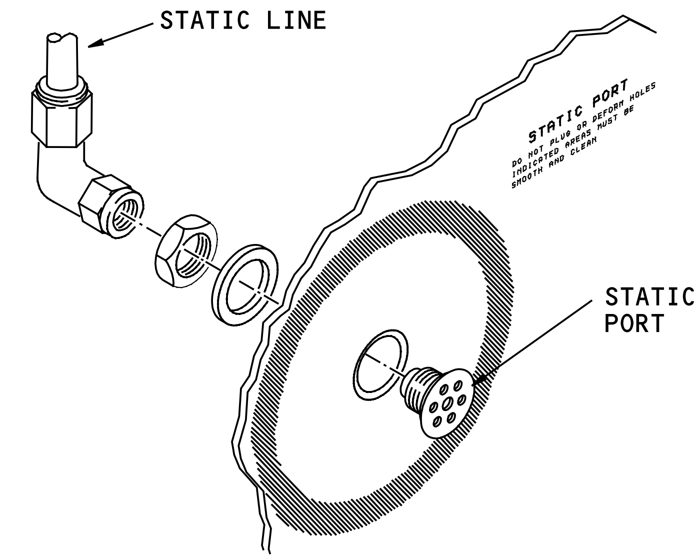
The pitot probes supply total pressure to the pitot ADMs.

Before you remove a pitot probe, obey this warning.

WARNING: MAKE SURE THAT THE PITOT PROBE HEAT IS OFF. INJURY TO PERSONS CAN OCCUR.



PITOT PROBE
(TYPICAL)



STATIC PORT

34-11-00-014 Rev 3 09/16/1997

PITOT-STATIC/AIR DATA INSTRUMENTS - PITOT PROBES AND STATIC PORTS

PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - STANDBY AIR DATA MODULE

General

There are two standby air data modules (SADMs) on the airplane.

The SADMs and the ADMs are different in size and shape. Since they send data on different ARINC formats, they are not interchangeable.

SADM Hardware

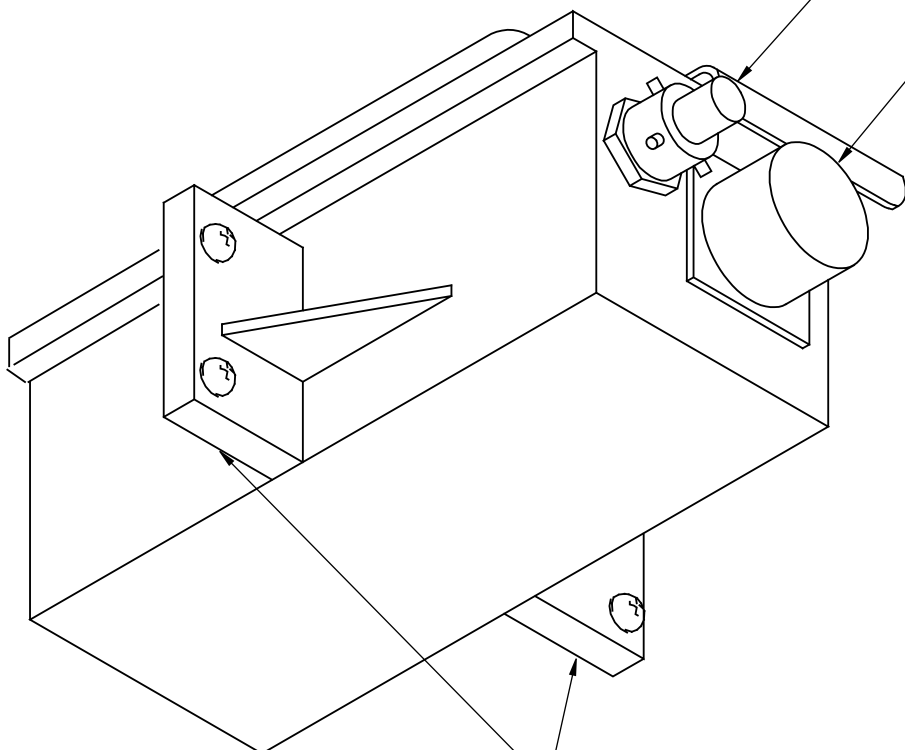
The SADM is rectangular, 6 in. deep x 3 in. wide x 2.5 in. tall (15.24 cm. x 7.62 cm. x 6.35 cm.). The SADM mounts directly to the airframe by the two flanges on the sides of the unit. The SADM weighs less than 2 lbs. and it has passive cooling. There is a pitot SADM and a static SADM. There is one electrical and one pneumatic connector on the front of each SADM. The SADMs are interchangeable. The SADMs are higher than the pitot probes and static ports to make sure that moisture does not enter the system.

SADM Data

The SADMs are part of the standby air data system. They are independent of the primary flight instrument system and isolated from all ARINC 629 buses. The SADMs receive pressure inputs from the center static ports or the center pitot probe. It converts these pressures to ARINC 429 data and sends this data to the air data standby instruments.

Training Information Point

The SADM is not software loadable.



34-11-00-010 Rev 3

PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - STANDBY AIR DATA MODULE

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PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - STANDBY AIRSPEED INDICATOR/ALTIMETER

Purpose

The standby airspeed indicator (SASI) and the standby altimeter (SALT) show airspeed and altitude. The standby airspeed indicator and the standby altimeter receive airspeed and altitude information from the standby air data modules (SADMs) through ARINC 429 buses.

Program Pin Configuration

The standby airspeed indicator and the standby altimeter are interchangeable. Program pins determine the function of the air data standby instruments. Install the air data standby instrument in the standby airspeed indicator location to show the standby airspeed indicator format. Install the air data standby instrument in the standby altimeter location to show the standby altimeter format.

The standby airspeed indicator and the standby altimeter can be put in the standby attitude indicator (SAI) position. However, the push button and knob (selector) used on the standby airspeed indicator and standby altimeter have no function when you install the standby instrument in the SAI position. When you put the SAI in the standby altimeter position PROGRAM PIN ERROR shows. When you put the SAI in the standby airspeed indicator position, the airspeed indication shows, but the standby airspeed bug does not show.

Standby Airspeed Bug

Use the standby airspeed bug selector to move the standby airspeed bug. Push the selector to select the airspeed bug on or off. The airspeed bug is off at electrical power-up.

Standby Airspeed Indicator

The standby airspeed indicator range is from 30 to 450 knots. This is the resolution of the indicator:

- 30 to 80 knots in 10 knot increments
- 80 to 250 knots in 5 knot increments
- 250 to 450 knots in 10 knot increments.

Standby Airspeed Indicator NCD

If the standby airspeed indicator detects a no computed data (NCD) condition, the indication is an airspeed of 30 knots. This can occur when the airplane is on the ground and not moving.

Standby Airspeed Indicator Fail

If the standby airspeed indicator or the air data input fails, the indicator goes blank and a fail flag shows in the center of the display. The fail flag is an amber outline box with SPD inside of the box.

Integral Light Sensor

There is an integral light sensor at the lower center of each instrument. The integral light sensor measures the amount of light on the front of the standby instrument. The standby instruments adjust the display brightness to the amount of light available.

The standby instruments send brightness data to each other to adjust their brightness.

Remote Light Sensors

Remote light sensors on the P7 glareshield panel supply brightness signals to the standby instruments. The standby instruments use the average of the integral light sensors and remote light sensors values to adjust the display brightness to the amount of light available.

Standby Altimeter

The standby altimeter shows barometric altitude from 250 to 60000 feet in 100 foot major numerical increments, and 20 foot minor graduation marks. A green hatched box shows in the 10000s digit location for altitude below 10000 feet.

Barometric Reference

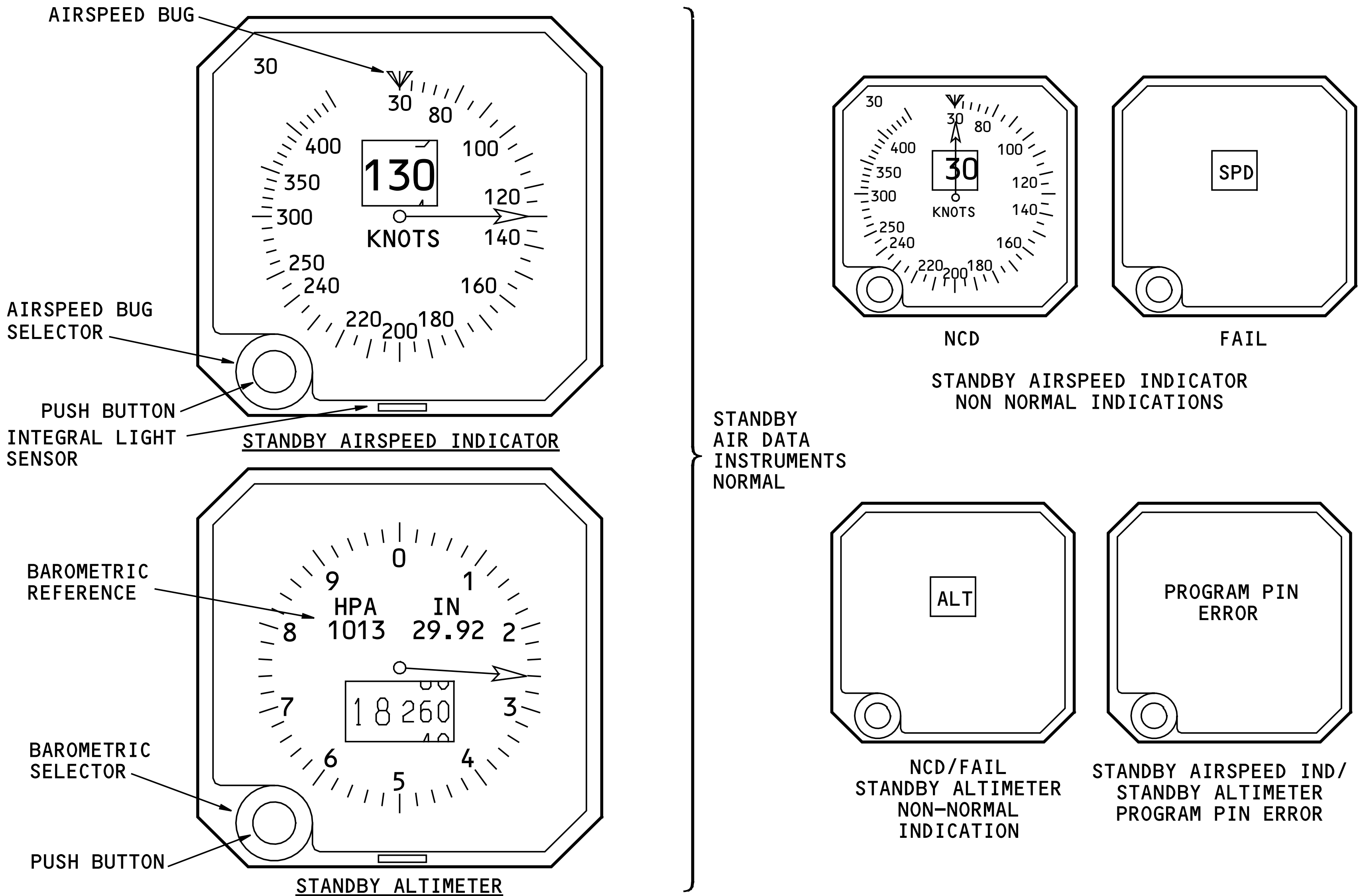
The barometric selector makes corrections to the barometric indication in inches of mercury (HG) and Hectopascal (HPA). The push button toggles the barometric reference between standard barometric pressure (29.92 in. Hg) and the last setting.

Standby Altimeter NCD or Fail

If the standby altimeter detects a NCD or fail condition, the indicator goes blank and a fail flag shows in the center of the display. The fail flag is an amber outline box with ALT inside of the box.

Program Pin Error

If either the standby airspeed indicator or the standby altimeter detects a program pin error, the indicator goes blank and the message PROGRAM PIN ERROR shows.



34-11-00-011 Rev 4

PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - STANDBY AIRSPEED INDICATOR/ALTIMETER

PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - FUNCTIONAL DESCRIPTION

Power

The air data standby instruments get power from the standby instrument circuit breakers. The air data standby instruments send 13.5v dc to the SADMs.

SADM Signal Processing

The SADMs receive pressure inputs from a static port or pitot probe. The microprocessor converts this pressure to an ARINC 429 word and sends this data to the standby instruments.

SADM Bite

The SADM built-in-test equipment (BITE) detects internal faults which are in nonvolatile memory that are shop accessible only.

Air Data Standby Instruments Pressure Inputs

SADM data goes to the air data standby instrument ARINC 429 receiver. The receiver sends this data to the microprocessor. The microprocessor supplies display data to the LCD display.

Standby Instruments Brightness Inputs

Brightness data comes from:

- The standby instruments
- Integral light sensor
- Remote light sensor

The microprocessor uses the brightness inputs to adjust the brightness of the LCD display.

Program Pin

Standby altimeter, standby airspeed indicator, and standby attitude indicator program pins select the appropriate standby instrument display format.

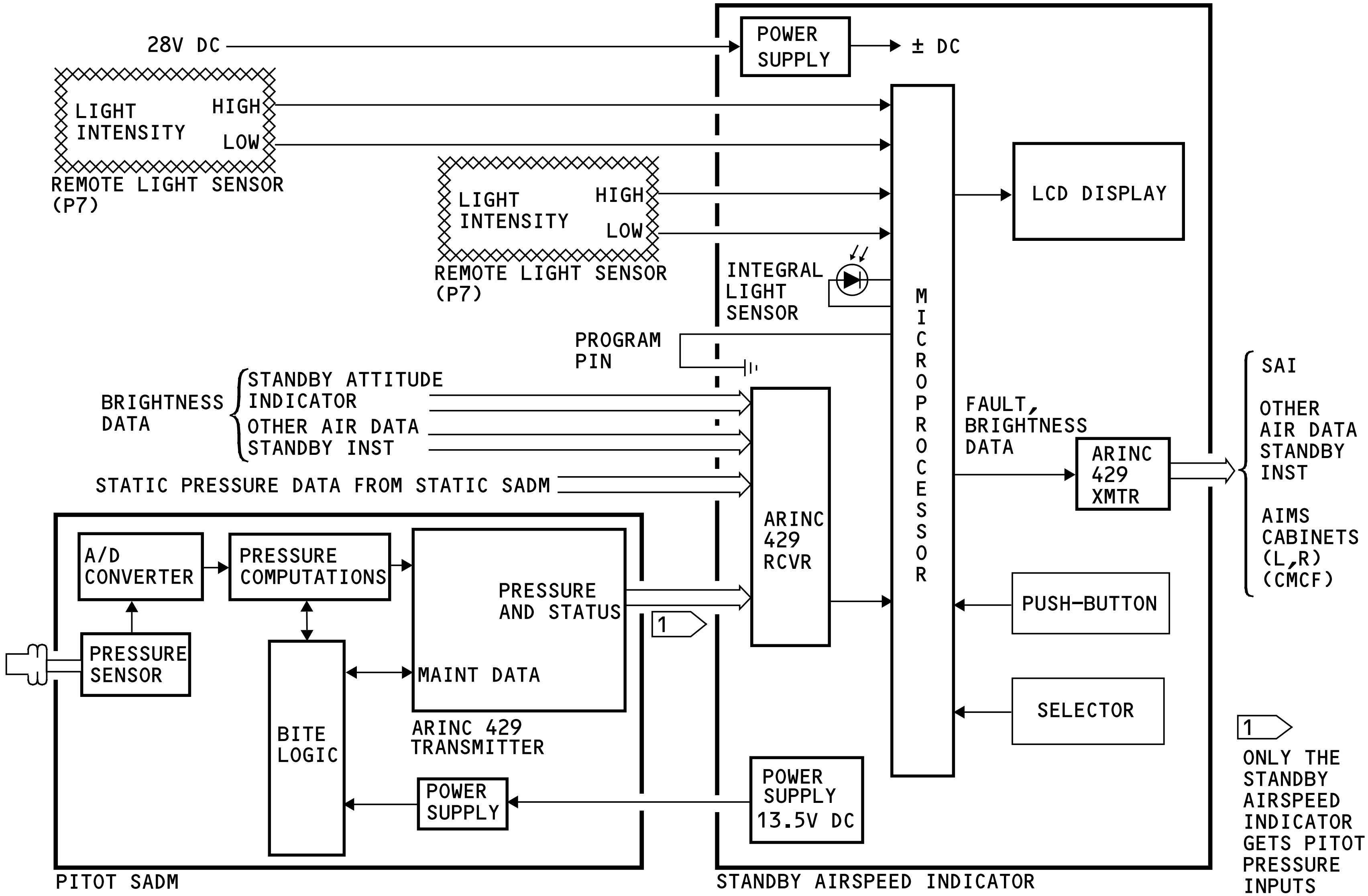
Push-button and Selector

The push-button and selector give the altitude correction value in the standby altimeter, and move the airspeed bug on the standby airspeed indicator.

The push-button and selector does not operate when the standby instrument is in the standby attitude indicator location.

Outputs

Brightness data goes from each standby instrument to the other two standby instruments. Fault data goes to the CMCF in the AIMS cabinets.



34-11-00-012 Rev 3 08/31/1995

PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - FUNCTIONAL DESCRIPTION

General

The pitot air data modules (ADMs) control the heat control relays in the power management panels. The heat control comes from data the ADMs receive from the primary flight computers (PFCs) through the flight controls ARINC 629 bus. If the PFCs are not valid, the ADMs use data from the autopilot/flight director computers (AFDCs). The AFDC data also comes through the flight controls ARINC 629 bus.

The pitot ADMs control the pitot heaters for the onside pitot probes.

Ground Mode

The ground and the air heat control relays supply 115v ac when the airplane is on the ground and either engine is on.

Air Mode

The air heat control relay supplies 115v ac when any of these conditions are true:

- The computed airspeed (CAS) is more than 50 knots
- The airplane is in the air.

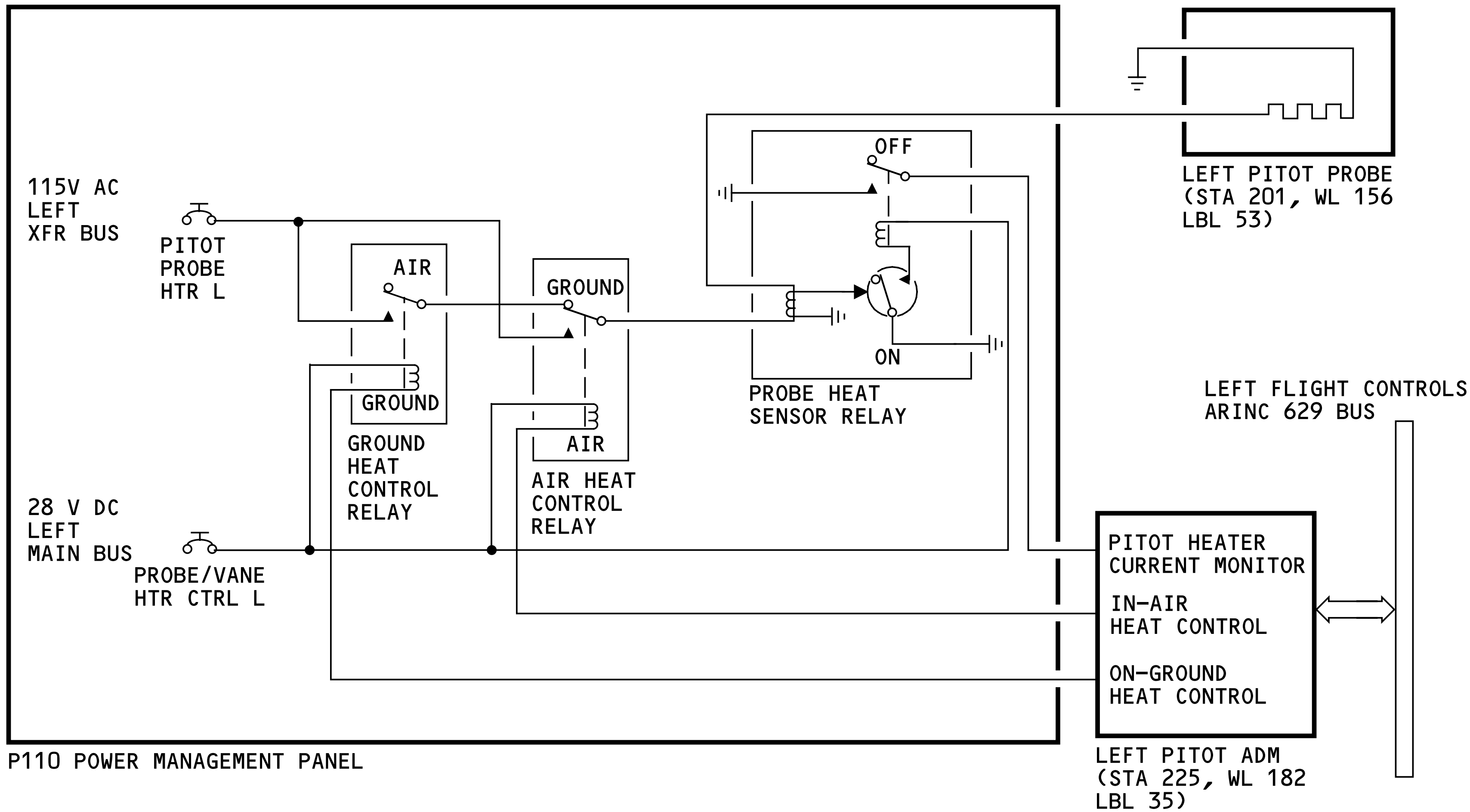
Pitot Heater Current Monitor

The probe heat sensor relay detects current when the pitot probe heat is on, and sends a ground signal to the pitot ADMs. The pitot ADMs send the status of the pitot heat to these units:

- ADIRU
- SAARU
- AIMS cabinets.

Training Information Point

See the ice and rain protection chapter for information on how to do a test of the pitot probe heat (AMM PART I 30).



34-11-00-013 Rev 9 03/08/1998

NOTE: LEFT PITOT PROBE HEAT SYSTEM SHOWN.
RIGHT AND CENTER SYSTEMS ARE SIMILAR.

PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - PITOT PROBE - HEAT

Continental Airlines, Inc

Air Data Inertial Reference System

WB371

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AIR DATA INERTIAL REFERENCE SYSTEM - INTRODUCTION

General

The air data inertial reference system (ADIRS) has two functions:

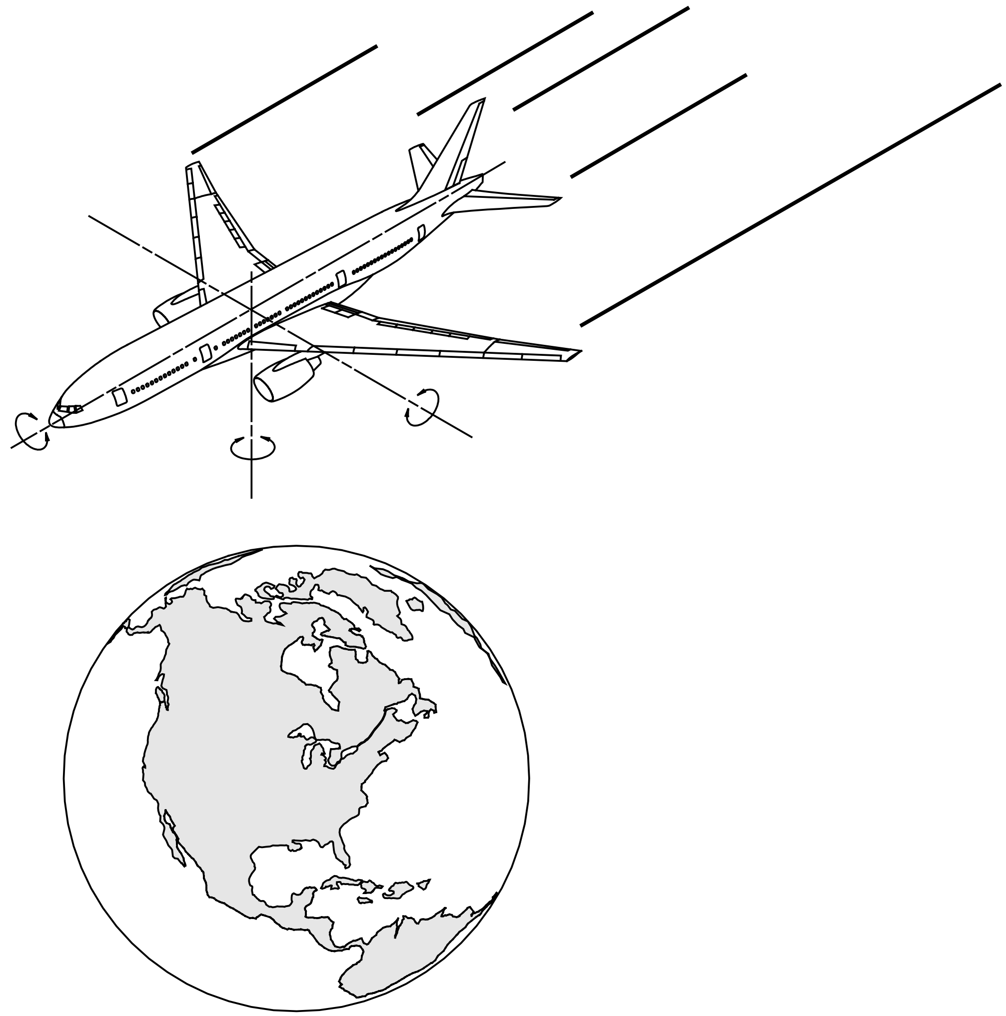
- Air data
- Inertial reference data.

An example of some of the systems that use ADIRS data are the:

- Primary flight control system (PFCS)
- Autopilot flight director system (AFDS)
- Airplane information management system (AIMS).

Abbreviations and Acronyms

ADIRS - air data inertial reference system
ADIRU - air data inertial reference unit
ADM - air data module
AFDC - autopilot flight director computer
AFDS - autopilot flight director system
AIMS - airplane information management system
AOA - angle of attack
ARINC - Aeronautical Radio, inc.
CDU - control display unit
CMCF - central maintenance computing function
CPU - central processing unit
FCA - fault containment area
FCM - fault containment module
FCDC - flight controls direct current
FMCF - flight management computing function
FSEU - flap/slat electronics unit
GPS - global positioning system
LCD - liquid crystal display
MAT - maintenance access terminal
NCD - no computed data
ND - navigation display
NVM - non-volatile memory
OPAS - overhead panel ARINC 629 system
PFC - primary flight computer
PFCS - primary flight control system
PSEU - proximity sensor electronics unit
SAARU - secondary attitude air data reference unit
TAT - total air temperature



34-20-00-001 Rev 1

AIR DATA INERTIAL REFERENCE SYSTEM - INTRODUCTION

ADIRS - GENERAL DESCRIPTION

General

The air data inertial reference system (ADIRS) has these components:

- Pitot probes
- Static port
- Air data modules
- Air data inertial reference unit (ADIRU)
- Total air temperature (TAT) probe
- Angle of attack (AOA) sensors
- Secondary attitude air data reference unit (SAARU)
- Standby attitude indicator.

Air Data Modules

The air data modules (ADMs) get air pressures from the pitot probes or the static ports. The ADMs convert the air pressures into ARINC 629 data. The ADMs send this data to the ADIRU and the SAARU.

Airplane Information Management System

The airplane information management system (AIMS) cabinets receive TAT and AOA analog inputs. The AIMS cabinets change this data to digital and send it to the ADIRU and the SAARU.

The AIMS cabinets receive display data from the ADIRS. The AIMS shows ADIRS data on the primary flight displays (PFDs) and the navigation displays (NDs).

Air Data Inertial Reference Unit

The air data inertial reference unit (ADIRU) uses these inputs to calculate and supply air data to user systems:

- Pitot pressure
- Static pressure
- Total air temperature
- Angle of attack.

The ADIRU uses six ring laser gyros and six accelerometers to calculate and supply inertial reference and navigation data to user systems.

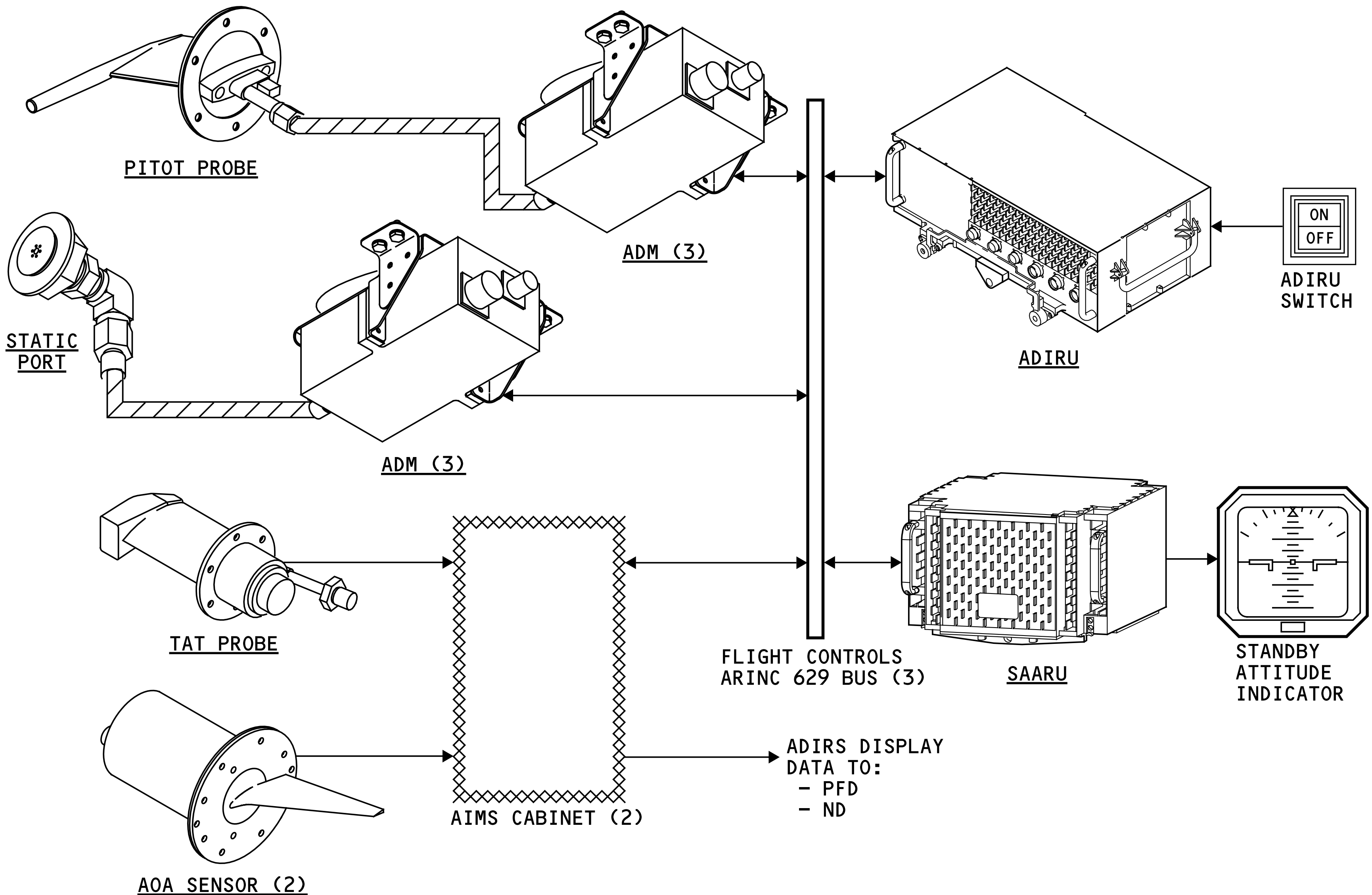
Secondary Attitude Air Data Reference Unit

The secondary attitude air data reference unit (SAARU) is a back-up source of attitude, heading and air data. The SAARU uses these inputs to calculate and supply air data to user systems:

- Pitot pressure
- Static pressure
- Total air temperature
- Angle of attack.

The SAARU uses four fiber optic gyros and four accelerometers to calculate and supply inertial reference data to user systems.

The SAARU supplies attitude data to the standby attitude indicator.



34-20-00-002 Rev 3 10/02/1997

ADIRS - GENERAL DESCRIPTION

ADIRS - COMPONENT LOCATION - FLIGHT DECK

ADIRS Component Location

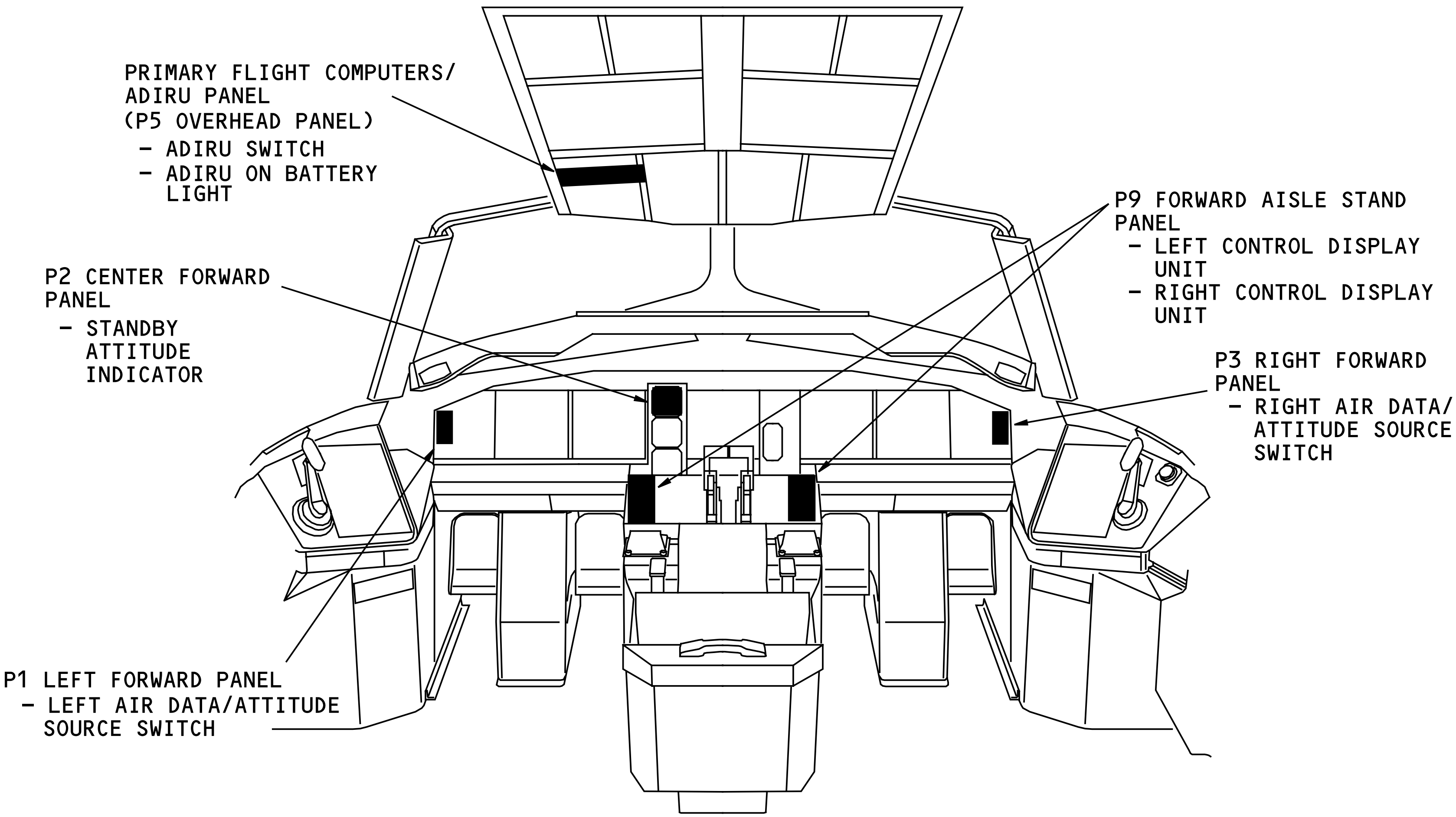
The ADIRS components in the flight deck are:

- ADIRU switch
- ADIRU on battery light
- Standby attitude indicator.

Other Systems Component Location

The components in the flight deck that have an interface with the ADIRS are:

- Left and right control display units (CDUs)
- Left and right air data/attitude source switches.



34-20-00-003 Rev 2

ADIRS - COMPONENT LOCATION - FLIGHT DECK

ADIRS - COMPONENT LOCATION - EQUIPMENT CENTERS

ADIRS Component Locations

The ADIRS components in the equipment centers are:

- Air data inertial reference unit (ADIRU)
- Secondary attitude air data reference unit (SAARU)
- ADIRU BAT PWR L, C, R circuit breakers
- ADIRU PRI PWR L, C, R circuit breakers.

Other Systems Component Location

The components in the equipment centers that have an interface with the ADIRS are:

- Left power supply assembly
- Center power supply assembly
- Right power supply assembly.

The center power supply assembly has these circuit breakers:

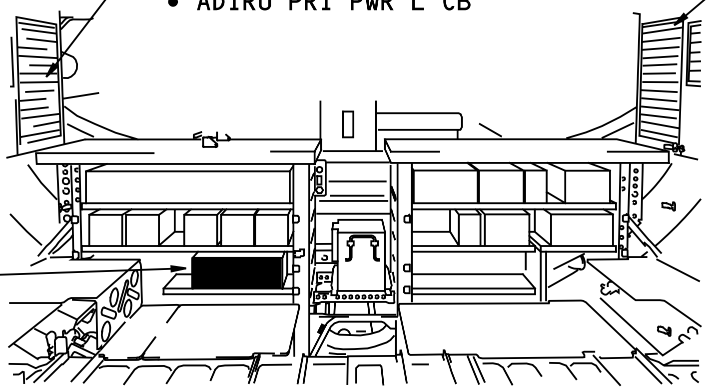
- ADM C ST
- ADM C PT
- Standby attitude display
- SAARU.

The left power supply assembly has these circuit breakers:

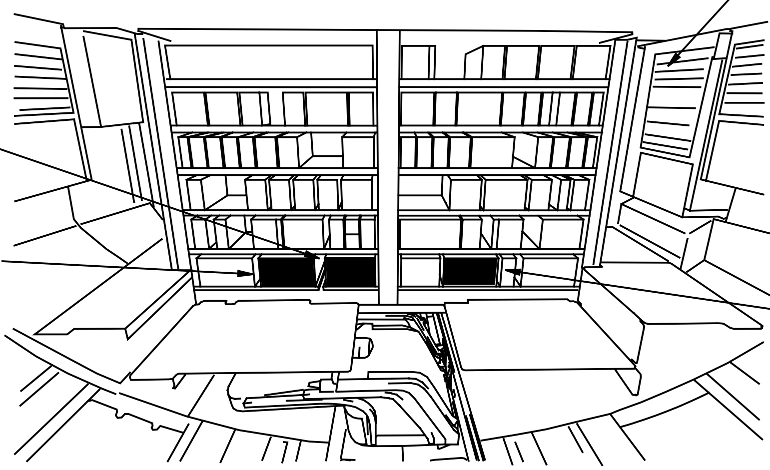
- ADM L ST
- ADM L PT.

The right power supply assembly has these circuit breakers:

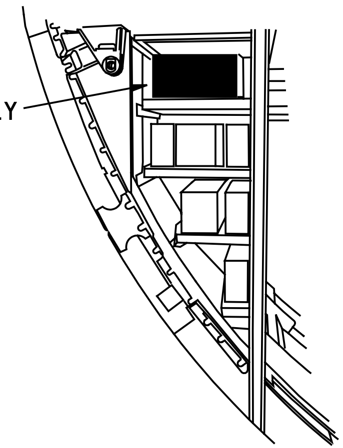
- ADM R ST
- ADM R PT.



MAIN EQUIPMENT CENTER
(LOOKING FORWARD)



MAIN EQUIPMENT CENTER
(LOOKING AFT)



FORWARD CARGO DOOR
(LOOKING AFT)

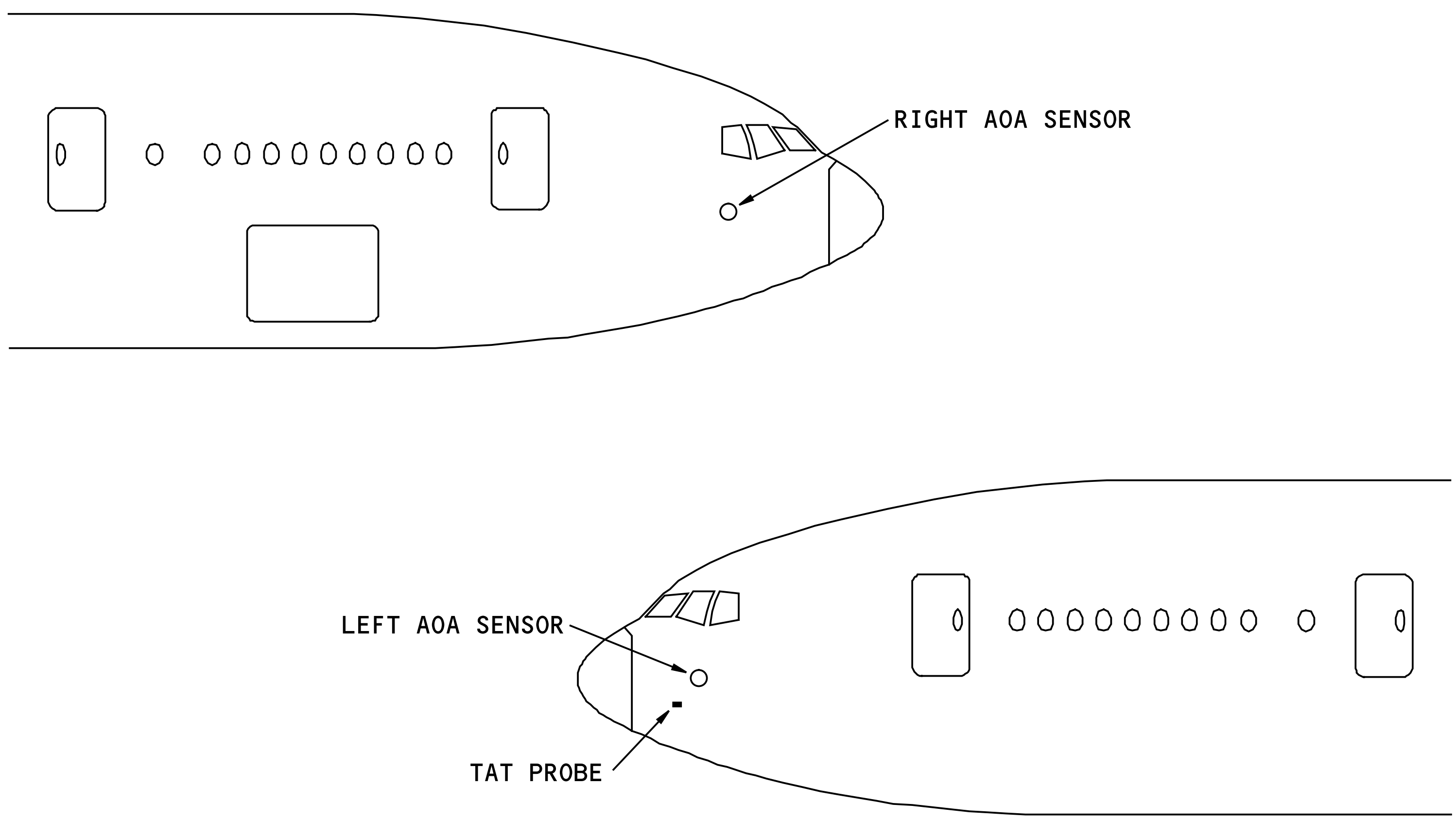
34-20-00-004 Rev 1

ADIRS - COMPONENT LOCATION - EQUIPMENT CENTERS

ADIRS - COMPONENT LOCATION - AOA SENSORS AND TAT PROBE

General

The angle of attack (AOA) sensors are on both sides of the fuselage and the TAT probe is on the left side.



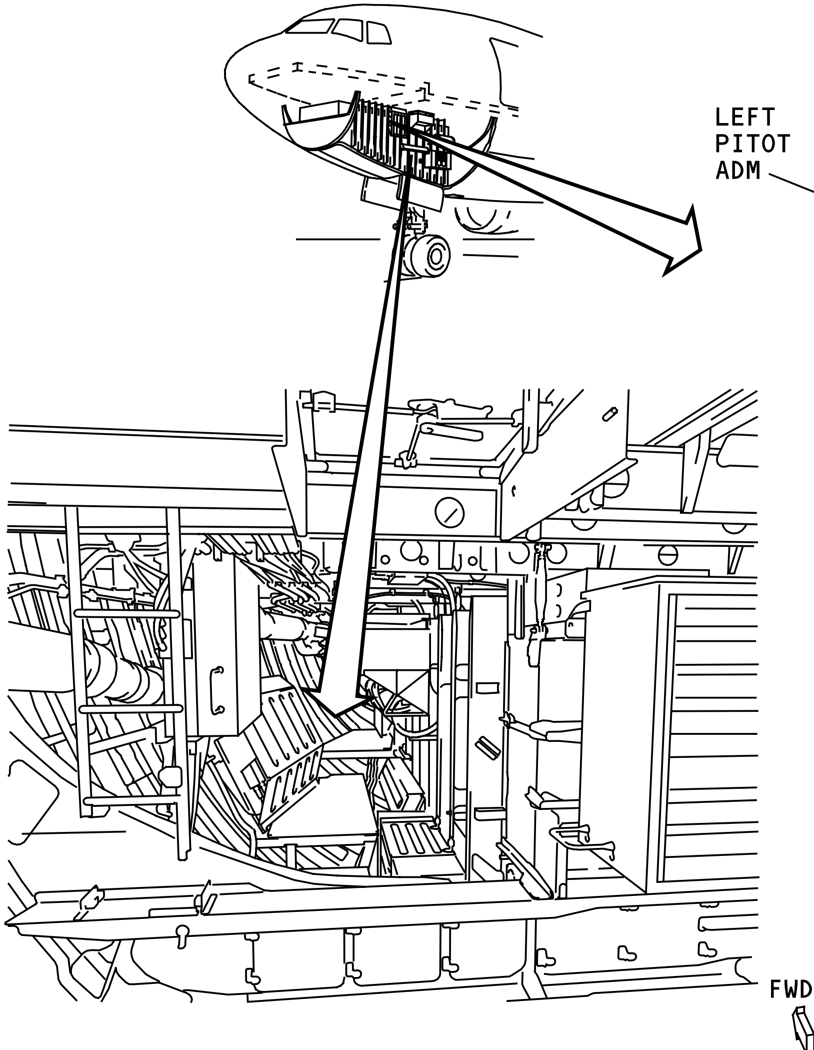
34-20-00-005 Rev 1

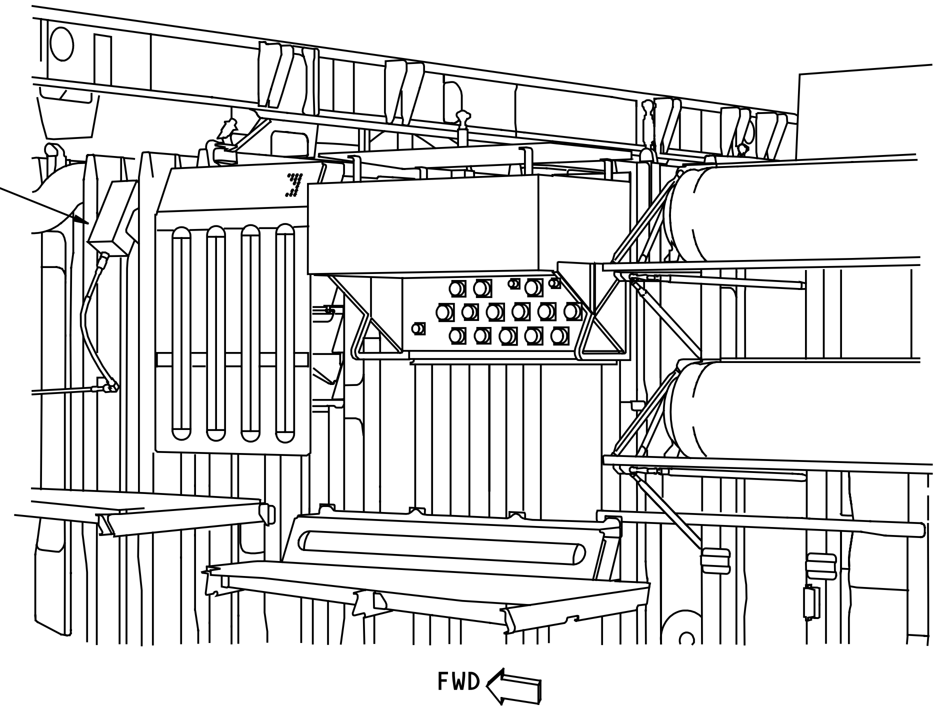
ADIRS - COMPONENT LOCATION - AOA SENSORS AND TAT PROBE

ADIRS - COMPONENT LOCATION - LEFT PITOT ADM

Left Pitot Air Data Module (ADM)

The location of this ADM is in the left forward section of the main equipment center.





34-20-00-006 Rev 2

ADIRS - COMPONENT LOCATION - LEFT PITOT ADM

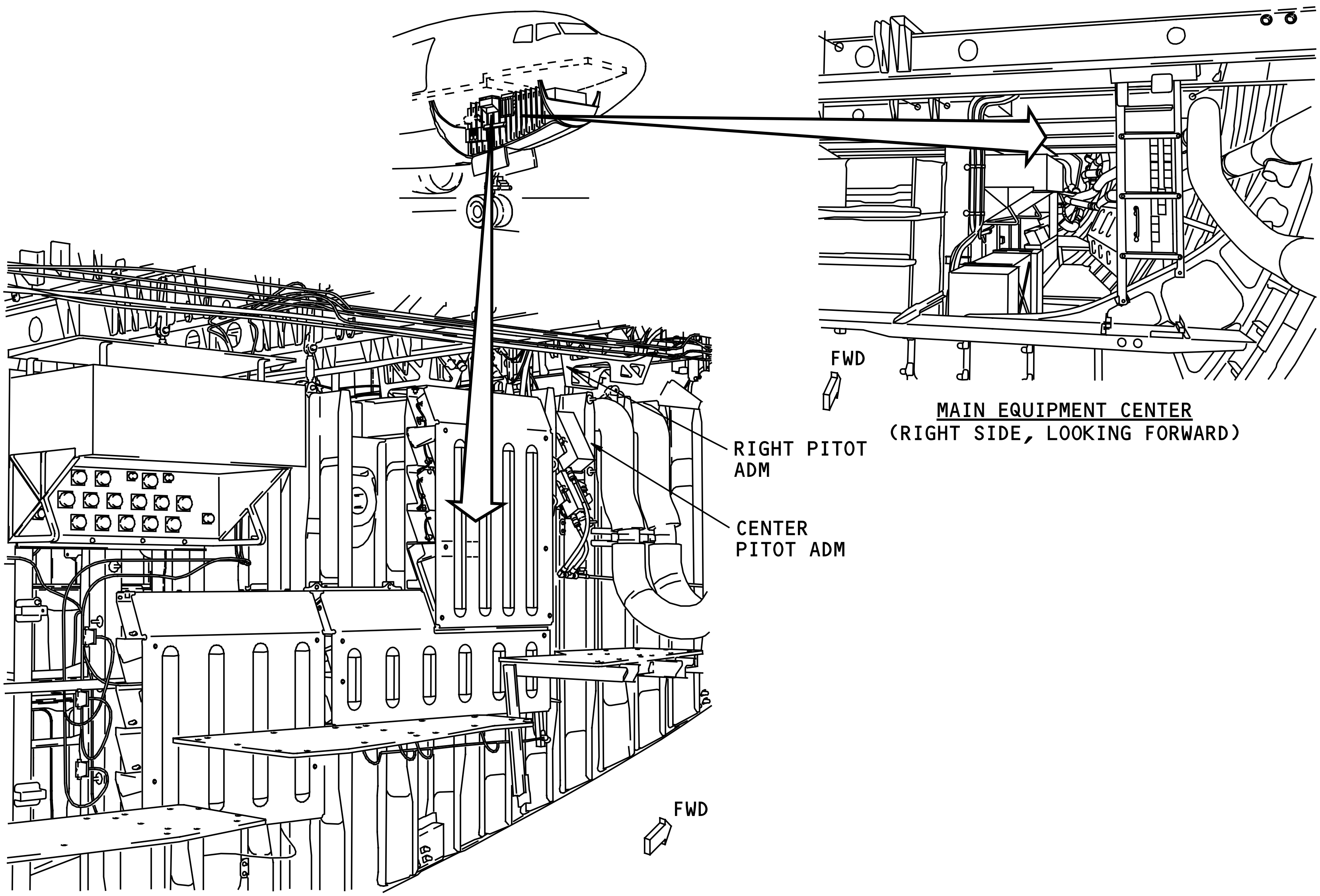
ADIRS - COMPONENT LOCATION - CENTER AND RIGHT PITOT ADM

Right Pitot Air Data Module (ADM)

The right pitot ADM is in the right forward section of the main equipment center.

Center Pitot ADM

The center pitot ADM is below the right pitot ADM in the right forward area of the main equipment center.



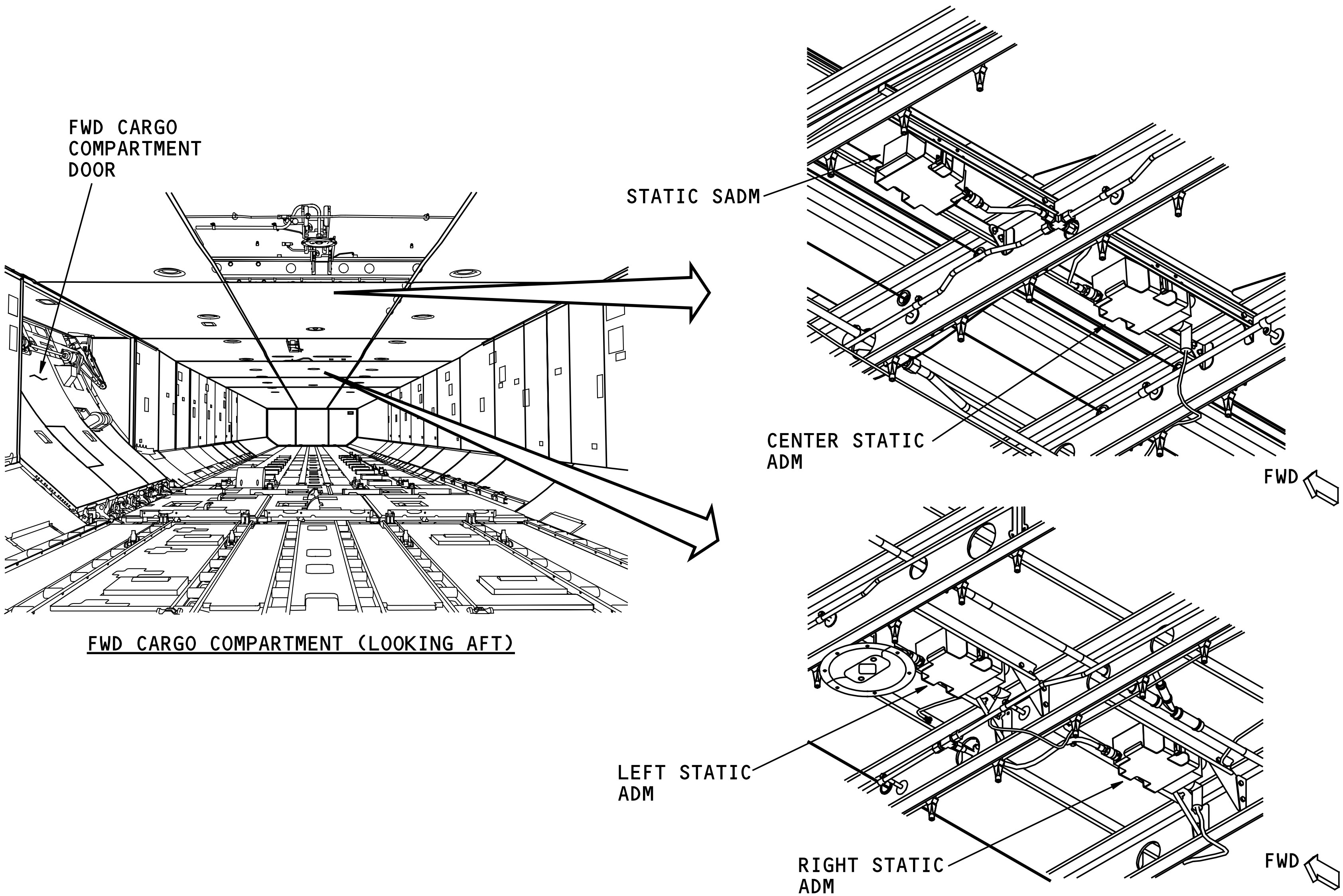
34-20-00-007 Rev 2

ADIRS - COMPONENT LOCATION - CENTER AND RIGHT PITOT ADM

ADIRS - COMPONENT LOCATION - LEFT AND CENTER STATIC ADM

Static Air Data Modules (ADM)

The static ADMs are in the forward cargo compartment ceiling above the cargo liner.



FWD CARGO COMPARTMENT (LOOKING AFT)

ADIRS - COMPONENT LOCATION - LEFT AND CENTER STATIC ADM

ADIRS - ADIRU, AOA AND SENSOR, SAARU, STANDBY ATTITUDE INDICATOR POWER

ADIRU

The ADIRU gets power from these sources:

- Right 28 volt DC bus
- Left 28 volt DC bus
- Hot battery bus.

The PFC (primary flight computer)/ADIRU panel supplies on/off discretes to the ADIRU. The ADIRU uses these discretes to enable power down.

AOA Sensors

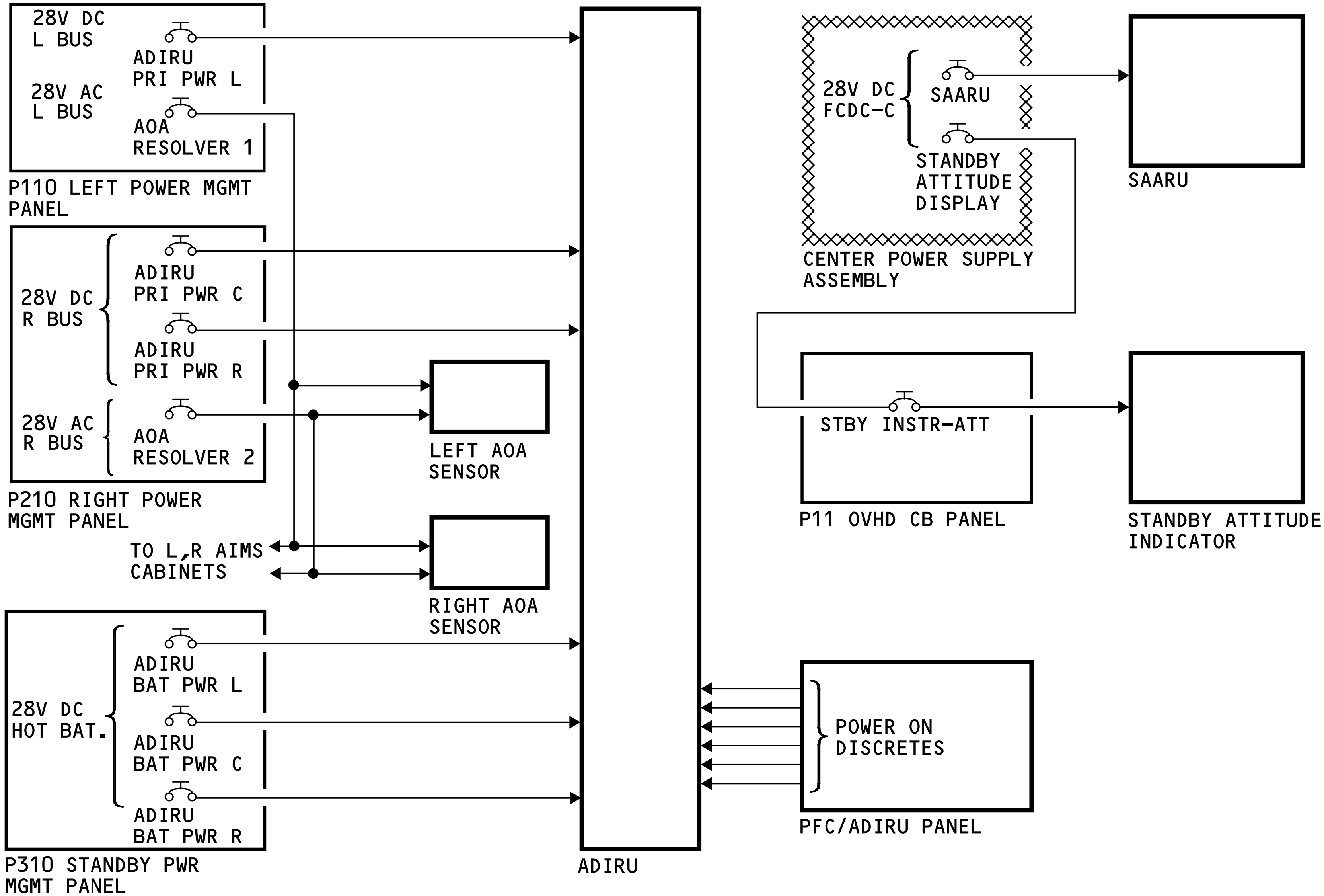
One resolver in each AOA receive 28v ac power from the left (P110) and one resolver in each AOA receive 28v ac from the right (P210). The AIMS cabinets receive the same 28v ac for resolver reference.

SAARU

The secondary attitude air data reference unit (SAARU) gets 28v dc power from the center power supply assembly.

Standby Attitude Indicator

The standby attitude indicator gets 28v dc power through a circuit breaker in the center power supply assembly. The 28v dc goes through a circuit breaker in the P11 overhead circuit breaker panel.



34-20-00-009 Rev 1 08/31/1995

ADIRS - ADIRU, AOA AND SENSOR, SAARU, STANDBY ATTITUDE INDICATOR POWER

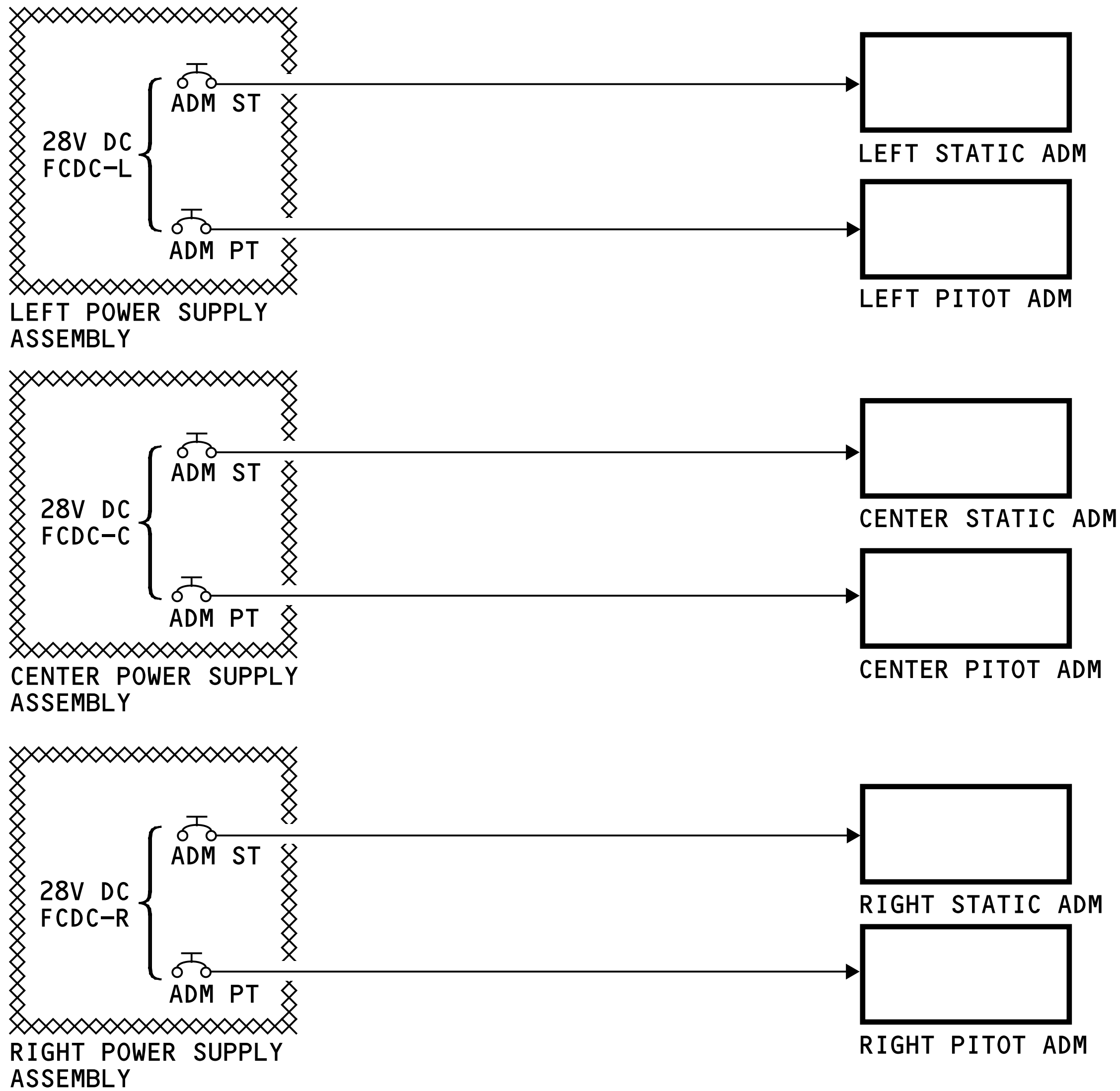
ADIRS - AIR DATA MODULES POWER

General

The left power supply assembly supplies power to the left static and pitot ADMs.

The center power supply assembly supplies power to the center static and pitot ADMs.

The right power supply assembly supplies power to the right static and pitot ADMs.



34-20-00-010 Rev 0

ADIRS - AIR DATA MODULES POWER

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ADIRS - DIGITAL INTERFACES

General

These components send data to the ADIRU and the SAARU through the flight controls ARINC 629 buses:

- Left and right AIMS cabinets
- Left, center, right pitot air data modules (ADMs)
- Left, center, right static ADMs
- Left, center, right PFC.

Total Air Temperature (TAT) Probe

The TAT probe sends analog temperature data to the left and right AIMS cabinets. The AIMS cabinets change the temperature data to ARINC 629 data. The AIMS cabinets send the temperature data to the ADIRU and the SAARU.

Angle of Attack (AOA) Sensors

The AOA sensors send the AOA resolver data to the left and right AIMS cabinets. The AIMS cabinets change the resolver data to ARINC 629 data. The AIMS cabinets send the AOA resolver data to the ADIRU and the SAARU.

FSEU and PSEU Data

The flap/slat electronic units (FSEUs) supply flap data and the proximity sensor electronic units (PSEUs) supply landing gear position to the AIMS cabinets. The AIMS cabinets send this data to the ADIRU and SAARU. The ADIRU and SAARU use this data to calculate corrected AOA data.

Pitot Probes

The pitot probes send total pressure to the pitot air data modules (ADMs). The pitot ADMs change the total pressure to ARINC 629 data. The pitot ADMs send the pitot pressure data to the ADIRU and the SAARU.

Static Ports

The static ports measure the static air pressure and send it through lines to the static ADMs. The static ADMs receive this pressure information and change it to ARINC 629 data. The static ADMs send the static air pressure data to the ADIRU and the SAARU.

PFC Data

The ADIRU and SAARU use speed brake position and air/ground data that comes from the PFCs. The ADIRU and SAARU use this data to calculate corrected AOA data. The AFDCs are the alternate source of air/ground and brake position if the PFCs fail.

ADIRU

The ADIRU receives data on all flight control ARINC 629 buses. The ADIRU has two connections to each flight control ARINC 629 bus.

The ADIRU sends air data and inertial reference data to user systems through the left and right flight control ARINC 629 buses.

ADIRS - DIGITAL INTERFACES

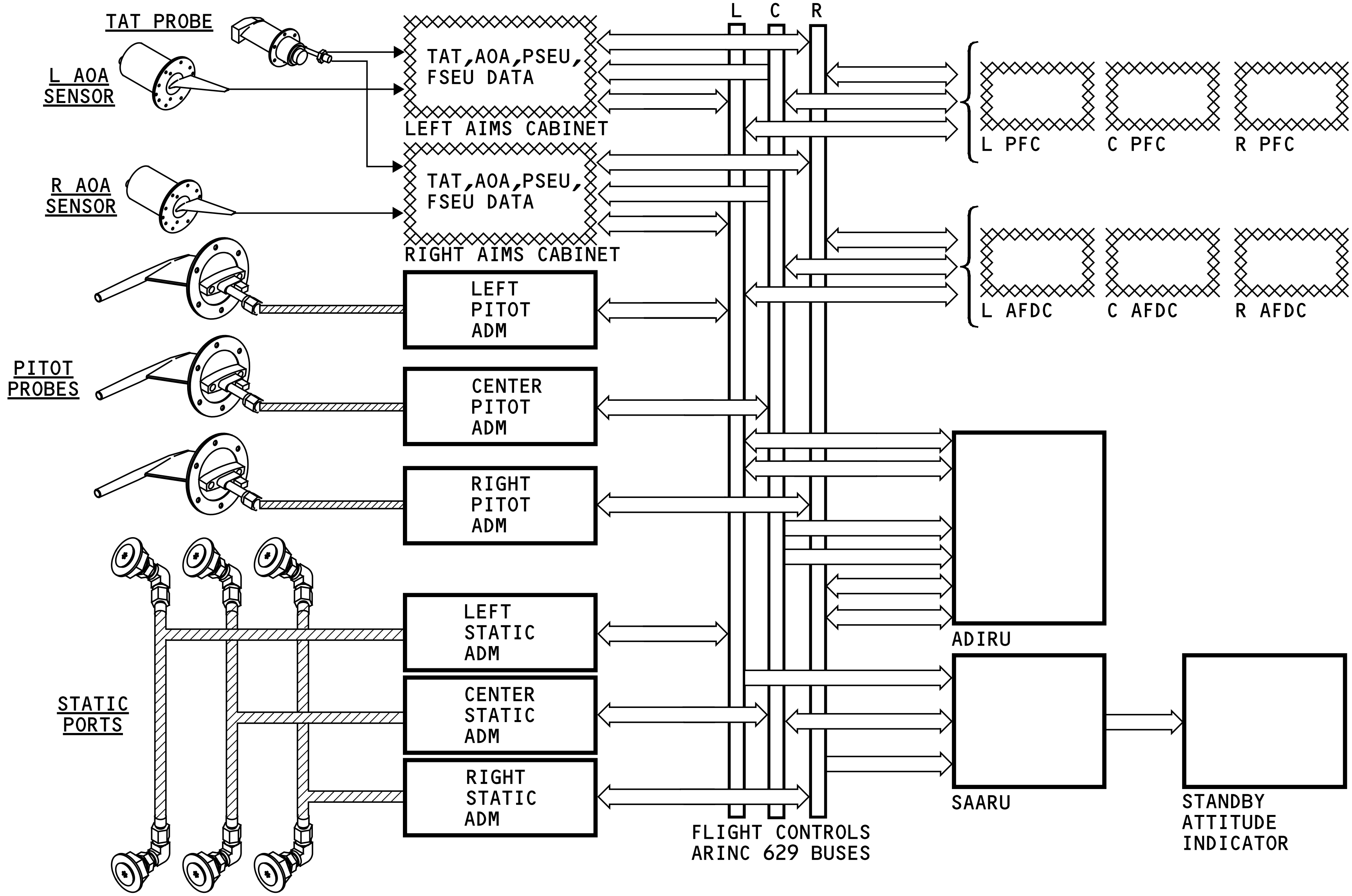
SAARU

The SAARU receives data on all flight control ARINC 629 buses. The SAARU has one connection to each flight control ARINC 629 bus.

The SAARU sends inertial reference and air data to user systems through the center flight control ARINC 629 bus.

Standby Attitude Indicator

The SAARU supplies ARINC 429 attitude data to the standby attitude indicator.



ADIRS - DIGITAL INTERFACES

ADIRS - ADIRU

General

The air data inertial reference unit (ADIRU) has two functions:

- Air data
- Inertial reference data.

The ADIRU has internal redundancy and automatically makes allowances for failures to keep its complete function.

Physical Description

The ADIRU weighs 68 pounds. The ADIRU is 22.75 inches wide, 7.64 inches high, and 13.61 inches deep.

The ADIRU has these features:

- 2 front handles
- Passive cooling fins
- A locking bar
- 2 installation screws
- Installation guide
- 3 ARINC 629 connectors
- 3 power connectors
- 2 side handles.

The ADIRU has these internal components:

- Six laser gyros
- Six linear accelerometers
- Four processors
- Three power supplies
- Three dual channel ARINC 629 input/output interfaces.

Software Loading

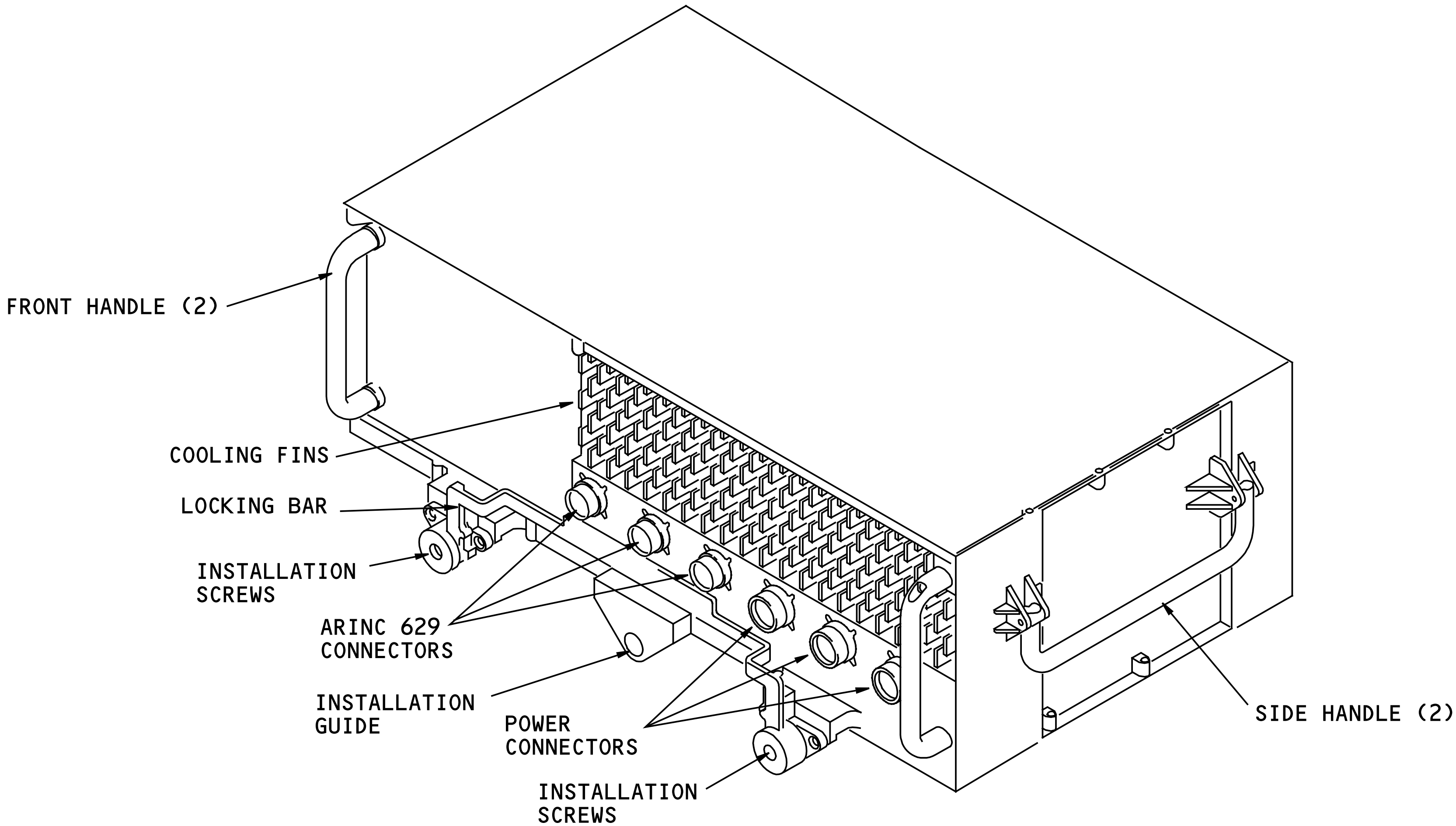
The ADIRU can receive operational program software (OPS) from the AIMS cabinets through the flight controls ARINC 629 buses.

Air Data Function

The ADIRU uses data from the air data sensors to make air data calculations.

Inertial Reference Data Function

The ADIRU uses the data from the accelerometers and gyros to calculate inertial navigation data.



34-20-00-013 Rev 1

ADIRS - ADIRU

ADIRS - ADIRU REMOVAL AND LOCK BAR OPERATION

Locking Bar

The locking bar prevents the:

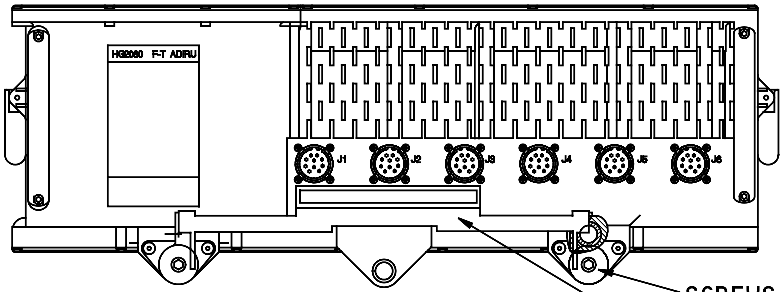
- Removal of the ADIRU until you disconnect the ARINC 629 connections
- Connection of the ARINC 629 interfaces until you install and secure the ADIRU.

Training Information Point

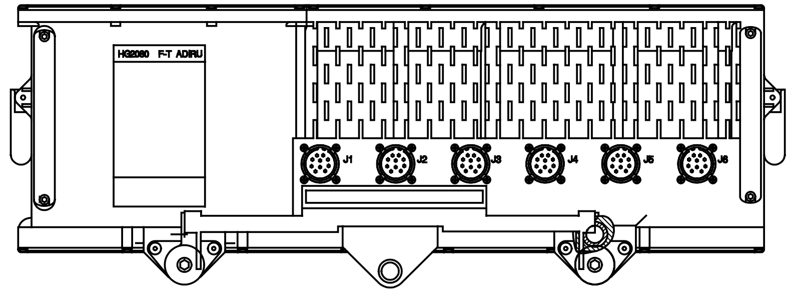
You must use a 1/4 inch hex wrench to turn the ADIRU installation screws.

To remove the ADIRU and operate the locking bar:

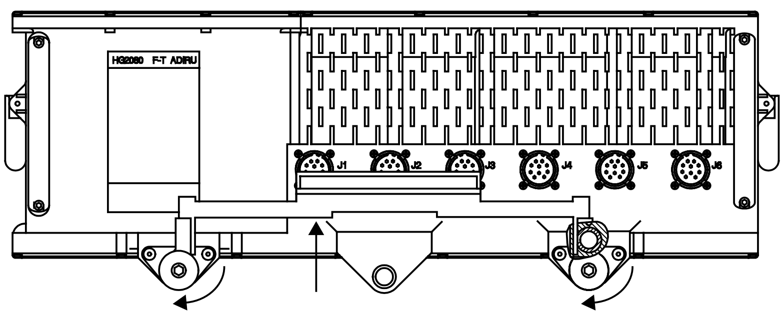
- Remove all six connectors
- Slide the locking bar up until it covers the three connectors
- Use a hex wrench to loosen the installation screws
- After you loosen the screws, a spring moves them out and they hold the locking bar up
- Remove the ADIRU.



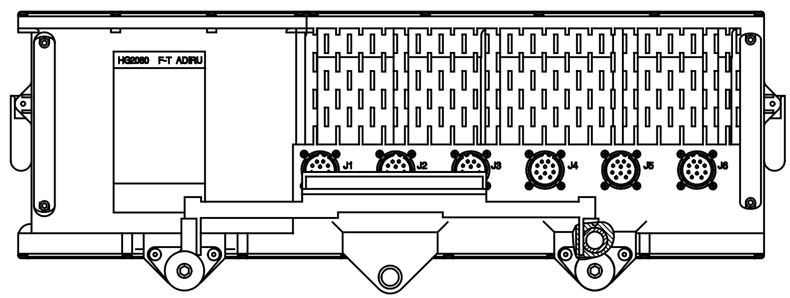
THE ADIRU IS FULLY INSTALLED WITH
SCREWS TIGHT, LOCKING BAR DOWN
AND CONNECTORS IN PLACE



1 ADIRU WITH 6 CONNECTORS REMOVED



2 SLIDE THE LOCKING BAR UP AND LOOSEN THE SCREWS



3 THE LOOSENED SCREWS MOVE OUT
AND HOLD THE LOCKING BAR UP
THE ADIRU IS READY FOR REMOVAL

34-20-00-014 Rev 2

ADIRS - ADIRU REMOVAL AND LOCK BAR OPERATION

ADIRS - ADIRU INSTALLATION

ADIRU Installation

Put the ADIRU on the rack and align the two alignment pins in the back of the ADIRU and one pin in the front of the ADIRU.

To install the ADIRU:

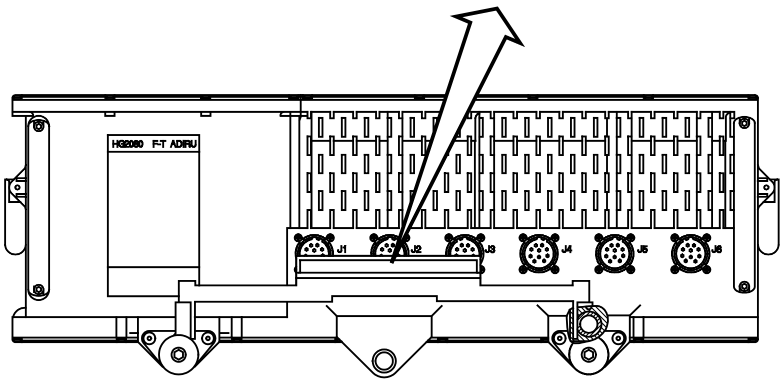
- Install the ADIRU in the rack
- Tighten the screws
- Slide the locking bar down
- Install the six connectors and make sure they are in the full lock position.

Training Information Point

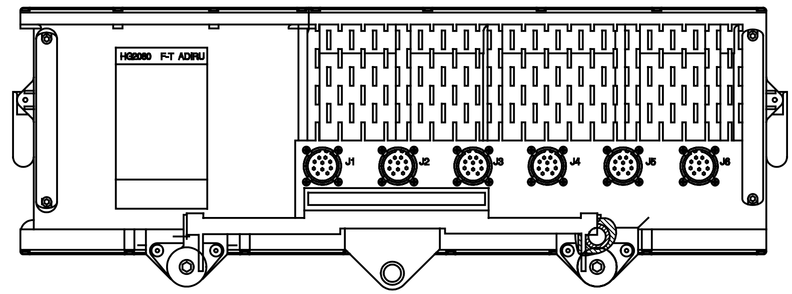
When the ADIRU is secured to the mounting tray, the locking bar is in the down position. Make sure all connectors are in the full lock position before you apply power. You cannot operate the ADIRU if it is not properly installed.

NOTICE: INSTALL THE ADIRU ON THE AIRPLANE MOUNTING SHELF, THEN LOWER THE LOCKING BAR BEFORE YOU ATTACH THE CONNECTORS.

LOCKING BAR NOTICE



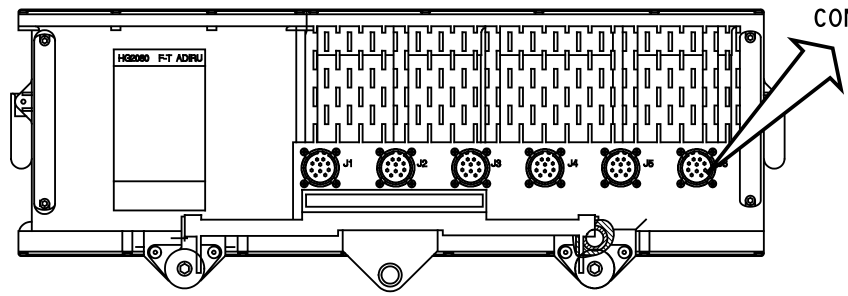
1 INSTALL THE ADIRU ON THE SHELF



2 TIGHTEN THE SCREWS
MOVE THE LOCK BAR DOWN

MAKE SURE ALL CONNECTORS ARE IN THE FULL LOCK POSITION.

CONNECTOR NOTICE



3 INSTALL THE CONNECTORS

ADIRS - ADIRU INSTALLATION

34-20-00-015 Rev 3

ADIRS - ADIRU RELIABILITY AND FAULT TOLERANCE

General

The ADIRU has fault containment areas (FCAs). The FCAs have fault containment modules (FCMs).

The ADIRU has redundancy features that make it more reliable. If a module fails, the ADIRU adjusts itself to use only those components that are good.

Fault Containment Areas and Fault Containment Modules

There are seven FCAs in the ADIRU. In each FCA there are FCMs. These are the FCAs and their FCMs:

- Gyro: 6 laser gyro FCMs
- Accelerometer: 6 accelerometer FCMs
- Power supply: 3 power supply FCMs
- Processor: 4 processor FCMs
- Left, center, and right ARINC 629 interface: 2 ARINC 629 I/O modules in each.

Each FCM is physically and electrically separate from all other like FCMs.

FCMs in the same FCA are the same and interchangeable by shop personnel only.

Single Failures In A Fault Containment Area

If a single FCM fails in one FCA or if there are single FCM failures in more than one FCA, the ADIRU sends data to AIMS to make a maintenance memo show on the maintenance access terminal (MAT). The maintenance memo is ADIRS and it shows on the maintenance planning page.

The flight crew will not see a flight deck effect.

Multiple Failures In The Same FCA

If there are two FCM failures in the same FCA, the ADIRU sends data to AIMS to make a maintenance message show on the MAT, and the status message ADIRU shows on the EICAS display.

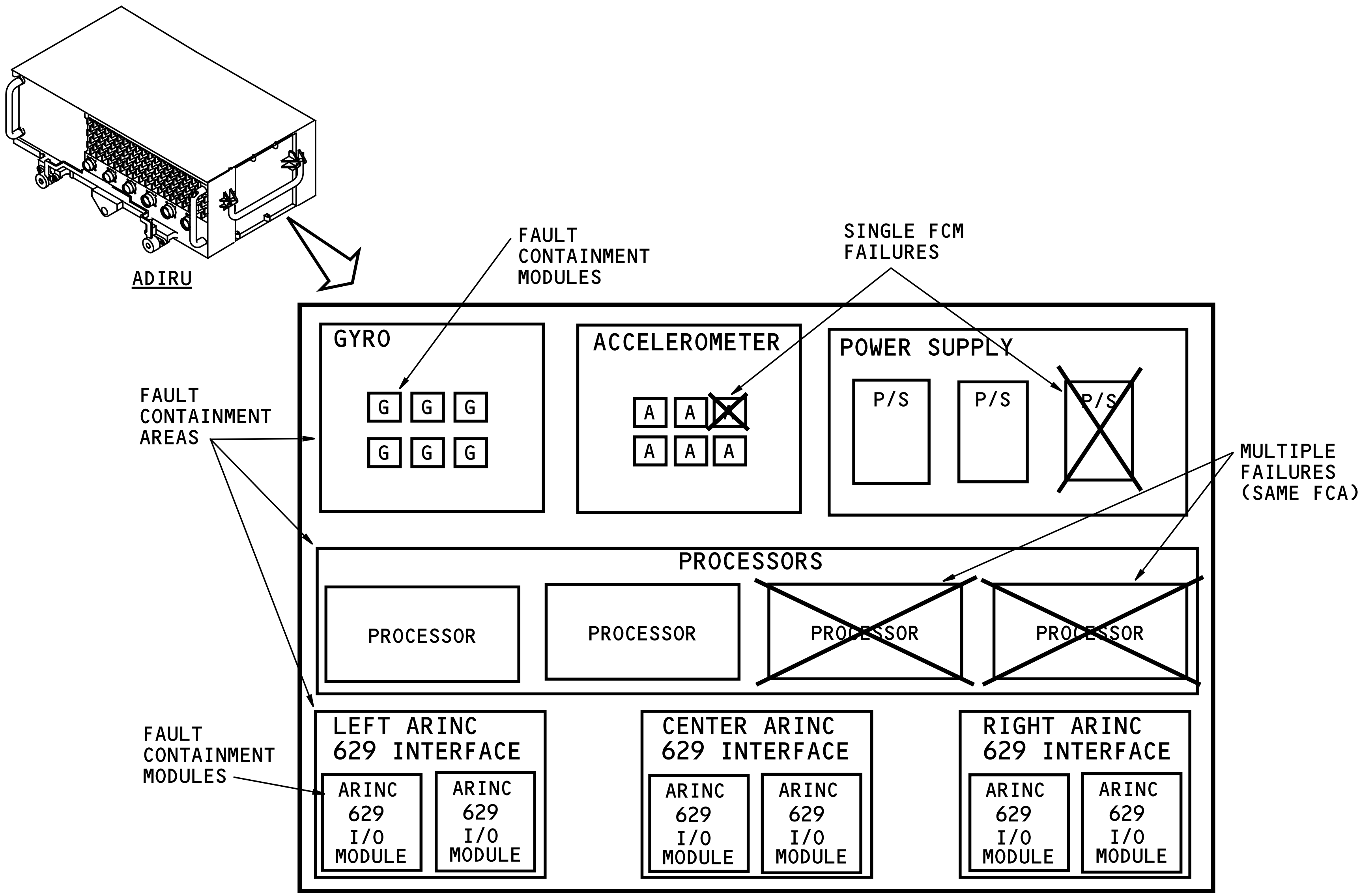
More Failures

The ADIRU must have at least these components in order to supply inertial reference data:

- 4 gyros
- 4 accelerometers
- 1 power supply
- 2 processors
- 1 ARINC 629 I/O module in the left and right FCA.

This happens if there are more than two failures in an FCA:

- The ADIRU does not supply inertial reference data
- The status message ADIRU shows
- The EICAS caution message NAV ADIRU INERTIAL shows
- The ADIRU sends data to AIMS to make a maintenance message show on the MAT.



ADIRS - ADIRU RELIABILITY AND FAULT TOLERANCE

34-20-00-016 Rev 4

ADIRS - ADIRU POWERUP, ON BATTERY, POWERDOWN

PFC/ADIRU Panel

The primary flight computer (PFC)/ADIRU panel has the ADIRU switch and the ADIRU on battery (ON BAT) light.

The ADIRU switch has five sets of contacts. Three of these contacts send discrete inputs to the ADIRU power and monitor circuit. One contact supplies a ground for the ADIRU OFF light, or a ground to energize the relay to make the ground crew call horn come on. The last contact makes the ADIRU ON light come on.

ADIRU Power Source

All the ADIRU power inputs go to the ADIRU power supply. This power goes to the power and I/O (input/output) monitor. The power and I/O monitor verifies the ADIRU switch inputs. If the ADIRU switch is in the on position, the power and I/O monitor permits the power to go to the ADIRU processors.

Ground Crew Alert

If the ADIRU loses primary power, it uses the airplane battery and the ADIRU ON BAT light comes on. The ground crew call horn comes on when the airplane is on the ground and the only source of power for the ADIRU is the hot battery bus. The ground crew call horn comes on to alert the ground crew that the hot battery bus is the only source of power for the ADIRU.

The ADIRU ON BAT light and the ground crew call horn come on if all these conditions are true:

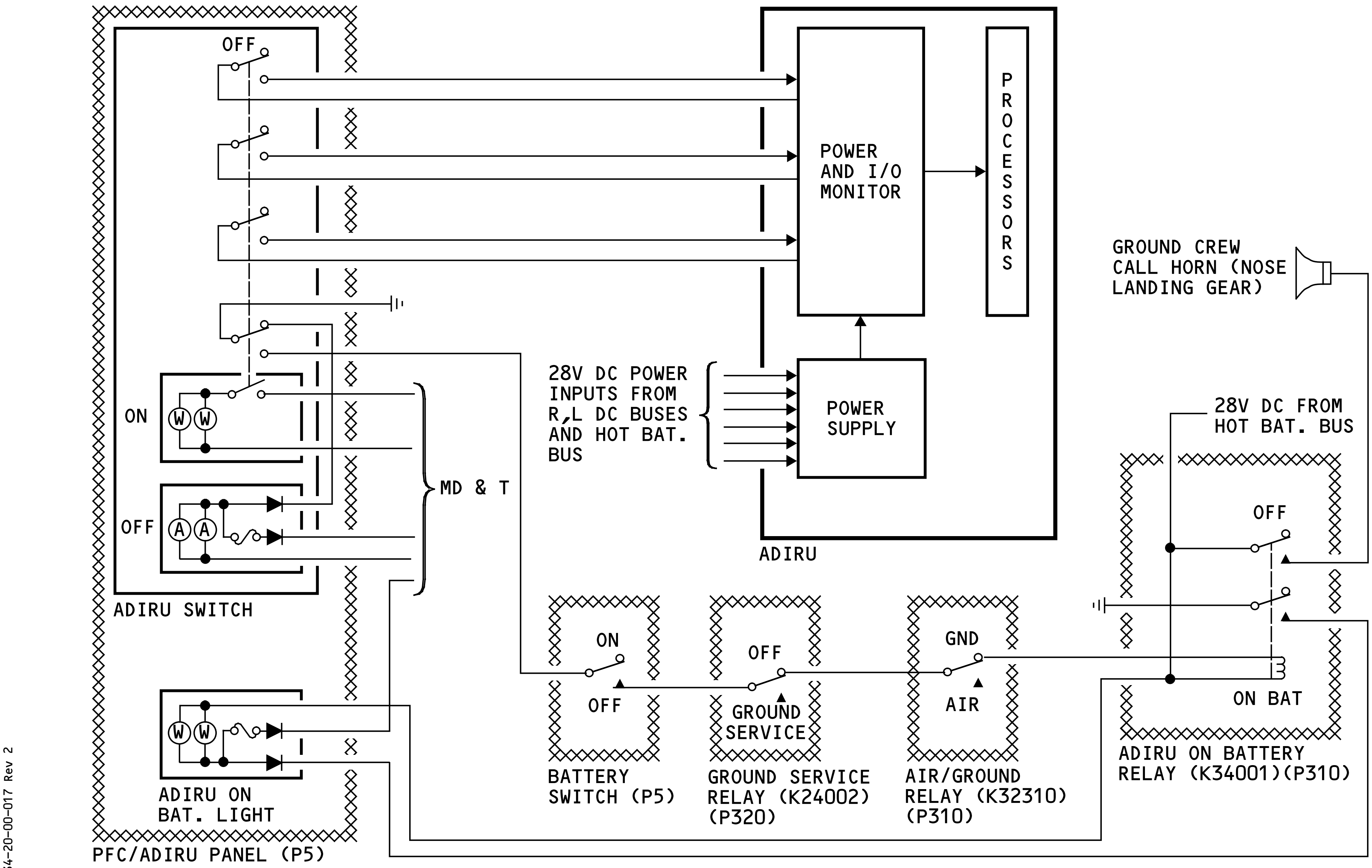
- Battery switch is in the off position
- Ground service relay is in the off position
- Air/ground relay is in the ground position
- The ADIRU switch is in the on position.

Power Down

With the ADIRU switch in the off position, one of these conditions must be present before the ADIRU will power down:

- Ground speed is less than 20 kts
- Computed airspeed is less than 30 kts.

All three power off discretes from the ADIRU on/off switch must be present for shutdown.



ADIRS - ADIRU POWERUP, ON BATTERY, POWERDOWN

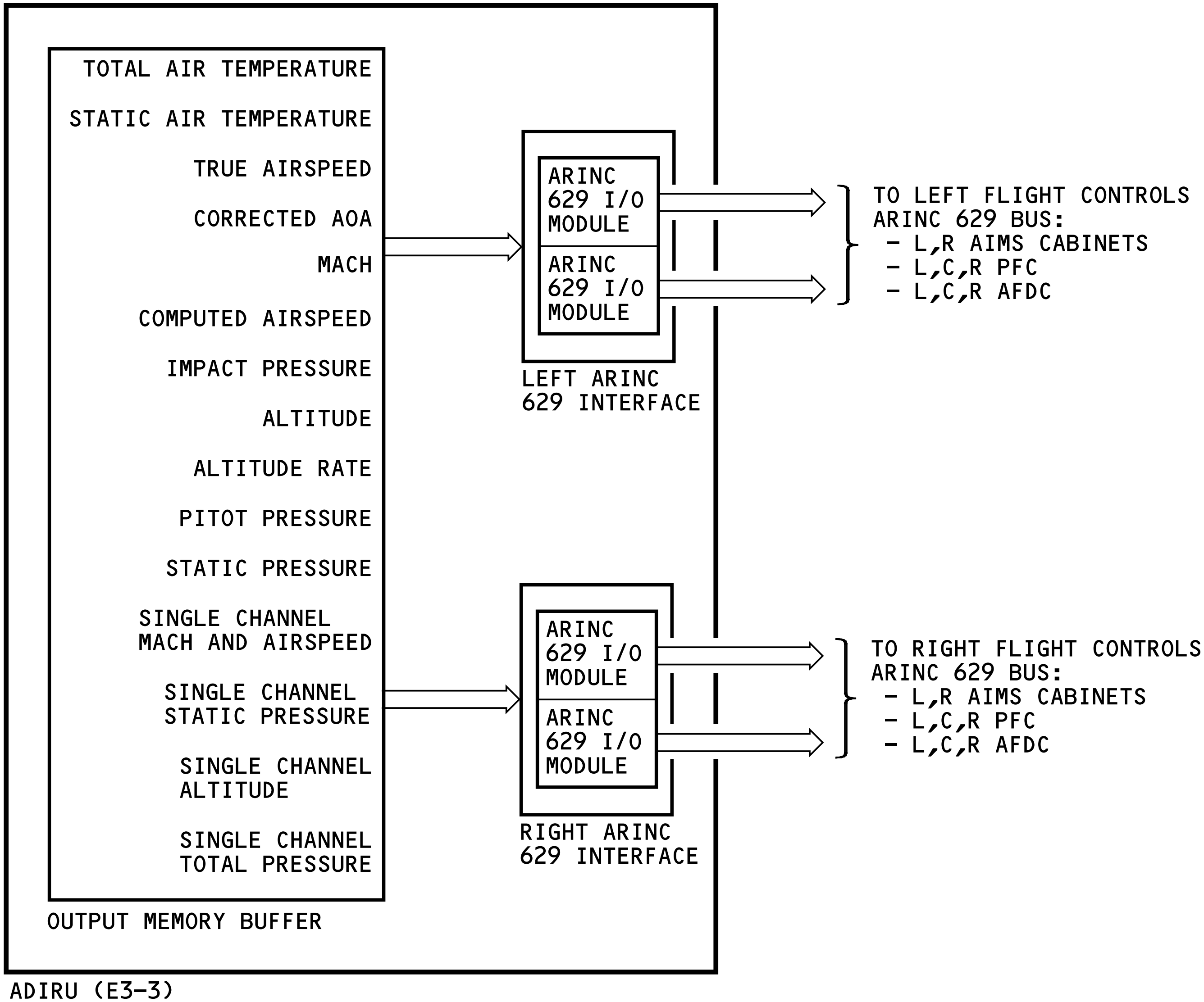
ADIRS - ADIRU AIR DATA FUNCTION - 3

Outputs

The ADIRU transmits air data to the left and right flight controls ARINC 629 buses. The air data goes to these components:

- Left and right AIMS cabinets
- Left, center, and right primary flight computers (PFCs)
- Left, center, and right autopilot flight director computers (AFDCs).

Only one of the two connections to each flight controls ARINC 629 bus is active at a time.



34-20-00-020 Rev 3 05/15/1997

ADIRS - ADIRU AIR DATA FUNCTION - 3

ADIRS - ADIRU INERTIAL REFERENCE DATA FUNCTION - 1

General

The ADIRU uses data from the flight management computing function (FMCF) in the AIMS cabinets to do these functions:

- Initialize the airplane position
- Calibrate the gyros and accelerometers.

Inputs

The FMCF sends this data to the inertial reference function in the ADIRU:

- Initial position
- Airplane type
- Global positioning system (GPS) position (longitude and latitude)
- GPS velocity (north, east, and vertical).

Initial Position

When the flight crew enters the initial position on the control display unit (CDU), the position goes to the FMCF of the AIMS. The AIMS sends the entered initial position to the ADIRU. The ADIRU's initial position validation logic does this:

- Verifies the validity of the entered initial position
- Compares the entered initial position to the global position system (GPS) position or the last ADIRU stored position if GPS data is not available.

If the entered initial position is good, the ADIRU uses it as the initial position for alignment.

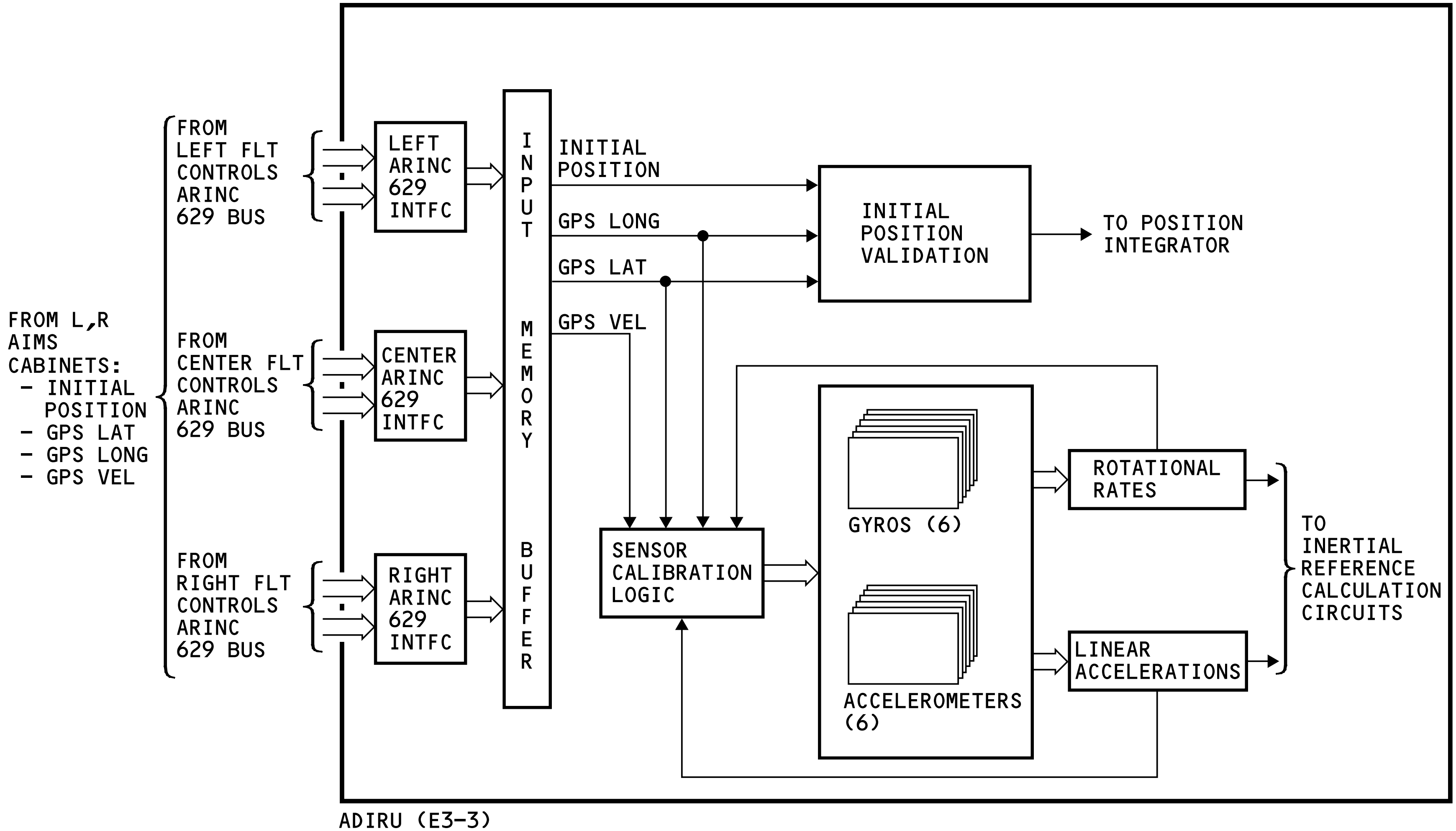
Gyro and Accelerometer Calibration

The GPS position and velocity goes to the sensor calibration logic. The sensor calibration logic supplies calibration data to the gyros and accelerometers. The calibration does not correct the ADIRU errors, it only reduces ADIRU drift errors as the airplane flies.

If the GPS position is not valid, there is no source of calibration data for the gyros and accelerometers.

Gyros and Accelerometers

The gyros send rotational rate data to the inertial reference calculation. The accelerometers send linear accelerations to the inertial reference calculation.



34-20-00-021 Rev 2 05/16/1997

ADIRS - ADIRU INERTIAL REFERENCE DATA FUNCTION - 1

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ADIRS - ADIRU INERTIAL REFERENCE DATA FUNCTION - 2

Wind Speed and Wind Direction

True airspeed data from the ADIRU air data function goes to the calculate wind speed and calculate wind direction function.

Pitch Rate, Roll Rate, Yaw Rate

The ADIRU uses the rotational rates from the six gyros to calculate:

- Pitch rate
- Roll rate
- Yaw rate.

Pitch Angle, Roll Angles, True Heading, Air data Function

The rotational rates from the six gyros go to the angles integrator. The angles integrator function calculates the airplane:

- Pitch angle
- Roll angle
- True heading.

Magnetic Heading And Magnetic Track

Rotational rates and linear accelerations go to the rotate accelerations to earth reference function. The rotate accelerations to earth reference function calculates accelerations in relation to the earth.

The accelerations in relation to the earth go to the velocities integrator. The velocities integrator calculates velocities. The velocities go to the position integrator and the calculate magnetic parameters function.

The position integrator calculates airplane position.

The calculate magnetic parameters uses the following data:

- Position integrator
- Velocities integrator
- Angles integrator.

The magnetic heading and magnetic track go to the output memory buffer only when the magnetic track is valid, and the ground speed is more than 20 knots.

Drift Angle

The velocities integrator sends data to the calculate drift angle circuit.

The drift angle goes to the output memory buffer only when the drift angle is valid and the groundspeed is more than 20 knots.

Latitude and Longitude

The velocities integrator sends velocities to the position integrator. The position integrator sends latitude and longitude to the output memory buffer.

ADIRS - ADIRU INERTIAL REFERENCE DATA FUNCTION - 2

Ground Speed, True Track, and Track Rate

The velocities integrator calculates:

- Ground speed
- True track
- Track rate.

This data goes to the output memory buffer only when the track is valid and the ground speed is more than 20 knots.

Vertical, Along Track, and Cross Track Accelerations

The rotate accelerations to earth reference circuit calculates:

- Vertical acceleration
- Along track acceleration
- Cross track acceleration.

This data goes to the output memory buffer only when the accelerations are valid and the ground speed is more than 20 knots.

Body Normal, Body Longitudinal, and Body Lateral Accelerations

The accelerometers supply these linear accelerations to the output memory buffer:

- Body normal
- Body longitudinal
- Body lateral.

Flight Path Angle

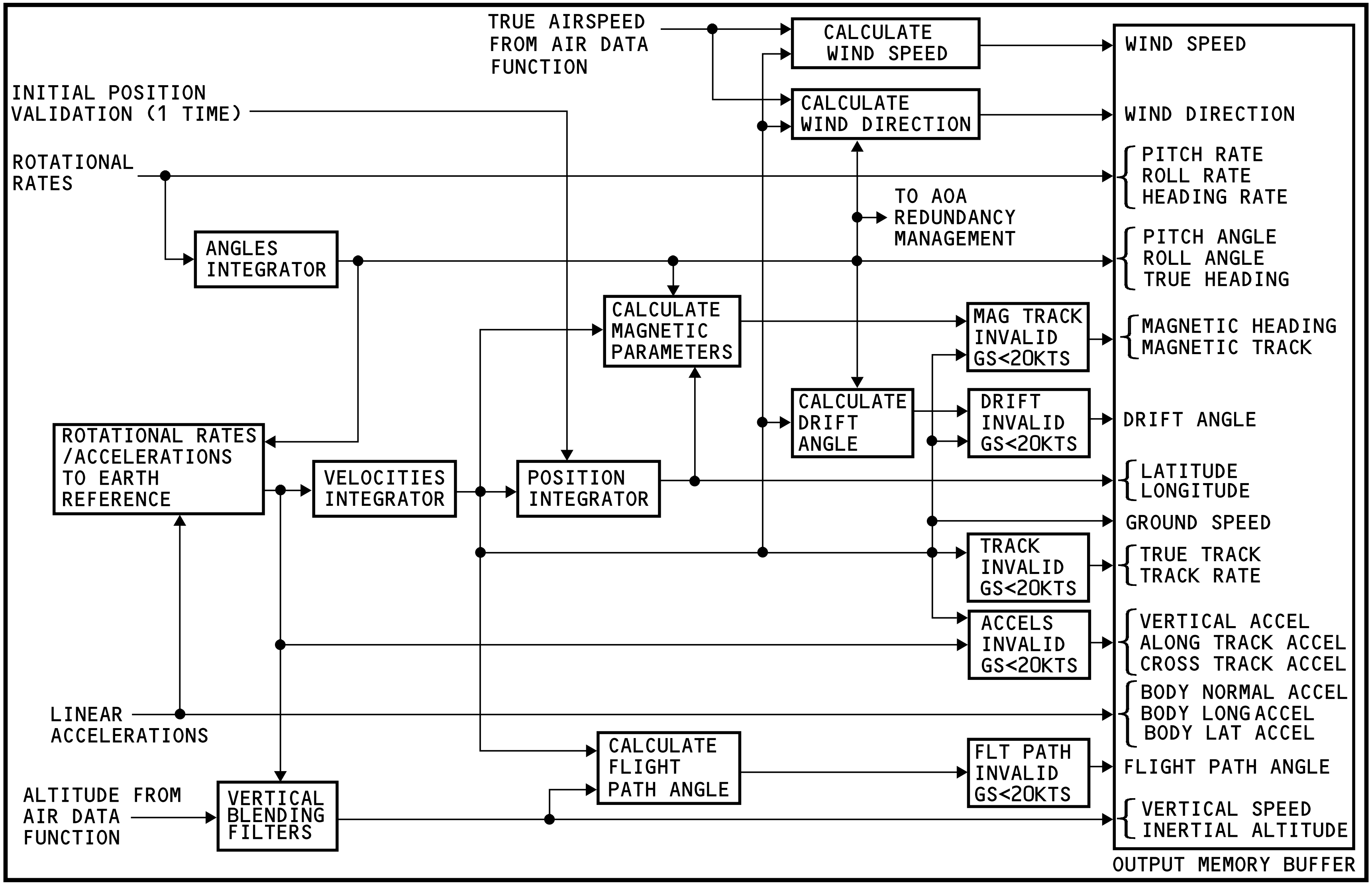
The air data function of the ADIRU supplies barometric altitude to the calculate flight path angle logic through vertical blending filters.

The calculate flight path angle logic also gets data from the velocities integrator.

The flight path angle goes to the output memory buffer only when the flight path is valid and the ground speed is more than 20 knots.

Vertical Speed and Inertial Altitude

Altitude from the ADIRU air data computing function combine with the rotational rates and linear accelerations through vertical blending filters. This data goes to the output buffer as vertical speed and inertial altitude.



ADIRU (E3-3)

34-20-00-022 Rev 3

ADIRS - ADIRU INERTIAL REFERENCE DATA FUNCTION - 2

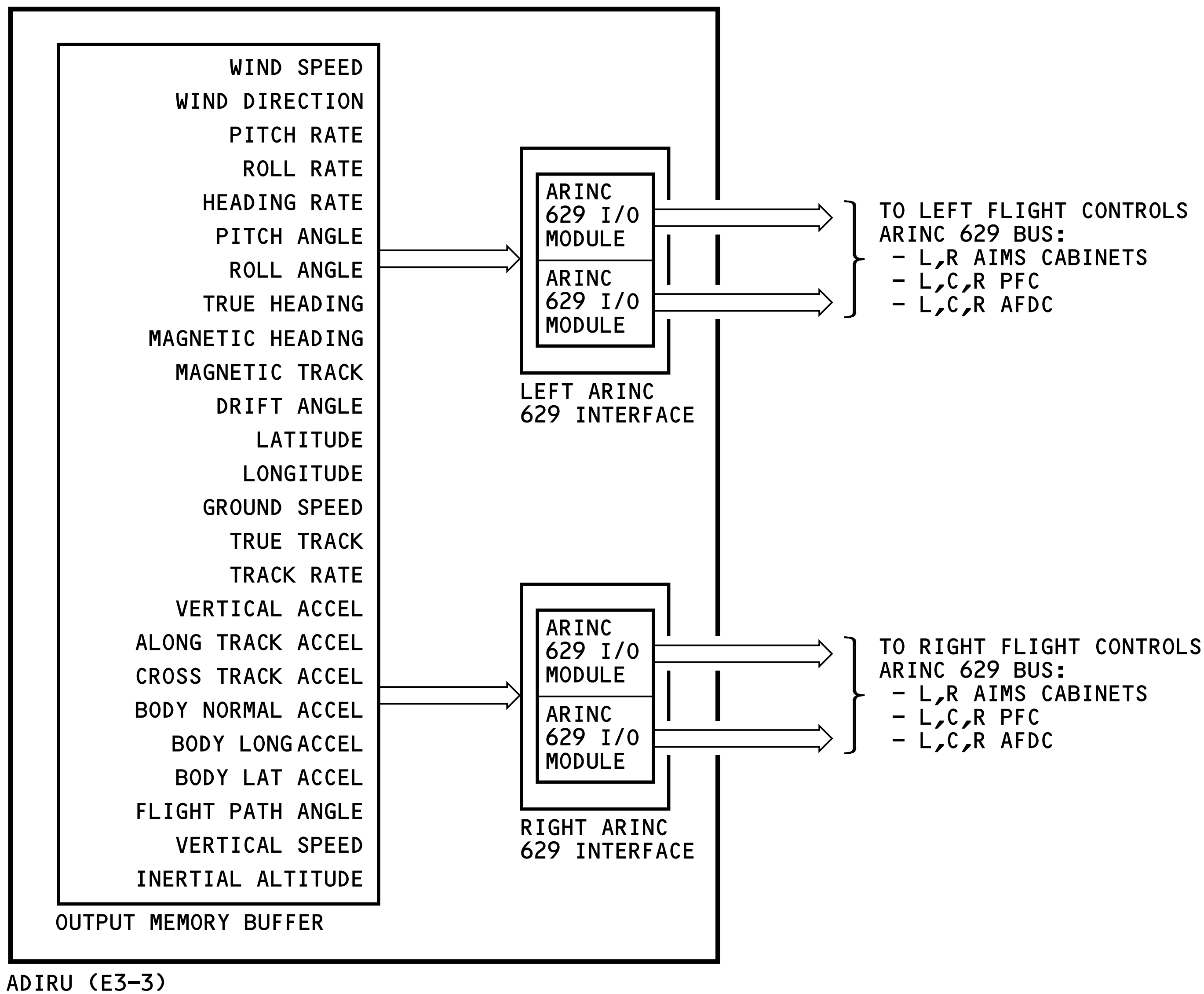
ADIRS - ADIRU INERTIAL REFERENCE DATA FUNCTION - 3

Output

The ADIRU transmits inertial reference data to the left and right flight control ARINC 629 buses. The inertial reference data goes to these components:

- Left and right AIMS cabinets
- Left, center, and right primary flight computers (PFCs)
- Left, center, and right autopilot flight director computers (AFDCs).

Only one of the two connections to each flight controls ARINC 629 bus is active at a time.



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ADIRS - ADIRU INERTIAL REFERENCE DATA FUNCTION - 3

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ADIRS - AIR DATA MODULE

ADM General

There are 6 air data modules (ADMs) in the air data inertial reference system (ADIRS). Three are for pitot pressure and three are for static pressure. All the ADMs operate in the same manner.

The air data module (ADM) measures absolute pressure. This pressure comes from a pitot probe or static pressure port. The ADM transmits this pressure on a flight controls ARINC 629 bus for use by the ADIRU and SAARU. All ARINC 629 ADMs are interchangeable and can be a pitot or a static ADM.

The pitot ADMs control the heat for the pitot probes and the angle of attack (AOA) sensors.

ARINC 629 Interface

The left ADM transmits and receives on the left flight controls ARINC 629 bus.

The center ADM transmits and receives on the center flight controls ARINC 629 bus.

The right ADM transmits and receives on the right flight controls ARINC 629 bus.

ADM Physical Description

The ADM weighs 2.6 pounds. The ADM has one pneumatic connector and two electrical connectors.

The ADM has a flange on each side. Each flange has two captive screws. The ADM mounts directly to the mounting tray flanges.

The pneumatic connector seals itself when removed from the ADM. You do not need to plug the pneumatic line when you remove the ADM.

One electrical connector is for program pins and power. The other electrical connector is for ARINC 629.

ADM Operation

The ADM gets 28v dc for power.

The ADM receives pneumatic pressure from a pitot probe or static ports. The pressure sensor changes the pressure value to an analog signal. The analog signal goes through an analog to digital converter. The ADM calibrates the pressure and compensates for temperature. The ARINC 629 transmitter/receiver sends the data on a flight controls ARINC 629 bus.

Program pins define the location of the ADM. The input/output decoder logic sends the program pin ADM location data to the processor.

This location information goes to the ADIRU and SAARU on a flight controls ARINC 629 bus.

ADIRS - AIR DATA MODULE

Pitot Probe and AOA Sensor Heat Control

The left pitot ADM controls the heat for the left pitot probe. The center pitot ADM controls the heat for the center pitot probe. The right pitot ADM controls the heat for the right pitot probe.

The left pitot ADM controls the heat for the left AOA sensor. The right pitot ADM controls the heat for the right AOA sensor.

The pitot ADMs control the heat control relays in the power management panels. The heat control comes from data the ADMs receive from the primary flight computers (PFCs) through the flight controls ARINC 629 bus. If the PFCs are not valid, the ADMs use data from the autopilot/flight director computers (AFDCs). The AFDC data also comes through the flight controls ARINC 629 bus.

The ADMs supply a ground heat signal to the power management panels when the PFCs report these two conditions are true:

- The airplane is on the ground
- An engine running.

The ADMs supply an air heat signal to the power management panels when any of these conditions is true:

- The airplane is in the air
- Computed airspeed (CAS) is more than 50 kts.

The power management panels connect the ground heat and the air heat signals to current sense relays to control the voltage to the pitot probes. The ADMs monitor the pitot probe and AOA heaters through three electrical input discretes. The ADM transmits heater fault data on the flight controls bus.

See chapter 30 for information on how to do a test of the pitot probe and the AOA sensor heat operation.

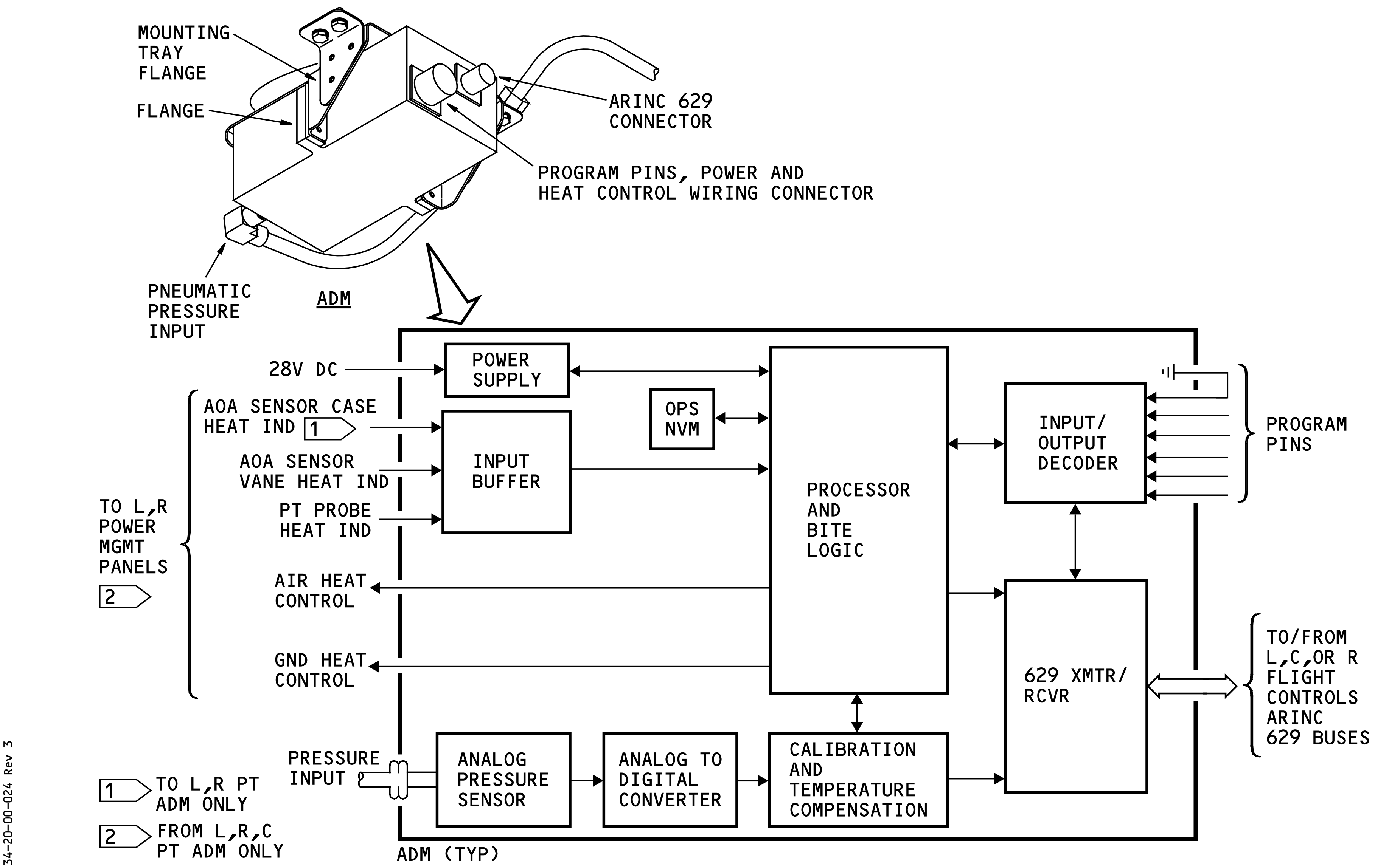
ADM Software Loading

The ADM can receive operational program software (OPS) from the AIMS cabinets through the flight controls ARINC 629 bus. You load the same software for pitot and static ADMs.

The ADM keeps the OPS in non-volatile memory (NVM).

Fault Data

The ADM sends fault and operational status data to the central maintenance computing function (CMCF) of the AIMS. The CMCF can command the ADM to test the pitot heaters and AOA heaters.



ADIRS - AIR DATA MODULE

ADIRS - SECONDARY ATTITUDE AIR DATA REFERENCE UNIT

General

The secondary attitude air data reference unit (SAARU) is a backup source of attitude and air data.

Physical Description

The SAARU weighs 30 pounds. It uses passive cooling. Cooling fins take heat away from the SAARU.

Software Load

The SAARU can receive new software from the flight controls ARINC 629 data bus. The software data modifies the operational program of the SAARU.

Sensors and Circuits

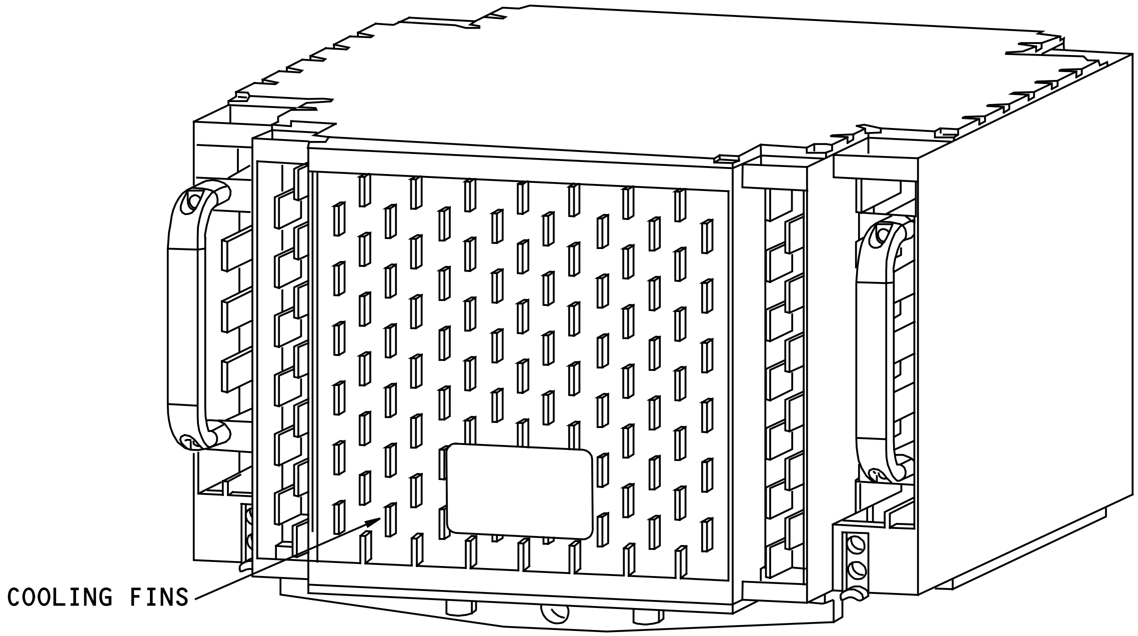
The SAARU has these components:

- Four fiber optic gyros
- Four linear accelerometers
- Two central processing units (CPUs)
- Three ARINC 629 interface modules.
- Two power supplies.

Three fiber optic gyros and three accelerometers are aligned with the roll, pitch, and yaw axis. The fourth fiber optic gyro and fourth accelerometer allow the SAARU to detect any faults in the other three.

Standby Instruments

The SAARU supplies attitude data to the standby attitude indicator through the ARINC 429 bus.



34-20-00-025 Rev 1

ADIRS - SECONDARY ATTITUDE AIR DATA REFERENCE UNIT

ADIRS - SAARU INERTIAL REFERENCE DATA FUNCTION

General

The secondary attitude air data reference unit (SAARU) uses gyros and accelerometers to calculate inertial reference data. The inertial reference data goes to airplane systems.

Power

The SAARU gets power from a circuit breaker in the center power supply assembly. The circuit breaker gets power from the center flight control DC bus.

Gyros and Accelerometers

The gyros and accelerometers measure rotation rates and accelerations. The rotation rates and accelerations go to buffers. The buffers supply the rotation rates and accelerations to the central processing unit which calculate SAARU data.

SAARU Data

The SAARU calculates this inertial reference data:

- Body frame accelerations
- Body frame angular rates
- Attitude (roll and pitch)
- Horizontal and vertical accelerations
- Inertial altitude
- Wander heading
- Vertical speed.

Barometric Altitude Input

The SAARU uses barometric altitude from its air data section to calculate vertical speed. This barometric altitude prevents fast changes in vertical speed.

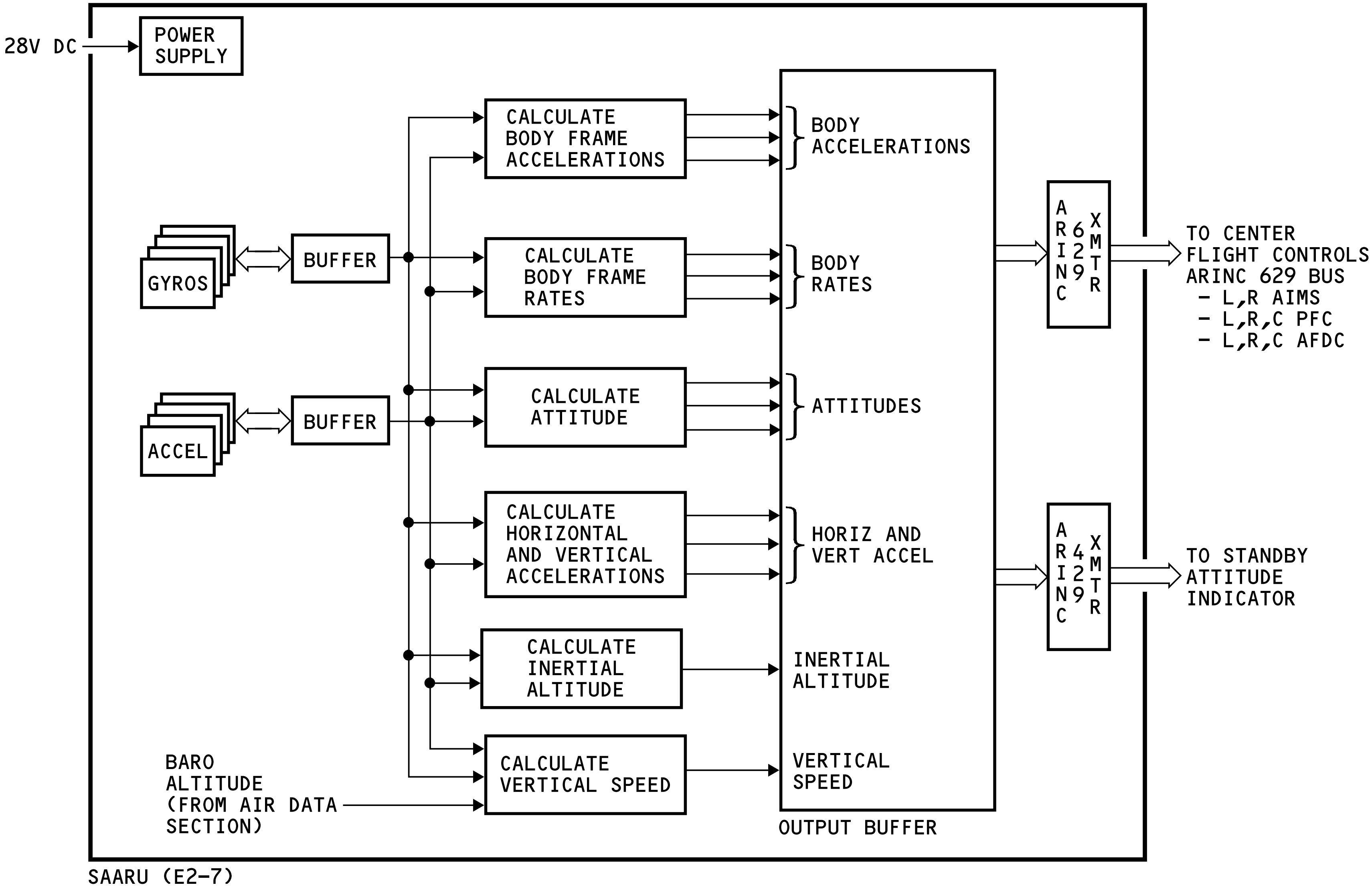
ARINC 629 Output

The SAARU sends inertial data on the center flight controls ARINC 629 bus. The SAARU data goes to the:

- Left and right AIMS cabinets
- Left, right, and center primary flight computers (PFCs)
- Left, right, and center autopilot flight director computers.

ARINC 429 Output

The SAARU sends attitude data through the output buffer to the standby attitude indicator.



34-20-00-026 Rev 2 10/23/96

ADIRS - SAARU INERTIAL REFERENCE DATA FUNCTION

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ADIRS - SAARU AIR DATA FUNCTION - 1

General

Redundancy management logic in the SAARU selects or votes a value for the inputs that come from the redundant air data sensors.

Total Air Temperature

The total air temperature (TAT) redundancy management logic calculates an average of the TAT values from TAT inputs 1 and 2.

Pitot Heater Valid

Pitot heater valid signals come from the left, center, and right pitot air data modules (ADMs). The pitot heater valid signals go to the pitot ADM redundancy management logic.

Pitot Pressure

Pitot pressure comes from the left, center, and right pitot air data modules (ADMs). The pitot ADM redundancy management logic calculates an average of the pitot pressures from the ADMs.

AOA Heater Valid

The angle of attack (AOA) heater valid signals go to the AOA redundancy management logic. The AOA redundancy management logic uses the AOA heater valid signal to find out if the AOA sensors are valid.

AOA Input

The AOA values go to the function that calculates the corrected AOA.

Speedbrake Lever Past Arm Signal

The primary flight computers (PFCs) supply the air ground speedbrake lever past arm signals to the SAARU. Input data redundancy management logic selects one of the PFC signals. The speedbrake lever past arm signals go to the AOA redundancy management logic.

Air/Ground, Nose Gear Position, and Flap Position

The proximity sensor electronics units (PSEUs) supply the air/ground and the nose gear position signals to the AIMS cabinets.

The flap/slat electronics units (FSEUs) supply the flap position signals to the AIMS cabinets.

The AIMS cabinets supply the signals to the SAARU. An input data redundancy management logic selects one of the PSEU signals, and one of the FSEU signals.

The air/ground signal, nose gear position, and flap position signals go to the calculate corrected AOA function.

ADIRS - SAARU AIR DATA FUNCTION - 1

Calculate Corrected AOA

The calculate corrected AOA logic calculates the left and right corrected AOA. The calculate corrected AOA function receives these additional signals:

- Mach
- Pitch rate
- True airspeed
- Flap position
- Nose gear position.

The corrected AOAs go to the AOA redundancy management logic.

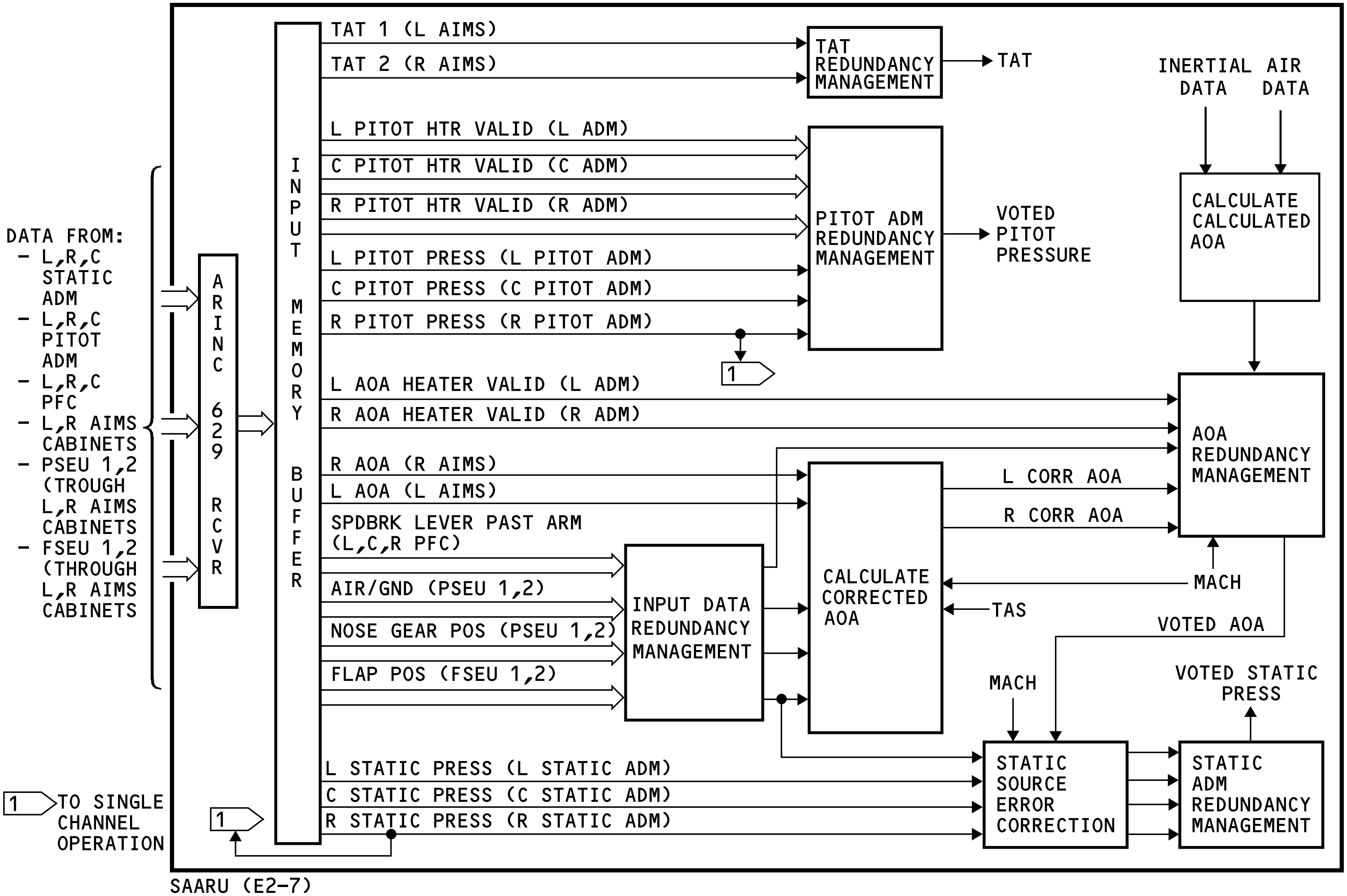
AOA Redundancy Management

The AOA redundancy management logic uses a modified average calculation. The modified average calculation calculates an average of three AOA values, the left corrected AOA, the right corrected AOA, and a calculated AOA. The calculated AOA logic receives inputs from the inertial and air data systems to calculate the calculated AOA.

Static Pressure

Static pressure comes from the left, center, and right static air data modules (ADMs). The static source error correction (SSEC) uses Mach and corrected AOA to compensate for errors in measurement of static pressure. The static pressure goes to the static ADM redundancy management logic.

The static ADM redundancy management logic calculates an average of the static pressures from the ADMs. The static ADM redundancy management logic uses body accelerations from the SAARU inertial reference section to determine error thresholds.



ADIRS - SAARU AIR DATA FUNCTION - 1

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ADIRS - SAARU AIR DATA FUNCTION - 2

Total Air Temperature (TAT)

The TAT signal is corrected for the small temperature rise that occurs when the air flow through the probe slows down.

Static Air Temperature (SAT)

The calculate static air temperature function receives TAT, mach and CAS inputs. The SAT signal goes to the output memory buffer.

True Air Speed (TAS)

The calculate TAS function uses static temperature CAS to calculate TAS. The corrected TAS goes invalid when the CAS is less than 50 knots.

Corrected Angle Of Attack (AOA)

The corrected AOA, from the AOA redundancy management, goes invalid when the CAS is less than 50 knots.

Mach and Computed Air Speed (CAS)

The calculate mach and CAS function uses impact pressure to calculate mach and CAS. The corrected mach goes invalid when the CAS is less than 50 knots.

Impact Pressure

The calculate impact pressure function receives static pressure inputs from the static ADM redundancy management logic. The calculate impact pressure function also receives pitot pressure from the pitot ADM redundancy management. The impact pressure signal goes to the output memory buffer.

Altitude and Altitude Rate.

The calculate altitude and altitude rate function gets signals from the static and pitot ADM redundancy management logic. Altitude and altitude rate signals go to the output memory buffer.

Pitot Pressure and Static Pressure

Pitot and static pressure come directly from the pitot and static ADM redundancy management logic. These pressures go to the output memory buffer.

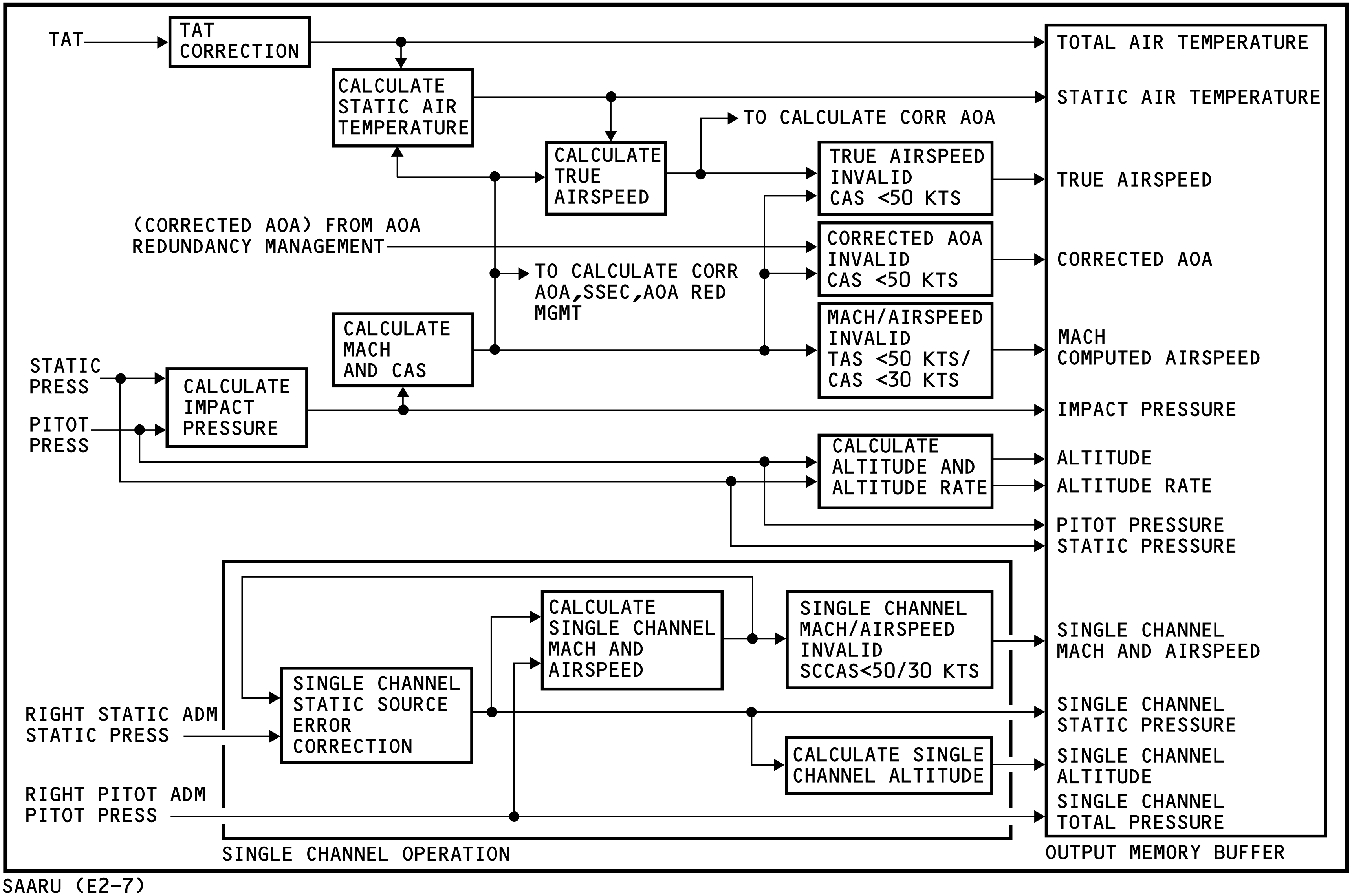
Single Channel Operation

If the ADIRU and SAARU air data parameters from the redundancy management logic are invalid, the flight deck displays show single channel air data from the ADIRU and SAARU. Single channel air data parameters bypass the redundancy management logic that the flight displays show during normal operation. Air data from the right pitot ADM and right static ADM goes to the the SAARU single channel operation function. This function calculates these single channel quantities:

- Mach
- Airspeed
- Static pressure

ADIRS - SAARU AIR DATA FUNCTION - 2

- Barometric altitude
- Total pressure.



34-20-00-028 Rev 4 05/16/1997

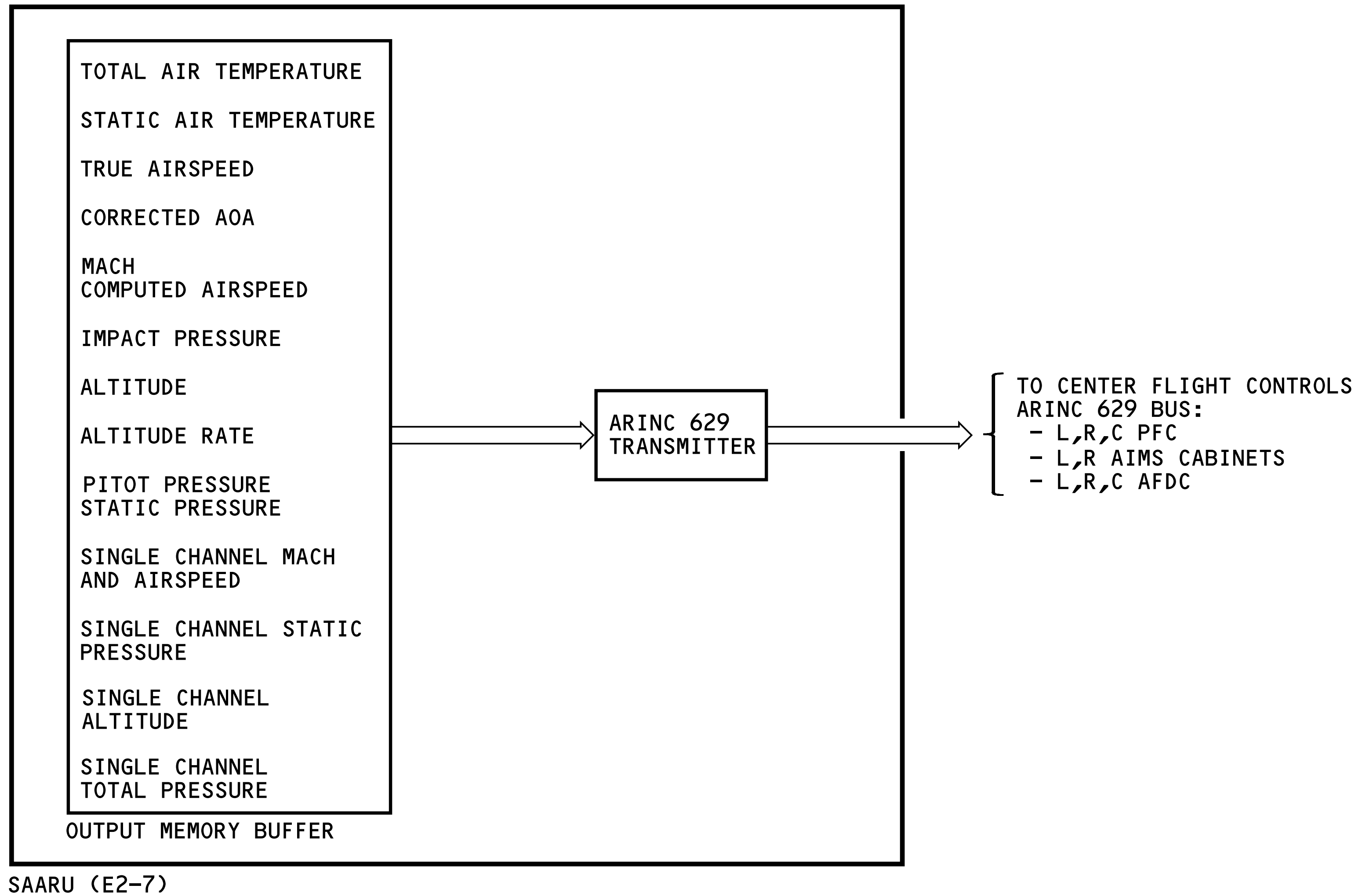
ADIRS - SAARU AIR DATA FUNCTION - 2

ADIRS - SAARU AIR DATA FUNCTION - 3

Air Data Outputs

The secondary attitude air data reference unit (SAARU) sends data on the center flight control ARINC 629 bus. The data goes to the:

- Primary flight computers (PFCs)
- AIMS cabinets
- Autopilot flight director computers (AFDCs).



34-20-00-029 Rev 1 05/15/1997

ADIRS - SAARU AIR DATA FUNCTION - 3

ADIRS - SAARU BACKUP NAVIGATION

General

The ADIRU supplies navigation data to the autopilot flight director system (AFDS) and the primary flight control system (PFCS). The AFDS uses the SAARU backup navigation data if the ADIRU fails.

ADIRU Tracking

When the ADIRU data from the SAARU input memory buffer is valid, the SAARU tracks the ADIRU navigation outputs. This makes the SAARU backup navigation data the same as the ADIRU.

If the ADIRU data goes invalid, the SAARU does not follow the ADIRU outputs. The SAARU continues to calculate backup navigation data independent of the ADIRU. The fiber optic gyros do not supply sufficiently accurate data for autopilot operation for extended periods of time, therefore, the backup navigation function goes invalid after 3 minutes.

ADIRU Inputs

The ADIRU supplies these inputs to the SAARU:

- Roll angle
- Pitch angle
- Magnetic heading
- True heading
- Along-track horizontal acceleration
- Cross-track horizontal acceleration
- North velocity
- East velocity.

The SAARU monitors the ADIRU inputs. If one or more inputs are invalid and the true airspeed (TAS) from the SAARU is more than 80 knots, the SAARU starts to calculate backup navigation data independent of the ADIRU.

Tracking Loops

The tracking loops make the SAARU follow the ADIRU data. If the ADIRU is valid, the SAARU backup navigation data out of the tracking loops and into the output buffer follows the ADIRU data. If the ADIRU fails, the tracking loops let the SAARU data go to the output memory buffer.

Calculate Magnetic Track Angle

The calculate magnetic track angle logic uses magnetic and true heading.

Calculate True Track Angle

The calculate true track angle logic uses north and east velocities.

Calculate Ground Speed

The calculate ground speed logic uses north and east velocities.

Calculate Flight Path Acceleration

The calculate flight path acceleration logic uses these inputs:

- Along track horizontal acceleration
- Ground speed
- Vertical speed
- Vertical acceleration.

SAARU Backup Navigation Outputs

The SAARU backup navigation outputs go to the autopilot flight director computers (AFDCs) and the primary flight computers (PFCs). These are the SAARU backup navigation outputs:

- Roll angle
- Pitch angle
- Magnetic heading
- Magnetic track
- True heading
- Along-track horizontal acceleration
- Cross-track horizontal acceleration
- True track angle
- Ground speed
- Flight path acceleration.

Training Information Point

The autopilot flight director system (AFDS) can use ADIRU or SAARU data. The AFDS uses ADIRU data first. If the ADIRU fails, the AFDS uses SAARU data. Some AFDS modes do not operate when the ADIRU fails and SAARU backup navigation is not available. These are the AFDS modes that do not operate in this condition:

- Approach (APP)
- Flight path angle (FPA)
- Takeoff/go-around (TO/GA)
- Track hold (TRK HLD)
- Track select (TRK SEL)
- Vertical navigation (VNAV)
- Lateral navigation (LNAV).

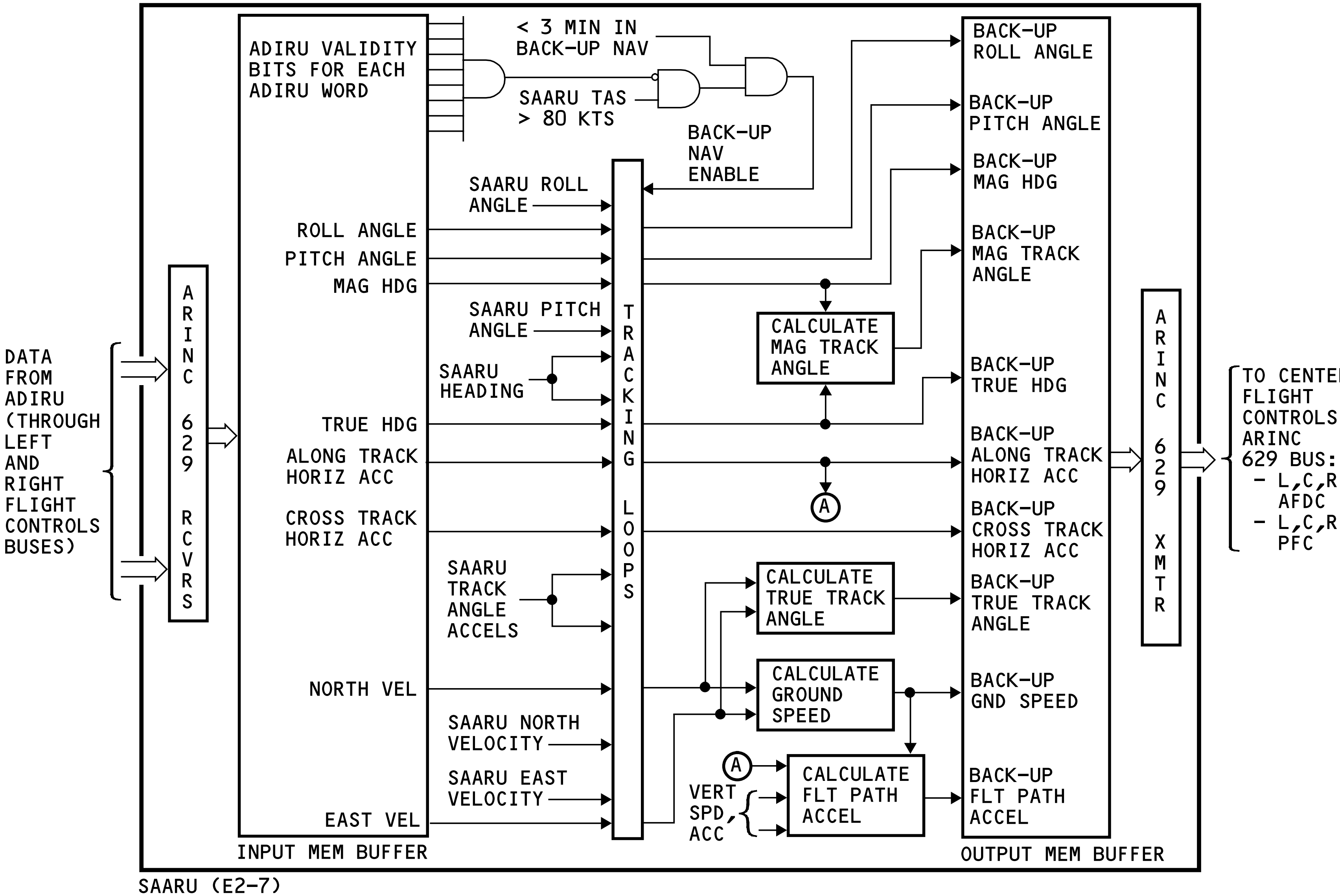
If the ADIRU fails when the APP mode is armed or engaged, the AFDS automatically selects the SAARU backup navigation data. If the airplane does not land within 3 minutes, the autopilot pitch and roll modes fail. The flight crew must select another autopilot mode or disengage the autopilot.

If the ADIRU fails when the FPA mode is engaged, the AFDS will automatically select the SAARU backup navigation data. If the autopilot does not go into another mode or if the flight crew does not select another mode within 3 minutes, the autopilot pitch mode fails. The flight crew must select another autopilot mode or disengage the autopilot.

If the ADIRU fails when the TO/GA mode is engaged, the AFDS will automatically select the SAARU backup navigation data. If the autopilot does not go into another mode or if the flight crew does not select another mode within 3 minutes, the autopilot roll mode fails. The flight crew must select another autopilot mode or disengage the autopilot.

If the ADIRU fails when the TRK HLD or TRK SEL mode is engaged, the AFDS will automatically select the SAARU backup navigation data. If the flight crew does not select another mode within 3 minutes, the autopilot roll mode fails. The flight crew must select another autopilot mode or disengage the autopilot.

VNAV and LNAV are not AFDS modes. VNAV and LNAV are flight management computing system (FMCS) modes that go through the AFDCs. VNAV and LNAV do not operate when the FMCS does not have valid ADIRU data. If the ADIRU fails, the autopilot pitch and roll modes immediately fail. The flight crew must select another autopilot mode or disengage the autopilot.



ADIRS - SAARU BACKUP NAVIGATION

ADIRS - STANDBY ATTITUDE INDICATOR

Purpose

The standby attitude indicator shows attitude data. The attitude data comes from the secondary attitude air data reference unit (SAARU). The standby attitude indicator is a liquid crystal display (LCD).

Program Pin Configuration

Program pins determine the function of the standby instruments. Install the standby instrument in the standby attitude indicator position to show the standby attitude indicator format.

If you replace the normal standby attitude indicator with an indicator that has a push-button and rotating knob, the knob has no function. The push-button and the rotating knob are active only when you install the standby instrument in the standby airspeed indicator position or the standby altimeter position.

Integral Light Sensor

There is an integral light sensor at the lower center of each standby instrument. The integral light sensor measures the amount of light on the front of the standby instrument. The standby instruments adjust the display brightness to the amount of light available.

The standby instruments send brightness data to each other to adjust their brightness.

Remote Light Sensor

Remote light sensors on the glareshield panel (P7) supply brightness signals to the standby instruments. The standby instruments adjust the display brightness to the amount of light available.

NCD Display

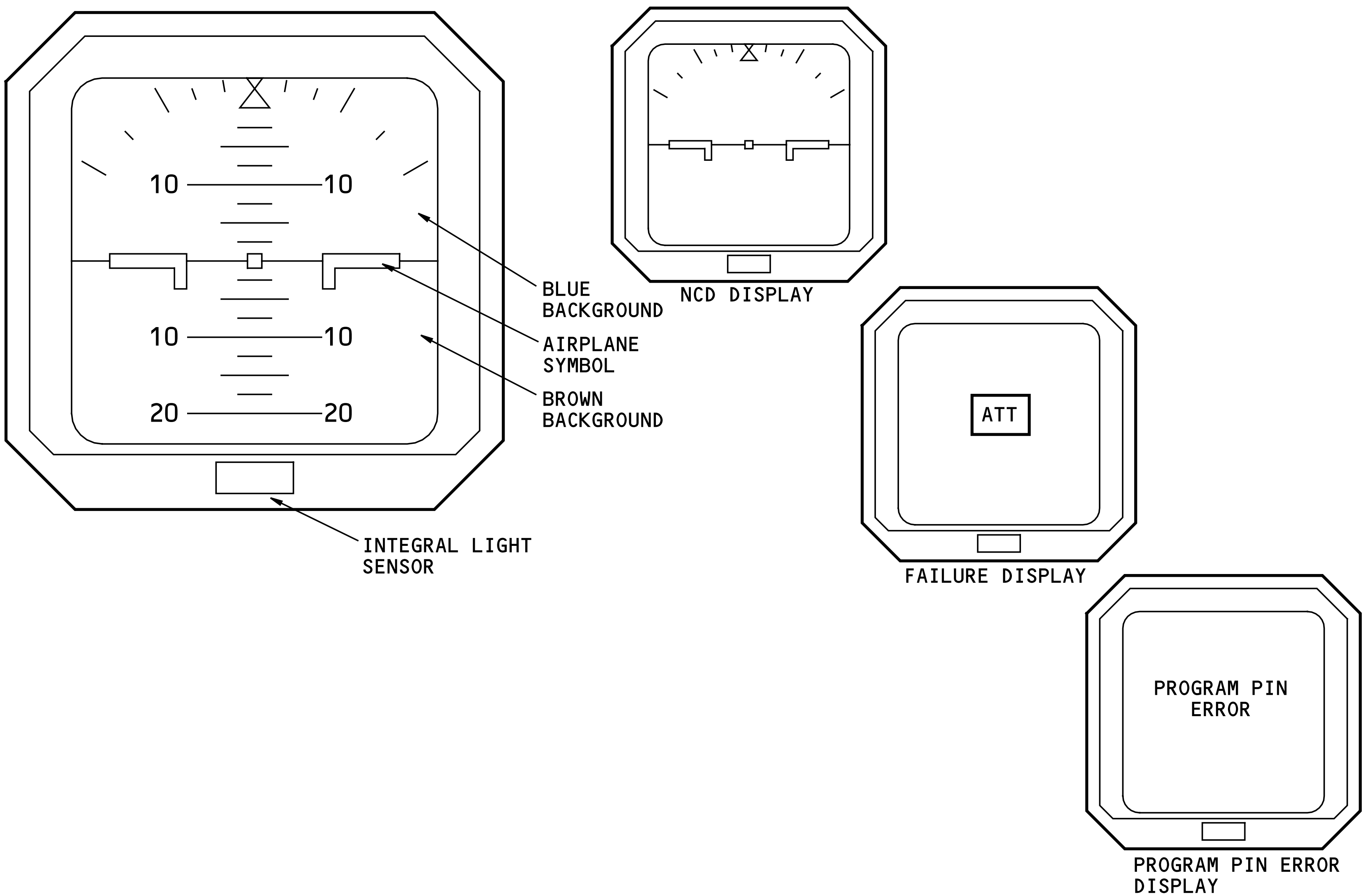
If data from the SAARU is NCD (no computed data), the standby attitude indicator shows only the airplane symbol, roll scale, and zero pitch angle.

Failure Display

If the standby attitude indicator or the data from the SAARU fails, an ATT (attitude) yellow flag shows. A yellow box is around the letters ATT.

Program Pin Error

If the standby attitude indicator finds a program pin error, the yellow message PROGRAM PIN ERROR shows. A program pin error message means the standby instrument finds the program pin connection invalid.



34-20-00-031 Rev 1

ADIRS - STANDBY ATTITUDE INDICATOR

ADIRS - STANDBY ATTITUDE INDICATOR FUNCTIONAL DESCRIPTION

Power

The standby attitude indicator gets 28v dc for power.

Attitude Inputs

The secondary attitude air data reference unit (SAARU) supplies attitude data to the standby attitude indicator. The data goes to a microprocessor. The microprocessor supplies display data to the liquid crystal display (LCD).

Brightness Inputs

Brightness data comes from the:

- Standby altimeter
- Standby airspeed indicator
- Integral light sensor
- Remote light sensors.

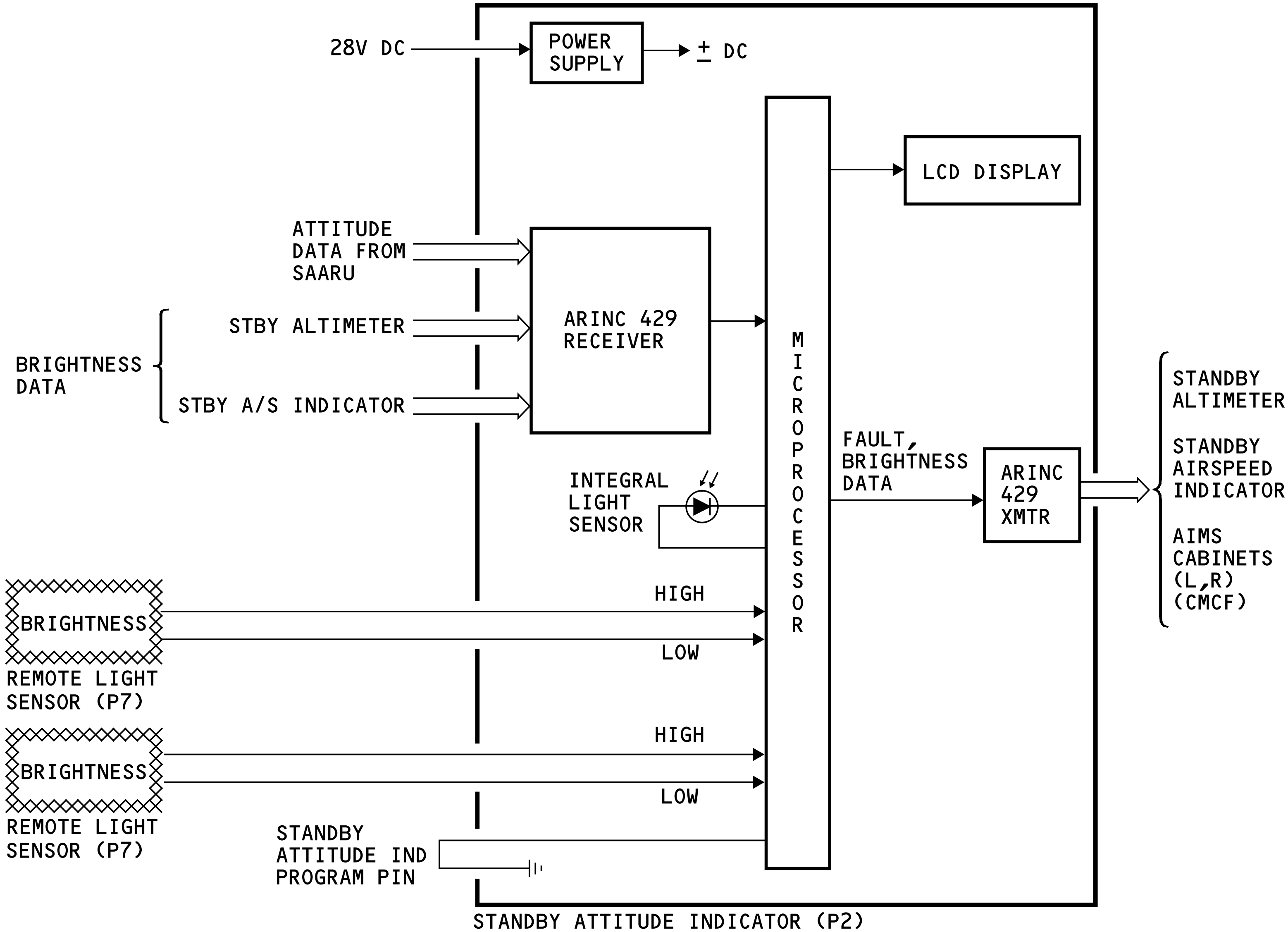
The microprocessor uses the brightness inputs to adjust the brightness of the LCD.

Program Pin

A standby attitude indicator program pin selects the standby attitude indicator display format.

Outputs

Brightness data goes to the standby altimeter and the standby airspeed indicator. Fault data goes to the central maintenance computing function (CMCF) of the AIMS.



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ADIRS - STANDBY ATTITUDE INDICATOR FUNCTIONAL DESCRIPTION

ADIRS - TOTAL AIR TEMPERATURE PROBE

Purpose

A total air temperature (TAT) probe measures temperature outside the airplane.

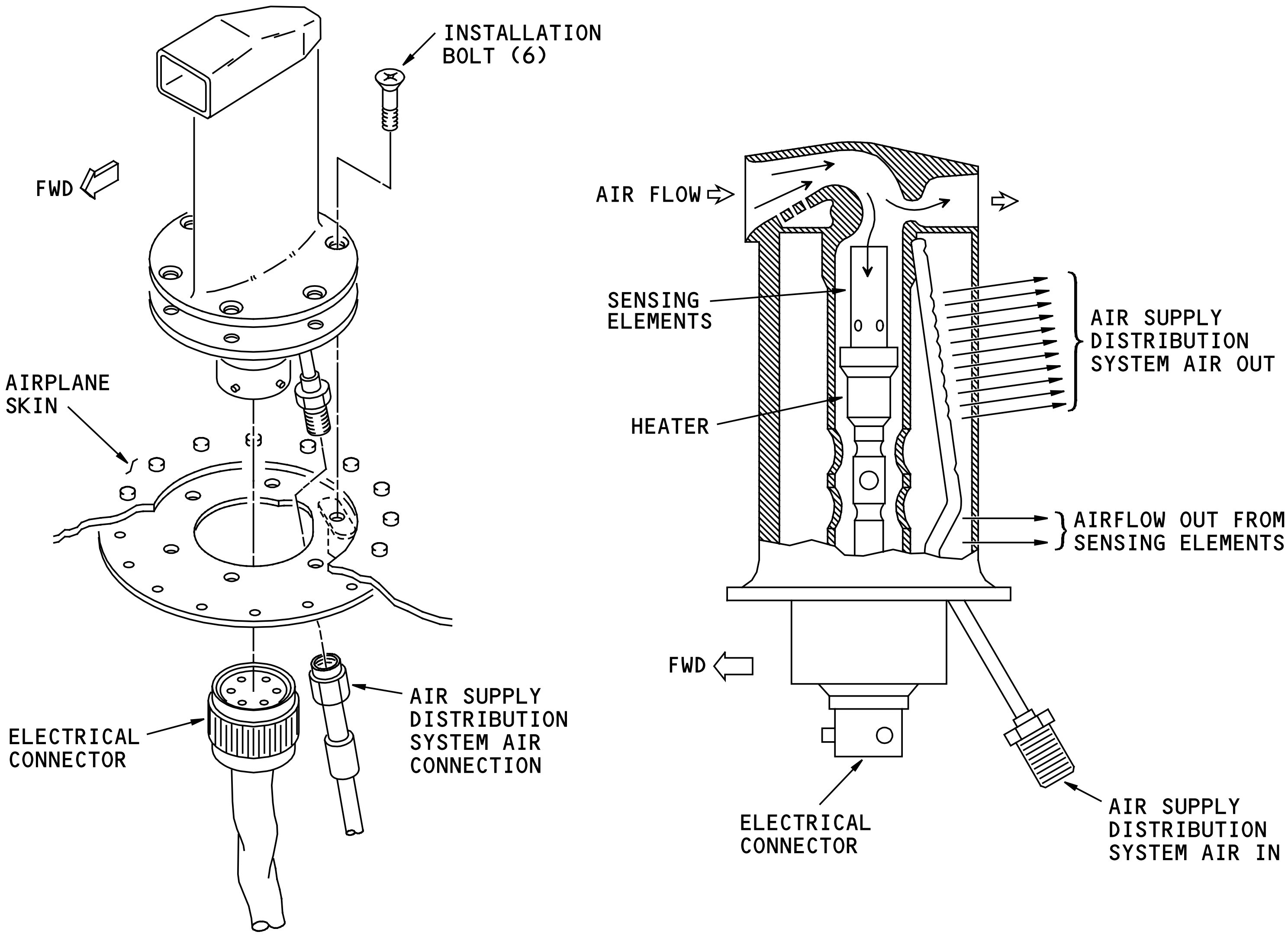
Sensing Elements

There are two sensing elements in a TAT probe. Each sensing element is a resistive element. The value of resistance changes when the temperature of the air flow across the element changes.

Air from the air supply distribution system makes a negative pressure inside the probe. The negative pressure pulls outside air across the sensing elements. This permits accurate temperature measurement when the airplane is on the ground or moving at low speed.

Electrical Connector

The analog connection to AIMS and the heater power connection comes through the electrical connector. The heater in the TAT probe prevents ice buildup.



34-20-00-033 Rev 3 05/06/96

ADIRS - TOTAL AIR TEMPERATURE PROBE

ADIRS - TAT PROBE FUNCTIONAL DESCRIPTION

Probe Heater

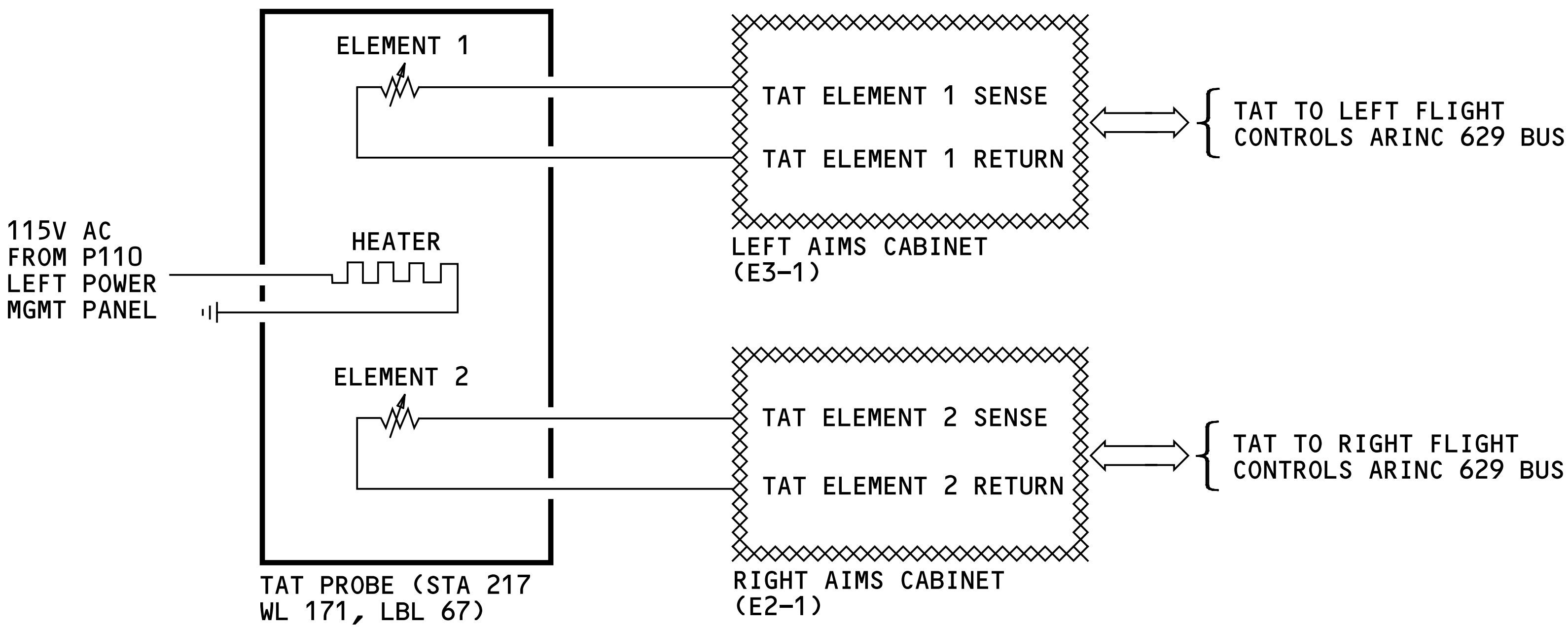
The TAT probe heater gets 115v ac from the P110 left power management panel. The TAT probe has heater power only when the airplane is in the air.

Total Air Temperature (TAT)

TAT element 1 connects to the TAT element 1 sense and return in the left AIMS cabinet. TAT element 2 connects to the TAT element 2 sense and return in the right AIMS cabinet.

The AIMS cabinets change the analog TAT probe data to ARINC 629 data. AIMS sends TAT temperature data from element 1 to the left flight controls ARINC 629 bus. AIMS sends TAT data from element 2 to the right flight controls ARINC 629 bus.

The ADIRU and SAARU receive TAT data to calculate air data.



34-20-00-034 Rev 3 11/29/95

ADIRS - TAT PROBE FUNCTIONAL DESCRIPTION

ADIRS - ANGLE OF ATTACK SENSOR

Electrical Connector

The angle of attack (AOA) sensor sends AOA data to the AIMS cabinet through the electrical connector, and receives heater power through the electrical connector.

Resolvers

There are two resolvers in each AOA sensor.

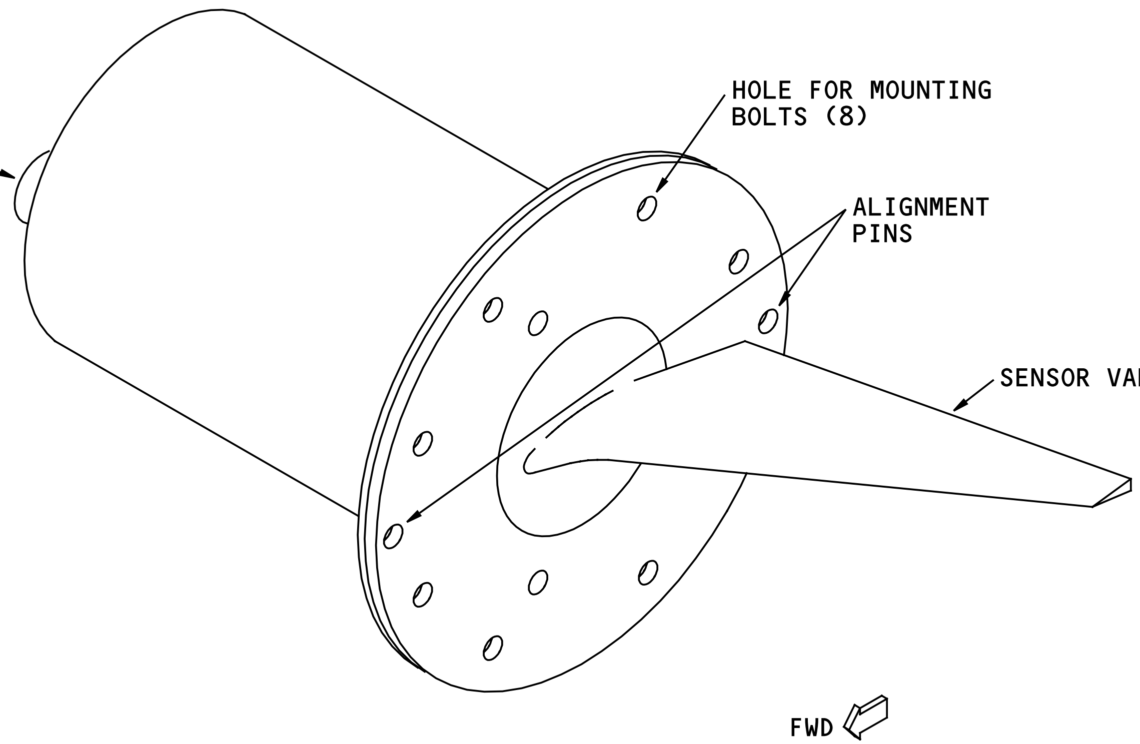
The AOA data from the two resolvers in the left AOA sensor goes to the left AIMS cabinet. The AOA data from the two resolvers in the right AOA sensor goes to the right AIMS cabinet.

Installation and Alignment Pins

You install the AOA sensor from the outside of the airplane.

Training Information Point

There are two alignment pins on the AOA sensor. Make sure the pins fit in their holes when you install the AOA sensor.



34-20-00-035 Rev 1

ADIRS - ANGLE OF ATTACK SENSOR

ADIRS - AOA SENSOR FUNCTIONAL DESCRIPTION

AOA Heaters

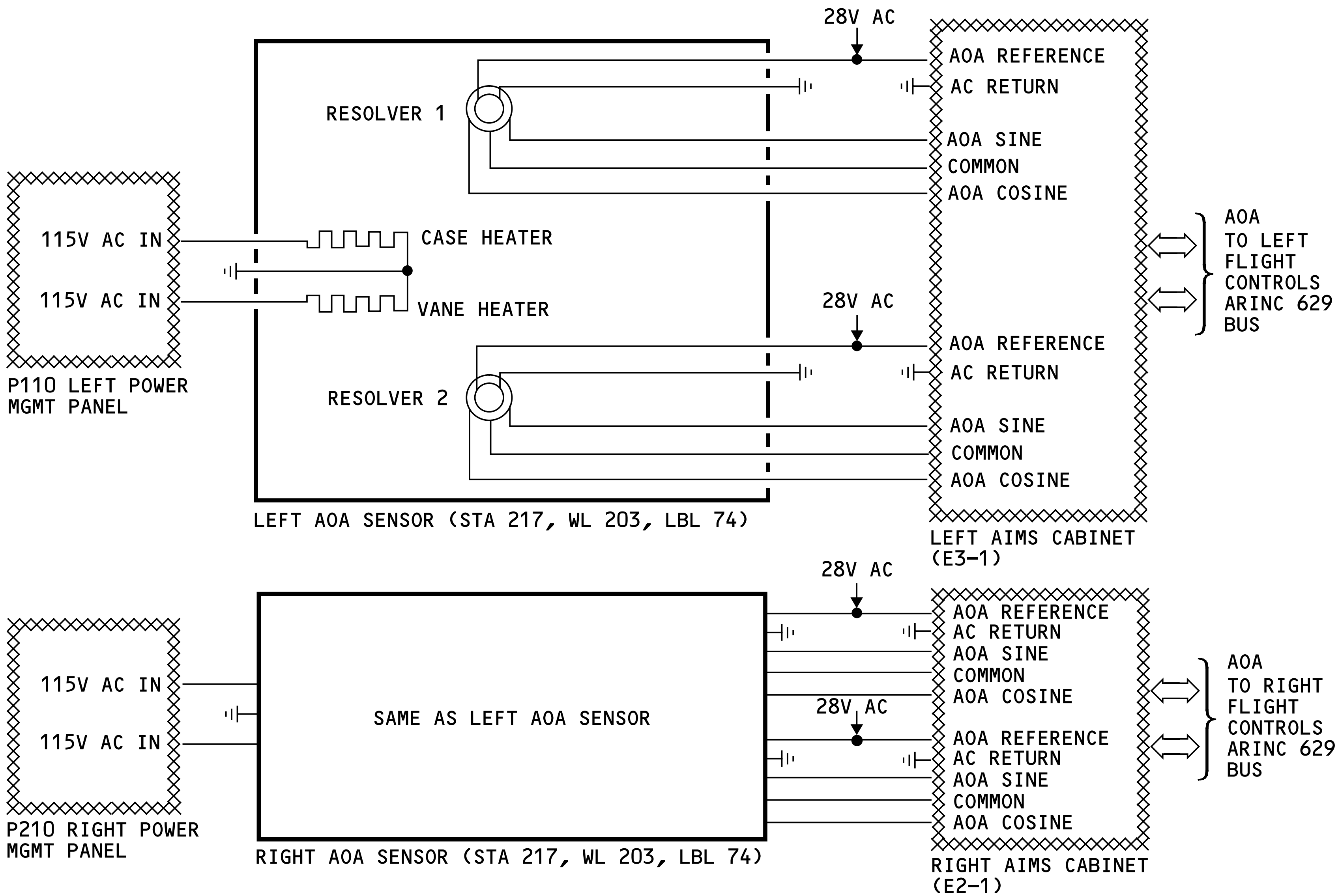
The case and the vane heaters in the angle of attack (AOA) sensors receive 115v ac from the power management panels for power.

AOA Measurement and Transmission

The resolvers in the left AOA sensor send the AOA to the left AIMS cabinet. The resolvers in the right AOA sensor send the AOA to the right AIMS cabinet.

The AIMS cabinets change the AOA sensor data to ARINC 629 format. The AOA sensor data goes to the left and right flight controls ARINC 629 buses.

The air data inertial reference unit (ADIRU) and the secondary attitude air data reference unit (SAARU) use AOA sensor data to calculate the corrected AOA.



34-20-00-036 Rev 2

ADIRS - AOA SENSOR FUNCTIONAL DESCRIPTION

ADIRS - ADM CONTROL OF AOA SENSOR HEAT

Functional Description

The angle of attack (AOA) sensor has two heaters, one for the AOA vane and one for the AOA case. Power for the heaters comes through the ground heat control relay or the air heat control relay.

The pitot air data modules (ADMs) control the relays.

There are two heat sensor relays, one for the vane heater and one for the case heater. The heat sensor relays supply a ground signal to the ADMs when the AOA heat is on.

Power goes through the ground heat control relay when both of these conditions are true:

- The airplane is on the ground
- Left or right engine is running.

Power goes through the air heat control relay when either of these conditions are true:

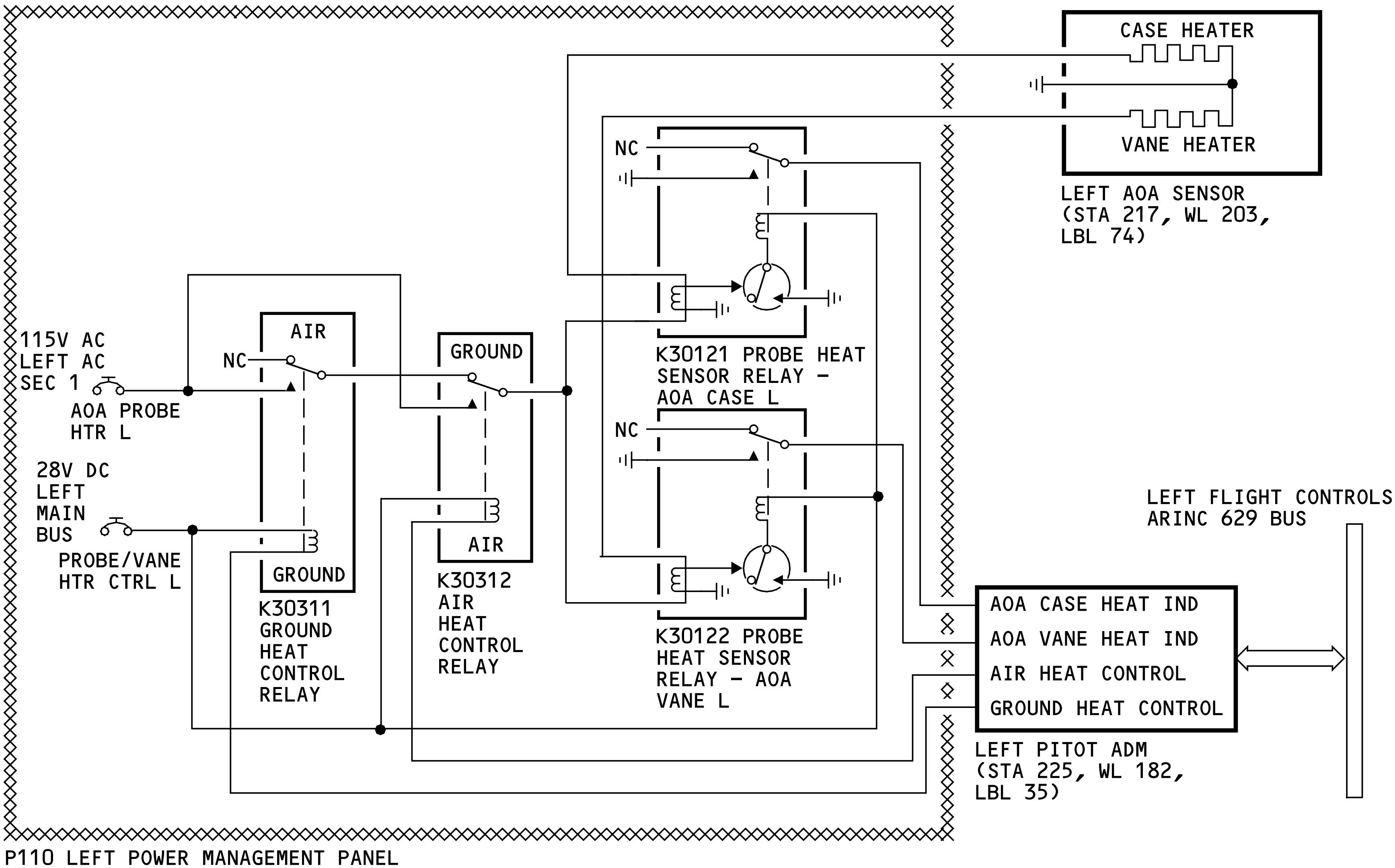
- The airplane is in the air
- CAS is more than 50 kts.

The primary flight computers (PFCs) are the source of air/ground, engine running, and CAS inputs. If the PFCs are not valid, the inputs come from the autopilot flight director computers (AFDCs).

Training Information Point

The air AOA heat and ground AOA heat is 115v ac.

See the ice and rain protection chapter for information on how to do a test of the AOA sensor heat operation (AMM PART I 30).



NOTE: RIGHT AOA SENSOR HEAT IS SIMILAR

ADIRS - ADM CONTROL OF AOA SENSOR HEAT

ADIRS - AIR DATA/ATTITUDE SOURCE SWITCH

General

The captain and first officer air data/attitude switches on the instrument source select panels control the source of air data and attitude data that shows for the onside PFD and ND.

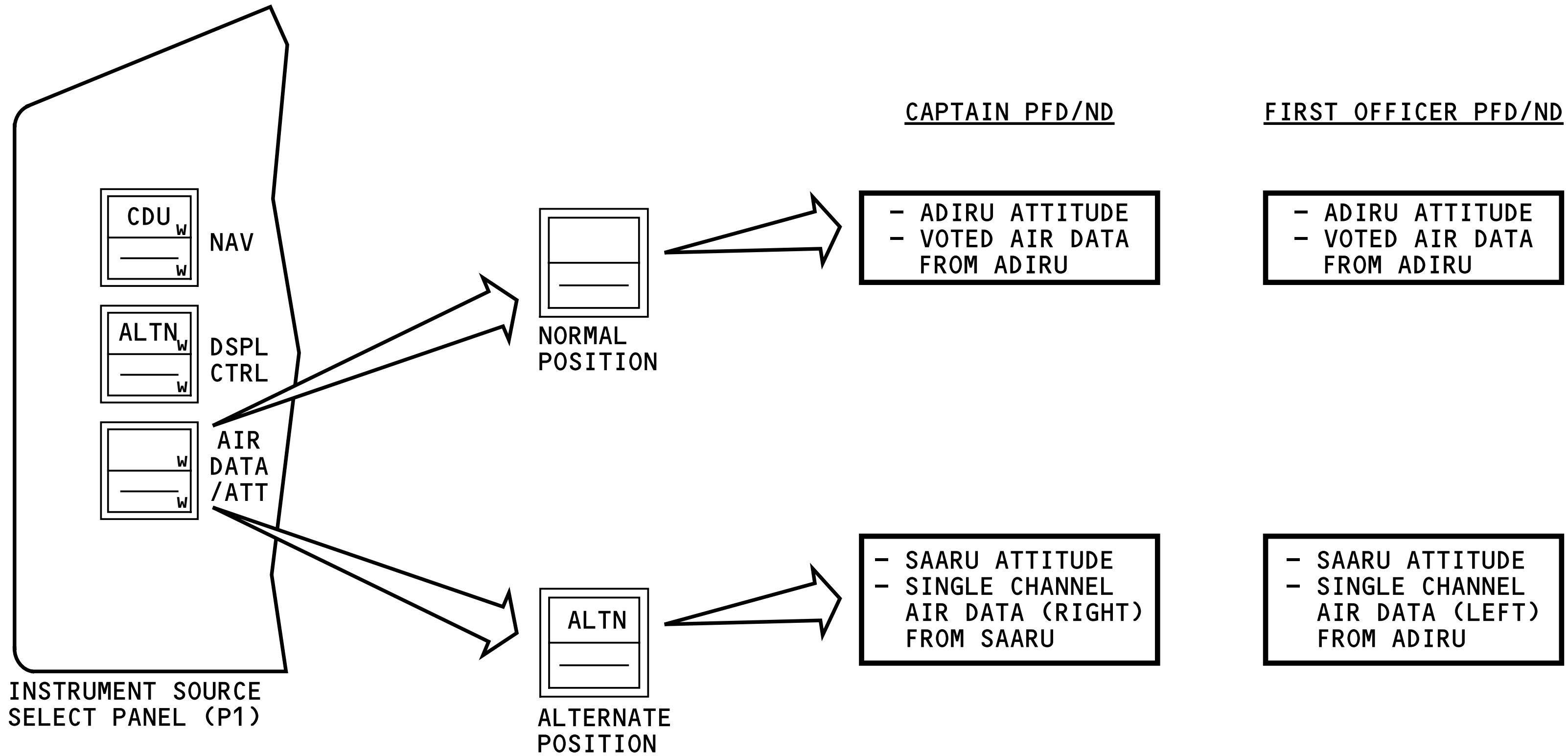
Air Data/Attitude Switch in the Normal Position

When the air data/attitude switches are in the normal position, the ADIRU left bus input to AIMS is the source of display data for the captain PFD and ND. The ADIRU right bus input to AIMS is the source of display data for the first officer PFD and ND. The ADIRU left bus and ADIRU right bus transmit the same data.

Air Data/Attitude Switch in the Alternate (ALTN) Position

When the captain air data/attitude switch is in the ALTN position, the sources for the captain displays are the SAARU for single channel air data and the SAARU for attitude. The ADIRU left bus input to AIMS remains the source for heading and track.

When the first officer air data/attitude switch is in the ALTN position, the sources for the first officer displays are the ADIRU right bus single channel for air data and the SAARU for attitude. The ADIRU right bus input to AIMS remains the source for heading and track.



34-20-00-037 Rev 5 11/06/1997

ADIRS - AIR DATA/ATTITUDE SOURCE SWITCH

ADIRS - AIR DATA/ATTITUDE SOURCE SWITCHING-NON NORMAL

General

The table shows the normal and alternate positions for the captain and first officer air data/attitude switch during normal and non-normal conditions.

The fail condition means that all output data to the buses are invalid.

Display Switching Priorities

These are the priorities for the source of the captain attitude and air data displays:

- ADIRU left flight controls ARINC 629 bus (air data and attitude)
- ADIRU right flight controls ARINC 629 bus (air data and attitude)
- SAARU center flight controls ARINC 629 bus (air data and attitude)
- ADIRU left flight controls ARINC 629 bus (single channel air data)
- ADIRU right flight controls ARINC 629 bus (single channel air data).

These are the priorities for the source of the first officer attitude and air data displays:

- ADIRU right flight controls ARINC 629 bus (air data and attitude)
- ADIRU left flight controls ARINC 629 bus (air data and attitude)
- SAARU center flight controls ARINC 629 bus (air data and attitude)
- ADIRU right flight controls ARINC 629 bus (single channel air data)
- ADIRU left flight controls ARINC 629 bus (single channel air data).

CONDITION / AIR DATA/ATT SWITCH POSITION	ADIRU NORMAL SAARU NORMAL	ADIRU FAIL SAARU NORMAL	ADIRU NORMAL SAARU FAIL	ADIRU FAIL SAARU FAIL
CAPT - NORMAL	ADIRU L BUS ATTITUDE AND VOTED AIR DATA	SAARU C BUS ATTITUDE AND VOTED AIR DATA	SAME AS ADIRU NORMAL SAARU NORMAL	NO DISPLAY DATA AVAIL
CAPT - ALTERNATE	SAARU C BUS SINGLE CHANNEL AIR DATA AND SAARU ATT	SAARU C BUS SINGLE CHANNEL AIR DATA AND SAARU ATT	ADIRU L BUS HEADING AND TRACK DATA ONLY	NO DISPLAY DATA AVAIL
F/O - NORMAL	ADIRU R BUS ATTITUDE AND VOTED AIR DATA	SAARU C BUS VOTED AIR DATA AND SAARU ATT	SAME AS ADIRU NORMAL SAARU NORMAL	NO DISPLAY DATA AVAIL
F/O - ALTERNATE	ADIRU R BUS SINGLE CHANNEL AIR DATA AND SAARU C BUS ATT	SAARU C BUS ATT AND LOSS OF AIR DATA	ADIRU R BUS SINGLE CHANNEL AIR DATA AND LOSS OF ATTITUDE	NO DISPLAY DATA AVAIL

NOTE: VOTED DATA MEANS DATA SELECTED THROUGH THE INPUT DATA REDUNDANCY MANAGEMENT LOGIC.

34-20-00-046 Rev 1 11/06/1997

ADIRS - AIR DATA/ATTITUDE SOURCE SWITCHING-NON NORMAL

ADIRS - ADIRU SWITCH, ADIRU ON BATTERY LIGHT

General

The primary flight computers/ADIRU panel has the ADIRU switch and the ADIRU on battery light.

ADIRU On Battery Light

The ADIRU on battery light comes on when the airplane is on the ground and the only source of power for the ADIRU is the hot battery bus.

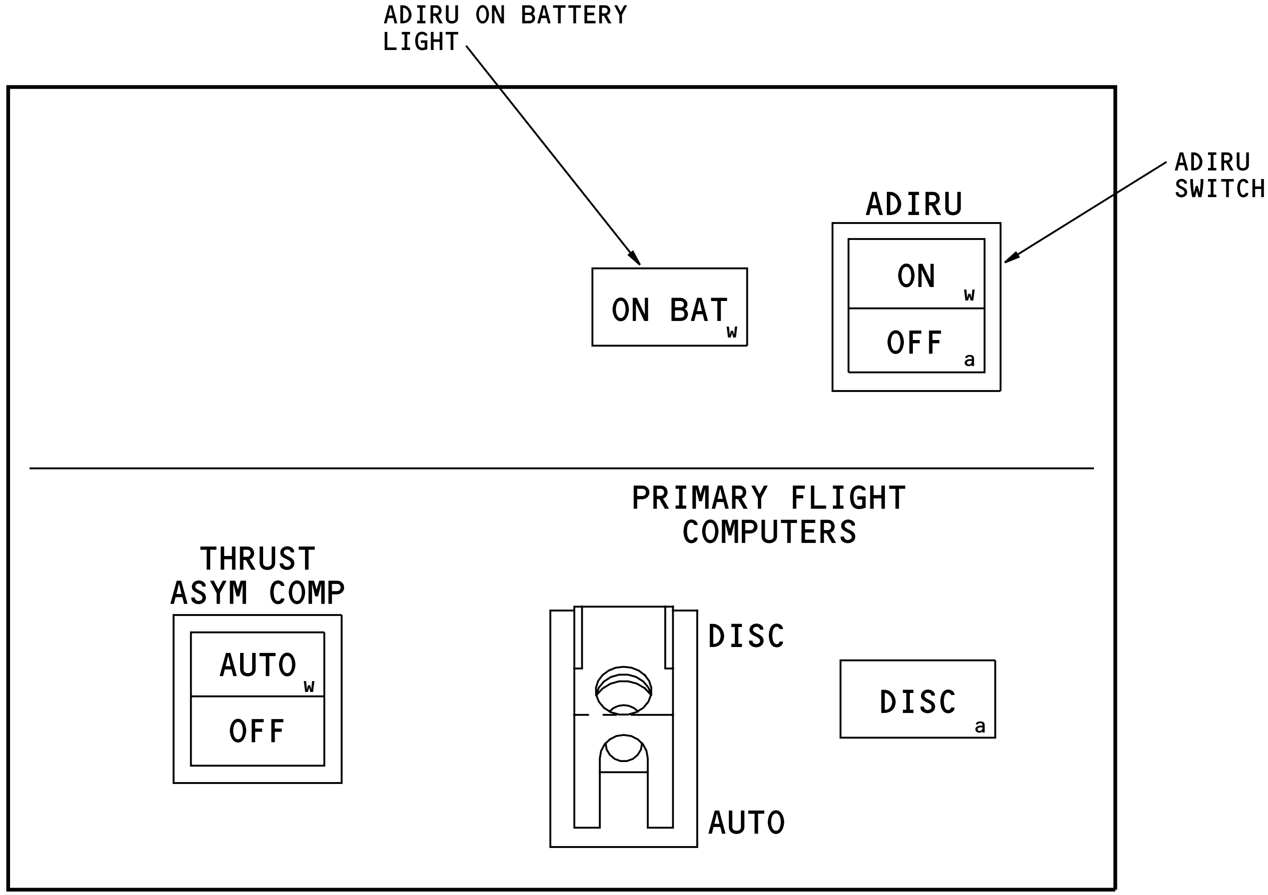
ADIRU Switch

Push the ADIRU switch to make the ADIRU go on. About thirty seconds after you push the ADIRU switch to the ON position, the ADIRU begins alignment. During the initial alignment, the attitude indications on the PFDs show as no computed data (NCD).

Push the ADIRU switch again to make the ADIRU go off.

The ADIRU goes off only when:

- Ground speed (GS) < 20 kts
- Computed airspeed (CAS) < 30 kts.



PRIMARY FLIGHT COMPUTERS/ADIRU PANEL (P5)

34-20-00-038 Rev 2 06/14/96

ADIRS - ADIRU SWITCH, ADIRU ON BATTERY LIGHT

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ADIRS - ALIGNMENT

General

Thirty seconds after you push the ADIRU switch, the ADIRU begins alignment and the position initialization process. Box prompts and a message show on the CDU to show that the ADIRU is ready to accept an inertial position.

Align Mode

For a new alignment, an inertial position compare test does a check of the entered inertial position with the GPS position or last stored position if GPS data is not available. The last stored position comes from the nonvolatile memory of the ADIRU. During a realignment, the test compares the current position calculated by the ADIRU.

The alignment takes between 7.5 minutes and 15 minutes to complete. The time depends on the latitude of the airplane position.

Align Reset Mode

If the airplane moves during the alignment, the align reset mode occurs until there is no movement. The align reset mode detects body rates and accelerations. When the movement stops, the ADIRU returns to the align mode.

GPS Valid Data

When the GPS signal is valid and you enter an inertial position into the CDU, the ADIRU compares the current GPS position to the entered inertial position. If the positions are different by more than 3.5 NM, the position is not accepted and the CDU shows the message ENTER INERTIAL POSITION. When you enter the same inertial position again, the ADIRU accepts the inertial position for alignment.

GPS Data Invalid

If GPS data is not available, the ADIRU uses its last stored position or last calculated position and compares it to the entered inertial position. The entered inertial position must be within the limits defined by the ADIRU. The limits the ADIRU defines depends on the length of the previous flight.

NAV Mode

After alignment, the ADIRU does a latitude compare test. If the ADIRU calculated latitude is the same as the entered inertial position latitude, the ADIRU goes into the NAV mode. If the latitudes are not the same, a latitude miscompare occurs and the CDU shows the ENTER INERTIAL POSITION message.

If you enter a new inertial position that has the same latitude as the ADIRU latitude, the NAV mode starts.

ADIRS - ALIGNMENT

If you enter a new inertial position that is the same as the first inertial position, a full alignment starts and the CDU shows ALIGNMENT REINITIATED.

Auto NAV Realign Mode

The auto nav realign (ANR) mode starts 30 seconds after the airplane stops. The ANR takes 7.5 to 15 minutes to complete.

When the ANR mode starts, dash prompts show on the CDU. The dash prompts show that you may enter a new inertial position. It is not required to enter a new inertial position.

If you do not enter a new position, the ADIRU sets the velocity errors to zero and corrects this data:

- Pitch attitude
- Roll attitude
- Heading.

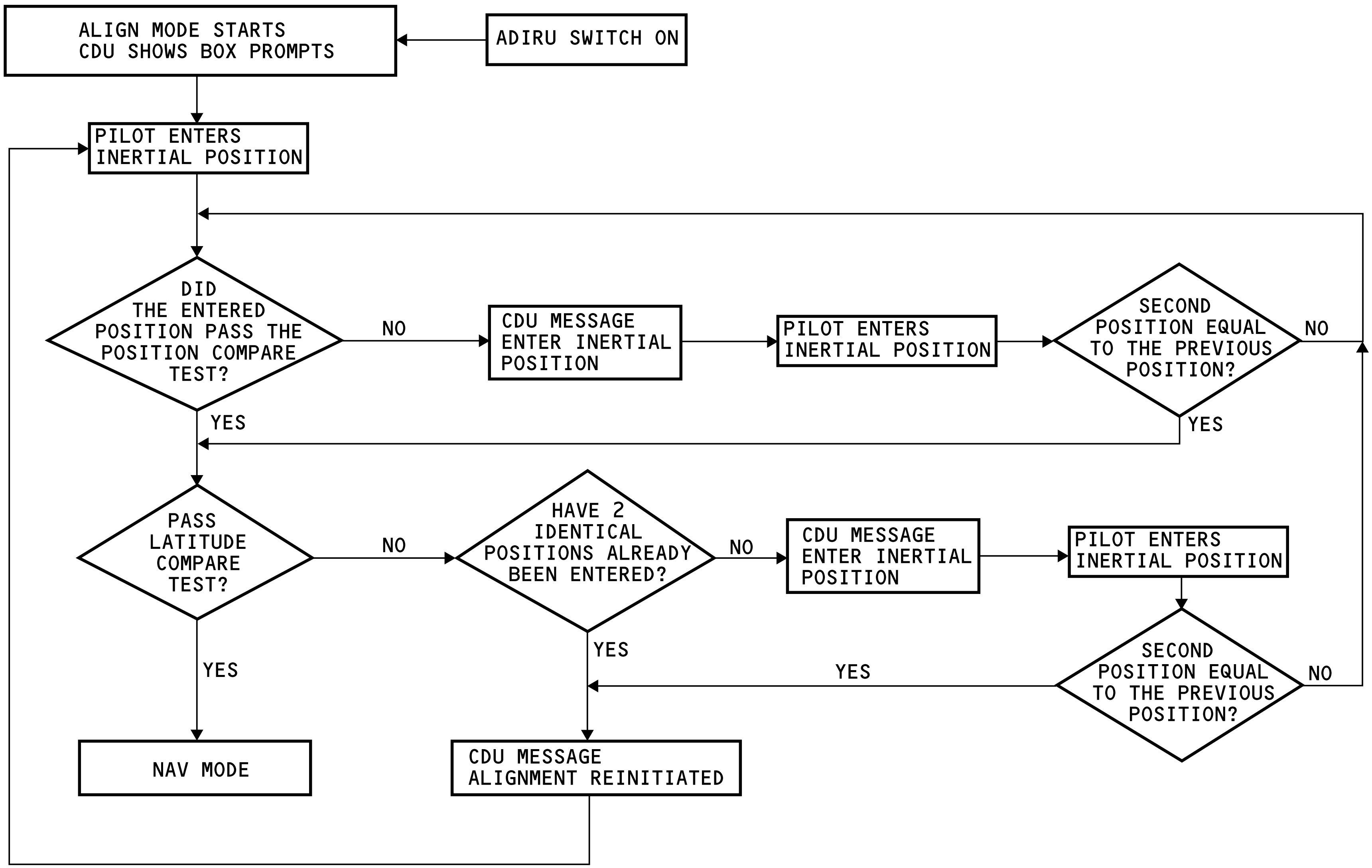
When you enter a new inertial position, the ADIRU does the latitude comparison test with the entered inertial position and the last calculated position.

If the entered position does not pass the latitude test, the CDU shows the ENTER INERTIAL POSITION message. The CDU shows the ALIGNMENT REINITIATED message if the next entered position is the same as the first entered position.

If the test passes, the ADIRU uses the entered position as the start point for the next flight.

If the airplane remains without motion, the ADIRU continues to zero any errors that occur. Also, the dash prompts return on the CDU.

If the ADIRU detects motion during the ANR mode, the ADIRU returns to the NAV mode and uses the last calculated inertial position.



34-20-00-039 Rev 4

ADIRS - ALIGNMENT

ADIRS - ALIGNMENT - POS INIT CDU PAGE

General

To begin alignment, access the POS INIT page on the CDU. Thirty seconds after the ADIRU powers up, the POS INIT page shows box prompts under the SET INERTIAL POS. At this time you can line select an inertial position into the SET INERTIAL POS line. You can use one of these positions:

- The inertial position you entered into the scratchpad
- GPS position
- Last position
- Reference airport
- Gate position.

To get the airport and gate position, line select the airport identifier and gate identifier into the appropriate line and the position shows on that line.

Enter Inertial Position

During alignment, the box prompts show until you enter an inertial position. If there is no entered inertial position when the ADIRU is ready to go into the NAV mode, the CDU shows the ENTER INERTIAL POS message.

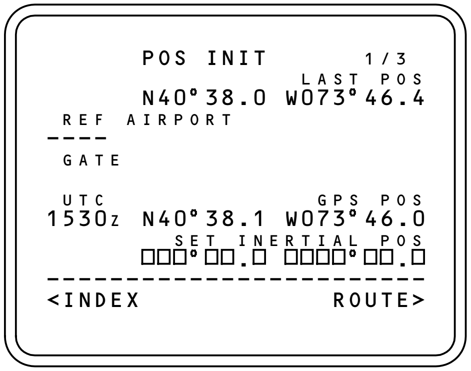
As part of the alignment and when there is an entered inertial position, the ADIRU goes through an inertial position comparison test and the latitude comparison test. If both of the tests pass, the ADIRU can complete the alignment and go into the NAV mode. If either of the tests fail, the CDU shows box prompts and the ENTER INERTIAL POS message. Enter the same inertial position again and the ADIRU uses that position to complete alignment and goes into the NAV mode.

Alignment Reinitiated

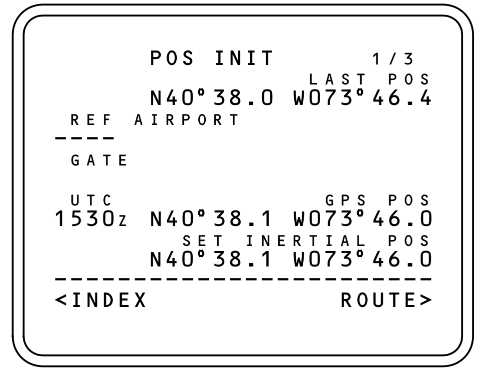
If the alignment cannot finish due to airplane movement or an invalid inertial position entered twice, the CDU shows dashes and the ALIGNMENT REINITIATED message.

Auto Nav Realign Mode

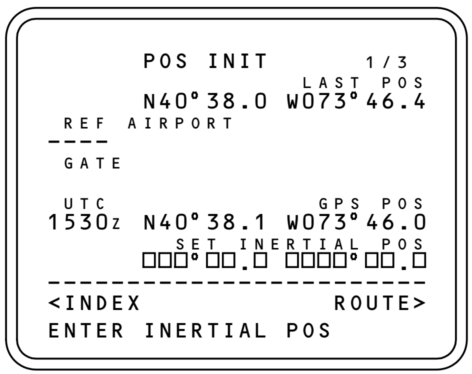
Dash promts show during the auto nav realign (ANR) mode. The dashes tell that the ADIRU is ready to accept an inertial position. Also, the dashes tell that inertial input is optional.



BOX PROMPTS SHOW 30 SECONDS AFTER POWER UP. ENTER THE INERTIAL POSITION ANY TIME.

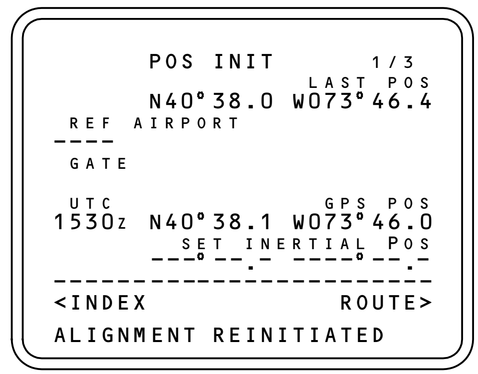


THE INERTIAL POSITION REPLACES THE BOX PROMPTS WHEN YOU LINE SELECT A VALUE INTO THE SET INERTIAL POS LINE.



BOX PROMPTS SHOW AND THE ENTER INERTIAL POS MESSAGE SHOWS WHEN:

- ENTERED POSITION DID NOT PASS THE ENTERED INERTIAL POSITION TEST OR THE LATITUDE COMPARISON TEST
- OR THE ADIRU IS READY TO GO INTO THE NAV MODE BUT AN INERTIAL POSITION IS NOT ENTERED



DASHES REPLACE THE BOX PROMPTS AND ALIGNMENT REINITIATED SHOWS WHEN ALIGNMENT FAILS.

DASHES ALSO SHOW WHEN THE ADIRU IS READY TO ACCEPT A NEW POSITION DURING AUTO NAV REALIGN.

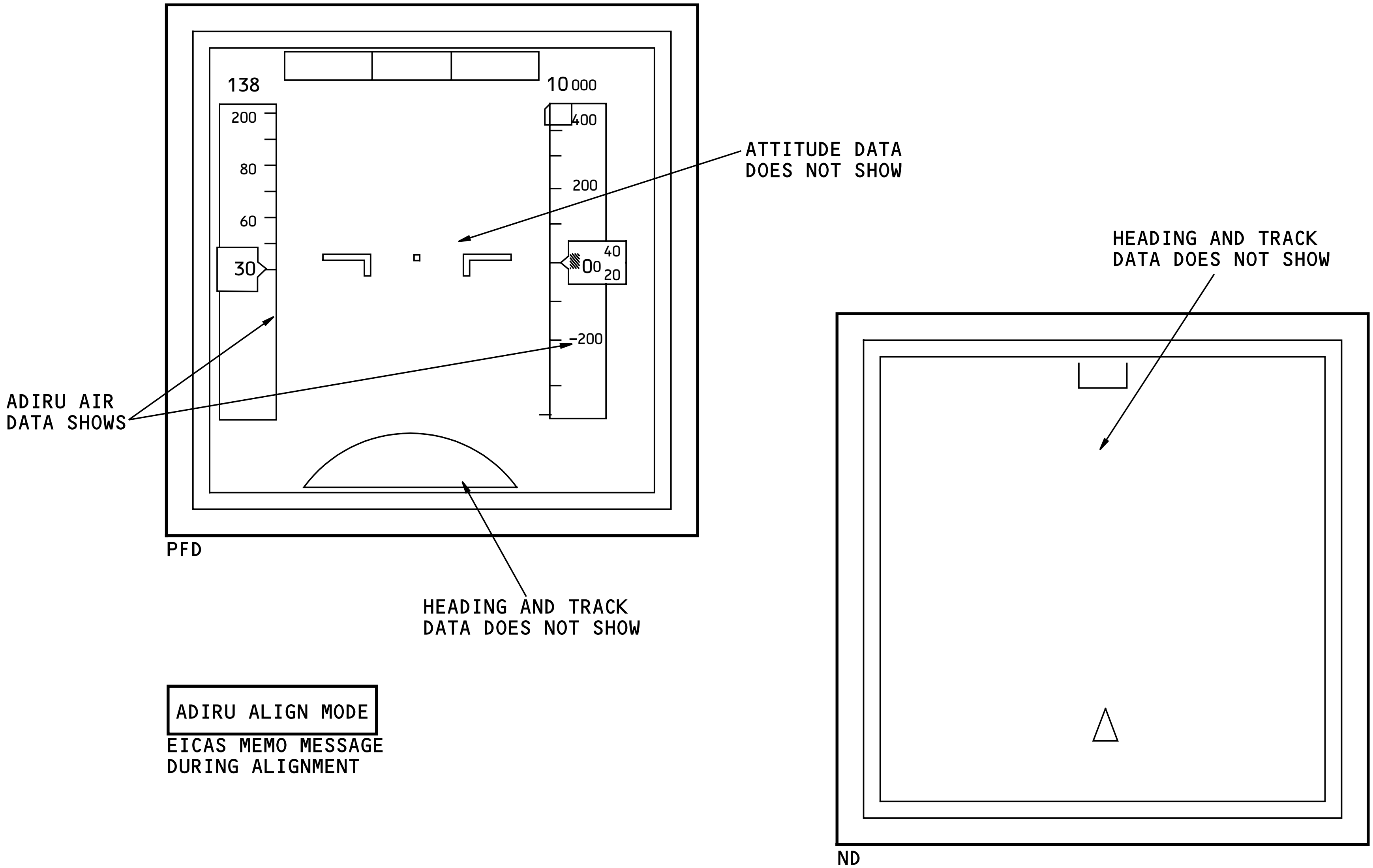
ADIRS - ALIGNMENT - POS INIT CDU PAGE

ADIRS - ND AND PFD INDICATIONS DURING ALIGNMENT

General

These are the indications when the ADIRU is in the align mode:

- The PFDs show no computed data (NCD) attitude, track and heading data
- The PFDs show ADIRU air data
- The NDs show NCD track and heading data
- ADIRU ALIGN MODE memo message shows on the EICAS display.



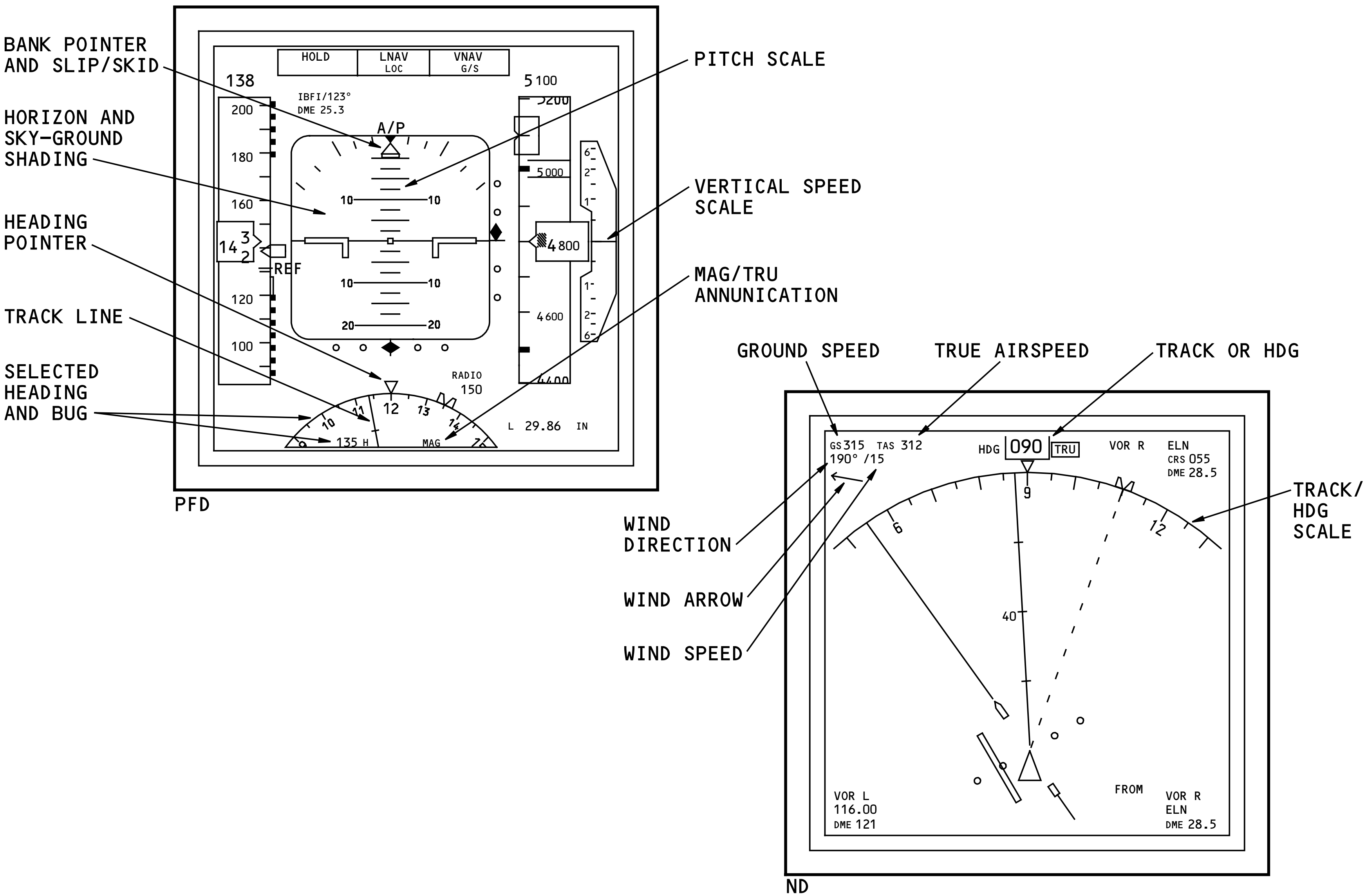
34-20-00-041 Rev 5 04/26/96

ADIRS - ND AND PFD INDICATIONS DURING ALIGNMENT

ADIRS - PFD AND ND INDICATIONS AFTER ALIGNMENT

General

When the ADIRU alignment completes and the ADIRU is in the NAV mode, the PFD AND ND show attitude and air data from the ADIRU.



ADIRS - PFD AND ND INDICATIONS AFTER ALIGNMENT

34-20-00-042 Rev 4 04/26/96

ADIRS - PFD AND ND INVALID IRS DATA

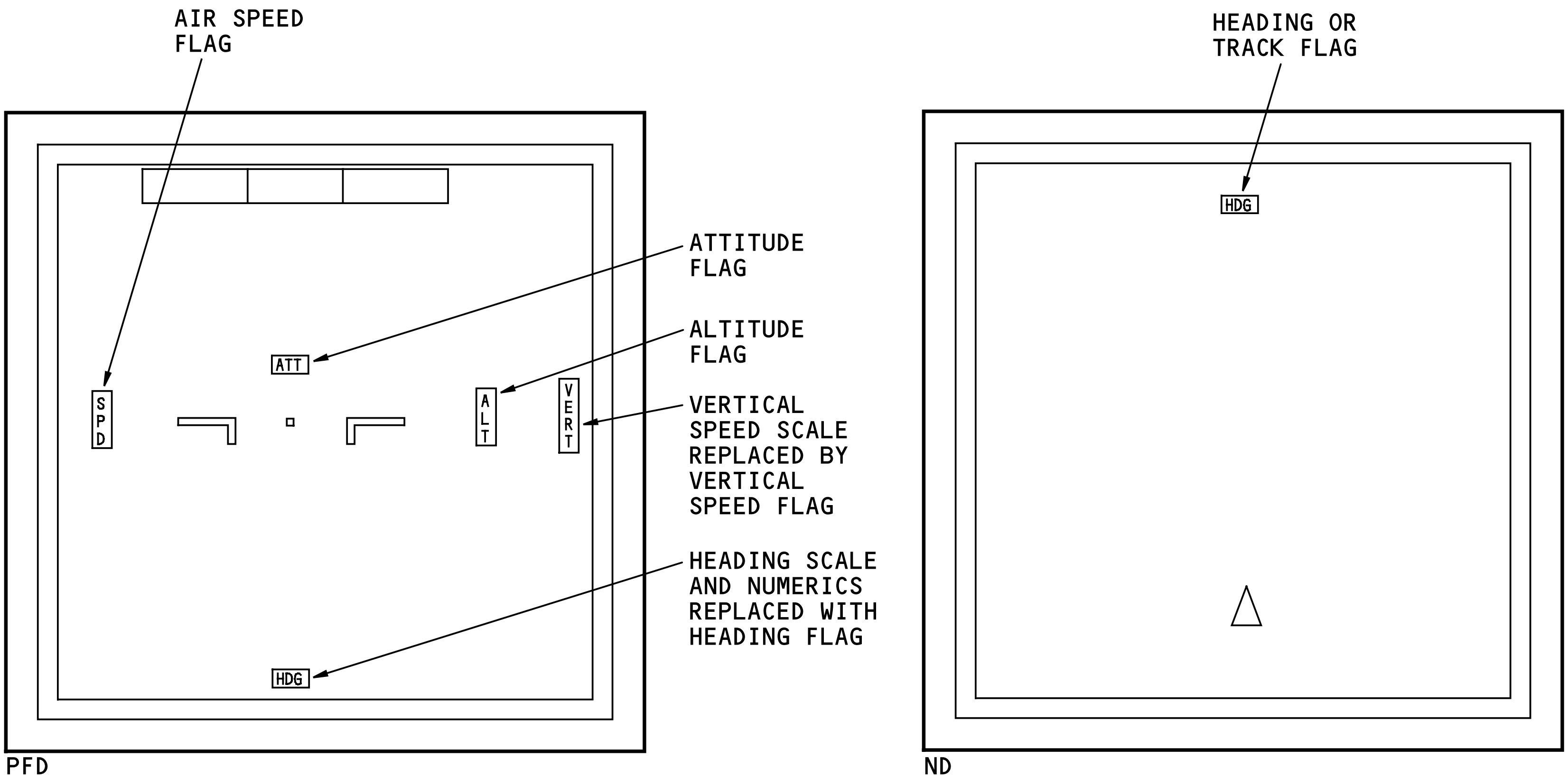
General

The PFD and ND show the invalid attitude and invalid air data indications.

The PFD shows flags for:

- Airspeed
- Attitude
- Altitude
- Vertical speed
- Heading.

The ND shows a heading or track flag.



34-20-00-043 Rev 4 04/26/96

ADIRS - PFD AND ND INVALID IRS DATA

ADIRS - INERTIAL MONITOR PAGE

Purpose

The inertial monitor page shows the position error rate for the ADIRU.

Page Access

To get access to the INERTIAL MONITOR page, select <INERTIAL MONITOR from the MAINTENANCE INDEX page.

Color

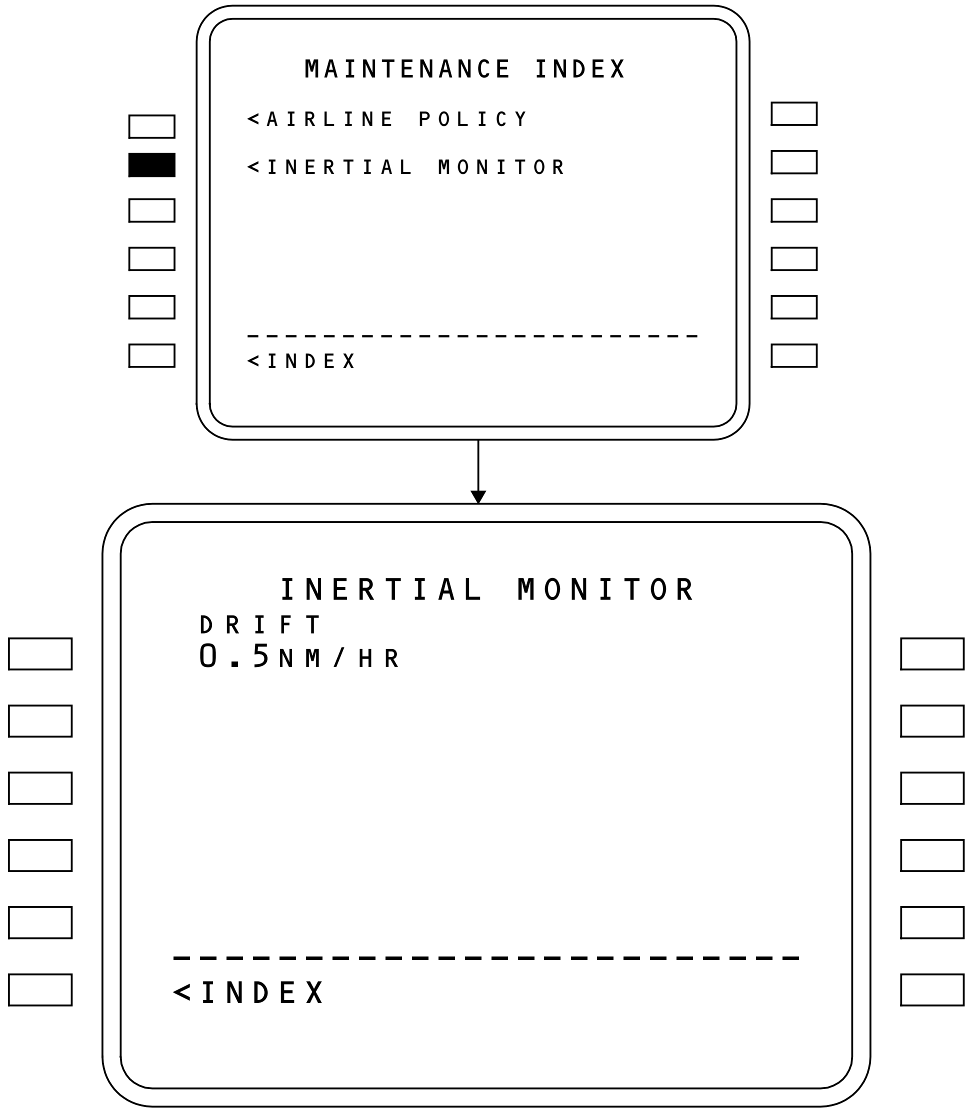
All text on this page is white.

Information

Line 1L is the inertial monitor drift. The drift rate shows for the last completed flight. It clears at the ground-to-air transition.

Page Selections

Select 6L, <INDEX to show the MAINTENANCE INDEX.



34-20-00-048 Rev 1 10/23/95

ADIRS - INERTIAL MONITOR PAGE

ADIRS - FAULT REPORT AND SOFTWARE DATA LOAD

General

These components in the ADIRS report faults and system status to the central maintenance computing function (CMCF) of the AIMS:

- ADIRU
- SAARU
- ADMs.

You can not start any tests for the ADIRU or the SAARU. These components have built-in test equipment (BITE). The BITE automatically detects faults in these ADIRS components. You start a test of the ADM heat control circuit from the ground test menu on the MAT, chapter 30, ice and rain protection.

ADIRU Power-Up Test and Status

The ADIRU does a 30 second test after you put the ADIRU on/off switch in the on position. The results of the test go to the CMCF of the AIMS. The test is automatic and there are no indications for the test.

The ADIRU starts normal operation after the test ends. The air data is valid after the test. The inertial data is invalid until alignment is complete. The ADIRU continuously supplies BITE status data to the CMCF of the AIMS.

SAARU and ADM Status

The SAARU and the ADMs continuously supply BITE status data to the CMCF of the AIMS.

ADIRS Status Monitoring

If there are faults with the ADIRU, SAARU, ADMs and standby attitude display, use the maintenance access terminal (MAT) to monitor the status.

Software Data Load

Use the MAT to load software data into the ADIRU, SAARU, and the ADMs.

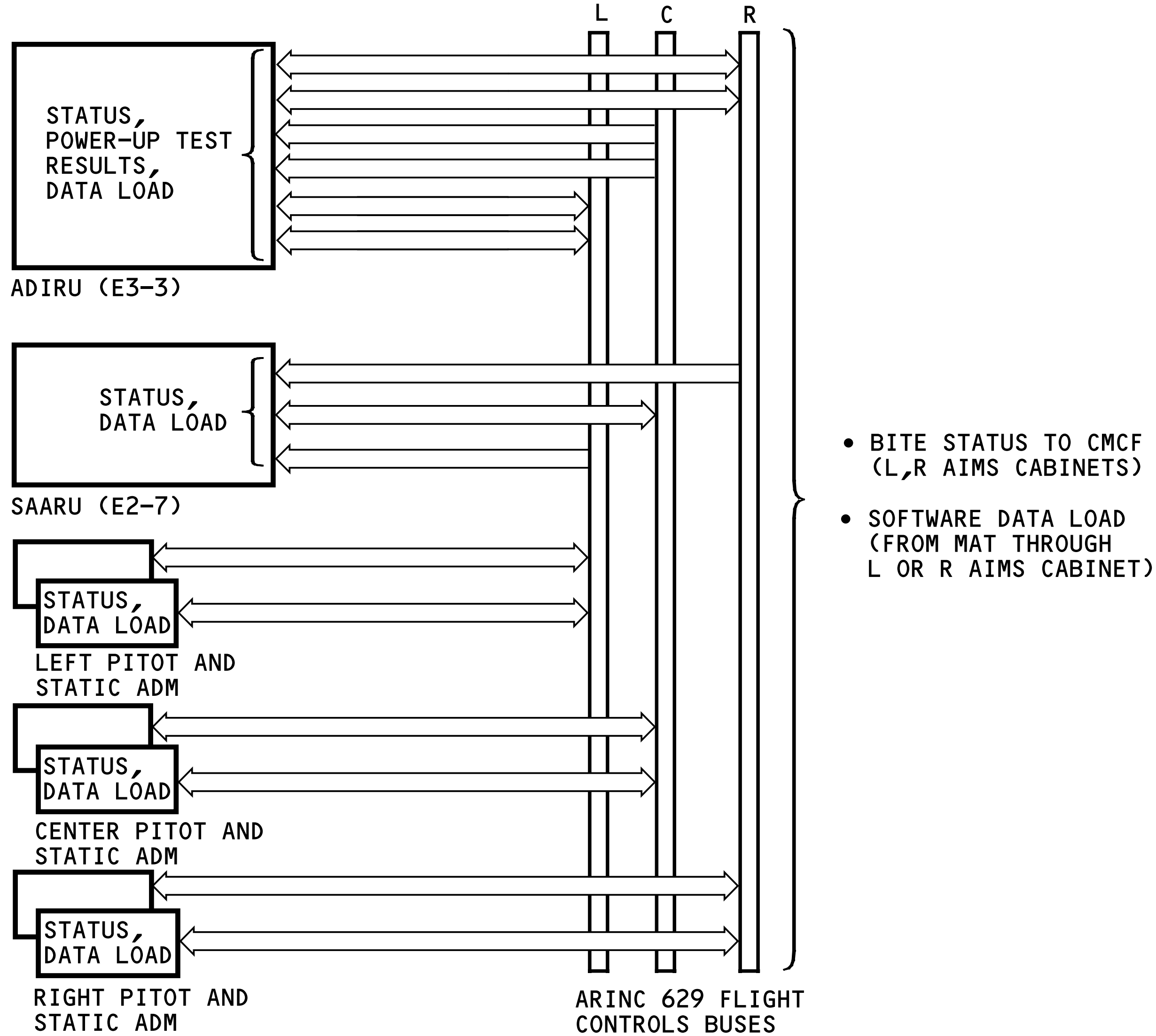
Training Information Point

The ADIRU accepts data load software from the left CMCF only.

The SAARU accepts data load software from the left or right CMCF.

The left ADMs accept data load software from the left CMCF only. The center ADMs accept data load software from the left or right CMCF. The right ADMs accept data load software from the right CMCF only.

Use the central maintenance computer switch control selection on the other functions menu from the MAT main menu to select the left or the right CMCF.



34-20-00-045 Rev 4 08/31/1995

ADIRS - FAULT REPORT AND SOFTWARE DATA LOAD

Continental Airlines, Inc

Standby Magnetic Compass

WB371

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STANDBY MAGNETIC COMPASS

Purpose

The standby magnetic compass is a backup magnetic heading reference.

Location

The standby magnetic compass is below the overhead panel (P5).

Power

The standby magnetic compass has a 5v ac light bulb. A lamp access cover permits replacement of the bulb.

Characteristics

The standby magnetic compass has a circular heading indicator card. The card floats in a case filled with liquid. The liquid does not permit the card to move quickly.

There are two magnets in the standby magnetic compass. The magnets are parallel to each other, and they are in the horizontal plane. The magnets align the compass with the magnetic flux lines of the earth.

Adjustment

The standby magnetic compass has N-S (north-south) and E-W (east-west) compensation screws. These screws change the position of the magnets.

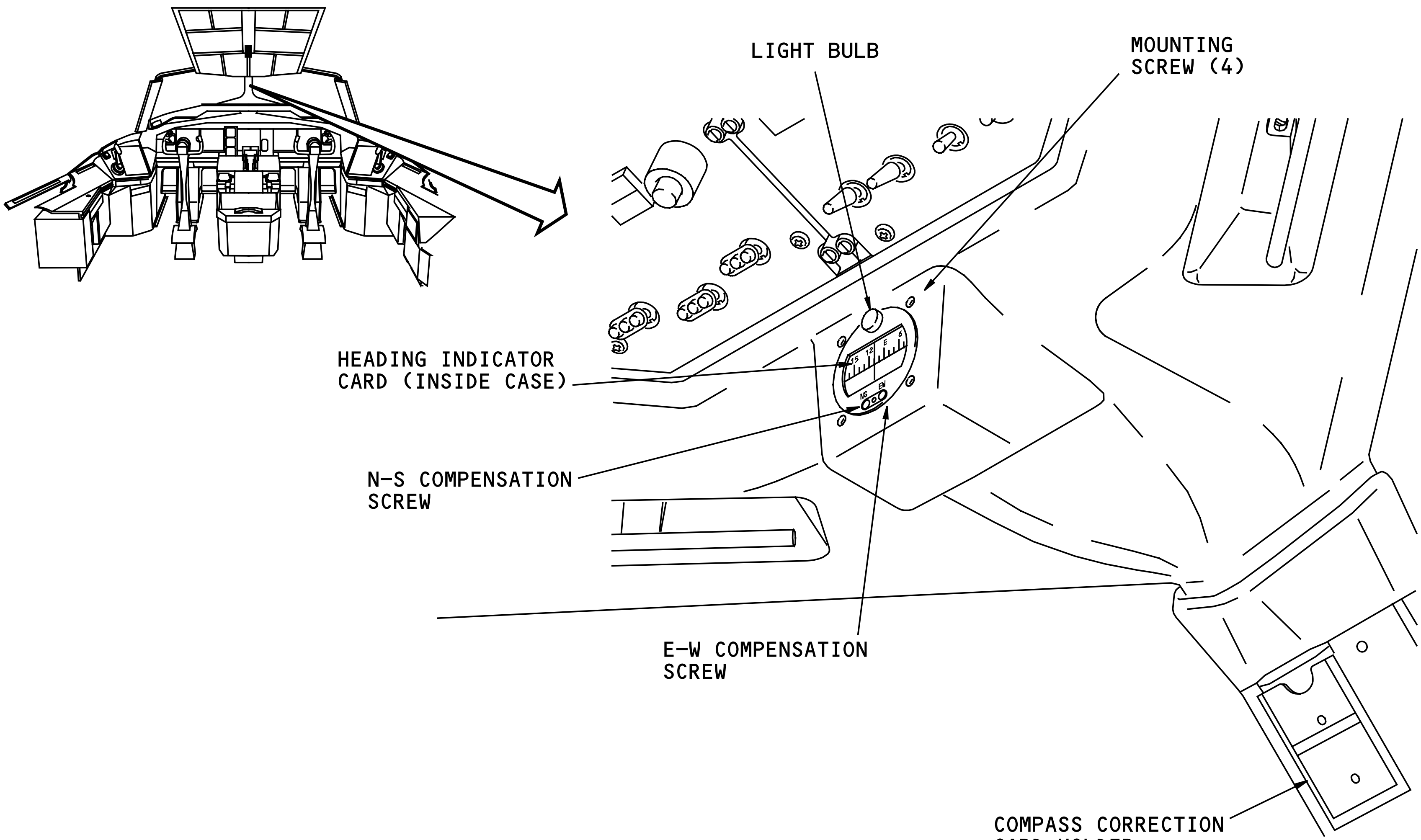
Use the compensation screws to correct for magnetic deviations generated by electrical currents in the flight deck. Use only non-magnetic tools to turn the compensation screws.

There is a compass correction card below the compass. Use this card to write small errors that the compensation screws cannot remove.

Removal/Installation

Four screws hold the standby magnetic compass in place. Use only non-magnetic tools and screws to remove and install the standby magnetic compass.

You must do a compass swing after you replace the standby magnetic compass.



34-23-00-001 Rev 1

STANDBY MAGNETIC COMPASS

Continental Airlines, Inc

Radio Altimeter System

WB371

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RADIO ALTIMETER SYSTEM - INTRODUCTION

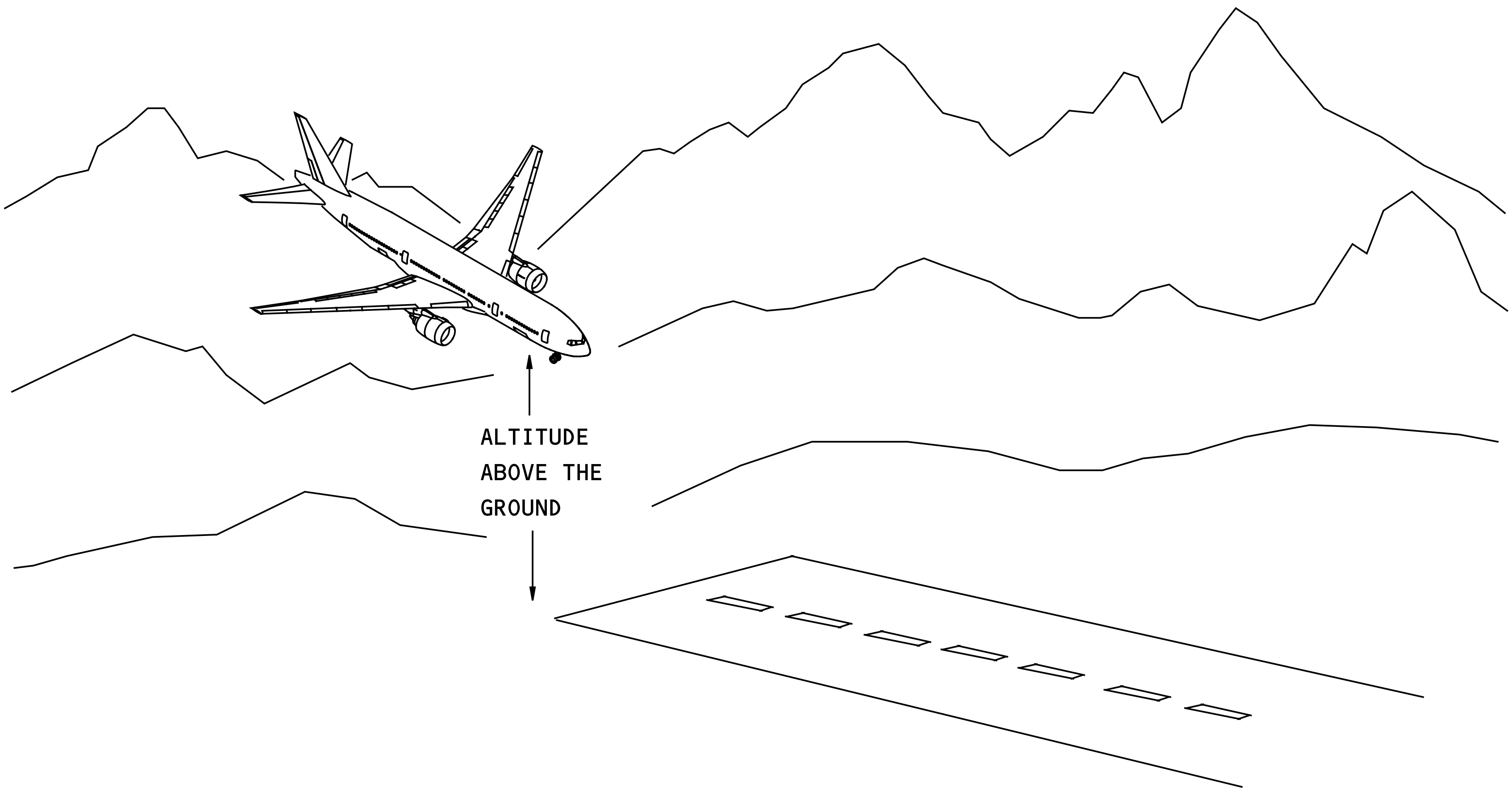
General

The radio altimeter (RA) system measures the distance from the airplane to the ground. The radio altitude shows in the flight deck.

The system has a range of -20 to 2500 feet. The flight crew and other airplane systems use radio altitude during approach and landing.

Abbreviations and Acronyms

AFDC	- autopilot flight director computer
AIMS	- airplane information management system
CMCF	- central maintenance computing function
GPWC	- ground proximity warning computer
PFC	- primary flight computer
PWS	- predictive windshear
RA	- radio altitude
TCAS	- traffic alert and collision avoidance system
WXR	- weather radar
xcvr	- transceiver



34-33-00-001 Rev 2

RADIO ALTIMETER SYSTEM - INTRODUCTION

RA SYSTEM - GENERAL DESCRIPTION

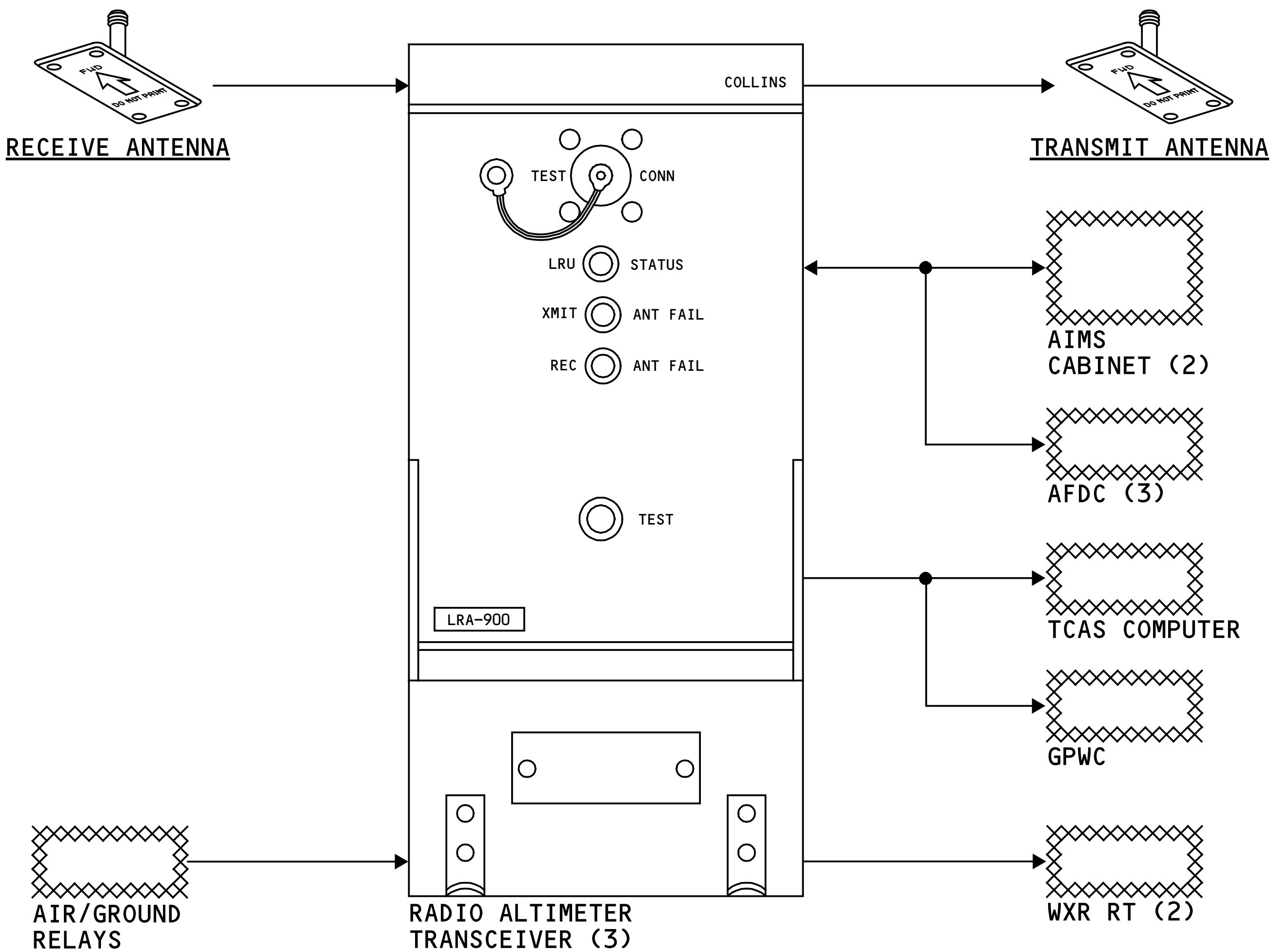
General

The system has three transceivers (xcvr). Each xcvr has a transmit and a receive antenna.

The transceivers get discrete inputs from the air ground relays and from the AIMS cabinets.

Radio altitude data goes on ARINC 429 data buses to the these components:

- Airplane information management system (AIMS) cabinets
- Autopilot flight director computers (AFDCs)
- Traffic alert and collision avoidance system (TCAS) computer
- Ground proximity warning computer (GPWC).
- Weather radar receiver-transmitters.



RA SYSTEM - GENERAL DESCRIPTION

RA SYSTEM - COMPONENT LOCATION - 1

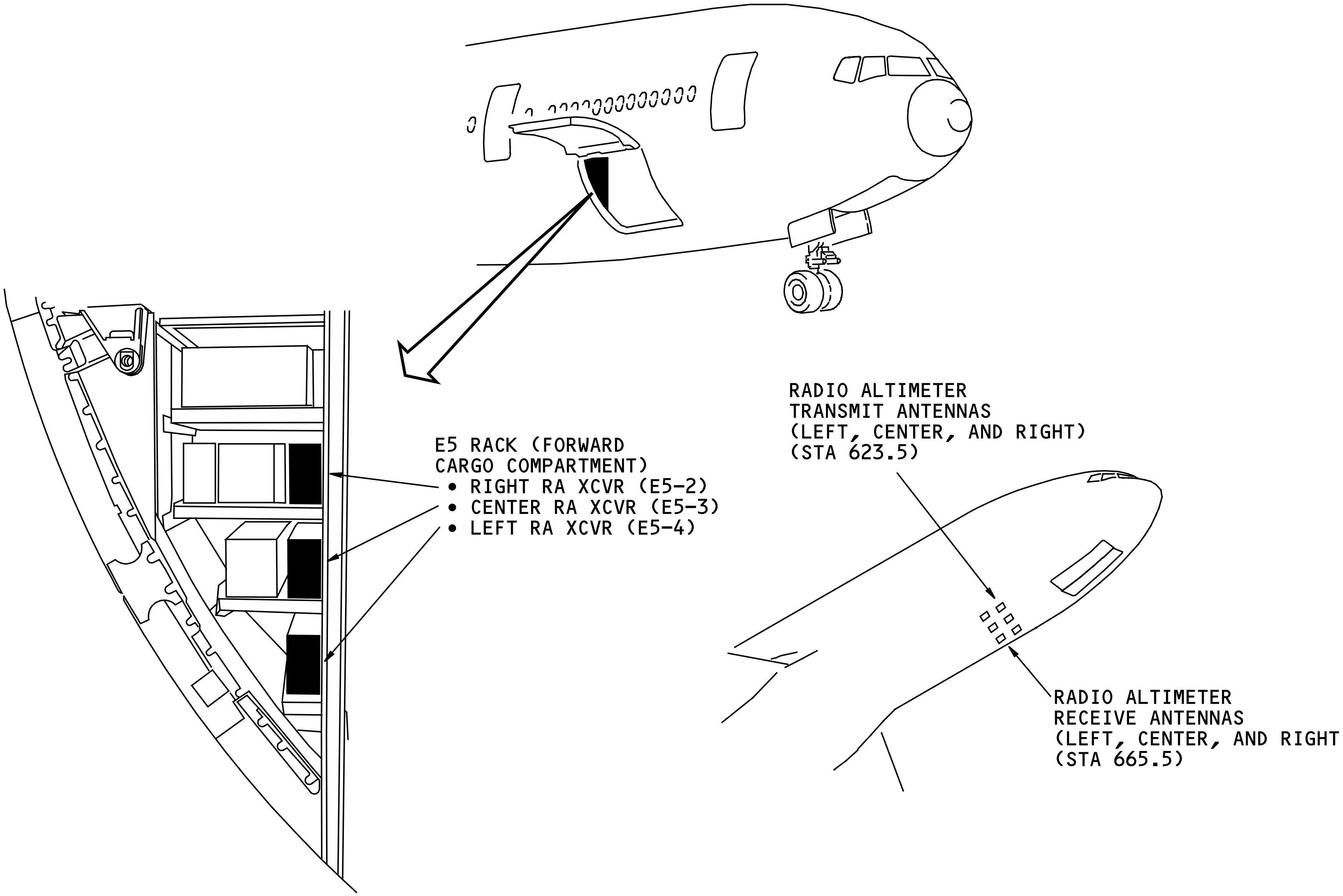
General

These are the RA system components in the E5 rack in the forward cargo compartment:

- Right RA transceiver (xcvr)
- Center RA xcvr
- Left RA xcvr.

These are the RA system components on the bottom of the fuselage:

- Left RA receive antenna
- Center RA receive antenna
- Right RA receive antenna
- Left RA transmit antenna
- Center RA transmit antenna
- Right RA transmit antenna.



34-33-00-003 Rev 1

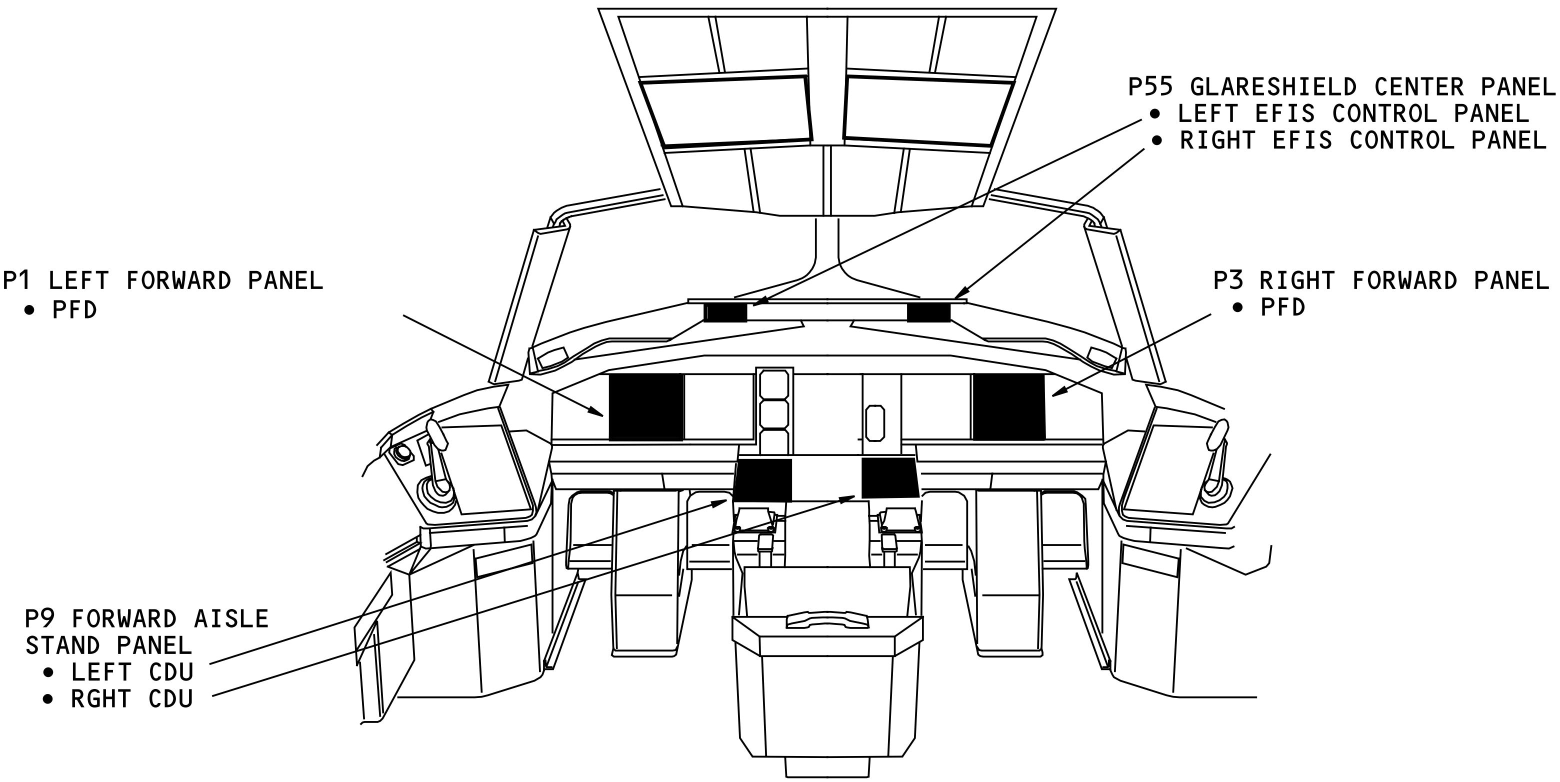
RA SYSTEM - COMPONENT LOCATION - 1

RA SYSTEM - COMPONENT LOCATION - 2

General

These are the RA system components and components that interface with the RA system in the flight deck:

- Primary flight displays (PFD)
- Left and right EFIS control panels
- Left and right control display units (CDU).



34-33-00-004 Rev 1

RA SYSTEM - COMPONENT LOCATION - 2

RA SYSTEM - POWER, ANTENNA, AND DISCRETE INPUTS

Power

Power for the RA xcvrs is 115v ac from:

- 115v ac left transfer bus (left RA)
- 115v ac standby bus (center RA)
- 115v ac right transfer bus (right RA).

Antenna Interfaces

The transmit antennas send radio frequency (RF) signals to the ground. The receive antennas send reflected RF signals to the receiver circuits of the RA xcvr.

AIMS Discrete

The primary flight control computers (PFCs) supply a test inhibit signal to the RA xcvr through the airplane information management system (AIMS) cabinets. This signal prevents a RA test when the primary flight computers detect a ground speed greater than 40 knots, or the airplane is in the air.

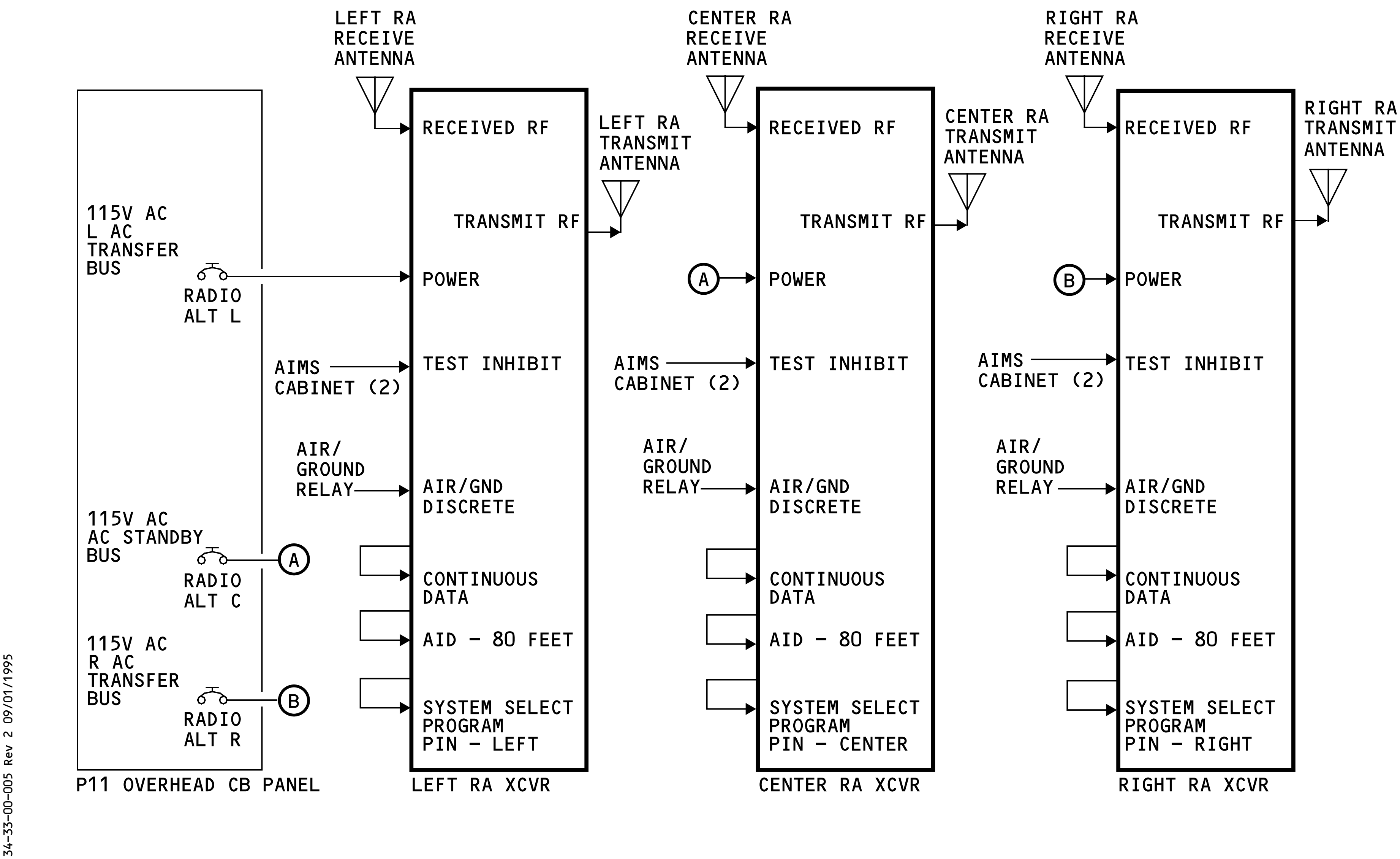
Air/Ground Discrete

The RA xcvr stores internal faults in a nonvolatile fault memory. The RA xcvr stores these faults by flight segments. The central maintenance computing function (CMCF) of the AIMS supplies the primary flight leg start times. The air/ground relay is an alternate way to detect the air/ground condition.

Input Program Pins

The RA xcvr program pins are:

- Continuous data
- Aircraft installation delay (AID) of 80 feet
- System select.



RA SYSTEM - POWER, ANTENNA, AND DISCRETE INPUTS

RA SYSTEM - DATA BUS OUTPUTS, RADIO MINIMUMS INTERFACE

General

The RA system supplies data to the:

- Left, center, and right AFDCs
- TCAS computer
- Left and right weather receiver transmitters
- GPWC
- Left and right AIMS cabinets
- Left, right, and center PFCs (through the AIMS cabinets).

Altitude Data

Radio altitude goes to the AIMS for PFD displays and status messages.

Each AFDC gets radio altitude from its onside RA transceiver. The AFDCs use radio altitude in their approach control calculations.

The GPWC uses radio altitude in its ground proximity alert and warning logic calculations.

The TCAS computer uses radio altitude to set the sensitivity levels and for intruder advisory calculations.

Weather radar (WXR) uses radio altitude data for the following:

- Automatic on/off logic
- Alert and display logic.

Fault Summary Data

Fault data from each radio altimeter goes to the AIMS cabinets. The AIMS cabinets send data to the status page. The status page shows RA status messages.

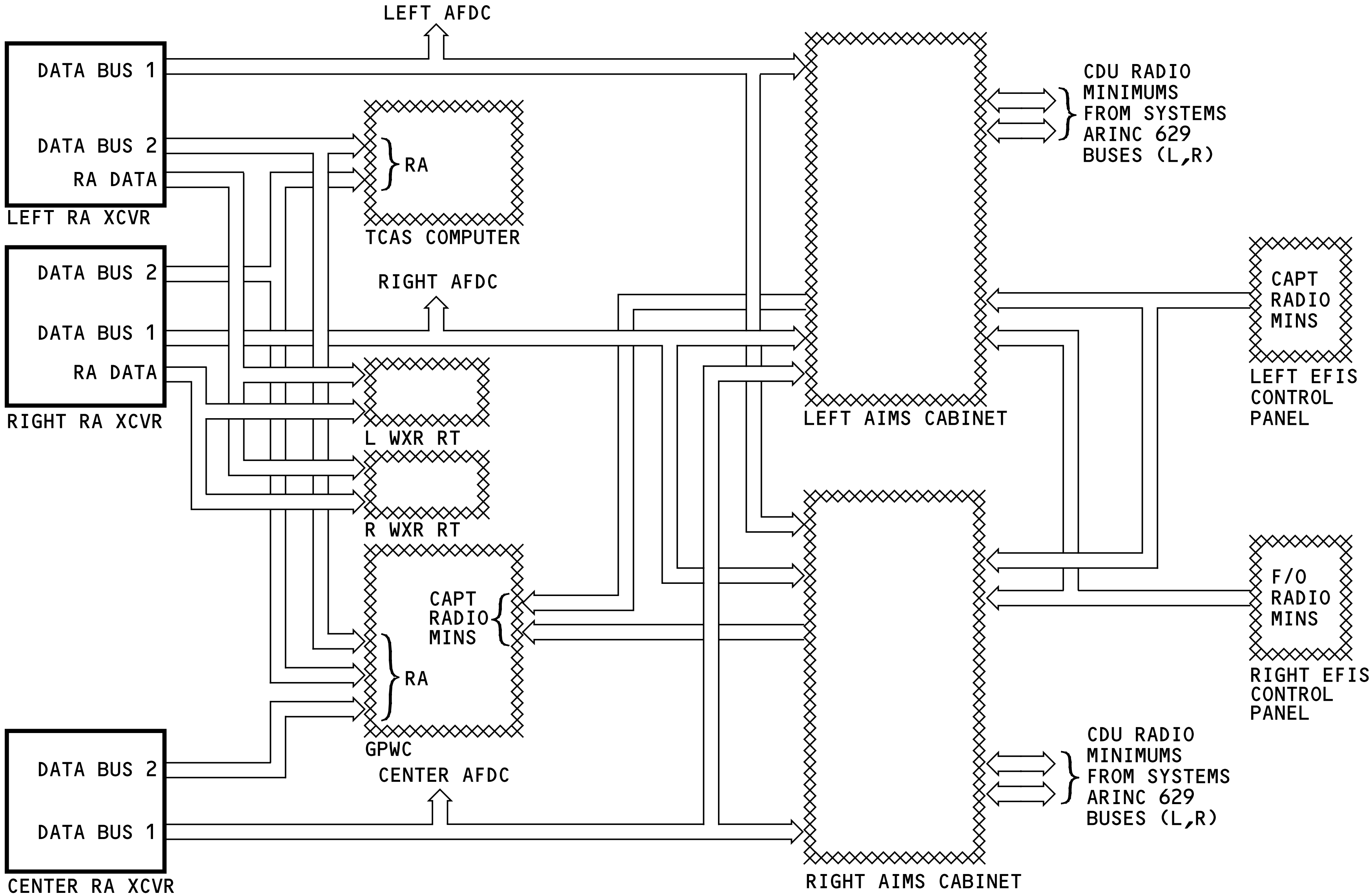
The CMCF of the AIMS cabinets receives and stores RA fault information. Maintenance personnel use the MAT to get fault information.

Radio Minimums GPWC Interface

Radio minimums and radio altitude go to the GPWC for various modes of warning.

Radio Minimums Interface

The EFIS control panels supply radio minimums values to the AIMS. The control display units (CDUs) supply backup radio minimums values to the AIMS.



34-33-00-006 Rev 3 12/01/95

RA SYSTEM - DATA BUS OUTPUTS, RADIO MINIMUMS INTERFACE

RA SYSTEM - RA TRANSCEIVER

Purpose

The RA transceiver calculates radio altitude.

The RA transceiver has a non-volatile memory which stores fault information from the last sixty-three flights. It can store up to thirteen faults per flight. Only shop personnel read the non-volatile memory information.

Operational Characteristics

These are the operational characteristics of the transceiver:

- Frequency = 4235 MHz to 4365 MHz
- Transmit power = 500 mw nominal
- Operating range = -20 to 2500 feet.

A test connector on the front panel connects test equipment for shop tests.

Operation

These are the three LED status indicators on the front panel:

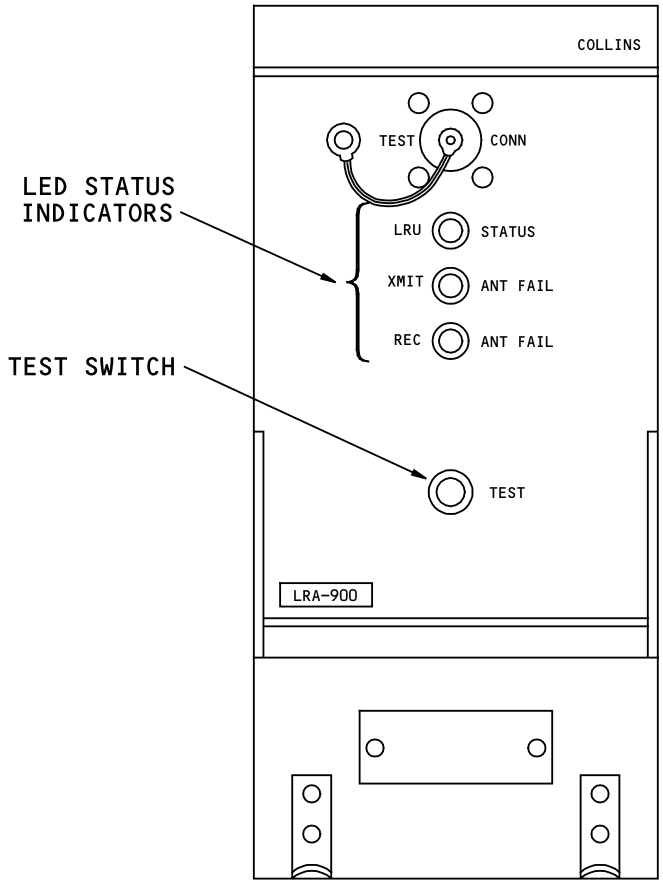
- A red or green LRU STATUS LED shows the transceiver operational status. It comes on green when the transceiver is OK. It comes on red when the transceiver has a fault
- A red XMIT ANT FAIL LED shows a transmission antenna or coax cable fault
- A red REC ANT FAIL LED shows a receive antenna or coax cable fault.

You push the test switch to start a self-test.

Training Information Point

The maintenance manual and the fault isolation manual do not have a task for the line maintenance technician to do a test from the front panel of the RA transceiver. You must do all tests for the RA transceiver from the MAT or a PMAT.

Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For that reason these LRUs have a front panel test feature.



34-33-00-008 Rev 4 10/11/95

RA SYSTEM - RA TRANSCEIVER

RA SYSTEM - RA ANTENNA

Purpose

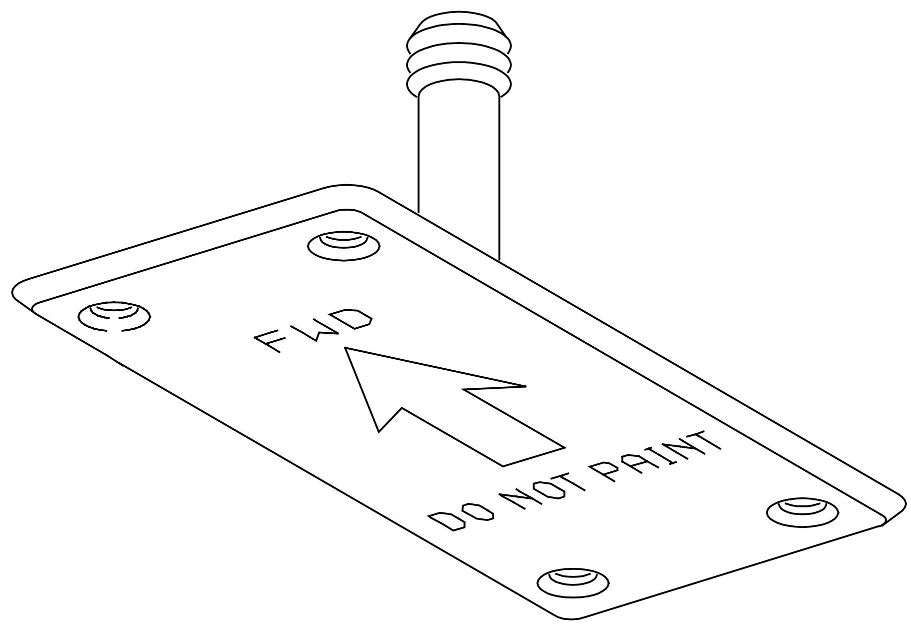
The RA system uses six antennas that transmit and receive RF signals. Each RA xcvr has a transmit and receive antenna. The transmit and receive antenna are the same and interchangeable.

Physical Description

Four screws attach each antenna to the bottom of the fuselage. There is an O-ring seal in a groove around the electrical connector. The O-ring seal supplies moisture protection. The radiation side of the antenna has red markings "FWD" and "DO NOT PAINT".

Training Information Point

Do not paint the radiation surface or the back plate of the antenna. Paint does not permit the antenna to radiate or receive RF signals.



34-33-00-009 Rev 1

RA SYSTEM - RA ANTENNA

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RA SYSTEM - OPERATION - 1

EFIS Control Panel

The EFIS control panel controls the radio minimums and resets the radio minimums alert. The radio minimums show on the captain's and first officer's PFDs. The left EFIS control panel controls the captain's PFD. The right EFIS control panel controls the first officer's PFD.

The RADIO/BARO MINS control has these three concentric controls:

- A two-position rotary switch (minimums reference selector)
- A three-position rotary switch which is spring loaded to center (minimums selector)
- A radio minimums reset switch.

The flight crew uses the minimums reference selector to select either radio minimums or barometric minimums. Radio minimums is the same as decision height (DH). Barometric minimums is the same as minimum descent altitude (MDA).

When the flight crew selects a radio minimums value, the three-position rotary switch, which is spring loaded to center, adjusts the radio minimums between -1 foot and +999 feet.

The flight crew pushes the reset switch to reset the radio minimums alert.

The barometric minimums function does not relate to the radio altimeter operation.

PFD

The PFD shows radio altitude and radio minimums values. The flight crew uses this data during approach and landing.

Radio altitude shows digitally for altitudes between -20 and 2500 feet. The display updates in:

- Two foot increments from -20 to 100 feet
- Ten foot increments from 100 to 500 feet
- Twenty foot increments from 500 to 2500 feet.

The display goes out of view above 2500 feet.

Radio minimums show on the PFD. The radio minimums display has the letters RADIO (radio minimums) and the radio minimums value. If the radio minimums value is less than zero feet or more than 999 feet, the display goes out of view.

Radio Minimums Alert

This happens as the airplane descends through the radio minimums value:

- The radio altitude display changes from white to yellow
- The green letters RADIO and the radio minimums value below it change from green to yellow.

RA SYSTEM - OPERATION - 1

- The radio altitude, the letters RADIO, and the radio minimums value blinks three times at a 4Hz rate.

Each of these resets the radio minimums alert:

- Push the radio minimums reset (RST) switch on the EFIS control panel
- The airplane climbs to 75 feet above the radio minimums value
- The radio minimums alert resets automatically at touchdown.

Reset causes the radio minimums value to go back to green and the radio altitude to go back to white.

RA Data Invalid

Invalid RA data causes a yellow RA flag to show in place of the radio altitude. The invalid occurs when the RA xcvr detects a failure in the RA system.

RA Data NCD

RA NCD causes the RA display to go out of view. The NCD occurs when the return RA signals are too weak or the radio altitude is more than 2500 feet.

Radio Minimums Data Invalid or NCD

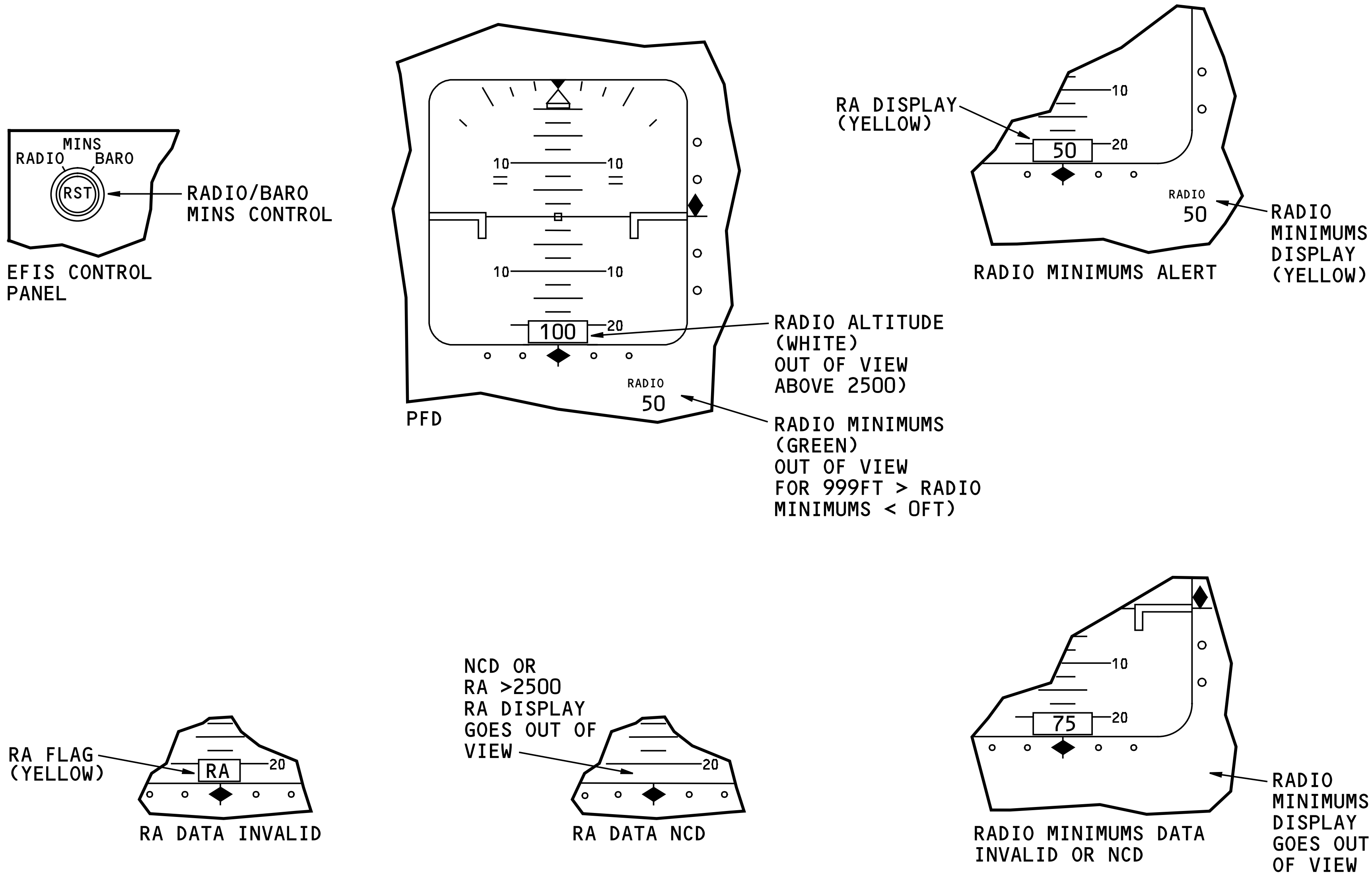
Invalid or NCD EFIS control panel data causes the letters RADIO and the radio minimums value to go out of view. The invalid occurs when the EFIS control panel, the onside CDU, and the center CDU fail.

RA Display Priority

The flight crew cannot manually select a radio altimeter for the PFD. When an RA xcvr fails, the AIMS selects another xcvr to show on the PFD. The selection priority shows below. A RA yellow flag shows on the PFDs only when all radio altimeters fail.

AIMS priority selection of PFD RA display:

Captain's PFD	L,C,R
First Officer's PFD	R,C,L



RA SYSTEM - OPERATION - 1

RA SYSTEM - OPERATION - 2

Purpose

In addition to the EFIS control panels, the flight crew can use the CDUs to select a radio minimums value and to reset a radio minimums alert. When the flight crew uses the CDU, the onside EFIS control panel does not operate.

Operation

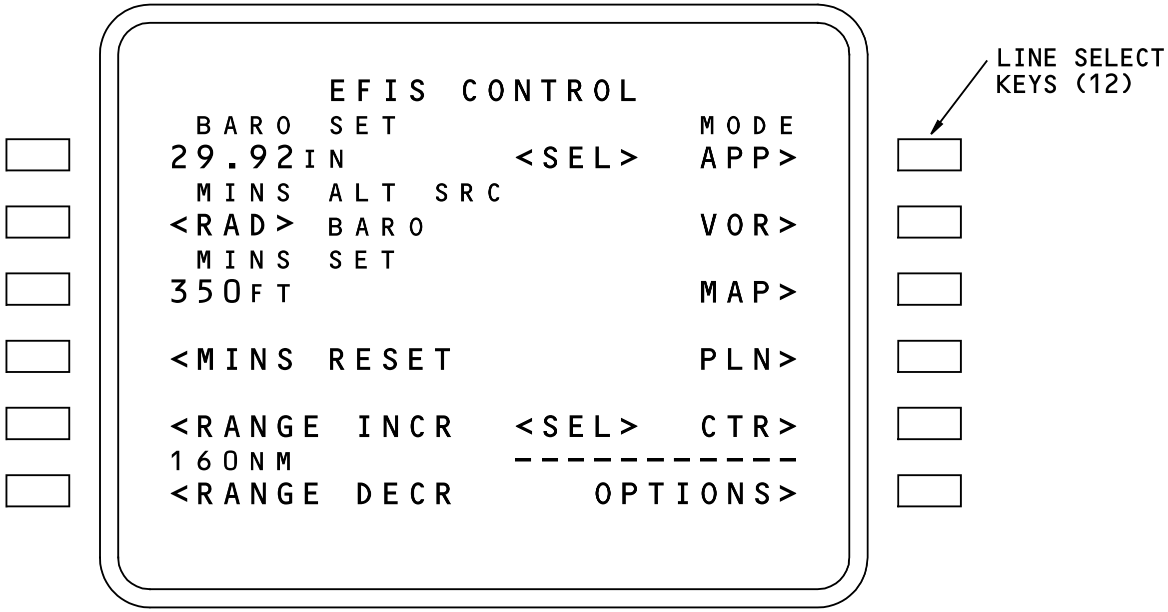
The captain selects a radio minimums value on the left CDU. The captain's radio minimums show on the captain's PFD. The first officer selects a radio minimums value on the right CDU. The first officer's radio minimums show on the first officer's PFD.

When the flight crew selects the EFIS control page on the CDU, the page shows the last radio minimums or barometric minimums of the onside EFIS control panel.

Push the line select key next to <RAD> BARO to make the letters RAD show in green large letters and the letters BARO show in white small letters. This action selects radio minimums in place of barometric minimums.

Type a new radio minimums value into the CDU scratch pad and push the line select key below MINS SET. Valid entries are 0 to 999 feet.

Push the line select key next to MINS RESET to clear a radio minimums alert.



CDU EFIS CONTROL PAGE

34-33-00-011 Rev 1

RA SYSTEM - OPERATION - 2

RA SYSTEM - SELF TEST

Operation

Push and hold the test switch on the front of the RA xcvr to start a self test. All the LED status indicators come on red for a few seconds. After this period, the LRU STATUS LED comes on green, the XMIT ANT FAIL LED and REC ANT FAIL LED go off for a few seconds. After that, all LEDs go off for a few more seconds. Finally, the applicable LEDs come on to show a normal (green) or fault (red) condition.

Test Inhibit

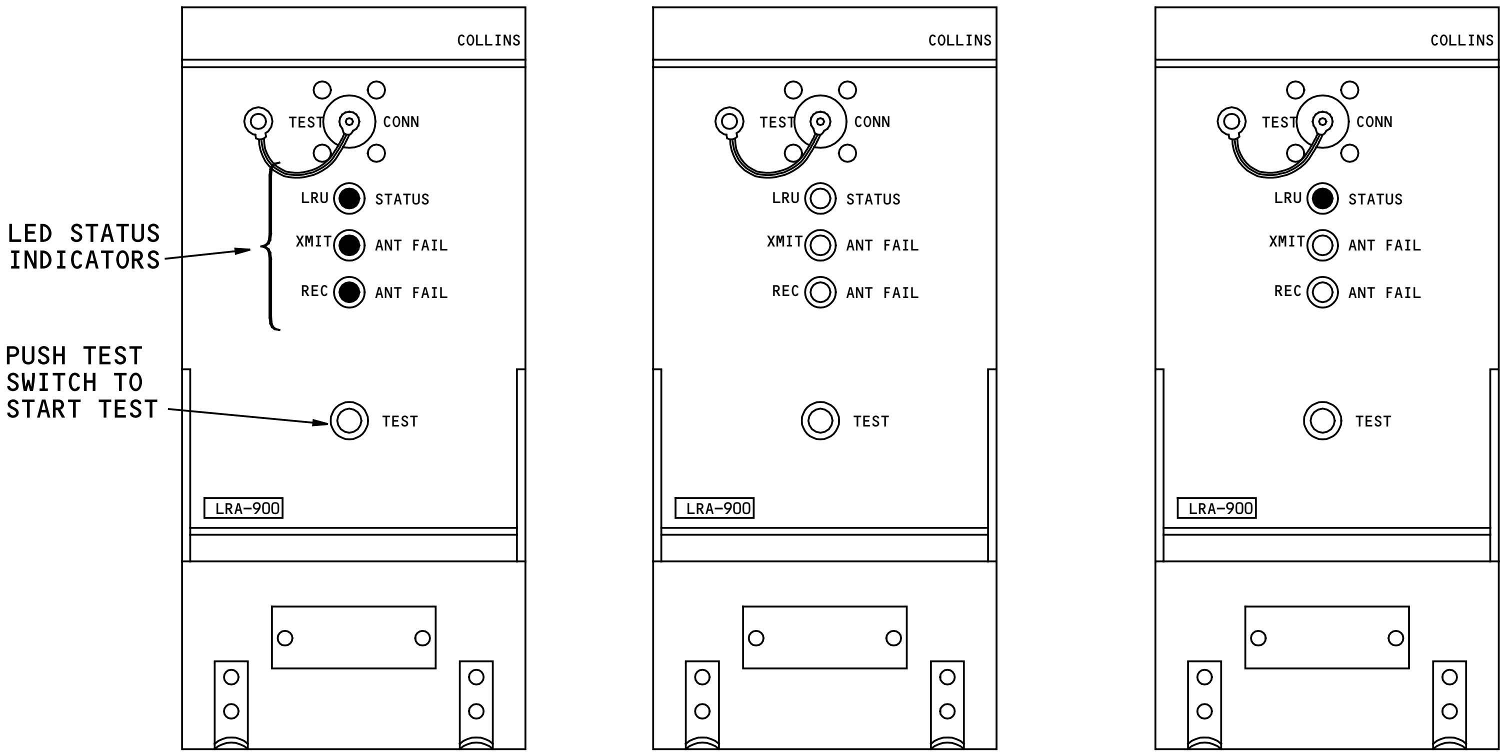
The primary flight control computers supply a test inhibit signal through the AIMS. This signal prevents a self test of the RA xcvr when the airplane is in the air or the ground speed is greater than 40 knots.

A discrete signal from the ground mode relay prevents a self test of the RA xcvr in flight.

Training Information Point

The maintenance manual and the fault isolation manual do not have a task for the line maintenance technician to do a test from the front panel of the RA xcvr. You must do all tests for the RA xcvr from the MAT or a PMAT.

Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For that reason these LRUs have a front panel test feature.



1 ALL LED(S) ON FOR A FEW SECONDS (LRU STATUS COMES ON RED THEN GREEN)

2 ALL LED(S) OFF

3 THE APPLICABLE LED(S) COME ON TO SHOW THE STATUS OF THE RA TRANSCEIVER

34-33-00-014 Rev 3 10/11/95

RA SYSTEM - SELF TEST

RA SYSTEM - GROUND TEST

General

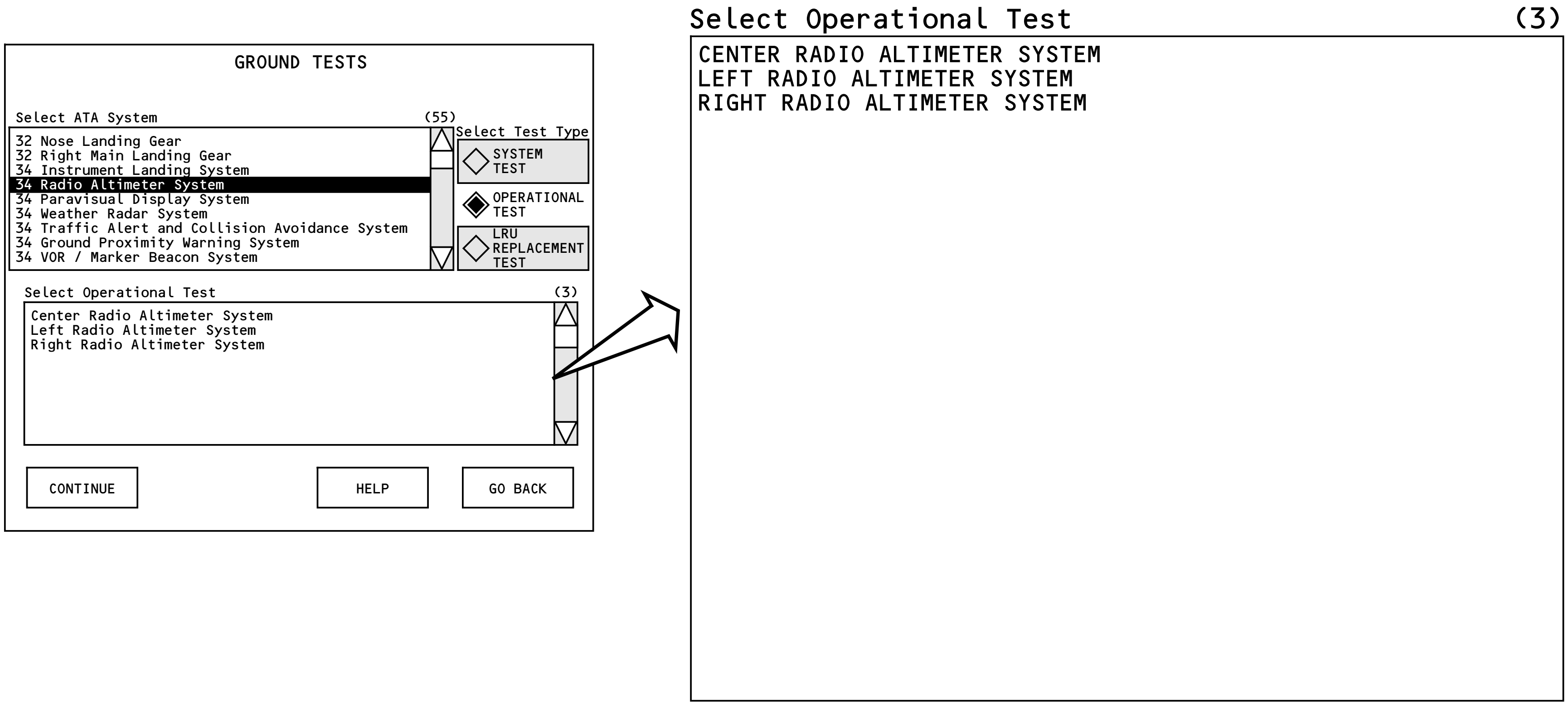
There are only operational tests available for the radio altimeter system. These are the operational tests available:

- Center radio altimeter system
- Left radio altimeter system
- Right radio altimeter system.

Operational Test

The purpose of this test is to verify the operation and function of the radio altimeter transceivers.

This test does a check of the radio altimeter transceiver operation. The test also does a check of the transmission and receive antennas and their coaxial cables.



34-33-00-015 Rev 2

RA SYSTEM - GROUND TEST

Continental Airlines, Inc

Global Positioning System

WB371

TABLE OF CONTENTS

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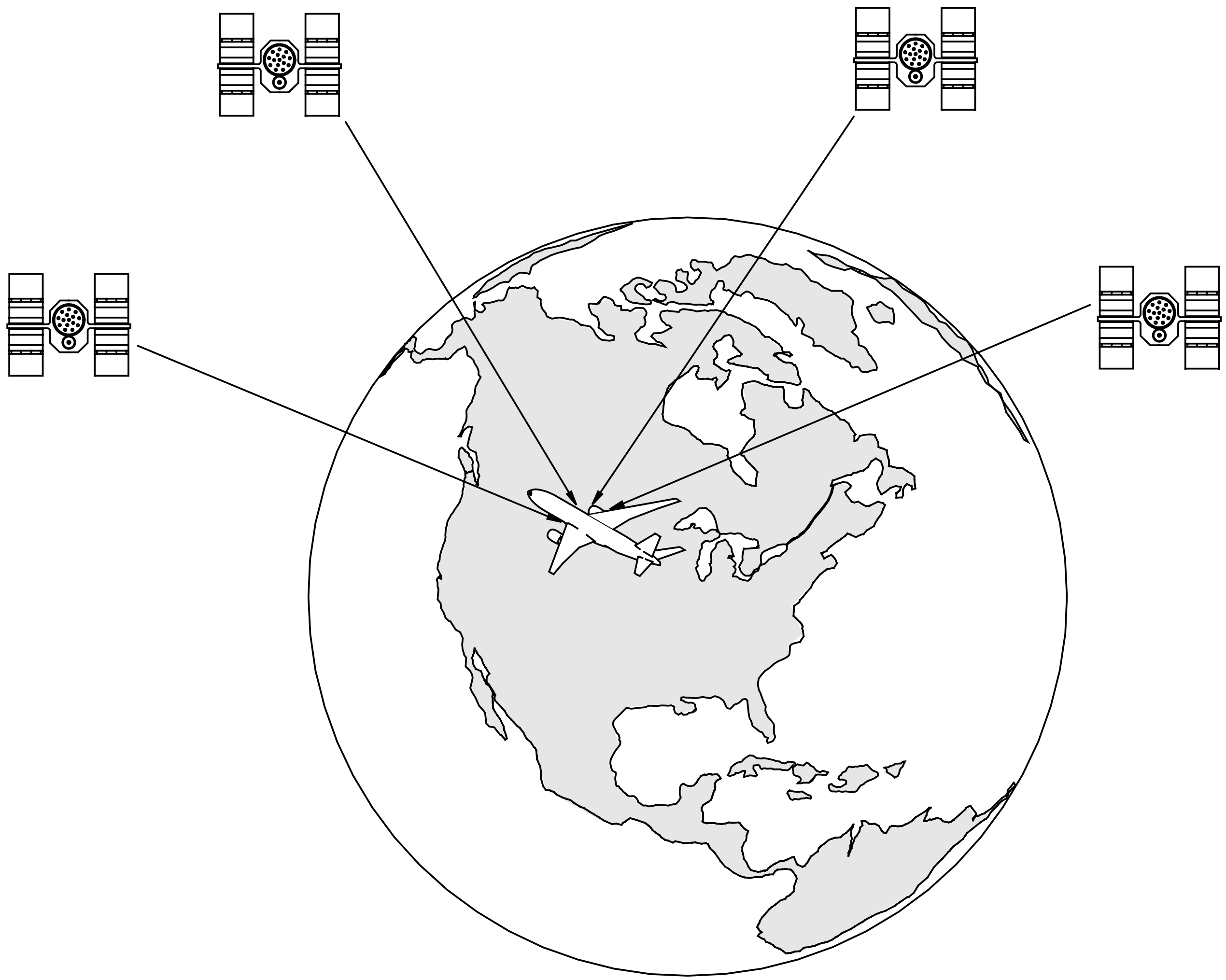
GLOBAL POSITIONING SYSTEM - INTRODUCTION

General

The global positioning system (GPS) uses navigation satellites to supply accurate airplane position to airplane systems and to the flight crew.

Abbreviations and Acronyms

ADIRU	- air data inertial reference unit
AIMS	- airplane information management system
BITE	- built-in-test equipment
CDU	- control display unit
CMCS	- central maintenance computing system
D/A	- digital-to-analog
FMCF	- flight management computing function
GP	- general purpose
GPS	- global positioning system
GPWC	- ground proximity warning computer
MAT	- maintenance access terminal
MMR	- multi-mode receiver
NCD	- no computed data
PPS	- precision positioning service
RAIM	- receiver autonomous integrity monitor
SPS	- standard positioning service
UTC	- universal time (coordinated)



34-58-00-001 Rev 3

GLOBAL POSITIONING SYSTEM - INTRODUCTION

GPS - GENERAL DESCRIPTION

General

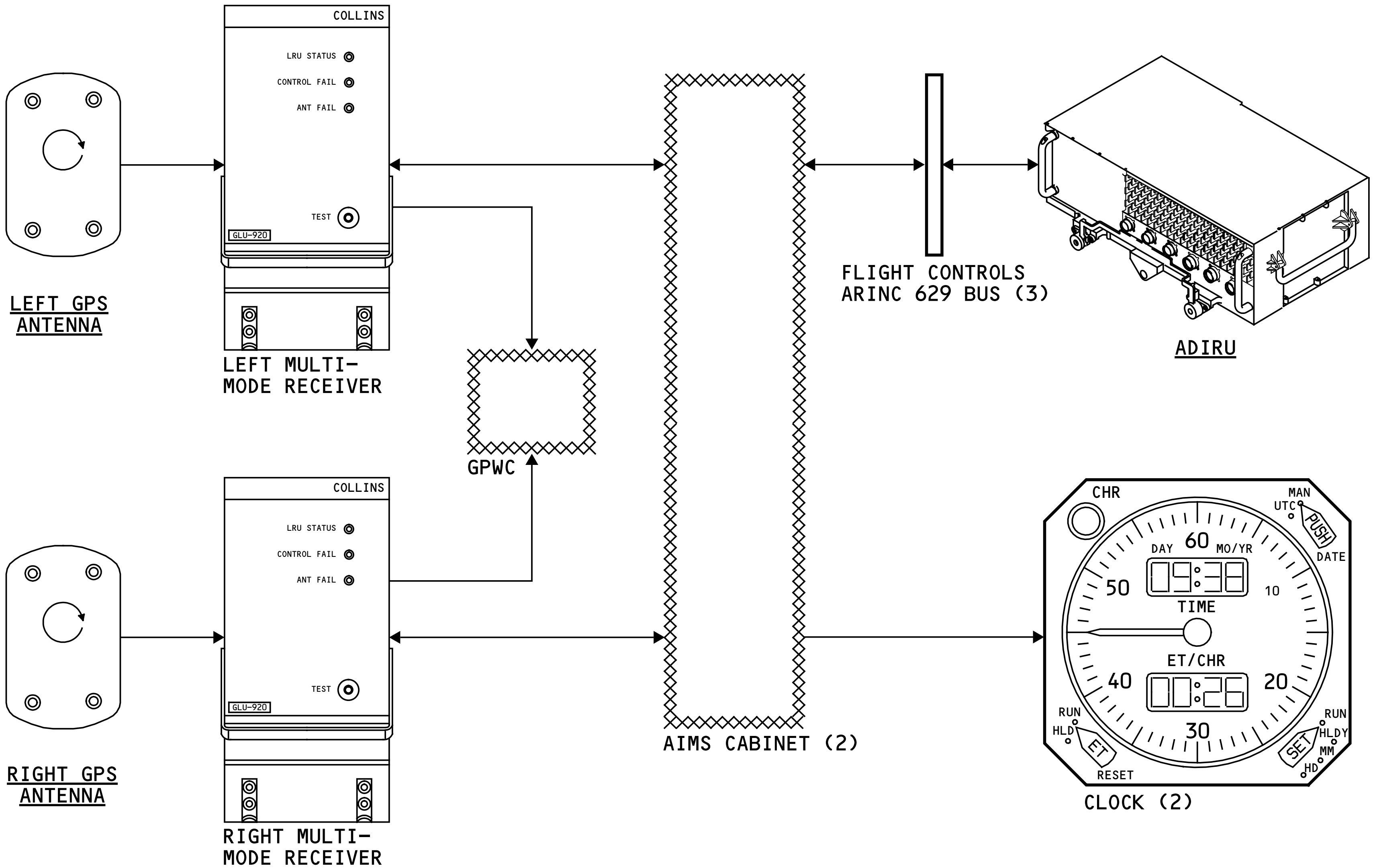
The global positioning system (GPS) calculates:

- Latitude
- Longitude
- Altitude
- Accurate time
- Ground speed.

There are two GPS antennas. The left antenna receives satellite signals and sends them to the left multi-mode receiver (MMR). The right GPS antenna connects to the right MMR. The MMRs calculate the airplane position and accurate time. This data goes to the AIMS cabinets and the ground proximity warning computer (GPWC). The flight management computing function (FMCF) in the AIMS uses GPS data to calculate the airplane position.

The AIMS cabinets send GPS data to the air data inertial reference unit (ADIRU). The ADIRU uses GPS data to calibrate its internal sensors. This decreases inertial reference drift.

GPS time goes to the universal time coordinated function (UTCF) in AIMS. GPS time goes to the clocks in the flight deck through the AIMS cabinets. The clocks can show GPS time.

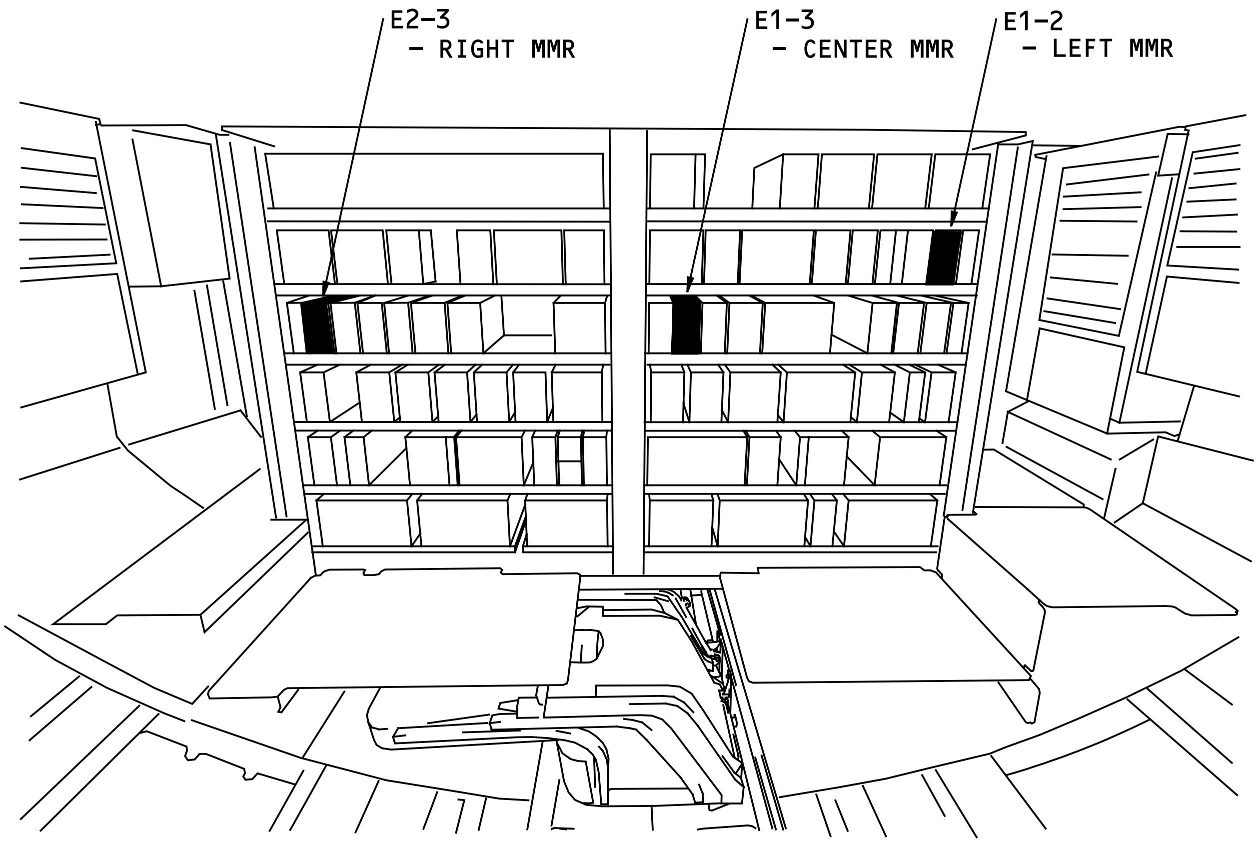


GPS - GENERAL DESCRIPTION

GPS - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

Equipment Center

The left MMR is on the E1-2 shelf. The center MMR is on the E1-3 shelf. The right MMR is on the E2-3 shelf.



(LOOKING AFT)

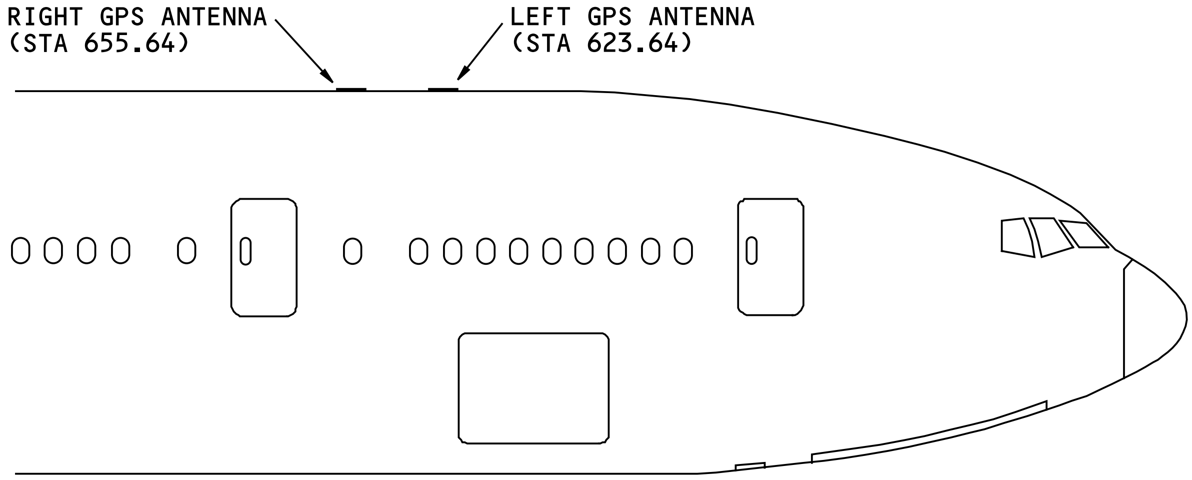
34-58-00-017 Rev 0 09/29/1997

GPS - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

GPS - ANTENNA LOCATIONS

General

The GPS antennas are on the top of the fuselage.



34-58-00-005 Rev 0

GPS - ANTENNA LOCATIONS

GPS - INTERFACES

Power and Antenna Interface

Each multi-mode receiver (MMR) has a circuit breaker. The 115v ac standby and transfer buses supply power to the MMRs.

Each MMR sends 12v dc to its GPS antenna. The power goes through the center conductor of the coaxial cable to each antenna. Amplifiers in the antennas use the power to increase the strength of the received RF signals from the satellites.

Each MMR receives a radio frequency (RF) signal from its GPS antenna.

IRS Data Bus

The MMRs get inertial reference from the flight management computing function (FMCF) in each AIMS cabinet. The MMRs use this data for system initialization and to help system operation during periods of low satellite coverage.

Central Maintenance Data

The left and right MMRs receive central maintenance computing system (CMCS) data from the left AIMS cabinet. The CMCS data supplies airplane ID and flight leg information.

GPS Data Output Bus

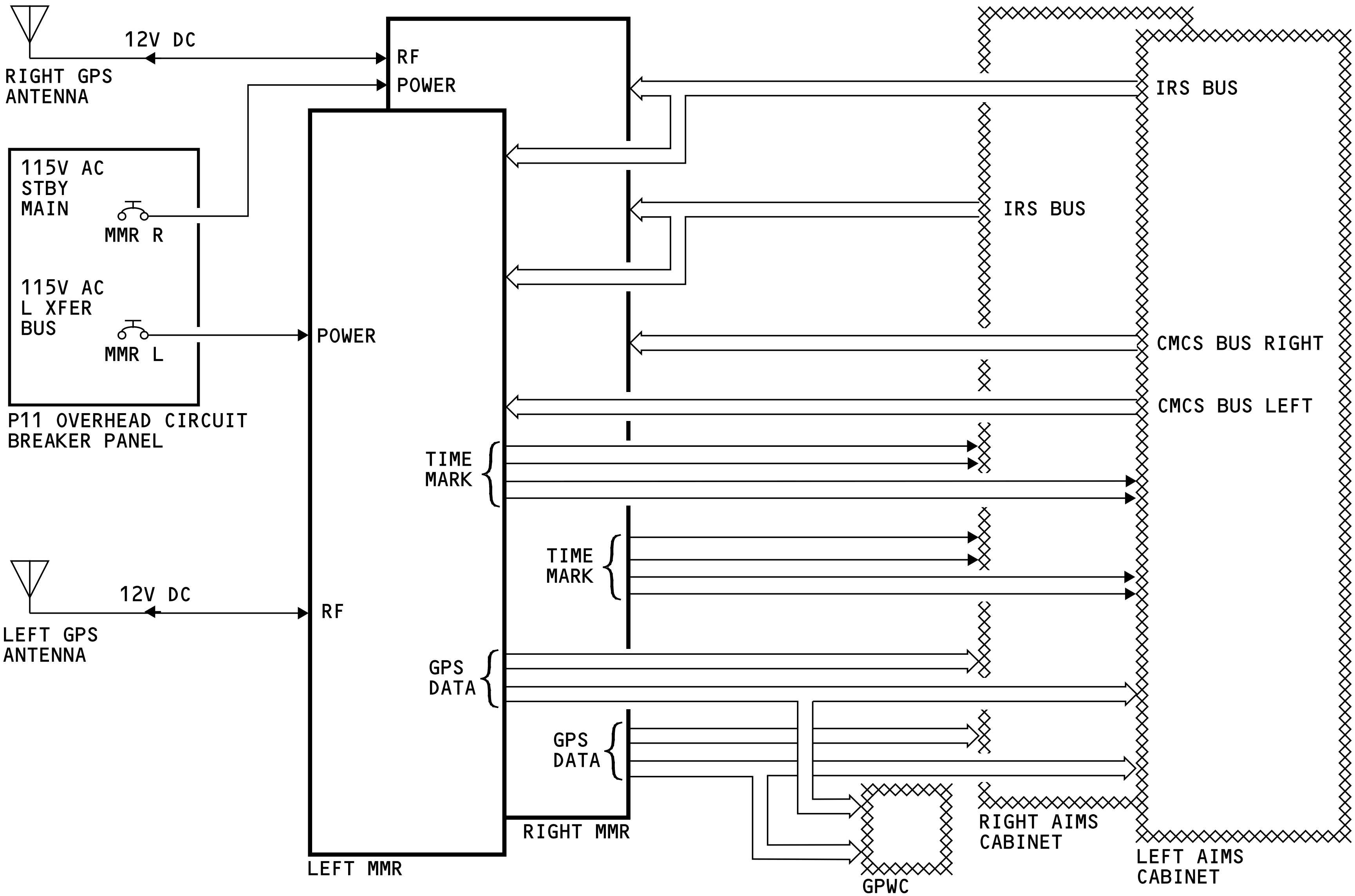
The left and right MMRs send GPS data to both AIMS cabinets. The data is for:

- GPS position reports
- General GPS data reports
- Fault information reports.

The left and right MMRs also send position data to the ground proximity warning computer (GPWC). The GPWC uses this data in its terrain awareness and terrain clearance floor functions.

Time Mark

The left and right MMRs supply time mark pulses to each AIMS cabinet. The pulses occur once per second and have an amplitude of approximately 4 volts. These pulses are the same as accurate universal time (coordinated) (UTC).



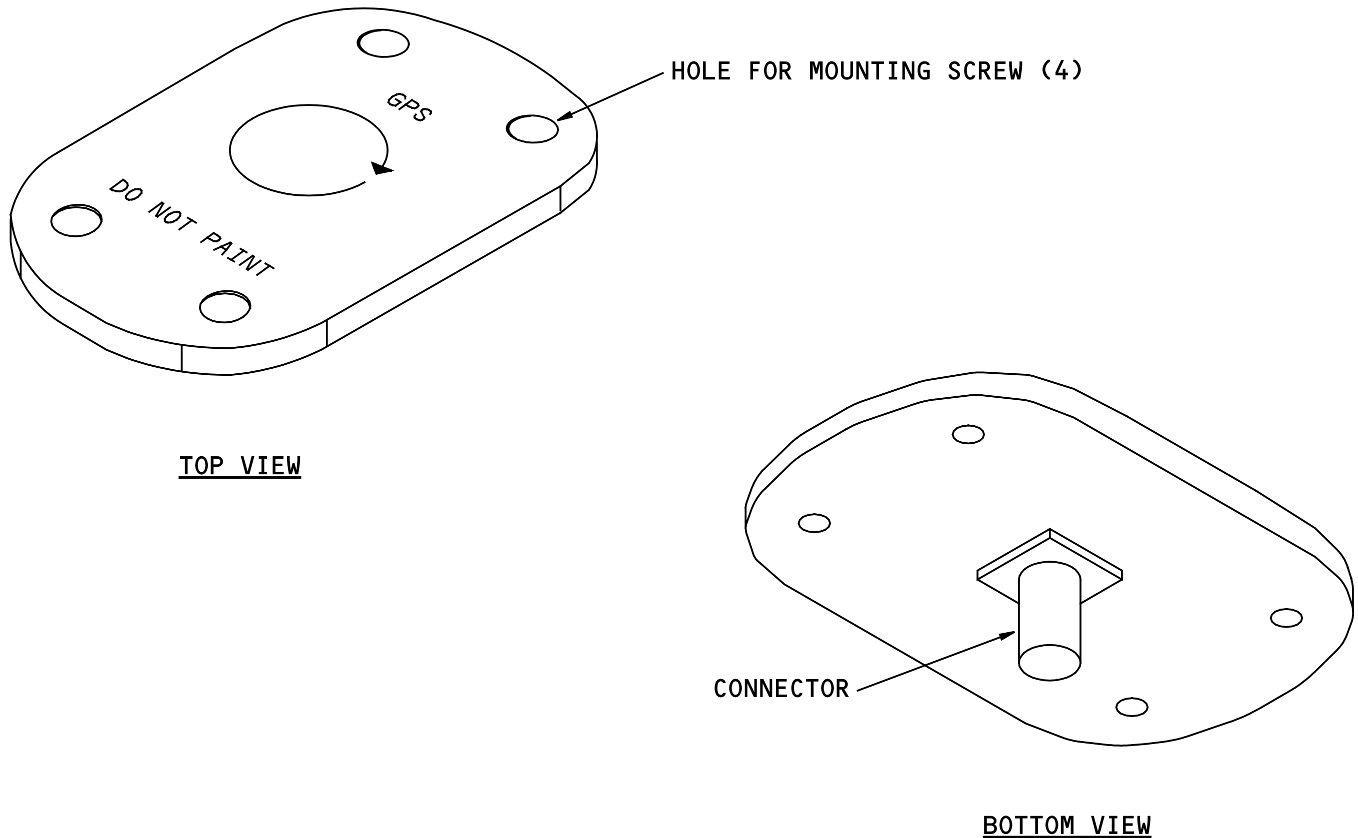
GPS - INTERFACES

GPS - GPS ANTENNA

General

The GPS antennas receive L-band frequency signals and send them to the multi-mode receivers (MMRs).

The GPS antenna impedance is 50 ohms.



34-58-00-008 Rev 1

GPS - GPS ANTENNA

GPS - THEORY OF OPERATION - 1

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GPS - THEORY OF OPERATION - 1

GPS Segments

The GPS has three segments:

- Satellite
- User
- Control.

Satellite Segment

The satellite segment is a group of satellites that orbit approximately 10,900 nautical miles above the earth. Each satellite completes an orbit approximately once every 12 hours. There are 21 operational satellites and 3 spares.

The satellites continuously transmit radio signals with navigation data, range code, and the exact time.

User Segment

The user segment is the multi-mode receiver (MMR) on the airplane. It receives the satellite signals. The MMR uses the satellite data to calculate the airplane position.

Control Segment

The control segment has control and monitor stations on earth that continuously monitor and track the satellites. The purpose of the control segment is to:

- Monitor and correct satellite orbits and clocks
- Calculate and format a satellite navigation message. This message has up-to-date descriptions of the satellites future positions, and a collection of the latest data on all GPS satellites
- Update the satellite navigation message regularly.

The control segment has one master control station and five monitor stations. Three of the monitor stations are also upload stations.

The master control station is in Colorado Springs, USA. The master control station is the operational center of the GPS. The master control station controls all operations in the control segment. The master control station has an atomic clock, this clock is the reference for the GPS.

The monitor stations track the satellites 24 hours a day. The master control station remotely controls the monitor stations through on-line connections. The monitor stations are in:

- Ascension island
- Colorado Springs
- Diego Garcia island
- Hawaii
- Kawajalein island.

The monitor stations receive the same information from the satellites that the MMRs in the airplane receive. The monitor stations:

GPS - THEORY OF OPERATION - 1

- Record the accuracy of the satellite clocks
- Collect and relay to the control station meteorologic data such as barometric pressure, temperature, and dew point. The master control station uses this data to calculate the tropospheric signal delay
- Continuously measure the ranges to all visible satellites. The master control station uses this data to calculate and predict the satellites orbits.

The master control station uses the upload stations to send:

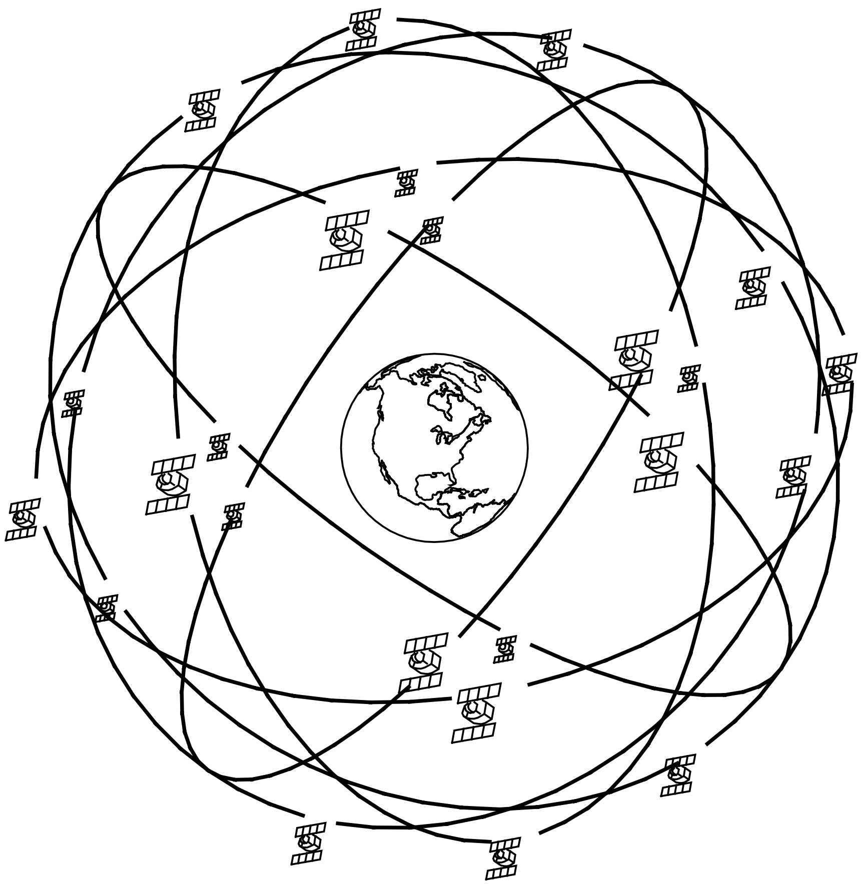
- Orbit correction commands to the satellites. The satellites use control rockets to correct their orbits
- The navigation message to the satellites.

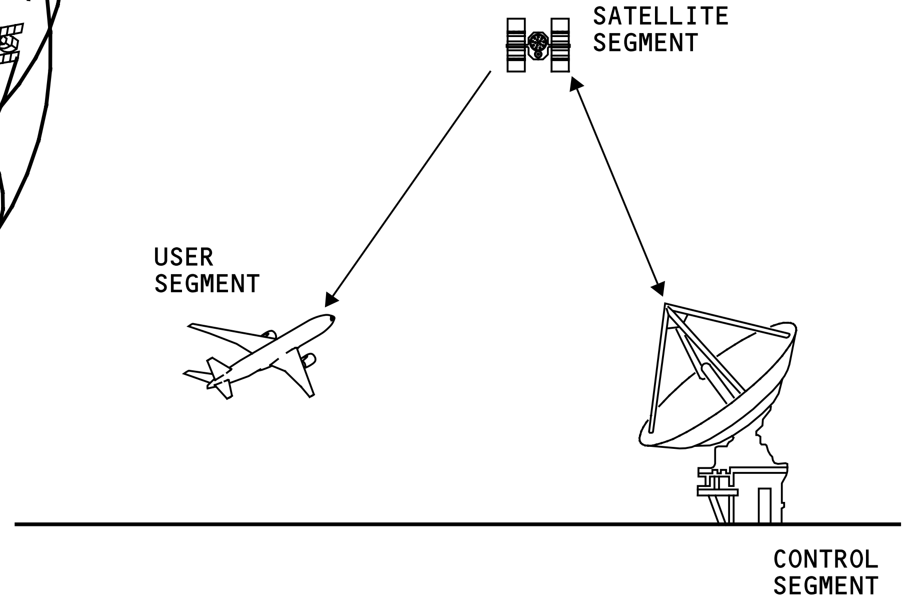
The upload stations are in Ascension island, Diego Garcia island, and Kawajalein island.

GPS Accuracy

Civilian users have access to standard positioning service (SPS). SPS has an accuracy of 15 - 25 meters in 95% of the position fixes. For security reasons, the American Department of Defense intentionally degrades the accuracy for civilian users to 100 meters in 95% of the fixes.

Military users have access to precision positioning service (PPS). PPS has an accuracy of 18 meters or less in 95% of the fixes.





34-58-00-009 Rev 2

GPS - THEORY OF OPERATION - 1

GPS - THEORY OF OPERATION - 2

Ranging

The multi-mode receivers (MMRs) use the principle of ranging to measure the distance between the MMR on earth and the satellites. The MMR has in memory the location of the satellites in their orbits at any time. It is possible for the MMR to know the position of each satellite because they follow a known orbit.

The MMR measures the time it takes for a radio signal to go from a satellite to the airplane. Since the MMR knows the location of the satellite and that the radio signal travels at the speed of light, it can calculate the distance to the satellite.

However since this is one way ranging, the MMR must know exactly at what time the satellite sent the radio signal. The MMR compares the satellite signal to a signal that the MMR makes at the same time as the satellite. The difference between the two signals (Δt) is the time the satellite signal took to get to the MMR.

Each satellite has atomic clocks to keep accurate time. All the satellites have precisely the same time. The MMR in the airplane has an internal clock but it is not atomic, so it is not as accurate. Thus, it is not possible for the MMR to have precisely the same time as the satellite.

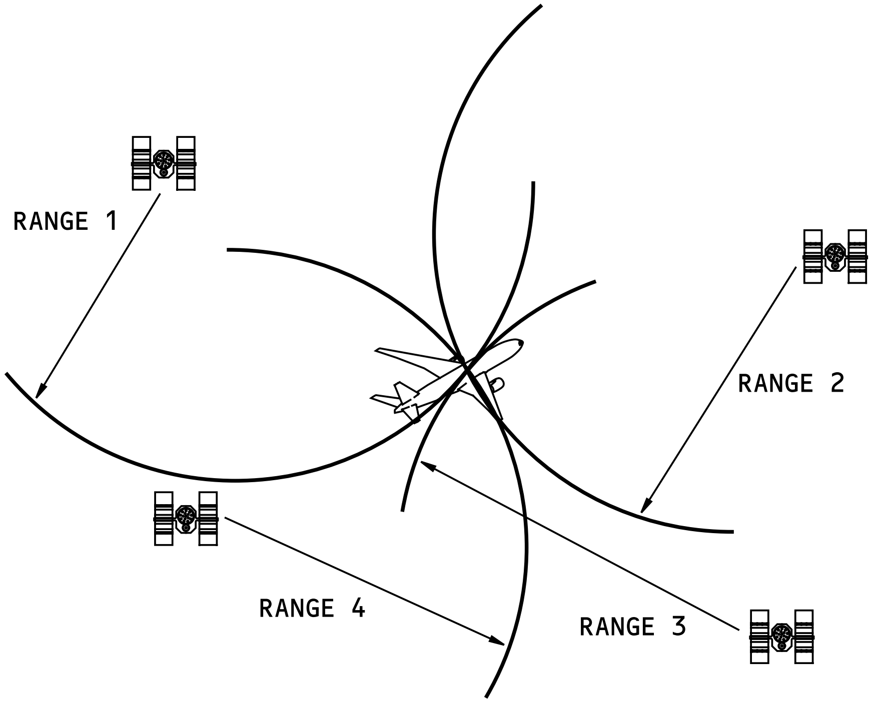
The MMR assumes that its internal clock is off by some clock bias. This clock bias is an unknown that the MMR must calculate. The clock bias is the difference between the MMR time and GPS time.

To calculate the airplane position (latitude, longitude, and altitude) and the clock bias, the MMR must know the position of at least four satellites. The MMR then measures the distances to all the satellites at the same time, and solves for these four unknowns with four range equations:

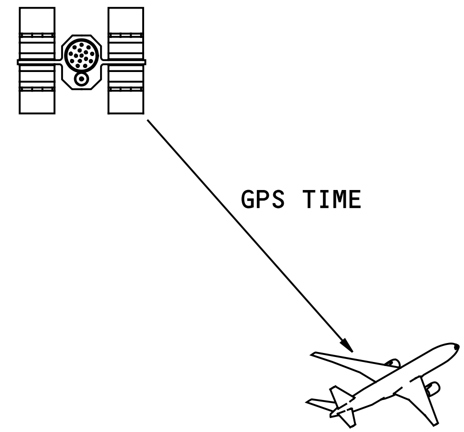
- Latitude
- Longitude
- Altitude
- Clock bias.

GPS Time

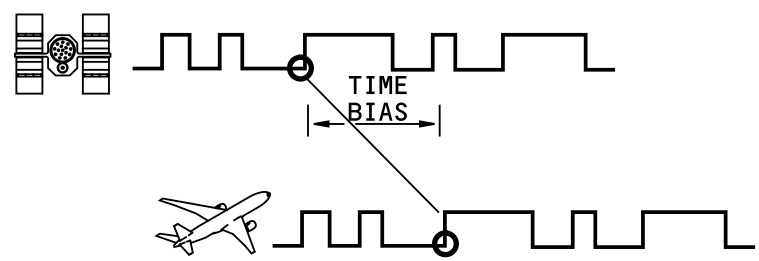
All the satellites synchronize to universal time (coordinated) (UTC). The satellites transmit this time to the MMR. The accuracy of the satellite UTC is approximately 100 nanoseconds. The MMR transmits UTC on an ARINC 429 format. The MMR also transmits a very accurate time mark once per second.



RANGING



GPS TIME



TIME BIAS

GPS - THEORY OF OPERATION - 2

GPS - THEORY OF OPERATION - 3

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GPS - THEORY OF OPERATION - 3

GPS Modes of Operation

The multi-mode receiver (MMR) operates in these modes:

- Acquisition mode
- Navigation mode
- Altitude aided mode
- Aided mode.

Acquisition Mode

The MMR looks for and locks on to the satellite signals. The MMR must find at least 4 satellites before it starts to calculate GPS data. The MMR accepts this data from the flight management computing function (FMCF) in the AIMS when the MMR is in the acquisition mode:

- Position
- Velocity
- Time
- Date.

The MMR uses the FMCF data to calculate which satellites are available at the present airplane position. This helps the MMR get the signals from those satellites available.

If the AIMS data is not available, the MMR can still acquire satellites signals. However, the MMR takes longer to acquire the satellite signals because it has to look for all the satellites. When the MMR finds the satellites, it calculates which it can use.

The MMR takes approximately 75 seconds to acquire the satellite signals when the AIMS data is available. The MMR takes approximately 4 minutes (maximum of 10 minutes) to acquire the satellites when the AIMS data is not available.

Navigation Mode

The MMR enters the navigation mode after it acquires and locks on to at least 4 satellites. When the MMR is in the navigation mode, it computes GPS data. The MMR output goes NCD (no computed data) when the accuracy is not within 16 nautical miles of the actual position.

Altitude Aided Mode

With four satellites available, the MMR stores the difference between the ADIRU inertial altitude and the GPS altitude.

The MMR stores the difference between inertial and GPS altitude so that it can estimate the GPS altitude when only three satellites are available.

In the altitude aided mode, the MMR uses the airplane altitude from the ADIRU and the length of the earth radius as the fourth range.

The MMR enters the altitude aided mode only after these three conditions are true:

- The MMR was in the navigation mode

GPS - THEORY OF OPERATION - 3

- There are only 3 satellites available with good geometry for position fixes
- The MMR stored the difference between inertial and GPS altitude in memory.

The MMR starts normal operation again when a fourth satellite comes into view.

Aided Mode

The MMR enters the aided mode during short periods (less than 30 seconds) of bad satellite coverage. An example of bad satellite coverage is poor satellite geometry, where at least four satellites are available but they are not spread out far enough so the MMR can make an accurate position fix.

In the aided mode, the MMR receives altitude, heading, and speed from the flight management computing function (FMCF) of the AIMS. The MMR uses the FMCF data to go back quickly to the navigation mode when there is good satellite coverage again. The MMR output is NCD in this mode.

GPS Frequencies

The satellites transmit to the MMR in the airplane on the L1 (1575.42 MHz) and L2 (1227.6 MHz) frequencies. The satellites downlink satellite status data to the monitor stations on 1783.74 MHz.

The upload stations send information to the satellites on 2227.5 MHz.

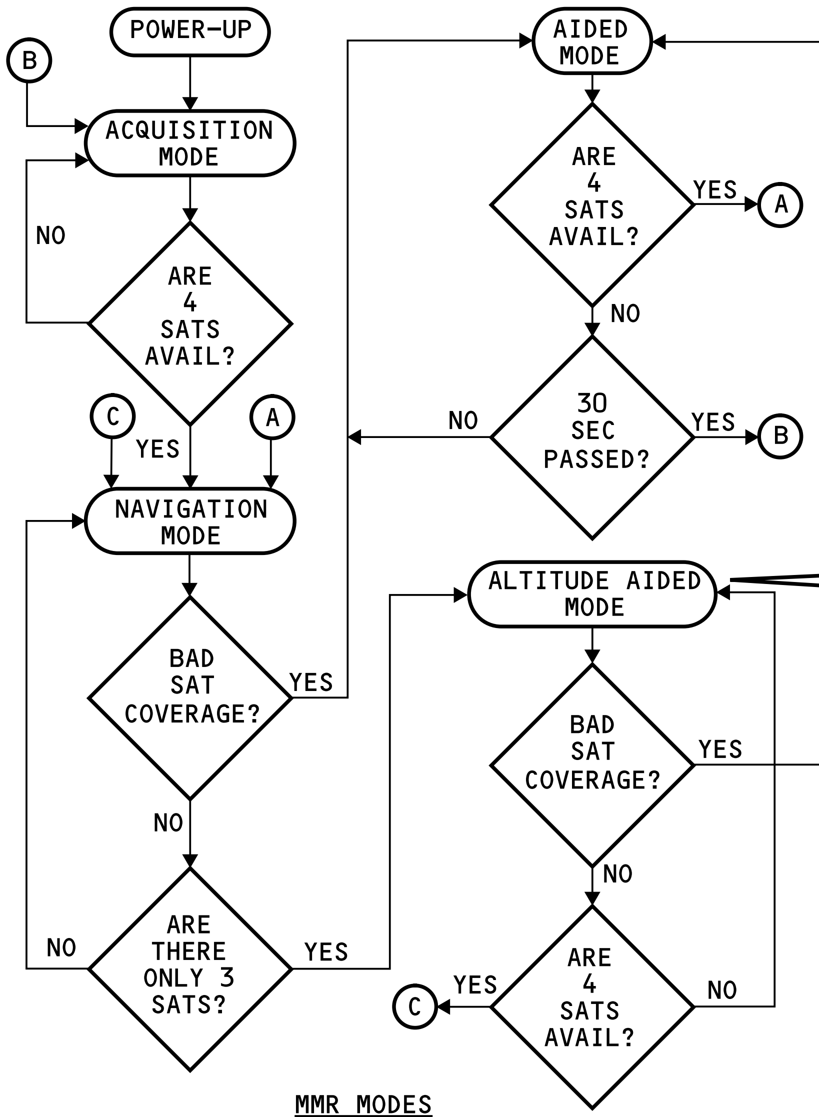
Autonomous Integrity Limit

The MMR has a receiver autonomous integrity monitor (RAIM) function. The RAIM monitors the status of the satellites that the MMR uses for calculations. The output of the RAIM function is an estimate of the GPS position error. The autonomous integrity monitor value goes to the flight management computing function (FMCF) of the AIMS. The FMCF uses the autonomous integrity monitor to determine if it can use GPS data for navigation.

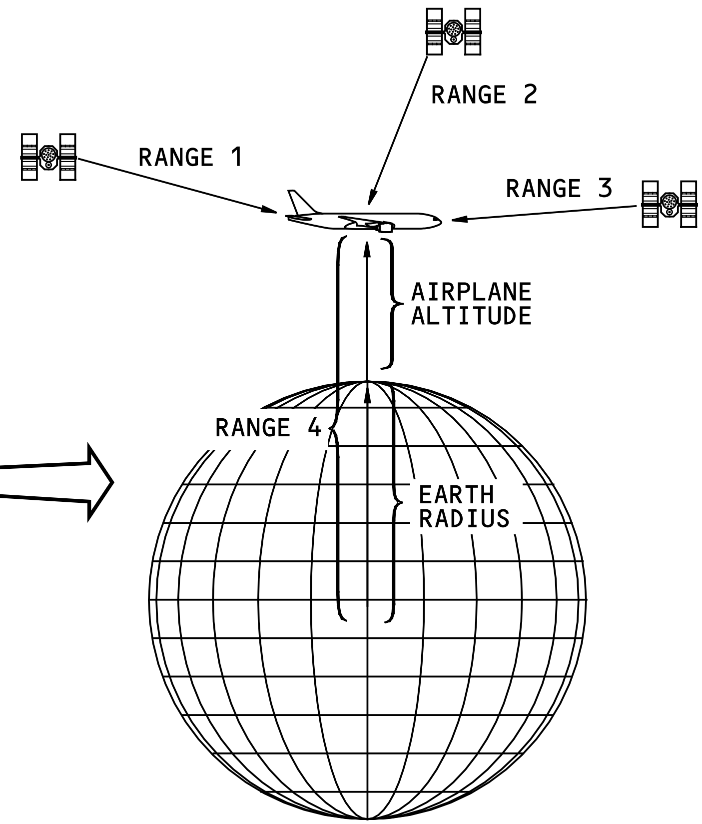
Values Calculated by the MMR

These are some of the values that the MMR calculates:

- Latitude
- Longitude
- Altitude
- Universal time (coordinated) (UTC)
- Date
- North/south velocity
- East/west velocity
- Vertical velocity
- Track angle
- Autonomous integrity limit
- Satellite position
- MMR status.



MMR MODES



ALTITUDE AIDED MODE

GPS - THEORY OF OPERATION - 3

34-58-00-011 Rev 3 09/29/1997

GPS - FUNCTIONAL DESCRIPTION

Power

The power supply makes various dc voltages from the 28v dc input to the multi-mode receiver (MMR).

Satellite Signal Processing

The low noise amplifier (LNA) receives and amplifies the satellite signals from the GPS antenna. The receiver detects the satellite signal and sends it to a digital-to-analog converter (D/A). The D/A sends the digitized signal to the microprocessor. The microprocessor calculates the airplane position and other GPS data. The GPS data goes to the flight management computing function (FMCF) in the left and right AIMS cabinets.

The MMR makes time mark pulses once per second. The time mark pulses goes to the AIMS cabinets.

Inputs

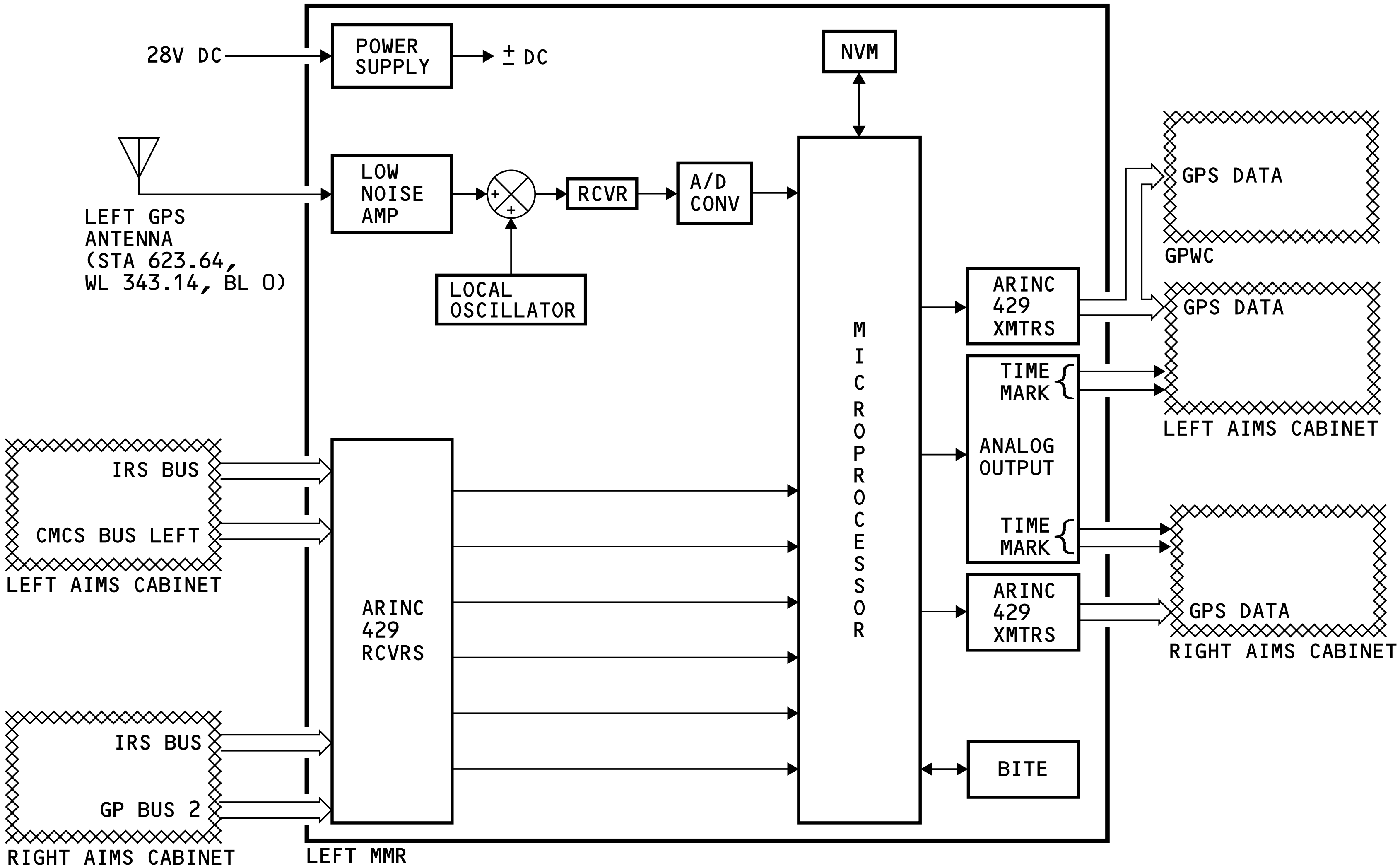
The AIMS cabinets use inertial reference data from the FMCF in the left and right AIMS cabinets during initialization. The MMR also uses this data in the aided and altitude aided modes.

The left MMR receives test and fault report requests on the central maintenance computing system (CMCS) bus from the left AIMS cabinet. Built-in-test equipment (BITE) circuits test and report faults to the AIMS cabinets.

Outputs

The left and right MMRs send position and time mark data to the left and right AIMS cabinets.

The GPSSUs also send position data to the ground proximity warning computer (GPWC). The GPWC uses this data in its terrain awareness and terrain clearance floor functions.



NOTE: LEFT MMR IS SHOWN. RIGHT MMR IS SIMILAR.

GPS - FUNCTIONAL DESCRIPTION

34-58-00-012 Rev 2 02/27/1998

GPS - DISPLAYS - 1

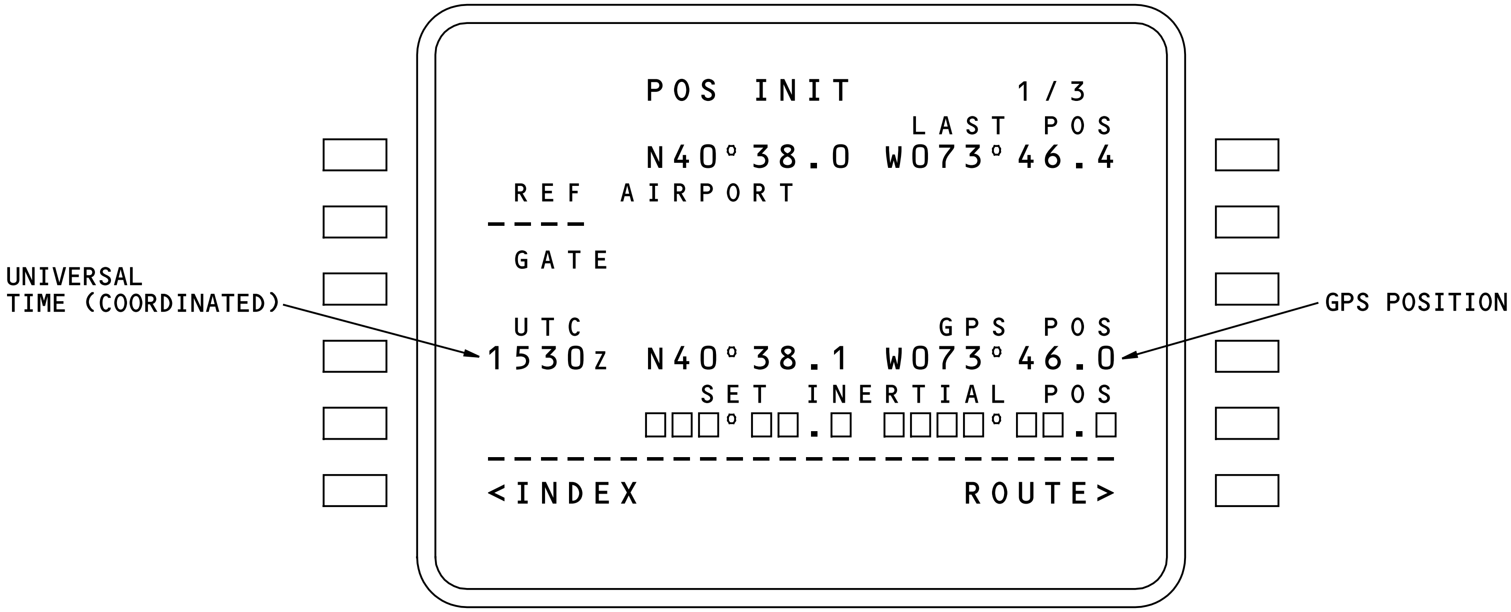
General

The flight management computing function (FMCF) of the AIMS shows position initialization and position reference pages on the control display unit (CDU).

The multi-mode receivers (MMRs) send GPS data to the AIMS cabinets. GPS data shows on the CDU. The position initialization page shows the GPS position and GPS time.

The flight crew can use the GPS position to initialize the air data inertial reference unit (ADIRU) position.

The GPS universal time (coordinated) (UTC) shows on the CDU when the GPS time is valid.



POSITION INITIALIZATION PAGE

34-58-00-013 Rev 1

GPS - DISPLAYS - 1

GPS - DISPLAYS - 2

General

Position reference page two shows the active flight management computing function (FMCF) airplane position.

The FMCF can use GPS position data to calculate the airplane position. The FMCF also uses these other navigation aids to calculate the airplane position:

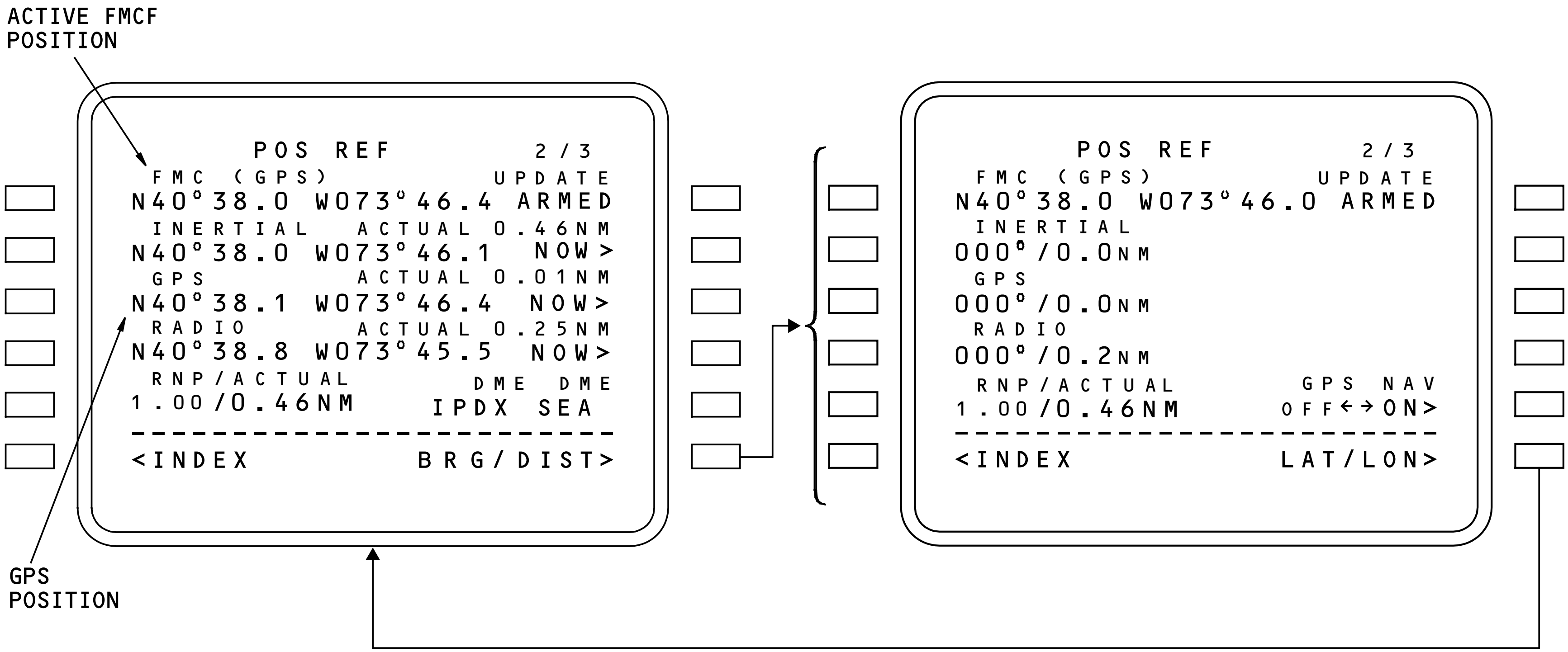
- Air data inertial reference unit (ADIRU)
- Distance measuring equipment (DME)
- Very high frequency omnidirectional ranging (VOR)
- Localizer (LOC).

The FMCF calculates the accuracy of the data from each navigation aid. These calculations show as ACTUAL next to each navigation aid on POS REF page 2 of 3. Accuracy shows in nautical miles.

Use line select keys (LSK) 2R-4R to make the active FMCF use the selected data to update the FMCF position.

The left FMCF uses the left multi-mode receiver (MMR), and the right FMCF uses the right MMR. If the onside MMR fails, the FMCFs use the offside MMR.

Use line select key 6R to see the position reference in bearing/distance format or in latitude/longitude format.



POSITION REFERENCE PAGE 2

GPS - DISPLAYS - 3

General

Position reference page three shows this information:

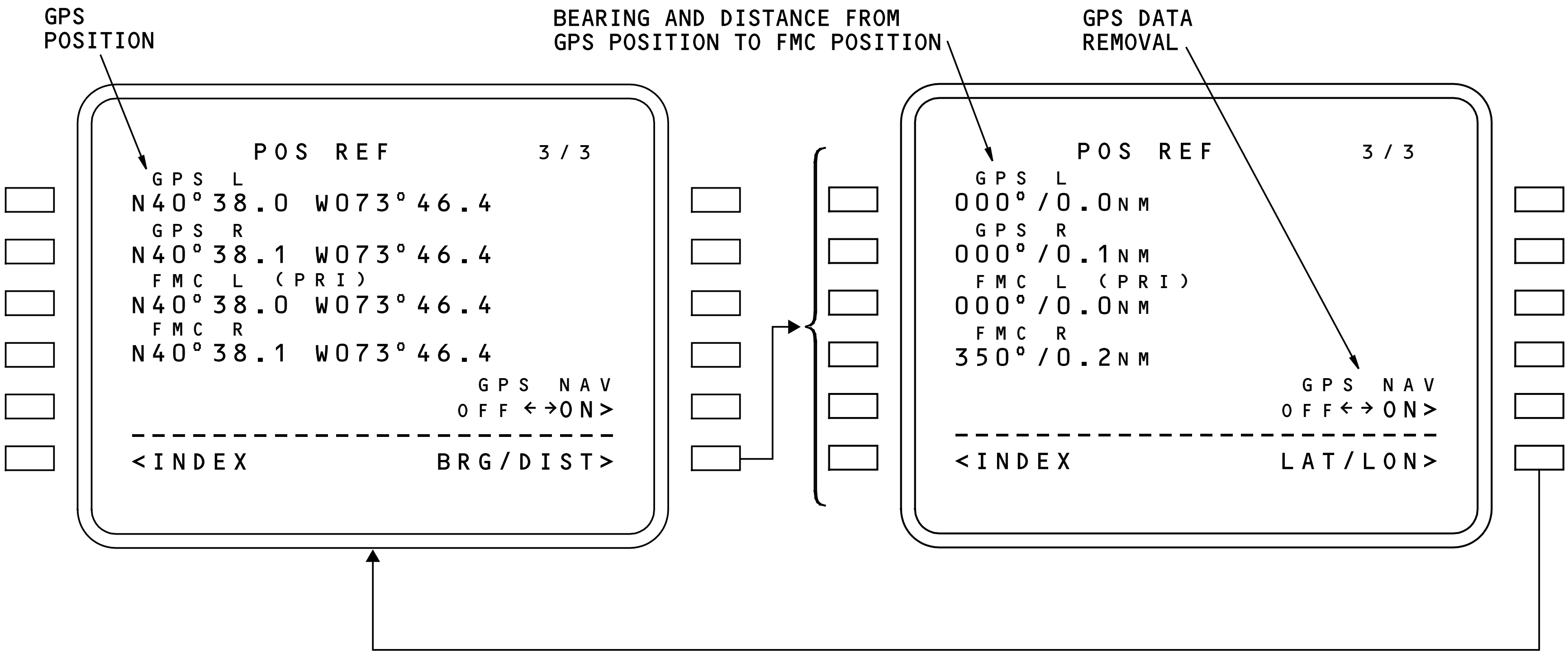
- GPS position
- Bearing and distance to the FMCF airplane position from the GPS position.

GPS Data Elimination

You can remove GPS data from the FMCF position calculation:

- Select line select key (LSK) 5R when ON shows in larger letters to remove GPS data from the FMCF calculation
- Select LSK 5R when OFF shows in larger letters to let the FMCF use GPS data.

Push LSK 6R to see the FMCF airplane position as bearing/distance or latitude/longitude.



POSITION REFERENCE PAGE 3

34-58-00-015 Rev 4 11/06/1997

GPS - DISPLAYS - 3

GPS - GROUND TEST

General

There are only system tests available for the GPS. These are the system tests available:

- Left global positioning system
- Right global positioning system.

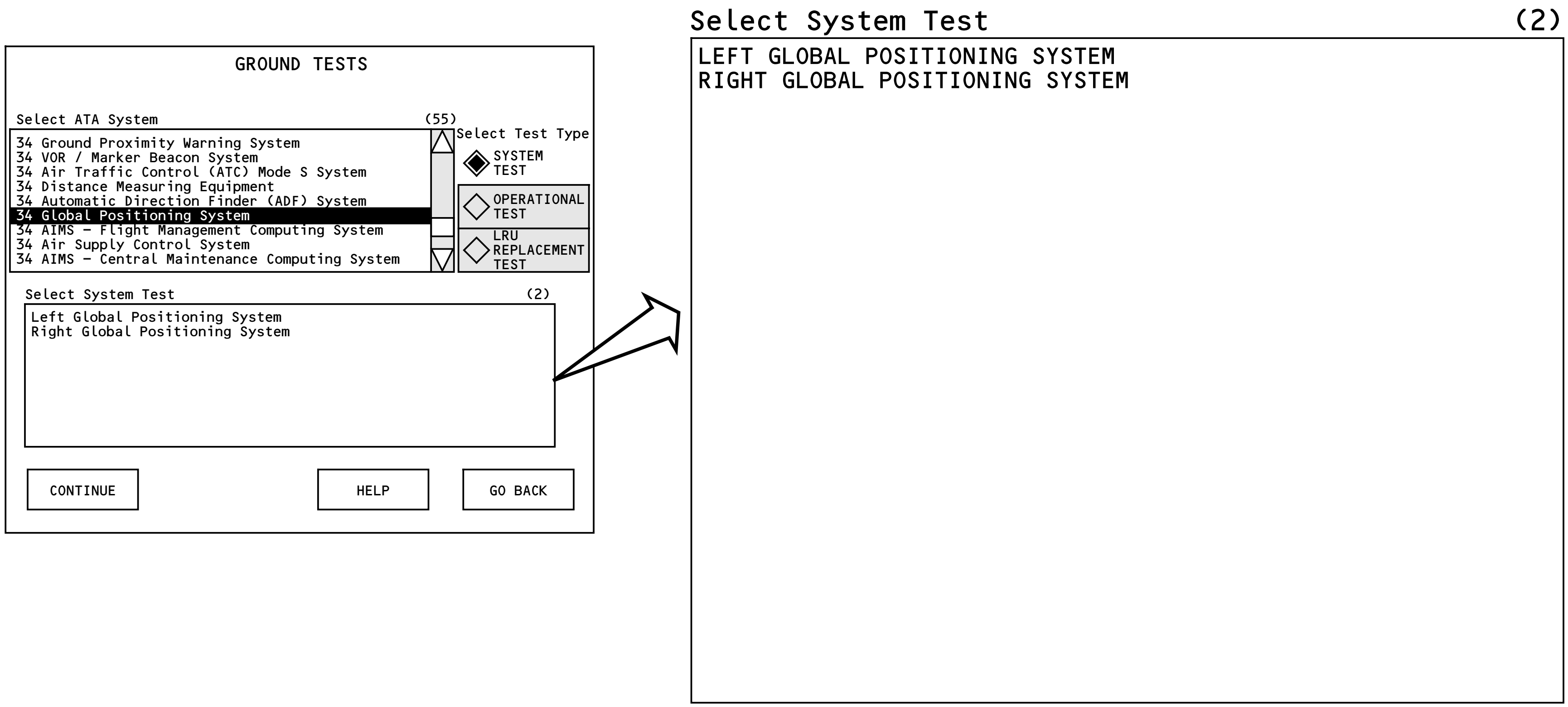
System Test

This test lets you verify the operation of the GPS function of the multi-mode receivers (MMRs).

Training Information Point

The MMRs report their operational status to the central maintenance computing system (CMCS) at all times during operation after power-up. The MMRs do not do any additional test when you do a test from the maintenance access terminal (MAT).

During power-up, the MRRs do a test of the antennas. At that time, the MRRs verify continuity on the antenna connections. The MRRs do not do a test of the antennas during operation after power-up.



34-58-00-016 Rev 1

GPS - GROUND TEST

Continental Airlines, Inc

VOR System

WB371

TABLE OF CONTENTS

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VHF OMNIDIRECTIONAL RANGING (VOR) SYSTEM

Purpose

The VHF omnidirectional ranging (VOR) system is a navigation aid that gives magnetic bearing data from a VOR ground station to the airplane.

Description

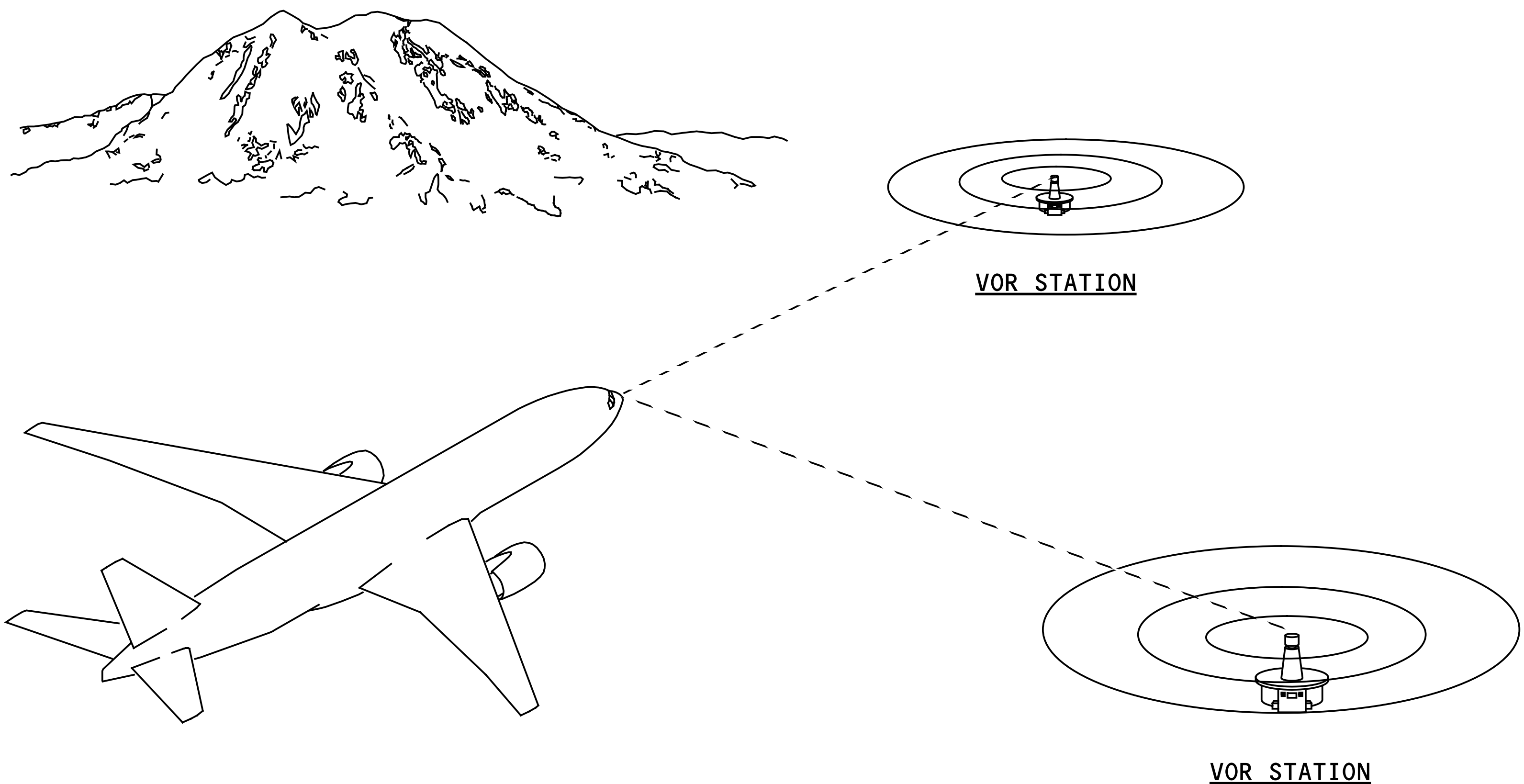
The VOR ground stations transmit an omnidirectional signal and directional signal. Together the signals give magnetic radial information from 000 degrees to 359 degrees. All VOR stations reference the 000 degree to magnetic north.

The VOR system receives the ground station signals and calculates bearing data. The data goes to various systems for display and navigation use.

The VOR system supplies station audio and identifier signals to the flight deck speakers and headsets.

Abbreviations and Acronyms

ACP	- audio control panel
AIMS	- airplane information management system
ALTN	- alternate
ARINC	- aeronautical radio, inc.
ATE	- automatic test equipment
auto	- automatic
BITE	- built-in test equipment
CDU	- control display unit
CMCF	- central maintenance computing function
CMCS	- central maintenance computing system
EFIS	- electronic flight instrument system
FMCF	- flight management computing function
LED	- light emitting diode
MHz	- megahertz
NCD	- no computed data
RF	- radio frequency
VHF	- very high frequency
VOR	- VHF omnidirectional ranging



34-51-00-001 Rev 1

VHF OMNIDIRECTIONAL RANGING (VOR) SYSTEM

VOR - GENERAL DESCRIPTION

General

The VOR system has two VOR/marker beacon (MB) receivers. The receivers have both VOR and marker beacon functions. This section covers only the VOR operation of the VOR/MB receiver. The VOR receivers get RF inputs from one VOR antenna on the vertical stabilizer.

Description

The receivers get manual tune inputs from the left or right CDU or autotune inputs from the airplane information management system (AIMS) cabinets. Manual or autotune inputs both go through the AIMS cabinets, then to the VOR receivers.

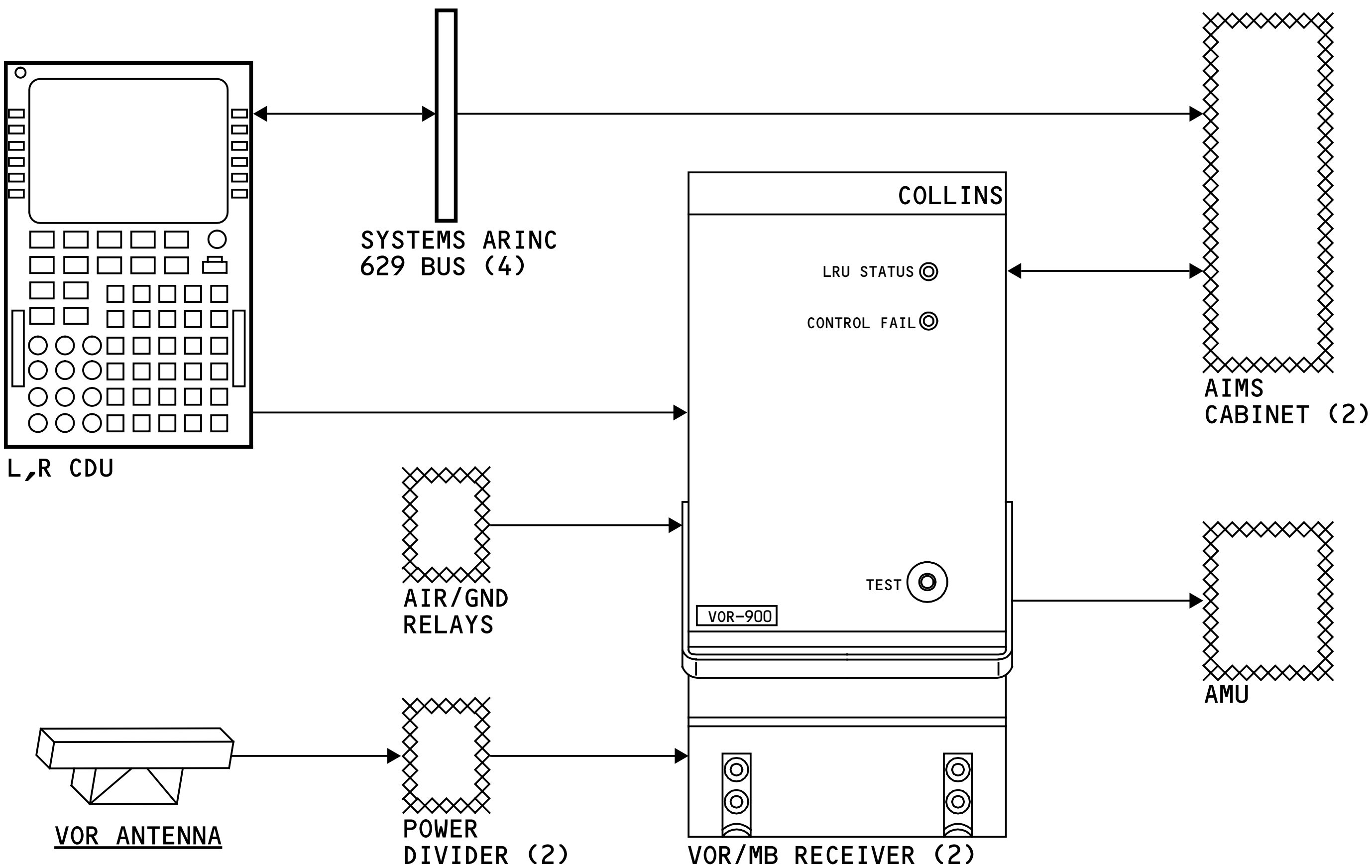
The VOR receivers can get tune inputs directly from the left or right CDU (alternate tune) if the tune inputs from the AIMS cabinets fail.

RF signals from the VOR antenna go through power dividers, then to the VOR receivers. The VOR receivers use the RF signals to calculate station bearing and to decode the Morse code station identifier signal.

The receivers get discretes from the air/ground relays.

The receivers send VOR bearing data to the AIMS cabinets to show on the navigation displays (NDs).

The VOR/MB receivers send station audio and identifier signals to the audio management unit (AMU).



34-51-00-002 Rev 4 11/06/1997

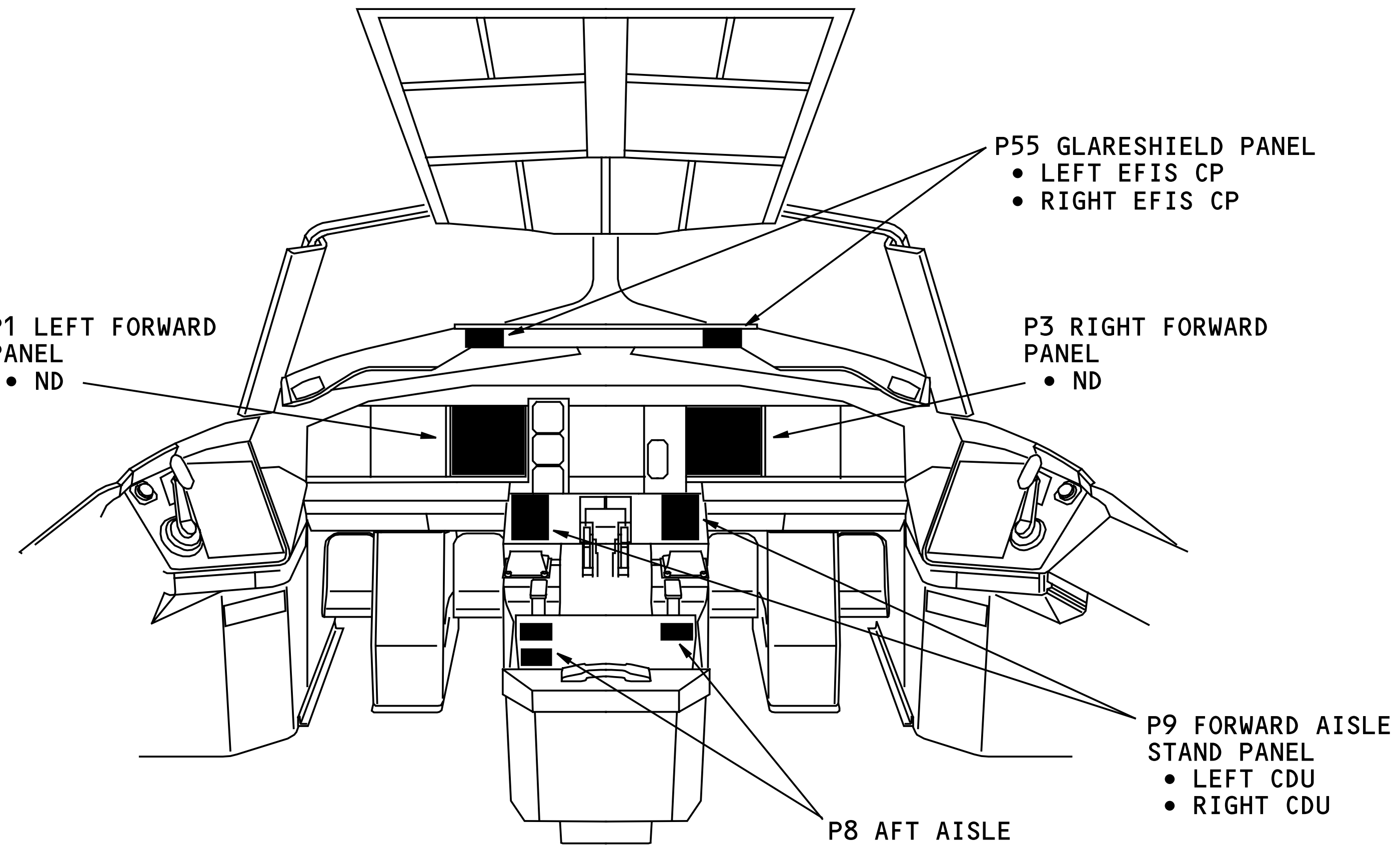
VOR - GENERAL DESCRIPTION

VOR - FLIGHT DECK COMPONENT LOCATION

General

The components on the flight deck that interface with the VOR system are:

- Captain's and first officer's navigation display (ND)
- Left and right EFIS control panel (CP)
- Left and right CDU
- Audio control panels (ACP).



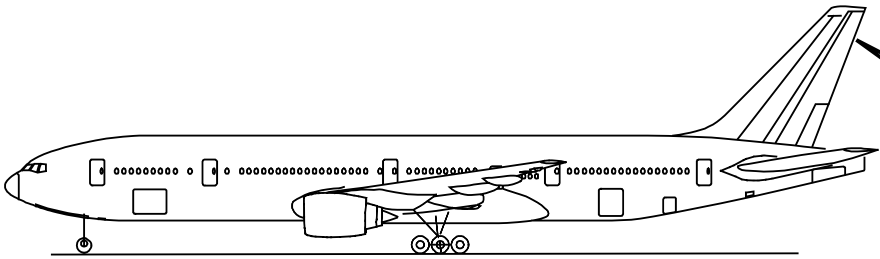
34-51-00-003 Rev 1

VOR - FLIGHT DECK COMPONENT LOCATION

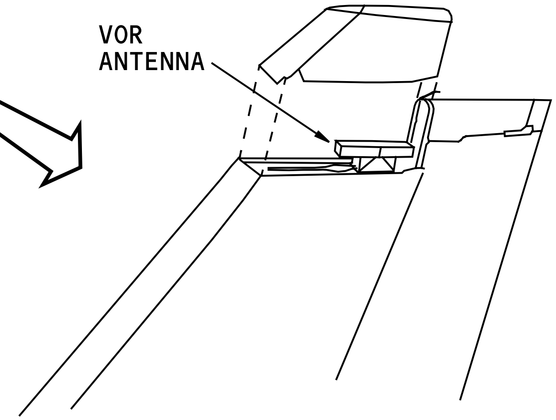
VOR - ANTENNA AND MAIN EQUIPMENT CENTER COMPONENT LOCATION

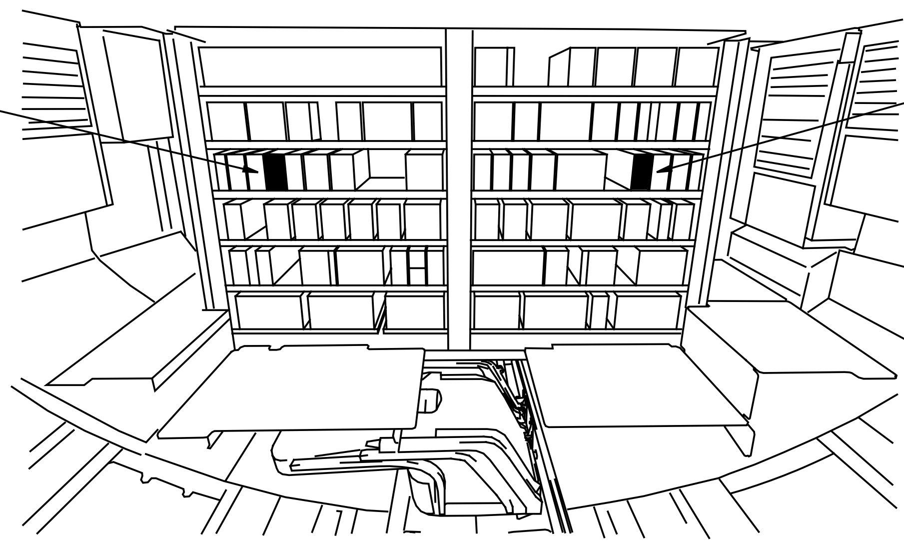
General

The VOR antenna is at the top of the vertical stabilizer. The left and right VOR/MB receivers are in the main equipment center on the E1 and E2 racks.



ANTENNA LOCATION





MAIN EQUIPMENT CENTER
(LOOKING AFT)

VOR - ANTENNA AND MAIN EQUIPMENT CENTER COMPONENT LOCATION

34-51-00-004 Rev 1

VOR - POWER, ANALOG, AND DISCRETE INTERFACE

General

These are the components that have interface with the VOR system:

- Circuit breakers
- VOR antenna
- Control display units (CDUs)
- AFDCs
- Air/ground relays
- Audio management unit (AMU).

Circuit Breakers

The VOR circuit breakers supply 115v ac power for operation. The left VOR/MB receiver gets power from the ac standby bus and the right VOR/MB receiver gets power from the right ac transfer bus.

CDUs

The CDUs send a frequency source select discrete to cause the VOR receivers to select the tune input from either the CDU or the AIMS cabinets. The resistor assemblies pull up the discretes to 28v dc. The left CDU sends a ground discrete to the left VOR receiver to change the source. The right CDU sends a ground discrete to the right VOR receiver to change the source.

Air/Ground Relay

The air/ground relays supply discrete inputs to the VOR/MB receivers to do these functions:

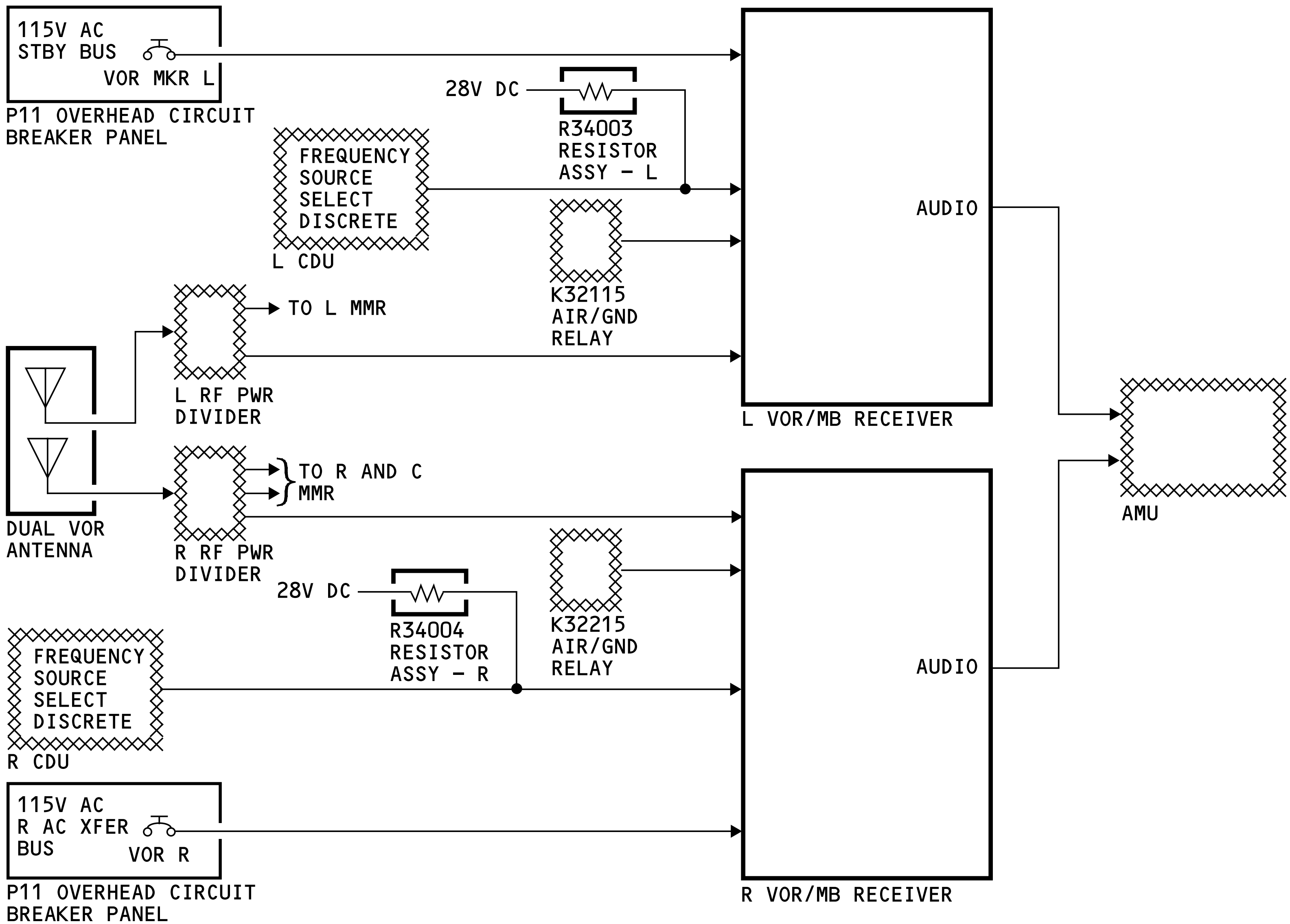
- Set flight legs (as alternate source, primary is from the CMCF of AIMS)
- Inhibit test commands in the air.

VOR Antenna

The VOR antenna sends RF signals through the left and right power dividers to the VOR/MB receivers.

Audio Management Unit

The audio management unit receives Morse code station identifier signals and station audio from the VOR receivers and supplies them to the flight interphone speakers and headsets.



34-51-00-021 Rev 2 02/27/1998

VOR - POWER, ANALOG, AND DISCRETE INTERFACE

VOR - SYSTEM INTERFACE

General

These are the components that interface with the VOR receivers:

- Left and right control display units (CDUs)
- Left and right airplane information management system (AIMS) cabinets.

All digital interfaces are on ARINC 429 data buses.

CDU

The left and right CDUs supply alternate tune inputs directly to the VOR receivers if the AIMS tune inputs fail. The left CDU alternate tunes the left VOR receiver and the right CDU alternate tunes the right VOR receiver.

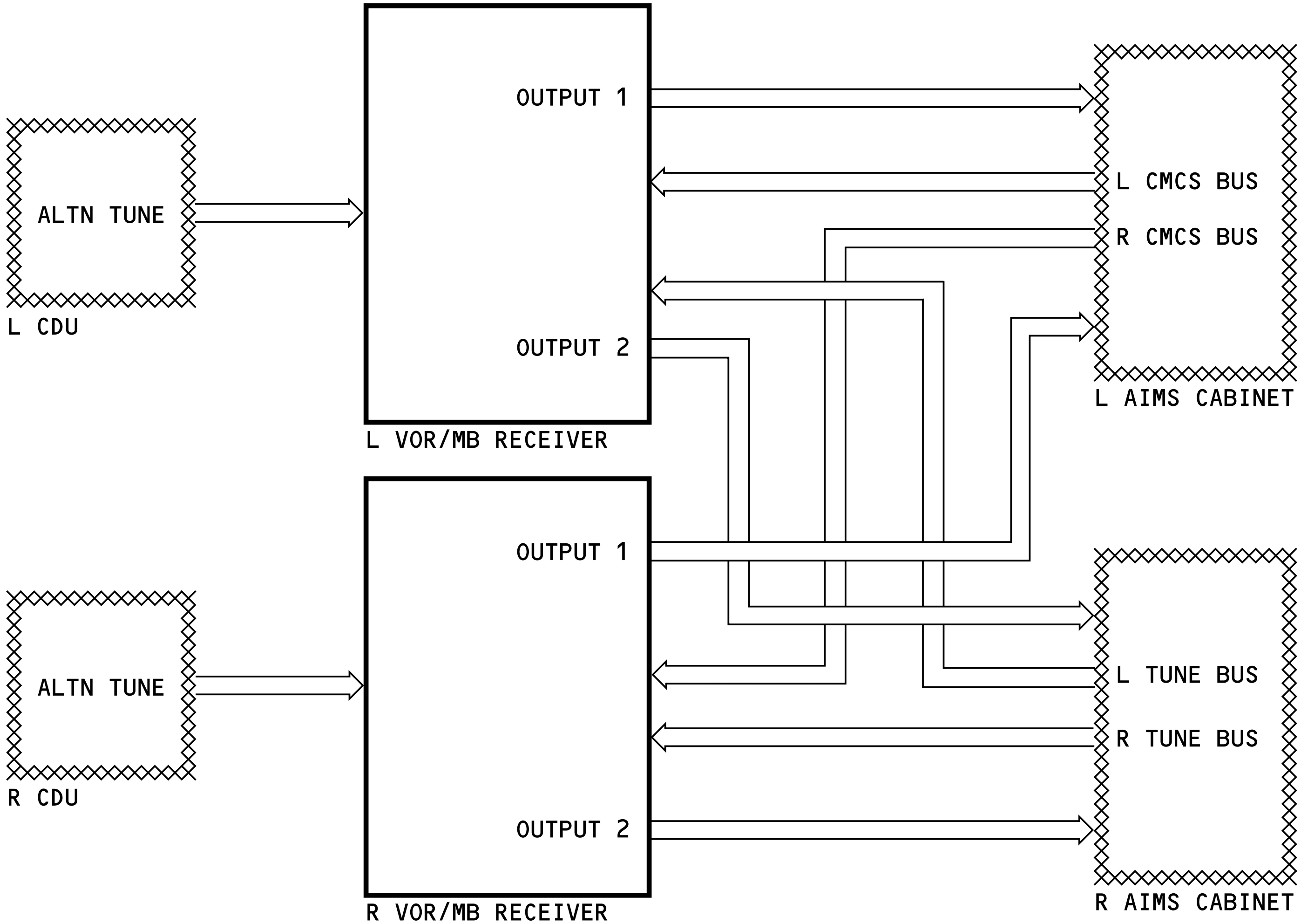
AIMS

The left AIMS cabinet sends test commands and primary flight leg information to the left and right receivers on the Left CMC bus and right CMC bus.

The right AIMS cabinet sends manual tune and autotune inputs to the left and right VOR receivers on the left tune bus and right tune bus.

VOR Outputs

Each VOR receiver has two output buses. One output bus to the left AIMS cabinet and one output bus to the right AIMS cabinet. Output bus one and two from each receiver sends VOR data, test results, and fault information to the left and right AIMS cabinets.



34-51-00-005 Rev 2

VOR - SYSTEM INTERFACE

VOR - VOR/MB RECEIVER

General

The VOR/marker beacon (VOR/MB) receiver has two receivers:

- VOR receiver
- Marker beacon receiver

Test and Indications

There are two light emitting diodes (LEDs) and a test switch on the front panel of the VOR/MB receiver. The LEDs show receiver test status when you do a test of the VOR/MB receiver. The red control fail input LED shows the status of the tune inputs. The green or red LRU status LED shows the status of the receiver test.

You can do a test of the VOR/MB receiver from the maintenance access terminal (MAT) or from the test switch on the VOR/MB receiver front panel. When you do a test of the left VOR/MB receiver, you do a test of the VOR function and the marker beacon function in the left VOR/MB receiver at the same time.

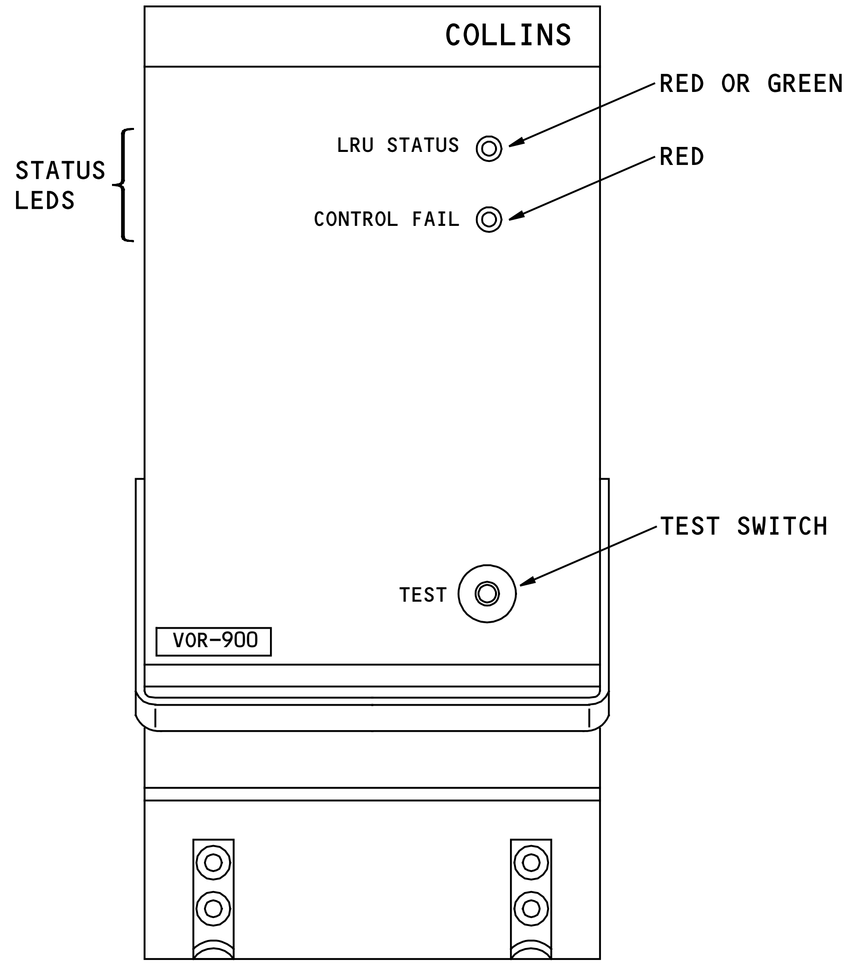
Flight Fault Memory

The VOR/MB receiver has a non-volatile flight fault memory. Only shop personnel can read the memory on the test bench.

Training Information Point

The maintenance manual and the fault isolation manual do not have a task for the line maintenance technician to do a test from the front panel of the VOR/MB receiver. You must do all tests for the VOR/MB receiver from the MAT or a PMAT.

Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For that reason these LRUs have a front panel test feature.



34-51-00-006 Rev 3 05/18/95

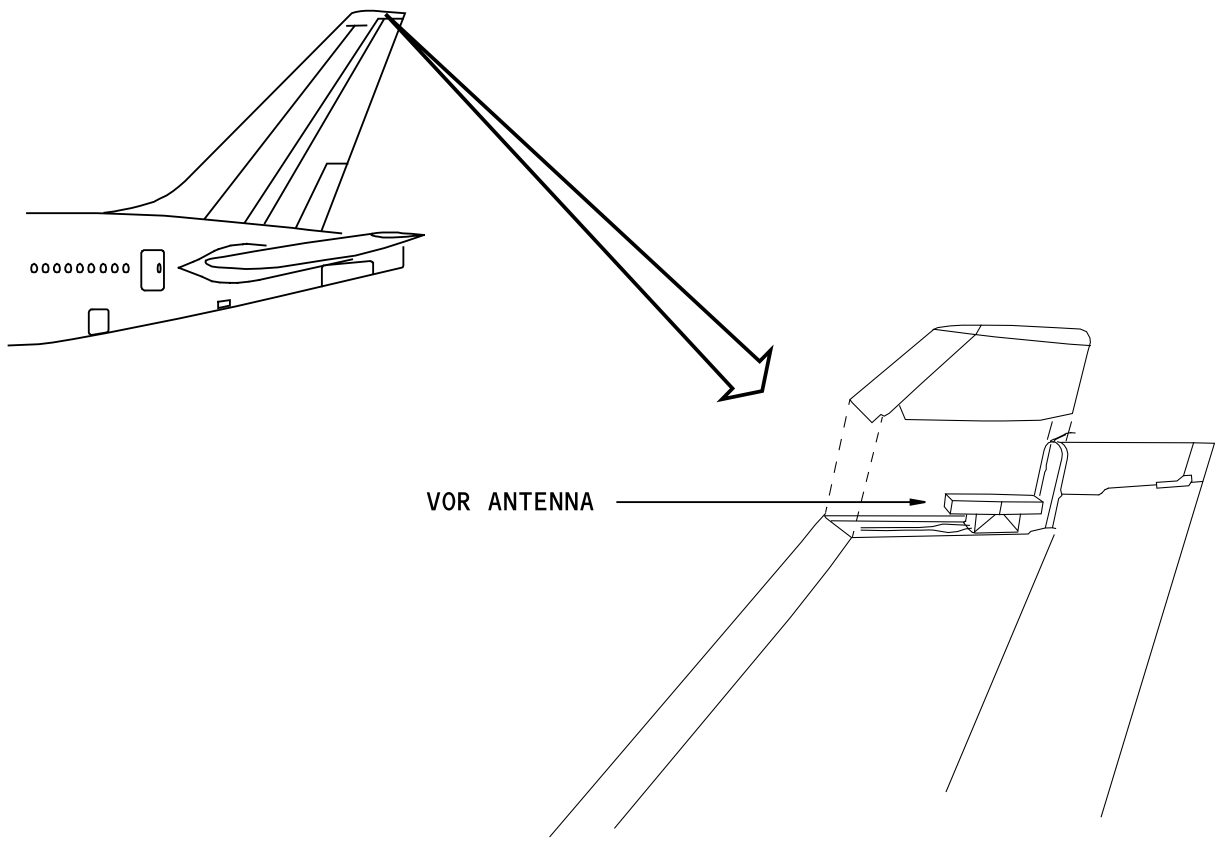
VOR - VOR/MB RECEIVER

VOR - ANTENNA

General

The VOR antenna is on the top of the vertical stabilizer. The VOR antenna receives RF signals in the frequency range of 108 MHz to 117.95 MHz. The antenna receives VOR and ILS frequencies. The VOR antenna sends VOR signals to both VOR/MB receivers.

The VOR antenna has two outputs, one to each VOR receiver.



34-51-00-007 Rev 1

VOR - ANTENNA

VOR - TUNE INPUTS

General

These are the three ways to tune the VOR receivers:

- Manually by the left, center, or right CDU
- Automatically by the AIMS cabinets
- By the CDUs as an alternate tune source.

Manual Tune

You manually tune the VOR receivers from the left or right control display unit (CDU). The center CDU can tune the receivers if the left or right CDU fails. Manual tune inputs from the CDUs go through the left and right systems ARINC 629 buses, then to the left and right AIMS cabinets.

The left AIMS cabinet sends manual and autotune data through the AIMS intercabinet ARINC 629 buses to the right AIMS cabinet.

Manual tune inputs from the left or right AIMS cabinet goes through the right AIMS cabinet to the VOR receivers.

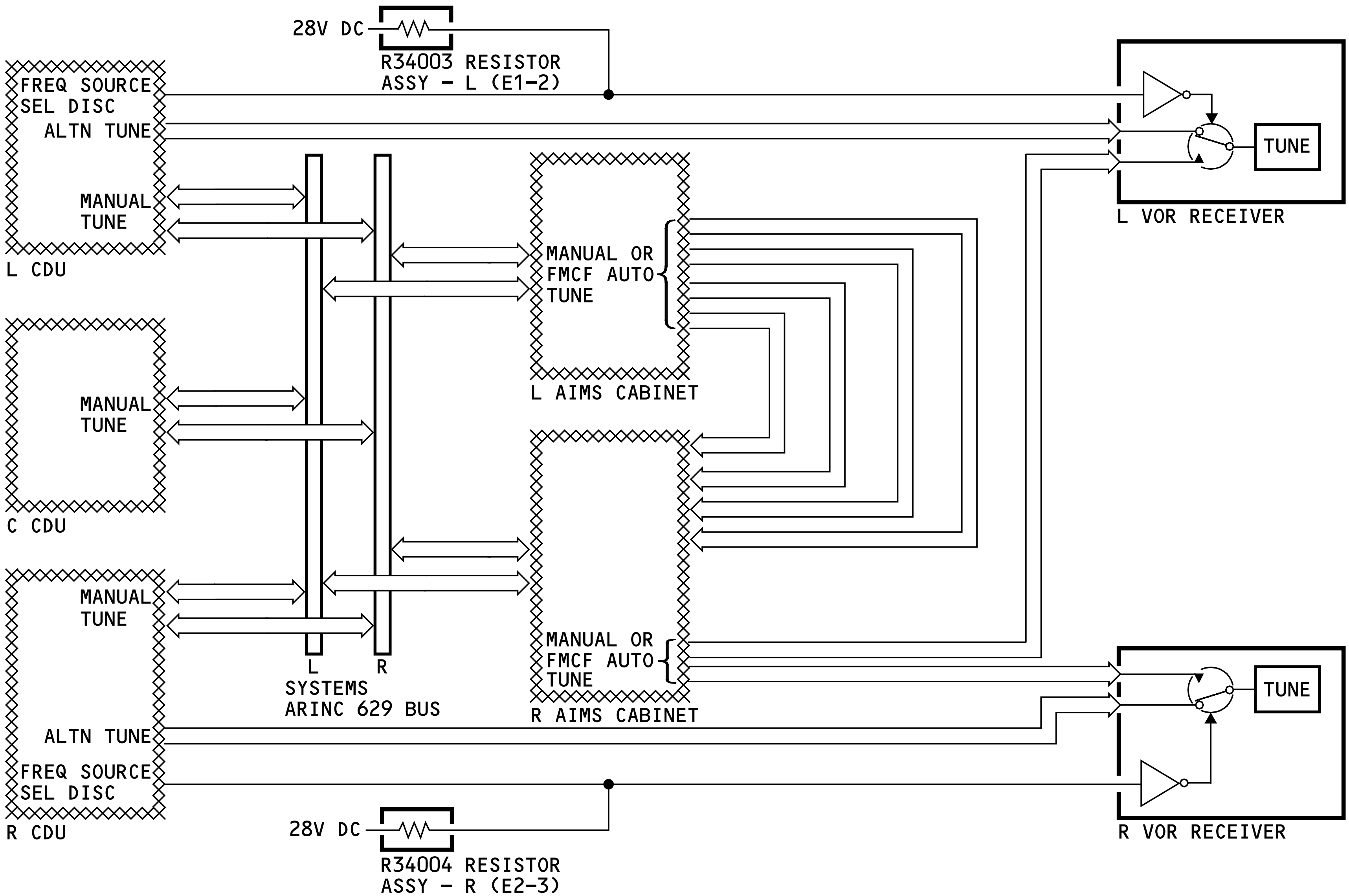
AIMS Autotune

The flight management computing function (FMCF) of the left or right AIMS cabinet can automatically tune (autotune) the VOR receivers. Autotune inputs from the left or right AIMS cabinet go through the right AIMS cabinet, then to the VOR receivers.

Alternate Tune

The CDUs monitor the AIMS cabinets tune functions. If the AIMS tune function fails, the CDUs send a frequency source select discrete to the VOR receivers that changes the tune input from the right AIMS cabinet to the tune input from the left or right CDU. The CDUs use 28v dc from a pull up resistor to set the discrete.

In the alternate tune mode, the left CDU tunes the left VOR receiver and the right CDU tunes the right VOR receiver. The center CDU has no alternate tune function.



VOR - TUNE INPUTS

34-51-00-009 Rev 3 02/06/1998

VOR - AUDIO CONTROLS

General

The audio control panels supply control inputs to the audio management unit. This lets the crew hear audio on the speakers and headsets in the flight deck.

Description

These are the controls on the audio control panel that let you hear VOR audio:

- VOR/ADF receiver selector
- VOR/ADF receiver volume control
- NAV filter selector.

VOR/ADF Receiver Selector

The VOR/ADF receiver selector lets you select ADF or VOR as the source of audio.

VOR/ADF Receiver Volume Control

The VOR/ADF receiver volume control turns on the audio and controls the volume.

NAV Filter Selector

The NAV filter selector lets you select one of these:

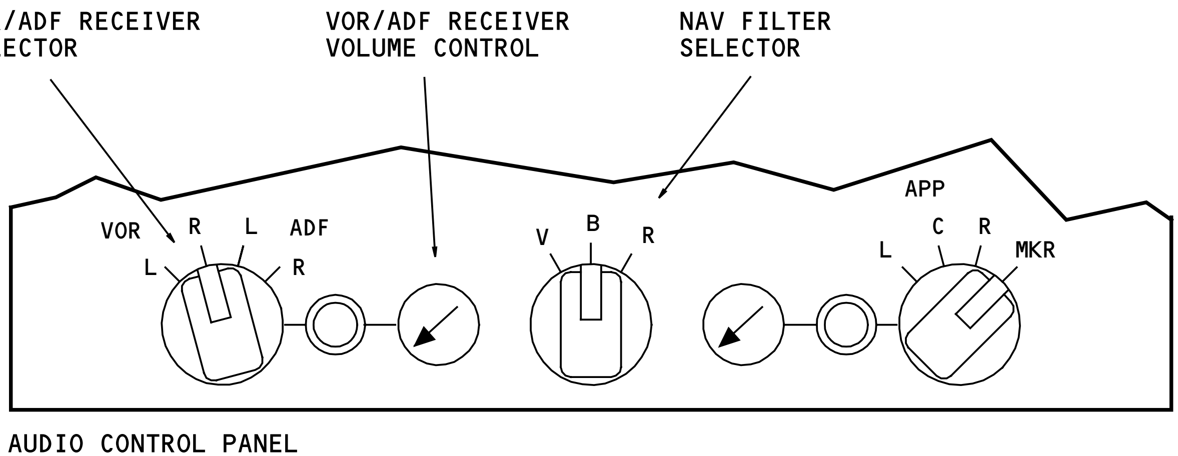
- Voice (V) audio
- Both (B) voice and range audio.
- Range (R) audio

Operation

To hear VOR audio, do this:

- Set the VOR/ADF receiver selector to the left (L) or right (R) VOR position
- Push the VOR/ADF receiver volume control to turn on the ADF audio (turn the control to adjust the volume)
- Set the NAV filter selector to the voice (V) position.

To hear the station identifier, set the NAV filter selector to either the both (B) or the range (R) position.



34-51-00-010 Rev 3 11/07/1997

VOR - AUDIO CONTROLS

VOR - CDU TUNING

General

The CDUs supply manual tune inputs during normal operation and alternate tune inputs when the AIMS tune functions fail.

Operation

To see VOR tune frequencies, push the NAV RAD key on the CDU. The NAV RADIO page shows data for the left and right VOR systems.

To manually tune a VOR receiver, enter a valid VOR frequency or identifier into the CDU scratch pad. Push line select key 1L or 1R to enter the frequency for the left or right VOR receiver.

When you manually enter a VOR frequency, the letter M shows after the frequency.

The letter A shows after the frequency when the FMCF of AIMS autotunes the receivers.

To enter the selected course, enter the course into the CDU scratchpad. Push line select key 2L or 2R to enter the course for the left or right VOR receiver.

To delete the frequency or course, push the delete (DEL) key on the CDU. The delete function shows in the CDU scratchpad. Next, push the line select key (LSK) next to the applicable VOR data line.

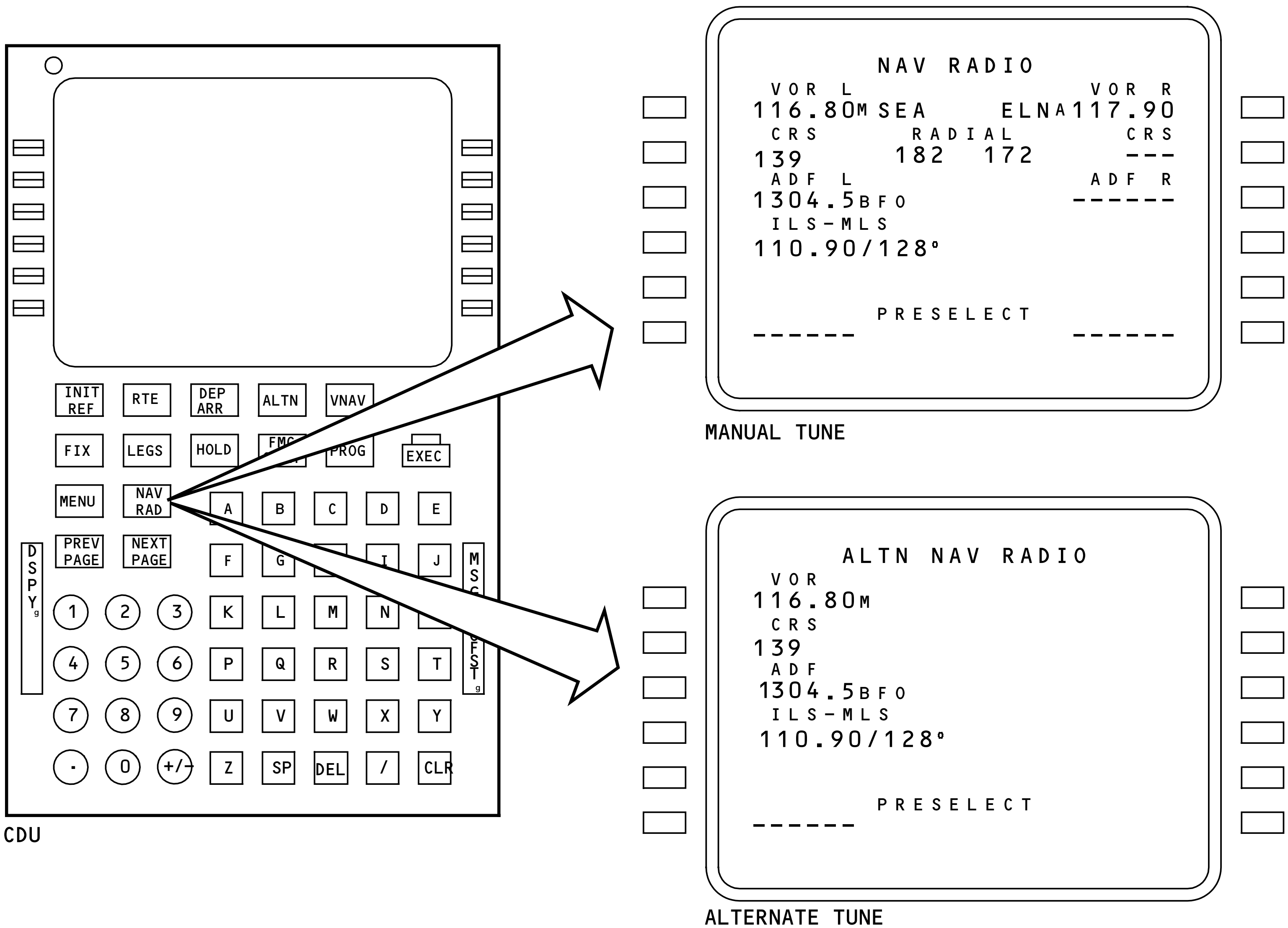
Alternate Tune

The ALTN NAV RADIO page is available only when the tune inputs from the AIMS cabinets fail.

To access the ALTN NAV RADIO page, push the NAV RAD key on the CDU.

The ALTN NAV RADIO page is different than the NAV RADIO page. The ALTN NAV RADIO page shows data for only the onside NAV radio systems. The left CDU ALTN NAV RADIO page controls the left VOR receiver. The right CDU ALTN NAV RADIO page controls the right VOR receiver.

You enter a VOR frequency and selected course the same as you do for normal manual tuning.



VOR - CDU TUNING

VOR - EFIS CONTROLS

General

The EFIS control panel has controls to select the display mode of the ND. These are the EFIS controls that cause VOR displays to show:

- Navigation display mode selector
- Left and right VOR/ADF switches.

Navigation Display Mode Selector

Use the mode selector to select the display mode. To see VOR data, set the mode selector to the VOR position.

VOR/ADF Switch

The VOR/ADF switches select the VOR or ADF receivers as the source of data for the left and right bearing pointers on the ND. There are two switches for the left and right bearing pointers. When the VOR/ADF switches are in the VOR position, VOR data shows in the approach (APP), VOR, and map modes. When the switches are set to the off position, the VOR data goes out of view.

Alternate or Backup EFIS Control Panel

You access the EFIS control page from the MENU page on the control display unit (CDU). The EFIS control page on the CDU permits alternate or backup controls for the VOR system displays.

The left CDU is the alternate or backup control for the left EFIS control panel and the right CDU is the alternate or backup for the right EFIS control panel.

When you select EFIS control from the CDUs, the onside EFIS control panel does not operate.

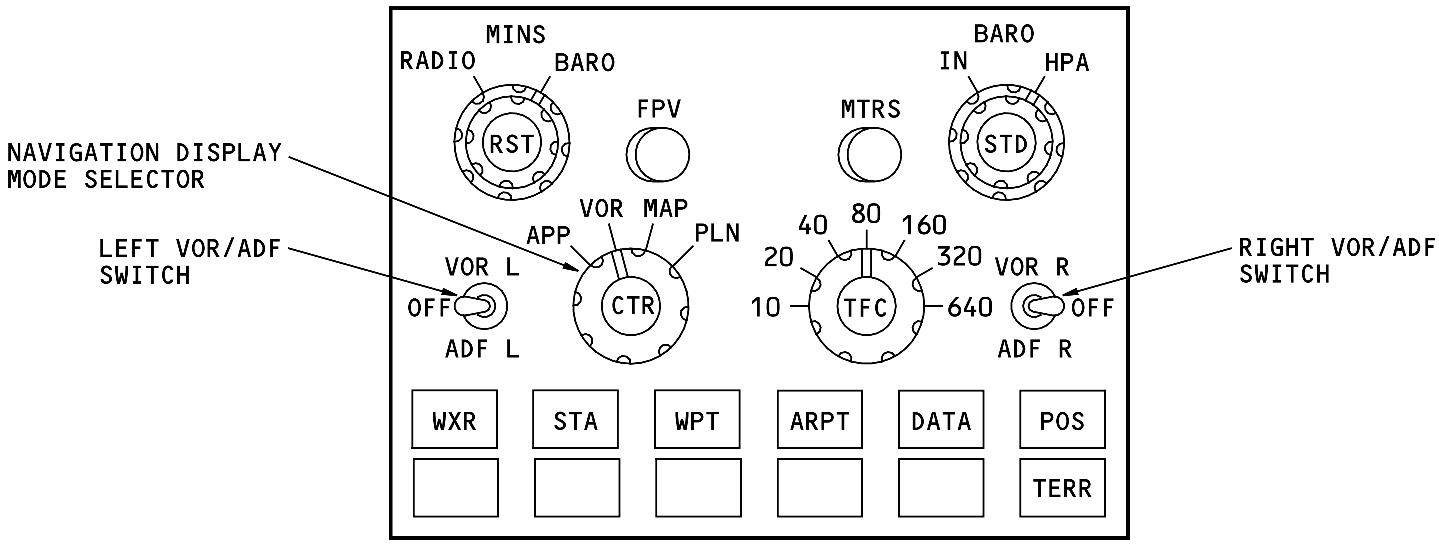
On the EFIS control page you can select the ND mode display for:

- APP
- VOR
- MAP.

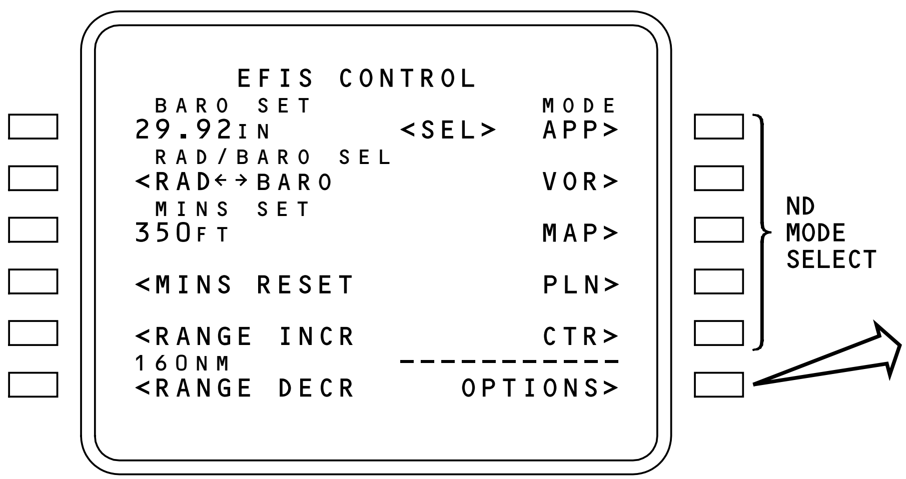
There is no VOR display for PLAN mode. To select VOR data for the bearing pointers, you must push the OPTIONS line select key on the EFIS control page. This brings up the EFIS OPTIONS page.

The line select key next to the OFF-ADF-VOR data line on the EFIS OPTIONS page permits you to toggle between ADF or VOR data as the source of data for the bearing pointers.

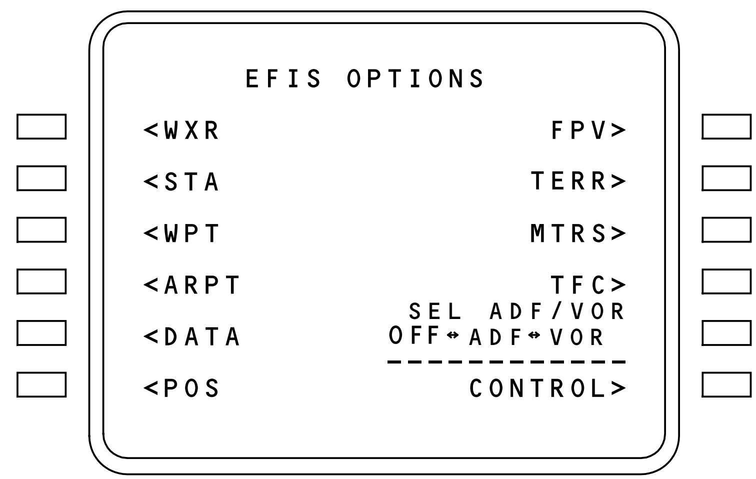
OFF selection removes the bearing pointer and data.



EFIS CONTROL PANEL



EFIS CONTROL PAGE



EFIS OPTIONS PAGE

VOR - EFIS CONTROLS

34-51-00-012 Rev 2 02/27/1998

VOR - ND VOR DISPLAYS

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VOR - ND VOR DISPLAYS

General

When the navigation display mode selector on the EFIS control panel is in the VOR position and the VOR/ADF switch is set to VOR, these displays show:

- VOR deviation bar and scale
- NAV data source
- VOR frequency or identifier
- Selected course
- Bearing pointers
- To/from pointer and indicator
- VOR data.

VOR displays show in the centered mode or expanded mode.

VOR Display Source

The VOR display source for the VOR mode is the onside VOR receiver only. If the left VOR receiver fails, the captain's VOR mode will not show VOR deviation. If the right VOR receiver fails, the first officer's VOR mode will not show VOR deviation.

VOR Deviation Bar and Scale

The deviation bar and scale shows deviation from the selected course.

NAV Data Source

The NAV data source display shows at the top right corner of the ND. The NAV data source shows which VOR system supplies the navigation data on the ND.

VOR Frequency or Identifier

The frequency or identifier shows at the top right of the ND next to the NAV data source. If the receiver gets a valid VOR ground station signal and the station identifier is present, then the station identifier replaces the frequency.

VOR Selected Course

The VOR selected course shows below the frequency or identifier. Selected course shows when there is a manual selection of the VOR station on the CDUs. The selected course becomes dashes when the AIMS cabinets autotunes the VOR stations.

Bearing Pointers

The left and right pointers show when the VOR/ADF switches are in the VOR or ADF position. The pointers show in APP, VOR, and MAP display modes. The pointers go out of view when the switches are in the off position. The pointers show around the compass arc. In the expanded mode, the pointers show if the bearing of the station is within the range of the compass arc.

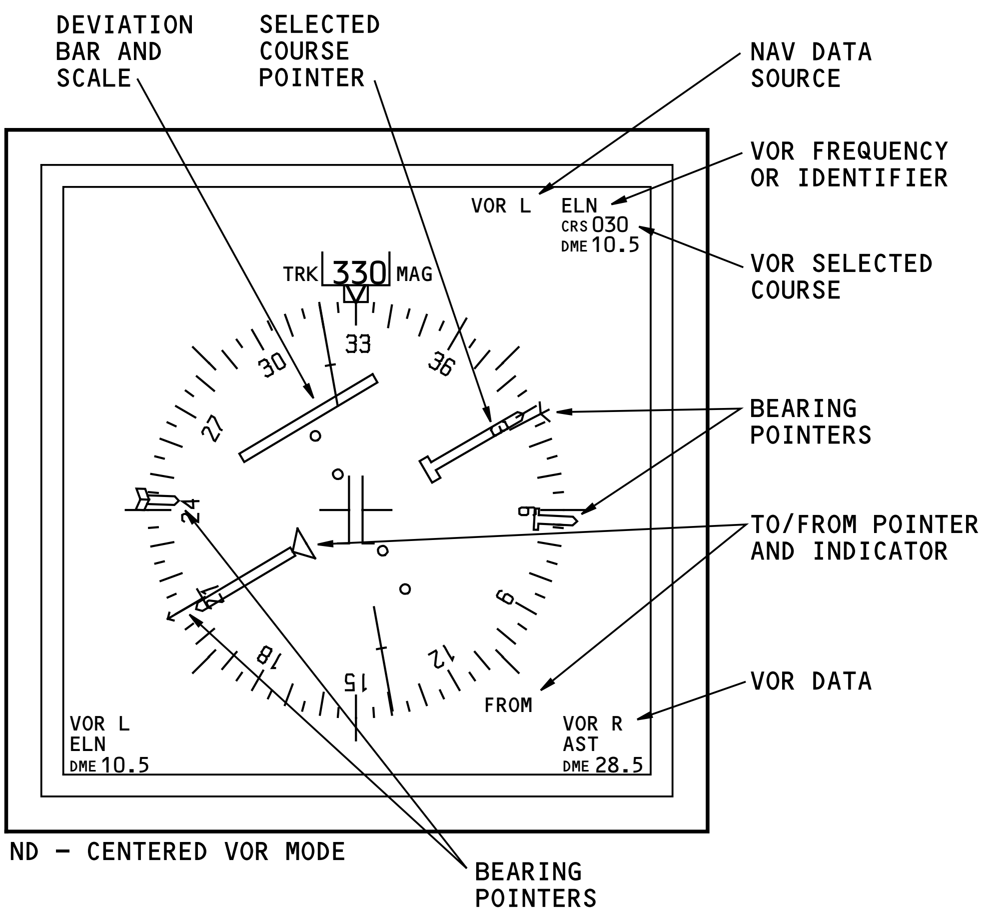
VOR - ND VOR DISPLAYS

To/From Pointer and Indicator

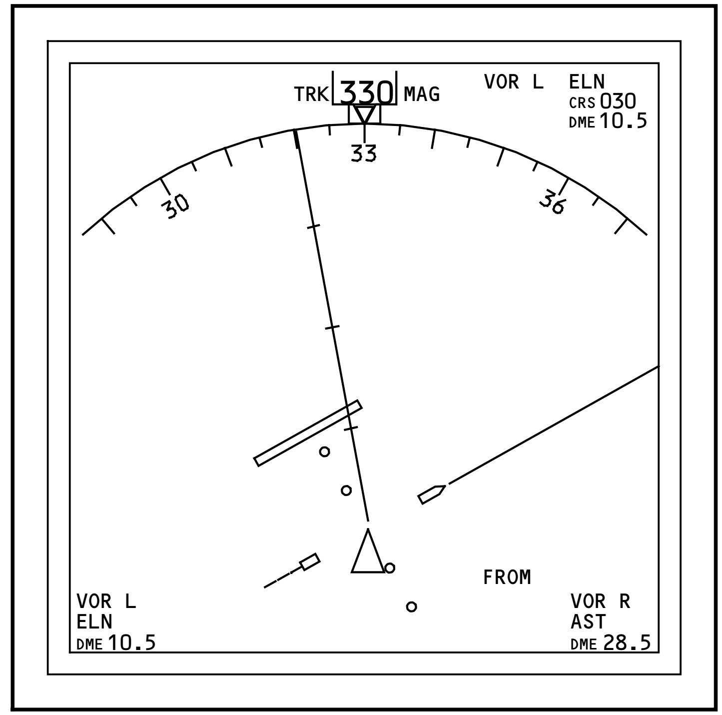
The to/from indications show if the selected course will take the airplane to or from the VOR station.

VOR/ADF Switch Data

The VOR/ADF data shows the data source for the left and right bearing pointers and their frequencies. The data shows at the lower corners of the ND in the APP, VOR, and MAP display modes.



ND - CENTERED VOR MODE



ND - EXPANDED VOR MODE

34-51-00-013 Rev 3 02/27/1998

VOR - ND VOR DISPLAYS

VOR - ND VOR AUTOTUNE DISPLAY

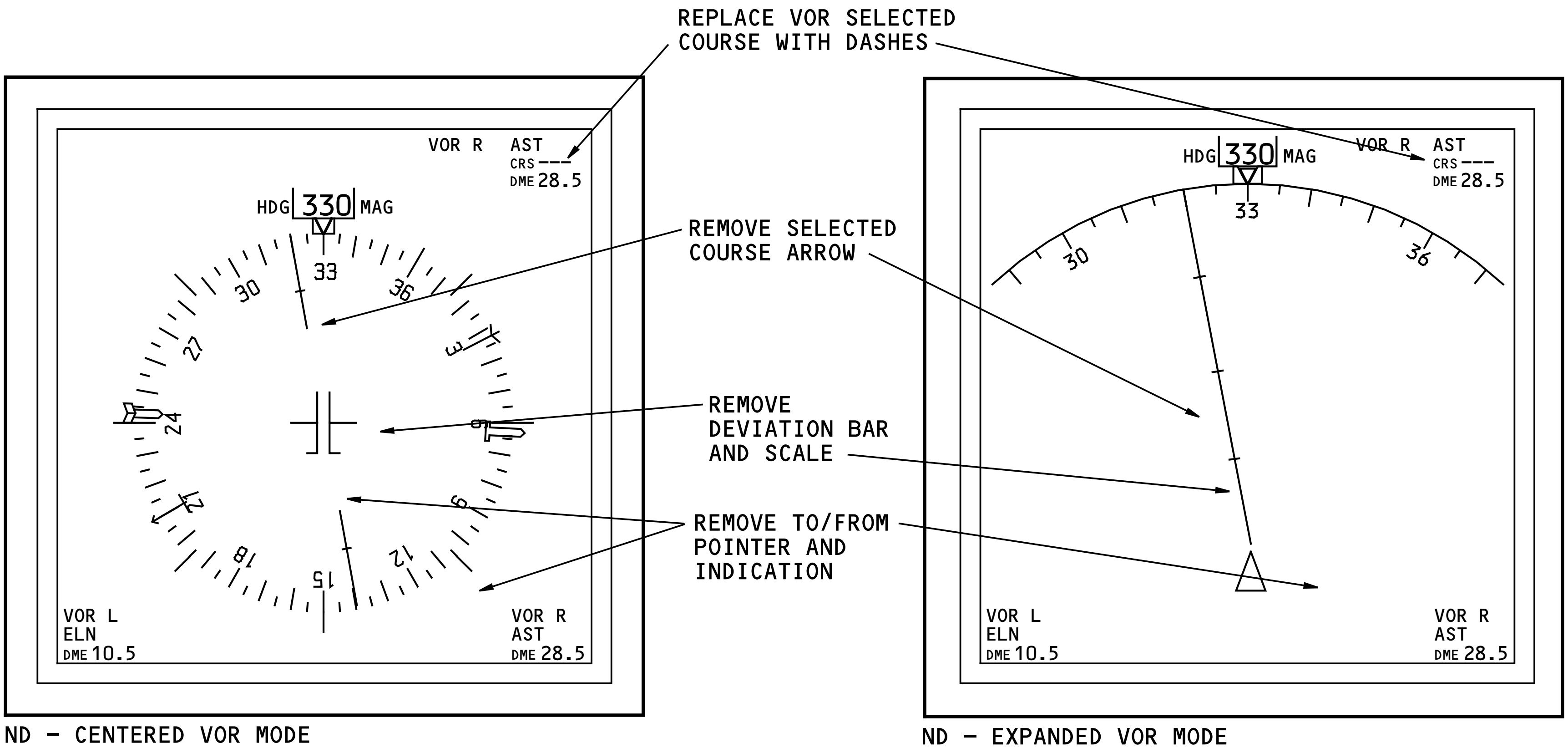
General

In autotune, the flight management computing function (FMCF) of AIMS supplies the VOR frequencies to the VOR/MB receivers.

Autotune Displays

When the FMCF of AIMS autotunes the receivers, these displays change:

- Replace VOR selected course numbers with dashes
- Remove selected course arrow
- Remove deviation bar and scale
- Remove to/from pointer and indication.



34-51-00-014 Rev 2

VOR - ND VOR AUTOTUNE DISPLAY

VOR - ND VOR MAP MODE DISPLAYS

General

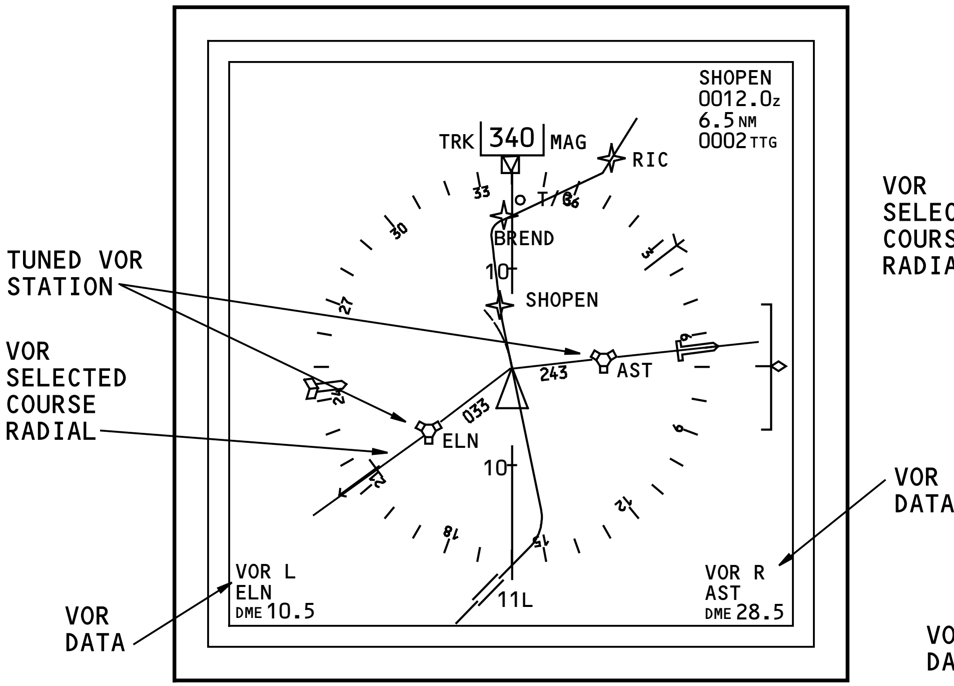
VOR data shows in the ND map mode when the VOR/ADF switches on the EFIS control panels are in the VOR position.

Description

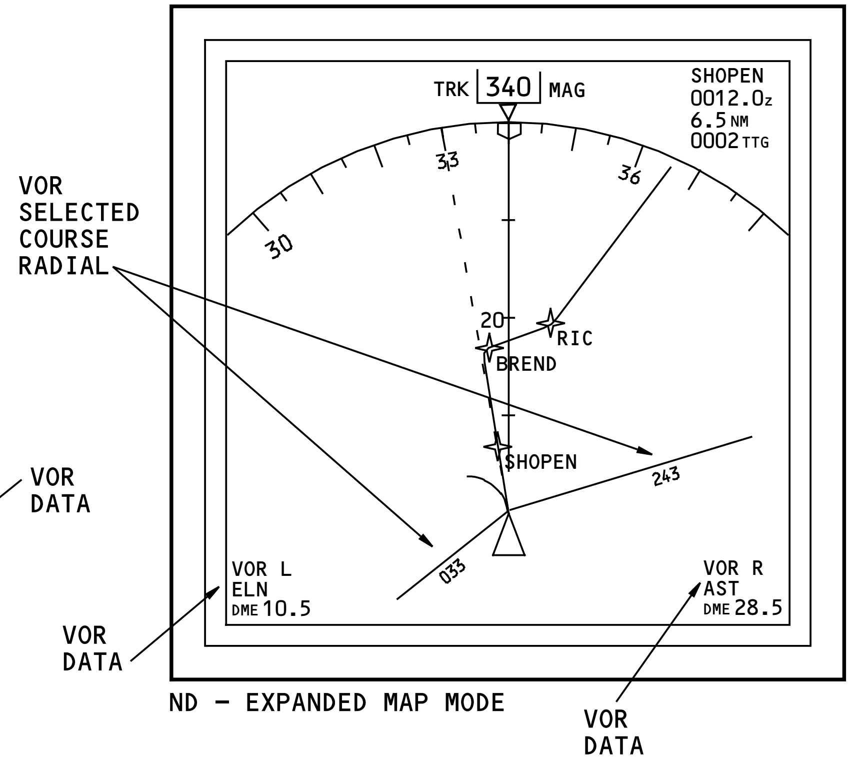
The ND map mode shows in the centered or expanded mode. The map mode shows the tuned VOR stations if they are inside the selected range. When you set the EFIS control panel VOR/ADF switches to the VOR position, the bearing pointers show on the compass scale and the VOR data show at the lower corners of the NDs.

When the VOR/ADF switches are set to the off position, the pointers and VOR data go out of view.

The VOR selected course radial shows on the ND when you push the POS switch on the EFIS control panel. The selected course number shows on the selected course radial with an R before the number to show that it is a radial.



ND – CENTERED MAP MODE



ND – EXPANDED MAP MODE

34-51-00-015 Rev 3 02/12/1998

VOR – ND VOR MAP MODE DISPLAYS

VOR - ND VOR NCD DISPLAYS

General

The inputs that are necessary for VOR displays are:

- Bearing from the VOR/MB receivers
- Frequencies from the CDUs or the AIMS cabinets
- Selected course from the CDUs or the AIMS cabinets.

When one of these inputs change to a no computed data (NCD) condition, some of the displays go out of view.

Bearing NCD

When the VOR bearing output from the VOR/MB receiver goes to an NCD condition, these VOR displays change:

- Remove the deviation bar
- Remove to/from pointer and indication.

Frequency NCD

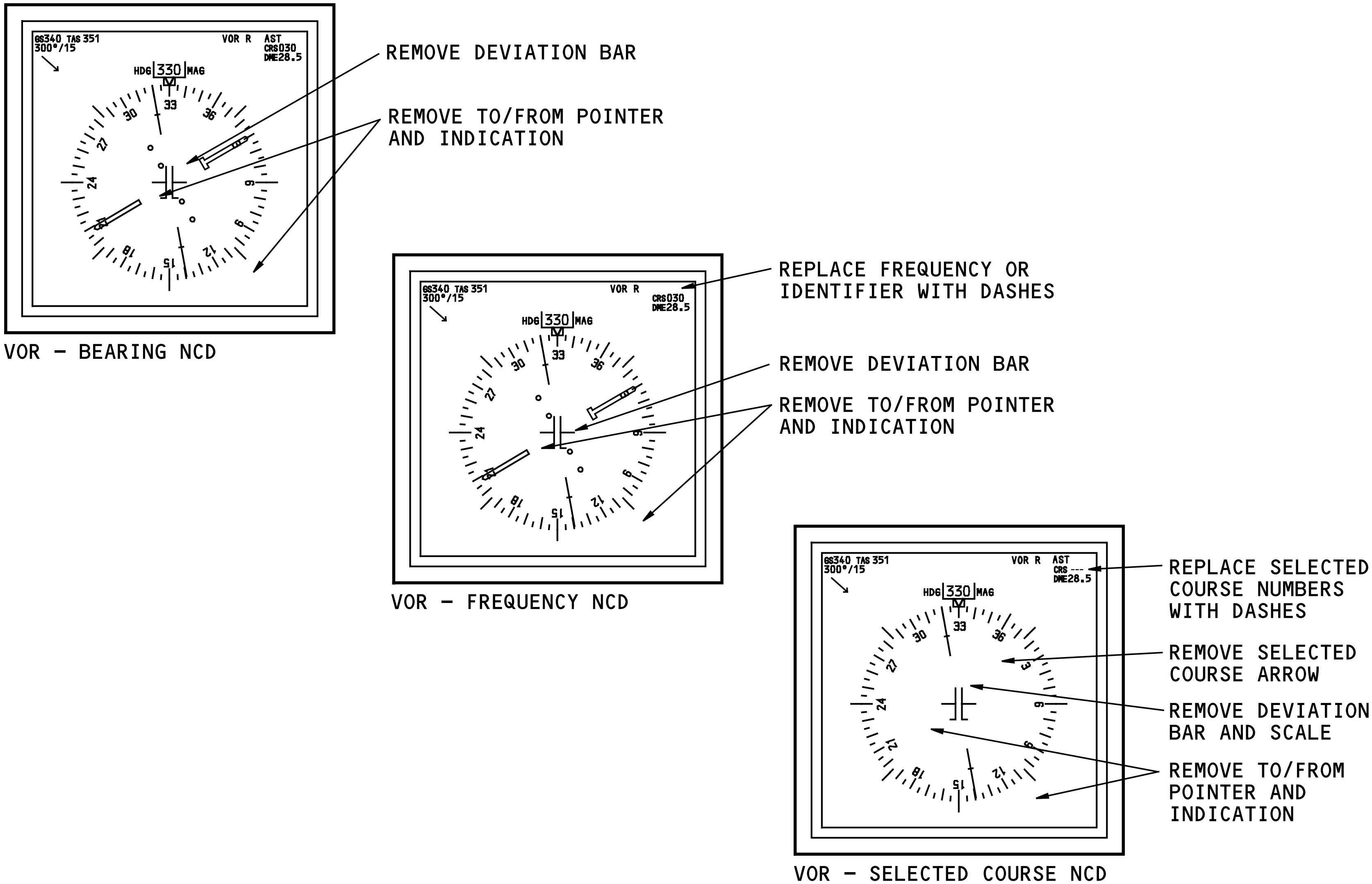
When the frequency input to the VOR/MB receiver goes to an NCD condition, these VOR displays change:

- Replace frequency or identifier with dashes
- Remove the deviation bar
- Remove the to/from pointer and indication.

Selected Course NCD

When the selected course input goes to an NCD condition, these displays change:

- Replace the selected course numbers with dashes
- Remove the selected course arrow
- Remove the deviation bar and scale
- Remove the to/from pointer and indication.



34-51-00-016 Rev 1

VOR – ND VOR NCD DISPLAYS

VOR - ND VOR INVALID DISPLAYS

General

The inputs that are necessary for VOR displays are:

- Bearing from the VOR/MB receivers
- Frequencies from the CDU or the AIMS cabinets
- Selected course from the CDUs or the AIMS cabinets.

When one of these inputs change to an invalid condition, some of the VOR displays change.

Bearing Invalid

When the VOR/MB receiver bearing goes invalid, these changes occur for the VOR displays:

- Show amber VOR flag
- Remove to/from pointer and indication.
- Remove VOR deviation bar and scale

Frequency Invalid

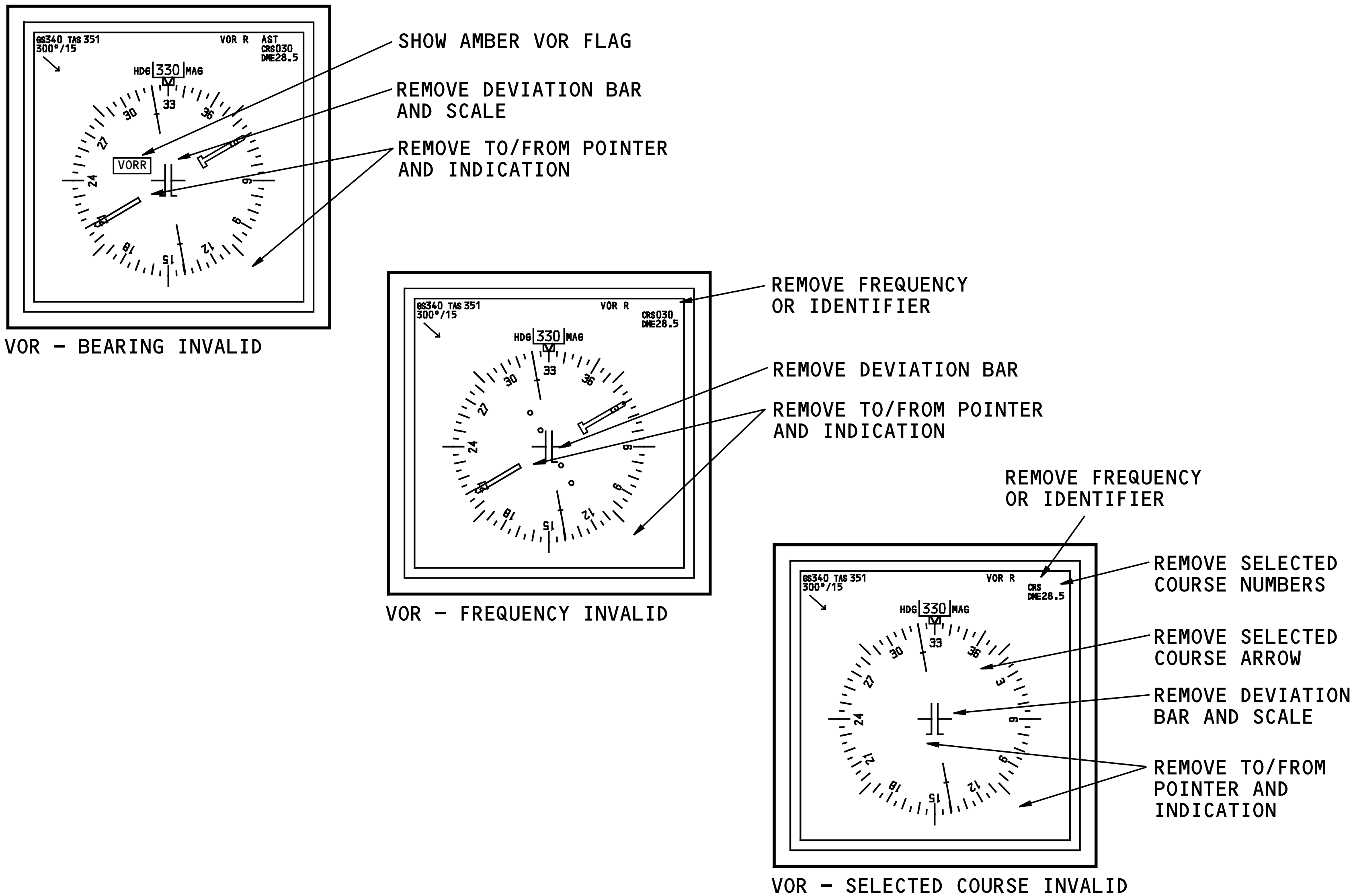
When the frequency input goes invalid, these changes occur for the VOR displays:

- Remove the VOR frequency or identifier
- Remove the to/from pointer and indication
- Remove the VOR deviation bar.

Selected Course Invalid

When the selected course input goes invalid, these changes occur for the VOR display:

- Remove the VOR frequency or identifier
- Remove the selected course number
- Remove the selected course arrow
- Remove the VOR deviation bar and scale
- Remove the to/from pointer and indication.



VOR - ND VOR INVALID DISPLAYS

34-51-00-017 Rev 1

VOR - ND VOR TEST DISPLAYS

General

When you do a test of the VOR/MB receiver, the receiver starts a test sequence that lasts approximately 15 to 20 seconds. During the test sequence, the receiver output changes to these conditions:

- Invalid data for the first three seconds
- NCD for two seconds
- Test display for approximately ten seconds.

Invalid Data Test Display

For the first three seconds of the test, the receiver output goes invalid. These are the ND display changes:

- Remove the selected course arrow
- Remove the deviation bar and scale
- Remove the to/from pointer and indication
- Show the amber VOR flag.

NCD Data Test Display

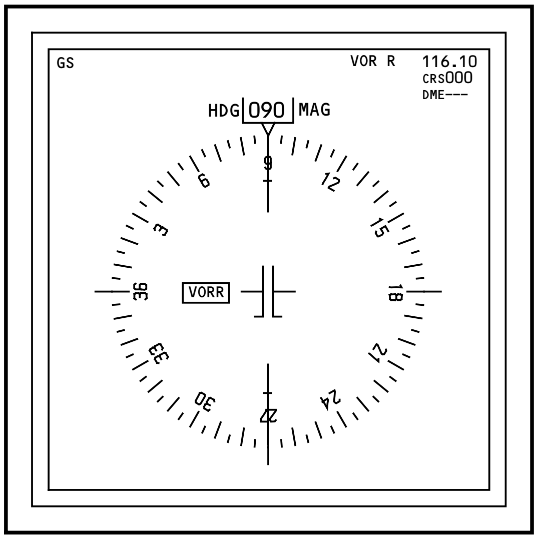
After the first three seconds of invalid data, the receiver output goes to an NCD condition for two seconds. These are the ND display changes:

- Remove the deviation bar
- Remove the to/from pointer and indication
- Show the selected course arrow
- Show the deviation scale.

VOR Test Display

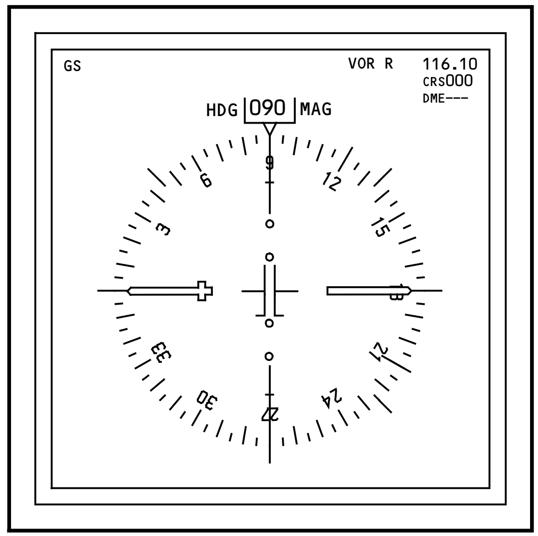
After the NCD condition, the receiver shows a valid test display for approximately ten seconds. These are the VOR test displays:

- Selected course arrow points to 0 degrees on the compass
- The deviation bar is centered if 000 is the selected course during the test
- The to/from pointer and indication show a FROM indication.



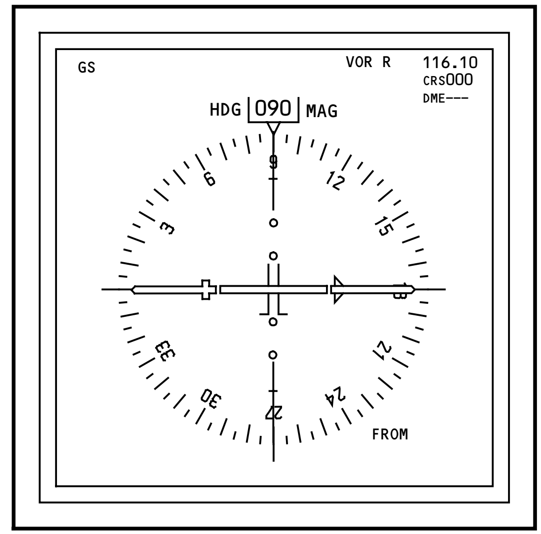
INVALID DATA FIRST 3 SECONDS:

- REMOVE SELECTED COURSE ARROW
- REMOVE DEVIATION BAR AND SCALE
- REMOVE TO/FROM POINTER AND INDICATION
- SHOW AMBER VOR FLAG



NCD DATA FOR 2 SECONDS:

- REMOVE DEVIATION BAR
- REMOVE TO/FROM POINTER AND INDICATION
- SHOW SELECTED COURSE ARROW
- SHOW DEVIATION SCALE



TEST DISPLAY FOR APPROX. 10 SECONDS:

- SELECTED COURSE POINTER AT 0 DEGREES (YOU MUST SELECT A COURSE OF 000)
- DEVIATION BAR CENTERED
- TO/FROM POINTER AND INDICATION SHOWS - FROM

34-51-00-018 Rev 2 11/06/1997

VOR - ND VOR TEST DISPLAYS

VOR - GROUND TEST

General

You can test the VOR/MB system from the MAT. These are the tests that are available from the operational test selection on the MAT:

- Left VOR M/B System
- Right VOR System.

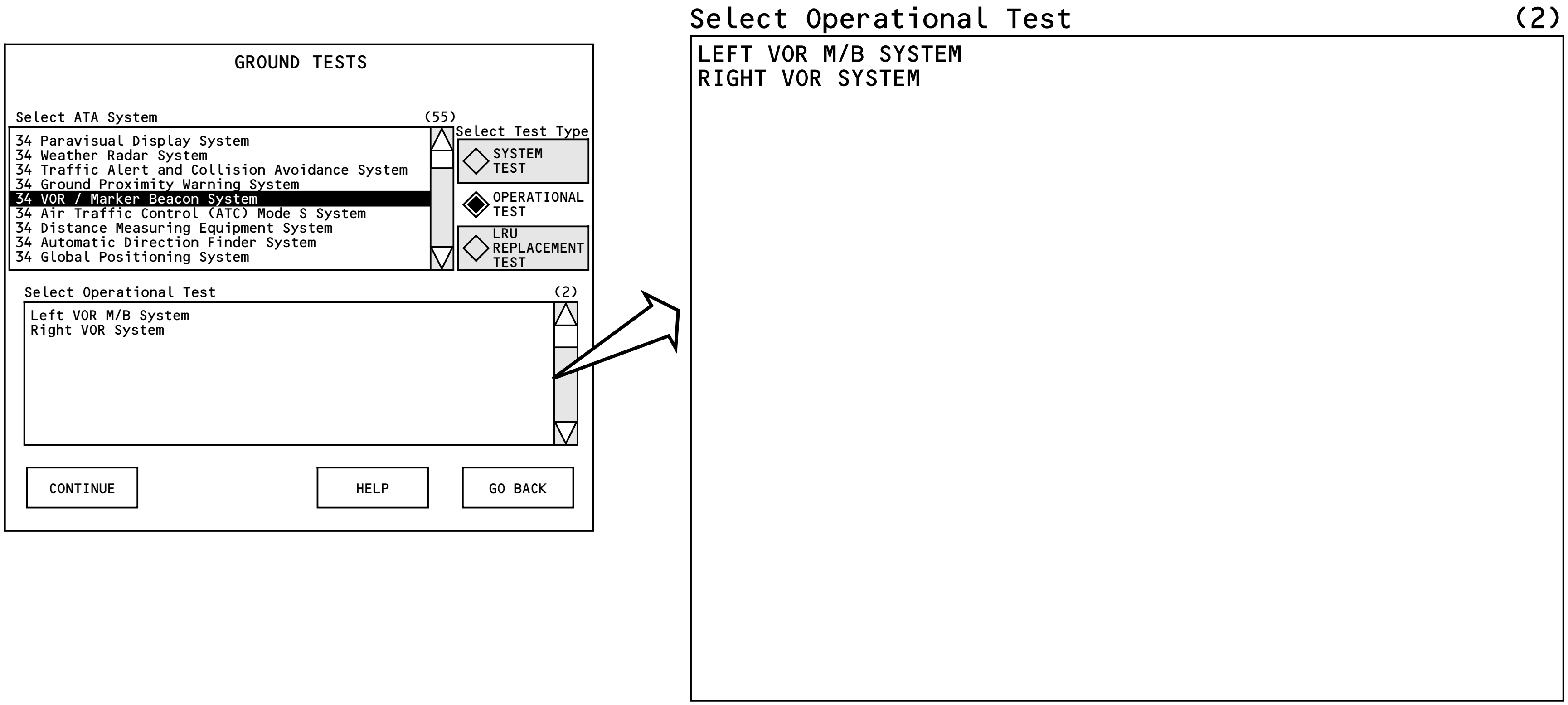
Operational Test

The operational test for the left VOR M/B system does a test of:

- Normal operation of the VOR receiver
- Normal operation of the marker beacon receiver.

The operational test for the right VOR system does a test for normal operation of the right VOR receiver.

The test is the same from the MAT or the receiver front panel test switch. The only difference is that the test from the MAT does not do a lamp test of the receiver front panel LEDs.



34-51-00-020 Rev 2

VOR - GROUND TEST

Continental Airlines, Inc

Instrument Landing System

WB371

TABLE OF CONTENTS

ILS - INTRODUCTION

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ILS - INTRODUCTION

Purpose

The multi-mode receiver (MMR) has these functions:

- Instrument landing system (ILS) function
- Global positioning system (GPS) function.

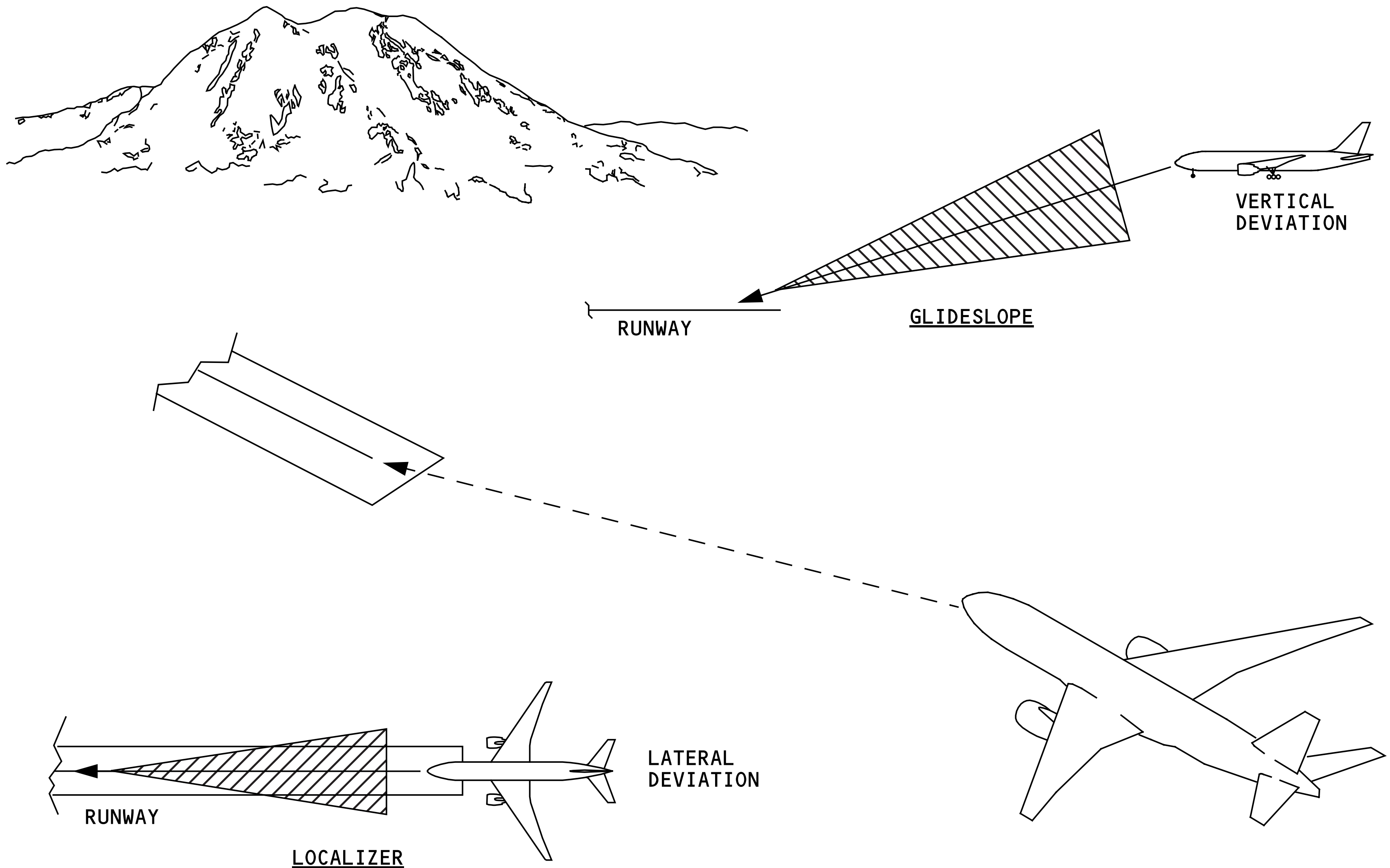
The ILS function provides lateral and vertical guidance to the runway on approach. The system uses signals from a glideslope ground station and a localizer ground station.

The glideslope station transmits signals to give the airplane a descent path to the touchdown point on the runway. The localizer station transmits signals to give a lateral path to keep the airplane centered on the runway.

The ILS system provides station audio and identifier signals to the flight interphone speakers and the headsets.

Abbreviations and Acronyms

ACP - audio control panel
AFDS - autopilot flight director system
AIMS - airplane information management system
AMU - audio management unit
CDU - control display unit
CMCS - central maintenance computing system
GPWC - ground proximity warning computer
ILS - instrument landing system
MMR - multi-mode receiver
ND - navigation display
PFD - primary flight display
VOR - VHF omnidirectional ranging



34-31-00-001 Rev 3

ILS - INTRODUCTION

ILS - GENERAL DESCRIPTION

General

The instrument landing system (ILS) has three multi-mode receivers (MMRs). The ILS system uses inputs from these antennas:

- VOR antenna
- Localizer antennas
- Glideslope capture antennas
- Glideslope track antennas.

Description

The antenna inputs go through localizer and glideslope antenna switches, then to the MMRs.

The receivers get manual tune inputs from the left or right CDU, or autotune inputs from the airplane information management system (AIMS) cabinets. The receivers get tune inputs directly from the left or right CDU (alternate tune) if the tune inputs from AIMS fails.

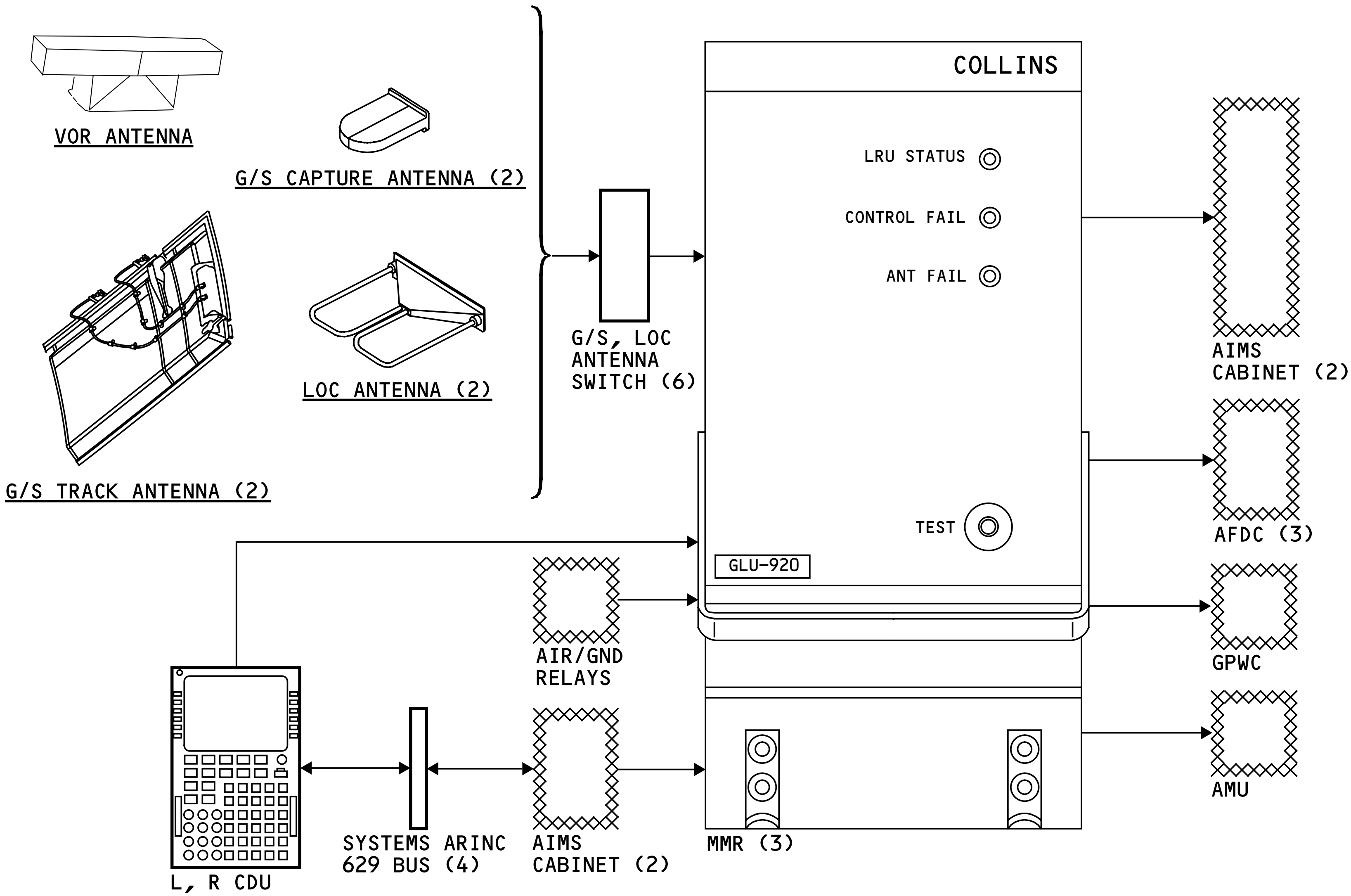
ILS deviations go to both AIMS cabinets to show ILS data on the primary flight displays (PFDs) and navigation displays (NDs).

ILS deviations go to the autopilot flight director computers (AFDCs) for autoland calculations.

The left MMR sends glideslope deviation to the ground proximity warning computer (GPWC) for mode 5 alerts.

The receivers also send station audio and identifier signals to the audio management unit (AMU).

The receivers get discrete inputs from the air/ground relays.



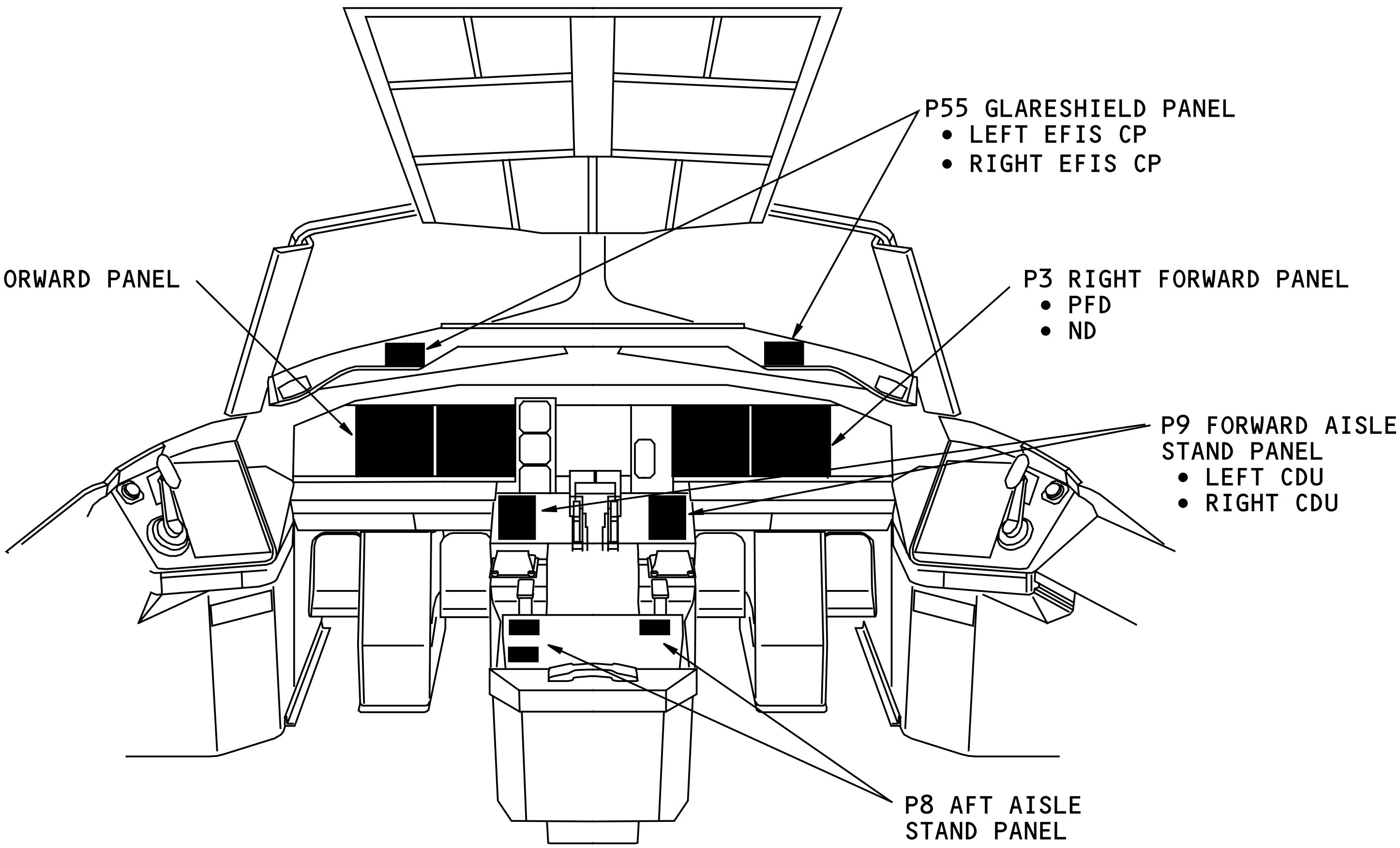
ILS - GENERAL DESCRIPTION

ILS - FLIGHT DECK COMPONENT LOCATION

General

The components on the flight deck that interface with the ILS system are:

- Left and right EFIS control panels (CP)
- Captain's and first officer's primary flight displays (PFD) and navigation displays (ND)
- Left and right CDUs
- Audio control panels (ACP).



34-31-00-003 Rev 2

ILS - FLIGHT DECK COMPONENT LOCATION

ILS - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

Equipment Center

The ILS components in the main equipment center are:

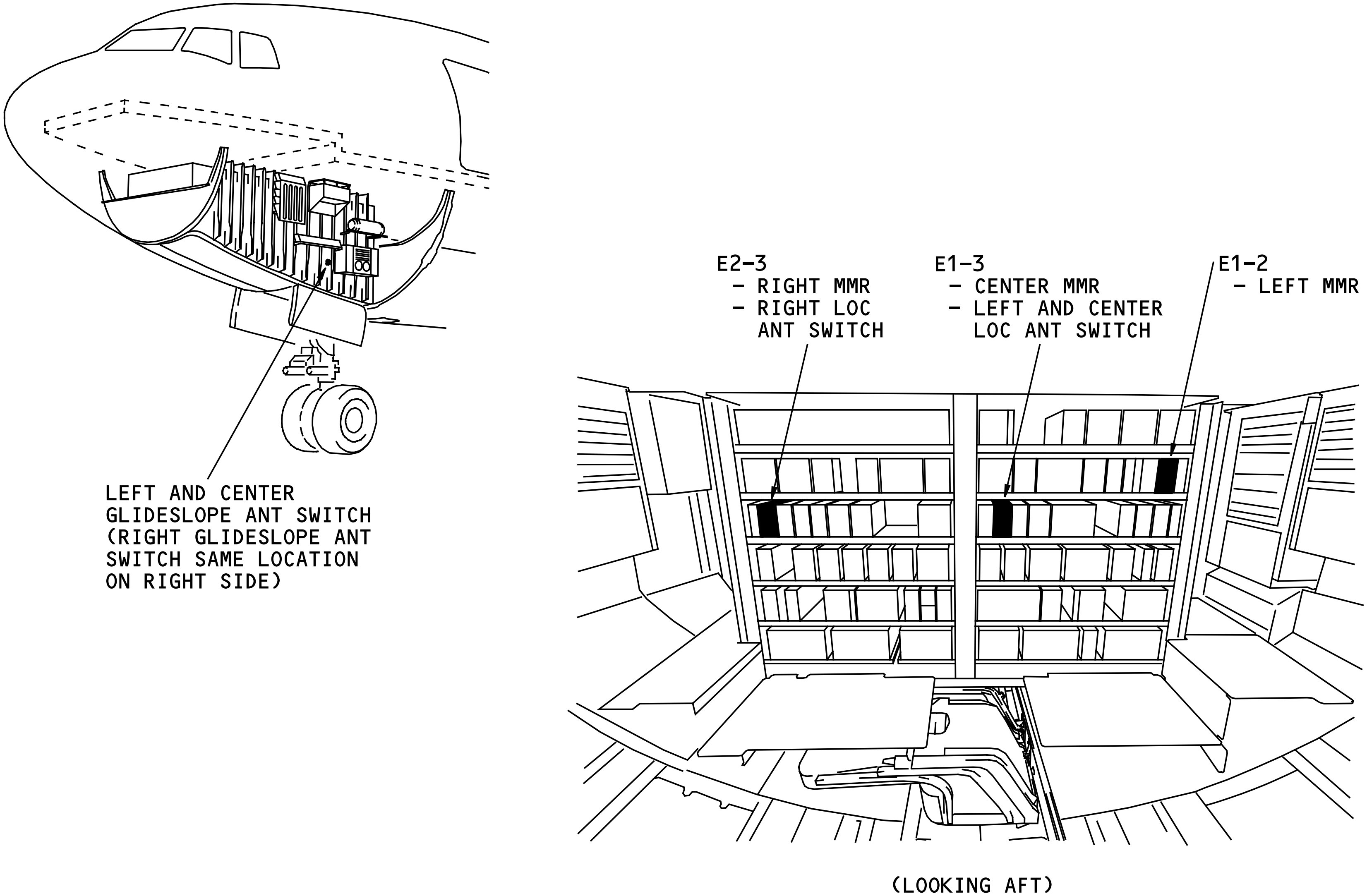
- Left, center, and right glideslope antenna switches
- Left, center, and right multi-mode receivers (MMRs)
- Left, center, and right localizer antenna switches
- Left and right RF power dividers.

The left MMR is on the E1-2 shelf. The center MMR is on the E1-3 shelf. The right MMR is on the E2-3 shelf.

The localizer antenna switches are on the electronic equipment racks (E1 and E2) in the main equipment center. The left localizer antenna switch is on the E1-2 shelf. The center localizer antenna switch is on the E1-3 shelf. The right localizer antenna switch is on the E2-3 shelf.

The glideslope antenna switches are in the forward section of the main equipment center, on the left and right sides of the nose wheel well.

There are two RF power dividers in the main equipment center. The left power divider is on the E1-3 shelf. The right power divider is on the E2-2 shelf.



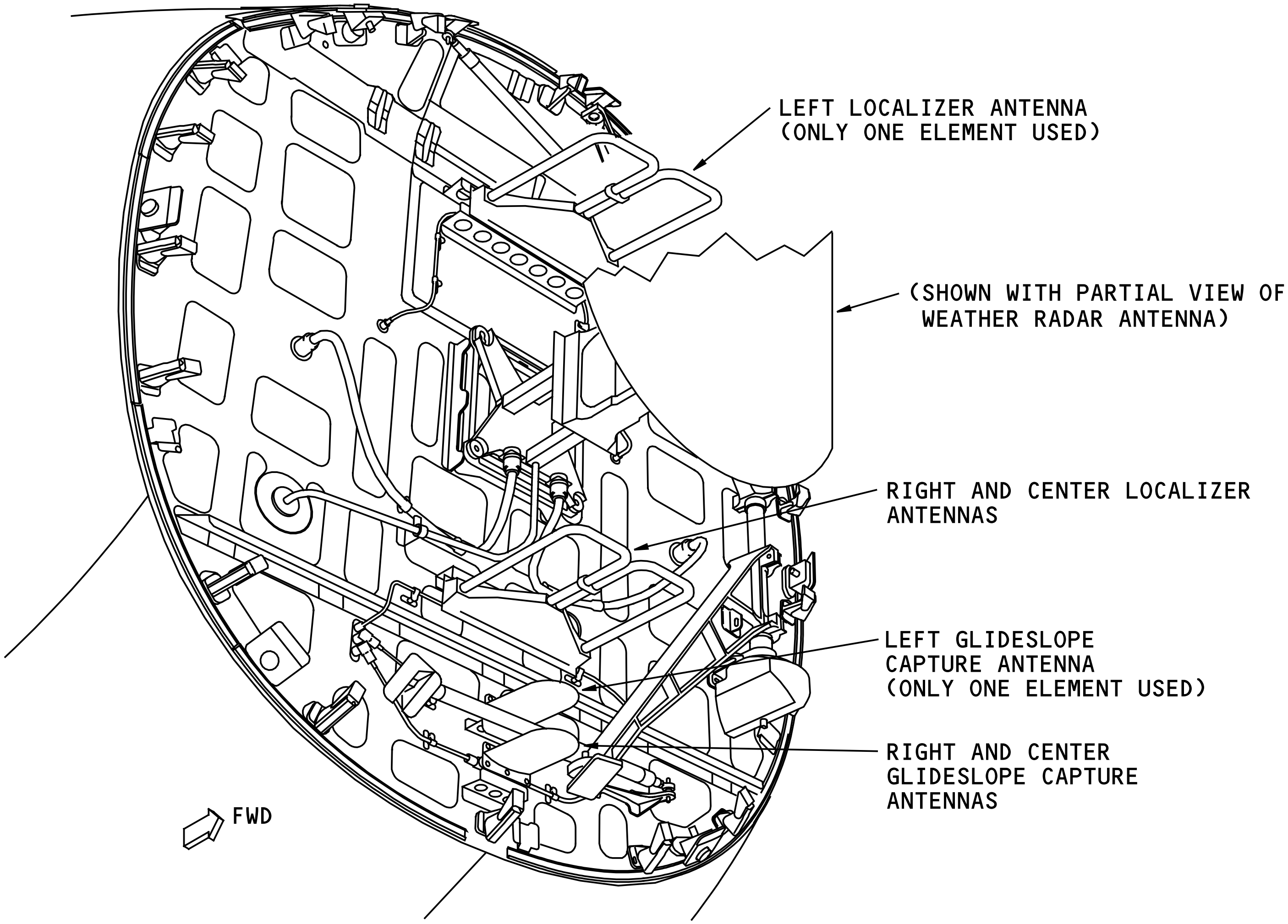
ILS - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

ILS - NOSE RADOME COMPONENT LOCATIONS

General

The ILS components in the nose radome are:

- Left localizer antenna
- Right and center localizer antennas
- Left glideslope capture antenna
- Right and center glideslope capture antennas.



34-31-00-005 Rev 0

ILS - NOSE RADOME COMPONENT LOCATIONS

ILS - FUSELAGE COMPONENT LOCATIONS

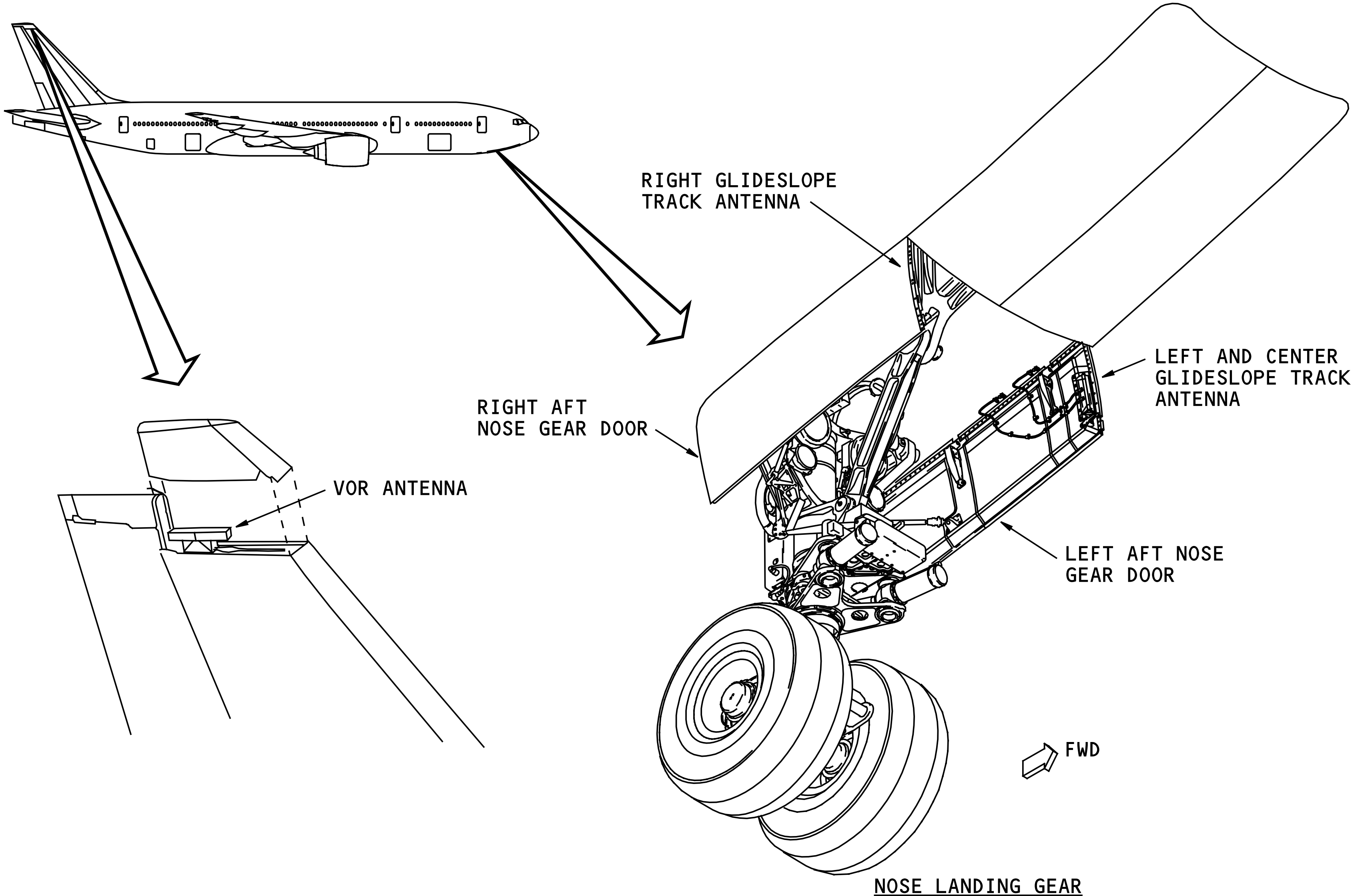
VOR Antenna

The VOR antenna is on top of the vertical stabilizer. The VOR antenna receives VOR and localizer signals.

Glideslope Track Antennas

The glideslope track antennas are on the leading edge of the left and right aft nose gear doors.

The left and center glideslope track antennas are on the left aft nose gear door and the right glideslope track antenna is on the right aft nose gear door.



34-31-00-006 Rev 2 06/17/1996

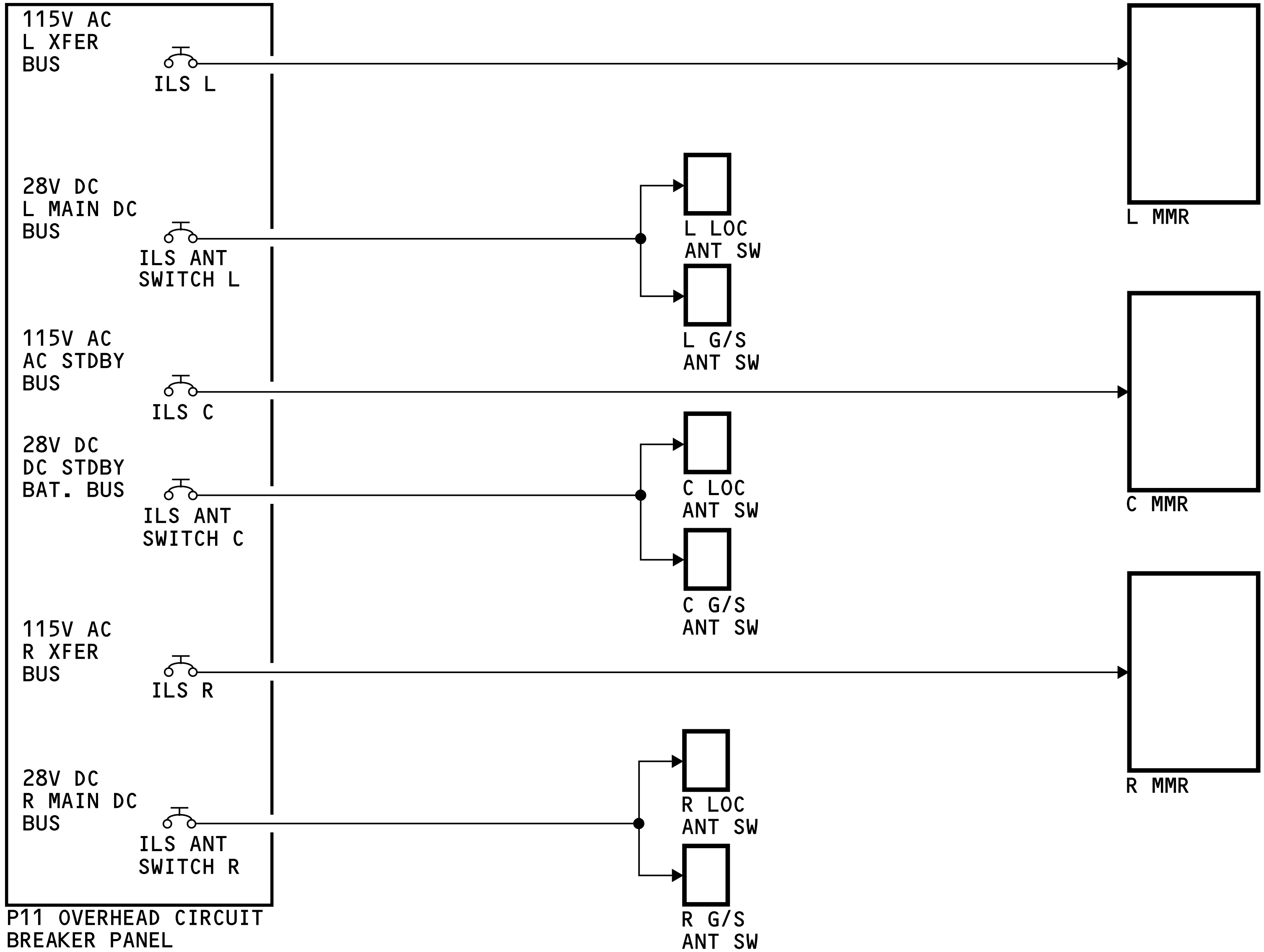
ILS - FUSELAGE COMPONENT LOCATIONS

ILS - POWER INPUTS

Power Inputs

The left and right multi-mode receivers (MMRs) get 115v ac, 400 Hz power from the left and right 115v ac transfer buses. The center MMR gets 115v ac, 400 Hz power from the AC standby bus.

The left and right localizer and glideslope antenna switches get 28v dc from the left and right main DC buses. The center localizer and glideslope antenna switches get 28v dc from the DC standby battery bus.



ILS - POWER INPUTS

ILS - ANALOG AND DISCRETE INTERFACE

General

The LRUs that interface with the multi-mode receivers (MMRs) with analog and discrete signals are:

- Left and right CDUs
- Air/ground relays
- Left, right, and center AFDCs
- Audio management unit (AMU).

Discrete Inputs

The receivers get discrete inputs from these sources:

- CDUs
- Air/ground relays
- AFDCs.

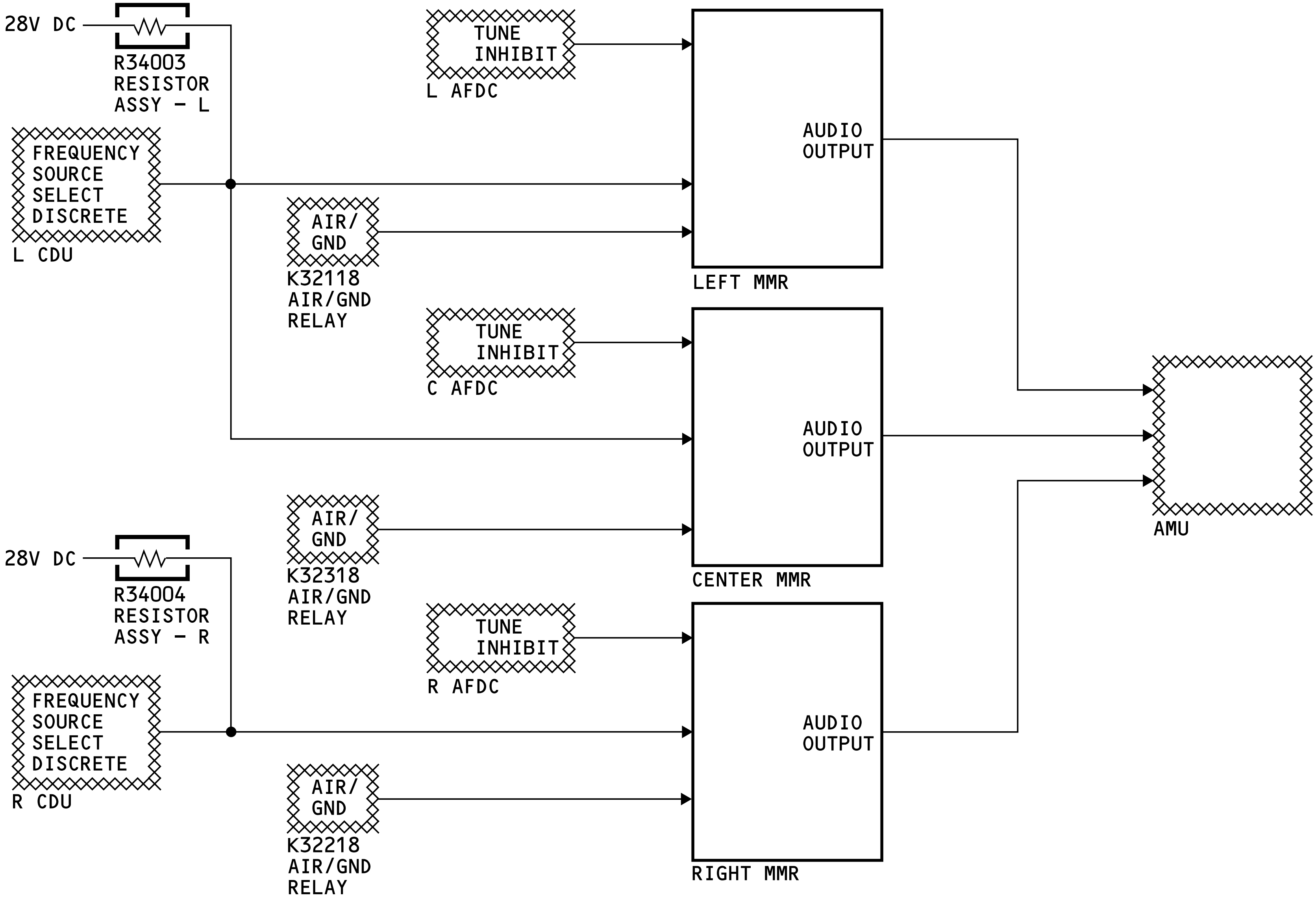
The CDUs send a frequency source select discrete to cause the receiver to select the tune input from either the CDU or the AIMS cabinets. The resistor assemblies pull up the discretes to 28v dc. The left CDU sends a ground discrete to the left and center receivers when the discrete is true. The right CDU sends a ground discrete to the right receiver when the discrete is true.

The air/ground relays send a discrete to the receivers to inhibit tests in the air. The discrete also supplies flight legs data as a backup to the AIMS cabinets flight legs data.

The AFDCs send a discrete to inhibit ILS tune inputs in approach (APP) mode when the airplane is at or below 1500 feet, and there is a localizer or glideslope signal capture. This prevents the flight crew from tuning the receivers.

Analog Outputs

Each receiver sends an audio output to the AMU. The pilots use the audio control panels (ACP) to send ILS audio to the headsets and flight deck speakers.



ILS - ANALOG AND DISCRETE INTERFACE

34-31-00-010 Rev 1 09/25/1997

ILS - ARINC 429 INTERFACE

General

These are the LRUs that have interface with the multi-mode receivers (MMRs) on ARINC 429 data buses:

- Left and right control display units (CDUs)
- Left and right AIMS cabinets
- Left, center, and right autopilot flight director computers (AFDCs)
- Ground proximity warning computer (GPWC).

CDU

The left and right CDUs supply alternate tune inputs directly to the receivers if the AIMS tune inputs fail. The left CDU sends alternate tune signals to the left and center receivers. The right CDU sends alternate tune signals to the right receiver.

AIMS

The right AIMS cabinet sends manual or automatic tune inputs to the receivers on the left, center, and right tune buses.

The left AIMS cabinet sends test commands and flight legs data to the receivers on the left, center, and right CMC buses.

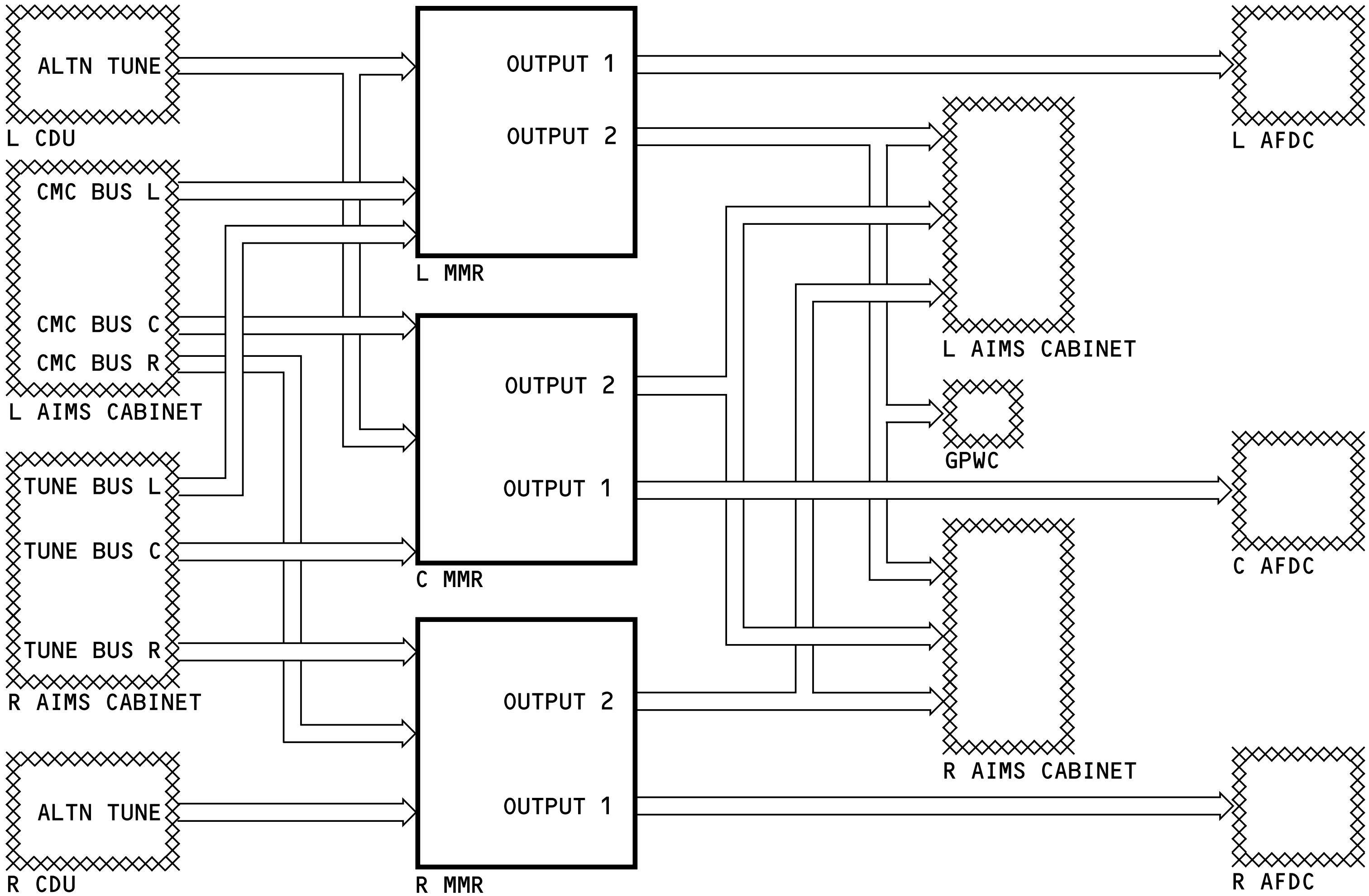
Receiver Outputs

Each receiver has two output buses. Output bus one supplies data to the onside AFDC. Output bus two supplies data to both AIMS cabinets.

Each receiver sends data to both AIMS cabinet to show ILS data on the PFDs and NDs. The receivers also send test status and fault reports.

The left receiver sends ILS data to the GPWC for mode five alerts.

Each receiver sends ILS data to the onside AFDC for autoland functions.



34-31-00-009 Rev 2 09/29/1997

ILS - ARINC 429 INTERFACE

ILS - LOCALIZER ANTENNA INPUTS

General

The multi-mode receivers (MMRs) get localizer signal inputs from the localizer antennas in the nose radome or from the VOR antenna on the vertical stabilizer.

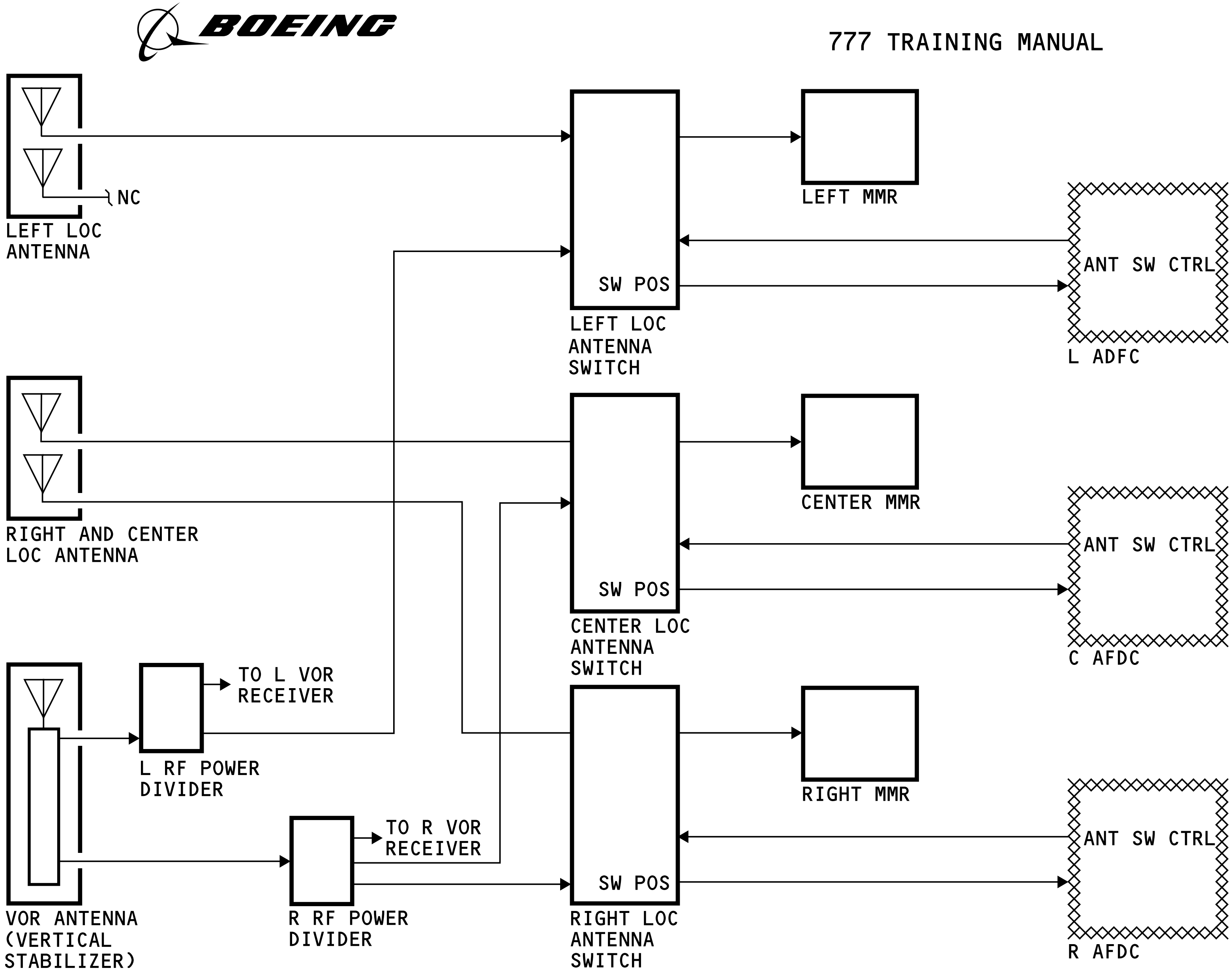
Antenna Inputs

Signal inputs from the VOR antenna on the vertical stabilizer go through the RF power dividers to the localizer antenna switches.

The antenna inputs go through the localizer antenna switches then to the receivers. The switch changes the input from the VOR antenna on the vertical stabilizer to the LOC antennas in the nose radome.

Antenna Switch Control

Each autopilot flight director computer (AFDC) controls its onside localizer antenna switch. Each switch sends antenna switch position feedback to its onside AFDC.



ILS - LOCALIZER ANTENNA INPUTS

ILS - GLIDESLOPE ANTENNA INPUTS

General

The multi-mode receivers (MMRs) get inputs from the glideslope capture antennas in the nose radome, or from the glideslope track antennas on the aft nose gear doors. The antenna inputs go through the glideslope antenna switch, then to the MMRs.

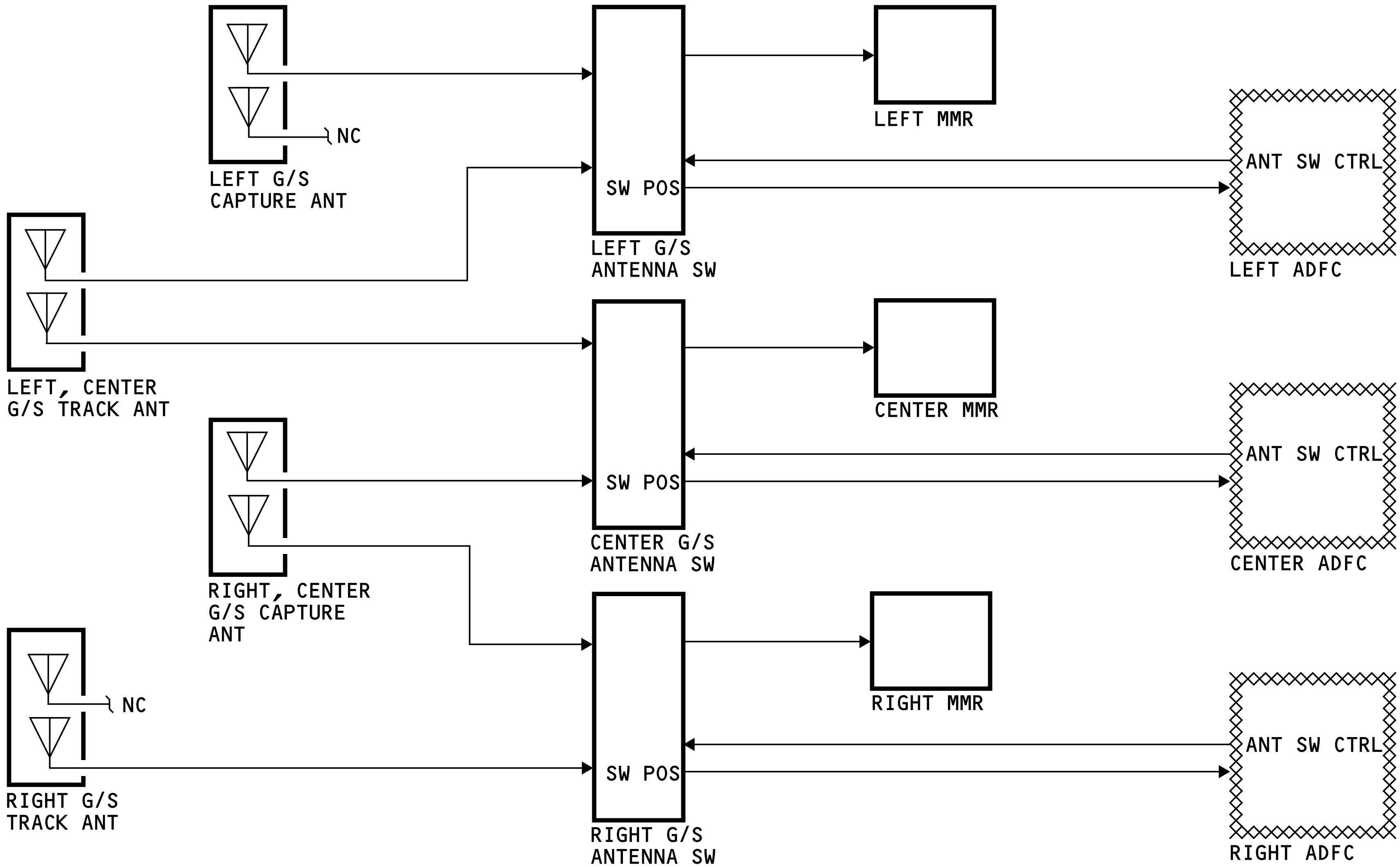
Antenna Inputs

Signal inputs from the glideslope track antenna on the left nose gear door go to the left and center receivers. Signal inputs from the glideslope track antenna on the right aft nose gear door go to the right receiver.

The left capture antenna signals go to the left receiver. The right capture antenna signals go to the center and right receivers.

Antenna Control

Each autopilot flight director computer (AFDC) controls its onside glideslope antenna switch. Each switch sends antenna switch position feedback to its onside AFDC.



34-31-00-012 Rev 2 09/25/1997

ILS - GLIDESLOPE ANTENNA INPUTS

ILS - RECEIVER

Purpose

The multi-mode receiver (MMR) supplies localizer and glideslope deviation to the autopilot flight director computers (AFDCs) and to the AIMS cabinets for display.

Description

Each receiver is a standard ARINC 600 3 MCU unit. The receiver weighs ten pounds and uses 115v ac power for operation.

There are status LEDs on the front panel and a receiver test switch. The ILS status LEDs show either green for a test pass, or red for a test fail.

The receiver has a nonvolatile flight fault memory. Use the ATE connector at the rear of the ILS receiver to access the fault memory. Only shop personnel can use this feature.

Front Panel LEDs

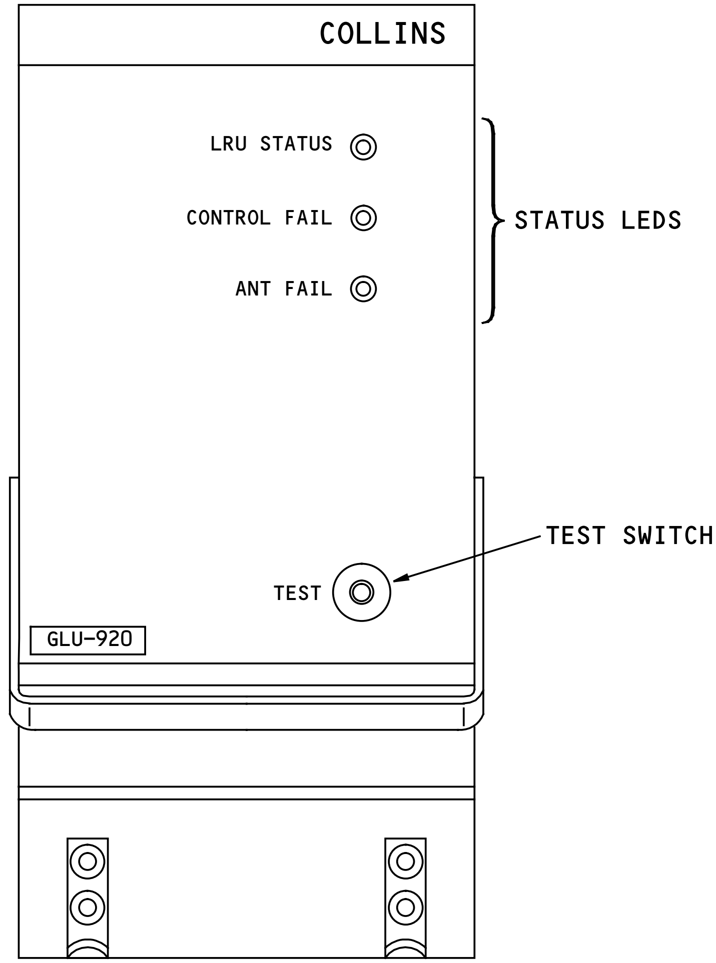
The receiver front panel has these LEDs:

- LRU STATUS - red shows for an internal receiver failure
- CONTROL FAIL - red shows for a control failure
- ANT FAIL - not connected.

Training Information Point

The maintenance manual and the fault isolation manual do not have a task for the line maintenance technician to do a test from the front panel of the receiver. You must do all tests for the receiver from the MAT or a PMAT.

Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For that reason those LRUs have a front panel test feature.



ILS - RECEIVER

ILS - LOCALIZER AND GLIDESLOPE ANTENNAS

Localizer Antennas

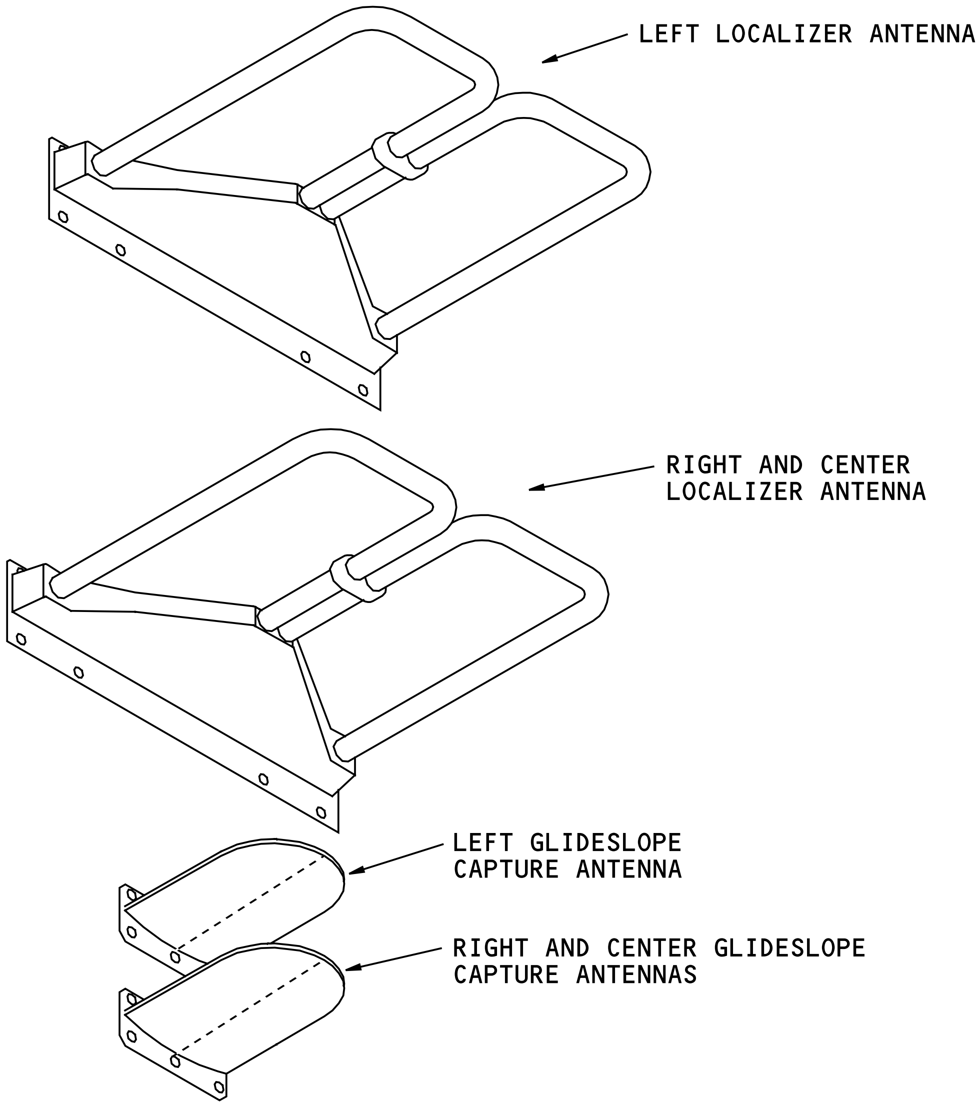
There are two localizer antennas. Each antenna has two elements. The localizer antennas receive frequencies from 108.1 MHz to 111.95 MHz at odd tenths intervals.

The antennas supply signal reception within 90 degrees to the left or right of the airplane centerline.

Glideslope Capture Antennas

There are two glideslope antennas. Each antenna has two elements. The glideslope antennas receive frequencies from 328.6 MHz to 335.4 MHz. The glideslope frequencies are paired with localizer frequencies.

The antennas supply signal reception within 90 degrees above or below the airplane centerline.



34-31-00-015 Rev 1

ILS - LOCALIZER AND GLIDESLOPE ANTENNAS

ILS - GLIDESLOPE TRACK ANTENNA

General

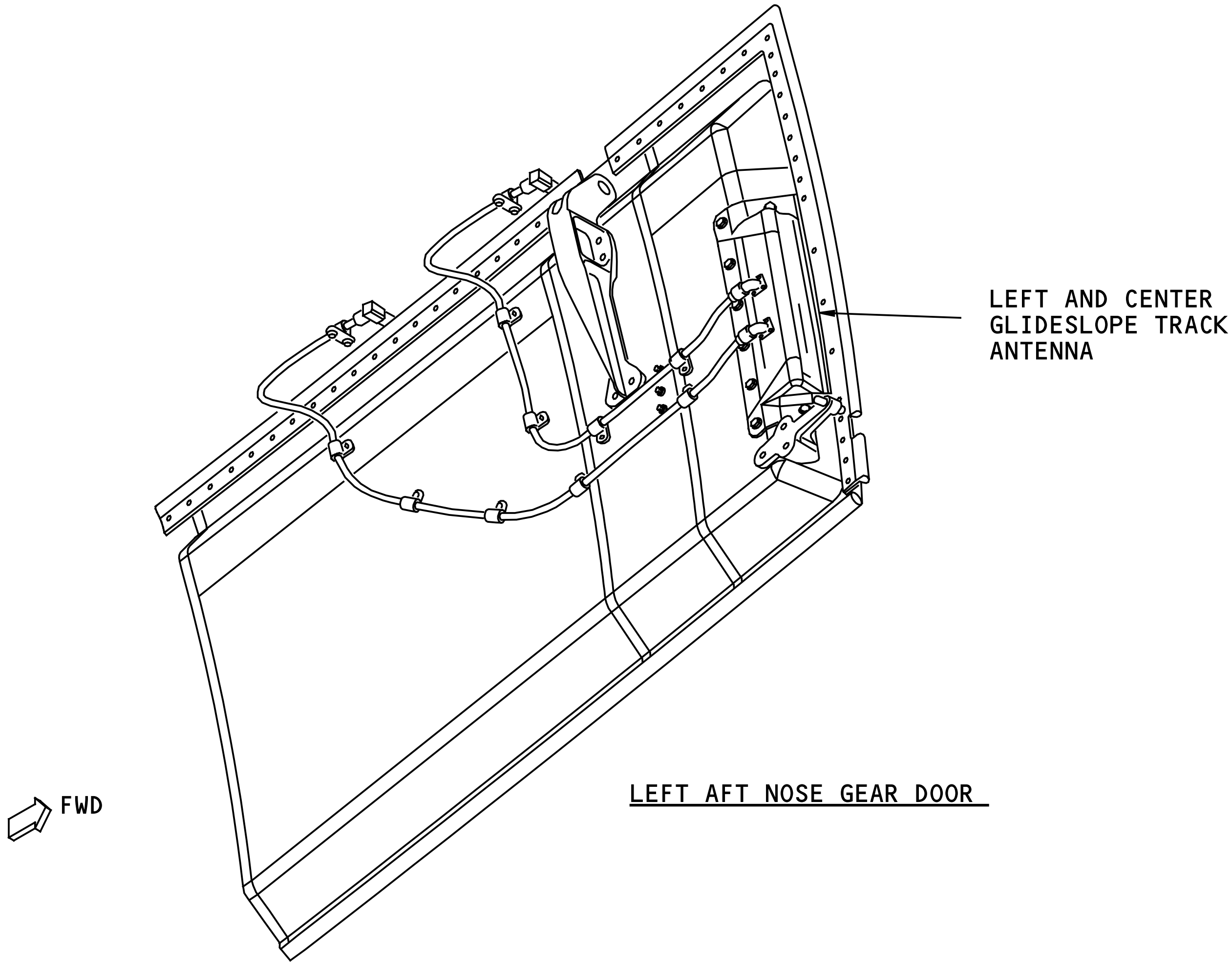
The glideslope track antennas supply final approach and landing glideslope signals. The track antennas are in a position to minimize the vertical distance between the antenna flight path and the main landing gear.

Description

The antennas receive in the frequency range of 328.6 MHz to 335.4 MHz. The glideslope track antennas are on the left and right aft nose gear doors.

Each antenna is a dual element antenna. The left glideslope track antenna on the left aft nose gear door supplies glideslope signals to the left and center ILS receiver. The right glideslope track antenna on the right aft nose gear door supplies glideslope signals to the right ILS antenna.

The graphic below shows the left and center glideslope antenna. The right glideslope antenna looks the same.



34-31-00-016 Rev 1

ILS - GLIDESLOPE TRACK ANTENNA

ILS - TUNING

General

There are three ways to tune the multi-mode receivers (MMRs):

- Automatically by the AIMS cabinets
- Manually by the left, right, or center CDU
- By the CDUs as an alternate tuning source.

AIMS Auto Tune

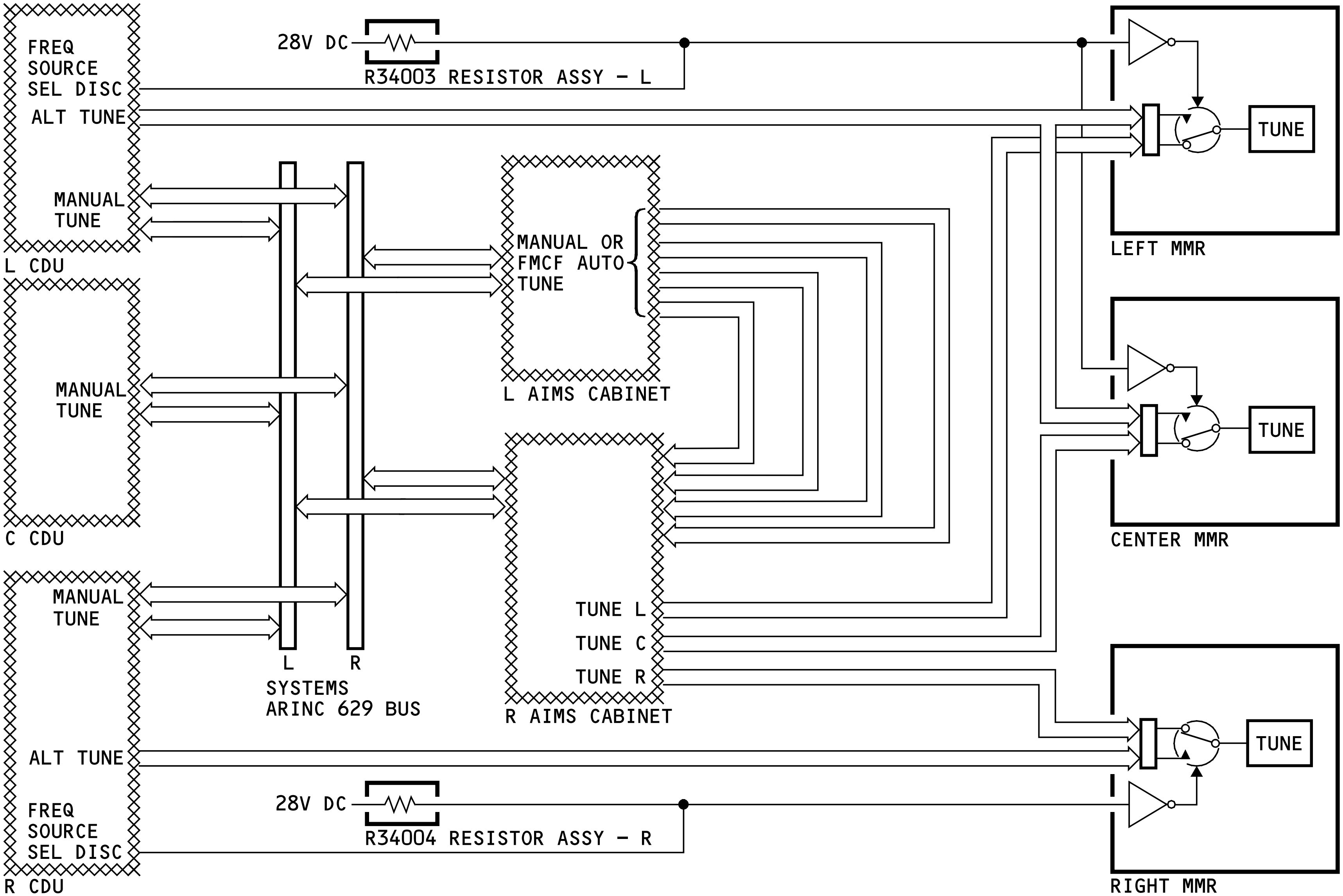
The flight management computing function (FMCF) of the right AIMS cabinet automatically tunes the receivers when the ILS station is part of the active flight plan. The left AIMS FMCF tunes the receivers through the right AIMS cabinet, if the right FMCF fails.

Manual Tuning

You use the left or right CDUs to manually tune the receivers. When you enter an ILS frequency or identifier into the CDU, the CDU frequency becomes the active frequency. It overrides the AIMS FMCF auto tune input. The CDU delete function deletes the CDU frequency selection and the AIMS FMCF auto tune becomes active. The center CDU tunes the ILS receivers if the left or right CDUs fail.

Alternate Tuning

If the AIMS FMCF tuning functions fail, the CDU sends a frequency source selection discrete to the receiver to select the tuning source. This ground signal to the switch in the receiver changes the tuning input from AIMS to the CDU. You use the right CDU to tune the right receiver. You use the left CDU to tune the left and center receivers. There is no alternate tune function from the center CDU.


FREQ SOURCE SEL DISC
ALT TUNE
MANUAL TUNE
L CDU
MANUAL TUNE
C CDU
MANUAL TUNE
ALT TUNE
FREQ SOURCE SEL DISC
R CDU
28V DC
R34003 RESISTOR ASSY - L
28V DC
R34004 RESISTOR ASSY - R
L
R
SYSTEMS ARINC 629 BUS
MANUAL OR FMCF AUTO TUNE
L AIMS CABINET
TUNE L
TUNE C
TUNE R
R AIMS CABINET
TUNE
LEFT MMR
TUNE
CENTER MMR
TUNE
RIGHT MMR

ILS - TUNING

ILS - AUDIO CONTROL PANEL ILS AUDIO CONTROLS

General

The audio control panels (ACPs) supply control inputs to the audio management unit. This lets the crew hear audio signals on the speakers and headsets in the flight deck.

Description

These are the controls on the audio control panel that let you hear ILS audio:

- NAV filter selector
- Approach receiver volume control
- Approach receiver selector.

NAV Filter Selector

The NAV filter selector lets you select one of these:

- Voice (V) audio
- Both (B) voice and range audio.
- Range (R) audio

Approach Receiver Volume Control

The approach receiver volume control turns on the audio and controls the volume.

Approach Receiver Selector

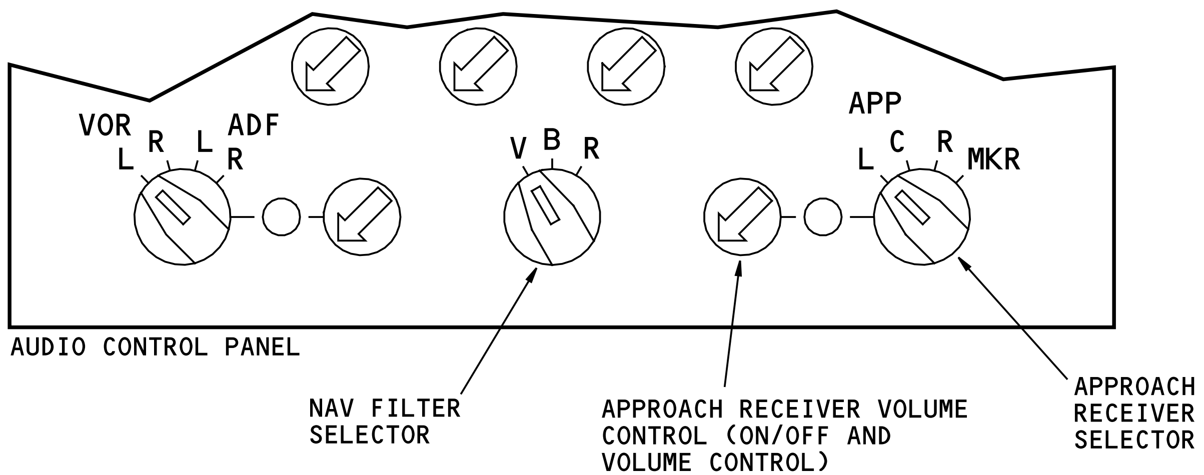
The approach receiver selector lets you select ILS or marker beacon as the source of audio.

Operation

To hear ILS audio, do this:

- Set the approach receiver selector to the left (L), center (C) or right (R) APP position
- Push the approach receiver volume control to turn on the ILS audio (turn the control to adjust the volume)
- Set the NAV filter selector to the voice (V) position.

To hear the station identifier, set the NAV filter selector to either the both (B) or the range (R) position.



34-31-00-020 Rev 2

ILS - AUDIO CONTROL PANEL ILS AUDIO CONTROLS

ILS - CDU ILS TUNING

General

The CDUs supply manual tune inputs during normal operation and alternate tune inputs when the AIMS tune functions fail.

Operation

To see ILS tune frequencies, push the NAV RAD key on the CDU. The NAV RADIO page shows data for the ILS systems.

To manually tune the multi-mode receiver (MMR), enter a valid ILS frequency or identifier and course into the CDU scratch pad and push line select key 4L.

You can enter the frequency and course together or separately. When you enter the course separately, a diagonal slash must be entered first followed by the course.

The PARK display can show on the CDU when the FMCF of AIMS autotunes the receivers. PARK shows for these conditions:

- PARK shows when the ILS is part of the active flight plan and not tuned, and the airplane is more than 200 nm from top of descent, or less than halfway to the destination.
- The frequency and PARK shows when the ILS is part of the active flight plan and not tuned, and the airplane is less than 200 nm from top of descent, or greater than halfway to the destination.

When the FMCF tunes the frequency, only the frequency shows. The PARK display goes out of view when less than 50 nm from top of descent, greater than 150 nm from the runway threshold, or the FMC is in the descent mode.

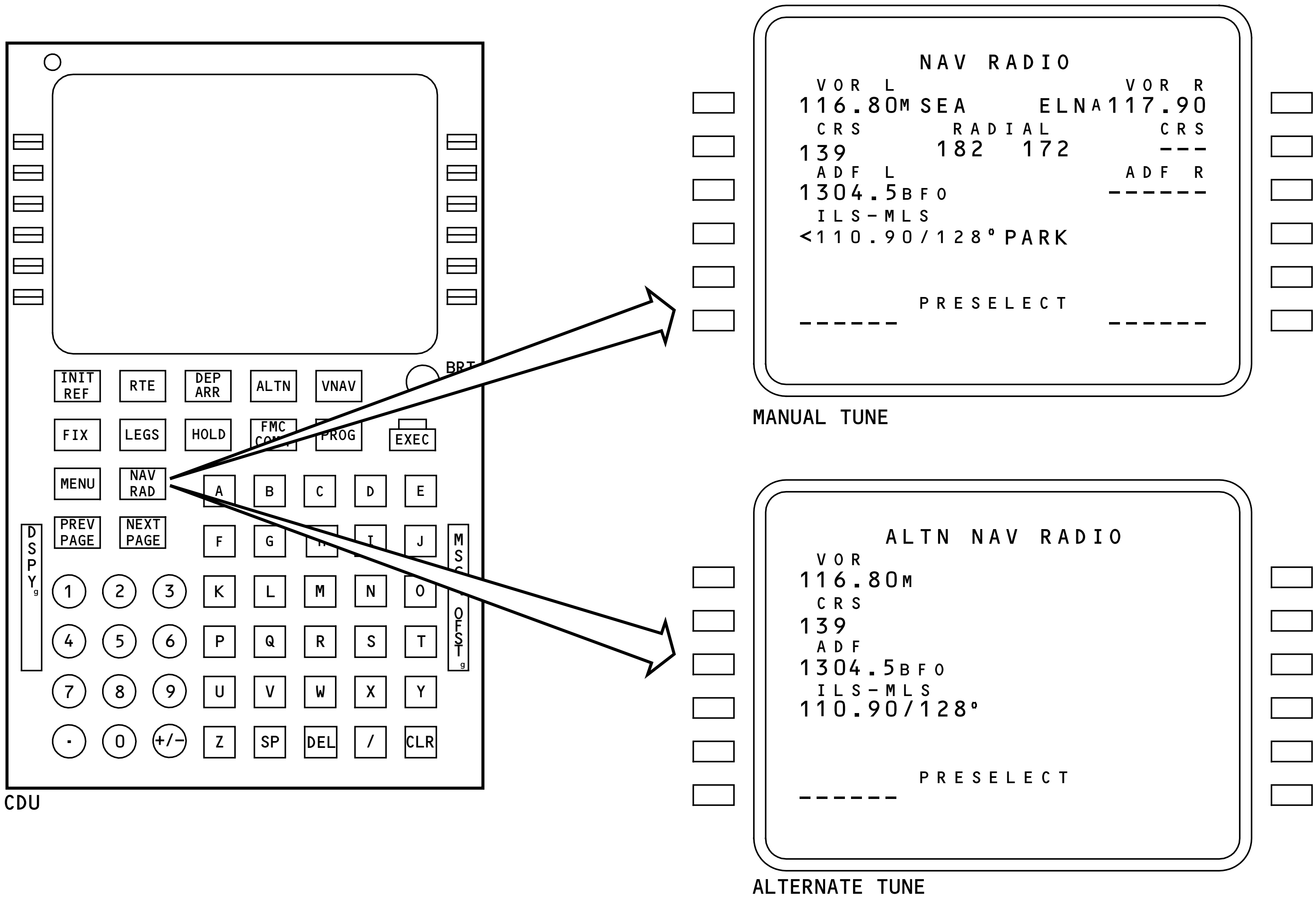
To delete the frequency and course, push the delete (DEL) key on the CDU. The delete function shows in the CDU scratchpad. Next, push the line select key next to the ILS data line to delete the frequency and course.

Alternate Tune

The ALTN NAV RADIO page is available only when the tune inputs from the AIMS cabinets fail.

To get to the ALTN NAV RADIO page, push the NAV RAD key on the CDU.

The ALTN NAV RADIO page is different than the NAV RADIO page. The ALTN NAV RADIO page shows data for the left NAV radio systems. Normally, the left CDU ALTN NAV RADIO page controls the left NAV receivers. The right CDU NAV RADIO page controls the right NAV radio receivers. However, for ILS in alternate tune, the left CDU tunes the left and center MMRs. The right CDU tunes the right MMR.



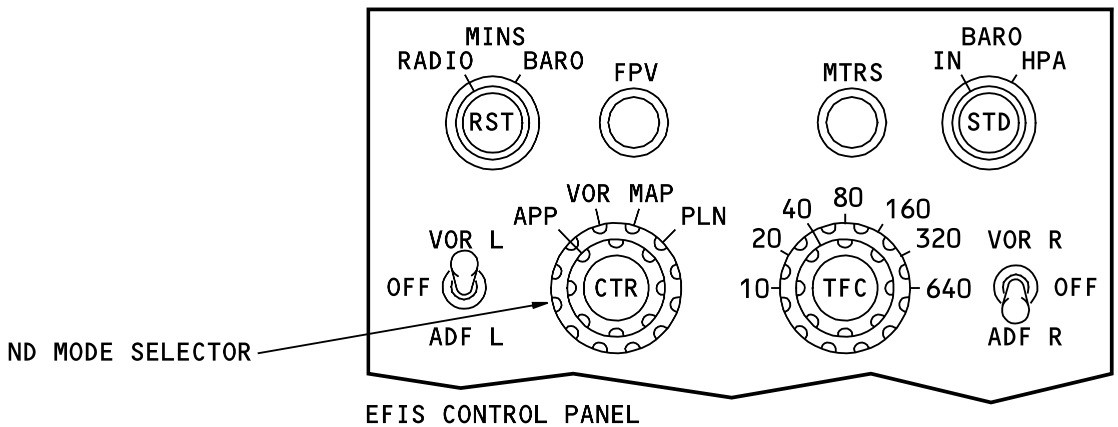
ILS - CDU ILS TUNING

34-31-00-021 Rev 4 09/25/1997

ILS - EFIS ILS CONTROLS

General

To show ILS data on the ND, turn the mode selector to the APP position. The switch has a CTR push on, push off switch in the center. This switch changes the display format from the expanded format to the centered format.



34-31-00-022 Rev 2 02/27/1998

ILS - EFIS ILS CONTROLS

ILS - PFD DISPLAYS

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ILS - PFD DISPLAYS

ILS Indications

These are the ILS indications on the PFD:

- Localizer frequency or identifier
- ILS course
- Localizer deviation scale and pointer
- Glideslope deviation scale and pointer
- ILS deviation warnings.

Display Source Priority

The flight crew cannot manually select a multi-mode receiver (MMR) for the PFD. When a MMR fails, the AIMS selects another receiver to show on the PFD. LOC and G/S flags show on the PFDs when all MMRs fail.

This is the AIMS priority selection of ILS display data on the PFD:

Captain's PFD	L,C,R
First Officer's PFD	R,C,L

Localizer Frequency and Identifier

The localizer frequency or four letter identifier shows at the top left corner of the PFD in white. The frequency shows until the MMR detects the ILS station Morse code identifier. When the station identifier is present, it replaces the frequency.

ILS Course

The ILS course shows to the right of the localizer frequency or identifier in white. It is a three digit display with a range of 1 to 360 degrees.

Localizer and Glideslope Deviation

The localizer deviation scale and pointer show at the bottom of the attitude display. The scale is a standard four dot scale where one dot equals 1 degree of deviation.

The scale can show in the standard display or the expanded scale where a 2 dot scale replaces the four dot scale. In the expanded scale, each dot equals 0.5 degrees of deviation.

The expanded scale shows when these conditions occur:

- LOC deviation is less than 5/8 dot
- The autopilot or flight director is engaged in the LOC or ROLLOUT mode
- ILS course and airplane track are within 5 degrees of each other
- RA is less than 200 feet.

The glideslope deviation scale and pointer show to the right of the attitude display. The scale is a standard four dot scale where one dot equals 0.35 degrees of deviation. There is no expanded scale for glideslope deviation.

ILS - PFD DISPLAYS

ILS Deviation Warning

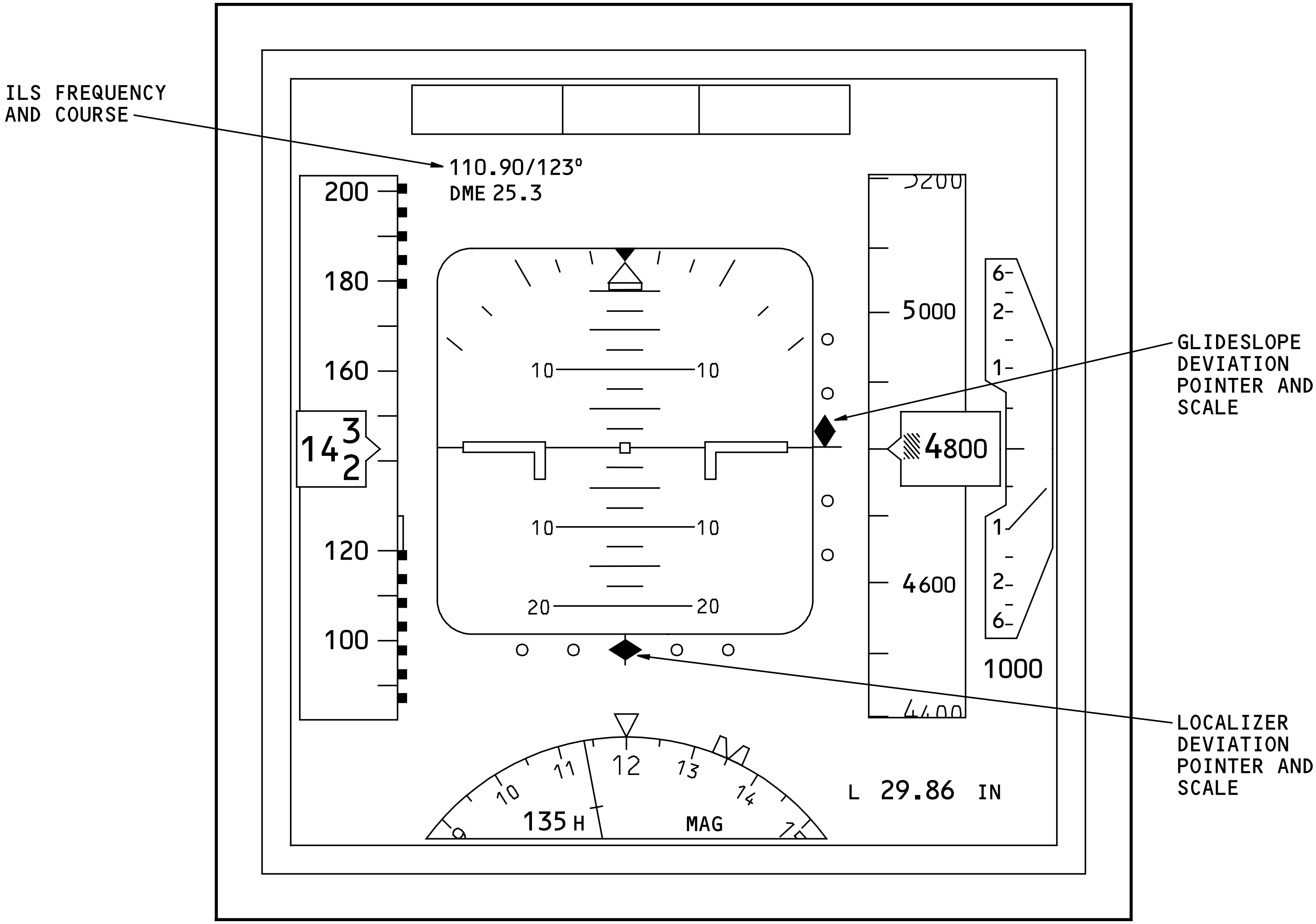
These are the two types of ILS deviation warnings:

- Localizer deviation warnings
- Glideslope deviation warnings.

Localizer deviation warnings occur between 0 and 500 feet RA with localizer captured. Glideslope deviation warnings occur between 100 feet and 500 feet RA with glideslope captured. Localizer deviation warnings occur when deviation is more than 1/4 dot or there is a localizer capture fail. Glideslope deviation warnings occur when the deviation is more than 7/8 dot. The deviation warnings cause the scales and the pointers to turn yellow and blink at a 5Hz rate.

Backcourse Deviation Indications

For backcourse indications, the glideslope pointer goes out of view and the localizer pointer moves in reverse operation. AIMS shows backcourse indications when the ILS course and airplane track is more than 90 degrees apart.



ILS - PFD DISPLAYS

ILS - PFD NCD AND INVALID ILS DISPLAYS

Frequency or Identifier

The ILS frequency or identifier does not show when the ILS input frequency goes invalid or if the selected frequency is not a valid localizer frequency.

ILS course

Dashes replace the ILS course display when the input goes NCD. The course display goes out of view when the course input goes invalid.

Localizer Pointer and Scale

The localizer scale remains in view and the localizer pointer goes out of view if:

- The localizer deviation is NCD
- The ILS course is invalid or NCD
- The airplane track is NCD or invalid.

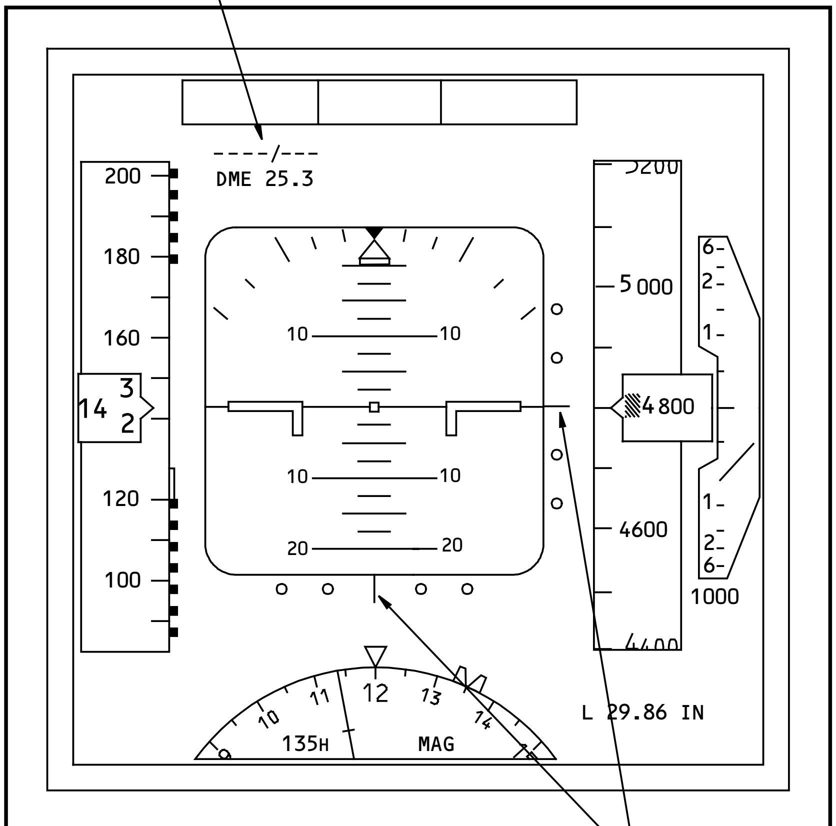
The amber LOC flag replaces the localizer scale and pointer when the localizer deviation goes invalid.

Glideslope Pointer and Scale

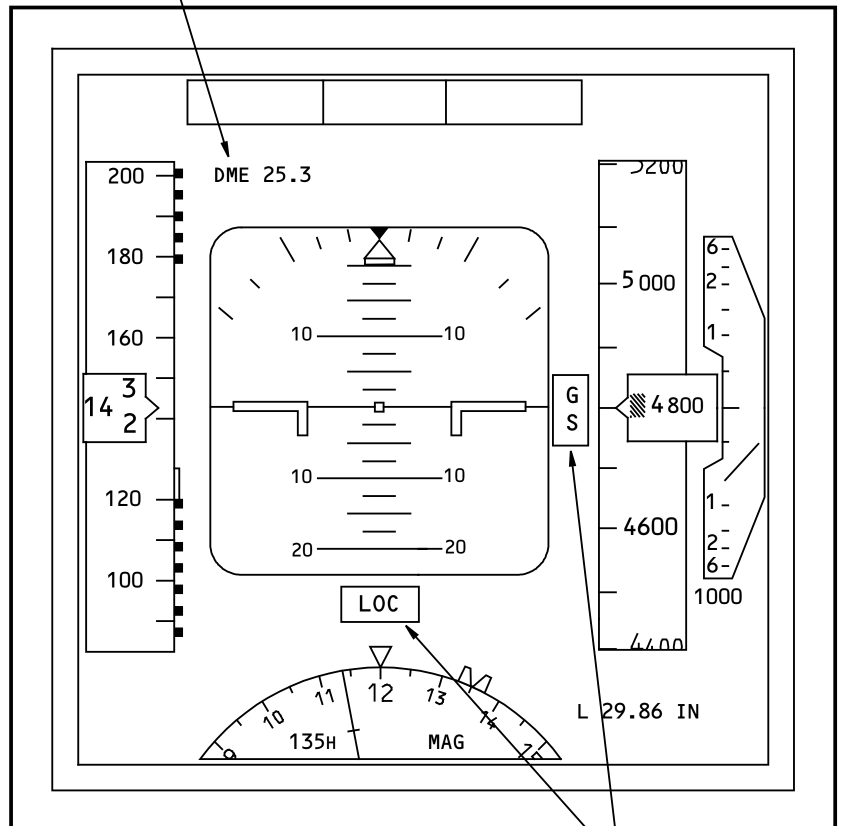
The glideslope scale remains in view and the glideslope pointer goes out of view when the deviation goes NCD or when the airplane is in a backcourse configuration. The amber G/S flag replaces the glideslope scale and pointer when the glideslope deviation goes invalid.

REPLACE LOCALIZER
FREQUENCY OR IDENTIFIER
AND ILS COURSE WITH DASHES

REMOVE LOCALIZER
FREQUENCY OR IDENTIFIER
AND ILS COURSE



NO COMPUTED DATA DISPLAY



INVALID DISPLAY

REMOVE GLIDESLOPE
AND LOCALIZER
POINTERS

REMOVE GLIDESLOPE
AND LOCALIZER
POINTERS AND SCALES
AND SHOW THE AMBER
GS AND LOC FLAGS

ILS - PFD NCD AND INVALID ILS DISPLAYS

34-31-00-024 Rev 4 04/26/96

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ILS - ND ILS DISPLAYS

General

Select approach (APP) on the EFIS control panel to show ILS displays on the navigation display (ND). The data shows in both the expanded or center mode formats. Use the mode selector on the EFIS control panel to choose which format shows on the ND.

ILS Displays

These are the ILS displays on the ND:

- Reference receiver for ILS deviation
- ILS frequency or identifier
- ILS course
- Localizer deviation indication
- Localizer deviation scale
- Glideslope deviation pointer
- Glideslope deviation scale.

Display Source Priority

The flight crew cannot manually select a multi-mode receiver (MMR) for the ND. When a MMR fails, the AIMS selects another MMR to show on the ND. LOC and G/S flags show on the NDs when all MMRs fail.

This is the AIMS priority selection of ILS display data on the ND:

Captain's PFD	L,C,R
First Officer's PFD	R,C,L

Reference Receiver for ILS Deviation

The reference receiver for ILS deviation shows to the left of the frequency display. It identifies the left, right, or center receiver as the source for the ILS deviation displays.

ILS frequency or Identifier

The ILS frequency or identifier show at the top right corner of the ND. The frequency shows until the receiver decodes the station identifier. When the receiver decodes the station identifier, the four letter code replaces the frequency.

ILS Course

The ILS course shows below the ILS frequency display at the upper right corner of the ND. The three digit display corresponds to the position of the course arrow. The display range is 1 degree to 360 degrees.

Localizer and Glideslope Deviation

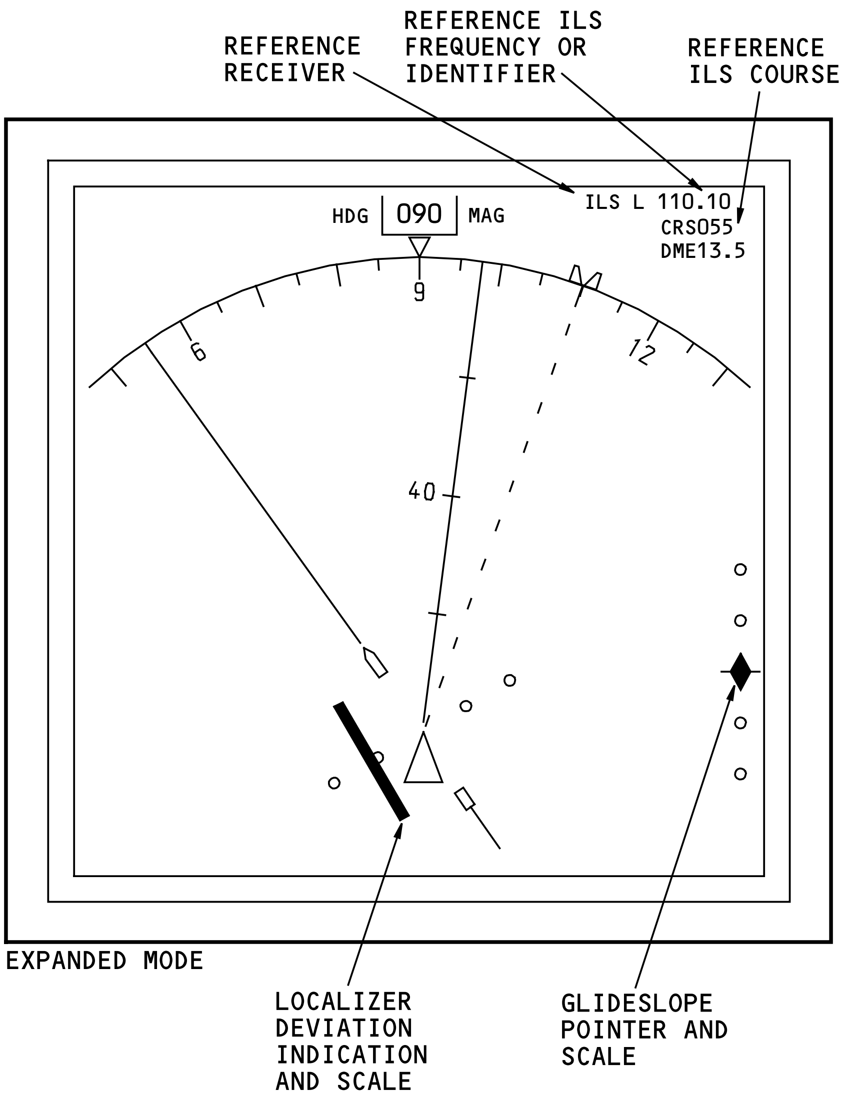
The localizer deviation indication and scale show in the center of the ND. In the expanded ND format, the deviation scale shows at the bottom of the ND. The deviation scale is the standard four dot scale where one dot is equal to 1 degree of deviation. The deviation indication shows deviation to the left or right of the runway centerline.

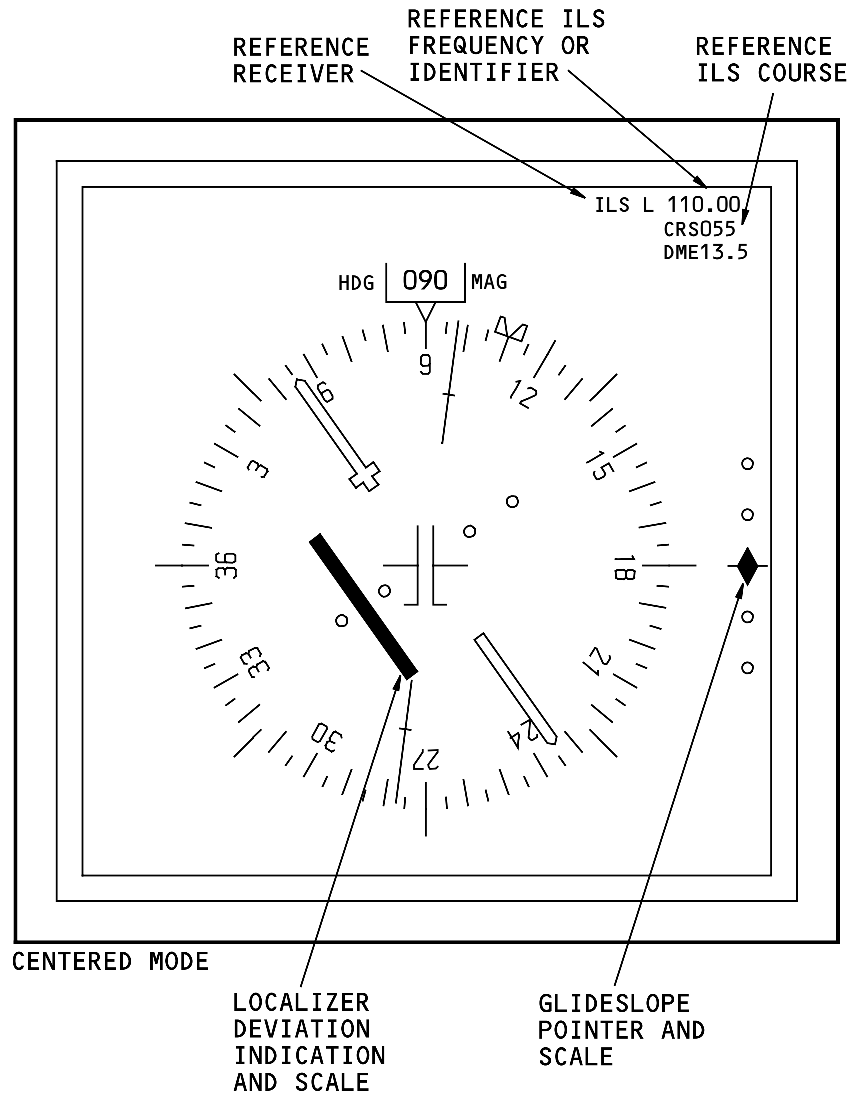
ILS - ND ILS DISPLAYS

The glideslope deviation scale and pointer show at the right side of the ND. The fixed scale is the standard four dot scale where each dot equals 0.35 degrees of deviation. The pointer gives fly to commands to intercept the glideslope beam.

Backcourse

Backcourse happens when the airplane track and runway heading are more than 90 degrees apart. In a backcourse configuration, the glideslope pointer goes out of view.





ILS - ND ILS DISPLAYS

34-31-00-025 Rev 3 10/02/1997

ILS - ND ILS NCD INDICATIONS

ILS Course

When the ILS course input is NCD, dashes replace the three digit course. These are the displays that go out of view:

- Course pointer
- Localizer deviation indication
- Localizer deviation scale
- Glideslope deviation pointer
- Glideslope deviation scale.

ILS Frequency

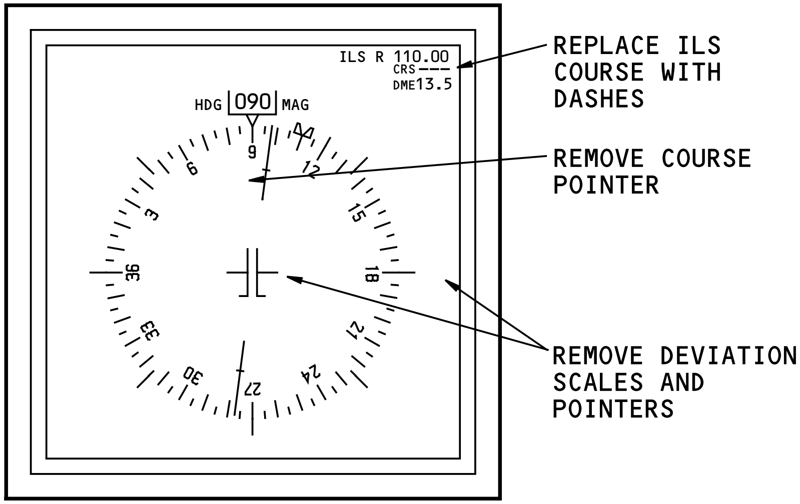
When the ILS frequency is NCD, dashes replace the frequency. These are the displays that go out of view:

- ILS course
- DME
- Localizer deviation indication
- Glideslope deviation pointer.

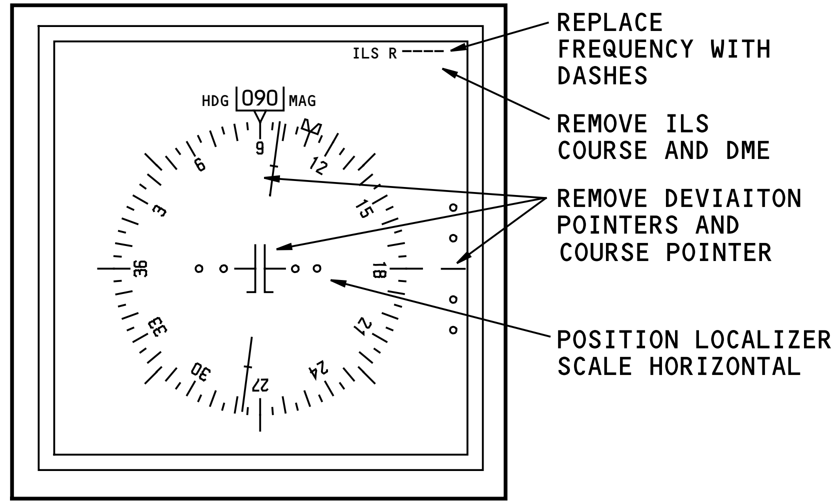
The localizer scale goes to the horizontal position.

ILS Deviation

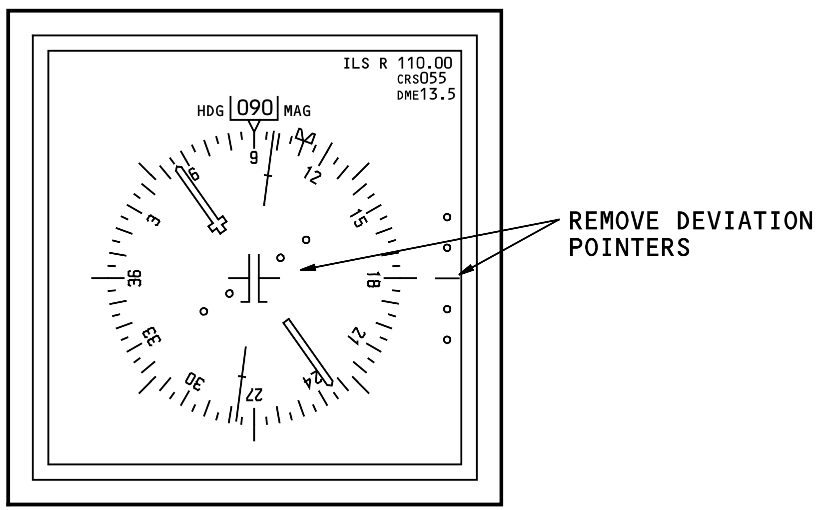
The localizer deviation indication goes out of view when the localizer deviation is NCD. The glideslope deviation pointer goes out of view when the glideslope deviation is NCD.



ILS COURSE NCD



FREQUENCY NCD



LOCALIZER/GLIDESLOPE
DEVIATION NCD

34-31-00-026 Rev 2

ILS - ND ILS NCD INDICATIONS

ILS - ND ILS INVALID DISPLAY

Localizer Frequency

When the localizer frequency goes invalid, the frequency/identifier line goes out of view. The localizer and glideslope pointers and scales go out of view.

ILS Course

When the ILS course input goes invalid, these are the displays that go out of view:

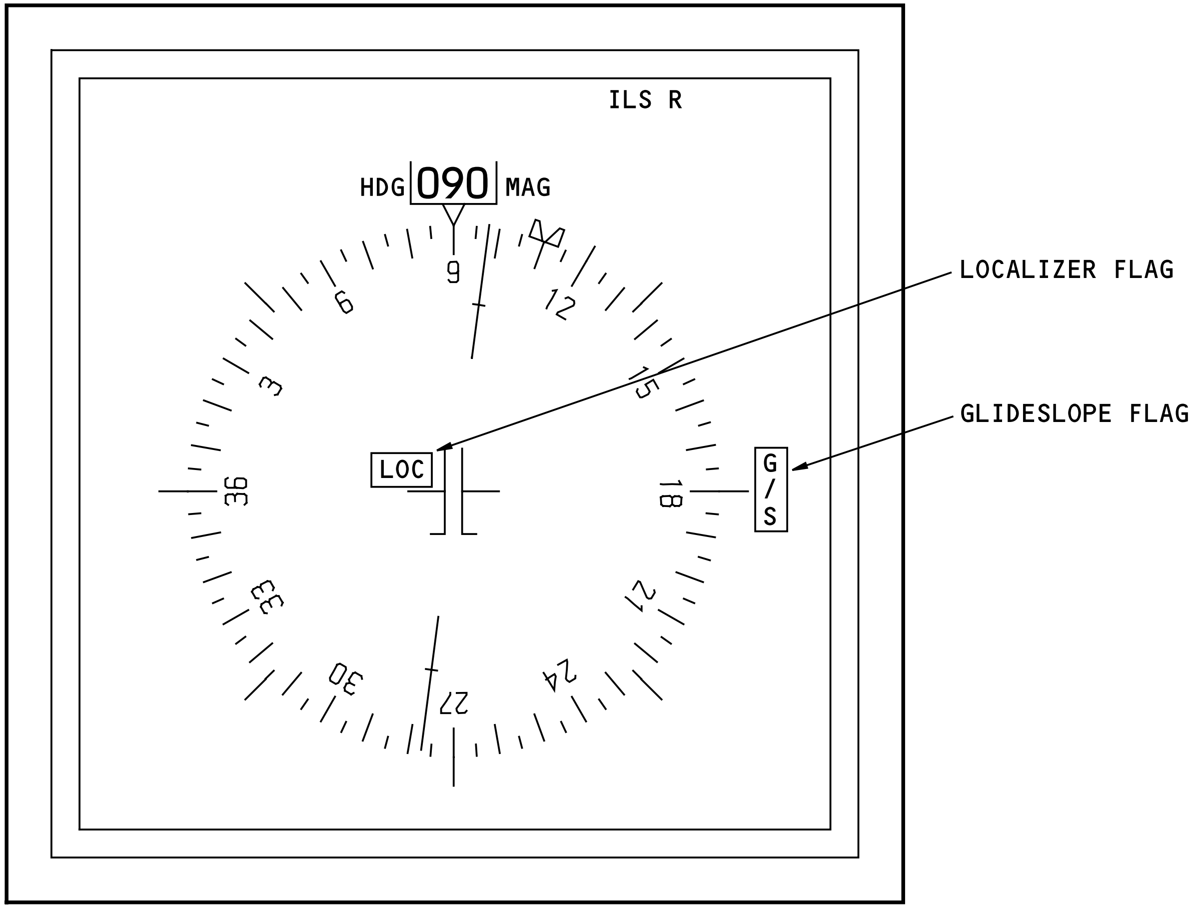
- CRS display and ILS course
- Localizer deviation indication and scale
- Glideslope deviation pointer and scale
- Course pointer.

Localizer Deviation

When the localizer deviation is invalid, the localizer deviation bar and scale go out of view. The LOC flag shows when all ILS receivers fail.

Glideslope Deviation

When the glideslope deviation is invalid, the glideslope deviation pointer and scale go out of view. The G/S flag shows when all ILS receivers fail.



34-31-00-027 Rev 2

ILS - ND ILS INVALID DISPLAY

ILS - PFD AND ND ILS TEST DISPLAYS

General

Use the maintenance access terminal (MAT) to test the multi-mode receivers (MMRs). The MAT sends the test command to the left AIMS cabinet. The central maintenance computer function of the left AIMS cabinet sends the command to the MMR.

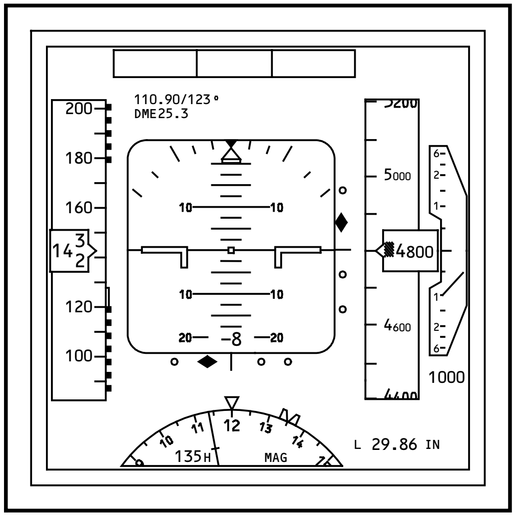
Test Sequence

The receivers start their test sequence when the test command comes from the AIMS cabinet. This is the sequence:

- Invalid data for the first three seconds
- NCD data for approximately two seconds
- Valid data; glideslope pointer up one dot, localizer pointer left one dot for 3 seconds
- Valid data; glideslope pointer down one dot, localizer pointer right one dot for 3 seconds
- Then back to pretest displays.

The AIMS cabinets change the ILS display source when a receiver goes invalid. For this reason, the LOC and G/S flags do not appear while the receiver test sequence goes invalid. To see the flags in the test sequence, the receivers that are not in test must be in a failed condition or power removed.

When the test sequence goes NCD, the localizer pointers and glideslope pointers go out of view.

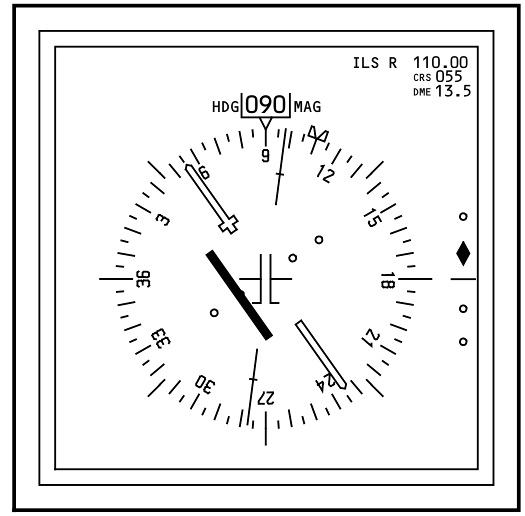


PFD

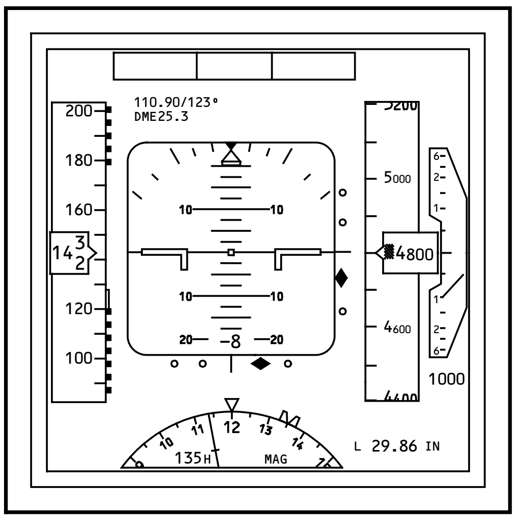
FIRST 3 SECONDS
OF TEST DISPLAY

LOCALIZER = ONE DOT LEFT

GLIDESLOPE = ONE DOT UP



ND

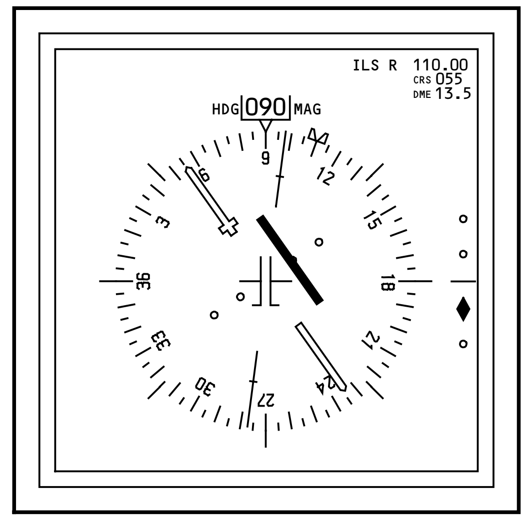


PFD

NEXT 3 SECONDS
OF TEST DISPLAY

LOCALIZER = ONE DOT RIGHT

GLIDESLOPE = ONE DOT DOWN



ND

ILS - PFD AND ND ILS TEST DISPLAYS

34-31-00-028 Rev 6 06/30/1997

ILS - GROUND TEST

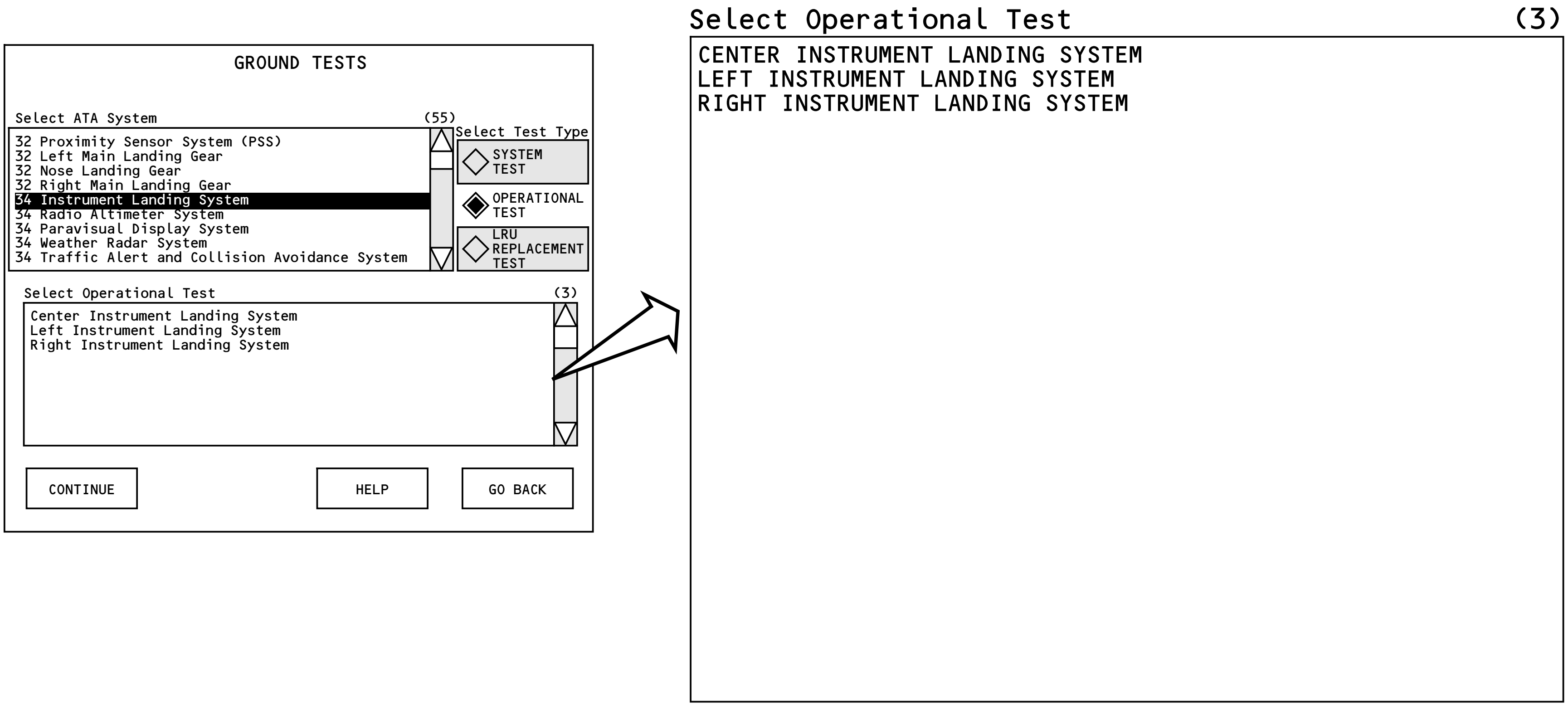
General

You can do a test of the ILS system from the MAT. These are the tests that are available from the operational test selection on the MAT:

- Center instrument landing system
- Left instrument landing system
- Right instrument landing system.

Operational Test

The operational test make sure that the instrument landing system is serviceable.



ILS - GROUND TEST

Continental Airlines, Inc

Distance Measuring Equipment System

WB371

TABLE OF CONTENTS

DISTANCE MEASUREMENT EQUIPMENT SYSTEM - INTRODUCTION

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DISTANCE MEASUREMENT EQUIPMENT SYSTEM - INTRODUCTION

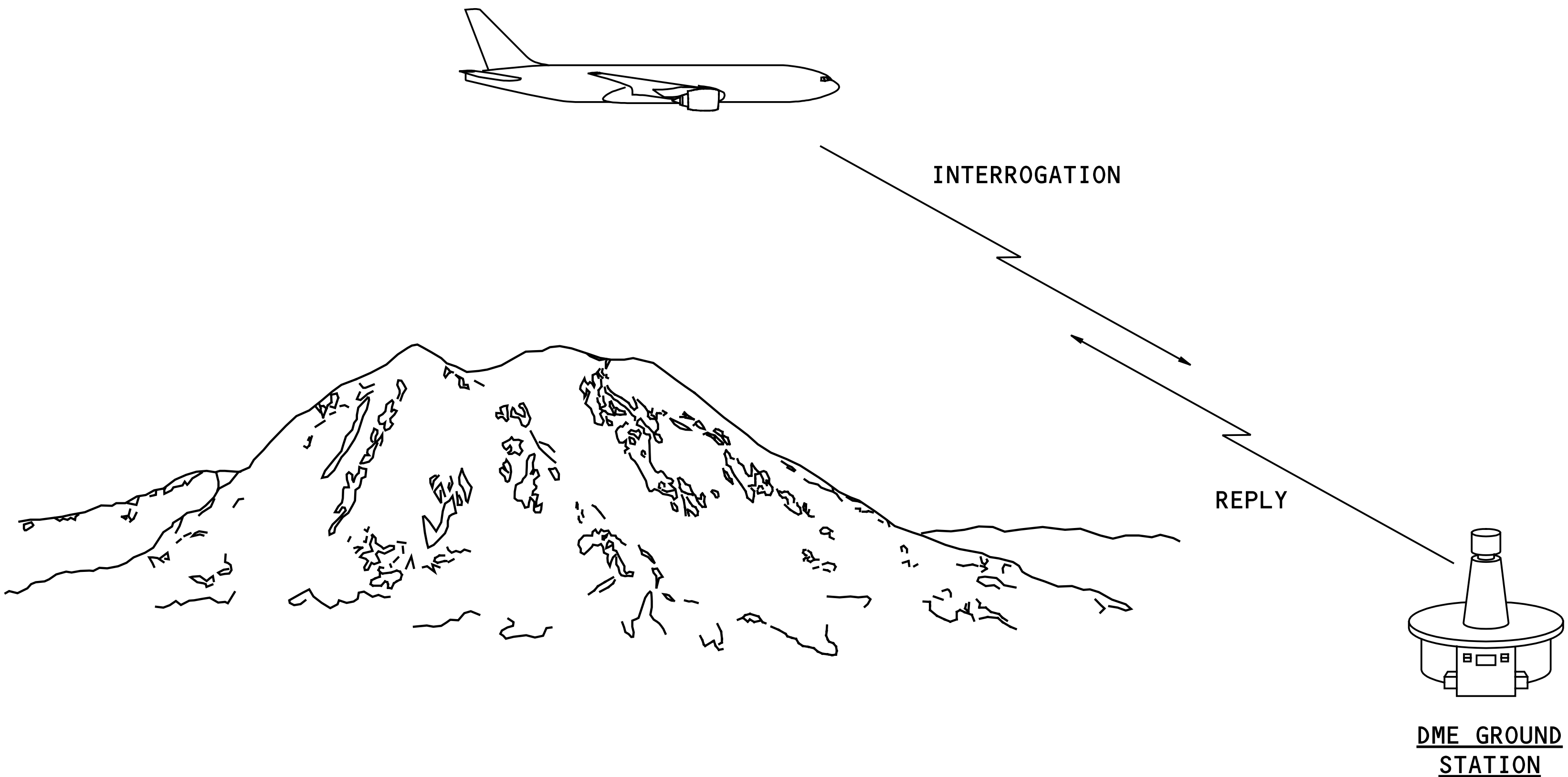
Purpose

The distance measuring equipment (DME) system supplies slant range (line of sight) distance between the airplane and the ground station.

The DME system supplies station audio and identifier signals to the flight deck speakers and headsets.

Abbreviations and Acronyms

ACP	- audio control panel
AIMS	- airplane information management system
ALTN	- alternate
ARINC	- aeronautical radio, inc.
ATE	- automatic test equipment
auto	- automatic
BITE	- built-in test equipment
CDU	- control display unit
CMCF	- central maintenance computing function
CMCS	- central maintenance computing system
DME	- distance measuremnet equipment
EFIS	- electronic flight instrument system
FMCF	- flight management computing function
LED	- light emitting diode
MHz	- megahertz
NCD	- no computed data
RF	- radio frequency



34-55-00-001 Rev 1

DISTANCE MEASUREMENT EQUIPMENT SYSTEM - INTRODUCTION

DME SYSTEM - GENERAL DESCRIPTION

General

The DME system has two interrogators and two antennas.

The DME interrogator transmits a signal to DME ground stations. The ground stations send a reply signal back to the interrogator. The interrogator measures the time between the transmit signal and the reply signal and calculates distance to the station.

Description

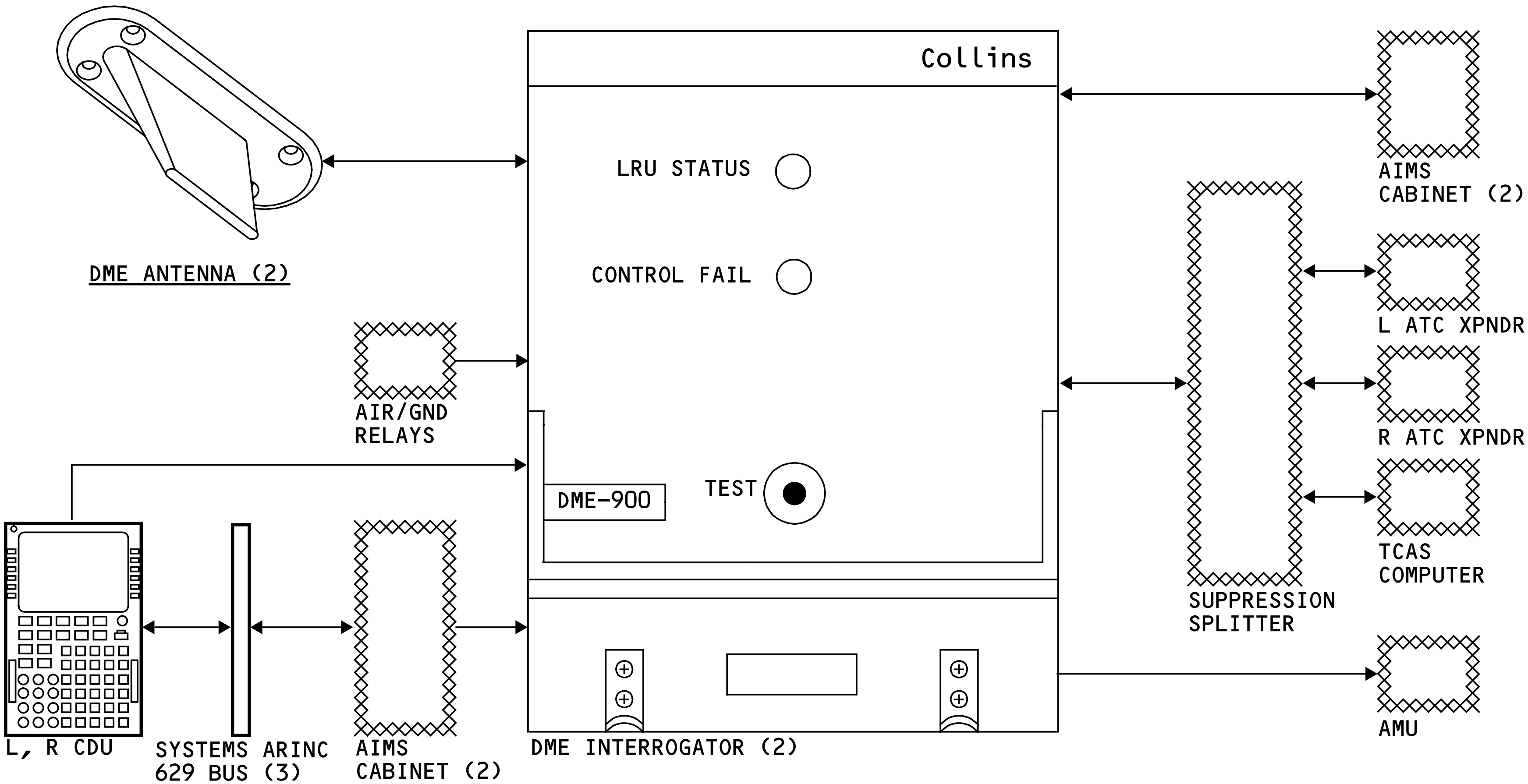
The interrogators get manual tune inputs from the left or right CDU or autotune inputs from the airplane information management system (AIMS) cabinets. The interrogators can get tune inputs directly from the left or right CDU (alternate tune) when the tune inputs from AIMS cabinet fails.

The air/ground relays send discretes to the DME interrogators.

The DME interrogators sends slant range data to the AIMS cabinets to show on the primary flight displays (PFDs) and navigation displays (NDs).

The DME system, air traffic control (ATC) system, and traffic alert and collision avoidance system (TCAS) operate on the same frequency band. When either DME interrogator, or either ATC transponder, or the TCAS computer transmits, that unit sends out a suppression pulse. This pulse goes through a suppression splitter to the other units to inhibit reception in the other units to prevent interference in them.

The DME interrogator receives the station audio identifiers and sends them to the audio management unit (AMU).



34-55-00-002 Rev 4 02/12/1998

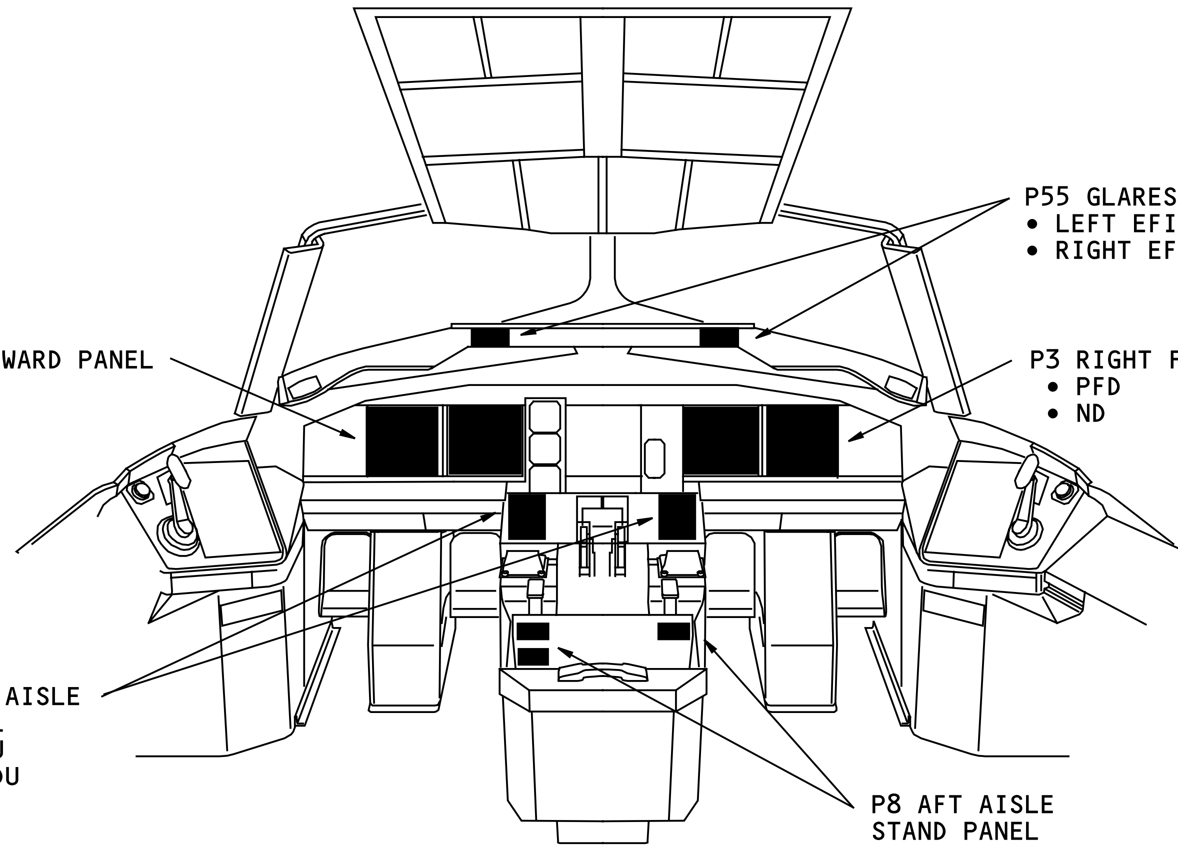
DME SYSTEM - GENERAL DESCRIPTION

DME SYSTEM - COMPONENT LOCATIONS - FLIGHT DECK

DME Component locations - Flight Deck

The components on the flight deck that interface with DME are:

- Left and right EFIS Control Panel (CP)
- Captain's and first officer's primary flight displays (PFDs) and navigation displays (NDs)
- Left and right control display units (CDUs)
- Audio Control Panels (ACPs).



34-55-00-003 Rev 1

DME SYSTEM - COMPONENT LOCATIONS - FLIGHT DECK

DME SYSTEM - COMPONENT LOCATION - MAIN EQUIPMENT CENTER AND ANTENNAS

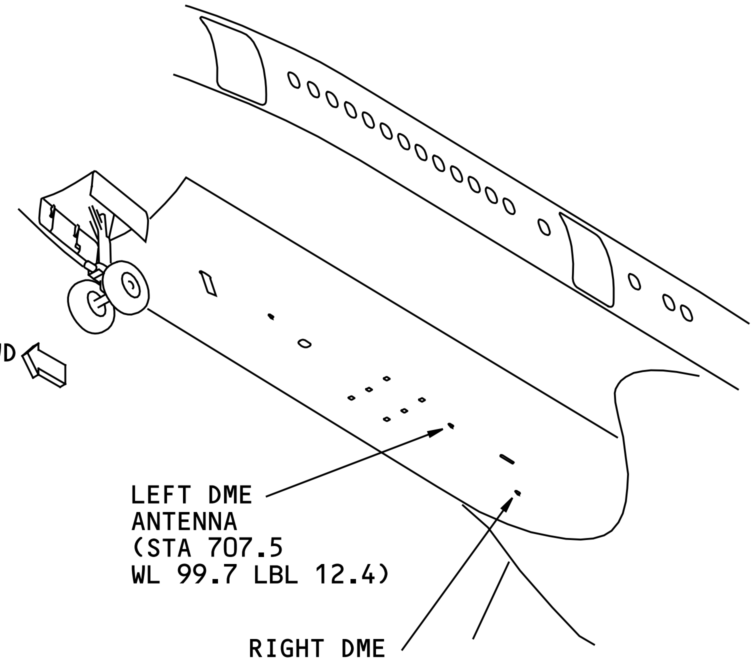
DME Component Locations

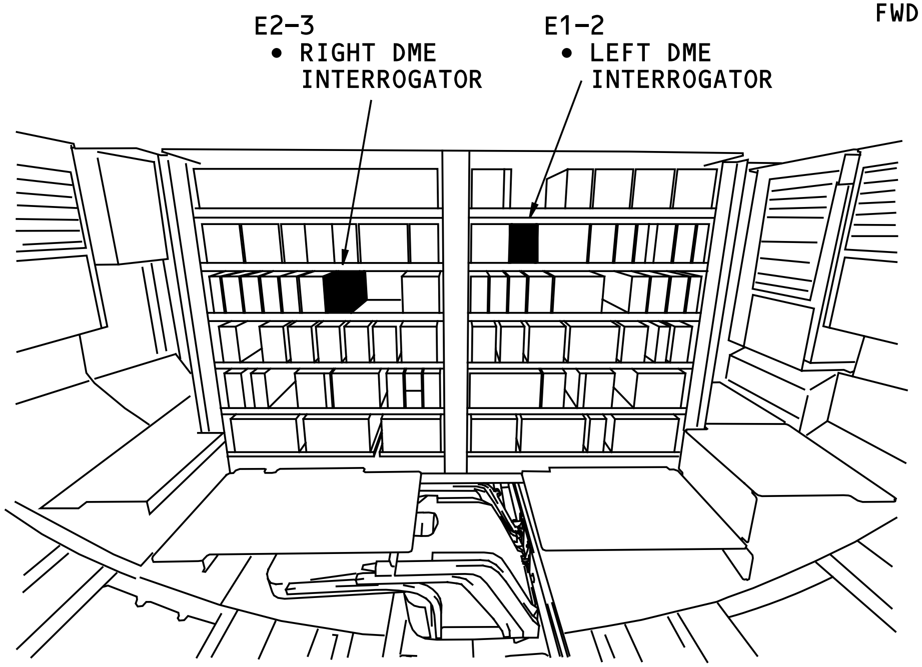
These components are in the main equipment center:

- Left DME interrogator
- Right DME interrogator.

These components are on the exterior of the airplane:

- Left DME antenna
- Right DME antenna.





MAIN EQUIPMENT CENTER

34-55-00-004 Rev 1

DME SYSTEM - COMPONENT LOCATION - MAIN EQUIPMENT CENTER AND ANTENNAS

DME SYSTEM - 429 INTERFACE

CDU

The left and right CDUs supply alternate tune inputs directly to the DME interrogators if the AIMS tune inputs fail. The left CDU alternate tunes the left interrogator and the right CDU alternate tunes the right interrogator.

DME Outputs

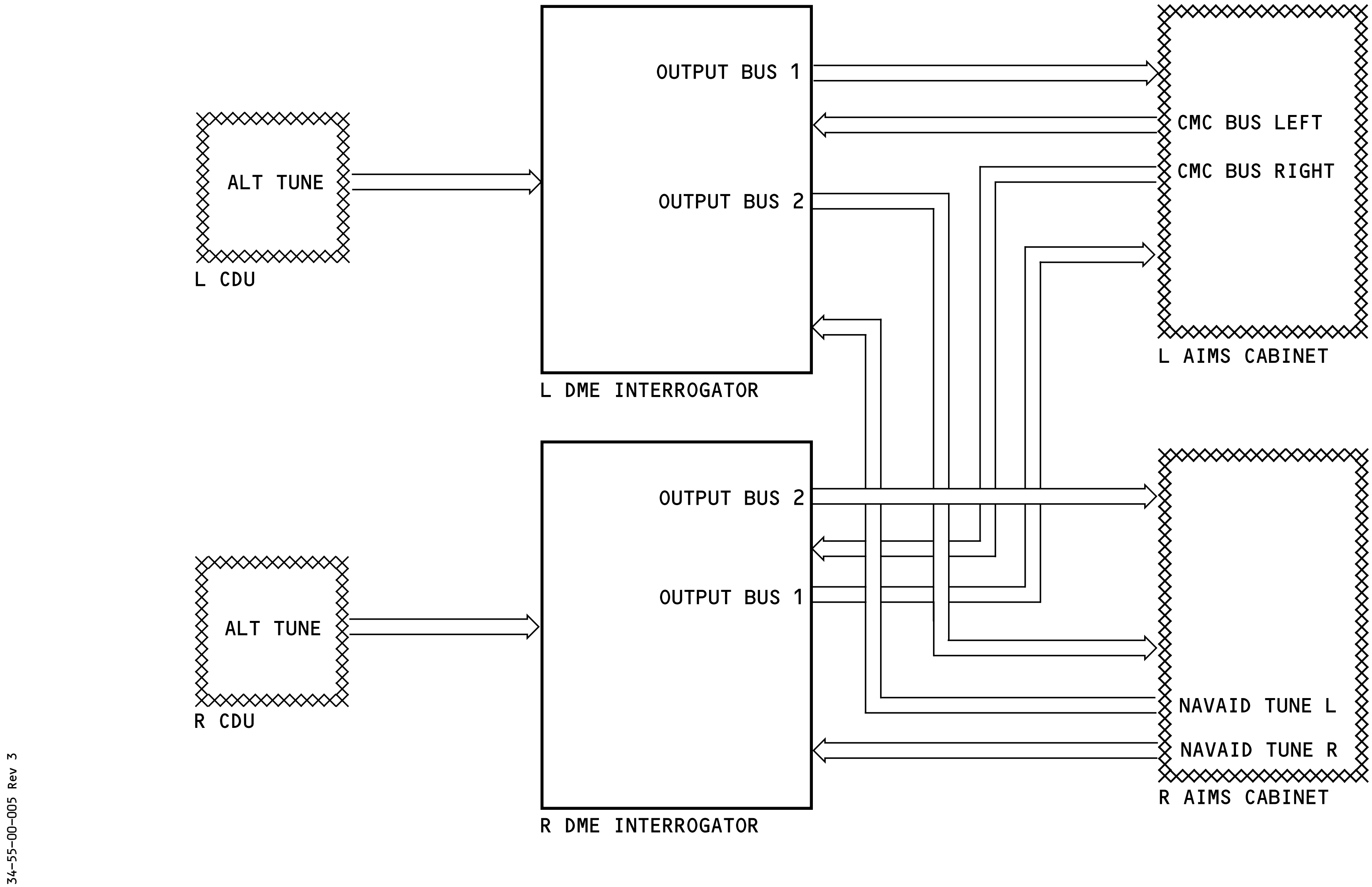
Each DME interrogator has two output buses. The output buses supply data to both AIMS cabinets.

Each DME interrogator sends data to both AIMS cabinet to display DME data on the PFDs and NDs. The interrogators also send test status and fault reports.

AIMS

The left AIMS cabinet sends test commands and flight legs data to the DME interrogators on the left and right CMC buses.

The right AIMS cabinet sends manual or automatic tune inputs to the DME interogators on the left and right tune buses.



DME SYSTEM - 429 INTERFACE

DME SYSTEM - POWER, ANALOG, AND DISCRETE INTERFACE

Power and Antenna Interface

Each DME interrogator receives 115v ac from its circuit breaker.

Air/Ground Relay

The air/ground relays supply discrete inputs to the DME interrogators for these functions:

- Set flight legs (as alternate source, primary is from the CMCF of AIMS)
- Inhibit test commands in the air.

CDU

The CDUs send a frequency source select discrete to cause the interrogator to select the tune input from either the CDU or the AIMS cabinets. The resistor assemblies pull up the discretes to 28v dc. The left CDU sends a ground discrete to the left interrogator when the discrete is true. The right CDU sends a ground discrete to the right interrogator when the discrete is true.

DME Antenna

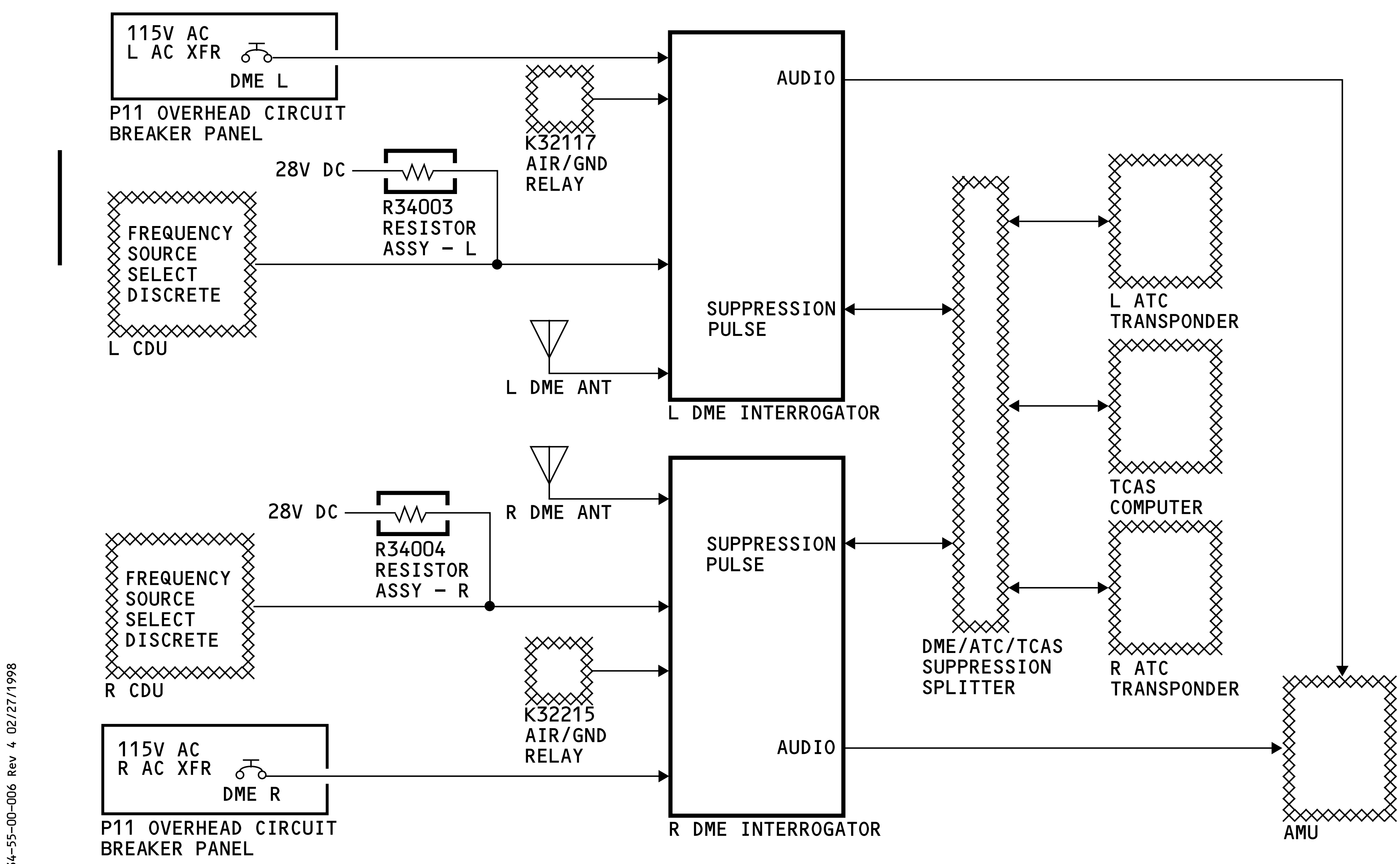
The DME antennas transmit and receive DME signals. The antenna transmits signal pulse pairs to the ground stations then receive the reply signal pulse pairs from the DME ground station and sends them to the interrogator.

DME/ATC/TCAS Suppression

The DME system, the air traffic control (ATC) system, and the traffic alert and collision avoidance system (TCAS) operate in the same frequency band. When a DME interrogator, an ATC transponder or a TCAS computer transmits, it sends a suppression pulse through the suppression splitter. This pulse inhibits reception of the other four units. This prevents damage to the receiver circuits of the other LRUs.

DME Audio

The DME interrogator sends the DME station audio identifier to the audio management unit (AMU). The AMU combines the DME audio with VOR or ILS audio. The audio goes to the headsets and the flight deck speakers.



DME SYSTEM - POWER, ANALOG, AND DISCRETE INTERFACE

DME SYSTEM - INTERROGATOR

General

The DME interrogator scans 252 channels and calculates distance information for all channels in the DME range. There are 200 DME channels paired with the VHF NAV frequencies. The other 52 channels are for military TACAN facilities. The DME receive frequency is 63 MHz above or below the transmit frequency.

Purpose

The purpose of the DME interrogator is to:

- Interrogate DME stations
- Receive the station replys
- Receive audio identifiers
- Calculate slant range distances.

Frequencies

The DME interrogator uses these L-Band frequencies:

- 1025 MHz to 1150 MHz (transmit)
- 962 MHz to 1215 MHz (receive).

These DME tuning frequencies are in the VHF band:

- 108.00 to 117.95 MHz paired VOR or ILS
- 133.30 to 135.95 MHz unpaired.

Front Panel

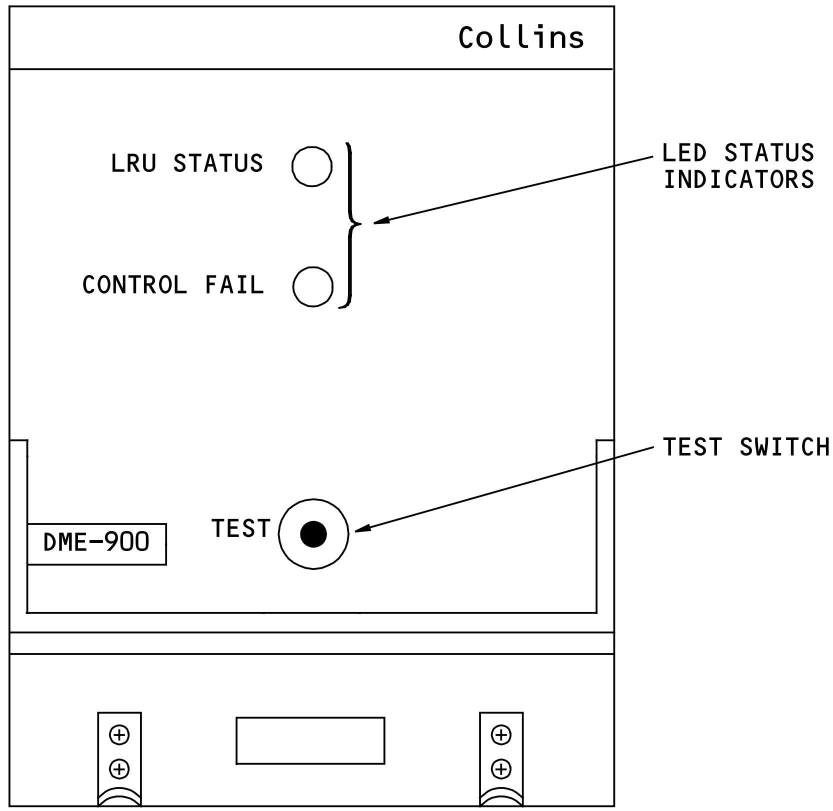
The front panel of the DME interrogator has these features:

-
- LED status indicators
- A self-test switch.

Training Information Point

The maintenance manual and the fault isolation manual do not have a task for the line maintenance technician to do a test from the front panel of the DME interrogator. You must do all tests for the DME interrogator from the MAT or a PMAT.

Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For that reason these LRUs have a front panel test feature.



DME SYSTEM - INTERROGATOR

DME SYSTEM - ANTENNA

General

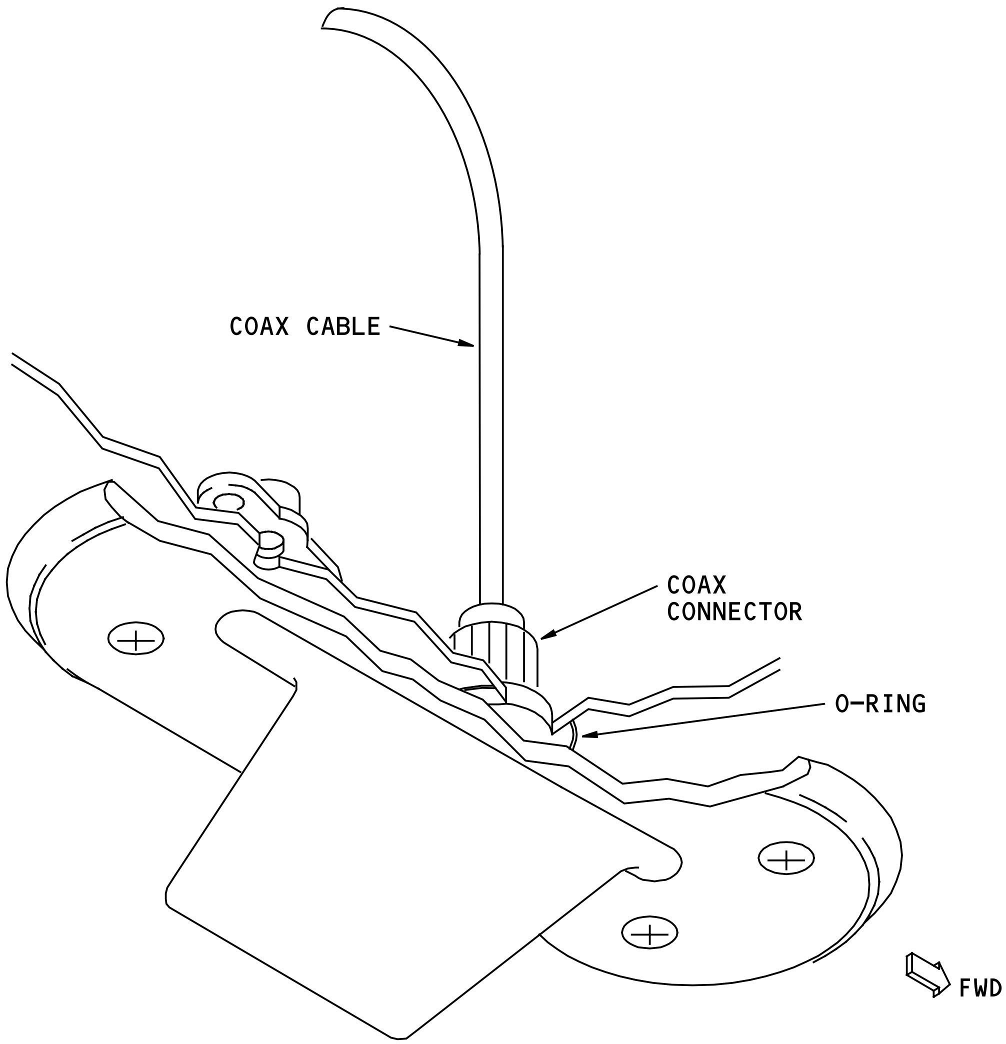
The DME l- band antenna transmits the interrogator output signal and receives the ground station reply signals.

Physical Description

The antenna has an O-ring moisture seal and attaches to the airplane by four screws. The DME and ATC antennas are the same and are interchangeable.

Training Information Point

WARNING: EXTRA FORCE ON THE ANTENNA BASE MAY BE REQUIRED TO BREAK THE WEATHERPROOFING SEAL. TO PREVENT DAMAGE TO AIRPLANE SKIN OR ELECTRICAL CABLE AT THE ANTENNA BASE, CAREFULLY PRY AROUND THE ANTENNA WITH A SEALANT REMOVAL TOOL.



34-55-00-008 Rev 1

DME SYSTEM - ANTENNA

DME SYSTEM - TUNING

General

These are the three ways to tune the DME interrogators:

- Manually by the left, right, or center CDU
- Automatically by the FMCF in the AIMS cabinets
- By the CDUs as an alternate tune source.

Manual Tune

You manually tune the DME interrogators from the left or right control display units (CDUs). The center CDU can tune the interrogators if the left or right CDU fails. Manual tune inputs from the CDUs go through the left and right systems ARINC 629 buses, then to the left and right AIMS cabinets. Manual tune inputs from the left or right AIMS cabinet comes from the right AIMS cabinet and goes to the DME interrogators.

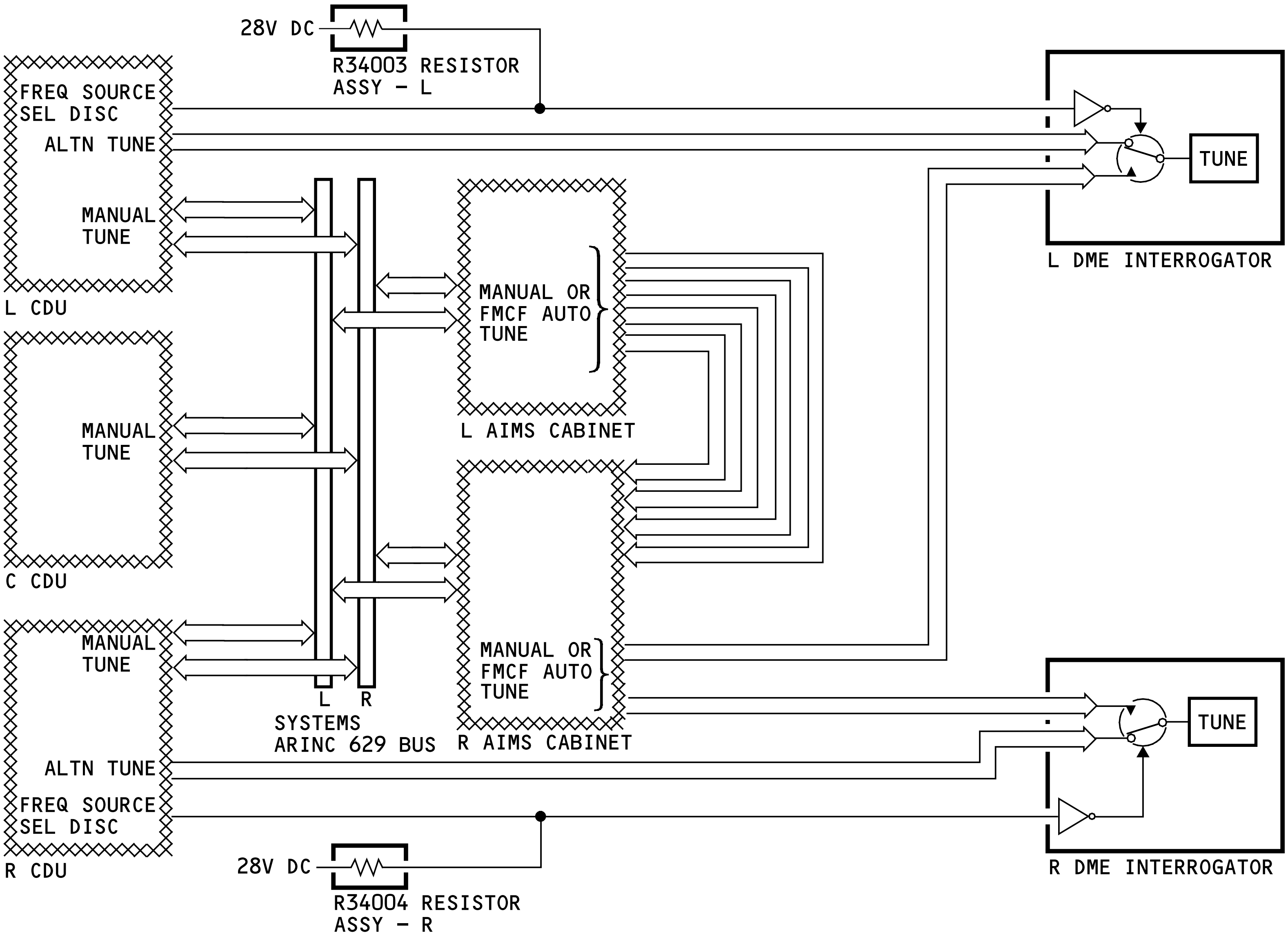
AIMS Autotune

The flight manangement computing function (FMCF) of the left or right AIMS cabinet can automatically tune (autotune) the DME interrogators. Autotune inputs from the left or right AIMS cabinets go through the right AIMS cabinet, then to the DME interrogators.

Alternate Tune

The CDUs monitor the AIMS cabinets tune functions. IF the AIMS tune function fails, the CDUs send a frequency source select discrete to the DME interrogators that changes the inputs from the right AIMS cabinet, to the input that comes directly from the left or right CDU. The CDUs use 28v dc from a pull-up resistor to set the discrete.

In the alternate tune mode, the left CDU alternate tunes the left DME interrogator and the right CDU alternate tunes the right DME interrogator. The center CDU has no alternate tune function.



DME SYSTEM - TUNING

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DME SYSTEM - AUDIO CONTROL PANEL

General

The audio control panels supply control inputs to the audio management unit. This lets the crew hear audio signals on the speakers and headsets in the flight deck.

DME Audio Pairing

The flight management computing function (FMCF) of AIMS can pair the DME station identifier audio with VOR station identifier audio, or with ILS station identifier audio.

The flight crew uses the EFIS control panels or the EFIS CONTROL page on the CDU to determine how to pair the DME audio. The flight crew selections go to the FMCF. The FMCF sends the DME pairing signal to the audio management unit (AMU). The AMU uses the pairing signal to pair the DME audio with ILS or VOR audio.

When the captain selects the approach (APP) ND mode on the left EFIS control panel or on the left CDU EFIS CONTROL page, the AMU pairs the left DME interrogator audio with the left multi-mode receiver (MMR) audio. When the captain selects the VOR, MAP, or PLAN mode, the AMU pairs the left DME interrogator audio with the left VOR receiver audio.

When the first officer selects the approach (APP) ND mode on the right EFIS control panel or on the right CDU EFIS CONTROL page, the AMU pairs the right DME interrogator audio with the right MMR audio. When the first officer selects the VOR, MAP, or PLAN mode, the AMU pairs the right DME interrogator audio with the right VOR receiver audio.

Description

These are the controls on the audio control panel that let you hear DME audio:

- VOR/ADF receiver selector
- VOR/ADF receiver volume control
- NAV filter selector.
- Approach receiver volume control
- Approach receiver selector.

VOR/ADF Receiver Selector

The VOR/ADF receiver selector lets you select VOR or ADF as the source of audio. With the selector in the VOR positions, you can hear DME station identifier audio and VOR station audio.

VOR/ADF Receiver Volume Control

The VOR/ADF receiver volume control turns on the audio and controls the volume.

NAV Filter Selector

The NAV filter selector lets you select one of these:

- Voice (V) audio
- Both (B) voice and range audio.

- Range (R) audio.

Approach Receiver Volume Control

The approach volume control makes the audio come on and controls the volume for the approach (APP) selector.

Approach Receiver Selector

The approach receiver selector lets you select ILS or marker beacon as the source for audio.

With the selector in the left (L) position, you can hear audio from the left DME interrogator. The DME audio you will hear is the DME station identifier audio that is paired with the multi-mode receiver (MMR) audio.

With the selector in the right (R) position, you can hear audio from the right DME interrogator. The DME audio you will hear is the DME station identifier audio that is paired with the right MMR audio.

With the selector in the center (C) position, you will not hear any DME audio. You will only hear ILS station identifier audio from the center MMR.

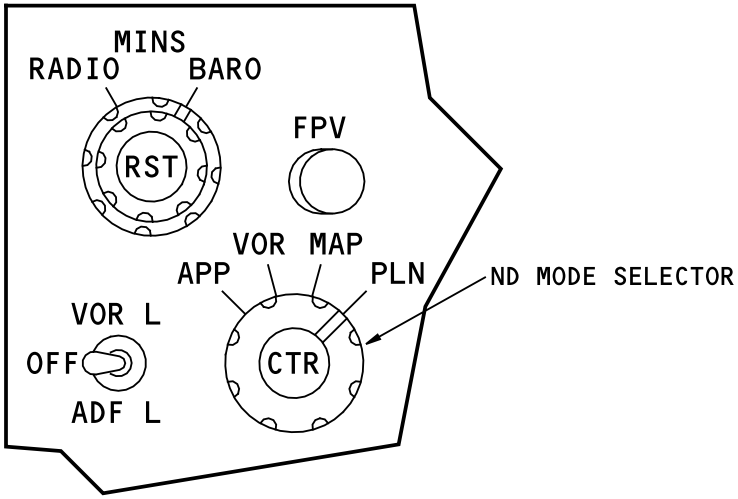
Operation

Do this to hear DME or VOR/DME audio:

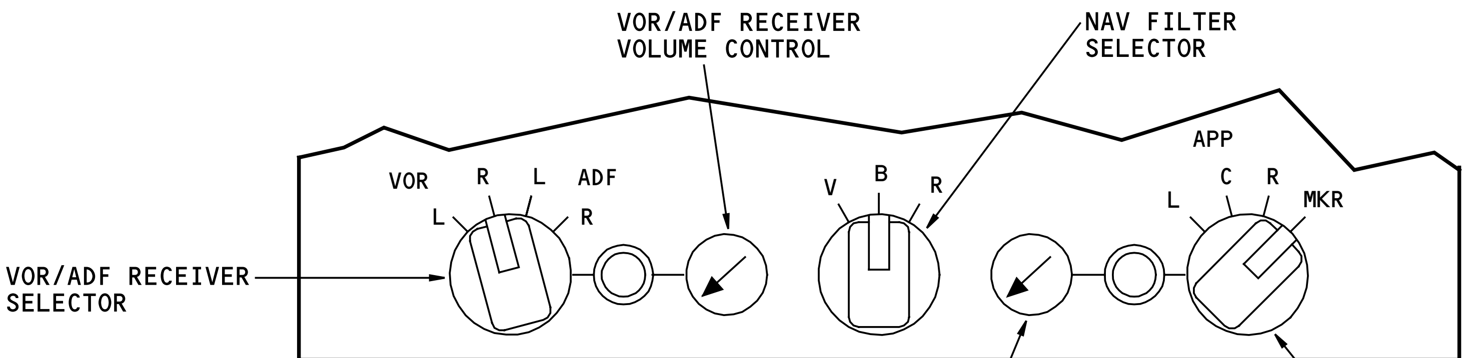
- Set the VOR/ADF receiver selector to the left (L) or right (R) VOR position
- Push the VOR/ADF receiver volume control to make the VOR audio come on (turn the control to adjust the volume)
- Set the NAV filter selector to the both (B) or range (R) position.

Do this to hear ILS/DME audio:

- Set the approach receiver selector to the left (L) or right (R) position
- Push the approach receiver volume control to make the ILS audio come on (turn the control to adjust the volume).



EFIS CONTROL PANEL



AUDIO CONTROL PANEL

34-55-00-010 Rev 4 06/28/96

DME SYSTEM - AUDIO CONTROL PANEL

DME SYSTEM - MANUAL AND ALTERNATE TUNING

General

The CDUs supply manual tune inputs during normal operation and alternate tune inputs when the AIMS tune inputs fail.

Since DME stations are normally paired with VOR or ILS stations, to tune the DME interrogators, you enter a VOR or ILS frequency. You can also tune DME stations that are not paired with VOR or ILS stations.

Operation

To see DME frequencies and DME/VOR or DME/ILS paired frequencies, push the NAV RAD key on the CDU. The NAV RADIO page shows data for the NAV radios.

To manually tune a DME interrogator, enter a valid VOR or ILS frequency or identifier into the scratch pad. Push the line select key to enter the frequency for the applicable data line. To tune an unpaired DME frequency, enter the VOR frequency into the VOR data line for the left or right VOR system.

When you manually enter a VOR frequency, the letter M shows after the frequency.

The letter A shows after the VOR frequency when the FMCF of AIMS autotunes the frequency.

To delete the frequency, push the delete (DEL) key on the CDU. The delete function shows in the CDU scratchpad. Next, line select the delete function to the applicable VOR data line.

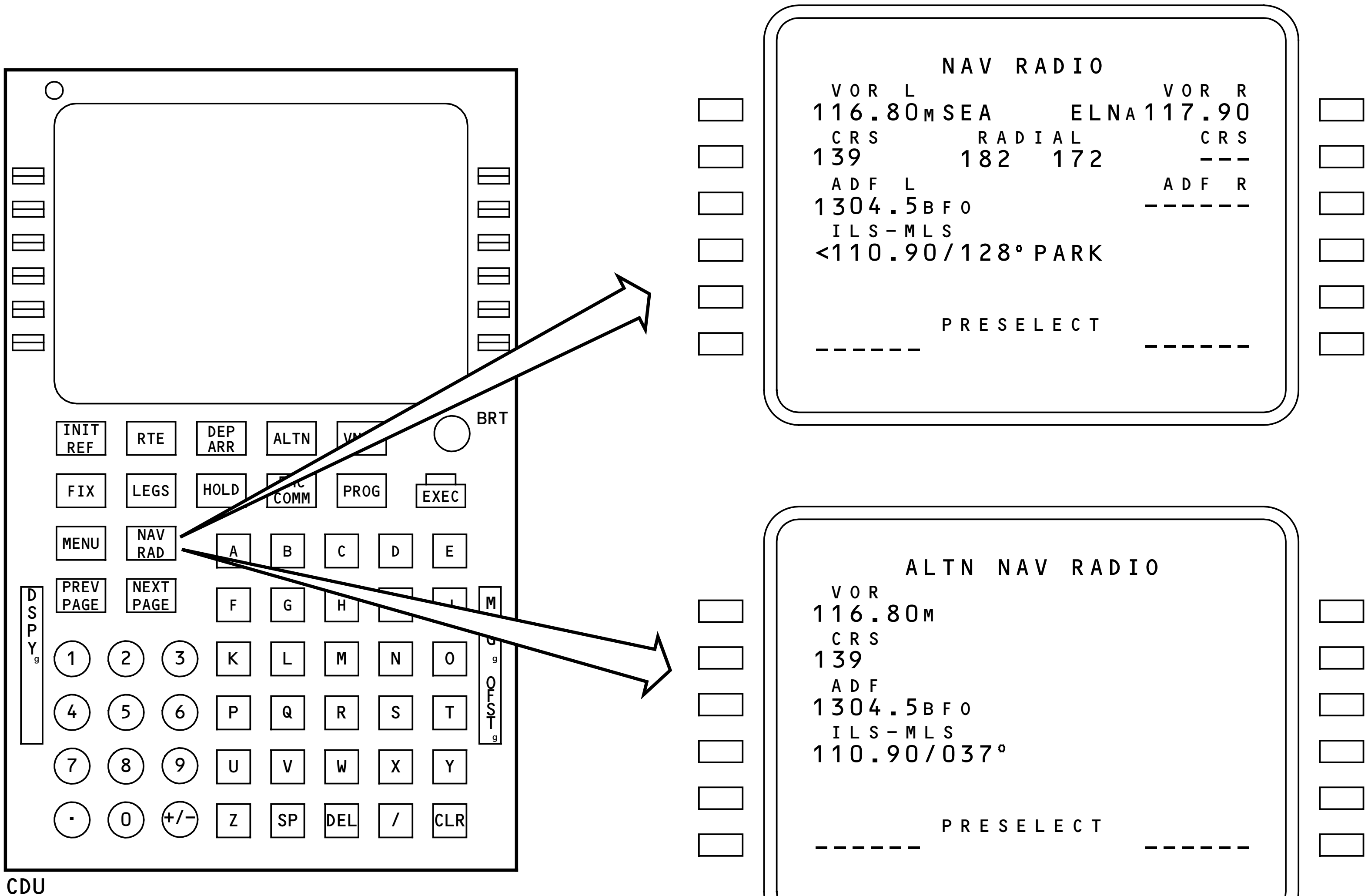
Alternate Tuning

The ALTN NAV RADIO page is available only when the tune inputs from the AIMS cabinets fail.

To get access to the ALTN NAV RADIO page, push the NAV RAD key on the CDU.

The ALTN NAV RADIO page is different from the NAV RADIO page. The ALTN NAV RADIO page shows data for only the left or right NAV radios. The left CDU ALTN NAV RADIO page controls the left NAV receivers and the right CDU ALTN NAV RADIO page controls the right NAV receivers.

You enter a VOR or ILS frequency the same as you do for normal manual tuning.



DME SYSTEM - MANUAL AND ALTERNATE TUNING

DME SYSTEM - EFIS CONTROLS

General

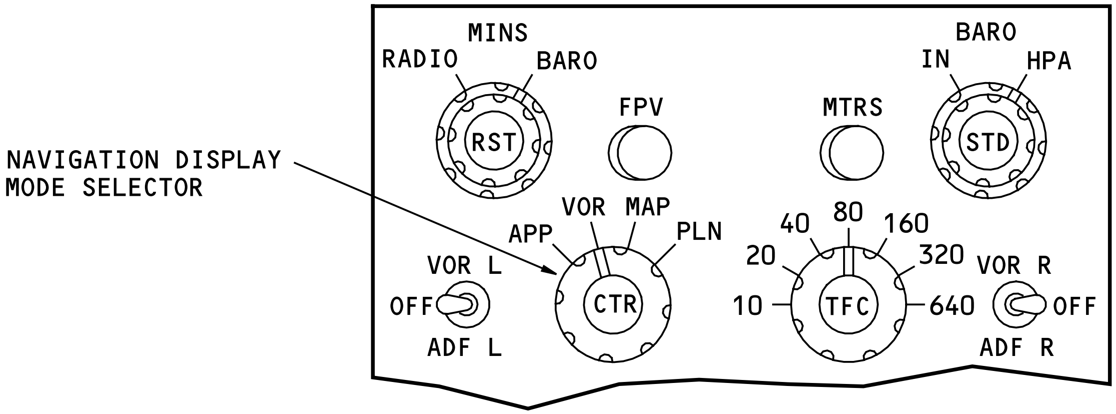
The EFIS control panel has controls to select DME data to show on the navigation displays (NDs).

Navigation Display Mode Selector

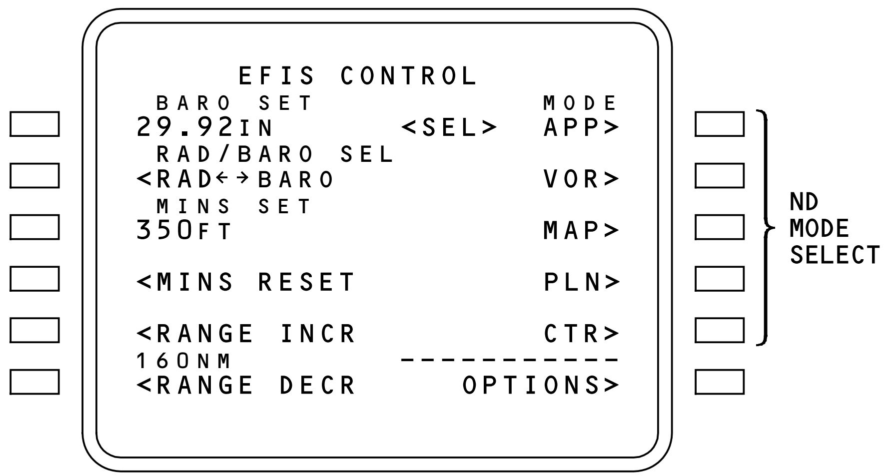
You use the navigation display mode selector to select the display mode on the NDs. DME data shows in all modes except plan (PLN) mode.

Alternate or Backup EFIS Control Panel

The EFIS control page on the CDU supplies backup controls for the EFIS control panel. You can use the EFIS control page to select the display mode for the NDs.



EFIS CONTROL PANEL



EFIS CONTROL PAGE

DME SYSTEM - EFIS CONTROLS

34-55-00-022 Rev 1 11/06/1997

DME SYSTEM - PRIMARY FLIGHT DISPLAY

Normal Display

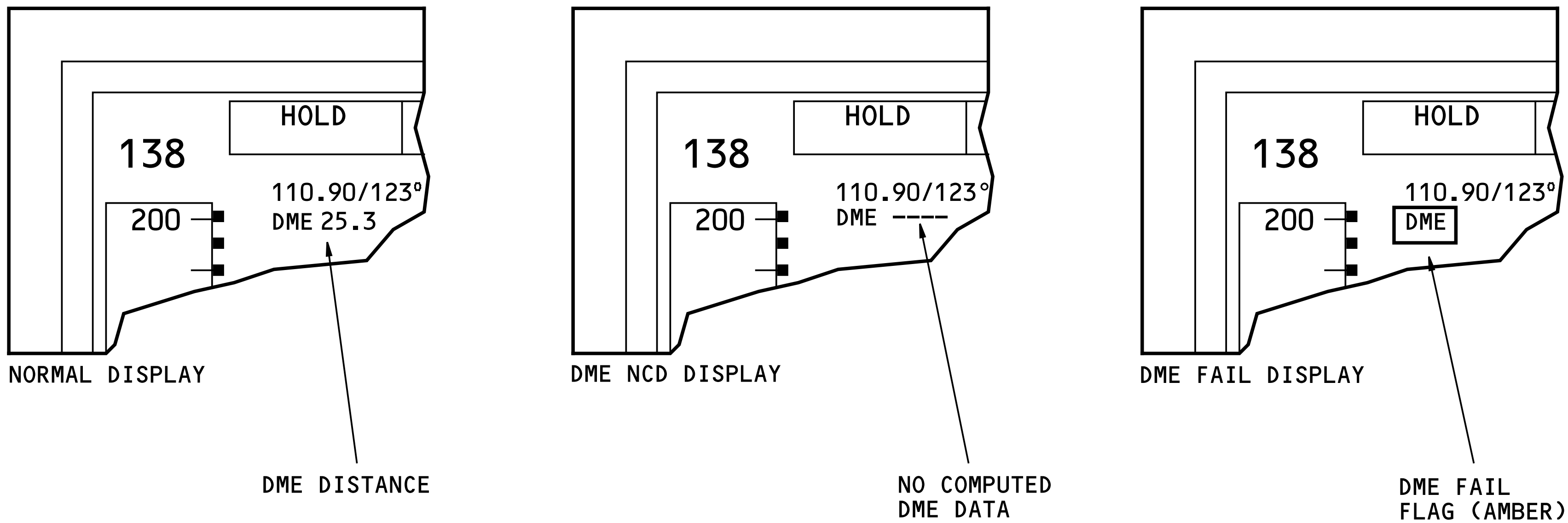
The primary flight display (PFD) format shows the ILS/ DME distance when you tune the onside DME to a paired ILS frequency and when the onside DME distance is valid.

The left PFD shows left DME data. The right PFD shows right DME data. The DME distance display shows in white letters and numbers.

DME NCD and Fail Displays

Dashes replace the DME distance when the DME distance data is no computed data (NCD). If the DME fails, the DME flag replaces the DME distance. Both the NCD and fail flag show in amber.

Only the onside DME distance shows on the PFDs. The left DME distance shows only on the captain's PFD. The right DME distance shows only on the first officer's PFD. If the left DME distance is NCD, dashes shows on the captain's PFD. If the left DME fails, a DME flag shows on the captain's PFD. The same occurs for the first officer's PFD if the right DME is NCD or fails.



34-55-00-011 Rev 2

DME SYSTEM - PRIMARY FLIGHT DISPLAY

DME SYSTEM - ND APPROACH MODE DISPLAY

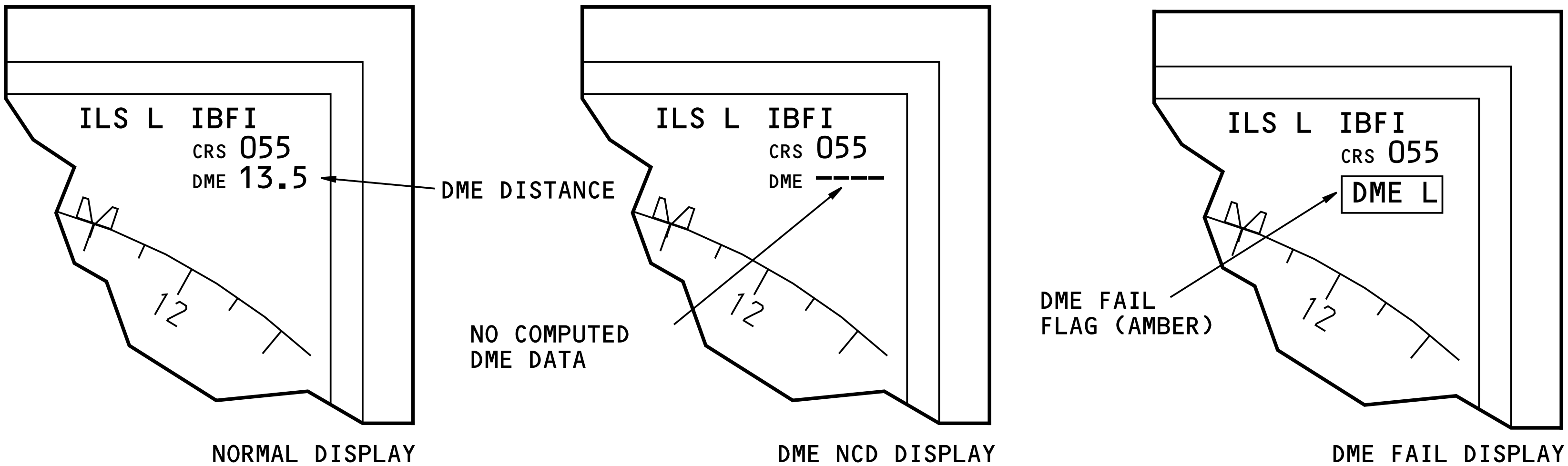
DME Normal Displays

The ILS/DME data shows on the ND in the centered and expanded approach (APP) modes. DME distance shows in the upper right corner of the ILS display when the onside DME is tuned to a paired ILS frequency, and the onside DME distance is valid.

DME NCD or Failed Displays.

Dashes replace digits when the DME distance is NCD. If the DME fails, an amber DME flag replaces the DME distance.

Only onside DME distance shows on the upper right corner of the approach mode. The left DME distance shows only on the captain's approach mode. The right DME distance shows only on the first officer's approach mode. If the left DME distance is NCD, dashes shows on the upper right corner of the captain's approach mode. If the left DME fails, a DME flag shows on the upper right corner of the captain's approach mode. The same occurs for the first officer's approach mode if the right DME is NCD or fails.



34-55-00-012 Rev 2

DME SYSTEM - ND APPROACH MODE DISPLAY

DME SYSTEM - MAP MODE DISPLAY

General

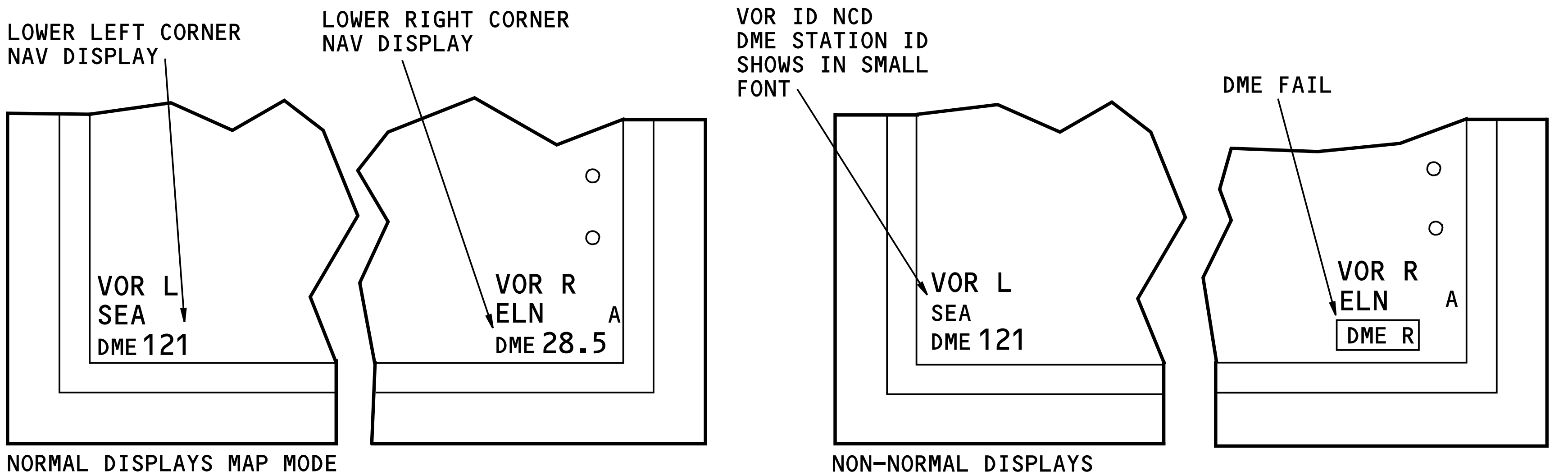
The DME distance shows in all ND modes except PLAN. With the EFIS control panel mode selector set to the MAP mode and the VOR/ADF switches in the VOR position, the ND shows slant range distance of the paired DME stations.

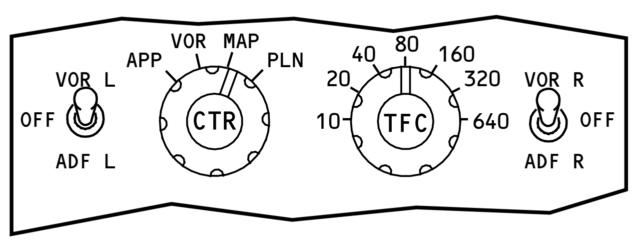
Distance Display

For DME distance less than 99.5 nm, the distance shows in tenths of an nm. For DME distances of 99.5 nautical miles (nm) or greater, the distance shows to the nearest 1 nm.

NCD or Invalid Displays.

Dashes replace digits when the DME distance data is NCD. A DME flag replaces the DME distance when DME fails.





EFIS CONTROL PANEL (P55)

34-55-00-013 Rev 2 02/27/1998

DME SYSTEM - MAP MODE DISPLAY

DME SYSTEM - VOR MODE DISPLAY

DME Normal Displays

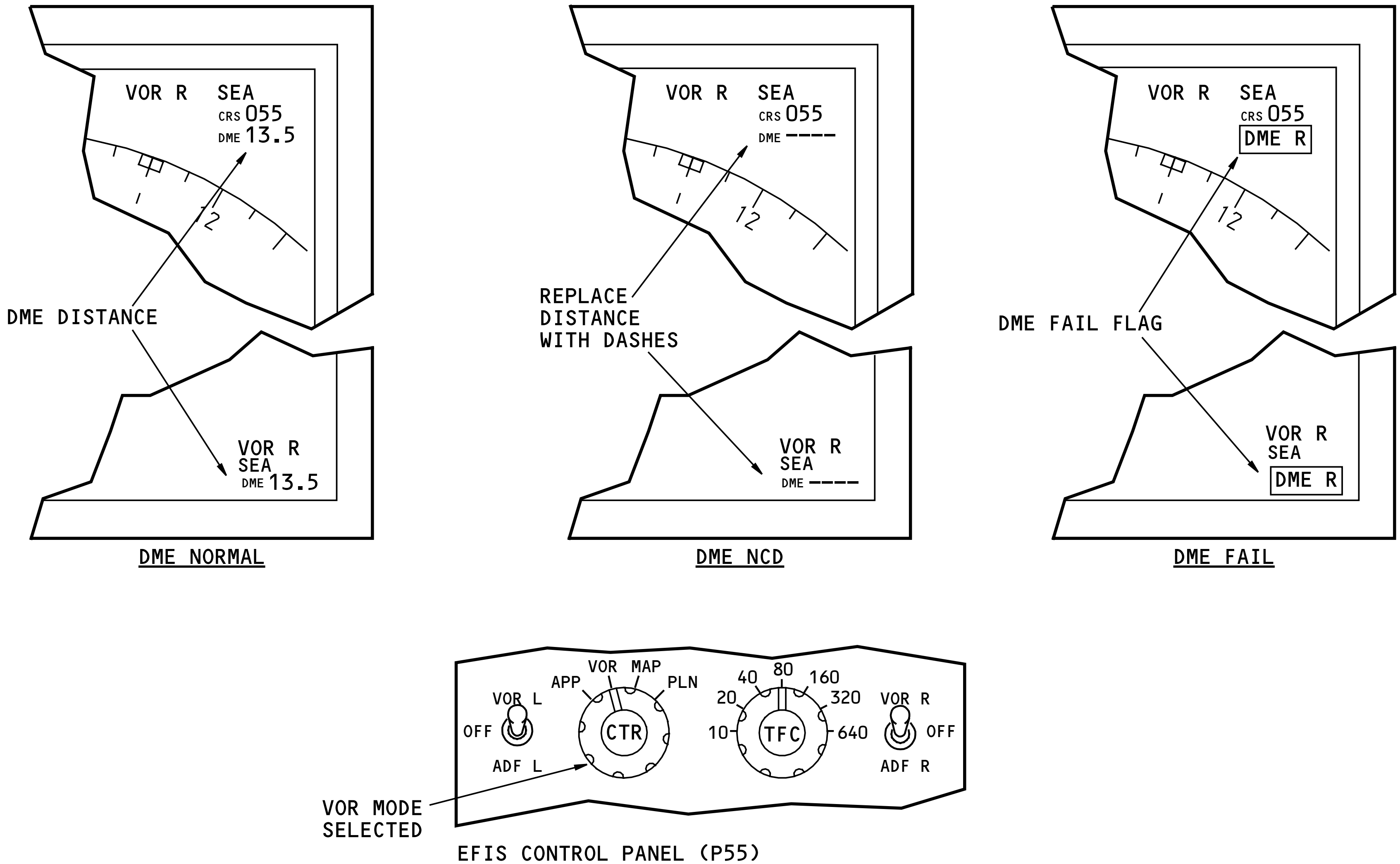
The VOR/DME data shows on the ND in center or expanded VOR modes. DME distance shows in the upper right corner of the VOR display when the onside DME is tuned to a paired VOR frequency, and the onside DME distance is valid.

When the VOR/ADF switches are in the VOR position the DME distance for a paired VOR station shows in the lower corners.

DME NCD or Failed Displays.

Dashes replace digits when the DME distance is NCD. If the DME fails, a DME flag replaces the DME distance.

DME distance shows only on the upper right corner of the onside VOR mode display. The left DME distance shows only on the captain VOR mode. The right DME distance shows only on the first officer VOR mode. If the left DME distance is NCD, dashes shows on the upper right corner captain VOR mode. If the left DME fails, a DME flag shows on the upper right corner of the captain VOR mode. The same occurs for the first officer VOR mode if the right DME is NCD or fails.



34-55-00-014 Rev 3 02/27/1998

DME SYSTEM - VOR MODE DISPLAY

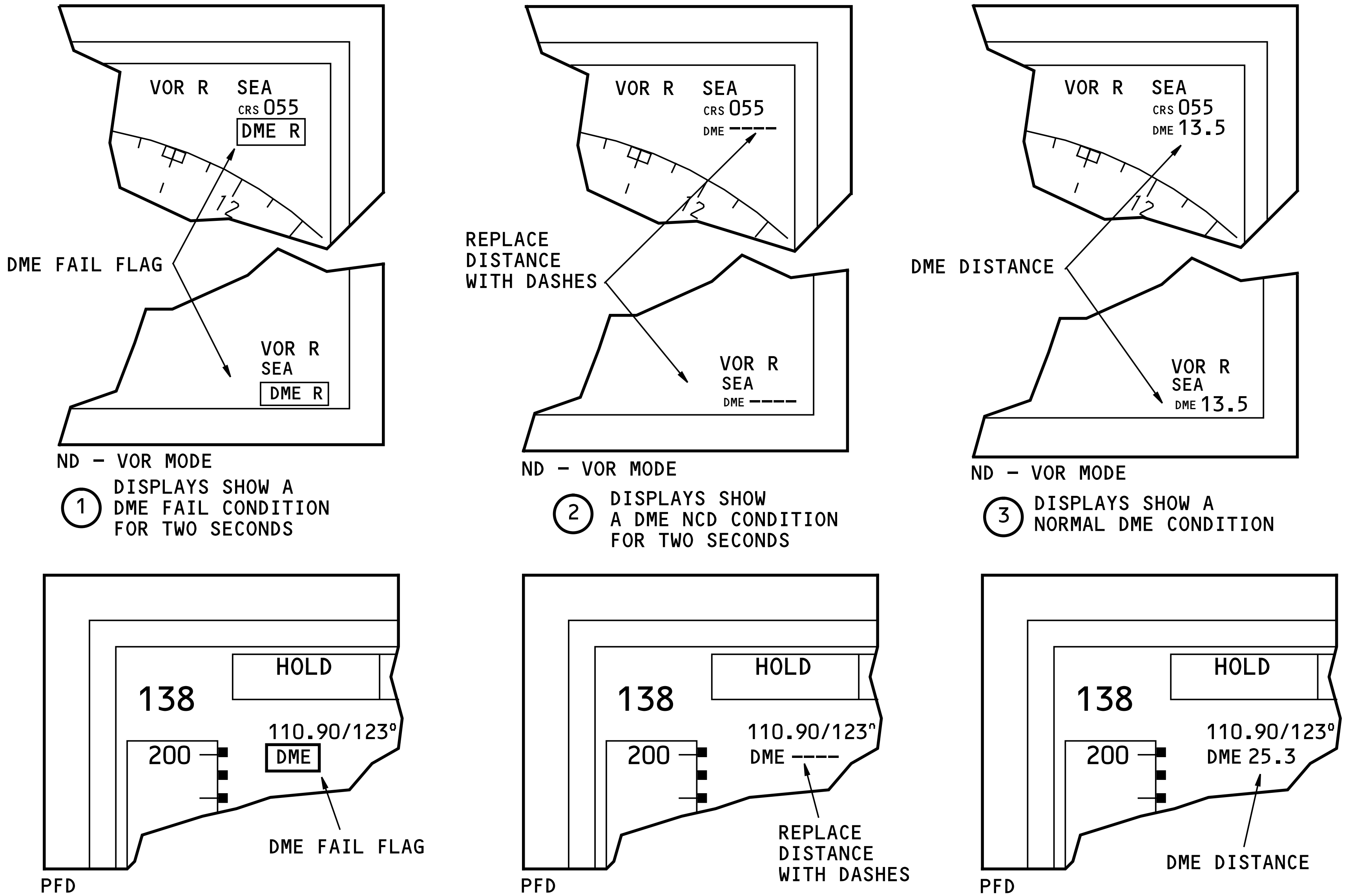
DME SYSTEM - TEST DISPLAYS

General

During a ground test or a self test, the onside PFD and ND show:

- The DME fail condition for two seconds
- The DME NCD condition for the next two seconds
- The DME normal condition to end the test.

The DME normal condition is the distance that shows before the test starts.



DME SYSTEM - TEST DISPLAYS

34-55-00-015 Rev 1

DME SYSTEM - GROUND TEST

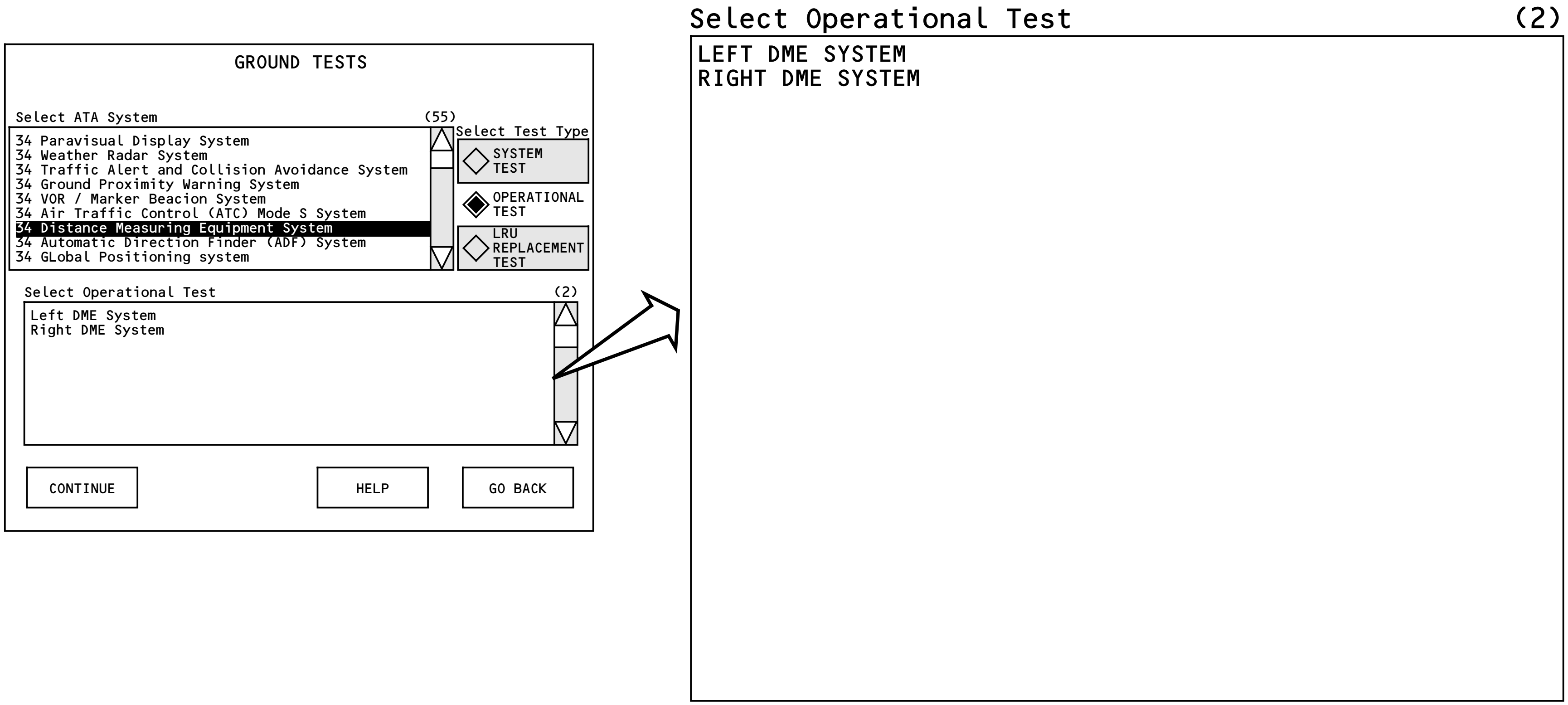
General

You can do a test of the DME system from the MAT. These tests are available from the operational test selection on the MAT:

- Left DME System
- Right DME System.

Operational Test

The operational test for the left and right DME systems does a check for normal operation of the DME interrogators and the control inputs to both interrogators.



34-55-00-020 Rev 3

DME SYSTEM - GROUND TEST

Continental Airlines, Inc

Automatic Direction Finder System

WB371

TABLE OF CONTENTS

AUTOMATIC DIRECTION FINDER SYSTEM - INTRODUCTION

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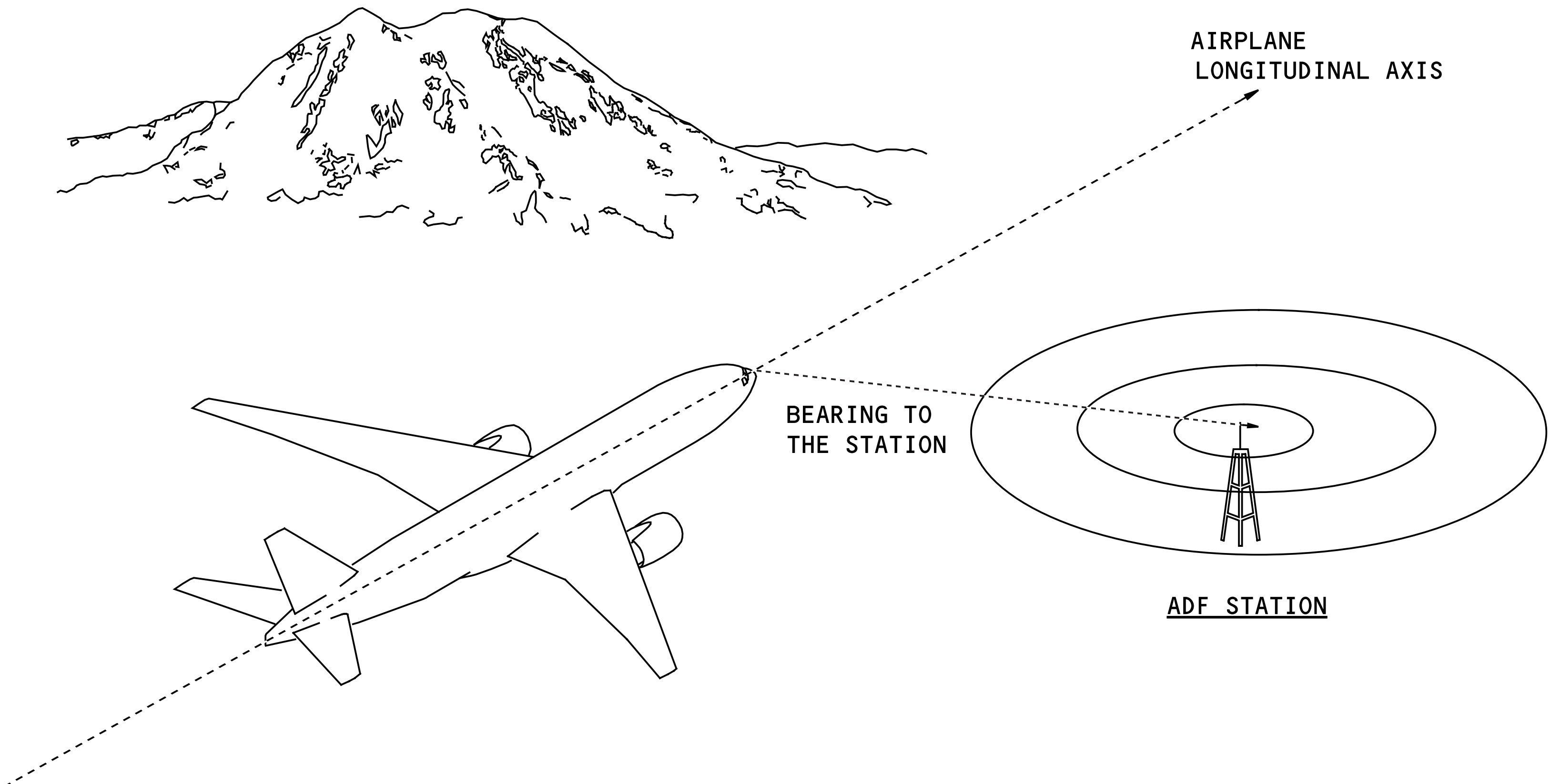
AUTOMATIC DIRECTION FINDER SYSTEM - INTRODUCTION

Purpose

The automatic direction finder (ADF) system is a navigation aid. The ADF receiver uses AM signals from ground stations to calculate the bearing to the station from the airplane longitudinal axis, and to receive standard AM radio broadcasts.

Abbreviations and Acronyms

ACP	- audio control panel
ADF	- automatic direction finder
AIMS	- airplane information management system
air/gnd	- air ground
altn	- alternate
AM	- amplitude modulation
AMU	- audio management unit
ant	- antenna
ARINC	- aeronautical radio, inc.
BFO	- beat frequency oscillator
CDU	- control display unit
CMCF	- central maintenance computing function
kHz	- kilohertz
MAT	- maintenance access terminal
NCD	- no computed data
ND	- navigation display
QEC	- quadrantal error correction
RF	- radio frequency
SDI	- source destination indicator
sta	- station



34-57-00-001 Rev 1

AUTOMATIC DIRECTION FINDER SYSTEM - INTRODUCTION

ADF SYSTEM - GENERAL DESCRIPTION

General

The ADF system has two receivers and two antennas.

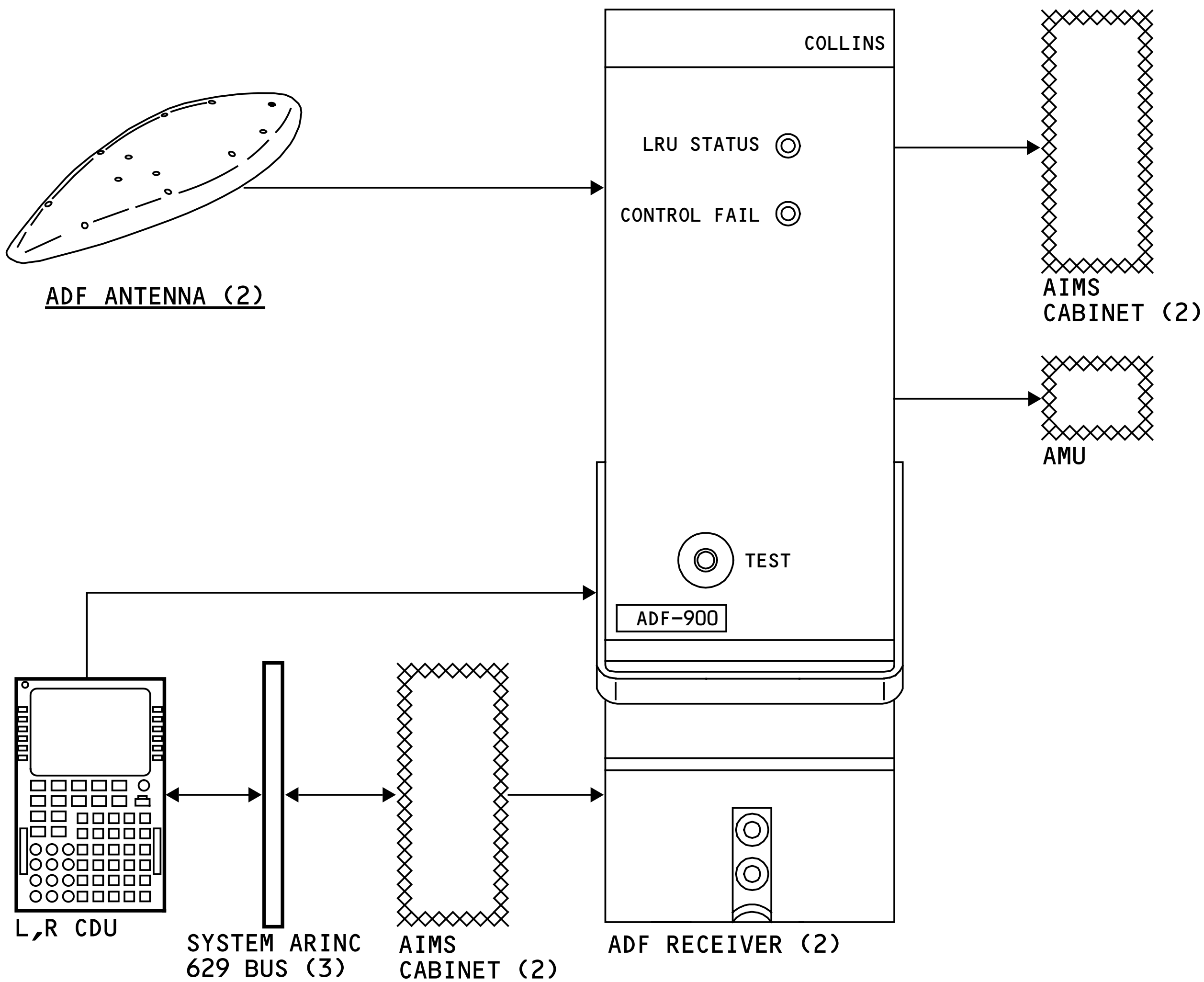
Description

The ADF antenna assembly has both the loop and sense antennas. The antenna receives signals from the ground stations and sends them to the ADF receiver.

The ADF receiver calculates the bearing to the station and sends it to the AIMS cabinets to show on the navigation displays (ND).

You can tune the ADF receivers manually from the left or right CDU. The airplane information management system does not autotune the ADF receivers. The receivers can get tune inputs directly from the left or right CDU (alternate tune) if the tune inputs through the AIMS cabinets fail.

The ADF receiver processes the station audio and sends it to the audio management unit (AMU).



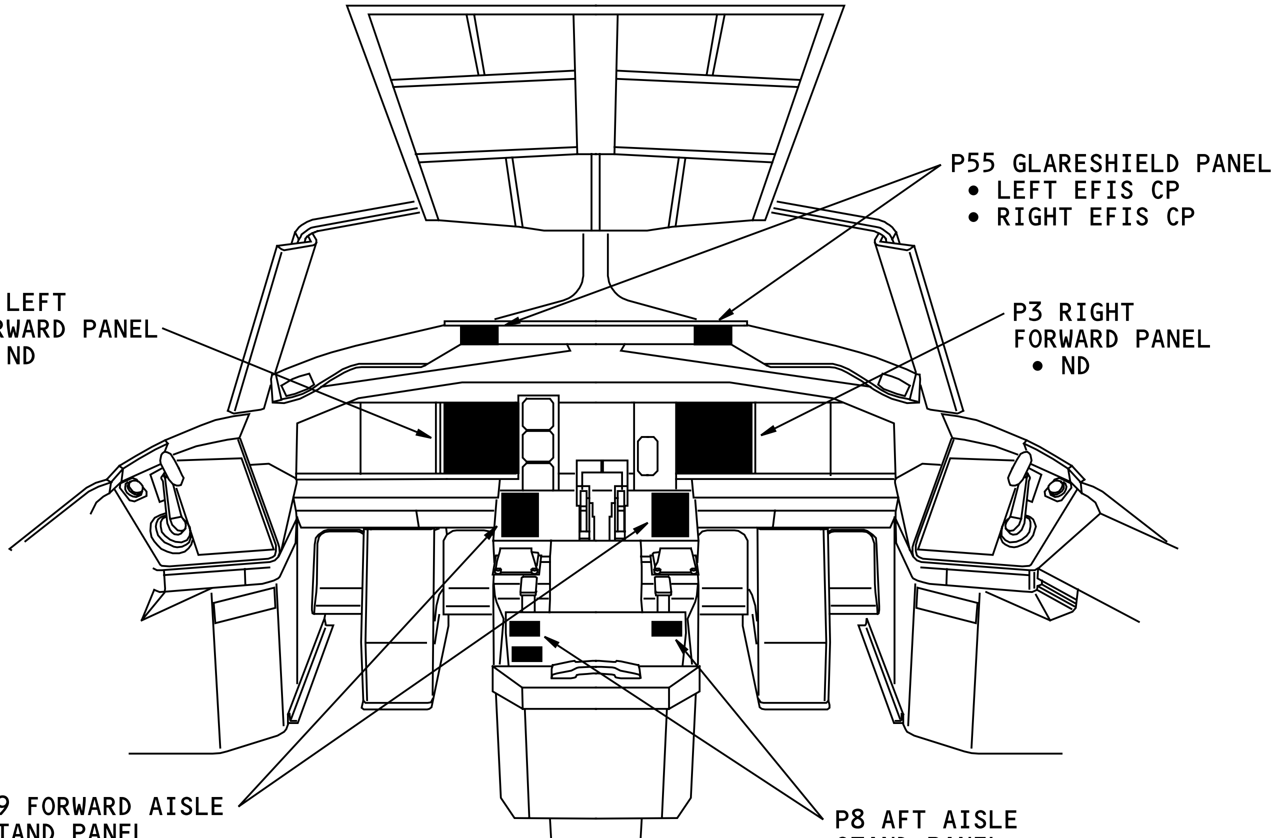
ADF SYSTEM - GENERAL DESCRIPTION

ADF SYSTEM - FLIGHT DECK COMPONENT LOCATION

General

The components on the flight deck that interface with the ADF system are:

- Left and right EFIS control panel (CP)
- Captain's and first officer's navigation display (ND)
- Left and right control display units (CDUs)
- Audio control panels (ACPs).



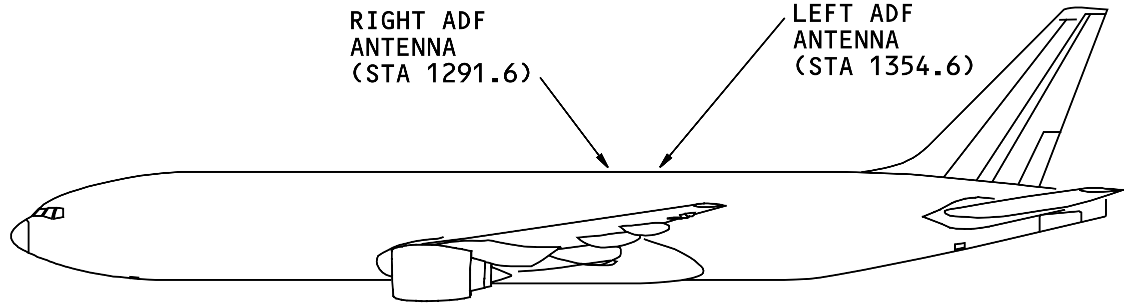
34-57-00-003 Rev 1

ADF SYSTEM - FLIGHT DECK COMPONENT LOCATION

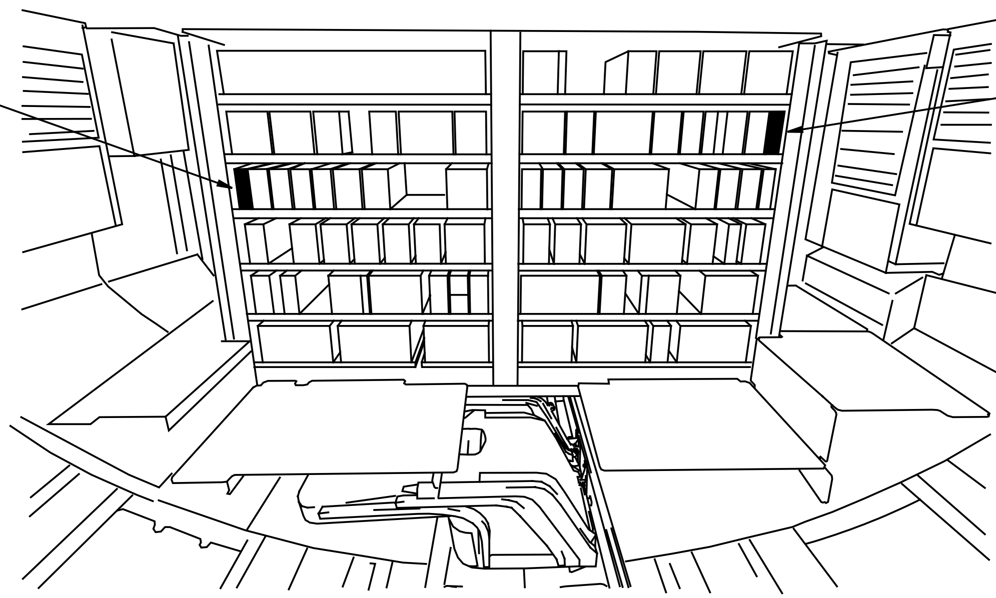
ADF SYSTEM - MAIN EQUIPMENT CENTER AND FUSELAGE COMPONENT LOCATION

General

The ADF antennas are on the top of the fuselage. The left and right ADF receivers are in the main equipment center on the E1 and E2 racks.



FUSELAGE ANTENNA LOCATION



MAIN EQUIPMENT CENTER
(LOOKING AFT)

ADF SYSTEM - MAIN EQUIPMENT CENTER AND FUSELAGE COMPONENT LOCATION

ADF SYSTEM - DIGITAL INTERFACE

General

The components that interface with the ADF receivers on ARINC 429 data buses are the left and right CDUs and the left and right AIMS cabinets.

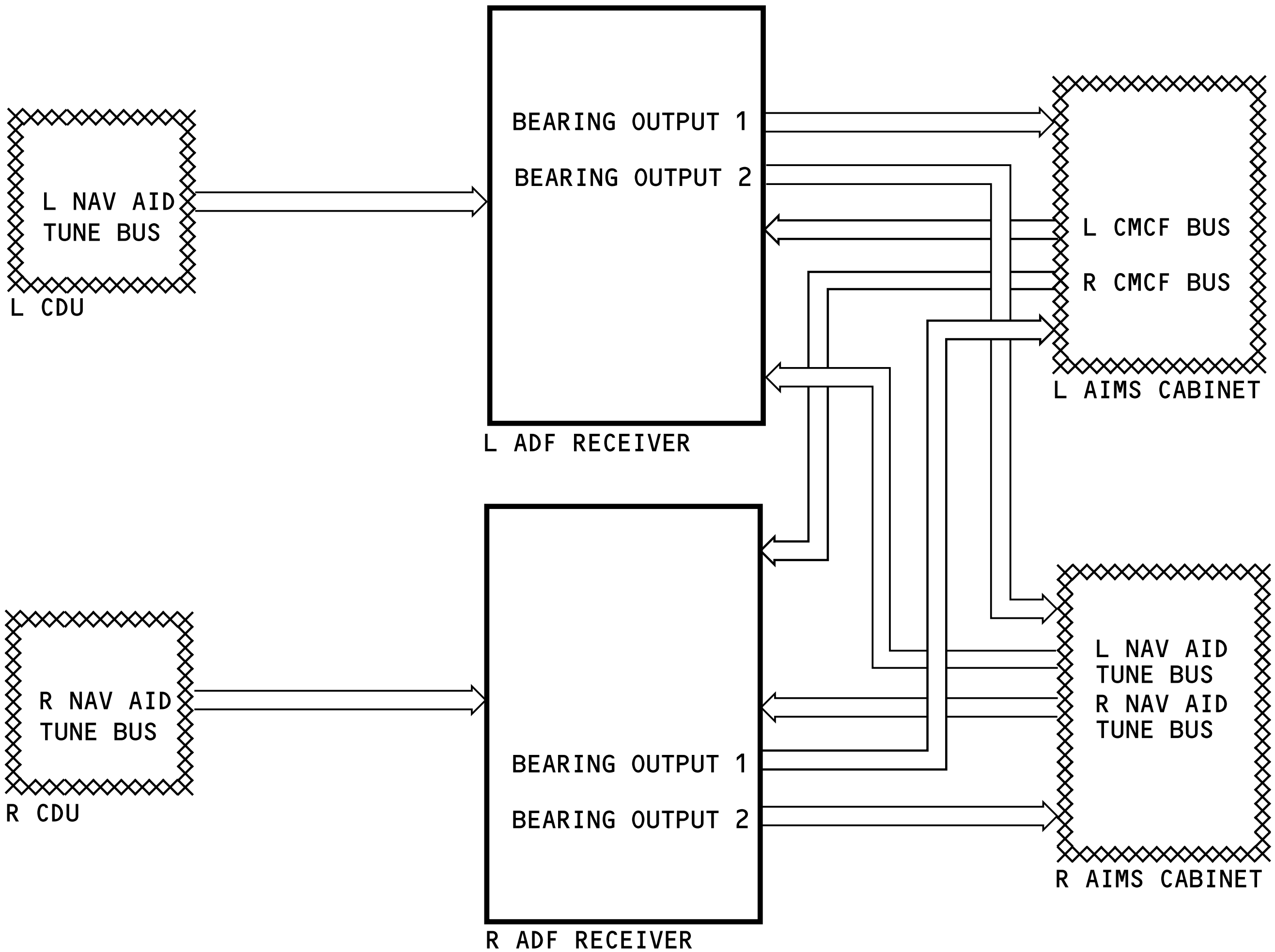
CDU Interfaces

The CDUs supply tune inputs directly to the ADF receivers on the NAV aid tune buses when the tune inputs from the AIMS cabinets fail.

AIMS Cabinet Interfaces

The ADF receivers get tune inputs from the flight management computer function (FMCF) in the right AIMS cabinet. The left and right ADF receivers get tune inputs on the left and right NAV aid tune buses from the right AIMS cabinet.

Test commands come from the central maintenance computer function (CMCF) in the left AIMS cabinet. The left and right ADF receivers get test commands on the left and right CMCF buses from the left AIMS cabinet. The AIMS cabinets also give flight leg data to the ADF receivers.



34-57-00-005 Rev 1

ADF SYSTEM - DIGITAL INTERFACE

ADF SYSTEM - POWER, ANALOG, AND DISCRETE INTERFACES

Power

The left and right ADF receivers get 115v ac from the left and right 115v ac transfer buses.

The ADF receivers send 12v dc to their ADF antennas.

ADF Antennas

The ADF antennas send AM ground station signals to the ADF receivers.

CDUs

The CDUs supply frequency source select discretes to the ADF receivers when the tune inputs from the AIMS fails. The resistor assemblies pull up the discretes to 28v dc. The left CDU sends a ground discrete to the left receiver when the discrete is true. The right CDU sends a ground discrete to the right receiver when the discrete is true.

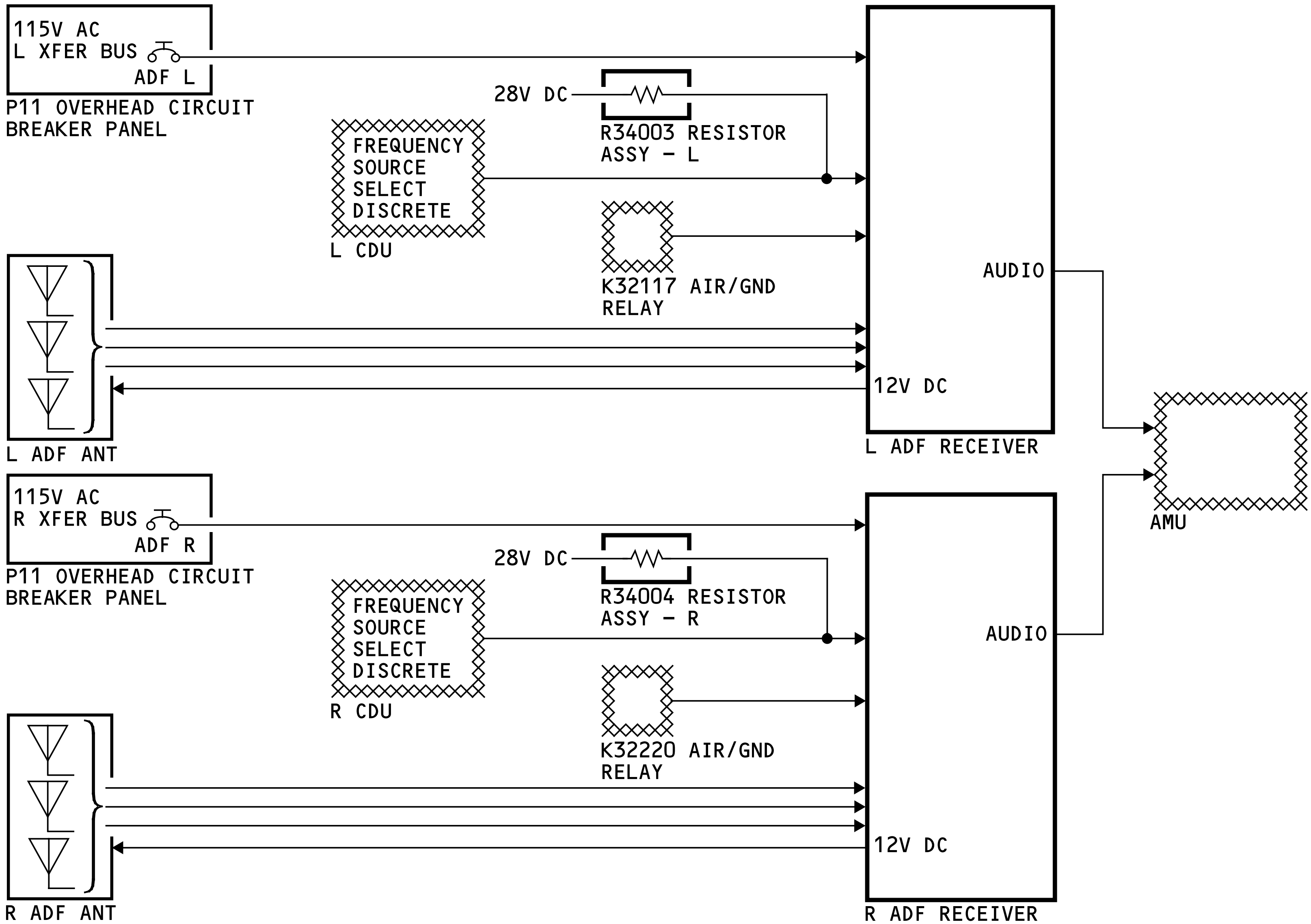
Air/Ground Relay

The air/ground relay supply discrete inputs to the ADF receivers to:

- Set flight legs (as alternate source, primary is from the CMCF of AIMS)
- Inhibit test commands in the air.

AMU

The audio management unit (AMU) receives Morse code station identifier signals and audio from the receivers and sends them to the flight interphone speakers and headsets.



34-57-00-006 Rev 4 02/27/1998

ADF SYSTEM - POWER, ANALOG, AND DISCRETE INTERFACES

ADF SYSTEM - ADF RECEIVER

Purpose

The ADF receiver calculates bearing to a station that transmits in the frequency range of 190 KHz to 1750 KHz. The receiver also receives station identifiers and AM broadcasts.

Description

The ADF receiver operates on 115v ac power. The receiver has built-in test equipment (BITE) that monitors receiver operation and data inputs.

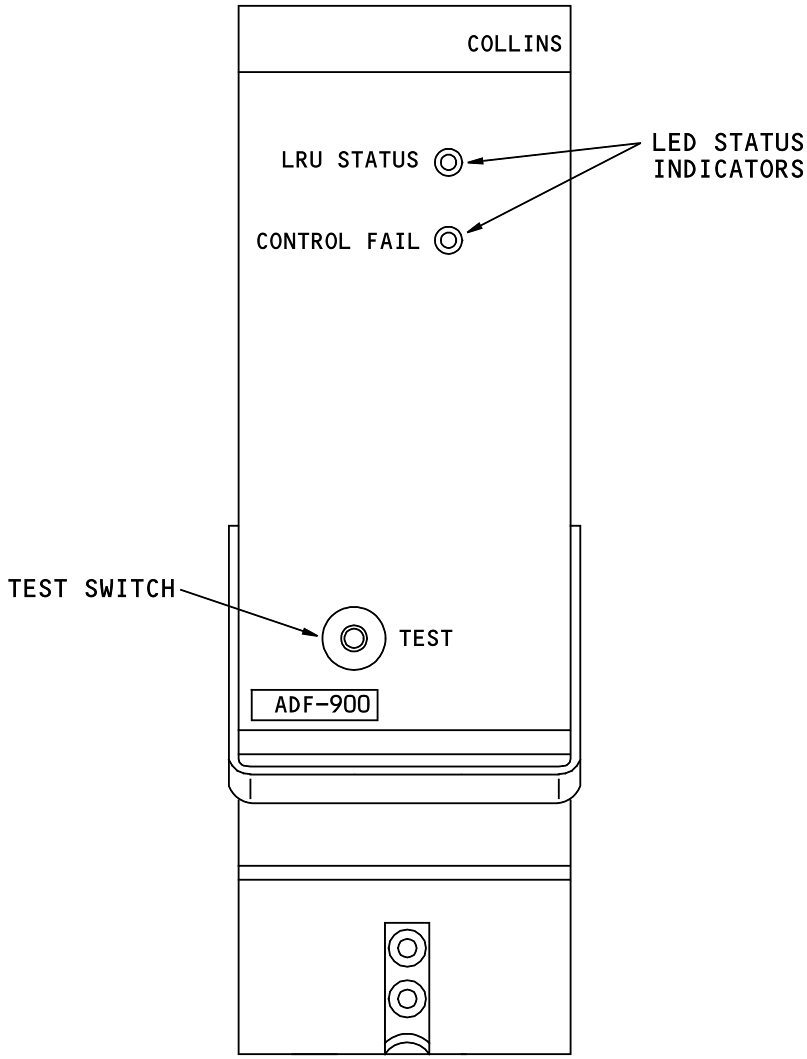
There is a test switch on the front panel of the receiver. When you push the test switch, a self-test begins. At the end of the test, the status of the ADF receiver and tuning inputs shows.

Use the maintenance access terminal (MAT) to do a test of the ADF receiver.

Training Information Point

The maintenance manual and the fault isolation manual do not have a task for the line maintenance technician to do a test from the front panel of the ADF receiver. You must do all tests for the ADF receiver from the MAT or a PMAT.

Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For that reason these LRUs have a front panel test feature.



34-57-00-008 Rev 2 05/18/95

ADF SYSTEM - ADF RECEIVER

ADF SYSTEM - ADF ANTENNA

Purpose

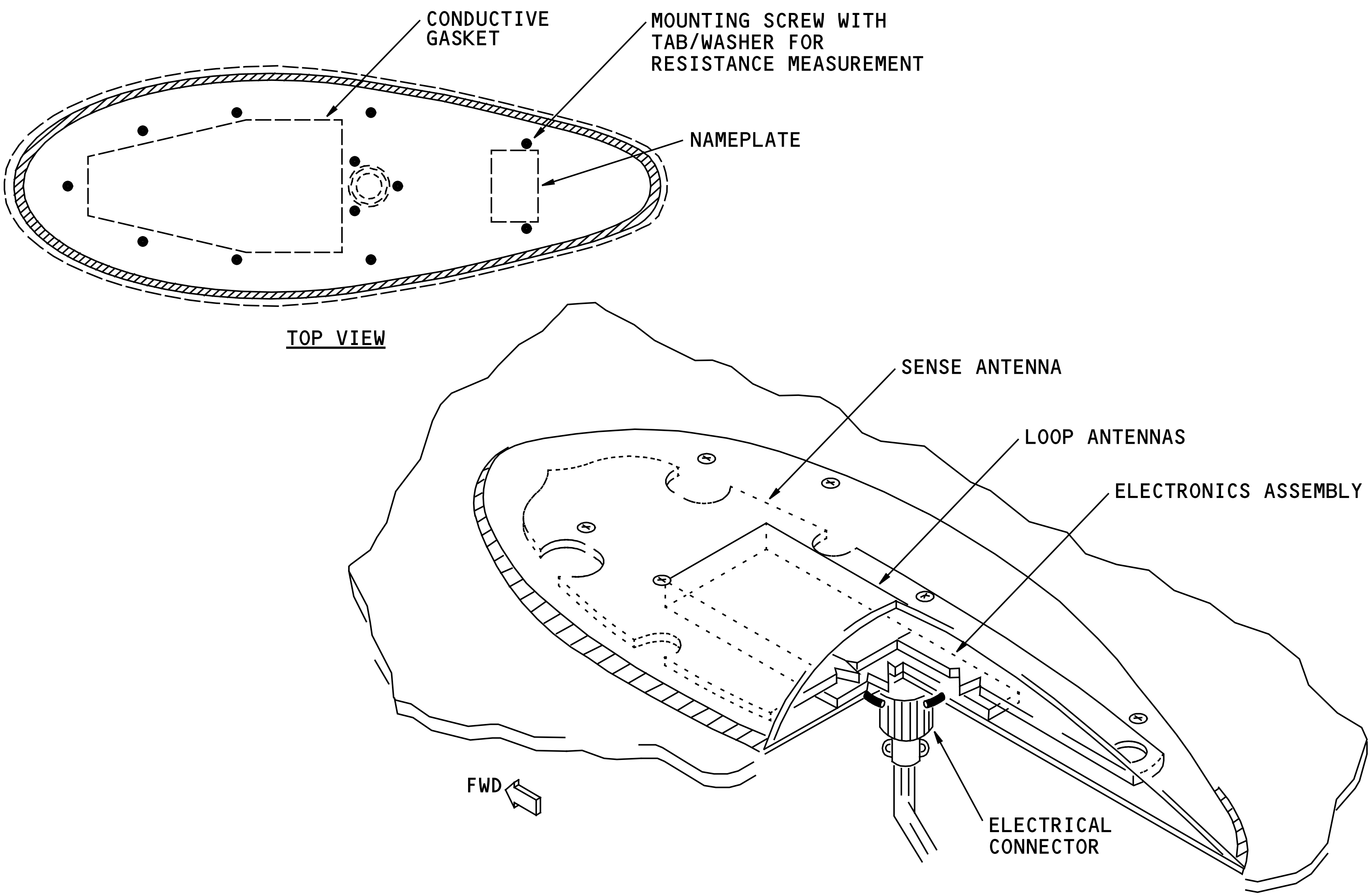
The ADF antenna receives electromagnetic signals from ground stations. The loop antenna receives the magnetic part of the ground station signal, and the sense antenna receives the electrical part of the signal.

Description

The antenna assembly is a one piece molded shell. The antenna assembly has:

- Loop antenna elements (2)
- Sense antenna (1)
- Amplifiers (3), one for each antenna element
- Transformers (3), one for each antenna element.

The ADF antenna elements each have an amplifier and output transformer. The amplifiers receive 12v dc power from the ADF receiver. The left ADF receiver sends power to the left antenna and the right ADF receiver sends power to the right antenna.



ADF SYSTEM - ADF ANTENNA

ADF SYSTEM - TUNING INPUTS

General

These are the two ways to tune the ADF receivers:

- Manually by the left, center, or right CDU
- By the CDUs as an alternate tune source.

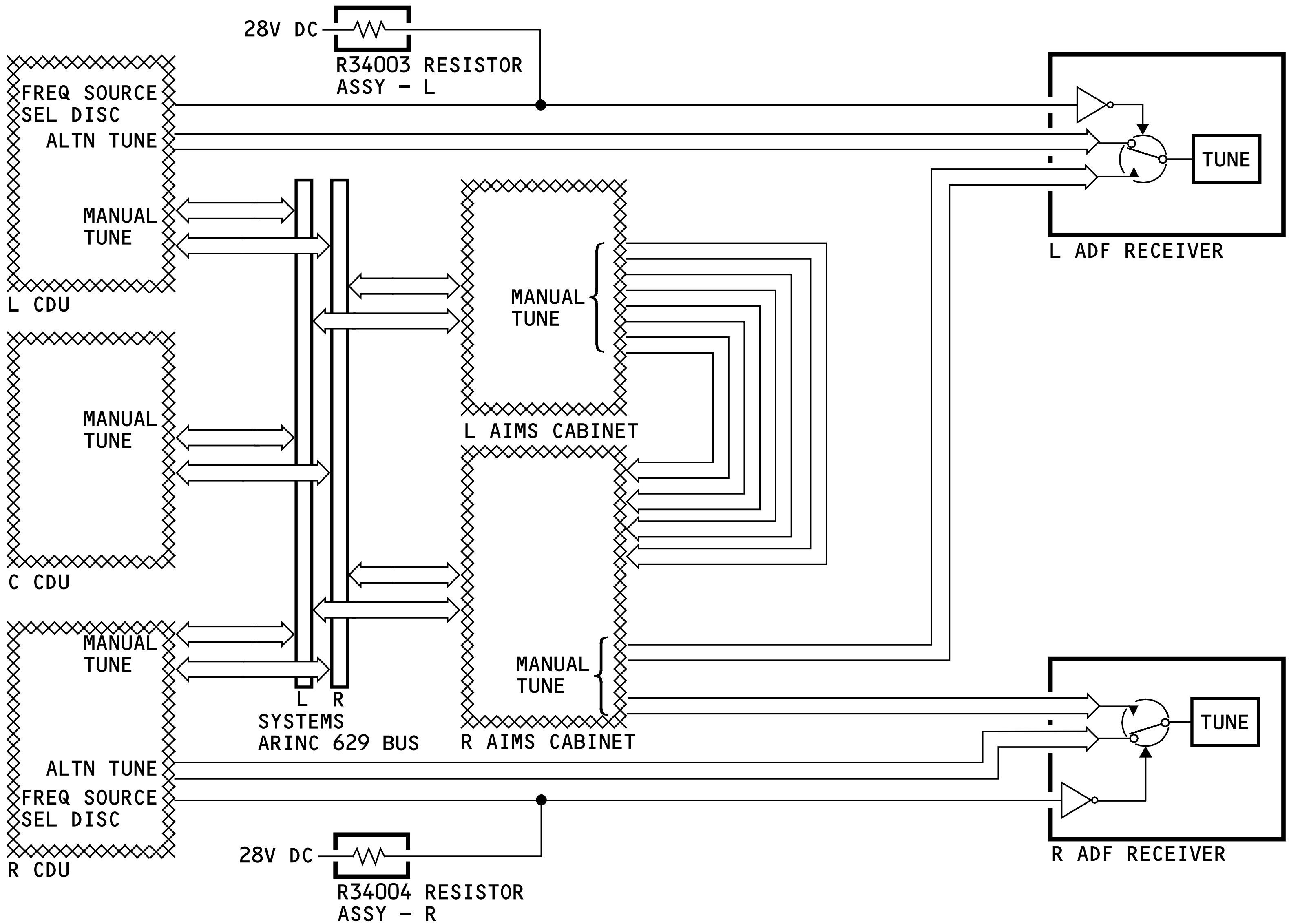
Manual Tuning

You manually tune the ADF receivers from the left or right control display units (CDUs). The center CDU can tune the recievers if the left or right CDU fails. Manual tune inputs from the CDUs go through the left and right systems ARINC 629 buses, then to the left and right AIMS cabinets. Manual tune inputs from the left or right AIMS cabinet goes from the right AIMS cabinet to the ADF receivers.

Alternate Tune

The CDUs monitor the AIMS cabinets tune functions. IF the AIMS tune function fails, the CDUs send a frequency source select discrete to the ADF receivers that changes the inputs from the right AIMS cabinet, to the input that comes directly from the left or right CDU. The CDUs use 28v dc from a pull-up resistor to set the discrete.

In alternate tune mode, the left CDU alternate tunes the left ADF receivers and the right CDU alternate tunes the right ADF receiver. The center CDU has no alternate tune function.



34-57-00-007 Rev 2 02/06/1998

ADF SYSTEM - TUNING INPUTS

ADF SYSTEM - AUDIO CONTROLS

General

The audio control panels supply control inputs to the audio management unit. This permits the crew to hear audio signals on the speakers and headsets in the flight deck.

Description

These are the controls on the audio control panel that let you to hear ADF audio:

- VOR/ADF receiver selector
- VOR/ADF receiver volume control
- NAV filter selector.

VOR/ADF Selector

The VOR/ADF receiver selector lets you select VOR or ADF as the source of audio.

VOR/ADF Receiver Volume Control

The VOR/ADF receiver volume control makes the audio come on and controls the volume.

NAV Filter Selector

The NAV filter selector lets you select one of these:

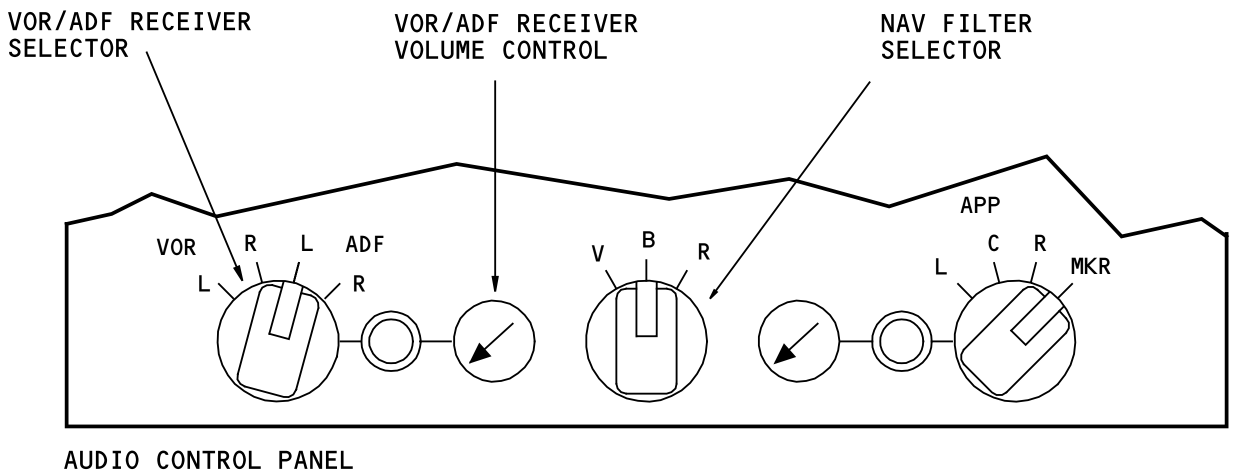
- Voice (V) audio
- Both (B) voice and range audio
- Range (R) audio.

Operation

Do this to hear ADF audio:

- Set the VOR/ADF selector to the left (L) or right (R) ADF position
- Push the VOR/ADF receiver volume control to make the ADF audio come on (turn the control to adjust the volume)
- Set the NAV filter selector to the voice (V) position.

To hear the station identifier, set the NAV filter selector to either the both (B) or the range (R) position.



34-57-00-011 Rev 2

ADF SYSTEM - AUDIO CONTROLS

ADF SYSTEM - CDU ADF TUNING

General

The CDUs supply manual tune inputs during normal operation and alternate tune inputs when the AIMS tune function fails.

Operation

To see ADF tune frequencies, push the NAV RAD key on the CDU. The NAV RADIO page shows data for the left and right ADF systems.

To manually tune an ADF receiver, enter a valid ADF frequency into the scratchpad. Push line select key 3L or 3R to enter the frequency for left or right ADF receiver.

You cannot use the delete key to delete an ADF frequency.

Alternate Tune

The ALTN NAV RADIO page is available only when the tune inputs from the AIMS cabinets fail.

To get to the ALTN NAV RADIO page, push the NAV RAD key on the CDU.

The ALTN NAV RADIO page is different from the NAV RADIO page. The ALTN NAV RADIO page shows data for only the onside NAV radio systems. The left CDU ALTN NAV RADIO page controls the left ADF receiver and the right CDU ALTN NAV RADIO page controls the right ADF receiver.

Antenna (ANT) Mode

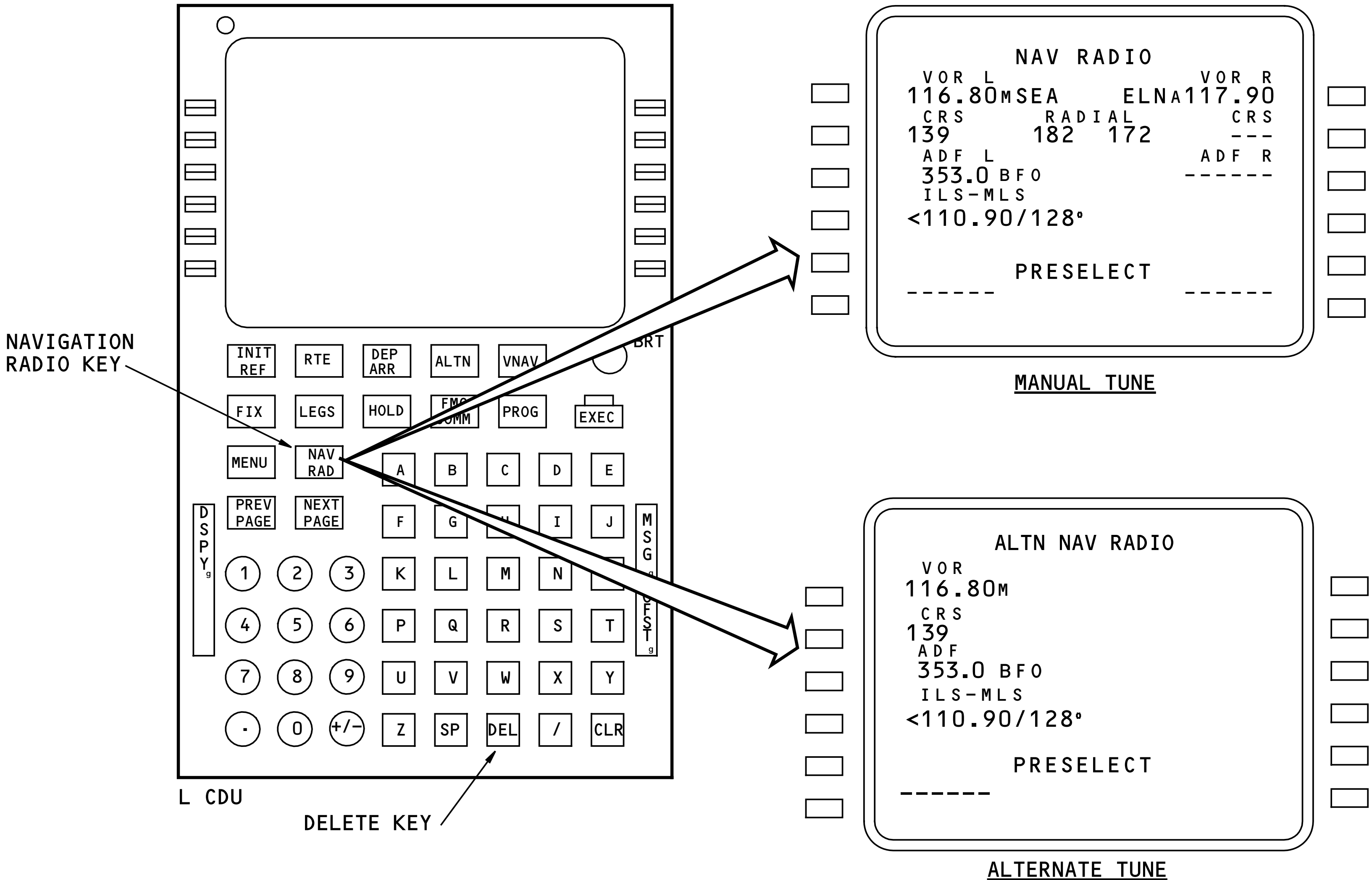
In the antenna (ANT) mode, the ADF receiver uses only the sense antenna to receive station audio broadcasts. To select the ANT mode, enter the letter A after the frequency, then line select the data to the ADF data line. When you enter the frequency, ANT shows after the frequency.

To delete the ANT mode, push the delete key on the CDU. The delete function shows in the CDU. Next, push the line select key next to the ADF line to delete the ANT.

Beat Frequency Oscillator (BFO) Mode

The ADF receivers can detect the station Morse code identifier if the 1020 Hz signal is amplitude modulated with the station audio signal. The ADF receiver can not detect the station Morse code identifier if the signal is a keyed Morse code signal. To hear the station morse code identifier, you must select the BFO mode. To select the BFO mode, type the letter B after the frequency and line select the data to the ADF data line. When you enter the frequency, BFO shows after the frequency.

To delete the BFO mode, push the delete key on the CDU. The delete function shows in the CDU. Next, push the line select key next to the ADF line to delete the BFO.



34-57-00-012 Rev 4 02/09/1998

ADF SYSTEM - CDU ADF TUNING

ADF SYSTEM - EFIS CONTROLS

General

The EFIS control panel has controls to select ADF data to show on the navigation displays (NDs).

VOR/ADF Switch

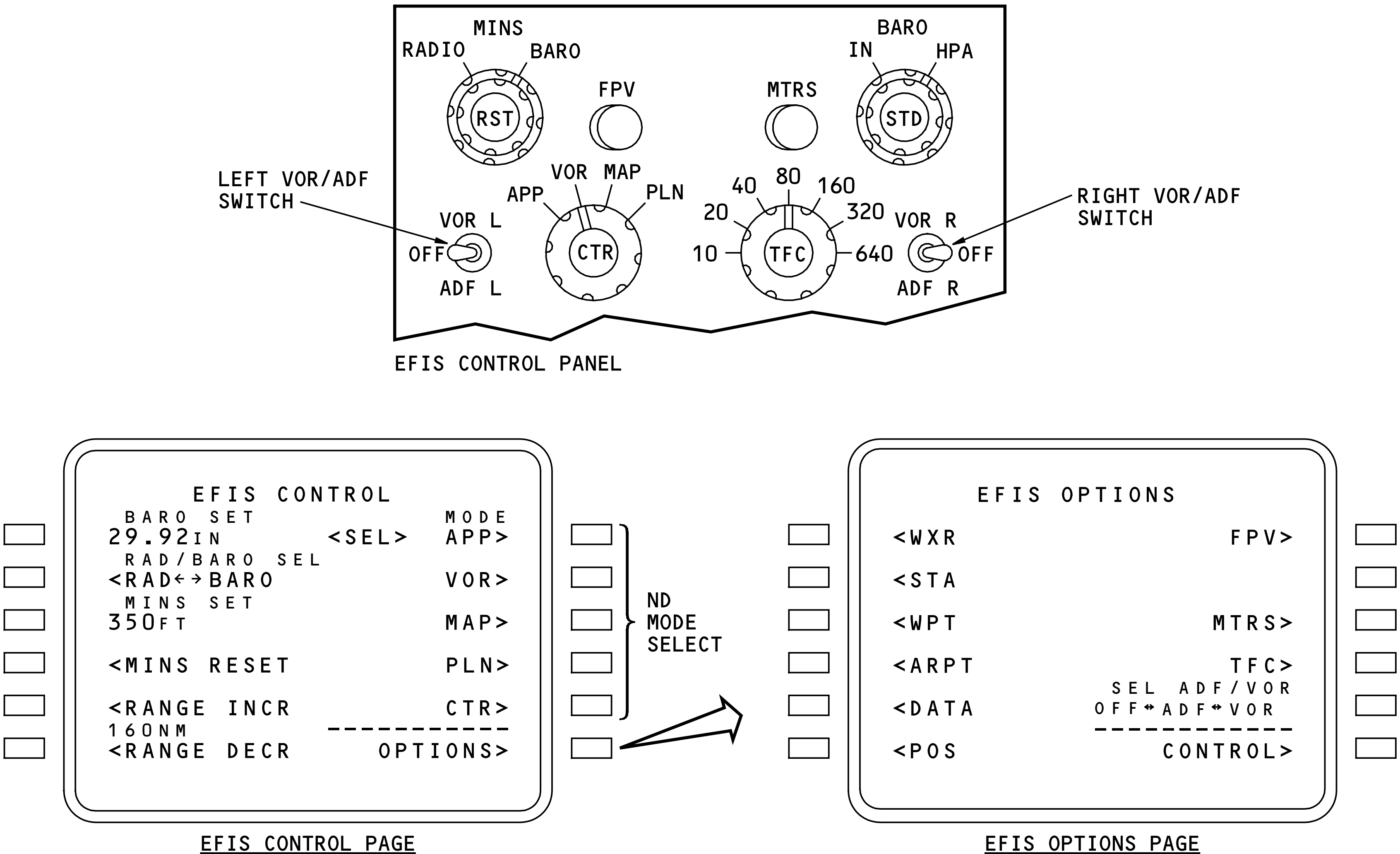
The VOR/ADF switches select the VOR or ADF receivers as the source of data for the left and right bearing pointers on the ND. There are two switches, one for the left bearing pointer and one for the right bearing pointer. When the switches are set to the off position, the bearing pointers and ADF data goes out of view.

Alternate or Backup EFIS Control Panel

The EFIS control page on the CDU supplies backup controls for the EFIS control panel. To select ADF data for the bearing pointers, push the OPTIONS line select key on the EFIS control page. This brings up the EFIS OPTIONS page.

Push the line select key next to the OFF-ADF-VOR data line on the EFIS OPTIONS page to toggle between ADF or VOR data.

The active data shows in large letters.



34-57-00-018 Rev 1 02/27/1998

ADF SYSTEM - EFIS CONTROLS

ADF SYSTEM - DISPLAYS

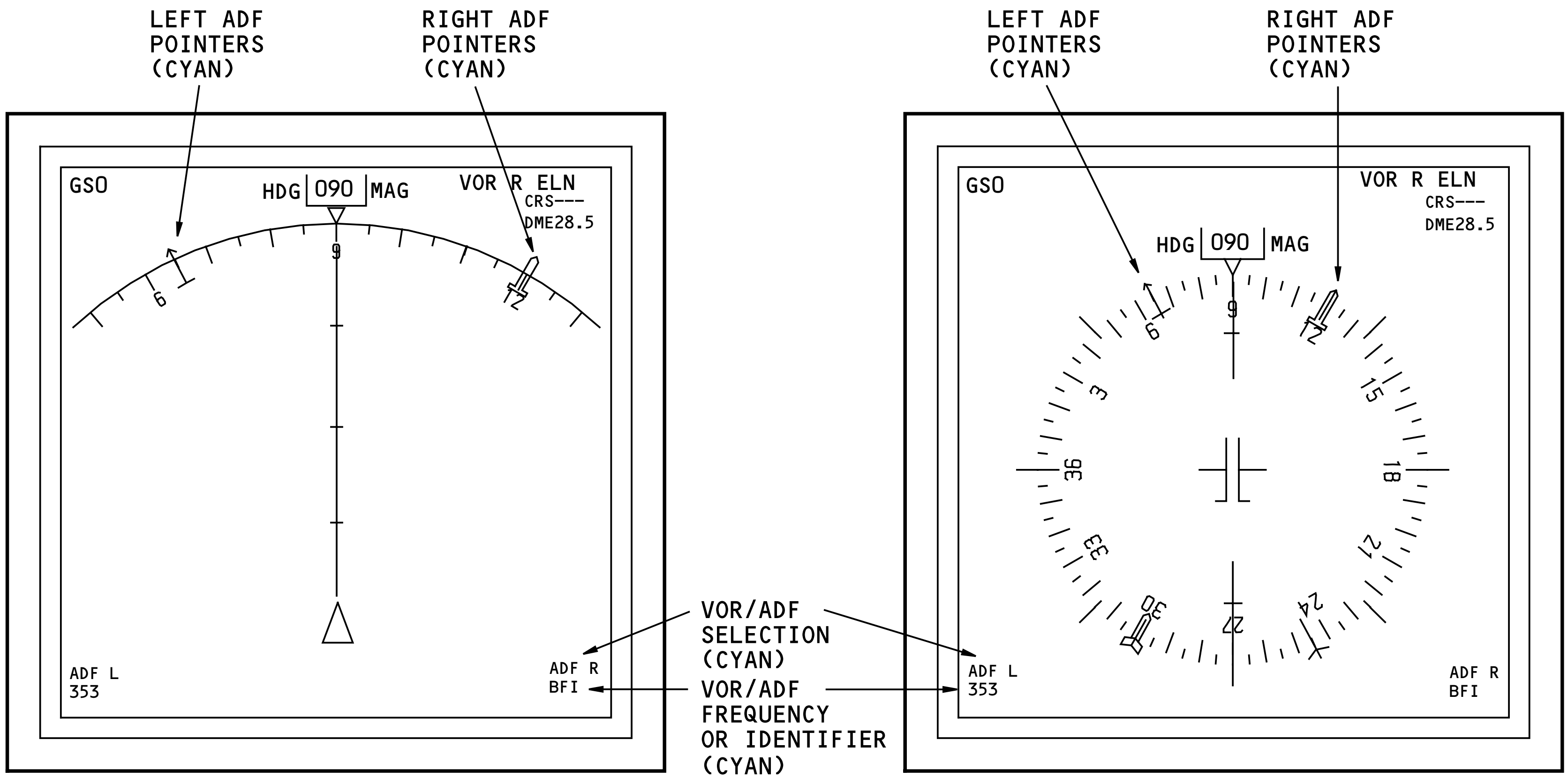
General

ADF pointers show in all EFIS modes but PLN (plan). The pointers are cyan in color. To display the ADF pointers, set the ND mode selector to APP, VOR, or MAP. Set the VOR/ADF switch on the EFIS control panel to the ADF position.

The ADF pointers move around the compass scale. The wide pointer shows the bearing from the right ADF receiver, and the thin pointer shows the bearing from the left ADF receiver.

The ADF source annunciation and frequency or identifier show in cyan at the lower corners of the NDs. The station identifier replaces the frequency when the data is valid from the ADF receiver.

NOTE: The graphic shows the displays for the VOR mode, the displays are the same for the other ND modes except PLN.



ND - EXPANDED MODE

ND - CENTERED MODE

34-57-00-013 Rev 1

ADF SYSTEM - DISPLAYS

ADF SYSTEM - ND NCD AND INVALID DISPLAYS

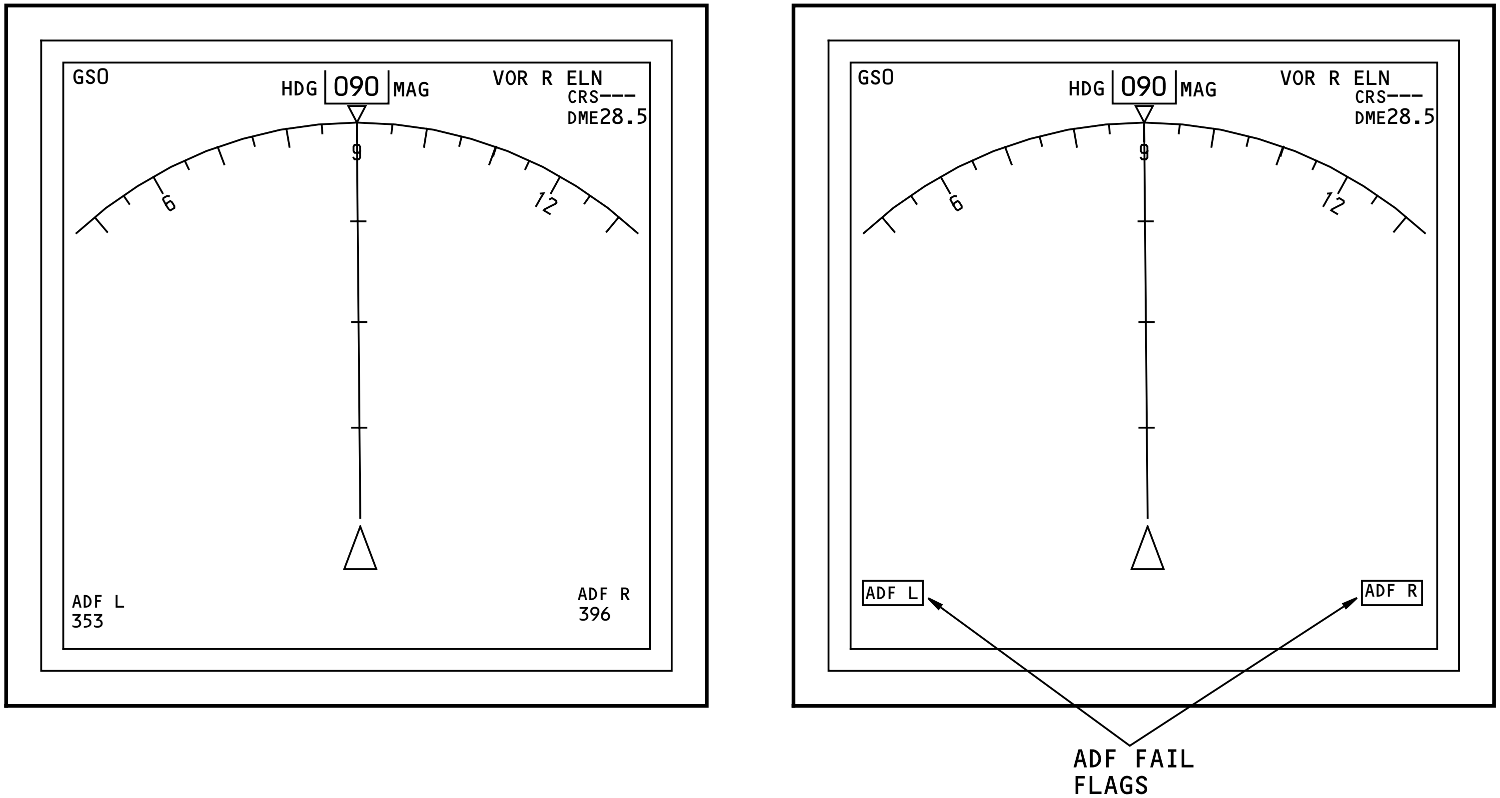
General

When the receiver output is no computed data (NCD), the ADF pointers go out of view. The source annunciation and frequency remain in view.

When the receiver output is invalid, all ADF data goes out of view and the amber ADF flags show.

When you move the VOR/ADF switch on the EFIS control panel from the ADF position, these displays go out of view:

- ADF flags
- Source annunciation
- Frequency
- ADF pointers.



NCD:

REMOVE POINTERS AND SHOW SOURCE ANNUNCIATION AND FREQUENCY.

INVALID:

REMOVE POINTERS, SOURCE ANNUNCIATION, AND FREQUENCY OR IDENTIFIER AND SHOW AMBER ADF FLAGS.

34-57-00-014 Rev 1

ADF SYSTEM - ND NCD AND INVALID DISPLAYS

ADF SYSTEM - TEST DISPLAYS

Test

Use the maintenance access terminal (MAT) to do a test of the ADF receivers. To see the test displays, select APP, VOR, or MAP on the ND mode selector of the EFIS control panel. Set the VOR/ADF switch to ADF.

When you select test on the MAT, the receiver starts a test sequence. The test displays show on the ND.

From one to three seconds, these invalid displays show on the ND:

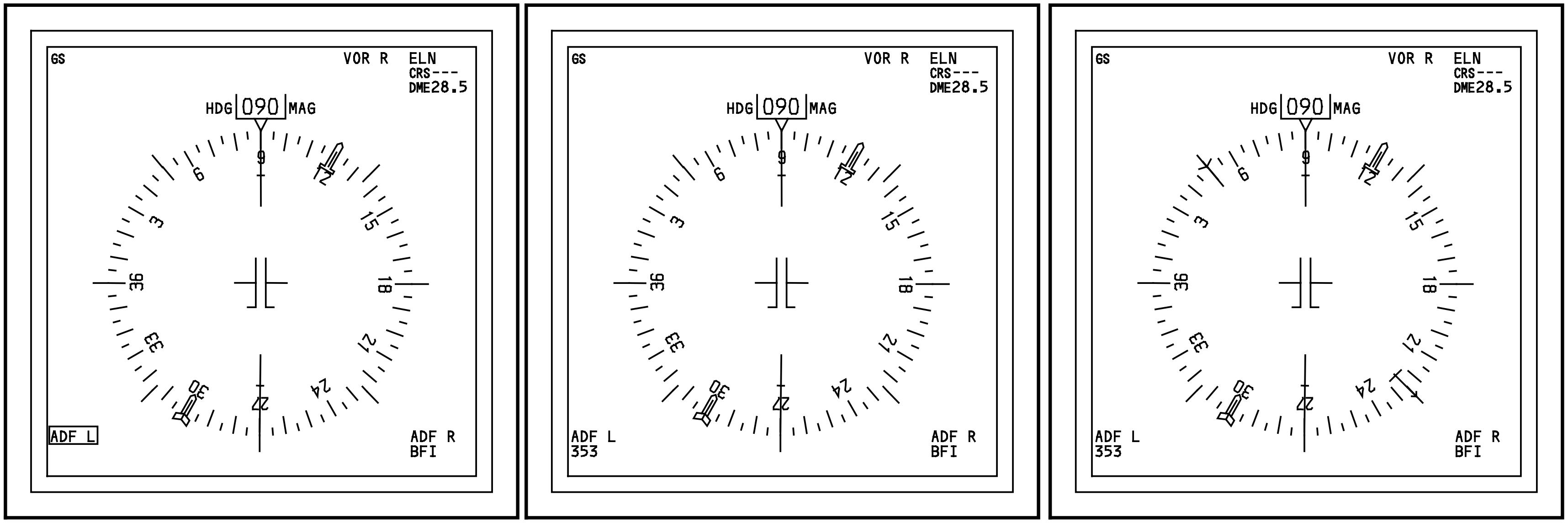
- Remove the ADF source annunciation
- Remove ADF frequency
- Remove ADF pointers
- Show the amber ADF flag.

From three to six seconds, these NCD displays show on the ND:

- Show source annunciation
- Show frequency.
- Remove ADF pointers
- Remove the amber flag.

From six seconds to the end of test, the ND shows the test display with the ADF pointer at 135 degrees in relation to the face of the ND until the end of test.

NOTE: The graphic shows a test of the left ADF receiver. The test is the same for the right ADF system.



1 TO 3 SECONDS:

THE RECEIVER OUTPUT GOES INVALID, ALL ADF DATA GOES OUT OF VIEW, AND THE AMBER ADF FLAG SHOWS.

3 TO 6 SECONDS:

THE RECEIVER OUTPUT GOES TO NO COMPUTED DATA (NCD). THE FLAG GOES OUT OF VIEW, THE SOURCE ANNUNCIATION AND FREQUENCY SHOW AND THE ADF POINTERS STAY OUT OF VIEW.

FROM 6 SECONDS TO END OF TEST:

THE RECEIVER OUTPUT GOES VALID AND THE POINTERS GO TO THE TEST POSITION (APPROX. 135 DEGREES FROM THE CENTER LINE.

34-57-00-015 Rev 3 02/06/1998

NOTE: THESE DISPLAYS ARE FOR THE LEFT ADF TEST.
THE RIGHT ADF TEST IS SIMILAR.

ADF SYSTEM - TEST DISPLAYS

ADF SYSTEM - GROUND TEST

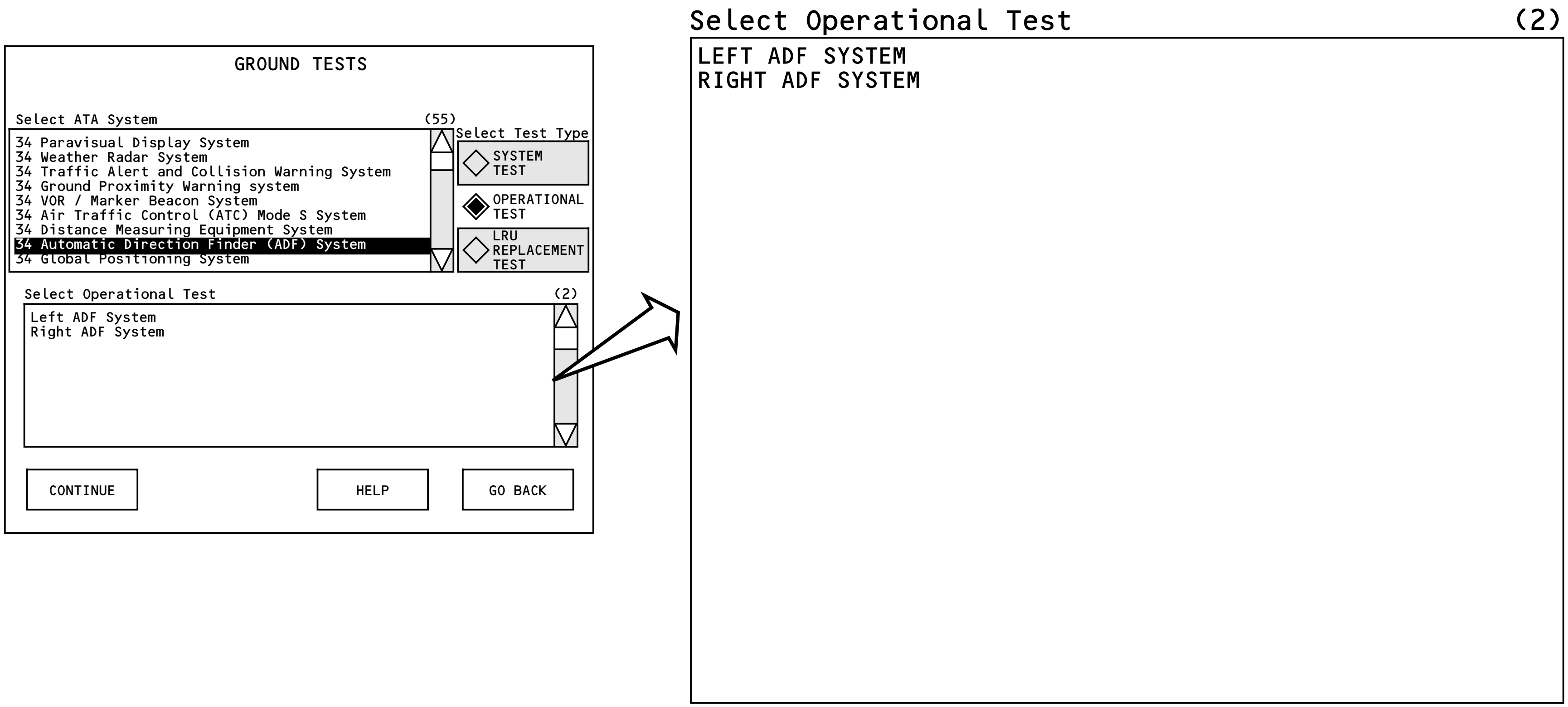
General

You can do a test of the ADF system from the MAT. These are the tests that are available from the operational test selection on the MAT:

- Left ADF System
- Right ADF System.

Operational Test

The operational test for the ADF system makes sure the ADF receiver operates normally.



34-57-00-017 Rev 1

ADF SYSTEM - GROUND TEST

Continental Airlines, Inc

Marker Beacon System

WB371

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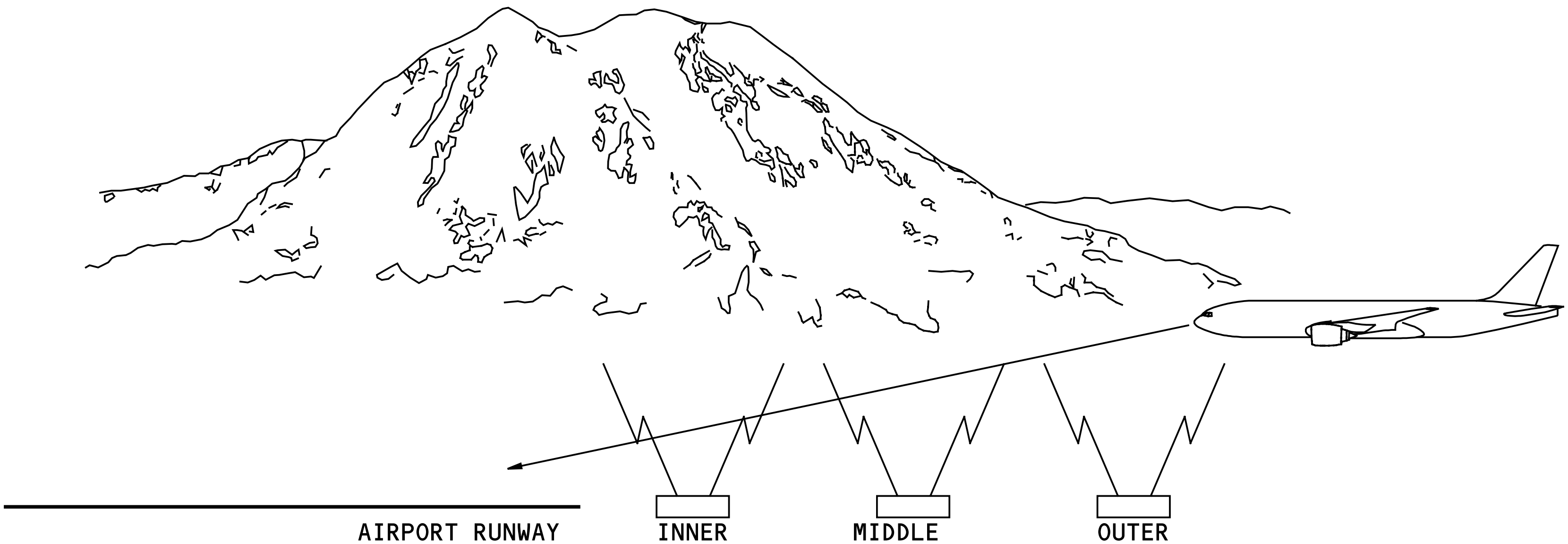
MARKER BEACON SYSTEM - INTRODUCTION

Purpose

The marker beacon system supplies visual and aural indications when the airplane flies over marker beacon transmitters.

Abbreviations and Acronyms

ACP	- audio control panel
AIMS	- airplane information management system
AMU	- audio management unit
BITE	- built-in test equipment
CMCF	- central maintenance computing function
CMCS	- central maintenance computing system
FT	- functional test
IM	- inner marker
I/O	- input/output
LED	- light emitting diode
MAT	- maintenance access terminal
MB	- marker beacon
MM	- middle marker
NVM	- non-volatile memory
OM	- outer marker
PDSF	- primary display system function
PFD	- primary flight display
RF	- radio frequency
SDI	- source/destination indicator
VOR	- VHF omnidirectional ranging



MARKER BEACONS

34-32-00-001 Rev 1

MARKER BEACON SYSTEM - INTRODUCTION

MARKER BEACON SYSTEM - GENERAL DESCRIPTION

General

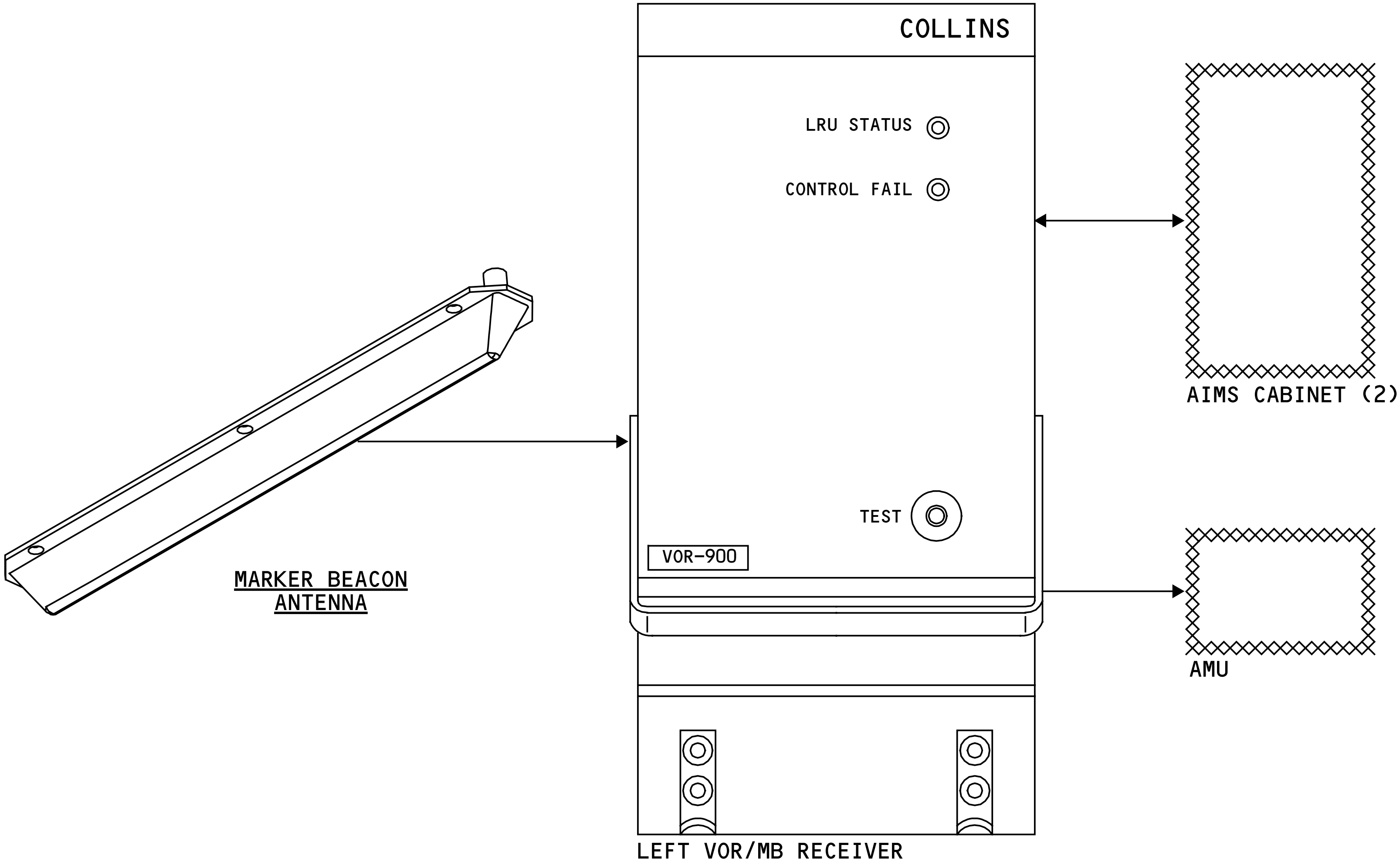
The marker beacon system has an antenna and a VOR/ marker beacon (VOR/MB) receiver. The marker beacon function only operates in the left VOR/MB receiver.

Description

The marker beacon antenna receives the marker beacon signals. The signals go to the left VOR/MB receiver.

The receiver sends marker beacon data to the airplane information management system (AIMS) cabinets to show on the the primary flight displays (PFDs).

The receiver sends marker beacon audio to the audio management unit (AMU).



34-32-00-002 Rev 4 02/12/1998

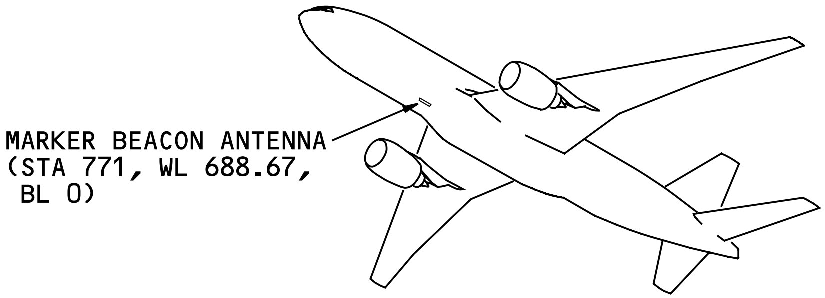
MARKER BEACON SYSTEM - GENERAL DESCRIPTION

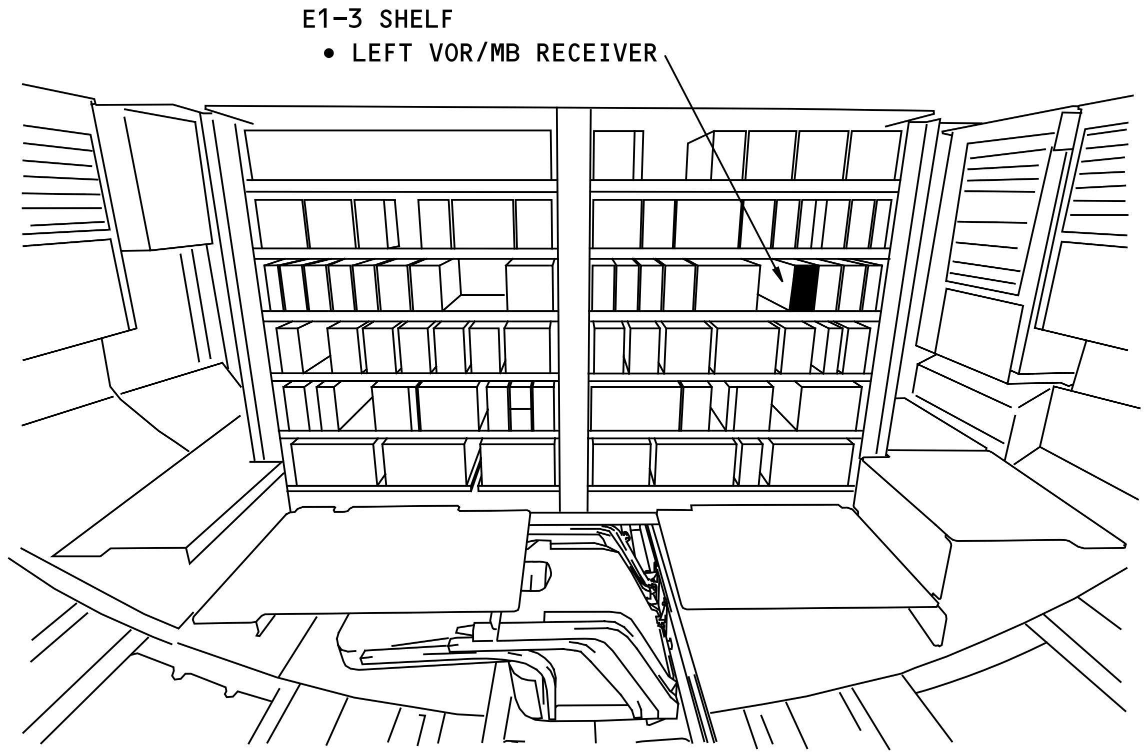
MARKER BEACON SYSTEM - COMPONENT LOCATIONS

General

The marker beacon antenna is on the bottom of the fuselage.

The left VOR/MB receiver is in the main equipment center.





MAIN EQUIPMENT CENTER

34-32-00-003 Rev 1

MARKER BEACON SYSTEM - COMPONENT LOCATIONS

MARKER BEACON SYSTEM - INTERFACES

Power

The left VOR/marker beacon (VOR/MB) receiver uses 115v ac for power.

Antenna Interface

The marker beacon antenna sends radio frequency (RF) signals to the left VOR/marker beacon (VOR/MB) receiver.

Air/Ground Relay

The air/ground relay supplies an air/ground discrete signal to the left VOR/marker beacon (VOR/MB) receiver. The VOR/MB receiver uses this signal:

- To prevent a test in the air
- To count flight legs for an internal nonvolatile fault memory.

Audio Interface

The VOR/MB receiver sends marker beacon audio to the audio management unit (AMU). The AMU supplies marker beacon audio to the flight deck.

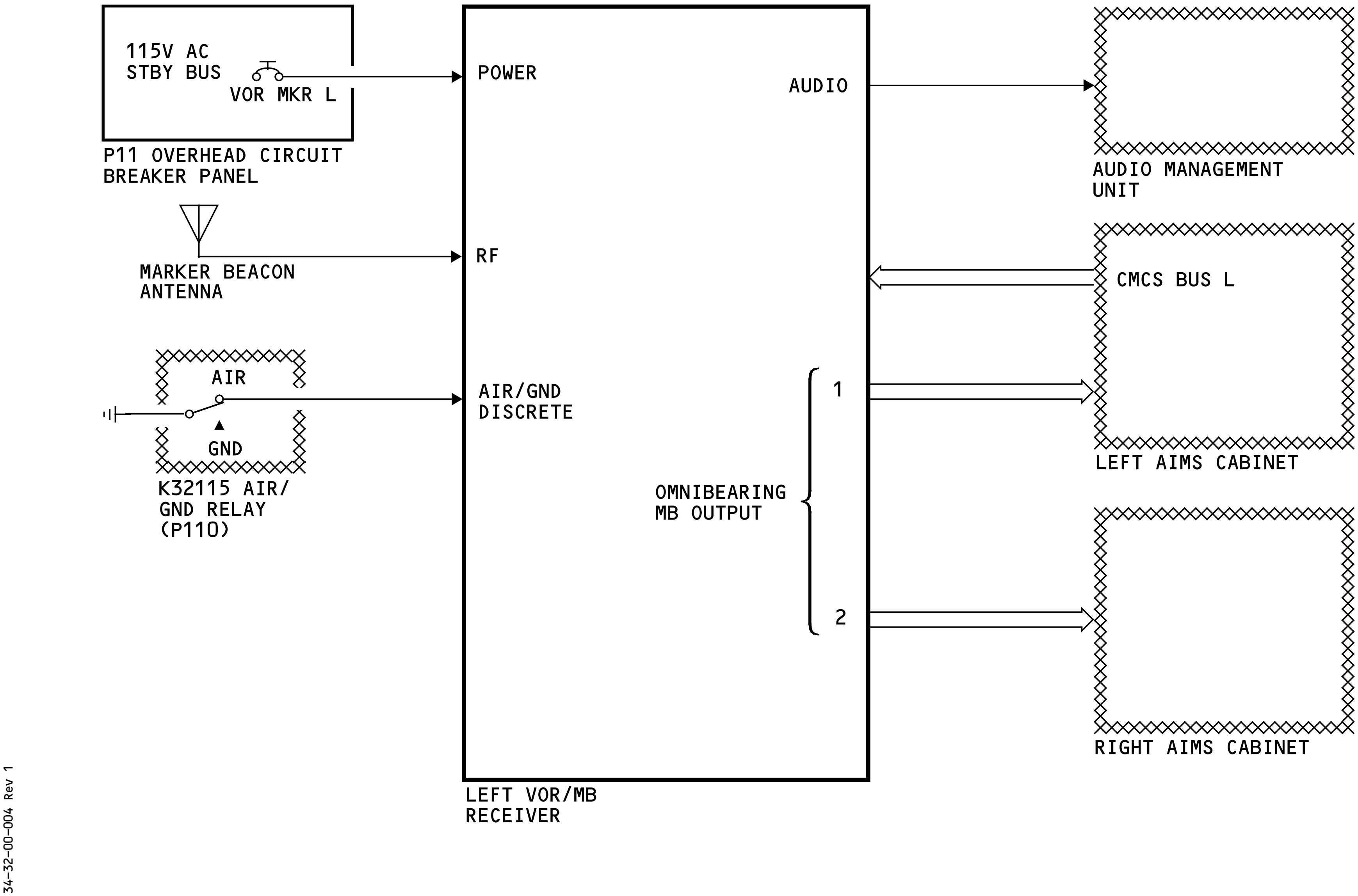
CMCS Interface

The left AIMS cabinet sends central maintenance computing system (CMCS) data to the left VOR/MB receiver. The receiver uses this data to start a test.

Marker Beacon Output

The left VOR/MB receiver supplies marker beacon data to the left and right AIMS cabinets. The AIMS cabinets:

- Supply marker beacon display data to the PFDs
- Receive marker beacon fault and status data.



MARKER BEACON SYSTEM - INTERFACES

MARKER BEACON SYSTEM - DISPLAYS AUDIO OUTPUTS

General

When the airplane passes over a marker beacon transmitter, marker beacon data shows on the primary flight display (PFD).

If you want to listen to marker beacon audio, select the marker beacon audio on the audio control panel (ACP).

Display Types

OM shows when the airplane passes over the outer marker. The OM letters and the circle around them are cyan.

MM shows when the airplane passes over the middle marker. The MM letters and the circle around them are yellow.

IM shows when the airplane passes over the inner marker, backcourse marker, or an airways marker. The letters IM and the circle around them are white.

Audio General

The audio control panel (ACP) supplies control signals to the audio management unit (AMU). The AMU uses the control signals to select the audio that goes to the flight interphone speakers and headsets.

Use the ACP to listen to marker beacon audio.

Audio Operation

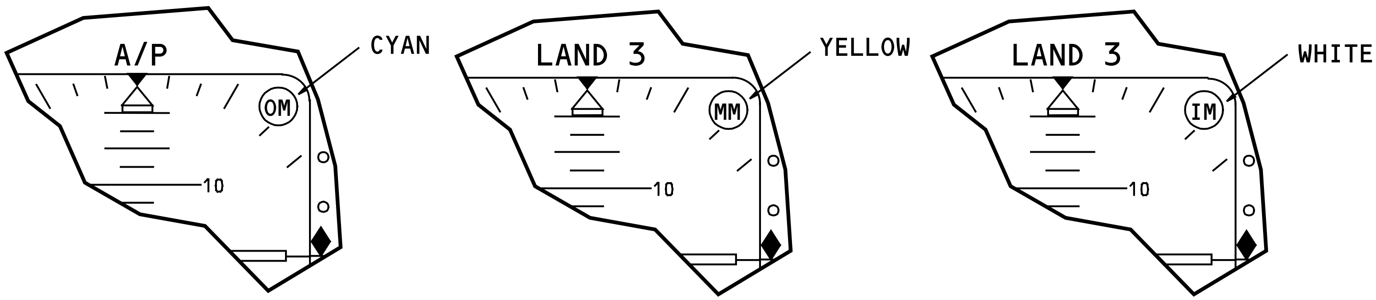
To listen to marker beacon audio signals:

- Select marker beacon audio with the approach receiver selector
- Push the approach receiver volume control to make the marker beacon audio come on
- Turn the approach receiver volume control to change the volume level.

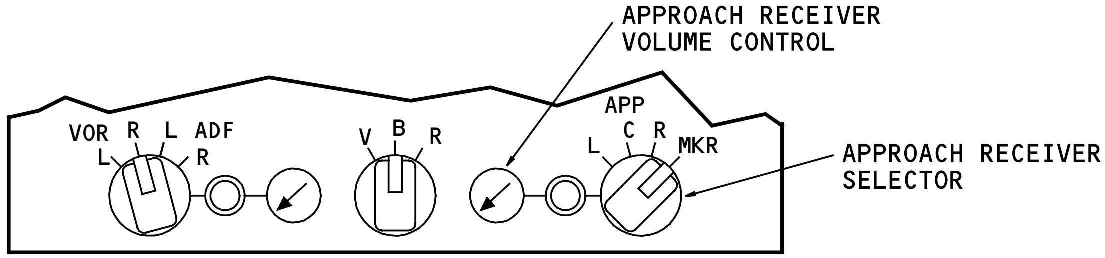
Audio Outputs

These are the marker beacon audio outputs:

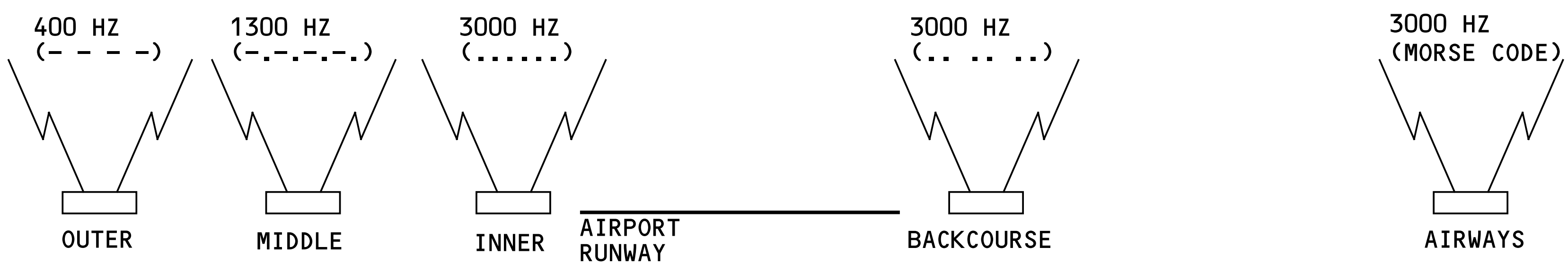
- Outer marker (OM) is 400 Hz, continuous dashes (- - - -)
- Middle marker (MM) is 1300 Hz, alternate dots and dashes (-.-.-.-.-)
- Inner marker (IM) is 3000 Hz, continuous dots (......)
- Backcourse marker is 3000 Hz, continuous paired dots (.. .. .. ..)
- Airways marker is 3000 Hz with the morse code identifier for that station.



MARKER BEACON
DISPLAYS (PFD)



AUDIO CONTROL PANEL



MARKER BEACON AUDIO OUTPUTS

MARKER BEACON SYSTEM - DISPLAYS AUDIO OUTPUTS

34-32-00-007 Rev 1 04/10/1997

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ADF SYSTEM - FUNCTIONAL DESCRIPTION

Power

The ADF receiver power supply receives 115v ac and supplies all the voltages for the internal circuits.

Antenna Inputs

The receiver circuits get radio frequency (RF) signals from the antenna. The antenna amplifiers receive 12v dc from the antenna control circuits in the ADF receiver. The RF signals from the antenna elements go through amplifiers and transformers then to the receiver circuits.

Tuning Inputs

The ADF receiver input/output data processor receives manual tune inputs from the right AIMS cabinet and alternate tune inputs from the CDUs. If the right AIMS cabinet tune input fails, alternate tune inputs come directly from the onside CDU.

When the AIMS cabinet fails, the CDU sets the frequency source select discrete to ground. This changes the tune input port to the CDU.

Receiver Operation

The data processor sends the tune frequencies to the receiver circuits.

For normal operation, the receiver circuit removes the audio signal from the RF signal and sends it to the audio processor. The audio goes through an audio amplifier then to the AMU.

The audio processor sends the Morse code station identifier to the Morse decoder circuits. when there is an identifier, the Morse decoder sends it to the ARINC 429 transmitter. The identifier replaces the frequency on the NDs.

The receiver circuits send the bearing part of the RF signal to the bearing computer circuit. The bearing circuit compares the inputs of the loop and sense antenna elements to calculate bearing to the ADF station.

Bearing data goes to an ARINC 429 transmitter that has two outputs. For the left ADF receiver, output 1 goes to the left AIMS cabinet and output 2 goes to the right AIMS cabinet. For the right ADF receiver, output 1 goes to the right AIMS cabinet and output 2 goes to the left AIMS cabinet.

If you select the antenna (ANT) mode, the processor sends a signal to the receiver circuit that removes the inputs from the loop antenna elements. In the ANT mode, the receiver circuits use inputs only from the sense antenna.

If you select the beat frequency oscillator (BFO) mode, the processor sends a BFO mode signal to the audio processor to enable a 1020 Hz oscillator. The oscillator permits the audio processor to identify the keyed morse code identifier.

ADF SYSTEM - FUNCTIONAL DESCRIPTION

Built-in-Test Equipment

The ADF receiver contains BITE that monitors ADF receiver operation and signal inputs. A fault memory keeps failures that occur by flight legs. A discrete from the AIMS cabinets sets the flight legs. If the input discrete from the AIMS cabinet fails, the ADF receiver uses the air/ground discrete from the air/ground relay to set the flight legs.

The central maintenance computer function (CMCF) in the left AIMS cabinet sends test signals to the ADF receivers. The processor sends test signals to the antenna control circuit and to a function test RF coupler.

Test

During a test, the antenna control removes power to the antenna amplifiers of the ADF antenna so that no RF signals go to the receiver circuits. A test RF frequency replaces the antenna RF input and the receiver sends the signal through its internal circuits. Test results show on the navigation displays.

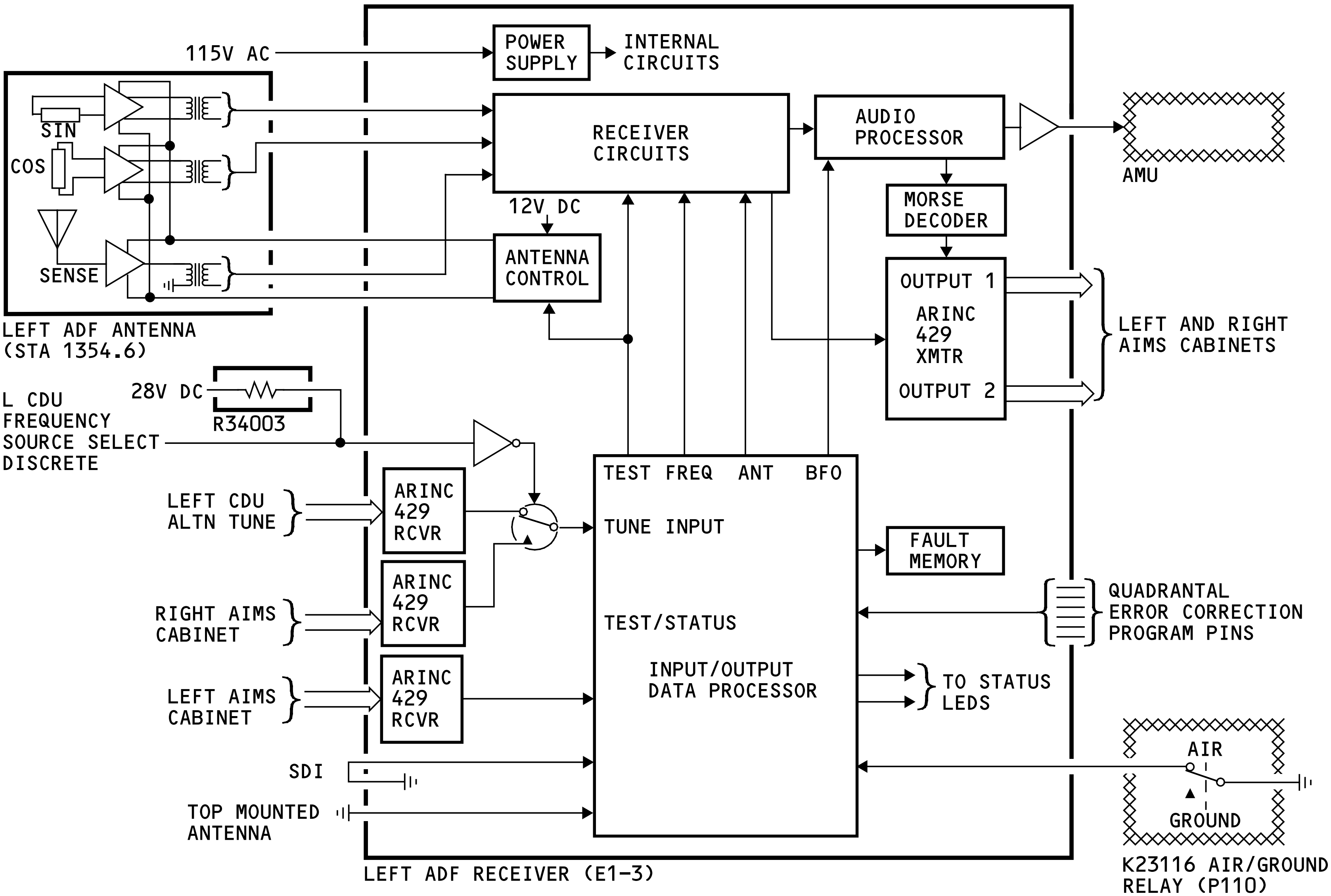
Program Pin Inputs

The ADF receivers get discretes from program pin selections.

The bearing computer circuit uses quadrantal error correction (QEC) program pin inputs to adjust for signal distortion caused by airplane structures.

The source destination indicator (SDI) discrete identifies the ADF receiver as the left or right receiver.

A discrete identifies the antenna location as a top mounted antenna.



ADF SYSTEM - FUNCTIONAL DESCRIPTION

34-57-00-010 Rev 3 03/03/1998

Continental Airlines, Inc

Ground Proximity Warning System

WB371

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Continental Airlines, Inc
Ground Proximity Warning System
WB371

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GPWS - INTRODUCTION

Purpose

The purpose of the ground proximity warning system (GPWS) is to alert the flight crew of an unsafe condition when near the terrain. It also supplies a warning for windshear conditions.

Description

The GPWS uses aural messages, lights, and displays to give alerts and warnings in the flight deck.

GPWS Modes

These are the GPWS modes:

- Mode 1 - Large descent rates
- Mode 2 - Too much of a closure rate when approaching terrain that is rising
- Mode 3 - Too much altitude loss during climbout (at takeoff or in go around) when not in landing configuration
- Mode 4 - Not enough terrain clearance when the airplane is not in landing configuration
- Mode 5 - Too much deviation below the glideslope centerline
- Mode 6 - Aural callouts when descending through selected radio altitudes
- Mode 7 - Warning for windshear conditions.

The GPWS also alerts the flight crew to early descent on approach, or to terrain threats ahead of the airplane.

Abbreviations and Acronyms

AOA	- angle of attack
BITE	- built-in test equipment
EFIS	- electronic flight instrument system
FMC	- flight management computer
GPS	- global positioning system
GPWC	- ground proximity warning computer
GPWS	- ground proximity warning system
IVS	- inertial vertical speed
LED	- light emitting diode
MAT	- maintenance access terminal
MMR	- multi-mode receiver
MWL	- master warning light
ND	- navigation display
OVRD	- override
PFD	- primary flight display
PWS	- predictive windshear
RA	- radio altitude
RT	- receiver-transmitter
TCAS	- traffic alert and collision avoidance system
TCF	- terrain clearance floor
WEU	- warning electronic unit
WES	- warning electronic system
WXR	- weather radar system

34-46-00-001 Rev 3

GPWS - INTRODUCTION

GPWS - GENERAL DESCRIPTION

General Description

The main component of the ground proximty warning system (GPWS) is the ground proximity warning computer (GPWC). It uses inputs from other systems to determine if an unsafe condition is present and then gives the proper annunciations.

The GPWS displays terrain forward of the airplane, and also alerts the flight crew of early descent when landing.

Visual annunciations show on the:

- Primary flight displays (PFDs)
- Navigation displays (NDs)
- GND PROX light
- Master warning lights.

Aural annunciations come from the aural warning speakers.

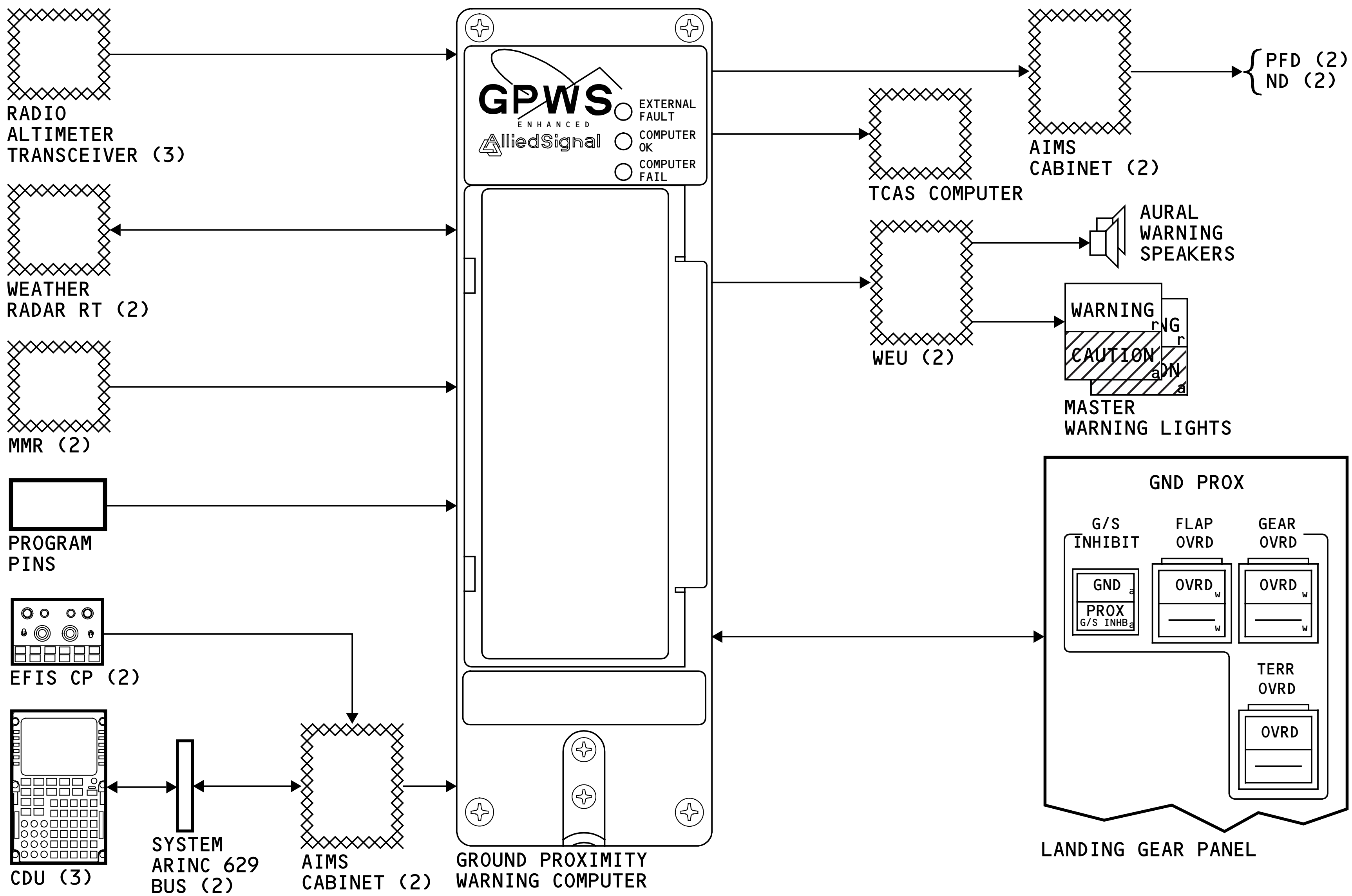
The GPWC sends terrain data to the airplane information management system (AIMS) cabinets to show on the NDs.

These components control GPWS:

- Electronic flight instrument system (EFIS) control panels (CPs)
- Control display units (CDUs)
- Glideslope inhibit switch
- Override switches.

The program pins selects options available for the GPWC.

The GPWC sends discretes to the weather radar (WXR) system and to the traffic alert and collision avoidance system (TCAS).



GPWS - GENERAL DESCRIPTION

GPWS - COMPONENT LOCATIONS - 1

GPWS Component Locations

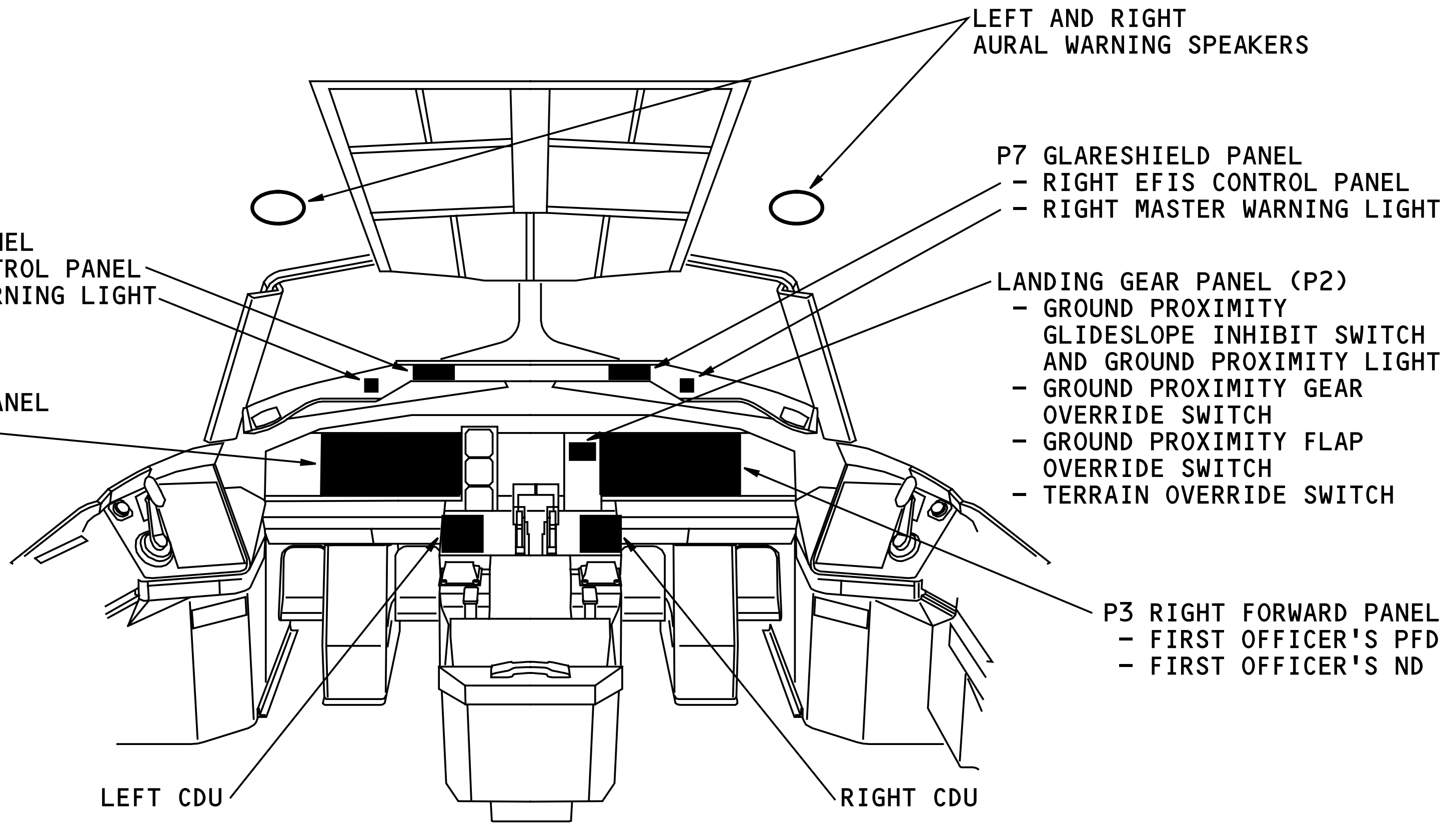
These are the GPWS components in the flight deck:

- Ground proximity glideslope inhibit switch and ground proximity light
- Ground proximity gear override switch
- Terrain override switch
- Ground proximity flap override switch.

Other Systems Component Locations

The components in the flight deck that have an interface with the GPWS are:

- Left and right aural warning speakers
- Left and right master warning lights
- Captain and first officer navigation displays (NDs)
- Left and right electronic flight instrument system (EFIS) control panel (CP)
- Left and right control display units (CDUs)
- Captain and first officer primary flight displays (PFDs).



34-46-00-003 Rev 2 01/23/1998

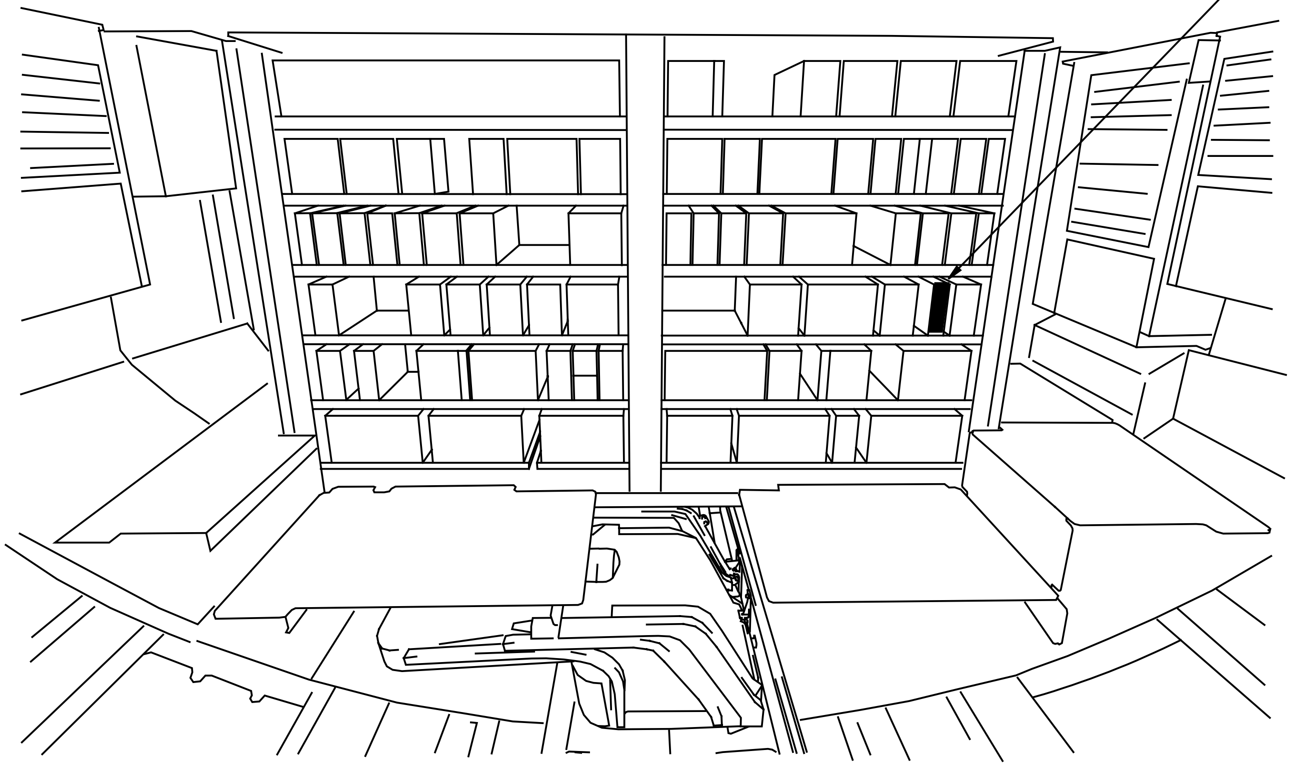
GPWS - COMPONENT LOCATIONS - 1

GPWS - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

GPWS Component Locations

These components are in the main equipment center:

- Terrain select relays
- Ground proximity warning computer (GPWC).



34-46-00-004 Rev 4 02/03/1998

GPWS - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

GPWS - INTERFACE

Power

The GPWC gets 115v ac power from the GND PROX circuit breaker on the P11 overhead circuit breaker panel.

General Interface

The ground proximity warning computer (GPWC) has an interface with these:

- Left, right, and center radio altimeter transceivers
- Weather radar (WXR) receiver/transmitters (RTs)
- Left and right AIMS cabinets
- Multi-mode receivers (MMRs)
- Warning electronic units (WEUs)
- Landing gear panel
- Program pins
- TCAS computer.

Radio Altimeter System

The GPWC uses radio altitude from the three radio altimeter transceivers. If the three radio altimeter transceivers are valid, the GPWC selects the left radio altimeter transceiver if the left radio altitude is within 500 feet of the center or right radio altitudes.

If the three radio altimeter transceivers are valid and the left radio altitude is not within 500 feet of the center or right radio altitudes, the GPWC uses the center radio altimeter transceiver provided its altitude is within 500 feet of the right radio altitude.

If the three radio altimeter transceivers are valid and the left, right, and center radio altitudes differ by more than 500 feet between each other, the GPWC uses the left radio altimeter transceiver.

If there are less than three valid radio altimeter transceivers, the GPWC selects one of the radio altimeter transceivers in this order:

- Left
- Center
- Right.

Airplane Information Management System (AIMS)

The GPWC receives data from the left and right AIMS cabinets. The primary input is from the left AIMS cabinet. Both cabinets supply data to the GPWS on three ARINC 429 data buses. A fourth data bus from the left AIMS cabinet supplies CMCF test requests to the GPWC.

IRS data buses supply this data:

- Latitude and longitude (from the ADIRU)
- Magnetic track
- Ground speed
- True heading
- Vertical speed
- True track
- Inertial vertical speed and altitude

GPWS - INTERFACE

- Pitch and roll angle
- Pitch rate
- Normal acceleration
- Longitudinal acceleration
- Vertical acceleration.

The general purpose (GP) data buses supply this data:

- Computed airspeed
- True airspeed
- Barometric altitude
- Baro-corrected altitude
- Barometric altitude rate
- Latitude and longitude (from the FMCF)
- Magnetic track
- Decision height
- Electronic flight instrument system (EFIS) control panel (CP) control data
- Control display unit (CDU) control data (alternate EFIS CP)
- Flap and gear position
- Indicated and corrected AOA
- Stick shaker AOA
- Minimum operating speed
- Air/ground status.

The central maintenance computing (CMC) data bus supplies test commands.

The GPWC sends digital data to the AIMS cabinets on an ARINC 429 data bus. This is the data:

- Windshear warning discrete
- Pull up warning discrete
- Test command reply.

Global Positioning System (GPS)

The GPS receives this data from the multi-mode receivers (MMRs):

- Latitude
- Longitude
- Altitude
- Vertical speed
- Date
- Time (UTC)
- Ground speed
- True track
- Integrity of data
- Sensor status.

Instrument Landing System (ILS)

The GPWC receives this data from the left multi-mode receiver (MMR):

- Glideslope deviation
- Localizer deviation
- Selected runway heading.

Warning Electronic System (WES)

Audio signals from the GPWC go to the warning electronic units (WEUs). The WEUs send the audio to the aural warning speakers.

GPWS - INTERFACE

Landing Gear Panel

The landing gear panel has these functions:

- Terrain override switch
- Ground proximity gear override switch
- Ground proximity flap override switch
- Ground proximity glideslope inhibit switch
- Ground proximity light.

The GPWC sends an alert discrete signal to the GPWS landing gear panel to turn on the GND PROX light.

Traffic Alert and Collision Avoidance System (TCAS)

The GPWC sends alert and warning discretes to the TCAS computer to inhibit TCAS advisories that may conflict with GPWS aural messages.

Program Pins

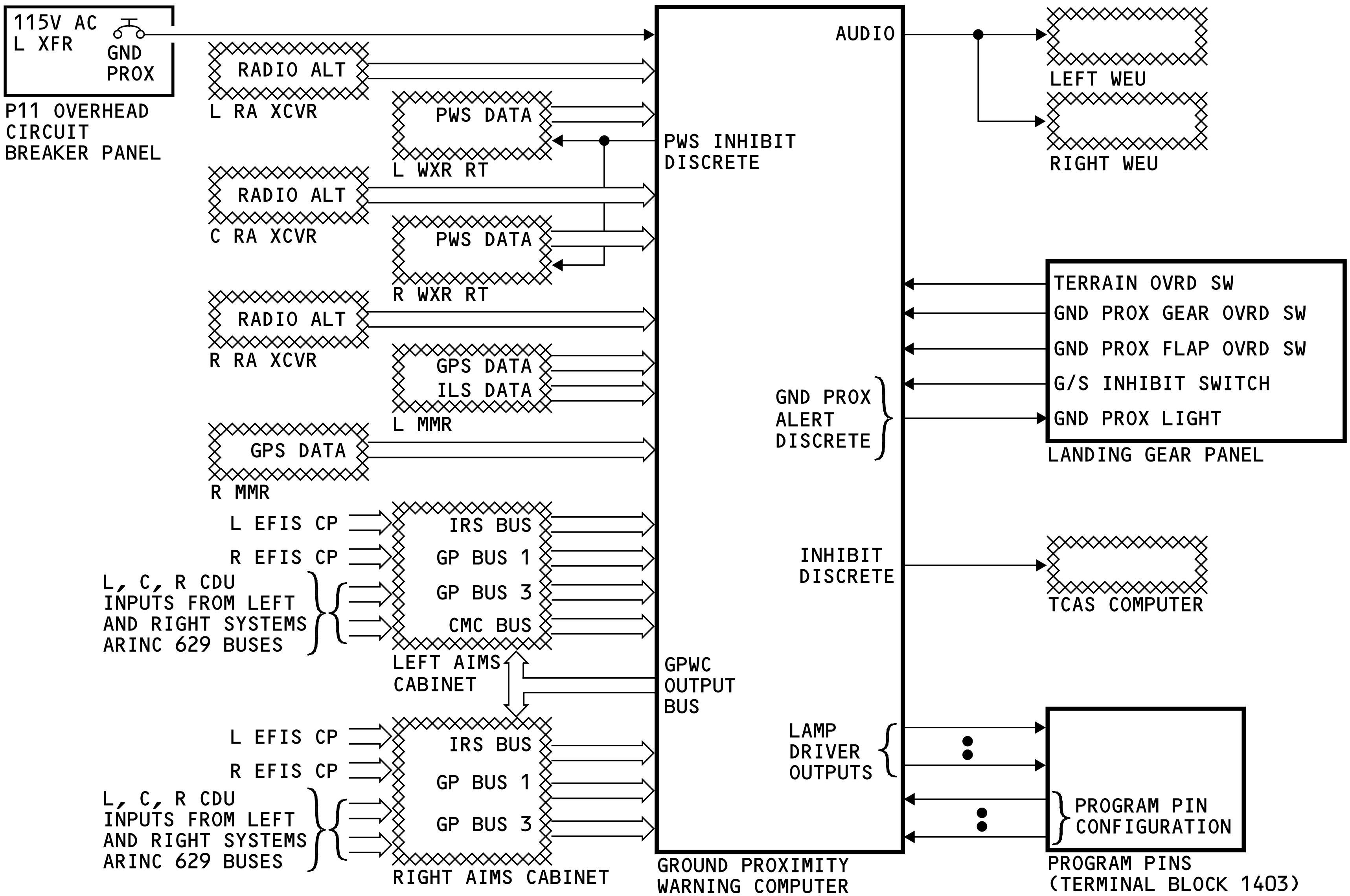
Seventeen program pins connect to six GPWS lamp drivers. The connections are at terminal blocks on the E1-4 shelf in the main equipment center (MEC). When the airplane powers up, the lamp drivers turn on and off one at a time to read the program pin connections. These connections make up the GPWS configuration. The non-volatile memory (NVM) stores this configuration. The configuration determines such parameters as:

- Airplane type
- Mode 6 callouts
- High or low audio volume.

Weather Radar (WXR) System

The WXR receiver-transmitters (RTs) sends predictive windshear (PWS) data to the GPWC to inhibit lower priority GPWS alerts.

The GPWC sends a discrete to the WXR RTs to inhibit lower priority PWS alerts.



GPWS - INTERFACE

GPWS - DISPLAY RELAY INTERFACE

Purpose

The ground proximity warning computer (GPWC) and the weather radar (WXR) receiver-transmitters (RTs) send display data that shows on the navigational displays (NDs). Four terrain select relays control which data shows on each ND.

Relay Power

The terrain select relays gets 28v dc from the TERRAIN DISPLAY circuit breaker on the P11 overhead circuit breaker panel.

Relay Interfaces

The GPWC connects to all terrain select relays with terrain display data buses. The WXR RTs connect to all terrain select relays with weather display data buses.

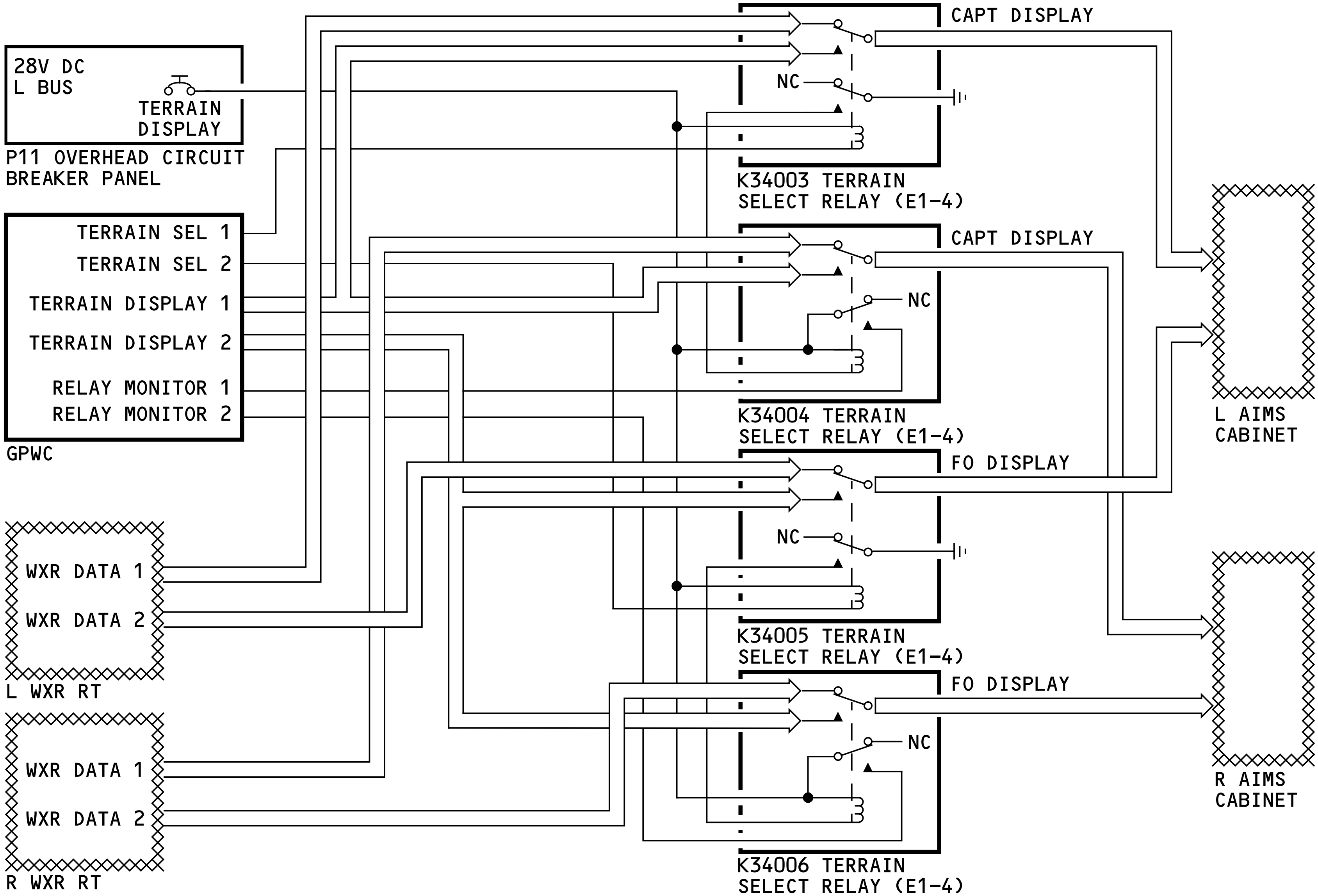
The terrain select relays connect to the AIMS cabinets with data buses. The AIMS cabinets show the data on the NDs.

Relay Control

With weather radar selected, the normal relay position lets weather radar data show on the NDs. When you select TERR on either EFIS control panel (CP), a terrain select ground signal energizes the two on-side terrain select relays. This allows the terrain data to show on the on-side display. Push the TERR switch again and the on-side relays deenergize. The display then shows weather radar data, if selected.

Relay Monitor

The GPWC monitors the terrain select relay positions for faults.



GPWS - DISPLAY RELAY INTERFACE

34-46-00-034 Rev 0 02/03/1998

GPWS - GROUND PROXIMITY WARNING COMPUTER

Purpose

The ground proximity warning computer (GPWC) compares the airplanes flight profile, flap and gear position, and terrain clearance to determine if an alert condition exists.

Description

The enhanced GPWS function contains a worldwide terrain database. It compares airplane position, track and speed with this database to determine if an alert condition exists. Terrain data displays on the navigation displays (NDs).

The enhanced GPWS function also contains an airport database. This database contains terrain information about all hard surface runways 3500 feet or more in length. GPWS compares airplane position and runway location to determine if an alert condition exists.

Physical Description

The ground proximity warning computer (GPWC) is a two MCU chassis and weighs seven pounds. The GPWC requires no forced cooling air.

Front Panel

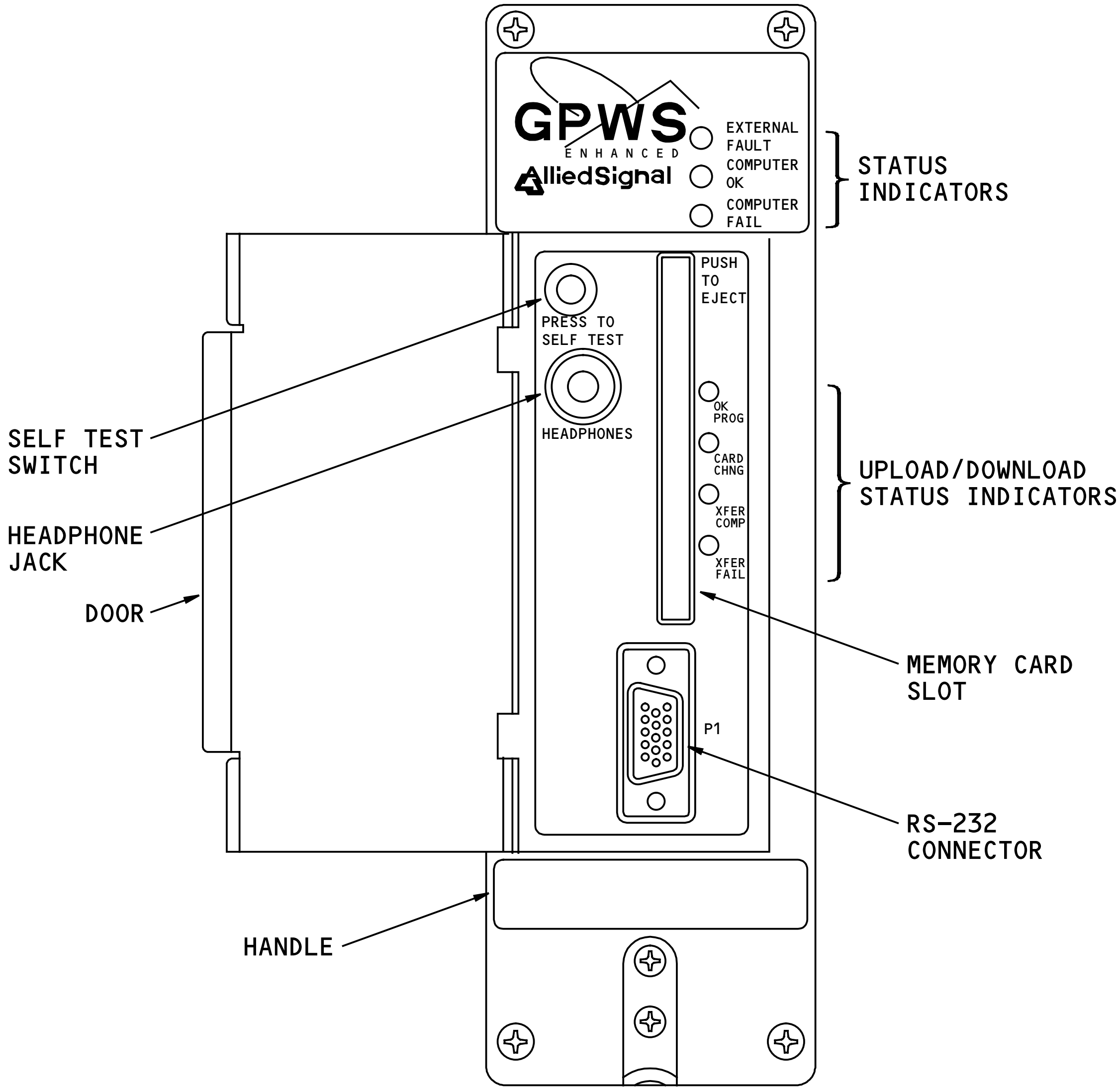
The GPWC front panel has three status LEDs and a door.

These are the three status LEDs on the front panel:

- EXTERNAL FAULT - amber LED turns on for a failure external to the GPWC.
- COMPUTER OK - green LED stays on when GPWC has power and operates normally
- COMPUTER FAIL - red LED turns on when the GPWC has an internal failure.

The front panel door allows access to the following:

- PRESS TO SELF TEST switch - begins a test of the GPWS
- Headphone jack - allows you to hear self test audio
- Memory card slot - allows you to upload software from a memory card, or download fault and warning history data
- Upload/download status indicators - displays conditions of upload or download operation
- RS-232 connector - used for shop test, or for the upload/download of data.



GPWS - GROUND PROXIMITY WARNING COMPUTER

GPWS - CONTROL - EFIS CONTROL PANEL

Description

The EFIS control panel provides these functions:

- Enables the navigation displays (NDs) to show terrain data
- Supplies the selection of different ND modes
- Supplies the selection of different ranges for terrain data to show on the NDs.

TERR Map Switch

When you push the TERR map switch on the EFIS control panel, terrain data shows on the on-side ND. Push the TERR map switch again to remove the display.

ND Mode Selector

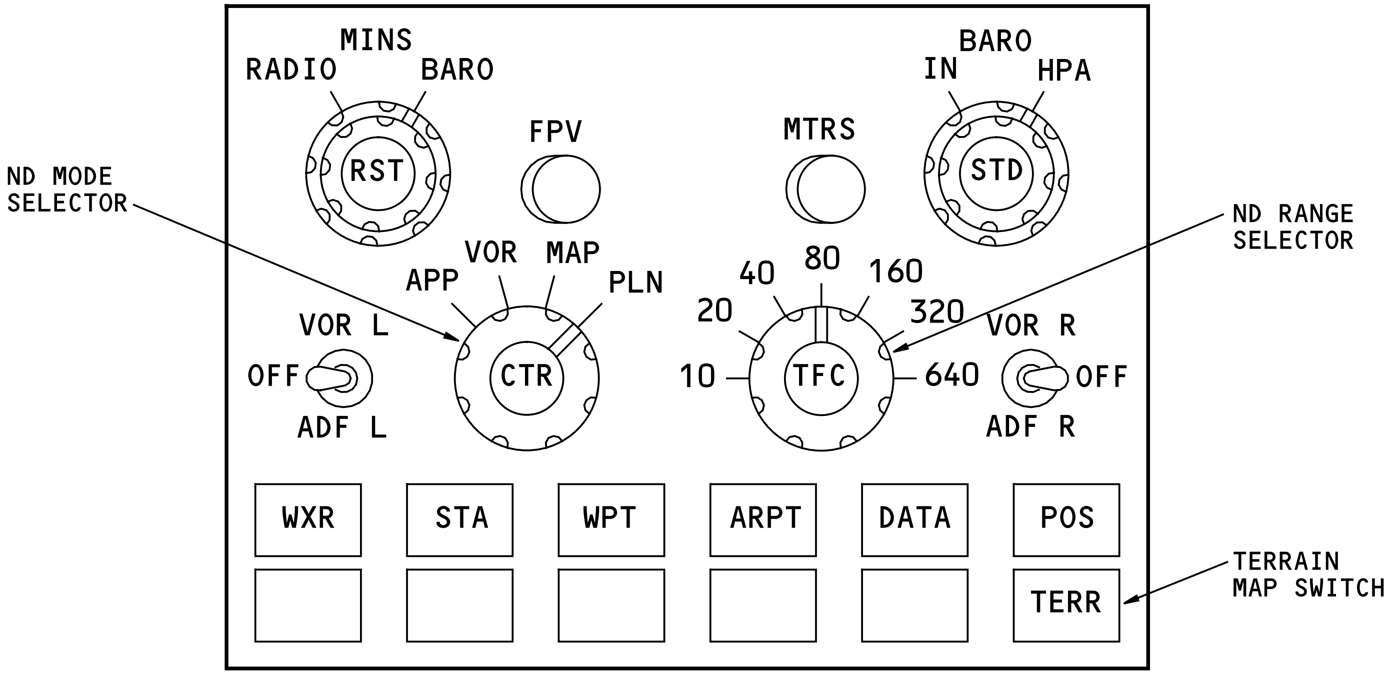
Use the ND mode selector to select an ND mode. The ND modes that show terrain data are:

- Expanded APP (approach) mode
- Expanded VOR mode
- Expanded MAP mode
- Centered MAP mode.

If the mode selector is not in a correct mode when you push the TERR map switch, the terrain display arms. When armed, the terrain display shows as soon as you change the ND selector to a correct mode. The terrain display stays armed even if you push the TERR map switch again. Push the WXR map switch to disarm the terrain display and arm the weather display.

ND Range Selector

The EFIS control panel has a six position range selector. The range selections are 10, 20, 40, 80, 320 and 640 NM. The map mode displays the range at all times. APP and VOR modes display the range only when TERR or WXR data show.



GPWS - CONTROL - EFIS CONTROL PANEL

GPWS - CDU SELECTIONS

Alternate or Backup EFIS Control Panel

The EFIS control page on the control display unit (CDU) permits alternate or backup controls for the ground proximity warning system.

If the EFIS control panel (CP) fails or for alternate operation, use the EFIS control CDU pages on the on-side CDU for:

- On/off control of the on-side terrain display
- Terrain display range selection
- ND mode selection.

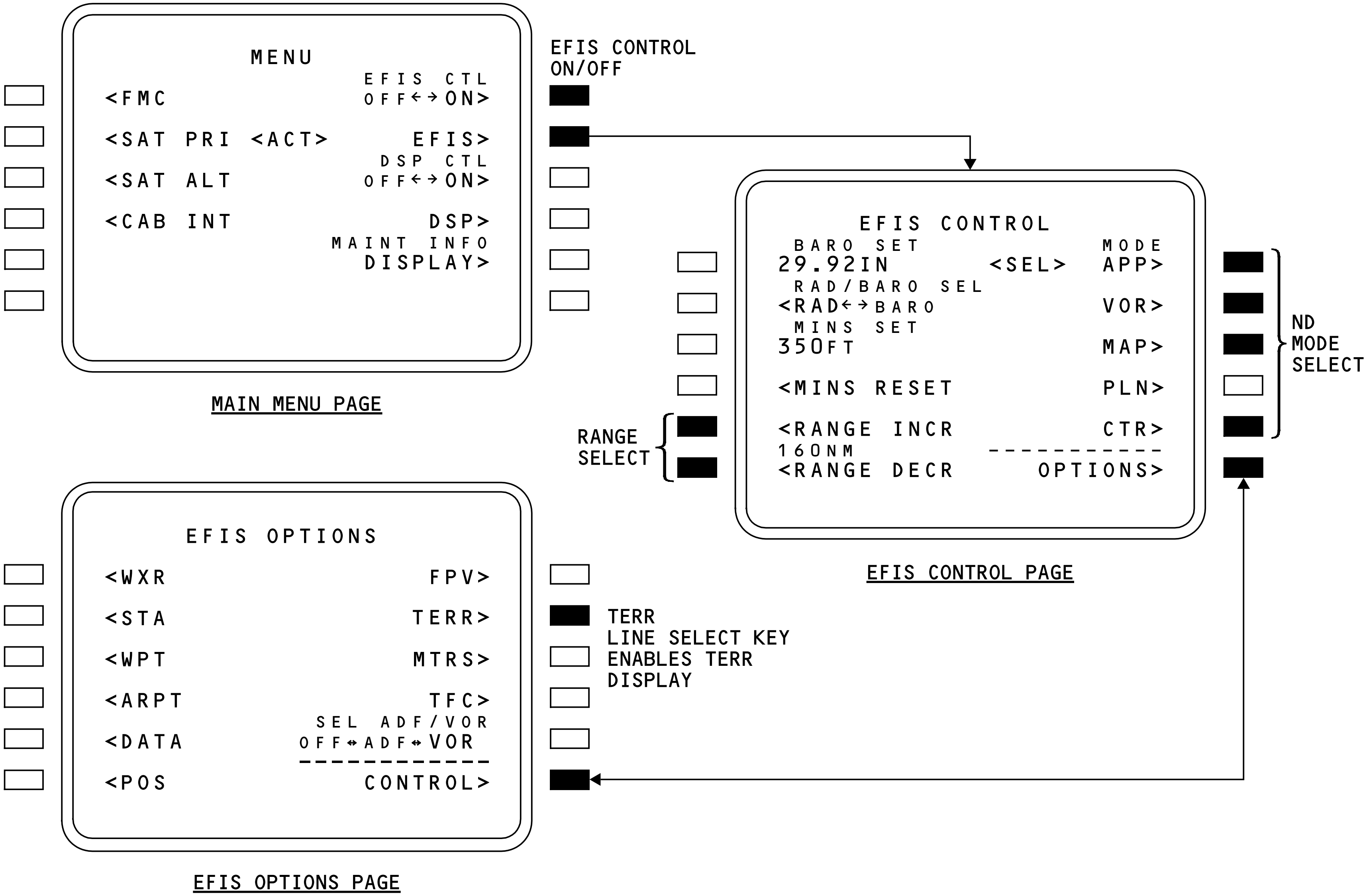
When you select EFIS control to ON from the CDU page, the on-side EFIS CP does not operate.

Access

To get the EFIS control CDU pages on the CDU:

- Push the MENU line select key (LSK) on the CDU to make the MENU page come on
- Push the EFIS CTL LSK on the MENU page and the EFIS prompt comes on
- Push the LSK next to EFIS and the EFIS control page comes on
- Select the ND modes and range From the EFIS CONTROL page
- Push the OPTIONS LSK on the EFIS CONTROL page to go to the EFIS OPTIONS page
- Push the TERR LSK on the EFIS OPTIONS page for ON/OFF control of the GPWS and to enable the terrain display for the on-side ND.
- Push the CONTROL LSK on the EFIS OPTIONS page to return to the EFIS CONTROL page.

You can use the EFIS CP CDU pages on the CDU at any time.



GPWS - CDU SELECTIONS

GPWS - CONTROL COMPONENTS

Description

These are the controls on the landing gear panel:

- Ground proximity light
- Glideslope inhibit switch
- Flap override switch
- Terrain override switch
- Gear override switch.

Ground Proximity Light/Glideslope Inhibit Switch

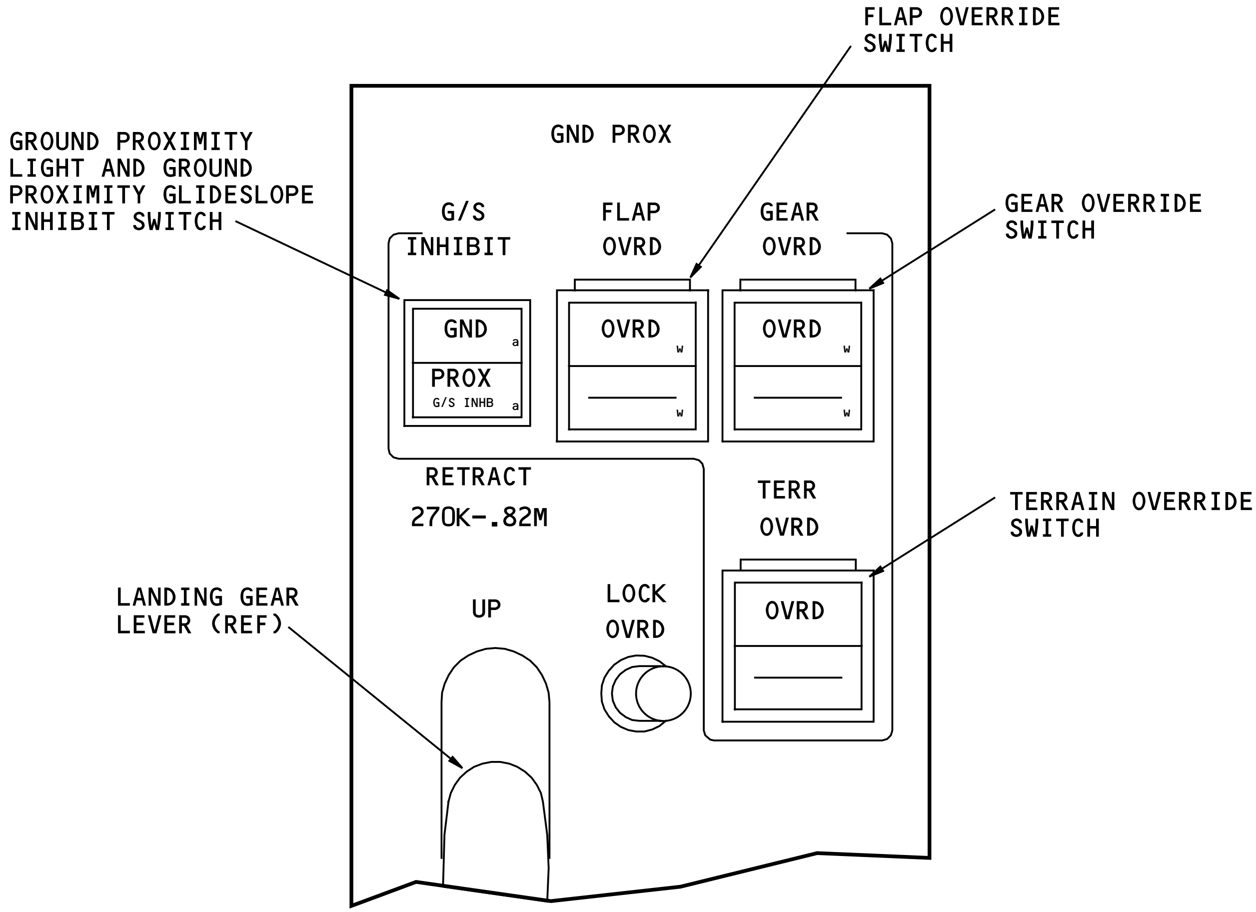
This combination light/switch has two functions. The amber ground proximity light shows ground proximity alerts for modes 1 through 5.

Push the switch to prevent mode 5 (below glideslope) alerts.

Override Switches

The flap override and the gear override switches simulate a flaps down condition and a gear down condition. The use of these switches prevent alerts when the flight crew makes flaps up or gear up approaches intentionally. The flight crew uses the terrain override switch for any of the following conditions:

- The crew determines position data is not valid
- Terrain awareness alerts show when it is obvious no terrain threats exist.



LANDING GEAR PANEL (P2)

34-46-00-007 Rev 2 01/23/1998

GPWS - CONTROL COMPONENTS

GPWS - MODE 1 DESCRIPTION

Purpose

Mode 1 supplies alerts and warnings for large descent rates when the airplane is near the terrain. This mode is independent of flap or gear positions.

Description

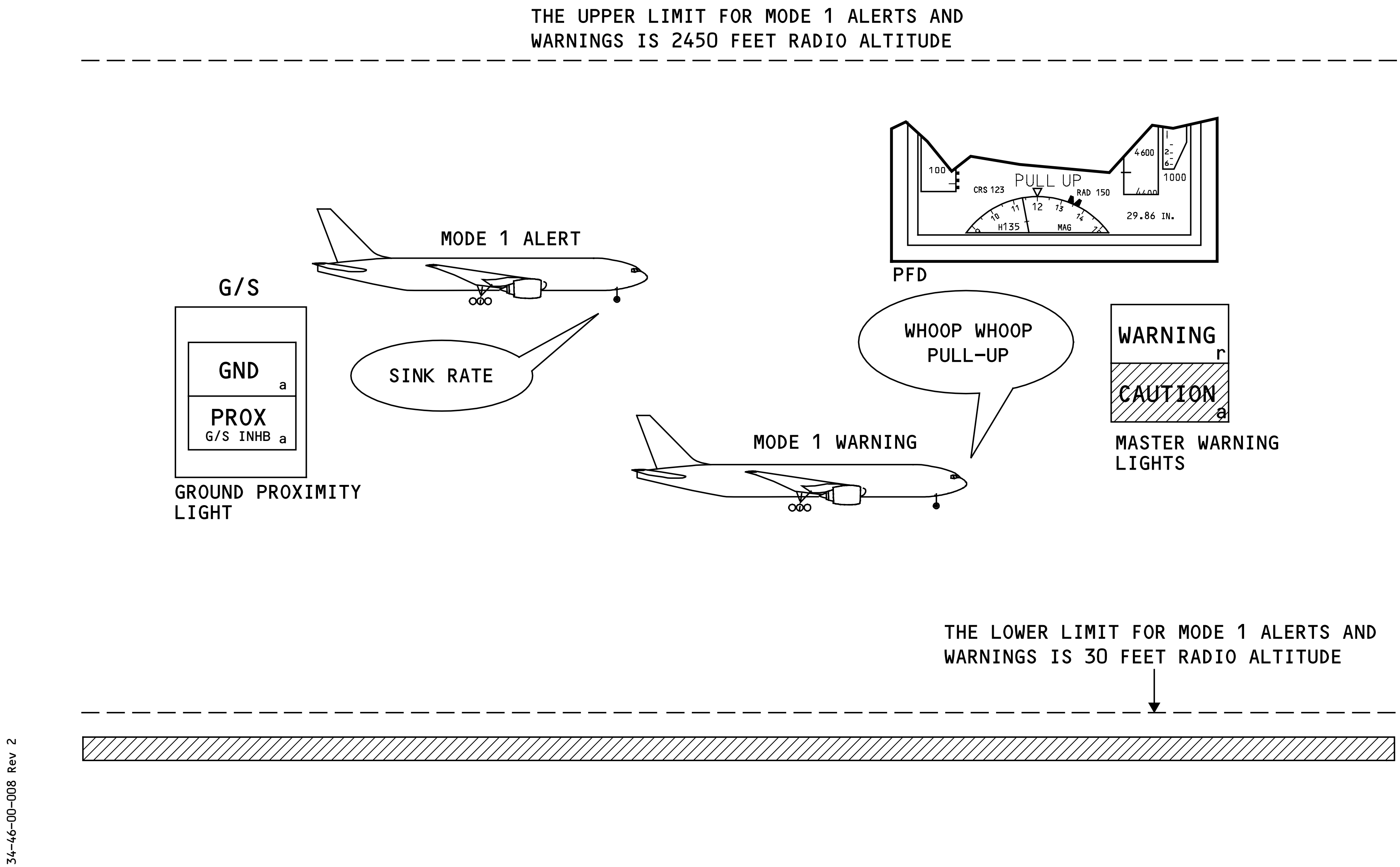
Mode 1 alerts or warnings occur between 2450 feet and 30 feet. The rate of descent sets the point at which mode 1 alerts occur.

The alert consists of these annunciations:

- Aural message SINK RATE
- Ground proximity light on the landing gear panel.

If the descent rate does not decrease, the alert changes to a warning. These are the warning annunciations:

- A red PULL-UP message on the PFD
- Red master warning lights
- The aural message WHOOP, WHOOP, PULL-UP.



GPWS - MODE 1 DESCRIPTION

GPWS - MODE 1 OPERATION

General

Mode 1 alerts and warnings occur at 2450 feet down to 30 feet of radio altitude. The LRUs that supply inputs for mode 1 operation are the left, right, and center radio altimeter transceivers and the AIMS cabinets.

The GPWC uses this data to detect mode 1 alerts and warnings:

- Radio altitude
- Inertial vertical speed
- Barometric altitude.

The mode detector in the GPWC calculates the descent rate from the inertial vertical speed input. If it is not available, the mode detector uses barometric altitude rate.

The type of annunciation depends on the rate of descent and the radio altitude.

The first annunciation is an alert. If the rate of descent does not decrease, the annunciation changes to a warning.

Operation

The mode detector uses the inputs to see if an alert or warning condition is present.

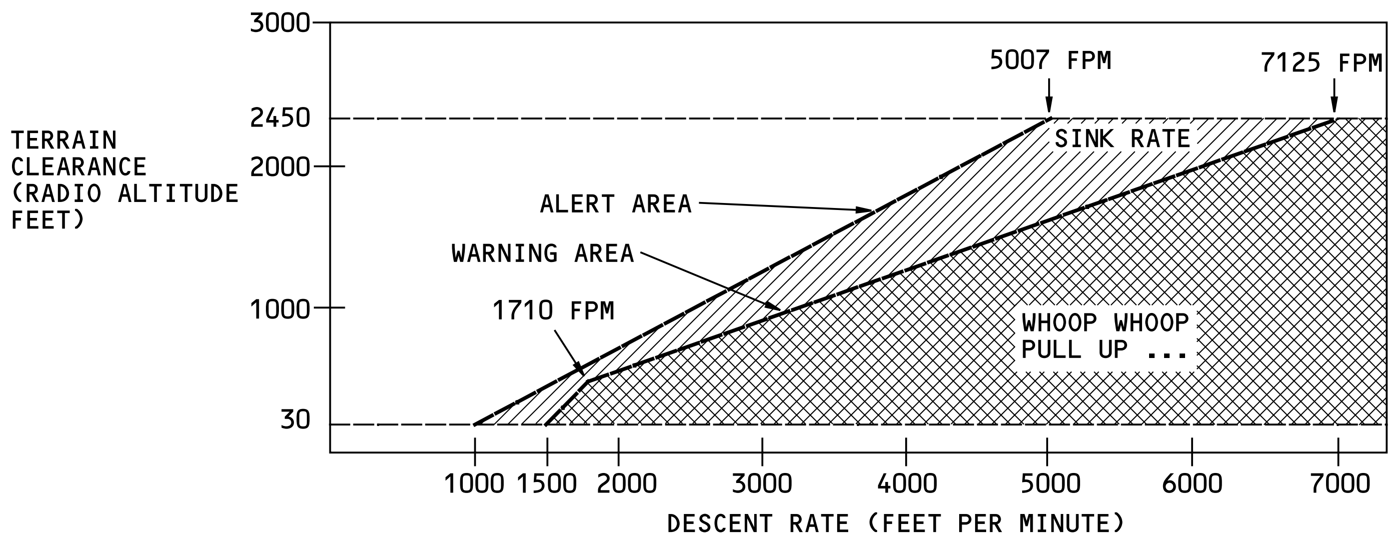
If an alert condition is present, the GPWC sends a discrete to the ground proximity light. The alert discrete goes to the speech prom to make the alert aural. The alert aural goes to the warning electronic units (WEUs) which amplify and send it to the aural warning speakers.

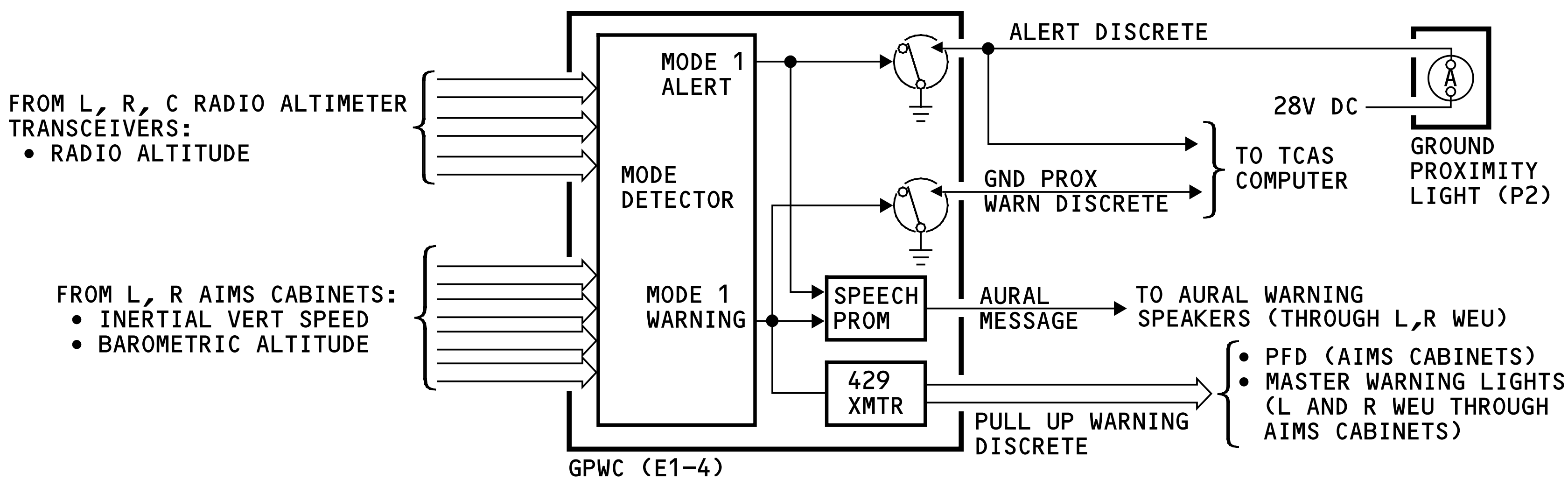
The alert discrete also goes to the TCAS computer to inhibit any TCAS advisory messages.

When a warning condition is present, the GPWC sends a PULL-UP warning discrete to the AIMS cabinets to show the message PULL UP on the PFDs. The warning discrete goes to the speech prom to make the warning aural. The warning aural goes to the warning electronic units (WEUs) which amplify and send it to the aural warning speakers.

The warning discrete also goes to the TCAS computer to inhibit any TCAS advisory messages.

The AIMS cabinets send the warning discretes to the warning electronic units (WEUs) to make the master warning lights come on.





GPWS - MODE 1 OPERATION

GPWS - MODE 2A DESCRIPTION

Purpose

Mode 2 supplies alerts and warnings if the closure rate to the terrain is too large. Mode 2 has two submodes (mode 2A and 2B).

The position of the flaps determine if it is a mode 2A or a mode 2B alert.

Description

Mode 2A gives annunciations for a large closure rate with the flaps up (less than 15 units). Mode 2A gives an alert and a warning. This is the alert:

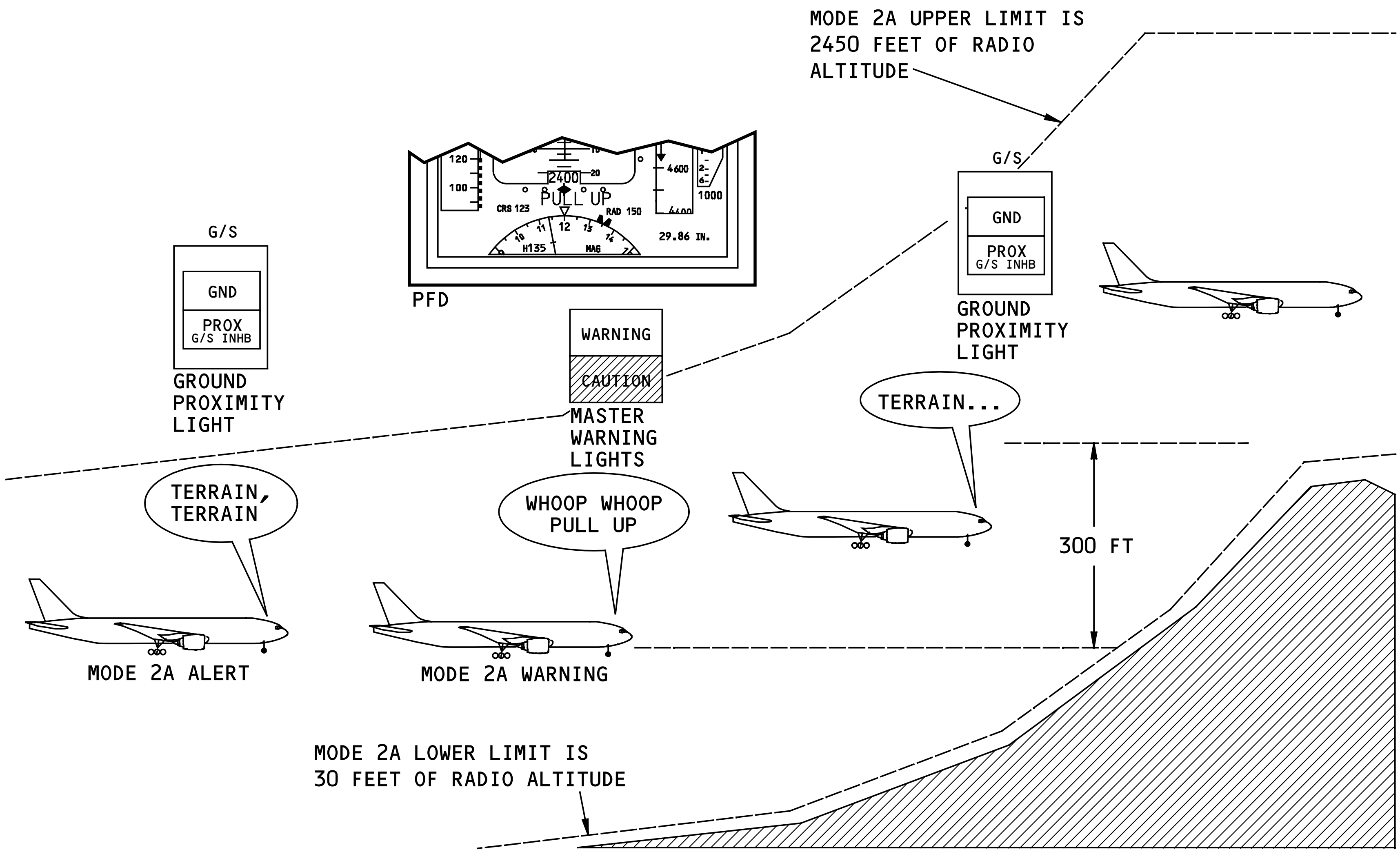
- An aural message TERRAIN, TERRAIN
- The ground proximity light.

This is the warning:

- A red PULL-UP message on the PFDs
- The master warning lights come on
- An aural message WHOOP, WHOOP, PULL-UP.

The warning changes back to the alert annunciation TERRAIN and the ground proximity light on if the closure rate decreases or if the pilot does a pull up maneuver.

The alert annunciation continues until there is a gain of 300 feet of inertial altitude or the gear comes down.



GPWS - MODE 2A DESCRIPTION

34-46-00-010 Rev 2

GPWS - MODE - 2B DESCRIPTION

General

Mode 2B gives annunciations for a large closure rate with the flaps down (greater than 15 units).

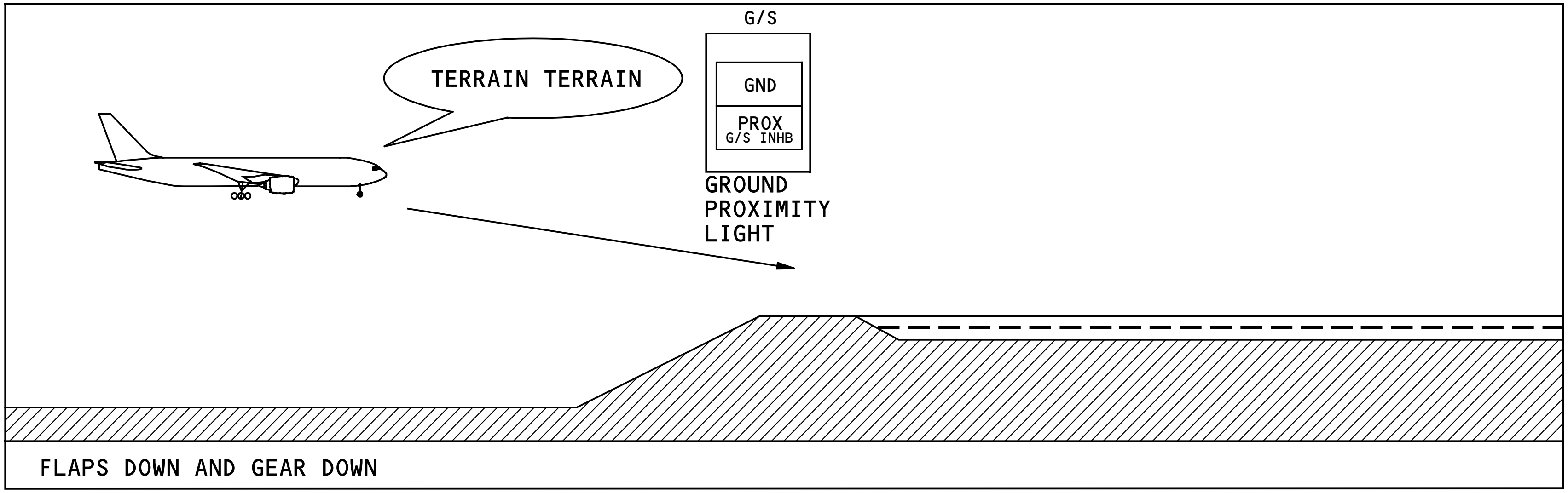
Mode 2B gives two types of annunciations that depend on the position of the landing gear.

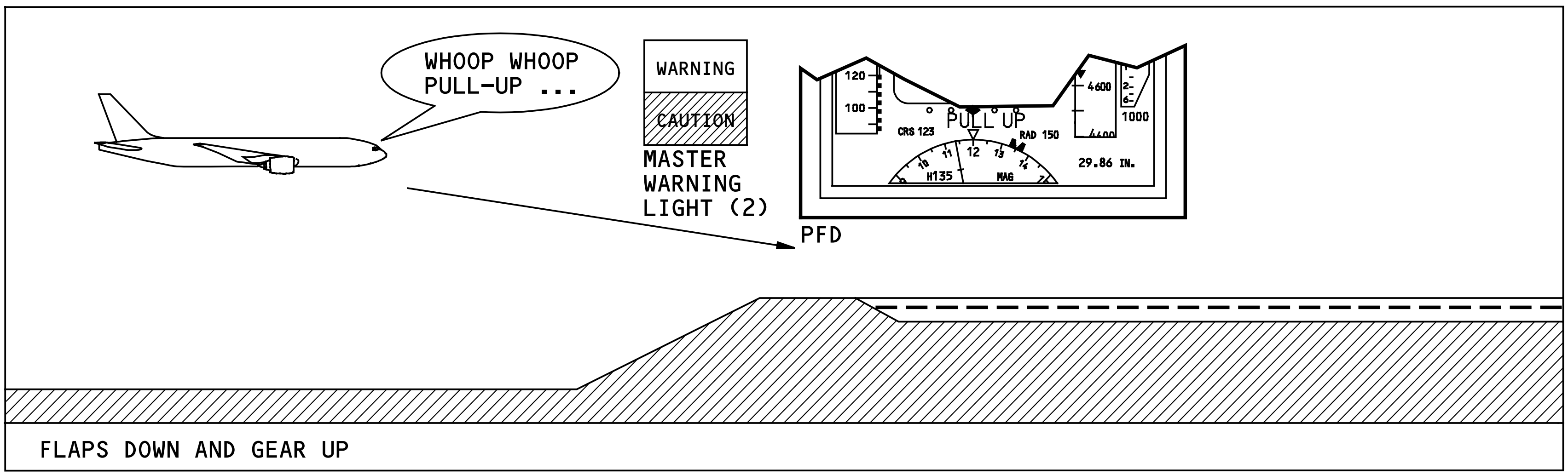
With the landing gear down, the GPWC gives an alert. These are the annunciations:

- The aural message TERRAIN TERRAIN
- The ground proximity light comes on.

With the gear up, the alert is a warning and these are the annunciations:

- The aural message WHOOP, WHOOP, PULL-UP
- Master warning lights come on
- A red PULL-UP message on the PFDs.





34-46-00-011 Rev 2

GPWS - MODE - 2B DESCRIPTION

GPWS - MODE 2 OPERATION

General

Mode 2A annunciations occur at 1650 feet down to 30 feet. The upper limit goes up to 2450 feet for airspeeds above 310 kts.

Mode 2B annunciations occur at 789 feet down to 600 feet. The lower limit goes down to 200 feet for inertial vertical velocity rates less than 400 feet per minute.

The LRUs that supply inputs for mode 2 operation are the left, right, and center radio altimeter transceivers and the AIMS cabinets.

This is the data the GPWC uses to detect mode 2 alerts and warnings:

- Radio altitude
- Inertial vertical speed (IVS)
- Barometric altitude rate
- Barometric altitude
- Computed airspeed
- Flap and gear position.

Operation

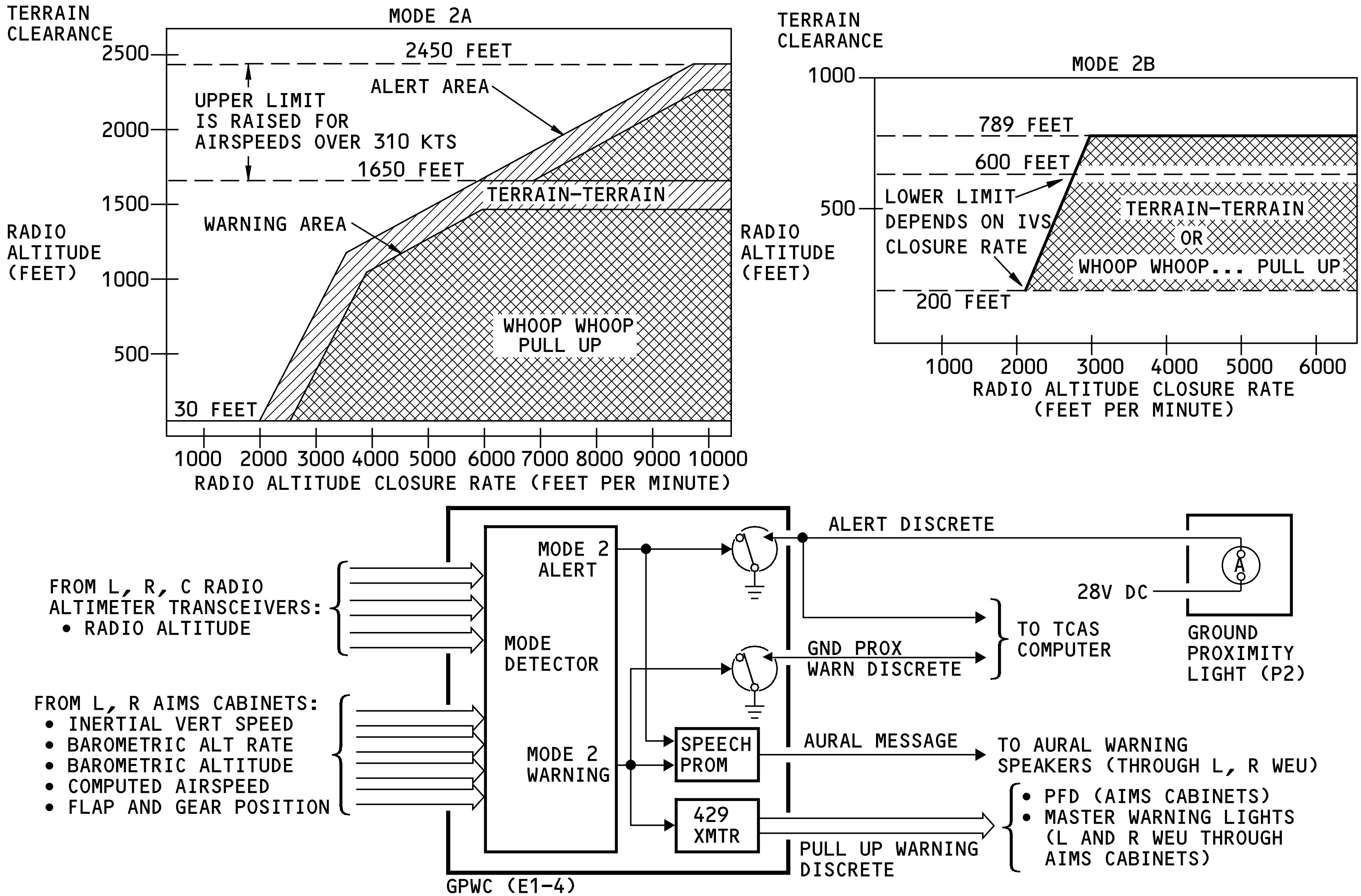
The mode detector uses the inputs to find if there is an alert or warning condition.

If there is an alert condition, the detector sends a discrete to the ground proximity light. The discrete goes to the speech prom to enable the alert aural. The alert aural goes to the WES which sends it to the aural warning speakers in the flight deck.

The alert discrete also goes to the TCAS computer to inhibit any TCAS advisory messages.

If there is a warning condition, the mode detector sends a PULL-UP discrete to the AIMS cabinet to show the message on the PFD's. The AIMS cabinets send the discrete to the WES to turn on the master warning lights. The warning discrete goes to the speech prom to enable the warning aural. The warning aural goes to the WES which sends it to the aural warning speakers in the flight deck.

The ground proximity warning discrete goes to the TCAS computer to inhibit any TCAS advisory messages.



GPWS - MODE 2 OPERATION

GPWS - MODE 3 DESCRIPTION

Purpose

Mode 3 supplies alerts for a large altitude loss during:

- Takeoff
- A missed approach with the gear up and flaps less than 25 units

Mode 3 consists of these two submodes:

- Submode 3A
- Submode 3B.

Submode 3A

Submode 3A gives an alert when the airplane looses too much inertial altitude after takeoff. The amount of inertial loss depends on the climb rate and radio altitude of the airplane.

This is the alert:

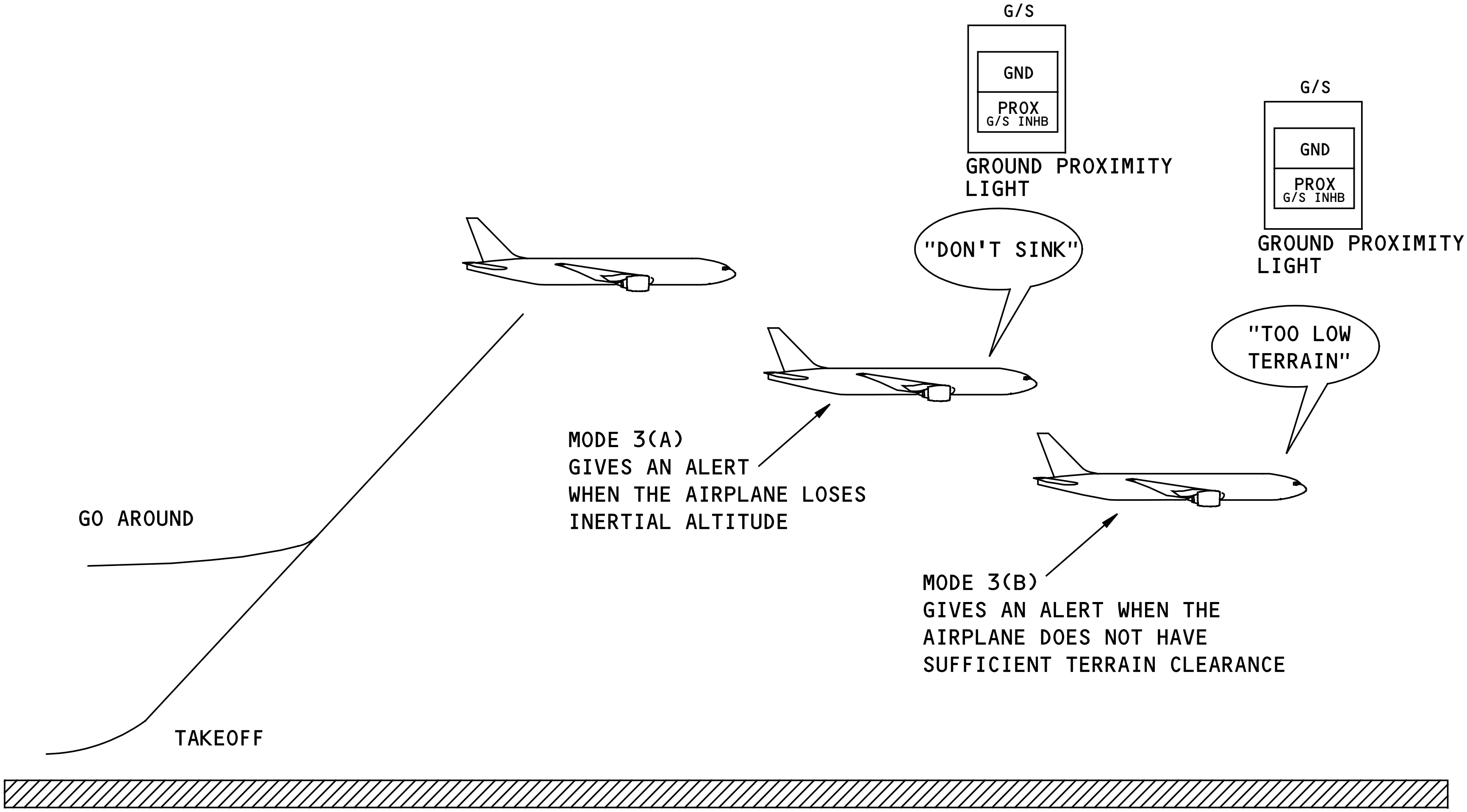
- Ground proximity light comes on
- Aural message DON'T SINK.

Submode 3B

Submode 3B gives an alert if the radio altitude terrain clearance goes below the amount stored in a filter in the GPWC, with the gear up and the flaps up (less than 15 units).

This is the alert:

- Ground proximity light comes on
- Aural message TOO LOW TERRAIN.



34-46-00-013 Rev 1

GPWS - MODE 3 DESCRIPTION

GPWS - MODE 3 OPERATION

General

Mode 3 alerts occur at 1333 feet down to 30 feet. Mode 3 arms when any of these conditions are true:

- Airplane goes below 245 feet in landing configuration (gear down, flaps less than 15 units)
- Airplane goes below 30 feet regardless of flap position.

The LRUs that supply inputs for mode 3 operation are the left, right, and center radio altimeter transceivers and the AIMS cabinets.

The GPWC uses this data to detect mode 3 alerts:

- Radio altitude
- Inertial altitude
- Inertial vertical speed
- Barometric altitude
- Barometric altitude rate
- Flap and gear position.

Mode 3B alerts occur when the altitude drops lower than the value stored in a filter in the GPWC. The filter activates at 150 feet and stores approximately 75% of the actual altitude.

The filter stores up to 500 feet altitude for airspeeds below 190 knots (500 feet in the filter represents an altitude of 667 feet).

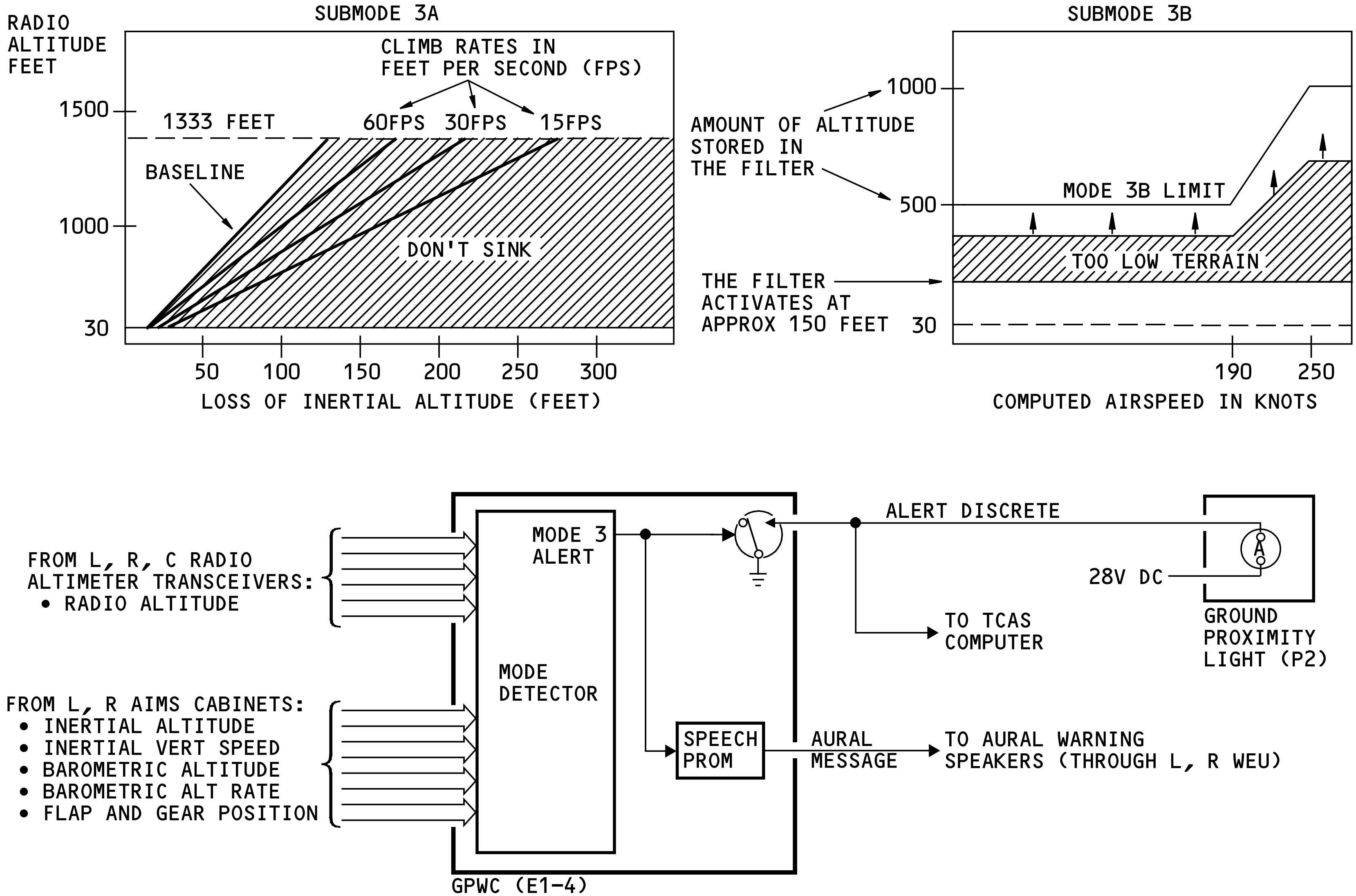
When the airspeed goes above 250 knots, the upper limit goes to 1000 feet (this represents an altitude of 1333 feet).

Mode 3 switches to mode 4 when the altitude gain filter gets to the upper limits.

Operation

The mode detector uses the inputs to determine if an alert condition is present. If present, the mode detector sends a discrete to the ground proximity light. The discrete goes to the speech prom to make the alert aural which goes to the WES. The WES sends the aural to the aural warning speakers.

A discrete also goes to the TCAS computer to inhibit any TCAS advisory messages.



GPWS - MODE 3 OPERATION

GPWS - MODE 4 DESCRIPTION

General

Mode 4 supplies alerts when the airplane is too close to the terrain and the airplane is not in the landing configuration.

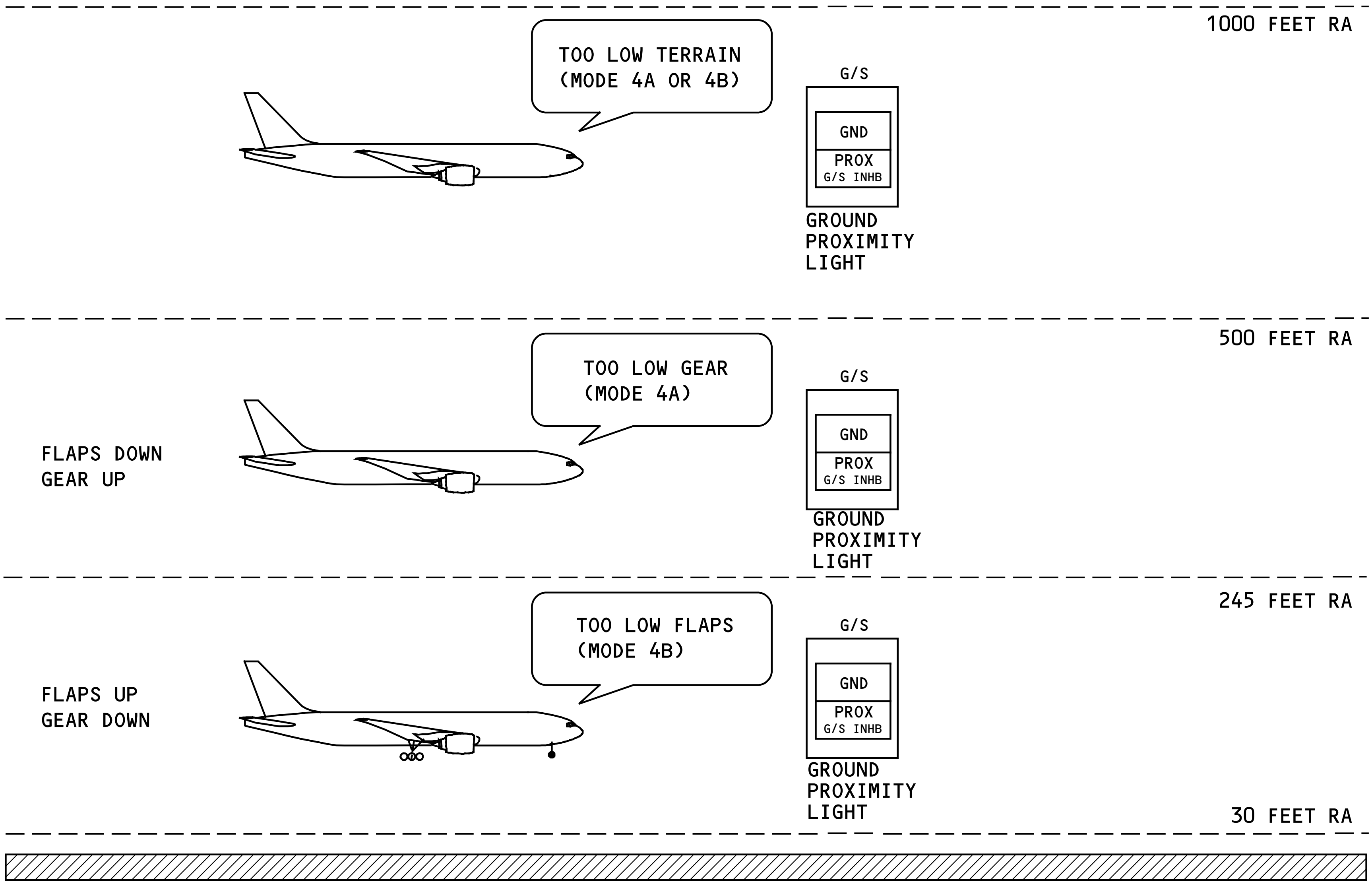
Mode 4 has these two submodes:

- 4A
- 4B

Description

The GPWC gives a mode 4A alert when the landing gear is up. Mode 4A gives different types of aural messages. The aurals are TOO LOW GEAR, and TOO LOW TERRAIN. The ground proximity light will come on for either of these aural messages.

The GPWC gives a mode 4B alert when the gear is down and the flaps are less than 15 units. Mode 4B can have two aural messages depending on airspeed. The aurals are TOO LOW FLAPS, and TOO LOW TERRAIN. The ground proximity light comes on for either of the aural messages.



34-46-00-015 Rev 1

GPWS - MODE 4 DESCRIPTION

GPWS - MODE 4 OPERATION

General

Mode 4 alerts occur at 1000 feet down to 30 feet. The LRUs that supply inputs for mode 4 operation are the left, right, and center radio altimeter transceiver and the AIMS cabinets.

The GPWC uses this data to detect mode 4 alerts:

- Radio altitude
- Computed airspeed
- Flap and gear position.

The mode 4A aural message TOO LOW-GEAR... changes to the aural TOO LOW-TERRAIN... when the airspeed goes above 190 knots with the flaps less than 15 units.

If the flaps are more than 15 units, the aural messages change at 159 knots.

Mode 4B aural message TOO LOW-FLAPS... changes to TOO LOW-TERRAIN...when the airspeed goes above 159 knots.

Mode 4 switches to mode 3 if the airplane goes below 245 feet in landing configuration (flaps and gear down).

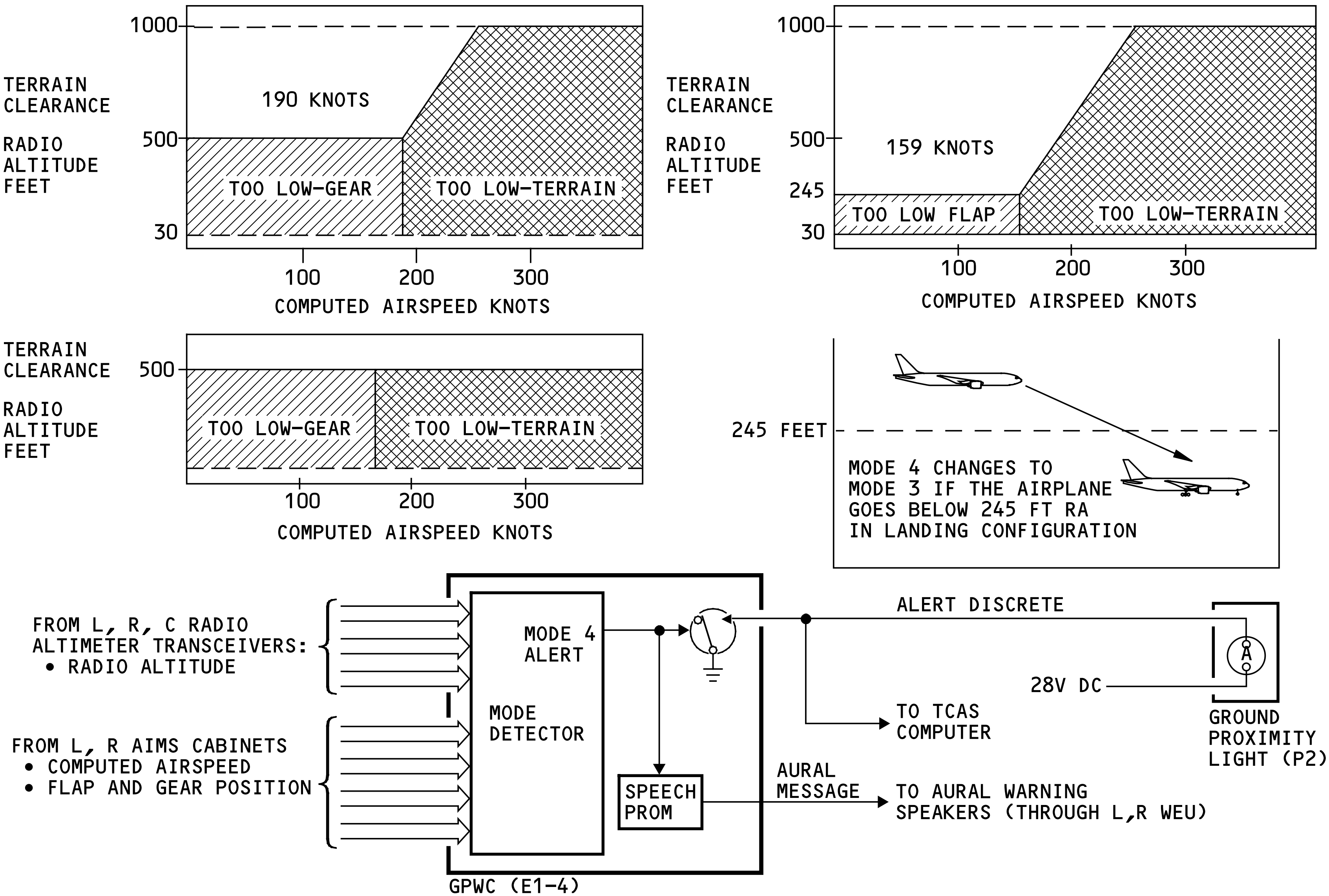
Operation

The mode detector uses the inputs to determine if an alert condition is present.

If present, the mode detector sends a discrete to turn on the ground proximity light. The alert discrete goes to the speech prom to make the alert aural.

The alert aural goes to the WES which sends it to the the aural warning speakers.

The alert discrete also goes to the TCAS computer to inhibit any TCAS advisory messages.



GPWS - MODE 4 OPERATION

GPWS - MODE 5 DESCRIPTION

General

The GPWC gives a mode 5 alert when the airplane is too far below the glideslope during a front course approach with the landing gear down. Mode 5 does not operate during back course approaches.

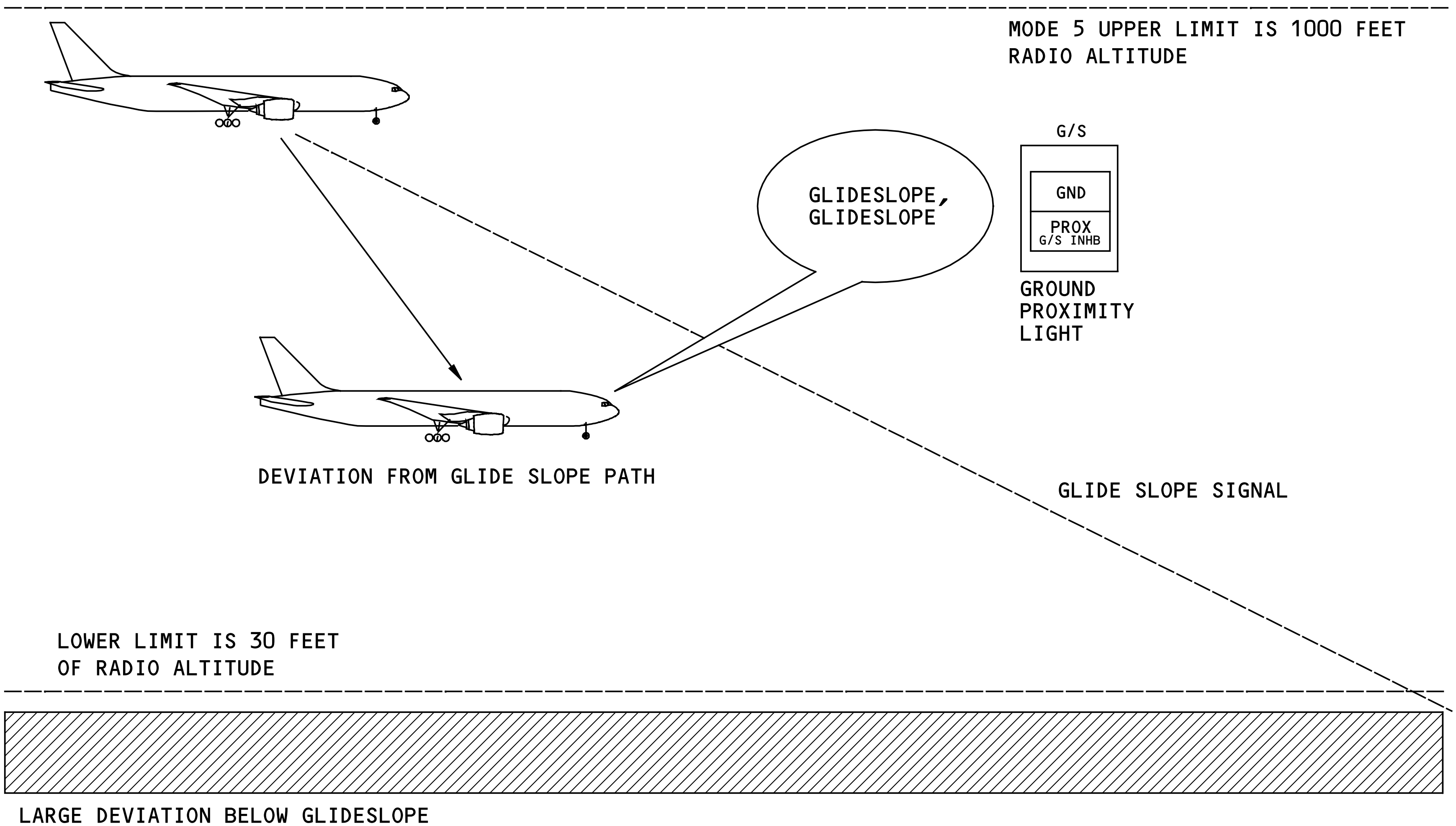
Description

Mode 5 alerts can occur between 30 and 1000 feet. The aural alert message is GLIDESLOPE GLIDESLOPE and the ground proximity light comes on.

The ground proximity glideslope inhibit switch inhibits or cancels mode 5 alerts.

As the deviation below the glideslope increases, the volume of the aural message increases.

The message repeats faster as the terrain gets closer, or if the glideslope deviation increases.



34-46-00-017 Rev 2

GPWS - MODE 5 DESCRIPTION

GPWS - MODE 5 OPERATION

General

Mode 5 alerts can occur between 30 and 1000 feet radio altitude. Mode 5 arms when:

- The airplane terrain clearance is less than 1000 feet
- The gear is down
- The glideslope signal is captured.

These LRUs supply inputs for mode 5 operation:

- Left, right, and center radio altimeter transceivers
- Left ILS receiver
- AIMS cabinets.

The GPWC uses this data to detect mode 5 alerts:

- Glideslope deviation
- Selected runway heading
- Magnetic track
- Gear position.

Low level audio occurs below 1000 feet down to 30 feet when the deviation is more than 1.3 dots.

Normal level audio occurs below 300 feet when the deviation is more than 2 dots.

The interval between messages is normally 5.15 seconds. At 300 feet, the message repeats at a faster rate depending on the glideslope deviation.

Operation

Push the ground proximity glideslope inhibit switch to inhibit or cancel mode 5 aural and visual alerts.

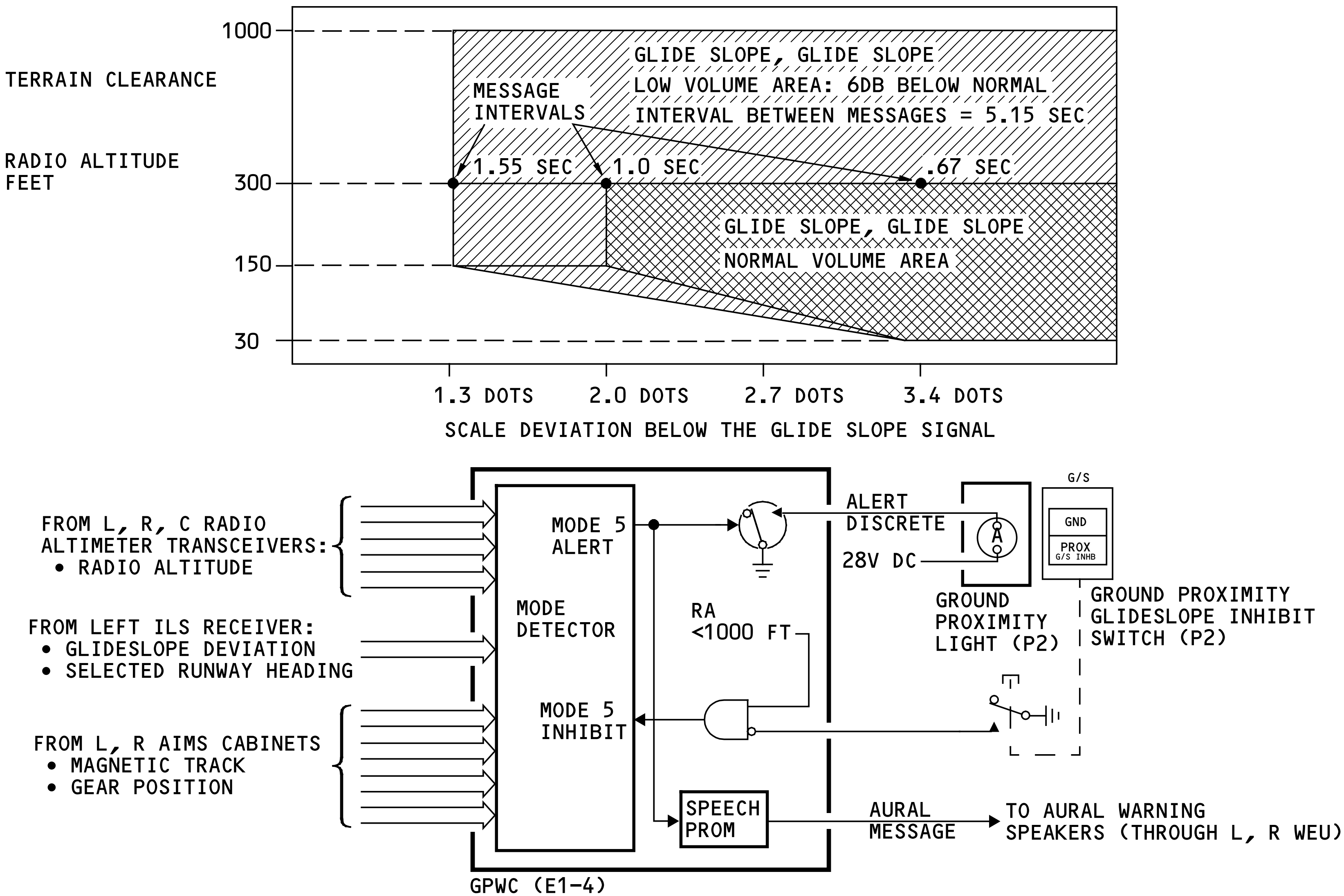
If you push the switch before mode 5 alerts begin, you inhibit the aural and visual annunciations.

If you push the ground proximity glideslope inhibit switch during a mode 5 alert, you cancel the aural and visual annunciations.

When you inhibit or cancel the alert, you cannot activate it again unless the airplane leaves the mode 5 alerting area or you operate the landing gear.

The mode detector uses the inputs to look for an alert condition. If there is an alert condition, the mode detector sends a discrete to turn on the ground proximity light. The discrete goes to the speech prom to make the alert aural.

The alert aural also goes to the WES which sends it to the aural warning speakers.



GPWS - MODE 5 OPERATION

GPWS - MODE 6 DESCRIPTION

General

The GPWC gives mode 6 aural callouts when the airplane descends through selected altitudes with the gear down. A program pin selection determines the callout configuration. Mode 6 supplies only callouts. There are no visual indications.

Description

The GPWC receives inputs from:

- Left, right, or center radio altimeter transceivers
- AIMS cabinets

The GPWC uses this data to determine mode 6 alerts:

- Radio altitude
- Gear position
- Program pin selection.

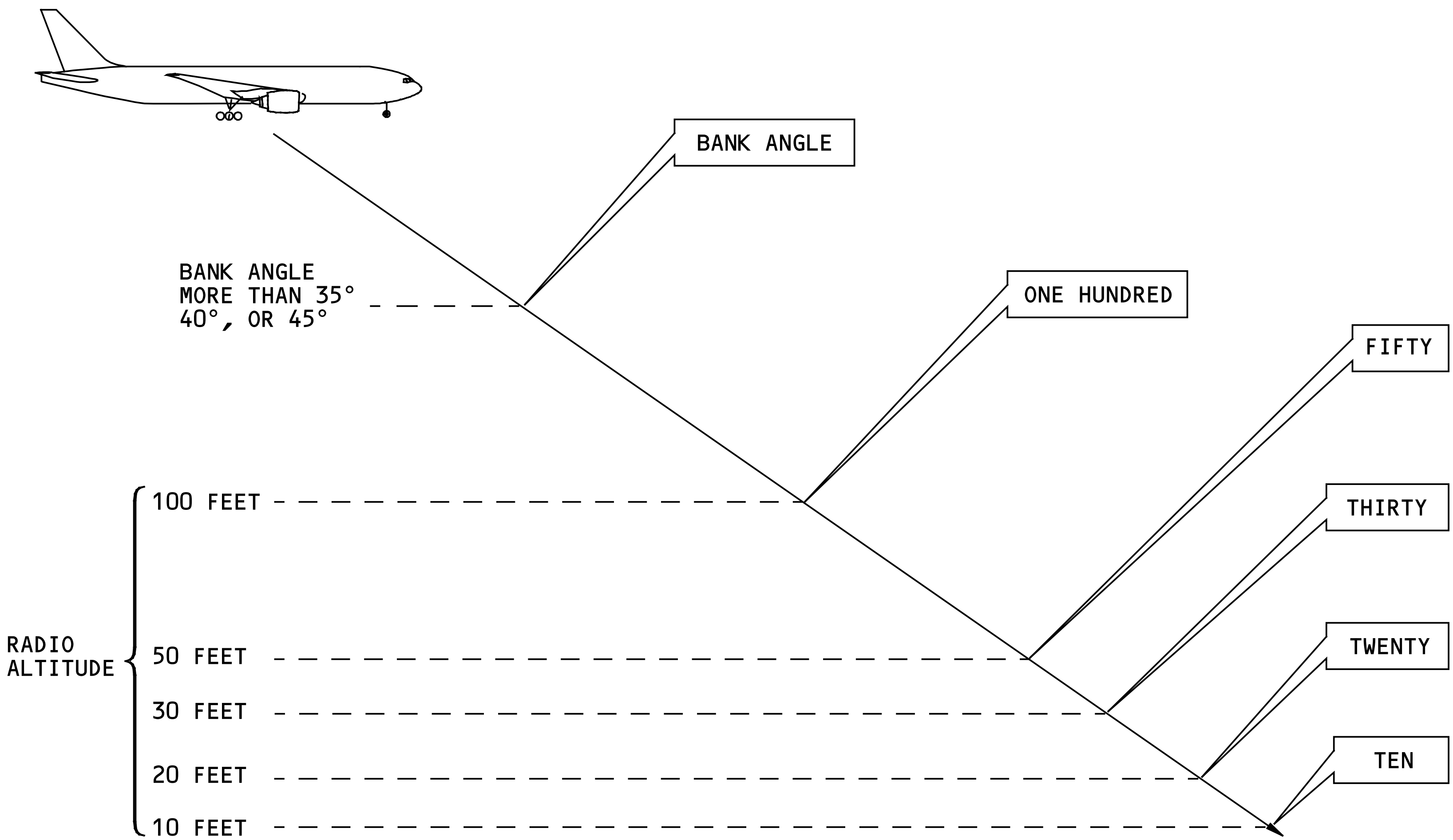
The program program pins do these functions:

- Enable the callouts
- Select the callout configuration
- Select low volume or normal volume for the callouts.

Low volume is one-quarter of the normal audio volume.

Mode 6 callouts come on only once. These are the two ways to reset mode 6 callouts:

- The airplane climbs through 1,000 feet of radio altitude while on approach.
- The airplane goes from takeoff to approach and the radio altitude is higher than an altitude callout. In this case, only those altitude callouts that are lower than the current radio altitude come on as the airplane descends.



34-46-00-019 Rev 15 02/12/1998

GPWS - MODE 6 DESCRIPTION

GPWS - MODE 7 DESCRIPTION

General

The GPWC gives mode 7 warnings when windshear conditions are present in takeoff or approach. The thresholds depend on flap position.

Description

Windshear is the effect of large volumes of air that change direction quickly. The most dangerous type of windshear for airplanes is the microburst. When the airplane is near the terrain, a downward microburst gives a pilot little time to respond to the effects.

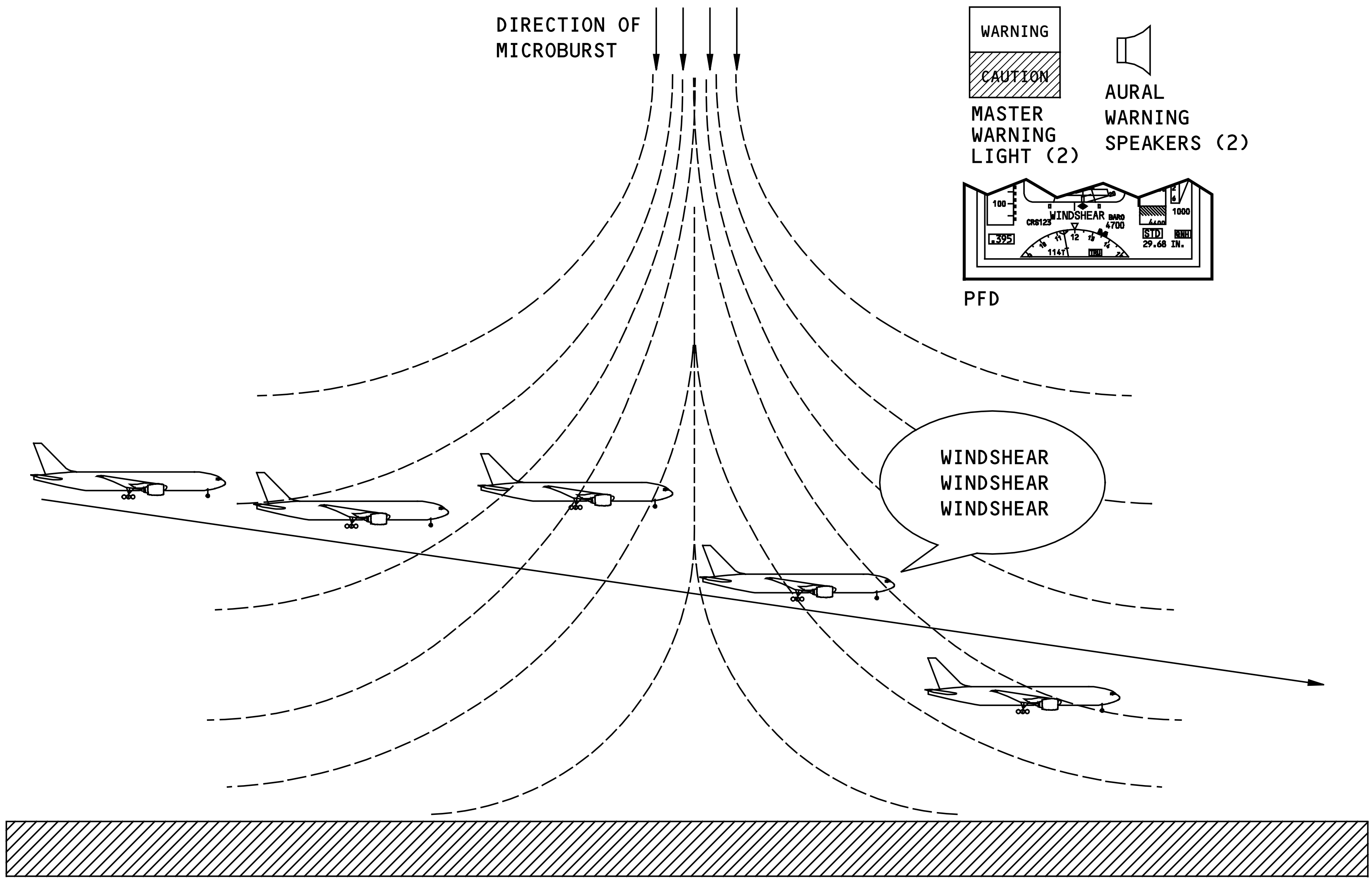
The initial effects on an airplane when it is in a microburst are an increase in airspeed and lift. Because of the increase in lift, the airplane altitude increases.

As the airplane continues through the microburst, the effects quickly change to a loss in airspeed and lift. Because of the decrease in lift, the airplane altitude decreases.

The GPWC uses inputs from airplane systems to detect the changes caused by windshear conditions.

Mode 7 warnings are:

- Master warning lights come on.
- Siren then the aural message WINDSHEAR WINDSHEAR WINDSHEAR from the aural warning speakers
- Red WINDSHEAR message on the PFDs.



GPWS - MODE 7 DESCRIPTION

GPWS - MODE 7 OPERATION

General

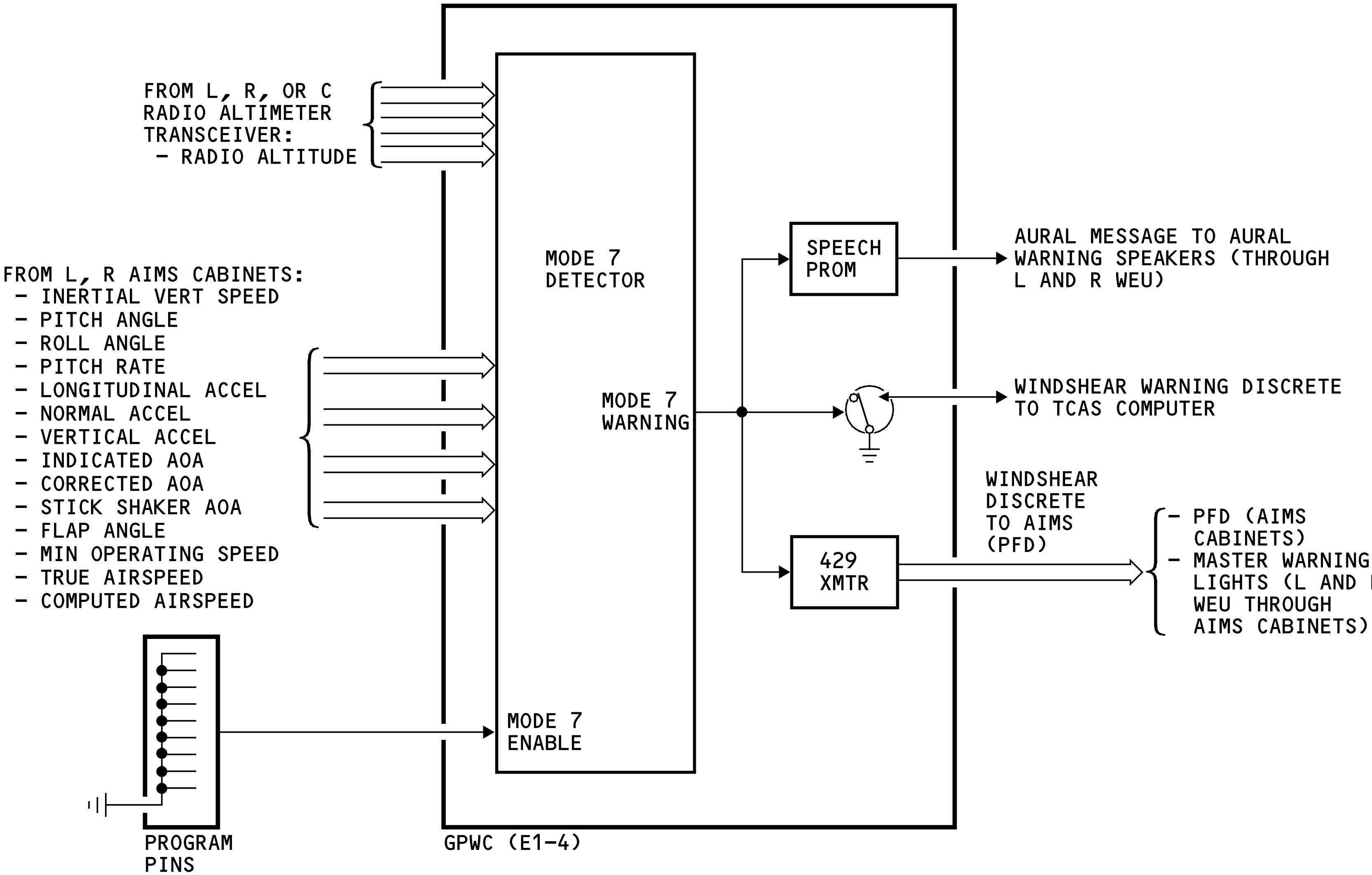
Program pins enable mode 7.

These LRUs supply data for mode 7 operation:

- Left, right, and center radio altimeter transceivers
- AIMS cabinets
- Program pins.

The GPWC uses this data to detect windshear:

- Radio altitude
- Inertial vertical speed
- Pitch and roll angle
- Pitch rate
- Longitudinal acceleration
- Normal acceleration
- Vertical acceleration
- Indicated angle of attack (AOA)
- Corrected AOA
- Stick shaker AOA
- Flap angle
- Minimum operating speed
- True airspeed
- Computed airspeed.



GPWS - MODE 7 OPERATION

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GPWS - TERRAIN AWARENESS

Purpose

The ground proximity warning computer (GPWC) compares the airplane flight profile, flap and gear position, and terrain clearance to determine if an alert or warning condition exists.

Terrain Awareness Inputs

The GPWC receives airplane data from the air data inertial reference system (ADIRS) and the global positioning system (GPS). The terrain awareness function uses this data:

- Latitude
- Longitude
- Barometric altitude
- Ground track
- Ground speed
- Heading
- Roll attitude
- Flight path angle (calculated by GPWC).

Terrain awareness uses GPS for latitude and longitude. It uses flight management computing function (FMCF) data if the GPS data is invalid or not available.

Terrain Awareness Calculation

The GPWC stores a world-wide terrain database in memory. The GPWC looks at airplane position and track, and compares this data to the terrain database. If the GPWC finds there is a terrain threat, it makes an alert.

Terrain Display Output

The GPWC makes a digital map of the terrain forward of the airplane. It sends this digital map to AIMS for display on the navigational displays (NDs). The display uses different colored dots to show terrain altitude relative to airplane altitude.

Terrain Alert Outputs

If the GPWC finds the airplane is about 60 seconds from a terrain conflict, it makes a terrain caution alert. These are the caution alert indications:

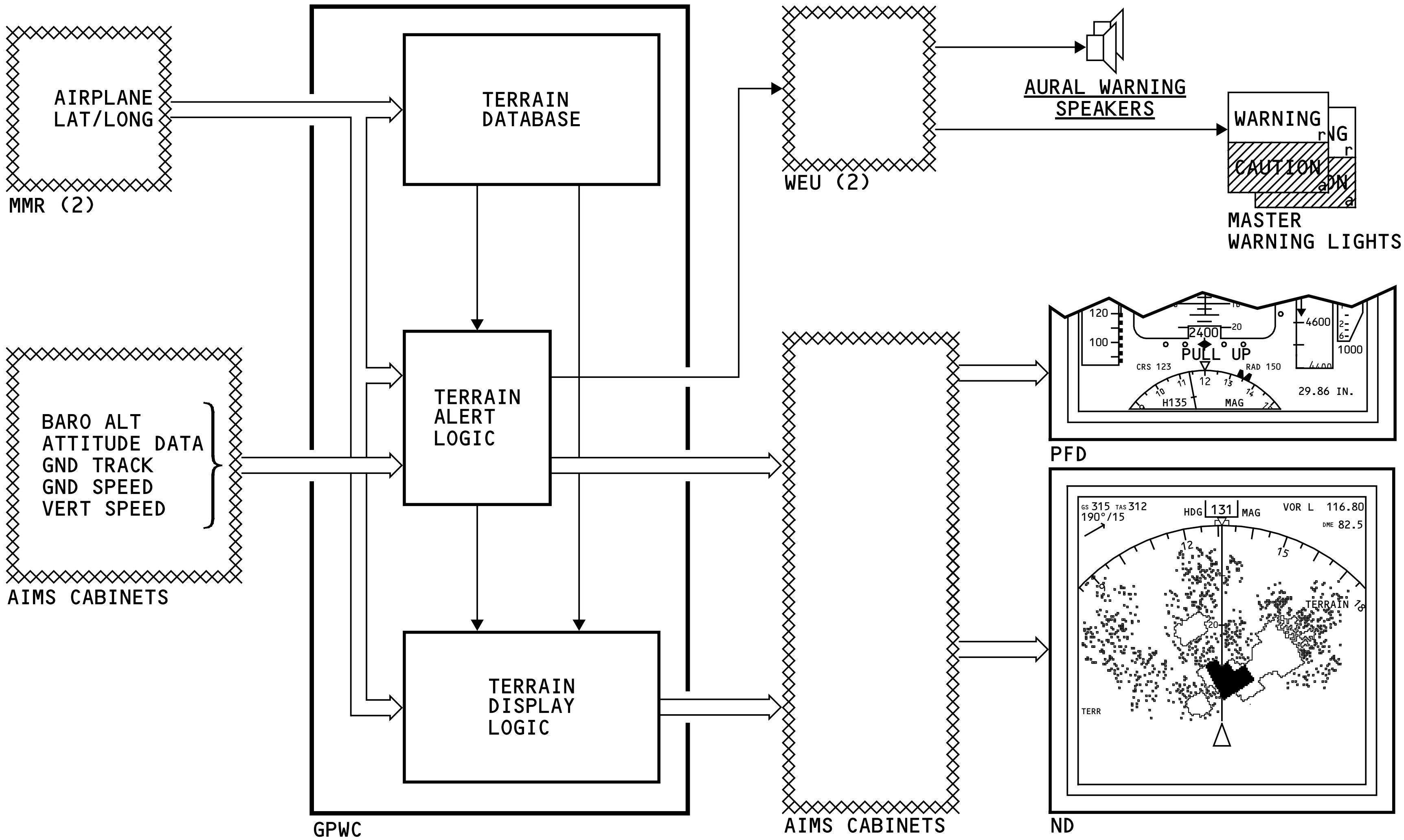
- Alert aural message CAUTION TERRAIN
- Amber message TERRAIN shows on the ND
- The terrain display shows on both NDs if not selected on either one
- The threat terrain on the ND changes from dots to a solid yellow color
- The ground proximity warning light comes on.

If the GPWC finds the airplane is about 30 seconds from a terrain conflict, it makes a terrain warning alert. These are the warning alert indications:

- Aural message TERRAIN, TERRAIN PULL UP
- A red PULL UP message shows on the primary flight display (PFD)
- A red TERRAIN message shows on the ND

GPWS - TERRAIN AWARENESS

- The terrain display shows on both NDs if not selected on either one
- The terrain threat on the ND changes from dots to a solid red color
- The master warning lights come on.



GPWS - TERRAIN AWARENESS

GPWS - TERRAIN CLEARANCE FLOOR

Description

Terrain clearance floor (TCF) alerts the flight crew when the airplane descends too low on approach. TCF uses airplane position and a runway database to determine if an alert condition exists.

Terrain Clearance Floor Inputs

The ground proximity warning system (GPWS) receives airplane data from these systems:

- Global positioning system (GPS)
- Air data inertial reference system (ADIRS)
- Radio altitude (RA) system.

TCF uses this data:

- Latitude
- Longitude
- Radio altitude.

TCF uses GPS for latitude and longitude. It uses flight management computing function (FMCF) data if GPS data is not valid.

Terrain Clearance Floor Logic

The GPWC stores a runway database in memory. This database contains the location of all hard surface runways in the world that are 3,500 feet or more in length. TCF makes a terrain clearance envelope around the runway. The altitude of the envelope increases as the distance from the airport increases. GPWC compares airplane latitude, longitude, and radio altitude with TCF envelope data. If the airplane descends through the floor of the envelope, GPWC makes an alert.

TCF makes an alert even if the airplane is in landing configuration.

Terrain Clearance Floor Caution Alert

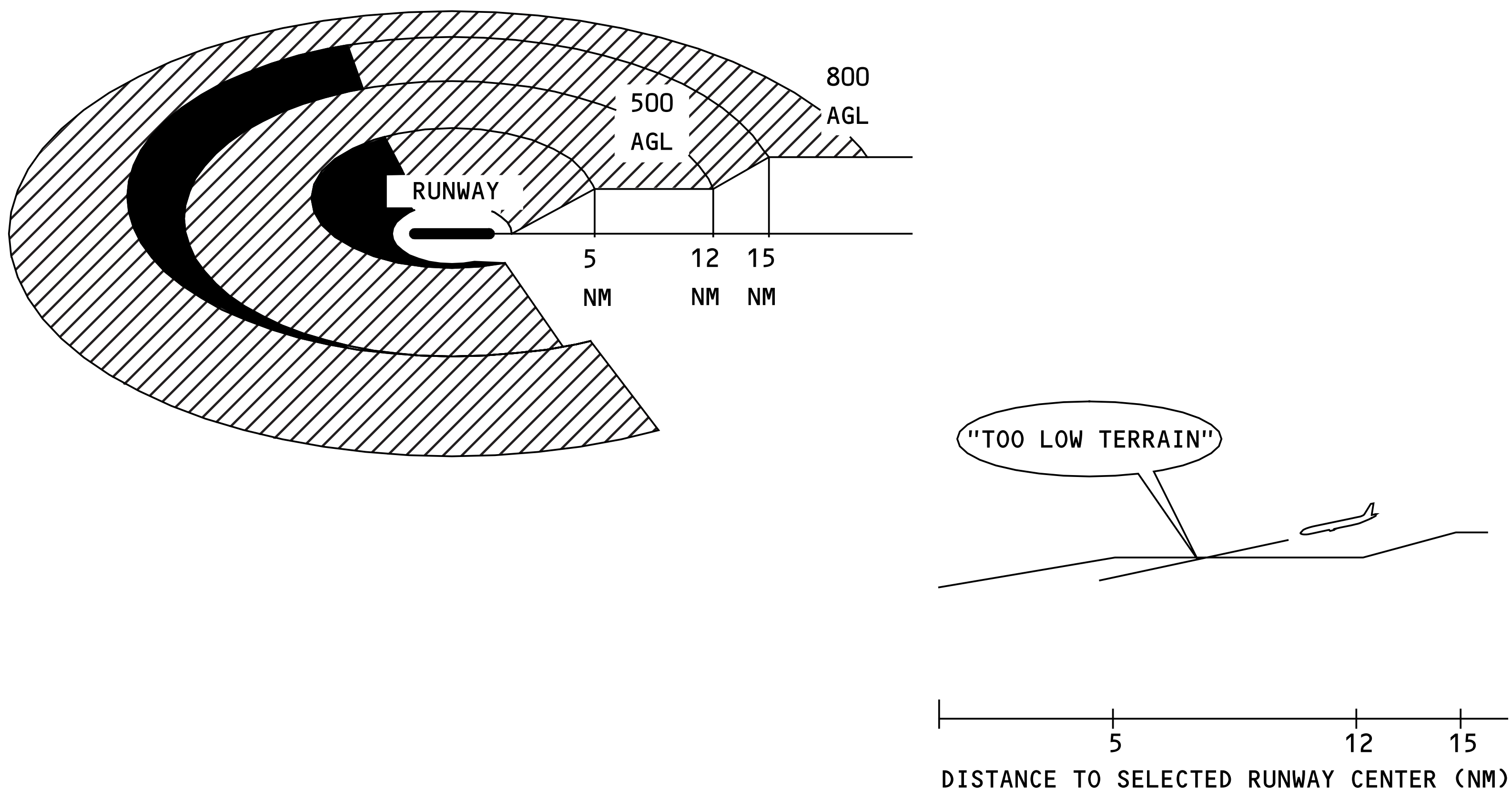
If the GPWC determines the airplane is below the TCF, it makes this caution alert:

- Aural message TOO LOW TERRAIN. This message repeats for each 20 percent loss of altitude.
- The ground proximity warning light comes on and stays on until the airplane climbs above the TCF.

There is no TCF warning alert.

The GPWC inhibits TCF alerts for any of these conditions:

- Airplane is on the ground
- Less than 20 seconds after takeoff
- Less than 30 feet radio altitude.



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GPWS - TERRAIN CLEARANCE FLOOR

GPWS - NORMAL DISPLAYS

Terrain Awareness Display Data

The navigational displays (NDs) show this GPWS data:

- Terrain awareness display
- GPWS system messages
- GPWS alert messages.

Terrain Awareness Display

The terrain awareness display on the NDs uses dots to show terrain ahead of the airplane. Dot color and dot pattern density compare terrain altitude with airplane altitude. These are the dot colors and patterns the terrain display uses:

- High density red - Terrain more than 2,000 feet above airplane altitude.
- High density yellow - Terrain 1,000 feet to 2,000 feet above airplane altitude.
- Medium density yellow - Terrain 500 feet below to 1,000 feet above airplane altitude. Gear down changes the 500 feet to 250 feet.
- Medium density green - Terrain 500 feet below to 1,000 feet below airplane altitude. Gear down changes the 500 feet to 250 feet.
- Low density green - Terrain 1,000 feet below to 2,000 feet below airplane altitude.
- Black - Terrain more than 2,000 feet below airplane altitude.
- Magenta - Unknown terrain.

If GPWS detects a terrain caution alert, the threat terrain changes from dots to a solid yellow color. If GPWS detects a terrain warning alert, the threat terrain changes from dots to a solid red color.

On final approach, terrain near the runway does not display.

GPWS System Messages

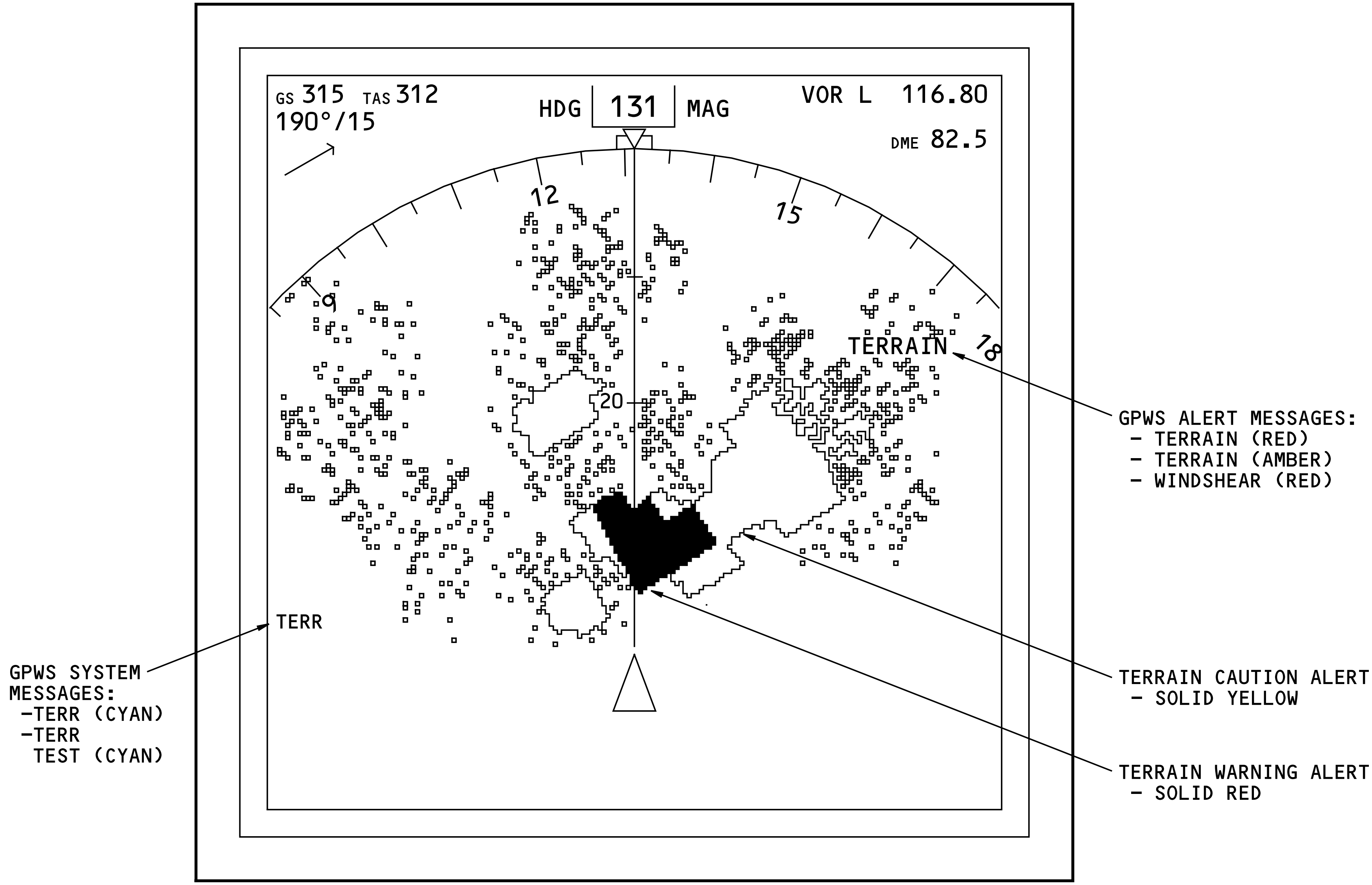
These GPWS system messages show in cyan on the left side of the ND:

- TERR shows when terrain data displays
- TERR TEST show when the GPWS is in self test mode.

GPWS Alert Messages

These GPWS alert messages show on the right side of the ND:

- WINDSHEAR (red) shows when a mode 7 windshear warning occurs.
- TERRAIN (red) shows when a terrain awareness warning occurs.
- TERRAIN (amber) shows when a terrain awareness caution occurs.



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GPWS - NORMAL DISPLAYS

GPWS - MODE DESCRIPTION SUMMARY

General

This summary shows this information:

- GPWS modes
- Mode conditions
- Aural messages for each mode
- Lights or displays that come on.

MODES	CONDITION			AURAL MESSAGE	PFD-RED MESSAGE	ND MESSAGE	GND PROX-G/S INHIBIT LIGHT	MWL
1	INITIAL ANNUNCIATION			"SINK RATE..."			X	
1	WARNING			"WHOOP WHOOP PULL UP..."	PULL UP			X
2A	FLAPS ≤20 AND G/S DEV >2 DOTS	INITIAL ANNUNCIATION		"TERRAIN TERRAIN"			X	
		WARNING		"WHOOP WHOOP PULL UP..."	PULL UP			X
		ALTITUDE GAIN FUNCTION: - STARTS WHEN MODE 2 CONDITION STOPS - ENDS WHEN 300 FT OF INERTIAL ALT IS GAINED OR GEAR GOES DOWN		"TERRAIN.."			X	
2B	FLAPS ≥25 OR G/S DEV <2 DOTS	FLAPS AND GEAR DOWN		"TERRAIN.."			X	
		FLAPS AND/OR GEAR UP	INITIAL ANNUNCIATION	"TERRAIN TERRAIN.."			X	
			WARNING	"WHOOP WHOOP PULL UP.."	PULL UP			X
3A	FLAPS ≤20 AND/OR GEAR UP (FOR ALTITUDE LOSS OF APPROXIMATELY 10% TO 20%)			"DON'T SINK..."			X	
3B	FLAPS ≤20 AND/OR GEAR UP. RA LESS THAN THRESHOLD VALUE.			"TOO LOW TERRAIN.."			X	
4A	GEAR UP	AIRSPEED <190 KNOTS AND RA <500 FT		"TOO LOW GEAR.."			X	
		AIRSPEED >190 KNOTS AND RA CHANGES BUT EQUAL TO OR LESS THAN 1000 FT		"TOO LOW TERRAIN.."			X	
4B	GEAR DOWN FLAPS ≤20	AIRSPEED <159 KNOTS AND RA <245 FT		"TOO LOW FLAPS.."			X	
		AIRSPEED >159 KNOTS AND RA CHANGES BUT EQUAL TO OR LESS THAN 1000 FT		"TOO LOW TERRAIN.."			X	
5	ILS FRONT COURSE APPROACH AND GEAR DOWN	RA <1000 FT AND G/S DEVIATION >1.3 DOTS		"GLIDE SLOPE..." AT 1/2 VOLUME, FREQ PROPORTIONAL TO DEVIATION AND GROUND PROXIMITY.			X	
		RA <300 FT AND G/S DEVIATION >2.0 DOTS		"GLIDE SLOPE..." AT FULL VOLUME, FREQ PROPORTIONAL TO G/S DEVIATION AND GROUND PROXIMITY.			X	
6	GEAR DOWN			RADIO ALTITUDE CALLOUTS AS SELECTED BY PROGRAM PINS				
7	WINDSHEAR CONDITION			SIREN, THEN "WINDSHEAR, WINDSHEAR, WINDSHEAR..."	WINDSHEAR			X
TERR	APPROX. 60 SEC. TO THREAT TERRAIN			"CAUTION, TERRAIN.."		TERRAIN	X	
	APPROX. 30 SEC. TO THREAT TERRAIN			"TERRAIN, TERRAIN, PULL UP.."	PULL UP	TERRAIN		X
TCF	AIRPLANE BELOW TERRAIN CLEARANCE FLOOR			"TOO LOW TERRAIN.."			X	

34-46-00-031 Rev 2 02/03/1998

GPWS - MODE DESCRIPTION SUMMARY

GPWS - ENVELOPE MODULATION

General

Some airports have unusual terrain clearances near their runways that cause false messages by the GPWS. Envelope modulation modifies specific alert and warning areas to prevent false messages.

Functional Description

The airports that need envelope modulation are in the GPWC memory and identified by their latitude and longitude. As the airplane approaches one of these airports, the GPWC looks at other airplane parameters to verify if an envelope modulation condition exists. The additional parameters are:

- Radio altitude
- Magnetic track
- Glide slope deviation
- Localizer deviation
- Selected runway heading
- Barometric corrected altitude.

MODE	TYPE OF MODULATION	PURPOSE OF MODULATION
1	RAISES THE DESCENT RATE LIMIT	TO PERMIT GREATER BAROMETRIC DESCENT RATES WITHOUT FALSE ALERTS/WARNINGS
2	LOWERS RADIO ALTITUDE LIMITS	TO PERMIT THE AIRPLANE TO FLY CLOSER TO THE TERRAIN WITHOUT FALSE ALERTS/WARNINGS
4	LOWERS RADIO ALTITUDE LIMITS	TO LOWER THE MINIMUM TERRAIN CLEARANCE DURING HIGH AIRSPEEDS TO PREVENT FALSE ALERTS
5	- RAISES RADIO ALTITUDE LIMITS - REMOVES GEAR DOWN REQUIREMENTS	TO PERMIT MODE 5 ANNUNCIATIONS AT HIGHER ALTITUDES WITHOUT THE GEAR DOWN
6	REMOVES GEAR DOWN REQUIREMENTS	TO PERMIT MODE 6 ANNUNCIATIONS WITHOUT THE GEAR DOWN

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GPWS - ENVELOPE MODULATION

GPWS - PFD AND MASTER WARNING LIGHT ANNUNCIATIONS

Master Warning Lights

The captain and first officer red master warning lights come on with a PULL UP or WINDSHEAR warning. The AIMS cabinets send a discrete to the warning electronic system (WES) to enable the lights.

PFD Warning Annunciations

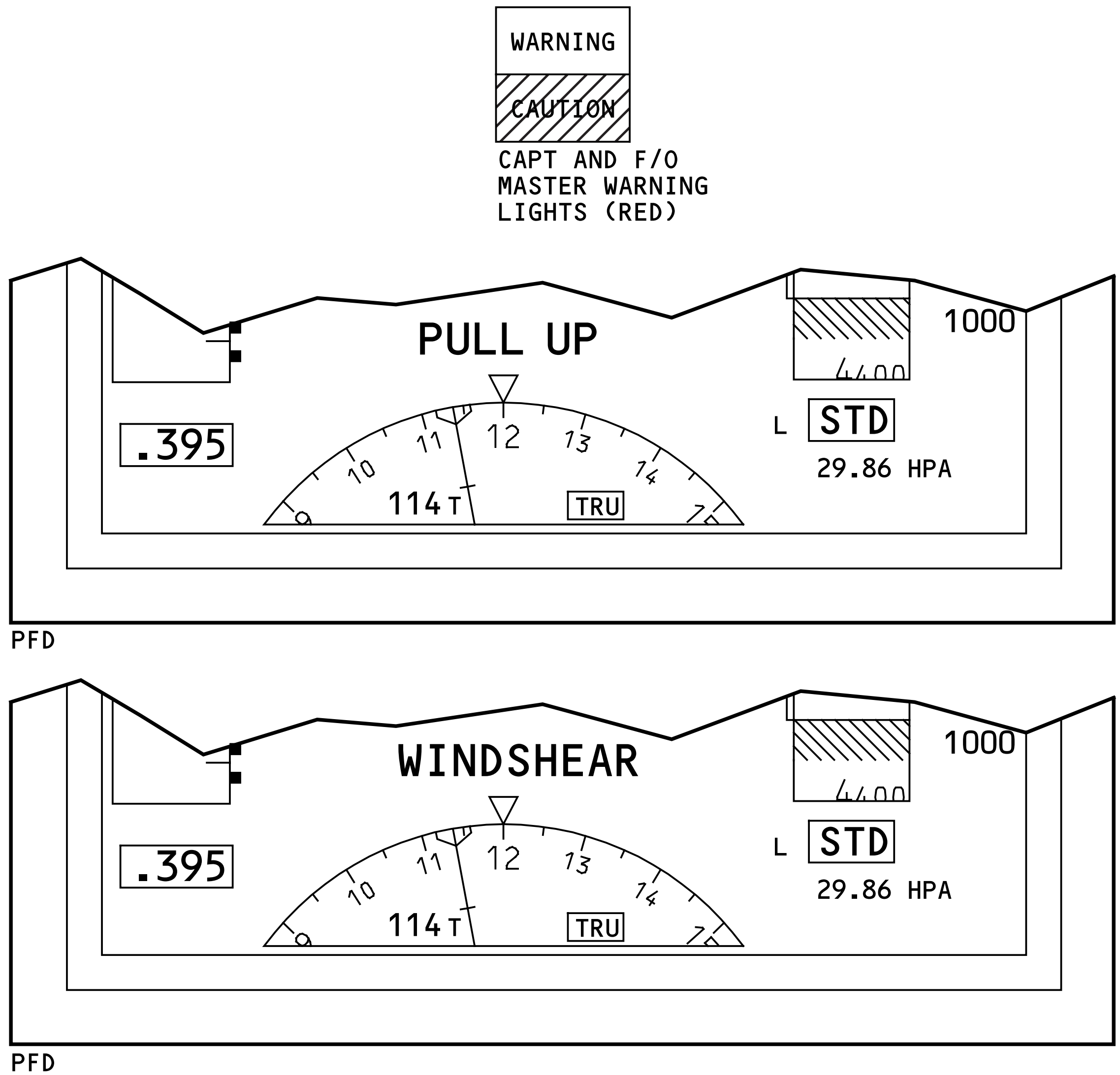
The primary flight displays (PFDs) show these two GPWS messages:

- Red PULL UP
- Red WINDSHEAR.

The red PULL UP message shows for these conditions:

- Mode 1 warnings
- Mode 2 warnings
- Terrain awareness warnings.

The red WINDSHEAR message shows a mode 7 warning.



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GPWS - PFD AND MASTER WARNING LIGHT ANNUNCIATIONS

GPWS - NON-NORMAL DISPLAYS

GPWS Non-Normal Messages

These messages show on the navigational display (ND) to alert the flight crew of GPWS non-normal conditions:

- System alert messages
- Range disagree messages.

GPWS System Alert Messages

These messages show in amber on the left side of the ND:

- TERR POS shows when the GPWS determines airplane position data is not valid
- TERR OVRD shows when you push the terrain override switch on the landing gear panel
- TERR FAIL shows when a fault occurs in the GPWS.

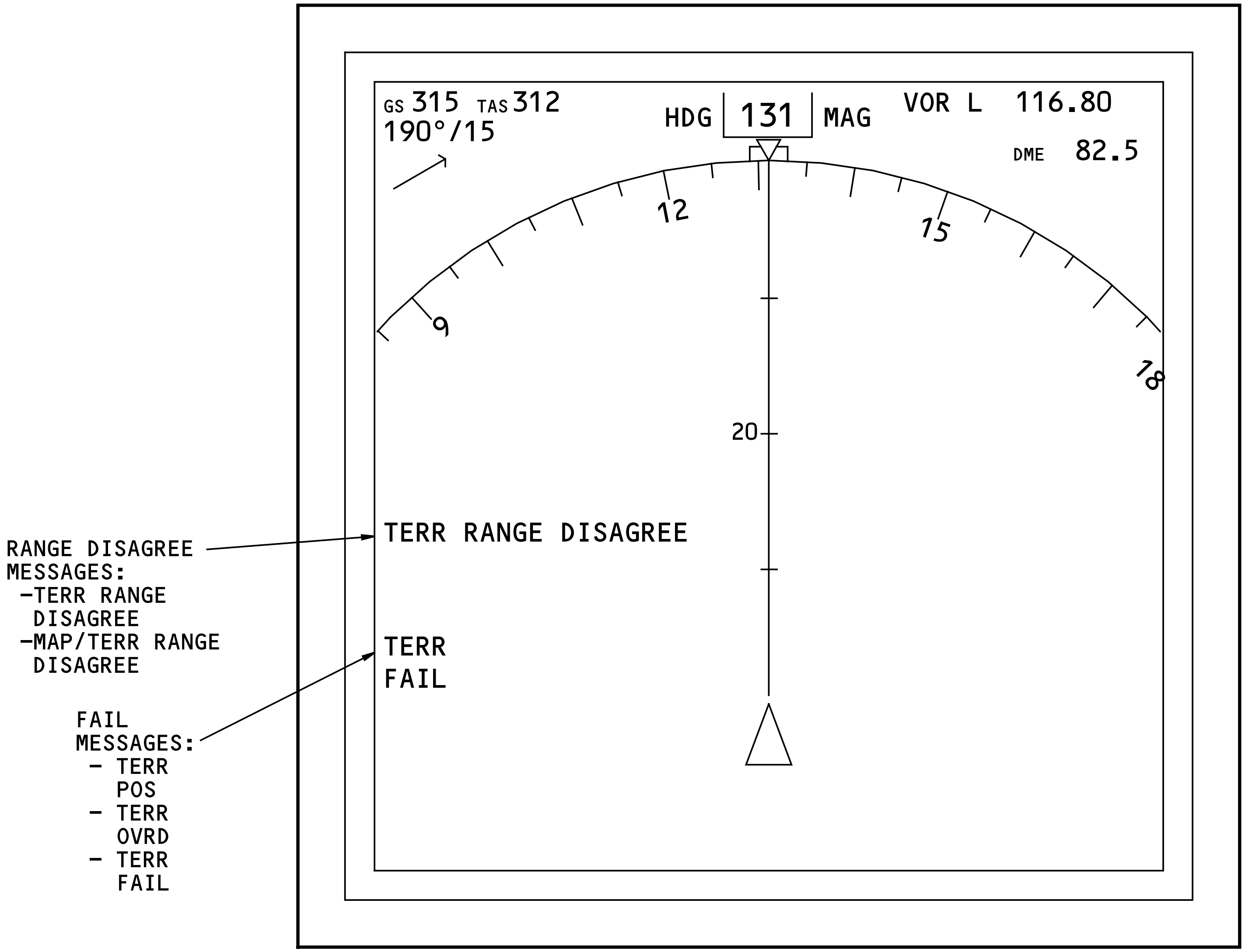
Terrain data does not show on either ND if there is a system alert message.

Range Disagree Messages

These alert messages show in amber on the ND when there is a range disagree fault:

- TERR RANGE DISAGREE shows when the GPWS range disagrees with the range selected on the on-side EFIS control panel
- MAP/TERR RANGE DISAGREE shows when the GPWS range, the on-side EFIS range, and the FMC range disagree.

Terrain data does not show on the ND if there is a range disagree message.



GPWS SYSTEM ALERT MESSAGES AND DISPLAY

GPWS - NON-NORMAL DISPLAYS

GPWS - SELF TEST - LEVEL 1

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GPWS - SELF TEST - LEVEL 1

General

The ground proximity warning system (GPWS) has six levels of self test. Each level provides different information about the GPWS. These are the six levels of self test:

- GO/NO-GO operational test
- Current faults
- System configuration
- Fault history
- Alert/warning history
- Discrete input test.

Level one is a GO/NO-GO operational test. A level one test provides visual and aural annunciations on the flight deck.

Level One Test Preparation

These conditions must be true to do a level one self test of the GPWS:

- Airplane on ground
- GPWS power on
- EFIS ND mode selector in correct mode (expanded VOR, APP, or MAP or centered MAP)
- TERR switch on EFIS control panel (CP) selected.

Level One Test Procedure

Select operational test from the maintenance access terminal (MAT) to begin a level one test. A level one test first does a test of these configuration conditions:

- Program pin parity
- Airplane configuration database validity
- Airplane type.

If the test finds a configuration fault, the self test annunciates the fault and the self test ends. If the GPWS passes the configuration test, the level one test continues.

Training Information Point

You can start a level one self test from the front panel of the GPWC, but you cannot see the flight deck annunciations. Use the MAT to start an operational test of the GPWS.

Level One Test - Normal Indications

These messages will show at some time for a normal Level one self test:

- EICAS Advisory - GROUND PROX SYS
- EICAS Advisory - WINDSHEAR SYS
- EICAS Advisory - ALTITUDE CALLOUTS
- EICAS Advisory - TERR POS
- EICAS Status - GROUND PROX SYS
- EICAS Status - WINDSHEAR REAC
- EICAS Status - TERR SYS
- Amber ND alert message - TERR TEST
- Amber ND alert message - TERR FAIL.

GPWS - SELF TEST - LEVEL 1

These visual and aural annunciations are for a normal level one test:

- ND system message TERR TEST shows in cyan
- Ground proximity warning light on and aural message GLIDESLOPE
- Master warning lights on, PFD message PULL UP (red), and aural message PULL UP
- Master warning lights on, PFD message WINDSHEAR (red), and aural message WINDSHEAR, WINDSHEAR, WINDSHEAR
- Terrain test pattern shows on ND for 12 seconds
- Master warning lights on, PFD message PULL UP (red), TERRAIN alert message (red) on NDs, and aural message TERRAIN, TERRAIN, PULL UP.
- Ground proximity light on and TERRAIN alert message (amber) on NDs
- Aural message SINKRATE
- Aural message PULL UP
- Aural message TERRAIN, TERRAIN
- Aural message PULL UP
- Aural message DONT SINK
- Aural message DONT SINK
- Aural message TOO LOW TERRAIN
- Aural message TOO LOW GEAR
- Aural message TOO LOW FLAPS
- Aural message TOO LOW TERRAIN
- Aural message GLIDESLOPE
- Mode 6 altitude callouts
- Aural message WINDSHEAR, WINDSHEAR, WINDSHEAR
- Aural message TOO LOW TERRAIN
- Aural message CAUTION TERRAIN, CAUTION TERRAIN
- Aural message TERRAIN, TERRAIN, PULL UP.

<u>Level One Self Test - Non-Normal Indications</u>

The GPWS level one test fails for any of these conditions:

- The terrain test pattern does not show
- The TERR FAIL message on the ND stays on
- You do not see and hear all annunciations.

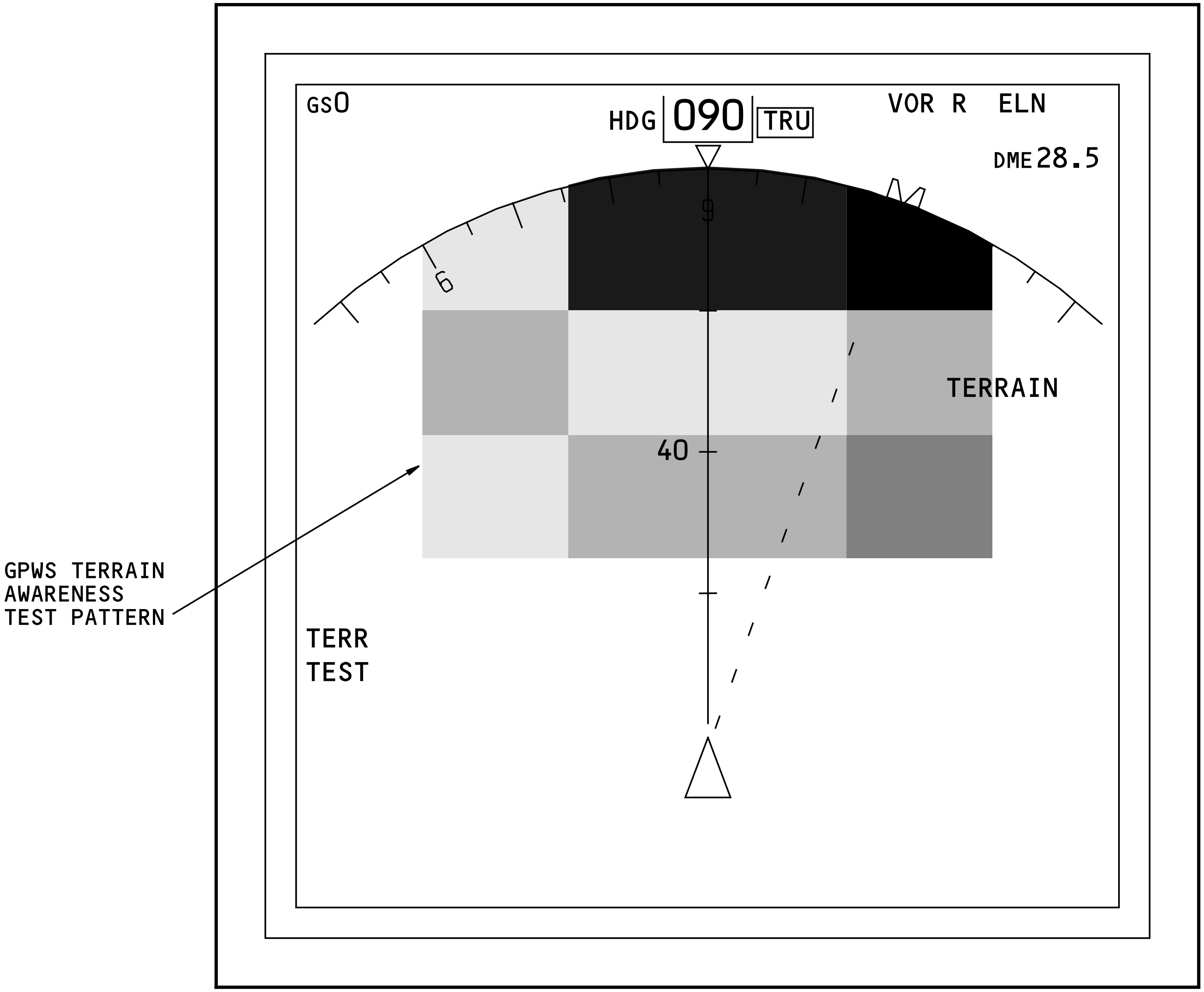
<u>Training Information Point</u>

Some GPWS modes have the same annunciations. If you do not see and hear all annunciations, the test fails.

<u>GPWS Mode Failures</u>

These aural messages annunciate for GPWS modes that do not function:

- GLIDESLOPE INOP
- GPWS INOP
- BANK ANGLE INOP
- CALLOUTS INOP
- WINDSHEAR INOP
- TERRAIN INOP.



GPWS - SELF TEST - LEVEL 1

GPWS - SELF TEST - LEVELS 2-5

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GPWS - SELF TEST - LEVELS 2-5

General Description

The ground proximity warning computer (GPWC) has six levels of self test:

- 1 - GO/NO-GO operational test
- 2 - Current faults
- 3 - System configuration
- 4 - Fault history
- 5 - Alert/warning history
- 6 - Discrete input test.

Self test levels 2-6 access self test information not available through the maintenance access terminal (MAT). Use a 600 ohm headphone to listen to the test information. Plug the headphone into the jack on the front panel of the GPWC.

Use the self test button on the front panel of the GPWC to access levels 2-6. The self test button has these two modes:

- Short cancel - push the button for less than two seconds
- Long cancel - push the button for more than two seconds.

Use the self test button for these functions:

- Start self test level one
- Go to the next item or flight leg within a test
- Go to the next self test level
- End the self test.

When a test level ends, the aural message PRESS TO CONTINUE annunciates. Push the self test button to go to the next test level. If you do not push the self test button within three seconds, self test ends.

Level Two Self Test - Current Faults

A level two test begins with the aural message CURRENT FAULTS. If there are no current faults, you hear the aural message NO FAULTS. If faults exist, the GPWC annunciates the faults one at a time. A short or long cancel ends the level two test.

Level Three Self Test - System Configuration

A level three test annunciates the GPWS configuration. A level three test begins with the aural message SYSTEM CONFIGURATION. A short cancel causes the test to go immediately to the next configuration item. A long cancel ends the level three test. A level three test provides this information:

- GPWC part number
- GPWC modification status
- GPWC serial number
- Application software version
- Configuration software version
- Terrain database version
- Envelope modulation database version
- Boot code version
- Aircraft type
- Audio menu
- Altitude callout menu number

GPWS - SELF TEST - LEVELS 2-5

- Selected options.

Level Four Self Test - Fault History

Level four self test annunciates the GPWS fault history over the last ten flights.

A level four test begins with the aural message FAULT HISTORY. If there are no faults in the flight history memory, you hear the aural message NO FAULTS. If there are faults in the flight history memory, you hear the most recent faults annunciate first. You hear the faults in this order:

- FLIGHT X (X is the most recent flight leg number)
- Internal faults for flight X
- External faults for flight X
- Go to next oldest flight leg and repeat.

A short cancel causes the test to go immediately to the next flight leg. A long cancel ends self test level four.

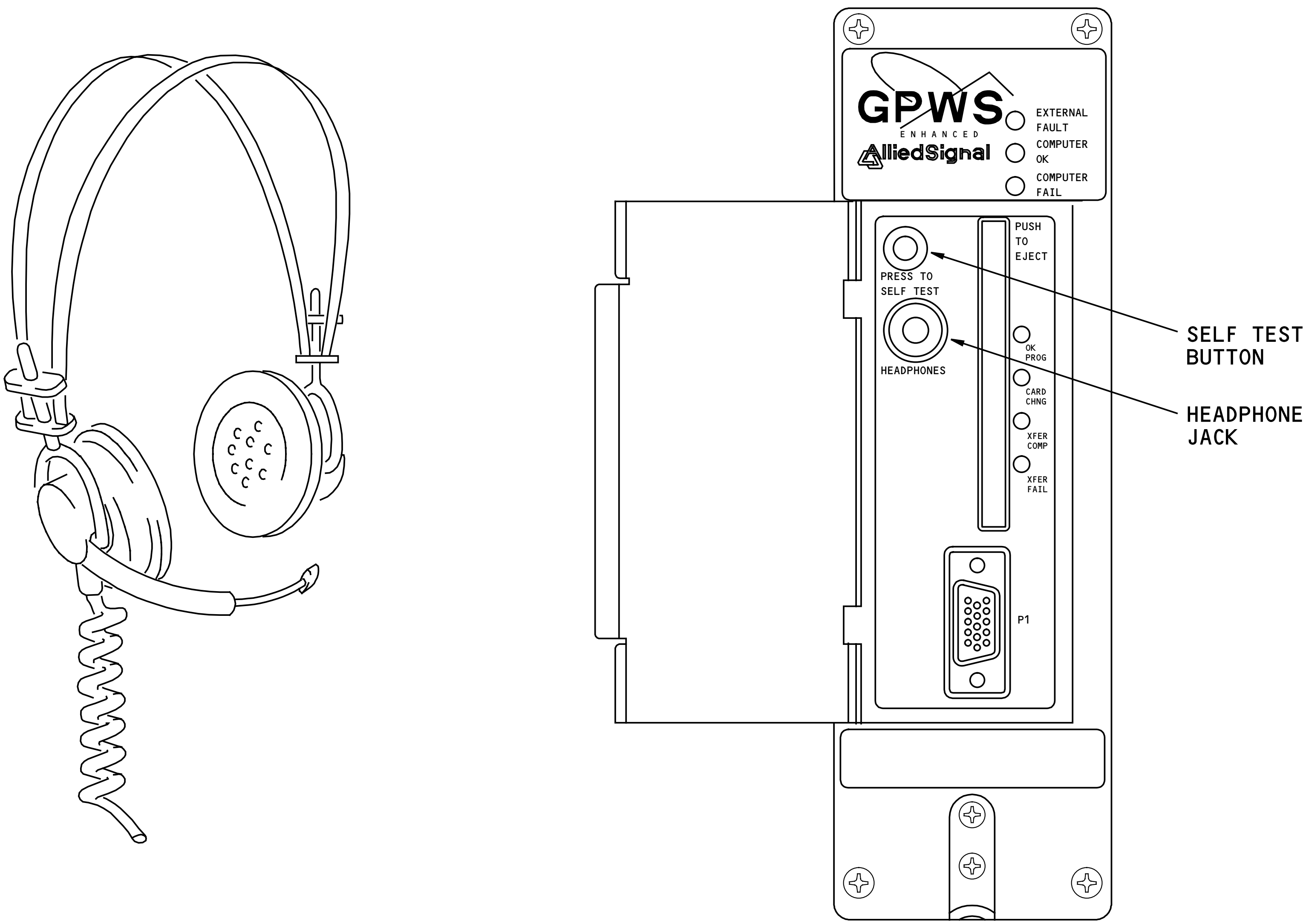
Level Five Self Test - Warning History

Level five self test annunciates GPWS alerts over the last ten flights.

A level five test begins with the aural message WARNING HISTORY. If there are no alerts in the flight history memory, you hear the aural message NO WARNINGS. If there are alerts in the flight history memory, you hear the most recent alerts first. You hear the alerts in this order:

- FLIGHT X (X is the most recent flight leg number)
- GPWS alerts for flight X
- Go to next oldest flight leg and repeat.

A short cancel cause the test to go immediately to the next flight leg. A long cancel ends self test level four.



GPWS - SELF TEST - LEVELS 2-5

GPWS - SELF TEST - LEVEL 6

General Description

The ground proximity warning computer (GPWC) has a level six discrete input test.

This test accesses test information not available from the maintenance access terminal (MAT). Use a 600 ohm headphone to listen to the test information. Plug the headphone into the jack on the front panel of the GPWC.

Use the self test button on the front panel of the GPWC to access level six. The self test button has these two modes:

- Short cancel - push the button for less than two seconds
- Long cancel - push the button for more than two seconds.

Use the self test button for these functions:

- Start self test level one
- Go to the next item or flight leg within a test
- Go to the next self test level
- End the self test.

When a test level ends, the aural message PRESS TO CONTINUE annunciates. Push the self test button to go to the next test level. If you do not push the self test button within three seconds, self test ends.

Level Six Self Test - Discrete Input Test

A level six test checks changes in discrete inputs.

The test starts with the aural message DISCRETE TEST. If the state of a discrete input changes, you hear the new state of the discrete.

You hear the aural message DISCRETE INPUT TEST - PRESS TO CANCEL every 60 seconds. Push a short or long cancel to end the self test.

DISCRETE INPUT	INPUT SOURCE	ANNUNCIATIONS
- GEAR OVERRIDE SWITCH	P2-2 PANEL	LANDING GEAR DOWN LANDING GEAR UP
- FLAP OVERRIDE SWITCH	P2-2 PANEL	LANDING FLAPS NOT LANDING FLAPS
- GLIDESLOPE OVERRIDE SWITCH	P2-2 PANEL	GLIDESLOPE CANCELLED GLIDESLOPE ENABLED
- TERRAIN OVERRIDE SWITCH	P2-2 PANEL	TERRAIN OFF TERRAIN ON
- TERRAIN RELAY 1	LEFT EFIS TERR SWITCH	TERRAIN RELAY 1 ON TERRAIN RELAY 1 OFF
- TERRAIN RELAY 2	RIGHT EFIS TERR SWITCH	TERRAIN RELAY 2 ON TERRAIN RELAY 2 OFF

LEVEL 6 DISCRETE INPUT TEST

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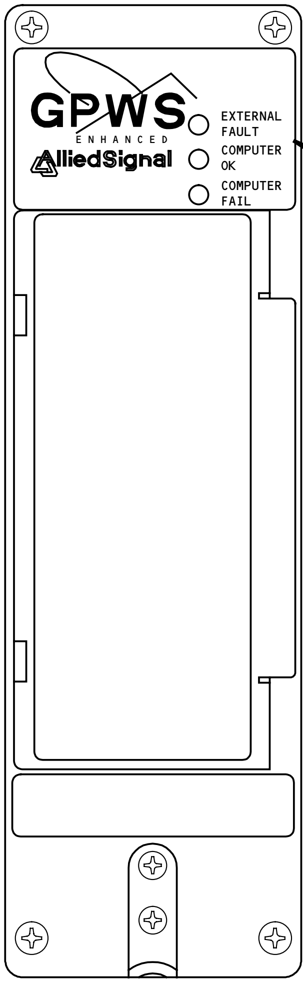
GPWS - SELF TEST - LEVEL 6

GPWS - STATUS LEDS

Purpose

There are three status LEDs on the front panel of the ground proximity warning computer (GPWC). These LEDs turn on when there is power to the GPWC. These LEDs are:

- External fault - yellow
- Computer OK - green
- Computer fail - red.



EXTERNAL FAULT	COMPUTER OK	COMPUTER FAIL	CONDITION
OFF	OFF	OFF	GPWC POWER OFF
OFF	OFF	RED	GPWC INTERNAL FAULT
OFF	GREEN	OFF	NORMAL OPERATION
OFF	GREEN	RED	GPWC INTERNAL FAULT
YELLOW	OFF	OFF	GPWS EXTERNAL FAULT
YELLOW	OFF	RED	BOTH GPWC INTERNAL AND GPWS EXTERNAL FAULTS
YELLOW	GREEN	OFF	GPWS EXTERNAL FAULT
YELLOW	GREEN	RED	GPWC INTERNAL FAULT

34-46-00-044 Rev 0 02/06/1998

GPWS - STATUS LEDS

GPWS - GROUND TESTS

General

You do an operational test of the GPWS from the MAT.

Operational Test

The operational test makes sure the ground proximity warning system operates correctly.

You get these indications when you do an operational test:

- All the GPWS aurals
- The master warning lights come on
- PULL UP and WINDSHEAR messages show on the PFDs
- The ground proximity light comes on.

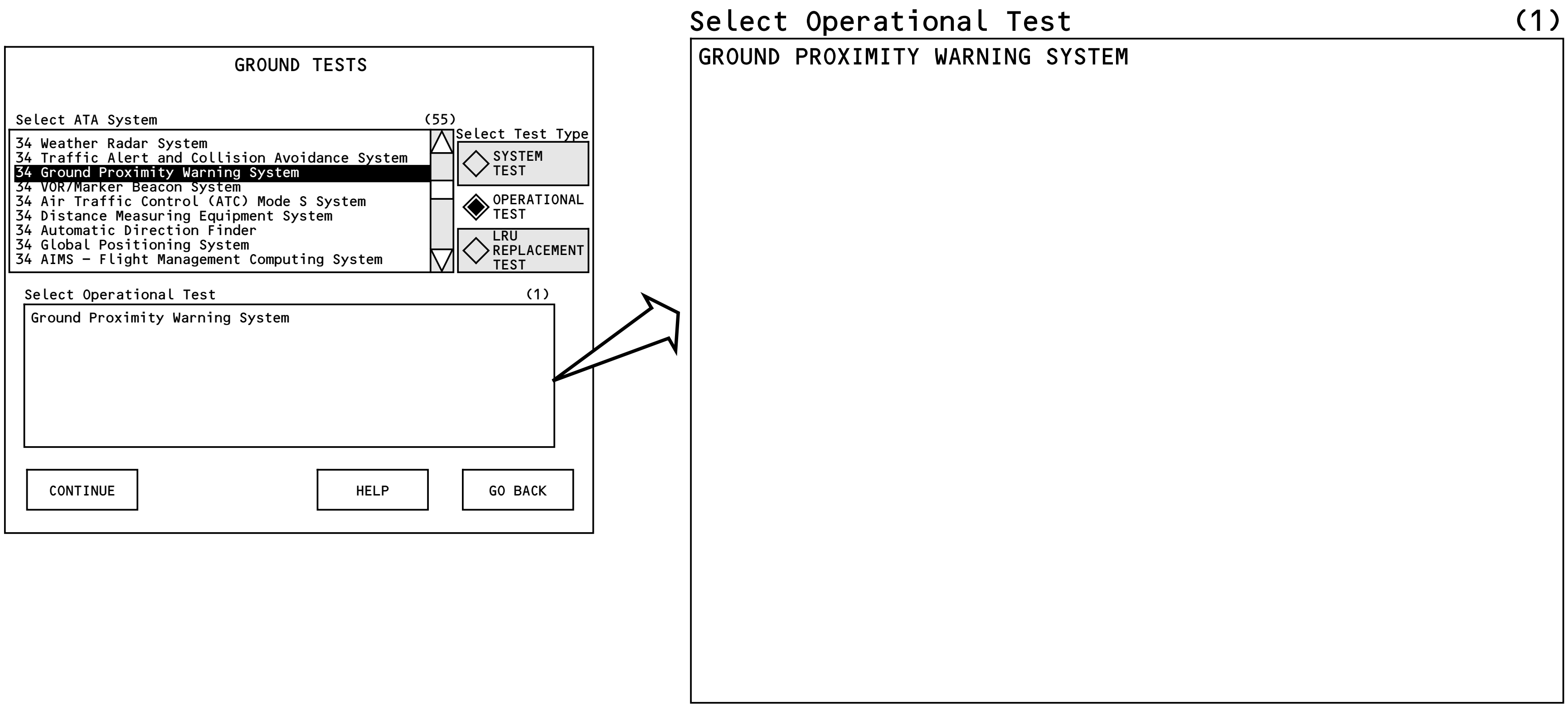
Training Information Point

If you do not hear all the GPWS aurals and see the master warning lights come on, PFD messages show, and the ground proximity light come on, the operational test failed.

During the test, these aurals do not come on:

- ENGINE FAIL
- V1.

During the test, EICAS shows WINDSHEAR WARNING SYS and GND PROX SYS messages.



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GPWS - GROUND TESTS

Continental Airlines, Inc

Weather Radar System

WB371

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WEATHER RADAR SYSTEM - INTRODUCTION

Purpose

The weather radar (WXR) system supplies:

- Visual indications of weather conditions
- Visual indications of land contours.

Description

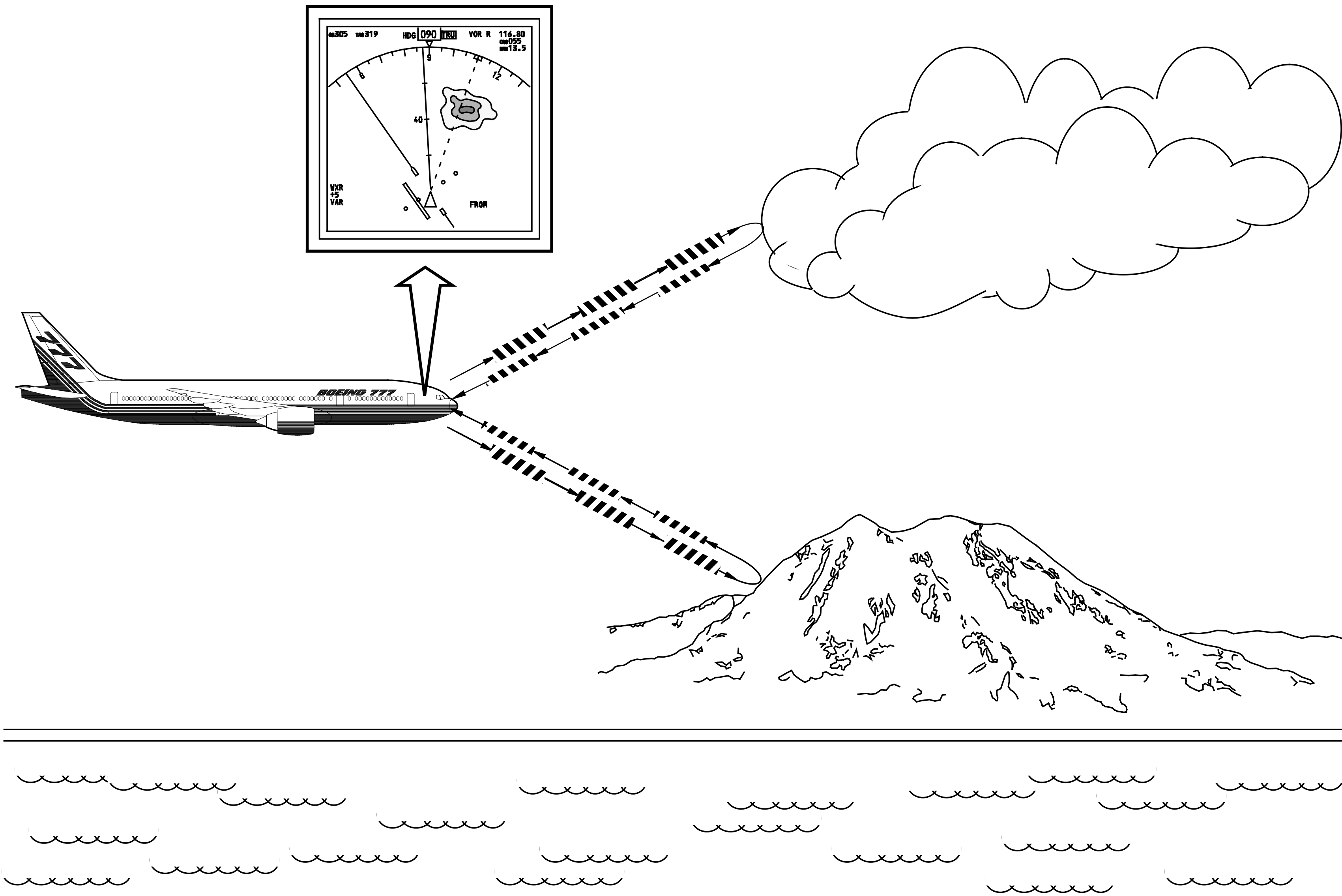
The WXR system transmits radio frequency (RF) pulses in a 180 degree sector forward of the airplane path. Precipitation or terrain contours reflect the pulses back to the airplane.

Display

The WXR returns show in four different colors on the navigation displays (ND). The colors of the indications depend on the intensity of the returns.

Abbreviations and Acronyms

AIMS	- airplane information management system
CMCF	- central maintenance computing function
CDU	- control display unit
CP	- control panel
GPWC	- ground proximity warning computer
MWL	- master warning light
ND	- navigation display
OPAS	- overhead panel ARINC 629 system
PFD	- primary flight display
PRF	- pulse repetition frequency
PWS	- predictive windshear
RA	- radio altimeter
RF	- radio frequency
RT	- receiver-transmitter
TCAS	- traffic and collision avoidance system
WES	- warning electronics system
WEU	- warning electronics unit
WX	- weather
WXR	- weather radar



34-43-00-001 Rev 1

WEATHER RADAR SYSTEM - INTRODUCTION

WXR SYSTEM - GENERAL DESCRIPTION

Control

These components supply weather radar (WXR) system control:

- Left, center, and right control display units (CDUs)
- Left and right EFIS CPs
- WXR panel.

Display

WXR data shows on the navigation displays (NDs). The weather data from the WXR RT goes through the AIMS cabinets then to the NDs.

Antenna

The WXR antenna radiates the RF pulses and receives the RF returns. The RT gets air data inertial reference system (ADIRS) pitch and roll data from the airplane information management system (AIMS) cabinets for antenna stabilization.

Receiver-Transmitter (RT)

The central component of the WXR system is the weather radar receiver-transmitter (RT). The system uses dual RTs with only one RT in operation at a time. The WXR RT does these functions:

- Produces RF pulses
- Transmits RF pulses
- Processes the RF returns
- Supplies the WXR display data.

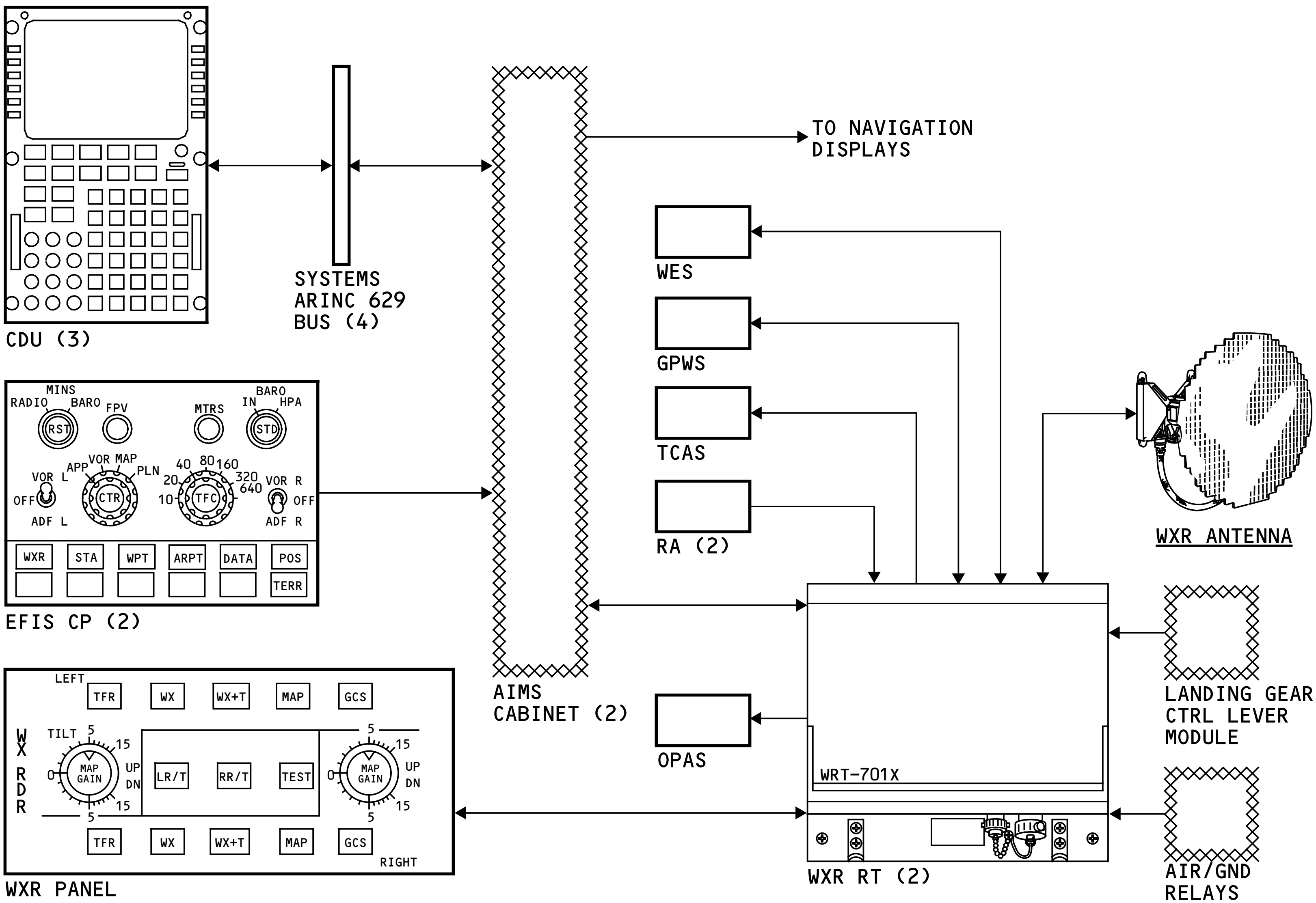
Interfaces

The WXR system interfaces with these systems:

- Warning electronic system (WES)
- Ground proximity warning system (GPWS)
- Traffic alert and collision avoidance system (TCAS)
- Radio altimeter system (RA)
- Overhead panel ARINC 629 system (OPAS).

The WXR system interfaces with these system components:

- Air/ground relay
- Landing gear control lever module.



WXR SYSTEM - GENERAL DESCRIPTION

WXR SYSTEM - COMPONENT LOCATIONS - FLIGHT DECK

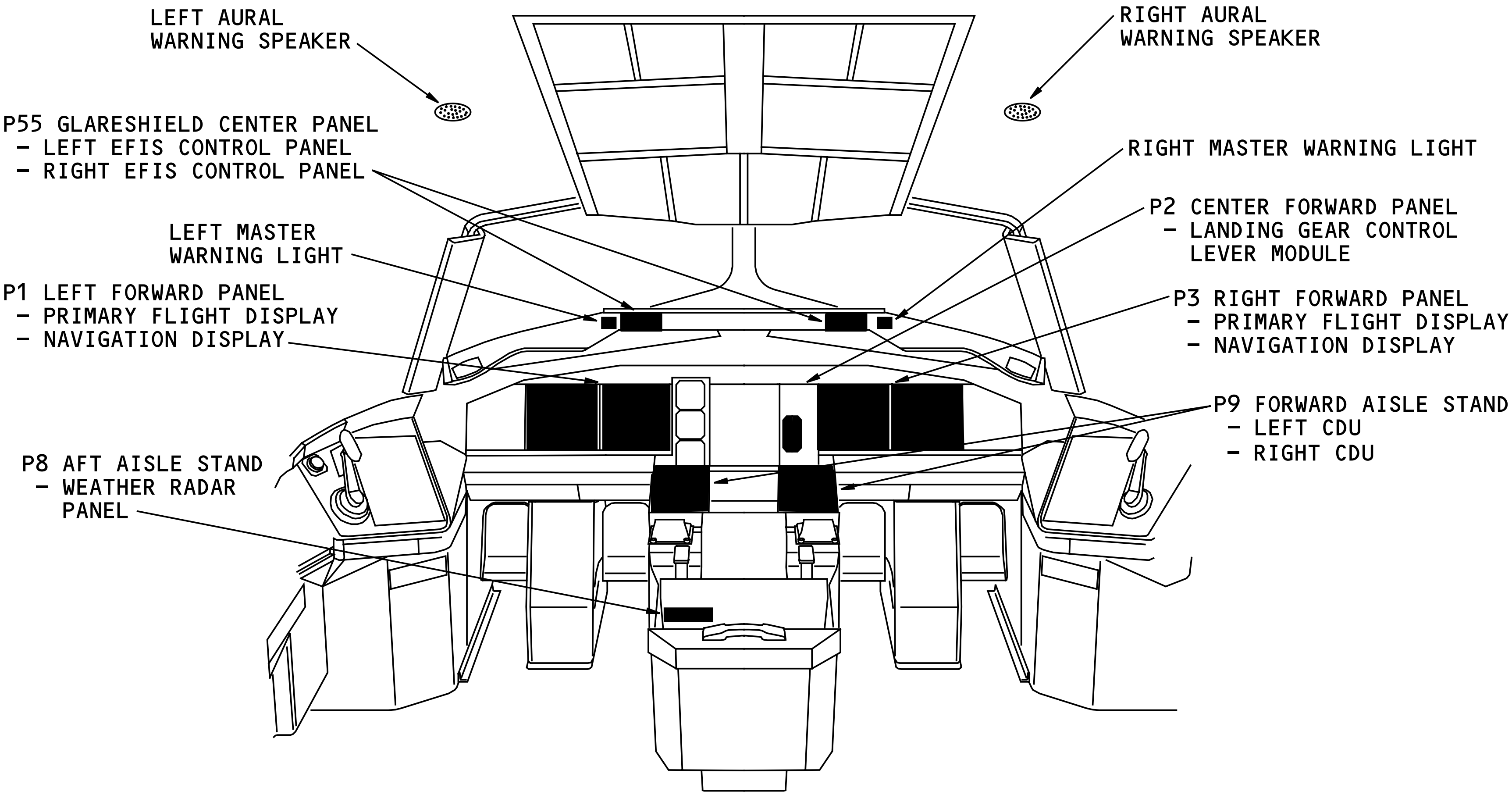
WXR System Components

The WXR system component on the flight deck is the weather radar panel.

WXR System Interface Components

The components that interface with the WXR system are:

- Left EFIS control panel
- Right EFIS control panel
- Left control display unit (CDU)
- Right CDU
- Left navigation display (ND)
- Right ND
- Left primary flight display (PFD)
- Right PFD
- Master warning lights
- Aural warning speakers
- Landing gear control lever module.



34-43-00-003 Rev 2 01/28/1998

WXR SYSTEM - COMPONENT LOCATIONS - FLIGHT DECK

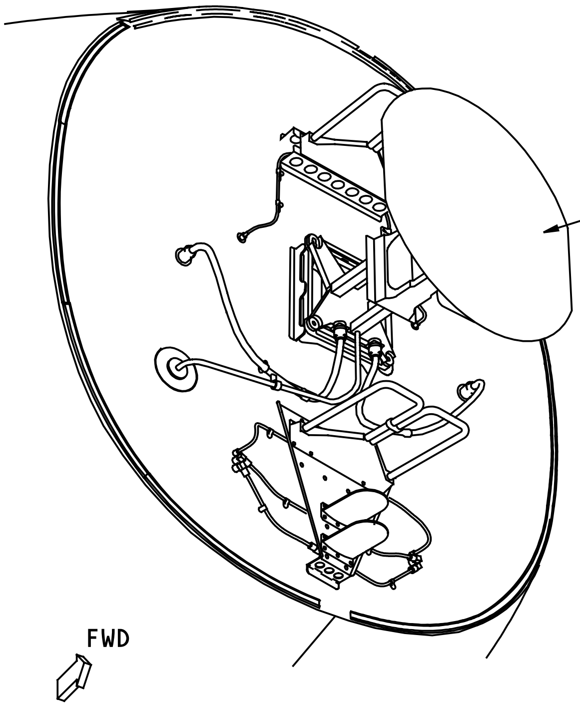
WXR SYSTEM - COMPONENT LOCATIONS - FORWARD EQUIPMENT CENTER AND NOSE RADOME

General

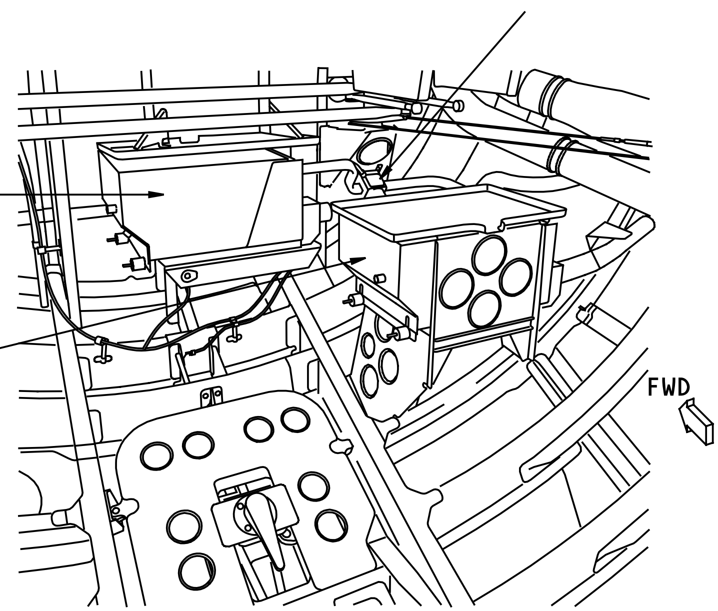
The WXR antenna assembly is in the nose radome.

The WXR system components in the forward equipment center are the:

- Left WXR RT
- Waveguide switch
- Right WXR RT.



NOSE RADOME



FORWARD EQUIPMENT CENTER

34-43-00-004 Rev 2

WXR SYSTEM - COMPONENT LOCATIONS - FORWARD EQUIPMENT CENTER AND NOSE RADOME

WXR SYSTEM - INTERFACE - POWER, INTERLOCKS, ENABLES AND RF TRANSMISSION

System Power

The left WXR RT gets 115v ac through the left WXR circuit breaker from the left ac transfer bus (L AC XFR).

The right WXR RT gets 115v ac through the right WXR circuit breaker from the right ac secondary 2 bus (R AC SEC 2).

The left and right WXR RTs send 28v dc to the onside power supply in the WXR panel.

Interlocks, Enables and RF Transmission

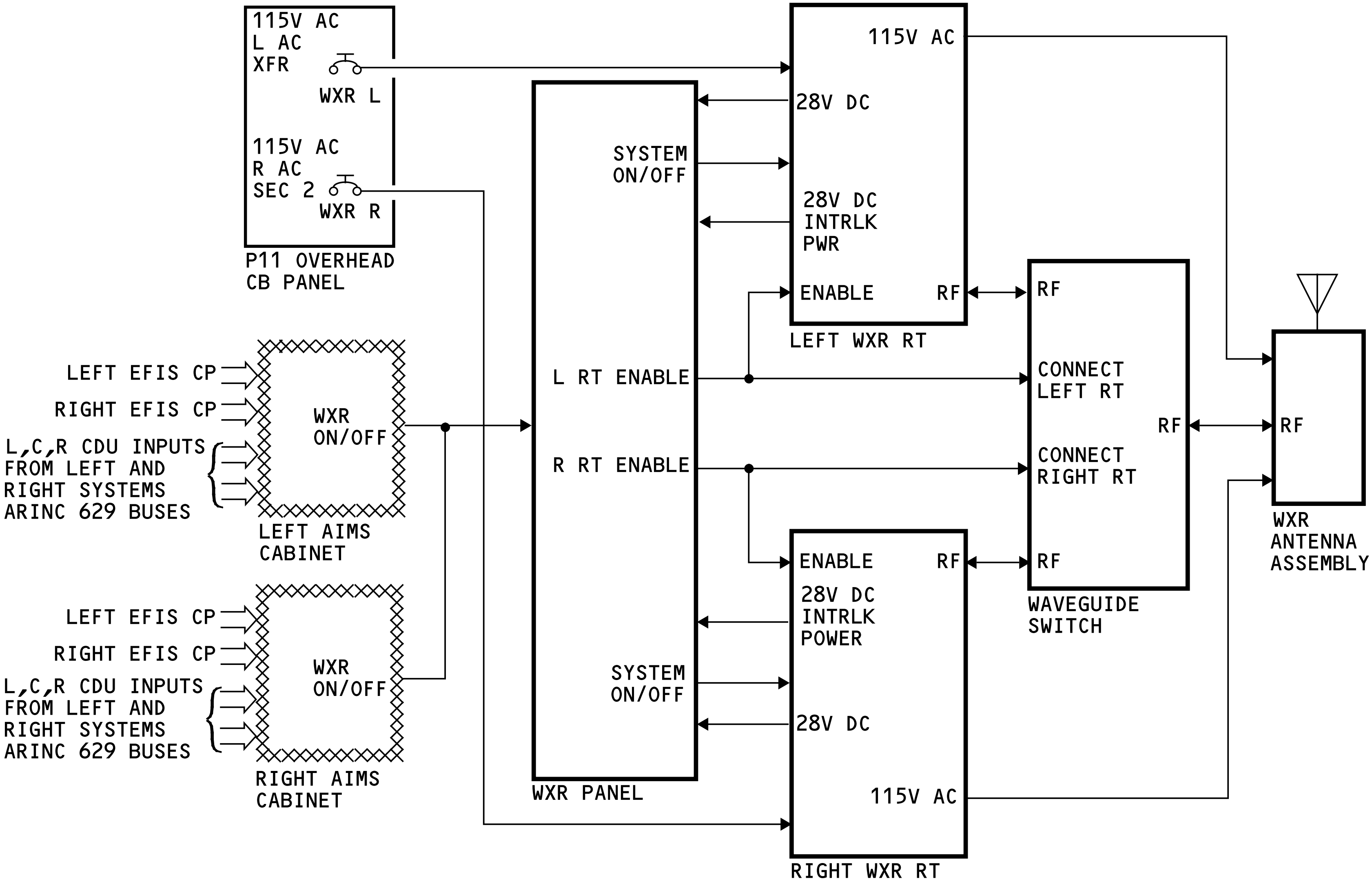
The left and right AIMS cabinets receives WXR on/off discrete inputs from the left and right EFIS CP or left, center, and right CDUs and sends the discrete to the WXR panel.

The WXR panel sends the ON/OFF discrete to the left and right RTs. This discrete permits the selected RT to operate.

The RTs send 28v dc to the WXR control panel for the power interlock (INTRLK) and RT ENABLE. The WXR CP RT ENABLE goes to the WXR RT to enable operation.

The RT ENABLE also causes the waveguide switch to connect the antenna to the selected RT. When the selected RT operates, it sends 28v to the WXR panel power supply to make the WXR panel operate.

The WXR antenna assembly gets 115v ac power from the WXR RTs.



34-43-00-005 Rev 4 01/21/1998

WXR SYSTEM - INTERFACE - POWER, INTERLOCKS, ENABLES AND RF TRANSMISSION

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WXR SYSTEM - CONTROL AND DISPLAY INTERFACE

Control Inputs

The WXR panel supplies this data to the WXR RTs:

- Transmit mode
- Tilt
- Gain control.

Range data and the on/off discretes go from the EFIS control panel or CDU through the AIMS cabinets to the WXR RTs.

WXR Output Data and Display

The selected WXR RT sends WXR display data to the left and right AIMS cabinets.

Display Relays

The weather radar (WXR) receiver-transmitters (RTs) and the ground proximity warning computer (GPWC) send display data that shows on the navigational displays (NDs). Four terrain select relays control which data shows on each ND.

Relay Power

The terrain select relays gets 28v dc from the TERRAIN DISPLAY circuit breaker on the P11 overhead circuit breaker panel.

Relay Interfaces

The WXR RTs connect to the terrain select relays with weather display data buses. The GPWC connects to the terrain select relays with terrain display data buses.

The terrain select relays connect to the AIMS cabinets with data buses. The AIMS cabinets show the data on the NDs.

Relay Control

With weather radar selected, the normal relay position lets weather radar data show on the NDs. When you select TERR on either EFIS control panel (CP), a terrain select ground signal energizes the two on-side terrain select relays. This allows the terrain data to show on the on-side display. Push the TERR switch again and the on-side relays deenergize. The display then shows weather radar data.

Relay Monitor

The GPWC monitors the terrain select relay positions for faults.

Cross Cabinet Bus

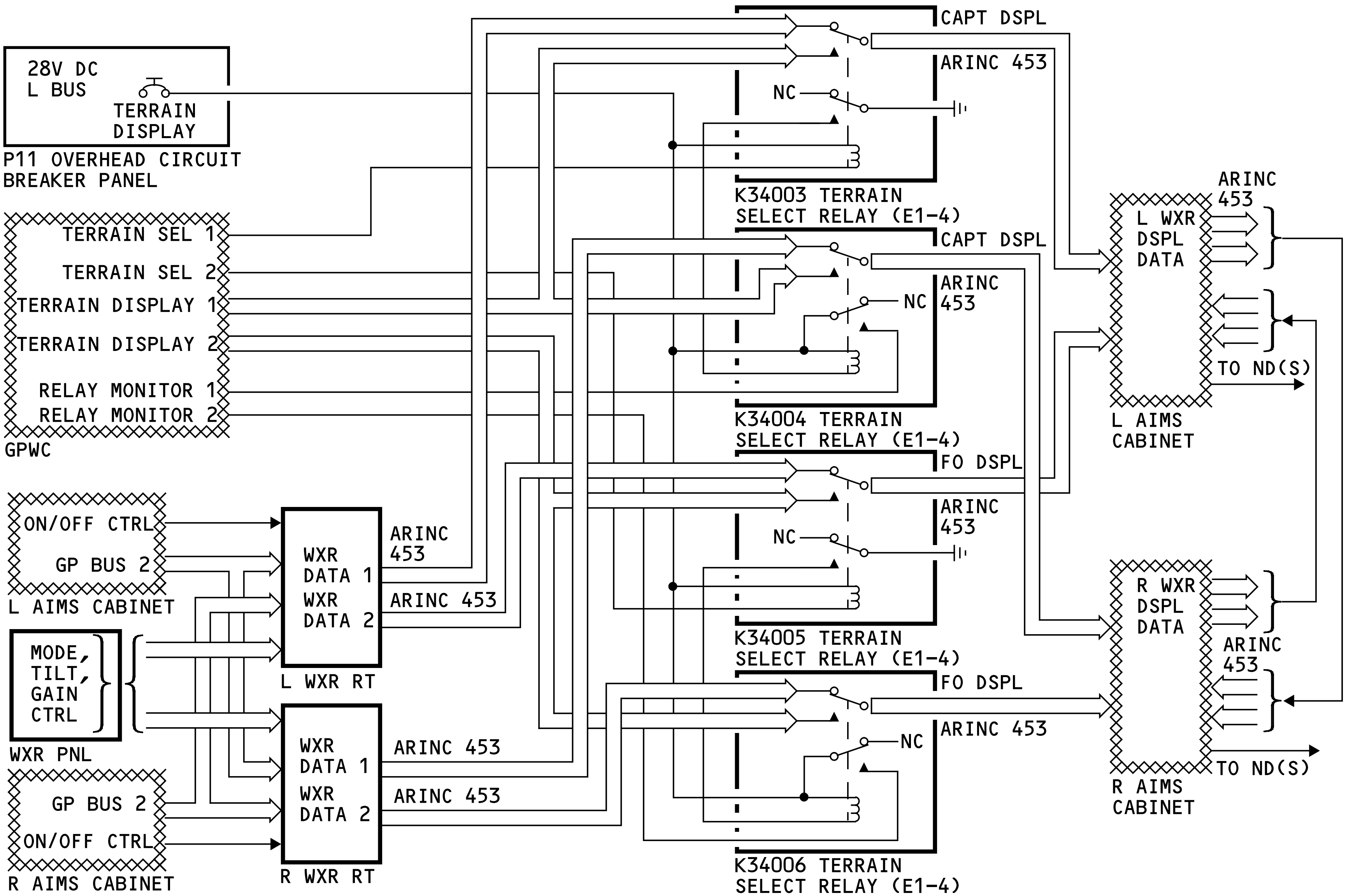
The left AIMS cabinet supplies WXR display data to the right AIMS cabinet and the NDs.

The right AIMS cabinet supplies WXR display data to the left AIMS cabinet and the NDs.

WXR SYSTEM - CONTROL AND DISPLAY INTERFACE

Status Display

The AIMS cabinets get WXR system mode and status data so the NDs can show WXR system mode of operation and system status.



WXR SYSTEM - CONTROL AND DISPLAY INTERFACE

34-43-00-006 Rev 3 02/04/1998

WXR SYSTEM - ANTENNA CONTROL INTERFACE

Antenna Tilt

The WXR panel supplies antenna tilt control signals to the WXR RT.

Attitude Sources

The WXR RT uses ADIRS attitude data from AIMS for antenna stabilization.

The left ADIRS signals from left AIMS cabinet connect to the onside attitude input of the left WXR RT and to the offside attitude input of the right WXR RT. The right ADIRS signals from right AIMS cabinet connect to the onside attitude input of the right WXR RT and to the offside attitude input of the left WXR RT.

Attitude On/Off Discrete

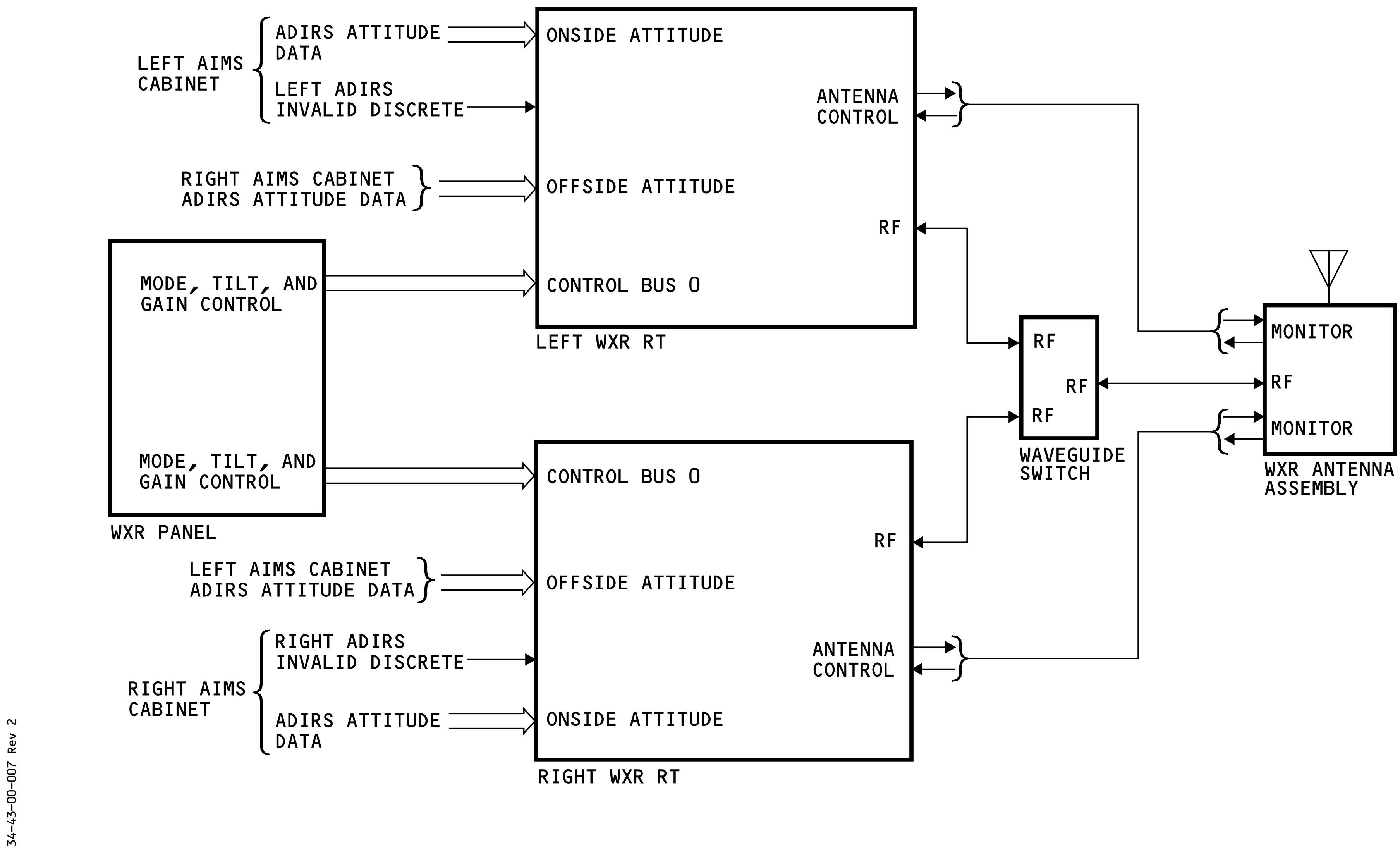
A failed AIMS cabinet supplies an ADIRS invalid discrete to the WXR RT. This permits the RT to use the offside attitude inputs.

WXR RT Antenna Control

The WXR RT sends antenna control and stabilization signals to the WXR antenna assembly.

Antenna Position Monitoring

The WXR antenna sends antenna position feedback to the WXR RT for scan and elevation position monitoring.



WXR SYSTEM - ANTENNA CONTROL INTERFACE

WXR SYSTEM - MAINTENANCE INTERFACES

RT Central Maintenance Computer System Interface

The central maintenance computer system (CMCS) of the left AIMS cabinets sends this data to the left and right WXR RTs:

- Flight legs for the RT nonvolatile memory (NVM)
- Ground test commands to start a WXR system test.

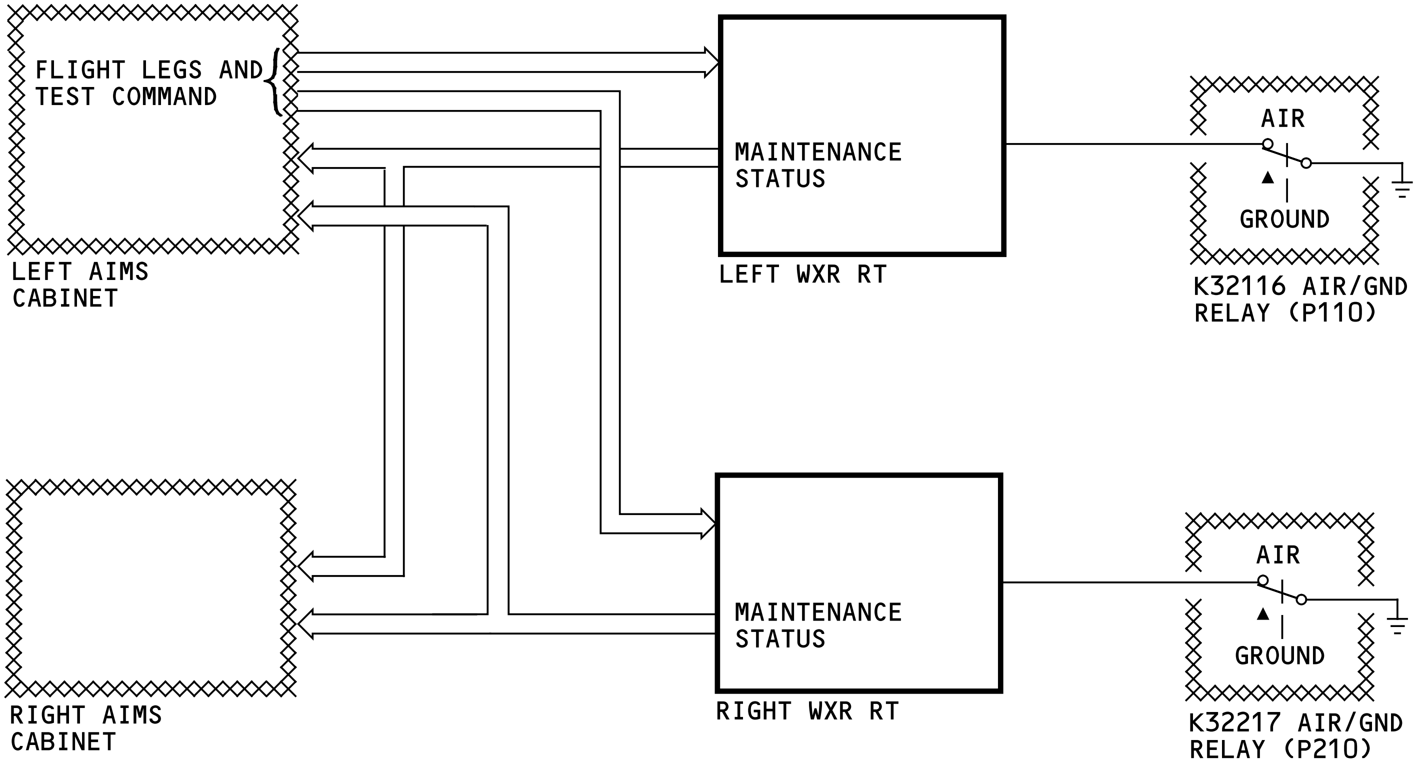
WXR System Maintenance Data

The WXR RTs send WXR system maintenance data to the CMCS in the left AIMS cabinets.

Air/Ground

The air/ground relay input does these functions:

- Inhibits PWS test alerts in the air
- Defines flight legs if the flight legs data from the CMCS fails.



34-43-00-008 Rev 2 01/23/1998

WXR SYSTEM - MAINTENANCE INTERFACES

WXR SYSTEM - WEATHER RADAR PANEL

Purpose

The weather radar (WXR) panel has controls for WXR system operation.

Mode Selector

The left and right alternate action mode select switches have these functions:

- TFR switch causes the RT to use the same mode, tilt, and gain as the other side
- WX/TURB switch selects the weather and turbulence mode (the RT processes turbulence returns for a maximum of 40 nm only)
- WX position selects the weather mode of operation
- MAP position selects the ground map mode
- GCS (ground clutter suppression) switch.

System Select Switch

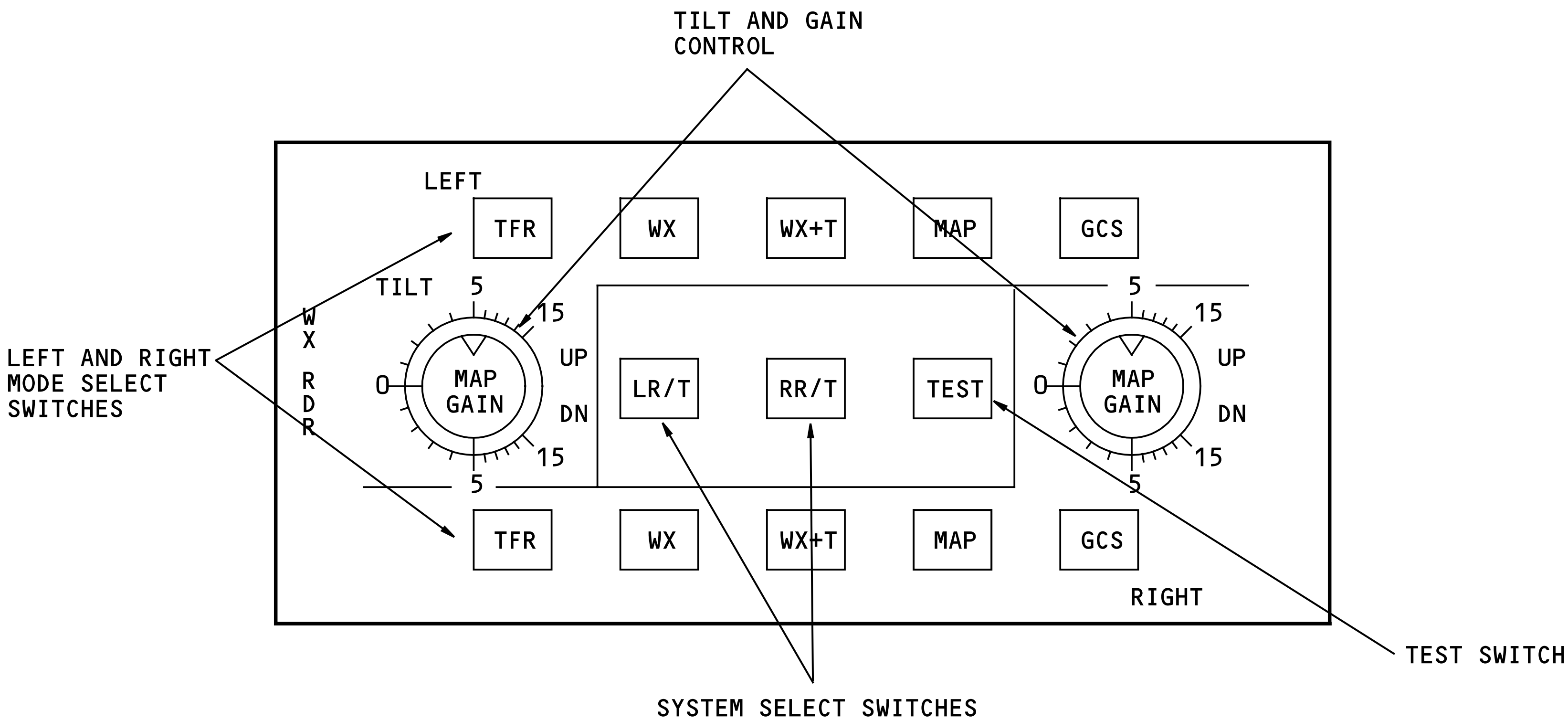
The left (L R/T) and right (R R/T) select switches let you select the left or right WXR RT for operation.

Tilt Control

The left and right antenna tilt controls let you select antenna tilt from +15 degrees to -15 degrees. The tilt controls also have the receiver gain control. The gain control adjusts the system gain in the MAP mode only.

Test

The test switch lets you do a test of the WXR RT that is in operation. The test results show on the NDs.



34-43-00-009 Rev 3

WXR SYSTEM - WEATHER RADAR PANEL

WXR SYSTEM - RECEIVER-TRANSMITTER

Purpose

The purpose of the WXR receiver-transmitter (RT) is to:

- Make and transmit RF pulses
- Process RF return signals
- Make display data
- Send display data to the AIMS
- Supply antenna stabilization
- Monitor and test system operation
- Send and record fault status and test results
- Make WXR display test patterns to show on the display units.

Physical Description

The WXR RT weighs 32 lb (14 kg). Forced air cools the WXR RT.

Front Panel

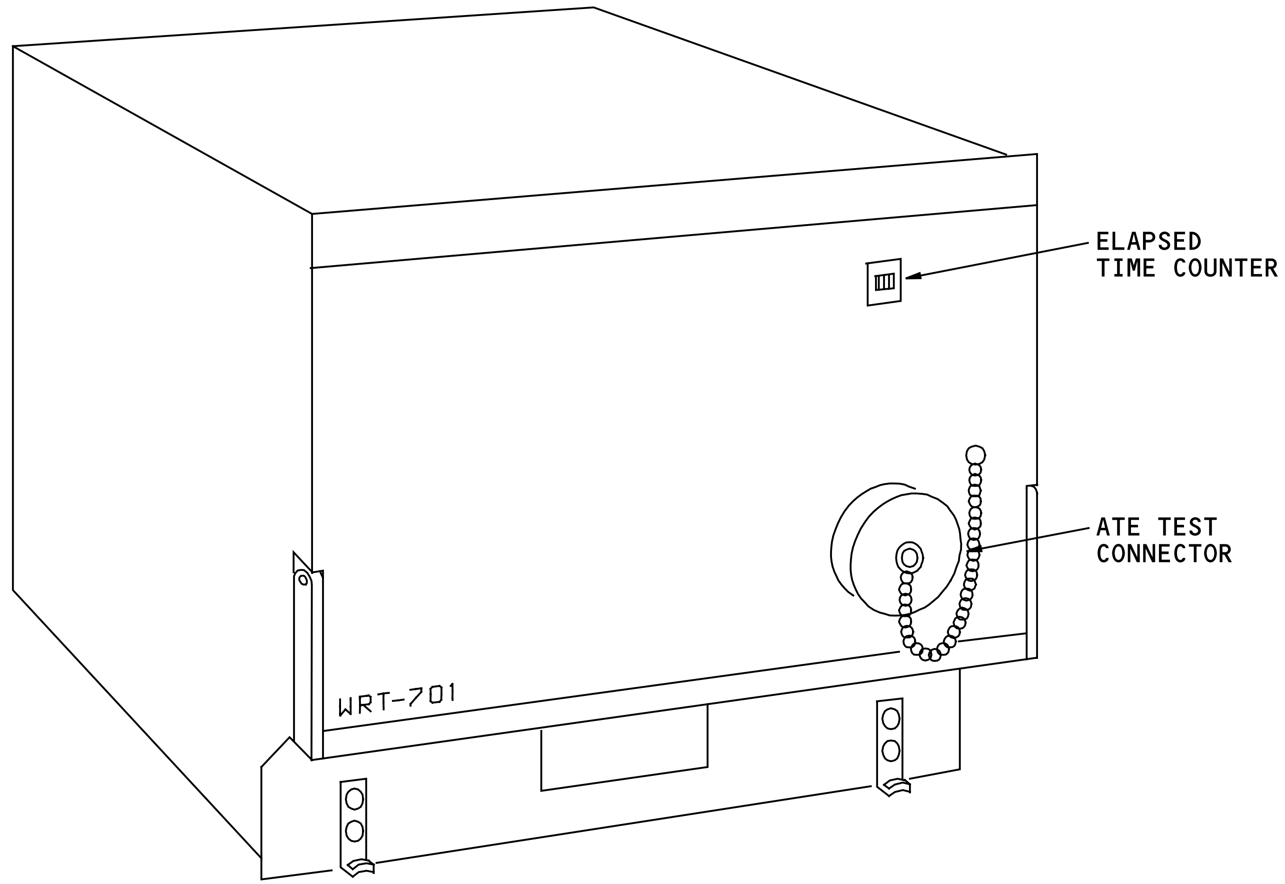
An elapsed time counter records the total hours of operation of the RT.

An ATE test connector supplies a test point to monitor RT operation during bench tests.

Training Information Point

The maintenance manual and the fault isolation manual do not have a task for the maintenance technician to do a test from the front panel of the WXR RT. You must do all tests for the WXR RT from the MAT, PMAT, or from the WXR panel.

Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For that reason, these LRUs have a front panel test feature.



34-43-00-010 Rev 3 06/18/96

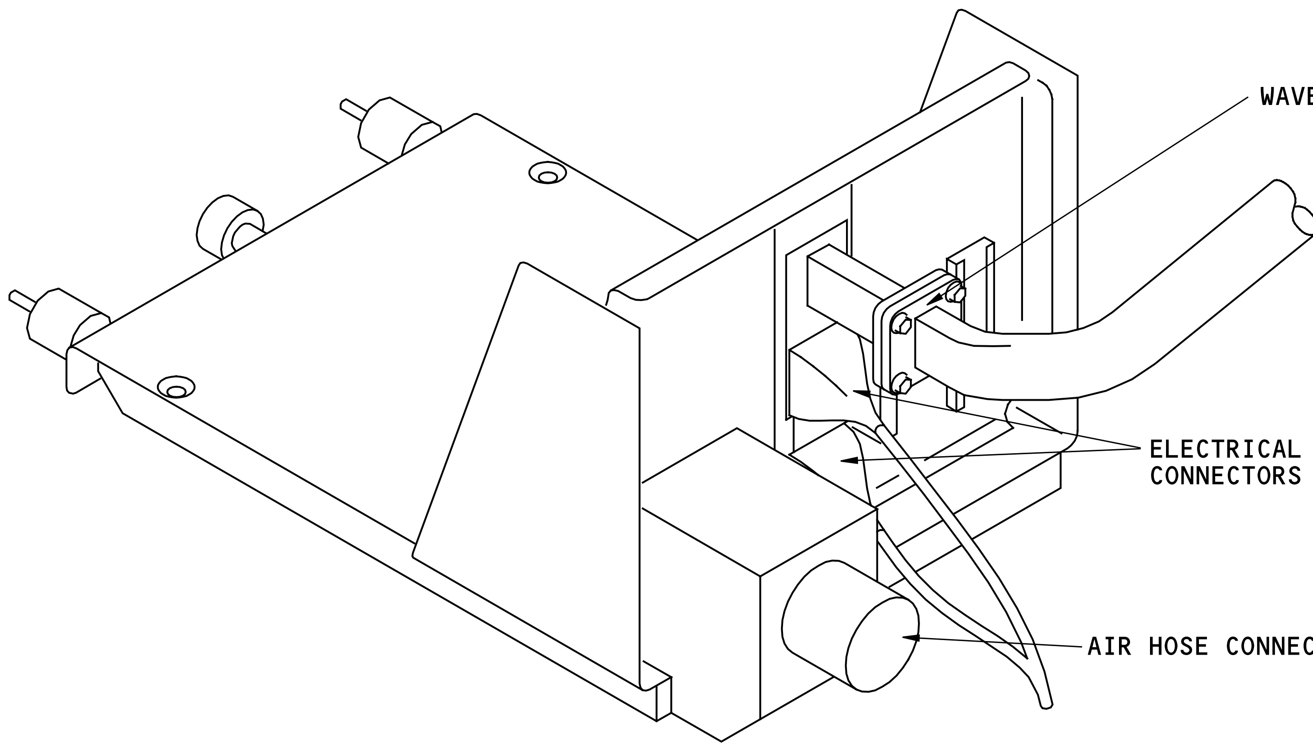
WXR SYSTEM - RECEIVER-TRANSMITTER

WXR SYSTEM - RT MOUNT

Purpose

The purpose of the WXR RT mount is to:

- Hold the RT
- Connect the RT to the airplane wiring
- Connect the RT to the waveguide
- Supply airplane cooling air to the RT.



34-43-00-011 Rev 1

WXR SYSTEM - RT MOUNT

WXR SYSTEM - ANTENNA ASSEMBLY 1

Antenna Assembly

The antenna assembly includes:

- The flat plate WXR antenna
- The antenna pedestal.

Flat Plate Antenna

The flat plate antenna transmits RF pulses from the WXR RT, and receives the pulses as they reflect off precipitation formations.

The flat plate antenna is an array of radiation slots. The RF pulses radiate from each of the slots and combine to make a pencil beam 5.4 degrees high and 5.4 degrees wide. The antenna weighs 6 lb (2.7 kg) and is 23 inches wide.

Antenna Pedestal

The antenna pedestal contains these items:

- Electrical connectors
- Stepper motors to drive the horizontal scan and vertical elevation scan
- Antenna position monitors
- Disable switches.

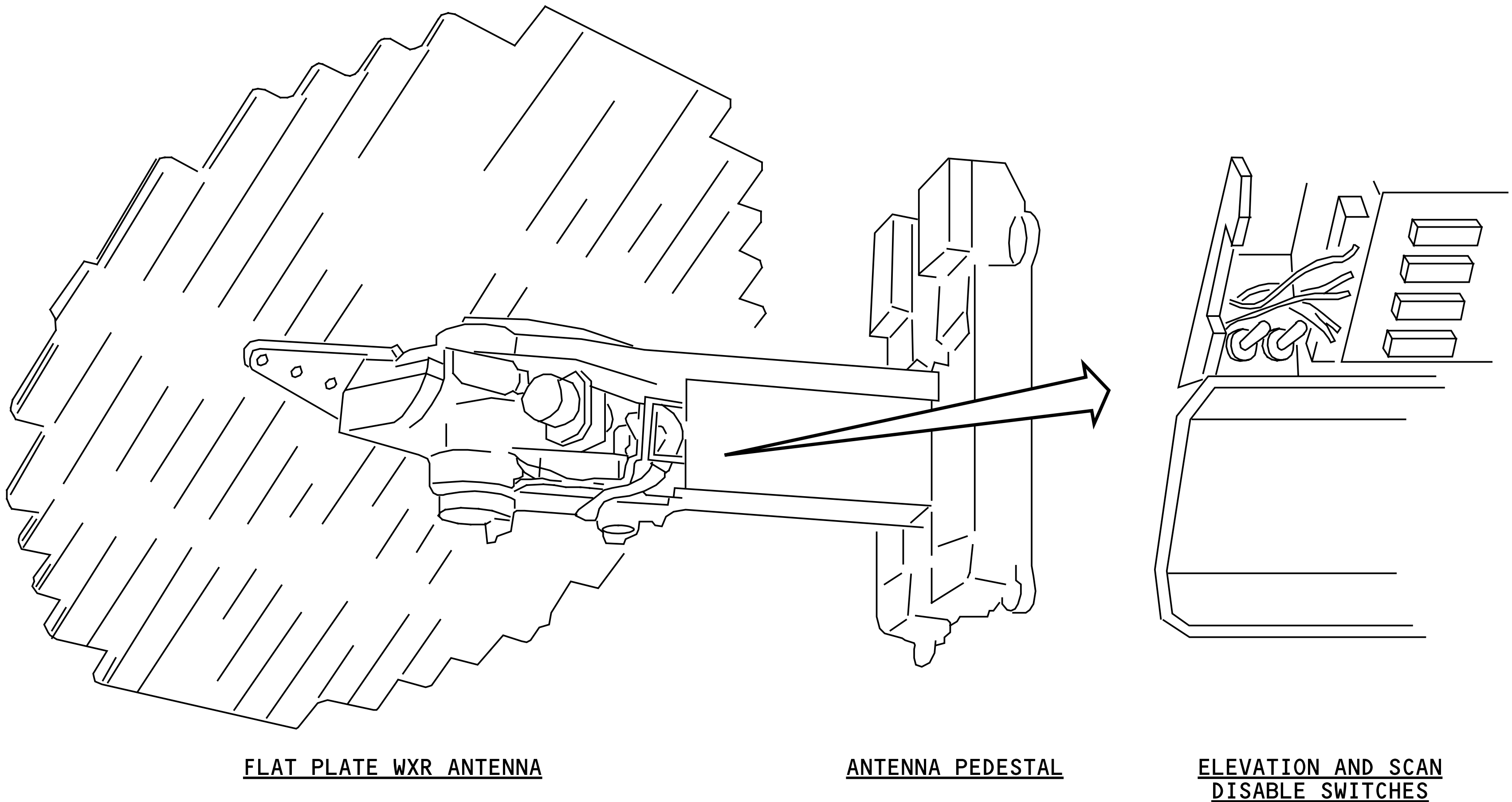
The antenna pedestal receives 115v ac power from the WXR RT. The antenna pedestal has two sets of power supplies and electronics. One set drives the antenna with the left RT selected. The other set drives the antenna with the right RT selected.

There is a horizontal scan stepper motor to drive the antenna +/- 90 degrees of the airplane centerline. There is also a vertical elevation scan stepper motor to drive the antenna +/- 40 degrees up or down (this includes the +/- degrees for manual tilt selection from the WXR control panel). The stepper motors use 26v dc for operation.

There is a zero position monitor and an incremental monitor for each motor. These monitors send antenna horizontal scan and elevation scan position feedback to the WXR RT. There are elevation and azimuth scales that permits a visual measurement of the tilt and scan angles.

There is a horizontal scan and elevation scan disable switch on the antenna pedestal to permit you to remove power to the scan and elevation stepper motors. Use these switches to inhibit movement of the antenna during maintenance. The switches do not stop RF transmissions from the WXR RT.

A torque spring inside the antenna pedestal counter balances the weight of the antenna. When you remove the antenna, the torque spring moves the elevation drive into the upper position.



WXR SYSTEM - ANTENNA ASSEMBLY 1

WXR SYSTEM - ANTENNA MOUNT ASSEMBLY

General

The antenna drive unit attaches to the antenna mount assembly with four antenna mount bolts.

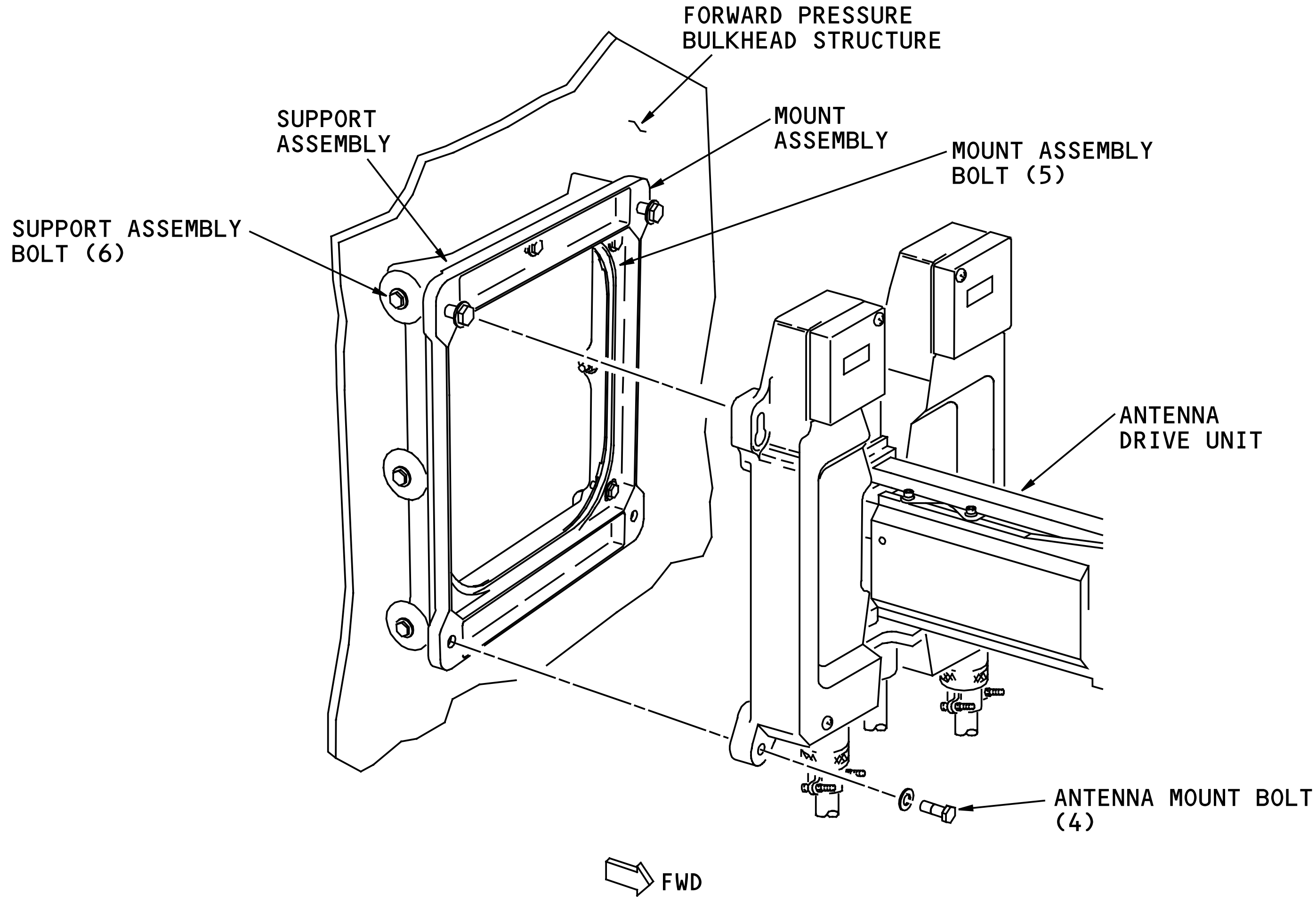
The mount assembly attaches to a support assembly with five mount assembly bolts.

The support assembly attaches to the forward pressure bulkhead with six support assembly bolts.

Training Information Point

The support assembly and mount assembly are aligned at the factory.

NOTE: Do not loosen the mount assembly bolts or the support assembly bolts. The support assembly and mount assembly are aligned at the factory. If the bolts are accidently loosened or if the base is loose or not aligned, special alignment procedures must be done by a Boeing specialty team. Contact Boeing Seattle A.O.G. Office, Technical Assistance Team.



34-43-00-014 Rev 1

WXR SYSTEM - ANTENNA MOUNT ASSEMBLY

WXR SYSTEM - RF SWITCHING

Purpose

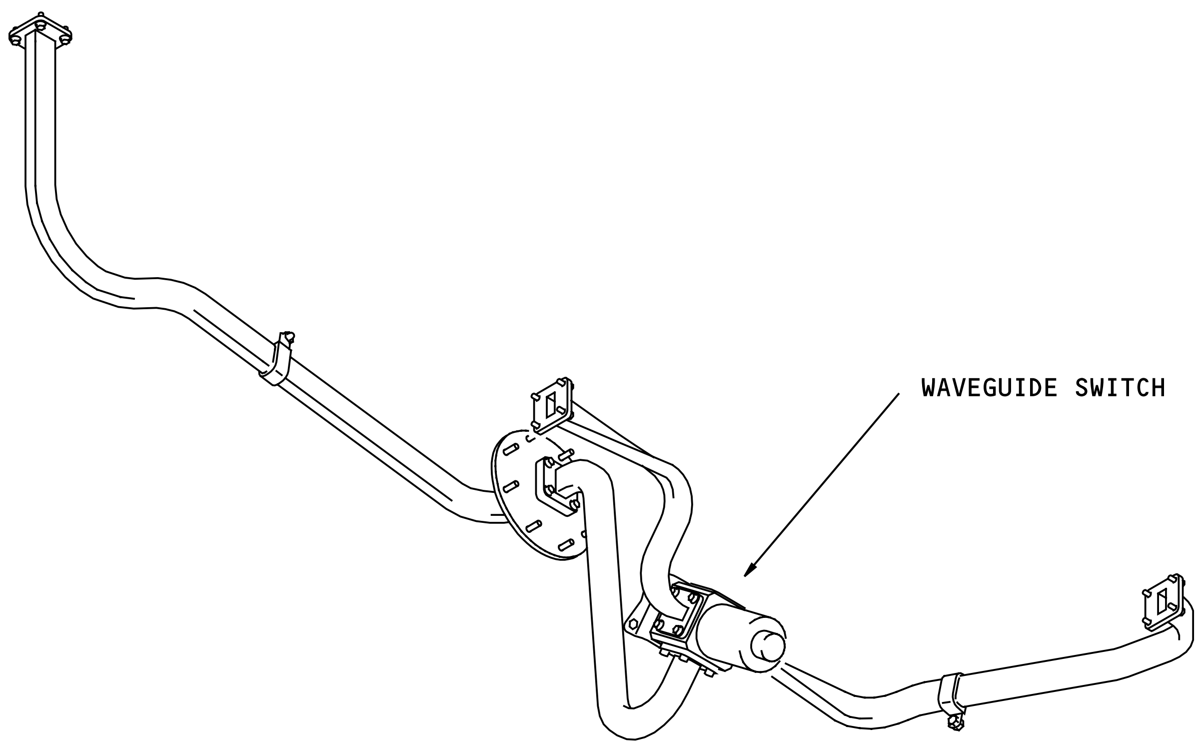
The WXR waveguide switch, switches the WXR antenna between the left and right WXR RTs.

Description

The WXR waveguide switch has three rigid waveguide sections attached to it that go to the:

- Left WXR RT
- Right WXR RT
- WXR antenna pedestal.

The waveguide switch has an electrical connection that enables the switch operation. A discrete signal from the WXR control panel causes the switch to operate.



34-43-00-015 Rev 1

WXR SYSTEM - RF SWITCHING

WXR SYSTEM - CONTROL - EFIS CONTROL PANEL

EFIS Control Panel

These are the functions of the EFIS control panel for WXR control:

- Supplies the on and off control of the WXR RTs
- Enables the NDs to show WXR data
- Supplies the selection of different ND modes
- Supplies the selection of different ranges for WXR data to show on the NDs.

WXR Map Switch

When you push the WXR map switch on the EFIS control panel:

- The WXR RT selected on the WXR panel starts to operate
- The WXR data shows on the onside ND.

To stop the operation of the WXR RT, the WXR switches on both EFIS control panels and the WXR selections on the CDUs must be off.

ND Mode Selector

Use the mode selector switch to select an ND mode. The ND modes that show a WXR display are:

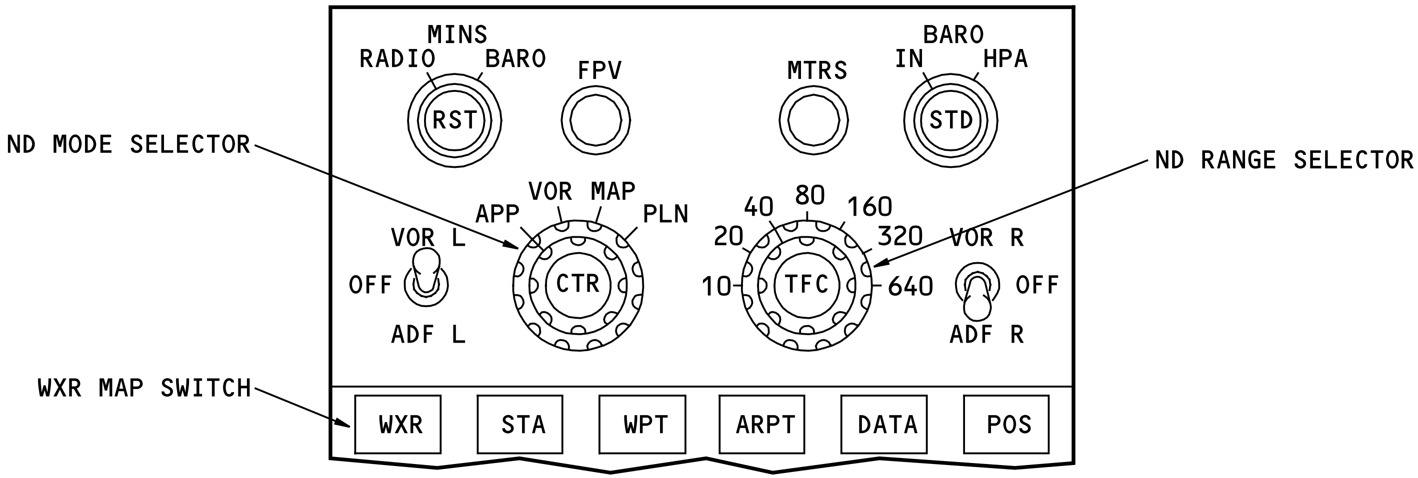
- Expanded APP (approach) mode
- Expanded VOR mode
- Expanded MAP mode
- Centered MAP mode.

If the mode selector is not in a correct mode when you push the WXR map switch, the weather display arms. When armed, the weather display shows as soon as you change the ND selector to a correct mode. The weather display stays armed even if you push the WXR map switch again.

ND Range Selector

The EFIS control panel has a six position range selector. The range selections are 10, 20, 40, 80, 160, 320 and 640 NM. With the 640 NM range selection, the 640 NM range shows on the ND, but the WXR RT only shows weather displays out to its maximum range of 320 NM.

The MAP mode shows the range at all times. The APP and VOR modes show the range only when the WXR is on.



WXR SYSTEM - CONTROL - EFIS CONTROL PANEL

WXR SYSTEM - CDU SELECTIONS

Alternate or Backup EFIS Control Panel

The EFIS control page on the control display unit (CDU) permits alternate or backup controls for the WXR system.

If the EFIS CP fails or for alternate operation, use the EFIS control CDU pages on the onside CDU for:

- On/off power control of the WXR system
- On/off control of the onside WXR display
- WXR range selection
- ND mode selection.

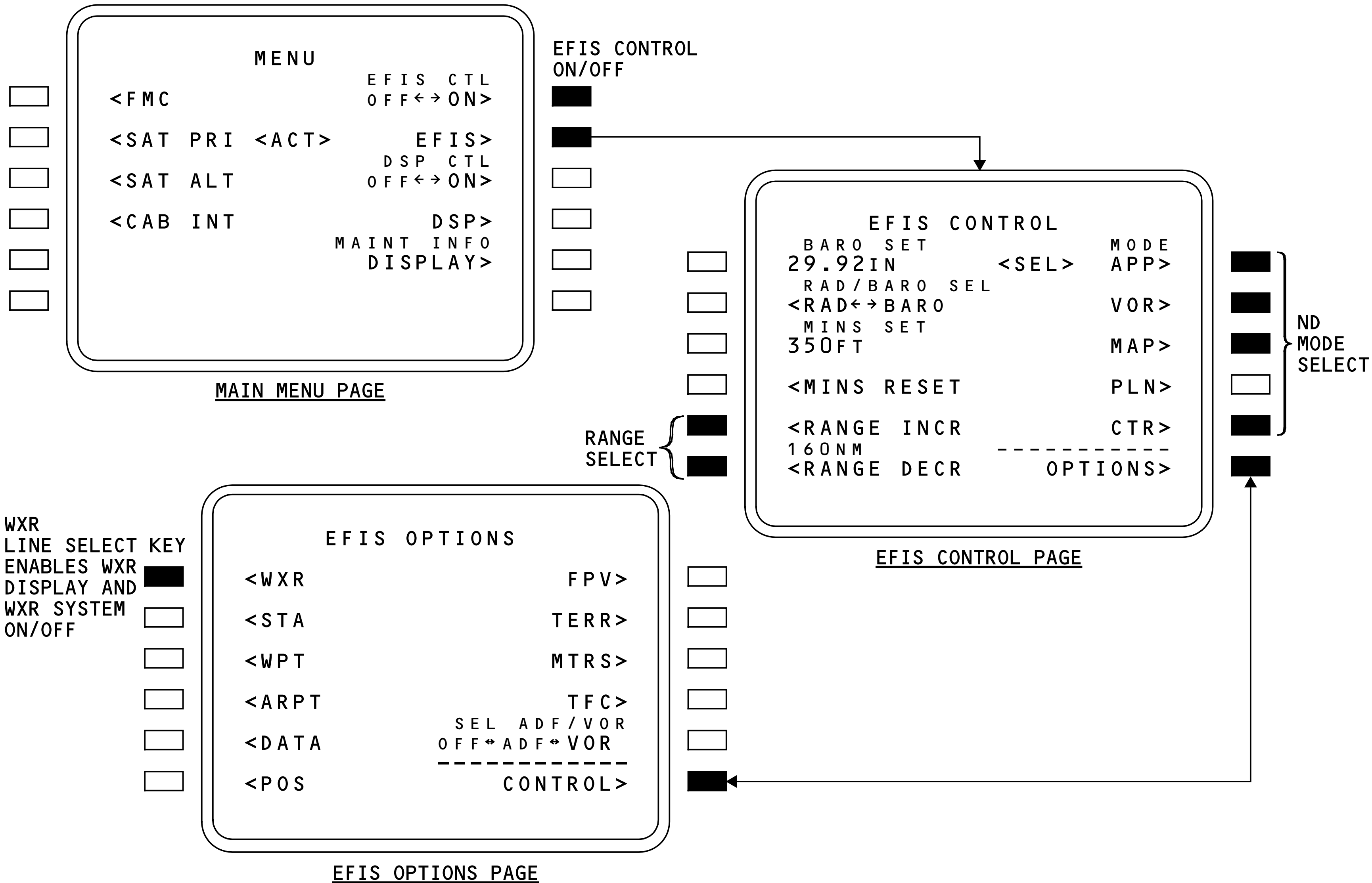
When you select EFIS control to ON from the CDU page, the onside EFIS CP does not operate.

Access

To get the EFIS control CDU pages on the CDU:

- Push the MENU line select key (LSK) on the CDU to make the MENU page come on
- Push the EFIS CTL LSK on the MENU page and the EFIS prompt comes on
- Push the LSK next to EFIS and the EFIS control page comes on
- Select the ND modes and range From the EFIS CONTROL page
- Push the OPTIONS LSK on the EFIS CONTROL page to go to the EFIS OPTIONS page
- Push the WXR LSK on the EFIS OPTIONS page for ON/OFF control of the WXR system and to enable the WXR display for the onside ND.
- Push the CONTROL LSK on the EFIS OPTIONS page to return to the EFIS CONTROL page.

You can use the EFIS CP CDU pages on the CDU at anytime, but normally the EFIS CP supplies the control for the WXR system.



WXR SYSTEM - CDU SELECTIONS

WXR SYSTEM - NORMAL DISPLAYS

Display Modes

The ND shows WXR system data in these modes:

- Expanded approach mode
- Expanded VOR mode
- Centered MAP mode
- Expanded MAP mode.

Each ND mode has a range selection for 10, 20, 40, 80, 160, 320, or 640 NM. Use the EFIS CP to select the mode and range for the ND.

WXR System Display Data

For the WXR system, the ND shows this information:

- WXR displays
- WXR system messages
- WXR alert messages.

WXR Displays

The WXR displays on the ND show the weather in front of the airplane or the terrain below. The WXR display shows in four colors. These colors represent the strength of the RF return signals from the weather or the terrain. These are the four colors for the WXR displays:

- Green shows light weather
- Yellow shows medium weather
- Red shows heavy weather
- Magenta shows turbulence.

The WXR system detects and shows turbulence only to 40 NM.

WXR System Messages

The ND shows WXR system messages on three lines. Line 1 shows WXR mode messages. These are the messages that show on line 1:

- WXR (weather precipitation mode)
- TURB (turbulence mode)
- WX+T (weather and turbulence mode)
- MAP (manual gain)
- TEST (test mode).

Line 2 shows the antenna tilt value set on the WXR panel. The tilt value is +15 degrees to -15 degrees.

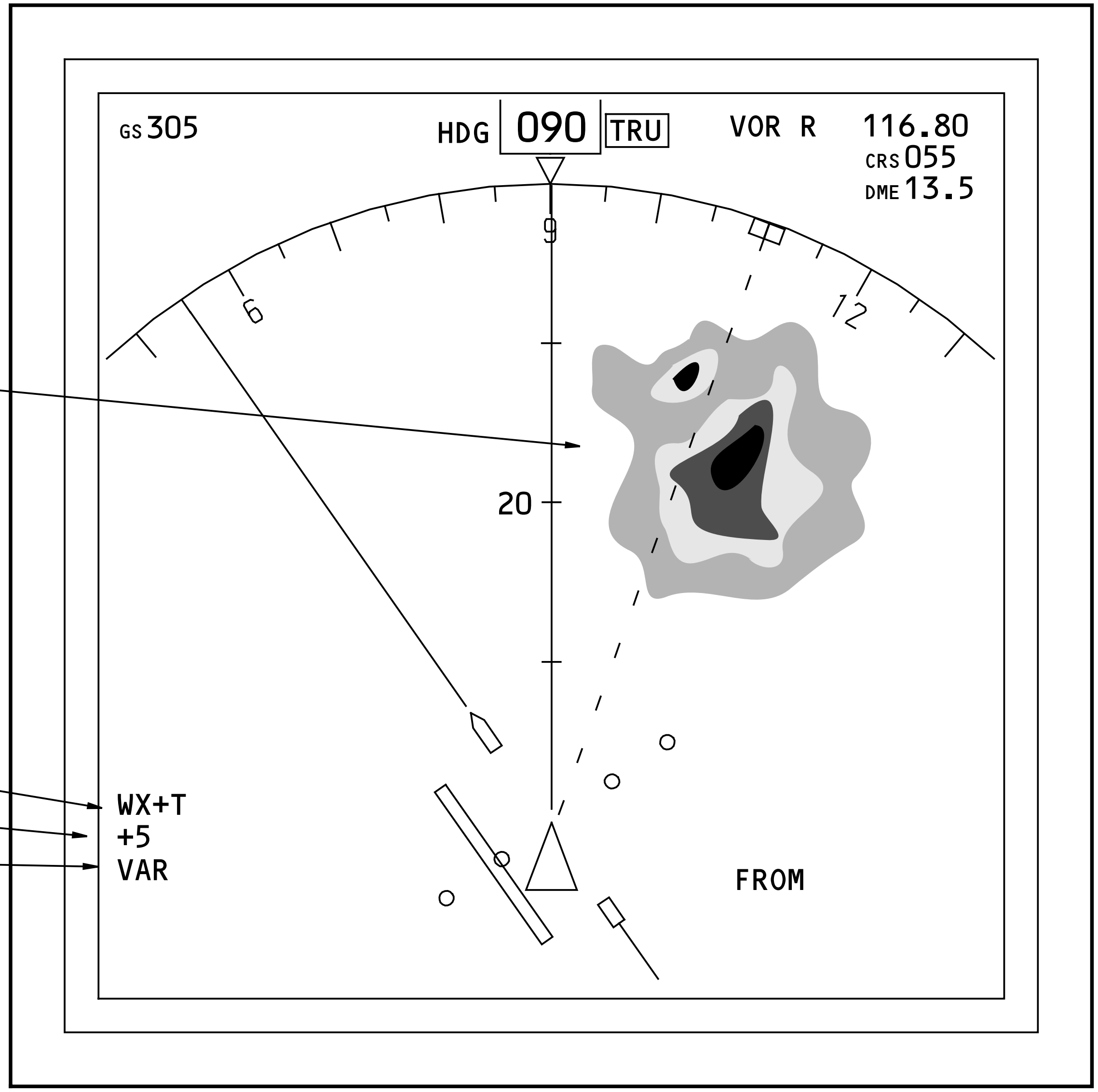
Line 3 shows the manual gain selection made on the WXR panel. The message for manual gain selection is VAR.

When the flight crew does not make a manual gain selection, the WXR RT uses preset calibrated gain and no gain message shows.

All WXR system messages show in the color cyan.

WEATHER DISPLAY:
- GREEN = LIGHT WEATHER
- YELLOW = MEDIUM WEATHER
- RED = HEAVY WEATHER
- MAGENTA = TURBULENCE

WEATHER SYSTEM MESSAGES:
- WEATHER MODE
- ANTENNA TILT
- GAIN VALUE



EXPANDED APPROACH MODE

WXR SYSTEM - NORMAL DISPLAYS

34-43-00-018 Rev 6 02/10/1998

WXR SYSTEM - FAIL MESSAGES AND DISPLAYS

WXR System Alert Messages and Display

When a WXR RT processes data that is not satisfactory, alert messages show on the ND and the WXR display continues to show. These alert messages are:

- WXR WEAK shows for a receiver gain calibration fail
- WXR ATT shows when both attitude inputs fail
- WXR STAB shows when the airplane attitude exceeds stabilization limits.

The alert messages show on these alert-lines:

- Line 1 shows WXR in amber
- line 2 shows WEAK or ATT in amber, WEAK has the highest priority
- Line 3 shows STAB in cyan.

WXR System Fail Messages and Display

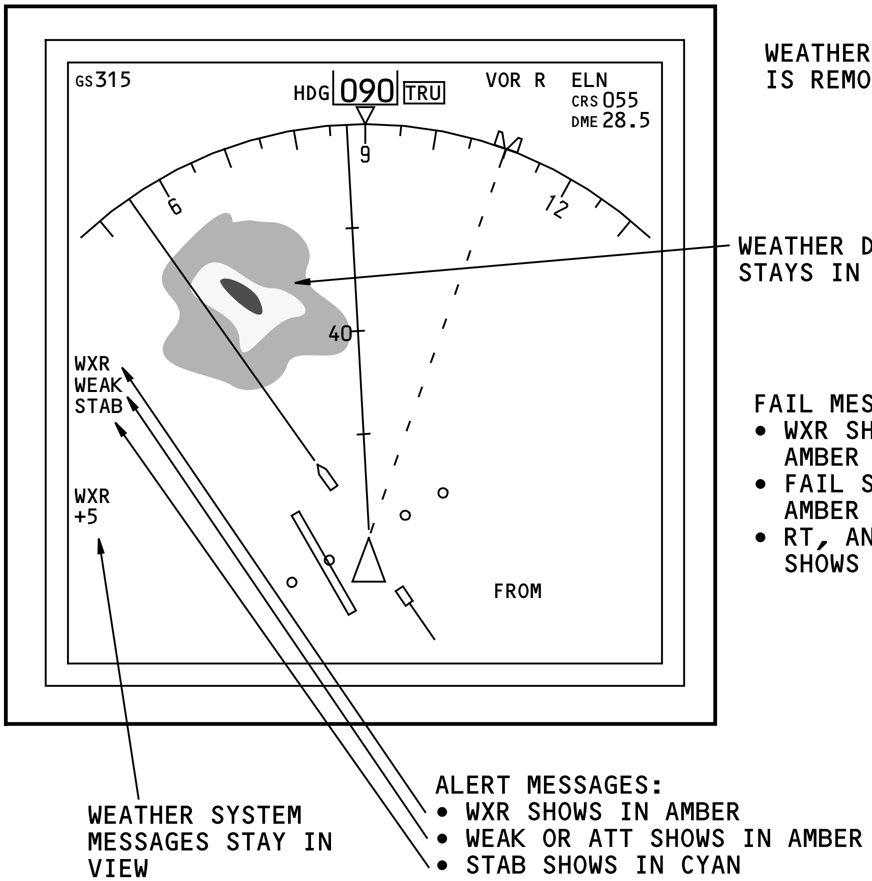
When a failure occurs, a WXR fail message shows and the WXR display does not show.

The fail messages show on these alert-lines:

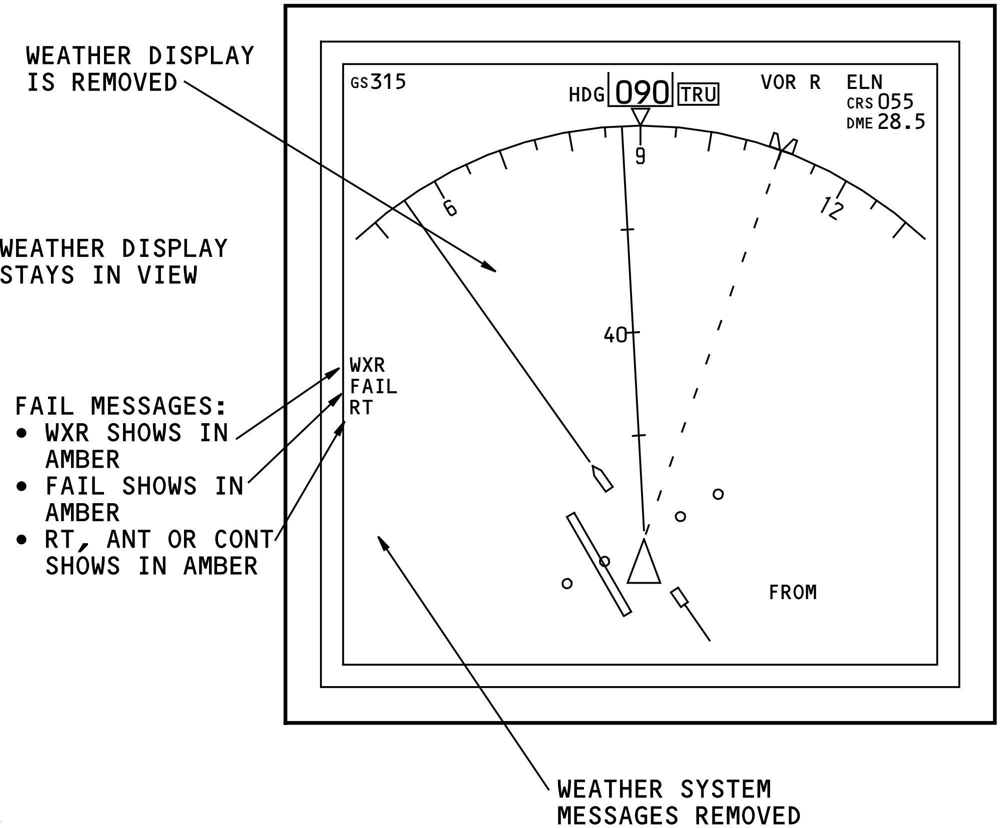
- Line 1 shows WXR in amber
- Line 2 shows FAIL in amber.

These WXR system fail messages show on alert-line 3:

- RT shows for a receiver-transmitter failure
- ANT shows for an antenna failure
- CONT shows for a WXR CP failure.



WXR SYSTEM ALERT MESSAGES AND DISPLAY



WXR SYSTEM FAIL MESSAGES AND DISPLAY

34-43-00-019 Rev 5 07/11/95

WXR SYSTEM - FAIL MESSAGES AND DISPLAYS

WXR SYSTEM - ND RANGE DISAGREEMENT

General

The graphics generators (GGs) in the left and right AIMS cabinets do a comparison of the ranges from these places:

- EFIS CP
- WXR RT
- Flight management computer function (FMCF).

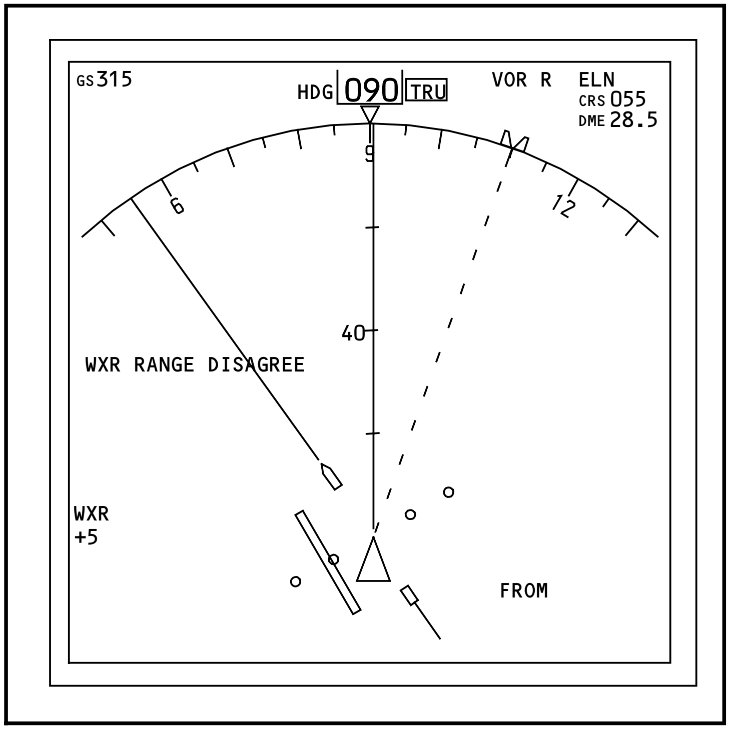
A difference between any of these ranges causes an amber range disagreement message.

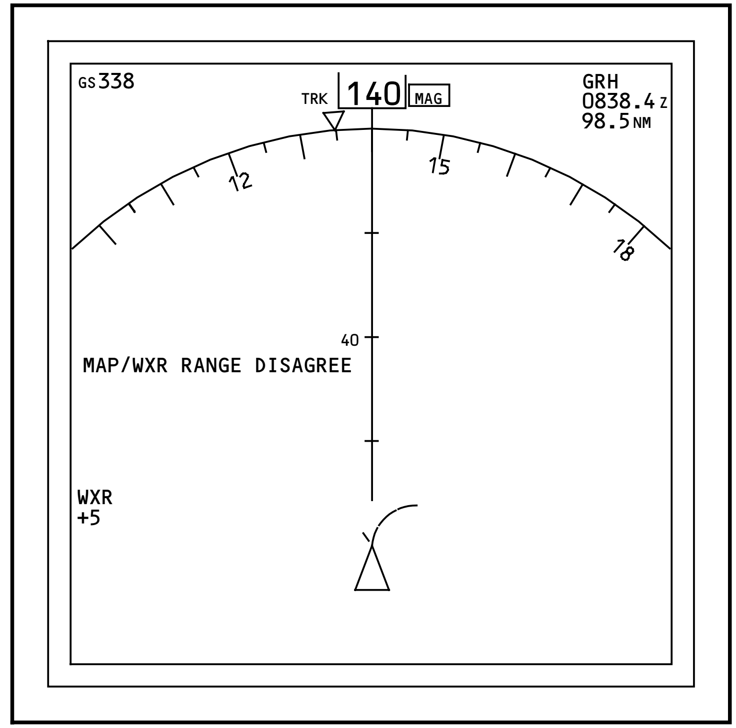
These two range disagreement messages are possible:

- WXR RANGE DISAGREE shows when there is a difference between the EFIS CP range and the WXR RT range
- MAP/WXR RANGE DISAGREE shows when there is a difference between the EFIS CP range, the WXR RT range, and the FMCF range.

This happens during a range disagreement:

- The WXR display does not show
- The mode, tilt, and gain messages show
- The FMCF range shows.





EXPANDED APPROACH
EXPANDED VOR
EXPANDED MAP
CENTERED MAP
} MODES

EXPANDED MAP
CENTERED MAP
} MODES

34-43-00-020 Rev 0

WXR SYSTEM - ND RANGE DISAGREEMENT

WXR SYSTEM - SYSTEM SELECT AND SYSTEM ON/OFF

System Select

When you select the left or right WXR system at the WXR panel, an RT ENABLE goes to switch S1 in the same WXR RT to enable the RT to operate. 28v dc from the keep-alive power supply goes from the selected RT through the system select switch in the WXR panel to the waveguide switch. The 28v dc energizes the waveguide switch relay to connect the selected RT to the WXR antenna.

System On

To make the WXR system operate, do either of these:

- Push the WXR switch on an EFIS control panel
- Push the LSK for WXR on the EFIS OPTIONS page on the CDU.

When you do this, the AIMS cabinets supply a ground level discrete through the WXR panel through switch S1 of the RTs. This ground level discrete lets 28v dc power go from the keep-alive power supply to energize the relay to close switches S2 and S3 if S1 is energized by the WXR control panel system select switch. The 28v dc keep-alive power supply sends power through switch S2 to energize the WXR CP power supply. 115v ac goes through switch S3 to energize the RT power supply and the WXR antenna drive.

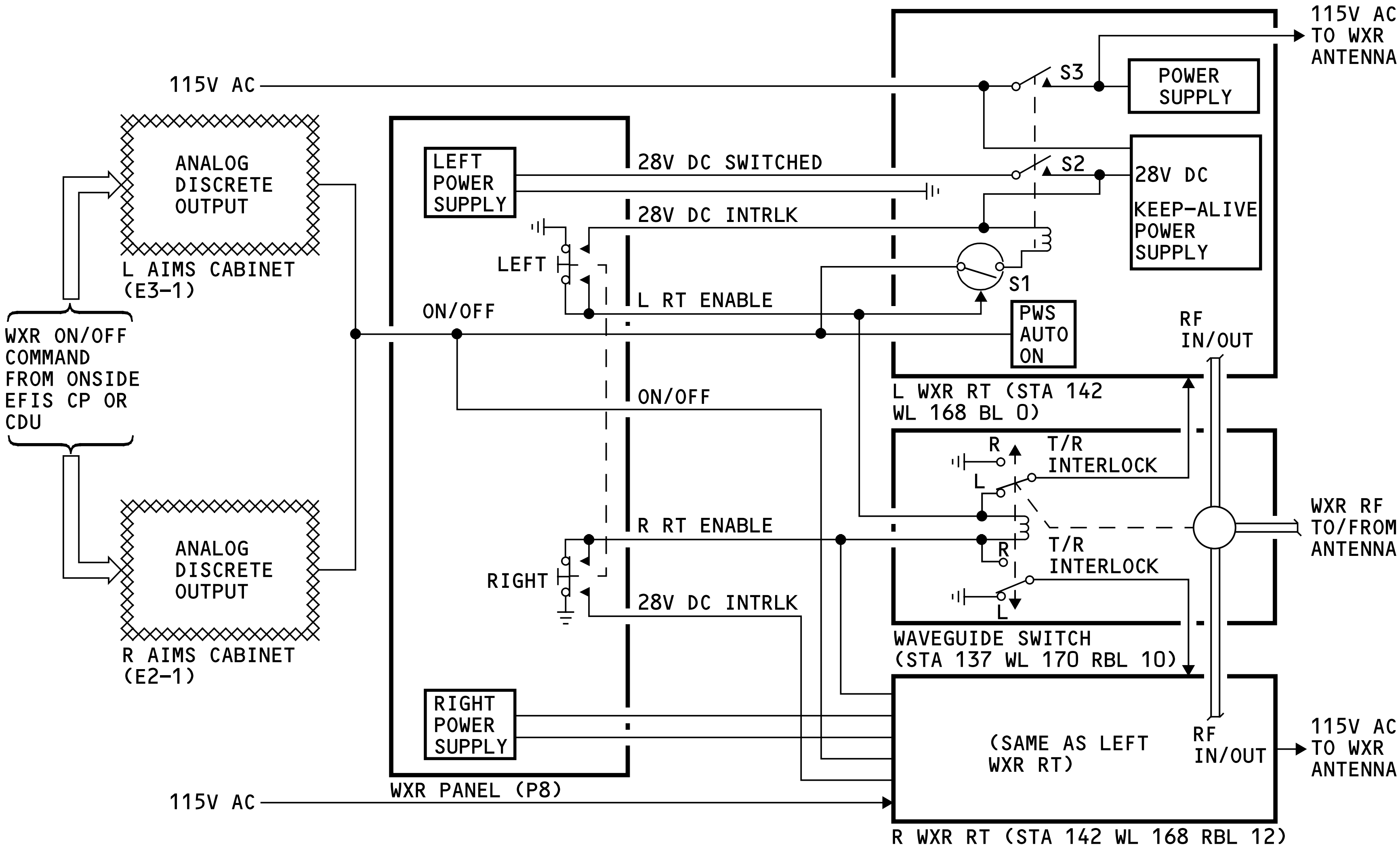
Certain conditions cause the predictive windshear (PWS) function to turn the WXR system on automatically. When this happens, the ground signal to switch S1 comes from the PWS card in the selected RT, instead of the AIMS cabinets.

System Off

To make the WXR system go OFF, do either of these:

- Push the WXR switch again
- Push the WXR LSK on the EFIS OPTIONS page again.

This removes the ground level discrete from the AIMS cabinet. If more than one WXR switch is on, push all of the switches again.



WXR SYSTEM - SYSTEM SELECT AND SYSTEM ON/OFF

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WXR SYSTEM - SELF-TEST

Training Information Point

The weather radar (WXR) system transmits some pulses to let BITE monitor for correct operation. Do not do a test of the WXR system in a hangar. Make sure the nose of the airplane points away from buildings and other aircraft or large metal objects.

Test Preparation

WARNING: DO NOT OPERATE THE WEATHER RADAR WHILE FUEL IS ADDED OR REMOVED FROM THE AIRPLANE. DO NOT TRANSMIT RF ENERGY WHILE FUEL IS ADDED OR REMOVED IN AN AREA 300 FEET OR LESS FROM THE ANTENNA. THIS CAN CAUSE AN EXPLOSION.

WARNING: MAKE SURE NO PERSONS ARE IN THE AREA 15 FEET OR LESS FROM THE ANTENNA WHEN IT TRANSMITS RF ENERGY. RF ENERGY CAN CAUSE INJURIES TO PERSONS.

Use an EFIS control panel or a CDU to:

- Select an ND mode that can show the WXR display
- Apply power to the selected RT
- Enable the WXR display to show on the on-side ND.

Test Start

When you select TEST on the WXR control panel, the WXR self-test starts.

Test Operation

These visual and aural annunciations show for a normal test:

- WXR test pattern and cyan WXR TEST message show on the ND
- Amber WINDSHEAR message on ND
- Aural message - MONITOR WINDSHEAR DISPLAY
- Red WINDSHEAR message on ND and PFD
- Aural message - WINDSHEAR AHEAD, WINDSHEAR AHEAD
- Master warning lights on
- EICAS status messages WINDSHEAR PRED
- EICAS advisory message WINDSHEAR SYS.

The WXR TEST pattern shows until you select another mode on the WXR panel or EFIS control panel.

The TEST pattern shows without any alert annunciations if either of these conditions exist:

- PWS is on
- Airplane is in the air.

The PWS symbol always shows in the TEST pattern. If PWS detects a real windshear threat while in TEST mode, the test stops. PWS then shows the actual display data and alert annunciations.

Test Pass

For a valid self-test, you must see and hear all visual and aural annunciations.

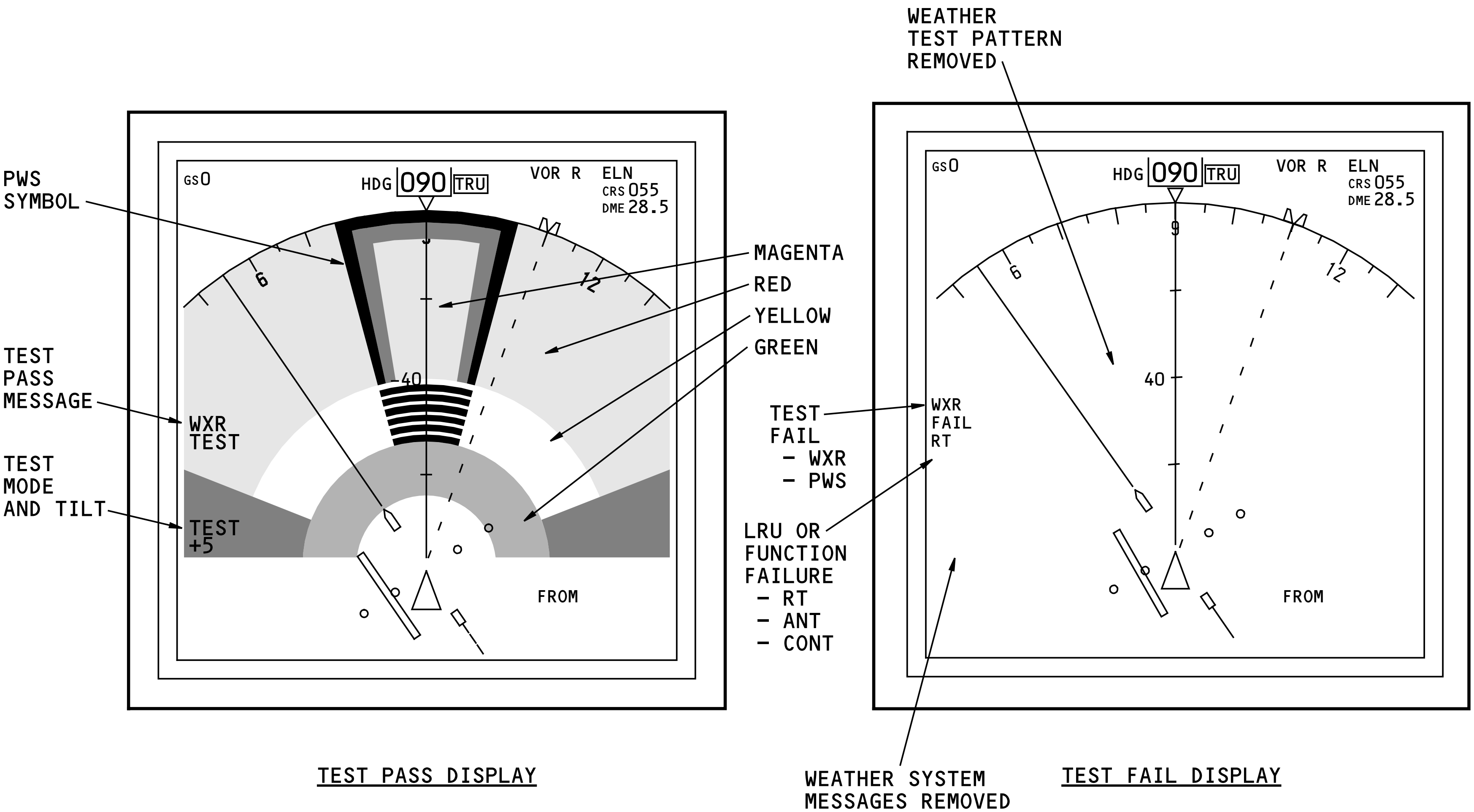
WXR SYSTEM - SELF-TEST

Test Fail

For a self-test that fails, these are the indications:

- For some faults, the WXR test pattern does not show
- WXR or PWS shows in amber on alert message line one
- FAIL shows in amber on alert message line two
- A fail message shows for the WXR system failure.

The windshear symbol shows on the ND, even if PWS fails self-test.



34-43-00-025 Rev 6 02/06/1998

WXR SYSTEM - SELF-TEST

WXR SYSTEM - LRU REPLACEMENT TEST

General

These are the LRU replacement tests for the weather radar system:

- Left WXR system
- Right WXR system.

Weather Radar LRU Replacement Test

The WXR system LRU replacement test causes the WXR RT to do a check of internal WXR RT operations. This test also makes sure the WXR RT connections are good. This test does not do a detailed check of the WXR RT data inputs.

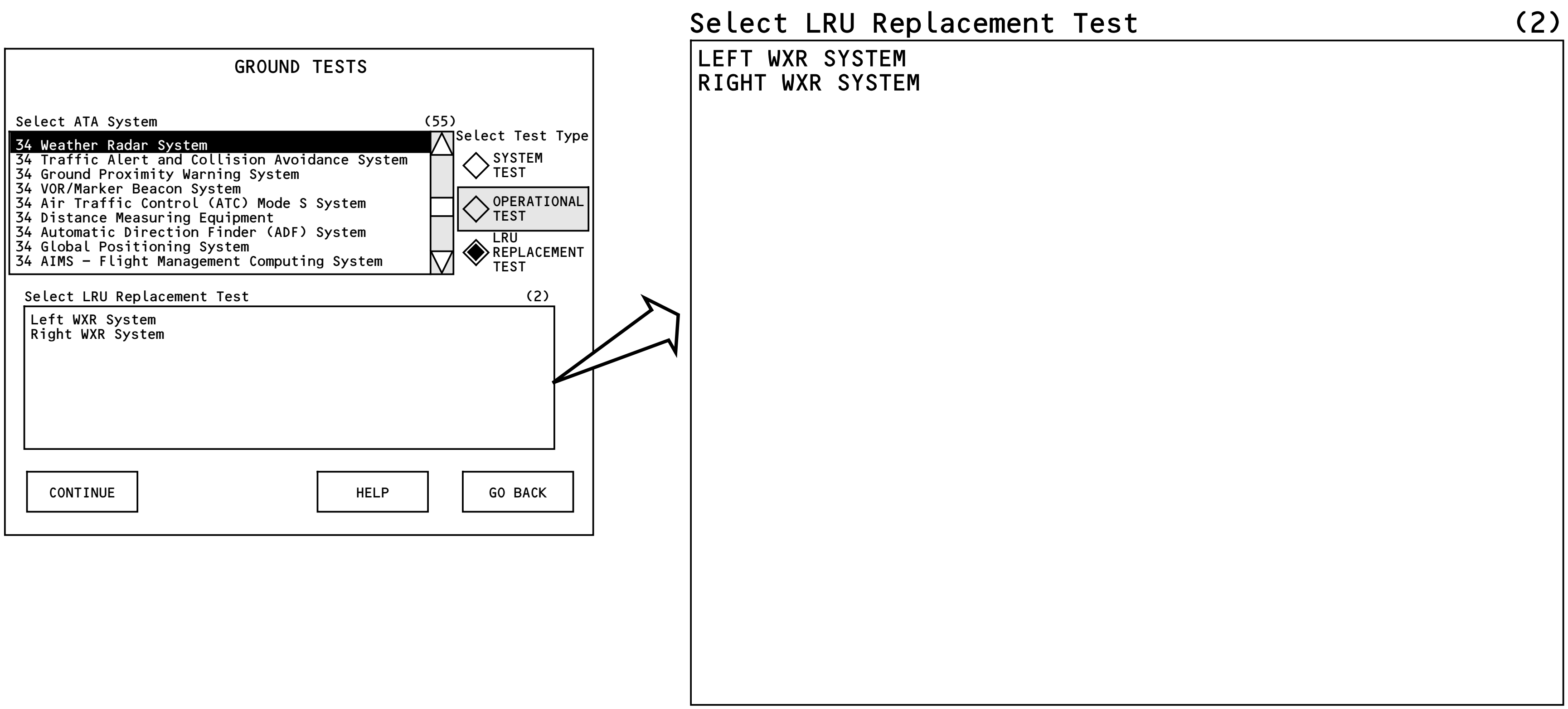
Training Information Point

There are no ND WXR test display patterns when you do a WXR LRU replacement test.

Do not do a WXR system test in a hangar. Make sure the nose of the airplane points away from buildings, other aircraft or large metal objects.

WARNING: DO NOT OPERATE THE WEATHER RADAR WHILE FUEL IS ADDED OR REMOVED FROM THE AIRPLANE. DO NOT TRANSMIT RF ENERGY WHILE FUEL IS ADDED OR REMOVED IN AN AREA 300 FEET OR LESS FROM THE ANTENNA. THIS CAN CAUSE AN EXPLOSION.

WARNING: MAKE SURE NO PERSONS ARE IN THE AREA 15 FEET OR LESS FROM THE ANTENNA WHEN IT TRANSMITS RF ENERGY. RF ENERGY CAN CAUSE INJURIES TO PERSONS.



34-43-00-026 Rev 4

WXR SYSTEM - LRU REPLACEMENT TEST

WXR SYSTEM - SYSTEM TEST

General

These are the system tests for the weather radar system:

- Left WXR system
- Right WXR system.

Weather Radar System Test

You use the WXR system test to verify the correct internal operation of the WXR RT, and to do a detailed check of the WXR RT data inputs.

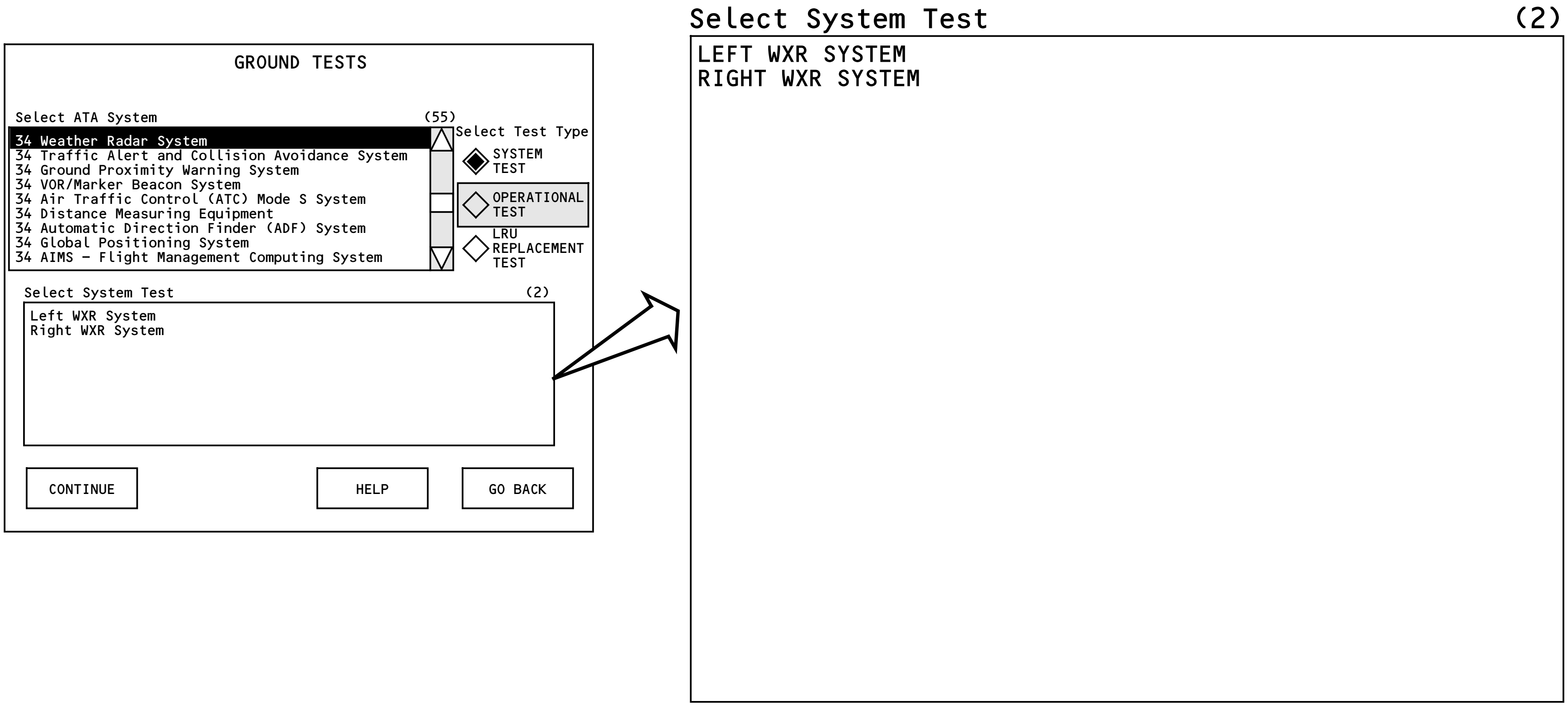
Training Information Point

There are no ND WXR test display patterns when you do a WXR system test.

Do not test the WXR system in a hangar. Make sure the nose of the airplane points away from buildings and other aircraft or large metal objects.

WARNING: DO NOT OPERATE THE WEATHER RADAR WHILE FUEL IS ADDED OR REMOVED FROM THE AIRPLANE. DO NOT TRANSMIT RF ENERGY WHILE FUEL IS ADDED OR REMOVED IN AN AREA 300 FEET OR LESS OR THE ANTENNA. THIS CAN CAUSE AN EXPLOSION.

WARNING: MAKE SURE NO PERSONS ARE IN THE AREA 15 FEET OR LESS FROM THE ANTENNA WHEN IT TRANSMITS RF ENERGY. RF ENERGY CAN CAUSE INJURIES TO PERSONS.



34-43-00-027 Rev 1

WXR SYSTEM - SYSTEM TEST

Continental Airlines, Inc

Air Traffic Control System

WB371

TABLE OF CONTENTS

AIR TRAFFIC CONTROL/MODE S TRANSPONDER SYSTEM

General

The air traffic control (ATC) ground stations interrogate the airborne ATC/Mode S transponder system. The ATC/Mode S transponder replies to the interrogations in the form of coded information that the ground station uses.

The ground station uses a primary surveillance radar (PSR) to get radar returns from airplanes within the radar range. To make a communication link with the airplanes in the radar range, the ground station uses a secondary surveillance radar (SSR) to interrogate the ATC/Mode S transponder. The ground station transmits a side lobe suppression signal to inhibit close ATC replies that come from a SSR side lobe transmission.

On the ground radar display, the ATC operator sees the radar returns, altitude, and a four digit airplane identifier.

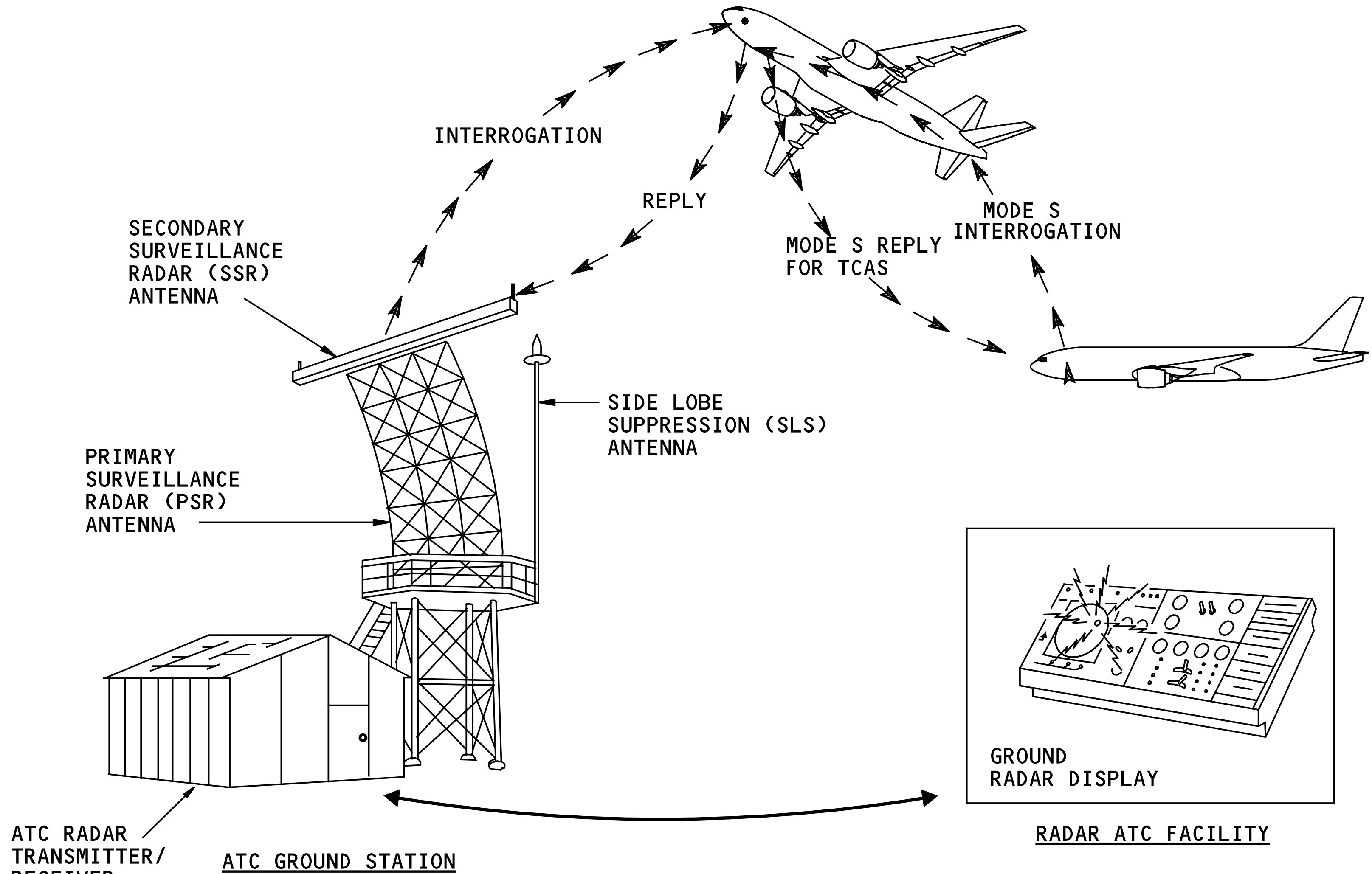
The ATC/Mode S transponder also replies to mode S interrogations from the traffic alert and collision avoidance systems (TCAS) of other airplanes.

Abbreviations and Acronymns

ABS - absolute
ABV - above
ADIRS - air data inertial reference system
AIMS - airplane information management system
ALT - altitude
ant - antenna
ATC - air traffic control
ATCRBS - air traffic control radio beacon system
BITE - built-in test equipment
BLW - below
CMCF - central maintenance computing function
CMCS - central maintenance computing system
coax - coaxial
CPU - central processing unit
gnd - ground
I/O - input/output
ident - identification
INS - instrument
LED - light emitting diode
MAT - maintenance access terminal
MAX - maximum
PSR - primary surveillance radar
RA - resolution advisory
REL - relative
RF - radio frequency
RPTG - reporting
SDI - source destination identifier
SLS - side lobe suppression
SSR - secondary surveillance radar
SPI - special purpose identification
STBY - standby
sw - switch
TA - traffic advisory
TAS - true air speed

AIR TRAFFIC CONTROL/MODE S TRANSPONDER SYSTEM

TCAS	-	traffic alert and collision avoidance system
tpr	-	transponder
XFR	-	transfer
xpdr	-	transponder
xpndr	-	transponder



34-53-00-001 Rev 1

AIR TRAFFIC CONTROL/MODE S TRANSPONDER SYSTEM

ATC/MODE S TRANSPONDER SYSTEM - GENERAL DESCRIPTION

General

When a ground station or a TCAS computer from another airplane interrogates the ATC/Mode S transponder system, the transponder transmits a pulse-coded reply signal. The reply signal identifies, and shows the altitude of the airplane.

General Description

The components of the ATC system are:

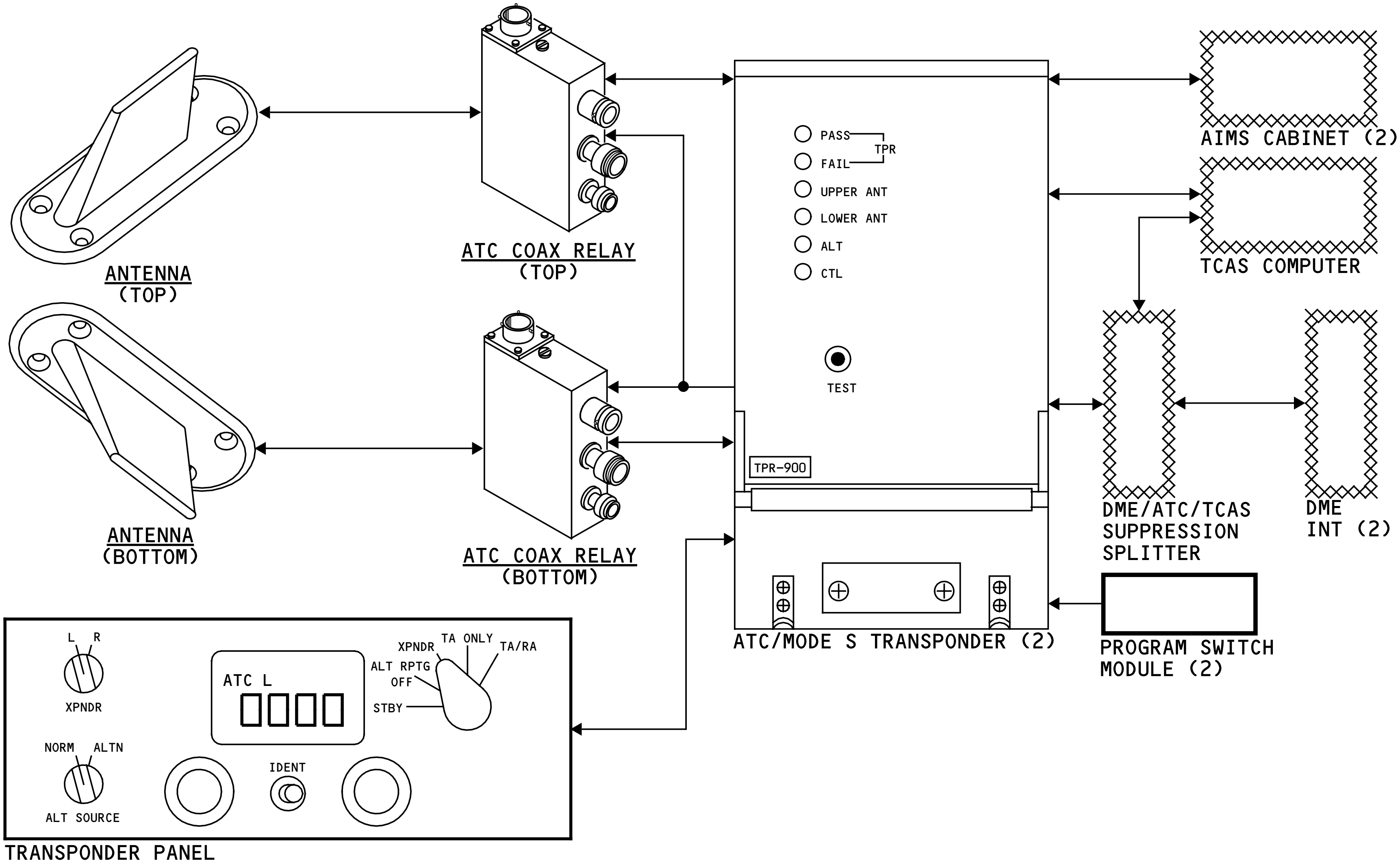
- Top antenna
- Bottom antenna
- ATC coaxial relay top
- ATC coaxial relay bottom
- Transponder panel
- Two ATC/Mode S transponders
- Two program switch modules.

The two antennas supply transmit and receive signals to the ATC/Mode S transponder through the ATC coax relays.

The transponder panel sends identification and control data to the transponders and control to the ATC coax relays.

The AIMS cabinets supply altitude and central maintenance computing function (CMCF) data to the ATC/ Mode S transponders.

The ATC/Mode S transponders have interface with the TCAS computer.



34-53-00-002 Rev 6 02/27/1998

ATC/MODE S TRANSPONDER SYSTEM - GENERAL DESCRIPTION

ATC/MODE S TRANSPONDER SYSTEM - COMPONENT LOCATION

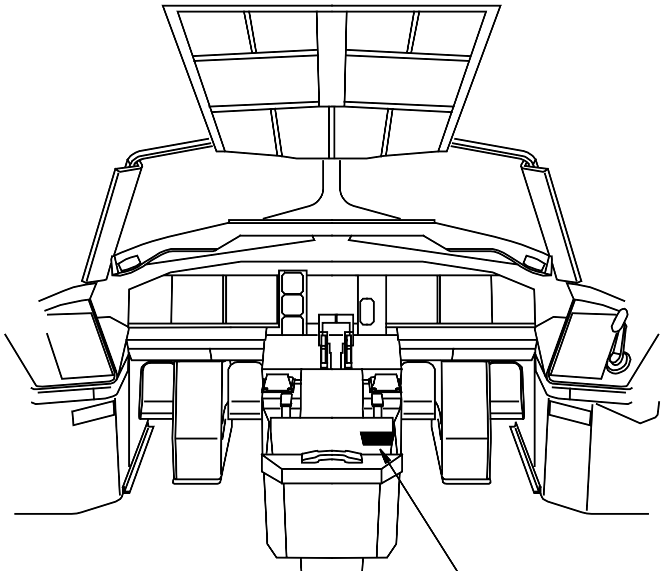
Flight Deck

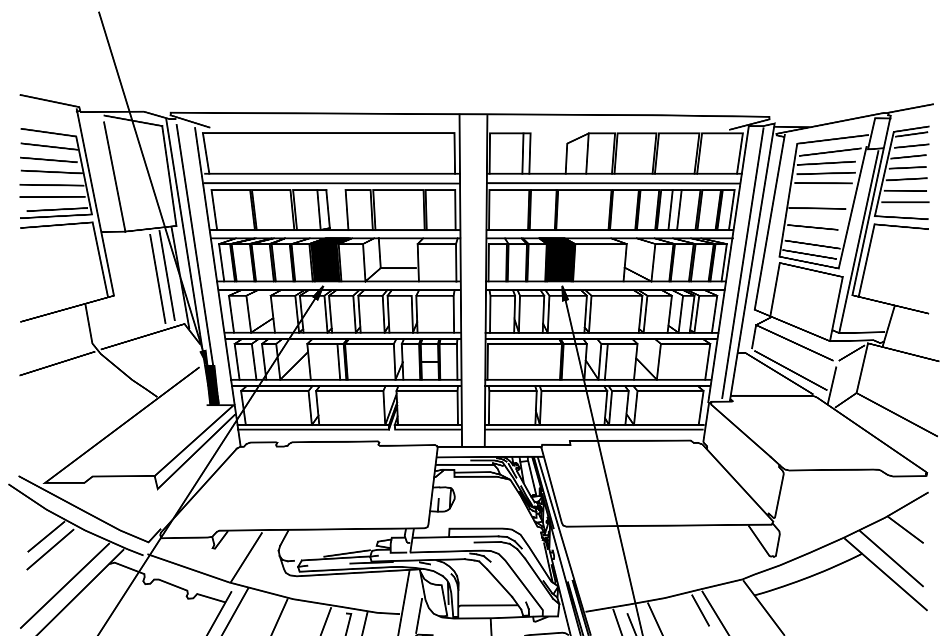
The transponder panel is on the P8 aft aisle stand.

Main Equipment Center

The ATC/Mode S transponder system components in the main equipment center are:

- Left ATC/Mode S transponder
- Right ATC/Mode S transponder
- Program switch modules
- Top ATC coax relay
- Bottom ATC coax relay.





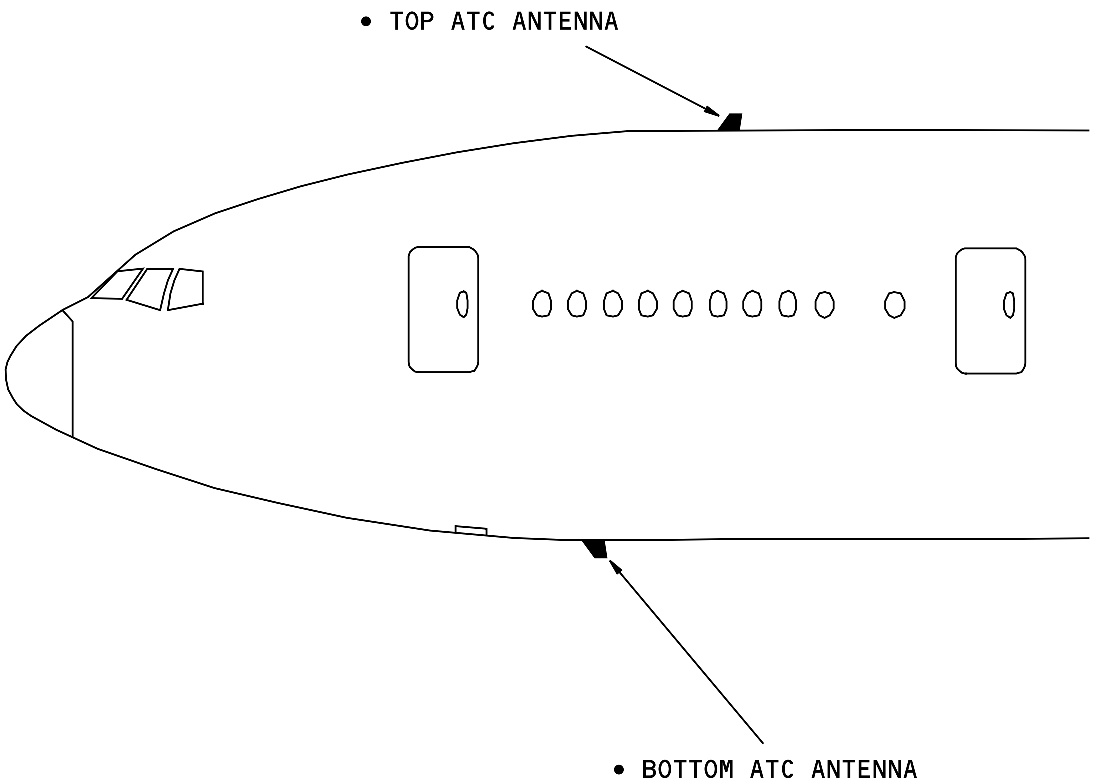
34-53-00-003 Rev 1 02/27/1998

ATC/MODE S TRANSPONDER SYSTEM - COMPONENT LOCATION

ATC/MODE S TRANSPONDER SYSTEM - ANTENNA LOCATION

GENERAL

The top antenna is at station 560.5 and the bottom antenna is at station 480.

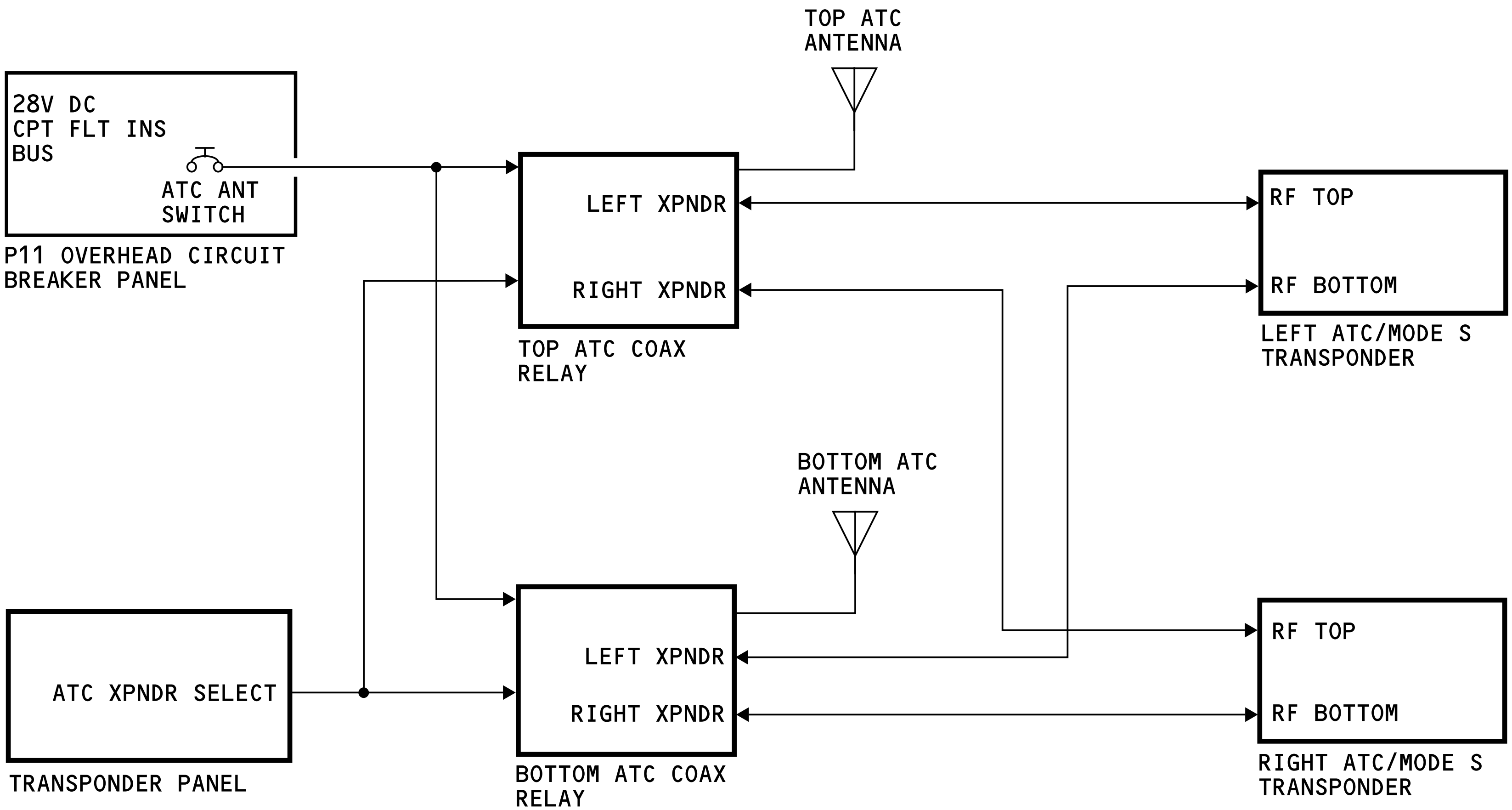


ATC/MODE S TRANSPONDER SYSTEM - ANTENNA LOCATION

ATC/MODE S TRANSPONDER SYSTEM - ANTENNA INTERFACE

General

When you select the left ATC/mode S transponder system, the ATC coax relays do not energize and the antennas connect to the left transponder. When you select the right ATC/mode S transponder system, the transponder panel sends a discrete to the ATC coax relays. This makes the top and bottom antennas connect to the right transponder.



34-53-00-005 Rev 1

ATC/MODE S TRANSPONDER SYSTEM - ANTENNA INTERFACE

ATC/MODE S TRANSPONDER SYSTEM - POWER, IDENTITY, CONTROL, AND AIR DATA INTERFACES

Power

The left ATC/Mode S transponder gets 115v ac power from the ac standby bus. The right ATC/Mode S transponder gets 115v ac power from the right ac transfer bus. The dual transponder panel gets 115v ac power from the ac standby bus.

Standby/On Discrete

The transponder panel sends a (ground) standby discrete to the transponder that is not in use.

Identity Code

The flight crew sets the four digit identity code and it shows on the transponder panel. Both transponders get the identity code from the transponder panel.

Control Data

The transponder panel also sends control data to the transponders. This control data does these functions:

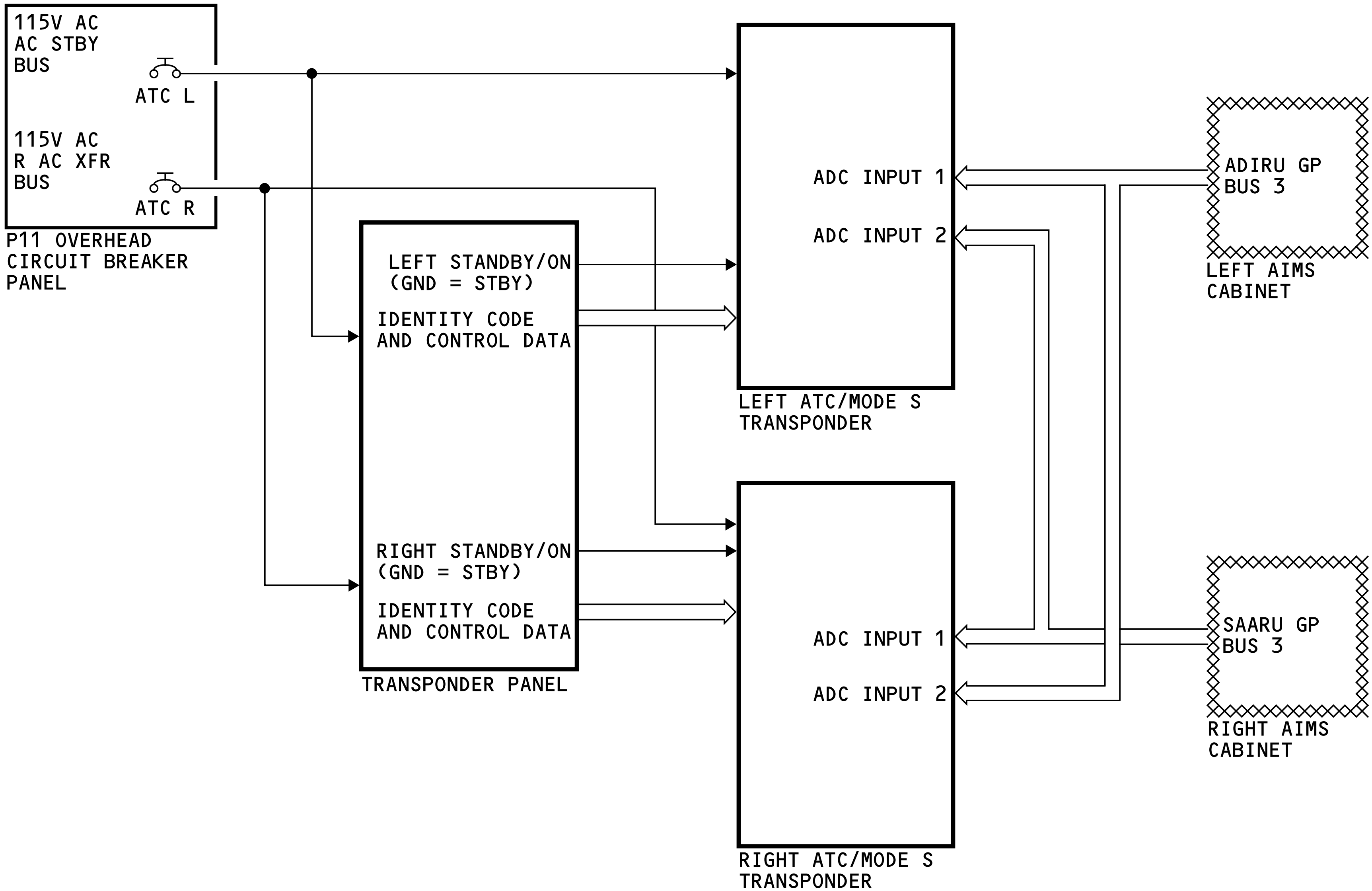
- Permit mode C altitude reporting
- Permit the transponder to send the special position identification (SPI) pulse or airplane identification code.

Air Data

The air data inertial reference unit (ADIRU) and the secondary attitude air data reference unit (SAARU) send air data to the AIMS cabinets. ATC/Mode S transponders receive the air data from both AIMS cabinets.

The left transponder gets air data at ADC input 1 from the ADIRU general purpose (GP) bus 3 from left AIMS cabinet. Air data at ADC input 2 comes from the SAARU GP bus 3 from the right AIMS cabinet.

The right transponder gets air data at ADC input 1 from the SAARU GP bus 3 of the right AIMS cabinet. Air data at ADC input 2 comes from the ADIRU GP bus 3 from the left AIMS cabinet.



34-53-00-007 Rev 2 03/23/1998

ATC/MODE S TRANSPONDER SYSTEM - POWER, IDENTITY, CONTROL, AND AIR DATA INTERFACES

ATC/MODE S TRANSPONDER SYSTEM - MAINTENANCE INTERFACE

Air/Ground

The air/ground discretes go through the transponder panel to the transponders.

The purpose of the air ground relay is to:

- Prevent ground tests of the ATC system in the air
- Define flight legs in the non-volatile memory if the CMCFs fail.

Transponder - Central Maintenance Computing Function Interface

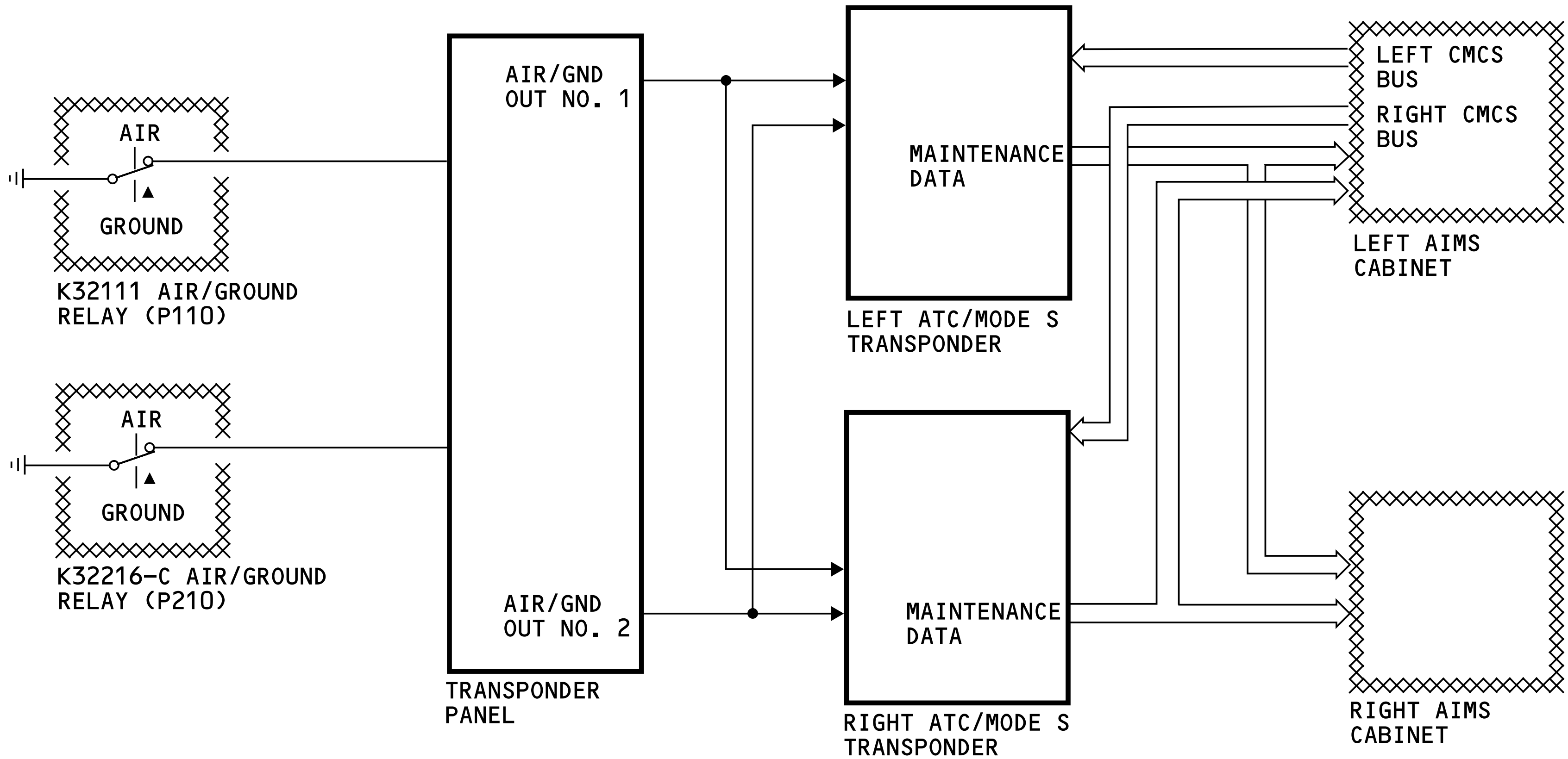
Each transponder has a maintenance interface to the central maintenance computing function (CMCF) of the AIMS cabinets.

The transponders continuously send ATC system maintenance data to the CMCFs in the AIMS cabinets.

The central maintenance computing function (CMCF) in the left AIMS cabinet sends data to both transponders to do these functions:

- Define flight legs for the non-volatile memory (NVM) in the transponder
- Command the ATC/Mode S transponder to start an ATC/Mode S transponder system test.

Use the maintenance access terminal (MAT) to start the ATC system test through the CMCFs.



34-53-00-008 Rev 0

ATC/MODE S TRANSPONDER SYSTEM - MAINTENANCE INTERFACE

ATC/MODE S TRANSPONDER SYSTEM - TCAS INTERFACE AND PROGRAM PINS

Program Pins

Each ATC/Mode S transponder has:

- Airplane mode S address program pins
- Source destination indicator (SDI) program pins
- Maximum true airspeed program pin.

There are 24 airplane address program pins on each transponder. A program switch module connects to the program pins. The program switch module supplies the open and ground connections necessary to make the 24 bit unique airplane identification.

The SDI defines the transponder as a left or right ATC/ Mode S transponder.

The maximum true airspeed pins define the maximum true airspeed for the airframe. The transponder formats and sends the maximum true airspeed to the TCAS computer.

Digital Data to TCAS

The active ATC/Mode S transponder sends this data to the traffic alert and collision avoidance system (TCAS) computer:

- The 24-bit mode S airplane identification. TCAS needs the airplane mode S identification for maneuver coordination
- Barometric altitude
- Maximum true airspeed
- TCAS coordination message data
- ATC/Mode S transponder system failure data.

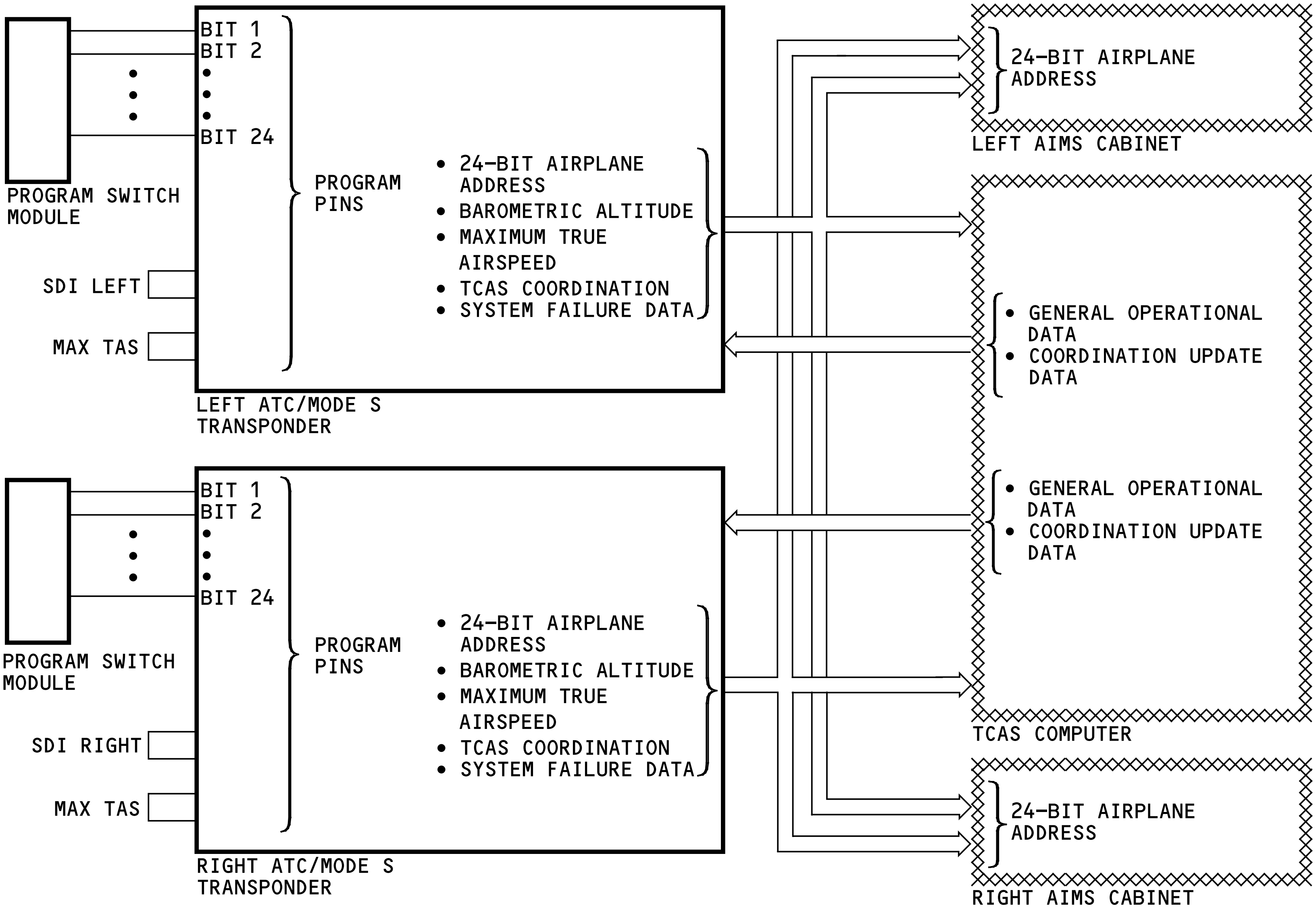
TCAS to Active Transponder

The TCAS computer sends this data to the active transponder:

- General TCAS operational data
- Coordination update data.

Digital Data to the AIMS Cabinets

The ATC/Mode S transponders send the airplane unique 24-bit mode S airplane identification to the AIMS cabinets for use in other systems.



34-53-00-009 Rev 1

ATC/MODE S TRANSPONDER SYSTEM - TCAS INTERFACE AND PROGRAM PINS

ATC/MODE S TRANSPONDER SYSTEM - ATC/MODE S TRANSPONDER

General

The ATC ground station interrogates the ATC/Mode S transponder with a pulse-coded signal at a frequency of 1030 MHz.

The transponder responds with pulse-coded signals at a frequency of 1090 MHz.

Characteristics

The transponder responds to air traffic control radar beacon system (ATCRBS) mode A and mode C interrogations. The transponder also responds to the TCAS computer with the mode select (mode S) format.

The ATC/Mode S transponder has a non-volatile flight-fault memory.

Front Panel Indications

The light emitting diode (LED) status indicators on the front panel show:

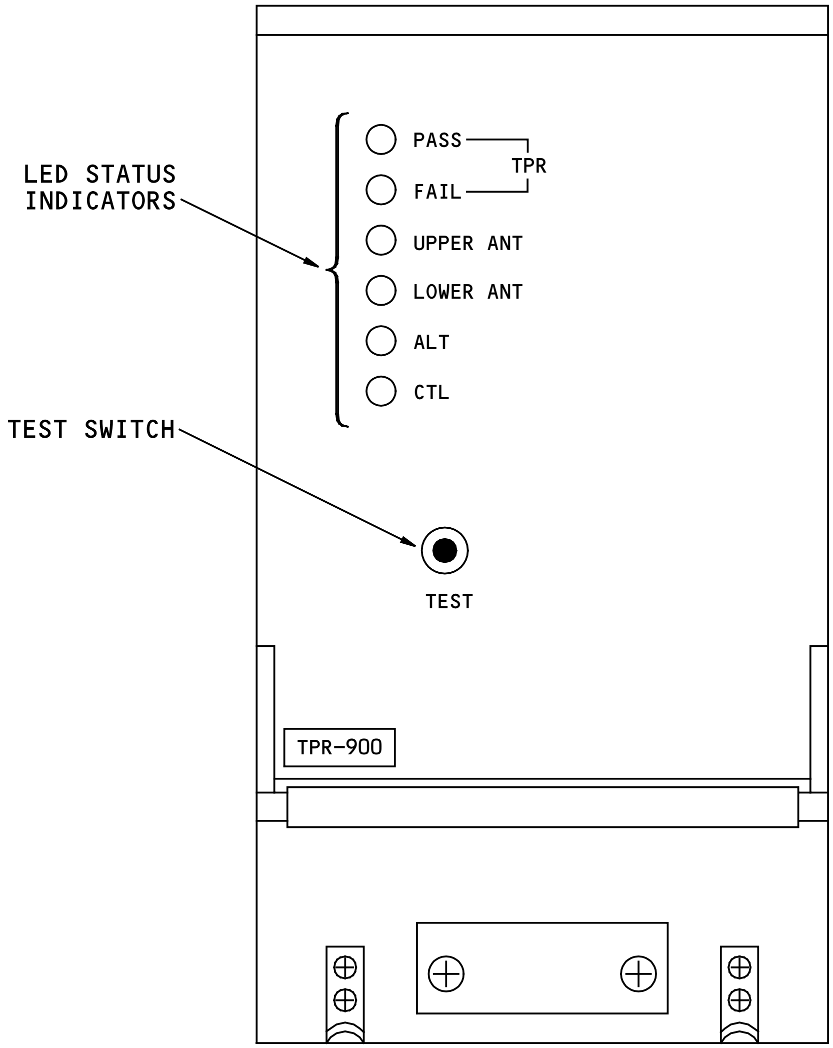
- Green PASS LED, if there are no LRU failures
- Red FAIL LED, if there is an LRU failure
- UPPER ANT, if the upper antenna fails
- LOWER ANT, if lower antenna fails
- ALT, if the altitude input from the AIMS cabinets fails
- CTL, if the input from the transponder panel fails.

The test switch starts a self-test.

Training Information Point

The maintenance manual and the fault isolation manual do not have a task for the line maintenance technician to do a test from the front panel of the ATC/mode S transponder. You must do all tests for the ATC/mode S transponder from the MAT or a PMAT.

Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For that reason these LRUs have a front panel test feature.



34-53-00-011 Rev 4 09/17/1997

ATC/MODE S TRANSPONDER SYSTEM - ATC/MODE S TRANSPONDER

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ATC/MODE S TRANSPONDER SYSTEM - TRANSPONDER PANEL

General

The dual transponder panel controls the ATC/Mode S transponder and the TCAS computer.

The ATC controls and displays on the transponder panel are:

- IDENT switch
- Four digit identification code
- Active system display
- Transponder mode selector
- Transponder code selectors
- Altitude source selector
- Transponder selector.

Altitude Source Selector

The altitude source selector has two positions, NORM and ALTN. Each transponder has two ADC inputs. With NORM selected, the active transponder uses the altitude data that comes from ADC input 1. With ALTN selected, the active transponder uses the altitude data that comes from ADC input 2.

Transponder Selector and Active System Display

The transponder selector has a left and a right transponder (XPNDR) position. With the left position selected, the control panel sends a ground standby/on discrete to the right transponder only. Then the right transponder is in standby. The left transponder is active.

With the right position selected, the control panel sends an open standby/on discrete to the right transponder to make it active. A ground standby/on discrete goes to the left transponder and an antenna transfer discrete goes to the ATC coax relays. This puts the left transponder in standby, and makes the relays connect the ATC antennas to the right transponder.

The selected ATC system shows on the LCD active system display.

Identification Code Display and Selection

The flight crew uses the code selectors to set the four digits of the identification code. The four digits show on the liquid crystal display (LCD). Codes are from 0000 to 7777, with 4096 different selections.

CAUTION: DO NOT SELECT CODES 7500, 7600 OR 7700. THESE CODES ARE USED ONLY FOR EMERGENCIES.

Transponder Mode Selector

The transponder mode selector has several positions. These are the functions that the ATC system uses:

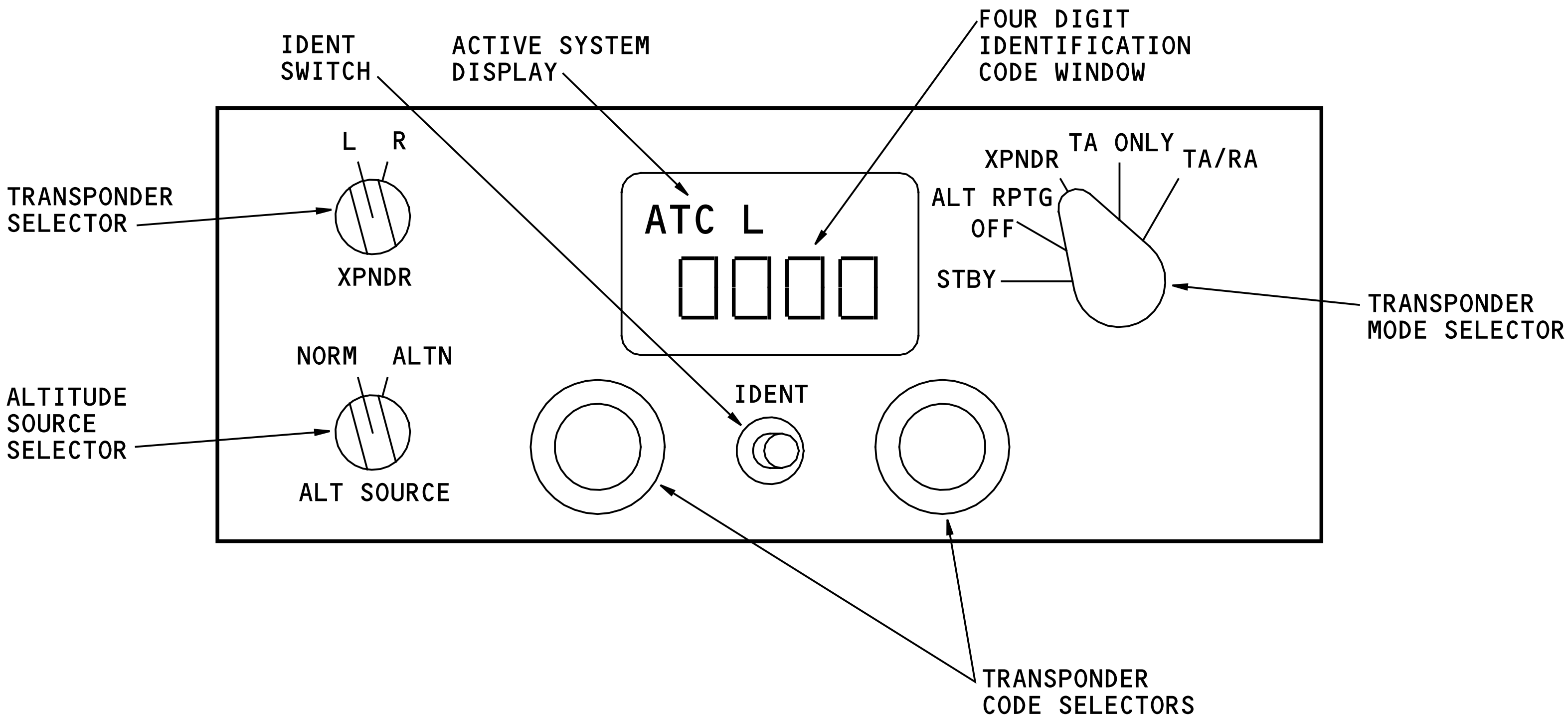
- STBY (standby) - a ground discrete goes to both transponders. This ground discrete prevents operation of the transponder, but does not prevent built-in-test-equipment (BITE) functions.

ATC/MODE S TRANSPONDER SYSTEM - TRANSPONDER PANEL

- ALT RPTG OFF (altitude reporting off) - the active transponder responds to ATC interrogations with mode A replies only.
- XPNDR (transponder) - the active transponder responds to ATC interrogations with mode A and mode C (altitude reporting) replies.

IDENT Switch

When the ATC controller requests the airplane identifier, the pilot pushes the momentary IDENT switch. The transponder adds a special position identification (SPI) pulse to the interrogation reply for the next 18 seconds.



34-53-00-012 Rev 5 09/18/96

ATC/MODE S TRANSPONDER SYSTEM - TRANSPONDER PANEL

ATC/MODE S TRANSPONDER SYSTEM - ATC ANTENNA

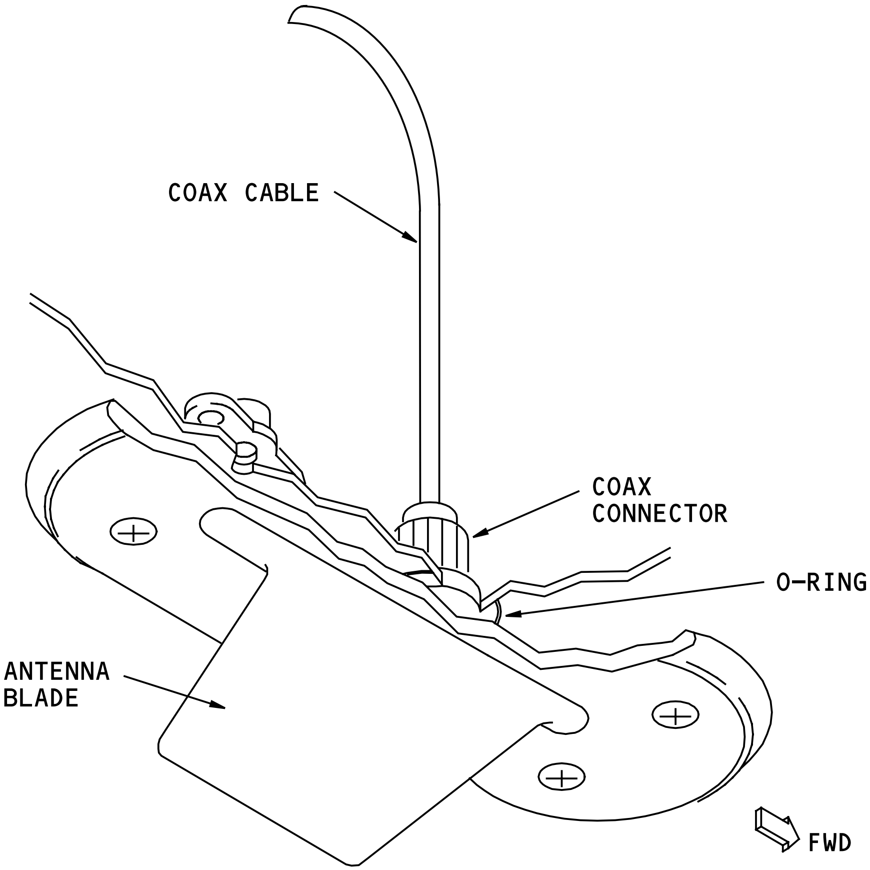
Purpose

The ATC L-band blade antenna receives 1030 MHZ interrogations from ATC ground stations and other airplanes that have TCAS. The ATC/Mode S transponder transmits the reply signals through the L-band antenna.

Physical Description

Connect the coaxial cable connector to the antenna. The antenna has an O-ring moisture seal and attaches to the airplane by four screws. The ATC and DME antennas are the same and are interchangable.

CAUTION: EXTRA FORCE ON THE ANTENNA BASE MAY BE REQUIRED TO BREAK WEATHERPROOFING SEAL. TO PREVENT DAMAGE TO AIRPLANE SKIN OR ELECTRICAL CABLE AT THE ANTENNA BASE, CAREFULLY PRY AROUND THE ANTENNA WITH A SEALANT REMOVAL TOOL.



34-53-00-013 Rev 1

ATC/MODE S TRANSPONDER SYSTEM - ATC ANTENNA

ATC/MODE S TRANSPONDER SYSTEM - ATC COAX RELAY

General

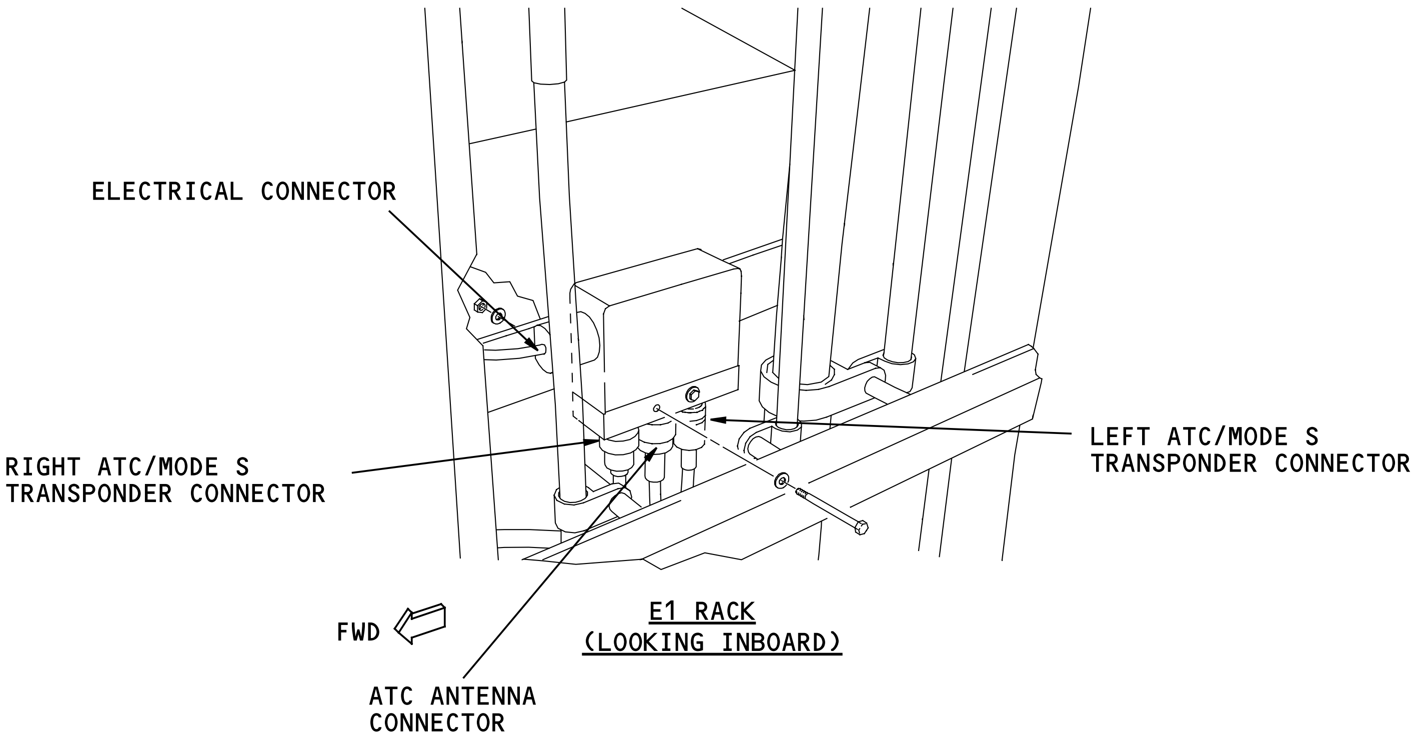
The ATC coax relays connect the active ATC/Mode S transponder to the top and bottom ATC antennas.

The electrical connector has an input from the:

- ATC antenna switch circuit breaker
- ATC control panel.

The ATC coax relays supply an RF interface for the ATC system interrogation and reply signals. These are the connectors:

- Right ATC/mode S transponder connector
- ATC antenna connector
- Left ATC/mode S transponder connector.



34-53-00-014 Rev 1

ATC/MODE S TRANSPONDER SYSTEM - ATC COAX RELAY

ATC/MODE S TRANSPONDER SYSTEM - ANTENNA COAX RELAY CONTROL

General

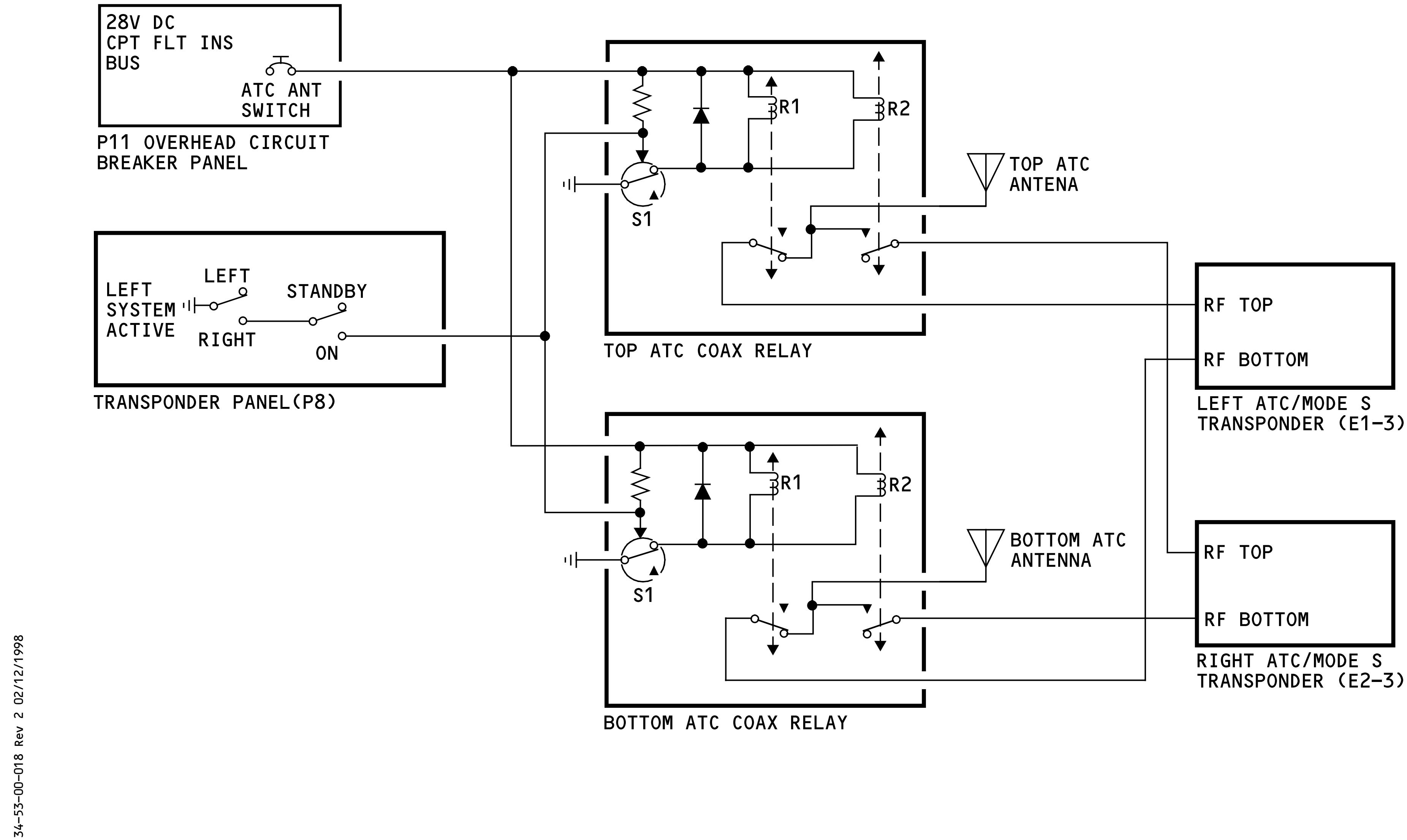
Use the transponder panel to select the active ATC system. When you do this, the transponder panel sends a discrete open or ground to the top and bottom ATC coax relays. This connects the right transponder or left transponder to the top and bottom ATC antennas.

Left System Select or Standby

When the airplane power is on and when the transponder panel has the left transponder or standby selected, the S1 switches open and relays R1 and R2 do not energize. The top and bottom antennas connect to the left ATC/ Mode S transponder.

Right System Select

With the right transponder selected, switch S1 closes to supply a ground to energize relay R1 and R2. The top and bottom antennas connect to the right ATC/Mode S transponder.



ATC/MODE S TRANSPONDER SYSTEM - ANTENNA COAX RELAY CONTROL

ATC/MODE S TRANSPONDER SYSTEM - GROUND TESTS

General

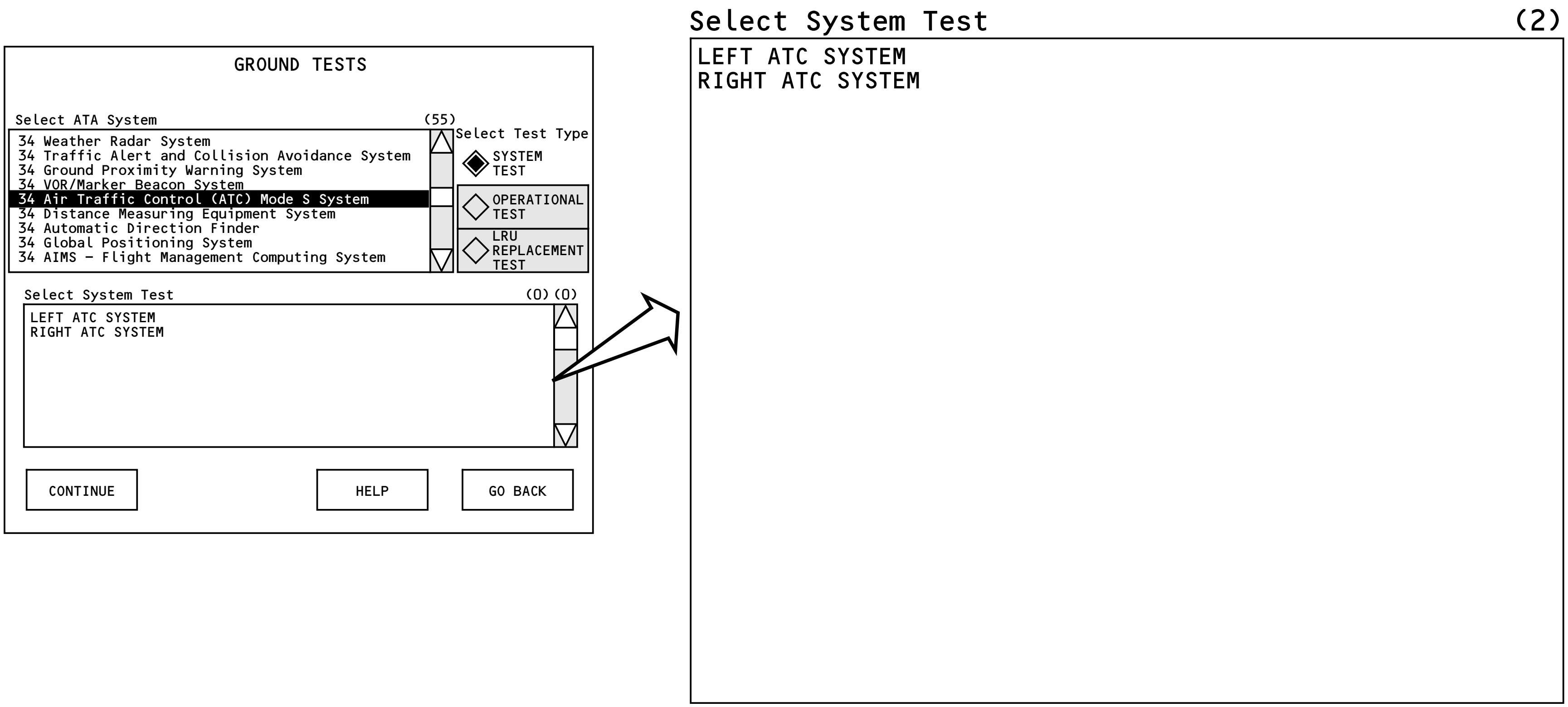
You can do a system test of the ATC/Mode S transponder system from the MAT.

System Test

There is a system test for the left ATC/Mode S transponder system and the right ATC/Mode S transponder system.

The system test for the ATC/Mode S transponder system does a check of these functions:

- Transponder for correct operation
- Transponder panel for correct control data
- Antennas for correct impedance
- Altitude input for correct altitude data.



34-53-00-020 Rev 1

ATC/MODE S TRANSPONDER SYSTEM - GROUND TESTS

Continental Airlines, Inc

Traffic Alert and Collision Avoidance System

WB371

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TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM - INTRODUCTION

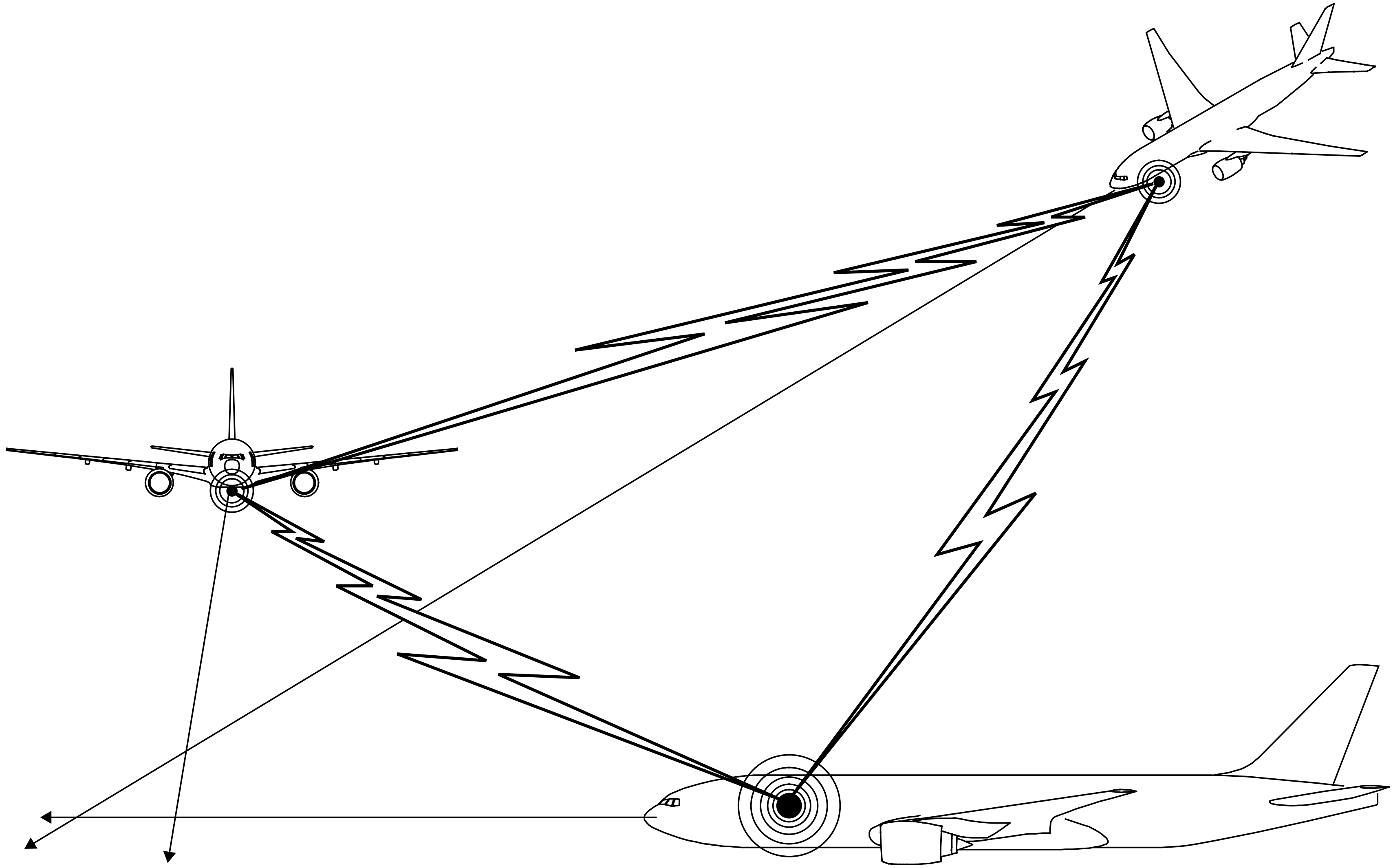
General

The traffic alert and collision avoidance system (TCAS) helps the flight crew and air traffic control maintain safe air traffic separation. TCAS is an airborne system. TCAS uses an air traffic control radar beacon system (ATCRBS) transponder or an ATC/Mode S transponder to track other airplanes. TCAS also coordinates maneuvers with other airplanes that have TCAS.

TCAS supplies a traffic display and visual and aural vertical commands to the flight crew. All commercial airlines and some general aviation airplanes have TCAS.

Abbreviations and Acronyms

ABS	- absolute
ABV	- above
AIMS	- airplane information management system
ATC	- air traffic control
ATCRBS	- air traffic control radar beacon system
BITE	- built-in-test equipment
BLW	- below
CMCS	- central maintenance computer system
CPA	- closest point of approach
GPWC	- ground proximity warning computer
PSEU	- proximity switch electronics unit
PWS	- predictive windshear
TCAS	- traffic alert and collision avoidance system
RA	- resolution advisory
REL	- relative
TCAS	- traffic alert and collision avoidance system
WEU	- warning electronic unit
WXR	- weather radar



TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM - INTRODUCTION

TCAS - GENERAL DESCRIPTION

General

The traffic alert and collision avoidance system (TCAS) interrogates other airplanes to get altitude, range, and bearing data. TCAS uses the replies and inputs from other onboard airplanes systems to calculate traffic avoidance data.

General Description

These are the TCAS components:

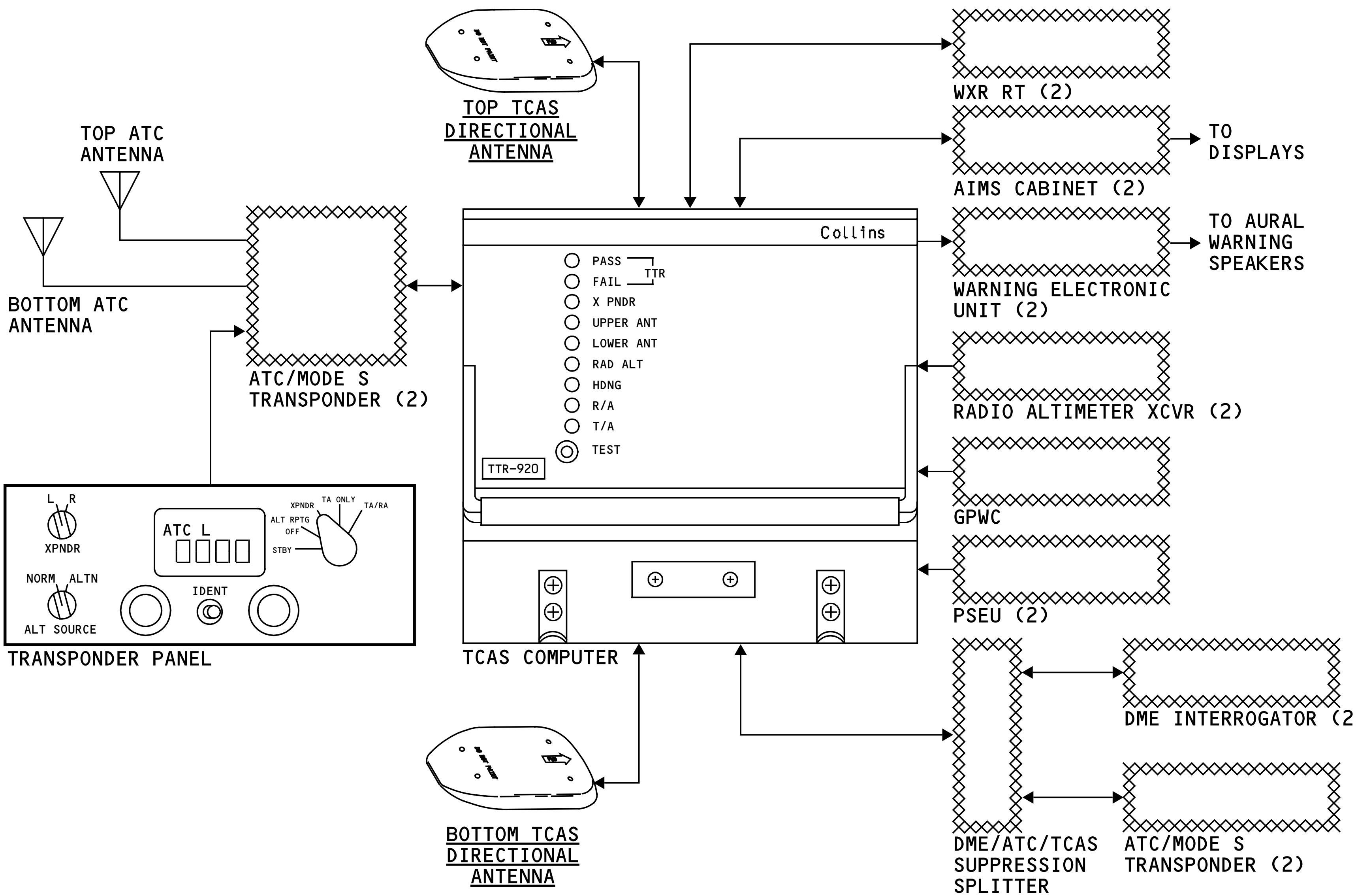
- ATC antennas
- Transponder panel
- TCAS directional antennas
- TCAS computer.

TCAS interfaces with these other system components:

- Left and right airplane information management system (AIMS) cabinets
- Left and right ATC/Mode S transponders
- Left and right warning electronic units (WEUs)
- Left and right radio altimeters
- Ground proximity warning computer (GPWC)
- Left and right weather radar receiver-transmitters (R/Ts)
- Left and right proximity switch electronic units (PSEUs).

Suppression

The TCAS computer connects to the DME interrogators and the ATC transponders through a suppression splitter.



TCAS - GENERAL DESCRIPTION

TCAS - COMPONENT LOCATION

Main Equipment Center

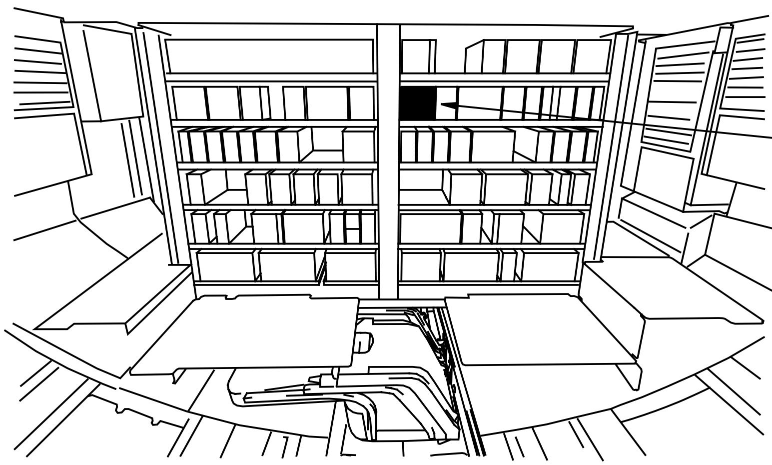
The TCAS computer is in the main equipment center.

Flight Deck

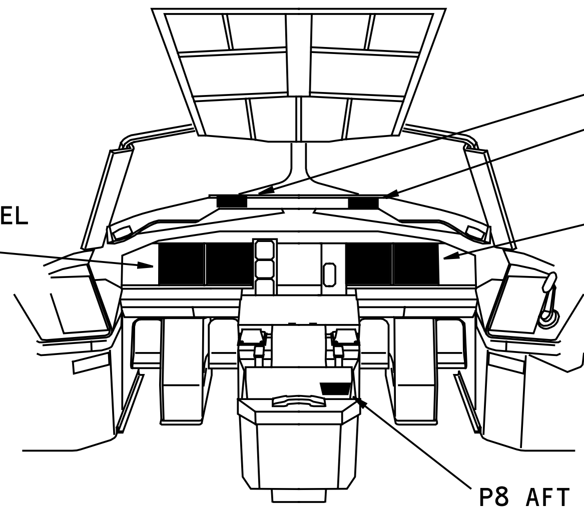
These are the components in the flight deck that interface with TCAS:

- Left EFIS control panel
- Captain's primary flight display (PFD)
- Captain's navigation display (ND)
- Right EFIS control panel
- First officer's PFD
- First officer's ND.

The transponder panel is on the P8 aft aisle stand panel.



MAIN EQUIPMENT CENTER
(LOOKING AFT)

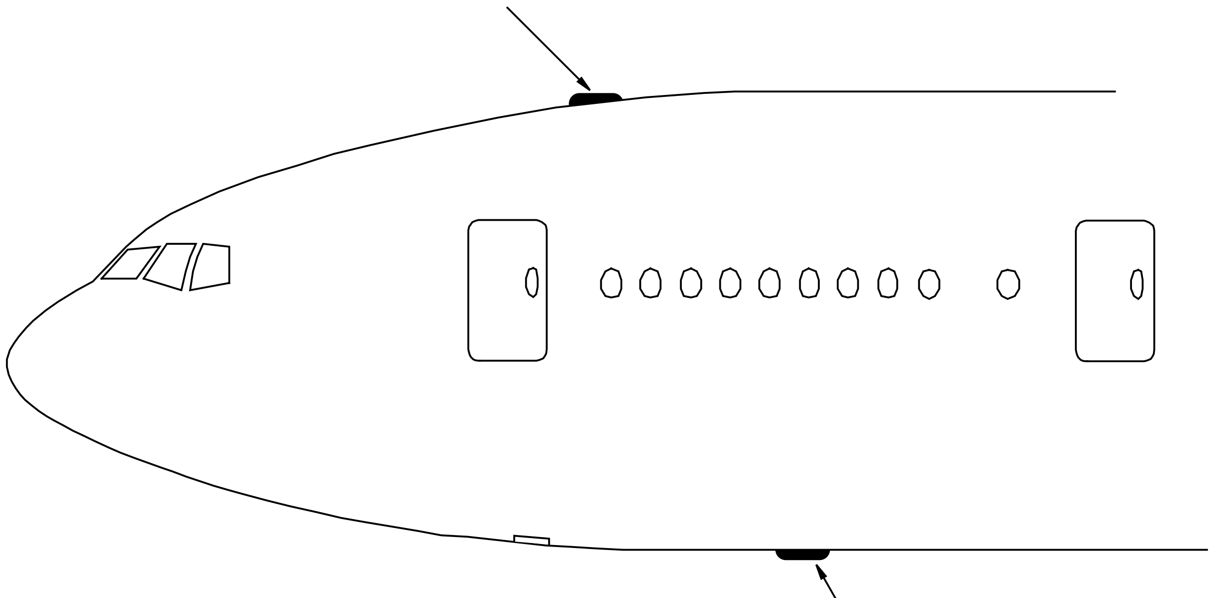


TCAS - COMPONENT LOCATION

TCAS - ANTENNA LOCATION

General

The top TCAS directional antenna is at station 455.5 on top of the fuselage. The bottom TCAS directional antenna is at station 539 and buttock line left 6.3.



TCAS - ANTENNA LOCATION

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TCAS - POWER, ANTENNAS, ANALOG DISCRETE INTERFACES AND PROGRAM PINS

General

The TCAS computer has interfaces with these components:

- Overhead circuit breaker panel
- Top and bottom TCAS directional antennas
- Left AIMS cabinet
- Right AIMS cabinet
- Air/ground relay
- Ground proximity warning computer (GPWC)
- Proximity sensor electronics unit (PSEU) 1
- PSEU 2
- DME/ATC/TCAS suppression splitter
- Left warning electronic unit (WEU)
- Left WXR RT
- Right WXR RT
- Right WEU.

There are program pins to supply control of the TCAS computer.

Power

The TCAS computer gets 115v ac from the left ac secondary 2 bus, through the overhead circuit breaker panel.

Antennas

There are two TCAS directional antennas, one on the top and one on the bottom of the airplane. The TCAS directional antennas receive traffic airplane reply signals. They also transmit the TCAS interrogation signals.

AIMS - Display Status

An analog discrete from either AIMS cabinet goes to the TCAS computer when the display function of AIMS fails. When the TCAS computer gets this discrete, the TCAS computer does not do these functions:

- Send TCAS display outputs to the AIMS
- Send TCAS aurals to the warning electronic system (WES)
- Transmit coordination data to traffic airplanes with TCAS.

Air/Ground Relay

This discrete from the air/ground relay supplies in-air or on-ground status to the TCAS computer. The air/ground discrete inhibits resolution advisories (RAs) when the airplane is on the ground and inhibits tests when in the air. Also, the air/ground discrete increments flight legs in the TCAS nonvolatile memory when the central maintenance computing system (CMCS) fails.

GPWC - Advisory Delay Discretes

The GPWC sends three analog discretes to the TCAS computer. These discretes inhibit advisories during some ground proximity warning and alert conditions.

TCAS - POWER, ANTENNAS, ANALOG DISCRETE INTERFACES AND PROGRAM PINS

PSEU - Landing Gear Position

This analog discrete from the PSEUs supply the TCAS computer with the position of the landing gear. When the TCAS computer gets this discrete, the TCAS computer makes the bottom directional antenna become an omnidirectional antenna.

Suppression Input/Output

The TCAS computer gets a suppression pulse when an ATC transponder or DME interrogator transmits. When the TCAS computer transmits, it sends a suppression pulse to the ATC transponders and the DME interrogators.

WEU - TCAS Aurals - Voice Outputs

The TCAS computer sends RA and TA aural signals to the warning electronic units (WEUs). The WEUs amplify the RA and TA aurals and send them to the aural warning speakers to alert the flight crew.

WXR - TCAS Alert Inhibit

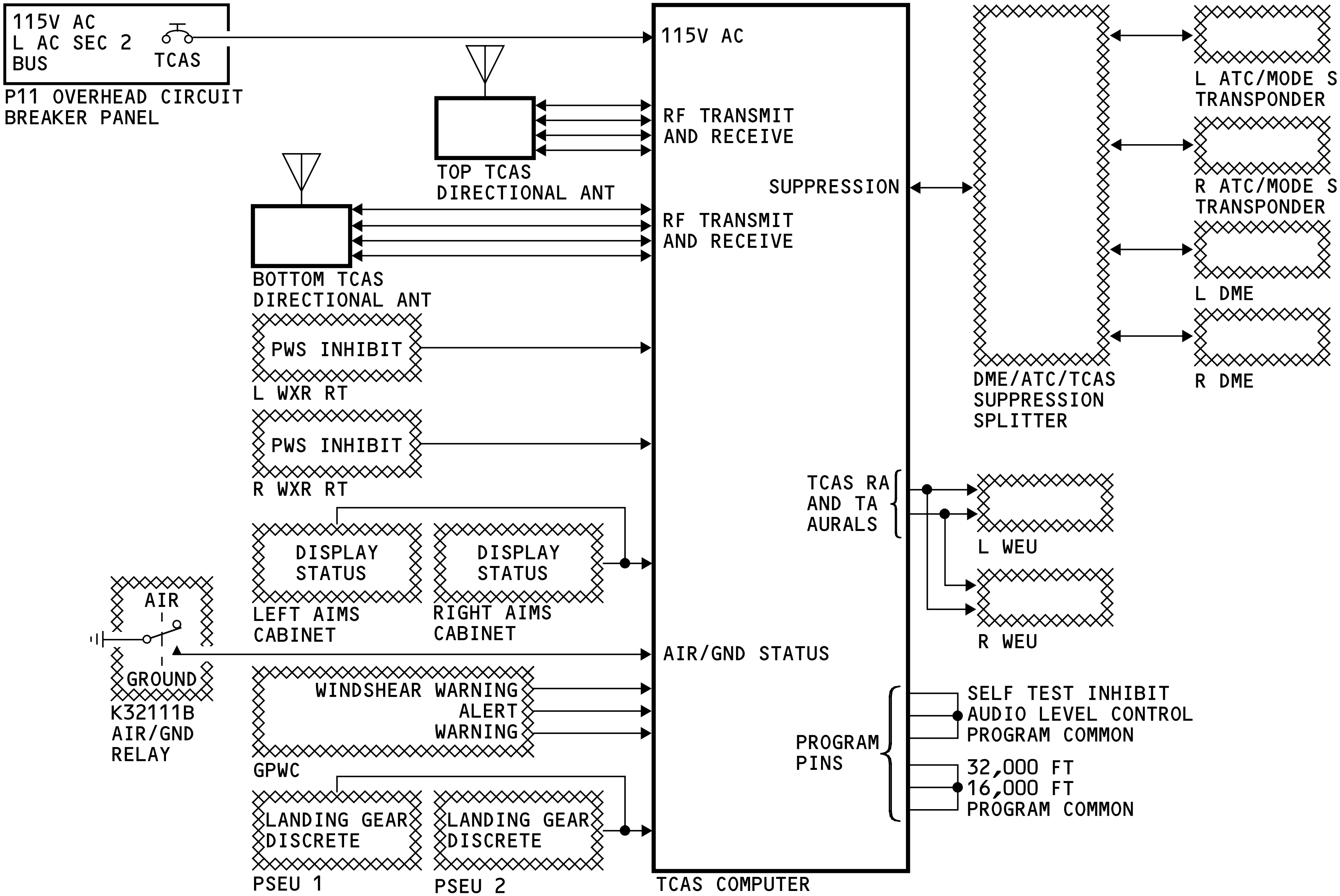
The TCAS computer gets an inhibit discrete from the predictive windshear (PWS) function of WXR. When there is a PWS alert, this discrete does these functions:

- Changes TCAS resolution advisories (RAs) to traffic advisories (TAs)
- Inhibits TCAS aural alerts.

Program Pins

These are the functions that the program pins on the TCAS computer enable:

- A self-test inhibit to prevent self-test in the air
- The audio level of the voice outputs
- The airplane altitude limit of 48,000 feet so TCAS does not command a climb or increase climb above this altitude.



TCAS - POWER, ANTENNAS, ANALOG DISCRETE INTERFACES AND PROGRAM PINS

TCAS - DIGITAL INTERFACES

General

The TCAS computer has digital interfaces with the:

- Left ATC/Mode S transponder
- Right ATC/Mode S transponder
- Left radio altimeter transceiver
- Right radio altimeter transceiver
- Left AIMS cabinet
- Right AIMS cabinet.

ATC/Mode S Transponder - Control and Coordination Data

The dual transponder panel sends this control data through the selected ATC/Mode S transponder to the TCAS computer:

- The TCAS mode selection (TA only or TA/RA)
- Control of the altitude limits for the TCAS display that shows on the ND.

For the TCAS computer to calculate coordination data, ATC transponder sends this to the TCAS computer:

- 24-bit airplane address
- Barometric altitude
- Maximum true airspeed.

The TCAS computer sends this to the transponder:

- General TCAS operational status
- Mode S coordination data.

Radio Altimeter Inputs

The TCAS computer gets radio altitude from the left and right radio altimeter transceivers.

TCAS Inputs from AIMS

The left AIMS cabinet supplies these inputs to the TCAS computer:

- Inertial reference unit (IRU) data from the air data inertial reference system (ADIRS).
- Data loader data
- Data loader enable analog discrete
- Central maintenance computing system (CMCS) data.

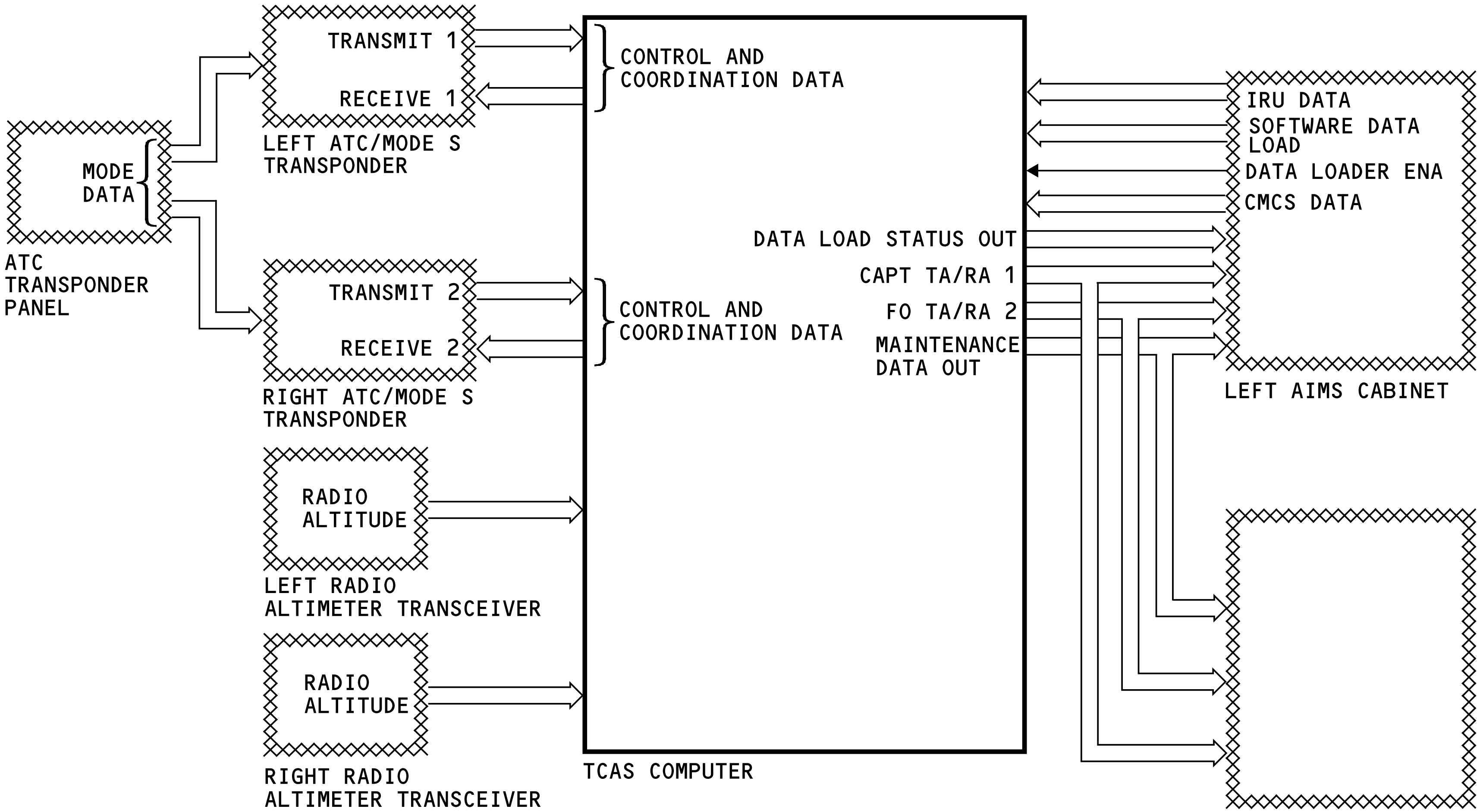
The right AIMS cabinet does not supply any inputs to the TCAS computer.

TCAS Outputs to AIMS

The TCAS computer sends TCAS data load status to the left AIMS cabinet.

The TCAS computer supplies these outputs to both AIMS cabinets:

- Traffic advisory (TA) and resolution advisory (RA) data, which includes all traffic data for TCAS displays
- TCAS maintenance data.



34-45-00-007 Rev 2 01/27/1998

TCAS - DIGITAL INTERFACES

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TCAS - TCAS COMPUTER

Purpose

The TCAS computer is the main component of the TCAS. It controls these functions:

- Surveillance
- Tracking
- Advisory
- Air-to-air maneuver coordination.

The TCAS computer sends signals alert the flight crew to:

- Maintain the current flight plan
- Make flight maneuvers to avoid a possible collision with other airplanes in the area.

Physical Description

The TCAS computer is a 6 MCU size unit that weighs 28 lbs.

Functional Description

The TCAS computer transmits 1030 MHz pulse-coded interrogation signals. It receives 1090 MHz pulse-coded reply signals from intruder airplanes with a transponder.

Front Panel LED Indications

The status light emitting diodes (LEDs) are:

- A green PASS to show that there is no TCAS computer failures
- A red FAIL to show a TCAS computer failure
- A red XPNDR to show an ATC transponder interface failure
- A red UPPER ANT to show a top TCAS antenna failure
- A red LOWER ANT to show a bottom TCAS antenna failure
- A red RAD ALT to show no radio altitude data from the RA
- A red HDNG to show no heading data from the AIMS
- A red R/A to show an AIMS display function failure
- The red T/A does not operate.

Front Panel Self-Test

Push the test switch on the front panel to start a test of TCAS. The applicable LED indications come on.

Software Loading

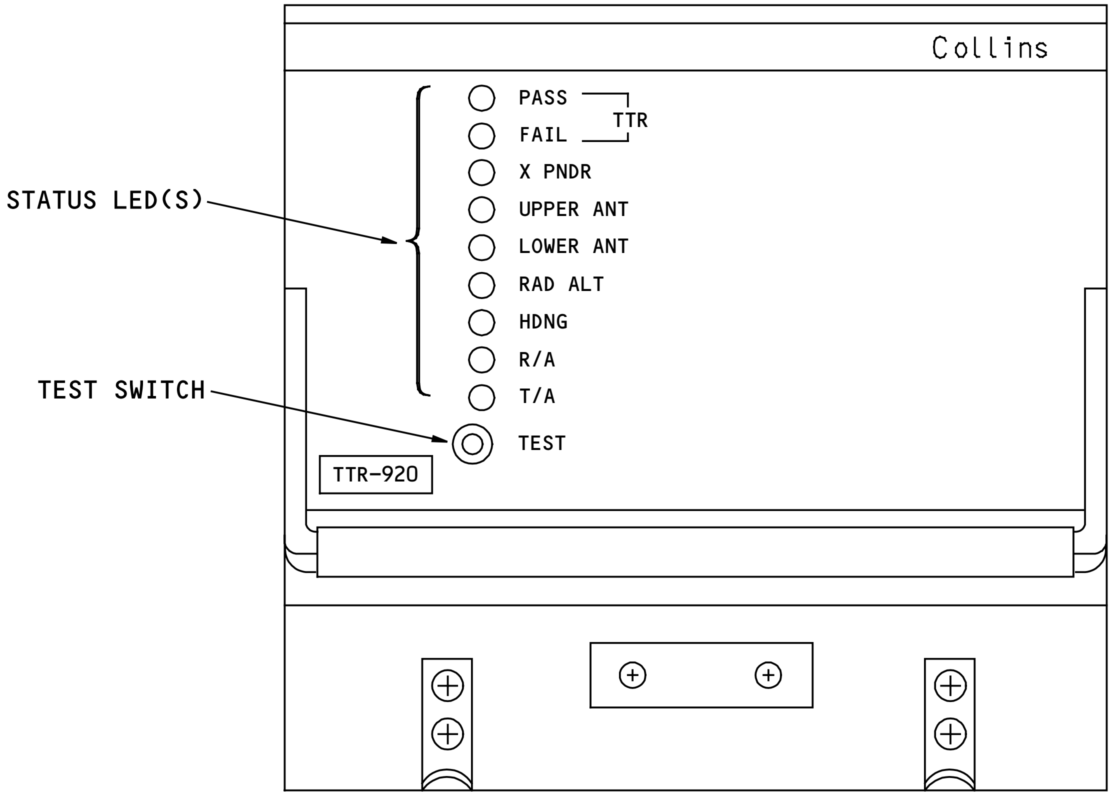
The TCAS computer is software loadable. Use the maintenance access terminal (MAT) to load the operational software into the TCAS computer.

Training Information Point

The TCAS computer receives data load information from the left central maintenance computing function (CMCF) only. You must use the left CMCF when you want to data load the TCAS computer.

TCAS - TCAS COMPUTER

Use the central maintenance computer switch control from the other functions menu on the MAT to select the active CMCF.



34-45-00-008 Rev 3 03/28/96

TCAS - TCAS COMPUTER

TCAS - TRANSPONDER PANEL

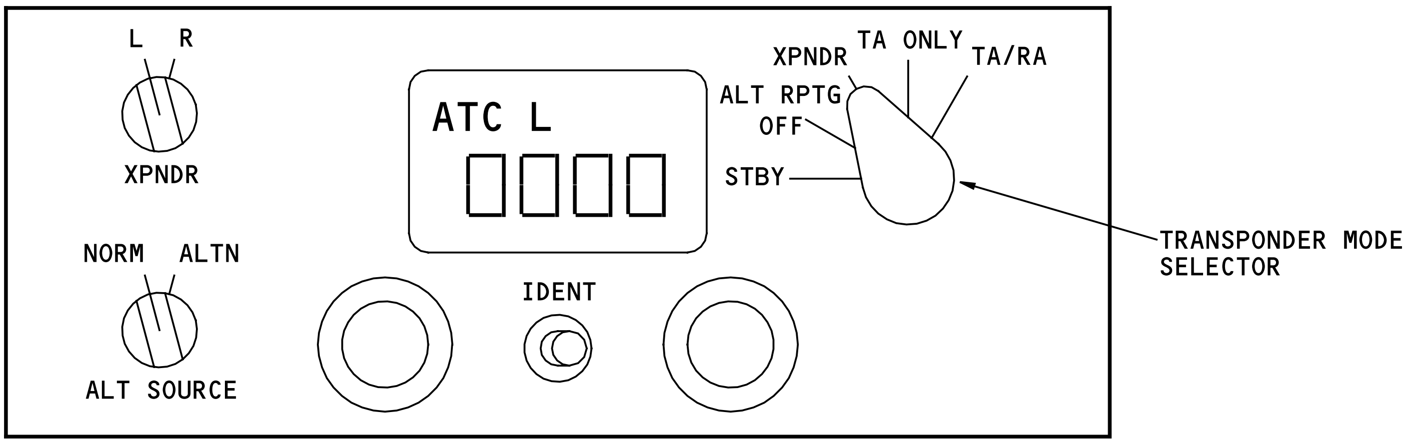
General

The transponder panel controls the TCAS computer to send the selected display data to the AIMS.

Transponder Mode Selector

The transponder mode selector lets the flight crew select one of these two TCAS modes:

- TA ONLY mode. In this mode, all intruder traffic except RAs show
- TA/RA mode. In this mode, all intruder traffic shows. This is the normal mode of operation for TCAS.



34-45-00-009 Rev 4 09/18/96

TCAS - TRANSPONDER PANEL

TCAS - TCAS DIRECTIONAL ANTENNA

General

The TCAS uses a top and bottom directional antenna. The antennas are the same and interchangeable.

Physical Description

The directional antenna is a phased array antenna. Four array elements on the antenna make up the array. Each element has a color coded connector. The TCAS computer sends the array elements transmit interrogation signals with different phases. This makes the interrogation signal directional.

To attach the antenna, match the color of the coaxial cable with the color coded band on the array element connector.

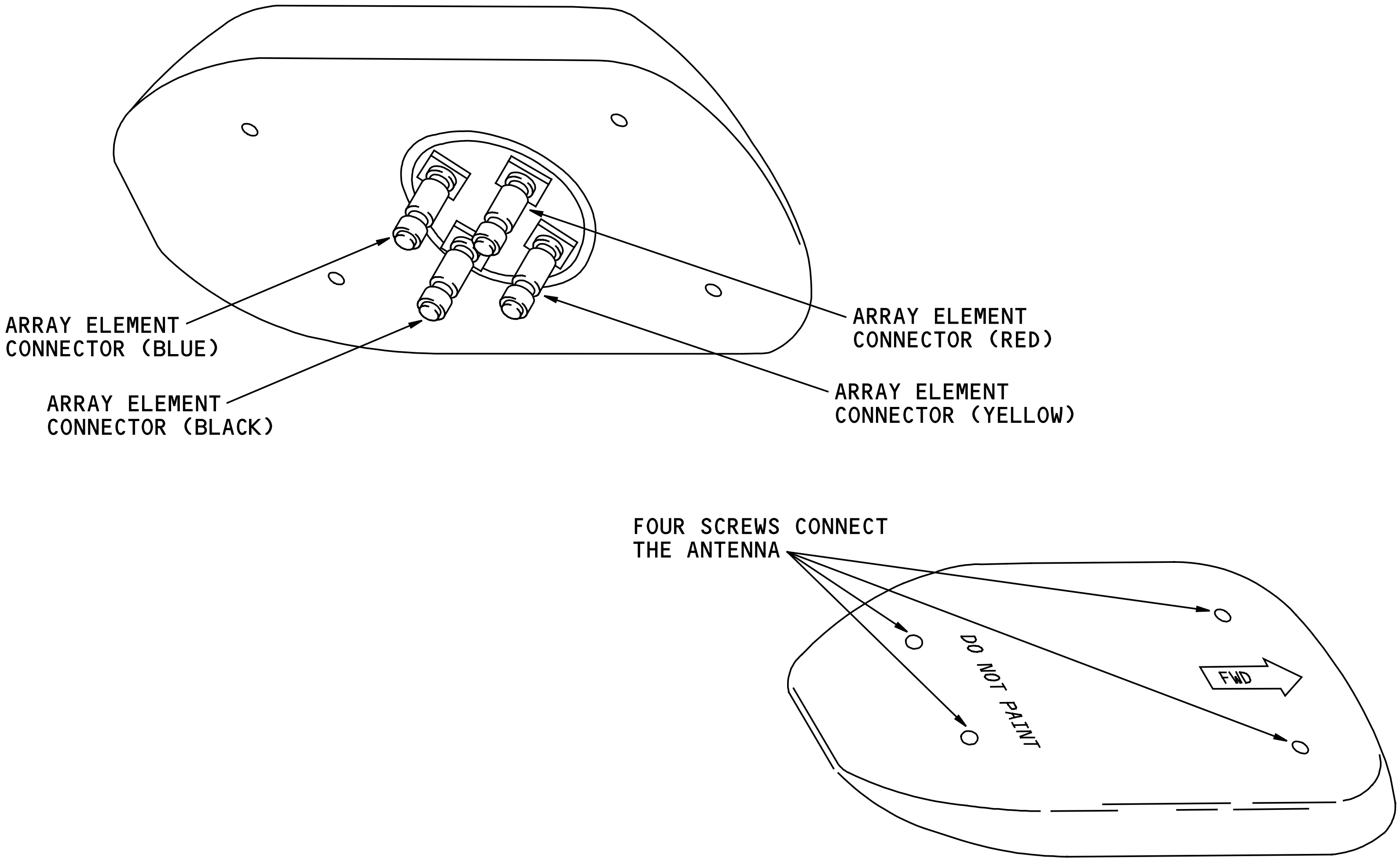
Four screws fasten each antenna to the airplane. The radiation side of the antenna shows "FWD" and "DO NOT PAINT".

CAUTION: DO NOT PAINT THE RADIATION SURFACE OR THE BACKPLATE OF THE ANTENNA. PAINT DOES NOT PERMIT THE ANTENNA TO RADIATE OR RECEIVE RF SIGNALS.

CAUTION: TO PREVENT DAMAGE TO THE ANTENNA CABLES, DO NOT PULL ON THEM.

Training Information Point

An antenna connection includes the coax cable and an antenna element. The TCAS computer checks the resistance of each antenna connection at power-up. The TCAS computer reports an antenna fault when it detects that the resistance of the connection is out of range. If you do not match the coax cable to the correct element, the TCAS computer reports an antenna fault.



34-45-00-010 Rev 3 03/28/96

TCAS - TCAS DIRECTIONAL ANTENNA

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TCAS - OPERATION-SURVEILANCE AREA

General

The TCAS tracks and evaluates the possible threat of up to 30 airplanes that are within the surveillance area.

These four types of traffic airplanes show on the NDs:

- Other traffic are airplanes that have an altitude separation of ±2700 feet and the time until closest point of approach (CPA) is greater than 40 seconds
- Proximate traffic are airplanes that have an altitude separation of ±1200 feet and the time until CPA is greater than 40 seconds
- Intruder traffic which causes a traffic advisory (TA), are airplanes that have an altitude separation of ±1200 feet and the time until closest point of approach (CPA) is between 25 and 40 seconds
- Threat traffic which causes a resolution advisory (RA), are airplanes that have an altitude separation of ±900 feet and the time until CPA is less than 25 seconds.

Surveillance Area

TCAS has a surveillance area that is about 10000 feet above and below the airplane and about 30 nm range in front of the airplane. The surveillance range behind and on the sides of the airplane is not as large as in the front of the airplane.

Within the surveillance area, there are two other areas called traffic advisory (TA) and resolution advisory (RA). To calculate RA and TA, the TCAS computer uses the time until closest point of approach (CPA) and the relative altitude of the traffic airplane.

To calculate CPA and the relative altitude, the TCAS computer uses:

- The TCAS airplane airspeed and altitude
- Range, altitude and airspeed of the traffic airplane.

The RA and TA times change between 20 and 45 seconds with the TCAS airplane altitude. The RA and TA times also change with the airspeed and altitude of the TCAS airplane, and the closure rate of each traffic airplane.

Traffic Advisory

When a traffic airplane is an intruder, the TCAS computer makes a traffic advisory (TA) that shows on the NDs.

Resolution Advisory

When a traffic airplane is a threat, the TCAS computer makes these resolution advisories (RA):

- Indications show on the NDs
- Maneuver indications on the PFDs guide the flight crew to avoid a possible collision

TCAS - OPERATION-SURVEILANCE AREA

- Aurals come from the aural warning speakers.

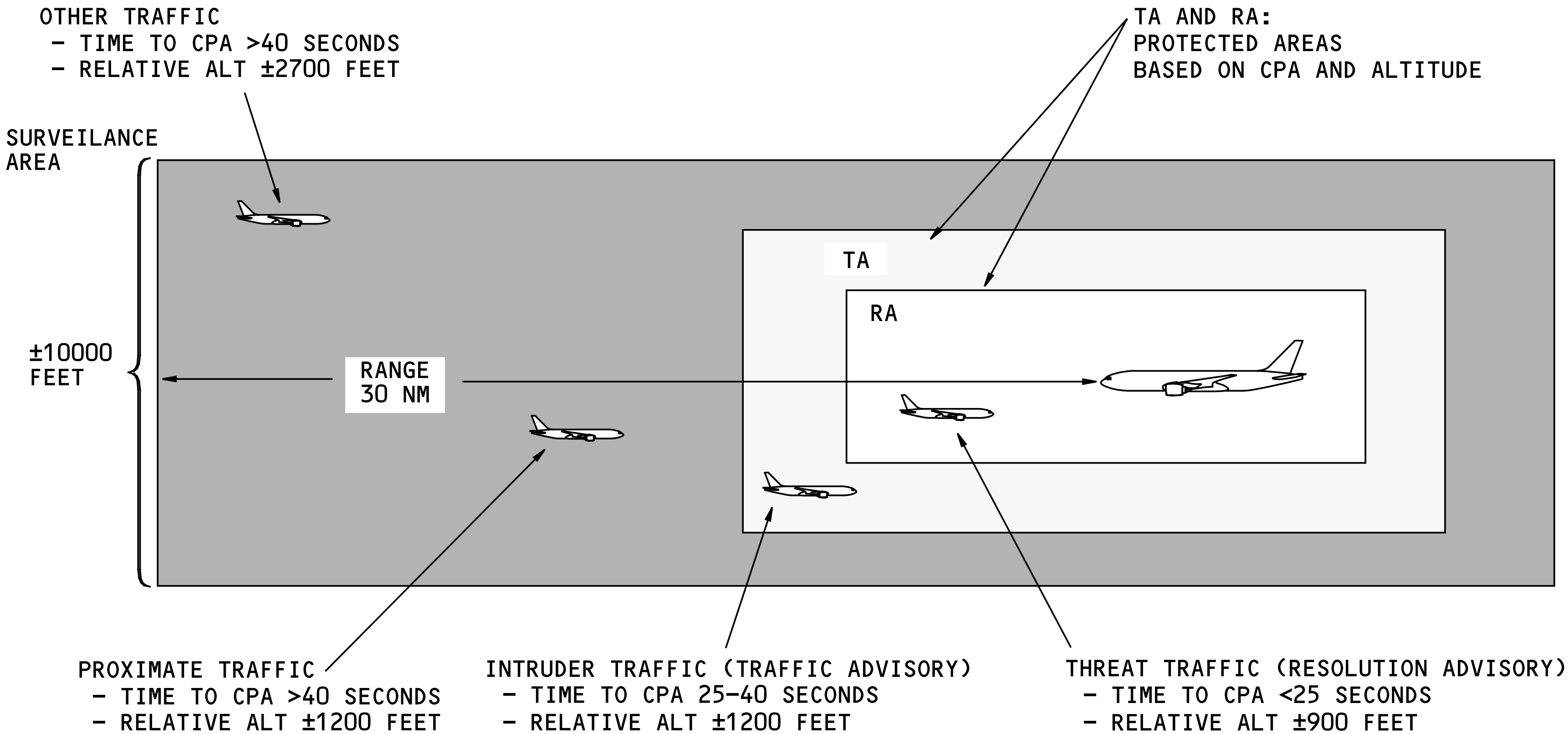
System Inhibits

Inhibits are dependent on the airplane parameters, which include:

- Maximum airplane climb rate
- Radio altitude
- Gear position
- Flap postion.

This table shows the inhibits and the parameters that cause the inhibits.

CONDITION	PARAMETERS
Increased descent RA	Inhibited below 1450ft. AGL
Descend RA	Inhibited below 1000ft. AGL in descent and 1200ft. AGL in climb
Resolution Advisories	Inhibited below 400ft. AGL in descent and below 600ft. AGL in climb.(TCAS automatically goes into TA ONLY)
TA voice message	Inhibited below 400ft. AGL in descent and below 600ft. AGL in climb
Climb or increased climb command	Can be inhibited, based on airplane configuration (flaps, gear, altitude limit, etc.)
Advisory priority	TA/RA goes to TA ONLY or STBY when there are higher priority advisories from GPWS



34-45-00-011 Rev 4

TCAS - OPERATION-SURVEILANCE AREA

TCAS - CONTROL AND DISPLAY

General

The EFIS control panel and the transponder panel control the TCAS data that shows on the PFD and ND.

EFIS Control Panel

To show the TCAS data on the ND, first put the mode control switch on the EFIS control panel in one of these modes:

- Expanded approach
- Expanded VOR
- Expanded map
- Centered map.

Then push the TFC (traffic) switch on the range selector to enable the ND to show the TCAS data. When you do this, the TFC message and all of the TCAS symbols shows on the ND.

To remove all of the TCAS messages and symbols from the ND, push the TFC switch again. To do this, the ND must be in one of these modes:

- Expanded approach
- Expanded VOR
- Expanded map
- Centered map.

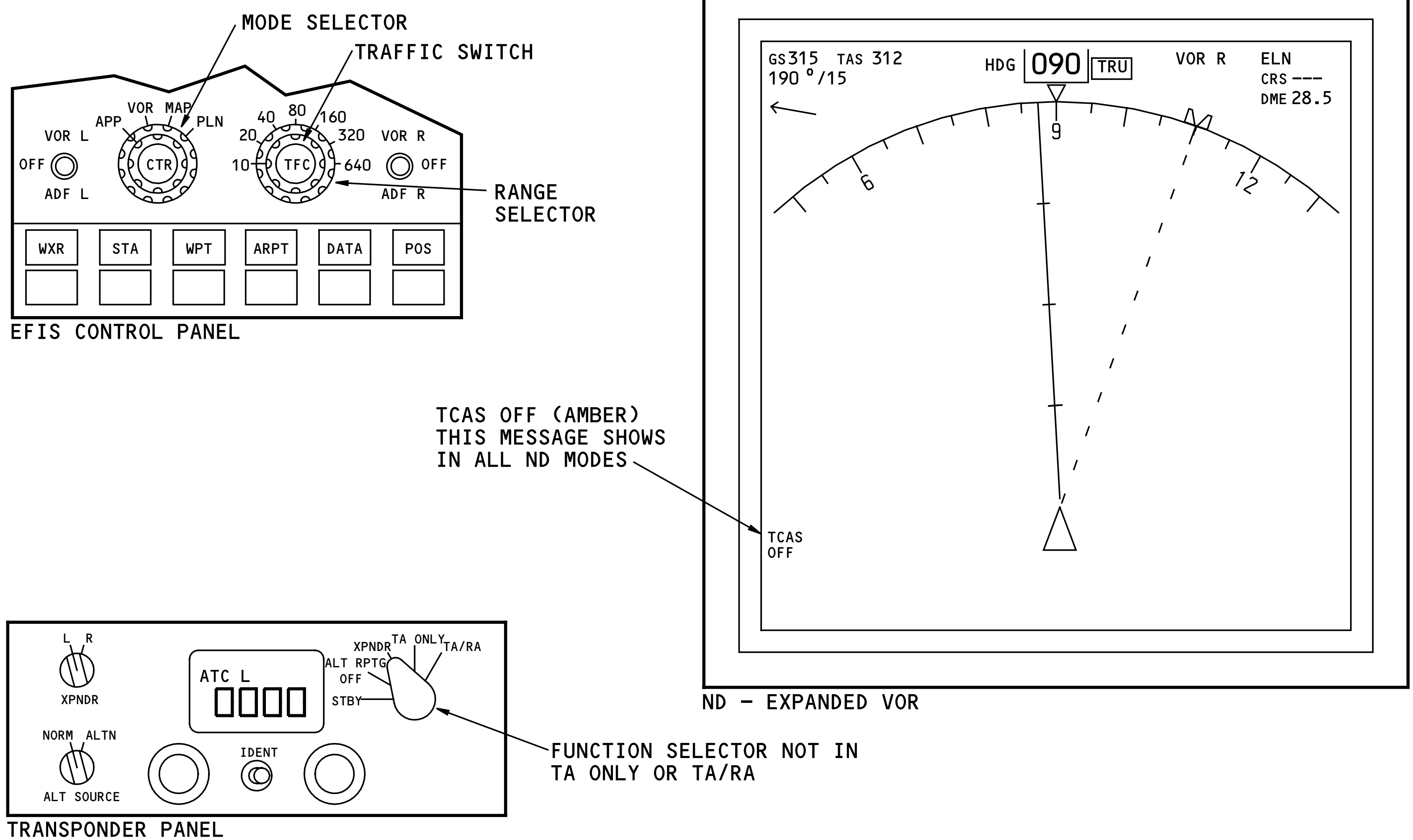
Transponder Panel

The transponder panel sends control data through the selected ATC/Mode S transponder to the TCAS computer.

The TCAS computer sends the selected data to the AIMS for display on the NDs and PFDs.

Push the TFC switch to show TCAS displays. If the function selector is not in the TA ONLY or TA/RA position, the ND:

- Shows a cyan message, TCAS OFF. TCAS OFF shows in all ND modes
- Removes all TCAS symbols.



34-45-00-013 Rev 3 09/18/96

TCAS - CONTROL AND DISPLAY

TCAS - NAVIGATION DISPLAY

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TCAS - NAVIGATION DISPLAY

General

The TCAS computer puts traffic into these four different groups with different symbols to show different types of traffic:

- Other traffic shows as a white open diamond, and the altitude readout is small white text
- Proximate traffic shows as a solid white diamond, and the altitude readout is small white text
- Traffic advisory (TA) shows as a solid amber circle, and the altitude readout is amber text
- Resolution advisory (RA) shows as a solid red square and the altitude readout is red text.

Each traffic symbol has an altitude readout and a vertical motion arrow. The traffic symbols show in one of these modes only:

- Center (CTR) MAP
- Expanded (EXP) MAP
- Expanded (EXP) VOR
- Expanded (EXP) APP.

Range Data

When you push the TFC switch on the EFIS control panel to show TCAS data, the range selected on the EFIS control panel shows on the ND.

TCAS Messages

The ND can show these messages for TCAS:

- TFC shows in cyan in and all modes
- TA ONLY shows in cyan and in all modes
- TCAS TEST shows in cyan and in all modes
- TCAS FAIL shows on two lines in amber, and in the CTR MAP and EXP MAP,VOR and APP modes
- TCAS OFF shows on two lines in amber, and in the CTR MAP and EXP MAP,VOR and APP modes

Altitude Separation

The TCAS computer uses the absolute altitude of the TCAS airplane and the traffic airplane to calculate the altitude separation. The altitude separation shows on the ND in hundreds of feet. If the traffic is above, the digits show above the traffic symbol with a plus (+) sign. If the traffic is below, the digits show below the traffic symbol with a minus (-) sign.

If the altitude separation is less than 100 feet, 00 feet shows.

If the altitude separation is NCD, the altitude readout does not show.

Absolute Altitude

The traffic airplane sends the TCAS computer its absolute altitude. The absolute altitude shows in thousands of feet. If the traffic is above, the digits show above the traffic symbol. If the traffic is below, the digits show below the traffic.

TCAS - NAVIGATION DISPLAY

If the altitude separation is NCD, the altitude readout does not show.

Vertical Motion Arrow

A vertical motion arrow shows on the right side of the traffic symbol. It is the same color as the traffic symbol. If the traffic airplane is in a descent the arrow points down. If the traffic airplane is in a climb the arrow points up.

OFFSCALE

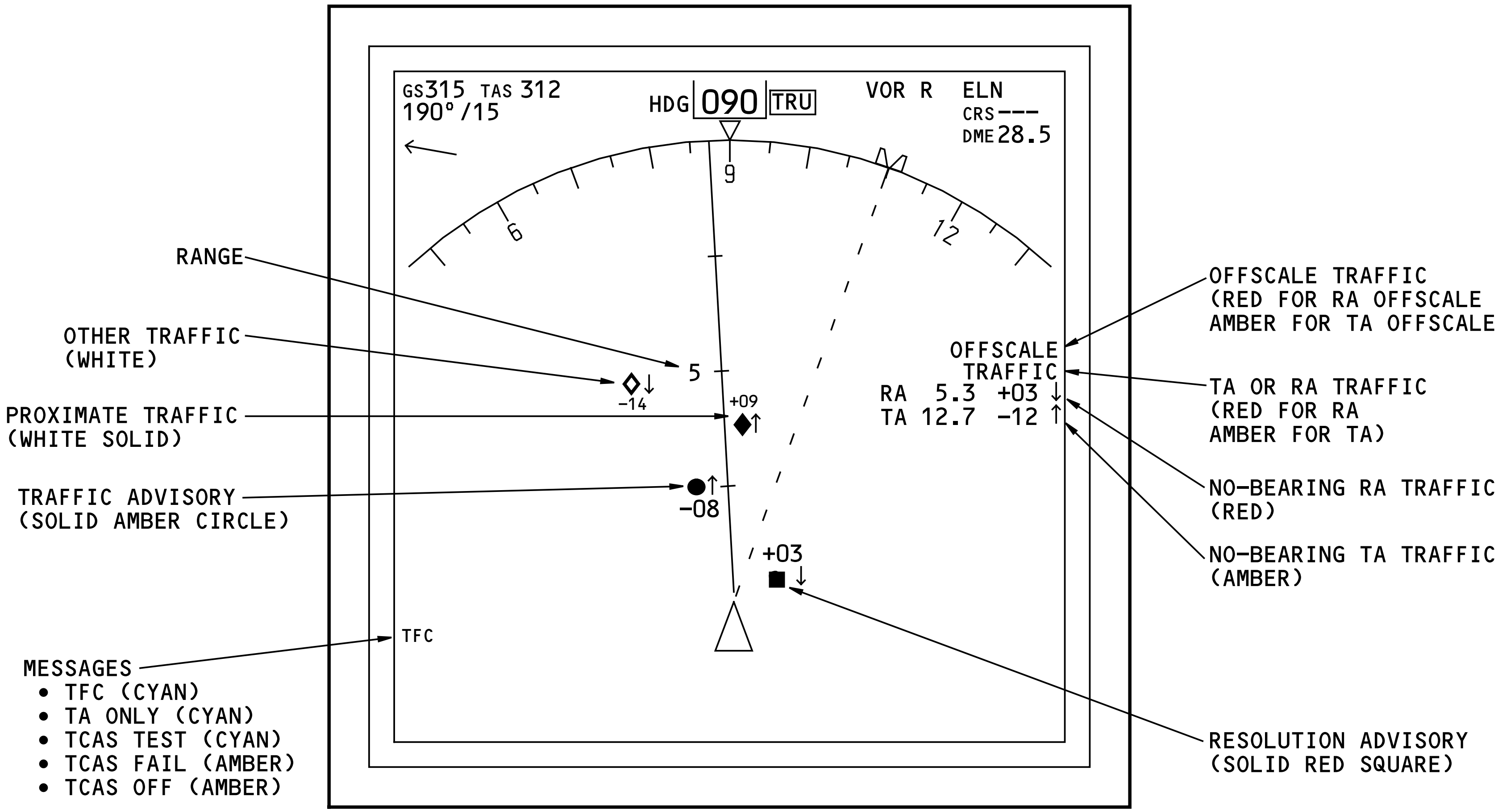
The OFFSCALE message shows on the ND when a RA or TA is outside the ND range. If a RA is outside the ND range, the OFFSCALE message shows in red. If a TA is outside the ND range, the OFFSCALE message shows in amber. If both a TA and RA are outside the ND range, the OFFSCALE message shows in red.

TRAFFIC

The red TRAFFIC message shows any time there is a RA. The amber TRAFFIC message shows any time there is a TA. The TRAFFIC message shows in all ND formats.

RA and TA No-Bearing Traffic

The no-bearing RA and TA messages show on the ND when TCAS loses the bearing of the RA or TA traffic. When the landing gear is down, the bottom directional antenna becomes an omnidirectional antenna. When this happens, the bottom antenna cannot track the bearing of the intruder traffic, thus the bearing is NCD. Because of this, the no-bearing messages show on the ND. If a TA becomes no-bearing traffic, an amber TA with the range, altitude, and vertical motion arrow shows on the ND. If a RA becomes no-bearing traffic, a red RA with the range, altitude, and vertical motion arrow shows on the ND.



ND - EXPANDED VOR MODE

34-45-00-014 Rev 2

NOTE: TCAS FAIL AND TCAS OFF SHOW ON TWO LINES

TCAS - NAVIGATION DISPLAY

TCAS - PRIMARY FLIGHT DISPLAY

General

These are the two types of TCAS advisories that can show on the PFD:

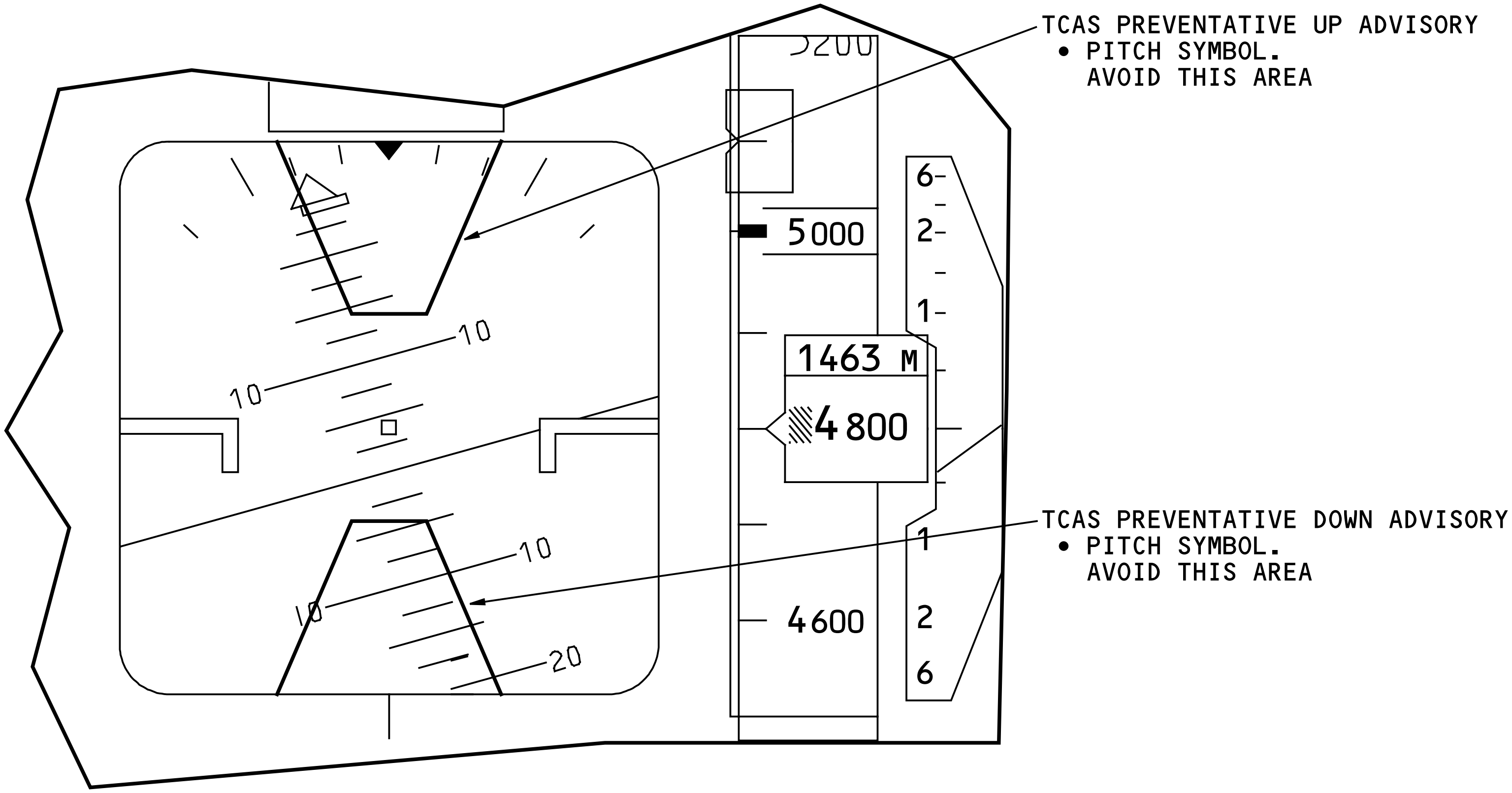
- TCAS preventative down advisory
- TCAS preventative up advisory.

These symbols only show for an RA when the function selector on the transponder panel is in the TA/RA or TA ONLY position and TCAS communicates with threat airplanes that have TCAS.

Description

The red advisories that show on the attitude display tells the flight crew to avoid this area.

The flight crew uses the advisories to avoid a possible collision with threat airplanes.



PRIMARY FLIGHT DISPLAY

34-45-00-015 Rev 3 04/26/96

TCAS - PRIMARY FLIGHT DISPLAY

TCAS - TEST DISPLAYS

General

When a self-test starts, TCAS test indications go to the PFDs, NDs, and the front panel of the TCAS computer. At the end of the test, a TCAS test aural comes on at the aural warning speakers.

There are two ways to start a self-test:

- From the maintenance access terminal (MAT)
- From the front panel test switch.

TCAS Self-Test Indications - ND

During a self-test, the ND shows this data:

- A cyan message, TCAS TEST
- Amber TA traffic symbol at 9 o'clock, -200 feet relative altitude with an up vertical motion arrow and 2 nm distance from the airplane center
- White other traffic symbol at 11 o'clock, +1000 feet relative altitude with no vertical motion arrow and 3.6 nm distance from the airplane center
- White proximate traffic symbol at 1 o'clock, -1000 feet relative altitude with a down vertical motion arrow and 3.6 nm distance from the airplane center
- Red RA traffic symbol at 3 o'clock, +200 feet relative altitude with no vertical motion arrow and 2 nm distance from the airplane center.

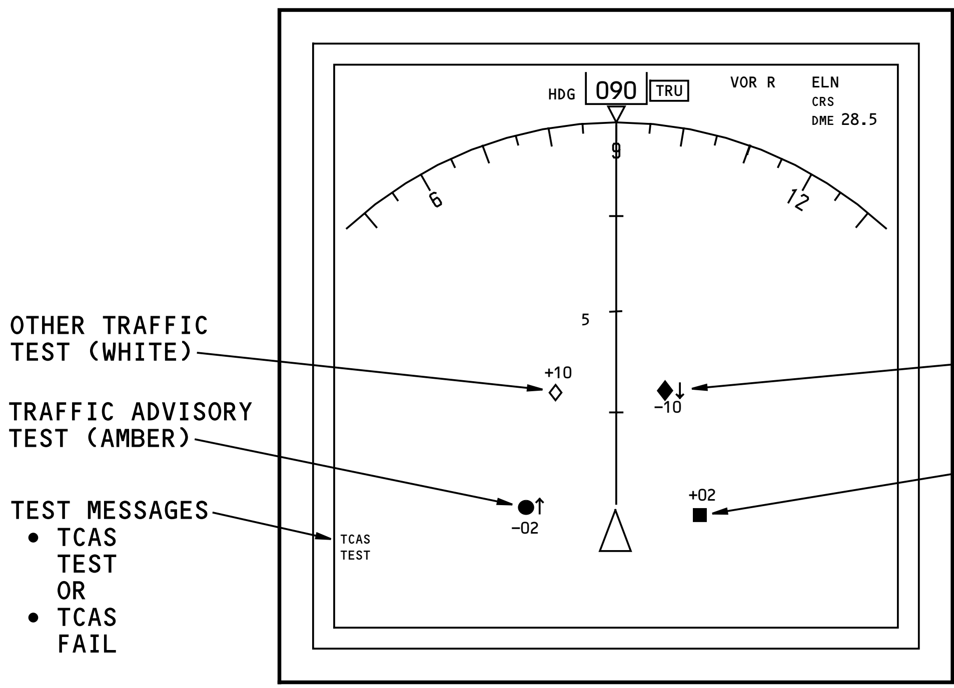
If the test fails, the message TCAS FAIL replaces the TCAS TEST message.

TCAS Self-Test Indications - PFD

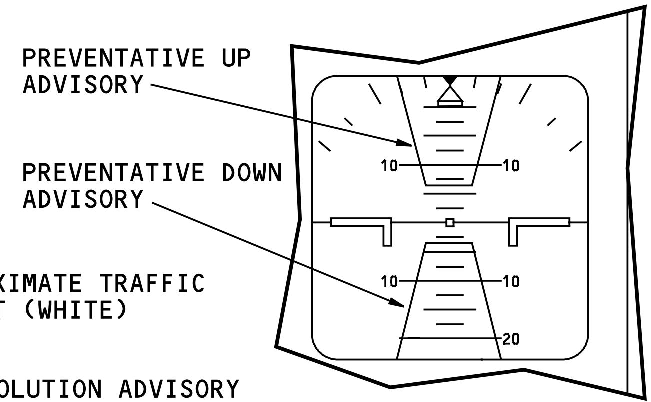
During a self-test, the PFD shows the red RA preventative down advisory and red RA preventative up advisory cues on the attitude display.

TCAS Self-Test Aurals

When the test completes with no faults, the aural message TCAS SYSTEM TEST OK comes on. If the BITE detects a fault during the self-test, the aural message is TCAS SYSTEM TEST FAIL.



ND - EXPANDED VOR



PFD

34-45-00-018 Rev 4 04/26/96

TCAS - TEST DISPLAYS

TCAS - GROUND TESTS

General

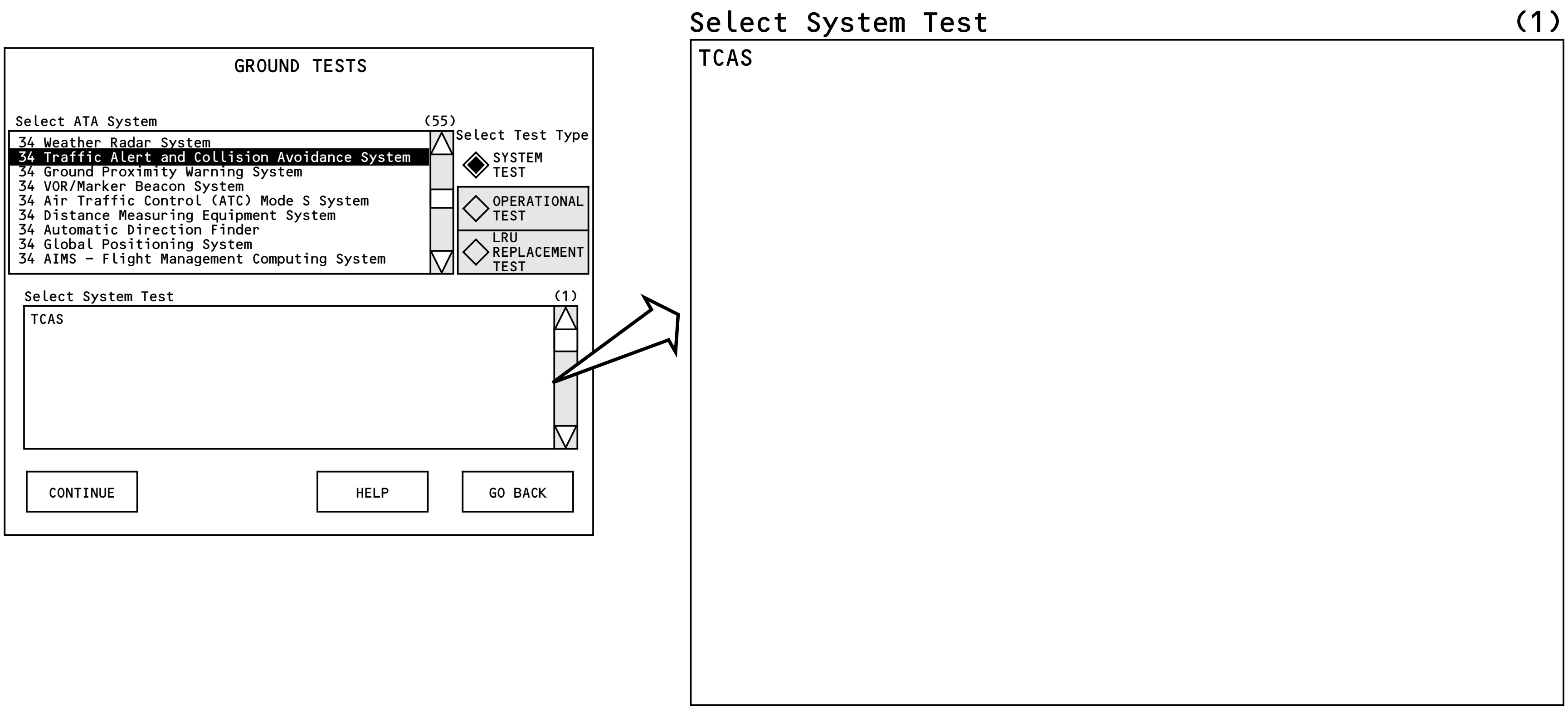
You can do a TCAS system test from the MAT.

TCAS System Test

The TCAS system test makes sure the TCAS computer and its interfaces operate properly.

You get these indications when you do a system test:

- Traffic symbols on the NDs
- Up and down preventative advisories on the PFDs
- TCAS TEST PASS or FAIL aural at the end of the test.



34-45-00-019 Rev 1

TCAS - GROUND TESTS

Continental Airlines, Inc

Clocks

WB371

TABLE OF CONTENTS

CLOCKS - INTRODUCTION

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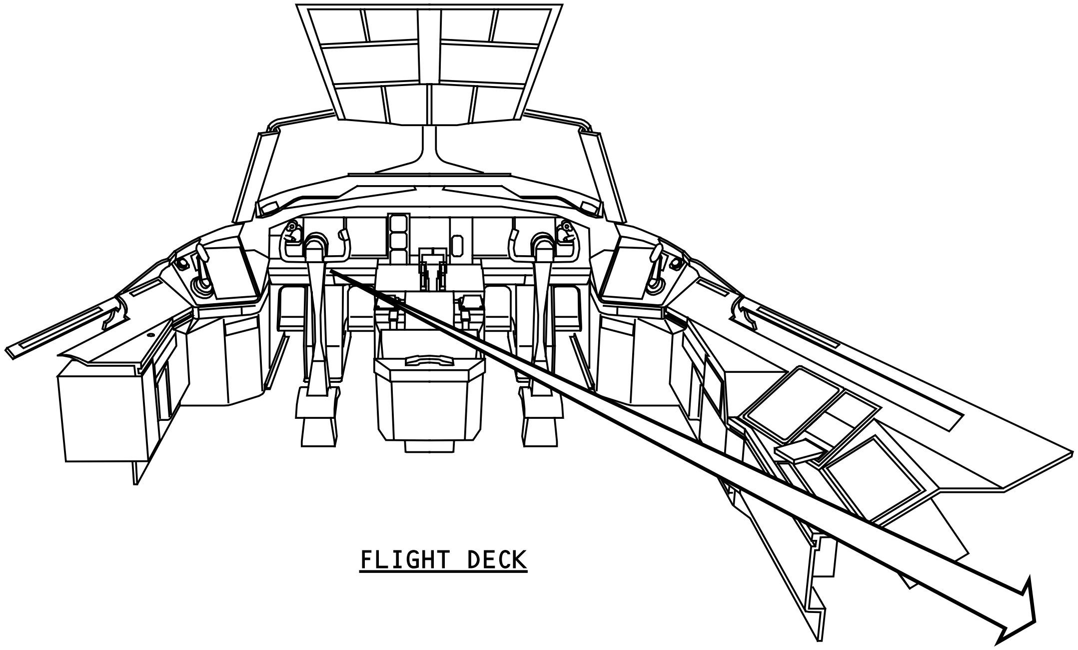
CLOCKS - INTRODUCTION

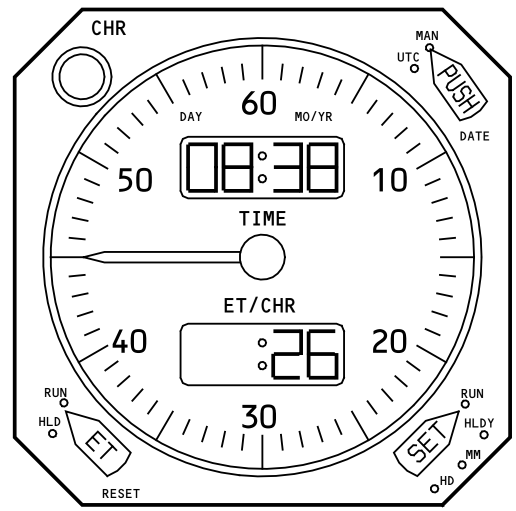
General

The clocks give time reference to the flight crew.

Abbreviations and Acronyms

AIMS	- airplane information management system
ARINC	- aeronautical radio, inc.
CDU	- control display unit
CHR	- chronograph
HD	- hours/days
HLDY	- hold/year
GPS	- global positioning system
GPSSU	- global positioning system sensor unit
LCD	- liquid crystal display
MAN	- manual
MM	- minutes/months
ND	- navigation display
UTC	- universal time (coordinated)
UTCF	- universal time (coordinated) function





31-25-00-001 Rev 1 06/17/96

CLOCKS - INTRODUCTION

CLOCKS - GENERAL DESCRIPTION

General

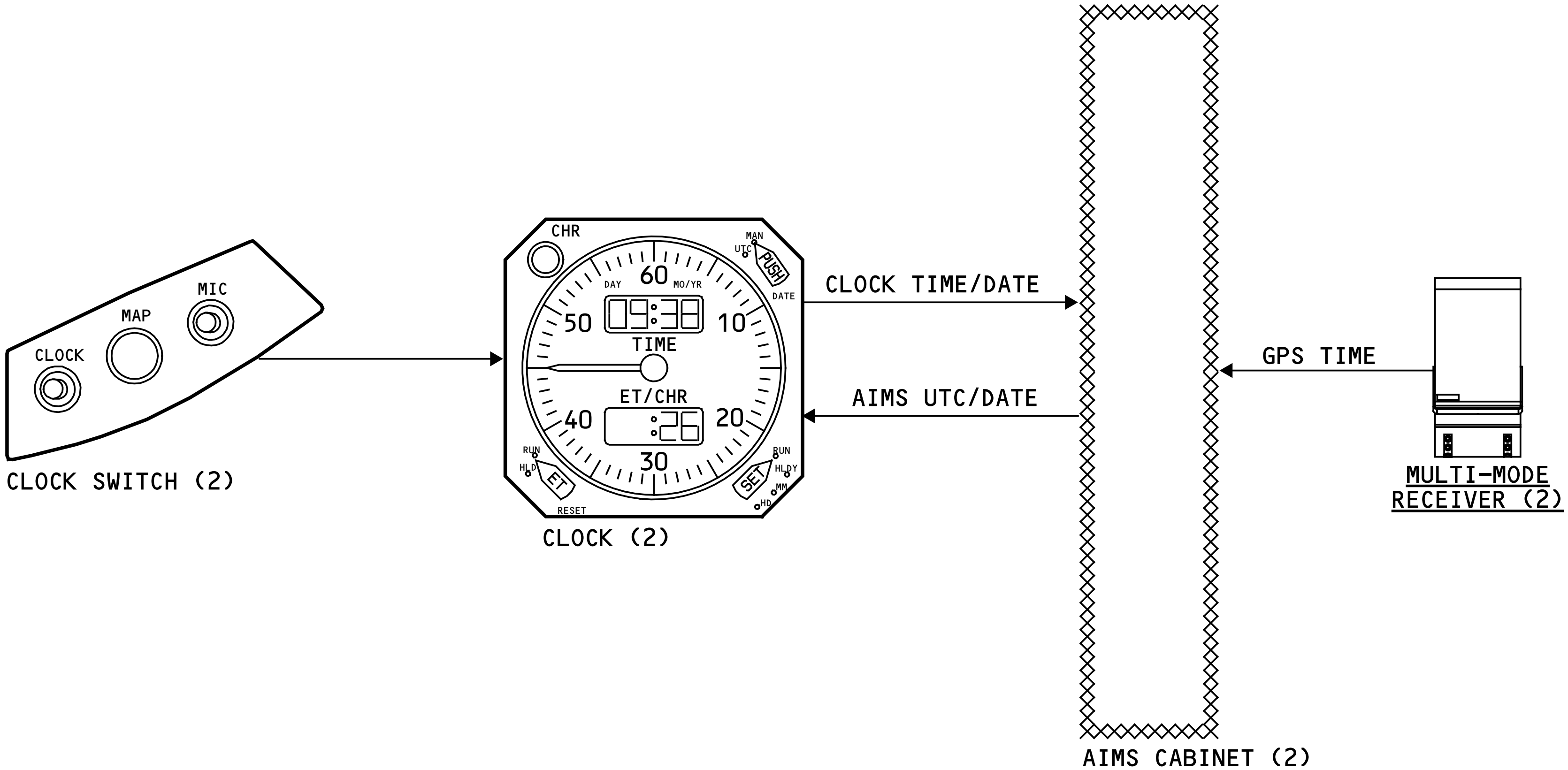
This is the data that the clocks show:

- Time and date set manually from the clock
- Universal time (controlled) (UTC) and date from the airplane information management system (AIMS)
- Elapsed time
- Chronograph time.

Use the clock switches on the glareshield panel to control the chronograph function of the clocks.

The clocks send manually set time and date to the airplane information management system (AIMS) cabinets. However, the AIMS cabinets do not use the clock time and date for any function.

The AIMS cabinets get UTC and date from the the multi-mode receivers (MMRs).



31-25-00-002 Rev 2 01/14/1998

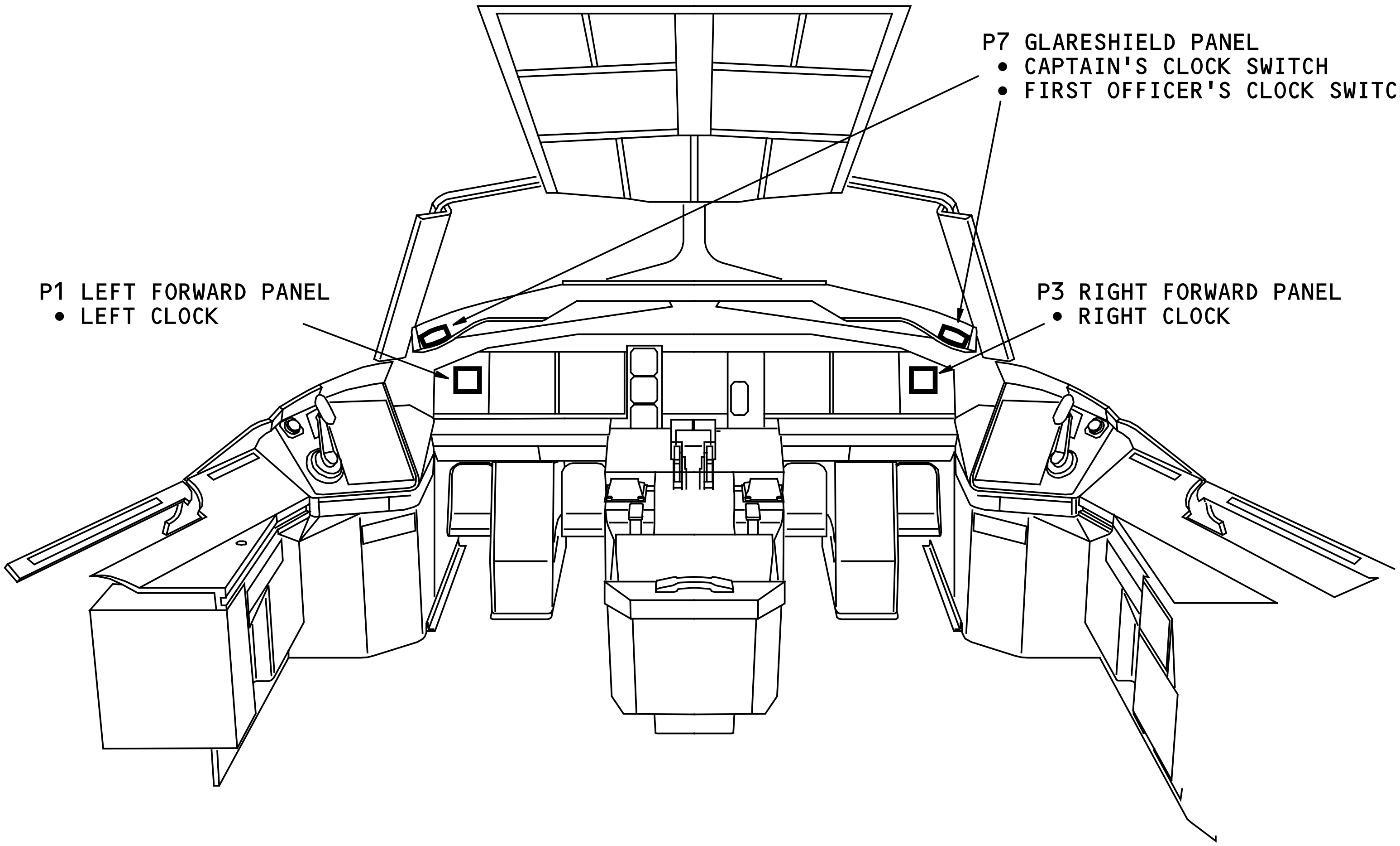
CLOCKS - GENERAL DESCRIPTION

CLOCKS - COMPONENT LOCATIONS

General

The clock system components are:

- Captain's clock
- First Officer's clock
- Captain's clock switch
- First Officer's clock switch.



31-25-00-003 Rev 0

CLOCKS - COMPONENT LOCATIONS

CLOCKS - INTERFACES

Power

Each clock gets 28v dc from a circuit breaker for operation. Each clock gets 5v ac for its internal instrument lights.

Clock Switches

Each clock gets a discrete signal from a clock switch on the glareshield. These discrete signals control the chronograph function of the clock.

Digital Input

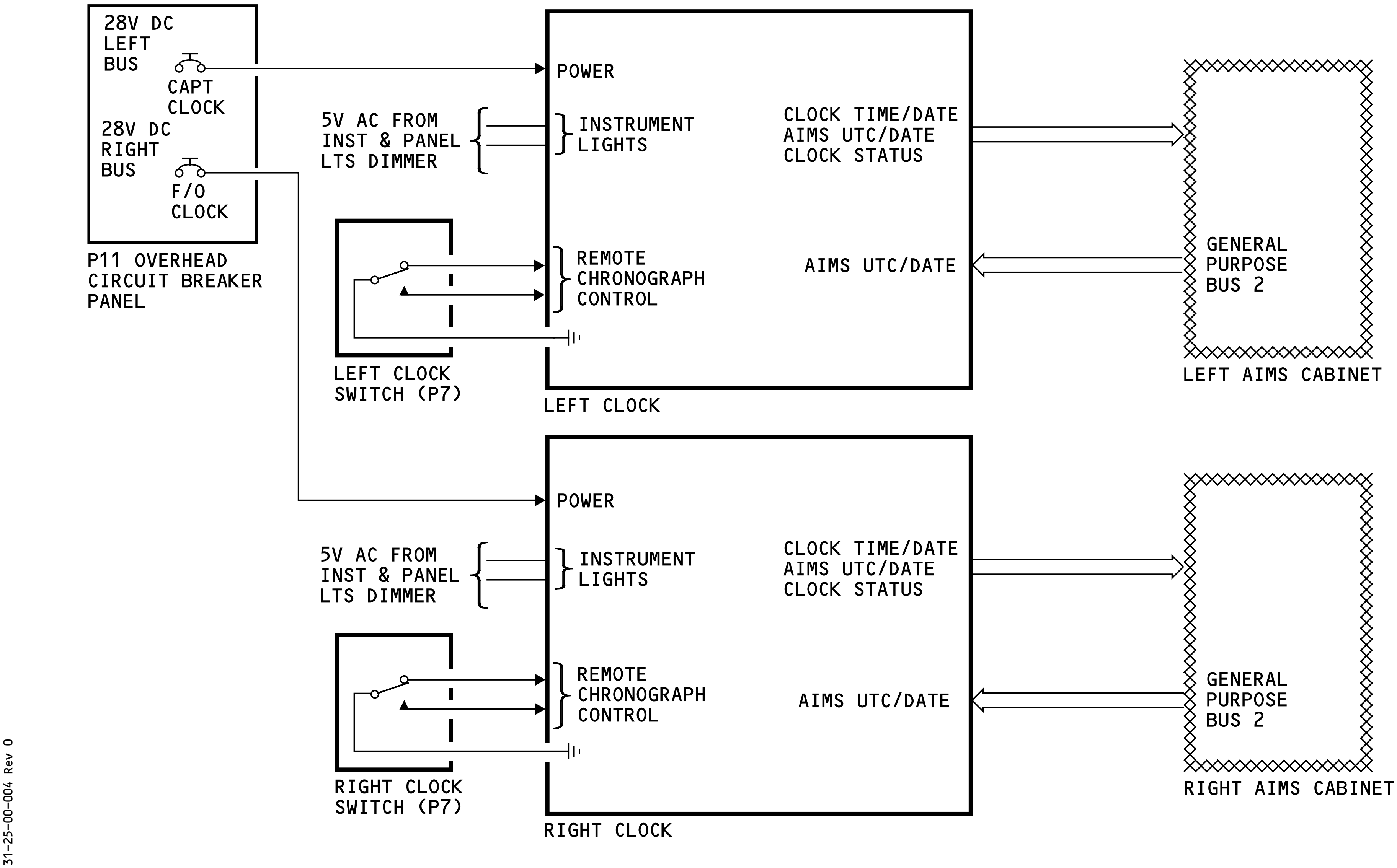
The left clock receives universal time (coordinated) (UTC) and date from the left AIMS cabinet. The right clock receives UTC and date from the right AIMS cabinet.

The clocks show AIMS UTC and date.

Digital Output

The left clock sends data to the left AIMS cabinet when in the manual mode. The right clock sends data to the right AIMS cabinet. The data is:

- UTC and date from the clock
- UTC and date from the AIMS
- Clock status data.



CLOCKS - INTERFACES

CLOCKS - CLOCK

Displays

The clock has a time/date window and an elapsed time/chronograph window. Both are liquid crystal displays (LCDs).

Chronograph Switch

The chronograph switch is a push-button switch. Use this switch to start, stop, and reset the chronograph function.

Sweep Second Hand

The sweep second hand only works with the chronograph function of the clock.

Elapsed Time Selector

The elapsed time selector is a three-position rotary switch. Use this selector to control the elapsed time function of the clock. The elapsed time selector positions are:

- RESET. This is a spring-loaded position. Use this position to reset the elapsed time
- HLD (hold). Use this position to hold the elapsed time
- RUN. Use this position to let the clock start to accumulate elapsed time.

Time/Date Selector

The time/date selector is a push-button rotary two-position switch. In the MAN (manual) position, clock time and date come from the clock. In the UTC position, UTC and date come from the AIMS universal time (coordinated) function (UTCF).

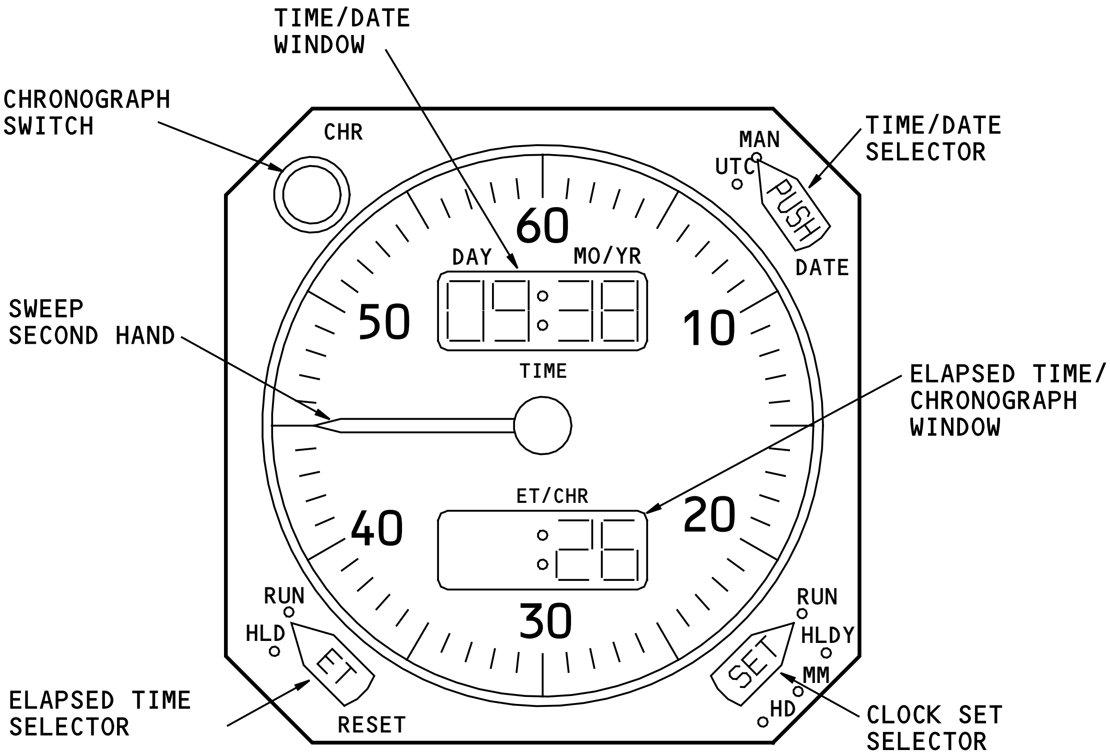
Push the selector once to show the date. Push it again to show the UTC.

Clock Set Selector

The clock set selector is a four-position rotary switch. Use this selector to set or change the clock time and date. You can only change the clock time and date in the manual mode. It is not possible to change the AIMS UTC and date.

The clock set selector positions are:

- HD (hours/date). Use this position to set the hours or the day
- MM (minutes/months). Use this position to set the minutes and the months
- HLDY (hold/year). Use this position to hold the time or set the year
- RUN. Use this position to let the clock begin the time update.



31-25-00-005 Rev 0

CLOCKS - CLOCK

CLOCKS - CLOCK TIME AND DATE SET FROM AIMS

Power-Up

If the time/date control switch is in MAN when the clock first receives power, the clock shows 00 hours, 00 minutes and does not change. You can use the AIMS UTC and date to set the clock time.

Update of Clock Time and Date From AIMS UTCF

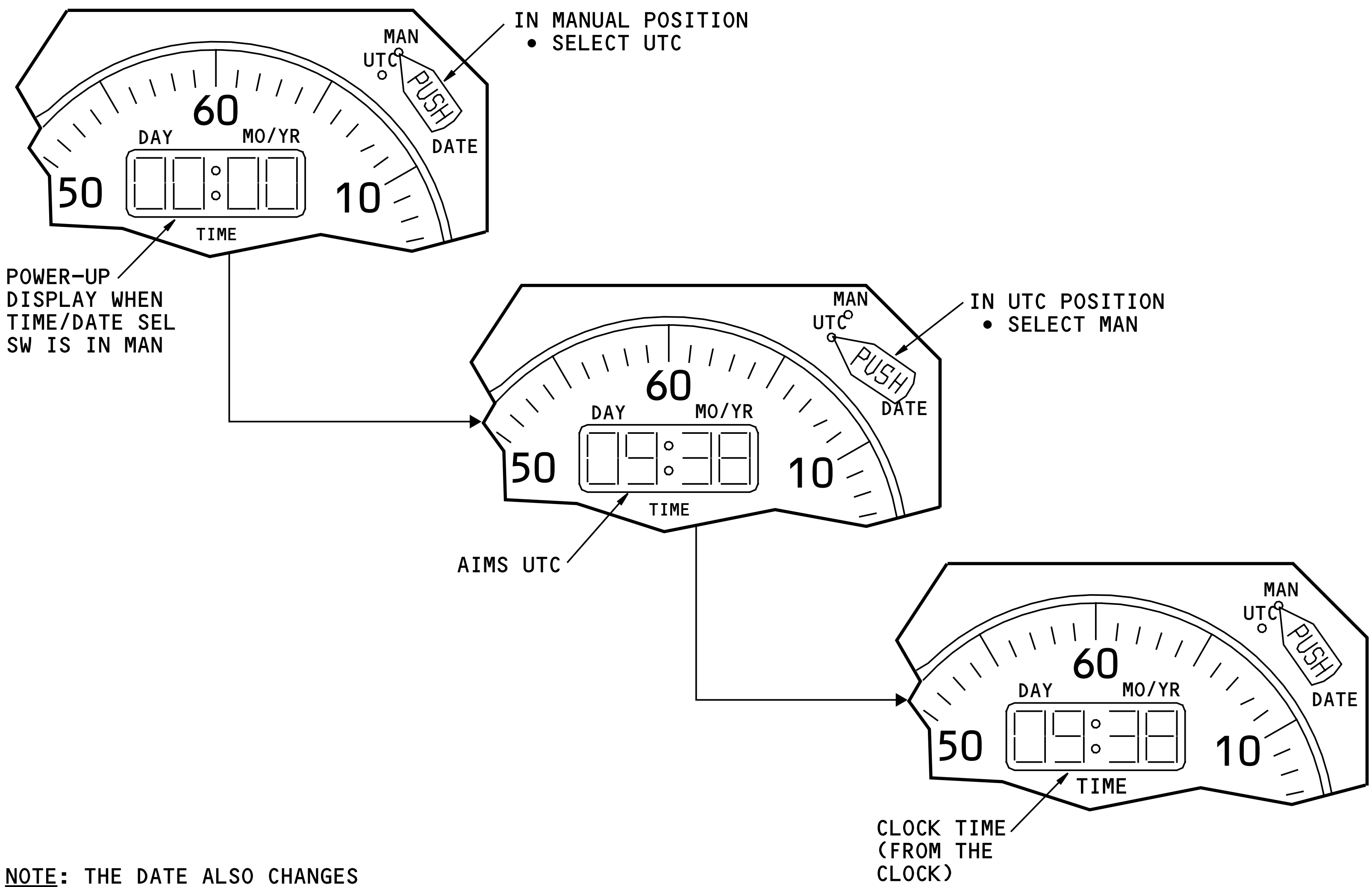
Put the time/date control switch in the UTC position. This causes the clock to:

- Show UTC from the AIMS universal time (coordinated) function (UTCF)
- Use the UTC from the AIMS as a starting point for an internal time accumulator. Once the accumulator starts, it does not look at UTC from the AIMS UTCF.

Put the time/date control switch in MAN. This causes the clock to show UTC and date from its internal time accumulator.

Power-up With Time/Date Control Switch in UTC

If the time/date control switch is in UTC when the clock receives power for the first time, the clock shows the AIMS UTC if it is valid.



NOTE: THE DATE ALSO CHANGES

31-25-00-010 Rev 0

CLOCKS - CLOCK TIME AND DATE SET FROM AIMS

CLOCKS - FUNCTIONAL DESCRIPTION

Inputs

The clock gets 28v dc for power.

The clock receives universal time (coordinated) UTC and date from the AIMS universal time (coordinated) function (UTCF).

A multiplexer senses the position of all the switches on the clock and also the clock switch on the glareshield panel P7.

Calculations and Outputs

A microprocessor does all the time calculations and controls the outputs of the clock.

A stepper motor moves the sweep second hand when the chronograph function is in use.

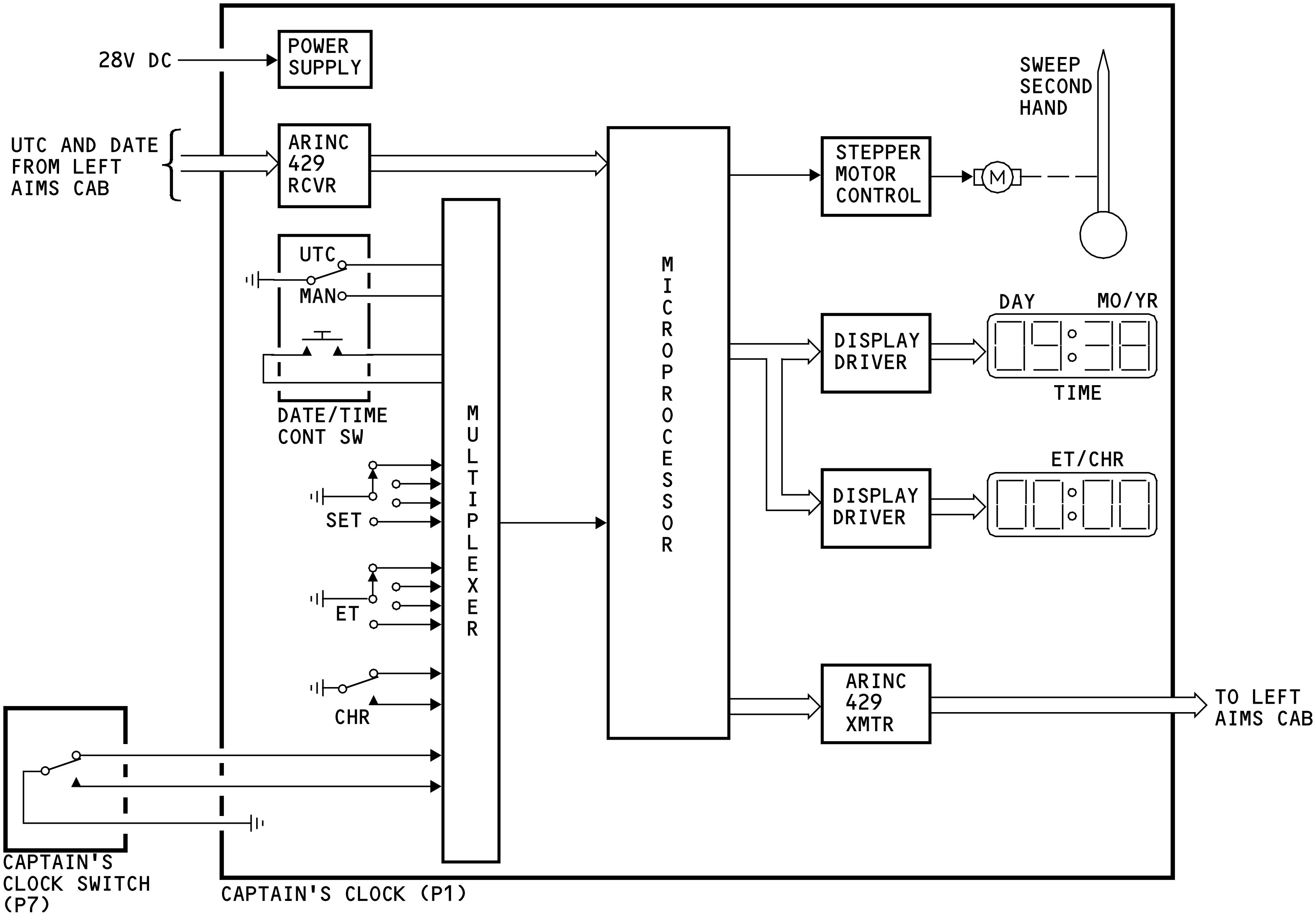
Display drivers supply display information to the clock displays.

ARINC 429 clock data goes to the AIMS cabinet.

Output to AIMS

The clock sends this data to the AIMS UTCF:

- Clock time
- Clock date
- AIMS UTC
- AIMS date
- Clock status data.



CLOCKS - FUNCTIONAL DESCRIPTION

31-25-00-013 Rev 0

Continental Airlines, Inc

Warning Electronic System

WB371

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Continental Airlines, Inc
Warning Electronic System
WB371

TABLE OF CONTENTS

WARNING ELECTRONIC SYSTEM - INTRODUCTION

General

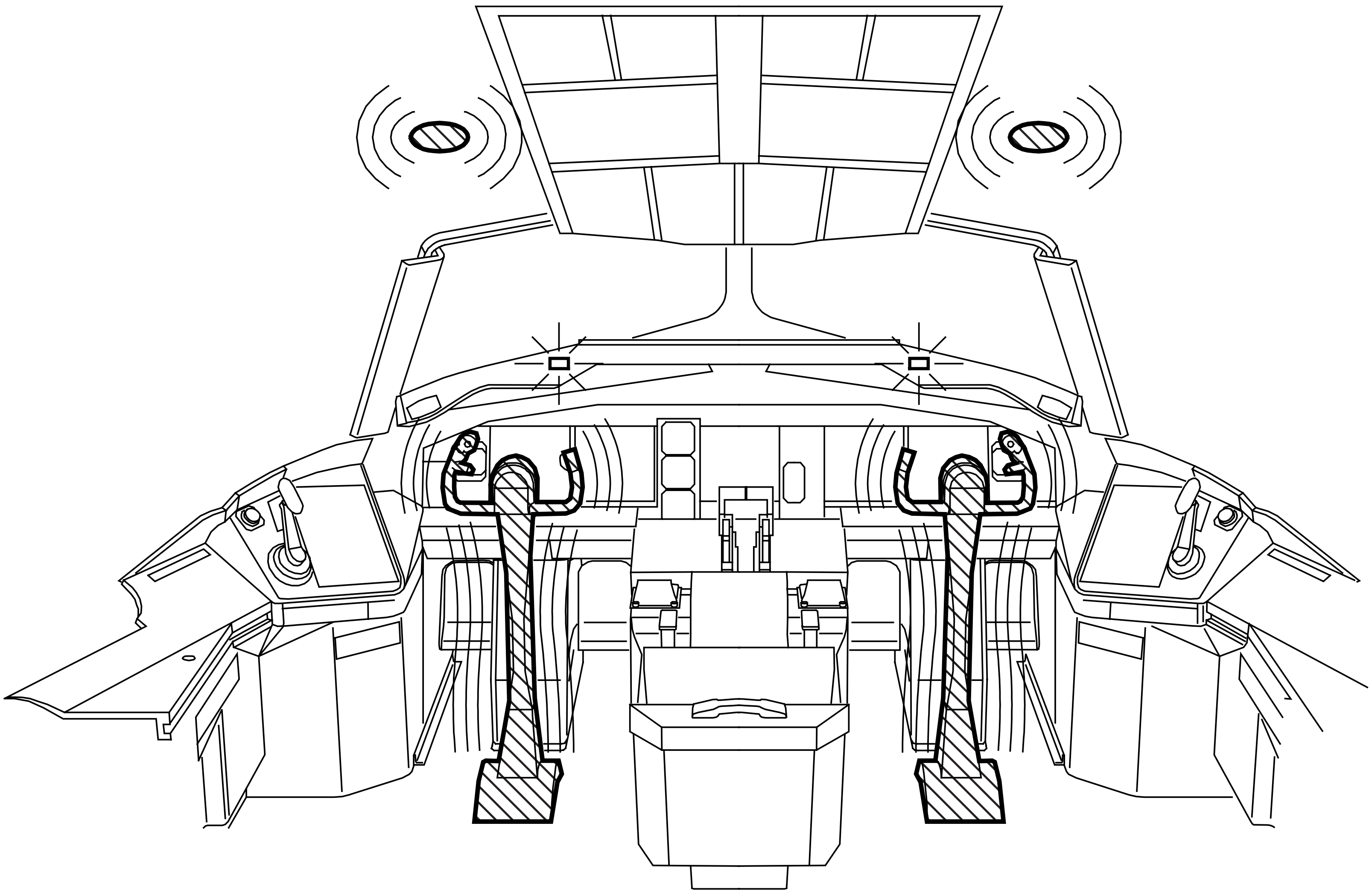
The warning electronic system (WES) supplies indications of incorrect airplane system conditions to the flight crew.

Abbreviations and Acronyms

ADIRU	- air data inertial reference unit
AFDC	- autopilot flight director computer
AGC	- automatic gain control
AIMS	- airplane information management system
AL	- body longitudinal acceleration
AN	- body normal acceleration
AOA	- angle of attack
AOA AS	- autoslat trip point
ARINC	- Aeronautical Radio, Incorporated
ASG	- ARINC signal gateway
BSCU	- brake system control unit
CG	- center of gravity
DB	- data base
FMCF	- flight management computing function
FSEU	- flap/slat electronics unit
GPWC	- ground proximity warning computer
GPSL	- glideslope power level
GW	- gross weight
HYDIM	- hydraulic interface module
MAT	- maintenance access terminal
MCP	- mode control panel
MGSCU	- main gear steering control unit
MLG	- main landing gear
MMO	- maximum operating mach number
MWL	- master warning light
NCD	- no computed data
NLG	- nose landing gear
OPBC	- overhead panel bus controller
OPC	- operational program code
OPS	- operational program system
PFC	- primary flight computer
PFCS	- primary flight control system
PFD	- primary flight display
PLI	- pitch limit indication
PSEU	- proximity sensor electronics unit
PWS	- predictive windshear
RA	- radio altitude
RA RT	- radio altimeter receiver-transmitter
SAARU	- secondary attitude air data reference unit
SBLP	- speedbrake lever position
SBPL	- speedbrake power level
STRIP	- stick shaker trip point
TBD	- to be determined
TCAS	- traffic alert and collision avoidance system
TLRA	- thrust lever resolver angle
V1	- decision speed
VBFLO	- initial buffet onset speed
VCAS	- computed airspeed
VCMIN	- active control minimum speed

WARNING ELECTRONIC SYSTEM - INTRODUCTION

VFE	- maximum flaps extended speed
VLE	- maximum gear extended speed
VMAX	- maximum speed limit
VMIN	- minimum speed limit
VMO	- maximum operating speed
VSS	- stick shaker speed
VSSNG	- maneuver margin above stick shaker speed
WES	- warning electronic system
WEU	- warning electronic unit
WXR	- weather radar



31-51-00-001 Rev 3

WARNING ELECTRONIC SYSTEM - INTRODUCTION

WES - GENERAL DESCRIPTION

General

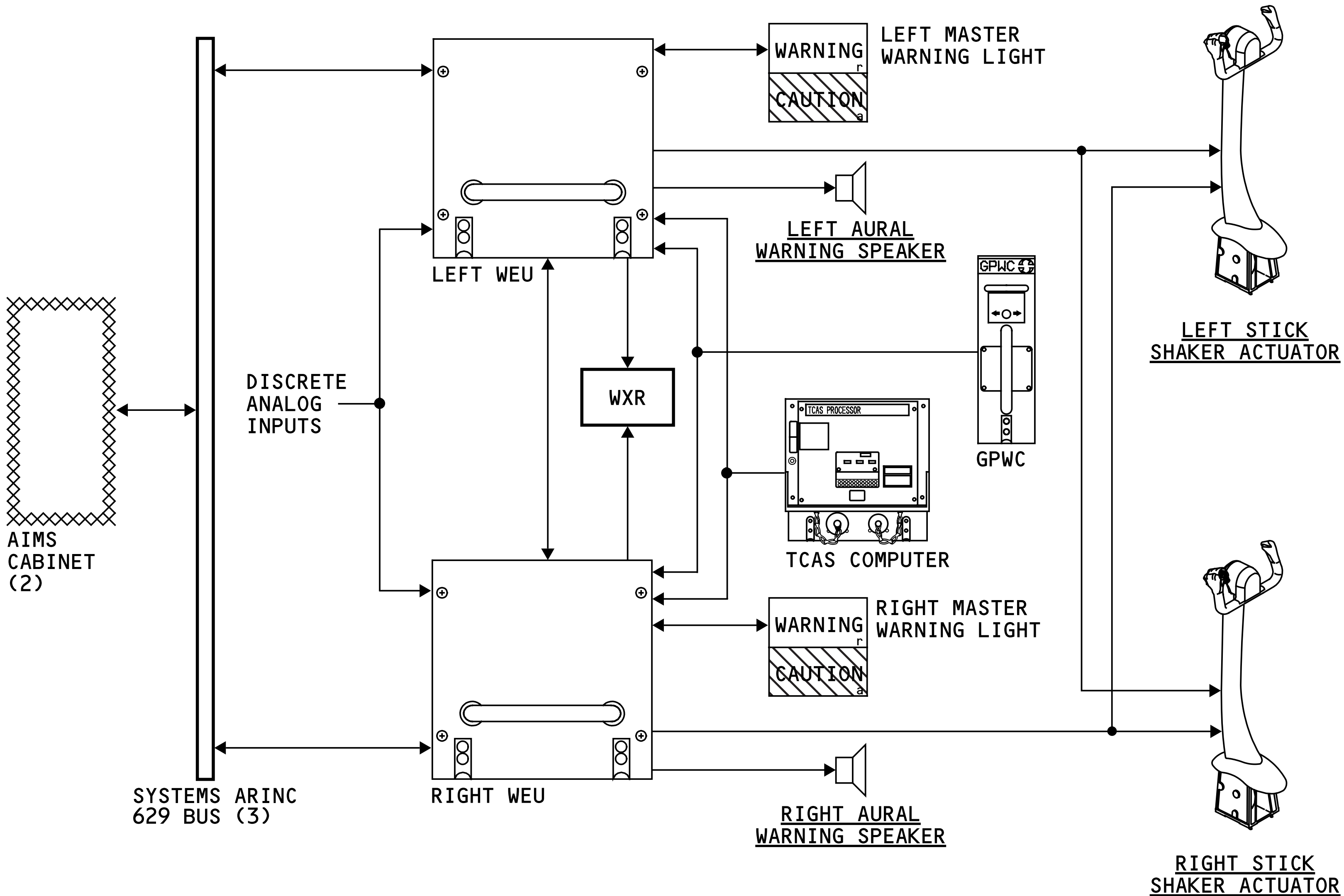
The warning electronic system (WES) has two warning electronic units (WEUs). Each WEU has two internal channels which do the same functions. The WES receives inputs from sensors, airframe, and avionics systems. The systems ARINC 629 buses supply most of the data. Discrete inputs supply the rest of the data.

The WES does these functions:

- Master warning light control
- Alert aurals control and amplification. This includes amplification of alert aurals from the traffic alert and collision avoidance system (TCAS) computer, the ground proximity warning computer (GPWC), and the predictive windshear (PWS) function of the weather radar (WXR).
- Landing and takeoff configuration warning
- Speedbrake alert
- Stabilizer green band
- Altitude alert
- Stall warning
- Auto slat enable
- Speed tape parameter calculation. This includes maximum operating velocity (Vmo), and maximum operating mach (Mmo) indication.

Outputs go to these:

- Master warning lights
- Aural warning speakers
- Stick shaker actuators
- Weather radar (WXR) system
- Airplane information management system (AIMS) for displays, maintenance functions, and data conversion.



31-51-00-002 Rev 2 02/03/1998

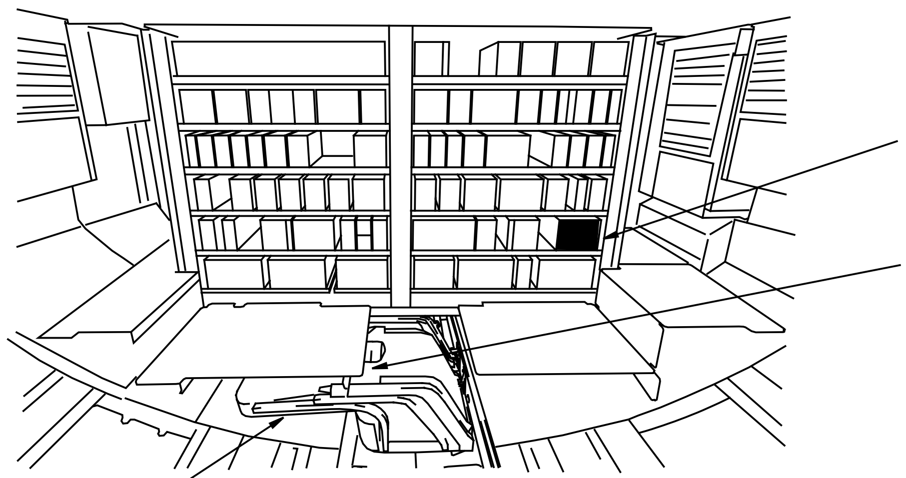
WES - GENERAL DESCRIPTION

WES - COMPONENT LOCATIONS 1

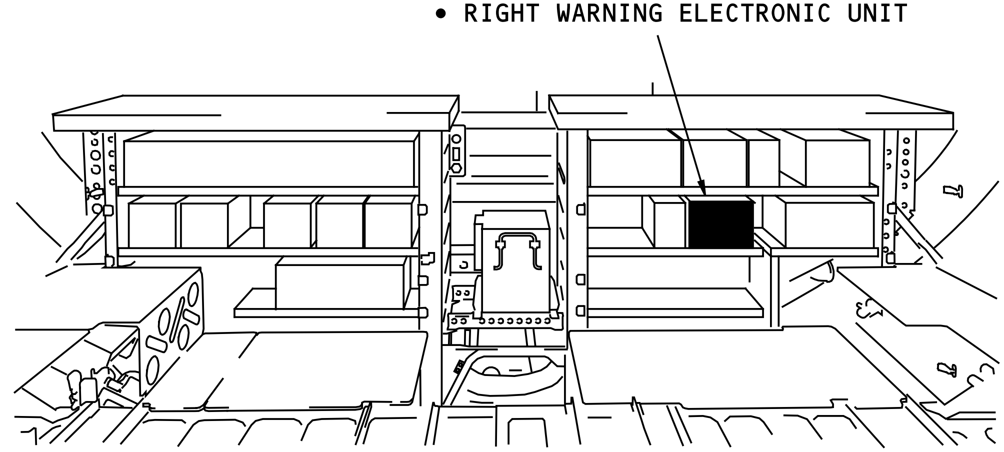
General

The warning electronic units (WEUs) are in the main equipment center.

The alternate gear down dispatch switch is on the right side of the lower main equipment access hatch.



MAIN EQUIPMENT CENTER
(LOOKING AFT)



MAIN EQUIPMENT CENTER
(LOOKING FWD)

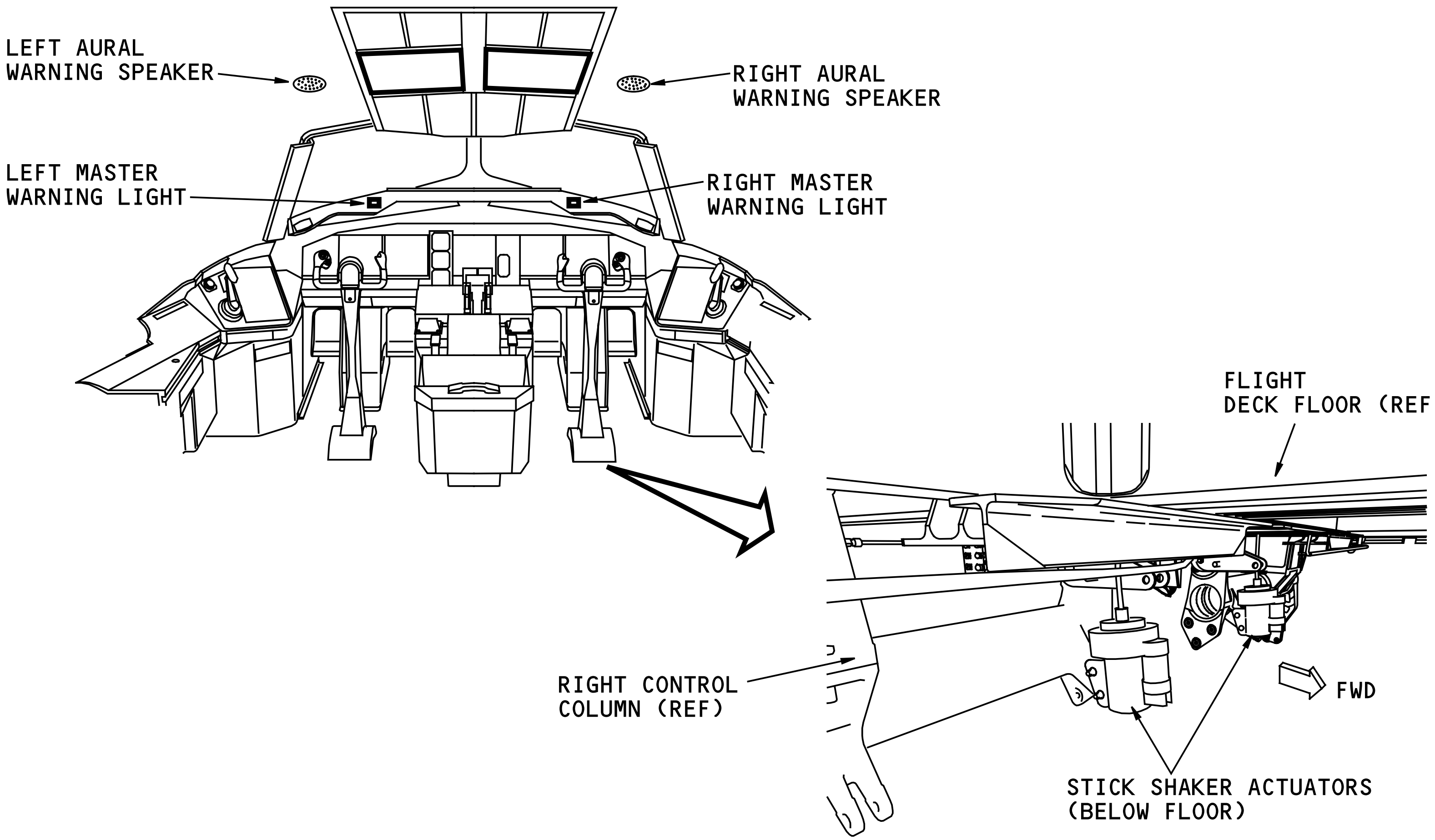
31-51-00-003 Rev 1

WES - COMPONENT LOCATIONS 1

WES - COMPONENT LOCATIONS - 2

General

The WES components in the flight deck, show on the graphic.



31-51-00-004 Rev 0

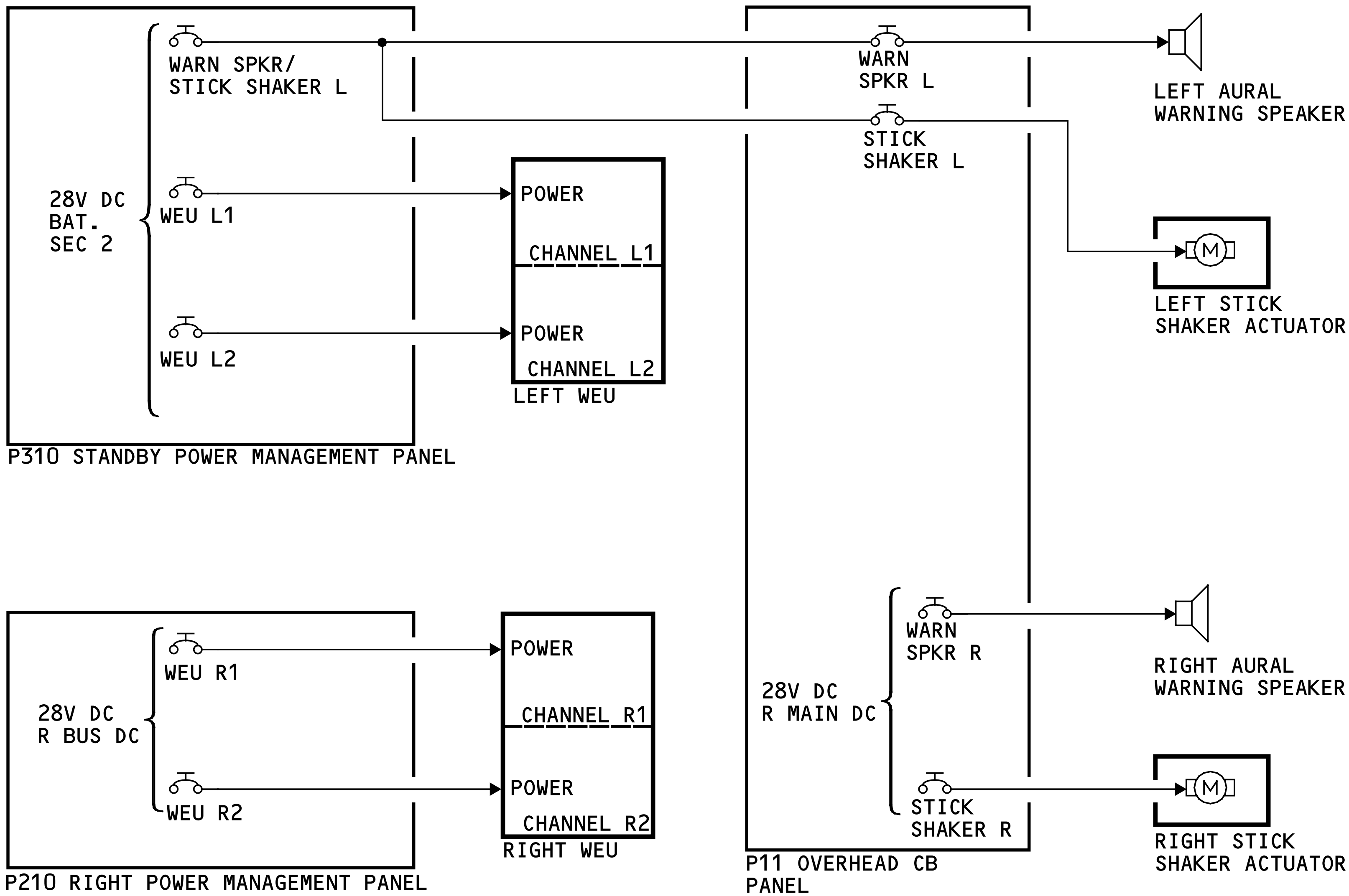
WES - COMPONENT LOCATIONS - 2

WES - POWER INPUTS

General

Each WEU receives two 28v dc inputs, one for each internal channel.

Each aural warning speaker and each stick shaker actuator receives 28v dc for operation.



31-51-00-005 Rev 0

WES - POWER INPUTS

WES - DIGITAL INTERFACES

ARINC 629 Interface

Each WEU channel connects to two system ARINC 629 buses.

Left WEU channel 1 (L1) transmits to and receives data from the left bus. Channel L1 only receives data from the center 1 bus.

Left WEU channel 2 (L2) transmits to and receives data from the center 1 bus. Channel L2 only receives data from the left bus.

Right WEU channel 1 (R1) transmits to and receives data from the right bus. Channel R1 only receives data from the center 1 bus.

Right WEU channel 2 right (R2) transmits to and receives data from the center 1 bus. Channel R2 only receives data from the right bus.

ARINC 629 Value Selection

One ARINC 629 data bus can have the same data value more than once. For example: radio altitude data from the left, center, and right radio altimeter transceivers is on the left system ARINC 629 bus.

Each WEU channel uses data from one ARINC 629 bus input.

Left WEU channel 1 (L1) uses data from the left bus. If a data value in the left bus fails, channel L1 uses the same data value from the center 1 bus.

Left WEU channel 2 (L2) uses data from the center 1 bus. If a data value in the center 1 bus data fails, channel L2 uses the same data value from the left bus.

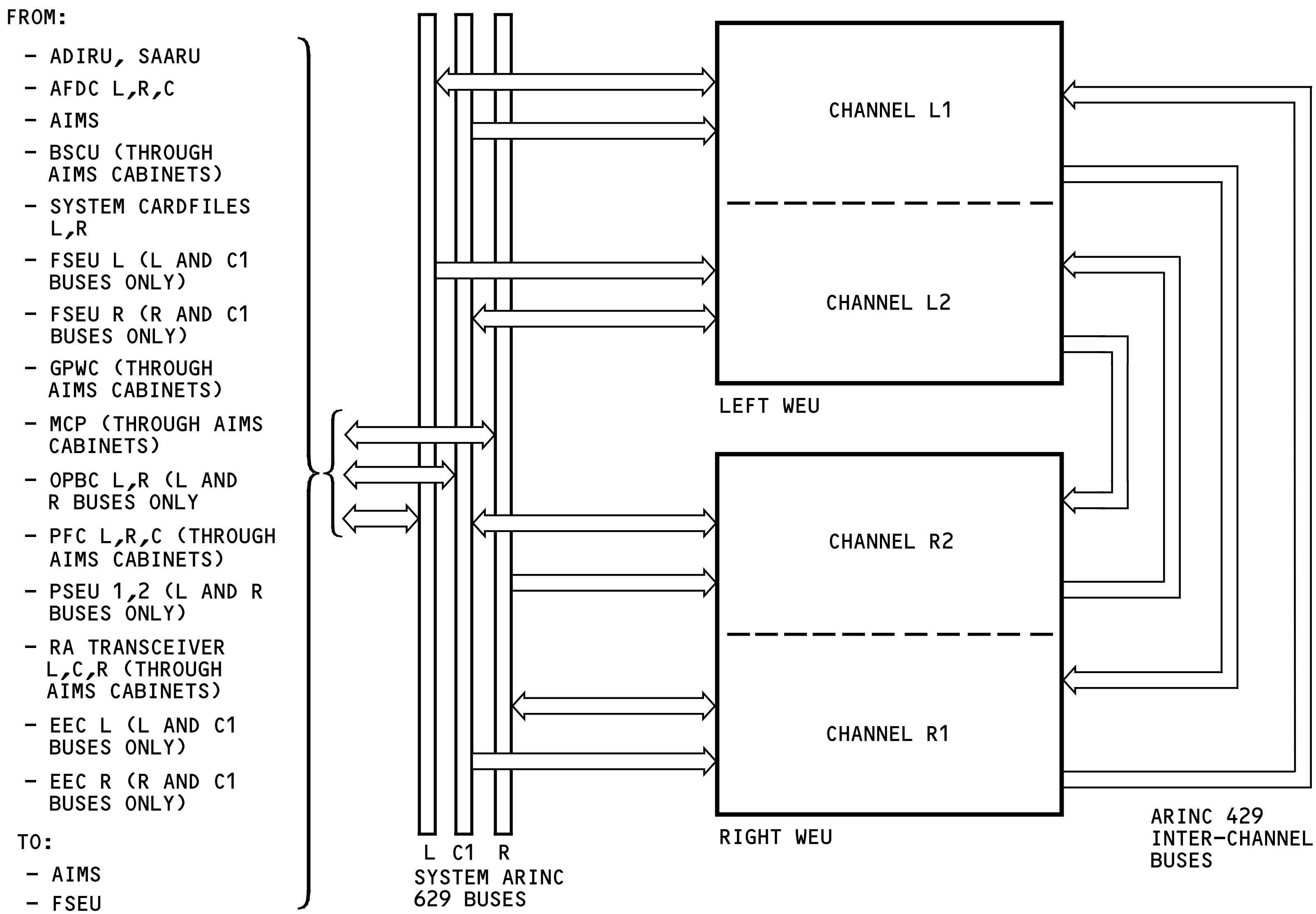
Right WEU channel 1 (R1) uses data from the right bus. If a data value in the right bus fails, channel R1 uses the same data value from the center 1 bus.

Right WEU channel 2 (R2) uses the center 1 bus. If a data value in the center 1 bus fails, channel R2 uses the same data value from the right bus.

Proximity switch electronic unit (PSEU) data selection is also different from the previous explanation. If at least one PSEU supplies a good data value to the WEUs, the WEUs use that data value.

ARINC 429 Inter-Channel Buses

Each WEU channel receives data from the opposite WEU on an ARINC 429 bus. Each WEU channel transmits data to the opposite WEU on an ARINC 429 bus.



WES - DIGITAL INTERFACES

31-51-00-006 Rev 3 01/23/1998

WES - ANALOG INTERFACES - 1

Autopilot Disconnect

The three autopilot flight director computers (AFDCs) supply autopilot disconnect ground signals to the WEUs when the autopilot disconnects. The WEUs use these inputs to make the master warning lights come on and make a siren aural.

Nose Gear Pressure Switch

The nose gear pressure switch supplies an aft or forward center of gravity (CG) signal to the WEUs. The WEUs use this input to verify stabilizer green band calculations.

Alternate Gear Down Dispatch Switch

The alternate gear down dispatch switch supplies three ground discrete signals to each WEU. When the switch is in the maximum operating speed (VMO) position, the WEUs use these signals to modify the maximum operating speed (VMO) and maximum operating mach (MMO).

Ground Proximity Gear Override Switch

The ground proximity gear override switch supplies an on/off signal to the WEUs. The WEUs use this input to inhibit the landing configuration warning siren.

Master Warning Light Interface

The left WEU makes the left master warning light come on. The right WEU makes the right master warning light come on. Each of the two channels in each WEU supplies a master warning arm signal to the opposite WEU. The master warning lights come on when at least two channels generate the master warning light on command.

Push the master warning lights to send a reset ground discrete signal to the WEUs. The reset signal makes the master warning lights go out. The master warning lights also go out when the problem that made them come on goes away.

GPWC,TCAS, and PWS Interface

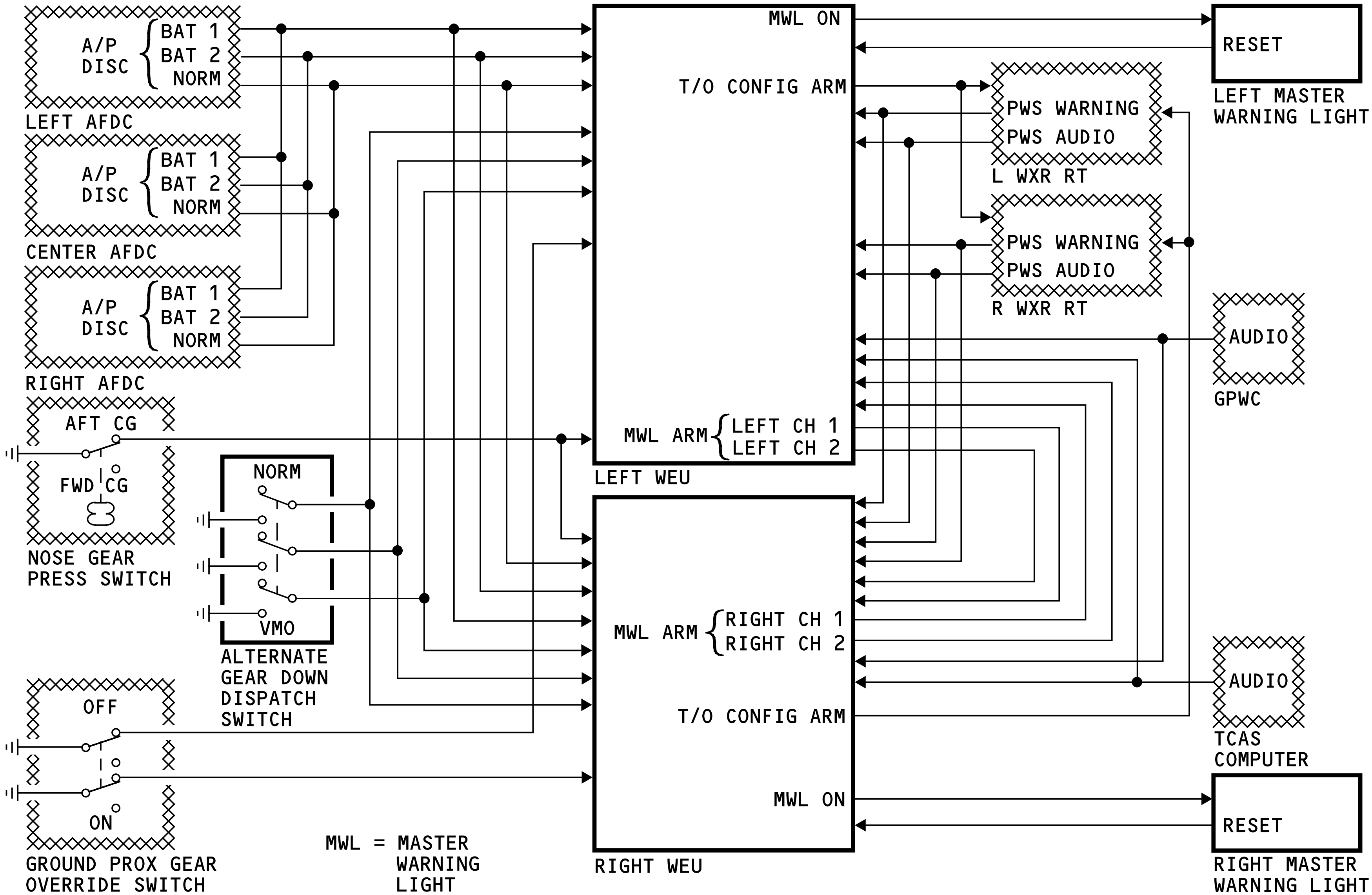
These systems supply analog alert audio to the WEU:

- Ground proximity warning system (GPWS)
- Traffic alert and collision avoidance system (TCAS)
- Weather radar (WXR) - For predictive windshear (PWS) alerts.

The WEUs amplify and send this audio to the aural warning speakers.

PWS Warning Discrete

The predictive windshear function in WXR sends a warning discrete to the WEUs. This discrete causes the master warning lights to come on when there is a PWS warning alert.



WES - ANALOG INTERFACES - 1

WES - ANALOG INTERFACES - 2

Fire Warning Inputs

The warning electronic units (WEUs) receive engine fire and APU fire signals from the engine and APU fire detection cards. The WEUs use these inputs to make a fire bell aural and to make the master warning lights come on.

Hydraulic Interface Modules Interface

The WEUs supply autoslat enable signals to the hydraulic interface modules (HYDIMs). The HYDIMs use these signals to increase available hydraulic flow for the slats.

Main Gear Steering Control Unit Interface

The main gear steering control unit (MGSCU) supplies main landing gear steering signals to the WEUs. The WEUs use these signals for takeoff configuration warning.

Stick Shaker Outputs

The stall warning function of the WEUs makes the stick shaker actuators come on when the airplane is near a stall.

Aural Warning Speaker Interface

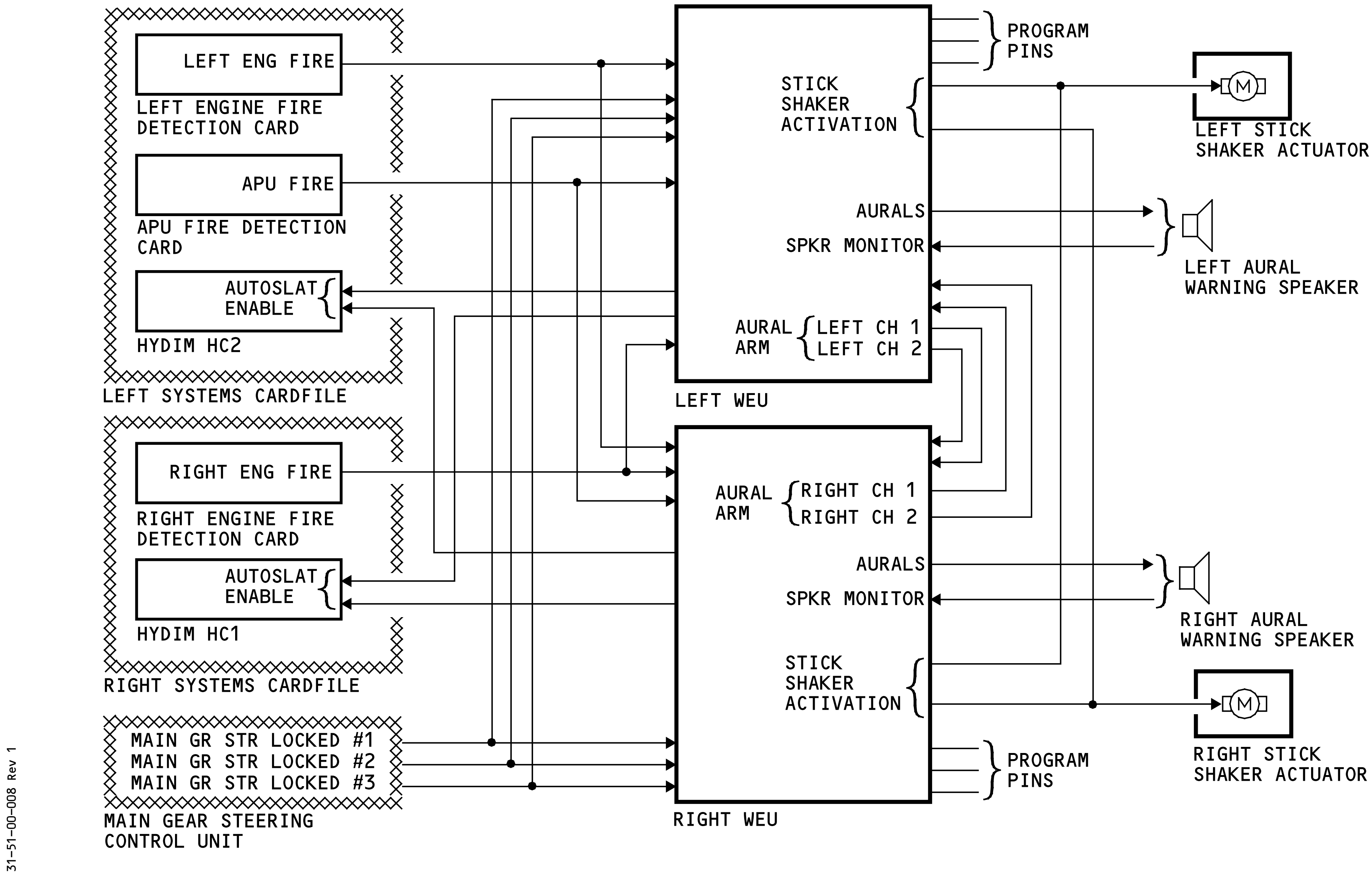
The left WEU supplies alert aurals to the left aural warning speaker. The right WEU supplies alert aurals to the right aural warning speaker.

The two channels in each WEU supplY an aural arm signal to the opposite WEU. An alert aural comes on when at least two channels generate the aural arm command.

The aural warning speakers send speaker monitor signals to the WEUs. The WEUs use these signals to check the speaker status.

Program Pins

Each WEU has program pins. Some program pins identify each WEU (left or right). The WEUs have other program pins, but they are for flight test only.



WES - ANALOG INTERFACES - 2

WES - WARNING ELECTRONIC UNIT

Purpose

The warning electronic unit (WEU) receives inputs from various systems. The WEU uses these inputs to show warning and alert indications to the flight crew.

WEU Channels

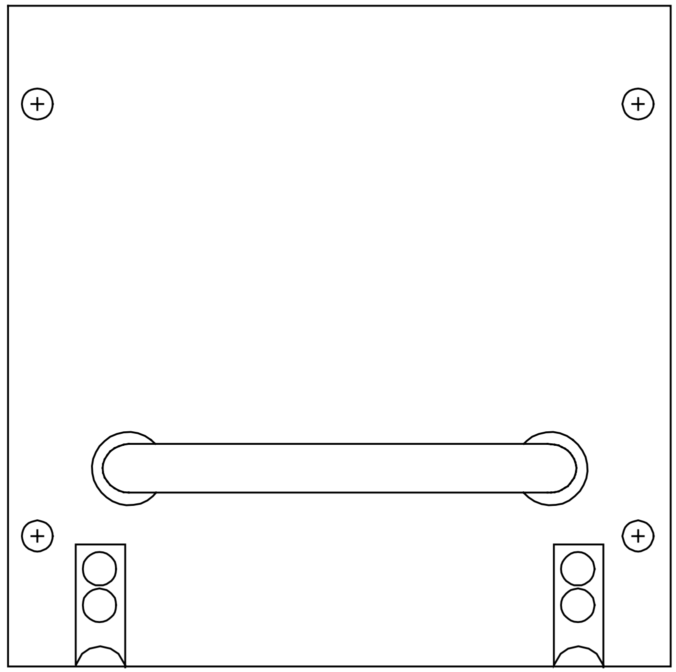
Each WEU has two channels that:

- Make alert aurals
- Do airplane configuration warning
- Do stall warning computations
- Process crew alerting signals.

The WEUs send data to each other. The WEU supplies warning and alerting outputs only when at least two out of the four channels make an output.

Software Loading

The WEUs must have software loaded in them. You use the maintenance access terminal (MAT) to load software into the WEUs.



31-51-00-009 Rev 2

WES - WARNING ELECTRONIC UNIT

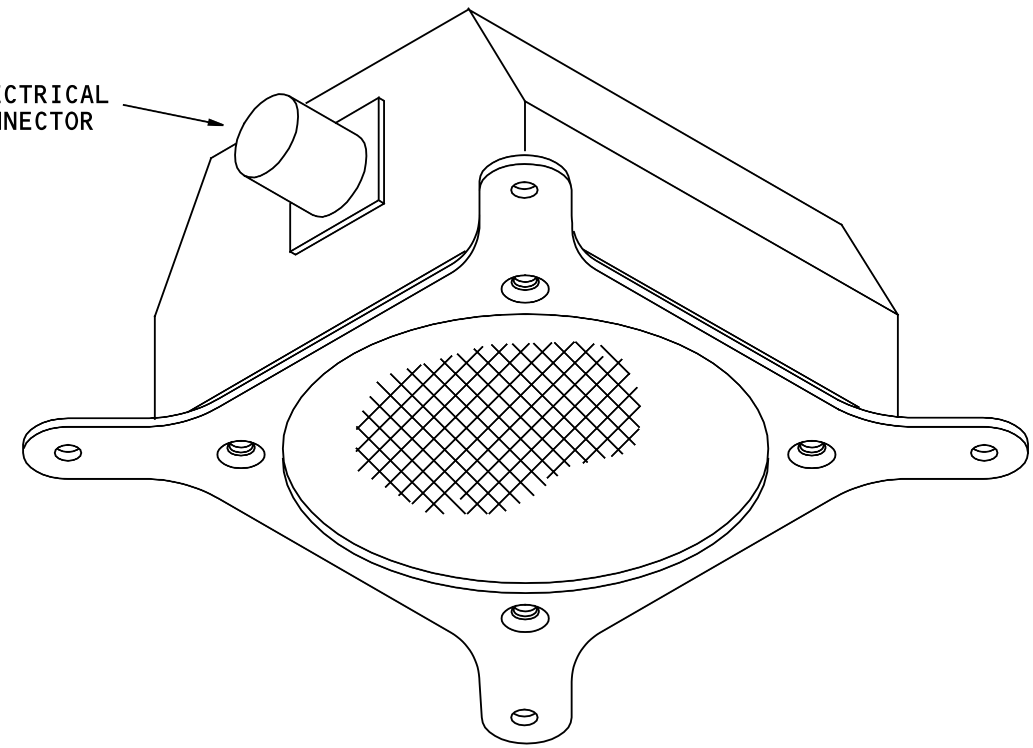
WES - AURAL WARNING SPEAKER

General

The aural warning speakers supply alert aurals to the flight crew.

There are two aural warning speakers. Each speaker gets 28v dc. The 28v dc energizes an amplifier in the speaker.

Each aural warning speaker supplies a speaker monitor signal to its WEU.



31-51-00-010 Rev 0

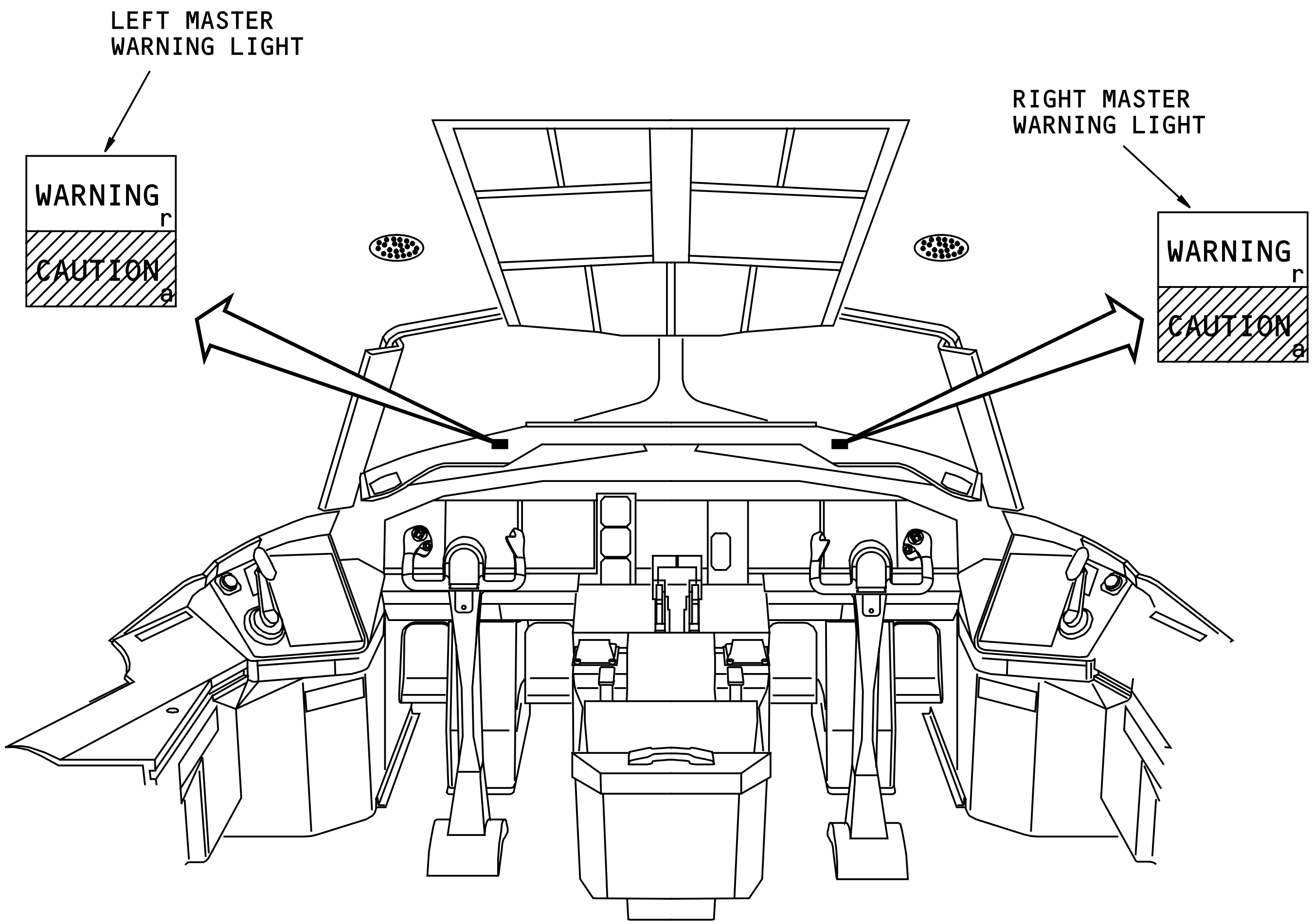
WES - AURAL WARNING SPEAKER

WES - MASTER WARNING LIGHTS

General

The master warning lights come on when the WEU sends a ground signal. The warning lights come on if there is a warning condition.

The master warning lights go out when the warning condition goes out, or when the flight crew pushes the lights.



31-51-00-011 Rev 0

WES - MASTER WARNING LIGHTS

WES - SPEEDBRAKE LEVER, STABILIZER POSITION INDICATOR, FLAP LEVER

General

The speedbrake lever, stabilizer position indicator, and flap lever are not WES components. However, they are critical for WES operation.

Speedbrake Lever

The speedbrake lever moves the speed brakes.

Stabilizer Position Indicator

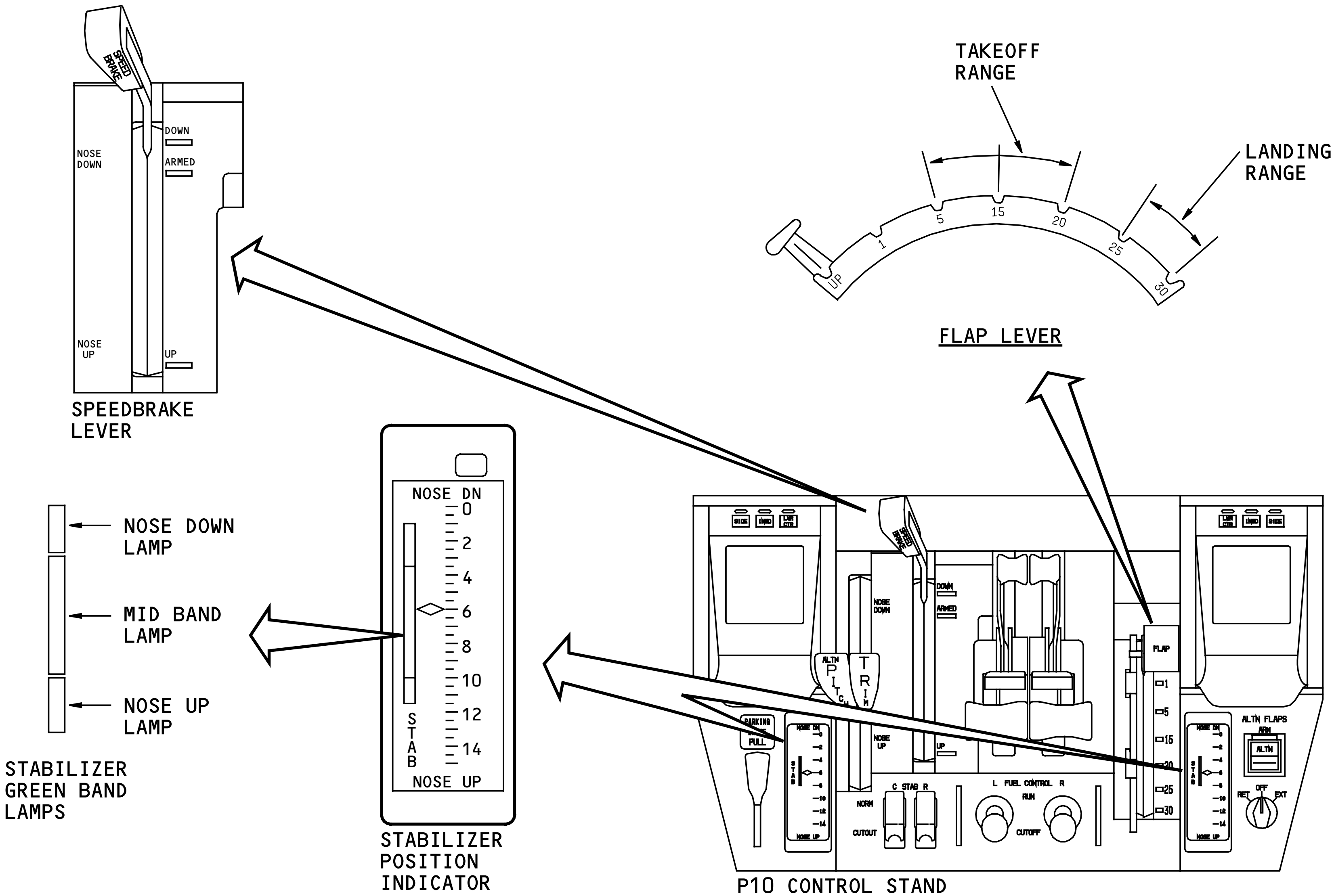
The stabilizer position indicators show the horizontal stabilizer position. Each indicator has three stabilizer green band lamps:

- Nose down
- Mid band
- Nose up.

The stabilizer green band lamps show the correct horizontal stabilizer position range for takeoff. The WEUs makes the stabilizer green band lamps come on.

Flap Lever

The flap lever sets the trailing edge and the leading edge devices position.



WES - SPEEDBRAKE LEVER, STABILIZER POSITION INDICATOR, FLAP LEVER

31-51-00-012 Rev 2 02/27/1998

WES - STICK SHAKER ACTUATOR

General

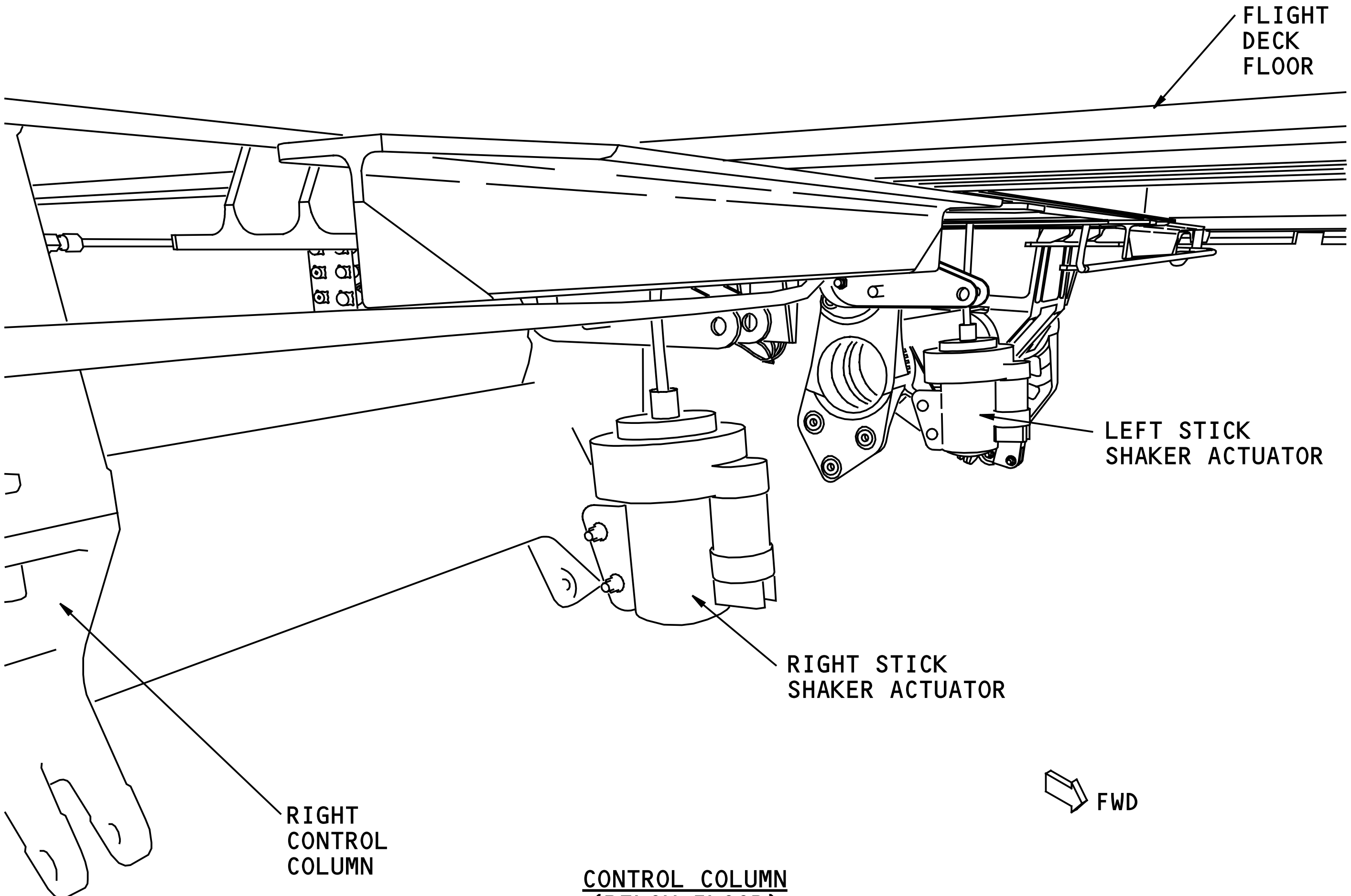
The stick shaker actuators are dc motors that shake the control columns when the airplane is near a stall condition.

The WEUs control the stick shaker actuators.

There are two stick shaker actuators, one below each control column.

Access

Access to the stick shaker actuators is from the forward equipment center.



31-51-00-013 Rev 0

WES - STICK SHAKER ACTUATOR

WES - ALTERNATE GEAR DOWN DISPATCH SWITCH

Description

The alternate gear down dispatch switch has two positions.

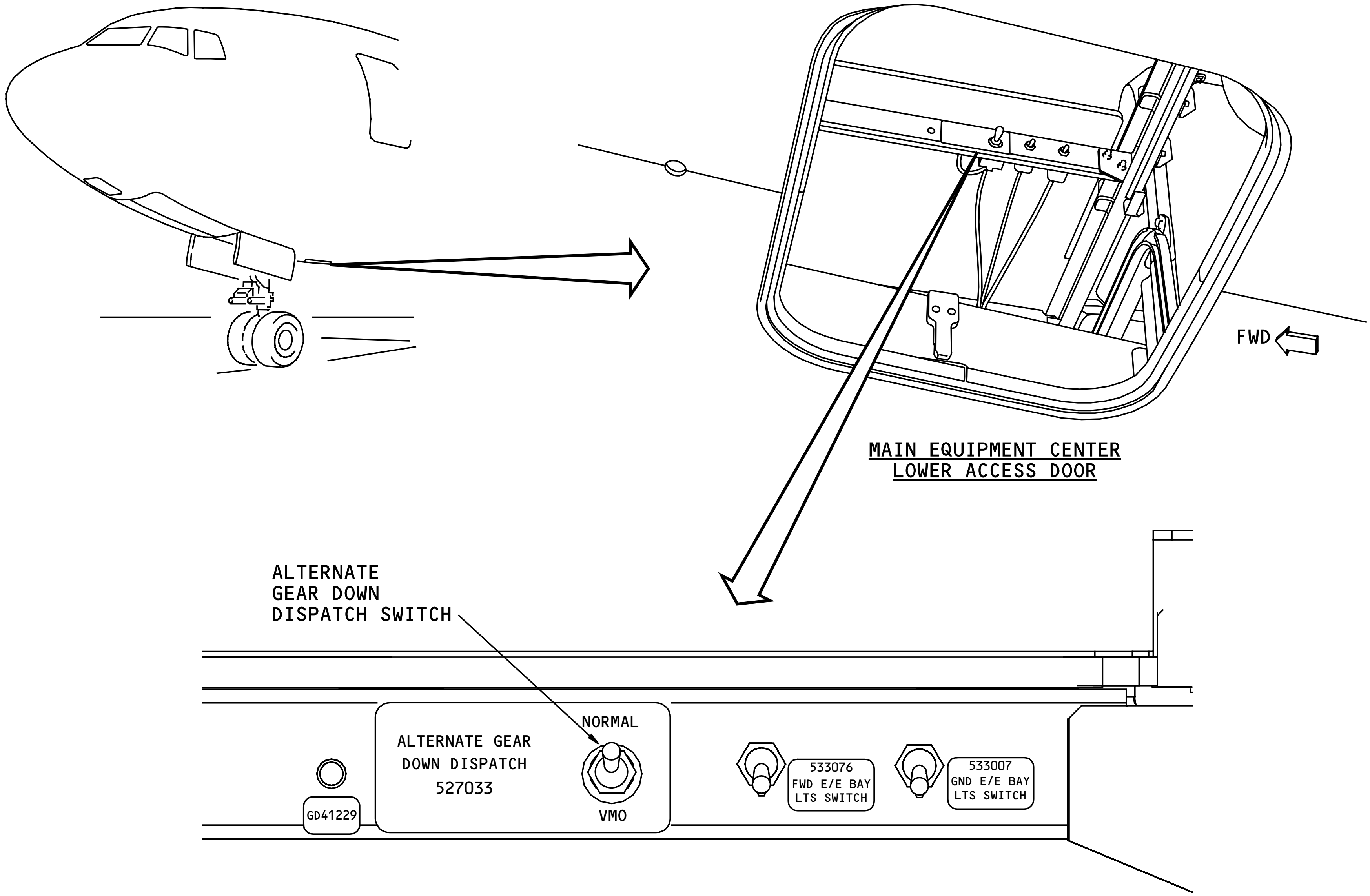
Operation

When the alternate gear down dispatch switch is in the maximum operating speed (VMO) position, the WEU channels use the switch signals to lower the maximum speed limit to 270 knots and the maximum operating mach (MMO) to mach .73.

When the alternate gear down dispatch switch is in the normal position, the VMO is 330 knots. The MMO is .87.

Training Information Point

The memo message VMO GEAR DOWN shows on EICAS when you put the switch in the VMO position.



WES - ALTERNATE GEAR DOWN DISPATCH SWITCH

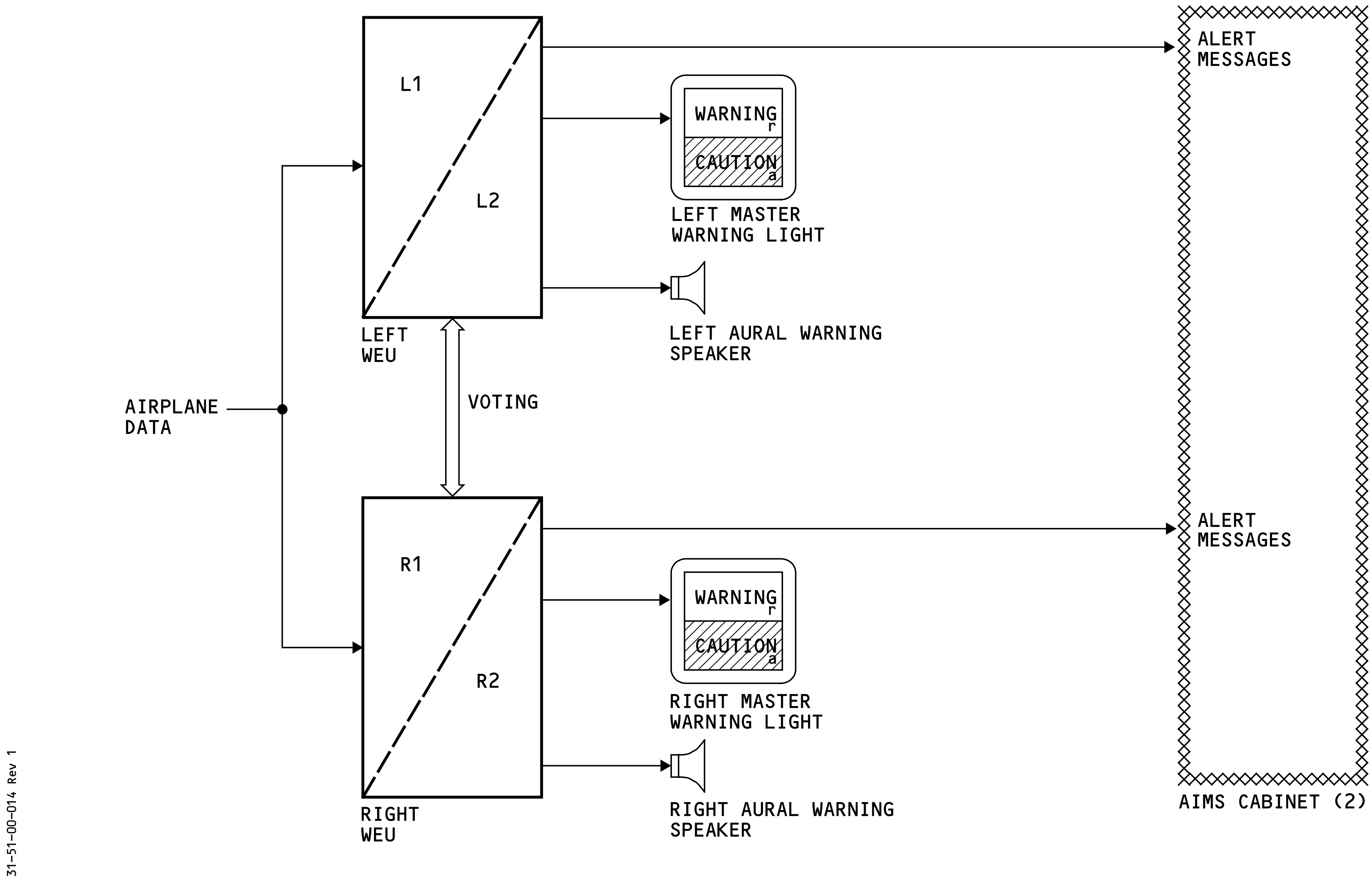
WES - INTERNALLY GENERATED WARNING AND ALERTS

Warning and Alerts

The WEUs receive airplane data to internally calculate and generate warnings and alerts. The four WEU channels vote to produce an alert or a warning. When any 2 out of the 4 channels make the same calculation, the WEUs make a warning or an alert.

These are the indications for warnings and alerts:

- Alert message requests to the AIMS cabinets. The AIMS uses the requests to show alert messages
- Master warning lights on
- Alert aurals.



WES - INTERNALLY GENERATED WARNING AND ALERTS

WES - EXTERNALLY GENERATED WARNING AND ALERTS

Warning and Alerts

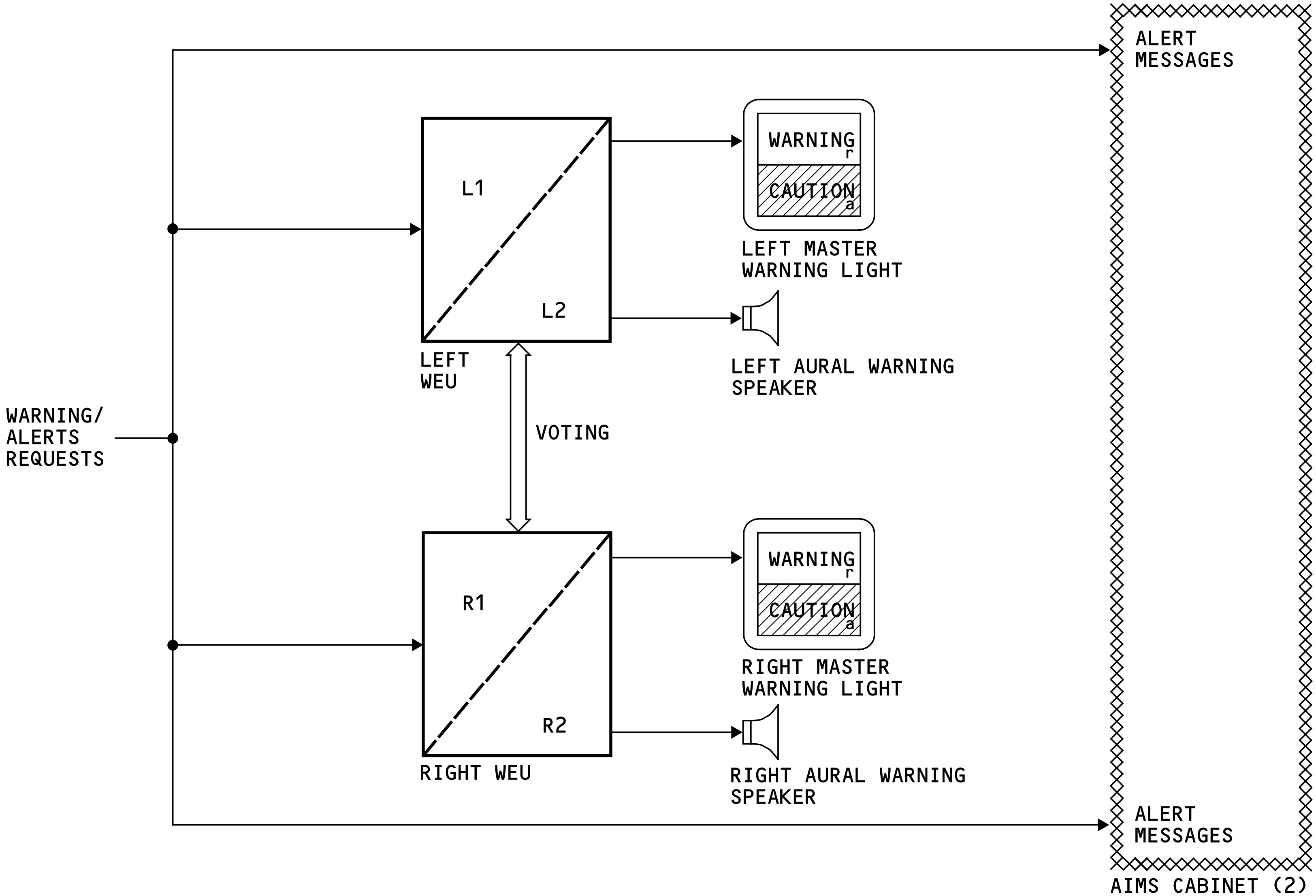
The WEUs receive warning and alert requests from airplane systems. In this case, the WEUs do not calculate an alert or a warning. The four WEU channels only vote to produce the alert or warning. When any 2 out of the 4 channels sense the same request, the WEUs make a warning or an alert.

These are the indications for warnings and alerts:

- Master warning lights on
- Alert aurals.

AIMS

The airplane systems also send warning and alert requests to the AIMS cabinets. The AIMS uses the requests to show alert messages.



31-51-00-015 Rev 1

WES - EXTERNALLY GENERATED WARNING AND ALERTS

WES - STICK SHAKER ACTUATION

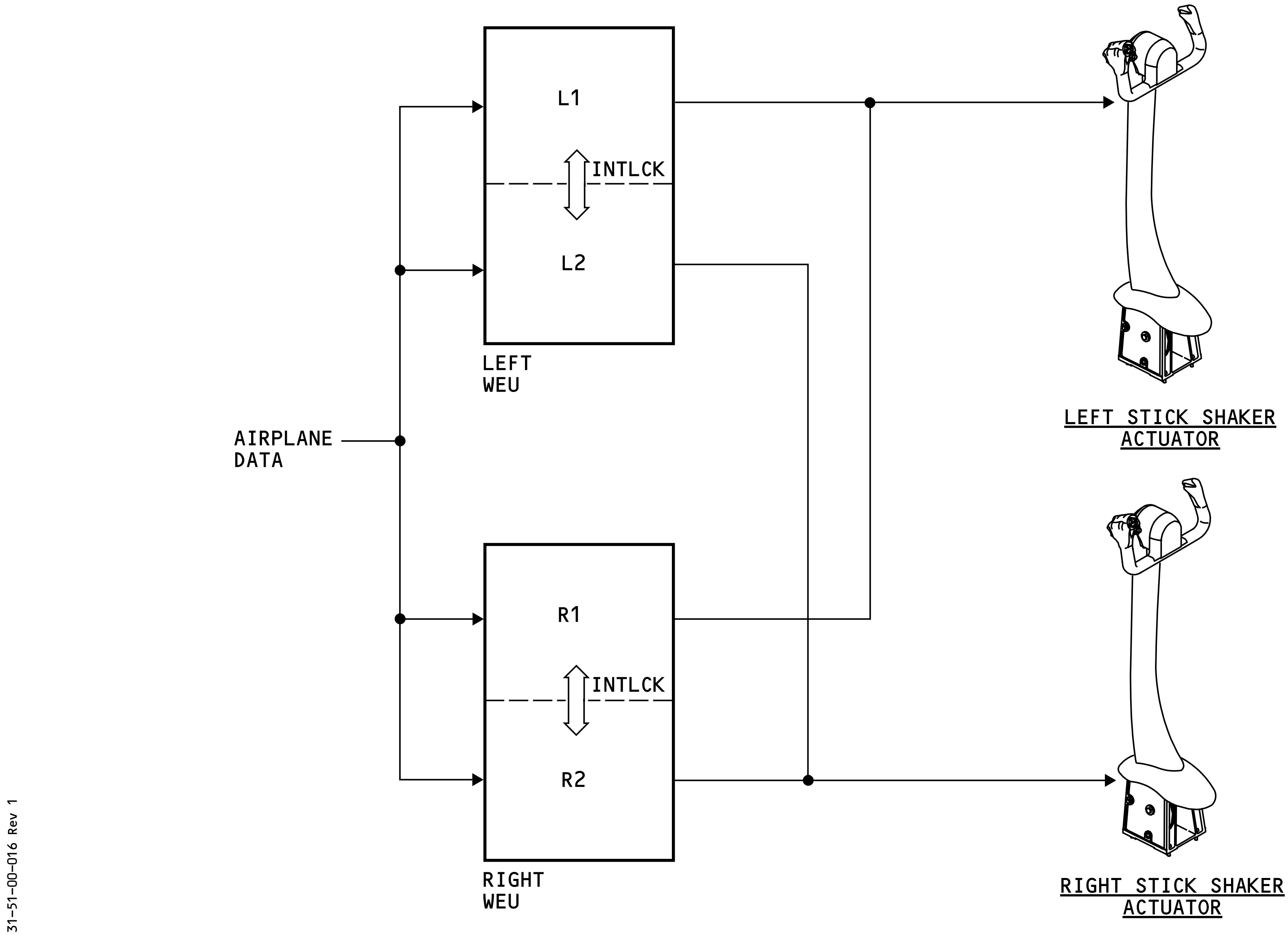
General

Each WEU channel independently calculates stick shaker actuator signals when the airplane is near a stall.

Interlocks

The stick shaker actuators come on only when the two channels inside a WEU produce a stick shaker actuation signal.

Any WEU can turn on both stick shaker actuators.



WES - STICK SHAKER ACTUATION

WES - TAKEOFF WARNING INHIBIT

Purpose and Operation

The takeoff warning inhibit prevents flight crew distractions during takeoff. The takeoff warning inhibit prevents some warning indications and some alert indications.

All channels in each WEU calculate the takeoff warning inhibit.

The takeoff warning inhibit starts when computed airspeed (VCAS) goes to the decision speed (V1), or pitch angle is 5 degrees or more.

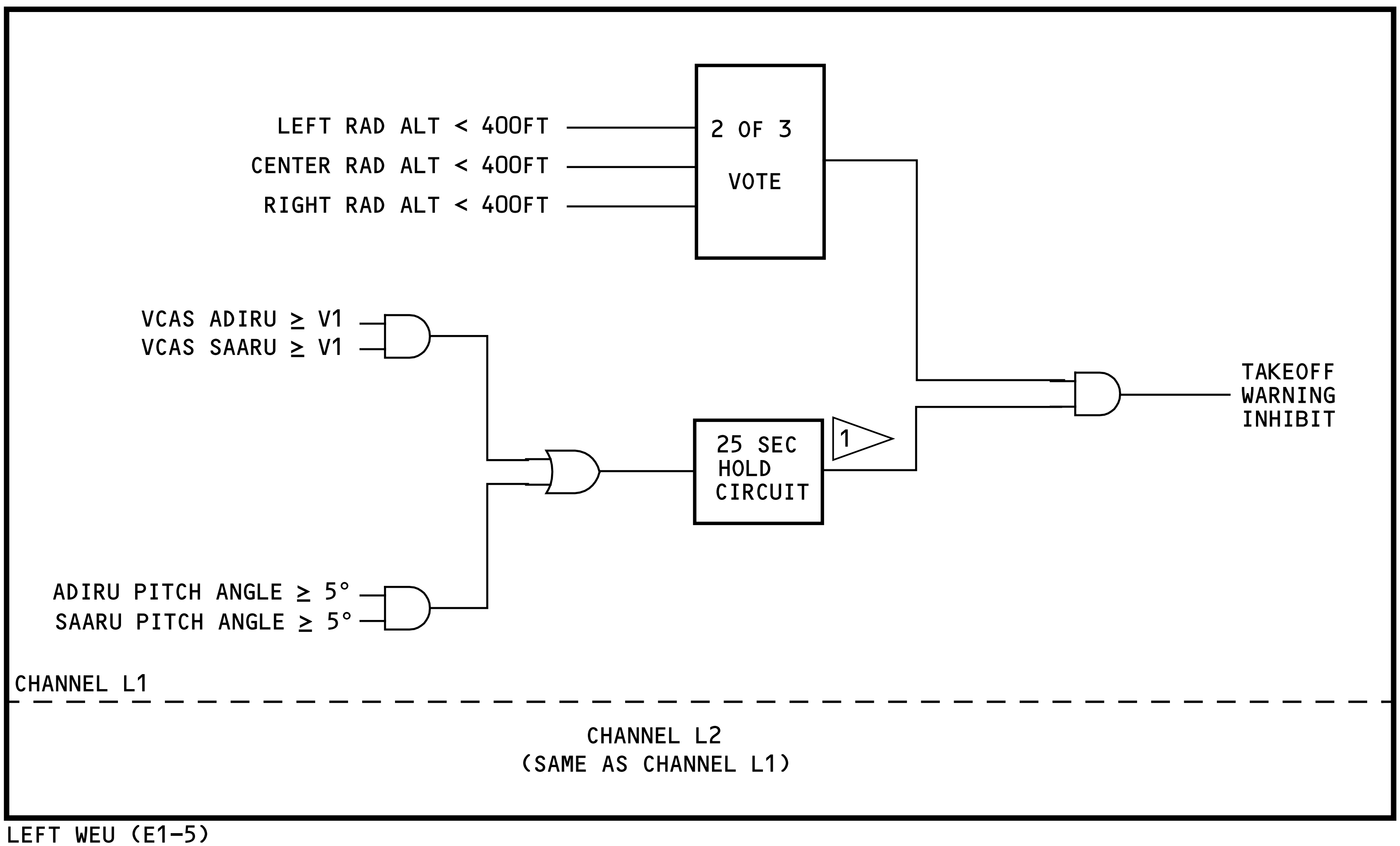
The takeoff warning inhibit stops when the radio altitude goes above 400 feet, or 25 seconds after either the pitch angle was 5 degrees or the airplane reaches V1.

Warnings and Alerts Prevented

The takeoff warning inhibit prevents these warnings and alerts:

- Cabin pressure
- Fire warning
- Altitude alert
- Overspeed
- Takeoff configuration warning.

31-51-00-017 Rev 1



1 WHEN THE INPUT GOES FROM LOW TO HIGH, THE OUTPUT GOES HIGH FOR 25 SECONDS. THEN THE OUTPUT GOES LOW.

31-51-00-017 Rev 1

WES - TAKEOFF WARNING INHIBIT

WES - ALERT AURAL GENERATION

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WES - ALERT AURAL GENERATION

Alert Aurals

The aural synthesizer control function of the WEU gives and amplifies alert aurals. These are the alert aurals, in order of priority:

- Siren
- Fire bell
- Caution
- Chime.

Siren

For all EICAS warning messages, except fire, the WEUs give the siren aural. The siren is a sound that alternates between 250 Hz and 950 Hz. The siren has the highest priority.

Fire Bell

The WEUs give the fire bell aural when there is a fire. The fire bell is a bell sound that is on for 0.85 seconds and off for 9.5 seconds. The fire bell is second in priority.

Caution

The WEUs give the caution aural when there is an EICAS caution message. The caution is four tones one after the other. Each tone is 160 msec long. Each tone has a constant amplitude and a frequency that varies from 20 Hz to 950 Hz. The caution aural is third in priority.

Chime

The WEUs give a high/low chime when there is a call to the flight deck, or when a comm low or medium message shows. The high/low chime is two tones one after the other. The first tone is 1160 Hz with an amplitude that goes down with time. The second tone is 580 Hz with an amplitude that goes down with time. The chime aural is the lowest in priority.

GPWS, PWS and TCAS

The WEUs do not make the GPWS, PWS, and TCAS alert aurals. The GPWS, PWS, and TCAS supply analog alert aurals to the WEUs. The WEUs amplify these alert aurals. The GPWS, PWS, and TCAS alert aurals have no priority. They go on top of other WEU alert aurals.

Alert Aural Logic

Each channel in each WEU makes the same alert aurals.

The alert aural logic makes alert aural requests. The requests are part of the warning and alert conditions for the WEUs.

When the alert aural logic makes an alert aural request, it also makes an aural arm signal. This signal goes to the other three WEU channels. The aural arm signal also permits the WEU channel to make alert aurals.

WES - ALERT AURAL GENERATION

Alert Aural Priority Logic

The alert aural priority logic receives alert aural requests from the alert aural logic.

If there is more than one alert aural request at a time, the alert aural priority logic decides which alert aural has the higher priority.

Only the higher priority alert aural request goes through the alert aural priority logic.

Two of Four Vote

The alert aural requests go to the aural synthesizer only when at least one other WEU channel supplies an aural arm signal.

Aural Synthesizer

The aural synthesizer makes the alert aurals. Gain control circuits set the aural synthesizer audio gain.

TCAS and GPWS Aurals

Each WEU mixes traffic alert and collision avoidance system (TCAS) and ground proximity warning system (GPWS) alert aurals with all other aurals.

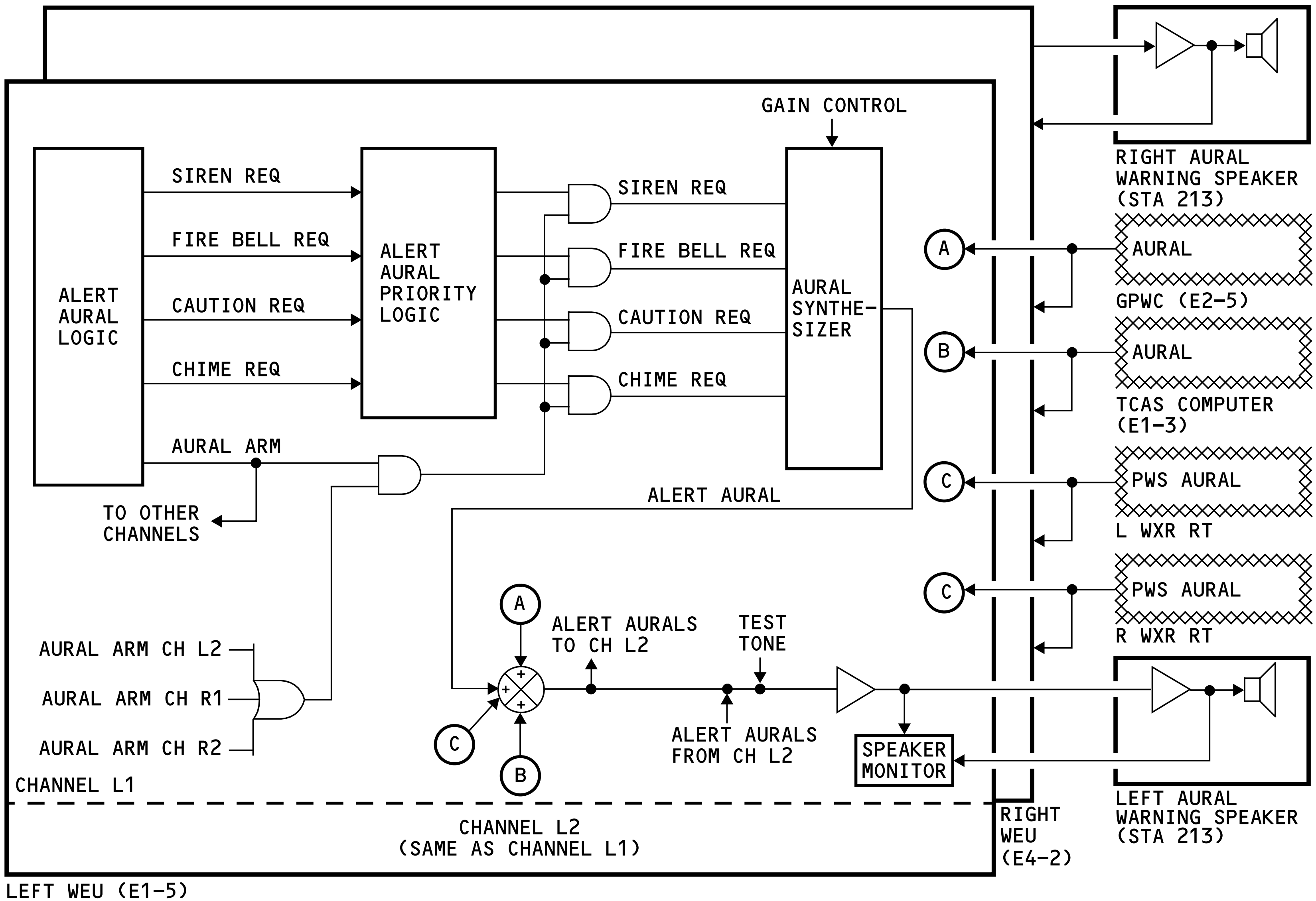
Opposite Channel Aurals, and Aural Warning Speaker Interface

Only channel 1 on each WEU has a direct connection to the aural warning speakers. The left WEU connects to the left aural warning speaker, and the right WEU connects to the right aural warning speaker. Channel 2 on each WEU supplies alert aurals to channel 1.

The aural warning speakers supply audio feedback signals to the WEUs. The WEUs use these signals to check speaker operation.

Test Tone

Each WEU channel makes a test tone during a WES system test.



WES - ALERT AURAL GENERATION

31-51-00-019 Rev 3 02/03/1998

WES - MASTER WARNING LIGHTS ACTIVATION

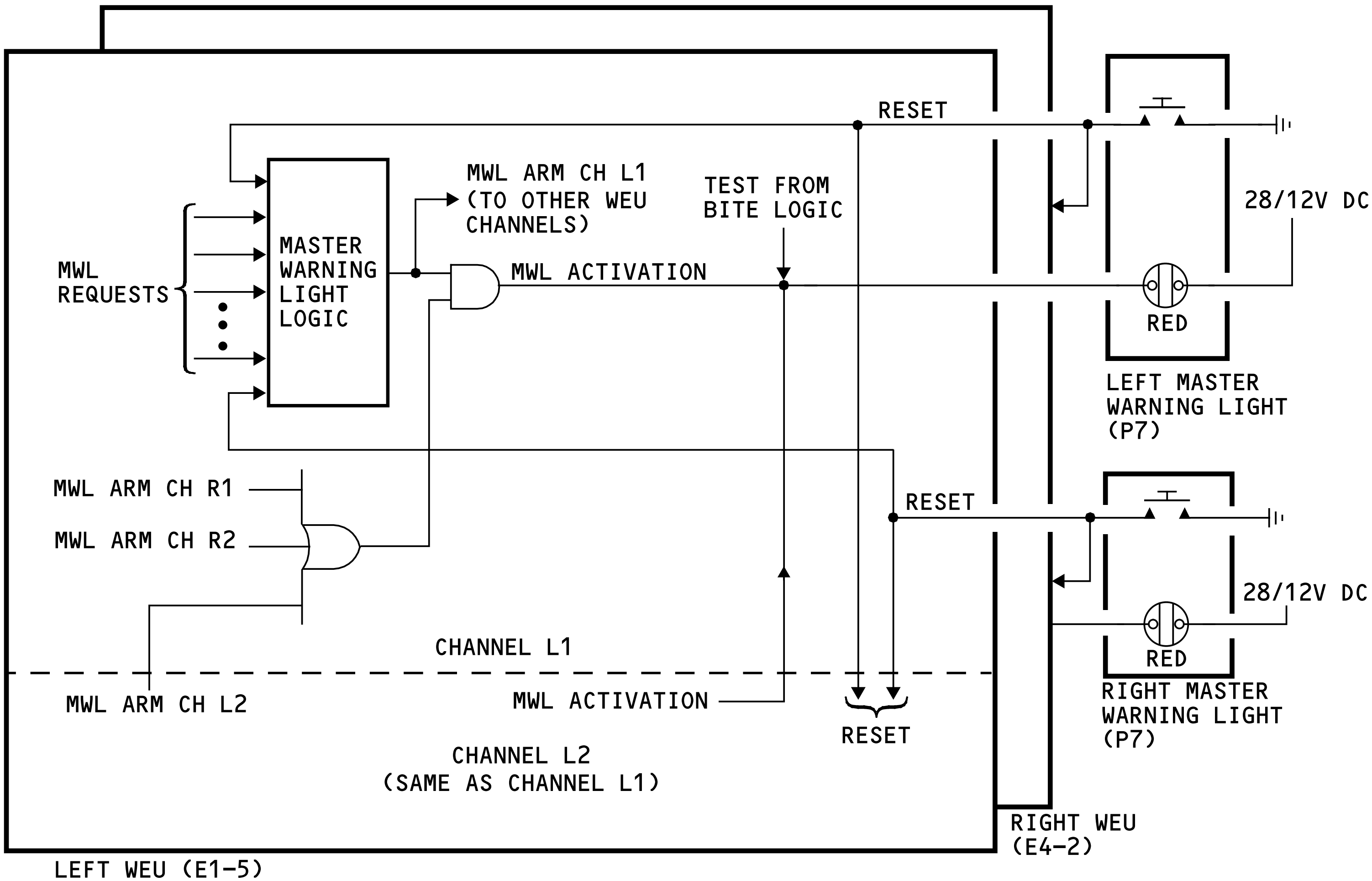
General

The left WEU connects to the left master warning light (MWL). The right WEU connects to the right master warning light.

Each WEU channel makes a MWL arm signal. A WEU channel must receive at least one MWL arm signal from another WEU channel before it makes the MWL activation signal.

The MWL activation signal makes the master warning lights come on.

Push the master warning lights to supply a reset signal to the WEUs. The reset signals make the master warning lights go out. If there is another warning condition, the master warning lights come on again.



31-51-00-021 Rev 1

MWL = MASTER WARNING LIGHT

WES - MASTER WARNING LIGHTS ACTIVATION

WES - FIRE WARNING

Fire Warning Inputs

The fire warning logic gets fire warning inputs from the system cardfiles. These cards supply fire warning inputs to the WEUs:

- Left engine fire detection card
- Right engine fire detection card
- APU fire detection card
- Left and right ARINC signal gateway (ASG) cards.

Each WEU channel inhibits fire warnings when the airplane is in takeoff.

The alert aural logic makes the fire bell alert aural. The master warning light logic makes the master warning lights (MWLs) come on.

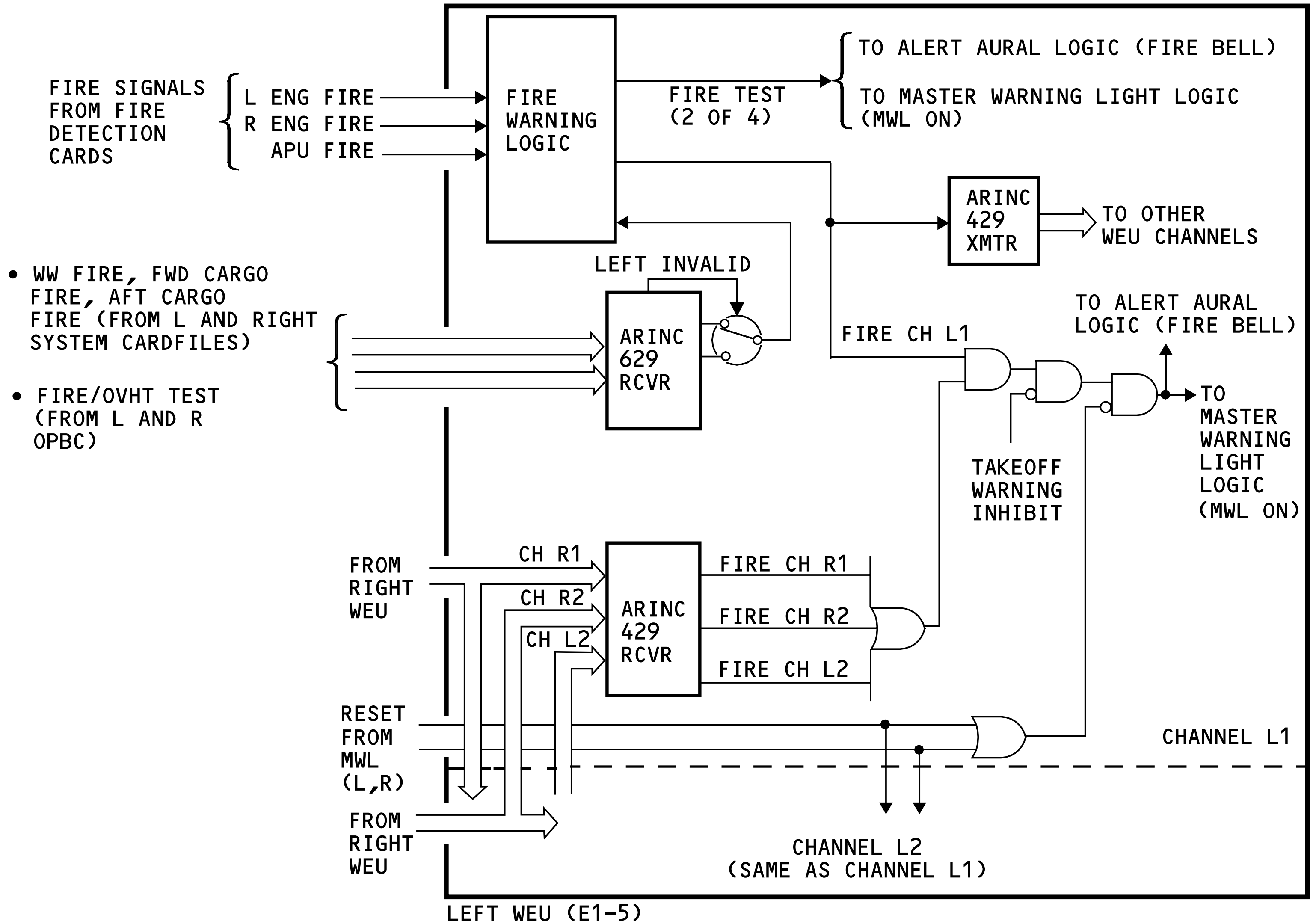
Push any master warning light to make the master warning lights and the fire bell go out.

Fire Test

When you do a fire warning test, the fire warning logic ignores fire warning inputs.

The fire warning logic makes a fire test signal. The fire warning logic makes the fire test signal only when at least one other WEU channel makes the same signal (2 of 4 vote).

The fire warning logic sends the fire test signal to the alert aural logic to make the fire bell and to the master warning light logic to make the master warning lights come on.



WES - FIRE WARNING

WES - AUTOPILOT DISCONNECT WARNING

General

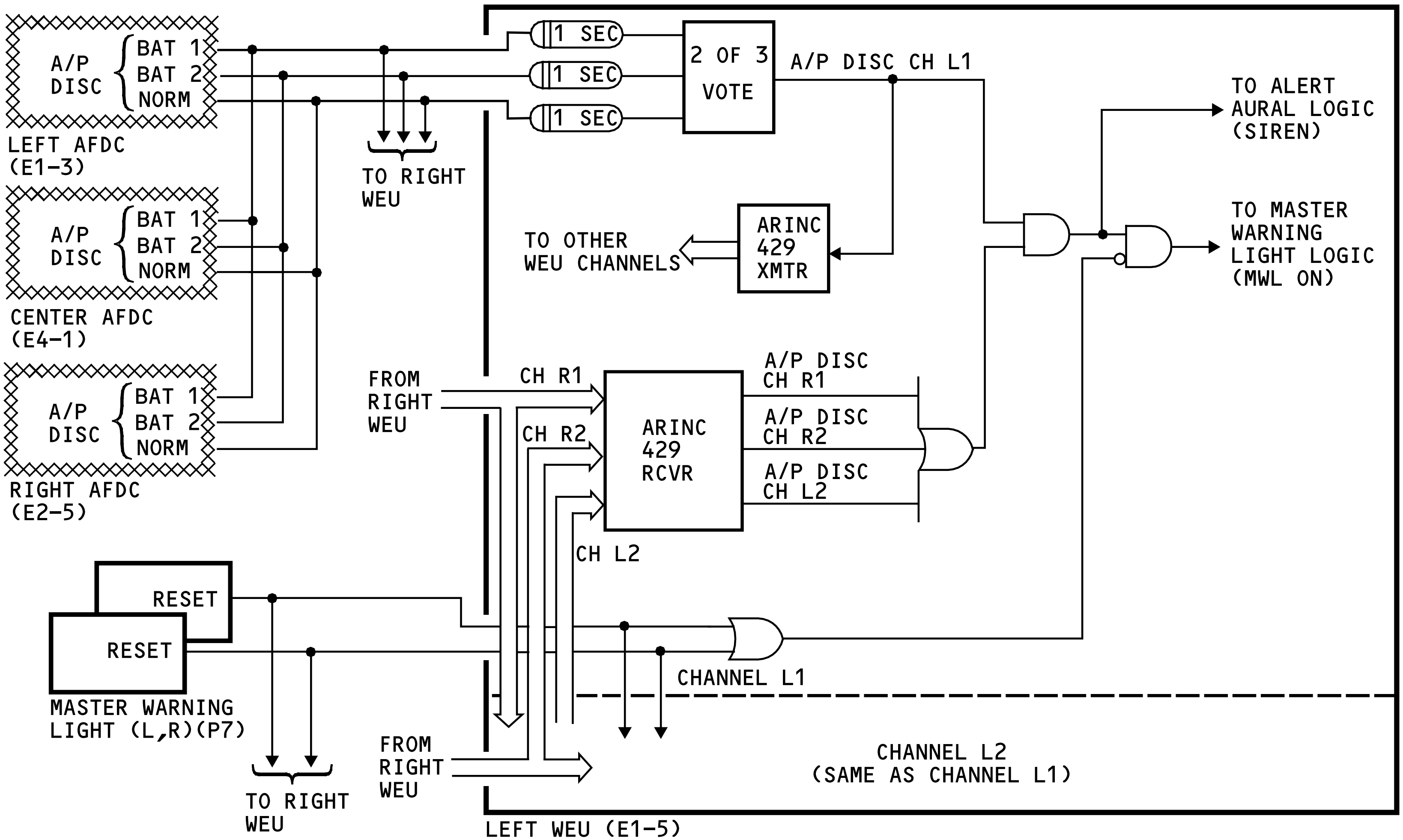
The autopilot flight director computers (AFDCs) supply autopilot disconnect discrete signals to the WEUs when the autopilot disconnects.

If at least two autopilot disconnect discrete signals show for at least one second, the WEUs give an autopilot disconnect warning.

Before a WEU channel gives an autopilot disconnect warning, at least one other WEU channel must give the same warning.

The aural alert logic gives the siren alert aural. The master warning light logic makes the warning lights (MWLs) come on.

Push any master warning light to make the master warning lights go out. The siren continues until the autopilot disconnect signals clear.



31-51-00-023 Rev 2

WES - AUTOPILOT DISCONNECT WARNING

WES - OVERSPEED WARNING

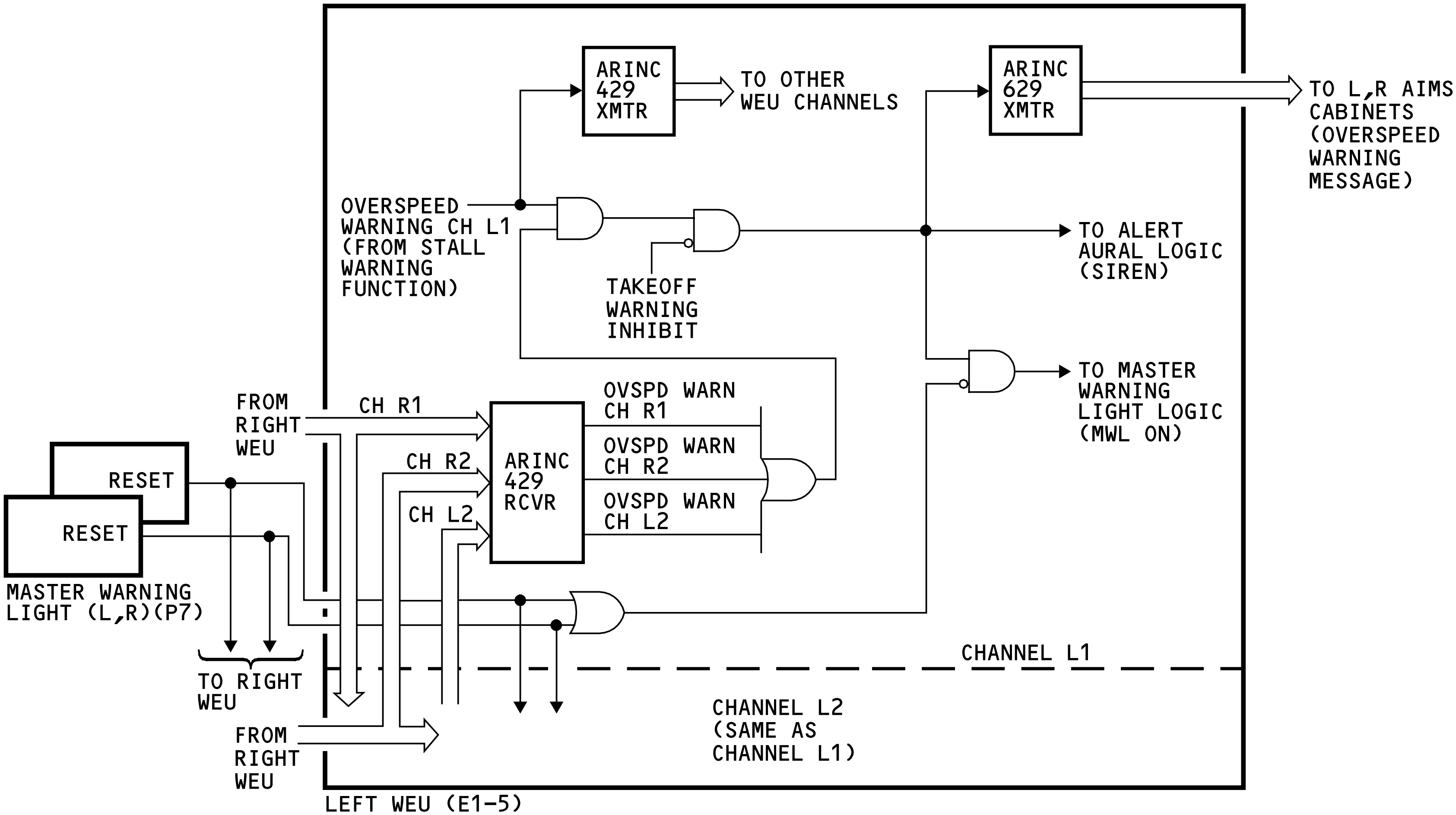
General

The stall warning function of the WEUs makes the overspeed warning signal.

Before a WEU channel gives an overspeed warning, at least one other channel must give the same warning.

If there is a takeoff warning inhibit, the WEUs do not make the overspeed warning signal.

Push any master warning light to make the master warning lights go out and stop the siren.



31-51-00-024 Rev 2 01/19/1998

WES - OVERSPEED WARNING

WES - CABIN PRESSURE WARNING

General

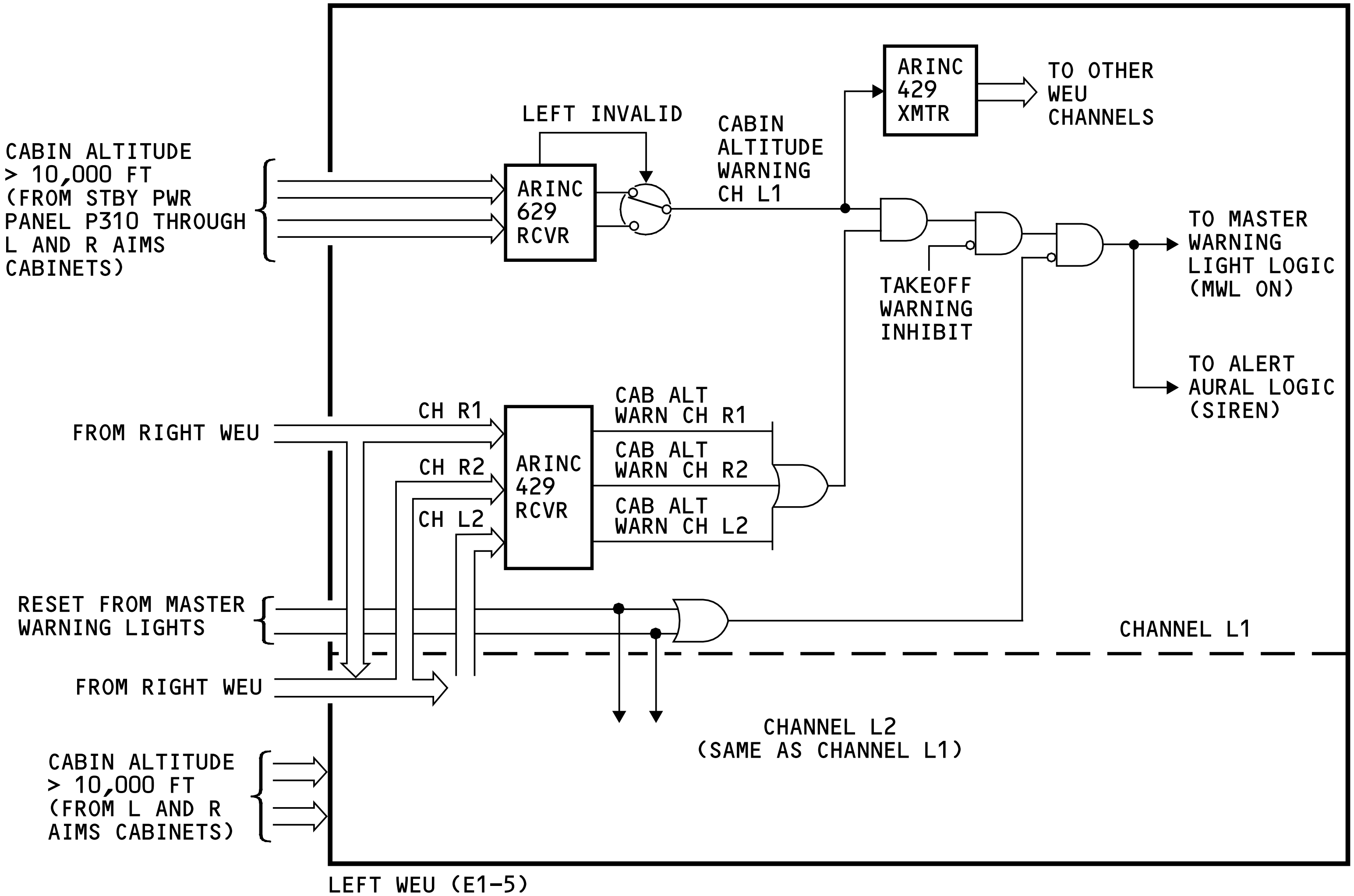
The remote cabin pressure sensor senses cabin pressure. The cabin pressure signal goes to the standby power panel (P310). The standby power panel (P310) supplies the cabin pressure signal to the AIMS cabinets. The AIMS cabinets supply a digital signal for a cabin altitude greater than 10,000 feet to the WEUs.

Before a WEU channel makes a cabin altitude warning, at least another WEU channel must make the same warning.

Each WEU channel inhibits cabin altitude warnings when the airplane is in takeoff.

The master warning light logic makes the master warning lights (MWLs) come on. The alert aural logic makes the siren alert aural.

Push any master warning light to make the master warning lights and the siren go out.



31-51-00-025 Rev 1

WES - CABIN PRESSURE WARNING

WES - UNSCHEDULED STABILIZER MOVEMENT WARNING

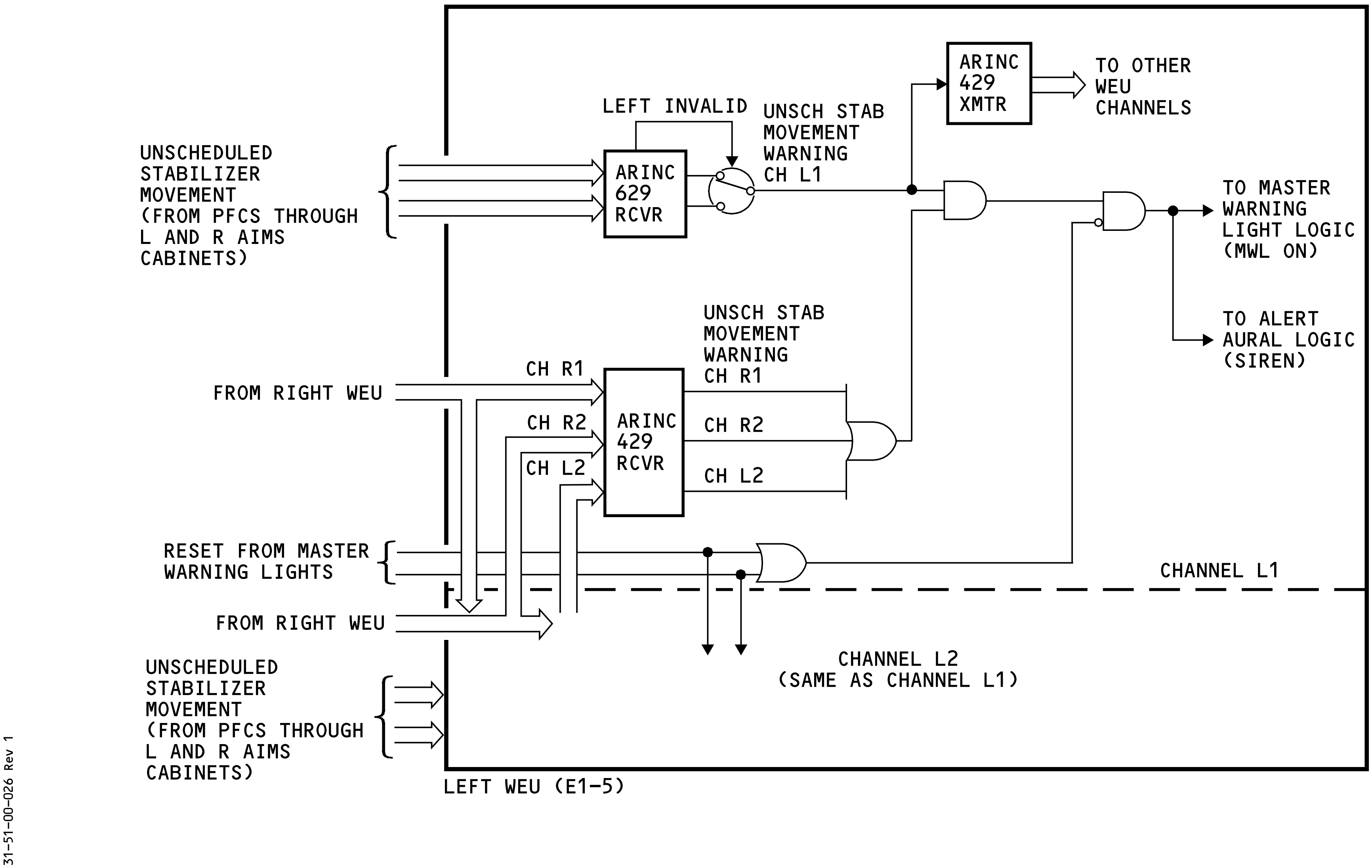
General

The primary flight computers (PFCs) supply a digital signal for unscheduled stabilizer movement to the AIMS cabinets. The AIMS cabinets supply this signal to the WEUs.

Before a WEU channel makes an unscheduled stabilizer movement warning, at least one other WEU channel must make the same warning.

The alert aural logic makes the siren alert aural. The master warning light logic makes the master warning lights (MWLs) come on.

Push any master warning light to make the master warning lights and the siren go out.



WES - UNSCHEDULED STABILIZER MOVEMENT WARNING

WES - ENGINE FAIL WARNING

Operation

The AIMS cabinets supply a digital signal for engine fail warnings.

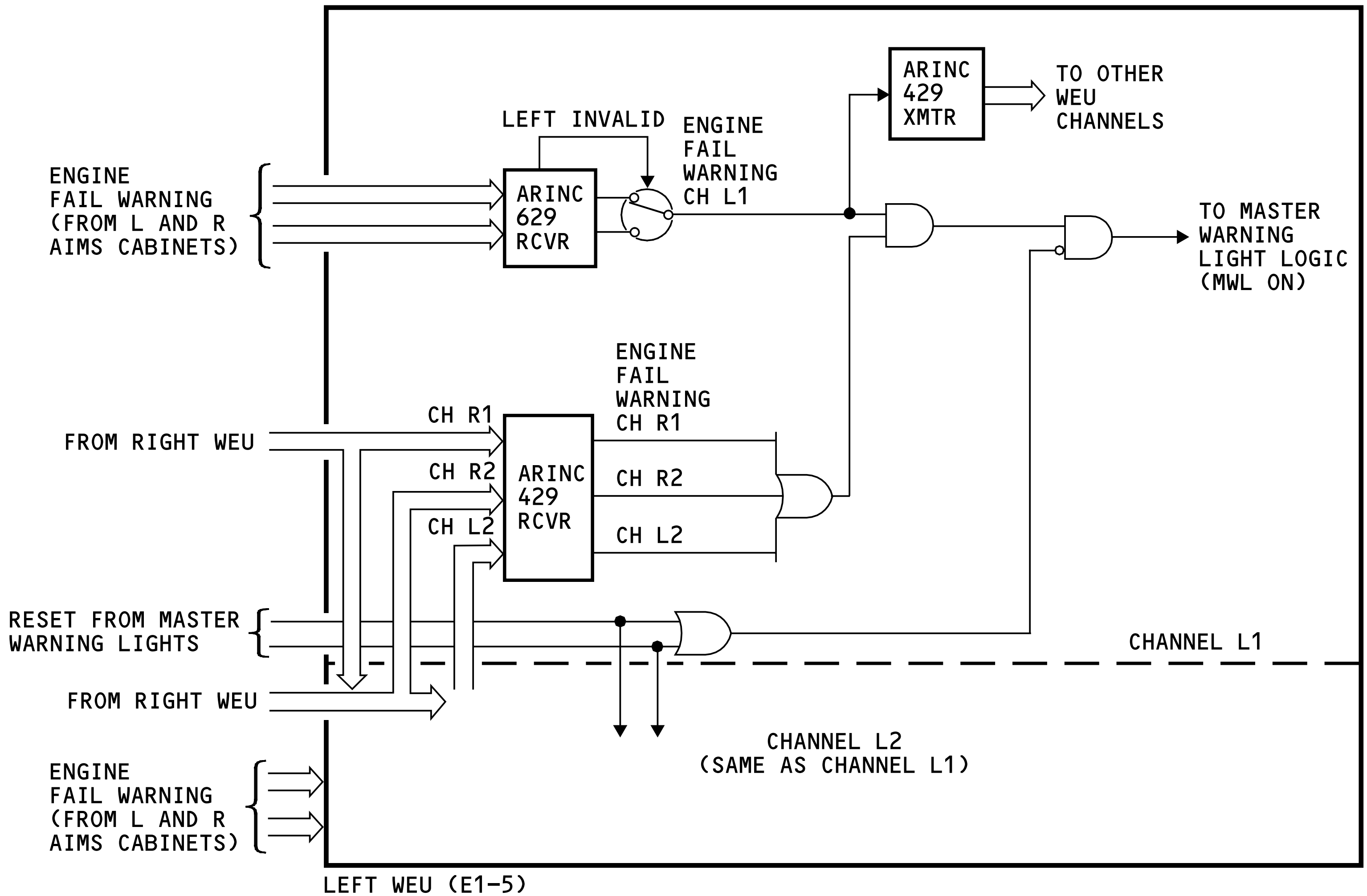
Before a WEU channel makes an engine fail warning, at least one other WEU channel must make the same warning.

The master warning light logic, makes the master warning lights (MWLs) come on.

Push any master warning light to make the master warning lights go out.

Training Information Point

If an engine fails when the airplane is on the ground and the airplane CAS is more than 65 knots but less than 3 knots below V1 (decision speed), the primary display function of AIMS shows the time critical warning message ENGINE FAIL on the PFDs. Also, the master warning lights come on. The AIMS cabinets also send a digital request signal to the ground proximity warning computer (GPWC). The GPWC makes an engine fail aural.



31-51-00-058 Rev 1

WES - ENGINE FAIL WARNING

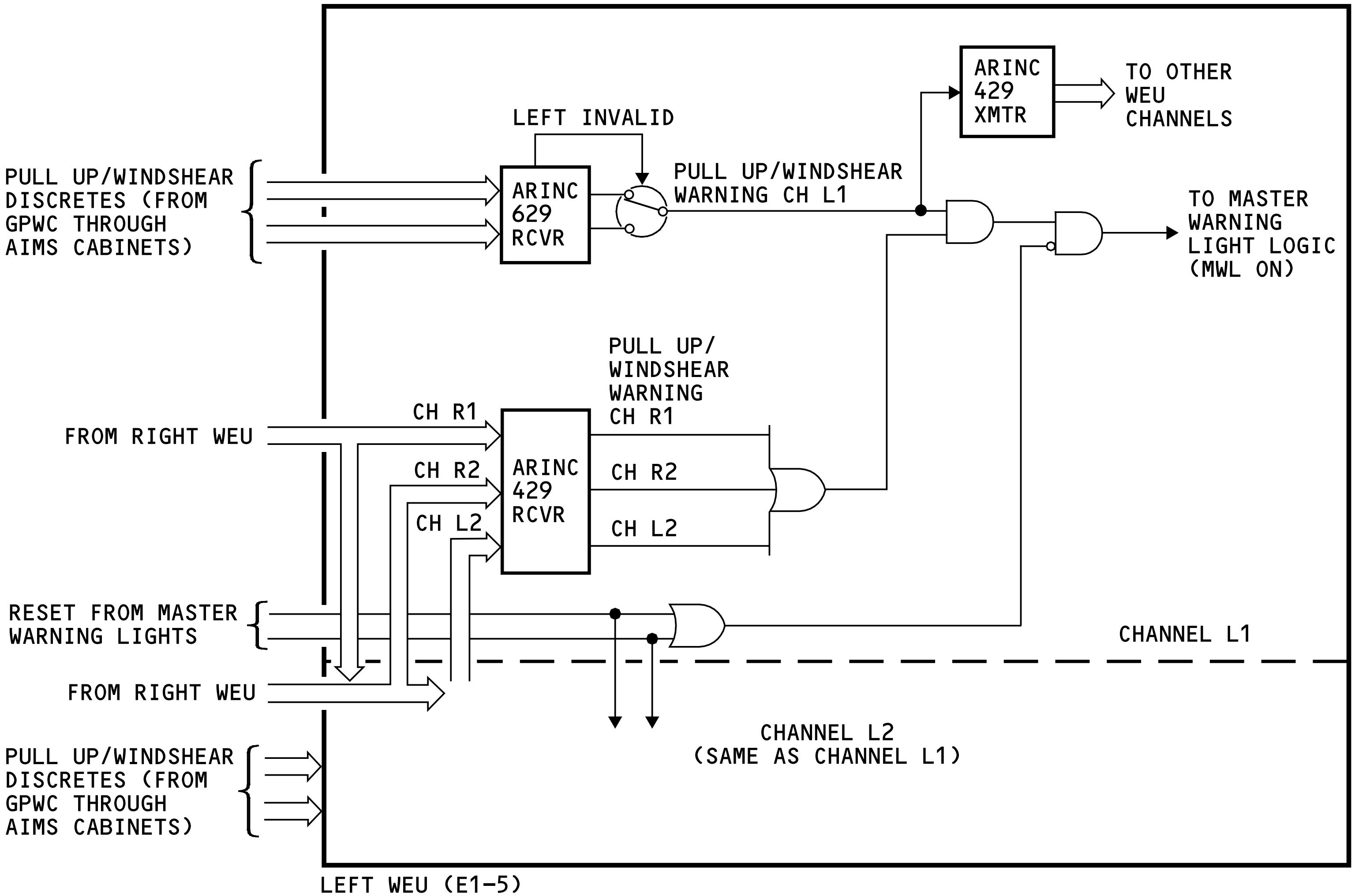
WES - GPWS PULL UP AND WINDSHEAR WARNINGS

General

The ground proximity warning computer (GPWC) supplies pull up and windshear digital discrete signals to the AIMS. The AIMS cabinets supply these signals to the WEUs.

Before a WEU channel makes a pull up or a windshear warning, at least one other WEU channel must make the same warning.

The master warning light logic makes the master warning lights (MWLs) come on. Push any master warning light to make the master warning lights go out.



31-51-00-028 Rev 1

WES - GPWS PULL UP AND WINDSHEAR WARNINGS

WES - TAKEOFF CONFIGURATION WARNING ENABLE

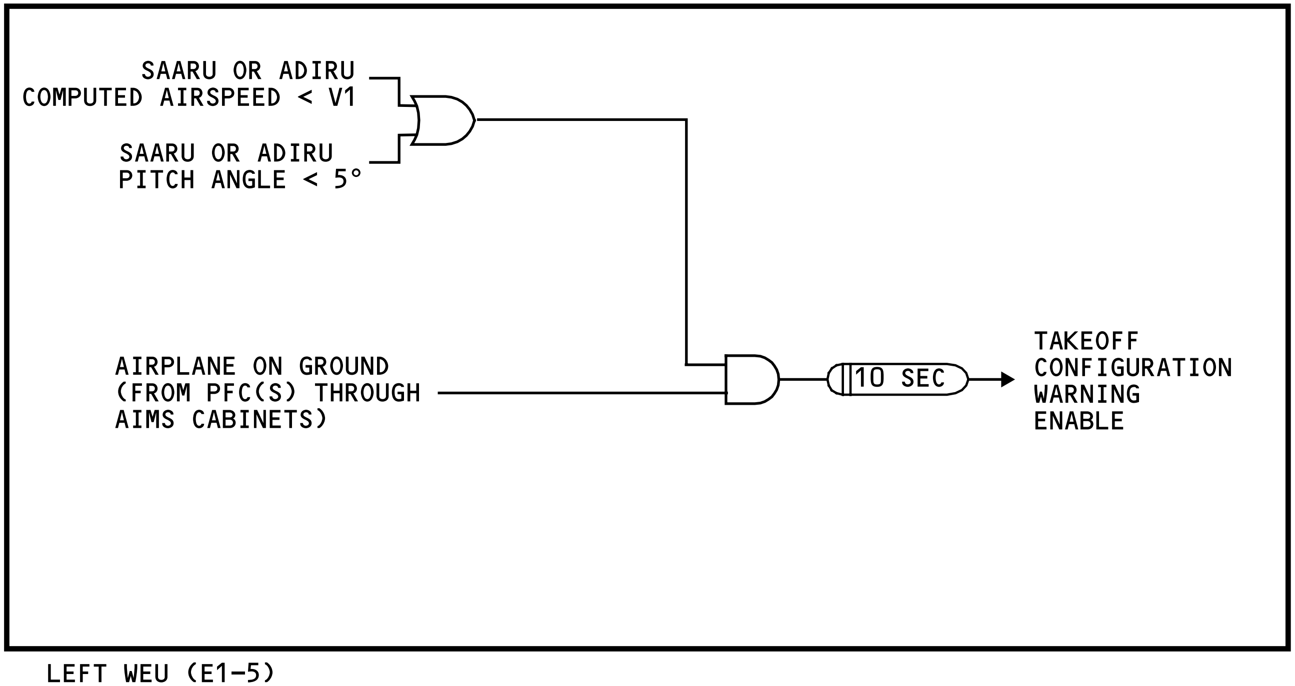
General

The WES makes a takeoff configuration warning when the airplane configuration is not safe for takeoff.

Each WEU has takeoff configuration warning enable logic. The takeoff configuration warning enable permits the WEUs to make takeoff configuration warnings only when it is possible to takeoff.

The WEUs use this data to make the takeoff configuration warning enable:

- Air data inertial reference unit (ADIRU) data
- Secondary attitude air data reference unit (SAARU) data
- Primary Flight Computer (PFC) data.



31-51-00-029 Rev 2 08/31/95

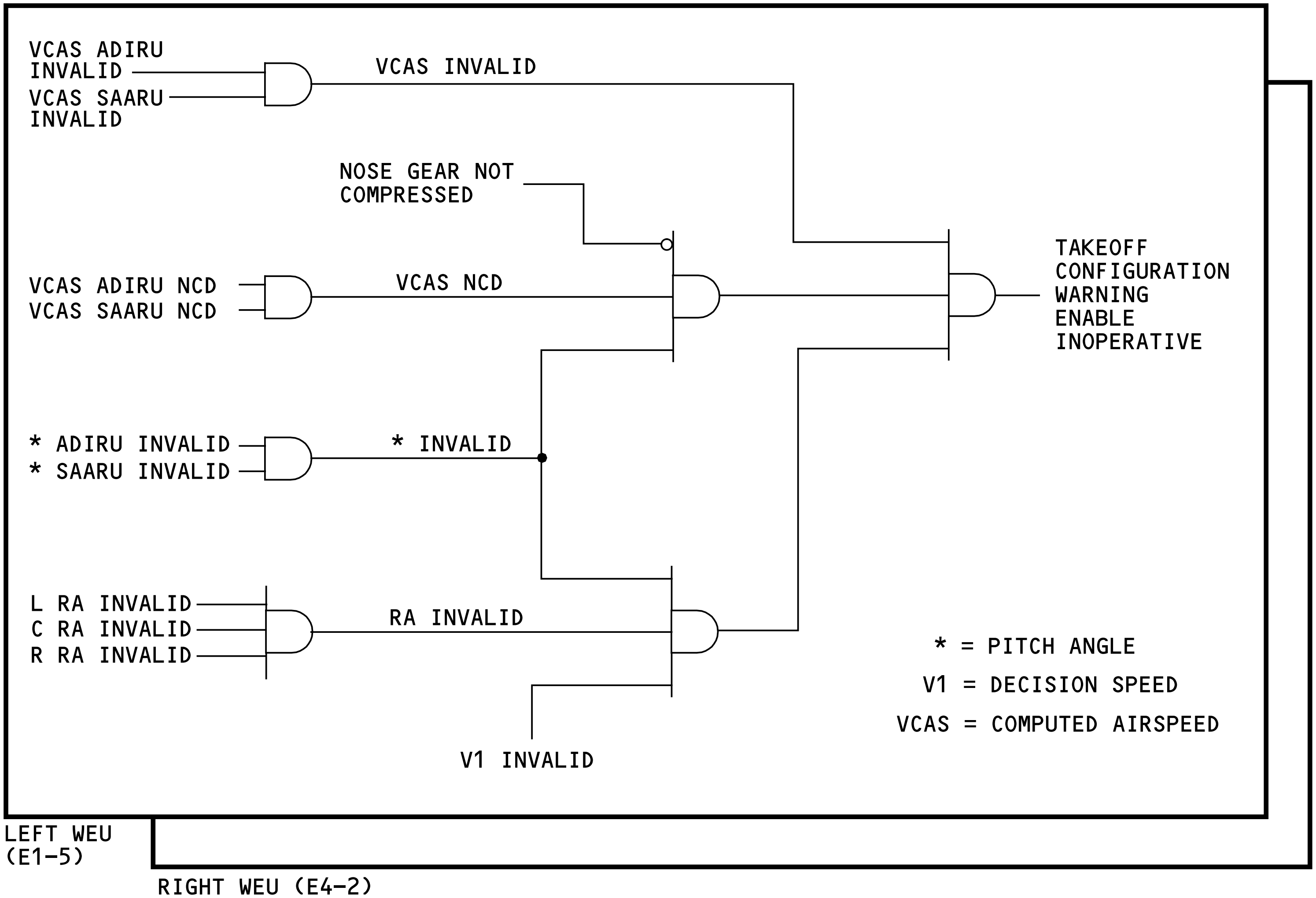
WES - TAKEOFF CONFIGURATION WARNING ENABLE

WES - TAKEOFF CONFIGURATION WARNING ENABLE INOPERATIVE

General

The takeoff configuration warning enable inoperative logic stops the takeoff configuration warning function of each WEU. The WEUs do this when there is not sufficient information from the air data inertial reference system, or the radio altimeter system to make a takeoff configuration warning.

When the takeoff configuration warning enable inoperative is true, the WEUs send a digital signal to the AIMS. The AIMS shows an advisory EICAS message to alert the crew that the takeoff configuration warning function does not operate.



31-51-00-030 Rev 1 02/06/1998

WES - TAKEOFF CONFIGURATION WARNING ENABLE INOPERATIVE

WES - TAKEOFF ATTEMPT AND CONDITIONS MONITORED IN TAKEOFF

Takeoff Attempt

The takeoff attempt signal enable permits the WEU to make a takeoff configuration warning.

The AIMS cabinets supply engine in takeoff thrust signals and the fuel control switch in run signals to the WEUs.

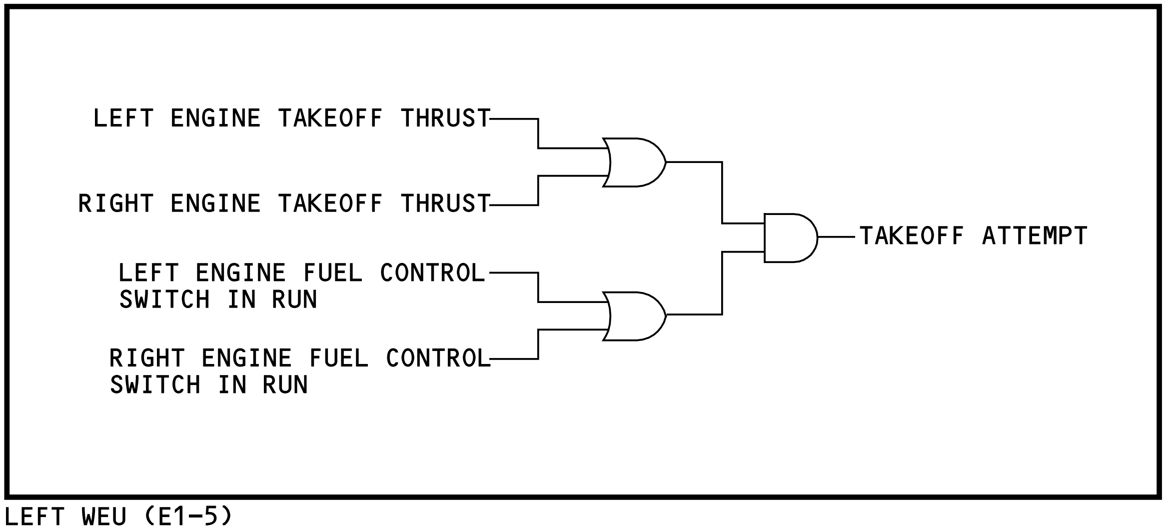
The WEUs make a takeoff attempt signal when a fuel control switch is in the run position and an engine makes takeoff thrust.

Conditions Monitored in Takeoff

The takeoff configuration function of the WEUs monitors these conditions when the flight crew makes a takeoff attempt:

- Flaps and leading edge devices not in takeoff position
- Stabilizer not in takeoff position
- Parking brake set
- Main gear steering not locked
- Rudder not in takeoff trim
- Speed brake lever not down
- Passenger entry and cargo doors closed, latched, and locked.

If any of the above conditions occurs in takeoff, the WEUs supply a takeoff configuration warning to the flight crew.



31-51-00-031 Rev 1

WES - TAKEOFF ATTEMPT AND CONDITIONS MONITORED IN TAKEOFF

WES - TAKEOFF CONFIGURATION WARNING FUNCTION INPUTS - 1

General

The flap slat electronic units (FSEUs) supply flaps and leading edge devices in takeoff position digital signals to the WEUs.

Each WEU channel gets inputs from the two FSEUs. Selection logic on each WEU channel uses one of the FSEUs to set a true output when the flaps or leading edge devices are in the takeoff position.

Each selection logic selects one FSEU input only. The selection priority depends on the WEU channel. This is the selection priority for channel L1:

- Left FSEU through the left bus
- Left FSEU through the center 1 bus
- Right FSEU through the center 1 bus.

This is the selection priority for Channel L2:

- Left FSEU through the center 1 bus
- Right FSEU through the center 1 bus
- Left FSEU through the left bus.

This is the selection priority for Channel R1:

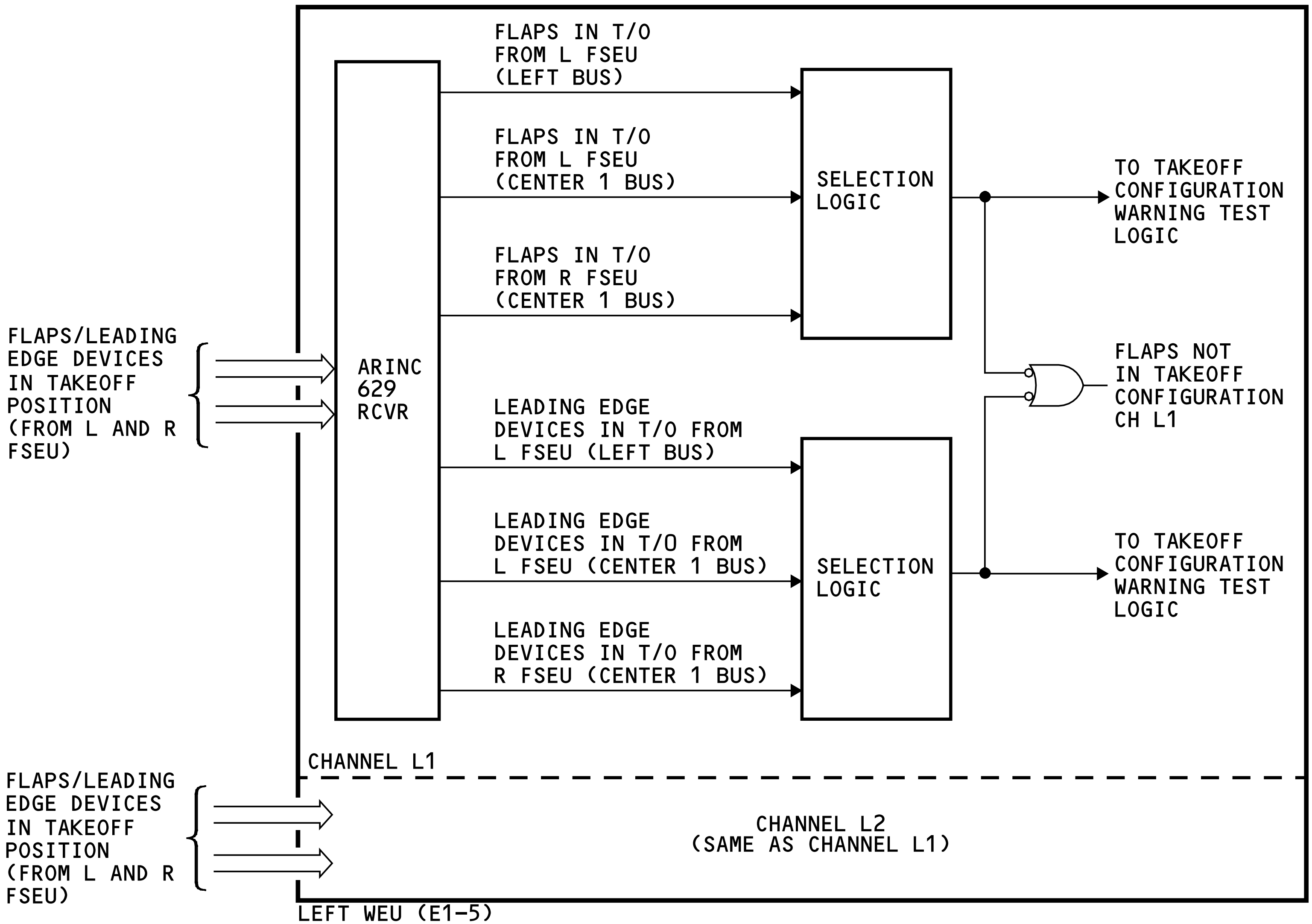
- Right FSEU through the right bus
- Right FSEU through the center 1 bus
- Left FSEU through the center 1 bus.

This is the selection priority for Channel R2:

- Right FSEU through the center 1 bus
- Left FSEU through the center 1 bus
- Right FSEU through the right bus.

Takeoff Configuration Warning Test Logic Interface

Each WEU channel has a takeoff configuration warning test logic. When you do a takeoff configuration warning test, this logic verifies all inputs to the takeoff configuration warning function. The logic checks that all inputs are available and valid.



31-51-00-032 Rev 2 10/23/95

WES - TAKEOFF CONFIGURATION WARNING FUNCTION INPUTS - 1

WES - TAKEOFF CONFIGURATION WARNING FUNCTION INPUTS - 2

Stabilizer Not In Takeoff Position

The primary flight computers (PFCs) supply stabilizer position signals to the AIMS cabinets. The AIMS cabinets supply the signals to the WEUs. The compare logic gets the stabilizer position signals.

The stabilizer green band function of the WEUs supplies stabilizer green band selection to the compare logic. The selection is one of these:

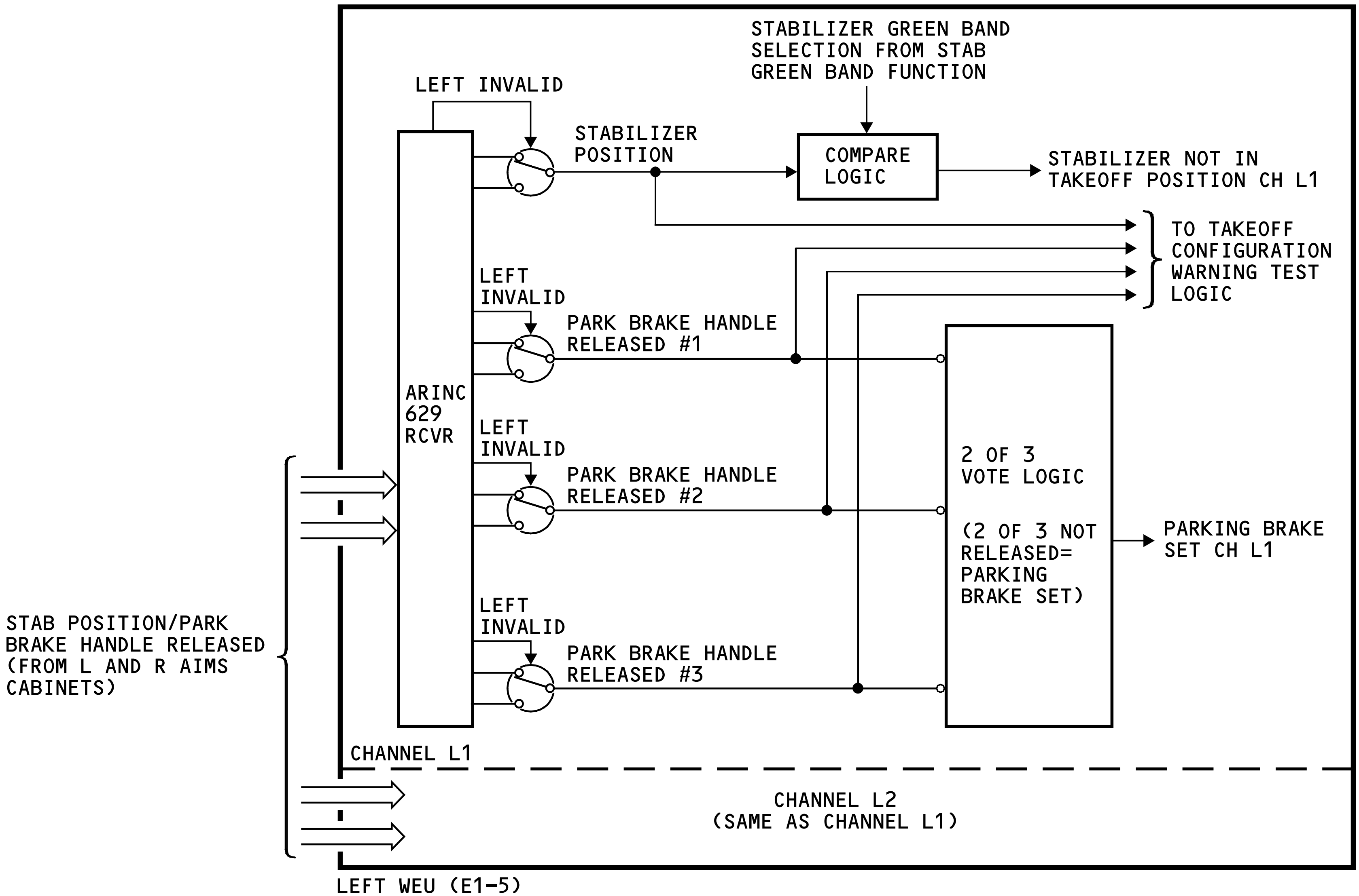
- Nose up band
- Mid band
- Nose down band.

The compare logic compares the stabilizer position and the stabilizer green band selection. If the stabilizer position is not in the green band, the compare logic makes a stabilizer not in takeoff signal.

Parking Brake Set

The parking brake handle has three switches. The switches supply parking brake handle released signals to the AIMS. The AIMS supplies the signals to the WEUs.

Each WEU channel supplies the signals from the three parking brake handle switches to a 2 of 3 vote logic. When at least two signals show the parking brake handle not released, the 2 of 3 vote logic makes a parking brake set signal.



31-51-00-033 Rev 0

WES - TAKEOFF CONFIGURATION WARNING FUNCTION INPUTS - 2

WES - TAKEOFF CONFIGURATION WARNING FUNCTION INPUTS - 3

Speed Brake Lever Not Down

The primary flight computers (PFCs) supply the speed brake lever not down signal to the WEUs.

Rudder Position

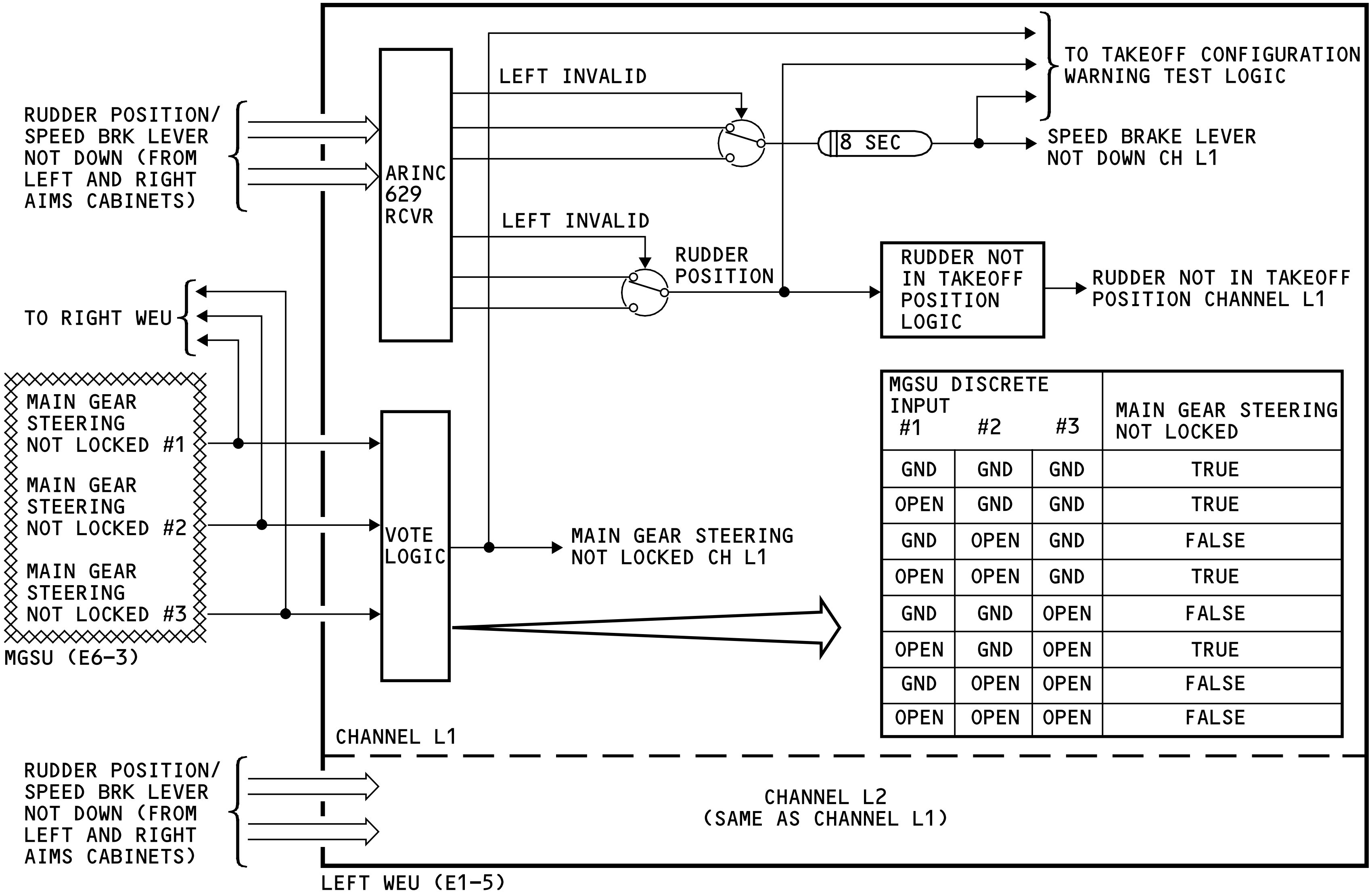
The PFCs supply the rudder position signal to the WEUs.

Each WEU channel has rudder not in takeoff position logic. This logic has the correct rudder position for takeoff. The logic compares the rudder position and the correct rudder position for takeoff. The rudder is in the correct position for takeoff when the trim value is 2 units or less.

If the rudder position is not in the correct takeoff position, the logic makes a rudder not in takeoff position signal.

Main Gear Steering Not Locked

The main gear steering unit (MGSU) supplies three discrete main gear steering not locked signals to the WEUs. Each WEU channel has vote logic. The vote logic makes the main gear steering not locked signal.



MGSU DISCRETE INPUT #1	#2	#3	MAIN GEAR STEERING NOT LOCKED
GND	GND	GND	TRUE
OPEN	GND	GND	TRUE
GND	OPEN	GND	FALSE
OPEN	OPEN	GND	TRUE
GND	GND	OPEN	FALSE
OPEN	GND	OPEN	TRUE
GND	OPEN	OPEN	FALSE
OPEN	OPEN	OPEN	FALSE

31-51-00-034 Rev 2 03/28/95

WES - TAKEOFF CONFIGURATION WARNING FUNCTION INPUTS - 3

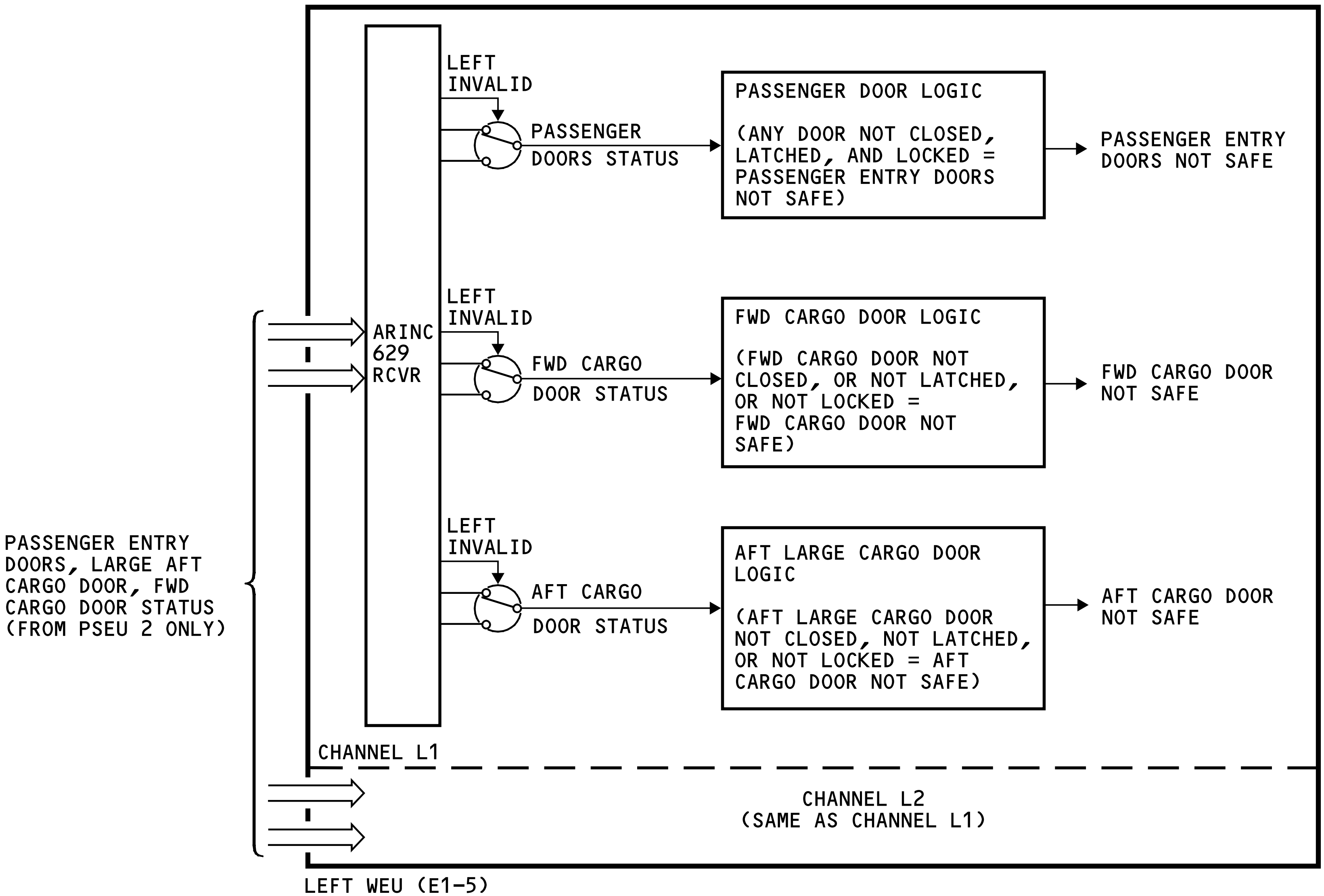
WES - TAKEOFF CONFIGURATION WARNING FUNCTION INPUTS - 4

Airplane Doors Status

The WEUs receive passenger entry and cargo doors status from the proximity switch electronic unit (PSEU) 2.

All doors must be closed, latched and locked before takeoff.

When any door is not closed, latched, and locked, each WEU channel makes doors not safe signals.



31-51-00-035 Rev 0

WES - TAKEOFF CONFIGURATION WARNING FUNCTION INPUTS - 4

WES - TAKEOFF CONFIGURATION WARNING FUNCTION OPERATION

Operation

When the takeoff configuration warning enable is true, and the flight crew makes a takeoff attempt, the WEUs check for correct airplane takeoff configuration.

Before a WEU channel gives a takeoff configuration warning, at least one more channel must give the same warning.

EICAS Warning Messages

The WEUs supply an EICAS message request to the AIMS cabinets. The AIMS shows a warning EICAS message to the flight crew. Before a warning message shows, the AIMS must receive the same message request from at least two WEU channels at the same time.

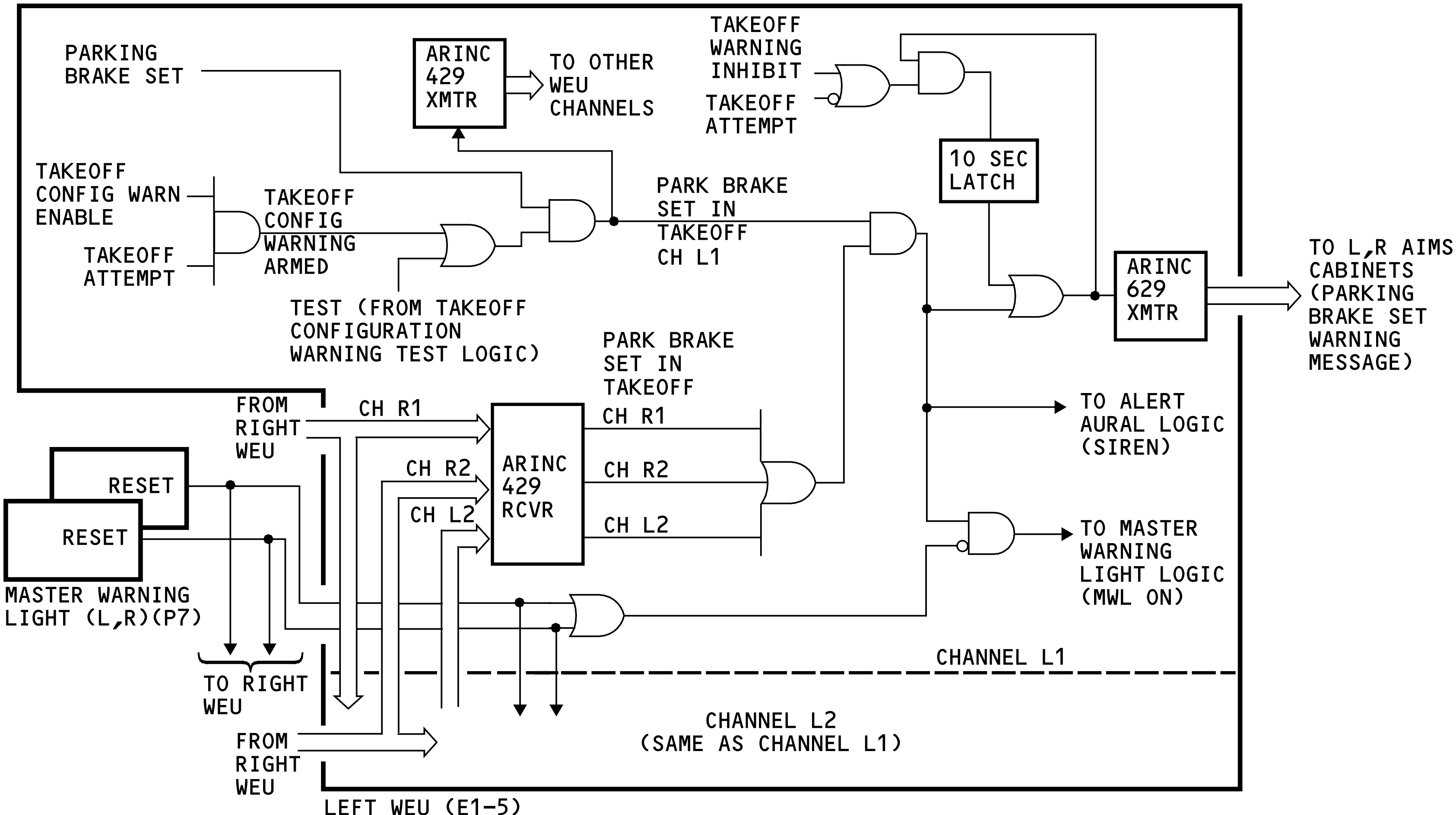
The WEUs latch the digital signal to the AIMS cabinets for 10 seconds after the flight crew stops the takeoff attempt or after the takeoff warning inhibit starts. This is to make sure that the flight crew sees the EICAS message.

Master Warning Lights Reset

Push any master warning light to make the master warning lights go out. The siren continues until the takeoff configuration warning condition is clear.

Test

A test signal comes from the takeoff configuration warning test logic. The test signal arms the takeoff configuration warning function. If the airplane is not in a good takeoff configuration, the WEUs make a takeoff configuration warning.



NOTE: OPERATION IS THE SAME FOR ALL TAKEOFF CONFIGURATION WARNING CONDITIONS

31-51-00-036 Rev 1

WES - TAKEOFF CONFIGURATION WARNING FUNCTION OPERATION

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WES - STABILIZER GREEN BAND FUNCTION

Operation

The stabilizer green band function calculates the correct green band selections for takeoff. These are the three selections:

- Nose up
- Mid band
- Nose down.

The WEUs use this data from the flight management computing function (FMCF) of the AIMS to calculate the green band selection:

- Gross weight (GW)
- Airplane center of gravity (CG)
- Takeoff thrust rating.

The stabilizer green band selection goes to the takeoff configuration warning function.

Green Band Indications

The green band selection logic sends the stabilizer green band selection to the AIMS. The AIMS changes the green band selection into ARINC 429, and sends it to the stabilizer trim position indicators.

An airplane nose down selection makes the mid band lamp and the nose down lamp come on. An airplane nose up selection makes the mid band lamp and the nose up lamp come on. A mid band indication makes only the mid band lamp come on.

If the WEUs get a CG that is more than 44.0 or less than 14.0, the WEUs make all the stabilizer green band lamps go out. The WEUs also supply a STAB GREENBAND advisory EICAS message request to the AIMS.

The green band selection logic changes the stabilizer green band selection only when the takeoff configuration enable is true. When a takeoff attempt is true, the green band selection logic locks the selection in its present condition.

The green band selection logic turns off the green band lamps when the takeoff configuration warning enable is false.

Nose Gear Pressure Switch

The WEUs use the nose gear pressure switch input to do a check of the stabilizer green band selection.

If the WEUs calculate a nose up band, the switch input must be forward CG (fly nose up condition). If the WEUs calculate a nose down band, the switch position must be aft CG (fly nose down condition). If the WEUs calculate a mid band, the WEUs ignore the switch input.

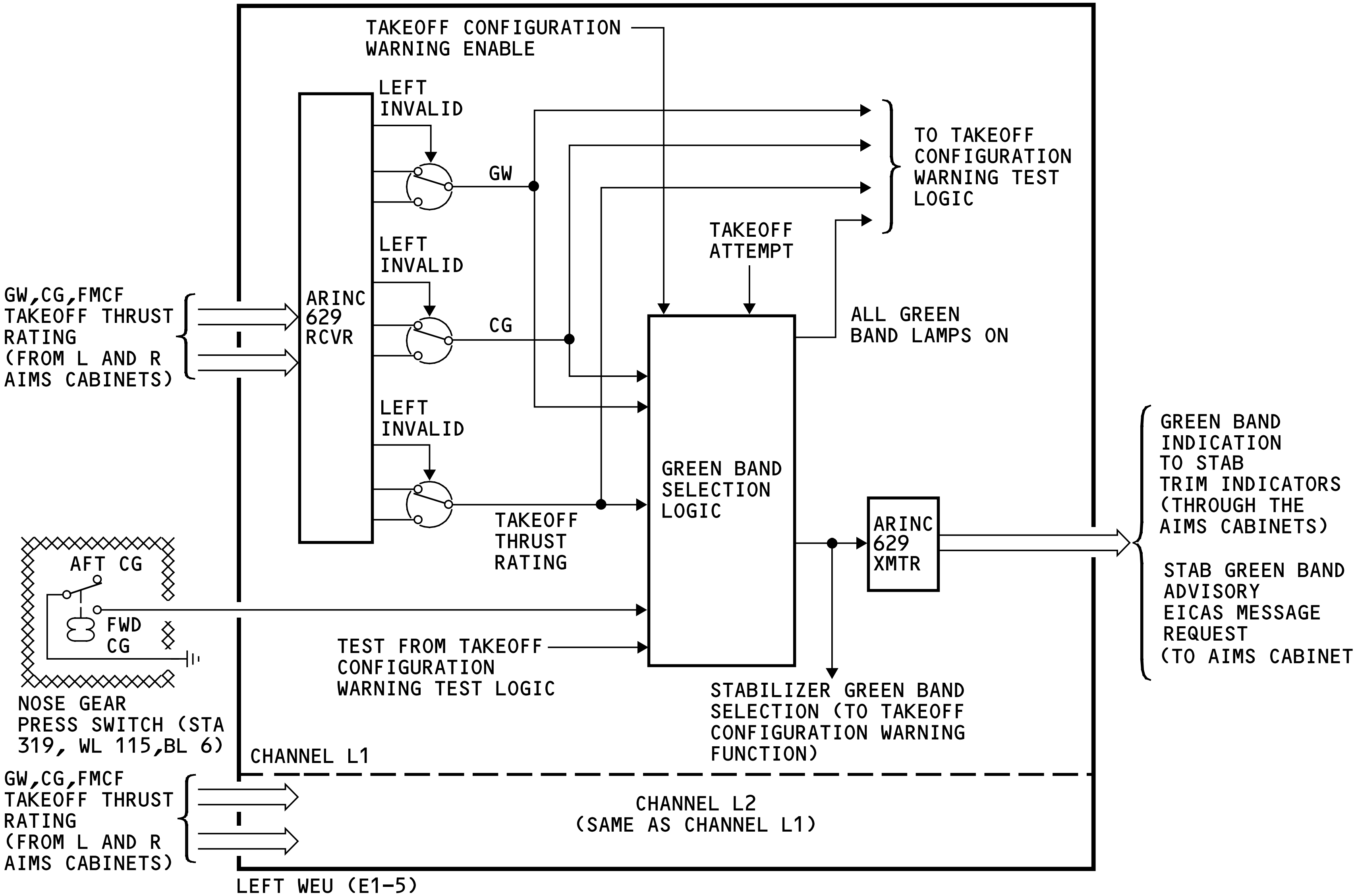
If the nose gear pressure switch input does not agree with the green band calculation, the WEUs supply a STAB GREENBAND advisory EICAS message request to the AIMS.

WES - STABILIZER GREEN BAND FUNCTION

Test

When you do a takeoff configuration warning test from the MAT, you do a test of the stabilizer green band function of the WEUs.

The takeoff configuration warning test logic supplies a test signal to the green band selection logic. The green band selection logic makes all three green band lamps come on each stabilizer trim indicator.



31-51-00-037 Rev 2

WES - STABILIZER GREEN BAND FUNCTION

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WES - TAKEOFF CONFIGURATION WARNING TEST

General

You start a takeoff configuration warning test from the maintenance access terminal (MAT). When you do a takeoff configuration warning test, you also do a stabilizer green band function test.

The takeoff configuration warning test logic checks the condition of the takeoff configuration warning and stabilizer green band function inputs. If any input is not present or is invalid, the test fails.

Initiated Test Inhibit

A WEU channel must make an initiated test inhibit signal as false before a takeoff configuration test can start.

When the initiated test inhibit signal is true, the WEU channels cannot start any test.

The initiated test inhibit signal within a WEU channel is false (a test can start) only when all these conditions are true:

- Both engines are at less than takeoff thrust
- The airplane is on the ground
- The nose gear is compressed
- The ADIRU and the SAARU send incomplete pitot/static data (airplane not moving)
- Three or more WEU channels detect the same previous conditions.

Test Signal

The takeoff configuration warning test logic supplies a test signal that is on for five seconds and then it goes off. The test signal goes to the:

- Takeoff configuration warning function
- Stabilizer green band selection logic
- AIMS.

The test signal arms the takeoff configuration warning function. If the airplane is not in a good takeoff configuration, the WEUs make a takeoff configuration warning. If the airplane is in a good configuration for takeoff, the WEUs do not make a takeoff warning.

The stabilizer green band selection logic supplies an all green band lamps on signal to the takeoff configuration warning test logic. The test signal goes to the AIMS. The AIMS sends the test signal to the stabilizer trim indicators. The indicators make all three green band lamps come on.

CONFIG WARN SYST Advisory Message

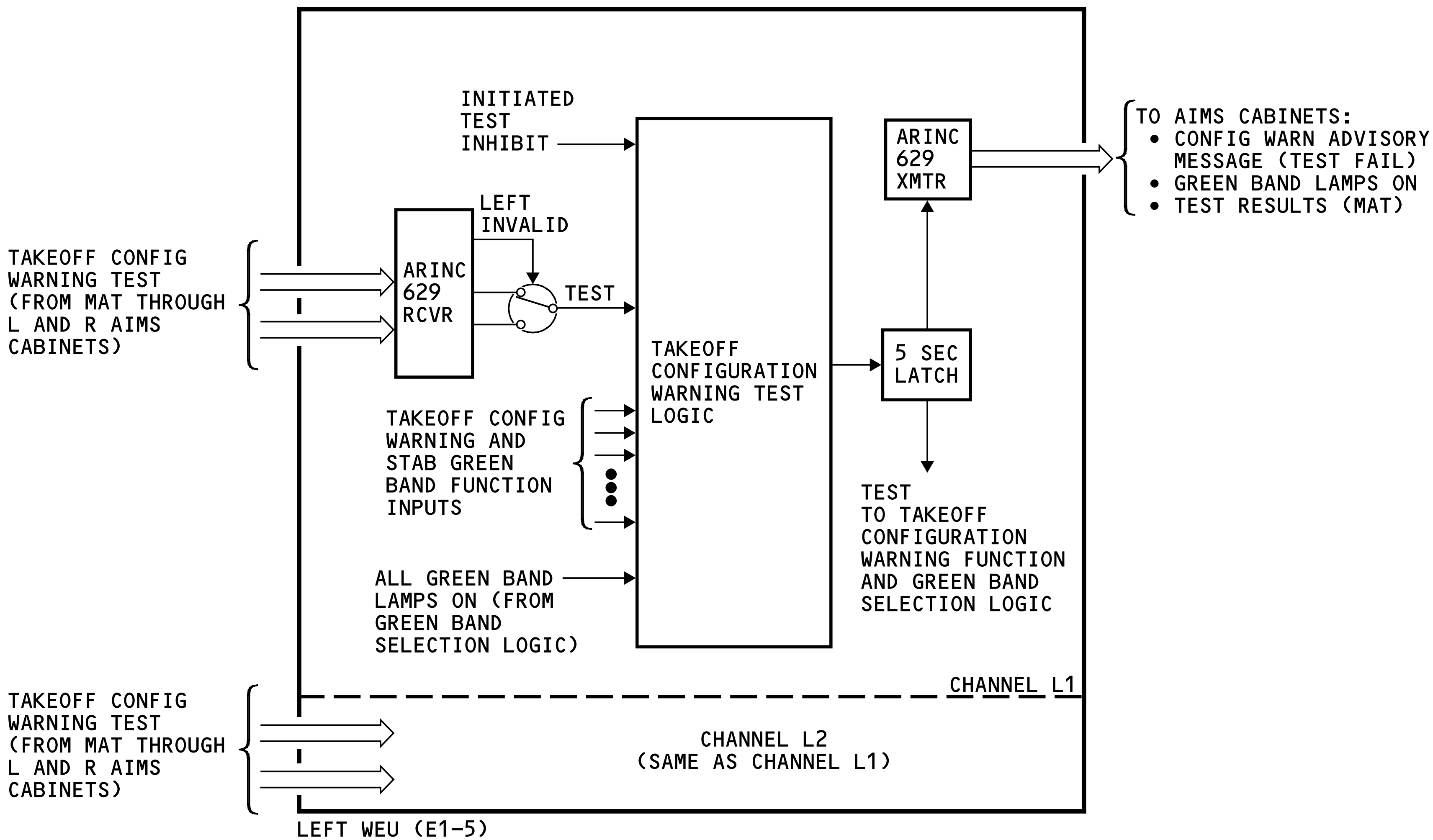
The AIMS shows the CONFIG WARN SYST EICAS advisory if the test fails. Each WEU channel latches the CONFIG WARN SYST message until you do another test or until you remove and reapply power to the WEUs.

The AIMS shows the CONFIG WARN SYST EICAS advisory message only when two or more channels supply a test fail signal.

WES - TAKEOFF CONFIGURATION WARNING TEST

MAT Display

The MAT shows a TAKEOFF CONFIGURATION TEST FAIL message or a TAKEOFF CONFIGURATION TEST COMPLETE message after the test ends.



31-51-00-038 Rev 1

WES - TAKEOFF CONFIGURATION WARNING TEST

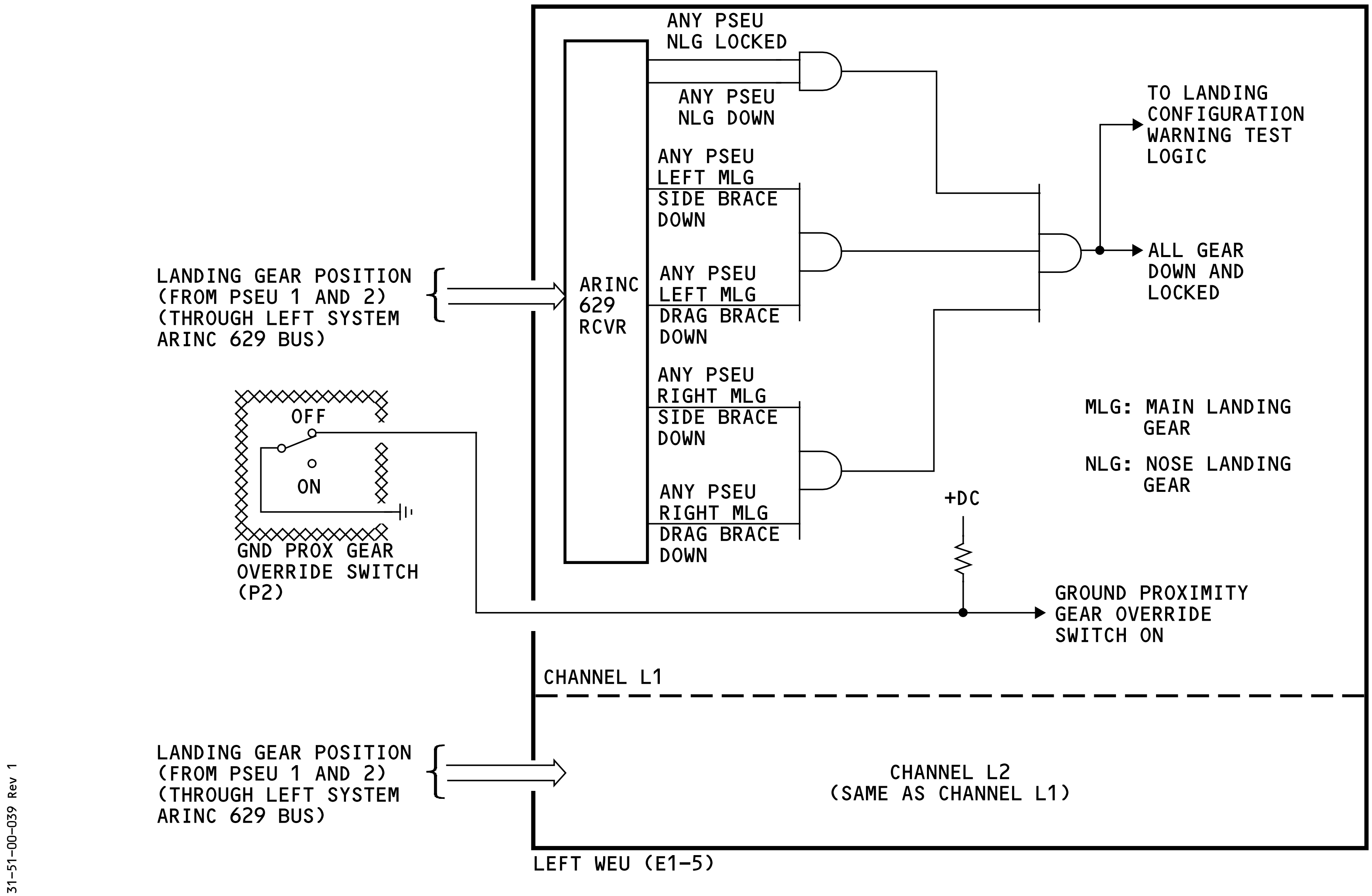
WES - LANDING CONFIGURATION WARNING INPUTS - 1

PSEU Inputs

The proximity switch electronic unit (PSEU) supplies landing gear position to the WEUs. The WEUs make an all gear down and locked signal.

Ground Proximity Gear Override Switch

The ground proximity gear override switch supplies an on signal to the WEUs.



WES - LANDING CONFIGURATION WARNING INPUTS - 1

WES - LANDING CONFIGURATION WARNING INPUTS - 2

Thrust Lever Resolver Angle Input

The electronic engine controls (EECs) supply thrust lever resolver angle (TLRA) to the WEUs. Compare logic in the WEUs make a true output when the TLRA is less than the glideslope power level (GSPL). The WEUs have the GSPL value in memory.

The compare logic also supplies a true output to the speed brake alert logic when the TLRA is greater than the speedbrake power level (SBPL). The WEUs have the SBPL value in memory.

Radio Altitude Input

The AIMS supplies radio altitude to the WEUs. The left WEU uses radio altitude in this priority:

- Left
- Right
- Center.

The right WEU uses radio altitude in this priority:

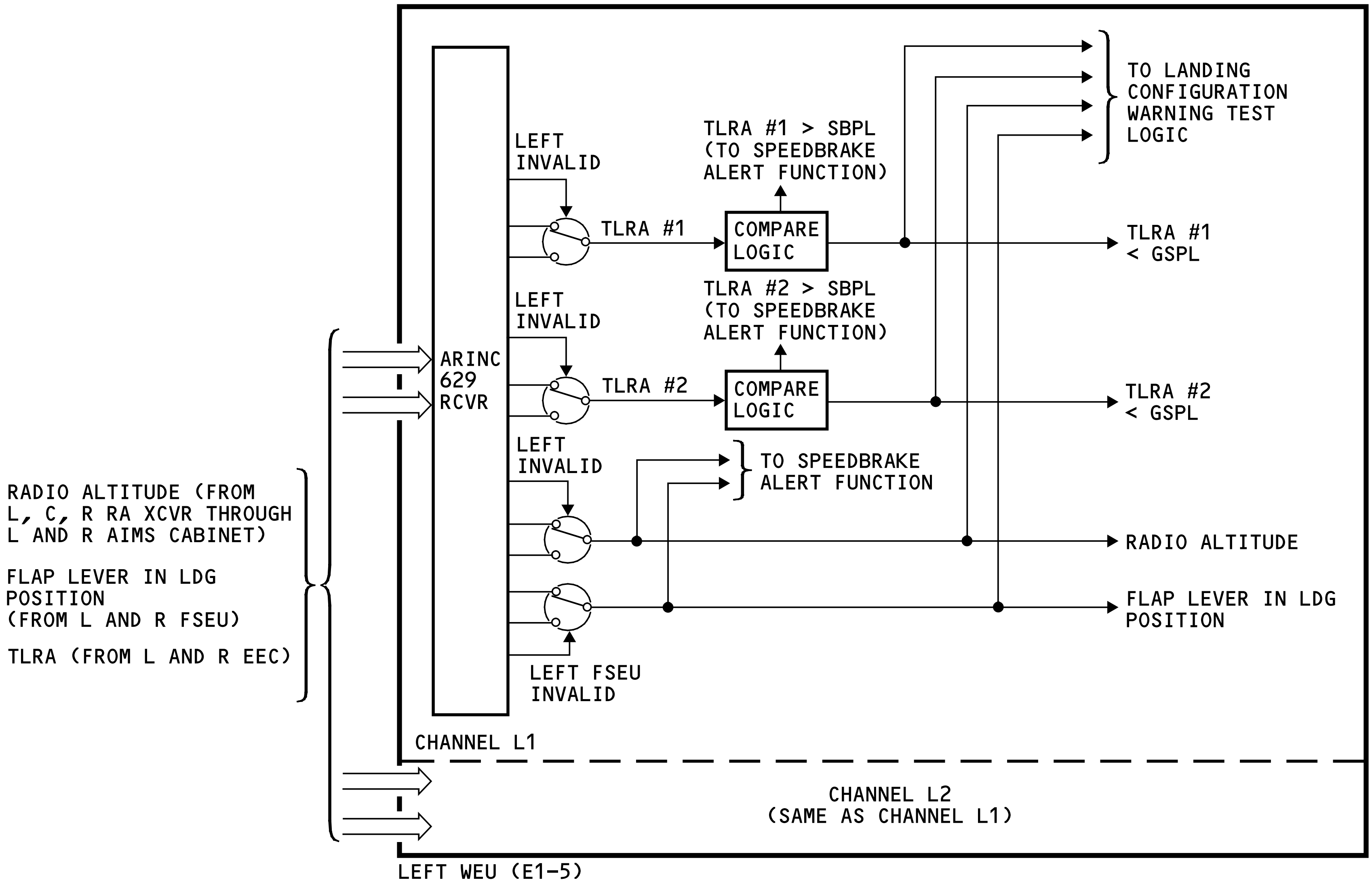
- Right
- left
- Center.

FSEU Inputs

The flap/slat electronic units (FSEUs) supply a flap lever in landing position digital discrete to the WEUs.

Landing Configuration Warning Test Logic Interface

All inputs that the WEUs use for landing configuration warning go to the landing configuration warning test logic.



31-51-00-040 Rev 2 02/12/96

WES - LANDING CONFIGURATION WARNING INPUTS - 2

WES - LANDING CONFIGURATION WARNING OPERATION

General

The WEUs make a landing configuration warning when the airplane is on approach and the landing gear is not down and locked.

There are two types of landing configuration warnings: resetable and non-resetable. Both types of warnings show the same indications. The indications are:

- CONFIG GEAR level A message shows on the EICAS primary display.
- Siren aural comes on
- Master warning lights come on

Resetable Landing Configuration Warning

During a resetable landing configuration warning, the CONFIG GEAR warning message stays until you lower the landing gear. Push any master warning light to stop the siren aural and to make the warning lights go out. The siren also stops when the ground proximity gear override switch is on.

Non-resetable Landing Configuration Warning

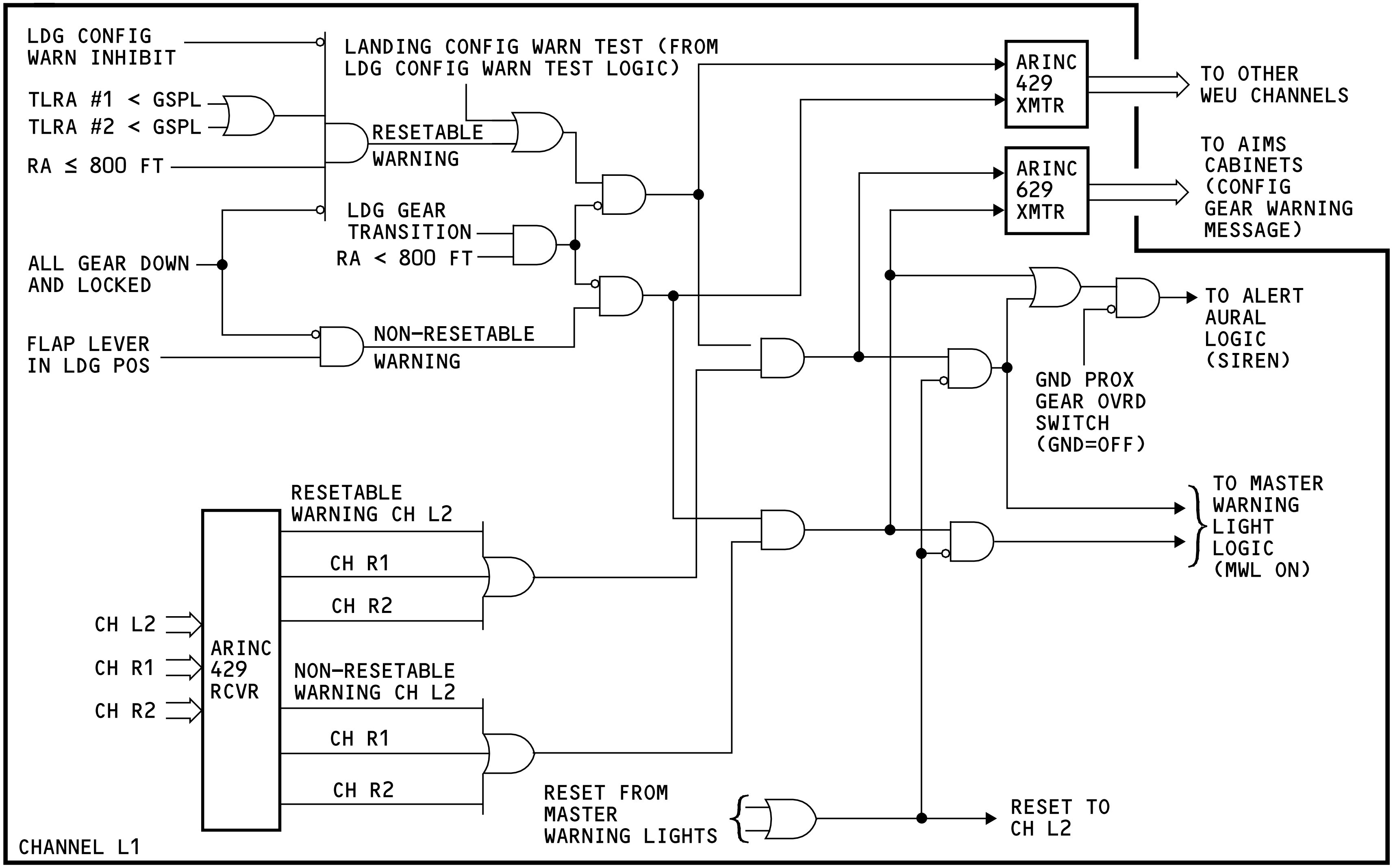
During a non-resetable landing configuration warning, the CONFIG GEAR warning message and the siren aural stay until you lower the landing gear. Push any master warning light to make the warning lights go out. The siren also stops when the ground proximity gear override switch is on.

Landing Configuration Warning Inhibit

The landing configuration warning inhibit prevents false resetable landing configuration warnings. The inhibit starts when the nose gear not compressed signal from the PSEU goes from false to true. The inhibit stops when the airplane goes above 800 feet of radio altitude, or 140 seconds after the nose gear not compressed signal was true.

Total Inhibit

The landing configuration warning function does not operate when the landing gear goes from all gear down and locked to all gears not down and locked (landing gear transition), and the radio altitude is below 800 feet. This is to prevent false warnings when the flight crew aborts a landing below 800 feet of radio altitude.



LEFT WEU (E1-5)

31-51-00-041 Rev 1

WES - LANDING CONFIGURATION WARNING OPERATION

WES - SPEEDBRAKE ALERT

General

The speedbrake alert function tells the flight crew when it is not safe to extend the speedbrakes.

Conditions Monitored

The WEUs make a speedbrake alert when the speedbrake handle is past the arm position, and any of these conditions is present:

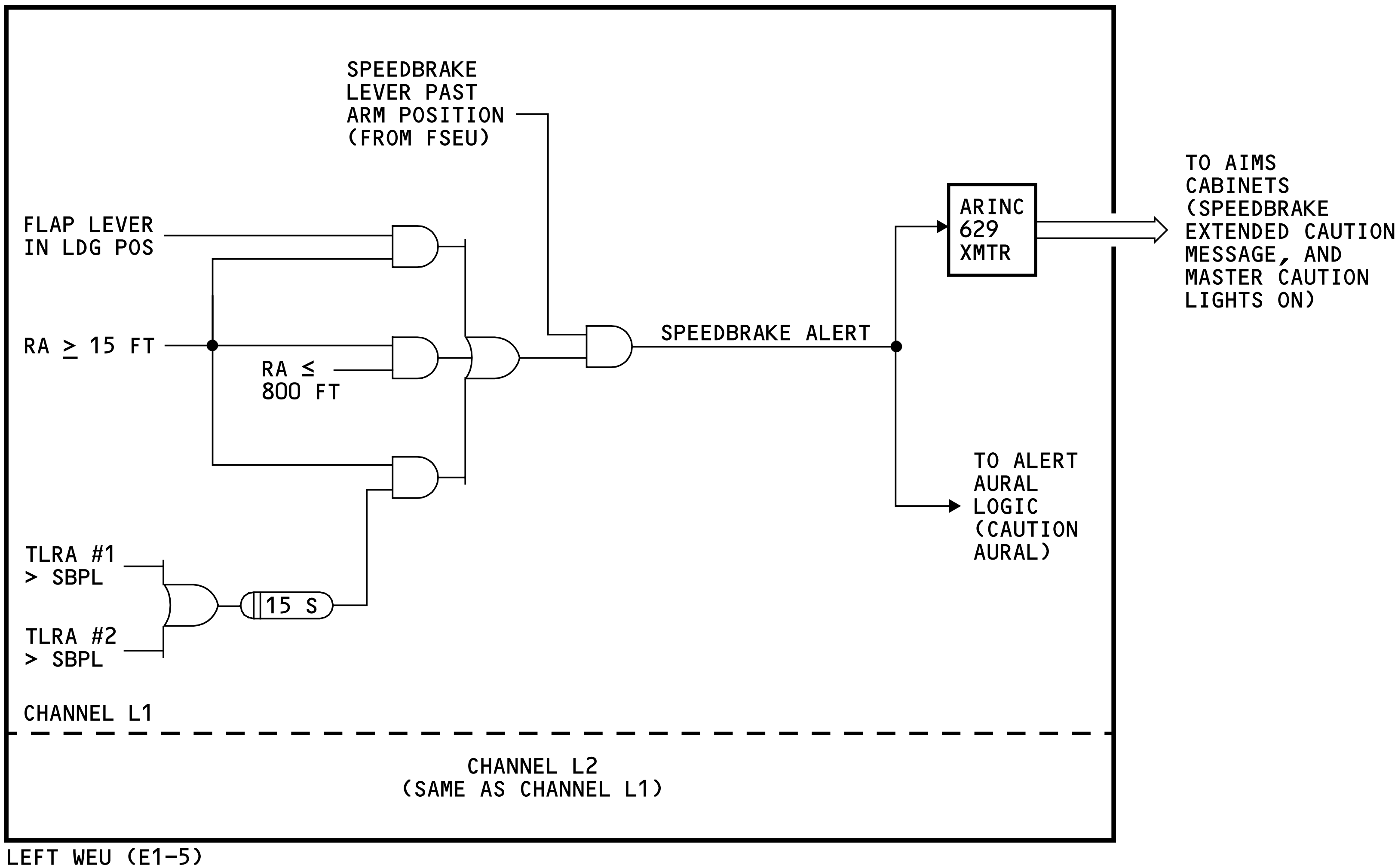
- Flaps lever in landing position with a radio altitude of 15 feet or more
- Radio altitude is between 15 and 800 feet
- 15 seconds after any thrust lever resolver angle (TLRA) is more than the speedbrake power level (SBPL) and the radio altitude is 15 feet or more.

Speedbrake Alert Indications

A speedbrake alert has these indications:

- A SPEEDBRAKE EXTENDED caution message shows on the EICAS display
- The master caution lights come on
- A caution aural comes on.

The AIMS shows the caution message and makes the master caution lights come on. The AIMS does this only when at least two WEU channels supply a speedbrake alert digital signal.



31-51-00-042 Rev 2 10/23/95

WES - SPEEDBRAKE ALERT

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WES - LANDING CONFIGURATION WARNING TEST

General

You start a landing configuration warning test from the maintenance access terminal (MAT). When you do a landing configuration warning test, you also do a test of the speedbrake alert function at the same time.

When the test passes, the WEUs make a landing configuration warning.

The landing configuration warning test logic checks the condition of the landing configuration warning and speedbrake alert function inputs. If any input is not present or is invalid, the test fails and you will not see a landing configuration warning.

Initiated Test Inhibit

A WEU channel must make an initiated test inhibit signal as false before a landing configuration warning test can start.

When the initiated test inhibit signal is true, the WEU channels cannot start any test.

The initiated test inhibit signal within a WEU channel is false (a test can start) only when all these conditions are true:

- Both engines are at less than takeoff thrust
- The airplane is on the ground
- The nose gear is compressed
- The ADIRU and the SAARU send incomplete pitot/static data (airplane not moving)
- Three or more WEU channels detect the same previous conditions.

Test Signal

The landing configuration warning test logic supplies a test signal that is on for 5 seconds and then it goes off. The test signal goes to the:

- Landing configuration warning function
- AIMS cabinets.

The landing configuration warning function makes a resetable landing configuration warning if all inputs to the landing configuration are valid.

CONFIG WARN SYST Advisory Message

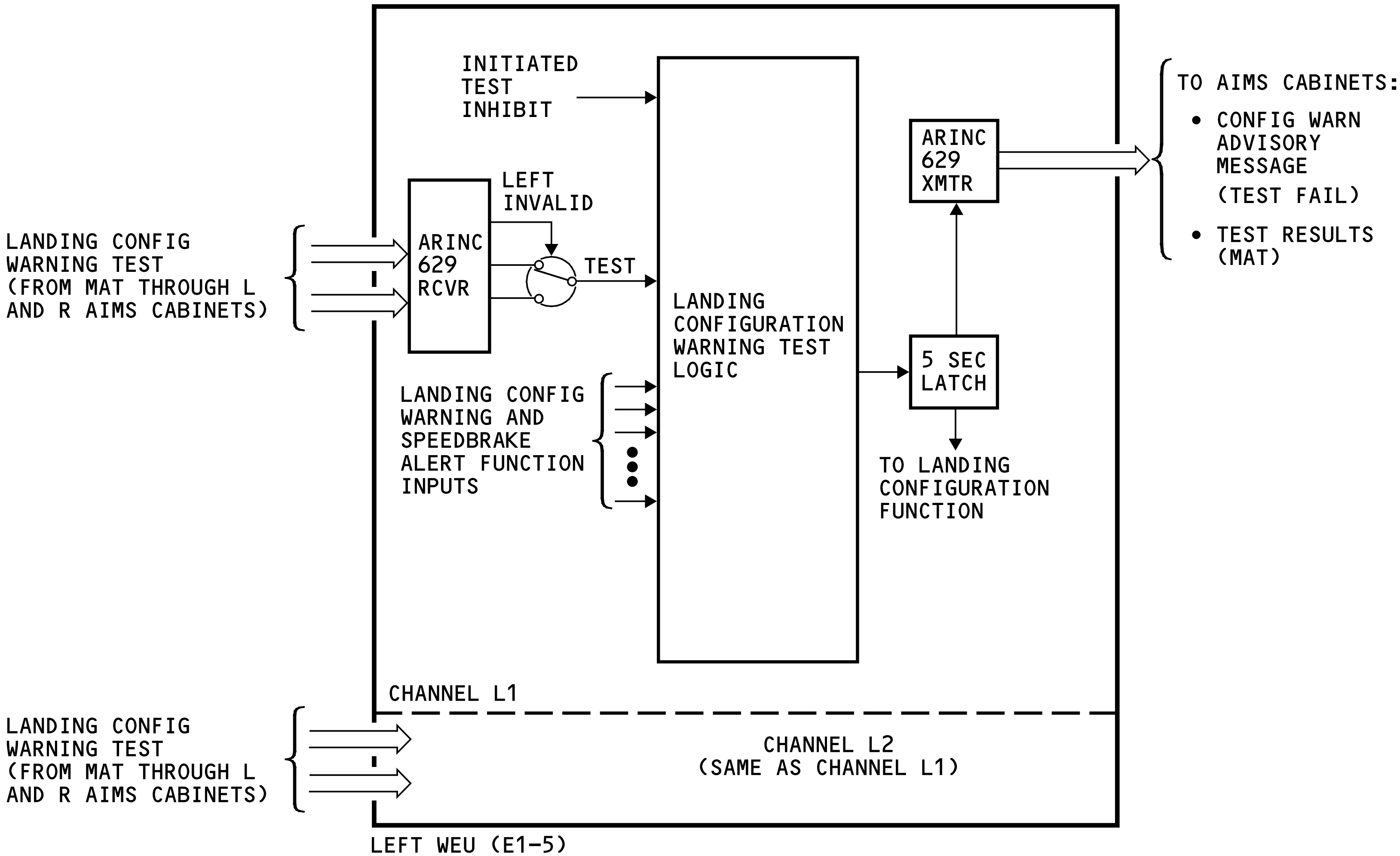
The AIMS shows the CONFIG WARN SYST EICAS advisory if the test fails. Each WEU channel latches the CONFIG WARN SYST message until you do another test or until you remove and reapply power to the WEUs.

The AIMS shows the CONFIG WARN SYST EICAS advisory message only when two or more channels supply a test fail signal.

WES - LANDING CONFIGURATION WARNING TEST

MAT Display

The MAT shows a LANDING CONFIGURATION TEST FAIL message or a LANDING CONFIGURATION TEST COMPLETE message after the test ends.



31-51-00-043 Rev 1

WES - LANDING CONFIGURATION WARNING TEST

WES - ALTITUDE ALERT FUNCTION

Purpose

The altitude alert function of the WEUs tells the pilots when the airplane approaches or deviates from the mode control panel (MCP) selected altitude.

Altitude Approach Point

The altitude approach point is 900 feet from the selected altitude.

Altitude Approach

Altitude approach indications show on the PFD when the airplane is less than 900 feet and more than 200 feet from the selected altitude.

Altitude Capture Point

The altitude capture point is 200 feet from the selected altitude.

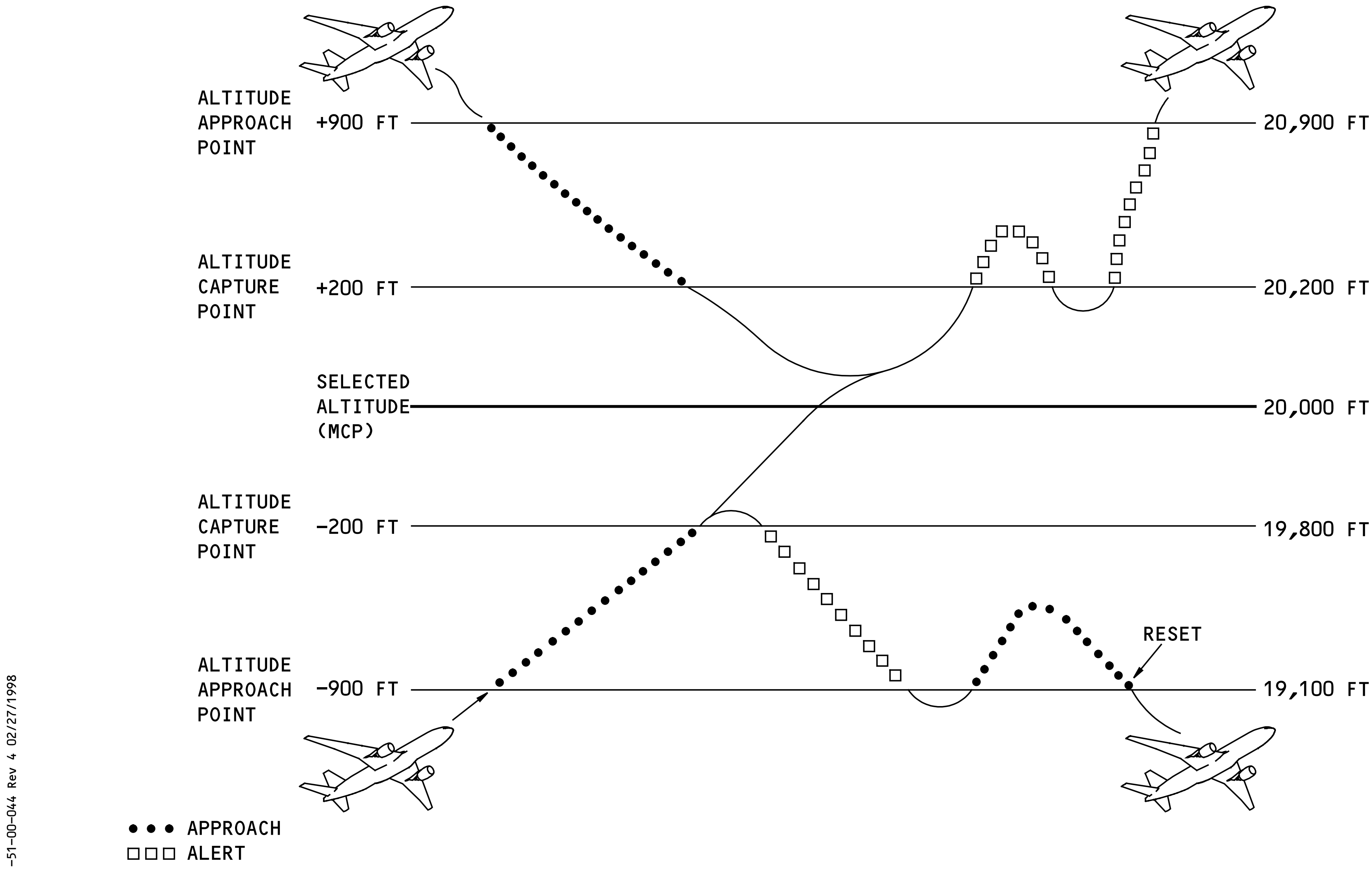
Altitude Alert

An altitude alert occurs when the airplane goes more than 200 feet away from the selected altitude.

Reset

An altitude alert reset occurs when one of these happens:

- The airplane goes 900 feet away from the selected altitude
- The flight crew changes the selected altitude on the mode control panel
- The airplane returns to within 200 feet of the selected altitude.



WES - ALTITUDE ALERT FUNCTION

WES - ALTITUDE ALERT PFD INDICATIONS AND CONTROL

General

The primary flight display (PFD) shows altitude alert indications.

Selected Altitude Display and Bug

The selected altitude from the mode control panel (MCP) shows above the altitude indication. The color of the selected altitude display is magenta.

The selected altitude bug is magenta. The bug points to the selected altitude when the selected altitude is on the PFD barometric altitude scale. If the selected altitude is not on the scale, the bug is at the top or bottom of the scale.

Selected Altitude Highlight Box

An altitude alert box is around the selected altitude when the airplane gets to the altitude capture point. This box stays when the airplane is less than 900 feet but more than 200 feet from the selected altitude (altitude approach).

Current Altitude Box

The box around the current altitude is usually white. The box is thicker when the airplane gets to the altitude capture point. The box stays thicker when the airplane is less than 900 feet but more than 200 feet from the selected altitude (altitude approach).

The box is yellow when the airplane goes more than 200 feet but less than 900 feet from the selected altitude (altitude alert).

MCP

The altitude selector is on the MCP. The selected altitude shows in the altitude window above the altitude selector.

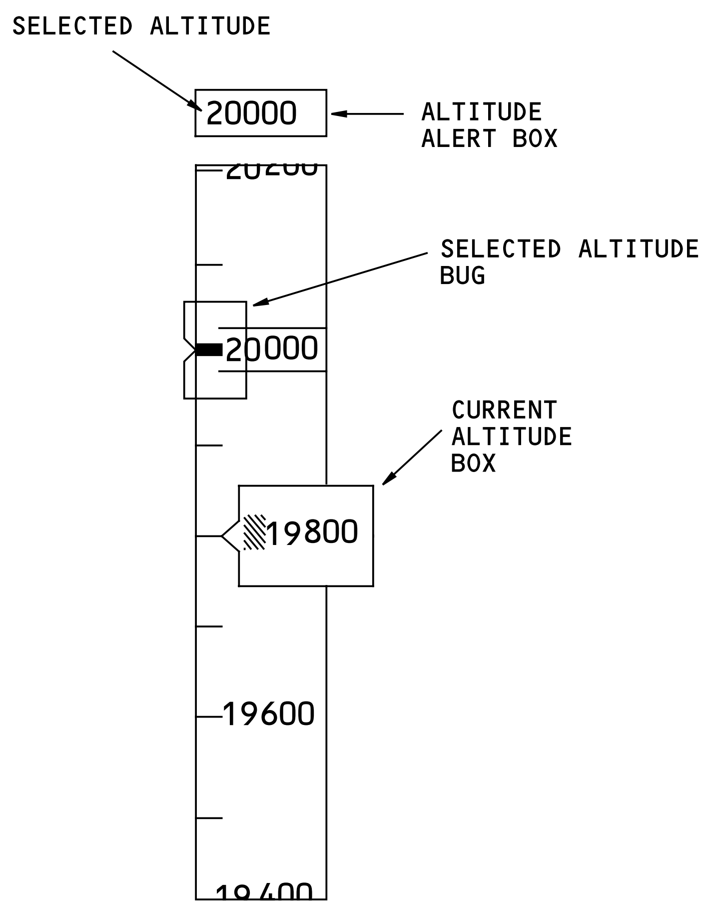
Rotate the altitude selector to change the selected altitude.

Caution Aural

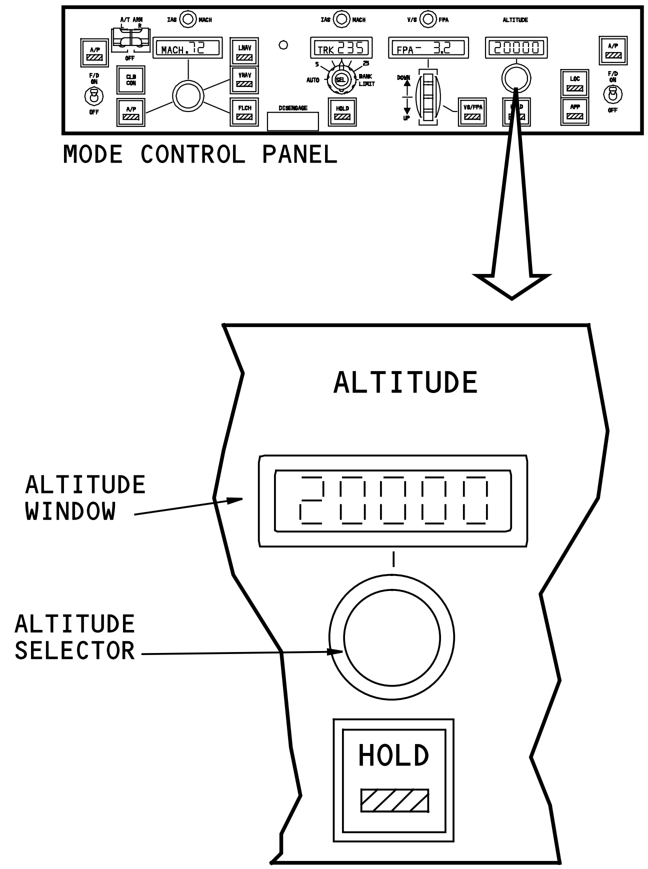
The WEUs make a caution aural when an altitude alert occurs.

EICAS Message and Master Caution Lights

The WEUs send a digital signal to the AIMS cabinets when an altitude alert occurs. The AIMS shows an ALTITUDE ALERT EICAS caution message. The AIMS also makes the master caution lights come on.



ALTITUDE INDICATION
ON PFD



SELECTED ALTITUDE CONTROLS

31-51-00-045 Rev 6

WES - ALTITUDE ALERT PFD INDICATIONS AND CONTROL

WES - ALTITUDE ALERT OPERATION

Altitude Comparator

The altitude comparator compares the selected altitude with the barometric altitude. The altitude comparator supplies these outputs:

- More than or equal to 200 feet from the selected altitude
- Less than or equal to 900 feet from the selected altitude
- Less than or equal to 200 feet from the selected altitude.

Alert/Approach Logic

The alert/approach logic calculates when the airplane approaches the selected altitude, or when it moves away from the selected altitude.

The alert/approach logic makes an altitude approach signal when the airplane is 200 feet or more, and 900 feet or less from the selected altitude. The altitude approach signal goes to the AIMS cabinets. The AIMS shows altitude approach indications on the primary flight displays (PFDs).

The alert/approach logic makes an altitude alert signal when the airplane goes 200 feet or more from the selected altitude. The altitude alert signals go to the aural alert logic and the AIMS cabinets.

The aural alert logic makes the caution aural.

The AIMS cabinets must receive an altitude alert signal from at least two WEU channels. The AIMS does these functions:

- Shows the ALTITUDE ALERT caution message
- Shows the altitude alert indications on the PFDs
- Makes the master caution lights come on.

Altitude Alert Inhibit

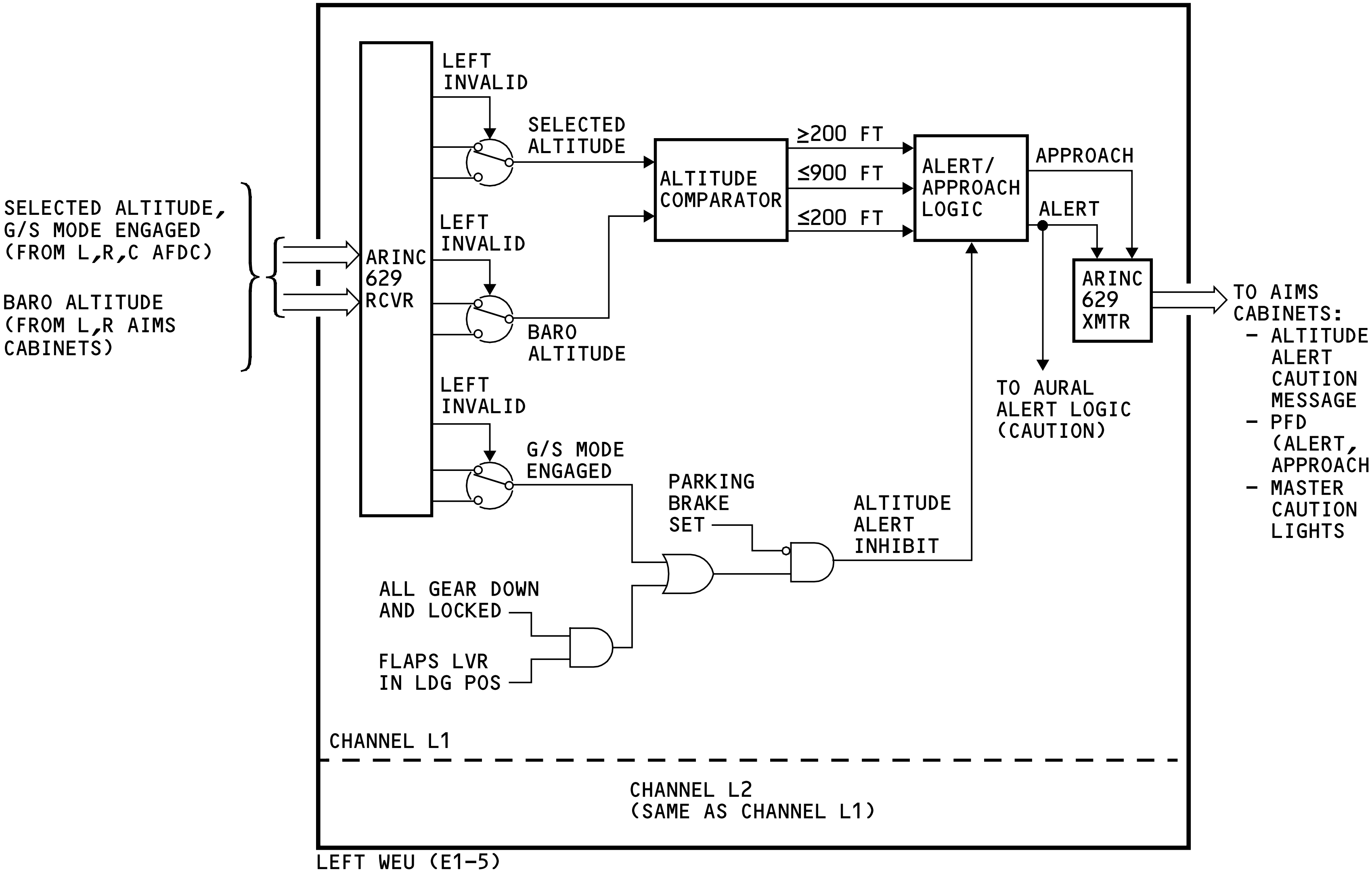
The altitude alert inhibit signal stops the operation of the altitude alert/approach logic. The WEUs use these signals to make an altitude alert inhibit signal:

- Glideslope (G/S) mode engaged
- Parking brake set
- All gear down and locked
- Flaps in landing position.

Operational Check

With the parking brake set, the altitude alert inhibit signal is false. This permits an operational check of the altitude alert function on the ground.

Move the altitude selector on the mode control panel (MCP). You will see altitude approach indications when the difference between the selected altitude and the barometric altitude is 900 feet or less. After that, you will see altitude alert indications when the difference between selected altitude and barometric altitude is 200 feet or more.



31-51-00-046 Rev 5 02/27/1998

WES - ALTITUDE ALERT OPERATION

WES - STALL WARNING FUNCTION

General

The stall warning function has these four functions:

- Stick shaker activation
- Pitch limit indication (PLI) calculation
- Speed tape parameter calculation
- Auto slat enable.

Stick Shaker Activation

The WEUs make the stick shaker actuators come on when the airplane has a corrected angle of attack (AOA) (alpha) that is too high.

The stick shaker trip point (AOA STRIP) logic calculates the AOA STRIP. The logic uses these inputs:

- Mach number from the air data inertial reference unit (ADIRU). Channels L1 and R1 use the ADIRU as the primary source and the SAARU as the secondary source. Channels L2 and R2 use the SAARU as the primary source and the ADIRU as the secondary source
- Nose gear down and locked from the proximity switch electronic unit (PSEU)
- Speedbrake lever position (SBLP) from the primary flight computers (PFCs)
- Flap and slat position from the flap/slat electronics units (FSEUs).

The WEUs compare the AOA STRIP and the AOA. If the AOA is equal to or higher than the AOA STRIP, each WEU channel makes a stick shaker actuator enable signal. This will happen only if the airplane is in the air.

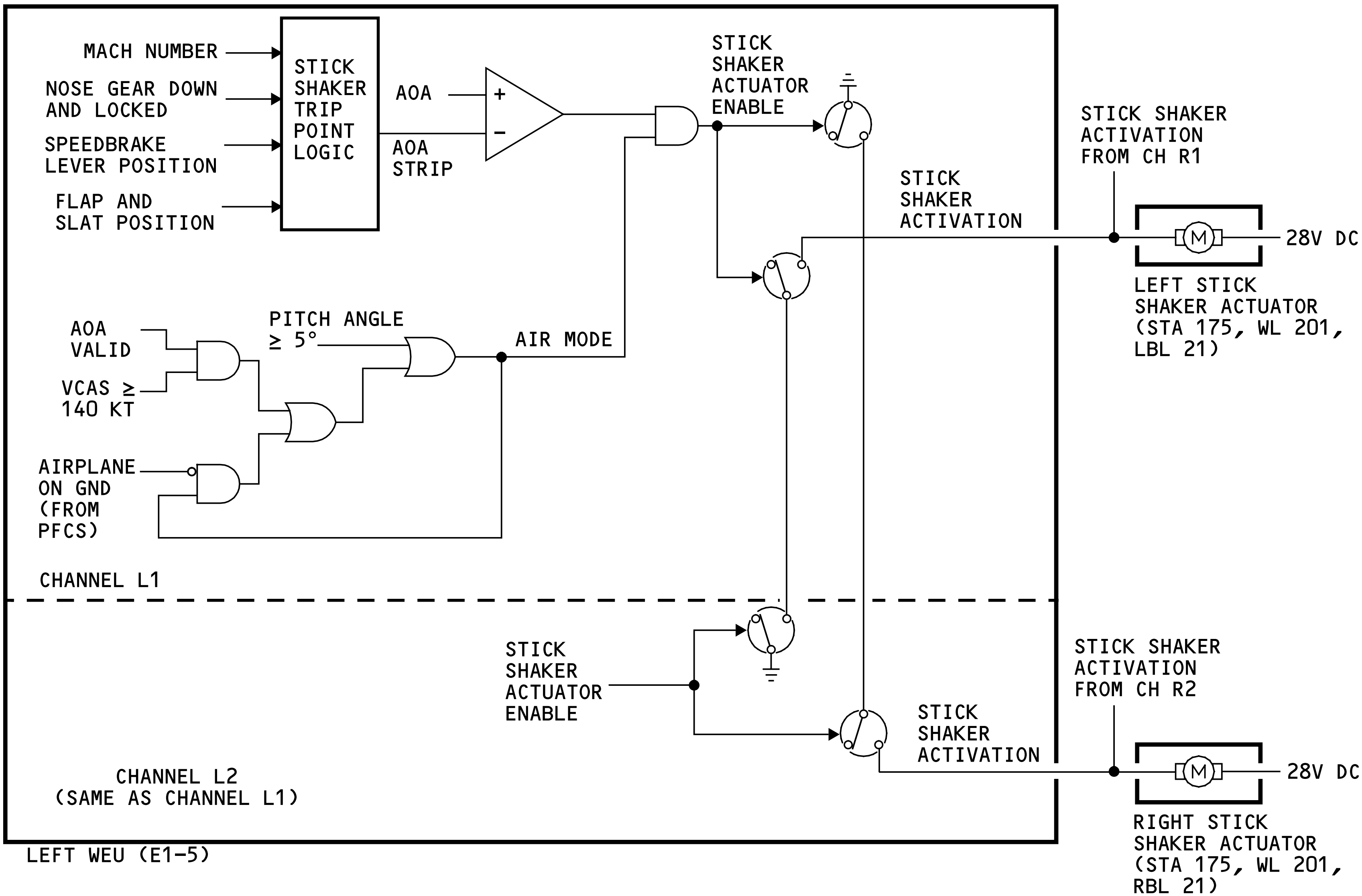
The stick shaker actuators come on only when at least two channels in the same WEU make a stick shaker actuator enable signal.

Air Mode

The WEUs make the stick shaker actuators come on only when the air mode signal is true. The WEUs use these inputs to calculate the air mode signal:

- Angle of attack (AOA)
- Computed airspeed
- Pitch angle.

All these signals come from the ADIRU. If the ADIRU fails, the WEUs use the SAARU.



31-51-00-047 Rev 4 02/09/1998

WES - STALL WARNING FUNCTION

WES - PITCH LIMIT INDICATION

General

The WEUs calculate and show the flight crew the maximum pitch limit. The maximum pitch limit is the number of degrees the airplane can pitch up from the current pitch angle before the stick shaker actuators come on.

PLI Logic

The pitch limit indication (PLI) logic in each WEU channel uses these inputs to calculate the maximum pitch limit:

- Active control minimum speed (VCMIN). VCMIN comes from the flight management computing function (FMCF) of AIMS
- Stick shaker speed (VSS). VSS comes from the VSS logic in each WEU
- Stick shaker trip point (AOA STRIP)
- Corrected angle of attack (AOA)
- Air mode signal
- Computed airspeed (VCAS)
- Flaps up. This signal comes from the flap slat electronic units (FSEUs)
- Leading edge devices retracted. This signal comes from the FSEUs.

PLI Data

The PLI logic sends the PLI data to the AIMS cabinets. The AIMS cabinets send the data to the primary flight displays (PFDs). The PFDs show the pitch limit indicator symbol.

The WEUs send valid PLI data to the AIMS only when any of these conditions is present:

- VCAS is less than the upper limit of the FMCF minimum maneuver speed (amber band) on the PFD speed tape
- VCAS is 1.44(VSS) or less
- The flaps are not up.

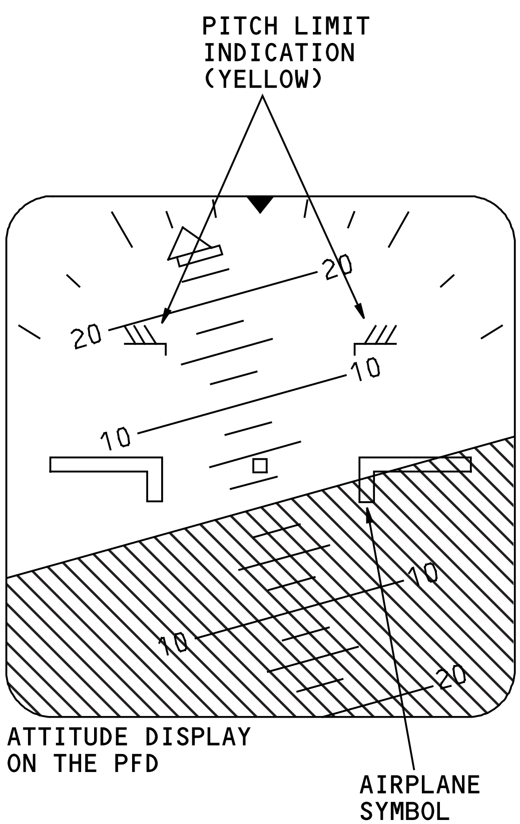
At any other time the data is no computed data (NCD).

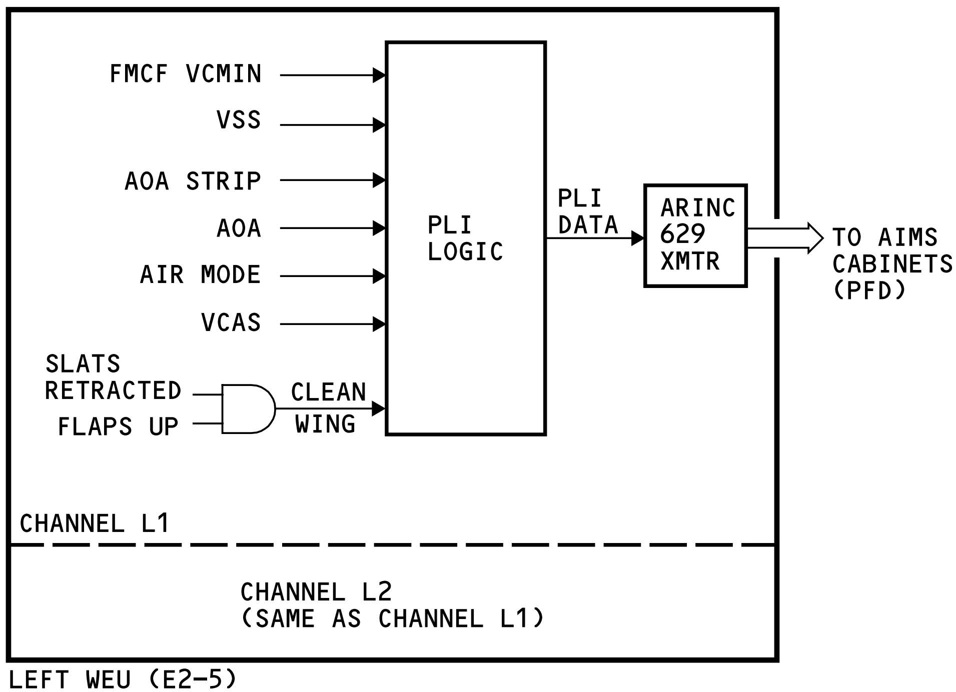
Pitch Limit Indications

When the airplane is on the ground, the pitch limit indicator shows 15 degrees pitch up attitude.

The maximum pitch limit indication at any time is 30 degrees minus the actual pitch angle.

The stick shaker actuators come on when the airplane symbol reaches the same pitch as the pitch limit indicator symbol.





31-51-00-048 Rev 3 04/26/96

WES - PITCH LIMIT INDICATION

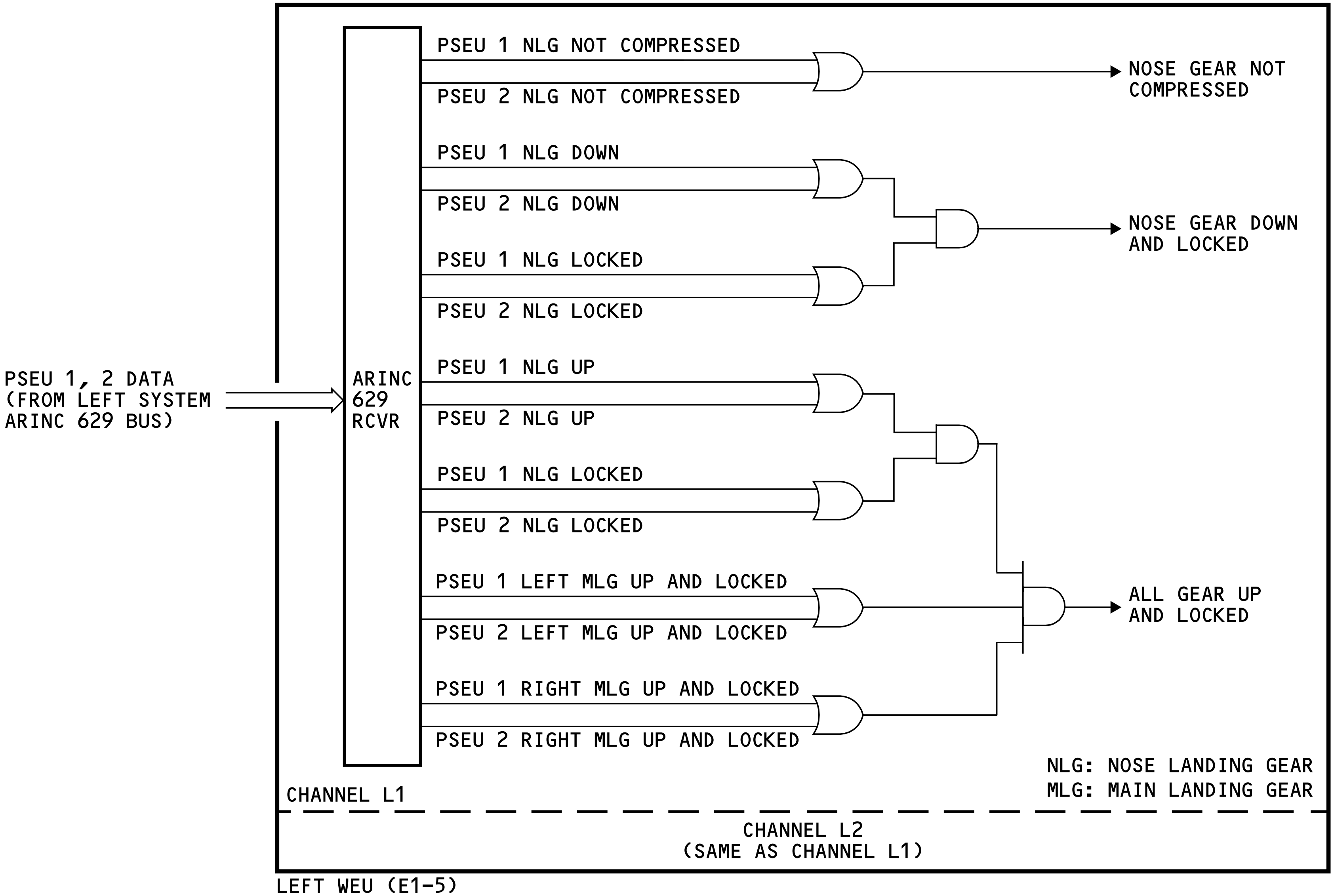
WES - SPEED TAPE PARAMETER CALCULATION - 1

General

The WEUs use proximity switch electronic unit (PSEU) data to make these signals:

- All gear up and locked
- Nose gear not compressed signal
- Nose gear down and locked.

The WEUs use those signals to make speed tape parameters.



31-51-00-049 Rev 0

WES - SPEED TAPE PARAMETER CALCULATION - 1

WES - SPEED TAPE PARAMETER CALCULATION - 2

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WES - SPEED TAPE PARAMETER CALCULATION - 2

Speed Tape Parameters

The WEUs calculate these speed tape parameters:

- Maximum operating speed and the maximum operating mach number (VMO/MMO)
- Maximum flaps extended/maximum gear extended speed (VFE/VLE)
- Maximum speed (VMAX)
- Minimum speed (VMIN)
- Maneuver margin above stick shaker speed (VSSNG).

Inputs

The air data inertial reference unit (ADIRU) supplies these inputs for speed tape parameter calculation:

- Corrected angle of attack (AOA)
- Barometric altitude
- Body longitudinal acceleration (AL)
- Body normal acceleration (AN)
- Computed airspeed (VCAS)
- Mach number (MACH NO)
- Static pressure.

If the ADIRU fails, the secondary attitude air data reference unit (SAARU) supplies the same inputs.

The primary flight computers (PFCs) supply the PFCS in secondary or direct mode of operation signal, and speedbrake lever position (SBLP).

The proximity switch electronic units (PSEU) supply these inputs:

- All gear up and locked
- Nose gear down and locked
- Nose gear not compressed.

The flap slat electronic units (FSEUs) supply flap and slat position.

The alternate gear down dispatch switch supplies three identical ground signals when the switch is in the VMO position. When the alternate gear down dispatch switch is in the VMO position, the WEUs send a memo message request to the AIMS cabinets. The primary display function of the AIMS shows the memo message VMO GEAR DOWN.

Speed Tape

The primary flight display (PFD) shows the speed tape. The maximum speed (VMAX) and minimum speed (VMIN) show on the speed tape.

VMO/MMO Logic

The VMO/MMO logic calculates the maximum operating speed (VMO) and the maximum operating mach number (MMO).

The VMO and MMO are normally 330 knots and mach .87. When at least two of the three ground signals from the alternate gear down dispatch switch show the switch is

WES - SPEED TAPE PARAMETER CALCULATION - 2

in the VMO position, the VMO/MMO logic changes the VMO and MMO to 270 knots and mach .73.

The VMO/MMO goes to the maximum operating speed (VMAX) logic. When the computed airspeed (VCAS) or the mach number (MACH NO) is more than the limit calculated by the VMO/MMO logic, the VMO/MMO logic makes an overspeed warning.

VFE/VLE Logic

The VFE/VLE logic calculates VFE/VLE.

When the flaps and slats are up and the gear not clean signal is false, VFE/VLE is no computed data. When the flaps are not up, VFE/VLE is the same as VFE. When the flaps are up and the gear not clean signal is true, VFE/VLE is the same as VLE.

VFE/VLE goes to the VMAX logic. VFE/VLE also goes to the AIMS cabinets for FMCF calculations.

VMAX Logic

The VMAX logic calculates the VMAX. If the wing is clean and the gear not clean signal is false, VMAX is the same as the VMO/MMO. VMAX is the same as VFE/VLE for any other condition.

VMAX goes to the AIMS cabinets for display on the PFD and for FMCF calculations.

VSS Logic

The stick shaker speed (VSS) logic calculates VSS. VSS goes to the VMIN logic.

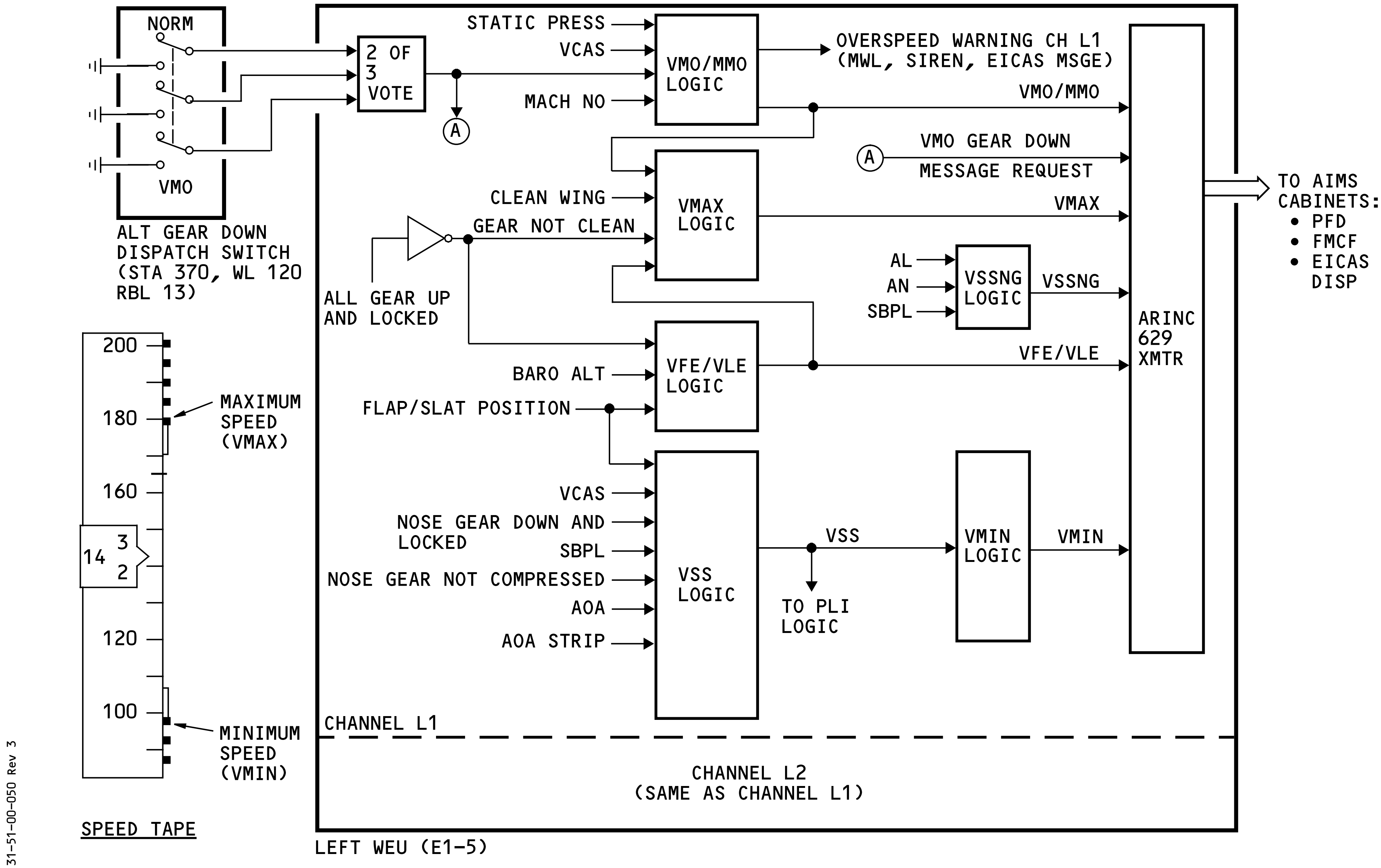
VMIN Logic

The VMIN logic calculates VMIN. VMIN is the same as VSS.

VMIN goes to the AIMS cabinets for display on the PFD and for FMCF calculations.

VSSNG Logic

The VSSNG logic calculates VSSNG. VSSNG goes the AIMS cabinets for FMCF calculations.



WES - SPEED TAPE PARAMETER CALCULATION - 2

WES - AUTO SLAT ENABLE

General

The auto slat enable function extends the leading edge slats automatically when the airplane is near a stall. The slats extend from the sealed position to the gapped position. This action gives more lift.

The auto slat enable function only operates when the flaps are 1 to 20 units, and the airplane is in the air.

Operation

If the corrected angle of attack (AOA) is more than the auto slat trip point (AOA AS), the WEUs make an auto slat enable signal.

The auto slat enable signal goes to the flap slat electronic units (FSEUs) and to the hydraulic interface modules (HYDIMs).

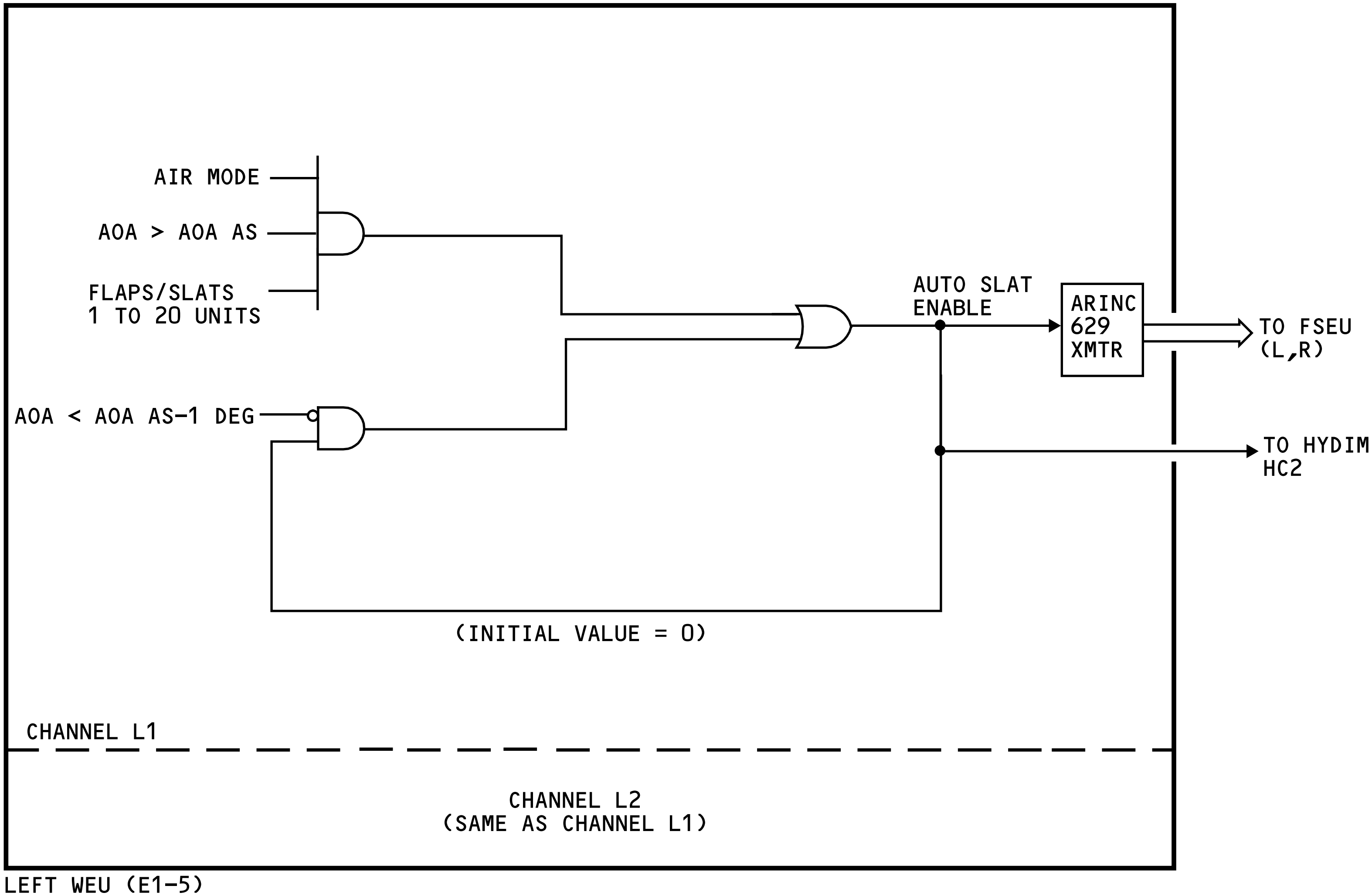
The FSEUs extend the slats from the sealed to the gapped position.

The HYDIMs increase available hydraulic flow for the slats. Because of the WEU signals to the HYDIMs, the slats move from the sealed position to the gapped position faster than normal.

When the auto slat enable signal is true, it stays true until the AOA is one degree below the AOA AS.

HYDIM Interfaces

Channels L1 and R1 auto slat enable signals go to HYDIM HC2. Channels L2 and R2 auto slat enable signals go to HYDIM HC1.



31-51-00-051 Rev 3 02/12/1998

WES - AUTO SLAT ENABLE

WES - STALL WARNING FUNCTION TEST

General

Start a stall warning function test from the maintenance access terminal (MAT).

The stall warning function test does a check of the stall warning function in each WEU channel. The stall warning function test also verifies the condition of the stall warning function inputs. If any input is not present or is invalid, the test fails.

Initiated Test Inhibit

A WEU channel must make an initiated test inhibit signal as false before a stall warning function test can start.

When the initiated test inhibit signal is true, the WEU channels cannot start any test.

The initiated test inhibit signal within a WEU channel is false (a test can start) only when all these conditions are true:

- Both engines are at less than takeoff thrust
- The airplane is on the ground
- The nose gear is compressed
- The ADIRU and the SAARU send incomplete pitot/static data (airplane not moving)
- Three or more WEU channels detect the same previous conditions.

Stall Warning Function Test Logic

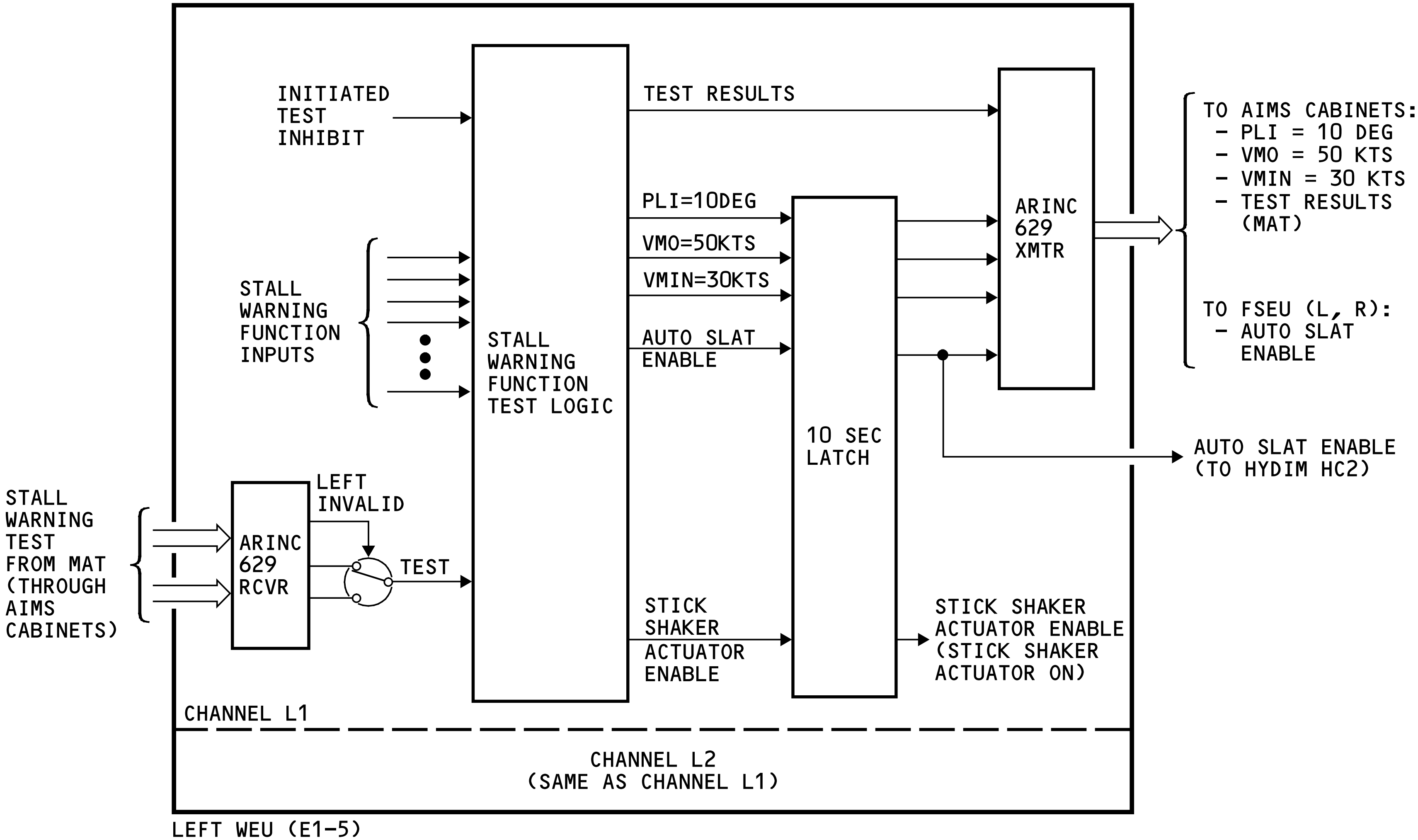
The stall warning function test logic receives the stall warning test signal from the AIMS cabinets. The stall warning function test logic supplies test signals that are on for 2 seconds and then go off. The stall warning function test logic does these functions:

- Makes the pitch limit indicators on the PFD go to 10 degrees
- The PFD speed tape shows a maximum operating speed (Vmo) of 50 knots, and a minimum speed limit of 30 knots
- Makes an auto slat enable signal that goes to a hydraulic interface module (HYDIM) and the flap slat electronic units (FSEUs)
- Makes the stick shaker actuators come on
- Verifies the condition of the stall warning function inputs
- Supplies test results to the MAT.

WARNING: IF THE FLAP LEVER IS AT 1,5,15, OR 20 AND HYDRAULIC POWER IS APPLIED TO THE AIRPLANE, THIS TEST WILL CAUSE THE LE SLATS TO MOVE FROM SEALED TO GAPPED. THIS LE SLAT MOVEMENT CAN BE PREVENTED BY SETTING BOTH THE C1 AND C2 AIR SWITCHES (P5 HYDRAULIC PANEL) TO THE OFF POSITIONS.

MAT Display

The MAT shows a STALL WARNING TEST FAIL message or a STALL WARNING TEST PASS message after the test ends.



31-51-00-052 Rev 3 02/13/1998

WES - STALL WARNING FUNCTION TEST

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WES - SYSTEM TEST

General

Use the MAT to start a WES system test. During the WES system test, each channel verifies:

- Its internal status
- The ARINC 629 inputs
- The ARINC 429 inputs
- All analog discrete inputs
- That all WEU channels have the same software
- Correct operation of the master warning lights and the aural warning speakers.

Each channel does the first five operations independent of each other. The four channels operate synchronously during the last operation.

The system test lasts approximately 20 seconds.

Initiated Test Inhibit

When the initiated test inhibit signal is true, the WEU channels cannot start any test.

These conditions must be true before you can do any WES test:

- Both engines are at less than takeoff thrust
- The airplane is on the ground
- The nose gear is compressed
- The ADIRU and the SAARU send incomplete pitot/ static data (airplane not moving)
- Three or more WEU channels detect the same previous conditions.

Initiated Test Enable, WES System Test Enable

Each WEU channel must make an initiated test enable signal and a WES system test enable signal before a WES system test can start.

The initiated test enable signal within a WEU channel is true only when all these conditions are true:

- Both engines are at less than takeoff thrust
- The airplane is on the ground
- The nose gear is compressed
- The ADIRU and the SAARU send incomplete pitot/ static data (airplane not moving).

The WES system test enable signal is true when all these conditions are present:

- Both engines fuel control switches are in the cut-off position (engines are not running)
- Initiated test enable signal is true.

Master Warning lights

Each WEU channel verifies its ability to make the master warning lights come on. Each WEU channel must receive at least one master warning light (MWL) arm signal from one other channel, before it makes a master warning light come on. Each WEU channel verifies all MWL arm combinations.

WES - SYSTEM TEST

The master warning lights will come on and then go out as each of the 4 WEU channels verifies its master warning light. You will see the master warning lights flash 4 times during the WES system test.

Each WEU channel verifies the status of a master warning light. If current flow is not present when a channel makes the master warning light come on, or if current flow is present when a channel makes the master warning light go off, the channel considers the light failed.

A MWL-L or R status message shows when a master warning light fails.

<u>Aural Warning Speakers</u>

Channel L1 does a test of the left aural warning speaker. Channel L1 must receive at least one aural arm signal from one other channel, before it sends a test tone for approximately 100 ms to the left aural warning speaker. Channel R1 does the same with the right aural warning speaker. You will hear a short test tone two times during the WES system test.

If a return voltage from the aural warning speaker is not present when a channel makes the test tone, or if a return voltage is present when a WEU channel makes the test tone, the channel considers the speaker failed.

A WARNING SPEAKER-L or R status message shows when an aural warning speaker fails.

<u>Test Status</u>

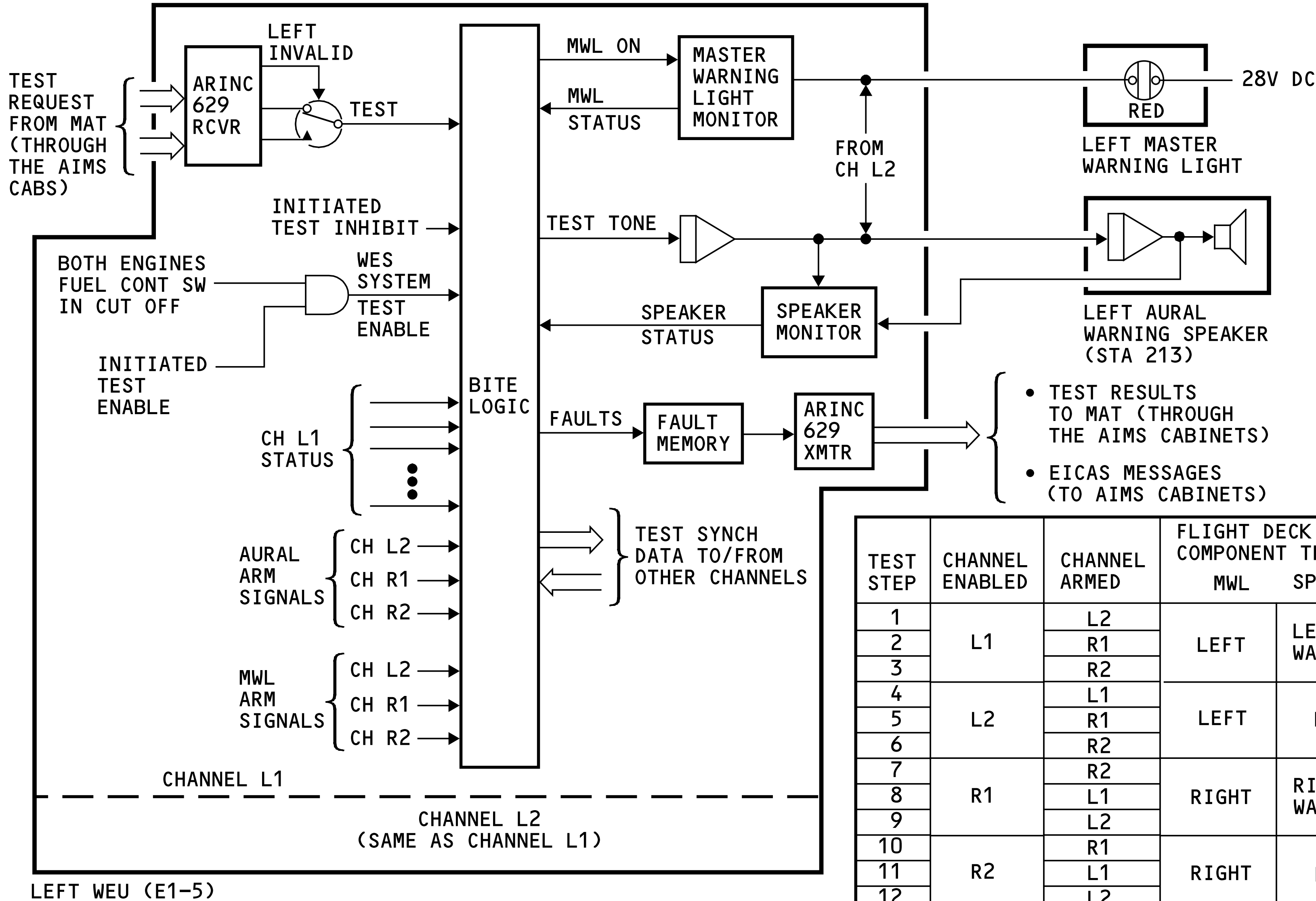
The MAT shows a WES SYSTEM TEST PASS message or a WES SYSTEM TEST FAIL after the WES system test ends.

<u>Channel Failure</u>

If a WEU channel fails during a system test, a WEU L1, L2, R1, or R2 EICAS status message shows.

<u>Automatic WES System Test</u>

The WEUs start a WES system test automatically when you apply power to the WEUs. However, the automatic test will start only if the WES system test enable signal is true.



TEST STEP	CHANNEL ENABLED	CHANNEL ARMED	FLIGHT DECK COMPONENT TESTED MWL	SPEAKER
1	L1	L2	LEFT	LEFT WARNING
2		R1		
3		R2		
4	L2	L1	LEFT	N/A
5		R1		
6		R2		
7	R1	R2	RIGHT	RIGHT WARNING
8		L1		
9		L2		
10	R2	R1	RIGHT	N/A
11		L1		
12		L2		

31-51-00-053 Rev 2

WES - SYSTEM TEST

WES - DATA LOAD

Software Loading

It is necessary to load software into the WEUs. The WEU software files are:

- WEU OPC (operational program codes)
- WEU OPS (operational program system)
- WEU DB (data base).

The WEU OPC file supplies the warning electronics system (WES) customer options.

The WEU OPS file supplies the WEU operational software system.

The WEU DB file supplies the WEU data bases. Examples of the WEU data bases are stabilizer green band look-up tables, and stall warning function limits.

Software Interlock and ARINC 629 Input Port

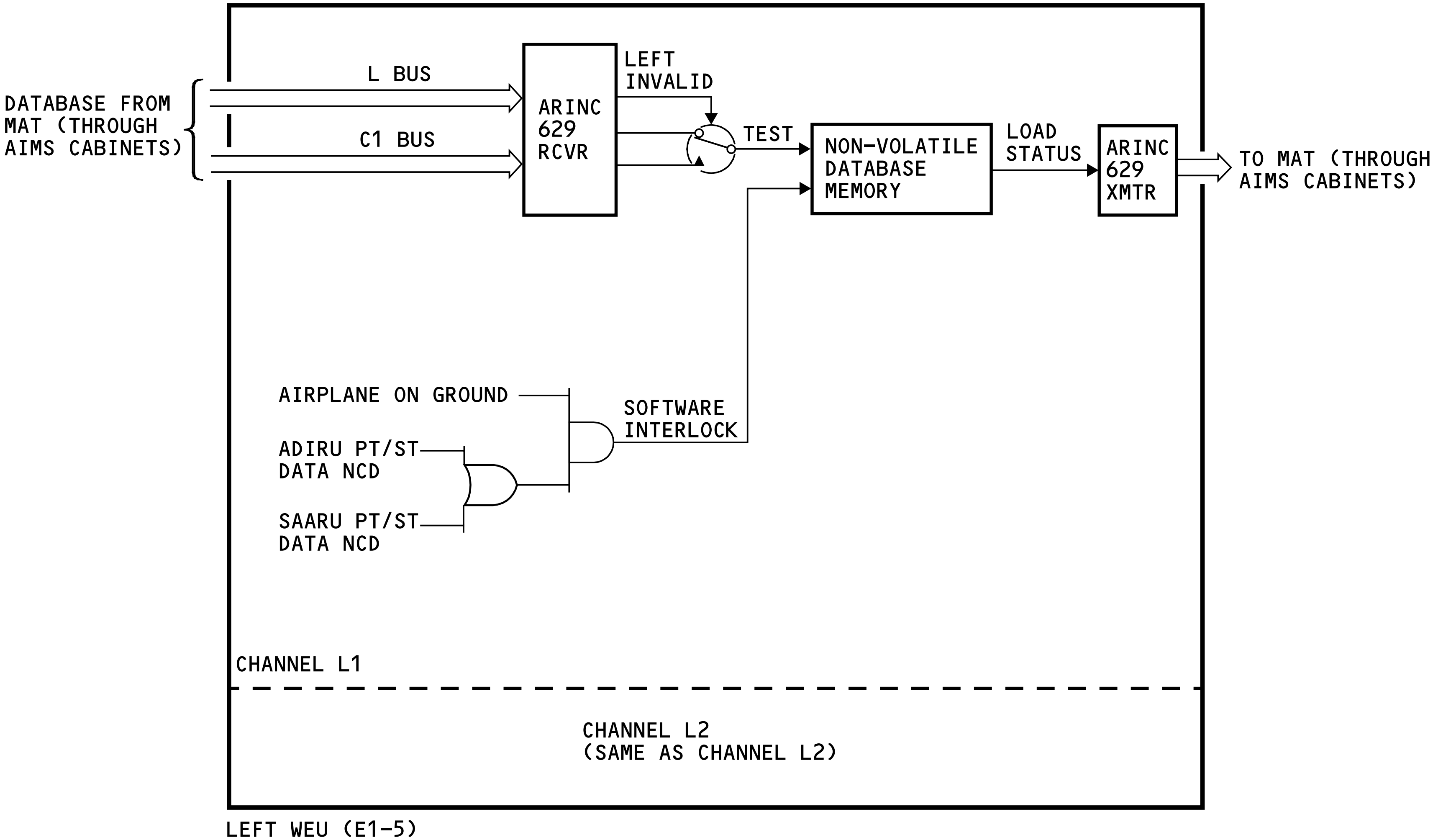
A software interlock must be present before a channel accepts a software data load.

Each channel accepts software data loads through only one ARINC 629 input port. If that input fails the channel switches to its other ARINC 629 input port.

Maintenance Practices

Each WEU must have software files. Use the MAT to make sure each WEU has software files loaded. All channels must have the same software.

If the WEUs do not have software files in them, use the MAT to load the WEU software files.



31-51-00-054 Rev 3 11/06/1997

WES - DATA LOAD

WES - GROUND TESTS - 1

General

These are the WES tests you can do from the MAT:

- WES system test
- Takeoff configuration warning test
- Landing configuration warning test.

Landing Configuration Warning Test

The landing configuration warning test verifies the operation of the landing configuration warning function and the speedbrake alert function. You will notice a landing configuration warning when you do this test.

Takeoff Configuration Warning Test

The takeoff configuration warning test verifies the operation of the takeoff configuration warning function. This test simulates takeoff thrust and looks for proper takeoff configuration warning function response.

When you do a takeoff configuration warning test, you also do a stabilizer green band test. You will see the green band lamps on the stabilizer trim indicators come on.

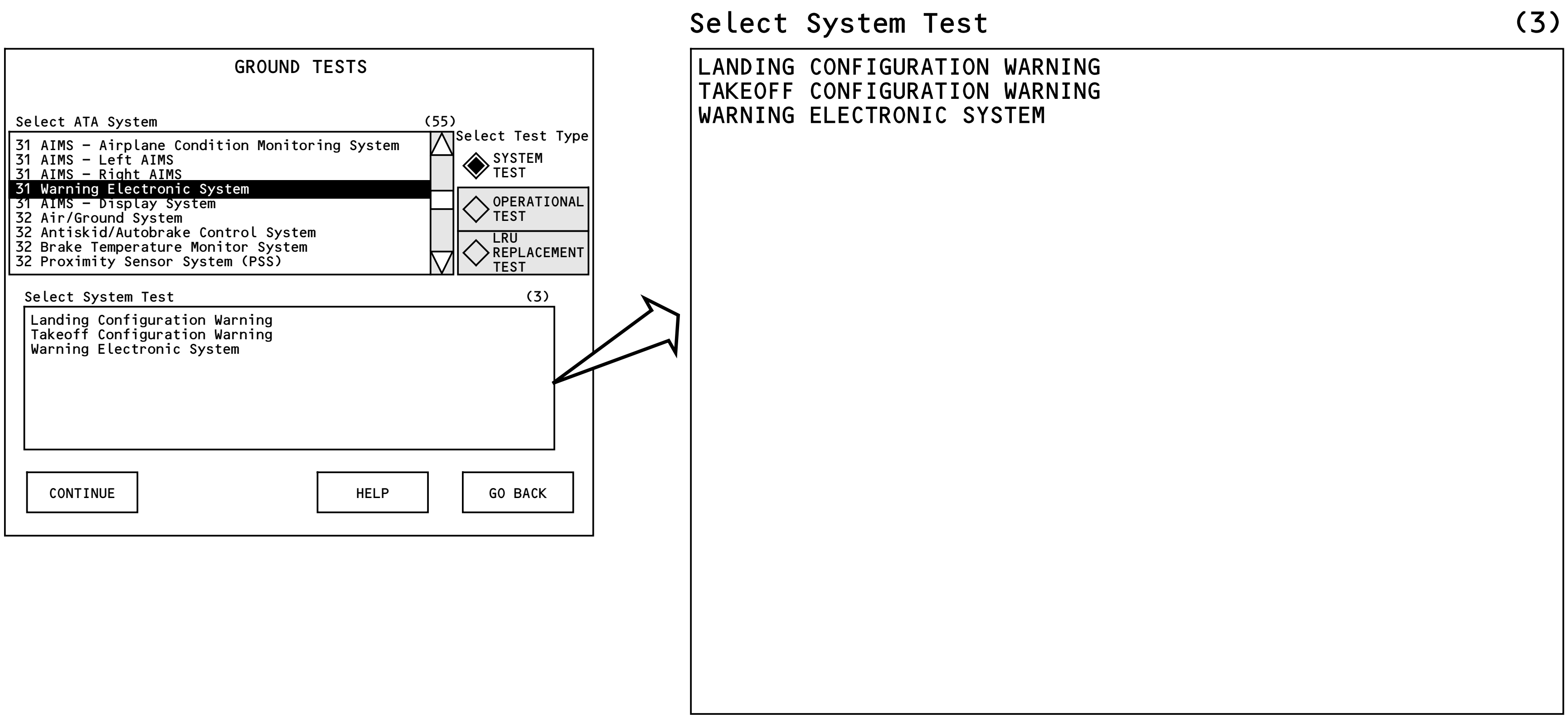
Training Information Point

The takeoff configuration warning test will supply a takeoff configuration warning only if the airplane is not in the proper configuration for takeoff.

WES System Test

The WES system test verifies the status of each one of the WES channels. The test also verifies the operation of these:

- Master warning lights
- Aural warning speakers
- Stick shaker actuators.



31-51-00-055 Rev 3

WES - GROUND TESTS - 1

WES - GROUND TESTS - 2

General

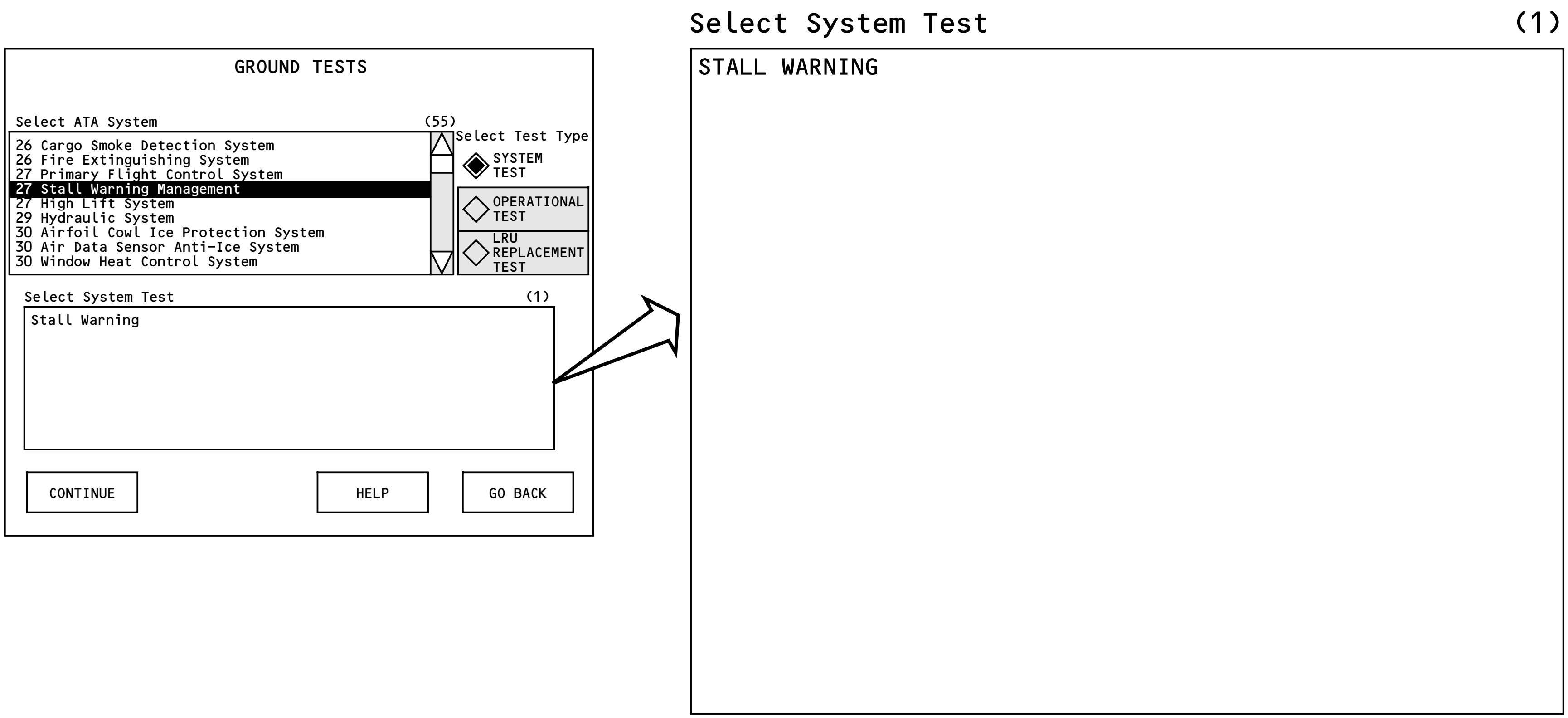
You do the stall warning test from the MAT.

Training Information Point

The WES is in ATA chapter 31. However, you must select ATA System 27 Stall Warning Management to do a stall warning test.

Stall Warning Test

The stall warning test verifies the operation of the stall warning function. This test will activate the stick shaker actuators momentarily. You will also see some speed tape parameters on the PFD.



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WES - GROUND TESTS - 2

Continental Airlines, Inc

Cabin Services System

WB371

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Continental Airlines, Inc

Cabin Services System

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Cabin Services System
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CABIN SERVICES SYSTEM - INTRODUCTION

General

The cabin services system (CSS) is an integrated system that combines these systems:

- Passenger address
- Cabin interphone
- Passenger service
- Cabin lighting
- Monitor and control.

Passenger Address System

The flight crew and cabin attendants use the passenger address system (PAS) to make announcements to the passengers. The PA audio goes to speakers in the passenger cabin.

Cabin Interphone System

The flight crew and cabin attendants use the cabin interphone system (CIS) to speak with each other. They use handsets in the cabin and flight deck.

Passenger Service System

Passengers use the passenger service system (PSS) to control reading lights and to call attendants. The PSS also controls the passenger information signs.

Cabin Lighting System

The cabin lighting system (CLS) controls the passenger cabin illumination.

Monitor and Control Functions

The CSS has interfaces with other airplane systems for different functions. Flight attendants use CSS control panels to select monitor and control functions. These are some of the CSS monitor and control functions:

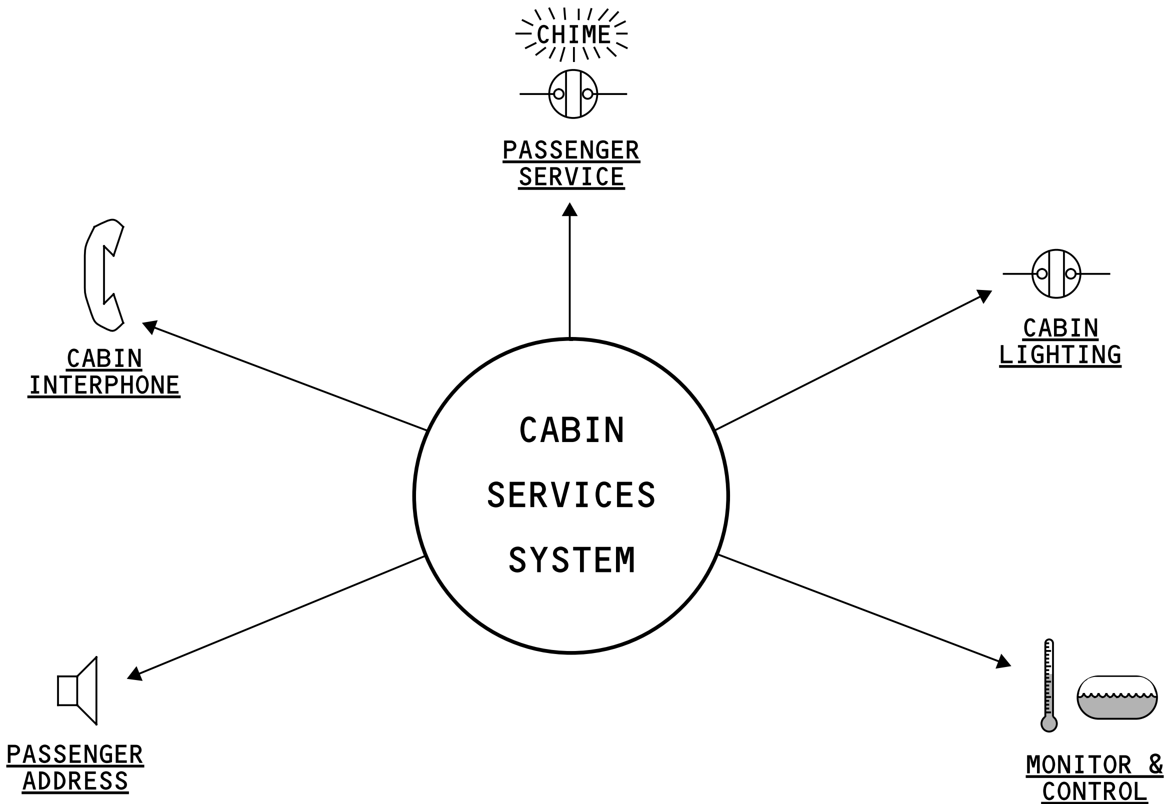
- Cabin temperature selection
- Potable water status
- Cabin door status.

Abbreviations and Acronyms

AIMS	- airplane information management system
AMU	- audio management unit
annct	- announcement
ANS	- ambient noise sensor
ASG	- ARINC signal gateway
ASP	- attendant switch panel
BFE	- buyer furnished equipment
CACP	- cabin area control panel
CAH	- cabin attendant handset
CCP	- cabin control panel
CDG	- configuration database generator
CDU	- control display unit
CIC	- cabin interphone controller

CABIN SERVICES SYSTEM - INTRODUCTION

CIS	- cabin interphone system
CLS	- cabin lighting system
CSCP	- cabin system control panel
CSMU	- cabin system management unit
CSS	- cabin services system
ECS	- environmental control system
ELMS	- electrical load management system
FDH	- flight deck handset
FSEU	- flap/slat electronics unit
IFE	- in-flight entertainment
LLAR	- lower lobe attendants rest
MCU	- modular concept unit
MMC	- mass memory card
OEU	- overhead electronics unit
OPAS	- overhead panel ARINC 629 system
PA	- passenger address
PA/CI	- passenger address/cabin interphone
PAC	- passenger address controller
PAS	- passenger address system
pax	- passenger
PRAM	- prerecorded announcement machine
PSEU	- proximity sensor electronics unit
PSS	- passenger service system
PTT	- push to talk
RF	- radio frequency
SDM	- speaker drive module
SFE	- seller furnished equipment
WES	- warning electronic system
ZMU	- zone management unit



CABIN SERVICES SYSTEM - INTRODUCTION

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CSS GENERAL - INTRODUCTION TO ARINC 628

General

ARINC 628 gives design guidance for the development, installation, and certification of new cabin systems.

The cabin system has two parts, the cabin services system (CSS) and the in-flight entertainment (IFE) system.

The CSS has these basic systems and functions:

- Cabin interphone system (CIS)
- Passenger address system (PAS)
- Passenger service system (PSS)
- Cabin lighting system (CLS)
- Monitor and control functions (MCF).

The IFE system provides passenger entertainment and other optional capabilities including passenger telephone.

ARINC 628 has four parts. Each part gives design guidance in a different part of the cabin system.

ARINC 628 Part 1 - Peripherals

Part 1 of the ARINC 628 specification defines standards for the interfaces between the IFE systems main controller(s) and the head-end equipment. These are examples of head-end equipment:

- Audio entertainment player (AEP)
- Video entertainment player (VEP)
- Passenger in-flight information computer (PIIC)
- Prerecorded announcement machine (PRAM).

ARINC 628 Part 2 - Seat Interfaces

Part 2 of the ARINC 628 specification defines standards for the interfaces between the seat peripherals and the seat-end equipment. These are examples of seat peripherals:

- Passenger control units (PCU)
- Passenger headphones
- Seat video displays (SVD)
- Passenger telephone handsets.

Seat-end equipment are equipment installed on the bottom of the seat group such as a seat electronics box (SEB).

ARINC 628 Part 3 - In-Flight Entertainment Interfaces

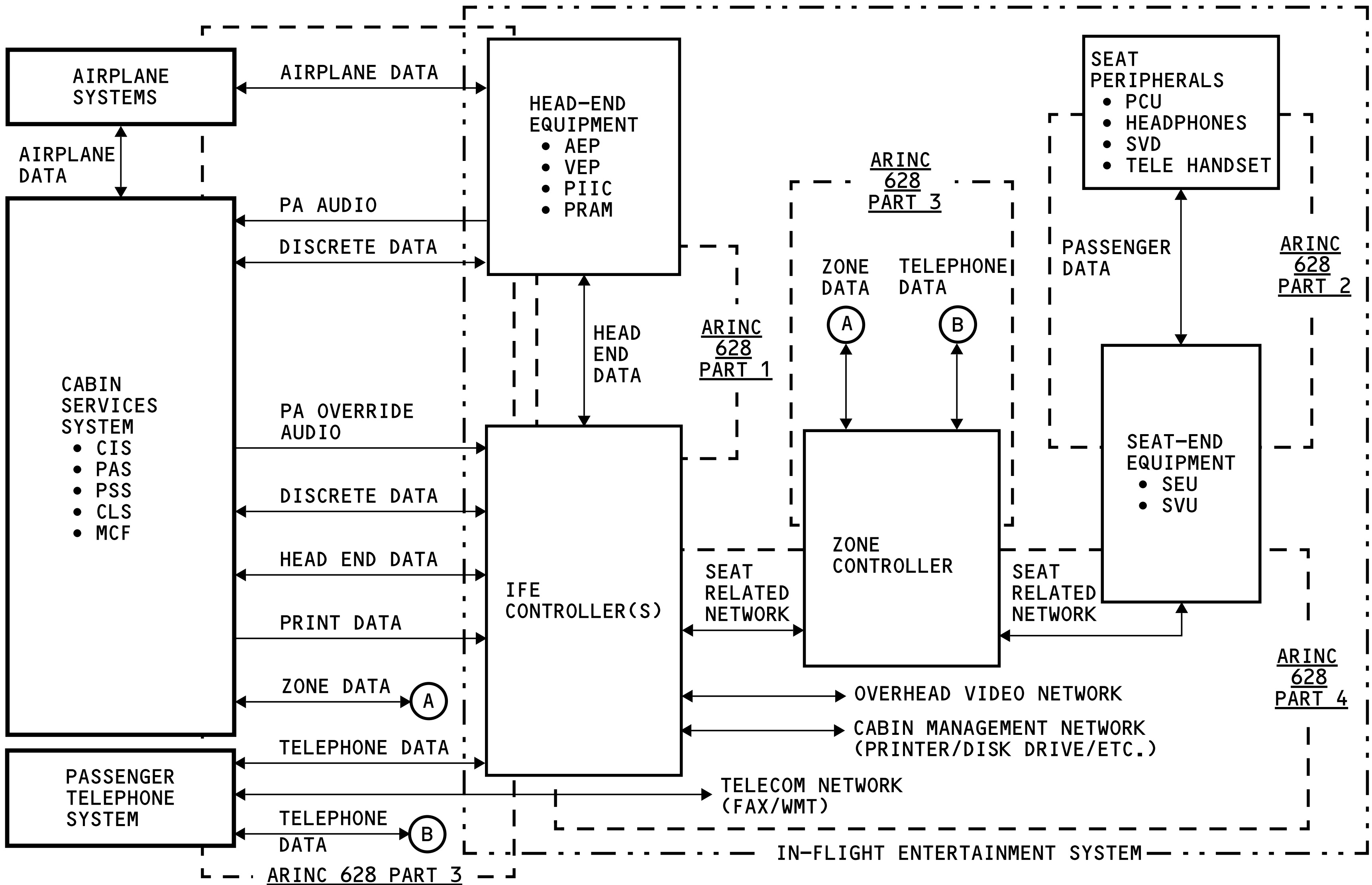
Part 3 of the ARINC 628 specification defines standards for the interfaces between the IFE system and other airplane systems.

ARINC 628 Part 4 - Cabin Distribution System

Part 4 of the ARINC 628 specification defines standards for an in-flight entertainment cabin distribution system (CDS). The CDS consists of some or all of these networks:

CSS GENERAL - INTRODUCTION TO ARINC 628

- A seat related network. This network distributes audio and video signals to each passenger seat and handles all passenger service functions. The network can also distribute data for functions like passenger telephone, games, and interactive services.
- An overhead video network. This network distributes video signals and control data such as monitor on/off and video select commands to the overhead display units.
- A cabin management network. This network provides a connection to printers, fixed or handheld terminals, data storage units, etc.
- A telecom network. This network provides for bidirectional voice and fax communication. The network is used for dedicated telephone/fax stations which are not integrated into the seat related network.



CSS GENERAL - INTRODUCTION TO ARINC 628

CABIN SERVICES SYSTEM - GENERAL DESCRIPTION

General

You use cabin control panels (CCPs) to operate the CSS. The hardware configuration of a CCP tells it to operate as a cabin area control panel (CACP) or a cabin system control panel (CSCP).

The CSS uses a configuration database to define the cabin interior. You change the configuration database to agree with changes in the cabin interior.

Operation

Maintenance personnel use the CSCP to test and to program the CSS. Flight attendants use the CSCP and the CACPs to select light settings and other monitor and control functions. The CSCP also has a mass storage device to keep program data and test results.

The cabin system management unit (CSMU) sends test commands. It also has interfaces with other airplane systems for some CSS functions.

The passenger address/cabin interphone (PA/CI) controller controls the passenger address and cabin interphone functions. It controls routing of cabin interphone calls. The PA/CI controller gets passenger address audio inputs and sends them through the speaker drive modules (SDMs) to cabin speakers. The ambient noise sensors (ANSs) supply cabin noise levels for automatic volume adjustment.

There are three zone management units (ZMUs). The ZMUs control these zones:

- ZMU 1 controls zone 1
- ZMU 2 controls zone 2
- ZMU 3 controls zone 3.

In each zone, the ZMUs connect to these three types of LRUs:

- Overhead electronics units (OEUs)
- Cabin attendant handsets (CAHs)
- Cabin control panels (CCPs).

The OEUs control lights and passenger information signs. They also receive inputs from other cabin systems.

Flight attendants use CAHs to talk on the cabin interphone and to make passenger address announcements.

Flight attendants use the CACPs to select cabin light settings, set some passenger service functions and operate the monitor and control functions.

The ZMUs also have an interface with the in-flight entertainment system. The passengers use controls at the passenger seat to control reading lights and make attendant calls.

The CSS components operate together in five subsystems.

CABIN SERVICES SYSTEM - GENERAL DESCRIPTION

Passenger Address System (PAS)

The PA/CI controller gets audio inputs from different sources. It selects the highest priority audio, digitizes it and sends it to the SDMs and the in-flight entertainment system. The SDMs change the signal back to analog and send it to one or two speakers. The inflight entertainment system overrides entertainment audio at the passenger seat with PA audio.

The PAS also supplies chimes to the cabin.

Cabin Interphone System (CIS)

CAHs connect to ZMUs to send and receive audio and dial codes. The ZMUs have a digital interface with the PA/CI controller. The PA/CI controller makes the connection between attendant stations.

When a station gets a call, the PAS makes a chime and the ZMU makes a master call light come on.

The flight crew interface to the CIS is almost the same, except the flight interphone system and flight deck handset connect directly to the PA/CI controller.

Passenger Service System (PSS)

Passengers use controls at the passenger seat to control reading lights and to call attendants. The passenger selections go to the ZMU over an ARINC 628 zone interface. The ZMU sends the data to an OEU. The OEU makes a reading light or row call light come on.

For an attendant call, the ZMU also makes a master call light come on. The PAS makes a chime sound.

Cabin Lighting System (CLS)

The CLS uses these four types of lights:

- Sidewall wash lights
- Indirect ceiling lights
- Direct ceiling lights
- Night lights.

Flight attendants use the CACPs to select light settings. The CACPs send the selection to the ZMUs. The ZMUs send signals to the OEUs which make the applicable lights go on or off.

Monitor and Control Functions

The CSS monitors many other cabin systems. This gives the flight attendants a central location to select cabin controls. Attendants use the CSCP and CACPs for monitor and control functions.

The monitor function shows information only. These are some of the monitored systems:

- Potable water status
- Waste tank status
- Cabin door status
- Smoke detectors.

CABIN SERVICES SYSTEM - GENERAL DESCRIPTION

The control function permits both display and selection. These are some of the systems controlled by the CSS:

- Cabin temperature selection
- Air/ground communication.

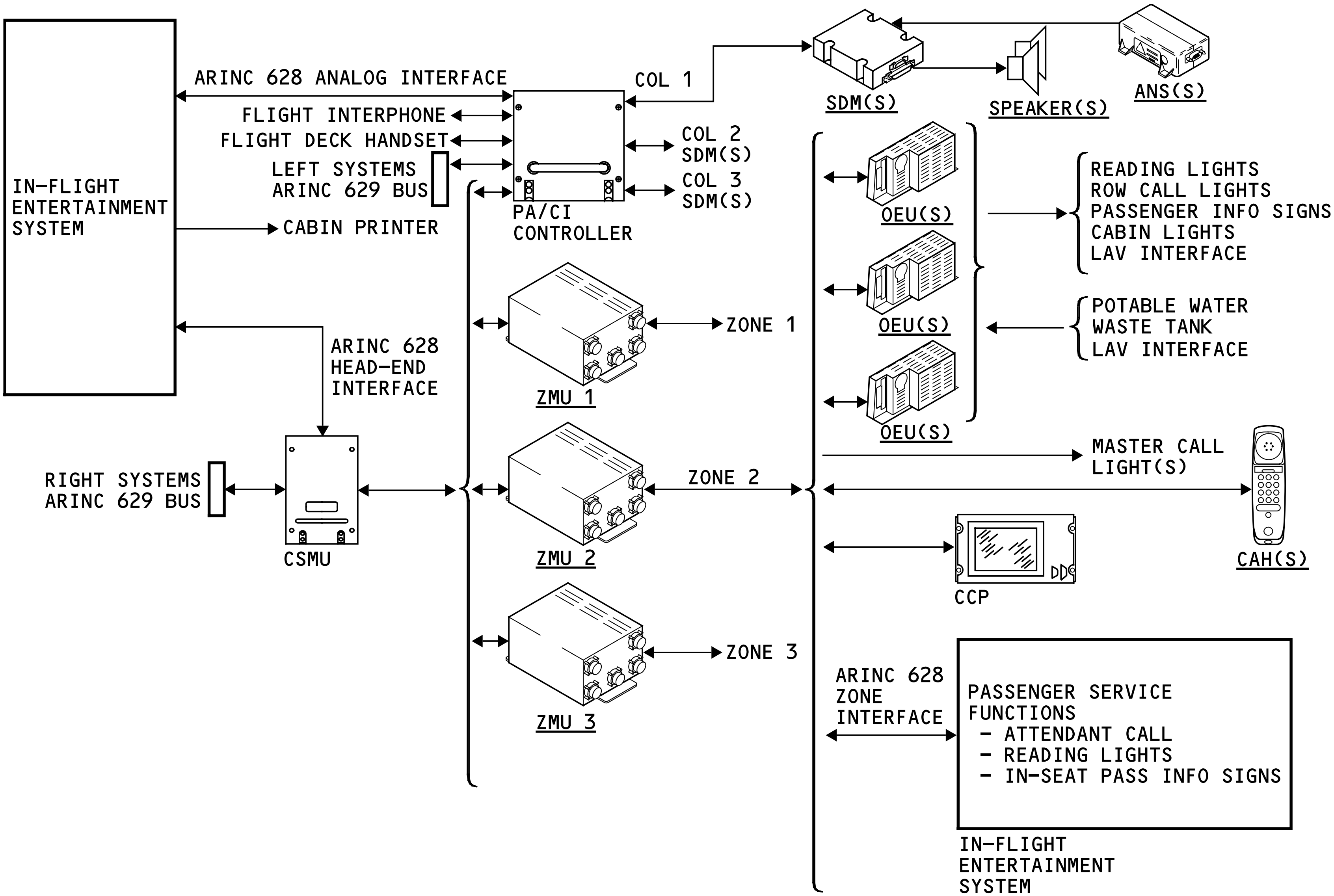
CSS Maintenance

Maintenance personnel use the cabin system control panel (CSCP) to test and to install software in the CSS. The CSCP has a touch sensitive screen for selections.

The CSCP sends test selections to the CSMU. The CSMU sends the test selection to the CSS components. The CSCP keeps test results in memory and shows them on the screen.

The CSCP also sends failure data through the in-flight entertainment system to the cabin printer for a paper copy.

The CSCP has a disk drive. You use the CSCP to install software for the configuration database and LRU operational programs.



CABIN SERVICES SYSTEM - GENERAL DESCRIPTION

CSS GENERAL - COMPONENT LOCATIONS

General

CSS components are in the main equipment center and the cabin area. The cabin diagram shows a typical configuration.

A typical passenger cabin has three zones:

- Zone 1 starts at the forward part of the cabin and ends at door 2
- Zone 2 is between doors 2 and 3
- Zone 3 is from door 3 to the aft end of the cabin.

Cabin Components

These components are above the cabin ceiling panels:

- Zone management units (ZMUs)
- Speaker drive modules (SDMs)
- Ambient noise sensors (ANSs).

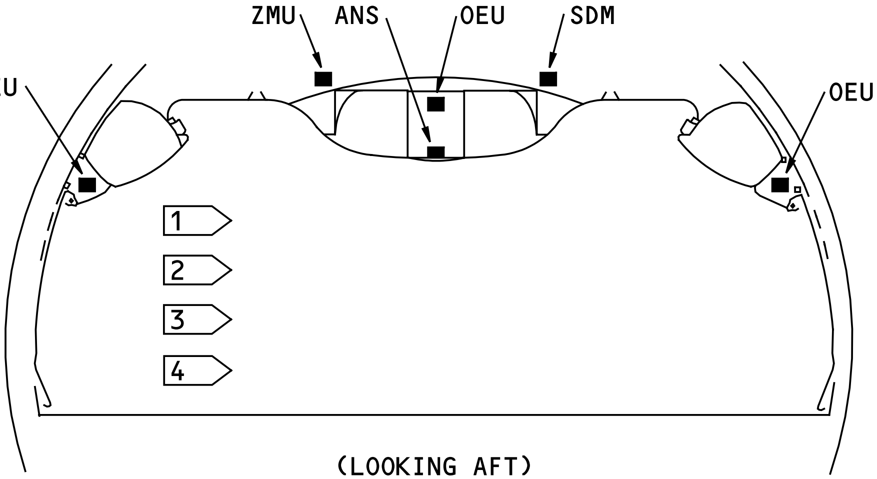
These components are in the passenger cabin:

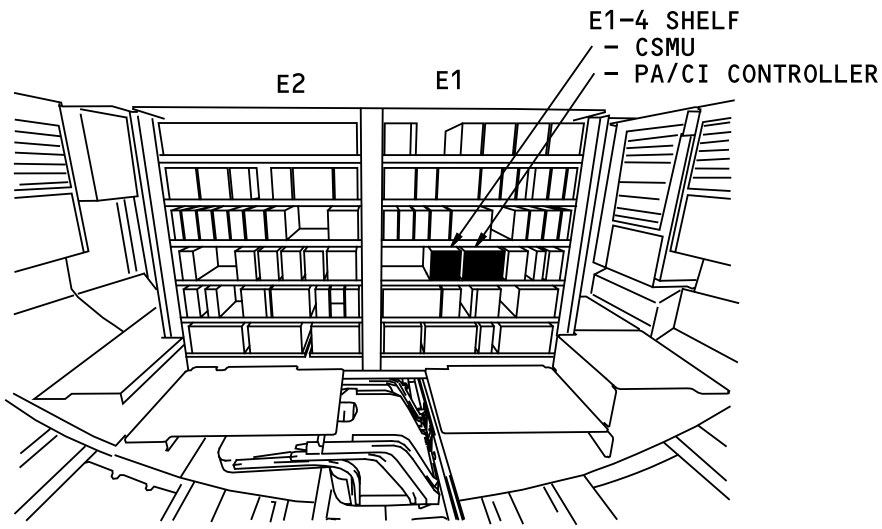
- Overhead electronics units (OEUs) (in the passenger service units)
- A cabin system control panel (CSCP)
- Cabin area control panels (CACP)
- Cabin printer
- Cabin attendant handsets (CAHs) (at each door).

Main Equipment Center Components

These components are in the main equipment center:

- Cabin system management unit (CSMU)
- Passenger address/cabin interphone (PA/CI) controller.





MAIN EQUIPMENT CENTER
(LOOKING AFT)

1 THE CSCP IS IN THE PASSENGER CABIN NEAR DOOR 2 LEFT.

2 THE CACP(S) ARE AT DOOR 1 LEFT AND DOOR 4 RIGHT.

3 THE FAX MACHINE IS IN THE PURSER STATION NEAR DOOR 2 LEFT.

4 THE CABIN PRINTER IS IN THE PURSER STATION NEAR DOOR 2 LEFT.

CSS GENERAL - COMPONENT LOCATIONS

CSS GENERAL - COMPONENT LOCATIONS 2

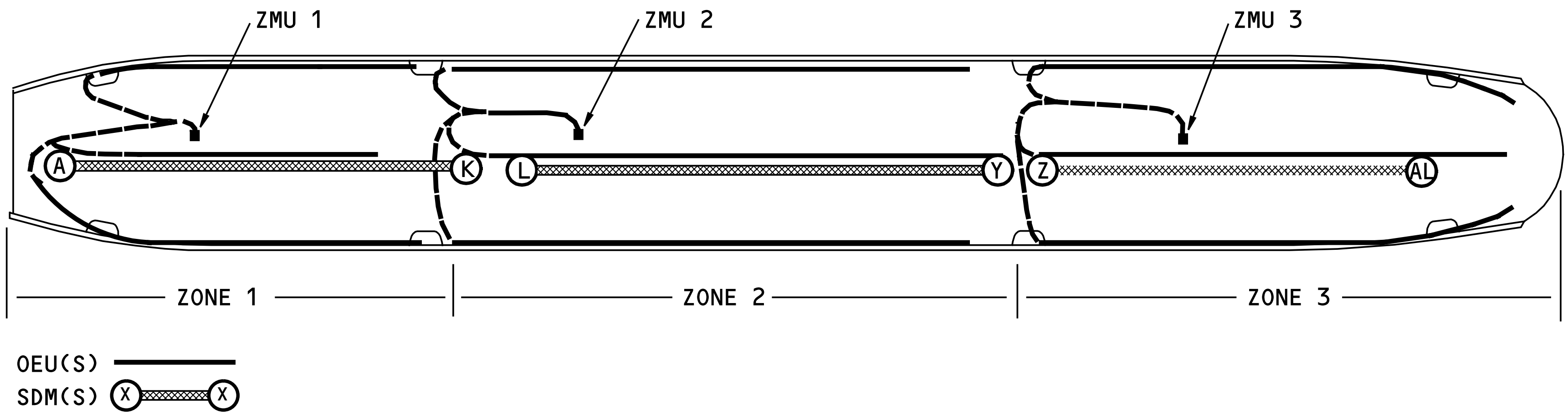
General

CSS components are in the main equipment center and the cabin area. The cabin diagram shows a typical configuration.

The passenger cabin has three zones:

- Zone 1 starts at the forward part of the cabin and ends at door 2
- Zone 2 is between doors 2 and 3
- Zone 3 is from door 3 to the aft end of the cabin.

Each zone has three columns of overhead electronics units (OEUs) and one column of speaker driver modules (SDMs).



23-39-00-535 Rev 0 10/29/1997

CSS GENERAL - COMPONENT LOCATIONS 2

CSS GENERAL - CONFIGURATION DATABASE GENERATOR

General

The CSS uses a database to identify the interior configuration and optional features of the system. The database software has programmable selections that permit changes to the interior configuration and optional features.

Many CSS components keep configuration data in nonvolatile memory. If you replace a component, you must install the configuration database.

The database controls many functions, including:

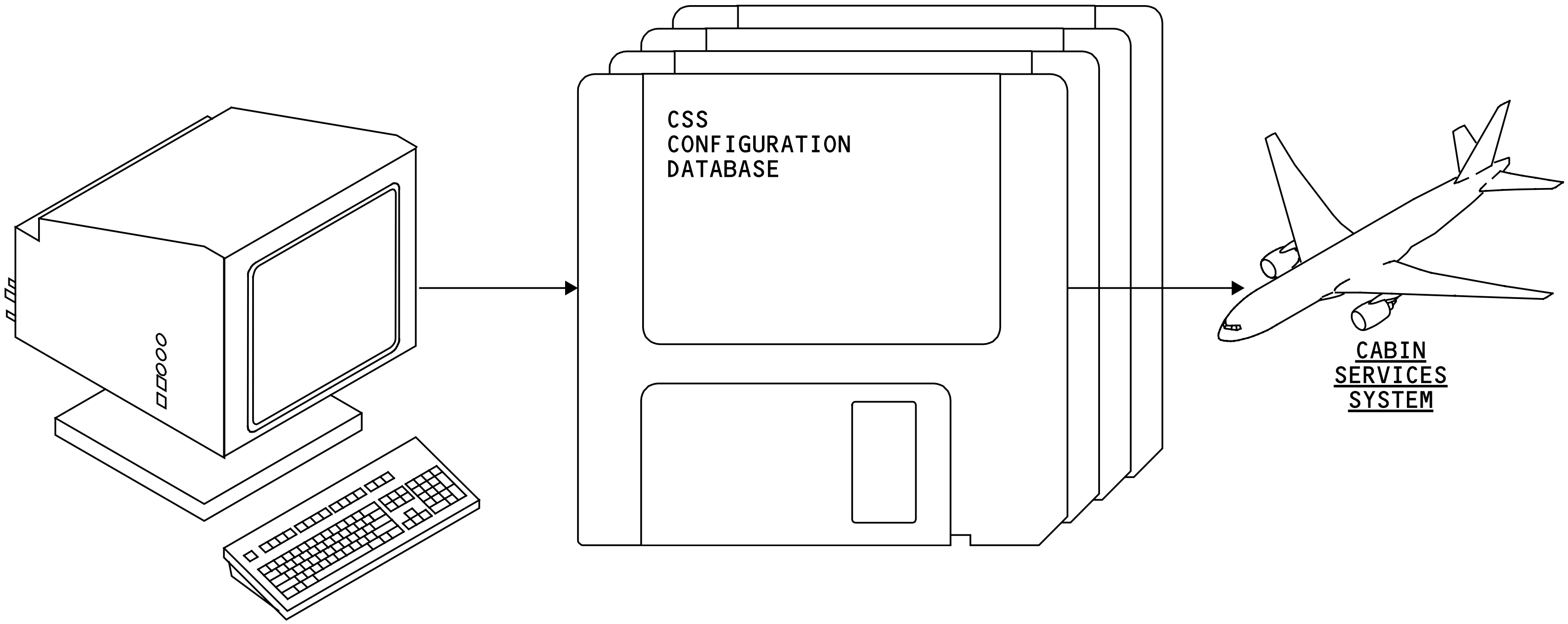
- Passenger seating area
- Cabin light levels
- Passenger address areas
- Cabin interphone handset locations and dial codes
- CSCP and CACP screen selections.

Configuration Database Generator

The configuration database generator (CDG) is a software tool that operates on a personal computer. Boeing uses the CDG to write the original configuration database.

Boeing copies the database onto 3 1/2 inch floppy diskettes and carries them to the airplane to install into the CSS.

The airline engineering organization also has a copy of the Boeing CDG. If the airline chooses to change the interior configuration or change an optional feature, they change the configuration database using the CDG. They copy the new database to a floppy disk and carry it to the airplane to install it into the CSS.



23-39-00-504 Rev 0 07/12/96

CSS GENERAL - CONFIGURATION DATABASE GENERATOR

CSS GENERAL - INSTALL CONFIGURATION DATABASE

General

Boeing engineering writes and loads the initial configuration database. Airline engineering may change the configuration database using the configuration database generator (CDG). The engineers copy the database to floppy diskettes.

You must load the diskettes to install the new database.

Disk Loading (Phase 1 Load)

The cabin system control panel (CSCP) has a disk drive. Put a floppy diskette in the disk drive to load it into the CSCP. The CSCP keeps the configuration database on a mass storage device.

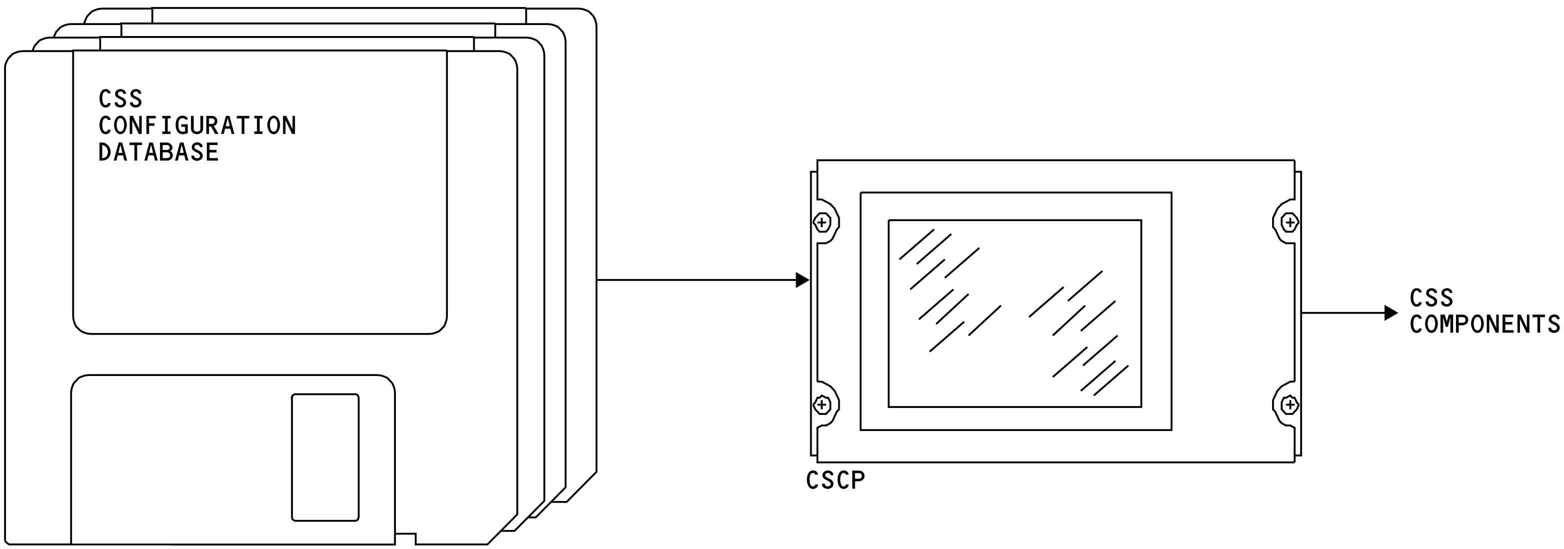
Installation of data to the CSCP mass storage is called a phase 1 load.

Database Installation (Phase 2 load)

When the configuration database is in the CSCP, you use selections on the CSCP screen to install it in the CSS.

Many CSS components use the configuration database to operate. If you replace a component, you must use the CSCP to send database information to the new component. Because the configuration database is normally in CSCP memory, you only need to use a CSCP screen selection to install the database.

Installation of data to the CSS components is called a phase 2 load.



23-39-00-509 Rev 1 07/08/1997

CSS GENERAL - INSTALL CONFIGURATION DATABASE

CSS GENERAL - OPERATIONAL PROGRAMS

General

The CSS components use special software for internal operation. The operational program controls the basic functions of the LRU. The LRU operational programs are not part of the configuration database.

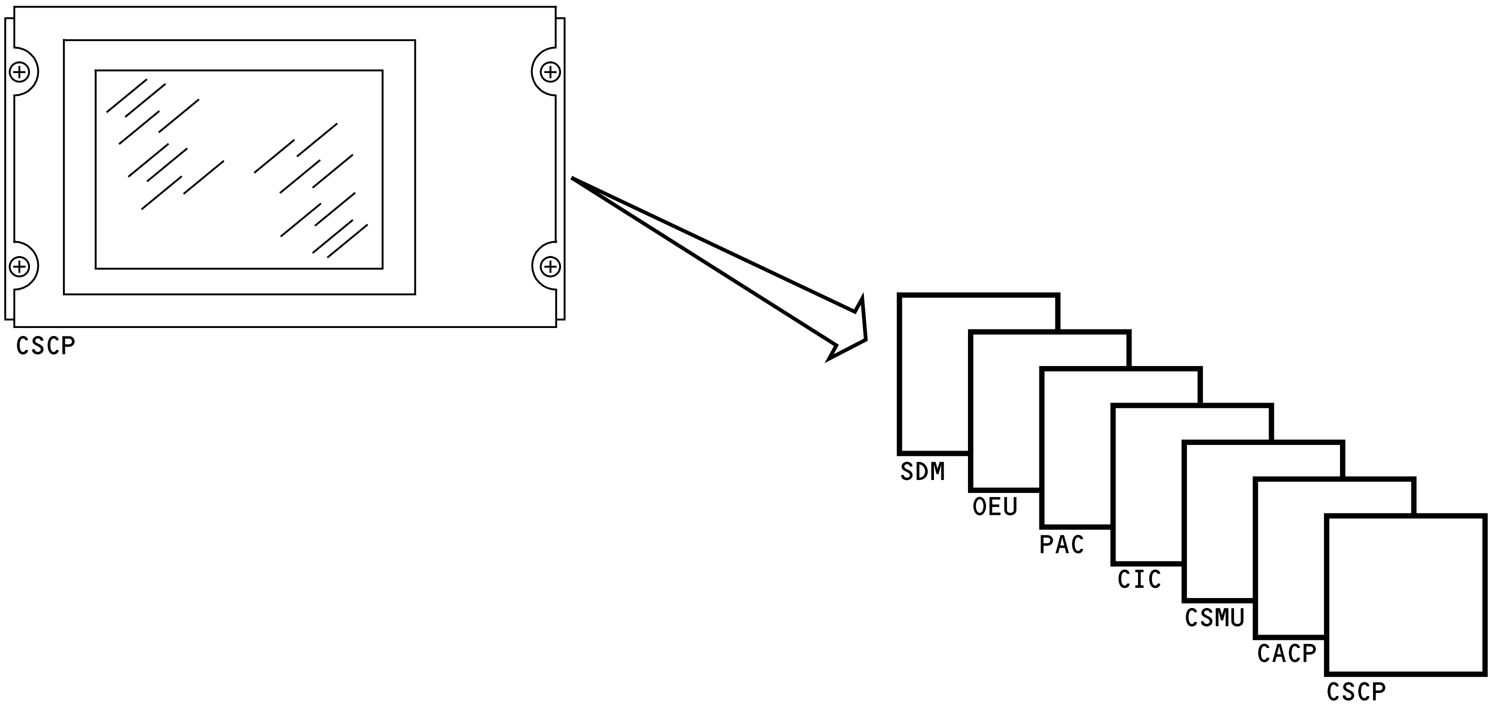
Operational Software Installation

The LRU manufacturer normally installs the operational program. A service bulletin may require you to install new operational programs.

You can select an LRU operational program from CSCP memory and install it in the LRU.

These LRUs have operational programs:

- Cabin system management unit (CSMU)
- Cabin system control panel (CSCP)
- Passenger address controller (PAC) - part of the passenger address/cabin interphone (PA/CI) controller
- Cabin interphone controller (CIC) - part of the PA/CI controller
- Zone management units (ZMUs)
- Cabin area control panels (CACPs)
- Overhead electronics units (OEUs)
- Speaker drive modules (SDMs).



CSS GENERAL - OPERATIONAL PROGRAMS

CSS GENERAL - POWER INTERFACE

General

Power for the cabin services system (CSS) comes through these three power management panels:

- P110 left power management panel
- P210 right power management panel
- P310 standby power management panel.

Circuit breakers control power to these CSS core components:

- Cabin system management unit (CSMU)
- Cabin system control panel (CSCP)
- Cabin area control panels (CACPs)
- Cabin printer
- Passenger address/cabin interphone (PA/CI) controller.

P110 Left Power Management Panel

The CAB SYS MGMT UNIT circuit breaker connects 115v ac power to the CSMU and the CSCP.

P210 Right Power Management Panel

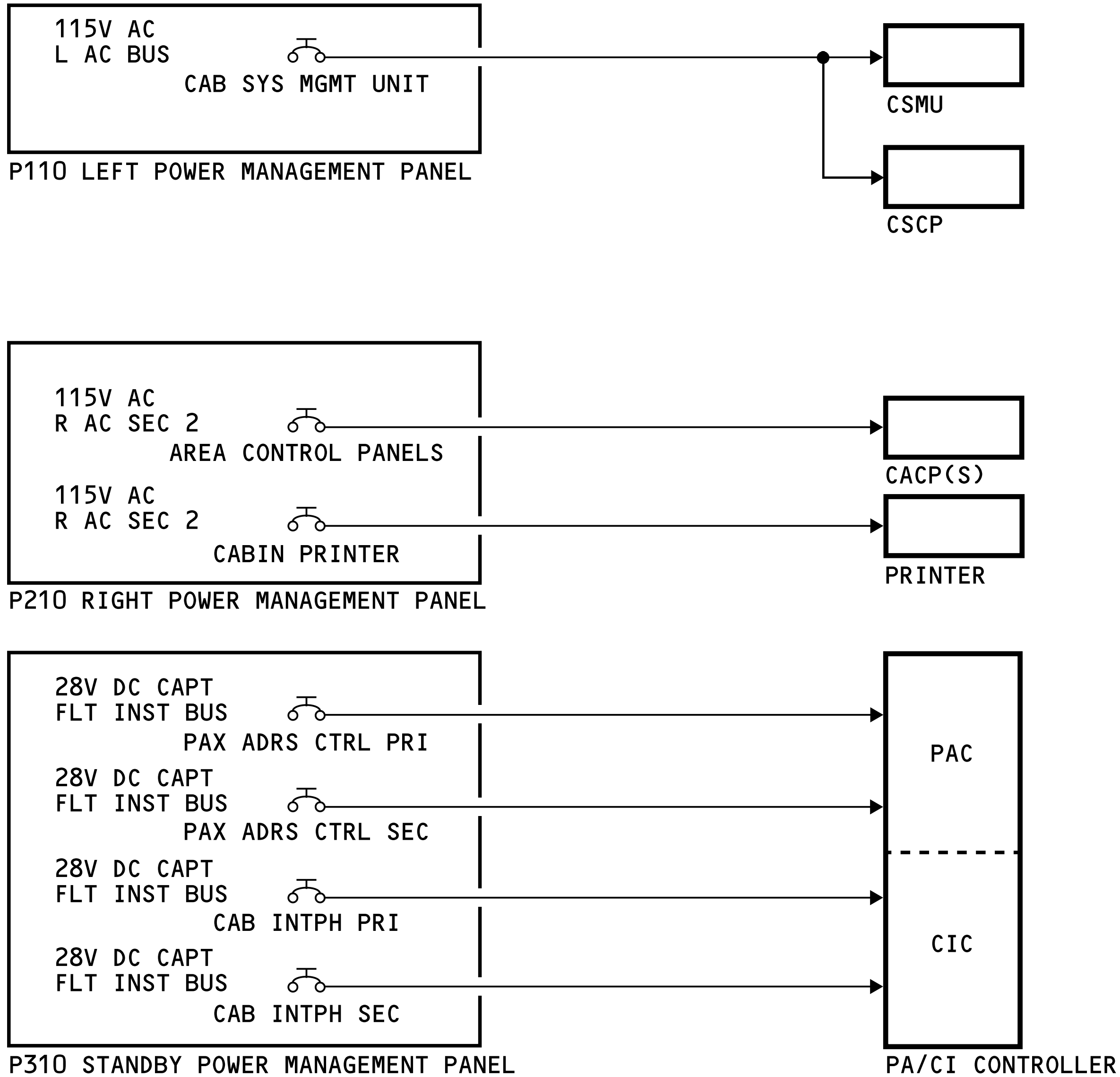
The AREA CONTROL PANELS circuit breaker connects 115v ac power to all CACPs.

The CABIN PRINTER circuit breaker connects 115v ac power to the cabin printer.

P310 Standby Power Management Panel

These circuit breakers connect 28v dc to the PA/CI controller:

- PAX ADRS CTRL PRI
- PAX ADRS CTRL SEC
- CAB INTPH PRI
- CAB INTPH SEC.



CSS GENERAL - POWER INTERFACE

CSS GENERAL - POWER INTERFACE - ZONE 1

General

Components on the left, right, and standby power management panels control power to these zone 1 LRUs:

- Left, center, and right overhead electronics units (OEUs)
- Zone management unit (ZMU) 1
- Speaker drive modules (SDMs).

Components

The P110 left power management panel has these components:

- OEU ZONE1 MAIN BUS circuit breaker
- OEU ZONE1 XFER BUS circuit breaker
- ZONE MGMT 1 circuit breaker.

The P210 right power management panel has the PAX MASTER CALL LT circuit breaker.

The P310 standby power management panel has these components:

- PA DIR ACCESS circuit breaker
- CAB INTPH ZMUS circuit breaker
- SDM COL 1 circuit breaker.

Overhead Electronics Unit Power

The OEU ZONE 1 MAIN and OEU ZONE 1 XFER circuit breakers connect 115v ac power to the left, center and right OEUs.

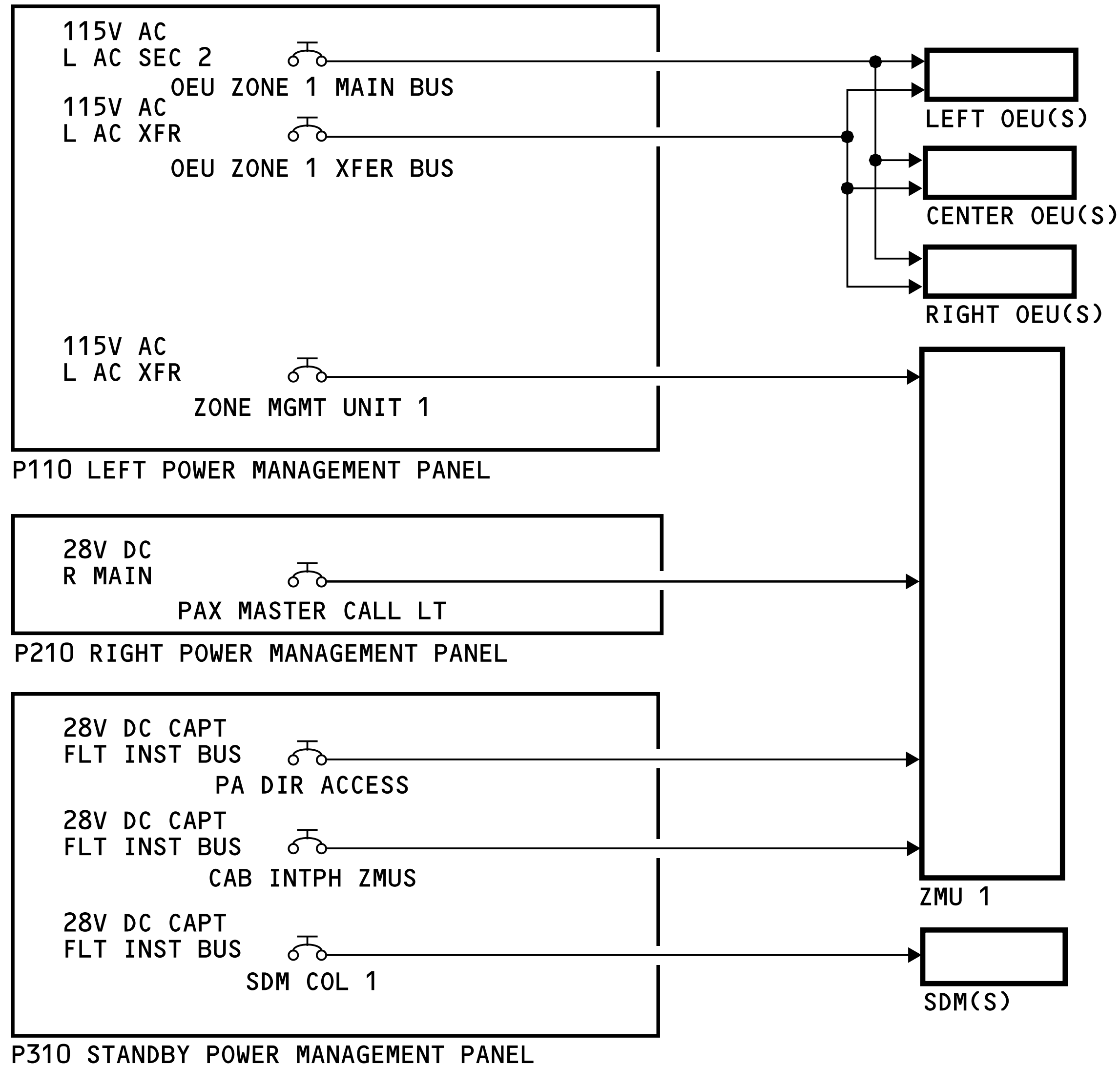
Zone Management Unit Power

These circuit breakers connect power to ZMU 1:

- ZONE MGMT UNIT 1 - 115v ac
- PA DIR ACCESS - 28v dc
- CAB INTPH ZMUS - 28v dc
- PAX MASTER CALL LT - 28v dc.

Speaker Drive Module Power

The SDM COL 1 circuit breaker connects 28v dc to all SDMs in zone 1.



23-39-00-512 Rev 0 07/12/96

CSS GENERAL - POWER INTERFACE - ZONE 1

CSS GENERAL - POWER INTERFACE - ZONE 2

General

Components on the right and standby power management panels control power to these zone 2 LRUs:

- Left, center, and right overhead electronics units (OEUs)
- Zone management (ZMU) unit 2
- Speaker drive modules (SDMs).

Components

The P210 right power management panel has these components:

- OEU ZONE2 LEFT MAIN BUS circuit breaker
- OEU ZONE2 CENTER MAIN BUS circuit breaker
- OEU ZONE2 RIGHT MAIN BUS circuit breaker
- OEU ZONE2 XFER BUS circuit breaker
- ZONE MGMT UNIT 2 circuit breaker
- PAX MASTER CALL LT circuit breaker.

The P310 standby power management panel has these components:

- PA DIR ACCESS circuit breaker
- CAB INTPH ZMUS circuit breaker
- SDM COL 2 circuit breaker.

Overhead Electronics Unit Power

These circuit breakers connect 115v ac to the OEUs:

- OEU ZONE2 LEFT MAIN BUS to the left column of OEUs
- OEU ZONE2 CENTER MAIN BUS to the center column of OEUs
- OEU ZONE2 RIGHT MAIN BUS to the right column of OEUs
- OEU ZONE2 XFER BUS to all OEUs.

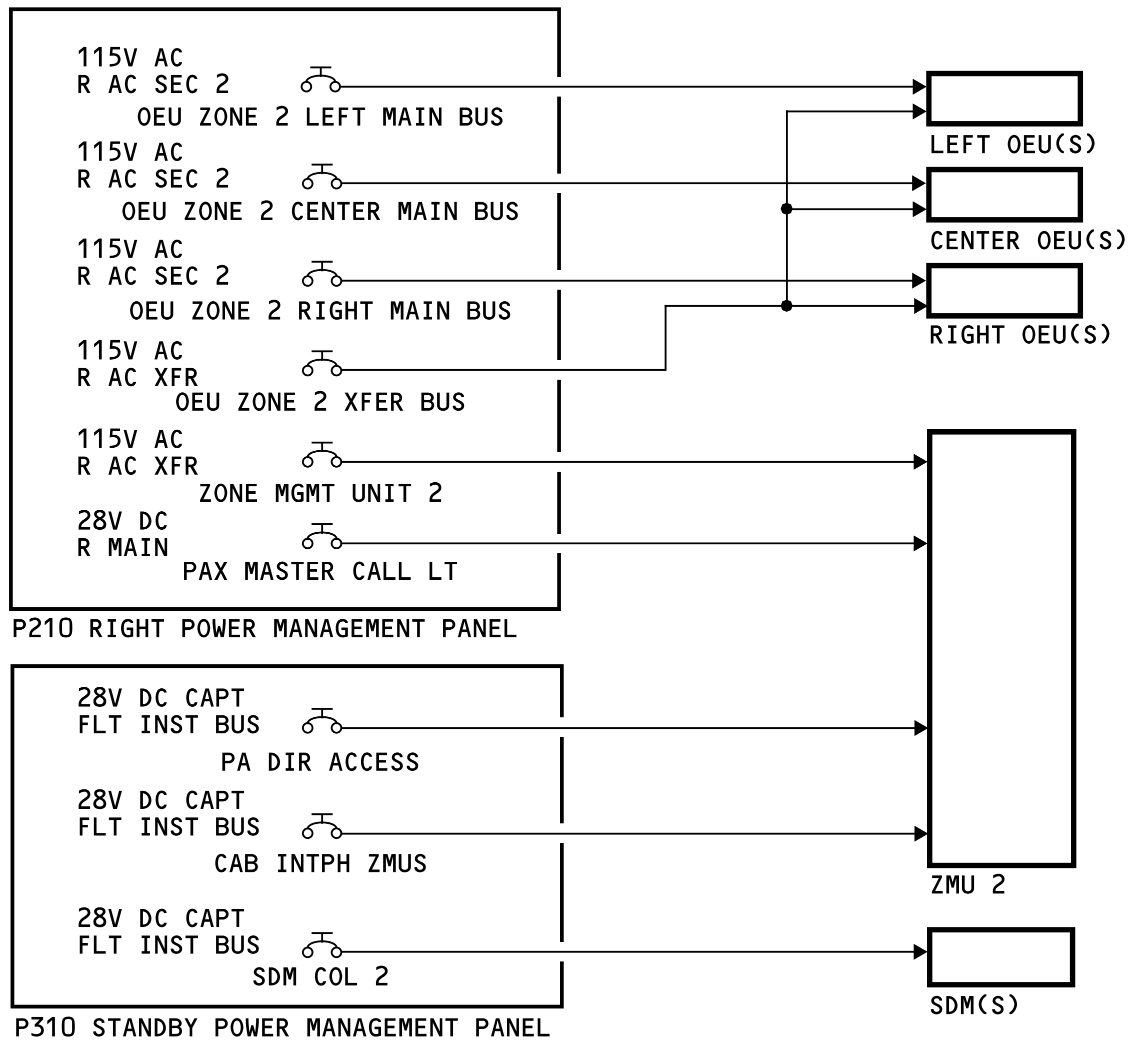
Zone Management Unit Power

These circuit breakers connect power to ZMU 2:

- ZONE MGMT UNIT 2 - 115v ac
- PAX MASTER CALL LT - 28v dc
- PA DIR ACCESS - 28v dc
- CAB INTPH ZMUS - 28v dc.

Speaker Drive Module Power

The SDM COL 2 circuit breaker connects 28v dc to all SDMs in zone 2.



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CSS GENERAL - POWER INTERFACE - ZONE 2

CSS GENERAL - POWER INTERFACE - ZONE 3

General

Components on the left, right, and standby power management panels control power to these zone 3 LRUs:

- Left, center, and right overhead electronics units (OEUs)
- Zone management unit (ZMU) 3
- Speaker drive modules (SDMs).

Components

The P110 left power management panel has these components:

- OEU ZONE3 LEFT MAIN BUS circuit breaker
- OEU ZONE3 CENTER MAIN BUS circuit breaker
- OEU ZONE3 RIGHT MAIN BUS circuit breaker
- OEU ZONE3 XFER BUS circuit breaker
- ZONE MGMT UNIT 3 circuit breaker.

The P210 right power management panel has the PAX MASTER CALL LT circuit breaker.

The P310 standby power management panel has these components:

- PA DIR ACCESS circuit breaker
- CAB INTPH ZMUS circuit breaker
- SDM COL 3 circuit breaker.

Overhead Electronics Unit Power

These circuit breakers connect 115v ac to the OEUs:

- OEU ZONE3 LEFT MAIN BUS to the left column of OEUs
- OEU ZONE3 CENTER MAIN BUS to the center column of OEUs
- OEU ZONE3 RIGHT MAIN BUS to the right column of OEUs
- OEU ZONE3 XFER BUS to all OEUs.

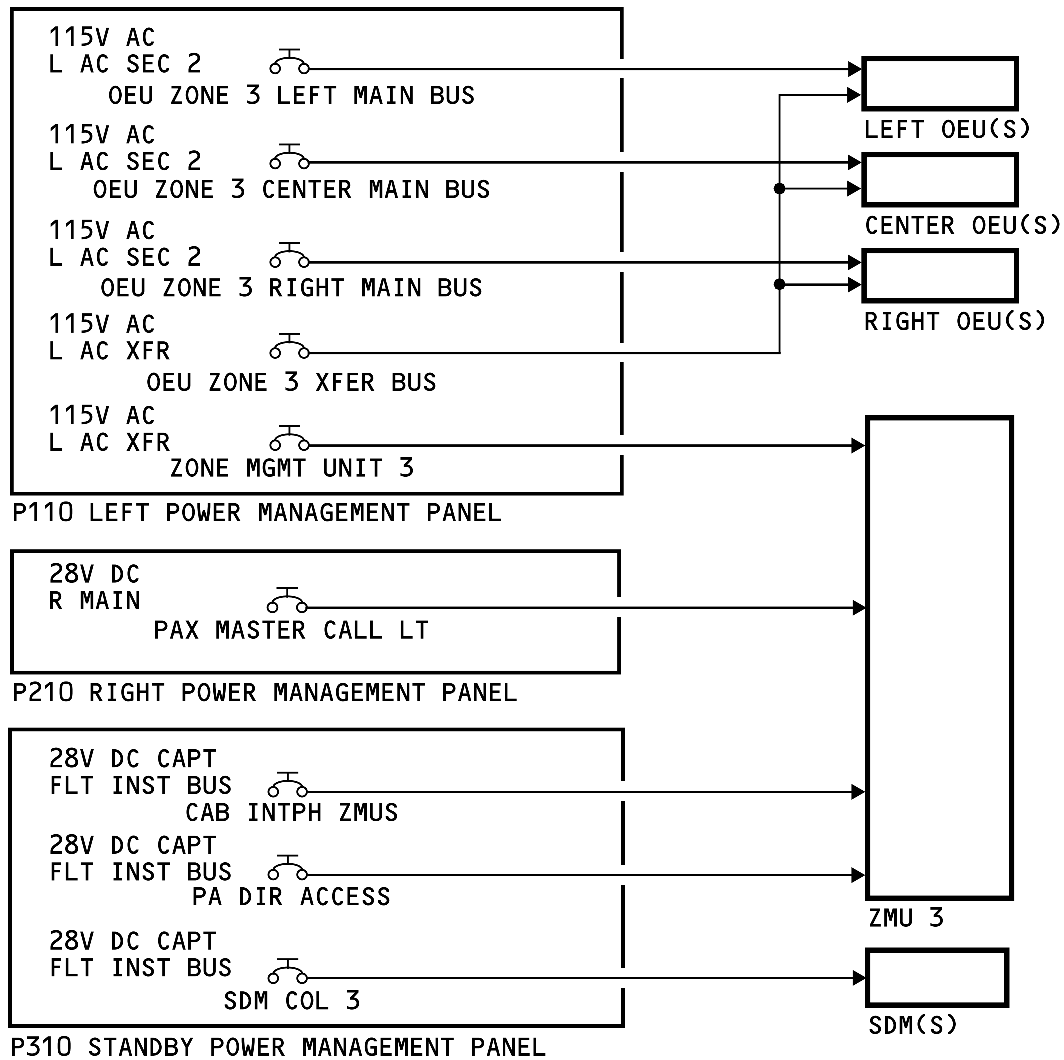
Zone Management Unit Power

These circuit breakers connect power to ZMU 3:

- ZONE MGMT UNIT 3 - 115v ac
- PAX MASTER CALL LT - 28v dc
- PA DIR ACCESS - 28v dc
- CAB INTPH ZMUS - 28v dc.

Speaker Drive Module Power

The SDM COL 3 circuit breaker connects 28v dc to all SDMs in zone 3.



CSS GENERAL - POWER INTERFACE - ZONE 3

CSS GENERAL - SYSTEM INTERFACES

General

The CSS uses different buses and interfaces to send data between the CSS components. These are the interfaces with the main CSS components:

- Intersystem (I/S) bus
- Cabin interphone (CI) bus
- Passenger address/cabin interphone (PA/CI) bus.

Intersystem Bus

The intersystem bus is the primary bus the CSS uses to send and get data.

The CSMU, passenger address/cabin interphone (PA/CI) controller, and zone management units (ZMUs) all send and receive data on the intersystem bus.

The intersystem bus passes through the components it connects. Thus, a failure of a component does not cause a failure of the bus.

The intersystem bus uses the IEEE 802.3 10 base 2 data standard for data transfer.

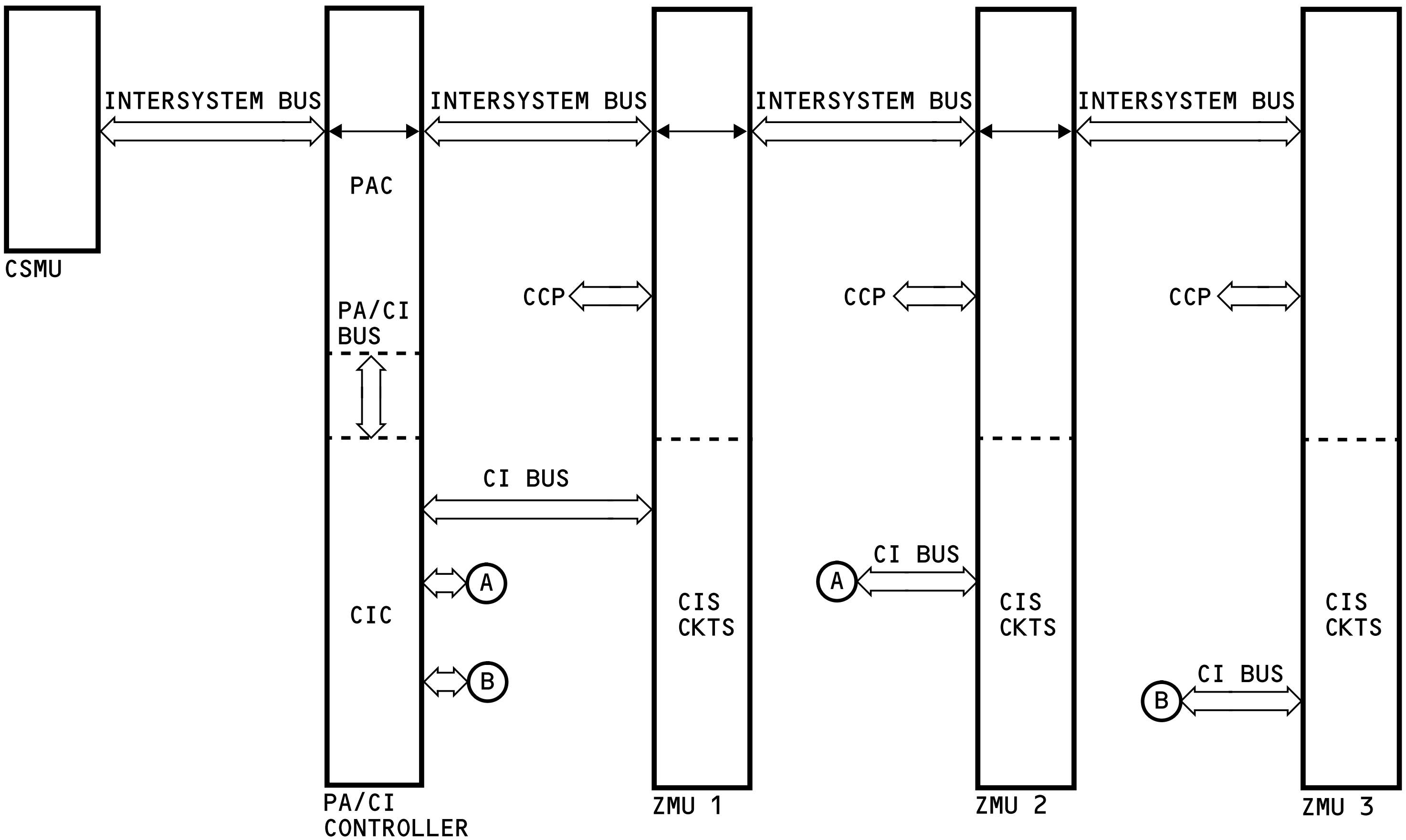
Each cabin control panel (CCP) can send and get commands and data from a related ZMU. The ZMUs change 10 base 2 data from the intersystem bus and send it to the CCP.

Passenger Address/Cabin Interphone (PA/CI) Bus

The passenger address controller gets and sends data on the intersystem bus. The cabin interphone controller does not have an interface with the intersystem bus. Any information the CIC needs from the intersystem bus is sent over the PA/CI bus from the PAC.

Cabin Interphone (C/I) Bus

A cabin interphone bus goes from the CIC to each of the ZMUs. These are the main communication busses for the cabin interphone system. A failure of the intersystem bus would have very little effect on the cabin interphone system. Likewise, a failure of a cabin interphone bus would have very little effect on the passenger address system.



23-39-00-515 Rev 3 07/08/1997

CSS GENERAL - SYSTEM INTERFACES

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CSS GENERAL - PASSENGER ADDRESS/CABIN INTERPHONE CONTROLLER INTERFACES

General

The passenger address/cabin interphone (PA/CI) controller connects to other CSS components and audio systems to control passenger address and cabin interphone audio. It also controls call indications.

The PA/CI controller has two passenger address controllers (normal and alternate) and two cabin interphone controllers (normal and alternate). Only one passenger address controller and one cabin interphone controller operate at a time.

CSMU

The cabin system management unit (CSMU) selects which controller is operational. If a normal controller fails, you select the alternate controller from a switch on an attendant switch panel (ASP). The ASP sends a signal to the CSMU. The CSMU sends the signal to the PA/CI controller.

The PA/CI controller sends cabin interphone controller (CIC) BITE status to the CSMU using a health discrete. The PA/CI controller sends passenger address controller (PAC) BITE status to the CSMU using the intersystem bus.

The PA/CI controller and CSMU send data on the intersystem bus.

Airplane Systems Interfaces

The PA/CI controller has interfaces with airplane systems on the left system ARINC 629 bus. The system interfaces are:

- Environmental control system (ECS)
- ARINC signal gateway (ASG) card
- Proximity sensor electronics unit (PSEU)
- Overhead panel ARINC 629 system (OPAS)
- Flap/slat electronics unit (FSEU)
- Electrical load management system (ELMS)
- Warning electronic system (WES)
- Airplane information management system (AIMS).

CDU, AMU, and FDH Interfaces

The flight crew uses the flight interphone system to talk on the passenger address system and cabin interphone system. The audio management unit (AMU) supplies the interface to the PA/CI controller. The center control display unit (CDU) sends dial data and shows call information. The flight crew uses the flight deck handset (FDH) to talk.

AIMS Interfaces

The PA/CI controller sends call signals to the AIMS for these four conditions:

- Cabin call
- Cabin ready
- Cabin alert

- Ground call.

IFE System Interfaces

The in-flight entertainment system sends these signals to the passenger address/cabin interphone (PA/CI) controller:

- Boarding music
- Prerecorded announcements
- Video entertainment audio
- Video in use.

The IFE system also sends keylines to tell the PAC when an audio signal is present.

The PA/CI controller sends these signals to the IFE system:

- PA override audio
- PA override keylines
- Prerecorded announcement machine pause
- PA-All keyline
- Decompression.

Speaker Drive Module Interfaces

There are three columns of speaker drive modules (SDMs), one column for each zone. The PA/CI controller sends digitized passenger address audio to the SDMs. The data format uses the EIA-485 data standard. Another EIA-485 bus is for data between the SDMs and PA/CI controller.

The PA/CI controller sends a token signal during configuration database installation.

Zone Management Unit Interfaces

The PA/CI controller receives mic audio and a PTT signal from zone management unit (ZMU) 1 for the passenger address direct access input. It sends and receives digital audio for the cabin interphone system. The cabin interphone bus uses the EIA-485 data format. The passenger address controller and cabin interphone controller send these signals to each other. The cabin interphone controller gets attendant announcements and sends them to the passenger address controller.

The PA/CI controller also connects to the other ZMUs on the cabin interphone buses.

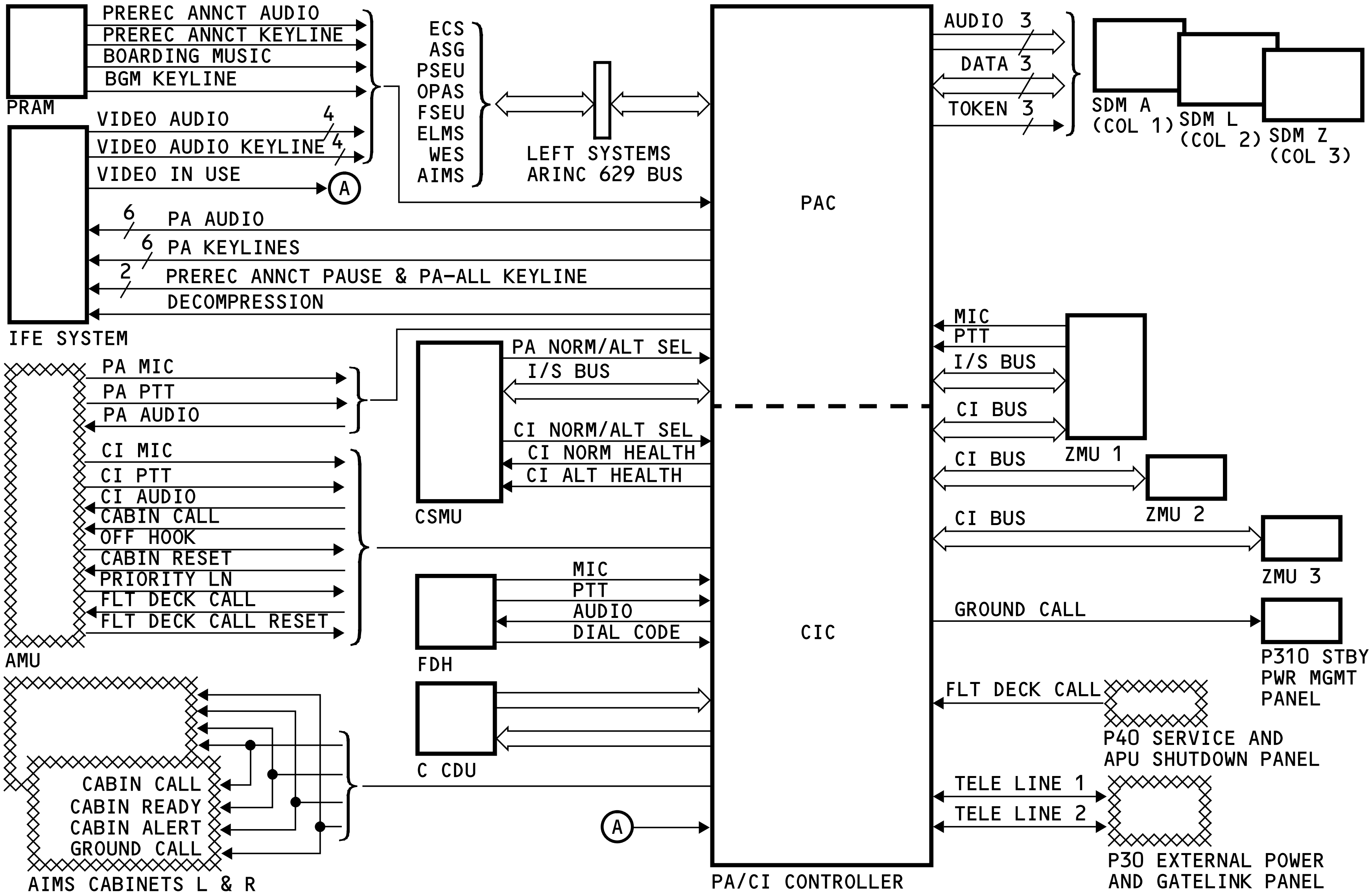
The PA/CI controller uses the intersystem bus between the CSMU and ZMU 1.

Panel Interfaces

The PA/CI controller sends a signal to the P310 standby power management panel for a ground crew call.

The P40 service and APU shutdown panel sends a signal to the PA/CI controller when the ground crew calls the flight deck.

The P30 external power and gatelink panel has two telephone jacks. They connect to the PA/CI controller.



CSS GENERAL - PASSENGER ADDRESS/CABIN INTERPHONE CONTROLLER INTERFACES

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CSS GENERAL - ZONE MANAGEMENT UNIT 1 INTERFACES

General

The zone management unit (ZMU) controls the cabin components connected to it. It is also an interface between cabin components and other main controllers.

Passenger Address/Cabin Interphone Controller Interfaces

The bus interfaces between the passenger address/cabin interphone (PA/CI) controller and ZMU 1 are the intersystem bus and the cabin interphone bus. The intersystem bus supplies a data interface for primary CSS components. It uses a 10 base 2 data format. The cabin interphone bus is for the cabin interphone function. It uses an EIA-485 data format.

ZMU 1 sends analog audio and a PTT signal to the PA/CI controller for the passenger address direct access function.

Zone Management Unit Interfaces

The intersystem bus from ZMU 1 connects to ZMU 2 which also connects to ZMU 3. Each ZMU uses the data from this bus to control their related zone components.

The ARINC 628 zone interface bus provides an interface with the in-flight entertainment system for passenger service functions.

ZMU 2 sends analog microphone audio and a PTT signal to ZMU 1 for the passenger address direct access function.

ZMU 2 also gets audio and a PTT signal from ZMU 3 to send to ZMU 1. ZMU 1 sends the signals to the PA/CI controller.

Cabin Attendant Handset Interfaces

Attendants use the cabin attendant handsets (CAHs) for cabin interphone calls and passenger address announcements. Each ZMU connects to as many as five CAHs. The CAH sends microphone audio, a PTT, and dialing signals to the ZMU. The ZMU sends receive audio to the CAH.

Each ZMU can have only one passenger address direct access interface. Attendants use the CAH that has a direct access button on the handset cradle to energize a relay in the ZMU. The interface between the cradle and the ZMU is a power signal, set signal, and reset signal.

Master Call Light Interfaces

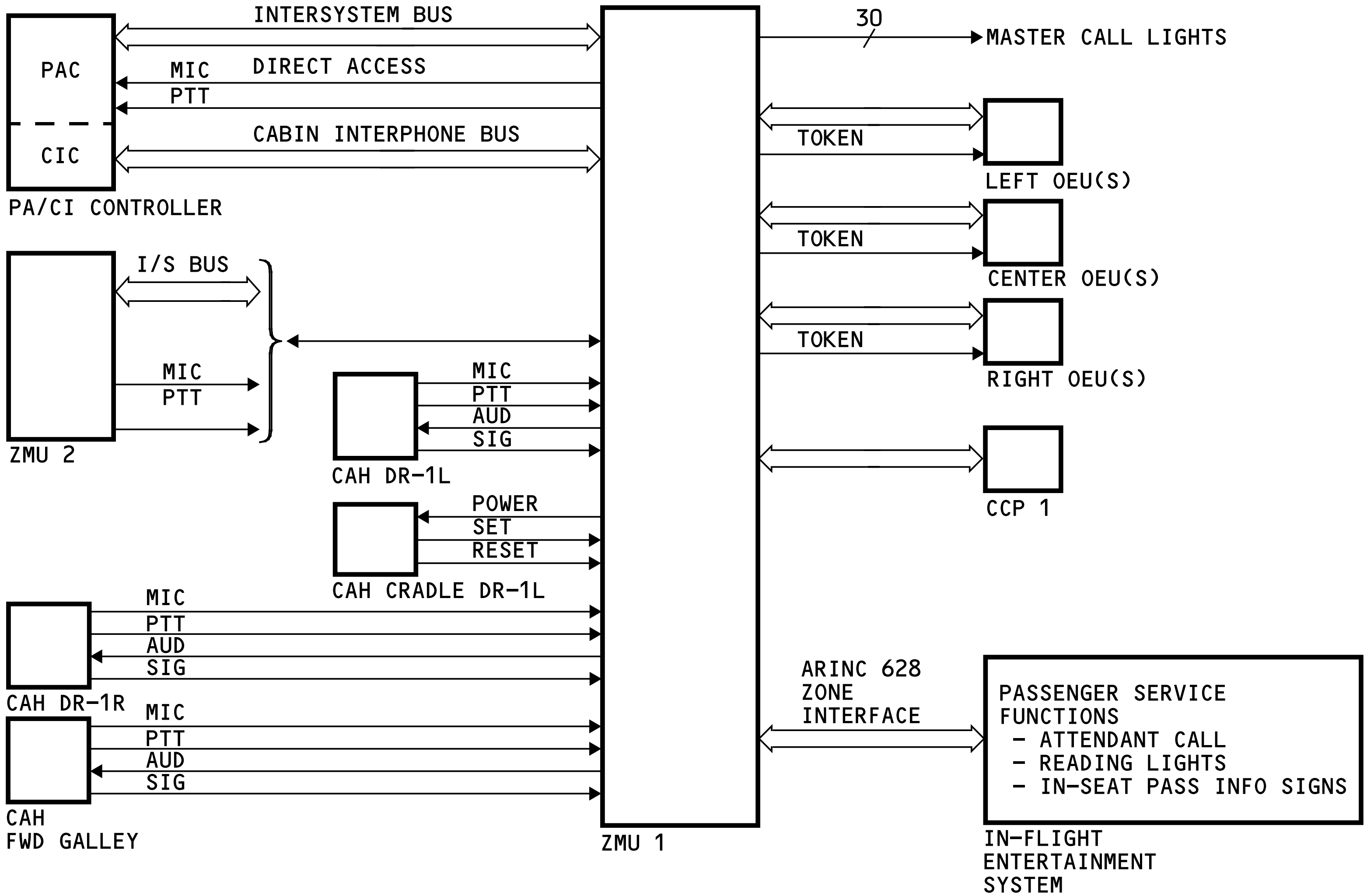
Each ZMU controls as many as 30 master call lights. Ten master call lights are for cabin interphone calls. Twenty master call lights are for passenger to attendant calls.

Overhead Electronics Unit Interfaces

Each ZMU connects to three columns of overhead electronics units (OEUs). The data bus uses an EIA-485 type of data format.

CSS GENERAL - ZONE MANAGEMENT UNIT 1 INTERFACES

OEUs control lights and passenger information signs. They also monitor different inputs. The token signal is for test and software installation.



23-39-00-518 Rev 12 02/25/1998

CSS GENERAL - ZONE MANAGEMENT UNIT 1 INTERFACES

CSS GENERAL - CABIN CONTROL PANEL

Purpose

You use the cabin control panels (CCPs) to operate the CSS. The hardware configuration of a CCP tells it to operate as a cabin area control panel (CACP) or a cabin system control panel (CSCP).

Flight attendants use the the CSCP or the CACPs to control CSS functions. Maintenance personnel use the CSCP to do tests and to install software.

Physical Description

The CCP weighs 13 pounds. These are the dimensions:

- Length - 16.5inches
- Width - 10.4inches
- Height - 3.3inches.

The front panel has these items:

- A touch-sensitive flat panel screen to select all functions
- Connector J1 for 115v ac power input and connection to the zone management unit (ZMU) panel bus
- Connector J2 for an RS-232 interface jack for shop maintenance functions
- Connector J3 for 10-base-T network interface.

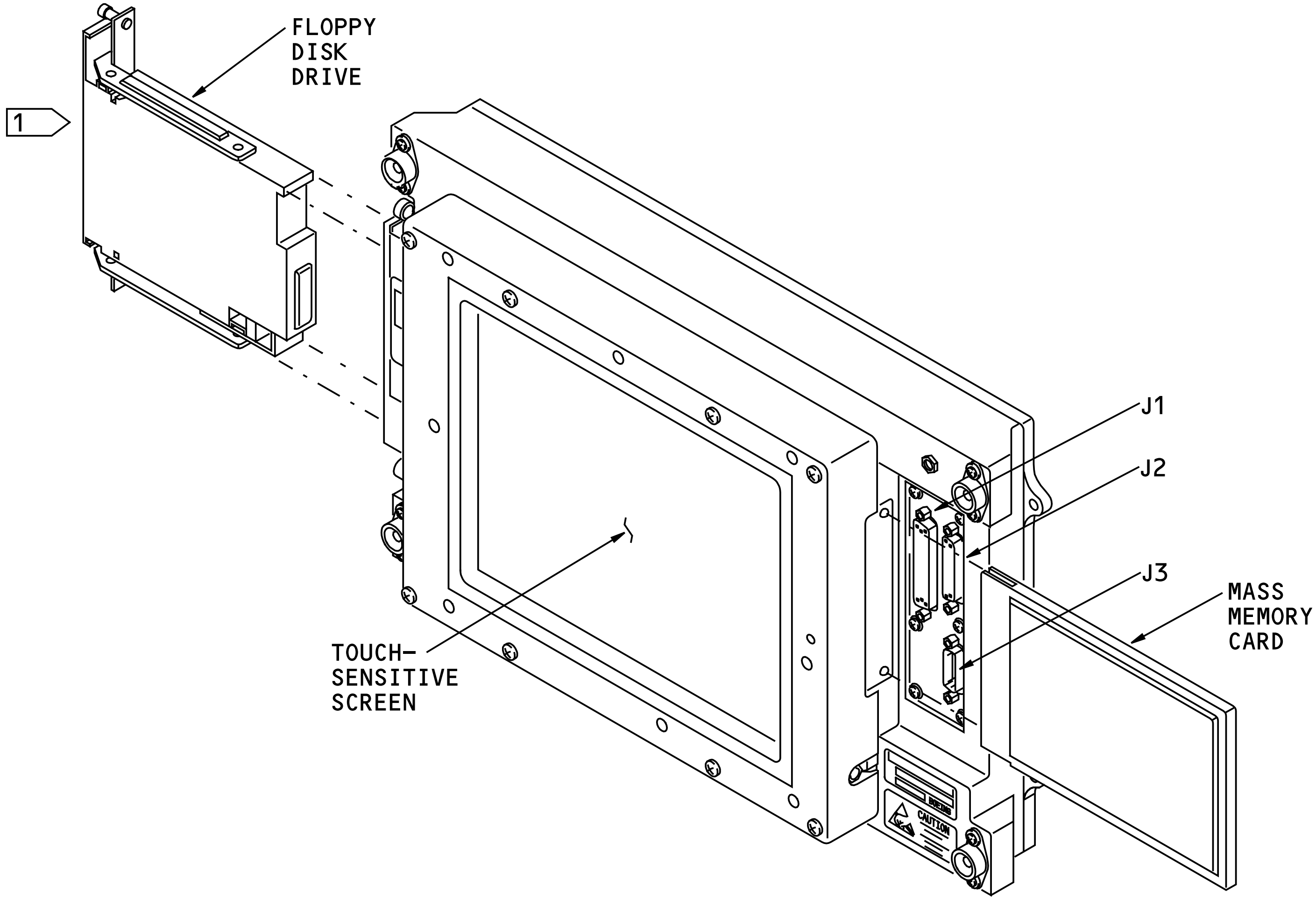
Functional Description

Attendants make selections on the touch screen to control these CSS functions:

- Cabin lighting
- Passenger services
- Cabin environment.

Training Information Point

The mass memory card and the floppy disk drive are line replaceable.



1 FLOPPY DISK DRIVE FOR
CSCP CONFIGURATION ONLY.

23-39-00-532 Rev 1 09/16/1997

CSS GENERAL - CABIN CONTROL PANEL

CSS GENERAL - CABIN SYSTEM MANAGEMENT UNIT

Purpose

The cabin system management unit (CSMU) supplies an interface between CSS LRUs and other airplane systems.

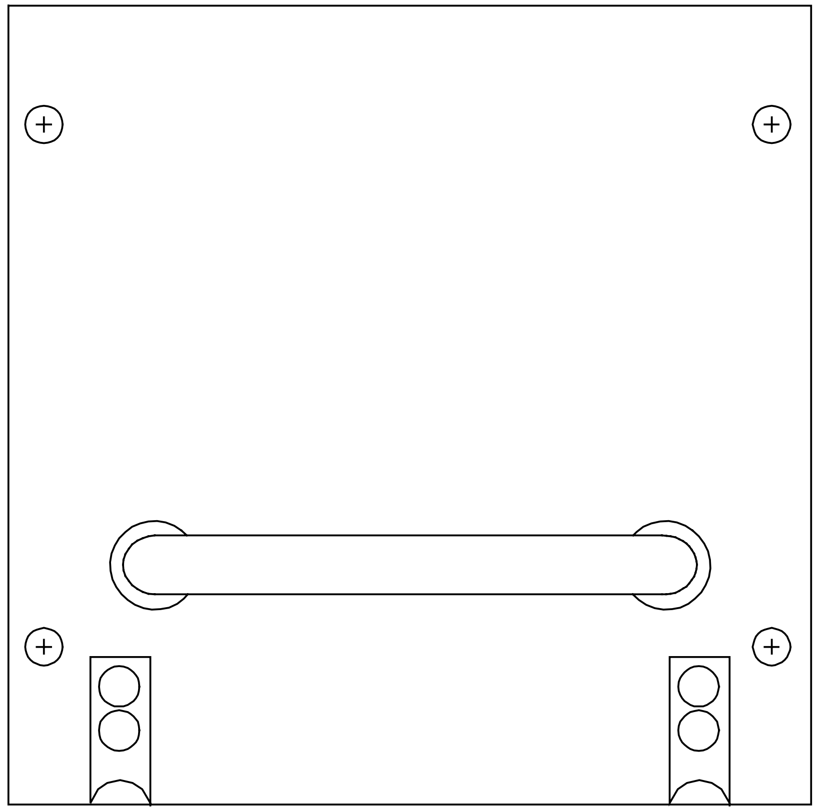
Physical Description

The CSMU is a 6 MCU LRU and weighs approximately 12 pounds.

Functional Description

The CSMU has these functions:

- Gets CSS database and operational program software from the cabin system control panel (CSCP) and sends it to other CSS LRUs
- Sends data to and gets data from the right systems ARINC 629 bus (temperature control, maintenance information, etc.)
- Does data bus conversion to and from the CSCP.



23-39-00-522 Rev 0 07/24/96

CSS GENERAL - CABIN SYSTEM MANAGEMENT UNIT

CSS GENERAL - PASSENGER ADDRESS/CABIN INTERPHONE CONTROLLER

Purpose

The passenger address/cabin interphone (PA/CI) controller permits announcements on the passenger address system. It also permits attendants to make station to station calls and calls to the flight deck.

Physical Description

The PA/CI controller is an 8 MCU LRU and weighs 21 pounds.

Functional Description

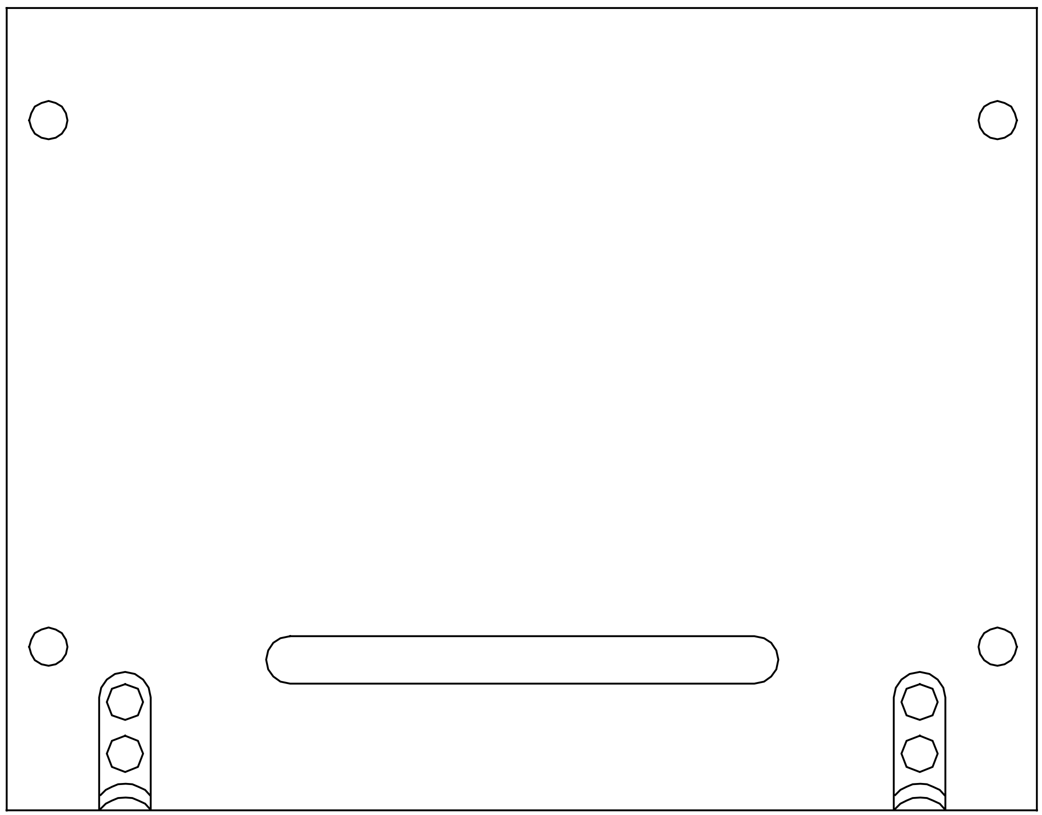
The PA/CI controller has two passenger address controllers and two cabin interphone controllers. Each controller uses different circuits in the LRU. Only one passenger address controller and one cabin interphone controller operates at a time. If a controller fails, you can select the alternate controller.

The PA controller does these functions:

- Digitizes six PA channels for audio output
- Sends PA override signals to the in-flight entertainment (IFE) system (overrides passenger entertainment audio when necessary)
- Calculates the volume for each speaker
- Receives audio inputs from the flight interphone system, direct access, cabin interphone controller, and IFE system (prerecorded announcements, video audio, boarding music)
- Controls the logic for the passenger information signs
- Has an interface with the left systems ARINC 629 bus.

The cabin interphone controller does these functions:

- Makes digital connections between stations
- Sends audio tones to off-hook handsets
- Sends audio sidetone to the flight deck
- Processes ground crew calls
- Has interfaces with the flight deck, flight interphone system, and AIMS.



23-39-00-523 Rev 0 07/15/96

CSS GENERAL - PASSENGER ADDRESS/CABIN INTERPHONE CONTROLLER

CSS GENERAL - ZONE MANAGEMENT UNIT

Purpose

The zone management units (ZMUs) primarily control passenger service and cabin lighting. They have interfaces with these components:

- Passenger address/cabin interphone (PA/CI) controller
- Cabin area control panels (CACPs)
- Cabin attendant handsets (CAHs)
- Overhead electronics units (OEUs).

Physical Description

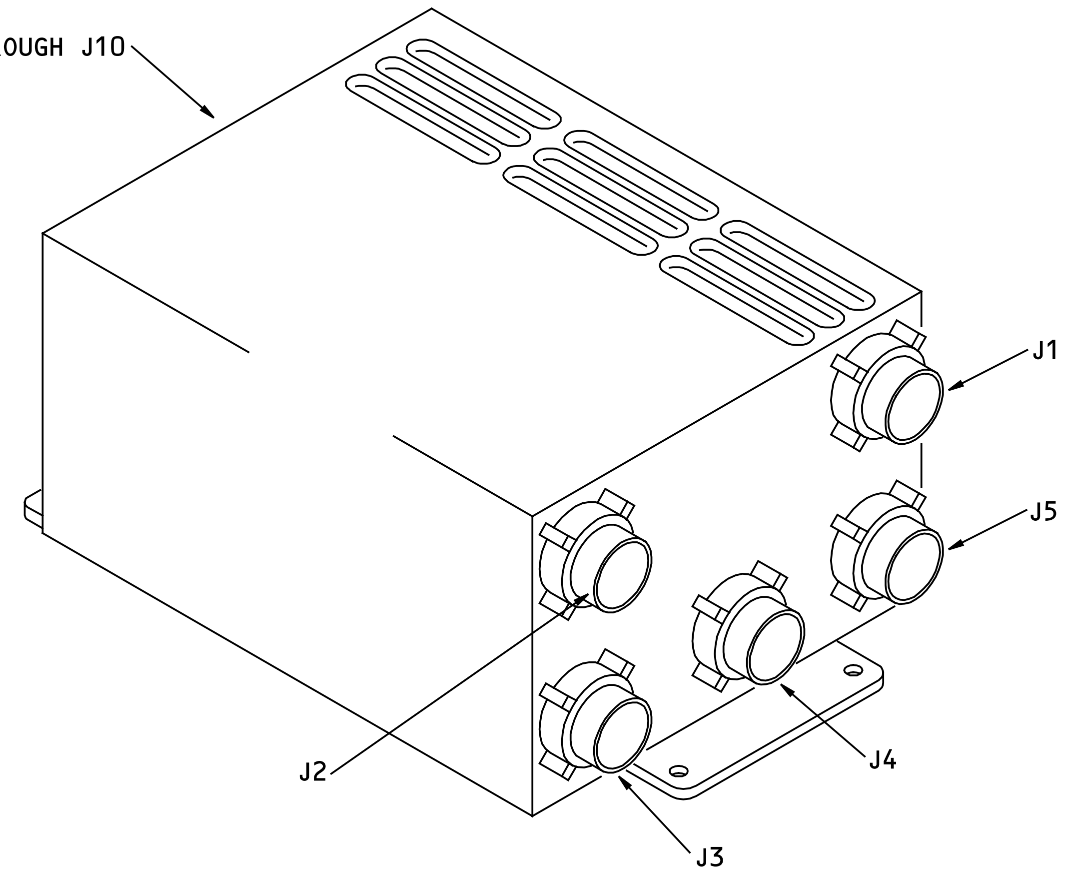
The ZMU weighs 12 pounds. These are the dimensions:

- Length - 10.3 inches
- Width - 8 inches
- Height - 5.8 inches.

Functional Description

Each ZMU does these functions:

- Does bus conversion from 10 base 2 to 10 base T for as many as three cabin area control panels
- Has interfaces for as many as five handsets and three columns of OEUs
- Controls as many as 30 master call lights
- Routes PA direct access signals.



23-39-00-524 Rev 0 07/15/96

CSS GENERAL - ZONE MANAGEMENT UNIT

CSS GENERAL - ZONE MANAGEMENT UNIT INSTALLATION

General

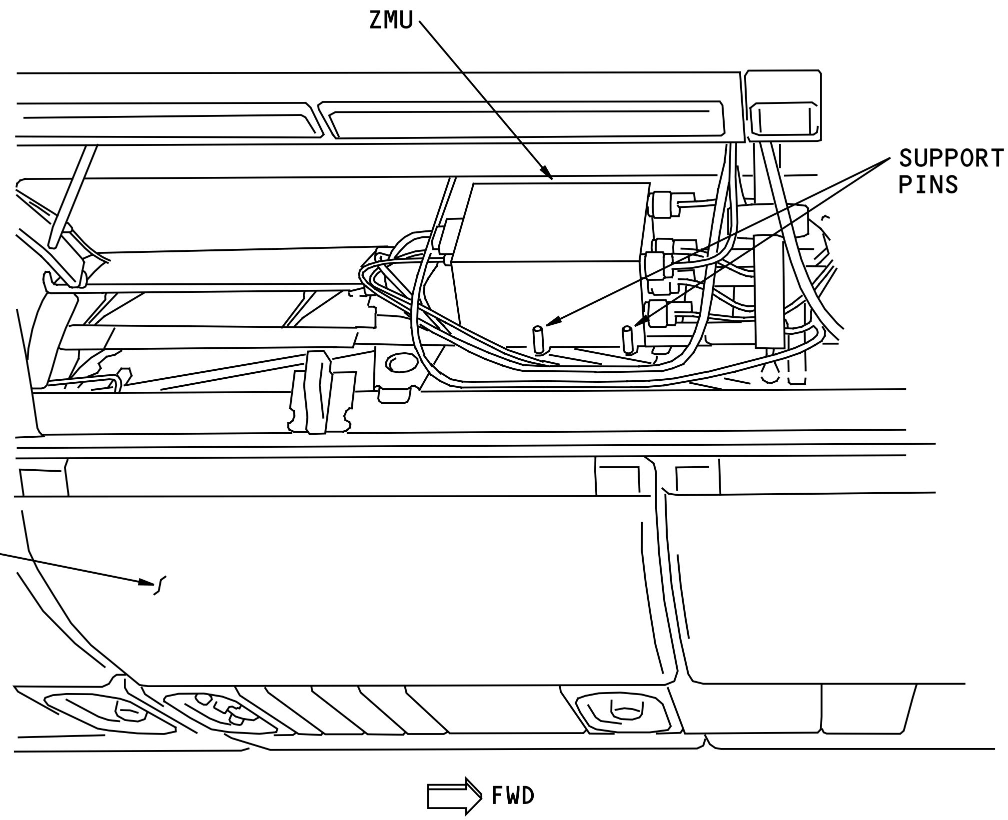
The ZMUs are above the cabin ceiling on the right side of the stow bin ladder assembly. Four screws attach the ZMU to the ladder assembly.

Training Information Point

You remove ceiling panels to get access to a ZMU.

Training Information Point

There are support pins to hold the ZMU during removal and installation.



(LOOKING INBOARD FROM RIGHT SIDE)
(TYPICAL INSTALLATION)

23-39-00-525 Rev 0 07/15/96

CSS GENERAL - ZONE MANAGEMENT UNIT INSTALLATION

CSS GENERAL - CABIN PRINTER

Purpose

The cabin printer makes reports of CSS data.

Physical Description

The printer has these characteristics:

- Weight - 12 pounds with a full roll of paper loaded
- Width - 5 inches
- Height - 9.75 inches
- Depth - 10.25 inches.

Controls and Indications

Push the PWR switch to enable the printer. When you enable the printer, an indicator on the switch comes on.

The FAULT indicator comes on for any of these reasons:

- A failure condition occurs
- The door is open
- There is no paper in the printer.

Push the momentary TEST button to do a test of the printer. During the test, a test pattern prints and an indicator on the TEST button comes on to show that a test is in progress.

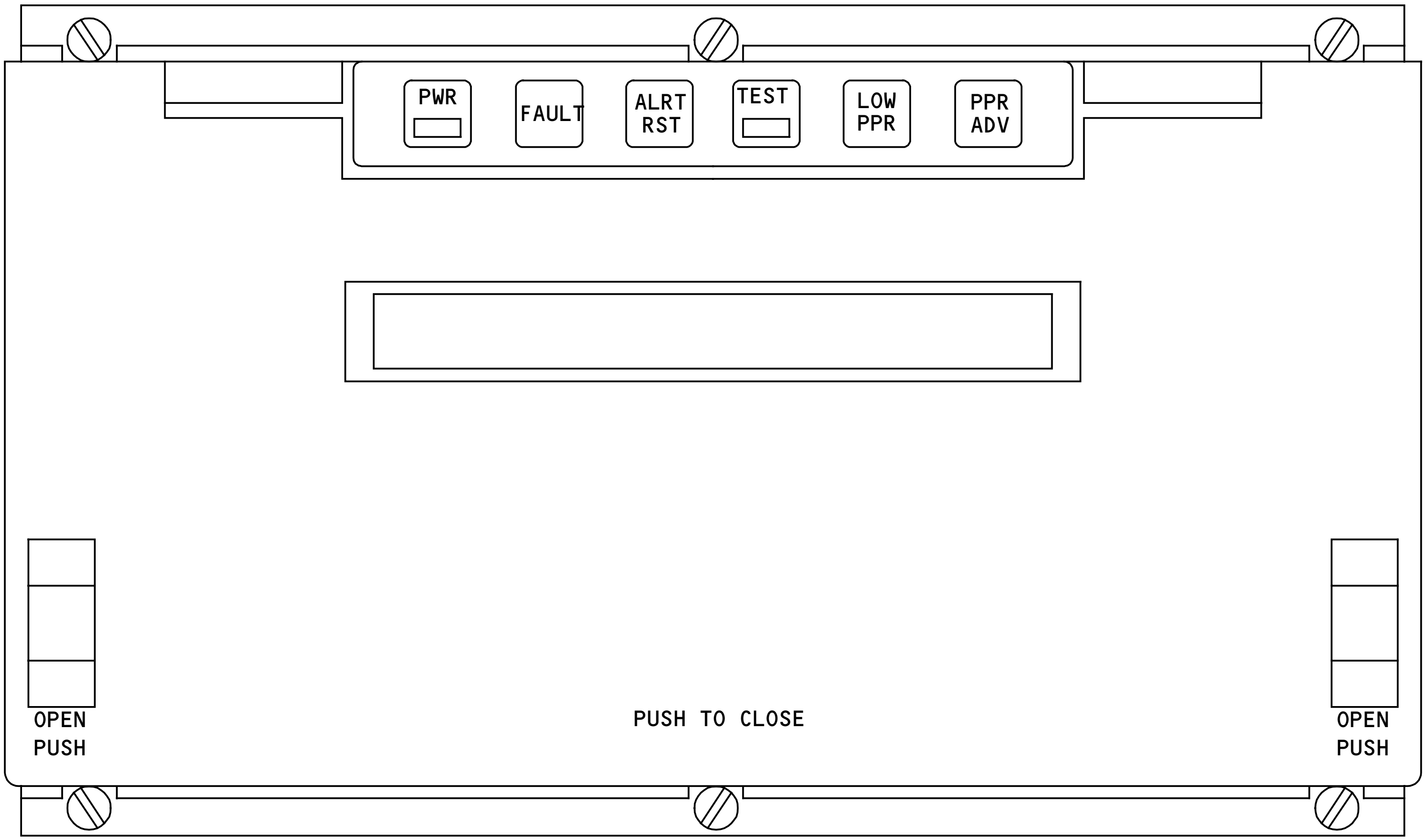
Push the PPR ADV button to advance the paper.

The LOW PPR shows when the paper supply is less than 10 feet. There is also a low paper stripe on the paper for the last 6 feet of paper.

Push the momentary ALRT RST switch to cause a power-on reset of the electronic circuitry of the printer. Printing will stop. This reset does not erase any messages in the printer memory.

Functional Description

The cabin printer is a thermal dot matrix printer. The printer paper is 8.5 inches wide in a roll 125 feet long. You open the printer door to load the paper. During print operation, a friction feed moves paper through the printer at the rate of 4 pages per minute. At the paper exit there is a cutting edge to help tear paper from the roll.



23-39-00-526 Rev 2 07/22/1997

CSS GENERAL - CABIN PRINTER

CSS GENERAL - CABIN CONTROL PANEL FUNCTIONAL DESCRIPTION

General

You use the cabin control panels (CCPs) to operate the CSS. The hardware configuration of a CCP tells it to operate as a cabin area control panel (CACP) or a cabin system control panel (CSCP).

The CSCP configuration has a floppy disk drive (FDD) and an 85 megabyte mass memory card (MMC). The CACP configuration has a 20 megabyte MMC and no FDD.

Controller

The controller controls CSS functions.

It controls tests and software installation in the CSS components. It also controls selection of normal CSS functions such as lighting, monitor and control, and passenger services.

Display

The CCP display is a touch-sensitive screen. The display shows menus for control of the CSS.

Mass Memory Card

The CCP uses a mass memory card (MMC) to keep software. The mass memory card is a solid state data storage device. The MMC keeps operational software and data from the configuration database (CDB). The CDB data in the CCP tells the CCP which screen selections it may show. The mass memory card is line replaceable.

Floppy Disk Drive

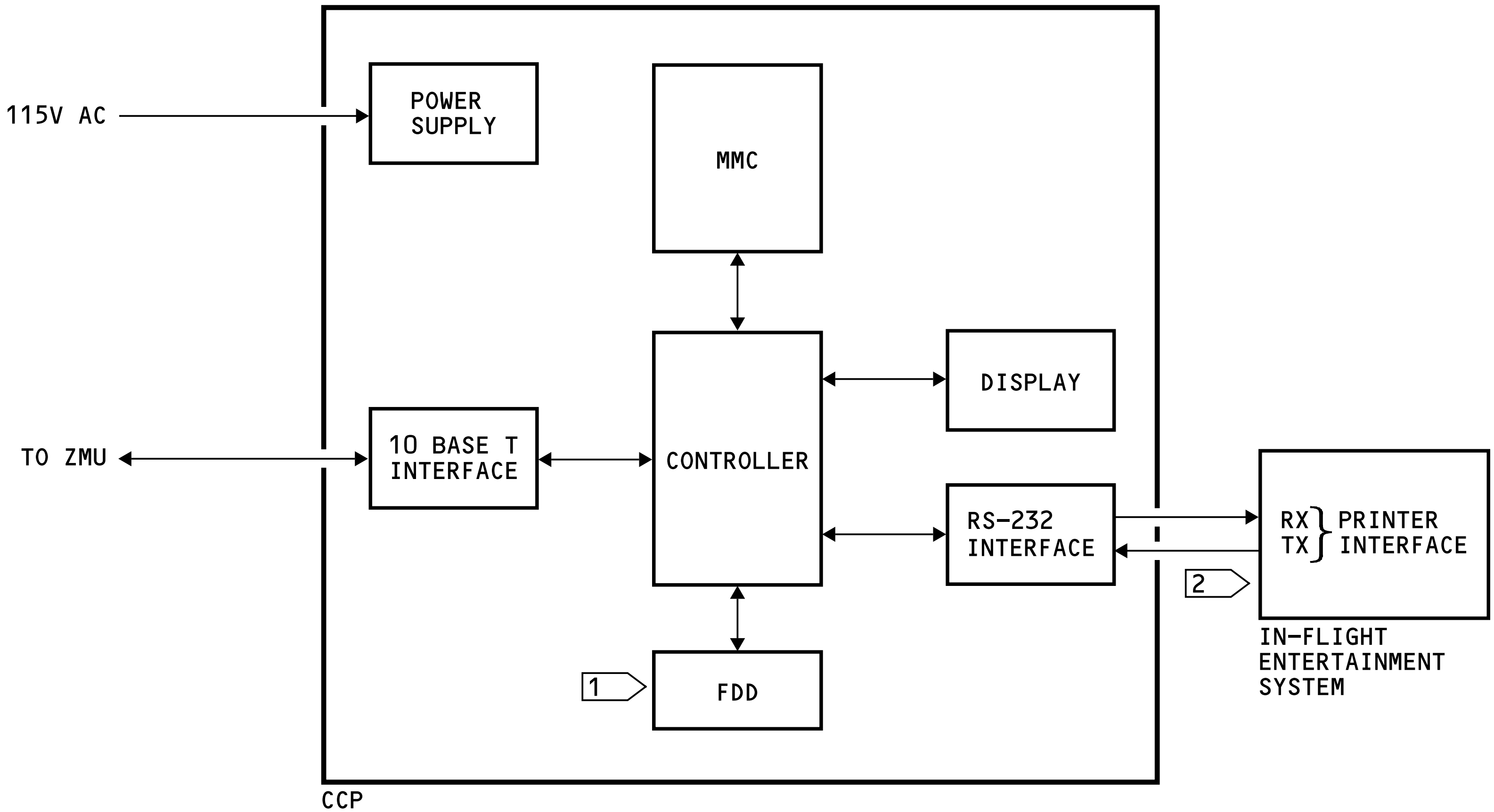
The FDD is only used in the CSCP . You use the FDD to install the database software and operational software into the MMC. The FDD also saves report data from the CSS on to a floppy disk.

Interfaces

The CCP sends and receives data on the intersystem bus. This includes these functions:

- Test commands
- Programming
- Normal CSS selections.

The CSCP sends report data to the in-flight entertainment (IFE) system. The IFE system sends the report data to a cabin printer to make printouts of CSS data.



1 FLOPPY DISK DRIVE FOR CSCP CONFIGURATION ONLY.

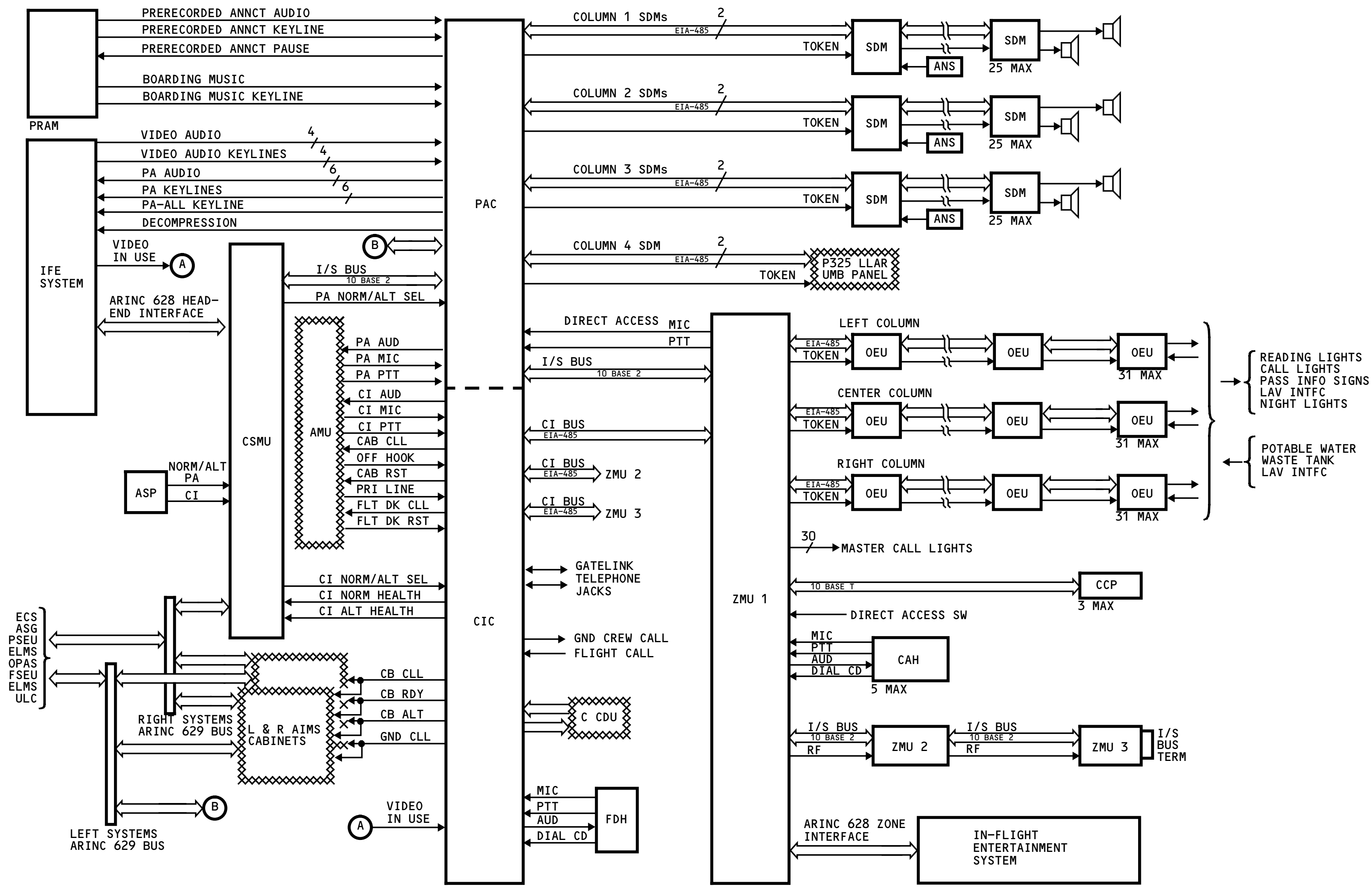
2 PRINTER INTERFACE FOR CSCP CONFIGURATION ONLY.

CSS GENERAL - CABIN CONTROL PANEL FUNCTIONAL DESCRIPTION

CSS GENERAL - INTERFACE DIAGRAM

Interface Diagram

This interface diagram is for reference only.



CSS GENERAL - INTERFACE DIAGRAM

23-39-00-531 Rev 6 10/29/1997

CSS GENERAL - CSCP/CACP SCREENS MENU TREE

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CSS GENERAL - CSCP/CACP SCREENS MENU TREE

General

The cabin system control panel (CSCP) and cabin area control panels (CACPs) selection screens are menu driven. To access a control screen, you may have to use one or more menu screens.

Because of selections made in the configuration database generator or airline equipment options, some menu selections will not operate.

Main Menu

The main menu shows only on the CSCP. You can select CABIN CONTROLS or CABIN MAINTENANCE from this screen.

The CABIN CONTROLS selection permits you to monitor and control cabin functions.

The CABIN MAINTENANCE selection shows the cabin maintenance menu. See the CSS test and software installation section for additional data.

Cabin Controls Main Menu

The cabin controls main menu shows on both the CSCP and CACPs. The cabin controls main menu is the highest level menu on the CACPs. It shows when power is supplied to the CSS.

Most selections on the cabin controls main menu cause a control screen to show. These are the control screen selections:

- CABIN TEMPERATURE
- BOARDING MUSIC
- PASSENGER ADDRESS
- SMOKING ASSIGNMENTS
- CABIN DOOR STATUS
- SPECIAL FUNCTIONS
- DISPLAY CONTROLS.

Other selections cause a sub-menu to show. These are the selections that have sub-menus:

- LIGHTING
- SERVICE CALL/CHIME CONTROL
- WATER/WASTE TANK STATUS.

Sub-menus

The lighting menu selections are:

- CABIN LIGHTING
- ENTRY WAY LIGHTS
- READING LIGHTS.

The service call/chime control menu selections are:

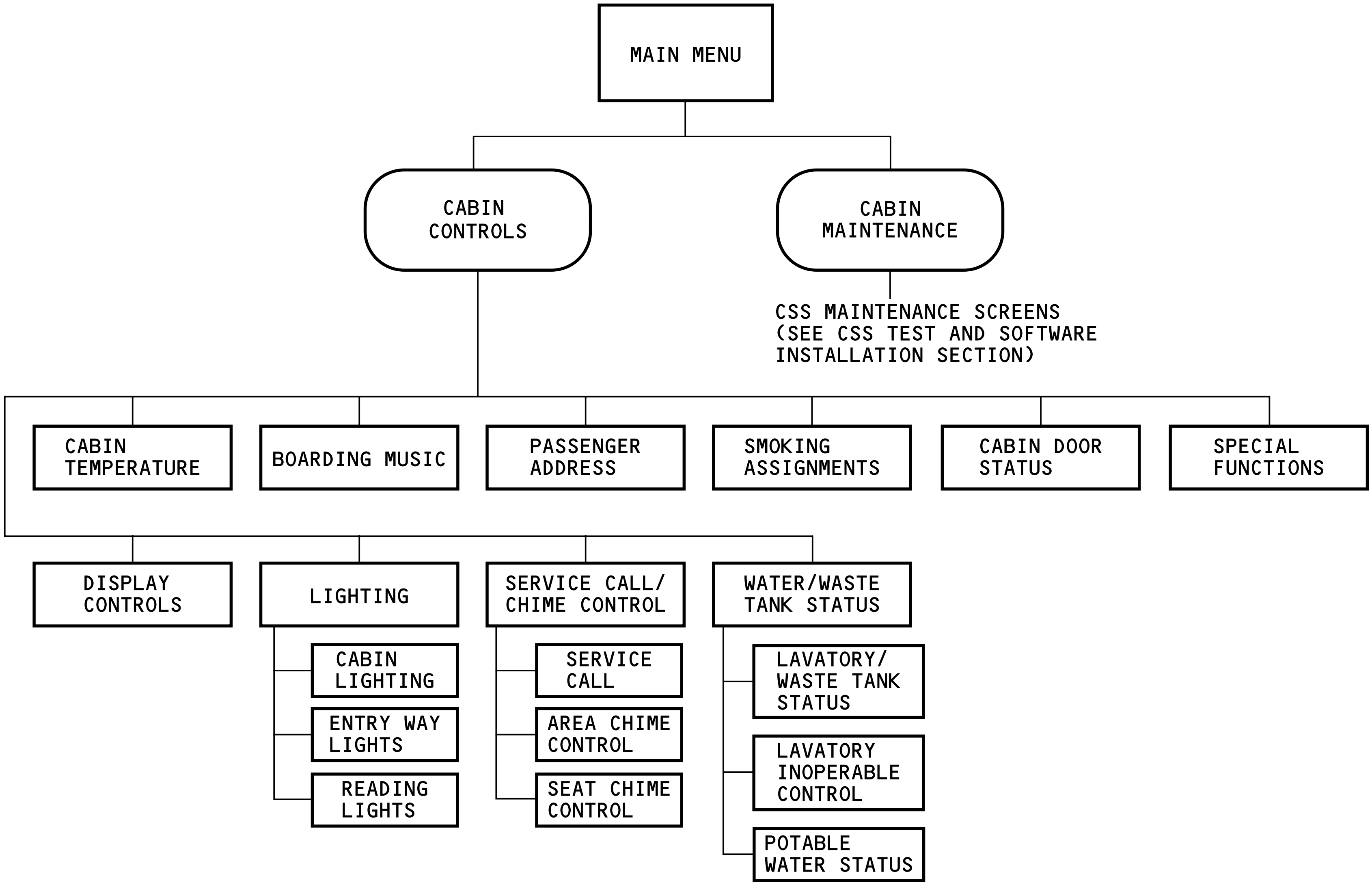
- SERVICE CALL
- AREA CHIME CONTROL
- SEAT CHIME CONTROL.

The water/waste tank status menu selections are:

- LAVATORY/WASTE TANK STATUS
- LAVATORY INOPERABLE CONTROL

CSS GENERAL - CSCP/CACP SCREENS MENU TREE

- POTABLE WATER STATUS.



23-39-00-601 Rev 0 06/18/96

CSS GENERAL - CSCP/CACP SCREENS MENU TREE

CSS GENERAL - MAIN MENU

General

This main menu only shows on the cabin system control panel (CSCP). It shows automatically when you apply power to the CSS.

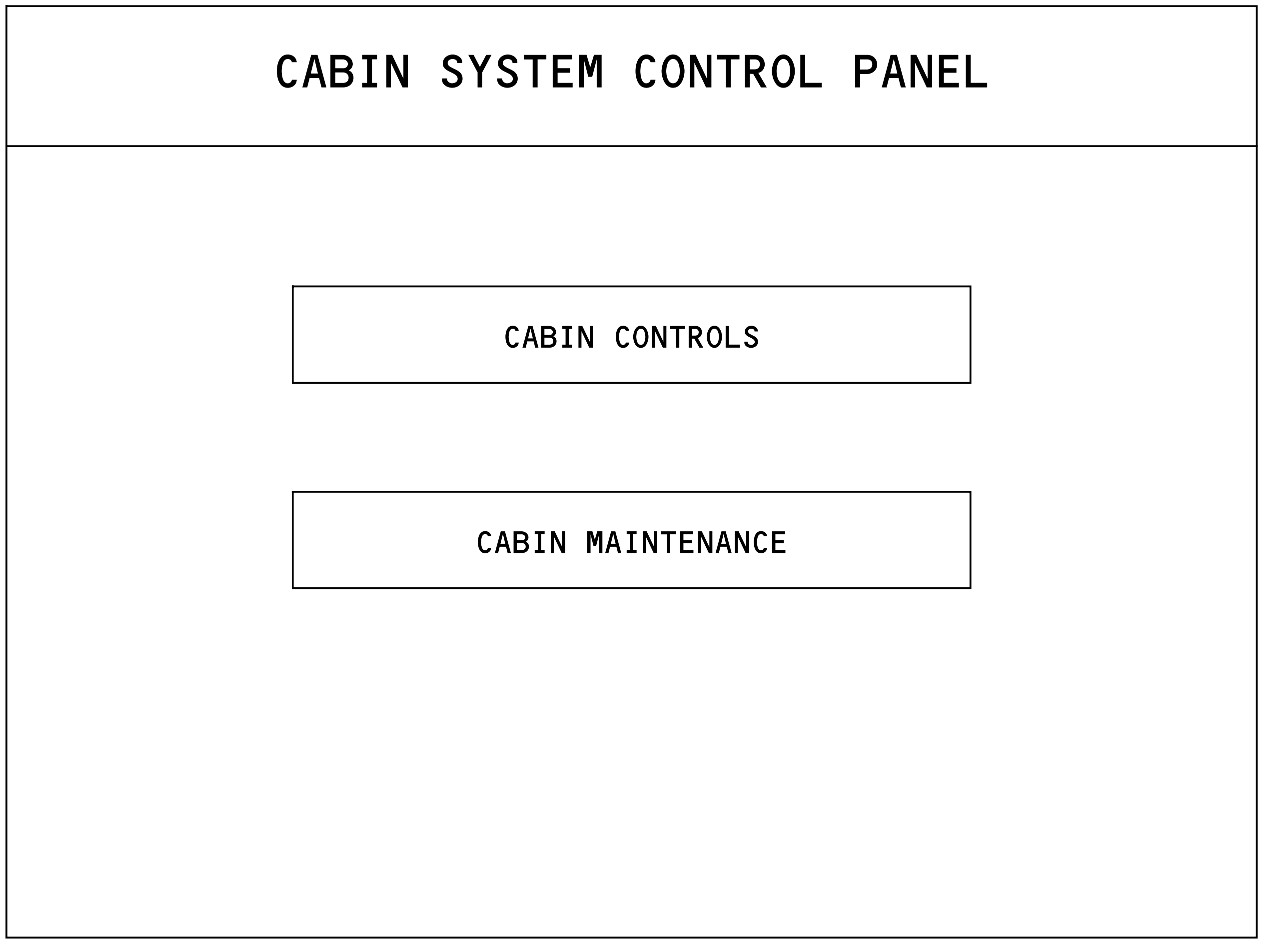
Cabin Controls

You use the CABIN CONTROLS selection to control these CSS core functions:

- Cabin lighting
- Passenger service
- Passenger address
- Monitor and control.

Cabin Maintenance

Use the CABIN MAINTENANCE selection to control maintenance related functions such as testing and software installation.



CSCP SCREEN

23-39-00-602 Rev 0 06/18/96

CSS GENERAL - MAIN MENU

CSS GENERAL - CABIN CONTROLS MAIN MENU

General

Attendants use the cabin controls main menu to select CSS core functions.

Access

Touch CABIN CONTROLS on the cabin system control panel (CSCP) main menu to show this screen.

On the cabin area control panels (CACPs), the cabin controls main menu is the highest level menu. It shows automatically when you apply power to the CSS.

The CACPs do not have the EXIT selection.

Controls and Indications

The cabin controls screens on the CSCP and CACPs may be different. Some selections may be available on one panel but not on another. The configuration database controls the selections that show on each screen.

Normally, the CACPs control only given seating areas of the cabin. The configuration database identifies the areas each CACP controls. The PANEL OVERRIDE selection lets all CACPs control any area.

The LIGHTING selection controls cabin illumination and reading lights.

The SERVICE CALL/CHIME CONTROL selection gives information on passenger-to-attendant calls. It also permits the attendants to disable the passenger-to-attendant chimes.

Use the CABIN TEMPERATURE selection to control the cabin temperature.

The WATER/WASTE TANK STATUS selection supplies data on potable water level status and waste tank status. It also gives selection for lavatory inoperable controls.

Attendants use the BOARDING MUSIC selection to control boarding music.

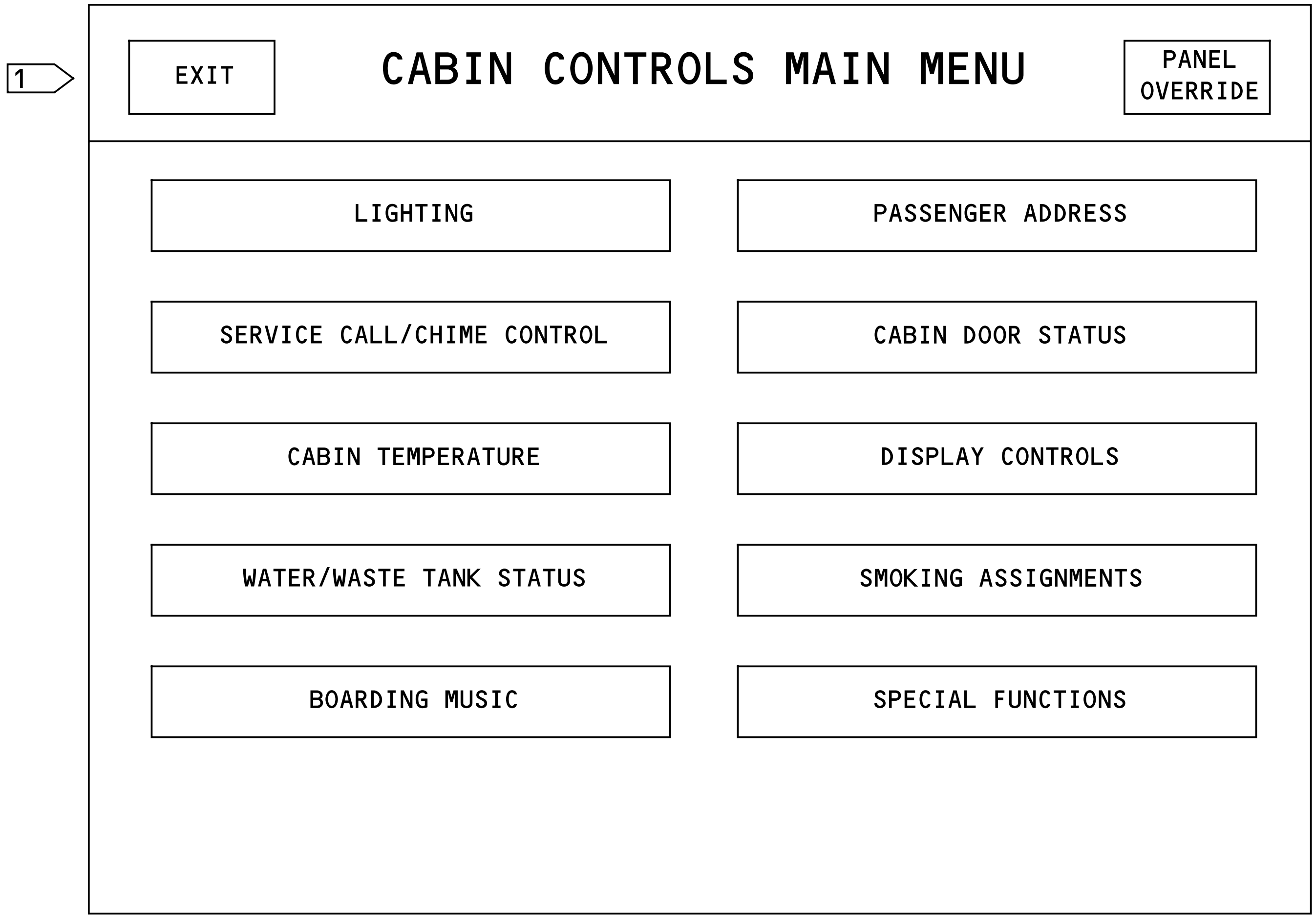
The PASSENGER ADDRESS selection supplies passenger address volume control and ambient noise sensor on/off control.

The CABIN DOOR STATUS supplies data for door positions (open or closed).

The DISPLAY CONTROLS selection supplies panel brightness controls and panel lockout control.

Use the SMOKING ASSIGNMENTS selection to control smoking area selections.

The SPECIAL FUNCTIONS selection gives on/off control of items identified by the configuration database.



CSCP/CACP SCREEN

1 THE EXIT SELECTION IS NOT ON THE CACP.

23-39-00-603 Rev 0 06/18/96

CSS GENERAL - CABIN CONTROLS MAIN MENU

CSS GENERAL - ENTRY WAY LIGHTS SCREEN

General

You use the entry way lights screen to operate the entry lights.

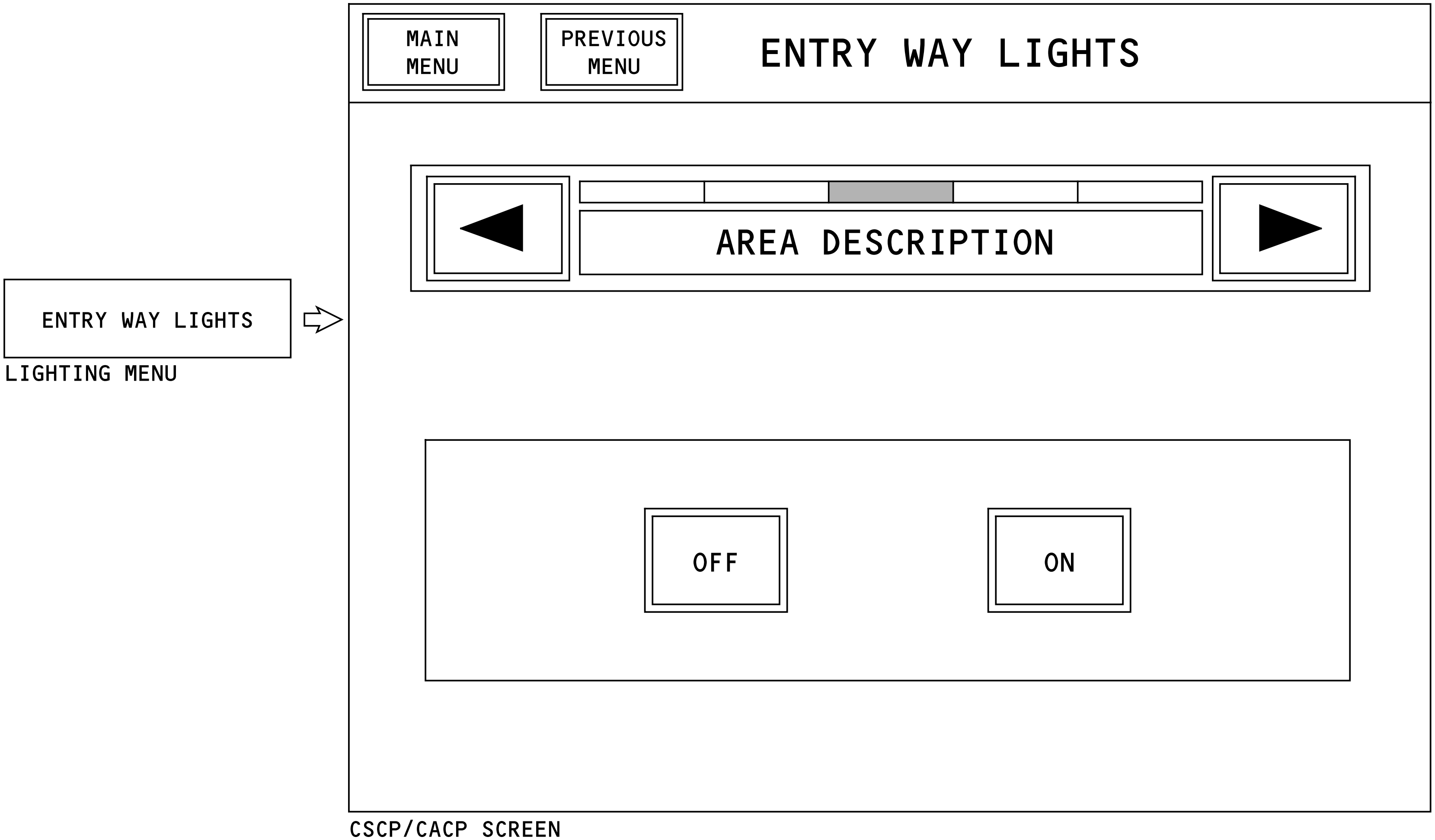
Access

Touch LIGHTING on the cabin controls main menu. Then touch ENTRY WAY LIGHTS to show the entry way lights screen.

Controls and Indications

Use the left and right arrows to select the cabin areas. The space between the arrows shows the selected cabin area description.

Use the selections below the cabin area description to make the lights come on or go off.



CSS GENERAL – ENTRY WAY LIGHTS SCREEN

CSS GENERAL - CABIN TEMPERATURE SCREEN

General

Attendants use the cabin temperature screen to set temperatures for each passenger zone.

Access

Touch CABIN TEMPERATURE on the cabin controls main menu to show this screen.

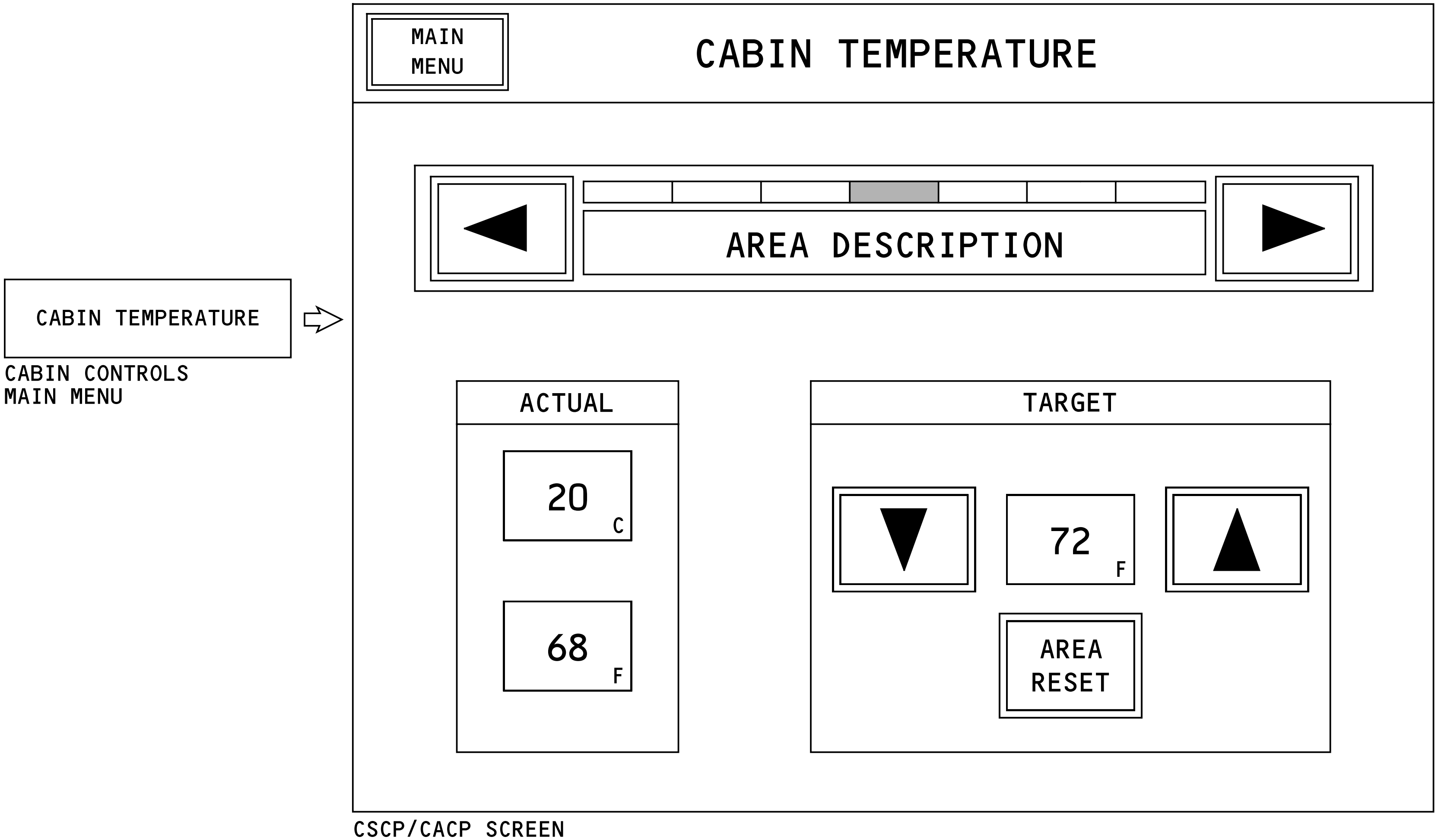
Controls and Indications

Use the left and right arrows to select the cabin areas. The space between the arrows shows the selected cabin area description.

The temperature of the selected area shows in degrees Celsius and degrees Fahrenheit in the lower left area of the screen.

Touch the up and down arrows in the lower right area of the screen to select the target temperature.

Touch AREA RESET to reset the area to the default temperature.



23-39-00-612 Rev 0 06/18/96

CSS GENERAL - CABIN TEMPERATURE SCREEN

CSS GENERAL - WATER/WASTE TANK STATUS MENU SCREEN

General

You use the water/waste tank status menu screen to select screens that show water and waste tank data.

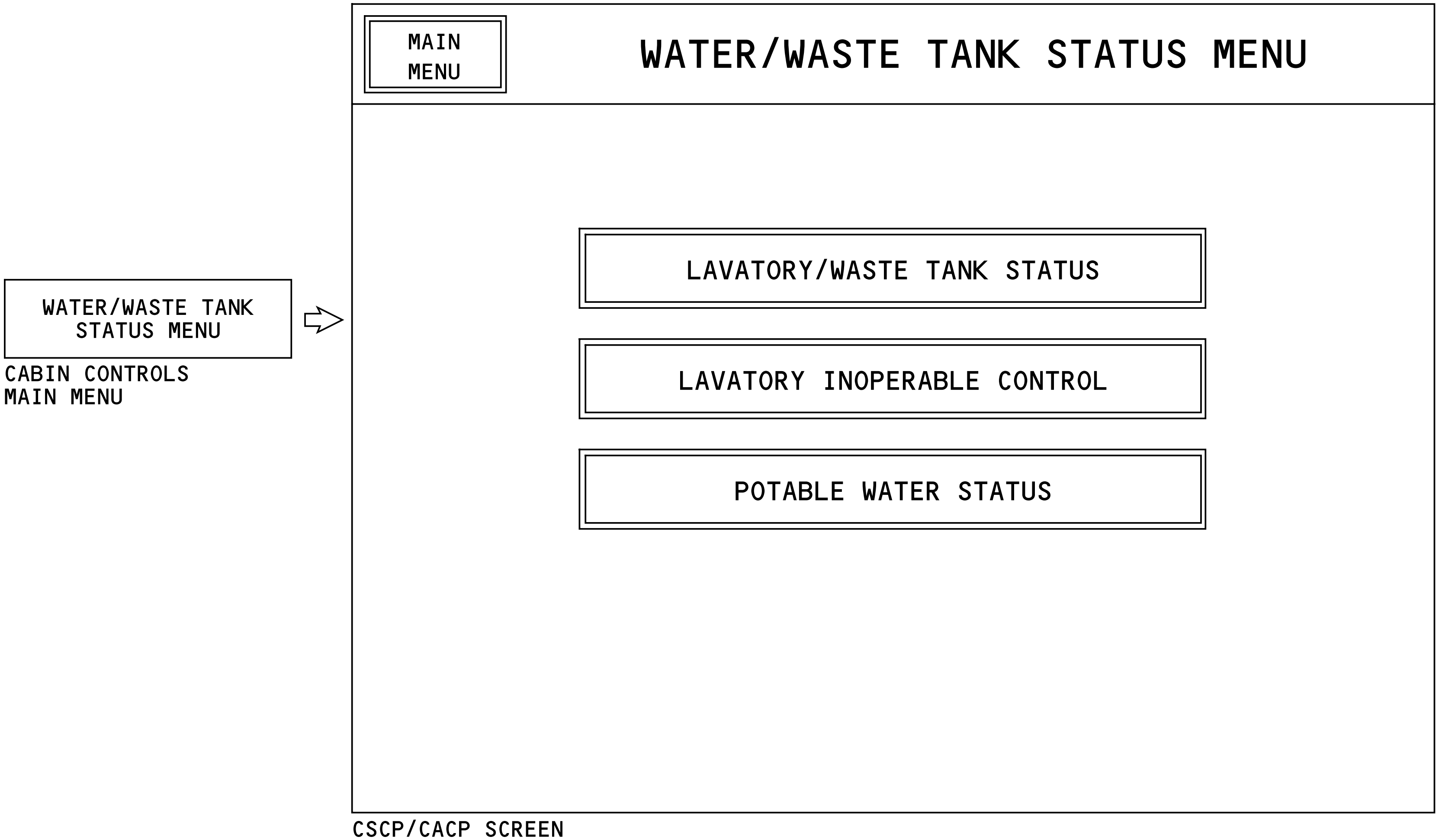
Access

Touch WATER/WASTE TANK STATUS on the cabin controls main menu to show this screen.

Controls and Indications

Touch these selections to go to the screen that controls the related function:

- LAVATORY/WASTE TANK STATUS - to see the condition of the lavatories and waste tanks
- LAVATORY INOPERABLE CONTROL - to control the condition of the lavatories
- POTABLE WATER STATUS - to see the condition of the potable water tanks.



23-39-00-613 Rev 0 06/18/96

CSS GENERAL - WATER/WASTE TANK STATUS MENU SCREEN

CSS GENERAL - LAVATORY/WASTE TANK STATUS SCREEN

General

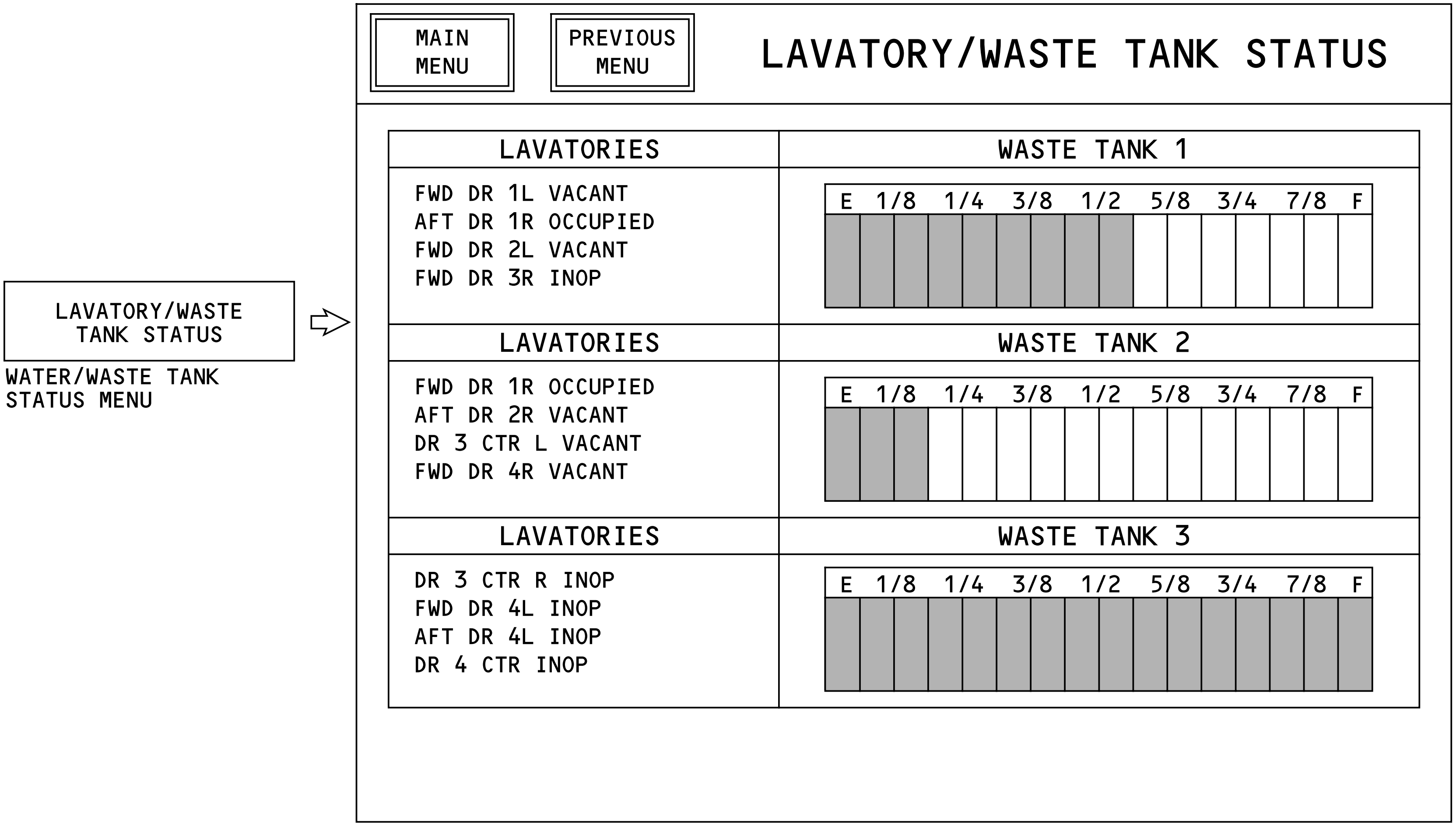
You use the lavatory/waste tank status screen to see the condition of the lavatories and waste tanks.

Access

Touch WATER/WASTE TANK STATUS on the cabin controls main menu. Then touch LAVATORY/WASTE TANK STATUS to show this screen.

Controls and Indications

The lavatories area of the screen shows lavatory locations and conditions. The area to the right of the lavatories shows the related waste tank and its level.



CSCP/CACP SCREEN

23-39-00-614 Rev 0 06/18/96

CSS GENERAL - LAVATORY/WASTE TANK STATUS SCREEN

CSS GENERAL - LAVATORY INOPERABLE CONTROL SCREEN

General

You use the lavatory inoperable control screen to control the status of the lavatories.

Access

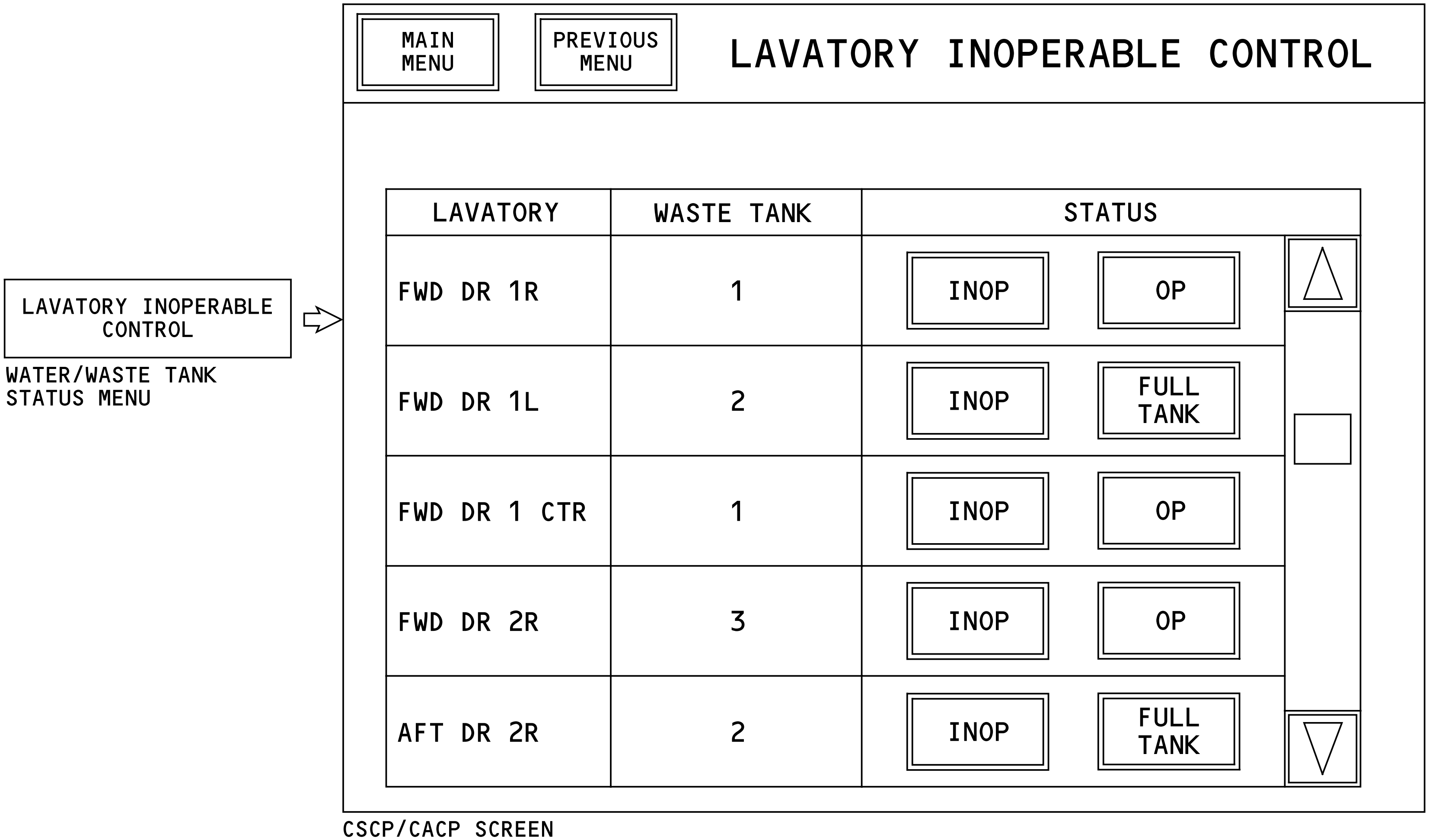
Touch WATER/WASTE TANK STATUS on the cabin controls main menu. Then touch LAVATORY INOPERABLE CONTROL to show this screen.

Controls and Indications

The screen shows the lavatories and assigned waste tanks. The status area of the screen shows the condition of each lavatory.

Touch OP or INOP to make the lavatory show operational or inoperative on the lavatory/waste tank status screen.

Use the up and down arrows on the right side of the display to scroll the lavatory data up and down.



23-39-00-615 Rev 0 06/17/96

CSS GENERAL - LAVATORY INOPERABLE CONTROL SCREEN

CSS GENERAL - POTABLE WATER STATUS SCREEN

General

You use the potable water status screen to see the condition of the potable water tanks.

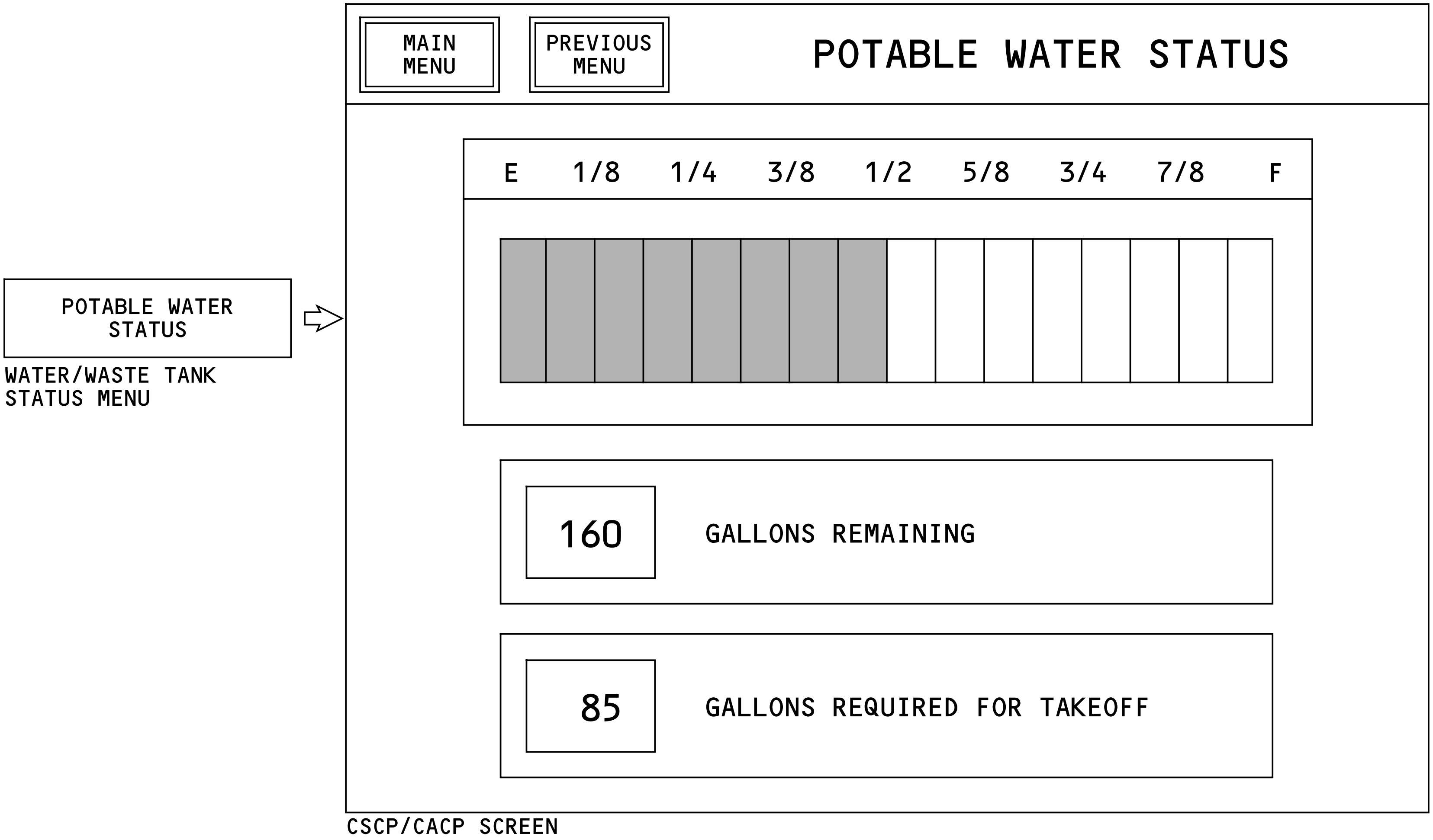
Access

Touch WATER/WASTE TANK STATUS on the cabin controls main menu. Then touch POTABLE WATER STATUS to show this screen.

Controls and Indications

The potable water status screen shows the total amount of water in the tanks. It also shows how much water must be in the tanks for takeoff.

The airplane holds approximately 327 gallons of potable water. Each segment is approximately 20.4 gallons.



23-39-00-616 Rev 1 10/06/1997

CSS GENERAL - POTABLE WATER STATUS SCREEN

CSS GENERAL - BOARDING MUSIC SCREEN

General

Attendants use the boarding music screen to select boarding music.

Access

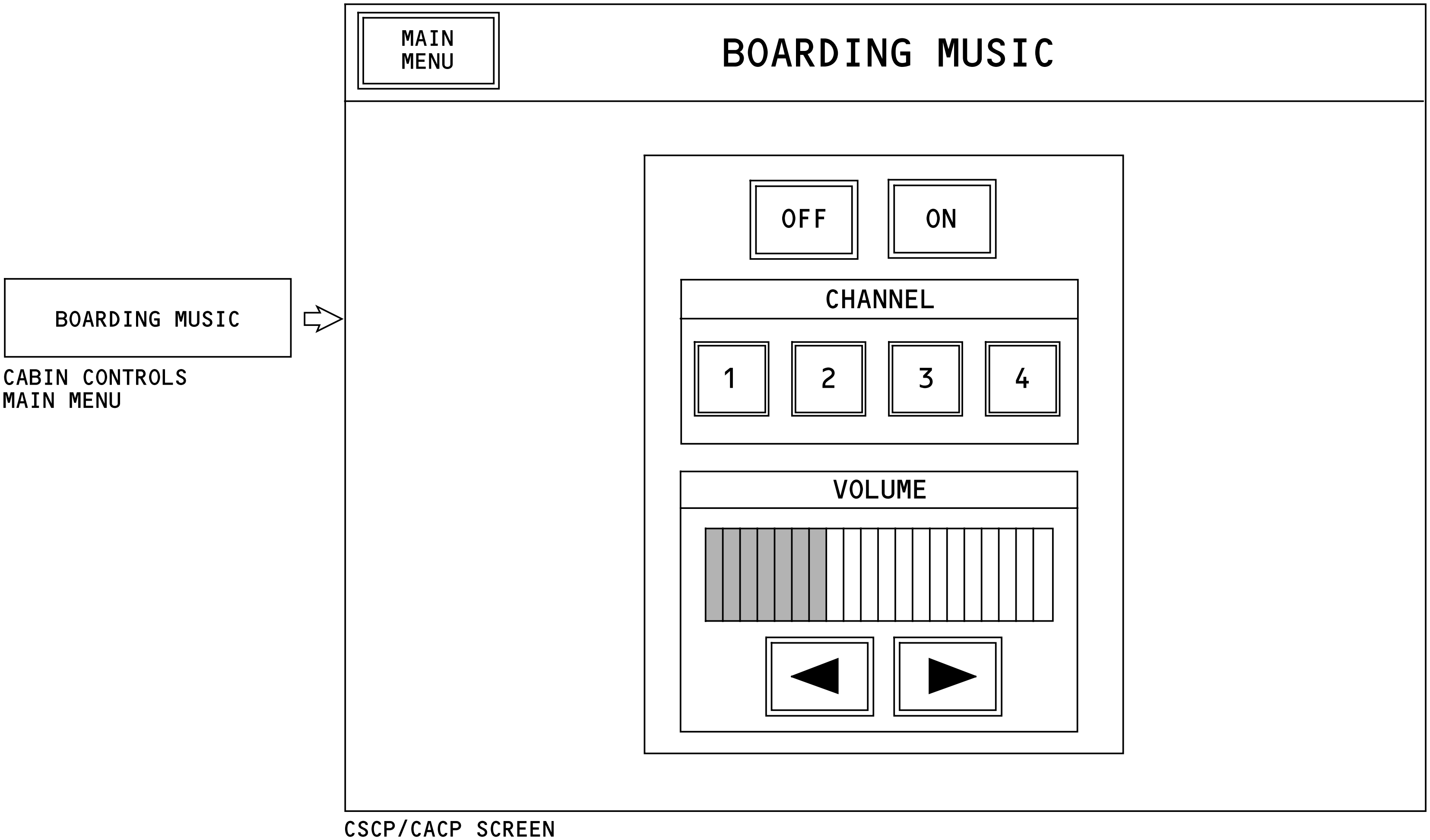
Touch BOARDING MUSIC on the cabin controls main menu to show this screen.

Controls and Indications

Touch ON or OFF to cause the boarding music to come on or go off.

Touch 1, 2, 3, or 4 to select a channel.

The volume indication shows the current volume. Touch the left arrow to decrease the volume. Touch the right arrow to increase the volume.



23-39-00-617 Rev 0 06/17/96

CSS GENERAL - BOARDING MUSIC SCREEN

CSS GENERAL - PASSENGER ADDRESS SCREEN

General

Attendants use the passenger address screen to adjust the passenger address volume and to control the ambient noise sensors.

Access

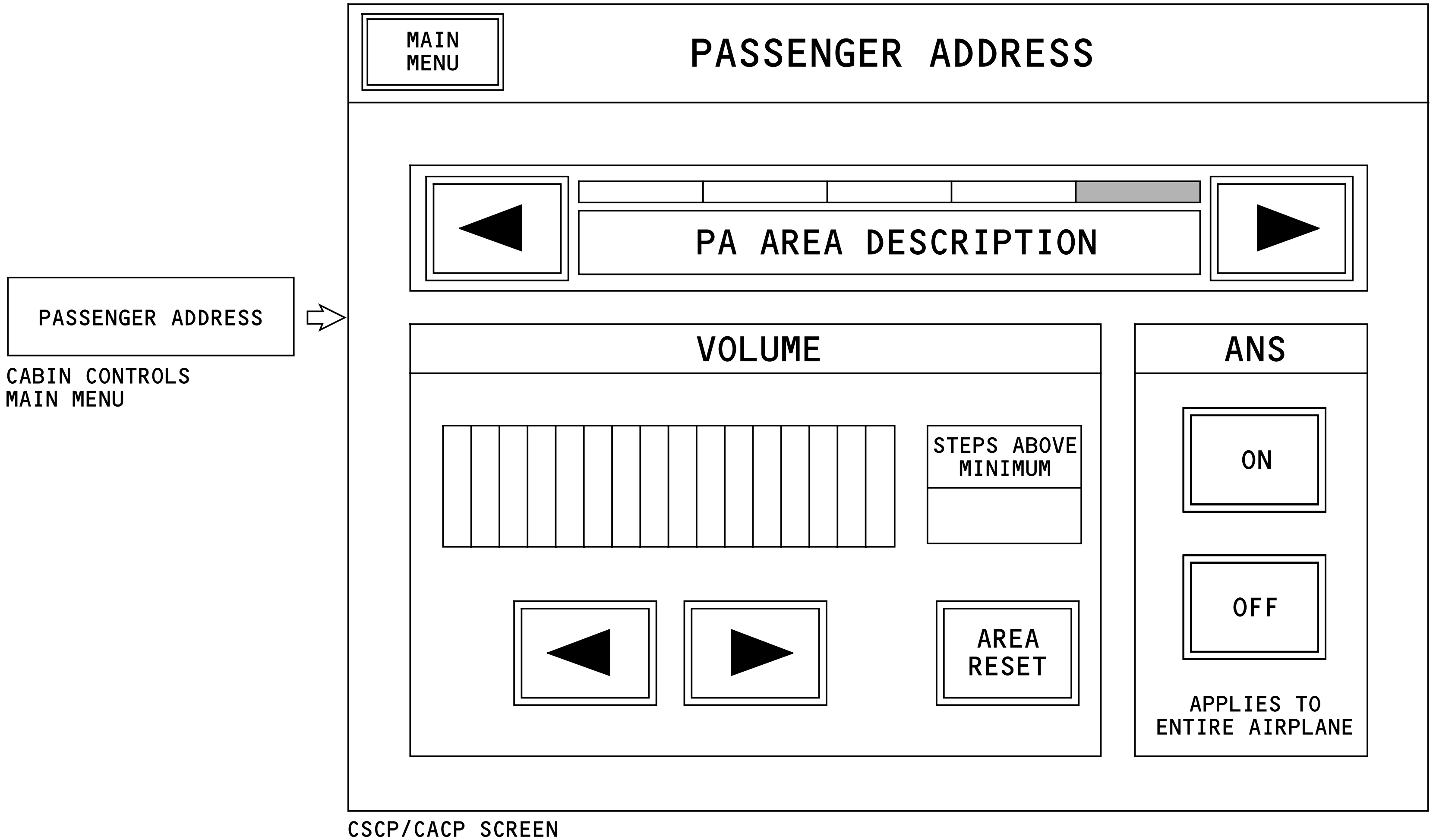
Touch PASSENGER ADDRESS on the cabin controls main menu to show this screen.

Controls and Indications

Use the left and right arrows to select the cabin areas. The space between the arrows shows the selected cabin area description.

Use the left and right arrows in the volume area to control the amount of increase in volume above the reference level. The number of steps above minimum you select shows in the steps above minimum area. Touch AREA RESET to return the volume to the reference level.

Use the ambient noise sensor (ANS) controls to enable or disable the ambient noise sensors.



23-39-00-618 Rev 0 06/17/96

CSS GENERAL - PASSENGER ADDRESS SCREEN

CSS GENERAL - CABIN DOOR STATUS SCREEN

General

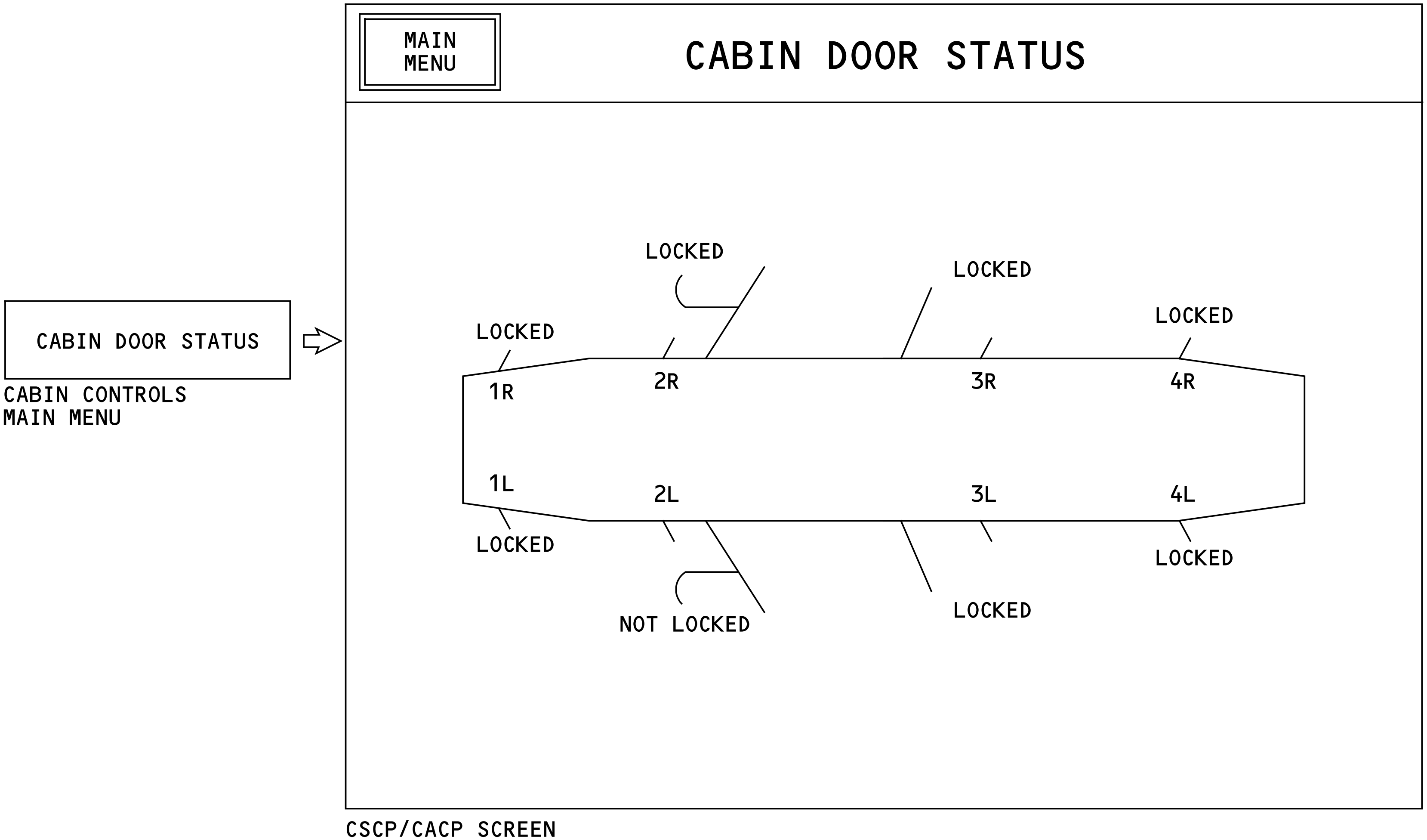
Attendants use the cabin door status screen to see if the doors are locked or not locked.

Access

Touch CABIN DOOR STATUS on the cabin controls main menu to show this screen.

Controls and Indications

The cabin door status screen shows the locked/not locked status of the cabin doors.



23-39-00-619 Rev 1 07/08/1997

CSS GENERAL - CABIN DOOR STATUS SCREEN

CSS GENERAL - DISPLAY CONTROLS SCREEN

General

You use the display controls screen to adjust the panel brightness and clean the display.

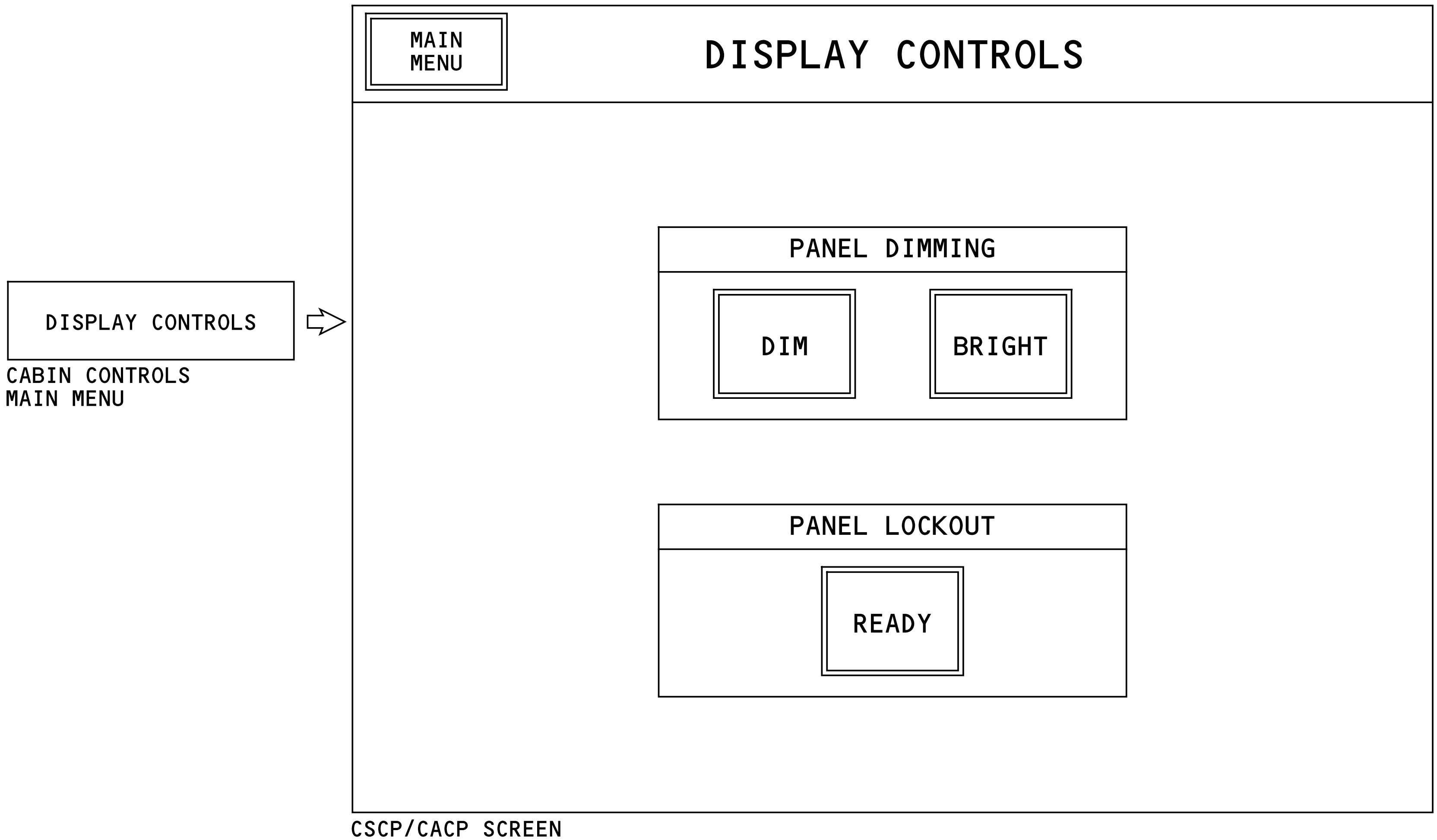
Access

Touch DISPLAY CONTROLS on the cabin controls main menu to show the display controls screen.

Controls

The panel dimming selections control the screen brightness. Touch DIM to decrease the brightness. Touch BRIGHT to increase the brightness.

Touch the panel lockout selection to stop panel operation for 30 seconds. A 30 second timer shows on the screen. You can not make screen selections while the panel is locked out. You can clean the screen while the panel is locked out.



23-39-00-620 Rev 0 06/17/96

CSS GENERAL - DISPLAY CONTROLS SCREEN

CSS GENERAL - POP-UP WINDOWS

General

The CMS shows pop-up windows on the CSCP and CACPs for important system messages. These windows show on top of the active window.

There are three types of pop-up windows:

- Alert messages
- Function lockout messages
- Error messages.

Alert Messages

The alert messages tell the flight attendants that a condition requires action. These conditions cause alert messages:

- Lavatory smoke detection
- Passenger address controller failures
- Cabin interphone controller failures
- Waste tank full
- Less than 1/4 tank of potable water.

Function Lockout Messages

Function lockout messages tell the flight attendants some functions may not operate because of system conditions. These conditions cause function lockout messages:

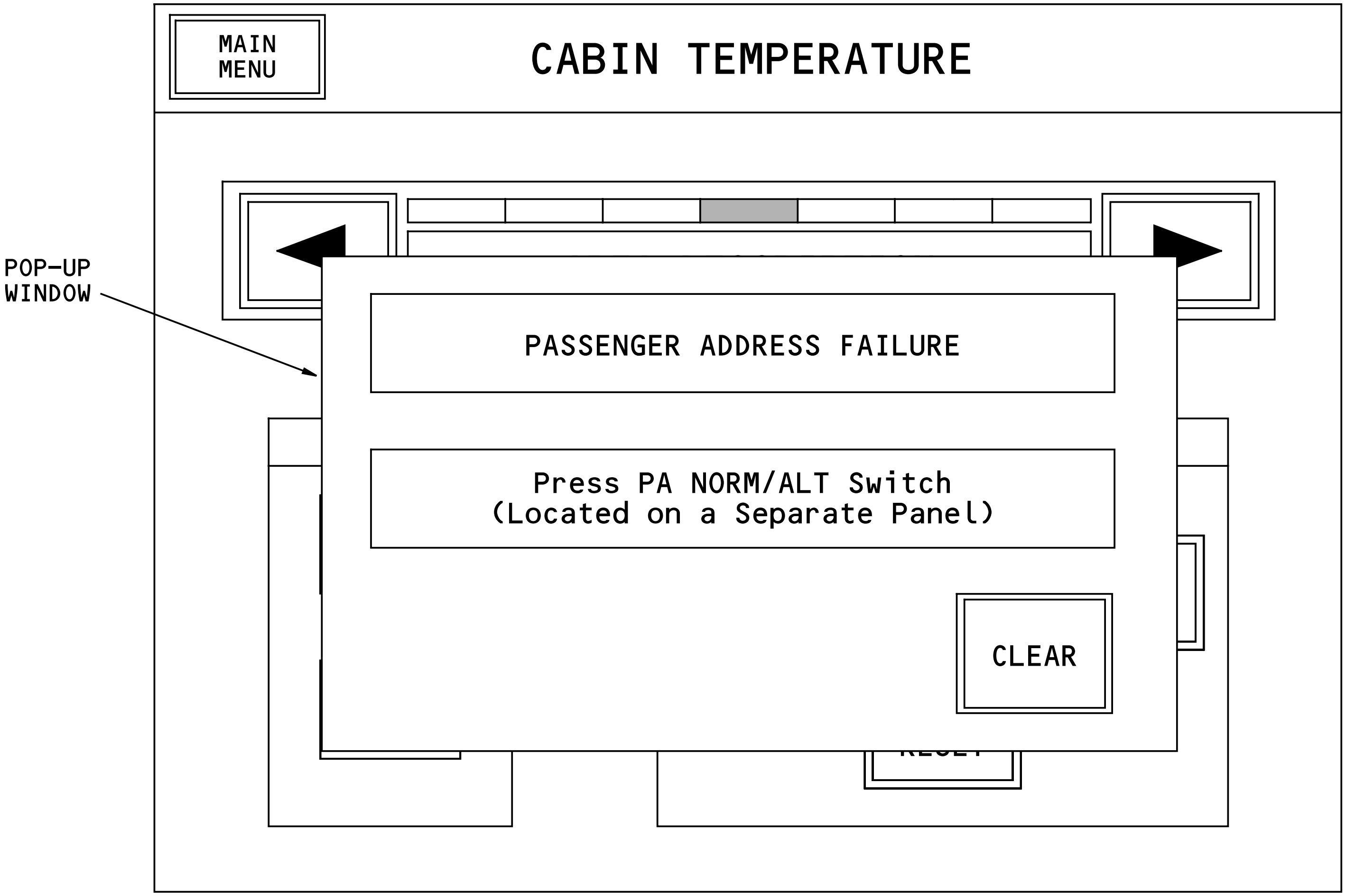
- Cabin decompression
- Loss of ground service bus power
- Loss of data from the environmental control system.

Error Messages

When a system does not respond to a selection, an applicable message shows.

Clearing Pop-up Windows

Touch CLEAR to remove the pop-up window from the display.



CSCP/CACP SCREEN

23-39-00-622 Rev 1 06/17/96

CSS GENERAL - POP-UP WINDOWS

CSS TEST AND SOFTWARE INSTALLATION - INTRODUCTION

General

You do most cabin services system (CSS) maintenance functions from the cabin system control panel (CSCP).

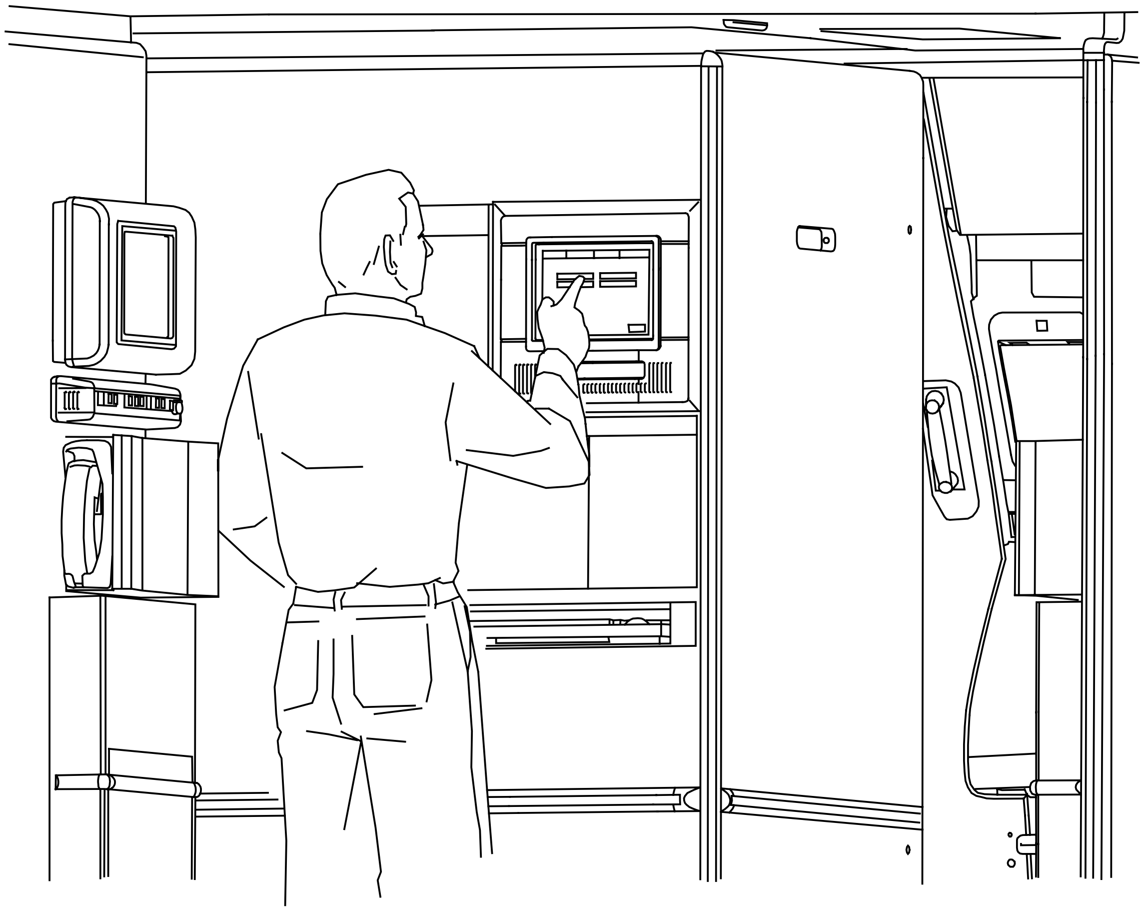
CSS maintenance includes two general areas; tests and software installation.

Tests

You use the CSCP to do tests and review failure data. BITE and continuous fault monitor are the two primary types of tests.

Software Installation

You use the CSCP to install software in the CSS. Software operation functions include software installation and configuration checks.



23-39-00-650 Rev 0 06/17/96

CSS TEST AND SOFTWARE INSTALLATION - INTRODUCTION

CSS TEST AND SOFTWARE INSTALLATION - REQUEST FOR PASSWORD DIALOGUE WINDOW

General

For some CSS maintenance functions, you may need to enter a password. The configuration database controls which functions require passwords.

A dialogue window shows automatically when you make a selection that requires a password.

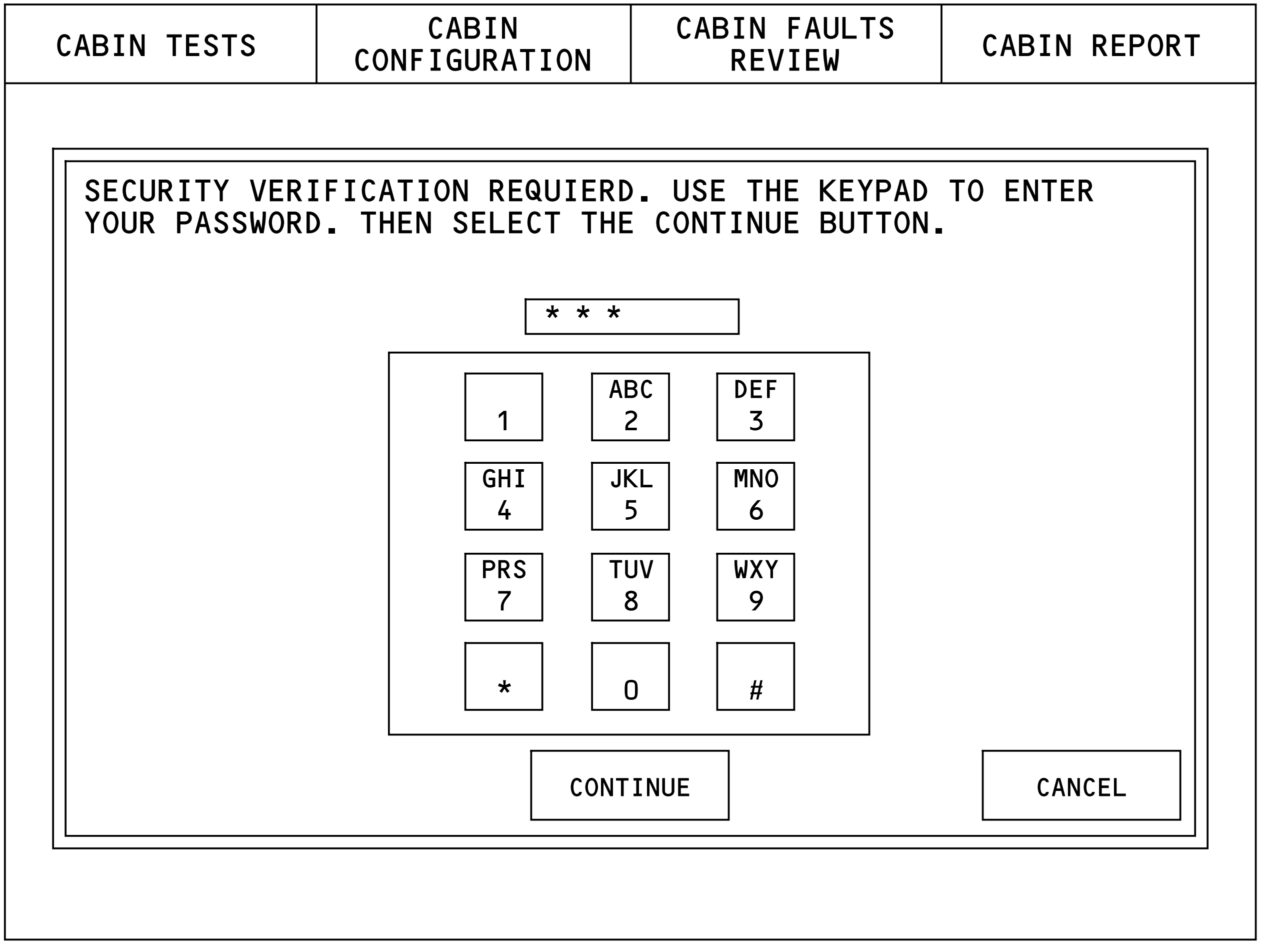
Controls and Indications

The request for password dialogue window tells you to enter a password for a selection you made on a previous screen. It also shows a keypad that looks like telephone keys.

Use the keys on the keypad to enter your password. An asterisk shows in the area above the keypad for each key you select.

After you enter your password, touch CONTINUE to go to the function you selected. If you enter a wrong password, an access denied dialogue window shows.

Touch CANCEL to stop password selections and return to the previous screen.



CSCP SCREEN

23-39-00-651 Rev 0 06/17/96

CSS TEST AND SOFTWARE INSTALLATION - REQUEST FOR PASSWORD DIALOGUE WINDOW

CSS TEST AND SOFTWARE INSTALLATION - CABIN MAINTENANCE MAIN MENU

General

You use the cabin system control panel (CSCP) cabin maintenance main menu to select all maintenance functions.

Access

Touch CABIN MAINTENANCE on the CSCP main menu to show the cabin maintenance main menu.

Controls

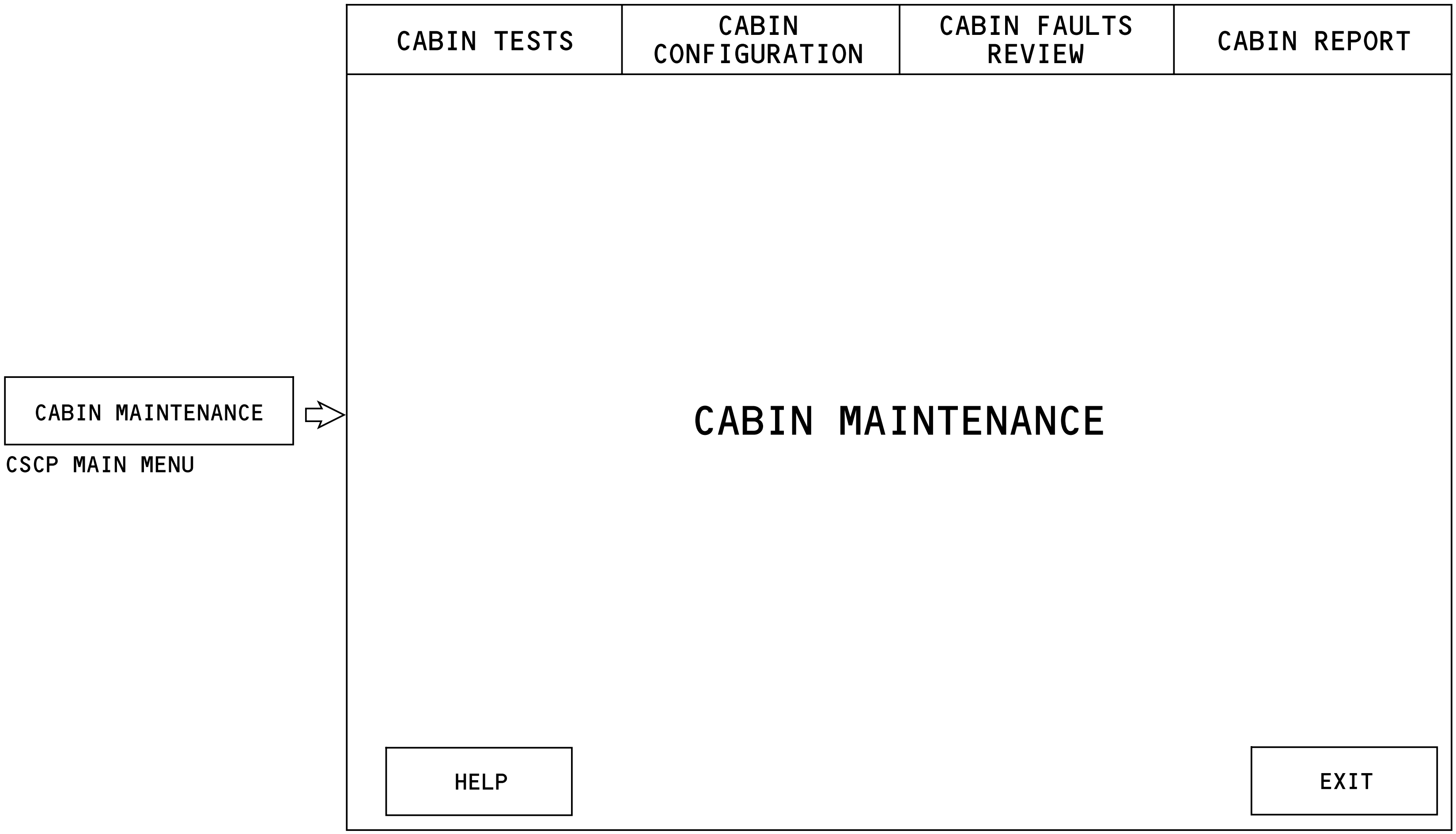
Touch any of these four selections at the top of this screen to do the related function:

- CABIN TESTS - start CSS tests and monitor test results
- CABIN CONFIGURATION - install software and see LRU hardware and software part numbers
- CABIN FAULTS REVIEW - review failure data including faults related to CSS flight deck effects
- CABIN REPORT - send fault and part number data to a cabin printer.

The four selections show at the top of all maintenance screens. You can select any of the four selections from any maintenance screen (except for dialogue windows).

Touch these selections at the bottom of the screen to do the related function:

- HELP - to go to the cabin maintenance menu tree. The menu tree shows cabin maintenance selections and gives access to additional data on cabin maintenance functions
- EXIT - to go back to the CSCP main menu.



CSCP SCREEN

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CSS TEST AND SOFTWARE INSTALLATION - CABIN MAINTENANCE MAIN MENU

CSS TEST AND SOFTWARE INSTALLATION - CABIN MAINTENANCE MENU TREE

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CSS TEST AND SOFTWARE INSTALLATION - CABIN MAINTENANCE MENU TREE

General

The cabin maintenance menu tree gives you data for all the available selections on the maintenance menus.

Because of selections made in the configuration database generator or airline equipment options, some menu selections will not operate.

Access

To show the cabin maintenance menu tree, touch HELP on the cabin maintenance main menu.

Controls and Indications

The selections at the top of the menu tree show general data about these four top-level selections available on all maintenance screens:

- Cabin Tests
- Cabin Configuration
- Cabin Faults Review
- Cabin Report.

Cabin Tests

The Cabin Tests selection shows you general data about the different tests of the CSS. Touch any of the four selections below Cabin Tests to see the help screen for that function.

These are the four cabin tests:

- Quick test; collects real-time failures for 20 seconds and shows them on the screen.
- All test; starts a full BITE of the CSS. The CSCP shows all failures the BITE finds.
- Engineering tests have a special use. Different functions have different engineering tests.
- Lamps test; lets you control cabin lights. It lets you visually check the operation of the lamps.

Cabin Configuration

The Cabin Configuration selection shows you general data about software installation and configuration checks of the CSS. Touch any of the three selections below Cabin Configuration to see the help screen for that function.

These are the three cabin configuration functions:

- You can select and install a configuration database in the CSS components.
- A software management menu lets you install operational programs in CSS LRUs and remove and load software programs in the CSCP memory.
- Use the configuration check to see the LRU part number data of CSS components installed in the airplane.

Cabin Faults Review

This selection shows you general data about faults review screens. Touch any of the six selections below

CSS TEST AND SOFTWARE INSTALLATION - CABIN MAINTENANCE MENU TREE

Cabin Faults Review to see the help screen for that function.

These are the different types of review screens:

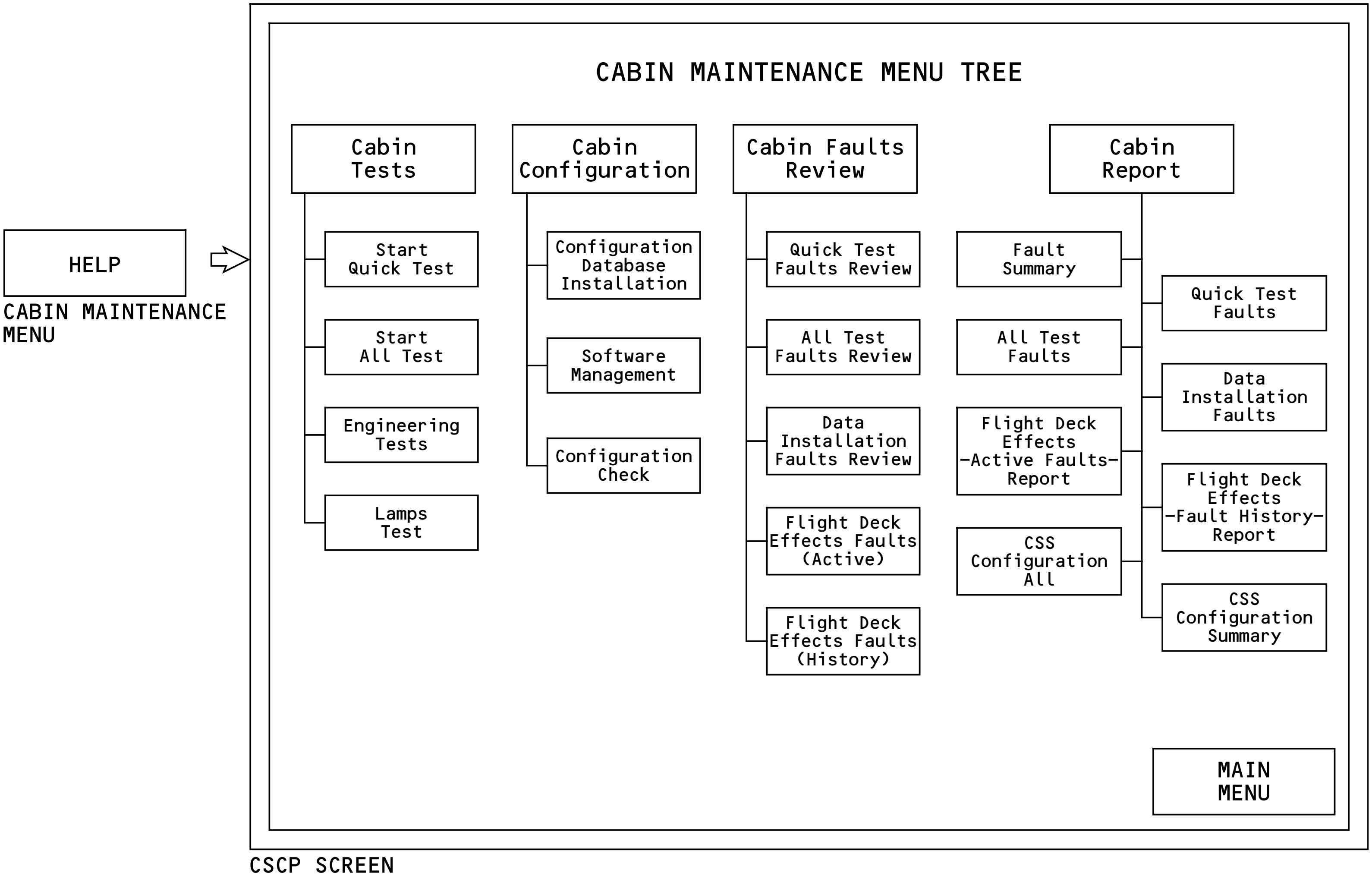
- The quick test faults review shows the results of the last quick test.
- The all test faults review shows the results of the last all test.
- A data installation faults review screen shows the results of the last software installation.
- The flight deck effects faults (active) screen shows active CSS related flight deck effects (FDEs). The CSCP shows all active CSS related FDEs and the failure that caused the FDE.
- The flight deck effects faults (history) screen shows CSS related flight deck effects (FDEs) in memory. The CSCP shows as many as 99 of the last CSS related FDEs and the failures that caused each FDE.

Cabin Report Menu

This selection tells you how to make a paper copy of the faults results and configuration data. Touch any of the eight selections below cabin report to see the help screen for that function.

These are the different reports:

- A fault summary report that shows maintenance message numbers and the number of times they have occurred.
- A quick test faults report that shows the results of the last quick test.
- A report of the results of the last all test.
- A data installation report that contains failure descriptions from the last configuration database or operational program installation.
- A list of active CSS related FDEs and maintenance messages.
- A list all CSS related FDEs and maintenance messages in memory (history).
- A CSS configuration report that lists the hardware and software part numbers of the CSS related items installed in the airplane.
- The CSS configuration summary report shows part number data for CSS components.



23-39-00-653 Rev 0 06/17/96

CSS TEST AND SOFTWARE INSTALLATION - CABIN MAINTENANCE MENU TREE

CSS TEST AND SOFTWARE INSTALLATION - CABIN MAINTENANCE MENU TREE HELP WINDOW

General

The help menu tree dialogue windows give you data for the selection that was made on the cabin maintenance menu tree help window.

Access

To show the help menu tree dialogue window:

- Touch HELP on the cabin maintenance main menu
- Make a selection on the cabin maintenance menu tree.

Controls and Indications

The screen shows data for the selected function. If there is more data than fits in the window, use the up and down arrows at the right of the display to show more. The square in the scroll bar between the arrows shows the location of the displayed data in the data field.

Touch MENU TREE to return to the menu tree.

Touch MAIN MENU to show the cabin maintenance main menu.

Flight Deck Effects Faults (Active)

CABIN MAINTENANCE MENU TREE

HELP FOR Flight Deck Effects Faults (Active)

FLIGHT DECK EFFECT FAULTS (ACTIVE) shows fault information for failures that cause Cabin Services System-related EICAS messages. Active EICAS messages are messages that currently exist. Touch this selection to show the active FLIGHT DECK EFFECTS FAULTS.

The FLIGHT DECK EFFECTS FAULTS (ACTIVE) Screen has two parts: fault conditions and maintenance message data.

The top part of the screen shows the part number of the currently installed configuration database for the current leg.

The top part of the screen also shows, for each fault in the list of active Flight Deck Effects Faults, the date and the time of the faults occurrence.

The main part of the screen shows the maintenance message data. One maintenance message shows for each fault. The sequence number of each maintenance message

MENU TREE

MAIN MENU

CSCP SCREEN

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CSS TEST AND SOFTWARE INSTALLATION - CABIN MAINTENANCE MENU TREE HELP WINDOW

CSS TEST AND SOFTWARE INSTALLATION - CABIN TESTS MENU

General

You use the cabin tests menu to start tests of the CSS. There are four selections on the cabin tests menu:

- START QUICK TEST
- START ALL TEST
- ENGINEERING TESTS
- LAMPS TEST.

Access

Touch CABIN TESTS on any maintenance screen to go directly to the cabin tests menu.

Quick Test

You use a quick test to find major faults or during a turn-around. To start a quick test, touch START QUICK TEST. The test may operate for as long as 20 seconds and then shows the results.

All Test

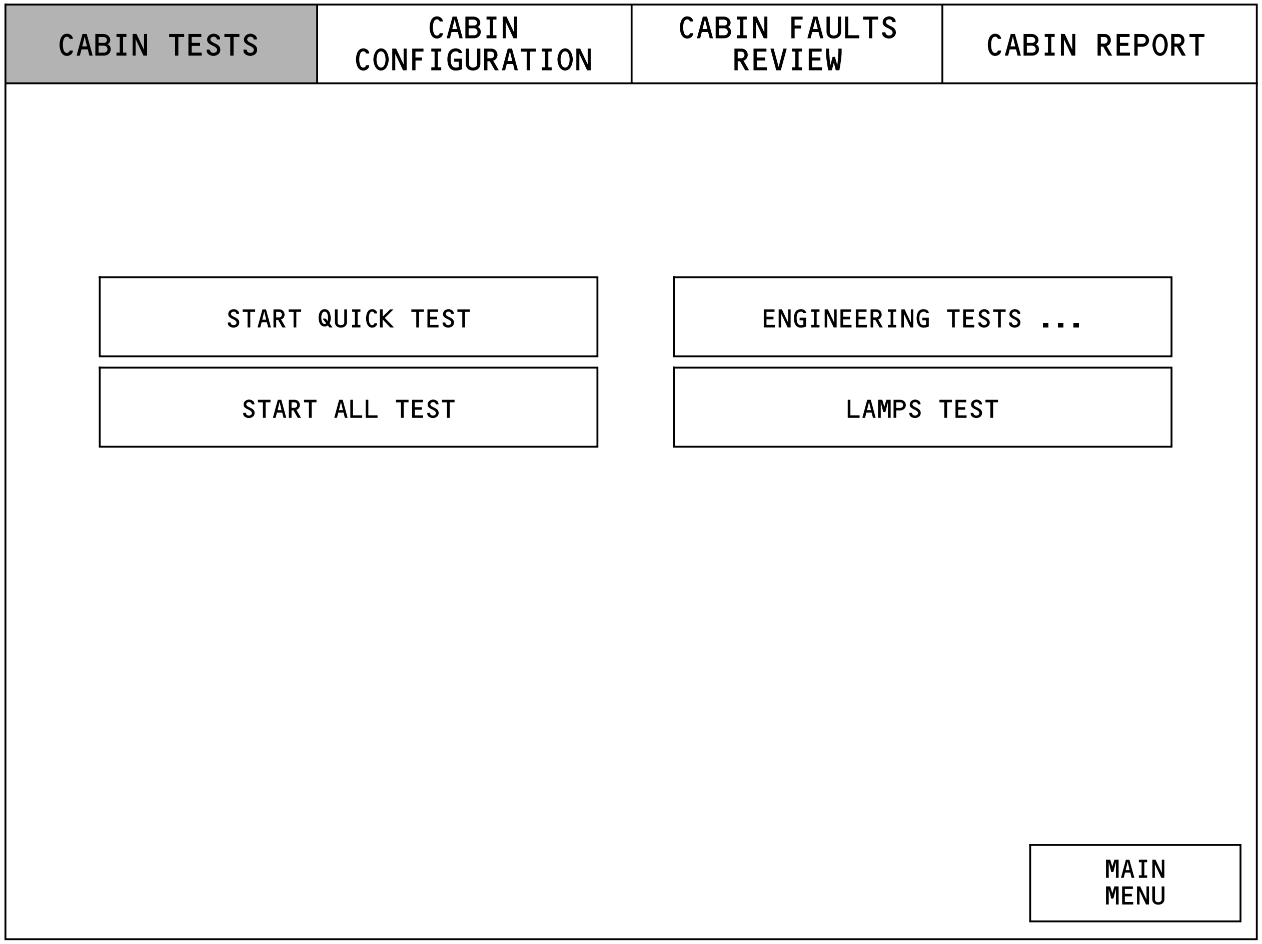
You use an all test for a more complete test. Normally you use an all test when the airplane is in for overnight service. To start an all test, touch START ALL TEST. The test operates for approximately two minutes then shows the results.

Engineering Tests

Touch ENGINEERING TESTS to show the engineering tests menu.

Lamps Test

Touch LAMPS TEST to show the lamps test control screens.



CSCP SCREEN

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CSS TEST AND SOFTWARE INSTALLATION - CABIN TESTS MENU

CSS TEST AND SOFTWARE INSTALLATION - QUICK TEST EXPLANATION DIALOGUE WINDOW

General

The quick test explanation window tells you what the quick test does.

Access

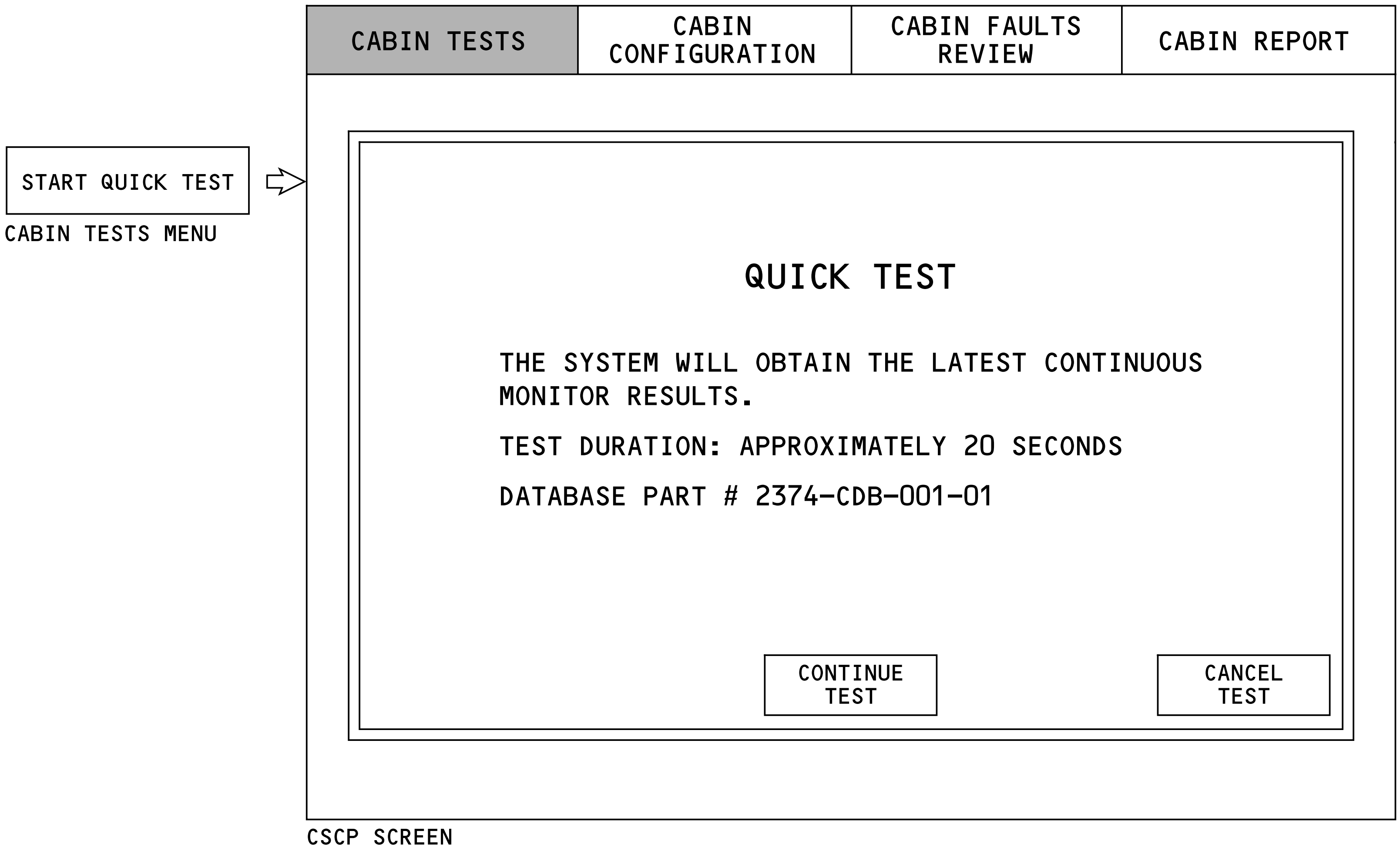
This window shows automatically when you touch START QUICK TEST.

Controls and Indications

The window gives you information on the quick test. It also shows the configuration database part number.

To start the test, touch CONTINUE TEST.

To stop the test, touch CANCEL TEST.



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CSS TEST AND SOFTWARE INSTALLATION - QUICK TEST EXPLANATION DIALOGUE WINDOW

CSS TEST AND SOFTWARE INSTALLATION - QUICK TEST OPERATING DIALOGUE WINDOW

General

During the quick test, the cabin system control panel (CSCP) shows the quick test operating window.

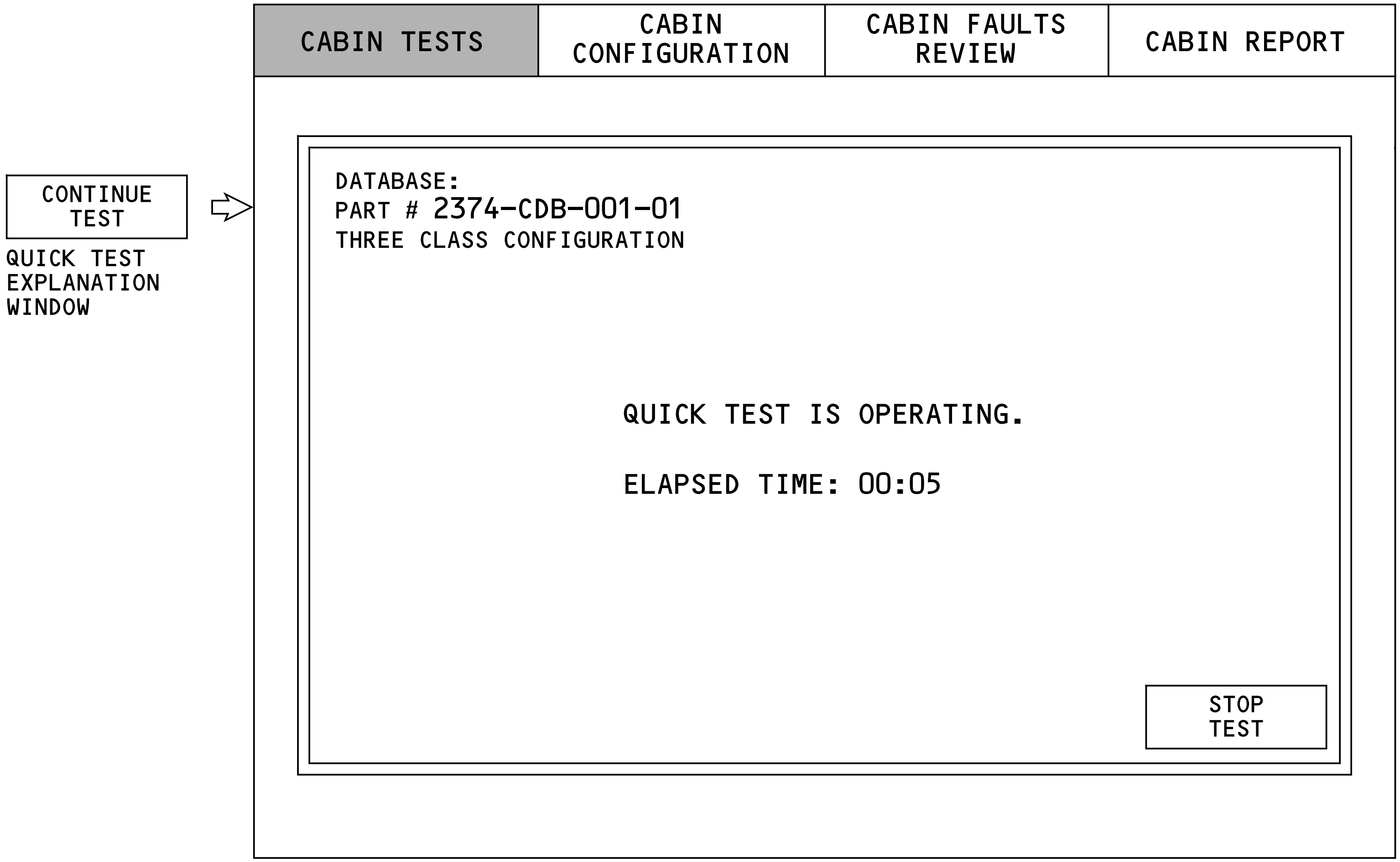
Controls and Indications

The elapsed time indication shows the time counted from the start of the test. The test may take as long as 20 seconds.

To stop the test, touch STOP TEST.

Operation

During normal operation, the CSS components monitor their operation. They send failure data to the cabin system management unit (CSMU). During the quick test, the CSMU collects failure data. The CSMU sends the results to the CSCP.



CSCP SCREEN

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CSS TEST AND SOFTWARE INSTALLATION - QUICK TEST OPERATING DIALOGUE WINDOW

CSS TEST AND SOFTWARE INSTALLATION - QUICK TEST COMPLETE - NO FAULTS SCREEN

General

The quick test complete with no faults screen shows if the test found no failures.

Access

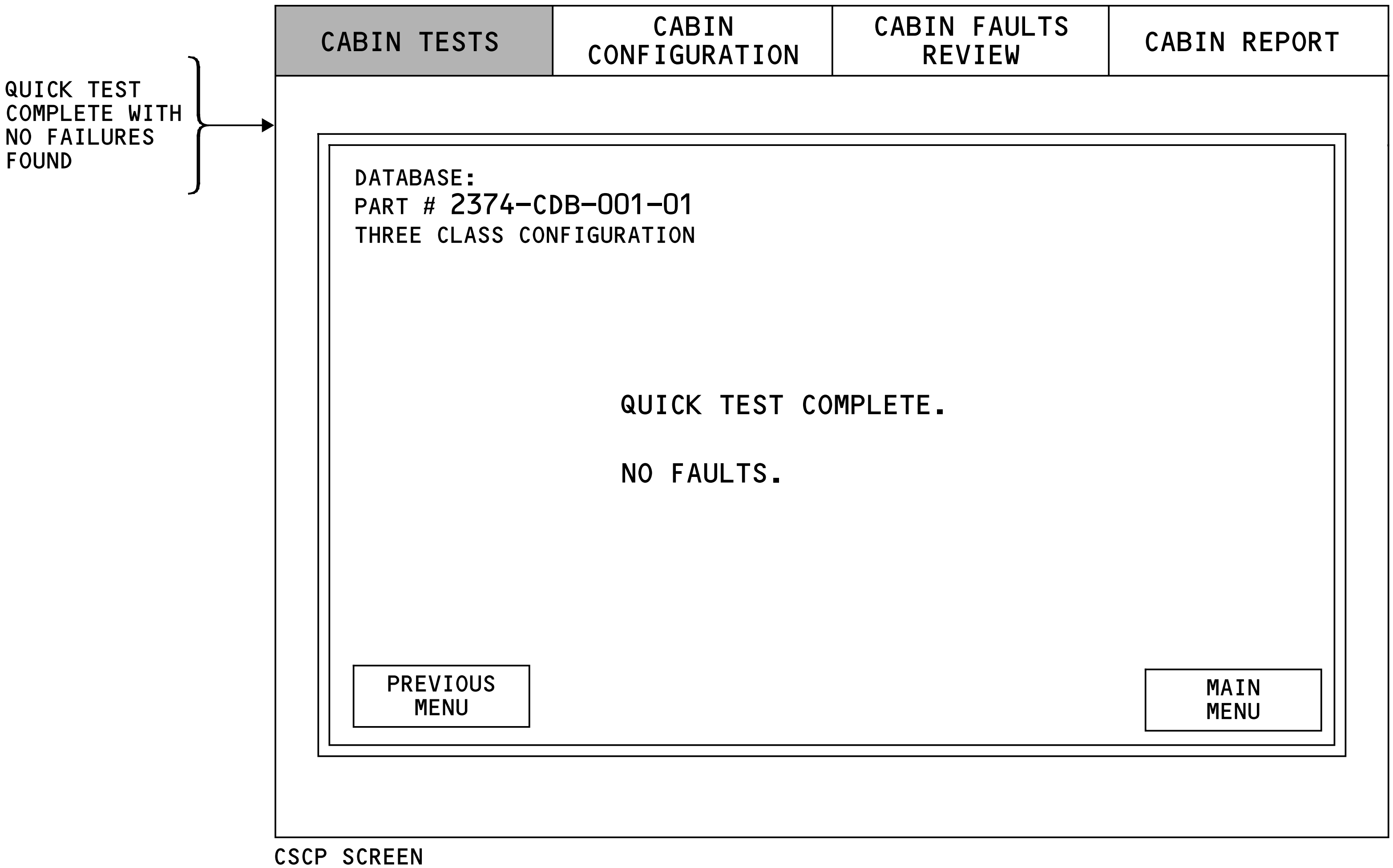
The screen shows automatically when the test is complete.

Controls and Indications

The screen shows the active database part number and description in the upper left corner.

Touch PREVIOUS MENU to show the cabin tests menu.

Touch MAIN MENU to show the cabin maintenance main menu.



23-39-00-658 Rev 0 06/17/96

CSS TEST AND SOFTWARE INSTALLATION - QUICK TEST COMPLETE - NO FAULTS SCREEN

CSS TEST AND SOFTWARE INSTALLATION - QUICK TEST FAULTS REVIEW SCREEN

General

You use the quick test faults review screen to identify failures from the last quick test.

Access

If a quick test finds any failures, this screen shows automatically when the test is complete. To start a quick test:

- Touch CABIN TESTS on any maintenance screen
- Touch START QUICK TEST on the cabin tests menu
- Touch CONTINUE TEST on the quick test explanation window.

You can also select this screen from the cabin faults review menu if there were faults. First touch CABIN FAULTS REVIEW at the top of any maintenance screen. Then touch QUICK TEST FAULTS REVIEW.

Controls and Indications

To show failure data, make a selection and then select CONTINUE.

Selections that have no faults show as gray text and are not selectable.

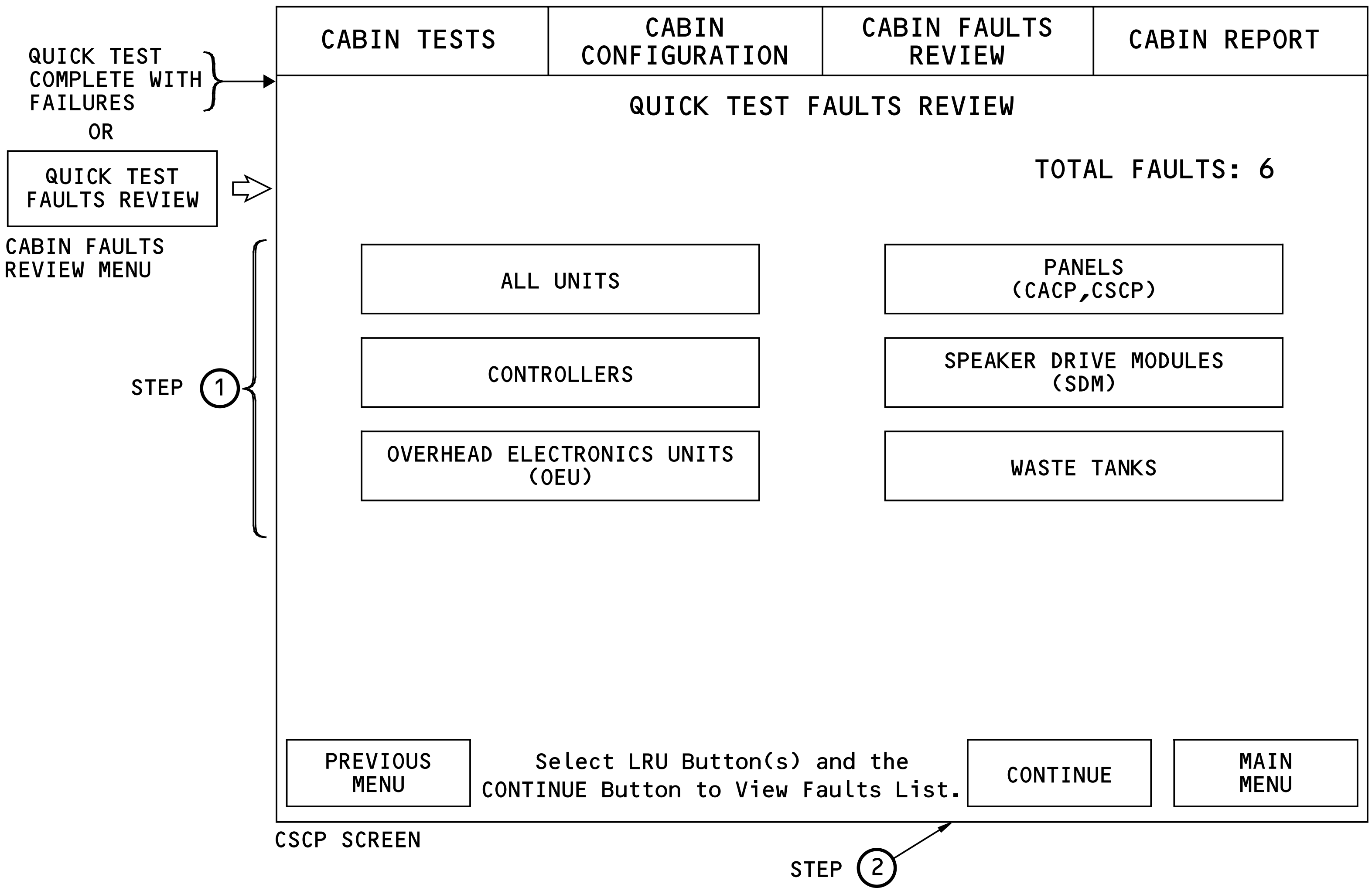
To see all failures, select ALL UNITS. This will deselect any other selections. When you select any other LRU, it deselects ALL UNITS.

Touch an LRU selection to enable it, touch it again to deselect it. You may select or deselect any combination of LRUs.

CONTINUE selects the fault results screen.

Touch PREVIOUS MENU to show the cabin tests menu or cabin faults review menu.

Touch MAIN MENU to show the cabin maintenance menu.



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CSS TEST AND SOFTWARE INSTALLATION - QUICK TEST FAULTS REVIEW SCREEN

CSS TEST AND SOFTWARE INSTALLATION - QUICK TEST FAULT RESULTS SCREEN

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CSS TEST AND SOFTWARE INSTALLATION - QUICK TEST FAULT RESULTS SCREEN

General

You use the quick test fault results screen to see failures found during the last quick test.

Access

You can select this screen from the quick test faults review screen. The faults review screen shows at the end of a quick test. To start a quick test:

- Touch CABIN TESTS on any maintenance screen
- Touch START QUICK TEST on the cabin tests menu
- Touch CONTINUE TEST on the quick test explanation window
- Touch ALL UNITS or an LRU type and then touch CONTINUE on the faults review screen.

You can also select the quick test fault results screen from the cabin faults review menu. To show the quick test faults review screen:

- Touch CABIN FAULTS REVIEW at the top of any maintenance screen
- Touch QUICK TEST FAULTS REVIEW on the cabin faults review menu
- Touch ALL UNITS or touch an LRU type on the quick test faults review screen
- Touch CONTINUE on the quick test faults review screen.

Controls and Indications

These are the three parts of the screen:

- Test conditions
- Maintenance message data
- Selection controls.

Test Conditions

The test conditions part of the screen shows this test data:

- Test type (quick test or all test)
- The configuration database part number installed at the time of the test.
- The date and time of the test
- The type of LRUs selected from the faults review screen
- The sequence of each maintenance message in the list of messages for the selected LRU type.

There is a HELP selection on the left. Touch HELP for data on how to use the screen.

Maintenance Message Data

Each page shows one maintenance message. The maintenance message shows data about each failure. There are three parts to the message:

- Fault description
- Maintenance message number

CSS TEST AND SOFTWARE INSTALLATION - QUICK TEST FAULT RESULTS SCREEN

- Recommended maintenance action.

The fault description identifies the failure condition detected by the test. It also identifies the component that found the fault.

You use the maintenance message number to find the corrective action in the fault isolation manual (FIM).

Some faults show as Latched. Most Latched faults are faults the system detects at power up. Some major faults are also latched during continuous monitor. Latched means the fault will stay in system memory until you take corrective action.

The recommended maintenance action identifies all the possible components or conditions that could cause the fault. The most probable cause shows first and the least probable cause shows last.

Each screen shows one maintenance message. Touch the down arrow to access additional messages. Touch the up arrow to return through the message list. The square on the scroll bar shows your position in the message list.

Selection Controls

Touch PREVIOUS MENU to show the cabin tests menu.

Touch PREVIOUS SCREEN to show the quick test faults review screen.

Touch SHOW LOCATION to show a visual reference of a defective component. If there is more than one defective component in the list of possible causes, another screen shows to let you select a component. Another screen will then show you the location of the component you selected.

Touch UNIT USAGE to show the components controlled by the defective component. If there is more than one defective component in the list of possible causes, another screen shows to let you select a component. Another screen will then show you the unit usage of the component you selected.

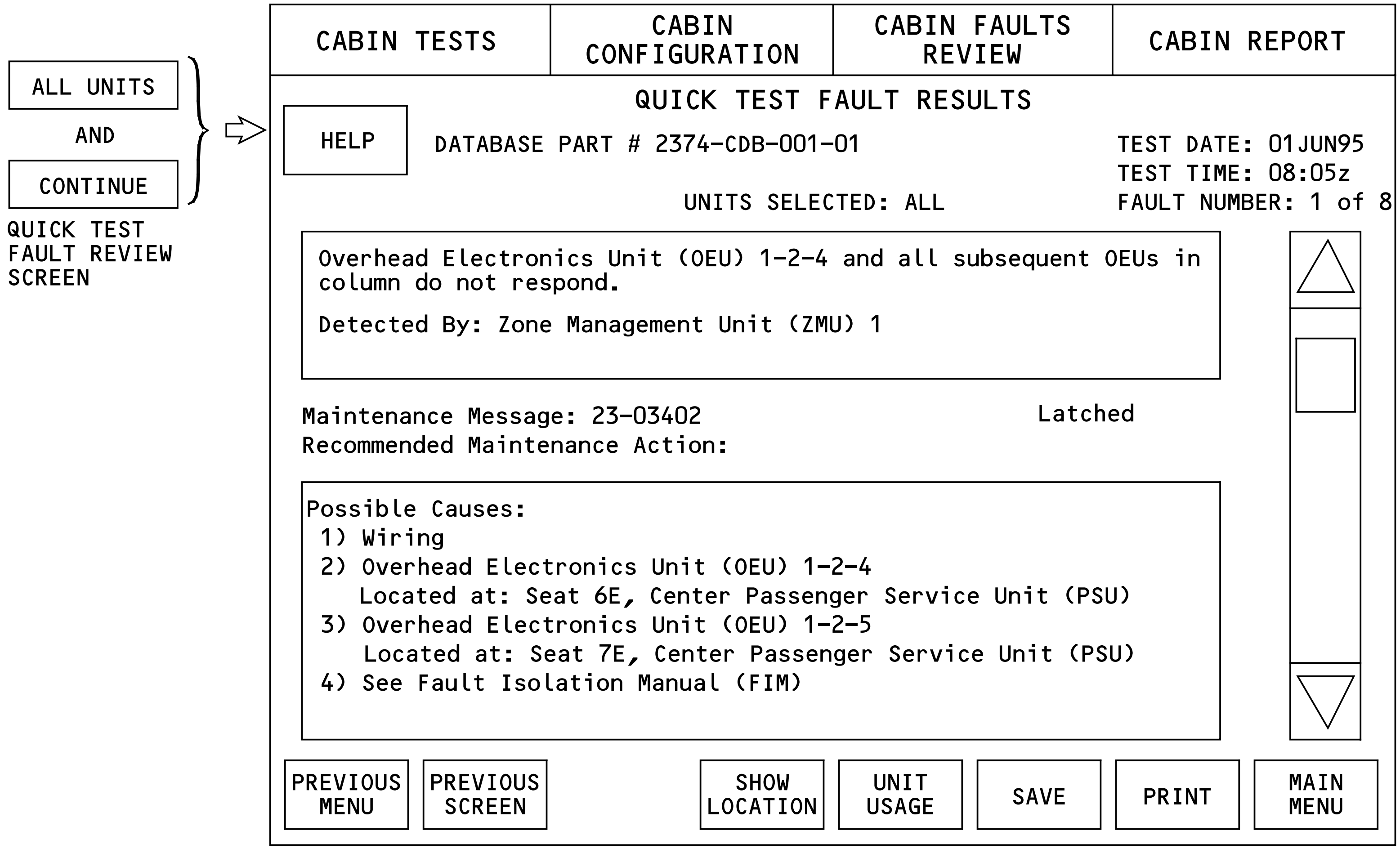
Touch SAVE to send the data to a diskette in the CSCP disk drive.

Touch PRINT to send the data to the printer for a paper copy.

Touch MAIN MENU to show the cabin maintenance menu.

Training Information Point

To determine if a fault is still active you must do a new test.



CSCP SCREEN

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CSS TEST AND SOFTWARE INSTALLATION - QUICK TEST FAULT RESULTS SCREEN

CSS TEST AND SOFTWARE INSTALLATION - SELECT LRU DIALOGUE WINDOW

General

The select LRU dialogue window lets you select an LRU to see its unit usage or location.

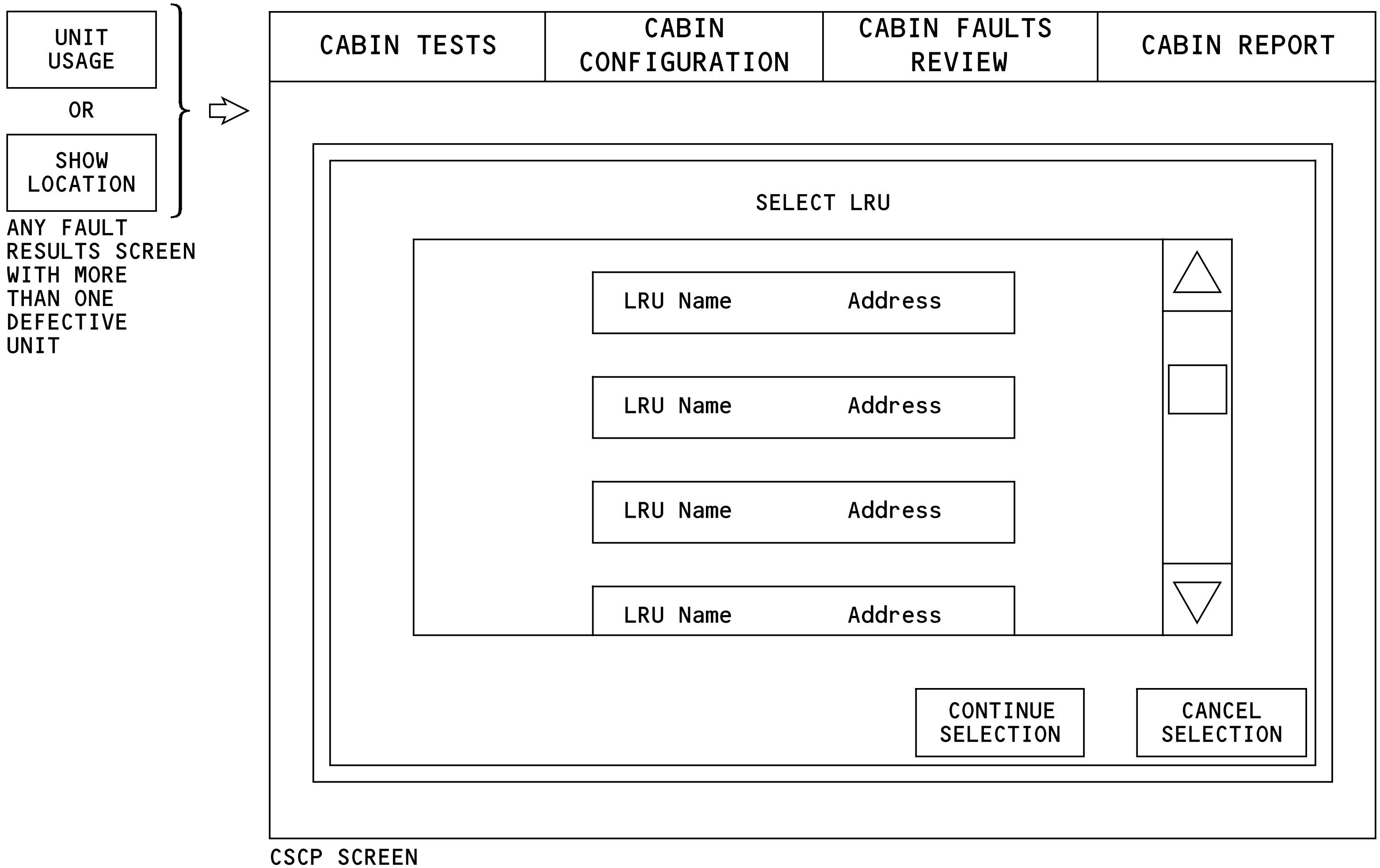
Access

This screen shows when you touch SHOW LOCATION or UNIT USAGE on any fault results screen and there is more than one defective unit in the list of possible causes.

Controls and Indications

Touch any LRU selection and then touch the CONTINUE SELECTION to go to a screen that shows the usage or location for the LRU. You can select only one LRU at a time. If you make another selection, the first selection is deselected.

Touch CANCEL SELECTION to stop any selections and return to the previous screen.



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CSS TEST AND SOFTWARE INSTALLATION - SELECT LRU DIALOGUE WINDOW

CSS TEST AND SOFTWARE INSTALLATION - FAULT RESULTS WITH UNIT USAGE WINDOW

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CSS TEST AND SOFTWARE INSTALLATION - FAULT RESULTS WITH UNIT USAGE WINDOW

General

The unit usage window shows the components controlled by a defective component.

Access

This window shows as an extension of the fault results screen. You select the fault results screen from the quick test faults review screen. The faults review screen shows at the end of a quick test.

To start a quick test:

- Touch CABIN TESTS on any maintenance screen
- Touch START QUICK TEST on the cabin tests menu
- Touch CONTINUE TEST on the quick test explanation window.

To show the quick test fault results screen:

- Touch CABIN FAULTS REVIEW at the top of any maintenance screen
- Touch QUICK TEST FAULTS REVIEW on the cabin faults review menu
- Touch ALL UNITS or touch an LRU type on the quick test faults review screen
- Touch CONTINUE on the quick test faults review screen.

To show the unit usage window, touch UNIT USAGE at the bottom of the screen. If there was more than one defective LRU in the list of possible causes, another screen shows to let you select the component.

Controls and Indications

The fault description identifies the failure condition detected by the test. It also identifies the component that found the fault.

You use the maintenance message number to find the corrective action in the fault isolation manual (FIM).

Touch HELP to show a screen that gives you data about the fault results screens.

Use the up and down arrows at the right of the unit usage window to scroll through the data. A scroll box between the arrows shows your position in the data list.

Touch PREVIOUS MENU to return to the quick test faults review screen.

Touch PREVIOUS SCREEN to return to the quick test fault results screen without the unit usage window.

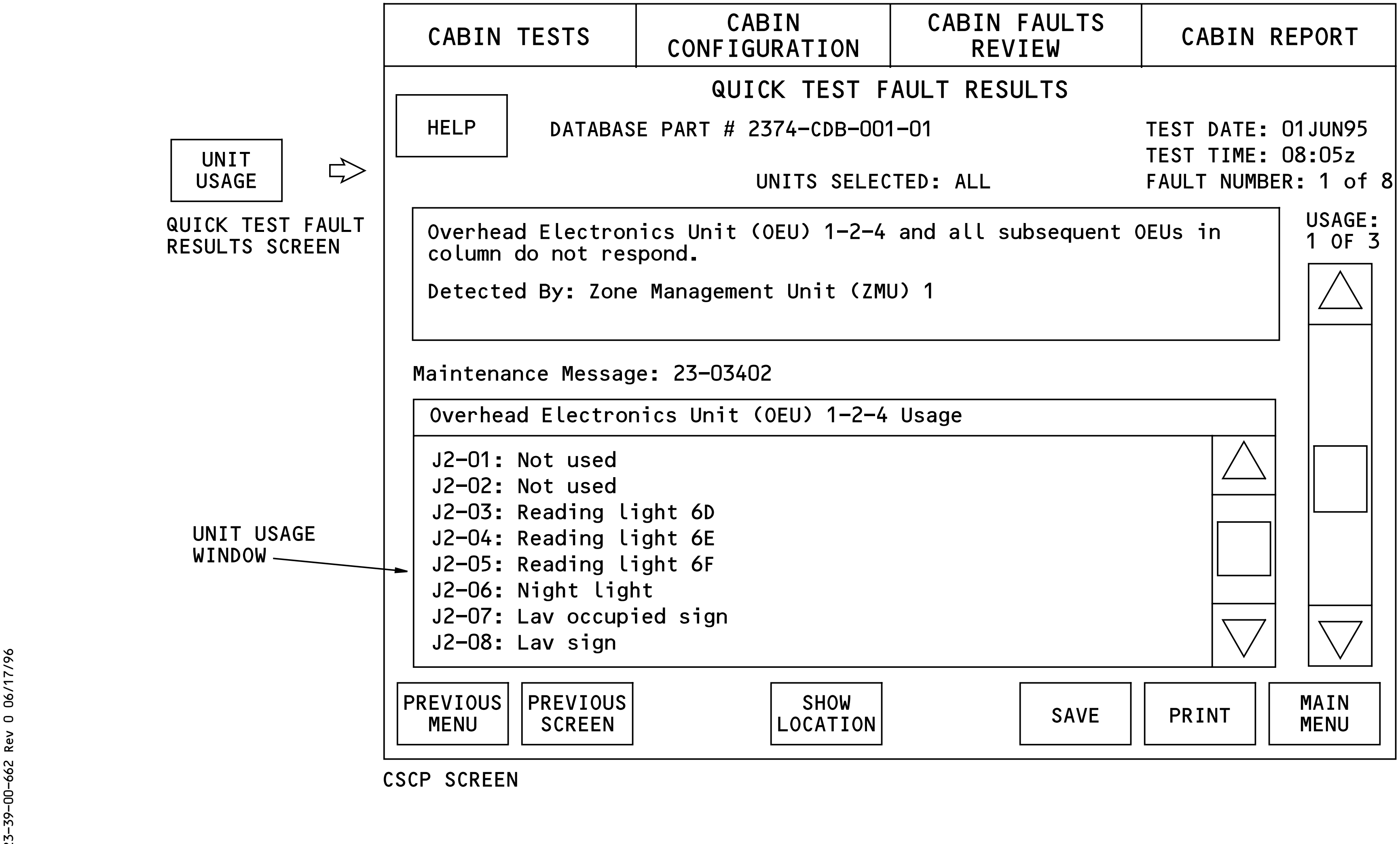
Touch SHOW LOCATION to go to the LRU location screen.

Touch SAVE to save all of the unit usage data to a floppy diskette in the CSCP disk drive.

Touch PRINT to print all of the unit usage data to a cabin printer.

CSS TEST AND SOFTWARE INSTALLATION - FAULT RESULTS WITH UNIT USAGE WINDOW

Touch MAIN MENU to return to the cabin maintenance menu.



CSS TEST AND SOFTWARE INSTALLATION - FAULT RESULTS WITH UNIT USAGE WINDOW

CSS TEST AND SOFTWARE INSTALLATION - SHOW LRU LOCATION SCREEN

General

The LRU location screen shows where the defective component is installed.

Access

You select this screen from the maintenance message on the fault results screen. Select the fault results screen from the quick test faults review screen. The faults review screen shows at the end of a quick test.

To start a quick test:

- Touch CABIN TESTS on any maintenance screen
- Touch START QUICK TEST on the cabin tests menu
- Touch CONTINUE TEST on the quick test explanation window.

To show the quick test faults review screen:

- Touch CABIN FAULTS REVIEW at the top of any maintenance screen
- Touch QUICK TEST FAULTS REVIEW on the cabin faults review menu
- Touch ALL UNITS or touch an LRU type on the quick test faults review screen
- Touch CONTINUE on the quick test faults review screen.

Touch SHOW LOCATION on the fault results screen to show the location screen. If there was more than one defective LRU in the list of possible causes, another screen shows to let you select the component.

You can also show this screen if you select SHOW LOCATION on the fault results screen with unit usage.

Controls and Indications

The screen shows a plan view of the airplane. An asterisk (*) shows the component location. The text below the airplane tells you the location.

Touch PREVIOUS MENU to return to the tests menu.

Touch PREVIOUS SCREEN to return to the fault results screen.

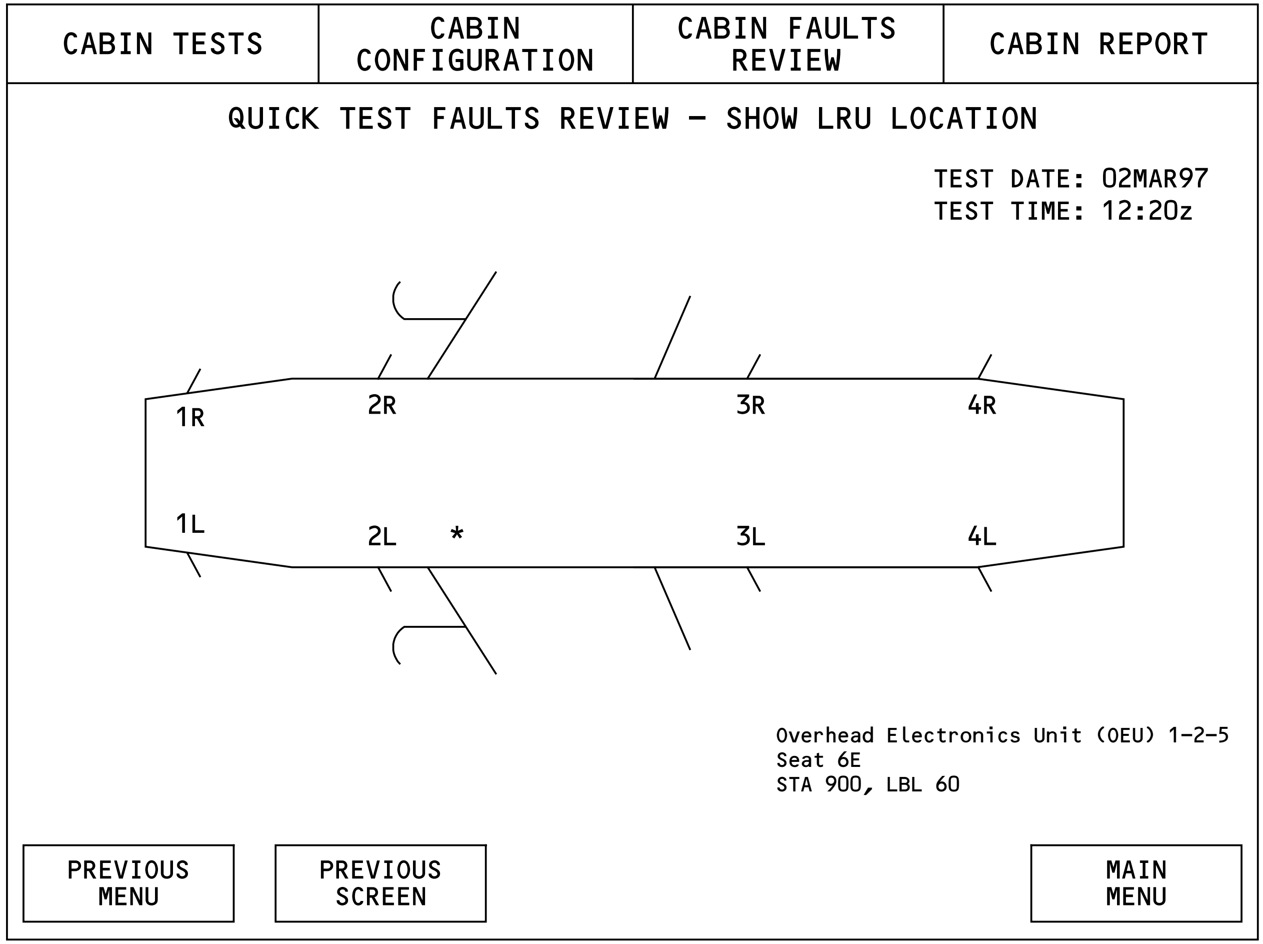
Touch MAIN MENU to return to the cabin maintenance menu.

SHOW LOCATION

QUICK TEST FAULT RESULTS SCREEN

OR

QUICK TEST FAULT RESULTS SCREEN WITH UNIT USAGE



CSCP SCREEN

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CSS TEST AND SOFTWARE INSTALLATION - SHOW LRU LOCATION SCREEN

CSS TEST AND SOFTWARE INSTALLATION - ALL TEST DIALOGUE WINDOW

General

The all test dialogue window tells you about the all test.

Access

This window shows automatically when you touch START ALL TEST on the cabin tests menu.

Controls and Indications

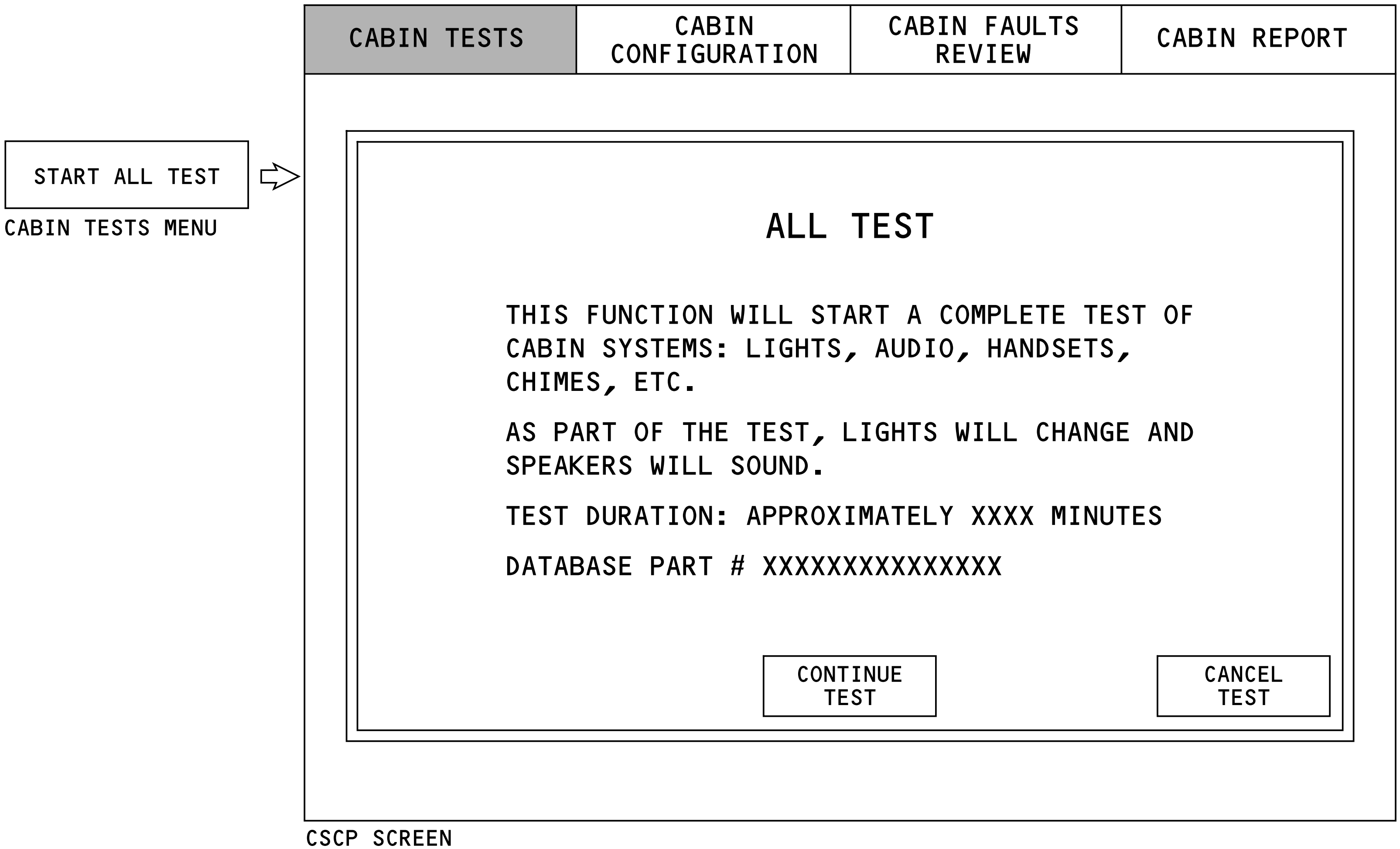
The all test dialogue window gives you data about the all test. It also shows the active configuration database part number.

To start the test, touch CONTINUE TEST.

To stop the test, touch CANCEL TEST.

Training Information Point

The all test makes noise and flashes lights in the cabin. You should not do this test with passengers on board.



CSS TEST AND SOFTWARE INSTALLATION – ALL TEST DIALOGUE WINDOW

CSS TEST AND SOFTWARE INSTALLATION - ALL TEST OPERATING DIALOGUE WINDOW

General

During the all test, the cabin system control panel (CSCP) shows the all test operating window.

Access

This screen shows when you make these selections:

- Touch START ALL TEST on the cabin tests main menu
- Touch CONTINUE TEST on the all test explanation window.

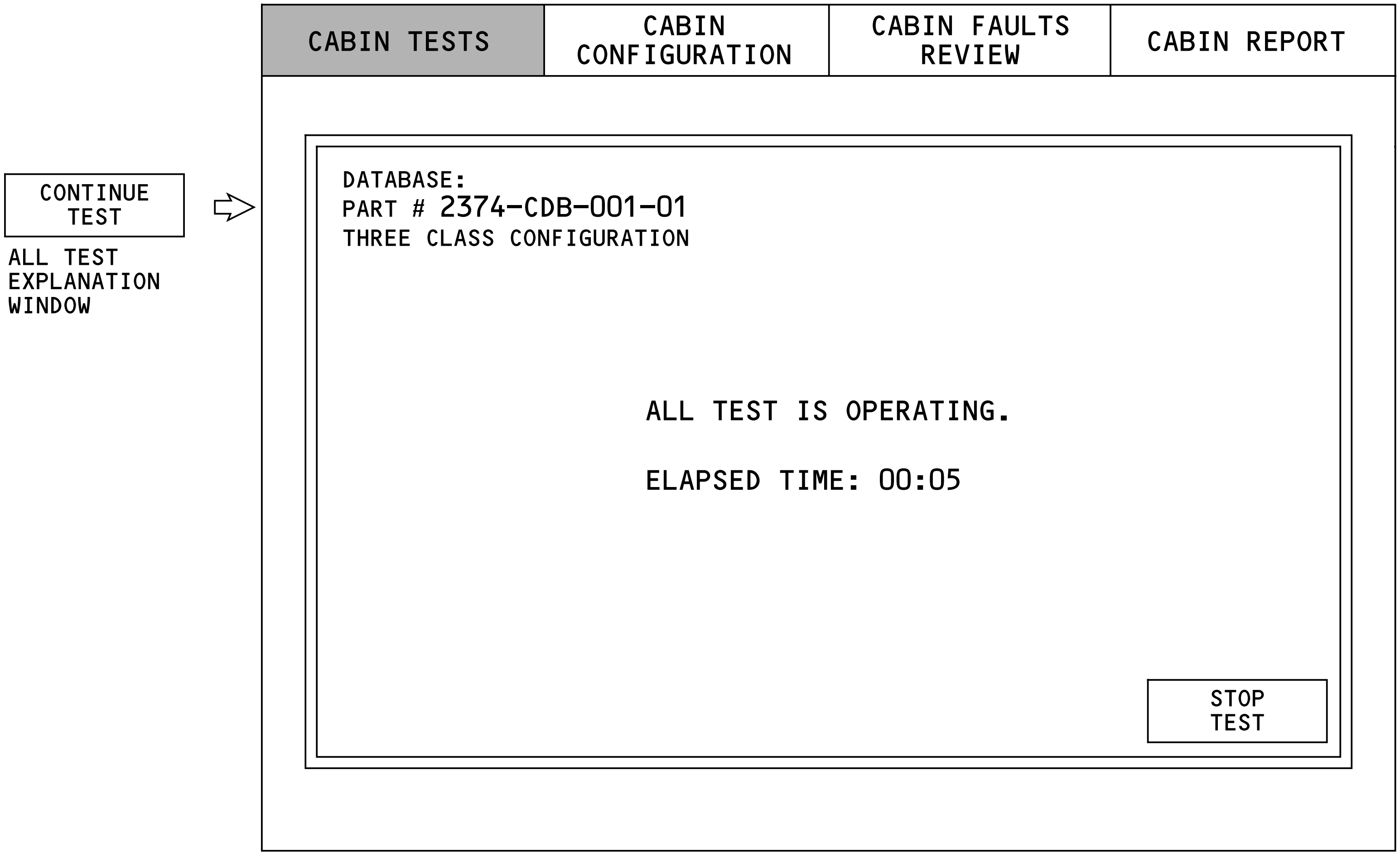
Controls and Indications

The elapsed time indication shows the time from the start of the test. The test lasts about two minutes.

To stop the test, touch STOP TEST.

Operation

The all test starts a full BITE of the CSS. All CSS components do a test of their internal operations. They also check their interfaces. Components that control lamps check for opens or shorts. Speaker drive modules also check speakers for opens or shorts.



CSCP SCREEN

23-39-00-666 Rev 0 06/17/96

CSS TEST AND SOFTWARE INSTALLATION - ALL TEST OPERATING DIALOGUE WINDOW

CSS TEST AND SOFTWARE INSTALLATION - ALL TEST COMPLETE - NO FAULTS

General

The all test complete no faults screen shows that the test found no failures.

Access

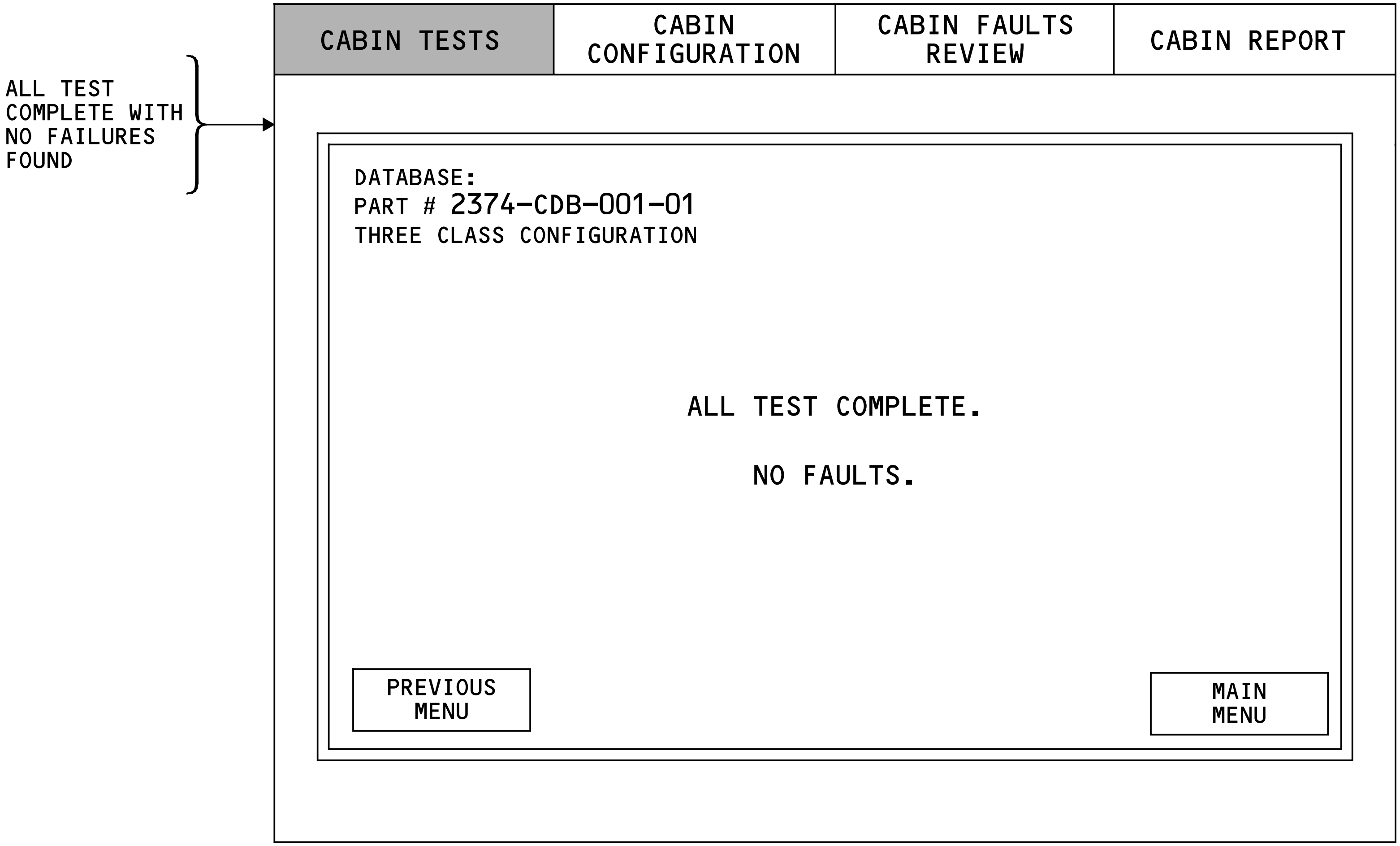
The screen shows automatically when the all test is complete.

Controls and Indications

If the system passes the test, ALL TEST COMPLETE - NO FAULTS shows. If there are failures, the CSCP shows the all test faults review screen.

Touch PREVIOUS MENU to show the cabin tests menu.

Touch MAIN MENU to show the cabin maintenance main menu.



CSCP SCREEN

23-39-00-667 Rev 0 06/17/96

CSS TEST AND SOFTWARE INSTALLATION - ALL TEST COMPLETE - NO FAULTS

CSS TEST AND SOFTWARE INSTALLATION - ALL TEST FAULTS REVIEW SCREEN

General

You use the all test faults review screen to identify failures found during the last all test.

Access

If an all test finds any failures, the all test faults review screen shows automatically when the test is complete. To start an all test:

- Touch CABIN TESTS on any maintenance screen
- Touch START ALL TEST on the cabin tests menu
- Touch CONTINUE TEST on the all test explanation window.

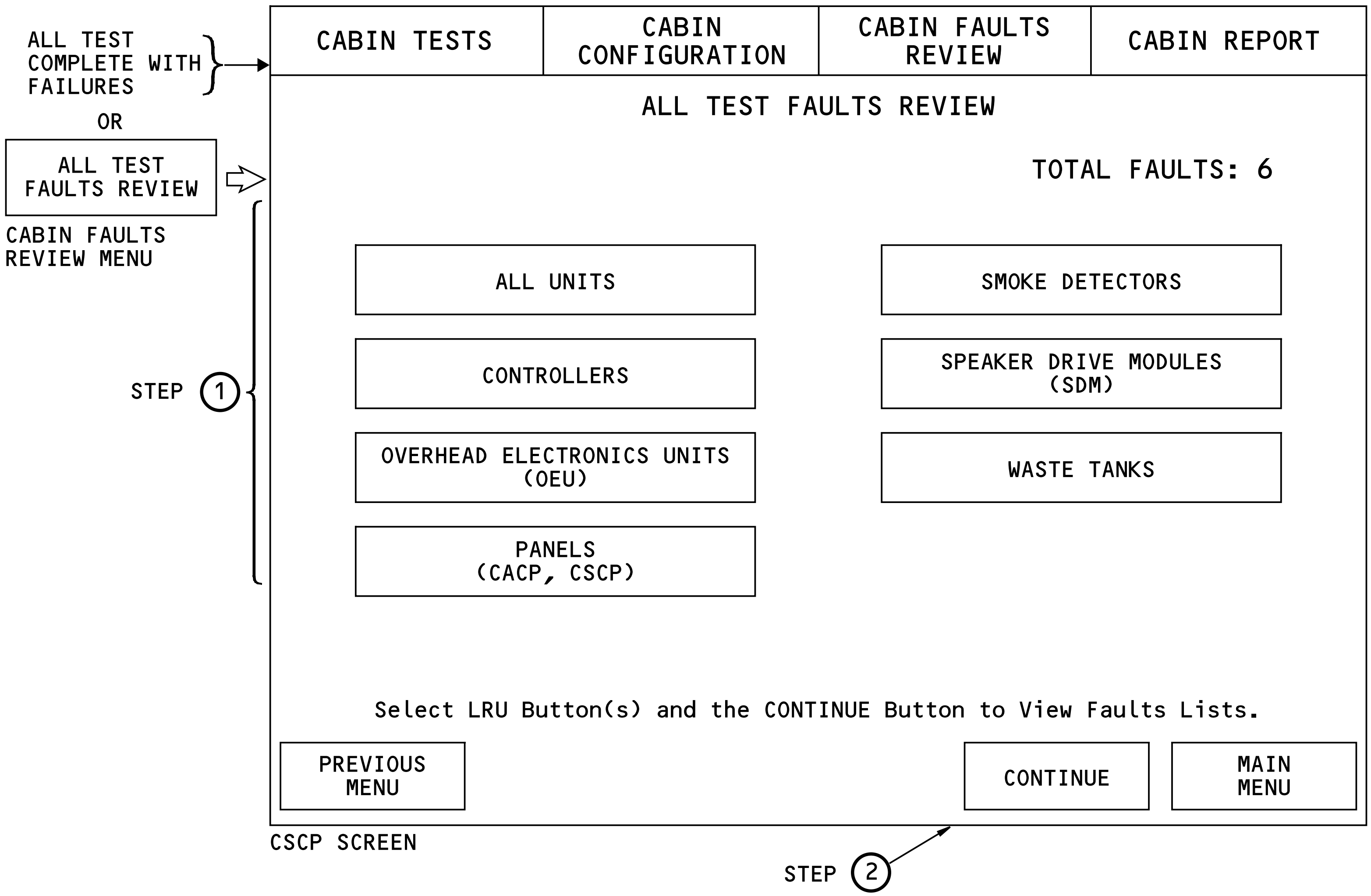
You can also select the all test faults review screen from the cabin faults review menu. To show the all test faults review screen, first touch CABIN FAULTS REVIEW at the top of any maintenance screen. Then touch ALL TEST FAULTS REVIEW.

Controls and Indications

To show all failures, touch ALL UNITS. The selection shows green. After you touch ALL UNITS, touch CONTINUE. To show the failures of one LRU type, touch the LRU type and then touch CONTINUE.

If you touch PREVIOUS MENU, the cabin faults review menu shows if you used that selection to see this screen. The cabin tests menu shows if you did a test.

Touch MAIN MENU to show the cabin maintenance menu.



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CSS TEST AND SOFTWARE INSTALLATION - ALL TEST FAULTS REVIEW SCREEN

CSS TEST AND SOFTWARE INSTALLATION - ALL TEST FAULT RESULTS SCREEN

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CSS TEST AND SOFTWARE INSTALLATION - ALL TEST FAULT RESULTS SCREEN

General

You use the all test fault results screen to see failures found during the last all test.

Access

You select the fault results screen from the all test faults review screen. The faults review screen shows at the end of an all test. To start an all test:

- Touch CABIN TESTS on any maintenance screen
- Touch START ALL TEST on the cabin tests menu
- Touch CONTINUE TEST on the all test explanation window
- Touch ALL UNITS or an LRU type and then touch CONTINUE on the faults review screen.

You can also select the all test fault results screen from the cabin faults review menu. To show the all test faults review screen:

- Touch CABIN FAULTS REVIEW at the top of any maintenance screen
- Touch ALL TEST FAULTS REVIEW on the cabin faults review menu
- Touch ALL UNITS or touch an LRU type on the all test faults review screen
- Touch CONTINUE on the all test faults review screen.

Controls and Indications

These are the three parts of the screen:

- Test conditions
- Maintenance message data
- Selection controls.

Test Conditions

The test conditions part of the screen shows this test data:

- Test type (quick test or all test)
- The configuration database part number installed at the time of the test
- The date and time of the test
- The type of LRUs selected from the faults review screen
- The sequence of each maintenance message in the list of messages for the selected LRU type.

There is a HELP selection on the left. Touch HELP for data on how to use the screen.

Maintenance Message Data

Each page shows one maintenance message. The maintenance message shows data about each failure. There are three parts to the maintenance message:

- Fault description
- Maintenance message number

CSS TEST AND SOFTWARE INSTALLATION - ALL TEST FAULT RESULTS SCREEN

- Recommended maintenance action.

The fault description identifies the failure condition detected by the test. It also identifies the component that finds the fault.

You use the maintenance message number to find the corrective action in the fault isolation manual (FIM).

The recommended maintenance action identifies all the possible components or conditions that could cause the fault. The most probable cause shows first and the least probable cause shows last.

Each screen shows one maintenance message. Touch the down arrow to access additional messages. Touch the up arrow to return through the message list. The square on the scroll bar shows your position in the message list.

Selection Controls

Touch PREVIOUS MENU to show the cabin tests menu.

Touch PREVIOUS SCREEN to show the all test fault review screen.

Touch SHOW LOCATION to show a visual reference of the defective component. If there is more than one LRU in the list of possible causes, another screen shows to let you select an LRU.

Touch UNIT USAGE to show the components controlled by the defective component. If there is more than one LRU in the list of possible causes, another screen shows to let you select an LRU.

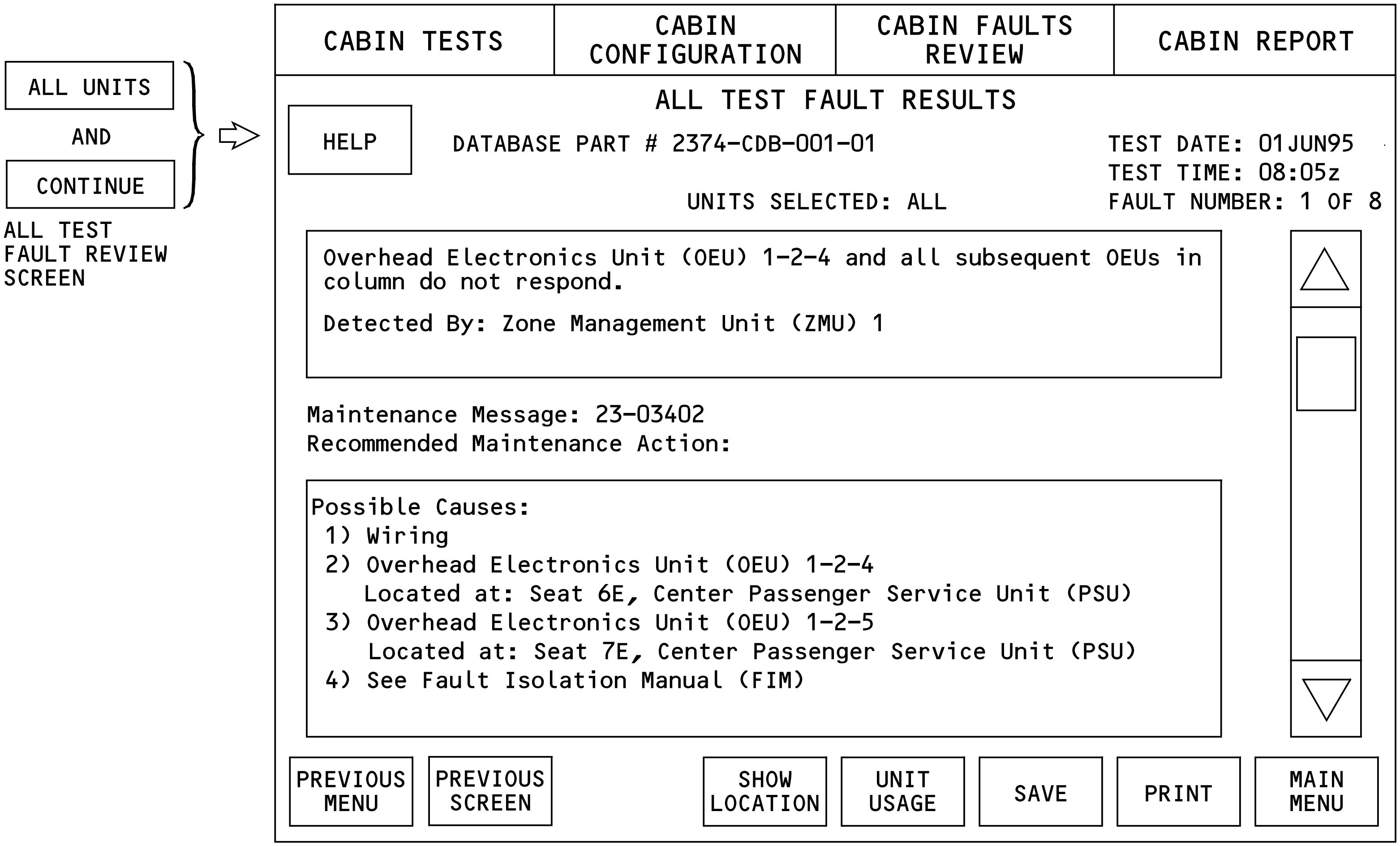
Touch SAVE to send the data to a diskette in the CSCP disk drive.

Touch PRINT to send the data to the printer for a paper copy.

Touch MAIN MENU to show the cabin maintenance menu.

Training Information Point

To determine if a fault is still active you must do a new test.



CSCP SCREEN

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CSS TEST AND SOFTWARE INSTALLATION - ALL TEST FAULT RESULTS SCREEN

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CSS TEST AND SOFTWARE INSTALLATION - ALL TEST FUNCTIONAL DESCRIPTION

General

The all test does a complete check of the CSS. You use the cabin system control panel (CSCP) to start the test and see the results.

To do an all test, at least one of these conditions must be true:

- Airplane is on ground
- Parking brake is set
- At least one passenger door is open.

Components

All the CSS components that use microprocessors have BITE circuits. These components use microprocessors:

- Cabin system control panel (CSCP)
- Cabin system management unit (CSMU)
- Passenger address/cabin interphone (PA/CI) controller
- Speaker drive modules (SDMs)
- Zone management units (ZMUs)
- Overhead electronics units (OEUs)
- Cabin area control panels (CACPs)

Operation

The BITE circuits check system operation. They do a complete test of internal operation and check interfaces. The BITE circuits also do a test of connected components that do not have a microprocessor.

The CSMU sends BITE commands to the PA/CI controller and ZMUs on the intersystem (I/S) bus. The CSMU gets failure data from the LRUs and sends them to the CSCP. The CSCP processes the data and keeps it in nonvolatile memory (NVM). You review the failure data at the CSCP on the all test fault results screen.

The PA/CI controller sends BITE commands to its SDMs. It sends failure data from SDMs and its own internal failures to the CSMU on the I/S bus. If the PA/CI does not get data from the SDM or it is out of tolerance, the PA/CI sends a failure message for that SDM.

Each ZMU sends BITE commands to its connected components. A ZMU sends its own internal failures and failure data from its OEUs and CACP to the CSMU on the I/S bus. The ZMUs also check the cabin attendant handsets (CAHs) and master call lights. If a ZMU does not get data from one of its LRUs or the data is out of tolerance, the ZMU sends a failure message for that LRU.

The SDMs do a test of the speakers and the ambient noise sensors (ANSs). The SDMs send failure data to the PA/CI controller.

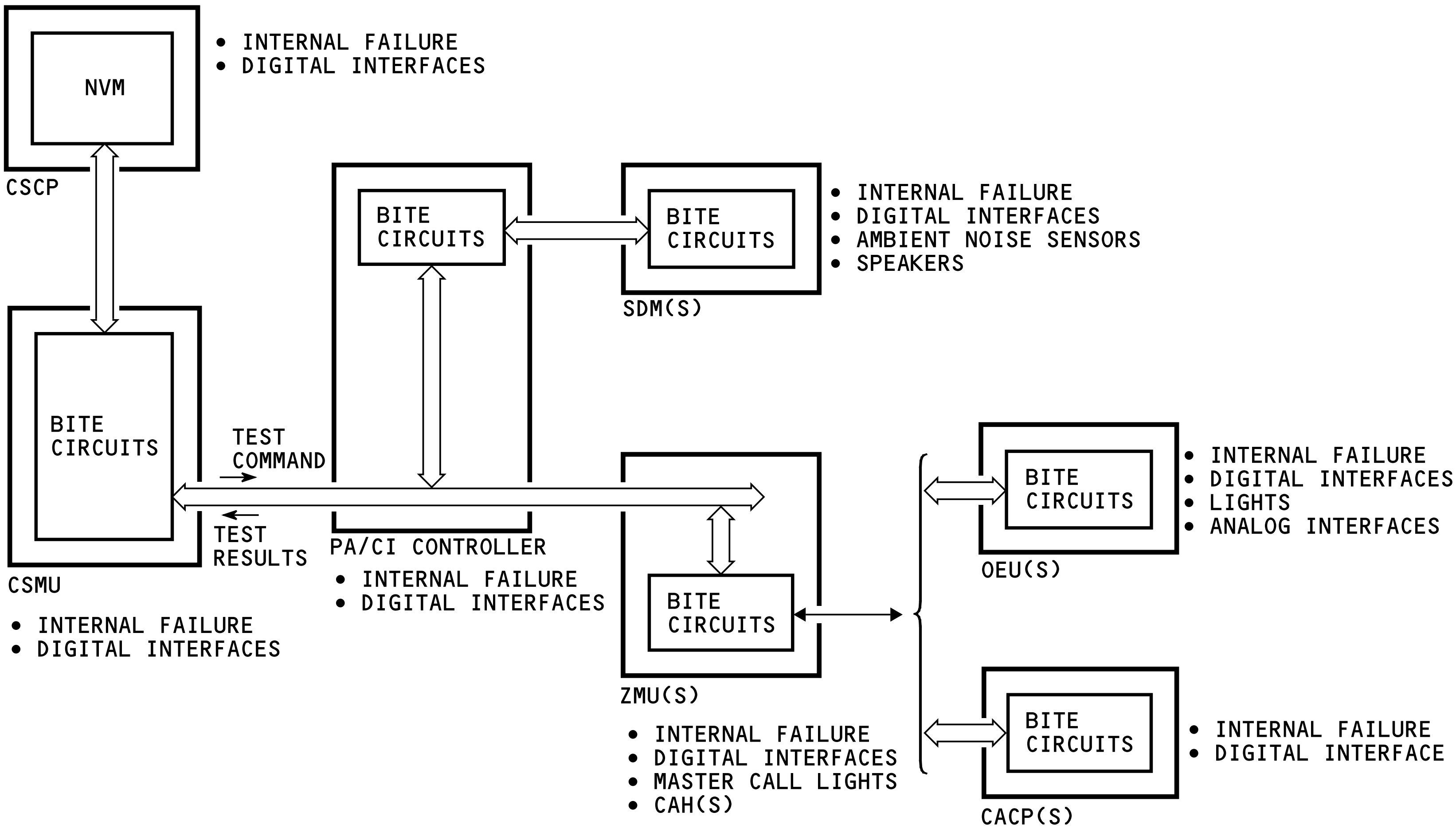
The OEUs do a test of all lights and ballasts they control. They also check their discrete and analog inputs such as smoke detectors and tank sensors.

CSS TEST AND SOFTWARE INSTALLATION - ALL TEST FUNCTIONAL DESCRIPTION

Fault Processing

The CSMU sends all fault data to the CSCP. The CSCP processes all fault data and stores it in memory.

The CSCP looks at the fault data to identify if multiple fault indications can be from one failure. If it is, the CSCP combines the fault indications into one maintenance message. This procedure is called fault consolidation.



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CSS TEST AND SOFTWARE INSTALLATION - ALL TEST FUNCTIONAL DESCRIPTION

CSS TEST AND SOFTWARE INSTALLATION - LAMPS TEST SCREEN - PAGE 1

General

The lamps test screen lets you control lights controlled by the CMS. You use this to see the operation of the lamps. There are two pages to the lamps test screen.

Access

To show the page one of the lamps test screen, touch CABIN TESTS at the top of any maintenance screen, then touch LAMPS TEST on the cabin tests menu.

Controls and Indications

Touch ON next to ALL to set all lights controlled by the CSS to on. The selection shows green. Touch OFF to set them all to off.

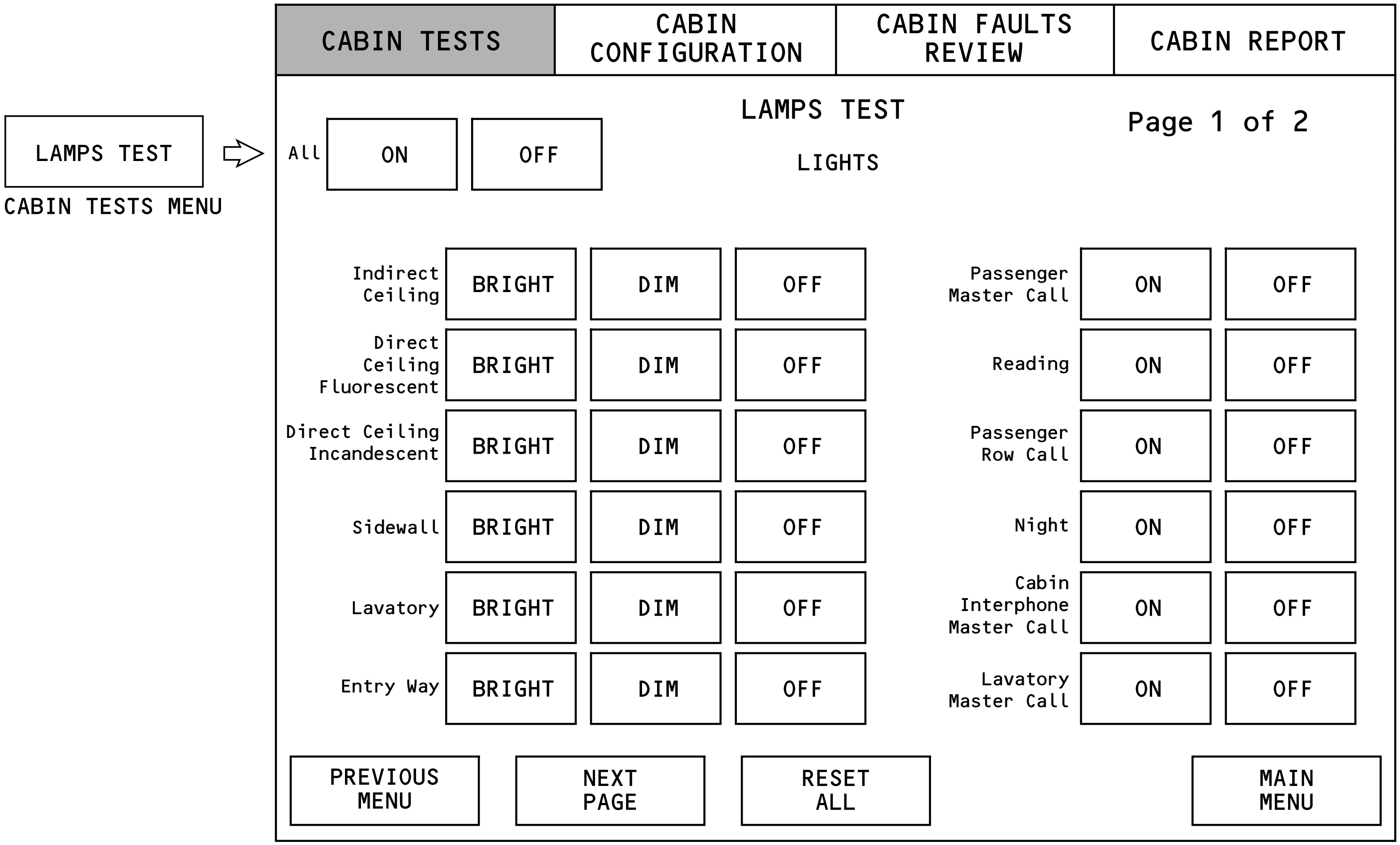
To check a type of light, touch one of the selections next to the name of a light type. All of the selected lights change to the set condition. The selection shows green.

Touch NEXT PAGE to show page two of the lamps test screen.

When you touch RESET ALL, it shows green. Then touch any other screen selection, except NEXT PAGE, to put all lights back to their initial condition.

Touch PREVIOUS MENU to show the cabin tests menu.

Touch MAIN MENU to show the cabin maintenance menu.



CSCP SCREEN

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CSS TEST AND SOFTWARE INSTALLATION - LAMPS TEST SCREEN - PAGE 1

CSS TEST AND SOFTWARE INSTALLATION - LAMPS TEST SCREEN - PAGE 2

General

Page two of the lamps test screen shows more light selections.

Access

To show page two of the lamps test screen:

- Touch CABIN TESTS at the top of any maintenance screen
- Touch LAMPS TEST on the cabin tests menu
- Touch NEXT PAGE on page 1 of the lamps test screen.

Controls and Indications

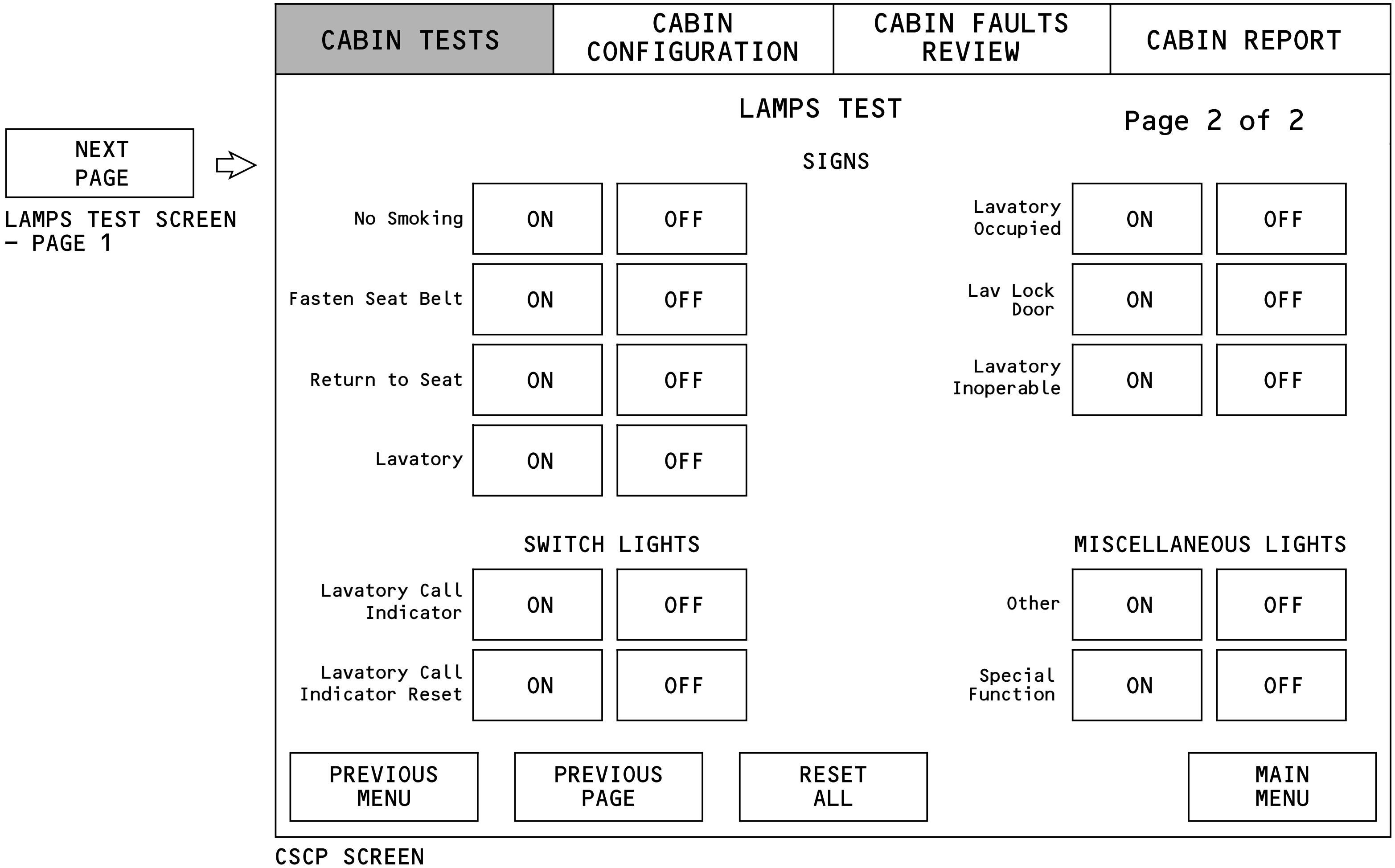
Touch one of the selections next to the name of a light type. All of the selected lights change to the set condition. The selection shows green.

Touch PREVIOUS PAGE to show page 1 of the lamps test screen.

When you touch RESET ALL, it shows green. Then touch any other screen selection, except PREVIOUS PAGE, to put all lights back to their initial condition.

Touch PREVIOUS MENU to show the cabin tests menu.

Touch MAIN MENU to show the cabin maintenance menu.



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CSS TEST AND SOFTWARE INSTALLATION - LAMPS TEST SCREEN - PAGE 2

CSS TEST AND SOFTWARE INSTALLATION - LAMPS STATES RESET WINDOW

General

The lamps states reset window tells you the light settings selected on the lamps test screen will be cancelled.

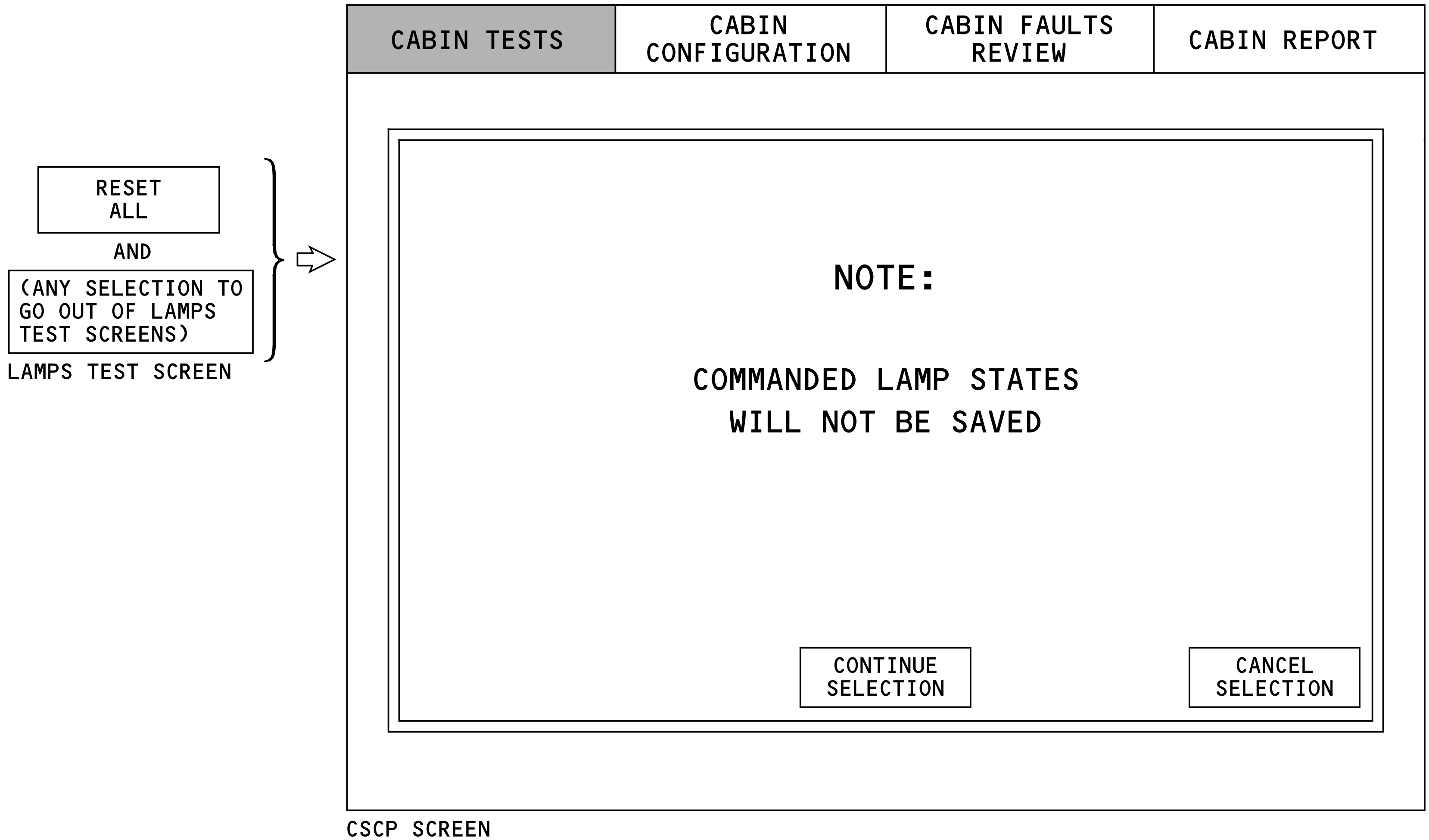
Access

The lamps states window shows when you touch RESET ALL and select a different screen than the lamps test screens.

Controls

Touch CONTINUE SELECTION to cancel the light selections set by the lamps test.

Touch CANCEL SELECTION to show the lamps test screen.



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CSS TEST AND SOFTWARE INSTALLATION - LAMPS STATES RESET WINDOW

CSS TEST AND SOFTWARE INSTALLATION - ENGINEERING TESTS MENU TREE

General

Each engineering test is for a special use. You normally use engineering tests for detailed troubleshooting.

The engineering tests menu has these selections:

- INPUT/OUTPUT MONITOR
- COMMAND OUTPUT
- SHOP FAULTS
- INSTALL ADDRESSES
- EXTENDED CABIN FAULTS REVIEW.

Sub-Menus

These four selections have sub-menus:

- INPUT/OUTPUT MONITOR
- COMMAND OUTPUT
- SHOP FAULTS
- EXTENDED CABIN FAULTS REVIEW.

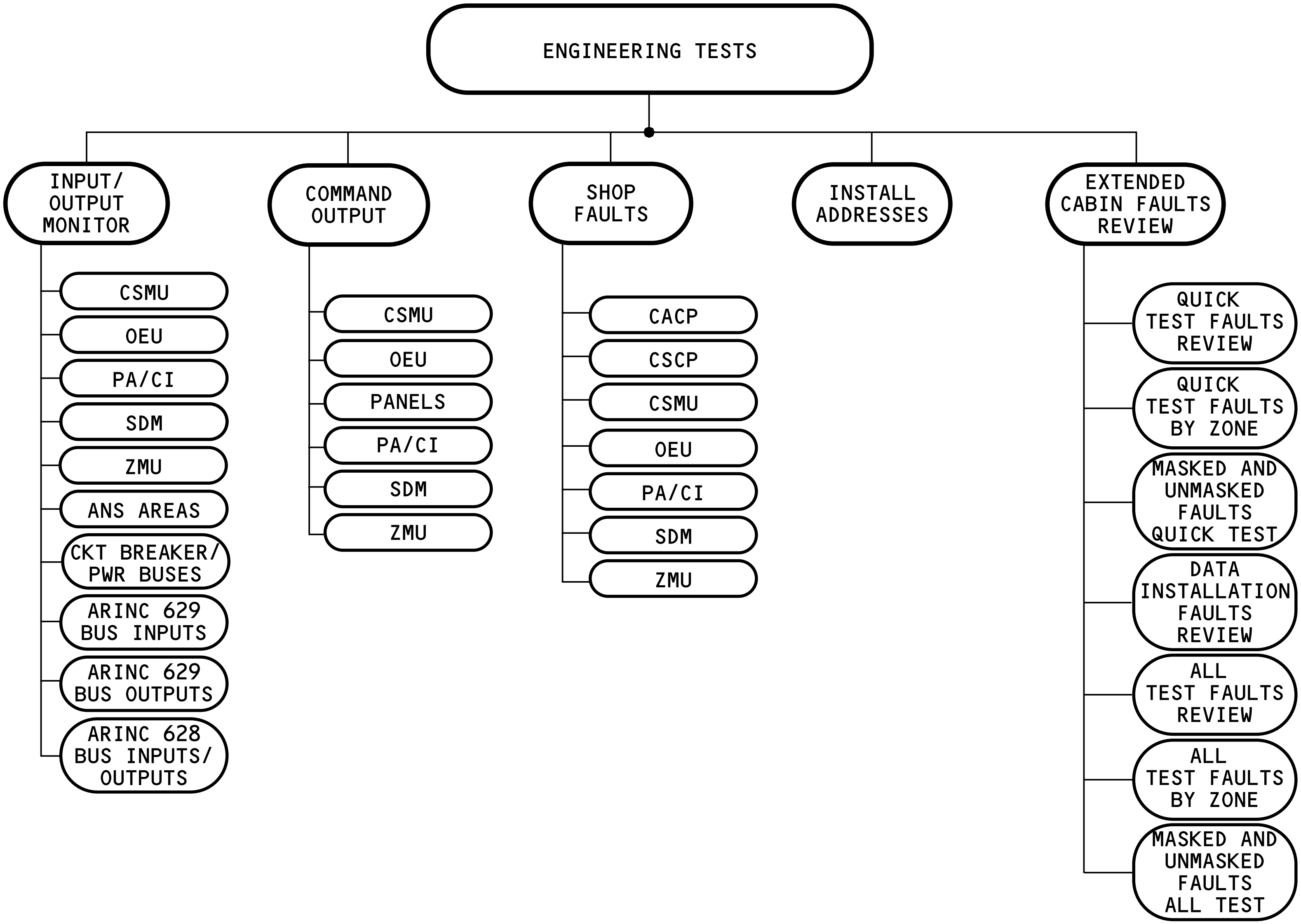
You use the input/output monitor to examine the condition of all the interfaces to a selected LRU. The input/output monitor menu gives selections for the LRUs you can monitor.

You use command output to set an output from an LRU. This lets you make sure the output is operational. The command output menu shows the LRUs for which you can set outputs.

You use shop faults to show the details of LRU internal failures. The shop faults menu shows from which LRU you can get shop fault data.

You use the extended cabin faults review to review test and installation faults. The menu gives selections for the tests and installation fault screens you can see.

You use install addresses to do engineering tests without a configuration database installed.



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CSS TEST AND SOFTWARE INSTALLATION - ENGINEERING TESTS MENU TREE

CSS TEST AND SOFTWARE INSTALLATION - ENGINEERING TESTS MENU

General

You use the engineering tests menu for detailed trouble-shooting.

Access

To show the engineering test menu, touch CABIN TESTS at the top of any maintenance screen, then touch ENGINEERING TESTS on the cabin tests menu.

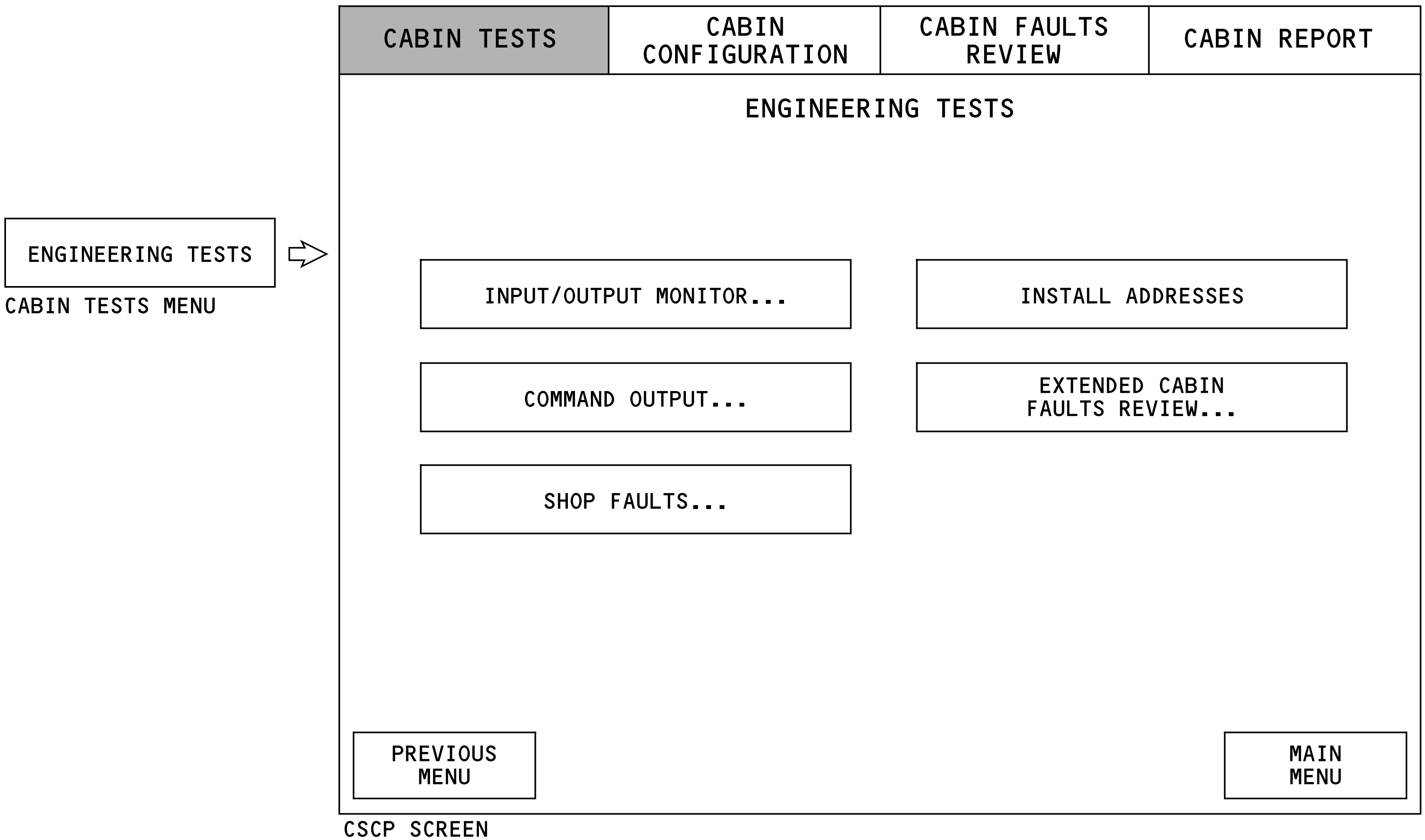
Controls and Indications

These selections cause other menus to show:

- INPUT/OUTPUT MONITOR
- COMMAND OUTPUT
- SHOP FAULTS
- EXTENDED CABIN FAULTS REVIEW.

Touch PREVIOUS MENU to show the cabin maintenance menu.

Touch MAIN MENU to show the cabin maintenance menu.



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CSS TEST AND SOFTWARE INSTALLATION - ENGINEERING TESTS MENU

CSS TEST AND SOFTWARE INSTALLATION - INPUT/OUTPUT MONITOR MENU

General

You use the input/output monitor tests to examine the condition of the interfaces to a CSS component. You use the input/output monitor menu to select the type of component.

Access

To show the input/output monitor menu:

- Touch CABIN TESTS on any maintenance screen
- Touch ENGINEERING TESTS on the cabin test menu
- Touch INPUT/OUTPUT MONITOR on the engineering tests menu.

Controls and Indications

You can monitor the interfaces to these components:

- Cabin system management unit (CSMU)
- Overhead electronics units (OEUs)
- Passenger address/cabin interphone (PA/CI) controller
- Speaker drive modules (SDMs)
- Zone management units (ZMUs)
- Ambient noise sensors (ANSs).

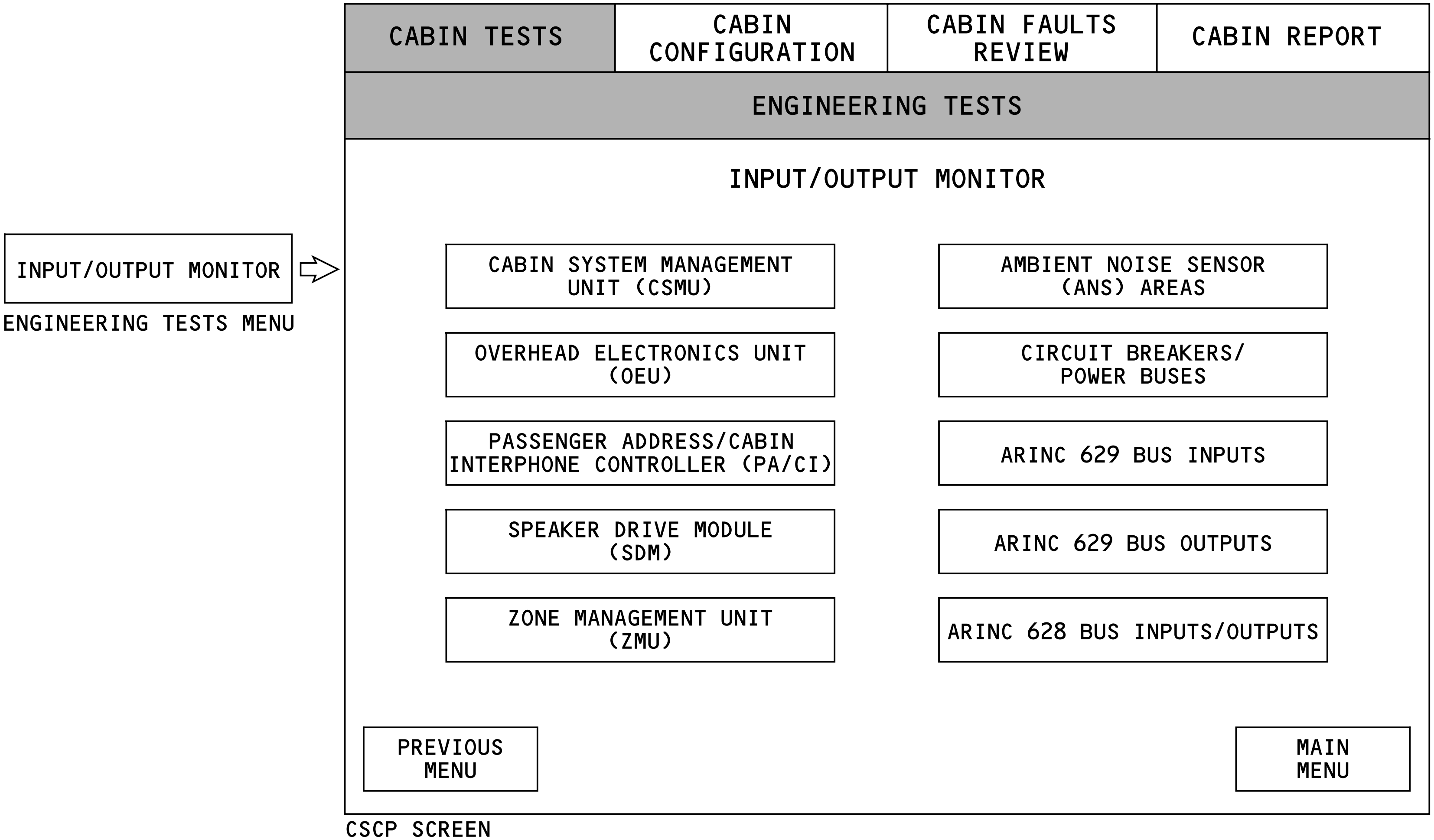
To select a component, touch the applicable selection.

You can also monitor the position of CSS circuit breakers and the condition of the connected power bus.

You can also monitor the inputs and outputs of the ARINC 629 and ARINC 628 data buses.

Touch PREVIOUS MENU to show the engineering tests menu.

Touch MAIN MENU to show the cabin maintenance menu.



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CSS TEST AND SOFTWARE INSTALLATION - INPUT/OUTPUT MONITOR MENU

CSS TEST AND SOFTWARE INSTALLATION - INPUT MONITOR - ANS AREA SELECTION

General

You use the input monitor - ANS area selection to monitor the input levels of ambient noise sensors (ANSs) in an area of the cabin.

Access

To show this screen:

- Touch CABIN TESTS on any maintenance screen
- Touch ENGINEERING TESTS on the cabin test menu
- Touch INPUT/OUTPUT MONITOR on the engineering tests menu
- Touch AMBIENT NOISE SENSOR (ANS) AREA on the input/output monitor menu.

Controls and Indications

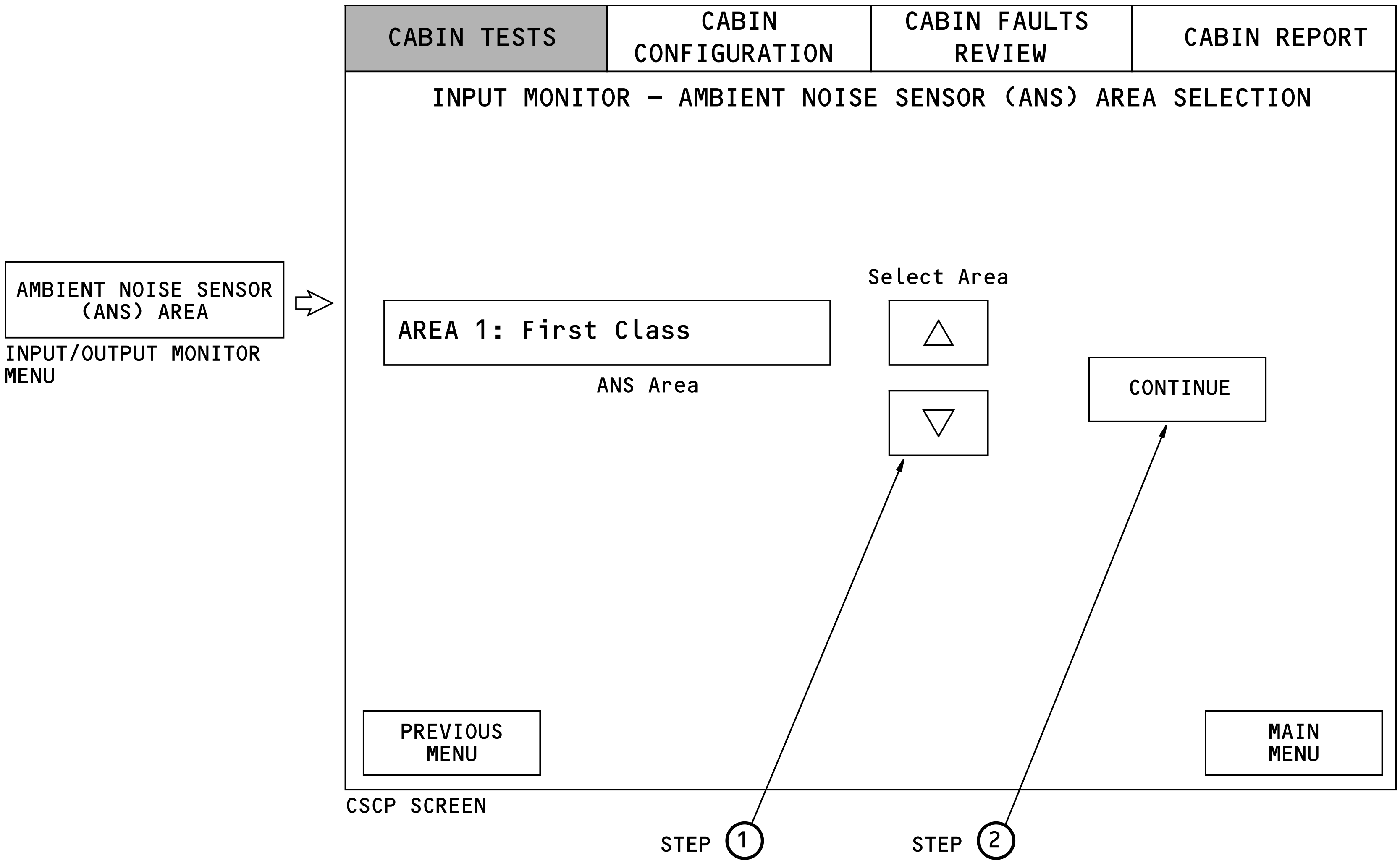
To select an ANS area, use the up or down arrow below Select Area. The CSS can have as many as 16 volume control areas. The configuration database defines the number of areas.

The area you select shows at the left of the arrows above ANS area.

After you select an area, touch CONTINUE to show the input monitor - ANS area screen.

Touch PREVIOUS MENU to show the input/output monitor menu.

Touch MAIN MENU to show the cabin maintenance menu.



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CSS TEST AND SOFTWARE INSTALLATION - INPUT MONITOR - ANS AREA SELECTION

CSS TEST AND SOFTWARE INSTALLATION - INPUT MONITOR - ANS AREA SCREEN

General

You use this screen to examine the inputs from ambient noise sensors (ANSs) in an area.

Access

To show the input monitor - ANS area screen:

- Touch CABIN TESTS on any maintenance screen
- Touch ENGINEERING TESTS on the cabin test menu
- Touch INPUT/OUTPUT MONITOR on the engineering tests menu
- Touch AMBIENT NOISE SENSOR (ANS) AREAS on the input/output monitor menu
- Select an area and touch CONTINUE on the ANS area selection screen.

Controls and Indications

The screen shows the time at the top.

A window below the time shows the average value of the ANS inputs for the area.

Another window shows each speaker drive module (SDM) in the area that has an ANS connected to it. This window gives the address and location of each SDM. It also shows the input of the related ANS.

Touch PREVIOUS MENU to show the input/output monitor menu.

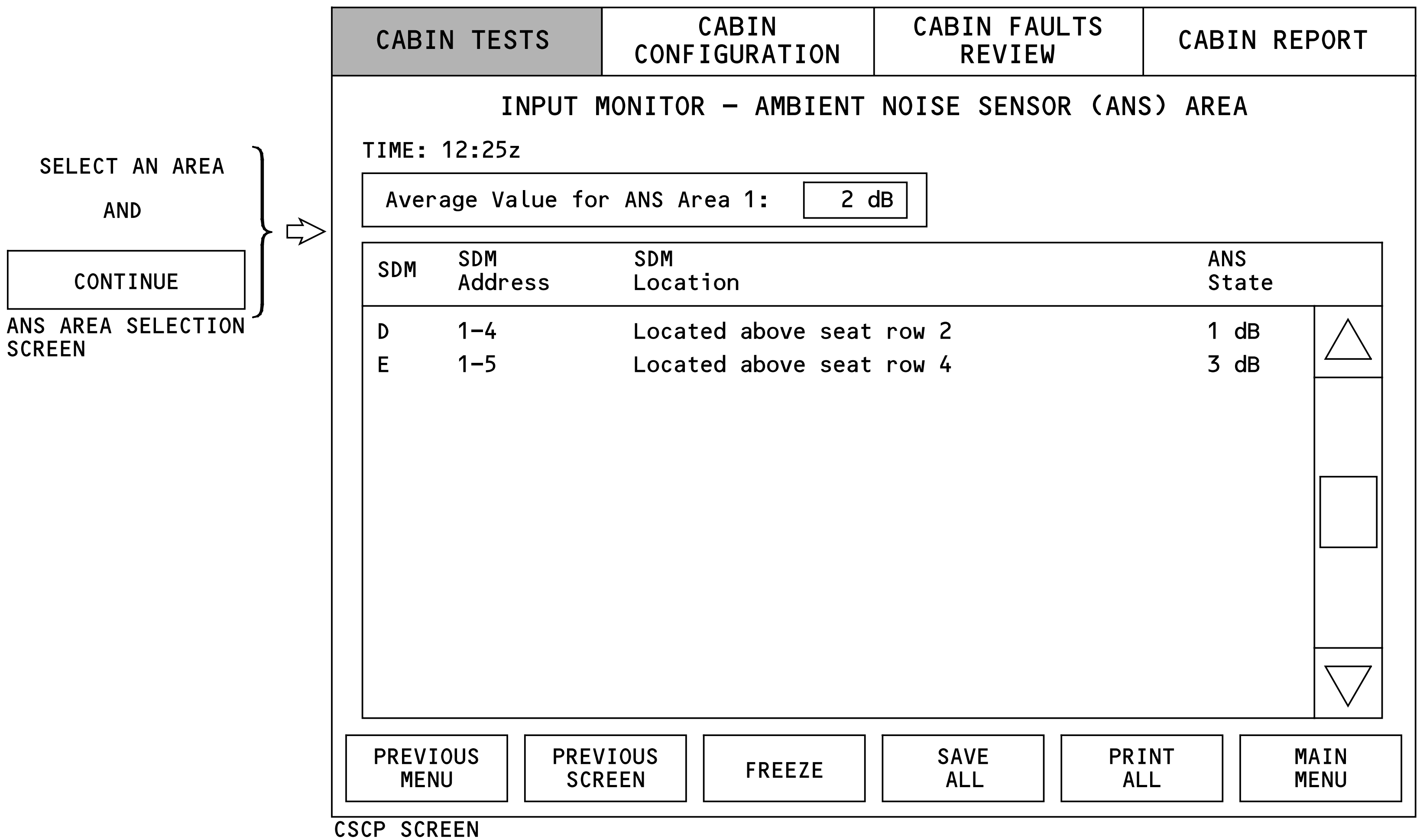
Touch PREVIOUS SCREEN to show the ANS area selection screen.

Touch FREEZE so the screen does not change if the condition of an interface changes.

Touch SAVE to send the data to a floppy diskette in the cabin system control panel (CSCP) disk drive.

Touch PRINT to send the data to the cabin printer.

Touch MAIN MENU to show the cabin maintenance menu.



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CSS TEST AND SOFTWARE INSTALLATION - INPUT MONITOR - ANS AREA SCREEN

CSS TEST AND SOFTWARE INSTALLATION - INPUT/OUTPUT MONITOR - OEU SELECTION

General

You use the input/output monitor - OEU test to examine the condition of the interfaces to an overhead electronics unit (OEU). You use the input/output monitor - OEU selection screen to select the OEU.

Access

To show this screen:

- Touch CABIN TESTS on any maintenance screen
- Touch ENGINEERING TESTS on the cabin test menu
- Touch INPUT/OUTPUT MONITOR on the engineering tests menu
- Touch OVERHEAD ELECTRONICS UNIT (OEU) on the input/output monitor menu.

Controls and Indications

To select an OEU, first select a zone with the up or down arrow below Select Zone. The CSS can have as many as five zones (one for each zone management unit).

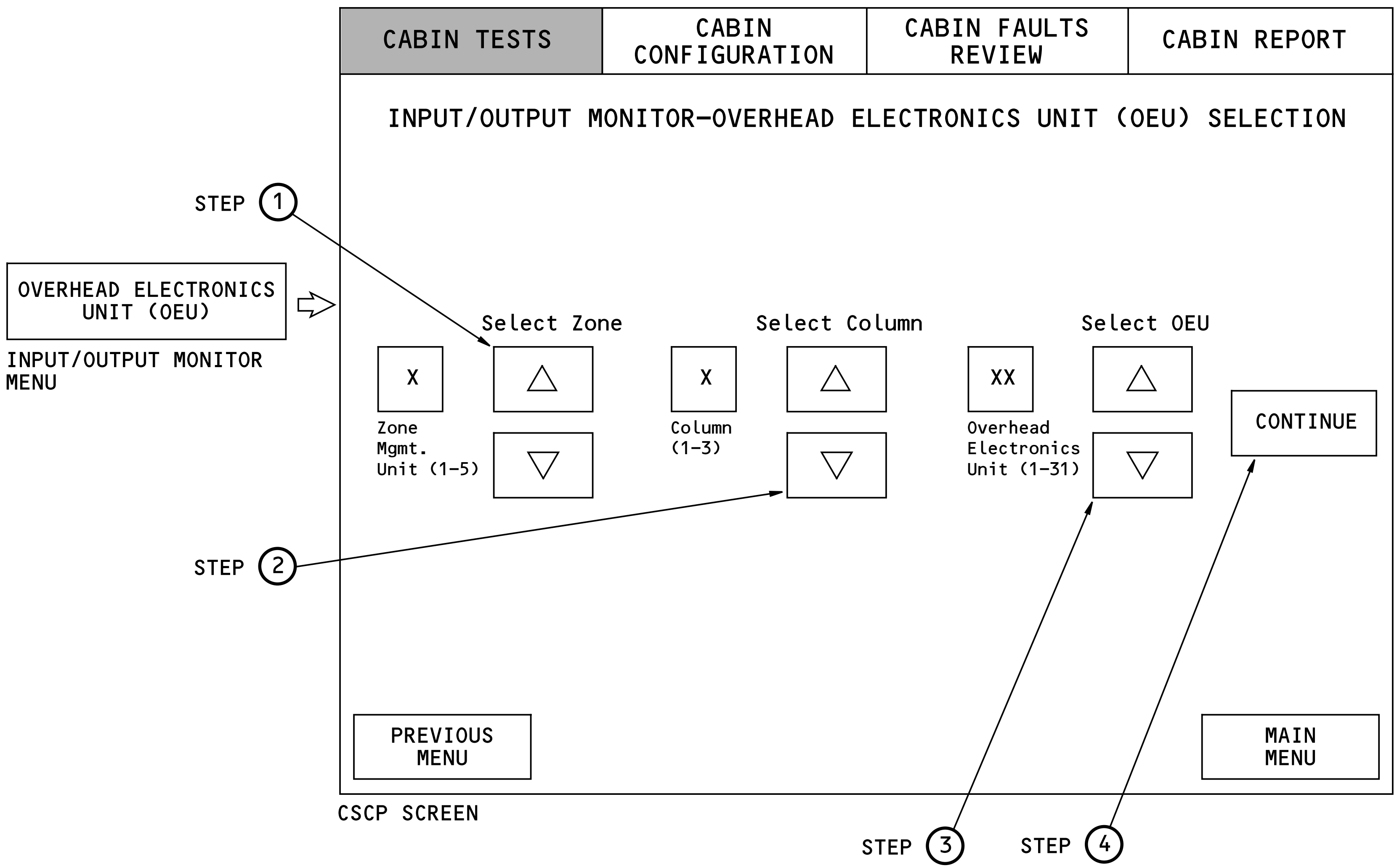
After you select a zone, select a column. Each zone has three columns (1 for left, 2 for center, and 3 for right). To select a column, touch the up or down arrows under Select Column.

After you select a column, select an OEU. The OEU number relates to the sequence in the column. The first OEU in a column is number one, the second is number two. To select an OEU, touch the up or down arrows under Select OEU. The CSS can have as many as 31 OEUs in a column.

After you select an OEU, touch CONTINUE to show the input/output monitor - OEU screen.

Touch PREVIOUS MENU to show the input/output monitor menu.

Touch MAIN MENU to show the cabin maintenance menu.



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CSS TEST AND SOFTWARE INSTALLATION - INPUT/OUTPUT MONITOR - OEU SELECTION

CSS TEST AND SOFTWARE INSTALLATION - INPUT/OUTPUT MONITOR - OEU SCREEN

General

You use this screen to examine the condition of the interfaces of an overhead electronics unit (OEU).

Access

To show the input/output monitor - OEU screen:

- Touch CABIN TESTS on any maintenance screen
- Touch ENGINEERING TESTS on the cabin test menu
- Touch INPUT/OUTPUT MONITOR on the engineering tests menu
- Touch OVERHEAD ELECTRONICS UNIT (OEU) on the input/output monitor menu
- Select an OEU and touch CONTINUE on the OEU selection screen.

Controls and Indications

The screen shows the time at the top.

The OEU data window show the OEU address and location.

The OEU data window gives this data for each OEU interfaces:

- Input (IN) or output (OUT)
- Connector pin number
- Type of interface (analog, discrete, shop, token, or lamp control)
- The condition of the interface (voltage, ground or open, active or not active).

Touch PREVIOUS MENU to show the input/output monitor menu.

Touch PREVIOUS SCREEN to show the OEU selection screen.

Touch FREEZE so the screen does not change if the condition of an interface changes.

Touch SAVE ALL to send the data to a floppy diskette in the cabin system control panel (CSCP) disk drive.

Touch PRINT ALL to send the data to the cabin printer.

Touch MAIN MENU to show the cabin maintenance menu.

SELECT AN OEU

AND

CONTINUE

OEU SELECTION SCREEN

CABIN TESTS	CABIN CONFIGURATION	CABIN FAULTS REVIEW	CABIN REPORT

INPUT/OUTPUT MONITOR - OVERHEAD ELECTRONIC UNIT (OEU)

TIME: 12:25z

OEU	OEU 1-3-08	OEU R OUTBOARD PSU - SEAT 6	
INPUT/ OUTPUT	**PIN #**	**DESCRIPTION**	**STATE**
IN	J3-07	ANALOG 1	4.8 VOLTS
IN	J3-09	ANALOG 2	0.2 VOLTS
IN	J3-11	DISCRETE INPUT 1	GROUND
IN	J3-12	DISCRETE INPUT 2	OPEN
IN	J3-13	DISCRETE INPUT 3	OPEN
IN	J3-14	DISCRETE INPUT 4	GROUND
IN	J3-20	SHOP MODE 0	OPEN
IN	J3-37	SHOP MODE 1	OPEN
IN	J1-01	TOKEN IN	NOT ACTIVE
OUT	J1-02	TOKEN OUT	NOT ACTIVE
OUT	J2-01	HIGH CURRENT PORT 1	GROUND
OUT	J2-02	HIGH CURRENT PORT 2	OPEN
OUT	J2-03	HIGH CURRENT PORT 3	OPEN
OUT	J2-04	HIGH CURRENT PORT 4	GROUND
OUT	J2-05	HIGH CURRENT PORT 5	OPEN
OUT	J2-06	HIGH CURRENT PORT 6	GROUND
OUT	J2-07	LOW CURRENT PORT 7	OPEN

PREVIOUS MENU	PREVIOUS SCREEN	FREEZE	SAVE ALL	PRINT ALL	MAIN MENU

CSCP SCREEN

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CSS TEST AND SOFTWARE INSTALLATION - INPUT/OUTPUT MONITOR - OEU SCREEN

CSS TEST AND SOFTWARE INSTALLATION - INPUT MONITOR - CKT BREAKER/POWER BUS

General

You use this screen to examine the position of CSS circuit breakers and the condition of the power buses.

Access

To show the input monitor-circuit breaker/power buses screen:

- Touch CABIN TESTS on any maintenance screen
- Touch ENGINEERING TESTS on the cabin test menu
- Touch INPUT/OUTPUT MONITOR on the engineering tests menu
- Touch CIRCUIT BREAKER/POWER BUSES on the input/output monitor menu.

Controls and Indications

The screen shows the time at the top.

The power buses off data window shows the electrical power buses that have no power. The scroll bar shows on the right of the window when the number of buses off is more than the window can show.

The circuit breakers off data window shows the CSS circuit breakers that are out. The scroll bar shows on the right of the window when the number of circuit breakers out is more than the window can show.

The passenger entertainment/service power shows OFF when the seat power is off.

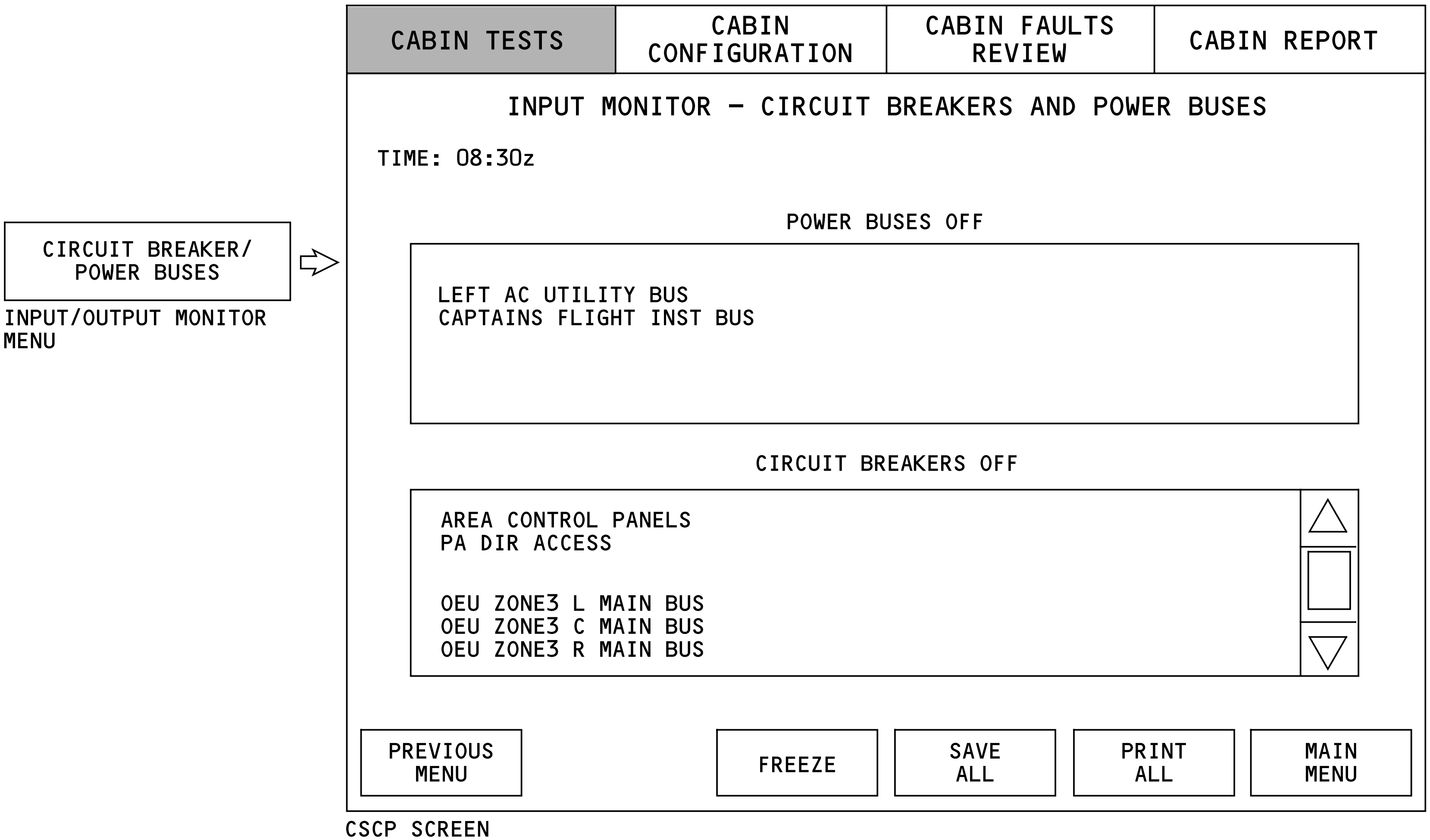
Touch PREVIOUS MENU to show the input/output monitor menu.

Touch FREEZE so the screen does not change when the condition of an interface changes.

Touch SAVE ALL to send the data to a floppy diskette in the cabin system control panel (CSCP) disk drive.

Touch PRINT ALL to send the data to the cabin printer.

Touch MAIN MENU to show the cabin maintenance menu.



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CSS TEST AND SOFTWARE INSTALLATION - INPUT MONITOR - CKT BREAKER/POWER BUS

CSS TEST AND SOFTWARE INSTALLATION - INPUT MONITOR - ARINC 629 INPUTS

General

You use the input monitor-ARINC 629 inputs screen to examine the data on the left and right systems ARINC 629 data buses.

Access

To show this screen:

- Touch CABIN TESTS on any maintenance screen
- Touch ENGINEERING TESTS on the cabin test menu
- Touch INPUT/OUTPUT MONITOR on the engineering tests menu
- Touch INPUTS next to ARINC 629 BUS on the input/ output monitor menu.

Controls and Indications

The screen shows the time at the top.

Touch HELP for more information on this screen.

The data window shows CSS related data on the left and right systems ARINC 629 buses.

Each row shows data for one ARINC 629 word. The word label shows at the left in hexadecimal format. The signal name shows adjacent to the label. The bus name shows adjacent to the signal name (LEFT for left systems ARINC 629 bus, RIGHT for right systems ARINC 629 bus). The word data shows on the right.

To show more data, touch the up or down arrow. The box shows your position in the data list.

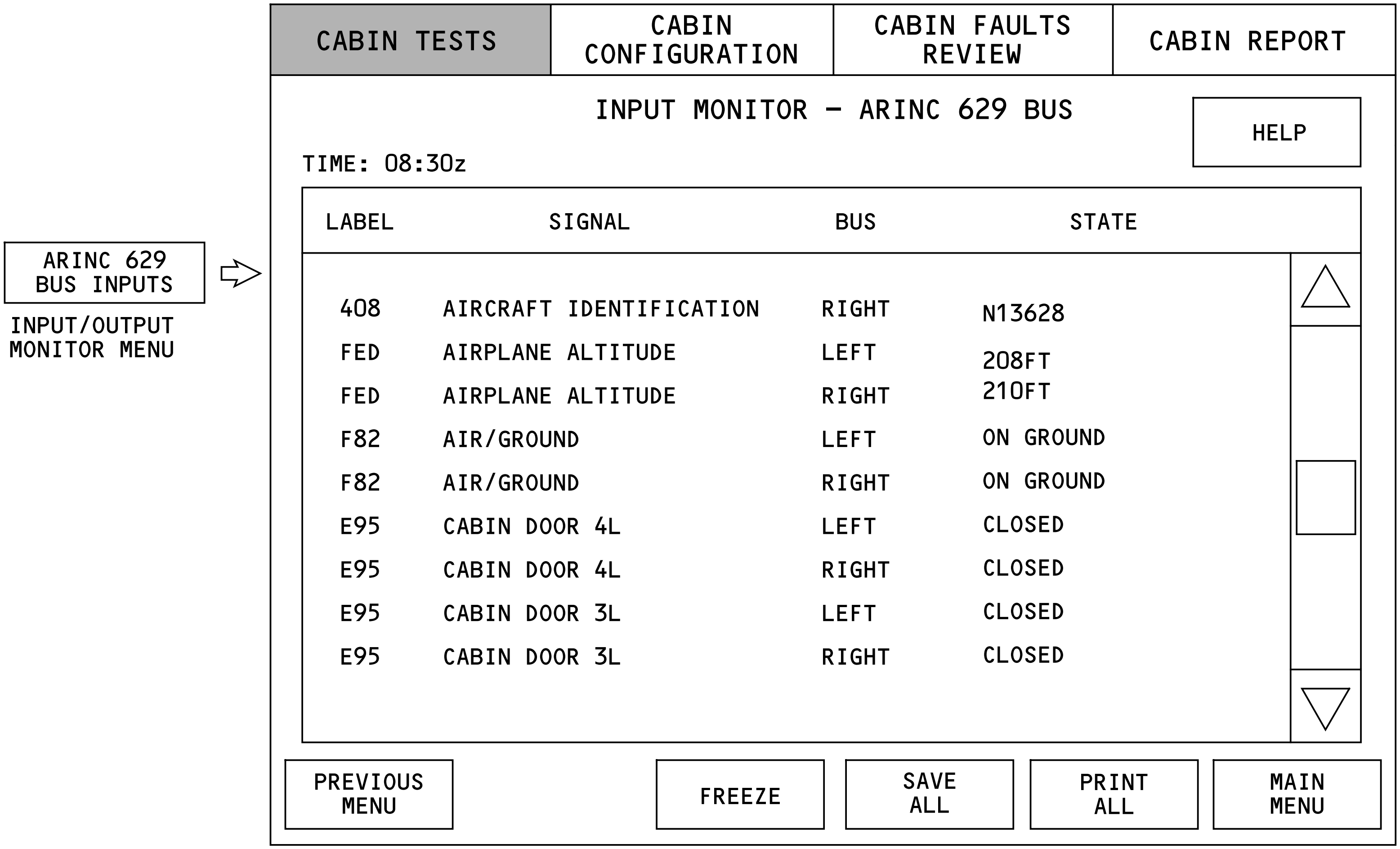
Touch PREVIOUS MENU to show the input/output monitor menu.

Touch FREEZE so the screen does not change when the condition of the data changes.

Touch SAVE ALL to send the data to a floppy diskette in the cabin system control panel (CSCP) disk drive.

Touch PRINT ALL to send the data to the cabin printer for a paper report.

Touch MAIN MENU to show the cabin maintenance menu.



CSCP SCREEN

23-39-00-682 Rev 0 06/17/96

CSS TEST AND SOFTWARE INSTALLATION - INPUT MONITOR - ARINC 629 INPUTS

CSS TEST AND SOFTWARE INSTALLATION - COMMAND OUTPUT MENU

General

You use command output to manually set the outputs of CSS components. You use the command output menu to select the type of component.

Access

To show the command output menu:

- Touch CABIN TESTS on any maintenance screen
- Touch ENGINEERING TESTS on the cabin test menu
- Touch COMMAND OUTPUT on the engineering tests menu.

Controls and Indications

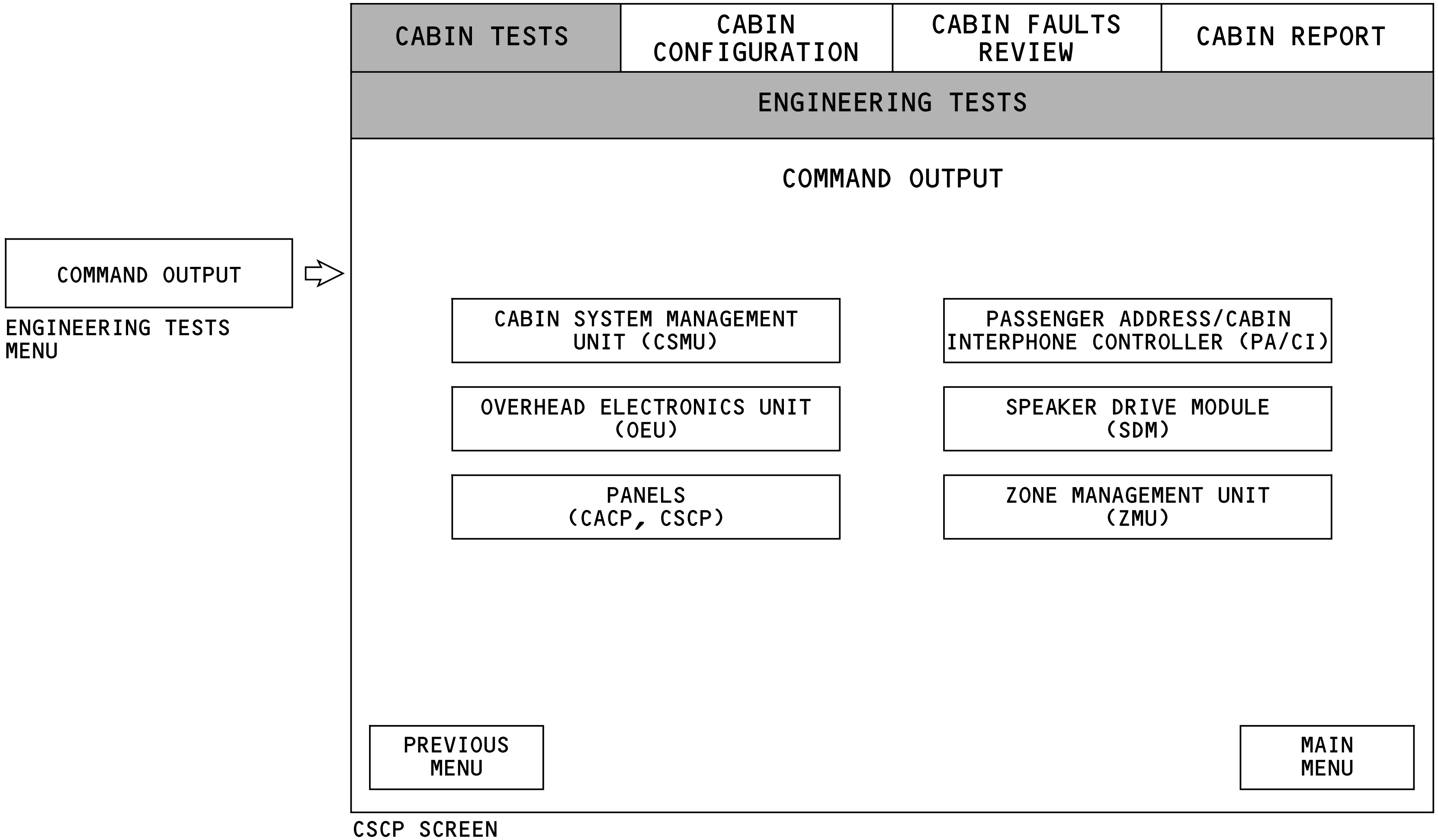
You can set outputs to these components:

- Cabin system management unit (CSMU)
- Overhead electronics units (OEUs)
- Panels (CACP, CSCP)
- Passenger address/cabin interphone (PA/CI) controller
- Speaker drive modules (SDMs)
- Zone management units (ZMUs).

To select a component, touch the applicable selection.

Touch PREVIOUS MENU to show the engineering tests menu.

Touch MAIN MENU to show the cabin maintenance menu.



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CSS TEST AND SOFTWARE INSTALLATION - COMMAND OUTPUT MENU

CSS TEST AND SOFTWARE INSTALLATION - COMMAND OUTPUT - OEU

General

You use the command output - OEU screen to set outputs of an overhead electronics unit (OEU).

Access

To show the command output menu:

- Touch CABIN TESTS on any maintenance screen
- Touch ENGINEERING TESTS on the cabin test menu
- Touch COMMAND OUTPUT on the engineering tests menu
- Touch OVERHEAD ELECTRONICS UNIT (OEU) on the command output menu.

Controls and Indications

You use the upper section of the screen to select an OEU.

To select an OEU, first select a zone with the up or down arrow below Select Zone. The CSS can have as many as five zones (one for each zone management unit).

After you select a zone, select a column. Each zone has three columns (1 for left, 2 for center, and 3 for right). To select a column, touch the up or down arrows under Select Column.

After you select a column, you select an OEU. The OEU number is its sequence in the column. The first OEU in a column is number 1, the second is number two. To select an OEU, touch the up or down arrows under Select OEU. The CSS can have as many as 31 OEUs in a column.

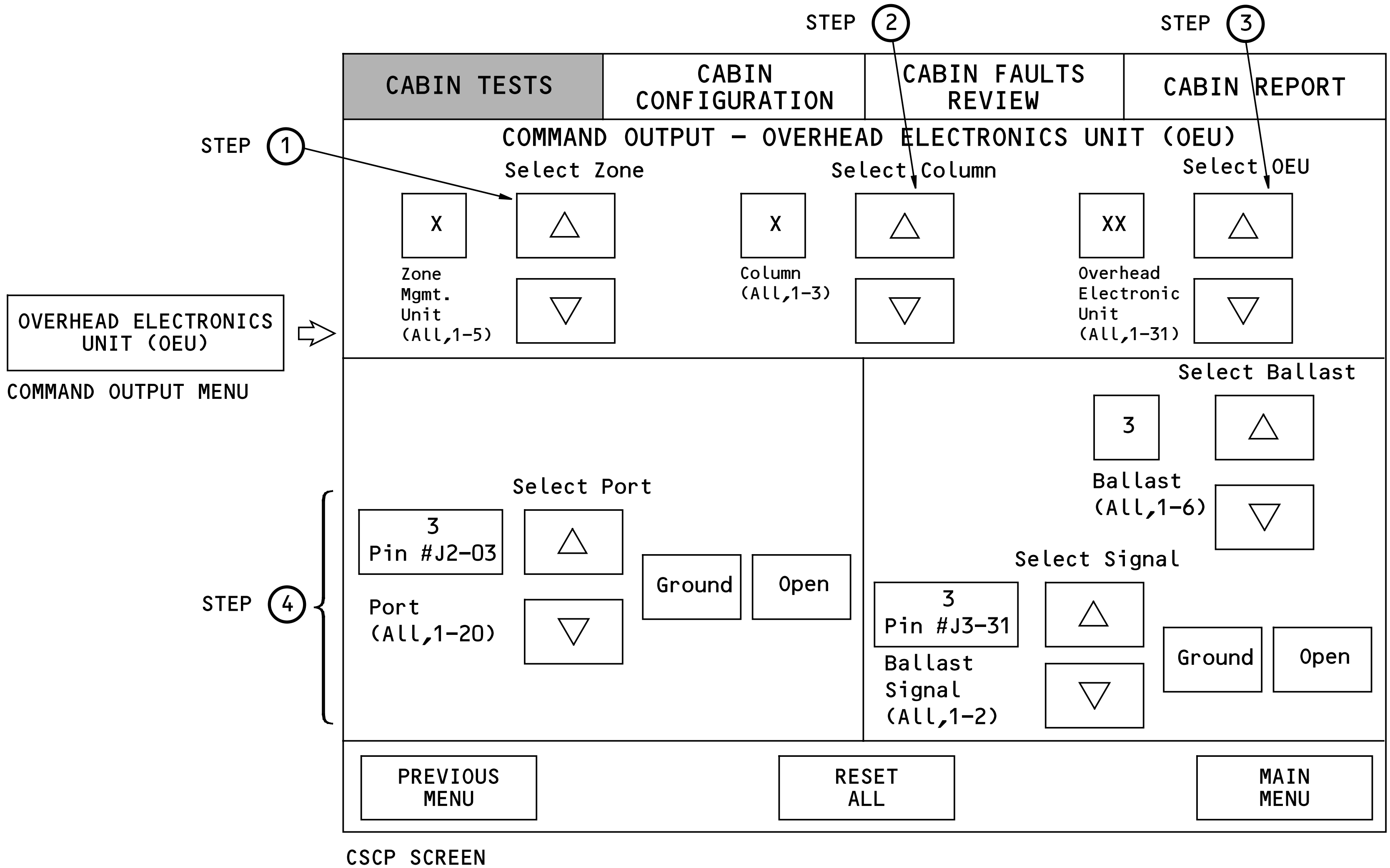
You use the lower left section of the screen to set a port output. There are twelve ports on an OEU. Touch the up or down arrows to select a port. The selected port number and connector pin number show next to the arrows. If you select all ports, ALL shows. After you select a port, touch either GROUND or OPEN to set the output.

You use the lower right section of the screen to set a ballast output. There are four ballasts to an OEU. You select a ballast in the same way that you select a port.

Touch PREVIOUS MENU to show the command output menu.

Touch RESET ALL to set the ports and ballasts back to their initial condition.

Touch MAIN MENU to show the cabin maintenance menu.



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CSS TEST AND SOFTWARE INSTALLATION - COMMAND OUTPUT - OEU

CSS TEST AND SOFTWARE INSTALLATION - COMMAND OUTPUT - SDM

General

You use the command output - SDM screen to cause the speaker drive modules (SDMs) to make noise.

Access

To show the command output menu:

- Touch CABIN TESTS on any maintenance screen
- Touch ENGINEERING TESTS on the cabin test menu
- Touch COMMAND OUTPUT on the engineering tests menu
- Touch SPEAKER DRIVE MODULE (SDM) on the command output menu.

Controls and Indications

Touch the column select arrows to select one or all columns (zones). There can be as many as five columns.

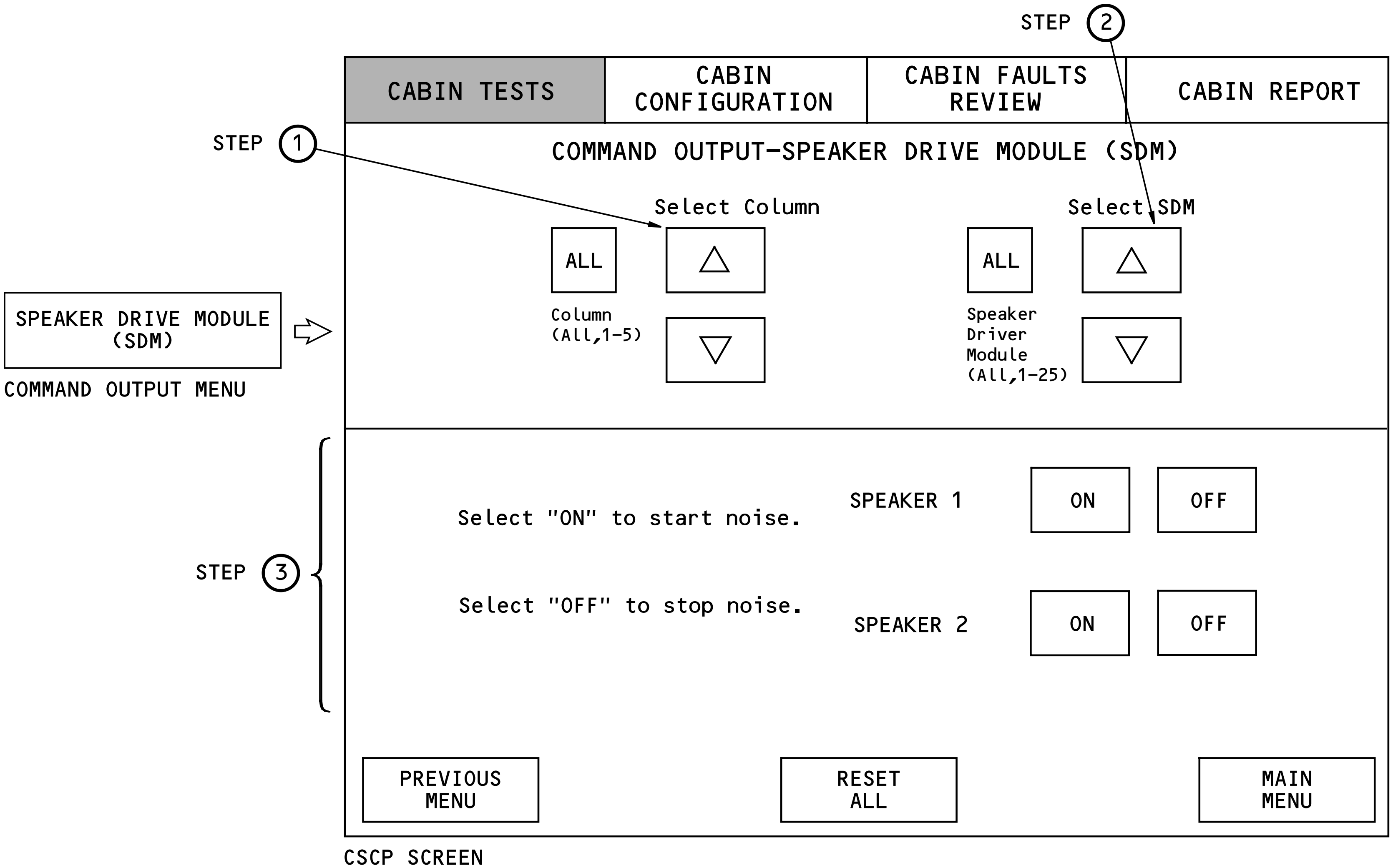
Touch the SDM select arrows to select one or more SDMs. There can be as many as 25 SDMs in a column.

Touch SPEAKER 1 ON and SPEAKER 2 ON to cause the SDMs to make noise. Each SDM has one or two speakers.

Touch RESET ALL to stop the random noise.

Touch PREVIOUS MENU to show the command output menu.

Touch MAIN MENU to show the cabin maintenance menu.



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CSS TEST AND SOFTWARE INSTALLATION - COMMAND OUTPUT - SDM

CSS TEST AND SOFTWARE INSTALLATION - EXTENDED CABIN FAULTS REVIEW MENU

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CSS TEST AND SOFTWARE INSTALLATION - EXTENDED CABIN FAULTS REVIEW MENU

General

You use the extended cabin faults review menu to show failure data for the CSS. These are the seven selections on the extended cabin faults review menu:

- QUICK TEST FAULTS REVIEW
- QUICK TEST FAULTS REVIEW BY ZONE
- MASKED AND UNMASKED FAULTS REVIEW (QUICK TEST)
- DATA INSTALLATION FAULTS REVIEW
- ALL TEST FAULTS REVIEW
- ALL TEST FAULTS REVIEW BY ZONE
- MASKED AND UNMASKED FAULTS REVIEW (ALL TEST).

Access

To show the extended cabin faults review menu, do this:

- Touch CABIN TESTS on any maintenance screen
- Touch ENGINEERING TESTS
- Touch EXTENDED CABIN FAULTS REVIEW.

Quick Test Faults Review

Touch QUICK TEST FAULTS REVIEW to show the faults review screen from the last quick test. See the quick test description for more information.

Quick Test Faults Review by Zone

Quick test faults review by zone is the same as quick test faults review but you can look at faults for a specified zone. You use this when you do trouble-shooting within a cabin zone.

Masked and Unmasked Faults Review (Quick Test)

Normally, quick test only shows unmasked faults. Masked faults are faults that do not normally show because the configuration database prevents them. Touch MASKED AND UNMASKED FAULTS REVIEW (QUICK TEST) to show both masked and unmasked faults from the last quick test.

Data Installation Faults Review

Touch DATA INSTALLATION FAULTS REVIEW to show an installation fault results screen from the last database or operational program installation. For more information on data installation, see the database or operational program installation description.

All Test Faults Review

Touch ALL TEST FAULTS REVIEW to show the faults review screen from the last all test. See the all test description for more information.

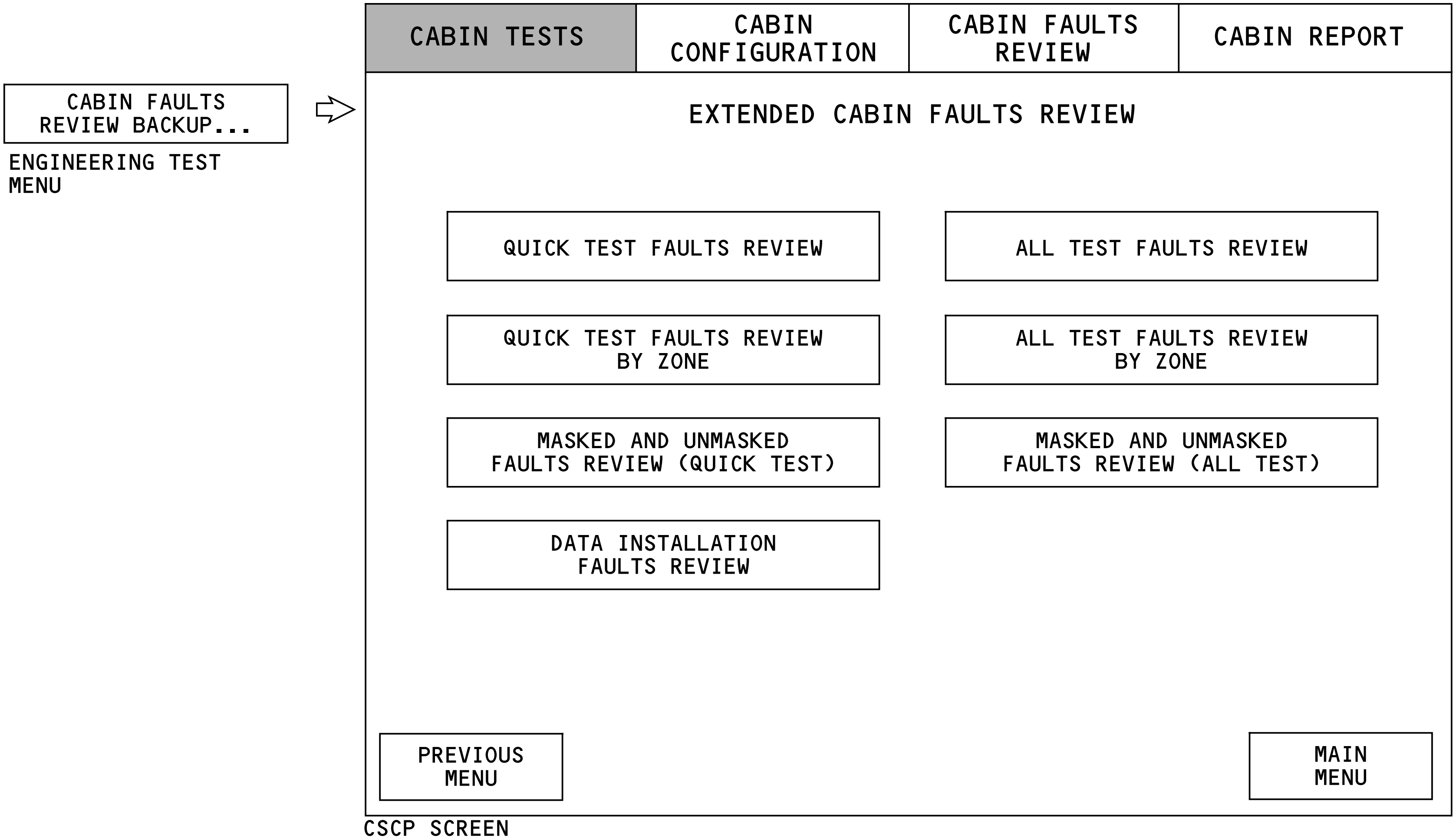
All Test Faults Review by Zone

All test faults review by zone is the same as all test faults review but you can look at faults for a specific zone. You use this when you do trouble-shooting within a cabin zone.

CSS TEST AND SOFTWARE INSTALLATION - EXTENDED CABIN FAULTS REVIEW MENU

Masked and Unmasked Faults Review (All Test)

Normally, all test only shows unmasked faults. Masked faults are faults that do not normally show because the configuration database prevents them. Touch MASKED AND UNMASKED FAULTS REVIEW (ALL TEST) to show both masked and unmasked faults from the last all test.



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CSS TEST AND SOFTWARE INSTALLATION - EXTENDED CABIN FAULTS REVIEW MENU

CSS TEST AND SOFTWARE INSTALLATION - QUICK TESTS FAULTS REVIEW BY ZONE

General

You use quick test faults review by zone to show failures from the last quick test for each cabin zone.

An equivalent function is available for all test review when you select all test review by zone.

Access

To show this screen:

- Touch CABIN TESTS on any maintenance screen
- Touch ENGINEERING TESTS on the cabin test menu
- Touch QUICK TEST FAULTS REVIEW BY ZONE on the engineering tests menu.

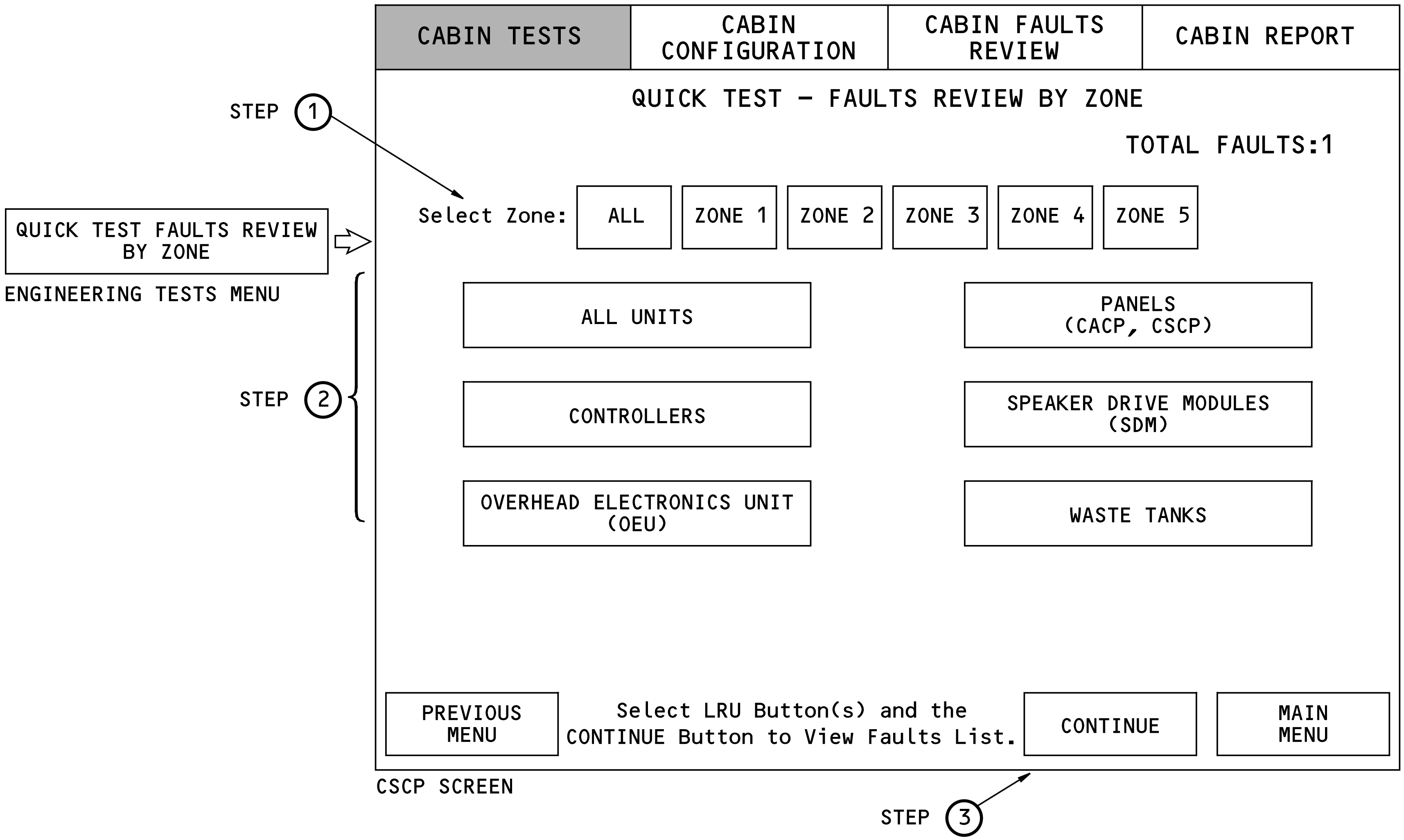
Controls and Indications

You use the upper selections to select a zone. The selection shows green.

After you select a zone and an LRU type, touch CONTINUE to show the quick test fault results screens for the selected cabin zone.

Touch PREVIOUS MENU to show the engineering tests menu.

Touch MAIN MENU to show the cabin maintenance menu.



CSS TEST AND SOFTWARE INSTALLATION - QUICK TESTS FAULTS REVIEW BY ZONE

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CSS TEST AND SOFTWARE INSTALLATION - CABIN CONFIGURATION MENU TREE

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CSS TEST AND SOFTWARE INSTALLATION - CABIN CONFIGURATION MENU TREE

General

You use the cabin system control panel (CSCP) for CSS maintenance procedures.

Use the cabin configuration menu to install software and check the configuration of components in the CSS. The cabin configuration menu has three selections:

- CONFIGURATION DATABASE INSTALLATION
- SOFTWARE MANAGEMENT
- CONFIGURATION CHECK.

Configuration Database Installation

Touch CONFIGURATION DATABASE INSTALLATION to install a configuration database.

The configuration database installation window shows the part number and version number of the active database. It also gives you alternative selections for installing the database.

After you install a database, one of two screens shows on the CSCP. Installation complete with no faults shows if the installation is good. If there are faults, a faults results screen shows them.

Software Management

You use the SOFTWARE MANAGEMENT selection to install operational programs. The SOFTWARE MANAGEMENT selection shows the software management menu. It has four selections:

- OPERATIONAL PROGRAM SOFTWARE INSTALLATION
- INSTALL DATA FROM FLOPPY DISK DRIVE
- LIST OF FILES ON FLOPPY DISKETTE
- DISK MAINTENANCE
- SOFTWARE IN MASS STORAGE.

Select OPERATIONAL PROGRAM SOFTWARE INSTALLATION to install software in selected LRUs. Installation of operational program software is almost the same as the configuration database installation.

LIST OF FILES ON FLOPPY DISKETTE shows you all of the software files on any disk you have in the CSCP disk drive.

Select INSTALL DATA FROM CSCP DISK DRIVE to install configuration database or operational software from a floppy disk in the CSCP disk drive.

DISK MAINTENANCE lets you remove database or operational programs from the system.

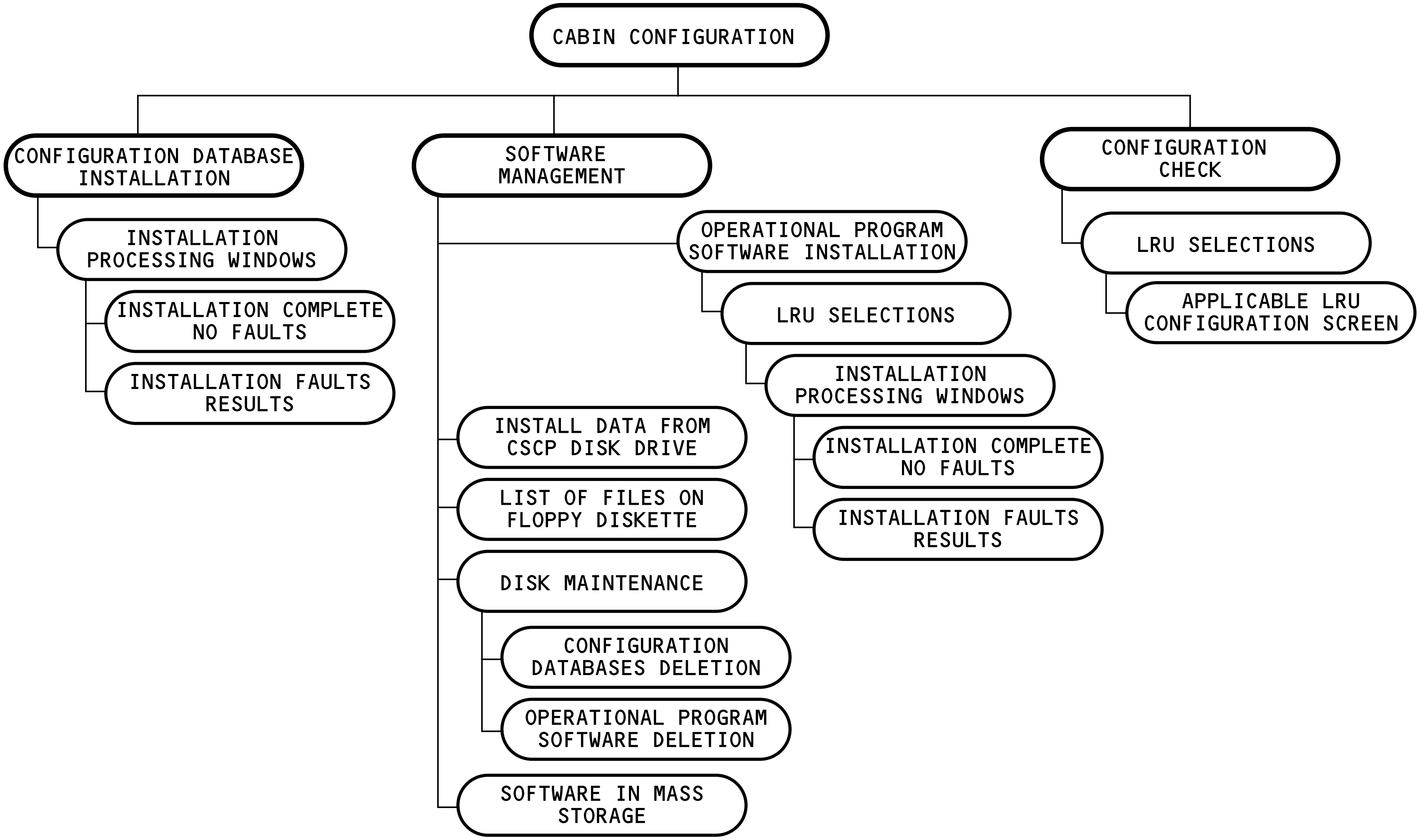
SOFTWARE IN MASS STORAGE lets you see the software files in the CSCP mass storage.

Configuration Check

The configuration check lets you see the current configuration of selected LRUs installed in the airplane.

CSS TEST AND SOFTWARE INSTALLATION - CABIN CONFIGURATION MENU TREE

You can use the configuration check to see all hardware/software part numbers related to a selected LRU.



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CSS TEST AND SOFTWARE INSTALLATION - CABIN CONFIGURATION MENU TREE

CSS TEST AND SOFTWARE INSTALLATION - CABIN CONFIGURATION MENU

General

You use the cabin configuration menu to install software and check the configuration of components in the CSS. These are the three selections:

- CONFIGURATION DATABASE INSTALLATION
- SOFTWARE MANAGEMENT
- CONFIGURATION CHECK.

Access

Touch CABIN CONFIGURATION on any maintenance screen to show the cabin configuration menu.

Configuration Database Installation

When you touch CONFIGURATION DATABASE INSTALLATION, a processing screen shows while the CMS installs addresses to the core components. Then the configuration database installation screen shows.

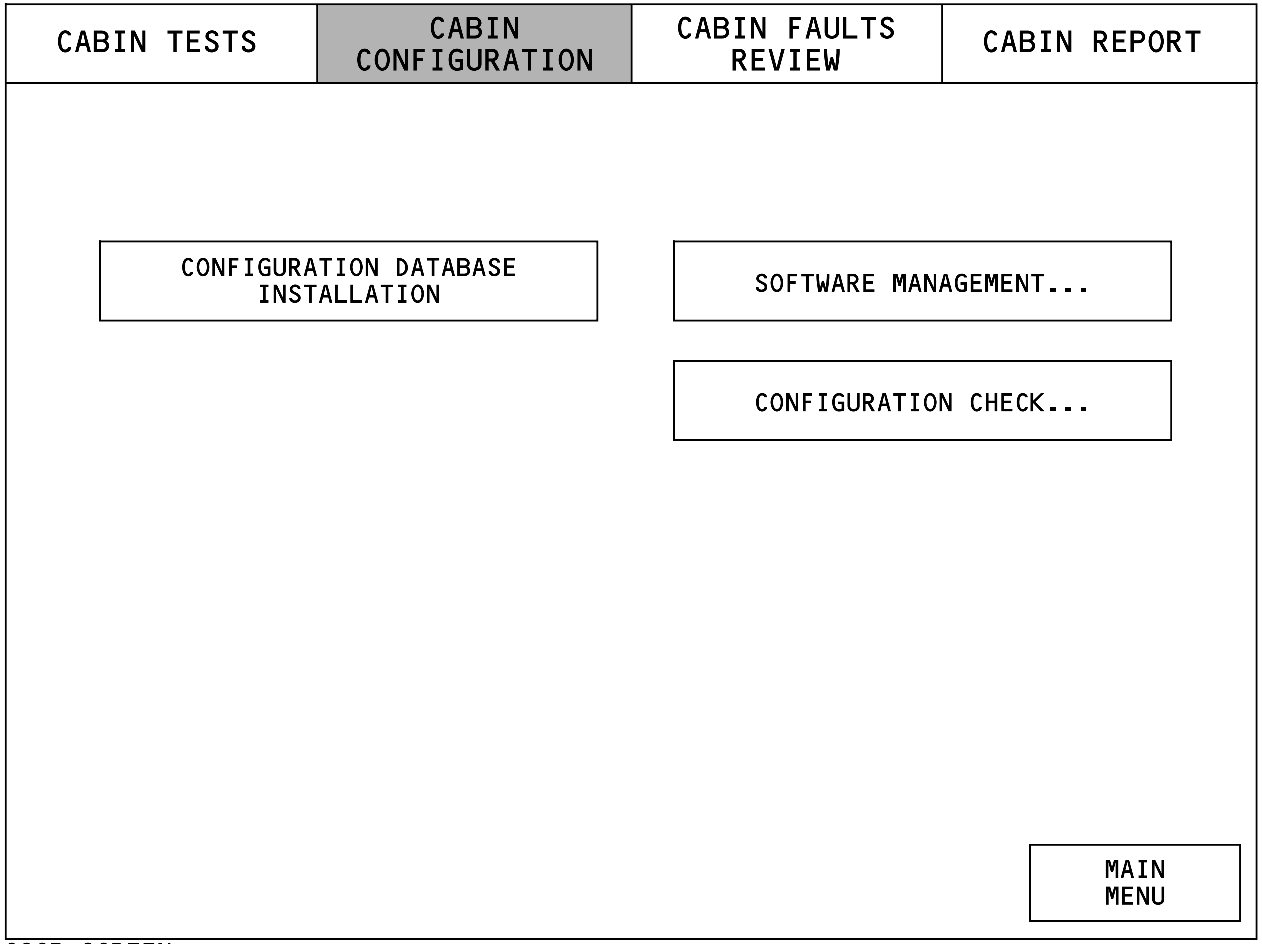
The configuration database installation screen shows the part number and version number of the active database. It gives you selections you use to install a configuration database.

Software Management

Software management lets you install operational programs in selected LRUs. You can also list disk files and control database and operational software programs installed in the cabin system control panel (CSCP).

Configuration Check

The configuration check lets you see the current LRU configuration of the CSS. It also shows you if the installed LRUs can operate with each other.



CSCP SCREEN

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CSS TEST AND SOFTWARE INSTALLATION - CABIN CONFIGURATION MENU

CSS TEST AND SOFTWARE INSTALLATION - CONFIGURATION DATABASE INSTALLATION

General

The configuration database installation window shows the active CSS database. It also gives you selections to install a database.

Access

Touch these selections to show the configuration database installation screen:

- CABIN CONFIGURATION on any maintenance screen
- CONFIGURATION DATABASE INSTALLATION on the cabin configuration menu.

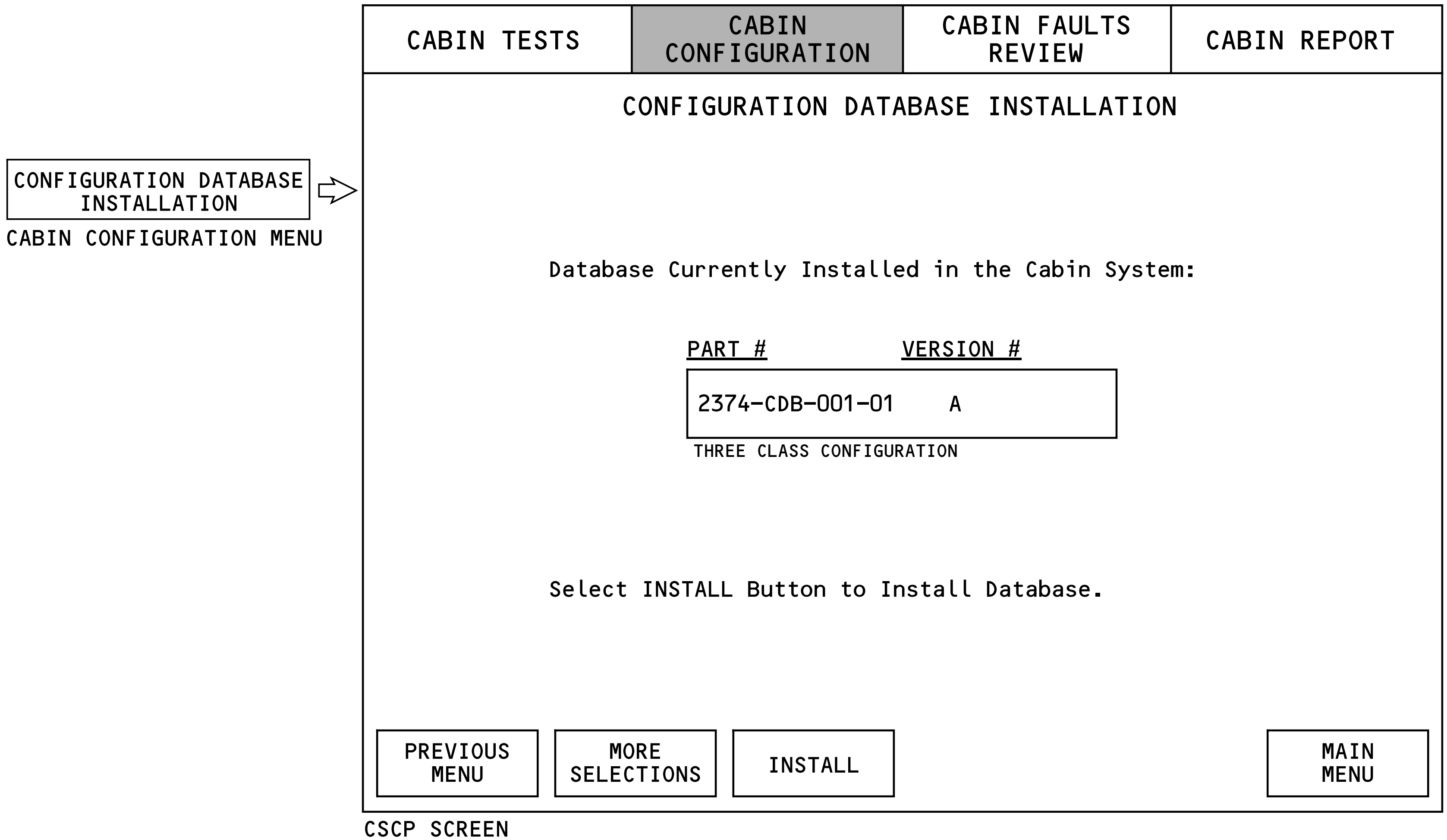
Controls and Indications

This window shows the part number and version of the database installed. Below the part number is the title of the database.

Touch INSTALL to install the database shown on the screen. After you touch INSTALL, a dialogue window shows to tell you that the database installation is operating.

You can not select INSTALL if the current database is not in the cabin system control panel (CSCP) mass storage.

Touch MORE SELECTIONS to see other databases that may be available.



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CSS TEST AND SOFTWARE INSTALLATION - CONFIGURATION DATABASE INSTALLATION

CSS TEST AND SOFTWARE INSTALLATION - CONFIGURATION DATABASE INSTALLATION - MULTIPLE DATABASES

General

This configuration database installation screen shows as many as six databases in the cabin system control panel (CSCP) memory.

Access

Touch one of these to show the configuration database installation screen for multiple databases:

- CABIN CONFIGURATION on any maintenance screen
- CONFIGURATION DATABASE INSTALLATION on the cabin configuration menu
- MORE SELECTIONS on the first configuration database installation screen.

Controls and Indications

This screen shows the part numbers and versions of all databases stored in memory in the CSCP. Below each part number is the database type.

In this example, the upper left database area shows that the active database is not in the CSCP memory. You use other screens to delete programs from memory.

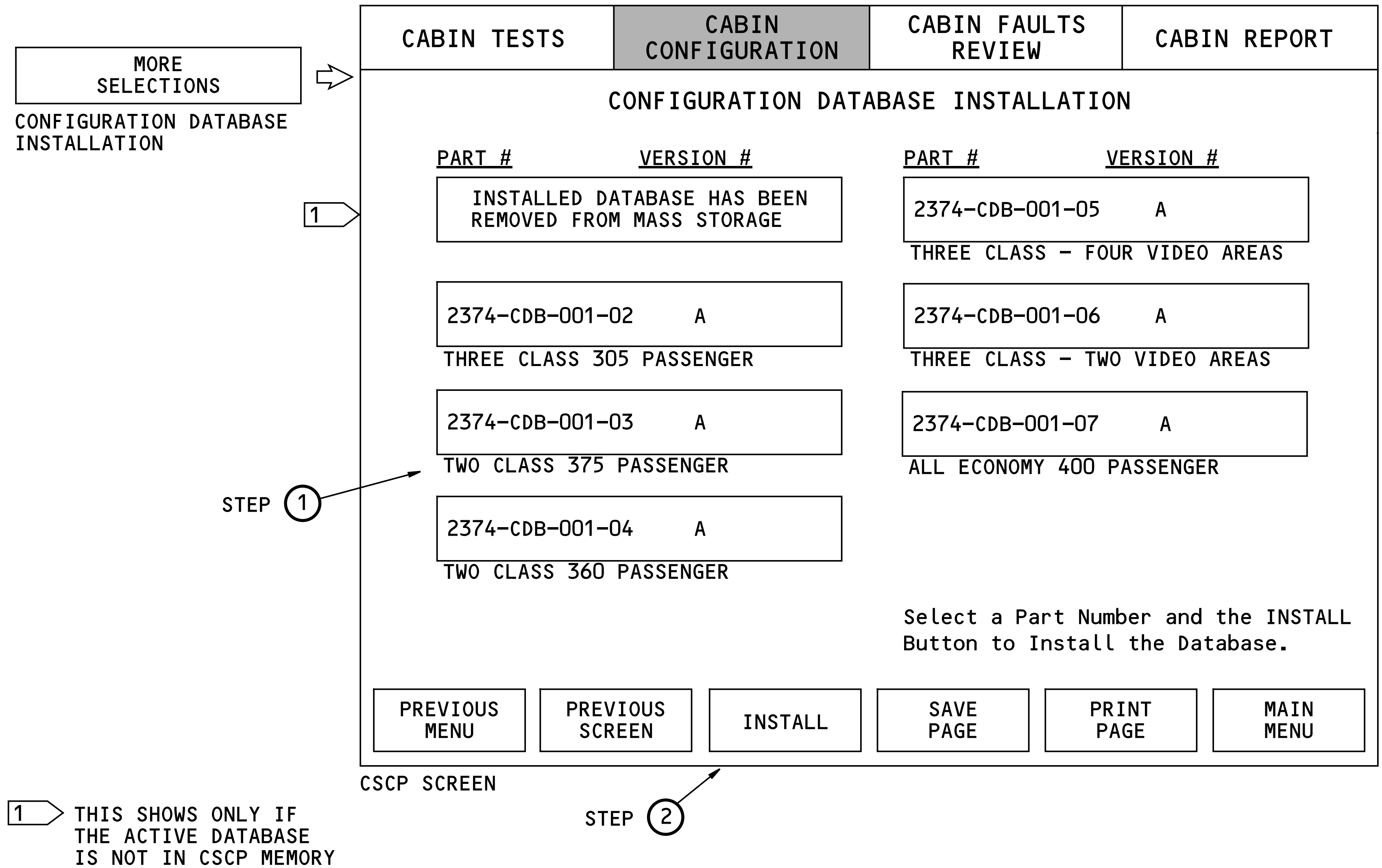
Touch any of these selections at the bottom of the screen to do the related function:

- PREVIOUS MENU - go to the cabin configuration menu
- INSTALL - install the selected database
- SAVE PAGE - save the contents of this screen to a floppy diskette in the CSCP disk drive
- PRINT PAGE - print the contents of this screen on the cabin printer
- MAIN MENU - return to the cabin maintenance main menu.

Database Installation

Touch the database part number on the screen to select it. The part number you select changes to green and the INSTALL selection at the bottom of the screen becomes active.

Touch INSTALL to install the database. After you touch INSTALL, a screen shows to tell you that the configuration database installation is operating.



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CSS TEST AND SOFTWARE INSTALLATION - CONFIGURATION DATABASE INSTALLATION - MULTIPLE DATABASES

CSS TEST AND SOFTWARE INSTALLATION - DATABASE DISCREPANCY DIALOGUE WINDOW

General

The database discrepancy dialogue window tells you that the database you selected is different from the active one.

Access

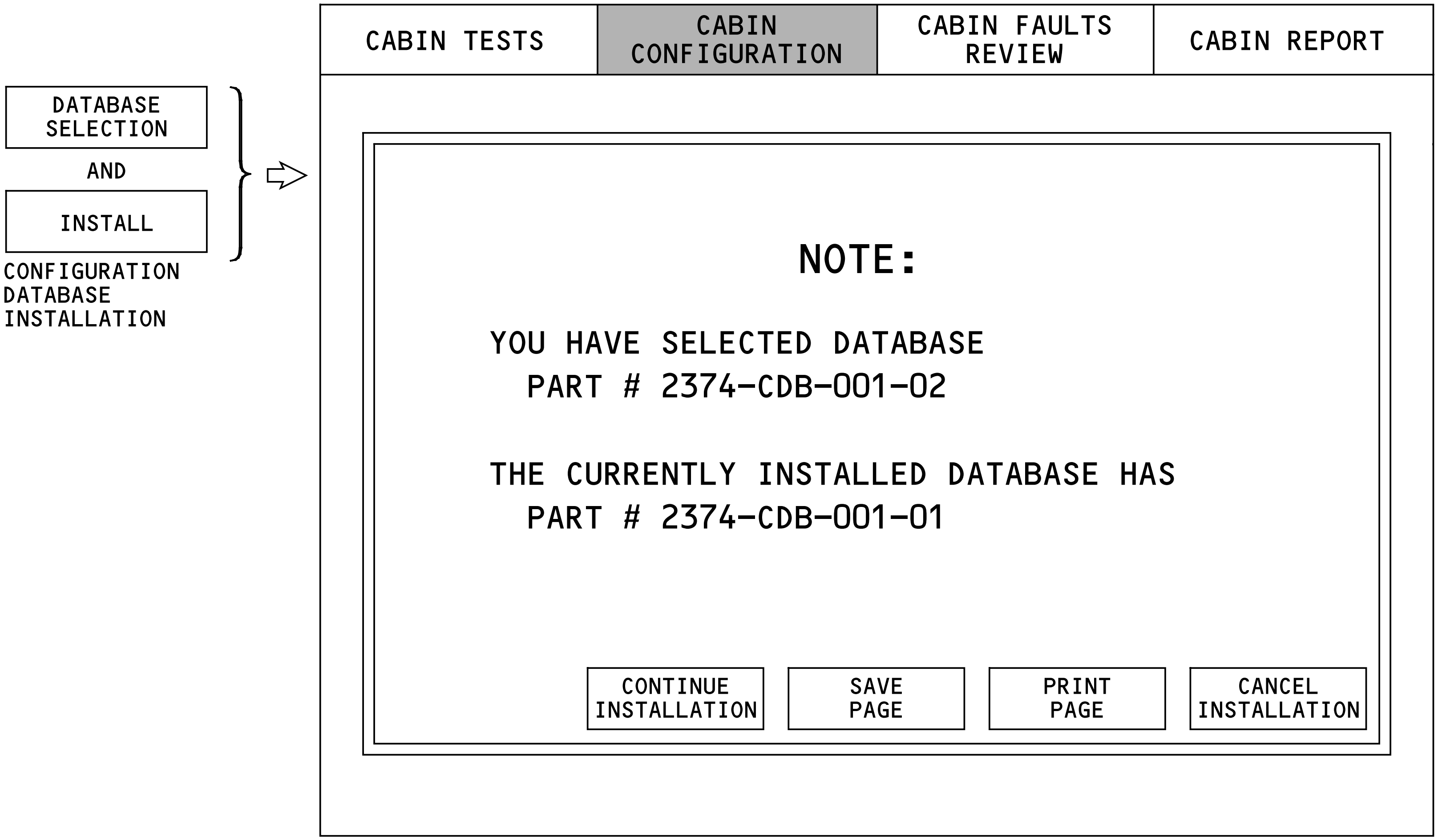
This screen shows automatically when you select a database different from the one installed in the cabin system control panel (CSCP) memory. It shows after you touch INSTALL on the configuration database installation screen.

Controls and Indications

This screen shows the part number of the database you selected. It also shows the part number of the active database.

Touch any of these selections at the bottom of the screen to do the related function:

- CONTINUE INSTALLATION - to install the database
- SAVE PAGE - to save the contents of this screen to a floppy diskette in the CSCP disk drive
- PRINT PAGE - to print the contents of this screen on the cabin printer
- CANCEL INSTALLATION - to cancel installation and return to the configuration database installation screen.



CSCP SCREEN

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CSS TEST AND SOFTWARE INSTALLATION – DATABASE DISCREPANCY DIALOGUE WINDOW

CSS TEST AND SOFTWARE INSTALLATION - CONFIGURATION DATABASE INSTALLATION IS OPERATING

General

The configuration database installation is operating screen shows when you install a configuration database.

Access

This screen shows automatically when you select a database and touch INSTALL on the configuration database installation screen.

It also shows if you touch CONTINUE INSTALLATION on the database discrepancy screen.

Controls and Indications

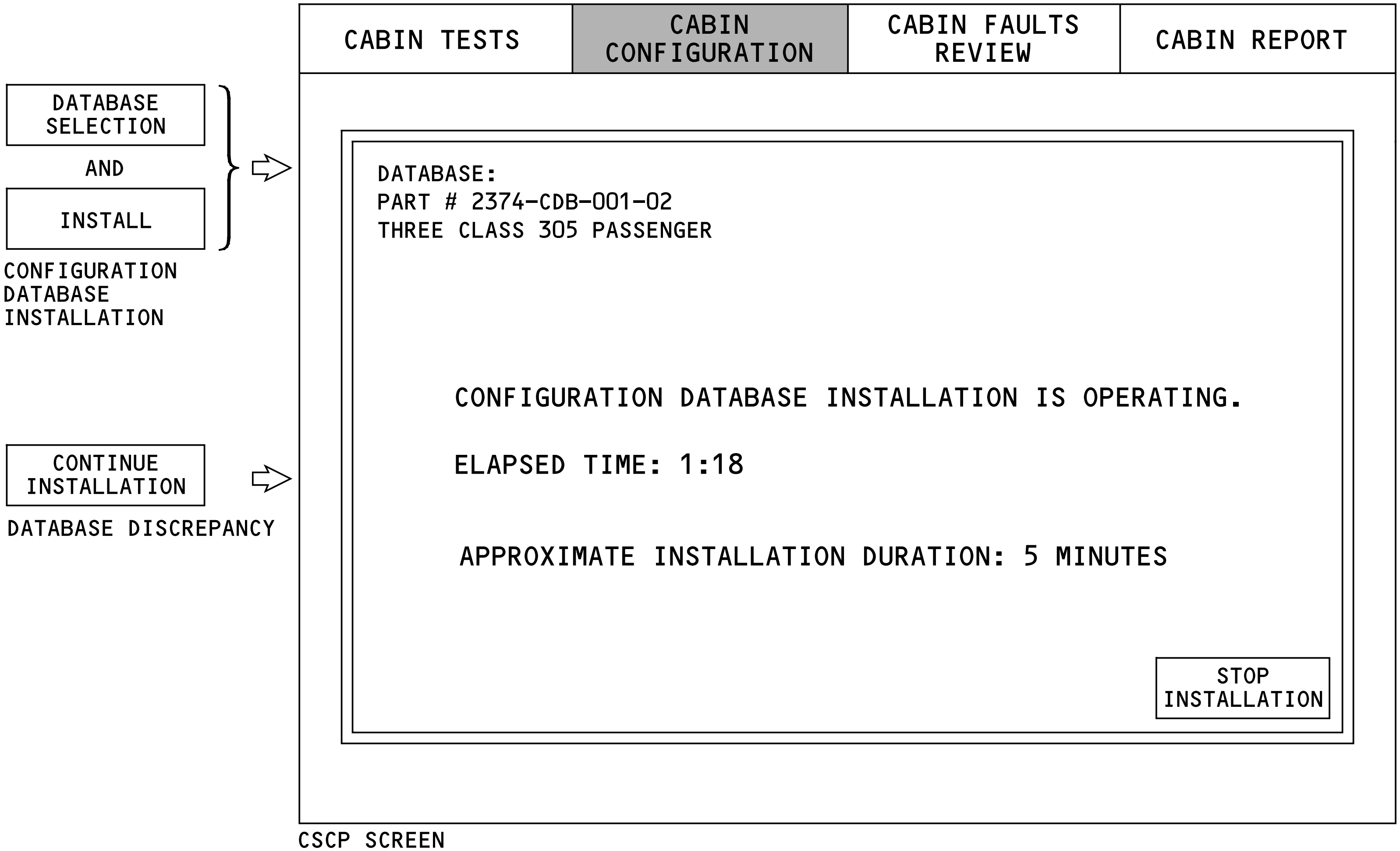
The part number and description of the database show in the top-left part of the window.

The center of the window shows you that the database is being installed and the elapsed time. This area also shows the approximate installation time.

Touch STOP INSTALLATION to cancel the database installation. When you stop in the middle of the installation, only some of the CSS components may get the database. A window shows you that stopping the installation may make the system not operate.

When the installation is done, one of two screen will show. The configuration database installation complete screen shows if there are no faults. The database installation fault results screen shows if there are faults.

All of the faults results screens work in the same way as in the CSS test section.



23-39-00-703 Rev 0 06/18/96

CSS TEST AND SOFTWARE INSTALLATION - CONFIGURATION DATABASE INSTALLATION IS OPERATING

CSS TEST AND SOFTWARE INSTALLATION - CONFIGURATION DATABASE INSTALLATION STOP

General

The configuration database installation stop screen shows when you cancel a configuration database installation.

Access

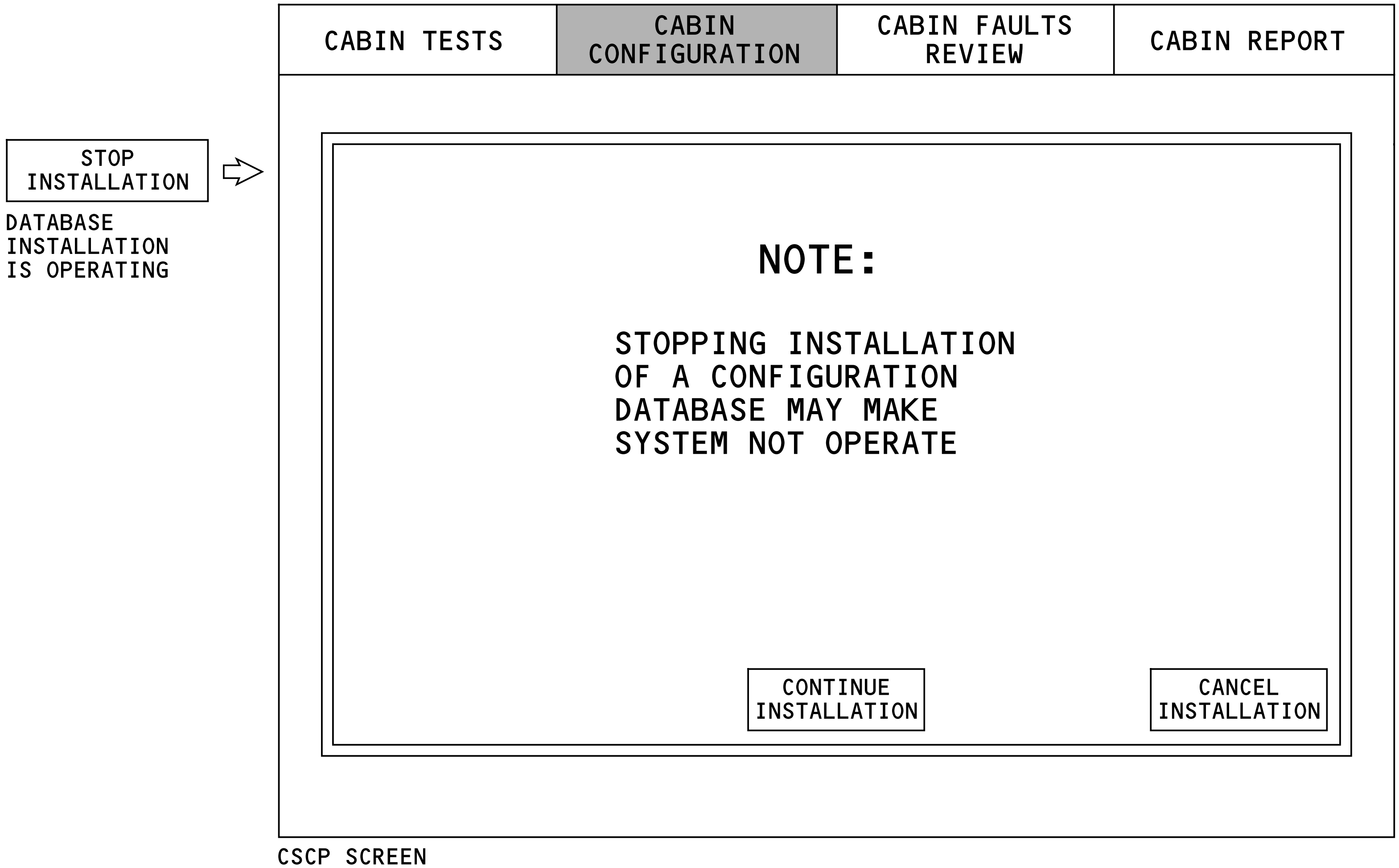
This screen shows when you touch STOP INSTALLATION on the database installation is operating screen.

Controls and Indications

The message tells you that if you cancel the installation, the CSS may not operate.

Touch CONTINUE INSTALLATION to install the remaining part of the database and show the database installation is operating screen.

Touch CANCEL INSTALLATION to stop the installation. A screen shows to tell you that the installation is being stopped. After the installation stops, the cabin configuration menu shows.



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CSS TEST AND SOFTWARE INSTALLATION - CONFIGURATION DATABASE INSTALLATION STOP

CSS TEST AND SOFTWARE INSTALLATION - CONFIGURATION DATABASE INSTALLATION COMPLETE

General

The configuration database installation complete screen automatically shows at the end of a database installation.

Access

This screen shows when you select a database and touch INSTALL on the configuration database installation screen.

It also shows if you touch CONTINUE INSTALLATION on the database discrepancy screen.

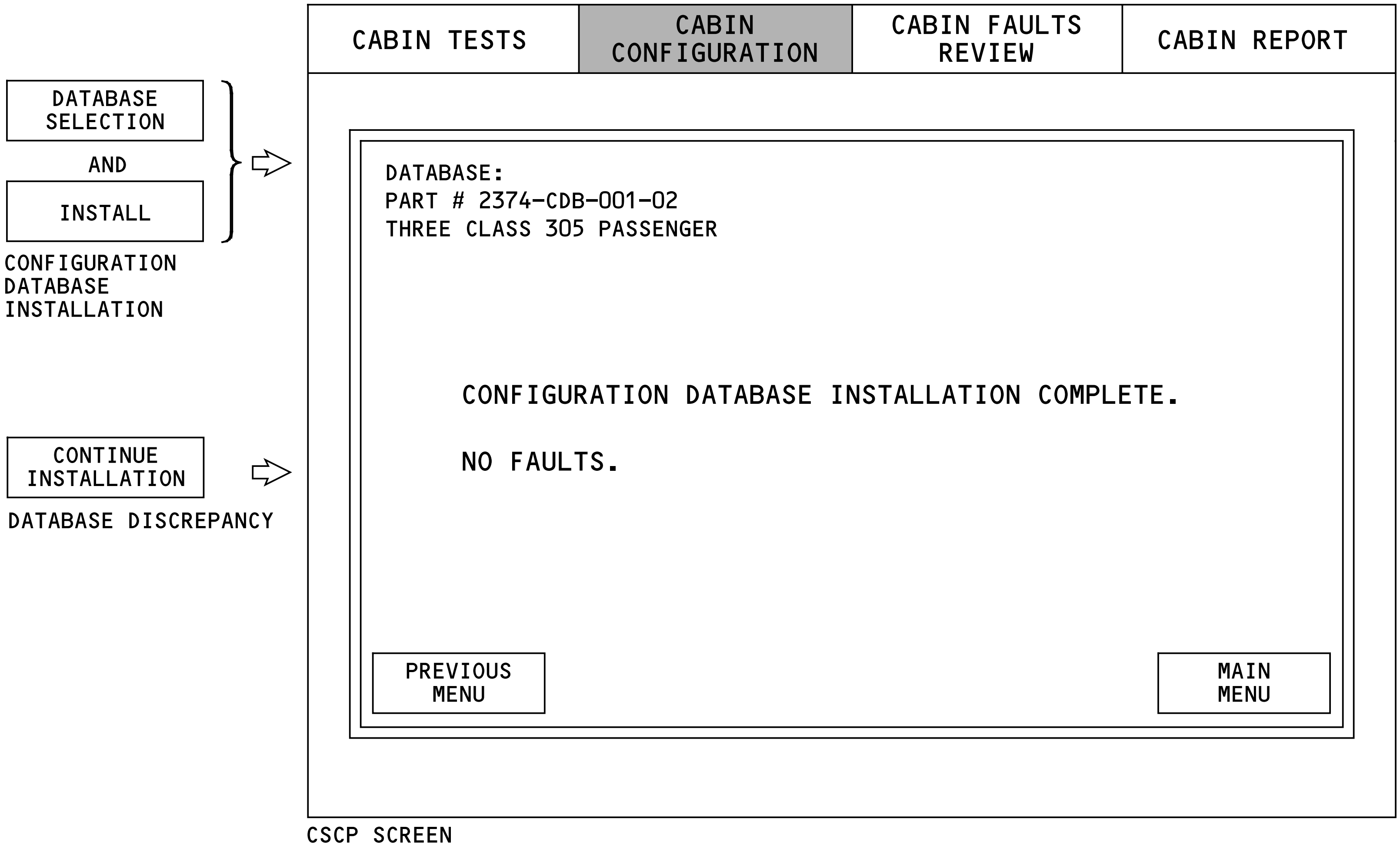
Controls and Indications

The part number and description of the database show in the top-left part of the window.

The center of the window shows you that the database is complete and there were no faults.

Touch PREVIOUS MENU to show the cabin configuration menu.

Touch MAIN MENU to show the cabin maintenance main menu screen.



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CSS TEST AND SOFTWARE INSTALLATION - CONFIGURATION DATABASE INSTALLATION COMPLETE

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CSS TEST AND SOFTWARE INSTALLATION - INSTALLATION FAULT RESULTS

General

This screen automatically shows when you install a configuration database and there are failures.

Access

Touch these selections to show the configuration database installation fault results screen:

- CABIN CONFIGURATION on any maintenance screen
- CONFIGURATION DATABASE INSTALLATION on the cabin configuration menu
- Select a database on the configuration database installation screen and touch INSTALL.

This screen shows automatically at the end of the installation. It also shows after you touch CLEAR SCREEN on the operational program software conflict screen.

Controls and Indications

These are the three parts of the screen:

- Installation conditions
- Maintenance message data
- Selection controls.

Installation Conditions

The test conditions part of the screen shows this test data:

- The configuration database part number installed at the time of the installation.
- The date and time of the installation.
- The sequence of each maintenance message in the list of messages.

There is a HELP selection on the left. Touch HELP for information on how to use the screen.

Maintenance Message Data

Each page shows one maintenance message. The maintenance message shows data about each failure. There are three parts to the maintenance message:

- Fault description
- Maintenance message number
- Recommended maintenance action.

The fault description identifies the failure condition detected by the installation. It also identifies the component that found the fault.

You use the maintenance message number to find the corrective action in the fault isolation manual (FIM).

The recommended maintenance action identifies all the possible components or conditions that could cause the fault. The most probable cause shows first and the least probable cause shows last.

Each screen shows one maintenance message. Use the up and down arrows at the far right of the screen to show the previous or next message. The square on the scroll bar shows your position in the message list.

Selection Controls

To show a visual reference of the defective component, touch SHOW LOCATION.

To show the components controlled by the defective component, touch UNIT USAGE.

Touch PREVIOUS MENU to show the cabin configuration menu.

Touch SAVE to send the data to a diskette in the CSCP disk drive.

Touch PRINT to send the data to the printer for a paper copy.

Touch MAIN MENU to show the cabin maintenance menu.

INSTALLATION COMPLETE WITH FAILURES FOUND

CABIN TESTS	CABIN CONFIGURATION	CABIN FAULTS REVIEW	CABIN REPORT

CONFIGURATION DATABASE INSTALLATION FAULT RESULTS

HELP

DATABASE PART # 2374-CDB-001-01

INSTALL DATE: 01JUN95
INSTALL TIME: 08:05z
FAULT NUMBER: 1 of 1

Overhead Electronics Unit (OEU) 3-3-8 program line output circuit is open.

Detected By: Overhead Electronics Unit (OEU) 3-3-8

Maintenance Message: 23-03429

Recommended Maintenance Action:

Possible Causes:
1) Overhead Electronics Unit (OEU) 3-3-8
   Located at: Seat 38F, Right Passenger Service Unit (PSU)
2) Overhead Electronics Unit (OEU) 3-3-7
   Located at: Seat 36F, Right Passenger Service Unit (PSU)
3) Wiring

PREVIOUS MENU | SHOW LOCATION | UNIT USAGE | SAVE | PRINT | MAIN MENU

CSCP SCREEN

23-39-00-706 Rev 0 06/18/96

CSS TEST AND SOFTWARE INSTALLATION - INSTALLATION FAULT RESULTS

CSS TEST AND SOFTWARE INSTALLATION - SOFTWARE MANAGEMENT MENU

General

You use this screen to install and remove software programs from the cabin system control panel (CSCP) memory. You also use it to install operational data in LRUs.

Access

Touch these selections to show the software management menu:

- CABIN CONFIGURATION on any cabin maintenance screen
- SOFTWARE MANAGEMENT on the cabin configuration menu.

Controls and Indications

Touch OPERATIONAL PROGRAM SOFTWARE INSTALLATION to install LRU operational programs from the CSCP memory. One of these screens shows after you touch the selection:

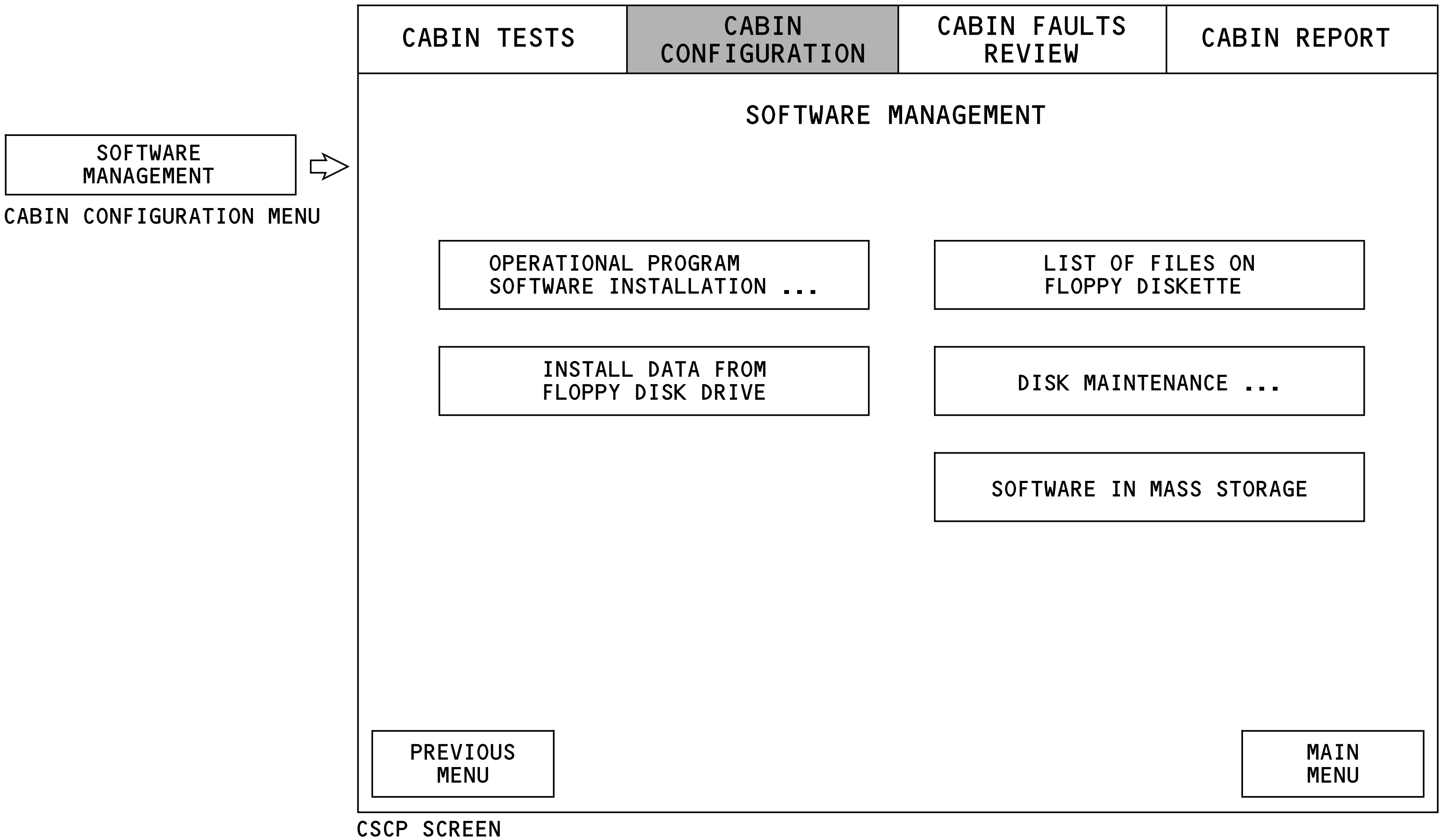
- The operational program software installation menu if there are no failures
- An intrusive function not available dialogue window if the airplane is not in the correct condition for an installation
- A breakers/buses off dialogue window to show any open CSS circuit breakers or power buses that are off
- A function not available dialogue window when a data load from a maintenance access terminal (MAT) is in progress.

Touch LIST OF FILES ON FLOPPY DISKETTE to show a list of the files on a floppy diskette in the CSCP disk drive. If you did not put the diskette in the disk drive, a dialogue window will tell you to do so.

Touch INSTALL DATA FROM FLOPPY DISK DRIVE to install a configuration database or operational program software from a diskette into CSCP memory. A screen shows to tell you that the data installation is operating.

Touch DISK MAINTENANCE to show a disk maintenance menu This lets you remove configuration databases or operational program software from the CSCP memory.

Touch PREVIOUS MENU at the bottom of the screen to return to the cabin configuration menu. Touch MAIN MENU to return to the cabin maintenance menu.



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CSS TEST AND SOFTWARE INSTALLATION - SOFTWARE MANAGEMENT MENU

CSS TEST AND SOFTWARE INSTALLATION - OPERATIONAL PROGRAM SOFTWARE INSTALLATION MENU

General

You use the operational program software installation menu to install operational program software in CSS LRUs. The cabin system control panel (CSCP) mass storage keeps the operational programs.

Access

Touch these selections to show this menu:

- Touch CABIN CONFIGURATION on any maintenance screen
- Touch SOFTWARE MANAGEMENT on the cabin configuration menu
- Touch OPERATIONAL PROGRAM SOFTWARE INSTALLATION on the software management menu.

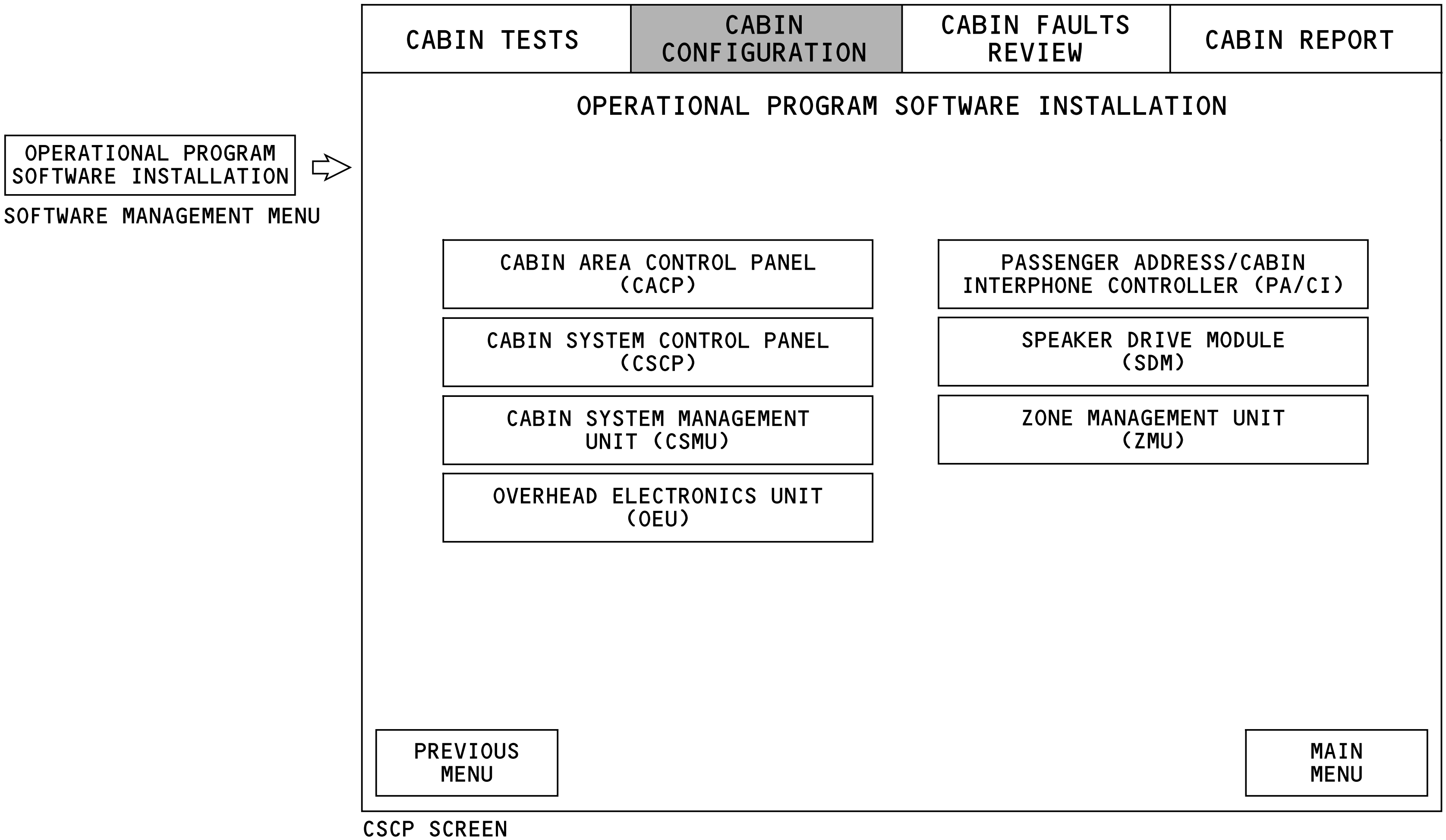
Controls and Indications

Touch any one of the LRU selections to start installation of the related operational software. The operational program software installation screen for that LRU will show to let you install the program.

A screen may show to tell you that an LRU that controls the LRU you selected does not have its operational software installed.

Touch PREVIOUS MENU to go to the software management menu.

Touch MAIN MENU to go to the cabin maintenance main menu.



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CSS TEST AND SOFTWARE INSTALLATION - OPERATIONAL PROGRAM SOFTWARE INSTALLATION MENU

CSS TEST AND SOFTWARE INSTALLATION - OPERATIONAL PROGRAM SOFTWARE INSTALLATION SCREEN

General

Use this screen to select and install operational program software in LRUs. The diagram shows a typical installation screen for an overhead electronics unit (OEU). Other LRU screens are similar.

Access

Touch these selections to show the operational program software installation screen:

- CABIN CONFIGURATION on any maintenance screen
- SOFTWARE MANAGEMENT on the cabin configuration menu
- OPERATIONAL PROGRAM SOFTWARE INSTALLATION on the software management menu.
- Touch any LRU selection on the operational program software installation menu.

Controls and Indications

The selected LRU shows in the screen title.

Use the up and down arrows on the left side of the screen to select applicable hardware part numbers.

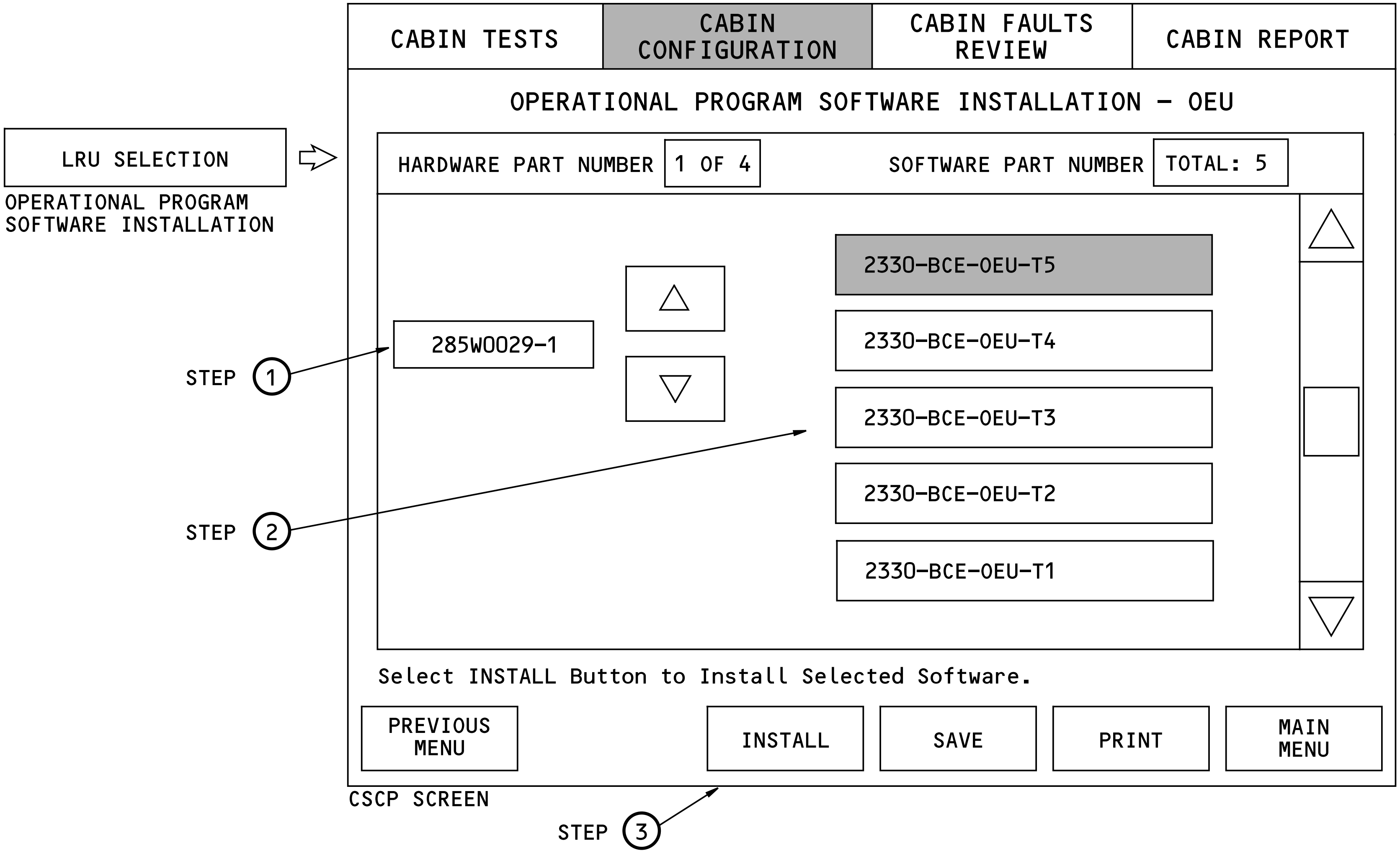
Each hardware part number has a list of related software part numbers. The recommended software part number for the LRU automatically shows green when the screen first comes on. Touch any of the software part numbers to select them. You can select only one software part number for each LRU part number.

Use the up and down arrows on the right side of the screen to scroll through the software part numbers.

Touch any of these selections at the bottom of the screen to do the related function:

- PREVIOUS MENU - to return to the operational program software installation menu
- INSTALL - to install the operational program software you selected on the screen
- SAVE - to save the entire list of hardware and software part numbers to a CSCP floppy diskette
- PRINT - to print the entire list of hardware and software part numbers to the cabin printer
- MAIN MENU - to return to the cabin maintenance main menu.

If the software you select is not the recommended part number, a preferred software dialogue window shows when you touch INSTALL. If there are no problems, a normal installation dialogue window shows.



23-39-00-709 Rev 0 06/18/96

CSS TEST AND SOFTWARE INSTALLATION – OPERATIONAL PROGRAM SOFTWARE INSTALLATION SCREEN

CSS TEST AND SOFTWARE INSTALLATION - PREFERRED SOFTWARE DIALOGUE WINDOW

General

This screen shows if you install operational software and did not select the recommended software part numbers for an LRU.

Access

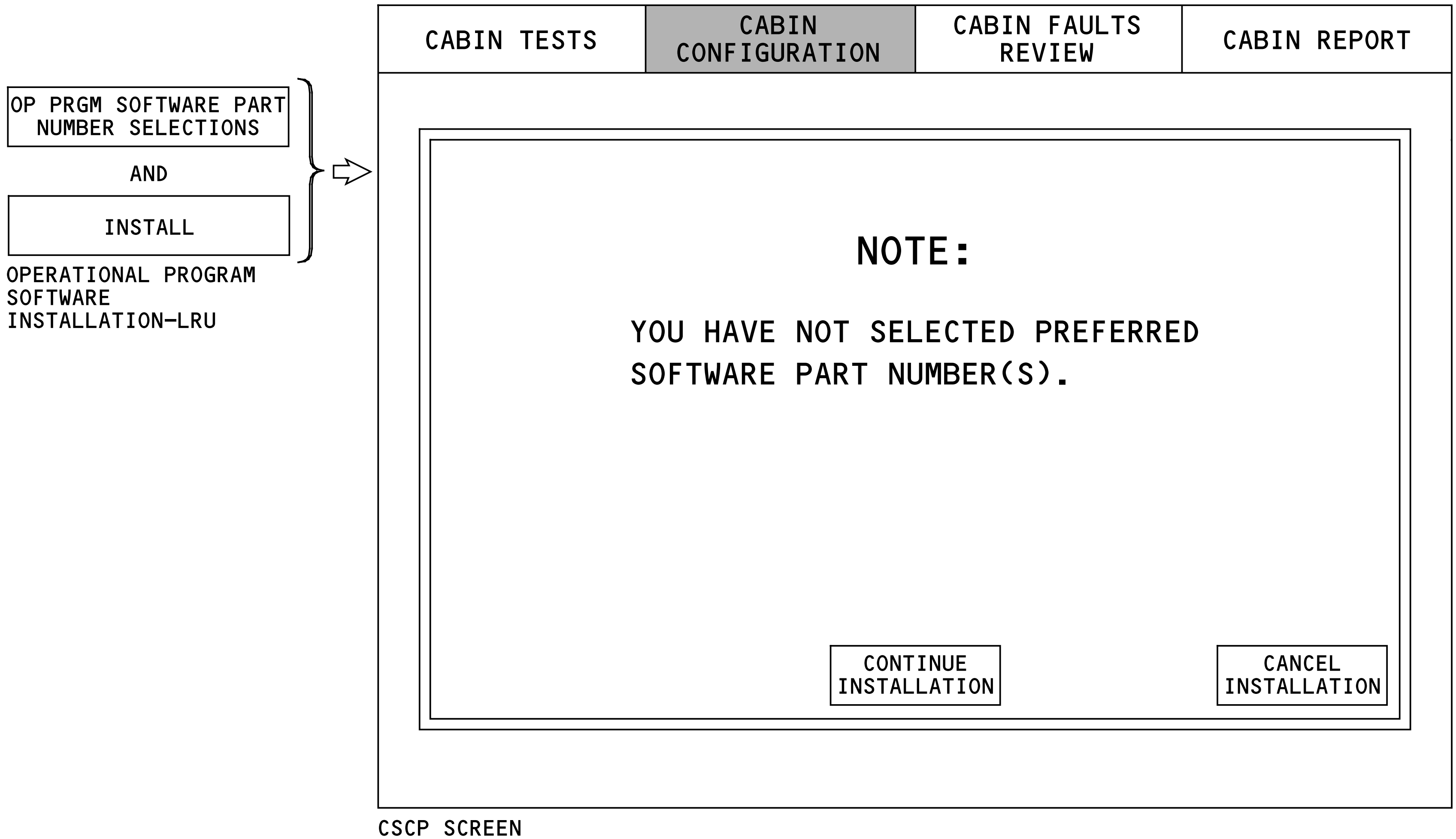
This screen shows if you make these selections:

- Touch CABIN CONFIGURATION on any maintenance screen
- Touch SOFTWARE MANAGEMENT on the cabin configuration menu
- Touch OPERATIONAL PROGRAM SOFTWARE INSTALLATION on the software management menu.
- Touch any LRU selection on the operational program software installation menu
- Select any software part number on the operational program software installation screen that does not show green when the screen first comes into view and touch INSTALL.

Controls and Indications

Touch CONTINUE INSTALLATION to install the operational program software. A window shows to tell you that the software installation is operating.

Touch CANCEL INSTALLATION to stop the installation and return to the operational program software installation screen for the LRU.



23-39-00-710 Rev 0 06/18/96

CSS TEST AND SOFTWARE INSTALLATION - PREFERRED SOFTWARE DIALOGUE WINDOW

CSS TEST AND SOFTWARE INSTALLATION - OPERATIONAL PROGRAM SOFTWARE INSTALLATION IS OPERATING

General

This screen shows when you install operational software.

Access

This screen shows when you make these selections:

- Touch CABIN CONFIGURATION on any maintenance screen
- Touch SOFTWARE MANAGEMENT on the cabin configuration menu
- Touch OPERATIONAL PROGRAM SOFTWARE INSTALLATION on the software management menu.
- Touch any LRU selection on the operational program software installation menu
- Select the software part number on the operational program software installation screen and touch INSTALL.

This screen also shows when you select the recommended software part numbers and touch INSTALL on the operational program software installation screen for an LRU.

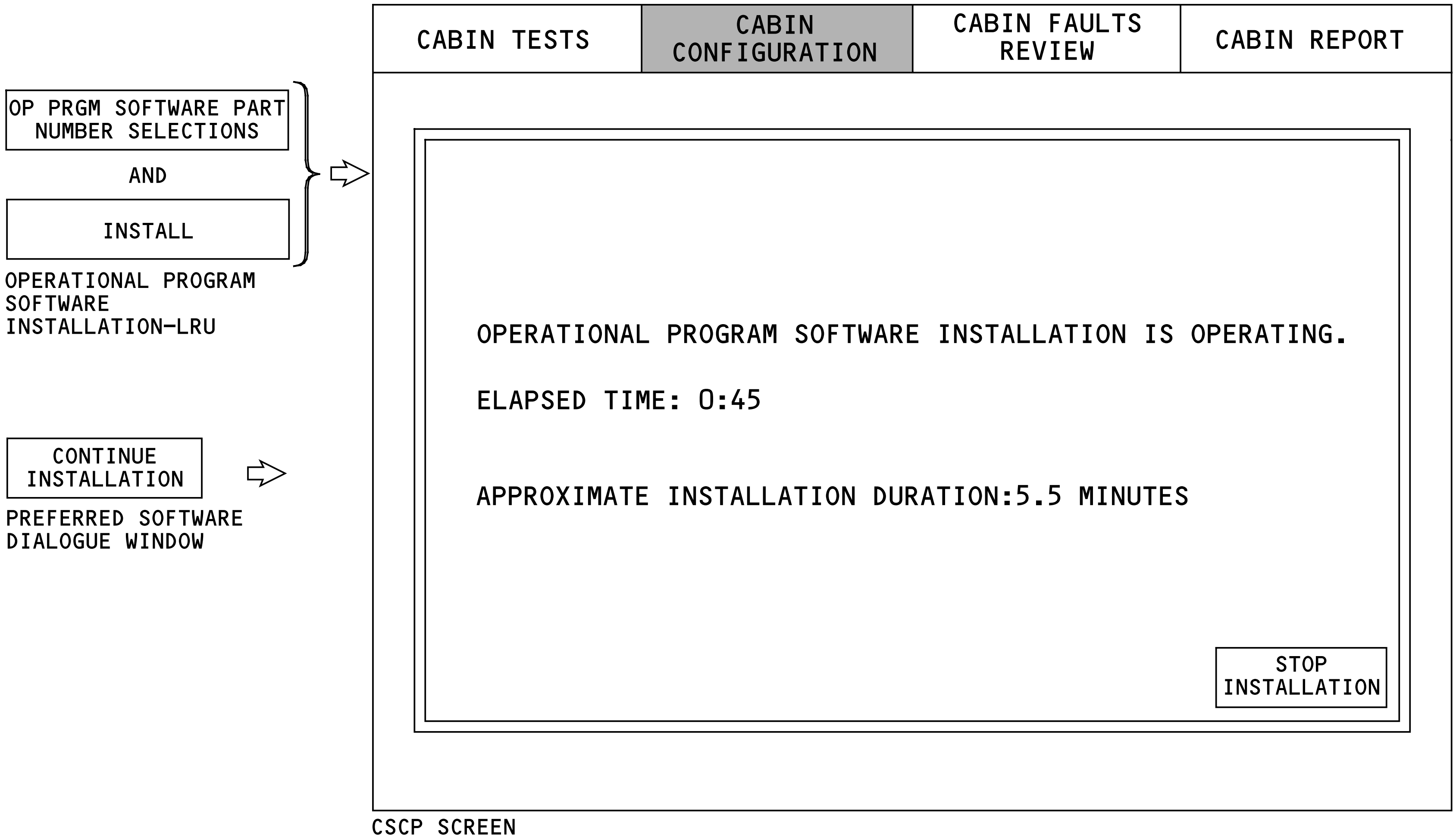
This screen will show when you select CONTINUE INSTALLATION from the preferred software dialogue window.

Controls and Indications

The center of the window shows you that the operational software is being installed and the elapsed time.

Touch STOP INSTALLATION to cancel the operational program software installation. A window shows you that stopping the installation may stop the system operation.

When the installation is done, one of two screens shows. The operational program software installation complete screen shows if there were no faults. The database installation fault results screen shows if there were faults. The installation fault results screen is the same as the one for the configuration database installation.



23-39-00-711 Rev 0 06/18/96

CSS TEST AND SOFTWARE INSTALLATION – OPERATIONAL PROGRAM SOFTWARE INSTALLATION IS OPERATING

CSS TEST AND SOFTWARE INSTALLATION - OPERATIONAL PROGRAM SOFTWARE INSTALLATION STOP

General

The operational program software installation stop screen shows if you cancel installation of an operational program.

Access

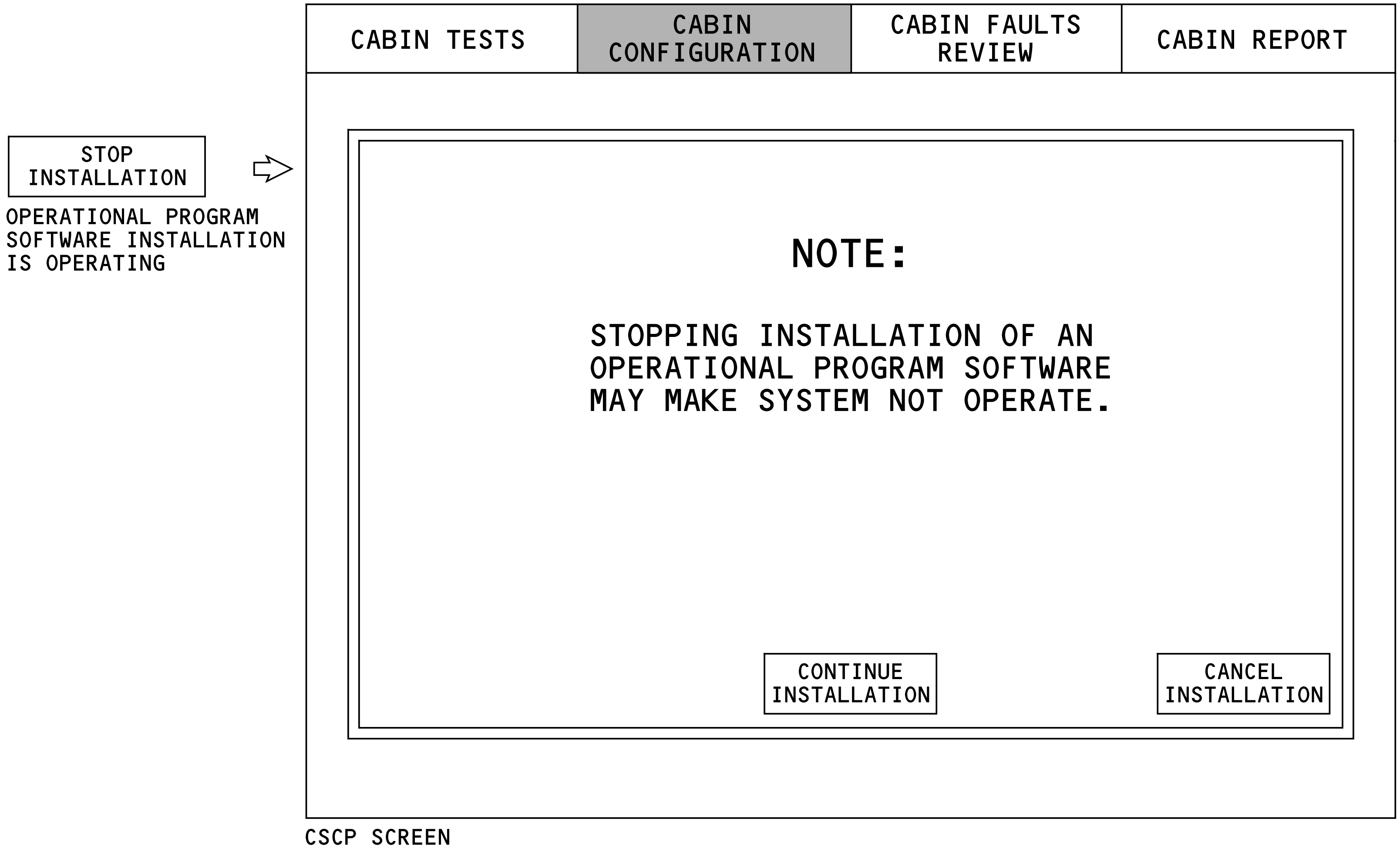
This screen shows when you touch STOP INSTALLATION on the installation is operating screen.

Controls and Indications

The message tells you that if you cancel the installation, the CSS may not operate.

Touch CONTINUE INSTALLATION to install the remaining part of the operational program and show the normal installation is operating dialogue screen.

Touch CANCEL INSTALLATION to stop the installation. A screen shows to tell you that the installation is being stopped. After the installation stops, the install dabase dialogue window shows.



23-39-00-712 Rev 0 06/18/96

CSS TEST AND SOFTWARE INSTALLATION - OPERATIONAL PROGRAM SOFTWARE INSTALLATION STOP

CSS TEST AND SOFTWARE INSTALLATION - OPERATIONAL PROGRAM SOFTWARE INSTALLATION IS COMPLETE

General

This screen automatically shows when you install operational software and there are no failures.

Access

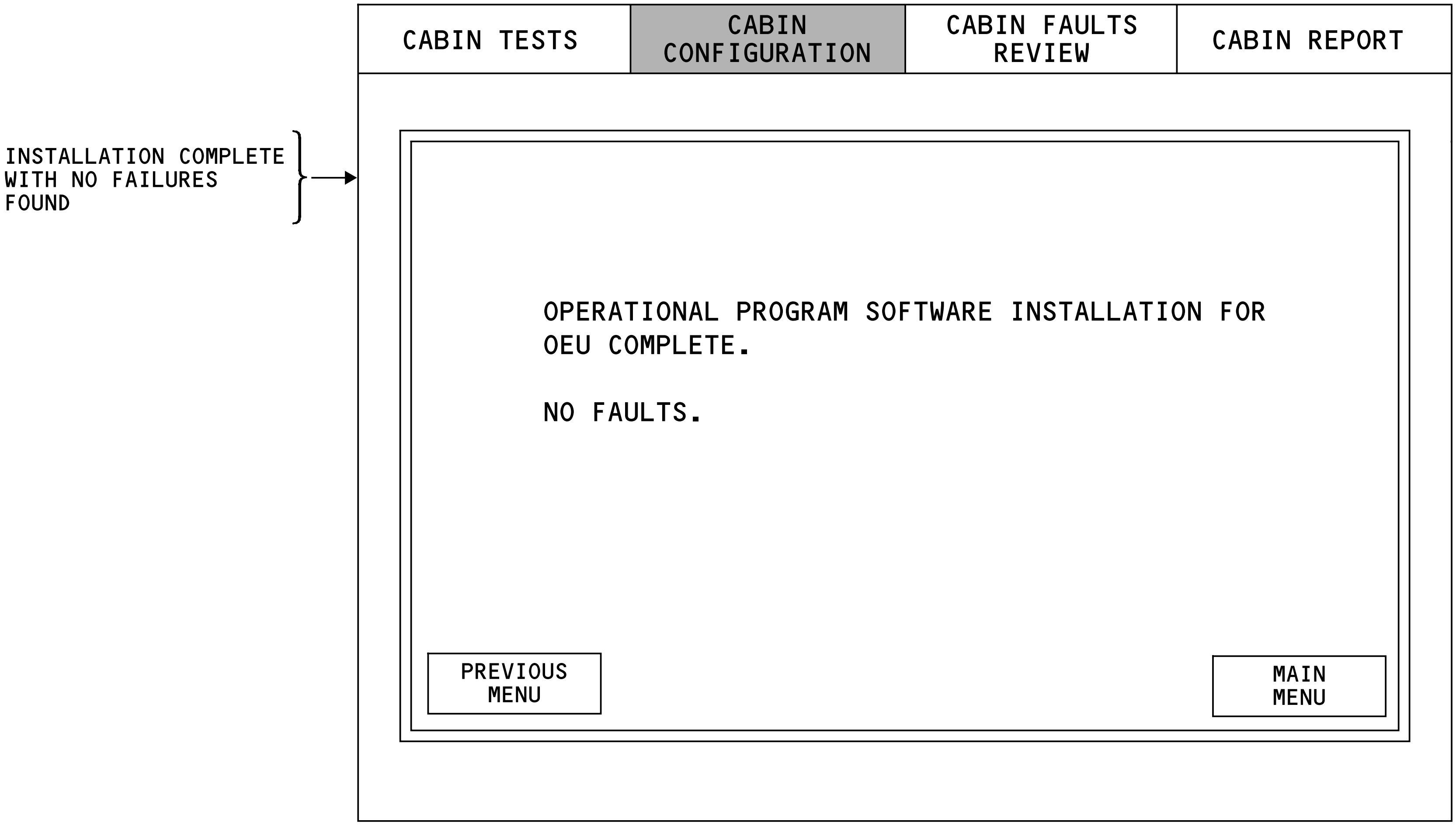
This screen shows when you make these selections:

- Touch CABIN CONFIGURATION on any maintenance screen
- Touch SOFTWARE MANAGEMENT on the cabin configuration menu
- Touch OPERATIONAL PROGRAM SOFTWARE INSTALLATION on the software management menu
- Touch any LRU selection on the operational program software installation menu
- Select the software part number on the operational program software installation screen and touch INSTALL.

This screen shows automatically at the end of the installation.

Controls and Indications

When you touch PREVIOUS MENU or MAIN MENU, another dialogue window shows to tell you to install the configuration database.



CSCP SCREEN

23-39-00-713 Rev 0 06/18/96

CSS TEST AND SOFTWARE INSTALLATION - OPERATIONAL PROGRAM SOFTWARE INSTALLATION IS COMPLETE

CSS TEST AND SOFTWARE INSTALLATION - INSTALL DATABASE DIALOGUE WINDOW

General

The install database dialogue window tells you to install the configuration database after you have installed any necessary operational program software.

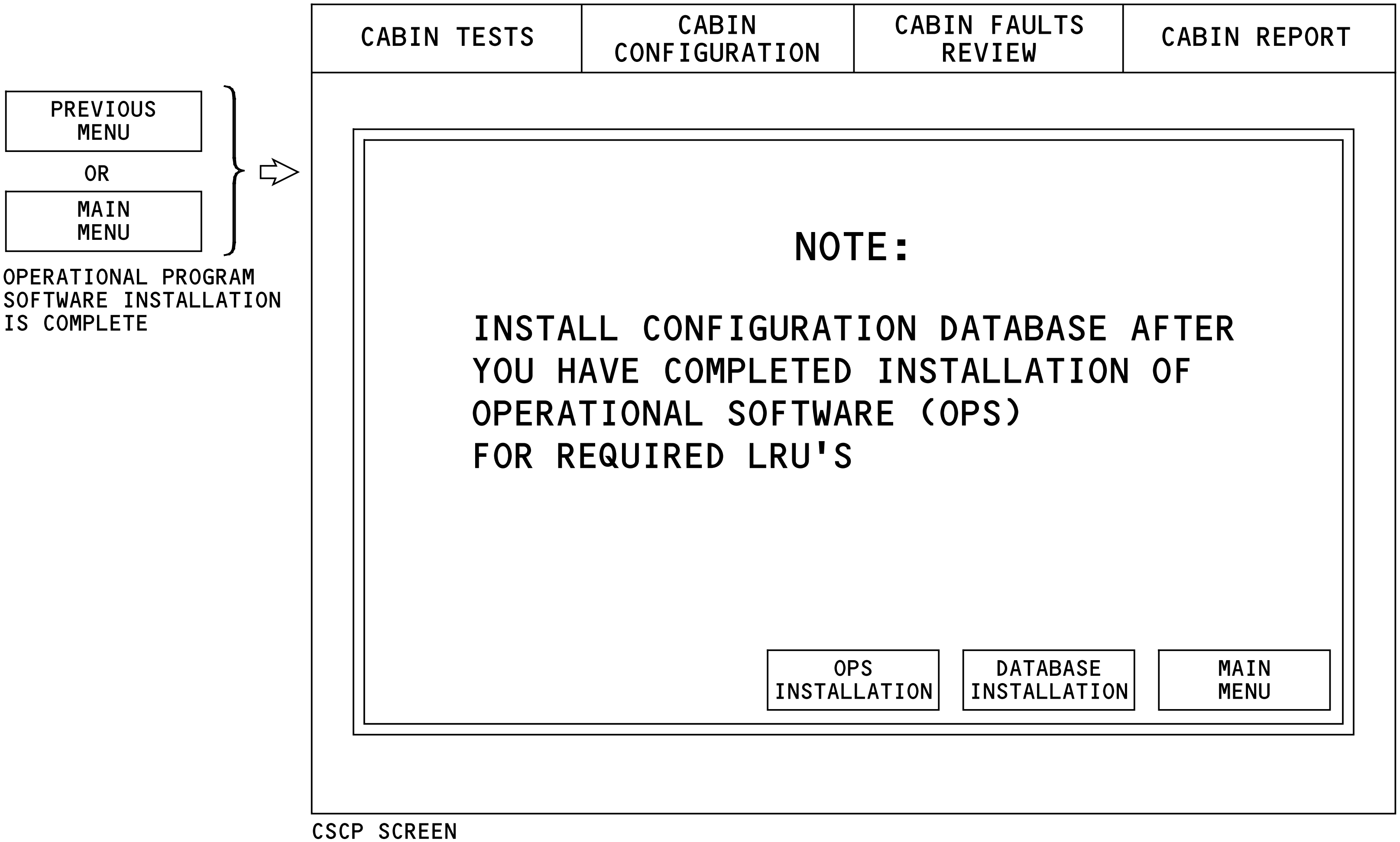
Access

This screen shows automatically when you select PREVIOUS MENU or MAIN MENU on the operational program software installation is complete screen.

Controls and Indications

Touch any of these selections at the bottom of the screen to do the related function:

- OPS INSTALLATION - to return to the operational program software installation menu
- DATABASE INSTALLATION - to show the configuration database installation screen
- MAIN MENU - to return to the cabin maintenance main menu.



23-39-00-714 Rev 0 06/18/96

CSS TEST AND SOFTWARE INSTALLATION - INSTALL DATABASE DIALOGUE WINDOW

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General

Software controls all cabin services system (CSS) functions. A configuration database and operational program software for the LRUs control the different systems that use the CSS.

The configuration database tells the CSS the cabin layout and customer options. Programmers use a configuration database generator on a computer to write this software. These are some of the items the configuration database identifies:

- Call light assignments
- Passenger information sign control
- The number and configuration of LRUs in the CSS
- Passenger address configuration
- Chime types and assignments
- Cabin interphone configuration.

Software Installation

The mass memory card in the cabin system control panel (CSCP) has all of the software programs. You use screens on the CSCP to install the configuration database and operational program software in CSS LRUs. These CSS components require the configuration database for operation:

- Cabin system control panel (CSCP)
- Cabin system management unit (CSMU)
- Passenger address/cabin interphone (PA/CI) controller
- Speaker drive modules (SDMs)
- Cabin area control panel (CACP)
- Zone management units (ZMUs)
- Overhead electronics units (OEUs).

Token Process

The PA/CI controller and ZMUs each use a data bus to load the SDMs, OEUs, and SEUs. The PA/CI controller and the ZMUs use a token signal to begin the sequence of data installation to these LRUs.

The token process enables each LRU to accept the data it needs. You start the token process when you install a configuration database or operational program software from the CSCP.

The PA/CI controller and the ZMUs send a token to the first LRU in each column. When the first LRU reads and accepts its data, it passes the token to the second LRU. When all the LRUs receive the token and accept their data, the token process is complete.

Configuration Database

You must install the configuration database after you replace any of these LRUs:

- CSCP
- CACPs
- CSMU
- ZMUs
- PA/CI controller

- SDMs
- OEUs.

You also install the configuration database if you install operational program software. Use screens on the CSCP to start the configuration database installation.

The CSCP sends configuration data to these components in this order:

- CSCP
- CSMU
- ZMUs (in sequence)
- PAC (normal)
- SDMs
- CIC (normal)
- PAC (alternate)
- CIC (alternate)
- CACPs (in sequence)
- OEUs (by zone).

Operational Program Software

Use the CSCP to start the operational program software installation. You can install data in only one LRU type at a time. Each LRU type has its own screen for you to select software part numbers.

The CSCP uses a panel bus to send data to the CSMU. The CSMU checks the operational program software to see where to send it. The CSMU puts it on the intersystem (I/S) bus for the other LRUs.

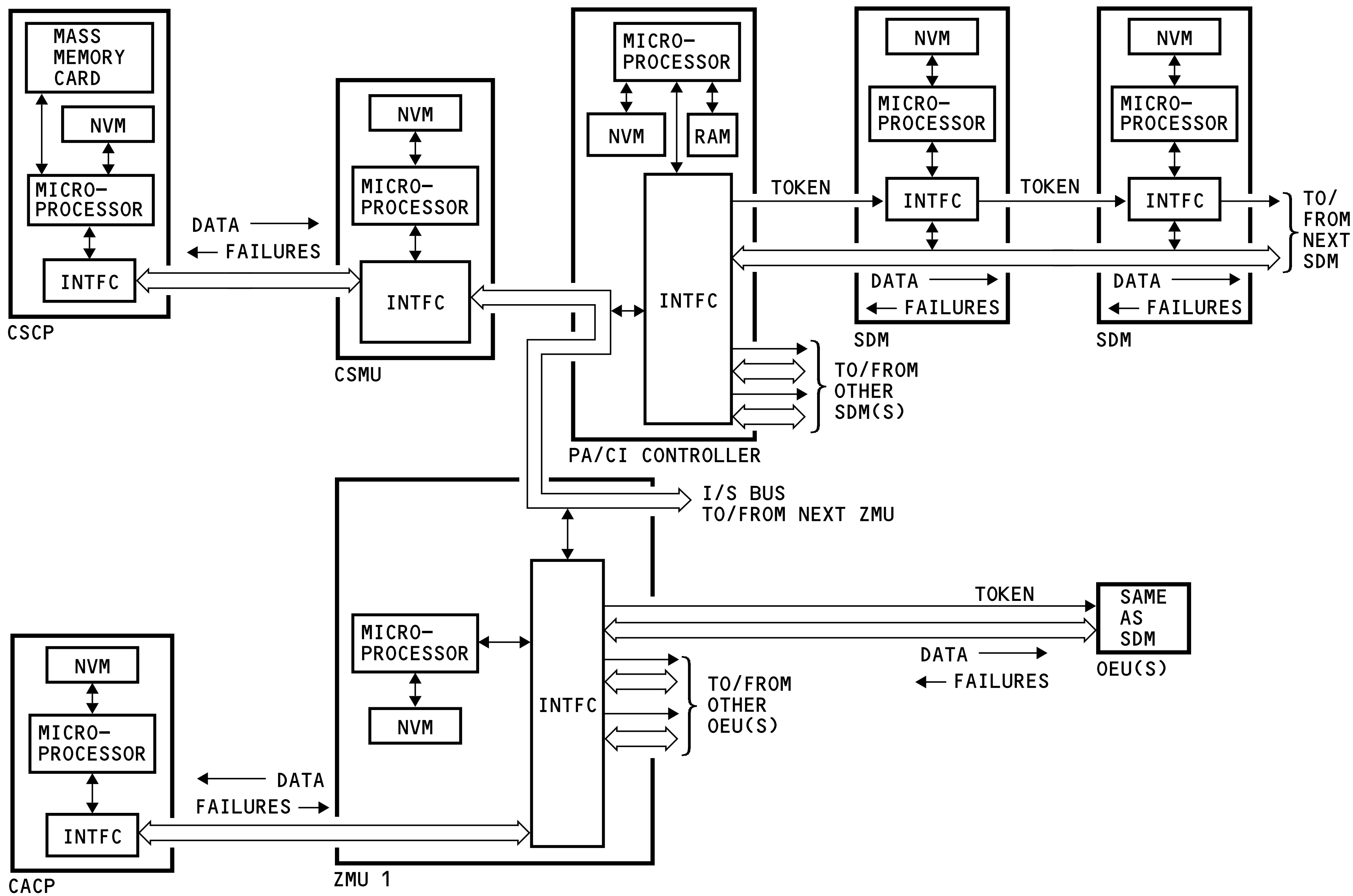
The PA/CI controller looks at the data on the bus to see if it is for itself or for the SDMs. If the data is for any of the SDMs, the PA/CI controller temporarily keeps the data in its random access memory (RAM). The PA/CI controller uses a data bus to send operational program software to all SDMs in a column at the same time. Each SDM makes a decision to install the data in its non-volatile memory (NVM).

Each ZMU does a check of the data to see if it is for itself or any of its OEUs or the CACP. Data loads to the OEUs or the CACP are almost the same as for the SDMs.

At the start of the installation, each LRU of the type you select does a check of its software part number to see if it already has the software in NVM. If it does not or if the software is failed, the LRU puts the data in NVM.

The LRU sends failure data back to the CSMU. The CSMU sends the failure data to the CSCP display.

After the data load, the LRU re-initializes itself and returns to normal operations.



23-39-00-715 Rev 0 06/18/96

CSS TEST AND SOFTWARE INSTALLATION - SOFTWARE INSTALLATION FUNCTIONAL DESCRIPTION

CSS TEST AND SOFTWARE INSTALLATION - DATA INSTALLATION IS OPERATING FROM DISK DRIVE

General

This screen shows automatically when you install data from a floppy diskette to the cabin system control panel (CSCP) memory.

Access

Touch these selections to show the data installation is operating from disk drive screen:

- CABIN CONFIGURATION on any maintenance screen
- SOFTWARE MANAGEMENT on the cabin configuration menu
- INSTALL DATA FROM FLOPPY DISK DRIVE on the software management menu.

Controls and Indications

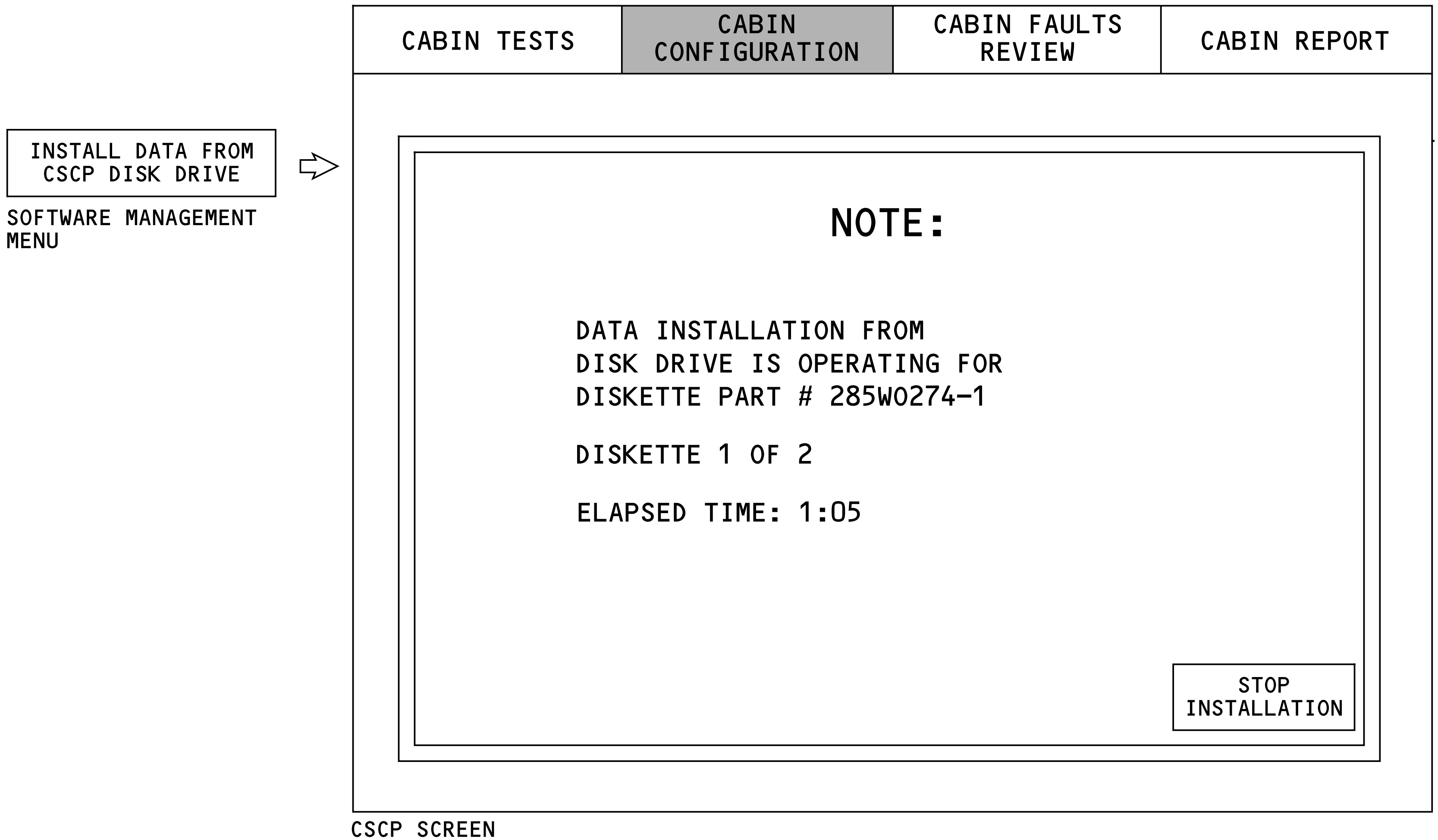
The screen shows you the part number of the diskette in the disk drive. It also shows if the diskette is one of a number of diskettes in a set.

The elapsed time shows during the installation.

Touch STOP INSTALLATION to stop the installation of the data and return to the software management menu.

When the installation is complete, an insert next diskette dialogue window may show if it is necessary to use more than one diskette to install the data.

After you load all of the necessary data, a screen shows to tell you the installation is complete.



23-39-00-719 Rev 0 06/18/96

CSS TEST AND SOFTWARE INSTALLATION - DATA INSTALLATION IS OPERATING FROM DISK DRIVE

CSS TEST AND SOFTWARE INSTALLATION - DISK MAINTENANCE

General

This screen gives you selections to delete software from the cabin system control panel (CSCP) memory.

Access

Touch these selections to show the disk maintenance menu:

- CABIN CONFIGURATION on any maintenance screen
- SOFTWARE MANAGEMENT on the cabin configuration menu
- DISK MAINTENANCE on the software management menu.

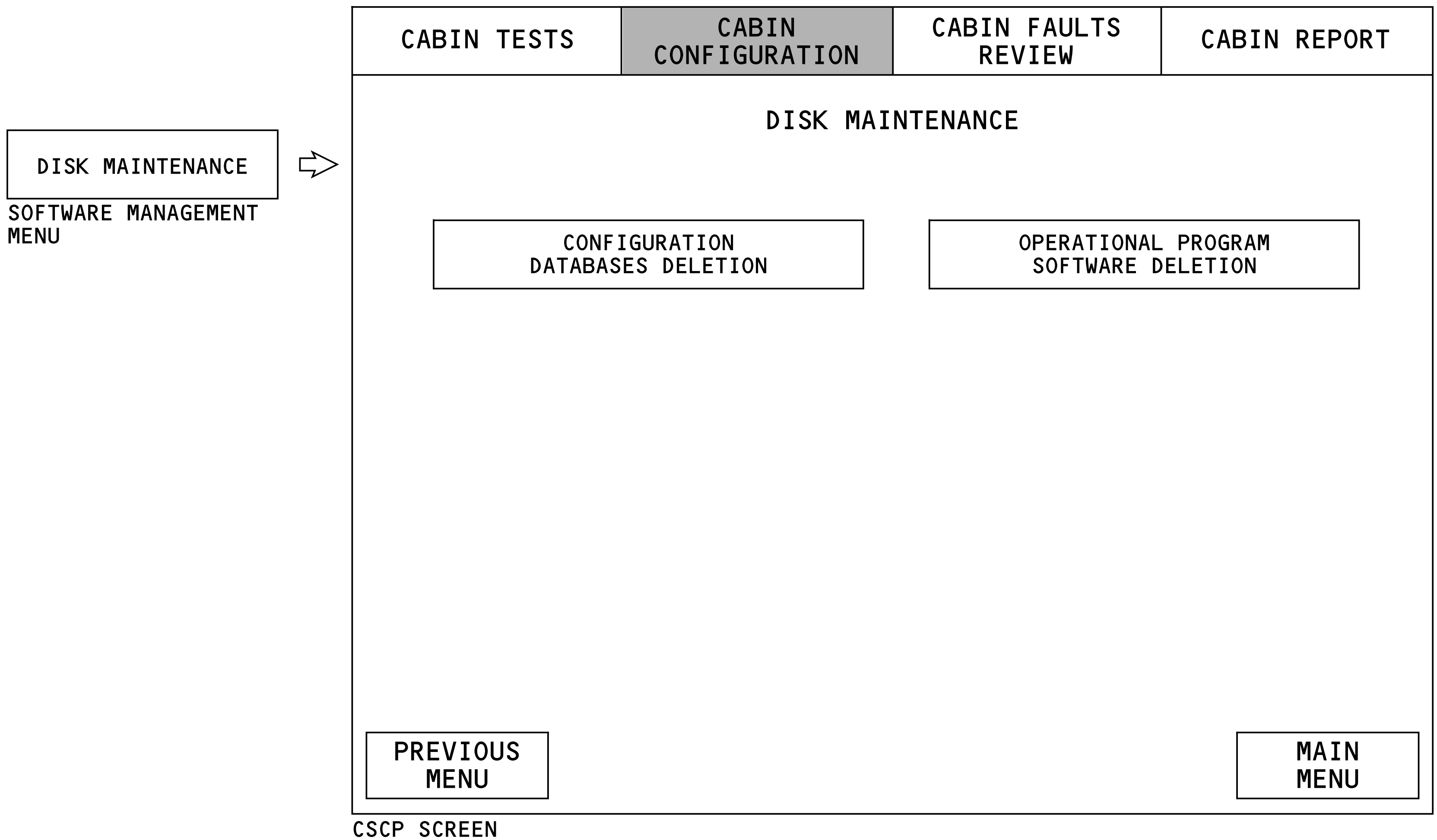
Controls and Indications

Touch CONFIGURATION DATABASES DELETION to show a screen that lets you remove databases from CSCP memory.

Touch OPERATIONAL PROGRAM SOFTWARE DELETION to show a screen that lets you remove LRU operational software from the CSCP memory.

Touch PREVIOUS MENU to return to the software management menu.

Touch MAIN MENU to return to the cabin maintenance menu.



23-39-00-720 Rev 0 06/18/96

CSS TEST AND SOFTWARE INSTALLATION - DISK MAINTENANCE

CSS TEST AND SOFTWARE INSTALLATION - CONFIGURATION DATABASES IN MASS STORAGE

General

This screen gives you selections to remove configuration databases from the cabin system control panel (CSCP) memory.

Access

Touch these selections to show the configuration databases in mass storage screen:

- CABIN CONFIGURATION on any maintenance screen
- SOFTWARE MANAGEMENT on the cabin configuration menu
- DISK MAINTENANCE on the software management menu
- CONFIGURATION DATABASES DELETION on the disk maintenance menu.

Controls and Indications

The screen shows as many as six database selections. If the operating database is not in the CSCP memory, the first selection on the top left of the screen shows you that it was removed.

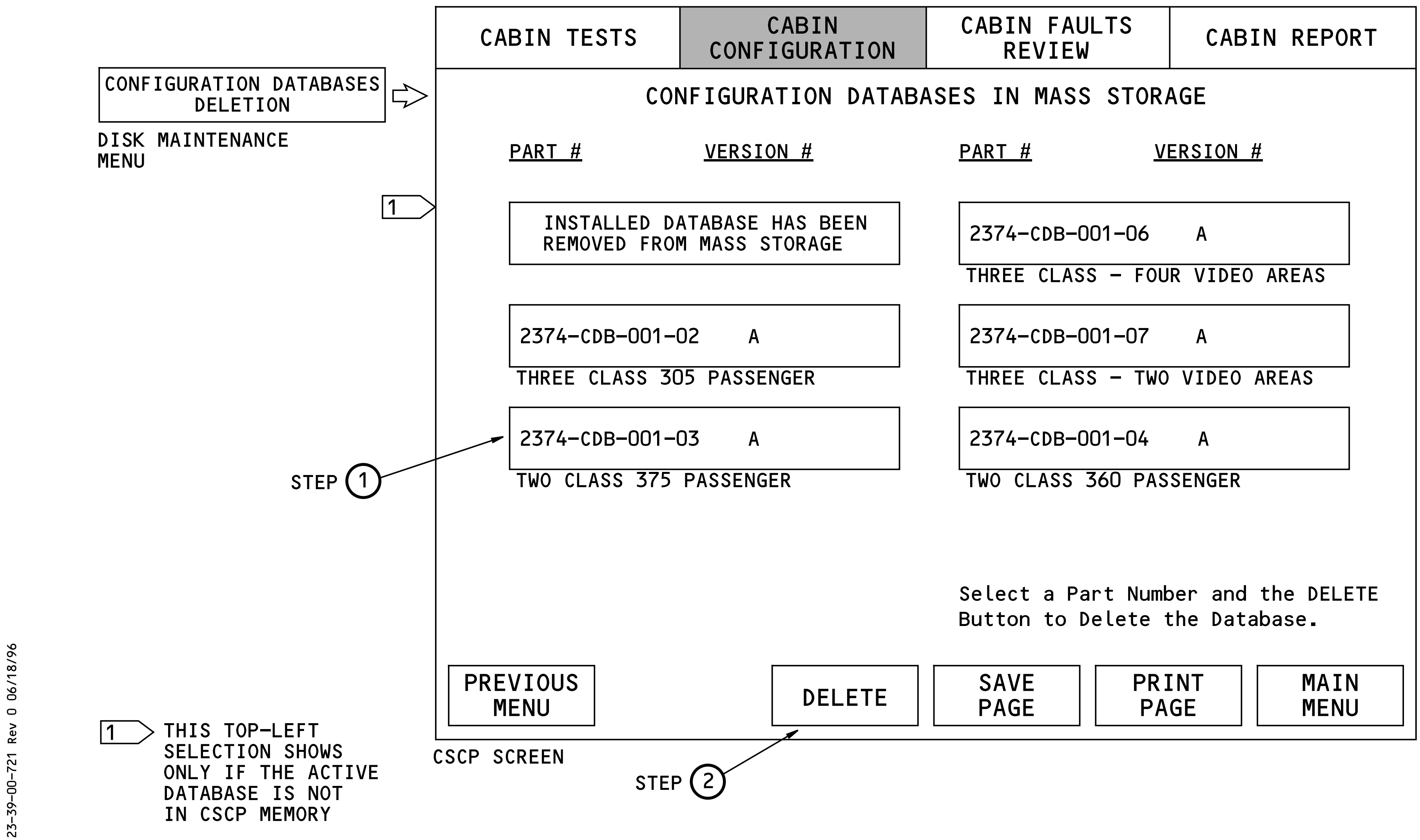
To remove a database from memory, first touch the database selection and then touch DELETE at the bottom of the screen. You can select only one database at a time.

After you touch DELETE, one of two screens will show. If you selected the active database, a dialogue window warns you that you are deleting the current database.

If you select any other database, a dialogue window asks you if you want to delete the database.

Touch any of these other selections at the bottom of the screen to do the related function:

- PREVIOUS MENU - to return to the disk maintenance menu
- SAVE PAGE - to save the screen data to a floppy diskette
- PRINT PAGE - to print the screen data to the cabin printer
- MAIN MENU - to return to the cabin maintenance menu.



CSS TEST AND SOFTWARE INSTALLATION - CONFIGURATION DATABASES IN MASS STORAGE

CSS TEST AND SOFTWARE INSTALLATION - CURRENT CONFIGURATION DATABASE DELETION

General

This screen shows automatically when you want to remove the operating database from the cabin system control panel (CSCP) memory.

Access

This screen shows if you make these selections:

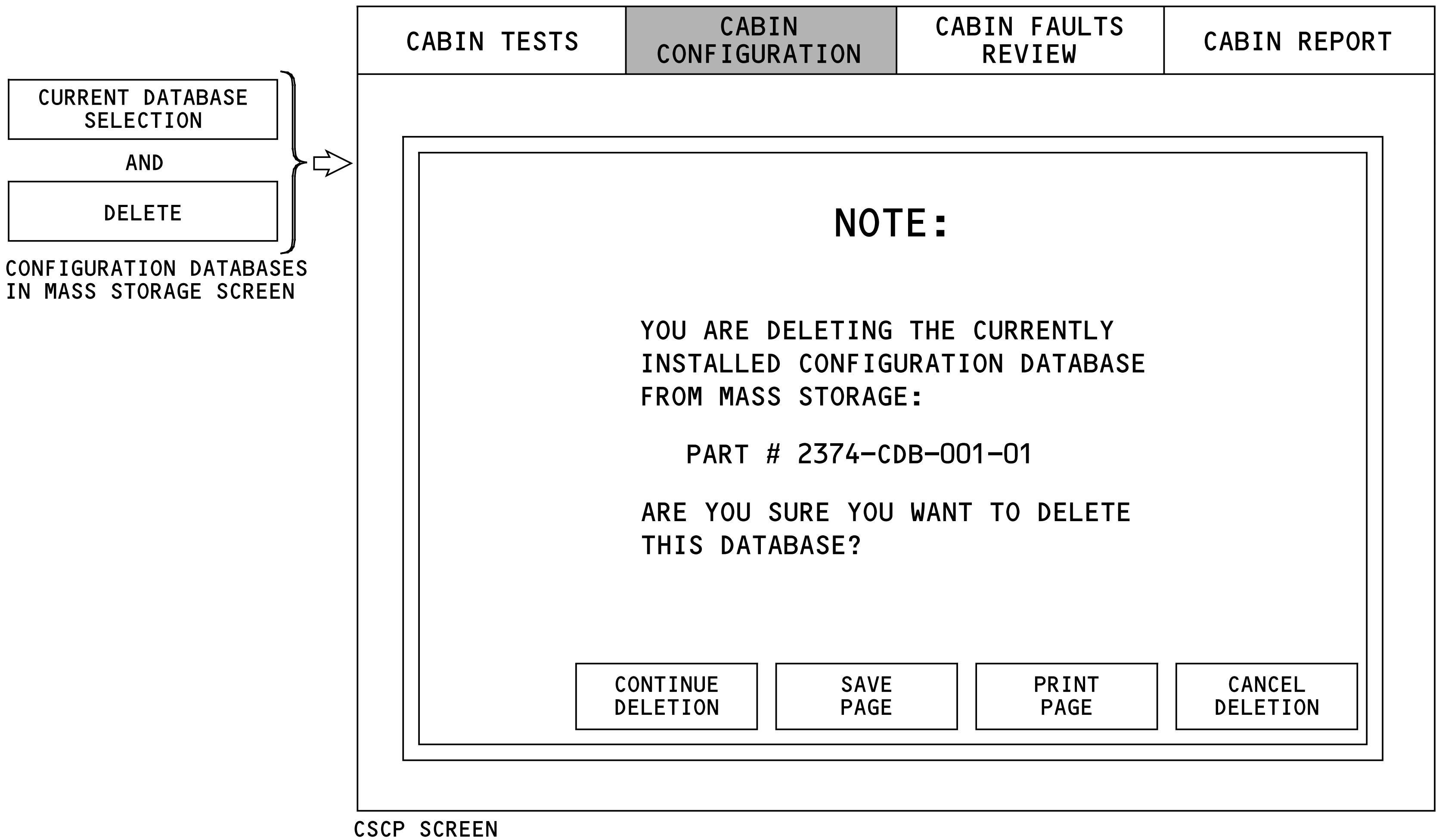
- Touch CABIN CONFIGURATION on any maintenance screen
- Touch SOFTWARE MANAGEMENT on the cabin configuration menu
- Touch DISK MAINTENANCE on the software management menu
- Touch CONFIGURATION DATABASES DELETION on the disk maintenance menu
- Select the currently installed database on the configuration databases in mass storage screen and touch DELETE.

Controls and Indications

The screen shows the part number of the database you selected on the configuration databases in mass storage screen.

Touch one of these selections at the bottom of the screen to do the related function:

- CONTINUE DELETION - to delete the selection and show the deleting configuration database window
- SAVE PAGE - to store the screen data to floppy diskette
- PRINT PAGE - to print the screen data on the cabin printer
- CANCEL DELETION - to cancel deleting and return to the configuration databases in mass storage screen.



23-39-00-722 Rev 0 06/18/96

CSS TEST AND SOFTWARE INSTALLATION - CURRENT CONFIGURATION DATABASE DELETION

CSS TEST AND SOFTWARE INSTALLATION - OPERATIONAL PROGRAM SOFTWARE DELETION

General

You use this screen to remove LRU operational program software from the cabin system control panel (CSCP) memory.

Access

Make these selections to show the operational program software deletion screen:

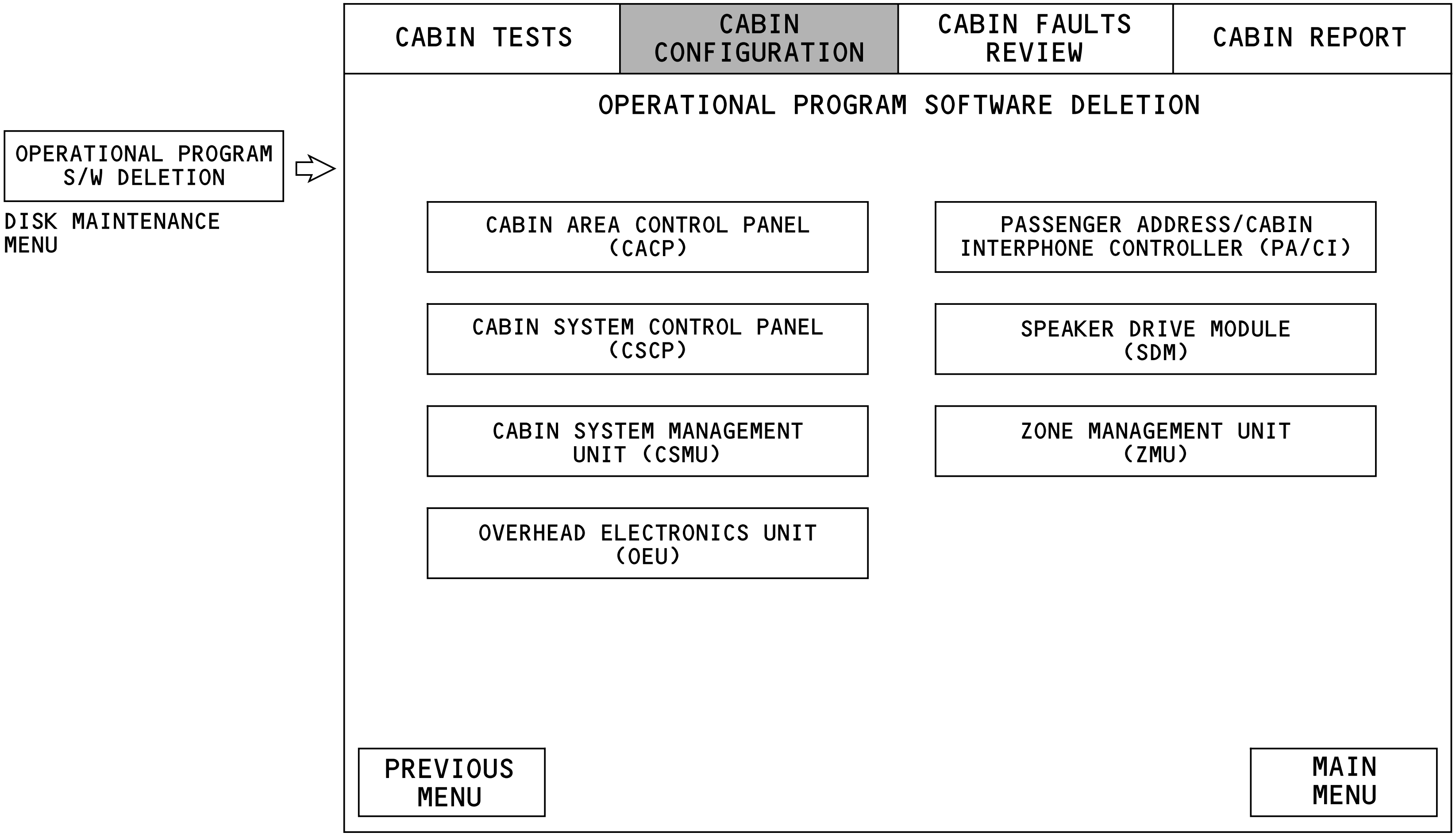
- Touch CABIN CONFIGURATION on any maintenance screen
- Touch SOFTWARE MANAGEMENT on the cabin configuration menu
- Touch DISK MAINTENANCE on the software management menu
- Touch OPERATIONAL PROGRAM SOFTWARE DELETION on the disk maintenance menu.

Controls and Indications

Touch any one of the LRU selections to show a screen with a list of software part numbers for the LRU.

Touch PREVIOUS MENU to go to the disk maintenance menu.

Touch MAIN MENU to go to the cabin maintenance menu.



CSCP SCREEN

23-39-00-724 Rev 0 06/18/96

CSS TEST AND SOFTWARE INSTALLATION - OPERATIONAL PROGRAM SOFTWARE DELETION

CSS TEST AND SOFTWARE INSTALLATION - OPERATIONAL PROGRAM SOFTWARE IN MASS STORAGE

General

This screen gives you selections to remove LRU operational program software from the cabin system control panel (CSCP) memory.

Access

Touch these selections to show the operational program software in mass storage screen:

- CABIN CONFIGURATION on any maintenance screen
- SOFTWARE MANAGEMENT on the cabin configuration menu
- DISK MAINTENANCE on the software management menu
- OPERATIONAL PROGRAM SOFTWARE DELETION on the disk maintenance menu
- Touch any LRU selection on the operational program software deletion screen.

Controls and Indications

The left side of the operational program software deletion screen shows the LRU hardware part numbers. To the right of each set of LRU part numbers is the related software part number.

There may also be software part numbers that do not have a related hardware part number. These will be shown at the bottom part of the screen.

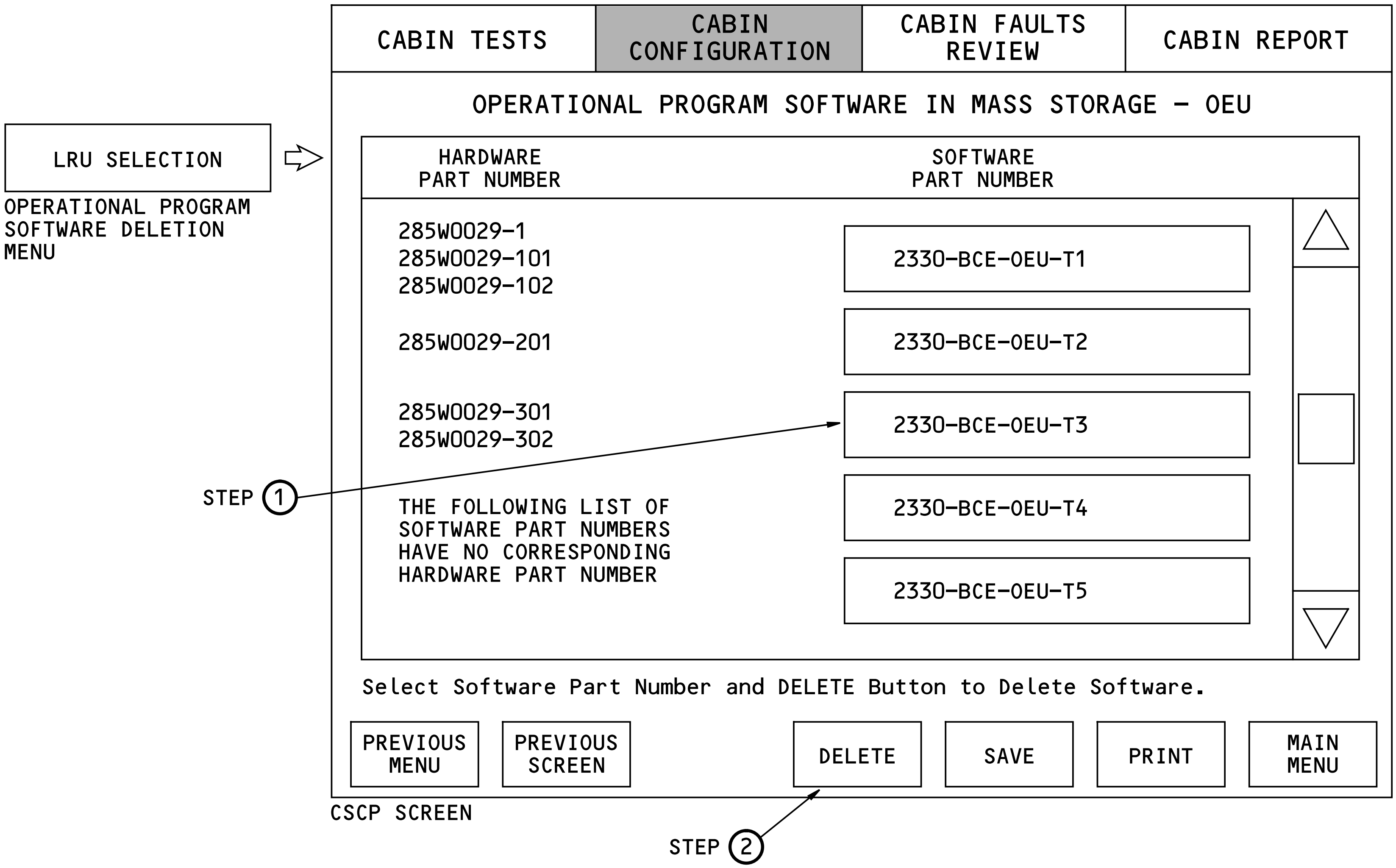
Use the up and down arrows at the right of the screen to scroll through the list.

To delete a software part number from CSCP memory touch a software part number to select it and then touch DELETE.

After you touch DELETE, one of two screens will show. A dialogue window may show to tell you that you are removing the only operational program software for that LRU type. Another dialogue window shows to ask if you want to delete the software you selected.

Touch any of these other selections at the bottom of the screen to do the related function:

- PREVIOUS MENU - to go to the disk maintenance menu
- PREVIOUS SCREEN - to go to the operational program software deletion screen
- SAVE - to save the screen data to floppy diskette
- PRINT - to print the screen data to the cabin printer
- MAIN MENU - to go to the cabin maintenance menu.



23-39-00-725 Rev 0 06/18/96

CSS TEST AND SOFTWARE INSTALLATION – OPERATIONAL PROGRAM SOFTWARE IN MASS STORAGE

CSS TEST AND SOFTWARE INSTALLATION - DELETING THE ONLY OPERATIONAL PROGRAM SOFTWARE SCREEN

General

This screen tells you that you are about to remove the only operational program software for a type of LRU from the cabin system control panel (CSCP) memory.

Access

This screen may show if you make these selections:

- Touch CABIN CONFIGURATION on any maintenance screen
- Touch SOFTWARE MANAGEMENT on the cabin configuration menu
- Touch DISK MAINTENANCE on the software management menu
- Touch OPERATIONAL PROGRAM SOFTWARE DELETION on the disk maintenance menu
- Touch any LRU selection on the operational program software deletion screen
- Select the software part number on the operational program software in mass storage screen and touch DELETE.

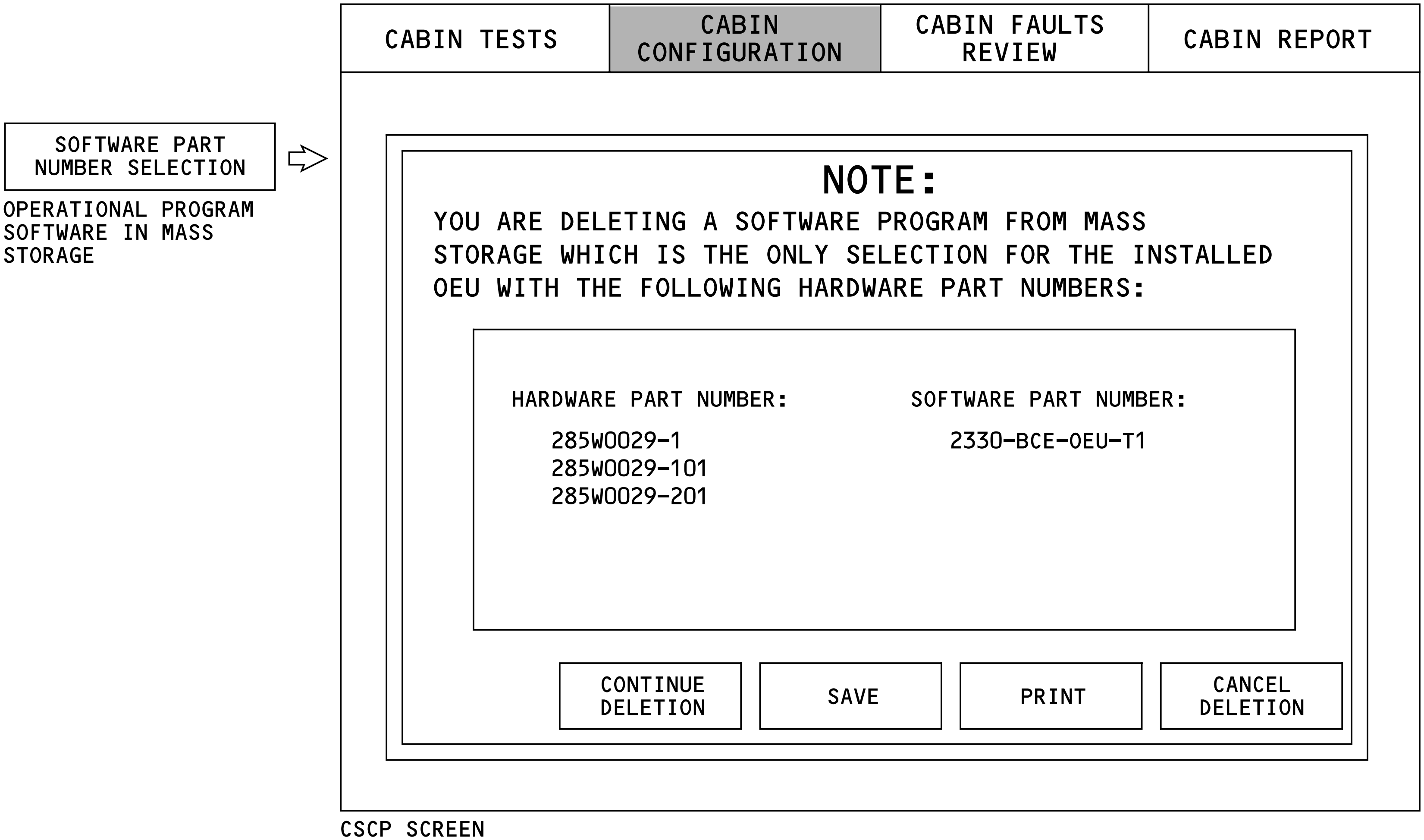
Controls and Indications

This screen shows an example of deleting the only operational program software for an overhead electronics unit (OEU). This screen for other LRUs is almost the same.

The left side of the screen shows a list of all of the LRU part numbers. To the right of the part numbers is the part number for the operational program software. When necessary, use the up and down arrows to scroll through the list.

Touch any of these selections at the bottom of the screen to do the related function:

- CONTINUE DELETION - to remove the software part number from CSCP memory and show the deleting operational program software screen
- SAVE - to save the screen data to floppy diskette
- PRINT - to print the screen data to the cabin printer
- CANCEL DELETION - to stop the operation and return to the operational program software in mass storage screen.



23-39-00-726 Rev 0 06/18/96

CSS TEST AND SOFTWARE INSTALLATION - DELETING THE ONLY OPERATIONAL PROGRAM SOFTWARE SCREEN

CSS TEST AND SOFTWARE INSTALLATION - DELETING OPERATIONAL PROGRAM SOFTWARE SCREEN

General

This screen shows when you remove an operational program software part number from the cabin system control panel (CSCP) memory.

Access

This screen shows automatically when you make these selections:

- Touch CABIN CONFIGURATION on any maintenance screen
- Touch SOFTWARE MANAGEMENT on the cabin configuration menu
- Touch DISK MAINTENANCE on the software management menu
- Touch OPERATIONAL PROGRAM SOFTWARE DELETION on the disk maintenance menu
- Touch any LRU selection on the operational program software deletion screen
- Select a software part number on the operational program software in mass storage screen and touch DELETE.

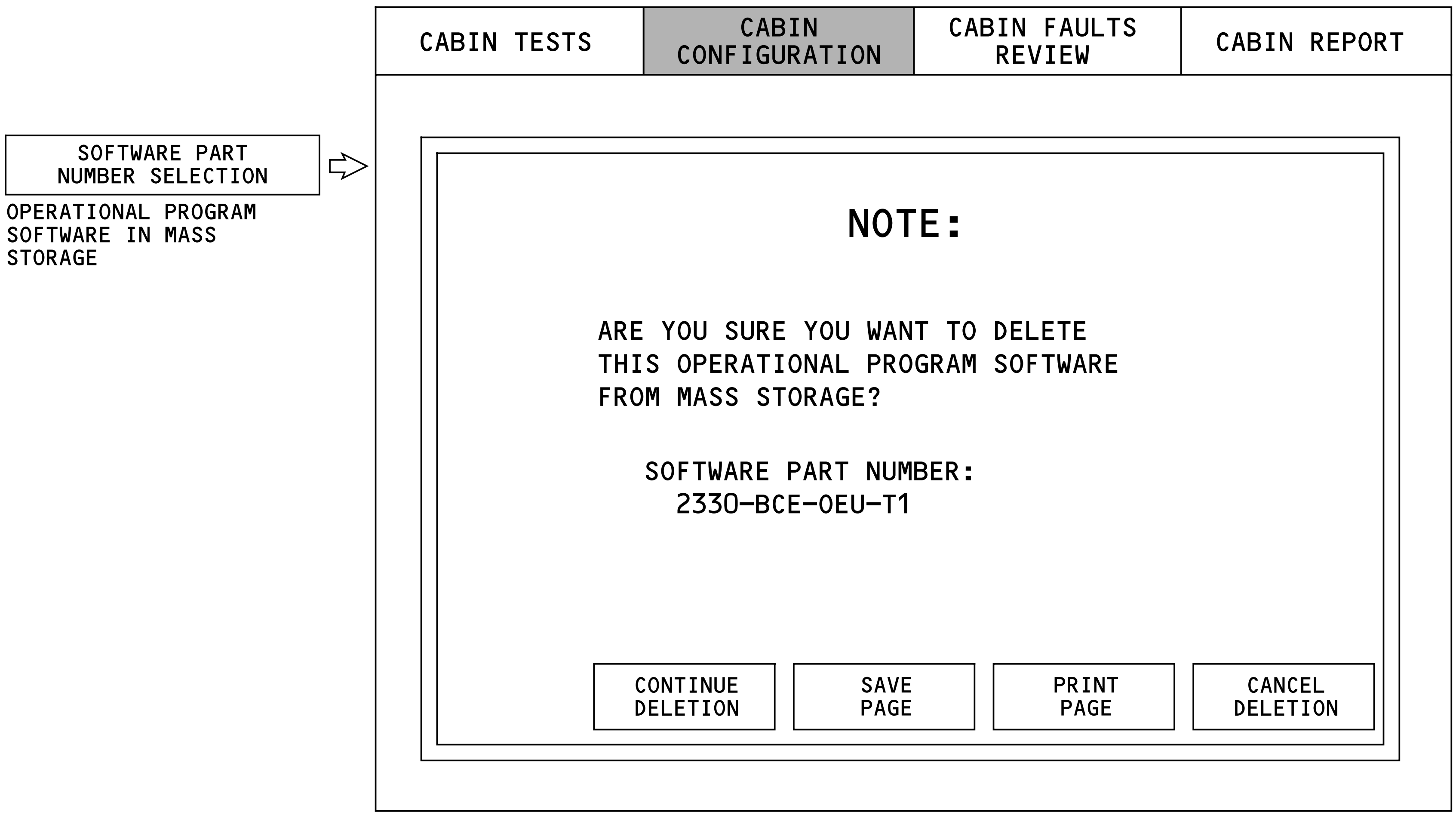
This screen also shows if you select CONTINUE DELETION on the deleting the only operational program software window.

Controls and Indications

The screen shows the part number of the software you selected on the previous screen.

Touch any of these selections at the bottom of the screen to do the related function:

- CONTINUE DELETION - to remove the software part number from CSCP memory and return to the operational program software in mass storage screen. The deleted software part number will not show
- SAVE - to save the screen data to floppy diskette
- PRINT - to print the screen data to the cabin printer
- CANCEL DELETION - to stop the operation and return to the operational program software in mass storage screen.



CSCP SCREEN

23-39-00-727 Rev 0 06/17/96

CSS TEST AND SOFTWARE INSTALLATION - DELETING OPERATIONAL PROGRAM SOFTWARE SCREEN

CSS TEST AND SOFTWARE INSTALLATION - CONFIGURATION CHECK MENU

General

You use the configuration check menu to select screens that show the current CSS LRU configurations. This menu also has selections to make sure the installed LRUs can operate with each other.

Access

Touch these selections to show the configuration check menu:

- CABIN CONFIGURATION on any maintenance screen
- CONFIGURATION CHECK on the cabin configuration menu.

Controls and Indications

Touch any one of these multiple-LRU selections to show a screen with selections to get configuration data for the LRU type:

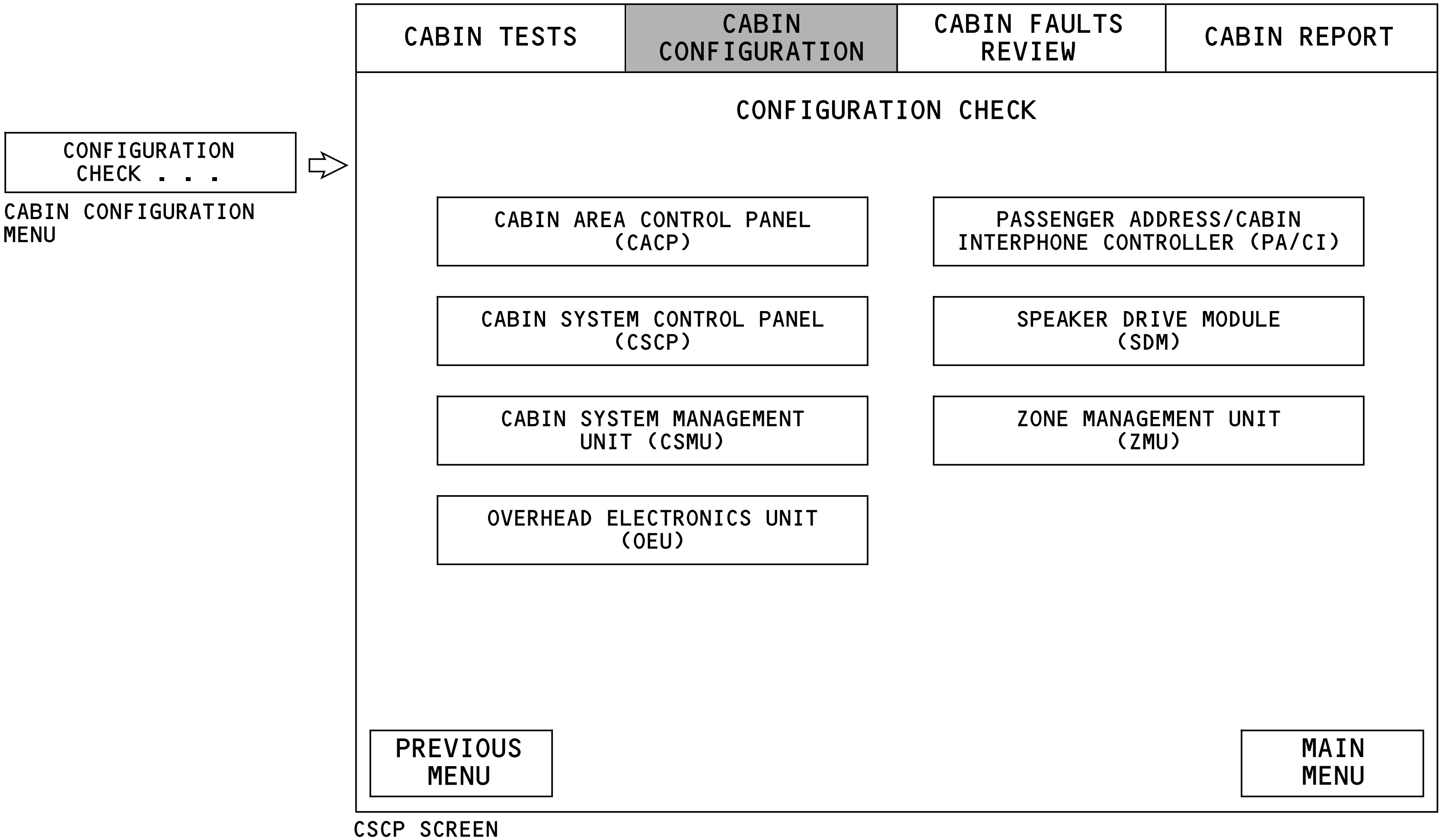
- CABIN AREA CONTROL PANEL (CACP)
- OVERHEAD ELECTRONICS UNIT (OEU)
- SPEAKER DRIVE MODULE (SDM)
- ZONE MANAGEMENT UNIT (ZMU).

Touch any of these single-LRU selections to show the related configuration screen. A no response from selected LRU dialogue window may show if the LRU is not active:

- CABIN SYSTEM CONTROL PANEL (CSCP)
- CABIN SYSTEM MANAGEMENT UNIT (CSMU)
- PASSENGER ADDRESS/CABIN INTERPHONE CONTROLLER (PA/CI).

Touch PREVIOUS MENU to return to the cabin configuration menu.

Touch MAIN MENU to return to the cabin maintenance menu.



23-39-00-728 Rev 0 06/17/96

CSS TEST AND SOFTWARE INSTALLATION - CONFIGURATION CHECK MENU

CSS TEST AND SOFTWARE INSTALLATION - CONFIGURATION CHECK - LRU SELECTION SCREEN

General

This configuration check - LRU selection screen is applicable to multiple-LRU types. It permits you to select any or all LRUs of a single type and get configuration data.

Access

Touch these selections to show a configuration check screen for an LRU:

- CABIN CONFIGURATION on any maintenance screen
- CONFIGURATION CHECK on the cabin configuration menu
- Touch an LRU selection on the configuration check menu.

Controls and Indications

This screen shows the overhead electronics unit (OEU) selection. Screens for other LRUs are almost the same.

The controls on the screen permit you to make any of these selections:

- One OEU in a column of a zone
- All OEUs in a column of a zone
- All OEUs in a zone
- All OEUs in the system.

Use the up and down arrows on the left side of the screen to select any one or all of the CSS zones. The zone number you select shows to the left of the arrows.

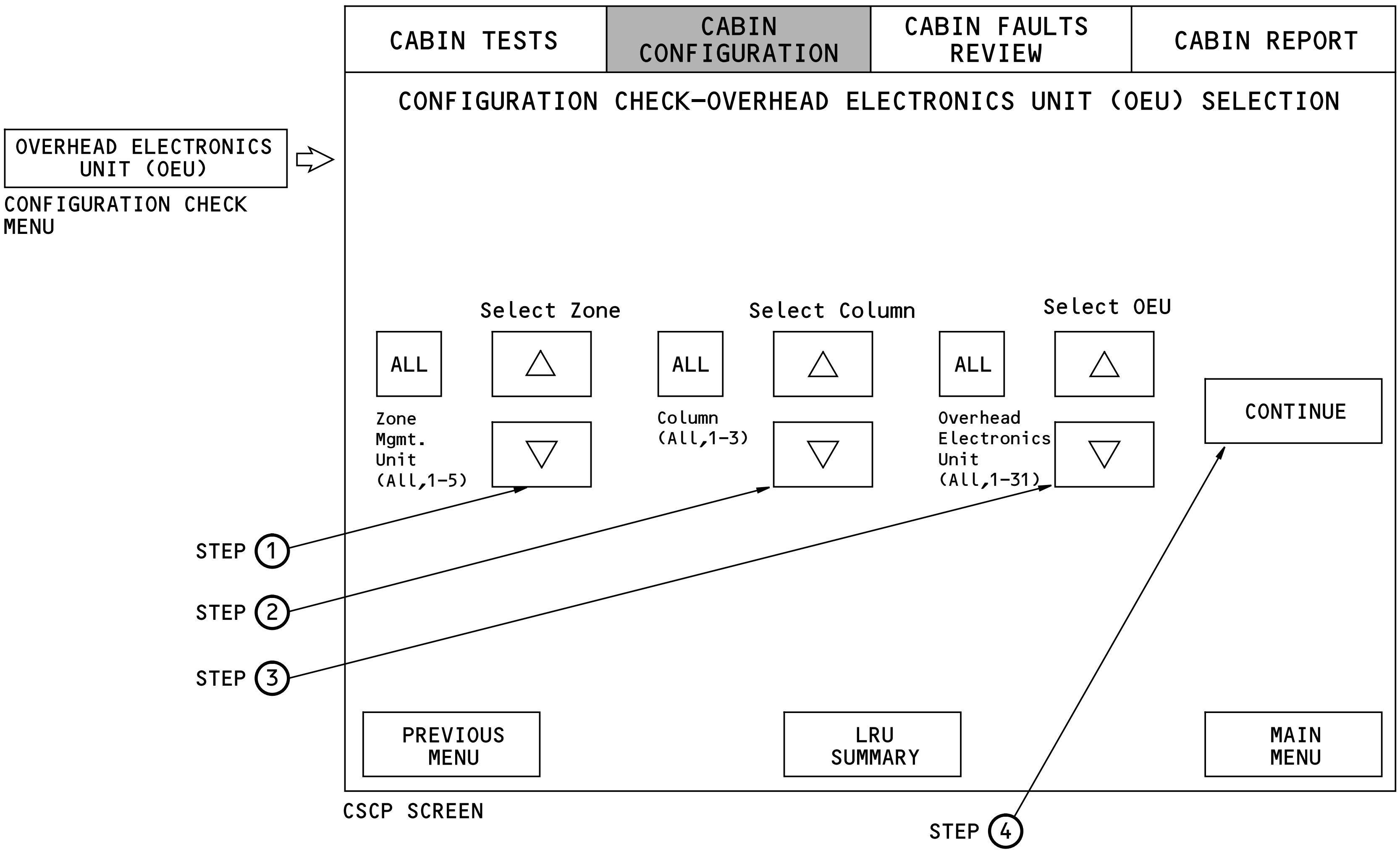
Use the up and down arrows in the center of the screen to select any one or all of the columns of the selected zone. The column number you select shows to the left of the arrows.

Use the up and down arrows on the right side of the screen to select any one or all of the OEUs in the selected column. The OEU you select shows to the left of the arrows.

After you make the selections, touch CONTINUE to get the configuration. If any LRU does not respond, a dialogue window shows you which ones. If all LRUs are active, the configuration check screen for the LRU type shows.

Touch any of these selections at the bottom of the screen to do the related function:

- PREVIOUS MENU - to return to the configuration check menu
- LRU SUMMARY - to see a screen that shows the number of OEUs in each column and zone
- MAIN MENU - to return to the cabin maintenance menu.



23-39-00-729 Rev 0 06/17/96

CSS TEST AND SOFTWARE INSTALLATION - CONFIGURATION CHECK - LRU SELECTION SCREEN

CSS TEST AND SOFTWARE INSTALLATION - CONFIGURATION CHECK - LRU SUMMARY SCREEN

General

This screen shows how all LRUs of the type you selected are configured in the CSS. This screen shows the overhead electronics unit (OEU) summary. This screen for other LRUs is almost the same.

Access

Touch these selections to show the configuration check - LRU summary screen:

- CABIN CONFIGURATION on any maintenance screen
- CONFIGURATION CHECK on the cabin configuration menu
- an LRU selection on the configuration check menu
- LRU SUMMARY on the configuration check - LRU selection screen.

Controls and Indications

This summary screen shows the number of OEUs in each column of a related zone. The first number shows how many OEUs are assigned to the column by the database. The second number shows how many of the LRUs are operating. Because there are only three zones, ZMU 4 and ZMU 5 should all be zero.

Touch any of these selections at the bottom of the screen to do the related function:

- PREVIOUS MENU - to return to the configuration check menu
- PREVIOUS SCREEN - to return to the configuration check - LRU selection screen
- SAVE PAGE - to save the data on the screen to a cabin system control panel (CSCP) floppy diskette
- PRINT PAGE - to print the data on the screen to the cabin printer
- MAIN MENU - to return to the cabin maintenance menu.

LRU SUMMARY

CONFIGURATION CHECK SELECTION SCREEN

CABIN TESTS | CABIN CONFIGURATION | CABIN FAULTS REVIEW | CABIN REPORT

CONFIGURATION CHECK - OVERHEAD ELECTRONICS UNIT (OEU) SUMMARY

	Column 1	Column 2	Column 3
ZMU 1	8/6	7/6	8/7
ZMU 2	11/11	22/22	11/11
ZMU 3	12/12	17/17	10/10
ZMU 4	0/0	0/0	0/0
ZMU 5	0/0	0/0	0/0

First Number = Number of OEUs per Database

Second Number = Number of OEUs Responding

PREVIOUS MENU | PREVIOUS SCREEN | SAVE PAGE | PRINT PAGE | MAIN MENU

CSCP SCREEN

23-39-00-730 Rev 0 06/17/96

CSS TEST AND SOFTWARE INSTALLATION - CONFIGURATION CHECK - LRU SUMMARY SCREEN

CSS TEST AND SOFTWARE INSTALLATION - NO RESPONSE FROM SELECTED LRU SCREEN

General

This screen shows when one or more LRUs do not operate.

Access

This screen shows automatically after you make the LRU selections and touch CONTINUE on the configuration check - LRU selection screen. It shows only if one or more of the LRUs you select do not operate.

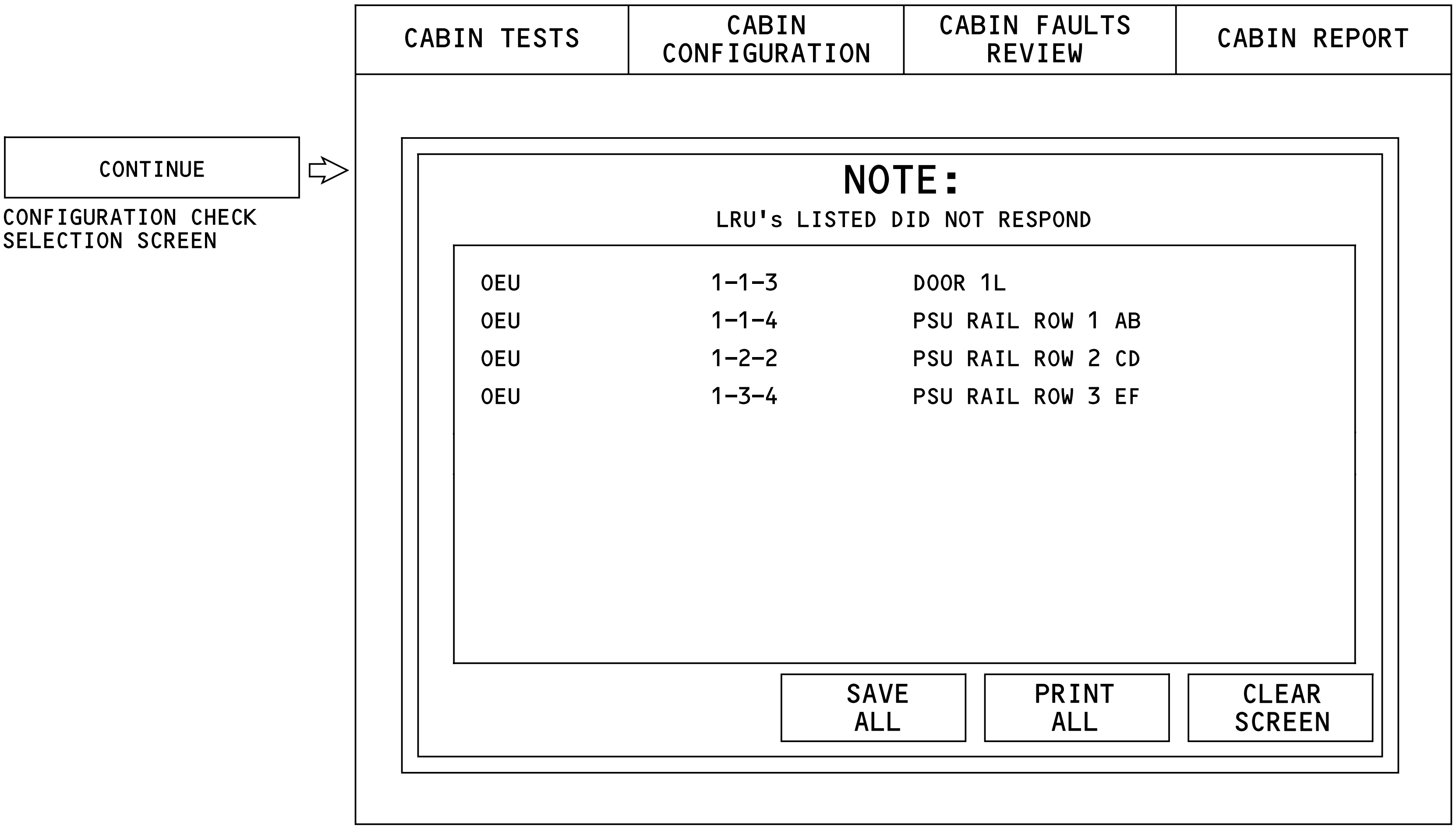
Controls and Indications

This example shows overhead electronics units (OEUs) that are not operating. Screens for other LRUs are equivalent.

If the list of LRUs is longer than the display, use the up and down arrows at the right to scroll through the list.

Touch any of these selections at the bottom of the screen for the related function:

- SAVE ALL - to save the entire contents of both windows to a floppy diskette in the cabin system control panel (CSCP)
- PRINT ALL - to print the entire contents of both windows to the cabin printer
- CLEAR SCREEN - to return to the configuration check selection screen.



CSCP SCREEN

23-39-00-731 Rev 0 06/17/96

CSS TEST AND SOFTWARE INSTALLATION - NO RESPONSE FROM SELECTED LRU SCREEN

CSS TEST AND SOFTWARE INSTALLATION - CONFIGURATION CHECK - LRU SCREEN

General

This screen shows the configuration of the LRUs of the type you selected with other screens.

Access

To show the LRU configuration check screen:

- Touch CABIN CONFIGURATION on any maintenance screen
- Touch CONFIGURATION CHECK on the cabin configuration menu
- Touch an LRU selection on the configuration check menu
- Make the necessary selections for the LRU and touch CONTINUE on the configuration check - LRU selection screen.

Controls and Indications

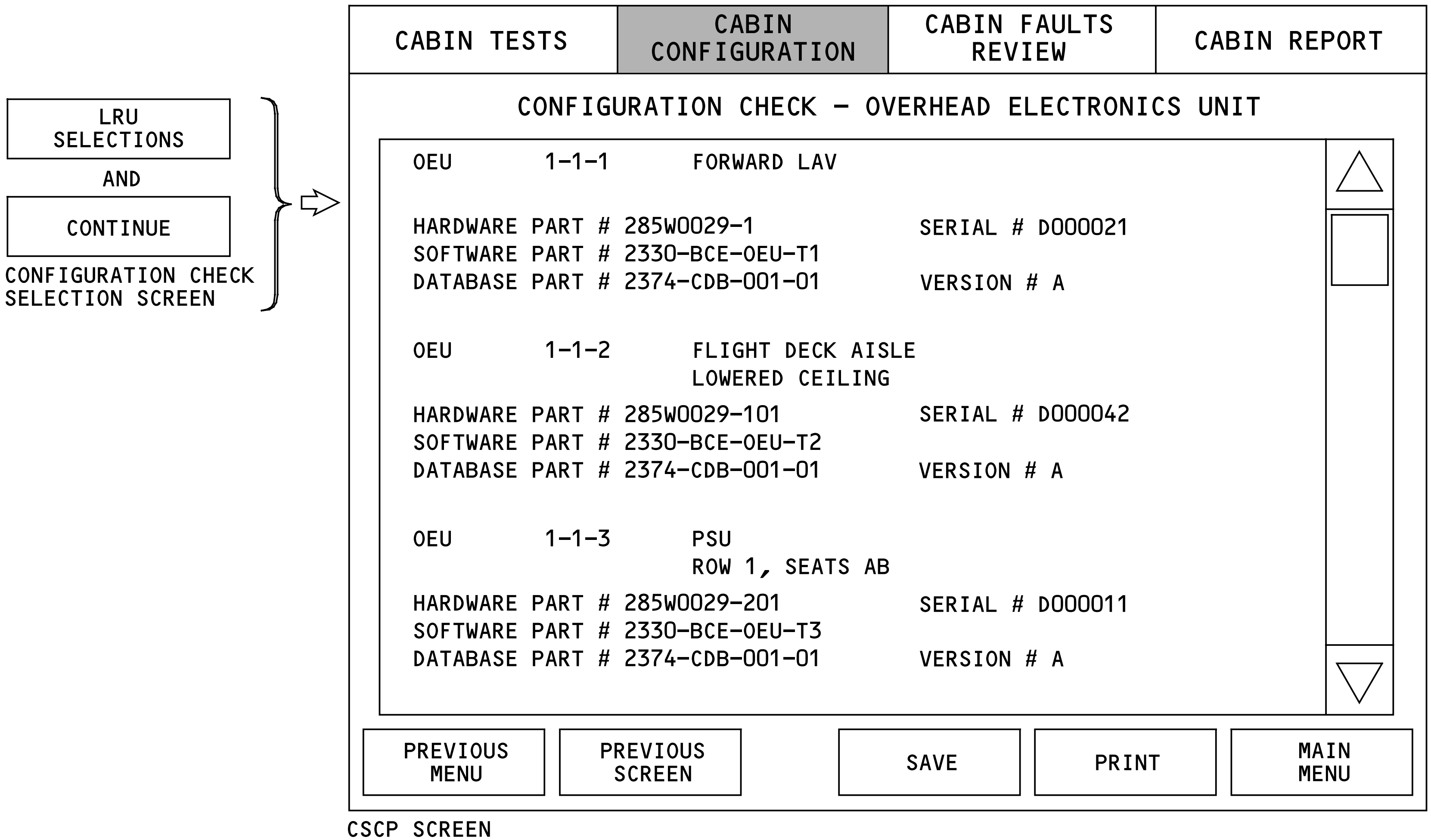
The screen shows each LRU of the type you selected on the configuration check selection screen. It shows these items for each LRU:

- The LRU name
- The address assigned by the configuration database
- LRU location
- The serial number of the unit
- The hardware part number
- The software part number of the operation program software installed
- The database part number and version number of the configuration database installed.

Use the up and down arrows at the right of the window to scroll through the data.

Touch any of these selections at the bottom of the screen to do the related function:

- PREVIOUS MENU - to return to the configuration check menu
- PREVIOUS SCREEN - to return to the configuration check - LRU selection screen
- SAVE - to save the data to a cabin system control panel (CSCP) floppy diskette
- PRINT - to print the data to the cabin printer
- MAIN MENU - to return to the cabin maintenance menu.



23-39-00-732 Rev 0 06/17/96

CSS TEST AND SOFTWARE INSTALLATION - CONFIGURATION CHECK - LRU SCREEN

CSS TEST AND SOFTWARE INSTALLATION - CABIN FAULTS REVIEW MENU

General

You use the cabin faults review menu to show failure data for the CSS. These are the five selections on the cabin faults review menu:

- QUICK TEST FAULTS REVIEW
- ALL TEST FAULTS REVIEW
- DATA INSTALLATION FAULTS REVIEW
- FLIGHT DECK EFFECTS FAULTS (ACTIVE)
- FLIGHT DECK EFFECTS FAULTS (HISTORY)

Access

Touch CABIN FAULTS REVIEW on any maintenance screen to show the cabin faults review menu.

Quick Test Faults Review

Touch QUICK TEST FAULTS REVIEW to show the faults review screen from the last quick test. See the quick test description for more information.

All Test Faults Review

Touch ALL TEST FAULTS REVIEW to show the faults review screen from the last all test. See the all test description for more information.

Data Installation Faults Review

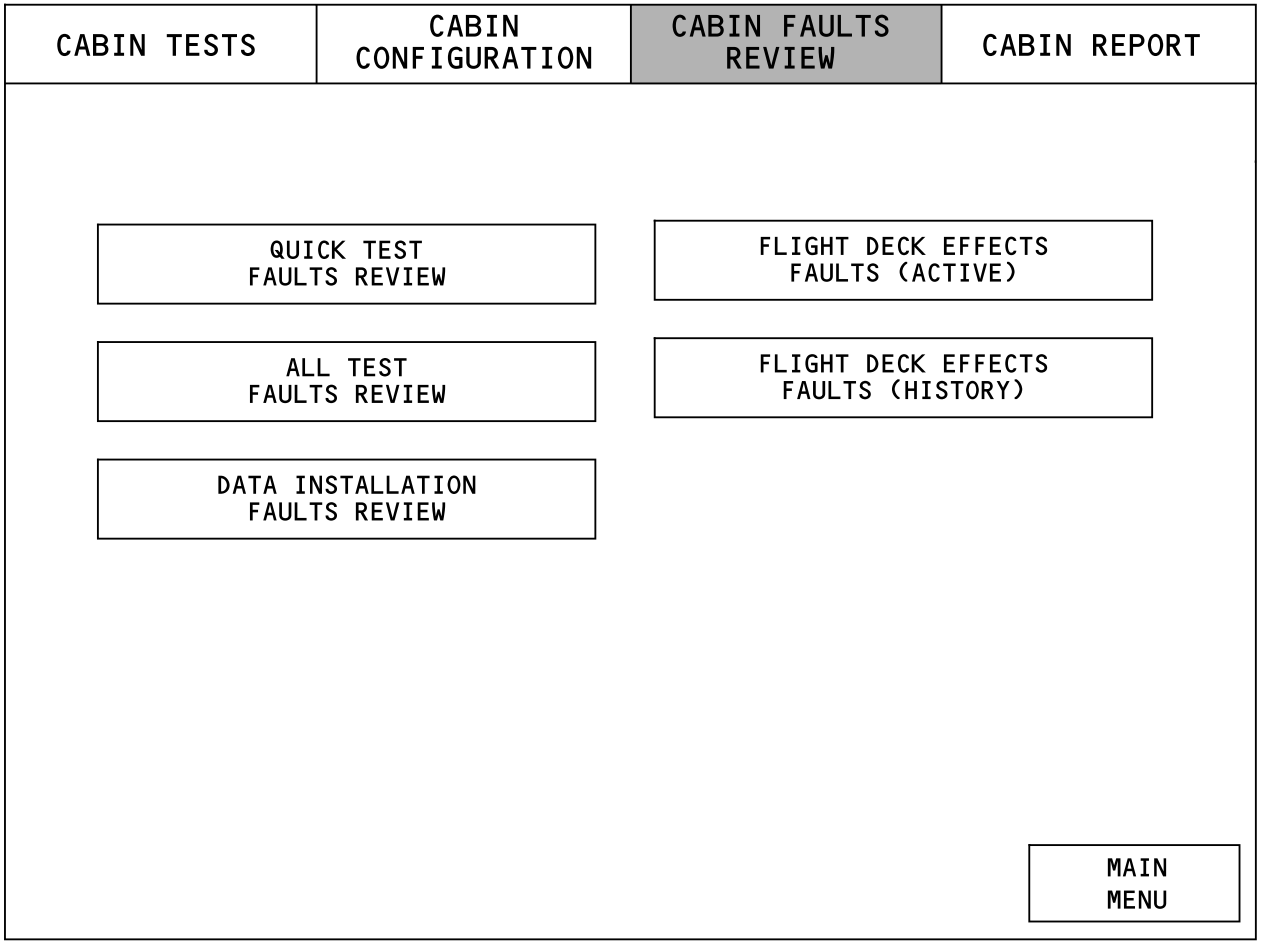
Touch DATA INSTALLATION FAULTS REVIEW to show an installation fault results screen from the last database or operational program installation. For more information on data installation see the database or operational program installation description.

Flight Deck Effects Faults (Active)

Touch FLIGHT DECK EFFECTS FAULTS (ACTIVE) to show CSS failures that cause EICAS messages. The screen shows all active CSS related EICAS messages and related maintenance messages.

Flight Deck Effects Faults (History)

The flight deck effects faults (history) screen is the same as flight deck effects faults (active) screen except it also has EICAS related failures kept in memory. It can keep as many as 99 failures in non-volatile memory.



CSCP SCREEN

23-39-00-733 Rev 1 06/17/96

CSS TEST AND SOFTWARE INSTALLATION - CABIN FAULTS REVIEW MENU

CSS TEST AND SOFTWARE INSTALLATION - FLIGHT DECK EFFECTS FAULTS (ACTIVE) SCREEN

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CSS TEST AND SOFTWARE INSTALLATION - FLIGHT DECK EFFECTS FAULTS (ACTIVE) SCREEN

General

You use the flight deck effects faults (active) screen to show failures that cause CSS related EICAS messages. Active EICAS messages are messages that currently show on EICAS.

Access

To show the flight deck effects faults (active) screen:

- Touch CABIN FAULTS REVIEW on any maintenance screen
- Touch FLIGHT DECK EFFECTS FAULTS (ACTIVE) on the cabin faults review menu.

Controls and Indications

These are the three parts of the screen:

- Fault conditions
- Maintenance message data
- Selection controls.

Fault Conditions

The fault conditions part of the screen shows this fault data:

- Screen title - FLIGHT DECK EFFECTS (FDE) FAULTS (ACTIVE)
- The configuration database part number currently installed
- The date and time of the fault
- The sequence of each maintenance message in the list of messages.

Flight Deck Effects

The data window shows maintenance messages for each flight deck effect. The bottom line of the data window shows the EICAS message. These are the two EICAS status messages that can occur because of CSS failures:

- PASSENGER ADDRESS - Caused by a failure of the active passenger address controller. It can also occur if two adjacent speaker drive modules have a failure.
- CABIN INTERPHONE - Caused by a failure of the active cabin interphone controller. It can also occur if a zone management unit fails, or if two cabin attendant handsets fail in the same zone.

Maintenance Message Data

Each page shows one maintenance message. The maintenance message shows data about each failure. These are the three parts to the maintenance message:

- Fault description
- Maintenance message number/fault activity level
- Recommended maintenance action.

The fault description identifies the failure condition detected by the continuous BITE. It also identifies the component that found the fault.

CSS TEST AND SOFTWARE INSTALLATION - FLIGHT DECK EFFECTS FAULTS (ACTIVE) SCREEN

There is one maintenance message number for every maintenance message. You use the maintenance message number to find the corrective action in the fault isolation manual (FIM). Some maintenance messages show Latched. latched means the fault will stay in the system until you take corrective action.

The recommended maintenance action identifies all the possible components or conditions that could cause the fault. The most probable cause shows first and the least probable cause shows last.

Each screen shows one maintenance message. Use the up or down arrow at the right of the screen to scroll through the messages. The square on the scroll bar shows your position in the message list.

Selection Controls

Touch PREVIOUS MENU to show the cabin faults review menu.

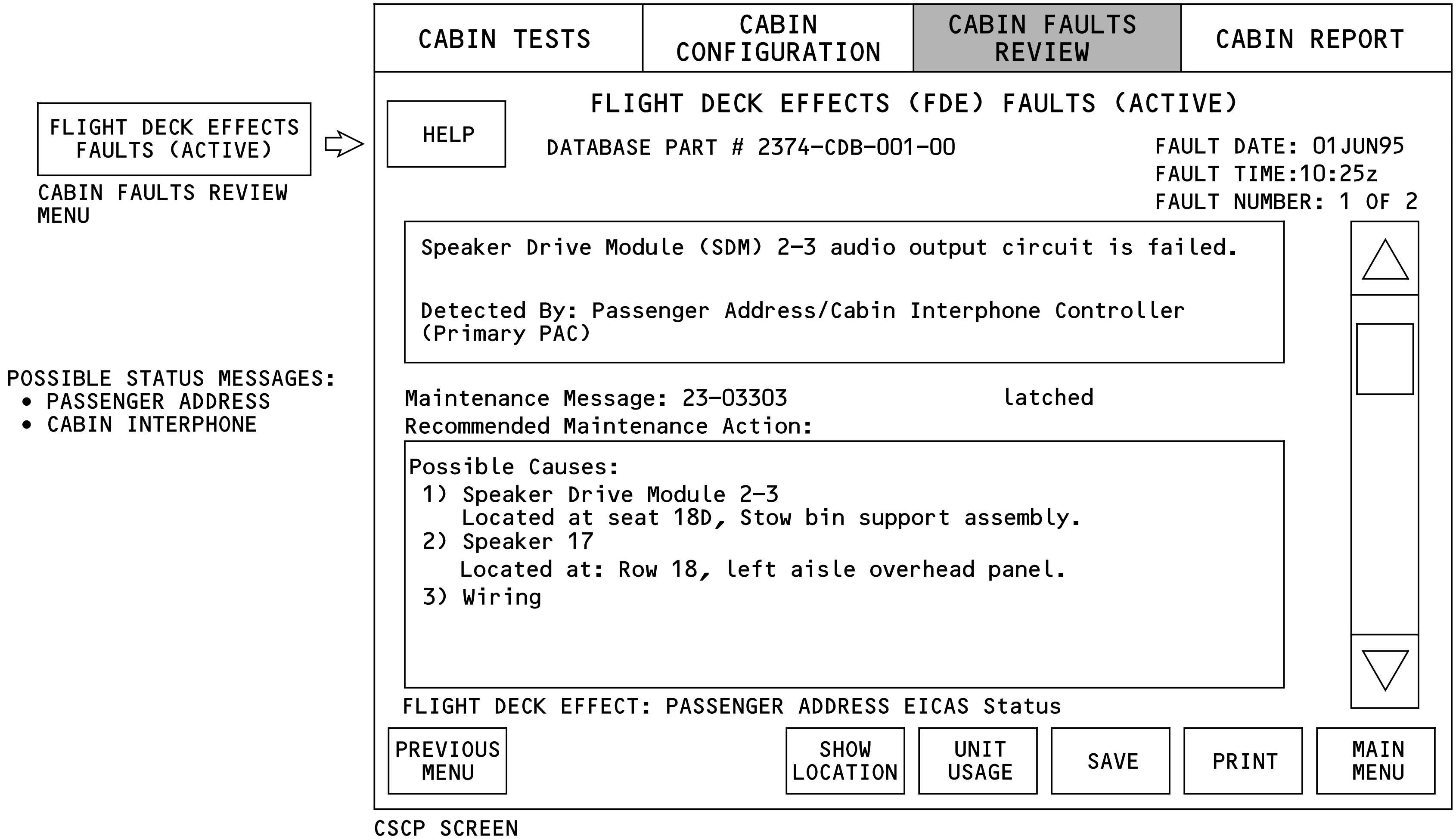
Touch SHOW LOCATION to show a visual reference of the defective component.

Touch UNIT USAGE to show the components controlled by the defective component.

Touch SAVE to send the data to a floppy diskette in the CSCP.

Touch PRINT to send the data to the printer for a paper copy.

Touch MAIN MENU to show the cabin maintenance menu.



23-39-00-734 Rev 0 06/17/96

CSS TEST AND SOFTWARE INSTALLATION - FLIGHT DECK EFFECTS FAULTS (ACTIVE) SCREEN

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CSS TEST AND SOFTWARE INSTALLATION - FLIGHT DECK EFFECTS FAULTS (HISTORY) SCREEN

General

You use the flight deck effects faults (history) screen to show failures that cause CSS related EICAS messages.

The flight deck effects faults (history) is the same as flight deck effects faults (active) except that it shows all faults in memory. The CSS can keep as many as 99 faults in non-volatile memory.

Access

To show the flight deck effects faults (history) screen, do this:

- Touch CABIN FAULTS REVIEW on any maintenance screen
- Touch FLIGHT DECK EFFECTS FAULTS (HISTORY) on the cabin faults review menu.

Controls and Indications

These are the three parts of the screen:

- Fault conditions
- Maintenance message data
- Selection controls.

Fault Conditions

The fault conditions part of the screen shows this fault data:

- Screen title - FLIGHT DECK EFFECTS (FDE) FAULTS (HISTORY)
- PRESENT LEG shows if the fault occurred on the current flight leg
- The configuration database part number installed at the time of the fault
- The date and time of the fault
- The number of times the fault occurred during the flight leg. If the number of occurrences is more than one, the fault is an intermittent fault
- The flight phase when the fault occurred
- The sequence of each maintenance message in the list of messages.

The flight phase shows the part of flight in which the fault first occurred. These are the possible flight phases:

- Power on
- Engine start
- Taxi out
- Takeoff
- Initial climb
- Climb
- Enroute
- Descent
- Approach
- Go around
- Flare
- Rollout
- Taxi in
- Shutdown
- Maintenance.

CSS TEST AND SOFTWARE INSTALLATION - FLIGHT DECK EFFECTS FAULTS (HISTORY) SCREEN

Flight Deck Effects

The data window shows maintenance messages for each flight deck effect. The bottom line of the data window shows the EICAS message. These are the two EICAS status messages that can occur because of CSS failures:

- PASSENGER ADDRESS - Caused by a failure of the active passenger address controller. It can also occur if two adjacent speaker drive modules have a failure.
- CABIN INTERPHONE - Caused by a failure of the active cabin interphone controller. It can also occur if a zone management unit fails or if two cabin attendant handsets fail in the same zone.

Maintenance Message Data

Each page shows one maintenance message. The maintenance message shows data about each failure. These are the three parts to the maintenance message:

- Fault description
- Maintenance message number
- Recommended maintenance action.

The fault description identifies the failure condition detected by the continuous BITE. It also identifies the component that found the fault.

There is one maintenance message number for every maintenance message. You use the maintenance message number to find the corrective action in the fault isolation manual (FIM). Some maintenance messages show Latched. latched means the fault will stay in the system until you take corrective action.

The recommended maintenance action identifies all the possible components or conditions that could cause the fault. The most probable cause shows first and the least probable cause shows last.

Each screen shows one maintenance message. Touch the down arrow to access additional messages. Touch the up arrow to return through the message list. The square on the scroll bar shows your position in the message list.

Selection Controls

Touch PREVIOUS MENU to show the cabin faults review menu.

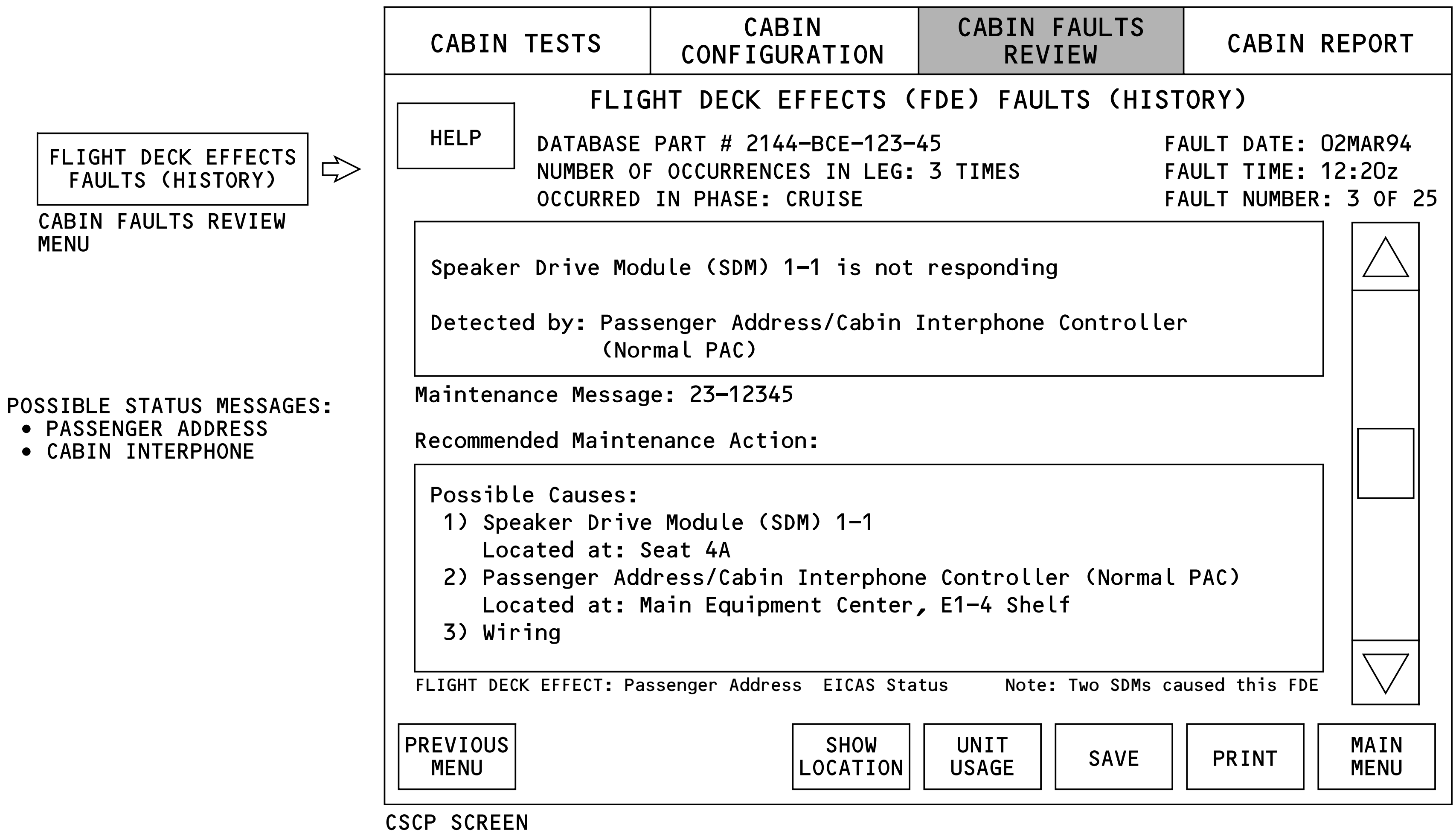
Touch SHOW LOCATION to show a visual reference of the defective component.

Touch UNIT USAGE to show the components controlled by the defective component.

Touch SAVE to send the data to a floppy diskette in the CSCP.

Touch PRINT to send the data to the printer for a paper copy.

Touch MAIN MENU to show the cabin maintenance menu.



23-39-00-735 Rev 0 06/17/96

CSS TEST AND SOFTWARE INSTALLATION - FLIGHT DECK EFFECTS FAULTS (HISTORY) SCREEN

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CSS TEST AND SOFTWARE INSTALLATION - CABIN REPORT MENU

General

You use the cabin report menu to make a paper copy or digital copy of fault results and configuration data. For a paper copy, the CSS sends the data to the cabin printer. For a digital copy, the CSS sends the data to a diskette in the cabin system control panel (CSCP).

Access

Touch CABIN REPORT on any maintenance screen to show the cabin report menu.

Fault Summary

The fault summary report shows maintenance message numbers and the number of times they have occurred.

Quick Test Faults

The quick test faults report contains test data and all maintenance messages from the last quick test.

All Test Faults

The all test faults report contains test data and all maintenance messages from the last all test.

Data Installation Faults

The data installation report contains failure descriptions from the last configuration database installation or operational program installation.

Flight Deck Effects-Active Faults-Report

The flight deck effects-active report contains CSS EICAS messages and related maintenance messages for active EICAS messages.

Flight Deck Effects-Fault History-Report

The flight deck effects-fault history report contains CSS EICAS messages and their related maintenance message for EICAS messages stored in non-volatile memory.

CSS Configuration All

The CSS configuration report shows part number data for CSS components. The list includes these items for each component:

- Hardware part number
- Software part number
- Database part number
- Database version number
- Serial number
- Name, address, and location
- Report date, time, and title.

CSS Configuration Summary

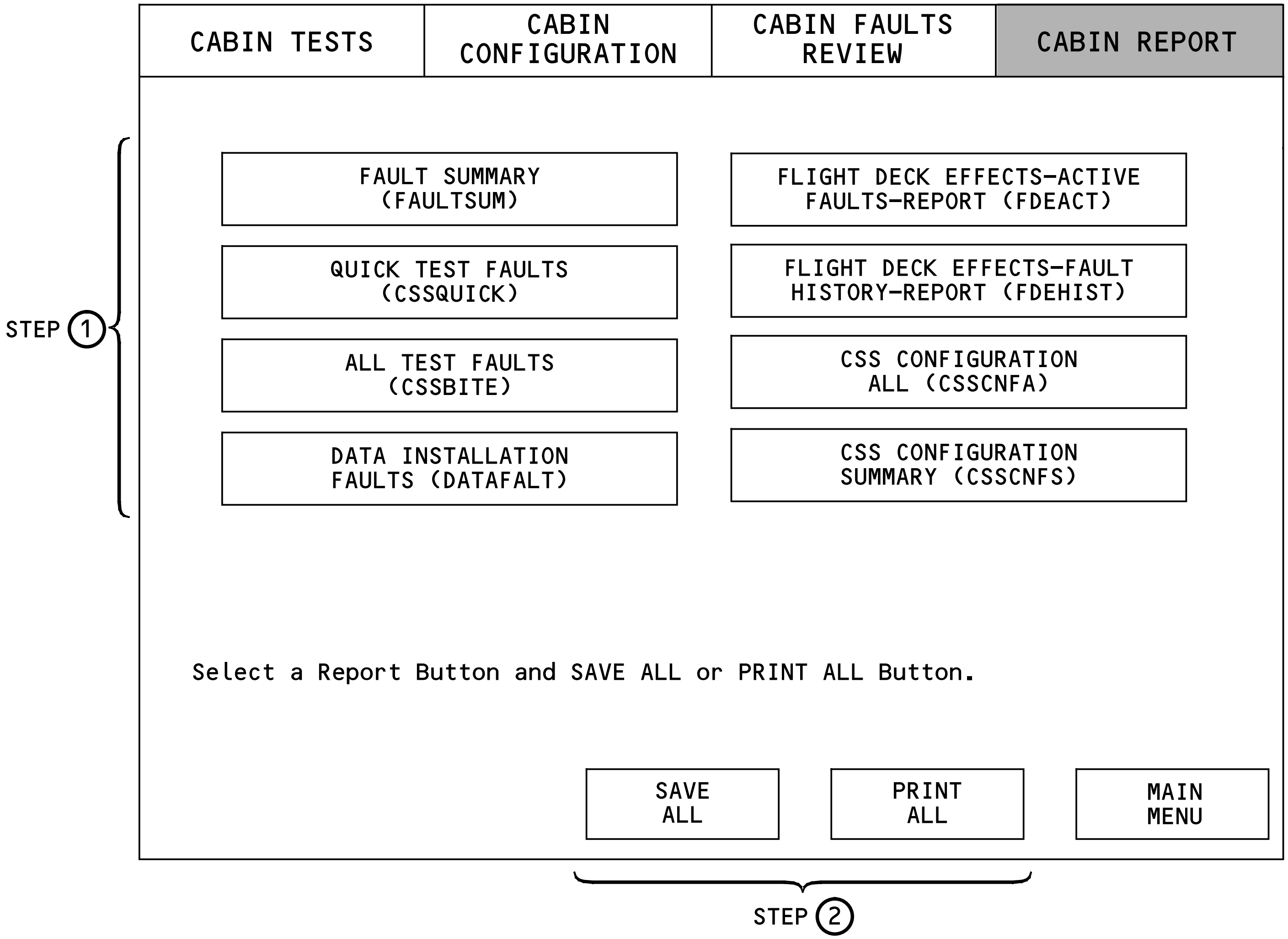
The CSS configuration summary report shows part number data for CSS components. The list includes these items for each component:

- Hardware part number
- Software part number
- LRU type name
- Report date, time, and title.

Cabin Report Menu Controls

To select a report, touch the report selection. The selection becomes green and the SAVE ALL and PRINT ALL selection show in dark print. Touch SAVE ALL to send the data to a diskette in the CSCP. Touch PRINT ALL to send the report to the cabin printer.

Touch MAIN MENU to show the cabin maintenance menu.



CSS TEST AND SOFTWARE INSTALLATION - CABIN REPORT MENU

23-39-00-736 Rev 0 06/17/96

Continental Airlines, Inc

Cabin Interphone System

WB371

TABLE OF CONTENTS

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CABIN INTERPHONE SYSTEM - INTRODUCTION

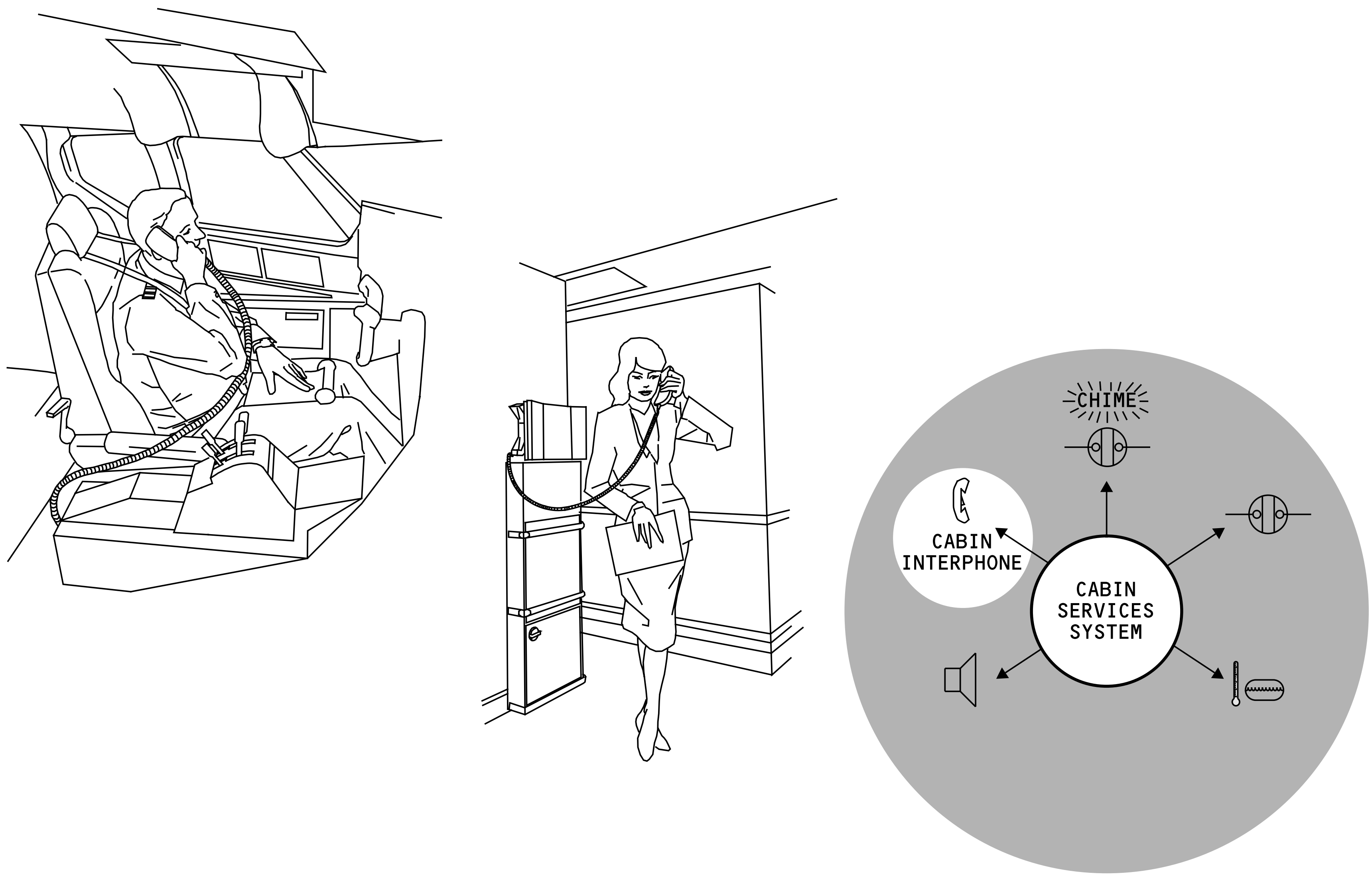
Purpose

Flight attendants use the cabin interphone system (CIS) to speak with each other and the pilots.

The CIS is like a telephone system which uses handsets and dial codes.

Abbreviations and Acronyms

AMU	- audio management unit
ASP	- attendant switch panel
alt	- alternate
aud	- audio
CACP	- cabin area control panel
CAH	- cabin attendant handset
CCP	- cabin control panel
CIC	- cabin interphone controller
CIS	- cabin interphone system
CDU	- control display unit
CSCP	- cabin system control panel
CSMU	- cabin system management unit
CSS	- cabin services system
dr	- door
FCR	- flight crew rest
FDH	- flight deck handset
FSEU	- flap/slat electronics unit
LLAR	- lower lobe attendants rest
PA/CI	- passenger address/cabin interphone
PAC	- passenger address controller
PAS	- passenger address system
PTT	- push to talk
ZMU	- zone management unit



23-42-00-001 Rev 5 08/07/96

CABIN INTERPHONE SYSTEM - INTRODUCTION

CIS - GENERAL DESCRIPTION

General

Flight attendants and the flight crew speak with each other on the CIS.

All audio signals go through the passenger address/ cabin interphone (PA/CI) controller. The PA/CI controller is the primary component of the CIS.

Flight Deck

The flight deck has a flight deck handset (FDH) that connects to the PA/CI controller. The flight crew uses the FDH to dial flight attendant stations and to talk to flight attendants.

The flight crew can also use the flight interphone system to talk on the CIS. They use the center control display unit (CDU) to call the attendant station. The audio management unit (AMU) connects the PA/CI controller to the flight crew headsets. The center CDU also shows incoming call information.

The PA/CI sends call alert signals to the AIMS cabinets. The AIMS shows EICAS messages for calls to the flight deck.

Cabin

Each attendant station has a cabin attendant handset (CAH). The flight attendants use the CAHs to talk to each other and the flight crew. They use dial code keys on the CAH to call other stations.

The CAHs connect to zone management units (ZMUs) for audio and dial codes. The ZMUs have a digital interface with the PA/CI controller. The ZMUs digitize the signal from the CAH and send it to the PA/CI controller. The PA/CI controller makes the connection between stations. The ZMU changes the signal back to analog and sends it to the CAH.

When an attendant station gets a call, the passenger address system (PAS) makes a chime. The ZMU causes a master call light to come on at the attendant station.

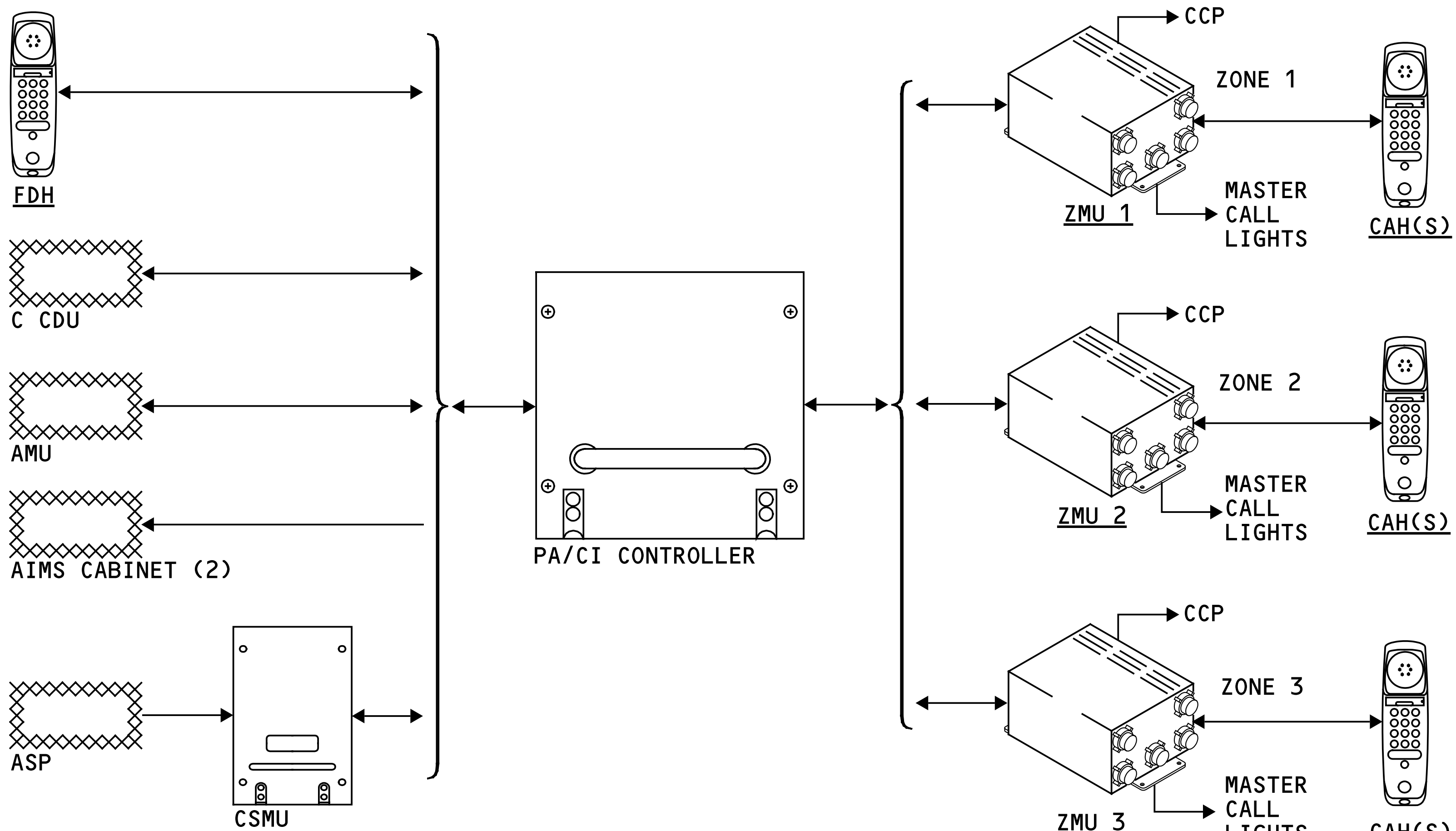
Other Interfaces

The PA/CI controller sends fault information on the left systems ARINC 629 bus. It also uses airplane systems information for some functions.

You use the cabin control panels (CCPs) to control the CIS. A CCP operates as a cabin area control panel (CACP) or as a cabin system control panel (CSCP), depending upon its configuration.

The PA/CI controller has two cabin interphone controllers, normal and alternate. If the normal cabin interphone controller fails, the flight attendants get a message on the cabin control panels (CCPs). The flight attendants use the attendant switch panel (ASP) to select the alternate controller.

You use the cabin system control panel (CSCP) to test and install software into the CIS.



CIS - GENERAL DESCRIPTION

CIS - COMPONENT LOCATIONS - CABIN AND MAIN EQUIPMENT CENTER

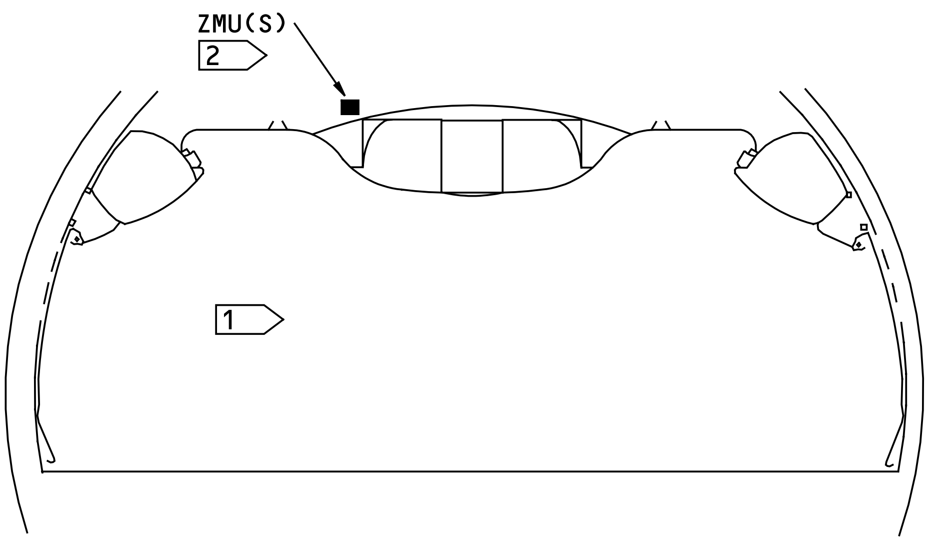
Cabin

The cabin attendant handsets (CAHs) are at each attendant seats station. The CI NORM/ALT switch is on the attendant switch panel (ASP) at door 2 left.

There is one CAH in the flight crew rest (FCR).

The zone management units (ZMUs) are above the passenger cabin area on the stow bin ladder assembly.

The passenger address/cabin interphone (PA/CI) controller is in the main equipment center (MEC).



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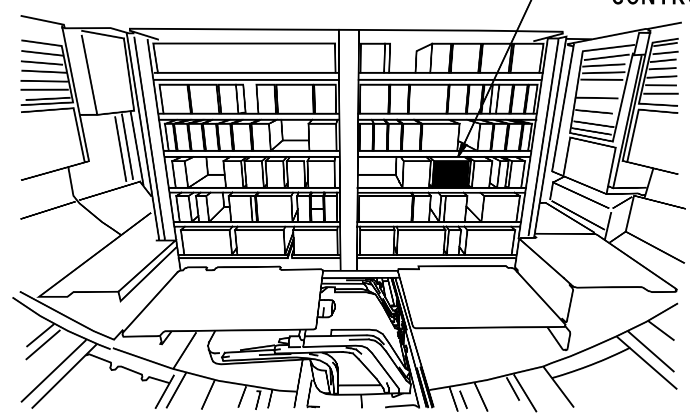


MAIN EQUIPMENT CENTER

1 CABIN ATTENDANT HANDSETS ARE AT EACH ATTENDANT STATION.

2 THERE IS ONE ZMU IN EACH ZONE.

23-42-00-003.018 Rev 0 12/22/1997

CIS - COMPONENT LOCATIONS - CABIN AND MAIN EQUIPMENT CENTER

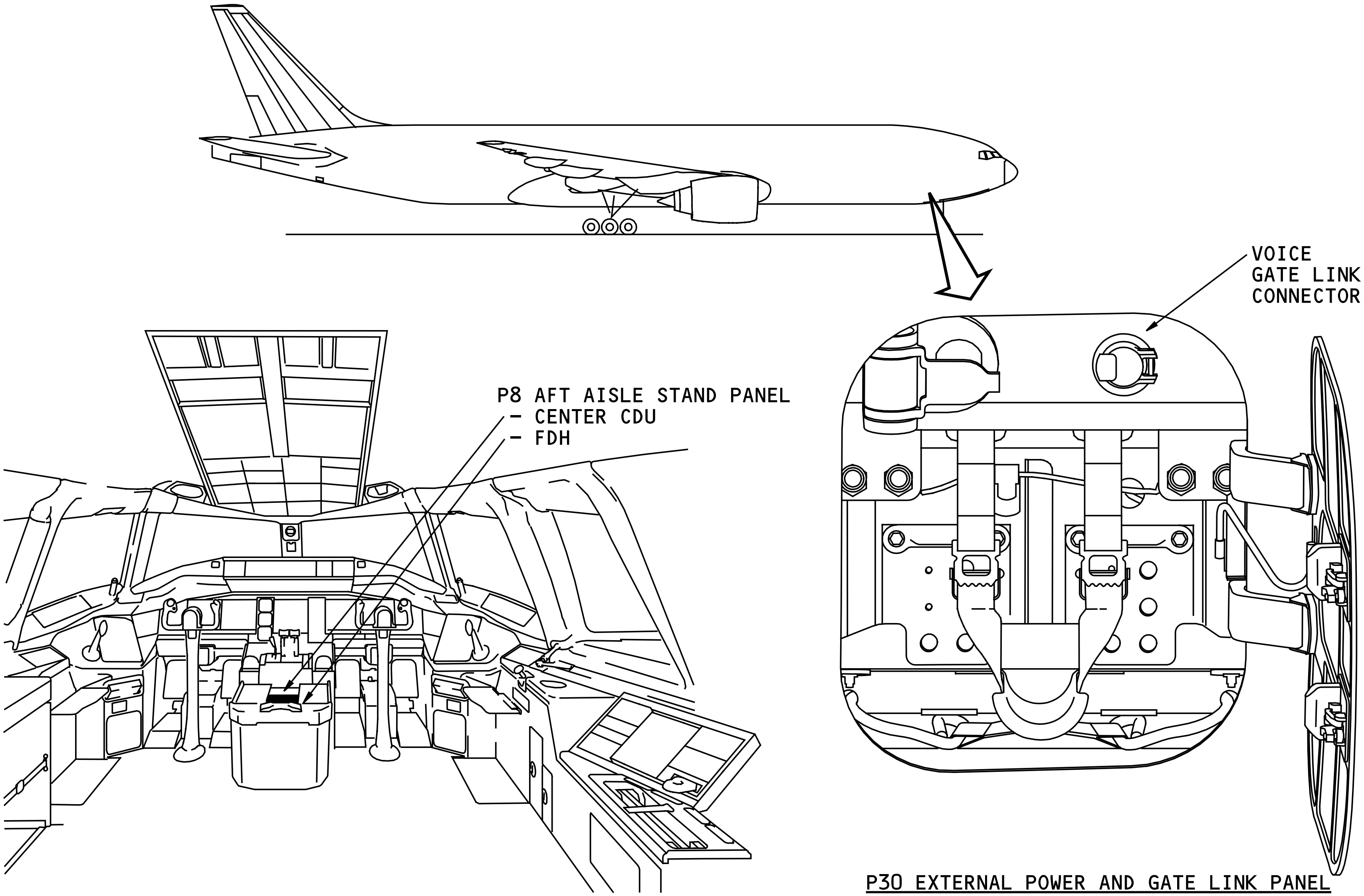
CIS - COMPONENT LOCATIONS - FLIGHT DECK AND P30

Flight Deck

The flight deck handset (FDH) and center control display unit (CDU) are on the aft aisle stand panel.

P30 External Power and Gate Link Panel

The external power and gate link panel has two telephone jacks on it. The jacks connect the passenger address/cabin (PA/CI) controller to land telephone networks.



CIS - COMPONENT LOCATIONS - FLIGHT DECK AND P30

CIS - POWER INTERFACE

General

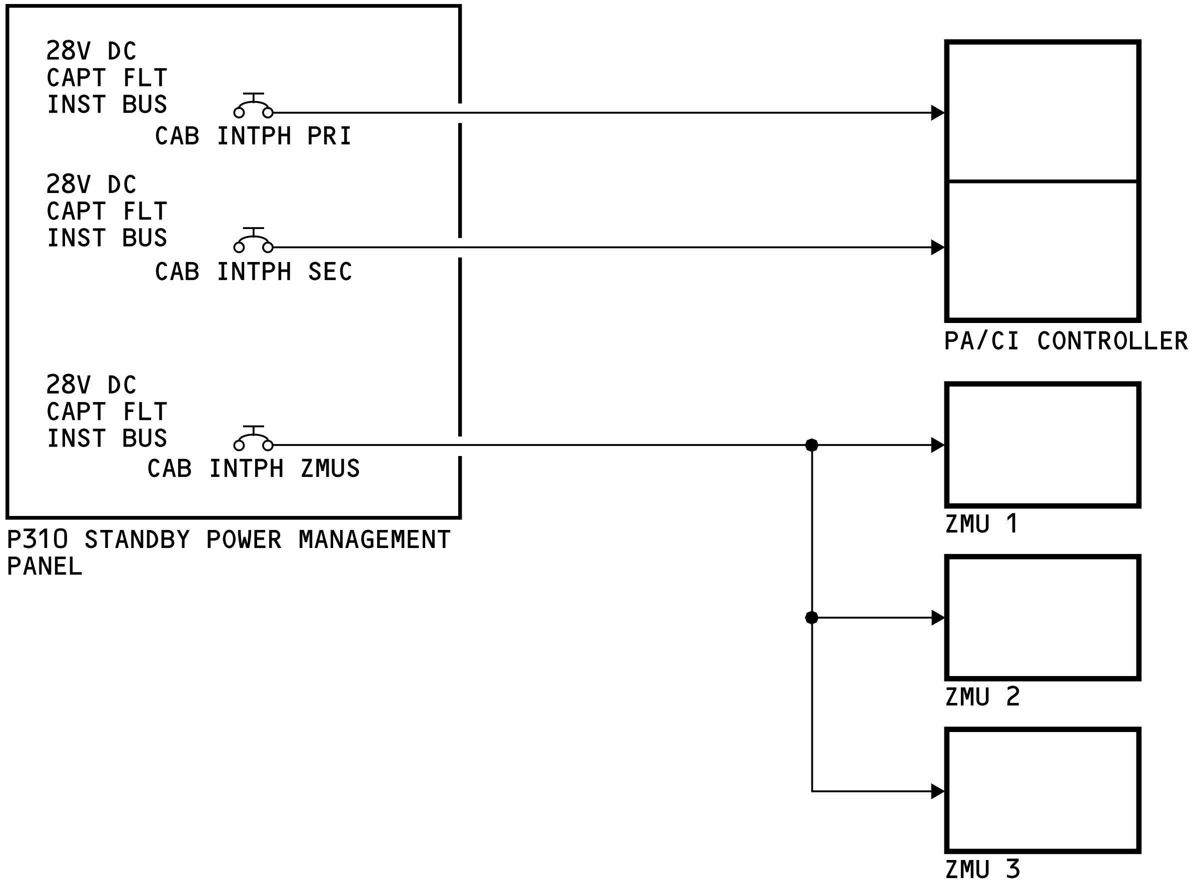
The standby power management panel has three circuit breakers that connect power to the CIS components.

PA/CI Controller

The passenger address/cabin interphone (PA/CI) controller uses two 28 volt inputs for the cabin interphone function. One input supplies power to the normal cabin interphone controller. The other supplies power to the alternate cabin interphone controller.

ZMUs

The zone management units (ZMUs) get 28v dc for their cabin interphone circuits.



23-42-00-005 Rev 1 07/02/1997

CIS - POWER INTERFACE

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CIS - PA/CI CONTROLLER INTERFACES

General

The passenger address/cabin interphone (PA/CI) controller has interfaces to connect the flight attendant and flight crew stations.

Flight Crew

The flight crew can use the flight deck handset (FDH) or the flight interphone system to talk on the cabin interphone system (CIS).

The FDH sends mic audio and dial code signals to the PA/CI controller. It also sends a push to talk (PTT) for passenger address announcements. The PA/CI controller sends receiver audio to the FDH.

To use the flight interphone system, the flight crew selects a dial code on the center control display unit (CDU). The center CDU shows call messages and data from the PA/CI controller.

The audio management unit (AMU) sends and receives the audio from the PA/CI controller. It also sends a PTT.

The in-flight entertainment system (IFE) sends a signal to the CSMU when the video system is on. The CSMU sends the signal to the center CDU to show VIDEO IN USE. The PA/CI controller also sends a signal to show PA IN USE when the passenger address system is on.

When a call goes to the flight deck, the PA/CI controller:

- Sends a cabin call discrete to the AMU
- Sends a discrete to the AIMS cabinets
- Shows a message on the center CDU.

The audio control panel (ACP) call lights come on. The AMU controls the call lights. When a pilot selects CAB on an ACP, the AMU sends an off-hook signal to the PA/CI controller. The PA/CI controller sends a cabin reset signal to the AMU. The call lights go off.

To make a priority line call, push the CAB transmit switch twice. The AMU sends a priority line signal to the PA/CI controller. The priority line call goes to a station defined by the configuration database.

When the ground crew calls the flight deck from the service and APU shutdown panel, the flight crew gets a call light on their ACPs and a message on EICAS. The PA/CI controller sends a flight deck call signal to the AMU. It also sends a signal to the AIMS cabinets. When a pilot selects FLT on an ACP, the AMU sends a flight deck reset signal to the PA/CI controller. This ends the flight call signal.

Cabin

The PA/CI controller connects to the zone management units (ZMUs) to connect cabin handsets. Each ZMU has a digital interface with the PA/CI controller. The ZMU sends digital audio and dial codes to the PA/CI controller. The PA/CI controller makes the internal connection and sends digital audio to the ZMU. It also sends cabin interphone master call light data to the ZMUs.

External Panels

When the ground crew calls the flight deck, the P40 service and APU shutdown panel sends a signal to the PA/CI controller. When the flight crew calls the ground crew, the PA/CI controller sends a signal to the standby power management panel. This causes the ground crew call horn to sound.

There are two telephone lines that connect to the P30 external power and gate link panel. This permits the cabin interphone system to connect to public telephone systems.

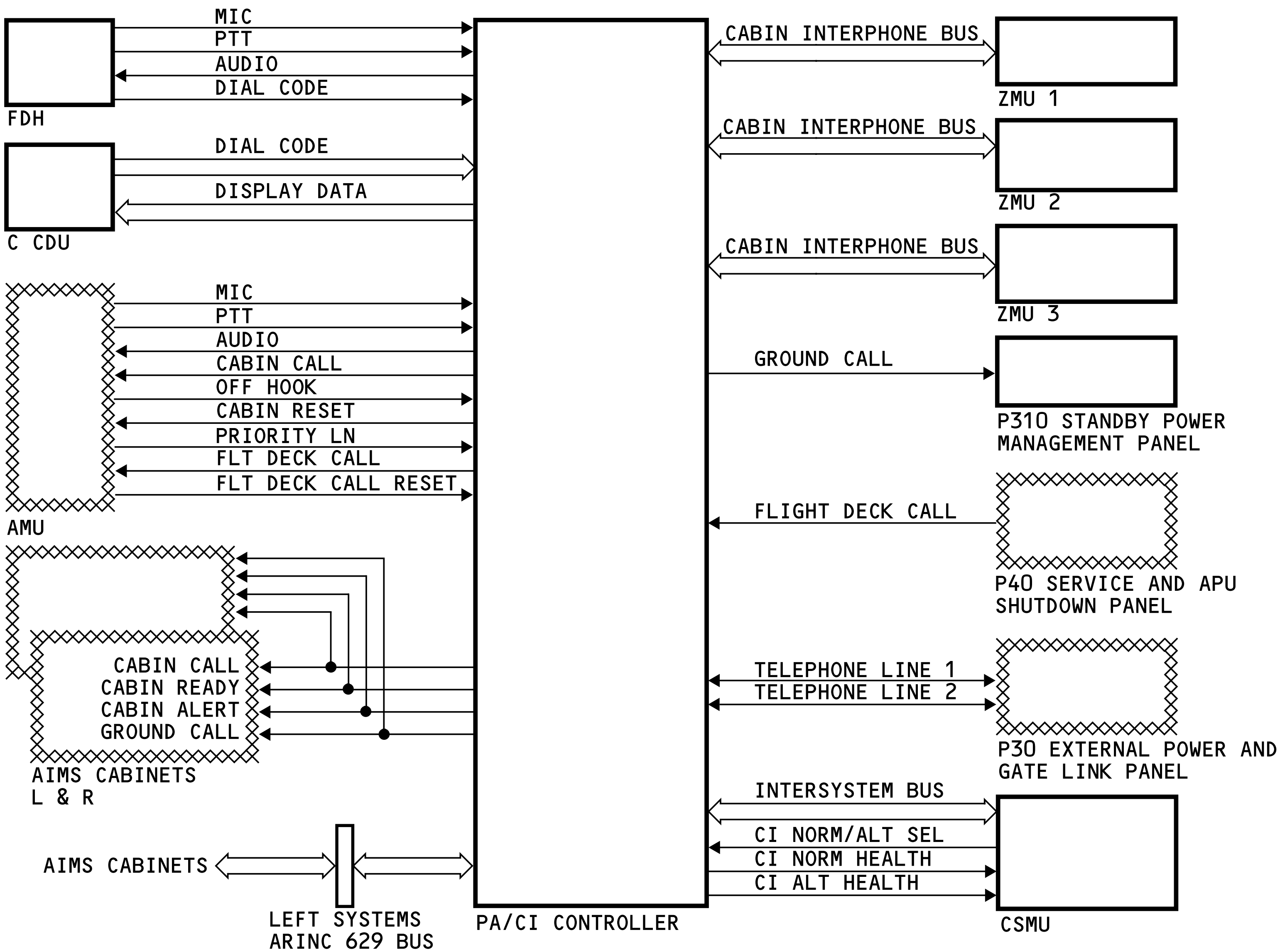
CSMU

The cabin system management unit (CSMU) sends and gets both test and software installation data on the intersystem bus from the PA/CI controller.

The PA/CI controller has two cabin interphone controllers, normal and alternate. Only one operates at a time. If the normal controller fails, flight attendants select the alternate from the attendant switch panel (ASP).

Each controller monitors its operation. If it finds a failure, it sets a discrete. The discrete is a health discrete and it goes to the CSMU. The CSMU and the PA/CI controller send the failure information on the intersystem bus. The cabin system control panel and cabin area control panels show a failure message.

The PA/CI controller sends failure data to the AIMS on the left systems ARINC 629 bus. The CSMU also sends failure information to the AIMS when either cabin interphone controller fails.



CIS - PA/CI CONTROLLER INTERFACES

CIS - ZMU INTERFACES

General

The zone management units (ZMUs) supply an interface between the passenger address/cabin interphone (PA/CI) controller and the cabin attendant handsets (CAHs).

The ZMUs digitize analog audio from the CAHs. They change digital audio from the PA/CI controller to analog.

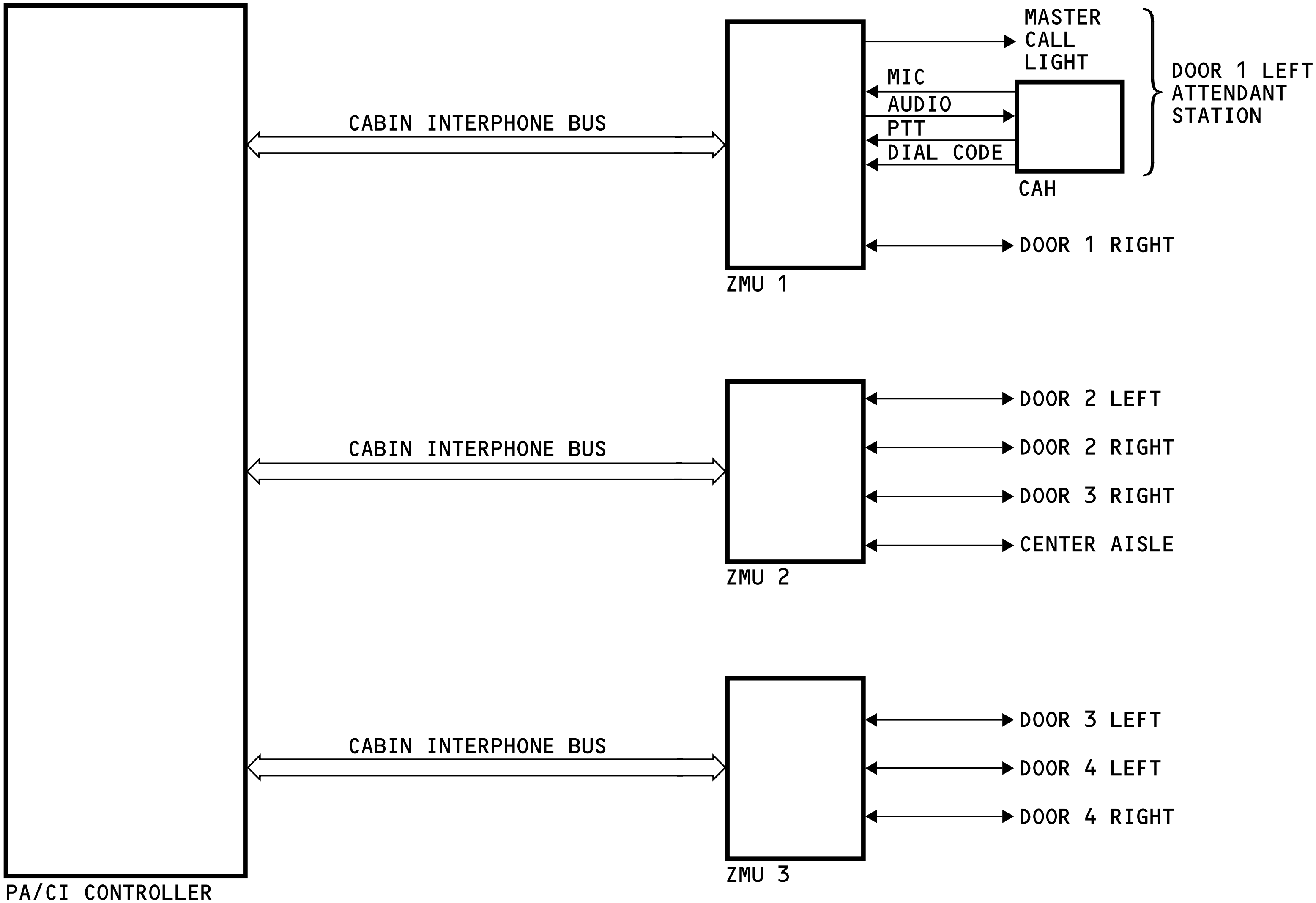
ZMU Interfaces

ZMU 1 gets microphone audio and dial codes from the CAH at door 1 left. It also gets a PTT for passenger address announcements. The ZMU digitizes the inputs and sends the data to the PA/CI controller.

The PA/CI controller makes the internal connection between the calling CAH and the called CAH. It sends the digital audio to the applicable ZMU. The ZMU changes the audio back to analog and sends it to the CAH.

The PA/CI controller also sends data to the ZMU. An incoming call makes the master call light at door 1 left come on.

The interfaces for other CAHs operate in the same way as the door 1 left interface.



NOTE: ALL ATTENDANT STATION INTERFACES ARE SIMILAR TO DOOR 1 LEFT

CIS - ZMU INTERFACES

CIS - CABIN ATTENDANT HANDSET/FLIGHT DECK HANDSET

Purpose

The crew uses cabin attendant handsets (CAH) and the flight deck handset (FDH) to speak with each other. They also use them to make an announcement on the passenger address system.

Physical Description

The CAH and the FDH are the same.

The CAH/FDH is like a telephone handset. It has these features:

- Earpiece
- Microphone
- Standard 12 digit keypad
- Reset switch.

It also has a PTT switch for use with the passenger address system.

The back of each handset has a directory that shows all the dial codes.

Location

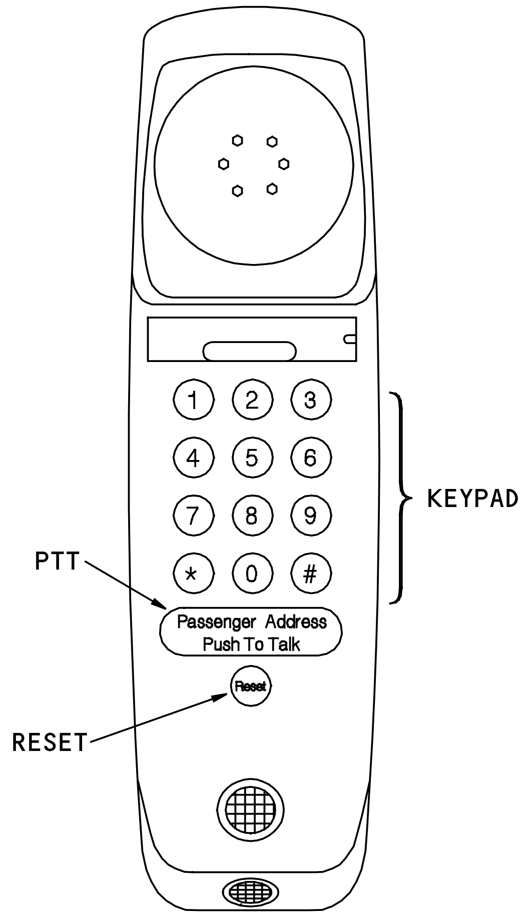
There is a CAH on the attendant seat at each door. The FDH is on the aisle stand in the flight deck.

Operation

All calls use a two digit dial code. To make a call, push the first key of the code, then push the second.

Functional Description

The CAH/FDH sends and receives analog audio. It also sends dial codes and a PTT signal.



CAH/FDH

23-42-00-008 Rev 0

CIS - CABIN ATTENDANT HANDSET/FLIGHT DECK HANDSET

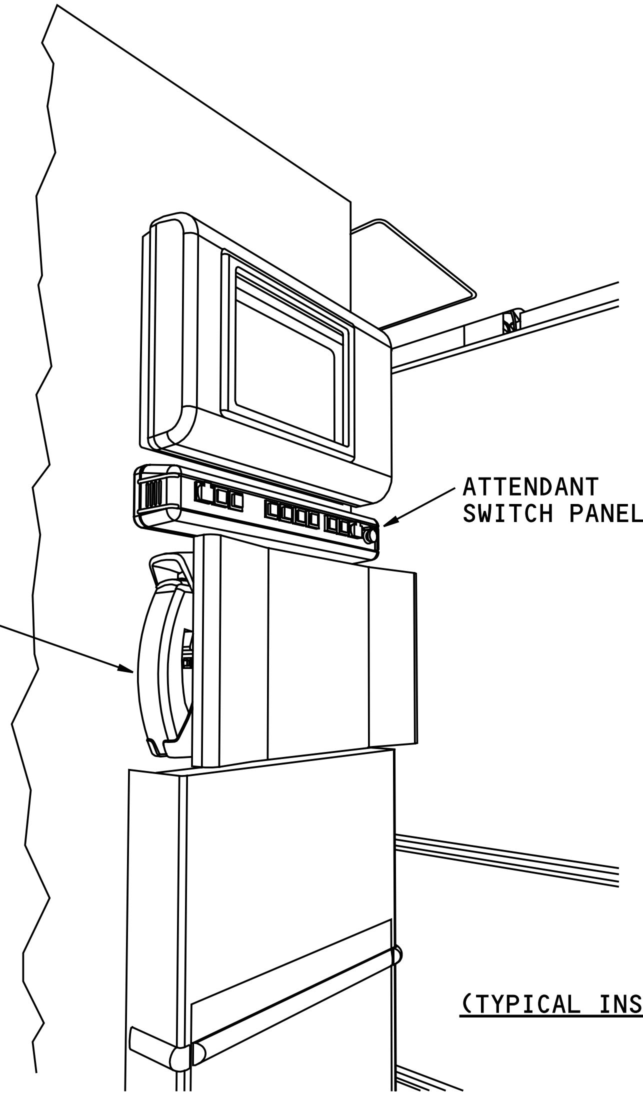
CIS - CAH AND ASP INSTALLATION

Cabin Attendant Handsets

The cabin attendant handsets (CAHs) are at the attendant seats at each door. The cradle and CAH is behind the headrest of the seat.

Attendant Switch Panel

The attendant switch panel (ASP) is at door 2 left. It has the cabin interphone normal/alternate switch on it.

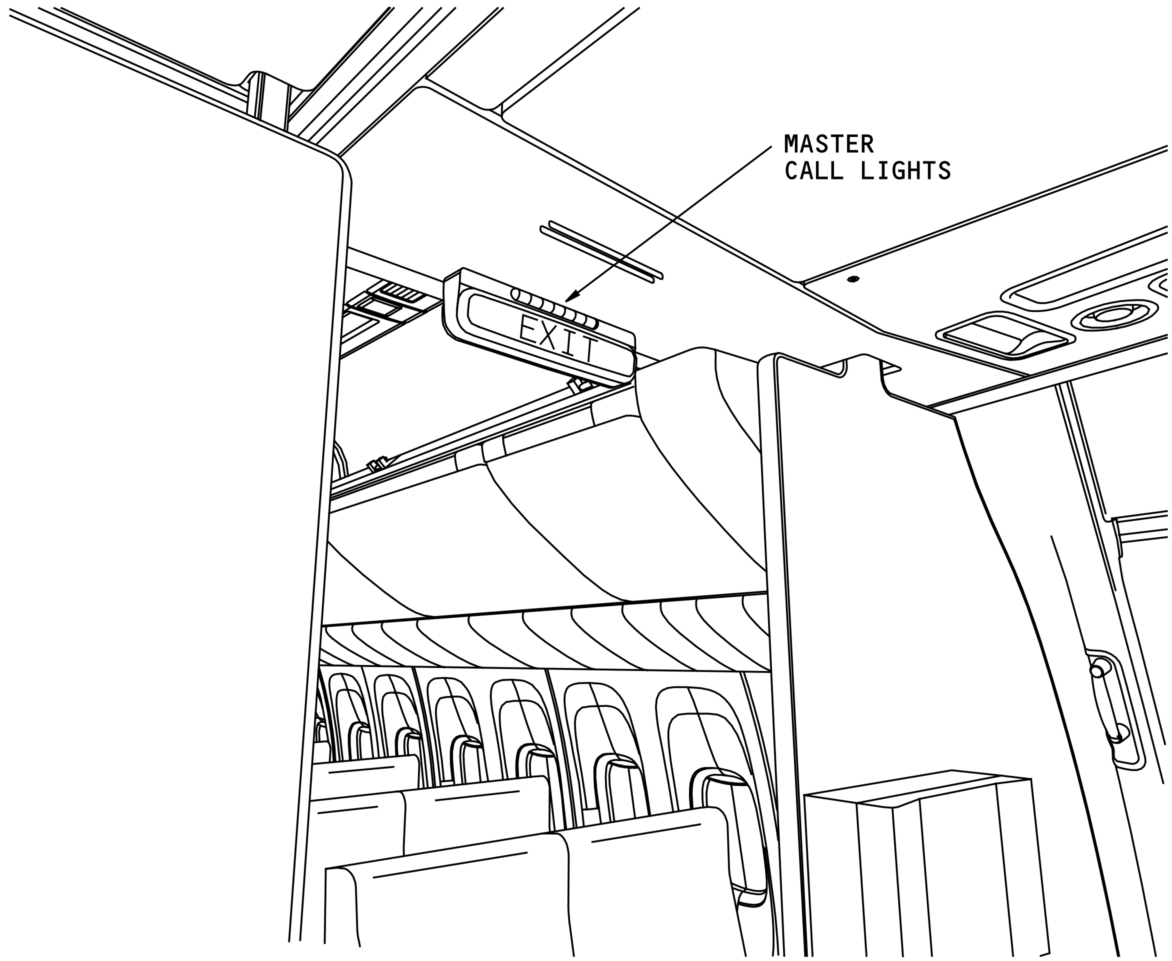


CIS - CAH AND ASP INSTALLATION

CIS - MASTER CALL LIGHTS

Operation

When an attendant gets a cabin interphone call, a pink master call light comes on. The call light is on the EXIT sign module near the station that gets the call.



CIS - MASTER CALL LIGHTS

CIS - CABIN INTERPHONE FAILURE MESSAGE

General

Each cabin interphone controller (CIC) of the PA/CI controller monitors its internal operation. If it finds a failure, it sends a message to the cabin system control panel (CSCP) and the cabin area control panels (CACPs). The CSCP and all the CACPs show a pop up window.

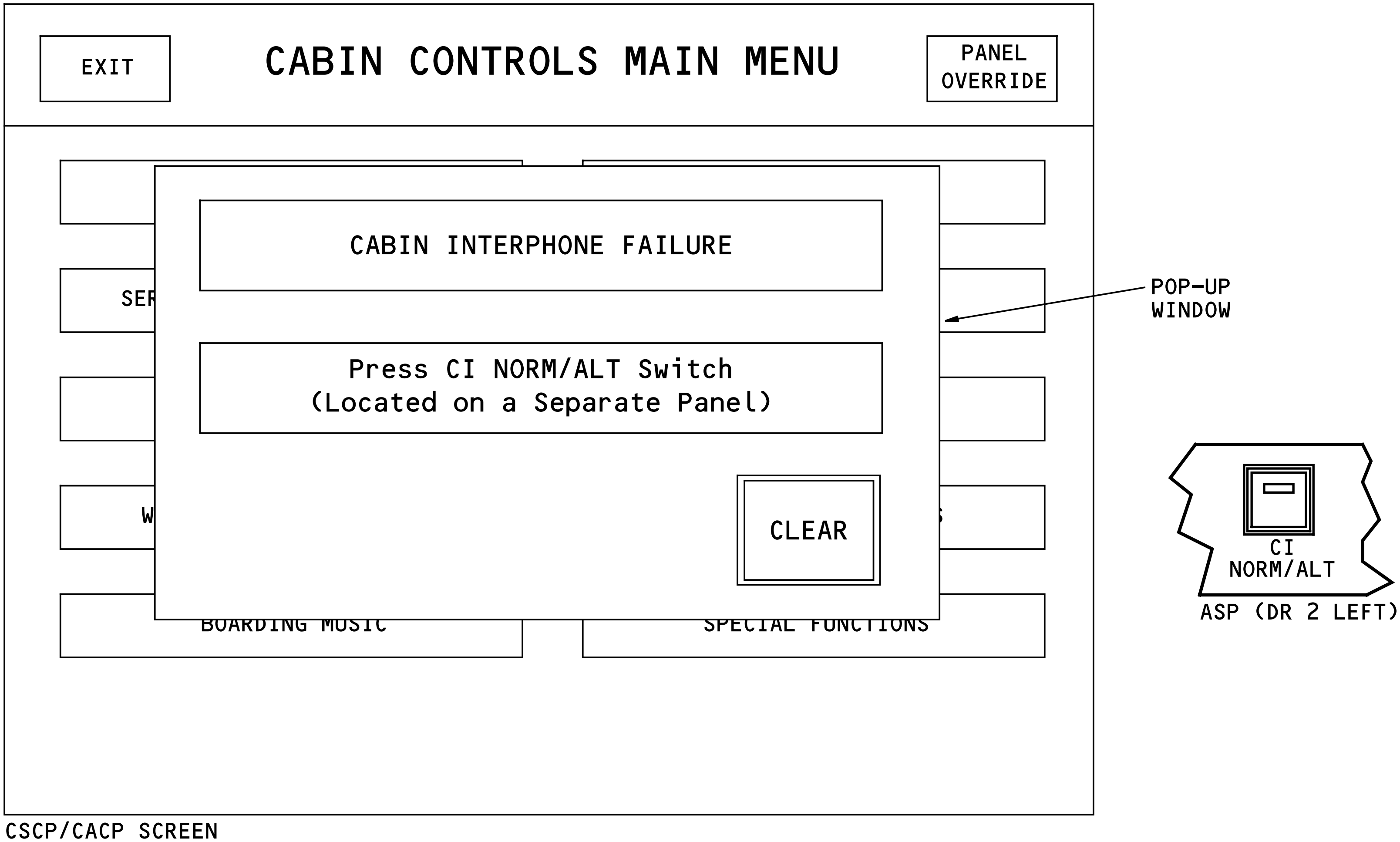
Message

The pop up window tells the flight attendants to push the CI NORM/ALT switch.

To clear the window, touch CLEAR or push the CI NORM/ALT switch. The CI NORM/ALT switch is on the attendant switch panel at door 2 left.

If you touch CLEAR and do not push the CI NORM/ALT switch, the CSCP and CACPs show this message at the bottom of the screen - CABIN INTERPHONE FAILURE Press CI NORM/ALT Switch. The message goes away when you push the CI NORM/ALT switch.

The CIC also sends a message to the AIMS for both EICAS and the central maintenance computing function (CMCF).



23-42-00-011 Rev 6 11/27/1996

CIS - CABIN INTERPHONE FAILURE MESSAGE

CIS - NORMAL/ALTERNATE CIC FUNCTIONAL DESCRIPTION

General

The PA/CI controller has two cabin interphone controllers (CICs), normal and alternate. Only one CIC operates at a time. If the normal CIC fails, the flight attendants select the alternate CIC. They do this from a switch on the attendant switch panel (ASP).

The interfaces to both CICs are the same.

Operation

The CI NORM/ALT switch is an alternate action switch. It sends a discrete signal to the cabin system management unit (CSMU).

During normal operation, the switch signal goes through a switch in the CSMU to the PA/CI controller. When you install software or test the system, the CSMU controls the selection of normal or alternate CIC.

Normal CIC

With the switch in the normal position, an open signal goes to the PA/CI controller. This causes the PA/CI to use the normal CIC. The alternate CIC is off.

Alternate CIC

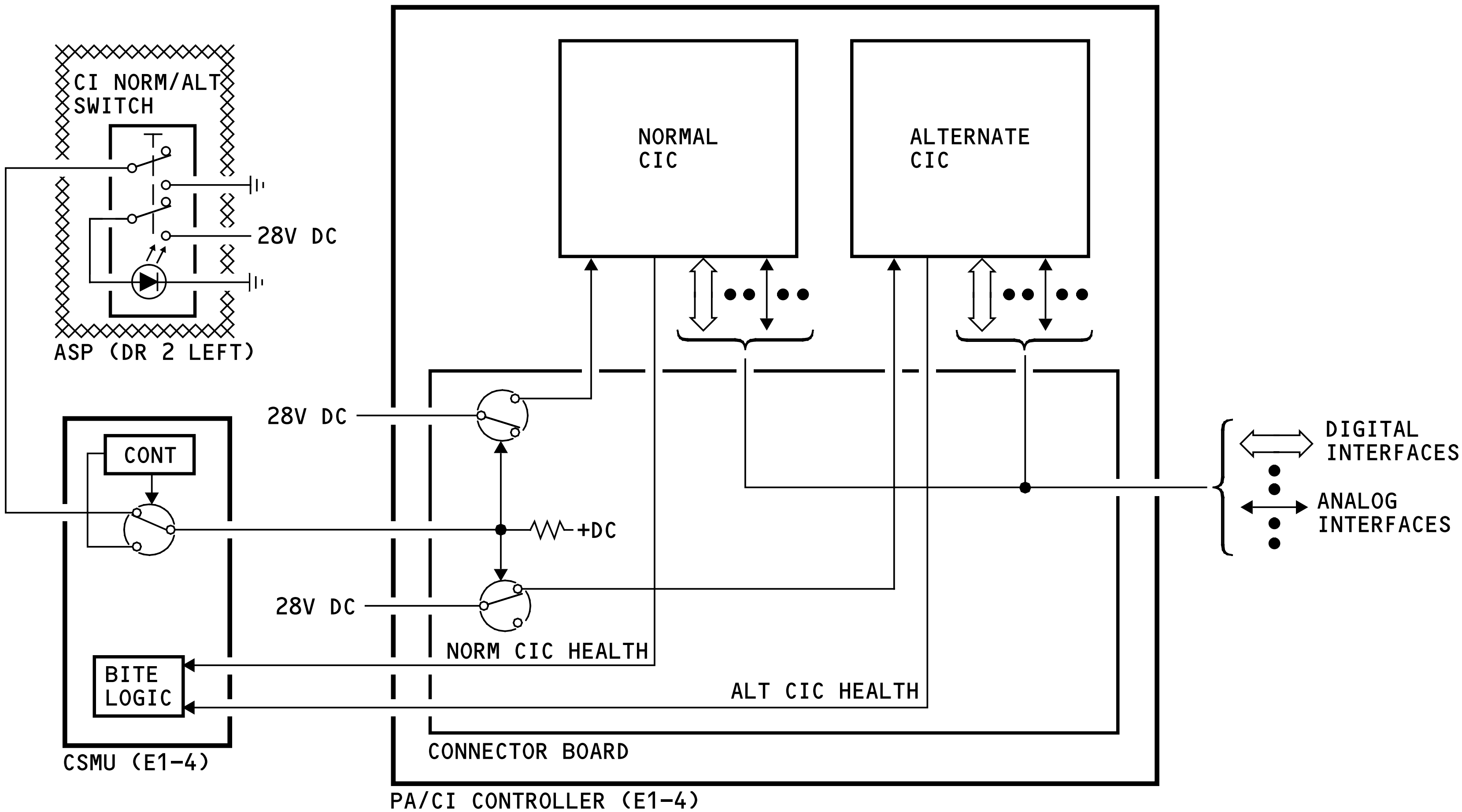
When you push the switch in, a ground signal goes to the PA/CI controller. The LED in the switch comes on. A ground signal causes the PA/CI controller to use the alternate CIC. The normal CIC is off.

Health Signals

Both CICs monitor their operation. Each CIC sends a health discrete to the CSMU. If the CIC finds a failure, it sets the health discrete. The CSMU sends a message to the CSCP and CACPs. The CSMU also sends a signal to the AIMS.

Training Information Point

Because only one CIC operates at a time, you can use the CI NORM/ALT switch to help isolate cabin interphone system problems. If the problem goes away when the other CIC is active, the problem is in the PA/CI controller.



23-42-00-012 Rev 10 10/21/96

CIS - NORMAL/ALTERNATE CIC FUNCTIONAL DESCRIPTION

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CIS - ZMU AND CAH FUNCTIONAL DESCRIPTION

General

The zone management units (ZMUs) supply an interface between the passenger address/cabin interphone (PA/CI) controller and the cabin attendant handsets (CAHs). The ZMUs also control the master call lights.

Each ZMU can connect to as many as five CAHs.

Zone Management Unit

The ZMU has circuits for the CIS. The ZMU digitizes CAH mic audio and changes PA/CI controller call audio to analog.

The ZMU receives data and digital audio from the PA/CI controller. The EIA-485 interface sends the digital audio to the multiplexer/demultiplexer. The multiplexer/demultiplexer isolates the different channels of audio. It sends each channel to the applicable CAH interface.

The CAH interface has a digital to analog (D/A) converter that changes the digital audio to analog. The CAH interface sends the analog signal to the CAH.

The CAH sends mic audio to the ZMU. The CAH interface has an analog to digital (A/D) converter that digitizes the audio signal. The digital signal goes to the multiplexer. The CAH interface also supplies the bias voltage for the CAH microphone.

The CAH sends dial codes and a PTT to the ZMU. The CAH interface has a PTT/dial code interface that digitizes the inputs. It sends the data to the multiplexer/demultiplexer.

The multiplexer/demultiplexer adds the signals together and sends it to the EIA-485 interface. The EIA-485 interface sends it to the PA/CI controller.

Each ZMU connects to one CAH that supplies a direct access input to the passenger address system. Normally the mic audio and PTT go through the direct access relay to the CAH interface. The direct access function sends the mic and PTT to the passenger address system.

Master Call Lights

The ZMU controls the master call lights. The EIA-485 interface isolates call light on/off data from the PA/CI controller. The EIA-485 interface sends the data to the master call light driver. The master call light driver controls the lights.

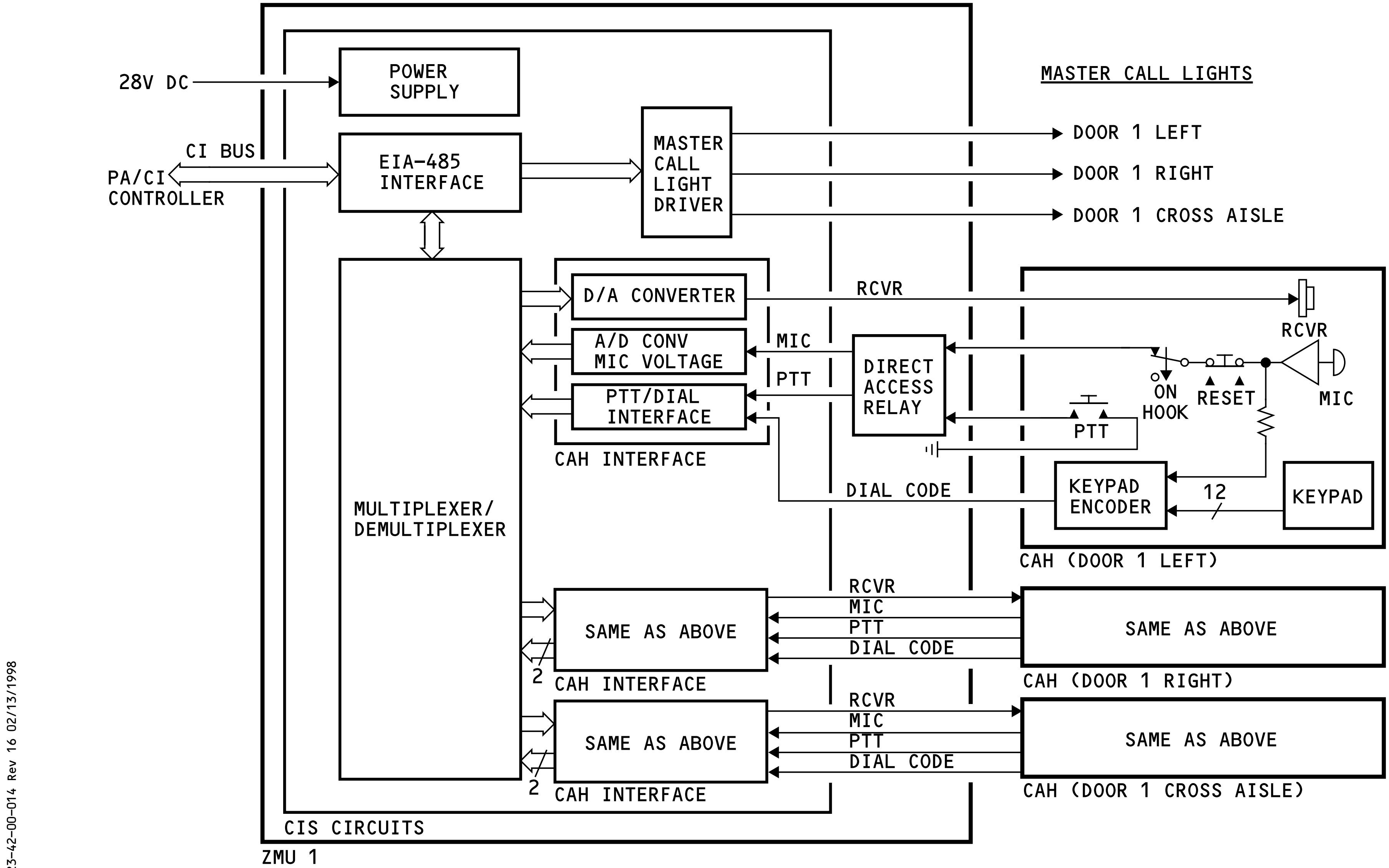
Cabin Attendant Handset

The CAH gets receiver audio from the ZMU. Mic audio goes through an amplifier. It passes through the RESET switch and on-hook switch. The RESET and on-hook switches stop the call.

The PTT sends a ground signal to the ZMU. It is for passenger address announcements.

CIS - ZMU AND CAH FUNCTIONAL DESCRIPTION

The CAH keypad has twelve momentary switches. They send signals to the keypad encoder. The keypad encoder sends dial code signals to the ZMU. The keypad encoder gets power from the mic line.



CIS - ZMU AND CAH FUNCTIONAL DESCRIPTION

CIS - TYPES OF CALLS

General

The CIS has different types of calls between cabin interphone stations. A station is any station with a cabin attendant handset (CAH) or the flight deck handset (FDH). The flight crew can also use the flight interphone system for CIS calls.

Call Types

The CIS has these three basic types of calls:

- Pilot alert call
- Conference call
- Station-to-station call.

Pilot Alert

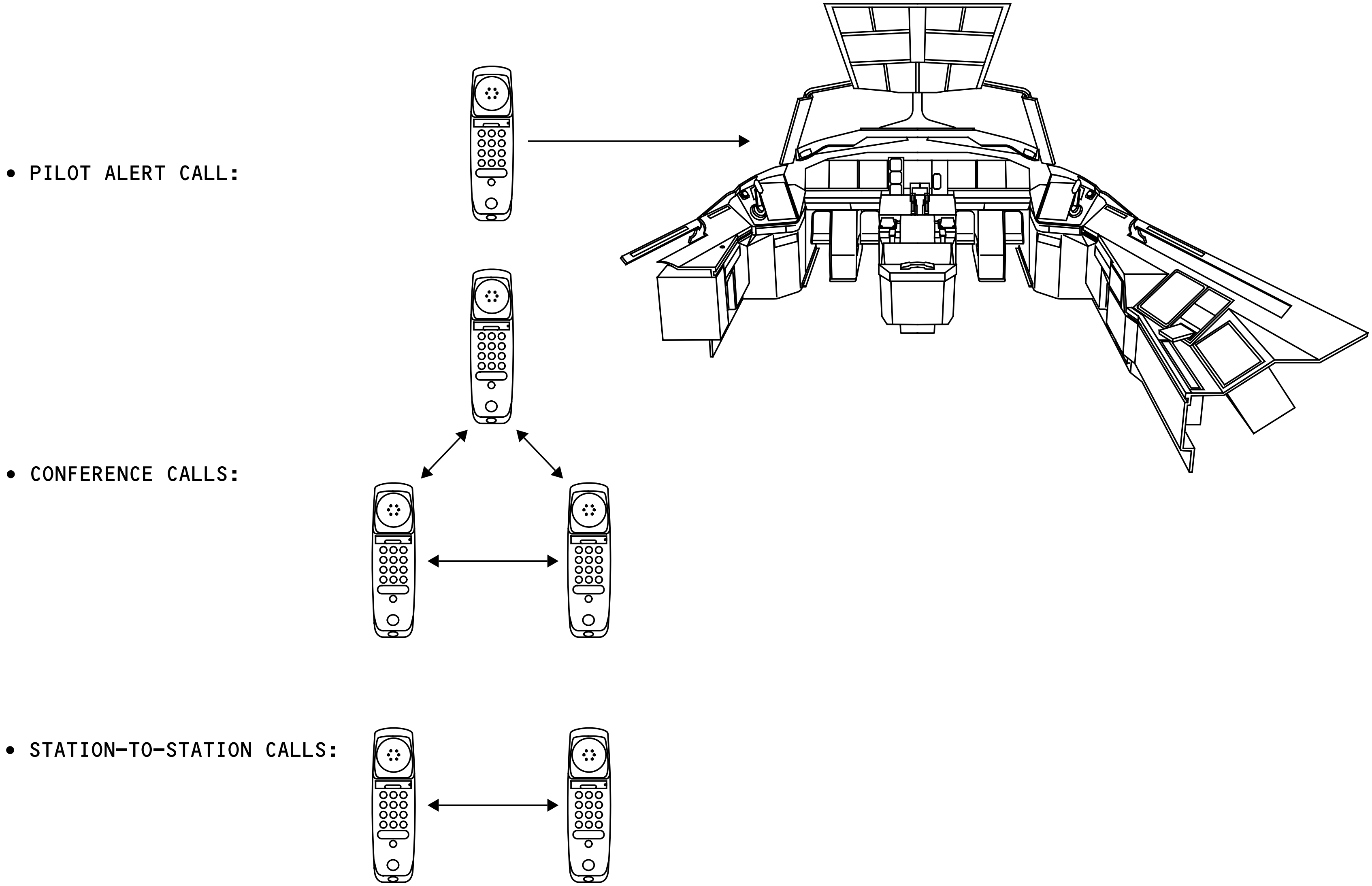
The flight attendants use the pilot alert call to tell the flight crew about an emergency. A pilot alert replaces all other calls to the flight deck. Any CAH can make a pilot alert call.

Conference Calls

A conference call connects a group of stations in one CIS call. The stations connect to the same line. Each conference call has one dial code for all stations included in the conference call.

Station-to-Station Calls

A station-to-station call is a normal two way call. Any station can make a call to any other station with a two digit dial code. Once you make a station-to-station call, you can add one or two more stations to the connection.



23–42–00–015 Rev 0

CIS – TYPES OF CALLS

CIS - DIAL CODES

General

The flight crew and flight attendants use two digit dial codes to make cabin interphone calls.

Station to Station Calls

Most station-to-station codes relate the location of the handset to the code.

To call the handset, push the first dial code key then the second for the station.

Conference Calls

Conference calls include a set number of stations. The configuration database identifies the stations.

To make a conference call, push the first dial code key then the second. The call can come from any handset.

Passenger Address Codes

The passenger address codes are for passenger address announcements.

Pilot Calls

The pilot call codes are for calls from the cabin to the flight deck.

The ground crew code is only for the flight crew to call the ground crew.

Land Line Calls

The external power and gate link panel has two telephone jacks. If you connect a local telephone network to a jack, you can access the network by dialing *9. With the system connected to a telephone network, you use the handset like a telephone.

Configuration Database

The configuration database identifies all types of calls and their dial codes. The configuration database also enables or disables the landline calls.

DOORS - LEFT

DOOR 1 LEFT - 11
DOOR 2 LEFT - 12
DOOR 3 LEFT - 13
DOOR 4 LEFT - 14

DOORS - RIGHT

DOOR 1 RIGHT - 21
DOOR 2 RIGHT - 22
DOOR 3 RIGHT - 23
DOOR 4 RIGHT - 24

CONFERENCE CALLS

CONFERENCE CALL 1 - 71
CONFERENCE CALL 2 - 72
CONFERENCE CALL 3 - 73
CONFERENCE CALL 4 - 74
CONFERENCE CALL 5 - 75
ATTENDANT ALL CALL - 54
ALL CALL - 55

PASSENGER ADDRESS CODES

PA AREA 1 - 41
PA AREA 2 - 42
PA AREA 3 - 43
PA AREA 4 - 44
PA AREA 5 - 45
PA AREA 6 - 46
PA ALL AREA - 40
PA PRIORITY ALL AREA - 47

PILOT CALLS

FLIGHT DECK - 31
PILOT ALERT - **
CABIN READY - 6*

OTHER CALLS

GROUND CREW - *1

LANDLINE CALLS

LANDLINE - *9

23-42-00-016 Rev 2

TYPICAL

CIS - DIAL CODES

CIS - FLIGHT DECK CONTROLS

General

The flight crew can use either the flight deck handset (FDH) or flight interphone system to connect to the CIS. The FDH is the same as the cabin attendant handsets.

To use the flight interphone system, select CAB on an audio control panel (ACP). Use the center control display unit (CDU) to select dial codes and receive CIS messages.

Audio Control Panel

The cabin interphone transmitter select switch connects the crew member to the CIS.

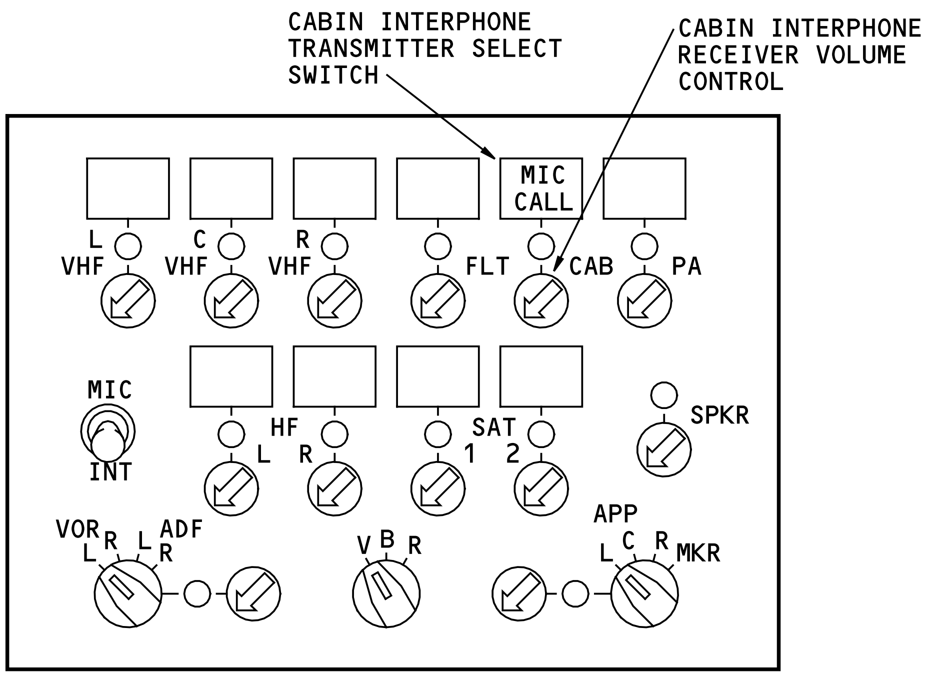
When a call comes to the flight deck, the ACP CALL light comes on. To answer the call, push the cabin interphone transmitter select switch. This also causes the CALL light to go off. The cabin interphone receiver volume control sets the volume.

To make a call, push the cabin interphone transmitter select switch. Then use the center CDU to select a dial code.

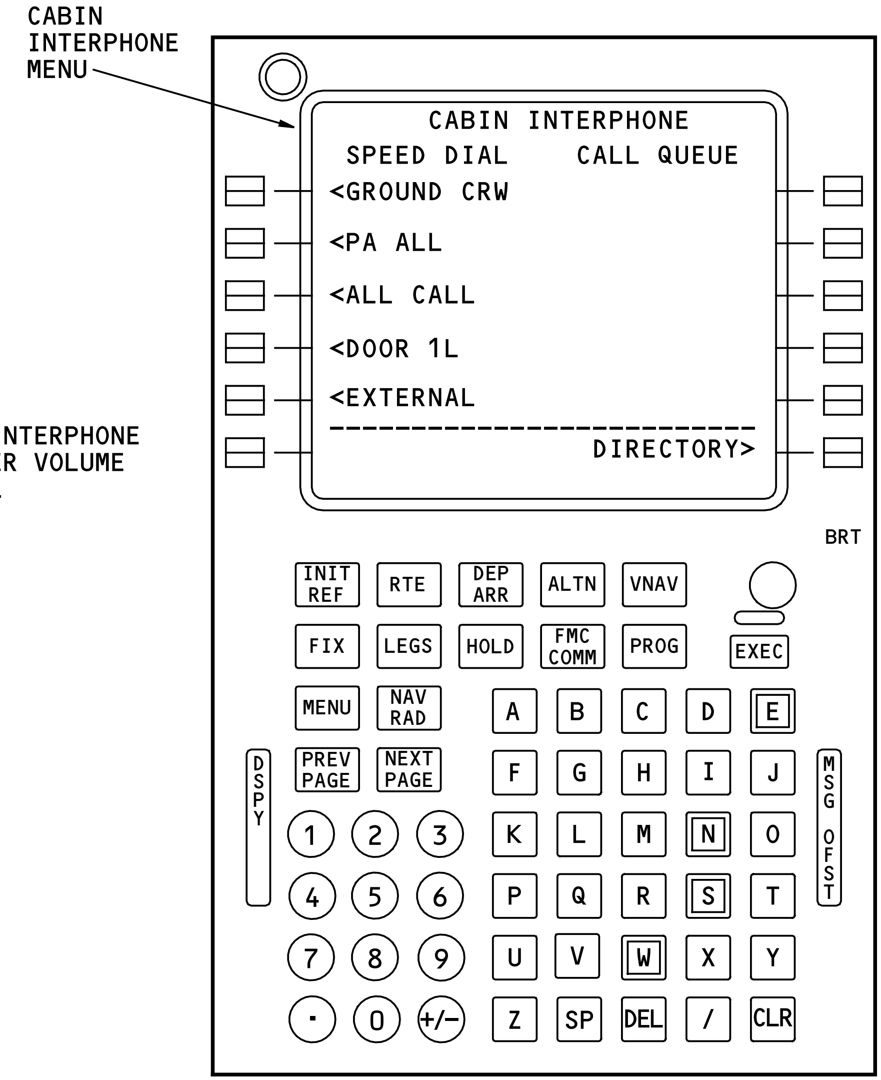
Push the cabin interphone transmitter select switch two times in one second to make a call to door 1 left.

Center Control Display Unit

Flight crew uses the center CDU to select dial codes. It also shows directories and incoming call data.



AUDIO CONTROL PANEL



CENTER CONTROL DISPLAY UNIT

CIS - FLIGHT DECK CONTROLS

23-42-00-021 Rev 2 03/18/96

CIS - CDU OPERATION - CABIN INTERPHONE MENU

General

The flight crew can use the center control display unit (CDU) to operate the CIS. The center CDU also shows CIS call data.

To show the cabin interphone menu, push the line select key (LSK) next to <CAB INT on the CDU menu.

The configuration database identifies all the selections on the cabin interphone CDU pages.

Cabin Interphone Menu

The cabin interphone menu has different selections. LSKs 1 left through 5 left are for speed dial selections. LSKs 1 right through 5 right are for stored messages. Use LSK 6 left to make a call. LSK 6 right selects the directory.

Speed Dial

The flight crew uses the speed dial selections to make a call. To make a call, push the LSK next to the call selection.

Send

The flight crew can make a call to any station from the cabin interphone menu. To call a station, push the station code numbers on CDU keys. The dial code and station shows in the scratch pad. <SEND shows next to LSK 6 left. Push LSK 6 left to make the call.

Call Queue

The call queue shows calls that came to the flight deck while the line was busy. The CDU shows the station that made the call. When the current call is over, the flight crew can call the station back. They push the LSK next to the stored message to make the call.

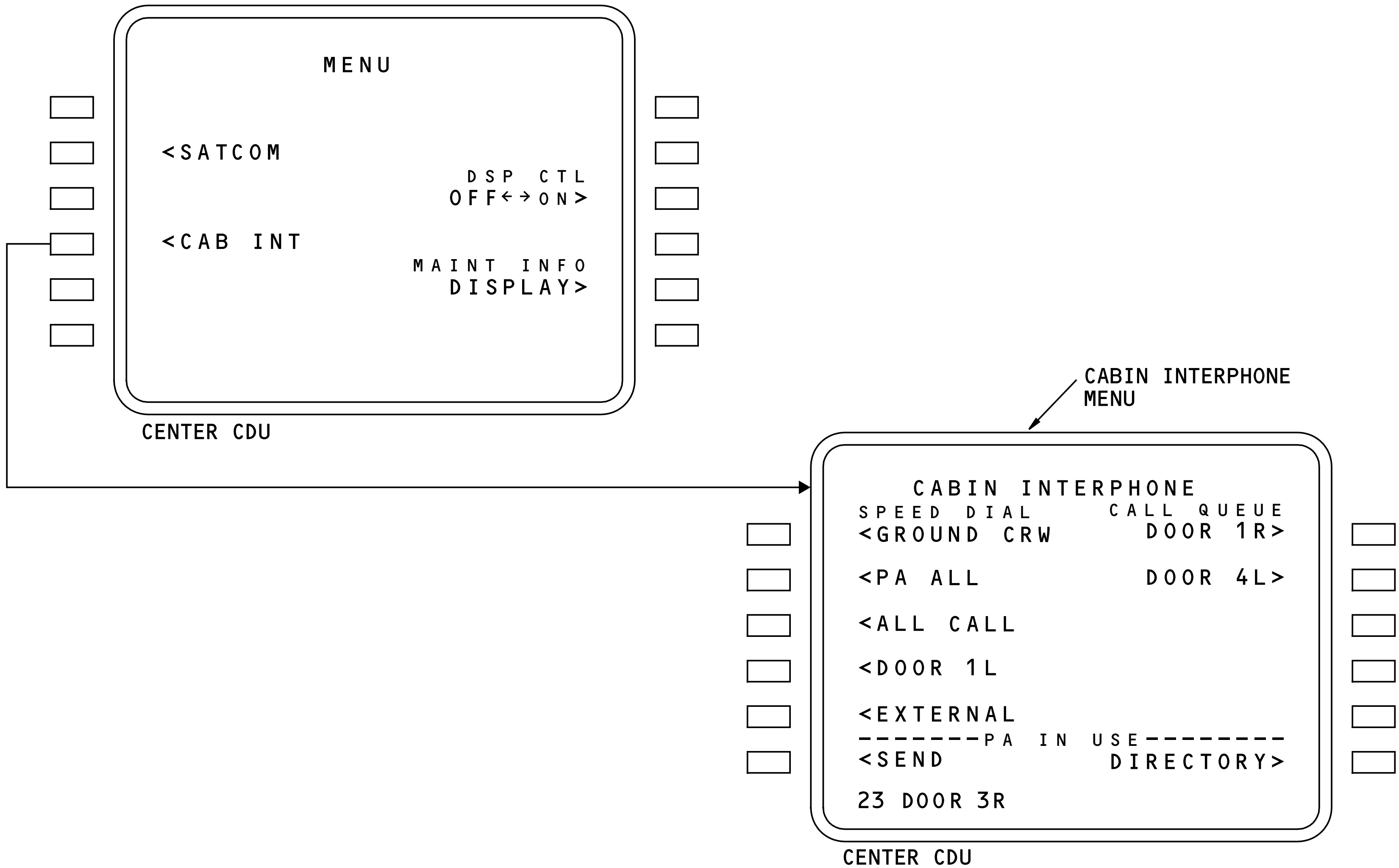
If more than one call goes to the flight deck while the line is busy, the CDU shows them in the call queue. The first message shows at LSK 1 right. The second message shows at LSK 2 right, and so on.

PA/Video In Use

The cabin interphone pages on the CDU show passenger address and video system activity. When the passenger address system is in use, PA IN USE shows above the scratch pad. When the video system is on, VIDEO IN USE shows above the scratch pad. When both the passenger address system and the video system are on, PA IN USE shows.

Directory

The directory pages give selections to call other stations. Push LSK 6 right to show the directory.



23-42-00-022 Rev 1 06/21/96

CIS - CDU OPERATION - CABIN INTERPHONE MENU

CIS - CDU OPERATION - MAIN DIRECTORY

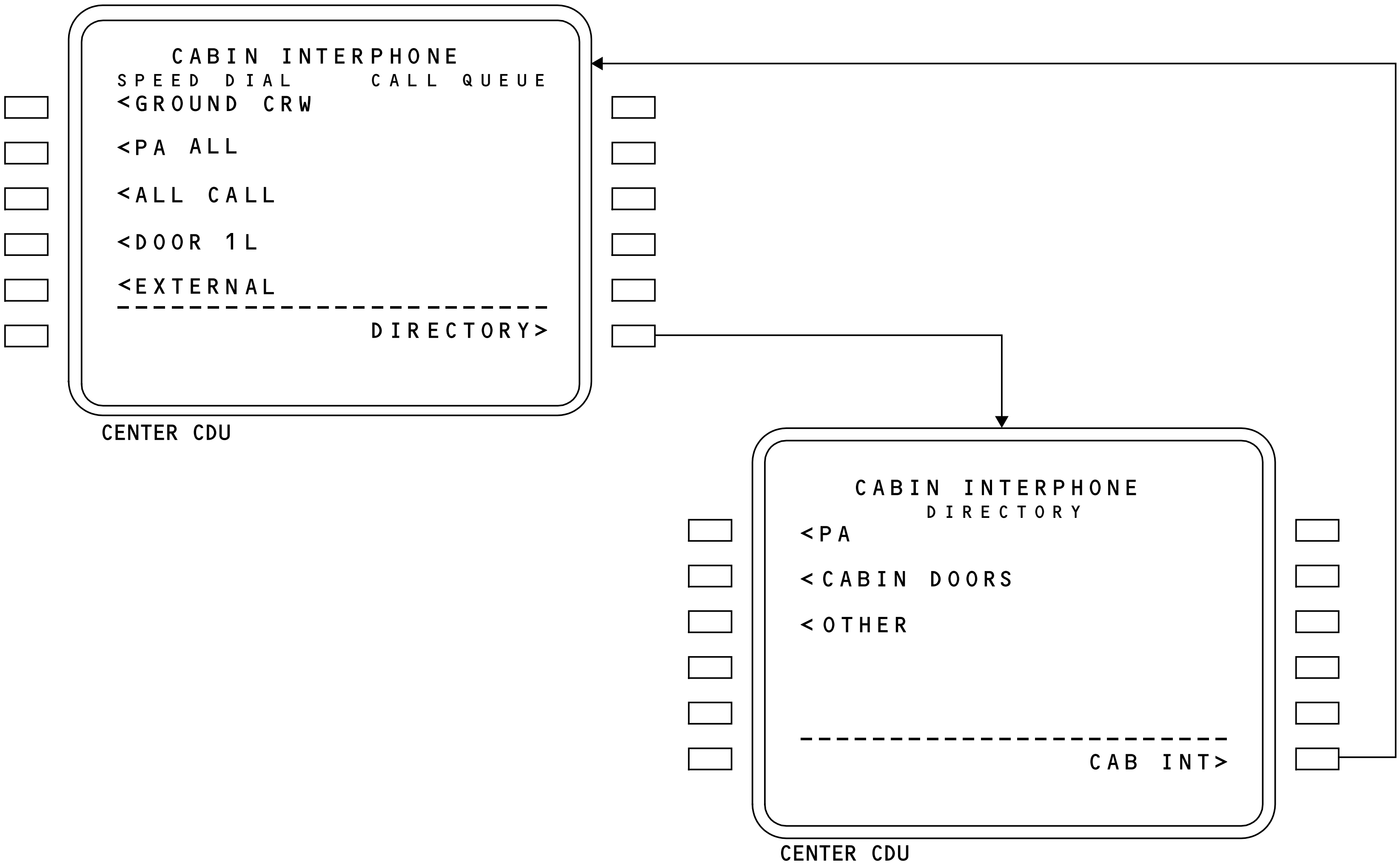
General

The flight crew uses the directory pages to make CIS calls. The main directory gives access to sub-directories.

Main Directory

To show the main directory, push line select key (LSK) 6 right on the cabin interphone menu. To show a sub-directory, push the LSK next to the applicable directory title.

To return to the cabin interphone menu, push LSK 6 right.



23-42-00-023 Rev 1 06/21/96

CIS - CDU OPERATION - MAIN DIRECTORY

CIS - CDU OPERATION - DOORS SUB-DIRECTORY

General

The flight crew uses the doors sub-directory to make station-to-station calls to handsets at the cabin doors.

Directory Access

To show the cabin doors sub-directory, push line select key (LSK) 2 left.

The other directories operate in the same way.

Push LSK 6 right to return to the cabin interphone menu.

23-42-00-024 Rev 2 07/08/1997

CIS - CDU OPERATION - DOORS SUB-DIRECTORY

CIS - CONFIGURATION DATABASE PROGRAMMED ITEMS

General

The CMS configuration database supplies details of CMS operation. For the CIS, the database gives configuration data for:

- Cabin attendant handsets (CAHs)
- Dial codes
- Conference calls
- Chimes
- Call lights
- CDU selections.

Cabin Attendant Handsets

The configuration database identifies the number of CAHs. It also supplies the location of each handset.

Dial Codes

The configuration database identifies the dial code for each station. It also identifies the dial code for conference calls and special function calls.

Conference Calls

The configuration database identifies the stations included in each conference call. A conference call has two or more stations on the same call. The call uses one dial code that can come from any station. The CIS can have as many as ten conference calls.

Chime Types and Count

The configuration database identifies the chime type and number of chimes for each type of call. When a station receives a call, it normally gets a single high-low chime. Special calls, such as an all call, may use different chimes. The station can get more than one chime. It can also get low-high chimes, instead of high-low chimes.

Call Lights

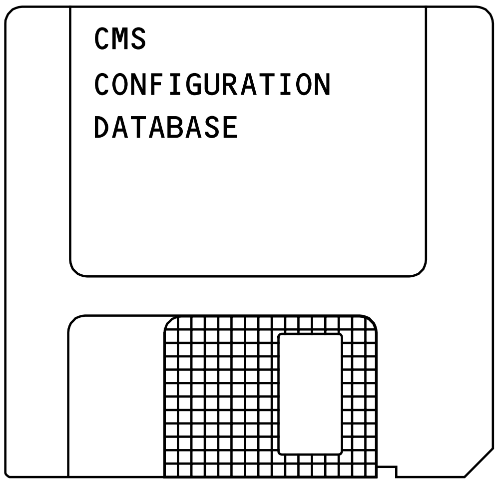
The configuration database identifies the flashing or non-flashing condition of call lights for each type of call. When a station receives a call, it normally gets a non-flashing call light. Special calls, such as an all call, may use a flashing call light.

CDU Selections

The configuration database identifies the selections available on the center control display unit (CDU). It identifies the calls that have a speed dial on the cabin interphone menu. It also supplies the selections on the directory page and sub-directory pages.

Priority Line Connection

When the flight crew pushes the CAB button twice on their audio control panel, they make a call to the priority station. The configuration database identifies where the call goes.



- NUMBER AND LOCATION OF CAH(S)
- DIAL CODES
- CONFERENCE CALLS
- CHIME TYPES AND COUNT
- FLASHING OR NON-FLASHING CALL LIGHTS
- CDU SELECTIONS
- PRIORITY LINE CONNECTION

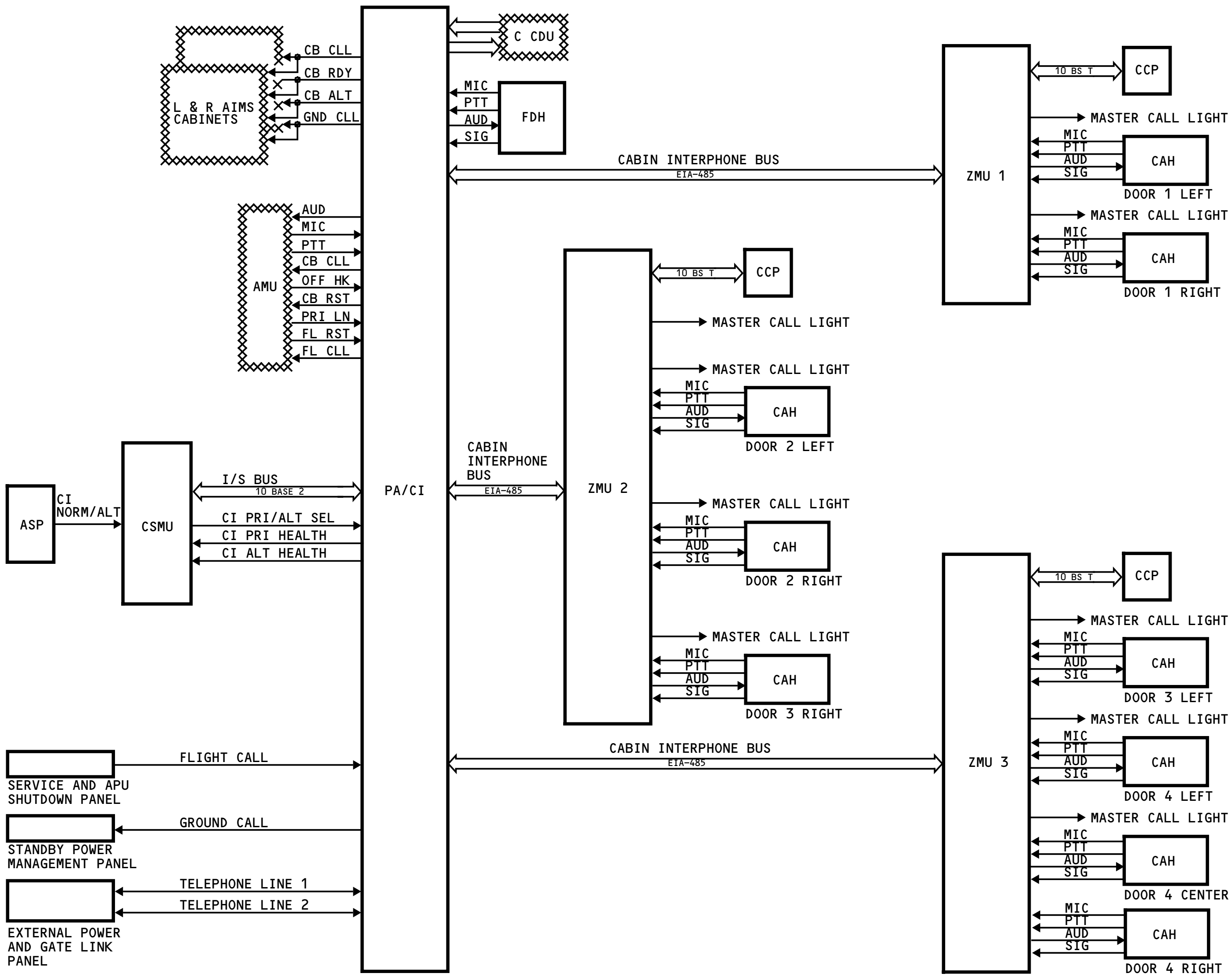
23-42-00-025 Rev 1

CIS - CONFIGURATION DATABASE PROGRAMMED ITEMS

CIS - INTERFACE DIAGRAM

Interface Diagram

This interface diagram is for reference purposes.



CIS - INTERFACE DIAGRAM

CIS - CABIN TESTS

General

Use the cabin system control panel (CSCP) to do the cabin test for the cabin interphone system (CIS).

See the cabin services system (CSS) section for more information about tests (AMM PART I 23-39).

Quick Test

Use quick test to quickly find major faults. This test checks these CIS components:

- Passenger address/cabin interphone (PA/CI) controller
- Zone management units (ZMUs).

This test collects continuous monitor data for as long as 20 seconds. The CSCP shows the failures.

To start a quick test, touch START QUICK TEST.

All Test

Use all test for a more complete test. All test starts a complete BITE of the system. The screen shows all the failures the BITE finds.

To start an all test, touch START ALL TEST.

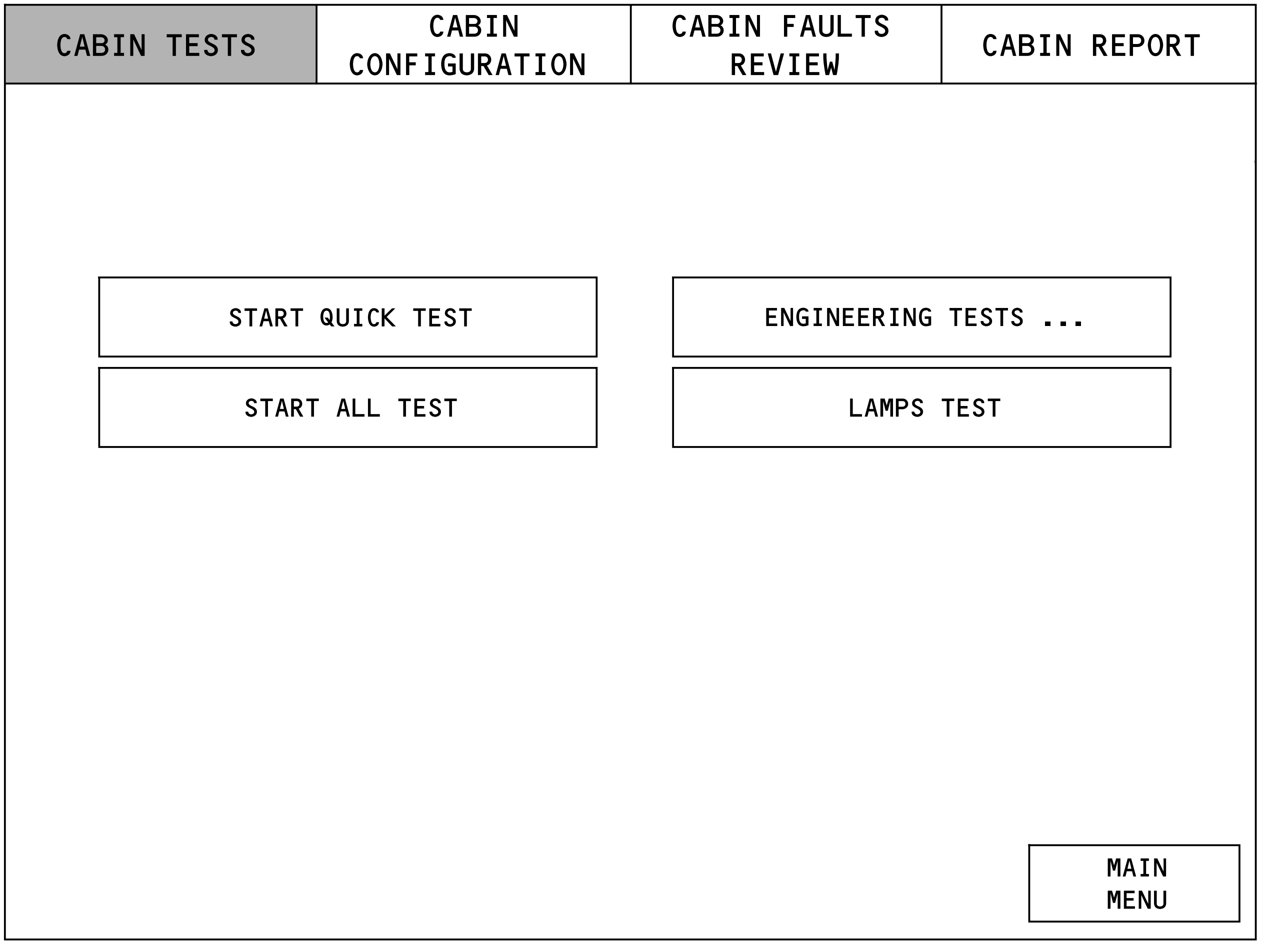
Engineering Tests

Use engineering tests for more detailed tests.

Touch ENGINEERING TESTS to show the engineering tests menu.

Lamps Test

The lamps test does not test the CIS.



CABIN SYSTEM CONTROL PANEL

23-42-00-028 Rev 1 02/25/1997

CIS - CABIN TESTS

Continental Airlines, Inc

Passenger Address System

WB371

TABLE OF CONTENTS

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PASSENGER ADDRESS SYSTEM - INTRODUCTION

Purpose

The passenger address system (PAS) lets the crew send announcements and other audio to the passenger cabin.

Announcement Types

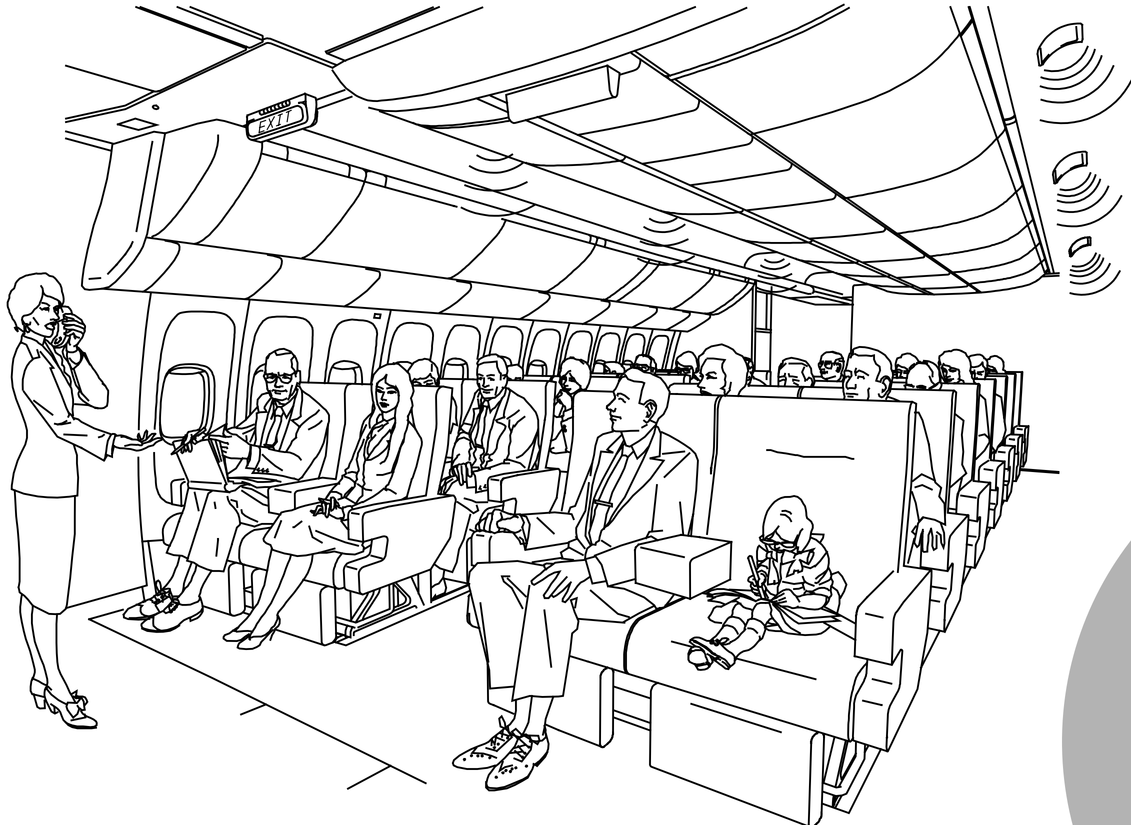
The PAS sends these types of audio to the cabin:

- Flight crew announcements
- Flight attendant announcements
- Recorded announcements
- Video system audio
- Boarding music.

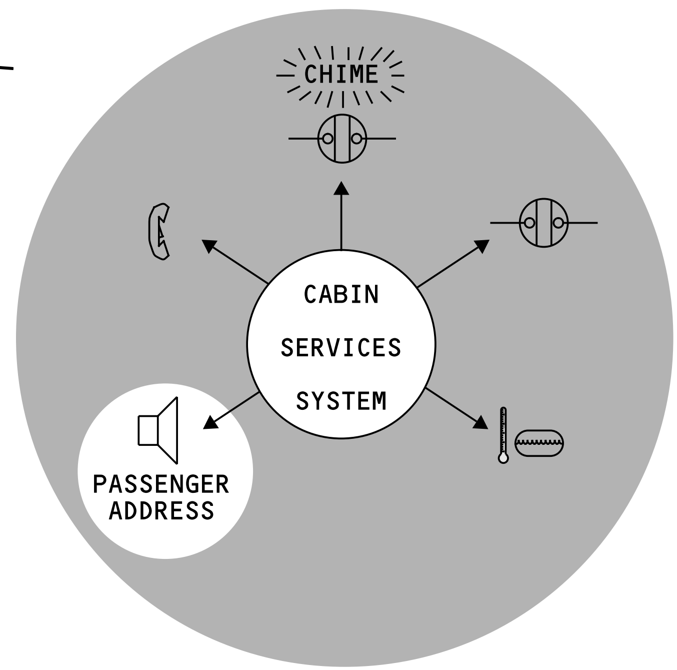
The PAS also makes chime sounds.

Abbreviations and Acronyms

AIMS	- airplane information management system
AMU	- audio management unit
ANS	- ambient noise sensor
ASG	- ARINC signal gateway
ASP	- attendant switch panel
BGM	- boarding music
CACP	- cabin area control panel
CAH	- cabin attendant handset
CCP	- cabin control panel
CIS	- cabin interphone system
CMCF	- central maintenance computer function
CSCP	- cabin system control panel
CSMU	- cabin system management unit
CSS	- cabin services system
FCR	- flight crew rest
FSEU	- flap/slat electronics unit
IFE	- in-flight entertainment
LLAR	- lower lobe attendants rest
NVM	- nonvolatile memory
OPAS	- overhead panel ARINC 629 system
PA	- passenger address
PA/CI	- passenger address/cabin interphone
PAS	- passenger address system
PRAM	- prerecorded announcement machine
PSEU	- proximity sensor electronics unit
PTT	- push to talk
SDM	- speaker drive module
umb	- umbilical
WES	- warning electronic system
ZMU	- zone management unit



- CREW ANNOUNCEMENTS
- RECORDED ANNOUNCEMENTS
- VIDEO SYSTEM AUDIO
- BOARDING MUSIC
- CHIMES



PASSENGER ADDRESS SYSTEM - INTRODUCTION

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PAS - GENERAL DESCRIPTION

General

The passenger address system (PAS) receives audio inputs and sends them to the passenger cabin. The cabin can have as many as six passenger address areas.

The PAS has interfaces with the in-flight entertainment (IFE) system on ARINC 628 head-end buses for PAS functions.

Components

The PAS uses these components:

- Passenger address/cabin interphone (PA/CI) controller
- Ambient noise sensors (ANSs)
- Speaker drive modules (SDMs)
- Zone management units (ZMUs)
- Cabin attendant handsets (CAHs)
- Cabin speakers.

These other components and systems connect to the PAS:

- Audio management unit (AMU)
- Left systems ARINC 629 bus
- In-flight entertainment (IFE) system
- Cabin system management unit (CSMU)
- Right systems ARINC 629 bus
- Attendant switch panel (ASP)
- Audio entertainment players (AEPs)
- Cabin control panels (CCPs).

Audio Inputs

All passenger address audio goes to the PA/CI controller.

The flight crew uses the flight interphone system to make announcements. The announcement audio goes from the AMU to the PA/CI controller.

The flight attendants use CAHs to make announcements.

Priorities

The PAS has these priorities:

- 1 - From flight interphone system
- 2A - Direct access
- 2B - From cabin interphone system
- 3A - Recorded announcements
- 3B - Video system audio
- 4 - Boarding music.

Audio Outputs

The PA/CI controller selects the audio with the highest priority and digitizes it. It sends the signal to the SDMs. The SDMs change the signal to analog and send it to one or two speakers.

The PA/CI controller also sends the announcement audio to the IFE system. This system then sends the audio over the passenger entertainment system so the passengers hear the announcement on their headphones.

PAS - GENERAL DESCRIPTION

The PAS also makes a chime sound for attendant calls and passenger information signs. The PA/CI controller sends chime signals to the SDMs.

Volume Control

The configuration database gives the normal volume level. The PAS makes automatic adjustments based on either cabin noise level inputs from the ANSs or flight data inputs. In addition, flight attendants use the CCPs to adjust the volume manually.

Pause Signals

When an announcement goes to all areas, the CSMU sends a pause signal to the IFE system.

Other Interfaces

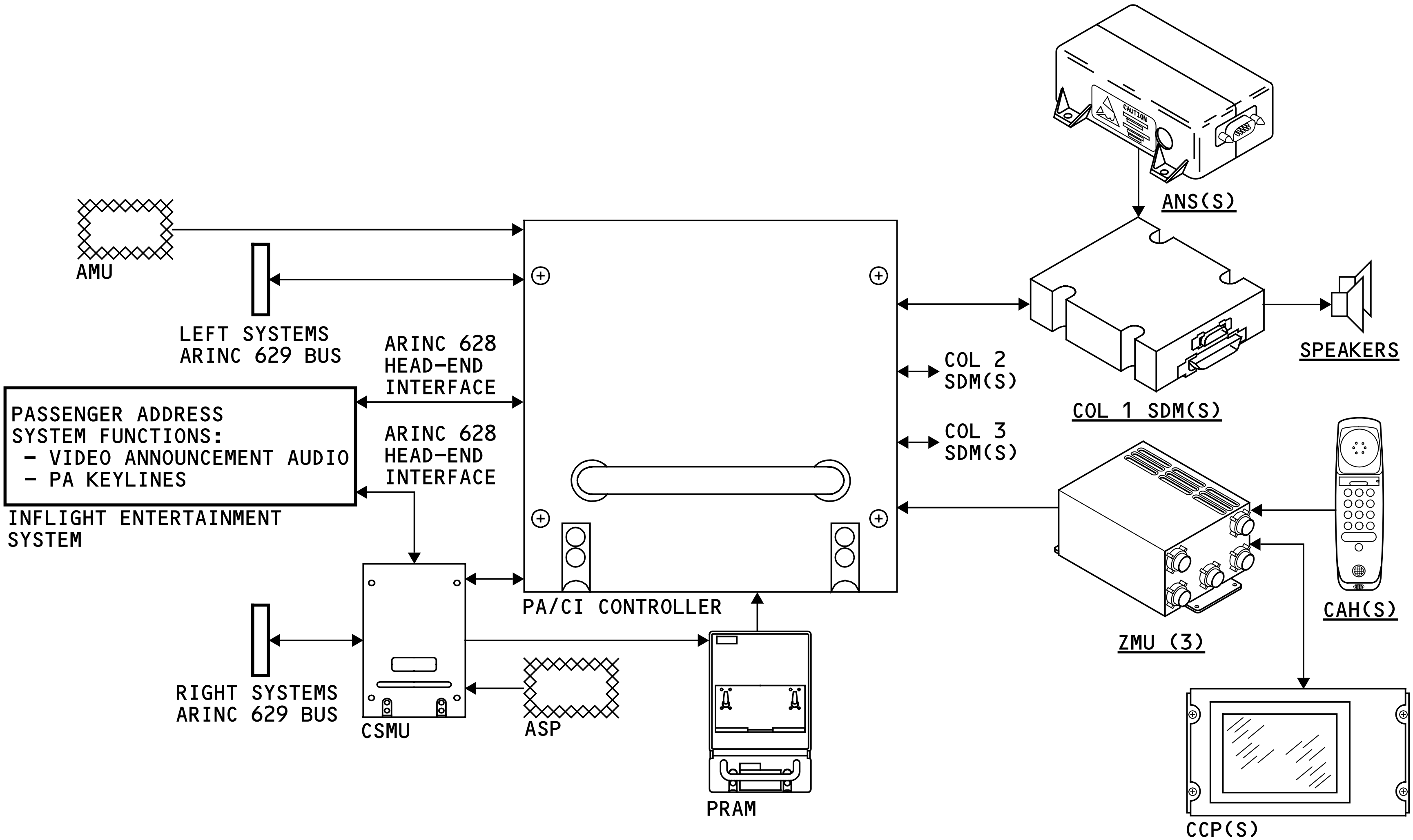
The PA/CI controller has an interface with the left systems ARINC 629 bus. It uses airplane system data to adjust volume and to control chime sounds.

You use the cabin control panels (CCPs) to control the PAS. A CCP operates as a cabin area control panel (CACP) or as a cabin system control panel (CSCP), depending upon it configuration.

The PA/CI controller has an alternate passenger address controller. If there is a failure on the normal passenger address controller, the flight attendants get a message on the cabin control panels (CCPs). The flight attendant pushes a button on the attendant switch panel (ASP) to select the alternate passenger address controller.

The CSMU sends the passenger address controller selection to the PA/CI controller. You use the CSCP to do tests and install software.

The CSMU connects to the IFE system with an ARINC 628 head-end interface. It sends airplane system data and cabin services system (CSS) configuration data to the IFE system.



PAS - GENERAL DESCRIPTION

PAS - COMPONENT LOCATIONS

PAS Components

These are the types of passenger address system (PAS) components in the cabin and crown:

- Speaker drive modules (SDMs)
- Speakers
- Ambient noise sensors (ANSs)
- PA NORM/ALT switch.

There are three columns of SDMs.

These PAS components are in the main equipment center:

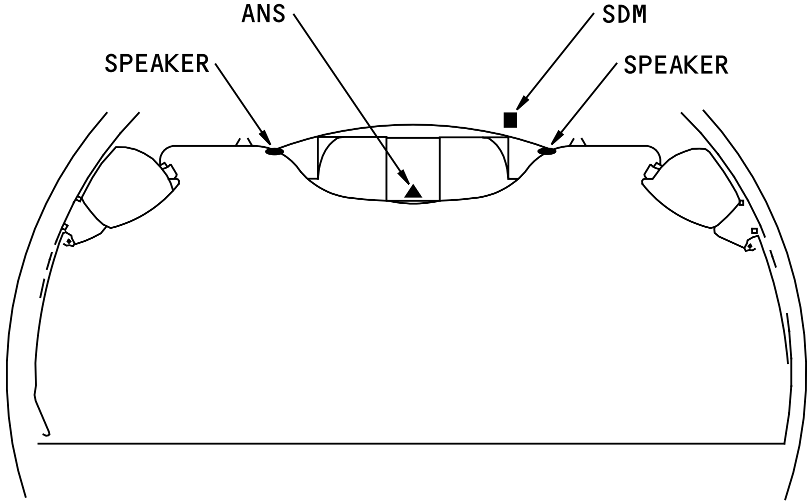
- Passenger address/cabin interphone (PA/CI) controller
- Prerecorded announcement machine (PRAM).

Other Components

These are the other CSS components in the cabin:

- Cabin system control panel (CSCP)
- Cabin area control panels (CACPs).

You find the exact locations of the components with the wiring diagram and functional schematic.



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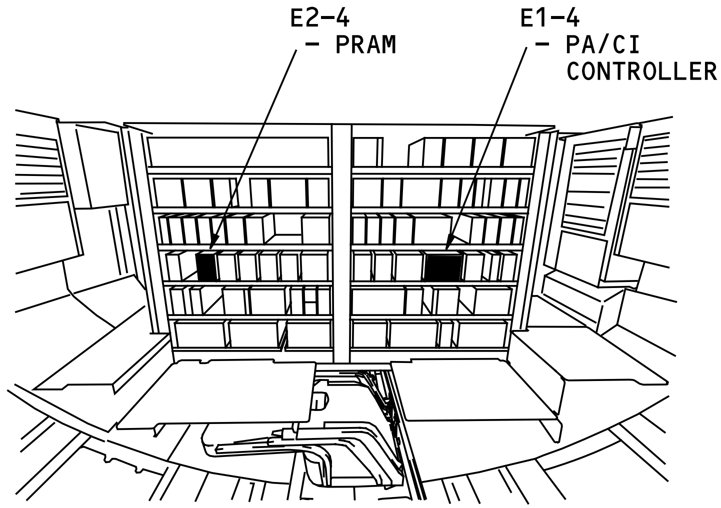
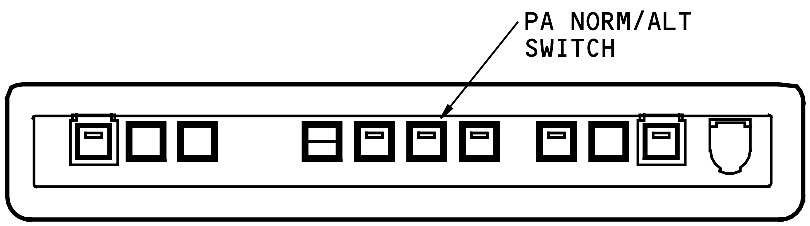


MAIN EQUIPMENT CENTER



ATTENDANT SWITCH PANEL DOOR 2 LEFT

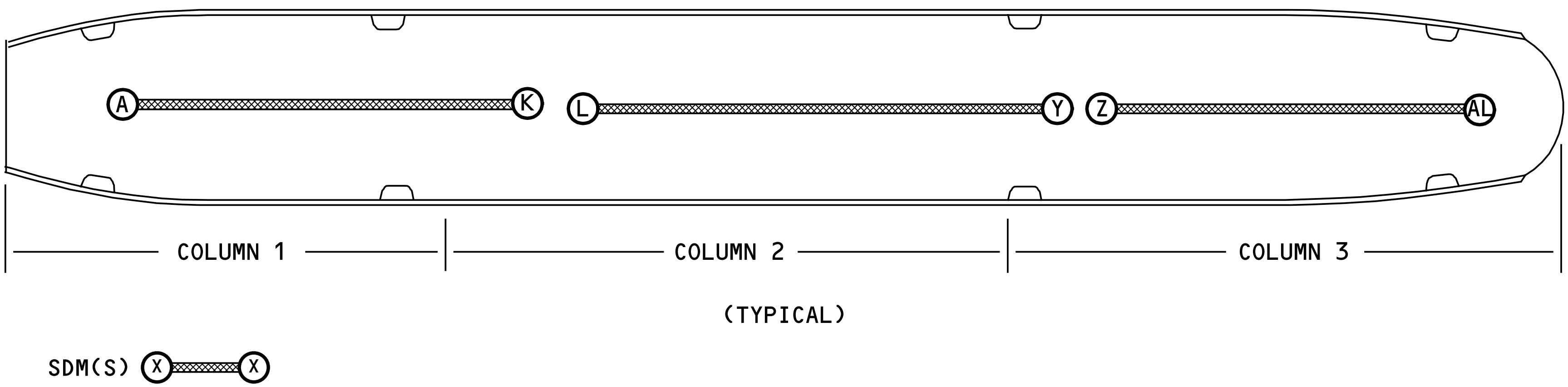
23-31-00-003 Rev 20 10/31/1997

PAS - COMPONENT LOCATIONS

PAS - COMPONENT LOCATIONS 2

PAS Components

The speaker drive modules (SDM)s are in three columns down the center of the airplane.



23-31-00-032 Rev 0 10/31/1997

PAS - COMPONENT LOCATIONS 2

PAS - CARGO COMPARTMENT COMPONENT LOCATIONS

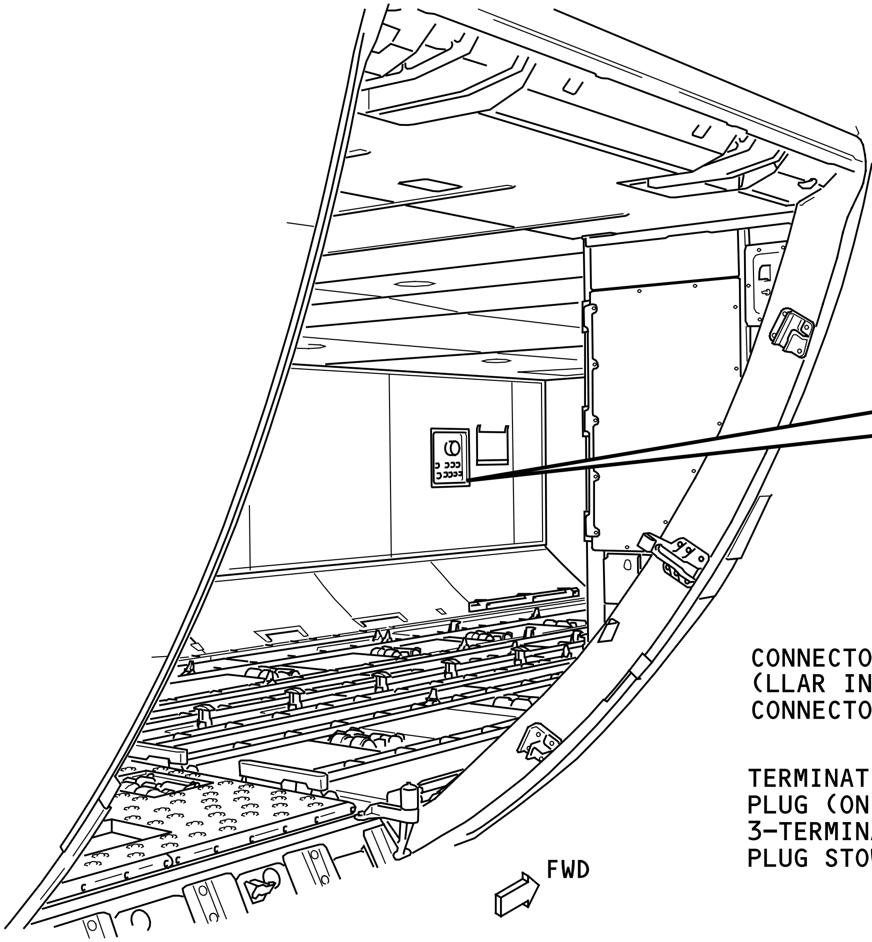
General

The P325 lower lobe attendants rest (LLAR) umbilical panel is on the left sidewall in the aft cargo compartment.

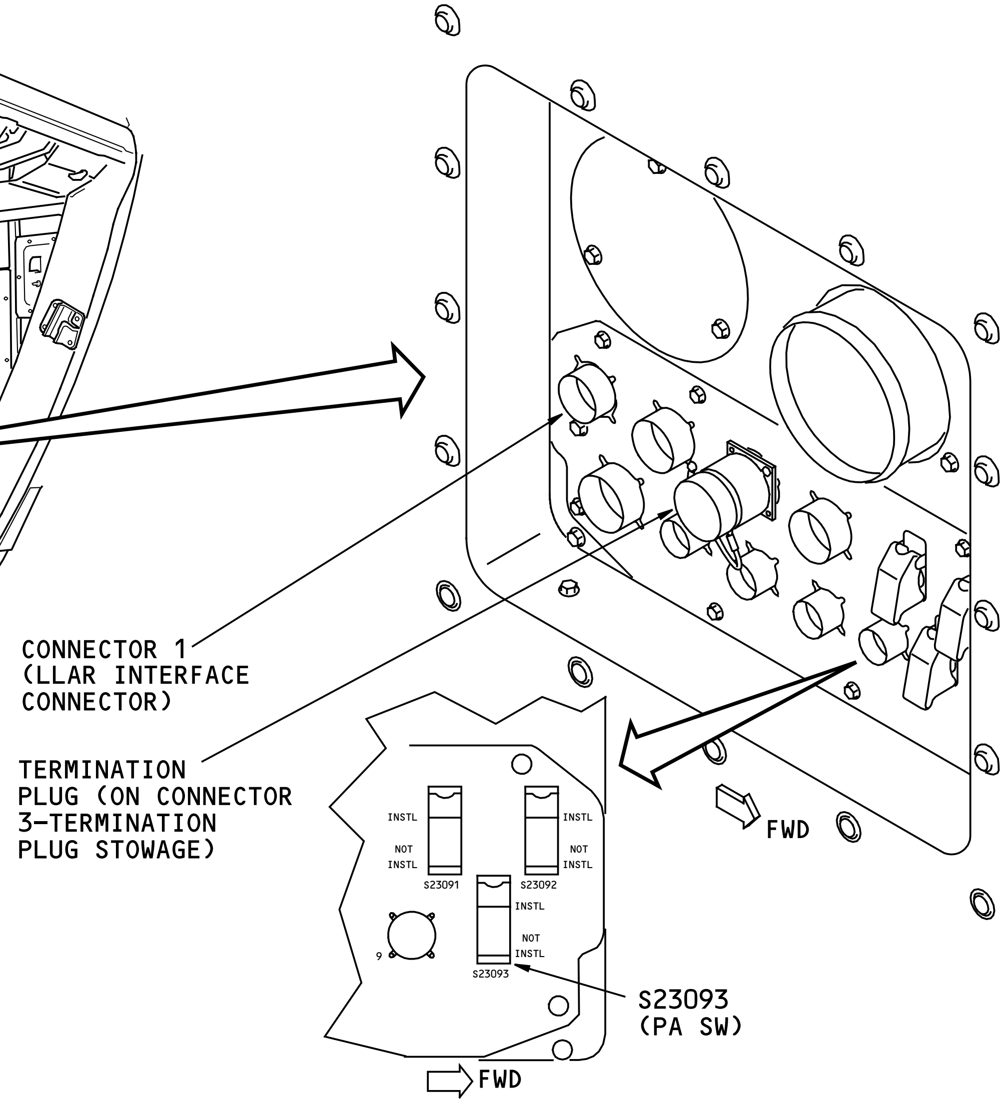
S23093 (PA switch) connects the passenger address functions to the LLAR components when you install the LLAR in the airplane.

When the LLAR is not in the airplane, you must put a termination plug on connector 1 on the P325 panel.

When you install the LLAR, one of the LLAR cables goes to connector 1 on the P325 panel. Move the termination plug to connector 3 for stowage. Connector 3 has no electrical connections.



AFT CARGO COMPARTMENT



P325 LLAR UMBILICAL PANEL

PAS - CARGO COMPARTMENT COMPONENT LOCATIONS

23-31-00-029 Rev 4 02/27/1997

PAS - POWER INTERFACES

General

Circuit breakers in two panels control power to the passenger address system.

Standby Power Management Panel

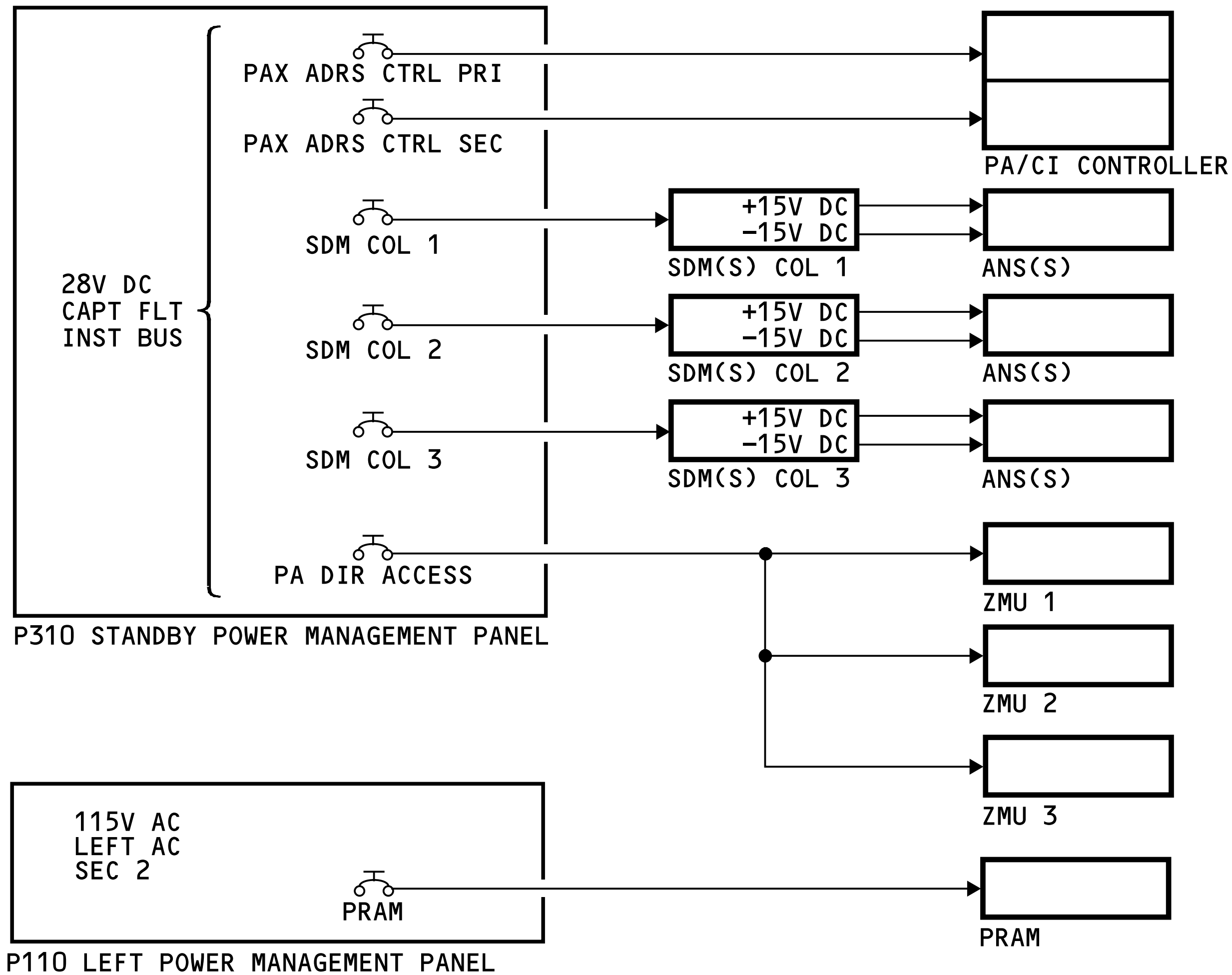
The passenger address/cabin interphone (PA/CI) controller uses two 28v dc inputs for the passenger address function. One input supplies power to the normal passenger address controller. The other supplies power to the alternate passenger address controller.

There is a circuit breaker for each column of speaker drive modules (SDMs). The ambient noise sensors (ANSs) get a positive 15v and a negative 15v from the connected SDM.

The zone management units (ZMUs) get 28v dc for the circuitry that does the direct access function.

Left Power Management Panel

The prerecorded announcement machine (PRAM) uses 115v ac.



23-31-00-004 Rev 10 07/02/1997

PAS - POWER INTERFACES

PAS - PRIORITY 1, 2A, AND 2B INTERFACES

General

The passenger address system accepts and sends announcements at these levels of priority:

- Flight interphone (priority 1)
- Direct access (priority 2A)
- Cabin interphone (priority 2B)
- Recorded announcements (priority 3A)
- Video system audio (priority 3B)
- Boarding music (priority 4).

Announcements from the flight crew and attendants have the three highest priority levels.

Priority 1 - Flight Interphone

The flight crew normally uses the flight interphone system to make passenger address announcements. The audio management unit (AMU) sends microphone audio and PTT to the passenger address/cabin interphone (PA/CI) controller. The PA/CI controller sends sidetone back to the AMU.

Priority 2A - Direct Access

Flight attendants normally use the cabin interphone system (CIS) to make PA announcements.

The direct access function lets attendant announcements go around the CIS circuits and connect directly to the PAS. They use direct access if there is a failure of the CIS.

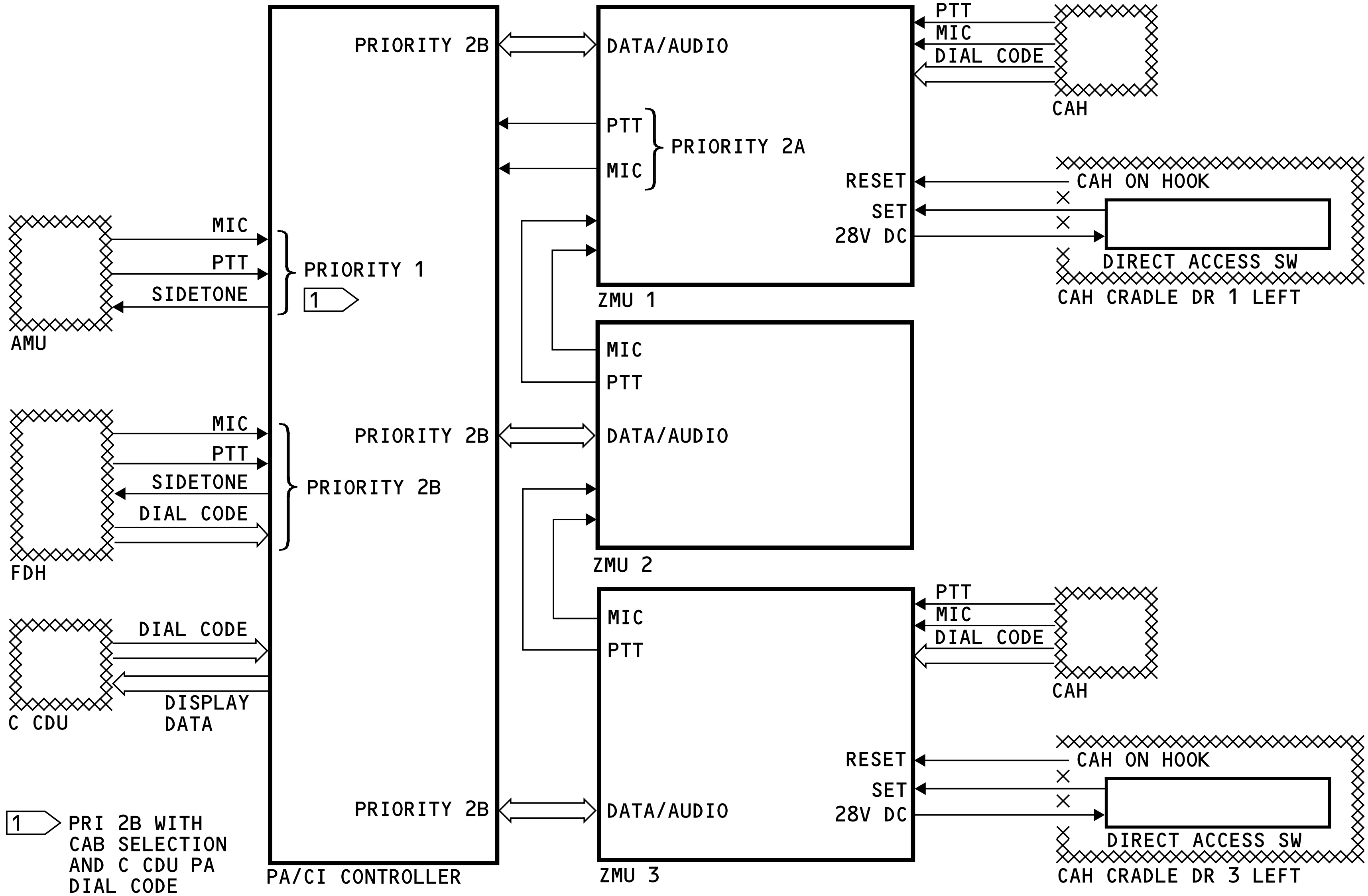
Only two of the cabin attendant handsets (CAHs) have the direct access function. They are at door 1 left and door 3 left.

To make a direct access announcement, you push a direct access switch on the cabin attendant handset (CAH) cradle. This energizes a relay in the ZMU and sends the audio past the CIS circuits to the PA/CI controller.

Priority 2B - Cabin Interphone

Flight attendants normally use the CIS to make passenger address (PA) announcements. They use any CAH to make an announcement and select a PA area. The attendant dials a PA code. This connects the mic and PTT to the CIS circuits in the zone management unit (ZMU).

The flight crew also uses the cabin interphone system to make announcements in a selected area. To do this, the flight crew uses either the flight deck handset (FDH) or the flight interphone system. To use the flight interphone system, they dial the area on the center control display unit (CDU).



PAS - PRIORITY 1, 2A, AND 2B INTERFACES

PAS - PRIORITY 3 AND 4 INTERFACES

General

These three lower priorities are for recorded announcements, video audio and boarding music.

Priority 3A - Recorded Announcements

The prerecorded announcement machine (PRAM) sends recorded announcements to the PA/CI controller. It also sends a keyline signal when a recorded announcement is in progress.

If cabin decompression occurs, the PA/CI controller sends a signal to the PRAM. This causes the PRAM to play an emergency announcement.

During a priority 1, 2A, or 2B announcement to all areas, the PA/CI controller sends a pause signal to stop the recorded announcement.

Priority 3B - Video Audio

The IFE system sends video audio to the PA/CI controller. The IFE system has a separate audio output and separate keyline for each video area. Attendants use the IFE system to select the video.

The cabin system management unit (CSMU) sends cabin services system (CSS) configuration data to the IFE system. This data includes video audio areas definition.

Priority 4 - Boarding Music

The PRAM also supplies boarding music. It sends boarding music and its keyline to the PA/CI controller. The CSCP permits selection of boarding music.

Chimes

The PAS makes chimes for these functions:

- Passenger to attendant calls
- Cabin interphone calls
- Passenger information signs.

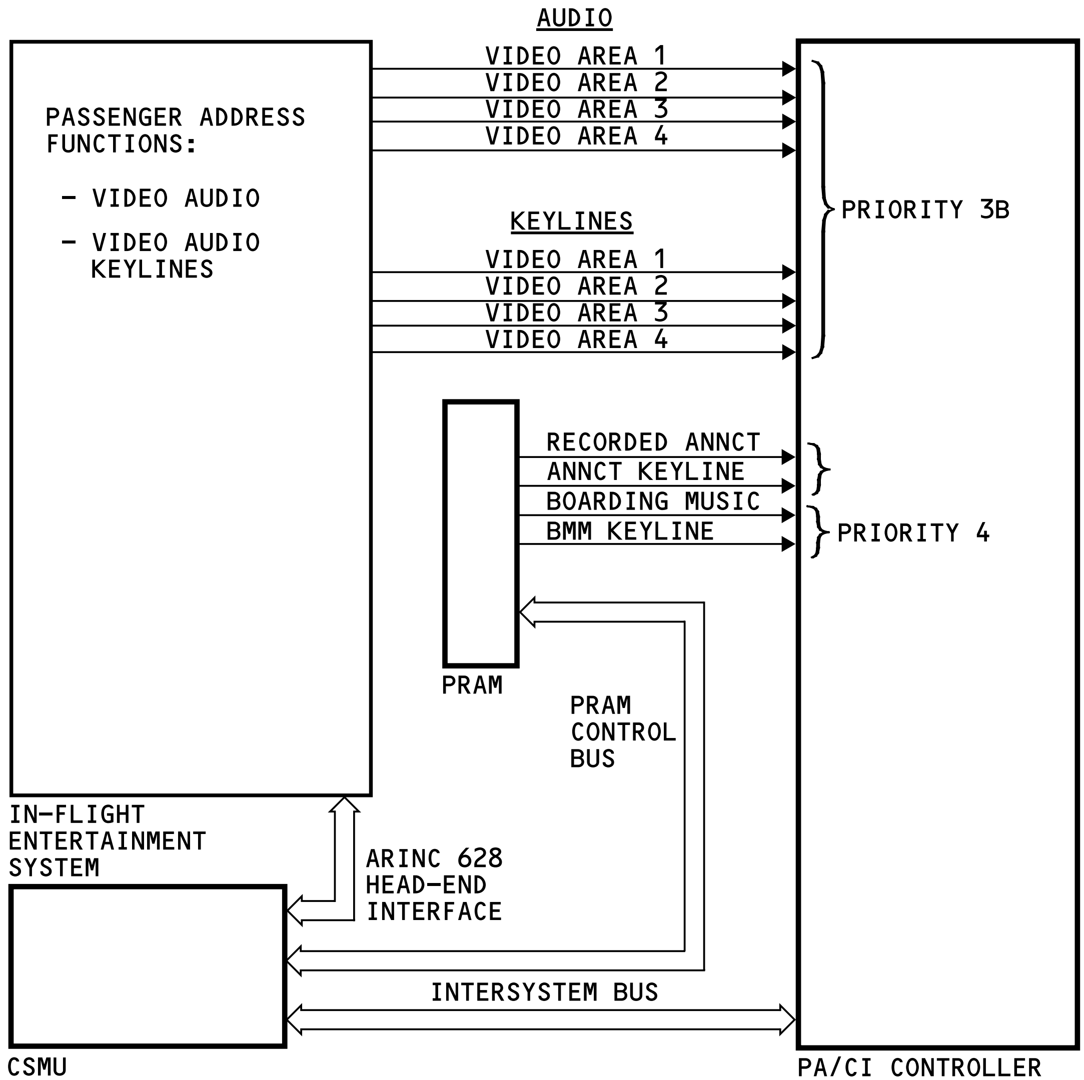
The PA/CI controller gets chime data for passenger to attendant calls from the ZMUs on the intersystem bus.

The passenger address function of the PA/CI controller gets cabin interphone call chime data from the cabin interphone function of the PA/CI controller.

The passenger information sign chime data comes from different airplane systems.

Pause Signals

During all area announcements, the PA/CI controller sends a PA-all keyline to the IFE system. This system pauses the entertainment equipment for priority 1, 2A, and 2B all area announcements.



PAS - PRIORITY 3 AND 4 INTERFACES

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PAS - OUTPUT INTERFACES

General

The passenger address/cabin interphone (PA/CI) controller gets all audio inputs. It selects the input with the highest priority and sends it to speaker drive modules (SDMs) and to the in-flight entertainment (IFE) system.

Speaker Drive Modules

There are three columns of SDMs in the cabin, one column for each zone. There can be as many as 25 SDMs in each column. Usually, each column has ten to thirteen SDMs.

The PA/CI controller selects the audio with the highest priority. The controller digitizes the audio and sends it to the SDMs.

The speaker drive module changes digital audio to analog audio. The PAS can have up to six passenger address (PA) areas. The SDM changes the audio for each speaker assigned to an area. Each SDM controls one or two speakers.

When the LLAR is not installed, the S23093 (PA) switch in the P325 LLAR umbilical panel terminates the audio and data buses.

The PAS uses the token signal for software installation.

Ambient Noise Sensor

The ambient noise sensors (ANSs) monitor cabin noise levels. They send a signal in proportion to the measured noise level to a nearby SDM. The SDMs send the data to the PA/CI controller. The PA/CI controller uses the data to set volume levels.

There are three to five ANSs in each column.

In-flight Entertainment System

The in-flight entertainment (IFE) system sends passenger entertainment audio to the cabin. When a PA all area announcement occurs, the PA/CI controller sends the PA audio to the IFE system. The passengers hear the announcement in their headphones.

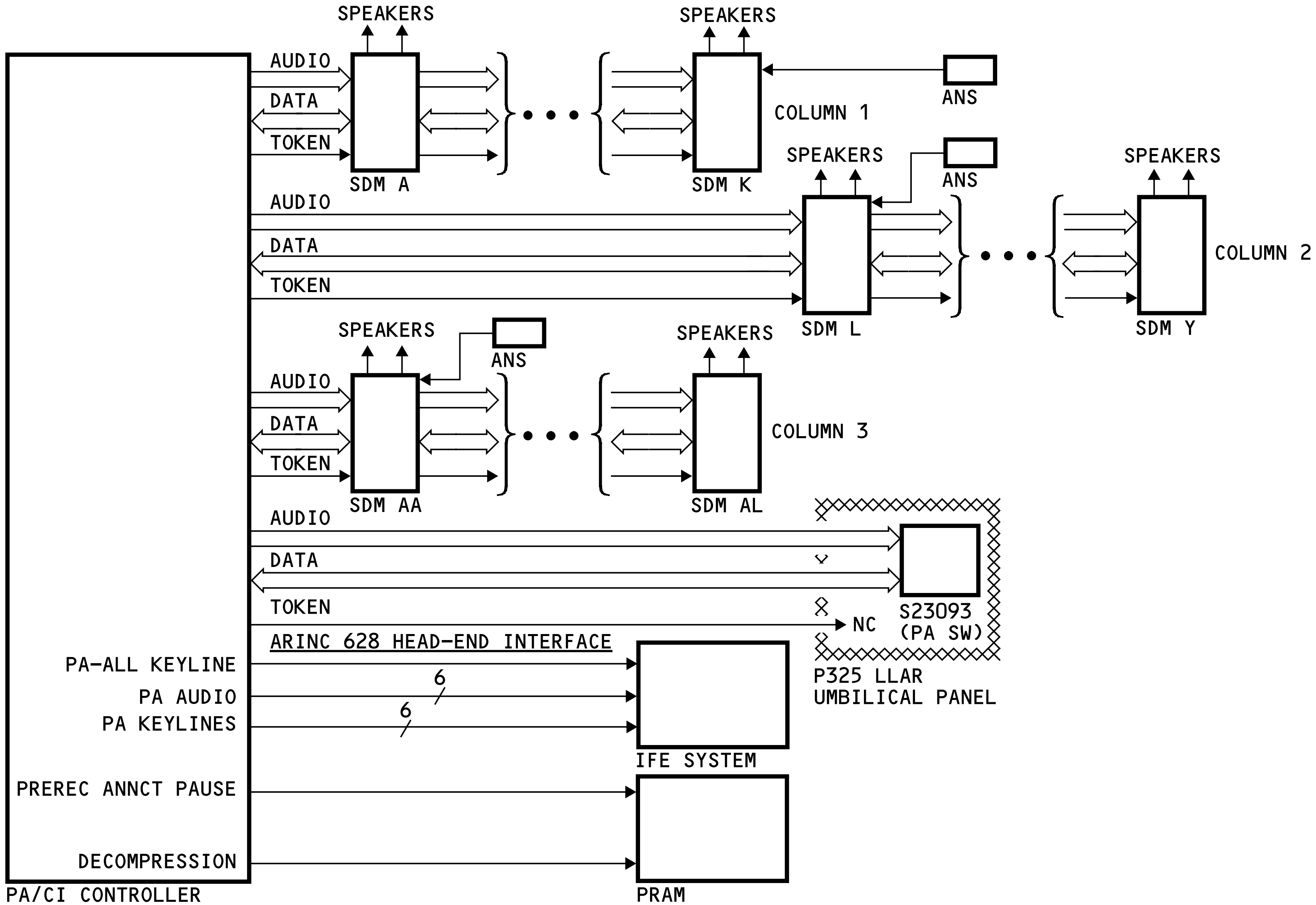
The PA/CI controller has seven keylines to the IFE system, one for each PA area and one for a PA-all area announcement.

Pause Signals

During all area announcements, the PA/CI controller sends a pause signal to the prerecorded announcement machine (PRAM).

Cabin Decompression

For a cabin decompression, the PA/CI controller sends a decompression signal to the prerecorded announcement machine (PRAM). The PRAM starts an emergency announcement and sends it to the PA/CI controller.



PAS - OUTPUT INTERFACES

23-31-00-007 Rev 14 09/16/1997

PAS - AIRPLANE SYSTEMS AND CSMU INTERFACES

General

The passenger address/cabin interphone (PA/CI) controller has interfaces with different airplane systems and with the cabin system management unit (CSMU).

Airplane Systems

The PA function of the PA/CI controller receives inputs from these airplane systems on the left systems ARINC 629 bus:

- ARINC signal gateway (ASG) card
- Proximity sensor electronics unit (PSEU)
- Overhead panel ARINC 629 system (OPAS)
- Flap/slat electronics unit (FSEU)
- Warning electronic system (WES)
- Airplane information management system (AIMS)
- Electrical load management system (ELMS).

The PA/CI controller uses these inputs to make chimes when the FASTEN SEAT BELTS and NO SMOKING signs go on or off. The PA/CI controller also uses airplane system data to adjust volume levels. The PA/CI controller uses flight data to set volume levels.

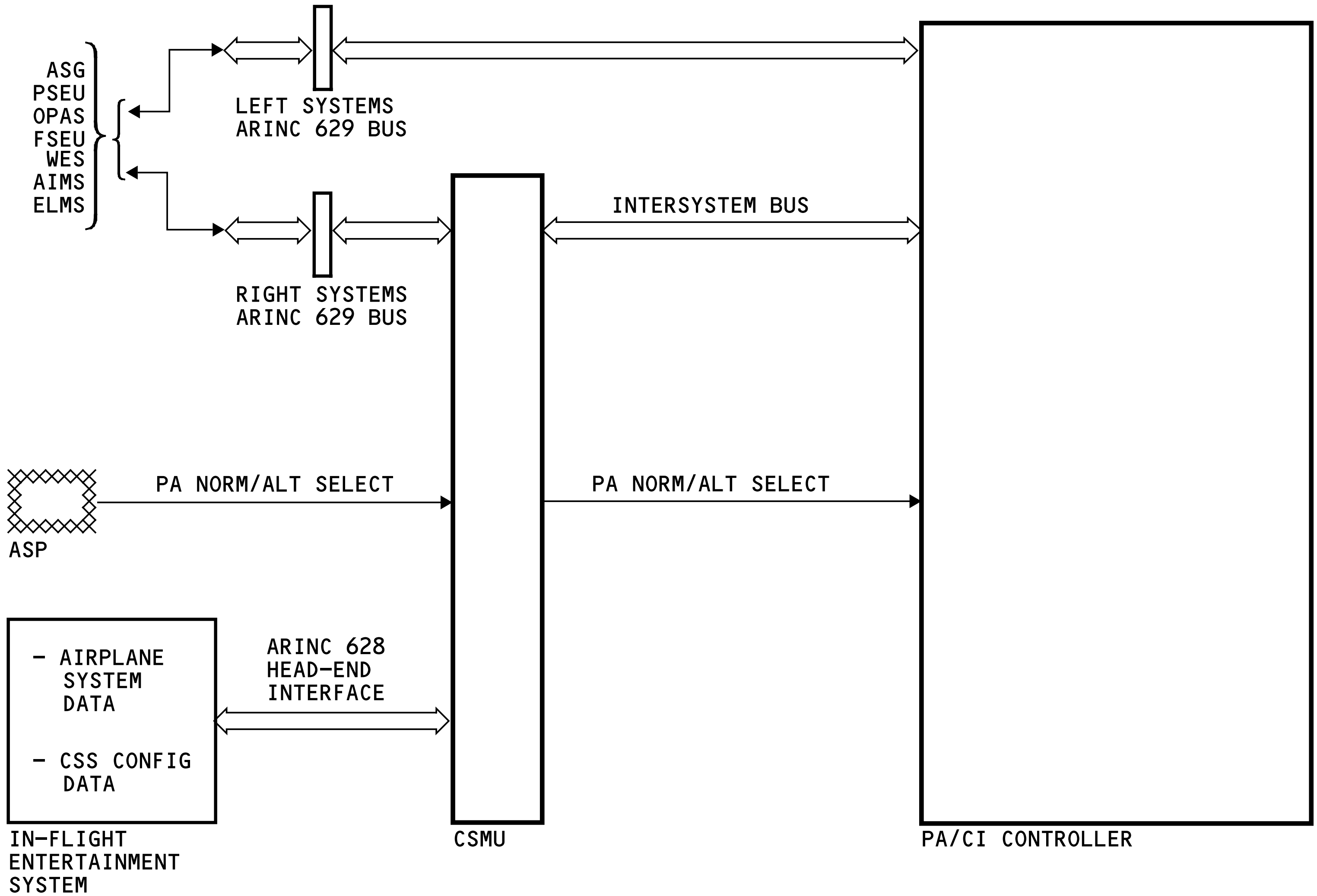
CSMU

There are two passenger address controllers in the PA/CI controller. They are normal and alternate. Only one controller operates at a time. If the normal controller fails, the crew selects the alternate controller at the attendant switch panel (ASP). The ASP sends a discrete to the cabin system management unit (CSMU). The CSMU sends a discrete to the PA/CI controller. The PA/CI controller then changes to the alternate PA controller.

The PA/CI controller also sends and receives data on the intersystem bus. The CSMU sends software installation data and test commands on the intersystem bus. The PA/CI controller sends fault status and test results to the CSMU on the intersystem bus.

The CSMU receives the same inputs from airplane systems on the right system ARINC 629 bus as the PA/CI controller does on the left systems ARINC 629 bus. If the left systems ARINC 629 bus fails, the PA function of the PA/CI controller gets right systems ARINC 629 bus information from the CSMU on the intersystem bus.

The CSMU sends airplane system data and cabin services system (CSS) configuration data to the in-flight entertainment (IFE) system.



23-31-00-008 Rev 10 10/31/1997

PAS - AIRPLANE SYSTEMS AND CSMU INTERFACES

PAS - PRERECORDED ANNOUNCEMENT MACHINE CONTROL PANEL

Purpose

The prerecorded announcement machine control panel (PRAM/CP)sends boarding music and announcment requests to the prerecorded announcment machine (PRAM).

General

The PRAM/CP controls the selection of emergency announcments and as many as 14 more announcements such as seat belt sign on/off and no smoking sign on/off announcements. The PRAM/CP also controls the boarding music in the PRAM.

Boarding music

To play boarding music, push the music on/off switch. When the music is on, volume 3 shows.

Music select

To select a boarding music channel, push the music select switch. The display shows the sequence of channels from the lowest to highest.

Music volume

Push the UP or the DOWN volume key to change the boarding music volume. Each time you push the UP or DOWN key it will increase or decrease the music volume. The volume range is 21db in five steps.

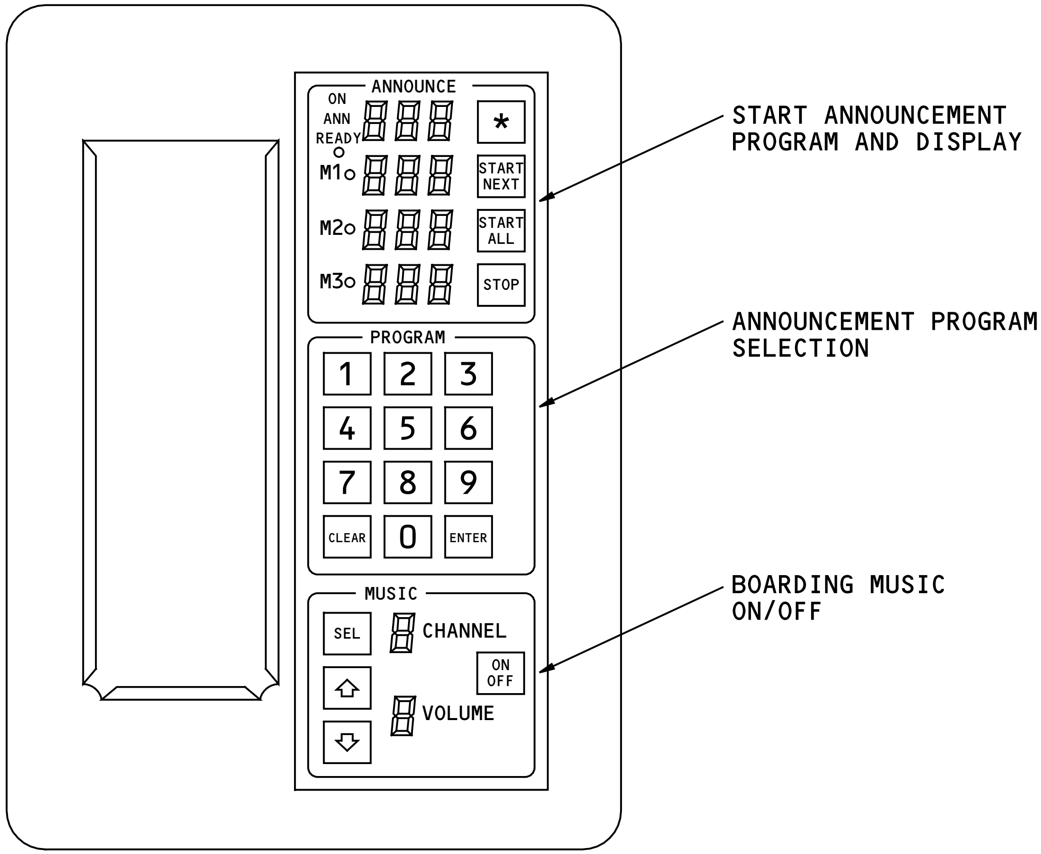
Recorded announcements

You use the PRAM/CP to program the PRAM to play the announcments that you want.

Controls

These are the announcement controls on the PRAM control panel:

- The ENTER pushbutton to enter programming data and to step the cursor to the next memory.
- The CLEAR pushbutton erases all data in the current memory.
- The START NEXT pushbutton (when the ready light is on) sends one play command to the A/R and updates the display.
- The START ALL pushbutton (when the ready light is on) sends sequential play commands to the A/R and updates the display.
- The STOP pushbutton interrupts the START ALL commands.



23-31-00-031 Rev 0 10/11/1997

PAS - PRERECORDED ANNOUNCEMENT MACHINE CONTROL PANEL

PAS - SPEAKER DRIVE MODULE

Purpose

The speaker drive modules (SDMs) send passenger address (PA) audio to the PA speakers. They also send inputs from ambient noise sensors (ANSs) to the PA/CI controller.

Physical Description

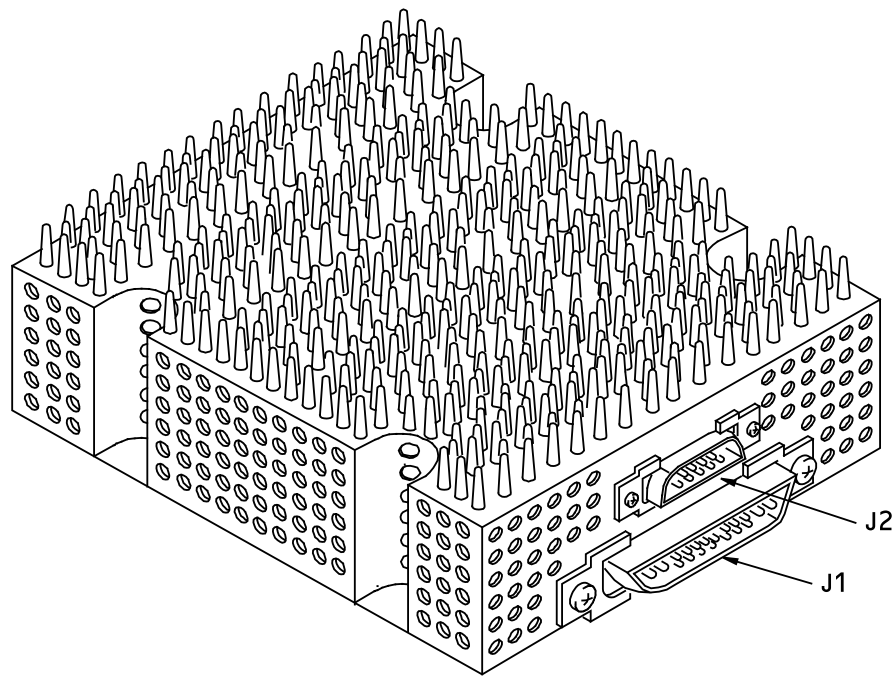
An SDM is about six inches wide and seven inches long. It weighs about one and a half pounds.

Functional Description

The SDMs get digital audio from the PA/CI controller and change it to analog audio. Each SDM can control as many as two speakers independently.

The SDMs also have a chime generator to make chime sounds.

Some SDMs connect to an ANS. The SDM supplies power to the ANS. The ANS sends a signal proportional to the cabin noise level. The SDM digitizes the signal and sends it to the PA/CI controller.



23-31-00-009 Rev 0

PAS - SPEAKER DRIVE MODULE

PAS - AMBIENT NOISE SENSOR

Purpose

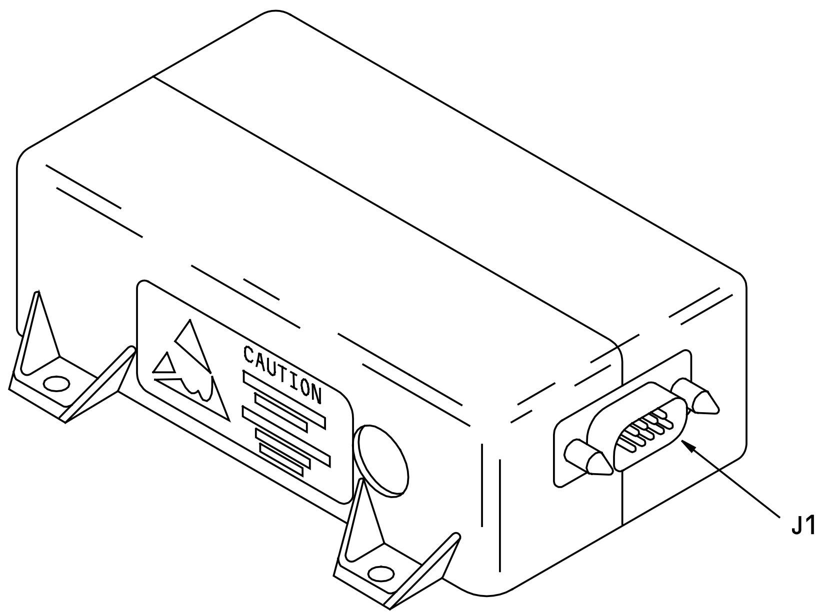
The ambient noise sensors (ANSs) measure cabin noise levels. The passenger address system uses ANS data to automatically adjust the PA volume.

Physical Description

The ANS is about four inches wide and five inches long. It weighs about 1/3 pound.

Functional Description

The ANS has a microphone that monitors cabin sounds. It makes a dc signal in proportion to the cabin noise level. The ANS sends the signal to the nearest speaker drive module.



PAS - AMBIENT NOISE SENSOR

PAS - SPEAKERS

Purpose

The speakers produce the passenger address audio in the passenger cabin.

Locations

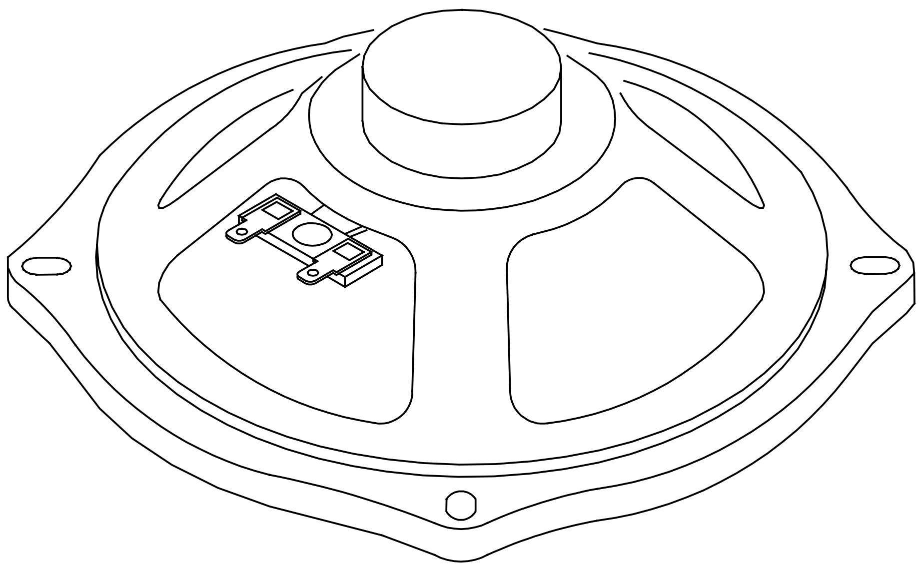
Most speakers are in the ceiling panels over the passenger seats and aisles. There are also speakers in the galleys, above the doors, and in each lavatory.

Functional Description

The speakers get audio signals from the speaker drive modules (SDMs). They change the electrical signal into an acoustic signal.

Training Information Point

A dot on one speaker terminal identifies it as positive. Connect the red lead to the positive terminal.



CABIN SPEAKER

23-31-00-011 Rev 1

PAS - SDM, ANS, AND SPEAKER INSTALLATION

SDM Installation

The speaker drive modules (SDMs) are above the cabin ceiling panels on the left side of the stow bin support assembly. Four screws attach the SDM to the support assembly.

Training Information Point

You must remove ceiling panels to get access to a SDM.

ANS Installation

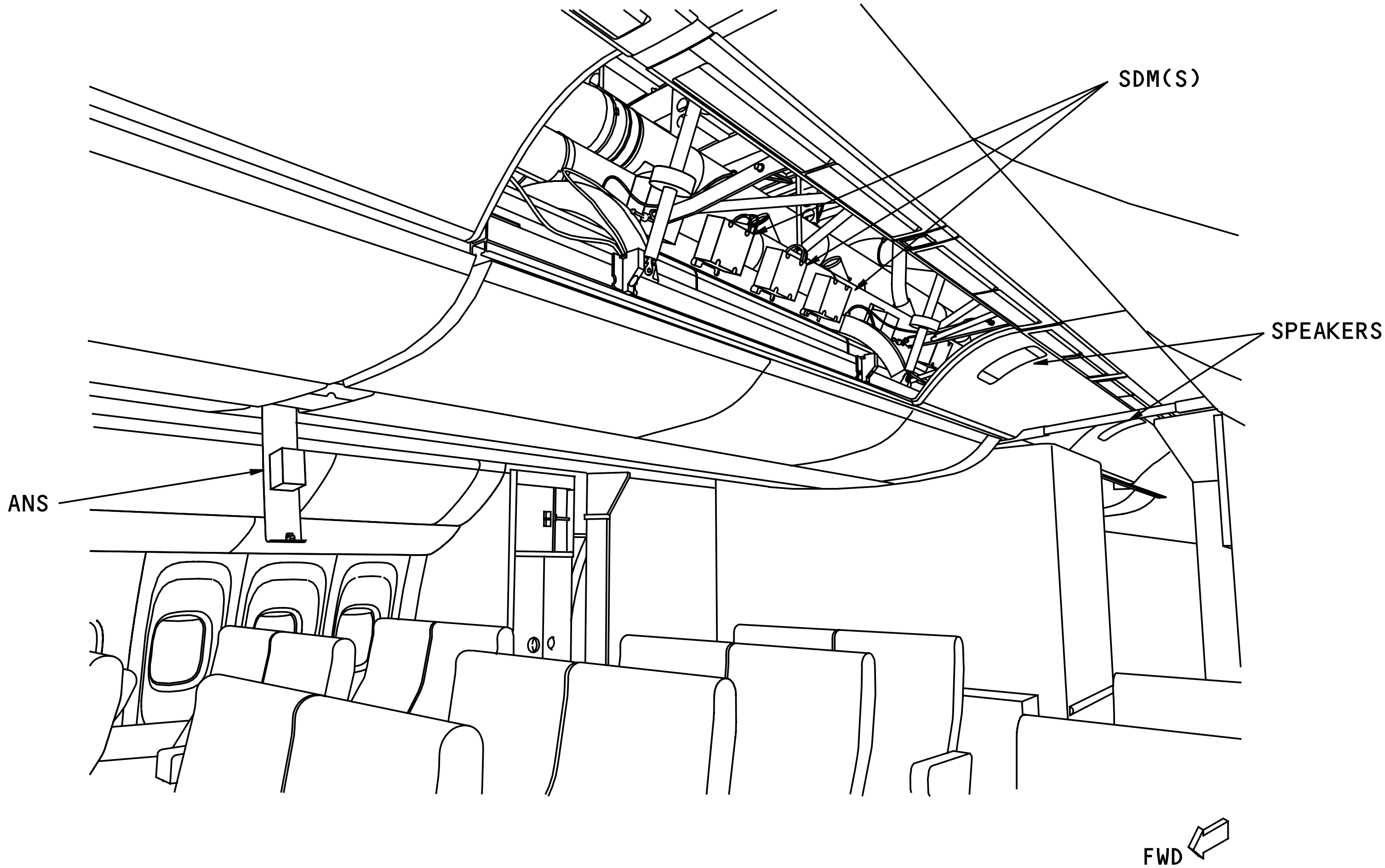
There are twelve ambient noise sensors. They are in the center passenger service unit rail.

Training Information Point

You must lower a passenger service unit panel to get access to an ANS.

Speakers

Most speakers are in the overhead panels. There are also speakers in the galleys and lavatories.



PAS - SDM, ANS, AND SPEAKER INSTALLATION

PAS - FLIGHT INTERPHONE ANNOUNCEMENT - OPERATION

General

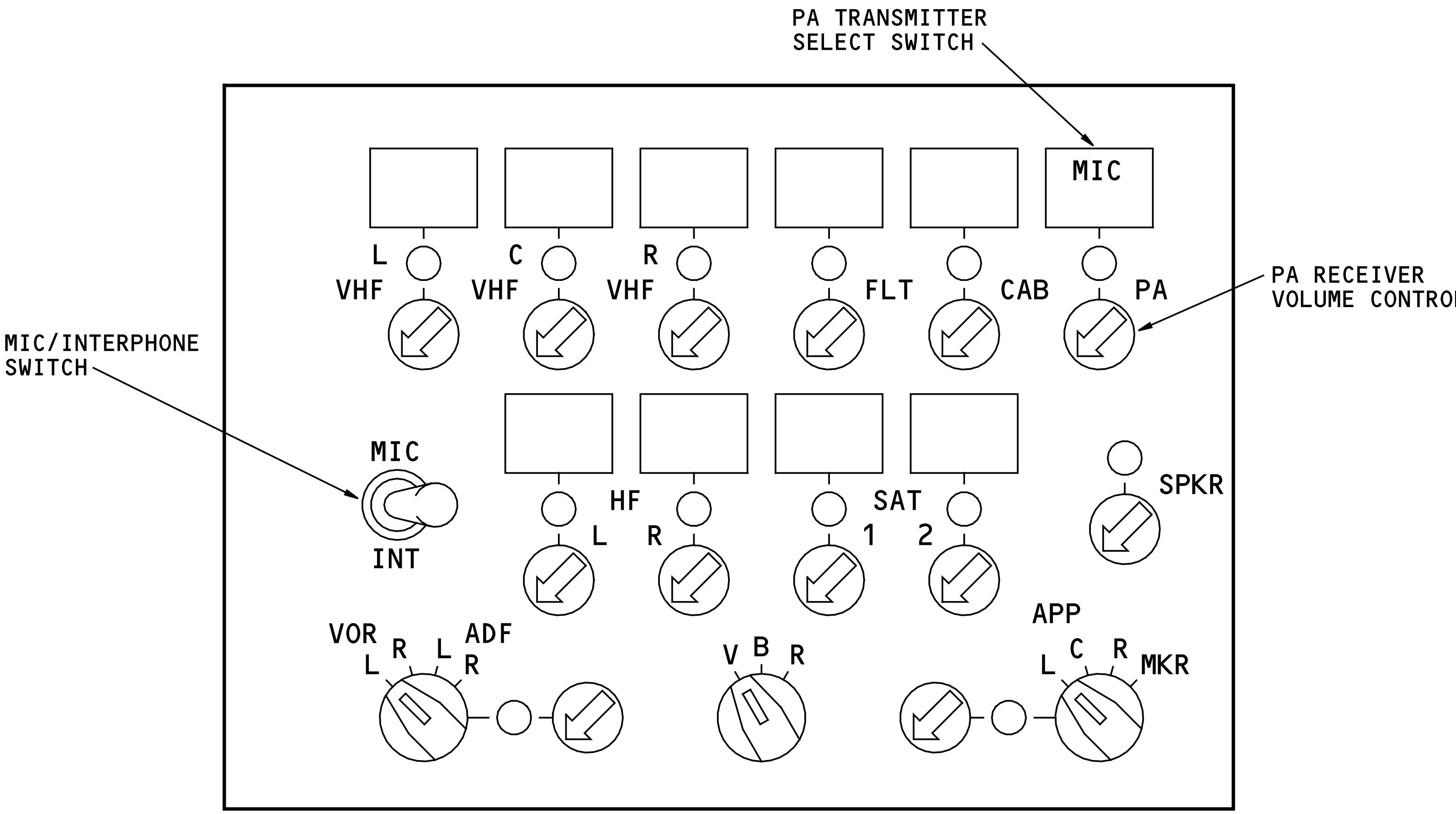
The audio control panel (ACP) lets the flight crew make priority 1 announcements.

Control and Indications

Push the PA receiver switch to listen to PA audio. The green PA receiver light above the receiver volume control comes on when the PA receive is on.

Push the PA transmitter select switch to make a priority 1 announcement. The white MIC light comes on. Push the MIC/interphone switch to connect the microphone to the PA/CI controller.

Priority 1 announcements go to all passenger address areas.



AUDIO CONTROL PANEL

23-31-00-013 Rev 1 08/08/96

PAS - FLIGHT INTERPHONE ANNOUNCEMENT - OPERATION

PAS - DIRECT ACCESS FUNCTIONAL DESCRIPTION

General

Flight attendants normally make PA announcements through the cabin interphone system (CIS) (priority 2B). If the CIS has a failure, attendants can make direct access announcements (priority 2A). Direct access announcements go around the CIS.

CIS Announcements

When an attendant selects a passenger address dial code, the CIS circuits in the zone management unit (ZMU) send digital audio to the PA/CI controller. The cabin interphone controller (CIC) sends the audio to the passenger address controller (PAC) in the PA/CI controller.

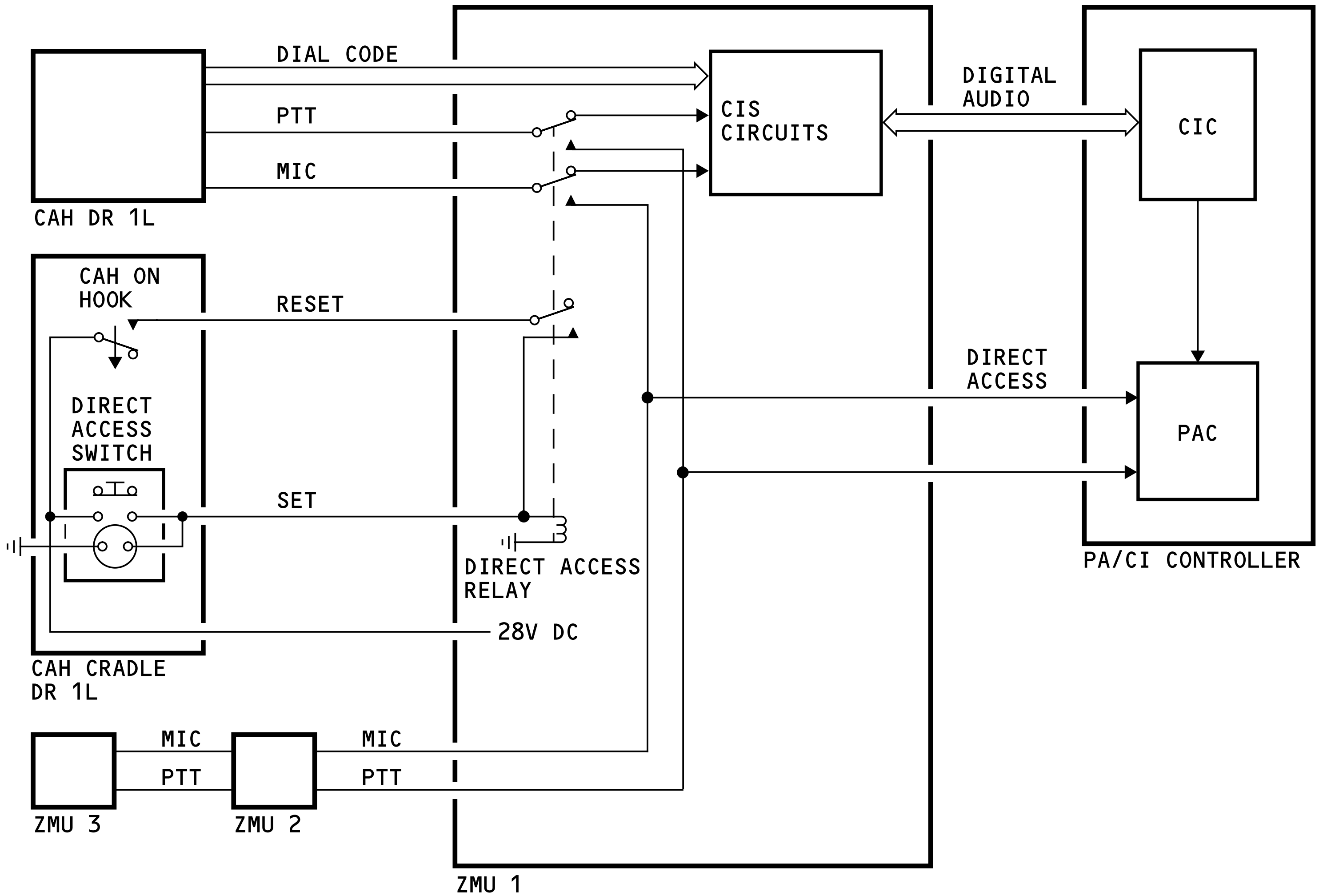
Direct Access

Two of the cabin attendant handsets (CAHs) have the direct access function. They are at door 1 left and door 3 left. Only one direct access handset may connect to a ZMU. The handset at door 1 left connects to ZMU 1. The handset at door 3 left connects to ZMU 3. There is no direct access handset connected to ZMU 2.

A momentary DIRECT ACCESS switch is on the front of the CAH cradle. When you push the switch, 28v dc goes though the contacts to the relay in the zone management unit (ZMU). The relay energizes. The 28v dc goes through the reset line and latches the relay in the energized position.

When the relay energizes, the CAH microphone audio and PTT signals go around the CIS circuits. In each ZMU, the direct access mic and PTT signals from the CAH mix with the signals from the previous ZMU. The direct access outputs from ZMU 1 connect directly to the PAC in the PA/CI controller.

When the CAH goes back in the cradle, it opens the CAH on hook switch. When the CAH on hook switch opens, this deenergizes the direct access relay.



23-31-00-014 Rev 7 02/25/1998

PAS - DIRECT ACCESS FUNCTIONAL DESCRIPTION

PAS - DIRECT ACCESS AND CABIN INTERPHONE ANNOUNCEMENT - OPERATION

General

You use cabin attendant handsets (CAHs) for both direct access and cabin interphone announcements.

Cabin Interphone

Flight attendants normally use the cabin interphone system (CIS) to make PA announcements (priority 2B). They can use any CAH to make a CIS announcement.

CIS announcements go to selected PA areas or all areas. To select a PA area, dial the code. These are typical PA dial codes:

- Area 1 - 41
- Area 2 - 42
- Area 3 - 43
- Area 4 - 44
- Area 5 - 45
- Area 6 - 46
- All areas - 40
- Priority all areas - 47.

To make a CIS announcement, dial the code for the area and push the PTT. To end the announcement, either push the RESET button or put the handset back in the cradle.

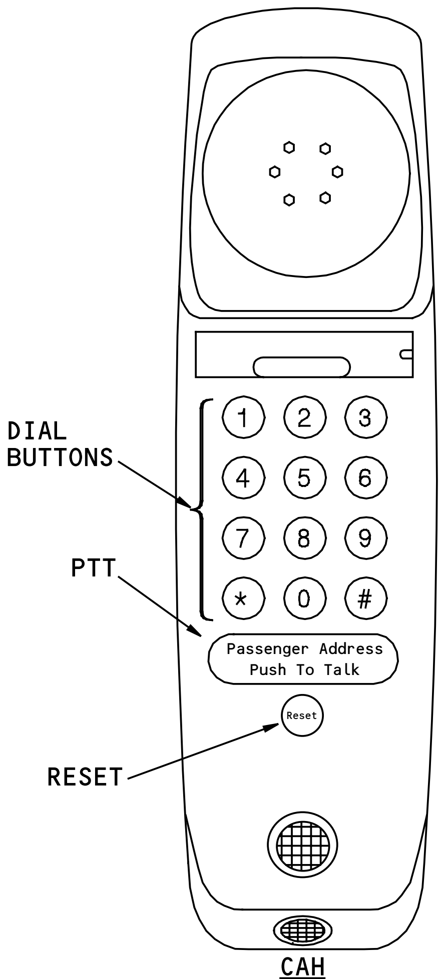
Direct Access

Flight attendants use CAHs at doors 1 left and 3 left to make direct access announcements (priority 2A).

The direct access CAH cradle has a PA switch. To make a direct access announcement, push the PA switch. Then push and hold the PTT. This connects the CAH microphone to the PA/CI controller.

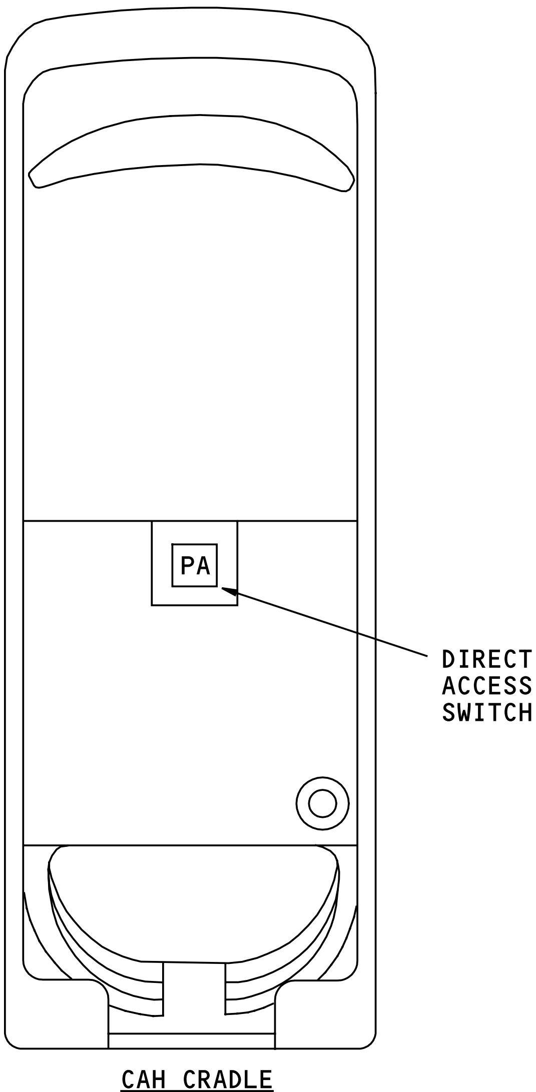
Direct access announcements go to all PA areas.

To end the direct access announcement, put the handset back in the cradle.



PA DIAL CODES (TYPICAL)

AREA 1 - 41
AREA 2 - 42
AREA 3 - 43
AREA 4 - 44
AREA 5 - 45
AREA 6 - 46
ALL AREAS - 40
PRIORITY ALL AREAS - 47



23-31-00-015 Rev 6

PAS - DIRECT ACCESS AND CABIN INTERPHONE ANNOUNCEMENT - OPERATION

PAS - BOARDING MUSIC SELECTION

General

Flight attendants use the cabin system control panel (CSCP) or cabin area control panels (CACPs) to select boarding music (priority 4).

Access

Touch BOARDING MUSIC on the cabin controls main menu to show the boarding music screen.

Controls

The boarding music selection screen gives control of these functions:

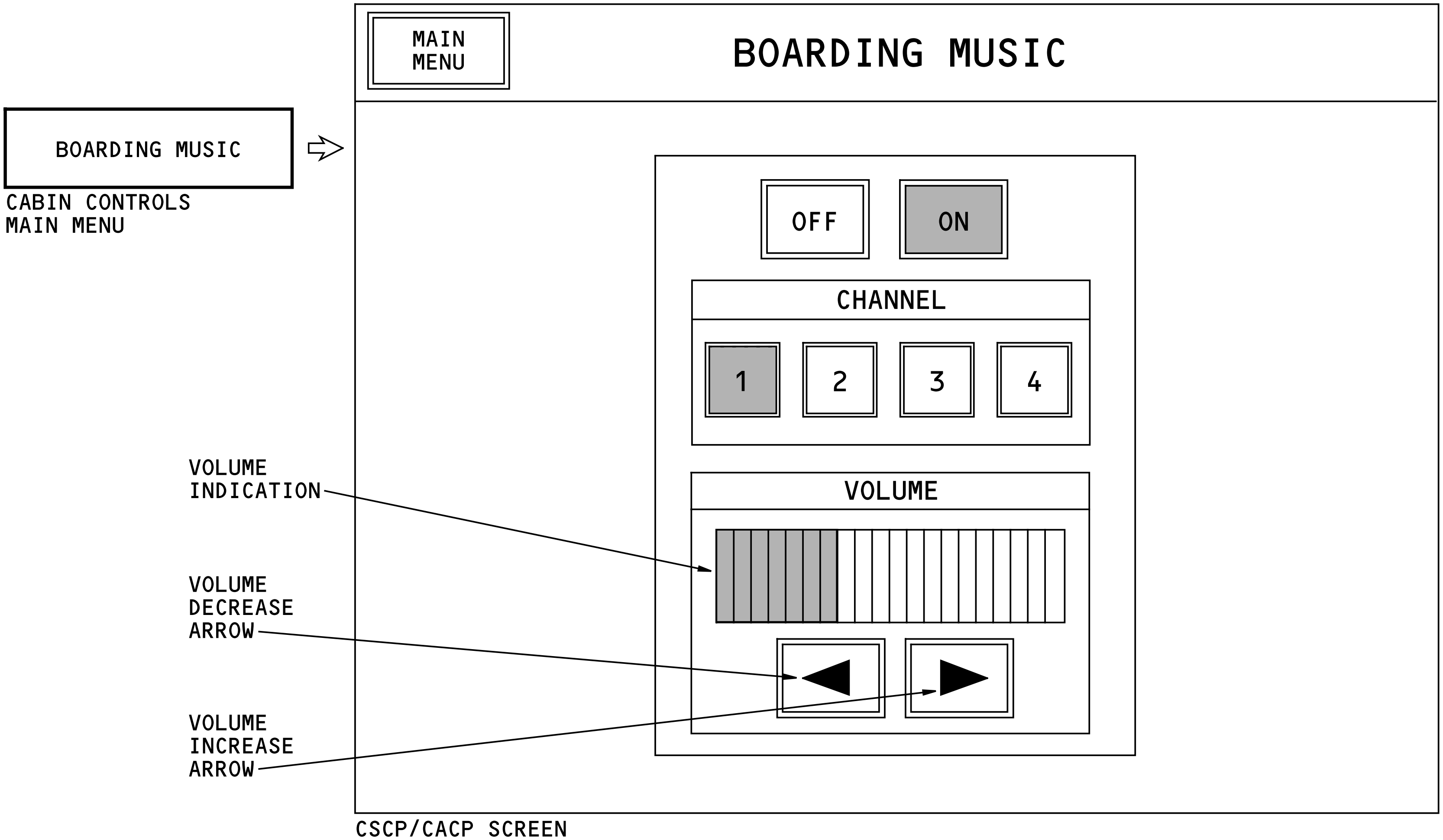
- Boarding music on/off
- Channel selection
- Volume.

Touch ON to cause the boarding music to come on. Touch OFF to cause the boarding music to go off.

There are four channels of boarding music from each. Touch 1, 2, 3, or 4 to select a channel.

The volume indication shows green vertical bars to show the current volume.

Touch the left arrow to decrease the volume. Touch the right arrow to increase the volume.



23-31-00-016 Rev 5 04/26/96

PAS - BOARDING MUSIC SELECTION

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PAS - CONFIGURATION DATABASE PROGRAMMED ITEMS

General

The configuration database supplies details of the system operation. For the PAS, the database gives configuration data for:

- Speaker drive modules (SDMs)
- Speakers
- Ambient noise sensors (ANS)
- Passenger address areas
- Volume
- Chimes.

SDMs, Speakers, and ANSs

The configuration database identifies the number of SDMs, speakers, and ANSs. It assigns as many as two speakers to a SDM and identifies the type of announcements each speaker transmits. The database assigns each ANS to a SDM.

The database also identifies the location of each component.

Speaker Mute Assignments

When an attendant makes an announcement, the PAS mutes up to three nearby speakers. This prevents speaker feedback. The configuration database assigns the speakers to a cabin attendant handset.

Passenger Address Areas

The PAS can have up to six passenger address areas. The configuration database assigns each speaker to a PA area.

Announcement Types for Each Speaker

The configuration database identifies the announcement types (priority 1, 2A, 2B, 3A, 3B, 4) each speaker plays.

Volume Control Areas

The PAS adjusts the volume in an area. The configuration database identifies the speakers assigned to a volume control area.

Volume Reference Level

The PAS uses a volume reference level to adjust the volume above or below reference level. The reference level is the normal in-flight volume. The configuration database gives the reference level.

ANS Reference Level

The configuration database identifies the reference level each ANS uses to measure noise.

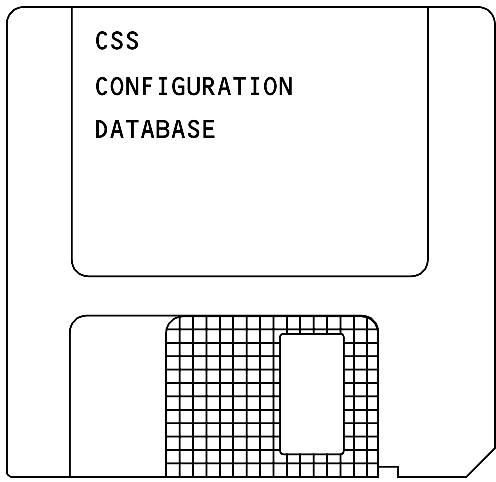
PAS - CONFIGURATION DATABASE PROGRAMMED ITEMS

Chimes Types and Count

The configuration database identifies the types of chimes the PAS makes for each chime condition. It also identifies the number of chimes for each chime condition.

PA Area to Video Area Assignment

The configuration database matches PA areas to video areas. The configuration database assigns each PA area to one video area. It assigns each video area to one or more PA areas.



- NUMBER OF SDM(S), SPEAKERS, AND ANS(S)
- SPEAKER MUTE ASSIGNMENTS
- PASSENGER ADDRESS AREAS
- TYPES OF ANNOUNCEMENTS FOR EACH SPEAKER
- VOLUME CONTROL AREAS
- VOLUME REFERENCE LEVEL
- ANS REFERENCE LEVEL
- CHIME TYPES AND COUNT
- PA AREA TO VIDEO AREA ASSIGNMENTS

23-31-00-017 Rev 2 09/16/1997

PAS - CONFIGURATION DATABASE PROGRAMMED ITEMS

PAS - PASSENGER ADDRESS FAILURE MESSAGE

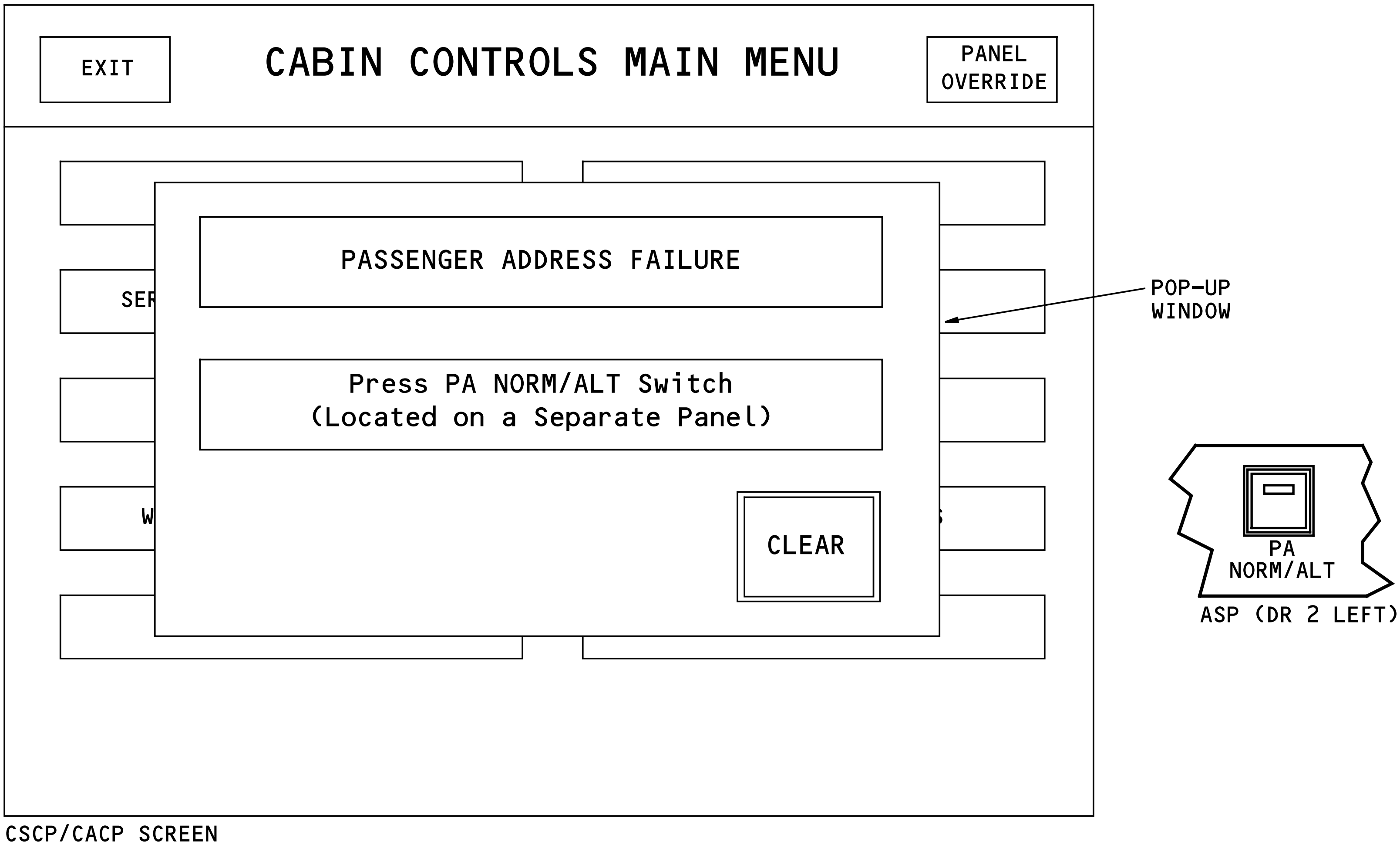
Operation

The passenger address controller (PAC) of the PA/CI controller has continuous BITE. If the BITE finds a failure, the PAC sends a message to the cabin system control panel (CSCP) and the cabin area control panels (CACPs). This causes the CSCP and all CACPs to show a PA failure message on a pop-up window.

The pop-up window tells the flight attendants to push the PA NORM/ALT switch.

To clear the pop-up window, touch CLEAR or push the PA NORM/ALT switch. The PA NORM/ALT switch makes the alternate PAC operational. The PA NORM/ALT switch is on the attendant switch panel (ASP) at door 2 left.

The PAC also sends a message to the AIMS for both EICAS and the central maintenance computing function (CMCF).



23-31-00-018 Rev 4 10/21/96

PAS - PASSENGER ADDRESS FAILURE MESSAGE

PAS - PASSENGER ADDRESS CONTROL SCREEN

General

The passenger address screen permits you to adjust the PA volume. It also permits you to disable the ambient noise sensors (ANS).

You can access the screen on the CSCP or on any CACP.

Access

Touch PASSENGER ADDRESS on the cabin controls main menu screen to show the passenger address screen.

Volume Control

Touch the area selection arrows to select an area.

The configuration database identifies the airborne volume reference level. The volume indication shows the current volume above the reference level. Green vertical bars show the volume for the area selected.

The STEPS ABOVE MINIMUM shows the number of increments above the reference level. The range is from 0 to 16. The configuration data base determines the amount each increment increases the volume.

To increase the volume, touch the right arrow. To lower the volume, touch the left arrow. You cannot lower the volume level below the reference level.

Touch AREA RESET to return the volume to the reference level.

Ambient Noise Sensor Control

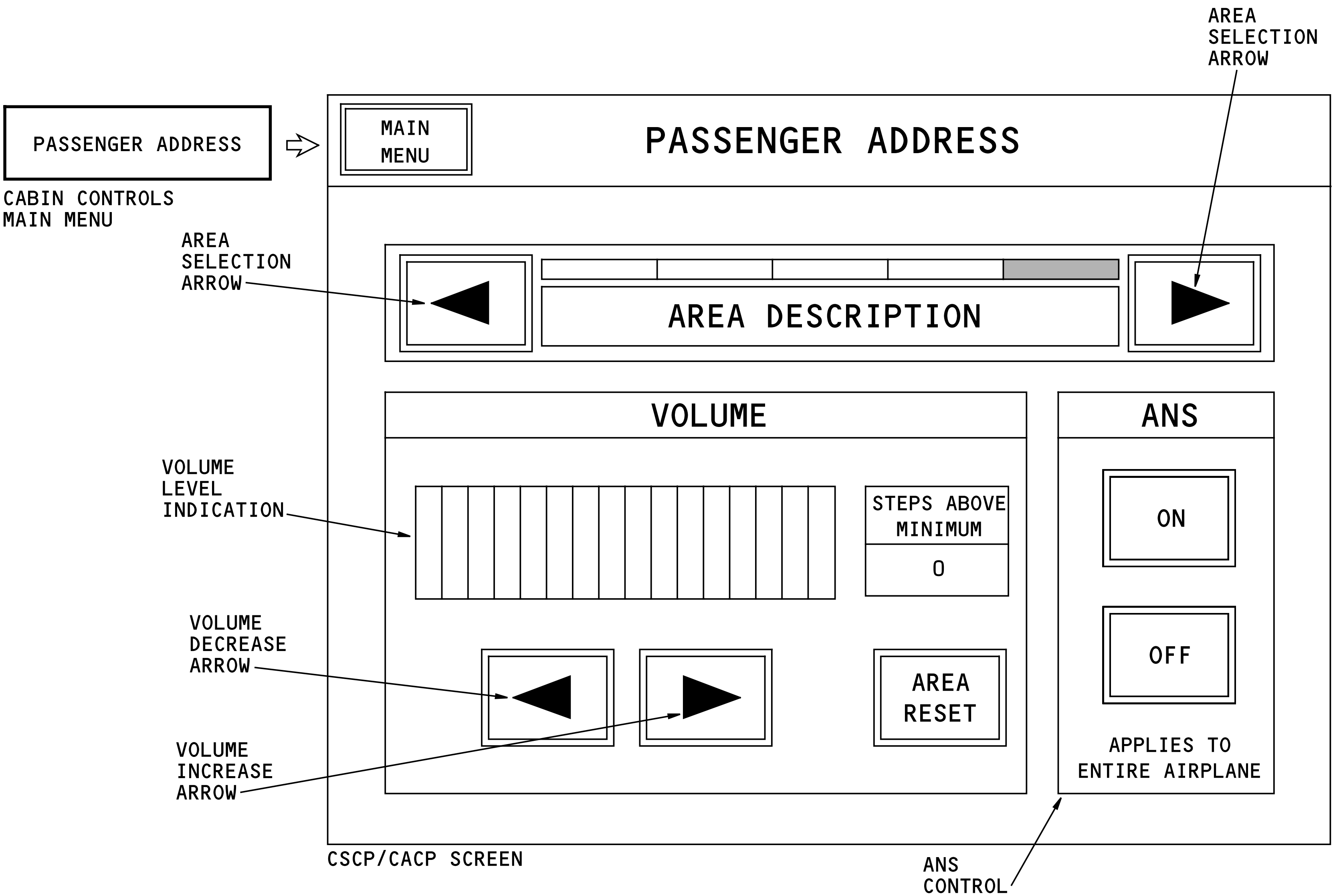
The ANS section permits you to enable or disable the ANSs. The ANS control goes to all ANSs in the airplane.

Touch ON to enable the ANSs. The PAS uses ANS inputs to calculate the volume levels.

Touch OFF to disable the ANSs. The PAS uses flight inputs to calculate the volume.

Training Information Point

It is normal to have the ambient noise sensors (ANSs) on. If the volume changes are too large, turn the ANSs off.



23-31-00-022 Rev 5 03/18/96

PAS - PASSENGER ADDRESS CONTROL SCREEN

PAS - NOISE GENERATION

General

Use the command output - speaker drive module (SDM) screen to make PAS noise for audio tests.

Access

Use these steps on the CSCP to select the screen:

- Touch CABIN MAINTENANCE on the CSCP main menu
- Touch CABIN TESTS on the cabin maintenance menu
- Touch ENGINEERING TESTS on the cabin tests menu
- Touch COMMAND OUTPUT on the engineering tests menu
- Touch SPEAKER DRIVE MODULE (SDM) on the command output menu.

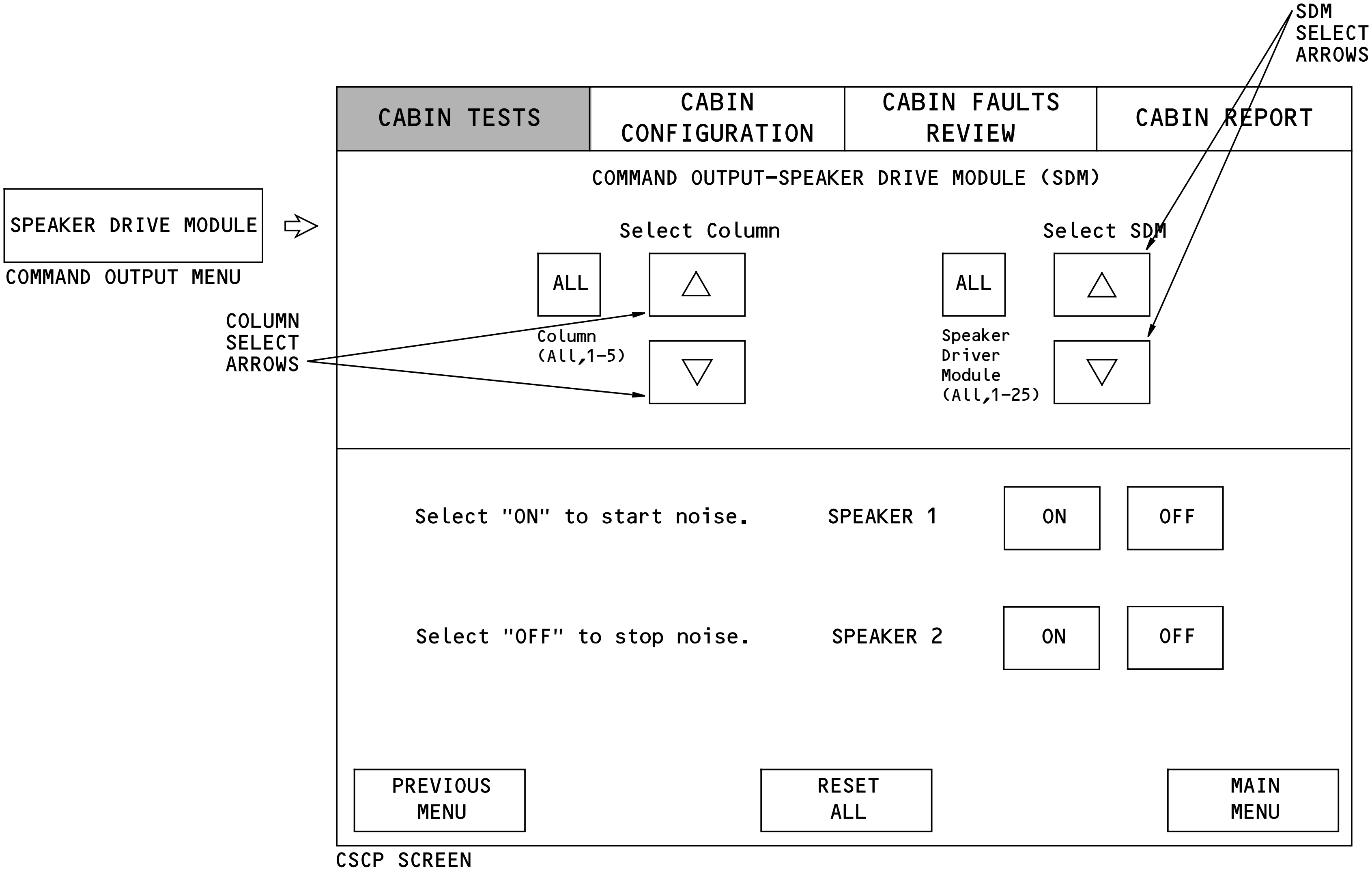
Command Output - Speaker Drive Modules Screen

Touch the column select arrows to select one or all columns (zones).

Touch the SDM select arrows to select one or more SDMs.

Touch SPEAKER 1 ON and SPEAKER 2 ON to cause the SDMs to make noise.

Touch RESET ALL to stop the random noise.



23-31-00-023 Rev 1 03/18/96

PAS - NOISE GENERATION

PAS - CABIN TESTS

General

Use the cabin system control panel (CSCP) to do the cabin test for the passenger address system (PAS).

See the cabin services system (CSS) section for more information about tests (AMM PART I 23-39).

Quick Test

Use quick test to quickly find major faults. This test does a check of these PAS components:

- Passenger address/cabin interphone (PA/CI) controller
- Speaker drive modules (SDMs).

This test collects continuous monitor data for as long as 20 seconds. The CSCP shows the failures.

To start a quick test, touch START QUICK TEST.

All Test

Use all test for a more complete test. All test starts a complete BITE of the system. The screen shows all the failures the BITE finds.

To start an all test, touch START ALL TEST.

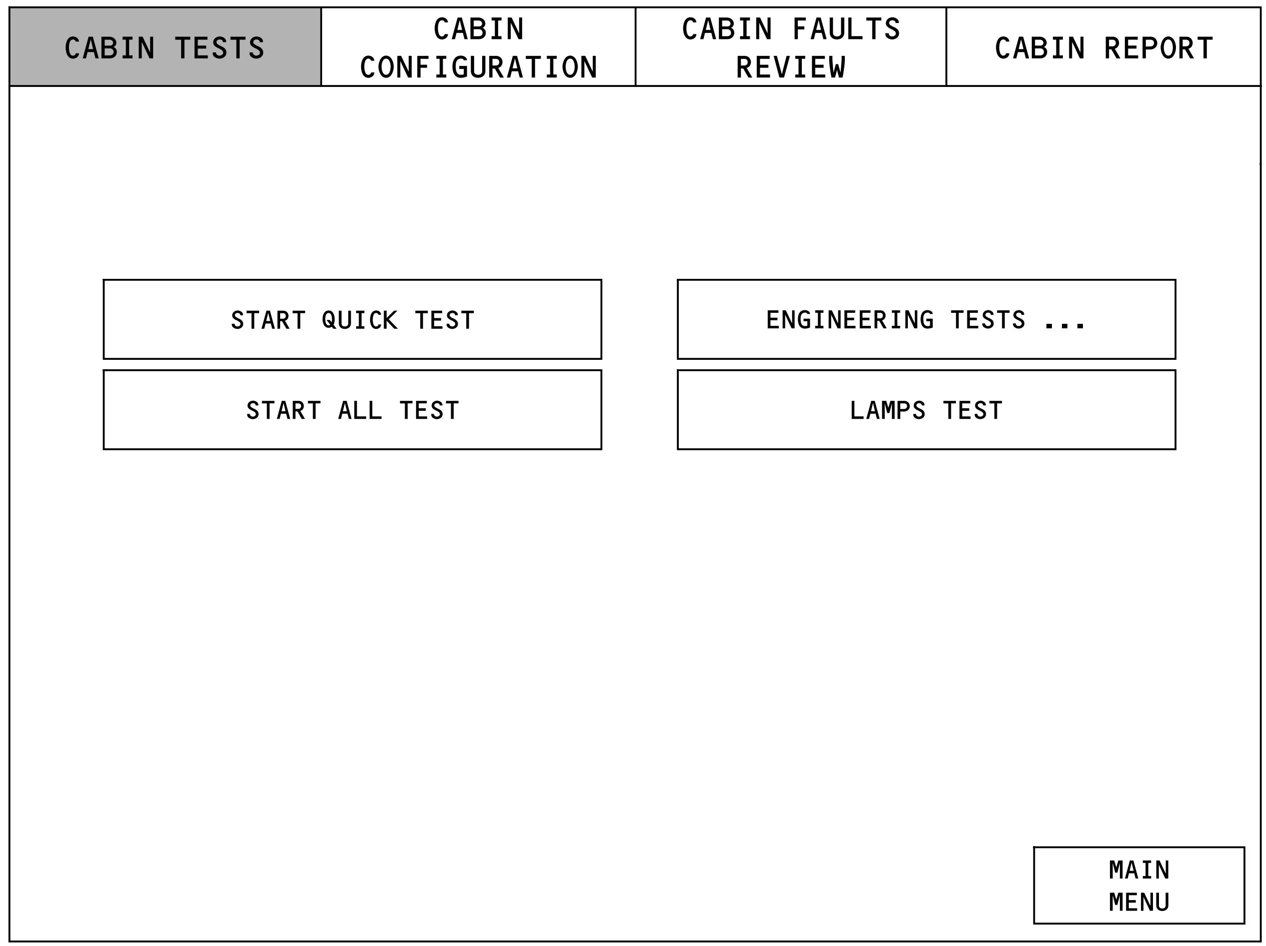
Engineering Tests

Use engineering tests for more detailed tests.

Touch ENGINEERING TESTS to show the engineering tests menu.

Lamps Test

The lamps test does not do a test of the PAS.



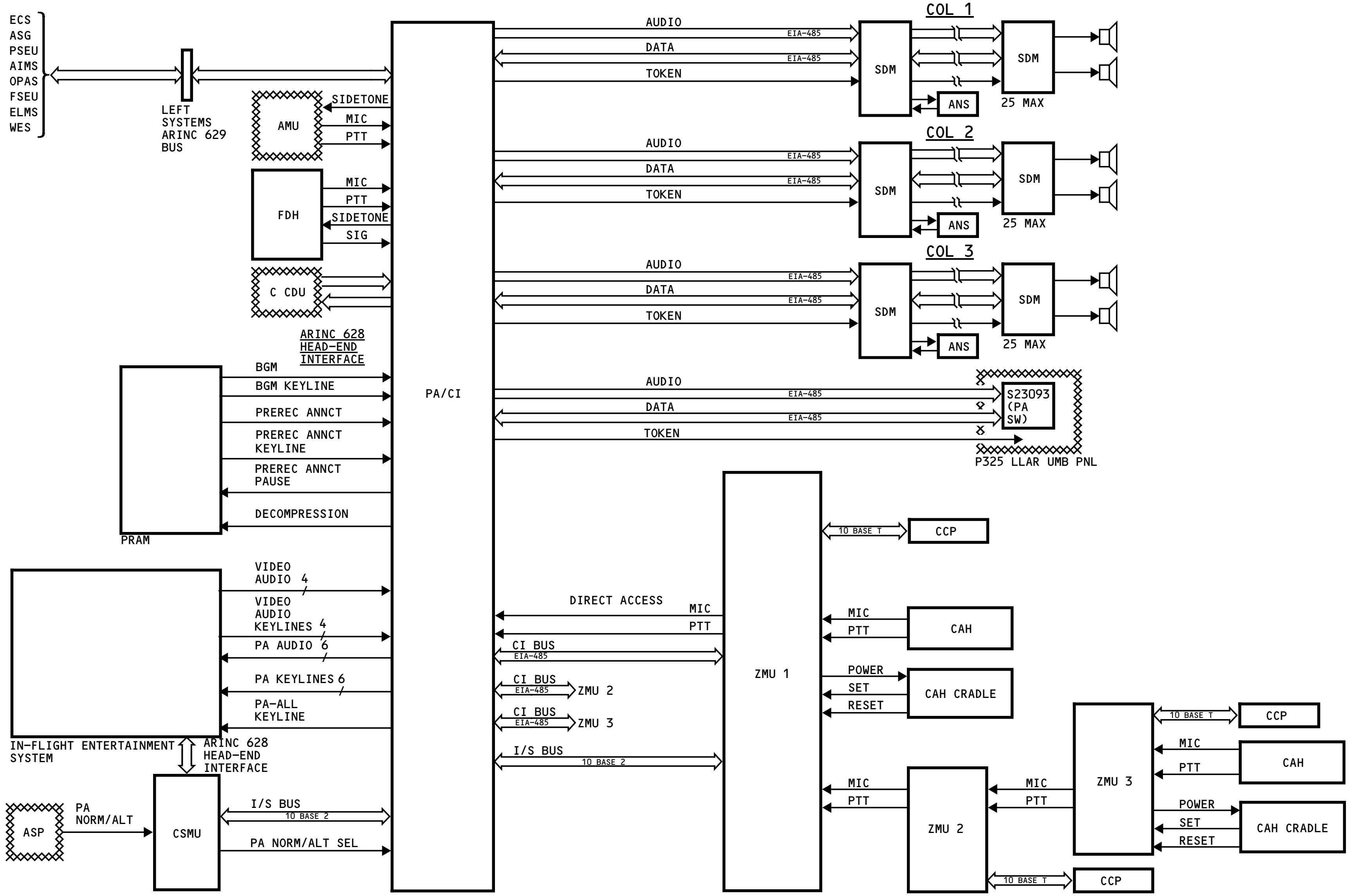
CABIN SYSTEM CONTROL PANEL

PAS - CABIN TESTS

PAS - INTERFACE DIAGRAM

Interface Diagram

This interface diagram is for reference purposes.



PAS - INTERFACE DIAGRAM

23-31-00-024 Rev 24 10/28/1997

Continental Airlines, Inc

Passenger Service System

WB371

TABLE OF CONTENTS

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PASSENGER SERVICE SYSTEM - INTRODUCTION

Introduction

The passenger service system (PSS) has these three functions:

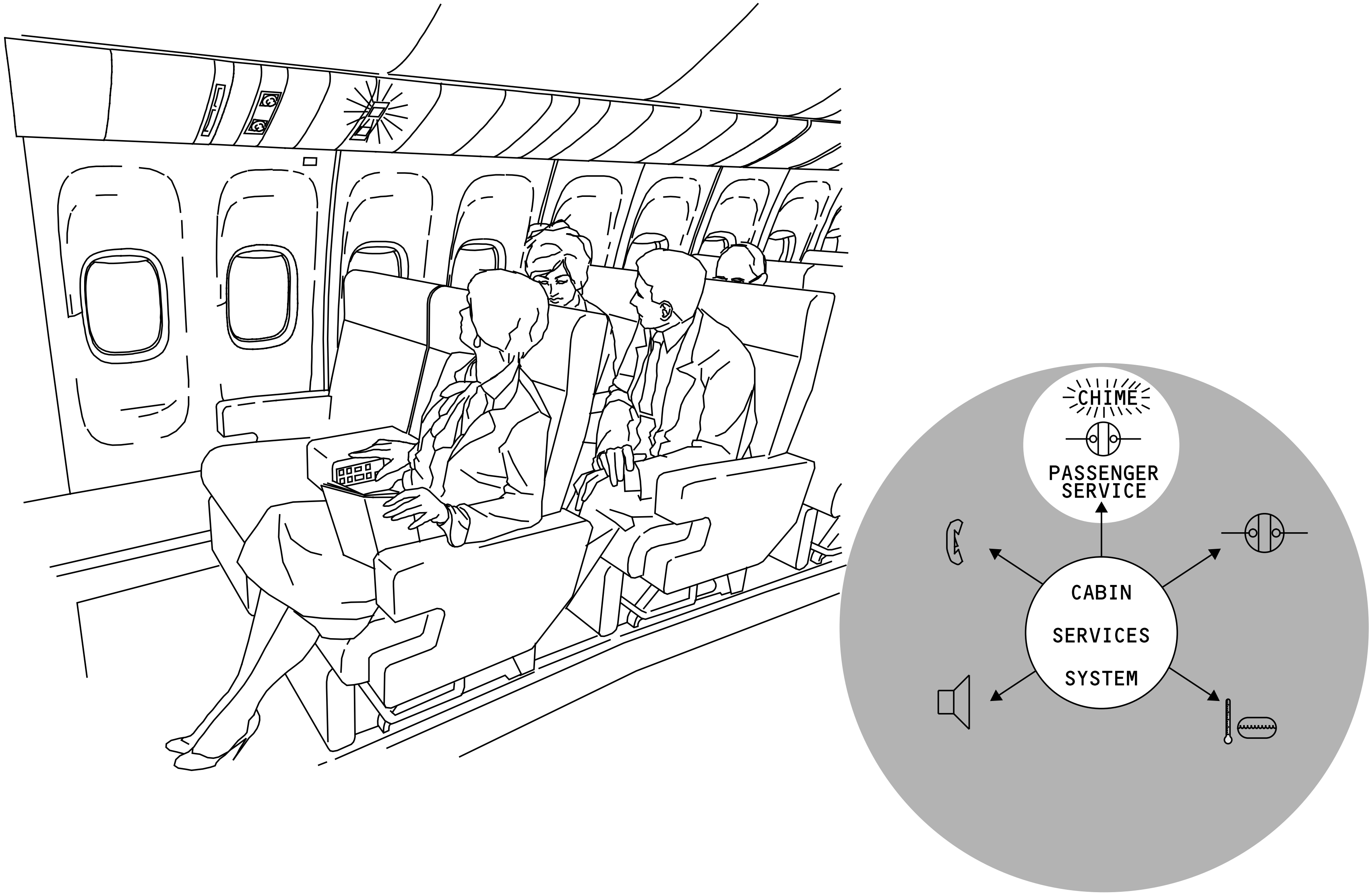
- Lets passengers call flight attendants for cabin service
- Gives passengers control of reading lights
- Shows passengers information on cabin signs.

The flight attendants use the PSS to do these functions:

- Turn off passenger to attendant call chimes
- Control no smoking areas
- Control passenger reading lights.

Abbreviations and Acronyms

AIMS	- airplane information management system
CACP	- cabin area control panel
CCP	- cabin control panel
CSS	- cabin services system
CSCP	- cabin system control panel
CSMU	- cabin system management unit
ELMS	- electrical load management system
FSEU	- flap/slat electronics unit
IFE	- in-flight entertainment
I/S BUS	- intersystem bus
LLAR	- lower lobe attendants rest
OEU	- overhead electronics unit
OPAS	- overhead panel ARINC 629 system
PA/CI	- passenger address/cabin interphone
pax	- passenger
PIS	- passenger information sign
PSEU	- proximity sensor electronics unit
PSS	- passenger service system
PSU	- passenger service unit
umb	- umbilical
ZMU	- zone management unit



PASSENGER SERVICE SYSTEM - INTRODUCTION

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PSS - GENERAL DESCRIPTION

General

The passenger services system (PSS) has head-end and zone interfaces with the in-flight entertainment (IFE) system for PSS functions.

The PSS gets inputs from the left and right systems ARINC 629 buses and flight attendants to control passenger information signs.

The PSS also gets data from passengers to control reading lights and attendant call lights.

The PSS sends configuration database information and status information to the IFE.

Components

These are the main components of the passenger service system (PSS):

- Zone management units (ZMUs)
- Cabin control panels (CCPs)
- Overhead electronics units (OEUs)

These other systems and components connect with the PSS:

- Cabin system management unit (CSMU)
- Passenger address/cabin interphone (PA/CI) controller
- Right and left systems ARINC 629 buses
- Lavatory modules
- Reading and call lights.

Passenger Service/Entertainment On/Off

Attendants may use the CCPs to enable or disable the reading lights and attendant call lights. They may also use a panel to turn off the attendant call and reading lights.

Passenger Information Signs

The PSS gets inputs from other systems to control passenger information signs. The OEUs send signals to control these types of signs:

- Lavatory
- Return to seat
- Fasten seat belts
- No smoking.

Reading Light Control

Passengers use controls at their seat to control reading lights. The reading light selection goes through the IFE seat components to the ZMU. The ZMU sends the on or off signal to an OEU to control the reading light.

Passenger to Attendant Call

Passengers use controls at their seat to call a flight attendant. When the passenger pushes the attendant call button:

PSS - GENERAL DESCRIPTION

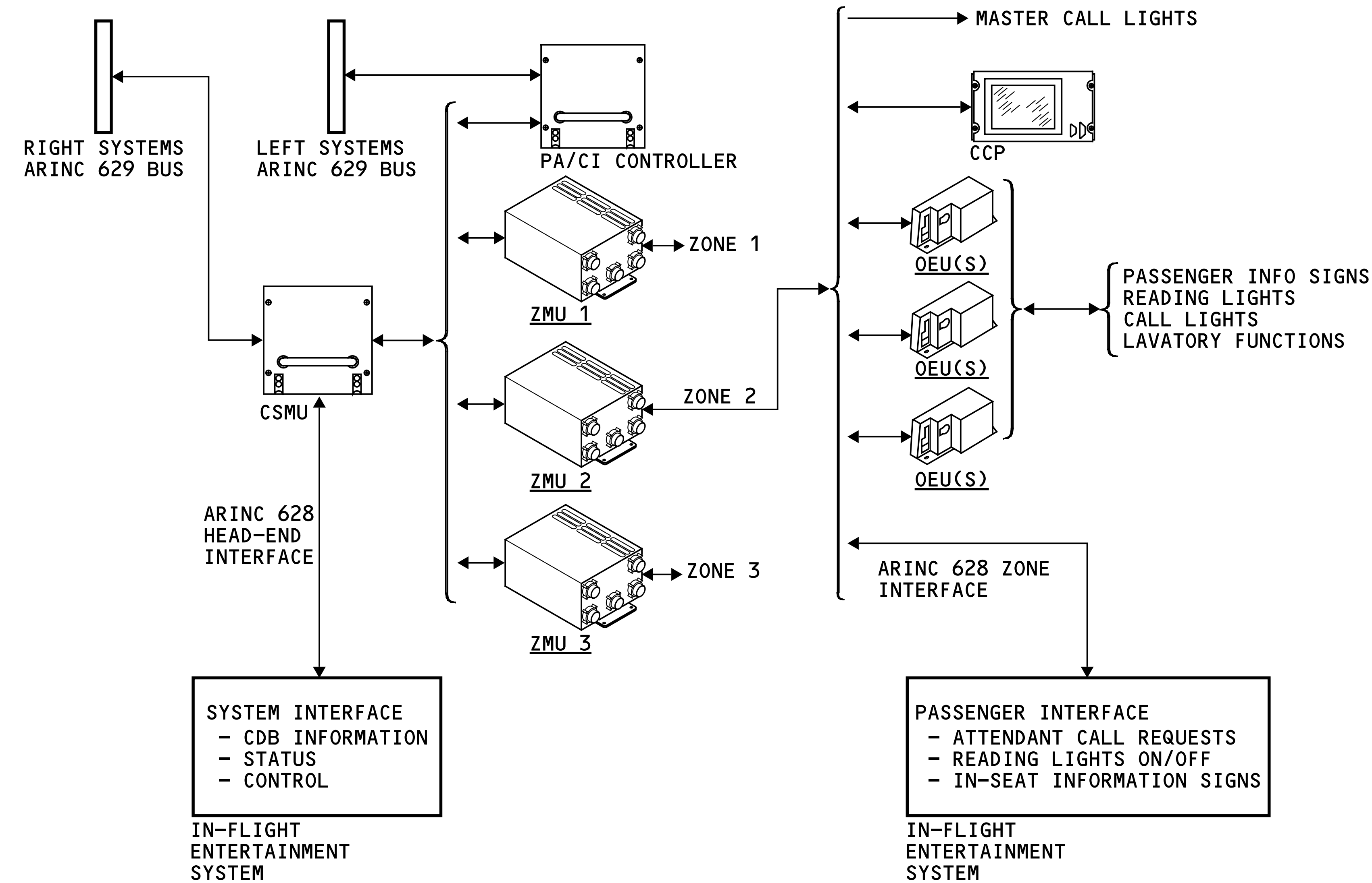
- A row call light in the passenger service unit (PSU) comes on
- A master call light at an attendant station comes on
- The passenger address system makes a chime.

Chime Cut-Off Function

Attendants use the CCPs to disable the chime related to a passenger-to-attendant call. Each CCP controls the chimes in an area identified by the configuration database.

Lavatory Functions

The lavatories connect with OEUs for lavatory to attendant calls and lavatory status signals.



PSS - GENERAL DESCRIPTION

23-33-00-002.018 Rev 2 02/11/1998

PSS - CARGO COMPARTMENT COMPONENT LOCATIONS

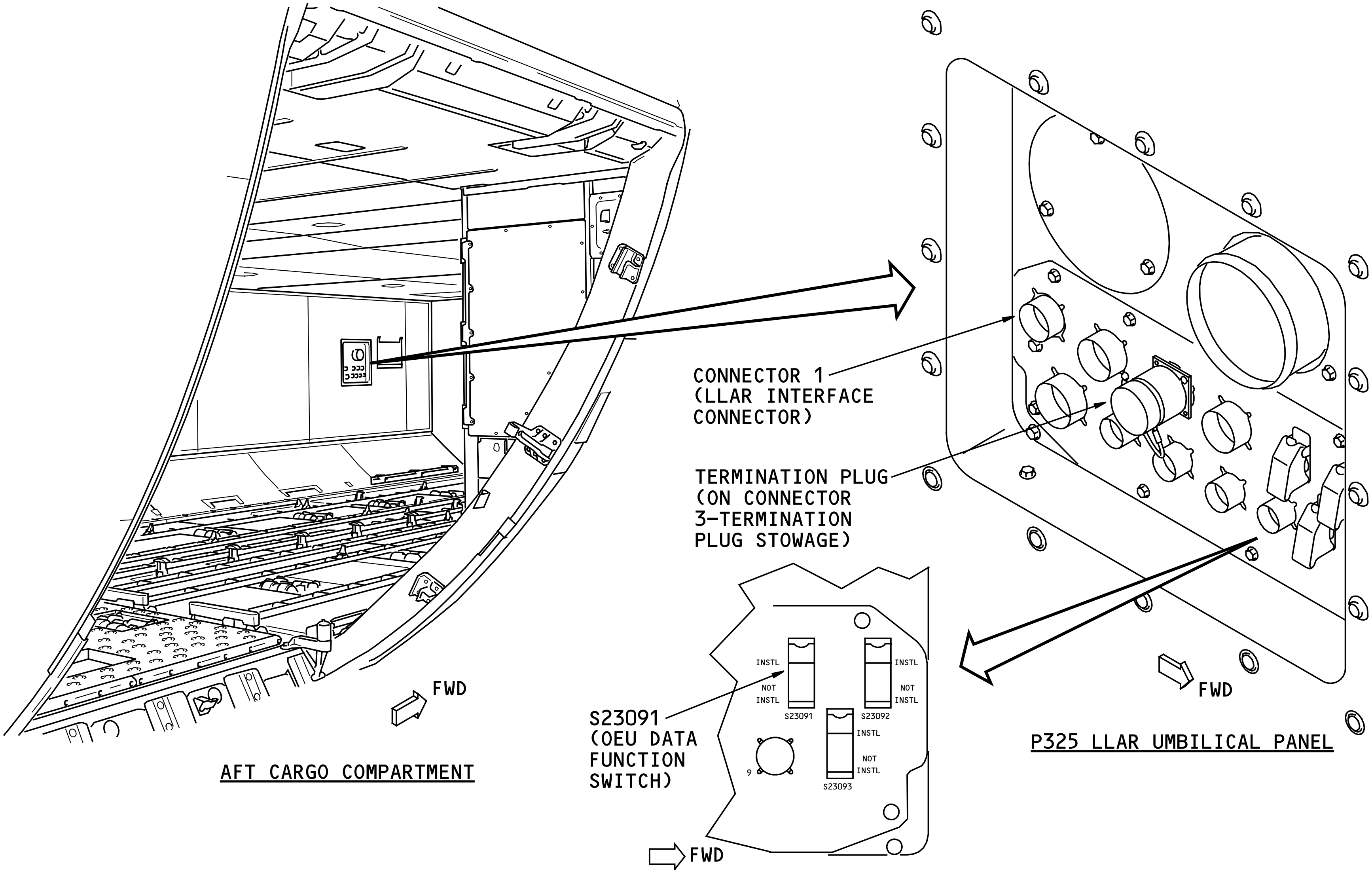
General

The P325 lower lobe attendants rest (LLAR) umbilical panel is on the left sidewall in the aft cargo compartment.

S23091 (OEU data function switch) connects the OEU functions to the LLAR components when you install the LLAR in the airplane.

When the LLAR is not in the airplane, you must put a termination plug on connector 1 on the P325 panel.

When you install the LLAR, one of the LLAR cables goes to connector 1 on the P325 panel. Move the termination plug to connector 3 for stowage. Connector 3 has no electrical connections.



23-33-00-035 Rev 3 03/12/1997

PSS - CARGO COMPARTMENT COMPONENT LOCATIONS

PSS - POWER INTERFACE - ZONE 1

General

Circuit breakers on the right and left power management panels control power to these zone 1 components:

- Zone management unit (ZMU) 1
- Overhead electronics units (OEUs).

The P210 right power management panel has the PAX MASTER CALL LT circuit breaker.

The P110 left power management panel has these components:

- ZONE MGMT UNIT 1 circuit breaker
- OEU ZONE1 XFER BUS circuit breaker
- OEU ZONE1 MAIN BUS circuit breaker.

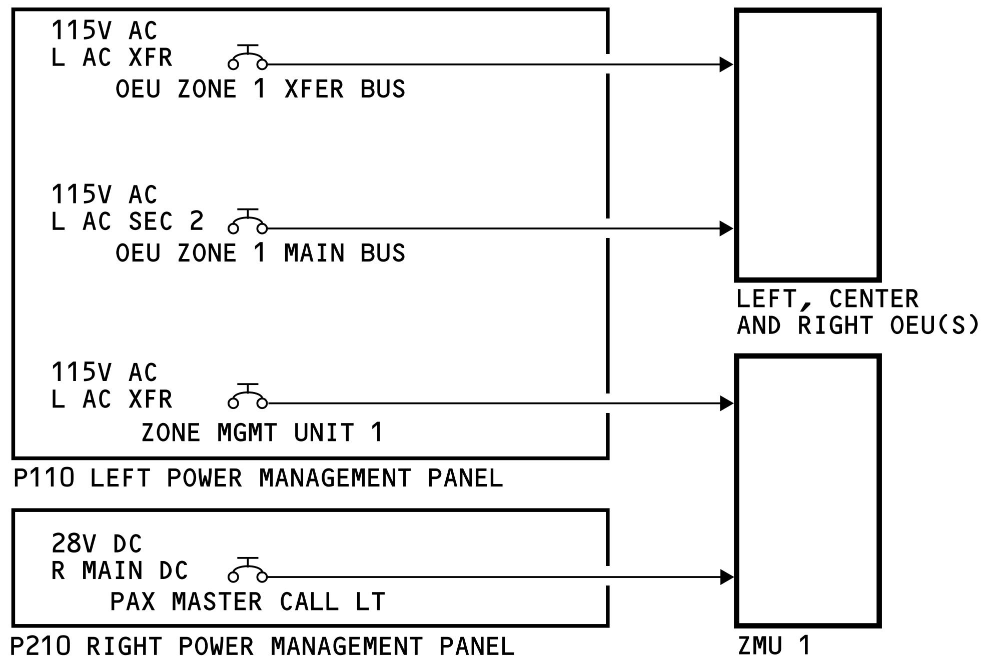
P210 Right Power Management Panel

The PAX MASTER CALL LT circuit breaker connects 28v dc to the ZMU.

P110 Left Power Management Panel

The ZONE MGMT UNIT 1 circuit breaker connects 115v ac to the ZMU.

The OEU ZONE1 XFER BUS and OEU ZONE1 MAIN BUS circuit breakers each connect 115v ac power to all three columns of OEUs.



23-33-00-004 Rev 6 10/28/1997

PSS - POWER INTERFACE - ZONE 1

PSS - POWER INTERFACE - ZONE 2

General

Circuit breakers on the right power management panel control power to these zone 2 components:

- Zone management unit (ZMU) 2
- Overhead electronics units (OEUs).

The P210 right power management panel has these components:

- PAX MASTER CALL LT circuit breaker
- ZONE MGMT UNIT 2 circuit breaker
- OEU ZONE2 LEFT MAIN BUS circuit breaker
- OEU ZONE2 CENTER MAIN BUS circuit breaker
- OEU ZONE2 RIGHT MAIN BUS circuit breaker
- OEU ZONE2 XFER BUS circuit breaker.

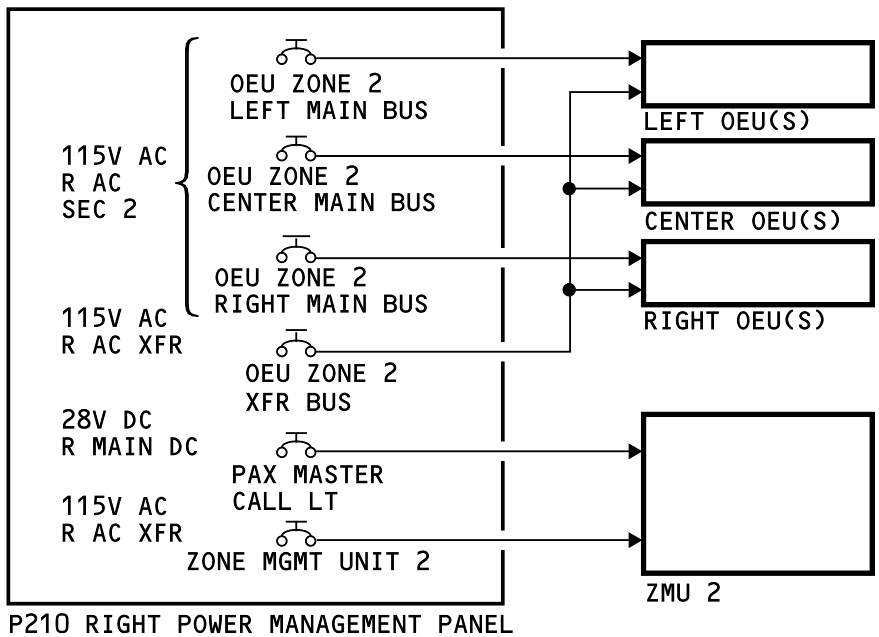
P210 Right Power Management Panel

The PAX MASTER CALL LT circuit breaker connects 28v dc to ZMU 2. The ZONE MGMT UNIT 2 circuit breaker connects 115v ac to the ZMU.

These circuit breakers each connect 115v ac power to a column of OEUs:

- OEU ZONE2 LEFT MAIN BUS to the left OEUs
- OEU ZONE2 CENTER MAIN BUS to the center OEUs
- OEU ZONE2 RIGHT MAIN BUS to the right OEUs.

The OEU ZONE2 XFER BUS circuit breaker connects 115v ac power to all of the OEUs in zone 2.



23-33-00-005 Rev 7 10/28/1997

PSS - POWER INTERFACE - ZONE 2

PSS - POWER INTERFACE - ZONE 3

General

Circuit breakers on the left and right power management panels control power to these zone 3 components:

- Zone management unit (ZMU) 3
- Overhead electronics units (OEUs).

The P110 left power management panel has these components:

- ZONE MGMT UNIT 3 circuit breaker
- OEU ZONE3 LEFT MAIN BUS circuit breaker
- OEU ZONE3 CENTER MAIN BUS circuit breaker
- OEU ZONE3 RIGHT MAIN BUS circuit breaker
- OEU ZONE 3 XFER BUS circuit breaker

The PAX MASTER CALL LT circuit breaker is on the P210 right power management panel.

P110 Left Power Management Panel

The ZONE MGMT UNIT 3 circuit breaker connects 115v ac to the ZMU.

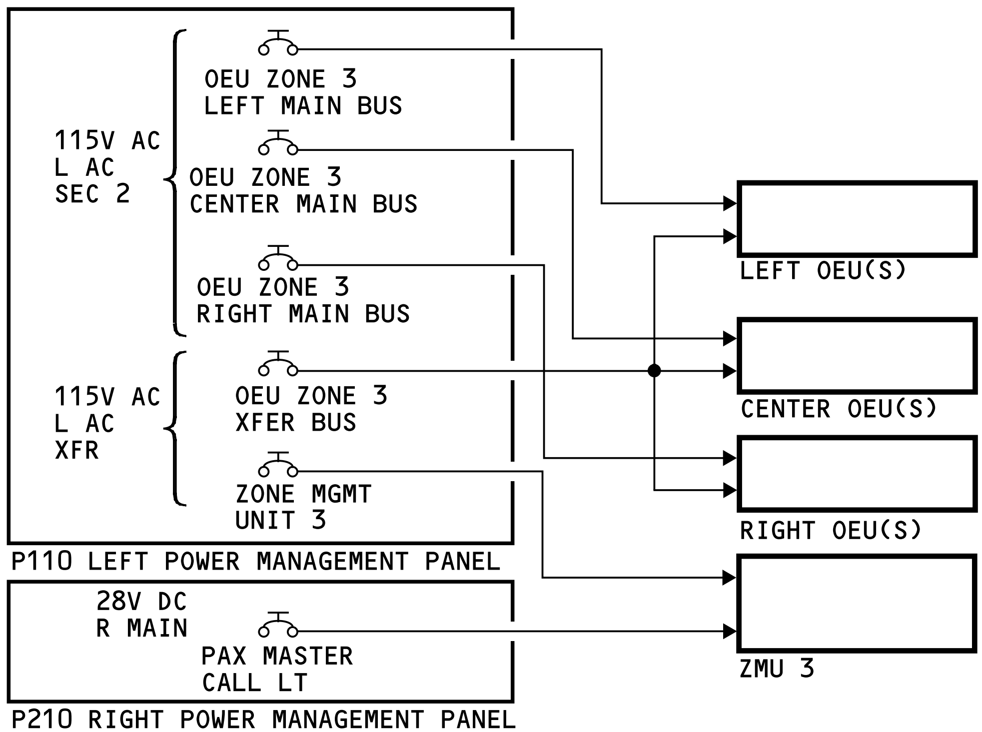
These circuit breakers each connect 115v ac power to a column of OEUs:

- OEU ZONE 3 LEFT MAIN BUS to the left OEUs
- OEU ZONE 3 CENTER MAIN BUS to the center OEUs
- OEU ZONE 3 RIGHT MAIN BUS to the right OEUs.

The OEU ZONE 3 XFER BUS circuit breaker connects 115v ac power to all of the OEUs in zone 3.

P210 Right Power Management Panel

The PAX MASTER CALL LT circuit breaker connects 28v dc to the ZMU.



23-33-00-006 Rev 7 10/28/1997

PSS - POWER INTERFACE - ZONE 3

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PSS - INTERFACES

General

The passenger service system (PSS) uses an ARINC 629 interface and an in-flight entertainment (IFE) system ARINC 628 head-end interface to get data from other systems. An intersystem (I/S) bus connects the three cabin zones. Other buses connect the other PSS components.

The passenger interface for PSS is through an IFE system ARINC 628 zone interface.

The diagram shows zone 1 interfaces. The other zones are the same.

ARINC 629

The passenger address/cabin interphone (PA/CI) controller connects to the left systems ARINC 629 bus. The cabin system management unit (CSMU) connects to the right systems ARINC 629 bus. The PA/CI and CSMU get data from these systems to control the passenger information signs:

- Airplane information management system (AIMS)
- Electrical load management system (ELMS)
- Overhead panel ARINC 629 system (OPAS)
- Flap/slat electronics unit (FSEU)
- Proximity sensor electronics unit (PSEU).

ARINC 628 Interface

PSS sends smoking area information and a no smoking signal to the IFE system on the ARINC 628 head-end interface.

The passenger interface for PSS is through an ARINC 628 zone interface to the IFE system. PSS gets attendant call requests and reading light inputs. PSS sends reset information and seat call status on the zone interface.

Intersystem Bus

Each of these components connects to the intersystem bus to control PSS functions:

- CSMU
- PA/CI controller
- Zone management units (ZMUs).

The intersystem bus passes through the components it connects. A failure of any component cannot cause a failure of the bus.

Other Buses

The cabin control panel (CCP) sends command signals to the ZMU on a panel bus. The ZMU sends display data to the CCP.

The ZMUs get commands and data from the I/S bus to control data to the OEUs and IFE. Each ZMU has an EIA-

PSS - INTERFACES

485 bus to each column of overhead electronics units (OEUs).

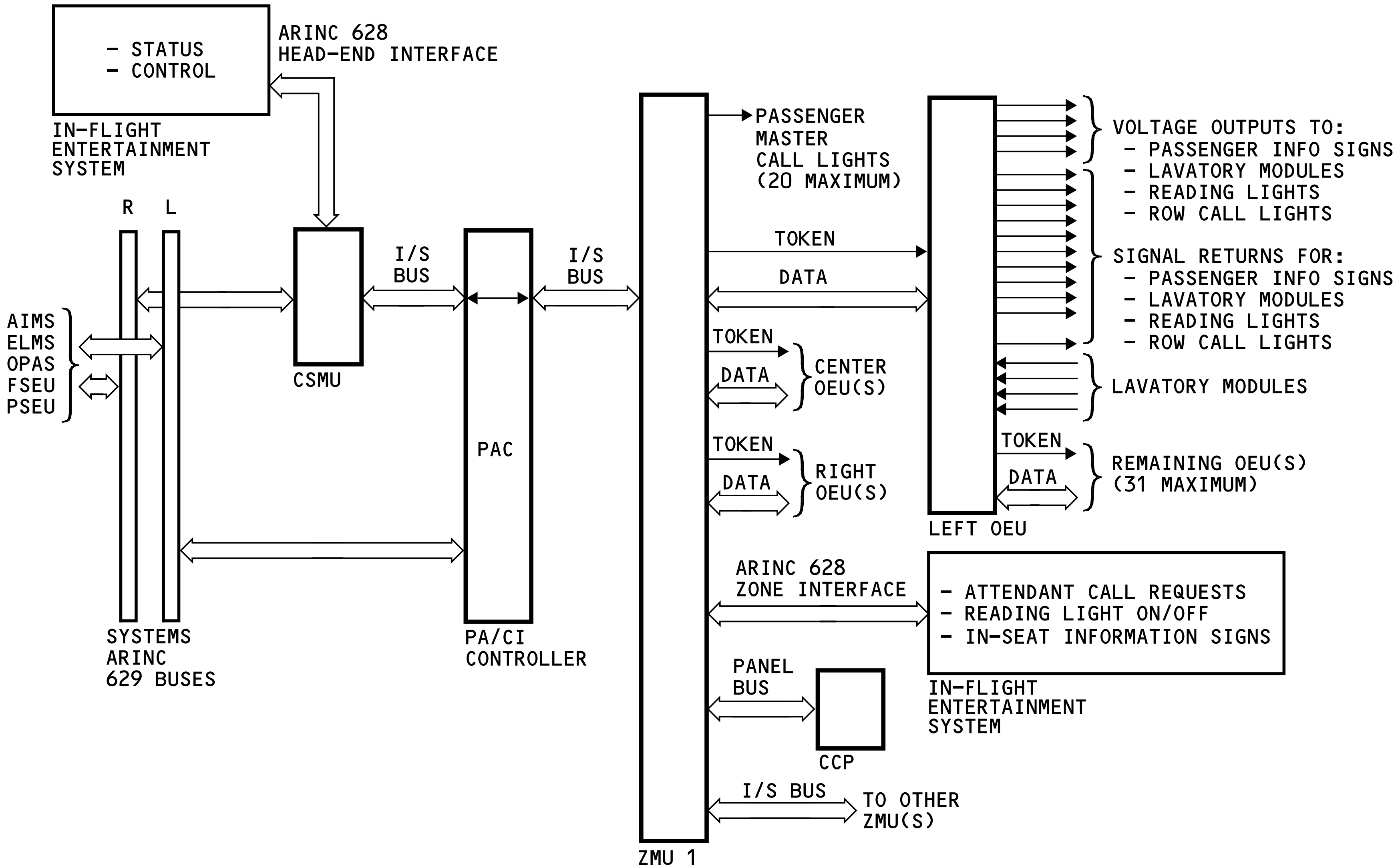
Discretes

Each ZMU can control as many as 20 passenger master call lights. The ZMU also sends a token signal to each column of OEUs for software installation.

Each OEU has four voltage outputs and twelve signal returns. The OEU controls the signal returns for these passenger service items:

- Passenger information signs
- Return to seat and lock door signs in the lavatories
- Reading lights
- Row call lights.

Each OEU has four inputs to monitor signals from lavatory modules.



23-33-00-007 Rev 9 10/28/1997

PSS - INTERFACES

PSS - LLAR INTERFACES

General

Zone management unit (ZMU) 3 has an interface with the P325 lower lobe attendant rest (LLAR) umbilical panel.

You use a switch on the P325 LLAR umbilical panel to control the OEU interfaces to LLAR components. A termination plug terminates the IFE system signals.

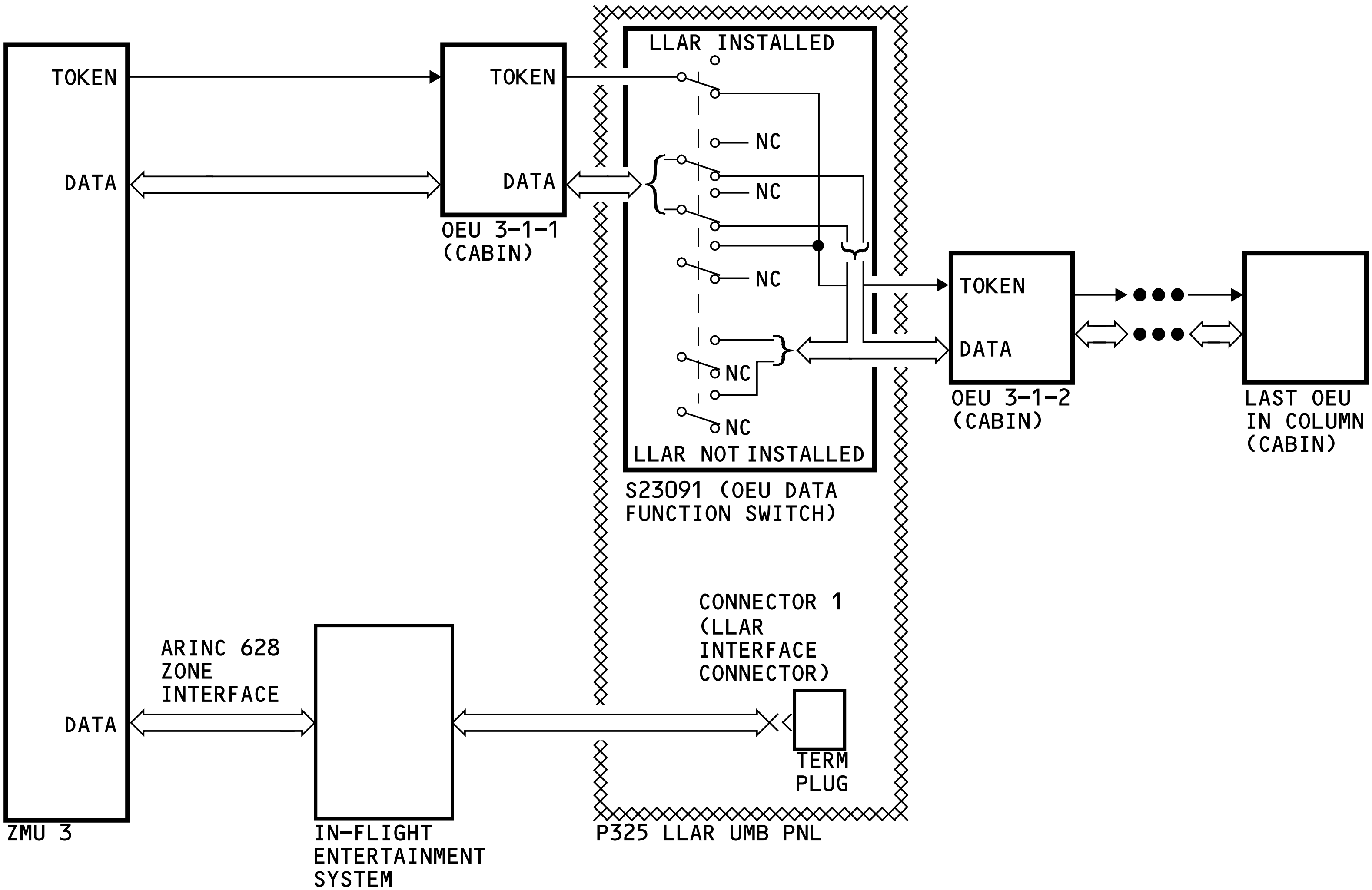
OEU Interface

When S23091 (OEU data function switch) on the P325 LLAR umbilical panel is in the LLAR NOT INSTALLED position, the signals go from OEU 3-1-1 to OEU 3-1-2 and then to the other OEUs in the column.

IFE System Interface

ZMU 3 sends data to the IFE system components in the cabin and to the P325 LLAR umbilical panel.

When the LLAR is not installed, the IFE system signals terminate at a termination plug on the LLAR interface connector.



23-33-00-034 Rev 6 04/10/1997

PSS - LLAR INTERFACES

PSS - OVERHEAD ELECTRONICS UNIT

General

The overhead electronics units (OEUs) control these components:

- Reading lights
- Call lights
- Passenger information signs.

They also monitor signals from lavatories and waste tanks.

Physical Description

The OEU weighs 1.7 pounds. It has these dimensions:

- Length - 8.7 inches
- Width - 2.75 inches
- Height - 4 inches.

The OEU has three connectors. J1 is the voltage and data bus input/output. It receives data from the ZMU or another OEU and sends it to the next OEU through the same connector. For correct operation, install a jumper plug when you remove an OEU.

J2 provides voltage and signal outputs.

J3 provides voltage and signal outputs and gets discrete inputs.

Functional Description

The OEUs change 115v ac power to these voltages:

- 28v ac for lavatory and passenger information signs
- 12v ac for reading lamps
- 5v ac for row call lights.

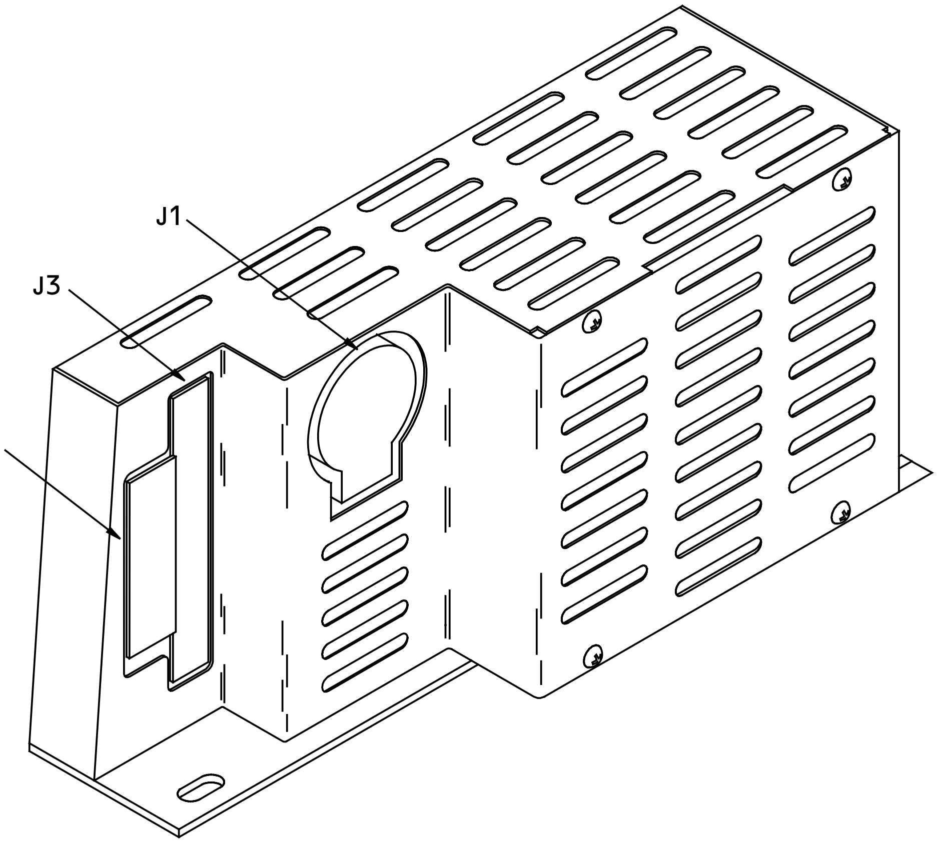
The OEUs get signals from the ZMU to control these PSS related items:

- Reading lights
- Call lights
- Passenger information signs.

The OEUs monitor lavatory-to-attendant calls and door latch discretes from the lavatory modules.

These systems and components also connect to OEUs:

- Lavatory and crew rest smoke detectors
- Water and waste system
- Cabin lighting system.



23-33-00-009 Rev 0

PSS - OVERHEAD ELECTRONICS UNIT

PSS - OEU INSTALLATION - PASSENGER SERVICE UNITS

General

There are overhead electronics units (OEUs) in the center and outboard passenger service units (PSUs). There are also OEUs in other cabin locations. Three screws attach the OEU to a panel.

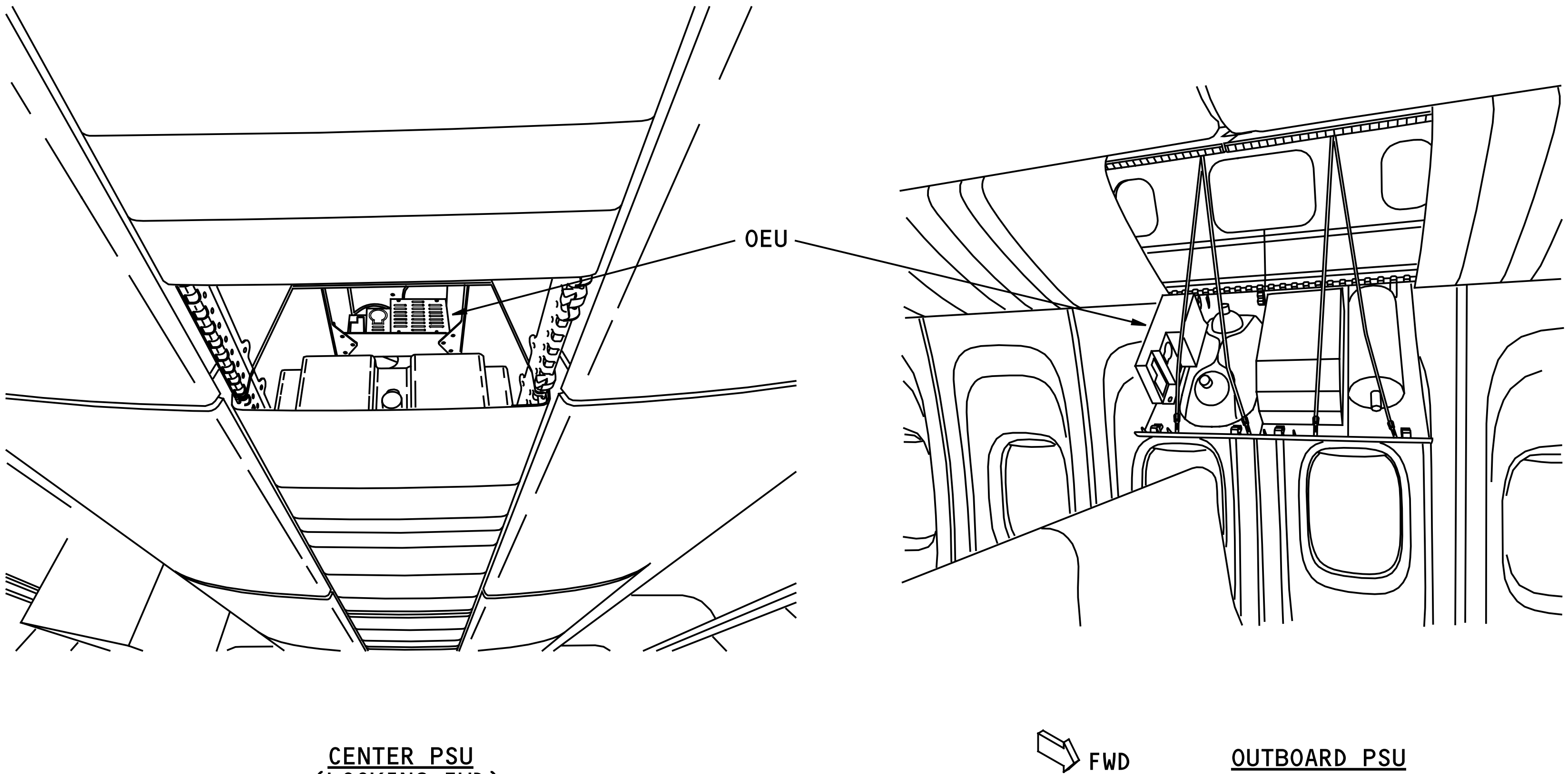
Center PSU

Release the PSU panel latches and lower the PSU to get to the OEU. The OEU is on a bracket approximately eight inches above the PSU panel.

Outboard PSU

The left and right OEUs are on outboard PSUs.

Release the panel latches and lower the PSU. The OEU is on the PSU panel.



23-33-00-010 Rev 2 05/03/95

PSS - OEU INSTALLATION - PASSENGER SERVICE UNITS

PSS - OEU INSTALLATION - LAVATORIES AND LOWERED CEILING AREAS

General

There are overhead electronics units (OEUs) in these locations:

- Each lavatory
- Above each passenger door
- Some lowered ceiling panels.

The diagram shows a typical lavatory and typical door area with lowered ceiling panels.

Lavatories

The lavatory OEUs mount to a passenger service unit (PSU) rail adjacent to the lavatory.

Training Information Point

You must remove ceiling panels adjacent to the lavatory to get to the OEU.

Overdoor Panels

Panels over each passenger door have an OEU.

Release the latches of the overdoor panel and lower it to get access to the OEU.

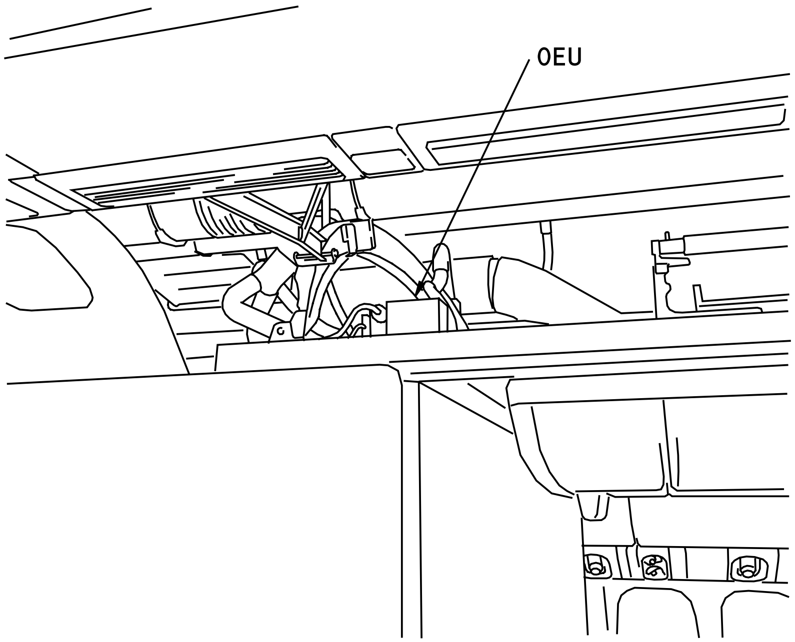
Lowered Ceiling Panels

The flight deck aisle access panel (near door 1 left) and a lowered ceiling panel at door 4 left have OEUs.

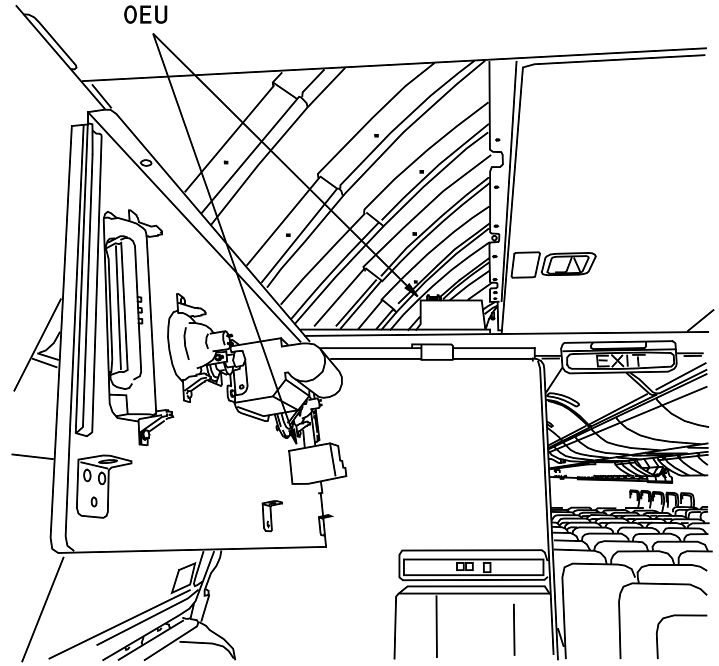
Training Information Point

Lower the flight deck aisle access panel to get access to the OEUs in the door 1 area.

Release the latches of the door 4L overdoor panel and lower it to get access to the OEU on the lowered ceiling panel.



TYPICAL LAVATORY MODULE



TYPICAL LOWERED CEILING AND OVERDOOR PANEL

23-33-00-011 Rev 1

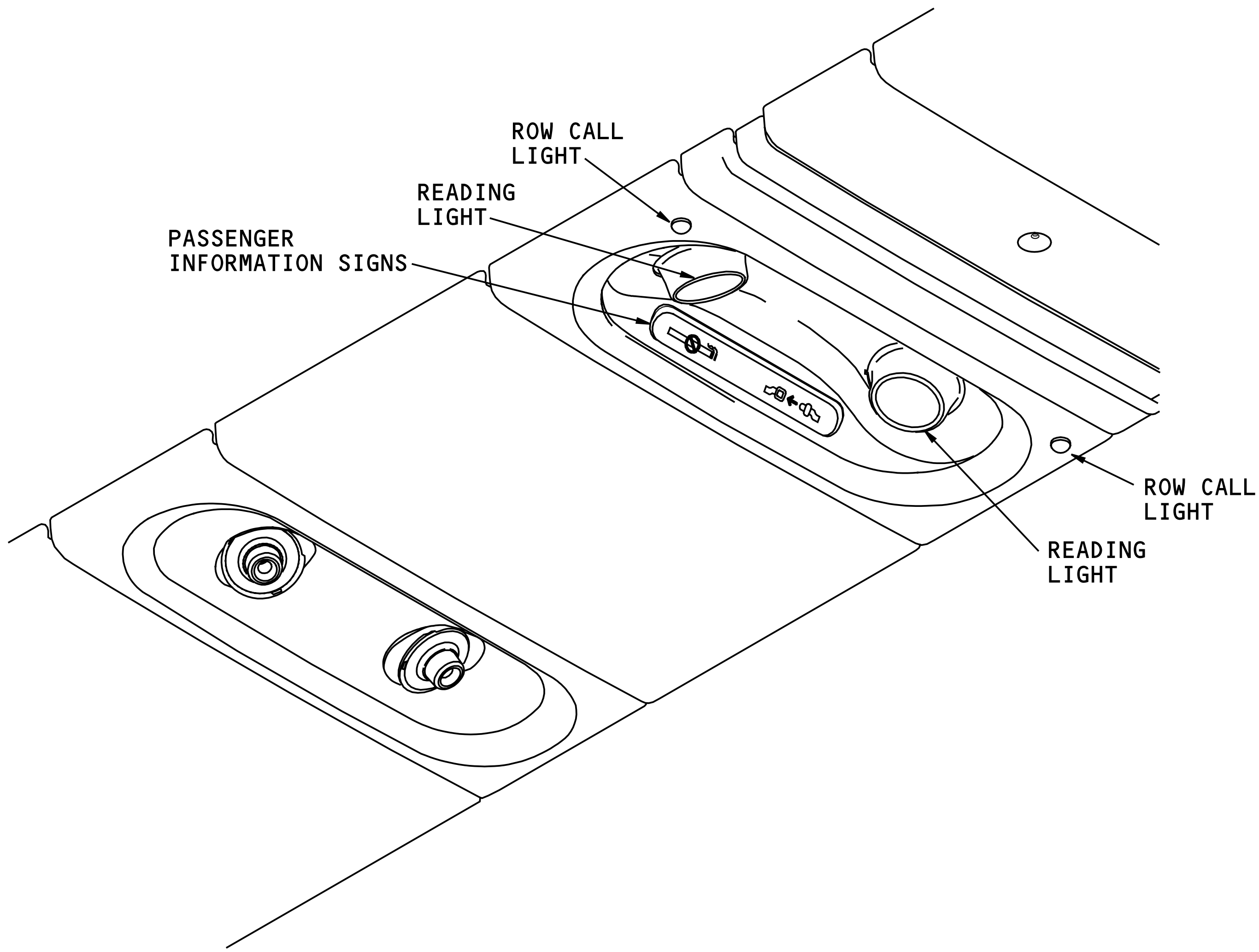
PSS - OEU INSTALLATION - LAVATORIES AND LOWERED CEILING AREAS

PSS - PASSENGER SERVICE UNIT

General

The passenger service unit (PSU) has these passenger service system items:

- Row call lights
- Reading lights
- Passenger information signs.



23-33-00-012 Rev 0

PSS - PASSENGER SERVICE UNIT

PSS - PASSENGER INFORMATION SIGNS

General

The passenger information signs show passengers these PSS conditions:

- No smoking
- Lavatory occupied
- Fasten seat belt.

TYPICAL PASSENGER INFORMATION SIGN

23-33-00-013 Rev 1

PSS - TYPICAL LAVATORY COMPONENTS

General

These lavatory components send and get signals through an overhead electronics unit (OEU):

- Lavatory call light/reset switch
- Return to seat sign
- Lavatory call switch
- Lock door sign
- Lavatory door latch.

Lavatory Call Light/Reset Switch

The lavatory call light comes on when you push the lavatory call switch. Attendants push this light/switch to cancel lavatory calls.

Return to Seat Sign

The return to seat sign comes on when the fasten seat belt signal is active and and cabin pressure is normal.

Lavatory Call Switch

Passengers use the lavatory call switch to call an attendant. The lavatory call switch makes the PSS do these things:

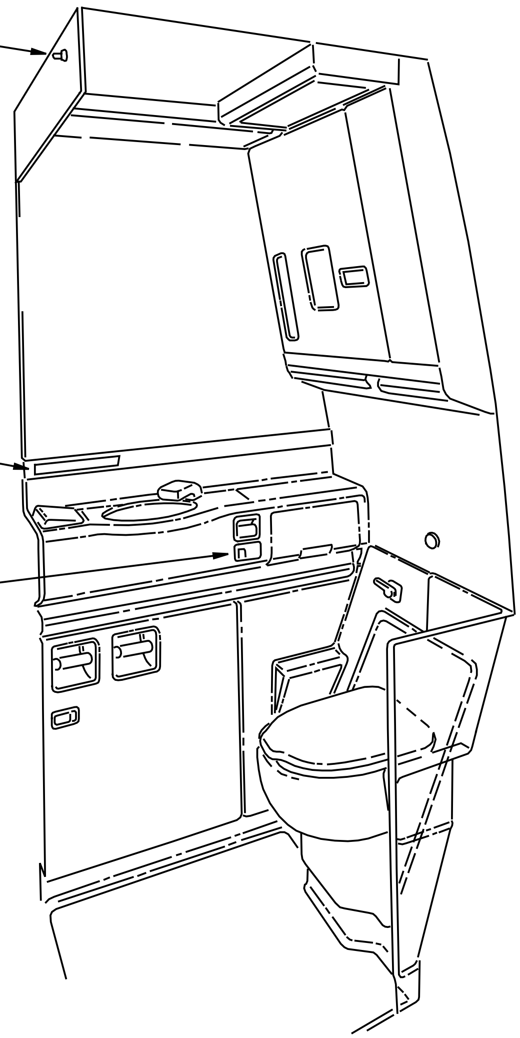
- The lavatory call light outside the lavatory comes on
- A lavatory master call light at an attendant station comes on
- A signal goes to the passenger address system for a chime.

Lock Door Sign

The lock door sign is on when the lavatory door is not locked.

Lavatory Door Latch

The lavatory door latch sends a signal to the PSS to make the lock door sign go off and a lavatory occupied sign come on.



NOT SHOWN:
- LOCK DOOR SIGN
- LAVATORY DOOR LATCH

PSS - TYPICAL LAVATORY COMPONENTS

PSS - CONFIGURATION DATABASE PROGRAMMED ITEMS

General

The cabin management system (CMS) configuration database supplies details of CMS operation. For the PSS, the database gives configuration data for these items:

- Master call light assignments
- Row call light assignments
- Lavatory call light assignments
- Reading light assignments
- Chime mute areas
- Passenger information sign control
- Panels for PSS on/off control
- OEU configuration.

Master Call Light Assignments

A passenger-to-attendant call or lavatory call makes a master call light come on. The configuration database specifies which master call lights come on in an area.

Row and Lavatory Call Light Assignments

The database specifies the relation of the attendant call button on each passenger control unit and the adjacent row call light on a passenger service unit.

The database also specifies which lavatory call light comes on when a passenger makes a call from a lavatory.

Reading Light Assignments

When a passenger pushes a reading light switch on the passenger control unit (PCU), a reading light comes on. The configuration database specifies which reading light comes on or goes off.

Chime Mute Areas

The configuration database specifies the chime mute areas for cabin control panels (CCPs).

Passenger Information Sign Control

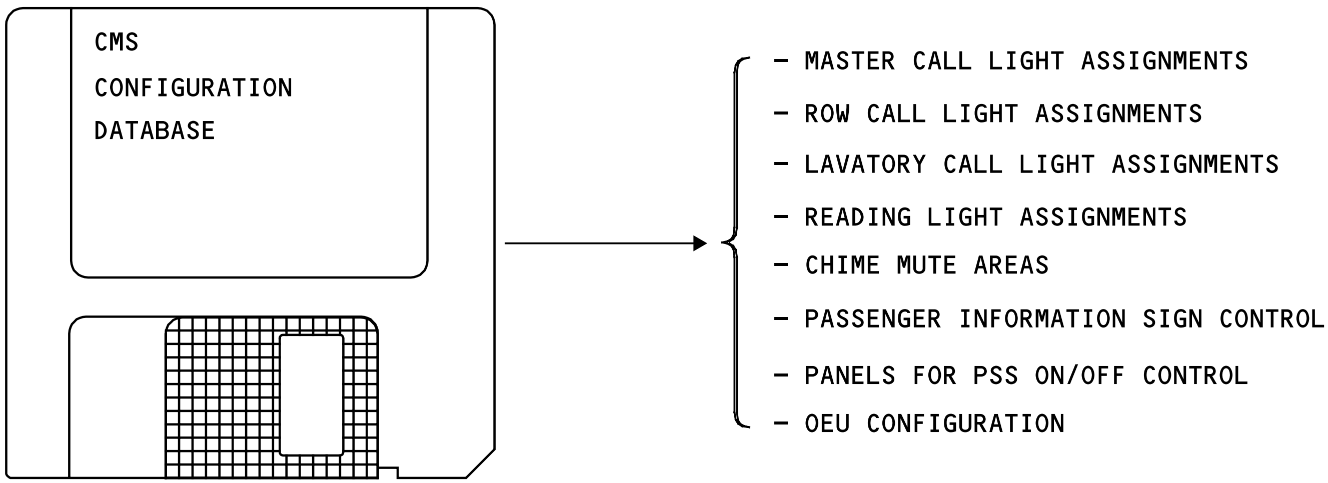
The database specifies the conditions that control all of the passenger information signs.

Panels for PSS On/Off Control

The configuration database specifies which control panels can turn the passenger service system on and off.

OEU Configuration

The database specifies how many OEUs are in each column. It also tells which components connect to each OEU.



23-33-00-015 Rev 2 04/24/1997

PSS - CONFIGURATION DATABASE PROGRAMMED ITEMS

PSS - OPERATION - CABIN CONTROLS MAIN MENU SCREEN

General

Attendants use the cabin controls main menu on the cabin system control panel (CSCP) or cabin area control panels (CACPs) to select screens that control PSS functions. Touch any one of these to show PSS related screens:

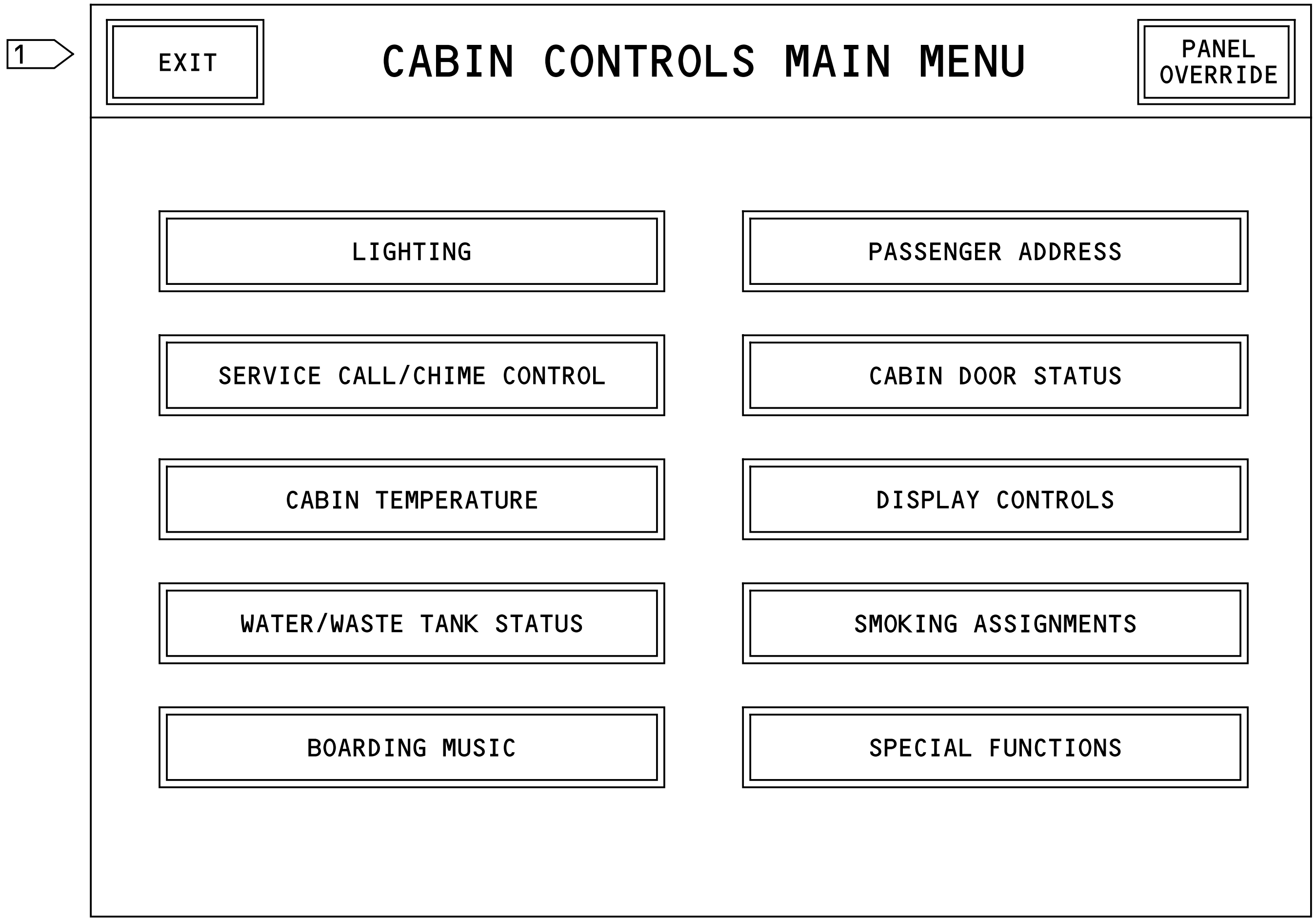
- LIGHTING
- SERVICE CALL/CHIME CONTROL
- SMOKING ASSIGNMENTS.

Access

Touch CABIN CONTROLS on the CSCP main menu to show this screen.

On the CACP, the cabin controls main menu is the highest level menu. It shows automatically when you apply power to the CSS.

The CACPs do not have the EXIT selection.



CSCP/CACP SCREEN

1 THE EXIT SELECTION IS NOT ON THE CACP.

PSS – OPERATION – CABIN CONTROLS MAIN MENU SCREEN

PSS - OPERATION - LIGHTING MENU SCREEN

General

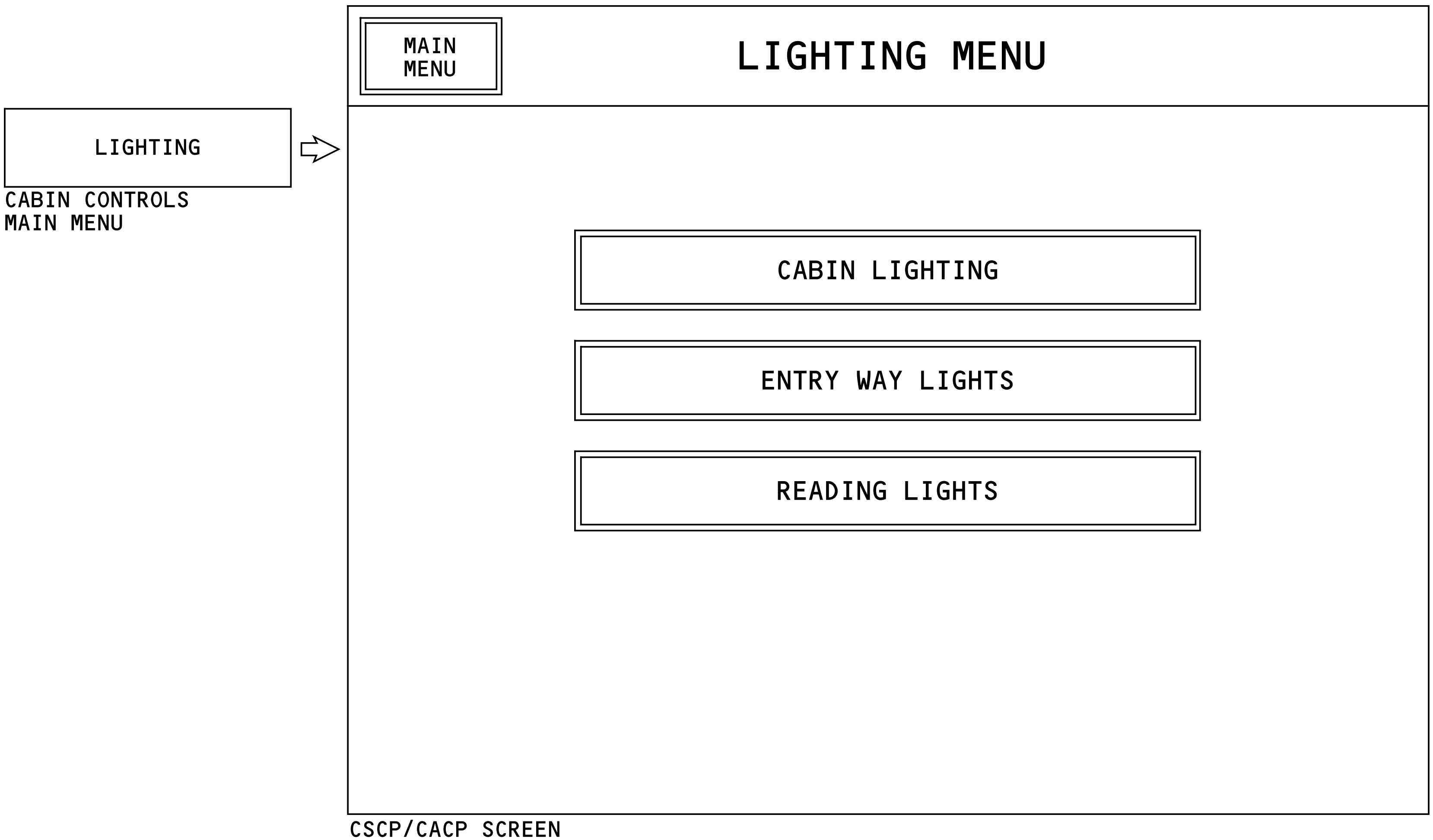
Attendants use the lighting menu on the cabin system control panel (CSCP) or cabin area control panels (CACPs) to select the reading lights control screen.

Access

Touch the LIGHTING selection on the cabin controls main menu to show this screen.

Controls and Indications

Touch READING LIGHTS to show the screen you use to control passenger reading lights.



23-33-00-021 Rev 1 03/26/96

PSS - OPERATION - LIGHTING MENU SCREEN

PSS - OPERATION - READING LIGHTS SCREEN

General

You use the reading lights screen to control the passenger reading lights.

Access

Touch LIGHTING on the cabin controls main menu. Then touch READING LIGHTS to show the reading lights screen.

Controls and Indications

Use the left and right arrows to select the cabin area. The space between the arrows shows the selected cabin area description.

Use the selections below the cabin area description to control the reading lights.

Latched Mode Operation

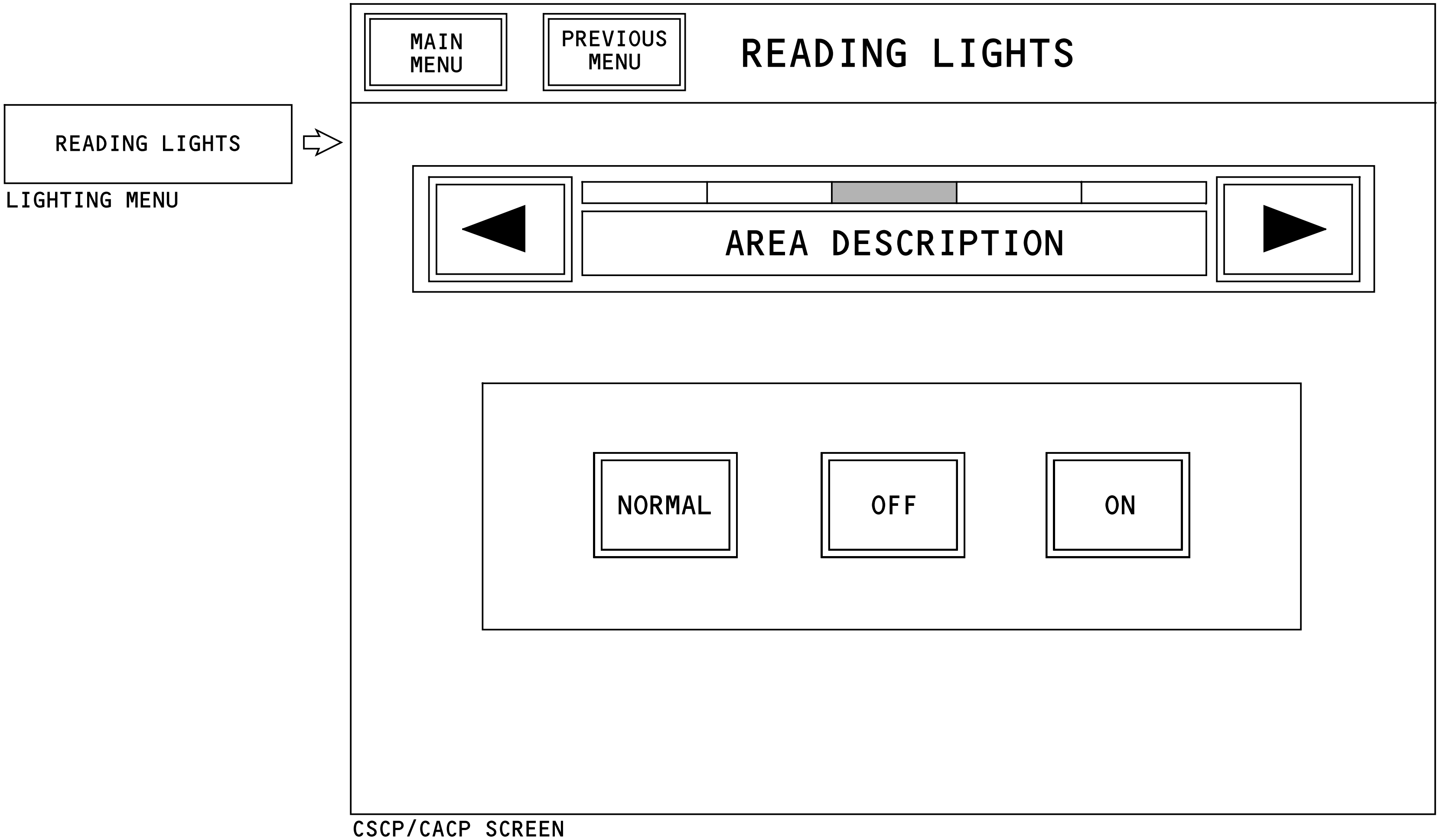
Touch NORMAL to let the passengers control their reading lights.

Touch OFF or ON to turn all reading lights in the selected area off or on. The screen selection shows green and the reading lights stay in the commanded mode until you make another selection.

Momentary Mode Operation

Touch ON or OFF to turn all reading lights in the selected area on or off. The screen selection changes to green for one-half second and the reading lights go to the commanded mode.

After one-half second, passengers can control their reading lights and the NORMAL selection on the panel changes to green.



23-33-00-022 Rev 1 03/26/96

PSS - OPERATION - READING LIGHTS SCREEN

PSS - OPERATION - SERVICE CALL/CHIME CONTROL MENU SCREEN

General

Attendants use the service call/chime control menu to select a screen that shows passenger calls. They can also select screens to control chimes.

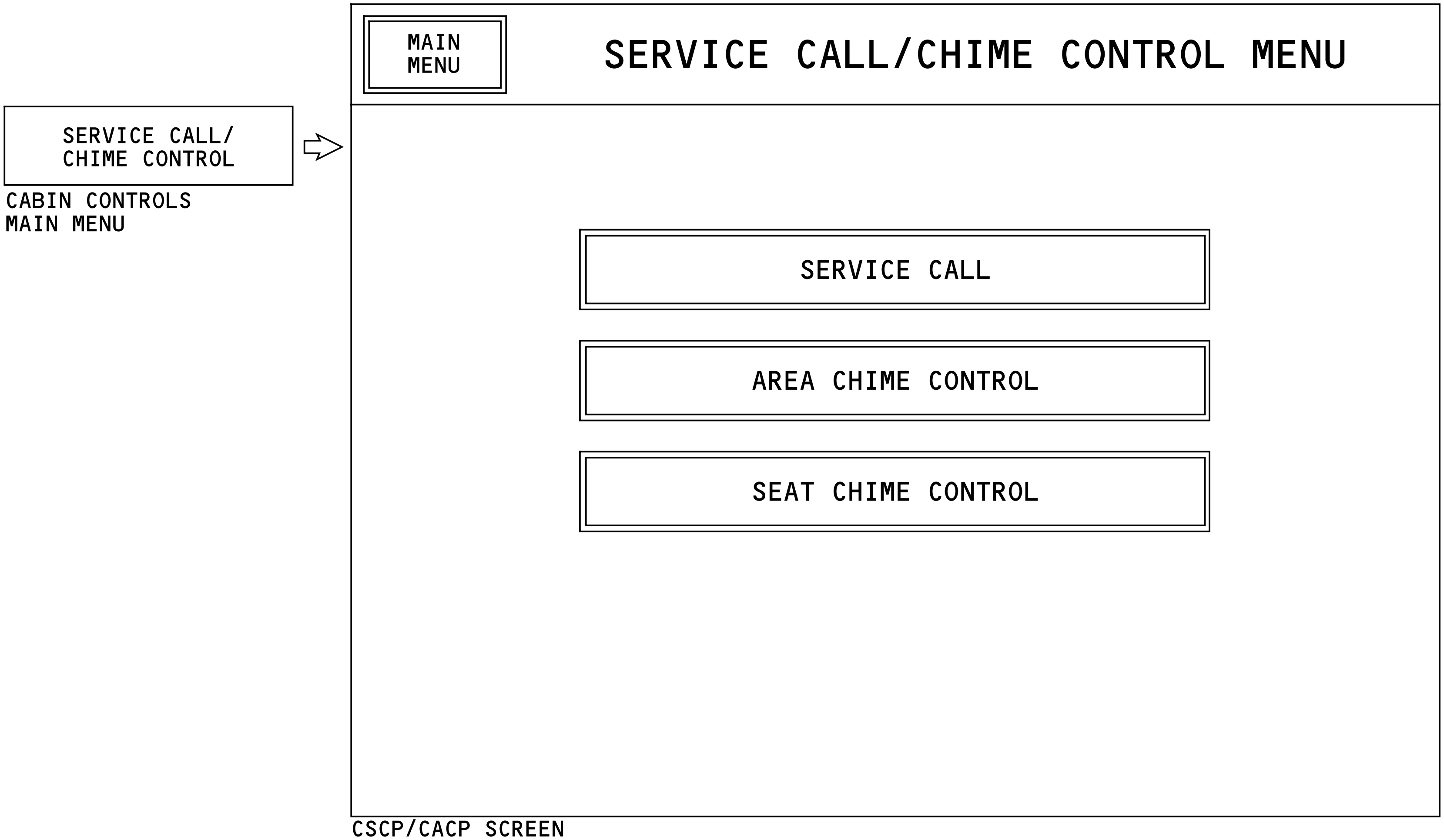
Access

Touch SERVICE CALL/CHIME CONTROL on the cabin controls main menu to show this screen.

Controls and Indications

Touch these selections to go to the screen that controls the related function:

- SERVICE CALL - to see passenger call data
- AREA CHIME CONTROL - to disable passenger-to-attendant chimes in a selected area
- SEAT CHIME CONTROL - to disable each passenger-to-attendant chime.



23-33-00-023 Rev 1 03/26/96

PSS - OPERATION - SERVICE CALL/CHIME CONTROL MENU SCREEN

PSS - OPERATION - SERVICE CALL SCREEN

General

Attendants use the service call screen to see active passenger-to-attendant calls and lavatory calls.

Access

Touch SERVICE CALL/CHIME CONTROL on the cabin controls main menu. Then touch SERVICE CALL to show this screen.

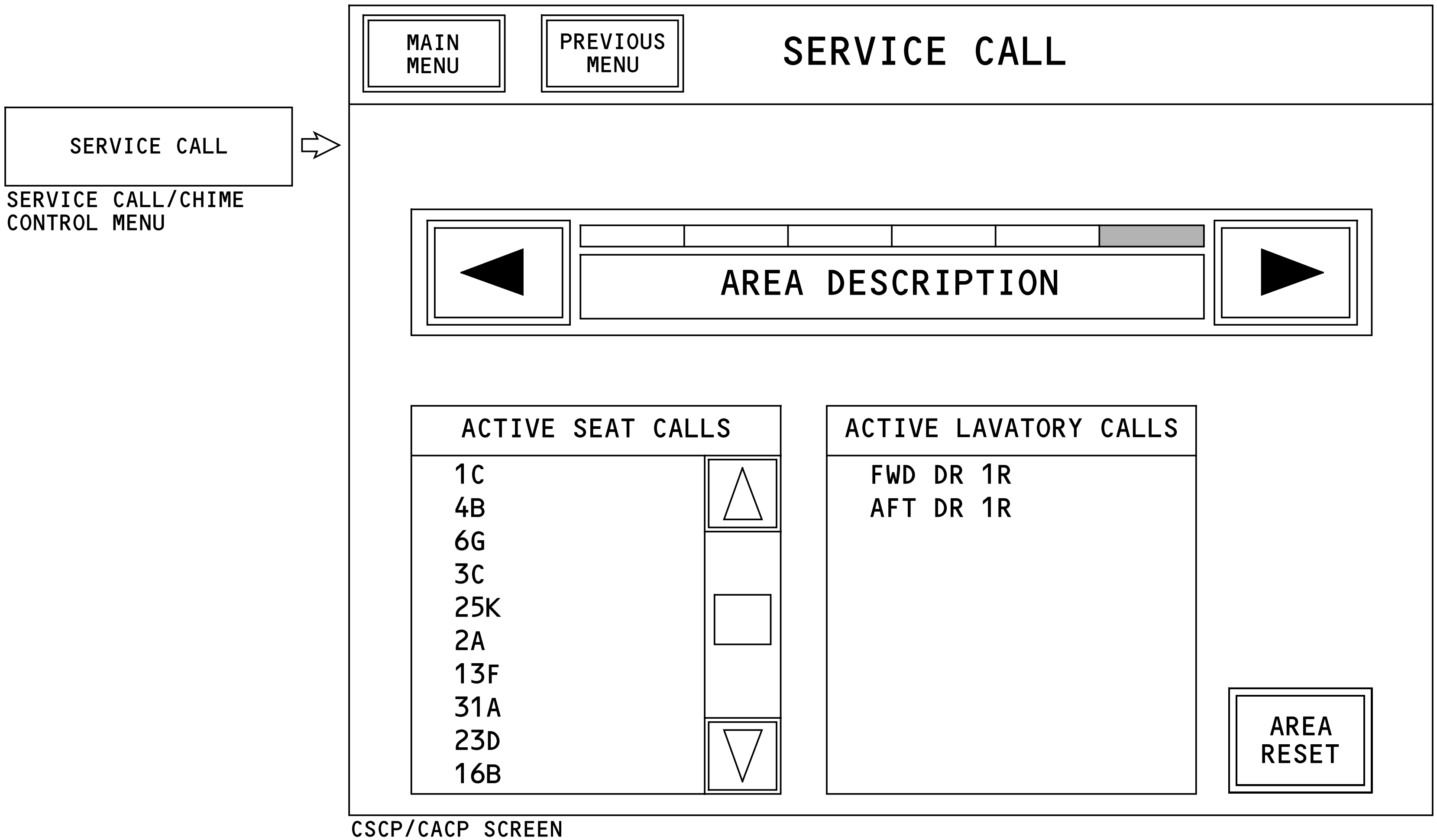
Controls and Indications

Use the left and right arrows to select the cabin areas. The space between the arrows shows the selected cabin area description.

The active seat calls and active lavatory calls areas on the screen show all active calls from the selected cabin area. The data on the display shows the locations of the calls in the order they were received.

Use the up and down arrows to scroll through the data in the active calls area.

Touch AREA RESET to cancel all active calls for the selected area.



PSS - OPERATION - SERVICE CALL SCREEN

23-33-00-024 Rev 1 03/26/96

PSS - OPERATION - AREA CHIME CONTROL SCREEN

General

Attendants use the area chime control screen to disable the passenger-to-attendant chimes in selected areas of the cabin.

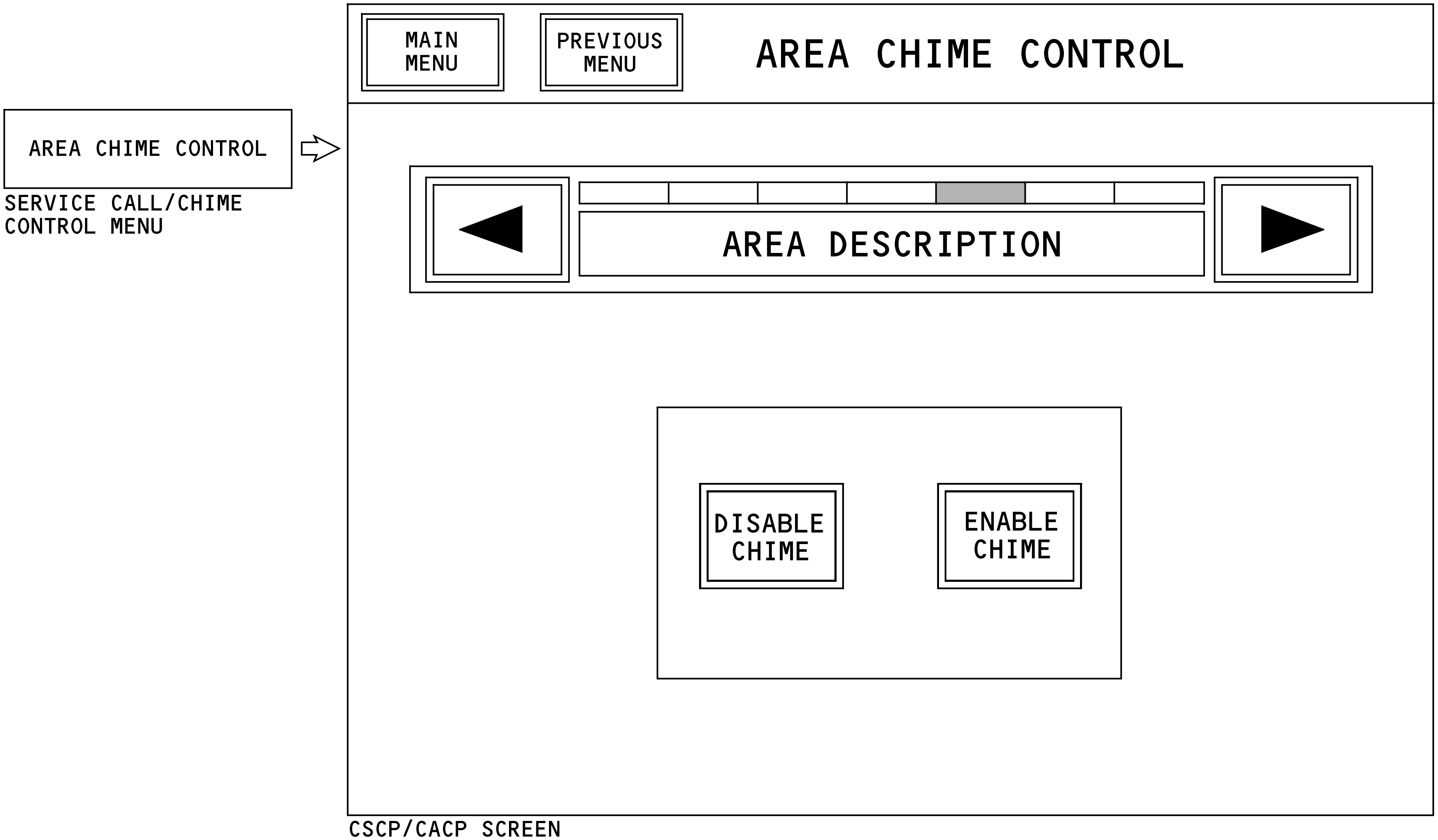
Access

Touch SERVICE CALL/CHIME CONTROL on the cabin controls main menu. Then touch AREA CHIME CONTROL on the service call/chime control menu to show this screen.

Controls and Indications

Touch the left or right arrow to select a cabin area. The space between the two arrows shows the cabin area description.

Touch ENABLE CHIME or DISABLE CHIME to enable or disable the passenger-to-attendant call chime for the selected area. These selections change to green to show the condition of the selected area.



23-33-00-025 Rev 1 03/26/96

PSS - OPERATION - AREA CHIME CONTROL SCREEN

PSS - OPERATION - SEAT CHIME CONTROL SCREEN

General

Attendants use the seat chime control screen to disable the passenger-to-attendant chimes at selected seats in the cabin.

Access

Touch SERVICE CALL/CHIME CONTROL on the cabin controls main menu. Then touch SEAT CHIME CONTROL to show this screen.

Controls and Indications

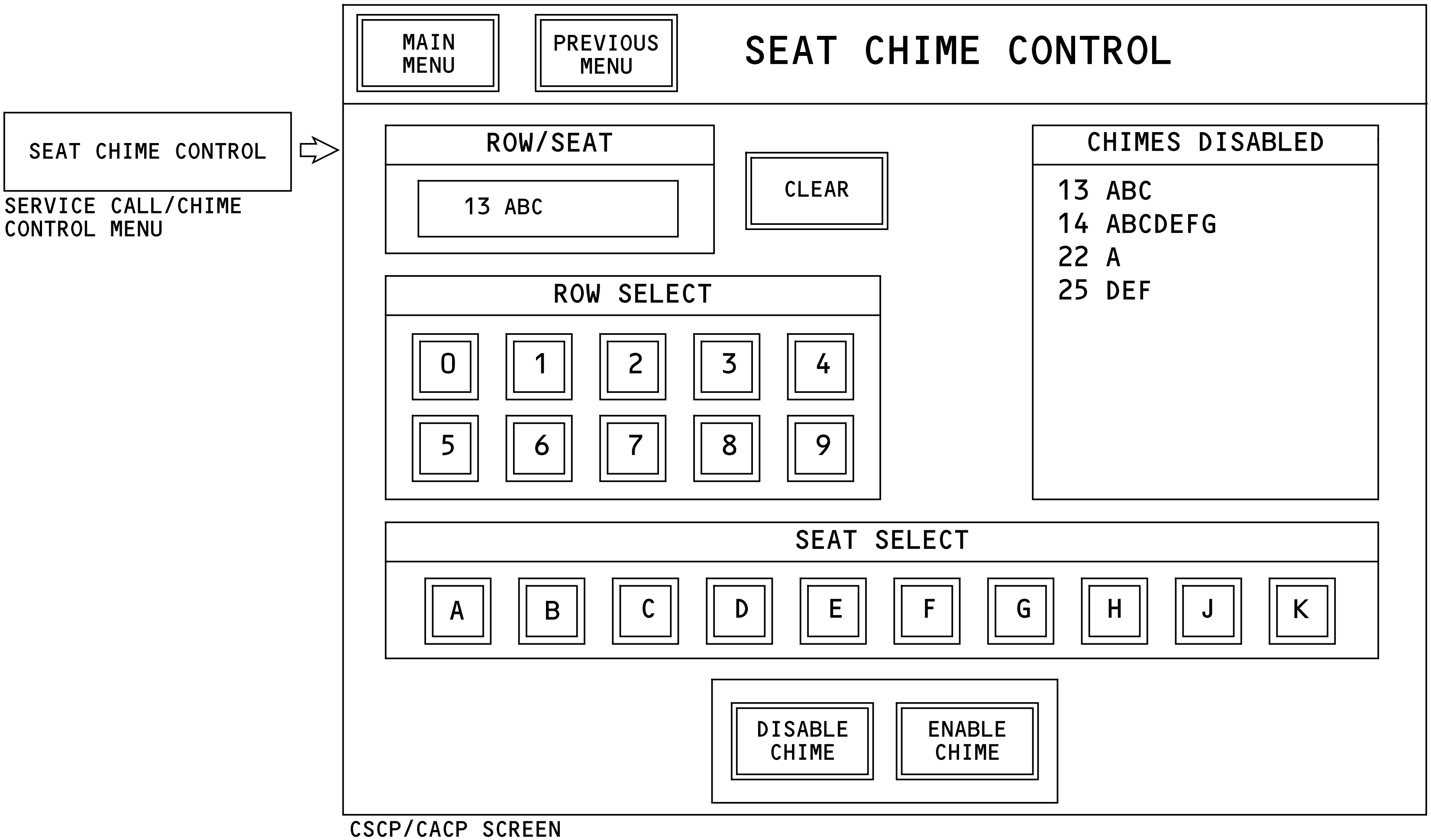
The configuration data base defines the row numbers and seat letters.

Touch the row select numbers and seat select letters to select seats. You must select the row before selecting a seat. If you only select a row and do not select any seats, the chime is enabled or disabled for all seats in the row.

The row/seat window above the numbers shows the selection.

Touch ENABLE CHIME or DISABLE CHIME to enable or disable the passenger-to-attendant call chime for the selected seats. Touch clear to clear the row/seat display.

The chimes disabled window shows all seats that have chimes disabled. Use the up and down arrows to scroll through the data.



23-33-00-026 Rev 1 03/26/96

PSS - OPERATION - SEAT CHIME CONTROL SCREEN

PSS - OPERATION - SMOKING ASSIGNMENTS SCREEN

General

Attendants use the smoking assignments screen to make changes to the smoking areas.

Access

Touch SMOKING ASSIGNMENTS on the cabin controls main menu to show this screen.

Controls and Indications

Use the left and right arrows to select the cabin areas. The space between the arrows shows the selected cabin area description.

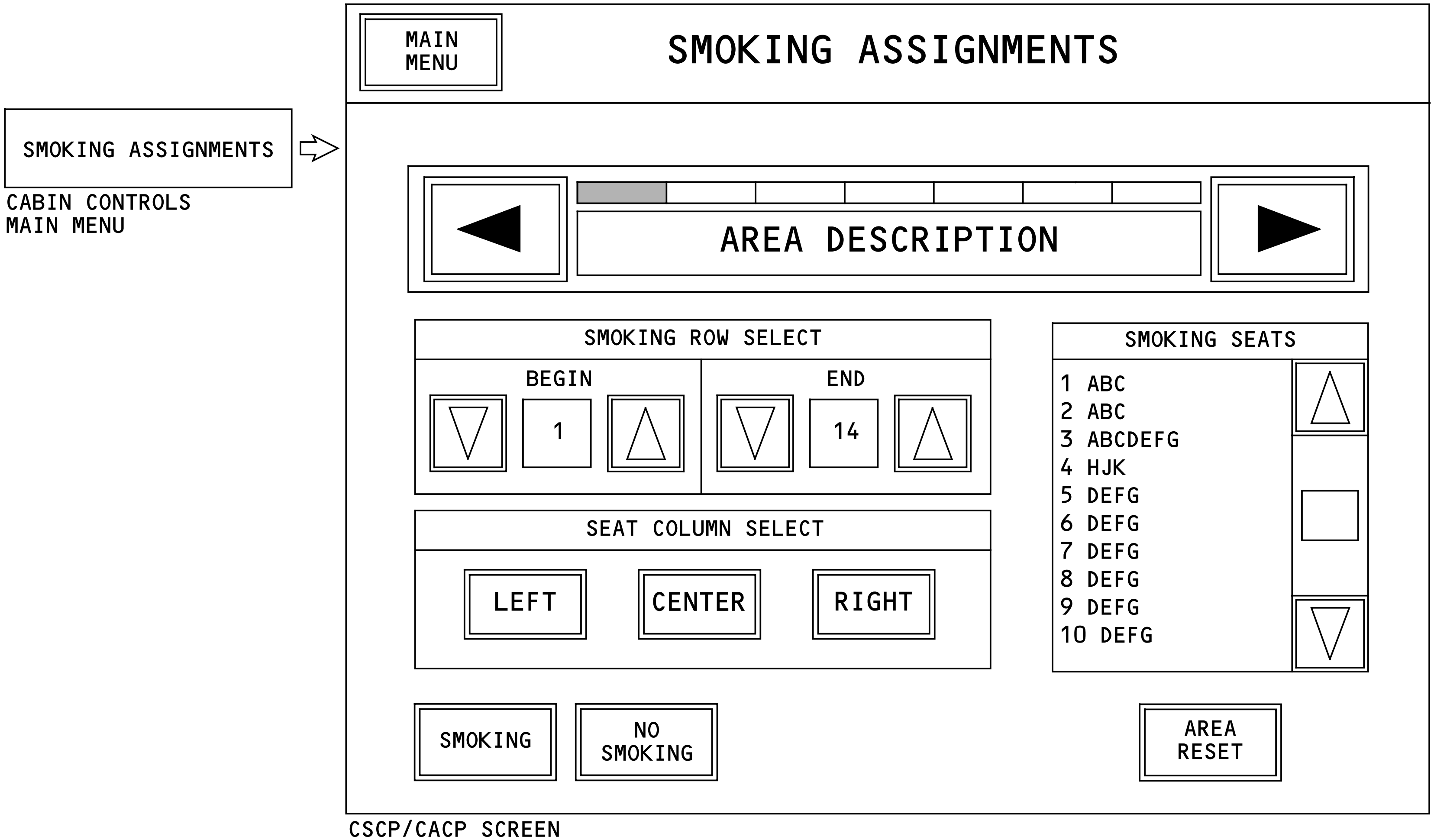
Use the smoking row select up and down arrows to select a begin and end seat row. Use the selections in the seat column select area to select columns. If you do not select a column, any changes affect all columns.

Touch SMOKING or NO SMOKING to make the selected seats as smoking or no smoking.

The smoking seats area of this display shows all assigned smoking seats in the selected cabin area. Use the up and down arrows to scroll through the list.

Touch AREA RESET to cancel all changes to the selected area. Smoking seat assignments return to those identified by the configuration database.

23-33-00-029 Rev 1



23-33-00-029 Rev 1 03/26/96

PSS - OPERATION - SMOKING ASSIGNMENTS SCREEN

PSS - CABIN TESTS

General

Use the cabin system control panel (CSCP) to do the cabin test for the passenger service system (PSS).

See the cabin services system (CSS) section for more information about tests (AMM PART I 23-39).

Quick Test

Use quick test to quickly find major faults. This test does a check of these PSS components:

- Passenger address/cabin interphone (PA/CI) controller
- Cabin system management unit (CSMU)
- Zone management units (ZMUs)
- Overhead electronics units (OEUs).

This test collects continuous monitor data for as long as 20 seconds. The CSCP shows the failures.

To start a quick test, touch START QUICK TEST.

All Test

Use all test for a more complete test. All test starts a complete BITE of the system. The screen shows all the failures the BITE finds.

To start an all test, touch START ALL TEST.

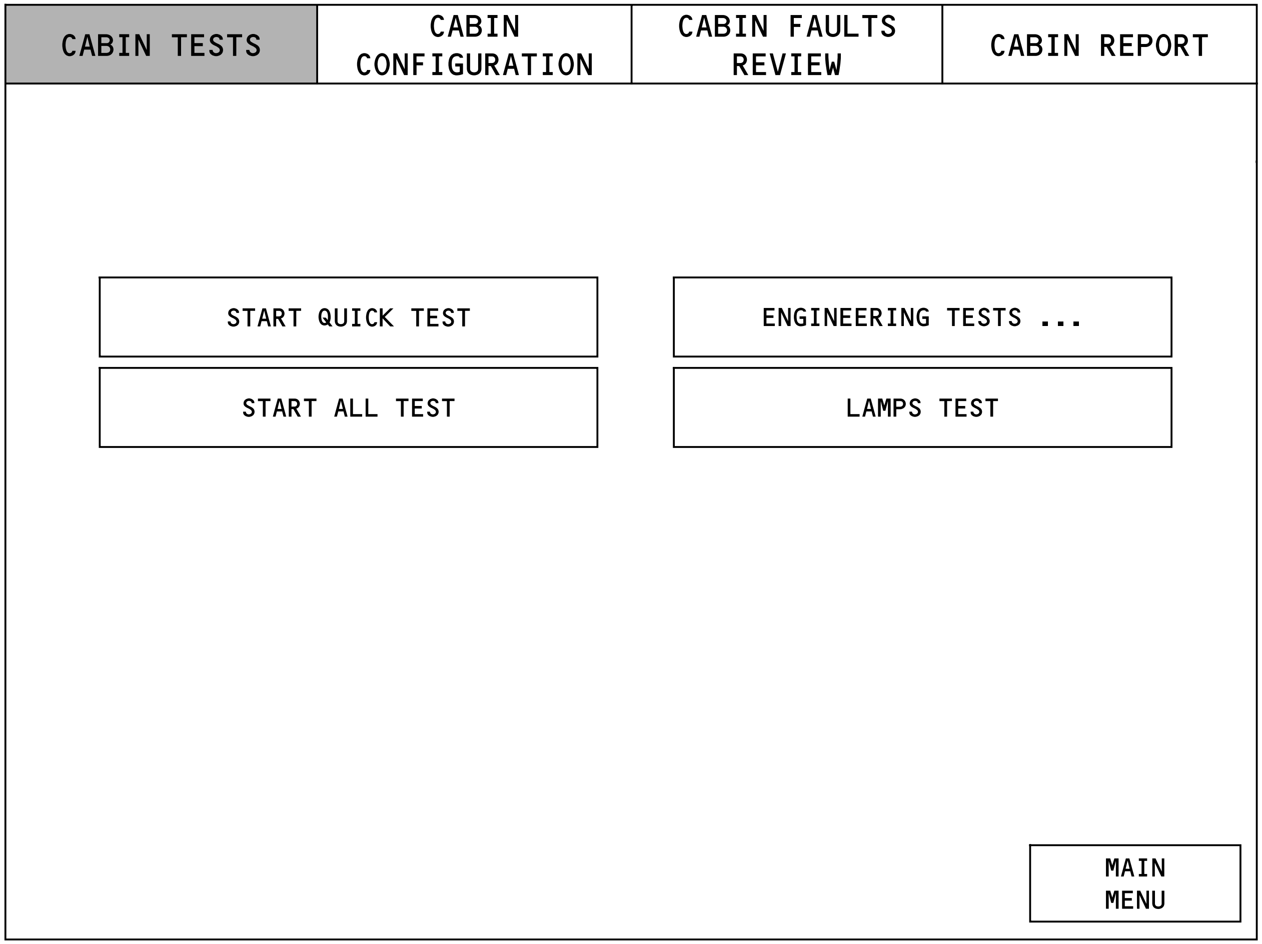
Engineering Tests

Use engineering tests for more detailed tests.

Touch ENGINEERING TESTS to show the engineering tests menu.

Lamps Test

The lamps test does not test the PSS.



CABIN SYSTEM CONTROL PANEL

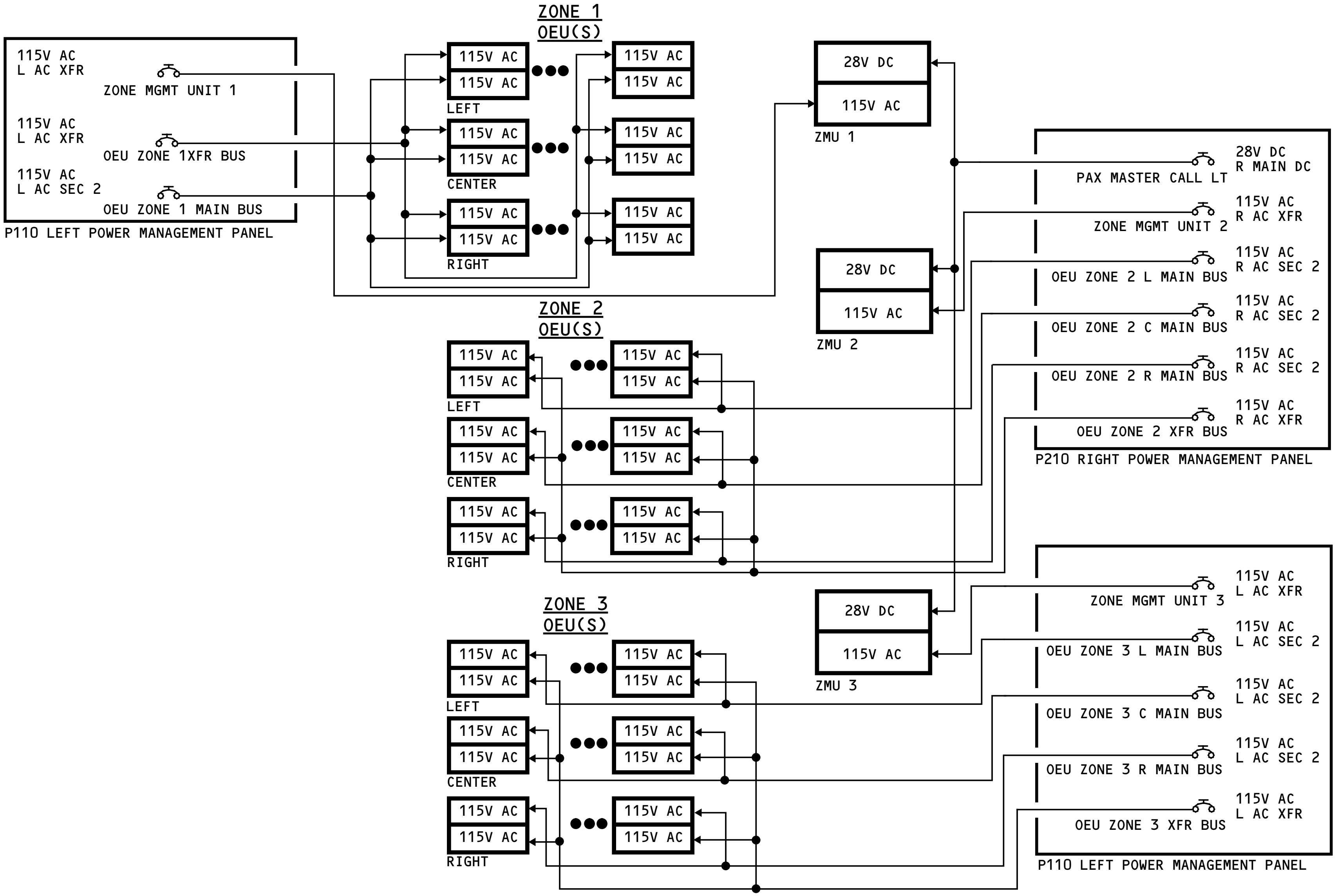
23-33-00-036 Rev 2 02/27/1997

PSS - CABIN TESTS

PSS - POWER INTERFACE

Power Interface

This power interface is for reference purposes.



PSS - POWER INTERFACE

Continental Airlines, Inc

CSS/IFE Pasenger Entertainment System Video

WB371

TABLE OF CONTENTS

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General

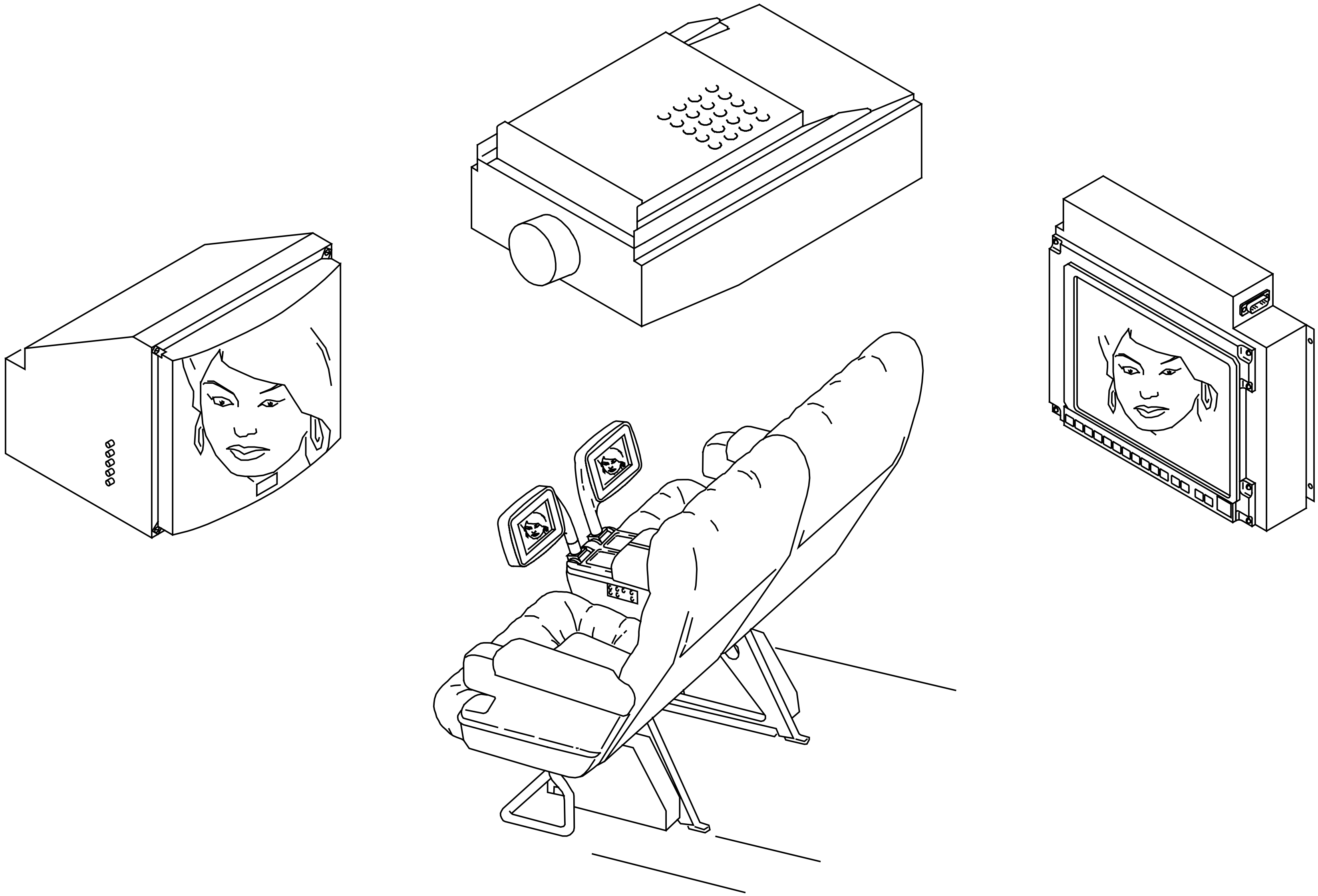
The passenger entertainment system (PES)-video supplies video entertainment to the passengers.

The in-flight entertainment (IFE) system vendor for an airline may use many different types of components to show video to the passengers. These are the types of components they may use:

- CRT and LCD monitors
- Video projectors
- Seat video displays.

Abbreviations and Acronyms

ADB - area distribution box
AIMS - airplane information management system
CCR - credit card reader
CDB - configuration data base
CD ROM - compact disk read only memory
CMEU - cabin management expansion unit
CMT - cabin management terminal
CSCP - cabin system control panel
CSMU - cabin system management unit
CSS - cabin services system
CTU - cabin telecommunications unit
DCMF - data communication management function
EPESC - enhanced passenger entertainment system controller
EVSCU - enhanced video system control unit
FDD - floppy disk drive
IFE - in-flight entertainment
IRS - inertial reference system
kbd - keyboard
LAN - local area network
NVM - non-volatile memory
PA/CI - passenger address/cabin interphone
PAS - passenger address system
pax tel - passenger telephone
PES - passenger entertainment system
PIIC - passenger in-flight information computer
PRAM - prerecorded announcement machine
RAD - random access device
RFCS - RF combiner/splitter
RFDA - RF distribution amplifier
SEB - seat electronics box
SSB - system setup box
SVD - seat video display
VDU - video distribution unit
VEP - video entertainment player
VHS - video helical scan
VMU - video modulator unit
ZIA - zone integration area
ZIU - zone integration unit
ZMU - zone management unit



IN-FLIGHT ENTERTAINMENT SYSTEM/PASSENGER ENTERTAINMENT SYSTEM-VIDEO - INTRODUCTION

IFE/PES-VIDEO - GENERAL DESCRIPTION

General

The passenger entertainment system (PES)-video gets video from many sources. Attendants can select a source and send video to the overhead video components.

For seats that have seat video displays, passengers may select and show one of many video channels on their display. In-flight entertainment (IFE) system software options may also let passengers make selections to play video games and buy duty free items.

Components

These are the types of components the PES-video may have:

- Video sources
- Head-end interface and control
- Zone interface and control
- Overhead video
- Local area network
- File servers for interactive functions
- Seat components.

The IFE connects to these other airplane systems and components:

- AIMS cabinets
- Cabin system management unit (CSMU)
- Passenger address system (PAS)
- Passenger telephone (pax tel) system
- Cabin system control panel (CSCP)
- Zone management unit (ZMU).

Video Sources

These components are the sources for video entertainment:

- Random access device (RAD)
- Passenger in-flight information computer (PIIC)
- Video entertainment players (VEPs).

Each video source sends its video signal to a video modulator unit (VMU). The VMUs put each video input on a different RF channel. Each VMU sends a mixed RF output to an RF combiner/splitter (RFCS). The RFCS combines the inputs and sends them to another RFCS.

The audio from the video sources goes to the enhanced video system control unit (EVSCU). The EVSCU changes the analog audio to digital and puts it on an RF carrier. It sends this RF signal to the enhanced passenger entertainment system controller (EPESC). The EPESC sends the digitized RF to an RFCS.

This RFCS mixes the video inputs with the RF audio from the EPESC and sends its output to another RFCS. The second RFCS sends the mixed RF signal to a seat electronics box (SEB) for the attendants to be able to see video selections on the cabin management terminal (CMT). The RFCS also sends the combined video signal to an RF distribution amplifier (RFDA) for distribution to the seats.

The RFDA amplifies the RF signal and sends it to the area distribution boxes (ADBs). The ADBs split the RF and send it to their related columns of SEBs.

The SEBs get video channel selections from the passengers. When a passenger makes a video channel selection, the SEB demodulates the RF signal and sends the selected video to the seat video display.

Interactive Video

Attendants use screens on the CMT to control the operation of the interactive functions.

The cabin management enhancement units (CMEUs) are the main controllers for interactive video. They are the file servers that store the interactive software. they connect to the LAN hub to provide game data and software storage for items such as in-flight sales data and configuration databases. The LAN hub allows many units to connect to each other on the network.

The EPESC connects to the LAN hub to send and get data to and from the passengers. Passengers use controllers at the seat to make game selections on the seat video display. The request goes from the related SEB to the ADB. The ADB sends the request to the EPESC. The EPESC gets the requested data from a CMEU and sends it back to the SEB through the ADB.

Interface and Control

Attendants may use a CMT to monitor and control all functions of the entertainment system. Maintenance technicians may also use screens on a CMT to test the system and install software. The CMT connects to the LAN hub to send commands and get data from other components in the system.

The system setup box (SSB) permits connection to the network for uploading and downloading data.

The CMT also connects to these components:

- Credit card reader (CCR)
- CD ROM drive
- Printer
- Keyboard (kbd)
- Floppy disk drive (FDD).

The cabin management terminal connects to a CD ROM drive to let you upload data to the system. You can only use the CD ROM on the ground.

The cabin system control panel (CSCP) may send print data to a CMT. The CMT then sends the data to the printer.

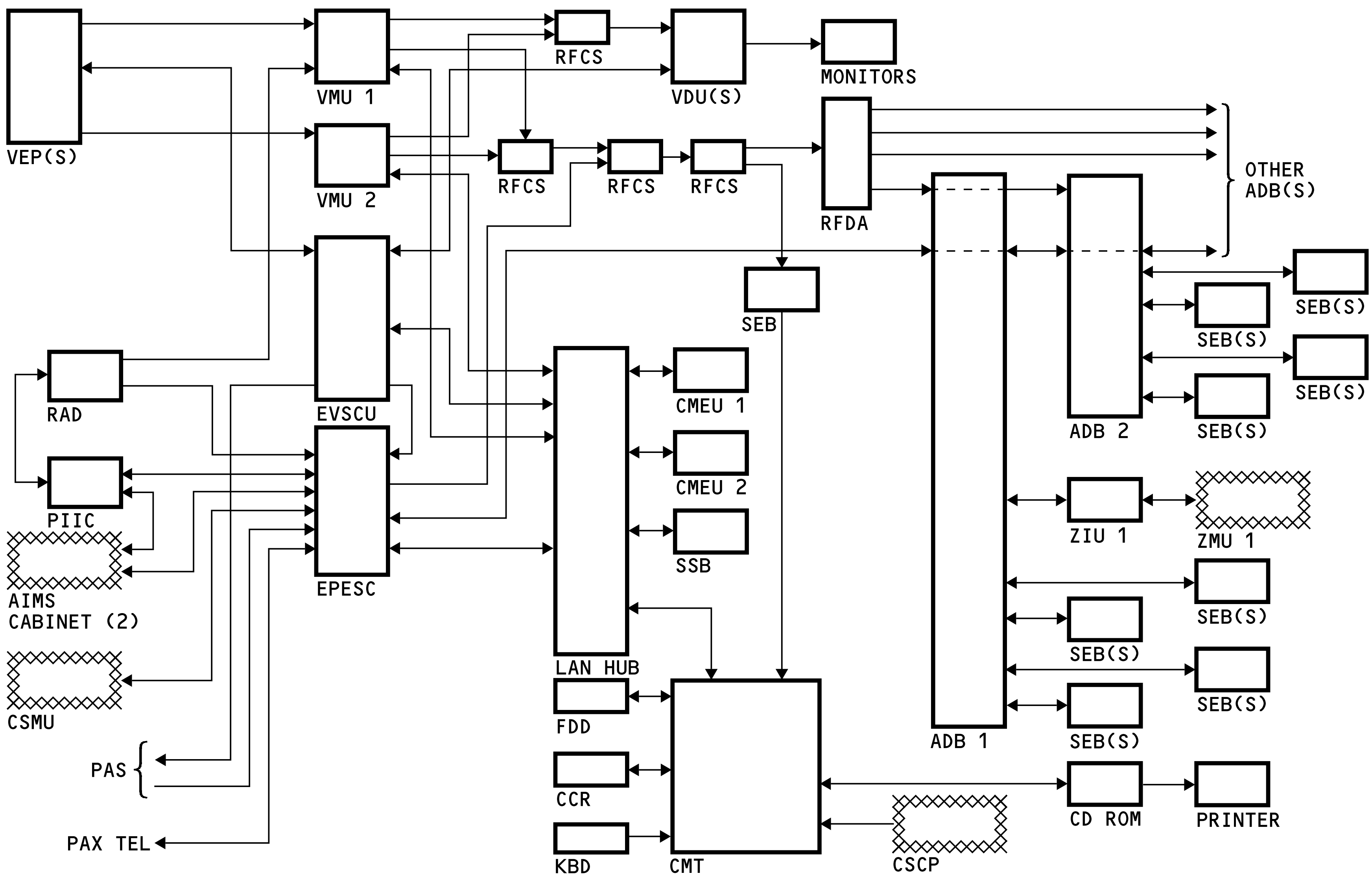
The EPESC connects to these other systems and components for the related functions:

IFE/PES-VIDEO - GENERAL DESCRIPTION

- Airplane information management system (AIMS) cabinets - send reports to the ground using ACARS and get uplink data from the data communication management function (DCMF)
- Cabin system management unit (CSMU) - sends and gets data such as airplane configuration and seating areas to and from the cabin services system (CSS)
- Passenger telephone (pax tel) - sends and gets telephone signals to and from the seat telephones if available
- Passenger address system (PAS) - gets PA override audio and keylines for passenger address announcements to the passenger headphones.

The passenger in-flight information computer (PIIC) connects to AIMS to get airplane data such as airspeed, location, and direction.

The EVSCU connects to the passenger address system to send video audio and related keylines for video announcements.



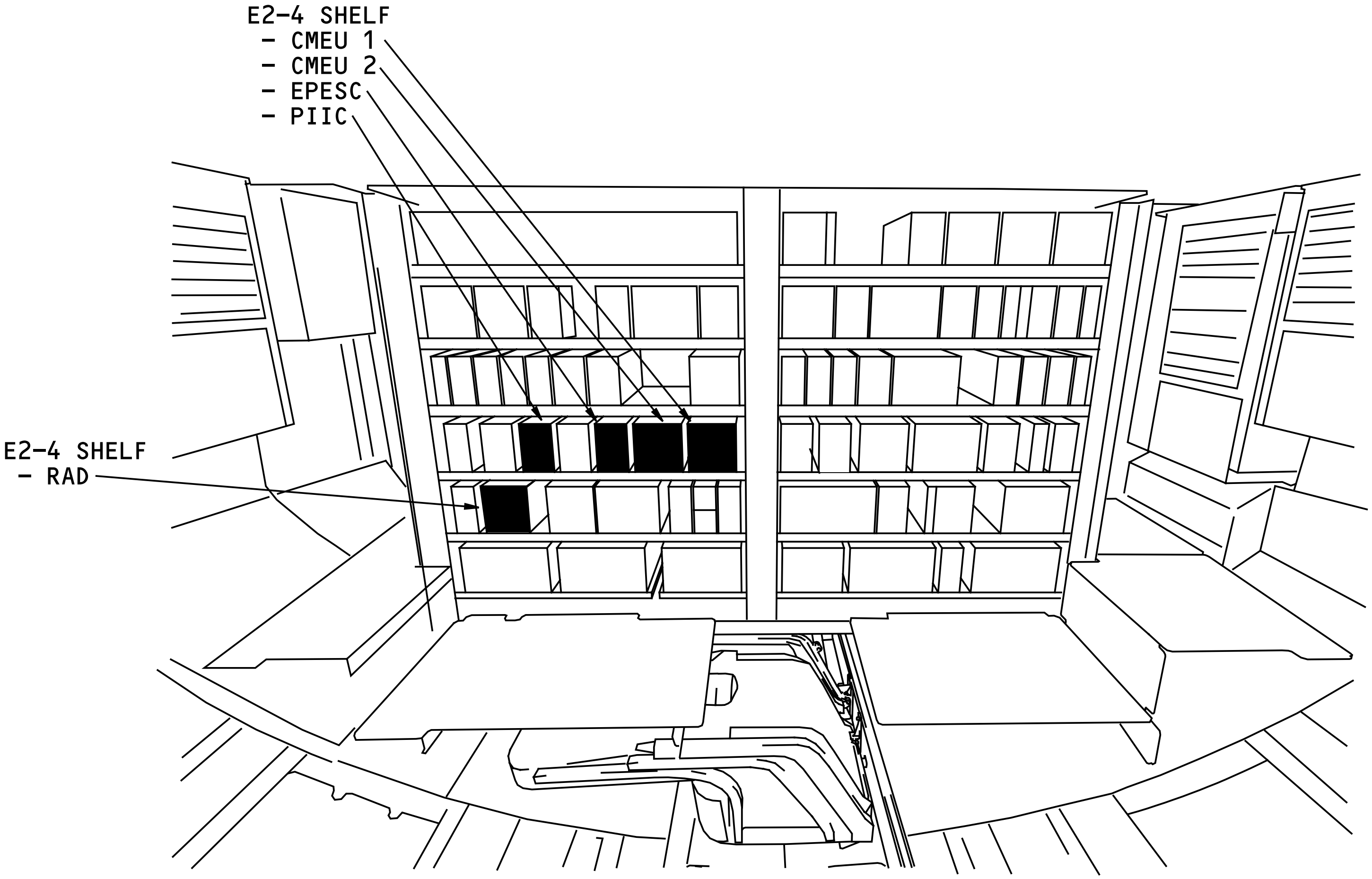
IFE/PES-VIDEO - GENERAL DESCRIPTION

IFE/PES-VIDEO - EQUIPMENT CENTER COMPONENT LOCATIONS

General

These in-flight entertainment components are in the main equipment center:

- Cabin management expansion unit (CMEU) 1 and 2
- Enhanced passenger entertainment system controller (EPESC)
- Random access device (RAD)
- Passenger in-flight information computer (PIIC).



MAIN EQUIPMENT CENTER
(LOOKING AFT)

23-32-00-502 Rev 11 02/24/1998

IFE/PES-VIDEO - EQUIPMENT CENTER COMPONENT LOCATIONS

IFE/PES-VIDEO - CABIN COMPONENT LOCATIONS

General

Many IFE components for PES-video are in the passenger cabin and above the cabin ceiling panels.

Cabin Area Components

The purser station has these IFE components:

- Credit card reader (CCR)
- Compact disk read only memory (CD ROM) drive
- Cabin management terminal (CMT)
- Enhanced video system control unit (EVSCU)
- Floppy disk drive (FDD)
- Keyboard
- Local area network (LAN) hub
- Printer
- RF combiner/splitters (RFCSs)
- RF distribution amplifier (RFDA)
- Seat electronics box (SEB)
- System setup box (SSB)
- Video modulation unit (VMU)
- Video entertainment players (VEPs).

Passenger Seat Components

Seats that have seat video displays (SVDs) also have seat electronics boxes (SEBs) under the passenger seats.

Passengers use controls at the seat to make video channel selections.

Overhead Video Components

Video monitors are on the class dividers and other vertical surfaces and over some doors.

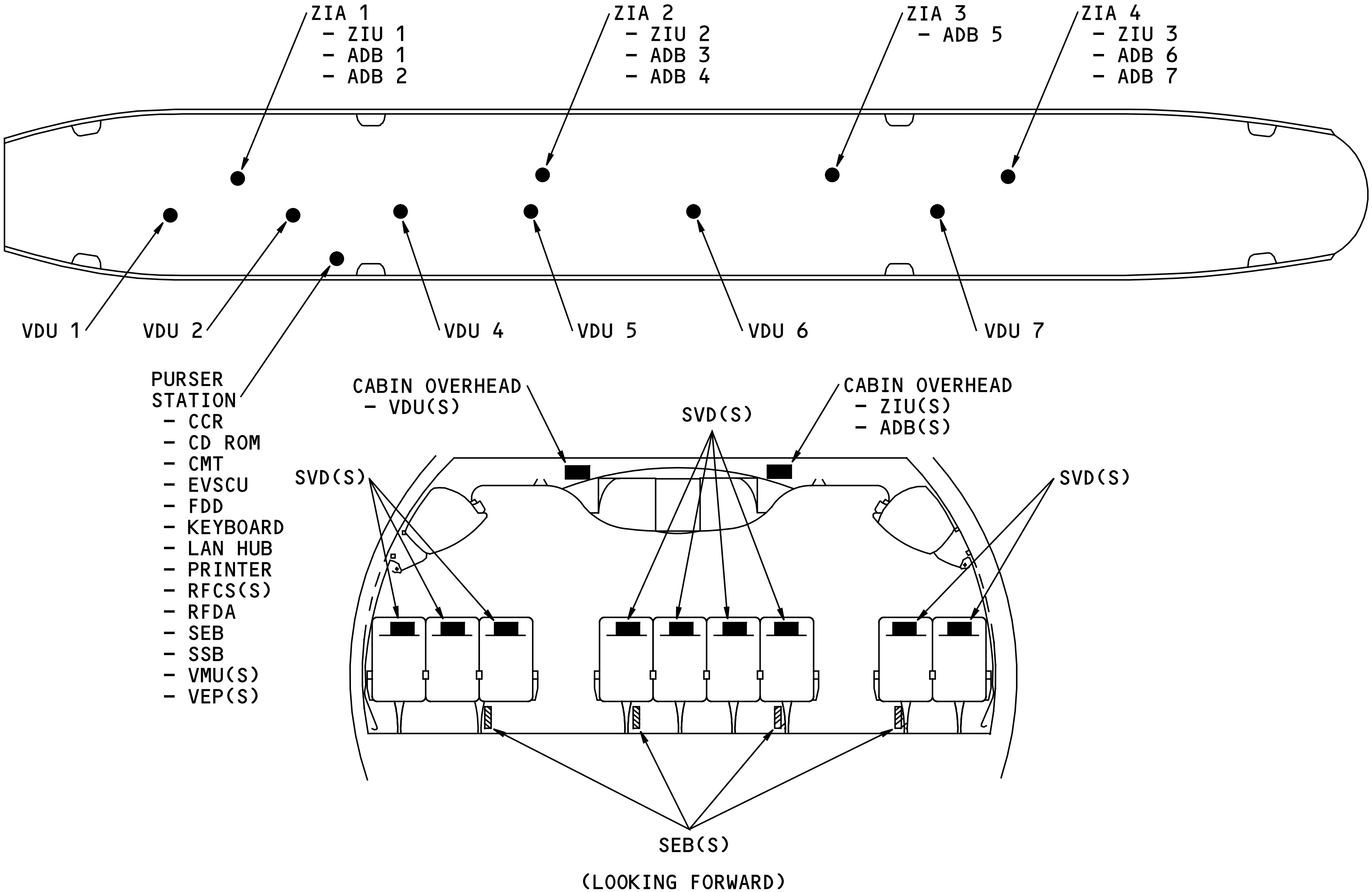
Some areas of the cabin may also have video projectors.

Video distribution units (VDUs) are on the left side of the crown area above the ceiling panels.

Zone Integration Areas

Some IFE components are on the right side of the crown area above the ceiling panels. These components are in locations called zone integration areas (ZIAs). There are four ZIAs.

Zone integration units (ZIUs) and area distribution boxes (ADBs) are in ZIA 1, ZIA 2, and ZIA 4. ZIA 3 has only one ADB.



IFE/PES-VIDEO - CABIN COMPONENT LOCATIONS

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IFE/PES-VIDEO - POWER INTERFACES

General

Power for the PES-video comes through the P110 left power management panel and the P210 right power management panel.

Circuit breakers control power to these PES-video components:

- Enhanced passenger entertainment system controller (EPESC)
- Cabin management expansion units (CMEUs)
- Enhanced video system control unit (EVSCU)
- 8 Passenger entertainment system controller-audio (PESC-A) 1 and 2
- Video entertainment players (VEPs)
- Cabin management terminal (CMT)
- Video modulation units (VMUs)
- Random access device (RAD)
- Passenger in-flight information computer (PIIC)
- Local area network (LAN) hub
- System setup box (SSB)
- RF distribution amplifier (RFDA)
- Compact disk read only memory (CD ROM) drive
- Seat electronics box (SEB)
- Printer
- Video distribution units (VDUs).

P110 Left Power Management Panel

The MULTP AUDIO ENTMT CTRL circuit breaker connects 115v ac through the audio entertainment player (AEP) relay to these LRUs:

- RAD
- EPESC
- CMEU 1 and 2

The ENTMT CTRL L circuit breaker connects 28v dc to the AEP relay. The ELMS electronic unit connects a ground to energize the relay during load shedding. When the relay energizes, it removes power from the components.

The VIDEO DISTR 1 circuit breaker connects 115v ac power to VDU 2.

The VIDEO DISTR 2 circuit breaker connects 115v ac power to VDU 4. VDU 4 connects 115v ac power to VDU 5.

P210 Right Power Management Panel

The VIDEO PGMS & CTRL circuit breaker connects 115v ac through the video programs and control relay to these LRUs:

- EVSCU
- CMT
- CD ROM
- VMU
- LAN hub
- SSB

IFE/PES-VIDEO - POWER INTERFACES

- RFDA
- SEB.

The VIDEO PGMS & CTRL B circuit breaker connects 115v ac through the video programs and control relay and a relay in the purser station to all video entertainment players (VEPs). The EVSCU controls the relay in the purser station. When the EVSCU connects a ground to the relay, it energizes and removes power from all VEPs.

The ENTMT CTRL R circuit breaker connects 28v dc to these components:

- Video programs and control relay
- A relay in the purser station
- RAD
- PIIC.

The ELMS electronic unit connects a ground to energize the video programs and control relay during load shedding. When the relay energizes, it removes power from the components.

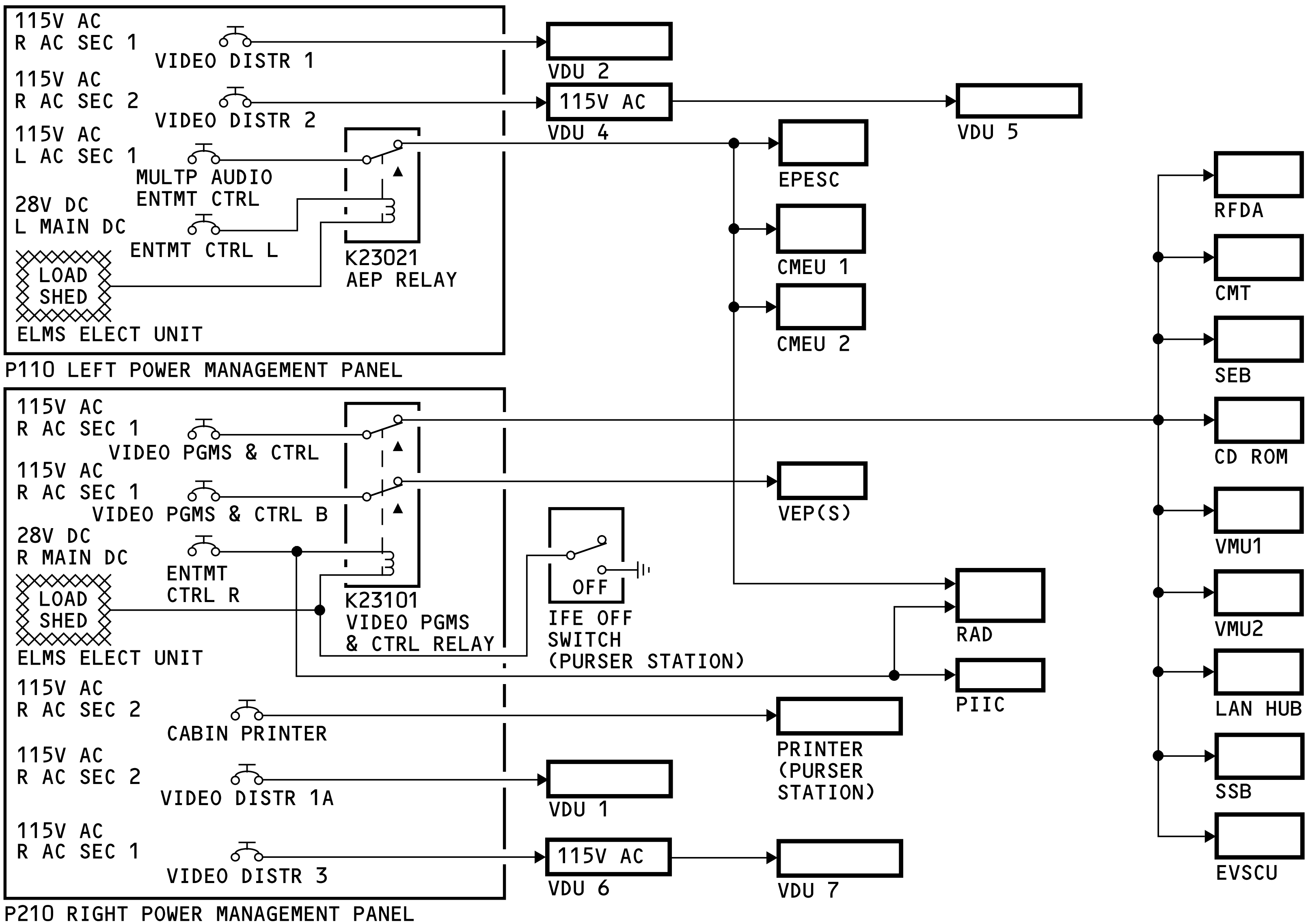
You can also use the IFE off switch in the purser station to remove power from the components. In the OFF position, the switch connects a ground to energize the video programs and control relay.

The CABIN PRINTER circuit breaker connects 115v ac to the printer in the purser station.

The VIDEO DISTR 1A circuit breaker connects 115v ac power to VDU 1.

The VIDEO DISTR 1 circuit breaker connects 115v ac power to VDU 2.

The VIDEO DISTR 2 circuit breaker connects 115v ac power to VDU 4. VDU 4 connects 115v ac power to VDU 5.



IFE/PES-VIDEO - POWER INTERFACES

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IFE/PES-VIDEO - ZONE INTEGRATION AREA 1 POWER INTERFACES

General

Circuit breakers and a relay on the P210 right power management panel controls power to the components in zone integration area 1.

Power

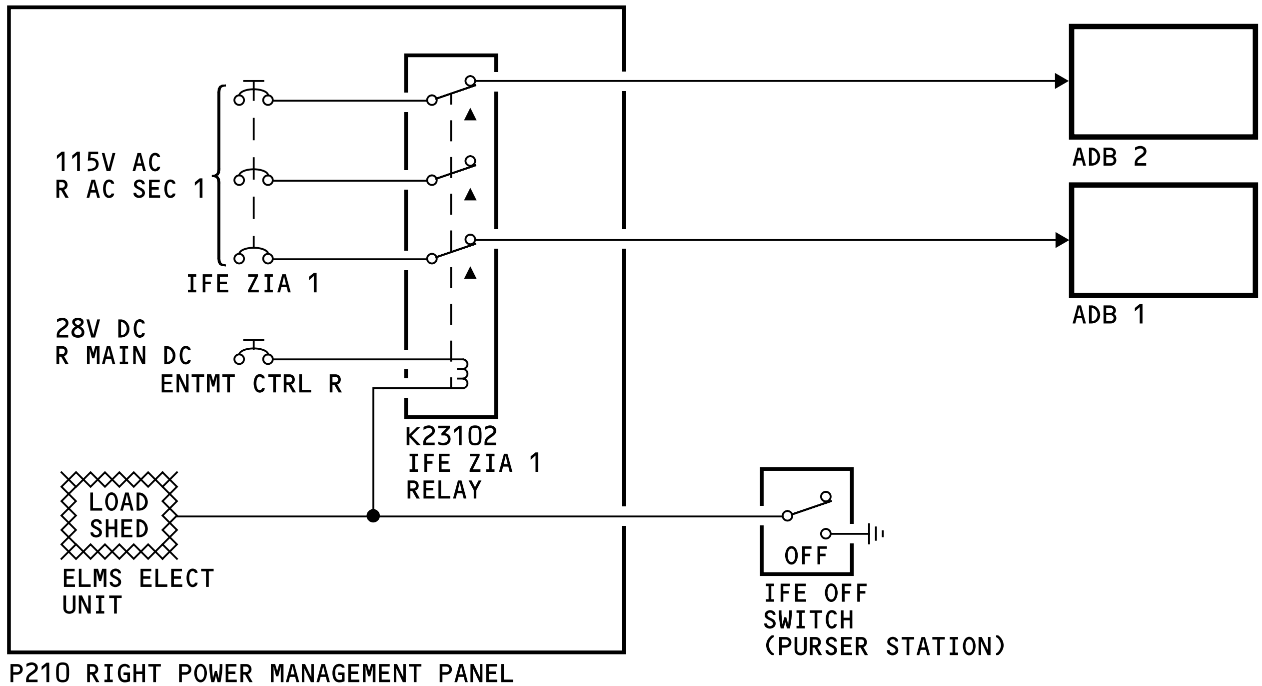
The IFE ZIA 1 circuit breaker connects 115v ac, three-phase power to the IFE ZIA 1 relay. The relay connects two phases of the power to the area distribution boxes (ADBs). Each ADB gets power from a different phase.

The ENTMT CTRL R circuit breaker connects 28v dc to the IFE ZIA 1 relay.

Relay Control

The ELMS electronic unit connects a ground to energize the relay during load shedding. When the relay energizes, it removes power from the components in the zone integration area.

You can also use the IFE off switch in the purser station to remove power from the relay. In the OFF position, the switch connects a ground to energize the relay.



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IFE/PES-VIDEO - ZONE INTEGRATION AREA 1 POWER INTERFACES

IFE/PES-VIDEO - ZONE INTEGRATION AREA 2 POWER INTERFACES

General

Circuit breakers and a relay on the P110 left power management panel controls power to the components in zone integration area 2.

Power

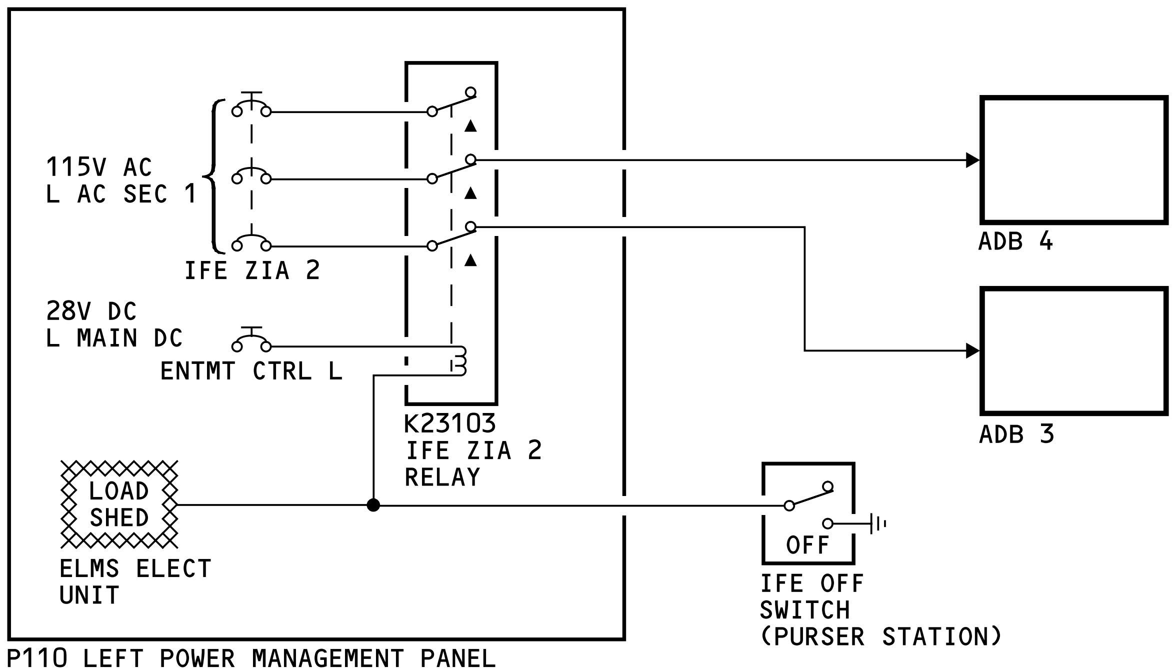
The IFE ZIA 2 circuit breaker connects 115v ac three-phase power to the IFE ZIA 2 relay. The relay connects two phases of the power to the area distribution boxes (ADBs). Each ADB gets power from a different phase.

The ENTMT CTRL L circuit breaker connects 28v dc to the IFE ZIA 2 relay.

Relay Control

The ELMS electronic unit connects a ground to energize the relay during load shedding. When the relay energizes, it removes power from the components in the zone integration area.

You can also use the IFE off switch in the purser station to remove power from the relay. In the OFF position, the switch connects a ground to energize the relay.



23-32-00-507 Rev 8 02/24/1998

IFE/PES-VIDEO - ZONE INTEGRATION AREA 2 POWER INTERFACES

IFE/PES-VIDEO - ZONE INTEGRATION AREA 3 POWER INTERFACES

General

Circuit breakers and a relay on the P110 left power management panel controls power to the components in zone integration area 3.

Power

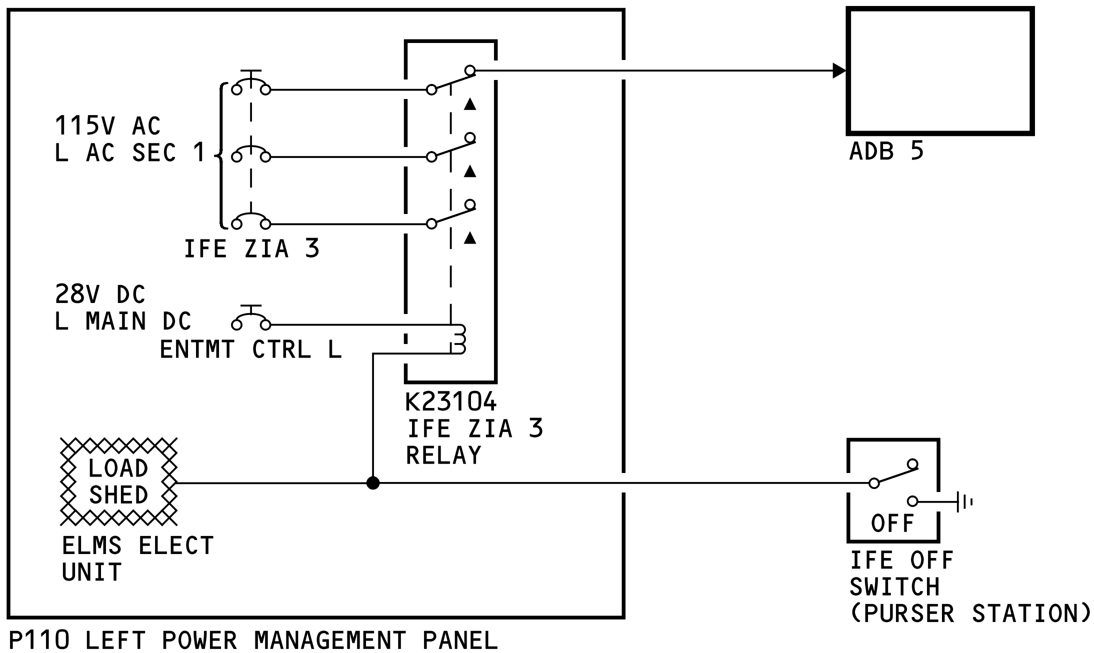
The IFE ZIA 3 circuit breaker connects 115v ac three-phase power to the IFE ZIA 3 relay. The relay connects only one phase of the power to area distribution box (ADB) 5.

The ENTMT CTRL L circuit breaker connects 28v dc to the IFE ZIA 3 relay.

Relay Control

The ELMS electronic unit connects a ground to energize the relay during load shedding. When the relay energizes, it removes power from the components in the zone integration area.

You can also use the IFE off switch in the purser station to remove power from the relay. In the OFF position, the switch connects a ground to energize the relay.



IFE/PES-VIDEO - ZONE INTEGRATION AREA 3 POWER INTERFACES

IFE/PES-VIDEO - ZONE INTEGRATION AREA 4 POWER INTERFACES

General

Circuit breakers and a relay on the P210 right power management panel controls power to the components in zone integration area 4.

Power

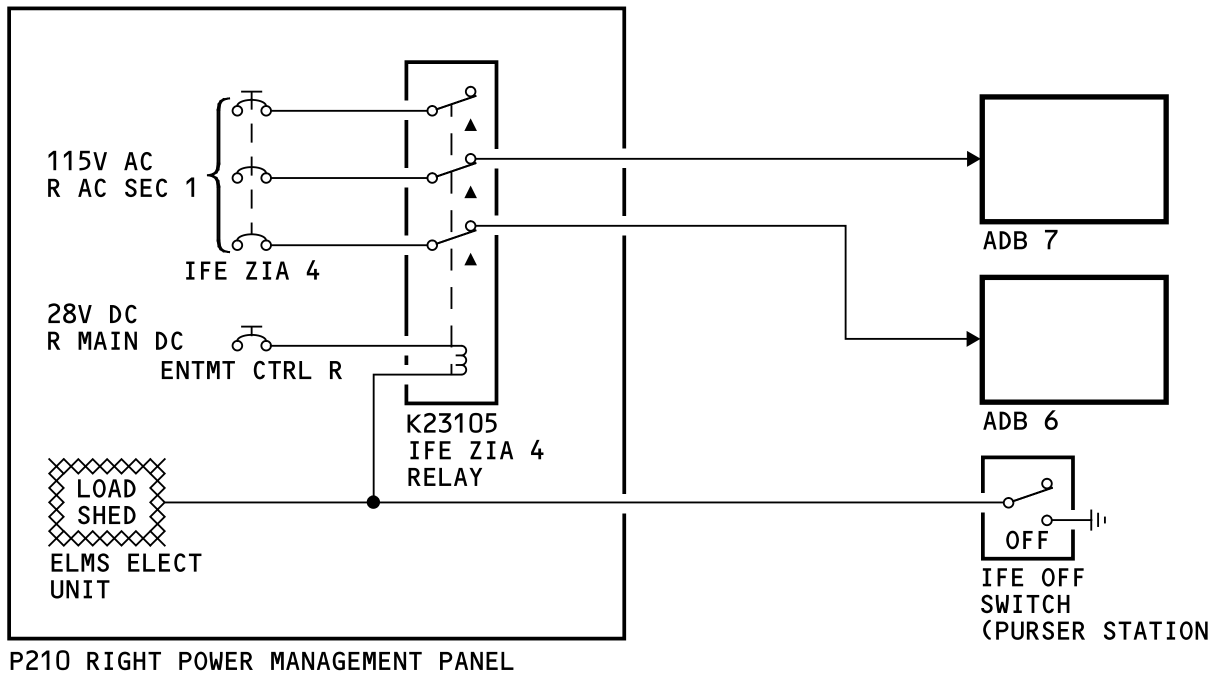
The IFE ZIA 4 circuit breaker connects 115v ac three-phase power to the IFE ZIA 4 relay. The relay connects two phases of the power to the area distribution boxes (ADBs). Each ADB gets power from a different phase.

The ENTMT CTRL R circuit breaker connects 28v dc to the IFE ZIA 4 relay.

Relay Control

The ELMS electronic unit connects a ground to energize the relay during load shedding. When the relay energizes, it removes power from the components in the zone integration area.

You can also use the IFE off switch in the purser station to remove power from the relay. In the OFF position, the switch connects a ground to energize the relay.



23-32-00-509 Rev 8 02/24/1998

IFE/PES-VIDEO - ZONE INTEGRATION AREA 4 POWER INTERFACES

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IFE/PES-VIDEO - AIRPLANE INTERFACES

General

The in-flight entertainment (IFE) equipment connects to these other airplane system components:

- Passenger address/cabin interphone (PA/CI) controller
- Right and left AIMS cabinets
- Cabin system management unit (CSMU)
- Prerecorded announcement machine (PRAM)
- Cabin telecommunications unit (CTU)
- Cabin system control panel (CSCP)
- Zone management unit (ZMU).

Passenger Address Interfaces

The enhanced video system control unit (EVSCU) can send as many as four video audio outputs and related keylines to the PA/CI controller. It also sends a signal through the cabin interphone controller to tell the flight crew when the video system is in use. The EVSCU gets a decompression discrete from the PA/CI controller when necessary.

The PA/CI controller sends as many as six channels of passenger address (PA) audio and related keylines to the enhanced passenger entertainment system controller (EPESC). The different channels relate to passenger address areas in the cabin that the configuration database defines. The IFE sends this audio to the passenger headphones. The PA/CI controller also sends a PA-All keyline for announcements in all areas of the cabin.

The EPESC connects to the PRAM to control automatic announcements and boarding music.

AIMS Interfaces

The right and left AIMS cabinets connect to the passenger in-flight information computer (PIIC) and the EPESC.

The PIIC can get this data from these AIMS buses:

- General purpose bus 1 - universal time, time and distance to destination, and present position
- Inertial reference system (IRS) bus - ground speed, track angle, and wind speed and direction
- General purpose bus 3 - altitude, airspeed, and air temperature.

The PIIC can also send and get cabin ACARS data to and from the EPESC. This data may be messages or other items uplinked from the ground and shown on the video displays.

The EPESC connects to the left and right data communication management function (DCMF) buses to get messages or other data from the ground. The EPESC can send messages to the ground or the PIIC on a cabin ACARS bus.

Other Interfaces

The EPESC connects to the cabin system management unit (CSMU) with an ARINC 628 head end bus. This connection

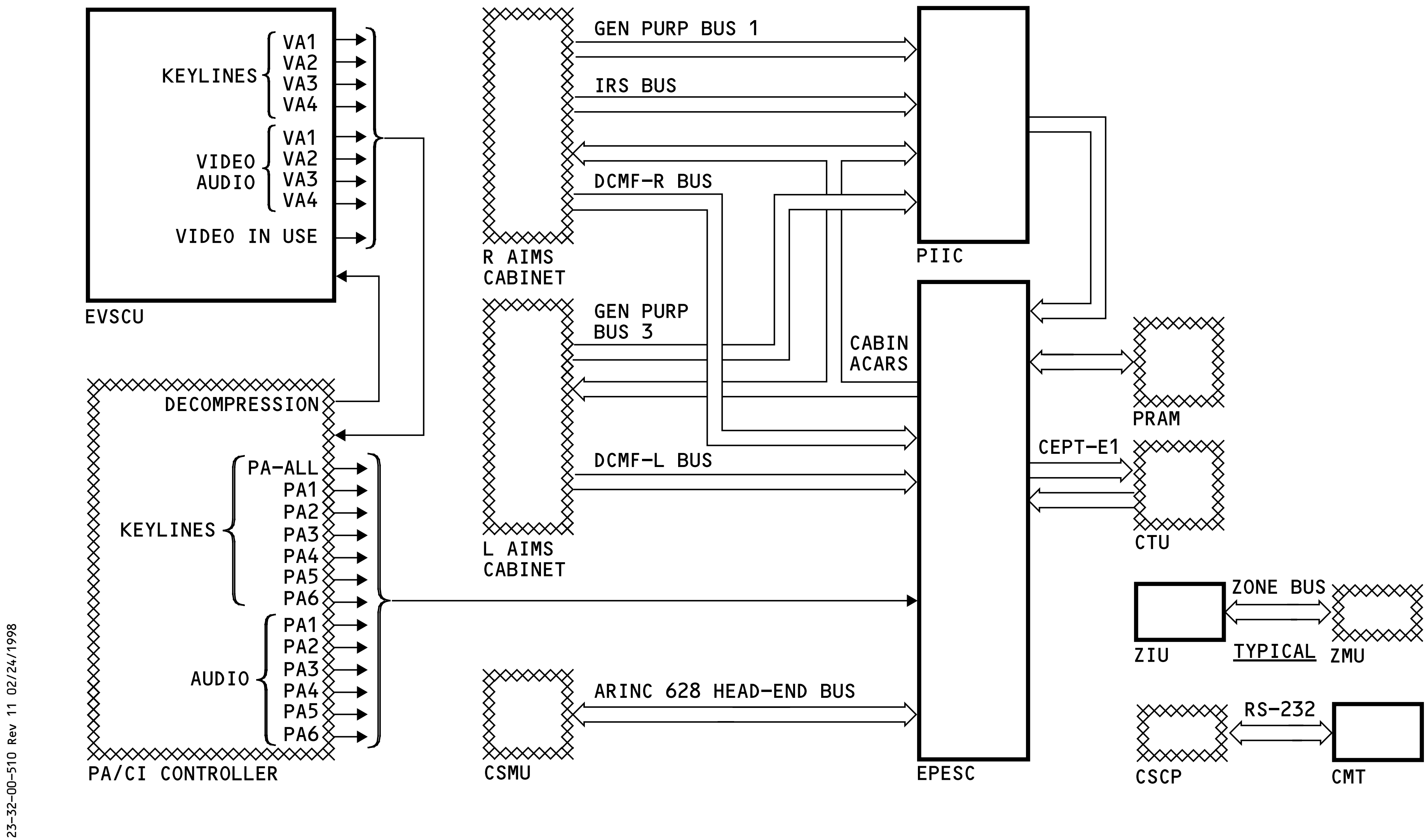
IFE/PES-VIDEO - AIRPLANE INTERFACES

lets the in-flight entertainment system and the cabin services system send configuration data to each other.

The EPESC also connects to the CTU with a standard CEPT-E1 telephone interface. This connection lets passengers make telephone calls on individual seat telephones if installed.

Each zone integration unit (ZIU) connects to a zone management unit of the cabin services system (CSS) with a zone bus. This connection permits passenger service system functions such as reading light control and passenger to attendant calls.

The cabin system control panel of the CSS can send print data to the cabin management terminal (CMT) on an RS-232 data bus. The CMT sends the data to a cabin printer if installed.



IFE/PES-VIDEO - AIRPLANE INTERFACES

Continental Airlines, Inc

CSS/IFE Passenger Entertainment System Audio

WB371

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Introduction

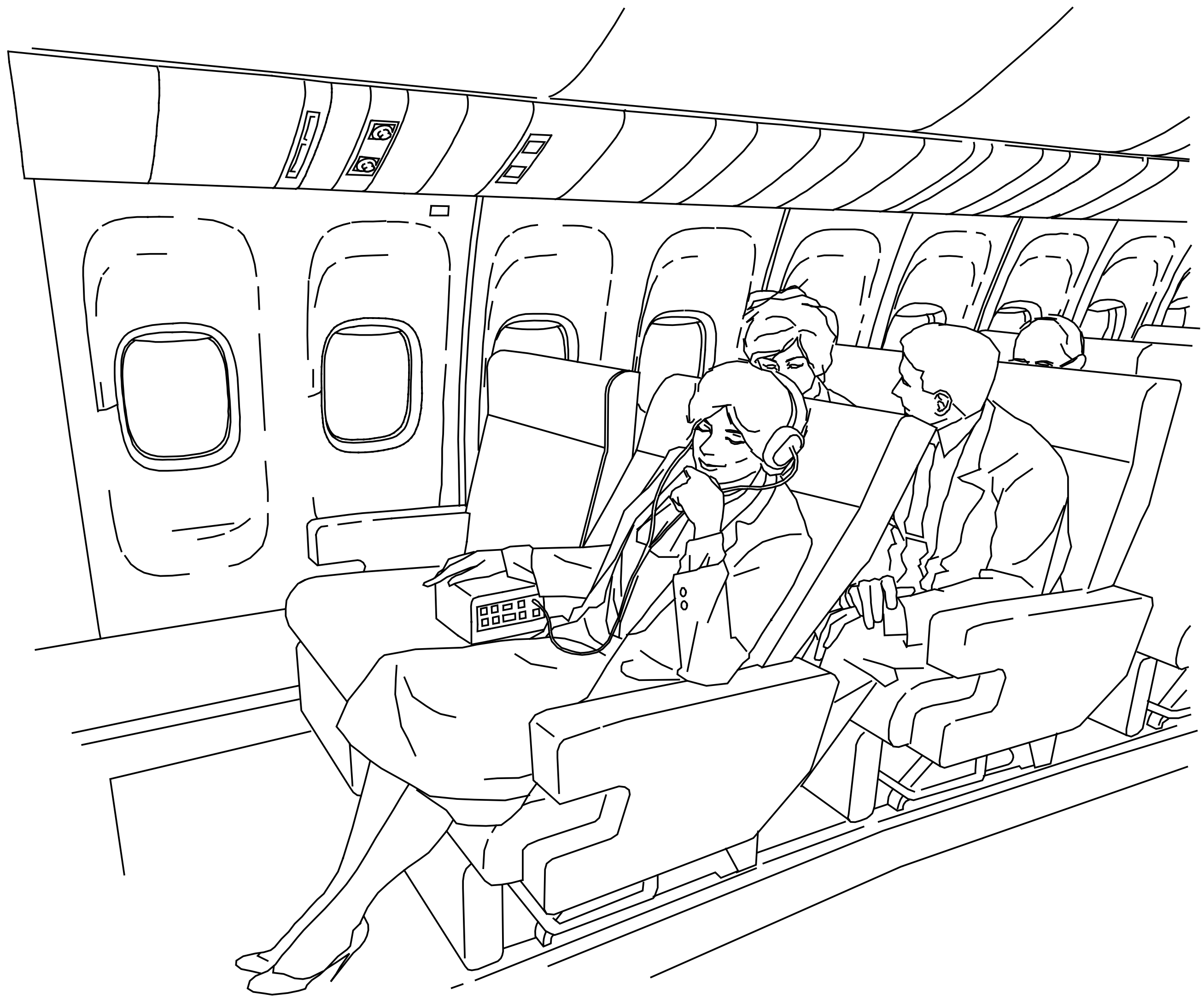
The passenger entertainment system (PES)-audio sends entertainment audio and passenger address audio to each passenger seat.

Passengers make selections to hear one of many available audio channels.

The PES-audio also gets audio from the PES-video and from the passenger address (PA) system.

Abbreviations and Acronyms

ADB - area distribution box
AEP - audio entertainment player
AIMS - airplane information management system
CDB - configuration data base
CMT - cabin management terminal
CSMU - cabin system management unit
CSS - cabin services system
ctrl - control
EPESC - enhanced passenger entertainment system controller
EVSCU - enhanced video system control unit
IFE - in-flight entertainment
intfc - interface
LAN - local area network
PA/CI - passenger address/cabin interphone
PAS - passenger address system
pax - passenger
PES - passenger entertainment system
pnl - panel
PRAM - prerecorded announcement machine
RFCS - RF combiner/splitter
RFDA - RF distribution amplifier
SEB - seat electronics box
vol - volume
ZIA - zone integration area
ZIU - zone integration unit
ZMU - zone management unit



IN-FLIGHT ENTERTAINMENT SYSTEM/PASSENGER ENTERTAINMENT SYSTEM-AUDIO - INTRODUCTION

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IFE/PES-AUDIO - GENERAL DESCRIPTION

General

The in-flight entertainment (IFE) system gets audio from many sources. The passengers select audio channels to hear the audio in their headphones. During passenger address (PA) announcements, passengers hear the PA audio in their headphones.

Components

These are the types of IFE components that PES-audio may have:

- Audio sources
- Video sources
- Head-end interface and control
- Zone interface and control
- Seat components.

The IFE system connects to these other airplane systems and components:

- Passenger entertainment system (PES)-video
- Passenger address system (PAS)
- Cabin system management unit (CSMU).

Audio Sources

These IFE components are the sources for audio entertainment:

- Audio entertainment players (AEPs)
- Video source components.

The audio sources send audio signals to the enhanced video system control unit (EVSCU).

The EVSCU changes the audio from analog to digital. The EVSCU then compresses and multiplexes it and sends this audio signal to the enhanced passenger entertainment system controller (EPESC).

The EPESC puts this signal on an RF carrier and sends it to an RF combiner/splitter (RFCS). This RFCS combines the audio signal with video RF from the video system.

The RFCS sends the signal to a second RFCS where the signal splits. This RF signal goes to the seat electronics box (SEB) for the attendants to preview the audio selections at the cabin management terminal (CMT).

The other RF signal from the second RFCS goes to an RF distribution amplifier (RFDA). The RFDA increases the RF signal strength and sends it to the area distribution boxes (ADBs). The ADBs split the RF and send it to their related columns of SEBs.

The SEBs at the passenger seats get audio channel selections from the passengers. When a passenger makes an audio channel selection, the SEB demodulates the RF signal and sends the audio to the passenger headphones.

When the EPESC gets a PA announcement, it changes the PA audio from analog to digital. It then puts the signal in the place of the entertainment audio in the

IFE/PES-AUDIO - GENERAL DESCRIPTION

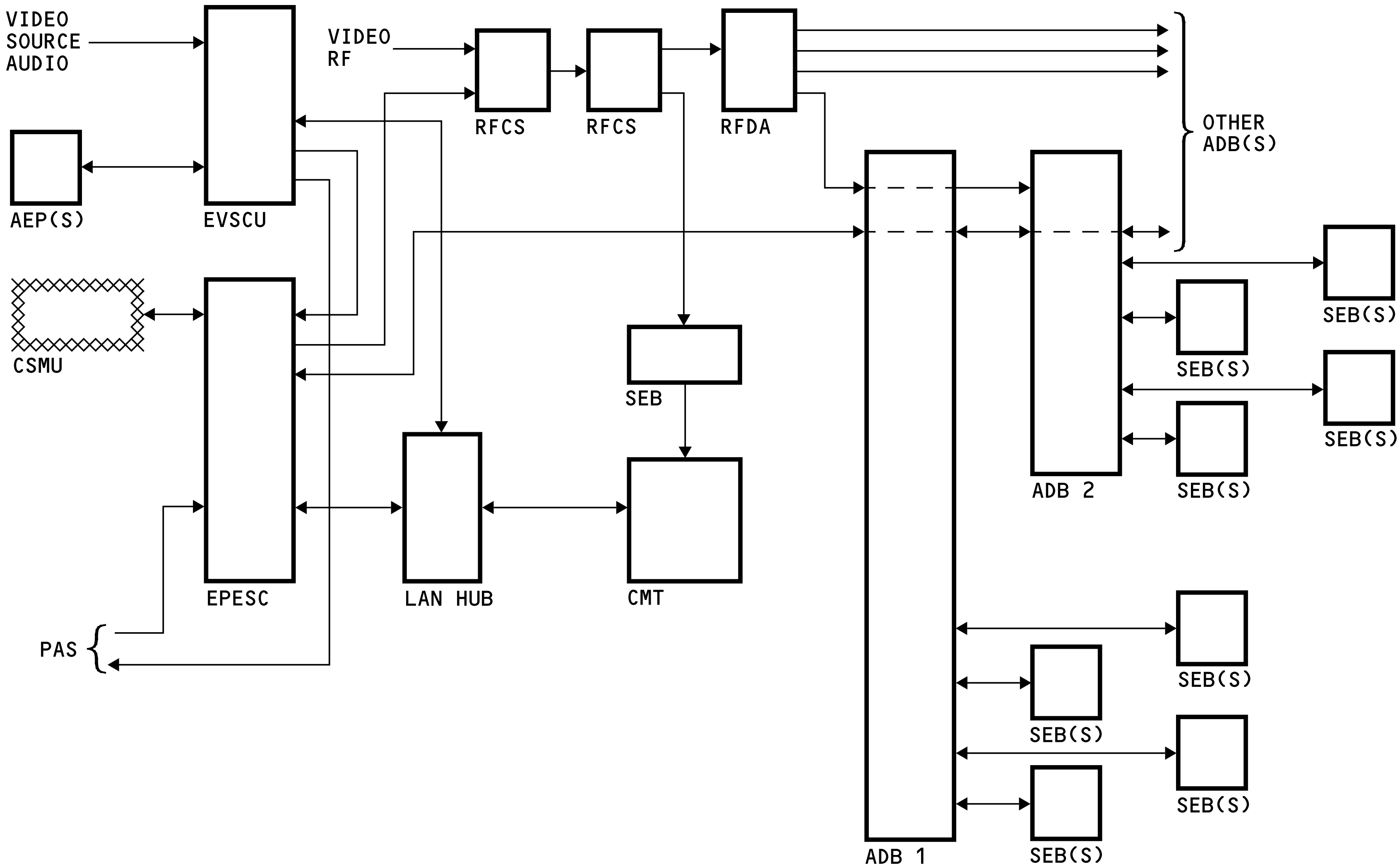
data stream. The EPESC puts this signal on an RF carrier and sends it to the area distribution boxes (ADBs). The EPESC sends data on a digital bus to the ADBs. This data tells the ADBs to demodulate the PA audio signals from the RF signal. The ADBs send this PA audio through the SEBs to the passenger headphones.

Interface and Control

The EPESC connects to these other systems and components for the related functions:

- Cabin system management unit (CSMU) - sends and gets data, such as airplane configuration and seating areas to and from the cabin services system (CSS)
- Passenger address system (PAS) - gets PA override audio and keylines from passenger address announcements to the passenger headphones.

Attendants use the CMT to control the audio entertainment. Control signals from the CMT go through the local area network (LAN) hub to the EVSCU and EPESC.



IFE/PES-AUDIO - GENERAL DESCRIPTION

IFE/PES-AUDIO - CABIN COMPONENT LOCATIONS

General

Many of the IFE components for PES-audio are in the passenger cabin and above the cabin ceiling panels.

Cabin Area Components

The purser station has these IFE components:

- Audio entertainment players (AEPs)
- Cabin management terminal (CMT)
- Enhanced video system control unit (EVSCU)
- Local area network (LAN) hub
- Radio frequency combiner/splitters (RFCSs)
- RF distribution amplifier (RFDA)
- Seat electronics box (SEB).

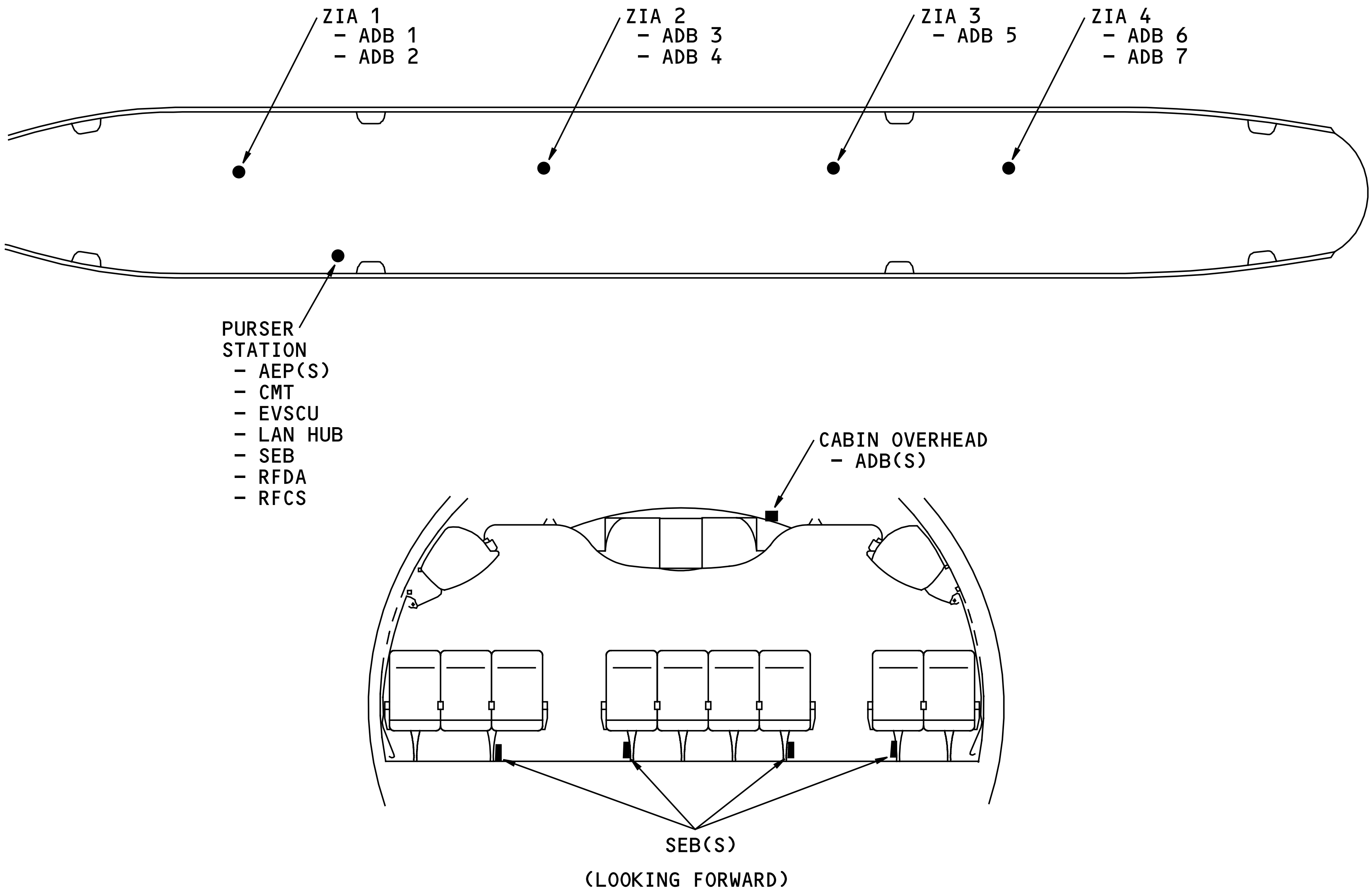
Passenger Seat Components

Passenger seats have seat electronics boxes (SEBs) under the seats. Passengers use controls at the seat to make audio channel selections.

Components Above the Ceiling Panels

Some of the IFE components are above the ceiling panels. The components are in locations called zone integration areas (ZIAs). There are four ZIAs.

The area distribution boxes (ADBs) are in ZIA 1, ZIA 2, ZIA 3 and ZIA 4.

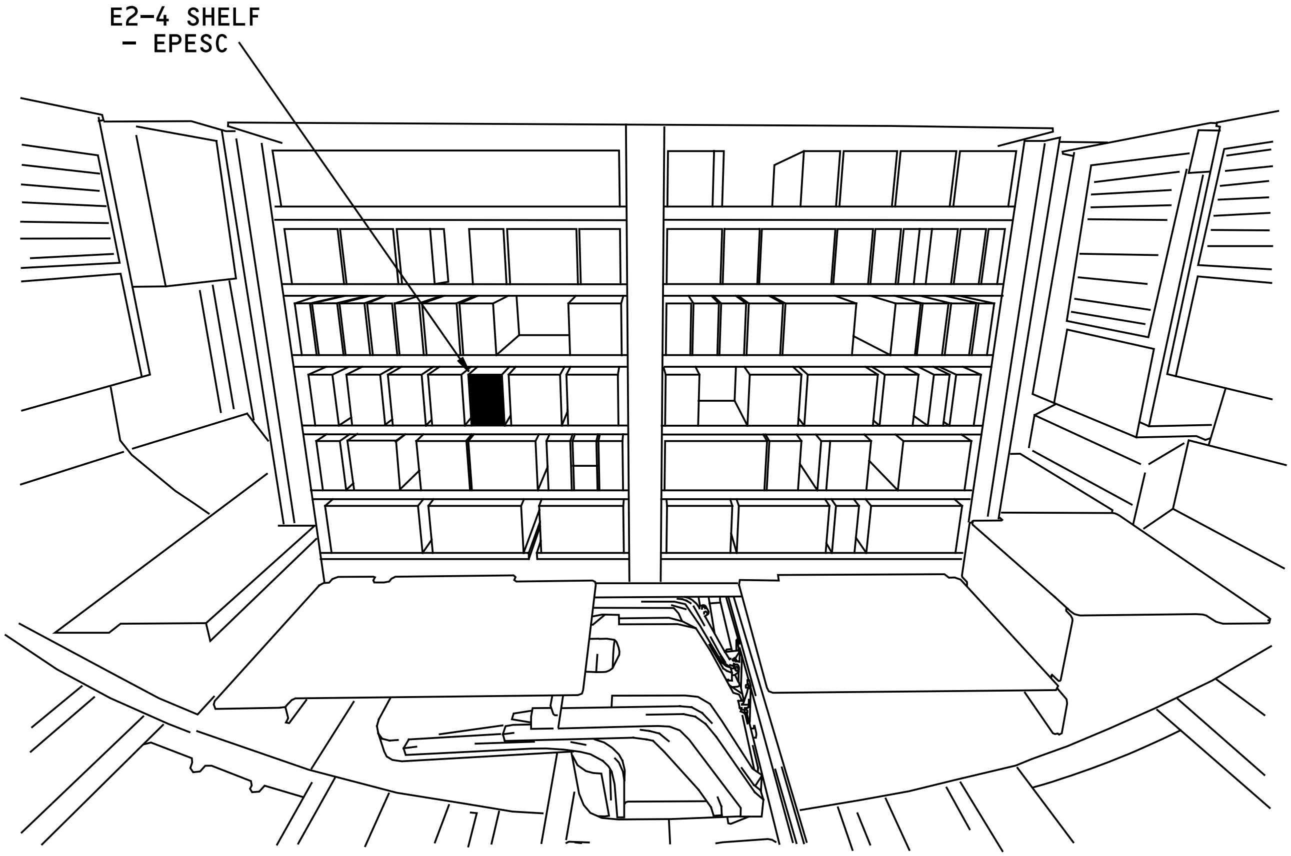


IFE/PES-AUDIO - CABIN COMPONENT LOCATIONS

IFE/PES-AUDIO - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

General

The enhanced passenger entertainment system controller (EPESC) is in the main equipment center.



MAIN EQUIPMENT CENTER
(LOOKING AFT)

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IFE/PES-AUDIO - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

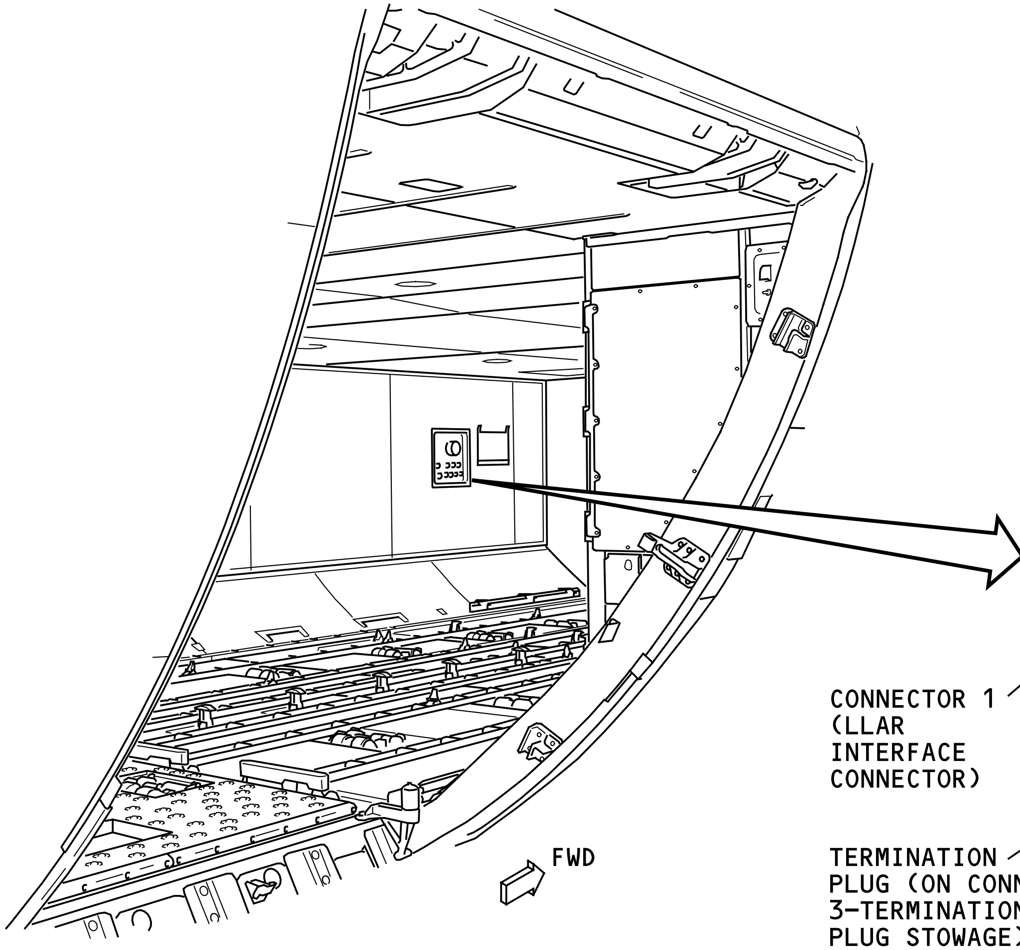
IFE/PES-AUDIO - CARGO COMPARTMENT COMPONENT LOCATIONS

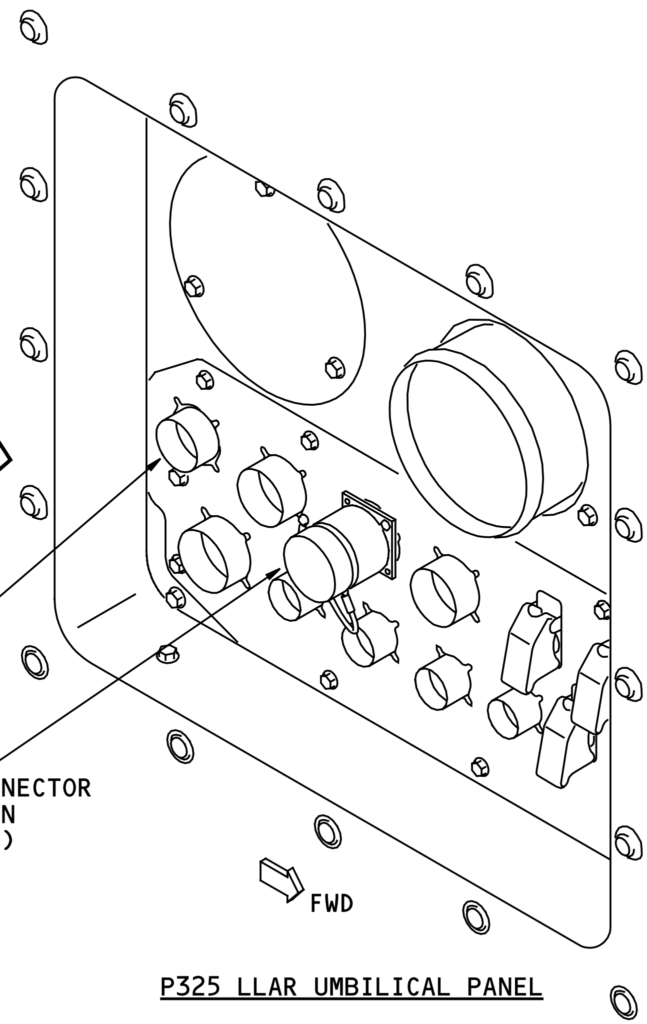
General

The P325 lower lobe attendants rest (LLAR) umbilical panel is on the left sidewall in the aft cargo compartment.

When the LLAR is not in the airplane, you must put a termination plug on connector 1 on the P325 panel.

When you install the LLAR, one of the LLAR cables goes to connector 1 on the P325 panel. Move the termination plug to connector 3 for stowage. Connector 3 has no electrical connections.





IFE/PES-AUDIO - CARGO COMPARTMENT COMPONENT LOCATIONS

IFE/PES-AUDIO - POWER INTERFACES

General

Power for the PES-audio comes through the P110 power management panel and the P210 right power management panel.

Circuit breakers control power to these PES-audio components:

- Audio entertainment players (AEPs)
- Enhanced passenger entertainment system controller (EPESC)
- Enhanced video system control unit (EVSCU)
- Cabin management terminal (CMT)
- RF distribution amplifier (RFDA)
- Local area network (LAN) hub
- Seat electronics box (SEB) in the purser station.

P110 Left Power Management Panel

The MULTP AUDIO ENTMT circuit breakers connects 115v ac through the AEP relay to the EPESC.

The ENTMT CTRL L circuit breaker connects 28v dc to the AEP relay. The ELMS electronic unit connects a ground to energize the relay during load shedding. When the relay energizes, it removes the power from the components.

You can also use the IFE off switch in the purser station to remove power from the components. When you turn the switch off, the switch connects a ground to the relay. The relay energizes and removes power from IFE/PES-audio components.

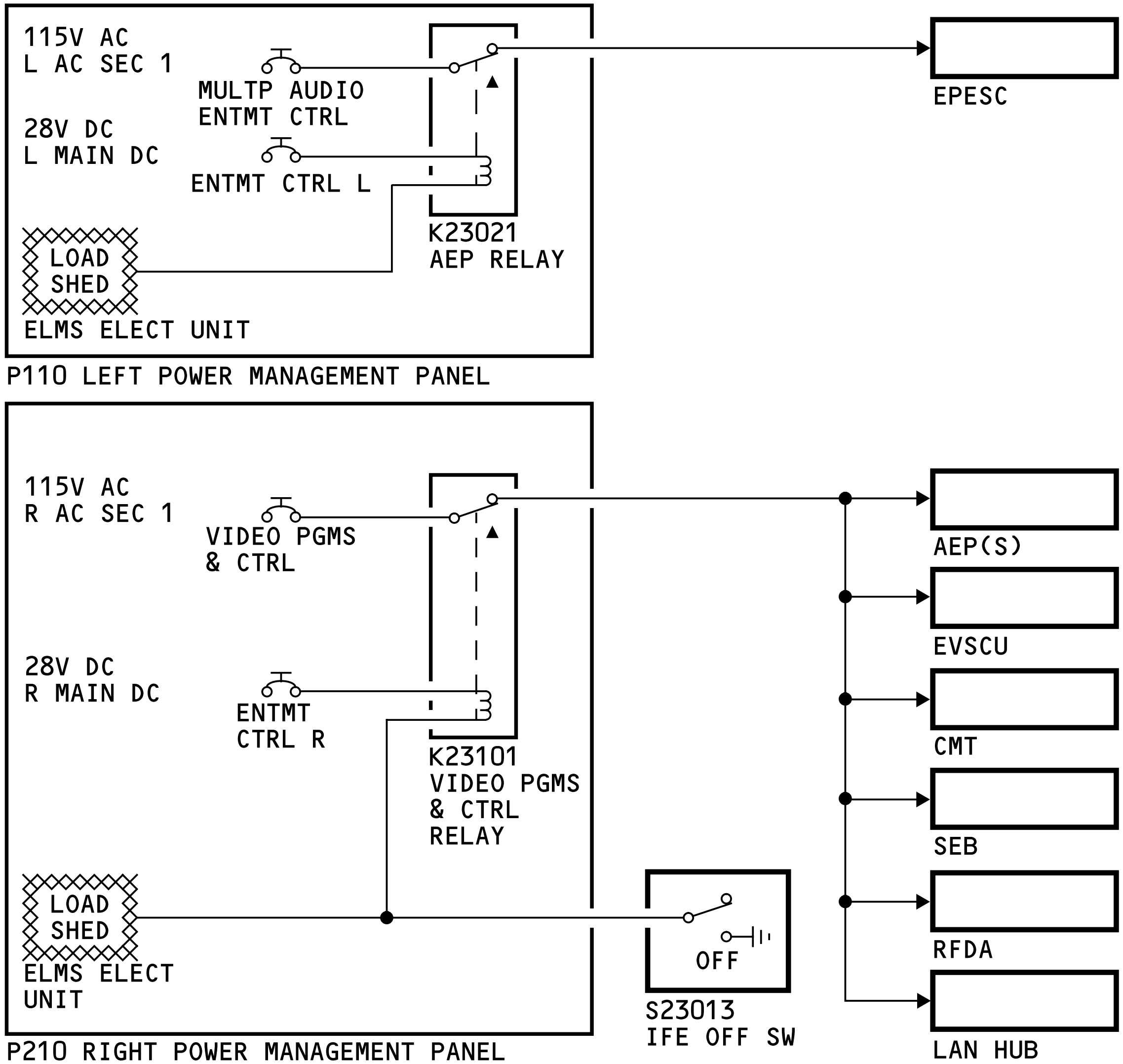
P210 Right Power Management Panel

The VIDEO PGMS & CTRL circuit breaker connects 115v ac through the video program and control relay to these LRUs:

- EVSCU
- CMT
- RFDA
- LAN hub
- SEB.

The ELMS electronic unit connects a ground to energize the relay during load shedding. When the relay energizes, it removes the power from the components.

You can also use the IFE off switch in the purser station to remove power from the components. When you turn the switch off, the switch connects a ground to the relay. The relay energizes and removes power from IFE/PES-audio components.



IFE/PES-AUDIO - POWER INTERFACES

IFE/PES-AUDIO - ZONE INTEGRATION AREA 1 POWER INTERFACES

General

Circuit breakers and a relay on the P210 right power management panel controls power to the components in zone integration area 1.

Power

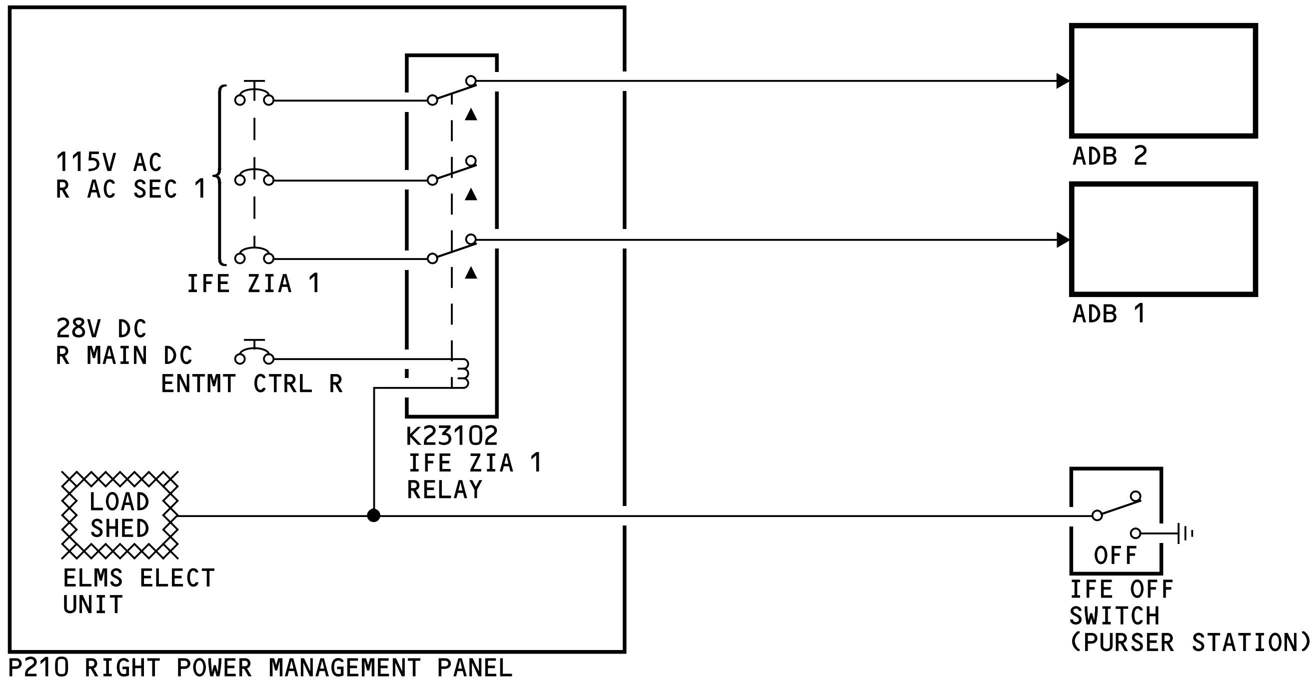
The IFE ZIA 1 circuit breaker connects 115v ac, three phase power to the IFE ZIA 1 relay. The relay connects two phases of the power to the area distribution boxes (ADBs). Each ADB gets power from a different phase.

The ENTMT CTRL R circuit breaker connects 28v dc to the IFE ZIA 1 relay.

Relay Control

The ELMS electronic unit connects a ground to energize the relay during load shedding. When the relay energizes, it removes power from the components in the zone integration area.

You can also use the IFE off switch in the purser station to remove power from the relay. In the OFF position, the switch connects a ground to energize the relay.



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IFE/PES-AUDIO - ZONE INTEGRATION AREA 1 POWER INTERFACES

IFE/PES-AUDIO - ZONE INTEGRATION AREA 2 POWER INTERFACES

General

Circuit breakers and a relay on the P110 left power management panel controls power to the components in zone integration area 2.

Power

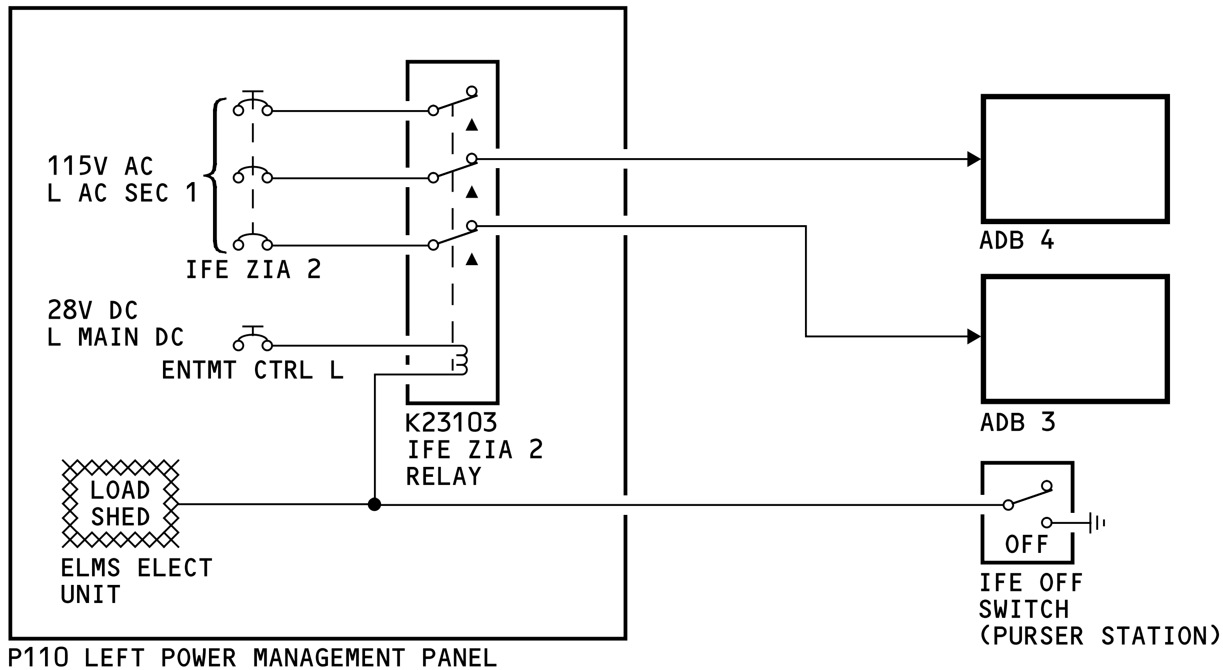
The IFE ZIA 2 circuit breaker connects 115v ac three phase power to the IFE ZIA 2 relay. The relay connects two phases of the power to the area distribution boxes (ADBs). Each ADB gets power from a different phase.

The ENTMT CTRL L circuit breaker connects 28v dc to the IFE ZIA 2 relay.

Relay Control

The ELMS electronic unit connects a ground to energize the relay during load shedding. When the relay energizes, it removes power from the components in the zone integration area.

You can also use the IFE off switch in the purser station to remove power from the relay. In the OFF position, the switch connects a ground to energize the relay.



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IFE/PES-AUDIO - ZONE INTEGRATION AREA 2 POWER INTERFACES

IFE/PES-AUDIO - ZONE INTEGRATION AREA 3 POWER INTERFACES

General

Circuit breakers and a relay on the P110 left power management panel controls power to the components in zone integration area 3.

Power

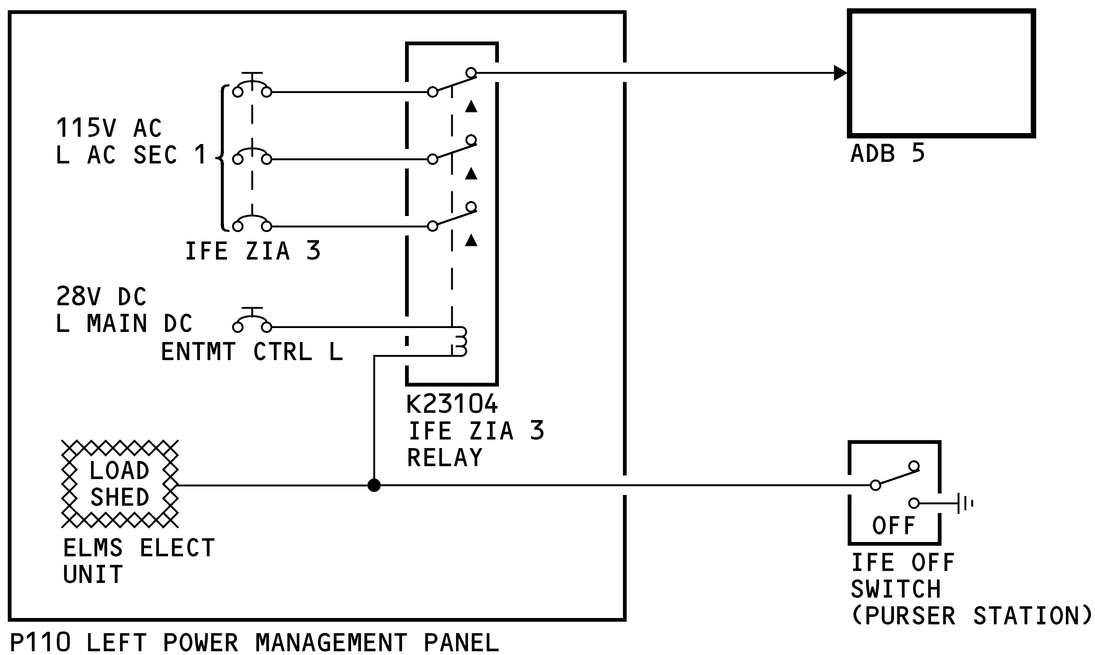
The IFE ZIA 3 circuit breaker connects 115v ac three phase power to the IFE ZIA 3 relay. The relay connects only one phase of the power to area distribution box (ADB) 5.

The ENTMT CTRL L circuit breaker connects 28v dc to the IFE ZIA 3 relay.

Relay Control

The ELMS electronic unit connects a ground to energize the relay during load shedding. When the relay energizes, it removes power from the components in the zone integration area.

You can also use the IFE off switch in the purser station to remove power from the relay. In the OFF position, the switch connects a ground to energize the relay.



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IFE/PES-AUDIO - ZONE INTEGRATION AREA 3 POWER INTERFACES

IFE/PES-AUDIO - ZONE INTEGRATION AREA 4 POWER INTERFACES

General

Circuit breakers and a relay on the P210 right power management panel controls power to the components in zone integration area 4.

Power

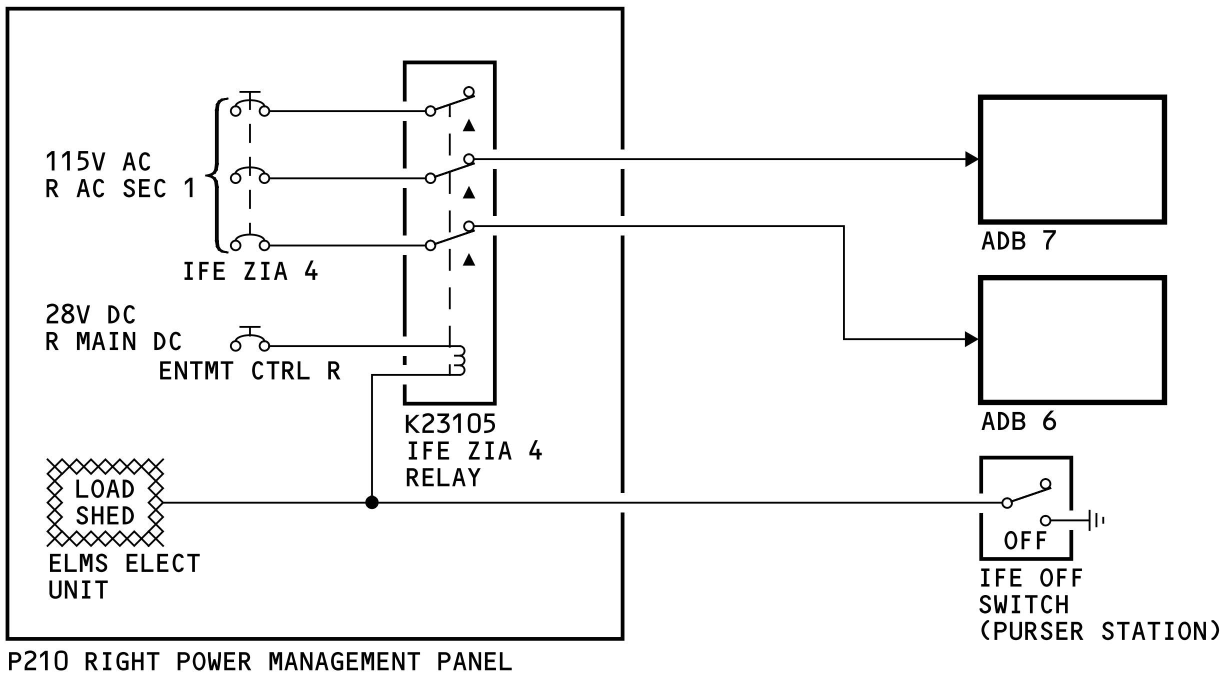
The IFE ZIA 4 circuit breaker connects 115v ac three phase power to the IFE ZIA 4 relay. The relay connects two phases of the power to the area distribution boxes (ADBs). Each ADB gets power from a different phase.

The ENTMT CTRL R circuit breaker connects 28v dc to the IFE ZIA 4 relay.

Relay Control

The ELMS electronic unit connects a ground to energize the relay during load shedding. When the relay energizes, it removes power from the components in the zone integration area.

You can also use the IFE off switch in the purser station to remove power from the relay. In the OFF position, the switch connects a ground to energize the relay.



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IFE/PES-AUDIO - ZONE INTEGRATION AREA 4 POWER INTERFACES

IFE/PES-AUDIO - AIRPLANE INTERFACES

General

The in-flight entertainment (IFE) system connects to these airplane systems and components:

- Passenger address/cabin interphone (PA/CI) controller
- Prerecorded announcement machine (PRAM)
- Cabin system management unit (7).

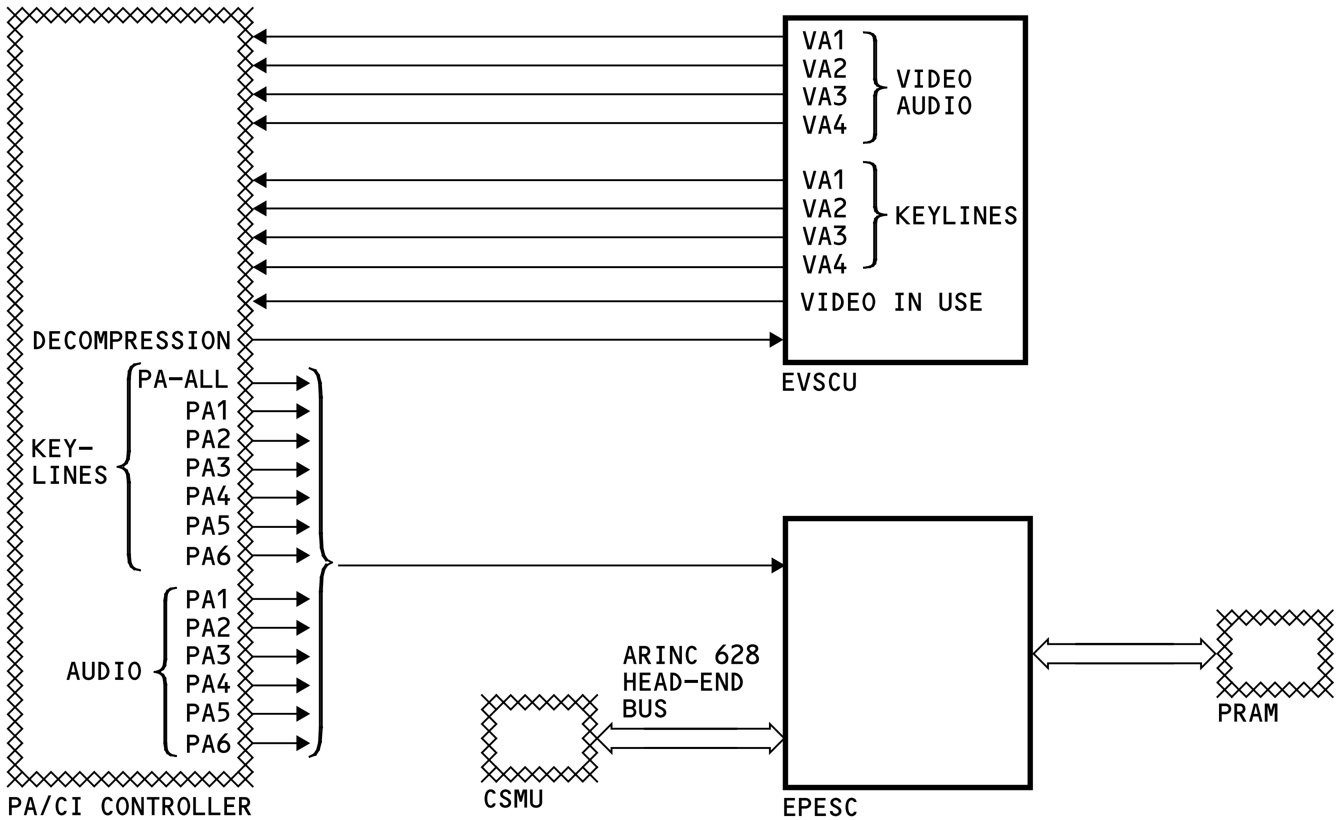
Passenger Address Interfaces

The enhanced video system control unit (EVSCU) sends as many as four video audio outputs and related video audio keylines to the PA/CI controller. It also sends a signal to tell the flight crew when the video is in use. The EVSCU gets a decompression signal from the PA/CI controller when necessary.

The PA/CI controller sends as many as six channels of passenger address (PA) audio and related keylines to the enhanced passenger entertainment system controller (EPESC). The different channels relate to the PA areas in the cabin that the configuration database defines. The IFE sends this audio to the passenger headphones. The PA/CI controller also sends a PA-All keyline for announcements in all areas of the cabin. This replaces PES-audio with the PA announcement. The PA audio then goes to the passenger headphones.

The EPESC connects to the PRAM to control the prerecorded announcements and boarding music.

The CSMU connects to the IFE system with an ARINC 628 head-end interface. It sends airplane data and cabin services system (CSS) configuration data to the IFE system.



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IFE/PES-AUDIO - AIRPLANE INTERFACES

Continental Airlines, Inc

CSS Passenger Telephone System

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AERONAUTICAL TELECOMMUNICATION SYSTEM/PASSENGER TELEPHONE SYSTEM - INTRODUCTION

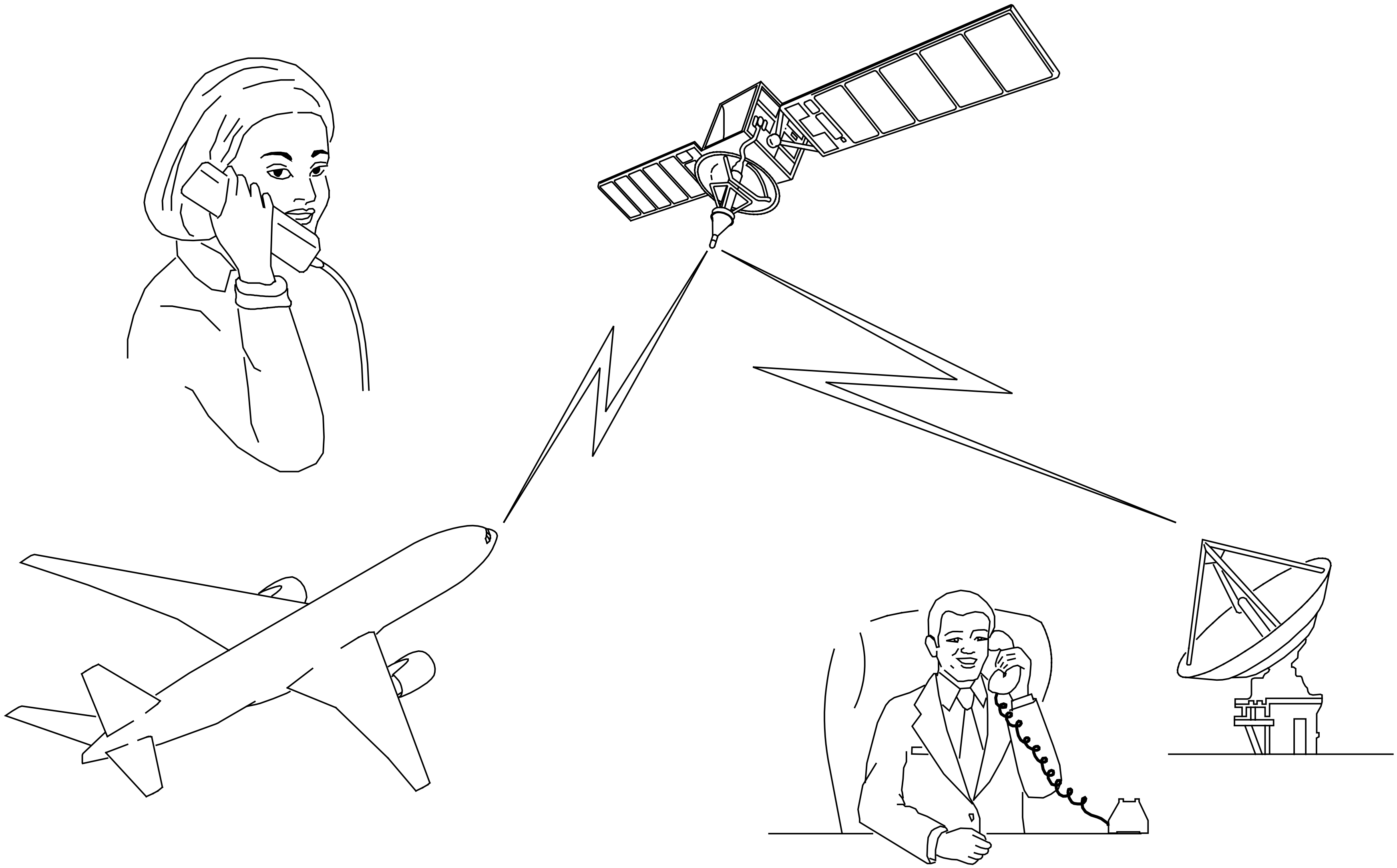
General

The passenger telephone system permits passenger communications to the ground.

Passengers use handsets to make calls. The passengers use a credit card to pay for the call. Handsets operate like usual telephone handsets.

Abbreviations and Acronyms

ATS	- aeronautical telecommunications system
AIMS	- airplane information management system
annun	- annunciator
bps	- bits per second
CMC	- central maintenance computer
CEPT	- Conference Europeenne des Administrations des Postes et des Telecommunications
CCR	- credit card reader
CCS	- cabin communication system
CSS	- cabin services system
CTU	- cabin telecommunications unit
EPESC	- enhanced passenger entertainment system controller
ICAO	- International Civil Aviation Organization
I/O	- input/output
IFE	- in-flight entertainment
intfc	- interface
modem	- modulator/demodulator
pax	- passengers
PAX HNDST	- passenger handset
SATCOM	- satellite communication
tel	- telephone
telecom	- telecommunications



AERONAUTICAL TELECOMMUNICATION SYSTEM/PASSENGER TELEPHONE SYSTEM - INTRODUCTION

ATS/PASSENGER TELEPHONE SYSTEM - GENERAL DESCRIPTION

General

Passengers use handsets to make telephone calls. Outgoing calls go to the cabin telecommunications unit (CTU). The CTU sends the calls to the satellite communication (SATCOM) system.

Components

The main component of the passenger telephone system is the cabin telecommunications unit (CTU).

The passenger telephone system connects with these airplane systems and components:

- In-flight entertainment (IFE) system. The IFE system has handsets that the passengers use to make telephone calls
- Satellite communication (SATCOM) system
- Airplane information management system (AIMS).

In-Flight Entertainment System

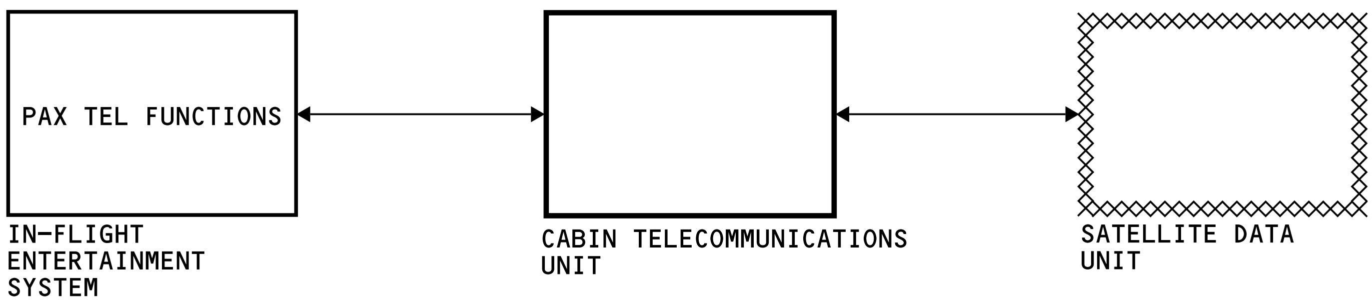
Passengers use a handset at the seat to make a telephone call. The call signals from the handset go through the IFE components to the CTU.

The CTU connects telephone calls to a ground station through the SATCOM system.

To make a facsimile (FAX) or modulator/demodulator (modem) call, the passenger starts the call the same as for a voice call. The passenger then connects a FAX machine or a modem to the FAX/modem connector on the handset or in the seat arm.

System Maintenance

The IFE system sends test commands and program data to the CTU. The results of a test or software installation, go to the IFE system for display.



23-18-00-502 Rev 11 02/23/1998

ATS/PASSENGER TELEPHONE SYSTEM - GENERAL DESCRIPTION

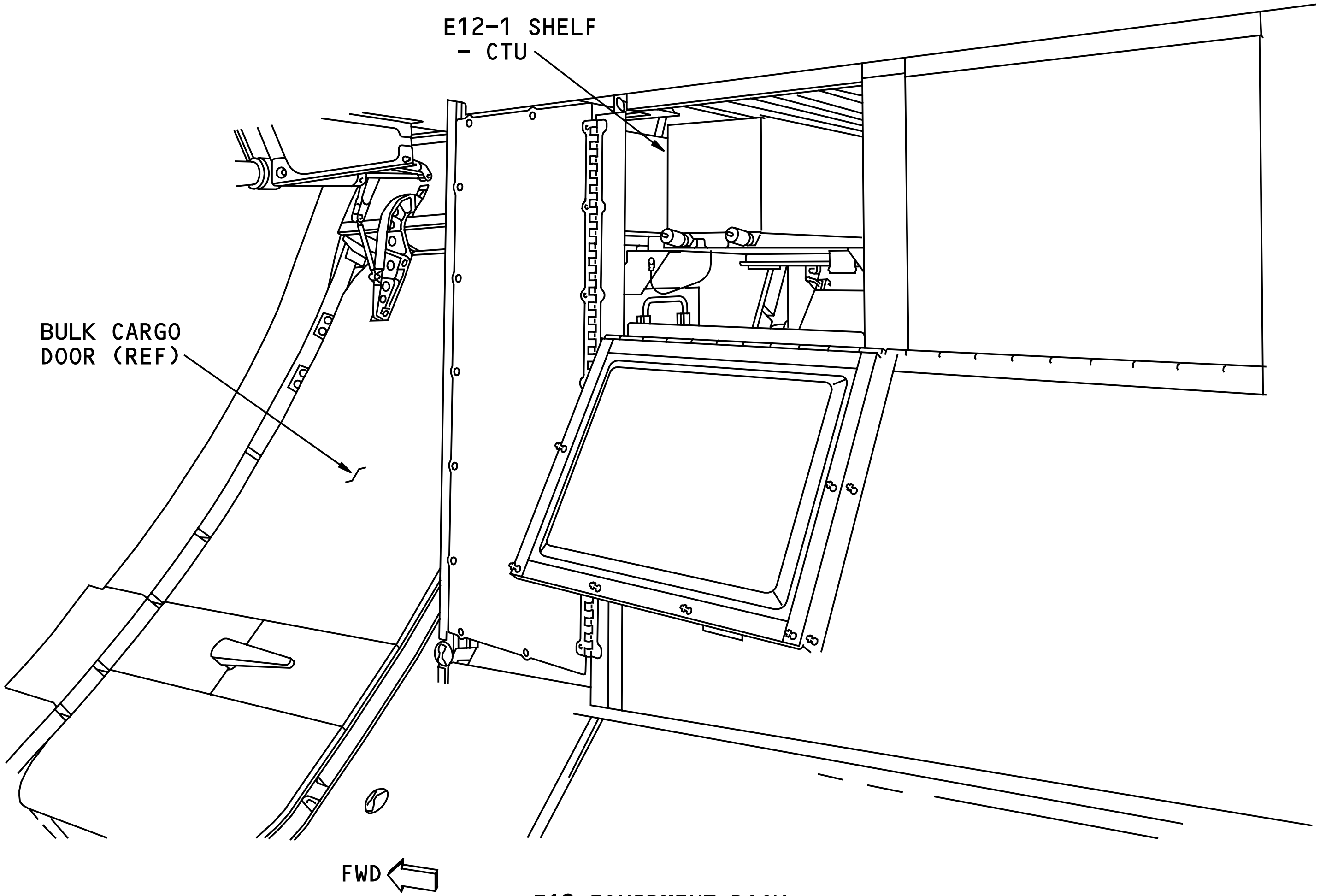
ATS/PASSENGER TELEPHONE SYSTEM - E12 RACK COMPONENT LOCATIONS

General

The cabin telecommunications unit (CTU) is on the E12-1 shelf.

Training Information Point

Open the side wall panels to get access to the E12 rack.



E12 EQUIPMENT RACK
(LOOKING OUTBOARD)

23-18-00-503 Rev 2 12/18/1997

ATS/PASSENGER TELEPHONE SYSTEM - E12 RACK COMPONENT LOCATIONS

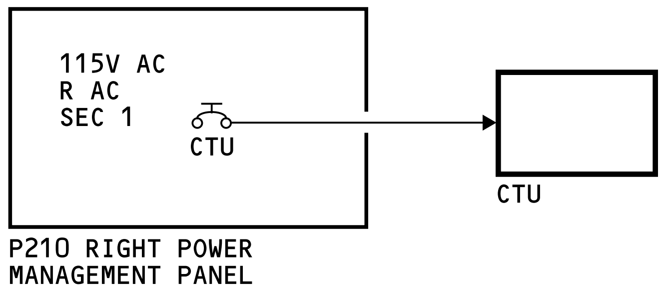
ATS/PASSENGER TELEPHONE SYSTEM - POWER INTERFACE

General

Power for the passenger telephone system comes from the P210 right power management panel.'

P210 Right Power Management Panel

The CTU circuit breaker connects 115v ac power to the CTU.



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ATS/PASSENGER TELEPHONE SYSTEM - POWER INTERFACE

ATS/PASSENGER TELEPHONE SYSTEM - AIRPLANE INTERFACES

General

The main component of the passenger telephone system is the cabin telecommunications unit (CTU). The CTU receives telephone signals on the Conference Europeenne des Administrations des Postes et des Telecommunications (CEPT)-E1 bus and sends these signals to the correct LRU.

These airplane systems have an interface with the passenger telephone system:

- In-flight entertainment system
- Satellite communications system (SATCOM)
- Airplane information management system (AIMS).

In-Flight Entertainment System Interface

The enhanced passenger entertainment system controller (EPESC) is part of the IFE system. The IFE system sends the passenger telephone system:

- Passenger telephone calls
- Digital data
- Facsimile (FAX)/modulator/demodulator (modem) data.

Passengers use passenger handsets to make telephone calls. The telephone signals go to the EPESC which sends the signals to the CTU on the CEPT-E1 bus. The EPESC may also send digital data, such as inventory information, from the in-flight entertainment system to the CTU.

A connector on the passenger handset allows passengers to connect a personal computer with FAX/modem capabilities. The passenger handset sends these signals the same as outgoing telephone calls.

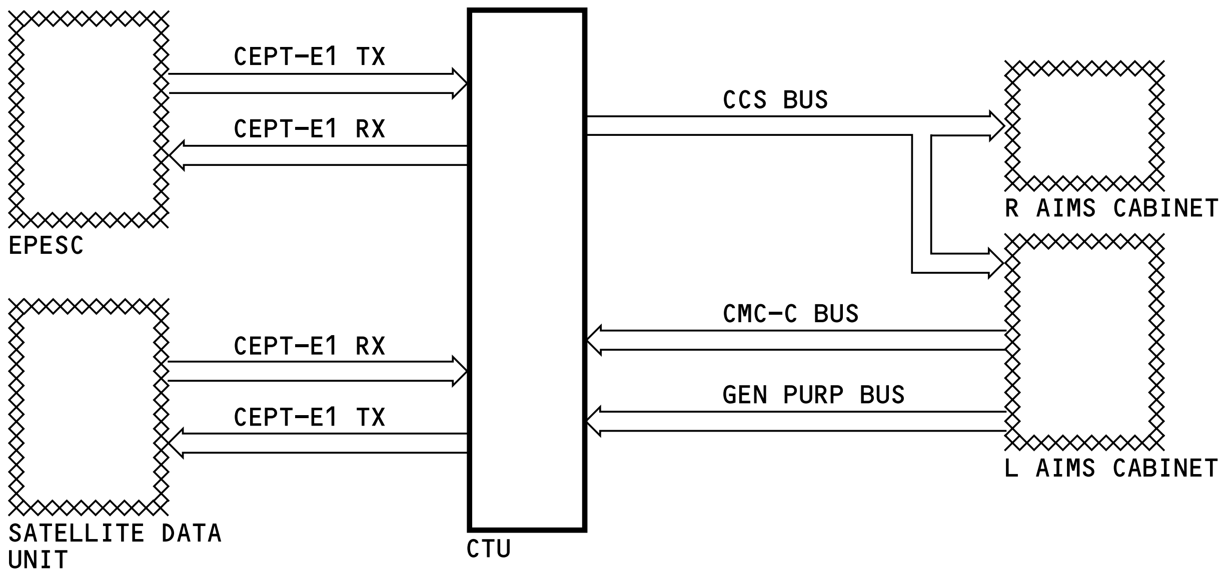
SATCOM System Interface

The CTU sends outgoing telephone signals to the satellite data unit (SDU). SATCOM transmits the signals through a satellite to the ground stations.

AIMS Interface

The right and left AIMS cabinets connect to the cabin telecommunications unit (CTU).

The CTU gets ICAO and weight on wheels (WOW) data from general purpose bus 1. It also gets time and date from the CMC-C bus. The CTU sends BITE status to the left and right AIMS cabinets on the cabin communication system (CCS) bus.



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ATS/PASSENGER TELEPHONE SYSTEM - AIRPLANE INTERFACES

Continental Airlines, Inc

Flight Interphone System

WB371

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FLIGHT INTERPHONE SYSTEM - INTRODUCTION

Purpose

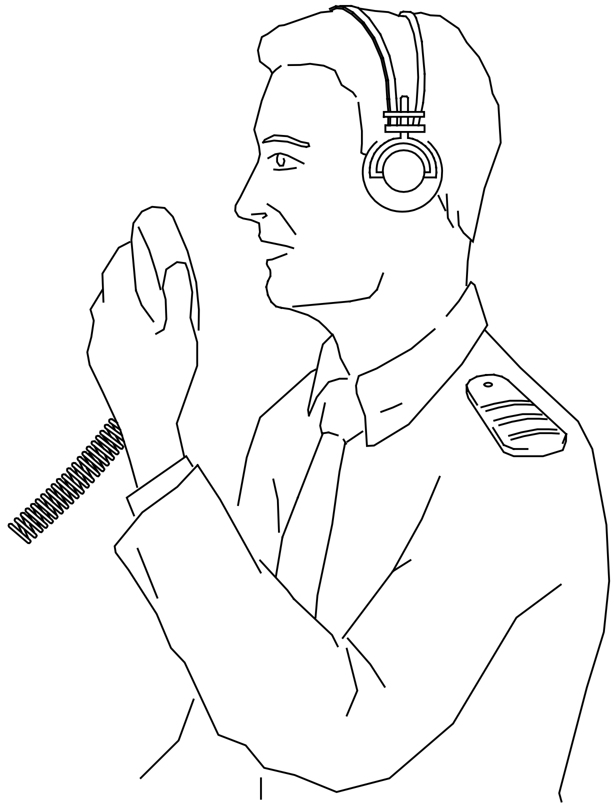
The flight crew uses the flight interphone system to speak with each other and the ground crew.

Flight and maintenance crews use the flight interphone system to get access to the communication systems and to monitor the navigation receivers.

The flight interphone system is part of the digital control audio system (DCAS).

Abbreviations and Acronyms

ACP - audio control panel
ADF - automatic direction finder
AIMS - airplane information management system
AMU - audio management unit
app - approach
CAB - cabin
CAPT - captain
COMM - communication
DCAS - digital control audio system
DME - distance measuring equipment
F/O - first officer
F/OBS - first observer
GSHLD - glareshield
HF - high frequency
ILS - instrument landing system
INT - interphone
MD&T - master dim and test
MEC - main equipment center
MIC - microphone
MB - marker beacon
nav - navigation
OBS - observer
PA - passenger address
PA/CI - passenger address/cabin interphone
PTT - push-to-talk
R/T - receive/transmit
RTP - radio tuning panel
S/OBS - second observer
SATCOM - satellite communications
SELCAL - selective calling
VHF - very high frequency
VOR - VHF omnidirectional range



23-51-00-001 Rev 1

FLIGHT INTERPHONE SYSTEM - INTRODUCTION

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FLIGHT INTERPHONE SYSTEM - GENERAL DESCRIPTION

General

The audio management unit (AMU) controls the routing of audio signals to and from the flight crew.

Flight Crew Interfaces

This system description shows the captain's system. Interfaces and components for other flight crew stations are almost the same.

The flight crew uses microphone (mic) switches on these components to send audio to the AMU:

- Glareshield
- Control column
- Hand microphone
- Audio control panel (ACP).

A microphone on these components lets the flight crew speak on the flight interphone system:

- Hand mic
- Oxygen mask
- Headset (through the boom mic/headphone panel).

The flight crew uses ACPs for these functions:

- Audio signal selection and monitoring
- Connect to other communication systems.

The AMU sends audio signals to the headsets and to the flight interphone speakers.

The observer audio selector controls a backup mode when the captain's or first officer's audio system has a failure.

Ground Crew Interfaces

The ground crew uses jacks in the main equipment center (MEC) and on the service and APU shutdown panel to connect to the flight interphone system.

Other Component and System Interfaces

The AMU connects to these other components for the related function:

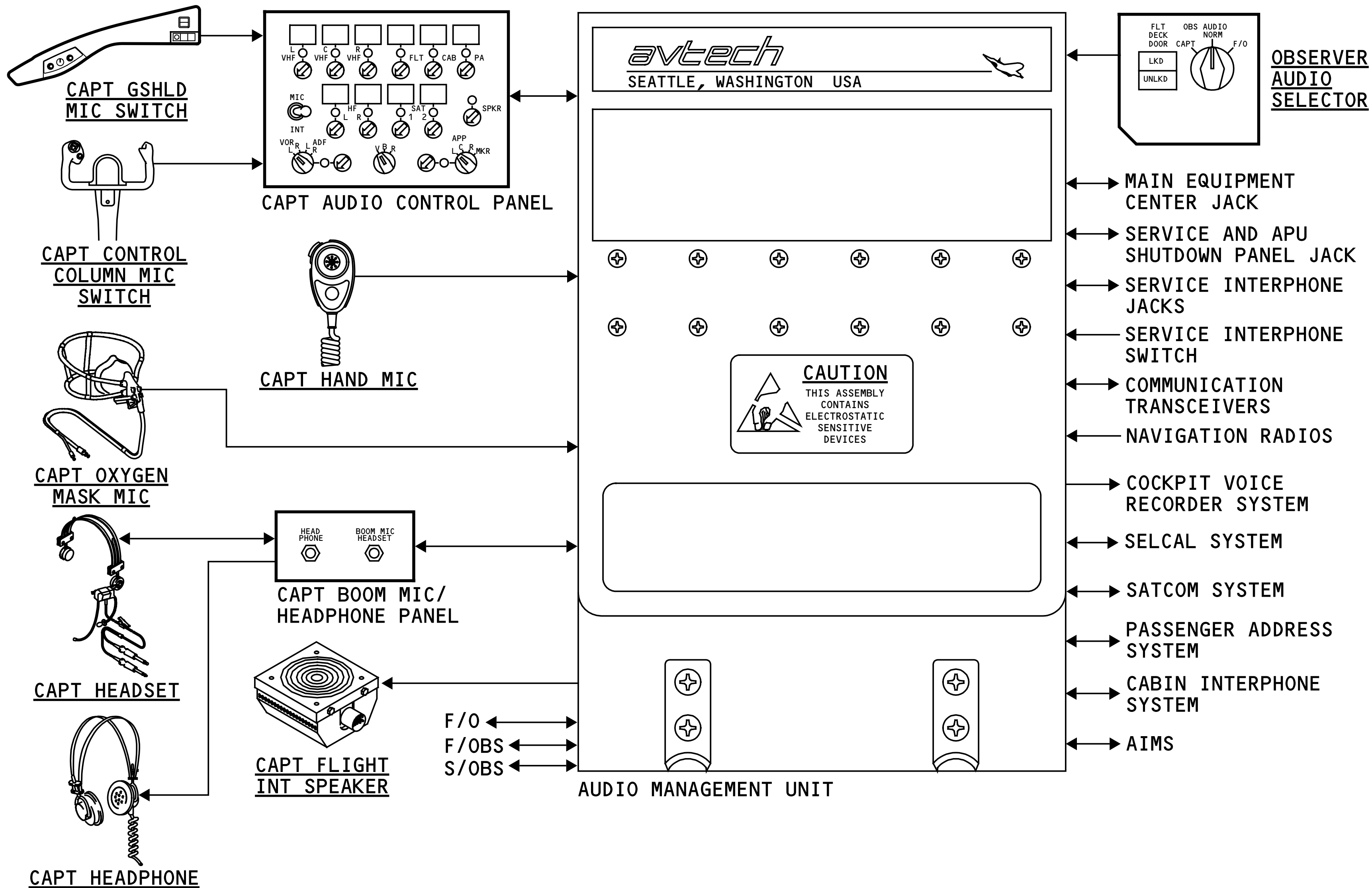
- Service interphone jacks - to send and get audio from the service interphone system
- Service interphone switch - connects the service interphone system with the flight interphone system
- Communications transceivers - the AMU sends push-to-talk (PTT) and microphone audio to the transceivers and gets audio back from them
- Navigation radios - the AMU gets voice and Morse code identification tones.

The flight interphone system also has an interface with these other systems:

- Cockpit voice recorder system - to record the flight crew microphone and receive audio

FLIGHT INTERPHONE SYSTEM - GENERAL DESCRIPTION

- SELCAL system - the AMU gets discretes to control call lights on the ACP and sends resets to the SELCAL decoder
- SATCOM system - permits the flight crew to speak with ground stations
- Passenger address system - this connection lets the flight crew make announcements to passengers
- Cabin interphone system - lets the flight crew speak with attendants
- AIMS - the AMU sends BITE data to AIMS and receives DME pairing data from AIMS over an ARINC 629 systems bus.



FLIGHT INTERPHONE SYSTEM - GENERAL DESCRIPTION

FLIGHT INTERPHONE SYSTEM - FLIGHT DECK COMPONENT LOCATIONS

Flight Deck Component Locations

These are the captain's flight interphone system components:

- Boom mic/headphone panel
- Control column mic switch
- Flight interphone speaker
- Hand mic jack
- Glareshield mic switch
- Audio control panel (ACP) on the P8 aft aisle stand panel.

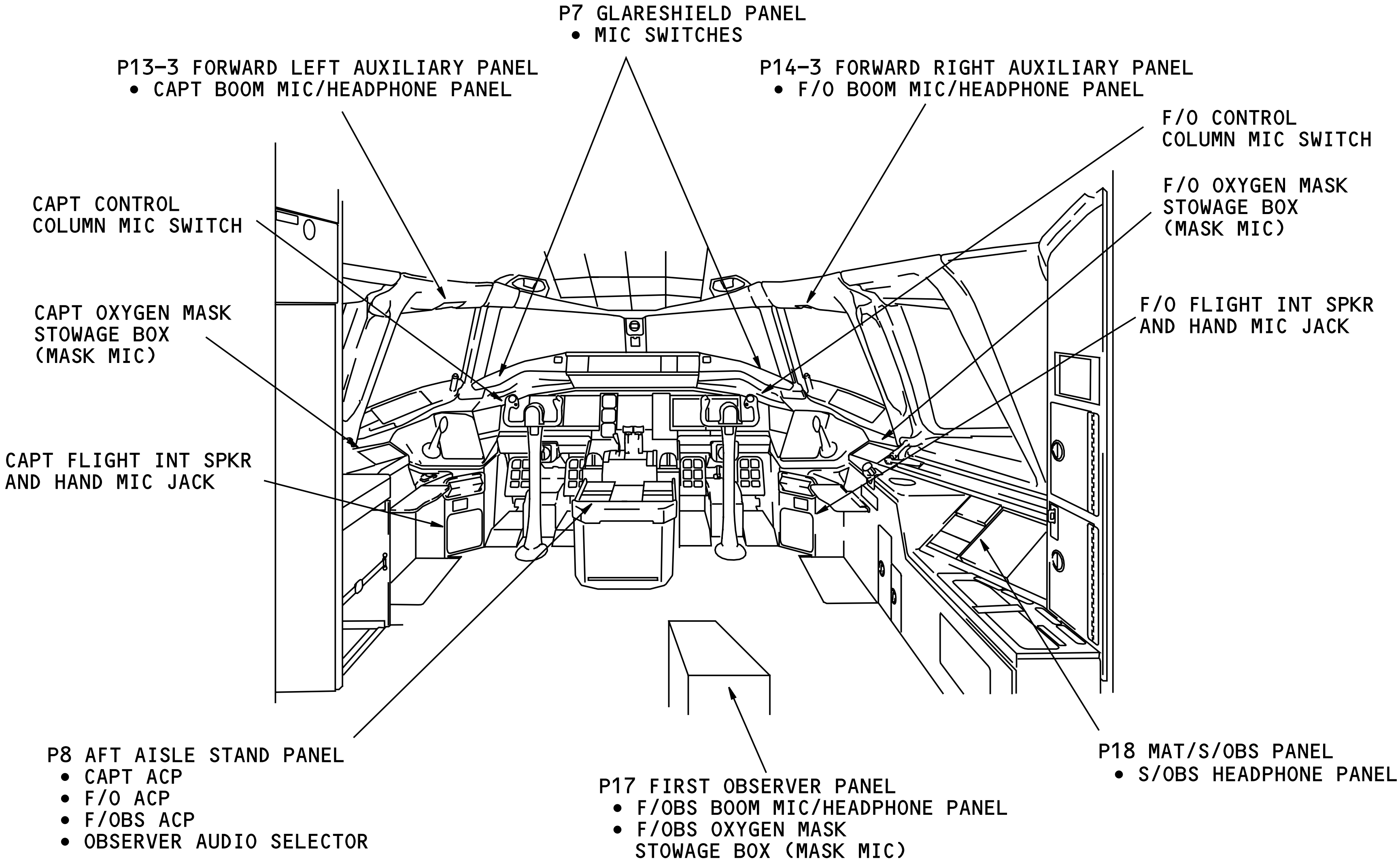
The other flight crew stations have the same components except that the first and second observers do not have a glareshield mic switch or a control column mic switch.

The second observer does not have an audio control panel or a hand mic jack.

The observer audio selector is on the P8 aft aisle stand panel.

Other Systems Component Locations

The captain, first officer and first observer each have an oxygen mask with a microphone in a stowage box adjacent to the station.



23-51-00-003 Rev 3 05/29/1996

FLIGHT INTERPHONE SYSTEM - FLIGHT DECK COMPONENT LOCATIONS

FLIGHT INTERPHONE SYSTEM - COMPONENT LOCATIONS

Flight Interphone Component Locations

There are flight interphone system components on the nose gear and in the main equipment center.

Nose Gear

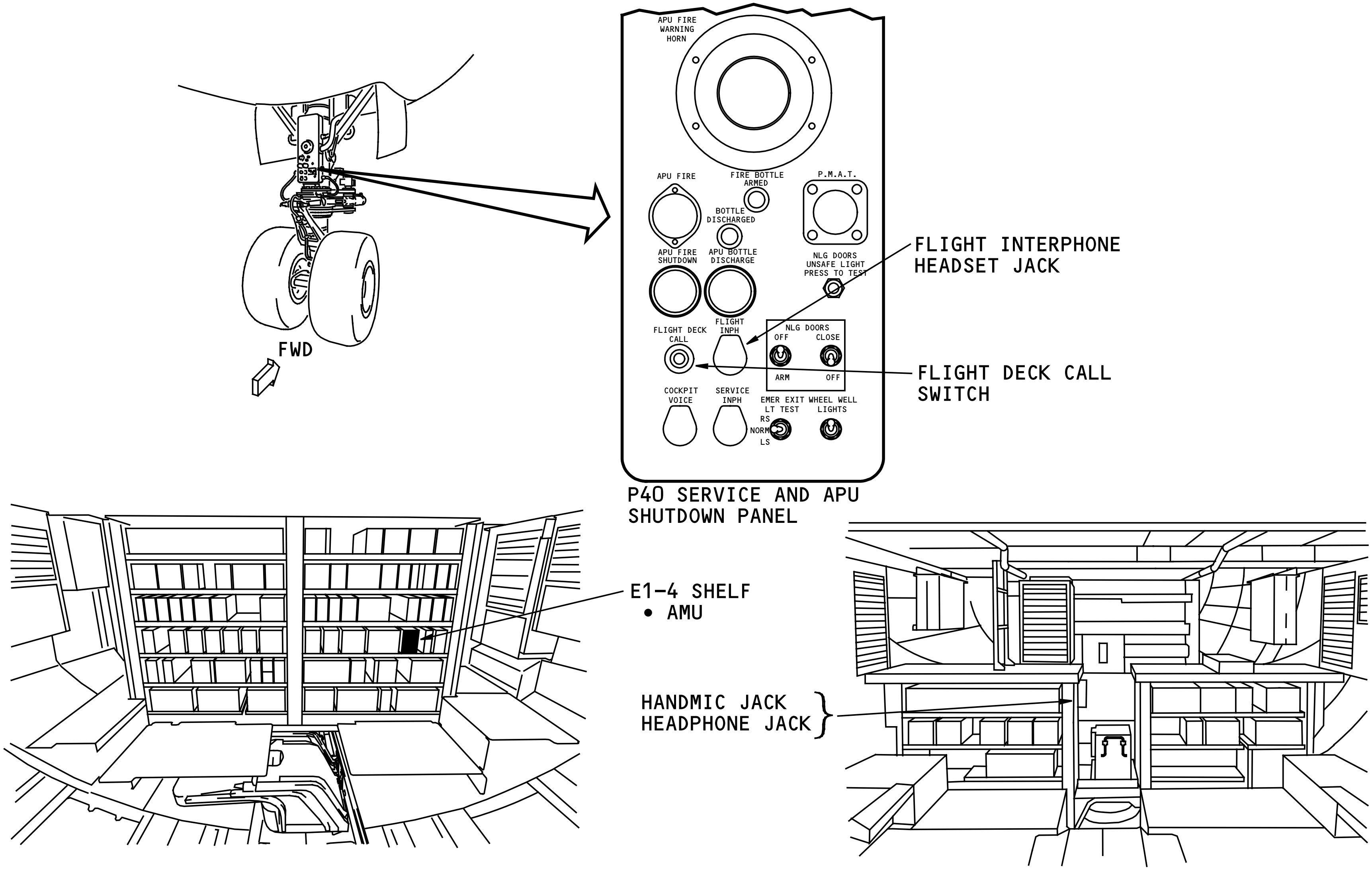
These flight interphone system components are on the service and APU shutdown panel:

- Flight interphone headset jack
- Flight deck call switch.

Main Equipment Center

These flight interphone system components are in the main equipment center (MEC):

- Audio management unit (AMU)
- Flight interphone handmic jack
- Flight interphone headphone jack.



MAIN EQUIPMENT CENTER
(LOOKING AFT)

MAIN EQUIPMENT CENTER
(LOOKING FORWARD)

FLIGHT INTERPHONE SYSTEM - COMPONENT LOCATIONS

23-51-00-004 Rev 2

FLIGHT INTERPHONE SYSTEM - POWER INTERFACE

General

Power for the flight interphone system comes through circuit breakers in the overhead circuit breaker panel.

The audio management unit (AMU) has a connector board and three station cards, one for each of the flight crew stations. Each station card has a power supply for its circuits.

INTERPHONE-CAPT Circuit Breaker

The INTERPHONE-CAPT circuit breaker connects 28v dc to these components:

- Captain's flight interphone speaker
- Captain's card
- Captain's audio control panel (ACP) through the AMU.

INTERPHONE-F/O Circuit Breaker

The INTERPHONE-F/O circuit breaker connects 28v dc to these components:

- First officer's flight interphone speaker
- First officer's card
- First officer's ACP through the AMU.

A different source of power for these components is through the INTERPHONE-F/O STBY PWR circuit breaker.

INTERPHONE-OBS Circuit Breaker

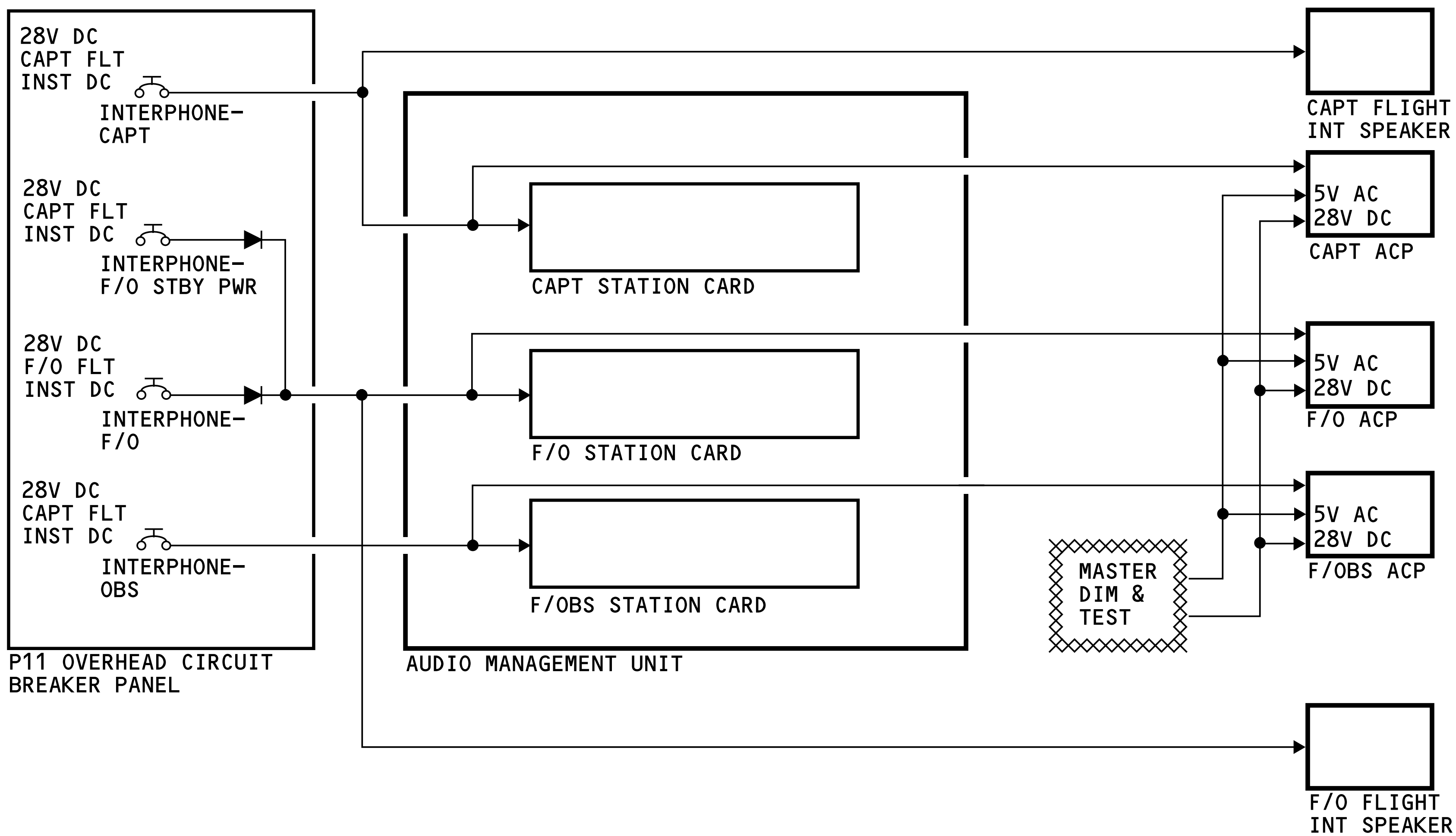
The INTERPHONE-OBS circuit breaker connects 28v dc to these components:

- First observer's card
- First observer's ACP through the AMU.

Master Dim and Test

Each ACP gets 5v ac and 28v dc from the master dim and test (MD&T) system. The ACP uses 5v ac for the panel lights and 28v dc for:

- Call lights
- Mic lights
- Receive LEDs.



23-51-00-005 Rev 5 01/16/95

FLIGHT INTERPHONE SYSTEM - POWER INTERFACE

FLIGHT INTERPHONE SYSTEM - FLIGHT DECK INTERFACES

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FLIGHT INTERPHONE SYSTEM - FLIGHT DECK INTERFACES

General

The flight interphone system has these four flight deck stations:

- Captain
- First officer
- First observer
- Second observer.

The captain's, first officer's and first observer's stations connect to a related circuit card in the audio management unit (AMU) for these functions:

- Receive inputs from the stations
- Supply audio signal routing
- Give selection indications to the audio control panels (ACPs).

Captain and First Officer Stations

The captain's and first officer's stations have these control signal and audio interfaces:

- Glareshield microphone (mic) switches
- Control wheel mic switches
- ACP
- Hand microphone
- Oxygen mask microphone and door switch (mask mic on/off)
- Headset
- Headphone
- Flight interphone speaker.

The glareshield and control wheel microphone switches connect to the station's ACP. The ACP sends a microphone or interphone (INT) PTT signal to the AMU. You use a mic/interphone switch on the ACP to send the related PTT signal to the AMU.

The hand microphone sends a PTT signal and audio through a jack panel to the AMU.

A door switch in the oxygen mask stowage box sends a mic on/off signal to the AMU. A microphone in the mask sends audio.

The AMU gets audio from a boom microphone on a headset.

The AMU sends audio to the headset, headphones, and flight interphone speaker.

First and Second Observer Stations

The first observer station has the same controls and interfaces as the captain and first officer except that it does not have these components:

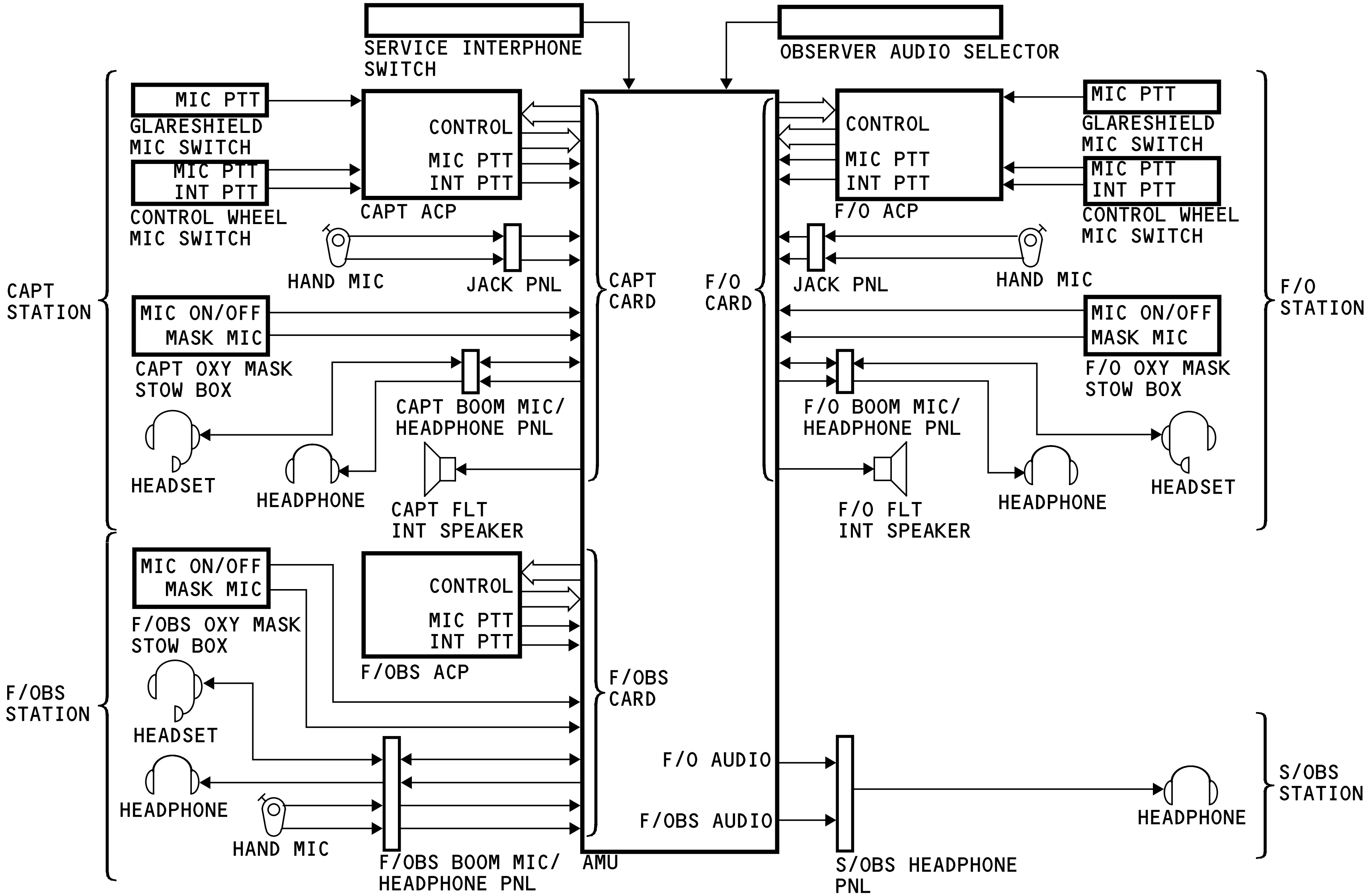
- Flight interphone speaker
- Control wheel mic switches
- Glareshield mic switches.

The second observer station has a jack panel that allows the second observer to monitor the first officer or the first observer audio.

FLIGHT INTERPHONE SYSTEM - FLIGHT DECK INTERFACES

Other Flight Deck Interfaces

The service interphone switch and observer audio selector connect to the AMU to control audio modes and selections.



FLIGHT INTERPHONE SYSTEM - FLIGHT DECK INTERFACES

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FLIGHT INTERPHONE SYSTEM - COMMUNICATION SYSTEM INTERFACES

General

The audio management unit (AMU) controls the routing of audio in the flight interphone system.

The AMU gets control and PTT signals from the audio control panels (ACPs). The AMU sends data to the ACPs to control lights.

Satellite Data Unit

The AMU gets call light and audio signals from the satellite data unit (SDU). The AMU turns on an associated call light on the ACPs. The flight crew makes selections on the ACP to reset the SATCOM call chime, turn on a microphone signal, and send audio to the SDU.

Communication Transceivers

The communication transceivers send audio outputs to the AMU. The transceivers get microphone audio and PTT discretes from the AMU.

The HF antenna couplers use the PTT signal to tune to a frequency.

SELCAL Decoder

The SELCAL decoder sends call set discretes to the AMU. The AMU uses them to control ACP call lights. The AMU sends call reset discretes to the SELCAL decoder to cancel the call discrete and turn off the call lights.

Passenger Address/Cabin Interphone (PA/CI) Controller

The AMU sends audio and PTT signals to the PA/CI controller. It receives audio from the PA/CI controller.

When the AMU receives a cabin call from the PA/CI controller, the ACP CALL lights come on. When the flight crew selects CAB on the ACP, the AMU sends a cabin call answer signal to the PA/CI controller. The PA/CI controller sends the cabin reset signal to the AMU. This causes the ACP CALL lights to go off.

The flight crew selects PA on the ACP to talk to passengers. The AMU sends a PTT signal and audio to the PA/CI controller. The PA/CI controller sends a sidetone audio back to the AMU.

When the ground crew calls the flight deck from the nose gear electrical service panel, the PA/CI controller sends a flight deck call signal to the AMU. This causes the ACP CALL lights to come on. When the flight crew selects FLT on any ACP, the AMU sends a flight reset signal to the PA/CI controller.

Cockpit Voice Recorder

The AMU sends audio from the captain, first officer, and first observer to the cockpit voice recorder.

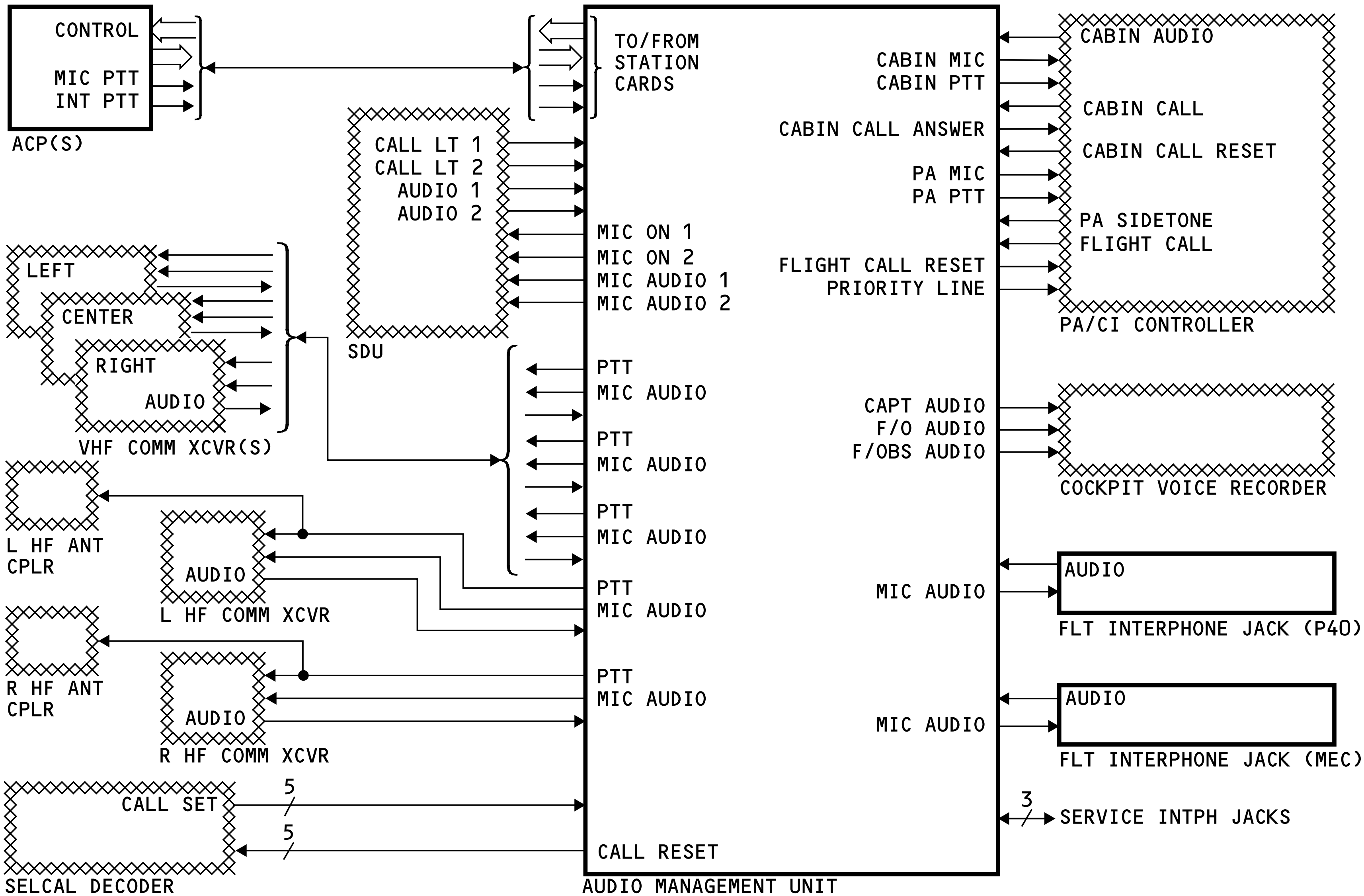
FLIGHT INTERPHONE SYSTEM - COMMUNICATION SYSTEM INTERFACES

Flight Interphone Jacks

The ground crew use the flight interphone jacks at the service and APU shutdown panel and in the main equipment center to talk to the flight crew.

Service Interphone Jacks

The AMU has three outputs that connect to many service interphone jacks on the airplane.



FLIGHT INTERPHONE SYSTEM - COMMUNICATION SYSTEM INTERFACES

23-51-00-007 Rev 6 11/10/1997

FLIGHT INTERPHONE SYSTEM - NAVIGATION AND AIMS INTERFACES

Navigation Interfaces

These four navigation radio systems send audio signals to the audio management unit (AMU):

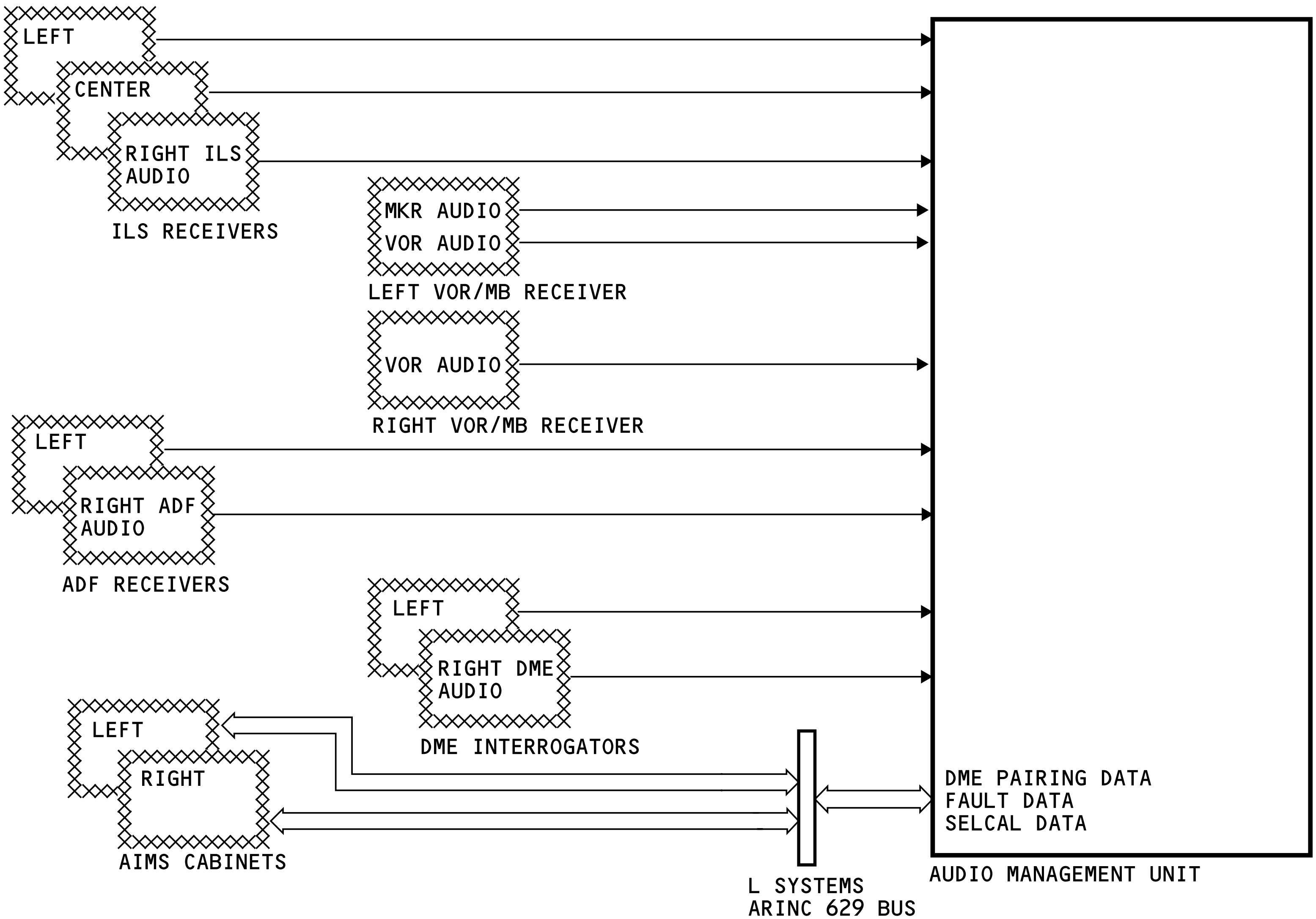
- Instrument landing system (ILS) receivers
- VHF omnidirectional range (VOR)/marker beacon receivers
- Automatic direction finder (ADF) receivers
- Distance measuring equipment (DME) interrogators.

AIMS Interface

The AIMS cabinets send DME pairing data to the AMU. This data tells the AMU to place DME audio on the VOR or ILS audio channel.

The AMU sends failure data to the AIMS cabinets.

The AMU also sends SELCAL set/reset data to the AIMS cabinets. The AIMS cabinets use this data to alert the flight crew.



23-51-00-008 Rev 1

FLIGHT INTERPHONE SYSTEM - NAVIGATION AND AIMS INTERFACES

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FLIGHT INTERPHONE SYSTEM - AUDIO CONTROL PANEL

Purpose

The flight crew uses the audio control panels (ACPs) to control audio for the communication and navigation radio systems. Each ACP controls one station.

Controls

These are the controls on the ACP:

- Transmitter select switches
- Receiver volume controls
- Speaker volume control
- Approach receiver selector
- NAV filter selector
- VOR/ADF receiver selector
- Mic/interphone switch.

Lights

These are the three kinds of lights on the ACP:

- Call lights
- Mic lights
- Receiver lights.

Transmit Operation

To connect a microphone (boom, oxygen mask, or handheld) to a communication radio or system, push the related transmitter select switch. You can select only one system at a time. When you push a transmitter select switch, this is what happens:

- The MIC light on the upper half of the switch comes on
- The receive audio of the selected system comes on at the volume set by the receiver volume control.

A call goes to an attendant station when you push the cabin interphone (CAB) transmitter select switch twice in one second. The cabin management system (CMS) identifies the attendant station.

When the ACP first gets power, all transmitter select switches are off.

Receive Operation

The lower half of a transmitter select switch is a CALL light. This light comes on when the related system calls the flight crew.

The call light goes off when you push the transmitter select switch. If the MIC light for that transmitter select switch is on, push any mic switch to reset the call light. The flight interphone call light also goes out when you select the INT position of the mic/int switch on the ACP or on the control column.

The call lights for the SATCOM system do not go off when you push the transmitter select switch. You make selections on a control display unit (CDU) to turn off the SATCOM call lights.

The SELCAL inputs to the audio management unit (AMU) control the HF and VHF call lights. The passenger address/cabin interphone controller input controls the CAB call light. The flight deck call switch on the P40 service and APU shutdown panel controls the FLT call light.

To listen to communication or navigation system audio, push the receiver volume control (push-on, push-off) and turn it to adjust the volume. You can monitor any combination of systems at any time. The receiver light comes on to show that the related receiver control is on.

Mic/Interphone Switch

This switch is a three-position switch that is spring loaded to center. In the MIC position, a PTT signal causes the selected system to transmit. The flight crew member talks on the oxygen mask microphone or the boom microphone.

In the INT position, a PTT signal to the AMU connects the flight crew together through the flight interphone system. It is not necessary to select any transmit switch to use the flight interphone. The flight crew member talks on either the oxygen mask microphone or the boom microphone.

Speaker Volume Control

This control is functional only on the audio control panels in the captain and first officer positions. The speaker volume control turns on or off the flight deck speaker at the related station and adjusts its volume.

VOR/ADF Selector

Use the VOR/ADF selector to select a VOR or ADF receiver.

Filter Selector

The filter selector tells the AMU how to process VOR, ADF, and ILS audio. In the V (voice) position, the AMU passes only voice frequencies through the filter and filters out the 1020 Hz range frequency.

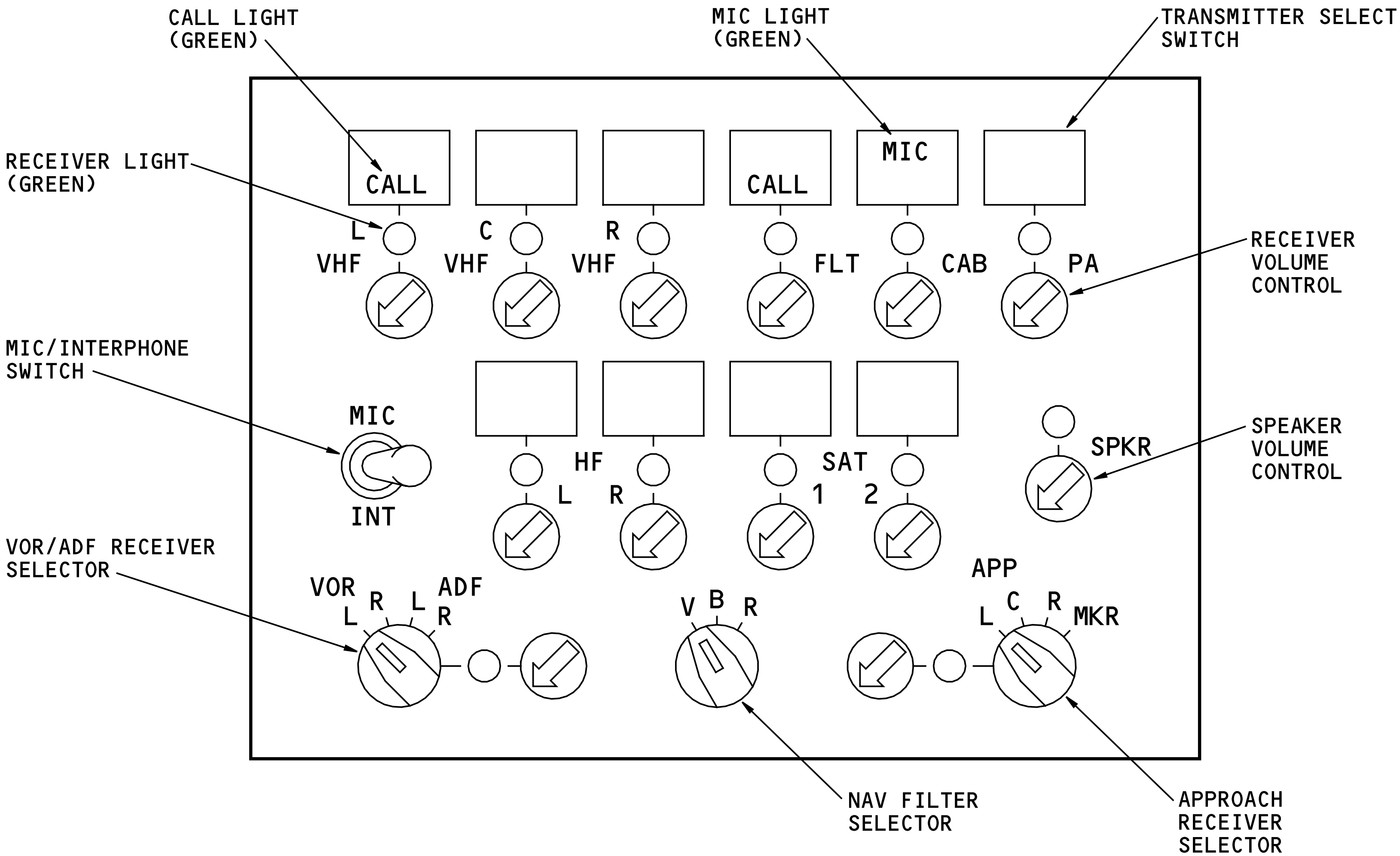
In the B (both) position, the AMU permits voice and range (coded station identification) frequencies through the filter to the audio output.

In the R (range) position, the AMU passes only the range frequency through the filter and filters out the voice frequencies.

Approach Receiver Selector

The approach receiver selector controls selection of these navigation radios:

- Left instrument landing system (ILS) receiver
- Center ILS receiver
- Right ILS receiver
- Marker beacon receiver.



FLIGHT INTERPHONE SYSTEM - AUDIO CONTROL PANEL

FLIGHT INTERPHONE SYSTEM - OBSERVER AUDIO SELECTOR

Purpose

The observer audio selector controls the inputs and outputs of the first observer's station card in the audio management unit (AMU).

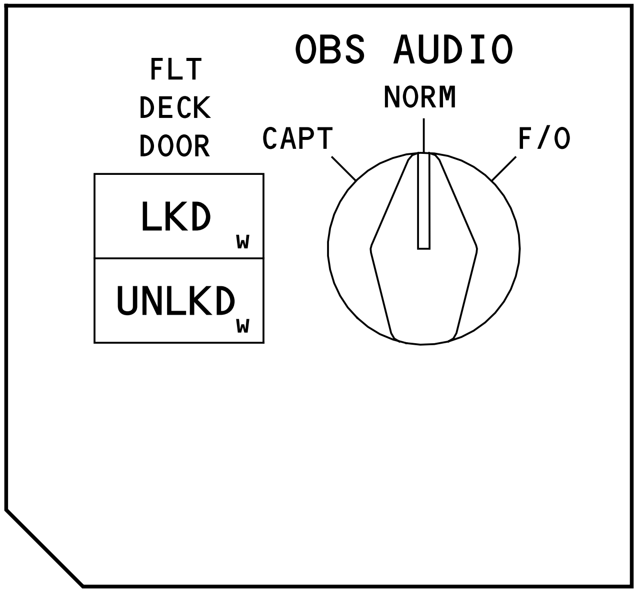
The switch lets the captain or first officer use the first observer's audio control panel (ACP) if their AMU audio station card or ACP has a failure.

Selector Positions

When you select CAPT, the captain's inputs and outputs connect to the first observer's station card.

When you select NORM, the first observer's inputs and outputs connect to the first observer's station card.

When you select F/O, the first officer's inputs and outputs connect to the first observer's station card.



OBSERVER AUDIO PANEL

23-51-00-011 Rev 0

FLIGHT INTERPHONE SYSTEM - OBSERVER AUDIO SELECTOR

FLIGHT INTERPHONE SYSTEM - JACK PANELS

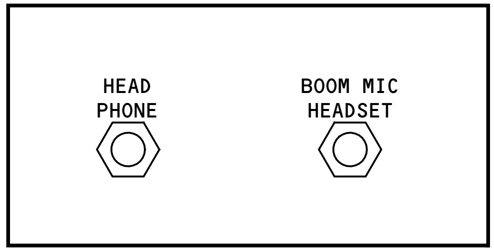
General

Handsets and headphones connect to jack panels at these three crew stations:

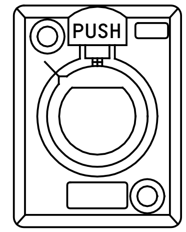
- Captain
- First officer
- First observer.

The second observer can monitor audio from the first officer or the first observer.

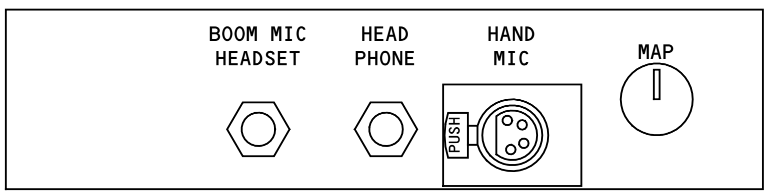
The captain and first officer hand microphone jacks are near the related flight interphone speaker. The first observer jack panel has a hand microphone jack.



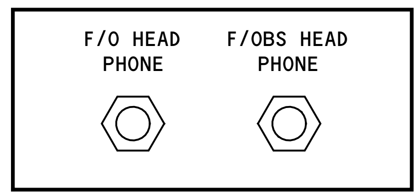
BOOM MIC/HEADPHONE PANEL -
CAPTAIN AND FIRST OFFICER



HAND MICROPHONE
JACK - CAPTAIN
AND FIRST OFFICER



BOOM MIC/HEADPHONE/MAP LIGHT PANEL -
FIRST OBSERVER



HEADPHONE PANEL -
SECOND OBSERVER

23-51-00-012 Rev 2

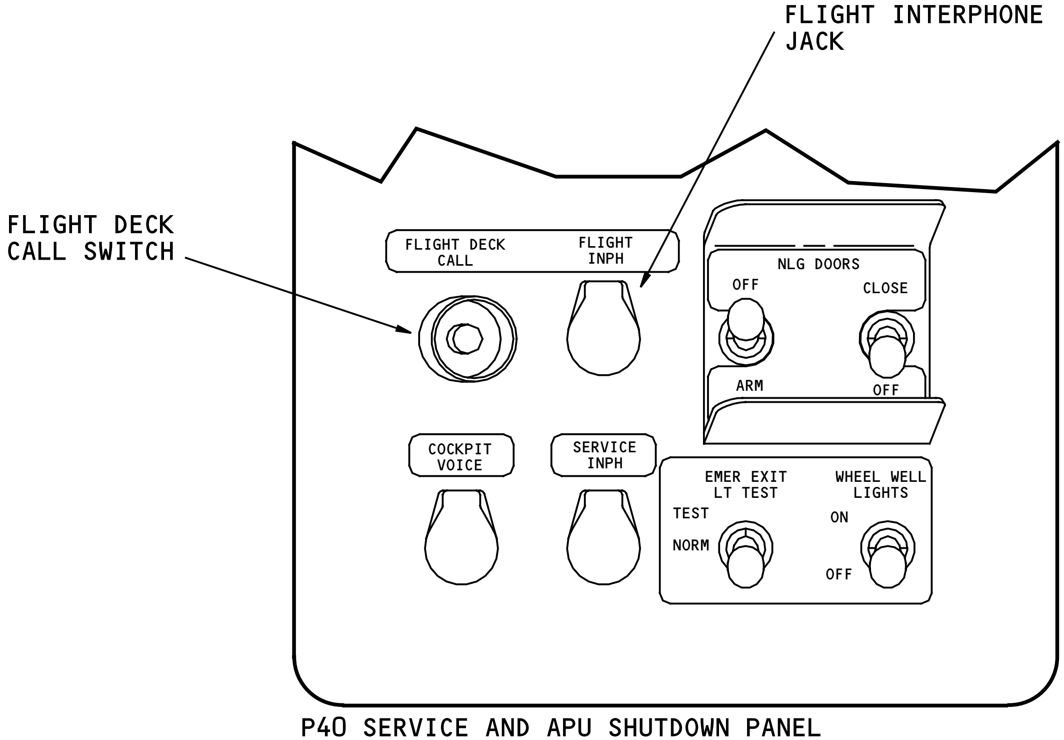
FLIGHT INTERPHONE SYSTEM - JACK PANELS

FLIGHT INTERPHONE SYSTEM - FLIGHT INTERPHONE JACK

Purpose

The ground crew talks to the flight crew on the flight interphone system. A ground crew headset connects to the flight interphone jack on the service and APU shutdown panel.

When you push the flight deck call switch, the flight interphone CALL lights on all audio control panels (ACPs) come on.



23-51-00-013 Rev 1

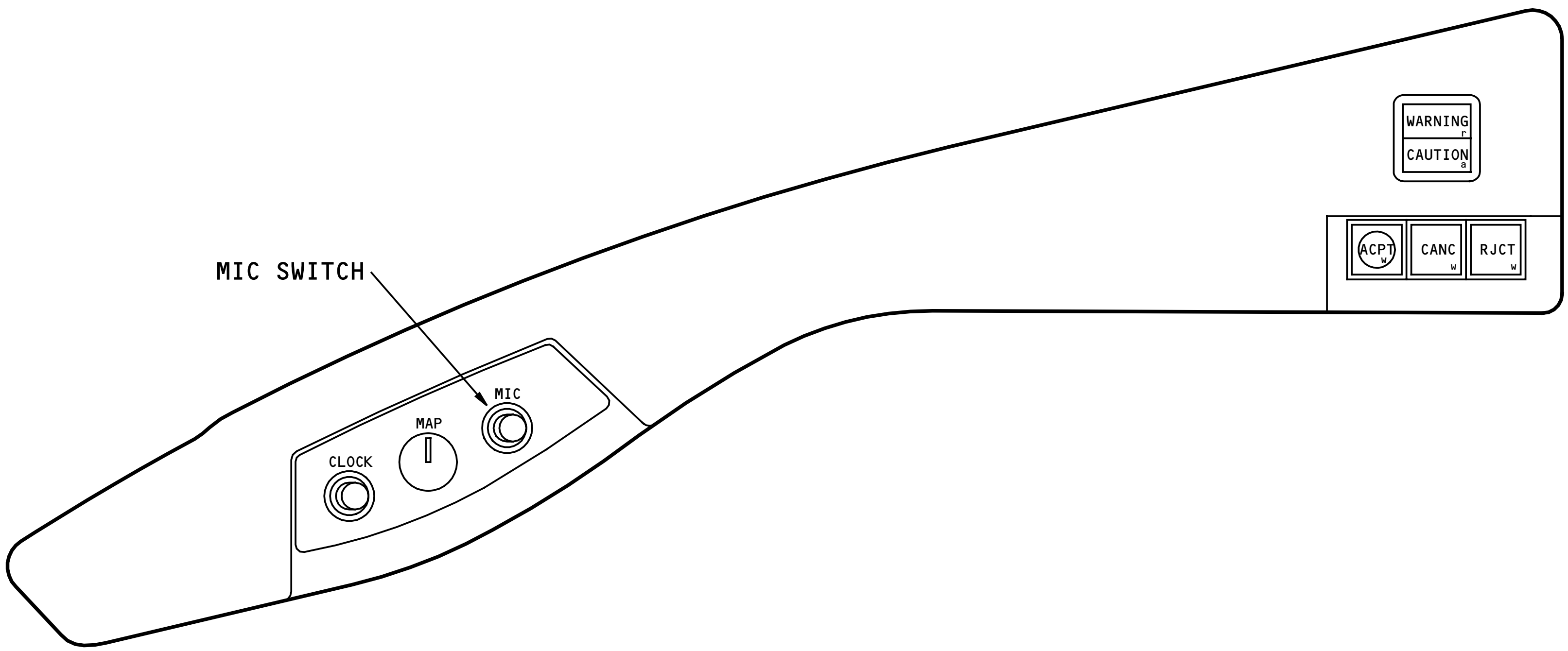
FLIGHT INTERPHONE SYSTEM - FLIGHT INTERPHONE JACK

FLIGHT INTERPHONE SYSTEM - GLARESHIELD MIC SWITCH

General

The glareshield microphone (mic) switch gives PTT inputs to the audio management unit (AMU) for the headset or oxygen mask microphones.

When you push the mic switch, microphone audio and the PTT signal go to the selected communication system.



CAPT GLARESHIELD

23-51-00-025 Rev 1 09/16/96

FLIGHT INTERPHONE SYSTEM - GLARESHIELD MIC SWITCH

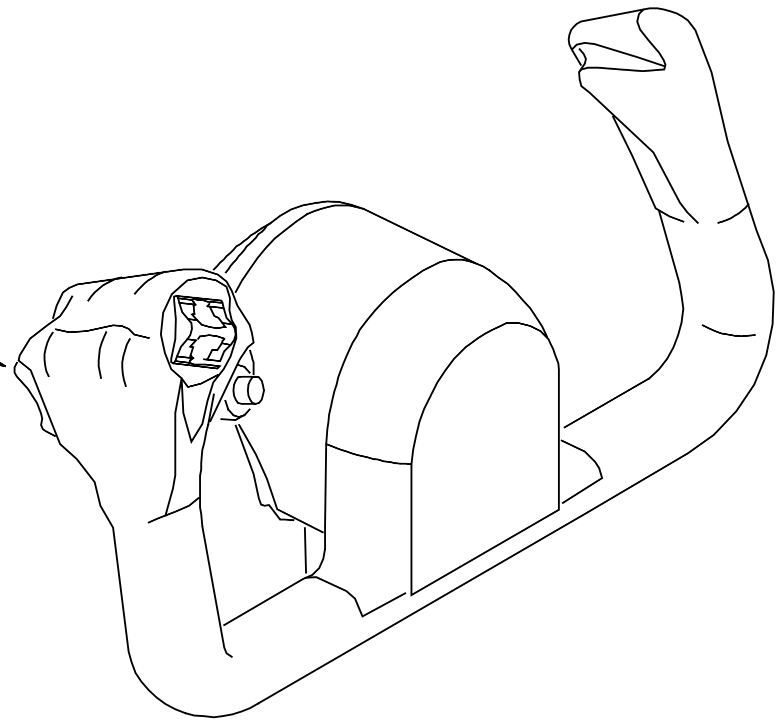
FLIGHT INTERPHONE SYSTEM - CONTROL WHEEL MIC SWITCH

Purpose

The control wheel microphone (mic) switch gives PTT inputs to the audio management unit (AMU) for the headset or oxygen mask microphones.

Locations and Functions

The switch is a three-position switch and is on the outboard horn of each control wheel. In the MIC position, the microphone audio goes to the selected communication system. In the INT position, the microphone audio goes directly to the flight interphone system without selecting the FLT transmit switch on the audio control panel.



CAPT CONTROL WHEEL

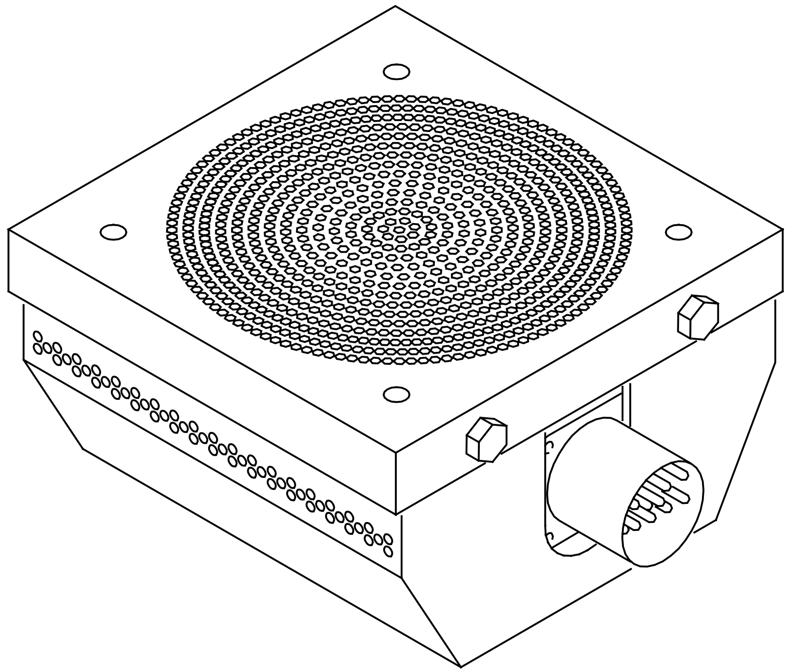
23-51-00-015 Rev 4 03/31/1997

FLIGHT INTERPHONE SYSTEM - CONTROL WHEEL MIC SWITCH

FLIGHT INTERPHONE SYSTEM - FLIGHT INTERPHONE SPEAKER

Function

The captain's and first officer's flight interphone speakers receive audio from the audio management unit (AMU). You use the speaker volume control on the audio control panel (ACP) to select and adjust the volume of the related speaker.



23-51-00-016 Rev 1 05/29/1996

FLIGHT INTERPHONE SYSTEM - FLIGHT INTERPHONE SPEAKER

FLIGHT INTERPHONE SYSTEM - OBSERVER AUDIO SYSTEM SWITCHING

General

The observer audio selector controls connections to the first observer's station card in the audio management unit (AMU). The AMU has many switches that connect the first observer to a flight crew station. The observer audio selector has these three positions:

- CAPT
- NORM
- F/O.

CAPT Position

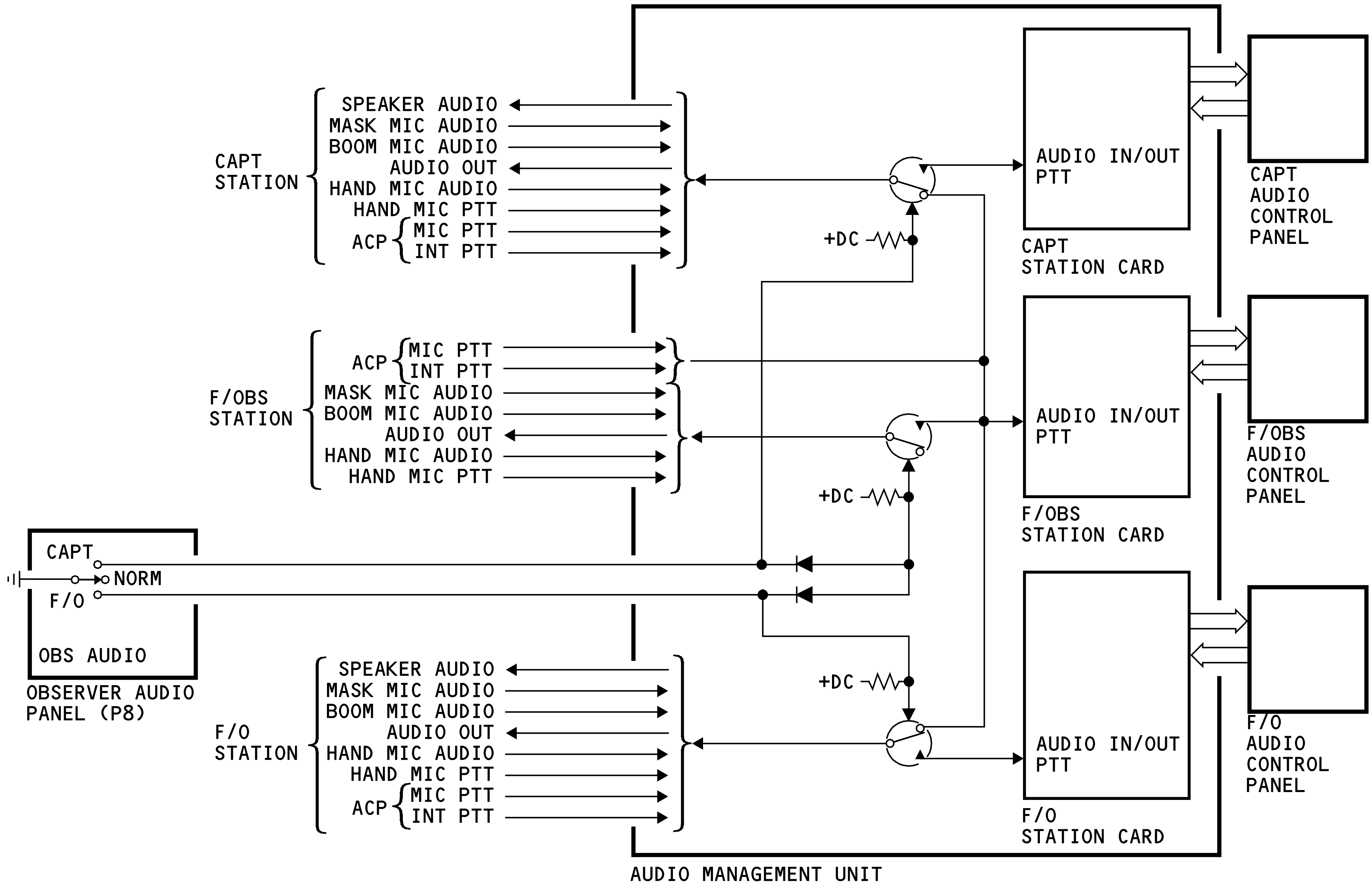
When you select the CAPT position, the switch connects a ground to the AMU. The AMU disconnects the first observer and connects the captain's audio and PTT interfaces to the first observer's card. This includes the microphone and interphone PTTs from the captain's ACP. The captain makes all other selections with the first observer's audio control panel (ACP).

NORM Position

When you select NORM, the first observer's AMU inputs and outputs connect to the first observer's card.

F/O Position

When the observer audio selector is in the F/O position, it sends a ground to the AMU. The AMU disconnects the first observer and connects the first officer's audio and PTT interfaces to the first observer's card. This includes the microphone and interphone PTTs from the first officer's ACP. The first officer makes all other selections with the first observer's ACP.



23-51-00-021 Rev 6 10/23/95

FLIGHT INTERPHONE SYSTEM - OBSERVER AUDIO SYSTEM SWITCHING

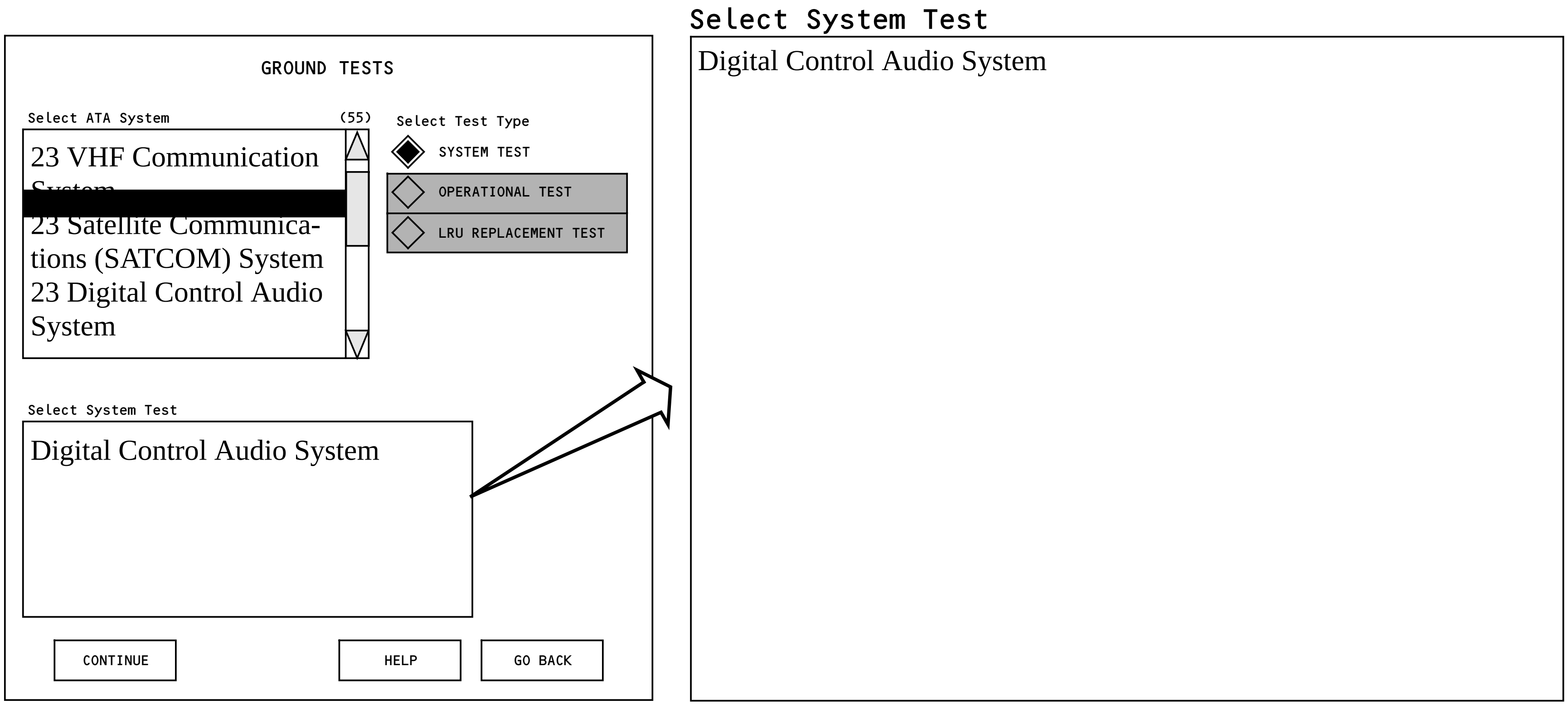
FLIGHT INTERPHONE SYSTEM - TEST

General

Use the digital control audio system test to test the flight interphone system.

Digital Control Audio System Test

This test verifies the operation of the digital control audio system. The digital control audio system includes the flight interphone system.



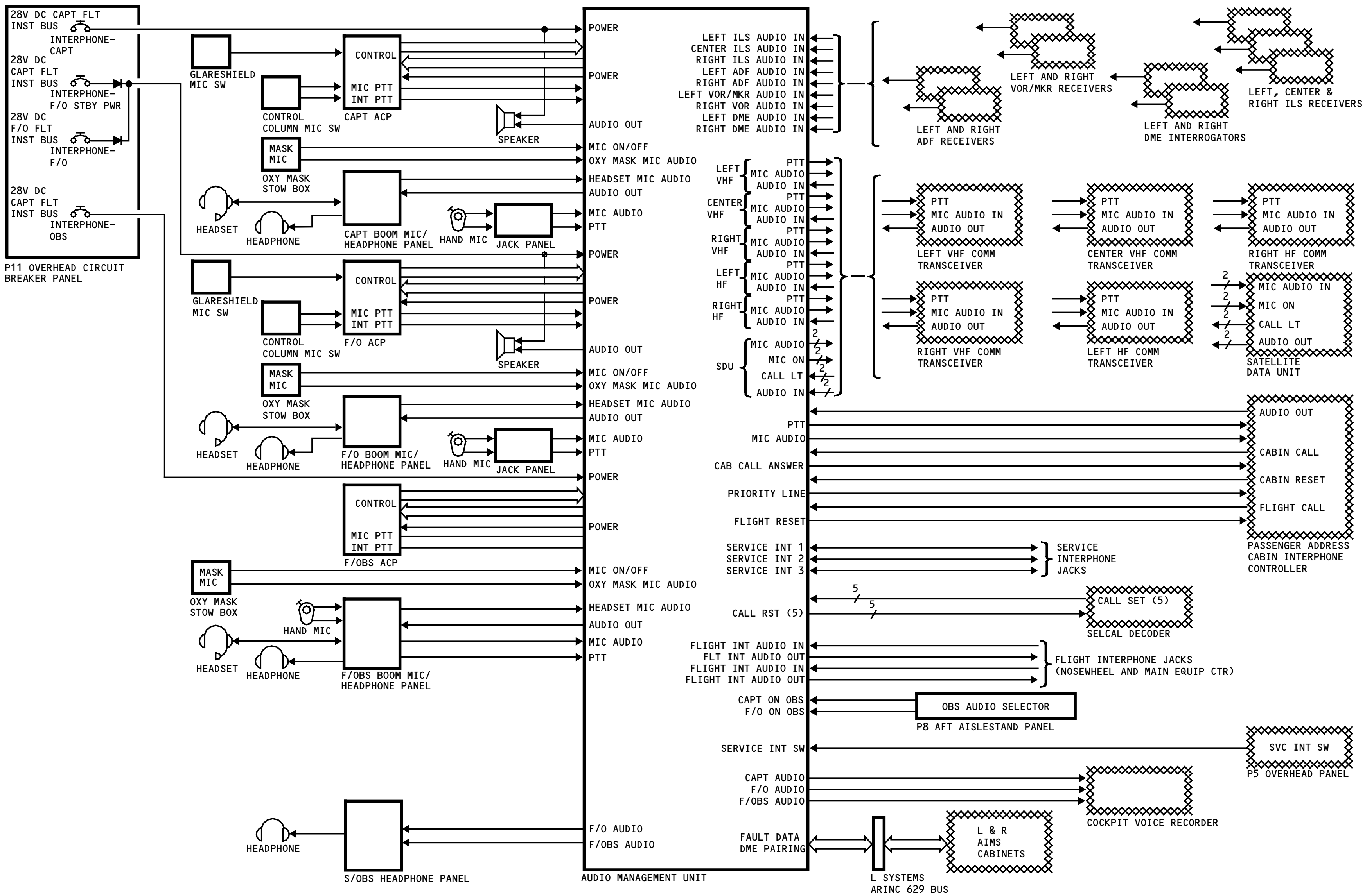
CMCS GROUND TEST SELECTION DIALOG BOX

23-51-00-022 Rev 0

FLIGHT INTERPHONE SYSTEM - INTERFACES

Interfaces

This interface is for reference purposes.



FLIGHT INTERPHONE SYSTEM - INTERFACES

23-51-00-023 Rev 14 03/23/1998

Continental Airlines, Inc

Service Interphone System

WB371

TABLE OF CONTENTS

SERVICE INTERPHONE SYSTEM - INTRODUCTION

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SERVICE INTERPHONE SYSTEM - INTRODUCTION

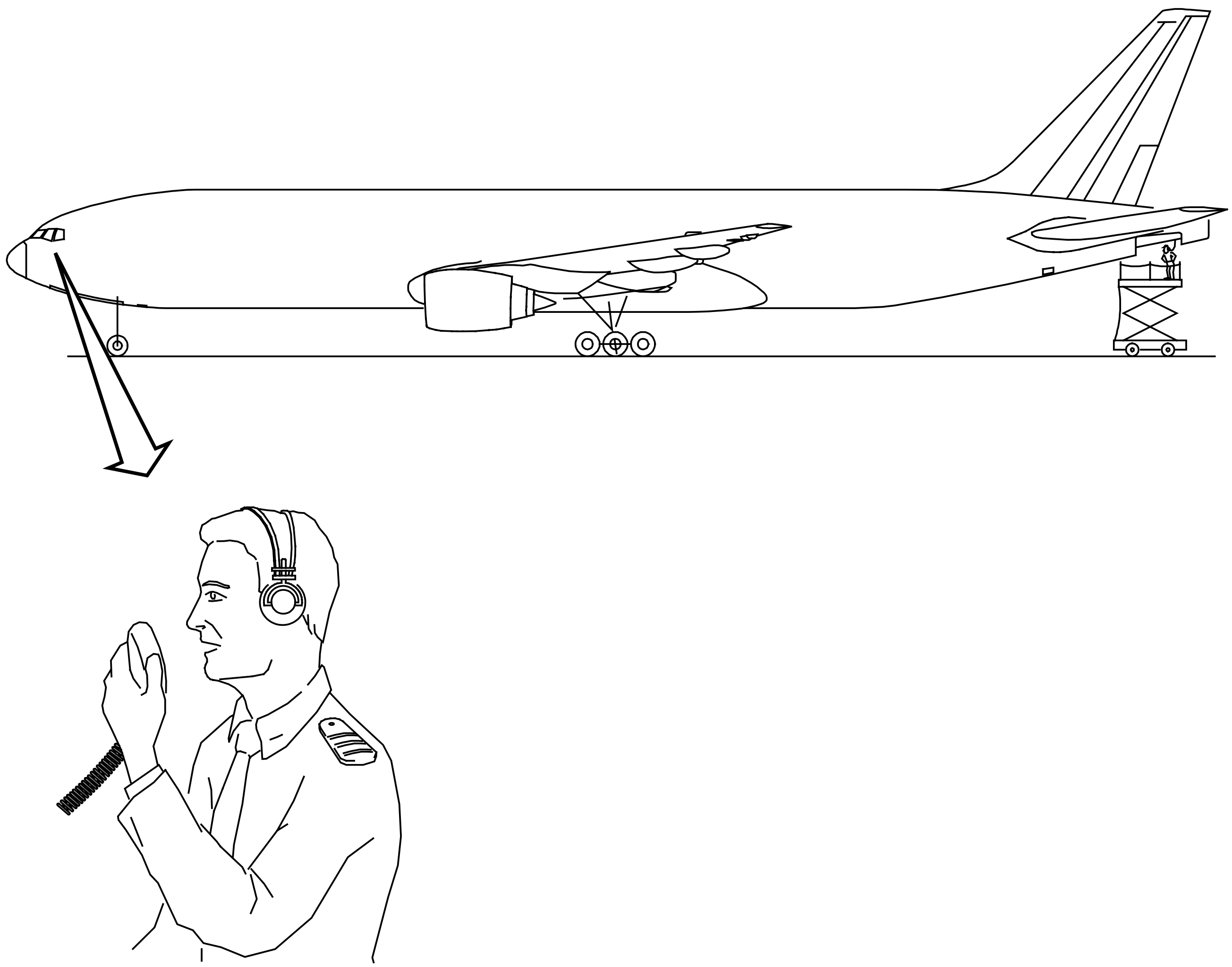
General

The ground crew uses the service interphone system to talk to each other and to the flight crew. There are service interphone jacks at different places on the airplane.

The service interphone system is part of the digital control audio system (DCAS).

Abbreviations and Acronyms

AIMS	- airplane information management system
AMU	- audio management unit
capt	- captain
DCAS	- digital control audio system
elec	- electric
flt	- flight
fwd	- forward
inst	- instrument
intph	- interphone
MEC	- main equipment center
MIC	- microphone
sta	- station
wxr	- weather radar
xcvr	- transceiver



SERVICE INTERPHONE SYSTEM - INTRODUCTION

SERVICE INTERPHONE SYSTEM - GENERAL DESCRIPTION

General

The service interphone jacks are in three groups:

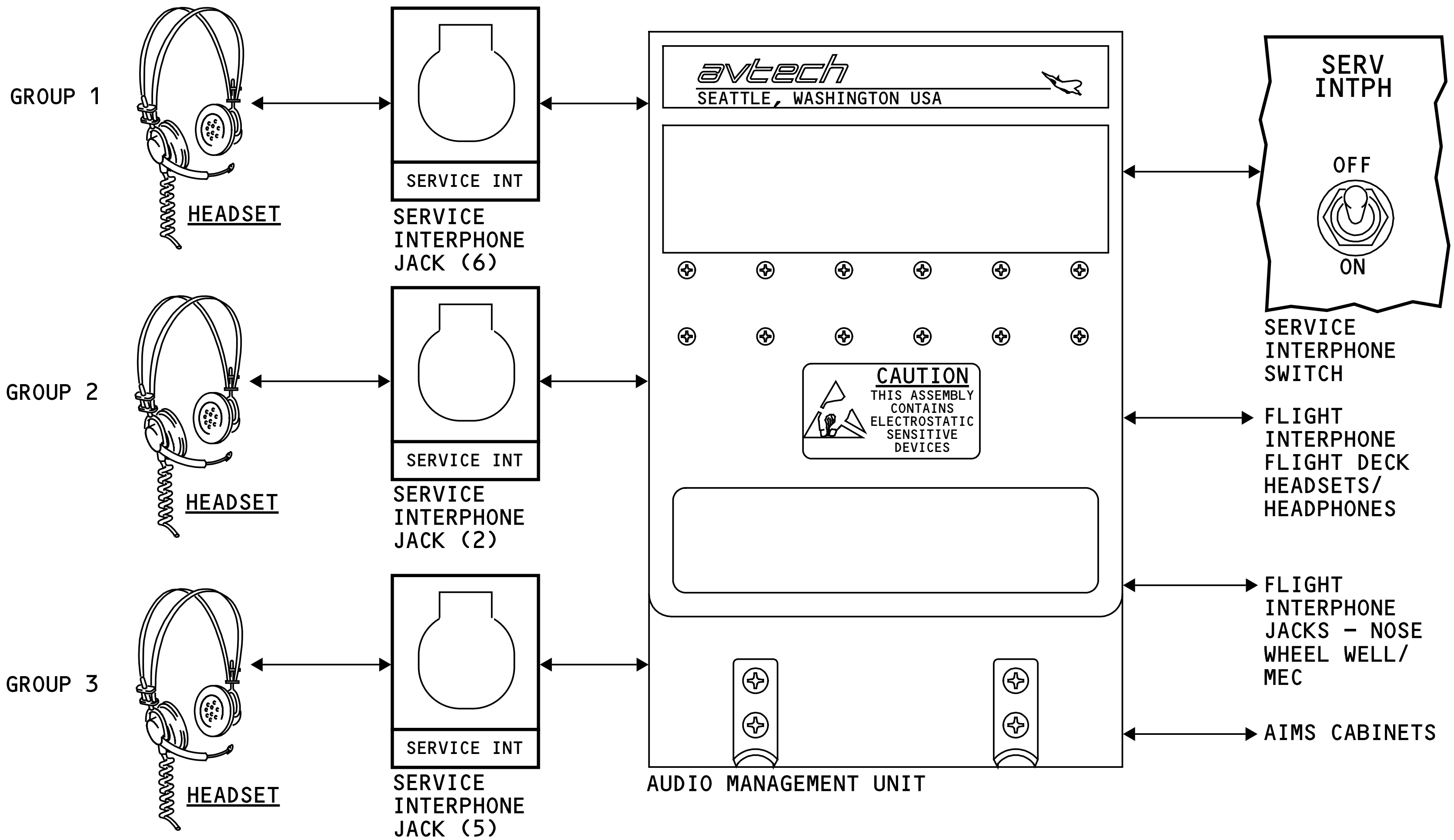
- Service interphone 1
- Service interphone 2
- Service interphone 3.

Each group sends a single audio input to the audio management unit (AMU).

The AMU mixes the audio from all three groups. It sends this mixed audio back to the headsets in all groups.

The AMU mixes the service interphone audio with the flight interphone audio if the service interphone switch is in the ON position.

The AMU sends fault data to AIMS over an ARINC 629 bus.



23-41-00-002 Rev 3 05/22/96

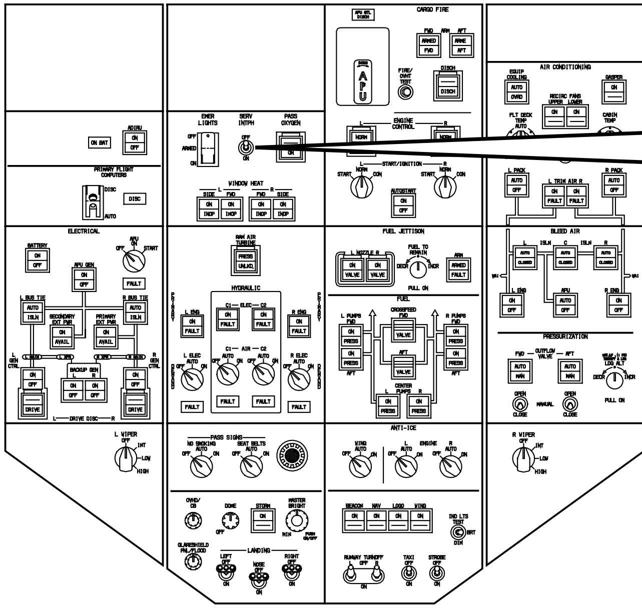
SERVICE INTERPHONE SYSTEM - GENERAL DESCRIPTION

SERVICE INTERPHONE SYSTEM - COMPONENT LOCATIONS

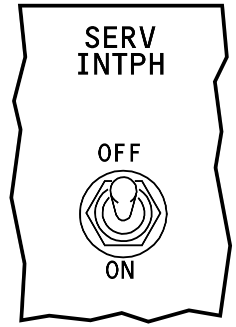
Service Interphone Component Locations

These components connect to the service interphone system:

- Service interphone switch on the flight deck
- Audio management unit (AMU) in the main equipment center (MEC).

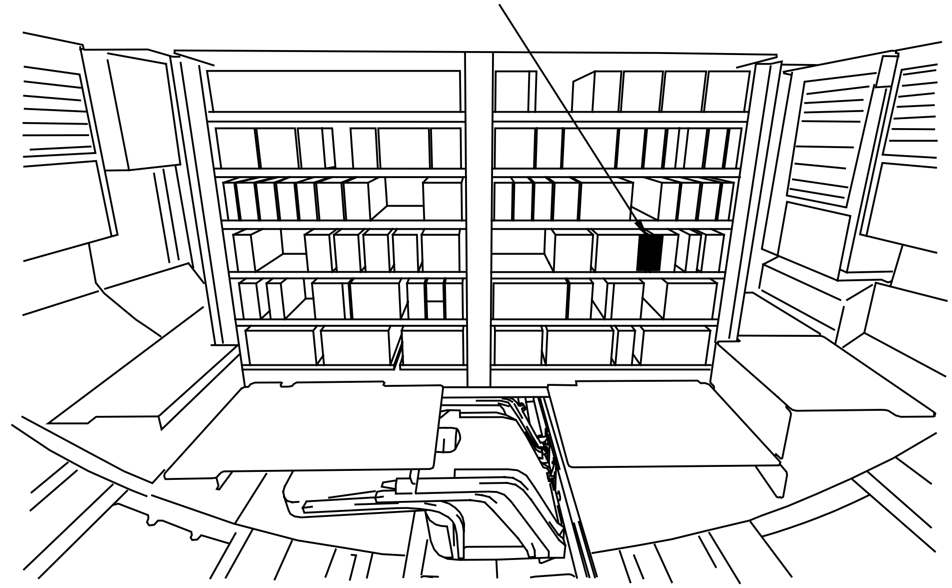


FLIGHT DECK
P5 OVERHEAD PANEL



SERVICE INTERPHONE
SWITCH

E1-4 SHELF
• AUDIO MANAGEMENT UNIT



MAIN EQUIPMENT CENTER

SERVICE INTERPHONE SYSTEM - COMPONENT LOCATIONS

SERVICE INTERPHONE SYSTEM - JACK LOCATIONS

Jack Locations

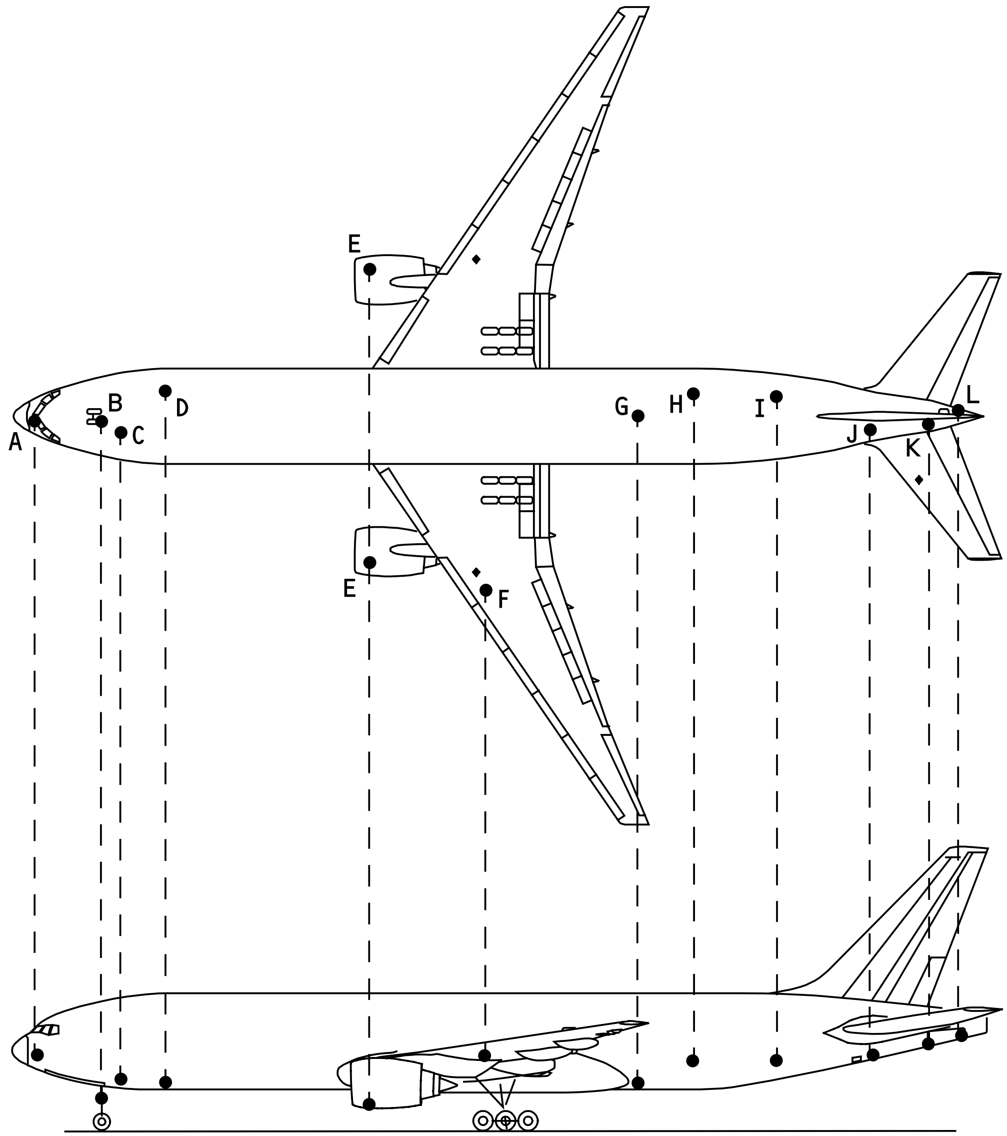
The service interphone jacks in group one are in these locations:

- Adjacent to the weather radar transceiver (location A)
- P40 nose gear electrical service panel (location B)
- E3 rack in the main equipment center (location C)
- P35 forward cargo handling accessory panel (location D)
- Left refuel station (location F)
- P56 wheel well electrical service panel (location G).

The service interphone jacks in group two are on the left and right engine nacelles (location E).

The service interphone jacks in group three are in these locations:

- Aft cargo handling (location H)
- Bulk cargo area access (location I)
- Forward tail cone (location J)
- Mid tail cone (location K)
- APU compartment (location L).



SERVICE INTERPHONE SYSTEM - JACK LOCATIONS

SERVICE INTERPHONE SYSTEM - INTERFACES

Power

Two circuit breakers control power to the service interphone circuits.

Jacks

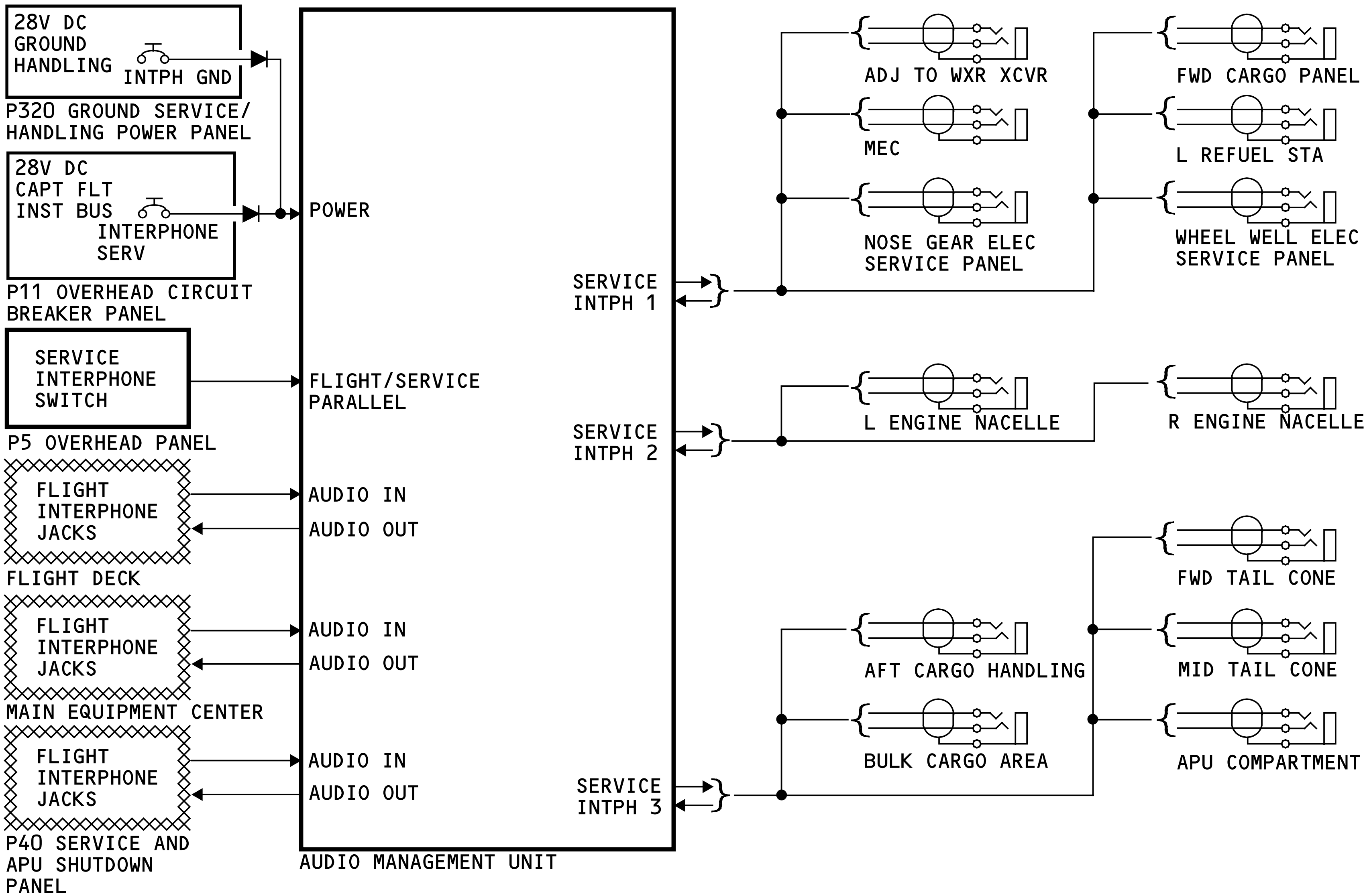
The jacks are in these three groups:

- Service interphone 1
- Service interphone 2
- Service interphone 3.

Service Interphone Switch

If you put the service interphone switch in the ON position, the service interphone system connects to these flight interphone components:

- Flight deck flight interphone jacks
- Main equipment center flight interphone jack
- P40 service and APU shutdown panel flight interphone jack.



SERVICE INTERPHONE SYSTEM - INTERFACES

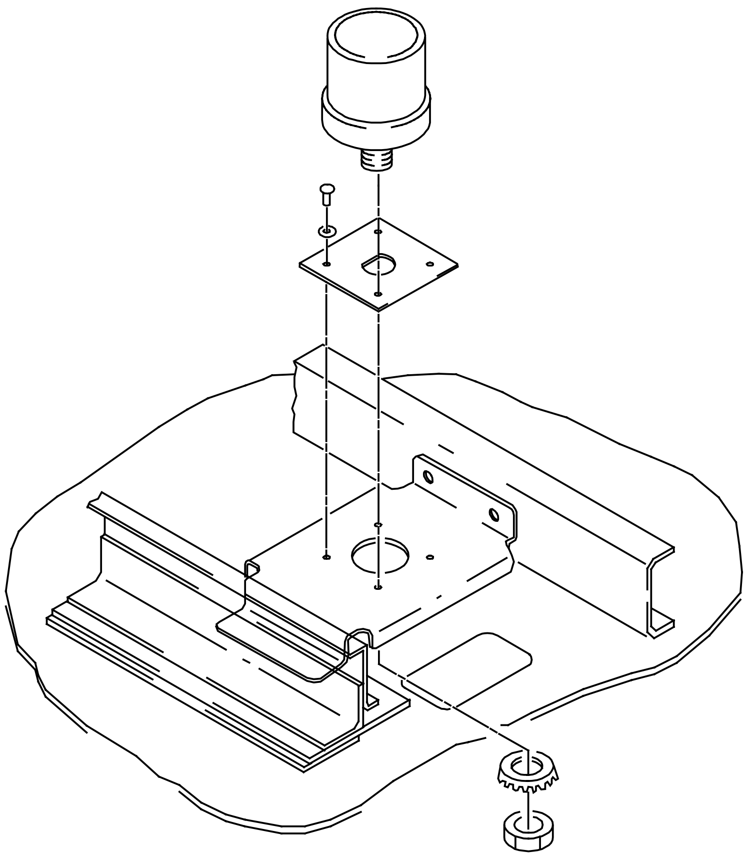
23-41-00-005 Rev 6 08/21/1997

SERVICE INTERPHONE SYSTEM - JACK AND HEADSET

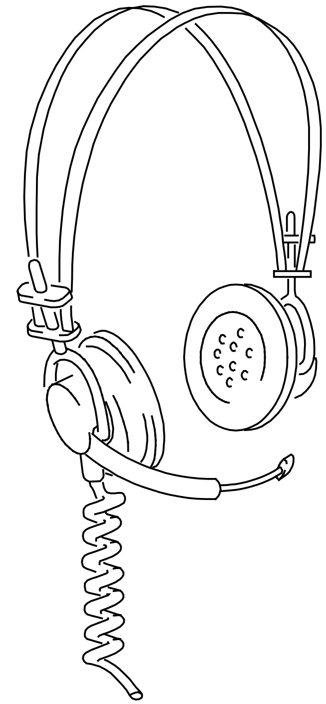
Purpose

The ground crew uses the service interphone jacks to talk to each other and the flight crew. The jacks attach by a nut and washer.

The service interphone headset is a boom microphone and headphone. The headset permits hands-free operation.



JACK (TYPICAL)



HEADSET

23-41-00-006 Rev 0

SERVICE INTERPHONE SYSTEM - JACK AND HEADSET

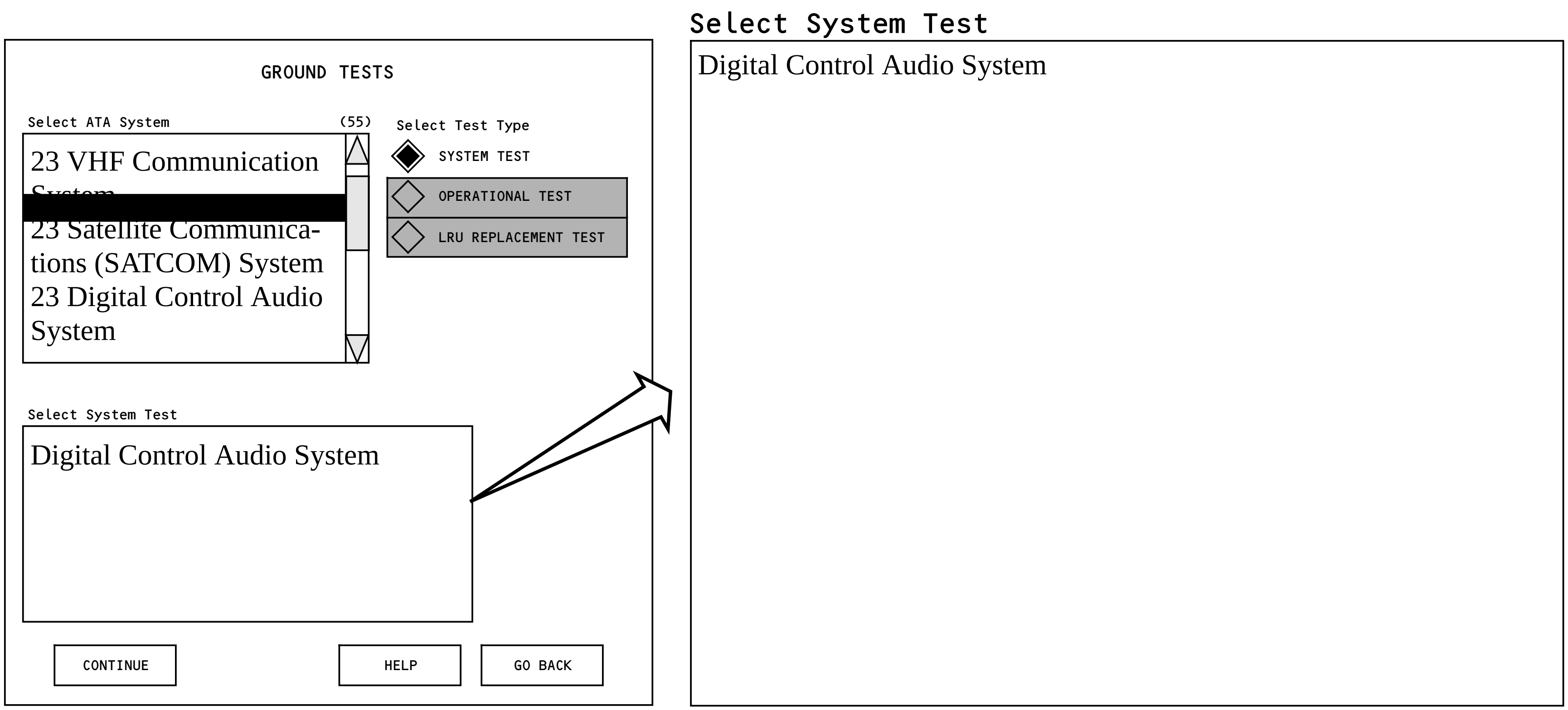
SERVICE INTERPHONE SYSTEM - TEST

General

Use the digital control audio system test to test the service interphone system.

Digital Control Audio System Test

This test verifies the operation of the digital control audio system. The digital control audio system includes the service interphone system.



CMCS GROUND TEST SELECTION DIALOG BOX

23-41-00-008 Rev 0

SERVICE INTERPHONE SYSTEM - TEST

SERVICE INTERPHONE SYSTEM - FUNCTIONAL DESCRIPTION

General

The audio management unit (AMU) controls all service and flight interphone audio signals. The service interphone circuits are on the connector board of the audio management unit (AMU). Service interphone circuits have amplifiers for output audio. The AMU uses the service interphone switch position to send signals through either or both interphone systems.

Operation

The connector board mixes the three service interphone microphone inputs. This audio signal goes to switches S1 and S2. If the service interphone switch is OFF, the audio goes through switch S1 to the service interphone jacks.

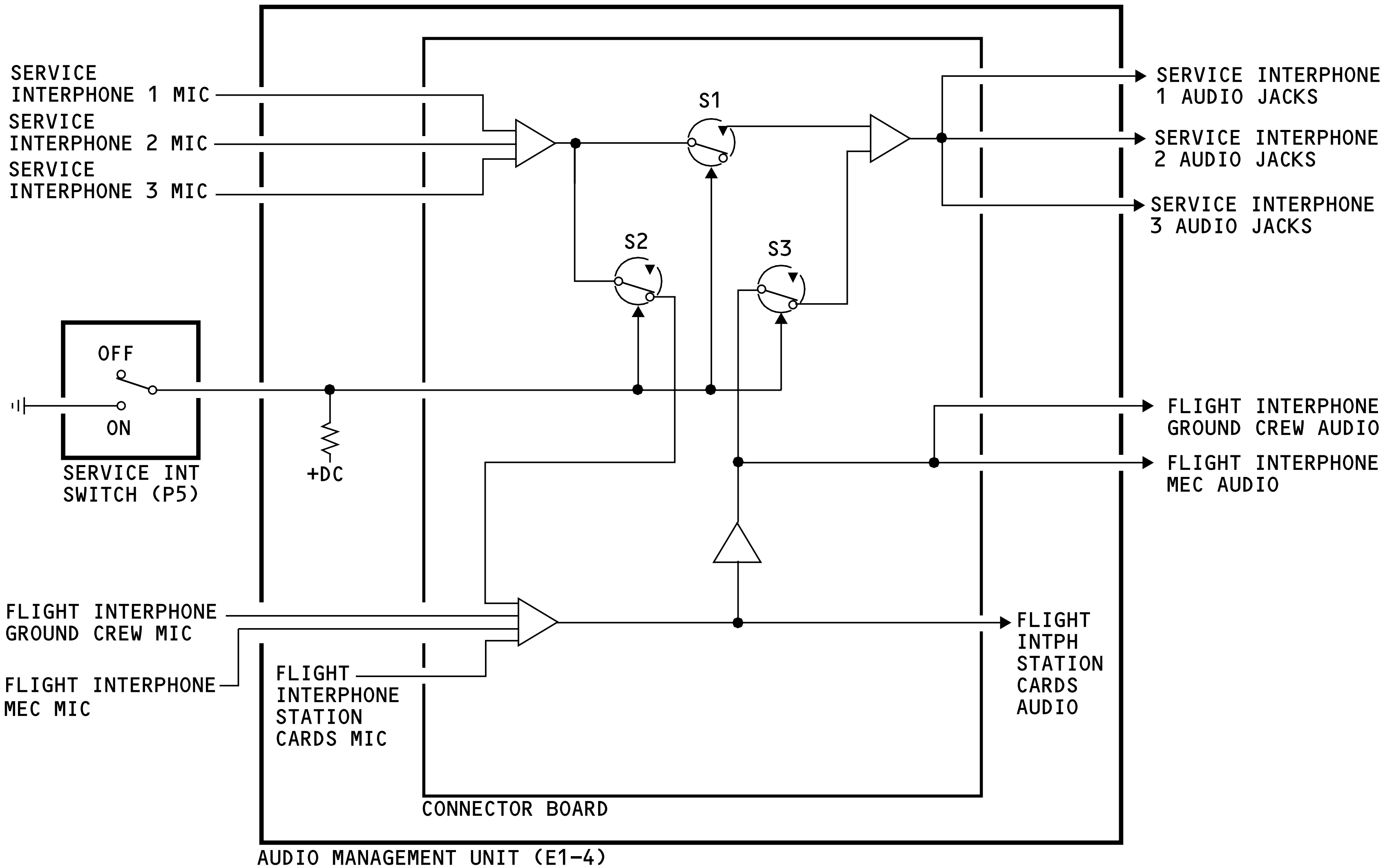
If the service interphone switch is ON, the audio goes through switch S2 and connects with these audio signals:

- Flight interphone ground crew mic
- Flight interphone main equipment center mic
- Flight interphone station cards mic.

This audio then goes to:

- The flight interphone station cards
- The flight interphone main equipment center audio jack
- The flight interphone ground crew audio jack
- Switch S3.

Switch S3 sends the audio to the service interphone jacks.



23-41-00-007 Rev 0

SERVICE INTERPHONE SYSTEM - FUNCTIONAL DESCRIPTION

Continental Airlines, Inc

Ground Crew Call System

WB371

TABLE OF CONTENTS

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GROUND CREW CALL SYSTEM - INTRODUCTION

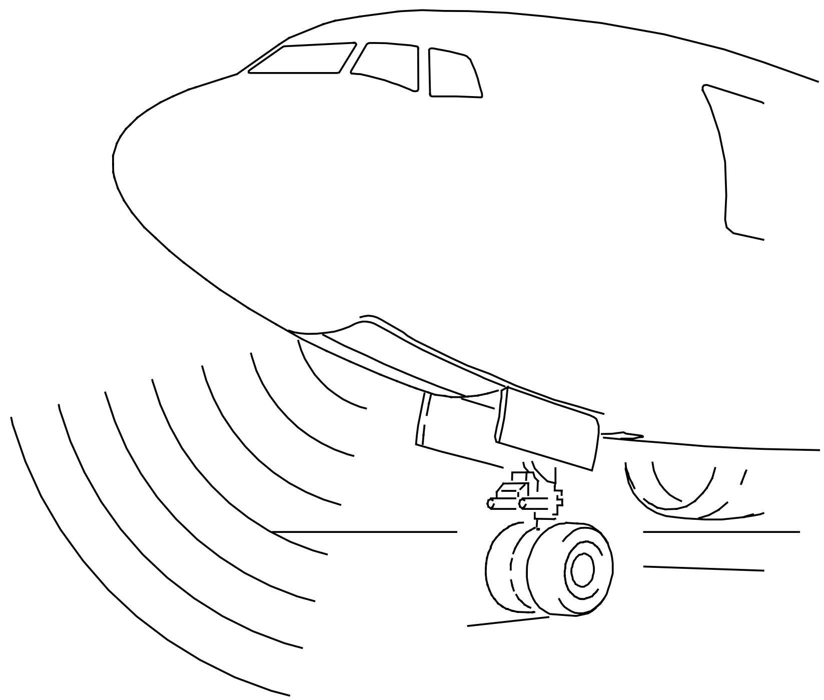
Purpose

The ground crew call system has these three functions:

- It tells flight deck personnel that there is a call from the ground
- It tells ground personnel that there is a call from the flight deck
- It tells ground personnel that the air data inertial reference unit (ADIRU) is on battery power or that there is an equipment cooling failure.

Abbreviations and Acronyms

ACP	- audio control panel
ADIRS	- air data inertial reference system
ADIRU	- air data inertial reference unit
AIMS	- airplane information management system
AMU	- audio management unit
CDU	- control display unit
ECS	- environmental control system
EICAS	- engine indication and crew alerting system
ELMS	- electrical load management system
flt	- flight
gnd	- ground
LSK	- line select key
PA/CI	- passenger address/cabin interphone



GROUND CREW CALL SYSTEM - INTRODUCTION

GROUND CREW CALL SYSTEM - GENERAL DESCRIPTION

General

The flight crew and the ground crew use the ground crew call system to tell each other to answer a call on the flight interphone system. The system supplies aural and visual signals in the flight deck and in the nose wheel well area.

Flight Deck Call

To call the flight deck, the ground crew pushes the flight deck call switch. This causes these flight deck indications:

- A light comes on the audio control panel (ACP)
- A chime comes on in the flight deck
- A message shows on EICAS.

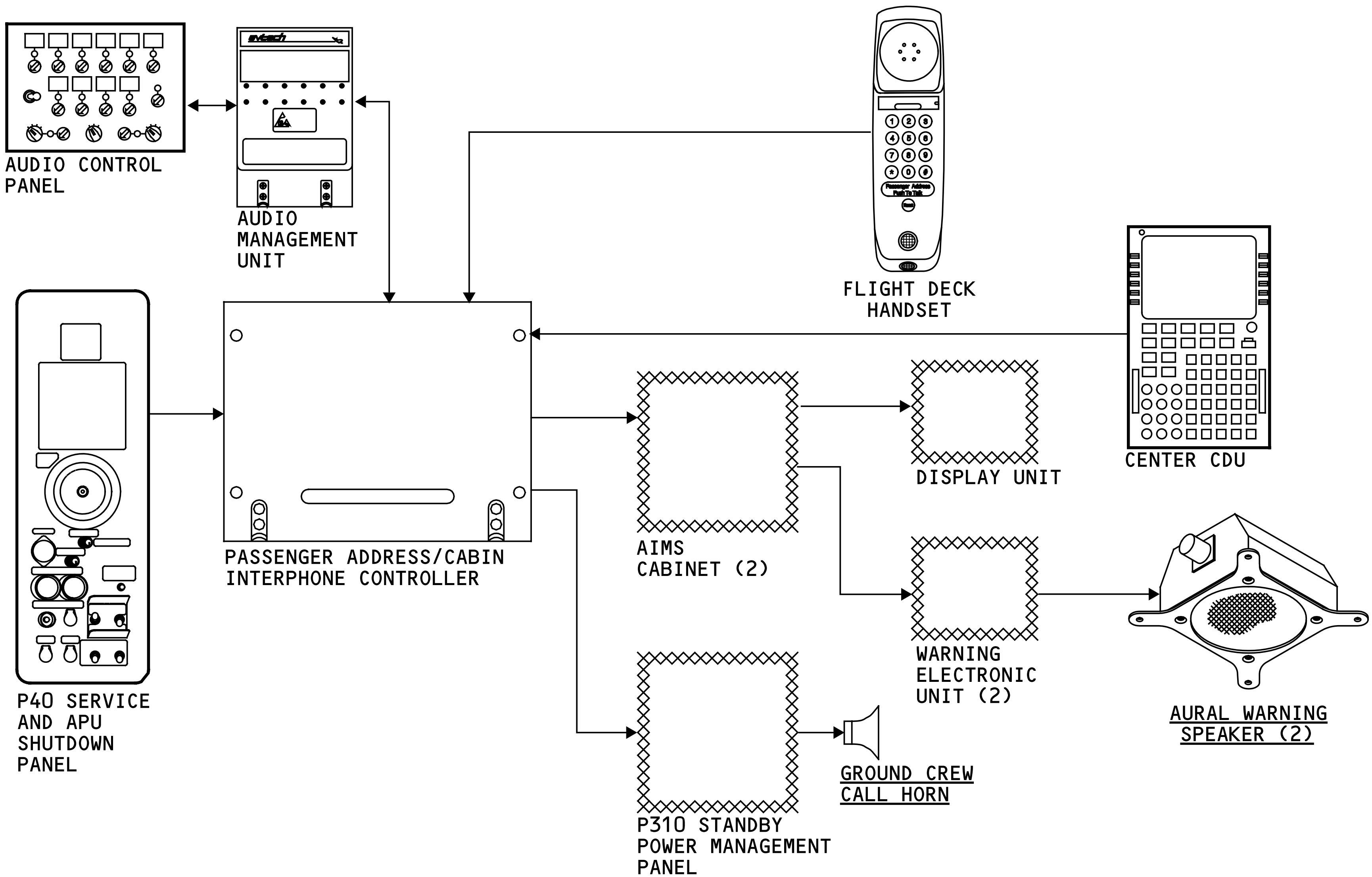
Ground Crew Call

To call the ground crew, the flight crew selects GND CREW on the center CDU cabin interphone menu or uses the flight deck handset. This causes the ground crew call horn to come on.

Power or Equipment Cooling Failures

The ground crew call horn also comes on when the airplane is on the ground and one of these occurs:

- There is an equipment cooling failure
- The air data inertial reference unit (ADIRU) is on and there is no ac power on the airplane.



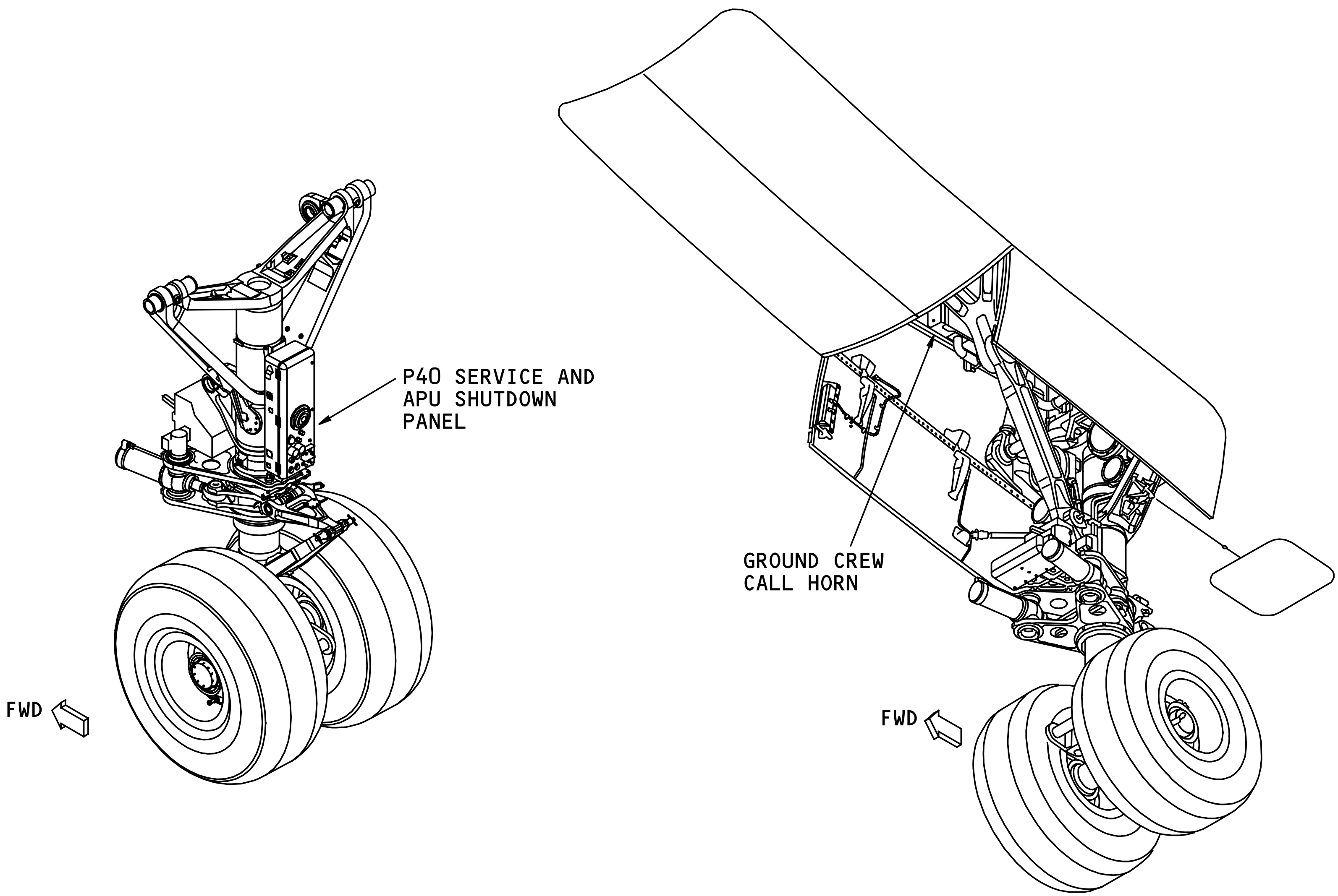
23-43-00-002 Rev 2 10/25/95

GROUND CREW CALL SYSTEM - GENERAL DESCRIPTION

GROUND CREW CALL SYSTEM - NOSE WHEEL WELL COMPONENT LOCATIONS

Ground Crew Call System Component Locations

The ground crew call horn and the service and APU shutdown panel are in the nose wheel well area.



GROUND CREW CALL SYSTEM - NOSE WHEEL WELL COMPONENT LOCATIONS

GROUND CREW CALL SYSTEM - INTERFACES

General

The ground crew call system uses the passenger address/ cabin interphone (PA/CI) controller to send signals between the flight crew and the ground crew.

PA/CI Controller

The standby power management panel has two circuit breakers that connect power to the PA/CI controller. One supplies power to the normal cabin interphone controller. The other supplies power to the secondary cabin interphone controller.

The nose gear electrical service panel sends a flight deck call discrete to the PA/CI controller.

The PA/CI controller sends a flight call discrete to the audio management unit (AMU) and gets a flight call reset signal from the AMU.

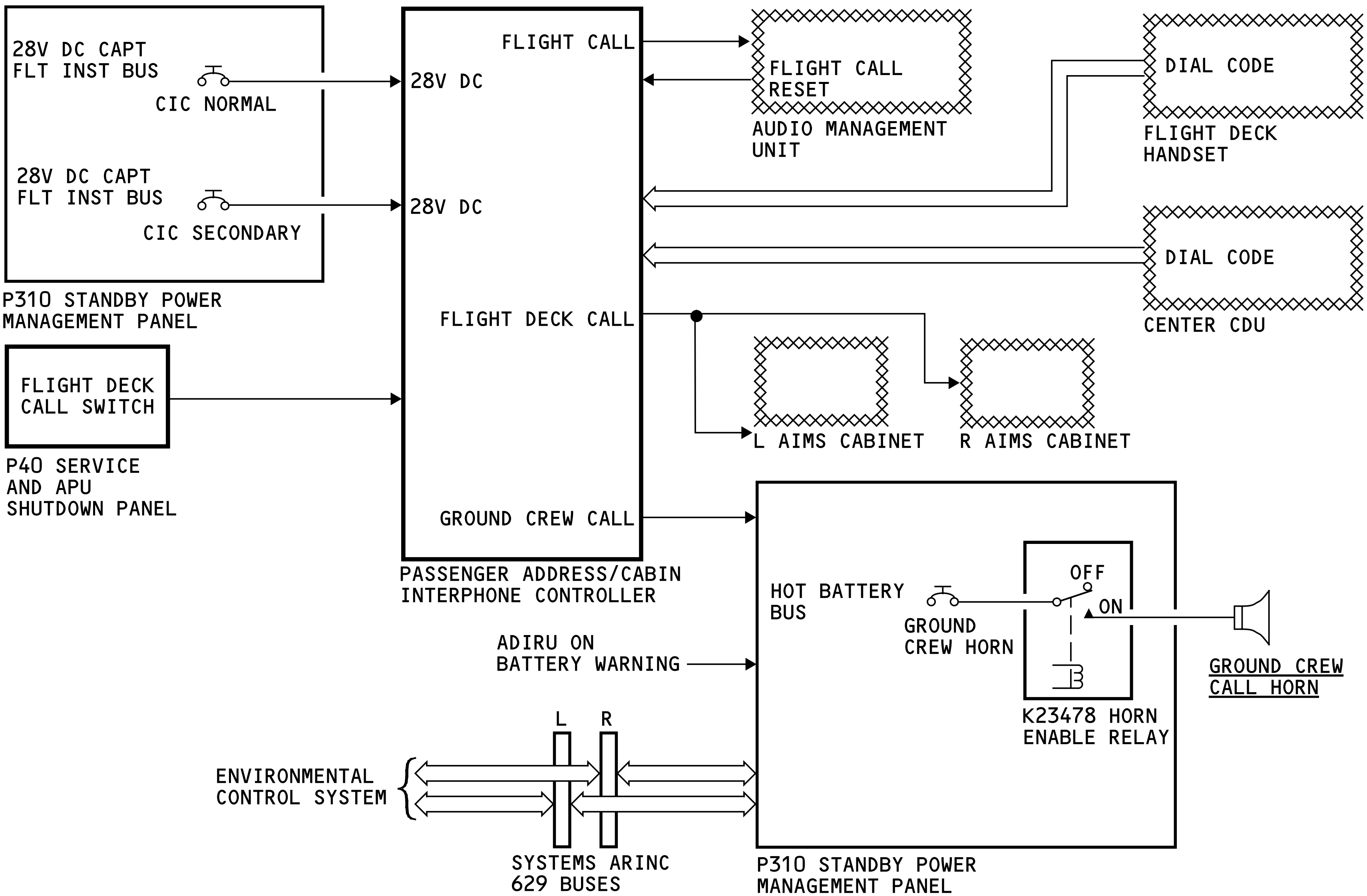
The center control display unit (CDU) or flight deck handset (FDH) sends dial code information to the PA/CI controller.

The PA/CI controller sends a flight deck call discrete to the AIMS cabinets to make a chime come on and show a message on EICAS.

Standby Power Management Panel

The PA/CI controller sends a discrete to the standby power management panel. The standby power management panel also gets signals from the environmental control system (ECS) and from the air data inertial reference system (ADIRS).

These signals cause the ground crew call horn to come on.



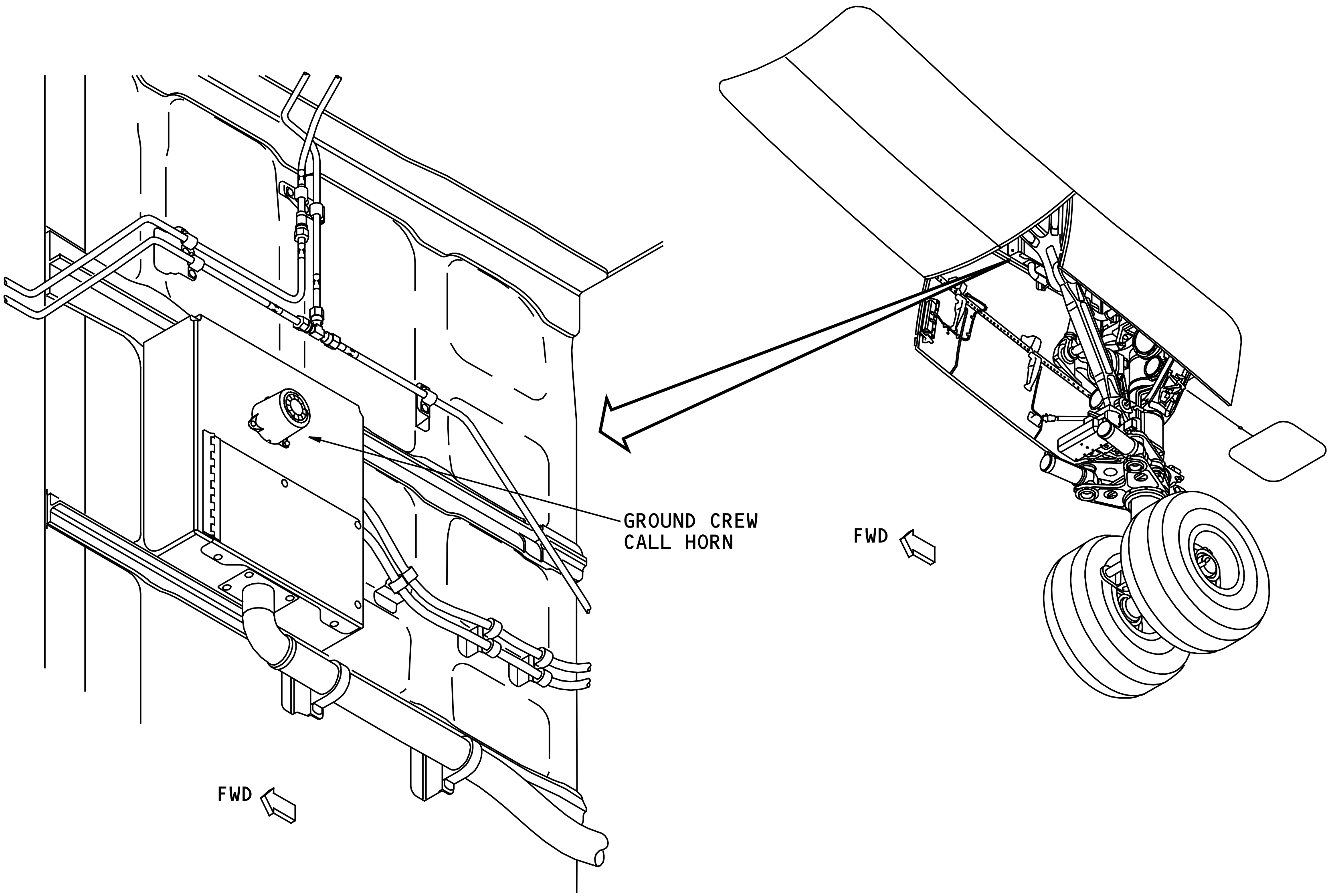
GROUND CREW CALL SYSTEM - INTERFACES

23-43-00-004 Rev 2 10/25/95

GROUND CREW CALL SYSTEM - GROUND CREW CALL HORN

Purpose

The ground crew call horn comes on for 3 seconds when there is a call from the flight deck. The horn comes on continuously when the air data inertial reference unit (ADIRU) is on battery power, or there is an equipment cooling failure.



23-43-00-005 Rev 2 11/14/95

GROUND CREW CALL SYSTEM - GROUND CREW CALL HORN

GROUND CREW CALL SYSTEM - FLIGHT DECK CALL SWITCH

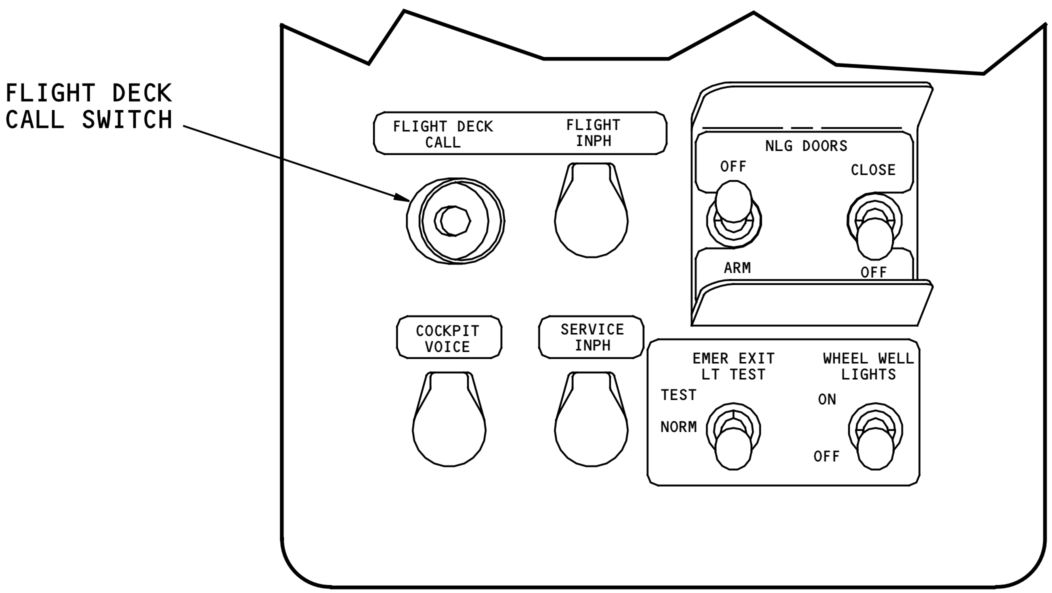
Purpose

You use the flight deck call switch on the service and APU shutdown panel to tell the flight crew to select the flight interphone system to speak with the ground crew.

Operation

Push the momentary FLIGHT DECK CALL switch to cause these three indications in the flight deck:

- A single high-low chime comes on through the aural warning speakers
- The FLT call lights on the audio control panels (ACP) come on
- The message GROUND CALL shows on EICAS.



P40 SERVICE AND APU SHUTDOWN PANEL

23-43-00-006 Rev 1

GROUND CREW CALL SYSTEM - FLIGHT DECK CALL SWITCH

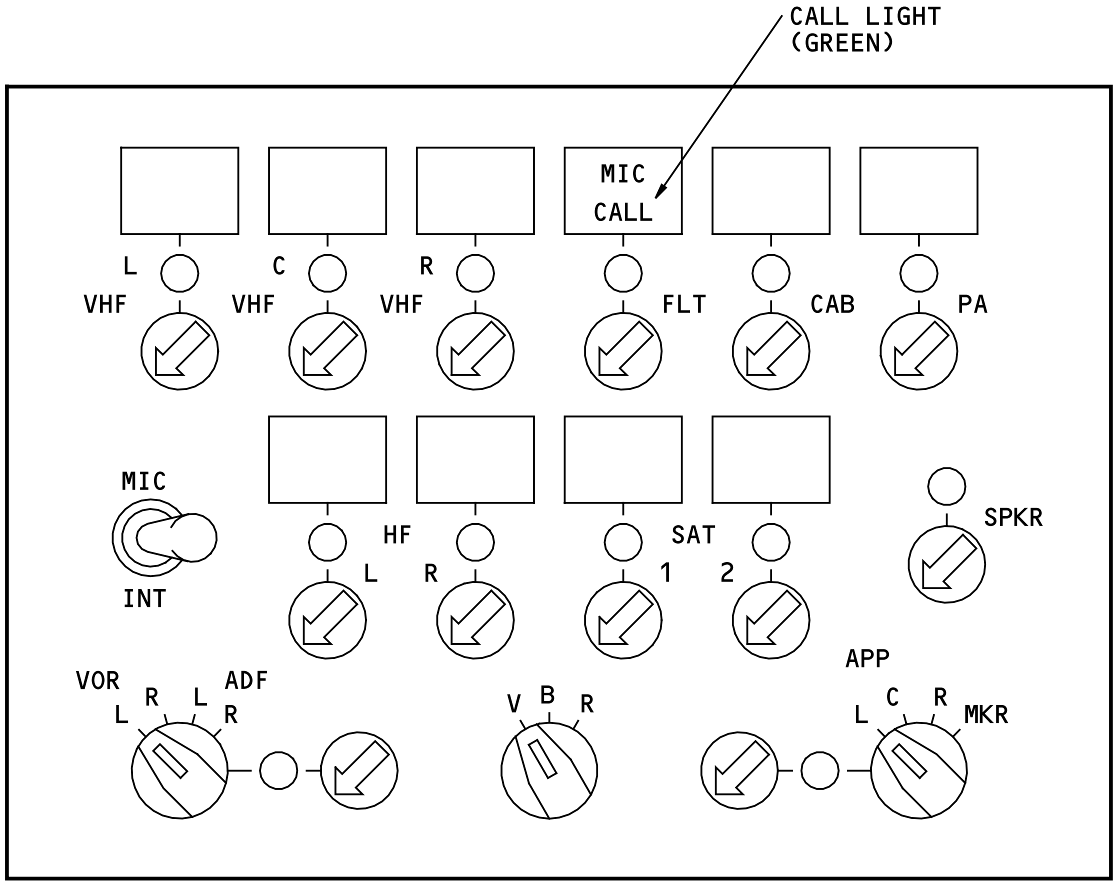
GROUND CREW CALL SYSTEM - AUDIO CONTROL PANEL

Purpose

The audio control panel (ACP) supplies call annunciations.

The audio control panel FLT call light shows CALL when you push the flight deck call switch on the service and APU shutdown panel.

When the flight crew selects the FLT transmit switch the CALL light goes off.



AUDIO CONTROL PANEL

23-43-00-007 Rev 3 03/29/96

GROUND CREW CALL SYSTEM - AUDIO CONTROL PANEL

GROUND CREW CALL SYSTEM - CENTER CDU

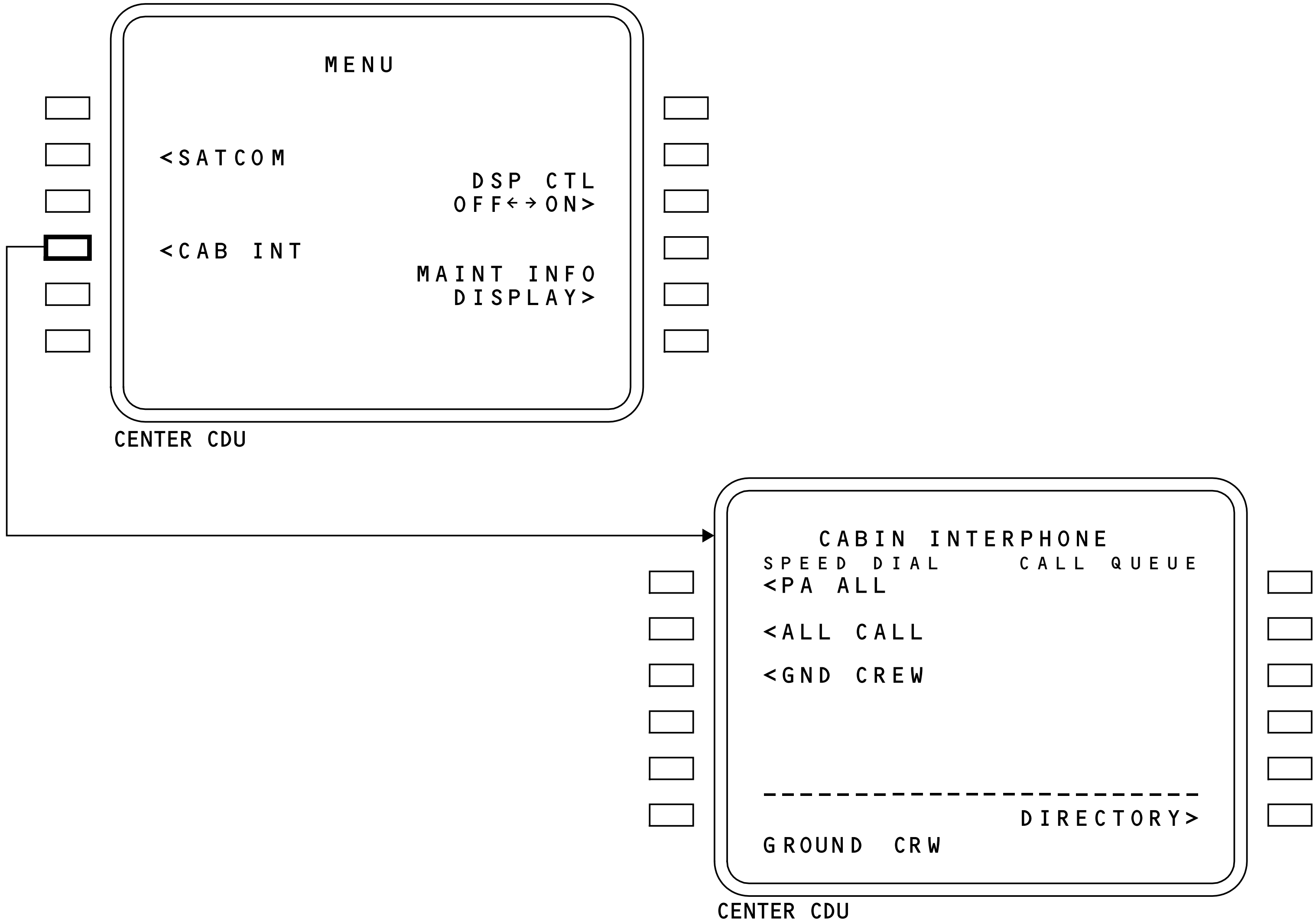
Purpose

The flight crew uses the center control display unit (CDU) or enters the applicable dial code on the flight deck handset to start a ground crew call.

Cabin Interphone Menu

The flight crew uses the cabin interphone menu to call the ground crew. To show the cabin interphone menu, push the line select key (LSK) next to <CAB INT on the CDU menu.

Push the LSK next to the <GND CREW selection or enter the applicable dial code on the CDU keypad, and push LSK 6L to call the ground crew.



23-43-00-008 Rev 2

GROUND CREW CALL SYSTEM - CENTER CDU

GROUND CREW CALL SYSTEM - FUNCTIONAL DESCRIPTION

General

The passenger address/cabin interphone (PA/CI) controller gets flight deck and ground crew call signals. It sends signals to cause different indications in the flight deck and at the nose wheel well.

Flight Deck Call Operation

When you push the flight deck call switch, a ground goes to the PA/CI controller. This causes the microprocessor to send messages to the:

- Audio management unit (AMU)
- AIMS cabinets.

The AMU causes the CALL light on the flight interphone transmit switch on each audio control panel (ACP) to come on.

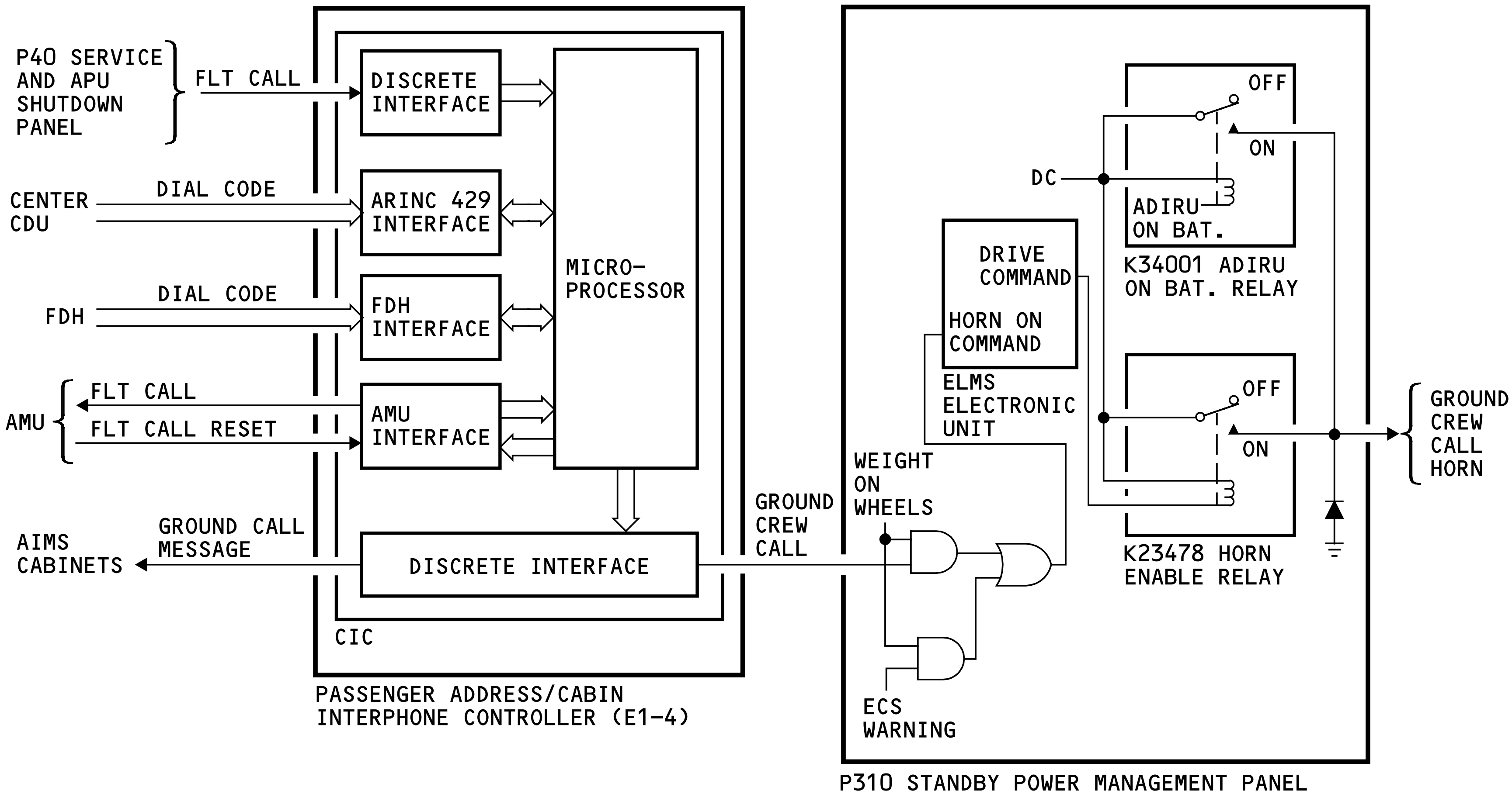
The AIMS cabinets send signals for a high-low chime through the aural warning speakers and a message on EICAS.

Horn Operation

When you select GND CREW on the center CDU cabin interphone menu or enter the applicable diale code on the flight deck handset, the microprocessor sends a signal to the standby power management panel. The electrical load management system (ELMS) electronic unit on the standby power management panel energizes the horn enable relay when the airplane is on the ground.

When there is an equipment cooling failure, the horn enable relay also energizes.

When the ADIRU is on without ac power, the ADIRU on-battery relay energizes and causes the horn to come on. This signal does not go through the horn enable relay.



GROUND CREW CALL SYSTEM - FUNCTIONAL DESCRIPTION

Continental Airlines, Inc

Very High Frequency Communications System

WB371

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VERY HIGH FREQUENCY COMMUNICATION SYSTEM - INTRODUCTION

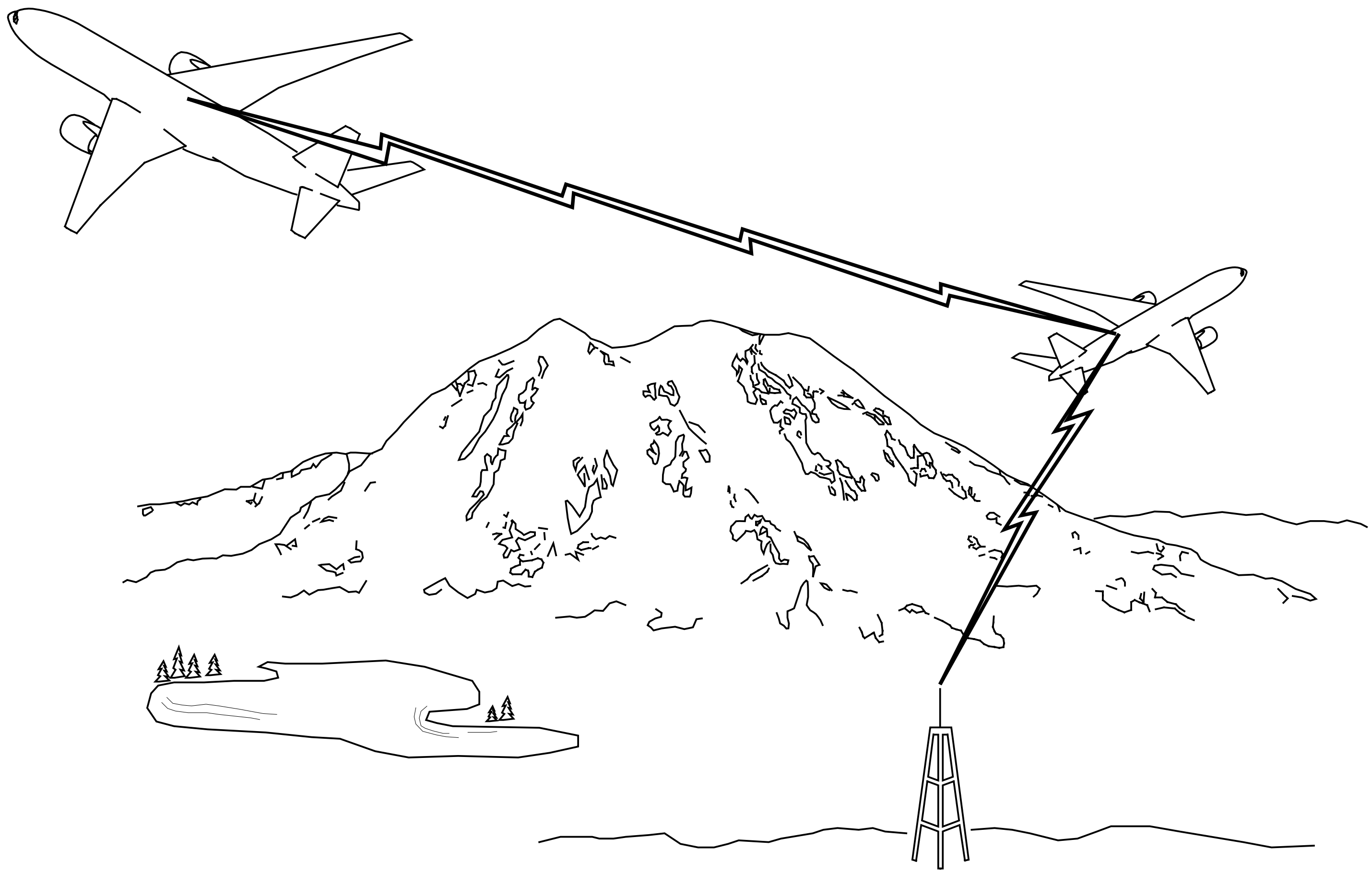
General

The very high frequency (VHF) communication system permits voice and data communication over line-of-sight distances. It permits communication between airplanes or between ground stations and airplanes.

The VHF system operates in the VHF aeronautical frequency range of 118.000 MHz to 136.975 MHz.

Abbreviations and Acronyms

ACP	- audio control panel
AIMS	- airplane information management system
AM	- amplitude modulation
AMU	- audio management unit
capt	- captain
CMCF	- central maintenance computing function
DCGF	- data conversion gateway function
DCMF	- data communication management function
DFDAF	- digital flight data acquisition function
ELMS	- electrical load management system
F/O	- first officer
F/OBS	- first observer
HF	- high frequency
MAT	- maintenance access terminal
pnl	- panel
PTT	- push to talk
RF	- radio frequency
RTP	- radio tuning panel
SSB	- single side band
VHF	- very high frequency
VSWR	- voltage standing wave ratio



VERY HIGH FREQUENCY COMMUNICATION SYSTEM - INTRODUCTION

VHF SYSTEM - GENERAL DESCRIPTION

General

The VHF communication system uses three VHF systems. Each VHF system has:

- A VHF antenna
- A VHF communication transceiver.

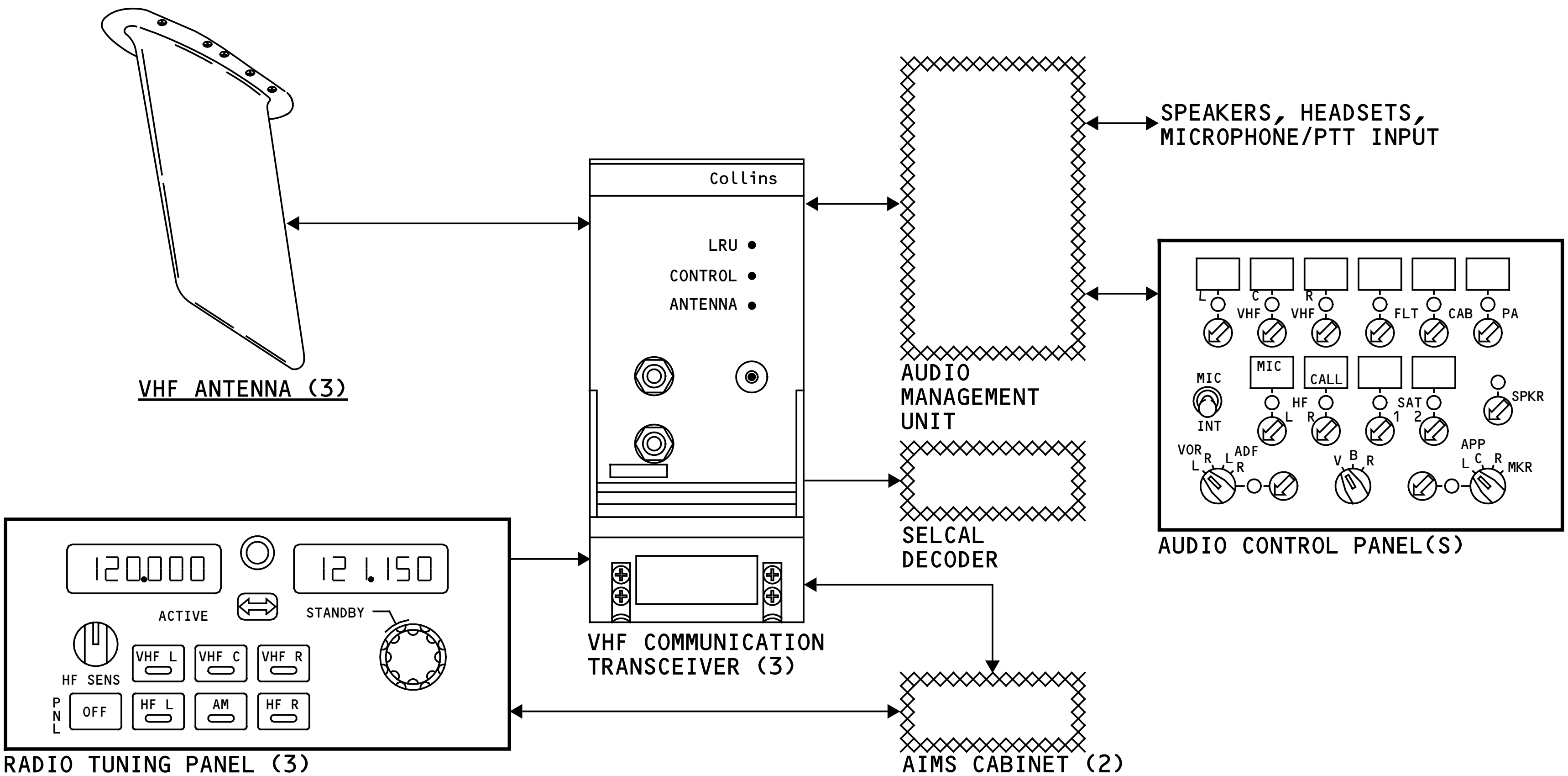
General Description

The VHF communication system connects with:

- Three radio tuning panels (RTPs). The RTPs send tuning data to the VHF communication transceiver.
- The audio management unit (AMU). Microphone audio and mic switch discretes go to the VHF transceiver through the AMU. Receiver audio goes from the VHF communication transceiver to the speakers and headsets through the AMU.
- The SELCAL decoder. The SELCAL decoder starts an alert when a call comes in for that airplane.

The VHF communication system also connects with the airplane information management system (AIMS) for these functions:

- Digital flight data acquisition function (DFDAF). The DFDAF in the AIMS cabinet receives the mic switch signals for input to the flight data recorder.
- Central maintenance computing function (CMCF). The CMCF gets fault reports from the VHF system and records this information in a fault history. This shows the maintenance crew the faulty component or function.
- Data conversion gateway function (DCGF). The VHF transceiver gets air/ground discretes from DCGF and uses its air/ground logic to define flight legs for its internal fault memory.
- Data communication management function (DCMF). The DCMF supplies data communications control and services for airplane air/ground datalink on the VHF system.



23-12-00-002 Rev 5 02/19/96

VHF SYSTEM - GENERAL DESCRIPTION

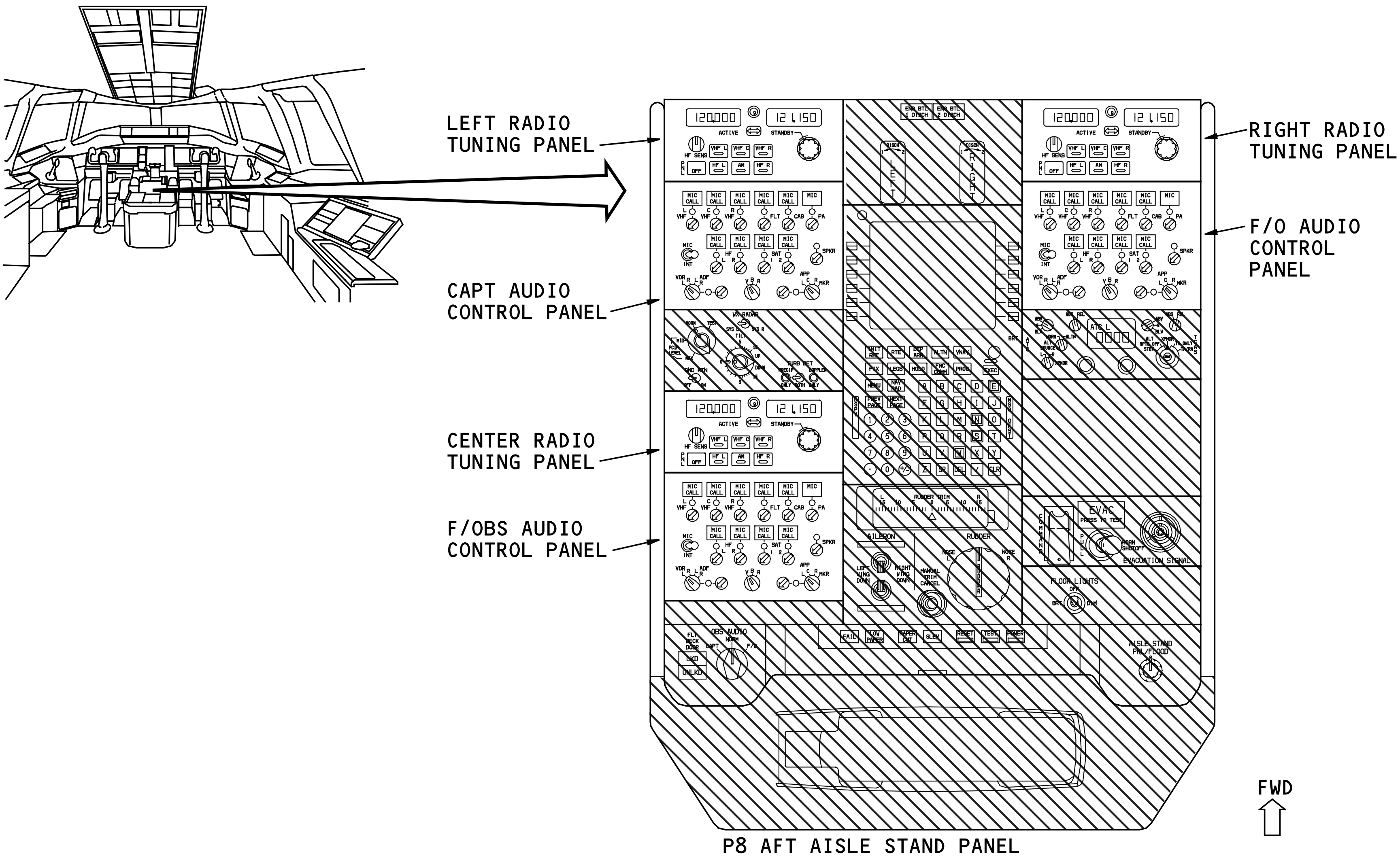
VHF SYSTEM - FLIGHT DECK COMPONENT LOCATIONS

VHF System Component Locations

The radio tuning panels (RTPs) are in the aft aisle stand panel.

Other Systems Component Locations

The audio control panels (ACPs) are part of the flight interphone system. They have an interface with the VHF communication system.

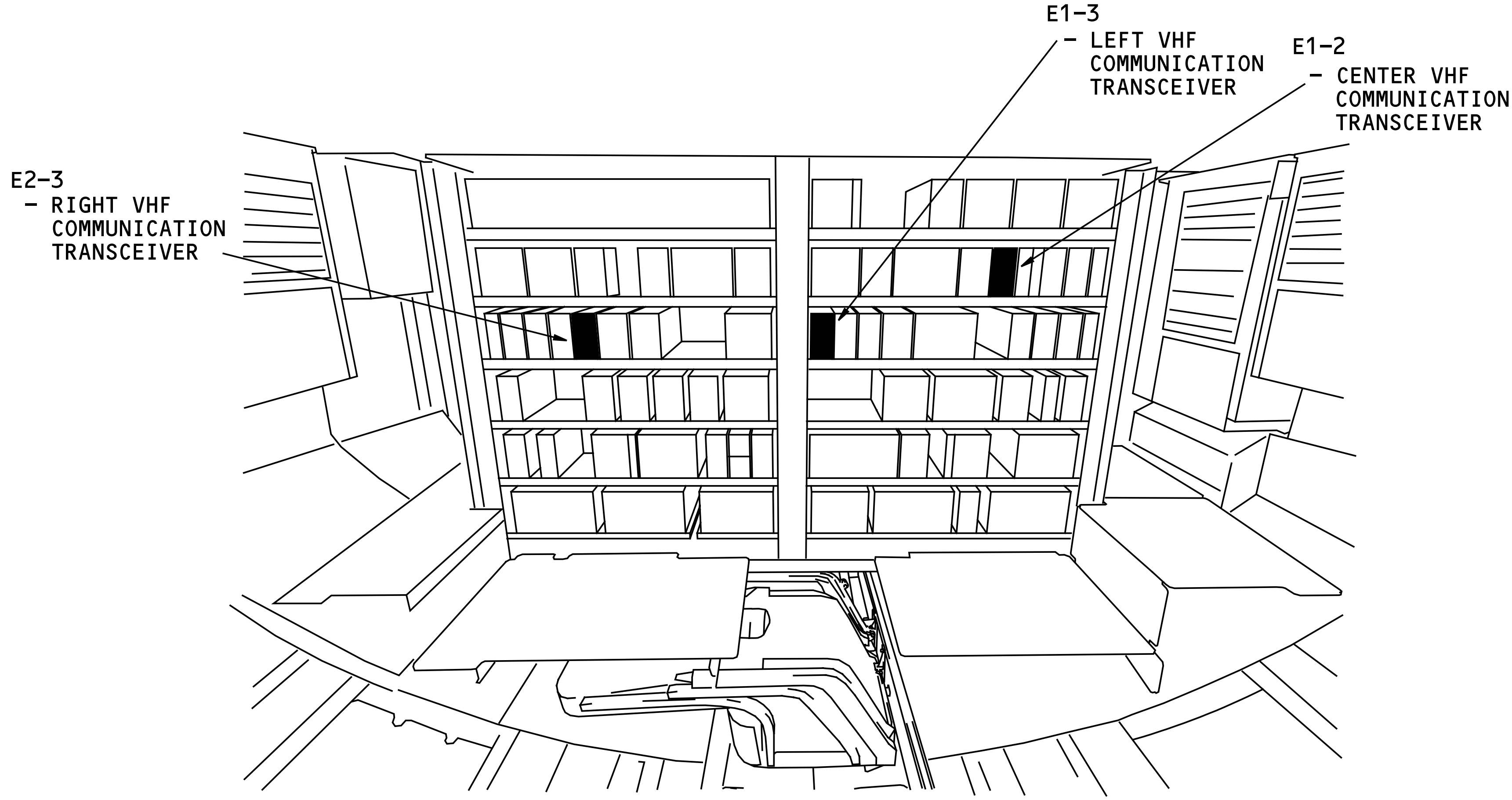


VHF SYSTEM - FLIGHT DECK COMPONENT LOCATIONS

VHF SYSTEM - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

VHF Component Locations

The VHF communication transceivers are in the main equipment center.



MAIN EQUIPMENT CENTER
(LOOKING AFT)

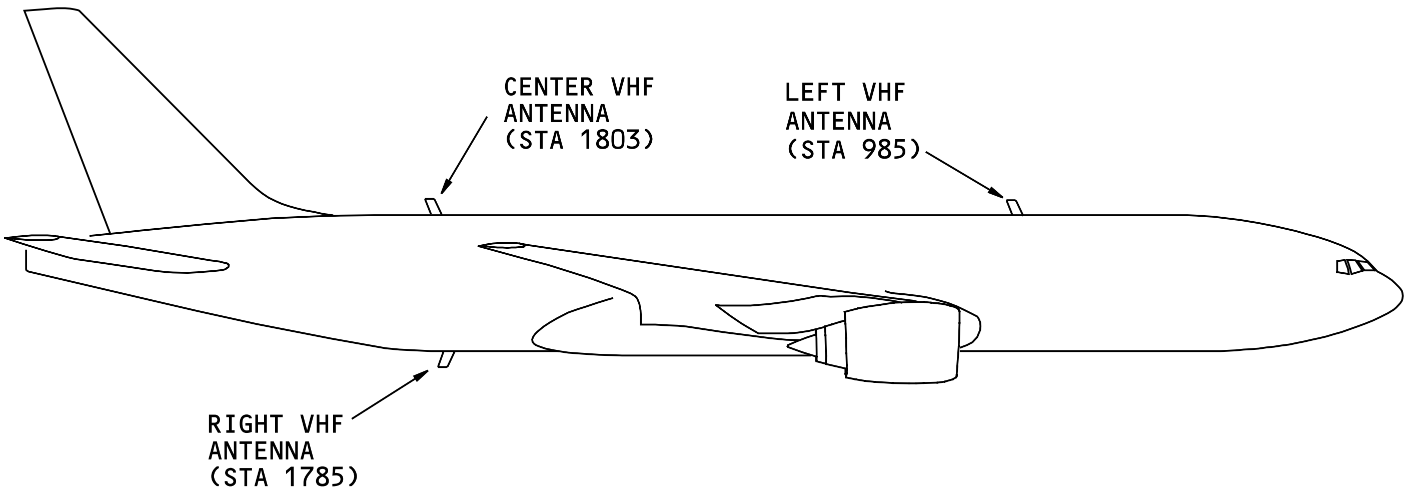
23-12-00-004 Rev 2 10/20/1997

VHF SYSTEM - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

VHF SYSTEM - EXTERNAL COMPONENT LOCATIONS

VHF Component Locations

The three VHF antennas are on the upper and lower fuselage. The left and center antennas are on the upper fuselage. The right antenna is on the lower fuselage.



23-12-00-005 Rev 3 07/31/1997

VHF SYSTEM - EXTERNAL COMPONENT LOCATIONS

VHF SYSTEM - POWER INTERFACE

General

The captain's flight instrument bus sends 28 VDC to:

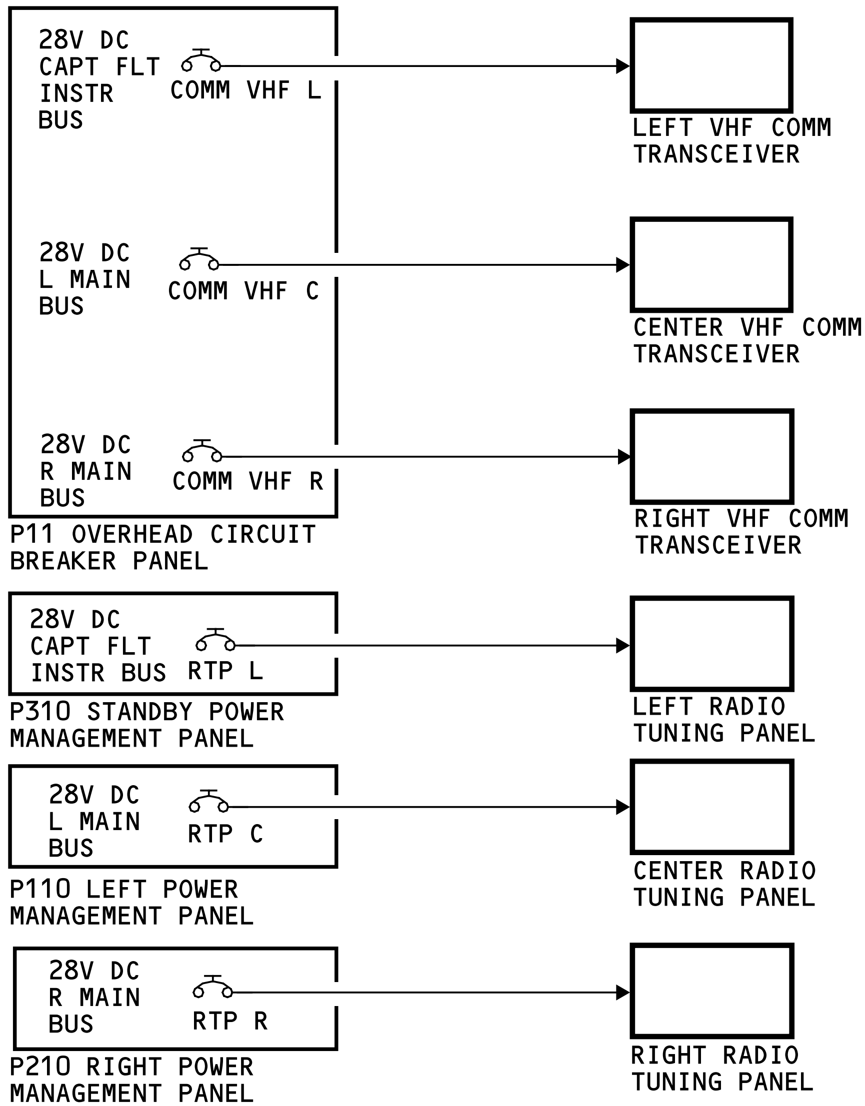
- The left VHF communication transceiver
- The left radio tuning panel (RTP).

The left main dc bus sends 28 VDC to:

- The center VHF communication transceiver
- The center RTP.

The right main dc bus sends 28 VDC to:

- The right VHF communication transceiver
- The right RTP.



23-12-00-006 Rev 0

VHF SYSTEM - POWER INTERFACE

VHF SYSTEM - TUNING INTERFACE

General

The VHF communication system uses data buses to share tuning information between the radio tuning panels (RTPs), the VHF communication transceivers, and the airplane information management system (AIMS) cabinets.

Tuning Buses

The RTPs send tuning data to the VHF communication transceivers. Any RTP can tune any transceiver.

Each RTP has these two ARINC 429 output buses:

- Tuning bus
- Crosstalk bus.

Both the left and right RTPs send tuning data to all three transceivers and to the left and right AIMS cabinets.

The center RTP sends tuning data to the left and right RTPs and to the left and right AIMS cabinets.

Both the left and right AIMS cabinets send auto-tune data to all three RTPs.

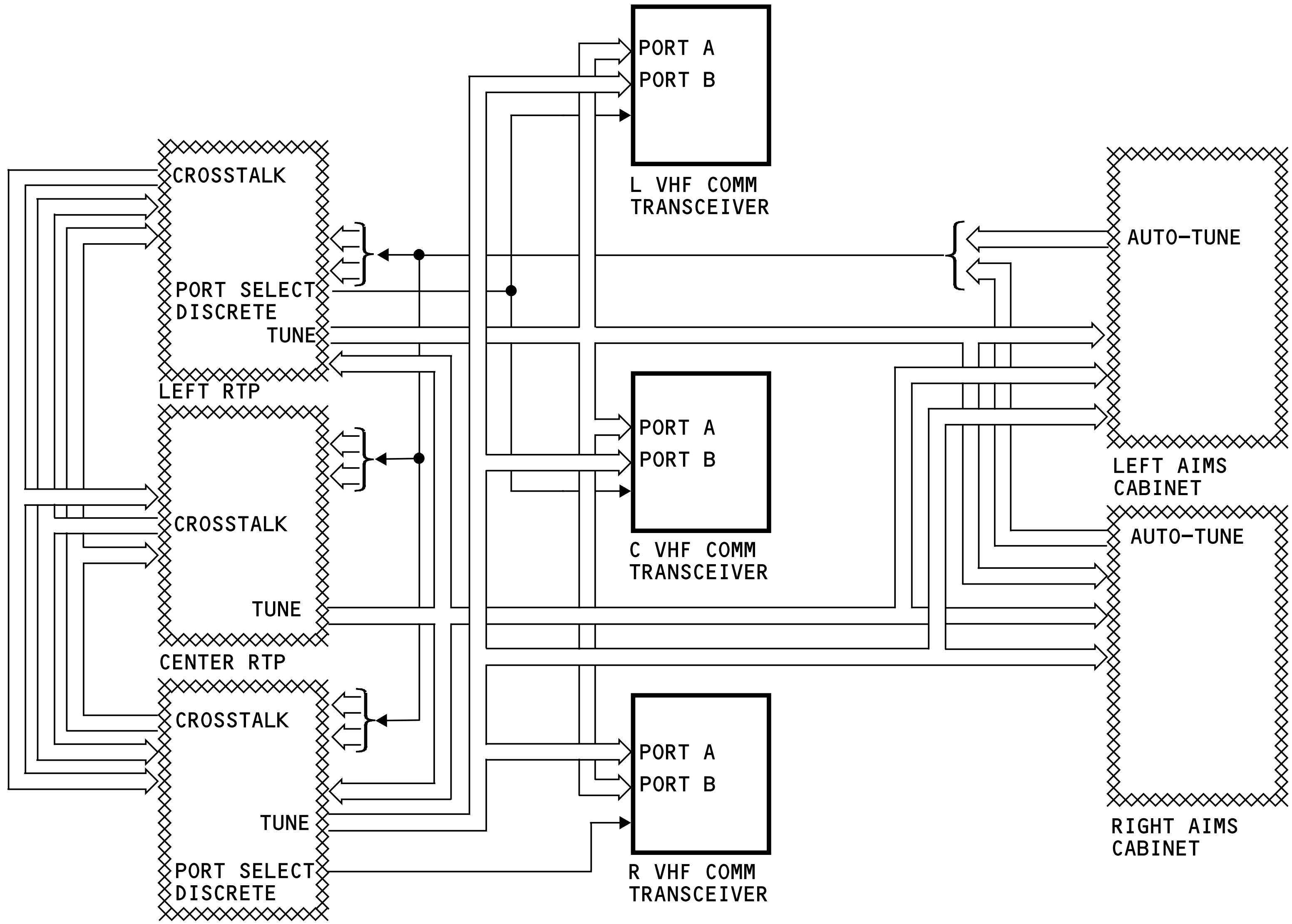
Port Select Discrete

The left RTP sends a port select discrete to the left and center transceivers. The right RTP sends a port select discrete to the right transceiver.

Each transceiver has two tuning data input ports; port A and port B. The transceiver uses the port select discrete to select its input port. A grounded port select discrete causes the transceiver to use port A. An open port select discrete causes the transceiver to use port B.

Crosstalk Buses

Each RTP sends tuning data to the other RTPs on crosstalk buses. This keeps the RTP tuning data synchronized and permits any RTP to tune any transceiver.



23-12-00-007 Rev 1

VHF SYSTEM - TUNING INTERFACE

VHF SYSTEM - VOICE RECEIVE/TRANSMIT INTERFACES

General

You use an audio control panel (ACP) to select a VHF communication transceiver for voice communication. You also use a radio tuning panel (RTP) to select a frequency for the transceiver. Any push to talk (PTT) signal activates the selected transceiver.

Signal Flow - Receive

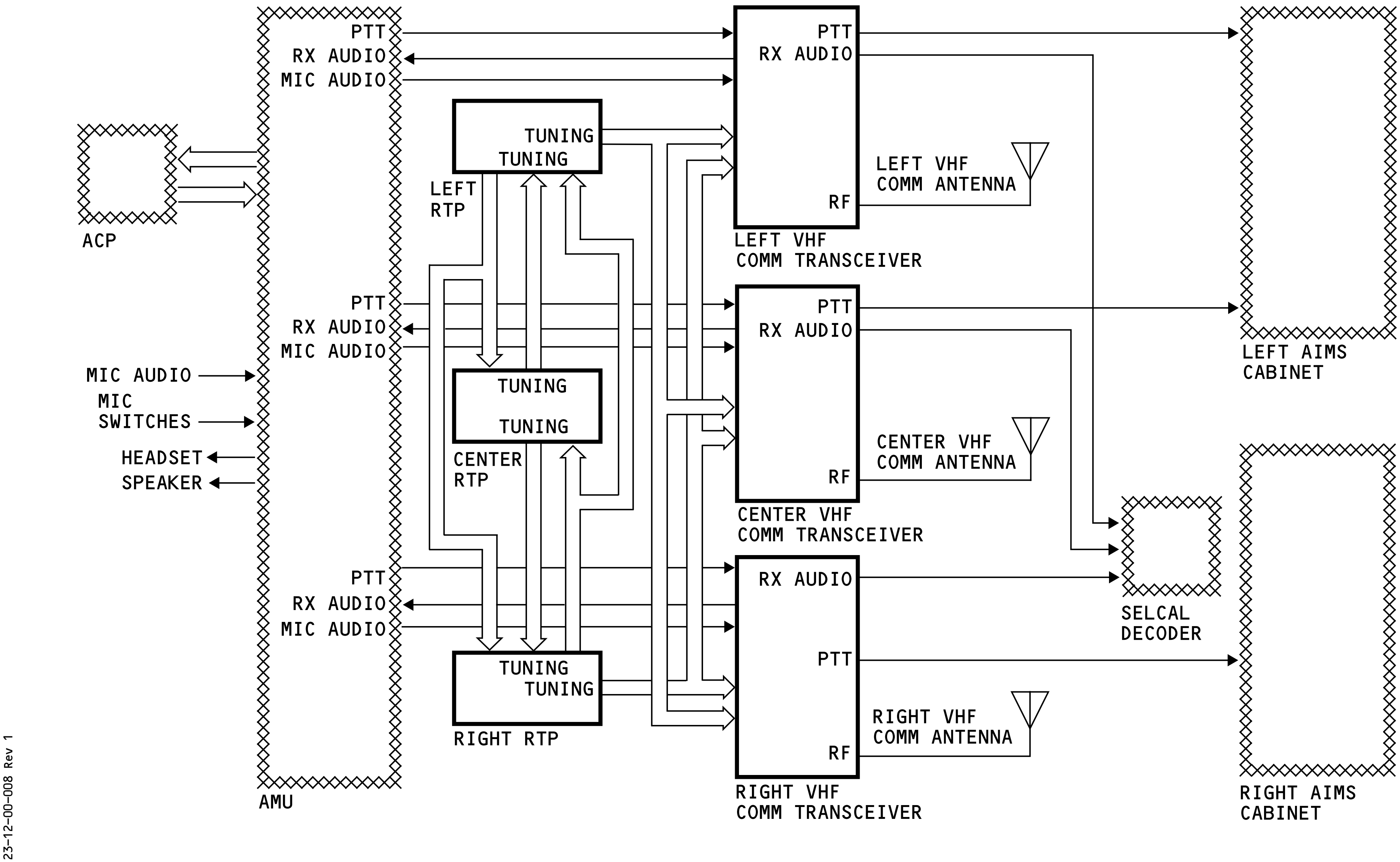
The VHF communication antennas receive RF signals and send them to the transceivers. The transceivers change the RF signals to audio signals and send them to the audio management unit (AMU). The AMU sends the audio signals to the headsets and speakers.

The transceiver sends received audio to the SELCAL decoder to monitor for selective call tones.

Signal Flow - Transmit

The AMU sends the mic audio and the mic switches signal to the selected transceiver. The transceiver changes the mic audio to an RF signal and sends it to the VHF antenna. The VHF antenna transmits the RF signal.

The transceiver sends key event (PTT) to the AIMS digital flight data acquisition function (DFDAF).



VHF SYSTEM - VOICE RECEIVE/TRANSMIT INTERFACES

VHF SYSTEM - DATA RECEIVE/TRANSMIT INTERFACES

General

To receive and transmit data, the VHF communication system uses the three radio tuning panels (RTPs) and only two VHF communication transceivers. These components continuously communicate with the airplane information management system (AIMS) during data communication.

Discrete Interfaces

The transceivers get a voice/data select signal from AIMS. The voice/data signal selects the voice or data transmission mode of the transceiver.

The selected transceiver receives a data keyline signal from AIMS. The data keyline signal starts the data transmission.

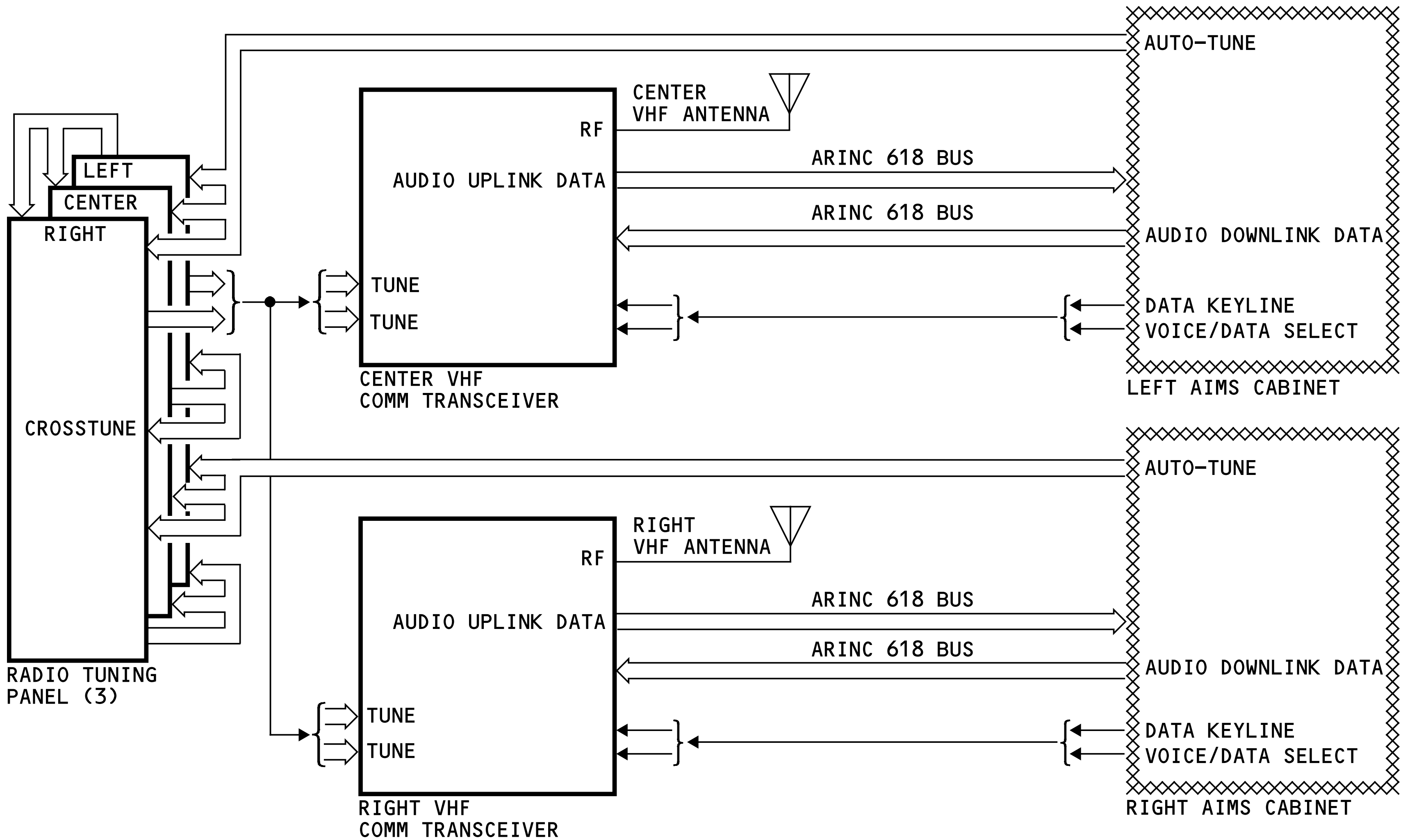
Tuning Interfaces

AIMS uses ARINC 429 buses to send auto-tuning frequencies to the left, right, and center RTPs. The RTPs send the tuning frequencies to the center transceiver or to the right transceiver.

Data Interface

The transceivers get audio uplink data from ground stations and send it to AIMS on ARINC 618 buses.

The AIMS data communication management function (DCMF) sends the audio downlink data to the transceivers on ARINC 618 buses. The transceivers send this data to the ground communication stations.



23-12-00-009 Rev 2 06/01/95

VHF SYSTEM - DATA RECEIVE/TRANSMIT INTERFACES

VHF SYSTEM - AIMS FAULT REPORTING AND TESTING INTERFACES

General

The VHF communication system sends fault information to the airplane information management system (AIMS) from the VHF transceivers and the radio tuning panels (RTPs).

VHF Communication Transceiver Interfaces

The transceivers send real time fault and status information to the AIMS cabinets.

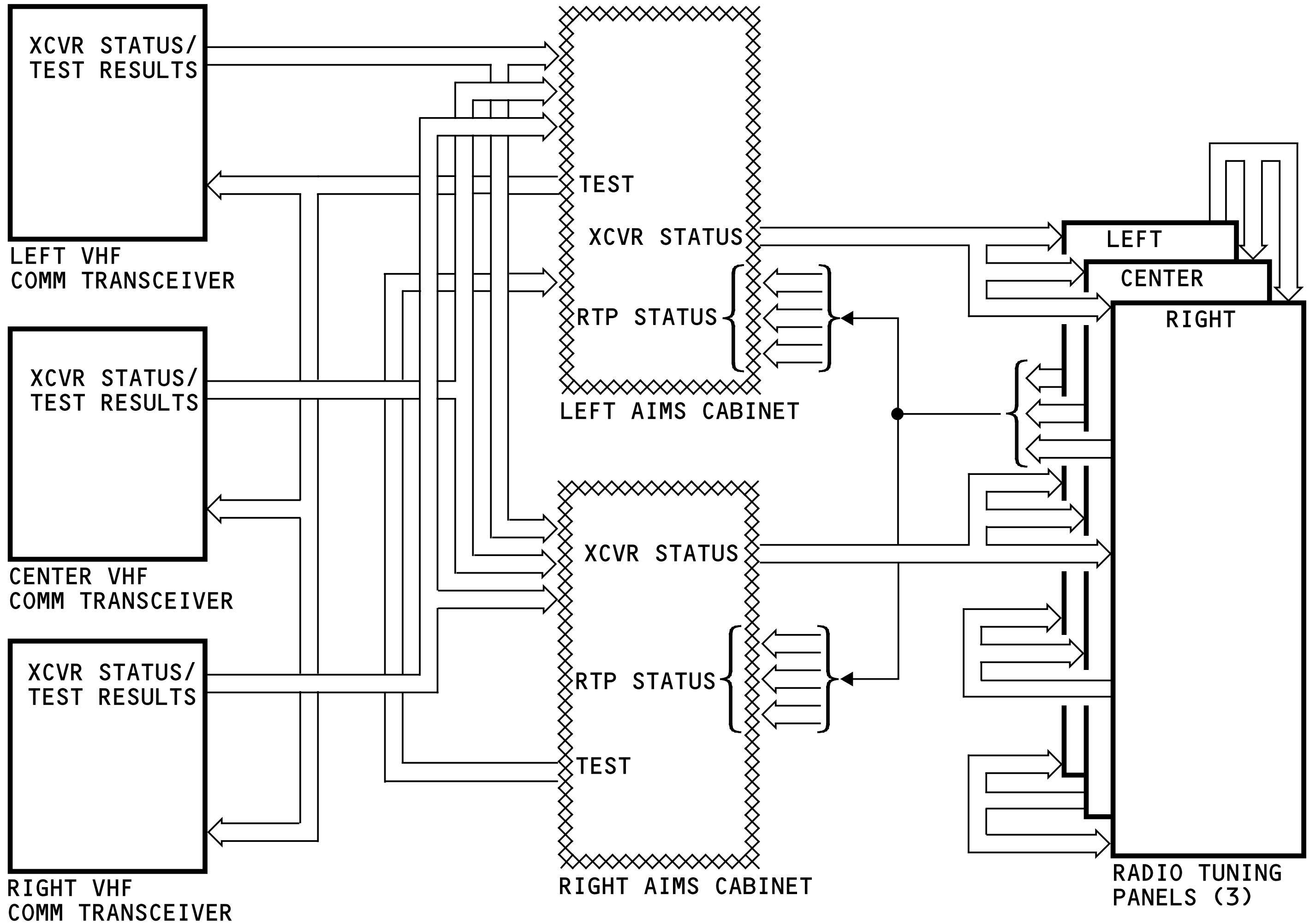
AIMS data conversion gateway function (DCGF) sends air/ground information to the transceiver.

The transceivers use the AIMS central maintenance computing function (CMCF) for on ground maintenance tests. The right AIMS cabinet CMCF sends ground maintenance test requests to the left AIMS cabinet. The left AIMS cabinet CMCF sends all test requests to the VHF transceivers. The transceivers return the test requests to the CMCF.

RTP Interfaces

The AIMS central maintenance computing function (CMCF) sends transceiver status to the RTPs.

The RTPs send fault status information to the AIMS cabinets.



23-12-00-010 Rev 1 06/01/95

VHF SYSTEM - AIMS FAULT REPORTING AND TESTING INTERFACES

VHF SYSTEM - VHF COMMUNICATION TRANSCEIVER

Purpose

The VHF communication transceiver changes RF signals to audio signals during receive and changes audio signals to RF signals during transmit.

General Description

The transceiver has:

- 8.33 KHz frequency spacing
- 118 MHz to 136.975 MHz frequency range
- 25 watts minimum output power.

Controls and Indications

The LED indicators show the status of the VHF system after you do a self-test from the front panel. These are the LED indicators on the front panel:

- LRU, shows a failure of the transceiver
- CONTROL, shows a failure of the ARINC 429 input
- ANTENNA, shows a failure of the antenna.

The TEST switch starts a 100 msec system self test. This includes these tests:

- Transceiver self-test
- Input serial tuning word test
- Antenna VSWR test.

All LEDs turn red for about two seconds. Then the LRU LED turns green and all other LEDs remain red for about 2 seconds. All LEDs turn off for about 2 seconds. Then the LRU LED comes on green for about 30 seconds and the CONTROL and ANTENNA LEDs turn off.

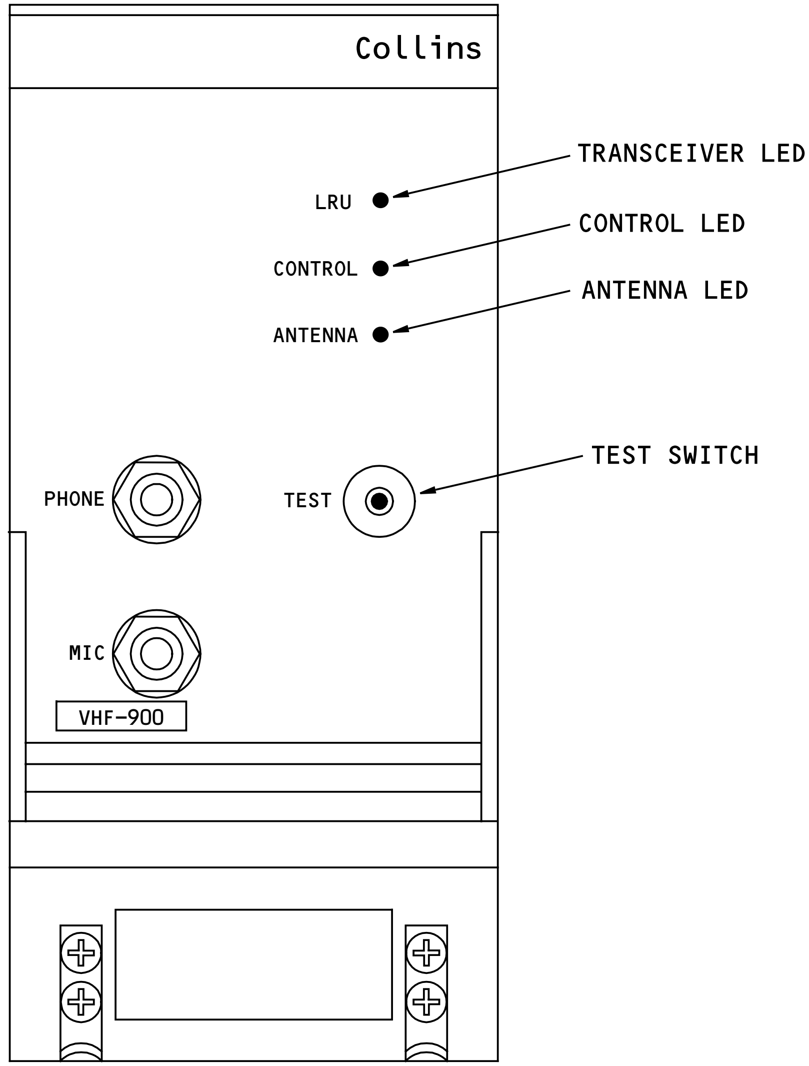
The LRU LED turns red after the self-test shows a failure.

The other LEDs come on red after the self-test to show a failure.

The self-test done from the MAT does the same tests but does not show the LED indications.

Phone and Mic Jacks

Phone and mic jacks give connection points for headphones and microphone.



23-12-00-011 Rev 5 06/02/95

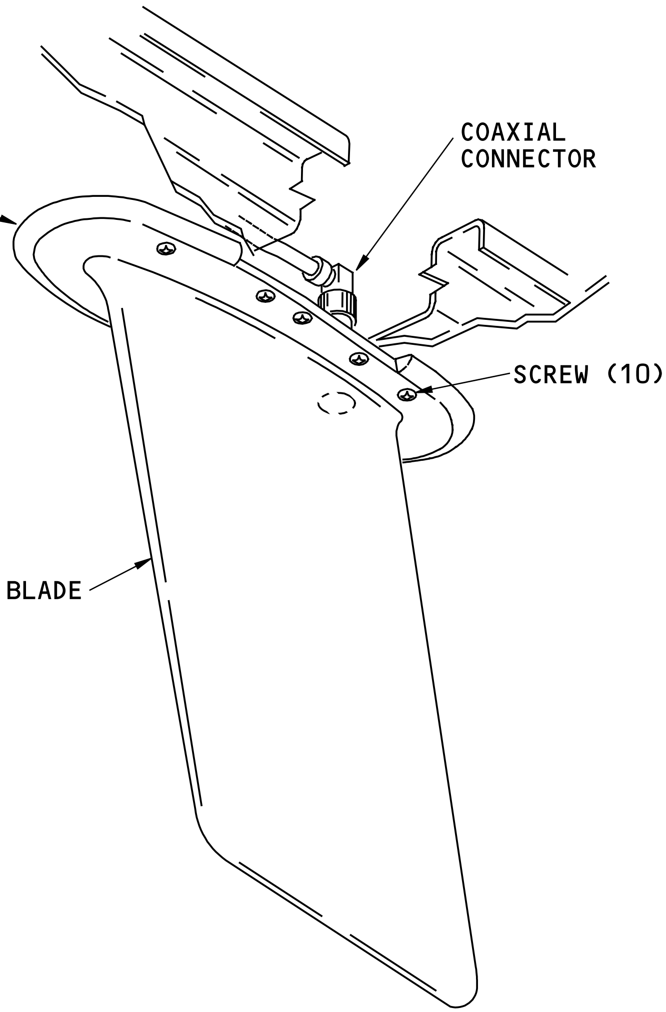
VHF SYSTEM - VHF COMMUNICATION TRANSCEIVER

VHF SYSTEM - VHF COMMUNICATION ANTENNA

General Description

The VHF communication antenna receives and transmits RF signals in the VHF frequency range.

The antenna attaches with 10 screws. There is an aerodynamic smoother around the antenna base. An o-ring seals the coaxial connector.



23-12-00-012 Rev 0

VHF SYSTEM - VHF COMMUNICATION ANTENNA

VHF SYSTEM - RADIO TUNING PANEL

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VHF SYSTEM - RADIO TUNING PANEL

Purpose

The radio tuning panel (RTP) selects the modes of operation, and selects the active and standby frequencies for each communication radio. Each RTP sends tuning and mode information to:

- Communication radios
- Other two RTPs
- Airplane information management system (AIMS) cabinets.

Description

Each RTP has these features:

- Active and standby frequency windows
- Frequency transfer switch
- Offside tuning light
- Frequency selectors
- Radio switches
- AM switch
- RTP off (OFF) switch
- HF sensitivity (HF SENS) control.

The frequency windows show this additional information:

- Messages from selected radio systems
- Transfer frequencies from the AIMS data communication management function (DCMF).

Operation

When the RTP is off, the white PNL OFF light comes on. Push the RTP OFF switch to turn the RTP on. When the RTP is on, the white PNL OFF light goes off.

The active frequency window shows the current frequency of the selected radio. The standby frequency window shows the frequency that the flight crew selects with the frequency selectors. The standby frequency window also shows autotune frequency information from the AIMS cabinets during a voice uplink.

The flight crew sets the standby frequency with the frequency selectors. The first digit is always 1. The outer knob adjusts the second two digits (10 MHz and 1 MHz) in 1 MHz steps. The inner knob adjusts the fourth, fifth and sixth digits (100 KHz, 10 kHz, and 1 kHz) in 8.33 kHz steps. The RTP automatically selects 25 kHz spacing for 121.425 to 121.575 for the 121.5 MHz emergency frequency.

The frequency transfer switch causes the active and standby frequencies to change windows. The active frequency goes to the standby frequency window, and the standby frequency goes to the active frequency window.

You use the radio switches to select a radio. You select only one radio at a time. The white light in the selected radio switch comes on.

When the flight crew selects an off-side radio, two offside tuning lights come on. One light is on the RTP that the flight crew uses to make the selection. The other light is on the onside RTP of the selected radio.

The HF SENS control sets the RF sensitivity level of the onside HF transceiver. The left RTP sets the left HF sensitivity. The right RTP sets the right HF sensitivity. The center RTP HF SENS control does not connect to any transceiver.

Use the AM switch to select between AM and SSB modulation modes for the selected HF transceiver. When you select AM mode, the white light comes on in the AM mode switch on its onside RTP if any of these conditions exist:

- Flight crew selects any VHF communication transceiver while in the AM mode
- Flight crew selects the onside HF transceiver while in the AM mode.

The AM mode light bar goes off when the flight crew selects SSB mode.

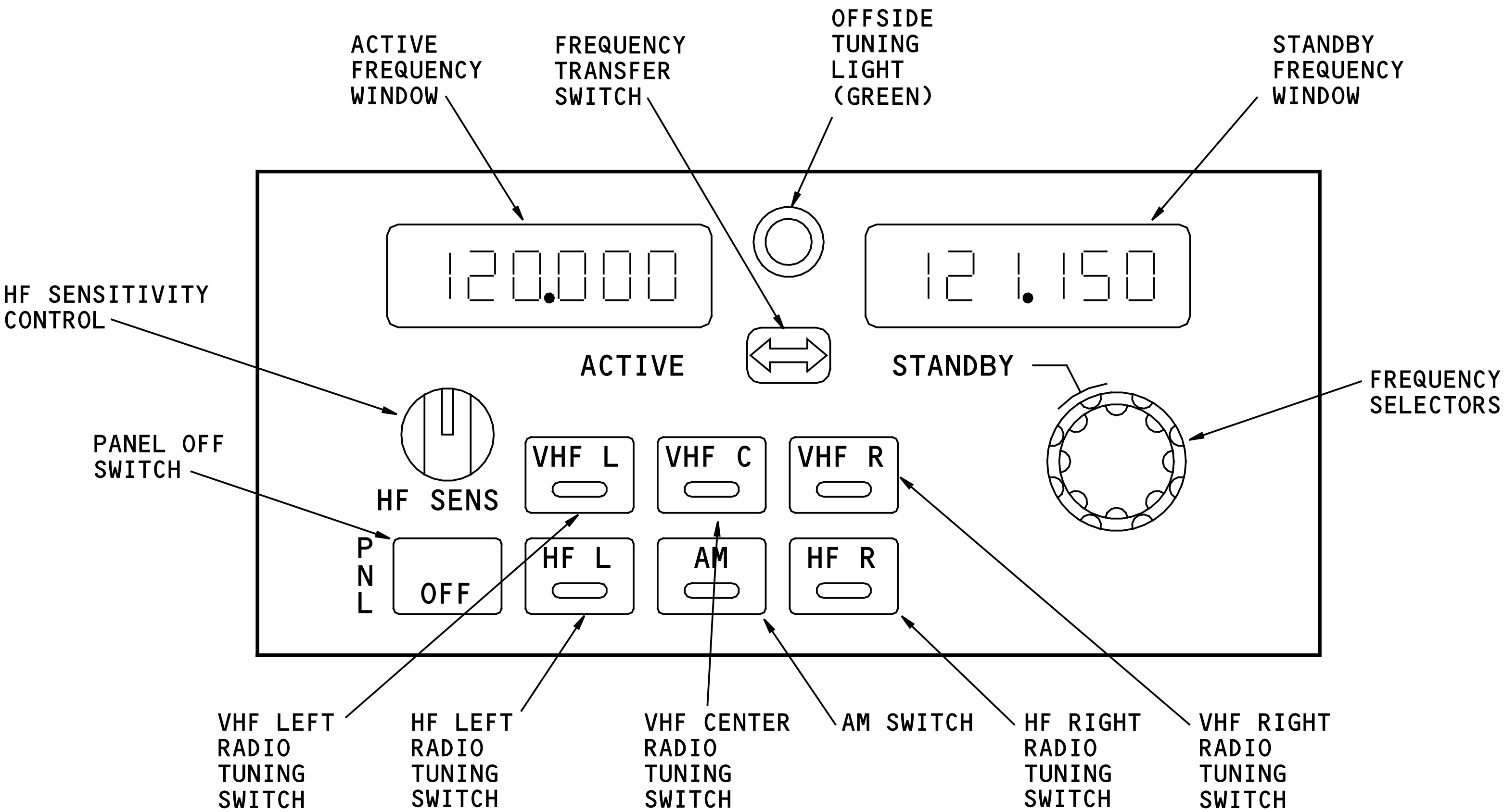
Push the PNL OFF switch to stop the operation of the RTP. When the RTP is off, the white PNL OFF light comes on and all functions stop except these:

- Displays continue to show any current fault
- RTP continues to receive 28v dc
- RTP continues to send BITE information to the AIMS central maintenance computer function (CMCF).

BITE

The RTP does a test of itself continuously. The RTP shows PANEL FAIL in the two frequency display windows when the RTP has an internal failure or there is a system failure.

The two frequency windows show all dashes if the flight crew selects a failed radio.



23-12-00-013 Rev 3 08/21/1997

VHF SYSTEM - RADIO TUNING PANEL

VHF SYSTEM - AUDIO CONTROL PANEL

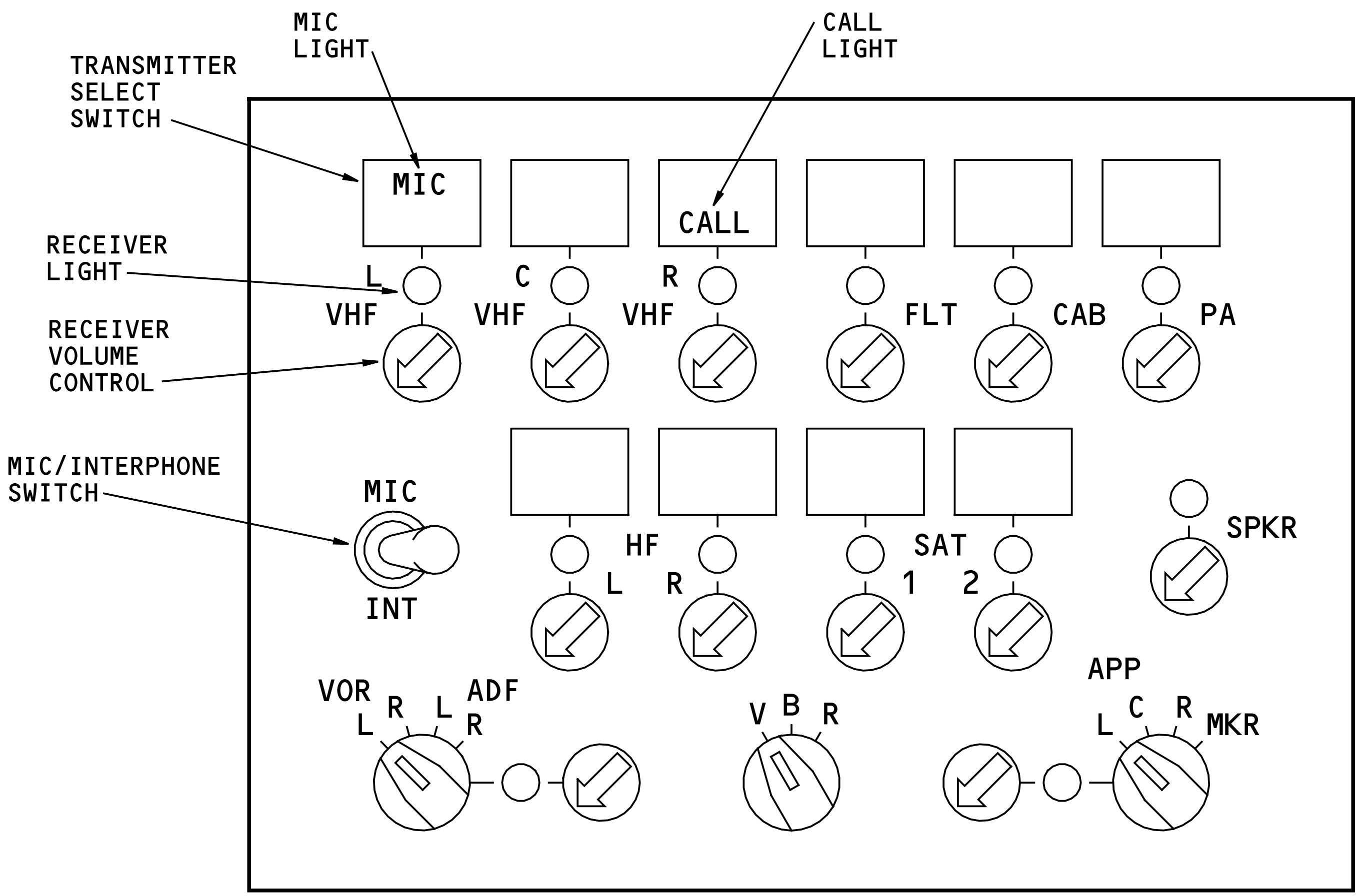
General Description

The audio control panel (ACP) supplies transmitter selection, receiver selection and volume control for the left, center, or right VHF communication transceiver. The VHF controls are on the upper half of the ACP.

Control and Indications

Push a VHF receiver volume control to listen to a VHF receiver. Rotate the receiver volume control for volume control. The receiver light above the control shows green with the receiver control on.

Push a transmitter select switch to select a transceiver for transmission. The mic light shows green for the selected system. Push the mic/interphone switch to connect the microphone to the transceiver and key the transceiver.



VHF SYSTEM - AUDIO CONTROL PANEL

23-12-00-014 Rev 1 11/08/1995

VHF SYSTEM - RECEIVE MODE

General

The VHF antenna receives RF signals and sends them to the VHF communication transceiver through the coaxial cable. The transceiver processes the RF signal and sends the audio to the audio management unit (AMU), the airplane information management system (AIMS), and SELCAL decoder.

The three VHF communication systems operate in a similar way. The right VHF system is an example.

Receive Operation

The microprocessor sends the receive frequency to the frequency synthesizer. The frequency synthesizer sets the frequency of the AM receiver.

The microprocessor also sends a logic 1 to the transfer switch when the transceiver is in the receive mode. This closes the transfer switch and sends the received RF signal from the antenna to the AM receiver.

The AM receiver demodulates the RF input and detects the audio signal.

The audio output from the AM receiver goes to:

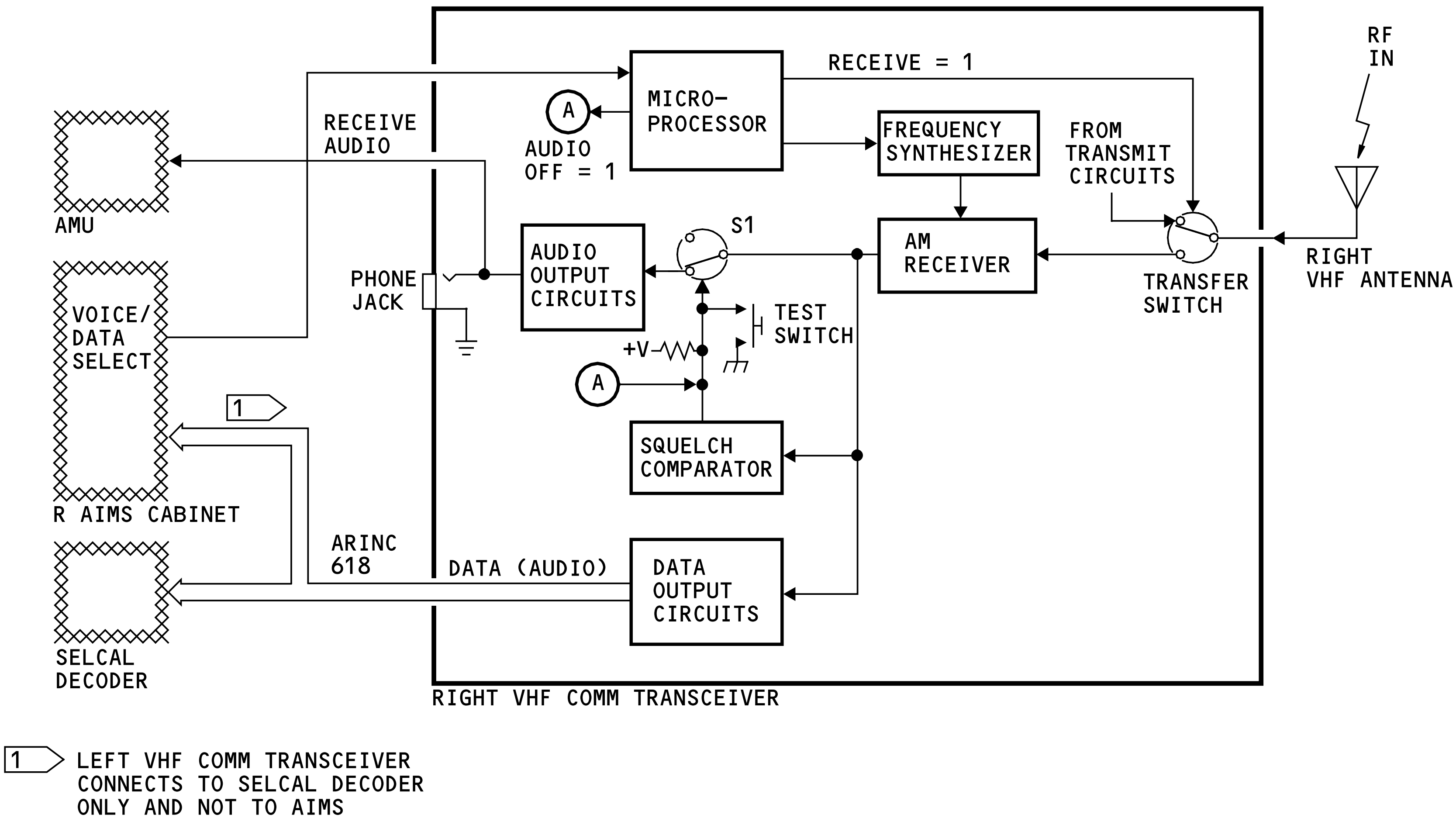
- Switch S1
- The squelch comparator
- The data output circuits.

The audio output circuits send the audio signal to the AMU and to the headphone jack. Push the TEST switch to close switch S1 and send the received audio to the audio output circuits.

The squelch comparator circuit compares the detected audio with a threshold value. If the level of the detected audio is greater than the threshold, the squelch circuits sends a ground to switch S1. Switch S1 closes and sends the audio to the audio output circuits.

The microprocessor changes the audio off signal to a logic 1 when the transceiver is in the data mode. This causes switch S1 to open and disable the audio output and the squelch comparator.

The data output circuits send unsquelched audio to the SELCAL decoder and to the right airplane information management system (AIMS) cabinets on an ARINC 618 bus.



VHF SYSTEM - RECEIVE MODE

VHF SYSTEM - TRANSMIT MODE

General

Audio signals from the audio management unit (AMU) and data (audio) from the airplane information management system (AIMS) go to the selected VHF transceiver. The transceiver processes the signals and sends them to the selected antenna for transmission.

The three VHF communication systems operate in a similar way. The right VHF system is an example.

Transmit Operation

During transmission, the microprocessor receives a push to talk (PTT) signal from the audio management unit (AMU) or a data key signal from AIMS. This causes the microprocessor to send a logic 0 to the transfer switch. The transfer switch connects the output of the transmit circuits to the VHF antenna.

The voice/data select discrete from AIMS determines the operation mode of the transceiver. A ground input sets the transceiver to the data mode. An open input sets the transceiver to the voice mode.

In the data mode, the microprocessor sets the audio off signal to a logic 1 to disable the sidetone.

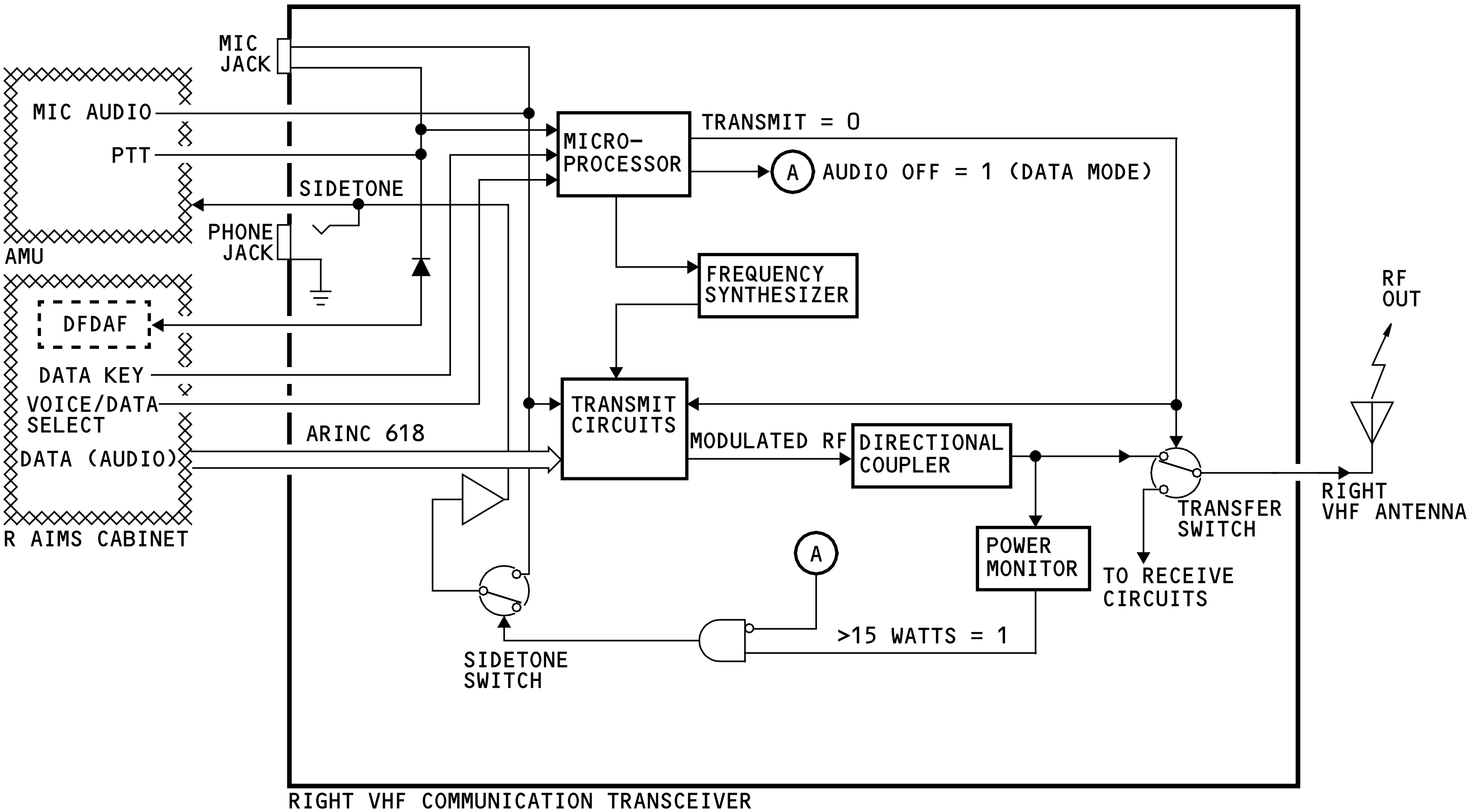
Mic audio from the AMU or the data audio from AIMS go to the transmit circuits in the transceiver. The AIMS cabinet uses an ARINC 618 bus to send the data to the transceiver. The transmit circuits modulate the transmit frequency with the mic audio or the data audio. This makes an amplitude modulated RF signal. The signal goes to the directional coupler and transfer switch. The RF signal goes through the closed transfer switch and to the antenna. The antenna transmits the RF signal.

The RF output from the directional coupler also goes to the power monitor. The power monitor sends a logic 1 when the output power is greater than 15 watts.

The sidetone switch closes when the output power is greater than 15 watts and the transceiver is in the voice mode.

The sidetone switch closes and the mic audio goes to the AMU for the flight crew.

The PTT signal goes to the AIMS cabinet for the digital flight data acquisition function (DFDAF).



23-12-00-017 Rev 2 05/31/95

VHF SYSTEM - TRANSMIT MODE

VHF SYSTEM - SYSTEM TESTS

General

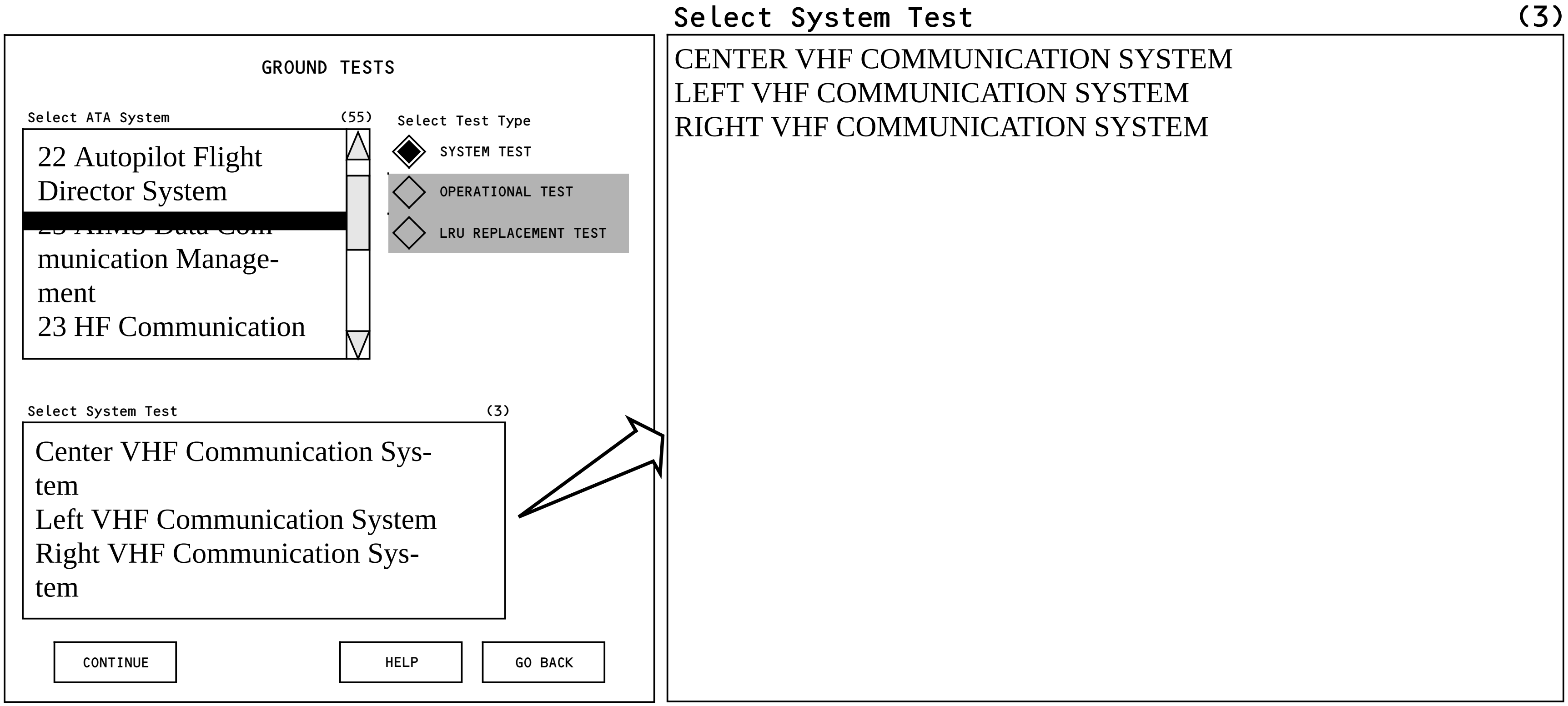
Use a maintenance access terminal (MAT) to do the system tests. These are the system tests for the VHF system:

- Center VHF communication system test
- Left VHF communication system test
- Right VHF communication system test.

VHF Communication System Test

Select the system (center, left or right) for test.

This test makes sure that the VHF communication system operates correctly. The approximate time to run the test is less than one minute. There are no airplane effects. There are no limitations or special requirements. To run the test select CONTINUE.



23-12-00-018 Rev 1

VHF SYSTEM - SYSTEM TESTS

VHF SYSTEM - INTERFACES

Interfaces

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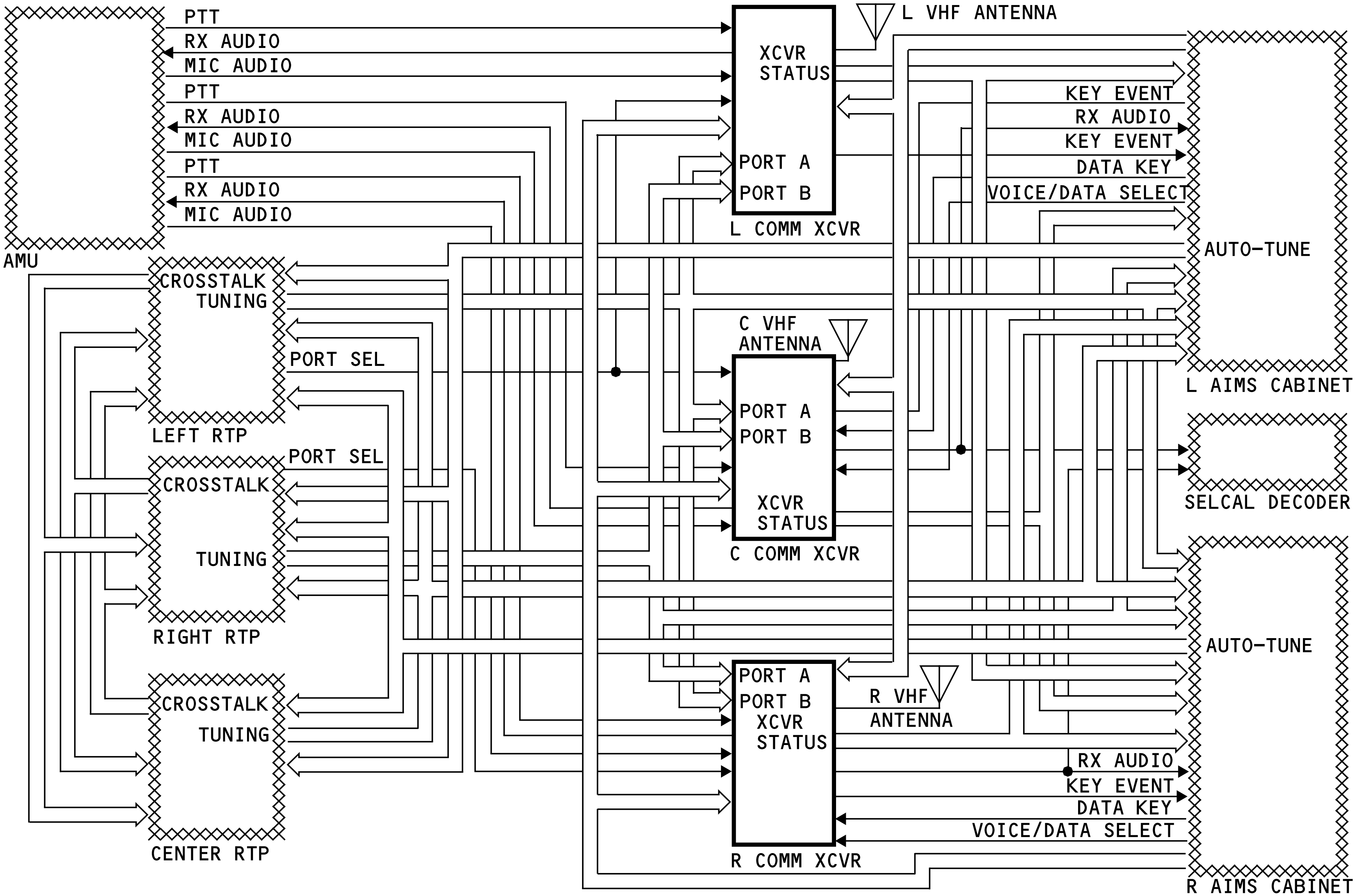

VHF SYSTEM - INTERFACES

23-12-00-019 Rev 1

Continental Airlines, Inc

High Frequency Communication System

WB371

TABLE OF CONTENTS

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HIGH FREQUENCY COMMUNICATION SYSTEM - INTRODUCTION

General

The high frequency (HF) communication system permits voice communication over greater distances than line-of-sight radio systems. The HF system is for communication with ground stations or with other airplanes during long over-water flights. The HF system operates in the HF aeronautical communication band between 2.000 MHz and 29.999 MHz.

Long Range Communication

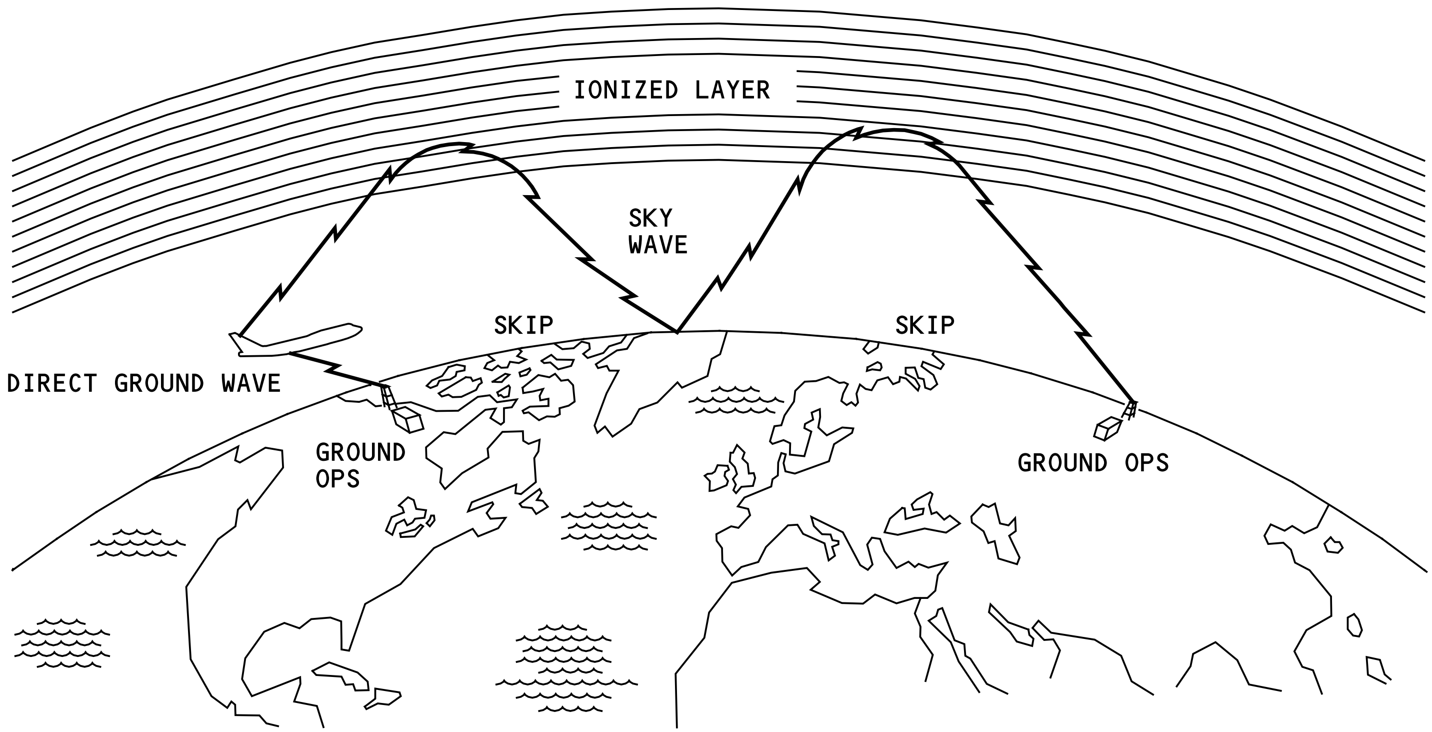
The HF system uses sky waves for long range communication. The HF signals pass into the ionized layers of the atmosphere. The ionized layers refract the signals toward the earth. The earth reflects the signals back toward the ionized layers. Sky wave distances depend upon frequency, time of day and airplane altitude. Skips are the areas between sky waves reflections.

Short Range Communication

HF signals also go directly to ground stations and other airplanes.

Abbreviations and Acronyms

ACP	- audio control panel
AM	- amplitude modulation
AMU	- audio management unit
CAPT	- captain
CMCF	- central maintenance computing function
CMCS	- central maintenance computing system
DFDAF	- digital flight data acquisition function
F/O	- first officer
F/OBS	- first observer
PSIGA	- pounds per square inch gage absolute
RTP	- radio tuning panel
sens	- sensitivity
seq	- sequence
USB	- upper side band



23-11-00-001 Rev 2

HIGH FREQUENCY COMMUNICATION SYSTEM - INTRODUCTION

HF SYSTEM - GENERAL DESCRIPTION

General

The HF communication system uses two HF systems. Each system has these components:

- A common HF antenna. The antenna transmits and receives RF signals in the HF range
- An HF antenna coupler. The antenna coupler matches the impedance of the antenna and transmission line to the output of the transceiver at the selected frequency
- An HF communication transceiver. The transceiver operates in the AM or upper side band (USB) mode.

WARNING: DO NOT TRANSMIT WITH THE HF COMMUNICATION SYSTEM WHILE THE AIRPLANE IS REFUELED OR DEFUELED. AN EXPLOSION CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO THE AIRPLANE.

WARNING: MAKE SURE PERSONNEL STAY A MINIMUM OF 6 FEET AWAY FROM THE VERTICAL STABILIZER WHEN THE HF SYSTEM TRANSMITS. RF ENERGY FROM THE HF COMMUNICATION ANTENNA CAN CAUSE INJURIES TO PERSONNEL.

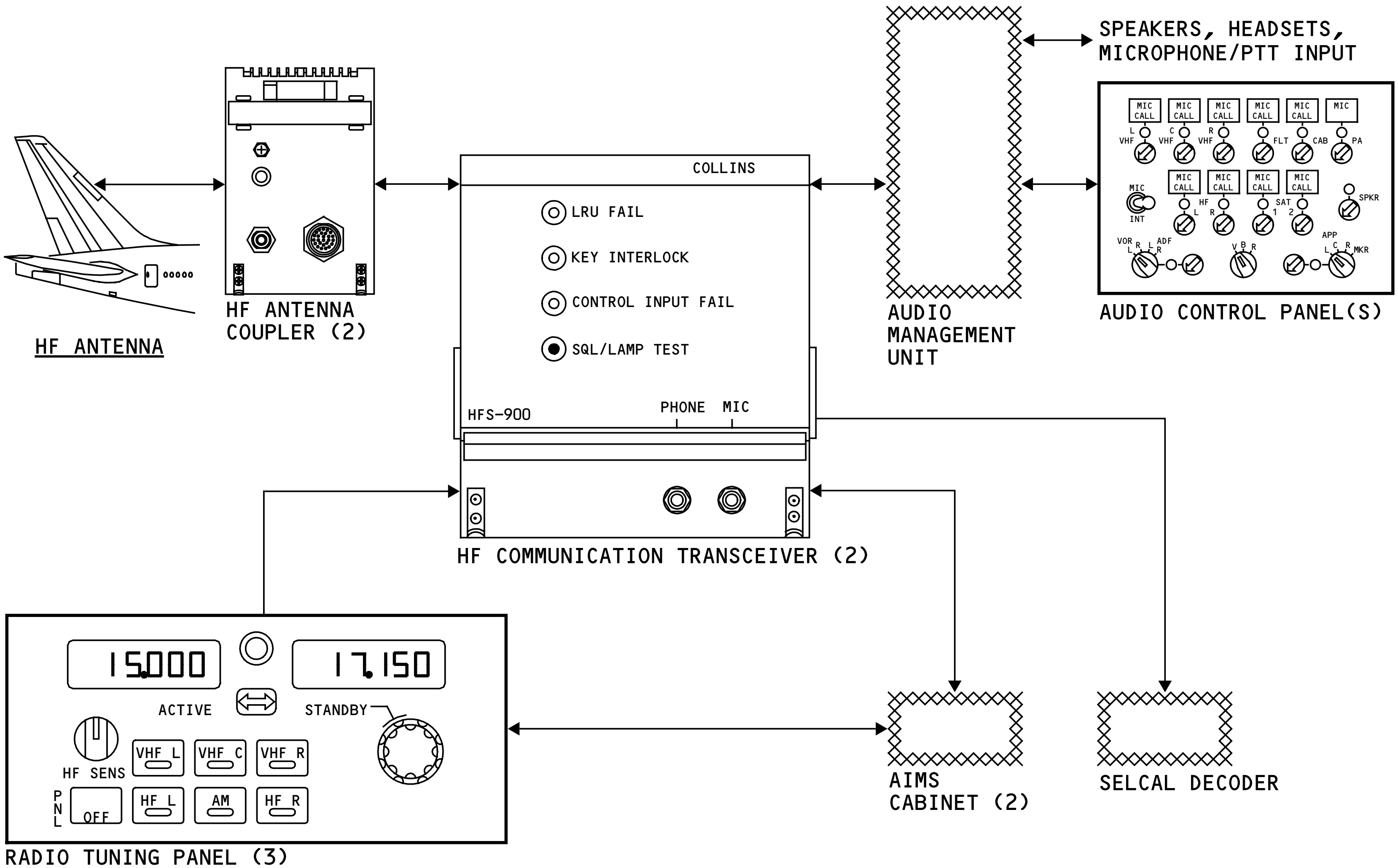
HF System Connections

The HF communication system connects with these components:

- Three radio tuning panels (RTPs). The RTPs send tuning data and mode information to the HF transceivers
- The audio management unit (AMU). Microphone audio and push-to-talk (PTT) discretes go to the transceiver through the AMU. Received audio goes from the transceiver to the speakers and headsets through the AMU
- The SELCAL decoder. The SELCAL decoder alerts the flight crew when the airplane receives a call.

The HF communication system also connects with the airplane information management system (AIMS) for these functions:

- Digital flight data acquisition function (DFDAF). The DFDAF in the AIMS cabinet receives the microphone PTT signal for input to the flight recorder
- Central maintenance computing function (CMCF). The CMCF gets fault reports from the HF system and records this information in a fault history. This shows the maintenance crew the faulty component or function.



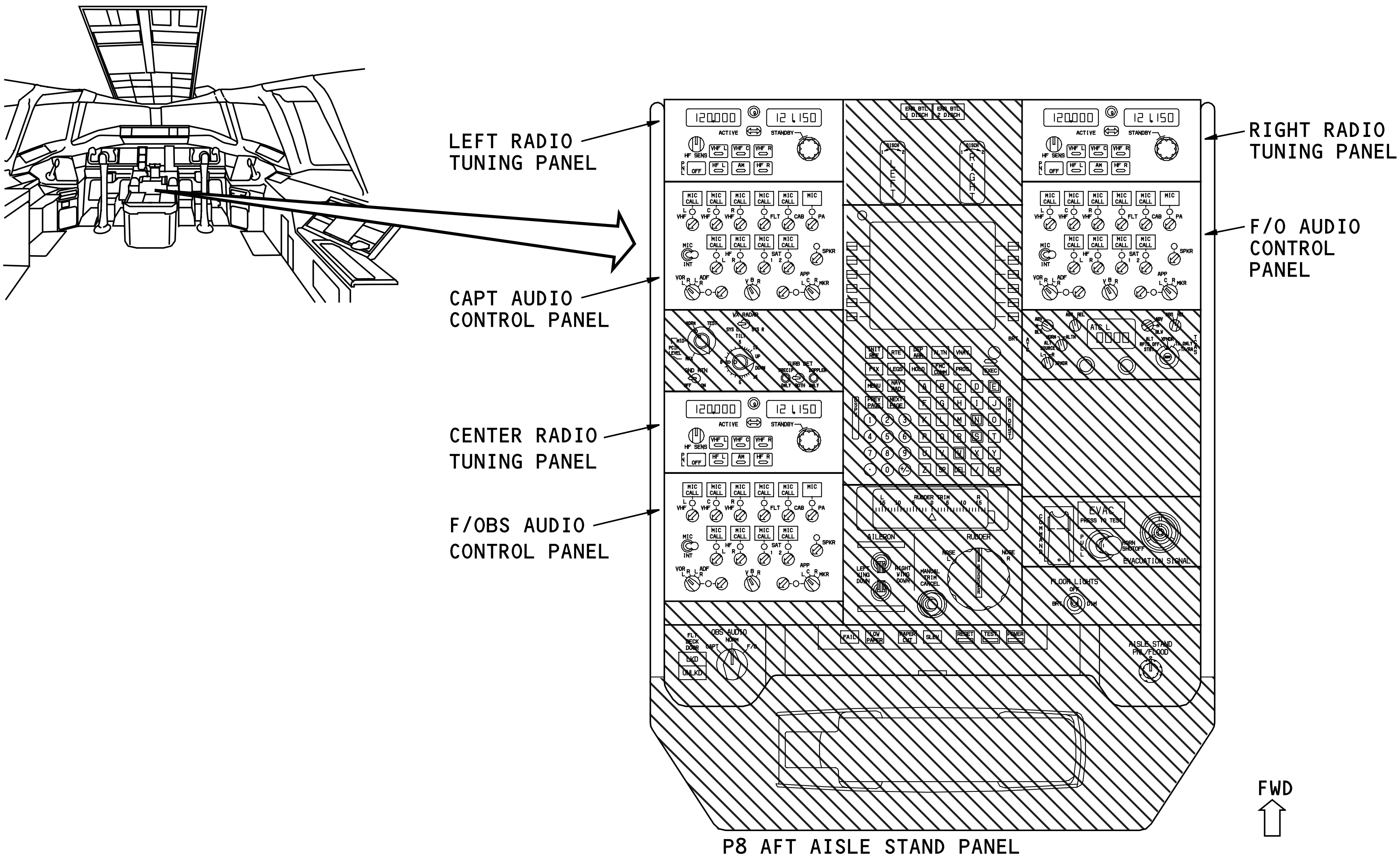
HF SYSTEM - GENERAL DESCRIPTION

HF SYSTEM - FLIGHT DECK COMPONENT LOCATIONS

HF Interface Component Locations

These are the components in the flight deck that have an interface with the HF communication system:

- Radio tuning panels (RTPs)
- Audio control panels (ACPs).



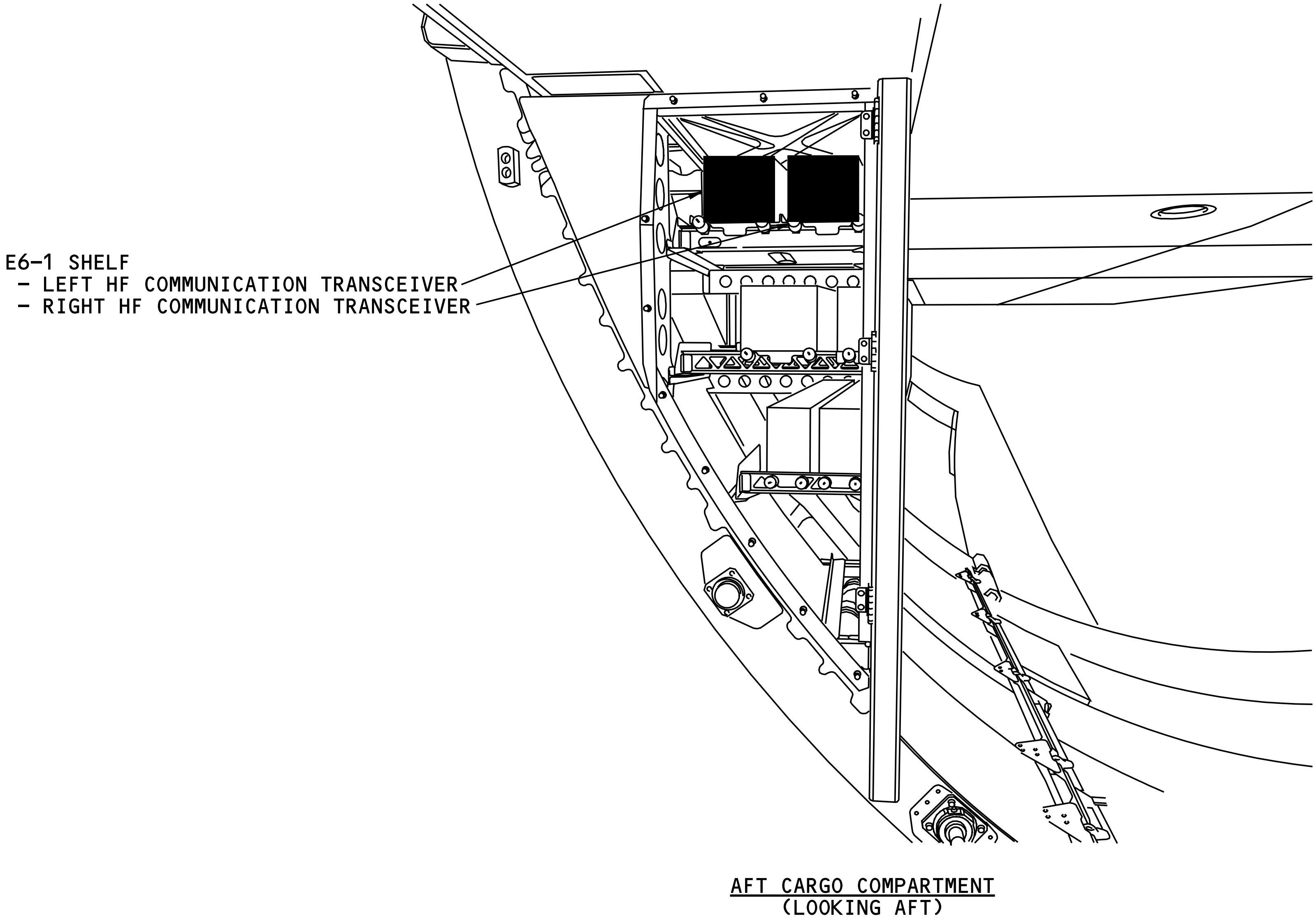
23-11-00-003 Rev 3 04/18/1997

HF SYSTEM - FLIGHT DECK COMPONENT LOCATIONS

HF SYSTEM - E6 RACK COMPONENT LOCATIONS

HF System Component Locations

The HF communication transceivers are in the E6 rack.



HF SYSTEM - E6 RACK COMPONENT LOCATIONS

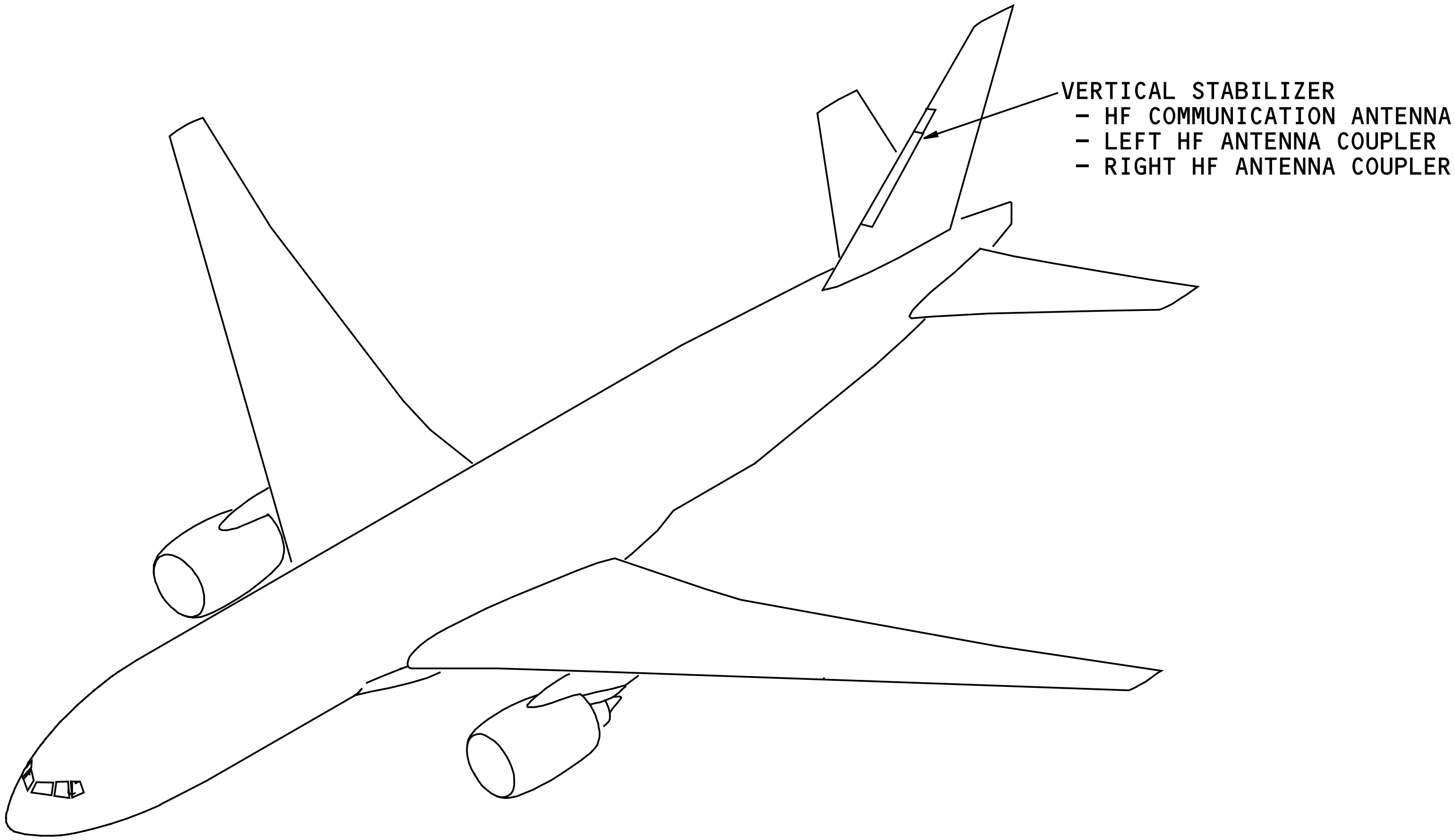
23-11-00-004 Rev 3 10/20/1997

HF SYSTEM - VERTICAL STABILIZER COMPONENT LOCATION

HF System Component Locations

These are the three HF system components in the vertical stabilizer:

- HF communication antenna
- Two HF antenna couplers.



23-11-00-005 Rev 2 10/31/1997

HF SYSTEM - VERTICAL STABILIZER COMPONENT LOCATION

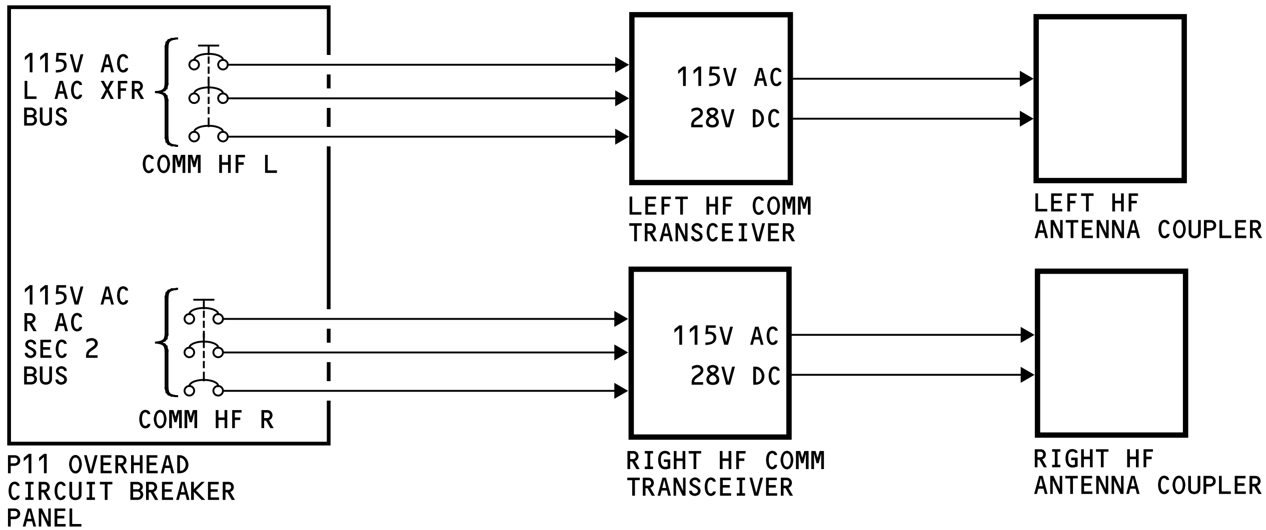
HF SYSTEM - POWER INTERFACE

General

The left transfer bus sends 115v ac three-phase power to the left HF communication transceiver.

The left HF communication transceiver supplies 115v ac single phase to the left HF antenna coupler for operational power. It also supplies 28v dc for the key interlock function.

The right HF communication system is the same as the left, except that it uses power from the right ac sec 2 bus.



23-11-00-006 Rev 1 03/07/96

HF SYSTEM - POWER INTERFACE

HF SYSTEM - TUNING INTERFACE

General

The HF communication system uses data buses to share tuning information between these:

- Radio tuning panels (RTPs)
- HF communication transceivers
- airplane information management system (AIMS) cabinets.

Tuning Buses

The RTPs send tuning data to the HF communication transceivers. Any RTP can tune any transceiver.

Each RTP has these two ARINC 429 output buses:

- Tuning bus
- Crosstalk bus.

Both the left and right RTPs send tuning data to both HF communication transceivers and to the left and right AIMS cabinets.

The center RTP sends its tuning bus output to the left and right RTPs in case of failure.

AIMS sends auto-tune data to all three RTPs.

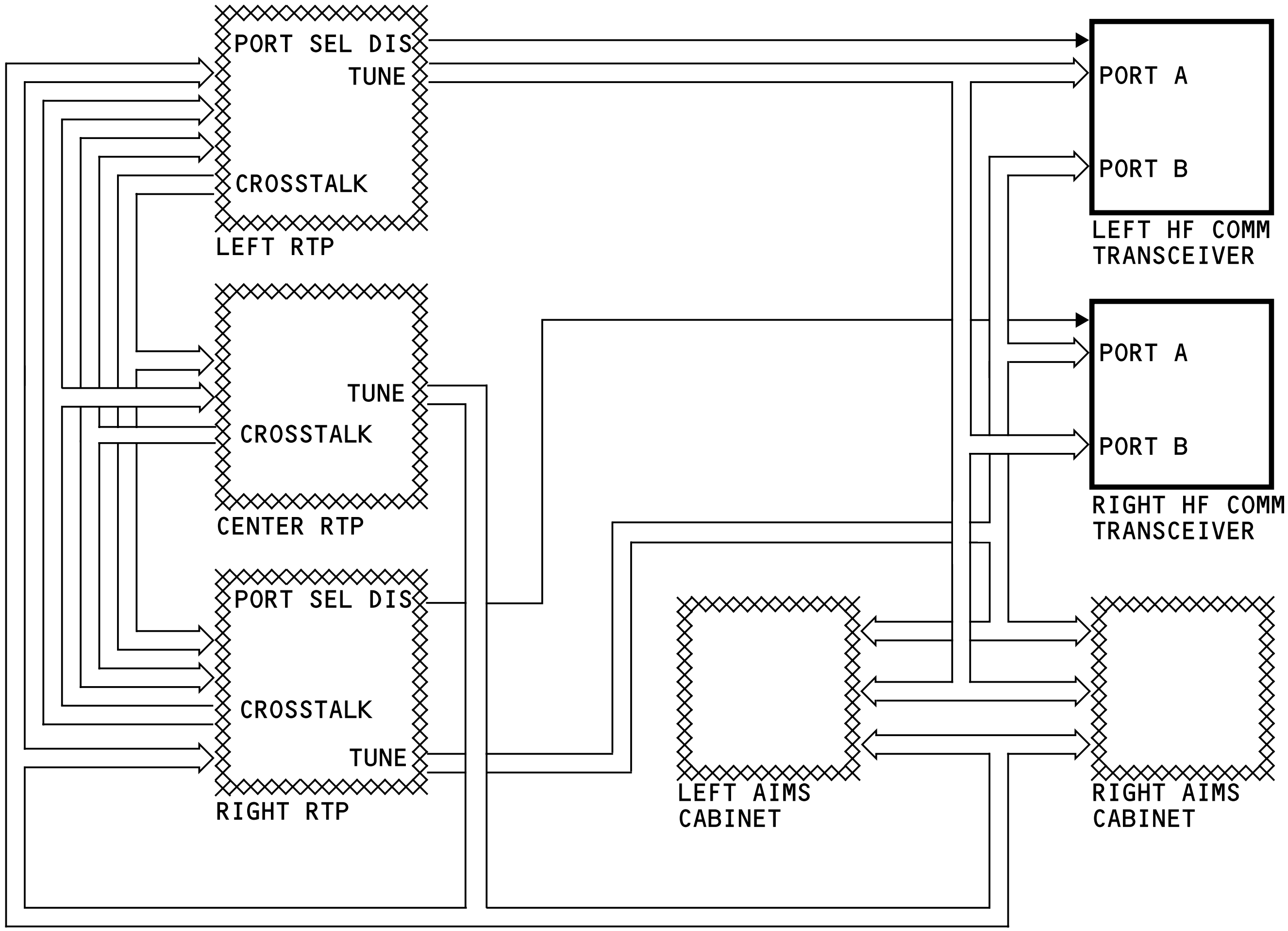
Port Select Discrete

Each HF communication transceiver has two tuning data input ports: port A and port B. The transceiver uses the port select discrete to select its input port. A grounded port select discrete causes the transceiver to use port A. An open port select discrete causes the transceiver to use port B.

The port select discrete for the left HF communication transceiver comes from the left RTP. The port select discrete for the right HF transceiver comes from the right RTP.

Crosstalk Buses

Each RTP sends tuning data to the other RTPs on crosstalk buses. Synchronized tuning data allows any RTP to tune any transceiver.



23-11-00-007 Rev 3 03/28/96

HF SYSTEM - TUNING INTERFACE

HF SYSTEM - RECEIVE/TRANSMIT INTERFACES

General

You use an audio control panel (ACP) to select an HF communication transceiver for voice communication. You use a radio tuning panel (RTP) to select a frequency or adjust HF sensitivity of the transceiver. A push-to-talk (PTT) signal from any mic switch activates the selected transceiver.

Signal Flow - Transmit

You select a transmit switch on any ACP and push a mic switch to transmit. The audio management unit (AMU) sends the mic audio and the PTT signal to the selected HF transceiver. The transceiver changes the mic audio to an RF signal. The transceiver sends the RF signal to the antenna coupler. Only one antenna coupler can transmit at a time. The antenna coupler sends the RF signal to the HF antenna. The HF antenna transmits the signal.

WARNING: DO NOT TRANSMIT WITH THE HF COMMUNICATION SYSTEM WHILE THE AIRPLANE IS REFUELED OR DEFUELED. AN EXPLOSION CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO THE AIRPLANE.

WARNING: MAKE SURE PERSONNEL STAY A MINIMUM OF 6 FEET AWAY FROM THE VERTICAL STABILIZER WHEN THE HF SYSTEM TRANSMITS. RF ENERGY FROM THE HF COMMUNICATION ANTENNA CAN CAUSE INJURIES TO PERSONNEL.

The antenna coupler tunes itself to match the output impedance of the transceiver to the impedance of the transmission line at the selected frequency.

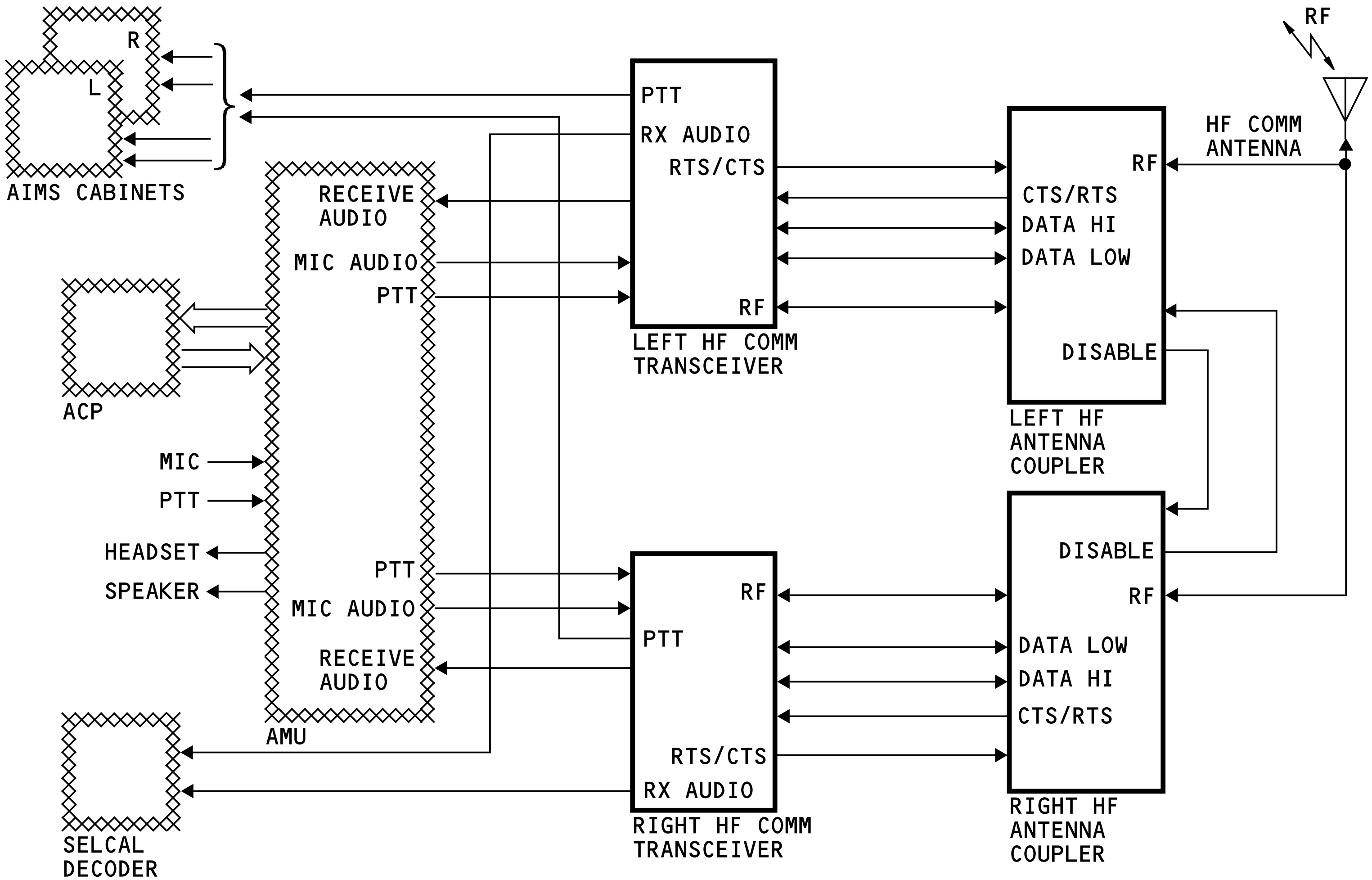
The PTT signal goes to the airplane information management system (AIMS) digital flight data acquisition function (DFDAF).

Signal Flow - Receive

The HF antenna receives RF signals and sends them to both HF antenna couplers. The antenna couplers send the RF signals to the HF communication transceivers. The transceivers change the RF signals to audio signals. The transceivers send the audio signals to the audio management unit (AMU).

The flight crew selects a receiver control switch on their ACP. The AMU sends the received audio to the flight crew stations.

The transceivers send received audio to the SELCAL decoder. The SELCAL decoder monitors the audio for an incoming call. It alerts the flight crew when the airplane receives a call.



23-11-00-008 Rev 3 07/17/1997

HF SYSTEM - RECEIVE/TRANSMIT INTERFACES

HF SYSTEM - AIMS FAULT REPORTING AND TESTING INTERFACES

General

The HF system sends fault information to the AIMS cabinets from three sources:

- HF communication transceivers
- HF antenna couplers
- Radio tuning panels (RTPs).

Transceiver and Antenna Coupler Interfaces

The HF communication transceivers send real time fault and status information to the AIMS cabinets. The fault information includes faults generated by the antenna couplers and the transceivers.

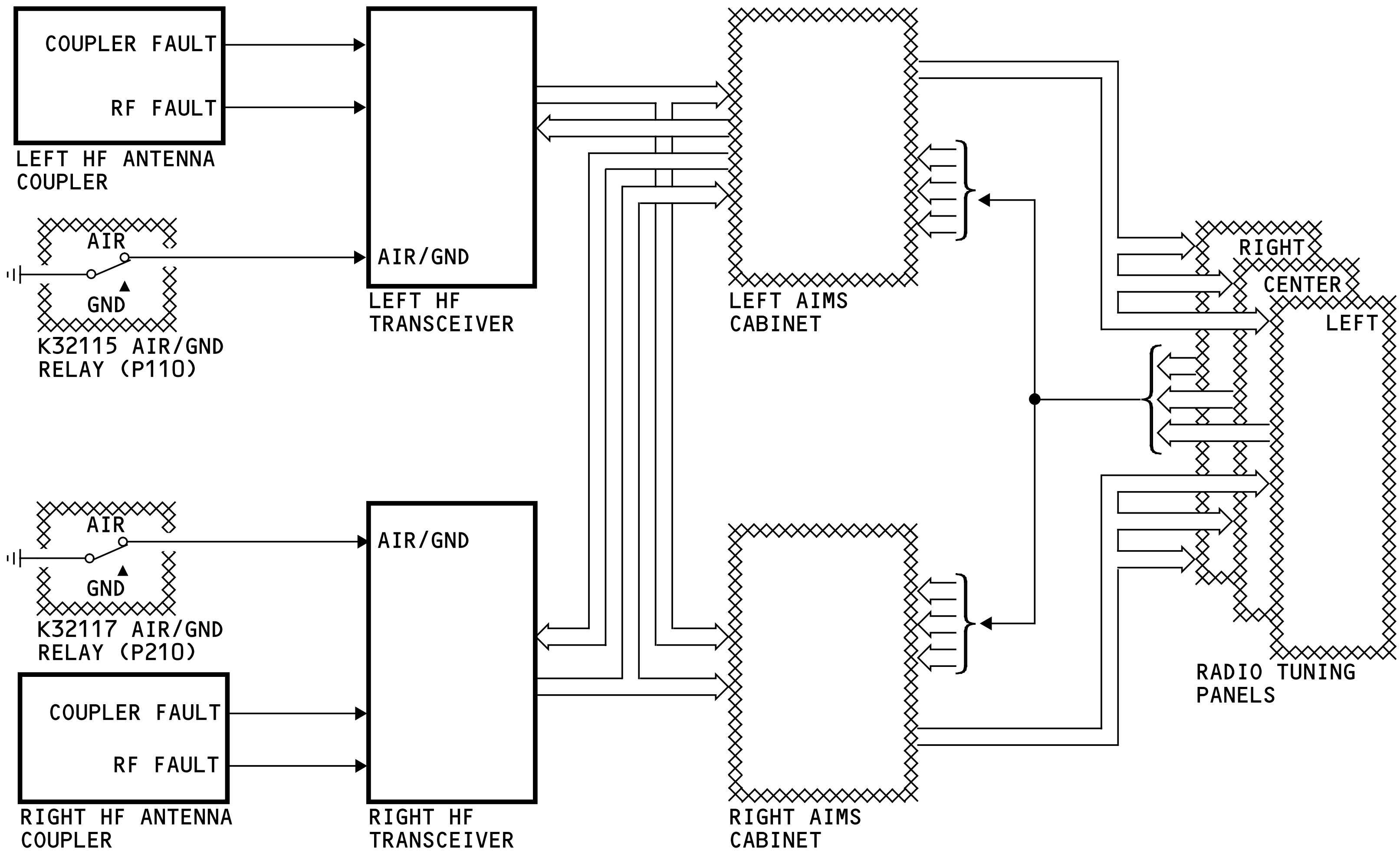
The air/ground relays send air/ground signals to the transceivers. The tranceivers use these signals to keep flight leg faults in memory.

The left AIMS central maintenance computing function (CMCF) tests the HF transceivers during ground tests. The CMCF sends test requests to the HF transceivers. The HF transceivers give the test results to the CMCF. The right AIMS cabinet gives test information, if the left AIMS cabinet fails.

Radio Tuning Panel (RTP) Interfaces

Each RTP sends HF system fault/status information to both AIMS cabinets.

AIMS sends HF system fault/status to the RTPs.



23-11-00-009 Rev 3 03/28/96

HF SYSTEM - AIMS FAULT REPORTING AND TESTING INTERFACES

HF SYSTEM - HF COMMUNICATION TRANSCEIVER

Purpose

The HF communication transceiver changes RF signals to audio signals during receive operation, and changes audio signals to RF signals during transmit operation. The transceiver amplifies RF transmit signals.

Physical Description

The HF transceiver has these features:

- One KHz channel spacing
- A frequency range of 2.000 MHz to 29.999 MHz
- Maximum RF output power of 400 watts peak envelope power (USB), 125 watts (AM).

Operation - Controls and Indications

There are three LED indicators and one push-button on the transceiver front panel:

- LRU FAIL indicator - comes on for a transceiver fault
- KEY INTERLOCK indicator - comes on for an antenna coupler fault
- CONTROL INPUT FAIL indicator - comes on for an RTP tuning fault
- SQL/LAMP TEST switch - HF system squelch disables and all LEDs come on.

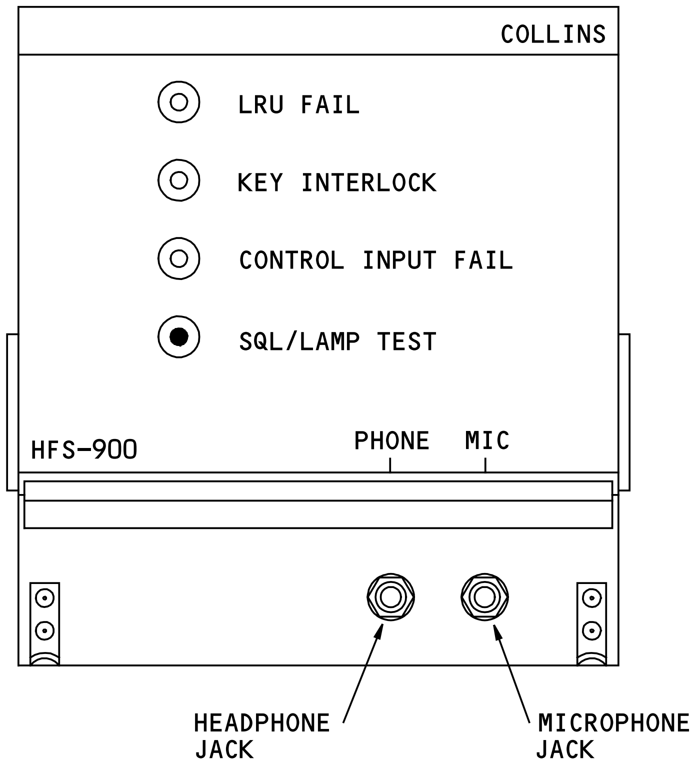
The LED indicators come on to show failures.

The headphone and microphone jacks permit operation of the HF transceiver from the E6 rack in the aft cargo compartment.

Functional Description

The HF communication transceiver operates as a receiver/transmitter in the amplitude modulation (AM) or upper side band (USB) modes. The transceiver detects the voice audio from the carrier frequency during reception, and modulates the voice audio during transmission.

An internal blower cools the transmitter.



23-11-00-010 Rev 3 04/18/1997

HF SYSTEM - HF COMMUNICATION TRANSCEIVER

HF SYSTEM - HF ANTENNA COUPLER

Purpose

The HF antenna coupler matches the impedance of the antenna and feedline with the output impedance of the transceiver at the selected frequency. This results in a voltage standing wave ratio (VSWR) of less than 1.3:1.

General Description

The antenna coupler is a sealed, pressurized unit that weighs 15.5 pounds. A feedline connects each coupler to the antenna. A coaxial cable connects each coupler to its transceiver.

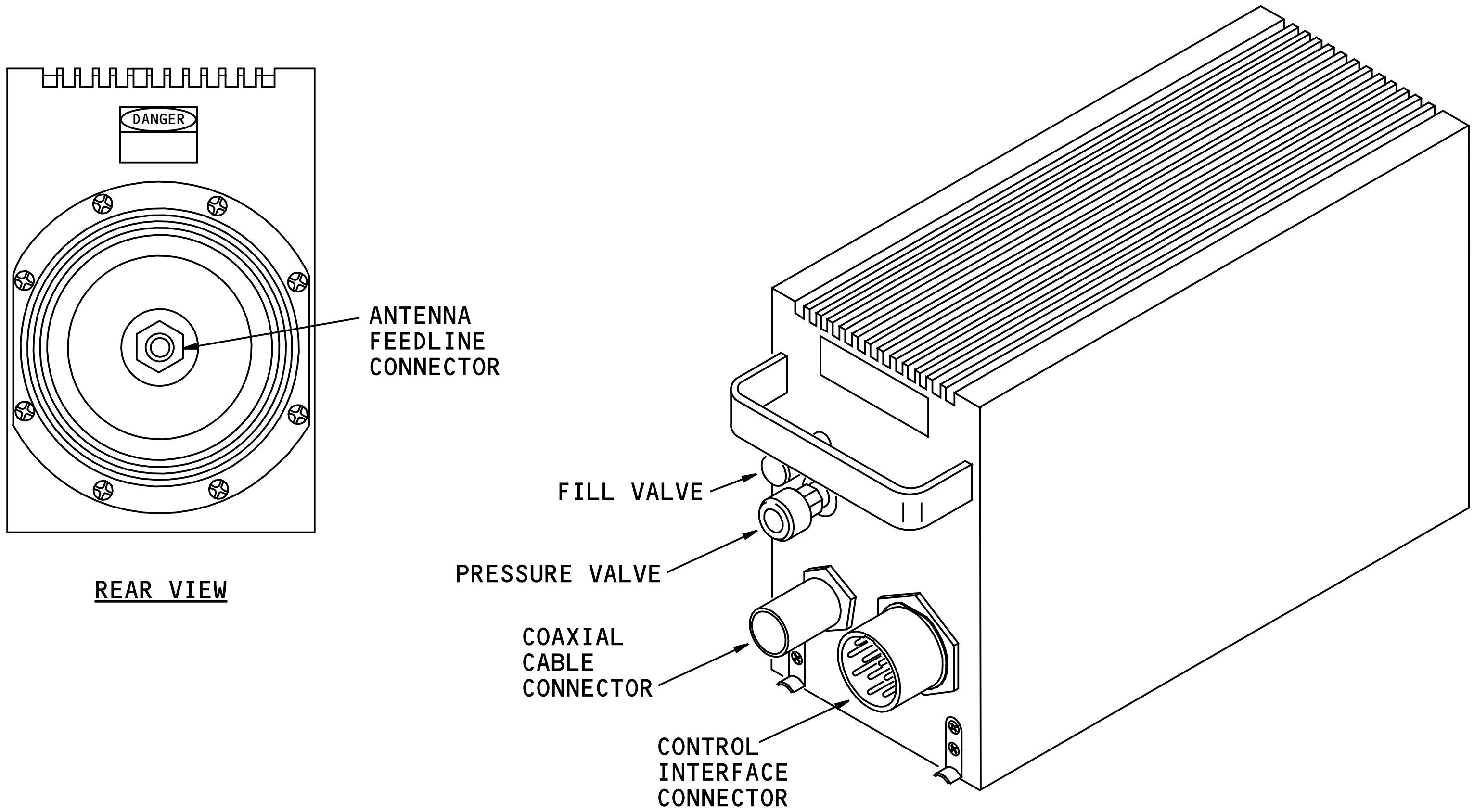
There are two connectors on the coupler:

- Control interface
- Coaxial cable.

Dry air or nitrogen pressurizes the antenna coupler at five to seven PSIGA. Pressurization is through the pressure valve on the front of the coupler.

Functional Description

The coupler has tuning elements and control circuits. The coupler constantly monitors the RF transmissions to automatically adjust the tuning elements. Typical tuning time is two to four seconds.



23-11-00-011 Rev 3 02/25/1997

HF SYSTEM - HF ANTENNA COUPLER

HF SYSTEM - HF ANTENNA COUPLER ACCESS AND INSTALLATION

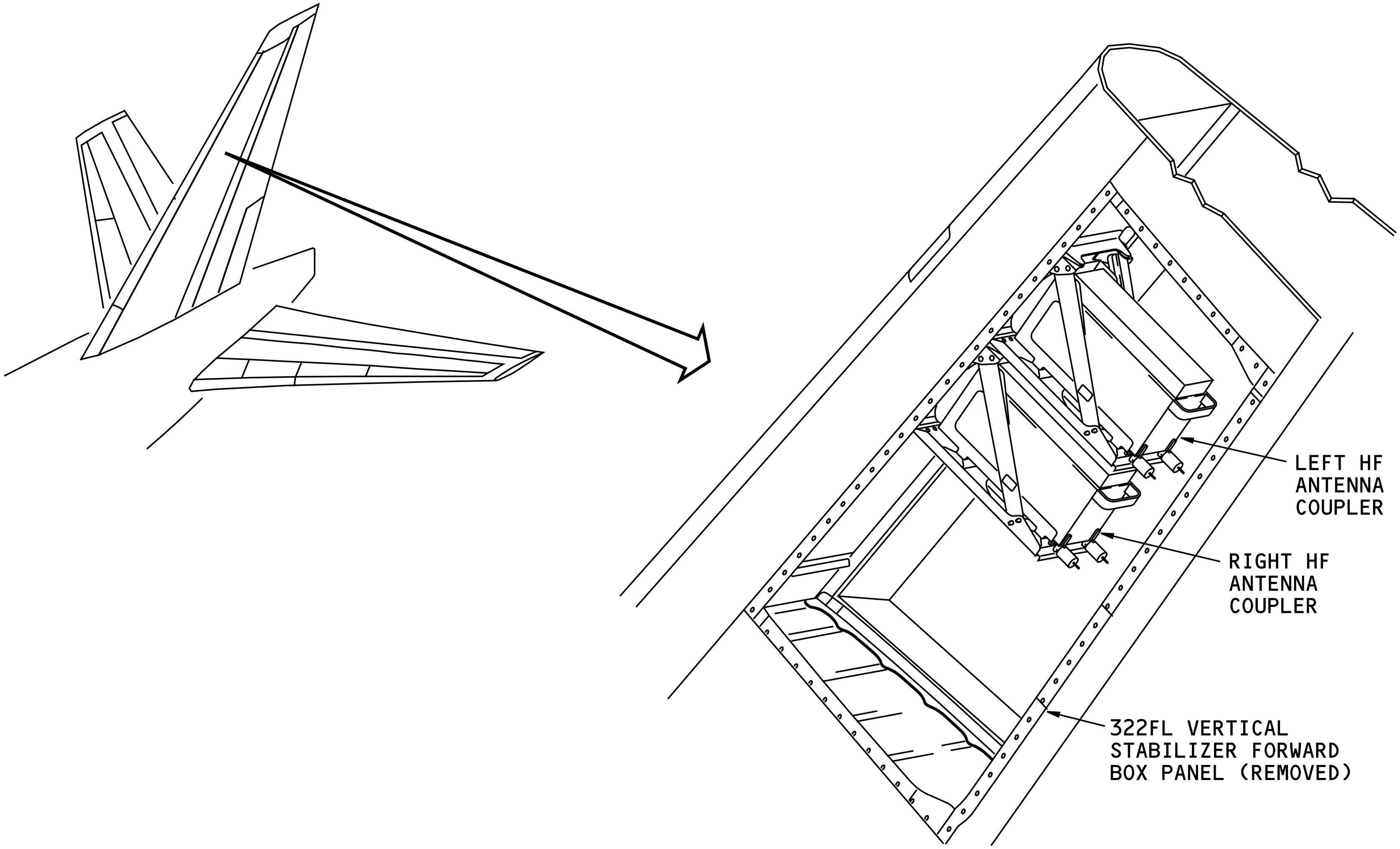
Installation

The two HF antenna couplers are in the vertical stabilizer at the top of the HF communication antenna. Each coupler is on a shelf. A coaxial cable and control interface cable connect to the coupler front panel.

CAUTION: YOU MUST PREPARE EACH HF ANTENNA COUPLER FOR THE REMOVAL, YOU CAN EASILY CAUSE DAMAGE TO INTERNAL PARTS OF THE HF ANTENNA COUPLER.

Access

A panel on the left side of the vertical stabilizer allows access to the antenna couplers.



23-11-00-012 Rev 5 04/28/1997

HF SYSTEM - HF ANTENNA COUPLER ACCESS AND INSTALLATION

HF SYSTEM - HF COMMUNICATION ANTENNA

Purpose

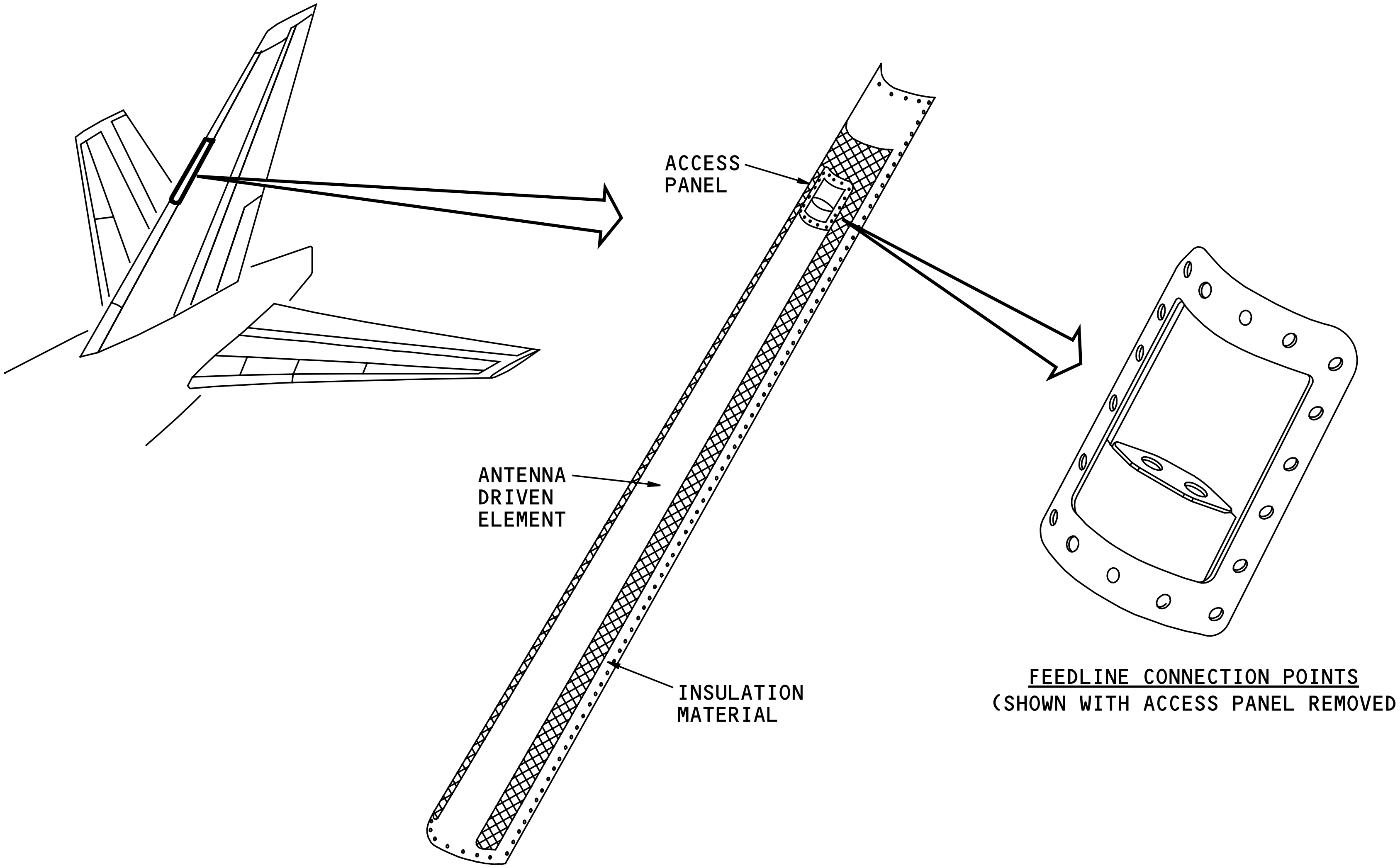
The HF communication antenna transmits and receives RF signals in the HF frequency range.

General Description

The antenna is a flush-mounted, slot-type antenna, approximately nine feet long. An inverted U-shaped insulation material on the leading edge of the vertical stabilizer surrounds the antenna driven element. The antenna insulation is composite material.

Location and Access

The HF antenna is a part of the leading edge of the vertical stabilizer. An access panel at the top of the antenna covers the connections to the antenna couplers.



23-11-00-013 Rev 1

HF SYSTEM - HF COMMUNICATION ANTENNA

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HF SYSTEM - RADIO TUNING PANEL

Purpose

Use the radio tuning panel (RTP) to select the modes of operation, and to select the active and standby frequencies for each communication radio. Each RTP sends tuning and mode information to these components:

- The communication radios
- The other two RTPs
- The airplane information management system (AIMS) cabinets.

Description

Each RTP has these features:

- Active and standby frequency windows
- A frequency transfer switch
- An offside tuning light
- Frequency selectors
- Radio tuning switches
- An AM switch
- A radio tuning panel off switch
- An HF sensitivity control.

Momentary switches have a white light in them that comes on when the function is selected.

Controls and Indications

Push the radio tuning panel off switch to turn the RTP on. When the panel is on, the white radio tuning panel off light goes off. When the RTP is off, the radio tuning panel off light comes on.

The active frequency window shows the frequency of the selected radio. The standby frequency window shows the frequency selected by the flight crew with the frequency selectors. The standby frequency window also shows auto-tune frequency information supplied by the AIMS cabinets during a data uplink.

You set the standby frequency with the frequency selectors. The outer knob adjusts the first three digits (10 MHz, 1 MHz and 100 KHz) in 100 KHz steps. The inner knob adjusts the fourth and fifth digits (10 KHz and 1 KHz) in 1 KHz steps.

The frequency transfer switch causes the active frequency to go to the standby frequency window, and the standby frequency to go to the active frequency window.

You use the radio tuning switches to select a radio. You select only one radio at a time. The white light in the selected radio tuning switch comes on.

When you select an offside radio, two offside tuning lights come on. One light is on the RTP that the flight crew uses to make the selection. The other light is on the onside RTP of the selected radio.

The HF sensitivity control sets the RF sensitivity level of the onside HF transceiver. The left RTP sets the left HF sensitivity. The right RTP sets the right

HF SYSTEM - RADIO TUNING PANEL

HF sensitivity. The center RTP HF sensitivity control does not connect to any transceiver.

Use the AM switch to operate the selected transceiver in the amplitude modulation (AM) mode. In the AM mode, the white light in the AM switch comes on if the onside HF transceiver is selected or if any VHF transceiver is selected. If the AM switch is not selected, the HF communication transceiver operates in the upper side band (USB) mode.

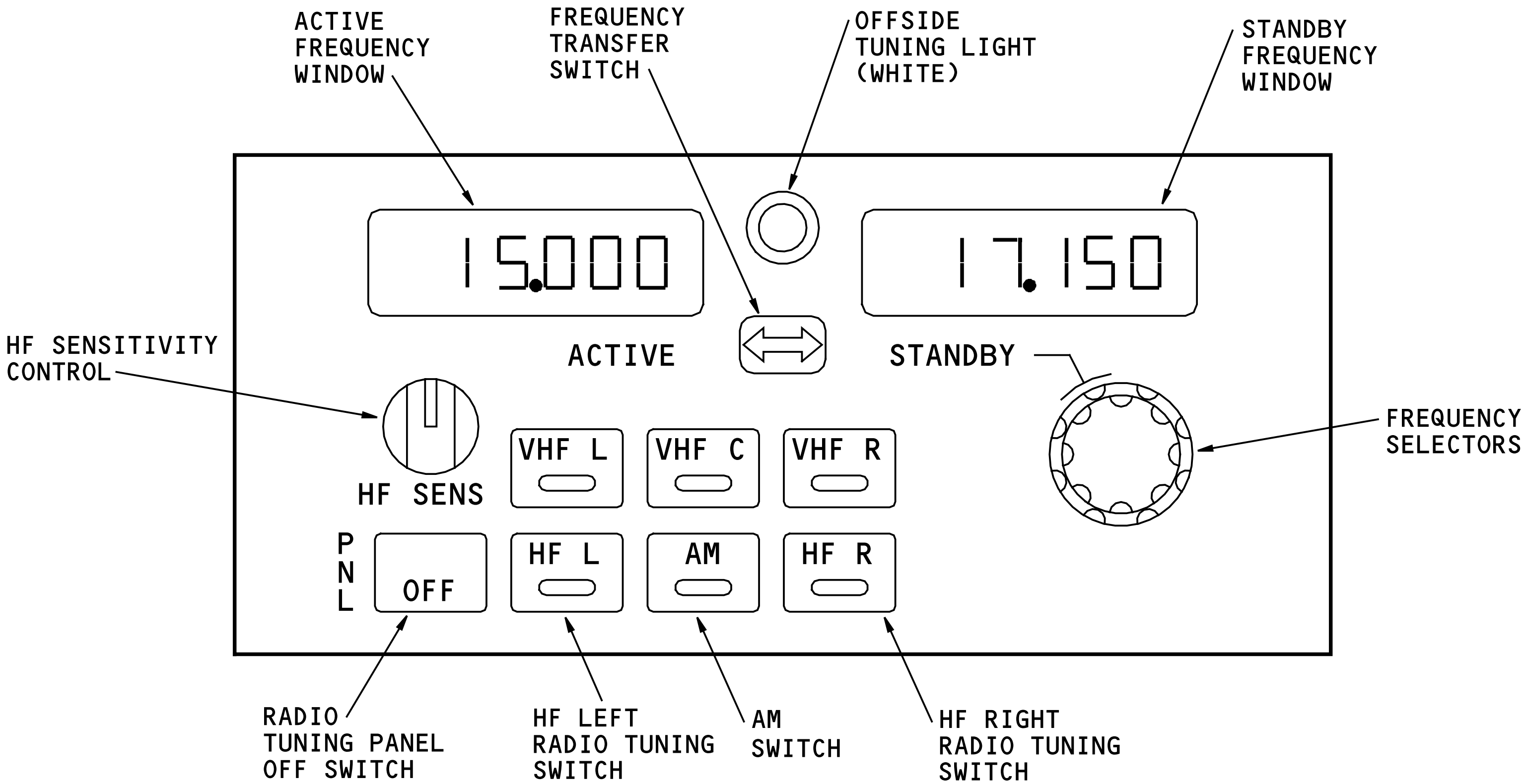
Push the radio tuning panel off switch to stop the operation of the RTP. When the RTP is off, the white radio tuning panel off light comes on and all functions stop except these three:

- The frequency windows continue to show any current fault
- The RTP continues to receive 28v dc
- The RTP continues to send BITE information to the AIMS central maintenance computer function (CMCF).

<u>BITE</u>

The RTP tests itself continuously. The RTP shows PANEL FAIL in the two frequency windows if the RTP has an internal failure or if there is a system failure.

The two frequency display windows show all dashes if the flight crew selects a failed radio.



23-11-00-014 Rev 2 03/18/96

HF SYSTEM - RADIO TUNING PANEL

HF SYSTEM - AUDIO CONTROL PANEL

General

The audio control panel (ACP) supplies transmitter selection, receiver selection and volume control for the left and right HF transceivers.

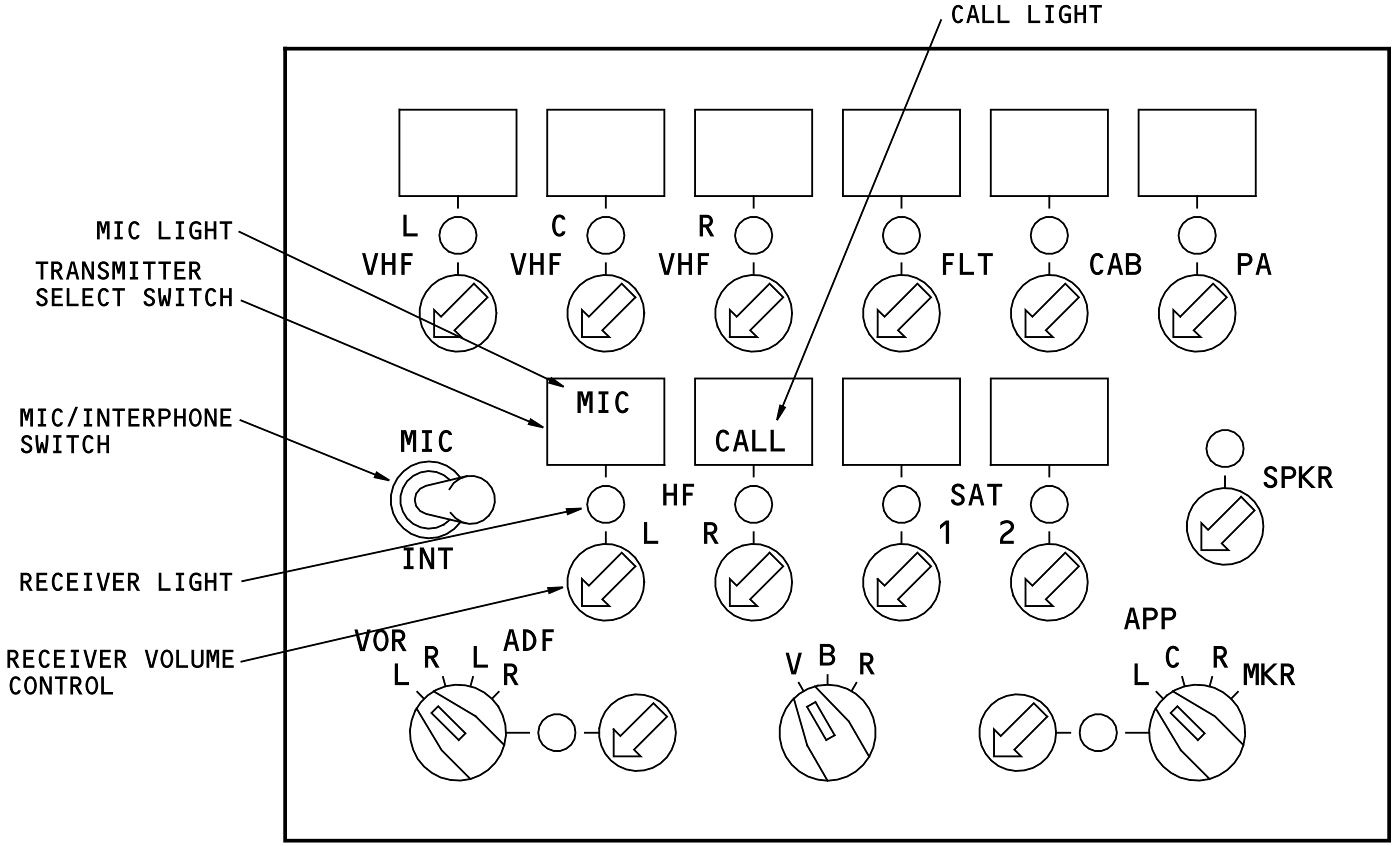
The operator transmits on only one HF system at a time. The ACP permits the operator to listen to one or both HF systems at the same time.

Control and Indications

Push an HF receiver volume control to listen to an HF receiver. Rotate the receiver volume control for volume control. The receive light above the control shows green when a receiver volume control is on. Push both HF receiver volume controls to listen to both HF radios at the same time.

Push an HF transmitter select switch to select an HF transceiver for transmission. The mic light shows green to show the selected system. Push the mic/interphone switch to connect the microphone to the transceiver and to key the transceiver.

The call light comes on when the SELCAL system detects a call for the system.



HF SYSTEM - AUDIO CONTROL PANEL

23-11-00-015 Rev 3 03/18/96

HF SYSTEM - TESTING

General

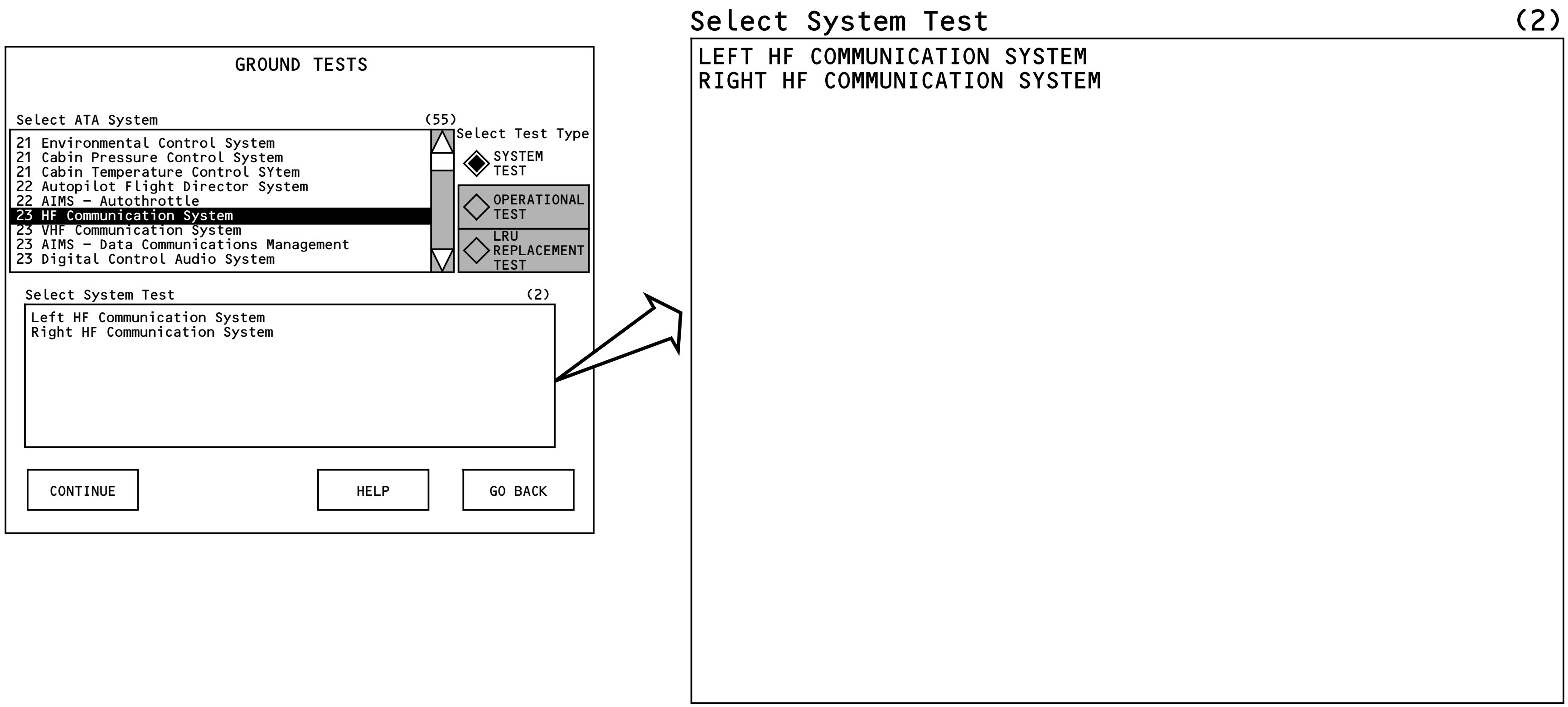
These are the tests for the HF communication system:

- Left HF communication system test
- Right HF communication system test.

HF Communication System Test

Select the system (left or right) for test.

This test makes sure that the HF communication system operates correctly. The approximate time to run the test is less than one minute. There are no airplane effects. There are no limitations or special requirements.

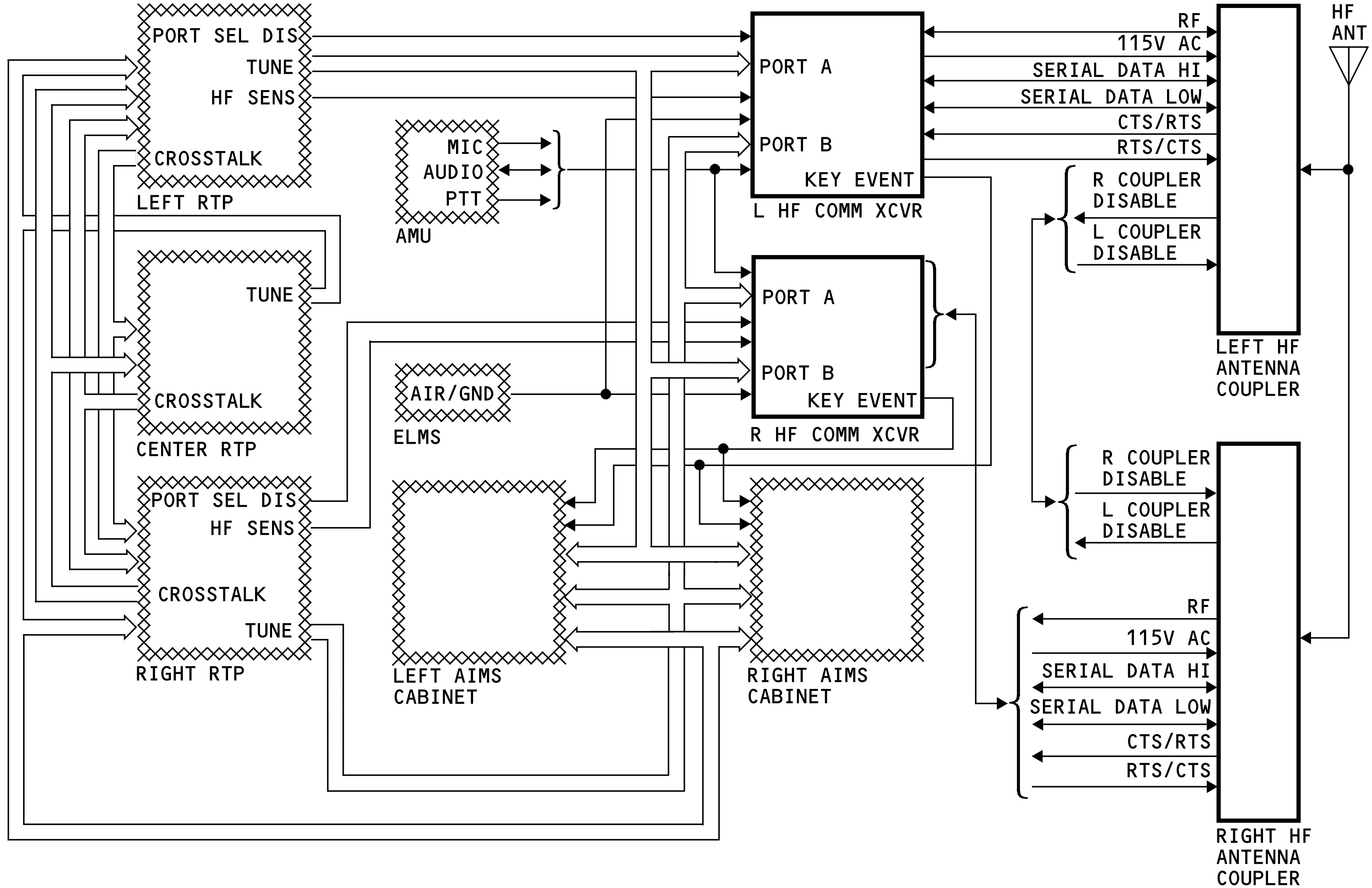


23-11-00-022 Rev 2 03/26/96

HF SYSTEM - INTERFACES

Reference Graphic

This graphic is for reference.



HF SYSTEM - INTERFACES

23-11-00-023 Rev 3 07/17/1997

Continental Airlines, Inc

Selective Calling System

WB371

TABLE OF CONTENTS

SELCAL - INTRODUCTION

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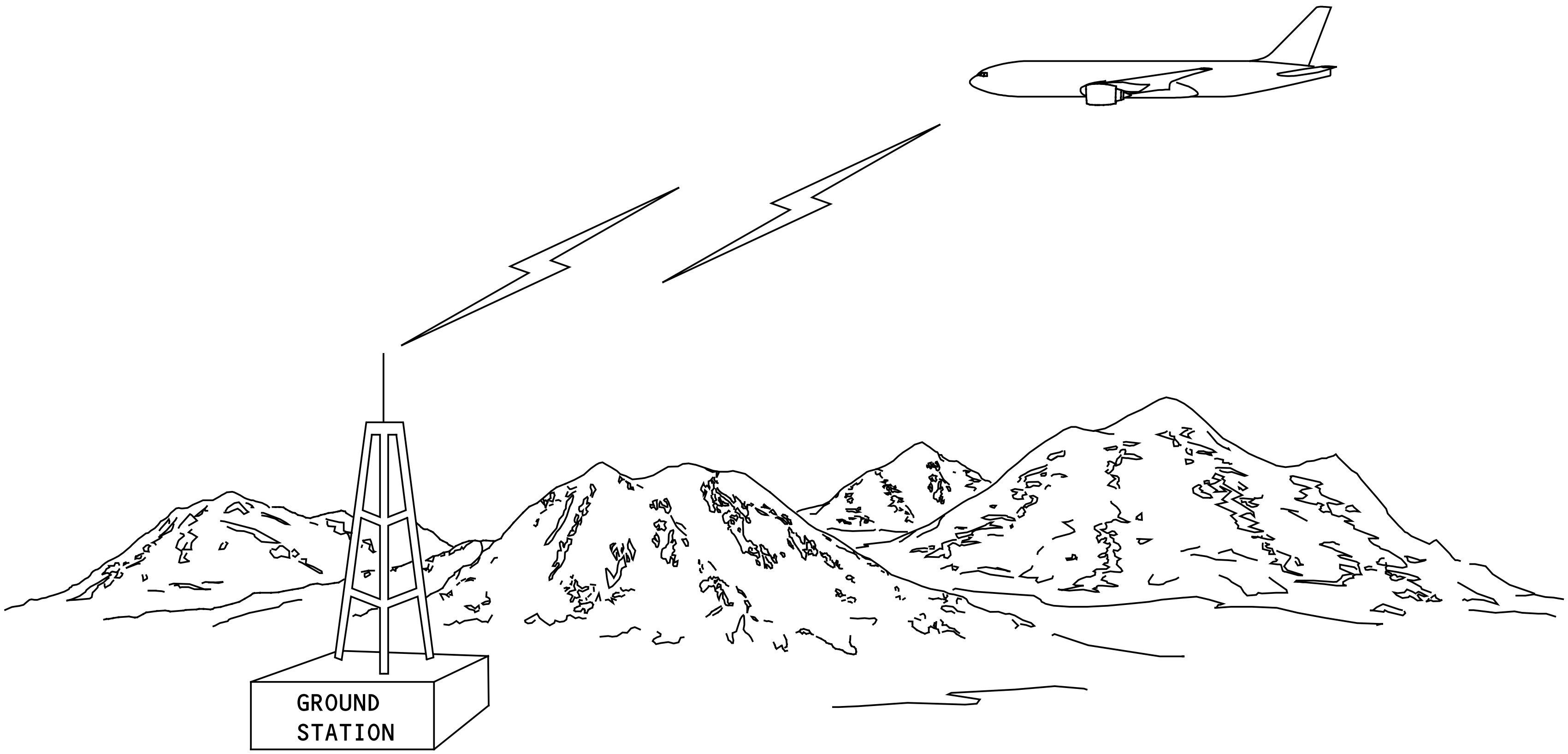
SELCAL - INTRODUCTION

Purpose

The selective calling (SELCAL) system tells the flight crew that there is a call from a ground station on a communication transceiver. Because the SELCAL system monitors all incoming signals, the flight crew does not need to continuously monitor the radio channels.

Abbreviations and Acronyms

ACP	- audio control panel
AIMS	- airplane information management system
AMU	- audio management unit
COMM	- communication
HF	- high frequency
mic	- microphone
PDF	- primary display function
PTT	- push to talk
SELCAL	- selective calling
VHF	- very high frequency
WEU	- warning electronic unit
WES	- warning electronic system



23-21-00-001 Rev 1

SELCAL - INTRODUCTION

SELCAL - GENERAL DESCRIPTION

General

Each airplane has a different SELCAL code. A ground station transmits this code with a signal to contact an airplane. When the airplane receives its SELCAL code, several flight deck indications come on to alert the flight crew.

HF and VHF Transceivers

The communication transceivers send received audio to the SELCAL decoder.

SELCAL Decoder

A SELCAL coding switch connects to the SELCAL decoder and gives each airplane its SELCAL code.

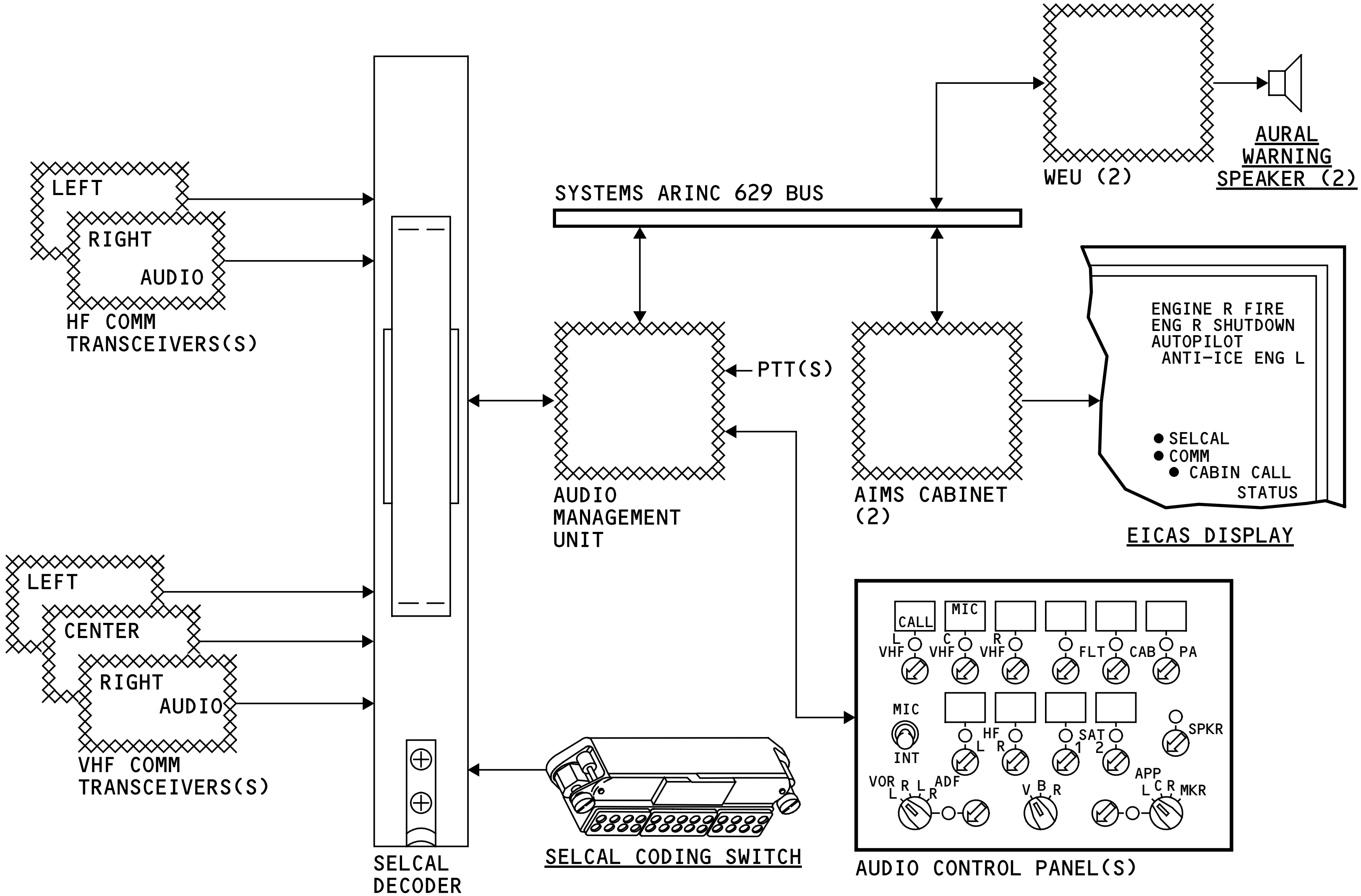
The SELCAL decoder monitors for audio tones. If the tones are the same as the code, the decoder sends a signal to the audio management unit.

Indications

The audio management unit (AMU) sends a signal to the AIMS cabinets. The AIMS primary display function (PDF) then makes a COMM medium message, SELCAL. The AIMS cabinets also send a chime request to the warning electronic units (WEUs). The WEUs make a chime signal and send it to the aural warning speakers.

The AMU also sends a signal to the audio control panels (ACPs). The ACPs turn on the call light for the transceiver that received the SELCAL code.

To reset the indications, push the CALL light on the audio control panel or push the mic switch for the related radio.

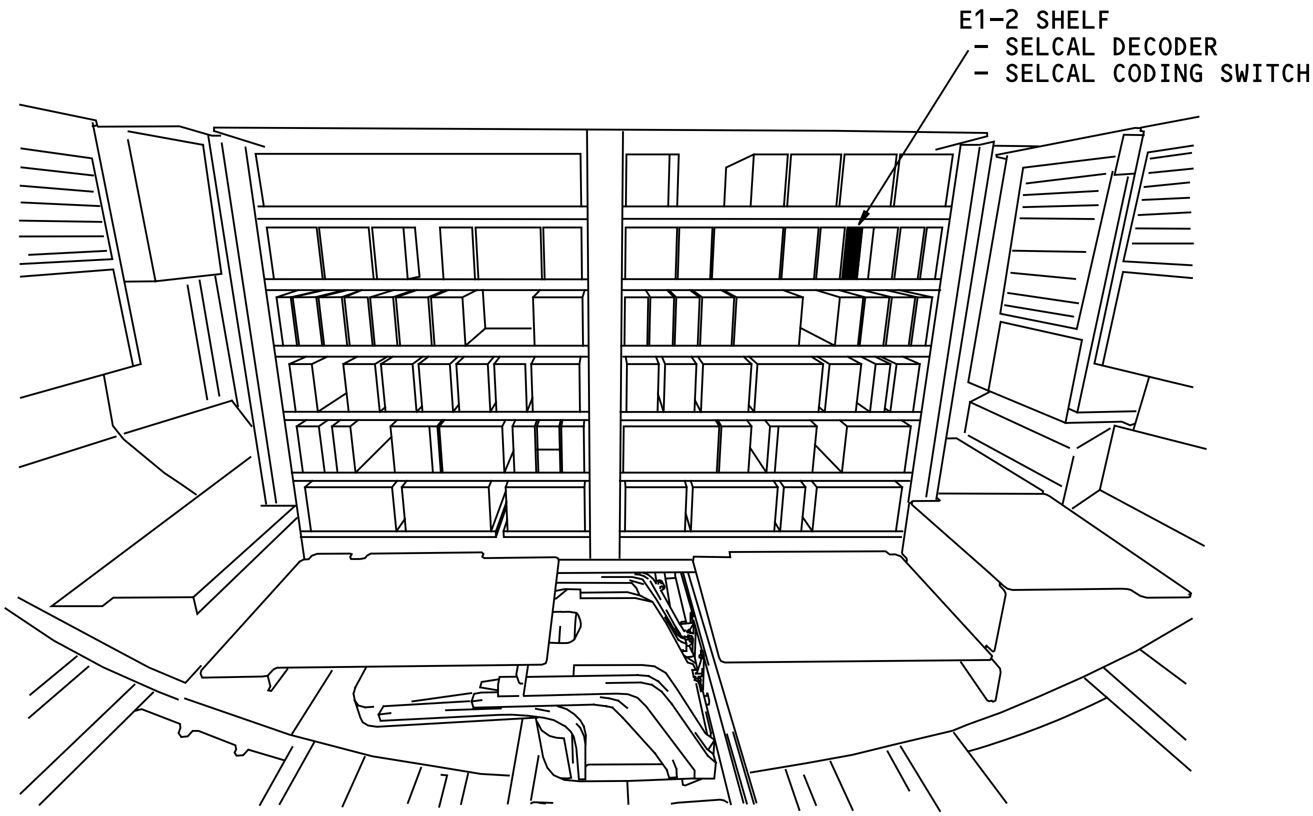


SELCAL - GENERAL DESCRIPTION

SELCAL - COMPONENT LOCATION

Main Equipment Center

The SELCAL decoder is in the main equipment center on the E1-2 rack. The SELCAL coding switch is on the rack behind the decoder.



MAIN EQUIPMENT CENTER
(LOOKING AFT)

23-21-00-003 Rev 1 10/20/1997

SELCAL - COMPONENT LOCATION

SELCAL - INTERFACES

Power

The left main DC bus sends 28v dc power to the SELCAL decoder power supply.

Audio

The SELCAL decoder gets audio from the communication transceivers.

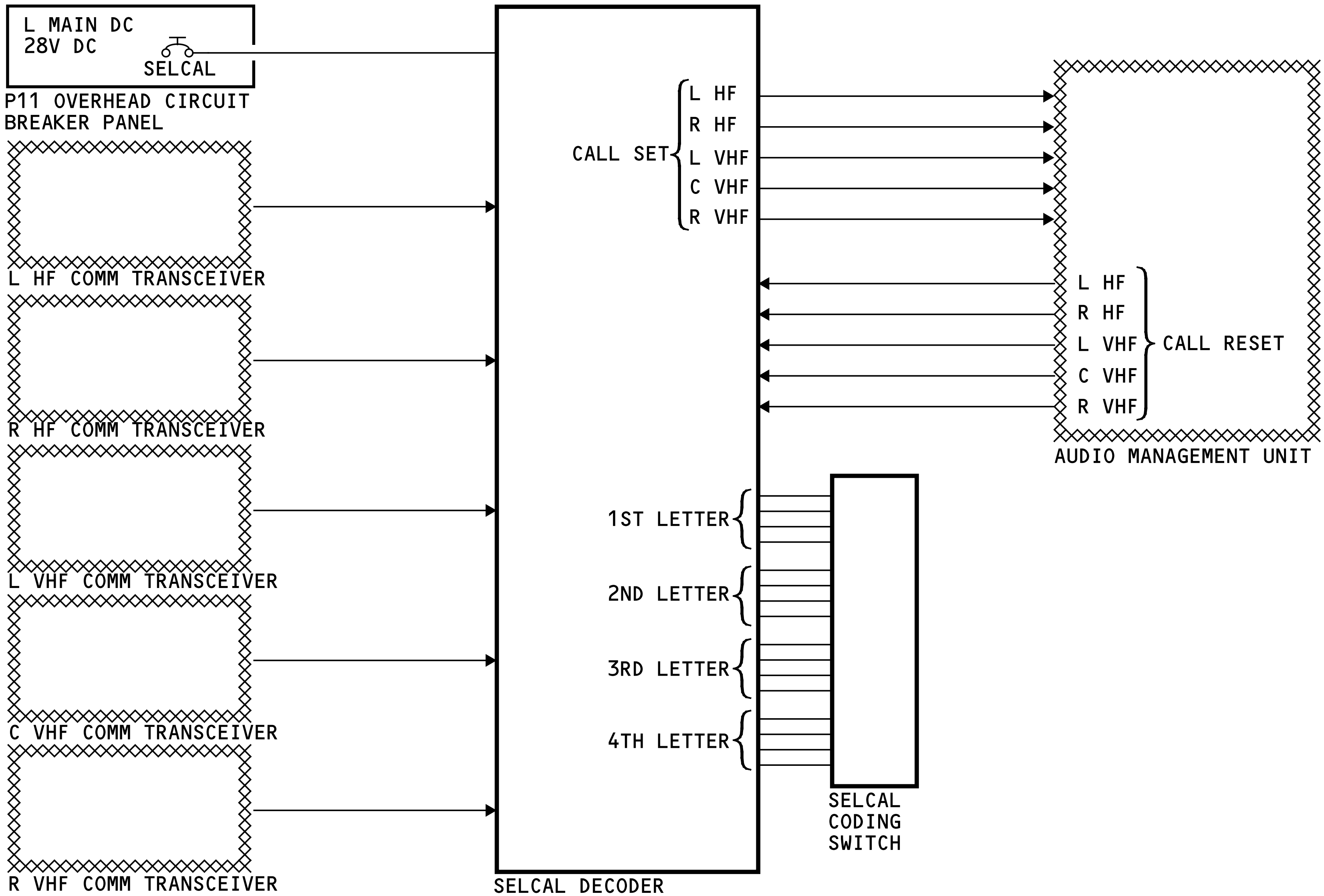
Discretes

The SELCAL decoder sends call set discretes to the audio management unit. There is a different discrete for each transceiver.

The audio management unit sends call reset discretes to the SELCAL decoder. There is a different discrete for each transceiver.

SELCAL Coding Switch

The SELCAL coding switch on the back of the decoder has 16 switches in groups of four. There are four letters in the SELCAL code. The positions of the switches in each group identify one of the four SELCAL code letters.



SELCAL - INTERFACES

23-21-00-004 Rev 2 05/16/96

SELCAL - SELCAL DECODER

Purpose

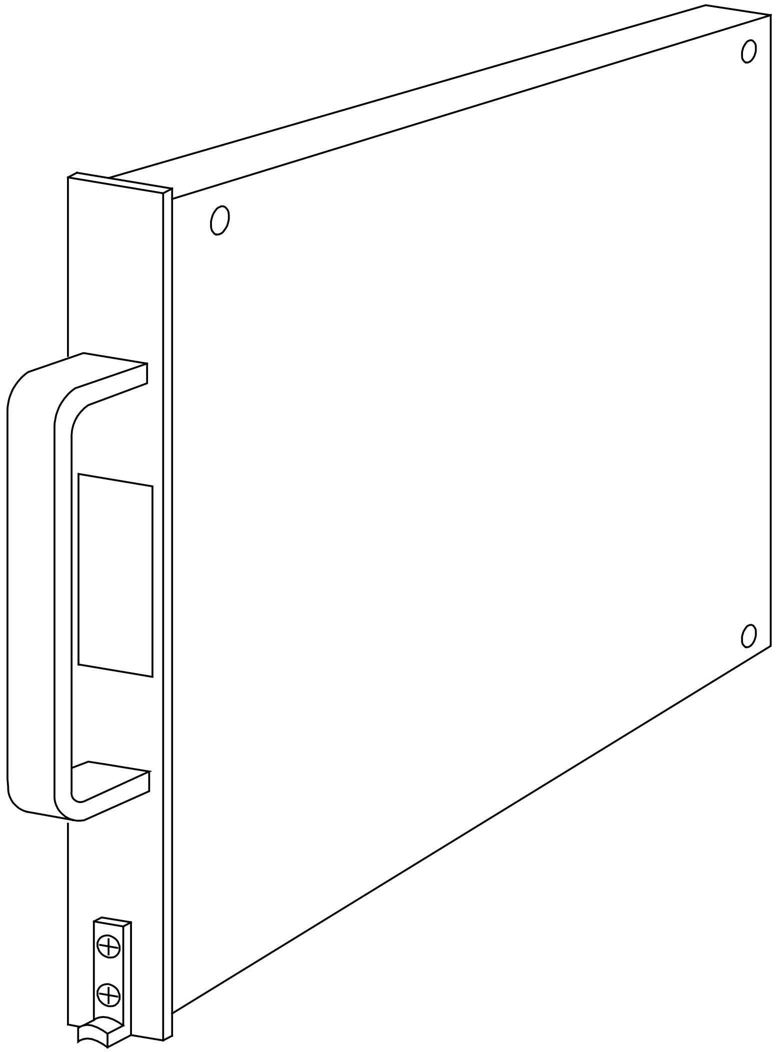
The SELCAL decoder has these functions:

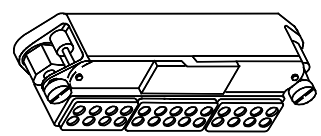
- Monitors audio from the communication transceivers
- Identifies the SELCAL signal that is the same as its code
- Causes flight deck indications for a call.

There are no lights or test switches on the SELCAL decoder front panel.

SELCAL Coding Switch

Switches inside of the SELCAL coding switch set the airplane's SELCAL code.





SELCAL CODING SWITCH

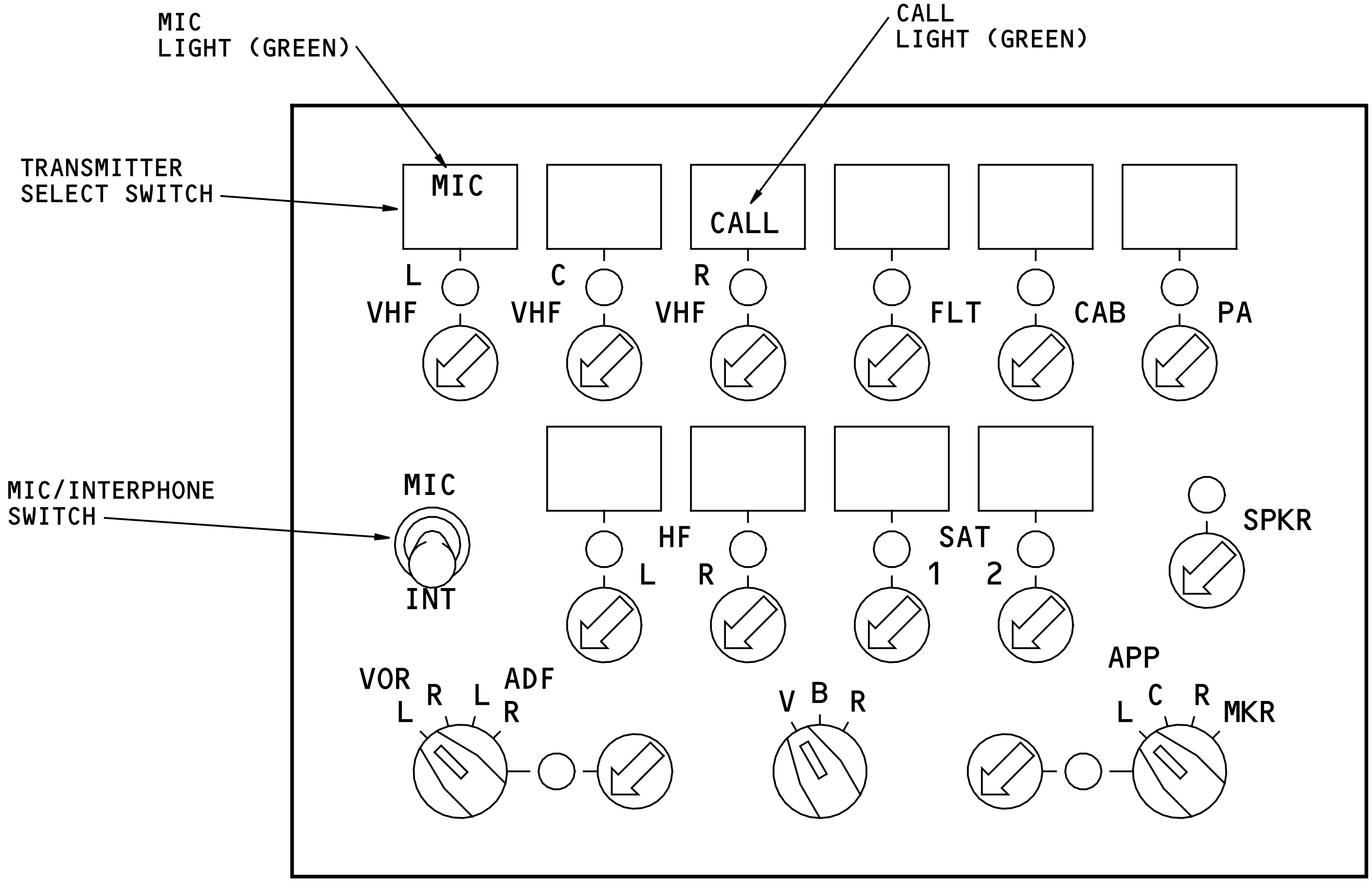
SELCAL - SELCAL DECODER

SELCAL - ACP CALL LIGHTS AND RESET SWITCHES

Control and Indications

On the audio control panel, a transmitter select switch CALL light comes on when the SELCAL decoder gets a SELCAL signal.

To make the CALL light go off, push the transmitter select switch. If the MIC light for that transmitter select switch is on, push any mic switch or that transmitter select switch to reset the call light.



SELCAL - ACP CALL LIGHTS AND RESET SWITCHES

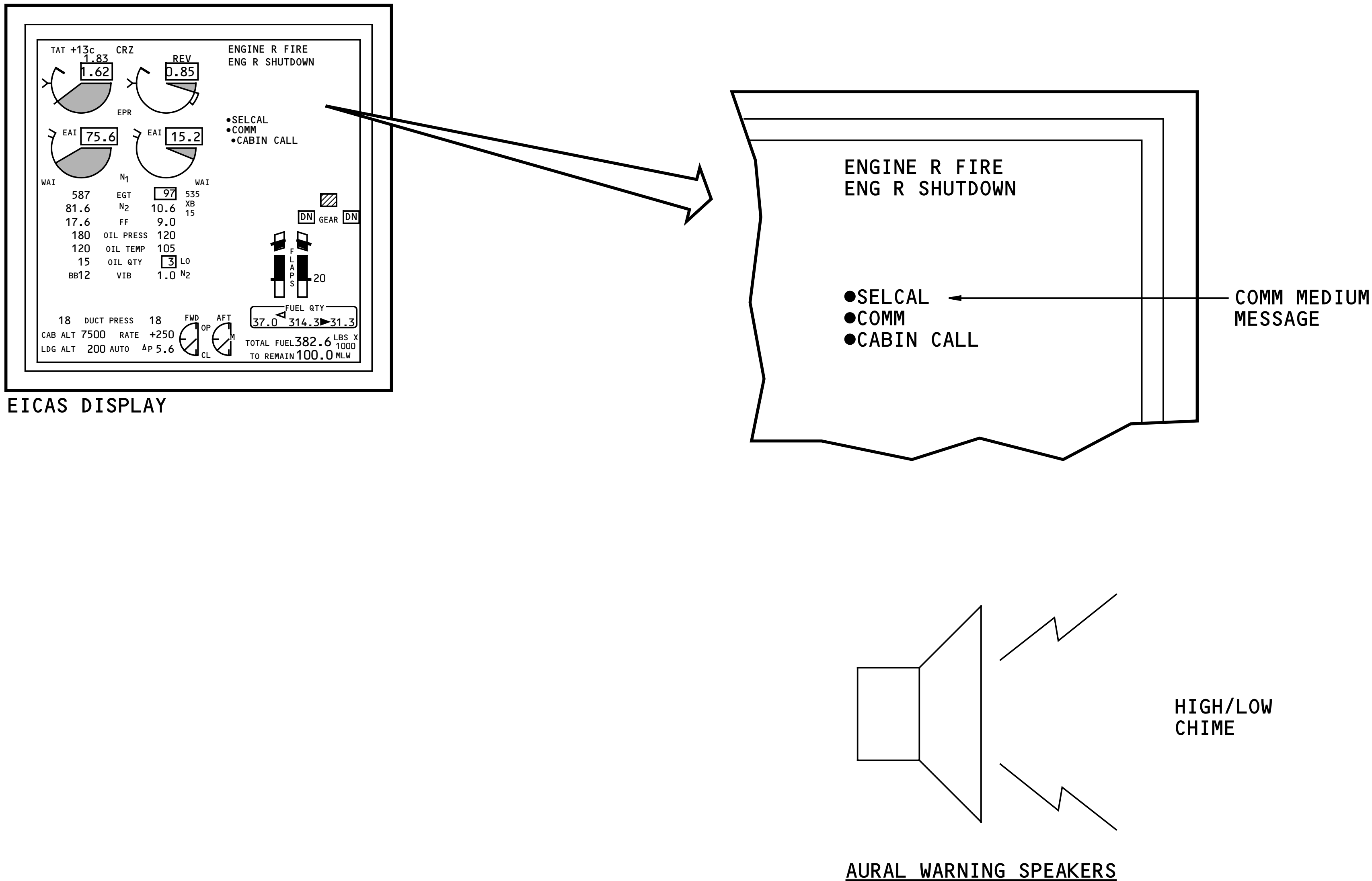
SELCAL - ALERT MESSAGE AND AURAL

Indications

An alert message shows when the SELCAL decoder gets a SELCAL signal. The alert message, SELCAL, is a comm medium message. With the comm medium message there is a high/low chime from the aural warning speakers.

Training Information Point

The same comm medium message, SELCAL, also shows when the SATCOM system receives a call.



23-21-00-007 Rev 3 05/02/95

SELCAL - ALERT MESSAGE AND AURAL

Continental Airlines, Inc

Satellite Communication System

WB371

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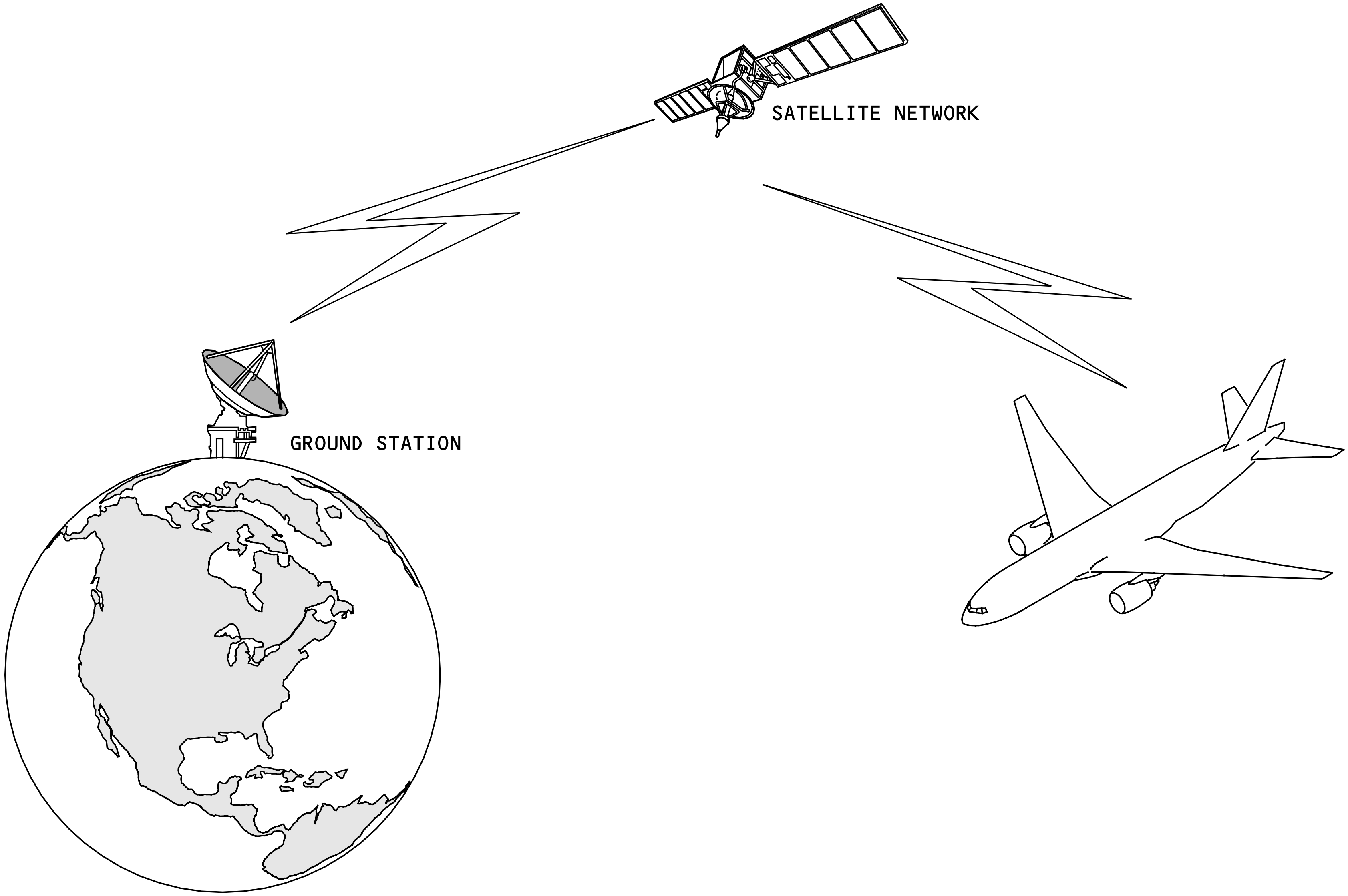
SATELLITE COMMUNICATIONS SYSTEM - INTRODUCTION

Purpose

The satellite communications (SATCOM) system uses ground stations and satellites to transmit and receive data and voice messages. SATCOM supplies higher quality data and voice message signals for passengers and crew, over longer distances than VHF/HF communication systems.

Abbreviations and Acronyms

ACARS	- aircraft communications addressing and reporting system
ACP	- audio control panel
ADL	- airborne data loading
AIMS	- airplane information management system
AMU	- audio management unit
attn	- attenuator
BSU	- beam steering unit
BITE	- built-in test equipment
CCD	- cursor control device
CDU	- control display unit
CMCF	- central maintenance computing function
CTU	- cabin telecommunication unit
DCGF	- data conversion gateway function
DCMF	- data communication management function
DSP	- display select panel
GHz	- gigahertz
HGA	- high gain antenna
HPA	- high power amplifier
HPR	- high power relay
I/O	- input/output
IF	- intermediate frequency
LNA/DIP	- low noise amplifier/diplexer
LGA	- low gain antenna
LSK	- line select key
MAT	- maintenance access terminal
MHz	- megahertz
OMF	- onboard maintenance function
OMS	- onboard maintenance system
RFC	- radio frequency combiner
RFS	- radio frequency splitter
RFU	- radio frequency unit
SATCOM	- satellite communications
SDU	- satellite data unit
stbd	- starboard



23-15-00-001 Rev 4

SATELLITE COMMUNICATIONS SYSTEM - INTRODUCTION

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SATCOM SYSTEM - GENERAL DESCRIPTION

General

The satellite communications (SATCOM) system uses a satellite network, ground stations and airplane satellite communication equipment to transmit and receive data and voice messages.

Satellites

Satellites act as relay stations between the ground stations and the airplane.

Ground Station

The ground station connects the SATCOM system to the ground-based aircraft communications addressing and reporting system (ACARS) and public telephone networks.

Airplane SATCOM Equipment

These are the components of a SATCOM system:

- Radio frequency unit (RFU)
- Radio frequency attenuator (RF ATTN)
- Radio frequency splitter (RFS)
- Class C high power amplifier (HPA)
- Class A high power amplifier (HPA)
- Low noise amplifier/diplexer (LNA/DIP)
- Low gain antenna (LGA)
- Beam steering unit (BSU)
- Top mounted high gain antenna (HGA)
- Radio frequency combiner (RFC)
- Satellite data unit (SDU).

SATCOM System Connections

The airplane SATCOM equipment connects with:

- The control display units (CDUs). The SATCOM control and status pages on the CDU give flight crew control of the SATCOM system. These pages also give system status data.
- The audio management unit (AMU). Microphone audio and push-to-talk discretes go to the SDU through the AMU. Receive audio goes from the SDU to the speakers and headsets through the AMU.
- The cabin telecommunications unit (CTU). Passengers use the SATCOM system through the CTU.

AIMS Connections

The SATCOM system also connects with the airplane information management system (AIMS) for these functions:

- Data communication management function (DCMF). The DCMF supplies data communications control for airplane air/ground datalink over the SATCOM system.
- Central maintenance computing function (CMCF). The CMCF gets SATCOM system fault reports and writes this data in a fault history. This shows the maintenance crew the defective component or function. The maintenance access terminal (MAT) gives access to the CMCF for loading and updating SATCOM configuration data.

- Data conversion gateway function (DCGF). The DCGF changes inertial reference system data into ARINC 429 data for high gain antenna (HGA) beam steering. The DCGF also supplies international civil aviation organization (ICAO) addresses.

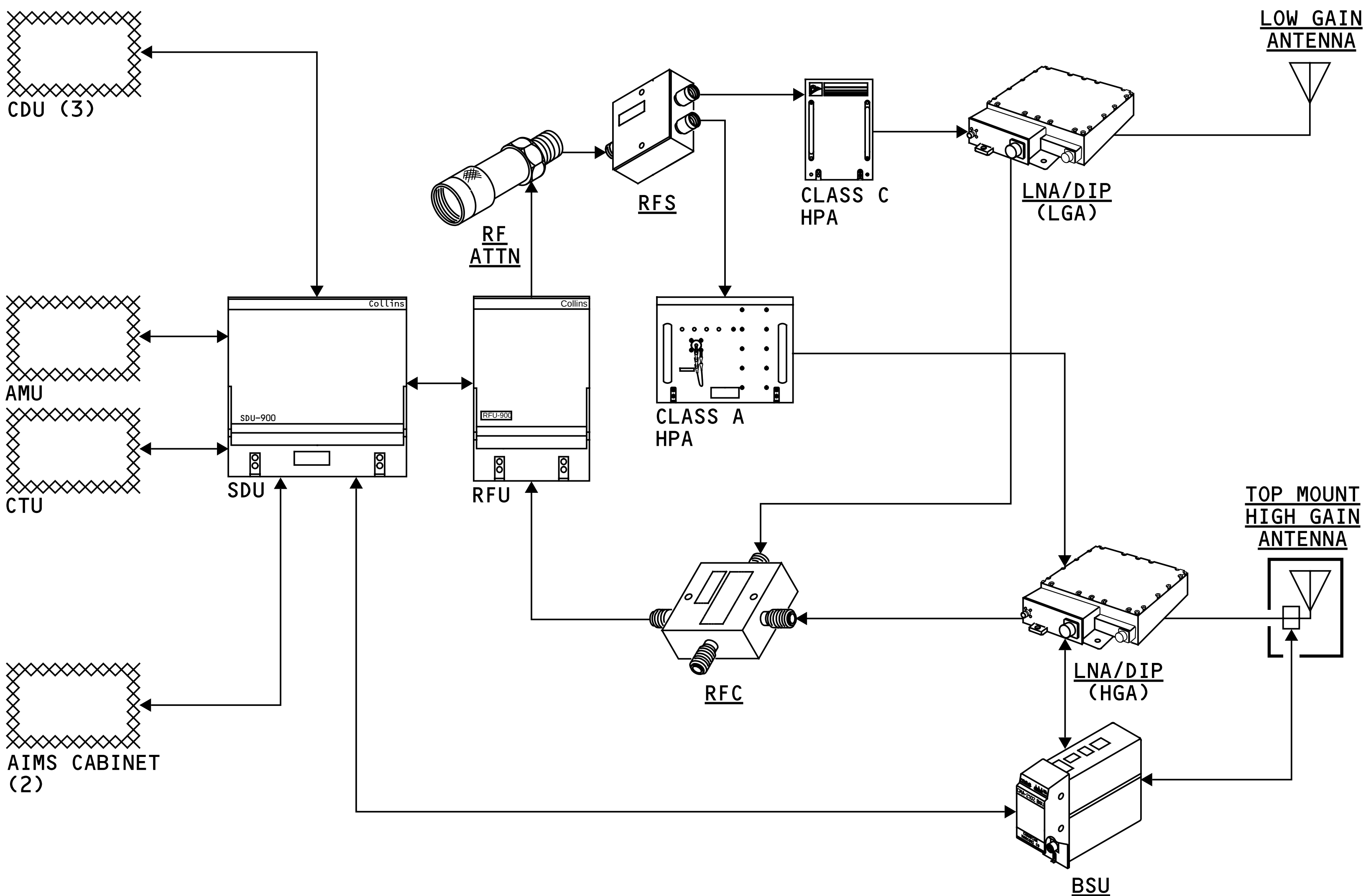
High Gain Antenna System

The high gain antenna system receives and transmits voice and data signals. A high power amplifier (HPA) sends transmit signals to the high gain antenna system. The antenna system sends receive signals to the radio frequency unit (RFU). The antenna system has these components:

- High gain antenna
- Beam steering unit
- Low noise amplifier/diplexer (LNA/DIP).

Low Gain Antenna System

The low gain antenna system receives and transmits data signals. This system operates only when a high gain antenna system fails or class A high power amplifier fails. The low gain antenna system has a low gain antenna (LGA) and a low noise amplifier/diplexer (LNA/DIP).



SATCOM SYSTEM - GENERAL DESCRIPTION

SATCOM SYSTEM - COMPONENT LOCATIONS - 1

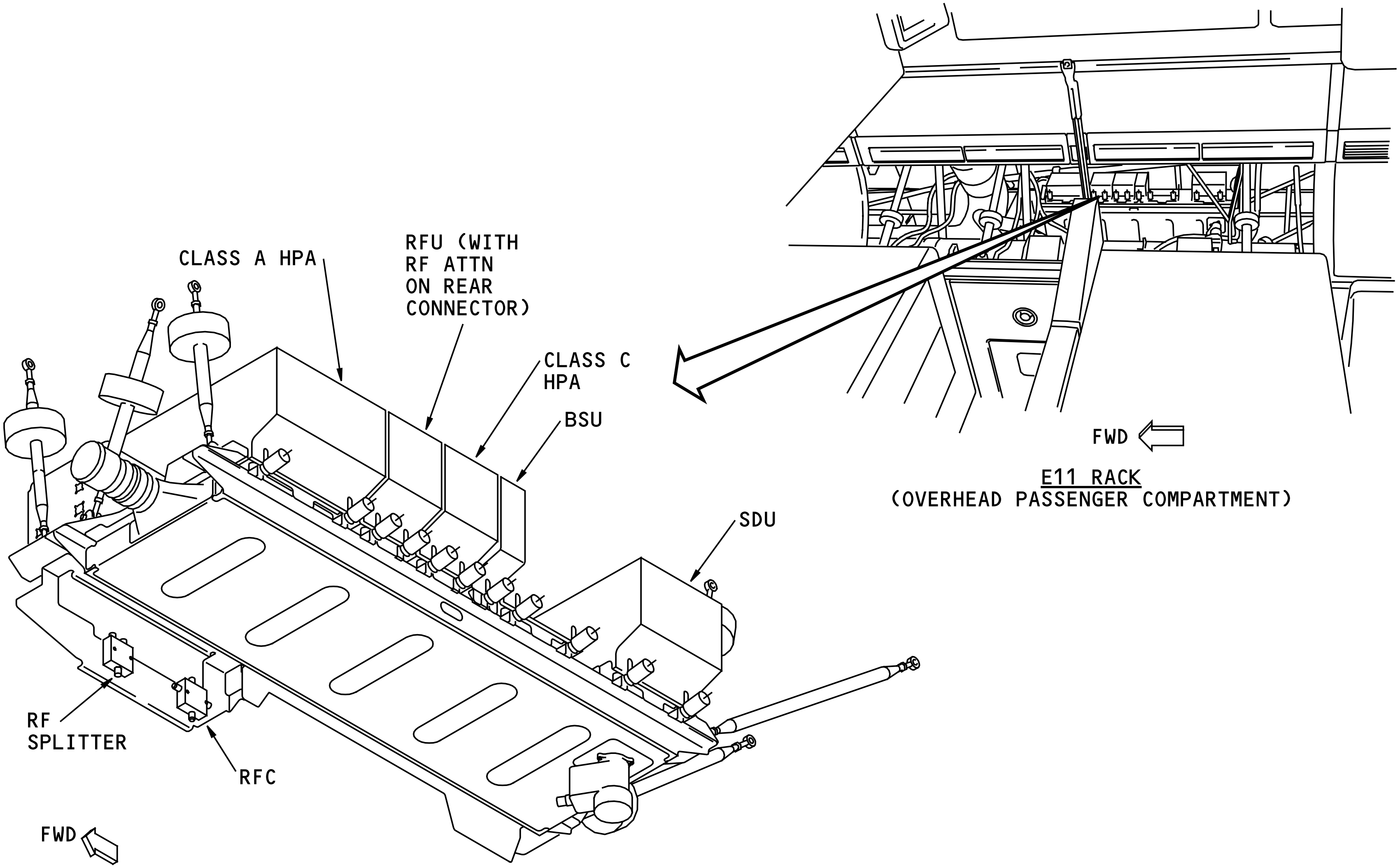
Cabin Overhead Area

This equipment is on the E11 rack:

- Radio frequency splitter (RFS)
- Radio frequency attenuator (RF ATTN)
- Radio frequency combiner (RFC)
- Satellite data unit (SDU)
- Class C high power amplifier (HPA)
- Radio frequency unit (RFU)
- Beam steering unit (BSU)
- Class A high power amplifier (HPA).

Access

Access to the E11 rack is through a ceiling panel on the left side of the door 3 cross aisle area.



SATCOM SYSTEM - COMPONENT LOCATIONS - 1

23-15-00-003 Rev 8 12/22/1997

SATCOM SYSTEM - COMPONENT LOCATIONS - 2

High Gain Antenna System

The SATCOM system has a top mounted high gain antenna system. The high gain antenna system has these components:

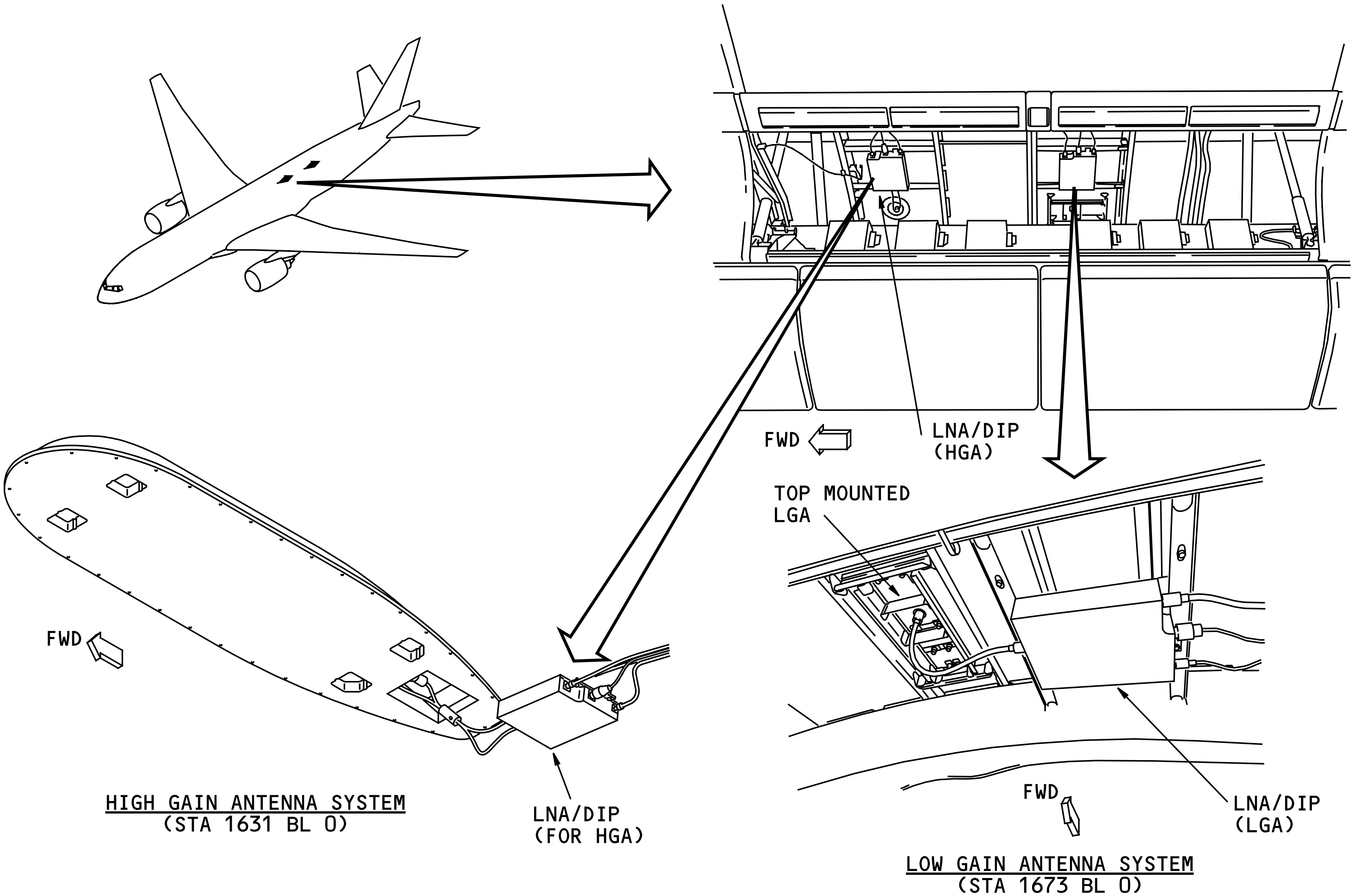
- High gain antenna (HGA)
- Beam steering unit (BSU)
- Low noise amplifier/diplexer (LNA/DIP).

Low Gain Antenna System

The low gain antenna system has a low gain antenna (LGA) and a low noise amplifier/diplexer (LNA/DIP) (top).

Access

Access to the antenna systems is through overhead panels in the passenger cabin.



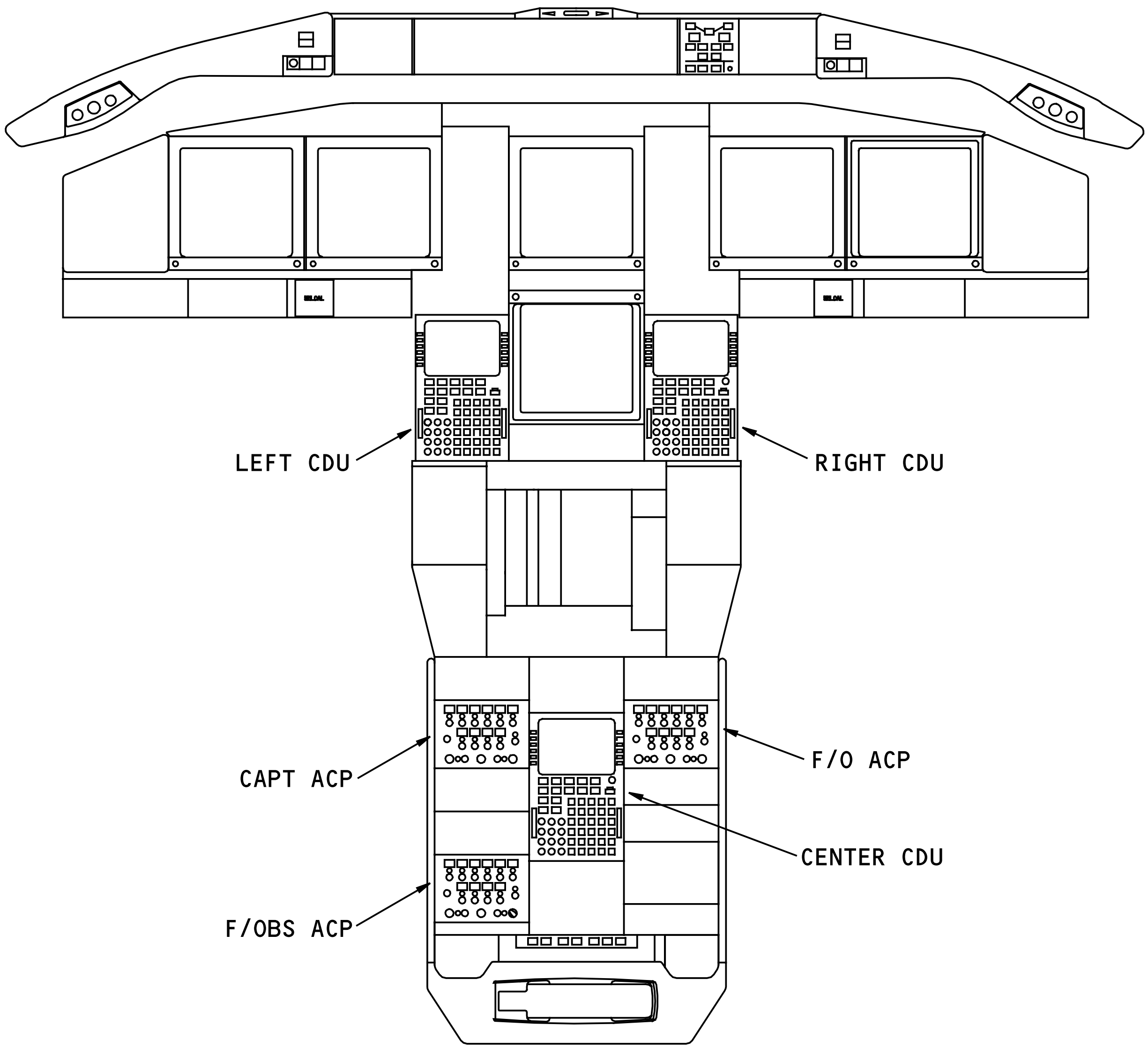
SATCOM SYSTEM - COMPONENT LOCATIONS - 2

SATCOM SYSTEM - FLIGHT DECK INTERFACE COMPONENT LOCATIONS

Flight Deck Interface Components

These components in the flight deck have interfaces with the SATCOM system:

- left, center, and right control display units (CDUs)
- Captain (CAPT), first officer (F/O), and first observer (F/OBS) audio control panels (ACPs).



23-15-00-005 Rev 4 05/01/1997

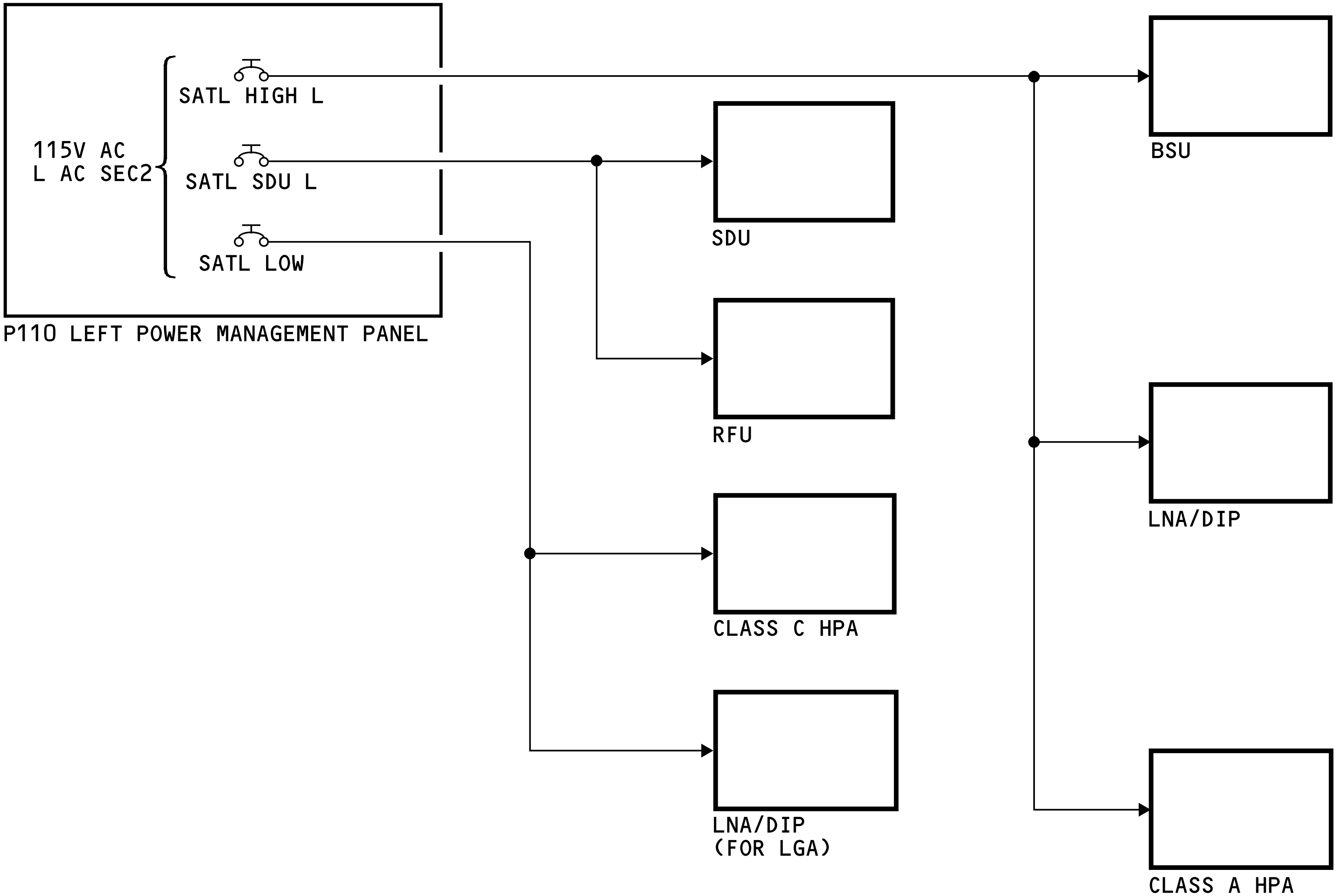
SATCOM SYSTEM - FLIGHT DECK INTERFACE COMPONENT LOCATIONS

SATCOM SYSTEM - POWER INTERFACE

Left Power Management Panel

The left main ac bus sends 115v ac to these units:

- Beam steering unit
- Low noise amplifier/diplexer (LNA/DIP)
- Class A high power amplifier (HPA)
- Class C HPA
- Satellite data unit (SDU)
- Radio frequency unit (RFU).



SATCOM SYSTEM - POWER INTERFACE

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SATCOM SYSTEM - VOICE AND DATA TRANSMIT/RECEIVE INTERFACES

General

The SATCOM system provides a total of five voice channels and one data channel.

The control display units (CDUs) connect with the satellite data unit (SDU). The flight crew use the CDUs to control the SATCOM system.

Voice Operation

Audio control panels (ACPs) connect to the audio management unit (AMU) to control the voice signals from the flight deck to the SATCOM system.

The AMU connects with the SDU to send and receive audio signals for the flight crew.

The cabin telecommunication unit (CTU) connects with the SDU to send and receive voice signals.

Data Operation

The airplane information management system (AIMS) connects with the SDU to send and receive data signals.

The CTU connects with the SDU to receive and transmit data signals.

Signal Flow - Receive

The high gain antenna (HGA) receives radio frequency (RF) signals. It sends them to the LNA/Diplexer (LNA/DIP).

The LNA/DIP increases the power level of the received signals. The LNA/DIP sends the amplified RF signals to the radio frequency unit (RFU).

The RFU receives the amplified signals and changes the RF signals to intermediate frequency (IF) signals for the satellite data unit (SDU).

The SDU demodulates the received IF signals and sends them to the AMU, the AIMS cabinets, or the CTU.

Signal Flow - Transmit

The AMU, AIMS, or the CTU sends transmit signals to the SDU. The SDU modulates the signals and sends them to the RFU.

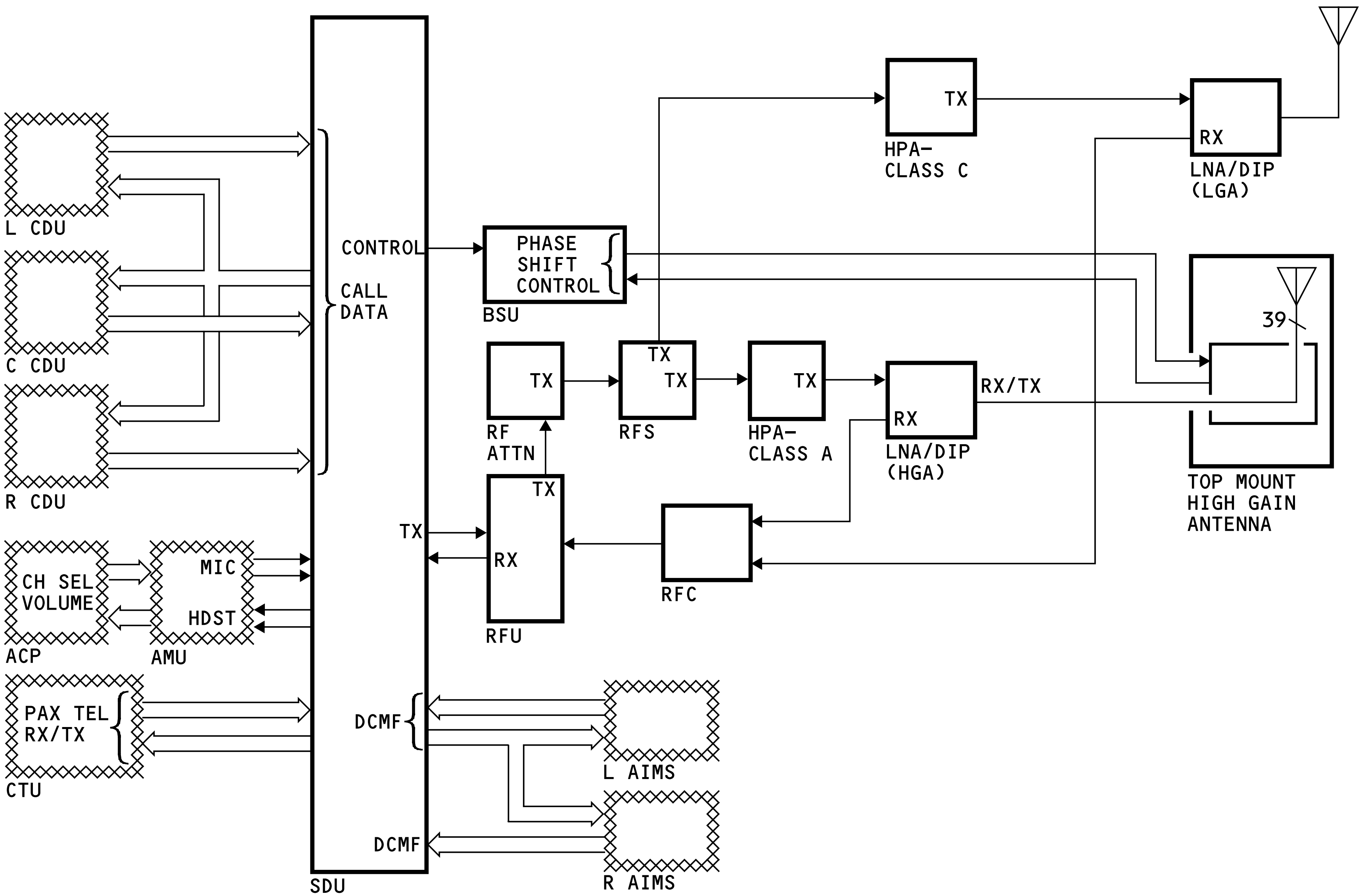
The RFU sends the RF signals through the radio frequency attenuator and the radio frequency splitter (RFS) to the high power amplifier (HPA).

The HPA increases signal strength and sends the signal to the low noise amplifier/diplexer (LNA/DIP).

The LNA/DIP sends the RF signal to the top mounted high gain antenna (HGA). The HGA receives beam steering information from the beam steering unit (BSU). The HGA splits the RF into thirty nine identical signals. The HGA electronically steers the RF signals to the satellite by sending them through the antenna arrays in an aligned beam.

Low Gain Antenna

The low gain antenna system is for data only. It operates if a high gain antenna system fails or the class A high power amplifier fails.



SATCOM SYSTEM - VOICE AND DATA TRANSMIT/RECEIVE INTERFACES

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SATCOM SYSTEM - CONTROL AND STATUS INTERFACES

General

The satellite data unit (SDU) supplies control and failure data for the SATCOM system.

These components have an interface with the SDU for control and status data:

- High power amplifiers (HPAs)
- Low noise amplifier/diplexers (LNA/DIPs)
- Beam steering unit (BSU)
- Airplane information management system (AIMS)
- Control display units (CDUs)
- Radio frequency unit (RFU).

High Power Amplifiers

The high power amplifiers (HPAs) receive control signals from the SDU. The HPAs receive the control signals to adjust the output of their transmit signals. The HPAs send BITE data to the SDU. The class A HPA receives a mute signal from the BSUs to shut down the HPA when the system switches outputs from one antenna to the other.

Low Noise Amplifier/Diplexer

The low noise amplifier/diplexer (LNA/DIP) for the low gain antenna (LGA) receives on/off signals from the SDU. The LNA/DIP sends BITE data to the SDU. The LNA/DIPs for the high gain antennas send BITE data to the beam steering units (BSUs).

The LNA/DIP for the high gain antenna (HGA) receives on/off control from the beam steering unit. The LNA/DIP for the HGA sends BITE data to the beam steering unit (BSU).

Beam Steering Unit

The BSU receives direction signals from the SDU. The BSU sends BITE data to the SDU. The BSU sends on/off signals to the LNA/DIP. The BSU sends beam steering data to the high gain antenna (HGA). The BSU receives BITE data from the HGA.

Airplane Information Management System (AIMS)

The central maintenance computing function (CMCF) in the airplane information management system (AIMS) receives SATCOM system BITE data from the SDU.

AIMS sends this data to the SDU:

- International Civil Aviation Organization (ICAO) address
- Inertial reference data
- Software for system configuration
- Data load enable
- BITE commands.

Radio Frequency Unit

The radio frequency unit (RFU) receives frequency selection data from the SDU. Each satellite operates on

SATCOM SYSTEM - CONTROL AND STATUS INTERFACES

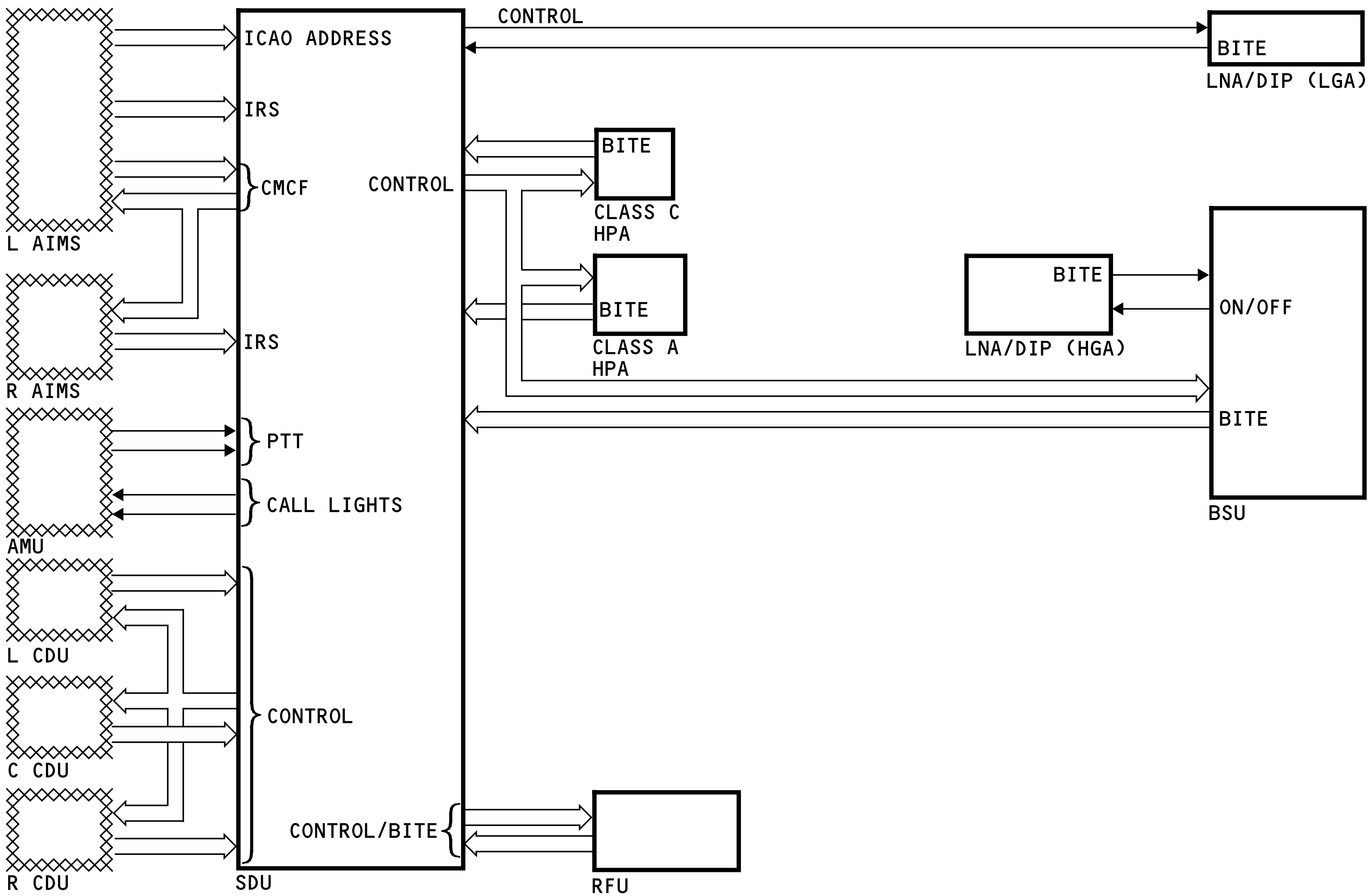
a different frequency to decrease interference from other satellite signals.

Audio Management Unit

The audio management unit (AMU) sends PTT signals to the SDU. The SDU sends call light signals to the AMU.

Control Display Units

The flight crew uses the control display units (CDUs) to send control signals to the SDU for SATCOM system operation.



SATCOM SYSTEM - CONTROL AND STATUS INTERFACES

SATCOM SYSTEM - HIGH GAIN ANTENNA

Purpose

The top mount high gain antenna (HGA) transmits and receives signals.

Functional Description

The HGA transmits signals from the low noise amplifier/diplexer (LNA/DIP). As the signal enters the antenna it goes through power divider/combiners. The signal divides into 39 identical signals. Each signal goes to an individual phase shift element. Each element phase shifts the signal. The phase shift aligns the signals in the antenna elements into a thin beam aimed at the satellite.

The beam steering unit provides beam alignment information to the HGA.

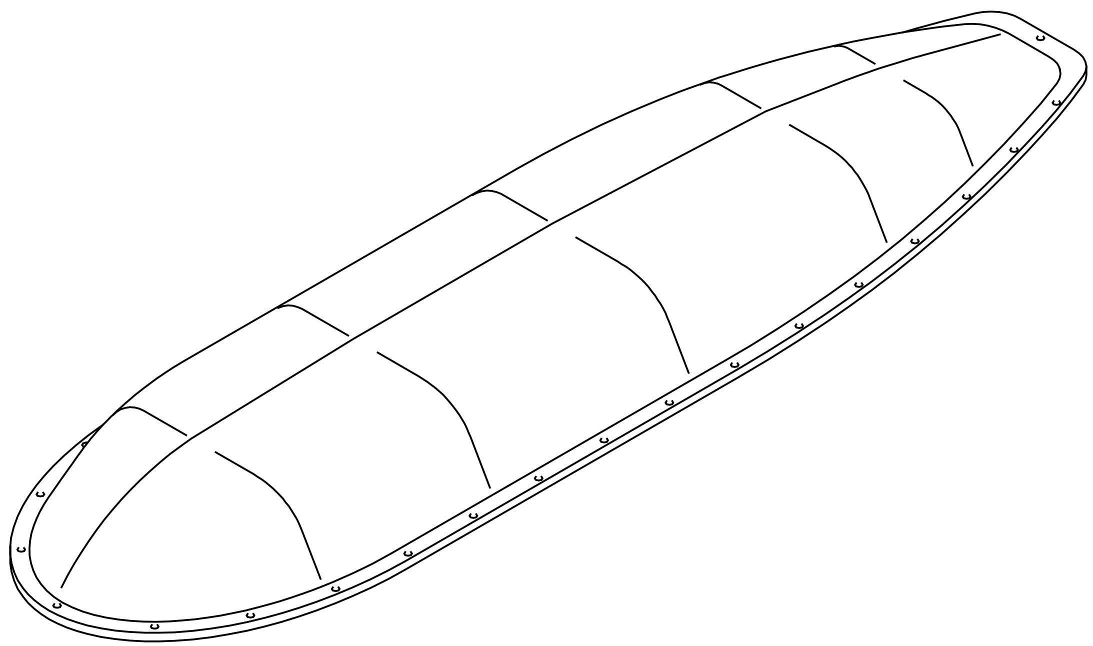
The HGA receives satellite signals through the 39 element array. The received signals go to the LNA/DIP.

Physical Description

The HGA has an array of 39 elements in an aerodynamic dome that is longer in the forward and aft directions.

The HGA has these properties:

- Length - 66 inches
- Height - 5 inches
- Width - 18 inches
- Weight - 65 pounds.



23-15-00-018 Rev 2 11/25/1996

SATCOM SYSTEM - HIGH GAIN ANTENNA

SATCOM SYSTEM - LOW GAIN ANTENNA

Purpose

The low gain antenna (LGA) transmits and receives radio frequency signals for low speed data link. The low gain antenna operates only if the high gain antenna (HGA) system fails.

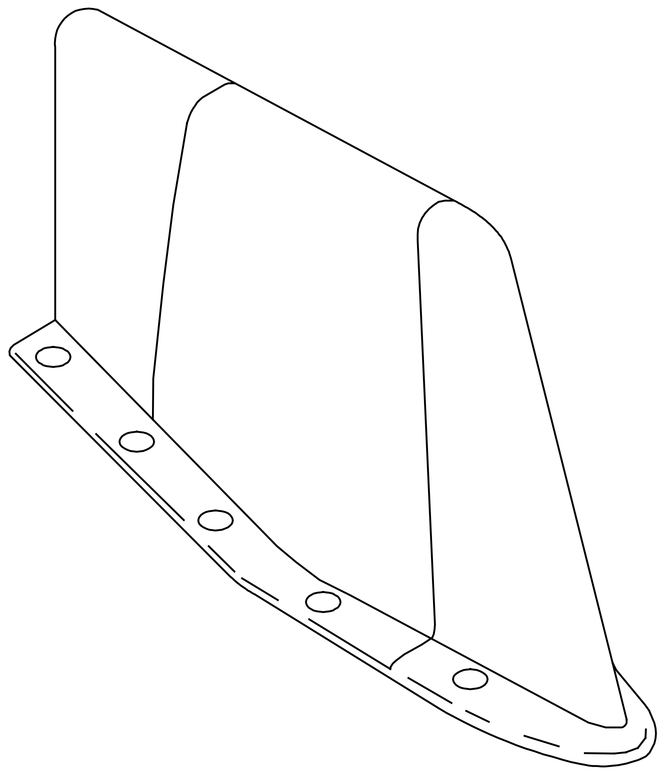
Physical Description

The LGA contains a single antenna element. A blade-shaped aerodynamic radome protects the element.

The LGA has these properties:

- Base length - 15 inches
- Base width -3.75 inches
- Height - 6 inches
- Weight - 2 pounds.

CAUTION: BE CAREFUL WHEN YOU REMOVE THE AERODYNAMIC SEAL WITH THE SEALANT REMOVAL TOOL. DAMAGE TO THE AIRPLANE SKIN CAN OCCUR.



23-15-00-019 Rev 2

SATCOM SYSTEM - LOW GAIN ANTENNA

SATCOM SYSTEM - CONTROL AND STATUS PAGES

General

The control display unit (CDU) has SATCOM pages that give control and status of the SATCOM system.

Satcom Main Menu

The SATCOM main menu shows:

- The name selected for call on channel 1 or 2.
- Call controls
- SATCOM directory access
- Log-on menu access
- BITE menu access and present BITE status.

For each channel, SATCOM shows these items:

- Channel status
- Call connection commands
- Call disconnect commands
- The call destination name chosen from the directory.

SATCOM Directory

The SATCOM directory pages show the labels for each phone number in the directory.

SATCOM Log Page

This page shows selections for control of system log on. The log-on status is on this page also.

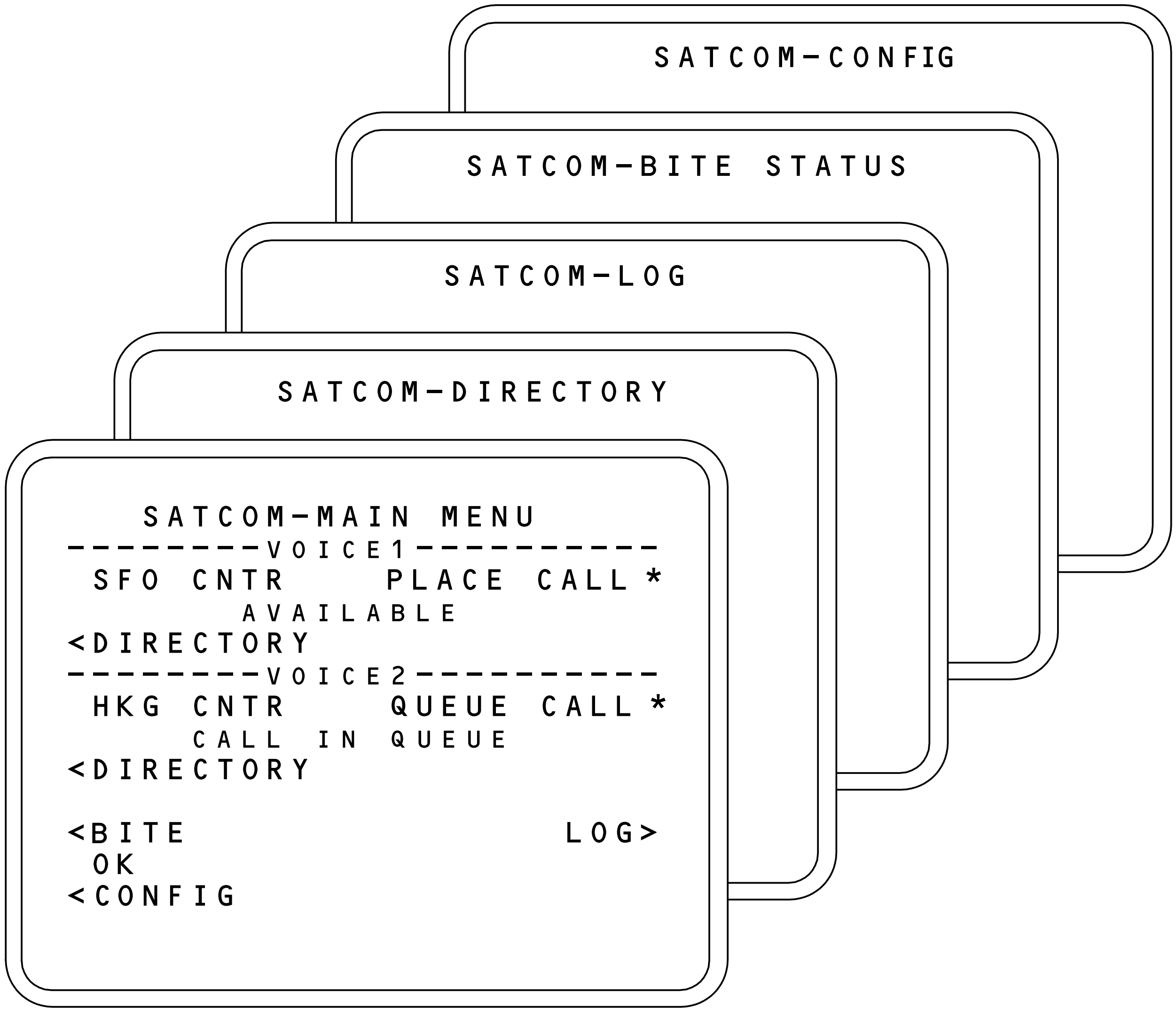
SATCOM BITE Status Page

The BITE status page shows:

- The status of the SATCOM system components
- The SATCOM system bus page. This page shows the status of systems that interface with SATCOM as OK or INACTIVE.

SATCOM CONFIG Page

This page shows the part number for the SDU and the airline database number.



23-15-00-028 Rev 3 01/24/95

SATCOM SYSTEM - CONTROL AND STATUS PAGES

SATCOM SYSTEM - LOG ON

General

To use the SATCOM system, the airplane must log-on to a communication service company.

Automatic Log-On

An automatic log-on occurs when the system powers up. The SATCOM system uses satellite frequencies in memory to find a satellite transmit signal. When the SATCOM system finds an active frequency from the satellite, it locks on to it. The system then uses the satellite as a relay to log-on to a ground station.

After the airplane logs on, the log-on data goes to all ground station networks so that any of the ground stations can locate a specified airplane SATCOM system.

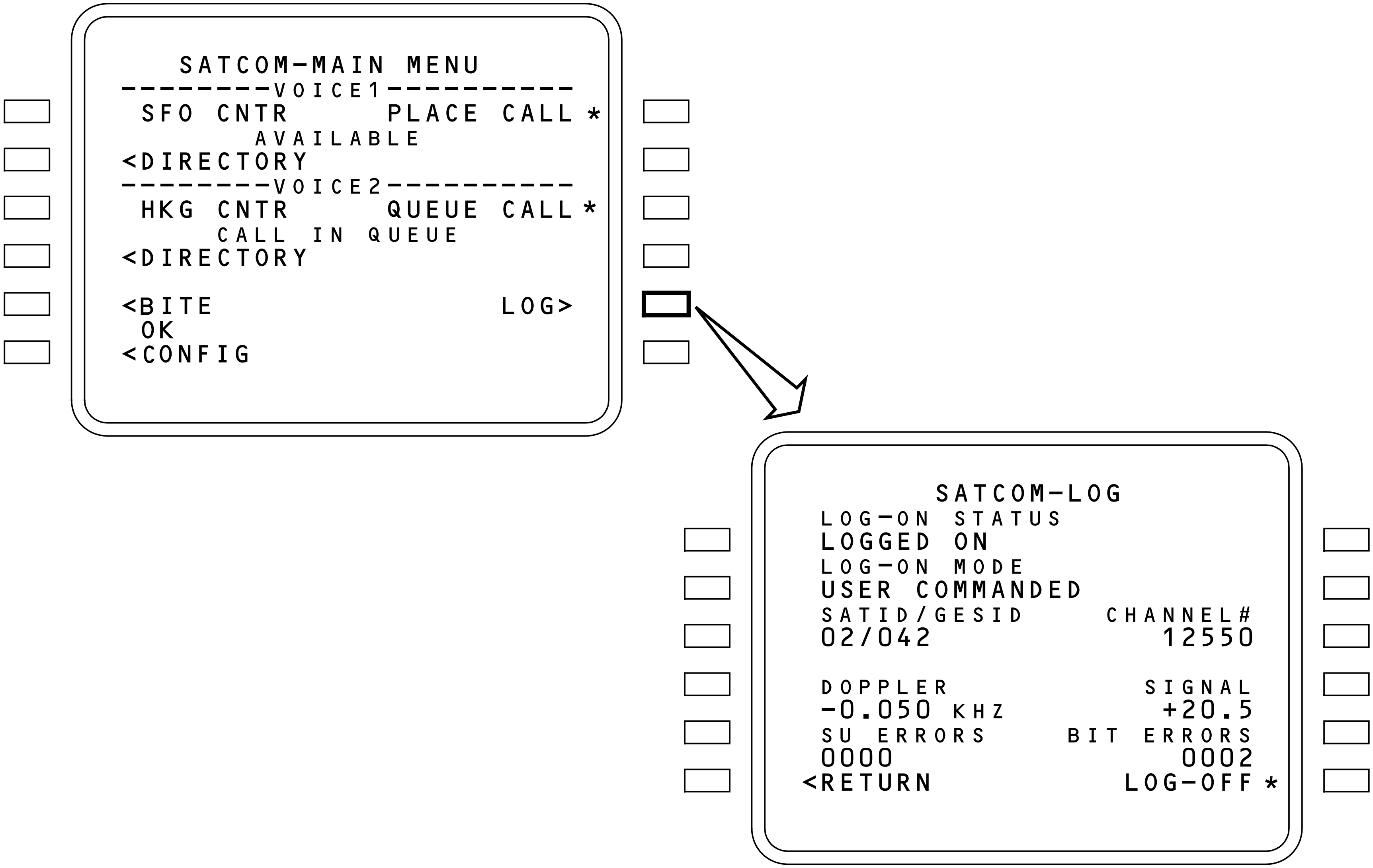
Manual Log-On

Use the control display unit (CDU) to see the SATCOM-main menu. Push the line select key (LSK) adjacent to LOG for the SATCOM-log page. The SATCOM-log page gives selection and control of the manual log-on process. Enter the satellite and ground station identification numbers and push the LSK 3 left. This starts manual log-on. The title field at LSK 1 left shows log-on status.

If the system is logged off, select the LSK adjacent to *AUTO LOG-ON to make the system automatically log-on to a satellite and GES. You may also push the LSK adjacent to GES-SEL to show a list of ground earth stations. From this screen, you may select a GES and log-on.

An airplane can only log-on to one ground station at a time. However, the airplane does not have to get all communication services from that ground station. The airplane may use other links with other ground stations. A typical multi-ground station operation permits an airplane to do these functions:

- Keep data links with the airline operations base
- Talk to an air traffic control (ATC) center through the log-on ground station
- Operate passenger communications through a different ground station.



23-15-00-029 Rev 4 01/05/95

SATCOM SYSTEM - LOG ON

SATCOM SYSTEM - VOICE OPERATIONS

General

The flight crew uses the control display units (CDUs) and audio control panels (ACPs) to control the voice mode of the SATCOM system.

Outgoing Calls

Push a SATCOM transmitter select switch on the ACP. Adjust the volume with the related SAT receiver control.

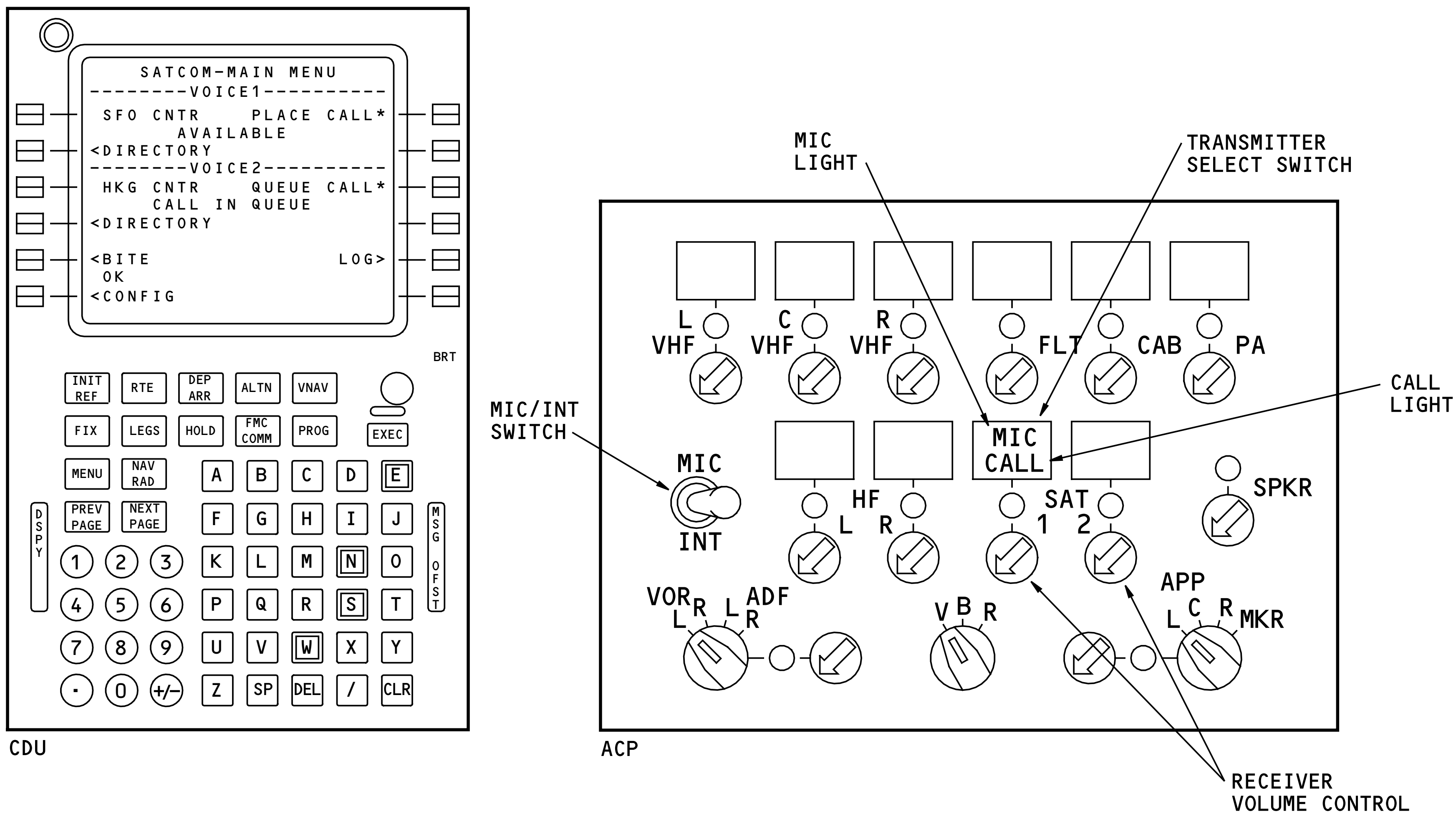
Push the MENU key on the CDU and then push the line select key (LSK) adjacent to <SAT. The SATCOM-MAIN MENU shows on the CDU.

Push the LSK adjacent to DIRECTORY for voice channel 1 or 2. Push the LSK next to the name you want to call.

Push the LSK adjacent to RETURN to go back to the SATCOM-MAIN MENU. Check that the name selected in the directory shows at LSK 1L if you use voice channel 1 or LSK 3L if you use voice channel 2.

Push the LSK adjacent to PLACE CALL. The airplane SATCOM system now makes the call. When the call is connected to the called station, the related SAT CALL light comes on, the SELCAL message shows on EICAS, and you hear the ringback tone in the headset.

When the called party answers, you can push any MIC/interphone switch and speak into the microphone. You do not need to release the MIC/interphone switch to listen. When you finish the call, push the LSK adjacent to END CALL from the SATCOM-MAIN MENU.



SATCOM SYSTEM - VOICE OPERATIONS

SATCOM SYSTEM - DATA OPERATIONS

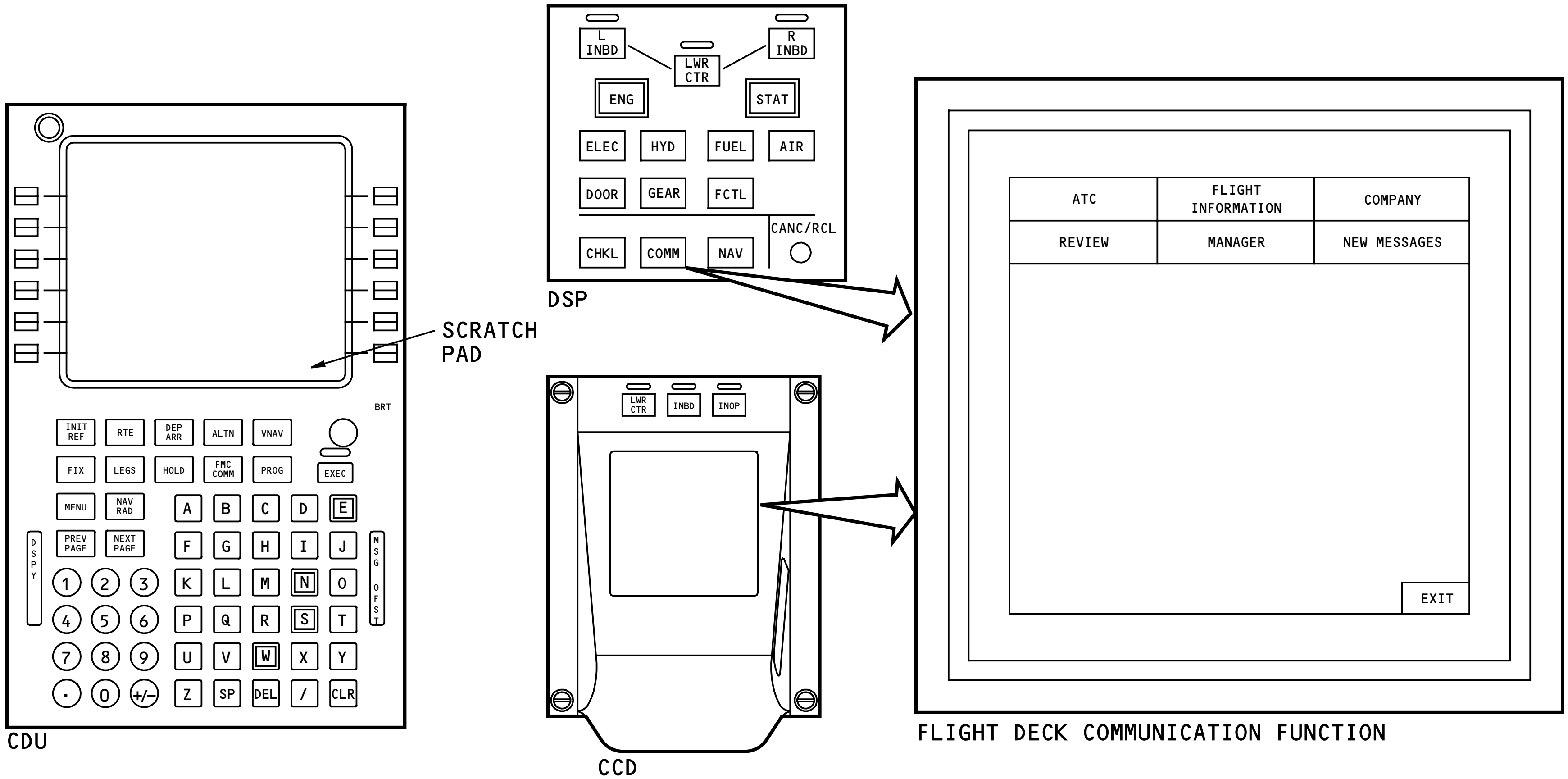
Outbound Datalink

Push the COMM button on the display select panel (DSP) to access the flight deck communication function (FDCF). The communication page shows on the selected display unit.

Use the cursor control device (CCD) to select the MANAGER menu from the main menu. Select the ACARS menu. Use the ACARS menu to select SATCOM for downlink. Use the control display unit (CDU) keyboard and the FDCF COMPANY menu to send a free text message.

Inbound Data link

When the airplane receives a data message through SATCOM, a chime sounds and a COMM or PRINTER message shows on the EICAS display. The COMM EICAS message tells you to read the message on the communication page under the NEW MESSAGES menu. The PRINTER message tells you the message is on the flight deck printer.



23-15-00-031 Rev 3 02/25/1997

SATCOM SYSTEM - DATA OPERATIONS

SATCOM SYSTEM - BITE

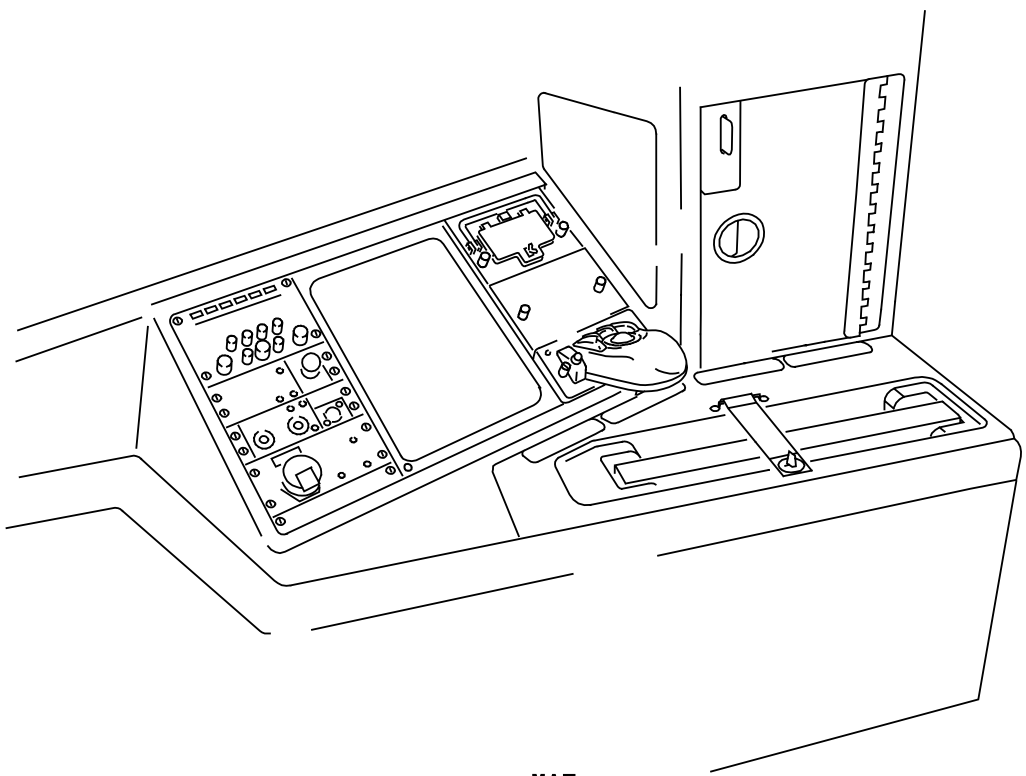
General

The SATCOM system has interfaces with the central maintenance computer system (CMCS) through the airplane information management system (AIMS). Use the maintenance access terminal (MAT) to do a test of the SATCOM system. You can see the test results on the MAT or on the SATCOM MAIN-MENU on the control display unit (CDU).

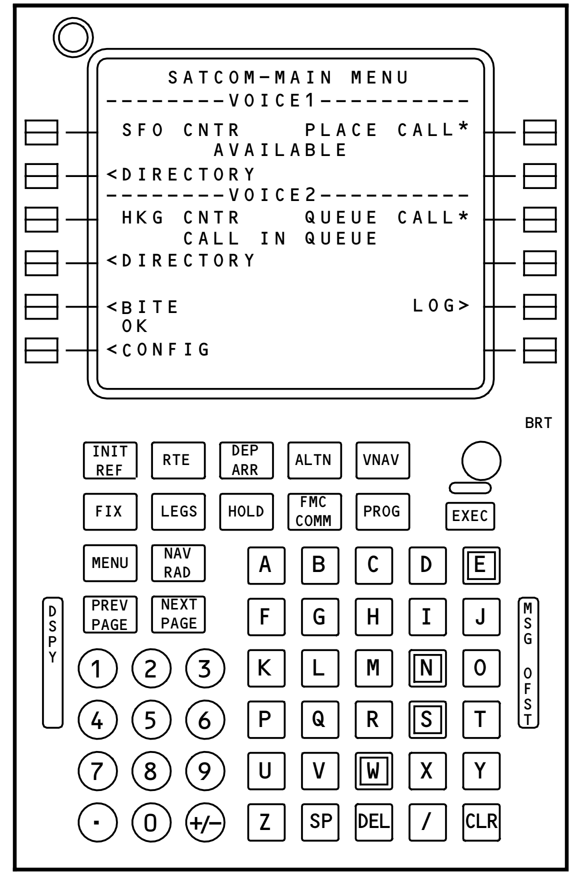
Built-In Test Equipment (BITE)

The SATCOM system has BITE to monitor line replaceable units (LRUs). At power-up, BITE automatically does a test of the system components. Use the MAT to start a manual BITE test.

SATCOM reports all BITE-detected faults to the on-board maintenance system (OMS). Use the MAT to get access to the OMS to get fault data. Use the CDU to get access to BITE-detected faults and system failures in the satellite data unit (SDU).



MAT



CDU

23-15-00-032 Rev 5 02/25/1997

SATCOM SYSTEM - BITE

SATCOM SYSTEM - SYSTEM TESTS

General

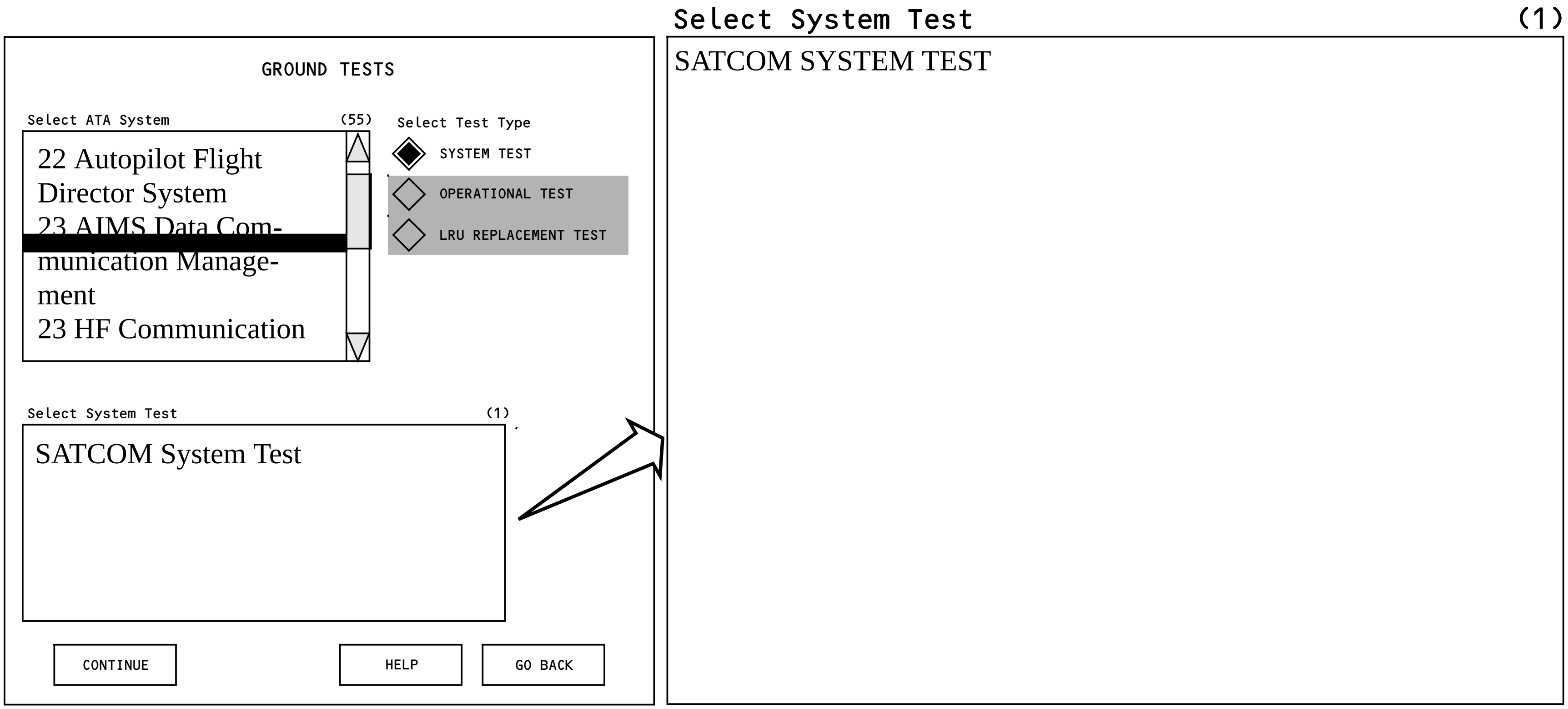
Use a maintenance access terminal to do the SATCOM system tests. To do a complete system test, you also need to make a call.

SATCOM System Test

The test does a check of the SATCOM system equipment and the data bus inputs to the system. The test takes between 2 and 5 minutes to complete. To run the test, select CONTINUE.

WARNING: MAKE SURE PERSONS STAY A MINIMUM OF 10 FEET AWAY FROM THE SIDE-MOUNTED HIGH GAIN ANTENNAS DURING THE INSTALLATION TEST. MAKE SURE THE PASSENGER ENTRY DOORS NEAR THE ANTENNAS ARE CLOSED. RF ENERGY CAN CAUSE INJURIES TO PERSONS.

NOTE: All SATCOM communications stop during this test. If SATCOM communications are in progress, they are disconnected when you do this test.



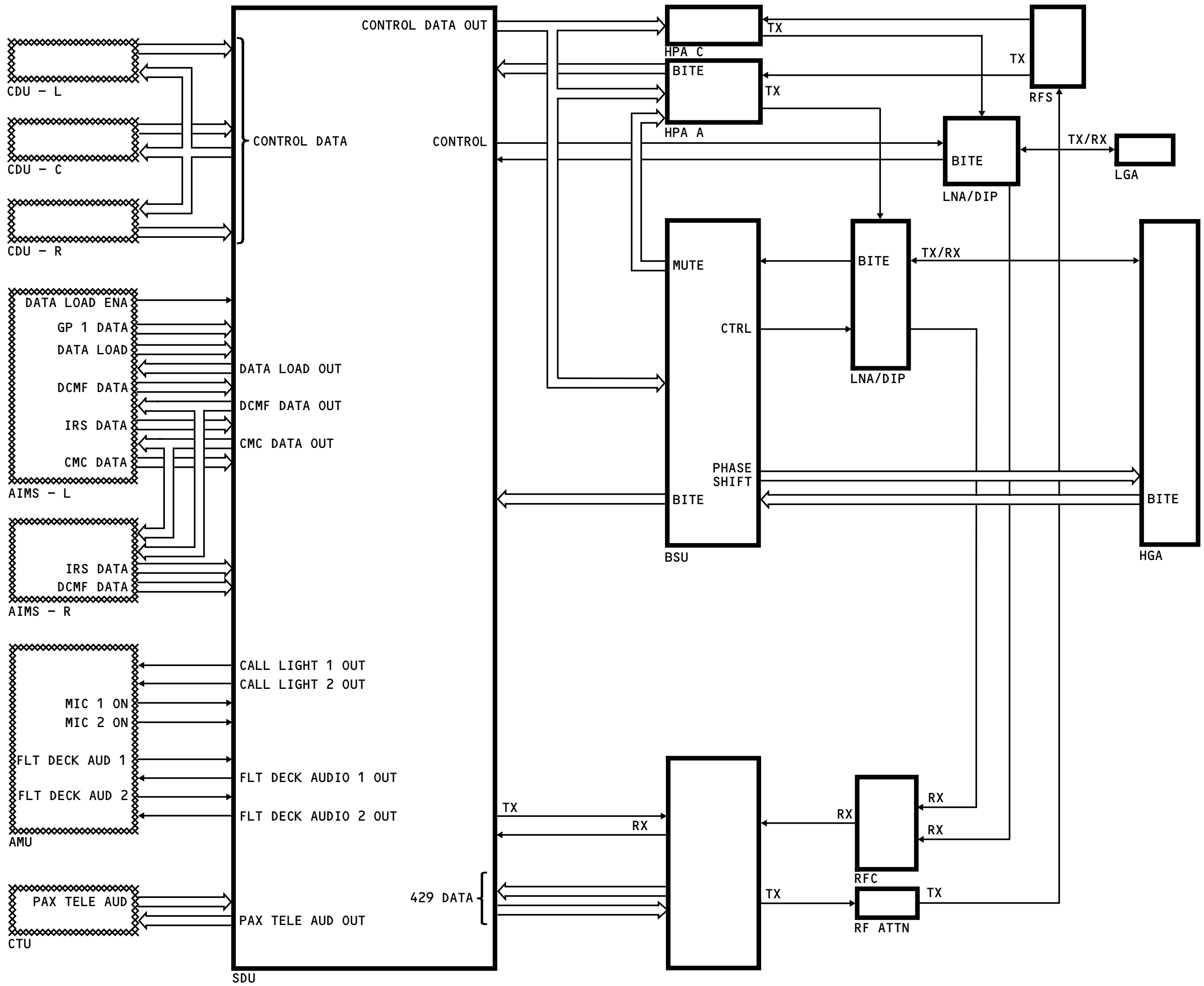
23-15-00-033 Rev 2

SATCOM SYSTEM - SYSTEM TESTS

SATCOM SYSTEM - INTERFACE DIAGRAM

Interface Diagram

This interface diagram is for reference purposes.



SATCOM SYSTEM - INTERFACE DIAGRAM

Continental Airlines, Inc

Cockpit Voice Recorder System

WB371

TABLE OF CONTENTS

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VOICE RECORDER SYSTEM - INTRODUCTION

General

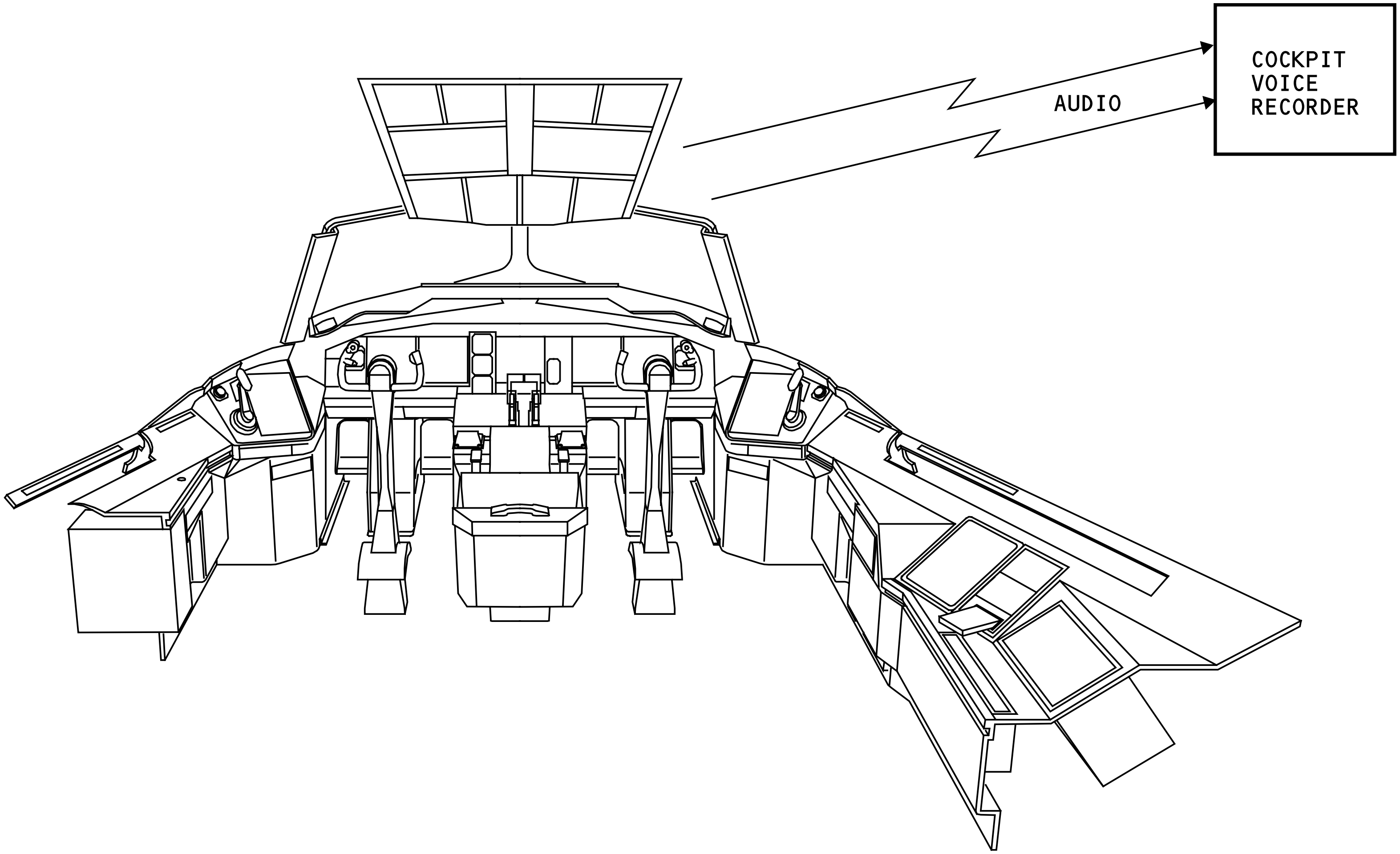
When activated manually or automatically, the voice recorder system continuously records these flight deck sounds:

- Flight crew communications
- Conversations
- Aural warnings.

The system keeps the last 30 minutes of audio. You use the recorded audio for post-incident inspection.

Abbreviations and Acronyms

A/D	- analog to digital
ACP	- audio control panel
AMU	- audio management unit
APU	- auxiliary power unit
Capt	- captain
CKT	- circuit
CVR	- cockpit voice recorder
D/A	- digital to analog
F/O	- first officer
F/OBS	- first observer
ULB	- underwater locator beacon
UTC	- universal coordinated time



23-71-00-001 Rev 3 10/10/96

VOICE RECORDER SYSTEM - INTRODUCTION

VOICE RECORDER SYSTEM - GENERAL DESCRIPTION

General

The cockpit voice recorder (CVR) receives audio from the audio management unit (AMU) and CVR microphone. The cockpit voice recorder panel connects the cockpit voice recorder microphone and the CVR.

Components

The voice recorder system has these components:

- Cockpit voice recorder microphone
- Cockpit voice recorder panel.

Functional Description

The voice recorder system records inputs from these two sources:

- Cockpit voice recorder microphone
- AMU.

The cockpit voice recorder microphone collects flight compartment sounds, such as voices and aural warnings. The audio goes through the cockpit voice recorder panel to the CVR.

The AMU sends these three channels of audio to the CVR:

- Captain
- First officer (F/O)
- First observer (F/OBS).

You monitor recorded audio with phone jacks at these locations:

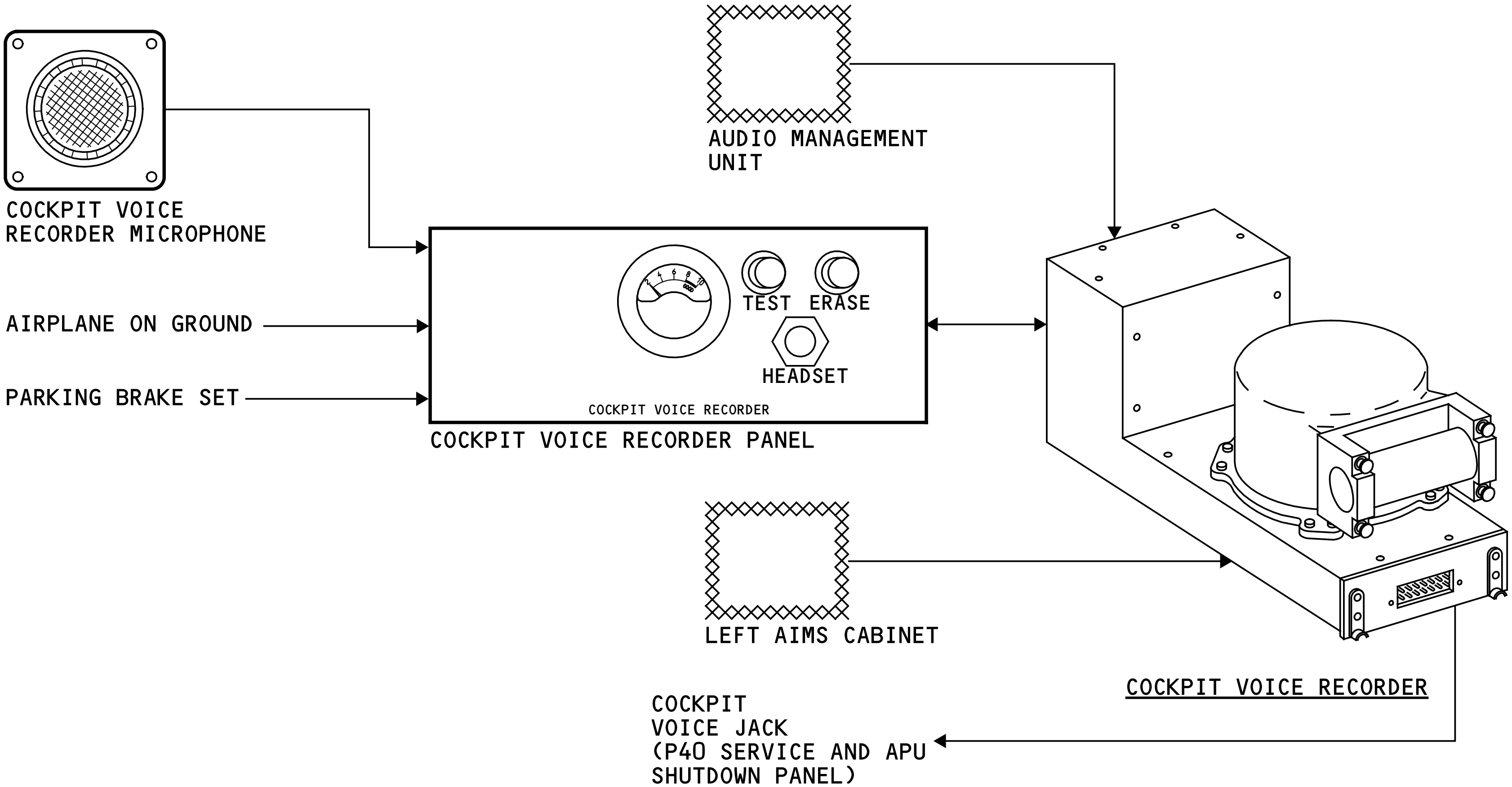
- Cockpit voice recorder panel
- P40 service and APU shutdown panel.

An erase switch on the cockpit voice recorder panel erases the recorded audio when the airplane is on the ground and the parking brake is set.

A test switch on the cockpit voice recorder panel starts a test of the voice recorder system. The cockpit voice recorder panel shows the results of the test.

An underwater locator beacon is on the front panel of the CVR. It operates underwater.

The CVR gets the universal coordinated time constant (UTC) from the left AIMS cabinet.

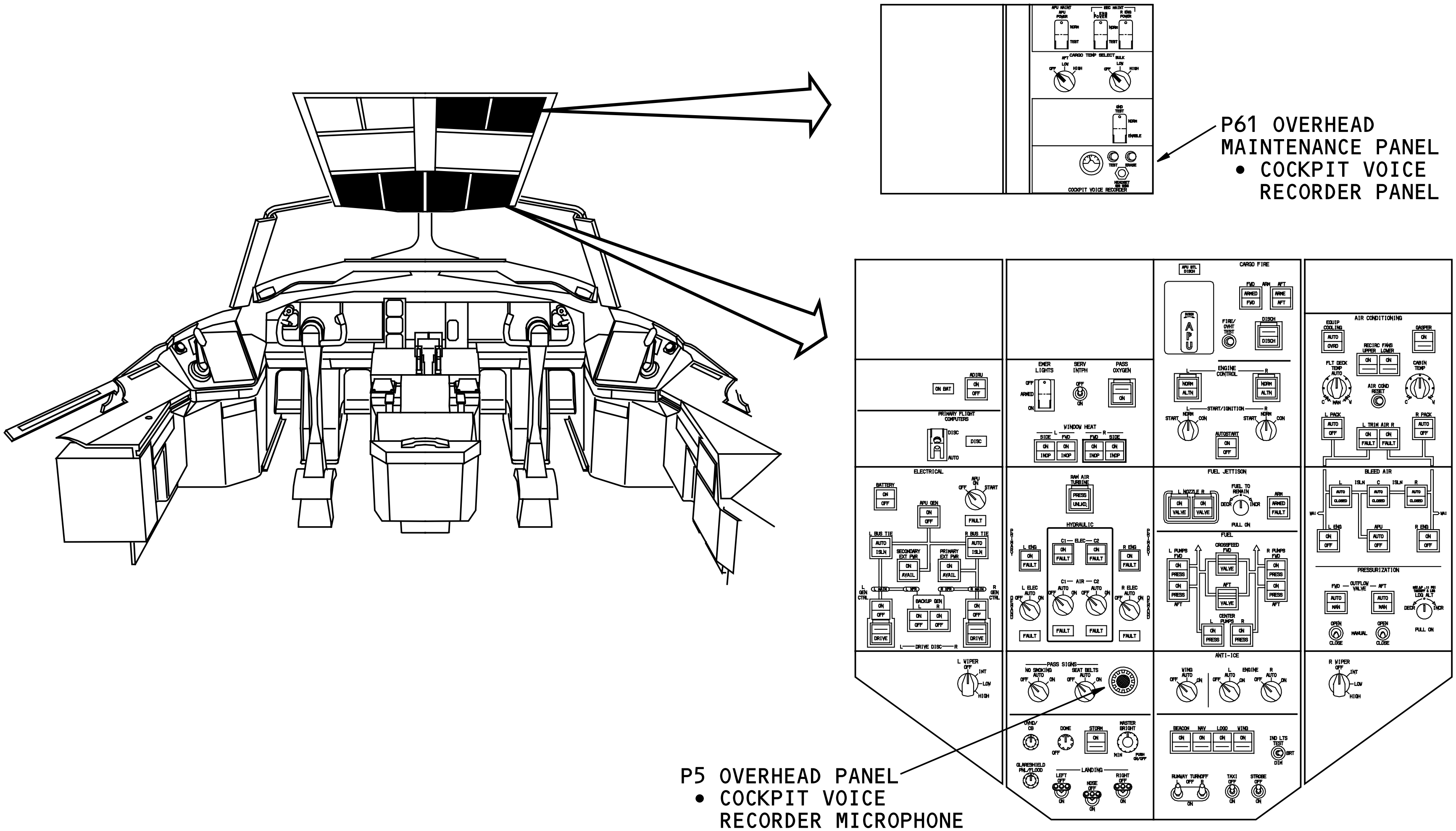


VOICE RECORDER SYSTEM - GENERAL DESCRIPTION

VOICE RECORDER SYSTEM - COMPONENT LOCATIONS 1

General

The cockpit voice recorder panel and cockpit voice recorder microphone are in the flight deck.

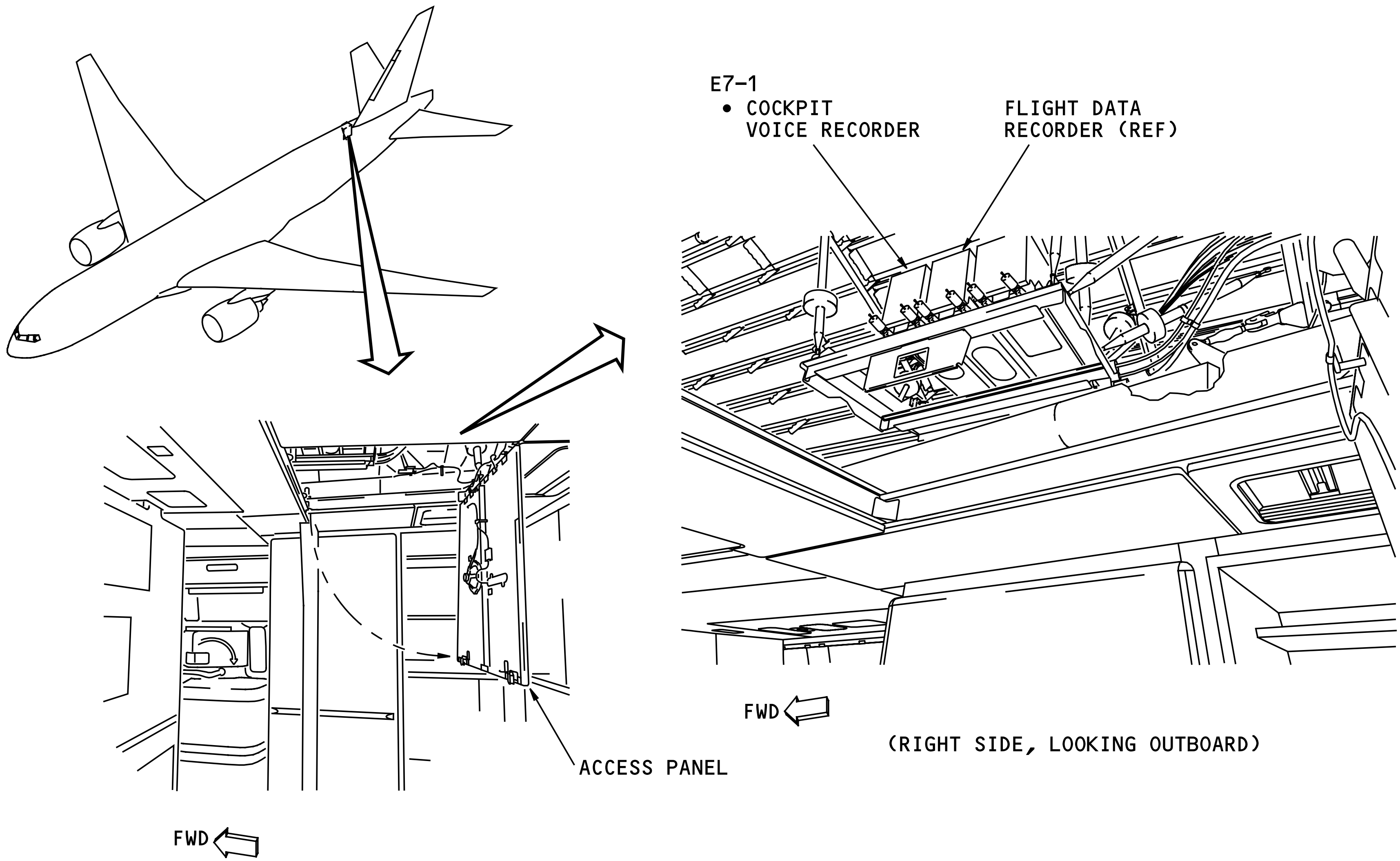


VOICE RECORDER SYSTEM - COMPONENT LOCATIONS 1

VOICE RECORDER SYSTEM - COMPONENT LOCATIONS 2

General

The cockpit voice recorder is overhead in the E7-1 rack in the aft cabin.



VOICE RECORDER SYSTEM - COMPONENT LOCATIONS 2

VOICE RECORDER SYSTEM - INTERFACE

Power

The cockpit voice recorder (CVR) gets 115v ac from the VOX RCDR circuit breaker. The CVR supplies 18v dc to the audio amplifier in the cockpit voice recorder panel.

Relays

The K32001 parking brake relay gets 30v dc from the CVR. When the parking brake is on, the relay closes. The relay sends 30v dc to the K32216 ground mode relay.

The K32216 ground mode relay gets 30v dc from the closed K32001 parking brake relay. When the airplane is on the ground, K32216 closes. The relay sends 30v dc to the cockpit voice recorder panel. This 30v dc goes to the erase switch.

Cockpit Voice Recorder Microphone

The cockpit voice recorder microphone sends area audio to the cockpit voice recorder panel.

Cockpit Voice Recorder Panel

The cockpit voice recorder panel sends these signals:

- Area audio to the channel 4 input of the CVR
- Test discrete to the CVR
- Erase discrete to the CVR.

Audio Management Unit

The audio management unit (AMU) sends these signals:

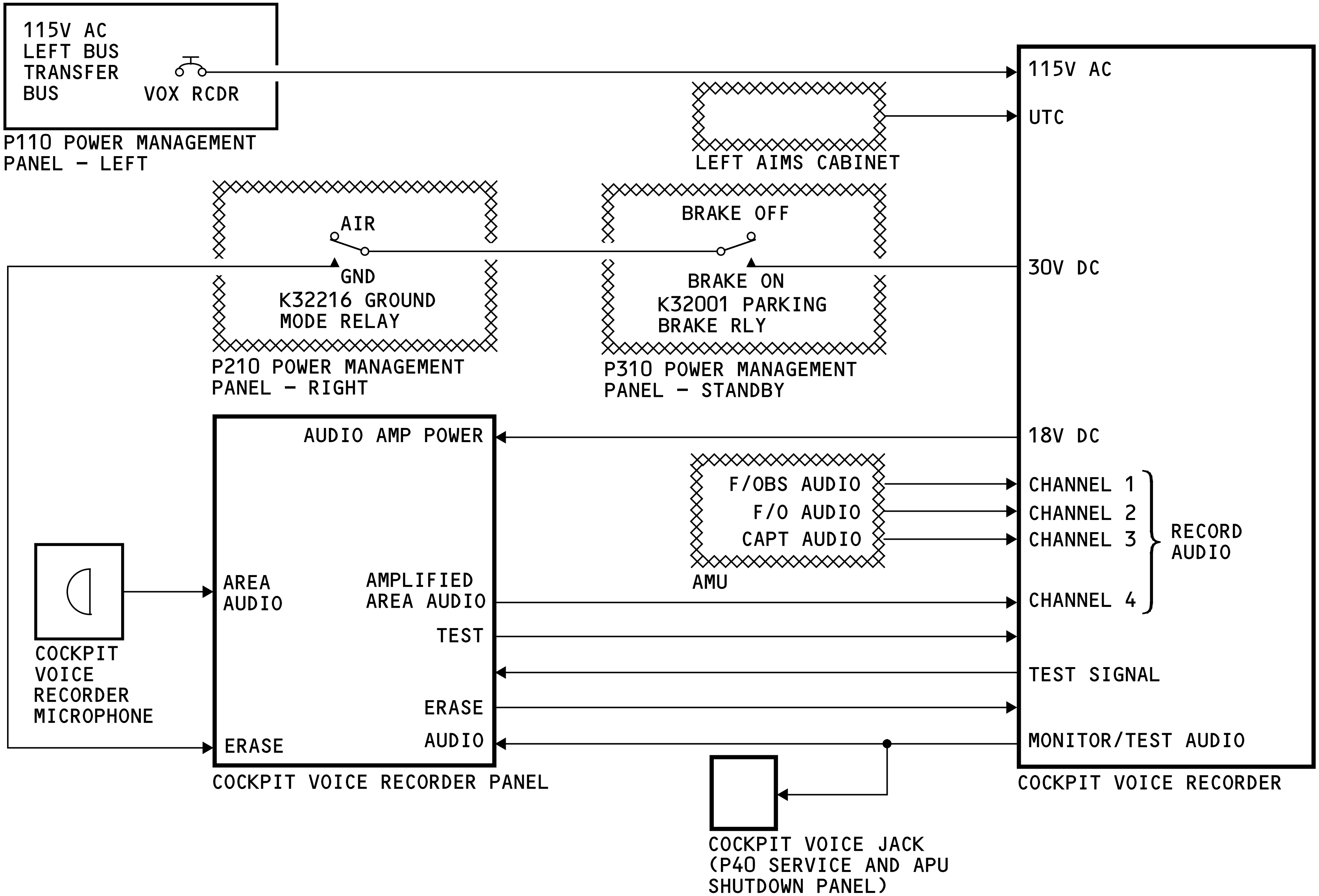
- First observer (F/OBS) audio to the channel 1 input of CVR
- First officer (F/O) audio to the channel 2 input of the CVR
- Captain (CAPT) audio to the channel 3 input of CVR.

Cockpit Voice Recorder

The CVR sends these signals:

- 30v dc to the parking brake relay
- Test results to the cockpit voice recorder panel
- Audio to the cockpit voice jack on the P40 service and APU shutdown panel
- Audio to the cockpit voice recorder panel.

The CVR gets these signals universal coordinated time (UTC) from the left AIMs cabinet



23-71-00-005 Rev 6 12/22/1997

VOICE RECORDER SYSTEM - INTERFACE

VOICE RECORDER SYSTEM - COCKPIT VOICE RECORDER

Purpose

When activated manually or automatically,the cockpit voice recorder (CVR) continuously records these flight deck sounds:

- Flight crew communications
- Conversations
- Aural warnings.

The recorder keeps the last 30 minutes of audio.

Physical Description

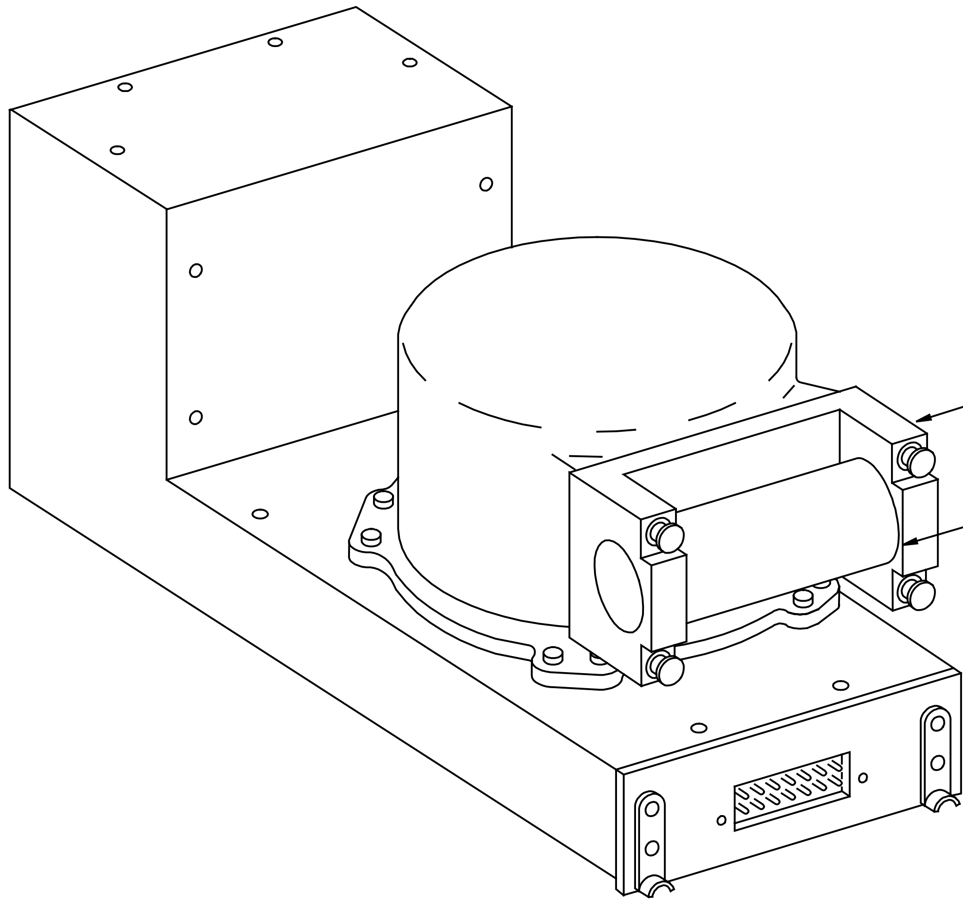
The CVR uses a solid-state memory as the record medium. The case of the CVR is watertight, shock resistant, and heat resistant.

The CVR has these physical characteristics:

- Height - 7.5 inches
- Width - 5.0 inches
- Depth - 12.5 inches
- Weight - 24 pounds maximum.
- Weight - 10.2 pounds maximum.

The CVR is bright orange with reflective stripes.

An underwater locator beacon (ULB) is on the CVR front panel. The ULB helps locate the CVR in water.



23-71-00-006 Rev 4 12/22/1997

VOICE RECORDER SYSTEM - COCKPIT VOICE RECORDER

VOICE RECORDER SYSTEM - COCKPIT VOICE RECORDER PANEL

Purpose

Use the cockpit voice recorder panel for these purposes:

- Monitor the recorded audio
- Erase the recorded audio
- Test the voice recorder system.

Controls and Indications

The cockpit voice recorder panel has these controls and indicators:

- Test meter
- TEST switch
- ERASE switch
- 600 Ohm headset jack.

The ERASE switch starts the erase operation. This erases the recorded audio if the airplane is on the ground with the parking brake set.

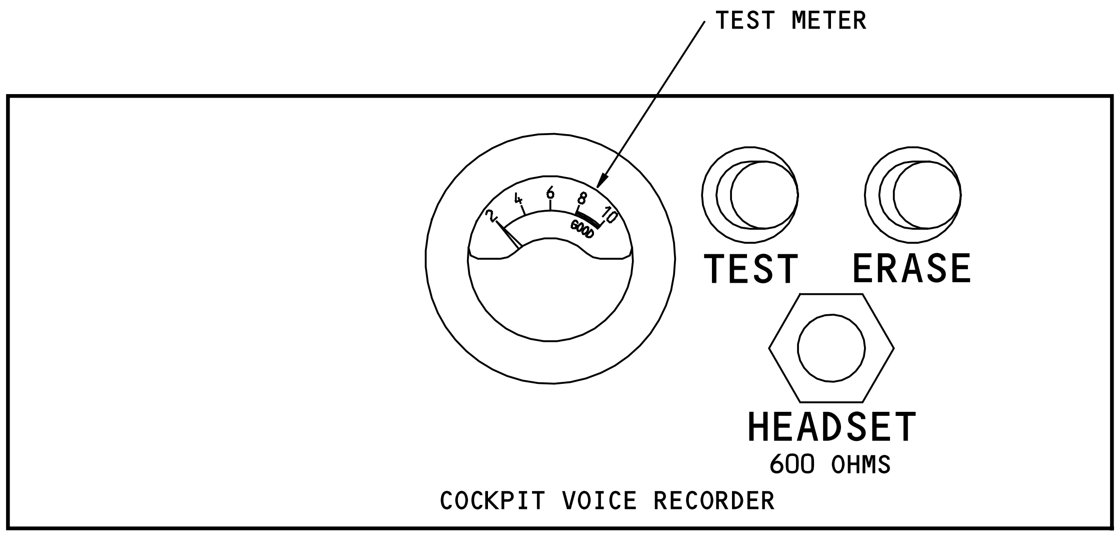
The headset jack permits you to monitor the mixed audio of the four channels during record operation.

Test

The operation test of the voice recorder system does a check of the audio circuits of the cockpit voice recorder (CVR).

To do the test, connect a headset to the headset jack on the cockpit voice recorder panel. Push and hold the TEST switch for a minimum of five seconds. These are the results of a good test:

- The needle on the test meter of the cockpit voice recorder panel goes to the green area and stays
- You hear a 620 Hz tone on the headset.



23-71-00-007 Rev 5 02/10/1997

VOICE RECORDER SYSTEM - COCKPIT VOICE RECORDER PANEL

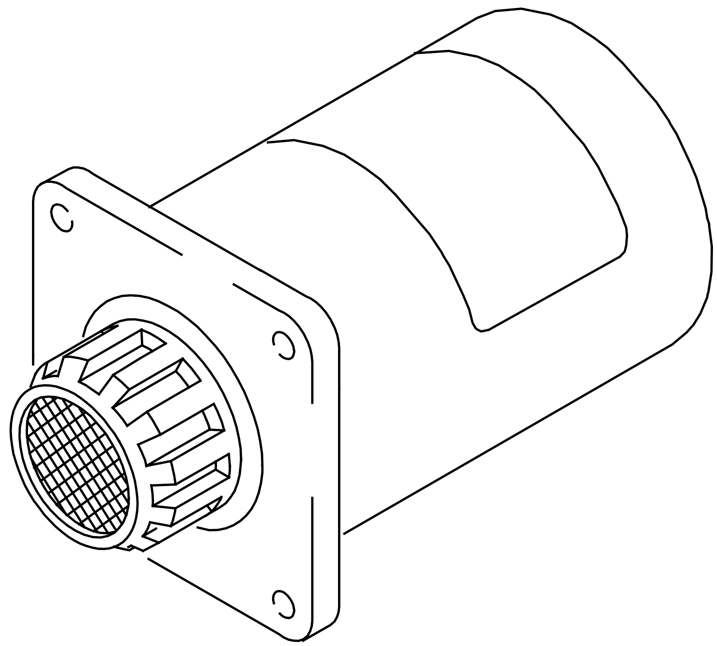
VOICE RECORDER SYSTEM - COCKPIT VOICE RECORDER MICROPHONE

Purpose

The cockpit voice recorder microphone collects flight deck area audio for input to the CVR.

Physical Description

The condenser-type microphone has a frequency range of 150 Hz - 5 kHz.



23-71-00-008 Rev 5 03/03/1997

VOICE RECORDER SYSTEM - COCKPIT VOICE RECORDER MICROPHONE

VOICE RECORDER SYSTEM - FUNCTIONAL DESCRIPTION

General

The voice recorder system receives flight deck sounds and flight crew communications. It keeps this audio in a solid state memory. The voice recorder system has these modes of operation:

- Normal operation
- Erase
- Test.

Normal Operation

With power on the airplane and the cockpit voice recorder (CVR) circuit breaker closed, the CVR operates continuously.

Four audio channels go to the CVR. Channel 1, 2, and 3 audio is from the audio management unit (AMU). Each channel carries audio from one crew member's flight interphone audio. The audio on each channel is the sum of these signals:

- Hot mic audio (microphone audio when there is no PTT)
- Received audio as selected on the crew member's audio control panel (ACP)
- Sidetone audio to the crew member.

Channel 4 audio is from the cockpit voice recorder microphone. The cockpit voice recorder microphone sends flight deck area audio to the CVR. The CVR panel gets 18v dc for the preamplifier from the CVR. The preamplifier in the panel increases the strength of the channel 4 audio and sends it to the CVR.

30v dc bias signal is a record enable signal from the airplane interface through an external jumper back to the airplane interface.

All audio goes to the CVR airplane interface. The airplane interface has these functions:

- Monitors power in the CVR
- Changes the format of input and output signals
- Controls the audio record process.

When CVR power is not in tolerance, the airplane interface sends a low power discrete to turn off other CVR circuits.

The airplane interface changes the input audio signals in the A/D-D/A circuits for use by the audio processor.

The airplane interface sends a record discrete to the audio processor and store processor to start the record process.

The audio processor samples the flight deck audio signals 8,000 times per second and the cockpit voice recorder microphone audio signals 12,000 times per second. It changes the analog signals to digital signals. These signals go to the store processor on the digital audio bus.

VOICE RECORDER SYSTEM - FUNCTIONAL DESCRIPTION

The audio processor also mixes the four digital signals and sends them to the airplane interface. The airplane interface sends these signals to headphone jacks in these locations:

- Cockpit voice recorder panel
- P40 service and APU shutdown panel.

The store processor uses signals on the control bus to control the functions of the flash memory. The store processor sends address signals to the flash store on the address bus. The addresses tell the flash memory where to keep the digital data. The data goes to the flash memory on the data bus.

The flash memory keeps the digital data in a first-in, first-out solid state memory.

The CVR gets universal coordinated time (UTC) data from the left AIMs cabinet. UTC data is sent to both the CVR and the flight data recorder (FDR). CVR and FDR events are synchronized using UTC data.

Test

Push and hold the TEST switch on the cockpit voice recorder panel to start a CVR self test. Hold the switch for a minimum of five seconds. The cockpit voice recorder panel sends a ground discrete to the airplane interface circuits in the CVR. The airplane interface sends this test discrete to the audio processor and to the store processor.

In the audio processor, the test discrete enables a tone generator. The tone generator sends a 620 Hz. tone to A/D-D/A circuits. They change the tone to a digital signal. The audio processor connects the digital tone in sequence to each of the four audio inputs of the store processor.

In the store processor, the test discrete enables the flash memory to store the digital test tones for each channel. It also enables the store processor to playback the test tones from the flash memory. The store processor sends the digital playback signals back to the audio processor.

The audio processor changes the digital signals to analog signals. It mixes the four signals into one audio signal and sends it to these locations:

- Test meter
- Cockpit voice recorder panel headset jack
- P40 service and APU shutdown panel.

The test meter reads the strength of the audio signal and shows it on the meter dial on the cockpit voice recorder panel. The meter needle moves to the green area of the meter dial for a normal test. The needle stays in the green area while you hold the TEST switch.

The store processor monitors for faults. When it finds one, it sends a fault signal to the airplane interface. When it detects the fault signal, the airplane interface keeps the audio signal from the meter.

VOICE RECORDER SYSTEM - FUNCTIONAL DESCRIPTION

You monitor the 620 Hz test tone at any of the headset jacks.

Erase

When the airplane is on the ground with the parking brake on, you push and hold the ERASE switch on the cockpit voice recorder panel to erase the CVR.

The airplane interface in the CVR sends 30v dc to K32001 parking brake relay. When the parking brake is on, the relay closes.

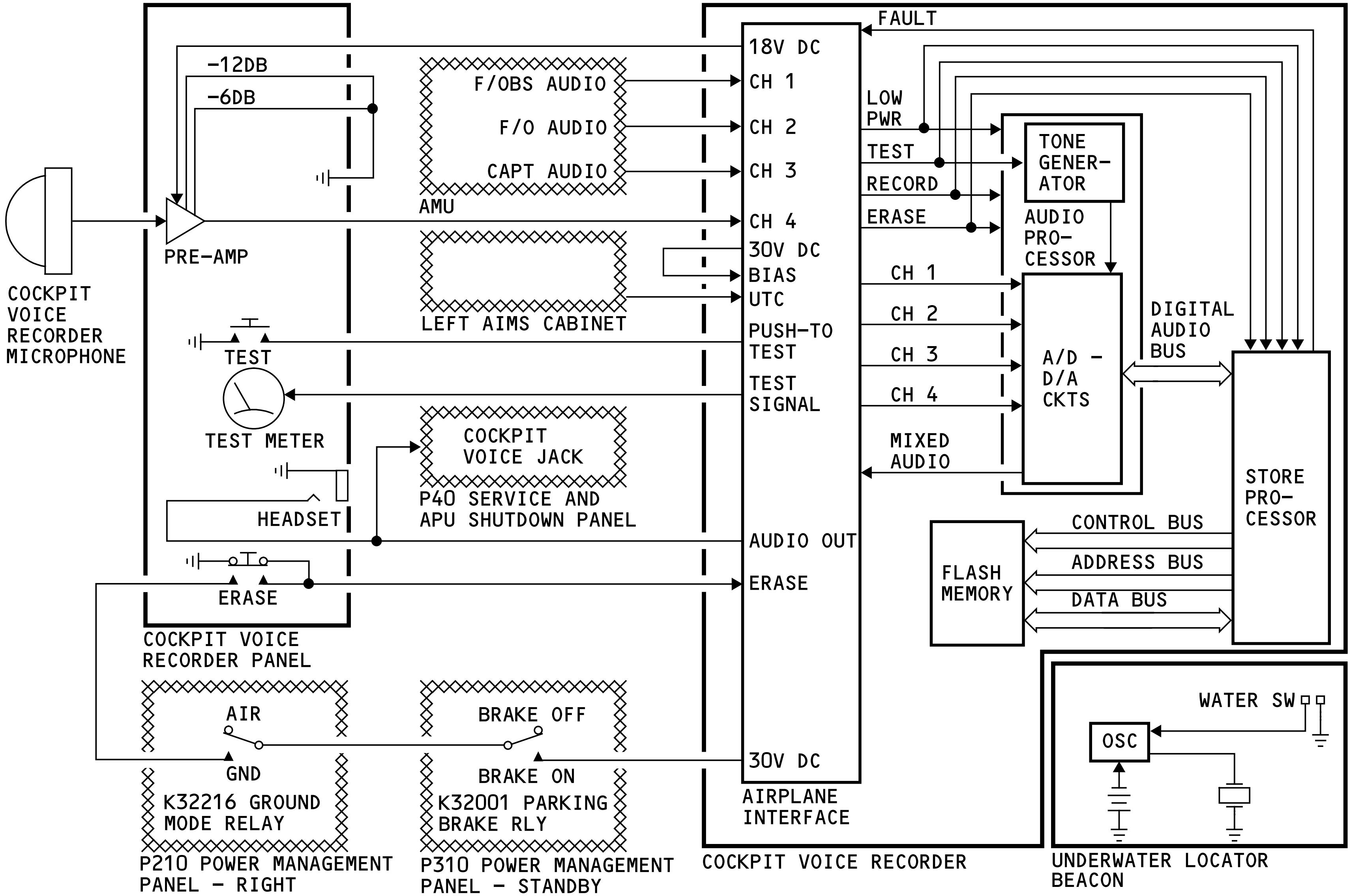
The 30v dc goes through the K32001 relay to K32216 ground mode relay. When the airplane is on the ground, the relay closes. The 30v dc goes through the K32216 relay to the ERASE switch in the cockpit voice recorder panel.

When you push the ERASE switch, the 30v dc goes to the airplane interface in the CVR. The airplane interface sends this erase discrete to the audio processor and the store processor.

In the audio processor, the erase discrete disables the A/D-D/A circuits. The store processor sends the erase discrete to the flash memory. The flash memory erases all data in the memory.

Underwater Locator Beacon Functions

The underwater locator beacon (ULB) sends a sound signal when in water. It uses a battery for power. The battery sends power to the oscillator when the ULB is in water. The oscillator operates at 37.5 kHz. The transducer changes electrical signal to a sound signal and transmits the signal once per second.



VOICE RECORDER SYSTEM - FUNCTIONAL DESCRIPTION

Continental Airlines, Inc

Fuel

WB371

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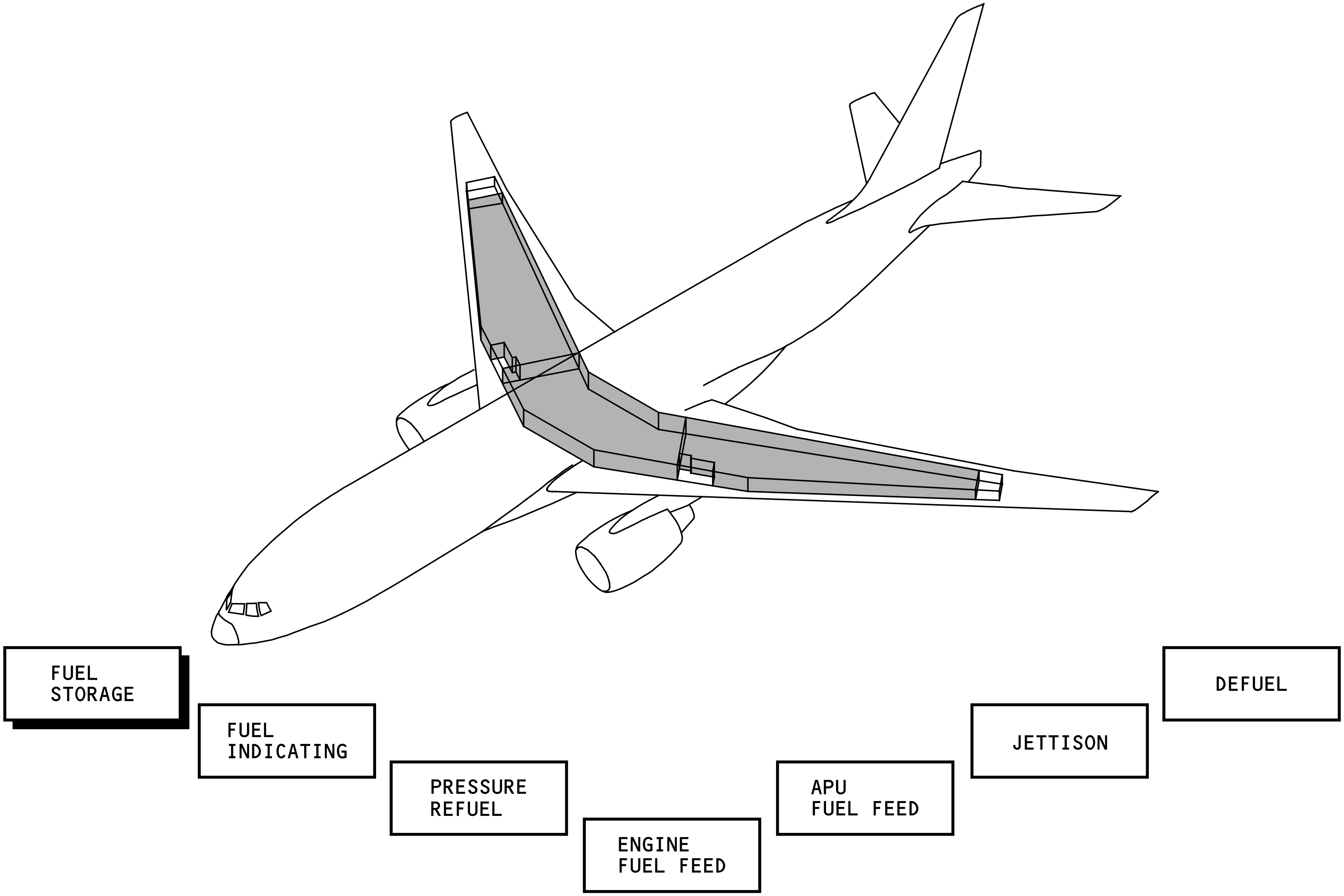
FUEL STORAGE - INTRODUCTION

General

The fuel storage system holds the fuel necessary for engine and APU operation.

The fuel storage system also does these functions:

- Gives maintenance access
- Prevents large pressure differences
- Helps drain the fuel tanks.



FUEL STORAGE - INTRODUCTION

FUEL STORAGE - GENERAL DESCRIPTION - TANK ARRANGEMENT

Fuel Tank Arrangement

These are the three fuel storage tanks:

- Left main tank
- Center tank
- Right main tank.

Surge tanks collect fuel overflow. The fuel overflow drains into the main tanks. Each main tank has a dry bay that does not hold fuel.

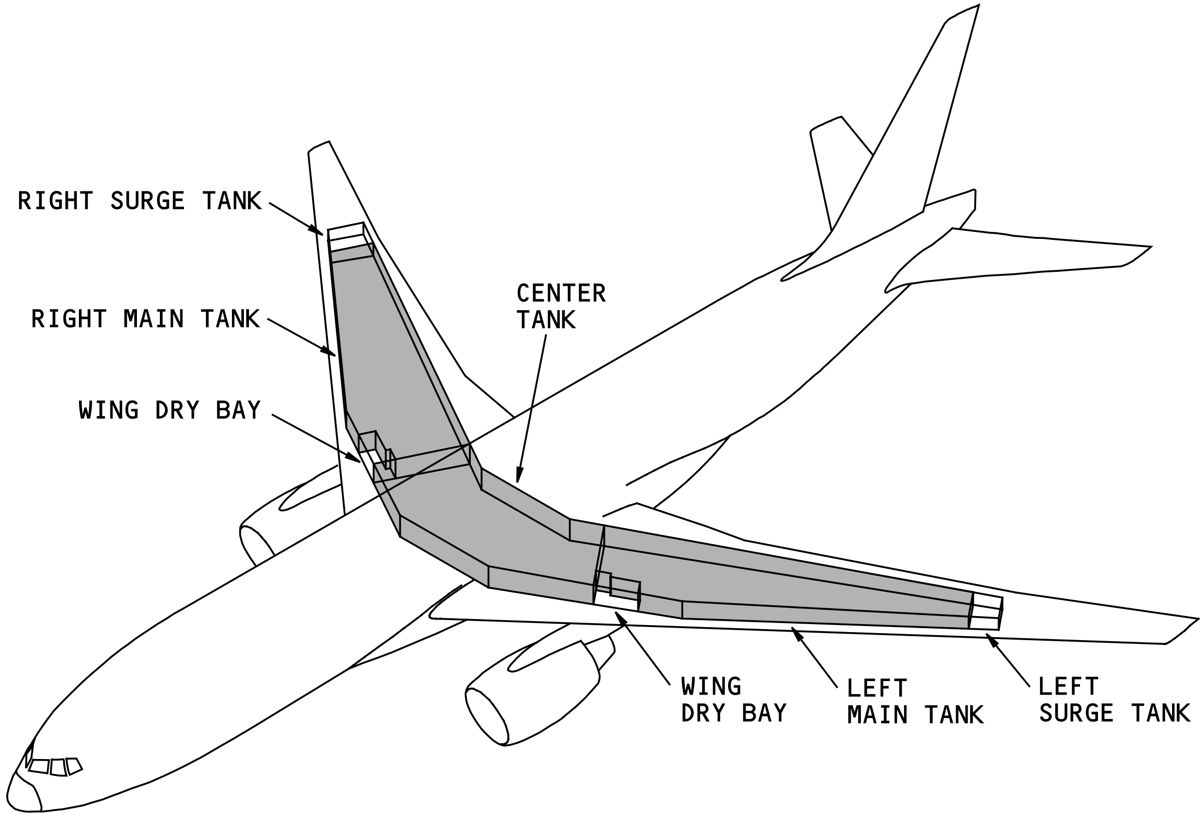
Component Locations

The left main tank is in the wing box of the left wing. The right main tank is in the wing box of the right wing. An adjacent surge tank is outboard of each main wing. An adjacent surge tank is outboard of each main tank. The wing dry bays are above each engine strut.

The center tank is in the center wing section and in the inboard wing box of the left and right wings.

Capacity

The capacity of each main tank is approximately 64,640 lb (29 320 kg) of fuel. The capacity of the center tank is approximately 176,440 lb (79 720 kg)



777 FUEL TANK CAPACITIES				
	GALS	LITERS	LB *	KG *
MAIN TANKS	9,560 EA	36 200 EA	64,626 EA	29 322 EA
CENTER TANK	26,100	98 800	176,436	80 028
TOTALS	45,220	171 200	305,687	138 672

* DENSITY = 6.76 LB/GAL (.81 KG/L)

FUEL STORAGE - GENERAL DESCRIPTION - TANK ARRANGEMENT

28-10-00-002 Rev 5 01/06/1997

FUEL STORAGE - GENERAL DESCRIPTION - TANK STRUCTURE AND ACCESS - 1

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FUEL STORAGE - GENERAL DESCRIPTION - TANK STRUCTURE AND ACCESS - 1

General

The fuel tanks are sealed parts of the wing structure. These are the parts of the fuel tanks:

- Upper wing skin
- Lower wing skin
- Front spar
- Rear spar
- Wing ribs.

Wing ribs divide the fuel tanks into bays, and reduce the movement of fuel during airplane maneuvers. Access doors and cutouts are entrances into the airplane fuel tanks for inspection or component repair.

Fuel Tank Locations

The center fuel tank is between rib 8 of the left wing and rib 8 of the right wing. Wing ribs divide each side of the center tank into seven fuel bays. The center wing section between the left and right side-of-body ribs (rib 1) is also a part of the center fuel tank. Three spanwise beams between the left and right side-of-body ribs divide the center wing section into four fuel bays. A purge door for the fuel bays in the center wing section is on the rear spar.

The main tanks are between rib 8 and rib 32 in each wing. Wing ribs divide each main tank into 24 fuel bays. The forward parts of the bays between rib 8 and rib 11 are dry. These wing dry bays prevent a fuel spill on the engine if an engine burst occurs.

The surge tanks are between rib 32 and rib 34 in each wing. A wing rib divides each surge tank into two fuel bays.

Wing Ribs

Standard wing ribs have upper and lower openings between the stringers that let fuel and air flow through them.

Tank-end ribs close the ends of each fuel tank. Tank-end ribs are sealed. No fuel can flow through them.

Rib 18 is a baffle rib. The rib is sealed, but has check valves between each lower stringer. The check valves let fuel flow inboard at a slow rate. One hole at the bottom of the rib lets fuel flow outboard. This keeps the fuel level on the two sides of the rib the same. Two large holes and six smaller holes at the top of the rib let air through it.

Rib 10 is a fuel dam rib. The lower section is the same as the baffle rib, but the upper section is the same as a standard rib. The fuel dams of rib 10 prevent fuel from flowing away from the fuel pump inlets.

Fuel Tank Access Doors

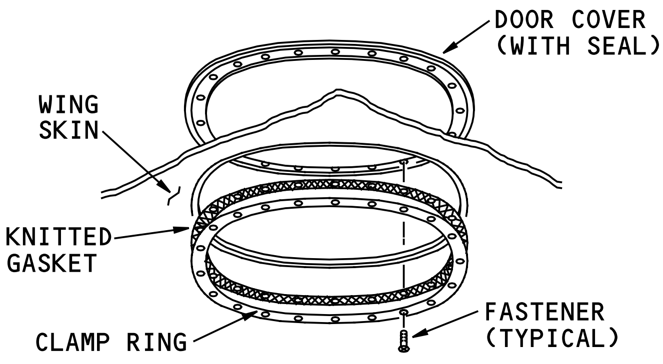
The access doors fit in fuel bays over openings in the airplane skin. A clamp ring and knitted aluminum gasket bolt to the access door from outside the airplane to hold the access door in its position. Thus, no bolt holes are in the skin. The gasket makes an electrical bond between the access door and the airplane skin. A rubber seal in the access door prevents fuel leaks around the access door.

Six of the access doors in each main fuel tank have fuel quantity measuring stick assemblies. The eleven inboard access doors of each wing have impact-resistant access doors.

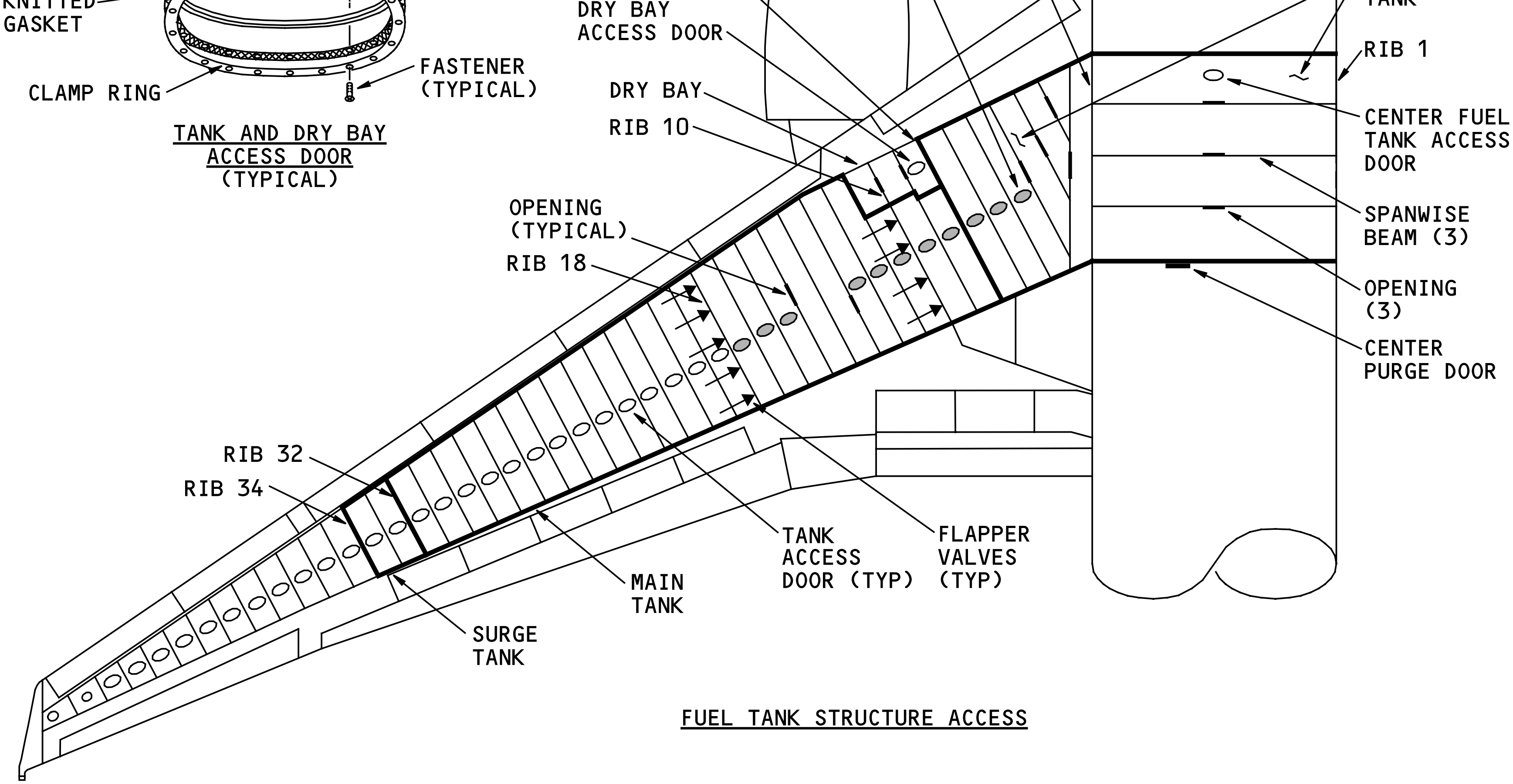
Rib and Spanwise Beam Cutouts

Some of the bays do not have an access door. You can get access to these bays from adjacent bays. Access openings in wing ribs and spanwise beams let you go in from an adjacent bay.

The purge door is in the left main wheel well. It supplies an opening for airflow when you purge the fuel bays in the center wing section.



TANK AND DRY BAY
ACCESS DOOR
(TYPICAL)



FUEL TANK STRUCTURE ACCESS

28-10-00-003 Rev 6 03/26/96

FUEL STORAGE - GENERAL DESCRIPTION - TANK STRUCTURE AND ACCESS - 1

FUEL STORAGE - GENERAL DESCRIPTION - TANK STRUCTURE AND ACCESS - 2

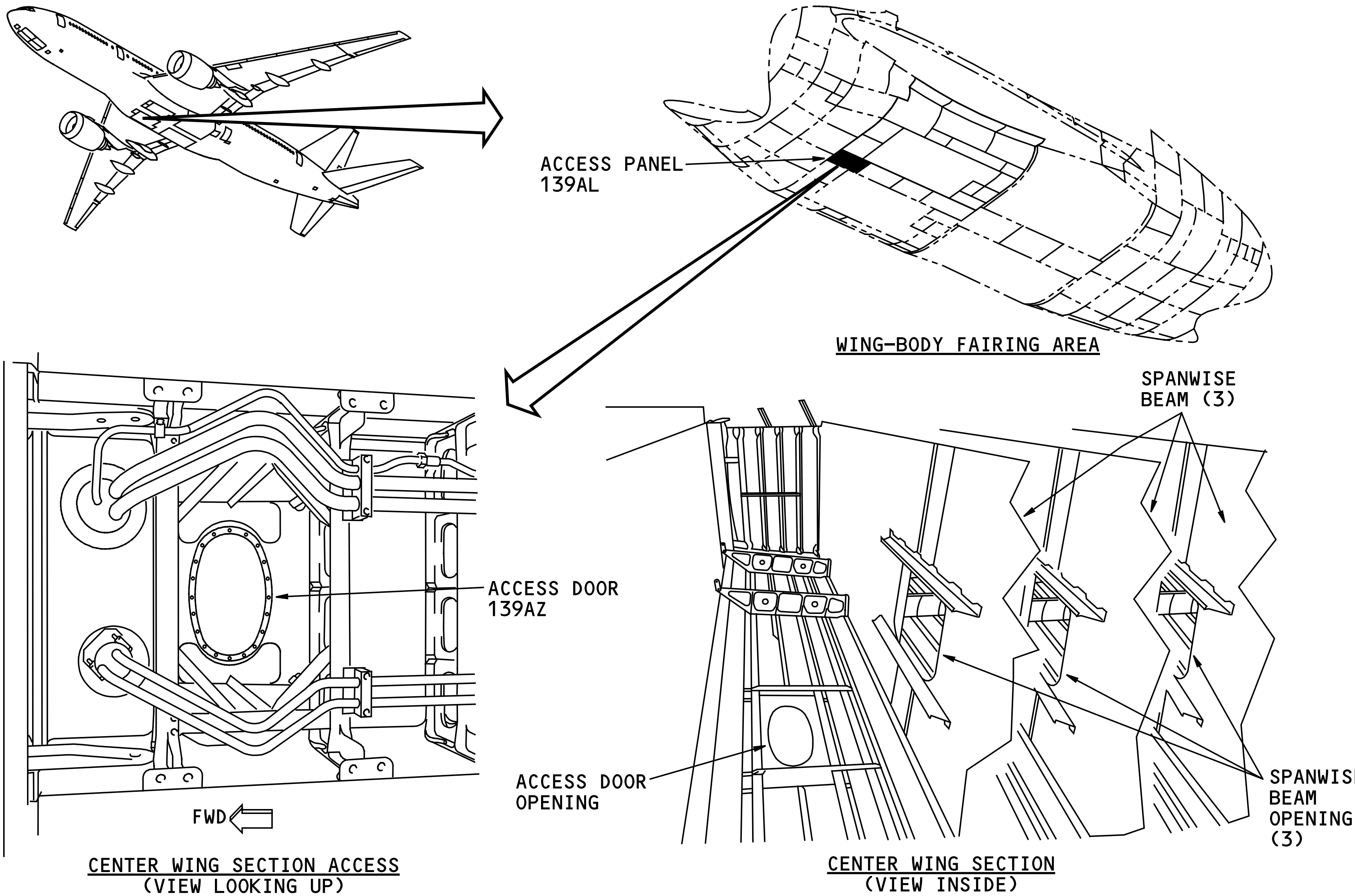
General

You remove access doors on the bottom of the tanks and dry bays to get access inside the tanks.

Center Wing Section Access

You get access into the center wing section fuel bays through a single access door. The access door (139AZ) is on the forward, center, lower skin of the center wing section. You must open panel 139AL on the wing-body fairing to get to access door 139AZ.

Spanwise beams in the center wing section have access openings. You get access to each bay through the spanwise beam openings.



FUEL STORAGE - GENERAL DESCRIPTION - TANK STRUCTURE AND ACCESS - 2

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FUEL STORAGE - SUMP DRAIN VALVES

General

Sump drain valves are at the low point of each fuel tank.

You use the sump drain valves to these functions:

- Get fuel samples
- Remove water and contaminants from the fuel tanks
- Drain all the fuel that remains after the defuel procedure
- Check for fuel in a surge tank before you open an access door.

Component Locations

The center tank has two sump drain valves. The valves are at the low points of the center wing section next to the side of body ribs. You get access to each valve through an access door in the wing-to-body fairing. A flexible hose connects the valve to a drain hole in the fairing.

Each main tank has one sump drain valve. The sump drain valve is in the lower wing skin near the fourth access door from the fuselage (between rib 8 and rib 9).

A sump drain valve for each surge tank is between rib 32 and rib 33 (26 access doors away from the fuselage).

Functional Description

Each sump drain valve in the main tank and the surge tank has a primary poppet and a secondary poppet (not shown). The secondary poppet lets you remove the primary poppet without defueling.

The sump drain valve in the center tank has a poppet valve in the valve body. A flapper valve lets you remove the valve body without defueling.

Operation

To drain fluid from the center tank, push up on the flexible hose connection on the sump drain valve. This opens the valve and lets the fuel sample drain through the hose. Use a container to collect the sample at the drain hole in the wing-to-body fairing. You must hold the valve in the open position.

To drain fluid from a main tank or to check for fuel in a surge tank, turn and push up on the primary poppet with a fuel sampling tool. You must hold the poppet in the open position.

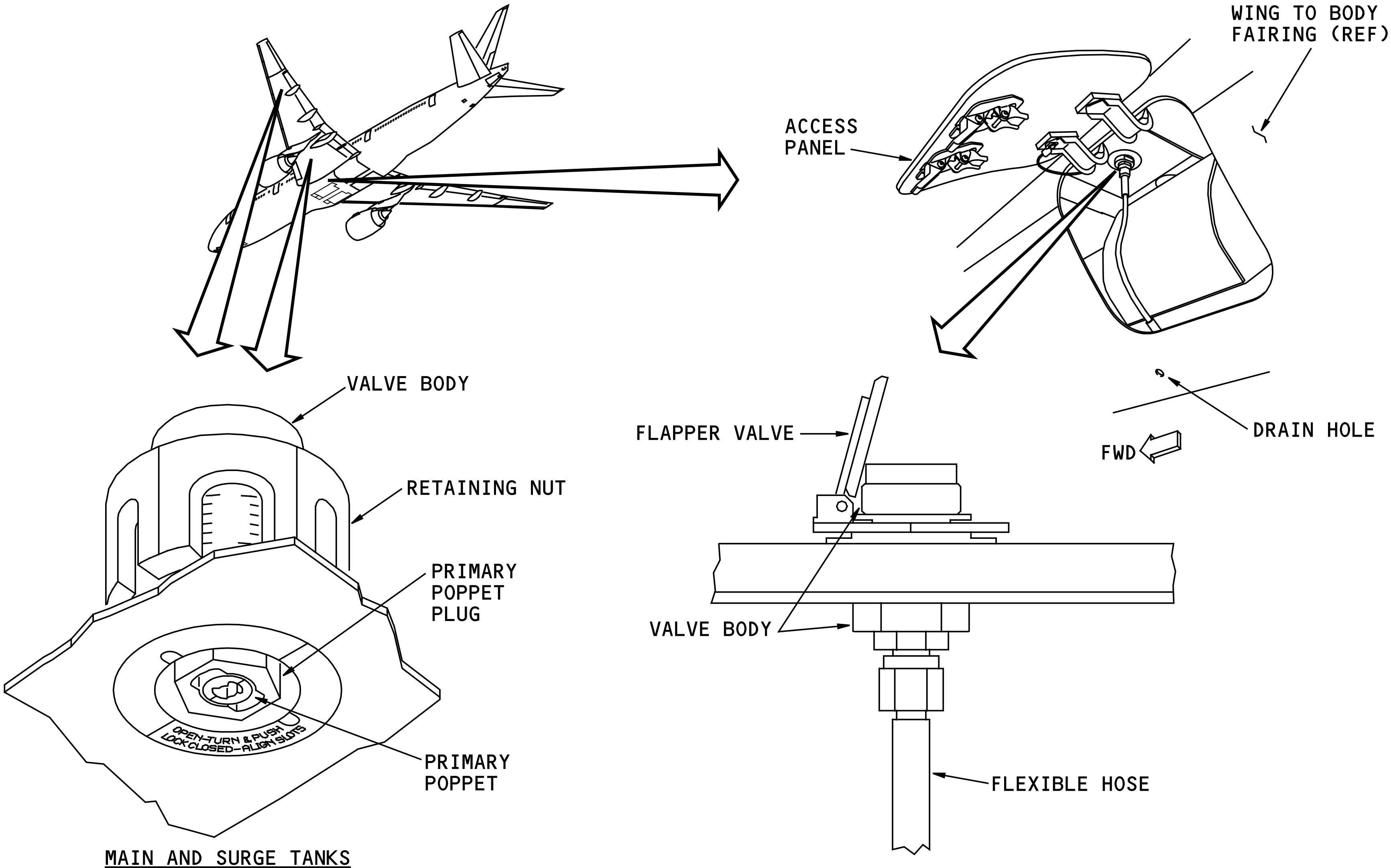
To drain the fuel that remains after you do the defuel procedure, you can remove the primary poppet plug and primary poppet. Then install the sump drain fitting/tool to hold the secondary poppet open. This lets all the fuel drain through the sump drain/fitting tool.

FUEL STORAGE - SUMP DRAIN VALVES

Training Information Point

You should get a fuel sample from the sump drain valves before and after you do the refuel procedure. A large quantity of water in a fuel sample that you drain from a tank before refueling is an indication of a blocked water scavenge jet pump.

Cold weather can freeze the water in the fuel tanks. This can prevent the drain valves from opening.



MAIN AND SURGE TANKS SUMP DRAIN VALVE (TYPICAL)

CENTER TANK SUMP DRAIN VALVE (TYPICAL)

FUEL STORAGE - SUMP DRAIN VALVES

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FUEL STORAGE - TANK VENT SYSTEM

General

The fuel vent system keeps the pressure of the fuel tanks near the pressure of the outside atmosphere. A large pressure difference can damage the wing structure.

Drains let fuel in the vent system return to the fuel tanks so the engines or APU can use it.

Flame arrestors make sure that a flame does not come inside the fuel tanks through the vent system. If a flame arrestor becomes blocked, pressure relief valves in the surge tank open to make a vent.

Component Locations

Hat-section upper stringers and the upper wing skin make vent channels. A vent tube that has a drain valve at the low point attaches to each vent channel.

Each main tank has a forward and an aft vent channel. A fuel vent float valve attaches to the outboard end of each forward vent channel.

The center tank has three vent channels. Two float actuated drain valves attach to the low points on each vent channel.

There is a vent scoop access door in each surge tank. Each vent scoop contains a flame arrestor.

There is a pressure relief valve in the inboard access door of each surge tank.

A check valve in the inboard rib of each surge tank lets any fuel in the surge tank drain back into the main tank.

Functional Description

Vent channels and vent tubes keep the pressure of all the fuel tanks near the pressure in the surge tanks. The surge tanks are open to outside air through the vent scoops. The shape of the vent scoops keep positive pressure inside the surge tanks during flight.

Vent tube drain valves let fuel in the vent tubes drain back into the tank when the fuel level is below the level of the valve.

Fuel in the center tank vent channels drains through the float-actuated drain valves when the drain valves are not covered by fuel. Float-actuated drain valves close when the fuel level is above them. Thus, fuel does not get into the vent channels through the drain valves.

When the fuel level is higher than the outboard end of the main tank vent channels, the fuel vent float valves close to keep fuel out of the vent channels. When the fuel level is below these valves, the floats open them.

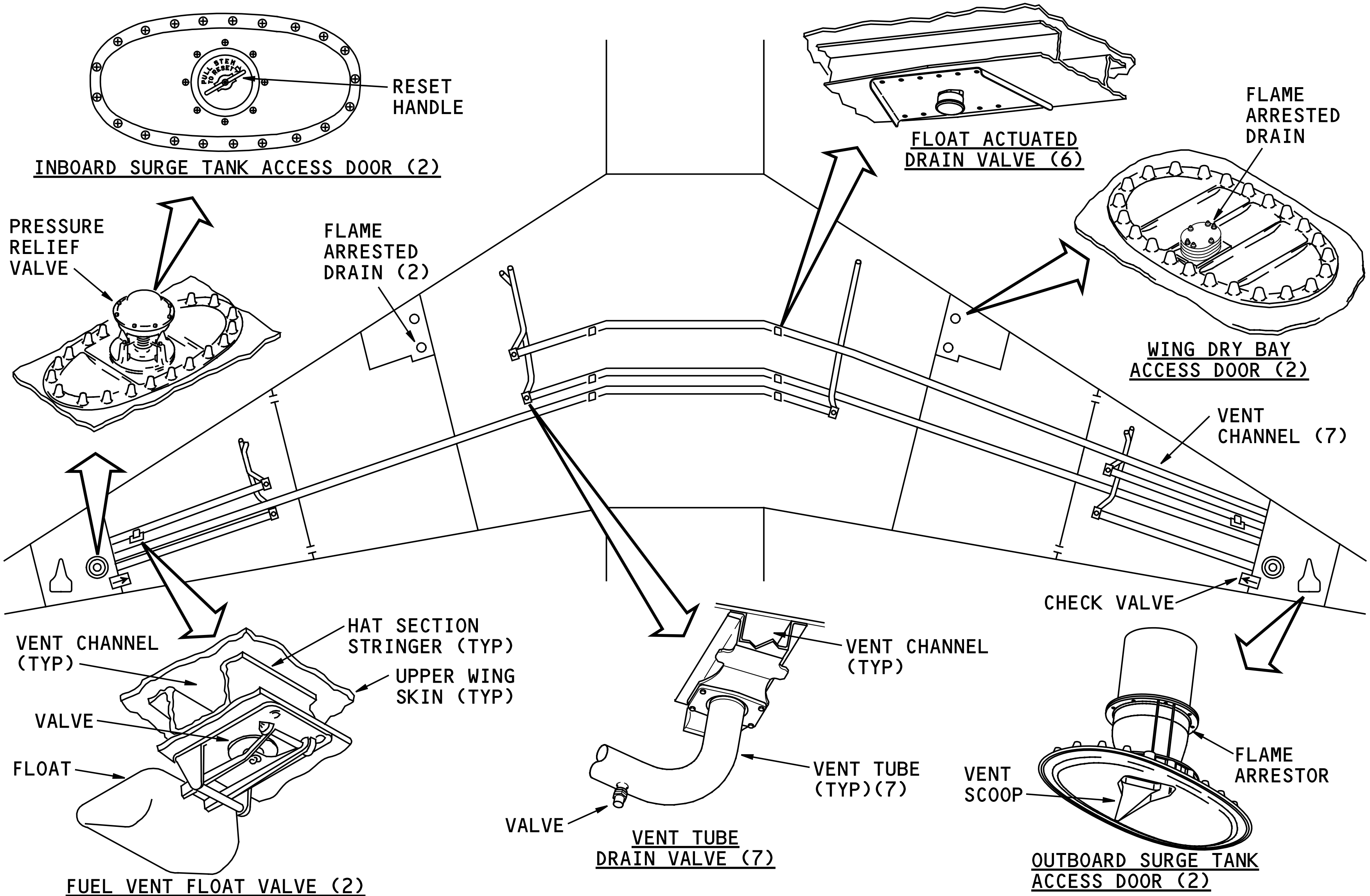
The pressure relief valve is normally closed. When it is closed, the valve is in line with the bottom of the

FUEL STORAGE - TANK VENT SYSTEM

wing. If a pressure difference opens the valve, it moves up as it opens. A spring holds the valve open until you close it. Pull the reset handle to move the valve back to the closed position.

Training Information Point

When you do an inspection, you must look at the pressure relief valves. Make sure they are closed. An open pressure relief valve is a symptom of a blocked vent scoop or flame arrestor. The pressure relief valve can also open to relieve air or fuel pressure if there is too much pressure during refueling.



FUEL STORAGE - TANK VENT SYSTEM

FUEL STORAGE - TANK ENTRY - TRAINING INFORMATION POINTS

Fuel Tank Entry

The fumes from fuel in a fuel tank are explosive and poisonous.

Before you go into a fuel tank, you must defuel the fuel tank and decrease the fuel fumes to a safe level. You do the purging and fuel tank entry procedure to remove fuel fumes.

A spark in the fuel tank can cause an explosion. When you are in a fuel tank you must do these things to prevent sparks:

- Put on approved clothing
- Obey the fuel fume concentration limits
- Have good air flow through the tank
- Obey instructions for use of tools.

Clothing

You must put on approved clothing, and rubber gloves. Nylon, rayon, silk, or wool clothing can cause sparks and are not approved.

Fuel Fume Concentration

The air in the fuel tank must be fire-safe or, health-safe. The limits for the fire-safe condition and the health-safe condition are in the purging and fuel tank entry procedure.

A fuel tank in the fire-safe condition is safe to work in if you use respirator equipment. A fuel tank in the health-safe condition is safe to work in without respirator equipment.

You use a combustible gas indicator to measure the fuel fume concentration in a fuel tank.

Air Flow

The fuel tank must have a good flow of air to keep it fire-safe or health-safe.

Install an air mover in an access door at one end of the tank. Remove an access door at the opposite end of the tank, so the air mover can pull a good flow of air through the fuel tank.

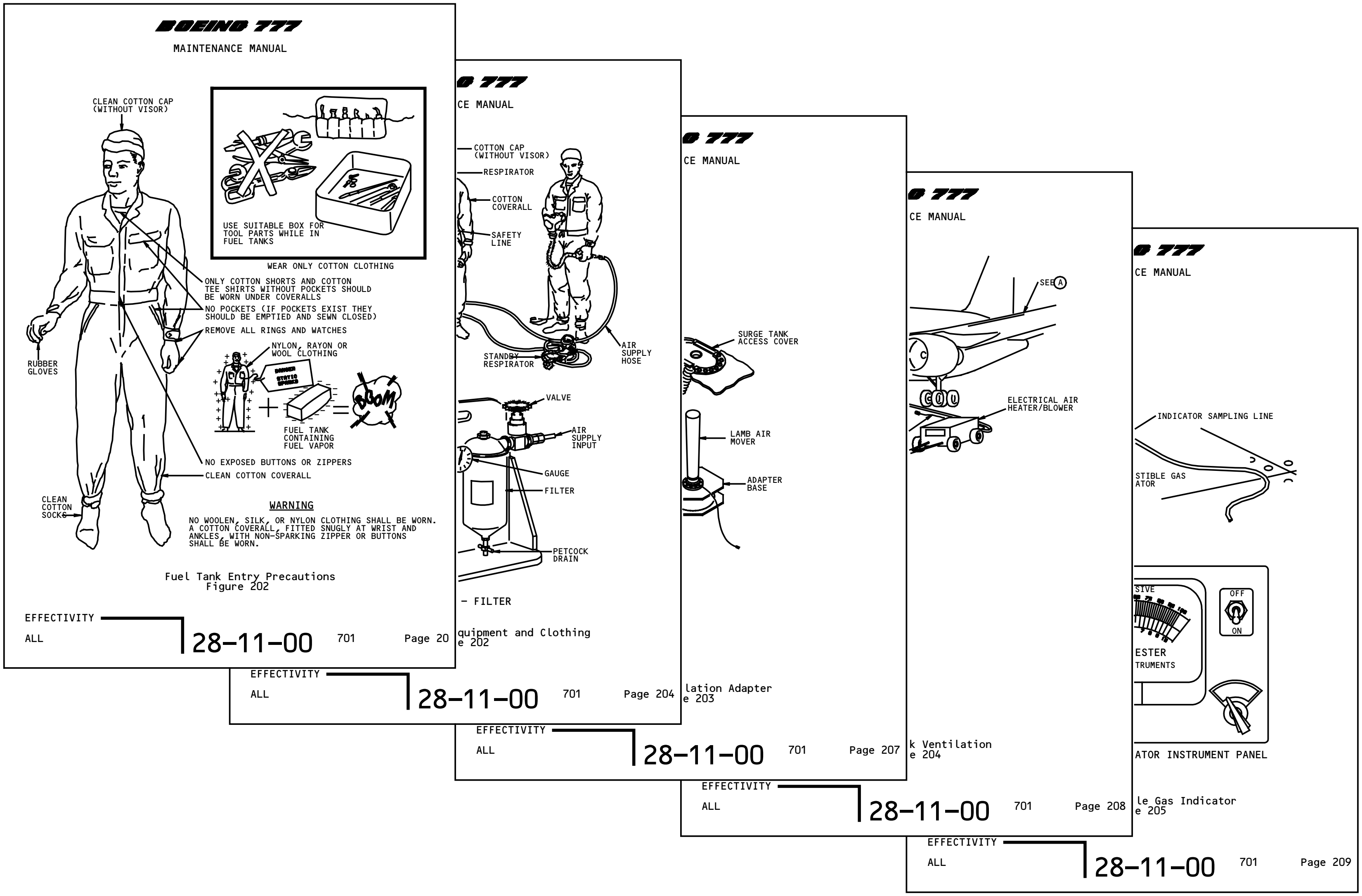
In the main tanks, make sure that the air mover pulls the air inboard. This lets a good flow of air go through the baffle rib.

Tools

Keep tools in non-static containers that have rounded corners while you do not use them.

Use only explosion-proof electrical equipment.

Make sure to remove all the equipment you bring into the fuel tank.



28-10-00-007 Rev 1

FUEL STORAGE - TANK ENTRY - TRAINING INFORMATION POINTS

FUEL INDICATING - INTRODUCTION

General

The fuel indicating system has these subsystems:

- Fuel quantity indicating system
- Fuel measuring sticks
- Fuel temperature indicating
- Fuel pressure indicating.

Fuel Quantity Indicating System (FQIS)

The FQIS measures fuel quantity in the tanks. The primary display system (PDS) and the IRP indicators show fuel quantity.

Fuel Measuring Sticks

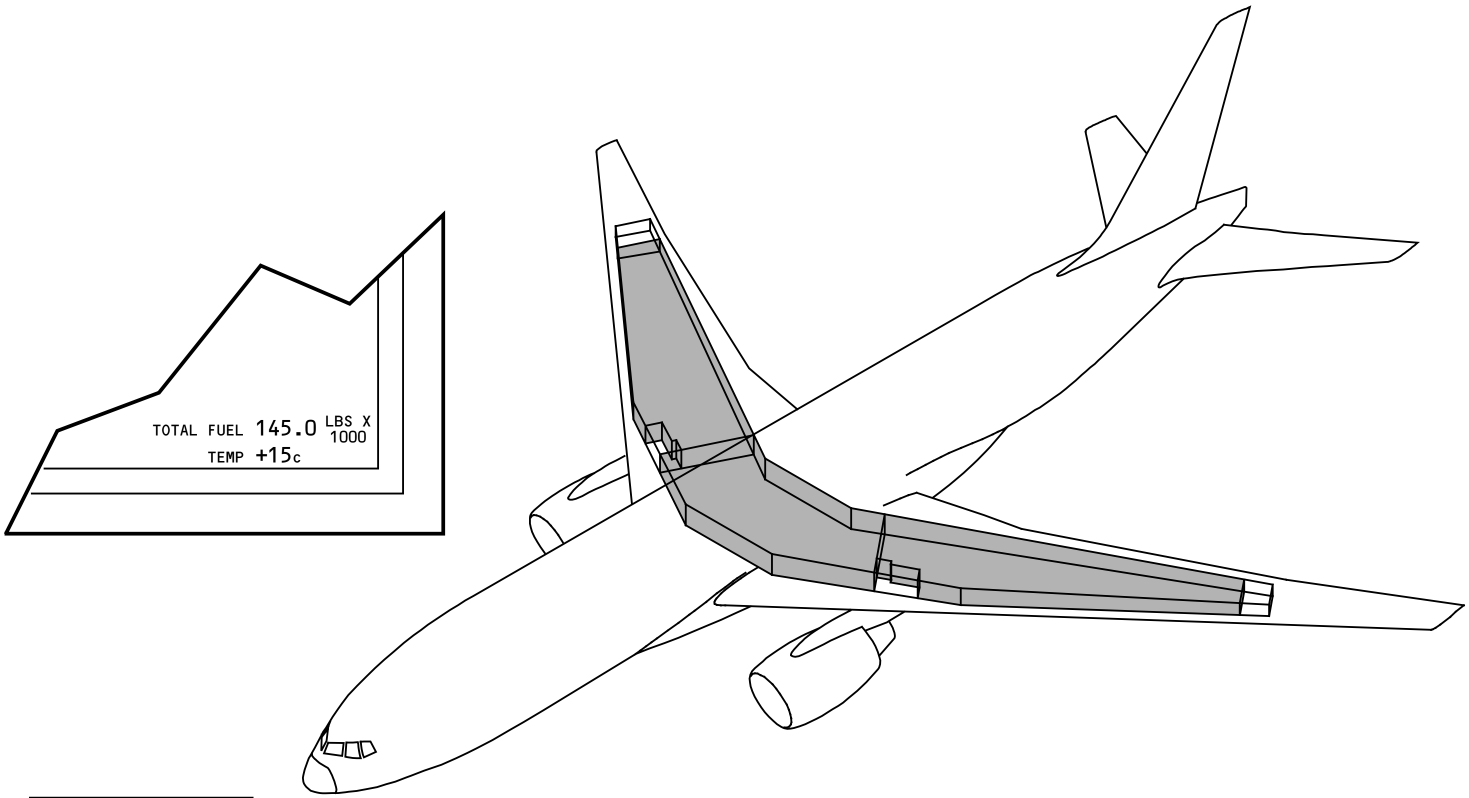
The fuel measuring sticks permit you to manually measure fuel quantity in each tank.

Fuel Temperature Indicating System

The fuel temperature indicating system measures the fuel temperature in the left main tank. The PDS shows the temperature.

Fuel Pressure Indicating System

The fuel pressure indicating system shows low pressure at the fuel pump outlets. See the engine fuel feed section for more information about fuel pressure indicating (AMM PART I 28-22).



FUEL STORAGE

FUEL INDICATING

PRESSURE REFUEL

ENGINE FUEL FEED

APU FUEL FEED

JETTISON

DEFUEL

FUEL INDICATING - INTRODUCTION

FUEL INDICATING - FQIS - GENERAL DESCRIPTION

General

The fuel quantity indicating system (FQIS) does these functions:

- Measures the fuel volume
- Calculates the fuel quantity
- Controls refuel operations
- Shows when there is water in the tanks.

These are the FQIS components:

- Tank units
- Densitometers
- Water detectors
- Fuel temperature sensor
- Wiring harnesses
- Fuel quantity processor unit (FQPU).

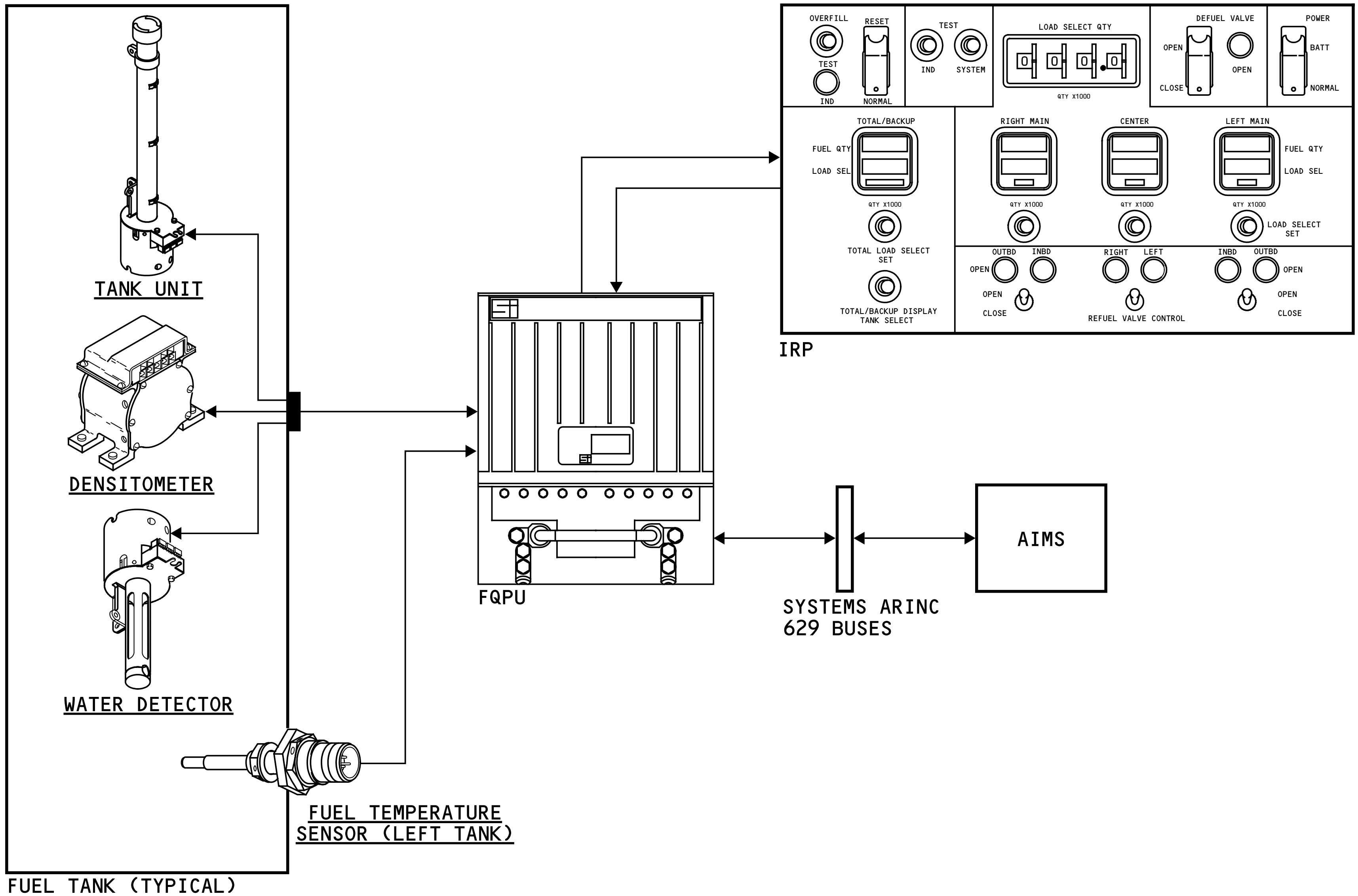
Operation

The FQPU sends signals to and gets signals from the fuel tank sensors. The FQPU uses the signals to calculate these data:

- Fuel height
- Fuel quantity in each tank
- Total fuel quantity.

The FQPU shows fuel quantity data on the EICAS display and on the integrated refuel panel (IRP) indicators.

Fuel weights go to the IRP on ARINC 429. Fuel weights, and FQIS data and fault information go to the AIMS on the systems ARINC 629 buses.



FUEL INDICATING - FQIS - GENERAL DESCRIPTION

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FUEL INDICATING - FQIS - FUEL TANK SENSORS

General

These are the sensors in the fuel tanks:

- Tank units
- Densitometers
- Water detectors
- Temperature sensor.

Tank Units

The tank units measure fuel height. There are 60 tank units in the three tanks: 20 in each main tank and 20 in the center tank.

Each tank unit position has a number. In the main tanks, tank unit 1 is at the inboard end of the tank. Tank unit 20 is at the outboard end of the tank. In the center tank, the left and right side tank unit numbers are from 1 to 10. The left tank unit 1 is at the left outboard end of the center tank. The right tank unit 1 is at the right outboard end of the center tank.

Each tank unit has an ultrasonic transmitter/receiver and a stillwell. Ten of the tank units also have calibration targets.

The fuel quantity processor unit (FQPU) sends a signal to the ultrasonic transmitter/receiver. This causes a sonic pulse to go through the fuel in the stillwell to the fuel surface, and back to the receiver. The FQPU measures the travel time of the pulse and uses it to find the fuel height.

The sonic pulse also reflects from the targets back to the receiver. The FQPU uses these pulses to measure the velocity of sound (VOS)in the fuel.

Densitometers

Each fuel tank has one densitometer. Densitometers use a vibrating cylinder transducer to measure the fuel density in each tank. The frequency of the vibrations is proportional to the fuel density. The densitometers are energized and monitored by the FQPU.

Water Detectors

Water detectors are at the low point in each fuel tank in the tank sump area. The FQPU uses water detector signals to see if there is water in the tank sump area. Each fuel tank has one water detector. The fuel quantity maintenance page shows a message when there is water in the fuel tank.

The water detectors are ultrasonic devices like the tank units. The FQPU sends a signal to the water detectors. The water detectors send a pulse to the bottom of the tank. If there is water in the bottom of the tank, the pulse reflects off the interface between the water and fuel.

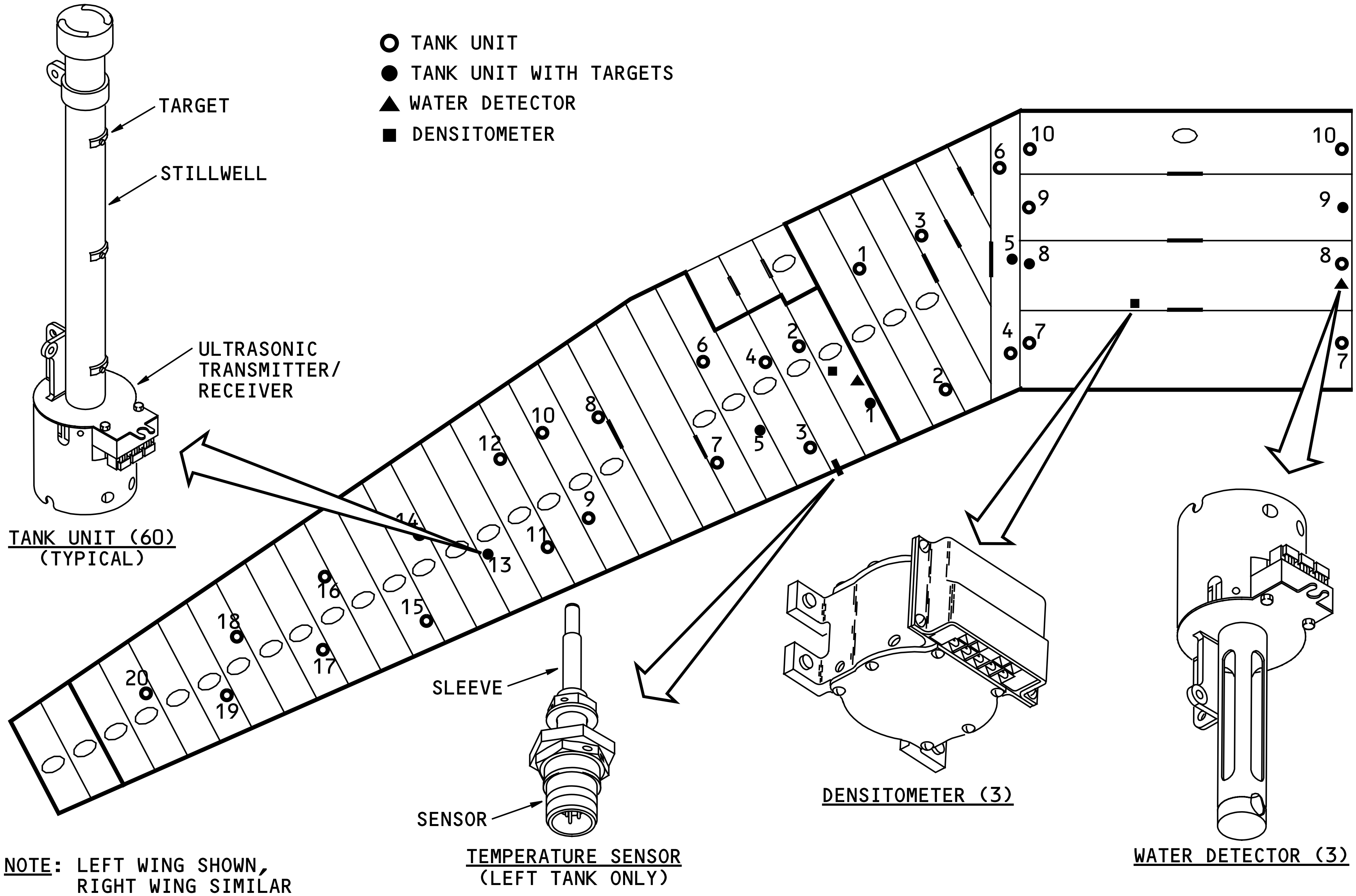
Temperature Sensor

There is only one fuel temperature sensor. It measures the fuel temperature in the left main tank. The

FUEL INDICATING - FQIS - FUEL TANK SENSORS

temperature sensor is a resistance-type sensor that fits inside a sleeve.

The sleeve is on the rear spar of the left wing, aft of the fifth fuel tank access door (between ribs 9 and 10).



FUEL INDICATING - FQIS - FUEL TANK SENSORS

FUEL INDICATING - FQIS - WIRING HARNESS

General

Tank wiring includes internal harnesses, external harnesses, and connectors. Internal harnesses connect the fuel tank sensors to connectors on the spars. External harnesses go from the spar connectors to the FQPU.

Internal Harness

Each main tank has two internal harnesses. The inboard harness connects eight tank units, one densitometer, and one water detector to one connector on the rear spar. The inboard harness connector is aft of the fifth fuel tank access door (between ribs 9 and 10). The outboard harness (not shown) connects twelve tank units to another connector on the rear spar. The outboard harness connector is aft of the sixth fuel tank access door (between ribs 10 and 11).

The center tank has two internal harnesses. The left center tank harness connects ten tank units and the densitometer to a connector on the left front spar. The right center tank harness connects ten tank units and the water detector to a connector on the right front spar. The connectors are between ribs 2 and 3.

The internal wire harnesses connect to fuel tank sensors with Faston connectors. The Faston connectors have a terminal and insulator on the wire, and a tab on the sensor. The insulator is around the terminal.

External Harness

There are two external harnesses for each tank. The main tank external harnesses go from the connectors on the rear spar to the FQPU.

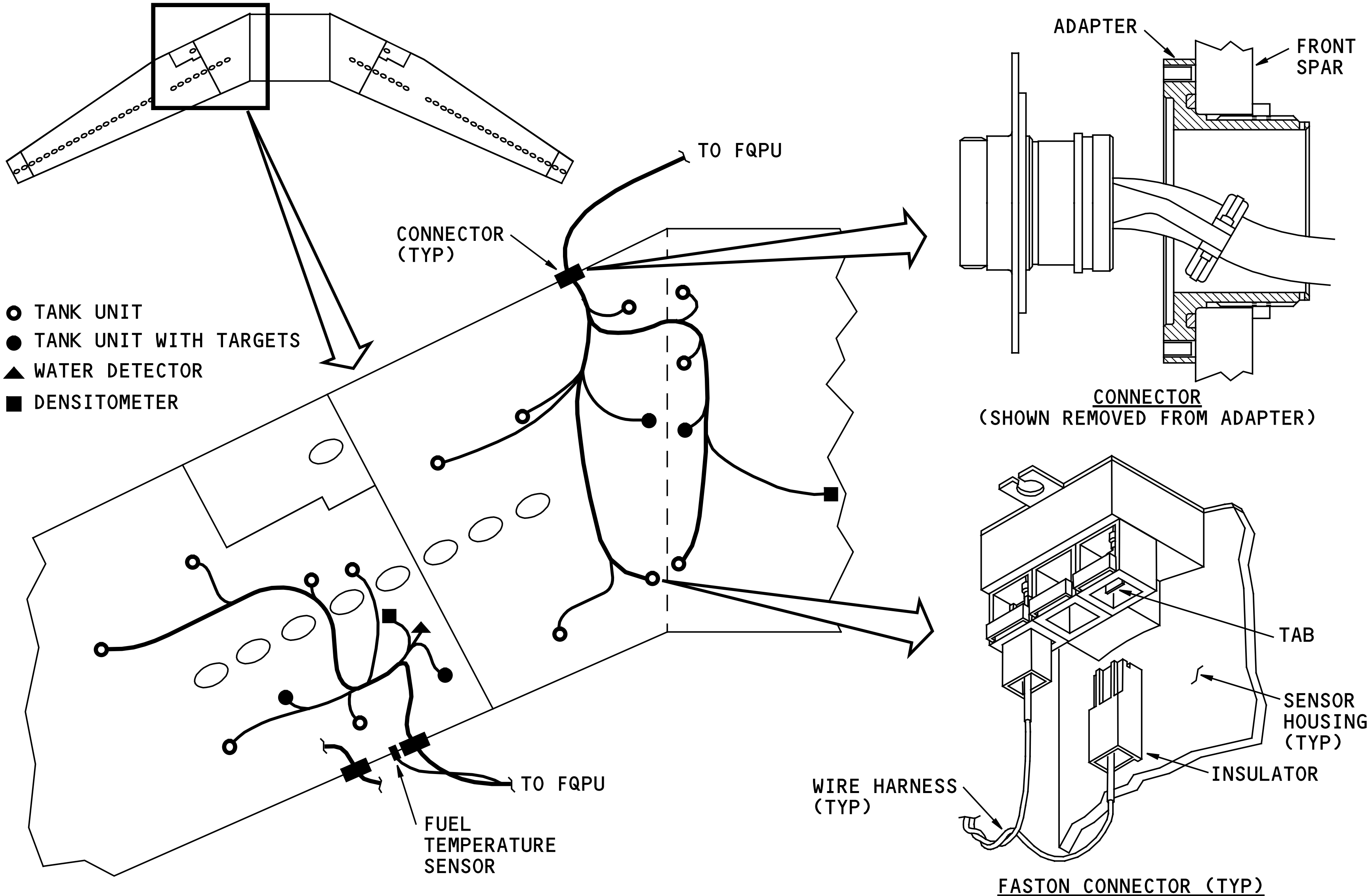
The center tank harnesses go from the connectors on the front spar to the FQPU.

Each connector attaches to the spar with an adapter. You can remove and repair the connectors without entering the tank.

Training Information Point

Each fuel tank sensor has a separate twisted wire pair. Thus, a single wire failure does not affect the whole tank. You cannot make splices in the wire harnesses.

You pull the insulator to disconnect the Faston connector. You push the insulator onto the tab to install the Faston connector. The shape of the insulator does not let you put a wire on the wrong tab.



FUEL INDICATING - FQIS - WIRING HARNESS

FUEL INDICATING - FQIS - COMPONENT LOCATIONS - WINGS

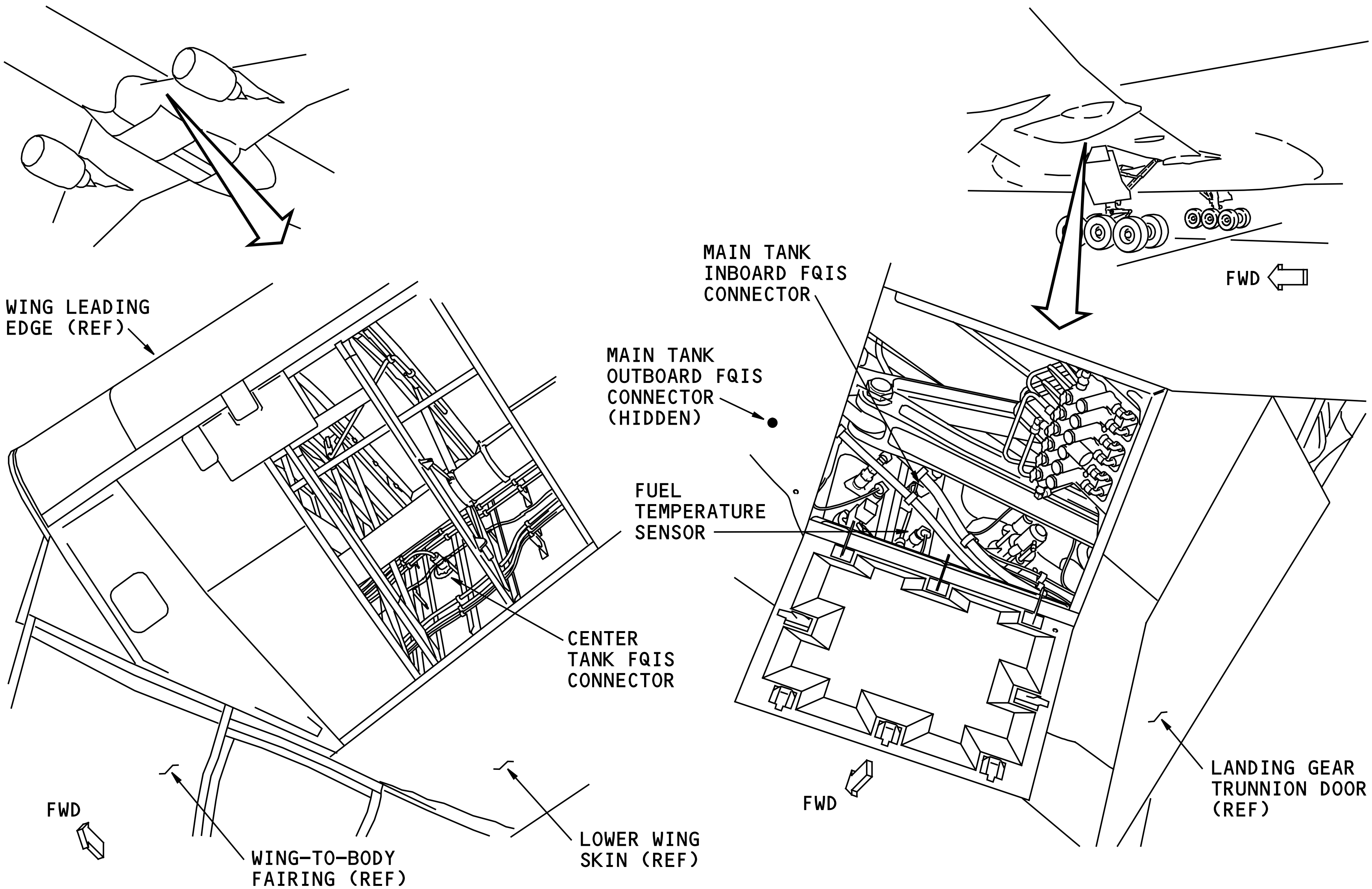
FQIS Connectors

Each half of the center tank has one FQIS connector. It is on the front wing spar near the wing-to-body fairing.

Each main tank has two FQIS connectors. They are on the rear wing spar, outboard of the main landing gear shock strut, near the landing gear trunnion door.

Fuel Temperature Sensor

There is one fuel temperature sensor in the left main tank. It attaches to the rear spar of the left wing, below the main tank inboard FQIS connector.



28-40-00-011 Rev 1

FUEL INDICATING - FQIS - COMPONENT LOCATIONS - WINGS

FUEL INDICATING - FQIS - FUEL QUANTITY PROCESSOR UNIT

Purpose

The fuel quantity processor unit (FQPU) does these functions:

- Calculates the fuel weight for each tank
- Calculates the total fuel weight
- Shows the weights on the IRP indicators
- Sends the weights to the AIMS
- Causes the refuel valves to close
- Monitors the FQIS for faults
- Sends fault data to the CMCS.

Location

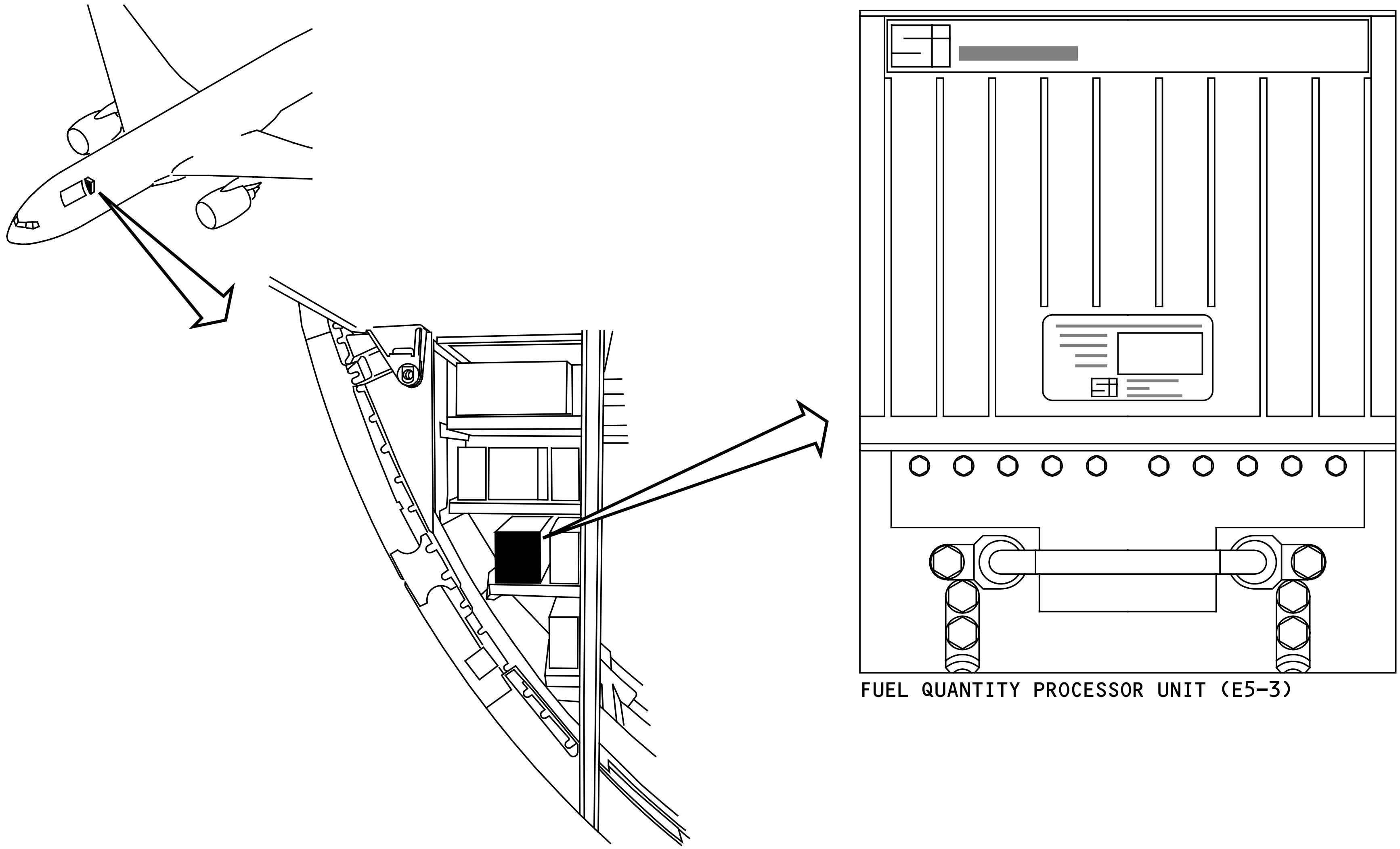
The FQPU is on the E5-3 shelf.

Physical Description

The FQPU is in a 5 MCU ARINC 600 container. The container has twelve printed circuit boards. The FQPU connects to airplane wiring.

Training Information Point

The FQPU has software that is data-loadable.



28-40-00-005 Rev 2

FUEL INDICATING - FQIS - FUEL QUANTITY PROCESSOR UNIT

FUEL INDICATING - FQIS - POWER

General

The FQPU connects to two isolated 28v dc power sources at one time. The FQPU operates when one or both of the sources have power.

Power Sources

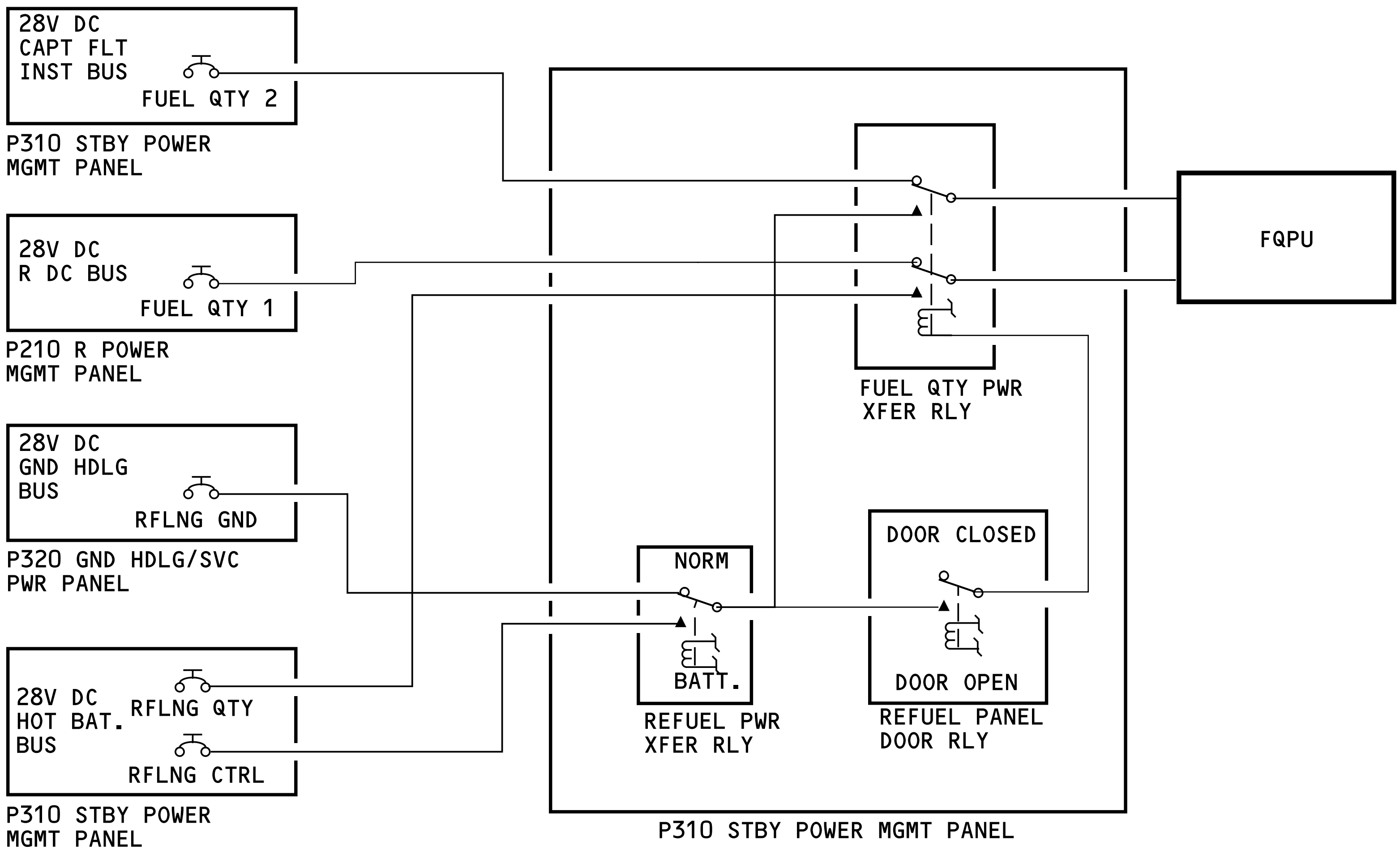
The FQPU gets power from four different sources:

- Captain's flight instrument bus
- Right dc bus
- Ground handling bus
- Hot battery bus.

During normal operation, the refuel station door is closed. The FQPU gets power from the captain's flight instrument bus and the right dc bus. The two power sources are connected together inside the FQPU. Whichever has the higher voltage supplies power to the two FQPU channels.

When the refuel station door is open and the ground handling bus has power, the fuel quantity power transfer relay energizes. This causes the FQPU to get power from different sources. The FQPU gets power from the ground handling bus and the hot battery bus.

If ground handling power is not available, you put the refuel station power switch in the battery position (BATT). This causes the hot battery bus to energize the refuel power transfer relay and the fuel quantity power transfer relay. When the two relays energize, the FQPU gets power from the hot battery bus only.



28-40-00-006 Rev 6 01/15/1997

FUEL INDICATING - FQIS - POWER

FUEL INDICATING - FQIS - INDICATIONS

General

The EICAS display shows total fuel quantity and fuel temperature in the lower right corner of the EICAS display.

The fuel synoptic display shows individual tank quantities and the total fuel quantity. It also shows the fuel temperature and the minimum fuel temperature. The minimum temperature is 3C more than the freeze temperature.

Non-Normal EICAS Displays

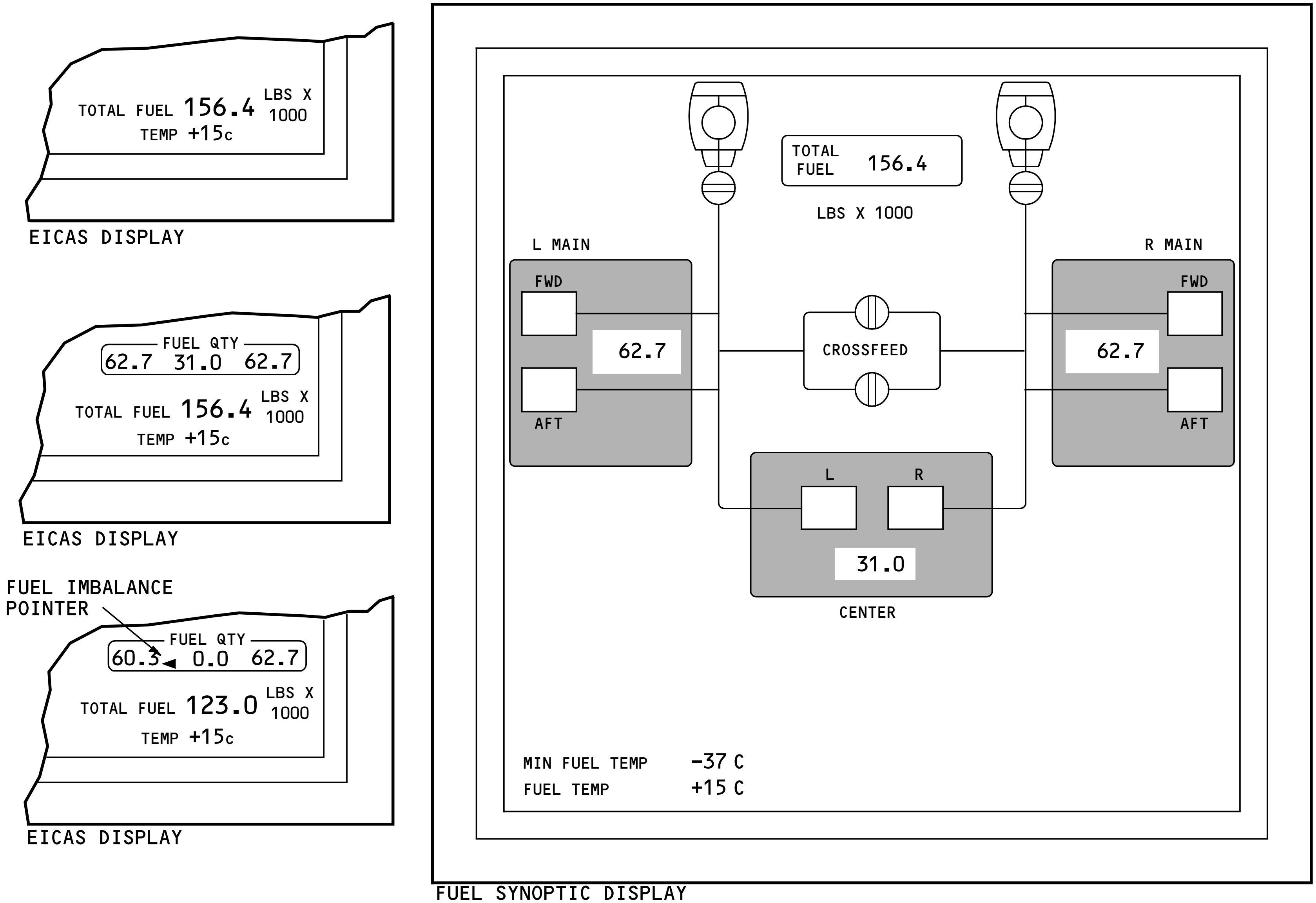
The EICAS display also shows the fuel quantity for each tank when these non-normal conditions exist:

- Low fuel in the main tanks
- Fuel is in the center tank and the center tank pumps are off
- Forward or aft crossfeed valve is open
- You select the fuel synoptic display and the MFD does not work
- Fuel imbalance between the left and right main tanks.

When a fuel imbalance larger than 1000 lb (454 kg) exists, the EICAS display also shows a fuel imbalance pointer. The pointer points to the main tank that has the least fuel. The pointer stays until the imbalance is less than 200 lb (91 kg). If a crossfeed valve is open, a fuel imbalance larger than 200 lb (91 kg) will cause the pointer to show.

The pointer is normally white. When the FUEL IMBALANCE EICAS advisory message shows, the color of the pointer changes to amber.

The fuel temperature data on the EICAS display and the fuel synoptic display can change from white to amber. This occurs when the fuel temperature equals, or becomes less than the minimum fuel temperature.



FUEL INDICATING - FQIS - INDICATIONS

28-40-00-008 Rev 5 02/11/1997

FUEL INDICATING - FQIS - MAINTENANCE PAGES

General

Fuel quantity data shows on the fuel quantity maintenance pages 1 and 2. Page 1 shows data for the left and right main tanks. Page 2 shows similar data for the center tank.

The maintenance page shows this data:

- Fuel quantities
- Fuel temperature
- Fuel densities
- Height of fuel at each tank unit
- Velocity of sound (VOS) at each tank unit
- Volumetric top-off (VTO) values
- Water detection status.

Uplift Quantity

The uplift quantity is the change in the total quantity from the time that the refuel station door opens to the time that the last refuel valve closes.

Uplift Density

The uplift density is the average density of the fuel added from the time that the refuel station door opens to the time that the last refuel valve closes.

Volumetric Top-Off

The VTO for a tank is the volume of fuel the tank can hold. The FQPU uses VTO values to calculate the load select set values for the main tanks when you do a total load select set for automatic refueling. The FQPU also uses the VTO value to close the refuel valves when the tank is full.

Water Detection Status

If a water detector finds water in a tank, the FQPU causes the water detection message for that tank to show. The main tank water detection messages show at the bottom of maintenance page 1. The center tank water detection messages show at the bottom of maintenance page 2.

Training Information Point

Fuel quantity maintenance page 2 shows airplane pitch and roll data. When you use the fuel measuring sticks to find fuel quantity, you can use the pitch and roll data from the maintenance page.

SHOW PG MENU

FUEL QTY PG 1/2

UPLIFT QUANTITY 29.5

TOTAL FUEL 55.3

UPLIFT DENSITY 6.575

TEMP +15c

U.S. STANDARD UNITS

	L MAIN	CTR	R MAIN
QUANTITY	27.6	0.0	27.7
DENSITY	6.564	6.800	6.567

L MAIN						R MAIN					
	HEIGHT	VOS		HEIGHT	VOS		HEIGHT	VOS		HEIGHT	VOS
1	41.9	4259	11	5.7	4264	1	41.9	4267	11	6.5	4254
2	42.6	4259	12	0.0	4264	2	41.7	4267	12	0.9	4254
3	37.3	4269	13	0.0	4223	3	37.3	4274	13	0.9	4206
4	36.6	4269	14	0.0	4223	4	35.9	4274	14	0.0	4206
5	34.6	4248	15	0.0	4223	5	34.0	4244	15	0.0	4206
6	21.4	4272	16	0.0	4223	6	21.3	4285	16	0.0	4206
7	27.5	4260	17	0.0	4223	7	27.0	4257	17	0.0	4206
8	12.4	4223	18	0.0	4223	8	12.9	4226	18	0.0	4206
9	10.3	4223	19	0.0	4223	9	10.8	4206	19	0.0	4206
10	3.6	4264	20	0.0	4223	10	4.5	4254	20	0.0	4206

L MAIN VTO SET 9560

R MAIN VTO SET 9560

L MAIN WATER

R MAIN WATER

DATE 23JUN94 UTC 18:54:04

FUEL QUANTITY MAINTENANCE PAGE 1

FUEL QTY PG 2/2

UPLIFT QUANTITY 29.5

UPLIFT DENSITY 6.575

U.S. STANDARD UNITS

L MAIN	CTR	R MAIN
27.6	0.0	27.6
6.564	6.800	6.567

		CENTER R					
T	VOS		HEIGHT	VOS		HEIGHT	VOS
0	4241	1	0.0	4241	6	0.0	4241
0	4241	2	0.0	4241	7	0.0	4241
0	4241	3	0.0	4241	8	0.0	4241
0	4241	4	0.0	4241	9	0.0	4241
0	4241	5	0.0	4241	10	0.0	4241

TANK VTO SET 26100

CENTER TANK WATER R

PITCH -0.7
ROLL +0.0

DATE 23JUN94 UTC 18:54:04

FUEL QUANTITY MAINTENANCE PAGE 2

FUEL INDICATING - FQIS - MAINTENANCE PAGES

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FUEL INDICATING - FUEL QUANTITY MEASURING STICK ASSEMBLY

General

You can manually measure fuel quantity with the fuel measuring stick assemblies.

Eight measuring stick assemblies install through the bottom of each wing. Six are in each main tank and two are in each section of the center tank. They are numbered from inboard to outboard.

The measuring sticks in the main tanks are installed in the fuel tank access doors. The measuring sticks in the center tank are installed in the lower wing skin.

Physical Description

The fuel measuring stick assemblies have these parts:

- Base
- Housing
- Magnetic float
- Measuring stick.

The base and housing are inside the tank. There is a red retainer in the base. The magnetic float surrounds the housing and moves up and down the housing as the fuel level changes. There is a float stop at the top of the housing to keep the float on the housing when the tanks are full.

The measuring stick is inside the housing. The measuring stick is flexible. It has a latch assembly at the bottom and a steel armature at the top. The stick has graduation marks to show the fuel level. The graduation marks are non-dimensional linear units.

You can remove the fuel measuring sticks from the assembly without defueling the airplane.

Operation

You use airplane attitude (pitch and roll) and fuel height to manually measure fuel quantity. The nose wheel well has inclinometers. The right main wheel well has a leveling scale and plumb bob attachment. You use the inclinometers or the leveling scale to measure airplane pitch and roll.

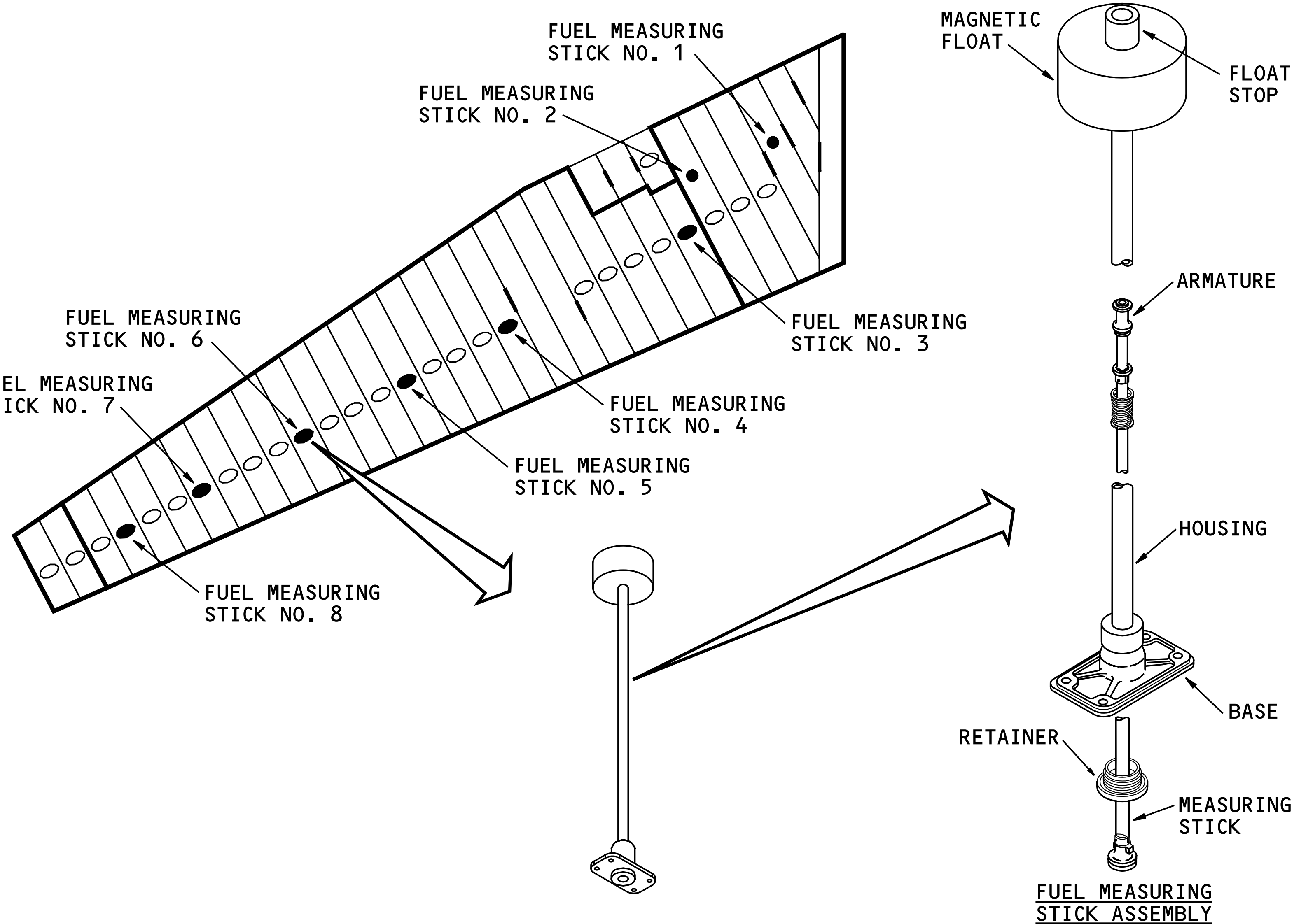
Use a screwdriver to unlock and release the measuring stick latch. Lower the stick to its fully extended length. Raise the stick slowly until you feel the magnetic float catch the stick. Read the graduation mark at the bottom of the stick to get the fuel level. You do this procedure three times to make sure you accurately read the fuel level.

You use airplane attitude, fuel density, and the fuel level from the sticks to find the fuel quantity in the fuel measuring stick conversion tables. The fuel measuring stick conversion tables are in the servicing section of part II of the airplane maintenance manual (AMM).

FUEL INDICATING - FUEL QUANTITY MEASURING STICK ASSEMBLY

Training Information Point

Because it is flexible, move the measuring stick slowly when you stow it.



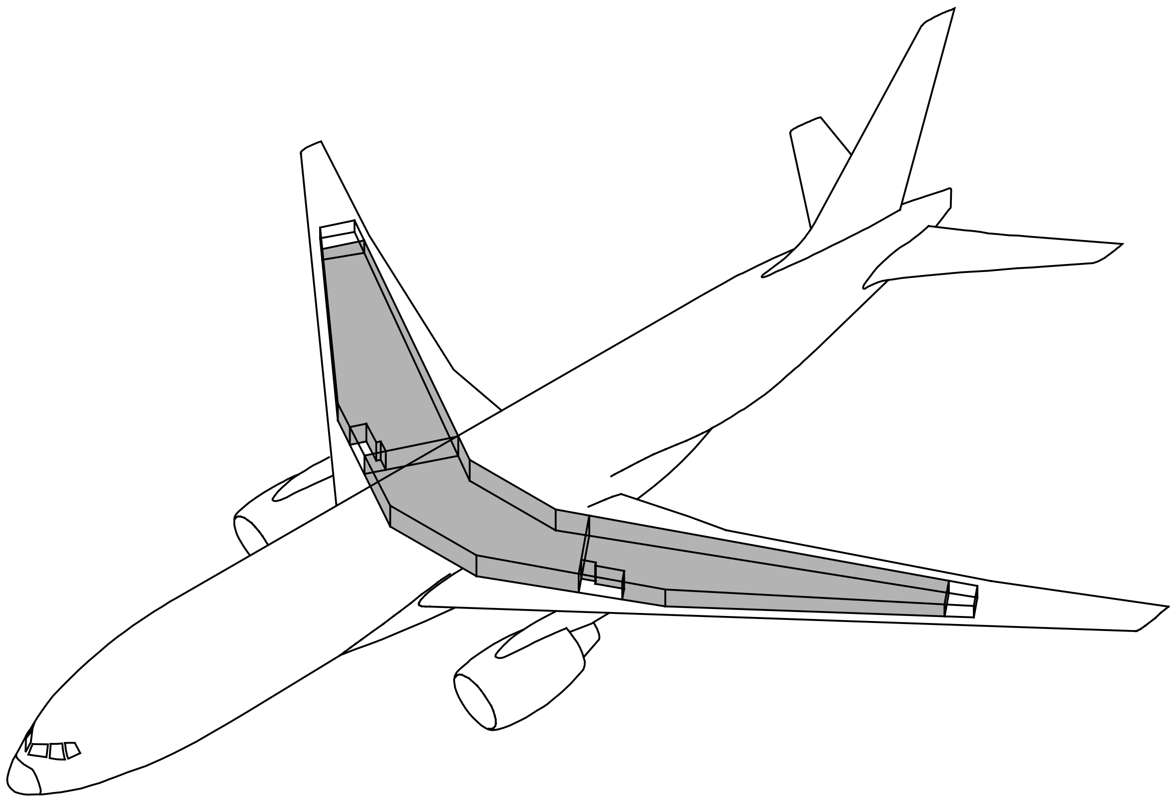
28-40-00-009 Rev 4

FUEL INDICATING - FUEL QUANTITY MEASURING STICK ASSEMBLY

PRESSURE REFUEL - INTRODUCTION

General

The pressure refuel system transfers fuel from the refuel adapters to the main and center tanks. You operate the pressure refuel system with an integrated refuel panel (IRP).



FUEL STORAGE

FUEL INDICATING

PRESSURE REFUEL

ENGINE FUEL FEED

APU FUEL FEED

JETTISON

DEFUEL

PRESSURE REFUEL - INTRODUCTION

PRESSURE REFUEL - GENERAL DESCRIPTION

General

The pressure refuel system transfers fuel from the refuel adapters to the airplane tanks. You operate the pressure refuel system with the IRP on the left wing. The FQPU and the ELMS control the system.

Fault information goes to the AIMS.

Control

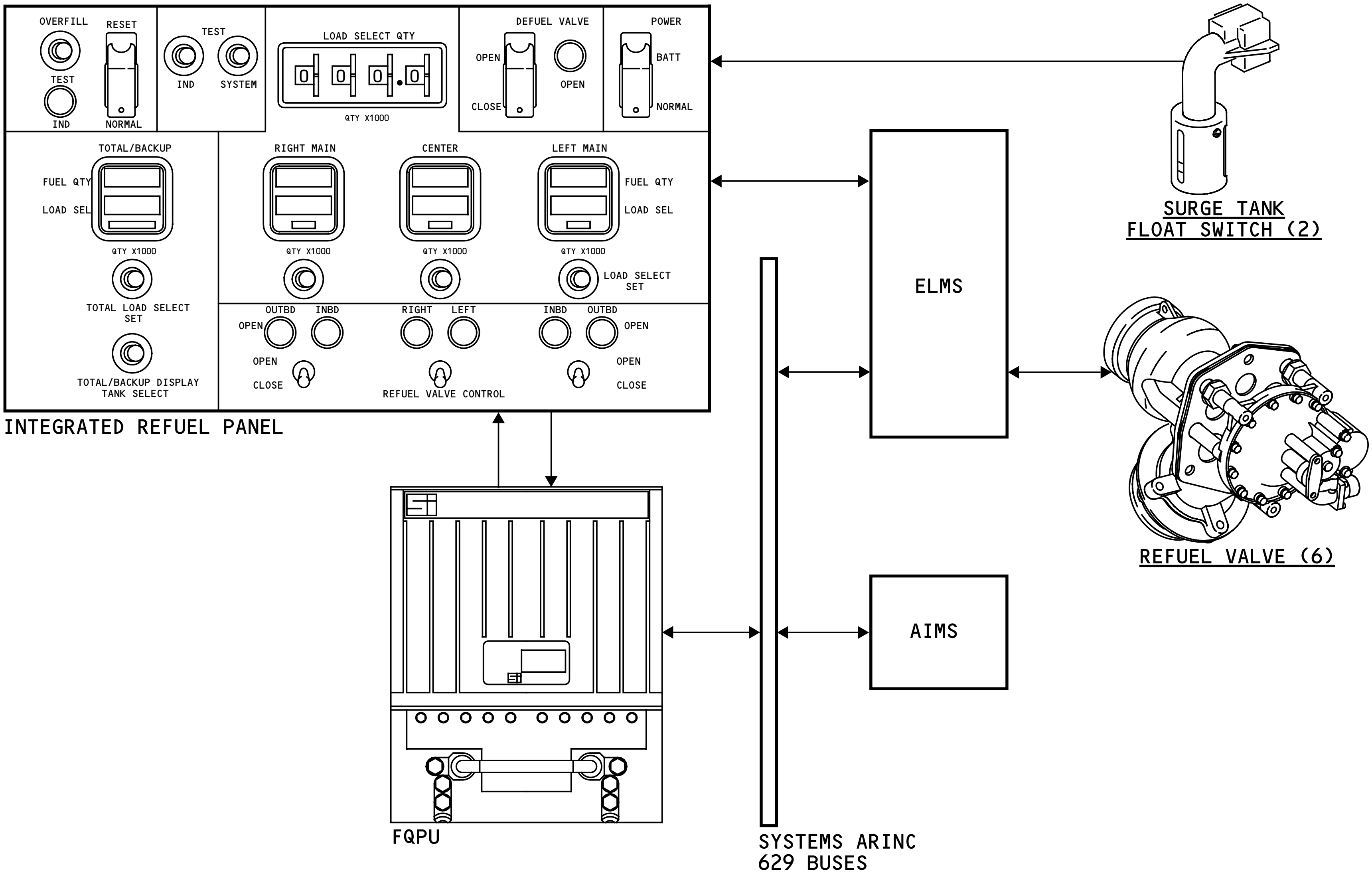
The IRP sends fuel load data and refuel valve switch positions to the FQPU through an ARINC 429 data bus. The processor sends the switch positions to the ELMS through the systems ARINC 629 buses. The ELMS supplies power to open and close the refuel valves.

Indication

The ELMS monitors refuel valve positions. When a refuel valve is open, the ELMS sends a signal to the FQPU on the systems ARINC 629 buses. The FQPU makes the related valve-open light come on.

Overfill Protection

There is a surge tank float switch in each surge tank. If fuel enters the surge tank, the surge tank float switch sends a signal through the IRP to the ELMS. This causes the ELMS to remove power from all the refuel valves so the valves close.



PRESSURE REFUEL - GENERAL DESCRIPTION

PRESSURE REFUEL - COMPONENT LOCATIONS

General

The components for the pressure refuel system are:

- Refuel station
- Refuel valves
- Refuel/jettison manifold
- Refuel/jettison manifold drain valves
- Refuel/jettison manifold vacuum relief valves.

Refuel Station

There is a refuel station on the leading edge of the left wing, outboard of the engine. The refuel station has an access door, two refuel adapters, and an IRP.

Refuel Valves

There are six refuel valves; two in each tank. The valve bodies are on the rear spar, inside the tanks. The valve actuators are on the rear spar, outside the tanks.

The refuel valve in the left side of the center tank is aft of the second fuel tank access door. The refuel valve in the right side of the center tank is in a similar position.

The inboard refuel valve in the left main tank is aft of the fourth fuel tank access door. The outboard refuel valve in the main tank is aft of the eighteenth fuel tank access door. The refuel valves in the right main tank are in similar positions.

Refuel/Jettison Manifold

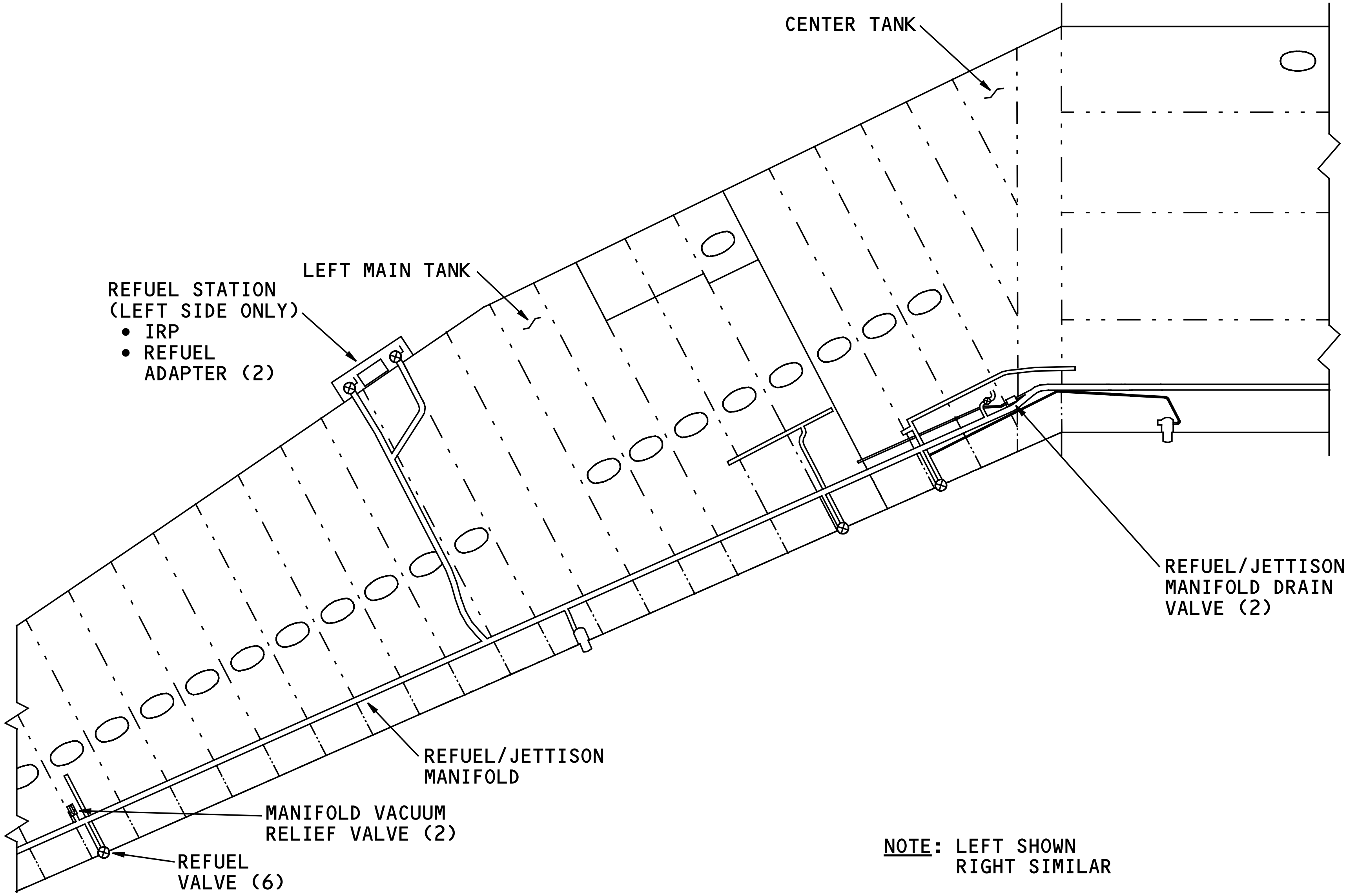
The refuel/jettison manifold connects the refuel station to all the refuel valves. It supplies fuel from the refuel adapters to each tank.

Refuel/Jettison Manifold Drain Valves

There are two refuel/jettison manifold drain valves. One is in each half of the center tank. You get access to them through the first fuel tank access door.

Refuel/Jettison Manifold Vacuum Relief Valves

There are two refuel/jettison manifold vacuum relief valves. They are on the refuel/jettison manifold, near the outboard refuel valve in each main tank. You get access to them through the eighteenth fuel tank access door.



PRESSURE REFUEL - COMPONENT LOCATIONS

PRESSURE REFUEL - REFUEL STATION

General

There is a refuel station on the leading edge of the left wing. The refuel station has these components:

- Access door
- Access door switch
- Refuel adapter (2)
- Bonding point (2)
- IRP.

You use the IRP to control refuel and defuel operations.

Access Door

Two hold-open rods keep the access door in the full-open position. To close the access door, you must move a collar on each hold-open rod. There are four placards on the access door. They tell you about refuel and defuel procedures.

When the access door is open, the access door switch permits power to go to the IRP and the FQIS processor unit. The switch also controls the panel lights.

Integrated Refuel Panel

The IRP has these parts:

- Front panel
- Fuel quantity indicators in an electronics module
- Switches and lights
- Load select module.

The electronics module has two channels.

Refuel Adapters

The refuel adapters connect the fueling nozzles to the refuel system. The two refuel adapters are at the refuel station. The adapters attach to the front spar of the wing.

Each adapter has these parts:

- Break-away flange
- Check valve (not shown)
- Refuel/defuel handle.

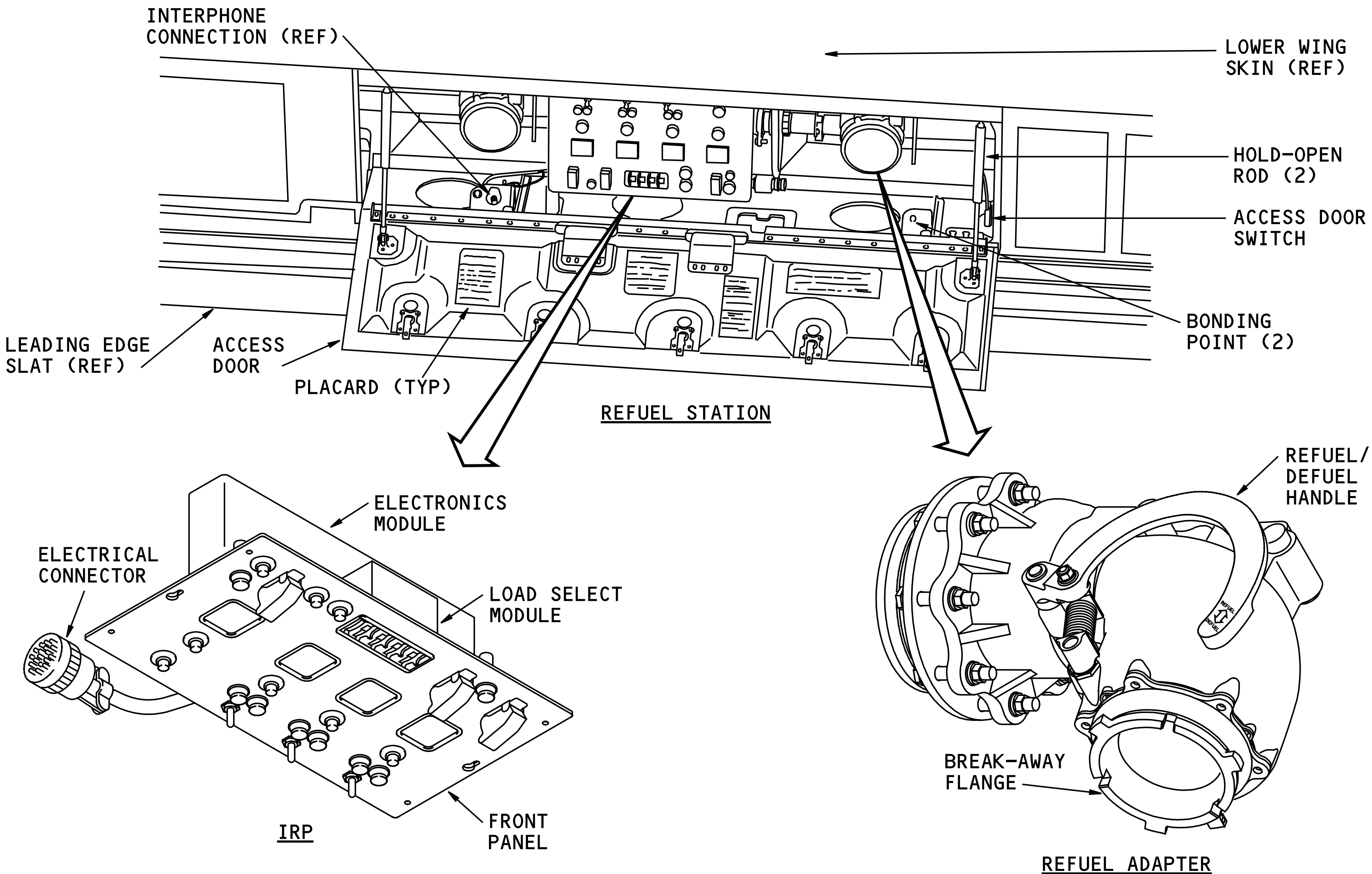
The adapter check valve prevents fuel in the refuel/jettison manifold from flowing back through the adapters.

Training Information Point

The adapter grounds the fueling nozzles to the airplane. If there is electrical continuity between the fueling source and the fueling nozzle, it is not necessary to attach a bonding cable.

Caps are not required on the adapters.

The IRP is an LRU.



PRESSURE REFUEL - REFUEL STATION

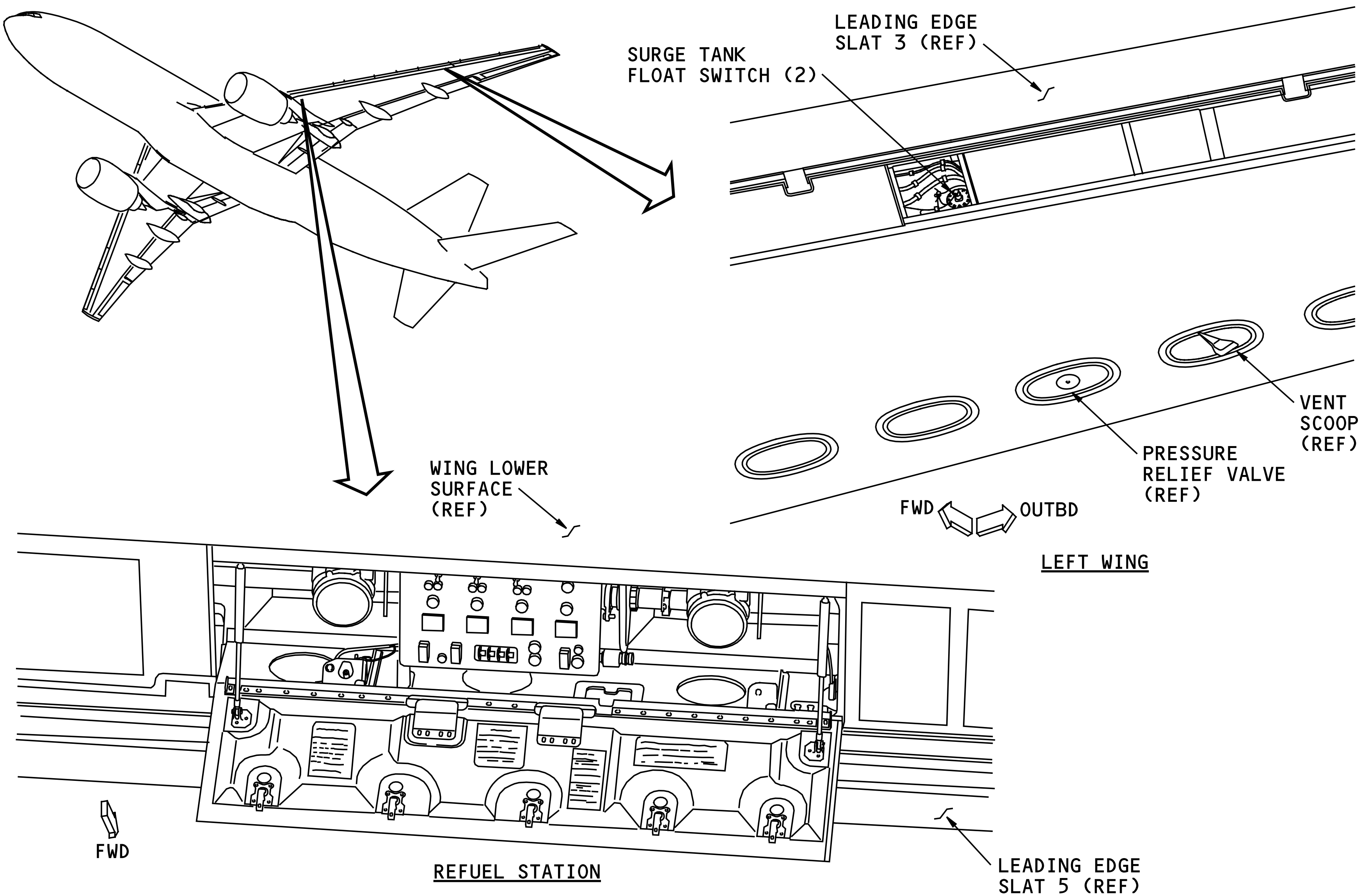
PRESSURE REFUEL - COMPONENT LOCATIONS - FRONT SPAR

Refuel Station

There is a refuel station on the left wing, aft of leading edge slat 5. The refuel station contains two refuel adapters and an IRP.

Surge Tank Float Switches

There is one surge tank float switch on each wing, near the pressure relief valve and vent scoop. The left switch is on the front spar, aft of leading edge slat 3. The right switch is on the front spar, aft of leading edge slat 12.



28-21-00-013 Rev 1 03/06/1996

PRESSURE REFUEL - COMPONENT LOCATIONS - FRONT SPAR

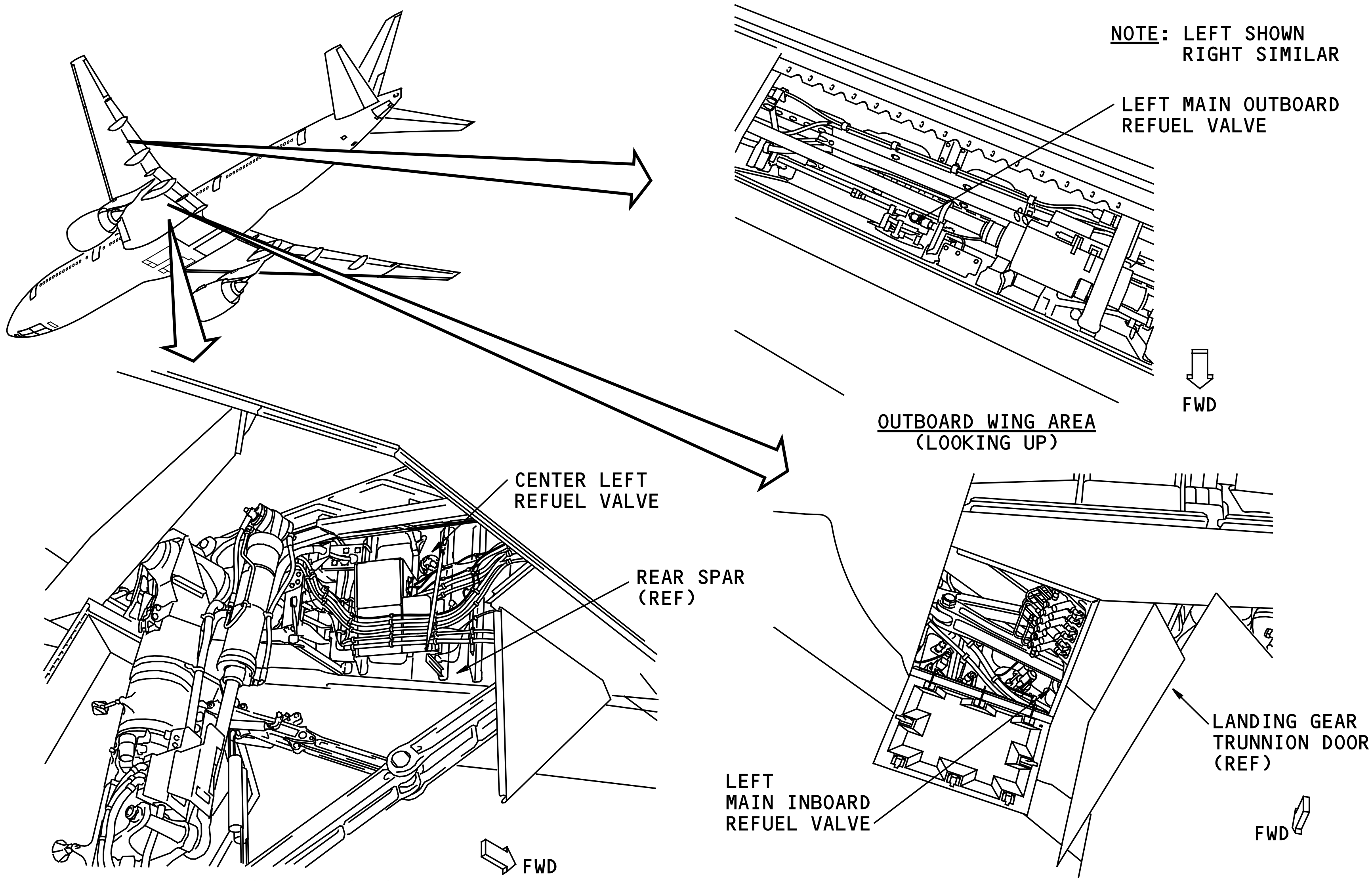
PRESSURE REFUEL - COMPONENT LOCATIONS - REAR SPAR

General

There are two refuel valves in each fuel tank.

In the left main fuel tank, the inboard refuel valve actuator is outboard of the main landing gear shock strut. The outboard refuel valve is between the fairings of the outboard flap. The refuel valve actuators are in similar locations in the right main fuel tank.

In the center tank, the left refuel valve actuator is on the rear spar, inboard of the main landing gear shock strut. The right refuel valve actuator is in a similar location in the right side of the center tank.



PRESSURE REFUEL - COMPONENT LOCATIONS - REAR SPAR

28-21-00-014 Rev 1 03/16/95

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PRESSURE REFUEL - INTEGRATED REFUEL PANEL

Overfill Test Switches

The overfill test switch starts the overfill test. This causes the overfill protection to immediately close all the refuel valves. You do the overfill test during refueling.

The overfill indication light is a red light that comes on when there is fuel in a surge tank, or when you do the overfill test. It stays on until the surge tanks are empty and the overfill reset switch is in the RESET position.

The overfill reset switch disables the overfill protection. It has two positions: NORMAL and RESET. The NORMAL position arms the overfill protection. The RESET position turns off the overfill protection.

Indicator Test Switch

The indicator test switch does a test of these indicators:

- Fuel quantity indicators
- Refuel valve position indication lights
- Defuel valve position indication light.

During the test, a test pattern shows in the fuel quantity indicators, and the valve position indication lights come on. If a fuel quantity indicator fails the test, all of its LEDs go off.

The IRP also does the indicator test when it initially gets power.

System Test Switch

You push the system test switch during refueling to do a test of the refuel system. During the test all the refuel valves close, two at a time, and the refuel valve position indication lights go off. Then, the valves automatically open, two at a time, and the lights come on again.

Load Select Quantity Selectors

The load select quantity selectors permit you to select fuel load quantity. There are four selectors. Each selector has a thumbwheel and shows a number. You turn the thumbwheel to set the related number of the fuel load quantity.

Defuel Valve Switch and Light

The defuel valve switch opens and closes the defuel valve.

The defuel valve open light is a blue light that shows the position of the defuel valve. It comes on when the defuel valve opens.

Power Switch

The power switch permits you to refuel the airplane when the ground handling bus does not have power. When

PRESSURE REFUEL - INTEGRATED REFUEL PANEL

you move the power switch to the battery (BATT) position, it causes the hot battery bus to send power to the refuel system.

Fuel Quantity Indicators

There are four fuel quantity indicators:

- Total/backup
- Right main
- Center
- Left main.

The fuel quantity indicators have two LED displays. The upper display shows actual fuel quantity. The lower display shows load select quantity.

The total fuel quantity indicator can show indications for one of the other tanks if its indicator fails.

Load Select Set Switches

There are four load select switches, one below each fuel quantity indicator. Load select set switches move the load select quantity from the selector to the related load select display. These switches permit you to set the total fuel load or the fuel load for each tank.

Refuel Valve Switches and Lights

Refuel valve control switches send command signals to the FQPU to control the refuel valves.

Each refuel valve open light is a blue light that shows the position of the related refuel valve. The light comes on when the valve opens.

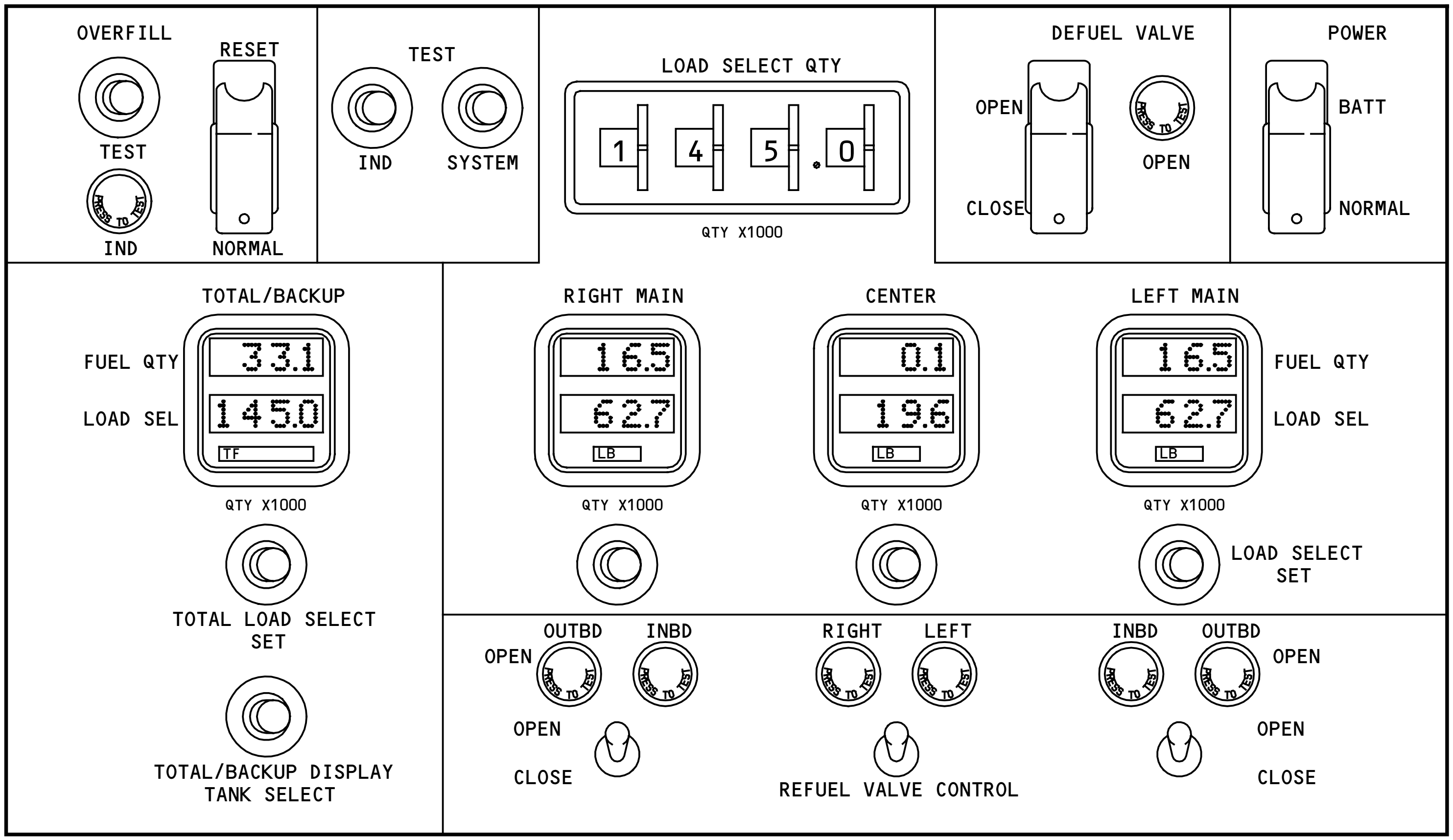
Total/Backup Display Tank Select Switch

The display tank select switch permits you to use the total fuel quantity indicator as a backup for the left, right, or center tank indicator. Each time you push the switch, a different tank quantity and identifier show on the total/backup display. This is the sequence of the identifiers:

- TF - total fuel quantity
- RM - right main tank quantity
- CT - center tank quantity
- LM - left main tank quantity.

Training Information Point

The IRP also does the indicator test when it initially gets power.



28-21-00-005 Rev 5

PRESSURE REFUEL - INTEGRATED REFUEL PANEL

PRESSURE REFUEL - REFUEL VALVE

General

The refuel valves permit fuel to flow from the refuel/ jettison manifold into the fuel tanks. Each valve has a valve body and a control unit.

Valve Body

The valve body has a poppet-type valve. The valve body is on the rear spar, inside the fuel tank.

Control Unit

The control unit opens and closes the valve. The control unit is on the rear spar, outside the fuel tank. It has these parts:

- Solenoid
- Actuator
- Manual override knob
- Position switch.

When the solenoid energizes, it supplies pressurized fuel into the actuator. This causes the valve to open.

If the valve does not open, you can use the manual override knob to manually open and close it.

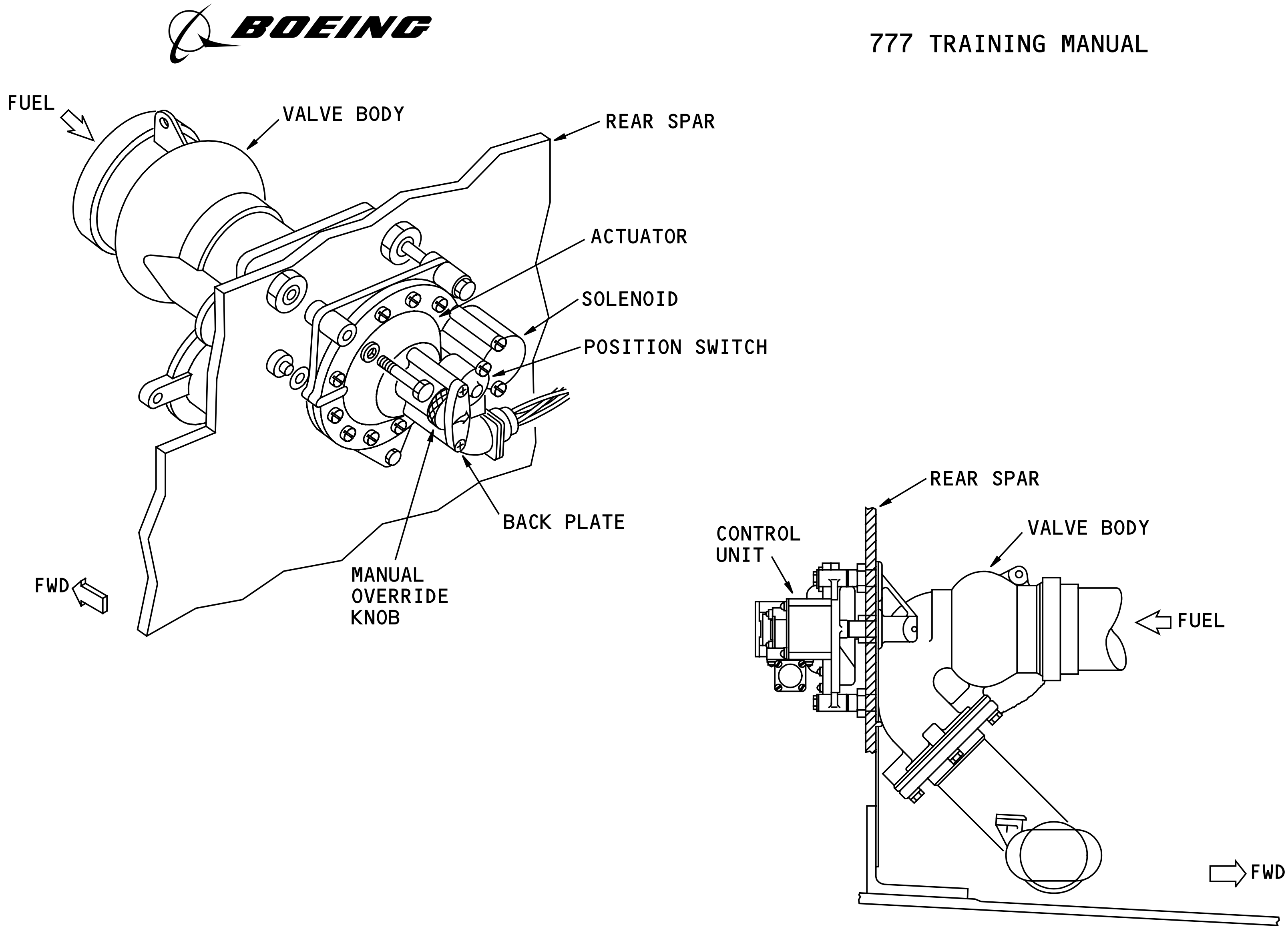
The valve position switch sends a signal to the ELMS when the valve is open. This causes the valve position light on the IRP to come on.

You can remove the control unit without defueling. A removal check valve in the valve body prevents fuel from coming out.

Do not remove or loosen the back plate when you open the valve manually.

Training Information Point

Keep manual operation of the valve to a minimum. Damage to an O-ring inside the valve can occur if you manually operate the valve many times.



28-21-00-006 Rev 3

PRESSURE REFUEL - REFUEL VALVE

PRESSURE REFUEL - SURGE TANK FLOAT SWITCH

Purpose

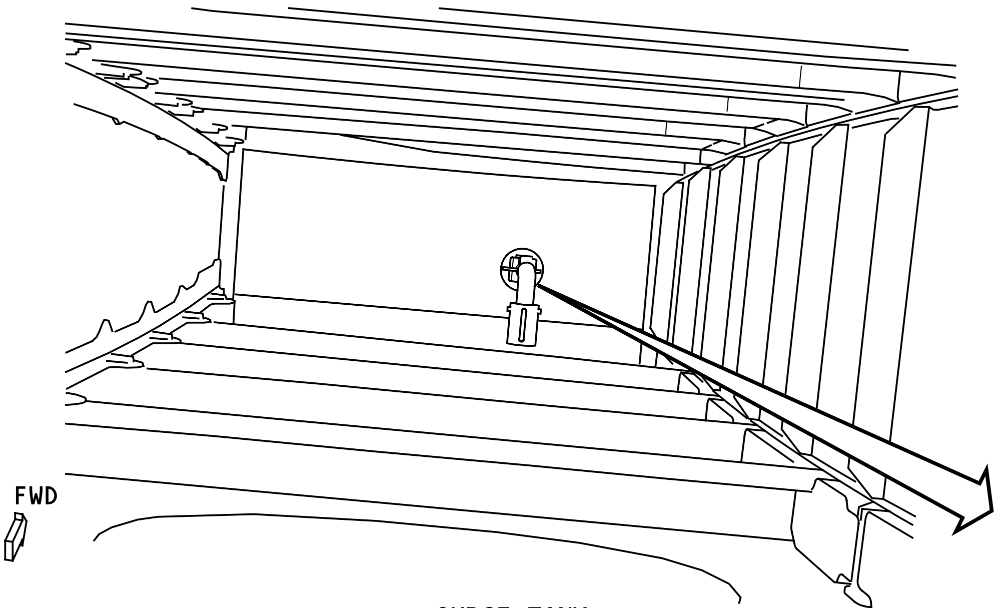
The surge tank float switch sends a signal to close all the refuel valves if there is fuel in the surge tank.

Location

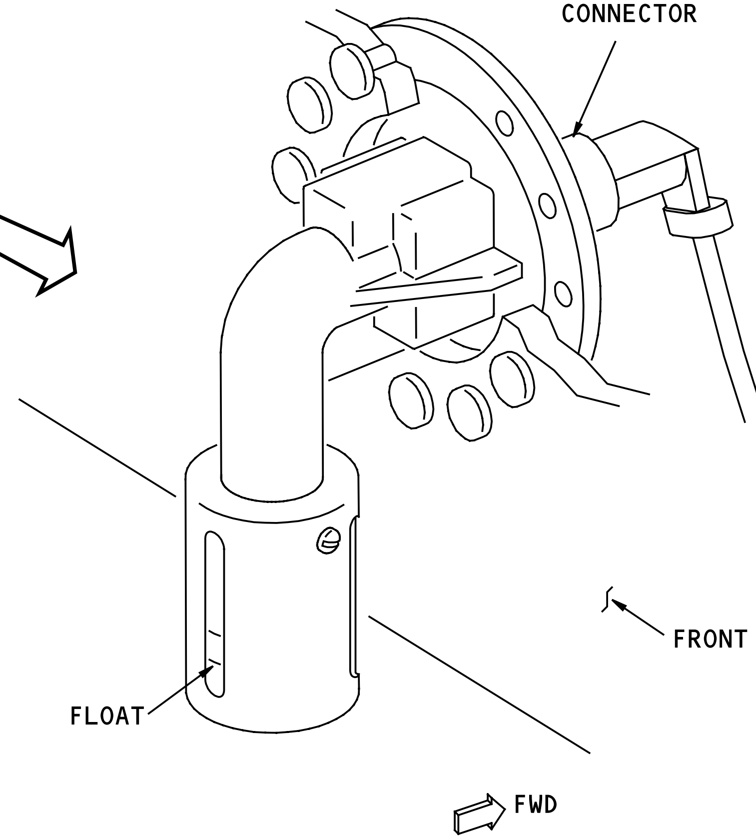
One surge tank float switch is on the front spar in each surge tank.

Functional Description

Each surge tank float switch contains a magnetic reed float switch. The switch closes when fuel in the surge tank gets above a specified level.



SURGE TANK



SURGE TANK FLOAT SWITCH

28-21-00-007 Rev 2

PRESSURE REFUEL - SURGE TANK FLOAT SWITCH

PRESSURE REFUEL - REFUEL MANIFOLD VALVES

Purpose

There are two types of refuel manifold valves: refuel manifold drain valves and refuel manifold vacuum relief valves.

The refuel manifold drain valves drain fuel from the refuel/jettison manifold into the main tanks. This increases the amount of fuel that the airplane can use.

The refuel manifold vacuum relief valves prevent a vacuum in the manifold, so fuel can drain.

Location

One refuel manifold drain valve is in each refuel manifold drain line. You get access to the drain valve through the first fuel tank access door.

One manifold vacuum relief valve is on the refuel manifold near the outboard refuel valve in each main tank. You get access to the drain valve through the eighteenth fuel tank access door (between ribs 24 and 25).

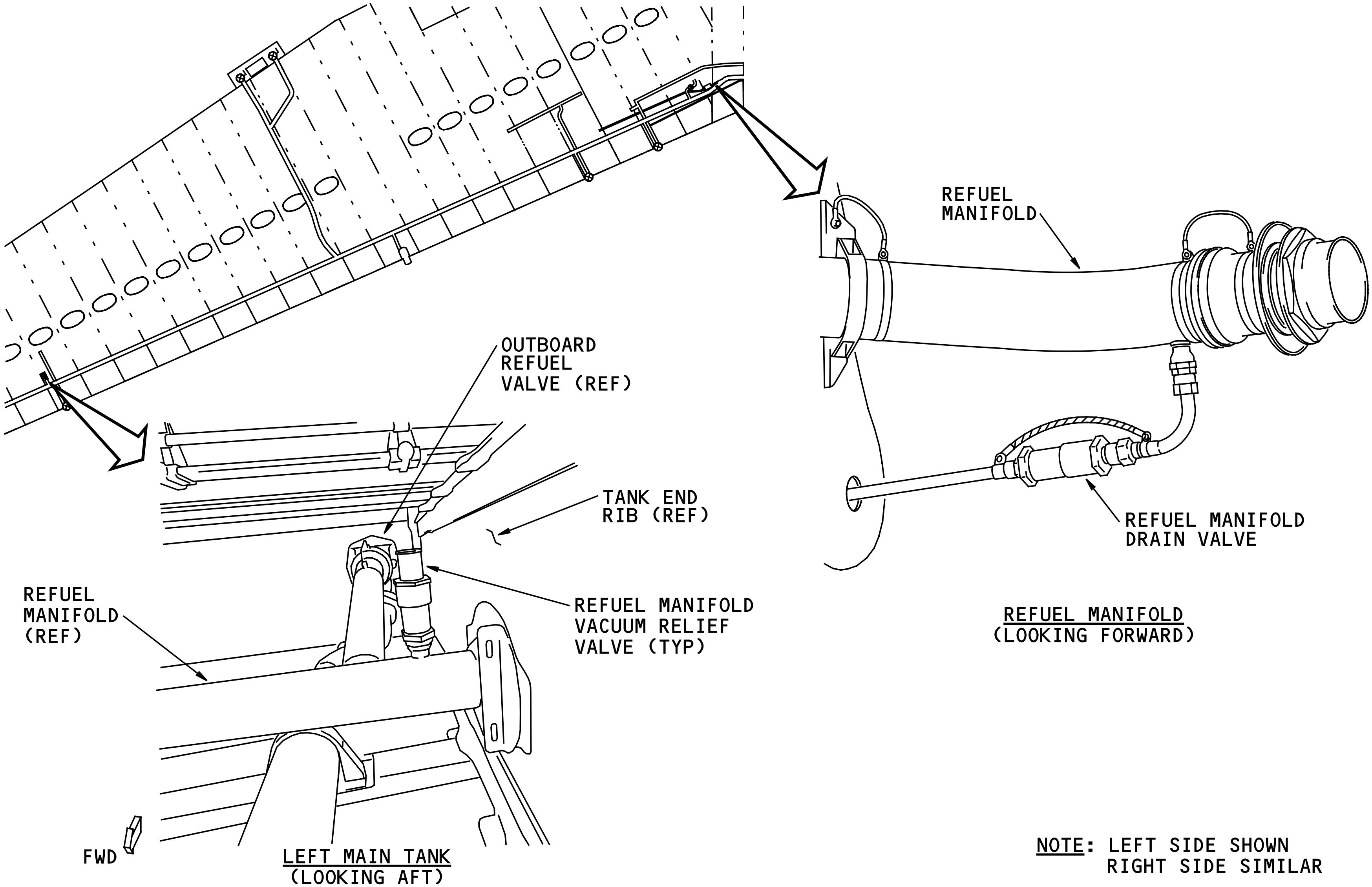
Refuel Manifold Drain Valve - Functional Description

When the manifold has pressure, the valve prevents fuel from flowing into the main tanks.

When the main tank is full, the drain valve prevents fuel from flowing from the tank into the manifold. When the main tank is not full, fuel drains from the refuel/jettison manifold into the main tank.

Refuel Manifold Vacuum Relief Valve - Functional Description

When fuel drains through a refuel manifold drain valve, the pressure in the refuel manifold becomes less than the pressure inside the fuel tank. This causes the refuel manifold vacuum relief valve(s) to open. The open valve permits air to enter the refuel manifold and increase the pressure. Then fuel can continue to drain from the refuel manifold.



28-21-00-008 Rev 4 03/18/96

PRESSURE REFUEL - REFUEL MANIFOLD VALVES

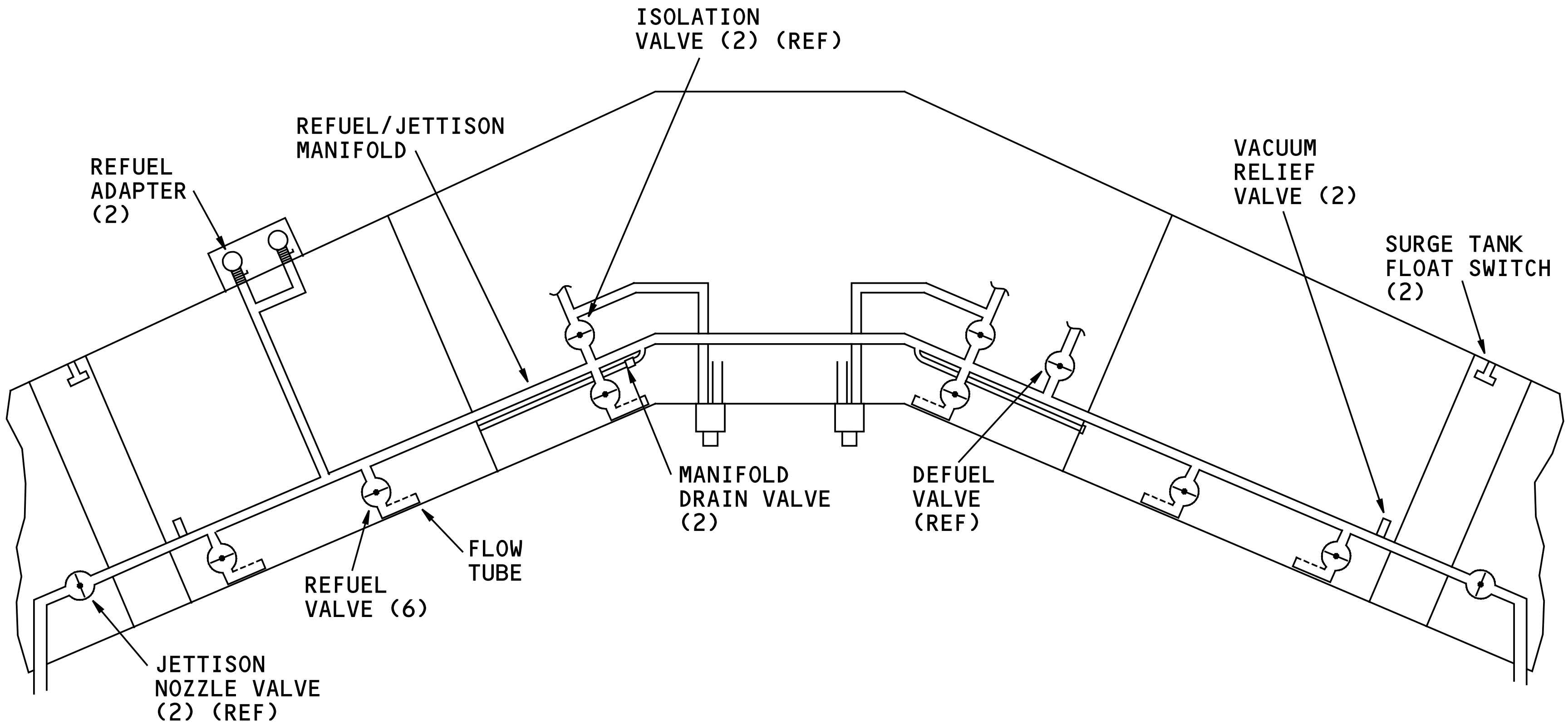
PRESSURE REFUEL - FUNCTIONAL DESCRIPTION - FUEL FLOW

General

Fuel flows from the refuel adapters into the refuel/jettison manifold. When the refuel valves open, fuel flows from the manifold into the fuel tanks. A flow tube at the end of each refuel valve decreases the exit force of the fuel. The flow tube also puts the fuel in different parts of the tank.

The refuel valves close to stop fuel flow. Fuel that is left in the refuel/jettison manifold goes through the manifold drain valves and into the main tanks. The manifold has two vacuum relief valves. These valves permit air to go into the manifold when the fuel goes out of the manifold drain valves.

If a refuel system failure prevents the refuel valves from closing, fuel goes into the surge tanks. If the fuel gets to the level of the surge tank float switches, the switches close. When one of the two switches close, the ELMS closes all refuel valves.



28-21-00-009 Rev 5 03/18/96

PRESSURE REFUEL - FUNCTIONAL DESCRIPTION - FUEL FLOW

PRESSURE REFUEL - FUNCTIONAL DESCRIPTION - POWER

General

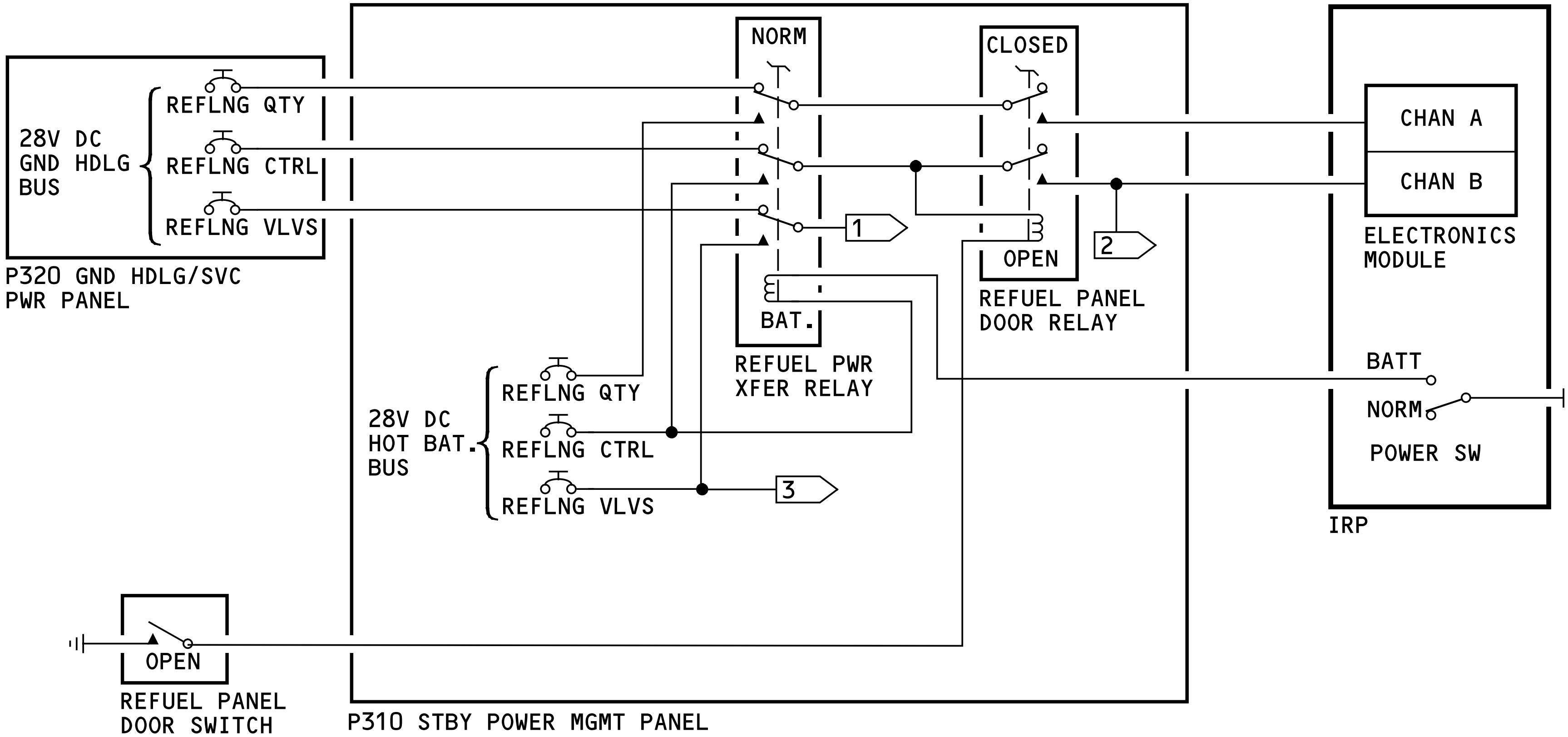
Power for the refuel system comes from the ground handling bus or the hot battery bus. Power control relays for the refuel system are in the standby power management panel.

Ground Handling Power

When the refuel panel door opens, the refuel panel door relay energizes. This permits power to go from the ground handling bus to the IRP.

Battery Bus Power

If the ground handling bus has no power, you close the refuel power (POWER) switch. This energizes the refuel power transfer relay and permits power to go from the hot battery bus to the IRP and the overfill control relay.



1 OVERFILL CONTROL RELAY

2 OVERFILL CONTROL RELAY COIL

3 REFUEL VALVE CONTROL RELAYS (6)

28-21-00-010 Rev 3 03/02/95

PRESSURE REFUEL - FUNCTIONAL DESCRIPTION - POWER

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PRESSURE REFUEL - FUNCTIONAL DESCRIPTION - CONTROL

General

During automatic refueling, you use the IRP to set the fuel load and to open the refuel valves. The FQPU closes the refuel valves.

During manual refueling, you use refuel valve control switches on the IRP to open and close the refuel valves

Refuel Valve Open Control

The refuel valves open when they get a refuel-valve-open command from the FQPU. The IRP sends refuel valve switch position signals to the FQPU on an ARINC 429 data bus. The FQPU sends refuel-valve-open commands on the systems ARINC 629 buses to the EEU in the P310 standby power management panel. The EEU supplies a ground to close each refuel valve control relay. This permits power to go to the related refuel valve solenoid. Fuel pressure opens the refuel valve.

Refuel Valve Close Control

Each refuel valve closes when the FQPU removes the related refuel-valve-open command.

When you put the refuel valve control switches in the close position, the FQPU removes the refuel-valve-open commands.

The FQPU automatically removes the refuel-valve-open commands for these conditions:

- Tank quantity reaches the load select value
- Tank quantity reaches the volumetric top-off (VTO) value
- System test switch is in (test position).

You set the load select value at the IRP. The refueling operation section describes this.

The FQPU memory has the VTO values for each tank. When a tank quantity equals the VTO value, the tank is full. The FQPU removes the refuel-valve-open commands for that tank.

Refuel Valve Indication

The refuel valve position switch closes when the valve opens. This sends a signal to the EEU. The EEU sends an ARINC 629 signal to the FQPU. The FQPU sends an ARINC 429 signal to the IRP. The IRP turns on the valve open light (not shown).

Overfill Protection

If fuel flows into a surge tank, the related surge tank float switch closes. This supplies a ground to energize the overfill control relay. The relay removes power from all the refuel valves. Immediately, all the refuel valves close at the same time.

The overfill control relay has a latching ground. After the fuel in the surge tank drains out, the relay stays energized. You must operate the overfill reset switch to remove the latching ground.

PRESSURE REFUEL - FUNCTIONAL DESCRIPTION - CONTROL

The overfill reset switch disables the overfill protection. When the overfill reset switch is in the reset position, the surge tank float switches and the overfill test switch can not energize the overfill control relay.

Overfill Test

You use the overfill test switch to do a test of the overfill protection. The switch supplies a ground, similar to a closed surge tank float switch, to energize the overfill control relay. Immediately, all the refuel valves close at the same time.

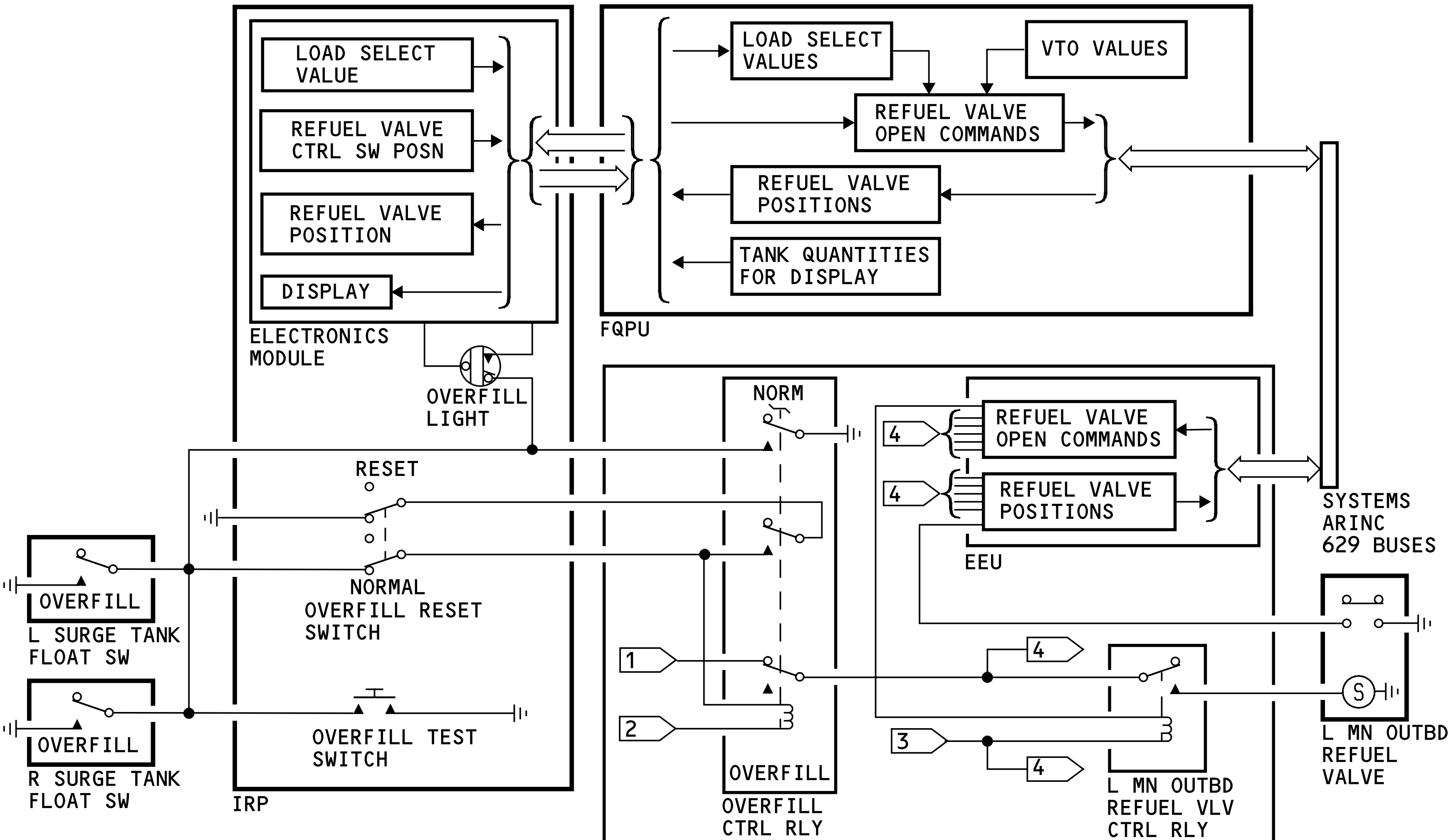
Overfill Indication

The overfill indication light on the IRP comes on for these conditions:

- A surge tank float switch is closed
- The overfill control relay is energized
- The overfill test switch is in (test position).

Training Information Point

When you set the total fuel load, the FQPU calculates the fuel load quantities for each tank two times. It calculates when you set the total fuel load, and when the main tanks are almost full. When the main tanks are almost full, the FQPU usually opens the center tank refuel valves again.



1 2 GROUND HANDLING DC BUS (NORMAL) OR HOT BATTERY BUS (ALTERNATE)

3 HOT BATTERY BUS

4 OTHER REFUEL VALVE CIRCUITS

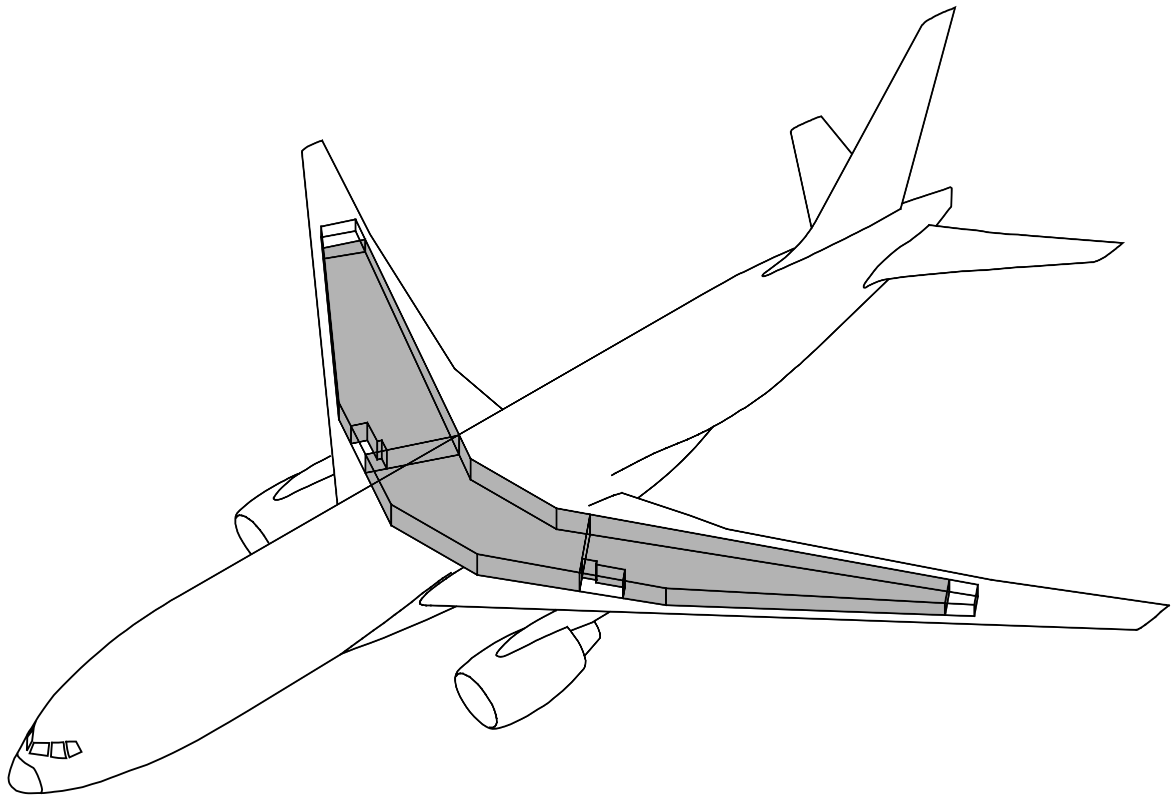
PRESSURE REFUEL - FUNCTIONAL DESCRIPTION - CONTROL

28-21-00-011 Rev 5 12/18/95

ENGINE FUEL FEED - INTRODUCTION

Purpose

The engine fuel feed system supplies fuel to the engines from the main and center tanks. You operate the engine feed system from the fuel panel on the P5 overhead panel.



FUEL STORAGE

FUEL INDICATING

PRESSURE REFUEL

ENGINE FUEL FEED

APU FUEL FEED

JETTISON

DEFUEL

ENGINE FUEL FEED - INTRODUCTION

ENGINE FUEL FEED - GENERAL DESCRIPTION

General

The engine fuel feed system controls and supplies fuel to the engines. It uses these inputs:

- Fuel panel
- Fuel control switches
- Engine fire switches
- The ELMS.

The engine fuel feed system uses these components to supply fuel to the engines:

- Fuel pumps
- Fuel pump pressure switches
- Crossfeed valves
- Spar valves

The engine fuel feed system uses power from the ELMS and the engine fuel spar valve battery.

Fuel Pump Control

Each fuel pump has a switch on the fuel panel. The switches control relays in the ELMS to supply power to the pumps.

Fuel Pump Pressure Switches

Pump pressure switches send low pressure signals to the ELMS. The ELMS sends the signals through OPAS to turn on the low pressure lights on the pump switches.

Crossfeed Valves Control

The crossfeed valve switches on the fuel panel directly control the crossfeed valves. The ELMS supplies the power that opens or closes the valves.

Spar Valve Control

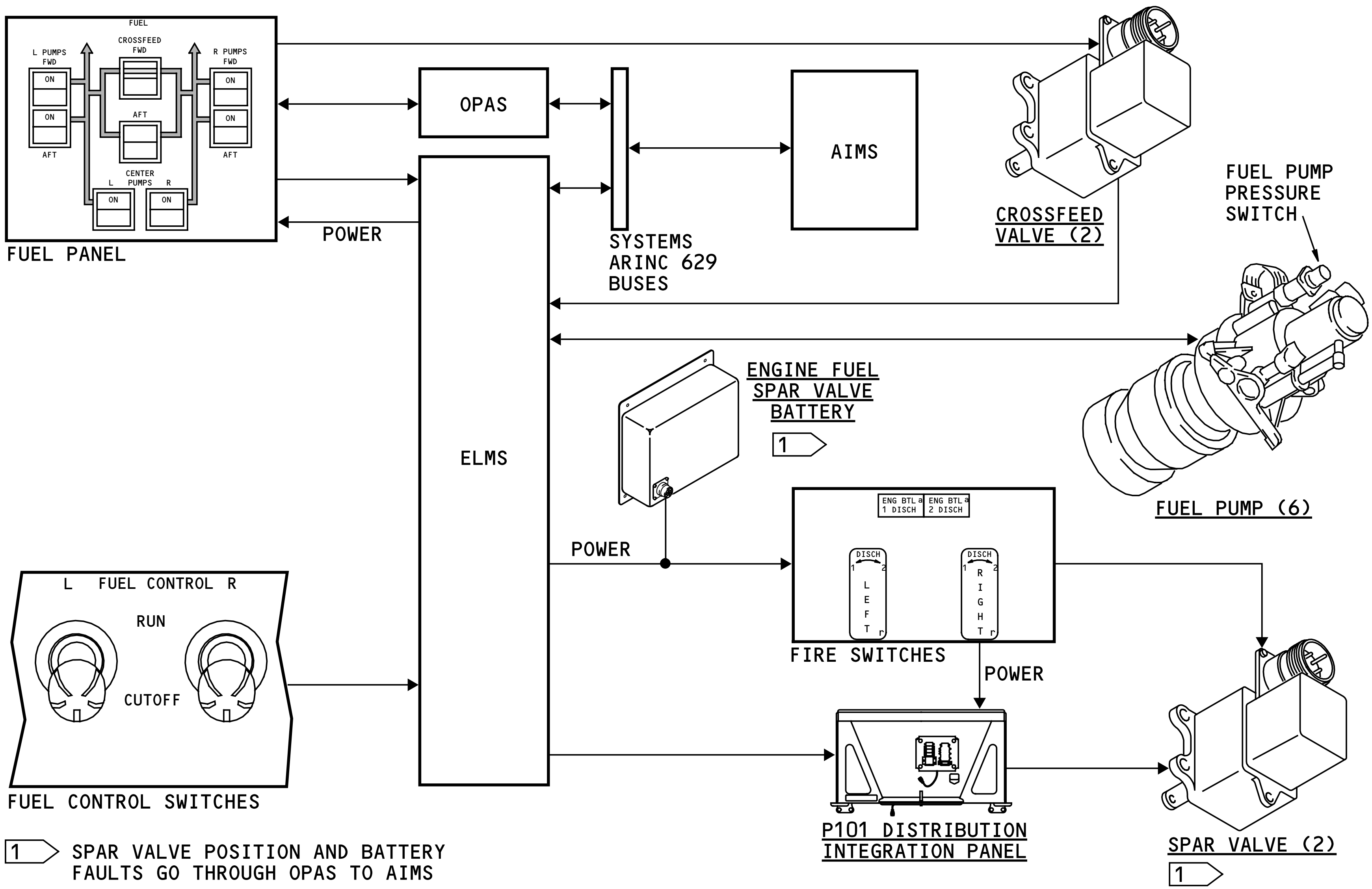
The fuel control switches control relays to open and close the spar valves. The engine fire switch must be down to permit the power to get through the relays to the spar valve.

The fire switch also has a direct circuit to the spar valve. This closes the valve when you pull the fire switch.

The hot battery bus (ELMS) or the engine fuel spar valve battery supply the power to open or close the spar valve.

Fault Indication

The ELMS compares fuel panel switch positions with crossfeed valve and fuel pump relay positions to look for disagreements. The ELMS receives switch positions on the systems ARINC 629 buses. The OPAS reports faults of the spar valves and the engine fuel spar valve battery. Faults go to the AIMS for indication.



ENGINE FUEL FEED - GENERAL DESCRIPTION

ENGINE FUEL FEED - COMPONENT LOCATIONS - TANKS

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ENGINE FUEL FEED - COMPONENT LOCATIONS - TANKS

General

The engine fuel feed system has these components:

- Fuel suction bypass valve (2)
- Outlet float-operated shutoff valve (2)
- Crossfeed valve (2)
- Engine feed manifold
- Override/jettison pump (2)
- Scavenge jet pump (6)
- Inlet float-operated shutoff valve (2)
- Boost Pump (4)
- Spar valve (2).

Main Tank Fuel Suction Bypass Valves

There is one fuel suction bypass valve in each main tank. It attaches to the engine feed manifold. You get access to the bypass valve through the fourth fuel tank access door.

Fuel Crossfeed Valves

The forward and aft crossfeed valves isolate the left and right sides of the engine feed manifold. Both valve bodies are in the left side of the center tank. You get access to the valve bodies through the first fuel tank access door in the left wing. The valve actuators are on the rear spar aft of the first fuel tank access door.

Engine Feed Manifold

The engine feed manifold connects the output of the fuel pumps to the engine fuel main supply line. Sections of the manifold are in the center tank and the main tanks.

Center Fuel Tank Override/Jettison Pumps

There are two override/jettison pumps that attach to the rear spar of the center tank. You get access to the pumps in the main wheel wells.

Scavenge Jet Pumps

There are four water scavenge jet pumps and two center tank fuel scavenge jet pumps. Each main tank has one water scavenge jet pump on the rear spar aft of the Fourth fuel tank access door.

Each side of the center tank has a water scavenge jet pump and a fuel scavenge jet pump. The water scavenge jet pumps are on the rear spar of the center fuel tank. The fuel scavenge jet pumps are on the rear spars of the wings.

Float-Operated Shutoff valves

Each center tank fuel scavenge jet pump has an inlet and an outlet float-operated shutoff valve. You get access to the inlet valve through the first fuel tank access door. You get access to the outlet valve through the seventh fuel tank access door.

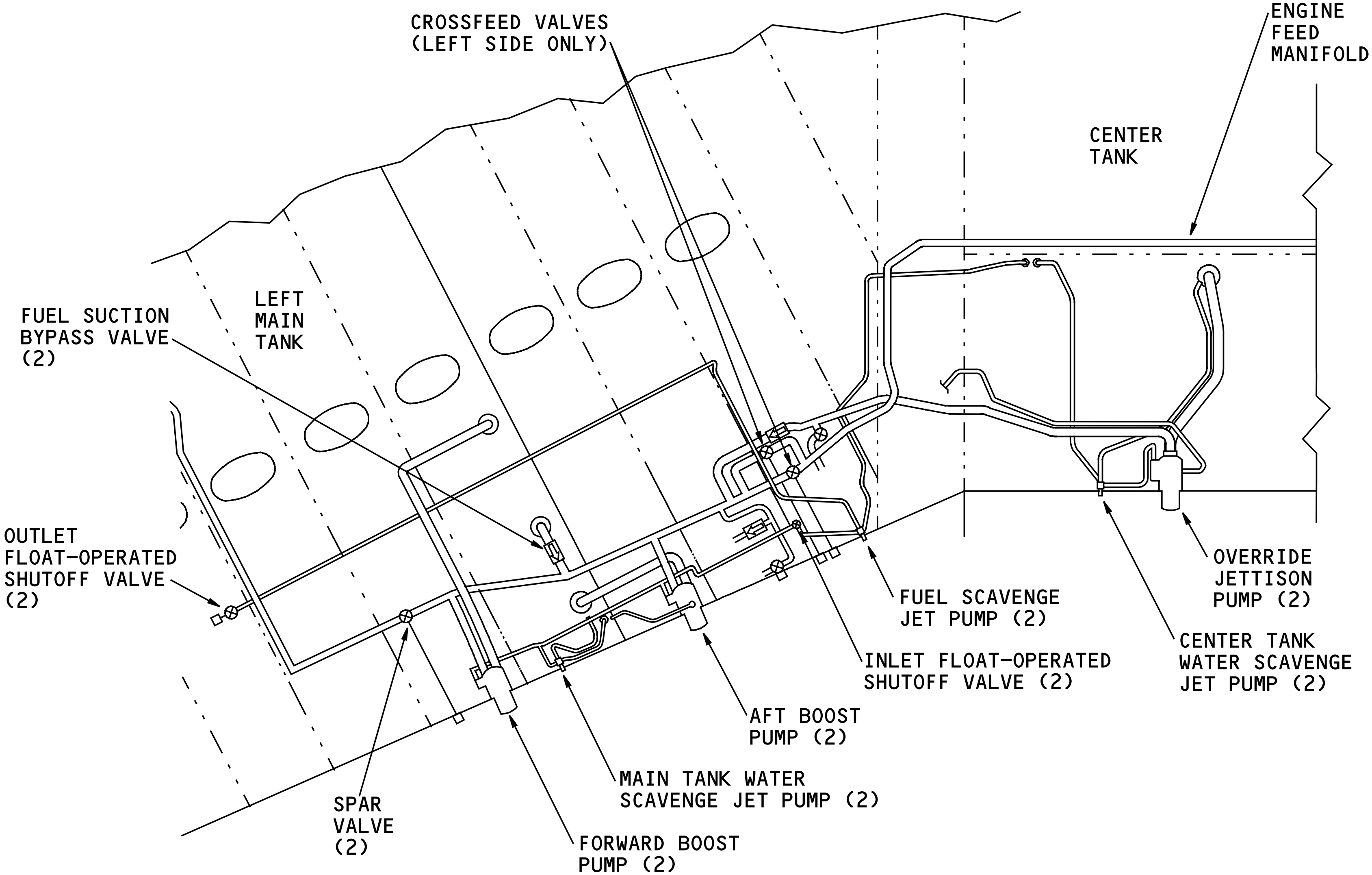
ENGINE FUEL FEED - COMPONENT LOCATIONS - TANKS

Main Fuel Tank Fuel Boost Pumps

Each main tank has a forward and an aft boost pump. The boost pumps are on the rear spar. The left forward boost pump is aft of the fourth fuel tank access door. The left aft boost pump is aft of the third fuel tank access door. The right tank boost pumps are in a similar position on the right rear spar.

Engine Fuel Spar Valves

There is one spar valve in each main tank. You get access to the valve bodies through the fifth fuel tank access doors. The valve actuators are on the rear spar aft of the fifth fuel tank access doors.



NOTE: LEFT SIDE SHOWN
RIGHT SIDE SIMILAR

ENGINE FUEL FEED - COMPONENT LOCATIONS - TANKS

28-22-00-003 Rev 7 08/21/96

ENGINE FUEL FEED - COMPONENT LOCATIONS - REAR SPAR - 1

Override/Jettison Pumps

The engine fuel feed system has two override/jettison pumps. One pump is for each half of the center tank. They attach to the rear spar of the center wing section. You get access to the pumps in the main wheel wells.

Center Tank Water Scavenge Jet Pumps

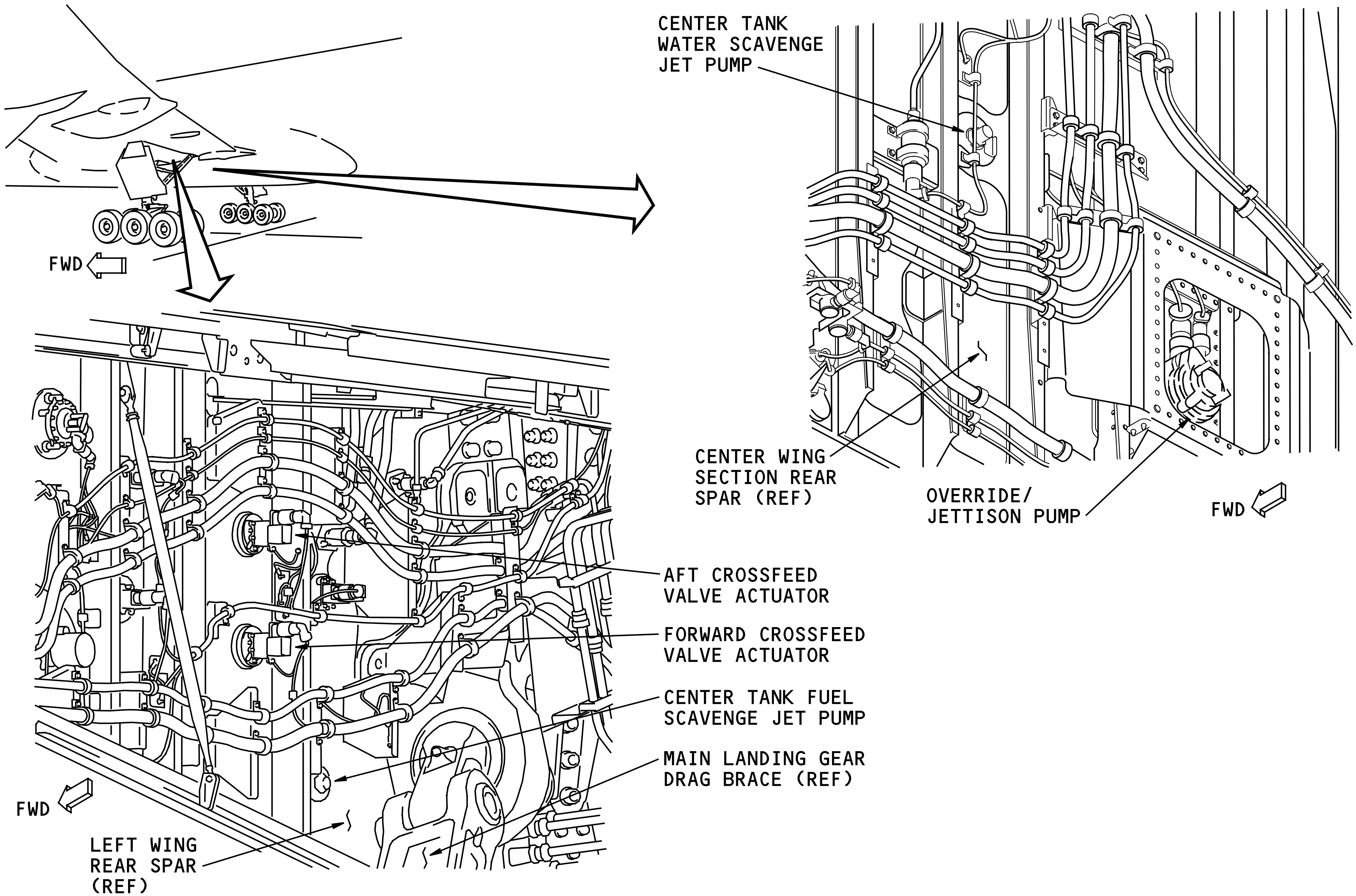
Each half of the center tank has a water scavenge jet pump. The pumps attach to the rear spar of the center tank wing section , outboard of the override/jettison pumps.

Center Tank Fuel Scavenge Jet Pumps

Each half of the center tank has a fuel scavenge jet pump. The pumps attach to the rear spar of each wing, outboard of the main landing gear drag brace.

Crossfeed Valves

The engine fuel feed system has two crossfeed valves. The crossfeed valve actuators attach to the rear spar of the left wing, outboard of the main landing gear drag brace.



28-22-00-018 Rev 2 07/18/1996

ENGINE FUEL FEED - COMPONENT LOCATIONS - REAR SPAR - 1

ENGINE FUEL FEED - COMPONENT LOCATIONS - REAR SPAR - 2

Boost Pumps

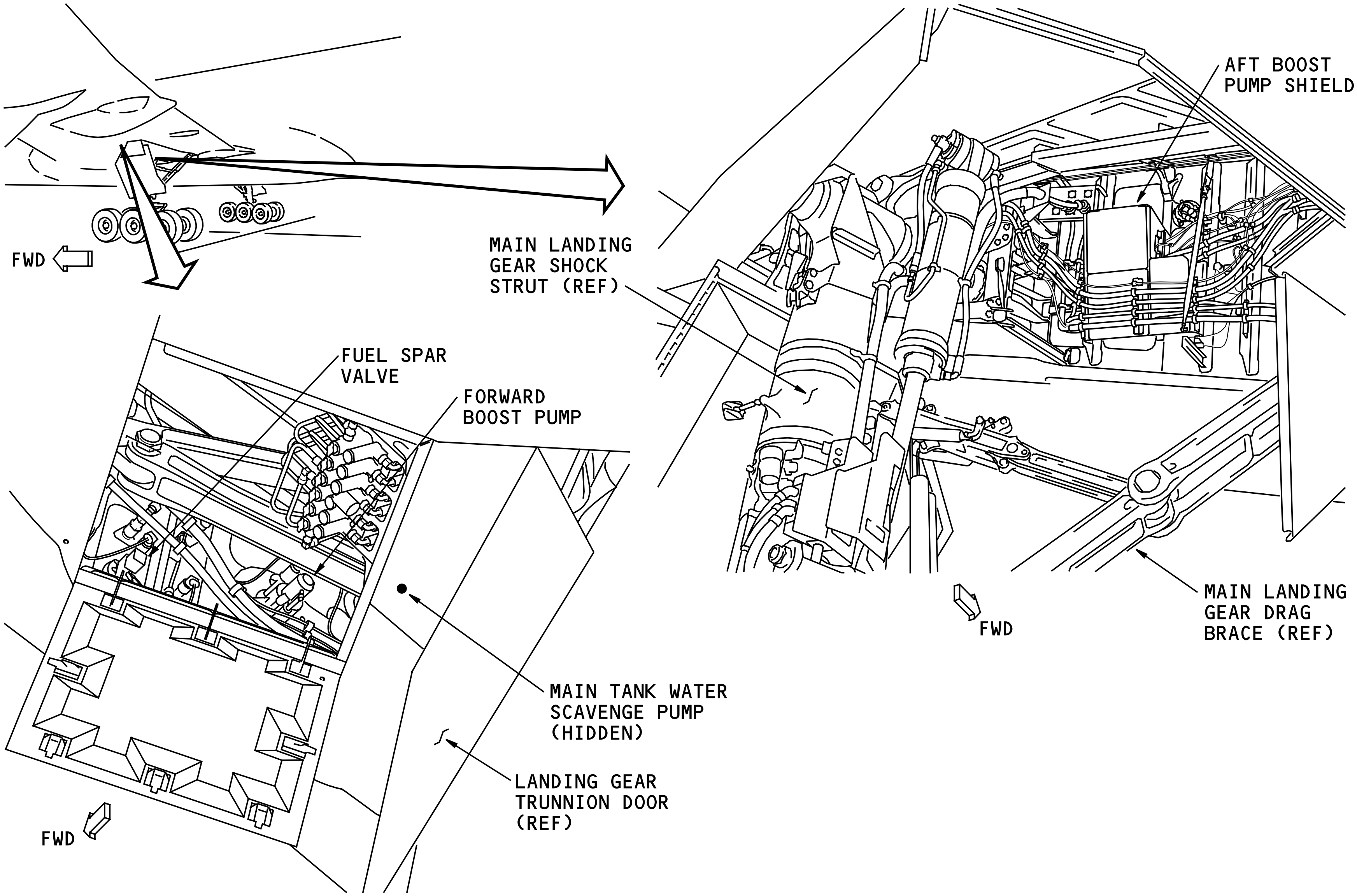
The engine fuel feed system has four boost pumps. Two pumps are for each main tank. They attach to the rear spar of each wing. The forward boost pumps are outboard of each main landing gear shock strut. The aft boost pumps are inboard of each main landing gear shock strut. The aft boost pump has a shield that protects it.

Main Tank Water Scavenge Jet Pumps

Each main tank has a water scavenge jet pump. The pumps attach to the rear spar of each wing, inboard of the forward boost pumps, near the landing gear trunnion door.

Engine Fuel Spar Valves

The engine fuel feed system has two fuel spar valves. The spar valve actuators attach to the rear spar of each wing, outboard of the forward boost pumps.



28-22-00-019 Rev 0

ENGINE FUEL FEED - COMPONENT LOCATIONS - REAR SPAR - 2

ENGINE FUEL FEED - COMPONENT LOCATIONS - FLIGHT DECK AND PASSENGER COMPARTMENT

Engine Fuel Spar Valve Battery

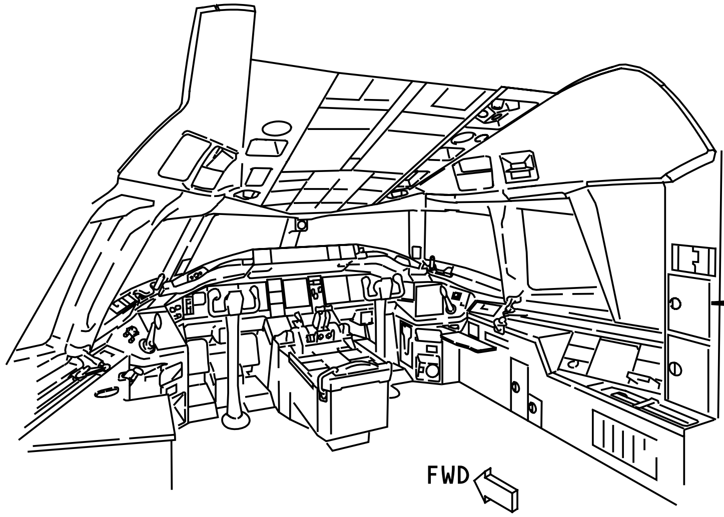
The engine fuel spar valve battery is in the flight deck. Four fasteners attach the battery to the outboard side of the right side stowage bin.

Relays

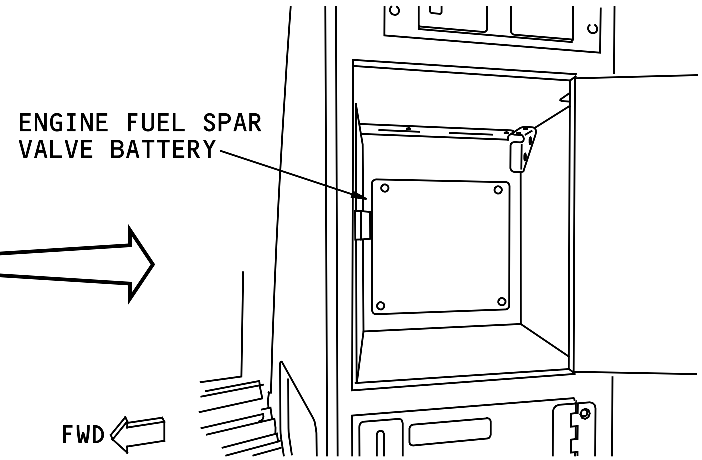
These relays are in the P101 distribution integration panel:

- Left engine fuel spar valve control
- Right engine fuel spar valve control
- APU shutoff valve control
- APU remote shutdown.

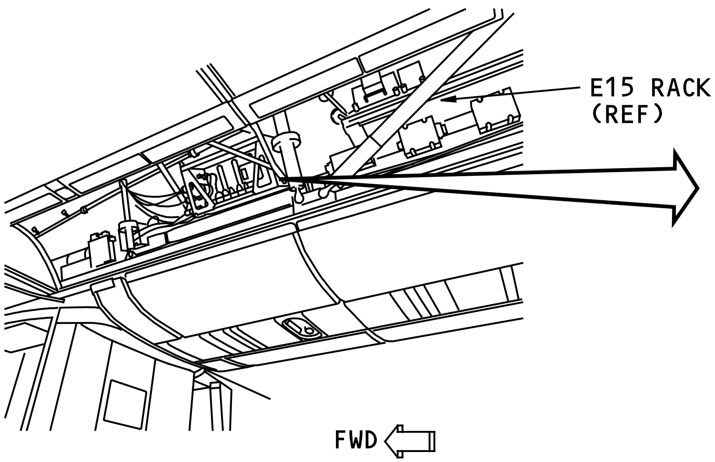
The P101 panel is in the passenger compartment. It is above the center stowage bins, near door 1L.



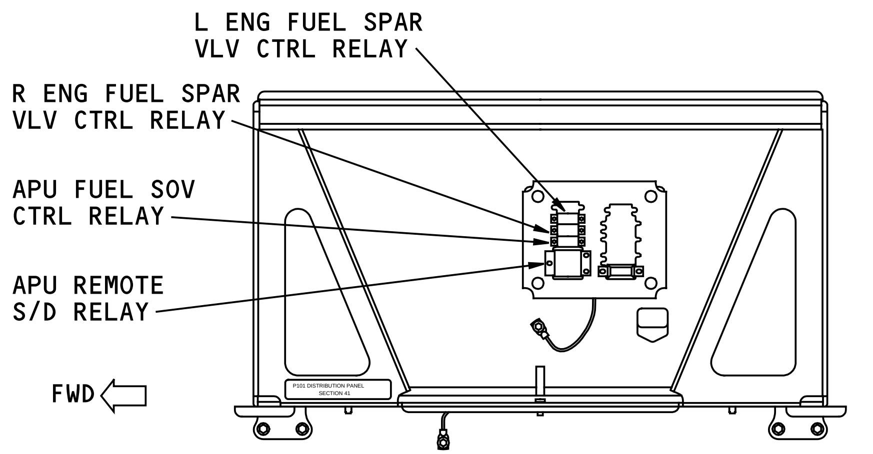
FLIGHT DECK



RIGHT SIDE STOWAGE BIN
(DOOR OPEN)



OVERHEAD PASSENGER COMPARTMENT
(LEFT SIDE LOOKING INBOARD)



P101 DISTRIBUTION INTEGRATION PANEL (DOOR 1L)

28-22-00-015 Rev 1

ENGINE FUEL FEED - COMPONENT LOCATIONS - FLIGHT DECK AND PASSENGER COMPARTMENT

ENGINE FUEL FEED - OVERRIDE/JETTISON PUMP

General

The override/jettison pumps supply fuel from the center tank to the engine feed manifold. They also supply fuel to the refuel/jettison manifold during fuel jettison.

The override/jettison pumps can supply fuel at a pressure of 36 psi and a flow rate of 70,000 pounds (31,750 kgs) per hour. Each pump assembly has a motor-impeller and a housing.

Location

There is one override/jettison pump in each main landing gear wheel well, at the rear spar. The housings are inside the center wing section, on the rear spar. The motor-impellers install in the housings.

Pump Housing

The housing contains the motor-impeller and these valves:

- Discharge check valve
- Motive flow check valve
- Vapor vent valve
- Inlet valve.

The discharge check valve prevents engine feed manifold fuel from flowing back through the pump.

The motive flow check valve prevents fuel from the scavenge pumps from flowing back through the pump.

The vapor vent valve permits fuel vapor to go into the tank, but does not permit fuel to enter the pump.

The inlet valve is a gate valve that closes when you remove the pump. This permits you to remove the pump when the tanks have fuel in them.

Motor-Impeller

The motor-impeller uses 115v ac power. Each pump has these parts:

- Electrical connector
- Pressure switch
- Drain plug
- Extraction lever.

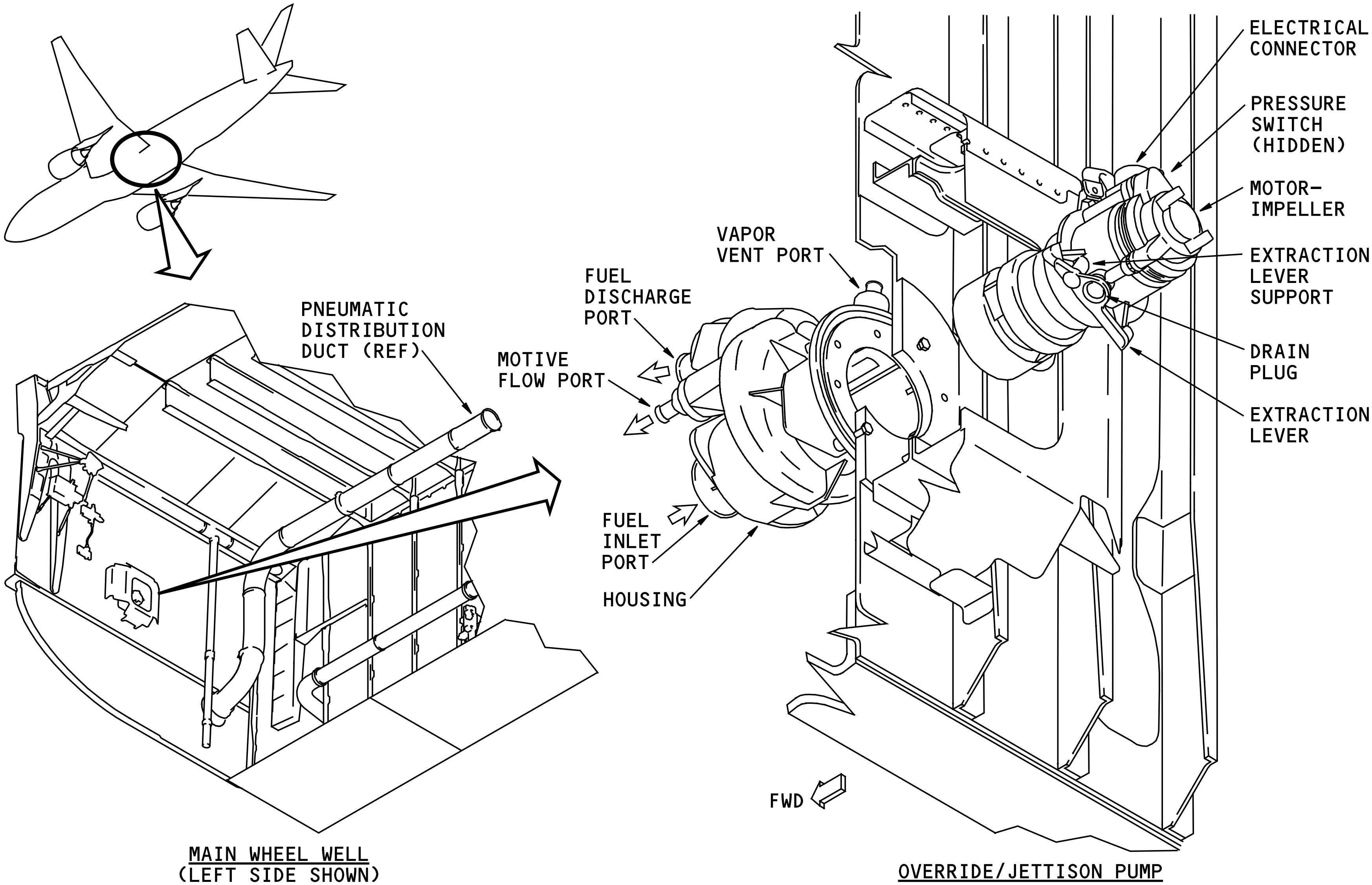
Training Information Point

The override/jettison pump motor-impellers are interchangeable with the jettison pump motor-impellers.

To remove the motor-impeller, you rotate it 35 degrees CCW to close the inlet valve. Then you remove the drain plug to remove residual fuel. You use the extraction lever to move the motor-impeller out of the housing.

To install the motor-impeller, you must align pins in the housing to slots on the motor-impeller.

You can remove the discharge, motive flow, and vapor vent valves through the housing from outside the tank.



28-22-00-004 Rev 4

ENGINE FUEL FEED - OVERRIDE/JETTISON PUMP

ENGINE FUEL FEED - CENTER TANK FUEL SCAVENGE JET PUMP

Purpose

The fuel scavenge jet pumps take fuel from the low points in the center tank and send it to the main tanks. This increases the amount of usable fuel in the center tank. Float-operated shutoff valves prevent fuel scavenge when the main tanks are full.

Location

There is one fuel scavenge jet pump in each side of the center tank. They are in the left and right wheel wells on the rear spar.

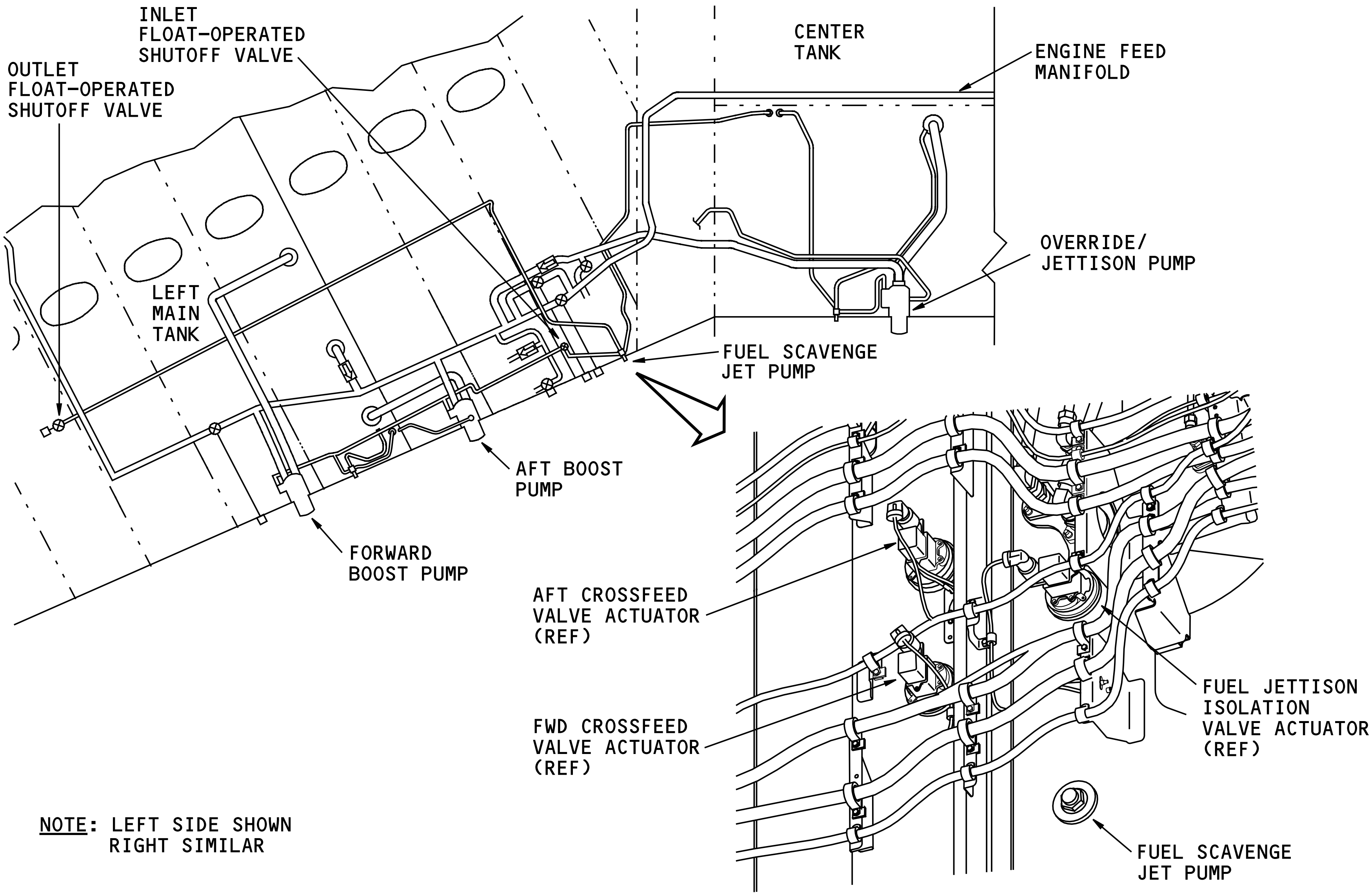
There is an outlet float-operated shutoff valve in each main tank. You get access to these valves through the seventh fuel tank access door.

There is an inlet float-operated shutoff valve in each side of the center tank. You get access to these valves through the first fuel tank access door.

Functional Description

The jet pumps operate automatically when the boost pumps are on. They use fuel from the boost pumps as motive fuel. The flow of the motive fuel through the jet pump causes suction that takes fuel from the center tanks. The fuel goes through the jet pump discharge lines to the main tanks. When the main tanks are full, the outlet float-operated shutoff valve closes to stop fuel flow through the discharge line.

The inlet float-operated shutoff valve prevents motive flow to the jet pump until the center tank is almost empty. This prevents the fuel from flowing into the main tank too early if the outlet float-operated shutoff valve fails. A check valve in the jet pump prevents fuel movement from the main tank to the center tank.



28-22-00-005 Rev 5 03/18/96

ENGINE FUEL FEED - CENTER TANK FUEL SCAVENGE JET PUMP

ENGINE FUEL FEED - BOOST PUMP

General

The boost pumps supply main tank fuel to the engine feed manifold.

The boost pumps can supply fuel at a pressure of 12 psi and a flow rate of 35,200 pounds (16,000 kgs) per hour. Each pump assembly has a motor-impeller and a housing.

Location

There are two boost pumps in each main tank. The forward boost pumps are on the rear spar, outboard of each main landing gear shock strut. The aft boost pumps are on the rear spar, inboard of each main landing gear shock strut. The housings are inside the tanks, on the rear spar. The motor/impellers install in the housings.

Pump Housing

The housing contains the motor-impeller and these valves:

- Discharge check valve
- Motive flow check valve
- Vapor vent valve
- Inlet valve.

The discharge check valve prevents engine feed manifold fuel from flowing back through the pump.

The motive flow check valve prevents fuel from the scavenge pumps from flowing back through the pump.

The vapor vent valve permits fuel vapor to go into the tank, but does not permit fuel to enter the pump.

The inlet valve is a gate valve that closes when you remove the pump. This permits you to remove the pump when the tanks are full.

Motor-Impeller Unit

The motor-impeller uses 115v ac power. Each pump has these parts:

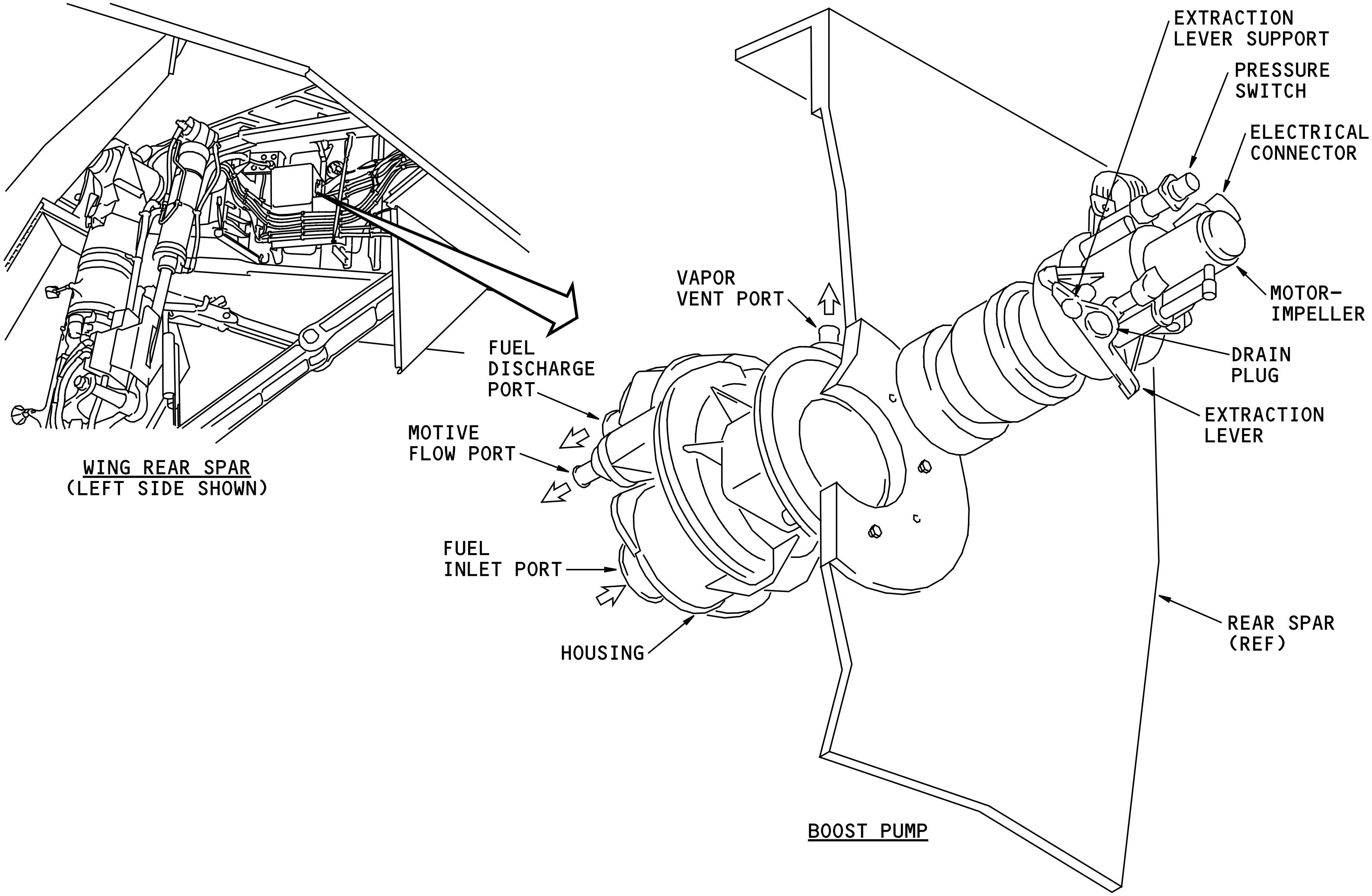
- Electrical connector
- Pressure switch
- Drain plug
- Extraction lever.

Training Information Point

To remove the motor-impeller, you turn it 35 degrees CCW to close the inlet valve. Then you remove the drain plug to remove residual fuel. You use the extraction lever to move the motor-impeller out of the housing.

To install the motor-impeller, you must align pins in the housing to slots on the motor-impeller.

You can remove the discharge, motive flow, and vapor vent valves through the housing from outside the tank.



ENGINE FUEL FEED - BOOST PUMP

ENGINE FUEL FEED - WATER SCAVENGE JET PUMP

General

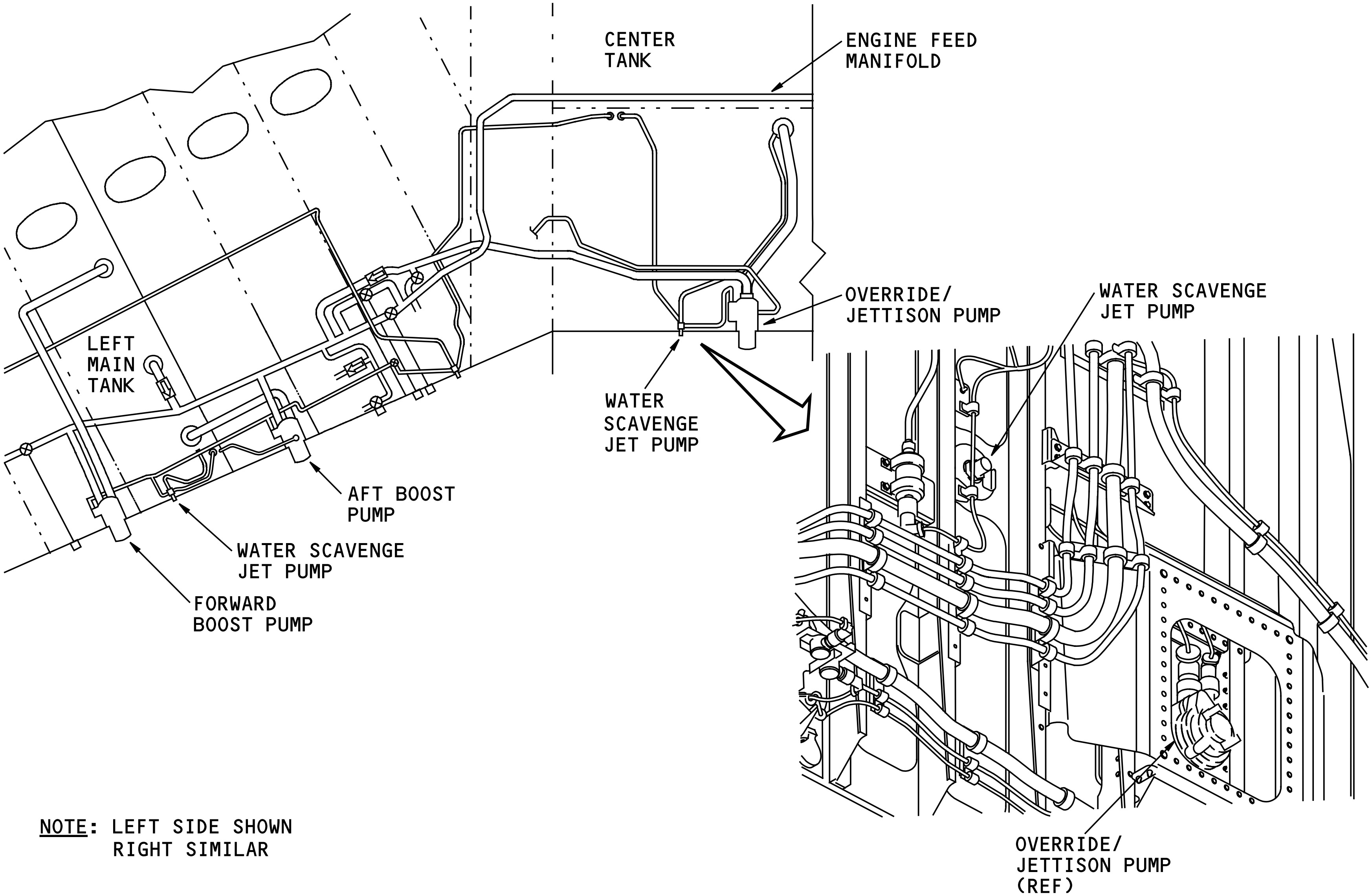
The water scavenge jet pumps take fluid from the low points in the tanks and send it to the pump inlets. This prevents water from collecting in the bottom of the tanks.

Location

The water scavenge jet pumps are on the rear spar. There is one jet pump in each side of the center tank and one in each main tank.

Functional Description

The jet pumps operate automatically when the fuel pumps are on. They use fuel from the fuel pumps as motive fuel. The flow of the motive fuel through the jet pump causes suction that takes fluid from the low points in the tanks.



NOTE: LEFT SIDE SHOWN
RIGHT SIMILAR

28-22-00-007 Rev 3 03/18/96

ENGINE FUEL FEED - WATER SCAVENGE JET PUMP

ENGINE FUEL FEED - MOTOR-ACTUATED VALVES

General

The fuel system has 11 motor-actuated valves. These seven valves have a valve body, an adapter/shaft and an actuator:

- Engine fuel spar valves (2)
- Fuel crossfeed valves (2)
- Fuel jettison isolation valves (2)
- Defuel valve.

These four valves have the same actuator, a different valve body, but no adapter/shaft:

- APU fuel shutoff valve
- APU fuel isolation valve
- Fuel jettison nozzle valves (2).

Valve Body

The valve body connects two fuel lines. It has these parts:

- Butterfly valve (not shown)
- Operating shaft
- Thermal relief valve.

There are no hard stops for the valve body. You look at alignment marks to find out if the valve is closed.

Adapter

The adapter/shaft mounts through the rear spar. It has these parts:

- Mount plate
- Index plate
- Adapter shaft.

The adapter shaft connects the adapter to the operating shaft on the valve body.

The index plate attaches to the mount plate with three screws. You loosen these screws to rotate the index plate when you align the valve. You must get access to the valve body to check the valve position when you align it.

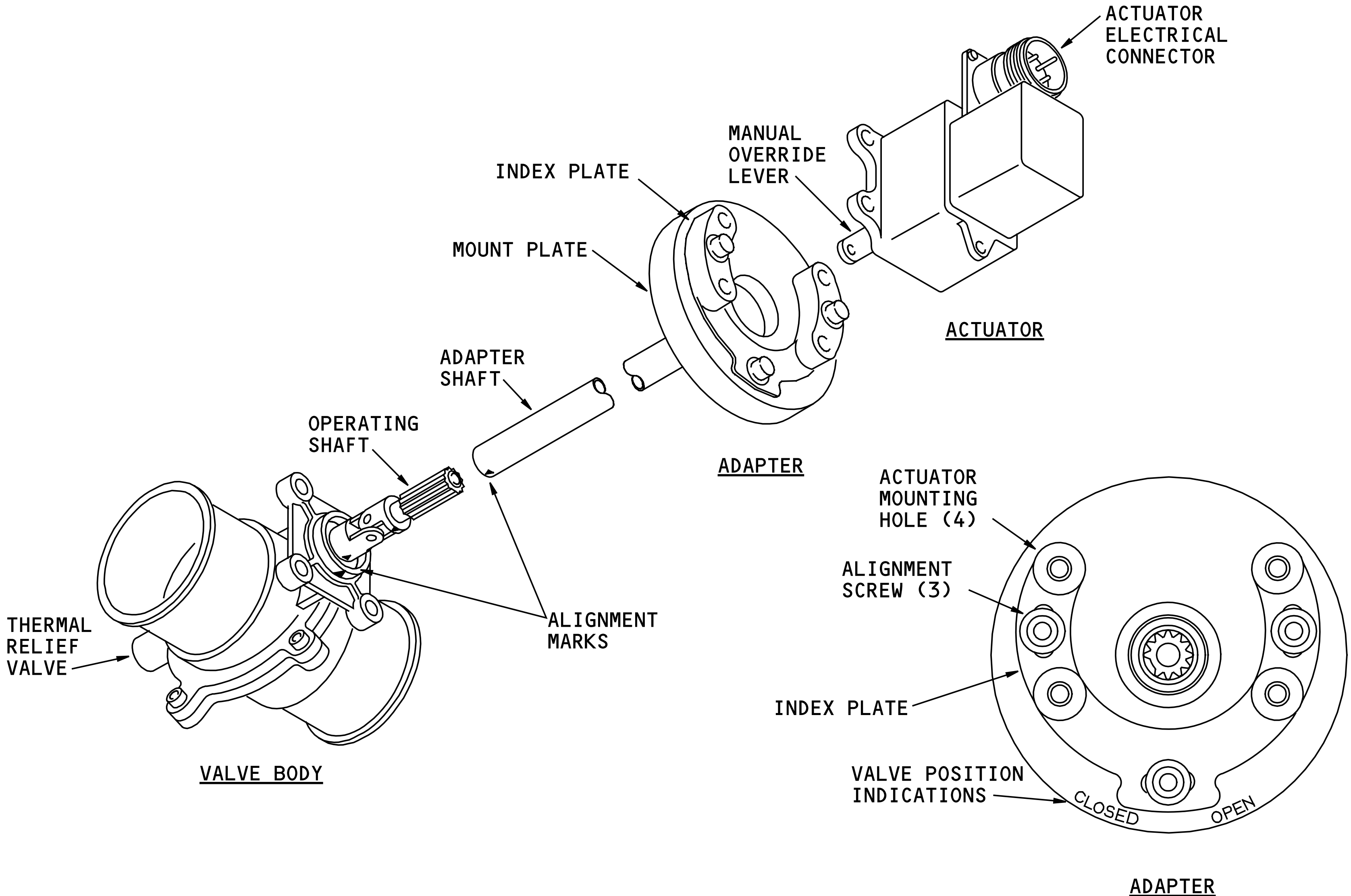
Actuator

The actuator is a 28v dc motor. It has a manual override lever that permits you to operate the actuator without electrical power. The lever aligns with marks on the adapter. This shows you the valve position.

You can remove the actuator without defueling the airplane.

Training Information Point

The valves use interchangeable actuators.



ENGINE FUEL FEED - MOTOR-ACTUATED VALVES

ENGINE FUEL FEED - SPAR VALVE BATTERY

Purpose

The engine fuel spar valve battery makes sure that the fuel system always has power to close these shutoff valves:

- Engine fuel spar valves
- APU fuel shutoff valve.

Components

The engine fuel spar valve battery has these components:

- Aluminum case
- Battery pack
- Printed circuit board assembly
- Electrical connector.

Battery Assembly

The battery pack contains rechargeable nickel-cadmium batteries. They supply 28v dc power to the valve actuators.

Printed Circuit Board Assembly

The printed circuit board assembly has these functions:

- Switching
- Charging
- Testing.

The switch circuit monitors the voltage of the hot battery bus. If the voltage becomes less than 22v, the switch circuit supplies power from the spar valve battery to the valve actuator circuits.

The charge circuit uses power from the right main dc bus to charge the batteries.

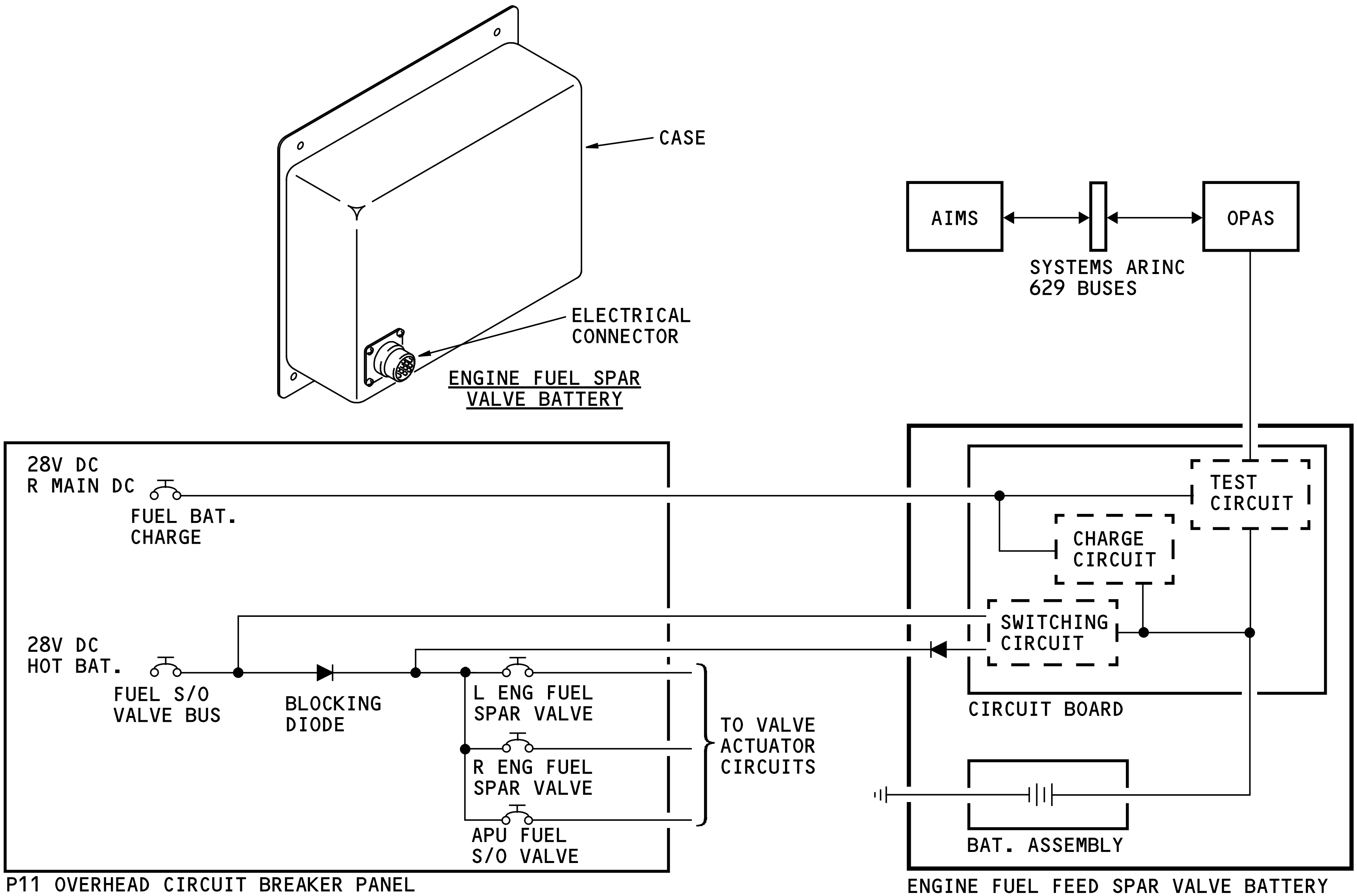
The test circuit does automatic tests of the spar valve battery. It also continuously monitors the battery for these faults:

- Voltage
- Shorted cell
- Open cell
- One battery section has lower voltage than the other battery section.

The test circuit sends a status signal to OPAS that tells the AIMS if the batteries have sufficient capacity. It sends a health signal to OPAS that tells the AIMS if a fault is found. The AIMS shows the EICAS status message FUEL SOV BATTERY when there is a fault.

Training Information Point

There is a airplane maintenance manual (AMM) test of the blocking diode for the fuel shutoff valve bus. The blocking diode is in the P11 panel.



ENGINE FUEL FEED - SPAR VALVE BATTERY

ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - FUEL FLOW

General

The normal procedure for engine fuel feed operation is to supply fuel from the center tank first. When the center tank is empty, you supply fuel from the main tanks.

If you open a crossfeed valve, you can feed an engine from the opposite main tank to correct a fuel imbalance between the main tanks.

The engines can also use suction feed from a main tank.

Center Tank Engine Feed

When the override/jettison pumps are on and there is fuel in the center tank, fuel goes from the center tank into the engine feed manifold. When the spar valves open, fuel goes from the engine feed manifold to the engines.

Main Tank Engine Feed

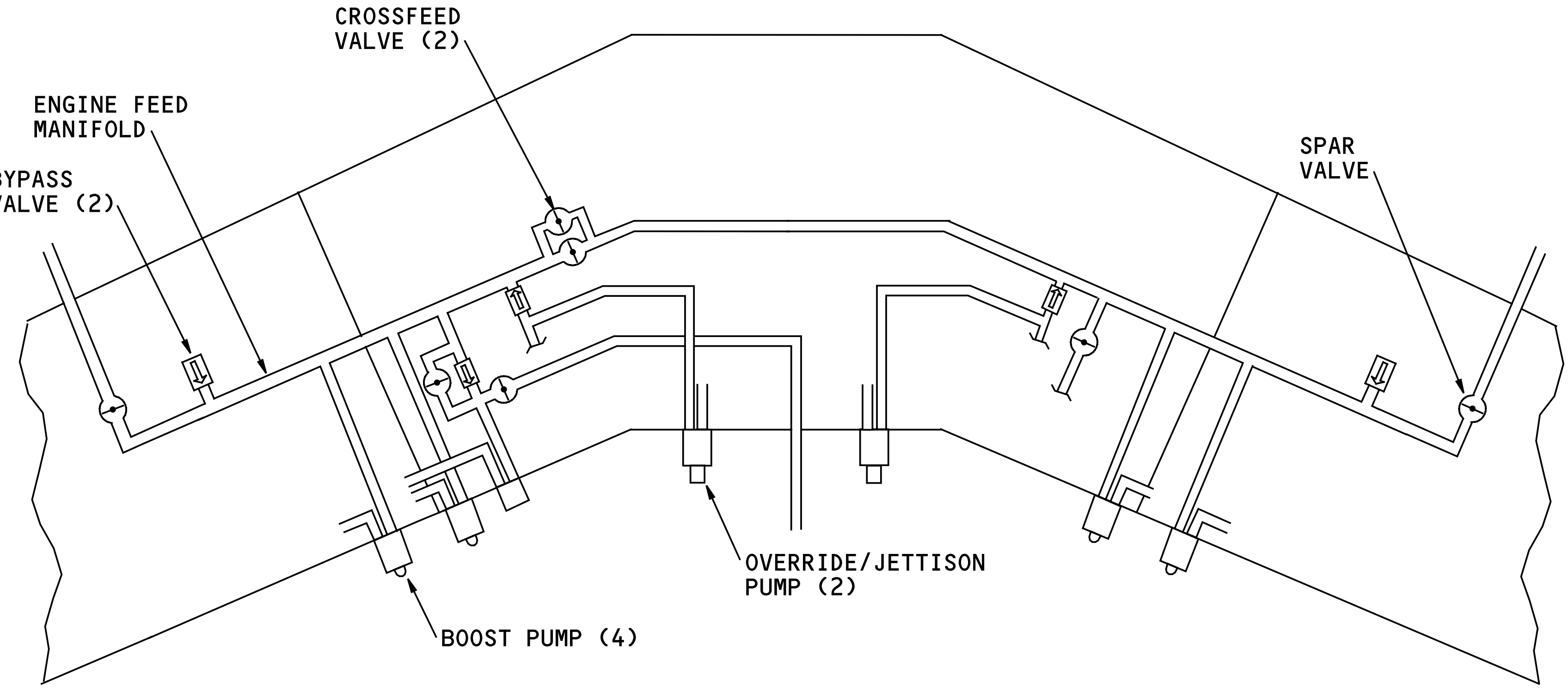
When the center tank is empty and the boost pumps are on, fuel goes from the main tanks into the engine feed manifold.

Cross Feed

The crossfeed valves isolate the left and right sides of the engine feed manifold. If a crossfeed valve is open, an engine can receive fuel from the fuel pumps on the opposite side.

Suction Feed

Suction (gravity) feed occurs when all the pumps on one side are off and the crossfeed valves are closed. During suction feed, the engine gets fuel through the suction bypass valve. The engines can only suction feed from the main tanks.



28-22-00-009 Rev 3 03/18/96

ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - FUEL FLOW

ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - LEFT FORWARD BOOST PUMP CONTROL

General

The left forward boost pump receives 115v ac power from two sources: the ground service bus or the left transfer bus.

The boost pump control switch controls power to the pump. A light on the switch shows when there is low pressure at the pump outlet.

Ground Service Bus Power

The usual power source for the boost pump is the ground service bus. Power goes through the boost pump switching and control relays to the pump.

Power from the ground service bus automatically closes the boost pump switching relay.

Left Transfer Bus Power

The left transfer bus is an alternative power source for the left forward boost pump. The left aft boost pump switch must be off for the forward boost pump to receive power from the left transfer bus. This prevents both boost pumps from operating when the backup generator is the power source.

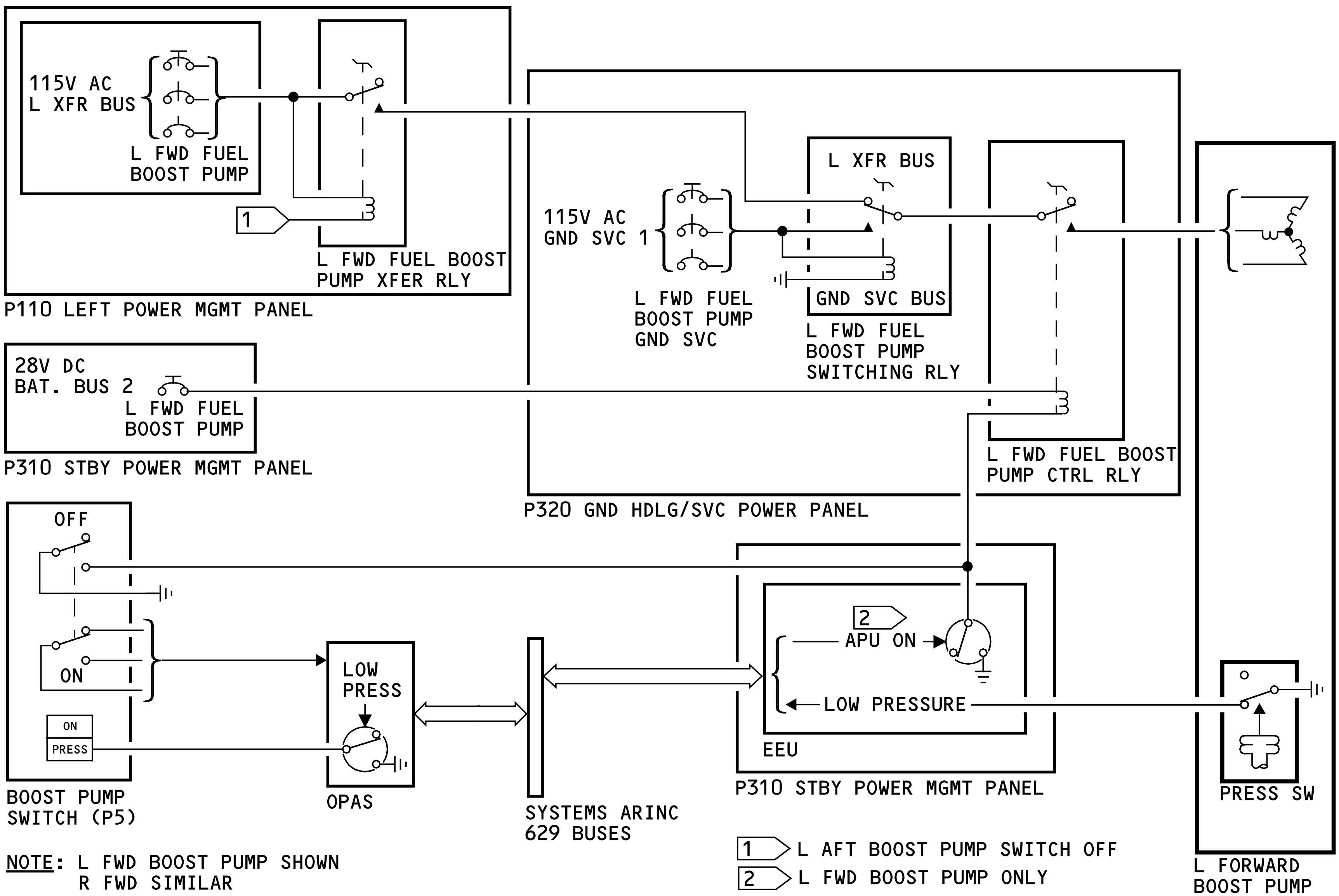
Boost Pump Power Control

The boost pump control switch supplies a ground to close the boost pump control relay.

The ELMS logic can also supply a ground to close the boost pump control relay. It does this when the airplane is on the ground and the APU selector is on or the APU is running. This permits the APU to get fuel when the boost pump switches are off.

Pressure Indication

The pressure light on the boost pump control switch shows low pump pressure. The boost pump pressure switch closes when there is low pressure at the pump outlet. The ELMS electronics unit sends a signal through OPAS to turn on the low pressure light.



NOTE: L FWD BOOST PUMP SHOWN
R FWD SIMILAR

ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - LEFT FORWARD BOOST PUMP CONTROL

ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - LEFT AFT BOOST PUMP CONTROL

General

This page shows control for the left aft boost pump. Control of the right aft boost pump is almost the same.

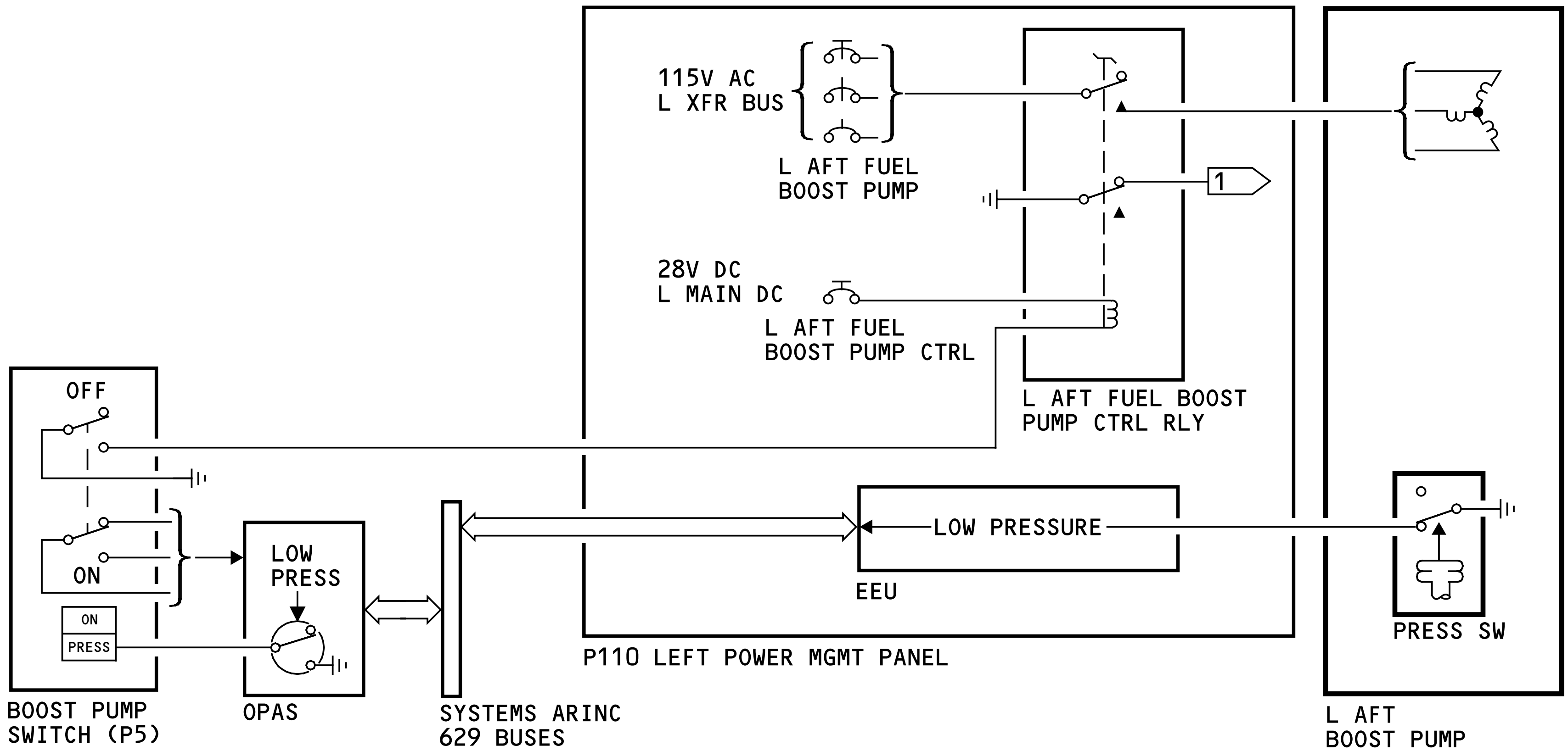
The left aft boost pump receives 115v ac power from the left transfer bus.

Left Aft Boost Pump Control

The boost pump control switch closes the boost pump control relay in the left power management panel. This permits power to go from the left transfer bus to the boost pump.

Pressure Indication

The boost pump control switch has a light to show when there is low pressure at the pump outlet. The boost pump pressure switch closes when there is low pressure. The ELMS logic sends a signal through OPAS to turn on the low pressure light in the switch.



28-22-00-011 Rev 3 02/20/95

NOTE: L AFT BOOST PUMP SHOWN
R AFT SIMILAR

1 TO L FWD FUEL BOOST PUMP XFER RELAY

ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - LEFT AFT BOOST PUMP CONTROL

ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - LEFT CENTER OVERRIDE/JETTISON PUMP CONTROL

General

The left center override/jettison pump receives 115v ac power from the left main bus. Control of the right center override/jettison pump is almost the same.

Left Center Override/Jettison Pump Control

The center left fuel pump switch supplies a ground to an electrical load control unit (ELCU) in the left power panel. The ELCU uses a control relay to close an internal contactor. This permits power to go from the left main bus to the pump.

The ELCU receives power from the left main dc bus. When the airplane is on the ground and has only one external power source, the ELMS removes the dc power to the ELCU. The right override/jettison pump operates the same. This inhibits the pump and prevents an electrical power overload. During the inhibit no EICAS message shows.

If the APU generator is the single power source, you can operate the left override/jettison pump. You cannot operate the right override/jettison pump if the APU generator is the only power source.

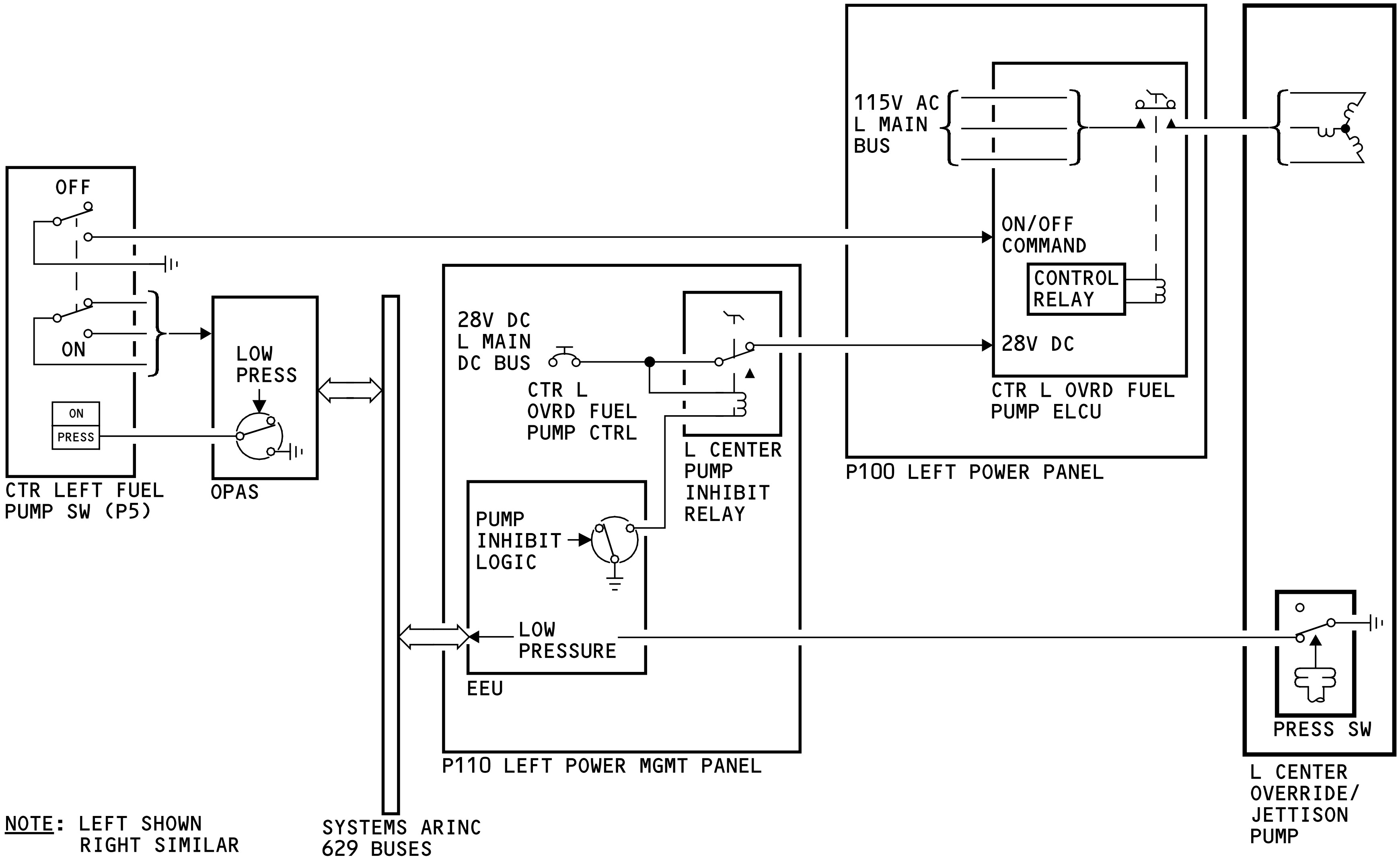
If an IDG is the single power source, you can operate the related override/jettison pump.

The pump inhibit logic does not operate during these conditions:

- The air/ground system is set to air mode
- A refuel panel door is open
- The fuel jettison arm switch is in the armed position.

Pressure Indication

The pressure light on the switch shows low pump pressure. The override/jettison pump pressure switch closes when there is low pressure at the pump outlet. The EEU sends a signal through the OPAS to turn on the pressure light on the switch. The pressure light will come on only when the pump is commanded on.



NOTE: LEFT SHOWN
RIGHT SIMILAR

28-22-00-012 Rev 5 03/31/95

ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - LEFT CENTER OVERRIDE/JETTISON PUMP CONTROL

ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - ENGINE FUEL SPAR VALVE

General

The engine fuel spar valves get power to operate from the hot battery bus or the spar valve battery. The fuel control switches control relays to operate the spar valves. The engine fire switch must be down to permit the spar valve to open.

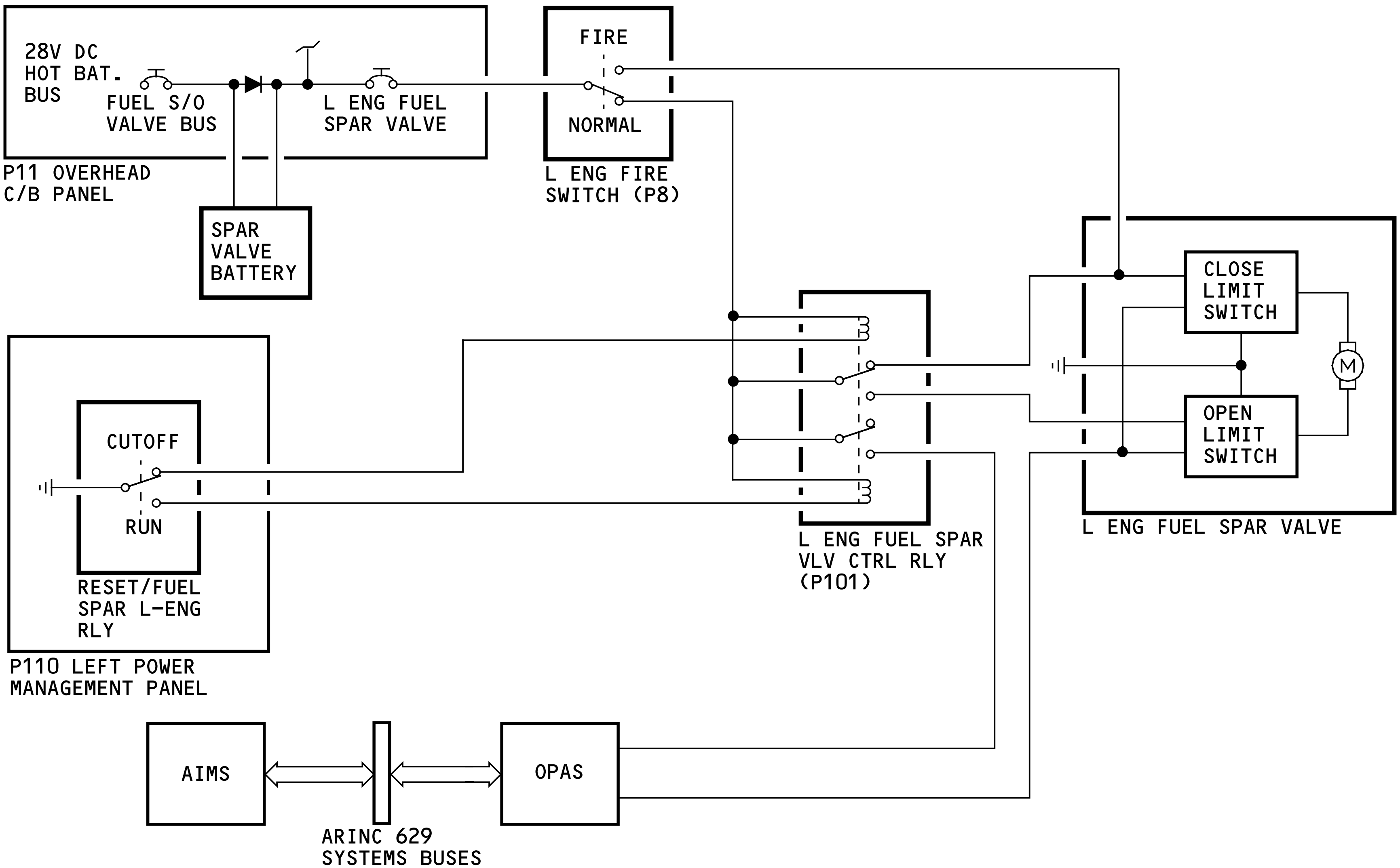
Control

Power goes through engine fuel spar valve control relay to the spar valve. The fuel control switch controls the reset/fuel spar relay to move the control relay. When the fuel control switch is in the RUN position, the open coil in the control relay energizes. This sends power to open the spar valve. When the fuel control switch is in the CUTOFF position, the close coil in the control relay energizes. This sends power to close the valve.

Power to operate the valve goes through limit switches to the actuator. The actuator moves the valve to the commanded position. When the valve is in the commanded position, the limit switches remove power from the actuator.

Fault Indications

The OPAS monitors the spar valve control relay position and the spar valve position. If there is a disagreement between the relay position and valve position, the OPAS sends a fault message to the AIMS. The fault messages cause an EICAS status message.



NOTE: LEFT SHOWN, RIGHT SIMILAR

ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - ENGINE FUEL SPAR VALVE

ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - CROSSFEED VALVE CONTROL

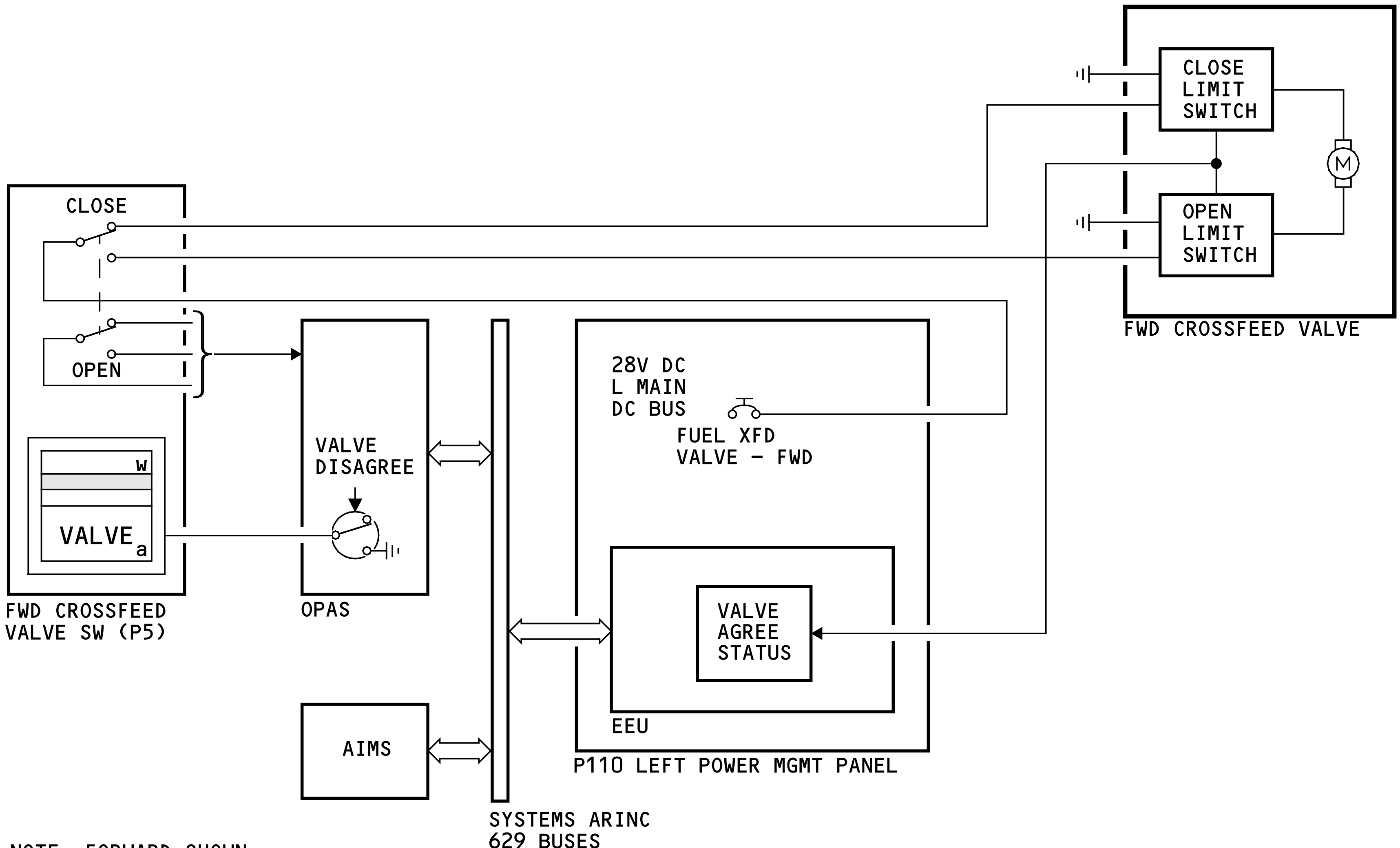
Control

The crossfeed valve switches on the P5 directly control the crossfeed valves. A 28v dc bus supplies power to the crossfeed valve actuator. When you push the switch, you supply power through the limit switches to the actuator. The actuator moves the valve to the commanded position. When the valve is in the commanded position, the limit switches remove power from the actuator and send power to the ELMS valve agree status logic.

Fault Indications

The VALVE light comes on to show the related valve is in transit, or a valve disagree fault exists. The light comes on when the valve position disagrees with the switch position. The ELMS controls the light. An EEU sends a valve disagree message to the OPAS to cause the OPAS to turn on the light.

If the valve disagree condition exists for more than 10 seconds, the ELMS sends a fault signal to the AIMS. The AIMS shows the related EICAS advisory and status messages.



NOTE: FORWARD SHOWN,
AFT SIMILAR

28-22-00-017 Rev 0

ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - CROSSFEED VALVE CONTROL

ENGINE FUEL FEED - OPERATION

Fuel Panel

The fuel panel is on the P5 overhead panel. It has alternate-action switches that control the fuel pumps and the crossfeed valves.

Each fuel pump switch has two indication lights. The ON light is on when the switch is on. The pressure light comes on when there is low pressure at the pump outlet.

Crossfeed Valve Switches

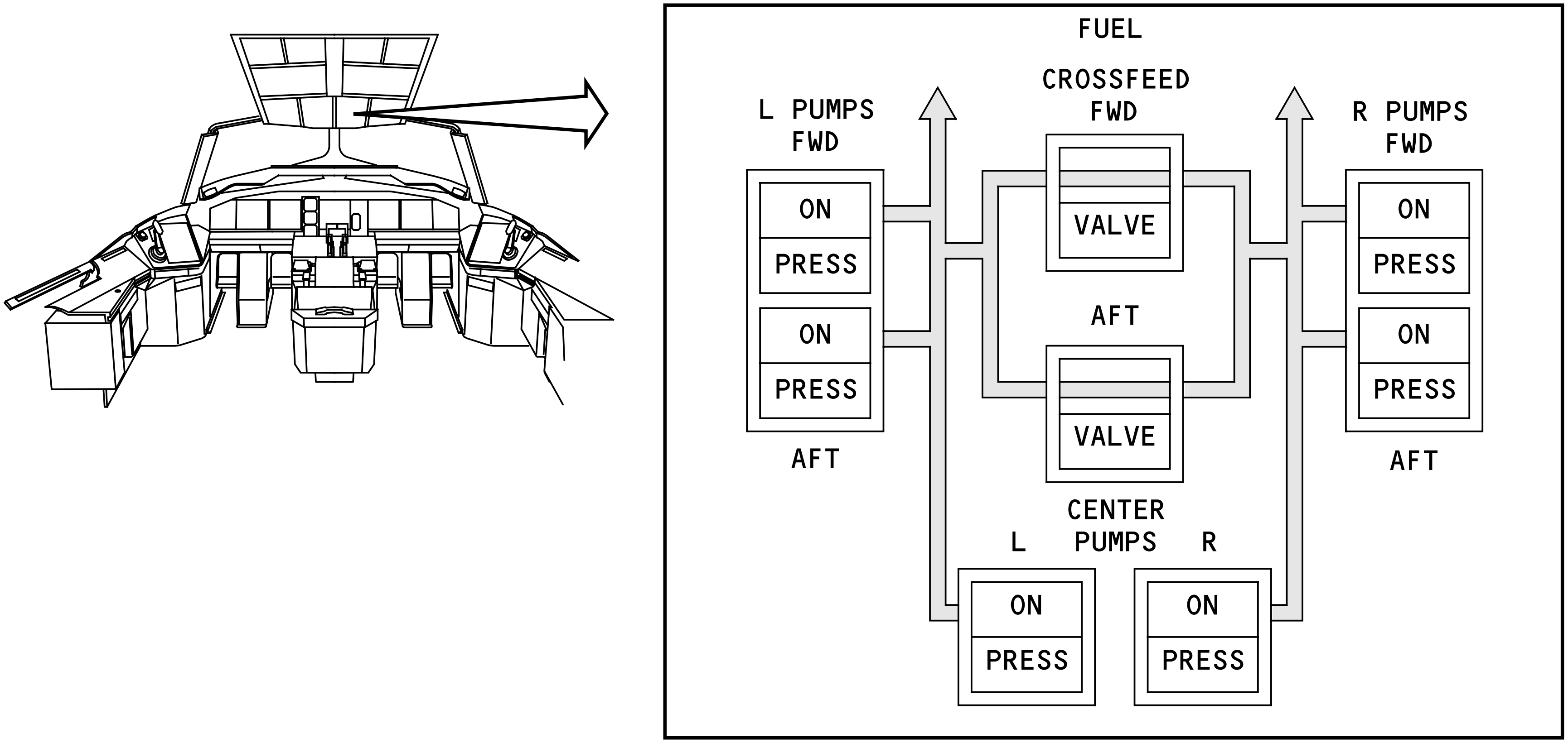
Each crossfeed valve switch has two indication lights. The flowbar light is on when the switch is on. The VALVE light comes on when there is disagreement between switch and valve positions.

Normal Operation

Normally all pump switches are on at the beginning of a flight. The center tank supplies fuel to the engines. When the center tank is empty, you turn off the override/jettison pumps.

Crossfeed

You supply fuel to an engine from the opposite tank through the crossfeed valve(s) to correct an imbalance between the main tanks. You open a crossfeed valve and turn off the boost pumps in the tank that has less fuel.



FUEL PANEL (P5)

28-22-00-013 Rev 2

ENGINE FUEL FEED - OPERATION

ENGINE FUEL FEED - INDICATIONS

Fuel Synoptic Display

The fuel synoptic display is a simplified schematic of the fuel system. It shows the system configuration for these components:

- Override/jettison pumps
- Boost pumps
- Spar valves
- Crossfeed valves

The fuel synoptic display also shows fuel quantity.

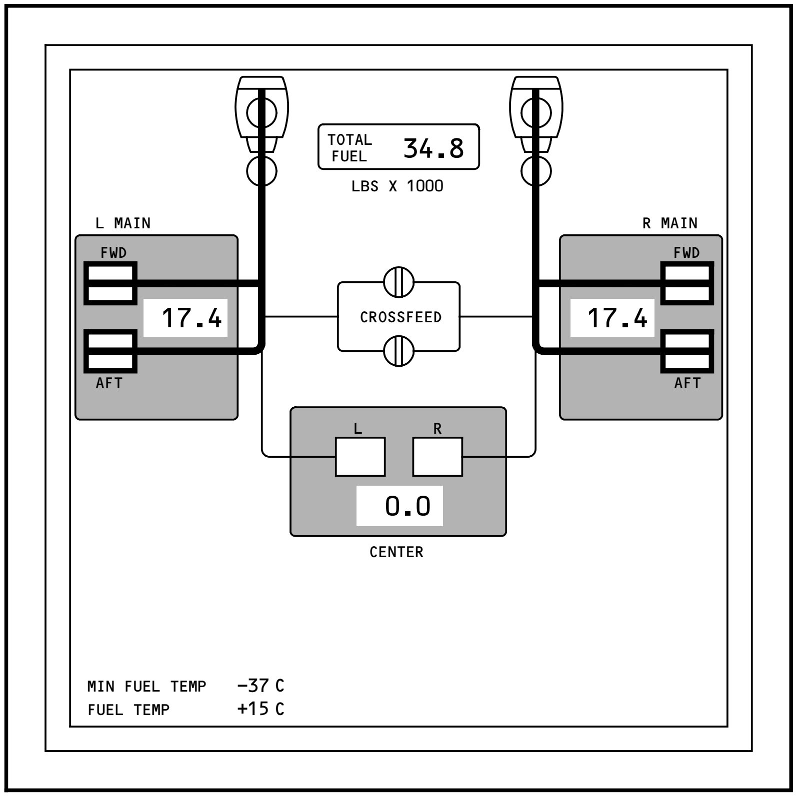
The configuration in the fuel synoptic display below shows the center tank empty and the boost pumps feeding the engines from the main tanks. The crossfeed valves are closed and the spar valves are open.

Fuel Management Maintenance Page

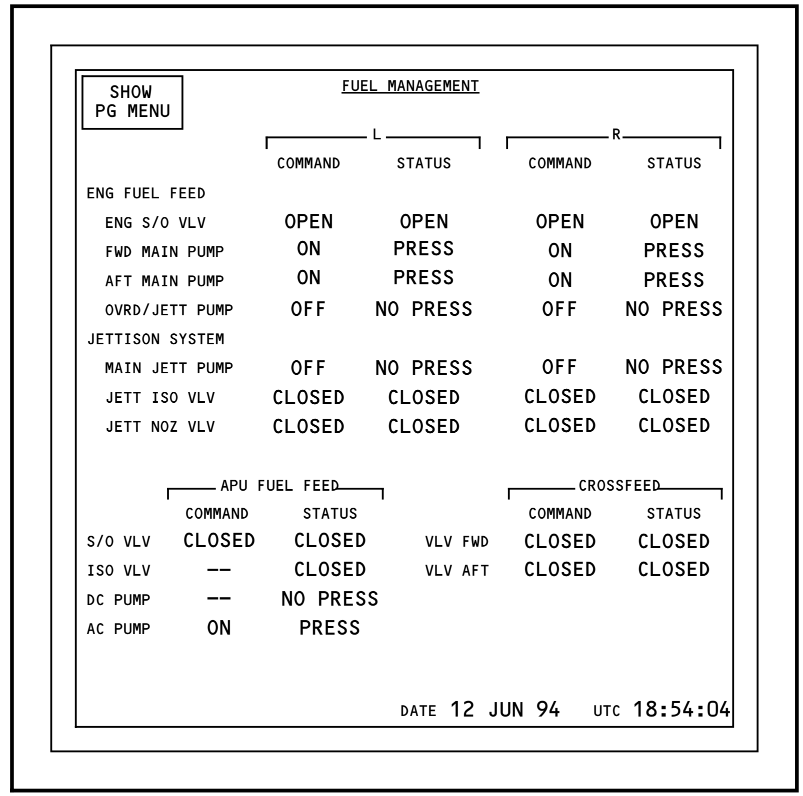
The fuel management maintenance page shows the commanded and actual status for the fuel system components.

Training Information Point

The ENG S/O VLV data tell you about the spar valves. The AC PUMP data tell you about the left forward boost pump. The VLV FWD data tell you about the forward crossfeed valve. The VLV AFT data tell you about the aft crossfeed valve.



FUEL SYNOPTIC DISPLAY



FUEL MANAGEMENT MAINTENANCE PAGE

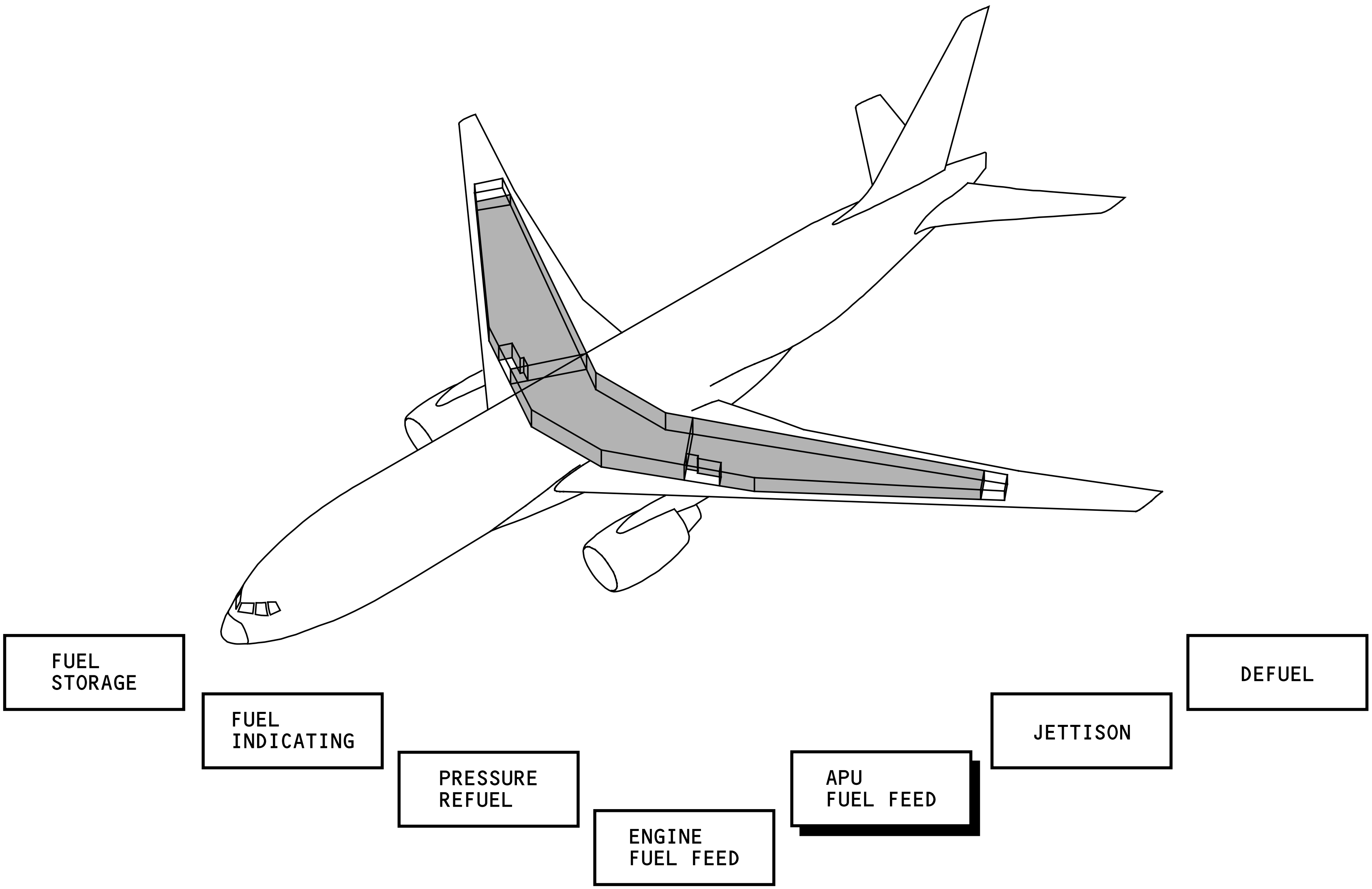
28-22-00-014 Rev 7

ENGINE FUEL FEED - INDICATIONS

APU FUEL FEED - INTRODUCTION

Purpose

The APU fuel feed system normally supplies fuel to the APU. It can also supply fuel to the left engine when there is no pressure in the left engine feed manifold and the left engine is not operating.



APU FUEL FEED - INTRODUCTION

28-25-00-001 Rev 2 03/26/96

APU FUEL FEED - GENERAL DESCRIPTION

General

The APU fuel feed system supplies fuel to the APU during APU operation. Fuel comes from the fuel pumps (not shown) or the APU dc fuel pump. Power and control come from the ELMS.

APU Feed

The ELMS supplies power to the APU dc fuel pump and APU fuel shutoff valve. The pump operates automatically when the APU selector is in the ON position and there is no pressure in the left engine feed manifold. When there is pressure in the left engine feed manifold, the pump does not operate.

The ELMS uses crossfeed valve position and pump pressure switch signals to find if there is pressure in the manifold. The ELMS uses the dc pump pressure switch to monitor pump operation.

The APU fuel shutoff valve opens to permit fuel to go to the APU. In normal operation, the ELMS controls the valve through the a relay in the P101 panel. The ELMS opens the APU fuel shutoff valve when the APU selector is in the ON position or when the APU is running. The APU controller tells the ELMS when the APU is running.

The hot battery bus or the engine fuel spar valve battery supplies the power to open or close the APU fuel shutoff valve. The APU fire switch must be down to open the valve.

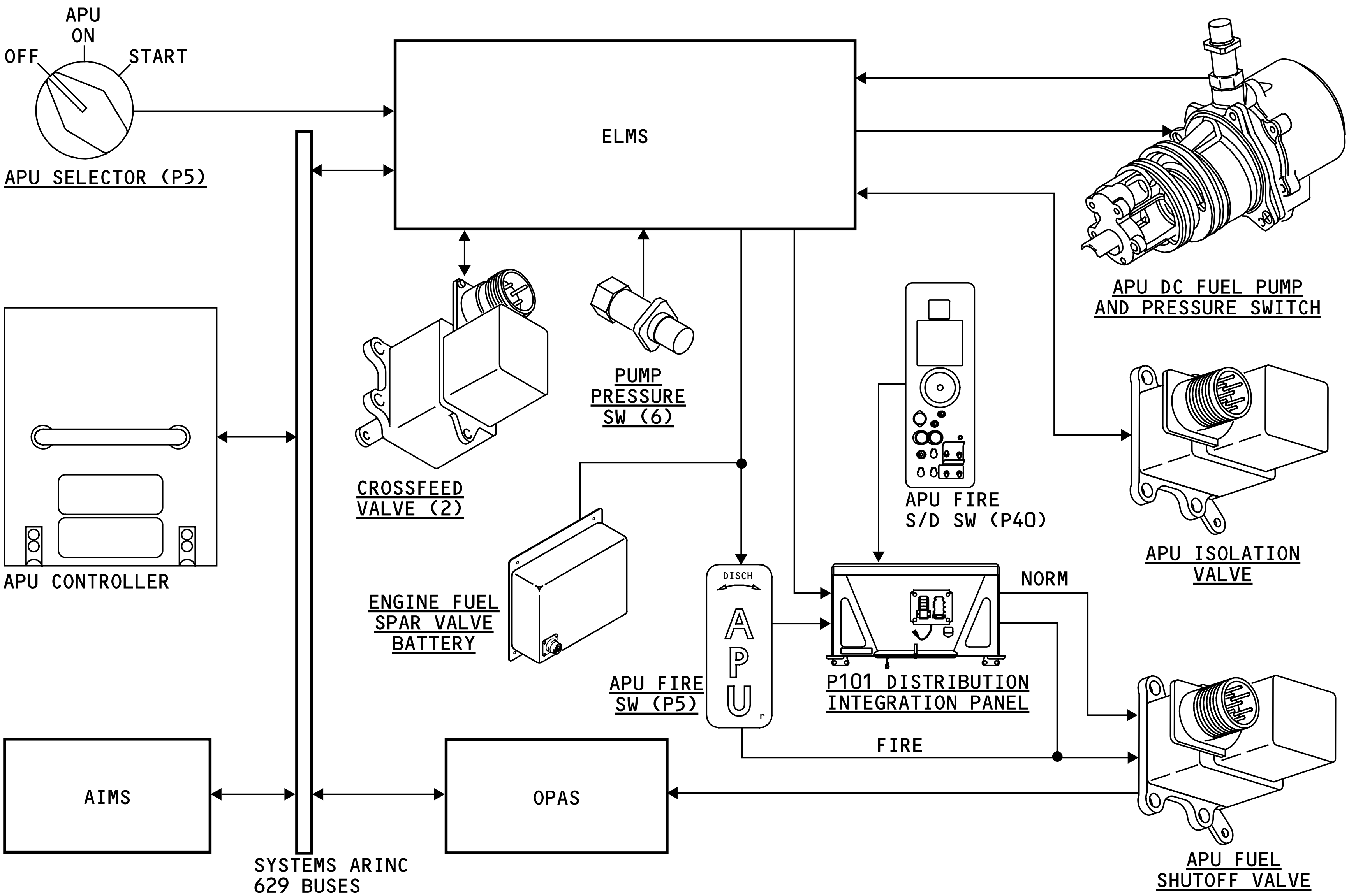
The APU fire switch and the APU fire shutdown switch close the APU fuel shutoff valve. The APU fire switch has a direct circuit to the valve. The APU fire shutdown switch controls a relay in the P101 panel to close the valve.

Engine Feed

The APU fuel feed system can supply fuel to the left engine in the air when there is no pressure in the left engine feed manifold and the left engine is not operating. The ELMS opens the APU isolation valve and turns on the APU dc fuel pump to permit this.

Fault and Indicating Information

APU fuel feed faults and indication information goes to the AIMS on the systems ARINC 629 buses.



APU FUEL FEED - GENERAL DESCRIPTION

28-25-00-002 Rev 5 07/27/95

APU FUEL FEED - COMPONENT LOCATIONS - FUEL TANKS

General

The APU fuel feed system has these components:

- APU DC fuel pump
- APU isolation valve
- APU fuel shutoff valve
- APU isolation check valve.

The APU fuel supply line goes through the center tank, then aft to the APU. The fuel supply line has a shroud around it. The shroud has a drain line that goes to the APU shroud drain mast on the bottom of the airplane.

APU DC Fuel Pump

The APU dc fuel pump is on the rear spar of the left wing, aft of the second fuel tank access door. The pump housing is inside the center tank. The pump inlet is in the left main tank.

APU Fuel Shutoff Valve

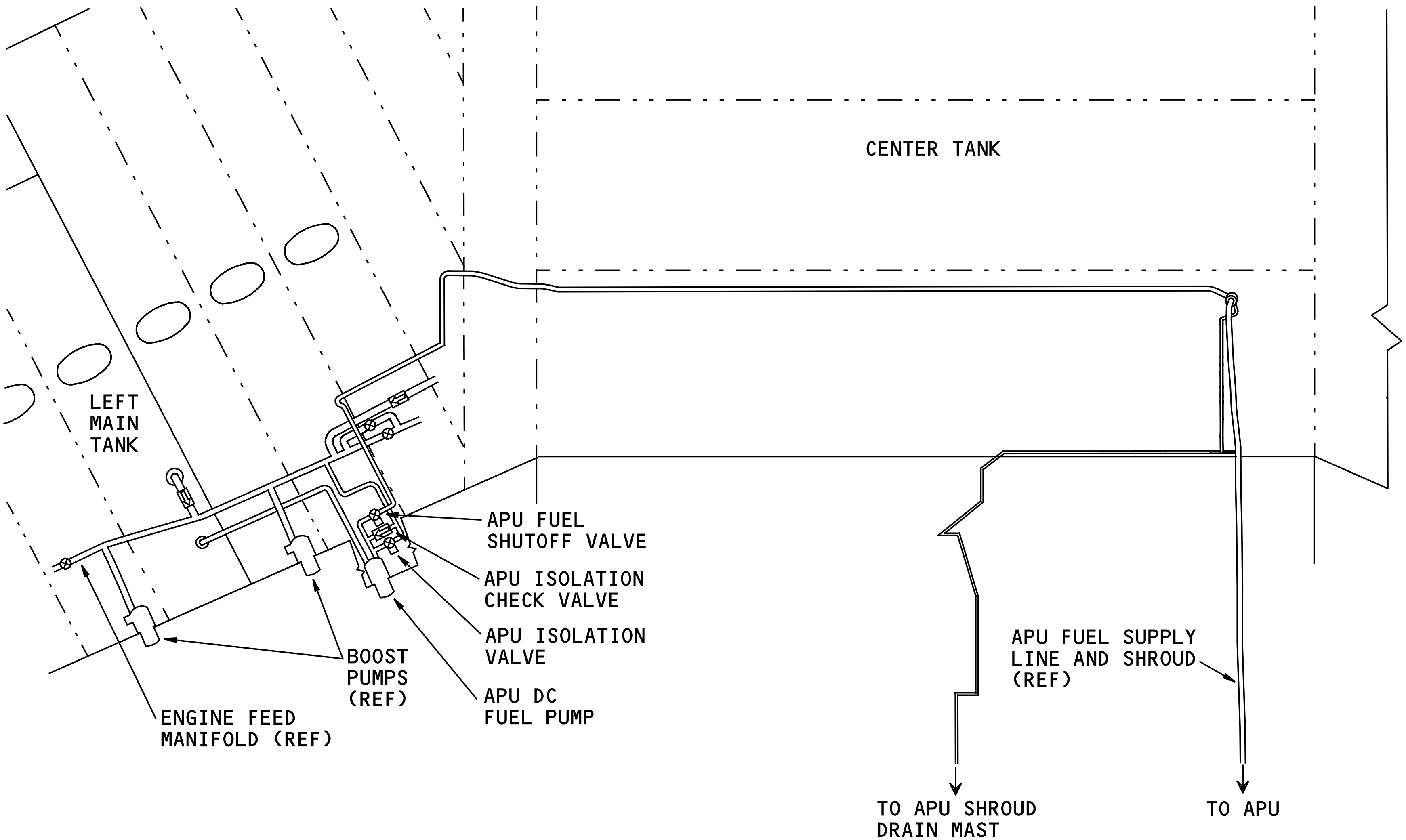
The APU fuel shutoff valve body is high in the left side of the center tank, above the APU isolation valve. You get access to the fuel shutoff valve through the second fuel tank access door. The valve actuator is on the rear spar of the left wing, inboard of the dc fuel pump.

APU Isolation Valve

The APU isolation valve body is in the left side of the center tank, below the APU fuel shutoff valve. You get access to the isolation valve through the second fuel tank access door. The valve actuator is on the rear spar of the left wing, inboard of the dc fuel pump.

APU Isolation Check Valve

The APU isolation check valve is in the left side of the center tank, between the APU fuel shutoff valve and isolation valve. You get access to the isolation check valve through the second fuel tank access door.



28-25-00-003 Rev 2 03/18/96

APU FUEL FEED - COMPONENT LOCATIONS - FUEL TANKS

APU FUEL FEED - COMPONENTS

APU DC Fuel Pump

The APU dc fuel pump supplies fuel to the APU and to the engine feed manifold. It uses 28v dc power. It supplies fuel at a pressure of 24 psi and a flow rate of 3150 pounds per hour (1430 kilograms per hour).

The pump has a pressure switch that sends a signal to the ELMS when the pump is operating.

APU Fuel Shutoff Valve

The APU fuel shutoff valve opens to permit fuel to flow to the APU. Fuel comes from the left engine feed manifold, or from the dc pump.

The APU fuel shutoff valve actuator is the same as the other 28v dc motor actuators on other fuel system valves. See the engine fuel feed section for more information about motor actuated fuel valves (AMM PART I 28-22).

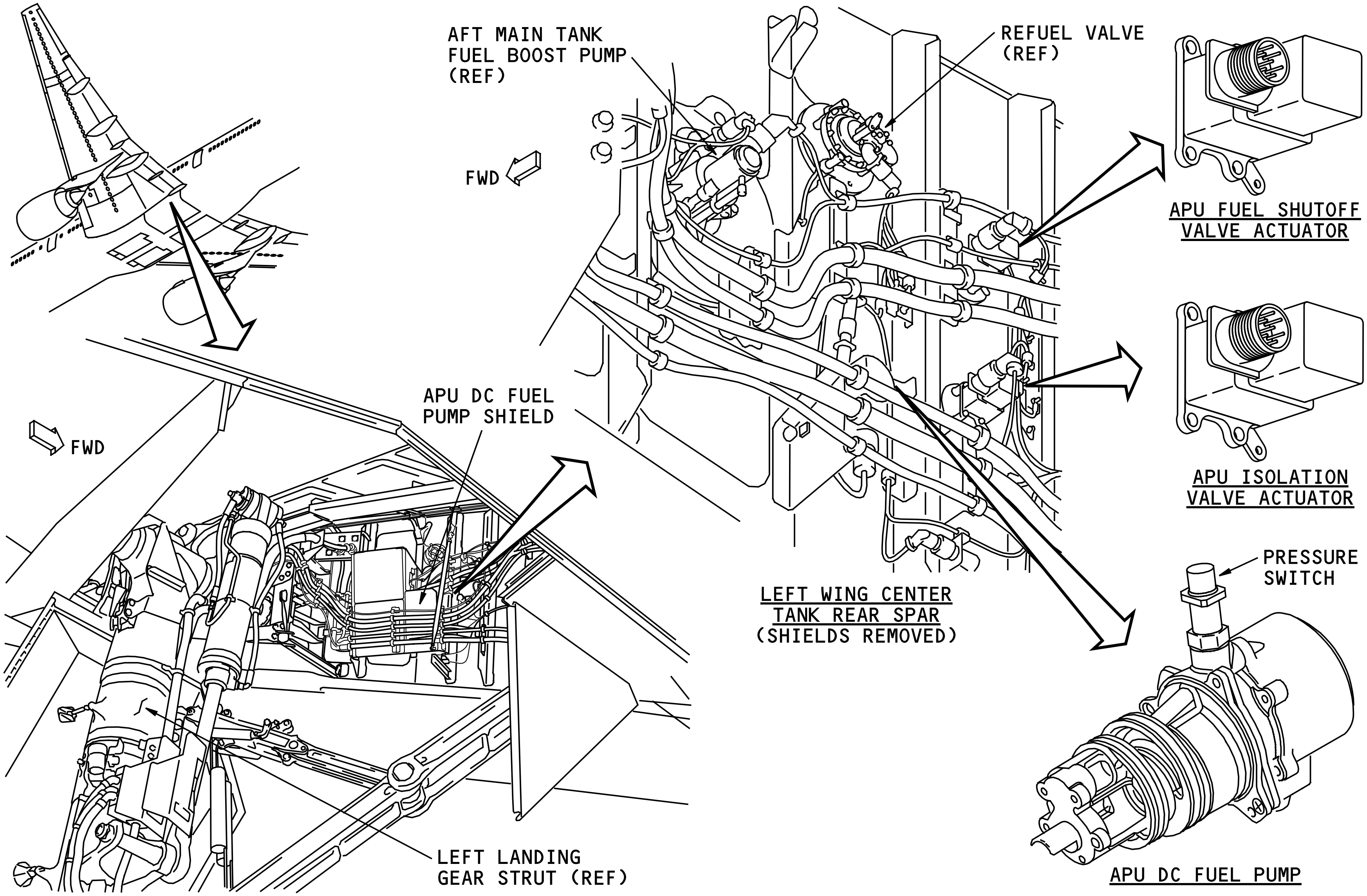
APU Isolation Valve

The APU isolation valve opens to let fuel flow from the APU dc fuel pump to the engine feed manifold. The isolation valve is normally closed. The valve operates automatically in flight when there is no engine fuel feed pressure and the engine has a flameout.

The APU isolation valve actuator is the same as the other 28v dc motor actuators on other fuel system valves. See the engine fuel feed section for more information about motor actuated fuel valves (AMM PART I 28-22).

Training Information Point

The APU dc fuel pump has a shield that protects it from thrown tire treads. You must remove the shield to get access to the pump.



APU FUEL FEED - COMPONENTS

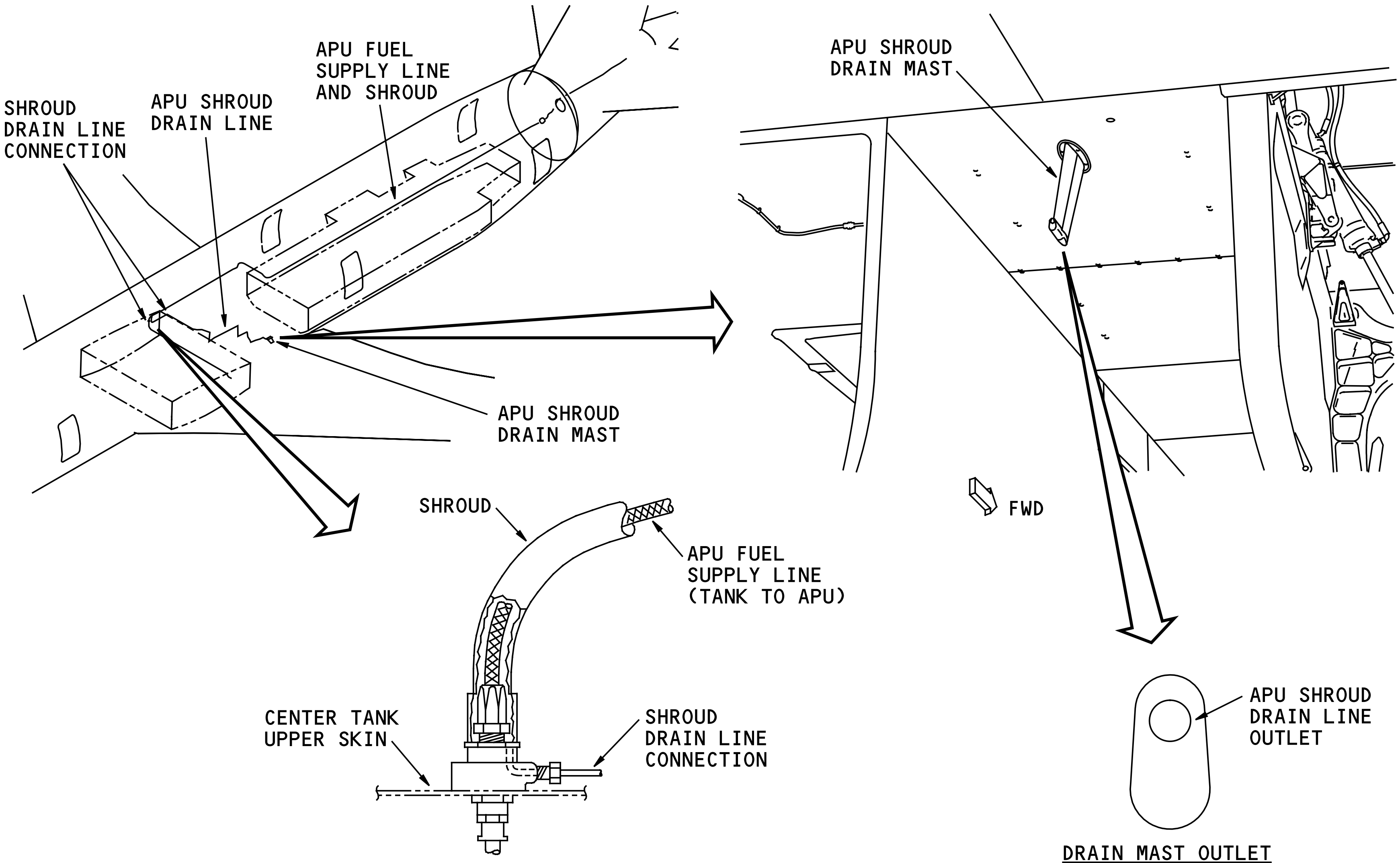
APU FUEL FEED - FUEL SUPPLY LINE AND SHROUD

APU Fuel Supply Line and Shroud

The APU fuel supply line is flexible rubber and kevlar. It has an aluminum shroud. The fuel supply line exits from the center fuel tank. It passes through the right wheel well, and goes under the floor to the APU.

Shroud Drain Line

The shroud drain line connects the fuel line shroud to the APU shroud drain mast. If there is a leak in the fuel supply line, the fuel is contained by the shroud and flows overboard through the drain mast.



APU FUEL SUPPLY LINE CONNECTION

DRAIN MAST OUTLET
(LOOKING FORWARD)

APU FUEL FEED - FUEL SUPPLY LINE AND SHROUD

28-25-00-005 Rev 2 03/18/96

APU FUEL FEED - FUNCTIONAL DESCRIPTION - FUEL FLOW

General

The APU fuel feed system uses the main pumps or the DC pump to supply fuel to the APU. The system can also supply fuel to the left engine feed manifold.

APU Fuel Feed From Main Pumps

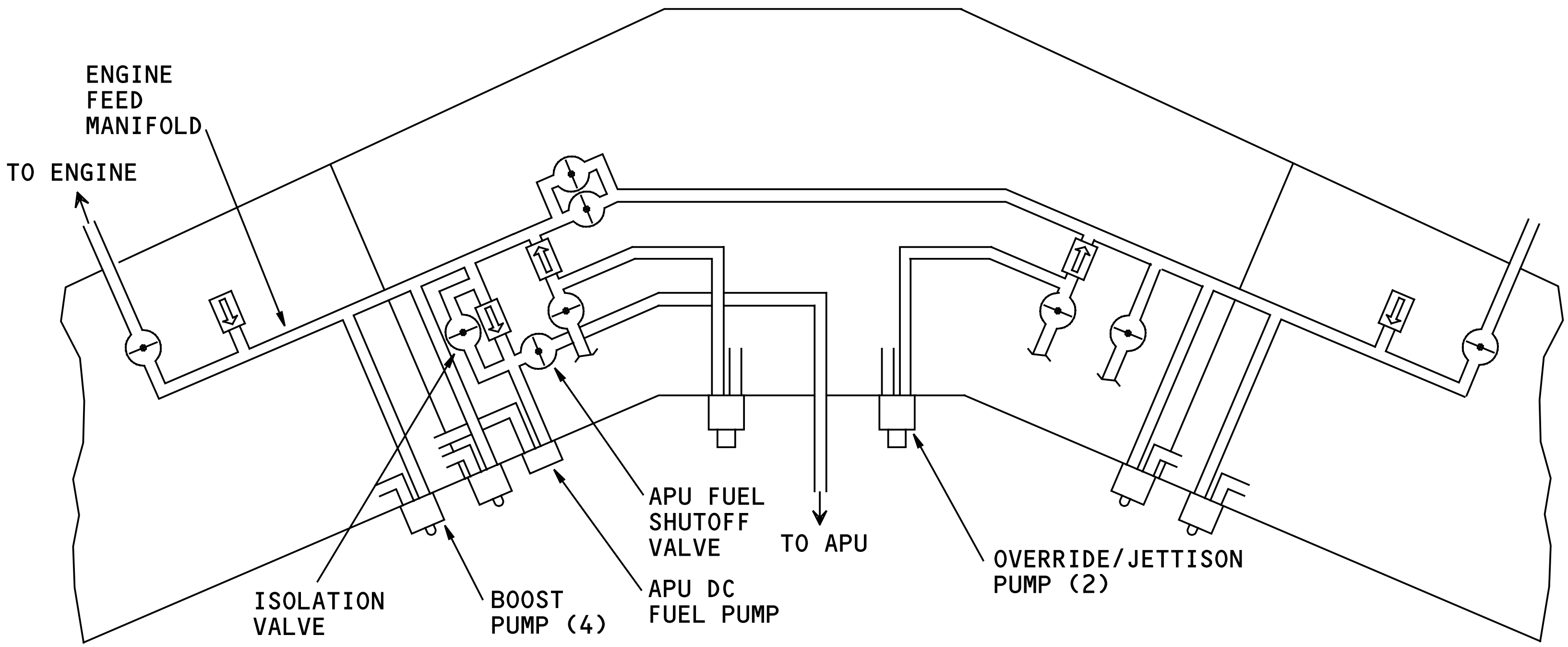
The APU normally receives fuel from the left engine feed manifold. The engine feed manifold receives fuel from any of the main or center tank fuel pumps. The fuel flows through a check valve and the APU fuel shutoff valve to the APU fuel line.

APU Fuel Feed From DC Fuel Pump

During APU starts and operation, if there is no fuel pressure in the left engine feed manifold, the APU dc fuel pump automatically turns on. This supplies fuel through the APU fuel valve to the APU fuel line.

Main Engine Feed From DC Fuel Pump

The APU dc fuel pump also turns on to feed the left engine during an in-flight flameout. Fuel flows through the APU isolation valve into the left engine feed manifold.



APU FUEL FEED - FUNCTIONAL DESCRIPTION - FUEL FLOW

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APU FUEL FEED - FUNCTIONAL DESCRIPTION - APU DC FUEL PUMP & ISOLATION VALVE

General

The ELMS automatically controls the APU dc fuel pump and the APU isolation valve. When you start the APU on the ground and ac power is not available, the ELMS starts the APU dc fuel pump. During flight, if there is an engine flameout, the ELMS can start the APU dc fuel pump and open the APU isolation valve. This lets the dc fuel pump supply fuel to the left engine when the ac boost pumps do not operate.

APU DC Fuel Pump

The APU dc fuel pump gets power from battery bus #2. The P310 EEU sends a signal to turn on the pump. This energizes the APU dc pump control relay to supply power to the pump.

Isolation Valve

The APU isolation valve gets power to open or close from the captain's flight instrument bus. The P310 EEU sends a signal to open the valve. This energizes the APU isolation valve relay to supply power to open the valve.

Power to operate the valve goes through limit switches to the actuator. The actuator moves the valve to the commanded position. When the valve is in the commanded position, the limit switches remove power from the actuator and send power to the ELMS valve agree status logic.

Control

For APU fuel feed, the P310 EEU sends the dc pump command signal when these conditions occur:

- No pressure in the left engine feed manifold
- APU running, or APU selector in START or ON position.

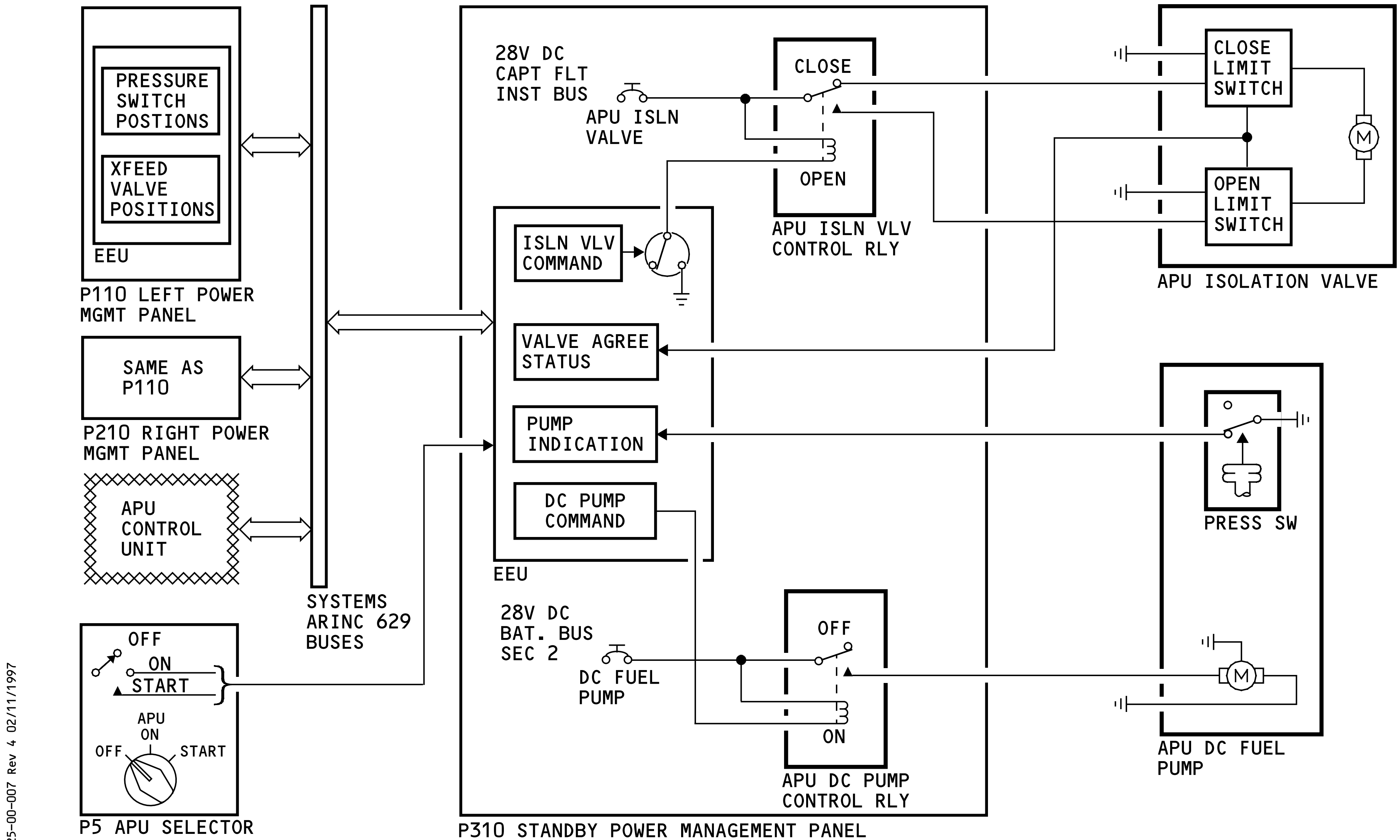
For left engine fuel feed, the P310 EEU sends the dc pump command signal and the isolation valve command signal when these conditions occur:

- No pressure in the left engine feed manifold
- left engine N2 is less than the engine run speed
- Left engine fuel control switch is in the RUN position
- The airplane is in the air.

The ELMS uses signals from the ac fuel pump pressure switches and the crossfeed valves to find if there is pressure in the left engine feed manifold. The P110 and P210 EEUs send the signals on the systems ARINC 629 buses to the P310 EEU. The APU signals come from the APU control unit and the APU selector.

Fault Indications

The P310 EEU monitors the status of the APU dc pump pressure switch and the APU isolation valve position. If the pressure switch does not agree with the dc pump command status, the EEU sends a fault message to the systems ARINC 629 buses. If the APU isolation valve position does not agree with the isolation valve command status, the EEU sends a fault message to the systems ARINC 629 buses. The fault messages cause EICAS advisory and status messages.



APU FUEL FEED - FUNCTIONAL DESCRIPTION - APU DC FUEL PUMP & ISOLATION VALVE

APU FUEL FEED - FUNCTIONAL DESCRIPTION - APU FUEL SHUTOFF VALVE

General

The ELMS automatically controls the APU fuel shutoff valve. The EEU in the P310 panel uses inputs from the APU controller and the APU selector to control the valve.

Control

The P310 EEU sends a valve open command when any of these conditions occur:

- APU is running
- APU selector is in the ON or START position.

It sends a valve close command when any of these conditions occur:

- APU is not running
- APU fire switch closes
- APU fire shutdown switch closes
- APU fire.

The APU running signal comes from the APU controller.

Power

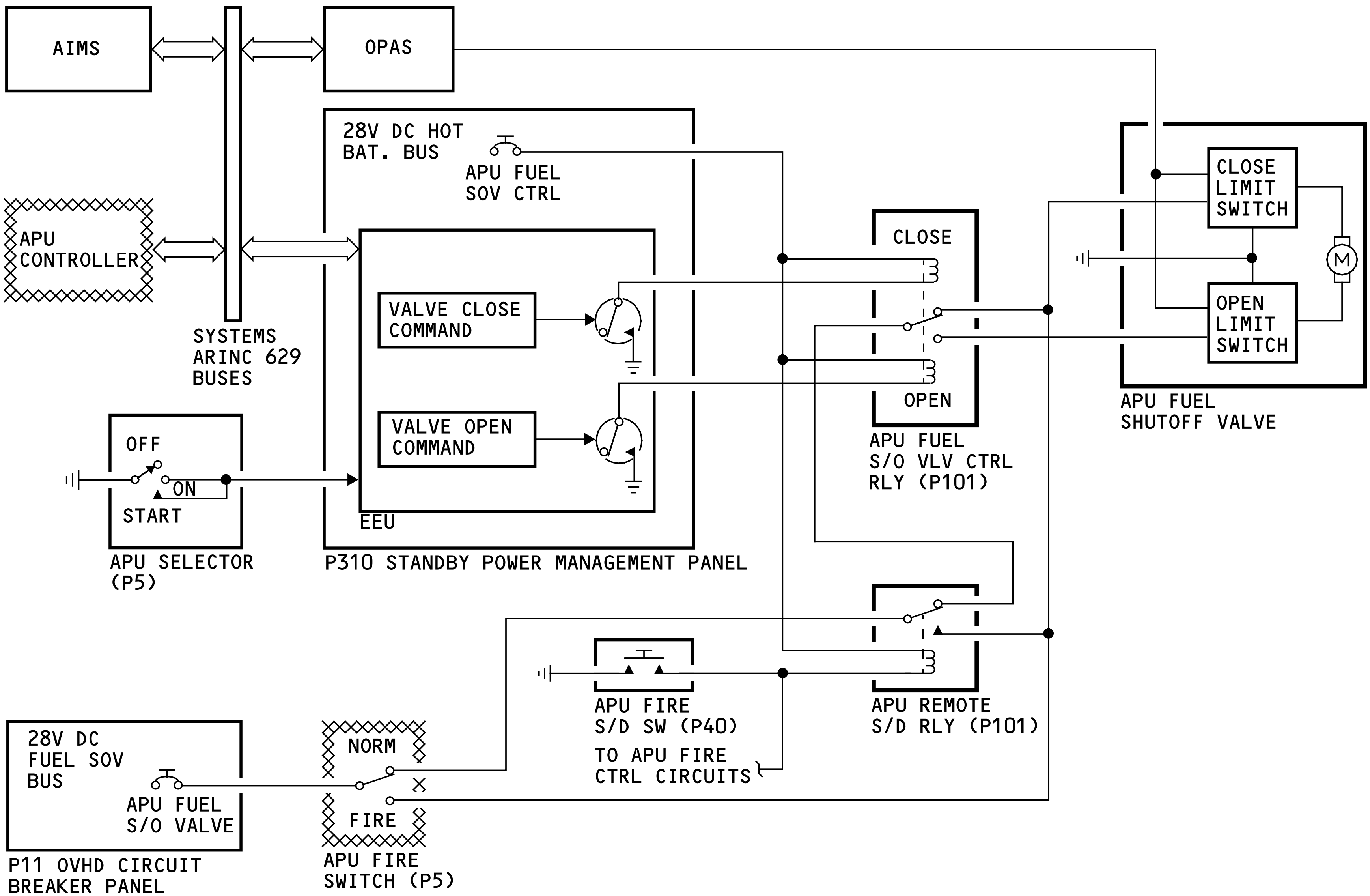
The APU fuel shutoff valve gets power to open or close from the fuel shutoff valve bus. The P310 EEU sends a command to operate the valve. This energizes the open or close coil of the APU fuel shutoff valve control relay and permits power to go to the valve.

Power to operate the valve goes through limit switches to the actuator. The actuator moves the valve to the commanded position. When the valve is in the commanded position, the limit switches remove power from the actuator.

If you pull the APU fire switch or push the APU fire shutdown switch, power goes directly to the APU fuel shutoff valve to close it. Pushing the APU fire shutdown switch energizes the APU remote shutdown relay. APU fire control circuits keep it energized.

Fault Indications

The P310 EEU monitors the positions of the APU fuel shutoff valve control relay and the APU remote shutdown relay. The EEU gets the APU fuel shutoff valve position from the OPAS on the systems ARINC 629 buses. If there is a disagreement between the valve position and the relay positions, the EEU sends a fault message to the AIMS. The fault message causes EICAS advisory and status messages.



28-25-00-008 Rev 2 05/23/1996

APU FUEL FEED - FUNCTIONAL DESCRIPTION - APU FUEL SHUTOFF VALVE

APU FUEL FEED - INDICATIONS

Fuel Synoptic Display

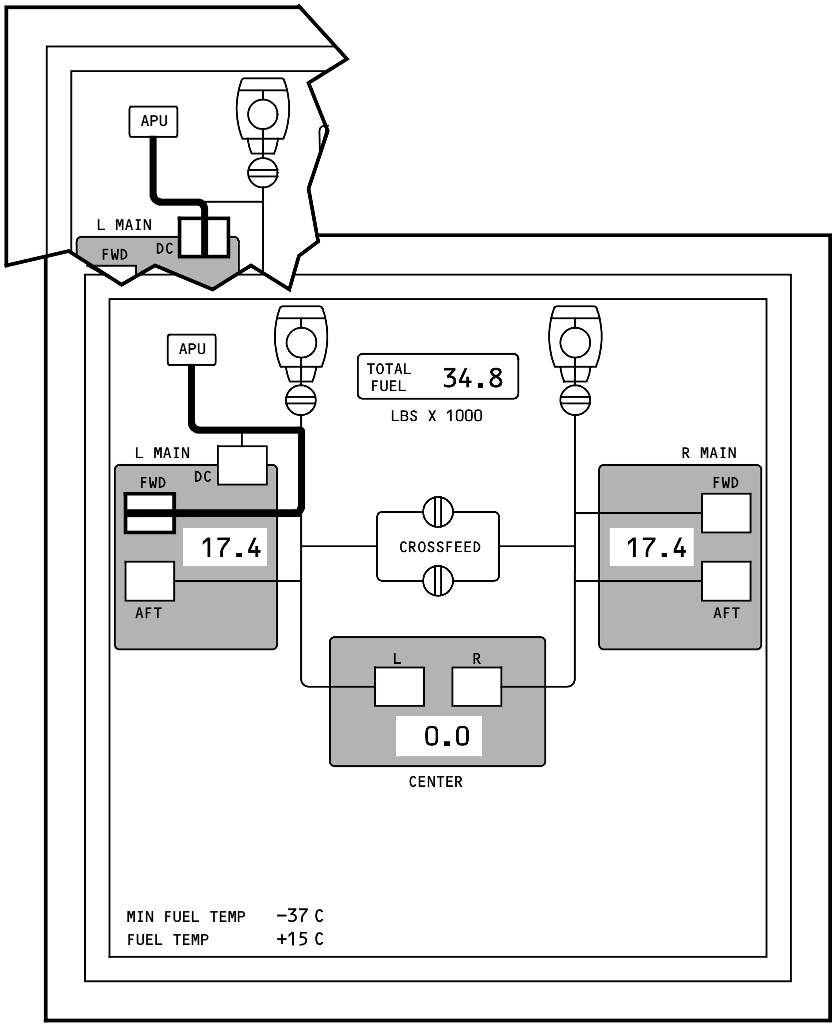
The fuel synoptic display is a simplified schematic of the fuel system. It shows the system configuration for the APU fuel feed system.

The configuration in the fuel synoptic display below shows the left forward boost pump feeding the APU. The inset display shows the APU dc fuel pump feeding the APU.

Fuel Management Maintenance Page

The fuel management maintenance page shows commanded and actual status for the APU fuel feed system components.

The AC PUMP data tell you about the left forward boost pump.



FUEL SYNOPTIC DISPLAY

SHOW PG MENU

FUEL MANAGEMENT

	L COMMAND	L STATUS	R COMMAND	R STATUS
ENG FUEL FEED				
ENG S/O VLV	CLOSED	CLOSED	CLOSED	CLOSED
FWD MAIN PUMP	ON	PRESS	OFF	NO PRESS
AFT MAIN PUMP	OFF	NO PRESS	OFF	NO PRESS
OVRD/JETT PUMP	OFF	NO PRESS	OFF	NO PRESS
JETTISON SYSTEM				
MAIN JETT PUMP	OFF	NO PRESS	OFF	NO PRESS
JETT ISO VLV	CLOSED	CLOSED	CLOSED	CLOSED
JETT NOZ VLV	CLOSED	CLOSED	CLOSED	CLOSED

APU FUEL FEED	COMMAND	STATUS
S/O VLV	OPEN	OPEN
ISO VLV	--	CLOSED
DC PUMP	--	NO PRESS
AC PUMP	ON	PRESS

CROSSFEED	COMMAND	STATUS
VLV FWD	CLOSED	CLOSED
VLV AFT	CLOSED	CLOSED

DATE 12 JUN 94 UTC 18:54:04

FUEL MANAGEMENT MAINTENANCE PAGE

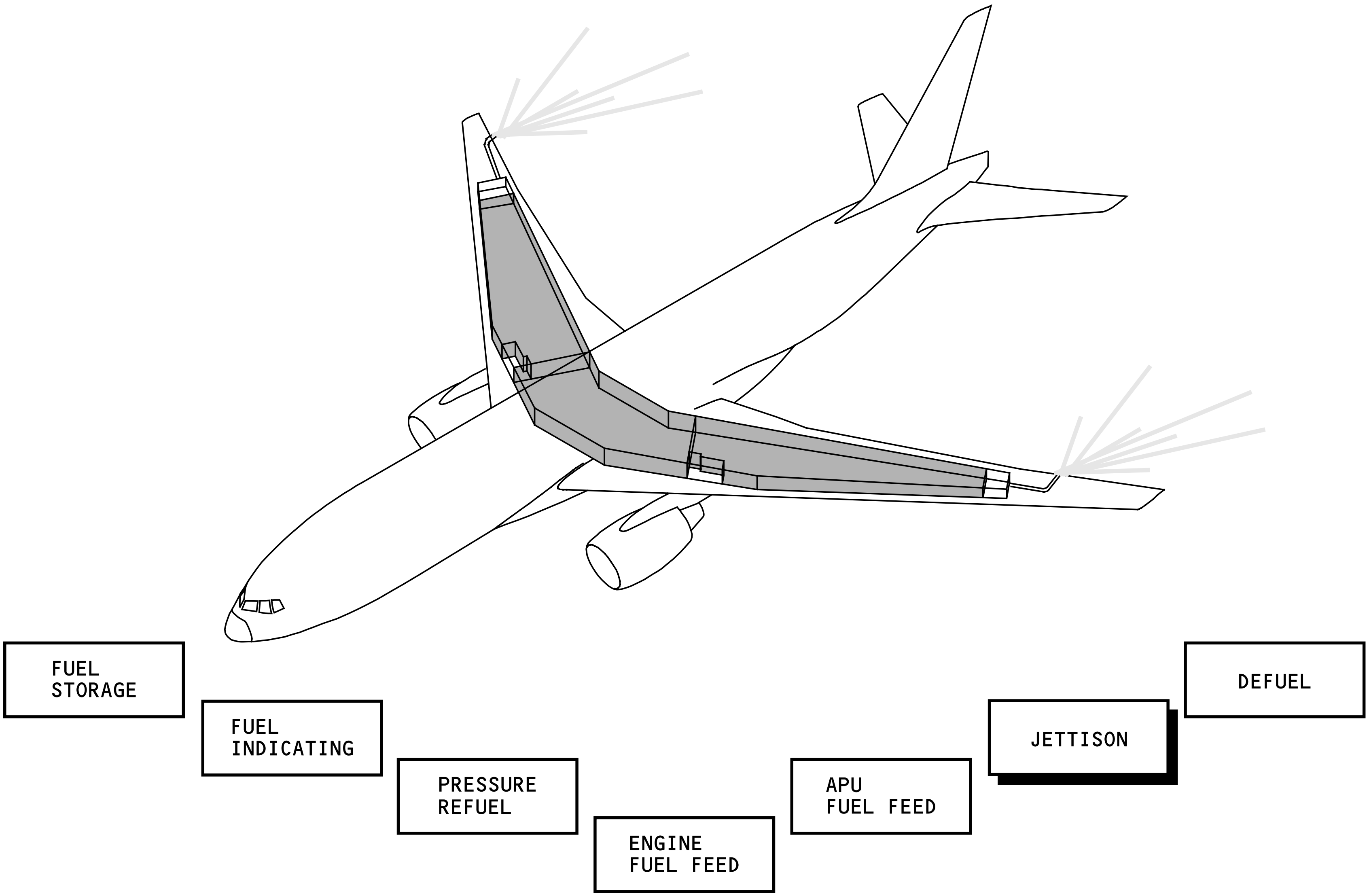
28-25-00-009 Rev 2

APU FUEL FEED - INDICATIONS

FUEL JETTISON - INTRODUCTION

Purpose

The fuel jettison system dumps fuel overboard to reduce the landing weight. You operate the jettison system from the fuel panel on the P5 overhead panel.



FUEL JETTISON - INTRODUCTION

FUEL JETTISON - GENERAL DESCRIPTION

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FUEL JETTISON - GENERAL DESCRIPTION

General

The fuel jettison system dumps fuel overboard to reduce the landing weight. You operate the jettison system from the fuel jettison panel (P5). The ELMS controls the fuel jettison system.

Jettison Pumps

There are two override/jettison pumps in the center tank and one fuel jettison pump in each main tank.

Each pump has a pressure switch that sends a signal through the ELMS to the systems ARINC 629 buses. The signal goes to the jettison panel and the AIMS for fault indication.

Jettison Isolation Valves

These valves let the override/jettison pumps put fuel into the refuel/jettison manifold (not shown). A signal goes to the AIMS for valve fault indication.

Jettison Nozzle Valves

In the air, the nozzle valves let fuel in the refuel/ jettison manifold go overboard. This reduces the landing weight.

On the ground, you cannot open the nozzle valves. The power to close the valves goes directly from the ELMS to the nozzle valve actuators.

A signal for valve fault indication goes to the fuel jettison panel and the AIMS.

General Operation

In the air, you push the arm switch to operate the fuel jettison system. The arm switch sends a signal through the systems ARINC 629 buses to the ELMS.

The jettison system has two operating modes:

- Maximum landing weight (MLW) mode
- Manual (MAN) mode.

When you arm the jettison system, it is in the MLW mode. The ELMS calculates the quantity of fuel to remain after it jettisons fuel to the MLW. The ELMS subtracts zero fuel weight (ZFW) from MLW to get the fuel to remain. It gets the MLW and ZFW from the AIMS. The quantity of fuel to remain in the airplane shows on the EICAS display.

The ELMS gets actual fuel quantity from the FQPU. It uses this information to calculate the time to jettison.

When you pull out the fuel-to-remain selector, the jettison system is in the MAN mode. You can use the fuel-to-remain selector to increase or decrease the quantity of fuel to remain.

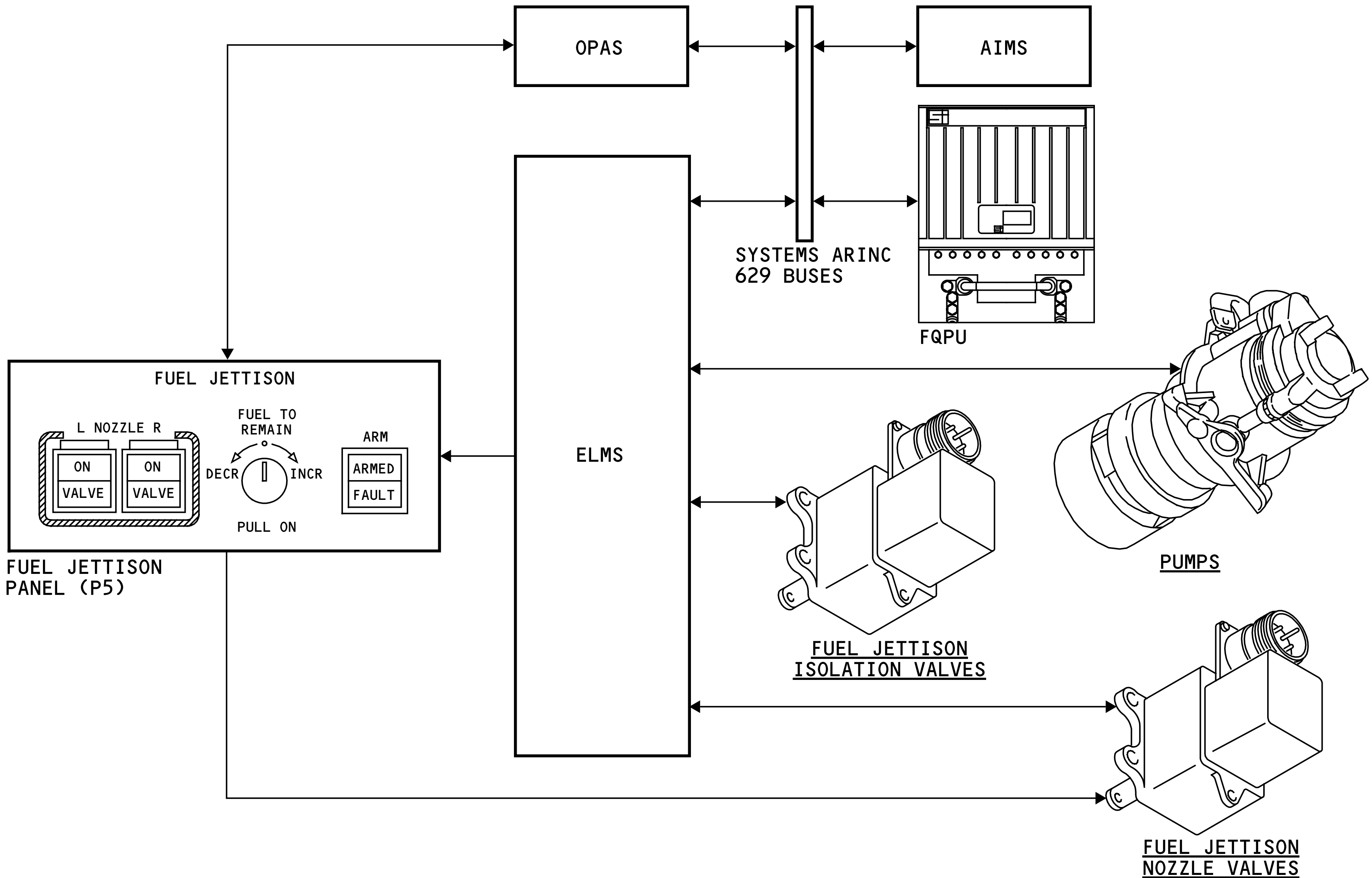
In the air, the jettison nozzle valve switches cause the ELMS to open the nozzle valves. Each switch also

FUEL JETTISON - GENERAL DESCRIPTION

causes the ELMS to open the isolation valves and start the fuel jettison pumps. You must use the center tank pump switches to start the override/jettison pumps.

Fuel jettison can cause the airplane center of gravity to be forward of the center of gravity limit. If the ELMS calculates that this will happen, it stops the main tank jettison pumps for 7.5 minutes.

On the ground, the arm switch causes the ELMS to open the two jettison isolation valves and start the fuel jettison pumps.



28-31-00-002 Rev 6 05/23/1996

FUEL JETTISON - GENERAL DESCRIPTION

FUEL JETTISON - COMPONENT LOCATIONS - FUEL TANKS

General

The jettison system has these components:

- Override/jettison pumps
- Jettison pumps
- Jettison isolation valves
- Isolation check valves
- Refuel/jettison manifold
- Jettison nozzle valves.

Override/Jettison Pumps

There are two override/jettison pumps in the center tank. They are in the left and right wheel wells on the rear spar. The engine feed section describes these pumps.

Fuel Jettison Pumps

There is one fuel jettison pump in each main tank. They are on the rear spar forward of the flaperons. These pumps are interchangeable with the override/jettison pumps.

Fuel Jettison Isolation Valves

There is one fuel jettison isolation valve in each section of the center tank. The valve actuators are on the rear spar just outboard from the fuselage.

These are the same kind of valve as the other motor-actuated valves in the fuel system.

Jettison Isolation Check Valve

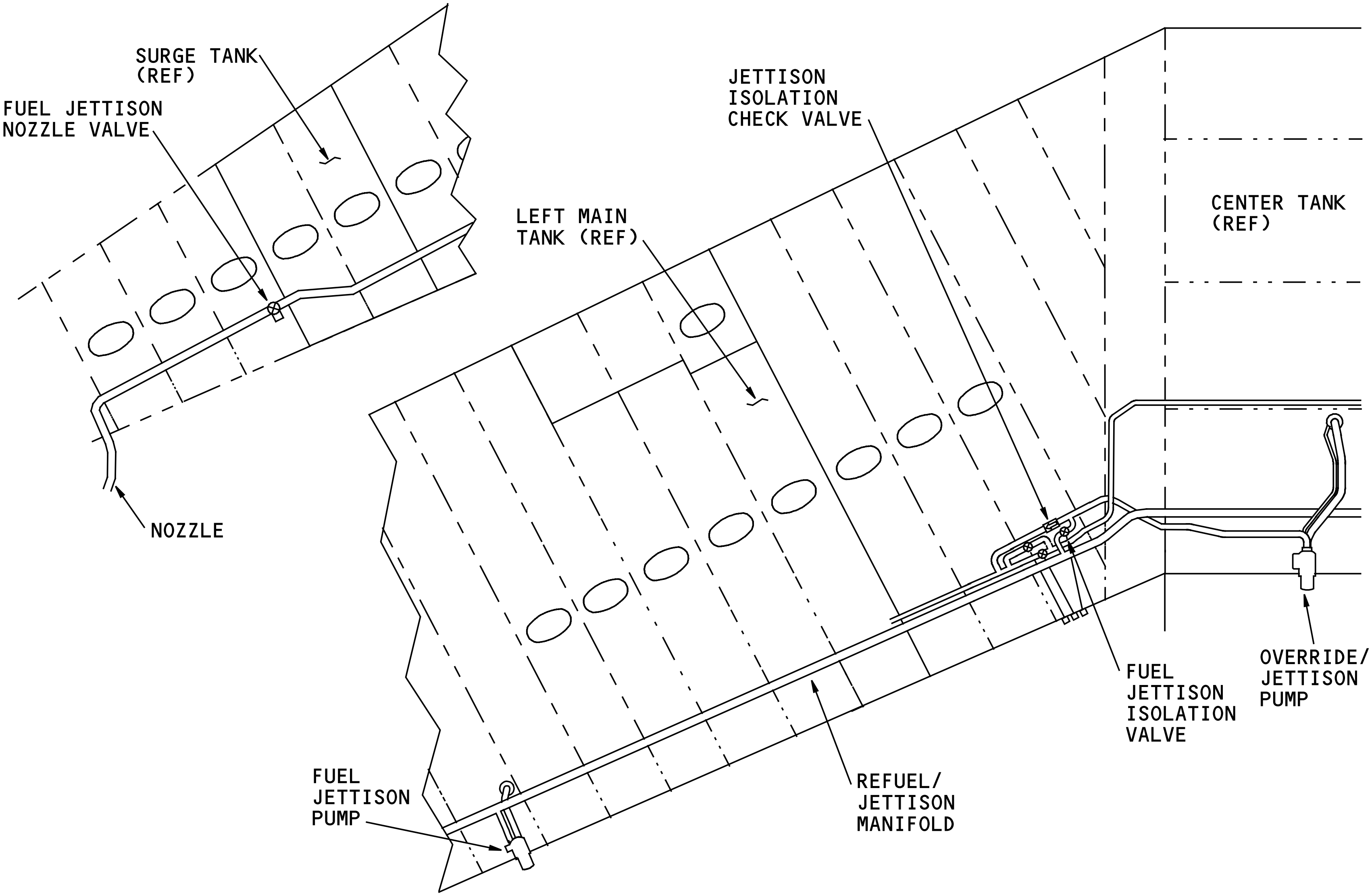
There is a jettison isolation check valve in each section of the center tank. The valve prevents fuel jettison by the left and right main tank fuel boost pumps.

Refuel/Jettison Manifold

The refuel/jettison manifold is in both wings and goes through the end of the main tank and surge tank. The end of the refuel/jettison manifold has a nozzle. The nozzle comes out of the trailing edge of each wing between the outboard flap and the aileron.

Fuel Jettison Nozzle Valves

There is one jettison nozzle valve near each end of the refuel/jettison manifold. They attach to the refuel/jettison manifold.



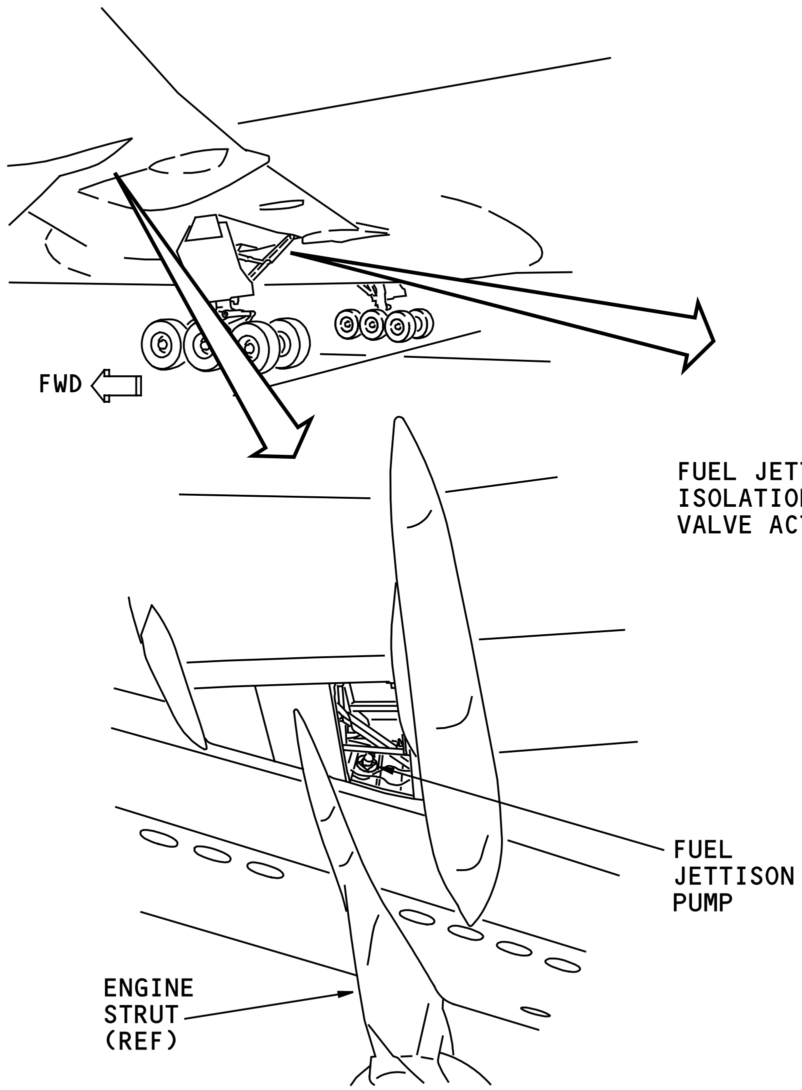
FUEL JETTISON - COMPONENT LOCATIONS - FUEL TANKS

FUEL JETTISON - COMPONENT LOCATIONS - REAR SPAR

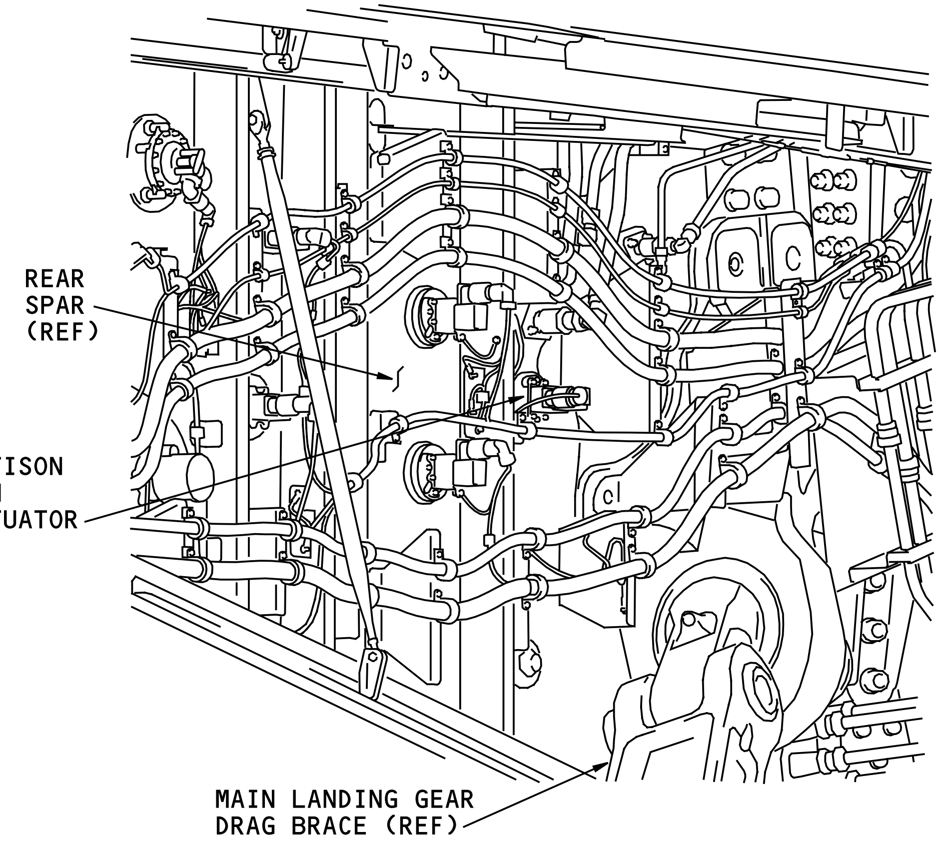
General

The fuel jettison pumps are on the rear spar, aft of each engine.

There are two fuel jettison isolation valves. The valve actuators are on the rear spar. There is an actuator in each main landing gear wheel well.



WING TRAILING EDGE



MAIN LANDING GEAR WHEEL WELL

28-31-00-011 Rev 0

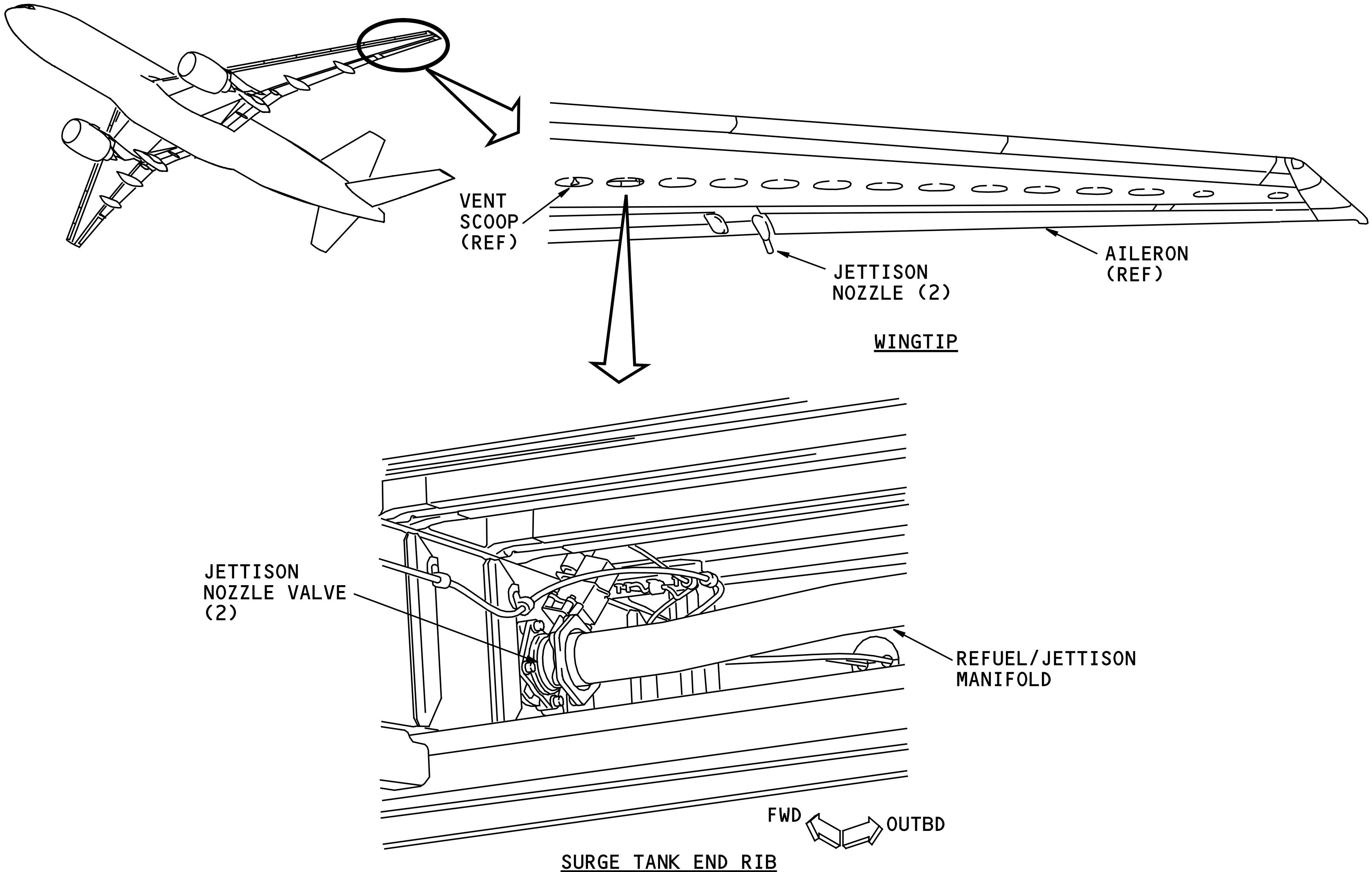
FUEL JETTISON - COMPONENT LOCATIONS - REAR SPAR

FUEL JETTISON - COMPONENT LOCATIONS - WINGS

General

There is a jettison nozzle on each wing. The nozzles are on the wing trailing edges, near the ailerons.

There is a jettison nozzle valve and actuator on each wing. Each nozzle valve is in the dry bays near the surge tanks. The valve attaches to the refuel/jettison manifold.



28-31-00-012 Rev 0

FUEL JETTISON - COMPONENT LOCATIONS - WINGS

FUEL JETTISON - FUEL JETTISON PUMP

General

The jettison pumps supply fuel from the main tank to the refuel/jettison manifold during fuel jettison.

The jettison pumps can supply fuel at a pressure of 36 psi and a flow rate of 70,000 pounds (31750 kg) per hour. Each pump assembly has a motor-impeller and a housing.

Location

There is one jettison pump in each main tank. They are on the rear spar, aft of the engine strut. The housings are inside the tanks, on the rear spar. The motor-impellers install in the housings.

Pump Housing

The housing contains the motor-impeller and these valves:

- Discharge check valve
- Vapor vent valve
- Inlet valve.

The discharge check valve prevents engine feed manifold fuel from flowing back through the pump.

The vapor vent valve permits fuel vapor to go into the tank, but does not permit fuel to enter the pump.

The inlet valve is a gate valve that closes when you remove the pump. This permits you to remove the pump when the tanks have fuel in them.

Motor-Impeller

The motor-impeller uses 115v ac power. Each pump has these parts:

- Electrical connector
- Pressure switch
- Drain plug
- Extraction lever.

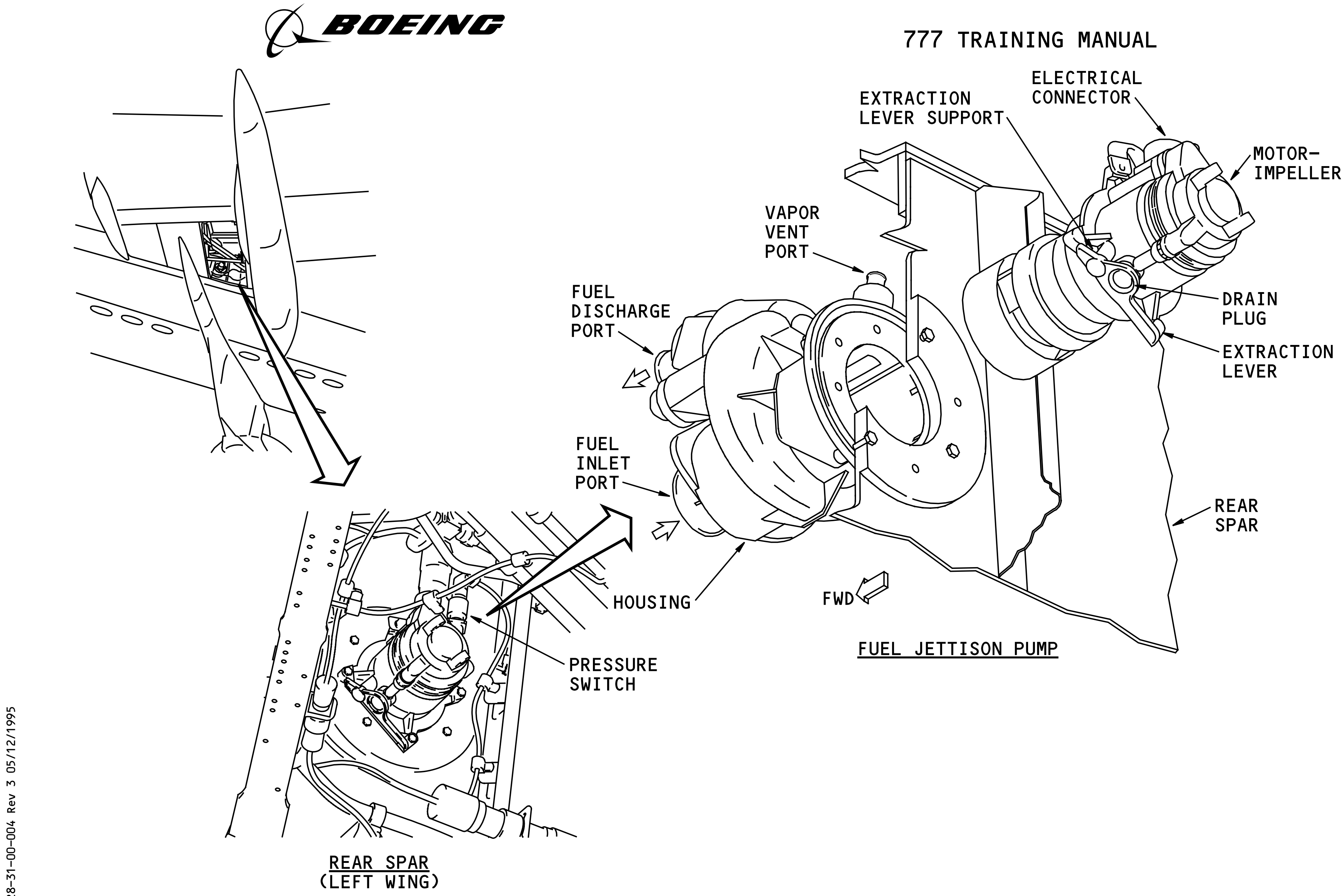
Training Information Point

The jettison pump motor-impellers are interchangeable with the override/jettison pump motor-impellers.

To remove the motor-impeller, you rotate it 35 degrees CCW to close the inlet valve. Then you remove the drain plug to remove residual fuel. You use the extraction lever to move the motor-impeller out of the housing.

To install the motor-impeller, you must align pins in the housing to slots on the motor-impeller.

You can remove the discharge and vapor vent valves through the housing from outside the tank.



FUEL JETTISON - FUEL JETTISON PUMP

FUEL JETTISON - ISOLATION VALVE

Purpose

The fuel jettison isolation valves open during fuel jettison operation. The open isolation valve lets override/jettison pump fuel go to the refuel/jettison manifold.

Location

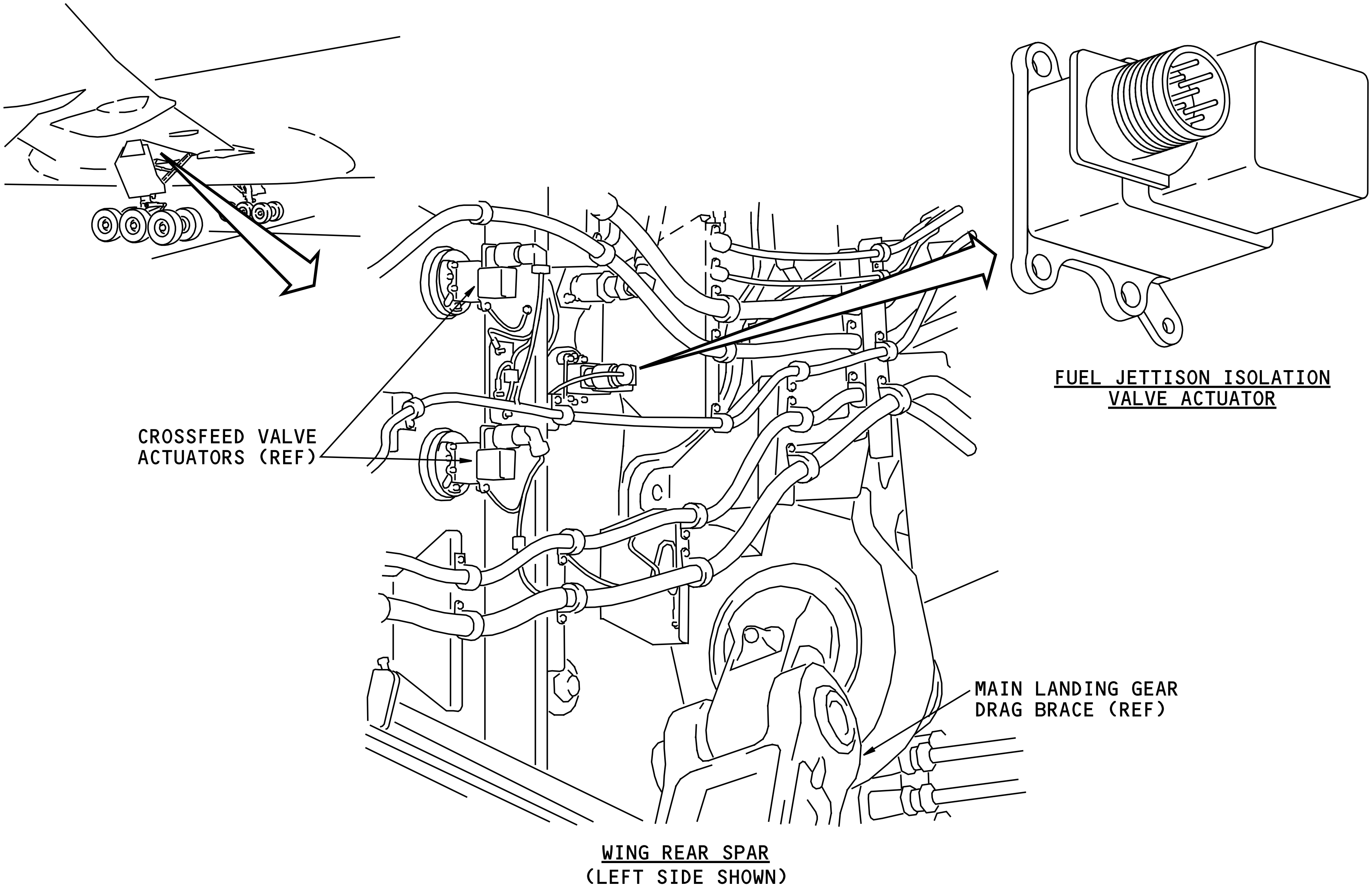
There is one fuel jettison isolation valve in each section of the center tank. The valve actuators are on the rear spar in the wheel wells.

Isolation Valve Description

The fuel jettison isolation valve is the same type of valve as the other motor-actuated valves in the fuel system.

Actuator

The actuator is a 28v dc motor. It has a manual override lever so you can operate the actuator without electrical power. The lever also shows valve position.



FUEL JETTISON - ISOLATION VALVE

28-31-00-005 Rev 2 05/12/1995

FUEL JETTISON - JETTISON NOZZLE VALVE

Purpose

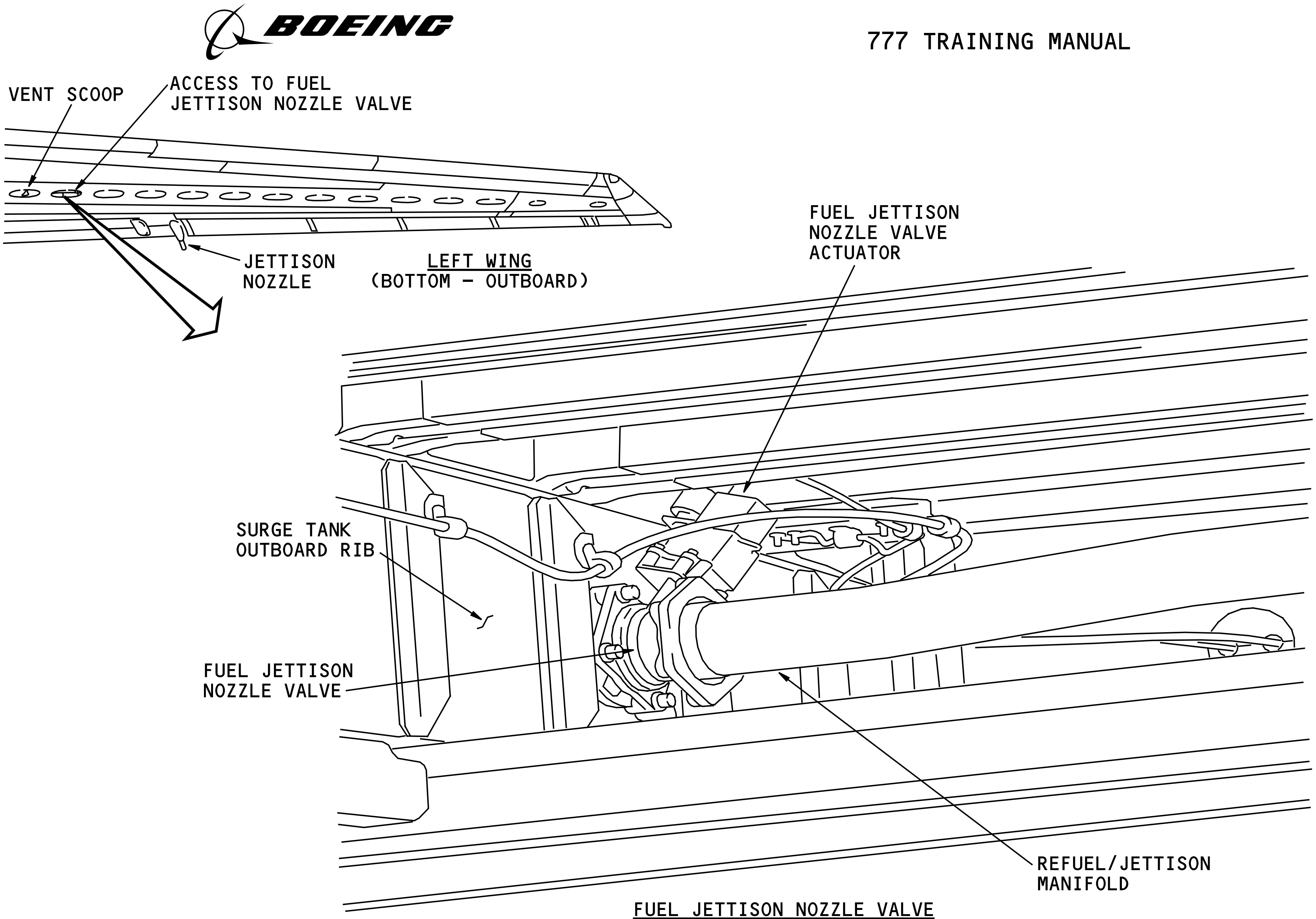
The fuel jettison nozzle valves open during fuel jettison operation. When the valve opens, fuel goes out of the jettison nozzle near the wing tip.

Location

There is one fuel jettison nozzle valve at each end of the refuel/jettison manifold. They are outboard of the surge tank (outboard of rib 34).

Jettison Valve Description

The fuel jettison nozzle valves are the same type of valve as the other motor-actuated valves in the fuel system.



FUEL JETTISON - JETTISON NOZZLE VALVE

28-31-00-006 Rev 3 05/12/1995

FUEL JETTISON - FUNCTIONAL DESCRIPTION - FUEL FLOW

General

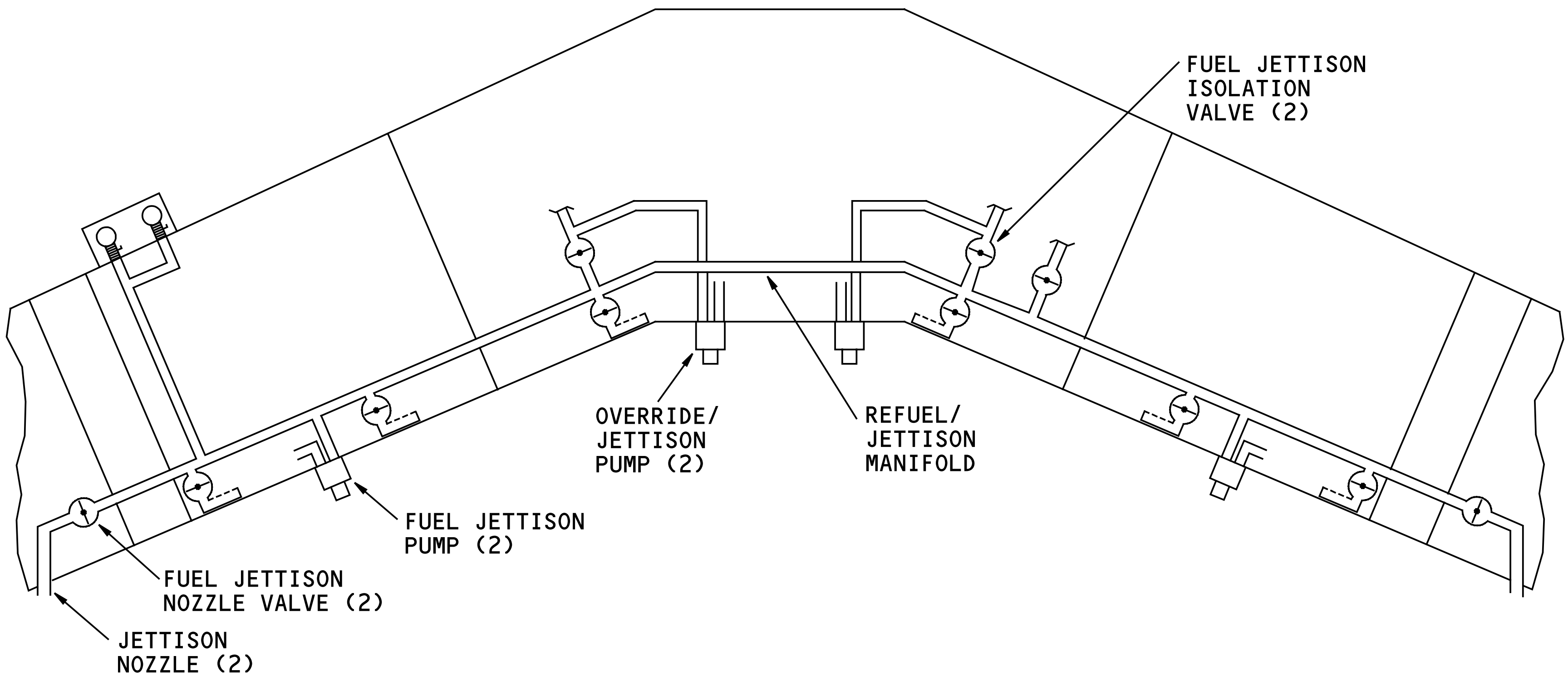
Jettison can occur from the center tank or the main tanks. Fuel from the tank flows through the refuel/ jettison manifold.

Center Tank Jettison

The center tank uses the override/jettison pumps as engine feed pumps and jettison pumps. When the jettison system operates, the pumps put fuel through the fuel jettison isolation valves into the refuel/jettison manifold. The fuel goes out of the manifold through the fuel jettison nozzle valves and jettison nozzles.

Main Tank Jettison

The main tanks have pumps that operate only during fuel jettison. These pumps deliver fuel directly into the refuel/jettison manifold. This fuel also leaves the manifold through the fuel jettison nozzle valves and jettison nozzles.



28-31-00-007 Rev 4 03/11/96

FUEL JETTISON - FUNCTIONAL DESCRIPTION - FUEL FLOW

FUEL JETTISON - FUNCTIONAL DESCRIPTION - POWER & CONTROL

Power

The left fuel jettison pump receives 115v ac power from the left main bus.

Jettison Pump Control - Ground

When the airplane is on the ground, the ELMS electronics unit turns on the fuel jettison pumps when you put the jettison ARM switch in the ARM position.

The jettison arm switch sends a signal on the systems ARINC 629 buses to the ELMS electronics unit in the left power management panel. Pump logic in the ELMS electronics unit sends a command to an ELCU in the left power panel to turn on the left fuel jettison pump. The pump logic also sends a signal to turn on the right fuel jettison pump. The ELCU closes a contactor to permit power to go from the left main bus to the pump. The ELCU receives power from the left main dc bus.

The pump control logic in the P210 panel can also turn on the left fuel jettison pump.

Jettison Pump Control - Air

When the airplane is in the air, the ELMS electronics unit turns on the fuel jettison pumps, when all of these conditions occur:

- Jettison arm switch is in the ARM position
- Left or right jettison nozzle valve is open
- Fuel quantity is more than the fuel-to-remain value.

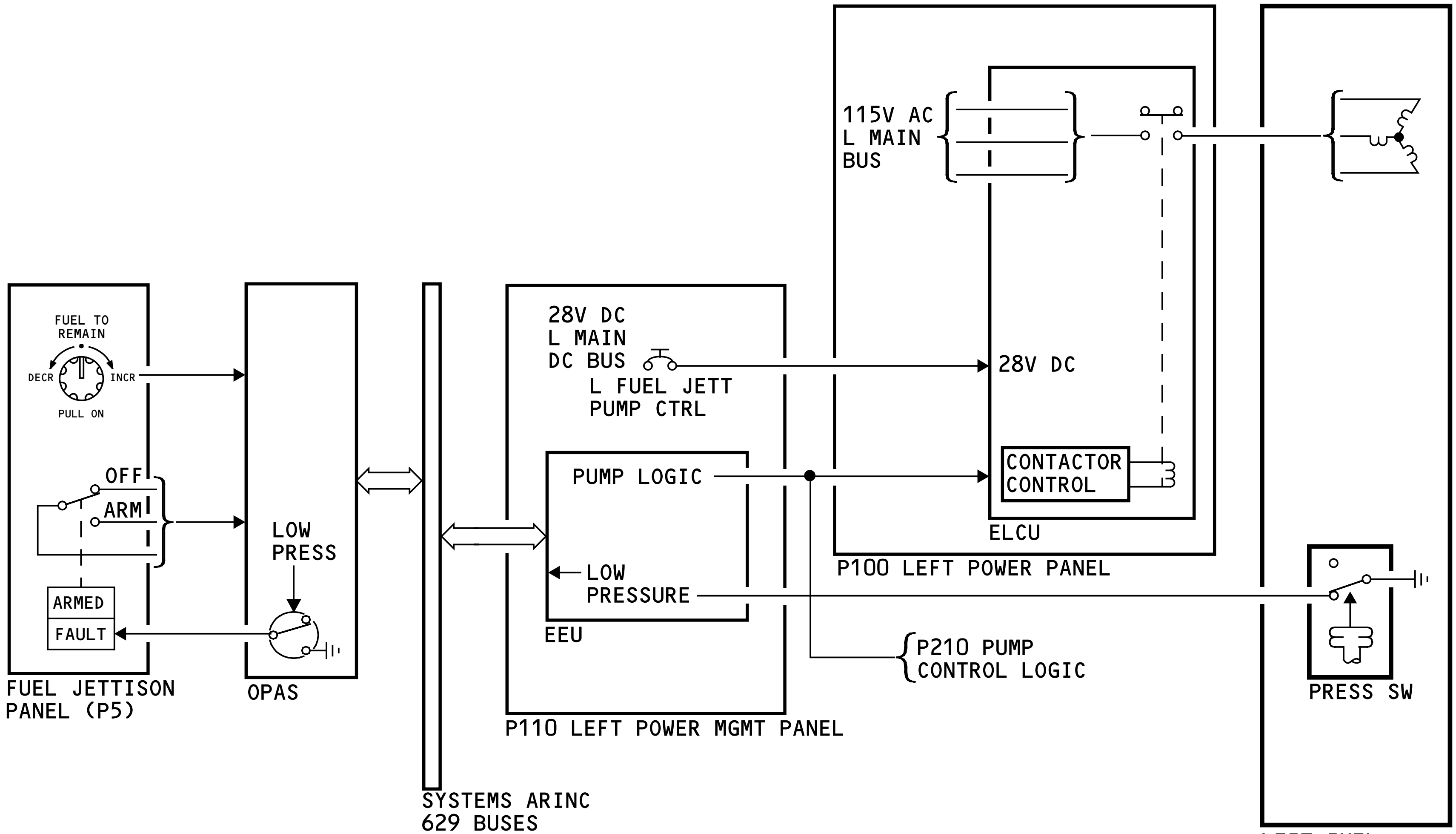
Fuel jettison can cause the airplane center of gravity to be forward of the center of gravity limit. If the ELMS calculates that this will happen, it stops the main tank jettison pumps for 7.5 minutes. The ELMS monitors these parameters to see if it is necessary to stop the main tank jettison pumps:

- Airplane center of gravity
- Airplane gross weight
- Center tank fuel weight.

Fault Indication

The jettison pump has a pressure switch to check for low pressure at the pump outlet. The jettison pump pressure switch closes when there is low pressure. The ELMS logic sends a signal through OPAS to turn on the fault light in the arm switch. The fault light comes on only when the system is armed.

An EICAS status message tells you which pump is defective.



NOTE: LEFT SHOWN
RIGHT SIMILAR

28-31-00-008 Rev 4 05/12/95

FUEL JETTISON - FUNCTIONAL DESCRIPTION - POWER & CONTROL

FUEL JETTISON - FUNCTIONAL DESCRIPTION - ISOLATION AND NOZZLE VALVE CONTROL

Fuel Jettison Isolation Valve

The left main dc bus supplies power to open and close the left fuel jettison isolation valve. Valve logic in two ELMS electronics units (P110 or P210) controls the left and right jettison isolation valve control relays. The relay energizes to open the isolation valve.

When the airplane is on the ground, the ELMS electronics units open the isolation valves when the jettison arm switch is on.

The ELMS electronics units open the isolation valves in the air when these conditions are met:

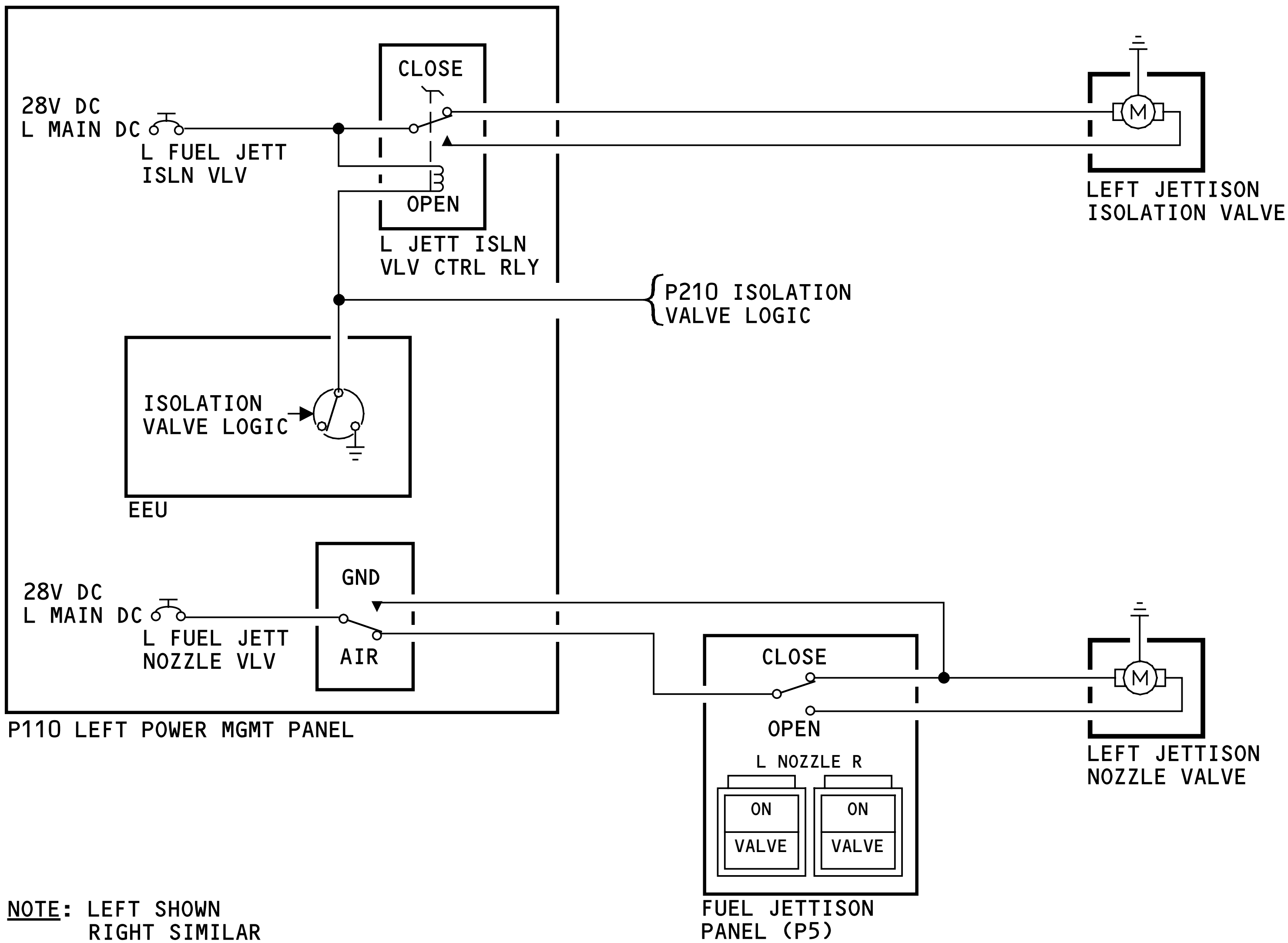
- Jettison arm switch is on
- Left or right jettison nozzle valve is open
- Fuel quantity is greater than fuel-to-remain.

Fuel Jettison Nozzle Valve

The left main dc bus supplies power to open and close the nozzle valve. Power goes through an air/ground relay.

The nozzle valve does not open when the airplane is on the ground.

When the airplane is in the air, the nozzle valve opens when the jettison system is armed and you push the nozzle switch.



28-31-00-009 Rev 2

FUEL JETTISON - FUNCTIONAL DESCRIPTION - ISOLATION AND NOZZLE VALVE CONTROL

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FUEL JETTISON - OPERATION

General

You can use the jettison system in the air to dump fuel overboard. The airplane must be in air mode for the jettison nozzle valves to open. If the airplane is in ground mode when you arm the jettison system, the main tank fuel jettison pumps and the jettison isolation valves operate immediately.

Jettison

This is a brief description of jettison system operation when the airplane is in the air mode:

- Push the ARM switch
- Increase or decrease the fuel-to-remain with the FUEL TO REMAIN selector
- Push the NOZZLE switches to open the jettison nozzle valves, start the jettison pumps, and open the jettison isolation valves
- Turn off the NOZZLE switches when the EICAS display shows the jettison complete advisory message
- Turn off the ARM switch.

When you arm the jettison system, it is in the maximum-landing-weight mode. In this mode, the jettison system automatically sets the fuel-to-remain quantity that will make the airplane weight equal to the maximum landing weight.

If you pull the FUEL TO REMAIN selector, the jettison system changes to the manual mode. Then you turn the FUEL TO REMAIN selector to change the fuel-to-remain quantity. Turn the selector left to decrease or right to increase the fuel-to-remain quantity.

You use the override/jettison pump switches to control the center tank override/jettison pumps. The jettison system does not control the override/jettison pumps.

The fuel jettison rate with one nozzle valve open is 2700 lbs/hr (1224 kg/hr) with the operation of the jettison pumps only, and 3500 lbs/hr (1587 kg/hr) with the jettison and the override/jettison pumps.

The fuel jettison rate with two nozzle valves open is 3100 lbs/hr (1406 kg/hr) with the operation of the jettison pumps only, and 5400 lbs/hr (2449 kg/hr) with the jettison and the override/jettison pumps.

Indications

The EICAS display shows these jettison system indications:

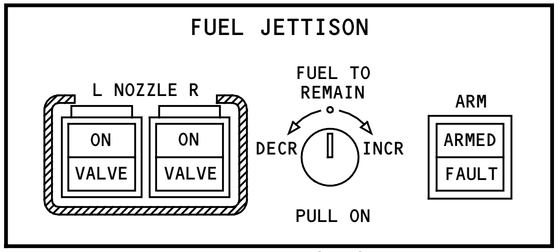
- Total fuel quantity
- Fuel-to-remain
- Jettison mode.

The jettison mode shows adjacent to the fuel-to-remain quantity. MLW shows if the jettison system is in the maximum-landing-weight mode. MAN shows if the jettison system is in the manual mode.

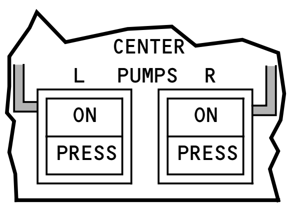
FUEL JETTISON - OPERATION

The fuel synoptic display shows these jettison system indications:

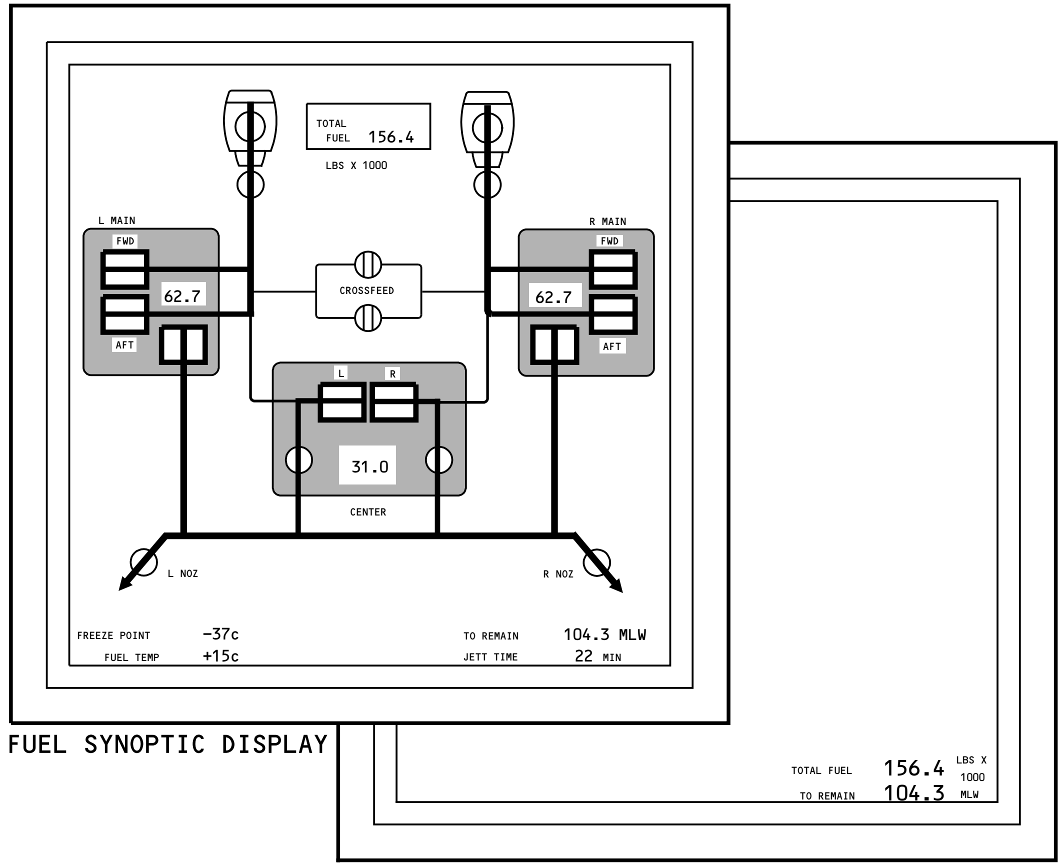
- Override/jettison pump operation
- Jettison isolation valve position
- Jettison pump operation
- Jettison nozzle valve position
- Fuel-to-remain
- Jettison mode
- Time until jettison complete.



FUEL JETTISON PANEL (P5)



FUEL PANEL (P5)



FUEL SYNOPTIC DISPLAY

EICAS DISPLAY

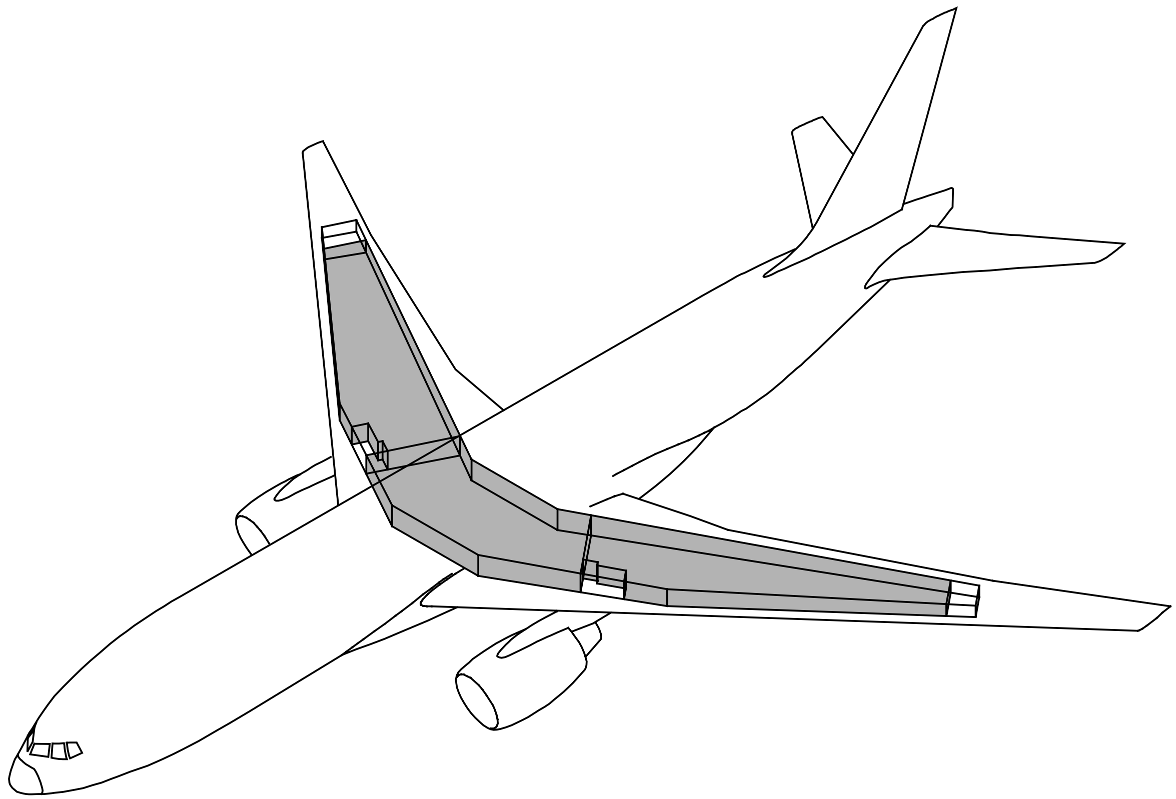
28-31-00-010 Rev 5 02/13/1997

FUEL JETTISON - OPERATION

DEFUEL - INTRODUCTION

General

The defuel system moves fuel from the airplane tanks to the refuel station, or from one airplane tank into another. You operate the defuel system with the refuel station controls.



FUEL STORAGE

FUEL INDICATING

PRESSURE REFUEL

ENGINE FUEL FEED

APU FUEL FEED

JETTISON

DEFUEL

28-26-00-001 Rev 3 03/26/96

DEFUEL - INTRODUCTION

DEFUEL - GENERAL DESCRIPTION

General

The defuel system moves fuel from the airplane tanks to refuel station. It also moves fuel from one airplane tank into another (tank-to-tank transfer). There are two ways to get fuel out of the tanks:

- Use the airplane fuel pumps (pressure-defuel)
- Use ground pumps (suction-defuel).

You must open the defuel valve to move fuel to the refuel station. Refuel hoses transfer fuel to ground tanks or a defuel truck.

You do these things for a tank-to-tank transfer:

- Open the defuel valve
- Open the applicable refuel valves
- Operate the applicable fuel pumps.

You must open a crossfeed valve to remove fuel from the left main tank through the engine feed manifold.

Control and Indication

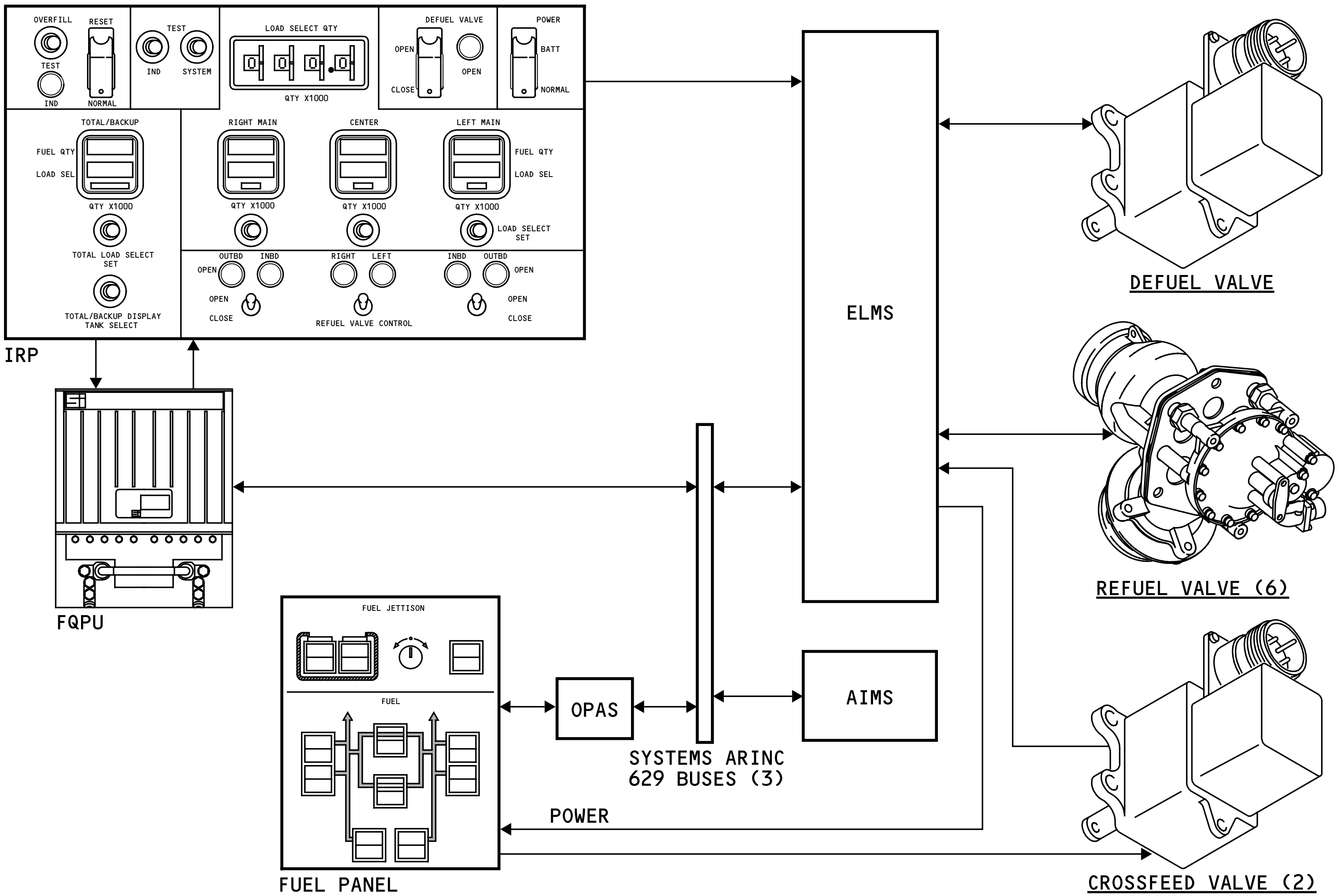
You use the IRP to open and close the defuel valve and refuel valves. The ELMS supplies power to open and close the valves.

The defuel valve switch controls relays in the ELMS to open and close the defuel valve. The refuel valve switches send valve position signals to the FQPU. The FQPU controls relays in the ELMS to open and close the refuel valves. The FQPU controls the refuel and defuel valve position lights on the IRP.

The FQPU supplies fuel quantity data to the IRP.

You use the fuel panel switches on the P5 panel to operate the fuel pumps.

The refuel section describes the refuel valves. The engine fuel feed section describes the fuel pumps and the crossfeed valves.



DEFUEL - GENERAL DESCRIPTION

DEFUEL - COMPONENT LOCATIONS - CENTER FUEL TANK

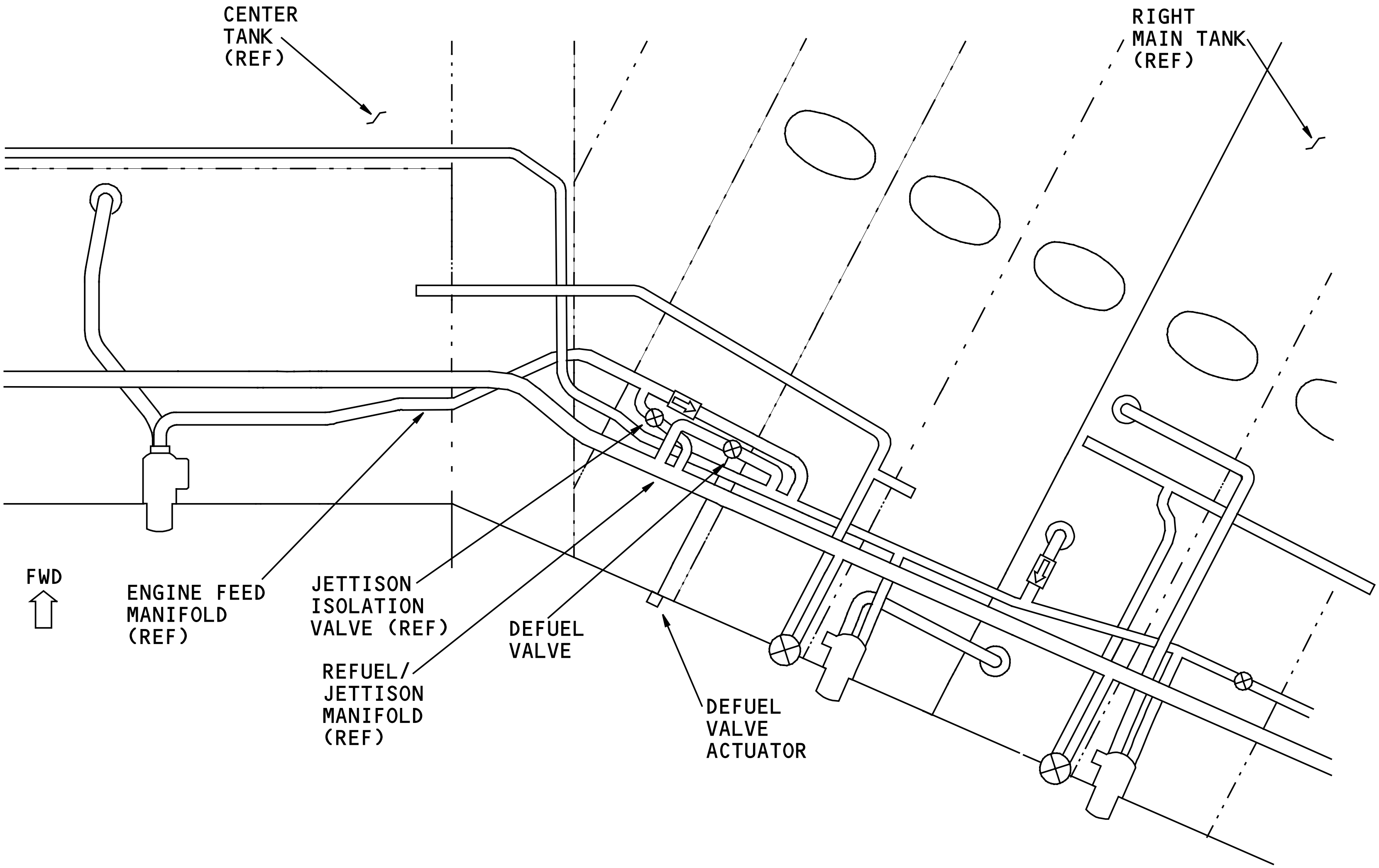
Purpose

The defuel valve connects the engine feed manifold to the refuel/jettison manifold.

Location

There is one defuel valve. It is in the right side of the center tank. You get access to the defuel valve though the first fuel tank access door in the right wing.

The defuel valve actuator is on the rear spar. It is aft of the first fuel tank access door in the right wing.



28-26-00-003 Rev 3 03/18/96

DEFUEL - COMPONENT LOCATIONS - CENTER FUEL TANK

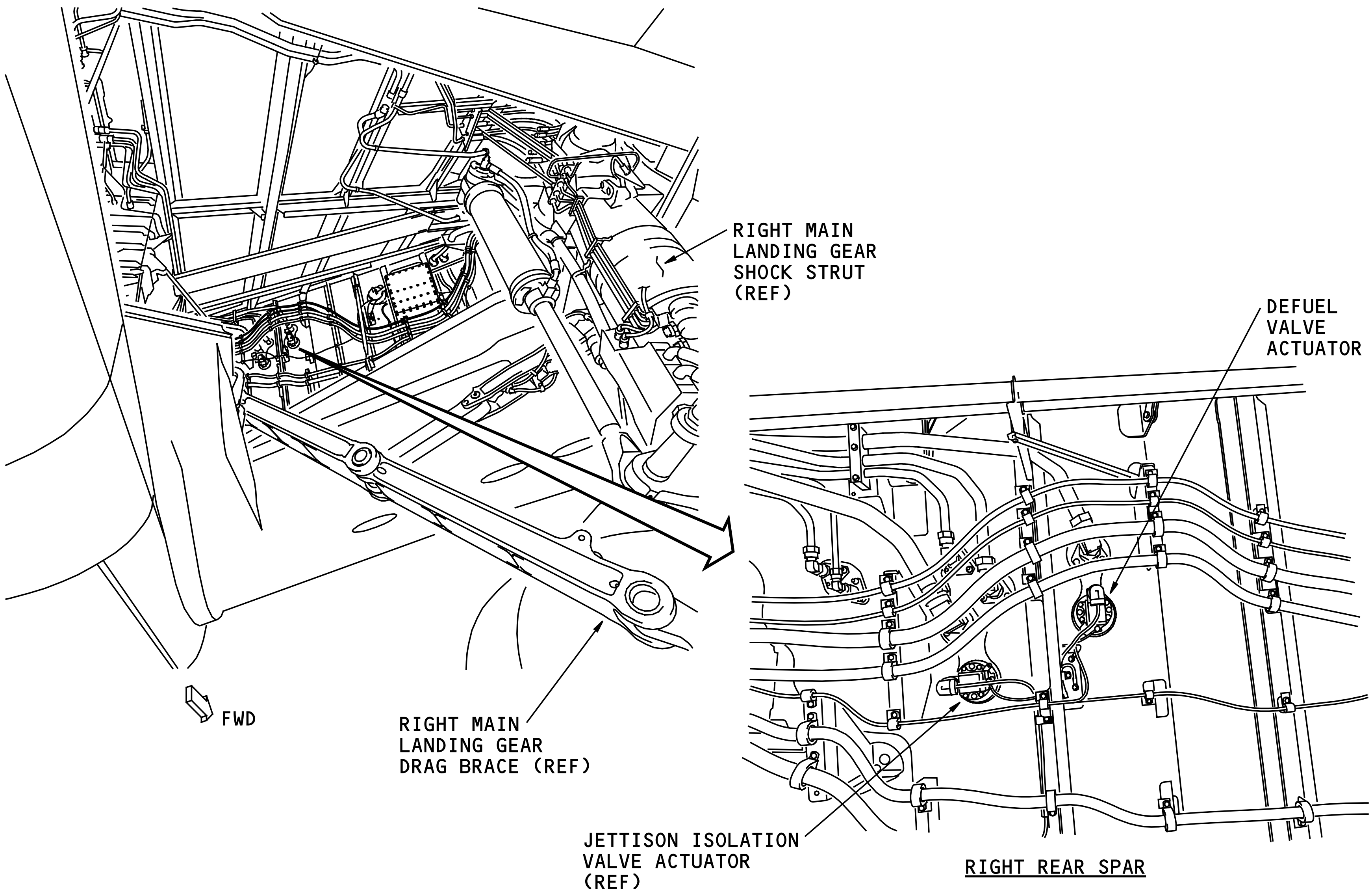
DEFUEL - DEFUEL VALVE

Purpose

The defuel valve connects the engine feed manifold to the refuel/jettison manifold so you can remove fuel from the fuel tanks.

Description

The defuel valve is a motor-actuated valve. The valve body is in tubing in the right side of the center tank. The tubing connects to the right engine feed manifold and the refuel/jettison manifold. The valve actuator is on the right rear spar. See the engine fuel feed section for more information about motor-actuated fuel valves (AMM PART I 28-22).



DEFUEL - DEFUEL VALVE

DEFUEL - FUNCTIONAL DESCRIPTION - FUEL FLOW

General

You can pressure-defuel the fuel tanks with the engine feed system. You can also suction defuel the main tanks through the bypass valve.

Pressure-Defueling With Engine Feed System

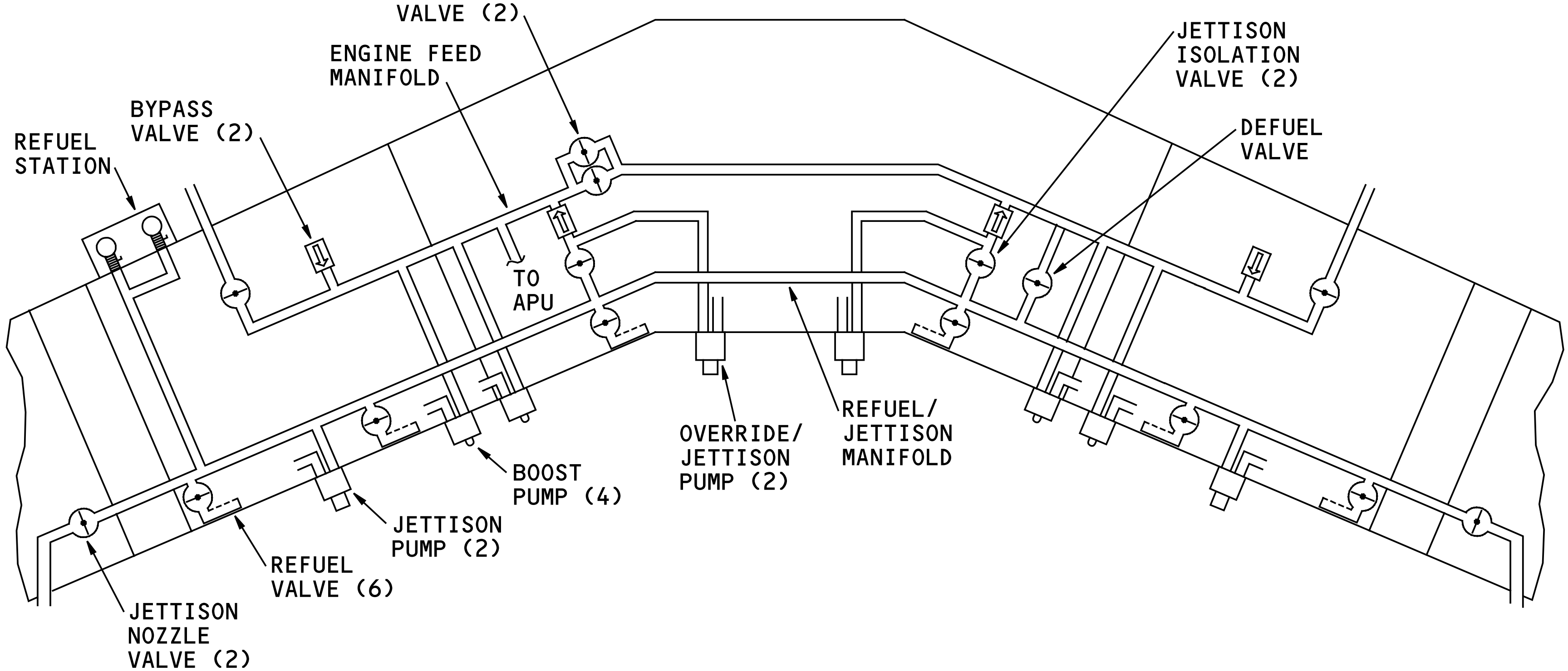
When you use the boost pumps to pressure-defuel the airplane, the pumps put fuel into the engine feed manifold. When you open the defuel valve the fuel goes into the refuel/jettison manifold and out the refuel station adapters. One of the crossfeed valves must be open for fuel from the left side to get to the defuel valve.

Suction-Defueling

You suction-defuel the main tanks through the bypass valves. You must open the defuel valve to get fuel from the engine feed manifold into the refuel/jettison manifold. Suction-defuel will remove fuel until the fuel level is below one of the two bypass valves. Then you must use another method to defuel the tanks.

Tank-to-Tank Transfer

You can also defuel a tank by moving fuel into another tank. In this case, instead of removing fuel through the refuel adapters at the refuel station, you open the refuel valves for the tank in which you want to put the fuel.



28-26-00-004 Rev 5 03/18/96

DEFUEL - FUNCTIONAL DESCRIPTION - FUEL FLOW

DEFUEL - FUNCTIONAL DESCRIPTION - ELECTRICAL

General

The hot battery bus supplies power to the defuel valves. Power goes through the refuel panel door relay and defuel valve control relay in the P310 standby power management panel.

Defuel Valve Control

Power to operate the valve goes through limit switches to the actuator. The actuator moves the valve to the commanded position. When the valve is in the commanded position, the limit switches remove power from the actuator and send power to the ELMS valve disagree logic.

The defuel valve control relay energizes when you put the defuel valve switch in the open position.

You can open the defuel valve only when the refuel panel door is open. When the refuel panel door closes, the defuel valve automatically closes. When the door closes, it also moves the defuel valve switch to the closed position.

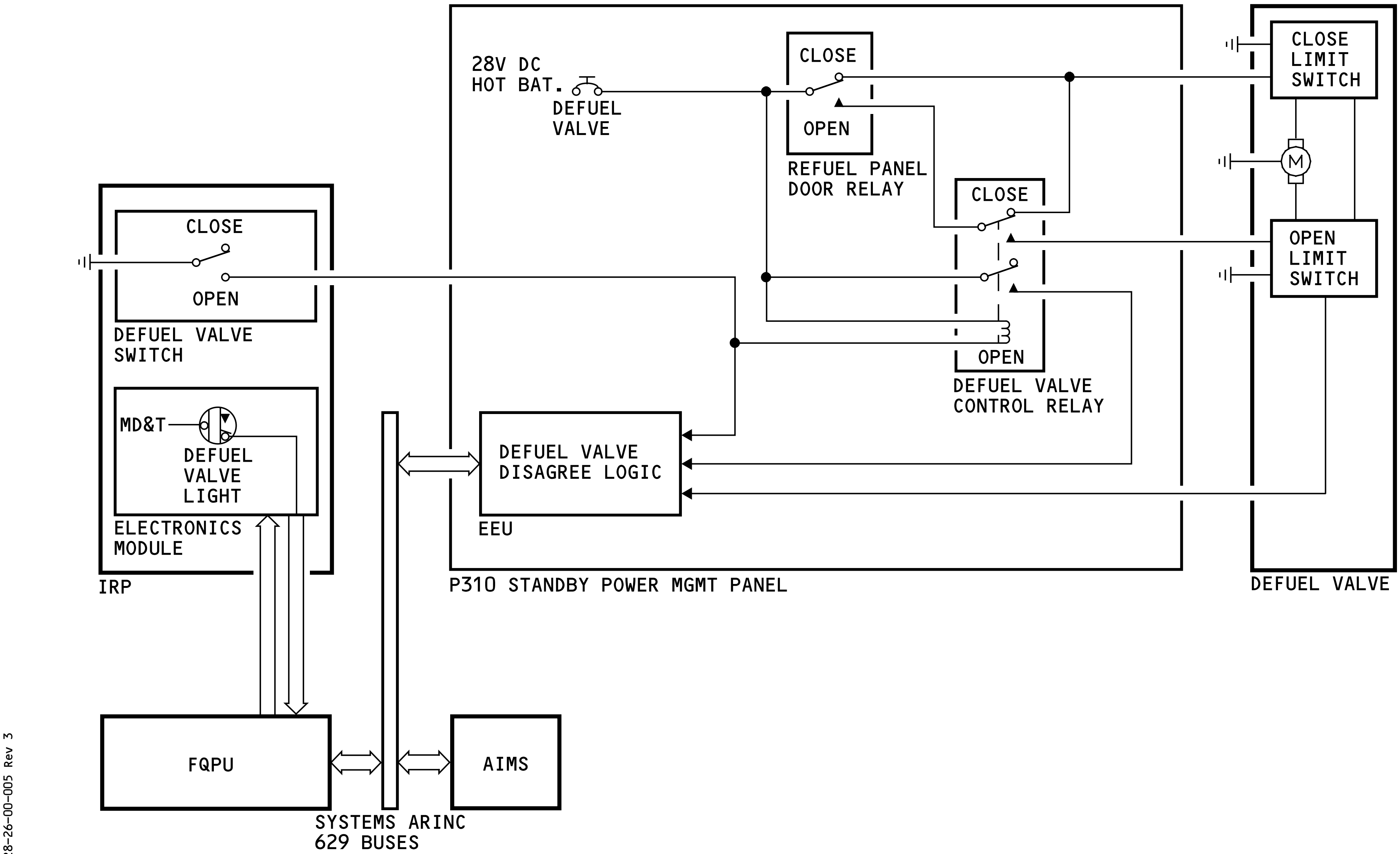
Indication

The P310 EEU monitors the position of these components:

- Defuel valve switch
- Defuel valve control relay
- Defuel valve.

The EEU sends the position signals to the FQIS processor unit (FQPU) on the ARINC 629 system buses. When the valve is open, the FQPU turns on the blue defuel valve light. You push the defuel valve light to do a test of it.

If there is a disagreement between the switch position and the defuel valve control relay, the FQPU sends a fault signal to the AIMS.



DEFUEL - FUNCTIONAL DESCRIPTION - ELECTRICAL

DEFUEL - OPERATION

General

The defuel procedure is on a placard on the refuel station door. The procedure is also in the maintenance manual.

Defuel Procedure

This is a brief summary of the pressure-defuel procedure:

- Connect the fueling nozzles
- Move the defuel lever on refuel adapter to the defuel position
- Move the defuel valve switch to OPEN
- Turn on the fuel pumps in each tank that you want to defuel
- Open crossfeed valve if necessary
- Move the defuel valve switch to CLOSE when the tanks are empty
- Turn off the fuel pumps
- Move the defuel lever on the refuel adapter to the refuel position
- Remove the fueling nozzles
- Do a test of the defuel valve open light.

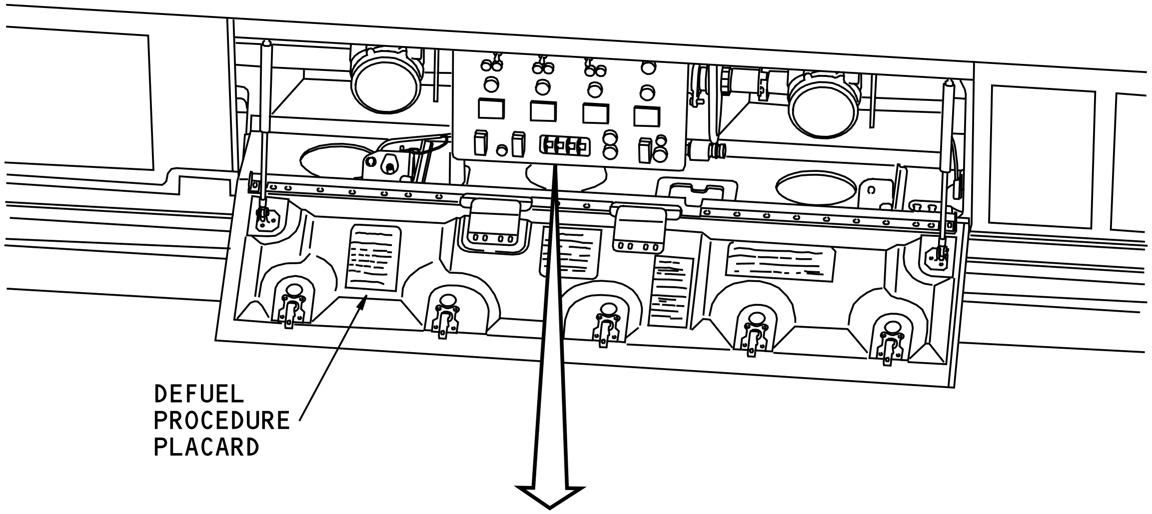
The suction-defuel procedure is the same as the pressure-defuel procedure except you do not turn on the fuel pumps. Suction defueling stops when one of the bypass valve inlets is uncovered. Thus, if the tanks do not become empty at the same time, there may be fuel remaining in one of the tanks.

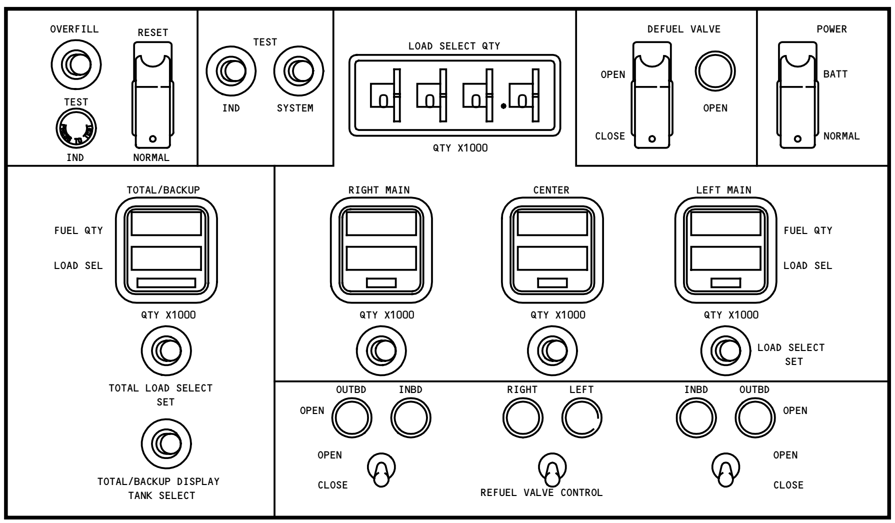
Tank-to-Tank Transfer

To move fuel from one tank to another you must use the engine feed, defuel, and refuel systems. These steps are necessary for tank-to-tank transfer:

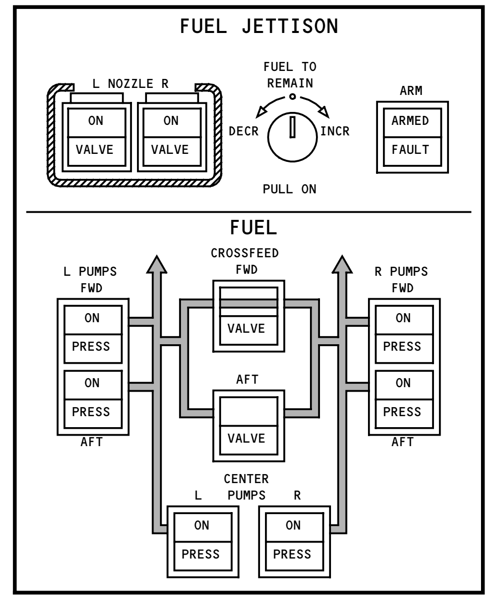
- Do a test of the indicators and defuel valve open light
- Move the defuel valve switch to OPEN
- Turn on the fuel pumps in the tank you want to defuel
- Open crossfeed valve if necessary
- Move the refuel valve switches to OPEN in the tank you want to put the fuel into.

If you want to defuel the tank, let the pump operate until the tank is empty. If you want to move only part of the fuel, use the refuel valve control switches to stop the fuel flow.





P28 INTEGRATED REFUEL PANEL



FUEL PANEL (P5)

DEFUEL - OPERATION

Continental Airlines, Inc

Power Plant

WB371

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Continental Airlines, Inc
Power Plant
WB371

TABLE OF CONTENTS

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General

Two General Electric GE90 engines supply airplane thrust during all phases of flight. The GE90 is a high bypass ratio, turbofan engine. The engines supply power for the electric, hydraulic, and pneumatic systems.

The engine systems are described in the following sequence:

- Power plant (71)
- Engine (72)
- Engine fuel and control (73)
- Engine controls (76)
- Engine indicating (77)
- Oil (79)
- Air (75)
- Starting (80)
- Ignition (74)
- Exhaust (78).

Abbreviations and Acronyms

ACTR - actuator
CTRL - control
EAI - engine anti-ice
FAV - fan air valve
GE - General Electric
GND - ground
HDLG - handling
HMU - hydromechanical unit
HP - high pressure
IDG - integrated drive generator
LP - low pressure
MAT - maintenance access terminal
PDOS - powered door opening system
PRSOV - pressure regulating and shutoff valve
SVC - service
TIP - training information points
T/R - thrust reverser
T12 - temperature at station 12
VSV - variable stator vanes

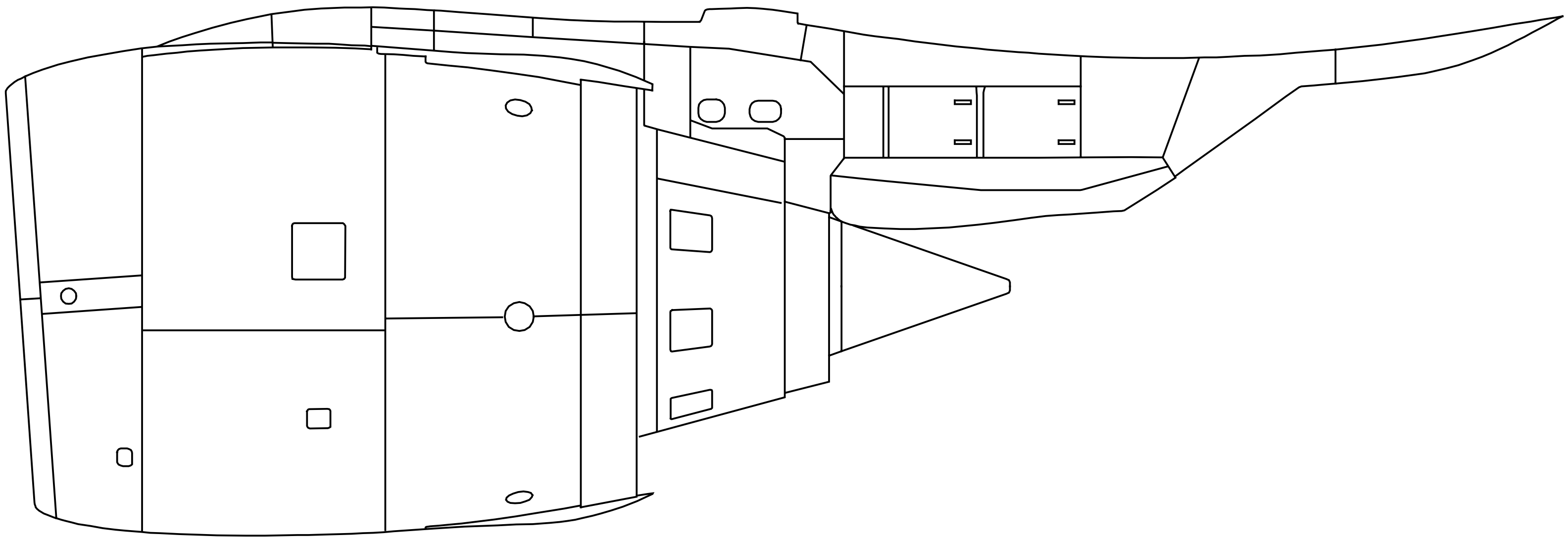
POWER PLANT (71)

ENGINE (72)

ENGINE FUEL AND CONTROL (73)

ENGINE CONTROLS (76)

ENGINE INDICATING (77)



ENGINE OIL (79)

ENGINE AIR (75)

STARTING (80)

IGNITION (74)

EXHAUST (78)

71-00-00-101 Rev 3 09/11/96

POWER PLANT - INTRODUCTION

POWER PLANT - ENGINE HAZARDS

General

It is dangerous to work around engines. Use the engine entry corridors to go near an engine in operation.You must stay out of the inlet and exhaust hazard areas when the engine is running.

The hazards around jet engines in operation include:

- Inlet suction
- Heat
- Exhaust
- Noise.

Engine Entry Corridors

Engine entry corridors are between the inlet hazard areas and the exhaust hazard areas. You should go near an engine in operation only when:

- The engine is at idle (forward thrust only)
- You can speak with the flight deck.

Inlet Suction

Suction at the inlet of an engine can pull objects, including a person, into the engine. At idle power, the hazard area is an 12 ft (3.7 m) radius around the inlet. At takeoff thrust, the hazard area is a 28.5 ft (8.8 m) radius around the inlet.

WARNING: IF SURFACE WIND IS GREATER THAN 25 KNOTS, INCREASE THE INLET HAZARD AREA BY 20%.

Engine damage can result when rags, eyeglasses, hats, or other loose objects go into the inlet cowl. You must attach or remove any loose objects before you work around the engine.

Heat

The engine exhaust temperature can remain high for a long distance behind the engine.

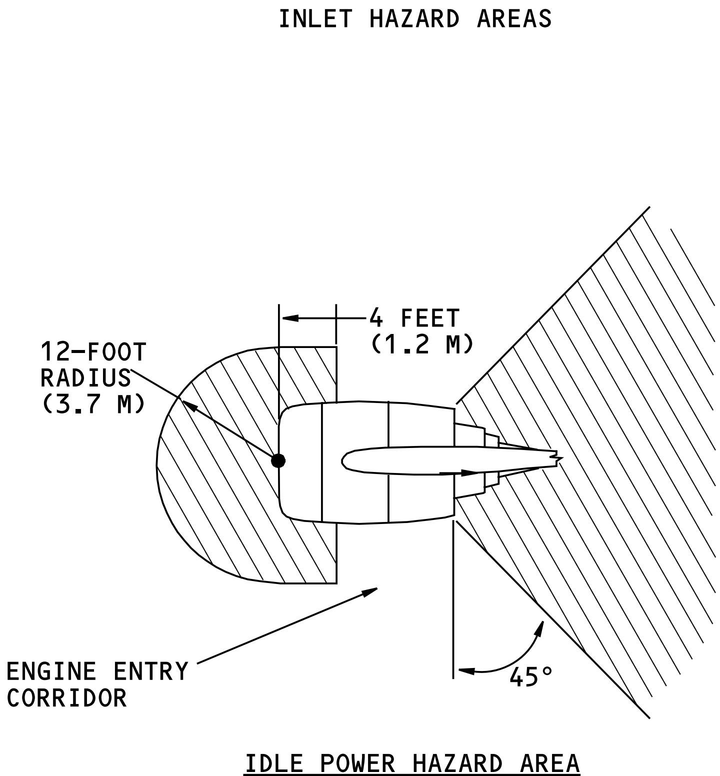
Exhaust

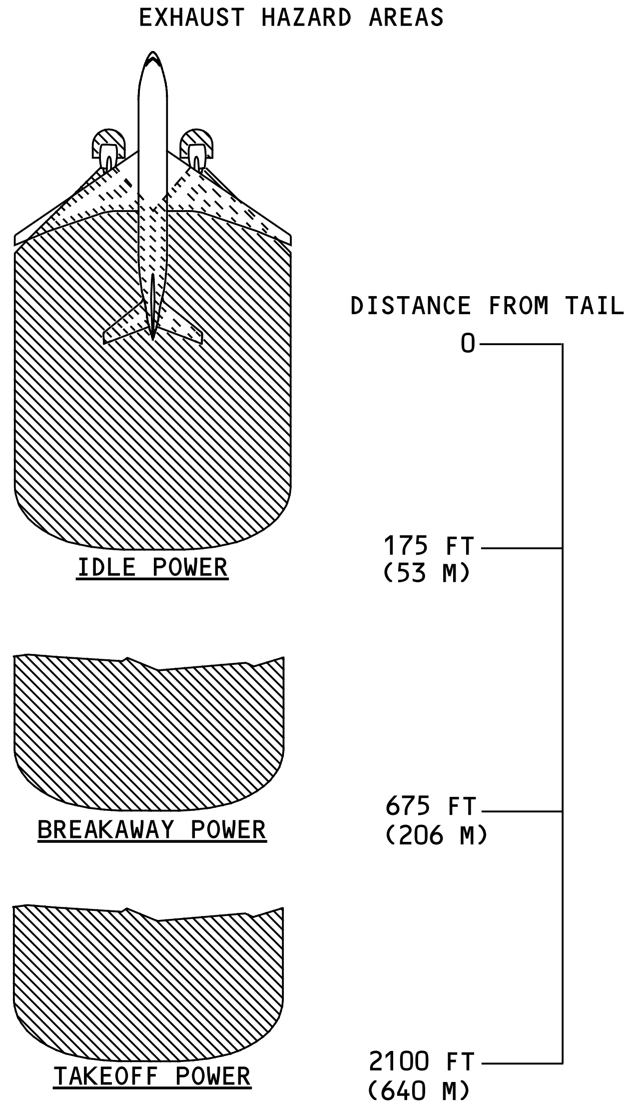
The engine fan and thrust reverser develop high speed exhaust gases that can cause injury. The exhaust gases move forward when the thrust reverser deploys.

Noise

Engine noise can cause temporary and permanent hearing loss. You must wear cup-type ear protection near an engine in operation.

WARNING: LONG EXPOSURES TO JET ENGINE NOISE CAN CAUSE HEARING DAMAGE EVEN WHEN YOU WEAR EAR PROTECTION.





71-00-00-103 Rev 4 12/19/95

POWER PLANT - ENGINE HAZARDS

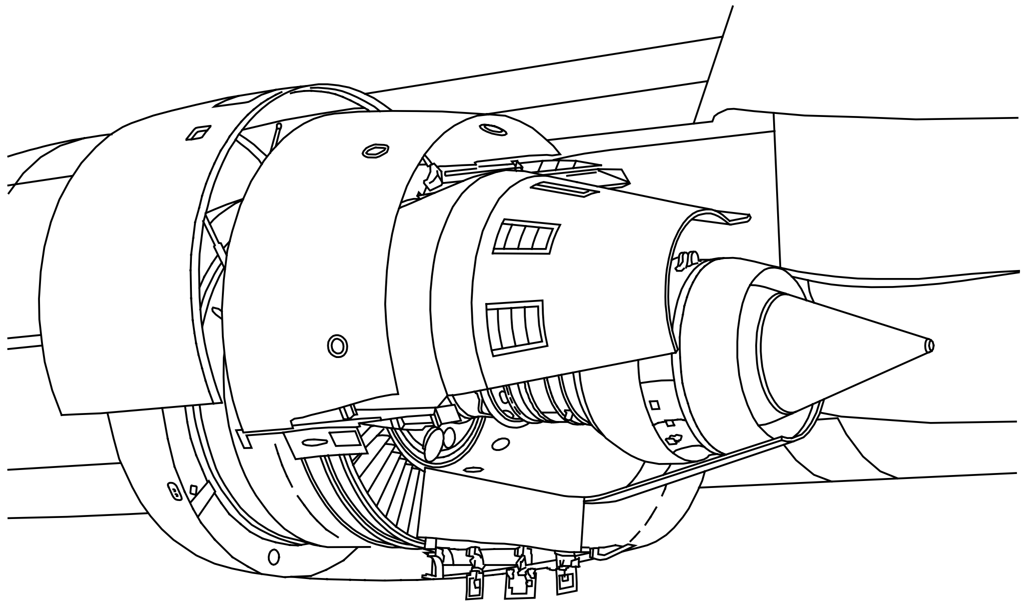
ENGINE COWLING - INTRODUCTION

General

The cowl contains and protects the engine components. The cowl also controls the airflow through and around the engine. Some of the engine cowl opens for maintenance access.

The engine cowl has four parts:

- Inlet cowl
- Fan cowl
- Thrust reverser
- Turbine exhaust system.



POWER PLANT

ENGINE COWLING | PDOS | TRAINING INFORMATION POINTS

ENGINE COWLING - INTRODUCTION

ENGINE COWLING - GENERAL DESCRIPTION

General

The engine cowling is a cover that contains and gives protection to the engine components. The cowling also controls the airflow through and around the engine. Some parts of the engine cowling open for maintenance access.

The engine cowling has four parts:

- Inlet cowl
- Fan cowl
- Thrust reverser
- Turbine exhaust.

Inlet Cowl

The inlet cowl supplies a smooth airflow into the engine. The inlet cowl weighs approximately 690 lb (315 kg).

Fan Cowl

The fan cowl is aft of the inlet cowl. The fan cowl attaches to the fan cowl support beam on the engine. The fan cowls open for maintenance. Each fan cowl panel weighs approximately 310 lb (140 kg).

Thrust Reverser

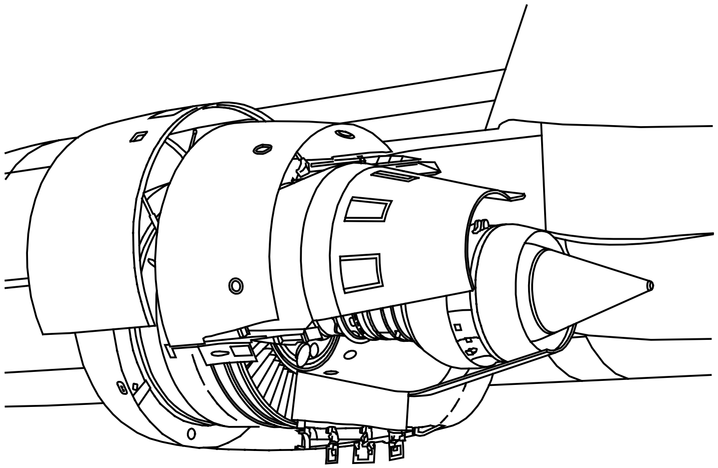
The thrust reverser is aft of the fan cowl. The thrust reverser attaches to the strut and opens for maintenance. Each thrust reverser half weighs approximately 1760 lb (800 kg).

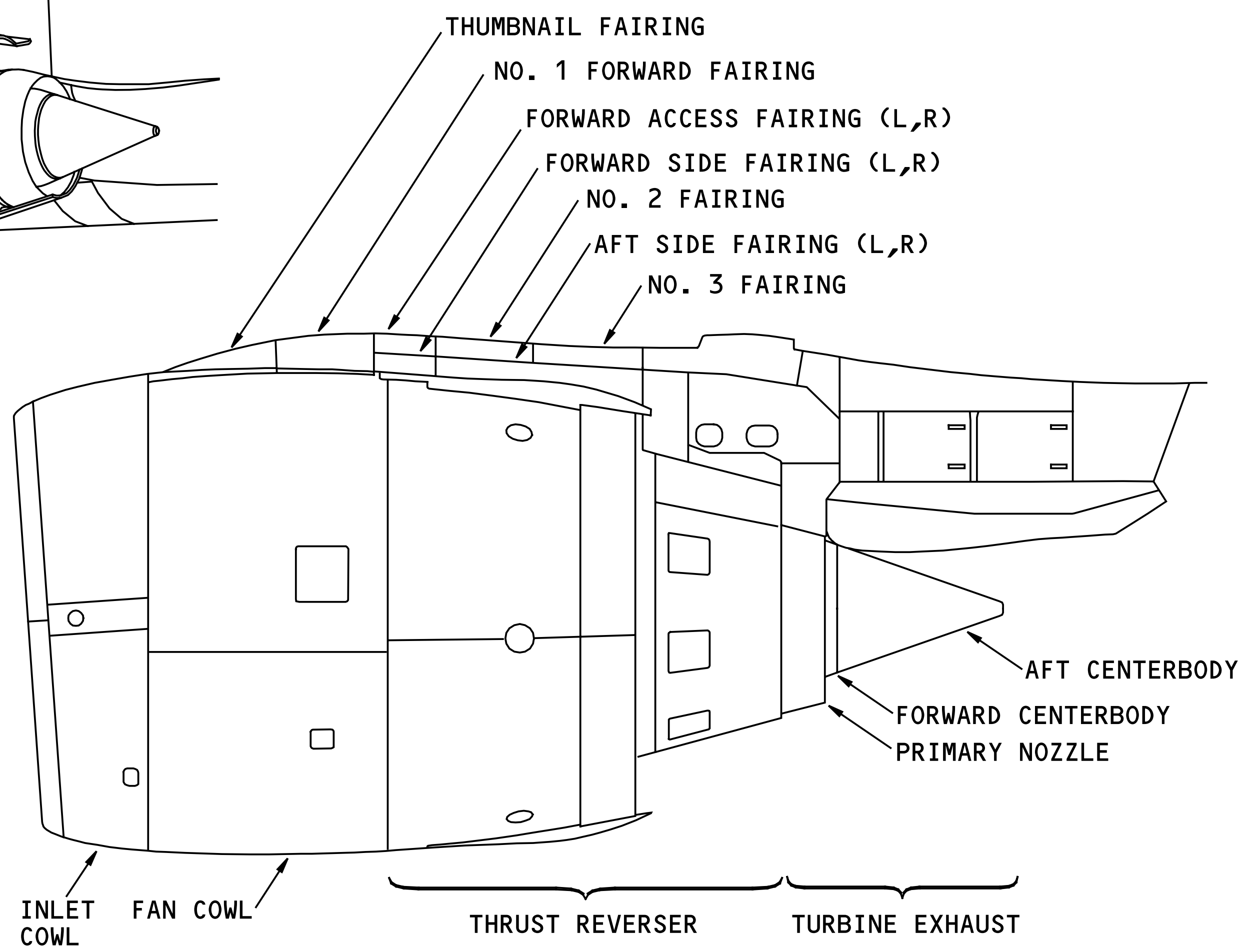
Turbine Exhaust

The turbine exhaust system is aft of the thrust reverser. The system has three parts:

- Primary nozzle
- Forward centerbody
- Aft centerbody.

The primary nozzle weighs approximately 70 lb (30 kg). The forward and aft centerbodies weigh approximately 80 lb (35 kg) together.





ENGINE COWLING - GENERAL DESCRIPTION

71-11-00-101 Rev 3 02/08/1997

ENGINE COWLING - INLET COWL

General

The inlet cowl controls the airflow into the engine fan. The inlet cowl is a single assembly with an upper and a lower half. The inlet cowls for the left and the right engines are interchangeable. The cowl includes these components:

- T12 sensor
- Engine anti-ice (EAI) system
- Powered door opening system (PDOS) actuation and control switches
- Hoist points.

EAI System

The EAI supply duct is at the 11:00 position on the inlet cowl. It gives anti-ice air to the inlet cowl.

The EAI exhaust duct is at the 9:00 position on the inlet cowl. The exhaust duct permits EAI air to flow overboard.

The EAI duct inside the inlet cowl has a shroud. It sends EAI air into the fan compartment if the duct breaks open.

Electrical Connections

There are two electrical connections on the aft bulkhead of the inlet cowl. They are at the 12:30 and the 3:00 positions. The connections are for the T12 sensor and the PDOS switches.

The T12 sensor measures engine inlet temperature and sends it to the EEC.

PDOS Actuation and Control Switches

The PDOS opens the fan cowls and the thrust reverser halves. Two PDOS switches are on each side of the inlet cowl. The fan cowl switches are at the 4:00 and the 8:00 positions on the outside of the inlet cowl. The thrust reverser switches are at the 4:00 and the 8:00 positions on the aft bulkhead of the inlet cowl.

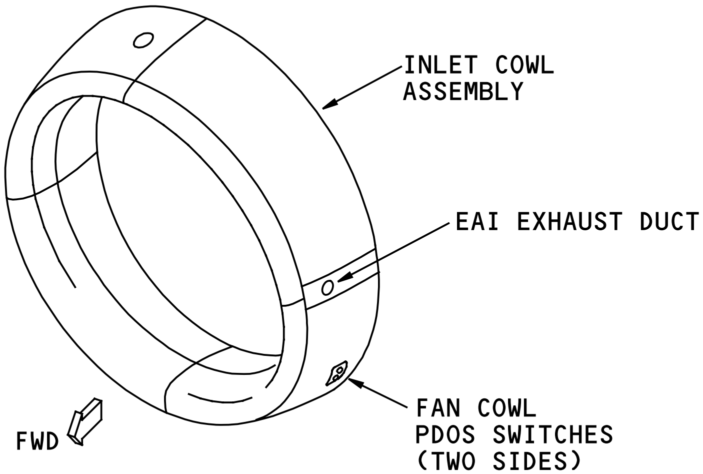
See the powered door opening system section for more information (AMM PART I 71-12).

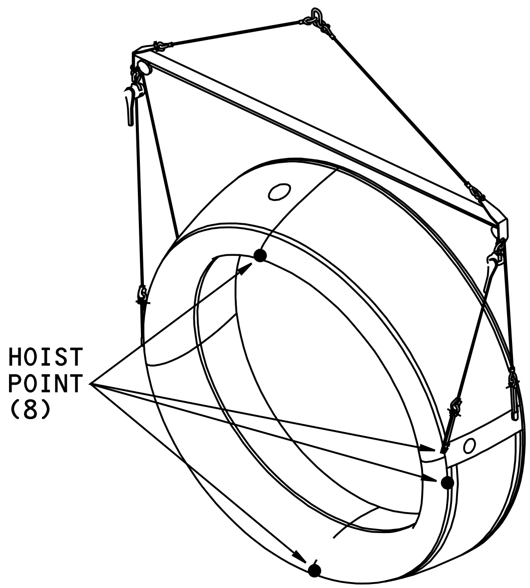
Hoist Points

The inlet cowl has eight hoist points. There are five hoist points on the upper inlet assembly and three on the lower inlet assembly.

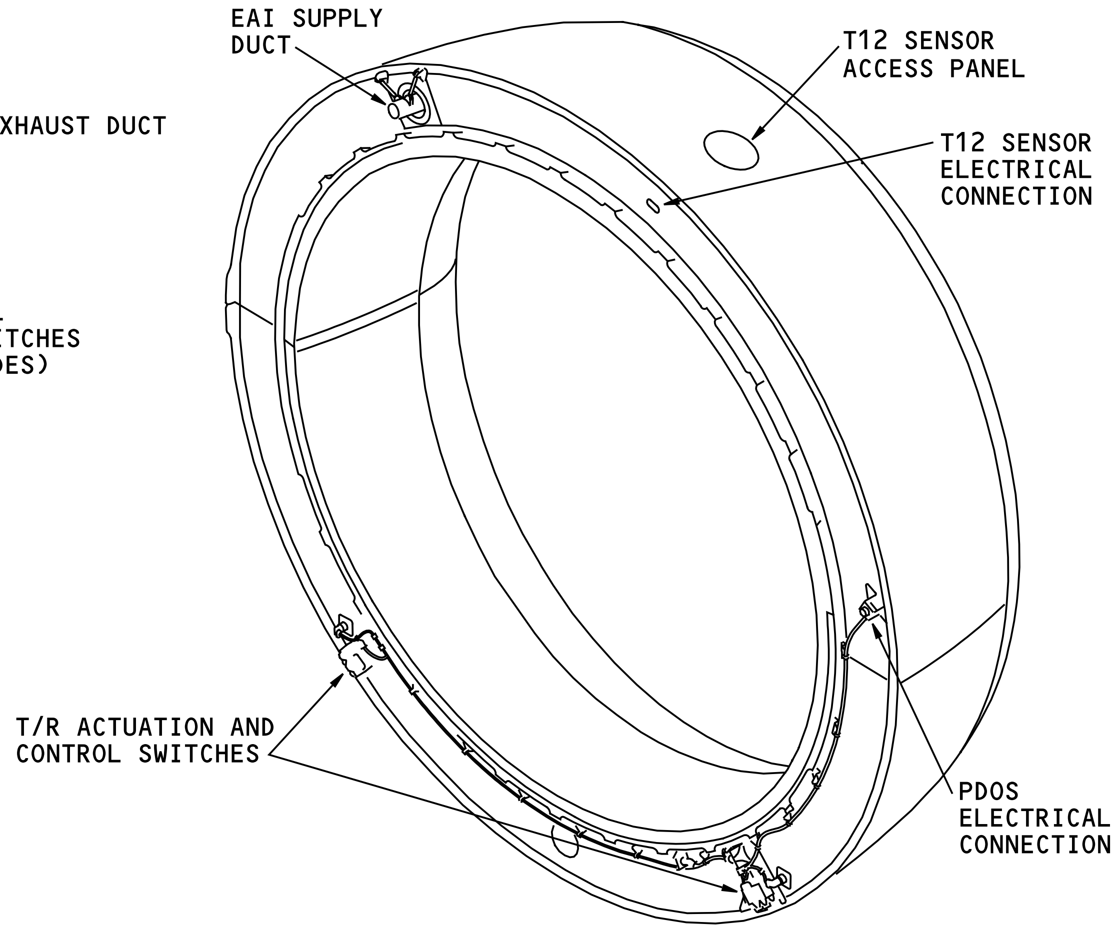
Training Information Point

You can separate the upper and the lower halves of the inlet cowl to move it. The upper and the lower halves are matched sets. They are not interchangeable with other inlet cowl halves.





SLING ATTACHMENT



INLET COWL ASSEMBLY

71-11-00-102 Rev 5 02/08/1997

ENGINE COWLING - INLET COWL

ENGINE COWLING - FAN COWL

General

Each engine has two fan cowls. The fan cowls let the air flow smoothly around the engine. The fan cowls open for maintenance.

Physical Description

The fan cowls are graphite-epoxy structures. Each fan cowl has four hinges. Each hinge attaches to the fan cowl support beam on the fan case. Each hinge has a quick release pin.

The inboard fan cowl on each engine has a chine at the 10:00 position. The fan cowl chine controls the airflow direction over part of the wing.

The left fan cowl has an oil tank access door and a pressure relief door. You service the engine oil tank through the oil tank access door.

You can remove each fan cowl panel with a sling that attaches at three hoist points.

Hold-Open Rods

Each fan cowl has a forward and an aft hold-open rod. The rods are telescopic. One end of the hold-open rod attaches to a bracket on the fan case. The other end attaches to fittings on the fan cowl.

Each hold-open rod has a locking collar. The collar locks the hold-open rod in place. When you can see a yellow stripe next to the collar, it is locked.

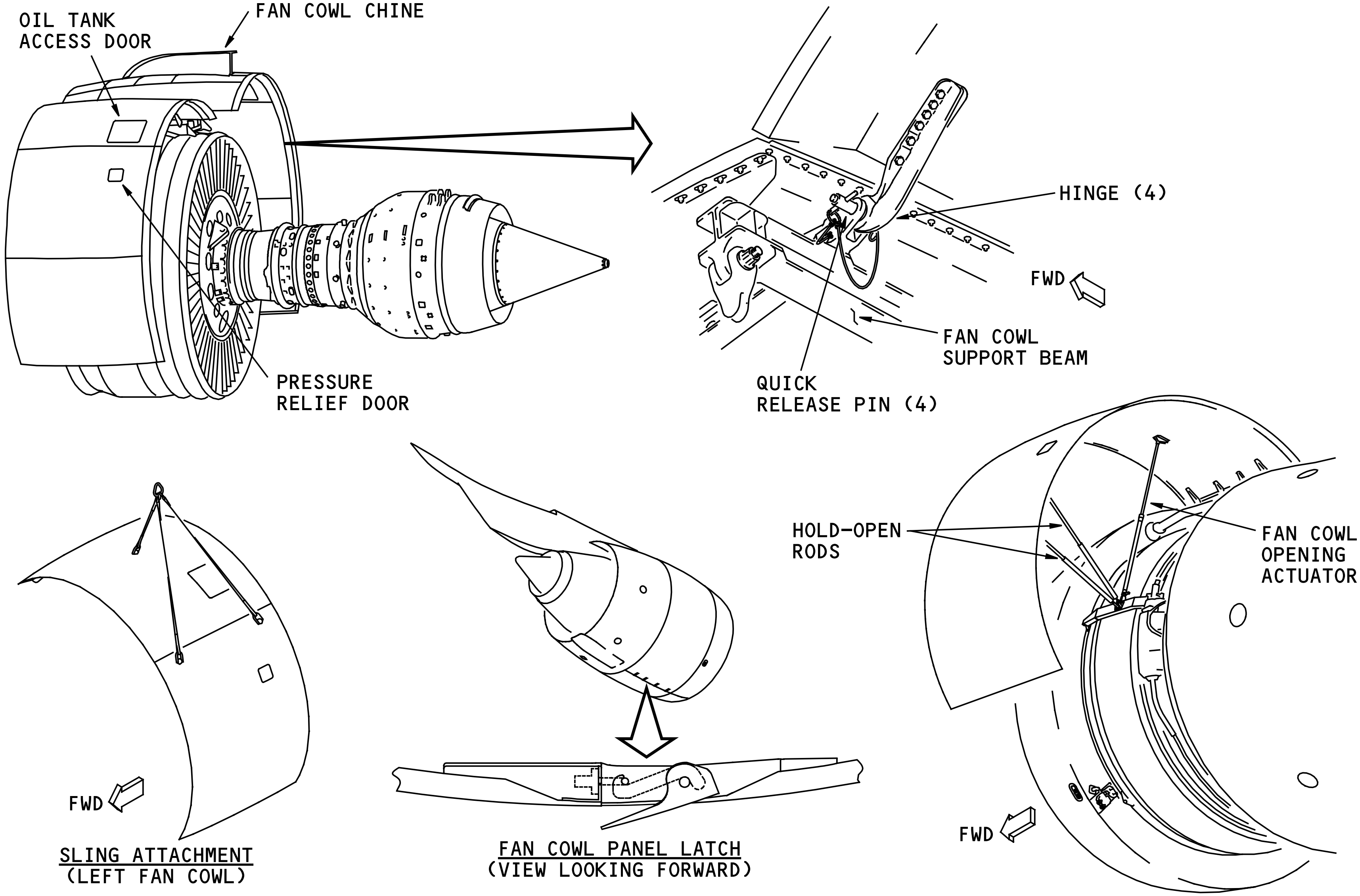
See the powered door opening system section for more information (AMM PART I 71-12).

Fan Cowl Opening Actuators

You use the PDOS to open and close the fan cowls. Each fan cowl has a fan cowl opening actuator. The actuator attaches to a bracket on the fan cowl and to the fan case. The fan cowl opening actuators open and close the fan cowls with hydraulic power.

Fan Cowl Panel Latches

There are four adjustable fan cowl panel latches at the bottom of the cowls. The latches hold the left and right fan cowl panels together.



ENGINE COWLING - FAN COWL

ENGINE COWLING - FAN COWL HOLD-OPEN RODS

General

The fan cowl hold-open rods keep the fan cowls open for maintenance. The hold-open rods are also a safety device. They protect persons at work on the engine or at work on the fan cowl from injury. They prevent the accidental closure of the fan cowl.

Fan Cowl Hold-Open Rods

Each fan cowl has a forward and an aft hold-open rod. The rods are telescopic. The rods stay attached to the fan case and fan cowl when you open and close the fan cowl

Each hold-open rod has a locking collar. The locking collars lock the hold-open rods. When you can see the red stripe next to the collar, the hold-open rod is not locked. When you can see the yellow stripe next to the collar, the hold-open rod is locked.

Fan Cowl Opening

This is a summary of how you open the fan cowl:

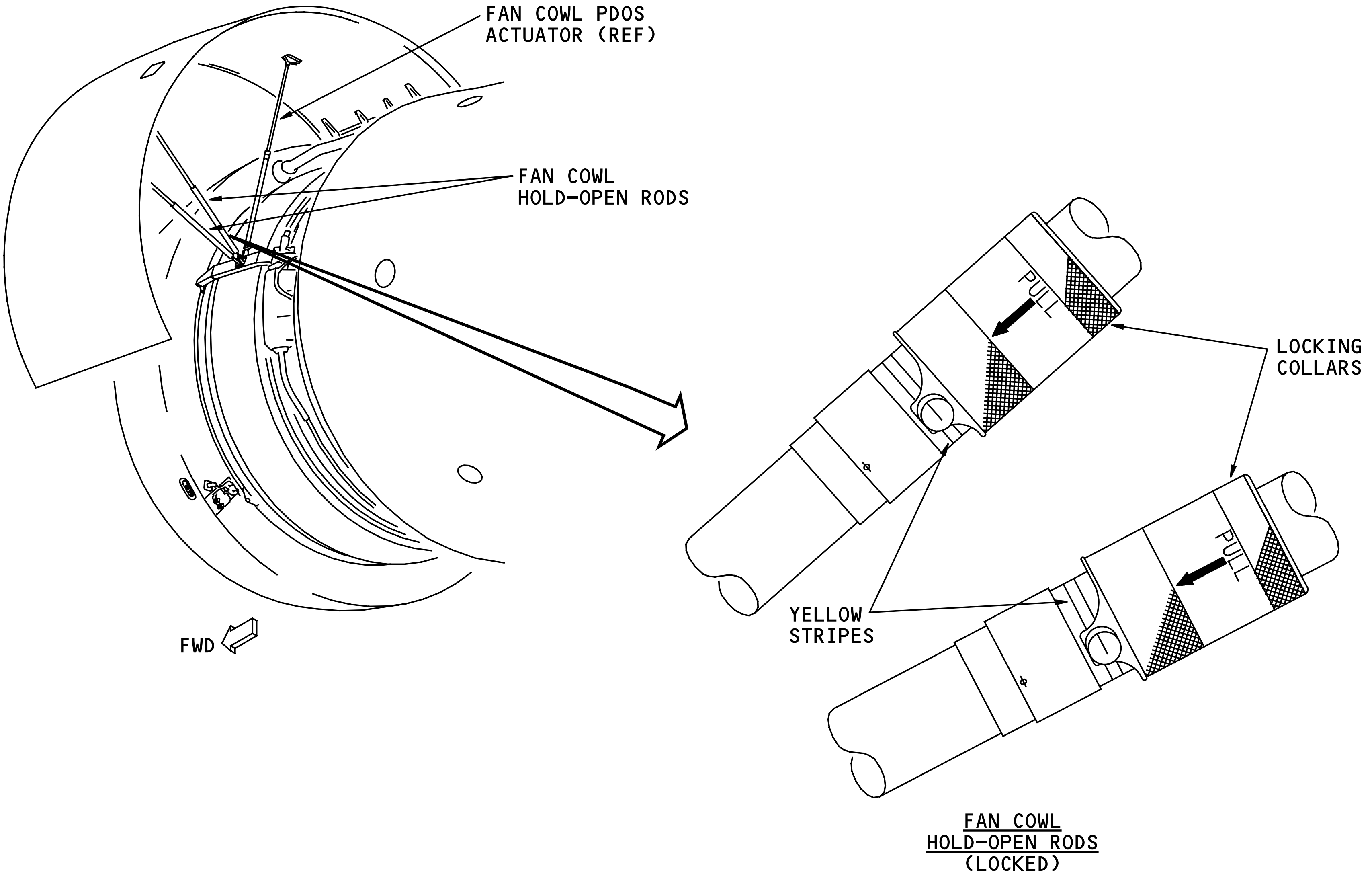
- Open the fan cowl panel latches from aft to forward
- Use the PDOS to open the fan cowl
- The hold-open rods automatically extend and lock.

Make sure the hold-open rod collars are locked (yellow stripes visible) before you go under the fan cowl.

Fan Cowl Closing

This is a summary of how you close the fan cowl:

- Unlock the hold-open rods
- Use the PDOS to close the fan cowl
- Close the fan cowl panel latches from forward to aft.



71-11-00-111 Rev 1 07/11/1997

ENGINE COWLING - FAN COWL HOLD-OPEN RODS

ENGINE COWLING - THRUST REVERSER

Purpose

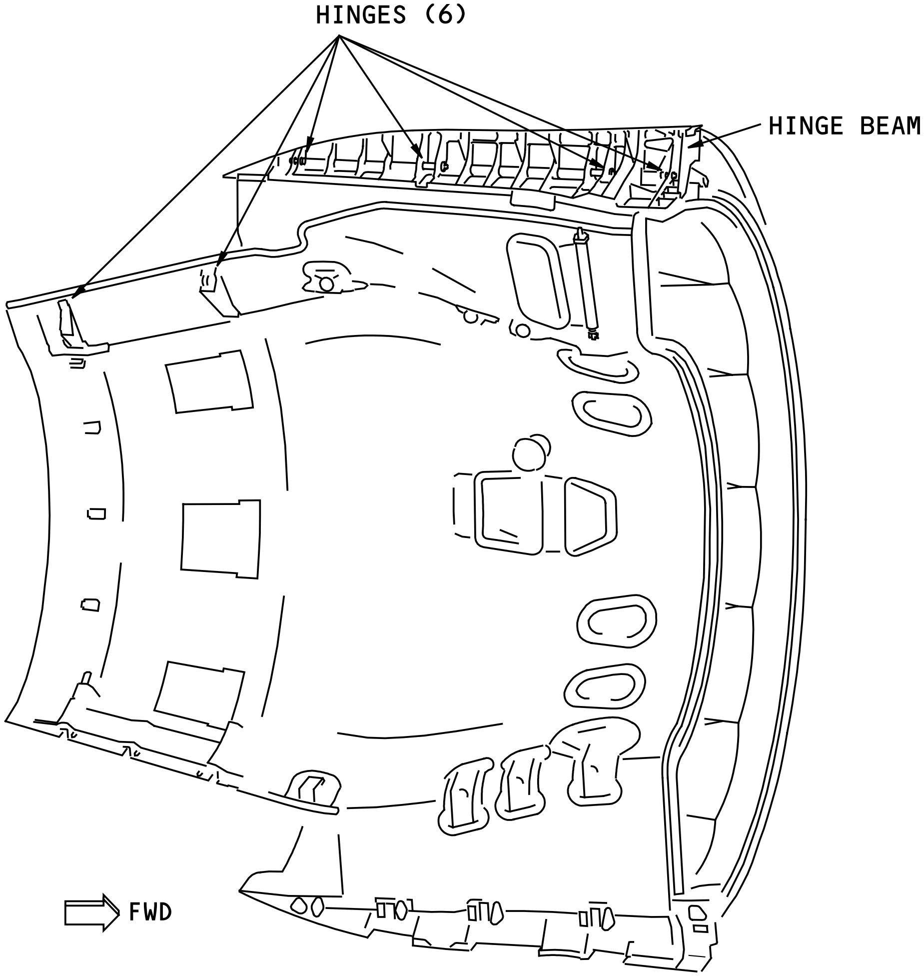
The thrust reverser controls the direction of the fan exhaust. It makes forward or reverse thrust. Reverse thrust can decrease the speed of the airplane during landing rollout or rejected take-off. The surface of the thrust reverser lets air flow smoothly around the engine. The thrust reverser halves open for maintenance.

Physical Description

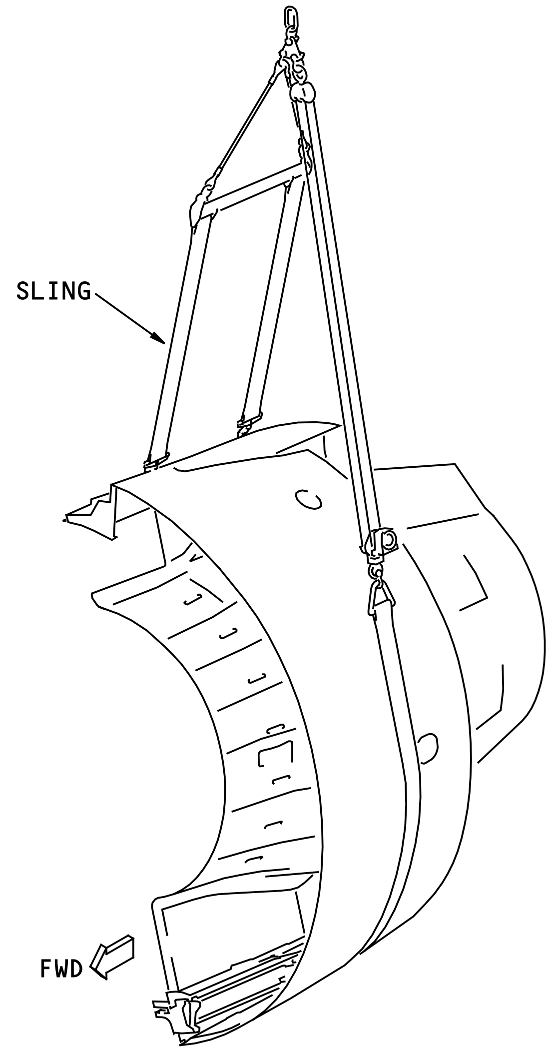
Each thrust reverser has a left and a right half. Each thrust reverser half has a hinge beam with six hinges. Four hinges attach the thrust reverser halves to the strut. The two aft hinges attach to cross-tie rods (not shown).

Sling Attach Points

Sling attach points for the thrust reverser are on the hinge beam and the latch beam of each thrust reverser half.You install attach fittings on the hinge beam and latch beam to attach a sling.



THRUST REVERSER HALF (LEFT SIDE)



LEFT THRUST REVERSER HALF

ENGINE COWLING - THRUST REVERSER

ENGINE COWLING - THRUST REVERSER LATCHES

General

The thrust reverser (T/R) latches hold the T/R halves together. There are four groups of latches:

- Deflection limiter (4)
- Aft cowl (3)
- Thrust reverser (5)
- V-band (1).

Deflection Limiter Latches

There are four deflection limiter latches. These latches attach to two straps that go around the aft part of the T/R. You open the deflection limiter latches first.

CAUTION: FAILURE TO OPEN THE DEFLECTION LIMITER LATCHES BEFORE YOU OPEN THE THRUST REVERSER CAN CAUSE DAMAGE TO THE THRUST REVERSER.

Aft Cowl Latches

There are three aft cowl latches. These latches hold the aft part of the T/R together. You open the aft cowl latches after you open the deflection limiter latches.

T/R Latches

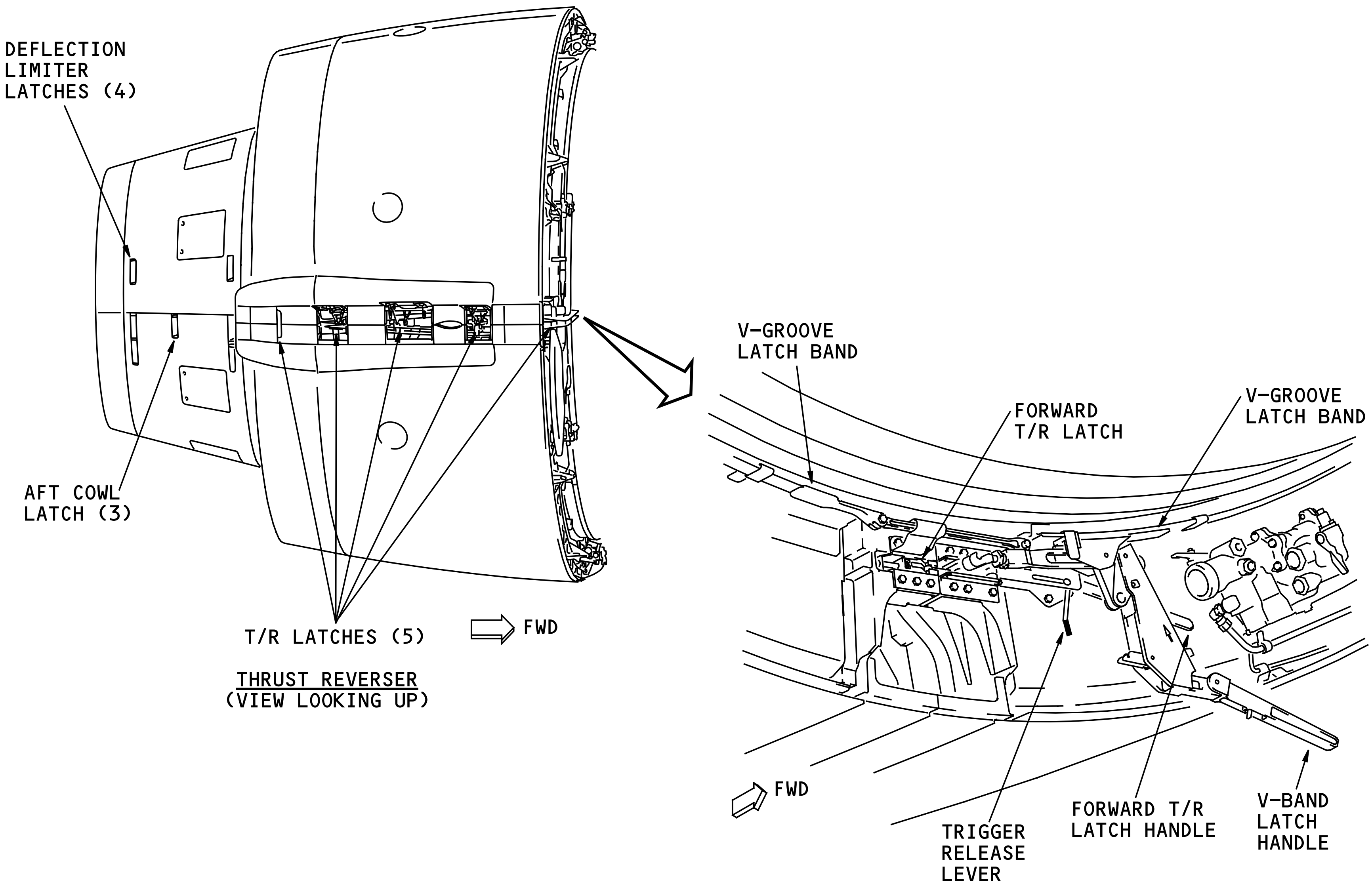
There are five T/R latches. These latches hold the forward part of the T/R together. You must open latch access doors to get access to the three middle T/R latches.

The forward latch is next to the V-band latch handle on the T/R torque box. There is a trigger release lever on the forward latch. You must move the trigger release lever to the left (looking aft) before you can open the forward latch.

You open the T/R latches after you open the aft cowl latches.

V-band Latch

The v-band latch supplies tension around the forward part of the T/R. This tension holds the T/R to the fan case. The v-band latch has a handle that loosens the v-groove latch band. You open the v-band latch last.



ENGINE COWLING - THRUST REVERSER LATCHES

ENGINE COWLING - THRUST REVERSER HOLD-OPEN ROD

General

The thrust reverser (T/R) hold-open rods keep the T/R halves open for maintenance. The hold-open rods are also a safety device. They protect persons at work on the engine or the T/R from injury. They prevent the accidental closure of the T/R.

Thrust Reverser Hold-Open Rod

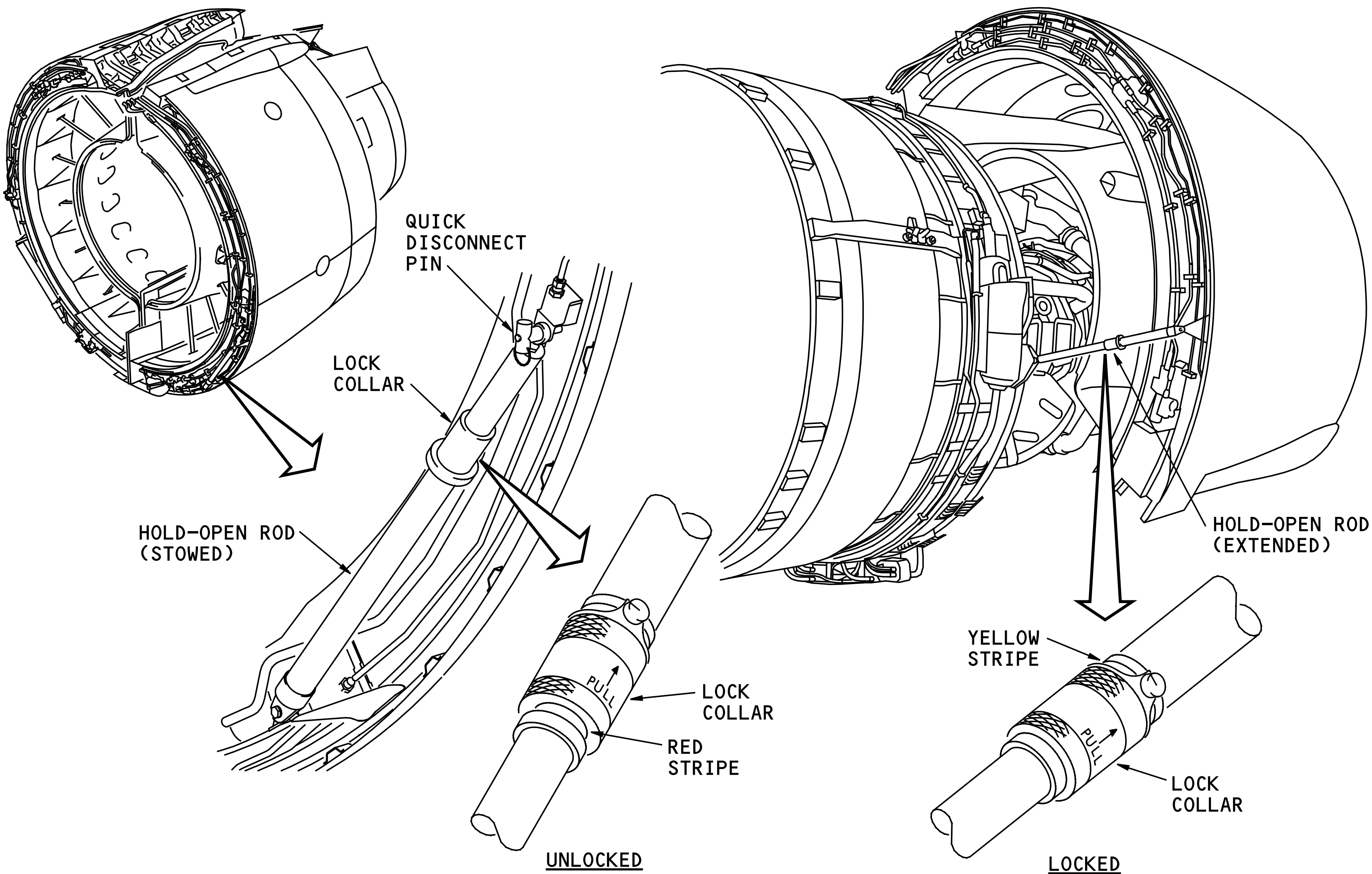
Each T/R half has one hold-open rod on the torque box of the T/R half. The rod is telescopic. There is a quick disconnect pin on the upper end of the hold-open rod.

Each hold-open rod has a lock collar. The collar locks the hold-open rod in place. When the hold open rod locks, you can see the yellow stripe next to the collar. When you can see the red stripe next to the collar, the hold-open rod is not locked.

WARNING: NEVER STAND UNDER THE THRUST REVERSER HALVES WHEN YOU OPEN OR CLOSE THE THRUST REVERSER.

Training Information Point

Before you remove the engine or thrust reverser you must stow the hold-open rod on the thrust reverser. First, remove the quick disconnect pin to disconnect the hold-open rod from the engine. Then attach the hold-open rod to the thrust reverser with the same quick disconnect pin.



ENGINE COWLING - THRUST REVERSER HOLD-OPEN ROD

ENGINE COWLING - TURBINE EXHAUST

Purpose

The turbine exhaust system makes the airflow smooth as it exits the engine. This increases engine efficiency and reduces noise.

Primary Nozzle

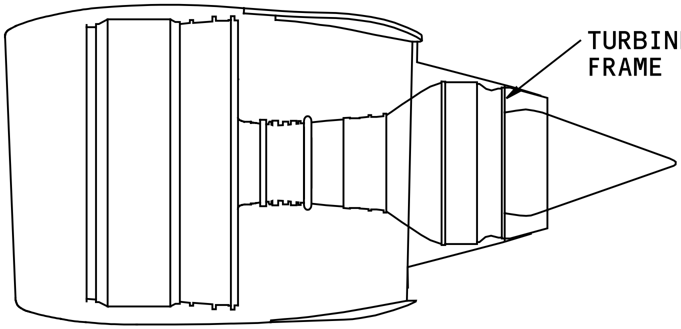
The primary nozzle is aft of the thrust reverser. The primary nozzle attaches to the turbine rear frame.

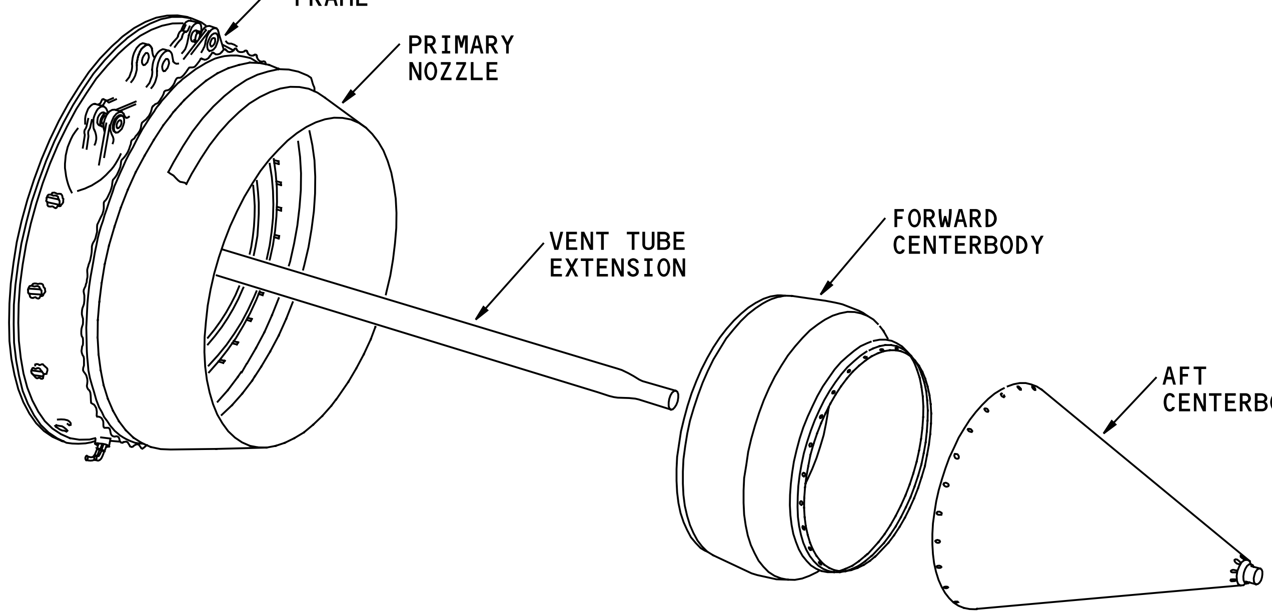
Centerbody

The centerbody is inside the primary nozzle. The centerbody has two parts. The forward centerbody attaches to the turbine rear frame. The aft centerbody attaches to the forward centerbody.

Vent Tube Extension

The vent tube extension supplies a path for the oil system vent air to go overboard. The vent tube extension fits inside the centerbody. It attaches to the no. 5 bearing sump cover.





TURBINE EXHAUST SYSTEM

71-11-00-107 Rev 2 09/11/96

ENGINE COWLING - TURBINE EXHAUST

ENGINE COWLING - FAN COWL LATCH ADJUSTMENT - TIP

General

The correct adjustment of fan cowl panel latches supplies a smooth airflow over the engine cowling. A latch with the correct adjustment closes with a loud pop noise.

You adjust the thrust reverser latches before you adjust the fan cowl panel latches. You adjust the fan cowl panel latches with the thrust reverser halves closed and latched. You adjust the fan cowl panel latches when you replace any of these components:

- Engine
- Fan cowl panel
- Fan cowl panel latches
- Thrust reverser.

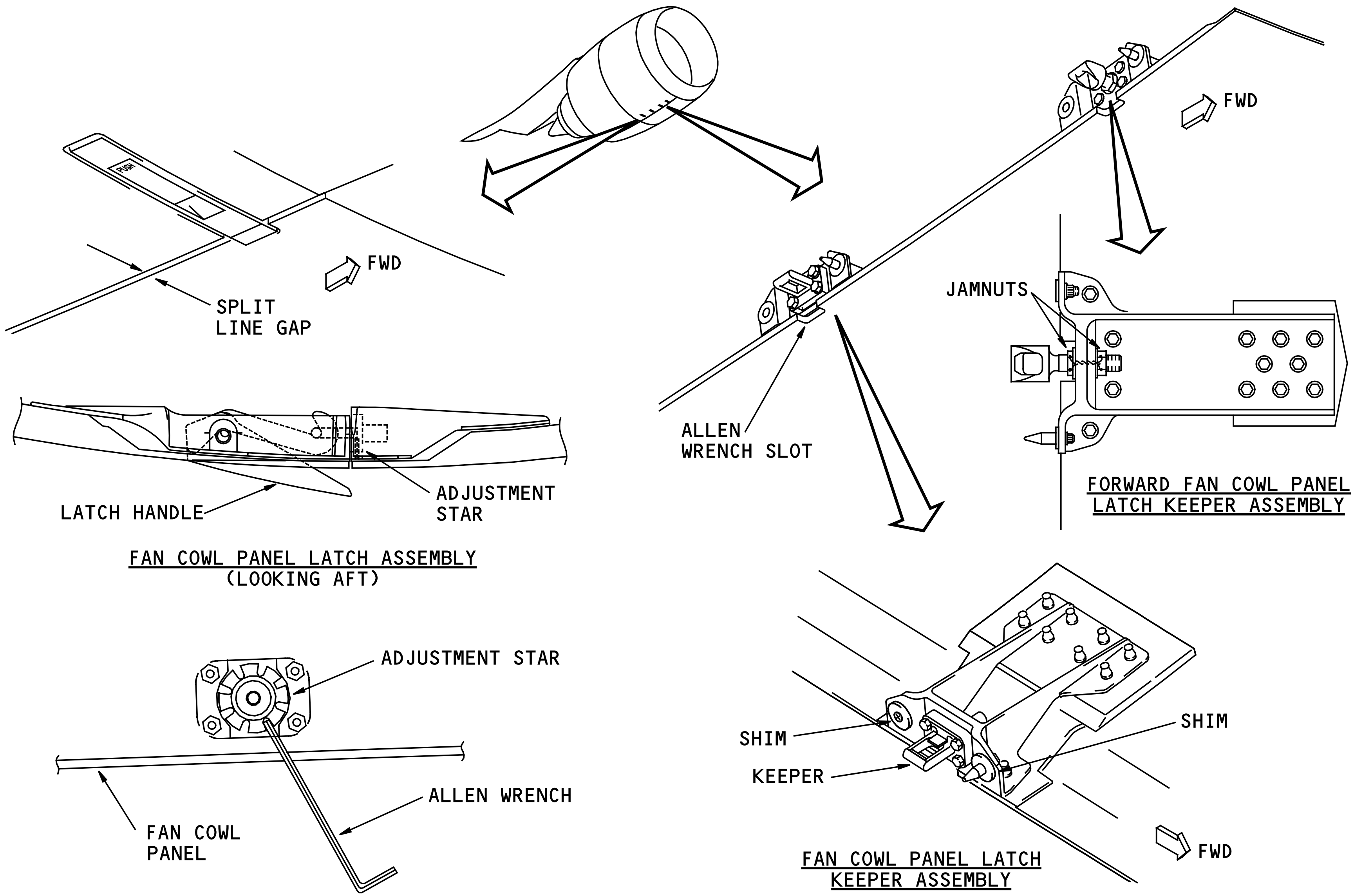
Fan Cowl Panel Latch Adjustment

CAUTION: DO NOT USE MORE THAN 100 POUNDS OF FORCE ON THE LATCH HANDLE. TOO MUCH FORCE CAN CAUSE DAMAGE TO THE LATCH, THE KEEPER, OR THE FAN COWL PANEL.

You adjust the fan cowl panel latches when you find the split line gap or the closing force of the latches is incorrect. The shims set the width of the split line gap between the fan cowl panels.

You adjust the closing force of the latches by changing the position of the keeper. Adjust the latches from forward to aft.

You change the position of the forward latch keeper with the two jamnuts that hold it in place. You change the position of the other three latch keepers by turning the adjustment star. Use an allen wrench to turn the adjustment star. The allen wrench goes through a slot in the fan cowl panel.



ENGINE COWLING - FAN COWL LATCH ADJUSTMENT - TIP

71-11-00-108 Rev 3 02/08/1997

ENGINE COWLING - THRUST REVERSER LATCH ADJUSTMENT - TIP

General

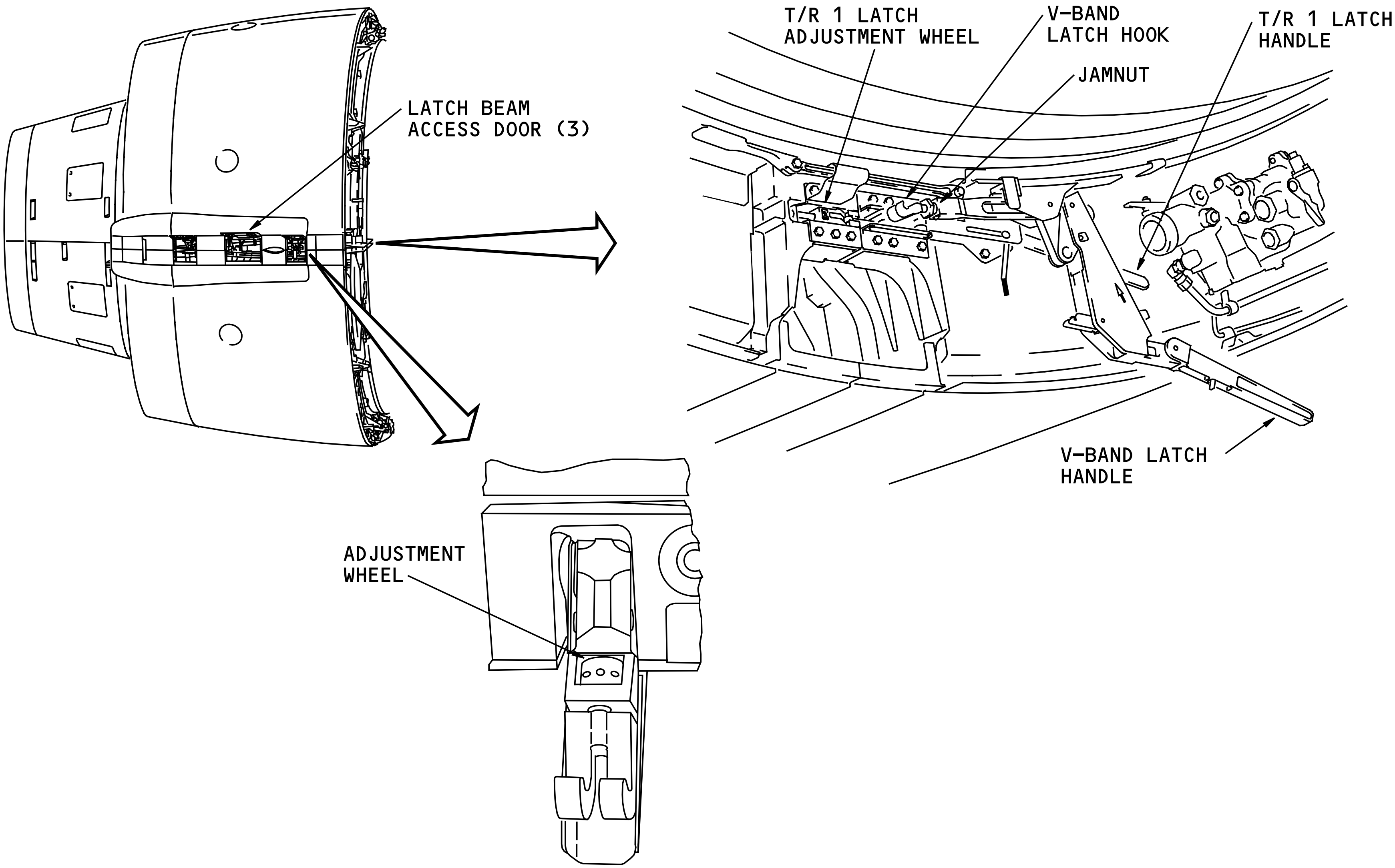
There are 13 latches which hold the thrust reverser (T/R) together. You adjust the tension of the v-band latch first. Then adjust the remaining latches from forward to aft with the v-band latch closed.

V-band Latch Adjustment

You adjust the v-band latch first. All of the other T/R latches must be open. You measure the force necessary to close the v-band latch with a spring scale. If the force is not within limits, adjust the v-band latch hook position with the jamnut until the closing force is within limits.

T/R Latch Adjustment

You measure the force necessary to close the T/R latches with a spring scale. If the force is not within limits, turn the adjustment wheel until the closing force is within limits.



71-11-00-109 Rev 5 07/11/1997

ENGINE COWLING - THRUST REVERSER LATCH ADJUSTMENT - TIP

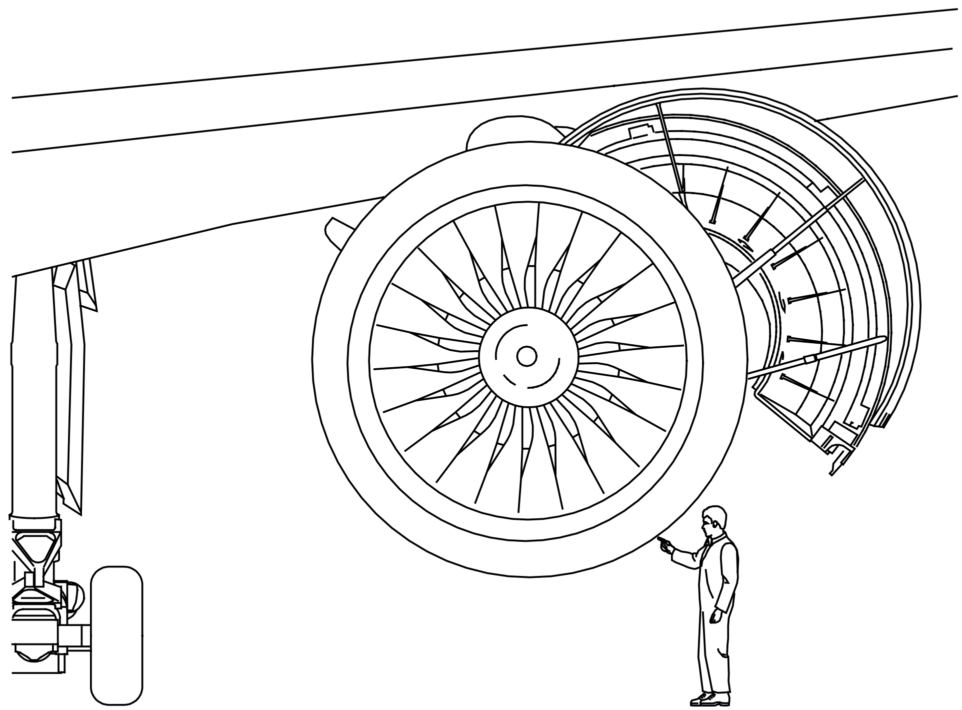
POWERED DOOR OPENING SYSTEM (PDOS) - INTRODUCTION

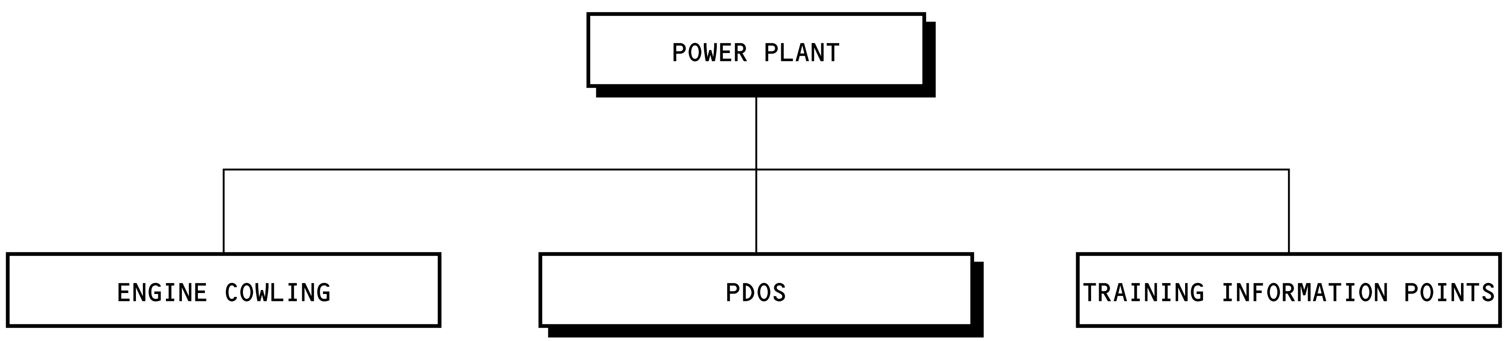
General

The powered door opening system (PDOS) opens and closes the fan cowls and the thrust reversers. You can also use the PDOS to manually open and close the fan cowls and the thrust reversers.

The PDOS uses hydraulic power to open the fan cowls and the thrust reversers. Gravity closes the fan cowls and the thrust reversers.

You operate the PDOS with the actuation and control switches. Each fan cowl and each thrust reverser half has an actuation and control switch.





POWERED DOOR OPENING SYSTEM (PDOS) - INTRODUCTION

PDOS - GENERAL DESCRIPTION

General

The powered door opening system (PDOS) uses hydraulic power to open the fan cowls and thrust reversers (T/R). It uses gravity to close them.

The PDOS has these components:

- Actuation and control switches
- Pump/power pack
- Actuators.

Actuation And Control Switches

Each fan cowl and each T/R half has an actuation and control switch. Each switch has an up and a down button. The up button opens the cowl and the down button closes the cowl. The switches permit 28v dc power to go to the pump/power pack solenoids.

Pump/Power Pack

The pump/power pack supplies hydraulic pressure to the actuators. It has a hydraulic reservoir and an electric hydraulic pump. The pump/power pack gets 115v ac power from the ground handling bus. The hydraulic fluid goes to an actuator when the related solenoid(s) energizes.

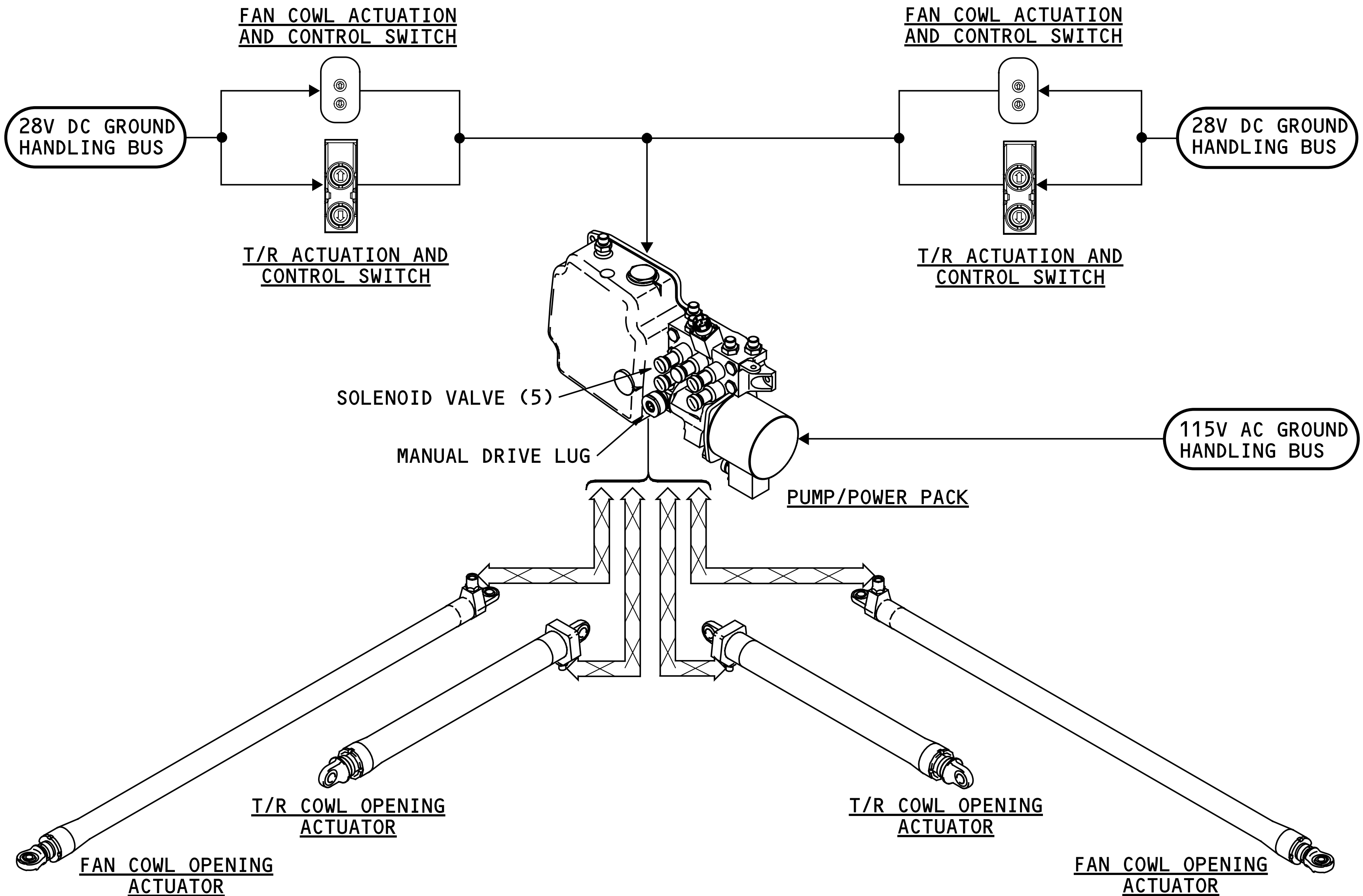
Actuators

There are four actuators on each engine. Each fan cowl and each T/R half has an actuator. When the actuators receive hydraulic pressure, they extend to open the cowls. When hydraulic pressure is removed, the actuators retract to close the cowls.

The actuators are also safety devices. Flow control valves in the actuators limit the flow of hydraulic fluid in the closing direction. This prevents the fan cowls and T/Rs from closing quickly.

Manual Operation

The PDOS pump/power pack has a manual drive lug. When there is no airplane power, you can manually operate the solenoid valves and the manual drive lug to open the fan cowls and T/Rs. You operate only the solenoid valves to permit gravity to close the fan cowls and T/Rs.



PDOS - GENERAL DESCRIPTION

PDOS - COMPONENT LOCATIONS

General

The PDOS has these components:

- Pump/power pack
- Cowl opening actuators
- Hydraulic cowl opening flex hoses
- Actuation and control switches.

Pump/Power Pack

Each engine has one pump/power pack. The pump/power pack is under forward fairing 1.

Fan Cowl Opening Actuators

The fan cowl opening actuators are under the fan cowls. The top of each actuator attaches to an actuator bracket on the fan cowl. The bottom of each actuator attaches to the engine fan case.

The thrust reverser (T/R) cowl opening actuators are under the T/Rs. The top of each actuator attaches to the engine strut. The bottom of each the actuator attaches to the inner wall of the T/R.

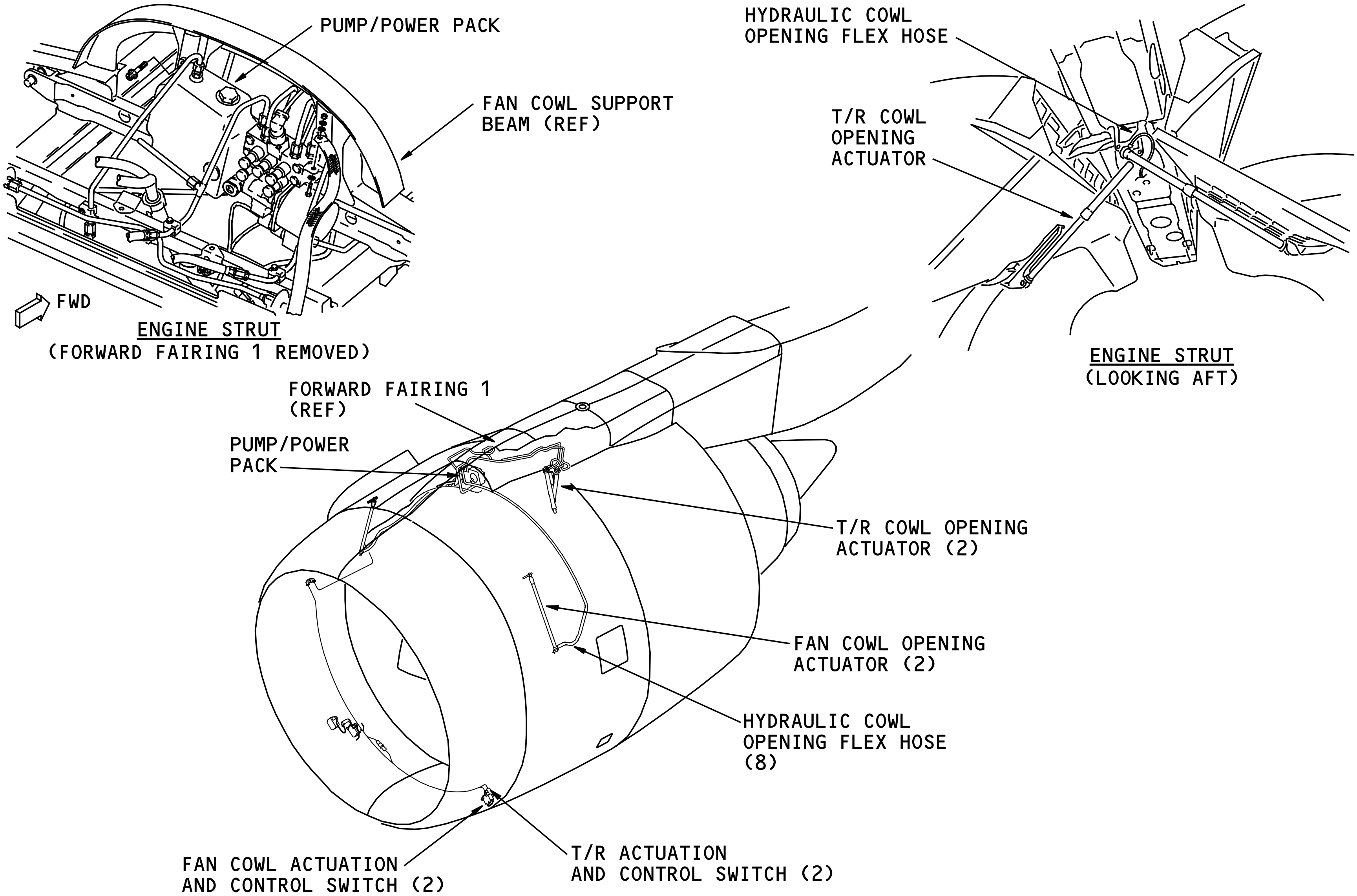
Hydraulic Cowl Opening Flex Hoses

The hydraulic cowl opening flex hoses permit the necessary movement of the PDOS hydraulic supply lines. The fan cowl flex hoses connect the PDOS hydraulic tubes on the fan case to the actuators and to the strut. The T/R flex hoses connect the PDOS hydraulic tubes in the strut to the actuators.

Actuation and Control Switches

The fan cowl actuation and control switches are on the inlet cowl at the 4:00 and 8:00 positions.

The T/R actuation and control switches are on the aft bulkhead of the inlet cowl near the fan cowl switches.



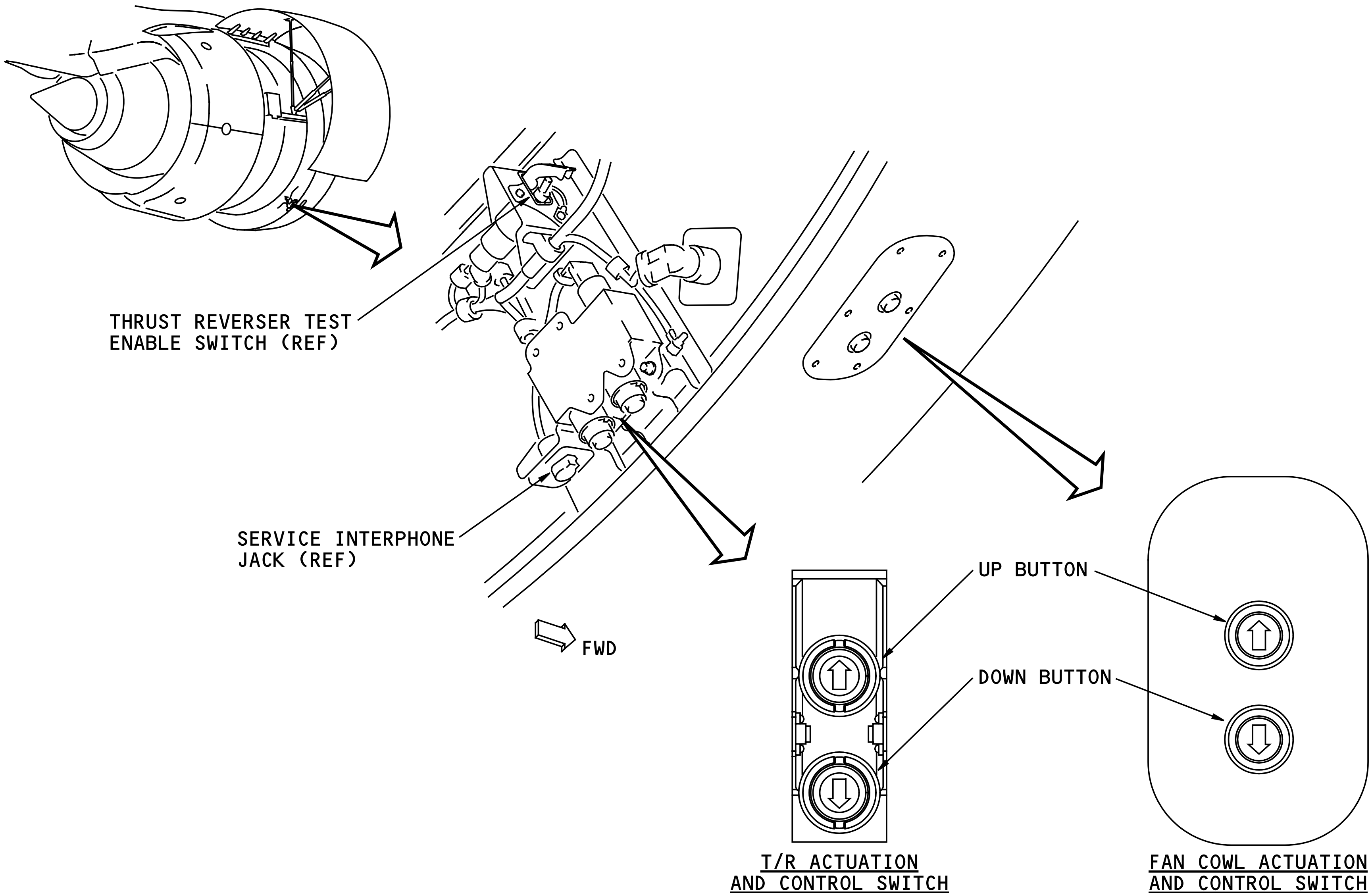
PDOS - COMPONENT LOCATIONS

71-12-00-103 Rev 5 07/11/1997

PDOS - ACTUATION AND CONTROL SWITCHES

Actuation And Control Switches

The actuation and control switches are on each side of the inlet cowl. Each actuation and control switch has an UP button and a DOWN button. The buttons are momentary-action type.



PDOS - ACTUATION AND CONTROL SWITCHES

71-12-00-104 Rev 4 02/08/1997

PDOS - PUMP/POWER PACK

General

The pump/power pack supplies hydraulic power to the cowl opening actuators. The actuators open and close the fan cowls and thrust reverser halves.

These are the parts of the pump/power pack:

- Housing
- Reservoir
- Solenoid valve (5)
- Electric motor
- Manual drive.

Housing

The pump/power pack parts attach to the housing. The housing contains the pump drive shaft and the pump filter element. The filter element is under the high pressure filter plug.

There are four connectors for hydraulic supply lines to the cowl opening actuators. There is one connector for the solenoid valves.

Reservoir

The reservoir attaches to the housing. The reservoir has a vent and an oil filler cap with a dipstick on it.

Solenoid Valves

Five solenoid valves attach to the housing. The solenoids get power from the 28v dc ground handling bus when you push the actuation and control switches.

Electric Motor

The electric motor turns the hydraulic pump. It gets power from the 115v ac ground handling bus.

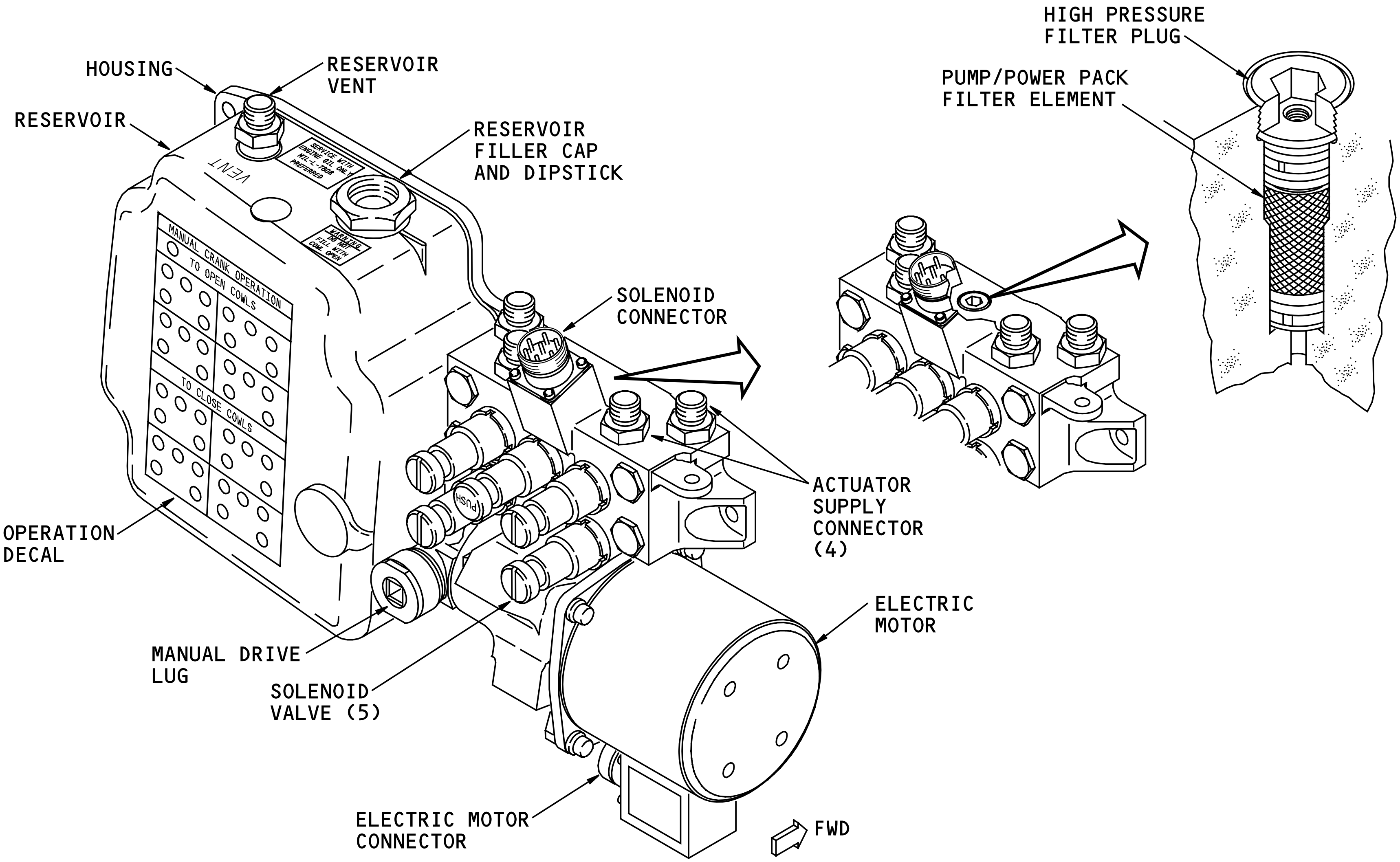
Manual Drive Lug

The manual drive lug is on the housing and connects to the pump drive shaft. You use a 3/8 inch square drive to turn the manual drive. A decal on the reservoir shows you how to manually operate the pump/power pack.

Training Information Point

You service the PDOS pump/power pack with engine oil.

The PDOS pump/power pack filter is an LRU.



PDOS - PUMP/POWER PACK

PDOS - OPERATION - FAN COWL

General

When you work on engine components under the fan cowl, you open the fan cowl only. If you must repair engine components under the thrust reverser (T/R), you open the fan cowl first, and then you open the T/R. You must have electric power before you use the PDOS.

Open the Fan Cowl

CAUTION: RETRACT THE LEADING EDGE SLATS AND DO THE DEACTIVATION PROCEDURE BEFORE YOU OPEN THE FAN COWL PANELS. IF THE LEADING EDGE SLATS ARE NOT RETRACTED, THE FAN COWL PANELS WILL HIT THEM AND CAUSE DAMAGE.

Here is a summary of how you open the fan cowl:

- Make sure the area around the engine is clear
- Open the four fan cowl latches
- Push the UP button until the cowl stops moving and you hear the collars lock
- Make sure the collars on the hold-open rods are locked (yellow stripes will be visible)
- Push the DOWN button momentarily to put the fan cowl weight on the hold-open rods.

WARNING: MAKE SURE THE FAN COWL HOLD-OPEN RODS ARE FULLY EXTENDED AND LOCKED WHEN THE FAN COWL PANEL IS OPEN. THE RODS ARE NOT LOCKED WHEN YOU CAN SEE THE RED STRIPE WITH THE WORD 'UNLOCKED' ON THE LOCK COLLAR. IF THE RODS ARE NOT LOCKED, THEY COULD RETRACT AND CAUSE INJURY TO PERSONS OR DAMAGE TO EQUIPMENT.

Close the Fan Cowl

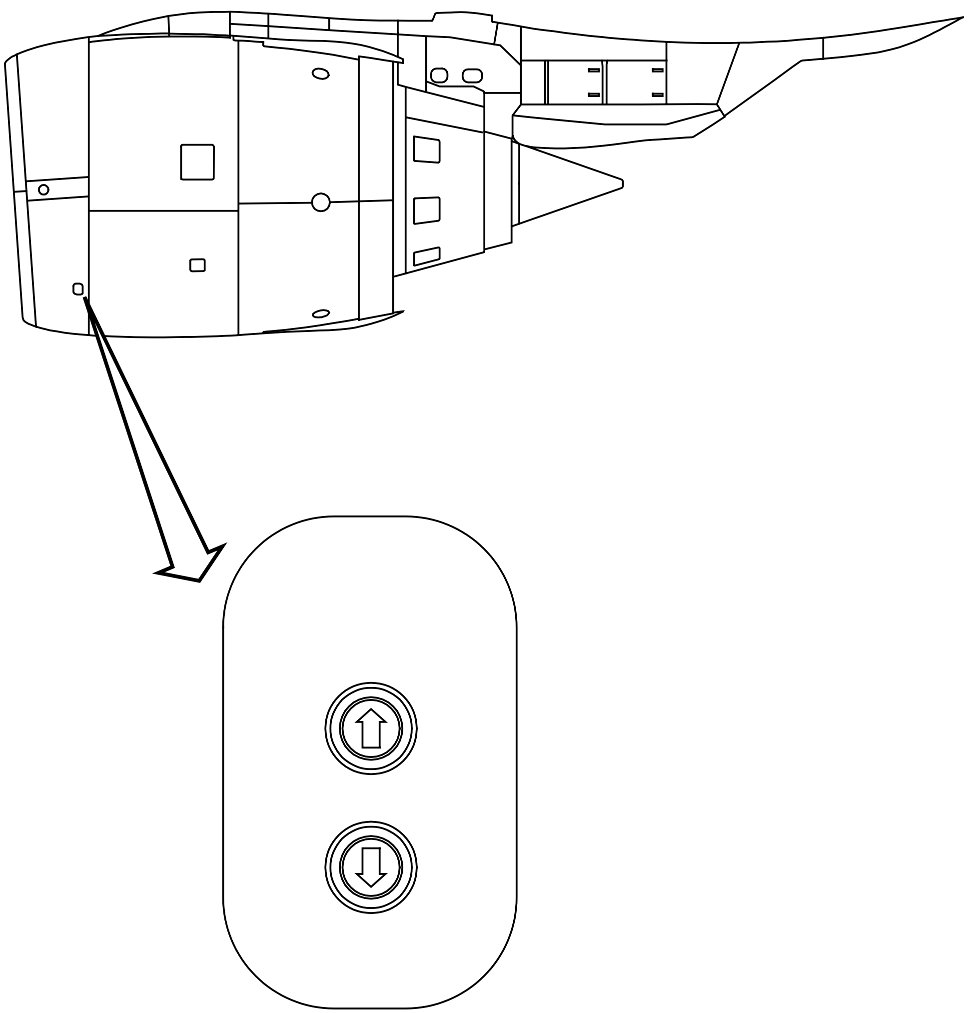
Here is a summary of how you close the fan cowl:

- Push the UP button to take the fan cowl weight off the hold-open rods
- Unlock the collars on the hold-open rods (red stripes will be visible)
- Push the DOWN button until the fan cowl closes
- Close the fan cowl latches.

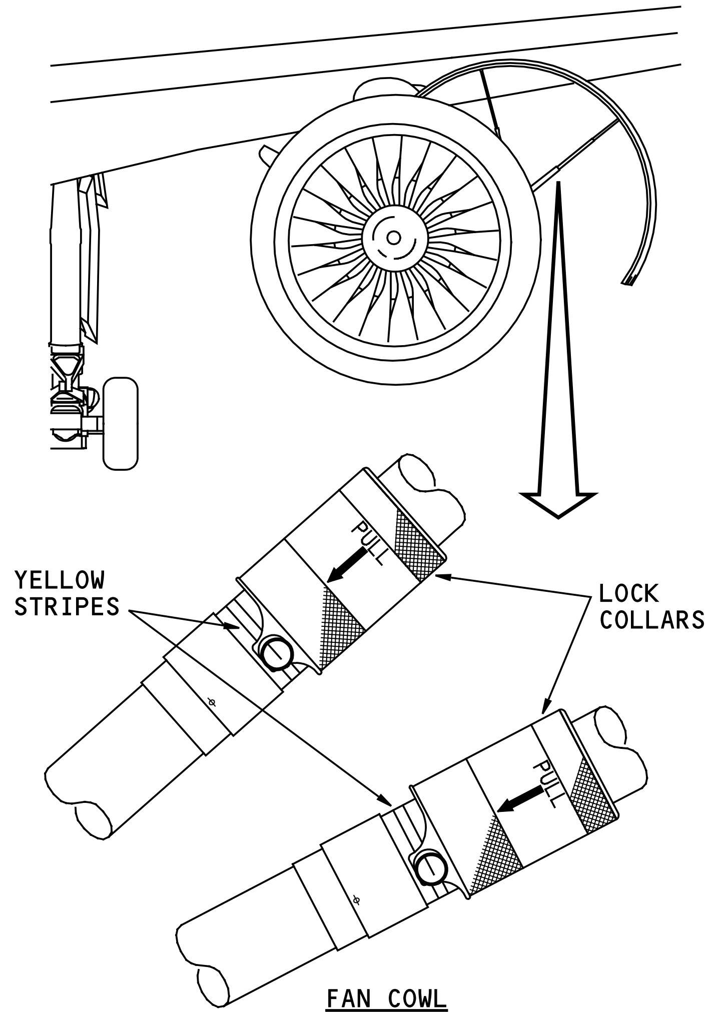
Training Information Point

The fan cowl opens in approximately 20 seconds. When you open the two fan cowls at the same time, it takes approximately 50 seconds.

You can close only one fan cowl at a time. The fan cowl closes in approximately 25 seconds.



FAN COWL ACTUATION
AND CONTROL SWITCH



FAN COWL
HOLD-OPEN RODS
(LOCKED)

PDOS - OPERATION - FAN COWL

71-12-00-107 Rev 5 02/08/1997

PDOS - OPERATION - THRUST REVERSER

General

Before you open a thrust reverser (T/R) half, you must open the necessary fan cowl(s). You must also make sure you do these three tasks:

- Retract the leading edge slats
- Deactivate the leading edge slats
- Deactivate the T/R for ground maintenance.

WARNING: DO NOT MOVE BETWEEN THE ENGINE AND THE OPEN THRUST REVERSER UNTIL YOU LOCK THE HOLD-OPEN ROD. THE THRUST REVERSER IS HEAVY AND CAN CLOSE QUICKLY IF THE PDOS HAS A FAILURE. THIS CAN CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

Open the Thrust Reverser

This is a summary of the procedure to open a T/R half:

- Open the T/R latches
- Push the UP button until the collar on the hold-open rod locks (a yellow stripe will be visible)
- Push the DOWN button to put the weight of the T/R on the hold-open rod.

Close the Thrust Reverser

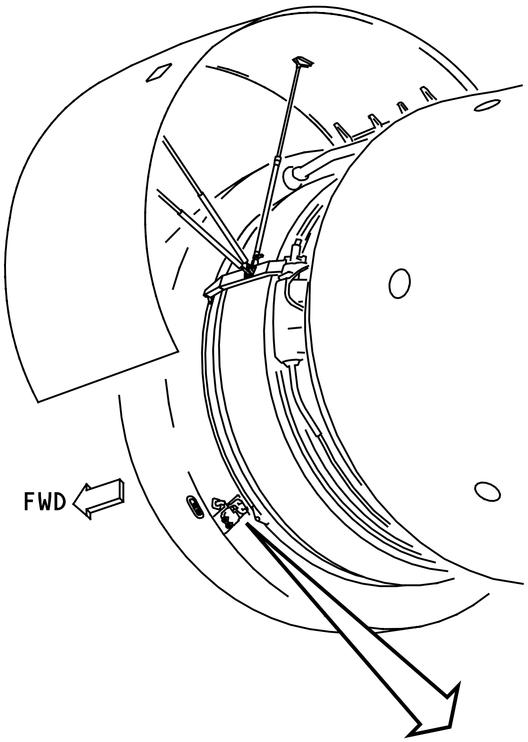
This is a summary of the procedure to close a T/R half:

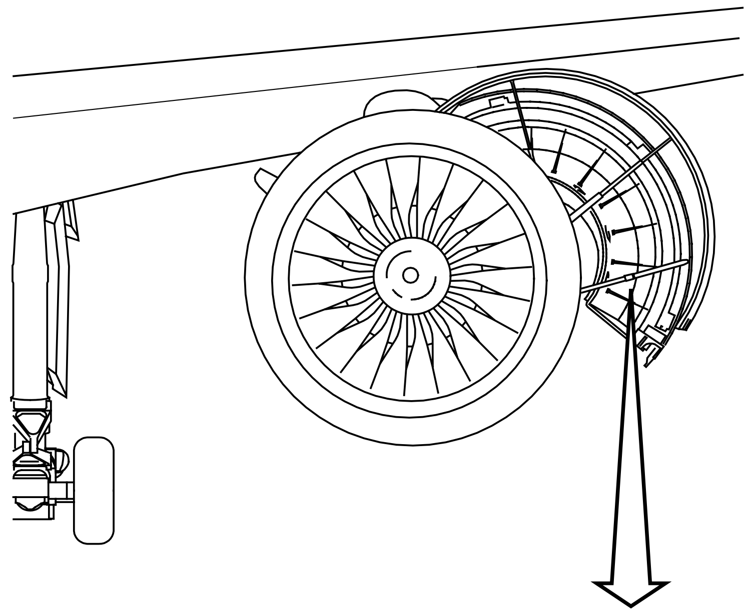
- Push the UP button to take the weight of the T/R off the hold-open rod
- Unlock the collar on the hold-open rod (a red stripe will be visible)
- Push the DOWN button until the T/R closes
- Close the T/R latches.

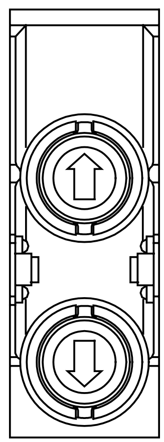
Training Information Point

A T/R half opens in approximately 40 seconds. When you open the two T/R halves at the same time, it takes approximately 100 seconds. A T/R half closes in approximately 25 seconds. You can close only one T/R half at a time.

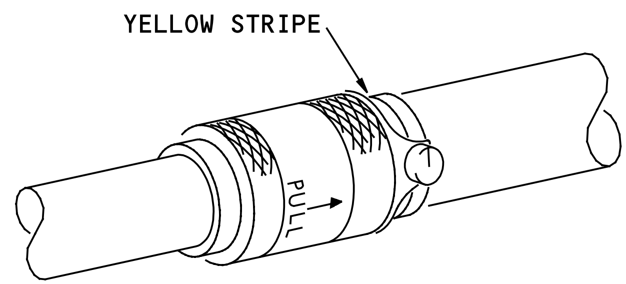
When you open the right T/R half you must open the left and right fan cowls. This is because the v-band latch handle will hit the left fan cowl panel if it is not open.







T/R ACTUATION
AND CONTROL SWITCH



HOLD-OPEN ROD
(LOCKED)

PDOS - OPERATION - THRUST REVERSER

71-12-00-108 Rev 4 09/11/96

PDOS - MANUAL OPERATION

General

When there is no airplane power you use the manual drive lug and the solenoid valves on the PDOS pump/power pack to open and close the fan cowls and the thrust reverser (T/R) halves. A decal on the pump/power pack shows the manual operation procedures.

The manual drive lug uses a 3/8 inch square drive.

Open the Fan Cowl and Thrust Reverser

This is a summary of the procedure to open a fan cowl or T/R half:

- Use a flat blade screwdriver to set the solenoid valves to the positions to open the related cowl
- Turn the manual drive lug
- When the cowl is open and the hold-open rods are locked, set the solenoid valves to the positions to close the related cowl
- Push and hold the V5 solenoid valve to put the weight of the cowl on the hold-open rods
- Put the solenoid valves back to their initial positions.

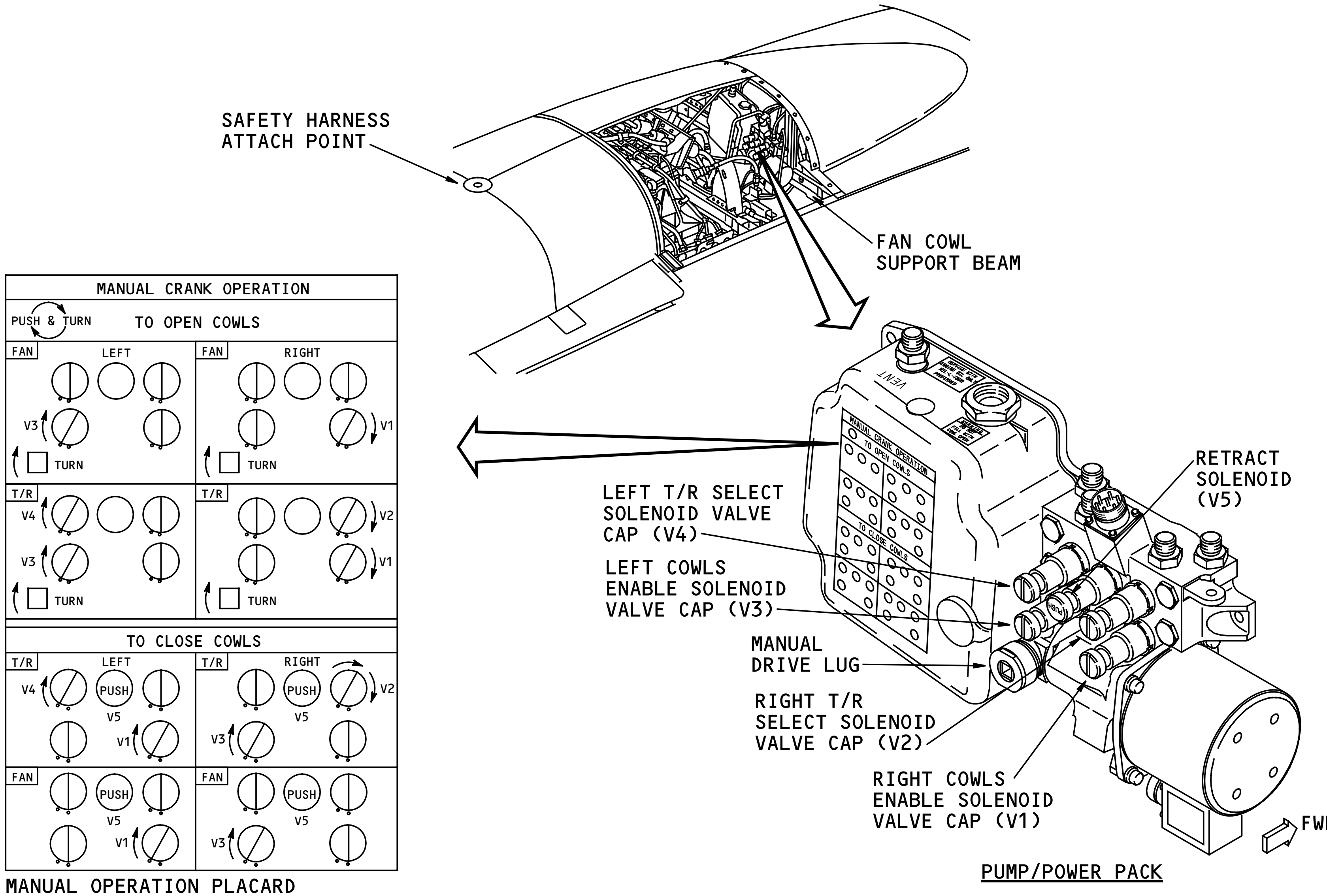
Close the Fan Cowl and Thrust Reverser

This is a summary of the procedure to close a fan cowl or T/R half:

- Use a flat-blade screwdriver to set the solenoid valves to the positions to open the related cowl
- Turn the manual drive lug to move the cowl up and then unlock the hold-open rods
- Set the solenoid valves to the positions to close the related cowl
- Push and hold the V5 solenoid valve to close the cowl
- Put the solenoid valves back to their initial positions.

Training Information Point

The pump/power pack is approximately 14 ft. (4.3 m) from the ground. There is a safety harness attach point with a receptacle for a safety harness. The safety harness attach point is aft of the forward access fairing. Attach the safety harness to the attach point when you operate the pump/power pack.



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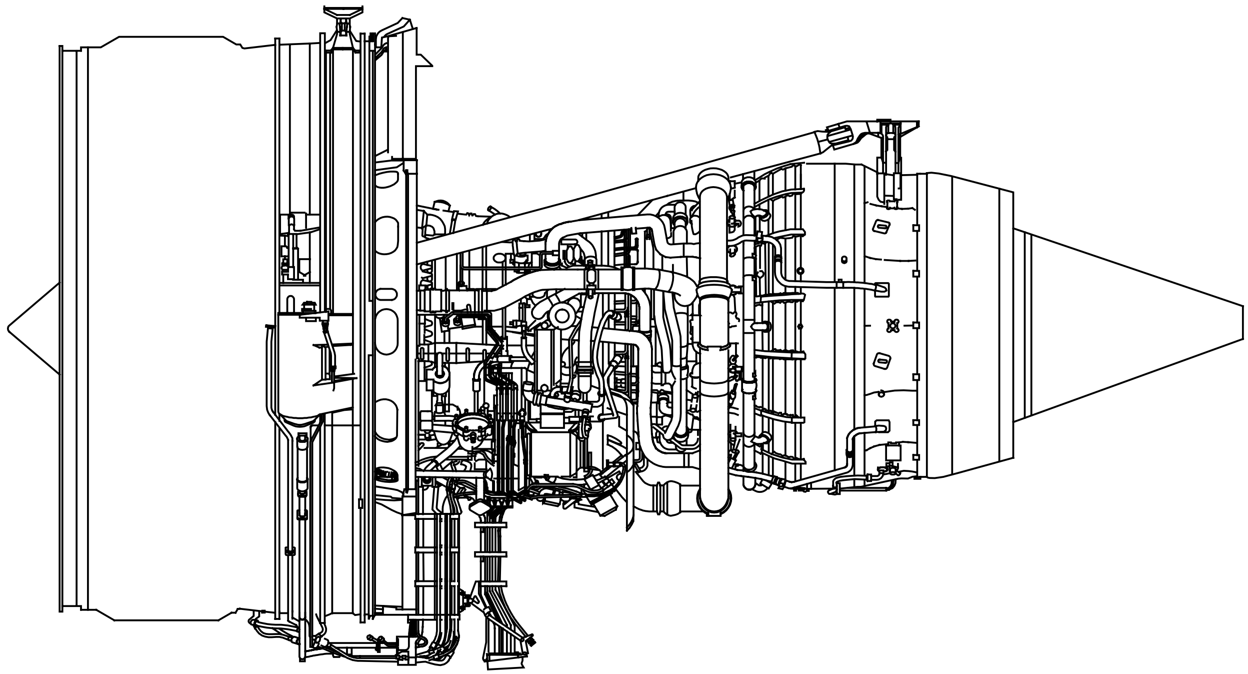
PDOS - MANUAL OPERATION

TRAINING INFORMATION POINT (TIP) - INTRODUCTION

General

The power plant has many LRUs. But, the power plant itself is an LRU. There are several procedures with related equipment that apply to the power plant as an LRU. These are the items in this training information points (TIP) section:

- Engine handling
- Thrust reverser hold-open equipment (engine removed)
- Engine disconnects
- Bootstrap equipment
- Engine mounts
- Engine drains
- System tests.



POWER PLANT

ENGINE COWLING

PDOS

TRAINING INFORMATION POINTS

TRAINING INFORMATION POINT (TIP) - INTRODUCTION

TIP - ENGINE HANDLING

General

The removal and installation of a power plant is a long task. Many special tools and equipment are necessary.

This is a summary of the tasks necessary to change an engine:

- Prepare the airplane for an engine change by doing all the necessary safety and disconnect tasks
- Install the engine ground handling adapters
- Install the bootstrap equipment
- Raise the engine cradle and attach it to the ground handling adapters
- Disconnect the engine mounts
- Lower the engine to the transportation stand.

To install the engine you reverse the procedures.

Preparation

Many procedures must be done to make it safe to remove and install the power plant. This is a summary of the procedures:

- Electrically ground the airplane
- Level the airplane
- Close the engine fuel valve and engine fuel spar valve
- Depressurize the hydraulic system
- Close the engine driven pump supply shutoff valve
- Depressurize the pneumatic system
- Retract the leading edge slats
- Deactivate the leading edge slats
- Deactivate the thrust reverser.

You must remove the fan cowls before you remove the engine. They attach to the fan cowl support beam which attaches to the engine.

Remove the inlet cowl before you remove the engine if you intend to install the same inlet cowl on the replacement engine.

You must open the thrust reverser halves before you remove the engine. You do not remove them for an engine change. The thrust reverser halves attach to the strut. Special hold-open equipment is necessary to keep the reverser halves open.

Apply tape over the bleed air deflector panels to prevent small parts from falling into the engine.

With the thrust reverser hold-open equipment installed, you disconnect all of these types of connections:

- Electrical
- Hydraulic
- Pneumatic
- Mechanical
- Fuel.

Ground Handling Adapters

There are four places on the engine to attach the ground handling adapters. You remove the adapters from the cradle and install them on the engine. The forward ground handling adapters attach to the fan case. A bracket on each side of the low pressure turbine case is where you attach the aft ground handling adapters.

NOTE: The forward ground handling adapters on some engine cradles attach to the fan hub frame. You must remove two blank-off panels to install these adapters. This type of engine cradle is required when you separate the fan stator module assembly from the core of the engine.

Bootstrap Equipment

The bootstrap equipment has the forward and aft bootstrap assemblies. The assemblies attach to fittings under the strut.

The forward bootstrap assembly uses only one dynamometer. It is part of the forward inboard cradle attach assembly.

Engine Cradle

The bootstrap assembly hoists attach to the engine cradle. You must be careful to attach the hoists to the proper lug holes on the cradle.

NOTE: Attach the outboard hoists to the inner hole and the inboard hoists to the outer hole.

You initially raise the cradle and transportation stand together to let gravity align them with the engine. You then lower them and disconnect the cradle from the stand. You raise the cradle and attach it to the ground handling adapters.

WARNING: MONITOR THE DYNAMOMETERS ON THE FORWARD AND THE AFT HOISTS. MAKE SURE THE LOADS ARE LESS THAN THESE LOAD LIMITS: 10,000 LB (4545 KG) ON THE FORWARD DYNAMOMETER, 3000 LB (1363 KG) ON AN AFT INBOARD DYNAMOMETER, AND 4000 LB (1818 KG) ON AN AFT OUTBOARD DYNAMOMETER. IF THE LOADS ARE MORE THAN THE LOAD LIMITS GIVEN, THE ENGINE CAN FALL AND CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

Engine Mounts

There are two engine mounts: forward and aft. The upper part of each mount is part of the strut. The lower part of each mount attaches to the engine. When the bootstrap loads are within limits, you remove the tension bolts that hold the upper and lower mounts together.

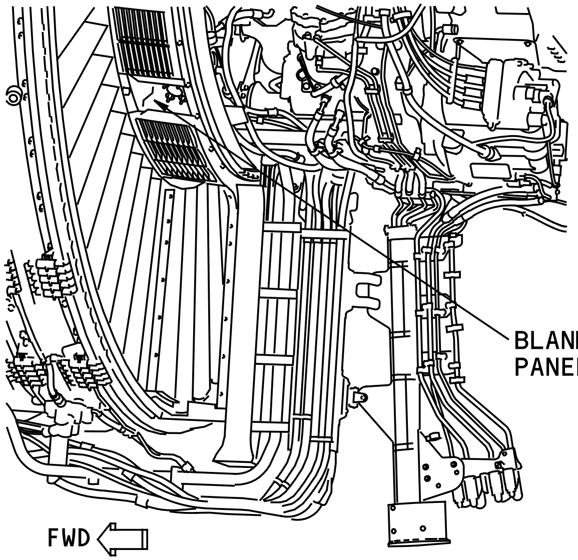
Transportation Stand

You lower the engine and cradle down to the transportation stand. Use the aft bootstrap assembly to change the roll angle of the engine to align it with the stand.

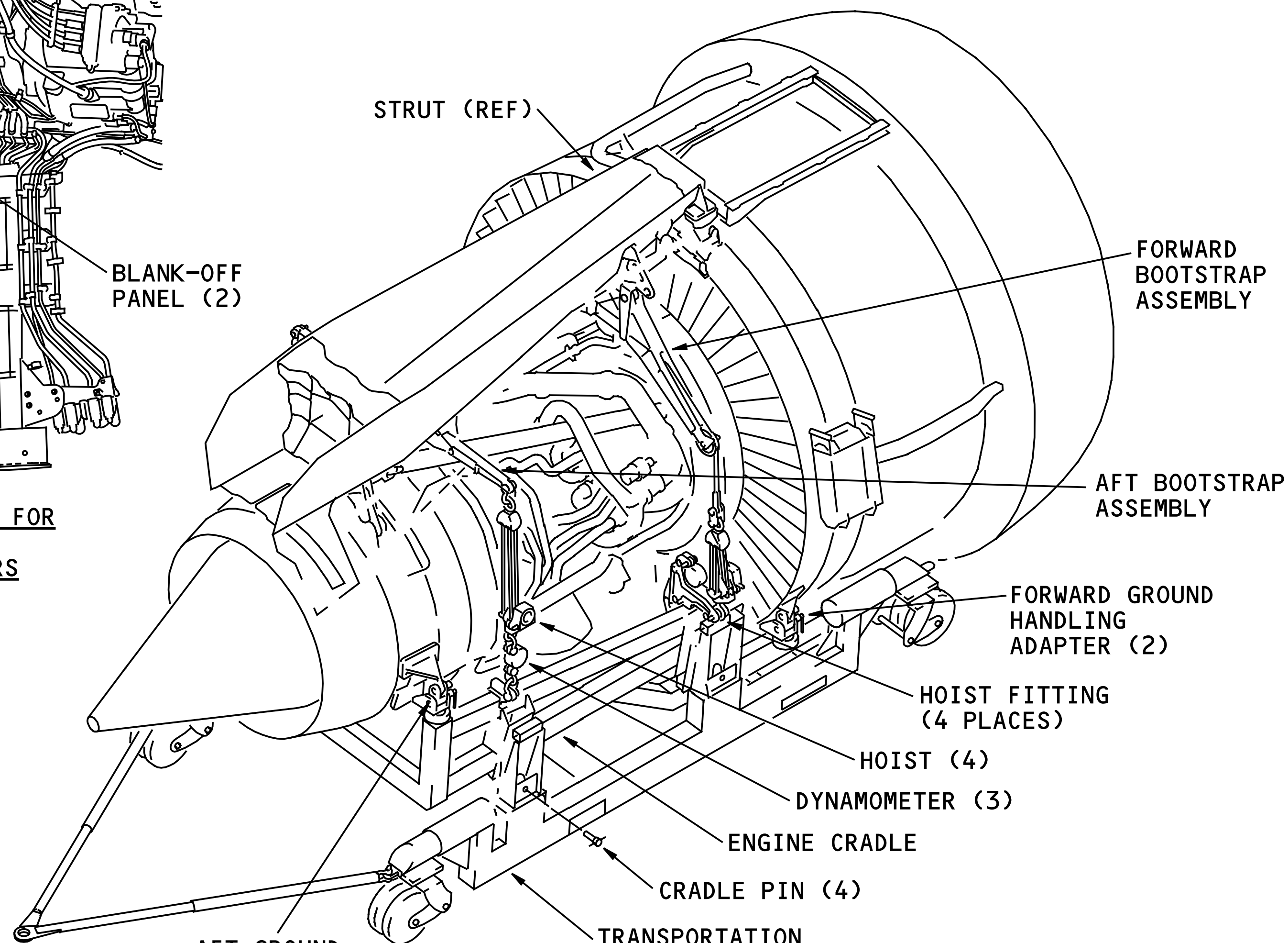
TIP - ENGINE HANDLING

Power Plant Installation

The procedures for installing the engine are basically the reverse of the removal procedures.



ALTERNATE LOCATION FOR
FORWARD GROUND
HANDLING ADAPTERS



TIP - ENGINE HANDLING

TIP - THRUST REVERSER HOLD-OPEN EQUIPMENT

General

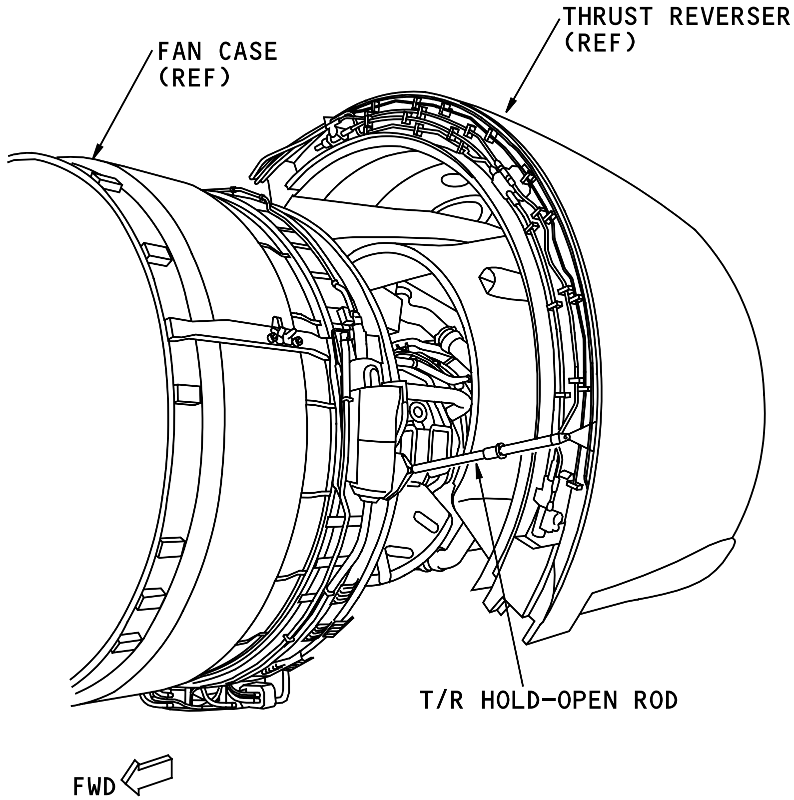
Normally when you open the thrust reverser (T/R) halves, hold-open rods that attach to the engine hold the T/R halves open. When you change an engine, you must attach special T/R hold-open equipment to the T/R PDOS actuators to hold the T/R halves open.

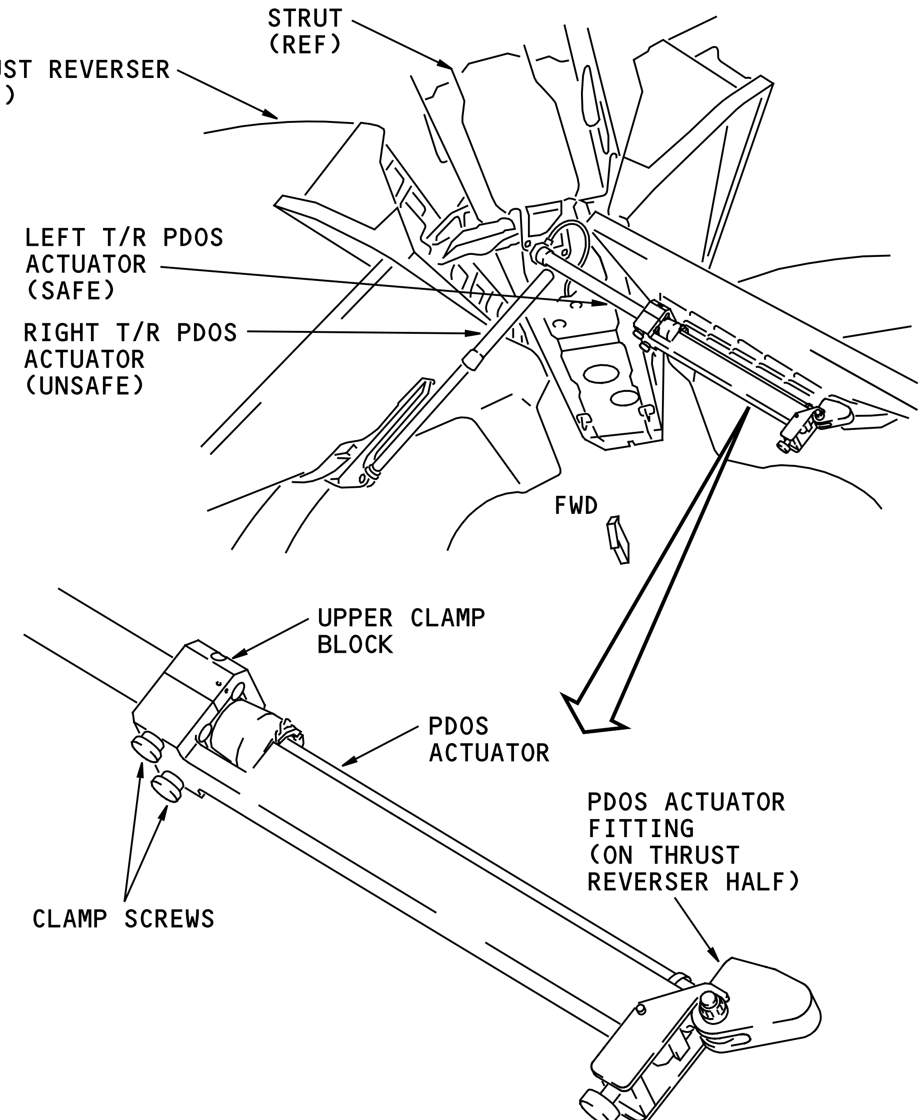
Thrust Reverser Hold-Open Tool

The T/R hold-open tools let the strut hold the weight of the T/R halves. There is one tool for each T/R half.

Operation

With the T/R held open by the hold-open rods, you install the T/R hold-open tools on the T/R PDOS actuators. This makes sure the T/R does not close when you disconnect the hold open rods.





THRUST REVERSER HOLD-OPEN TOOL

TIP - THRUST REVERSER HOLD-OPEN EQUIPMENT

TIP - ENGINE DISCONNECTS LEFT

General

When you change an engine you must disconnect many things. You make the disconnects above the fan case and above the engine core just below the strut.

Fan Disconnects

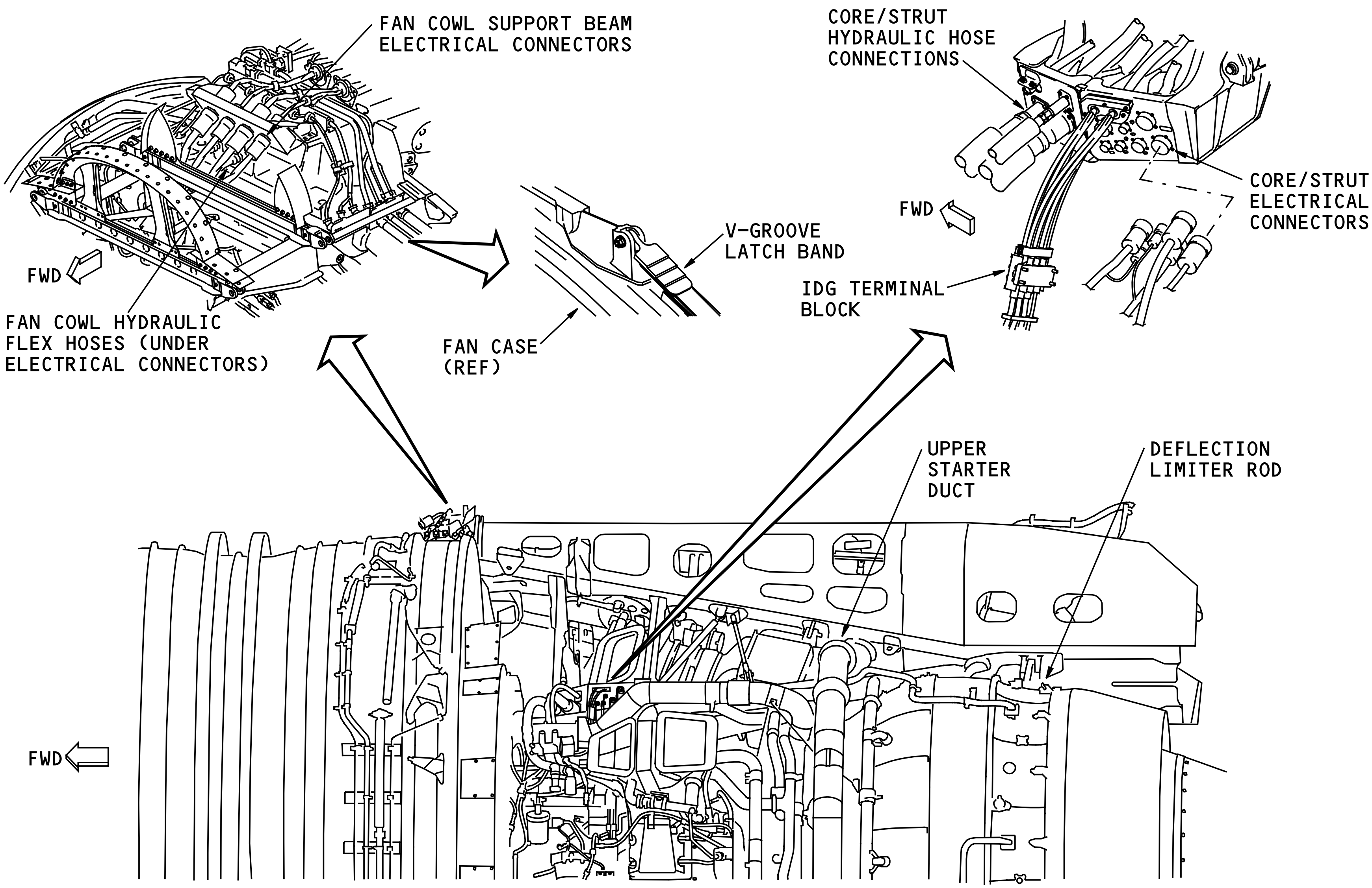
There is a fan/strut disconnect panel above the fan case on the forward end of the strut. The panel contains four electrical connectors and the fan cowl PDOS hydraulic tubes.

When you change an engine, you must also disconnect the left T/R v-groove latch band.

Core Disconnects

There is a core/strut disconnect panel on the left side of the engine that attaches to the bottom of the strut. This panel has seven electrical connections and three hydraulic hose connections. Just below the panel is the IDG terminal block. This is where you disconnect the IDG feeder cables.

When you change an engine, you must also disconnect the upper starter duct and the left end of the deflection limiter rod.



TIP - ENGINE DISCONNECTS LEFT

TIP - ENGINE DISCONNECTS (RIGHT)

General

When you change an engine you must disconnect many things. You make the disconnects above the fan case and above the engine core.

Fan Disconnects

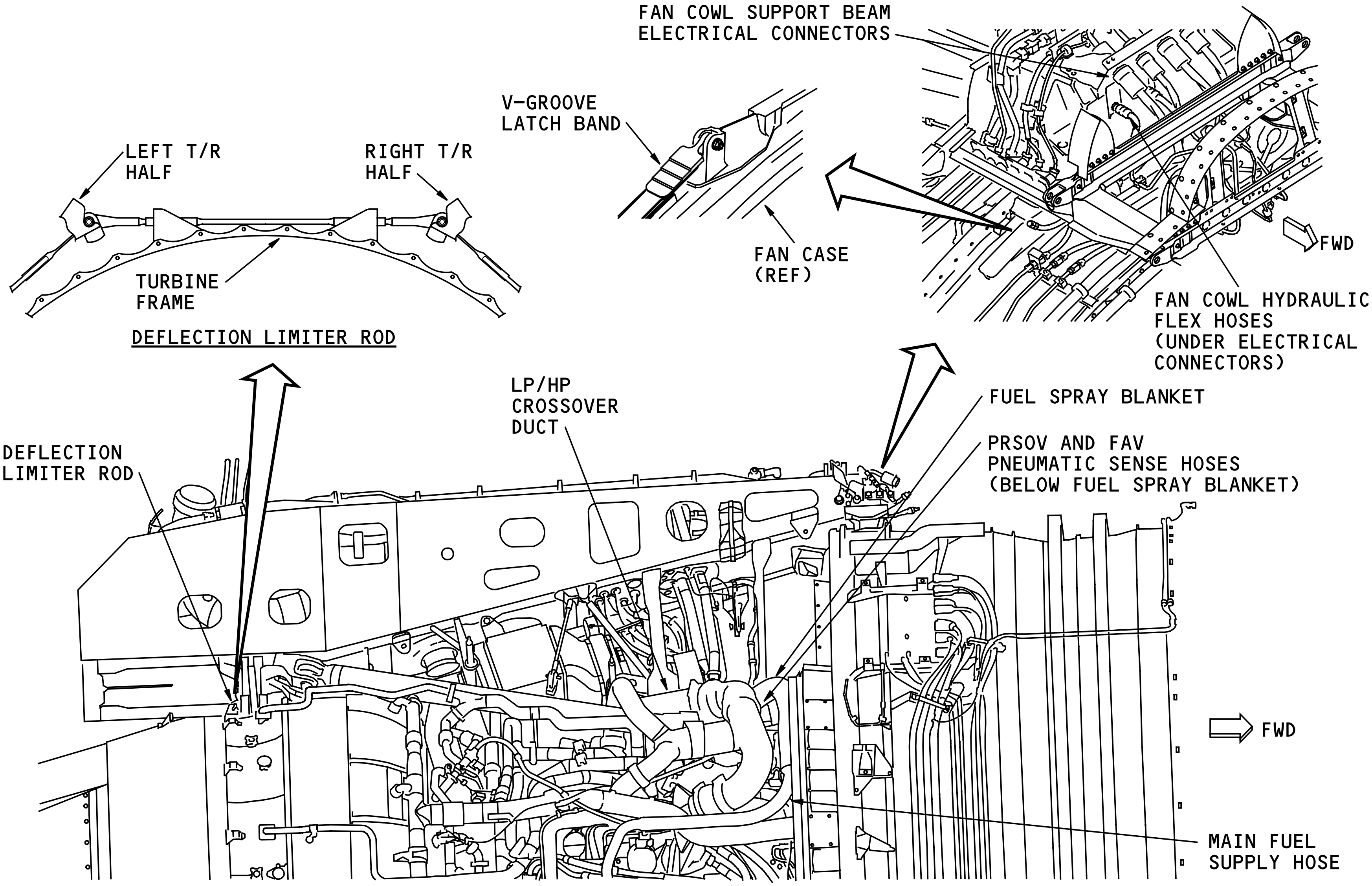
There is a fan/strut disconnect panel above the fan case on the forward end of the strut. The panel contains four electrical connectors and the fan cowl PDOS hydraulic tubes.

When you change an engine, you must also disconnect the right T/R v-groove latch band.

Core Disconnects

When you change an engine, you must disconnect these five mechanical connections:

- Right end of the deflection limiter rod
- LP/HP crossover duct
- PRSOV pneumatic sense hose
- FAV pneumatic sense hose
- Main fuel supply hose.



71-00-00-111 Rev 0 02/11/1997

TIP - ENGINE DISCONNECTS (RIGHT)

TIP - BOOTSTRAP EQUIPMENT

General

When you change an engine, you lift and lower it with bootstrap equipment. The bootstrap equipment includes these assemblies:

- Forward bootstrap
- Aft bootstrap
- Hoist.

Forward Bootstrap Assembly

The forward bootstrap assembly attaches to the bottom, forward end of the strut. The assembly has these seven structural components:

- Forward arm (2)
- Forward upper attach fitting (2)
- Forward center plate assembly 1
- Forward center plate assembly 2
- Upper forward center beam.

Aft Bootstrap Assembly

The aft bootstrap assembly attaches to the bottom, aft end of the strut. The assembly has these three structural components:

- Aft inboard arm (short)
- Center beam
- Aft outboard arm (long).

Hoist Assemblies

The hoist assemblies connect the bootstrap assemblies to the engine cradle. These are the three hoist assemblies:

- Forward inboard
- Forward outboard
- Aft.

The forward inboard hoist assembly includes these components:

- Hoist
- Forward inboard cradle attach assembly
- Dyno link assembly.

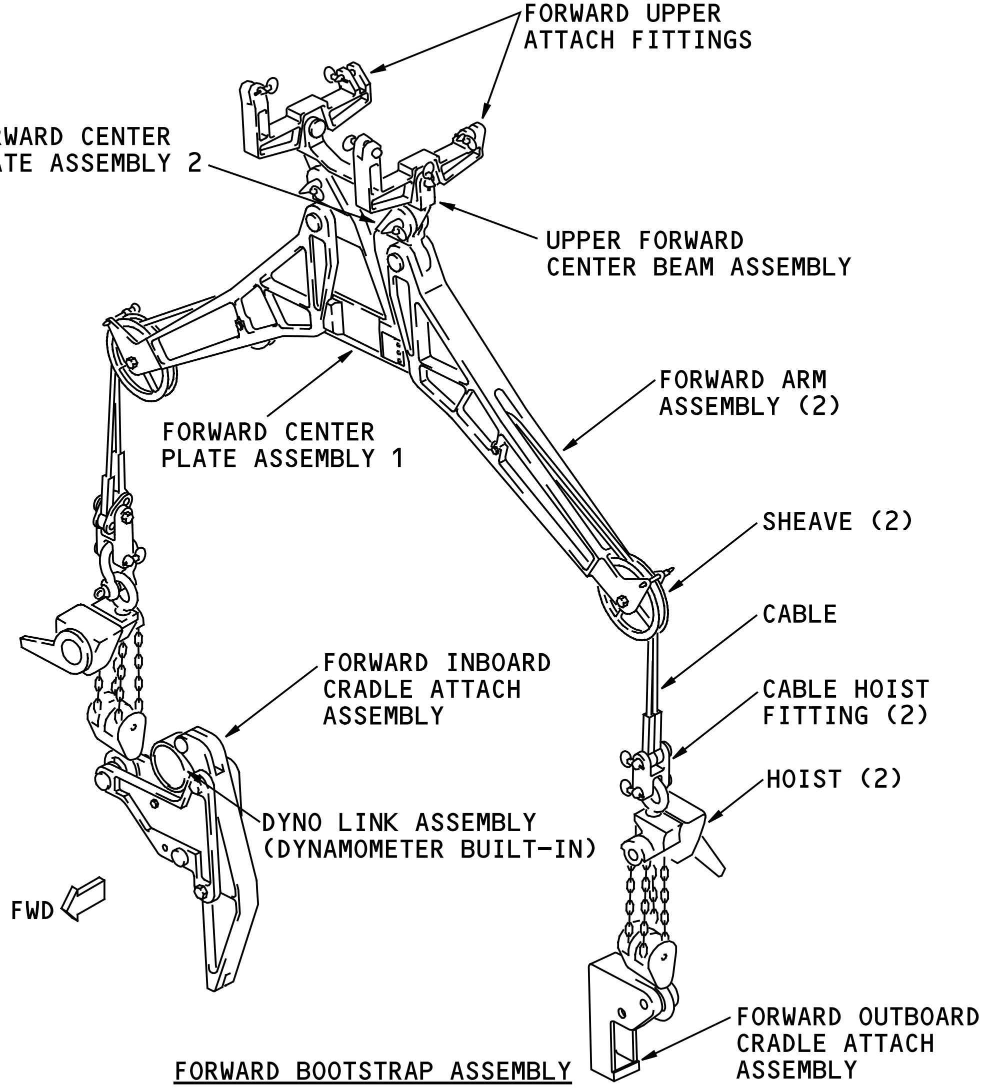
The forward outboard hoist assembly includes these components:

- Hoist
- Forward outboard cradle attach assembly.

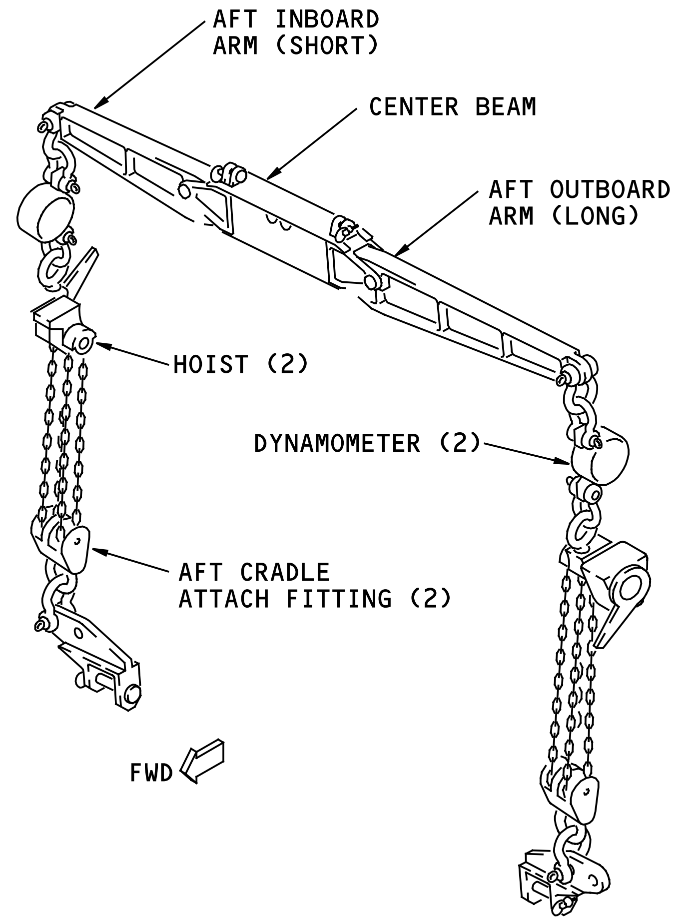
The aft hoist assembly includes these components:

- Hoists
- Dynamometers
- Aft cradle attach fittings.

You use the aft hoist assembly to change the roll of the engine.



FORWARD BOOTSTRAP ASSEMBLY



AFT BOOTSTRAP ASSEMBLY

NOTE: LEFT ENGINE INSTALLATION SHOWN

TIP - BOOTSTRAP EQUIPMENT

TIP - ENGINE DRAINS

Purpose

The engine drains system removes fluid from the engine cowls, components, and strut. This prevents fluid leakage on to the engine.

Drains

The drain system collects fuel, oil, and hydraulic fluid from leaking components and sends it overboard. The fluids go overboard through the drain mast.

The drain mast is at the 6:00 position on the thrust reverser aft of the forward latch beam access door. Eight drain tubes go from engine components to the drain mast.

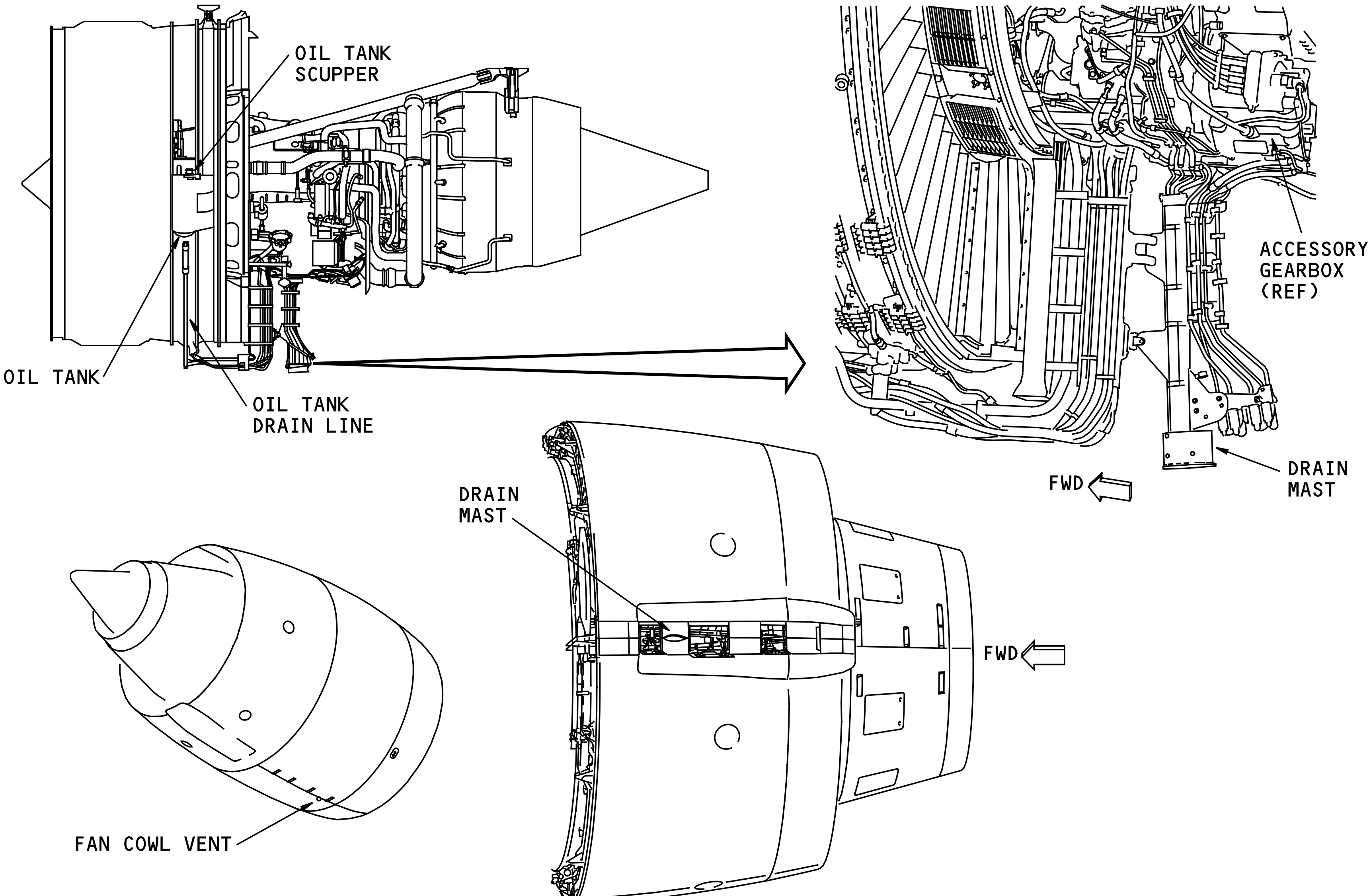
These are the engine components that drain through the eight drain tubes:

- VBV/VSV actuators
- HPT ACC and STB valve actuators
- Main fuel pump drive pad
- HMU drive pad
- Backup generator seal and drive pad
- Hydraulic pump seal
- Hydraulic pump drive pad
- IDG drive pad.

The components that mount to the accessory gearbox have drains that connect to their adapter drive pads.

Some of the fuel driven actuators have drain lines that combine into a single line before they get to the drain mast. These components have drain cans (not shown) which also collect leakage. You look in the drain cans to isolate the leakage to a specific component.

The oil tank scupper has a drain line that goes down to the fan cowl vent. The oil tank scupper collects leakage from oil tank servicing and drains it overboard through the fan cowl vent.



TIP - ENGINE DRAINS

71-00-00-106 Rev 3 02/08/1997

TIP - SYSTEM TESTS

General

There are four system tests and two special function tests for each engine. You use the maintenance access terminal (MAT) to do the tests. The left and right engine tests are the same except for the titles.

These are the system tests:

- Fuel Driven Actuator
- Air Driven Actuator
- Ignition System
- Reverse Thrust Lever Interlock Actuator.

This is the special function test:

- VSV Opening for Maintenance.

Fuel Driven Actuator Test

As you dry motor the engine, this test opens and closes the actuators for these components:

- Fuel metering valve (in HMU)
- Staging valve (in HMU)
- Variable stator vanes
- Variable bypass valves
- HPT active clearance control valve
- Start transient bleed valve.

Air Driven Actuator Test

With the engine at approach idle, this test opens and closes the actuators for these components:

- Core compartment cooling valve
- LPT active clearance control valve.

Ignition System Test

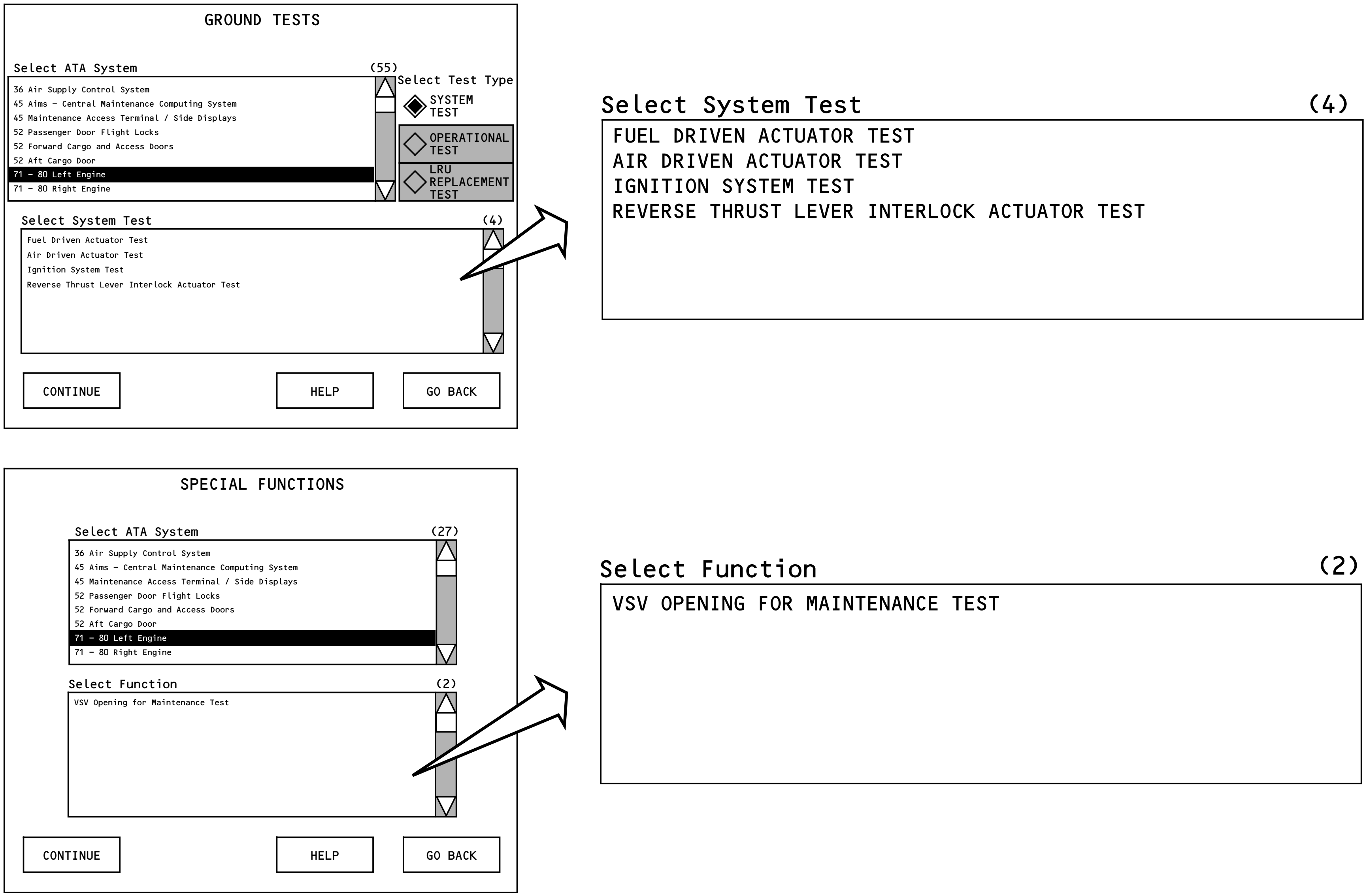
This test makes the EEC supply power to the igniters.

Reverse Thrust Lever Interlock Actuator Test

This test makes the EEC open and close the interlock actuator.

VSV Opening for Maintenance Test

As you dry motor the engine, this test opens the variable stator vanes (VSV). When you stop the dry motor the VSVs stay open so you can do maintenance. The VSVs reset the next time the engine is started or motored.



71-00-00-107 Rev 4 08/21/1997

TIP - SYSTEM TESTS

Continental Airlines, Inc

Engine

WB371

TABLE OF CONTENTS

ENGINE - INTRODUCTION

General

This chapter gives general information about the modules and internal components of the GE90-90B engine.

The bypass ratio is a ratio of the mass of air going through the fan duct to the mass of air going through the engine core.

The engine weight includes the engine build up (EBU) equipment that Boeing installs. The engine driven hydraulic pump (EDP), the integrated drive generator (IDG), and the inlet cowl are examples of EBU equipment.

Data Plate

The engine data plate is on the aft face of the fan hub frame at the 9:00 position. It is below the configuration box. The data plate shows this information about the engine.

- Type certificate number
- Model number
- Serial number
- Engine configuration
- Take off (TO) thrust
- Maximum continuous thrust
- Service bulletin number that sets engine configuration
- Date of manufacture
- Emissions compliance
- Manufacturing location.

Type certificate is issued by the applicable regulatory agency. The certificate shows that the agency approves the engine as airworthy.

The production certificate number is issued by the applicable regulatory agency. The space shows the current Production Certificate number, PC - 108.

The CONFIG field shows engine rating and configuration information. TO THRUST is the takeoff thrust (in pounds) at the specified rating. The TO thrust is the approved maximum thrust level at which the engine can operate. The TO thrust on the data plate is different than the TO thrust that Boeing uses, called Boeing equivalent thrust (BET). The thrust on the data plate is measured on a test stand and is equivalent to the static thrust at sea level. Boeing equivalent thrust (BET) is a calculated number. It is equivalent to the thrust at 165 knots at sea level. BET is defined so that engines with the same BET will have approximately the same TO performance at sea level.

MAX CONT is the maximum continuous thrust (in pounds) at specified rating. Maximum continuous thrust is measured on a test stand. It is the approved maximum thrust level at which the engine can operate with no time limit.

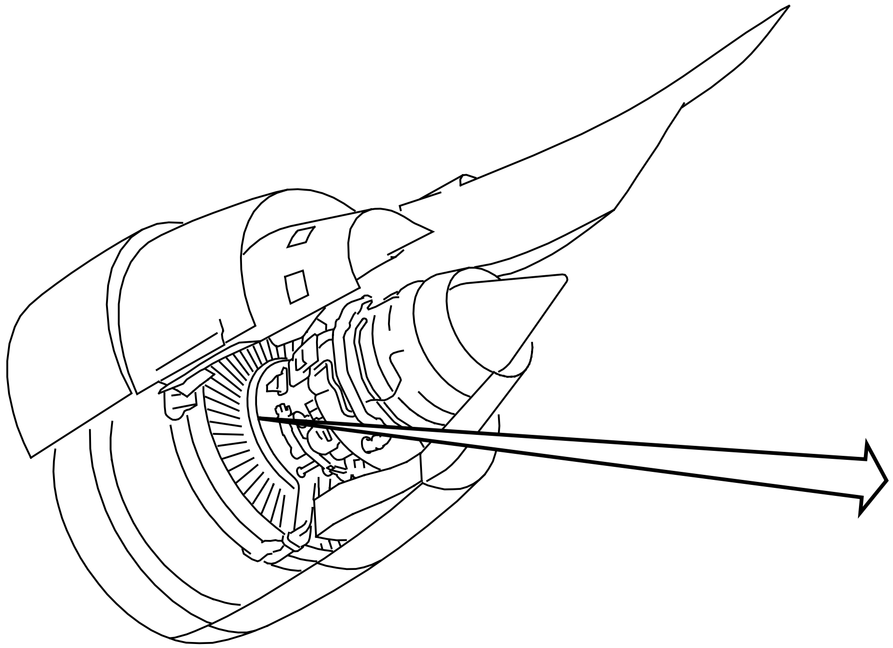
The SERV BUL field shows the service bulletin number that goes with a change in the engine configuration. You install different EEC rating and configuration plugs to change the engine configuration.

ENGINE - INTRODUCTION

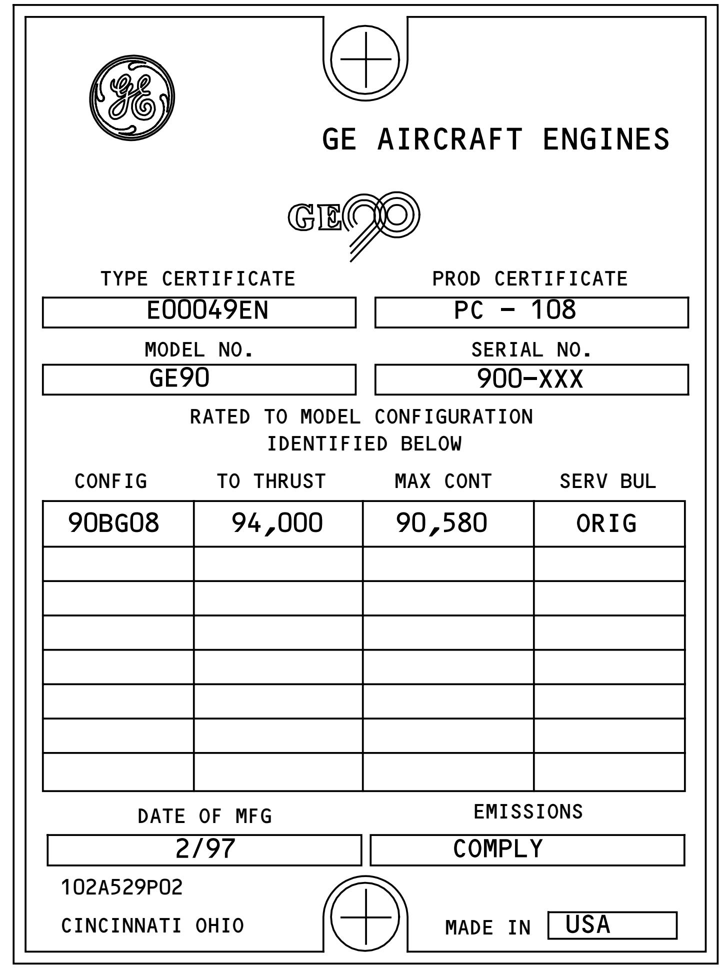
The emissions field shows that the engine complies with emissions standards.

Abbreviations and Acronyms

AGB	- accessory gearbox
BET	- Boeing equivalent thrust
cont	- continuous
EEC	- electronic engine control
GE	- General Electric
HPC	- high pressure compressor
HPT	- high pressure turbine
IDG	- integrated drive generator
IGV	- inlet guide vane
LPC	- low pressure compressor
LPT	- low pressure turbine
max	- maximum
OGV	- outlet guide vane
TCF	- turbine center frame
TO	- takeoff
TRF	- turbine rear frame



TO THRUST (BET)	90,600 LB
BYPASS RATIO	8.4:1
WEIGHT (APPROXIMATE)	18,700 LB (8500 KG)
FAN CASE DIAMETER	150.6 IN (3.8 M)
FAN DIAMETER	123.0 IN (3.1 M)
LENGTH	285.8 IN (7.3 M)



ENGINE DATA PLATE

72-00-00-101 Rev 4 03/12/1998

ENGINE - INTRODUCTION

ENGINE - GENERAL DESCRIPTION - 1

General

The GE90 is a high-bypass, two shaft, turbofan engine. It has a low pressure (LP) rotor system (N1) and a high pressure (HP) rotor system (N2).

The engine has station numbers to identify locations along its axis.

Airflow

The engine has primary (core) airflow and secondary (bypass) airflow. The bypass ratio of this engine is 8.4:1. This means that 8.4 times more secondary air goes through the engine than primary air.

The primary airflow goes through the compressors, combustion section, and turbines. The combustion section also gets fuel from the fuel nozzles. This mixture of air and fuel burns to make high pressure exhaust gas. The exhaust gas goes out of the combustion section to turn the turbines. The exhaust gas from the primary airflow makes approximately 20 percent of the forward thrust.

The secondary airflow goes around (bypasses) the core of the engine. The secondary airflow makes approximately 80 percent of the forward thrust. The thrust reverser system also uses secondary airflow for reverse thrust.

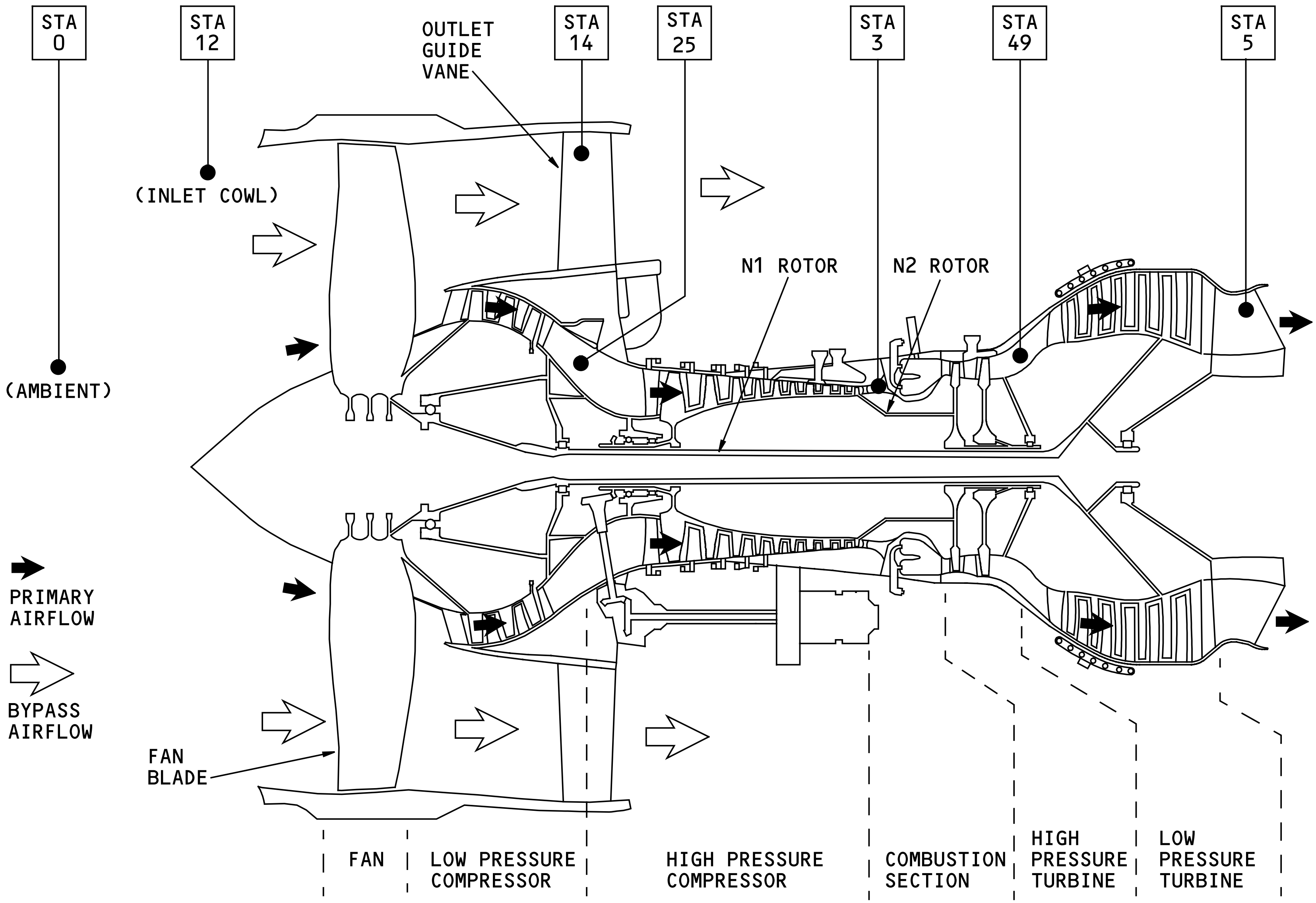
Low Pressure Rotor System (N1)

The LP rotor system includes the fan and a three-stage low pressure compressor (LPC) connected to a six-stage low pressure turbine (LPT). A coupling connects the LPT drive shaft to the LPC.

High Pressure System

The HP rotor system is an ten-stage high pressure compressor (HPC) connected to a two-stage high pressure turbine (HPT). A coupling connects the HPT drive shaft to the HPC.

The HPC has variable stator vanes in the first four stages.



ENGINE - GENERAL DESCRIPTION - 1

ENGINE - GENERAL DESCRIPTION - 2

Main Engine Bearings

Six main engine bearings hold the N1 shaft and the N2 shaft. Numbers identify the engine bearings. The main engine bearings are in three dry-sump cavities. The letters A, B, and C identify the sumps. The lube and scavenge pump supplies lubricating oil to the bearings and draws oil out of the bearing sumps.

The number 1 and number 2 bearings hold the front of the N1 shaft. The number 1 bearing is a ball bearing. It is the thrust bearing for the N1 shaft. The number 2 bearing is a roller bearing and holds only radial loads.

There are two number 3 bearings. One is a ball bearing and one is a roller bearing. The two of them hold the front of the N2 shaft. The ball bearing is the thrust bearing for N2 shaft. The roller bearing holds only radial loads.

The number 1, 2, and 3 bearings are in the A sump.

The number 4 roller bearing holds the rear of the N2 shaft. The number 4 roller bearing is in the B sump.

The number 5 roller bearing holds the rear of the N1 shaft. The number 5 roller bearing is in the C sump.

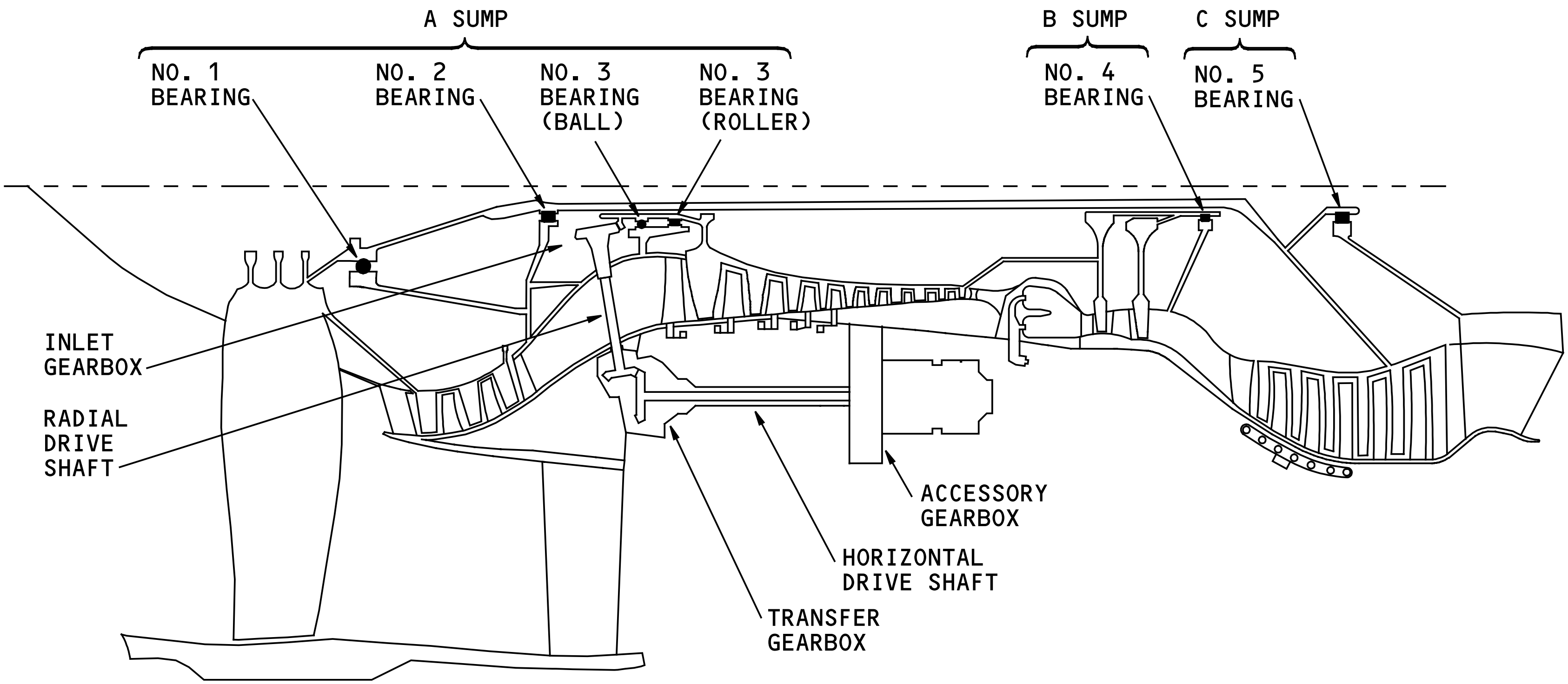
Accessory Drives

There are three gearboxes on the engine:

- Inlet gearbox
- Transfer gearbox
- Accessory gearbox.

The inlet and transfer gearboxes transfer energy from the N2 shaft to the accessory gearbox. The accessory gearbox holds and turns the engine accessories.

The N2 shaft turns the radial drive shaft through the inlet gearbox. The radial drive shaft turns the horizontal drive shaft through the transfer gearbox. The horizontal drive shaft turns the accessory gearbox.



72-00-00-103 Rev 4 02/12/96

ENGINE - GENERAL DESCRIPTION - 2

ENGINE - COMPONENT LOCATIONS

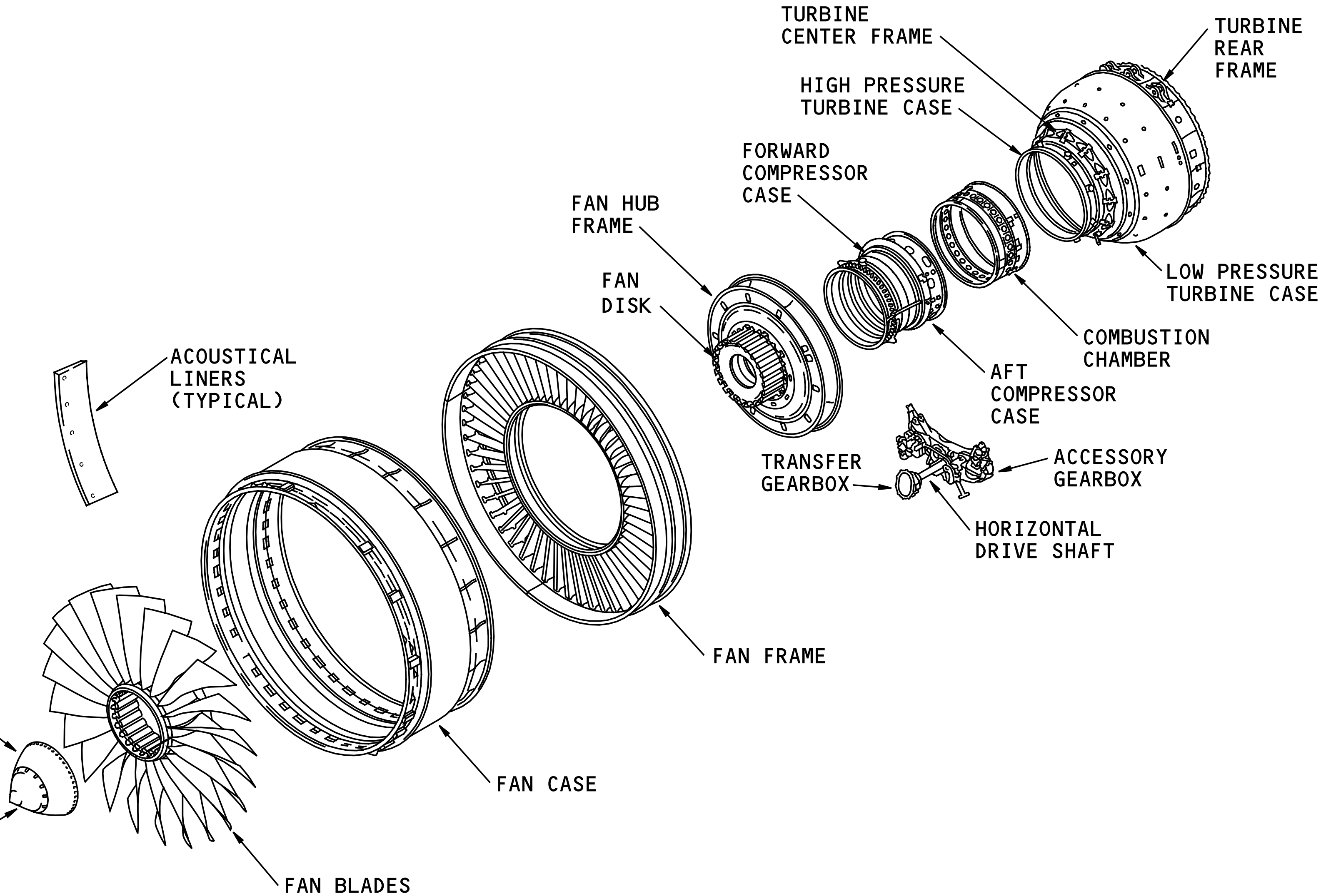
General

The GE90 engine has these primary engine modules and components:

- Forward and aft spinners
- Fan blades
- Fan disk
- Fan case
- Fan frame
- Fan hub frame
- Forward compressor case
- Aft compressor case
- Combustion chamber
- HPT case
- Turbine center frame
- LPT case
- Turbine rear frame
- Accessory drives.

Acoustical liners attach to the inside of the fan case to absorb the sound of the fan blades. There are eight forward and eight aft acoustical liners.

The accessory drives are below the HPC at the 6:00 position.



72-00-00-104 Rev 5 02/12/96

ENGINE - COMPONENT LOCATIONS

ENGINE - SPINNERS AND FAN BLADES

Spinners

The one piece spinner is an aerodynamic fairings that directs inlet airflow. The spinner attaches to the fan disk with 22 attach screws.

Fan Blades

There are 22 wide-chord fan blades on the engine. The fan blades are carbon fiber and resin with a titanium leading and trailing edge. The fan blades are line replaceable units.

The fan blades fit into dovetail slots in the fan disk. The dovetail slots hold the fan blades in place radially. There are fan blade platforms between the fan blades. They make an aerodynamic surface for the air flow. The spinner, fan disk, and forward face of the fan hub frame hold the fan blade platforms in place.

Fan blade spacers and dovetail keys fit at the base of the fan blade in the dovetail slot. These help the fan blade fit tight in the dovetail slot.

Fan Blade Removal

You remove each fan blade independently. To prepare for fan blade removal, first put the fan blade you will remove in the 6:00 position. Turn the fan blades counterclockwise to move the fan blades. To remove a fan blade, remove the components in this order:

- Forward and aft spinner
- Fan blade platform
- Retainer bolt
- Fan blade spacer
- Dovetail key
- Retainer
- Fan blade.

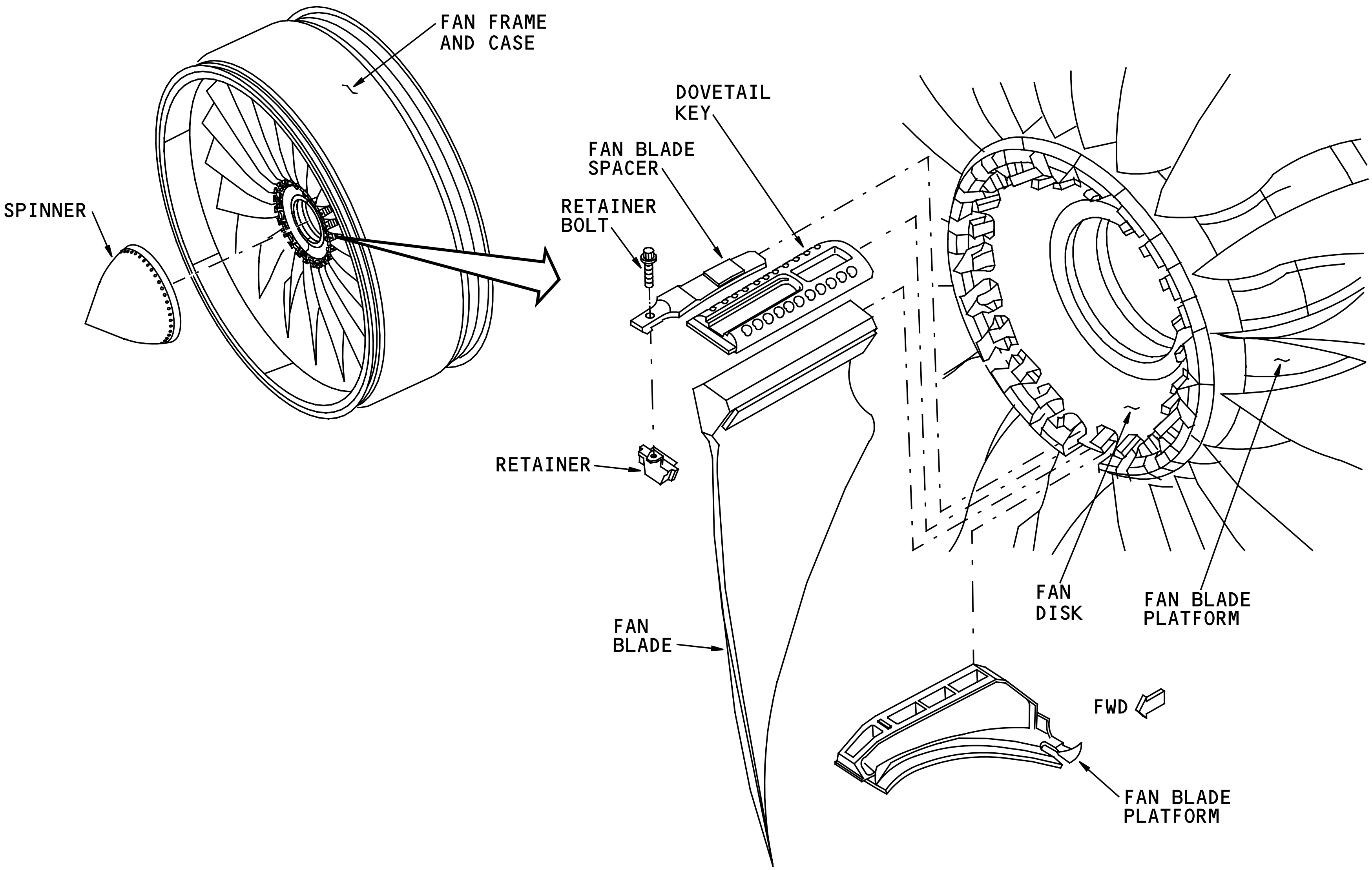
You use a slide hammer to remove the fan blade spacers. You use a plastic hammer to install the fan blade spacers.

Training Information Point

The dovetail slots for fan blade numbers 1 and 5 are marked. The numbers are on the fan disk.

You must apply dry teflon spray lubricant to the dovetail end of the fan blade and to the fan blade spacer before you install them.

CAUTION: MAKE SURE YOU PUT A MAT IN THE INLET COWL. THIS WILL PREVENT DAMAGE TO THE INLET COWL OR ENGINE BY TOOLS, PARTS, OR UNWANTED MATERIALS THAT FALL ON THE INLET COWL SURFACE.



ENGINE - SPINNERS AND FAN BLADES

ENGINE - ENGINE SEPARATION

General

You can remove the fan case and frame from the core engine. This divides the engine into two parts. There are two advantages to this:

- The engine is easier to move
- When you replace the engine, you only need to replace the engine core.

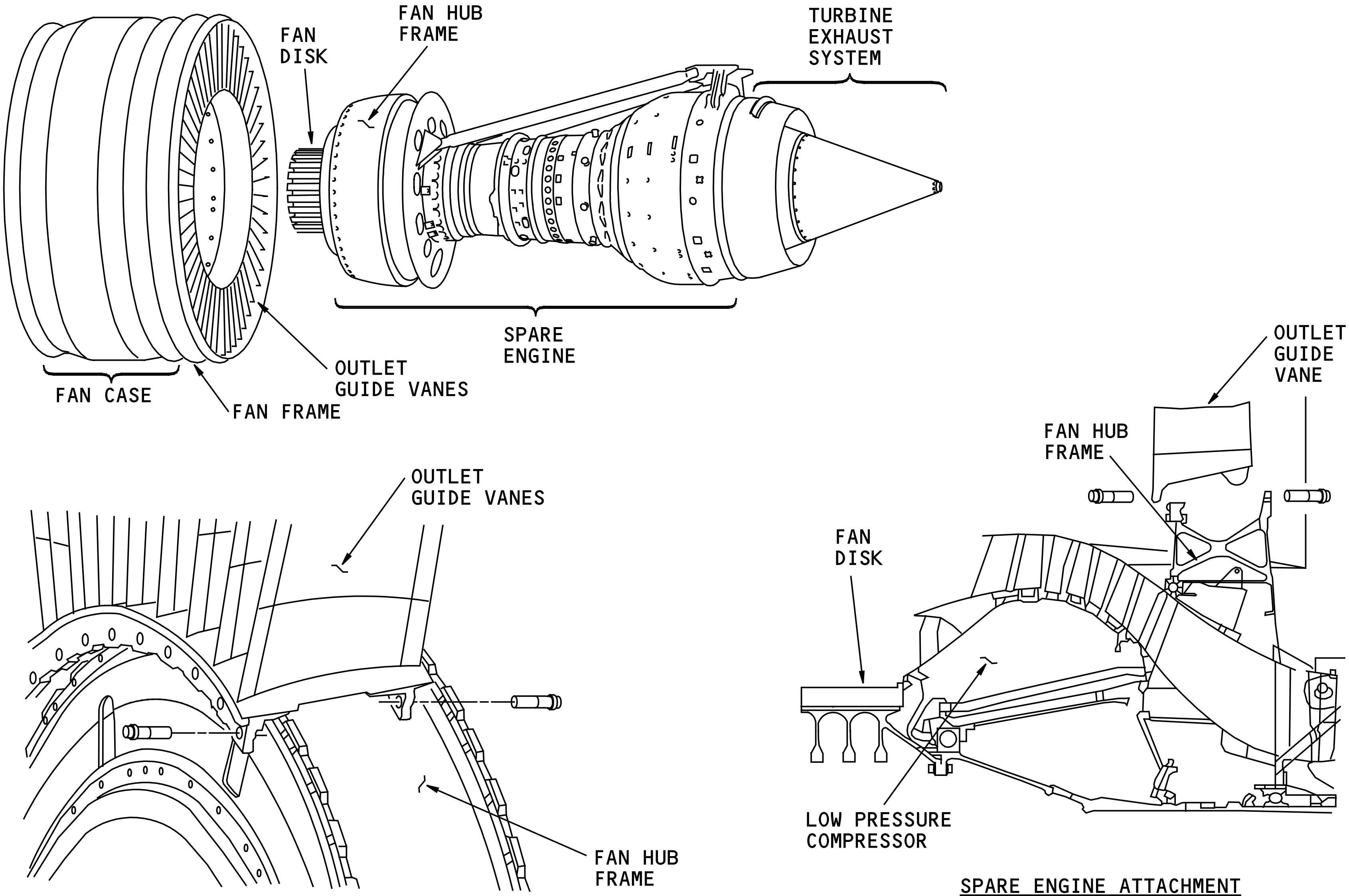
When you move the engine over long distances, it is necessary to divide it into two parts because it is so big.

Most engine work is done on the core engine. Very little work is done on the fan case and frame. Since you can remove the fan case and frame from the core engine, you do not have to include those parts with a spare engine. You can install the same fan case and frame on the new engine.

The spare engine attaches to the rear of the fan case and frame. The forward flange of the fan hub frame attaches to the inner diameter of the outlet guide vanes (OGVs) on the aft fan case.

Training Information Point

You remove the turbine exhaust system and put a cover on the fan disk when you move the engine.



ENGINE - ENGINE SEPARATION

72-00-00-106 Rev 3

ENGINE - BALANCE WEIGHTS

General

You can balance the fan section and the low pressure turbine on the GE90 engine. See the airborne vibration monitoring section for more information on the engine balance procedure (AMM PART I 77-31).

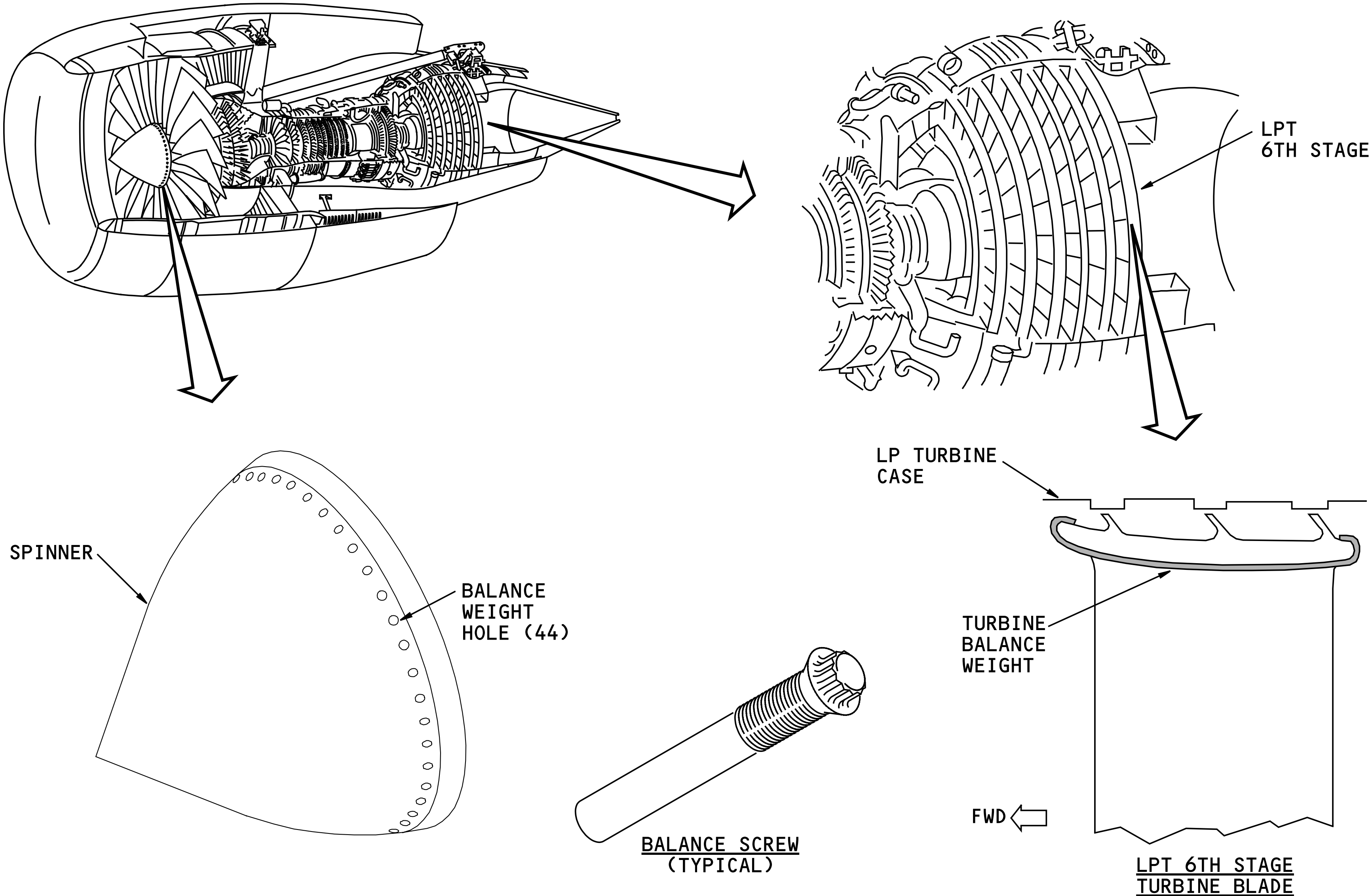
Fan Balance

To balance the fan, you change balance screws in the spinner. There are 44 balance weights on the aft edge of the spinner between the spinner attach screws.

LP Turbine Balance

You balance the LPT with sheet metal clip-on weights. The weights attach at the tip shroud of the LPT stage 6 blades.

You use a special tool to attach the LPT clip-on balance weights. The tool bends (crimps) the aft end of the balance weight to hold it in place.



ENGINE - BALANCE WEIGHTS

72-00-00-107 Rev 6 03/18/1998

ENGINE - ACCESSORY DRIVES - COMPONENT LOCATIONS - FORWARD

Accessory Gearbox

The accessory gear box (AGB) turns the engine accessories. The AGB gets torque from the N2 shaft through the horizontal drive shaft. It sends the torque through spur gears to turn the components on the gearbox. You get access to the accessory gearbox (AGB) with the thrust reverser halves open. The AGB is below the high pressure compressor.

Heat Shield

A titanium heatshield is between the core engine and the AGB. The heatshield protects the components on the gearbox from engine heat. It also prevents the spray of combustible fluids from the components on the hot engine case.

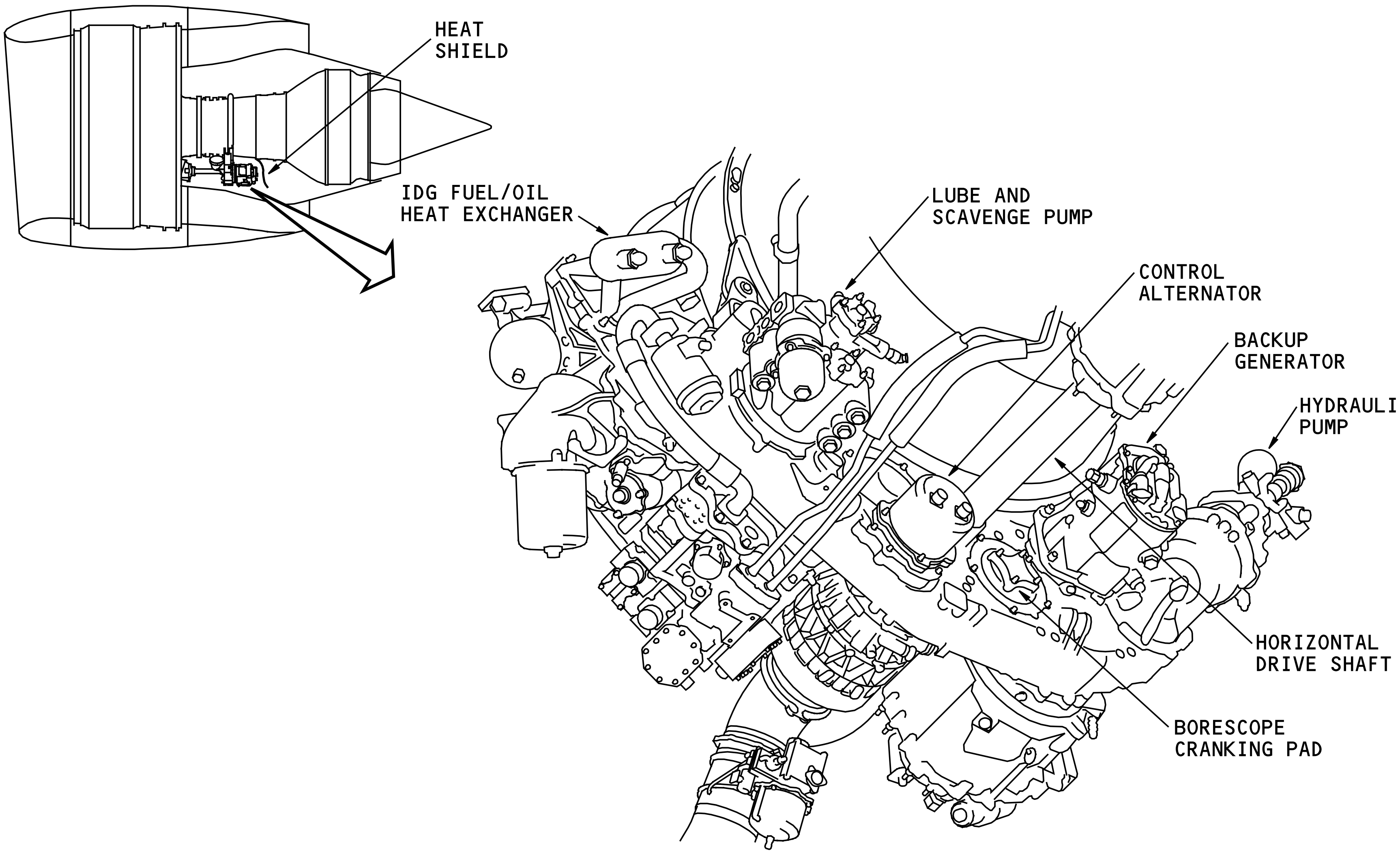
Accessory Gearbox Components

These components are on the front of the accessory gearbox:

- IDG fuel/oil heat exchanger
- Hydraulic pump
- Backup generator
- Borescope cranking pad
- Horizontal drive shaft
- Control alternator
- Lube and scavenge pump.

Training Information Point

The borescope cranking pad is on the front of the AGB on the left side. Engine components do not cause a blockage of access to the borescope cranking pad. Use a CF6-80C2 core motoring device to turn the borescope cranking pad.



ACCESSORY GEARBOX
(LOOKING AFT)

ENGINE - ACCESSORY DRIVES - COMPONENT LOCATIONS - FORWARD

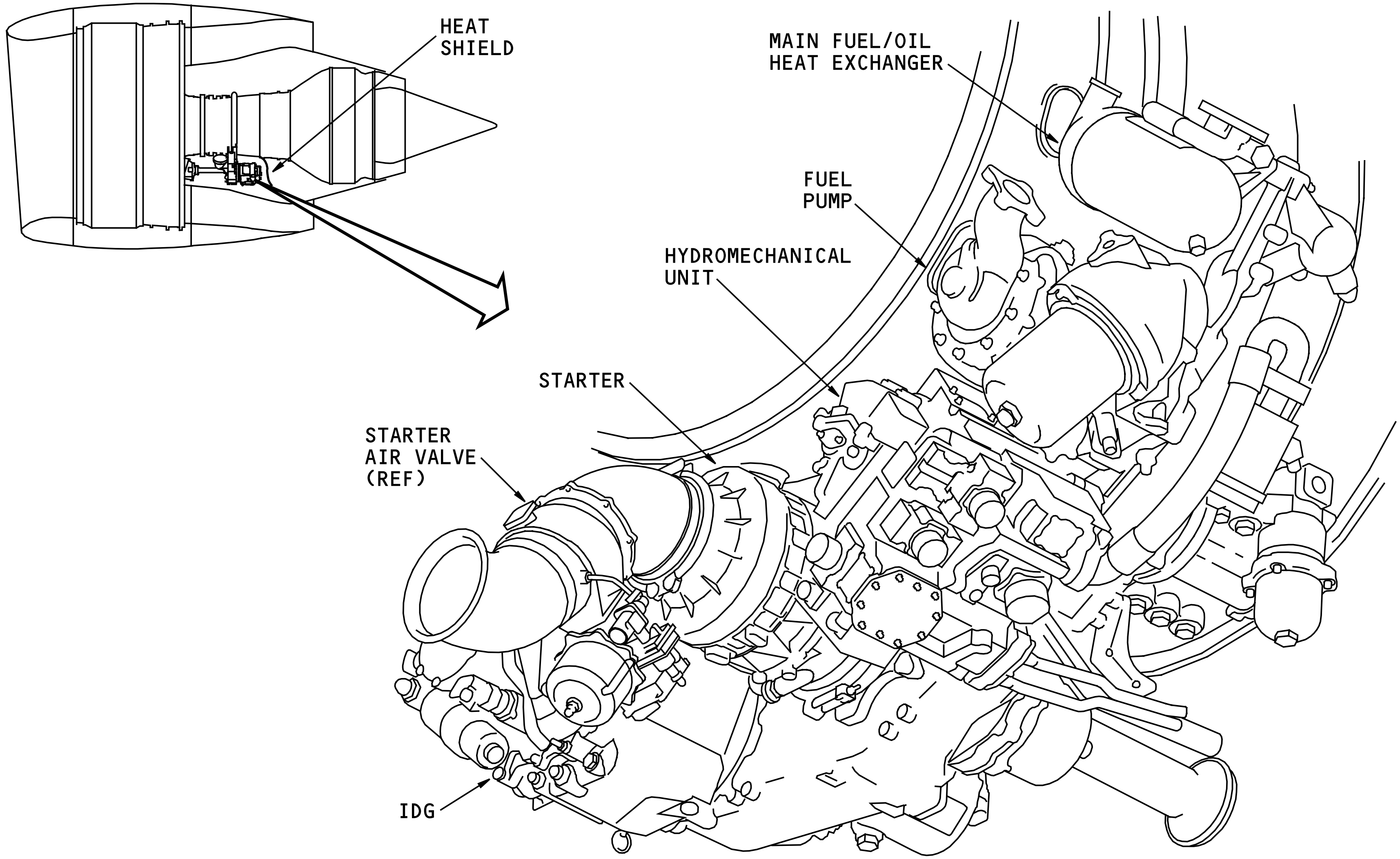
72-00-00-108 Rev 5 03/10/96

ENGINE - ACCESSORY DRIVES - COMPONENT LOCATIONS - AFT

Accessory Gearbox Components

These components are on the aft face of the accessory gearbox:

- Main fuel/oil heat exchanger
- Fuel pump
- Hydromechanical unit (HMU)
- Starter
- IDG.



ACCESSORY GEARBOX
(LOOKING FORWARD)

ENGINE - ACCESSORY DRIVES - COMPONENT LOCATIONS - AFT

72-00-00-109 Rev 2 03/10/96

ENGINE - BORESCOPE ACCESS PORTS

General

There are 19 borescope ports on the GE90 engine. There are 17 ports on the left side of the engine. Two borescope ports are on the right side of the combustion chamber.

You use the borescope cranking pad to turn the horizontal drive shaft when you make borescope inspections.

Borescope Access Port Identification

These are the borescope access ports on the engine:

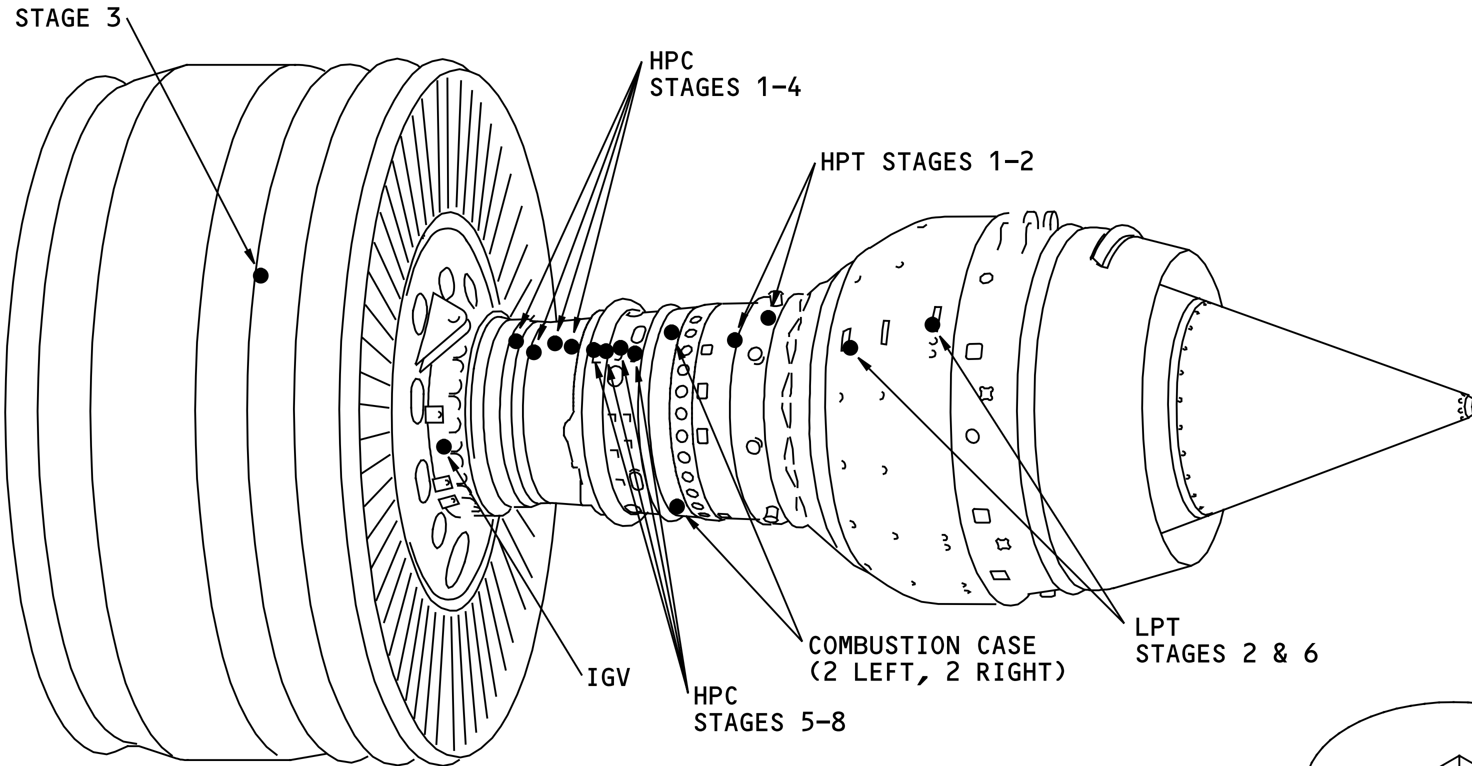
- Booster acoustical panel - LPC stage 3 (no plug)
- Fan hub frame - IGV
- Forward HPC case - HPC stages 1-4
- Aft HPC case - HPC stages 5-8
- Combustion chamber - 2 ports on the left side and 2 on the right side (not shown)
- HPT case - HPT stages 1 and 2
- LPT case - LPT stages 2 and 6.

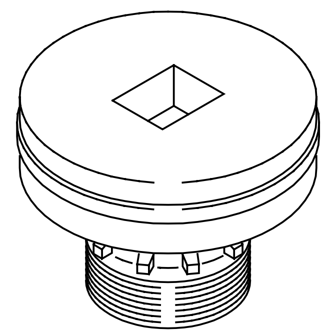
Training Information Point

The GE90 borescope plugs are self-locking and do not use seals. You remove the plugs with a standard 3/8 inch square drive.

The aft HPC has an inner and outer case which cover the five aft stages of the HPC. For this reason, the borescope plugs in the HPC ports at stator stages 5, 6 and 8 have double plugs which seal in the inner case and the outer case. You remove and install each double plug as a single assembly.

When you do a borescope inspection, use a 30 inch probe for the HPC inlet guide vanes (IGVs) borescope port. Use a 20 inch probe for all other borescope ports.





BORESCOPE PLUG
(TYPICAL)

72-00-00-110 Rev 7 03/18/1998

ENGINE - BORESCOPE ACCESS PORTS

Continental Airlines, Inc

Engine Fuel and Controls

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Engine Fuel and Controls
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ENGINE FUEL AND CONTROL - INTRODUCTION

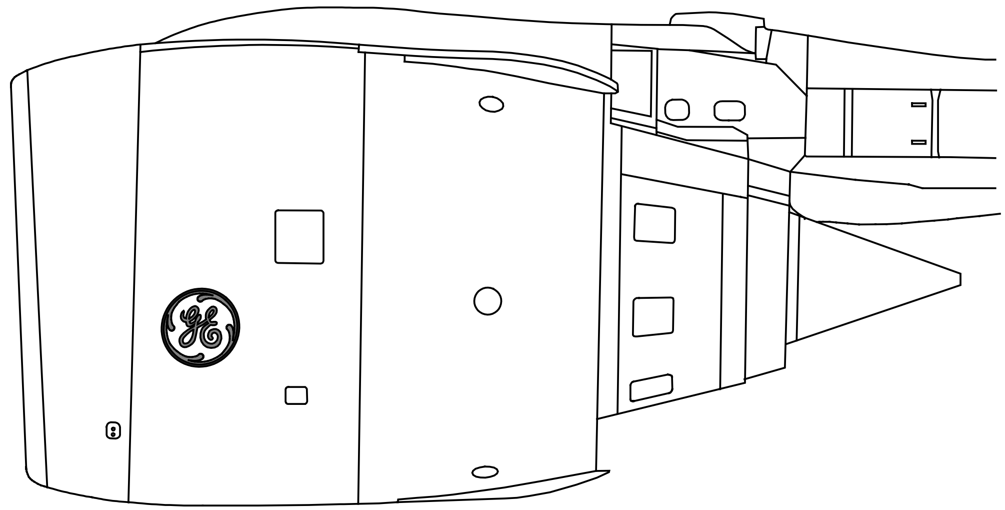
General

The engine fuel and control system supplies airplane fuel to the engine at the correct pressure and rate. The system has these subsystems:

- Distribution
- Control
- Indicating.

Abbreviations and Acronyms

ACC	- active clearance control
ACMS	- airplane condition monitoring system
AIMS	- airplane information management system
ARINC	- Aeronautical Radio, Inc.
ASCPC	- air supply and cabin pressure controller
BPV	- bypass valve
CCC	- core compartment cooling
CDU	- control display unit
CH	- channel
DP	- differential pressure
DRV	- driver
EDIU	- engine data interface unit
EEC	- electronic engine control
EGT	- exhaust gas temperature
EHSV	- electro-hydraulic servo valve
EICAS	- engine indication and crew alerting system
ELMS	- electrical load management system
ENG	- engine
F/O HX	- fuel/oil heat exchanger
FMV	- fuel metering valve
FSEU	- flap/slat electronics unit
GSE	- ground support equipment
HMU	- hydromechanical unit
HPC	- high pressure compressor
HPT	- high pressure turbine
ID	- identification
IDG	- integrated drive generator
LPC	- low pressure compressor
LPT	- low pressure turbine
MFD	- multi-functional display
OPAS	- overhead panel ARINC system
OSG	- overspeed governor
PDS	- primary display system
PHS	- pressure of heated servo
RVDT	- rotary variable differential transducer
SOV	- shutoff valve
STB	- start/transient bleed
SV	- staging valve
TLA	- thrust lever angle
T/R	- thrust reverser
VBV	- variable bypass valve
VSV	- variable stator vane



ENGINE FUEL AND CONTROL

DISTRIBUTION

- PRESSURIZING
- FILTERING
- INJECTING

CONTROL

- METERING
- SENSING
- POWER
- INTERFACES

INDICATING

- FUEL FLOW

73-00-00-101 Rev 1

ENGINE FUEL AND CONTROL - INTRODUCTION

ENGINE FUEL AND CONTROL - INTERFACES

General

The engine fuel and control system has interfaces with many systems and components. The interfaces with other engine systems are primarily analog. The interfaces with airplane systems and components are primarily on the ARINC 629 buses.

Analog Interfaces

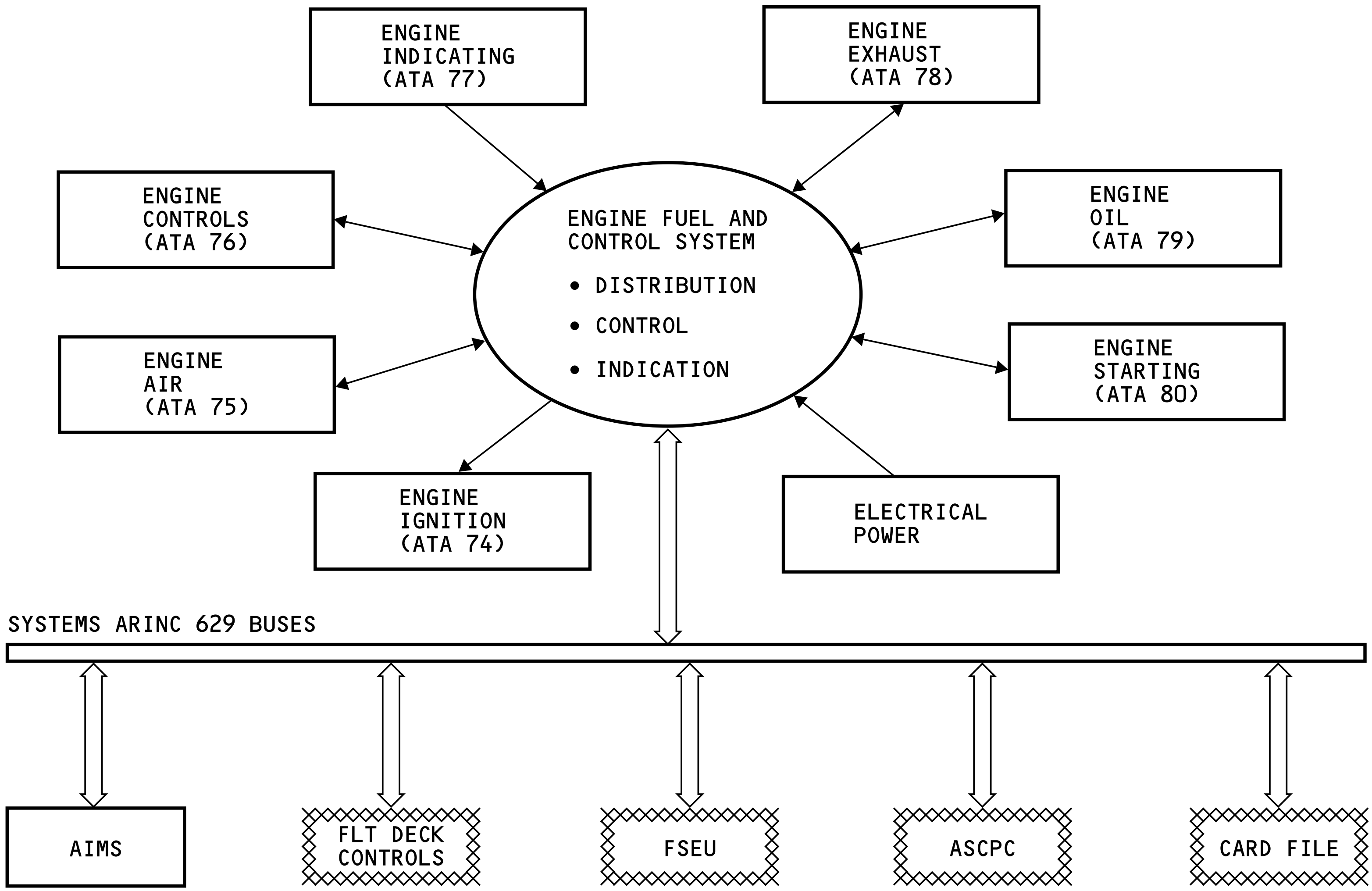
These analog engine fuel and control system interfaces supply control and feedback:

- Engine ignition - exciter power
- Engine air - actuator positions
- Engine controls - resolver excitation
- Engine indicating - engine parameter data
- Engine exhaust - thrust reverser operation
- Engine oil - indication
- Engine starting - starter pneumatic supply
- Electrical power - airplane power application.

ARINC 629 Interfaces

These ARINC 629 engine fuel and control system interfaces supply and receive control and indication data:

- AIMS - indication, air data, and flight management control
- Flight deck controls - switch position and indication
- FSEU - flap position
- ASCPC - pneumatic supply status
- Card file - air driven pump and anti-ice status.



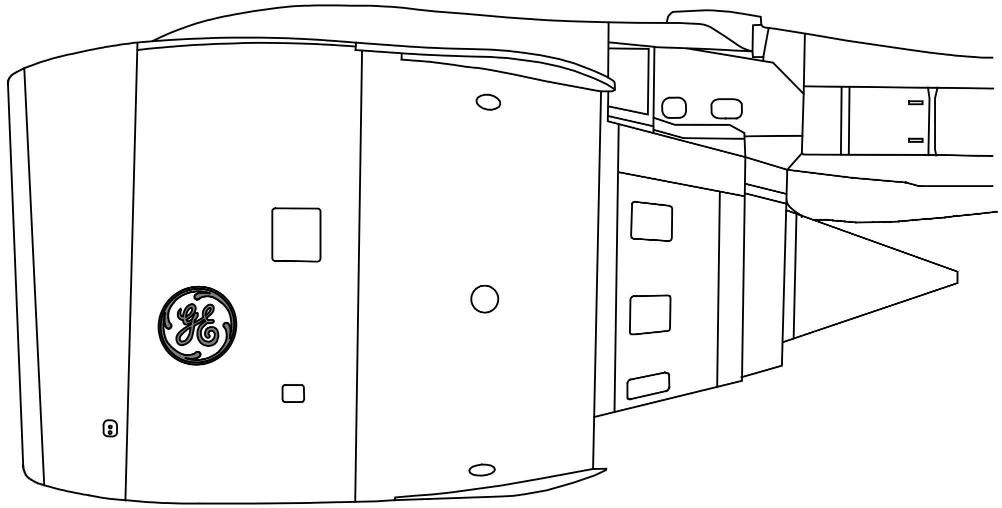
73-00-00-102 Rev 2 08/03/1995

ENGINE FUEL AND CONTROL - INTERFACES

ENGINE FUEL DISTRIBUTION - INTRODUCTION

Purpose

The engine fuel distribution system components pressurize and clean (filter) fuel from the airplane. They also put (inject) metered fuel into the engine.



ENGINE FUEL AND CONTROL

DISTRIBUTION

- PRESSURIZING
- FILTERING
- INJECTING

CONTROL

- METERING
- SENSING
- POWER
- INTERFACES

INDICATING

- FUEL FLOW

73-11-00-101 Rev 0

ENGINE FUEL DISTRIBUTION - INTRODUCTION

ENGINE FUEL DISTRIBUTION - GENERAL DESCRIPTION

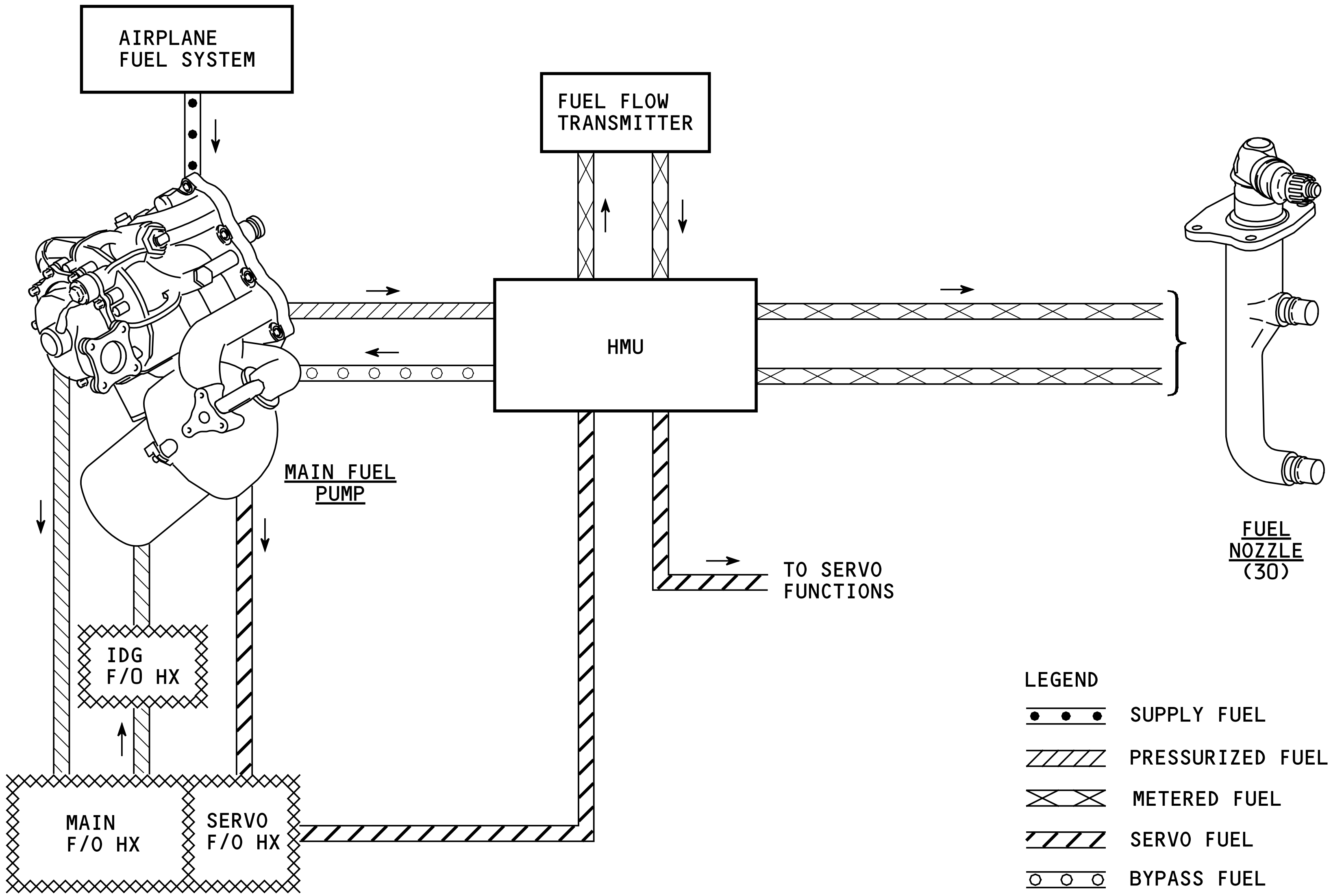
General

The main fuel pump gets fuel from the airplane fuel system. The pump pressurizes the fuel and sends it through the main and IDG fuel/oil heat exchangers. After the fuel goes through the heat exchangers, it flows back to the pump where it goes through the fuel filter element.

After the fuel goes through the fuel filter element, it goes to the hydromechanical unit (HMU). The HMU meters the fuel. The fuel goes from the HMU, through the fuel flow transmitter, then back into the HMU. The HMU distributes the fuel into two fuel supply manifolds. The supply manifolds send the fuel to 30 fuel nozzles.

The HMU gets more fuel from the pump than the engine needs. The fuel that the HMU does not use goes back to the main fuel pump. This fuel is called bypass fuel.

Downstream from the fuel filter, a small amount of fuel also goes to the servo fuel/oil heat exchanger then to the HMU. The servo fuel/oil heat exchanger increases the temperature of the servo fuel before it goes to the HMU. The HMU uses servo fuel pressure to move internal valves and engine air system components (not shown).



73-11-00-102 Rev 2 08/21/1997

ENGINE FUEL DISTRIBUTION - GENERAL DESCRIPTION

ENGINE FUEL DISTRIBUTION - COMPONENT LOCATIONS

General

These are the fuel distribution system components:

- Main fuel supply hose
- Main fuel pump
- Fuel filter element
- Fuel supply manifolds
- Fuel nozzles.

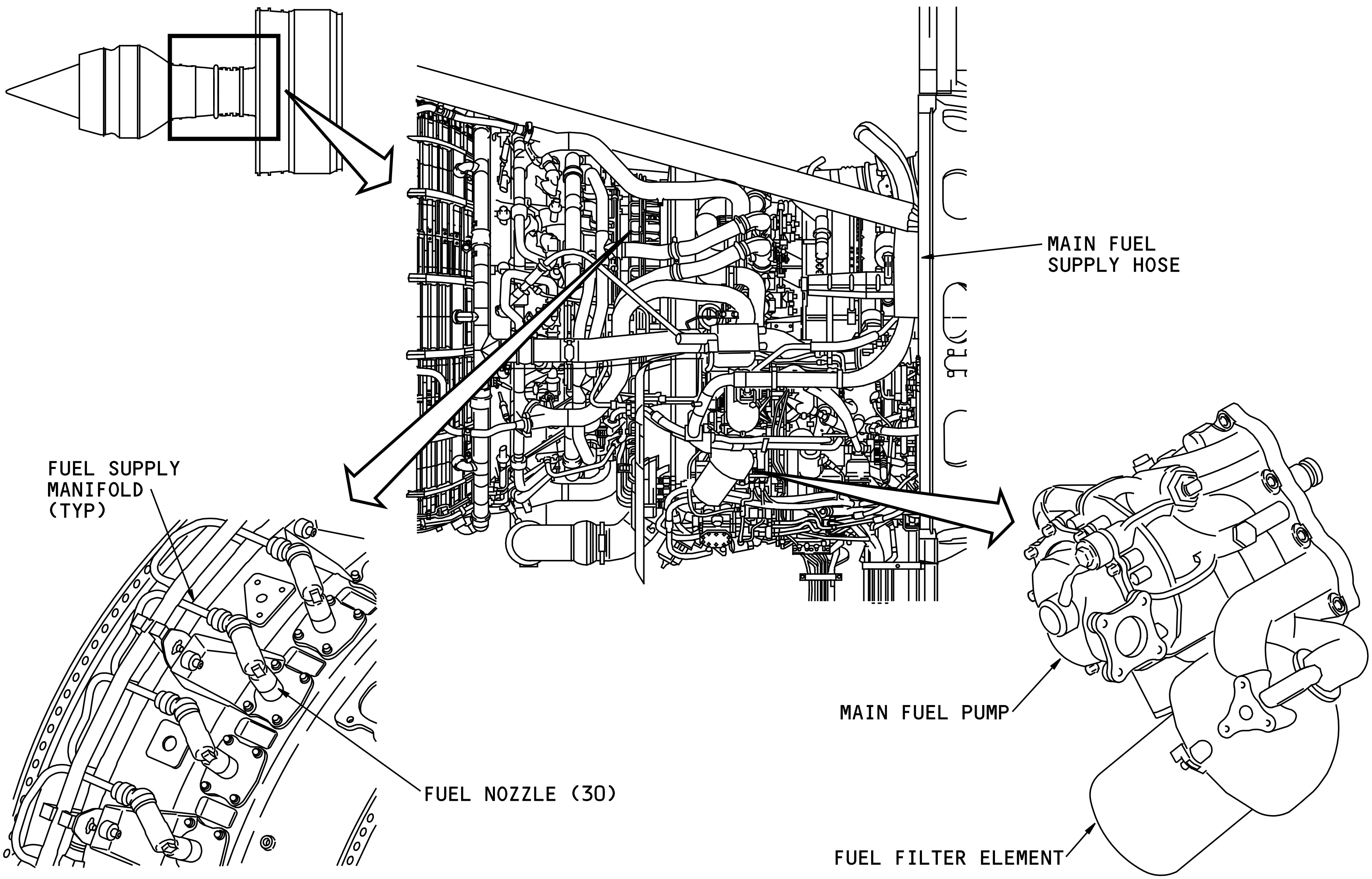
Component Locations

The main fuel supply hose is on the right side of the engine core. It goes from the forward engine strut to the main fuel pump.

The main fuel pump attaches to the aft, right face of the main gearbox. The fuel filter element attaches to the main fuel pump.

The two fuel supply manifolds attach to the compressor rear frame around the engine.

The 30 fuel nozzles attach to the combustor diffuser nozzle case around the engine.



ENGINE FUEL DISTRIBUTION - COMPONENT LOCATIONS

ENGINE FUEL DISTRIBUTION - MAIN FUEL PUMP

General

The main fuel pump pressurizes and cleans fuel from the airplane fuel system. It is on the aft face of the gearbox. The pump has external and internal connections for fuel flow.

The main fuel pump has a pump and a filter assembly element.

Fuel Pump

The fuel pump is a two-stage pump. The main gearbox turns the pump. The pump has an external connection for fuel from the airplane tanks. The other fuel flow into and out of the pump is through the fuel adapter on the gearbox (not shown).

The pump has an inlet drain plug. You remove this plug to get access to the strainer between the two pump stages and to drain fuel from the pump.

Fuel Filter Assembly

The fuel filter assembly has these parts:

- Housing
- Filter element
- Bypass valve.

You remove the filter housing to change or inspect the filter element. The filter housing has a ratchet lock. To remove the housing, you must push the ratchet lock while you turn the housing. You drain the fuel from the housing with the drain plug before you remove the housing.

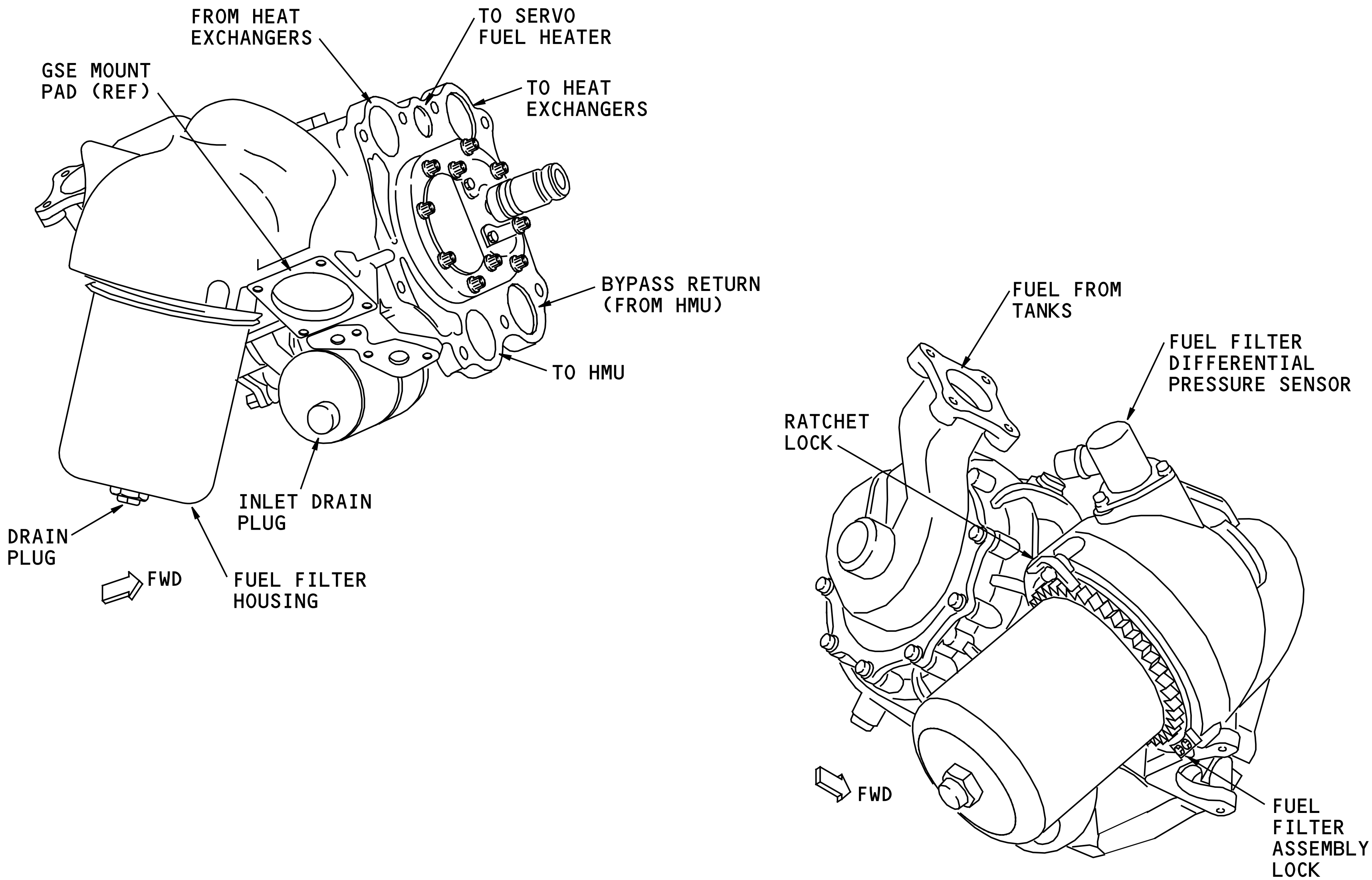
You can remove the filter assembly as a unit. You must remove the filter assembly lock and use a special tool to remove the filter assembly.

Pressure Sensors

The fuel manifold pressure sensor mounts to the forward side of the HMU. This sensor provides the fuel pressure in the HMU manifold 2. The EEC uses this information for fuel system fault monitoring.

The fuel pump has a fuel filter differential pressure sensor on the aft end of the MFP just above the filter bowl.

See the fuel control system section for more information on these sensors (AMM PART I 73-21).



ENGINE FUEL DISTRIBUTION - MAIN FUEL PUMP

ENGINE FUEL DISTRIBUTION - FUEL SUPPLY MANIFOLDS AND NOZZLES

General

Fuel goes through the fuel supply manifolds to 30 fuel nozzles. The fuel nozzles spray fuel into the combustion chamber.

Fuel Supply Manifolds

There is one dual fuel supply manifold which includes these:

- Manifold 1
- Manifold 2.

The fuel supply manifold has two halves to make it easy to remove and install it.

Fuel Nozzles

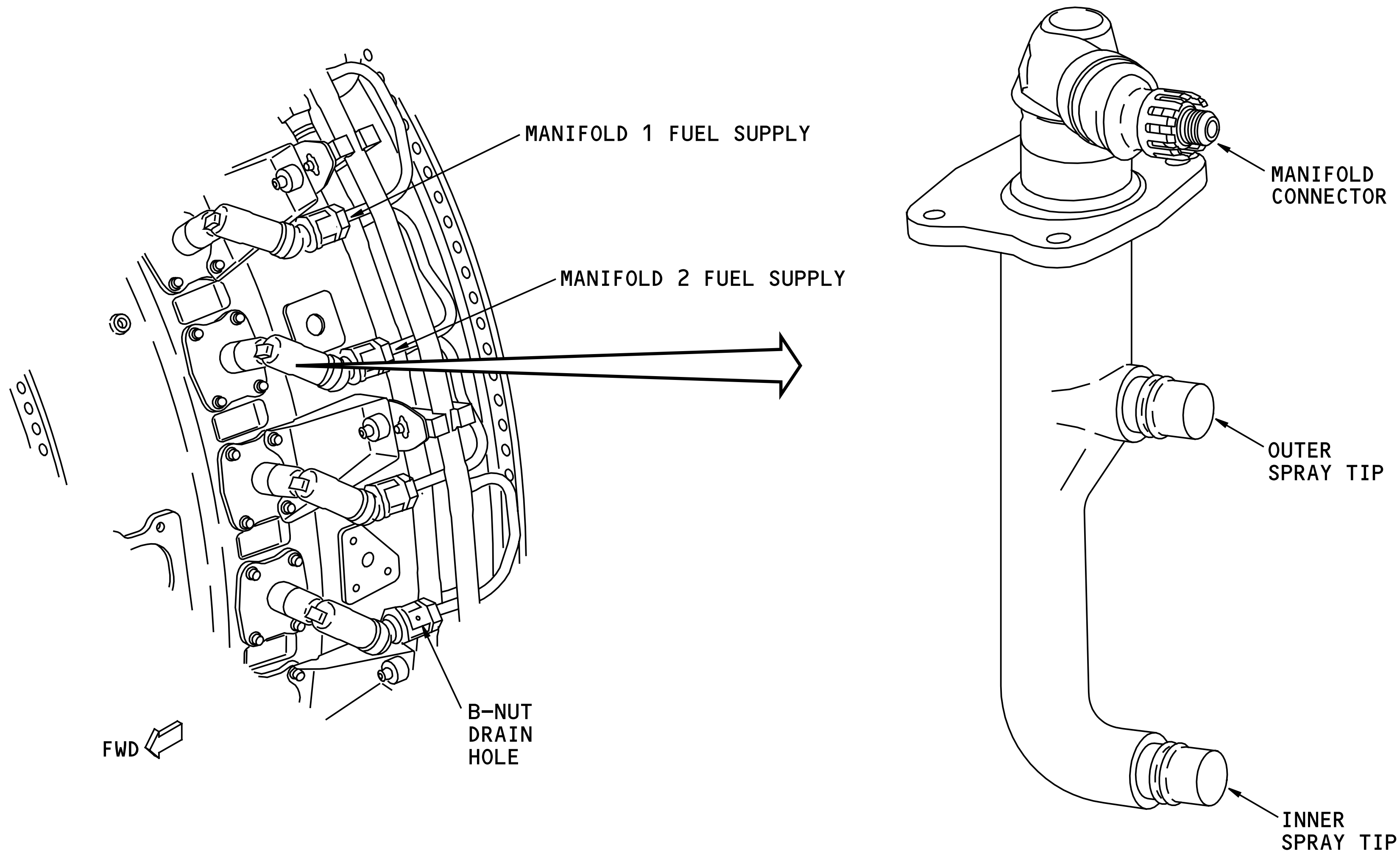
There is one kind of fuel nozzle. Each fuel nozzle has one connector and two spray tips. Twenty fuel nozzles use fuel from manifold 1. Manifold 2 supplies fuel to the other ten fuel nozzles. There are two nozzles with fuel from manifold 1 between each nozzle with fuel from manifold 2.

Fuel comes out of all 60 tips except for these conditions when 40 tips, connected to manifold 1, supply fuel:

- Decel (transient condition)
- Cold day decent idle.

Training Information Point

The fuel manifold connects to the nozzle with a B-nut. There are two seals (not shown) at the connection. If the first seal leaks, the fuel comes out of a small drain hole in the B-nut. You do a check for leaks from the B-nut drain hole after you replace a fuel nozzle.



73-11-00-105 Rev 5 03/12/1998

ENGINE FUEL DISTRIBUTION - FUEL SUPPLY MANIFOLDS AND NOZZLES

ENGINE FUEL DISTRIBUTION - FUNCTIONAL DESCRIPTION

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ENGINE FUEL DISTRIBUTION - FUNCTIONAL DESCRIPTION

General

The main fuel pump pressurizes and cleans fuel from the airplane fuel tanks. The pump supplies the fuel to the HMU and the servo fuel heater. The HMU sends metered fuel to the fuel flow transmitter, then to the fuel supply manifolds. The manifolds connect to the fuel nozzles. The fuel nozzles spray the fuel into the engine for combustion.

Main Fuel Pump

The main fuel pump has two pump stages and a fuel filter element. The boost stage is a centrifugal-type pump. The main stage is a gear-type pump. Fuel goes through both stages of the pump, then to the main and IDG fuel/oil heat exchangers. Fuel then goes back into the pump and through the filter.

After the filter, fuel goes to the HMU. A small amount of fuel also goes through the servo fuel/oil heat exchanger to the HMU. This fuel supplies servo pressure to move HMU valves and engine air system actuators.

The main fuel pump has one sensor, the Fuel filter differential pressure sensor. It sends signals to the EEC.

HMU

The HMU has these valves to control and distribute the fuel:

- Fuel metering valve (FMV)
- Bypass valve (BPV)
- Engine fuel shutoff valve (SOV)
- Staging valve (SV).

The fuel metering valve controls the amount of fuel that goes to the engine for combustion.

The HMU sends fuel that is not necessary for combustion (bypass fuel) through the bypass valve, back to the gear stage inlet.

The engine fuel shutoff valve opens to permit fuel to go to the engine for combustion. After the engine fuel shutoff valve, the fuel goes through the fuel flow transmitter.

See the fuel control system section for more information on the HMU (AMM PART I 73-21).

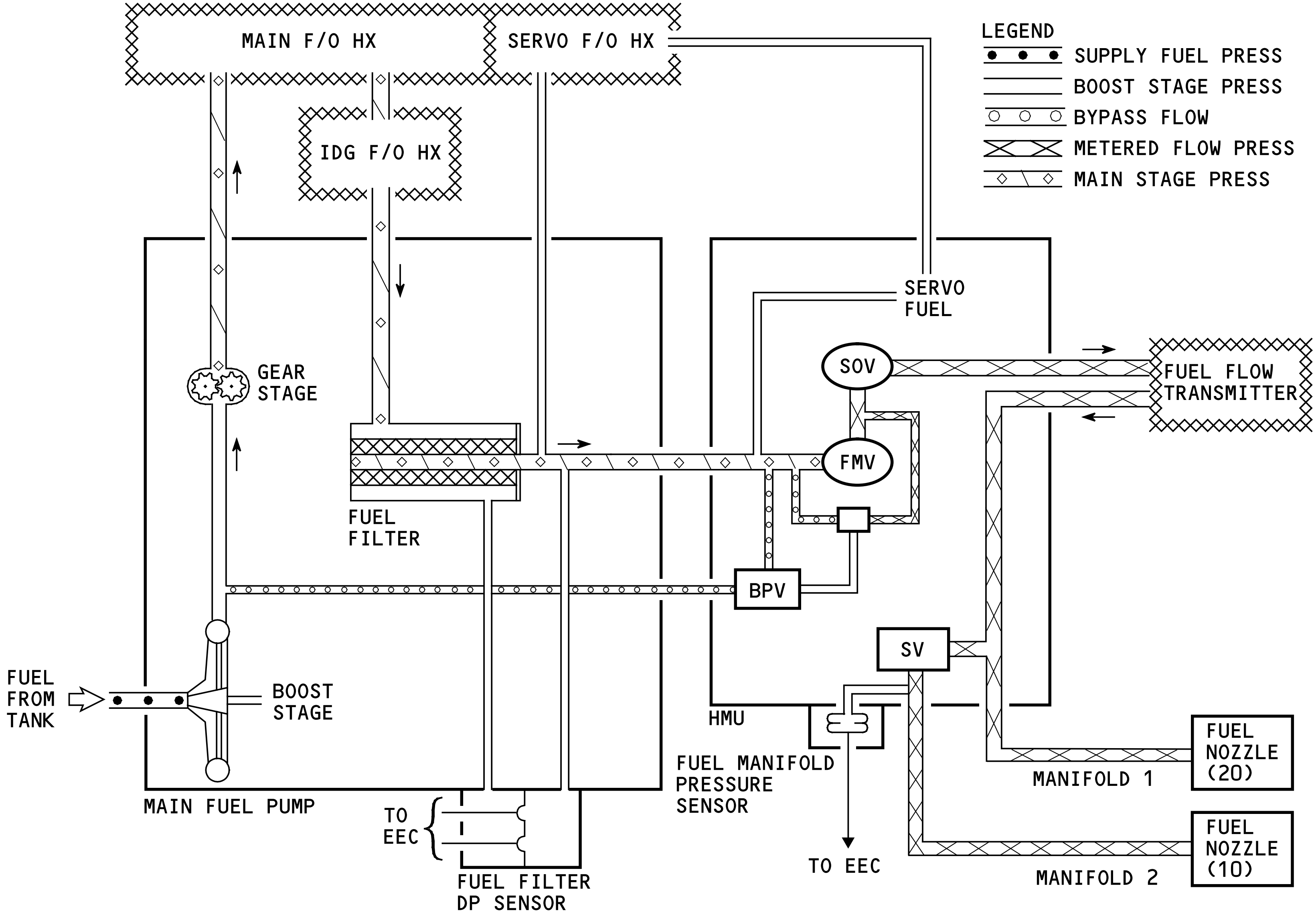
Fuel Flow

Fuel returns to the HMU from the fuel flow transmitter. The HMU distributes the fuel to the two manifolds. Fuel flow to manifold 2 is controlled by the staging valve (SV).

The manifolds distribute fuel to 30 nozzles. Fuel in manifold 1 goes to 20 fuel nozzles. Fuel in manifold 2 goes to the other ten fuel nozzles.

ENGINE FUEL DISTRIBUTION - FUNCTIONAL DESCRIPTION

When the engine is at idle and above, fuel goes to both manifolds. The staging valve closes during cold day descent idle and transient rapid decel operations.



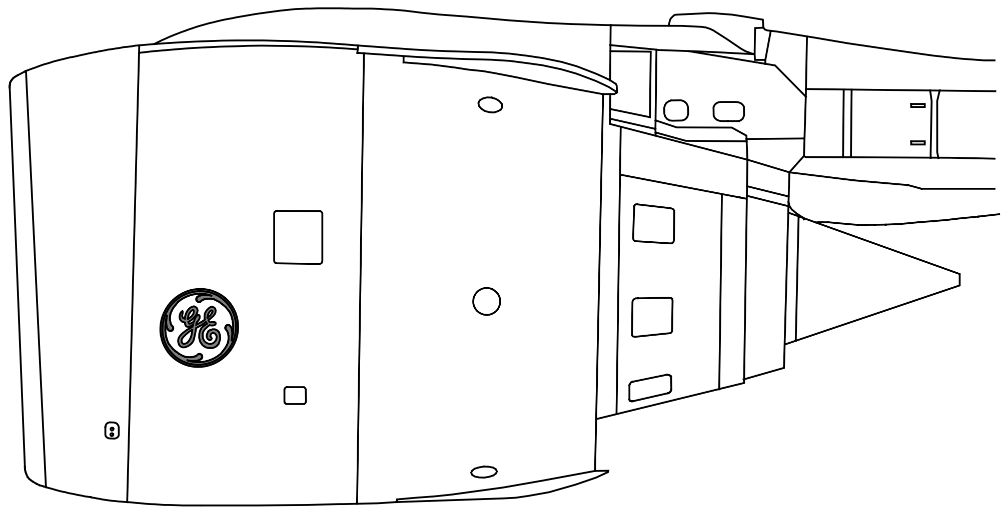
ENGINE FUEL DISTRIBUTION - FUNCTIONAL DESCRIPTION

ENGINE FUEL CONTROL - INTRODUCTION

General

The engine fuel control system controls the flow of fuel to the engine for combustion.

System sensors supply information necessary for correct operation.



ENGINE FUEL AND CONTROL

DISTRIBUTION
- PRESSURIZING
- FILTERING
- INJECTING

CONTROL
- METERING
- SENSING
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- INTERFACES

INDICATING
- FUEL FLOW

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ENGINE FUEL CONTROL - INTRODUCTION

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ENGINE FUEL CONTROL - GENERAL DESCRIPTION

General

The EEC is the primary component of the engine fuel control system. The EEC uses data from engine sensors and airplane systems to control the engine operation.

POWER

The EEC gets power from two sources, the airplane or the engine. When the engine is not running, the electrical load management system (ELMS) supplies airplane power to the EEC. The ELMS supplies power to the EEC when any of these conditions occur:

- Fuel control switch is in the RUN position
- Start/ignition selector is in the START position
- EEC maintenance switch is in the TEST position.

When the engine is running, the control alternator supplies power to the EEC. If the control alternator has a failure, the ELMS supplies power to the EEC.

EEC

The EEC is a two channel computer that controls the operation of the engine. Each channel can completely control the operation of the engine.

The EEC uses N1 to calculate thrust. The EEC controls thrust in three different modes:

- Normal
- Soft reversionary
- Hard reversionary (alternate).

When the EEC is in the soft or hard reversionary mode, the thrust calculations are less accurate. The EEC goes into soft reversionary mode automatically. You push the EEC mode switch to put the EEC in hard reversionary mode.

The EEC also controls many components in other engine subsystems and gets feedback of their status.

The EEC monitors engine sensors to get data. It is also the interface for some sensors with thier systems.

When you move the fuel control switch from RUN to CUTOFF, the EEC resets. When the EEC resets, it writes all fault data in its non-volatile memory (NVM). The reset also sets the engine start logic to run from the start of the program.

HMU

The EEC controls valves in the HMU to supply metered fuel flow to the engine and to distribute fuel to the fuel nozzles. The EEC also controls torque motors in the HMU to supply servo fuel to engine air system actuators (not shown). The HMU gives the EEC feedback about valve and torque motor positions.

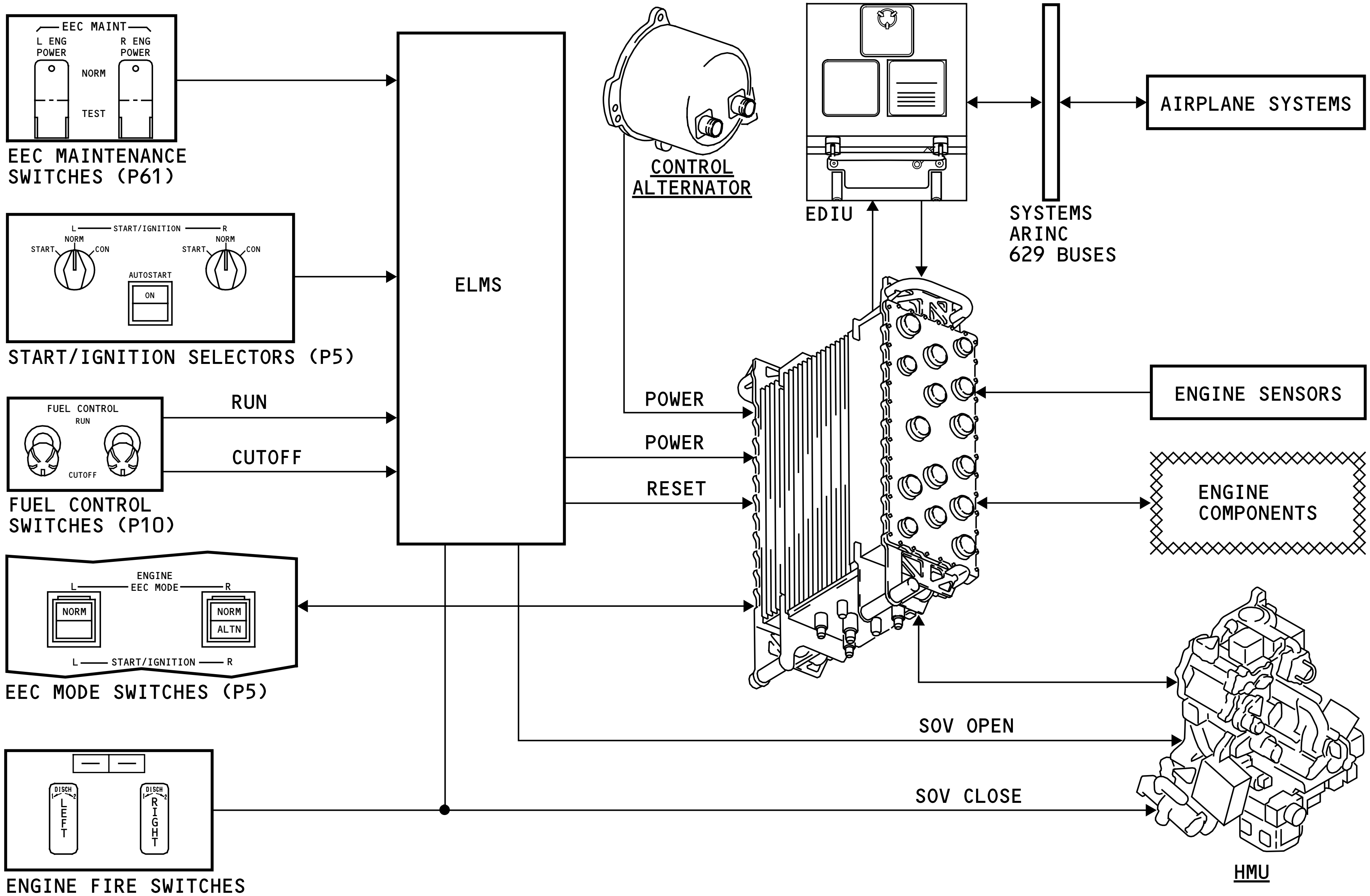
The fuel control switch controls the engine fuel shutoff valve (SOV) in the HMU to start and stop fuel flow to the engine. When you move the fuel control switch to the RUN position, the ELMS sends power to

ENGINE FUEL CONTROL - GENERAL DESCRIPTION

open the valve. When you move the fuel control switch to the CUTOFF position, the ELMS sends power to close the valve. The valve also closes when you pull up on the engine fire switch.

EDIU

The engine data interface unit (EDIU) changes the ARINC 429 formatted data of the EEC to ARINC 629. It also changes ARINC 629 data to ARINC 429. This permits the EEC to transmit data to and receive data from airplane systems.



ENGINE FUEL CONTROL - GENERAL DESCRIPTION

ENGINE FUEL CONTROL - ENGINE COMPONENT LOCATIONS - 1

Component Locations - Engine Right Side

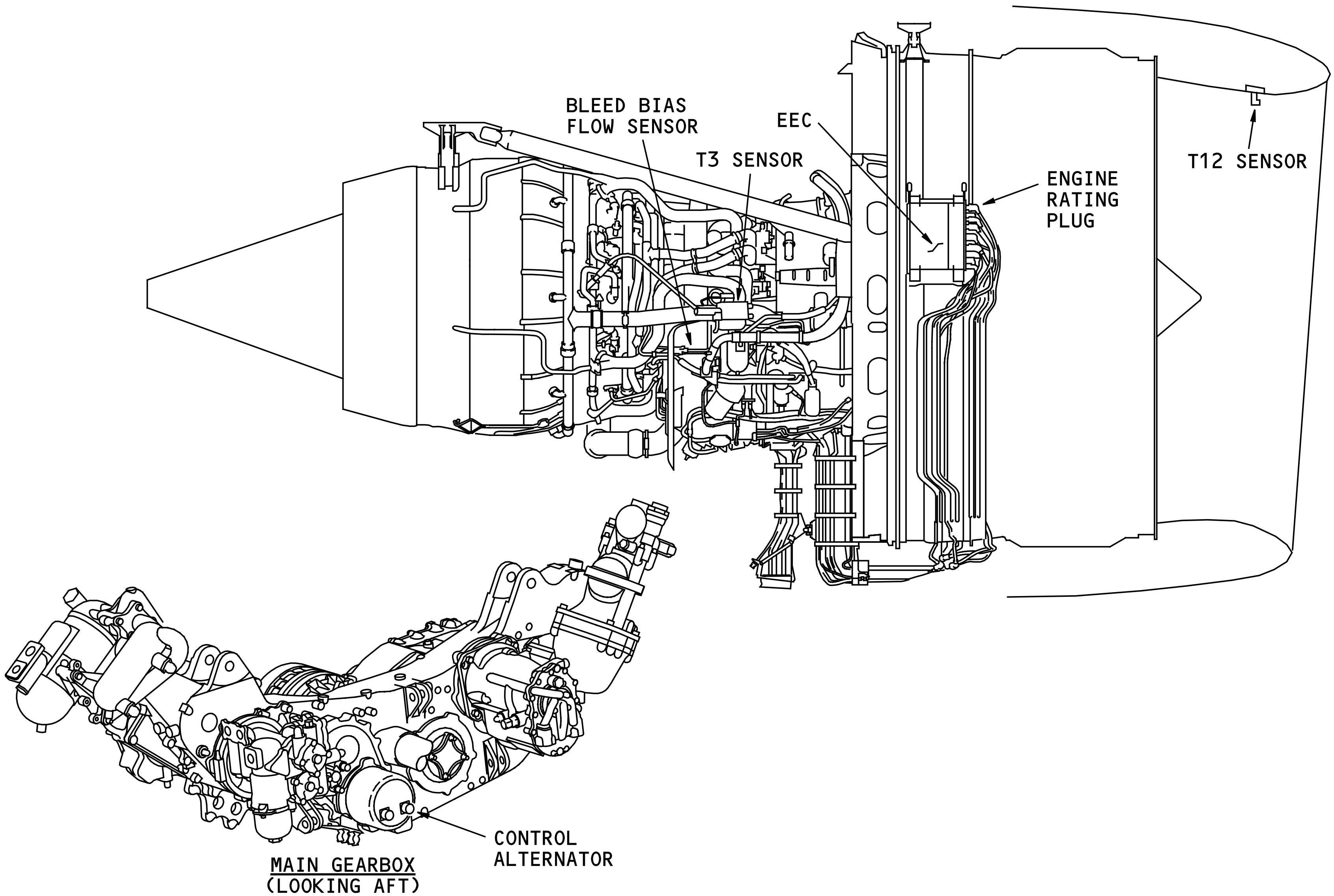
Most of the engine fuel control components are on the right side of the engine. These are the components:

- EEC
- Engine rating plug
- T12 sensor
- T3 sensor
- Bleed bias flow sensor.

The EEC attaches to the fan case. The engine rating plug is on the EEC.

Component Locations - Main Gearbox Front Face

The control alternator is on the front face of the main gearbox.



73-21-00-103 Rev 1

ENGINE FUEL CONTROL - ENGINE COMPONENT LOCATIONS - 1

ENGINE FUEL CONTROL - ENGINE COMPONENT LOCATIONS - 2

Engine Left Side Component Locations

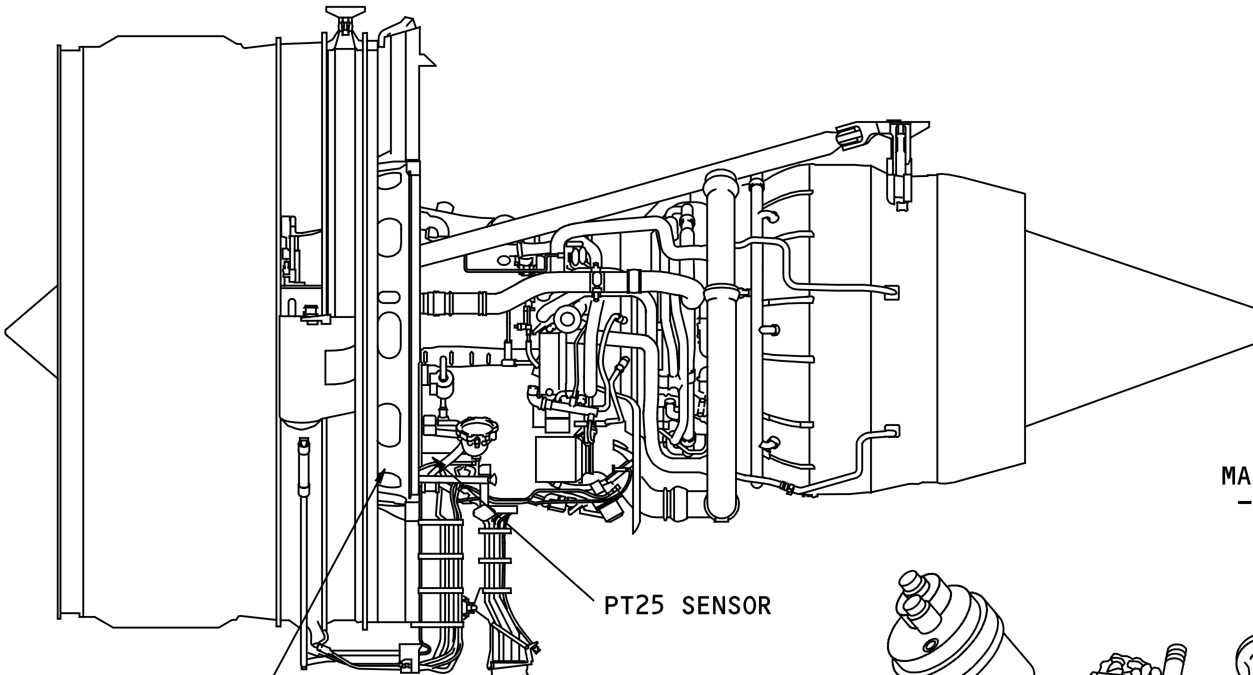
These components are on the left side of the engine:

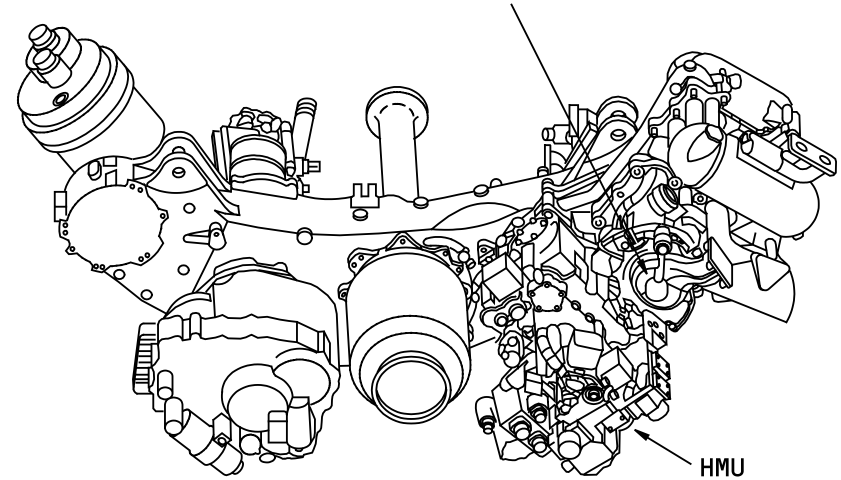
- Engine identification (ID) box
- Configuration Box

Main Gearbox Aft Face Component Locations

The HMU is on the aft face of the main gearbox.

The main fuel pump is mounted to the aft side of the main gearbox. The Fuel filter differential pressure sensor is on the main fuel pump.





MAIN GEARBOX
(LOOKING FORWARD)

ENGINE FUEL CONTROL - ENGINE COMPONENT LOCATIONS - 2

ENGINE FUEL CONTROL - AIRPLANE COMPONENT LOCATIONS

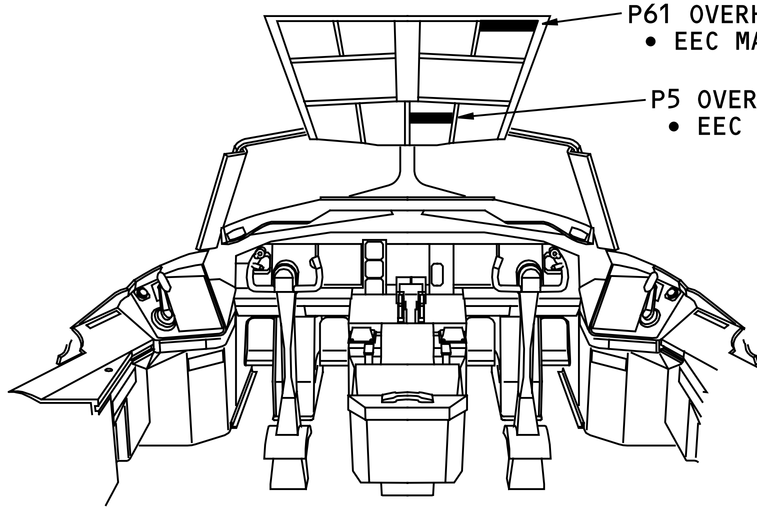
Flight Deck

The EEC mode switches are part of the start/ignition controls on the P5 overhead panel.

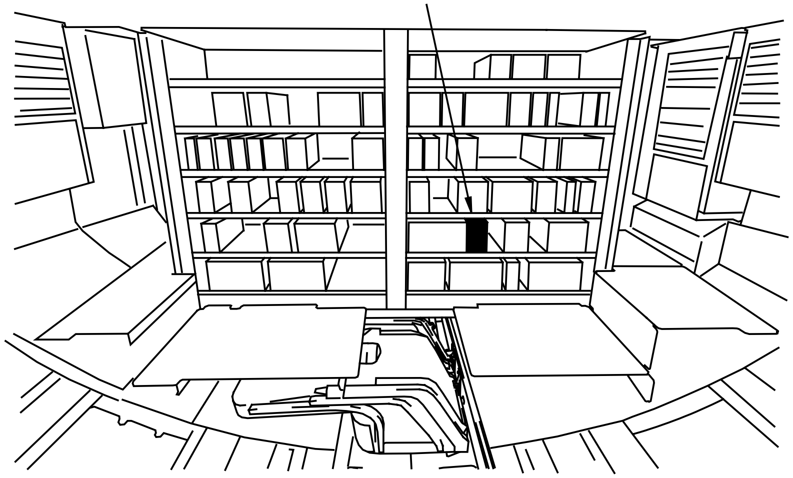
The EEC maintenance switches are on the P61 overhead maintenance panel.

Main Equipment Center

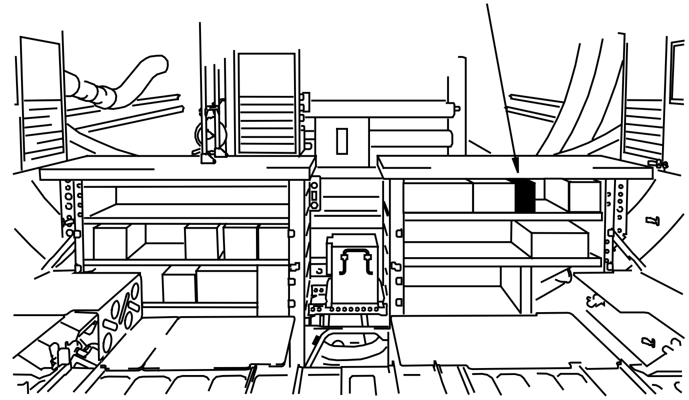
The two EDIUs are in the main equipment center. The left EDIU is on the E1-5 shelf. The right EDIU is on the E4-1 shelf.



FLIGHT DECK



MAIN EQUIPMENT CENTER
(LOOKING AFT)



MAIN EQUIPMENT CENTER
(LOOKING FORWARD)

73-21-00-105 Rev 0

ENGINE FUEL CONTROL - AIRPLANE COMPONENT LOCATIONS

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ENGINE FUEL CONTROL - AIRPLANE INTERFACES

General

The engine fuel control system has many interfaces with airplane components and systems. Most of the interfaces are digital, but some are analog. The interfaces are with the EEC and EDIU. The EDIU permits digital interfaces with the EEC.

Analog Interfaces

These components have analog interfaces with the engine fuel control system:

- EEC mode switch
- Thrust lever angle (TLA) resolver
- Thrust reverser interlock actuator
- Fuel control switch
- EEC maintenance switch
- Start/ignition selector
- ELMS.

EEC Mode Switch

The EEC mode switch sends a signal to the EEC to put it into the normal or alternate mode of control. The EEC turns on the ALTN light in the mode switch to tell you to put the switch into the alternate position.

Thrust Lever Angle Resolver

The TLA resolver supplies the EEC with a signal in proportion to the thrust lever position. The EEC supplies power to the resolvers.

Thrust Reverser Interlock Actuator

The EEC energizes the thrust reverser (T/R) interlock actuator during reverser operation when the reverser extends. The EEC supplies a ground through the ELMS to energize the actuator.

Fuel Control Switch

When you move the fuel control switch to the RUN position, a signal permits the ELMS to supply ac power to the EEC. When you move the fuel control switch from RUN to CUTOFF, the ELMS sends a reset signal to each EEC channel. The reset signal stops the programs of the EEC and sets them to run from the start (boots the computer).

EEC Maintenance Switch

The EEC maintenance switch permits the ELMS to supply ac power to the EEC during maintenance operations.

Start/Ignition Selector

The start/ignition selector sends a start signal to the EEC and permits the ELMS to supply ac power to the EEC. The selector is held in the START position by a ground in the AIMS.

ENGINE FUEL CONTROL - AIRPLANE INTERFACES

AIMS

The AIMS transmits and receives a large amount of data to and from the EEC. This is a summary of that data and its function:

- Bleed status - EEC thrust limit calculations
- Air data - EEC thrust limit calculations
- Engine data - system data requirements
- Autothrottle trim - thrust balancing
- Condition monitoring - performance tracking
- Maintenance data - fault isolation
- EICAS data - indication.

FSEU

The FSEU supplies the EEC with flap position data for idle and ignition logic.

Card File

The card file supplies the EEC anti-ice bleed status and air driven pump status for idle logic.

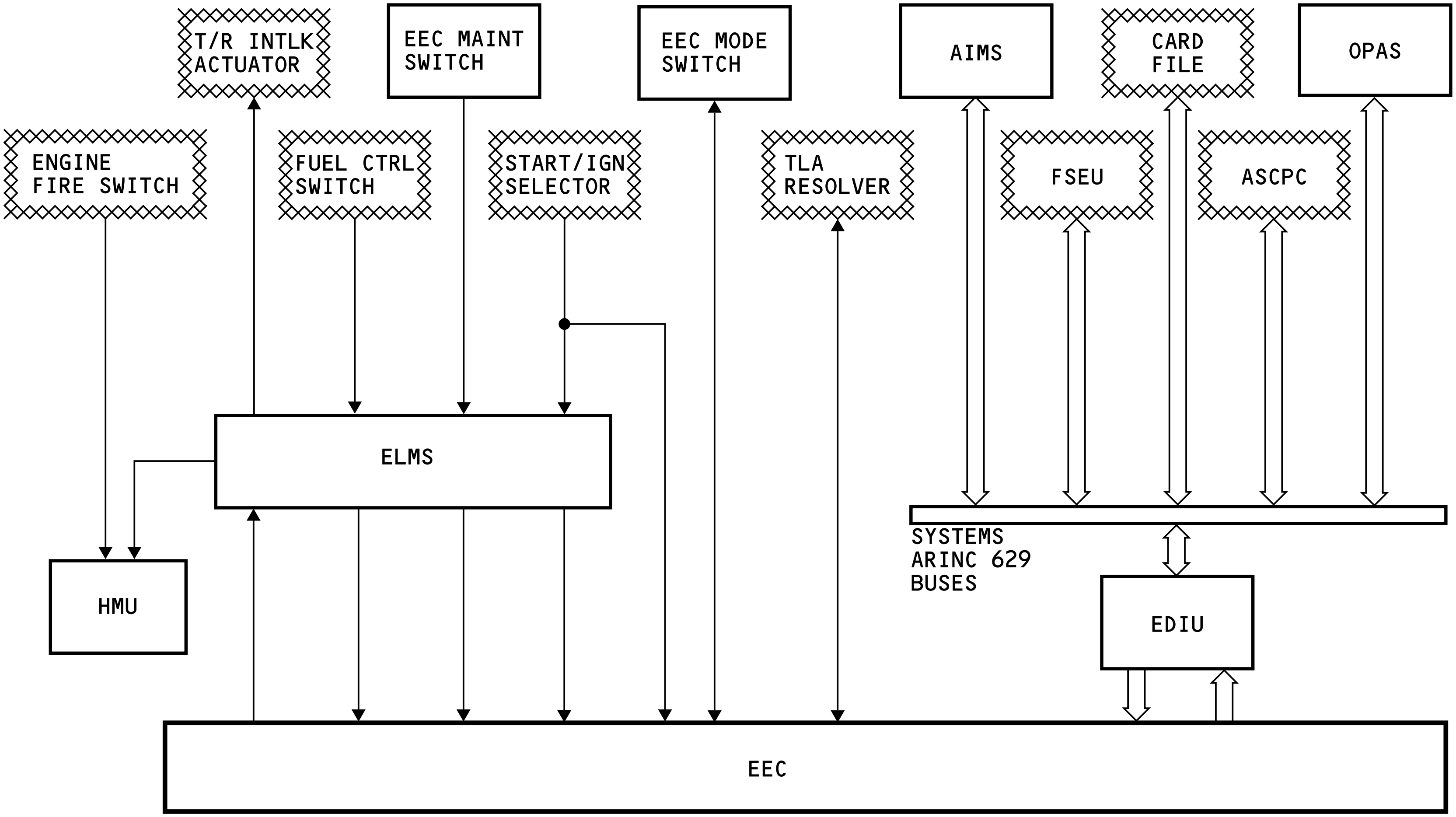
ASCPC

The ASCPC supplies the EEC with duct pressure, and pressure regulating and shutoff valve status. The EEC uses this information for thrust calculations, start control, and idle speed control.

OPAS

The OPAS sends a digital signal of these switch positions to the EEC:

- Autostart switch
- EEC maintenance switch
- Start/ignition selector.



ENGINE FUEL CONTROL - AIRPLANE INTERFACES

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ENGINE FUEL CONTROL - ENGINE INTERFACES

General

The EEC controls most engine components and receives feedback from them. Many components send data to the EEC for engine operation.

The EEC uses torque motor drivers to move multiple-position actuators. It uses solenoid drivers to move two-position open/close valves.

Engine Rating Plug

The engine rating plug selects the software in the EEC that corresponds to the thrust rating of the engine. It connects to the EEC.

Configuration Box

The configuration box supplies data on the correct version of the engine hardware to the EEC.

Engine Identification Box

The engine identification (ID) box supplies the EEC with the engine serial number. This input is only connected the first time the EEC gets power.

Control Alternator

The control alternator supplies the EEC with dedicated electrical power.

HMU

The EEC controls these valves in the HMU:

- Fuel metering valve
- Burner staging valve
- Main staging valve.

The EEC also controls torque motors in the HMU that send servo fuel to operate these engine air system components:

- VSVs
- VBVs
- STB valve
- HPT ACC valve.

All these valves and components send position feedback signals to the EEC.

Starter Air Valve

The EEC energizes the starter air valve solenoid to open the valve. The EEC receives feedback of the valve position from the starter air pressure sensor.

Ignition Exciters

The EEC sends 115v ac power to the ignition exciters.

CCC Valve

The EEC energizes the core compartment cooling (CCC) valve solenoid to close the valve. The EEC receives feedback of the valve position from a switch.

LPT ACC Valve

The EEC energizes the LPT active clearance control (ACC) valve solenoid to open the valve. The EEC receives feedback of the valve position from a switch.

T/R Test Enable Switch

The T/R test enable switch puts the EEC into a maintenance mode. This permits the thrust reverser to be extended or retracted without running the engine.

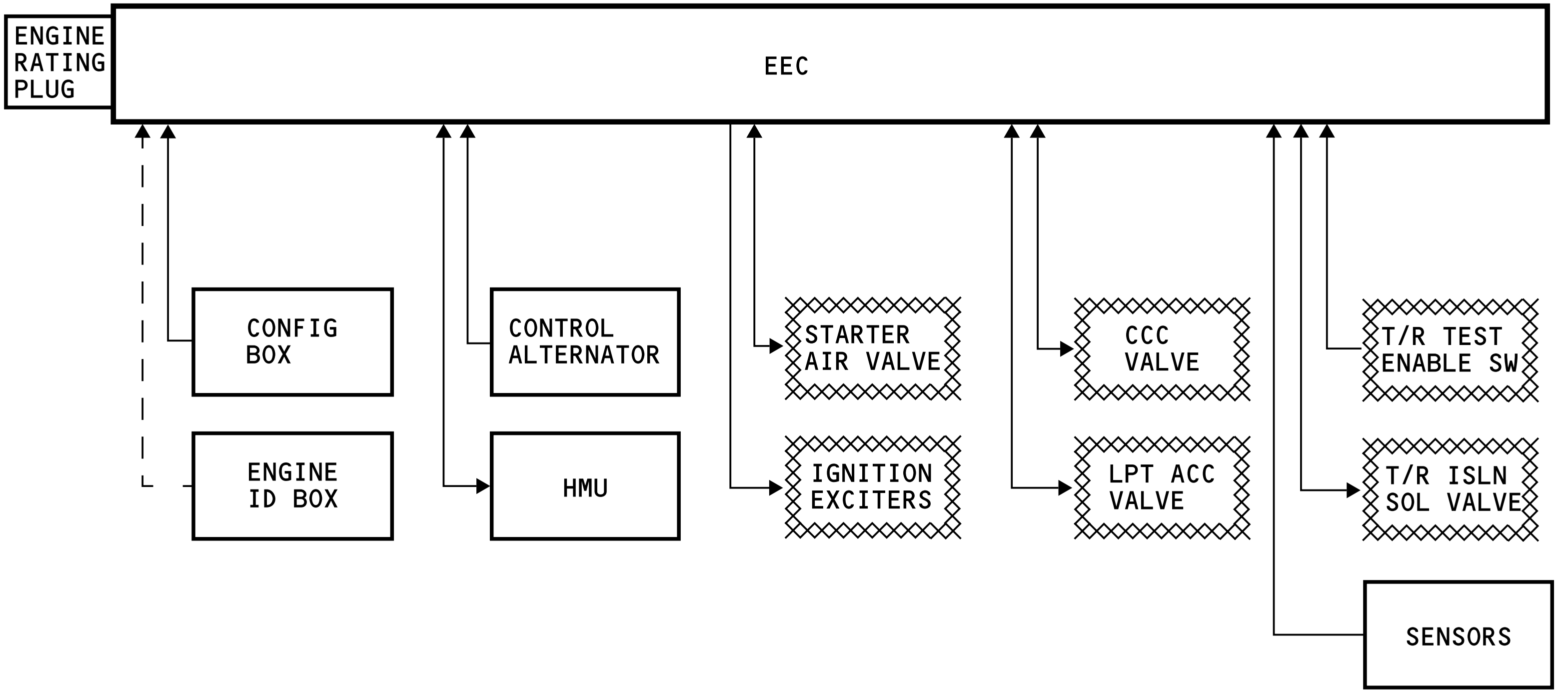
T/R Isolation Valve

The EEC energizes the T/R isolation solenoid valve to open the valve. The EEC receives feedback of the valve position from a pressure switch.

Sensors

Many engine sensors supply this information to the EEC:

- Rotor speeds
- Pressures
- Temperatures
- Valve and actuator positions
- Oil data
- Fuel data.



73-21-00-107 Rev 3 08/24/95

ENGINE FUEL CONTROL - ENGINE INTERFACES

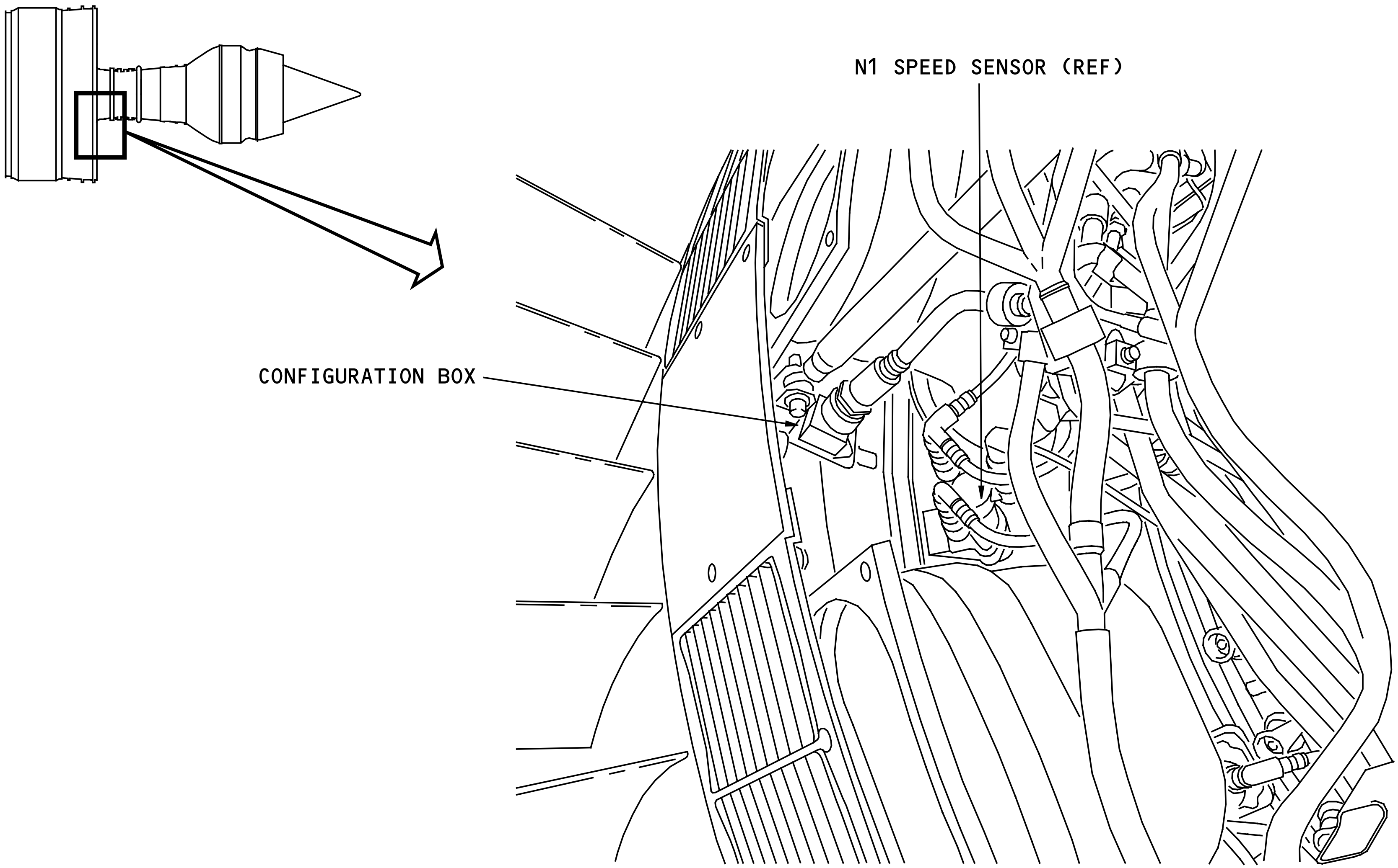
ENGINE FUEL CONTROL - CONFIGURATION / IDENTIFICATION

General

The configuration box is on the left side of the engine on the fan hub frame. The engine serial number (ESN) is input into the EEC through the Special Functions page on the MAT.

Configuration Box

The configuration box supplies data on the correct version of the engine hardware to the EEC. An electrical connector on the box attaches it to the EEC.



ENGINE FUEL CONTROL - CONFIGURATION / IDENTIFICATION

ENGINE FUEL CONTROL - EEC - INTRODUCTION

General

The EEC is a computer that controls the operation of the engine. It attaches to the upper-right fan case with shock mounts. It is cooled by convection.

Electrical Connections

The EEC has fifteen electrical connections labeled J1-J15. J1-J4 connect the EEC to airplane systems. J5-14 are engine inputs to the EEC. The odd numbered connections go to channel A. The even numbered connections go to channel B. Each channel A connection has a colored outline around its base. Each channel B connection has a colored outline with a white stripe around it.

J15 is the engine rating plug connection. The engine rating plug selects the software in the EEC that corresponds to the thrust rating of the engine. The plug attaches to the engine fan case with a lanyard. When you remove the EEC, the plug stays with the engine fan case.

Pneumatic Connections

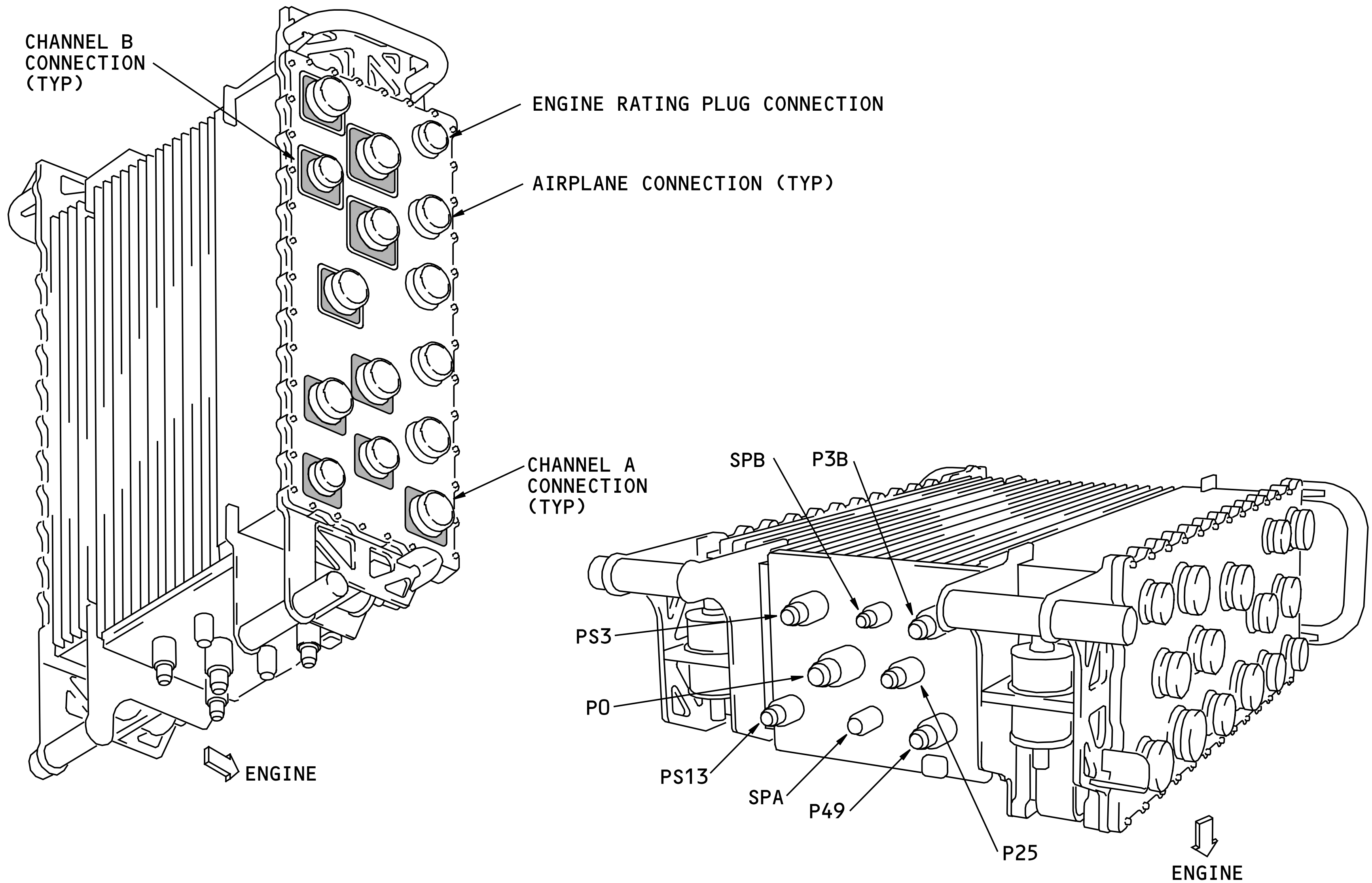
There are eight pneumatic connections on the bottom of the EEC. Transducers inside the EEC change the pneumatic signals to electrical signals. These are the pneumatic connections:

- PS3 (combustion inlet static pressure)
- P3B (HP bleed duct pressure)
- P25 (LPC exit pressure)
- P49 (LPT inlet pressure)
- PS13 (fan exit static pressure)
- P0 (ambient pressure).

SPA and SPB connections are spare pneumatic connections.

Training Information Point

The EEC mount (not shown) has hooks that permit you to hang the EEC on the engine. The hooks support the weight of the EEC while you install the mount bolts.



ENGINE FUEL CONTROL - EEC - INTRODUCTION

73-21-00-109 Rev 3 02/08/1997

ENGINE FUEL CONTROL - EEC - FUNCTIONAL DESCRIPTION

General

The EEC is a two-channel computer that controls the operation of the engine. It has two channels, but only one is in control at a time (active channel). The active channel changes each time you start the engine.

Power

Each channel of the EEC gets power from two sources: airplane and engine. The EEC gets power from the airplane when one or more of these conditions occur:

- Fuel control switch in RUN
- Start/ignition selector in START
- EEC maintenance switch in TEST.

Engine power for the EEC comes from the control alternator. The control alternator has a separate winding for each channel of the EEC. The control alternator starts to supply power at approximately 7 percent N2. The control alternator has priority over airplane power.

Computer

The EEC has two channels with these main sections:

- Processor
- Cross-talk logic
- Input/Output (I/O)
- Memory
- Pressure transducers.

The processor does all of the control calculations. It supplies all the data for the I/O section and control signals to the drivers.

For some inputs, the cross-talk logic compares the signals to channels A and B. If both channels get a good signal, the EEC uses the average of the two signals. If one channel does not get a good signal, the EEC uses only the other channel signal. If both channels get good a signal but they do not agree, the EEC uses a calculated value.

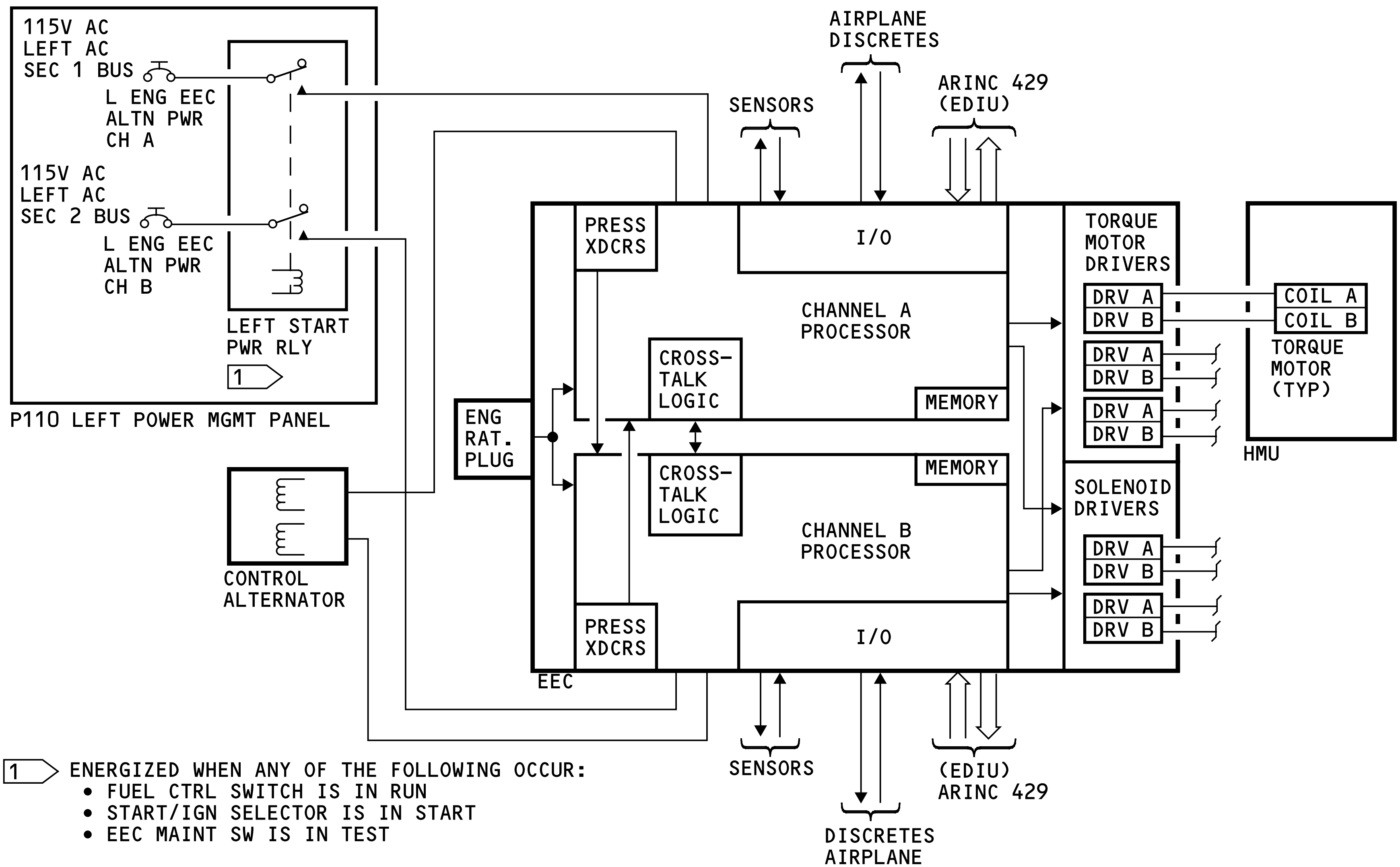
The I/O section receives and transmits digital and analog data.

The EEC has both non-volatile and volatile memory to keep performance and maintenance data.

Each channel has four pressure transducers. They send signals in proportion to the pressure in the lines connected to the EEC. The transducers also send the signals to the other channel. One transducer in each channel is not used.

Output Drivers

The EEC has output drivers that send the control signals to engine components. The active channel of the EEC sends control signals to the drivers. There are torque motor drivers and solenoid drivers.



1 ENERGIZED WHEN ANY OF THE FOLLOWING OCCUR:
- FUEL CTRL SWITCH IS IN RUN
- START/IGN SELECTOR IS IN START
- EEC MAINT SW IS IN TEST

NOTE: LEFT ENGINE SHOWN
RIGHT SIMILAR

ENGINE FUEL CONTROL - EEC - FUNCTIONAL DESCRIPTION

ENGINE FUEL CONTROL - CONTROL ALTERNATOR

General

The control alternator supplies power to the EEC. It attaches to the front of the main gearbox.

Physical Description

The control alternator has a rotor and a stator. The rotor attaches to a shaft on the main gearbox. The stator goes over the rotor and attaches to the gearbox housing.

Engine oil cools the control alternator.

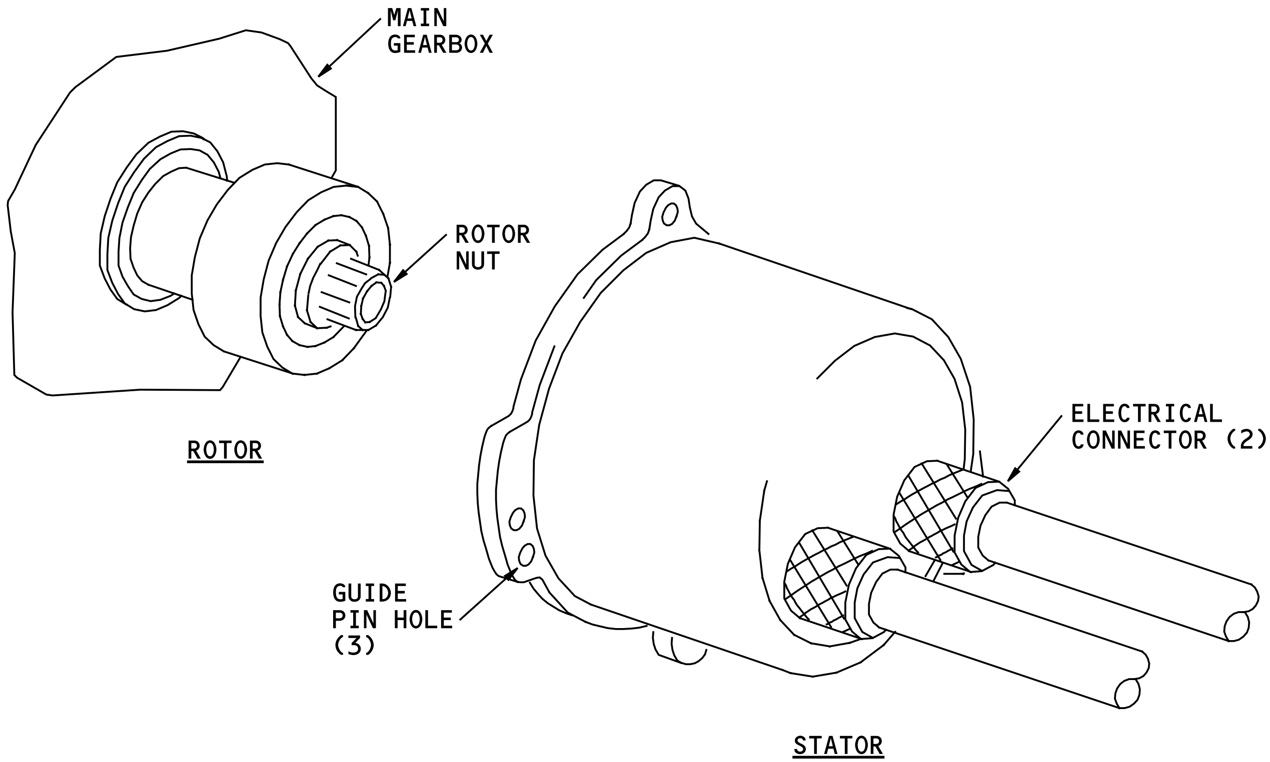
Functional Description

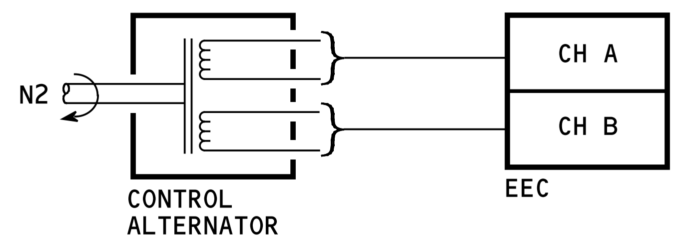
The control alternator makes electrical power when the gearbox turns the rotor inside the stator. The stator has two coils. Each EEC channel gets power from one of the coils when the engine reaches approximately 7 percent N2.

Training Information Point

You use guide pins when you remove or install the stator. The guide pins prevent the stator windings from hitting the rotor. The guide pins install in two places.

A nut holds the rotor on the gearbox shaft. You use a special tool to prevent the rotor drive shaft from turning when you turn the nut.





73-21-00-111 Rev 3

ENGINE FUEL CONTROL - CONTROL ALTERNATOR

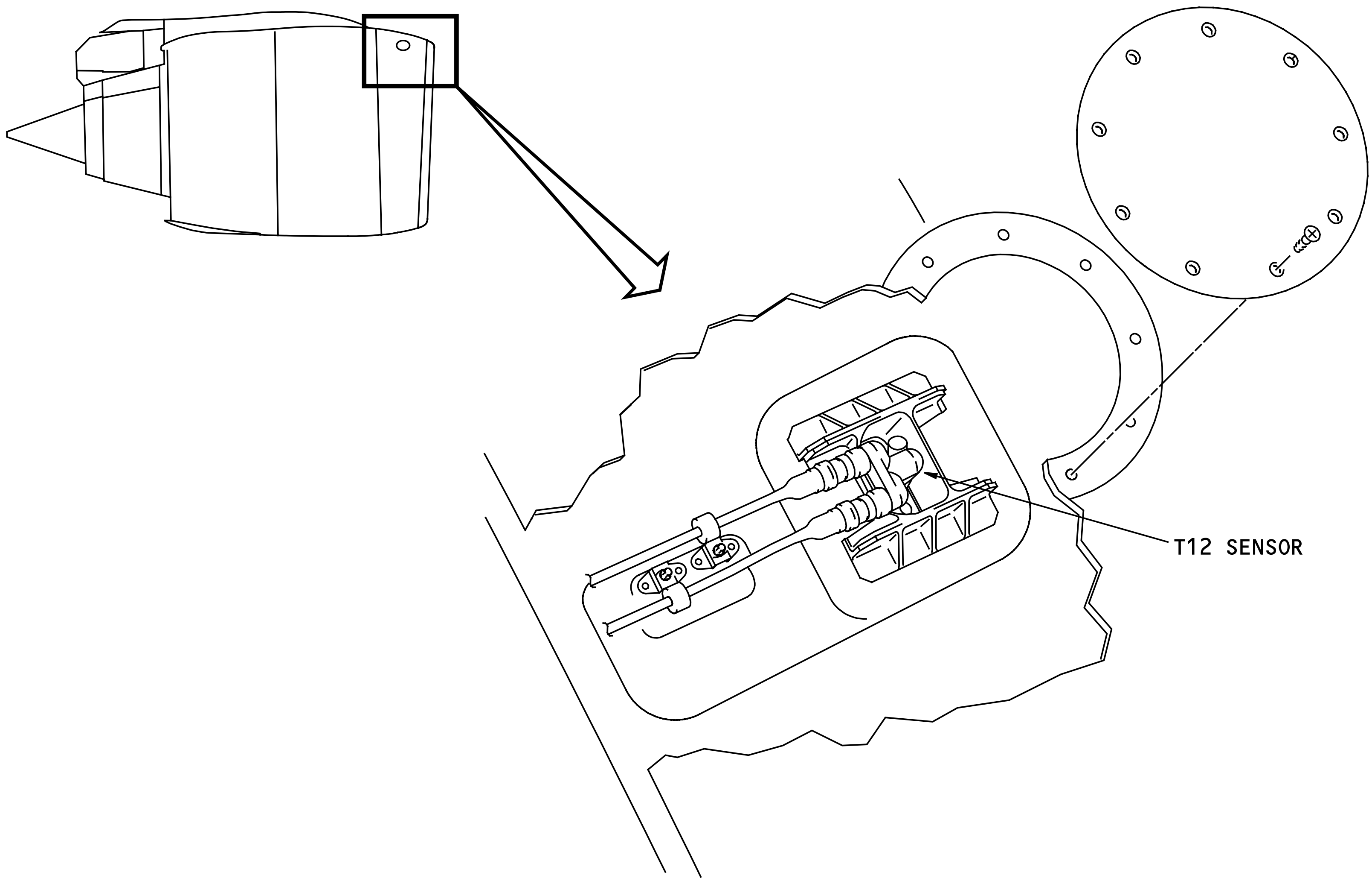
ENGINE FUEL CONTROL - T12 SENSOR

General

The T12 sensor sends the fan inlet air temperature to the EEC. The EEC uses T12 as an input to control fuel flow.

The T12 sensor is on the inlet cowl at the 12:30 position. You get access to the sensor through a panel on top of the inlet cowl.

The T12 sensor has two outputs, one to each channel of the EEC. It is a resistive thermal sensor. The EEC monitors the T12 sensor for faults.



ENGINE FUEL CONTROL - T12 SENSOR

ENGINE FUEL CONTROL - PT25 SENSOR

General

The PT25 sensor supplies HPC inlet pressure and temperature to the EEC. The EEC uses T25 as one of the inputs to control the variable bypass valves (VBV) and variable stator vanes (VSV). The EEC sends P25 to the AIMS as part of the airplane condition monitoring system (ACMS).

The EEC monitors the PT25 sensor for faults.

Location

The PT25 sensor is on the fan hub frame at the 7:00 position.

Temperature Sensing

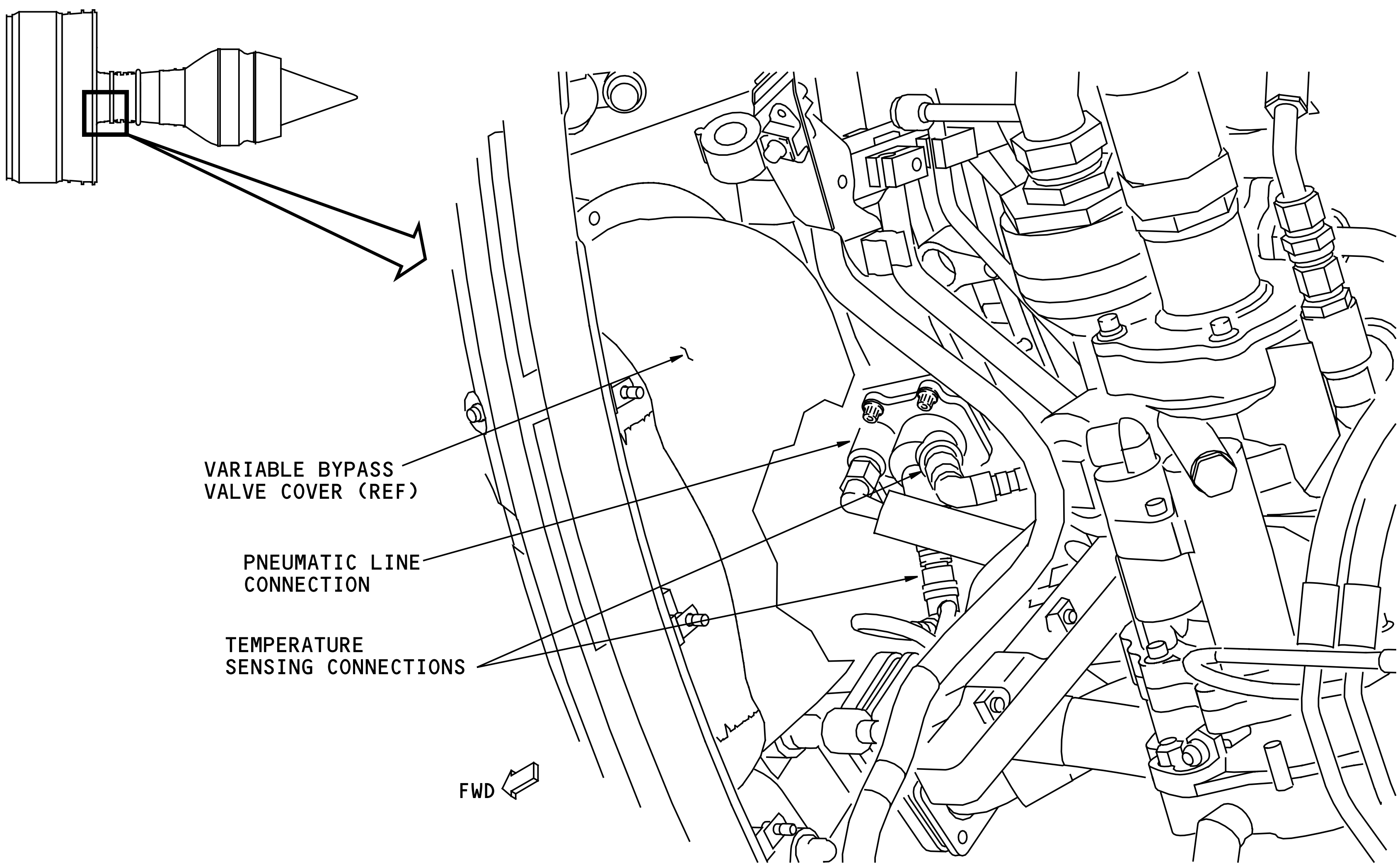
The PT25 sensor has two resistive thermal sensors. There are two outputs, one to each channel of the EEC.

Pressure Sensing

The PT25 sensor has a pneumatic line that goes to a pressure transducer in the EEC. The transducer sends an electrical signal to each channel of the EEC. The electrical signal is proportional to P25.

Training Information Point

You must remove the oil/oil heat exchanger before you can remove the PT25 sensor.



73-21-00-113 Rev 3 03/30/95

ENGINE FUEL CONTROL - PT25 SENSOR

ENGINE FUEL CONTROL - T3 SENSOR

General

The T3 sensor supplies combustion inlet (HPC exit) temperature to the EEC. The EEC uses T3 in some of its calculations.

It is on the combustor diffuser nozzle case at the 3:30 position

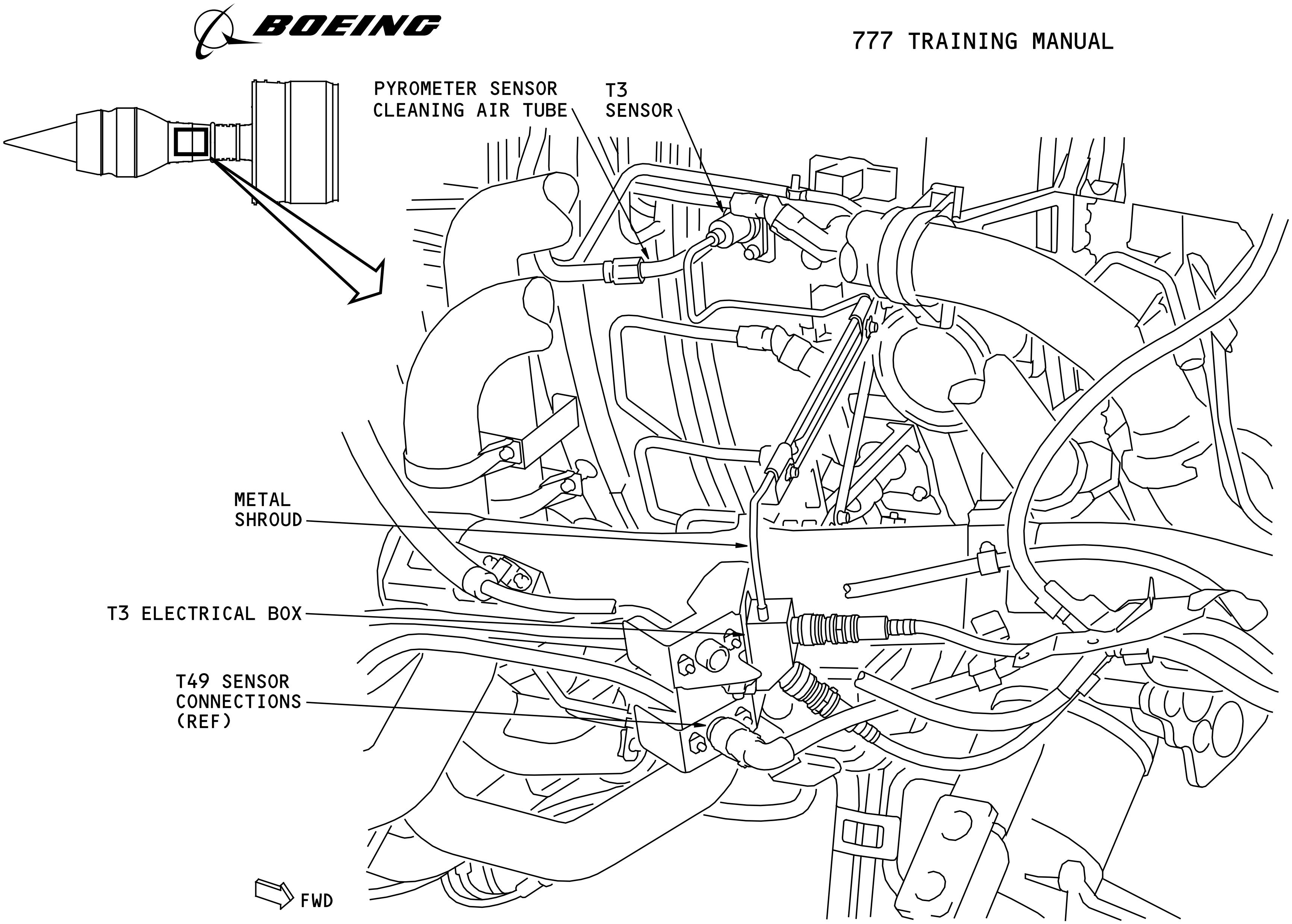
Physical Description

The T3 sensor has two thermocouples. One thermocouple goes to each channel of the EEC. The wires go from the sensor, through a metal shroud, to the electrical box. The electrical box is part of the T3 sensor.

Functional Description

Air from the combustion inlet flows into the T3 sensor and over the thermocouples. The air then goes through a cooling air tube to the pyrometer and flows over the pyrometer lens (not shown). This keeps the lens clean.

The EEC monitors the T3 sensor for faults.



ENGINE FUEL CONTROL - T3 SENSOR

73-21-00-114 Rev 6 08/21/1997

ENGINE FUEL CONTROL - BLEED BIAS FLOW SENSOR

General

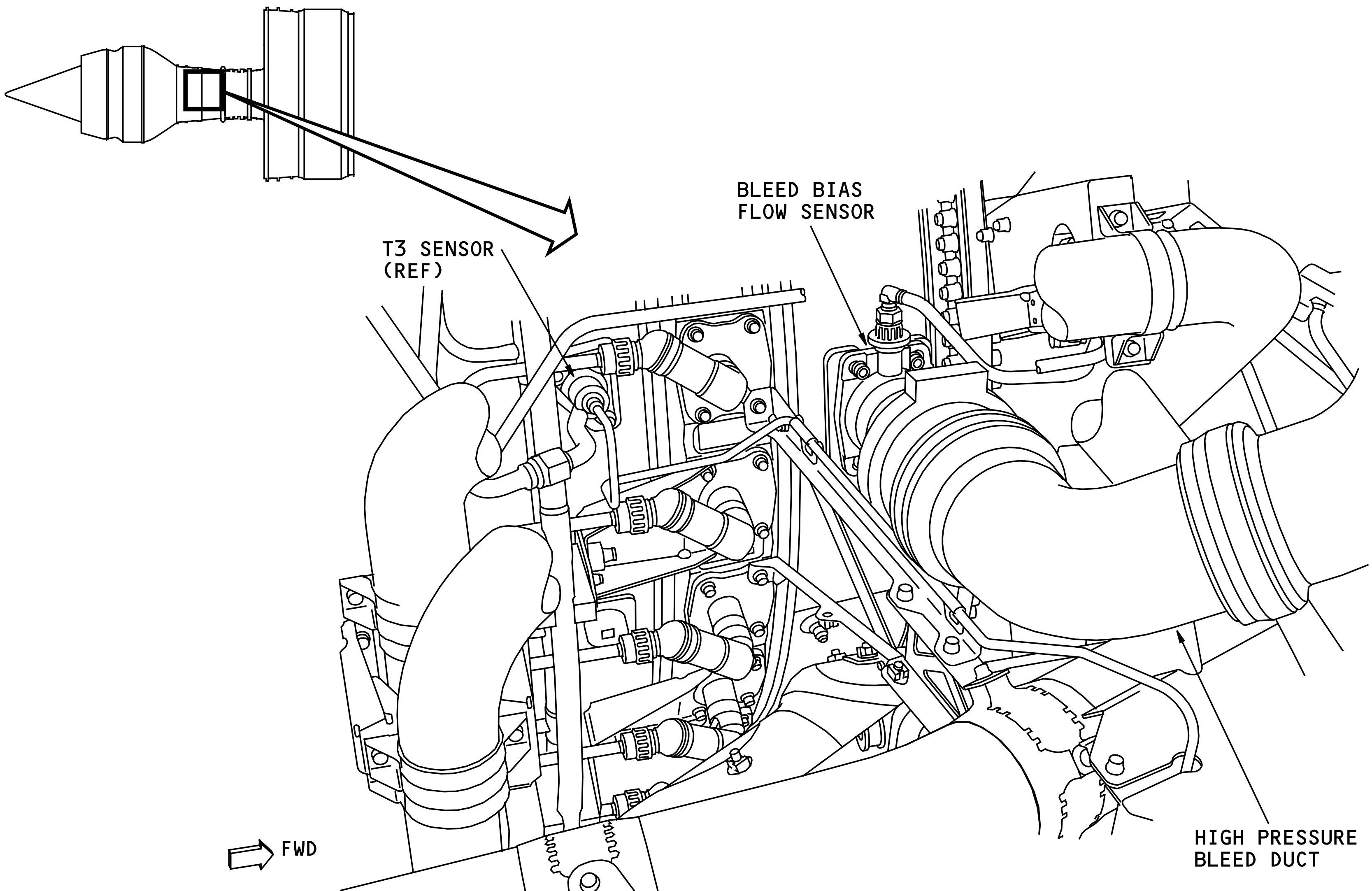
The bleed bias flow sensor has a venturi in the high pressure bleed duct. It supplies the EEC with the static pressure at the throat of the venturi. This pressure is called P3B.

The EEC uses P3B and PS3 (not shown) to calculate the high stage bleed flow rate. The EEC also uses P3B to make adjustments to improve engine acceleration.

It is on the combustor diffuser nozzle case at the 3:30 position. It attaches between the case and the lower high pressure bleed duct.

The bleed bias flow sensor has a pneumatic line that goes to a pressure transducer in the EEC.

The EEC monitors the bleed bias flow sensor for faults.



ENGINE FUEL CONTROL - BLEED BIAS FLOW SENSOR

73-21-00-115 Rev 5 08/21/1997

ENGINE FUEL CONTROL - ACMS SENSORS

Airplane Condition Monitoring System (ACMS)

The ACMS sensors supply specific pressures and temperatures to the EEC. The ACMS monitors the engine condition to look for engine degradation.

PS13 Pressure Probe

The PS13 pressure probe supplies fan exit static pressure to the EEC. It is on the aft fan case at the 2:00 position. The probe connects to a pneumatic line that goes to a pressure transducer in the EEC.

See the engine mounted sensors section for more information about the PS13 sensor (AMM PART I 77-34).

P49 Pressure Probe

The P49 pressure probe supplies LPT inlet total pressure to the EEC. It is on the turbine center frame at the 4:00 position. The probe connects to a pneumatic line that goes to a pressure transducer in the EEC.

See the engine mounted sensors section for more information about the P49 sensor (AMM PART I 77-34).

T5 Sensor

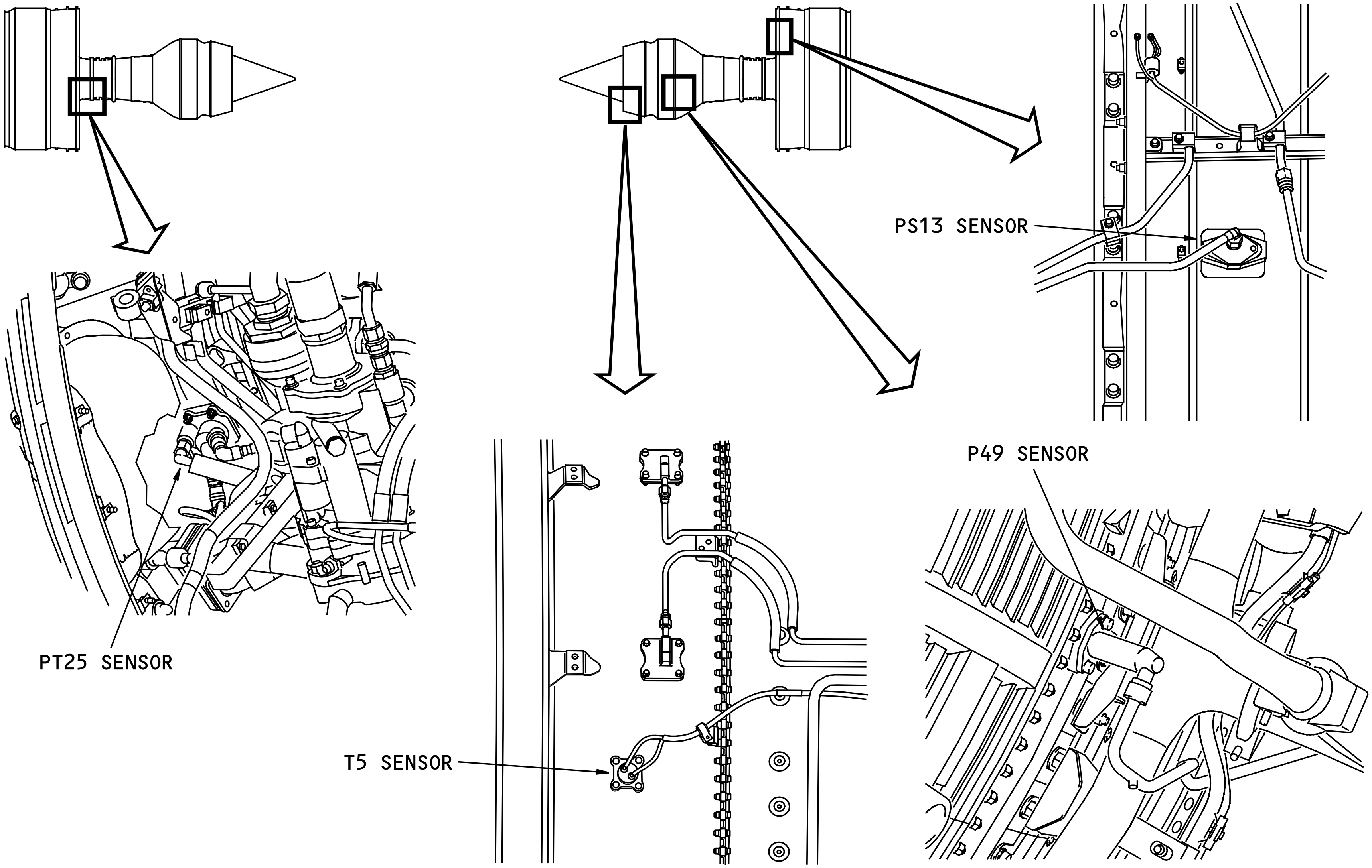
The T5 sensor supplies LPT exit temperature to the EEC. It is on the turbine rear frame at the 5:30 position. The sensor has two thermocouples that go to different depths at the LPT exit. The average of the two thermocouples goes to the EEC.

See the engine mounted sensors section for more information about the T5 sensor (AMM PART I 77-34).

PT25 Sensor

The PT25 sensor supplies HPC inlet pressure and temperature to the EEC. It is on the fan hub frame at the 7:00 position.

The PT25 sensor has a pneumatic line that goes to a pressure transducer in the EEC. The EEC measures the pressure.



ENGINE FUEL CONTROL - ACMS SENSORS

ENGINE FUEL CONTROL - FUEL PRESSURE SENSORS

General

The fuel control system has two pressure sensors. One on the main fuel pump and one on the hydromechanical unit (HMU). Signals from the pressure sensors go to the EEC. The EEC uses the information to monitor the fuel filter, fuel pump and HMU for faults.

These are the pressure sensors:

- Fuel filter differential pressure
- Fuel manifold pressure sensor.

Each sensor has two sensing elements, one for each channel of the EEC. The EEC monitors the sensors for faults.

Fuel Filter Differential Pressure Sensor

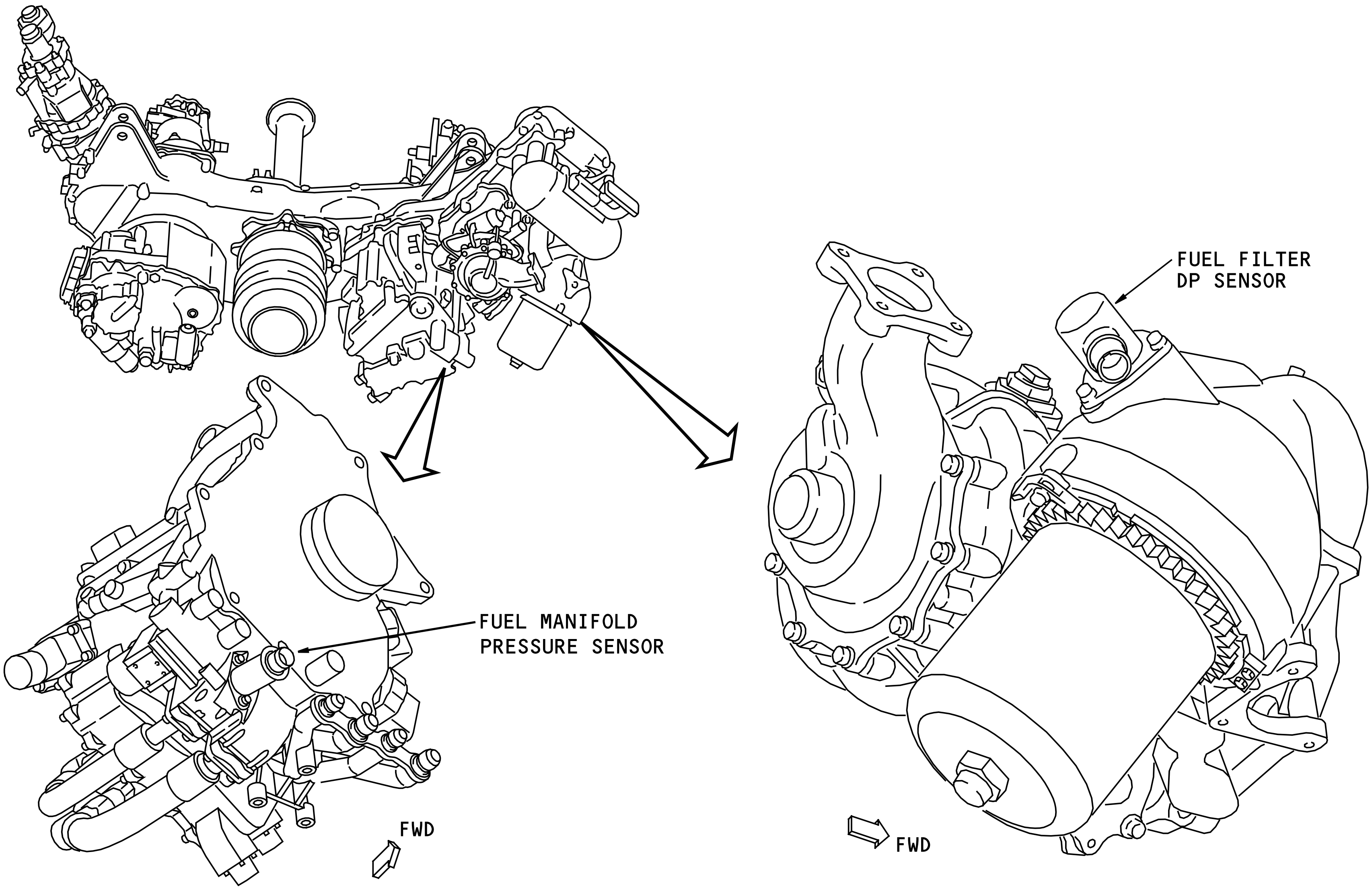
The fuel filter differential pressure sensor measures the fuel pressure on each side of the filter. The EEC sends a signal to the AIMS when the filter begins to clog. The fuel filter will bypass fuel if it becomes clogged.

It is on the aft side of the fuel pump, just above the filter.

Fuel Manifold Pressure Sensor

The fuel manifold pressure sensor (FMPS) measures the fuel pressure in the HMU output to manifold 2. The pressure signal provides the staging valve and pressurizing and shutoff valve position feedback to the EEC. The EEC sends a signal to the AIMS when the sensor has a fault.

It is on the aft side of the hydromechanical unit, just above the fuel feeder hoses.



73-21-00-117 Rev 4 08/21/1997

ENGINE FUEL CONTROL - FUEL PRESSURE SENSORS

ENGINE FUEL CONTROL - HMU - INTRODUCTION

Purpose

The hydromechanical unit (HMU) meters and distributes the proper amount of fuel needed for combustion. It also supplies servo fuel to move actuators and valves of the engine air system.

Location

The HMU is on the aft face of the main gearbox.

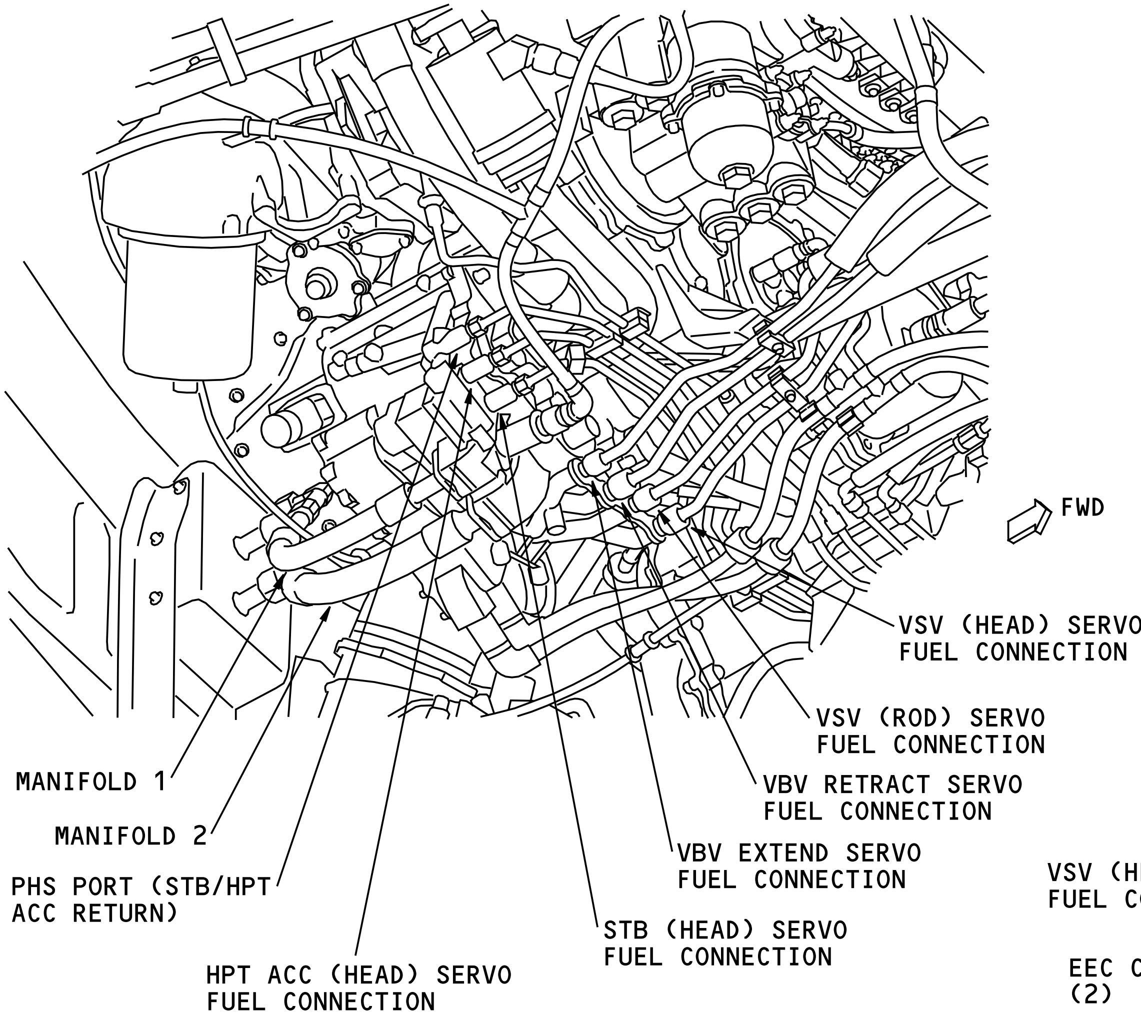
Physical Description

These electrical connections are on the left side of the HMU:

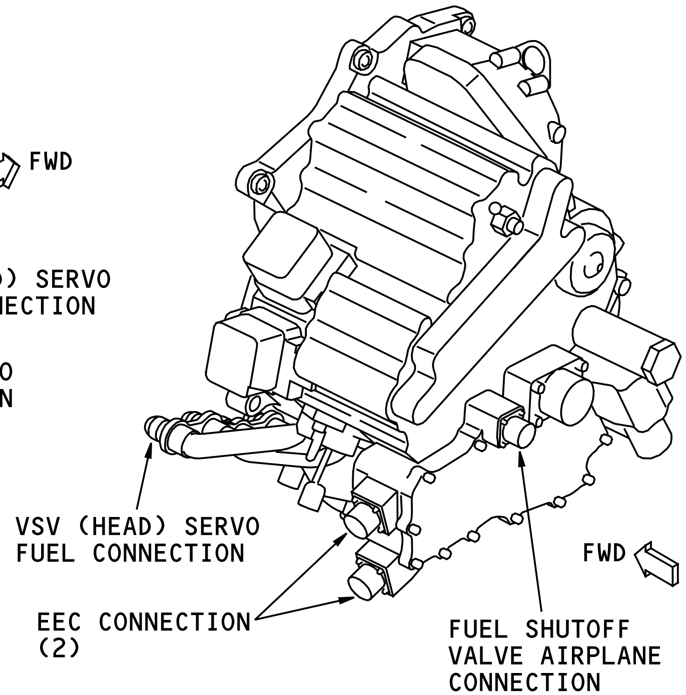
- EEC Connections (2)
- Fuel shutoff valve.

These servo fuel tube and fuel manifold connections are on the bottom of the HMU:

- Manifold 1
- Manifold 2
- PHS port (STB/HPT ACC return)
- HPT active clearance control (ACC)
- Start/transient bleed (STB) valve
- Variable bypass valve (VBV) (2)
- Variable stator vane (VSV) (2).



HMU BOTTOM



HMU LEFT SIDE

73-21-00-118 Rev 1 08/21/1997

ENGINE FUEL CONTROL - HMU - INTRODUCTION

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ENGINE FUEL CONTROL - HMU FUNCTIONAL DESCRIPTION

General

The HMU has these functions:

- Permits only the correct amount of fuel to flow to the engine for combustion
- Turns fuel flow to the engine on or off
- Distributes fuel to the manifolds
- Supplies servo fuel to actuators and valves of other engine systems.

Metered Fuel Flow Control

Fuel flows into the HMU from the fuel pump. The fuel metering valve (FMV) controls how much fuel goes to the engine (metered fuel). Fuel not used for combustion (bypass fuel) returns to the fuel pump through the bypass valve (BPV).

The EEC controls a torque motor in the HMU (not shown) to control the FMV position. The torque motor controls servo fuel pressure to the FMV. The EEC gets FMV position feedback.

An overspeed governor (OSG) mechanically connects the differential pressure regulator to the main gearbox. If the engine overspeeds, the OSG causes the differential pressure regulator to open the bypass valve to send most of the fuel back to the fuel pump.

Run/Cutoff Control

The engine fuel shutoff valve (SOV) turns fuel flow to the engine on or off. The ELMS energizes the run and cutoff solenoids (not shown) to open or close the SOV. The cutoff solenoid also energizes when you pull the fire switch.

When the run solenoid energizes, fuel pressure opens the SOV. The valve stays open until the ELMS energizes the cutoff solenoid. This permits fuel pressure to close the SOV.

Fuel Distribution

After fuel goes through the fuel flow transmitter, it goes to manifold 1 and to the staging valve (SV).

Fuel to manifold 2 goes through the SV. The EEC controls the SV. The fuel manifold pressure sensor (FMPS) provides feedback to the EEC about the positions of the SV and the SOV.

Servo Fuel

The HMU supplies servo fuel pressure to move these engine air system actuators:

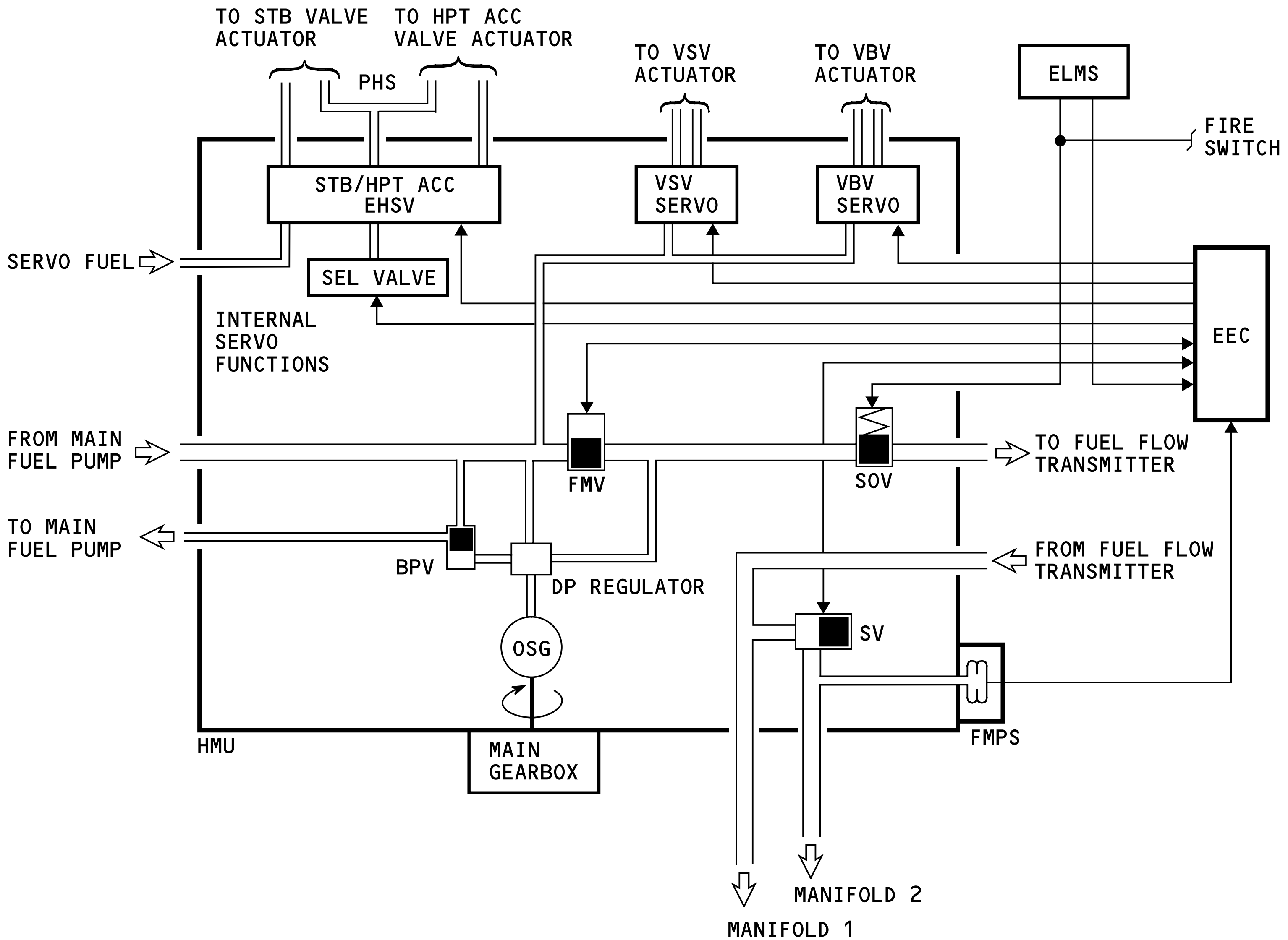
- Start transient bleed (STB) valve
- HPT ACC valve
- Variable stator vanes (VSV)
- Variable bypass valves (VBV).

ENGINE FUEL CONTROL - HMU FUNCTIONAL DESCRIPTION

The EEC controls torque motors and an electro-hydraulic servo valve (EHSV) to let servo fuel pressure go to the actuators.

The STB/HPT ACC EHSV can operate either the STB or the HPT ACC valve but not both at the same time. The EEC controls the selector valve and moves the STB/HPT ACC EHSV in either the STB or HPT ACC operating range. The PHS (pressure heated servo) port supplies a reference pressure of heated servo fuel. There is a port for HPT ACC head pressure and a port for STB head pressure. The HPT ACC and STB valves make the head pressure greater than or less than the PHS reference pressure.

The HMU also uses servo fuel pressure to move internal HMU valves.

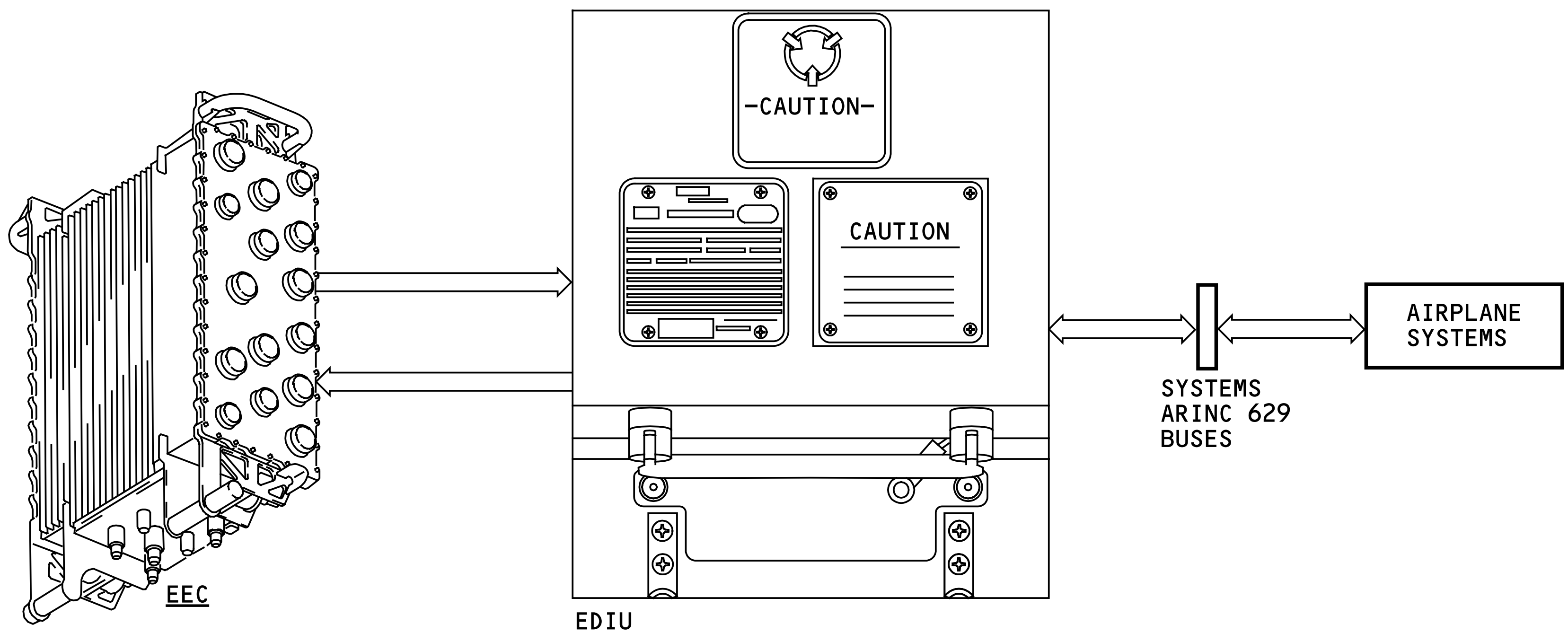


ENGINE FUEL CONTROL - HMU FUNCTIONAL DESCRIPTION

ENGINE FUEL CONTROL - EDIU

General

The EDIU changes the ARINC 429 formatted data to ARINC 629. The EDIU also changes ARINC 629 data to ARINC 429. This permits the EEC to transmit and receive data to and from airplane systems. Each engine has its own EDIU.



73-21-00-120 Rev 0

ENGINE FUEL CONTROL - EDIU

ENGINE FUEL CONTROL - CONTROL - EEC POWER MANAGEMENT - FUNCTIONAL DESCRIPTION

General

The EECs get airplane power when one of these conditions occur:

- Fuel control switch is in RUN position
- Start/ignition selector is in START position
- EEC maintenance switch is in TEST position.

The left EEC gets power from the left ac bus. The right EEC gets power from the right ac bus. Each channel of the EEC has a separate source. Channel A gets power from section 1 of the ac bus. Channel B gets power from section 2.

The EEC gets airplane power when the start power relay in the P110 left power management panel energizes. The start power relay coil gets power from the captain's flight instrument bus. The switches control the ground for the start power relay coil.

The control alternator supplies each channel of the EEC with power at approximately 7 percent N2.

Fuel Control Switch

The fuel control switch energizes the ignition/fire detection relay when it is in the RUN position. The ignition/fire detection relay supplies a ground for the start power relay. This permits the EEC to get airplane power during engine operation when there is a control alternator failure. The control alternator (not shown) is the normal power source when the engine is running.

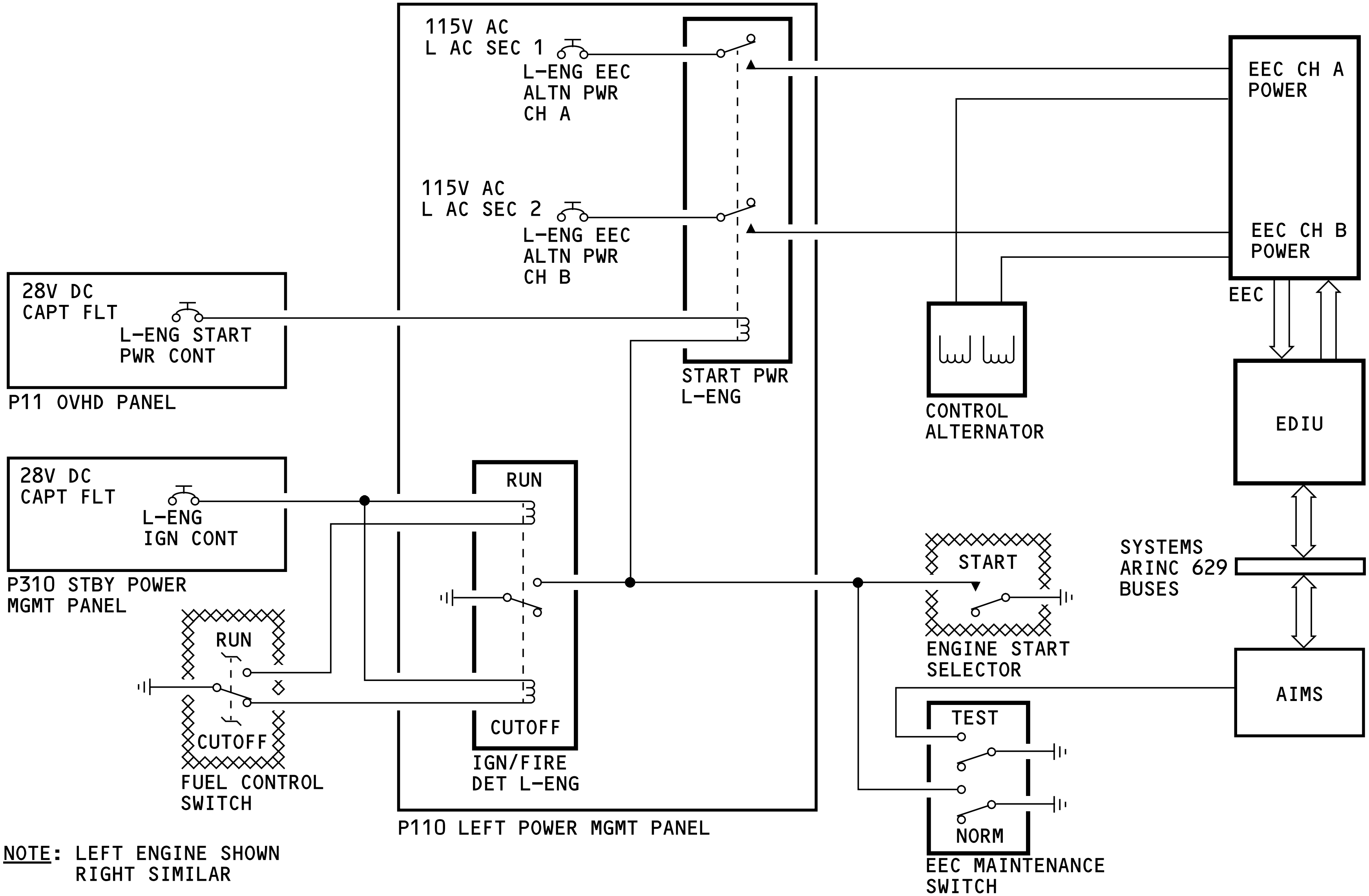
Engine Start/Ignition Selector

The engine start/ignition selector supplies a ground for the start power relay when it is in the START position. This gives the EEC power during engine starts.

EEC Maintenance Switch

The EEC maintenance switch supplies a ground for the start power relay when it is in the TEST position. This gives the EEC power during tests and maintenance operations.

The AIMS sends the position of the switch to the EEC.



NOTE: LEFT ENGINE SHOWN
RIGHT SIMILAR

ENGINE FUEL CONTROL - CONTROL - EEC POWER MANAGEMENT - FUNCTIONAL DESCRIPTION

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ENGINE FUEL CONTROL - OPERATION

Controls

You operate the engine fuel and control system with these flight deck controls:

- EEC maintenance switch
- EEC mode switch
- Thrust lever
- Fuel control switch
- Fire switch.

EEC Maintenance Switch

The EEC maintenance switch is on the P61 overhead maintenance panel. The switch is a two-position, guarded, toggle switch.

When the switch is in the NORM position, it permits power to go from normal operating power sources to the EEC. When the switch is in the TEST position, it connects airplane ac power to the EEC without starting any EEC control logic. It also sends a ground test discrete signal to the AIMS.

EEC Mode Switch

The EEC mode switch is on the engine start/ignition panel on the P5 overhead panel. The switch is a two-position, guarded, alternate-action switch.

The switch permits the pilots to set the EEC control mode. You should always operate the engines in the same control mode.

CAUTION: DO NOT MOVE THE EEC MODE SWITCH FROM NORM TO ALTN WHEN THE ENGINE IS OPERATING AT HIGH POWER. THE ENGINE MAY OVERBOOST IF YOU DO.

Normal Mode (N1)

The normal position of the EEC mode switch is in. When the switch is in, the EEC is in normal mode (NORM). In normal mode, the EEC uses N1 corrected for inlet temperature as the main thrust parameter.

You can put the thrust levers at specified positions to set thrust ratings. When the thrust levers are all the way forward, the engine is at takeoff thrust or maximum continuous thrust. The maximum climb and cruise thrust ratings are set at thrust lever positions less than all the way forward.

Alternate Mode (N1)

The non-normal position of the EEC mode switch is out. When the switch is out, the EEC is in alternate mode (ALTN). In alternate mode, the EEC uses N1 and a TLA schedule to control the engine thrust.

In alternate mode with the thrust levers at a specific position, the thrust changes as the flight condition changes. This requires adjustment of the thrust levers as the airplane flies in order to keep the correct thrust.

The EEC turns on the ALTN light on the EEC mode switch if it does not get the aircraft total pressure signal.

ENGINE FUEL CONTROL - OPERATION

Then, you must put the switch in the ALTN position to put the EEC in alternate mode.

Thrust Lever

The thrust levers move the TLA resolvers. The resolver sends the EEC a position signal to permit it to set the proper thrust.

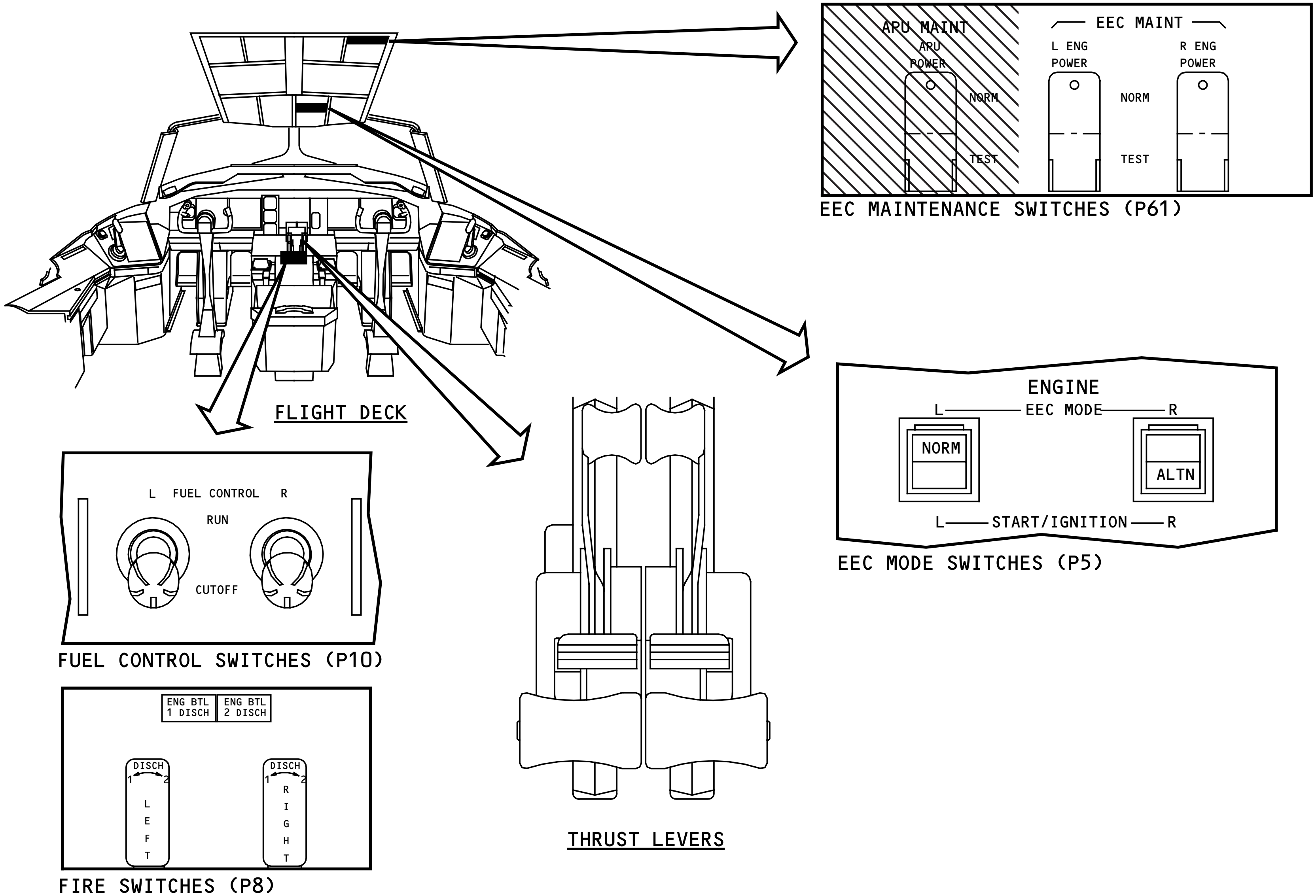
Fuel Control Switch

The fuel control switches have two positions: RUN and CUTOFF. The switches control the shutoff valve in the HMU to control fuel flow to the engine.

In addition, when you move the fuel control switch from RUN to CUTOFF, the EEC resets. This stops the EEC programs and sets them to run from the start.

Fire Switch

The fire switch permits power to go to the shutoff valve relays when the switch is in. When the switch is in the out position, power connects directly to the HMU cutoff solenoid to stop fuel flow to the engine.



ENGINE FUEL CONTROL - OPERATION

73-21-00-123 Rev 5 02/08/1997

ENGINE FUEL CONTROL - CONTROL - EEC RESET/ENGINE FUEL SHUTOFF VALVE CONTROL

General

The EEC gets a reset signal when you move the fuel control switch from the RUN to the CUTOFF position. When the EEC resets, it writes all fault data in its non-volatile memory (NVM). It also sets the engine start logic to run from the start of the program.

The fuel control switch controls relays in the P110 to open or close the engine fuel shutoff valve (SOV). The SOV gets power to open or to close. Power to operate the SOV comes from the captain's flight instrument bus.

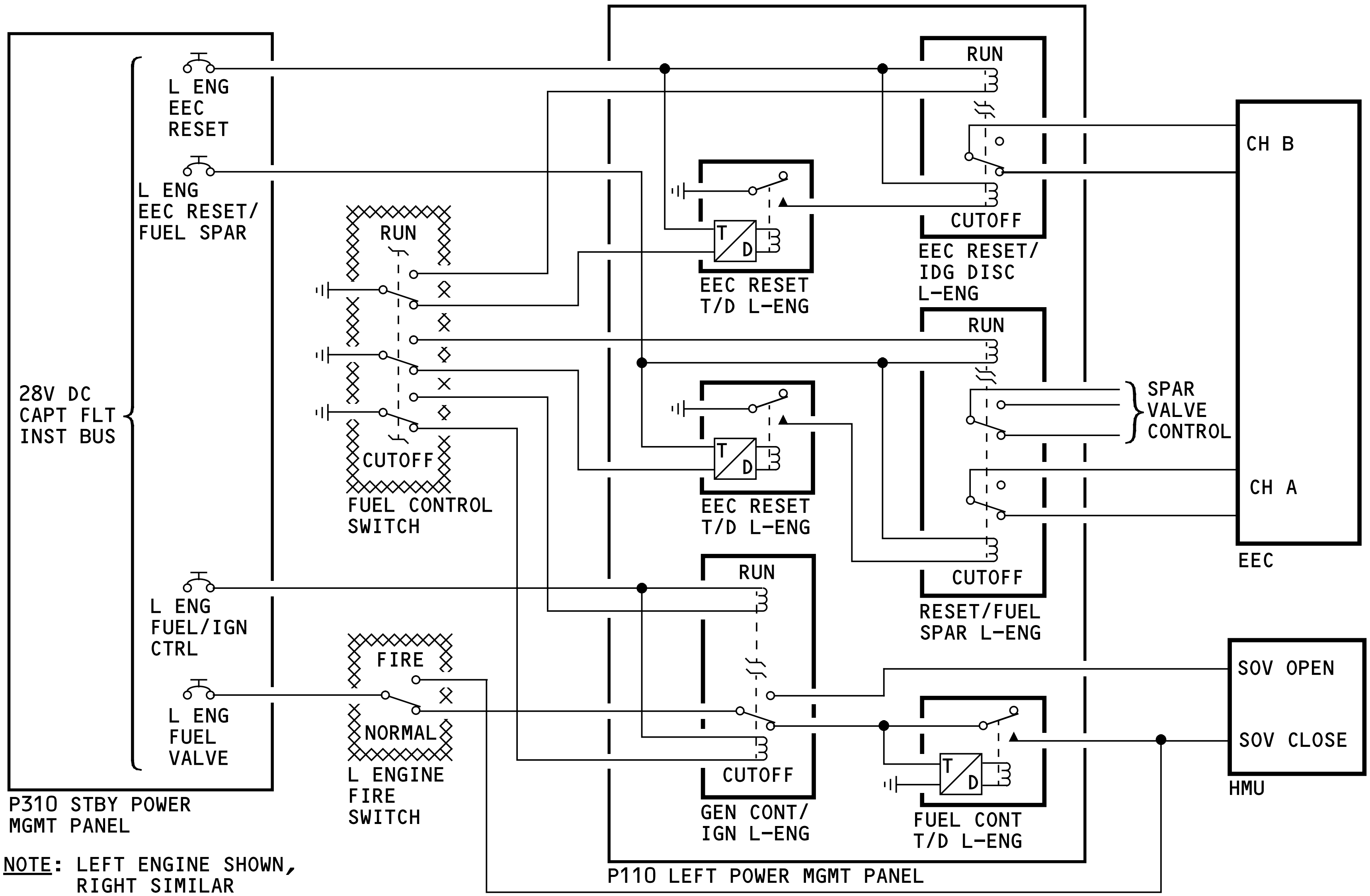
EEC Reset Control

Each channel of the EEC gets a reset signal from a relay in the P110. When you put the fuel control switch in the CUTOFF position, the two EEC reset relays energize after a short time dalay. This energizes the cutoff coils in the reset/fuel spar relay and the EEC reset/IDG disconnect relay. The relay contacts close a circuit to the EEC, which causes the EEC to reset.

Engine Fuel Shutoff Valve Control

When the fuel control switch is in the RUN position, power goes through the generator control/ignition relay to open the SOV. When the fuel control switch is in the CUTOFF position, the generator control/ignition relay energizes to the cutoff position and then, after a short time delay, the fuel control T/D relay energizes and power goes to close the SOV.

The fire switch must be in the NORMAL position to permit power to go through the P110 to operate the SOV. When the fire switch is in the FIRE position, power to close the SOV goes directly to the SOV. It does not go through the P110.



NOTE: LEFT ENGINE SHOWN, RIGHT SIMILAR

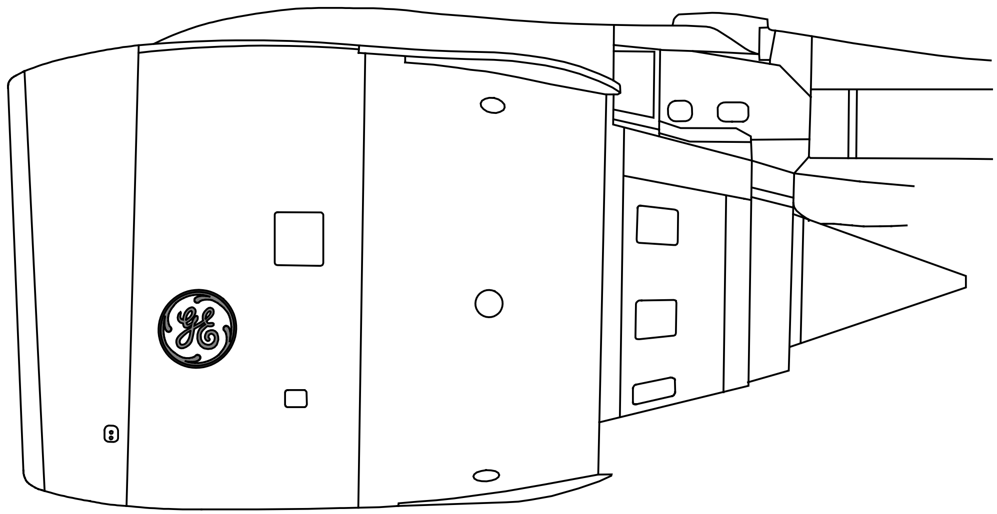
73-21-00-124 Rev 2 04/10/1997

ENGINE FUEL CONTROL - CONTROL - EEC RESET/ENGINE FUEL SHUTOFF VALVE CONTROL

ENGINE FUEL FLOW INDICATING - INTRODUCTION

Purpose

The engine fuel indicating system supplies fuel flow data to the EEC. The EEC transmits this data to the AIMS.



ENGINE FUEL AND CONTROL

DISTRIBUTION

- PRESSURIZING
- FILTERING
- INJECTING

CONTROL

- METERING
- SENSING
- POWER
- INTERFACES

INDICATING

- FUEL FLOW

73-31-00-101 Rev 0

ENGINE FUEL FLOW INDICATING - INTRODUCTION

ENGINE FUEL FLOW INDICATING - GENERAL DESCRIPTION

Purpose

The fuel flow indicating system measures the engine fuel flow rate. It also supplies the airplane with the information for indication and flight management.

Fuel Flow Transmitter

The fuel flow transmitter is on the right side of the engine at approximately the 5:00 position. Fuel flows from the HMU to the transmitter, then back to the HMU.

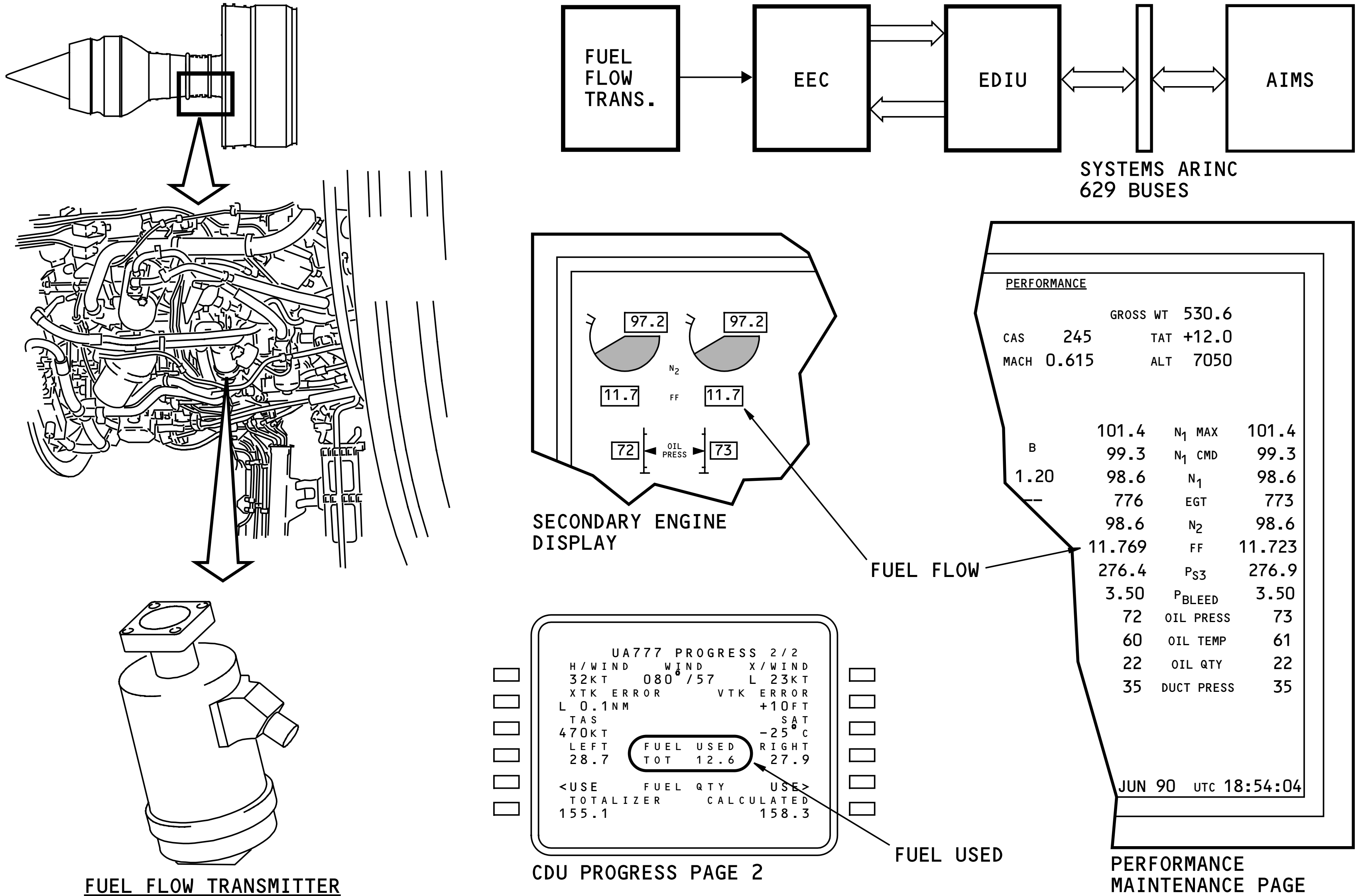
The transmitter does not have a motor. It sends analog pulse signals to the EEC that are in proportion to the fuel mass flow rate.

Functional Description

The EEC uses the signals from the fuel flow transmitter to calculate the fuel mass flow rate. The EEC sends this data to the AIMS.

The AIMS shows the fuel flow rate in thousands of pounds per hour, on the secondary engine display and performance maintenance page.

The flight management function of the AIMS uses the data to calculate fuel-used data. The control display unit (CDU) shows the fuel used on the CDU progress page 2.



ENGINE FUEL FLOW INDICATING - GENERAL DESCRIPTION

Continental Airlines, Inc

Engine Control

WB371

TABLE OF CONTENTS

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ENGINE CONTROLS - INTRODUCTION

General

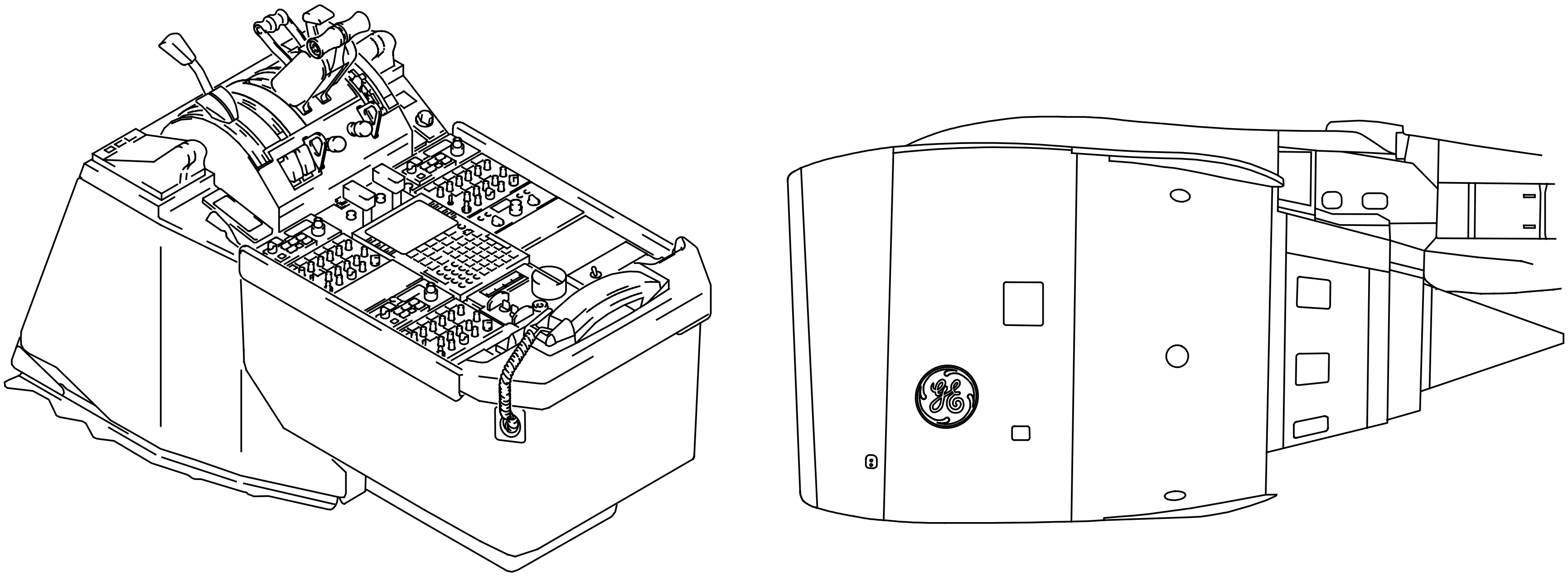
The engine controls system supplies most of the control signals the engine needs to operate. It also controls inputs to other airplane systems that require engine control status.

The engine controls system includes these components:

- Thrust levers
- Fuel control switches
- Autothrottle servo motors
- Thrust lever switches
- Microswitch pack
- Thrust lever angle (TLA) resolvers.

Abbreviations and Acronyms

AIMS	- airplane information management system
ASM	- autothrottle servo motor
ATA	- air transport association
A/T	- autothrottle
EDIU	- engine data interface unit
EEC	- electronic engine control
ELMS	- electrical load management system
EPCS	- electronic propulsion control system
GSE	- ground support equipment
HMU	- hydromechanical unit
IDG	- integrated drive generator
MFD	- multi-function display
TLA	- thrust lever angle
TO/GA	- takeoff/go-around
TRA	- thrust resolver angle
T/R	- thrust reverser



ENGINE CONTROLS

- THRUST LEVERS
- FUEL CONTROL SWITCHES
- AUTOTHROTTLE SERVO MOTORS
- THRUST LEVER SWITCHES
- MICROSWITCH PACK
- TLA RESOLVERS

76-00-00-101 Rev 0

ENGINE CONTROLS - INTRODUCTION

ENGINE CONTROLS - GENERAL DESCRIPTION

General

The engine controls system supplies manual and automatic control inputs to operate the engine. You use the thrust levers and fuel control switches to supply the manual inputs. The AIMS supplies the automatic inputs.

Thrust Control

The thrust levers supply thrust command signals to the electronic engine controls (EEC) through the TLA resolvers. Each thrust lever mechanically connects to a TLA resolver. When the thrust lever moves, it turns the TLA resolver. The EEC supplies power to excite the TLA resolver and reads the position of the resolver.

The thrust management function of the AIMS supplies automatic thrust command signals to the EEC with the TLA resolver. To do this, it turns the TLA resolver (and thrust lever) with the autothrottle servo motor (ASM). The ASM turns a brake that connects to the thrust lever and TLA resolver. See the autoflight chapter for more information on the ASM control (AMM PART I 22).

Fuel Control Switches

The fuel control switches control relays in the electrical load management system (ELMS). The relays control the start and stop functions of the engine.

Thrust Lever Switches

These are the thrust lever switches:

- Takeoff/Go-around (TO/GA)
- Autothrottle (A/T) disconnect
- Thrust reverser (T/R) sync lock control valve.

See the autoflight chapter for more information on the TO/GA and A/T disconnect switches (AMM PART I 22).

See the engine exhaust chapter for more information on the T/R sync lock control valve switch (AMM PART I 78).

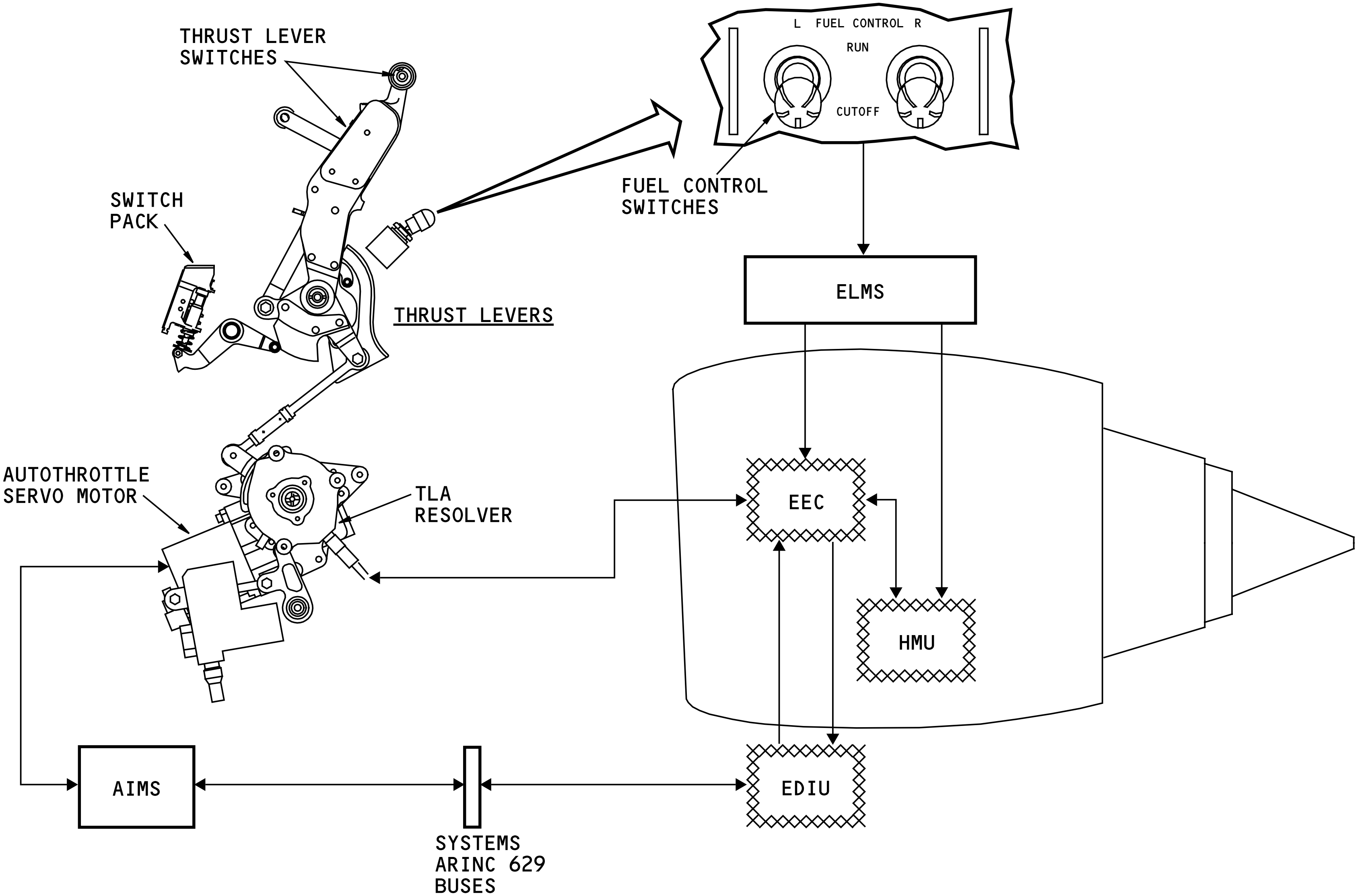
Switch Pack Switches

These are the switch pack switches:

- T/R directional control valve
- Autobrake inhibit.

See the engine exhaust chapter for more information on the T/R directional control valve pack switch (AMM PART I 78).

See the landing gear chapter for more information on the autobrake inhibit pack switch (AMM PART I 32).



ENGINE CONTROLS - GENERAL DESCRIPTION

76-00-00-102 Rev 3

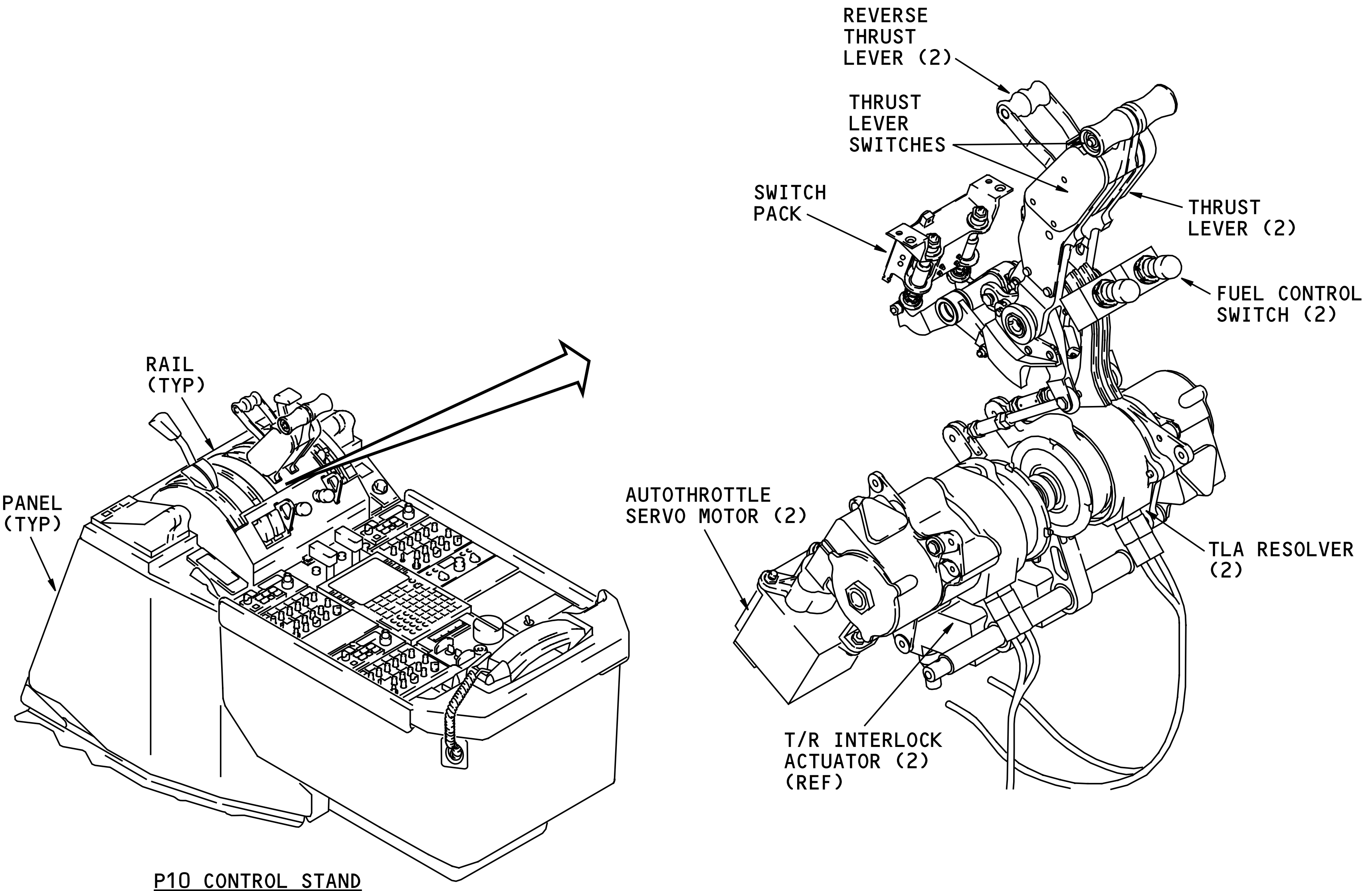
ENGINE CONTROLS - COMPONENT LOCATIONS

General

All of the engine controls components are at the P10 control stand in the flight deck. You get access to the components by removing panels, rails, or covers. These are the components:

- Switch pack
- Thrust lever switches
- Thrust levers
- Fuel control switches
- TLA resolvers
- Autothrottle servo motors.

See the autoflight chapter for more information on the autothrottle servo motors (AMM PART I 22).



76-00-00-103 Rev 1

ENGINE CONTROLS - COMPONENT LOCATIONS

ENGINE CONTROLS - SWITCHES - COMPONENT LOCATIONS

General

The thrust levers contain removable control switches. You remove covers to get access to the switches.

Thrust Lever Switches

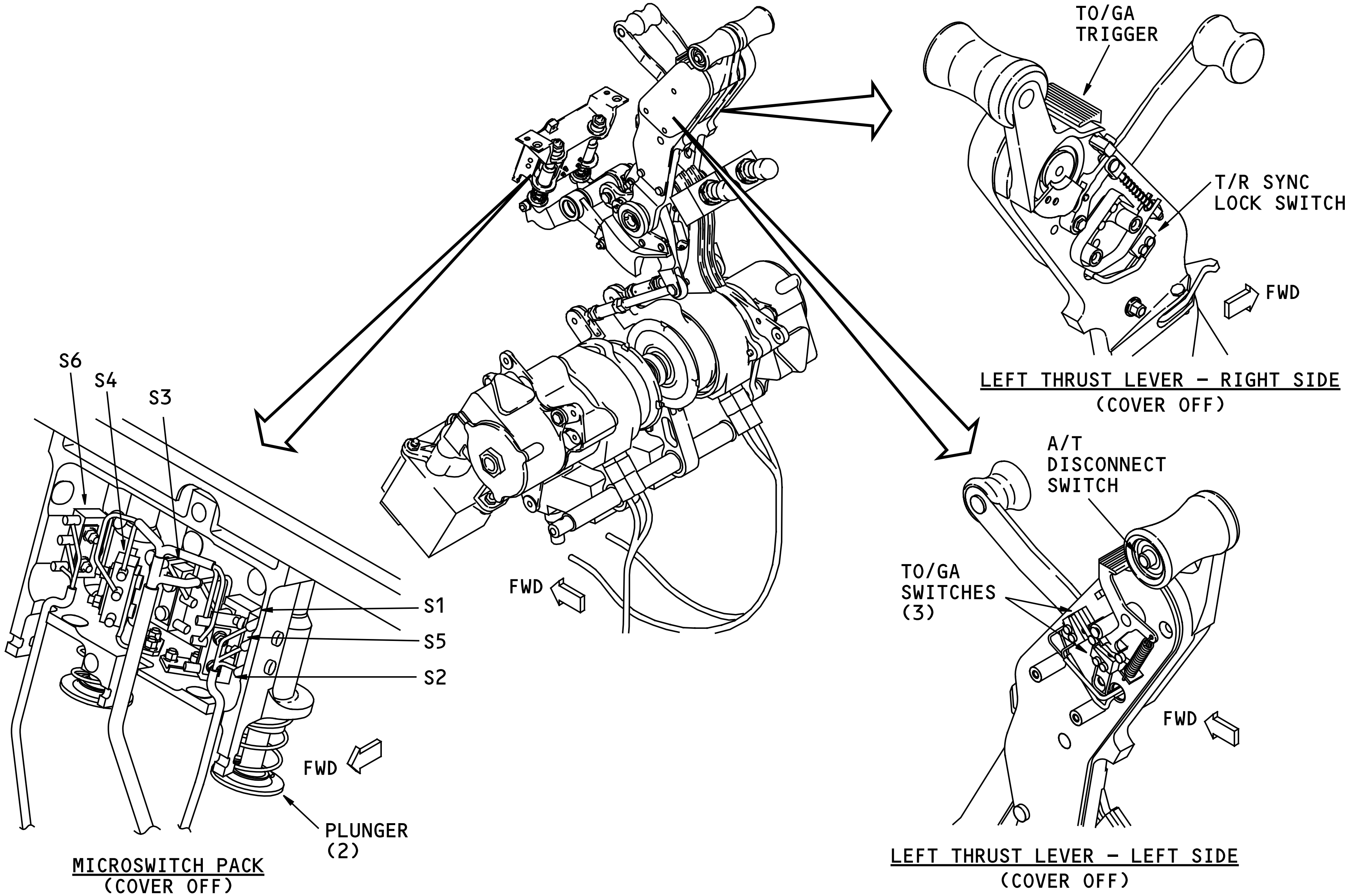
Four switches attach to the sides of each thrust lever. The TO/GA switches are on the outboard side. The T/R sync lock switch is on the inboard side. The TO/GA trigger moves the TO/GA switches. The reverse thrust lever moves the T/R sync lock switch.

The A/T disconnect switch is in the handle of the forward thrust lever.

Microswitch Pack

The microswitch pack is in the forward part of the control stand. It contains six switches. Each thrust lever moves a plunger in the switchpack to operate three of the switches. You can remove and install the pack as an assembly or replace an individual switch. You must use a soldering iron to replace an individual switch. These are the switches:

- S1 - autobrake inhibit left 1
- S2 - autobrake inhibit left 2
- S3 - autobrake inhibit right 1
- S4 - autobrake inhibit right 2
- S5 - T/R directional control solenoid valve left
- S6 - T/R directional control solenoid valve right.



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ENGINE CONTROLS - SWITCHES - COMPONENT LOCATIONS

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ENGINE CONTROLS - THRUST LEVER & AUTOTHROTTLE ASSEMBLY - FUNCTIONAL DESCRIPTION

General

The thrust lever and autothrottle assembly work together to supply thrust commands to the EEC. You use the thrust levers to make manual inputs. The autothrottle servo motor (ASM) makes automatic inputs.

Thrust Lever

The thrust lever is one assembly with many pieces. These pieces mechanically transmit the thrust lever commands to the autothrottle assembly:

- Reverse thrust lever
- Forward thrust lever
- Thrust lever crank
- Lever latch
- Control rod.

When you move the forward thrust lever, the force goes through the reverse thrust lever down to the thrust lever crank. The forward thrust lever and crank turn on the same shaft, but only connect together with the reverse thrust lever. The crank connects to the ASM brake with the control rod. The ASM brake turns the rotor of the TLA resolver. The resolver sends a thrust resolver angle (TRA) signal to the EEC.

When the forward thrust lever is not at idle, the lever latch holds the reverse thrust lever down. When the forward thrust lever is at idle, you can raise the reverse thrust lever. When the reverse thrust lever is up, the latch holds the forward thrust lever at idle.

Autothrottle Assembly

These are the four components of the autothrottle (A/T) assembly:

- ASM
- ASM gearbox
- TLA resolver
- ASM brake.

The ASM turns a shaft in the A/T assembly through the ASM gearbox. When the shaft turns, it turns the ASM brake. The ASM brake turns the rotor of the TLA resolver and, at the same time moves the thrust lever.

ASM Brake

The ASM brake is a spring-loaded clutch assembly. These are its functions:

- Mechanical connection to the thrust lever
- Friction source for the thrust lever
- Mechanical connection to the TLA resolver
- Mechanical connection to the A/T assembly shaft
- T/R control interface.

The ASM brake connects to the A/T assembly shaft with a clutch. This permits you to manually override ASM inputs.

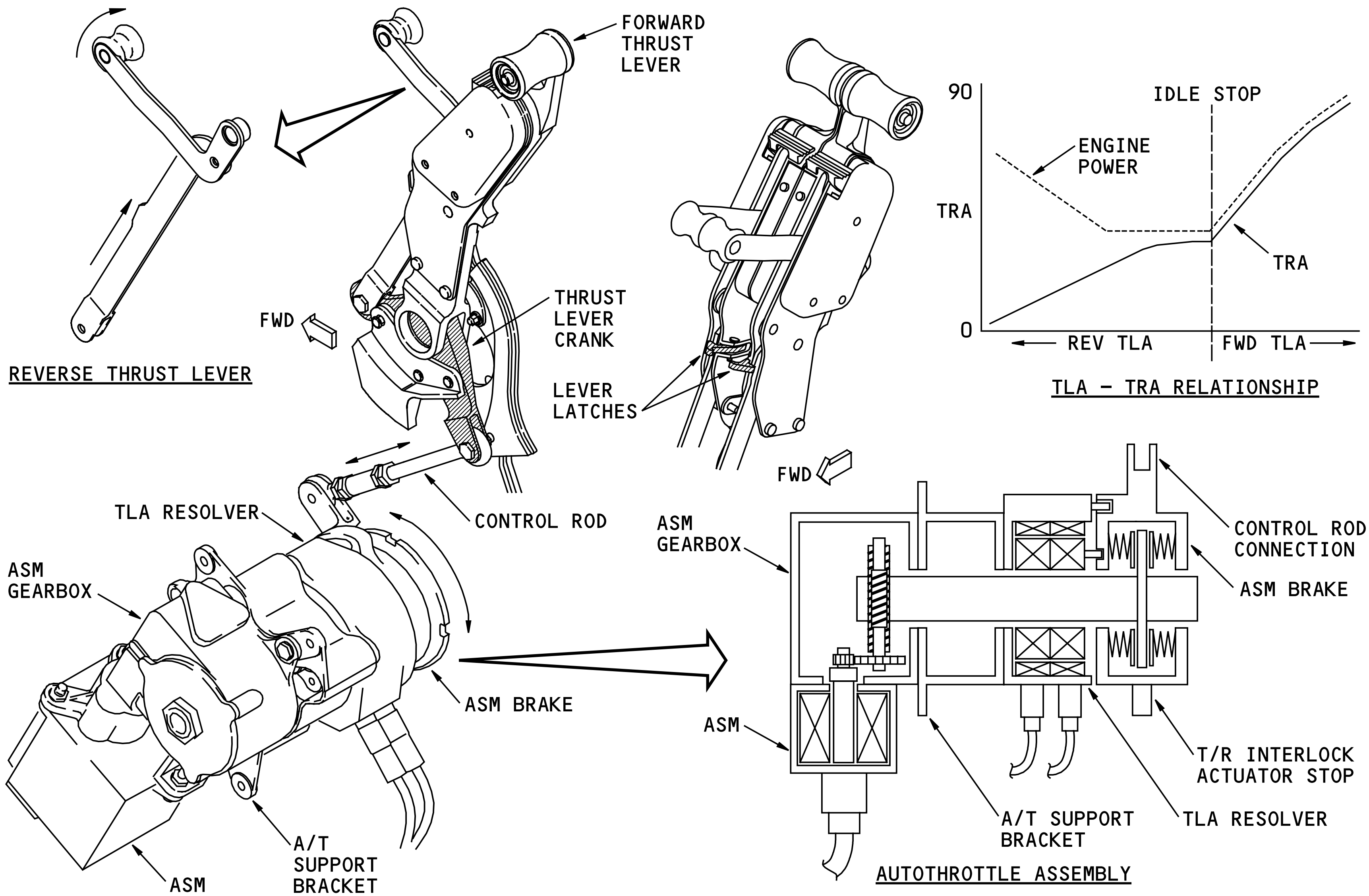
The T/R interlock actuator (not shown) keeps the ASM brake from turning beyond reverse idle until the thrust reverser deploys.

TLA-TRA Relationship

When the thrust lever is at idle, the TRA is approximately 34 degrees. As you move the thrust lever forward, the forward TLA increases. At full forward TLA, the TRA is approximately 85 degrees.

When you raise the reverse thrust lever, the reverse TLA increases. At full reverse TLA, the TRA is approximately 5 degrees. The flat spot in the reverse TRA curve is where the reverse thrust lever closes reverser control switches without increasing engine power.

Engine power increases between approximately 34 and 85 degrees TRA in forward thrust. Engine power increases between approximately 24 and 5 degrees TRA in reverse thrust.



ENGINE CONTROLS - THRUST LEVER & AUTOTHROTTLE ASSEMBLY - FUNCTIONAL DESCRIPTION

ENGINE CONTROLS - TLA RESOLVER

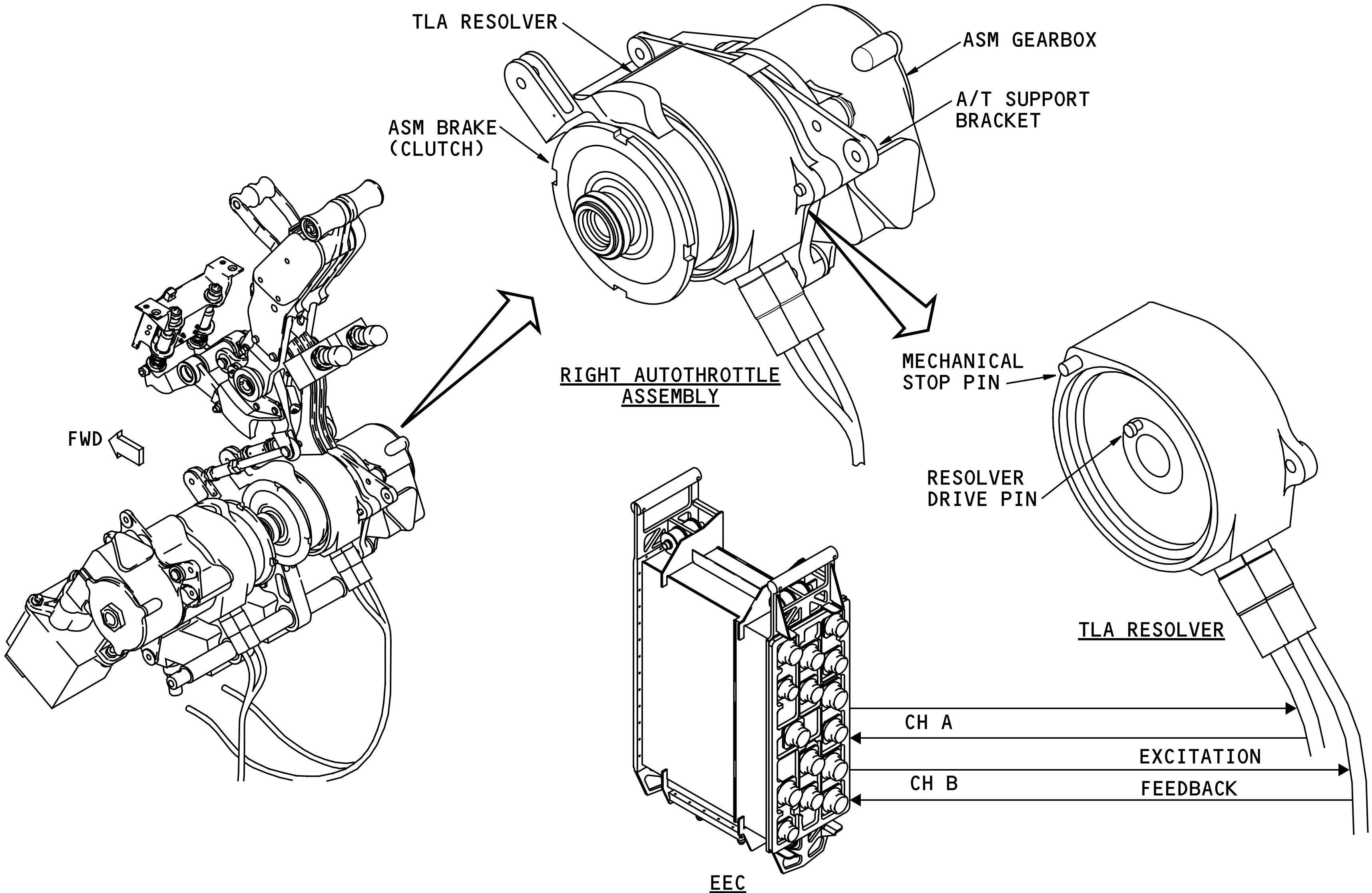
General

There is one TLA resolver for each engine. The resolver supplies the EEC with an electrical signal in proportion to the thrust lever angular position.

Functional Description

The TLA resolver has two elements. Each channel of the EEC supplies a low-voltage, ac excitation signal to one element of the resolver. The feedback signal from the resolver to the EEC is in proportion to the thrust lever angular position.

The ASM brake turns the resolver with the resolver drive pin. The mechanical stop pin prevents too much ASM brake movement that can damage the resolver.



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ENGINE CONTROLS - TLA RESOLVER

ENGINE CONTROLS - FUEL CONTROL SWITCHES - FUNCTIONAL DESCRIPTION

General

Each fuel control switch controls a set of four relays in the ELMS. The relays control many functions. These are the relays:

- A: reset/fuel spar
- B: ignition/fire detection
- C: generator control/ignition
- D: EEC reset/IDG disconnect.

One electrical source supplies power to both coils of each relay. Each position of the fuel control switch supplies a ground for one coil of each relay.

A: Reset/Fuel Spar Relay

The reset/fuel spar relay controls these functions:

- Fuel control switch position signal to the AIMS
- EEC channel A reset signal
- Fuel control switch position signal to the ELMS
- Fuel spar valve control.

B: Ignition/Fire Detection Relay

The ignition/fire detection relay controls these functions:

- EEC power control
- Fuel control switch position signal to the engine data interface unit (EDIU)
- Ignition 1 power
- Fire switch lockout control.

C: Generator Control/Ignition Relay

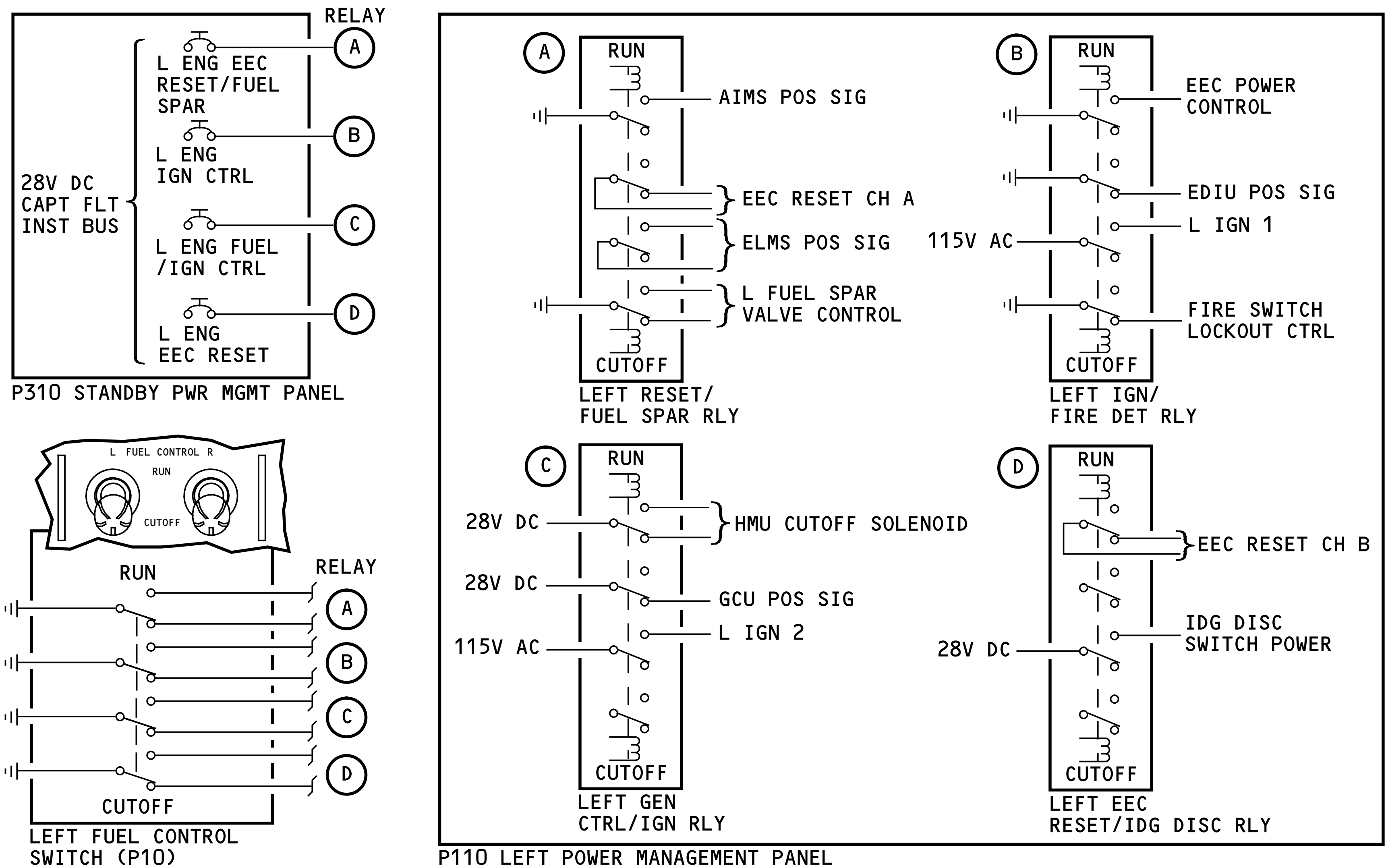
The generator control/ignition relay controls these functions:

- Hydromechanical unit (HMU) cutoff solenoid power
- Fuel control switch position signal to the generator control unit (GCU)
- Ignition 2 power.

D: EEC Reset/IDG Disconnect Relay

The EEC reset/IDG disconnect relay controls these functions:

- EEC channel B reset signal
- IDG disconnect switch power.



NOTE: LEFT SYSTEM SHOWN,
RIGHT SIMILAR

ENGINE CONTROLS - FUEL CONTROL SWITCHES - FUNCTIONAL DESCRIPTION

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ENGINE CONTROLS - OPERATION

Controls

You use many flight deck controls and displays with the engine controls system to operate the engine. These are the controls and displays and the ATA chapters where you find the details on them:

- Thrust levers (76)
- Fuel control switches (76)
- EEC maintenance switches (73)
- EEC mode switches (73)
- Start/Ignition switches (74,80)
- Autostart switch (80)
- Fire switches (26)
- EICAS display (77)
- Multi-function display (MFD) (73,75,76,77,78,79,80).

Thrust Lever (76)

Each thrust lever mechanically moves its TLA resolver. The resolver sends the EEC a signal in proportion to the angular position of the thrust lever. This permits the EEC to set the proper thrust.

Fuel Control Switch (76)

Each fuel control switch has two positions; RUN and CUTOFF. In RUN, the switch controls the HMU to open the engine fuel shutoff valve. In CUTOFF, the switch controls the HMU to close the valve.

In addition, when you move the fuel control switch from RUN to CUTOFF, the EEC resets. This stops the software programs in the EEC and sets them to run from the start.

EEC Maintenance Switch (73)

Each EEC maintenance switch has two positions; NORM and TEST. In NORM, the switch lets EEC power come from normal operating power sources. In TEST, the switch connects airplane ac power to the EEC without starting any EEC control logic.

EEC Mode Switch (73)

Each EEC mode switch lets the pilots set the EEC control mode: normal or alternate. You should always operate both engines in the same control mode.

Start/Ignition Switches (74,80)

You use the start/ignition switch to begin the start of the engine. It also lets you select continuous ignition on the engine.

Autostart Switch (80)

The autostart switch permits the EEC to automatically control engine starts.

ENGINE CONTROLS - OPERATION

Fire Switch (26)

The fire switch permits fuel control power to go to the hydromechanical unit (HMU) when the switch is in its normal position (in). If the switch is pulled out, power connects directly to the HMU cutoff solenoid to stop fuel flow to the engine.

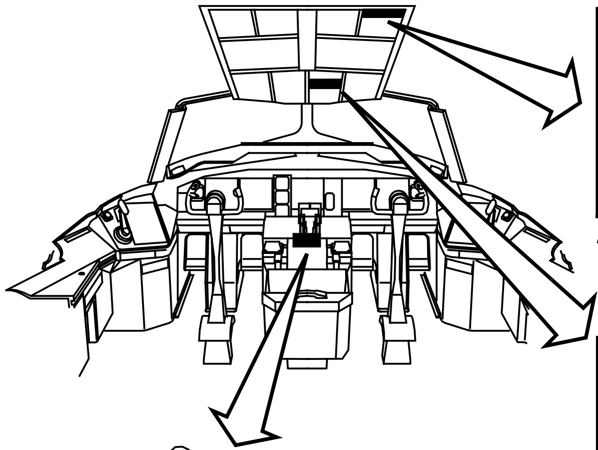
EICAS Display (77)

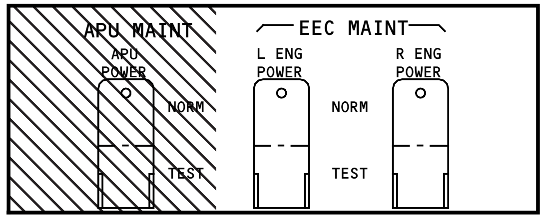
The EICAS display shows the primary engine indications. These are N1 and EGT.

Multi-Function Display (MFD) (73,75,76,77,78,79,80)

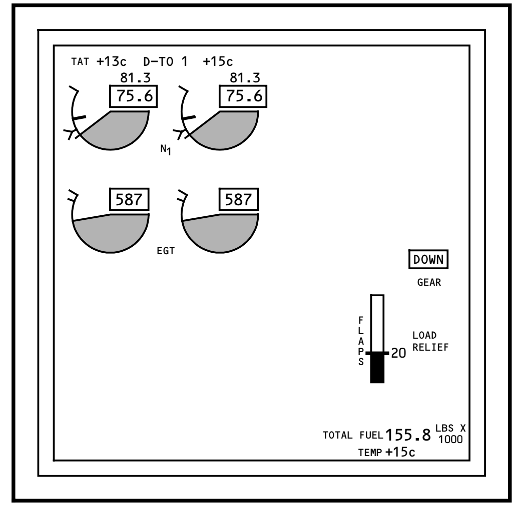
Many different MFDs show data that relates to engine controls. These are those MFDs:

- Secondary engine display
- Performance maintenance page
- EPCS maintenance page
- Propulsion data limits maintenance page
- Engine exceedance maintenance page.

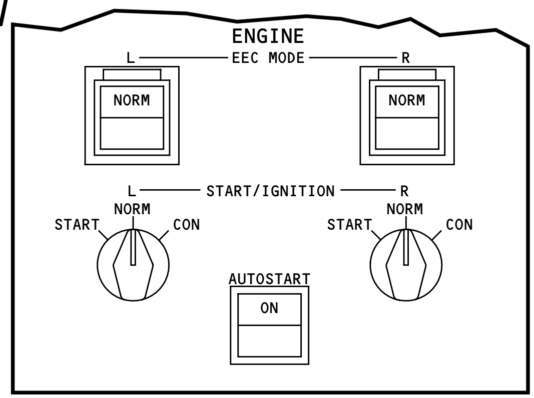




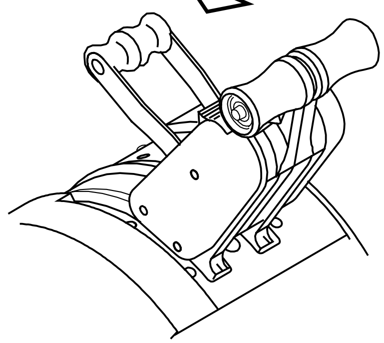
APU/EEC MAINTENANCE PANEL (P61)
- CHAPTER 73



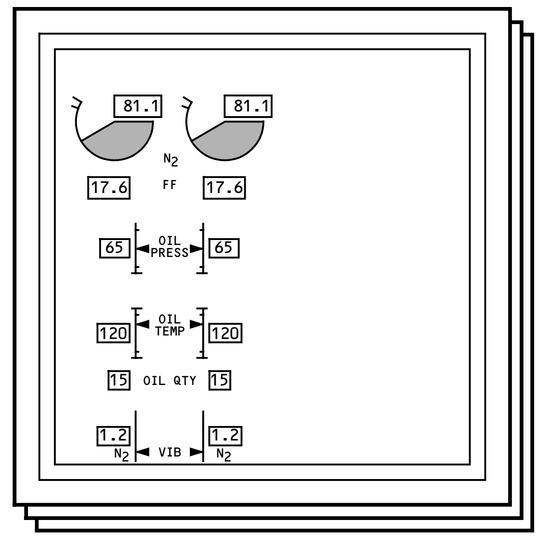
EICAS DISPLAY
- CHAPTER 77

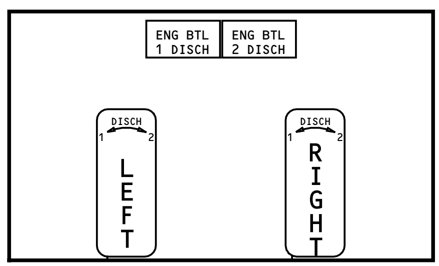


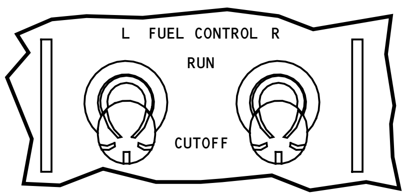
ENGINE CONTROL PANEL (P5)
- CHAPTERS 73,74,80



THRUST LEVERS (P10)
- CHAPTER 76







FUEL CONTROL SWITCHES (P10)
- CHAPTER 76

ENGINE FIRE PANEL (P8)
- CHAPTER 26

MFD
- CHAPTERS 73,75,76,77,78,79,80

ENGINE CONTROLS - OPERATION

Thrust Lever Check

You measure the force to move the thrust levers to make sure they are within limits. To move the reverse thrust lever, you must disconnect the T/R interlock actuator rod end from the thrust lever assembly.

TLA Resolver Adjustment

Each thrust lever connects to an ASM brake with an adjustable control rod. The ASM brake turns the TLA resolver. You adjust the length of the control rod to change the relationship between the thrust lever position and the resolver position. You make the adjustment with either portable ground support equipment (GSE) or with onboard equipment.

Adjustment - GSE

The most accurate method of adjustment for the TLA resolver is to use special GSE to:

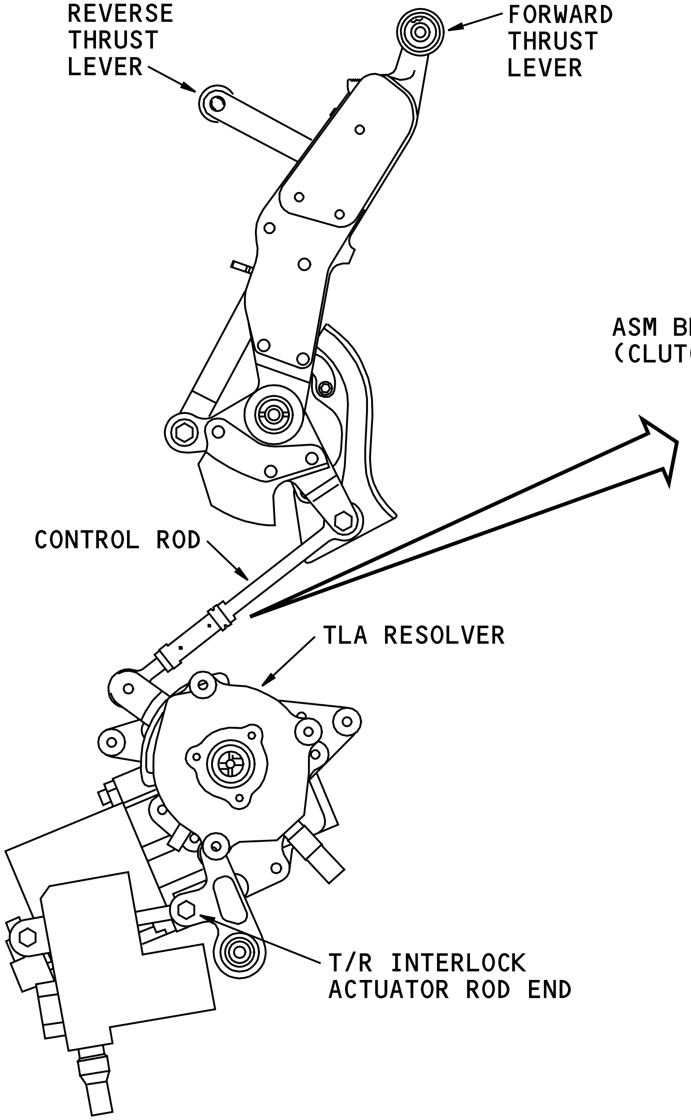
- Measure the thrust lever position
- Excite the resolver
- Read the resolver angle.

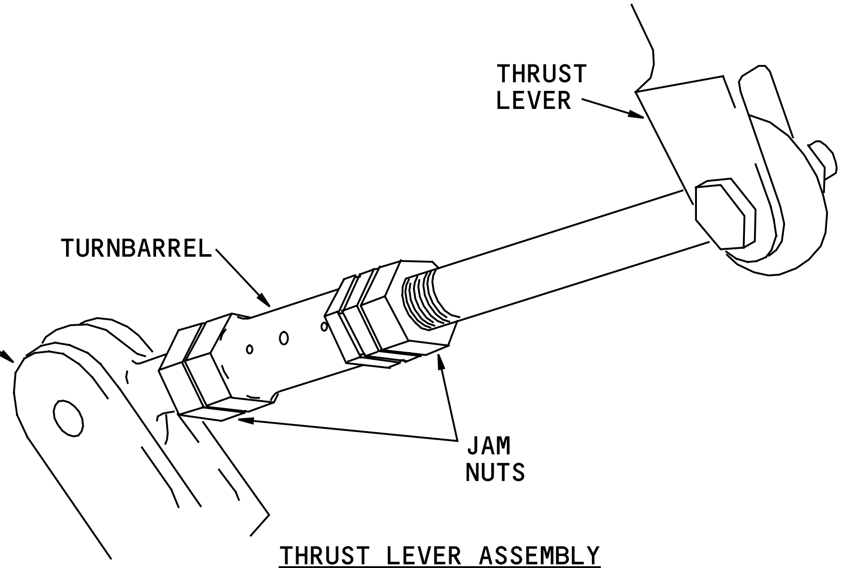
With the thrust lever at idle, you turn the turnbarrel to change the length of the control rod to get the correct resolver angle. Jam nuts and safety wire hold the turnbarrel in position.

To make sure the adjustment is correct, you move the thrust lever to its full-forward position and back to idle. Read the resolver angle again. It should agree with the first number. You also check the resolver angle at the thrust lever positions of full-forward and full-reverse.

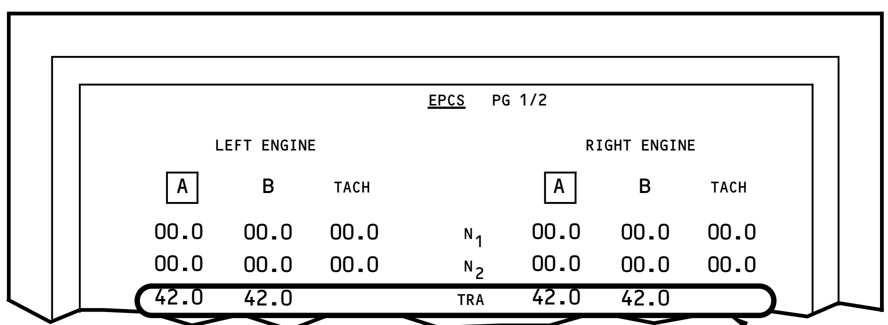
Adjustment - Onboard

You can adjust the resolver using airplane equipment. You supply the EEC with airplane power and read the TLA resolver angle (thrust resolver angle - TRA) on the electronic propulsion control system (EPCS) maintenance page 1.





THRUST LEVER ASSEMBLY



EPCS MAINTENANCE PAGE 1

76-00-00-109 Rev 1

ENGINE CONTROLS - TRAINING INFORMATION POINTS

Continental Airlines, Inc

Engine Indicating

WB371

TABLE OF CONTENTS

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ENGINE INDICATING - INTRODUCTION

Purpose

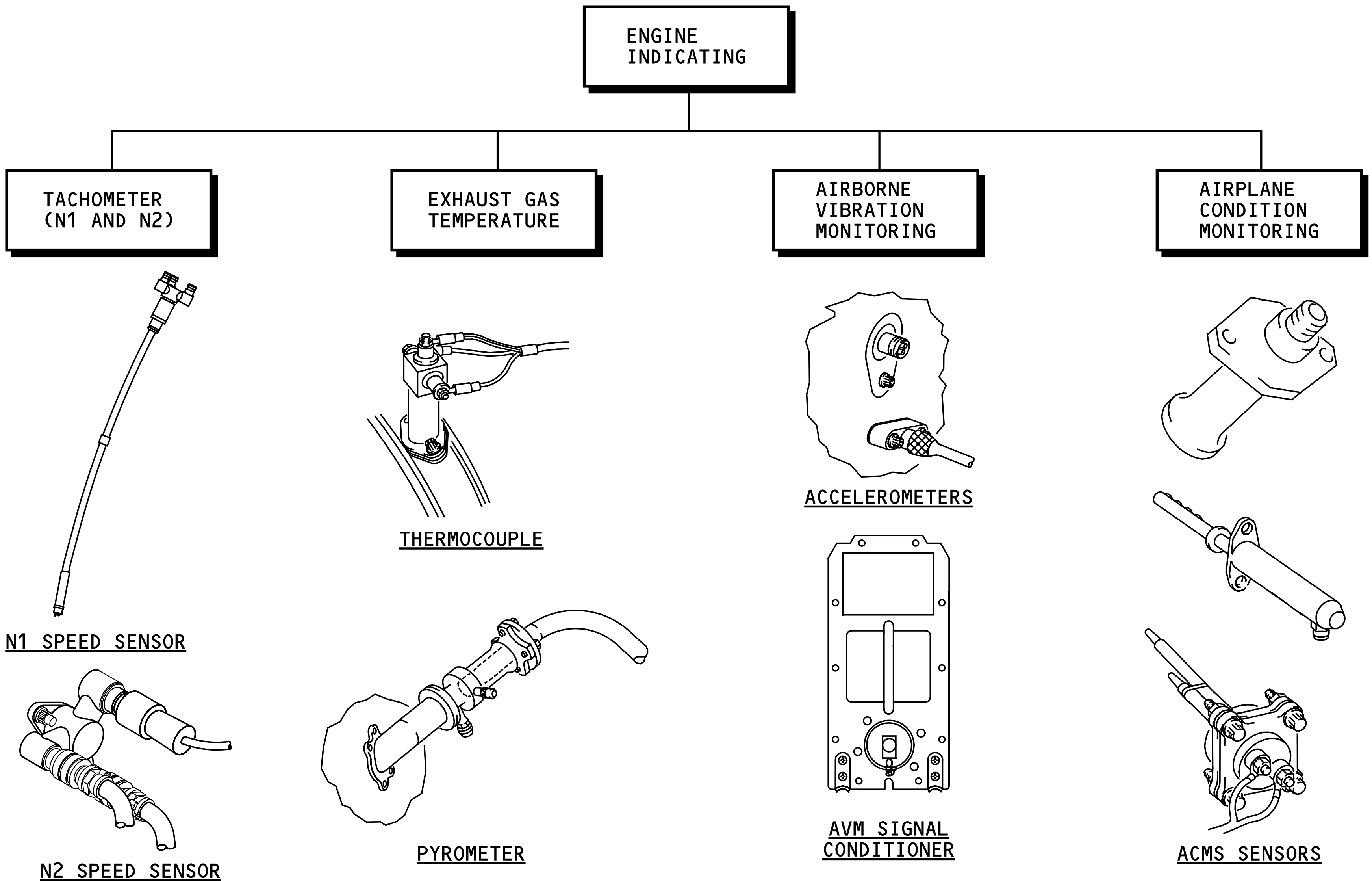
The engine indicating system supplies engine performance data to the AIMS for display on the primary display system. The indicating system has these subsystems:

- N1 and N2 tachometer
- Exhaust gas temperature (EGT)
- Airborne vibration monitoring (AVM)
- Airplane condition monitoring (ACMS).

The ACMS data is available from the AIMS through the MAT.

Abbreviations and Acronyms

AIMS - airplane information management system
ACMF - airplane condition monitoring function
ACMS - airplane condition monitoring system
AVM - airborne vibration monitoring
CMCF - central maintenance computing function
EBS - engine balancing system
EDIU - engine data interface unit
EEC - electronic engine control
EGT - exhaust gas temperature
EPCS - electronic propulsion control system
HPC - high pressure compressor
HPT - high pressure turbine
LPC - low pressure compressor
LPT - low pressure turbine
MFD - multi-function display
N1 - low pressure rotor speed
N2 - high pressure rotor speed
PDS - primary display system
P49 - HPT exit or LPT inlet pressure
PT25 - total pressure LPC exit
RCC - remote charge converter
TCF - turbine center frame
TRF - turbine rear frame
T/R - thrust reverser
T49 - HPT exit or LPT inlet temperature
T5 - LPT exit temperature
PS13 - fan exit static pressure
QAR - quick access recorder.



77-00-00-101 Rev 4 04/03/95

ENGINE INDICATING - INTRODUCTION

ENGINE INDICATING - COMPONENT LOCATIONS - LEFT SIDE

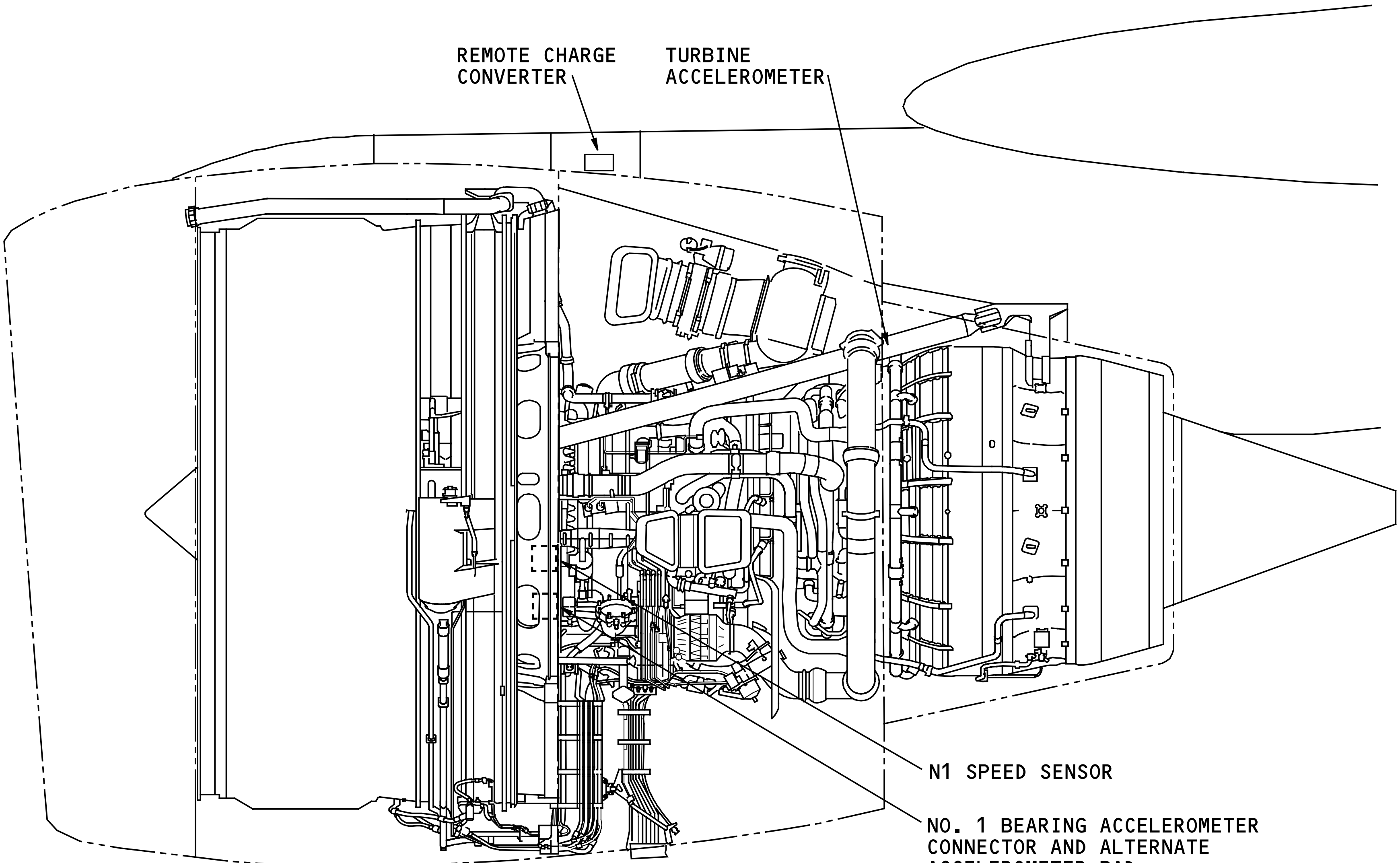
General

These engine indicating components are on the left side of the engine:

- No. 1 bearing accelerometer connector
- Alternate accelerometer pad
- N1 speed sensor
- Turbine accelerometer.

The No. 1 bearing accelerometer is inside the engine near the No. 1 bearing. You can only get access to the accelerometer connector.

The remote charge converter (RCC) is in the strut under the No. 2 fairing.



77-00-00-103 Rev 5 02/12/96

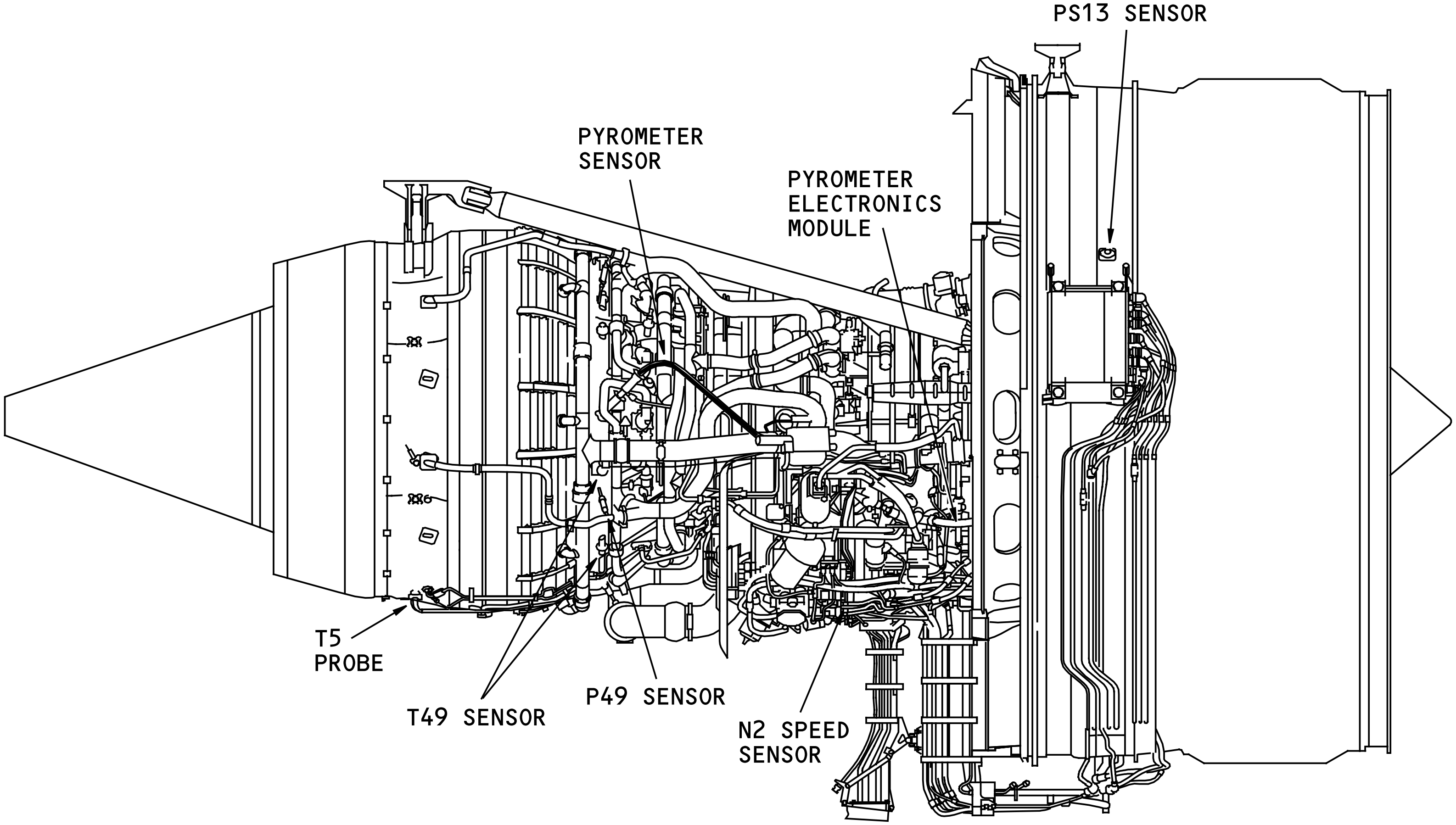
ENGINE INDICATING - COMPONENT LOCATIONS - LEFT SIDE

ENGINE INDICATING - COMPONENT LOCATIONS - RIGHT SIDE

General

These engine indicating components are on the right side of the engine:

- Pyrometer (sensor and electronics module)
- PS13 sensor
- N2 speed sensor
- P49 sensor
- T49 sensor
- T5 probe.



ENGINE - RIGHT SIDE

ENGINE INDICATING - COMPONENT LOCATIONS - RIGHT SIDE

ENGINE INDICATING - ENGINE TACHOMETER - GENERAL DESCRIPTION

Purpose

The engine tachometer system supplies N1 and N2 signals to engine and airplane systems. The engine and airplane systems use N1 and N2 for control, indication, and monitoring.

General Description

The N1 and N2 speed sensors each send three analog speed signals. Two signals from each sensor go to the EEC channels A and B.

The EEC changes the analog speed data into ARINC 429 digital data. The EDIU receives the digital data and sends ARINC 629 data to the AIMS.

The N1 speed sensor also sends analog signals to the AIMS, the AVM signal conditioner, and the EDIU. The N2 speed sensor sends analog signals to the AIMS and the AVM signal conditioner.

The AIMS uses the analog speed signals when there is no digital engine speed data.

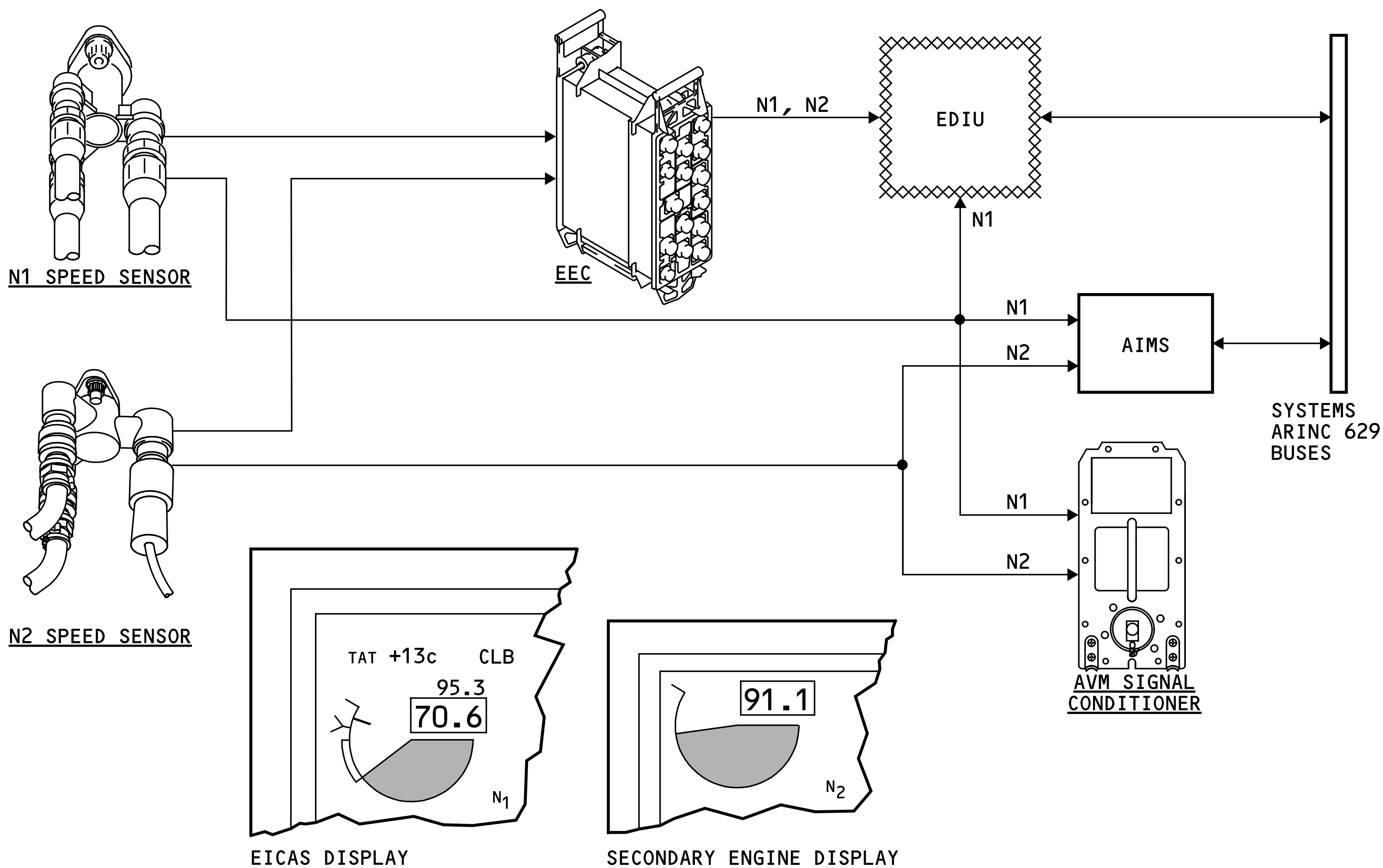
The AVM signal conditioner uses the analog speed signals in its vibration calculations.

The EDIU uses the analog N1 signal for thrust asymmetry compensation (TAC).

See the rudder control section for more information on the TAC (AMM PART I 27-21).

Indication

The EICAS display and the secondary engine display show N1 and N2 data. The data also shows on the performance maintenance page. Percent rpm are the units for the data.



ENGINE INDICATING - ENGINE TACHOMETER - GENERAL DESCRIPTION

ENGINE INDICATING - ENGINE TACHOMETER - N1 SPEED SENSOR

General

The N1 speed sensor uses signal pulses to measure N1 rotor speed.

The N1 sensor is at the 8:30 position on the fan hub frame aft side. You get access to the sensor with the left T/R half open.

Physical Description

The N1 sensor has a rigid probe that goes inside the fan hub frame. The outer end of the probe has three electrical connectors. Two bolts hold the sensor on the fan hub frame.

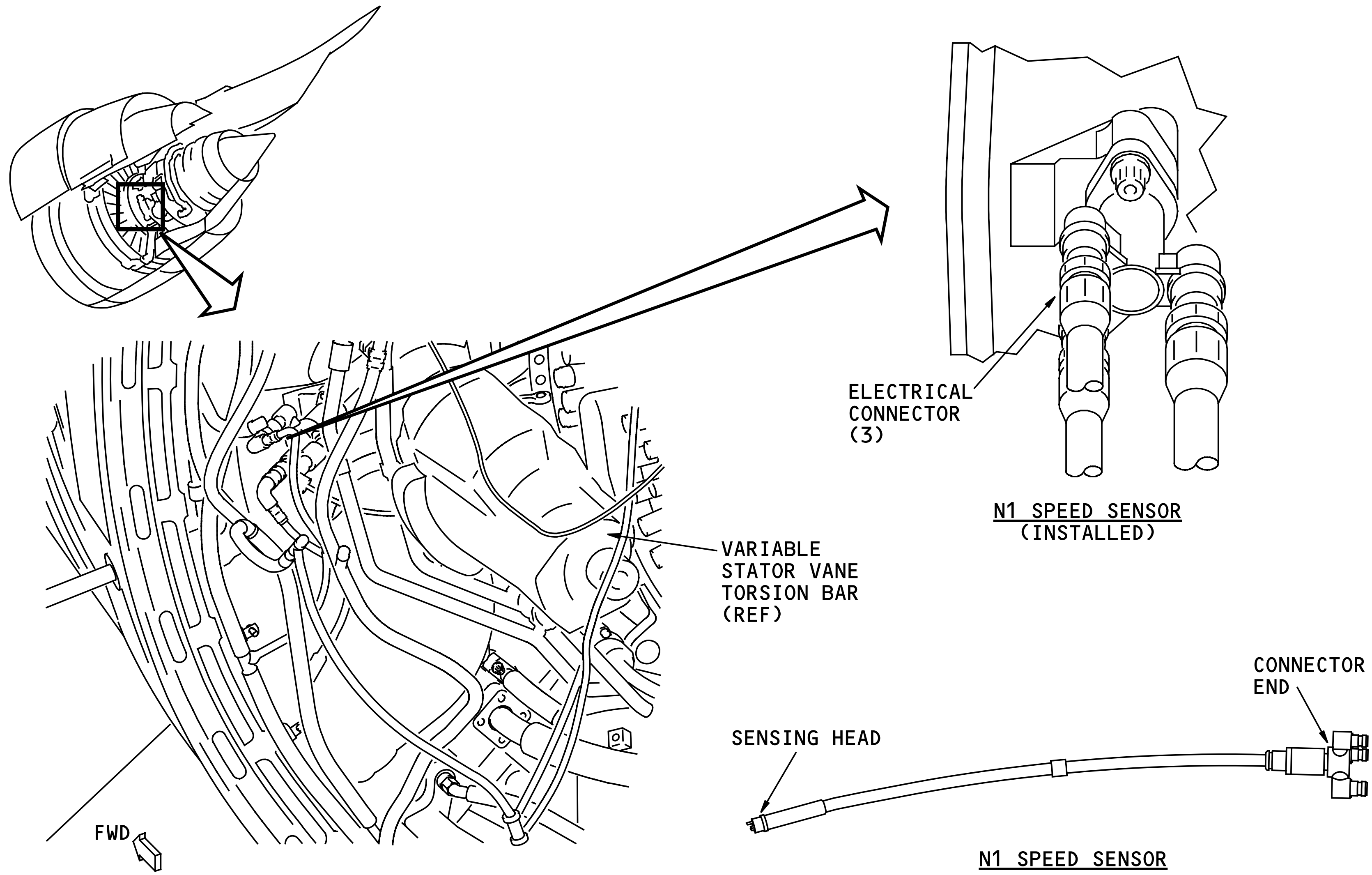
Functional Description

A sensing head on the inner end of the probe is near a wheel with teeth on the N1 shaft. The speed sensor receives electromagnetic pulses from the teeth as they go by the sensing head.

Training Information Point

The N1 speed sensor is about 2 feet (600 mm) long. You should be careful when you remove or install the sensor.

When you remove the N1 speed sensor, approximately one cup of oil comes out.



77-12-00-102 Rev 3 12/19/95

ENGINE INDICATING - ENGINE TACHOMETER - N1 SPEED SENSOR

ENGINE INDICATING - ENGINE TACHOMETER - N2 SPEED SENSOR

General

The N2 speed sensor uses signal pulses to measure N2 rotor speed.

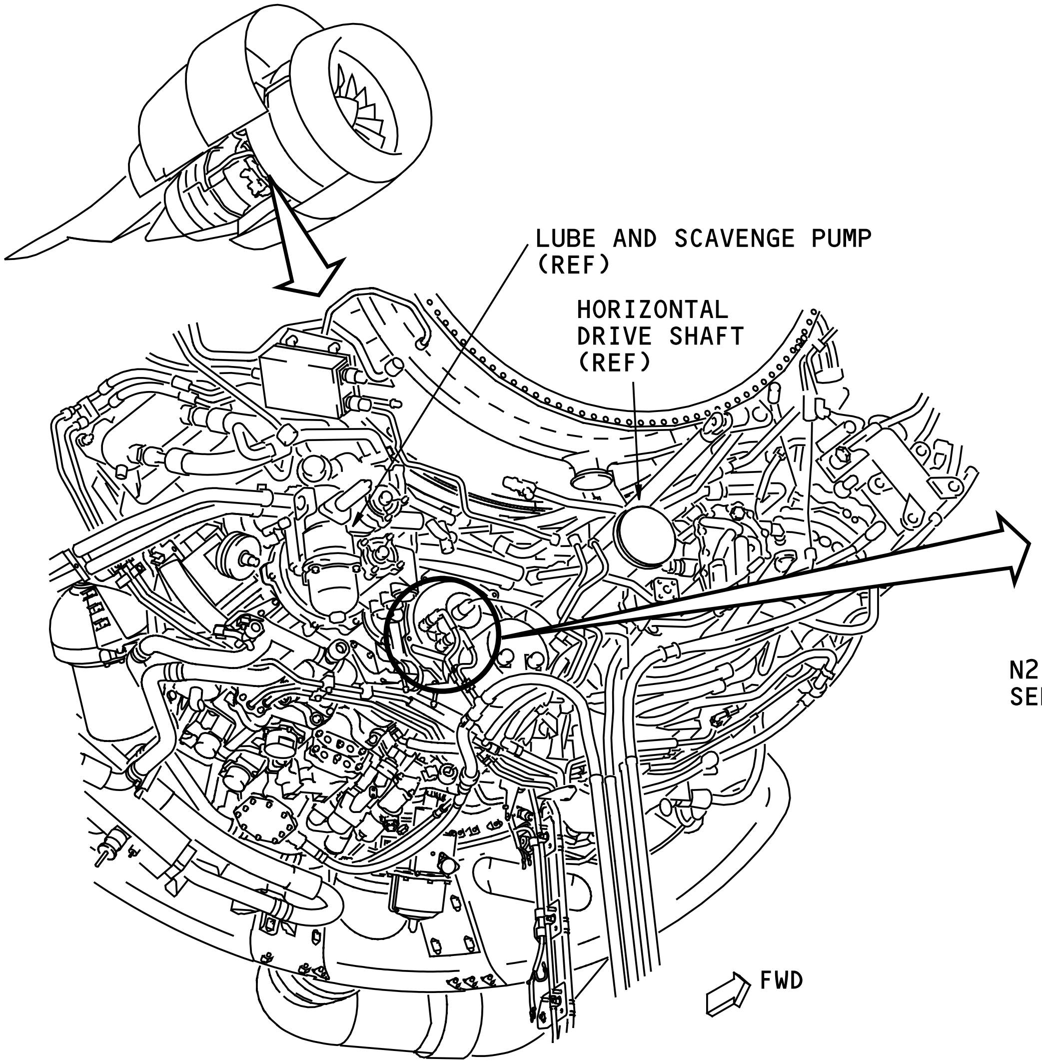
The N2 sensor is at the 5:30 position on the front of the accessory gearbox. You get access to the sensor with the right T/R half open.

Physical Description

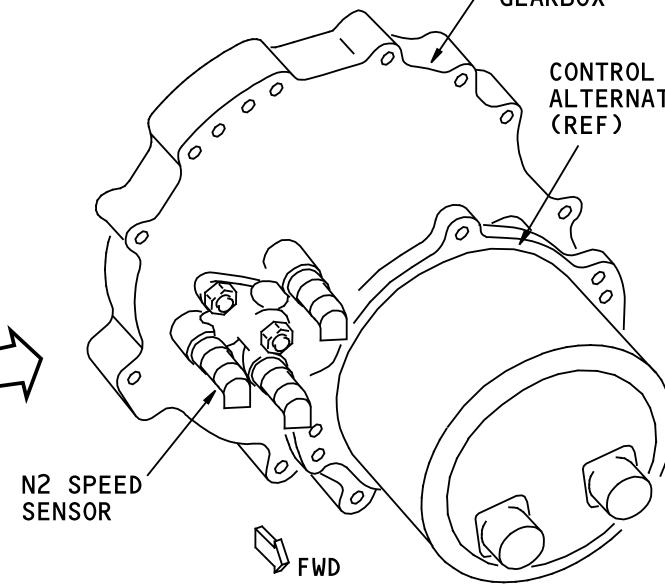
The N2 sensor has a short probe that fits into the accessory gearbox. The outer end has three electrical connectors. Two nuts hold the sensor on the gearbox.

Functional Description

A sensing head on the inner end of the N2 sensor probe is near a gear in the accessory gearbox. The speed sensor gets electromagnetic pulses as the gear teeth go by sensing head.



ENGINE ACCESSORY GEARBOX
(LOOKING AFT)



N2 SPEED SENSOR INSTALLATION

77-12-00-103 Rev 2 11/28/95

ENGINE INDICATING - ENGINE TACHOMETER - N2 SPEED SENSOR

ENGINE INDICATING - ENGINE TACHOMETER - INDICATIONS

N1

The EEC uses N1 to set engine thrust. These N1 indications show on the EICAS display:

- N1 redline
- Maximum N1
- Reference/target N1
- N1 command sector
- Actual N1.

N1 redline is the maximum speed limit for the N1 rotor.

Maximum N1 is the highest rotor speed that will not cause the engine to exceed maximum rated thrust. The EEC calculates maximum N1.

Reference/target N1 is the best N1 for the selected thrust reference mode. The flight management computing function of the AIMS supplies the reference/target N1.

N1 command sector is a function of thrust lever position, air data, and altitude. The EEC calculates N1 command. A command sector shows the difference between N1 command and actual N1.

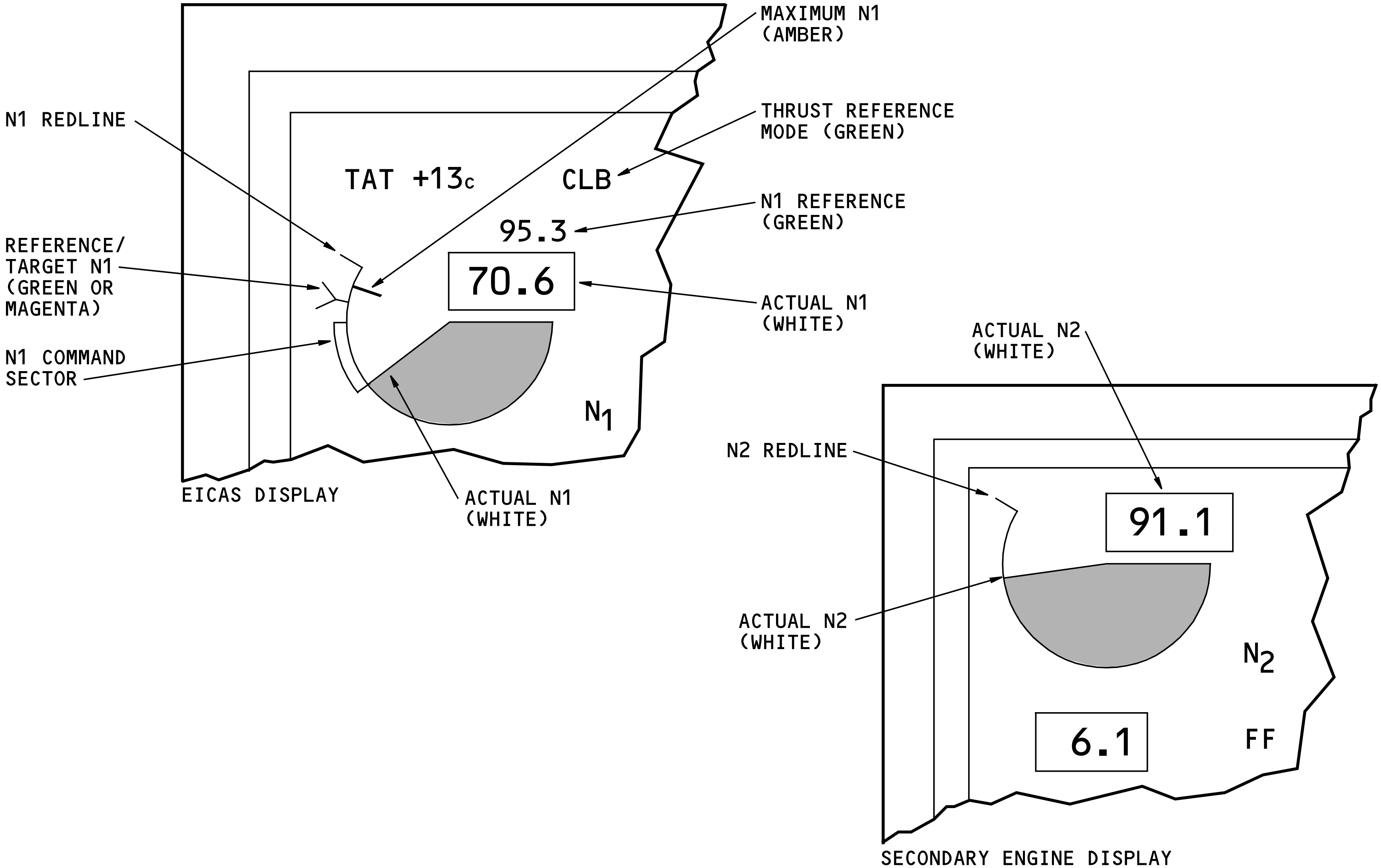
N2

You use N2 during engine start and to monitor HPC rotor speed when the engine operates. The engine secondary display shows actual N2 and N2 redline.

N2 redline is the maximum speed limit for the N2 rotor.

N1 or N2 Exceedance

If N1 or N2 goes above the redline the display turns red. When N1 or N2 goes back to a value below the limit, the display turns to the normal color. The box around the readout, however, stays the exceedance color until you push the CANCEL/RECALL switch on the display select panel (DSP).



77-12-00-104 Rev 5 11/28/95

ENGINE INDICATING - ENGINE TACHOMETER - INDICATIONS

ENGINE INDICATING - AVM - GENERAL DESCRIPTION

Purpose General

The airborne vibration monitoring (AVM) system monitors and records the engine vibration levels.

General Description

There is one AVM system for each engine. Each AVM system has these components:

- No. 1 bearing accelerometer
- Turbine accelerometer
- Remote charge converter (RCC)
- AVM signal conditioner unit.

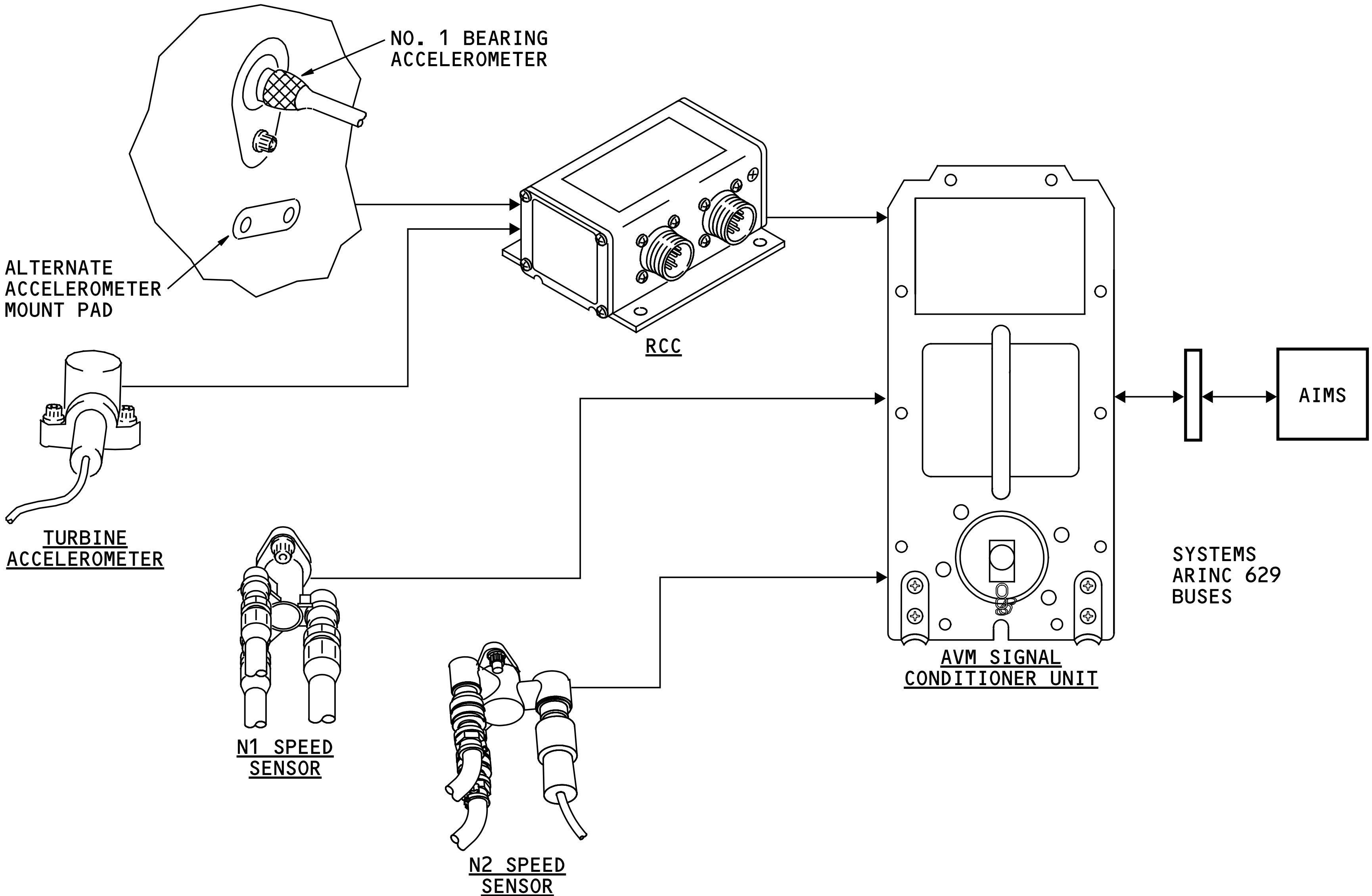
The accelerometers send signals that are proportional to the engine vibration. Each accelerometer signal goes to the RCC for signal conversion and amplification. The RCC sends amplified vibration signals to the AVM signal conditioner unit.

An alternate accelerometer can replace a failed No. 1 bearing accelerometer.

The signal conditioner unit uses the accelerometer signals and N1 and N2 speed signals to calculate the engine vibration levels for each rotor. The AVM signal conditioner unit sends the vibration data to the AIMS. The AIMS shows the vibration data on the primary display system.

The signal conditioner unit also stores the vibration data for use with the engine balancing system (EBS).

The EBS is a function of the signal conditioner unit and the AIMS. You get access to it through the MAT.



ENGINE INDICATING - AVM - GENERAL DESCRIPTION

ENGINE INDICATING - AVM - ACCELEROMETERS AND REMOTE CHARGE CONVERTER

Accelerometers

The accelerometers use piezoelectric crystals to get input for engine vibration and send it to the remote charge converter (RCC).

The No. 1 bearing accelerometer connector is on the fan frame hub at the 7:00 position. The No. 1 bearing accelerometer is inside the engine on the No. 1 bearing housing. If the No. 1 bearing accelerometer fails, you can attach an alternate accelerometer to the mounting pad on the fan hub frame.

The turbine accelerometer is on the turbine center frame at the 11:30 position.

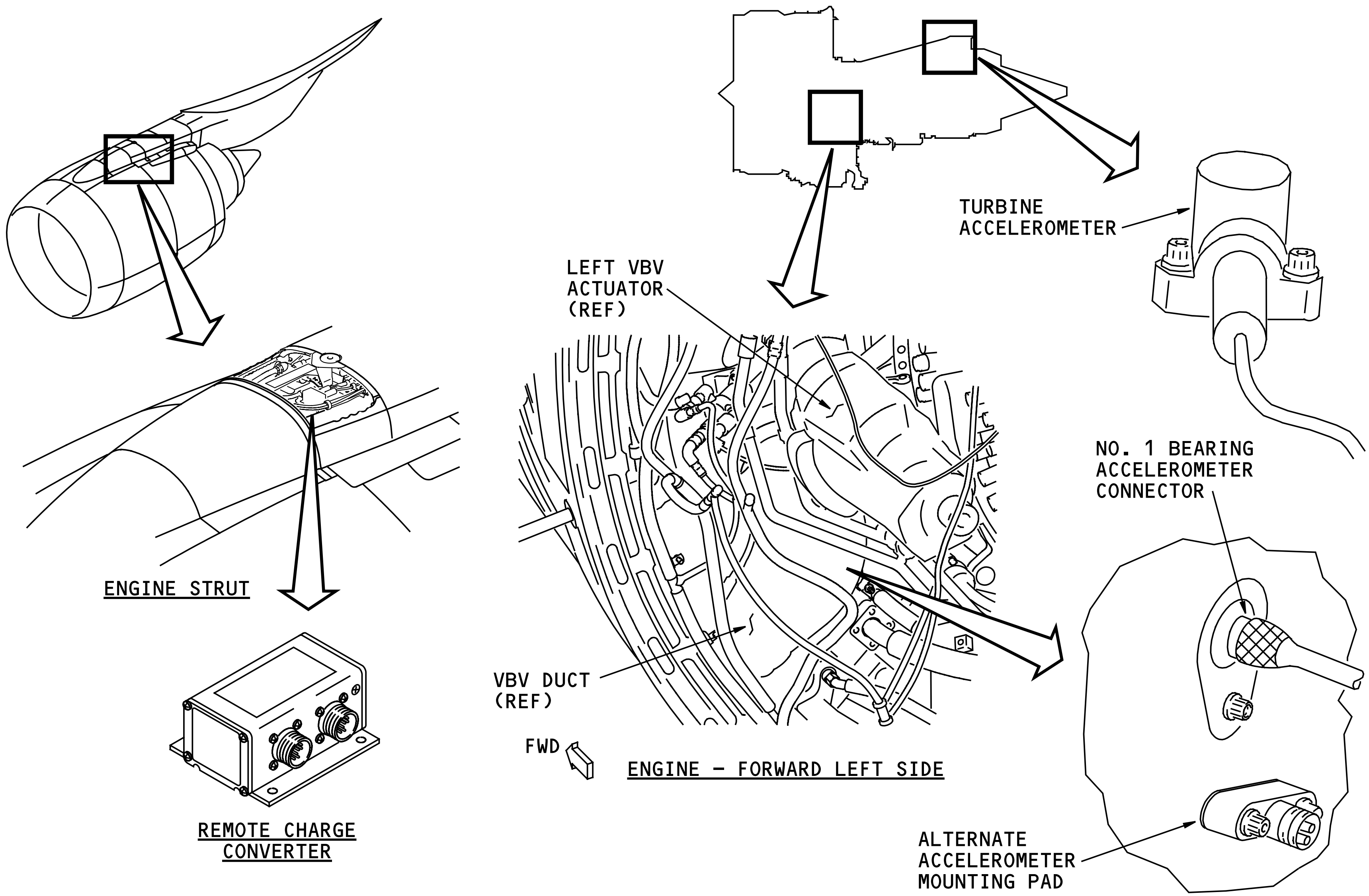
The accelerometers make electrical charge signals that change in proportion to the engine vibration level. The signals go to the RCC.

Remote Charge Converter

The RCC amplifies accelerometer charge signals and changes the signals into voltage signals. It sends the voltage signals to the AVM signal conditioner unit.

The RCC is in the engine strut. You get access to it through the forward access fairing.

The RCC has self-test circuits to continually monitor vibration amplitude and phase accuracy.



77-31-00-102 Rev 5 02/12/96

ENGINE INDICATING - AVM - ACCELEROMETERS AND REMOTE CHARGE CONVERTER

ENGINE INDICATING - AVM - SIGNAL CONDITIONER UNIT

General

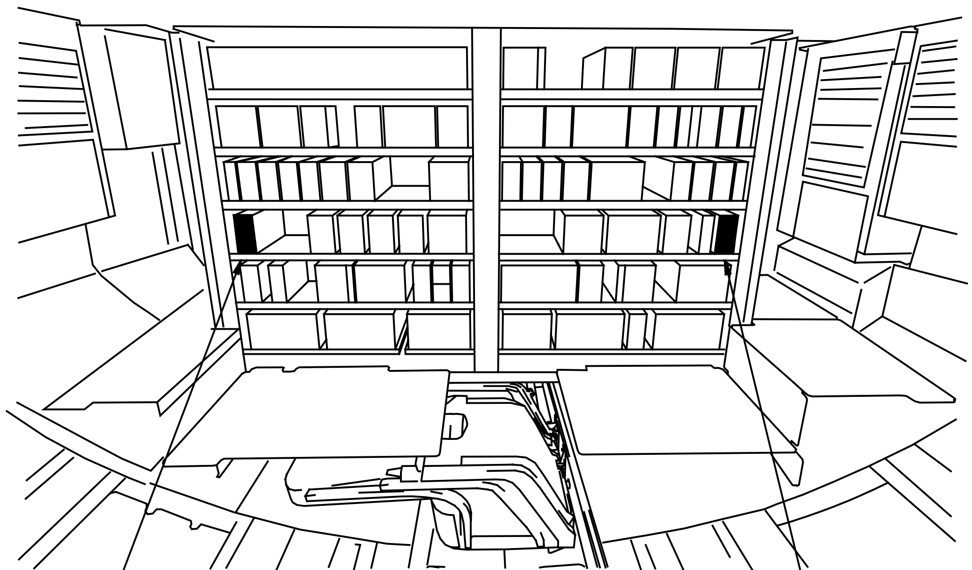
The AVM signal conditioner unit uses vibration and speed signals from engine sensors to calculate engine vibration levels. The signal conditioner unit also does these functions:

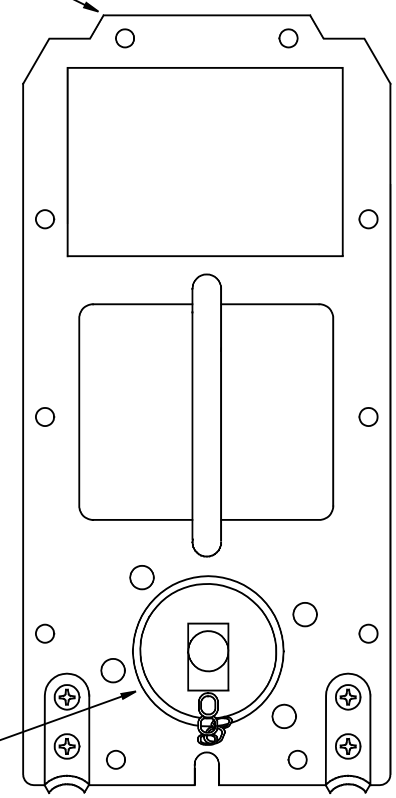
- Compares the N1 and N2 vibration levels to find which is highest
- Keeps in memory the vibration data for the last six flight legs
- Calculates engine balance solutions
- Self-test.

Each engine has one AVM signal conditioner unit. The signal conditioner units are in the main equipment center.

Maintenance Connector

The AVM signal conditioner unit has a maintenance connector on the front. The maintenance connector supplies alternative access for the engine balancing system (EBS) and for data loading. Normal access for these functions is on the MAT.





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ENGINE INDICATING - AVM - SIGNAL CONDITIONER UNIT

ENGINE INDICATING - AVM - INDICATION

Secondary Engine Display

The secondary engine display shows the highest vibration level for each engine. The rotor identification is below the vibration data. If the N1 or N2 speed signal fails, the rotor identification shows broadband (BB) vibration.

If the vibration level is equal to or more than 4.0 scalar units, the vibration display automatically shows on the secondary engine display. Also, the digital display will show in reverse video format (black numbers on a white background).

When an engine is shut down, the related vibration data does not show.

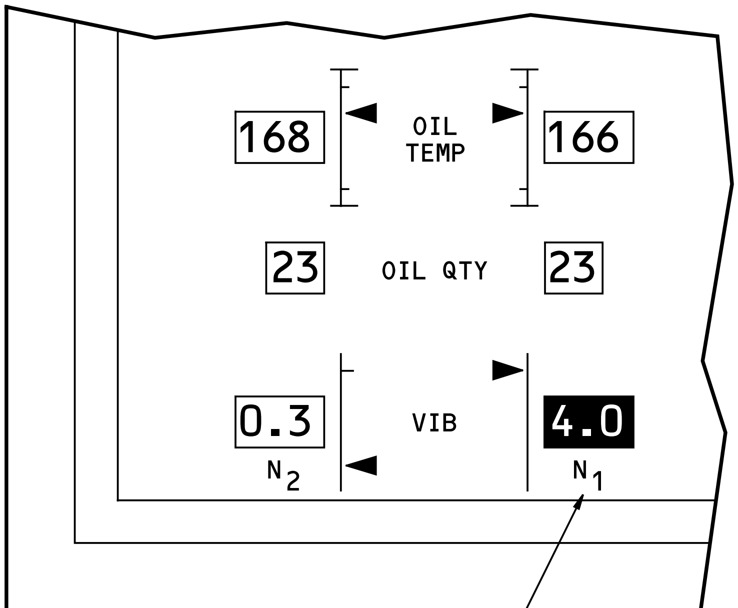
Performance Maintenance Page

The performance maintenance page shows all the engine vibration data. N1 fan vibration shows under channel B for the AVM signal conditioner unit. The other vibration data shows under channel A.

If the N1 or N2 speed signal fails, only the broadband vibration data shows.

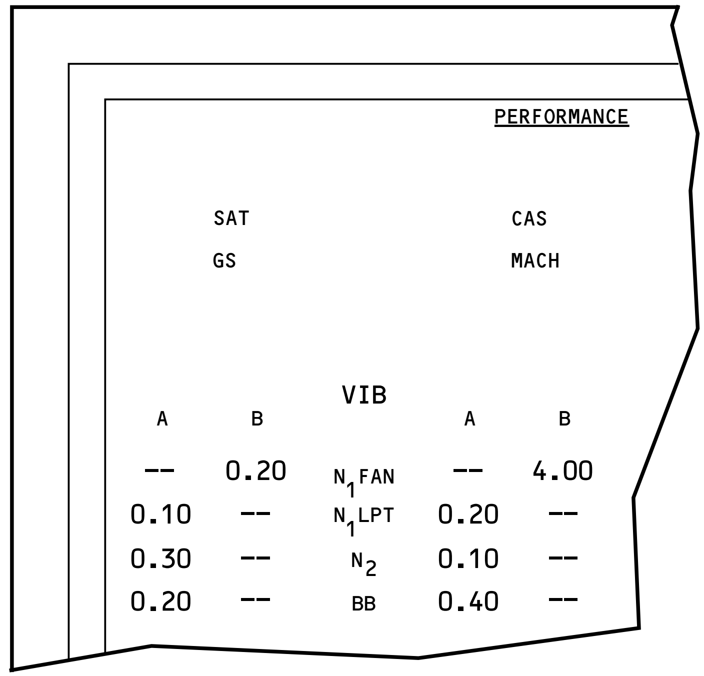
Training Information Point

At low engine speeds, the N1 FAN and N1 LPT data change to dashes. This is because the broadband vibration is too large in proportion to the N1 vibration.



SECONDARY ENGINE DISPLAY

ROTOR IDENTIFICATION



PERFORMANCE MAINTENANCE PAGE

77-31-00-105 Rev 7 05/19/1997

ENGINE INDICATING - AVM - INDICATION

ENGINE INDICATING - AVM - ENGINE BALANCING SYSTEM (EBS)

General

The engine balancing system (EBS) permits you to select which balance weights on the engine to change to decrease engine vibration.The AVM signal conditioning unit for each engine and the AIMS central maintenance computing function (CMCF) make up the EBS.

The AVM signal conditioner unit supplies the data for the engine balancing displays. You use the MAT to operate the EBS.

Engine Balancing Main Menu

You use the MAT to select the OTHER FUNCTIONS menu. The ENGINE BALANCING function shows on the OTHER FUNCTIONS menu.

The HELP selection is active if there is help text in the airline data base.

To start the engine balancing process you must choose these selections:

- ENGINE 1 or ENGINE 2
- PERFORM BALANCE or CALCULATE SPECIFIC BALANCE COEFFICIENTS/GROUND RUN
- CONTINUE.

Perform Balance

The PERFORM BALANCE selection of the EBS calculates a balance solution that corrects high engine vibration.

The solution identifies the balance weights that you should remove and install in the aft spinner or on the LPT blades.

Calculate Specific Balance Coefficients/Ground Run

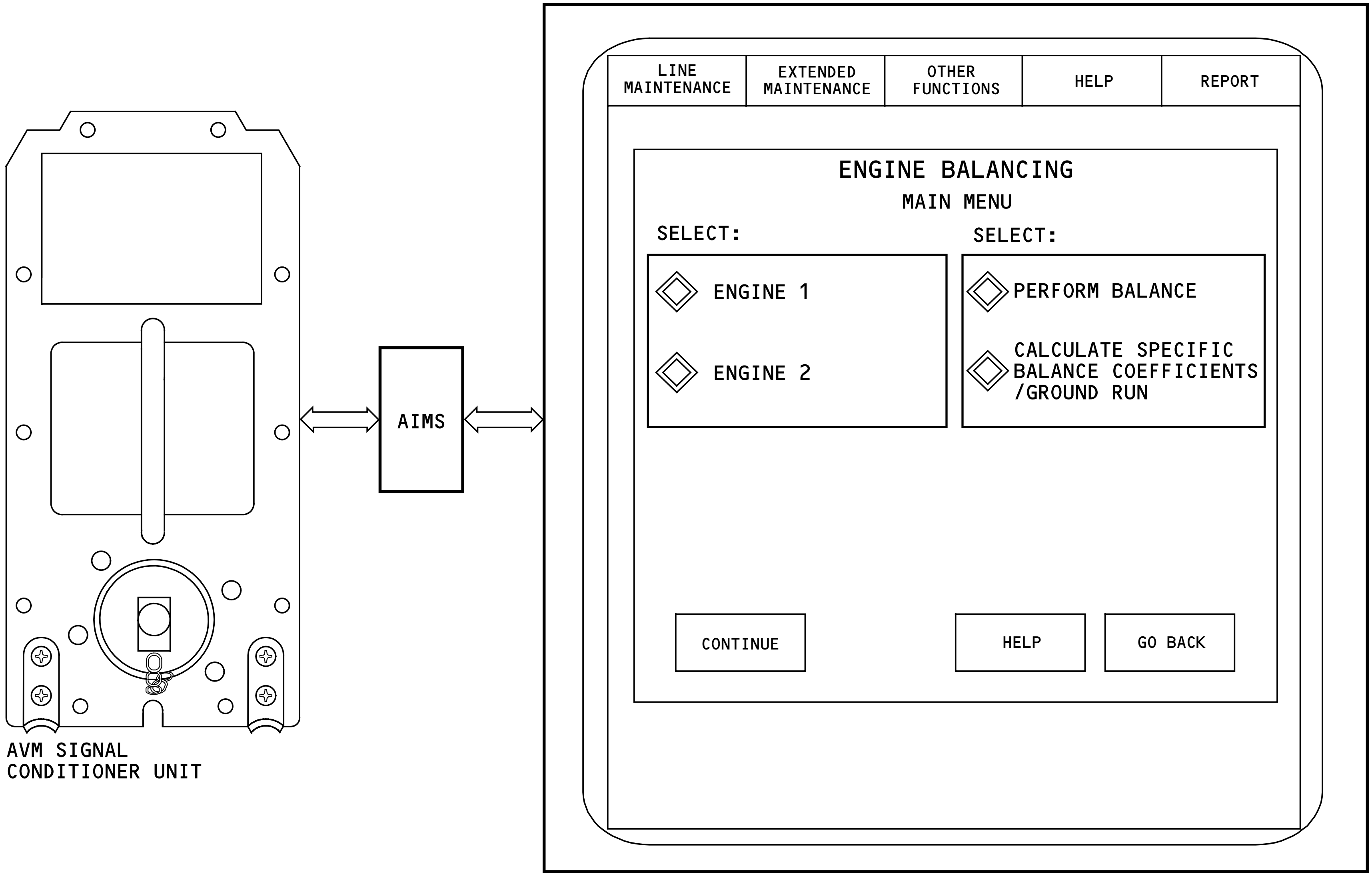
The CALCULATE SPECIFIC BALANCE COEFFICIENTS/GROUND RUN selection of the EBS lets you do these functions:

- Calculate new specific balance coefficients
- Record ground run data for the EBS to use.

When you calculate specific balance coefficients, the EBS replaces the existing balance coefficients. The AVM signal conditioner unit can use ground run data, or both flight data and ground run data, to calculate the new coefficients.

Continue

When you select CONTINUE, the MAT shows the EXISTING BALANCE WEIGHTS display. The CONTINUE selection becomes active after you make the first two selections.



ENGINE INDICATING - AVM - ENGINE BALANCING SYSTEM (EBS)

ENGINE INDICATING - AVM - EBS - PERFORM BALANCE - 1

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Existing Balance Weights Display

The EXISTING BALANCE WEIGHTS display shows the part number and location of the fan and LPT balance weights. The data is in the AVM signal conditioner unit memory.

NOTE: The holes in the aft spinner that do not have balance weights contain a standard weight. The EBS part number for this weight is P01. The EXISTING BALANCE WEIGHTS display does not show P01 weights.

You use this data to make sure the balance weight data in the AVM signal conditioner unit memory matches the weights on the engine. This is necessary for the AVM signal conditioner unit to calculate a correct balance solution. If the balance weight data is not correct, you must change the data. When you select the data or a blank text field, an edit dialog box shows.

On the EXISTING BALANCE WEIGHTS display, you can make two selections:

- CONTINUE
- FLIGHT HISTORY.

When you select CONTINUE, the AVM signal conditioner unit calculates a balance solution and the MAT shows the SOLUTION SUMMARY display.

When you select FLIGHT HISTORY, the MAT shows the N1 VIBRATION FLIGHT HISTORY display.

N1 Vibration Flight History Display

The N1 VIBRATION FLIGHT HISTORY display shows the fan (Front) and LPT (Rear) vibration data and phase angle for six flight legs. The data shows for different N1 speeds. Vibration data shows in reverse video format (black numbers on a white background) when the vibration level is more than the recommended vibration guideline.

You select AVERAGE to cause the AVM signal conditioner unit to use that data to calculate a solution for engine balancing. You may also select a specific flight leg to cause the AVM signal conditioner unit to use that data.

You select GO BACK to return to the EXISTING BALANCE WEIGHTS display.

You select N2 FLIGHT HISTORY to show the N2 VIBRATION FLIGHT HISTORY display (not shown). The N2 VIBRATION FLIGHT HISTORY display shows the N2 rotor vibration data for six flight legs. You use the N2 vibration data to make sure N2 vibration is less than the recommended vibration guideline. You cannot balance the N2 rotor with the EBS.

Training Information Point

When the AVM signal conditioner unit calculates the leg average it uses only the legs or ground runs with the same weight configuration as the present leg (LG 0). When you do a PERFORM BALANCE, the EBS will not let you

ENGINE INDICATING - AVM - EBS - PERFORM BALANCE - 1

select legs with weights that are different from the present leg (LG 0).

Some legs may not have data for one or more engine speeds. This occurs if the engine does not operate at that speed for 30 seconds or more. The AVM signal conditioner unit must have vibration data for a minimum of four speeds to calculate the balance solution.

The N1 VIBRATION FLIGHT HISTORY display shows N1 vibration data in mils S.A. (single amplitude). These are different than the scalar units for N1 vibration on the secondary engine display and the performance maintenance page.

The N2 VIBRATION FLIGHT HISTORY display shows N2 vibration data in scalar units.

ENGINE BALANCING
PERFORM BALANCE
EXISTING BALANCE WEIGHTS

Aircraft ID: N123456 Engine Type: GE90

Engine Position: L Engine Serial Number: 123456

Make sure that the PART and HOLE/BLADE numbers agree with the balance weights and their locations on the engine. Edit the PART and HOLE/BLADE numbers as necessary.

FAN

Part Number	HOLE Number
P02	3
P04	10
P02	19

LPT

Part Number	BLADE Number
P01	12

CONTINUE | FLIGHT HISTORY

ENGINE BALANCING
PERFORM BALANCE
N1 VIBRATION FLIGHT HISTORY

Aircraft ID: N12345 Engine Type: GE90
Engine Position: L Engine Serial No.: 123456

Select a leg or the leg average. Select GO BACK to continue.

ENGINE SPEED (%N1)

Leg		60 Front	60 Rear	84 Front	84 Rear	86 Front	86 Rear	89 Front	89 Rear	95 Front	95 Rear	98 Front	98 Rear
LG-5 22DEC95 09:20	N1	0.4	0.1	0.3	0.1	0.7	0.2	0.9	0.4	0.6	0.3	0.4	0.2
	Phase	193	355	261	074	253	087	295	113	332	062	315	045
LG-4 22DEC95 13:20	N1	0.3	0.1	0.4	0.1	0.6	0.2	0.9	0.4	0.6	0.2	0.4	0.3
	Phase	196	001	258	076	255	092	302	110	336	063	313	042
LG-3 23DEC95 09:20	N1			0.4	0.1	0.7	0.2	0.9	0.4	0.5	0.3	0.4	0.2
	Phase			259	073	252	088	294	112	332	065	315	043
LG-2 23DEC95 13:20	N1	0.4	0.1	0.4	0.1	0.8	0.2	1.0	0.4	0.6	0.3	0.4	0.2
	Phase	195	002	258	081	251	087	291	115	332	062	317	045
LG-1 24DEC95 09:20	N1	0.5	0.2	0.6	0.1	0.9	0.3	1.2	0.5	0.8	0.5	0.7	0.3
	Phase	198	358	262	090	262	101	341	124	285	061	304	042
LG-0 24DEC95 13:20	N1	0.7	0.3	0.8	0.2	1.3	0.2	1.6	0.5	1.4	0.4	1.0	0.2
	Phase	187	355	257	083	294	095	312	102	298	054	310	044
AVERAGE	N1	0.5	0.2	0.5	0.1	0.8	0.2	1.1	0.4	0.8	0.3	0.6	0.2
	Phase	194	358	259	080	261	092	306	113	319	061	312	044

GO BACK | N2 FLIGHT HISTORY

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ENGINE INDICATING - AVM - EBS - PERFORM BALANCE - 1

Solution Summary Display

The SOLUTION SUMMARY display lets you select a one-plane or two-plane solution.

When you select ONE PLANE, the AVM signal conditioner unit finds the weights you must change in the front balance plane (FAN) to correct high N1 vibration. The SOLUTION SUMMARY display shows the part numbers and locations of the fan balance weights you must remove and install. The display also shows the predicted overall vibration reduction.

When you select TWO PLANE, the AVM signal conditioner unit finds the weights you must change in the front and rear balance planes (FAN and LPT) to correct high N1 vibration. In this case the SOLUTION SUMMARY display also shows the part numbers and locations of the LPT weights you must remove and install.

A message shows at the bottom of the SOLUTION SUMMARY display. This message tells you when:

- An engine check run is not necessary
- A low power engine check run is recommended
- A high power engine check run is recommended
- No solution is available

After you select ONE PLANE or TWO PLANE, you must select CONTINUE or SOLUTION PREDICTION.

When you select CONTINUE, the MAT shows the NEW BALANCE WEIGHTS display.

When you select SOLUTION PREDICTION, the MAT shows the N1 VIBRATION PREDICTION display.

N1 Vibration Prediction Display

The N1 VIBRATION PREDICTION display shows the front and rear vibration at different N1 speeds. It shows the actual and the predicted vibration levels.

The actual vibration comes from the leg average or the specific flight leg you selected on the N1 VIBRATION FLIGHT HISTORY display.

The predicted vibration shows what the vibration will be if you make the balance solution weight changes.

You select GO BACK to return to the SOLUTION SUMMARY display.

Training Information Point

The N1 VIBRATION PREDICTION display shows N1 vibration data in mils S.A. (single amplitude). These are different than the scalar units for N1 vibration on the secondary engine display and the performance maintenance page.

The N1 VIBRATION PREDICTION display shows predicted vibration that is higher than the recommended vibration guideline in reverse video format (black letters on a white background). The display does not show actual vibration in reverse video format.

ENGINE BALANCING
PERFORM BALANCE
SOLUTION SUMMARY

Aircraft ID: N123456 | Engine Type: GE90
Engine Position: L | Engine Serial Number: 123456
Balance Coefficients: GE001

Select a one or two plane solution. Install and remove all balance weights shown in selected list.

◆ ONE PLANE

◇ TWO PLANE

FAN

	Part Number	Hole Number
Install	P03	35
Install	P06	41
Remove	P02	3

Predicted overall vibration reduction

54%

WITH ABOVE SOLUTION NO POST BALANCE ENGINE CHECK RUN IS NECESSARY.

CONTINUE | SOLUTION-PREDICTION

ENGINE BALANCING
PERFORM BALANCE
N1 VIBRATION PREDICTION

Aircraft ID: N123456 | Engine Type: GE90
Engine Position: L | Engine Serial Number: 123456
Balance Coefficients: GE001 | Solution Configuration:ONE PLANE

ENGINE SPEED (%N1)

	50	60	70	80	90	100
Front Vibration	0.7	0.8	1.3	1.6	1.4	1.0
Predicted Front Vibration	0.2	0.3	0.4	0.6	0.5	0.2
Rear Vibration	0.3	0.2	0.2	0.5	0.4	0.2
Predicted Rear Vibration	0.0	0.1	0.2	0.3	0.2	0.2

GO BACK

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ENGINE INDICATING - AVM - EBS - PERFORM BALANCE - 2

ENGINE INDICATING - AVM - EBS - PERFORM BALANCE - 3

New Balance Weights Display

The NEW BALANCE WEIGHTS display shows the part number and location of the new FAN and LPT balance weights. This is what the balance weight configuration will be after you change the weights. The display does not show P01 weights.

When you select KEEP WEIGHTS, the MAT shows the ENGINE BALANCING EXIT APPROVAL display.

Engine Balancing Exit Approval

The EXIT APPROVAL display permits the approval of the balance weights shown on the NEW BALANCE WEIGHTS display.

When you select KEEP WEIGHTS on the EXIT APPROVAL display the new balance weight data goes into the AVM SCU memory. After you select KEEP WEIGHTS, the EXIT APPROVAL display goes away and and you return to the NEW BALANCE WEIGHTS display.

If you select GO BACK on the EXIT APPROVAL display, you return to the NEW BALANCE WEIGHTS display. You select GO BACK to look at any of the data again or to reject the new weights.

Training Information Point

To exit the NEW BALANCE WEIGHTS display, you select another function from the menu. The ENGINE BALANCING/ NOTICE display shows (not shown). You must select STOP on this display to complete the EBS procedure.

ENGINE BALANCING
PERFORM BALANCE
NEW BALANCE WEIGHTS

Aircraft ID: N123456 Engine Type: GE90

Engine Position: L Engine Serial Number: 123456

Make sure that the PART and HOLE/BLADE numbers agree with the balance weights and their locations on the engine when balancing is completed. Edit PART and HOLE/BLADE numbers as necessary. When PART and HOLE/BLADE numbers agree, select KEEP WEIGHTS.

FAN

Part Number	HOLE Number
P04	10
P02	19
P03	35
P06	41

LPT

Part Number	BLADE Number
P01	12

KEEP WEIGHTS

ENGINE BALANCING
EXIT APPROVAL

NOTICE: THIS FUNCTION WILL COMPLETE.

- If the balance weights list has not been checked, select GO BACK
- To complete this function, select KEEP WEIGHTS

KEEP WEIGHTS HELP GO BACK

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ENGINE INDICATING - AVM - EBS - PERFORM BALANCE - 3

ENGINE INDICATING - ENGINE MOUNTED SENSORS - GENERAL DESCRIPTION

General

The engine mounted sensors supply data, through the EEC, to the airplane condition monitoring system (ACMS) in the AIMS. You use the ACMS to get reports of engine sensor data for ground-based engine condition monitoring. The EEC does not use these sensors for engine control.

Other engine sensors also supply data for the ACMS. See the engine fuel control section for more information on the other engine sensors (AMM PART I 73-21).

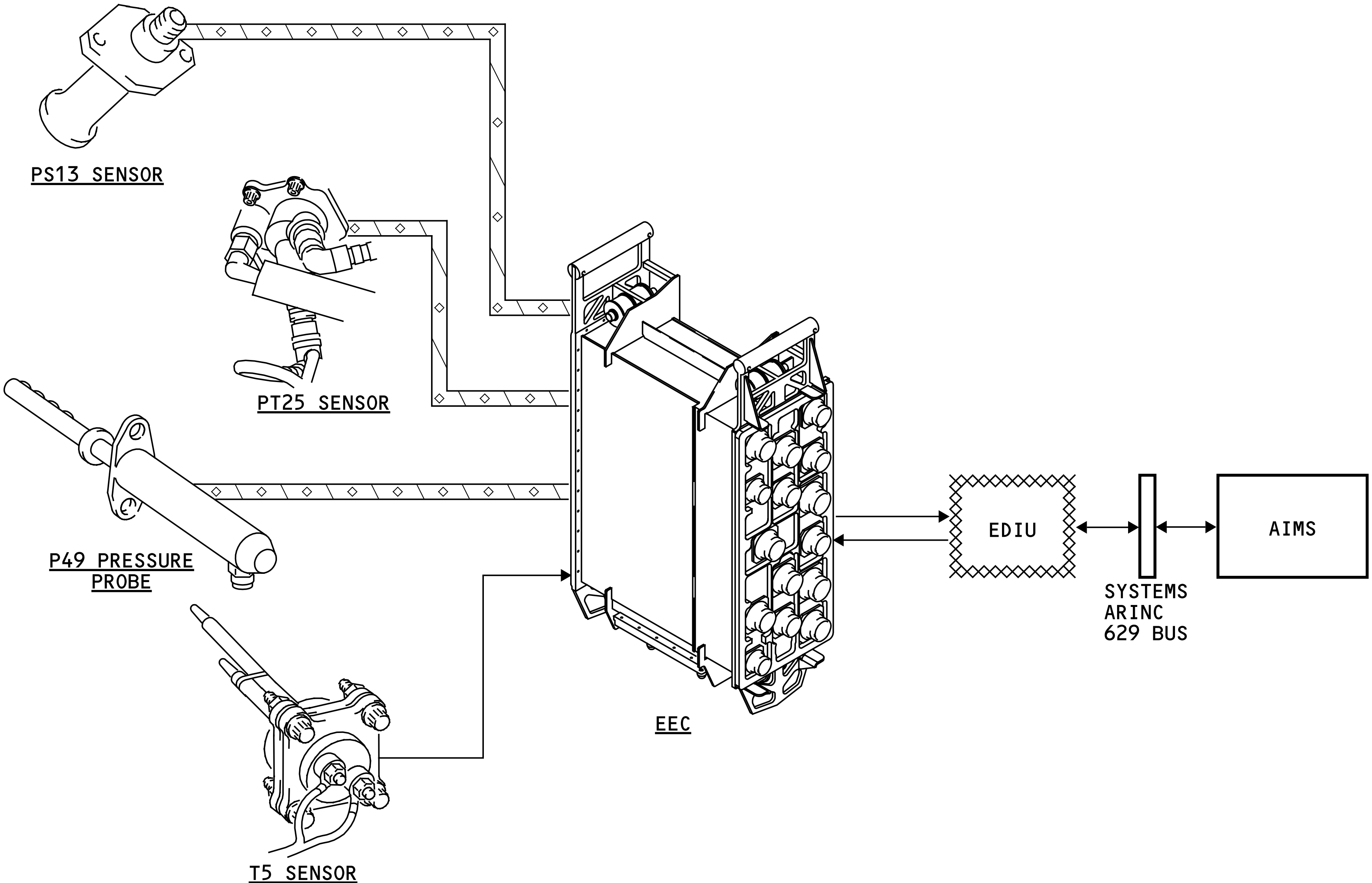
These are the sensors and the data they monitor:

- PS13: fan flow static pressure
- P25: LPC exit pressure
- P49: total pressure between the HPT and LPT
- T5: temperature at the LPT exit.

The EEC gets P25 from the PT25 sensor.

Indications

The engine mounted sensor data does not show in the flight deck.



ENGINE INDICATING - ENGINE MOUNTED SENSORS - GENERAL DESCRIPTION

ENGINE INDICATING - ENGINE MOUNTED SENSORS - T5, P49, AND PS13 SENSORS

PS13 Sensor

The PS13 sensor measures the static air pressure in the fan bypass flow. The pressure data goes to channel A of the EEC.

The PS13 sensor is on the fan case above the EEC at the 2:00 position. Two bolts hold the PS13 sensor on the fan case. A single, pressure-sensing line connects the sensor to the EEC.

You open the right fan cowl to get access to the sensor.

P49 Pressure Sensor

The P49 pressure sensor measures the total air pressure between the HPT and LPT. The pressure data goes to channel A of the EEC.

The P49 pressure sensor is on the turbine center frame (TCF) at the 4:00 position. Two bolts hold the P49 sensor on the TCF. A single, pressure-sensing line connects the sensor to the EEC.

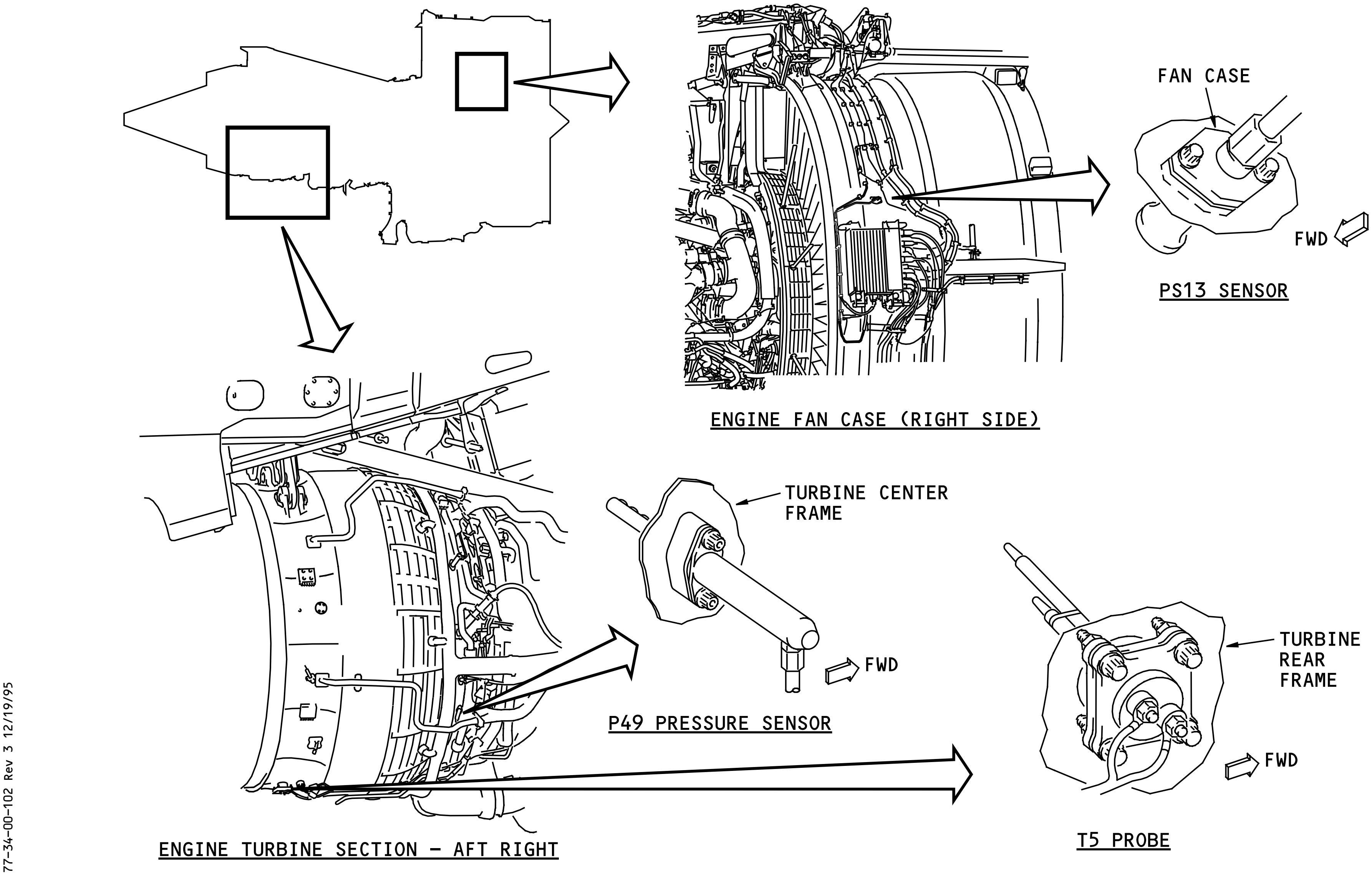
You open the right T/R half to get access to the sensor.

T5 Probe

The T5 probe measures the LPT outlet temperature. The temperature data goes to channel A of the EEC.

The T5 probe is on the turbine rear frame (TRF) at the 5:30 position. Four bolts hold the T5 probe on the TRF. Captured nuts hold chromel and alumel leads on the probe connections.

You open the right T/R half to get access to the T5 probe.



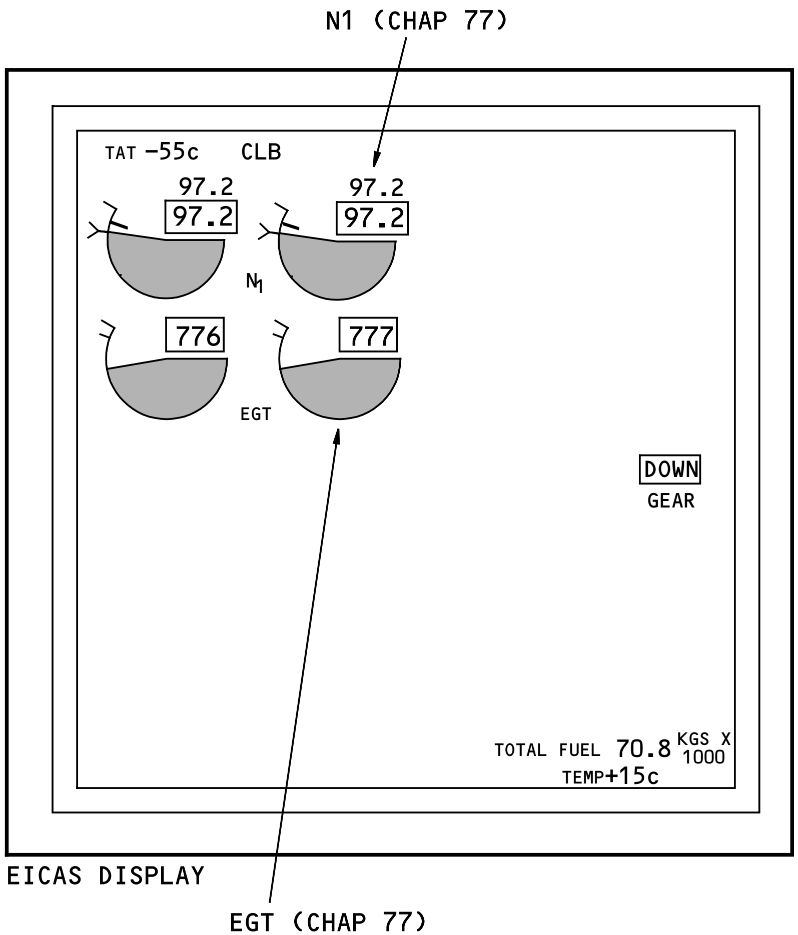
ENGINE INDICATING - ENGINE MOUNTED SENSORS - T5, P49, AND PS13 SENSORS

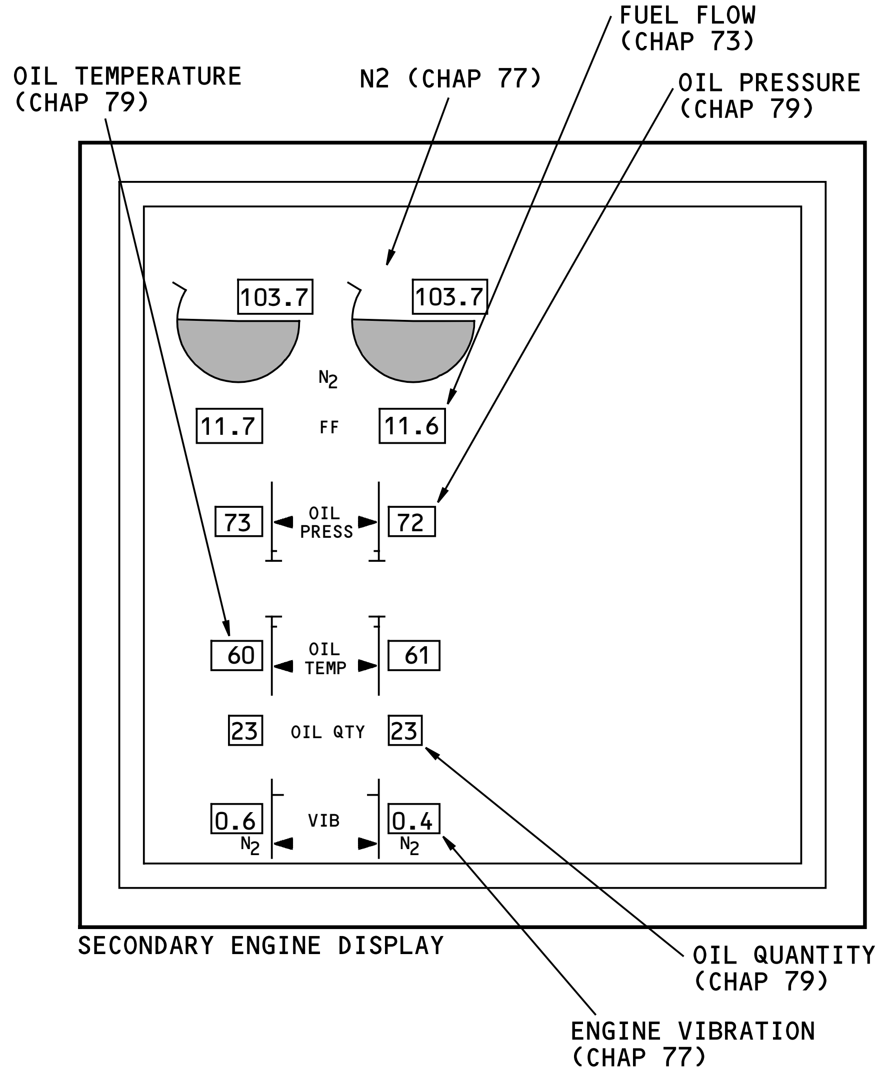
Indications

The EICAS display and the secondary engine display show these engine parameters:

- N1, LPC rotor speed
- EGT, exhaust gas temperature
- N2, HPC rotor speed
- FF, fuel flow
- OIL PRESS
- OIL TEMP
- OIL QTY
- VIB, engine vibration.

Refer to the related ATA chapter for more information about these indications.





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ENGINE INDICATING - EICAS & SECONDARY ENGINE DISPLAYS

ENGINE INDICATING - PERFORMANCE & ENGINE EXCEEDANCE MAINTENANCE PAGES

Performance Maintenance Page

The top part of the performance maintenance page shows some general airplane and environment data. GROSS WT is the gross weight of the airplane that the dispatch agent puts in. SAT is the static air temperature and TAT is the total air temperature. Both show in degrees Celsius. GS is the ground speed and CAS is the calibrated air speed. Both show in knots. ALT is the altitude in thousands of feet.

The bottom part of the performance maintenance page shows the same engine parameters as the EICAS display and the secondary engine display. These indications are described in their related sections.

The performance maintenance page also shows the value for these indications:

- PS3
- P-BLEED
- DUCT PRESS.

PS3 is the static pressure from the HPC exit. The EEC gets PS3 from the PS3 sensor. The units are in psi.

P-BLEED is the flow rate of the air in the high stage bleed duct. The EEC uses the pressure from the bleed bias sensor to calculate P-BLEED. The units are in percent of core air flow.

DUCT PRESS is the manifold duct pressure. It comes from the air system cabin pressure controller (ASCPC). The units are in psi.

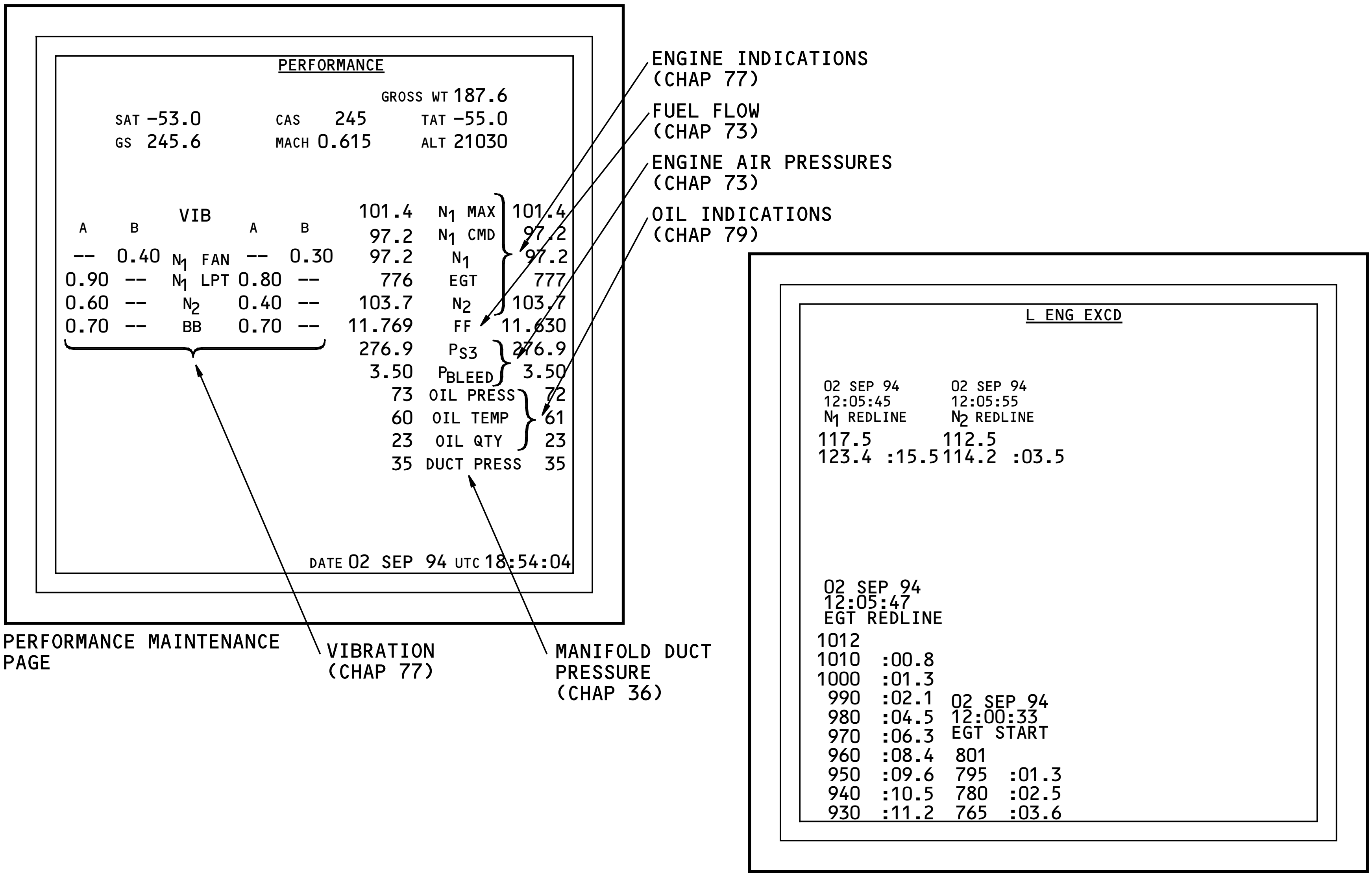
Engine Exceedance Maintenance Page

The N1 and N2 exceedance displays show the redline for the LP and HP rotors. If a rotor speed goes higher than the redline, the exceedance display shows the maximum actual rotor speed, and the time that the rotor speed was above the redline.

The EGT exceedance display shows an EGT profile if the EGT goes above the redline. This display can show as many as four EGT profiles. The most recent profile is on the left. The oldest profile is on the right. If a new EGT exceedance occurs, the profile shows on the left and the oldest profile goes out of view.

There are two separate profiles for each engine. One profile is for the engine run redline. The other profile is for the engine start redline. If the EGT exceeds the redline while the engine is running, the profile shows the EGT in increments up to the maximum actual EGT. It also shows the time that the EGT was more than each increment.

If the EGT exceeds the redline during an engine start, the profile shows the EGT in increments up to the maximum actual EGT. It also shows the time that the EGT was above each increment.



ENGINE EXCEEDANCE MAINTENANCE PAGE

ENGINE INDICATING - PERFORMANCE & ENGINE EXCEEDANCE MAINTENANCE PAGES

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Indications

The EPCS maintenance pages show engine parameters from many engine sensors. The parameters show for channels A and B of the EEC. There is a box around the channel that the EEC is using to control the engine.

These are the parameters that show on the EPCS maintenance page 1:

- N1: LPC rotor speed (percent)
- N2: HPC rotor speed (percent)
- TRA: thrust resolver angle (degrees)
- T/R: left and right thrust reverser position (percent deployed)
- PAMB: ambient pressure (psi)
- PS3: compressor discharge pressure (psi)
- T12: fan inlet temperature (degrees Celsius)
- T25: core engine inlet temperature (degrees Celsius)
- T3: compressor discharge temperature (degrees Celsius)
- VBV: variable bypass valve position (percent open)
- VSV: variable stator vane position (percent open)
- STB: start/transient bleed valve position (percent open)

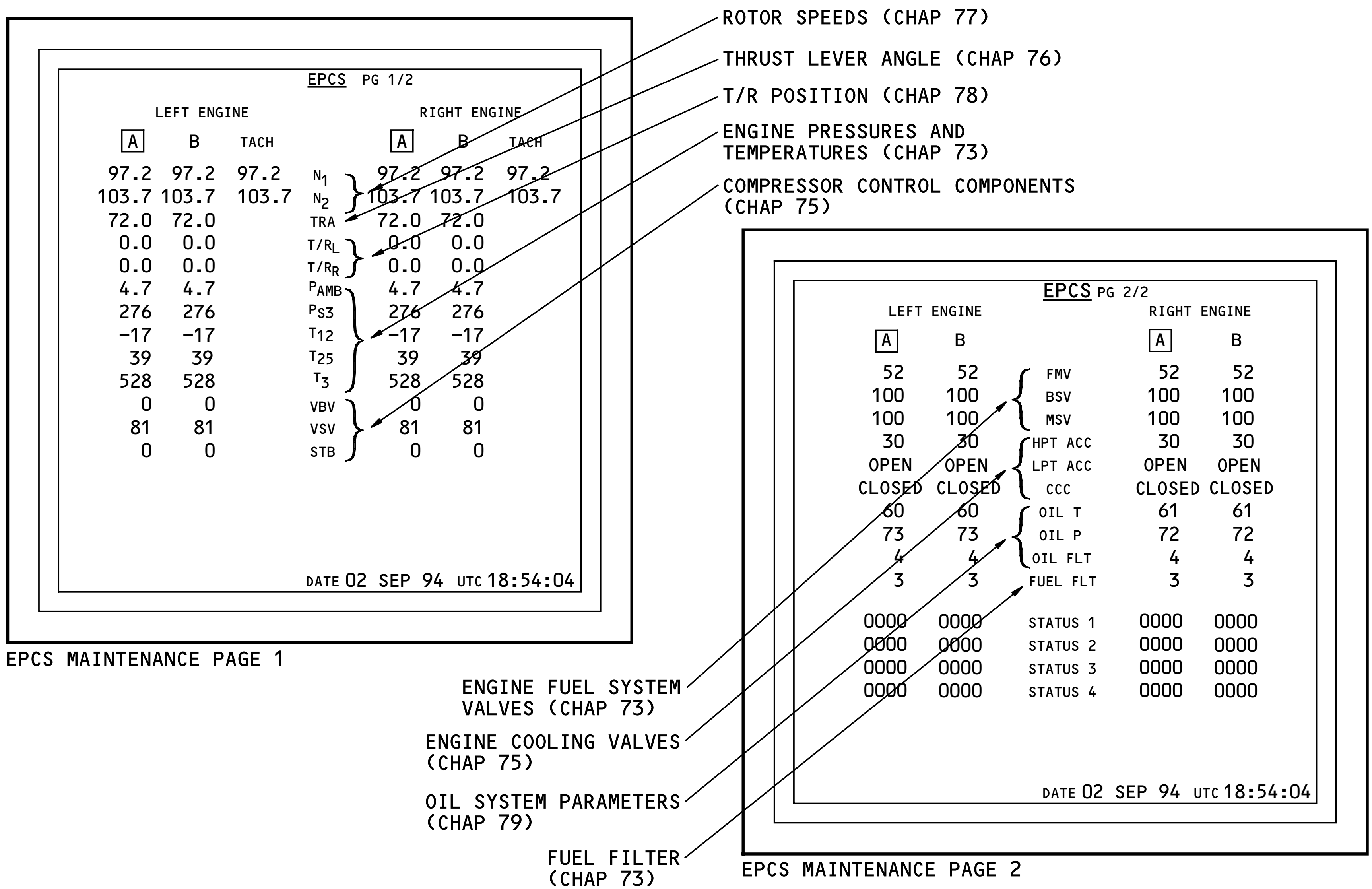
These are the parameters that show on the EPCS maintenance page 2:

- FMV: fuel metering valve position (percent open)
- BSV: burner staging valve position (percent open)
- MSV: main staging valve position (percent open)
- HPT ACC: HPT active clearance control valve position (percent open)
- LPT ACC: LPT active clearance control valve position (OPEN or CLOSED)
- CCC: core compartment cooling valve position (OPEN or CLOSED)
- OIL T: oil temperature (degrees Celsius)
- OIL P: oil pressure (psi)
- OIL FLT: oil filter differential pressure (psi)
- FUEL FLT: fuel filter differential pressure (psi).

Refer to the related ATA chapter for more information about these indications.

Status Words

The status words at the bottom of the page show data about the EEC. Each word is a four character hexadecimal number. When decoded, each word shows 16 different parameters.



ENGINE INDICATING - EPCS MAINTENANCE PAGES

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ENGINE INDICATING - PROPULSION DATA LIMITS MAINTENANCE PAGES

Propulsion Data Limits - Page 1

The propulsion data limits maintenance page 1 shows data limits for these engine parameters:

- Rotor speeds
- EGT
- Oil pressure
- Oil temperature.

Propulsion Data Limits - Page 2

The propulsion data limits maintenance page 2 shows these limits:

- Exceedance profiles
- Takeoff thrust
- Minimum idle
- Oil quantity
- Vibration
- In-flight relight
- Cross-bleed start.

The exceedance profile display shows the limits for the EGT profiles. The EGT profiles show on the engine exceedance maintenance page (not shown). EGT OPER ORIGIN is the temperature at which the EGT exceedance profile starts when the engine is running. EGT START ORIGIN is the temperature at which the EGT exceedance profile starts during an engine start. DELTA is the temperature increment for the related exceedance profile.

TAKEOFF THRUST is the N1 value at which the AIMS sets the takeoff thrust discrete. The AIMS shows a takeoff warning if the takeoff thrust discrete is set and the airplane is not in the correct takeoff configuration.

The MINIMUM IDLE and DELAY display show data that the AIMS uses to find if the engine is running. MINIMUM IDLE is an N2 reference value. DELAY is a time delay in seconds. The AIMS usually gets an engine run discrete signal from the EEC. If that signal is invalid, it uses N2. If N2 is above minimum idle for more than the time delay shown, then AIMS sets the engine run discrete.

The OIL QTY: LOW display shows the low limit, in quarts, for engine oil quantity. When the quantity gets below the low limit, the oil quantity display on the secondary engine page (not shown) shows in reverse video (black letters on a white background). The letters LO also show next to the oil quantity display.

The VIB: WHITE display shows the vibration level that causes the vibration display on the secondary engine page (not shown) to show in reverse video (black letters on a white background). This vibration level also causes the secondary engine page to show automatically.

In-Flight Relight Data

The IN-FLIGHT RELIGHT display shows data points that the AIMS uses to make the in-flight relight envelope (not shown). The in-flight relight envelope shows on the EICAS display.

ENGINE INDICATING - PROPULSION DATA LIMITS MAINTENANCE PAGES

Cross-Bleed Start Data

The CROSS-BLEED START display shows data points that define the cross-bleed start envelope. If the airplane is in the cross-bleed start envelope, the cross-bleed start annunciation (not shown) shows with the relight start envelope on the EICAS display.

APU Data Limits

The APU display shows data limits for these APU parameters:

- RPM
- EGT
- Oil pressure
- Oil temperature
- Oil quantity.

PROPULSION DATA LIMITS PAGE 1/2

	L	R
N_1:		
REDLINE	109.0	109.0
AMBER BAND	--	--
EGT:		
REDLINE	1030	1030
AMBER BAND	985	985
START	750	750
N_2:		
REDLINE	117.0	117.0
AMBER BAND	--	--
OIL PR:		
LOW AMBER	40	40
LOW REDLINE	10	10
OIL T:		
HIGH REDLINE	135	135
HIGH AMBER	118	118
LOW AMBER	--	--

PROPULSION DATA LIMITS MAINTENANCE PAGE 1

PROPULSION DATA LIMITS PAGE 2/2

EXCD PROFILE:	L	R
EGT OPER ORIGIN	985	985
DELTA	10	10
EGT START ORIGIN	750	750
DELTA	15	15

TAKEOFF THRUST	60.0
FUEL ON CMD: GND	--
AIR	--
MINIMUM IDLE	60.0
DELAY	5.0
OIL QTY: LOW	4.0
VIB: REDLINE	--
WHITE	4.0
WHITE DELAY	0

IN-FLIGHT RELIGHT DATA PTS (CAS,ALT)

1	0, 0	0,140
3	150,140	150,300
5	335,300	365,286
7	365, 0	-- , --
9	-- , --	-- , --
11	-- , --	-- , --
13	-- , --	-- , --
15	-- , --	-- , --

CROSS-BLEED START DATA PTS (CAS,ALT)

1	0, 0	0,300
3	220,300	220, 0
5	-- , --	-- , --
7	-- , --	-- , --
9	-- , --	-- , --

APU

	AMBER	REDLINE
RPM	--	106.0
EGT	650	710
OIL PRESS	55	35
OIL TEMP	135	155
OIL QTY	4.4	3.8

PROPULSION DATA LIMITS MAINTENANCE PAGE 2

77-00-00-108 Rev 4 01/07/1998

ENGINE INDICATING - PROPULSION DATA LIMITS MAINTENANCE PAGES

ENGINE INDICATING - FUNCTIONAL DESCRIPTION

General

The engine indicating system supplies engine data to the EEC. The EEC monitors the engine parameters and sends them to the AIMS and the AVM signal conditioner unit. The AIMS shows the engine parameters on the EICAS and secondary engine displays.

These are the engine parameters that engine indicating system monitors:

- N1 (LPC rotor speed)
- N2 (HPC rotor speed)
- EGT (T49)
- Engine vibration
- Fan exit pressure (PS13)
- HPC inlet pressure (P25)
- HPT exit pressure (P49)
- LPT exit temperature (T5).

Engine Tachometer System

The engine tachometer system monitors N1 and N2. The system has an N1 and an N2 speed sensor. The N1 sensor sends signals to the EEC, EDIU, AVM signal conditioner, and the AIMS. The N2 sensor sends signals to the EEC, AVM signal conditioner and the AIMS.

Temperature Sensing System

The EEC uses T49 sensors and a pyrometer to monitor EGT. The T49 sensors are thermocouples. They measure the temperature between the LPT and HPT. The pyrometer is an infrared sensor system. It measures the blade heat energy of the first stage LPT blades.

Airborne Vibration Monitoring (AVM) System

The AVM system measures engine vibration. The two engine accelerometers send electrical charges to the remote charge converter (RCC). The RCC changes the accelerometer electrical charges to voltage signals and sends them to the AVM signal conditioner. The signal conditioner uses the voltage signals and engine speed signals to calculate engine vibration.

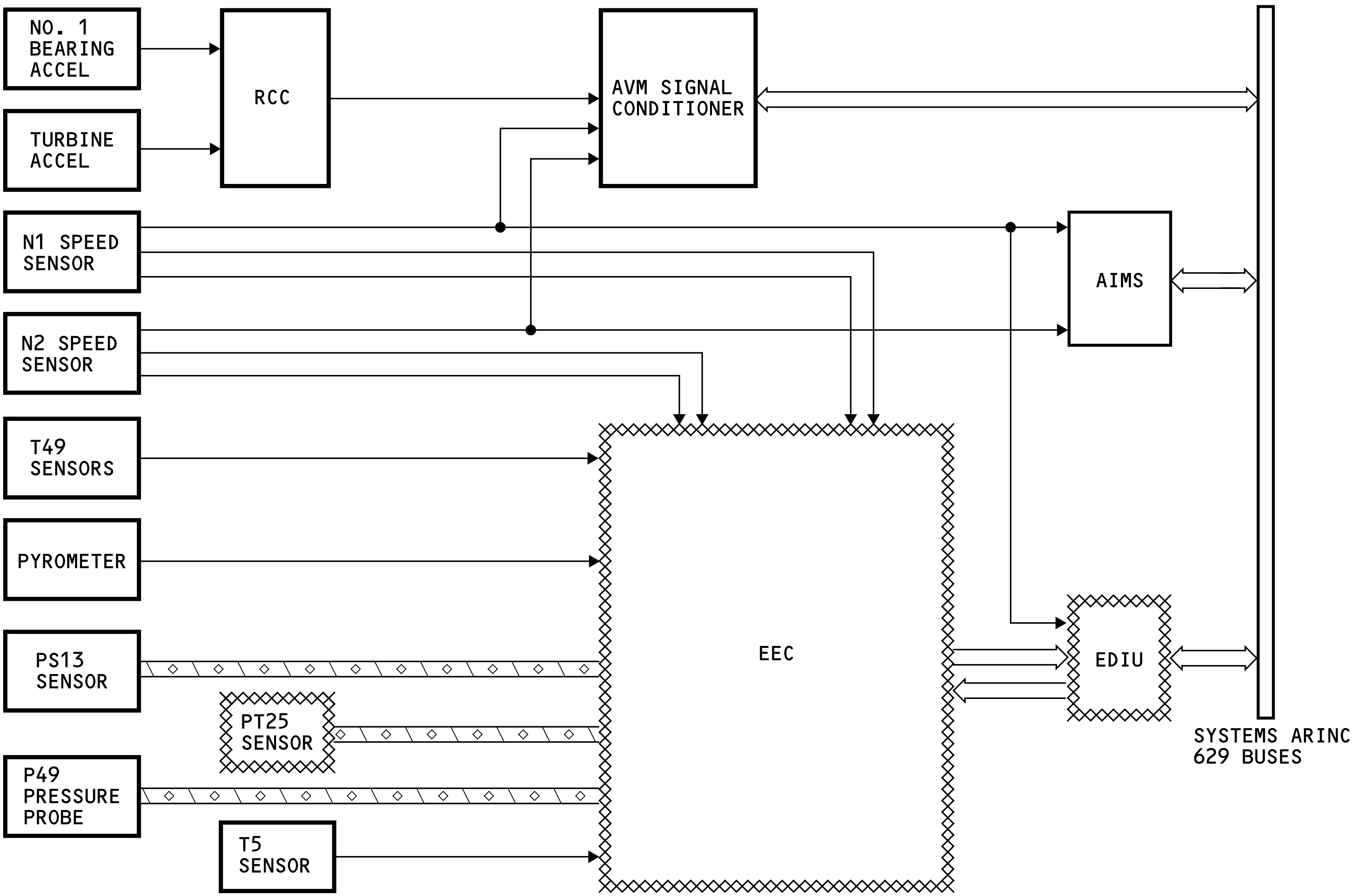
The AVM signal conditioner unit also contains engine balancing system (EBS) functions. It uses speed and vibration signals to calculate a balance solution. You use the EBS to correct high engine vibration caused by the fan or the LPT. The signal conditioner sends the EBS data to the AIMS.

Engine Mounted Sensors

The engine mounted sensors supply this data to the EEC:

- PS13
- P25
- P49
- T5.

This data goes to the ACMS function in the AIMS. You can get reports from the ACMS for engine condition monitoring.



ENGINE INDICATING - FUNCTIONAL DESCRIPTION

Continental Airlines, Inc

Engine Oil

WB371

TABLE OF CONTENTS

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OIL - INTRODUCTION

Purpose

The engine oil system does these functions:

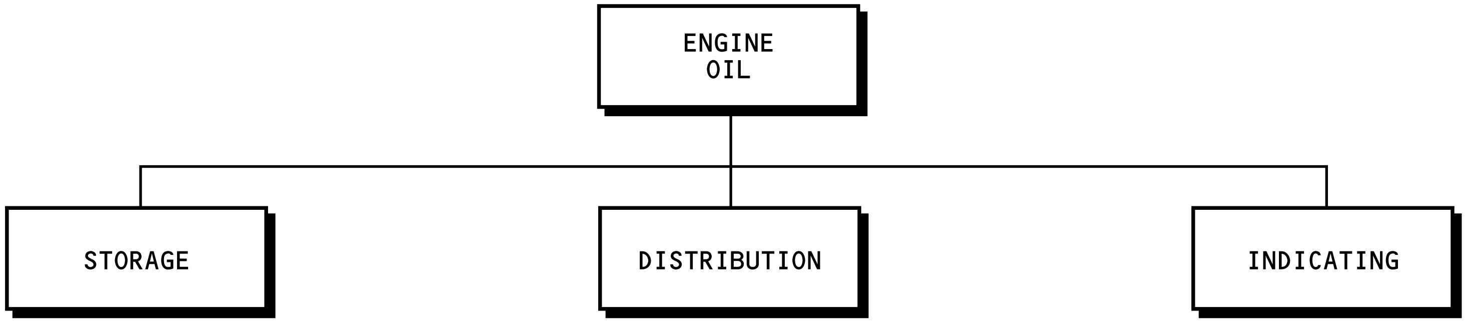
- Supplies oil to lubricate, cool, and clean the engine bearings and gearboxes
- Supplies oil to decrease vibration at the engine bearings (oil damping)
- Gives heat to the engine fuel to prevent ice formation in the fuel.

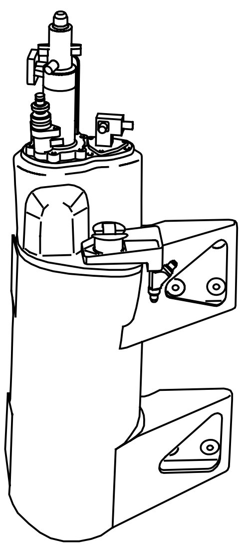
The oil system has these subsystems:

- Storage
- Distribution
- Indicating.

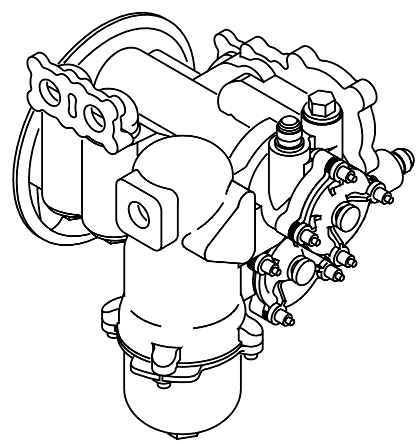
Abbreviations and Acronyms

AGB	- accessory gearbox
AIMS	- airplane information management system
ARINC	- Aeronautical Radio, Inc.
C	- Celsius
CA	- control alternator
DMS	- debris monitoring system
EDIU	- engine data interface unit
EEC	- electronic engine control
EICAS	- engine indication and crew alerting system
eng	- engine
EPCS	- electronic propulsion control system
filt	- filter
fwd	- forward
HPC	- high pressure compressor
IDG	- integrated drive generator
LPT	- low pressure turbine
MFD	- multi-function display
press	- pressure
psi	- pounds per square inch
qty	- quantity
ref	- reference
temp	- temperature
TGB	- transfer gearbox

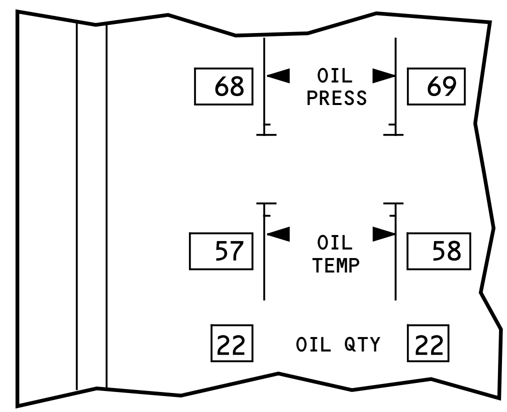




OIL TANK



LUBE & SCAVENGE PUMP



SECONDARY ENGINE DISPLAY

79-00-00-101 Rev 3 04/03/95

OIL - INTRODUCTION

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OIL - GENERAL DESCRIPTION

Storage

The engine oil tank is the reservoir for the engine oil system. You fill the oil tank through the manual gravity filling cap assembly.

Distribution

The engine oil distribution subsystem has these parts:

- Pressure
- Scavenge
- Breather.

Oil flows from the engine oil tank to the lube and scavenge pump. The lube pump elements pressurize the oil for output. The lube pump does not control the oil output pressure. When the engine speed changes, the oil pressure changes.

The pressurized oil flows through the oil filter element. The oil filter differential pressure sensor and the EEC monitor the condition of the filter.

The oil flows through the main fuel/oil heat exchanger. The heat exchanger gives the heat of the engine oil to the fuel. The fuel/oil heat exchanger is the primary source of engine oil cooling. The oil/oil heat exchanger uses engine oil to cool the backup generator oil. The oil then flows to the engine bearings and gears.

See the generator drive section for more information (AMM PART I 24-10).

Downstream of the main fuel/oil heat exchanger, some pressurized oil returns to the lube pump boost element. The engine uses this boost oil at the bearings to decrease engine vibration.

The scavenge oil flows through the scavenge oil inlet screens inside to the lube and scavenge oil pump. The scavenge pump elements remove oil and contaminants from the bearing compartments and gearboxes. The scavenge oil returns to the engine oil tank.

The scavenge oil enters the oil tank through the debris monitoring system (DMS). The DMS has an air/oil separator, sensor, and conditioner that monitor ferrous particles in the scavenge oil.

The DMS air/oil separator removes air from the scavenge oil. This air pressurizes the oil tank and then goes overboard through the center vent tube extension in the turbine exhaust plug.

Indication

The engine oil indication subsystem uses these sensors and the EEC to monitor the oil system:

- Oil pressure sensor
- Oil temperature sensor
- Oil filter differential pressure sensor.

OIL - GENERAL DESCRIPTION

The AIMS uses the oil level sensor to monitor the oil quantity.

The primary display system (PDS) shows oil pressure, temperature, and quantity.

The PDS also shows advisory and status messages to indicate oil system fault conditions.

Additional oil system data is available at the maintenance access terminal (MAT).

Training Information Point

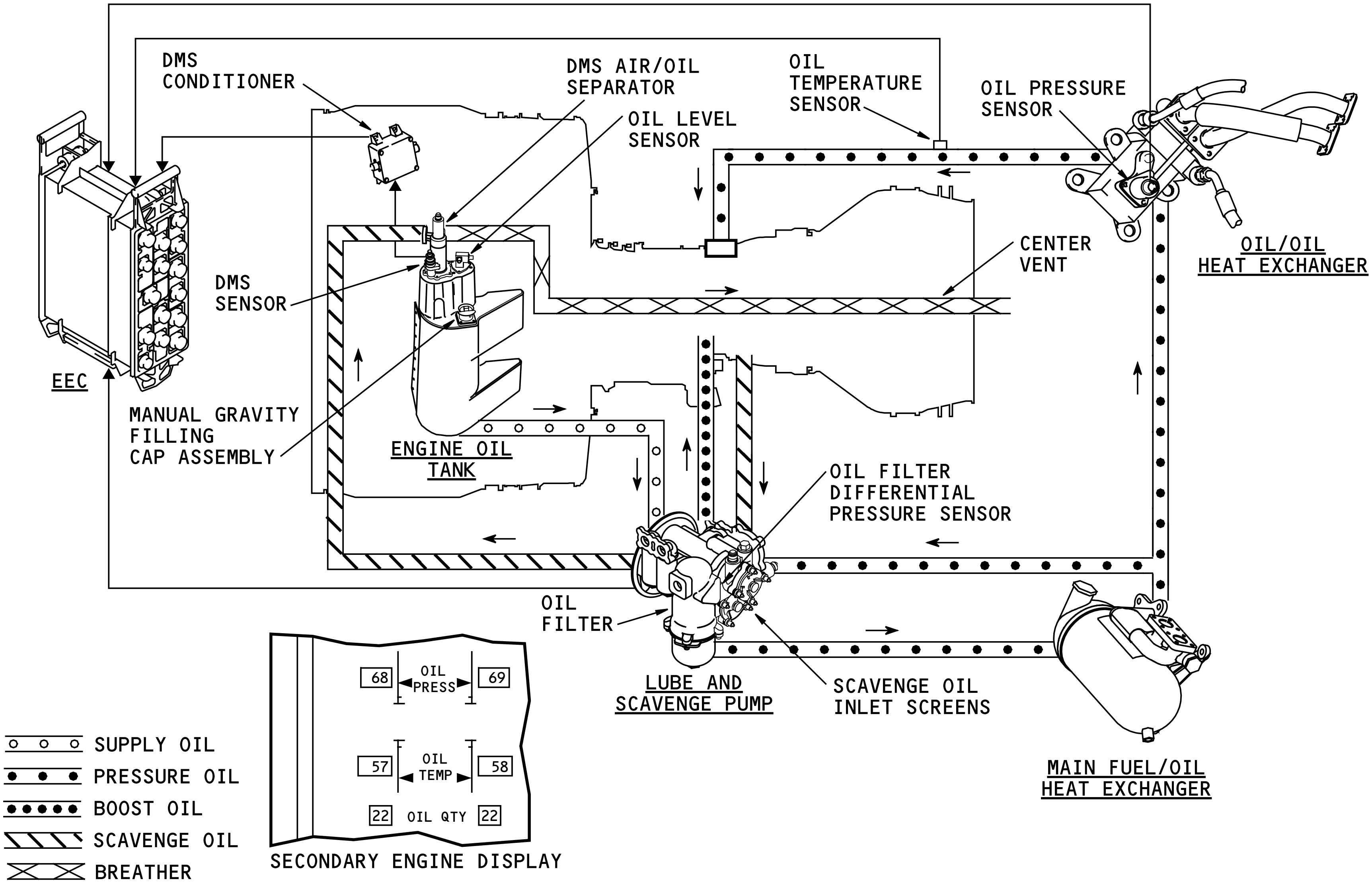
Obey these WARNINGS and CAUTIONS when you do maintenance on the engine oil system:

WARNING: DO NOT TOUCH THE COMPONENTS OF THE OIL SYSTEM IF THE ENGINE IS HOT. THESE COMPONENTS STAY HOTTER THAN OTHER COMPONENTS. HOT COMPONENTS CAN BURN YOU.

WARNING: DO NOT OPEN THE OIL SYSTEM UNTIL THE PRESSURE GOES TO ZERO. THE PRESSURE GOES TO ZERO APPROXIMATELY 5 MINUTES AFTER AN ENGINE SHUTDOWN. A PRESSURIZED OIL SYSTEM CAN RELEASE A SPRAY OF HOT OIL THAT CAN BURN YOU.

WARNING: DO NOT LET THE OIL STAY ON YOUR SKIN. YOU CAN ABSORB POISONOUS MATERIALS FROM THE OIL THROUGH YOUR SKIN.

CAUTION: DO NOT LET OIL GET ON THE ENGINE OR OTHER COMPONENTS. IMMEDIATELY CLEAN THE OIL WHEN IT FALLS ON THEM. OIL CAN CAUSE DAMAGE TO PAINT AND RUBBER.



79-00-00-102 Rev 6

OIL - GENERAL DESCRIPTION

OIL - STORAGE - GENERAL DESCRIPTION

Purpose

The engine oil tank contains the engine oil. It supplies oil to the lube pump elements and gets scavenge oil from the scavenge pump elements.

Location

The engine oil tank attaches to the fan case at the 9:00 position.

Physical Description

The engine oil tank is an aluminum structure. It has a maximum capacity of 28 quarts (26.5 liters).

The oil tank has these line replaceable units (LRU):

- Oil level sensor
- Manual gravity filling cap assembly
- DMS sensor
- DMS air/oil separator.

Functional Description

The oil level sensor sends oil quantity data to the AIMS for display.

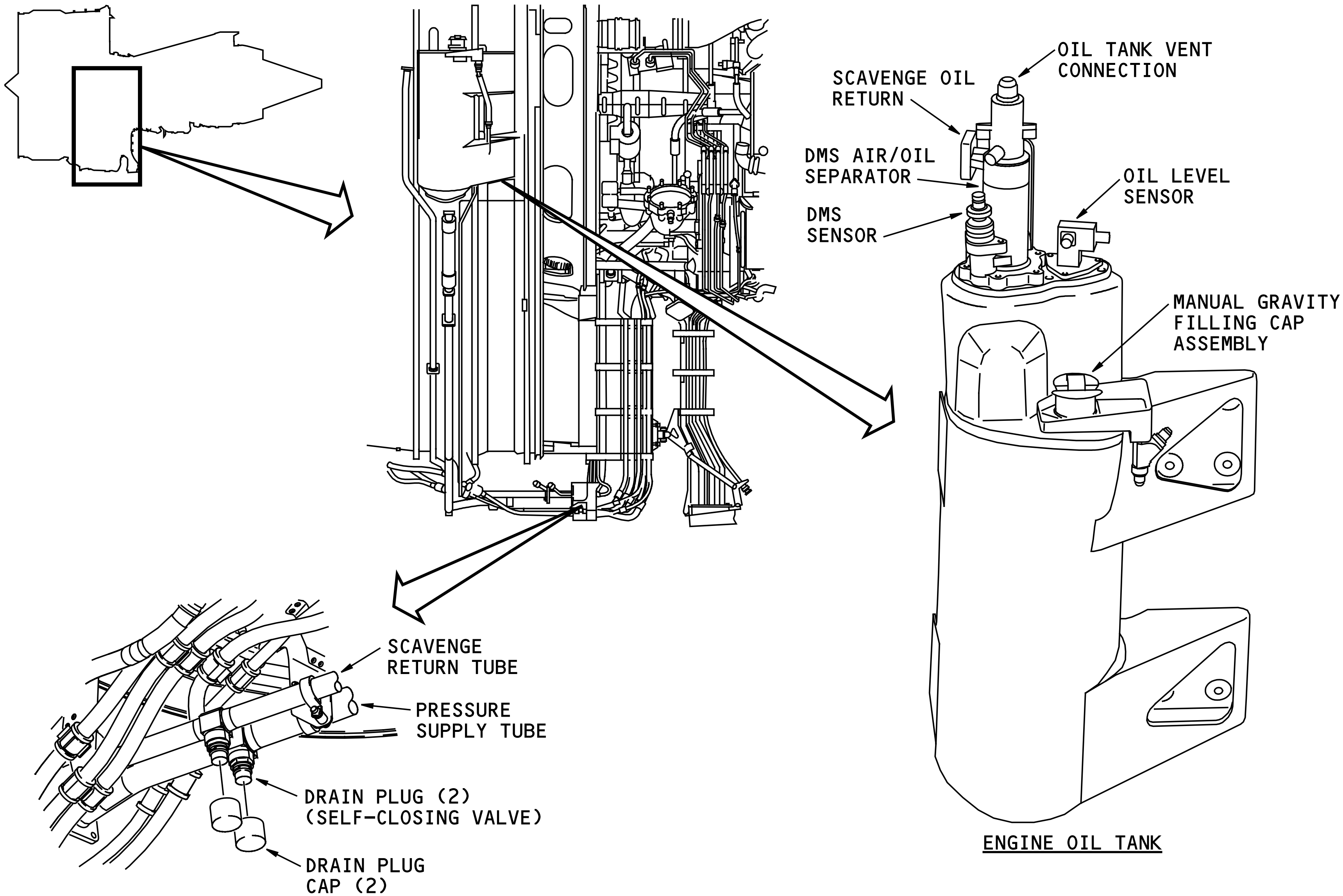
You fill the oil tank through the manual gravity filling cap assembly.

The DMS sensor finds ferrous particles in the scavenge oil.

The DMS air/oil separator removes the air from the scavenge oil.

Training Information Point

You use the drain plugs in the oil pump supply tube and oil tank supply tube to drain the engine oil tank.



79-10-00-101 Rev 4 04/03/95

OIL - STORAGE - GENERAL DESCRIPTION

OIL - STORAGE - TRAINING INFORMATION POINTS - SERVICING

General

You use gravity to fill the engine oil tank for any of these conditions:

- Normal servicing
- After replacement of an oil system component
- An engine oil change.

The oil tank access door is on the left fan cowl. You get access to the engine oil tank filler cap through this door.

Engine Oil Level

Examine the engine oil level in the engine oil tank in 30 minutes or less after you stop the engine.

WARNING: DO NOT OPEN THE OIL SYSTEM UNTIL THE PRESSURE GOES TO ZERO. THE PRESSURE GOES TO ZERO APPROXIMATELY 5 MINUTES AFTER AN ENGINE SHUTDOWN. A PRESSURIZED OIL SYSTEM CAN RELEASE A SPRAY OF HOT OIL THAT CAN BURN YOU.

When you open the engine oil filler cap, do a check for fuel in the oil. A smell check at the engine oil tank fill port can find the odor of fuel.

CAUTION: DO NOT MIX OILS OF DIFFERENT TYPES OR BRAND NAMES. SOME OILS WILL CHEMICALLY CHANGE WHEN YOU MIX THEM. THIS CAN CAUSE DAMAGE TO THE ENGINE.

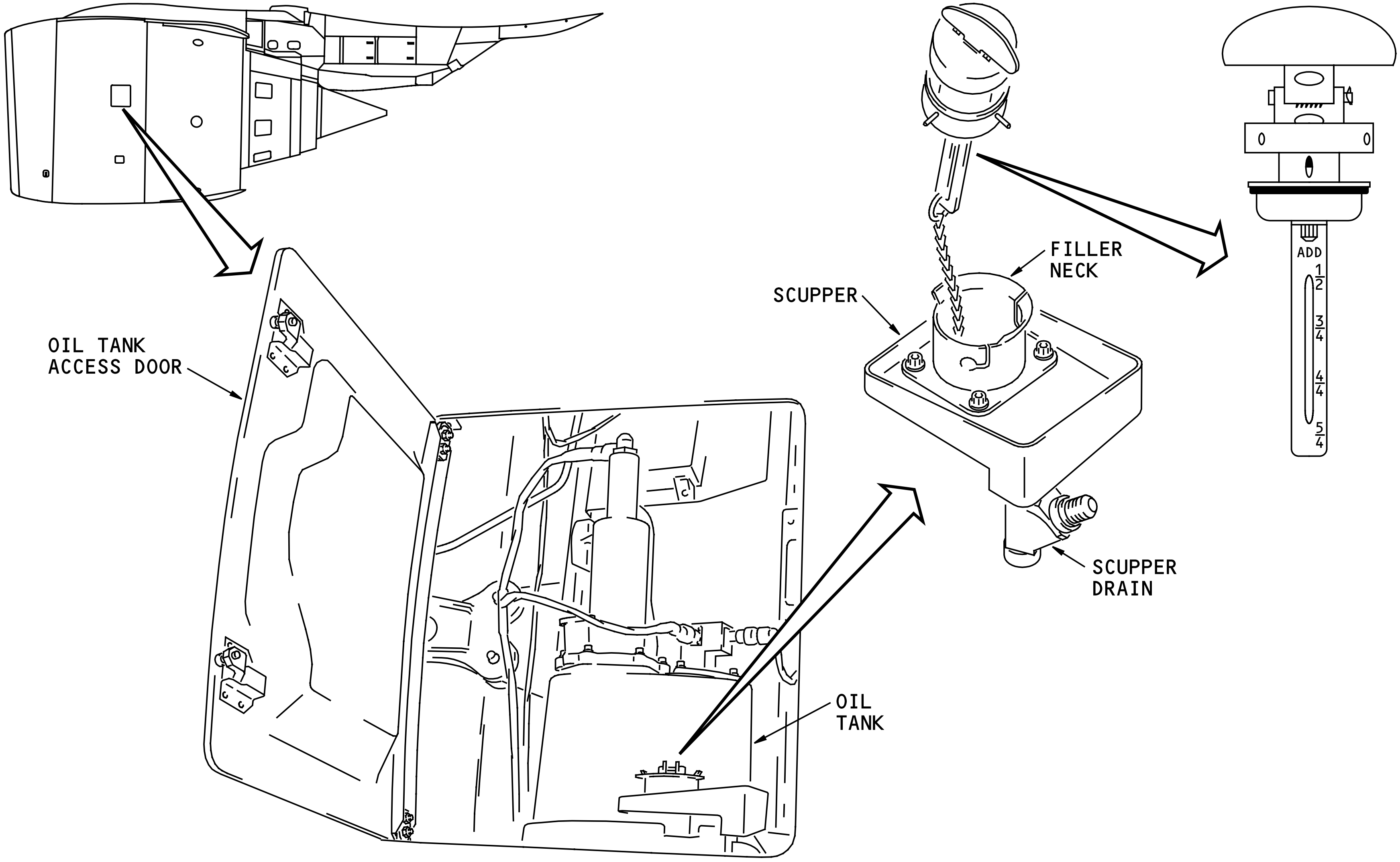
CAUTION: IF YOU ACCIDENTALLY SERVICE THE ENGINE OIL TANK WITH A DIFFERENT TYPE OR NAME BRAND OIL, DO NOT OPERATE THE ENGINE UNTIL A COMPREHENSIVE EVALUATION OF THE EFFECTS ON THE OIL SYSTEM AND ENGINE IS DONE AND A CORRECTIVE ACTION IS COMPLETED.

You measure the oil quantity with the dipstick. The markings on the dipstick show the amount of oil, in fractions of a gallon, that you must add.

NOTE: When you add engine oil to the engine oil tank, make sure you add the oil slowly. If you fill the engine oil tank too quickly, it can cause an overflow at the fill port or cause oil spillage.

The scupper catches the oil overflow and the scupper drain hose removes the overflow to the fan cowl vent.

Close the engine oil filler cap and the oil tank access door.



OIL TANK ACCESS DOOR

79-10-00-103 Rev 2 05/12/95

OIL - STORAGE - TRAINING INFORMATION POINTS - SERVICING

OIL - DISTRIBUTION - COMPONENT LOCATIONS

Left Side

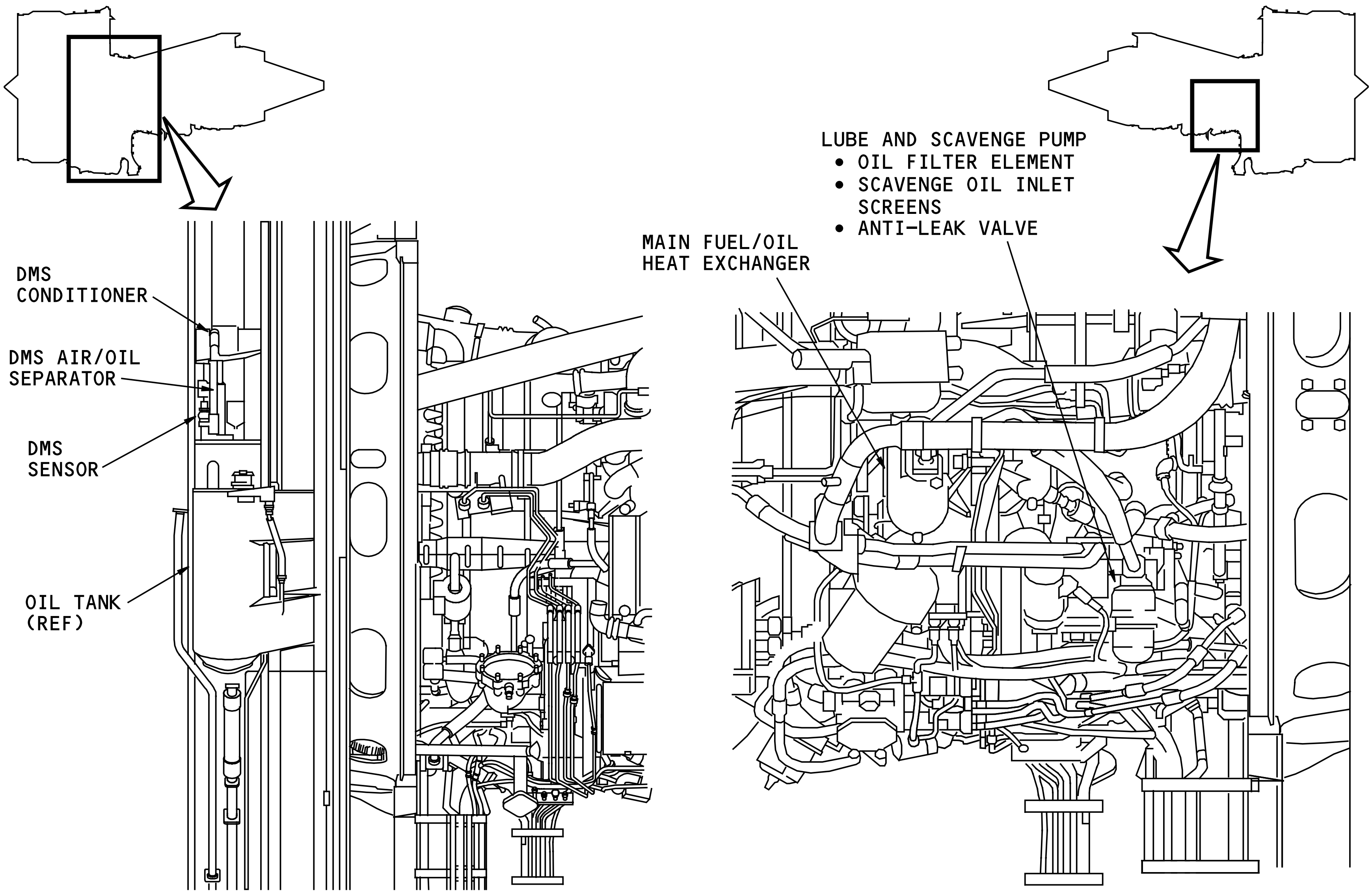
These are the engine oil distribution components on the left side of the engine:

- DMS air/oil separator
- DMS conditioner
- DMS sensor.

Right Side

These are the engine oil distribution components on the right side of the engine:

- Main fuel/oil heat exchanger
- Lube and scavenge pump
- Scavenge oil inlet screens
- Oil filter element
- Anti-leak valve.



OIL - DISTRIBUTION - COMPONENT LOCATIONS

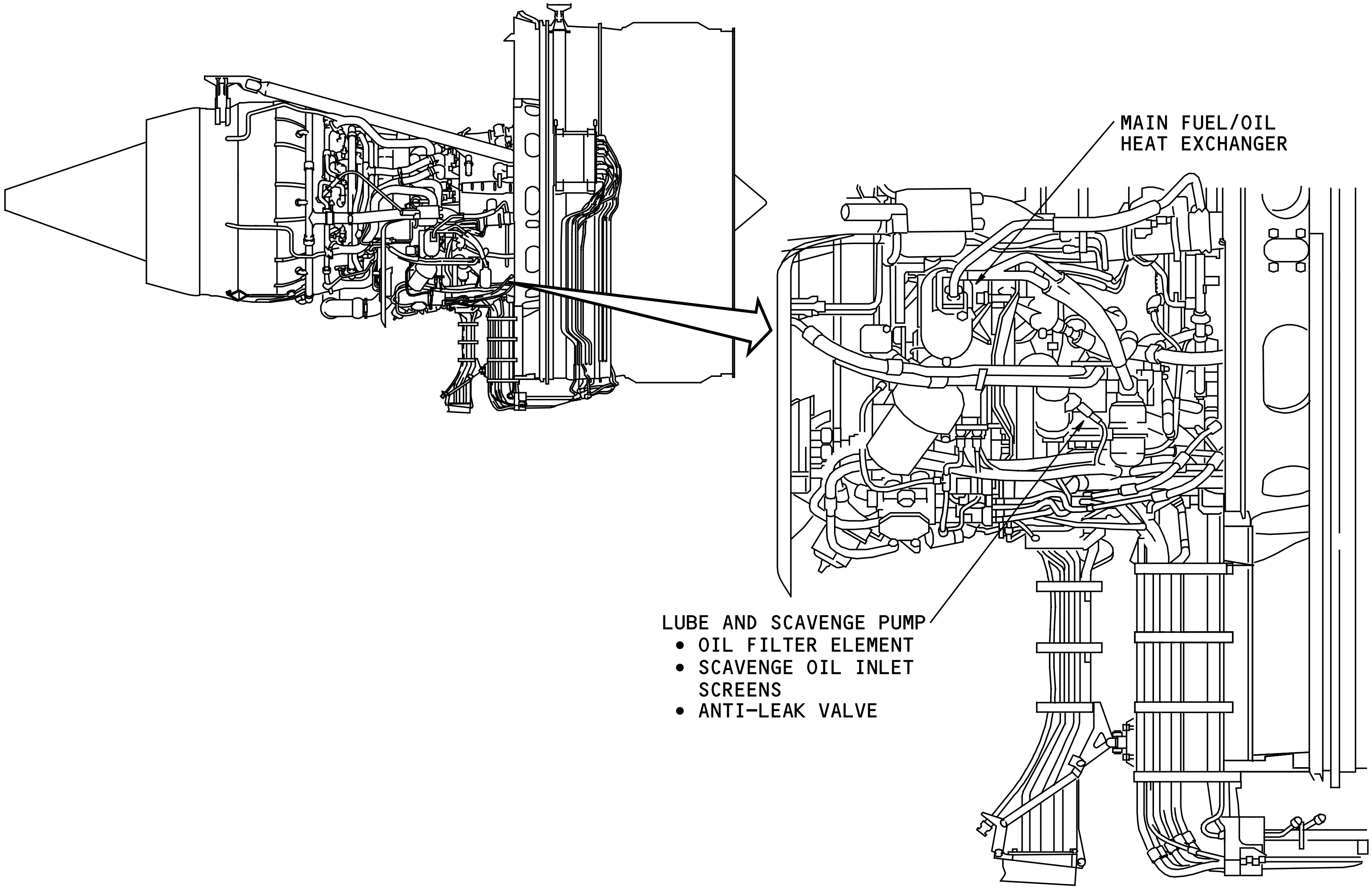
79-20-00-102 Rev 3 04/03/95

OIL - DISTRIBUTION - RIGHT SIDE COMPONENT LOCATIONS

Component Locations

These engine oil distribution components are on the right side of the engine:

- Main fuel/oil heat exchanger
- Lube and scavenge pump
- Scavenge oil inlet screens
- Oil filter element
- Anti-leak valve.



OIL - DISTRIBUTION - RIGHT SIDE COMPONENT LOCATIONS

79-20-00-103 Rev 2

OIL - DISTRIBUTION - OIL FILTER ELEMENT

Purpose

The oil filter element cleans the engine oil.

Location

The oil filter element is in the filter housing. The filter housing is part of the lube and scavenge pump.

There is a shutoff valve and bypass valve in the filter housing.

Physical Description

The oil filter element is a disposable element. One end of the filter element has a mechanical interface that opens the shutoff valve when the element is in the filter housing. The other end of the element has threads and a locating pin.

The drain plug, the filter bowl, and the bolts keep the filter element in the filter housing. You use the drain plug to drain the filter bowl when you do maintenance on the oil filter element.

Functional Description

If the oil filter element becomes blocked, an internal bypass valve opens and lets the oil go around the filter element.

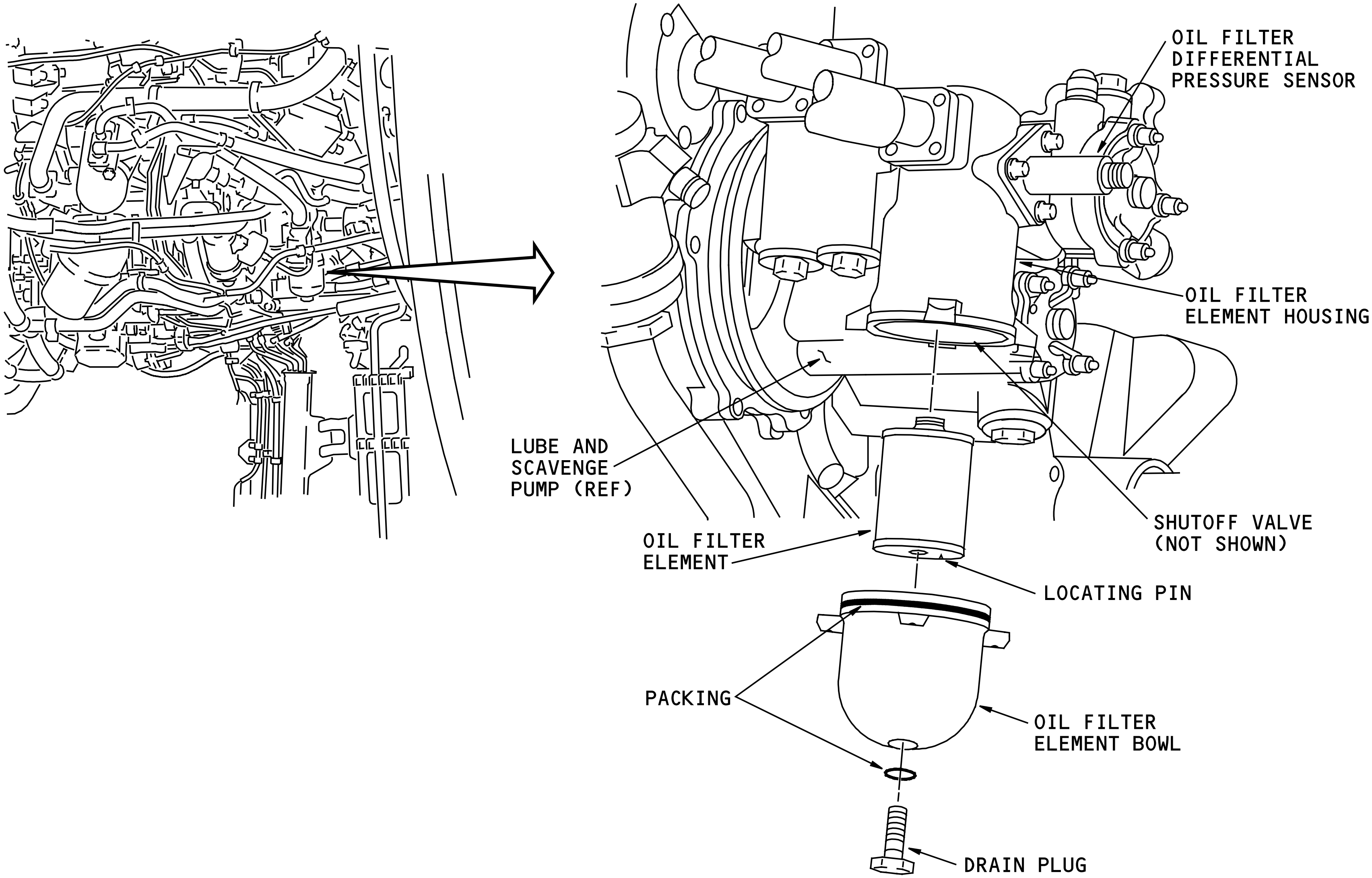
When you remove the oil filter element, an internal shutoff valve (not shown) closes. This prevents the loss of oil.

See the oil filter differential pressure sensor section for more information (AMM PART I 79-30).

Training Information Point

The locating pin aligns the filter element with a hole inside the filter bowl. It prevents the filter element from turning when you remove and install the drain plug.

NOTE: Make sure the locating pin on the filter element is in the hole in the filter bowl.



79-20-00-106 Rev 4 04/03/95

OIL - DISTRIBUTION - OIL FILTER ELEMENT

OIL - DISTRIBUTION - SCAVENGE OIL INLET SCREENS

Purpose

The scavenge oil inlet screens catch particle contamination in the scavenge oil.

Location

Five scavenge oil inlet screens are in the bottom of the lube and scavenge pump. Marks on the pump housing identify the scavenge oil source and the inlet screen location.

Physical Description

The scavenge oil inlet screens are made of metal and have a magnetic plug inside. They use threads for installation. Each screen has a preformed packing and a back up seal. You can clean the scavenge oil inlet screens.

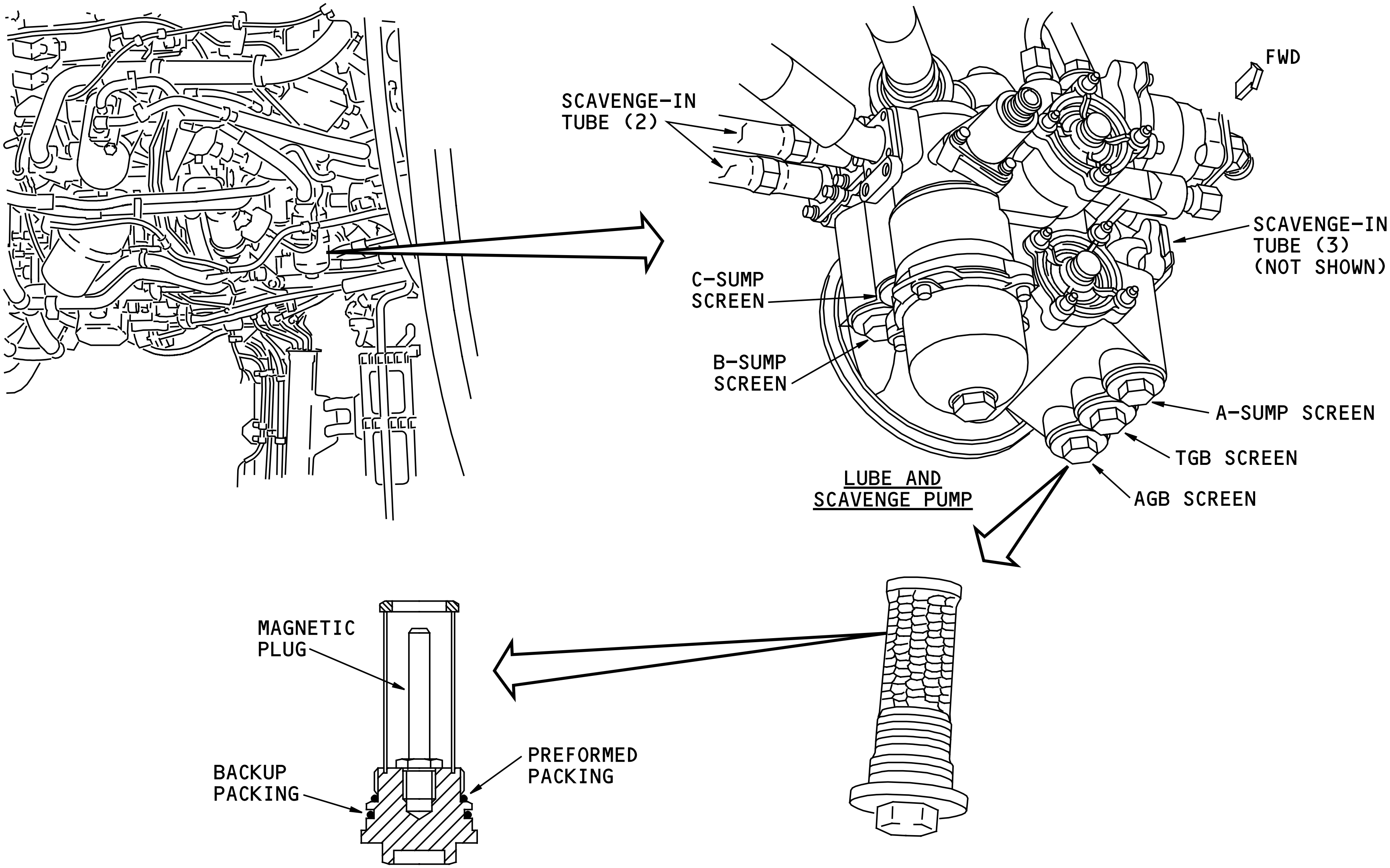
Functional Description

These are the scavenge oil inlet sources:

- A-sump
- TGB
- AGB
- B-sump
- C-sump.

When the scavenge oil returns to the scavenge pump elements, the screens catch the larger particles of contamination. This prevents damage to the pump elements.

You do a check of the magnetic plugs in the scavenge oil inlet screens if the debris monitoring system (DMS) finds ferrous contamination in the scavenge oil. The magnetic plugs catch the ferrous material and let you determine the source(s) of the contamination.



79-20-00-108 Rev 4 04/29/95

OIL - DISTRIBUTION - SCAVENGE OIL INLET SCREENS

OIL - DISTRIBUTION - DEBRIS MONITORING SYSTEM (DMS)

Purpose

The debris monitoring system (DMS) does these functions:

- Removes the air from the engine scavenge oil/air mixture
- Controls the breather air pressure in the engine oil tank
- Catches scavenge oil particle contamination
- Tells the EEC of ferrous contamination in the scavenge oil.

Location

The DMS has these LRU components:

- DMS air/oil separator
- DMS sensor
- DMS conditioner.

The air/oil separator and sensor are on the top of the engine oil tank. The conditioner is on the left side of the fan case above the engine oil tank.

Physical Description

The DMS air/oil separator is a single assembly that has these internal parts:

- Deaerator
- Particle separator.

The DMS sensor has a sensor probe and an adapter. The sensor has a threaded collar that attaches to the adapter. The adapter attaches to the air/oil separator. The sensor has one electrical connector.

The DMS conditioner is an electronic unit that has two electrical connectors. It attaches to the DMS mount adapter on the fan case.

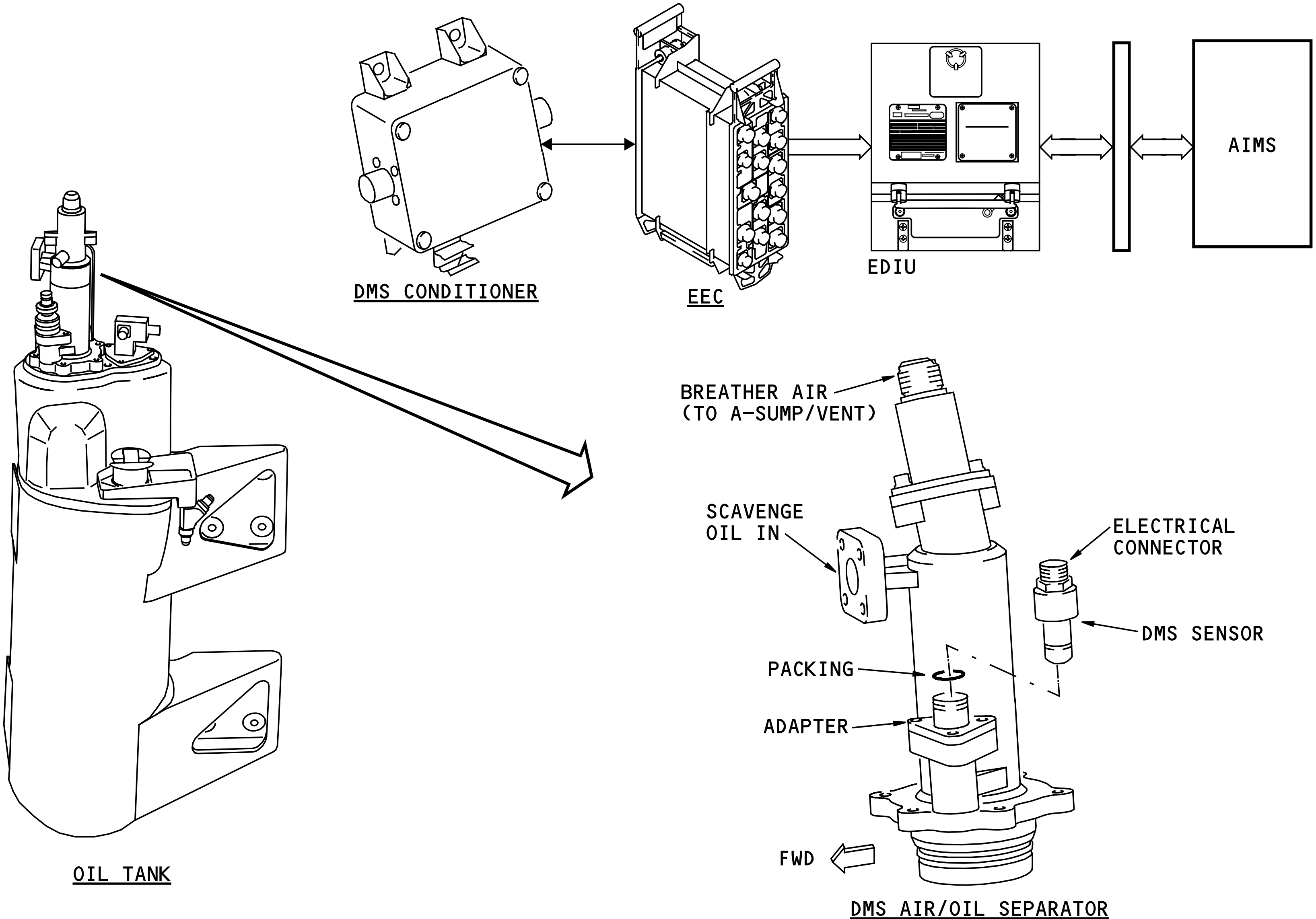
Functional Description

The DMS air/oil separator gets the scavenge oil/air mixture from the lube and scavenge pump. The deaerator removes the air from the mixture. Breather air pressure from the tank goes to A-sump and then to the overboard vent. The particle separator collects particle contamination at the DMS sensor.

The DMS sensor finds ferrous particles in the contamination. It sends a contamination data signal to the DMS conditioner.

The DMS conditioner changes the sensor signal and sends it to the EEC.

A CMCS maintenance message shows if the sensor finds ferrous contamination. The MAT can also tell you if the DMS is defective.



79-20-00-109 Rev 3 04/29/95

OIL - DISTRIBUTION - DEBRIS MONITORING SYSTEM (DMS)

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OIL - DISTRIBUTION - FUNCTIONAL DESCRIPTION

Storage

The engine oil tank contains the engine oil. It supplies oil to the pressure system and gets oil from the scavenge system. Air from the scavenge air/oil mixture pressurizes the oil tank. This prevents cavitation at the lube pump.

You fill the oil tank through the manual gravity filling cap assembly.

Pressure

The oil from the tank flows through the anti-leak valve to the lube pump. The anti-leak valve prevents the flow of oil from the oil tank to the lube and scavenge pump and the AGB when the engine is shutdown.

The lube pump uses two gerotor-type pump elements to pressurize the oil for distribution to the bearings and gearboxes.

The oil filter element cleans the oil before it enters the engine. An internal bypass valve allows unfiltered oil to not go through the filter element if there is a blockage of the element.

The main fuel/oil heat exchanger removes the heat from the engine oil. It also gives heat to the main fuel and servo fuel paths. This prevents ice in the fuel.

Pressure oil from the fuel/oil heat exchanger flows to these items:

- Lube pump
- Oil/oil heat exchanger.

The oil that returns to the lube pump gets more pressure from a single gerotor pump element. This is boost oil and it flows to these bearings for damping:

- Number 3 roller bearing
- Number 5 roller bearing.

The engine oil that flows to the oil/oil heat exchanger gets more cooling. It then goes to lubricate, clean, and cool the individual bearings and gearboxes.

Scavenge

The scavenge pump uses seven gerotor-type pump elements to remove the scavenge air/oil mixture from these engine locations:

- A-sump
- B-sump
- C-sump
- TGB
- AGB.

The scavenge oil inlet screens catch any large particle contamination before the air/oil mixture flows into the pump elements. This prevents damage to the pump.

The DMS receives the scavenge air/oil mixture from the scavenge pump and does these functions:

OIL - DISTRIBUTION - FUNCTIONAL DESCRIPTION

- Removes the air from the mixture
- Controls the air pressure in the tank
- Catches small particle contamination
- Tells the EEC of ferrous contamination in the scavenge oil.

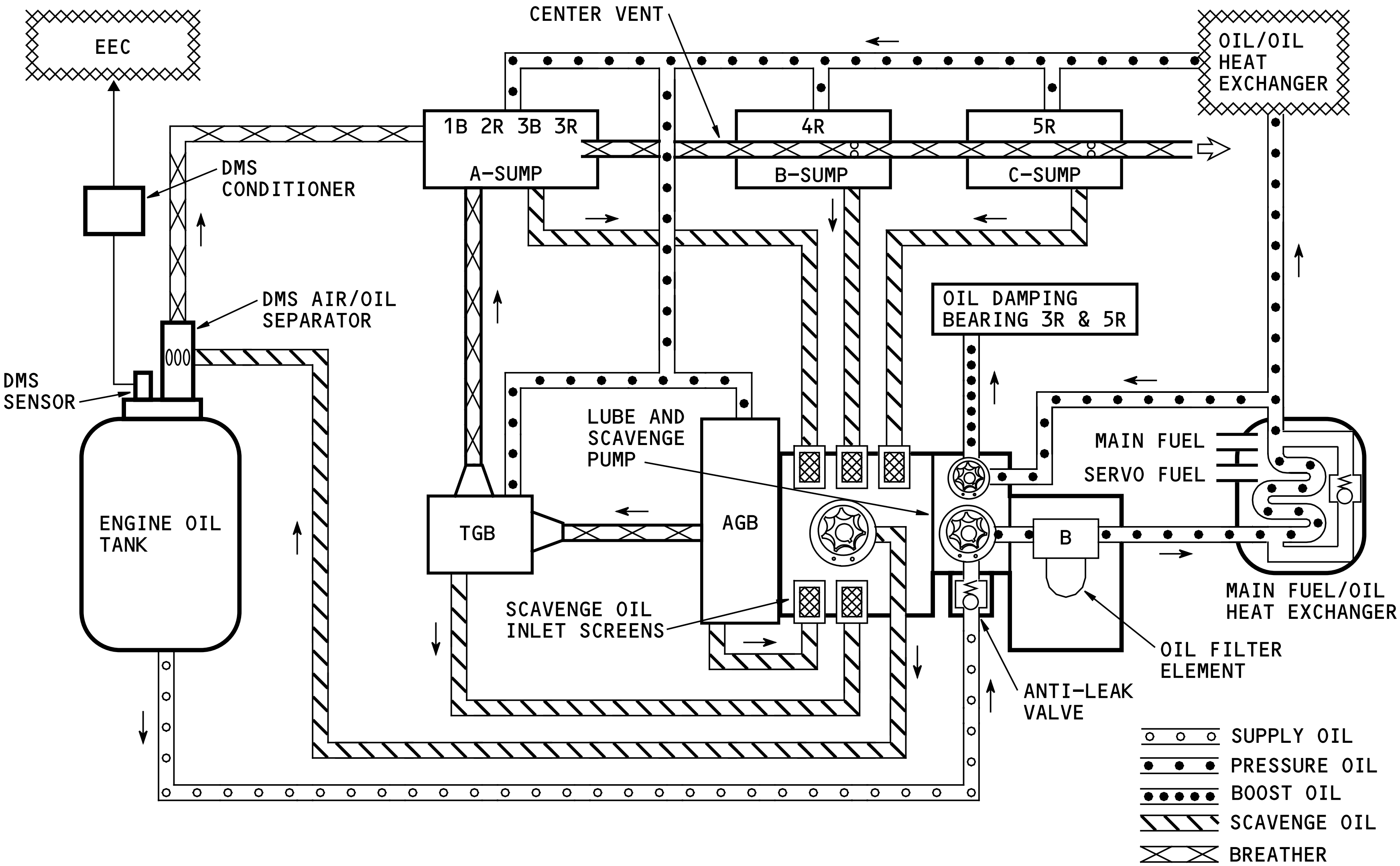
You do a check of the magnetic plugs in the scavenge oil inlet screens if the DMS finds ferrous contamination. The plugs catch the ferrous contamination at the screen location and permit you to identify the source of the contamination.

Breather

The breather system lets the air pressure in the sumps, the gearboxes, and the excess air pressure in the oil tank go to ambient.

The AGB and TGB breather pressure goes to the A-sump. The excess breather pressure from the DMS air/oil separator also goes to the A-sump.

The center vent permits the A, B, and C-sumps breather pressure to go to ambient through the vent tube extension in the aft exhaust plug.



79-20-00-110 Rev 3 09/21/1995

OIL - DISTRIBUTION - FUNCTIONAL DESCRIPTION

OIL - INDICATING - GENERAL DESCRIPTION

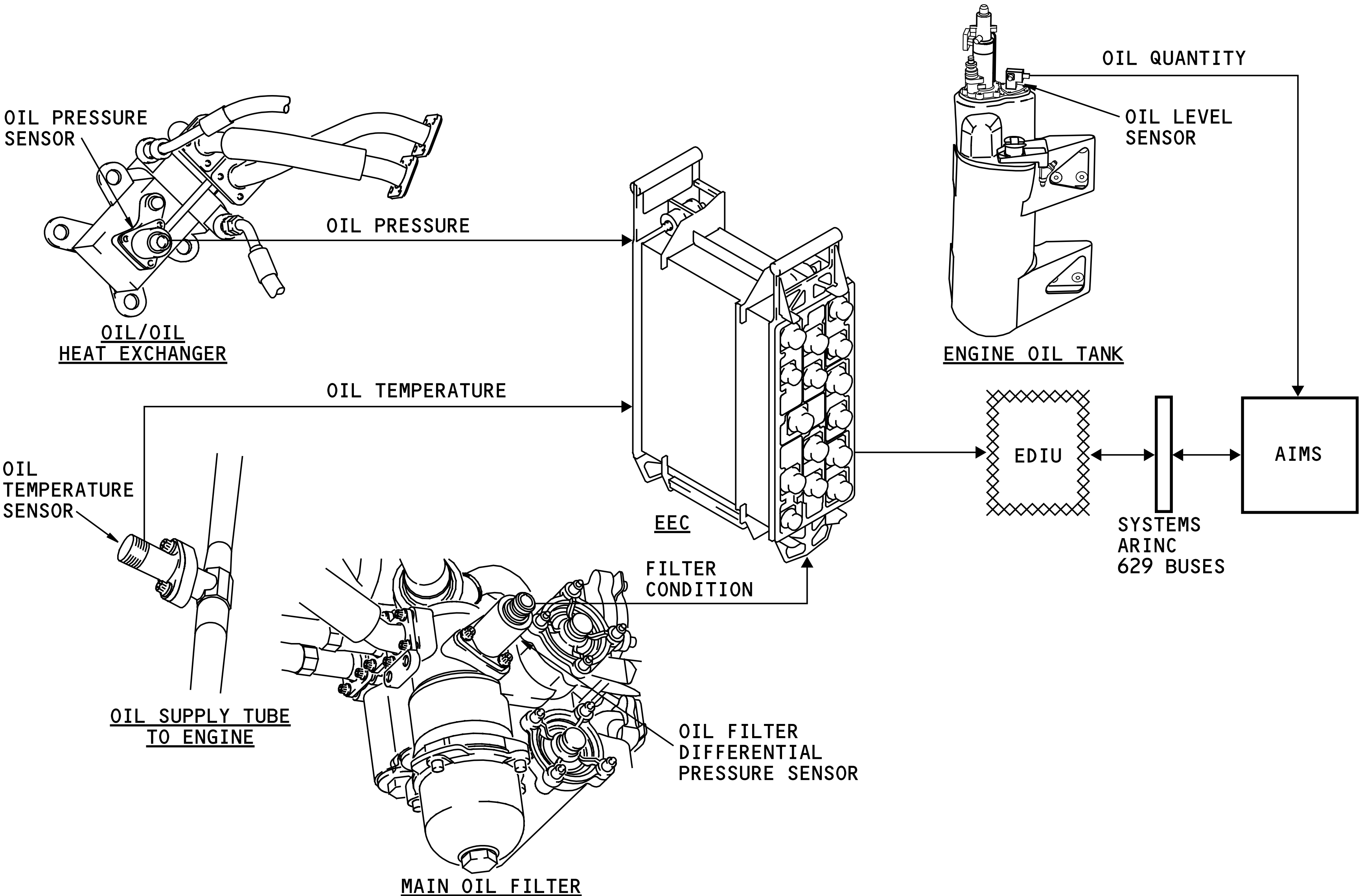
General

The oil indicating subsystem supplies engine oil data to the AIMS for display.

These components monitor the engine oil system:

- Oil level sensor
- Oil pressure sensor
- Oil temperature sensor
- Oil filter differential pressure sensor.

The EEC sends oil pressure, oil temperature, and oil filter element condition to the AIMS. The oil level sensor sends oil quantity data directly to AIMS.



OIL - INDICATING - GENERAL DESCRIPTION

OIL - INDICATING - COMPONENT LOCATIONS

Component Locations

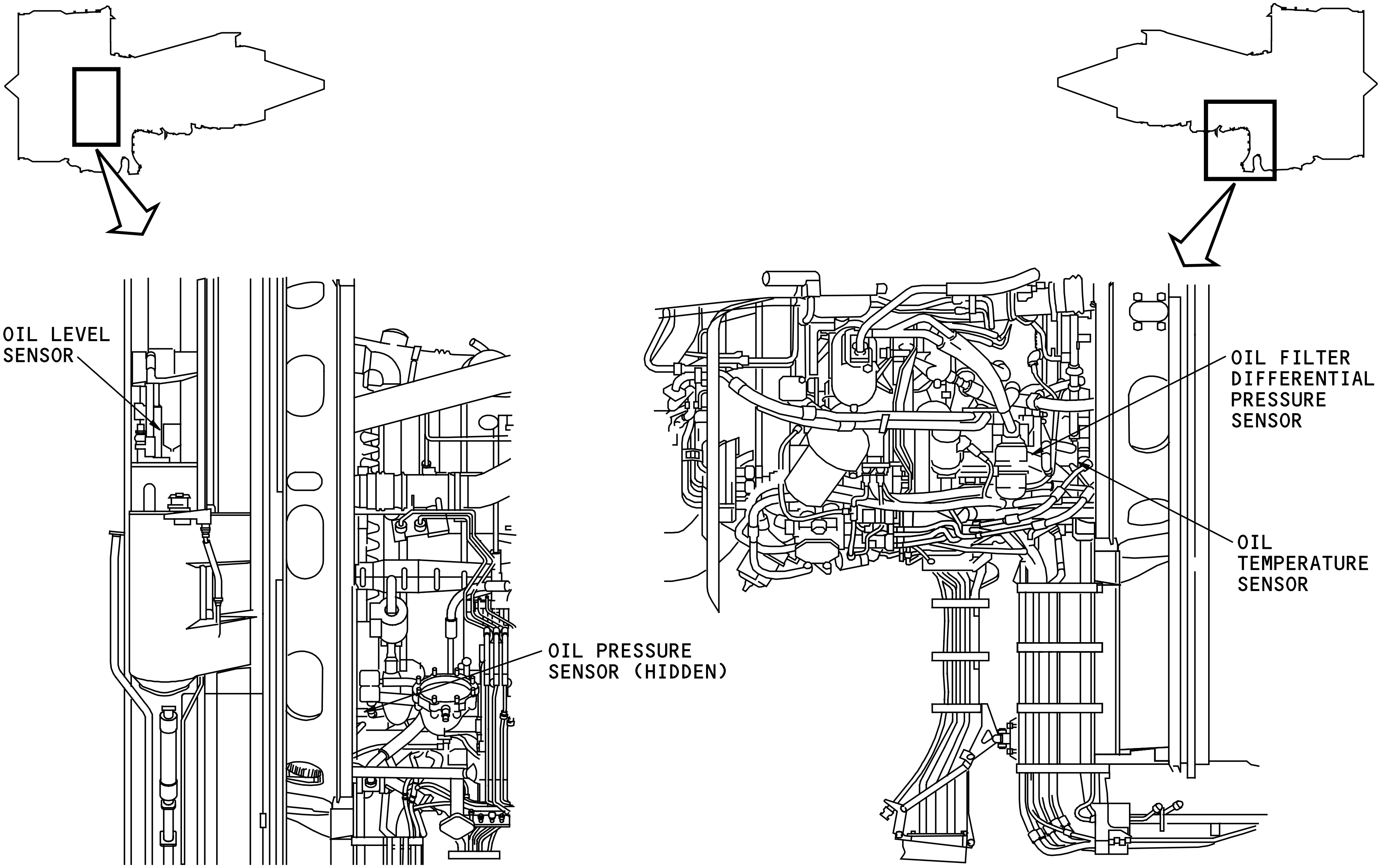
These are the oil indicating components on the left side of the engine:

- Oil level sensor
- Oil pressure sensor.

Component Locations

These are the oil indicating components on the right side of the engine:

- Oil filter differential pressure sensor
- Oil temperature sensor.



79-30-00-102 Rev 2 04/03/95

OIL - INDICATING - COMPONENT LOCATIONS

OIL - INDICATING - OIL QUANTITY INDICATING SYSTEM

Purpose

The oil quantity indicating system sends data about the quantity of oil in the engine oil tank to the AIMS for display. It uses an oil level sensor.

Location

The oil level sensor is on the top of the oil tank and extends into the tank.

Physical Description

The oil level sensor is a magnetic float-reed switch device. It has one sensing circuit that use resistors and one electrical connector.

Functional Description

The AIMS supplies an excitation signal to the sensing circuit of the oil level sensor. As the magnetic float moves up and down with the oil level, the reed switches open and close different resistor circuits. A feedback signal in proportion to the oil level goes to the AIMS. The AIMS changes its feedback signal to oil quantity for display on the secondary engine display.

When the AIMS does not get a satisfactory feedback signal, a status message shows.

Indication

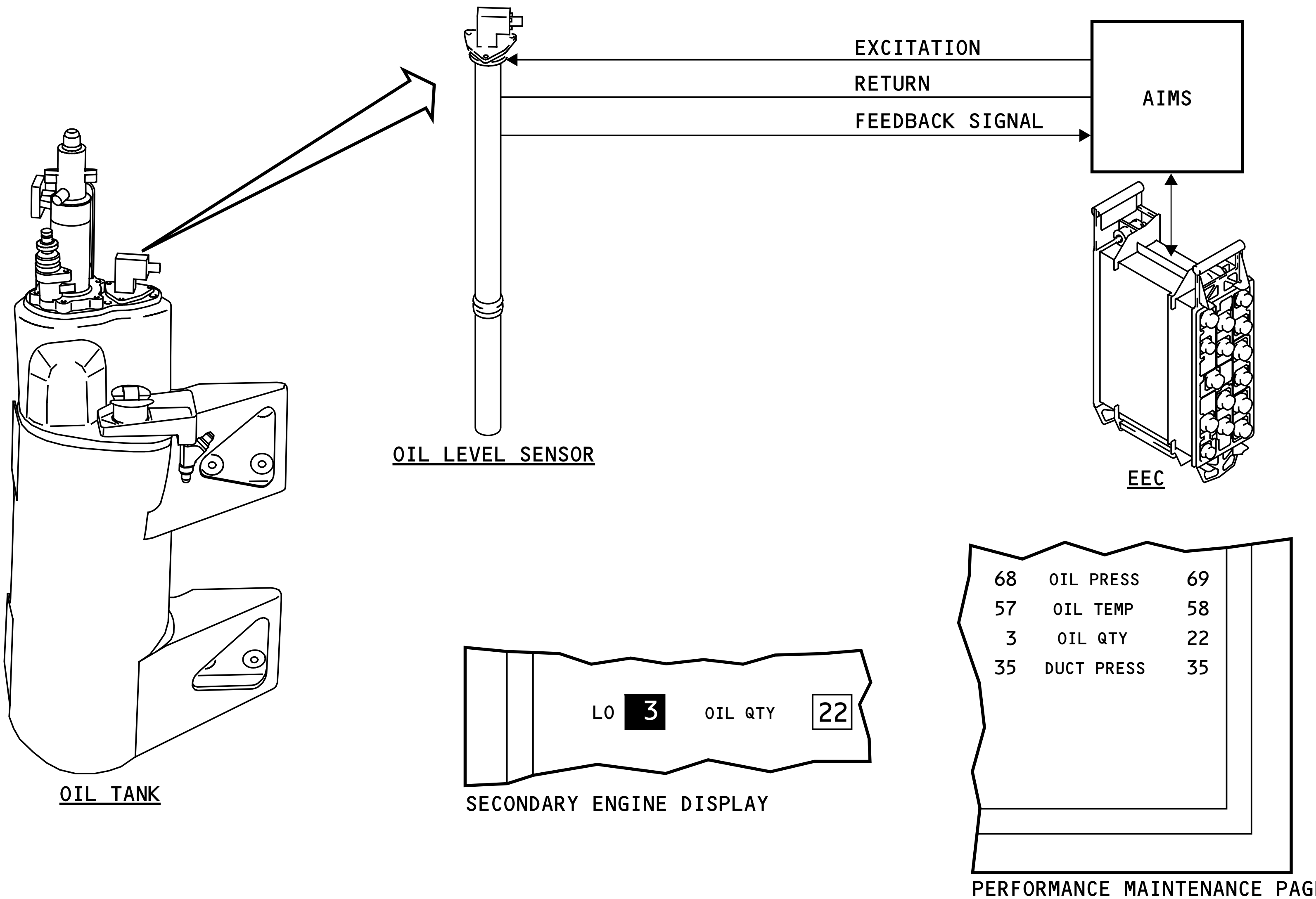
Oil quantity shows in quarts (liters).

Oil quantity shows on the secondary engine display and the performance maintenance page. The propulsion data limits maintenance page (not shown) shows the oil quantity low limit.

The oil quantity low limit is 4 quarts (3.8 liters). When the oil level is below the limit, the oil quantity readout on the secondary engine display changes to reverse video (black numbers on a white background). Also, the letters LO show next to the oil quantity display.

Training Information Point

Put the EEC Maintenance Test Switch to TEST position to read the Oil Quantity on the Secondary Engine page.



79-30-00-104 Rev 4 03/17/1998

OIL - INDICATING - OIL QUANTITY INDICATING SYSTEM

OIL - INDICATING - OIL PRESSURE INDICATING SYSTEM

Purpose

The oil pressure indicating system sends the engine oil pressure data to the AIMS for display. It uses an oil pressure sensor.

Location

The oil pressure sensor attaches to the oil/oil heat exchanger at the 7:30 position on the fan hub frame.

Physical Description

The oil pressure sensor is a piezoresistive device that contains two sensing elements. The sensor has one electrical connector.

Functional Description

The oil pressure sensor gets oil pressure data after the oil flows through the oil/oil heat exchanger.

Each EEC channel supplies an excitation signal to one sensing element. Each element measures the difference between the engine oil pressure and the bearing sump air pressure. Each element sends an oil pressure signal to its EEC channel.

When both signals from an oil pressure sensor are unsatisfactory, the status display shows a status message.

Indication

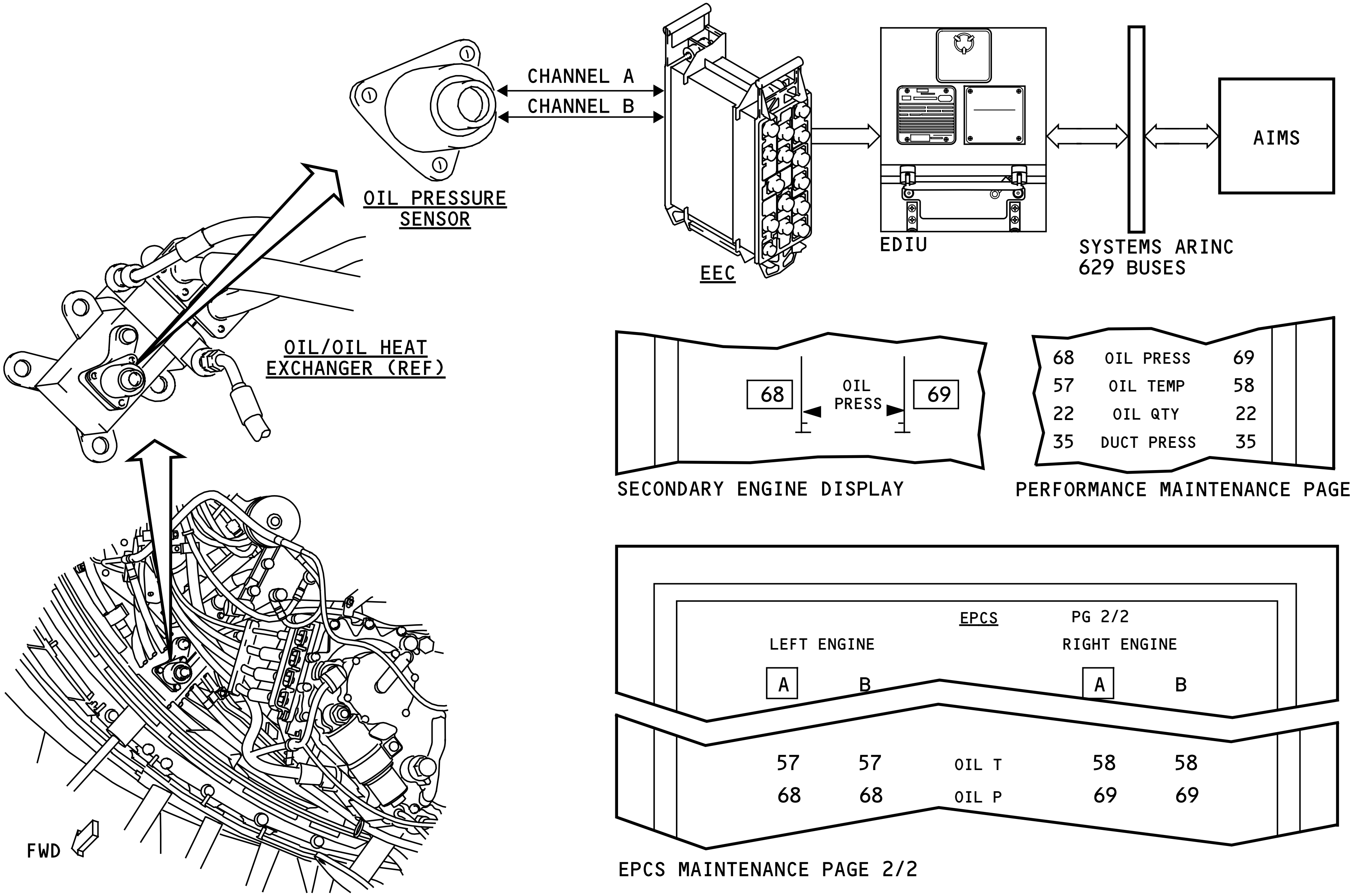
Oil pressure shows in psi.

Oil pressure shows on these formats:

- Secondary engine display
- Performance maintenance page
- EPCS maintenance page 2.

The propulsion data limits maintenance page format shows the oil pressure limits. See the propulsion data limits maintenance page section for more information (AMM PART I 77-00).

When the engine oil pressure is at or below the red line limit, the ENG OIL PRESS L or R caution message shows. An engine shutdown prevents the message.



79-30-00-105 Rev 5 04/29/95

OIL - INDICATING - OIL PRESSURE INDICATING SYSTEM

OIL - INDICATING - OIL TEMPERATURE INDICATING SYSTEM

Purpose

The oil temperature indicating system sends the engine oil temperature data to the AIMS for display. It uses an oil temperature sensor.

Location

The oil temperature sensor installs in an adapter in the engine oil supply tube downstream from the oil/oil heat exchanger. It is at the 5:30 position of the HPC immediately aft of the fan hub frame.

Physical Description

The oil temperature sensor is a variable resistance device. It has two platinum elements and one electrical connector.

Functional Description

The oil temperature sensor gets oil temperature data as the oil flows from the oil/oil heat exchanger to the engine.

Each EEC channel supplies an excitation signal to one element. The resistance value of the element changes as the oil temperature changes. This changes the oil temperature signal to each EEC channel.

When both signals from an oil temperature sensor are unsatisfactory, a status message shows.

Indication

Oil temperature shows in degrees Celsius.

The MFD shows the oil temperature on these pages:

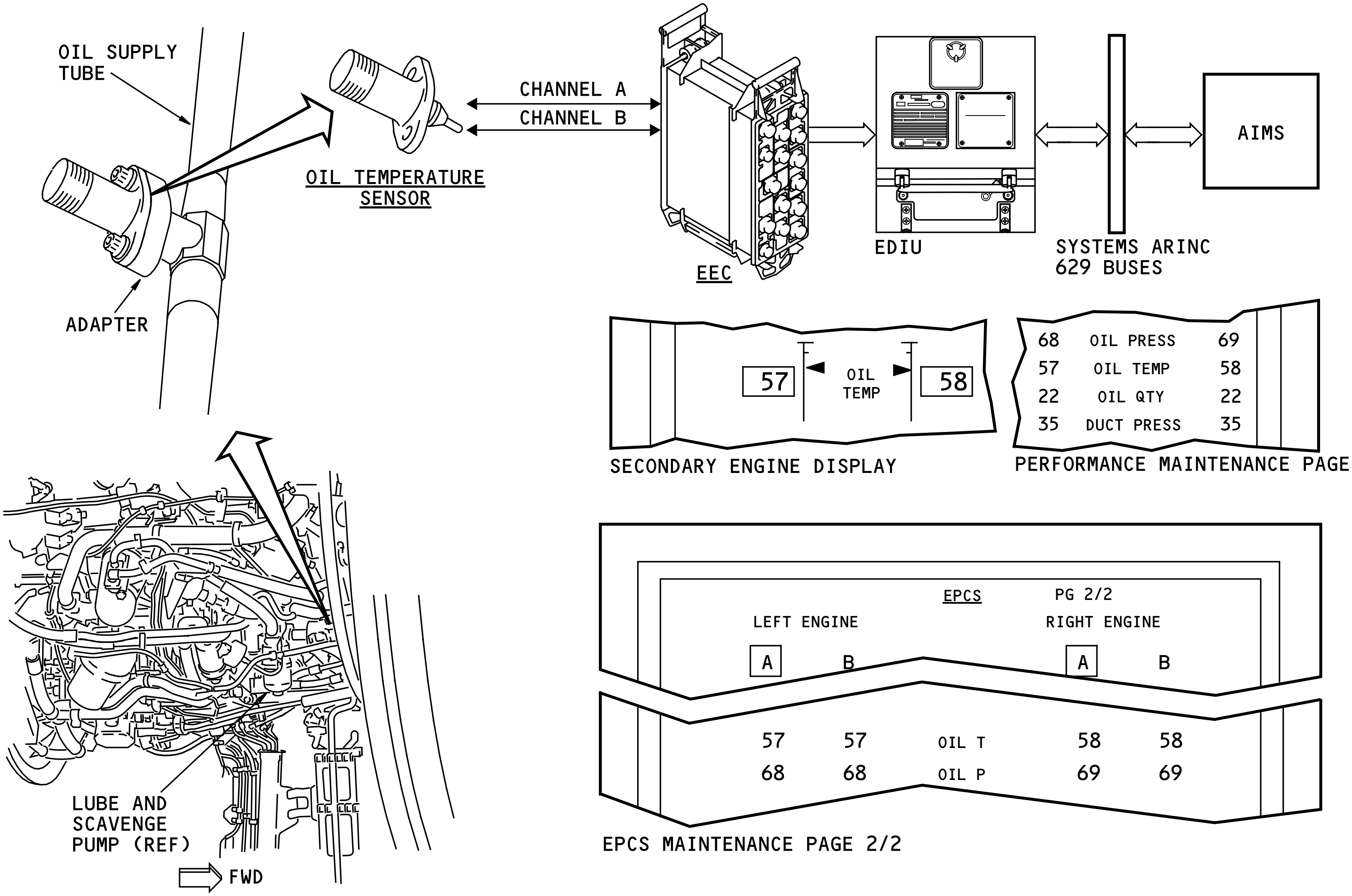
- Secondary engine display
- Performance maintenance page
- EPCS maintenance page 2.

The oil temperature display on the secondary engine display has these limit indications:

- High red line limit
- High amber limit.

The propulsion data limits maintenance page shows the oil temperature limits. See the engine indicating chapter for more information on the propulsion data limits page (AMM PART I 77).

When the engine oil temperature is at or above the amber limit, the ENG OIL TEMP L or R advisory message shows.



OIL - INDICATING - OIL TEMPERATURE INDICATING SYSTEM

OIL - INDICATING - OIL FILTER BYPASS WARNING SYSTEM

Purpose

The oil filter bypass warning system sends engine oil filter differential pressure data to the EEC. This permits the EEC to monitor the condition of the oil filter element. The system uses an oil filter differential pressure sensor.

Location

The sensor is on the forward end of the lube and scavenge pump.

Physical Description

The oil filter differential pressure sensor is a piezoresistive device. It has two sensing elements and one electrical connector.

Functional Description

Each EEC channel supplies an excitation signal to one sensing element. Each element gets an oil pressure input before and after the oil filter. Each element sends an oil pressure signal to its EEC channel.

When both signals from an oil filter differential pressure sensor are unsatisfactory, a the ENG OIL FILT SNSR L or R status message shows.

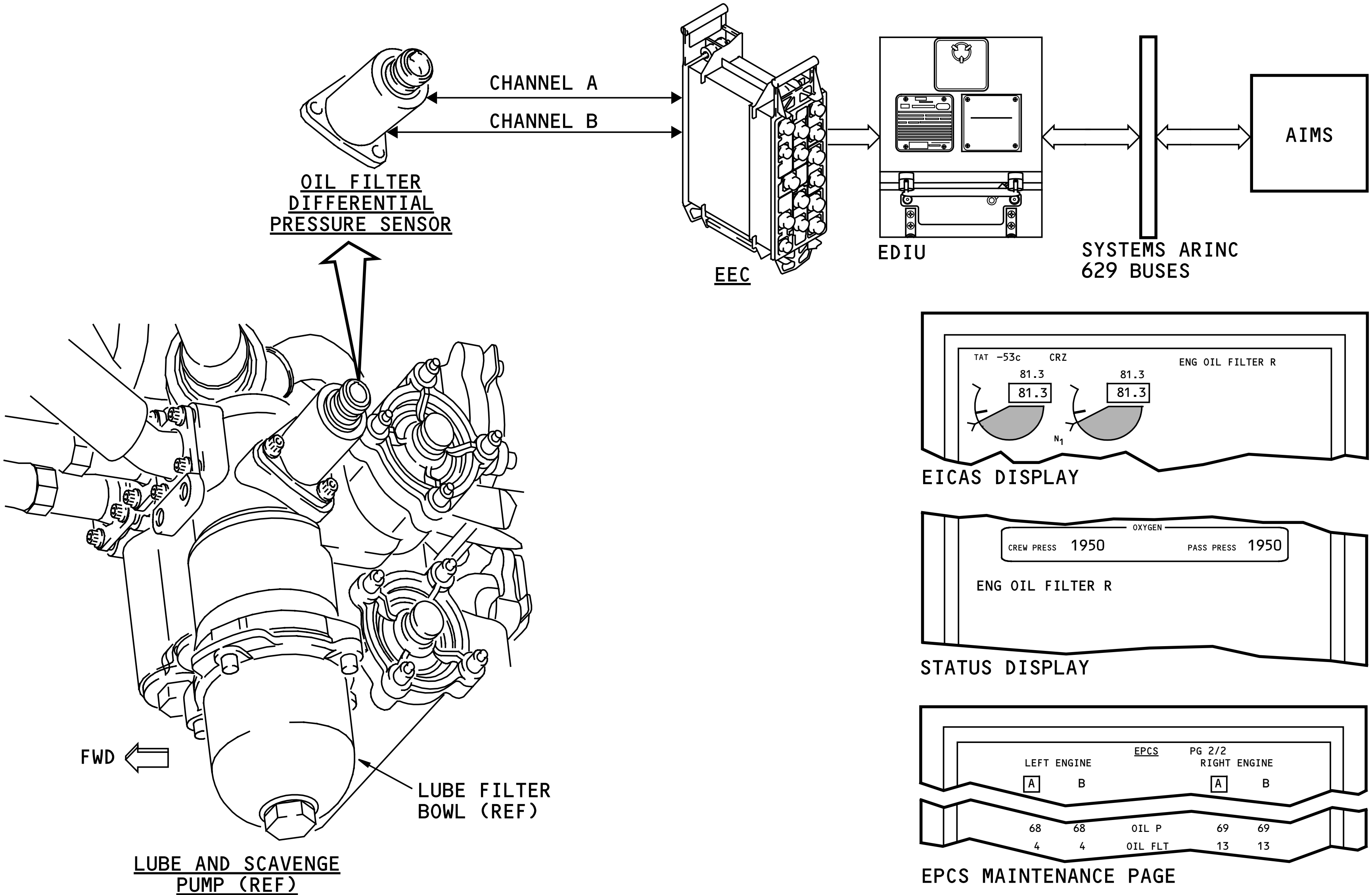
Indication

The MFD shows the oil filter differential oil pressure in psi on the EPCS maintenance page 2/2.

The EEC determines the filter condition and sends signals to AIMS to show advisory and status messages.

When the engine oil filter differential oil pressure goes near the filter bypass condition, the status page display shows the ENG OIL FILTER L or R status message.

When the engine oil filter differential oil pressure is at or above the filter bypass condition, the ENG OIL FILTER L or R advisory message shows.



79-30-00-107 Rev 3 04/03/95

OIL - INDICATING - OIL FILTER BYPASS WARNING SYSTEM

Continental Airlines, Inc

Engine Air

WB371

TABLE OF CONTENTS

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ENGINE AIR - INTRODUCTION

Purpose

The engine air system controls the cooling air to the engine and the airflow through the compressors.

These are the engine air sub-systems:

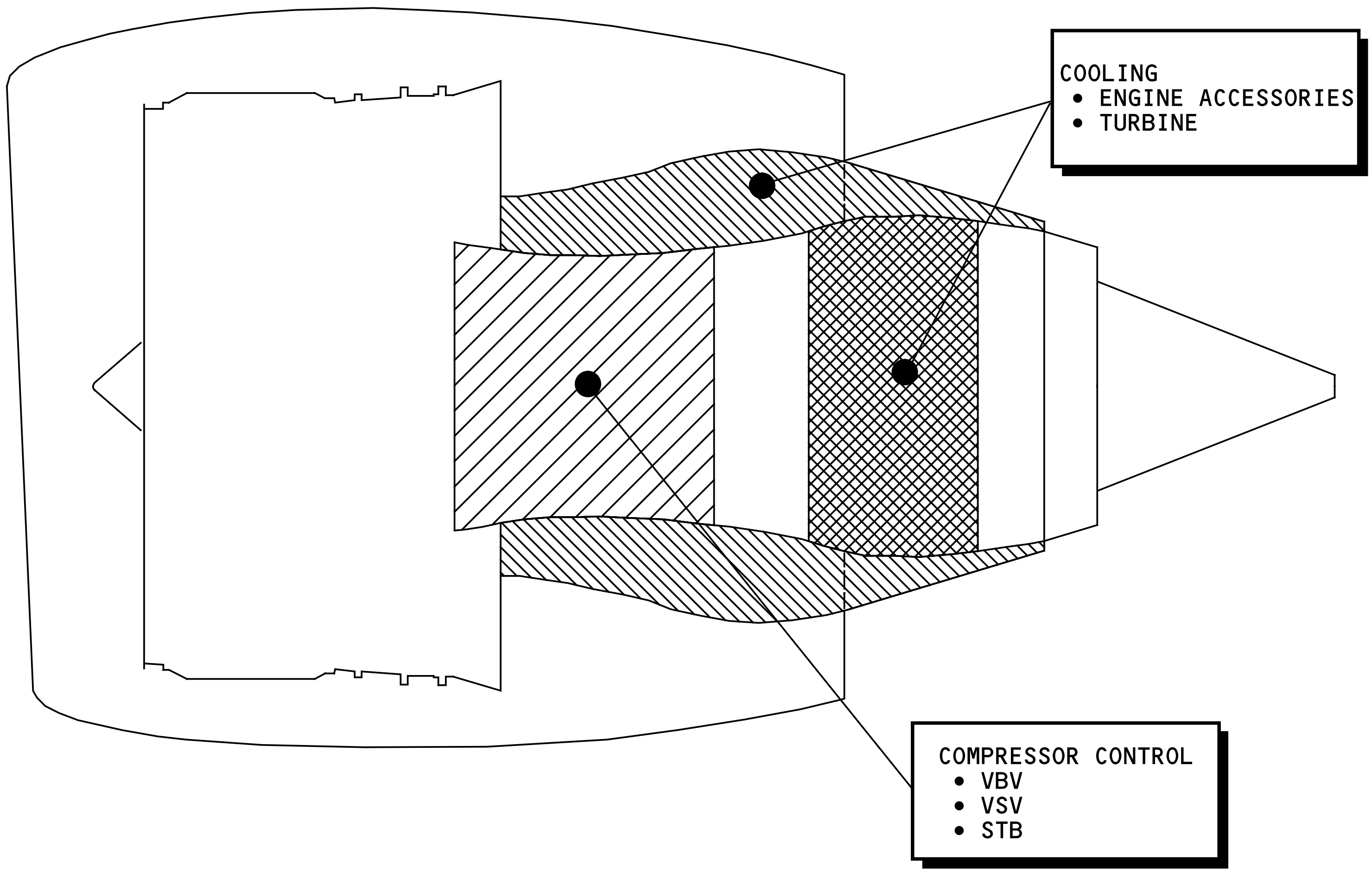
- Cooling system
- Compressor control system.

The cooling system supplies air to cool the engine accessories and turbine case.

The compressor control system controls the airflow through the low pressure compressor (LPC) and high pressure compressor (HPC).

Abbreviations and Acronyms

ACTR	- actuator
AIMS	- airplane information management system
ARINC	- aeronautical radio, incorporated
CCC	- core compartment cooling
EDIU	- engine data interface unit
EEC(FADEC)	- electronic engine control (full authority digital electronic control)
EGT	- exhaust gas temperature
EHSV	- electrohydraulic servo valve
EPCS	- electronic propulsion control system
FOD	- foreign object damage
FDBK	- feedback
HMU	- hydromechanical unit
HPC	- high pressure compressor
HPTACC	- high pressure turbine active clearance control
IGV	- inlet guide vane
LPC	- low pressure compressor
LPTACC	- low pressure turbine active clearance control
LVDT	- linear variable differential transformer
MAT	- maintenance access terminal
MFD	- multi-function display
OVBD	- overboard
PDS	- primary display system
STB	- start/transient bleed
SW	- switch
T/R	- thrust reverser
VBV	- variable bypass valve
VSV	- variable stator vane



75-00-00-101 Rev 1

ENGINE AIR - INTRODUCTION

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ENGINE AIR - GENERAL DESCRIPTION

General

The engine air system has two subsystems:

- Engine air cooling
- Engine compressor control.

The electronic engine control (EEC) controls the engine air system components. The engine air system component positions and faults show on the primary display system (PDS).

Engine Air Cooling

These are the engine air cooling subsystems:

- Engine accessory cooling
- Turbine cooling system.

Engine accessory cooling uses fan or LPC air to keep core components cool. The EEC controls the core compartment cooling (CCC) valve. Seventh stage servo air operates the CCC valve.

The turbine cooling system uses fan air to cool the turbine cases. This makes the turbine case smaller and decreases the clearance between the turbine blade tips and the turbine case. The smaller clearance increases engine efficiency.

The low pressure turbine active clearance control (ACC) valve permits fan air blow on the LPT case. The EEC controls the LPT ACC valve. Seventh stage servo air operates the valve.

The high pressure turbine (HPT) active clearance control (ACC) valve permits fan air blow on the HPT case. The EEC controls a torque motor in the HMU to operate the HPT ACC valve. The torque motor sends servo fuel pressure to the valve actuator.

Compressor Control System

The compressor control system matches low pressure compressor (LPC) and high pressure compressor (HPC) airflows for all power conditions. This helps to prevent an engine stall.

These are the compressor control subsystems:

- Variable bypass valve system
- Variable stator vane system
- Start transient bleed system.

The variable bypass valve (VBV) system sends air from the LPC exit into the fan stream. This decreases the amount of air going into the HPC. The EEC controls a torque motor in the HMU to operate the VBVs. The torque motor sends servo fuel pressure to two VBV actuators. The actuators move 10 bypass valves

The variable stator vane (VSV) system moves HPC stator vanes to control HPC airflow. The EEC controls a torque motor in the HMU to operate the VSVs. The torque motor sends servo fuel pressure to two VSV actuators. The VSV

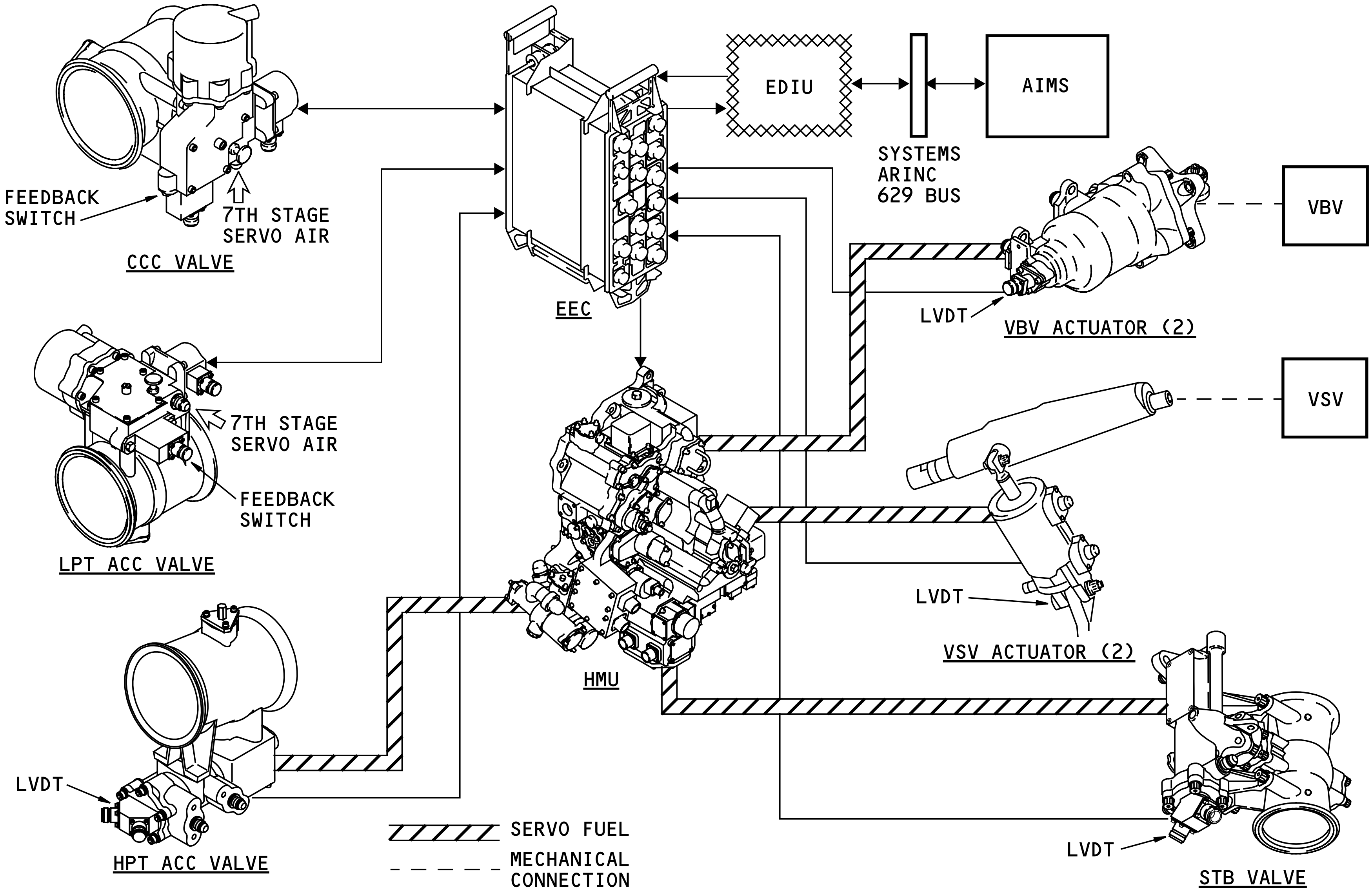
ENGINE AIR - GENERAL DESCRIPTION

actuators operate the HPC inlet guide vanes (IGV) and the stage 1 through 4 stator vanes.

The start/transient bleed (STB) system sends 7th stage HPC air to the fan stream. The STB valve only operates during engine starts to unload the HPC. The EEC controls a torque motor in the HMU to operate the STB valve. The torque motor sends servo fuel pressure to the STB actuator.

Indication and Control

The valves and actuators send feedback data to the EEC. The EEC uses the feedback data for control and indication. The AIMS receives position data from the EEC to show on the PDS.



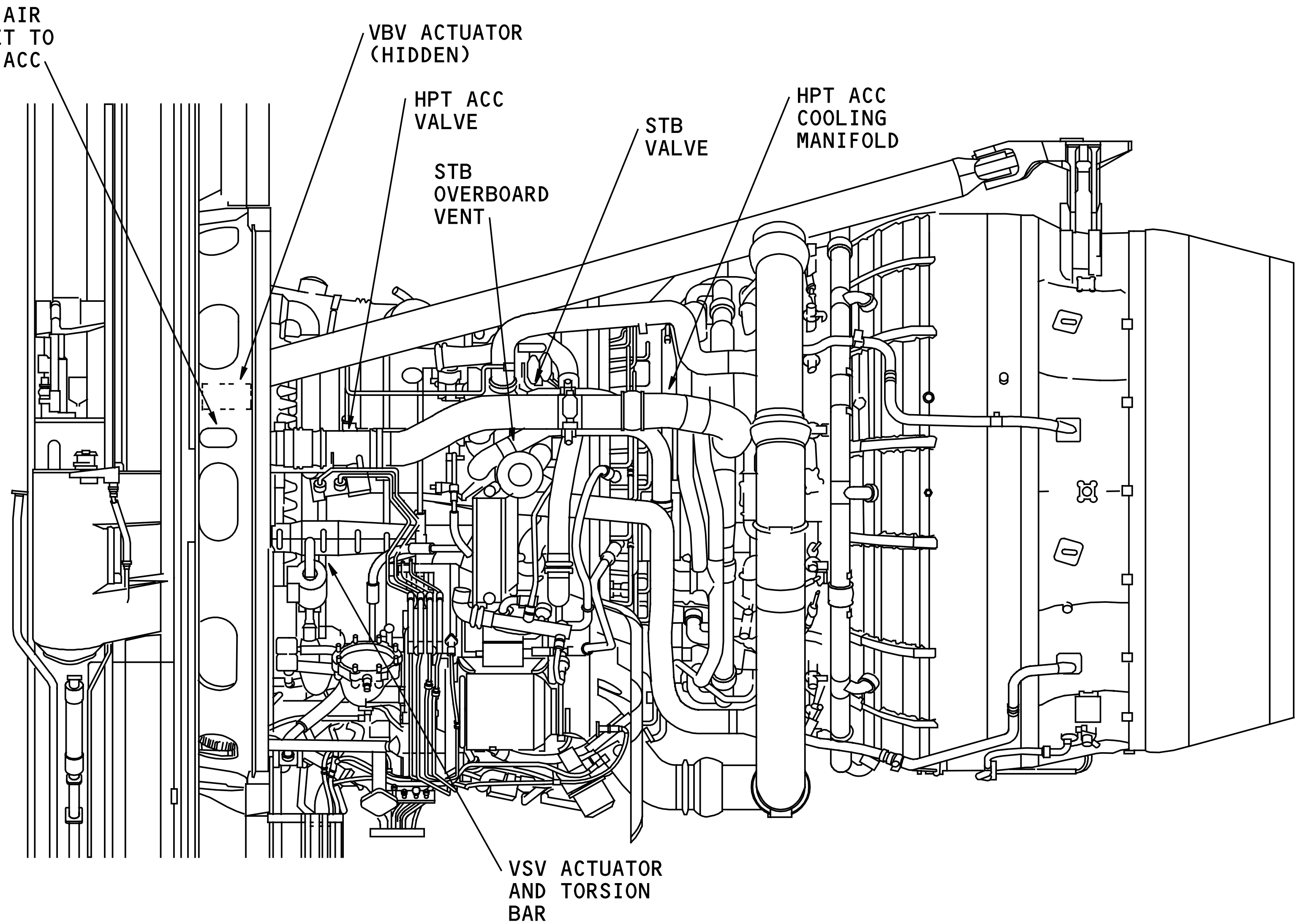
ENGINE AIR - GENERAL DESCRIPTION

ENGINE AIR - COMPONENT LOCATIONS - LEFT

Component locations - Left Side

These engine air cooling and compressor control components are on the left side of the engine core:

- HPT ACC valve
- HPT ACC cooling manifold
- STB valve
- STB overboard vent
- VBV actuator
- VSV actuator and torsion bar.



75-00-00-103 Rev 2

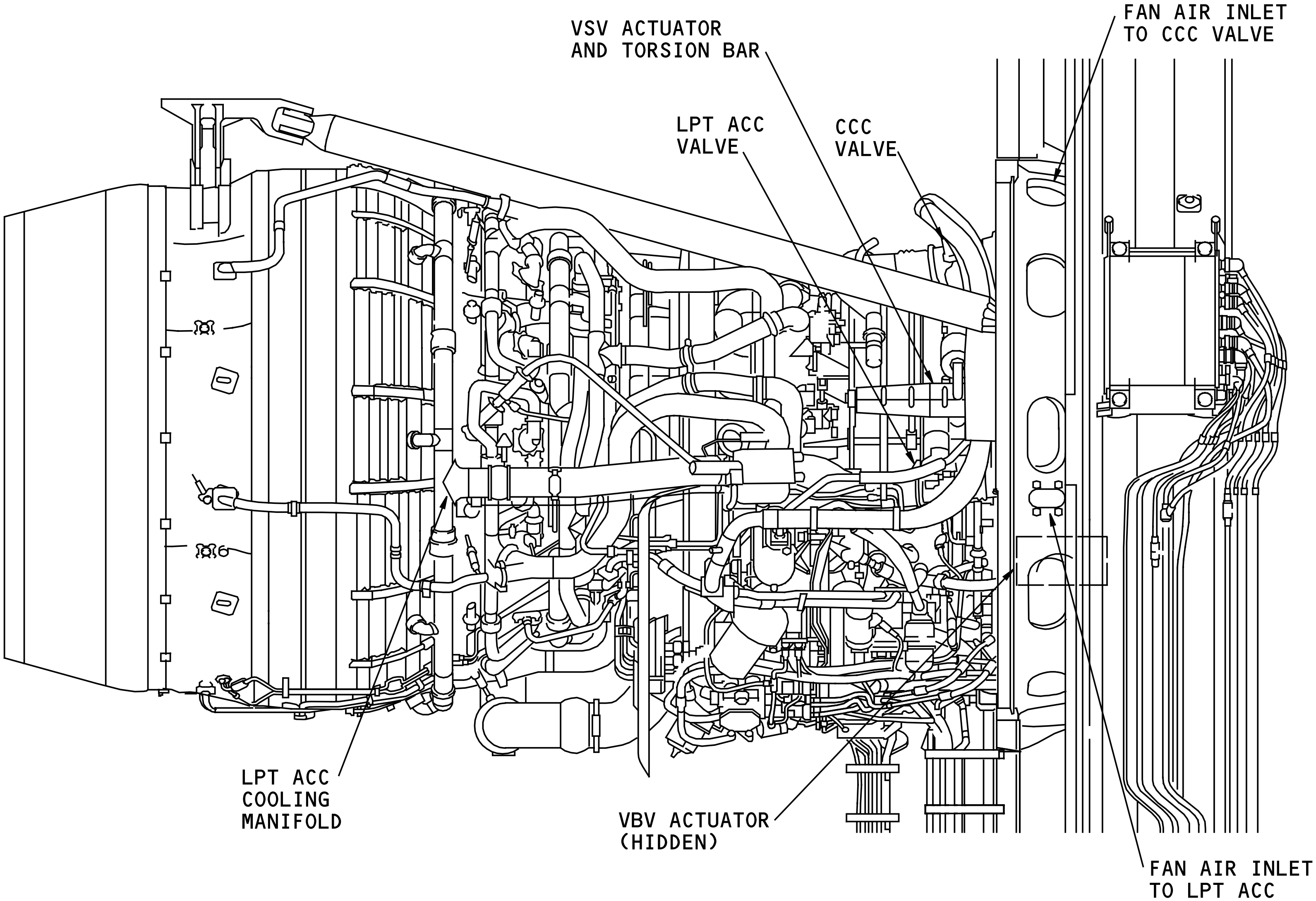
ENGINE AIR - COMPONENT LOCATIONS - LEFT

ENGINE AIR - COMPONENT LOCATIONS - RIGHT

Component locations - Right Side

These engine air cooling and compressor control components are on the right side of the engine core:

- VSV actuator and torsion bar
- CCC valve
- VBV actuator
- LPT ACC valve
- LPT ACC cooling manifold.



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ENGINE AIR - COMPONENT LOCATIONS - RIGHT

ENGINE AIR - ENGINE ACCESSORIES COOLING - GENERAL DESCRIPTION

General

The engine accessories cooling system uses air from the LPC or the fan stream to cool the core compartment. When the VBVs are open, LPC air cools the core compartment. When the VBVs close, fan air cools the core compartment. The cooling air goes through the CCC valve.

The EEC sends engine accessory cooling faults to the AIMS.

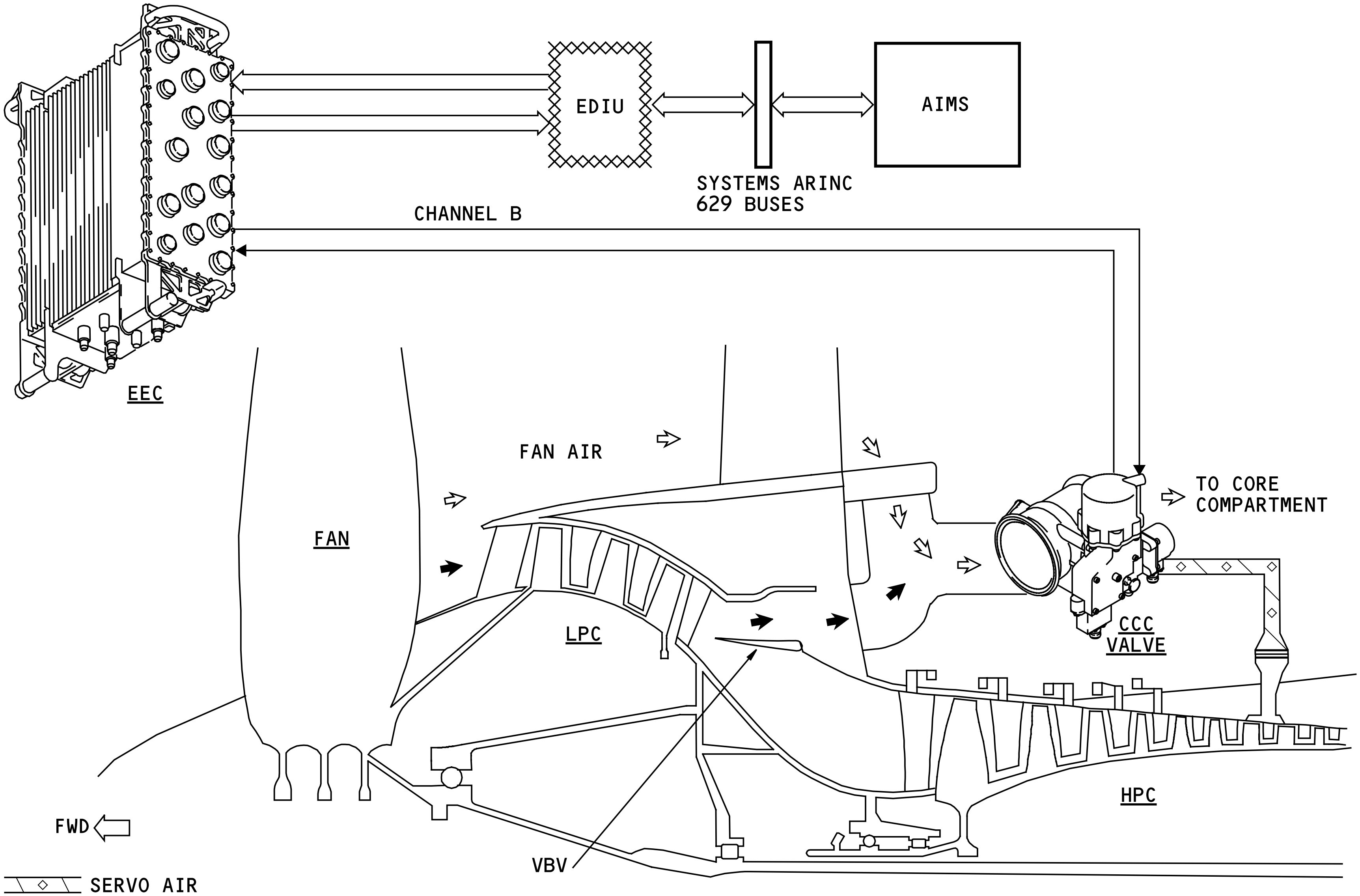
CCC Control

Channel B of the EEC controls a solenoid on the CCC valve to operate the valve. When the solenoid energizes, 7th stage servo air goes to the valve actuator to close the valve.

When the airplane is at cruise, the valve closes to increase engine efficiency. At all other times the valve is open. The EEC uses altitude and N1 to find when the airplane is at cruise. The CCC valve permits low air flow when it is closed.

Position Feedback

A feedback switch on the CCC valve sends a valve position signal to each channel of the EEC. You can see CCC valve position on the EPCS maintenance page (not shown). The position shows OPEN or CLOSED.



ENGINE AIR - ENGINE ACCESSORIES COOLING - GENERAL DESCRIPTION

ENGINE AIR - ENGINE ACCESSORIES COOLING - CORE COMPARTMENT COOLING VALVE

Purpose

The CCC valve controls the cooling air to the engine core compartment and the aft face of accessory gearbox.

Location

The CCC valve is on the forward engine core at the 1:00 position. You must open the right thrust reverser (T/R) to get access to the CCC valve.

Physical Description

The CCC valve has solenoid control and pneumatic actuation. The valve has two positions: open or closed. The CCC valve has these parts:

- Solenoid
- Lockout control
- Servo air connector
- Valve position indicator
- Feedback switch.

The CCC valve feedback switch is line replaceable.

Functional Description

The CCC valve inlet connects to the VBV duct. The CCC valve outlet connects to the CCC air distributor duct.

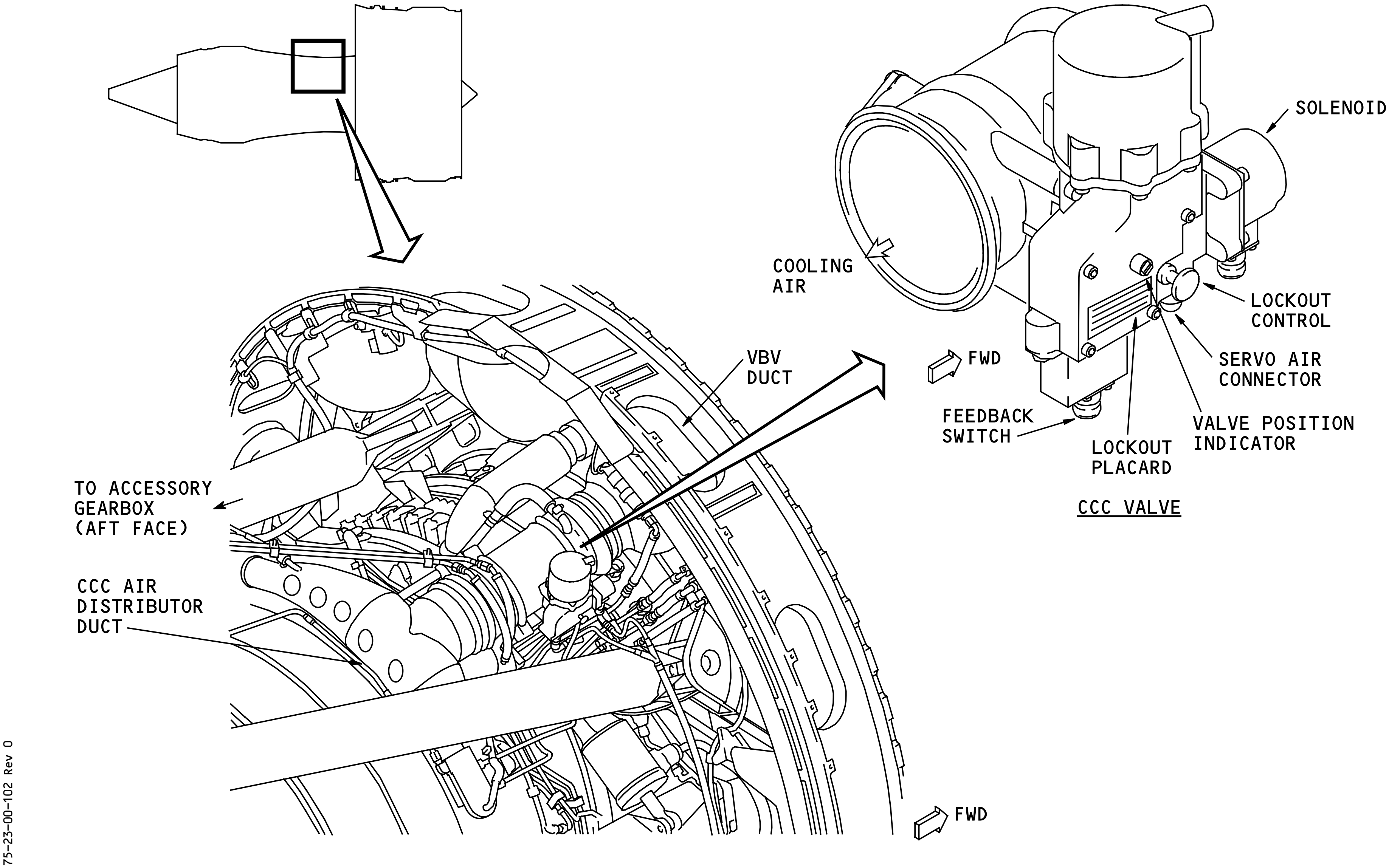
The cooling air flows out of the CCC air distributor duct into the core compartment. A connecting duct also sends cooling air to the aft face of the accessory gearbox. The cooling air goes overboard through vents in the cowling.

Training Information Point

A placard on the CCC valve tells you how to lock the valve open. You use a tool in a slot in the valve position indicator to move the valve. You turn the lockout control on the valve to lock it open.

The servo air line attaches to the CCC valve actuator with a B-nut. Observe this note when you tighten the B-nut:

NOTE: Use the wrench arc method to tighten the B-nut (AMM 70-51-00/201).



ENGINE AIR - ENGINE ACCESSORIES COOLING - CORE COMPARTMENT COOLING VALVE

ENGINE AIR - TURBINE COOLING - GENERAL DESCRIPTION

General

The turbine cooling system uses fan air to cool the LPT and HPT turbine cases. This makes the turbine cases smaller and decreases the clearance between the turbine blade tips and the turbine case. The smaller clearance increases engine efficiency.

The turbine cooling system has two subsystems:

- LPT ACC system
- HPT ACC system.

Each system has a valve that permits fan air to go through a duct to the turbine case. The duct puts the air into a manifold that goes around the turbine case. The inside of the manifold has holes that blow air onto the turbine case.

The EEC sends turbine cooling system faults to the AIMS.

LPT ACC System

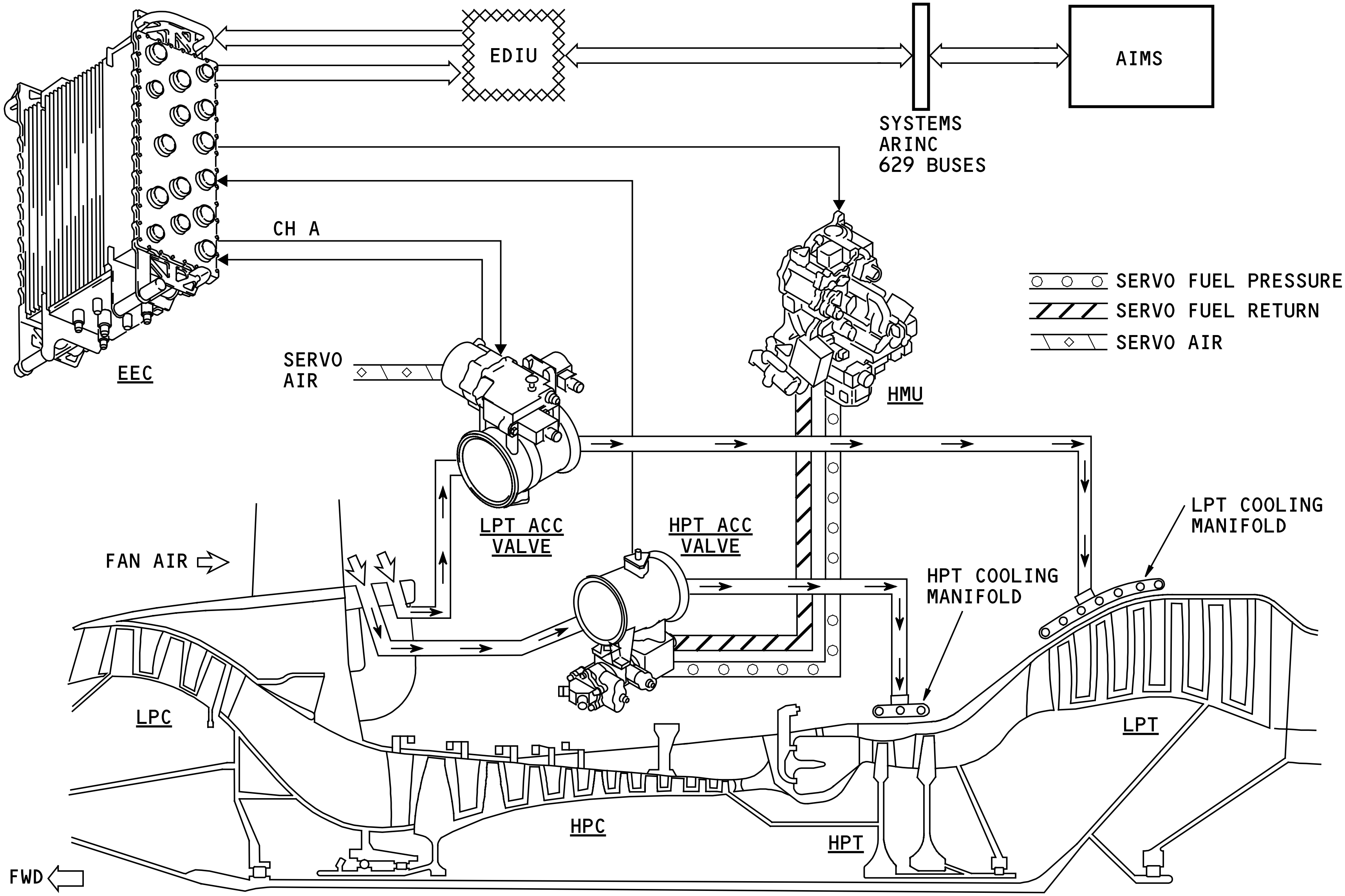
The EEC only uses channel A to control the LPT ACC valve. When the EEC energizes the LPT ACC valve solenoid, 7th stage servo air opens the valve. The valve permits full flow when it opens, and low flow when it closes. The EEC uses N1 and altitude to control the valve. The valve opens when the engine goes to takeoff thrust, and stays open through the climb and cruise flight phases.

A feedback switch on the LPT ACC valve sends a valve position signal to each channel of the EEC. You can see the valve position on the EPCS maintenance page (not shown). Valve position shows OPEN or CLOSED.

HPT ACC System Functional Description

The EEC controls a torque motor in the HMU to modulate the HPT ACC valve. The EEC controls the torque motor based on inlet temperature, N1, and N2. The torque motor sends servo fuel pressure to the HPT ACC valve actuator to move the valve. When the valve opens, fan air blows on the HPT case. The valve opens for a short time after the engine goes to takeoff thrust. The valve modulates during engine operation. The valve permits low flow when it closes.

An dual LVDT on the valve sends a valve position to each channel of the EEC. You can see the valve position on the EPCS maintenance page (not shown). Valve position shows in percent open.



ENGINE AIR - TURBINE COOLING - GENERAL DESCRIPTION

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ENGINE AIR - TURBINE COOLING - LPT ACTIVE CLEARANCE CONTROL VALVE

Purpose

The LPT ACC valve controls fan air flow to cool the LPT case.

Location

The LPT ACC valve is at the 3:00 position on the engine core. You must open the right T/R to get access to the LPT ACC valve.

Physical Description

The LPT ACC valve has solenoid control and pneumatic actuation. The valve has two positions: open or closed. The LPT ACC valve has these parts:

- Valve position indicator
- Lockout control
- Servo air connection
- Solenoid
- Feedback switch.

A feedback switch sends a valve position signal to the EEC. The feedback switch is an LRU.

Functional Description

When the LPT ACC valve is open, full cooling flow goes to the LPT case. When the valve closes, a small amount of cooling flow goes to the LPT case.

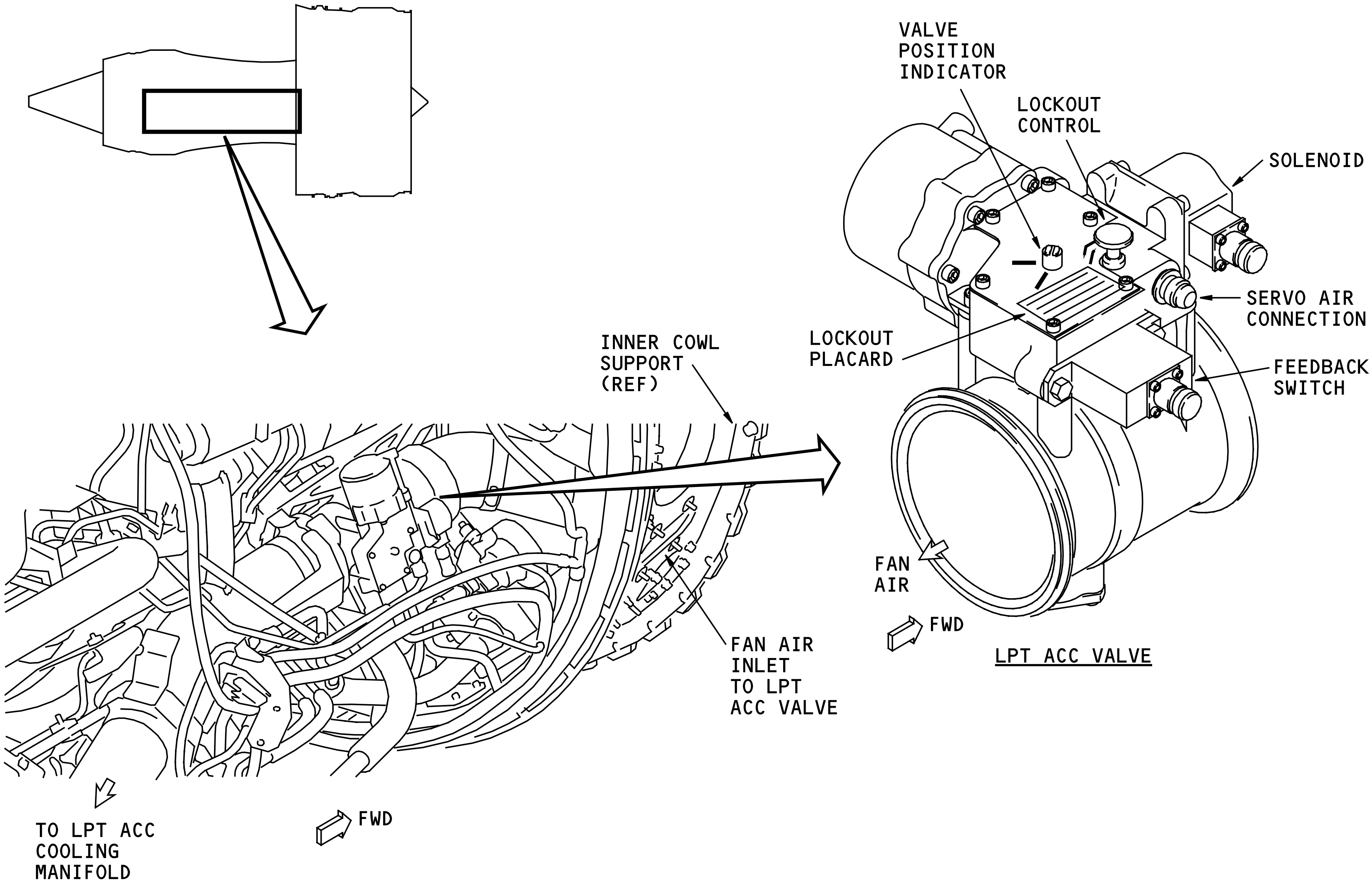
The EEC controls the LPT ACC valve solenoid to move the valve. When the solenoid is not energized, a spring closes the valve. The valve is fail-safe to the closed position. When the solenoid energizes, seventh stage servo air moves the valve open.

Training Information Point

You can lock the LPT ACC valve closed. A placard on the valve tells you how to lock the valve. You use a tool in a slot in the valve position indicator to move the valve. You turn the lockout control on the valve to lock it closed.

The servo air line attaches to the actuator with a B-nut. Observe this note when you tighten the B-nut:

NOTE: Use the wrench arc method to tighten the B-nut (AMM 70-51-00/201).



75-24-00-102 Rev 1 08/28/1995

ENGINE AIR - TURBINE COOLING - LPT ACTIVE CLEARANCE CONTROL VALVE

ENGINE AIR - TURBINE COOLING - HPT ACTIVE CLEARANCE CONTROL VALVE

Purpose

The HPT ACC valve controls fan air flow to cool the HPT case.

Location

The HPT ACC valve is on the forward engine core at the 9:00 position. You must open the left T/R to get access to the HPT ACC valve.

Physical Description

The HPT ACC valve is a modulating valve. It uses servo fuel pressure for actuation. The HPT ACC valve has these parts:

- Valve position indicator
- Servo fuel connection (2)
- Drain can (2)
- Lockout pin
- LVDT.

Each servo fuel connection has a drain line and a drain can. The drain lines combine into one drain line that goes to the drain mast. The drain can collects fuel leakage. You do a check of the drain cans if you see a leak at the drain mast. This permits you to identify which connection has leakage. Observe the following caution:

CAUTION: DO NOT REMOVE THE CAPTIVE BOLTS FROM THE DRAIN CAN. DAMAGE CAN OCCUR TO THE DRAIN CAN OR THE CAPTIVE BOLTS.

An LVDT sends HPT ACC valve position to the EEC. It has two connections, one for each channel of the EEC.

Functional Description

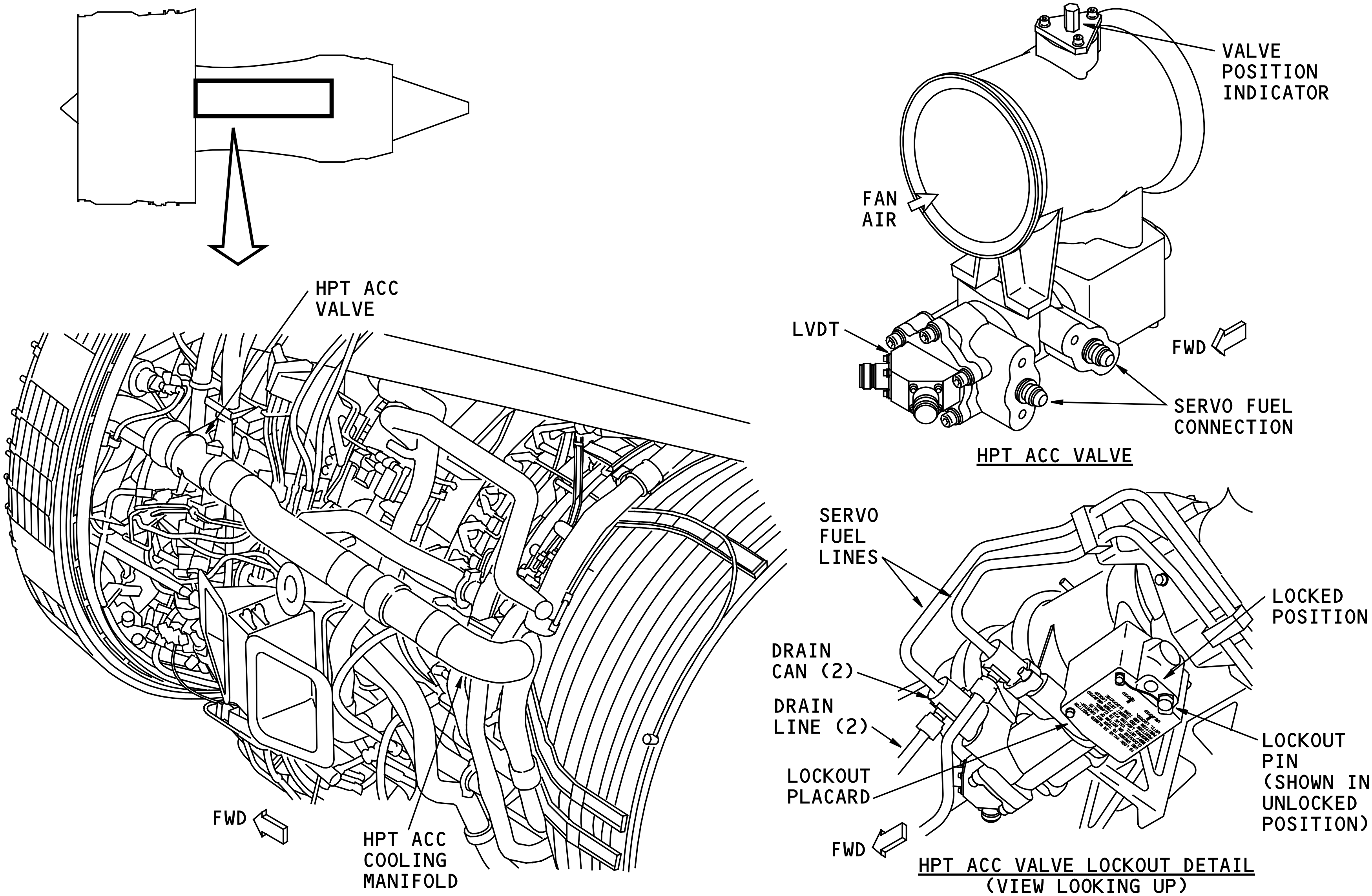
The EEC controls a torque motor in the HMU to control servo fuel pressure to the valve. There are two servo fuel lines to the valve. Pressure in one line moves the valve more open. Pressure in the other line moves the valve more closed.

Training Information Point

You can lock the HPT ACC valve closed. A placard on the valve tells you how to lock the valve. You put a tool on the hexagonal valve position indicator shaft to move the valve. You move the lockout pin from the UNLOCKED to the LOCKED position to keep the valve closed.

The servo fuel lines attach to the HPT ACC valve actuator with B-nuts. Observe this note when you tighten the B-nuts:

NOTE: Use the wrench arc method to tighten the B-nut (AMM 70-51-00/201).



75-24-00-103 Rev 1 08/28/1995

ENGINE AIR - TURBINE COOLING - HPT ACTIVE CLEARANCE CONTROL VALVE

ENGINE AIR - VSV SYSTEM - GENERAL DESCRIPTION

General

The VSV system moves the HPC inlet guide vanes (IGV) and the 1st through 4th stage stator vanes. The system operates automatically at all power settings to control airflow through the HPC. The VSVs move from full closed at idle to full open at takeoff.

There are two VSV actuators. One actuator is on the left side of the engine and one actuator is on the right side.

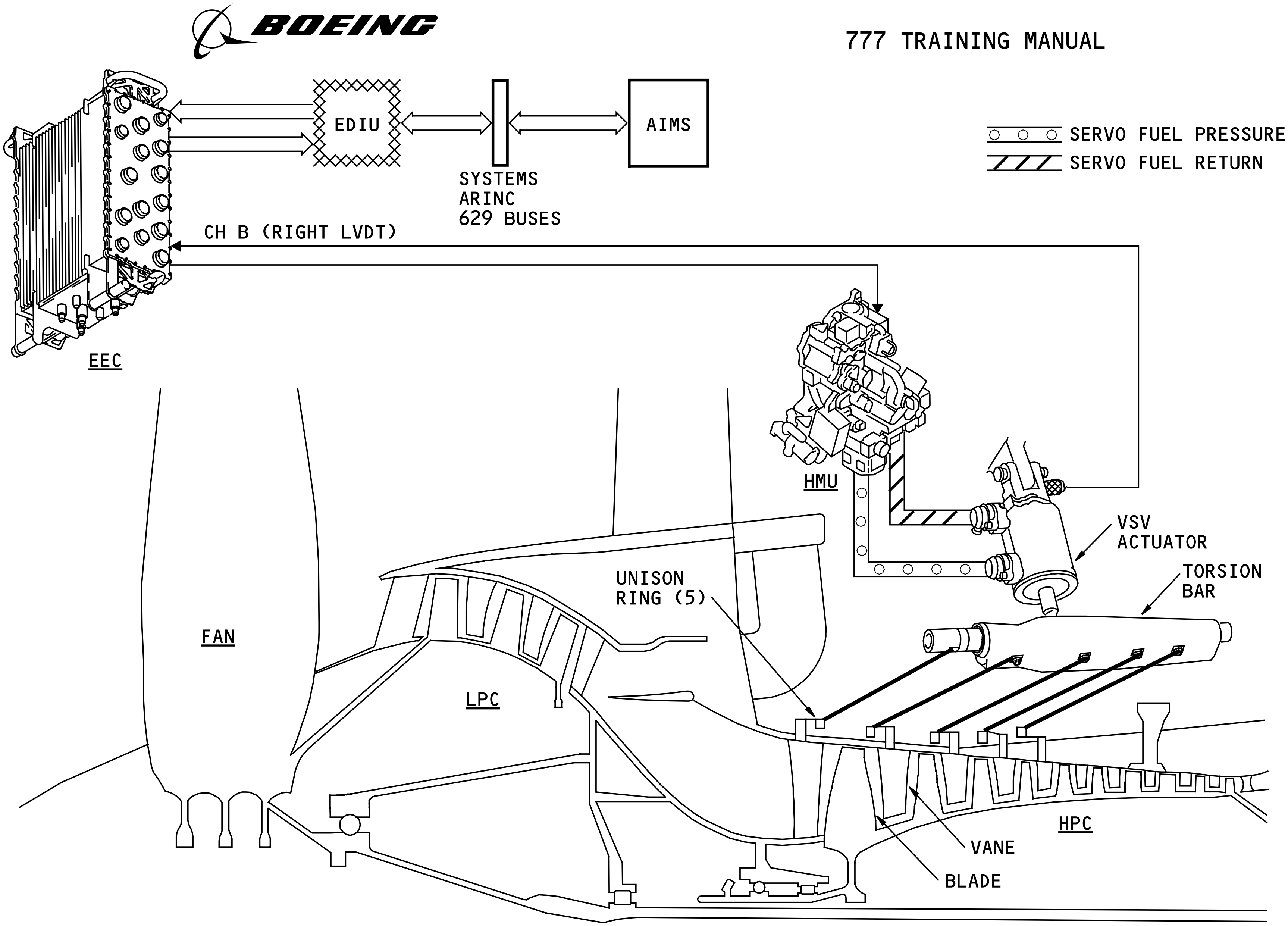
You find VSV system faults on the MAT.

VSV Control

The EEC controls a torque motor in the HMU to operate the VSVs. The EEC uses N2 and T25 to control the torque motor. The torque motor sends fuel pressure to the VSV actuators to turn the torsion bars. The torsion bars move unison rings on the HPC. The unison rings connect to the stator vanes. When the unison rings move, the stator vane angles change.

Position Feedback

An LVDT in each actuator sends a position signal to the EEC. The left actuator LVDT sends a signal to EEC channel A. The right actuator LVDT sends a signal to EEC channel B. You can see VSV position on the EPCS maintenance page (not shown). The VSV position shows in percent open.



ENGINE AIR - VSV SYSTEM - GENERAL DESCRIPTION

ENGINE AIR - VSV SYSTEM - VSV ACTUATOR

Purpose

The VSV actuators move the variable stator vanes in the HPC.

Location

The VSV actuators are on the HPC case at the 2:30 and 8:30 positions. Each actuator attaches to the HPC case with a pin.

Physical Description

Each actuator has these parts:

- Servo fuel connection (2)
- Drain can (2)
- Actuator rod
- LVDT.

Each servo fuel connection has a drain line and a drain can. The drain lines combine into one drain line that goes to the drain mast. The drain can collects fuel leakage. You check the drain cans if you see a leak at the drain mast. This permits you to identify which connection has leakage. Observe the following caution:

CAUTION: DO NOT REMOVE THE CAPTIVE BOLTS FROM THE DRAIN CAN. DAMAGE CAN OCCUR TO THE DRAIN CAN OR THE CAPTIVE BOLTS.

The actuator has a rod that attaches to the torsion bar. When the actuator rod moves, the torsion bar turns.

A single channel LVDT in each actuator sends actuator position to one channel of the EEC. The left actuator LVDT connects to channel A and the right actuator connects to channel B.

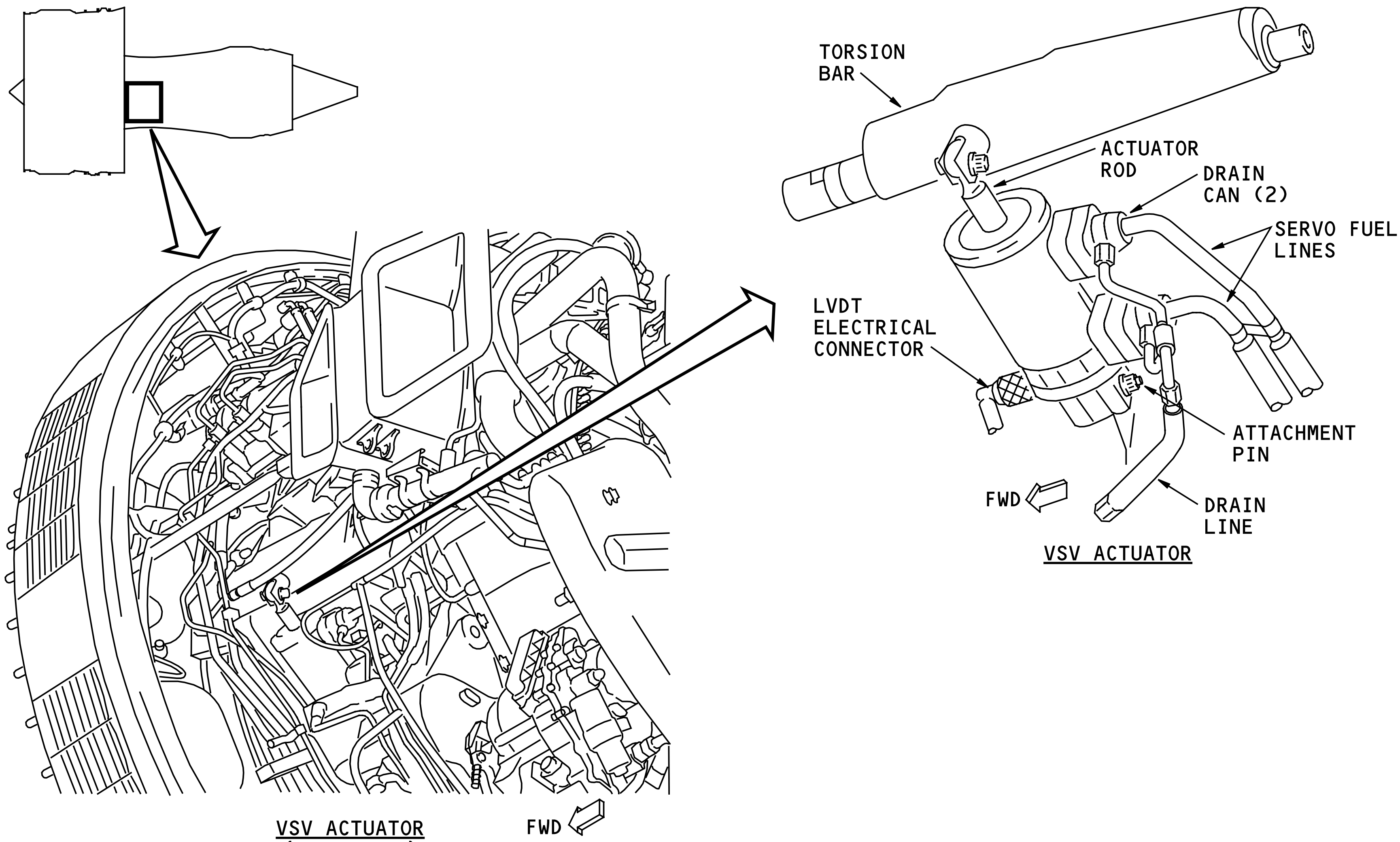
Functional Description

Servo fuel pressure moves each VSV actuator at the same time. Each actuator rod turns a torsion bar. The torsion bars attach to 5 unison rings (not shown). The unison rings attach to the HPC inlet guide vanes (IGV), and the 1st through 4th stage stator vanes. When the unison rings move, the IGVs and stator vanes move.

Training Information Point

The servo fuel lines attach to the VSV actuators with B-nuts. Observe this note when you tighten the VSV actuator B-nuts:

NOTE: Use the wrench arc method to tighten the B-nut (AMM 70-51-00/201).



VSV ACTUATOR
(LEFT SIDE)

NOTE: LEFT SIDE SHOWN
RIGHT SIMILAR

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ENGINE AIR - VSV SYSTEM - VSV ACTUATOR

ENGINE AIR - VBV SYSTEM - GENERAL DESCRIPTION

General

The VBVs open to let air go out of the engine core, through the VBV ducts, and into the fan stream. The VBV ducts open to the fan stream just aft of the LPC exit. This decreases the amount of air that goes into the HPC. The system operates automatically at all power settings. The VBVs move from full open at idle to full closed at takeoff.

There are two VBV actuators and ten VBVs. One actuator is on the left side of the engine and one actuator is on the right side.

You find VBV system faults on the MAT.

VBV Control

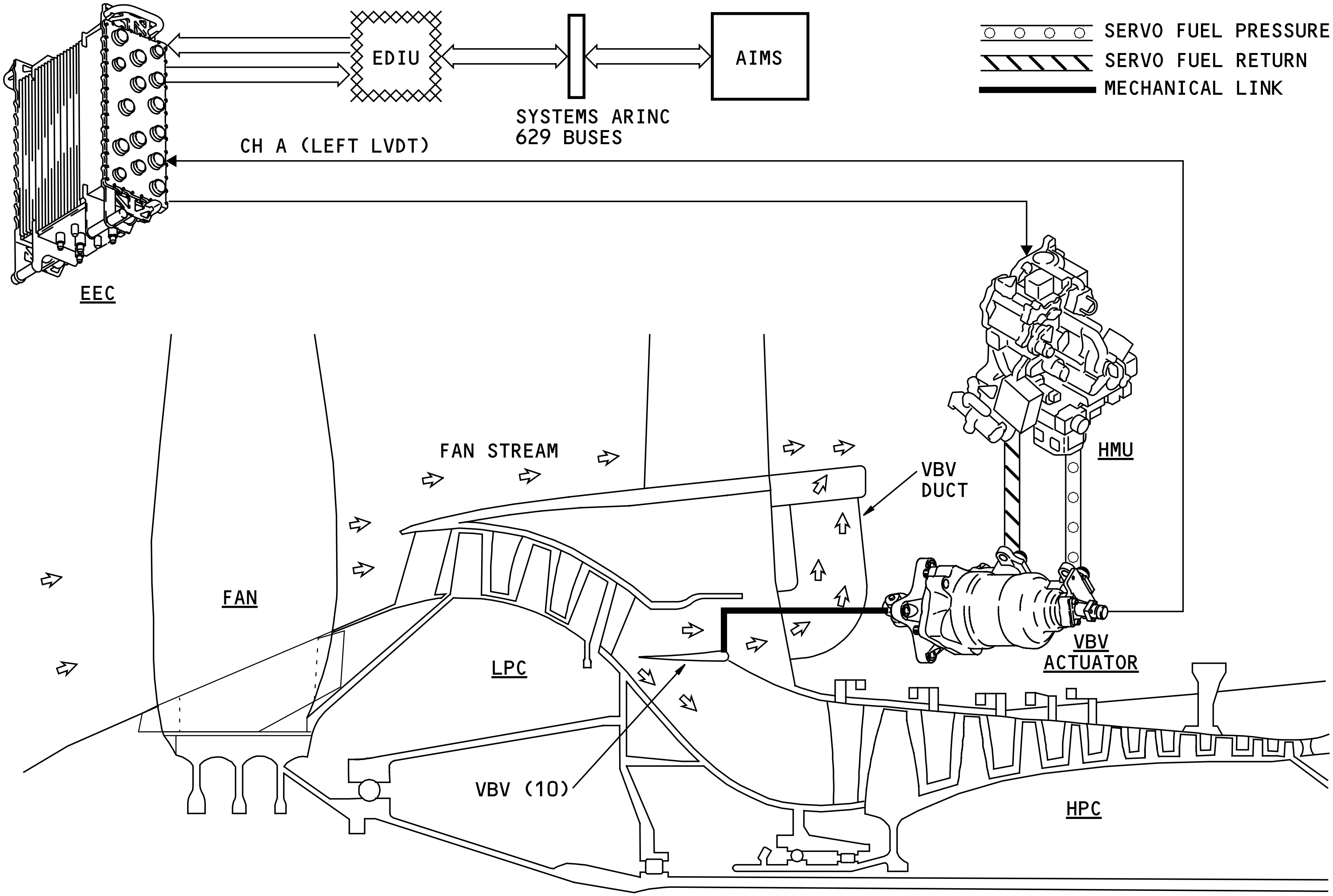
The EEC controls a torque motor in the HMU to operate the VBVs. These are the main inputs the EEC uses to control VBV operation:

- N1
- N2
- T12
- T25.

The EEC sends a signal to a torque motor in the HMU. The torque motor sends fuel pressure to the VBV actuators to open or close the VBVs.

Position Feedback

An LVDT in each actuator sends a position signal to the EEC. The left actuator LVDT sends a signal to EEC channel A. The right actuator LVDT sends a signal to EEC channel B. You can see VBV position on the EPCS maintenance page (not shown). The VBV indication shows in percent open.



ENGINE AIR - VBV SYSTEM - GENERAL DESCRIPTION

ENGINE AIR - VBV SYSTEM - VBV ACTUATOR AND VBV

General

The VBV system has two actuators and ten valves. A unison ring and bellcrank linkages connect the actuators to the valves. The actuators turn the unison ring to move the VBVs.

Location

The actuators are on the forward engine core at the 3:30 and 9:30 positions. The VBV actuators attach to the fan hub frame with bolts.

The VBVs are forward of the actuators inside the fan hub frame. They are equally spaced around the engine.

VBV Actuators

Each actuator has these parts:

- Servo fuel connection (2)
- Drain can (not shown) (2)
- Rod
- LVDT.

Each servo fuel connection has a drain line (not shown) and a drain can. The drain lines combine into one drain line that goes to the drain mast. The drain can collects fuel leakage. You do a check of the drain cans if you see a leak at the drain mast. This permits you to identify which connection has leakage. Observe the following caution:

CAUTION: DO NOT REMOVE THE CAPTIVE BOLTS FROM THE DRAIN CAN. DAMAGE CAN OCCUR TO THE DRAIN CAN OR THE CAPTIVE BOLTS.

Each VBV actuator has a rod that attaches to one end of a bellcrank linkage. The other end of the bellcrank linkage attaches to the unison ring. When the actuator rod moves, the unison ring turns.

A single channel LVDT in each actuator sends actuator position to the EEC. The left actuator LVDT connects to channel A and the right LVDT connects to channel B.

Functional Description

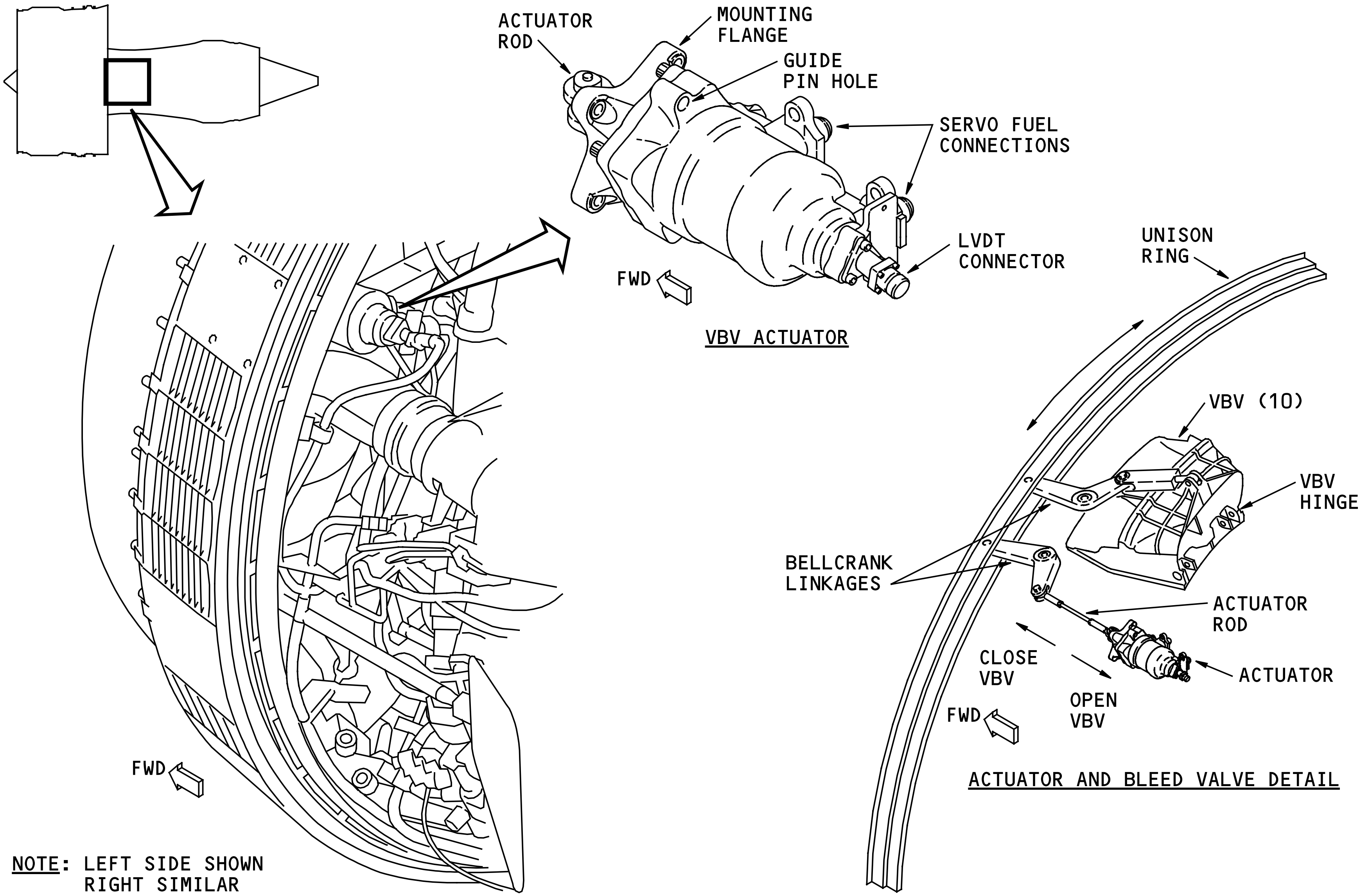
Servo fuel pressure moves the actuator rods forward and aft. The actuators move together to modulate the VBVs. When the rod moves forward, the unison ring turns clockwise. This causes the VBVs to move towards the closed position.

Training Information Point

You use a guide pin to install or remove the VBV actuator. The pin goes through a hole in the mounting flange and attaches to the fan hub frame. The pin supports and guides the actuator.

The servo fuel lines attach to the VBV actuators with B-nuts. Observe this note when you tighten the B-nuts:

NOTE: Use the wrench arc method to tighten the B-nut (AMM 70-51-00/201).



ENGINE AIR - VBV SYSTEM - VBV ACTUATOR AND VBV

ENGINE AIR - STB SYSTEM - GENERAL DESCRIPTION

General

The start/transient bleed (STB) valve opens during engine starts to remove the load on the HPC. When the valve opens, 7th stage HPC air goes to the fan stream. The STB valve has only two positions, open and closed.

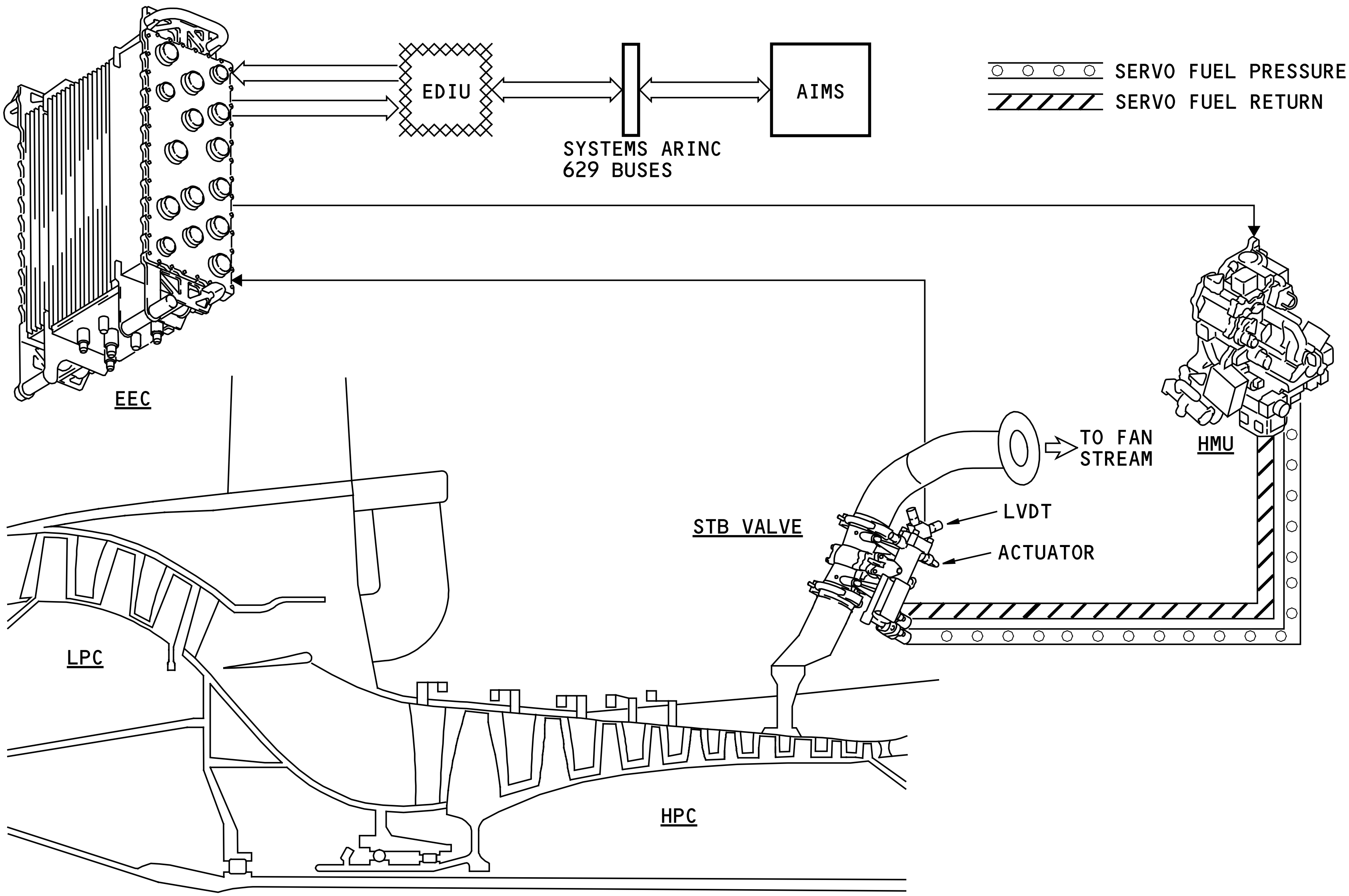
You find STB system faults on the MAT.

STB Valve Control

The EEC controls a torque motor in the HMU to operate the STB valve. The torque motor sends servo fuel pressure to the STB valve actuator. The actuator opens the valve.

Position Feedback

A dual LVDT in the STB valve sends valve position to each channel of the EEC. You can see STB valve position on the EPCS maintenance page (not shown). STB valve position shows in percent open.



ENGINE AIR - STB SYSTEM - GENERAL DESCRIPTION

ENGINE AIR - STB SYSTEM - STB VALVE

Purpose

The start/transient bleed (STB) valve opens to send HPC 7th stage air to the fan stream. The valve operates with servo fuel pressure.

Location

The STB valve is at the 10:30 position on the left side of the HPC.

Physical Description

The STB valve is in the 7th stage bleed duct. An actuator is part of the valve assembly. The actuator uses servo fuel pressure to open the valve. The STB valve has these components:

- Servo fuel connection (2)
- Drain line
- LVDT
- LVDT cooling line
- Lockout knob and valve position indicator.

A fuel drain line goes from the STB valve to the drain mast.

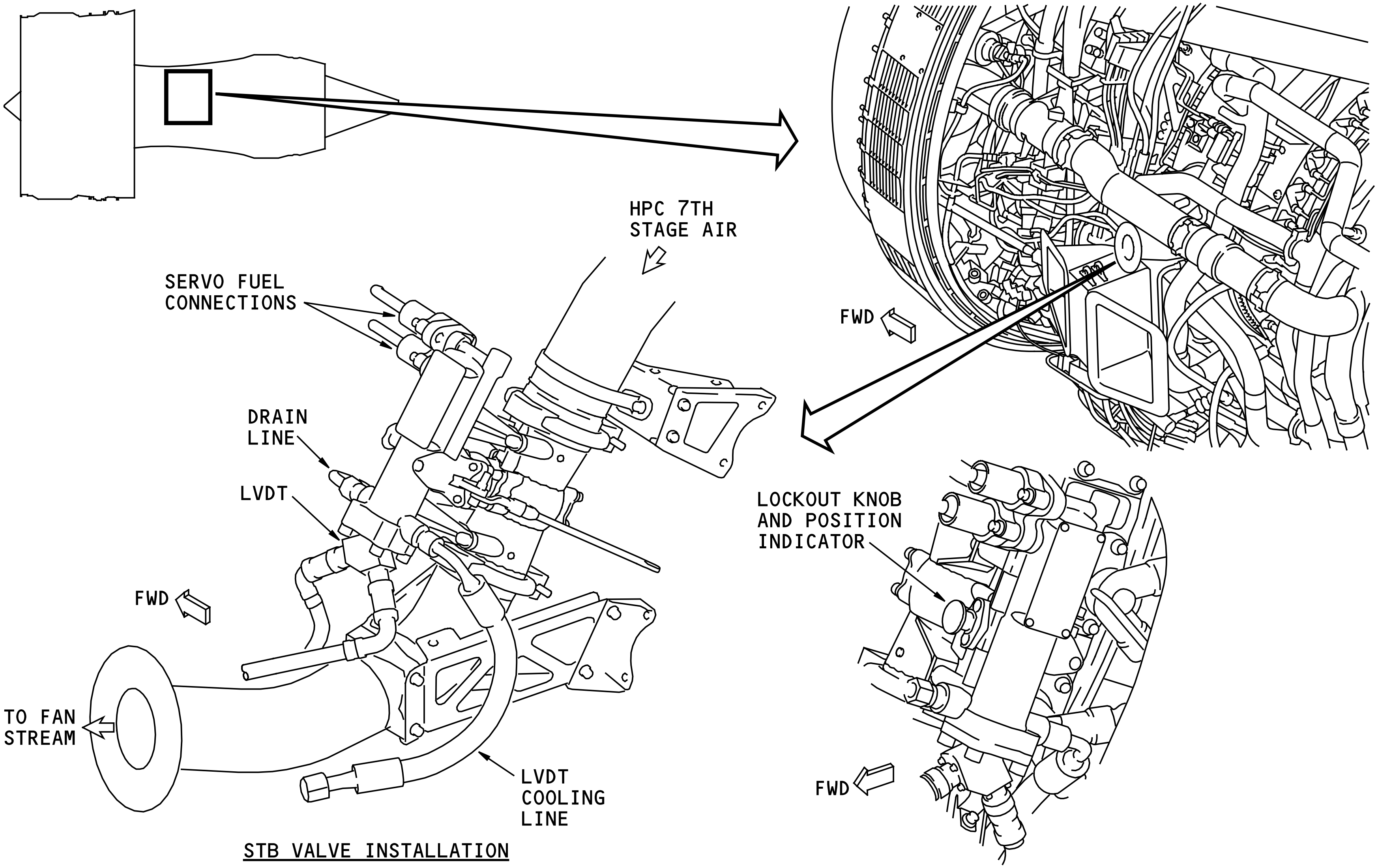
A dual channel LVDT sends valve position to the EEC. One signal goes to each channel of the EEC. Fan air cools the LVDT.

Training Information Point

The lockout instructions are on the lockout knob. You can use the valve position indicator to manually operate the valve. You push and turn the lockout knob 180 degrees to lock the valve.

The servo fuel lines attach to the VBV actuators with B-nuts. Observe this note when you tighten the VSV actuator B-nuts:

NOTE: Use the wrench arc method to tighten the B-nut (AMM 70-51-00/201).



STB VALVE INSTALLATION

STB VALVE LOCKOUT DETAIL

ENGINE AIR - STB SYSTEM - STB VALVE

ENGINE AIR - FUNCTIONAL DESCRIPTION

General

The EEC automatically controls the engine air system to cool engine components and to improve compressor operation.

Valves control fan bypass air for cooling. Bleed valves and variable stator vanes control the compressor.

The EEC uses engine and airplane data to control the air system. The EEC also sends valve and stator vane position and system faults through the EDIU to the AIMS.

Cooling

These valves control engine cooling air:

- CCC valve
- LPT ACC valve
- HPT ACC valve.

Cooling air goes through the CCC valve to cool the area between the engine core and the thrust reverser cowl. The valve closes during cruise to improve engine efficiency. Channel B of the EEC controls the valve. Servo air operates the valve.

Fan air goes through the LPT ACC and HPT ACC valves to cool the LP and HP turbine cases. Channel A of the EEC controls the LPT ACC valve. Servo air actuates the valve. The EEC controls a torque motor in the HMU to operate the HPT ACC valve. Servo fuel actuates the valve.

Compressor Control

These components control airflow through the compressor:

- VBVs
- VSVs
- STB valve.

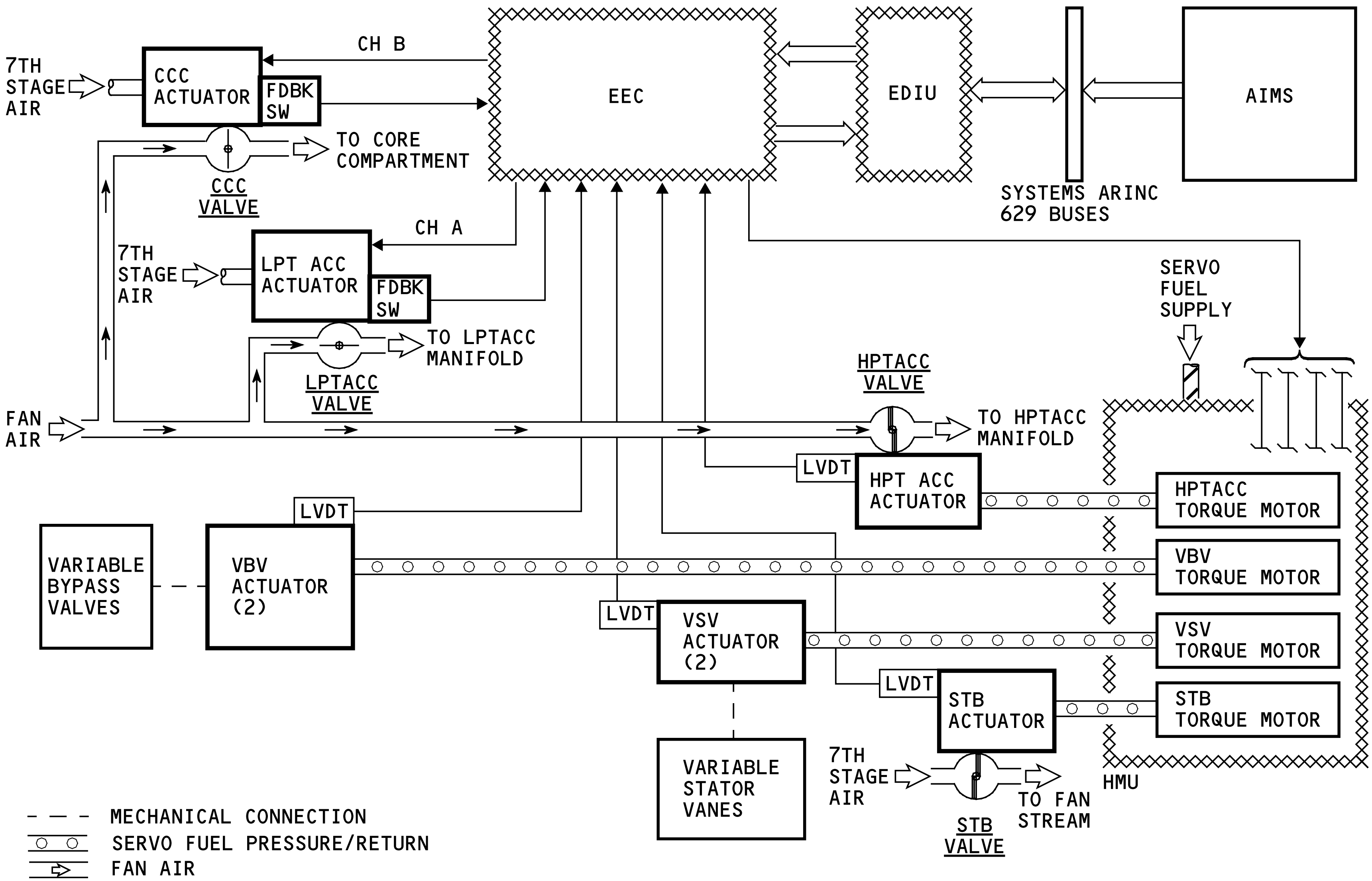
The EEC controls torque motors in the HMU to operate the VBVs, VSVs and the STB valve. Servo fuel actuates the components.

The VBVs open to bleed air from the LPC to the fan duct. The VBVs open at low power and move closed at high power.

The VSVs control airflow through the HPC with variable stators. The VSVs are closed at low power and move to open at high power.

The STB valve bleeds 7th stage HPC air to increase stall margin for engine starts.

Feedback switches or LVDTs on the valves and actuators send valve and actuator position signals to the EEC.



ENGINE AIR - FUNCTIONAL DESCRIPTION

Continental Airlines, Inc

Engine Starting

WB371

TABLE OF CONTENTS

ENGINE STARTING - INTRODUCTION

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ENGINE STARTING - INTRODUCTION

General

The engine starting system uses pneumatic power to turn the N2 shaft during an engine start. You also use the system to motor the engine.

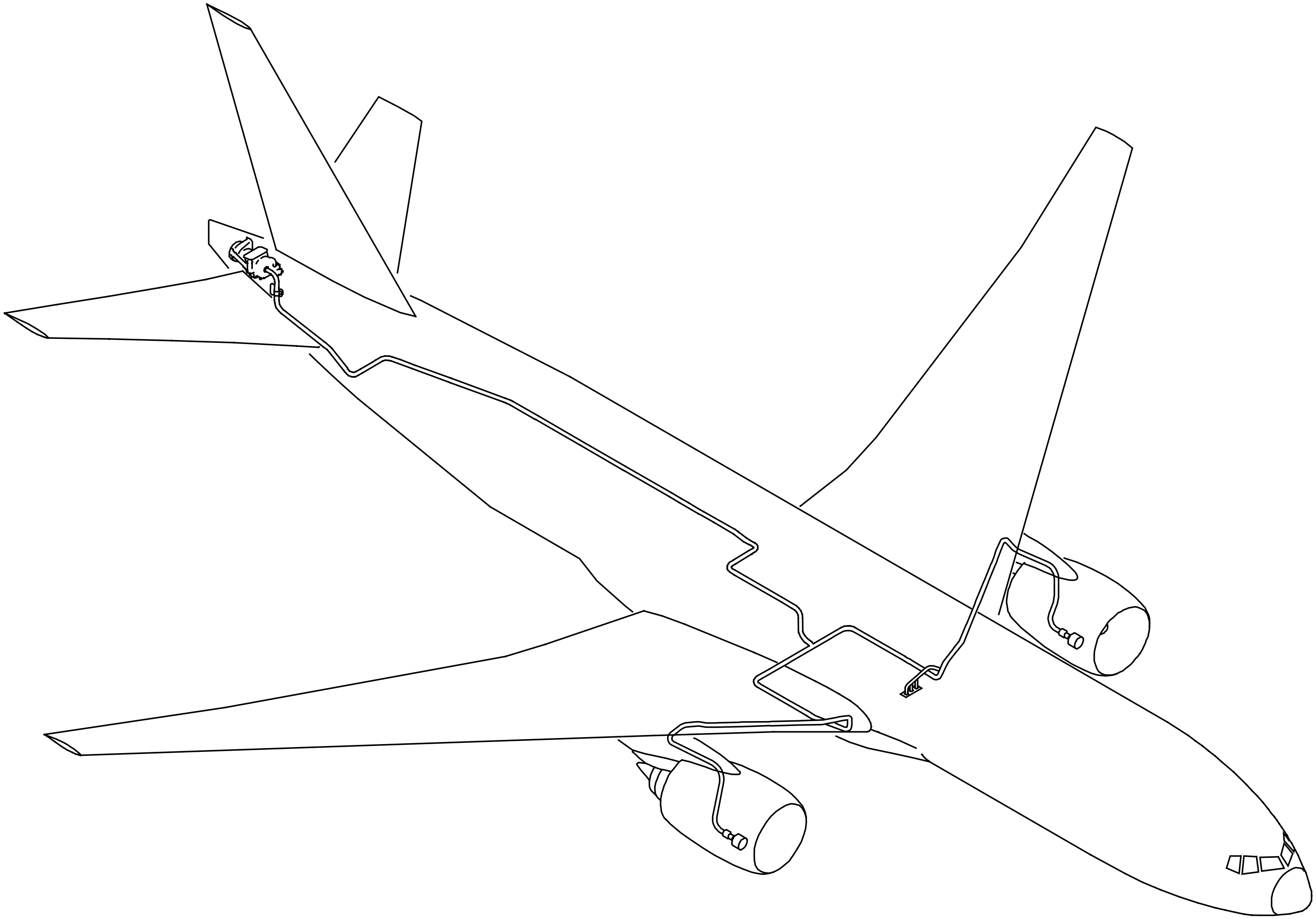
The engine starting system operates on the ground and in the air. Flight deck switches and the EEC control the system.

The engine starting system uses these pneumatic power sources:

- Auxiliary power unit (APU)
- Ground power unit (GPU)
- Opposite operating engine.

Abbreviations and Acronyms

AIMS	- airplane information management system
APU	- auxiliary power unit
ASCPC	- air supply cabin pressure controller
capt	- captain
EEC	- electronic engine control
EDIU	- engine data interface unit
EICAS	- engine indication and crew alerting system
ELMS	- electrical load management system
flt	- flight
GPU	- ground power unit
inst	- instrument
LRU	- line replaceable unit
max	- maximum
mgmt	- management
OPAS	- overhead panel ARINC system
PRSOV	- pressure regulating and shutoff valve
QAD	- quick attach detach
SAV	- starter air valve
stby	- standby
typ	- typical
vlv	- valve



ENGINE STARTING - INTRODUCTION

General

The EEC controls the engine starting system using these inputs:

- Flight deck controls
- Electrical power
- Pneumatic power.

Start Selection

You can start the engines manually or automatically, but you normally do automatic starts. You control the type of start with the autostart switch.

The autostart switch sends a signal to the EEC on the systems ARINC 629 buses. When the autostart switch is in the ON position, the EEC controls fuel and ignition, and monitors the engine parameters. The fuel control switch (not shown) must be in the RUN position for the EEC to do an autostart.

When the autostart switch is in the OFF position, you manually control and monitor the engine start.

Engine Starting

When you put the start/ignition selector to the START position it does these functions:

- Energizes a relay in the ELMS to supply 115v ac power to the EEC
- Energizes a relay in the ELMS to supply 28v dc power to the EEC to open the SAV
- Sends analog and digital start signals to the EEC
- Sends a discrete signal to the air supply cabin pressure controller (ASCPC).

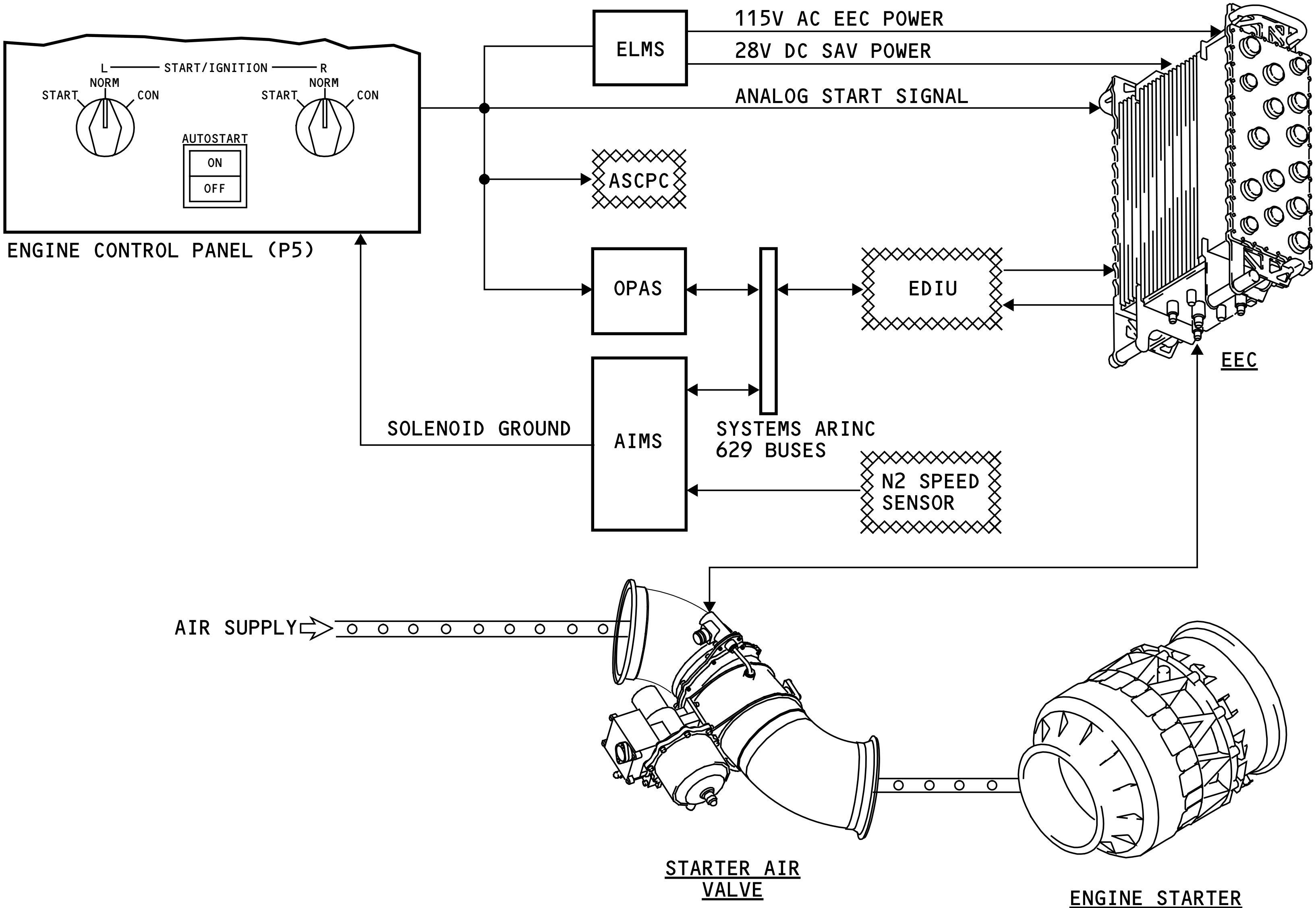
The AIMS supplies a ground for a solenoid that holds the engine start/ignition selector in the START position. The EEC sends a digital signal to tell the AIMS when to release the selector. If the AIMS does not receive the signal from the EEC, it uses N2 to decide when to release the selector.

See the engine air supply section for more information about the ASCPC (AMM PART I 36-11).

Starter Air Valve and Engine Starter

The EEC controls the starter air valve (SAV). When the valve is open, pneumatic power from the airplane air supply goes to the engine starter. This causes the engine starter to turn the N2 rotor.

The starter air valve has a pressure sensor that measures the pressure downstream of the valve. The sensor sends a signal to the EEC. The EEC uses this to find the valve position.



ENGINE STARTING - GENERAL DESCRIPTION

ENGINE STARTING - COMPONENT LOCATIONS - ENGINE

General

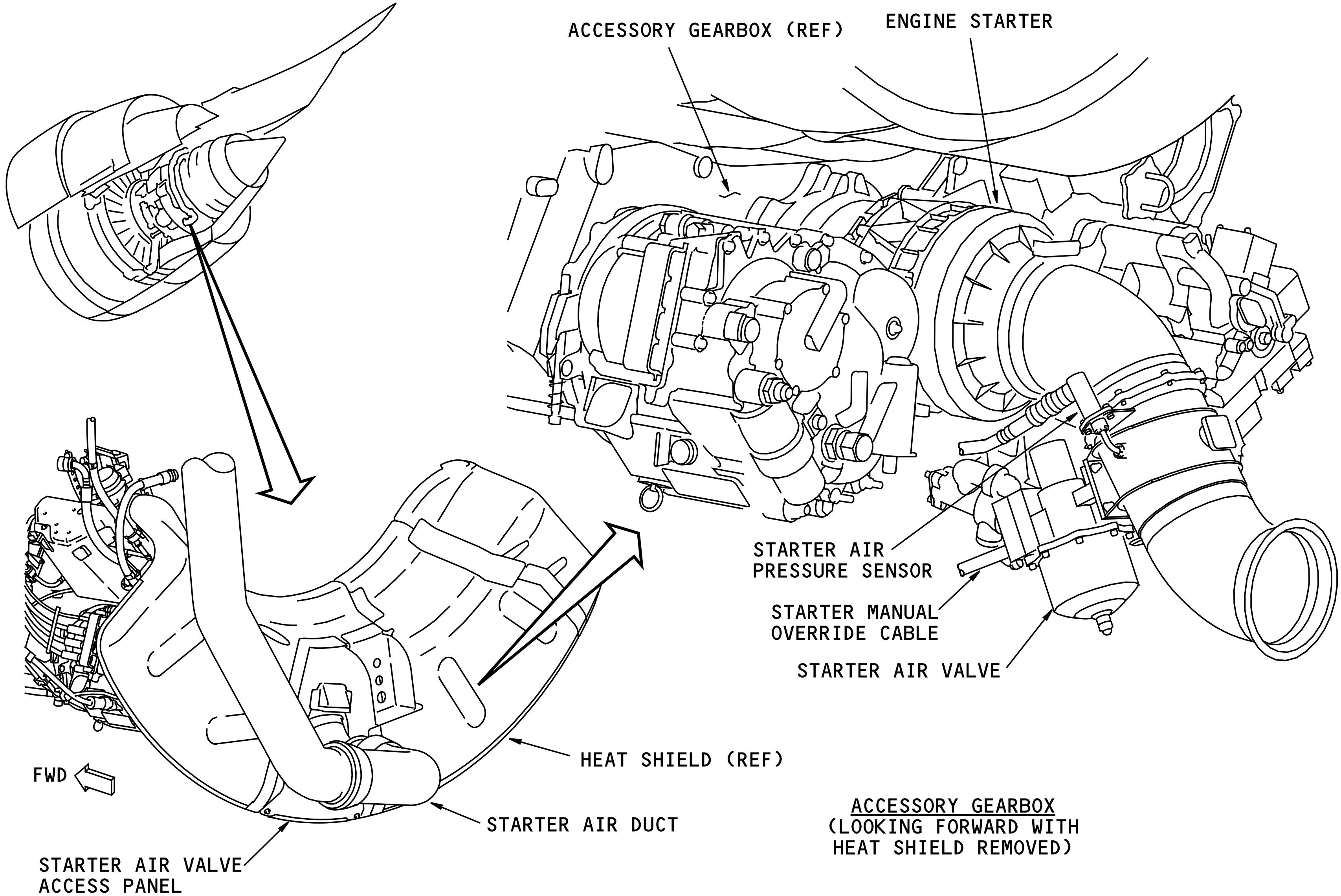
You open the fan cowls and thrust reversers to get access to these engine starting system components:

- Starter air duct
- Starter air valve
- Starter manual override cable
- Starter air pressure sensor
- Engine starter.

All of the engine starting system components are just aft of the accessory gearbox.

Training Information Point

To remove the starter air valve, you must first remove the starter air valve access panel which is part of the heat shield.



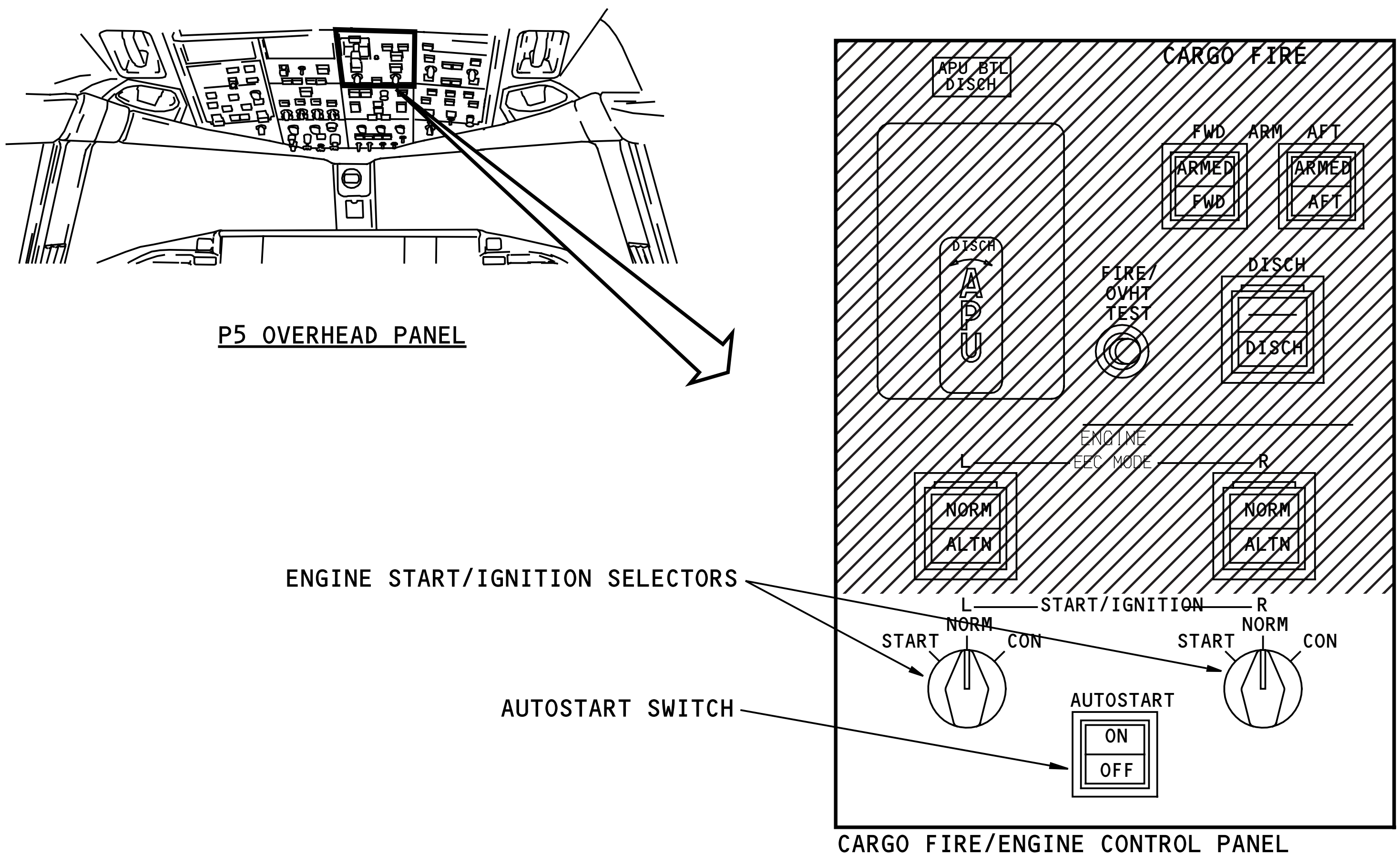
80-00-00-103 Rev 2 02/28/96

ENGINE STARTING - COMPONENT LOCATIONS - ENGINE

ENGINE STARTING - COMPONENT LOCATIONS - FLIGHT DECK

Engine Start Controls

The engine start/ignition selectors and the autostart switch are on the cargo fire/engine control panel on the P5 overhead panel.



ENGINE STARTING - COMPONENT LOCATIONS - FLIGHT DECK

ENGINE STARTING - STARTER AIR VALVE - MANUAL OVERRIDE

General

If the starter air valve (SAV) does not open automatically, you can manually open the valve.

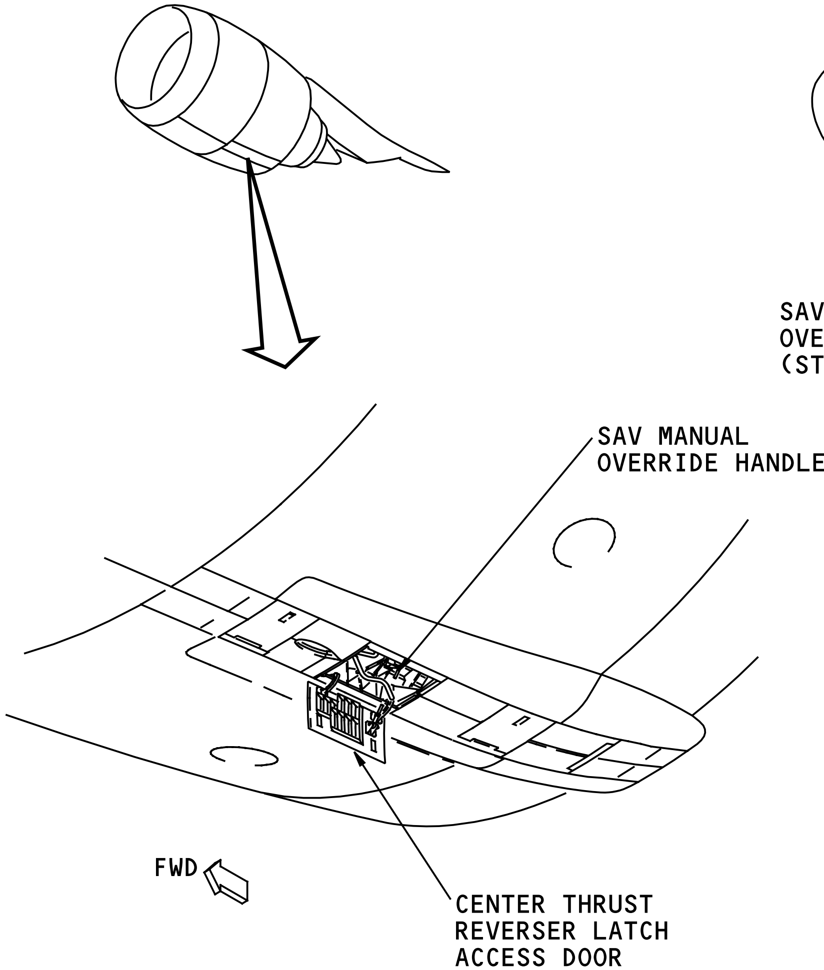
Location

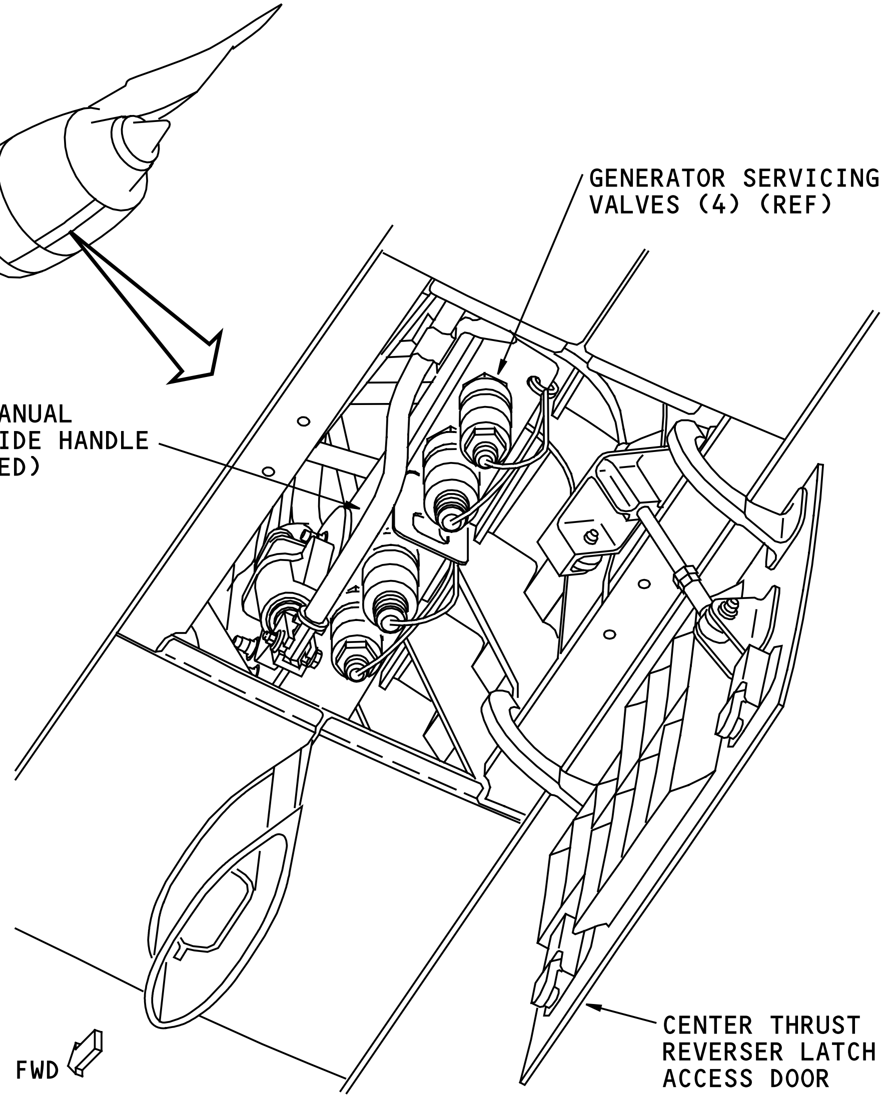
You open the center thrust reverser latch access door to get access to the starter air valve manual override handle. The handle folds down and extends out through the access opening.

Operation

Rotate the handle down, then push the handle up to engage it with the manual override flex cable. Turn the handle to open the valve (counter-clockwise as seen looking up at the bottom of the engine). The valve has a spring that closes it, so you must hold the handle to keep the valve open. When you release the handle, the valve closes.

CAUTION: MAKE SURE THERE IS AIR PRESSURE IN THE STARTER AIR DUCT. IF YOU DO NOT HAVE AIR PRESSURE, DAMAGE TO THE STARTER AIR VALVE CAN OCCUR.





80-00-00-106 Rev 3 11/25/1996

ENGINE STARTING - STARTER AIR VALVE - MANUAL OVERRIDE

ENGINE STARTING - ENGINE STARTER

Purpose

The engine starter turns the accessory gearbox for starting or motoring the engine. The accessory gearbox turns the high pressure compressor (N2) shaft.

Physical Description

The engine starter is a single stage, axial flow, turbine air motor. It attaches to the aft face of the accessory gearbox with a v-band clamp.

The starter has an oil sight glass and an oil fill and drain plug on the bottom. The plug has a magnetic chip detector for oil inspection. You remove the oil fill and drain plug by hand (push and turn). A check valve in the fill and drain port prevents oil from coming out.

Functional Description

Pneumatic power from the starter air duct turns the turbine air motor. The turbine air exhaust then goes out through the exhaust deflector baffles.

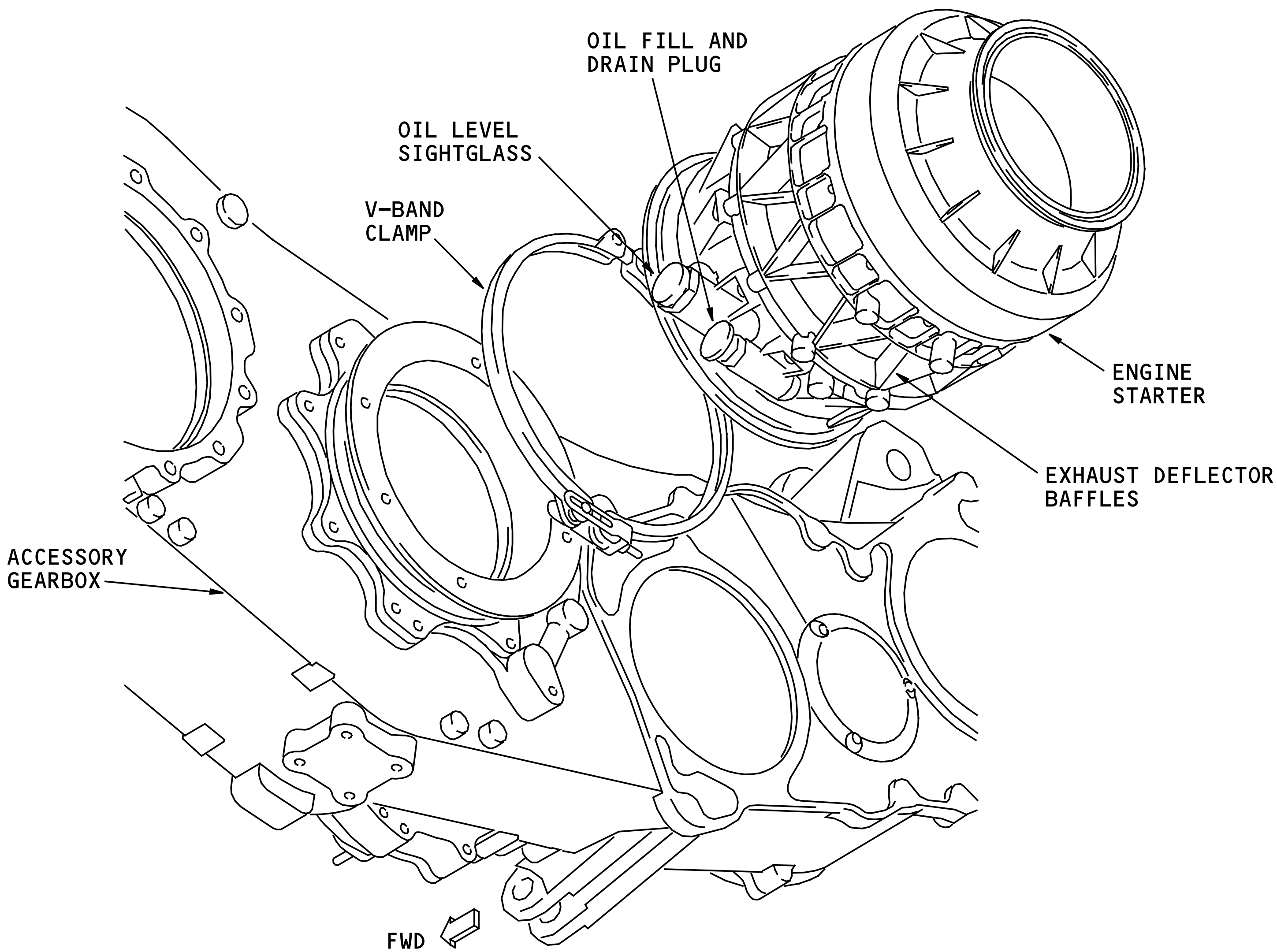
The starter uses reduction gears and a clutch mechanism to turn the output shaft. The clutch mechanism has a primary and a secondary clutch that prevent crash engagements.

Training Information Point

The engine starter uses engine oil for lubrication and cooling.

When you install a new starter, you must fill it with oil. After that, it is not necessary to add oil to the starter because it is automatically kept full with oil from the engine oil system.

You use a tool in the oil fill and drain plug port to drain and fill the starter. Do not use the oil level sightglass to get the correct oil level.



80-00-00-107 Rev 3 02/28/96

ENGINE STARTING - ENGINE STARTER

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ENGINE STARTING - FUNCTIONAL DESCRIPTION

General

You control the engine starting system with the autostart switch and the start/ignition selector. The EEC automatically controls the starter air valve (SAV).

Autostart Switch

The position of the autostart switch goes to the EEC digitally. When the switch is in the ON position, it arms the EEC to do an autostart operation.

Start/Ignition Selector

When you put the start/ignition selector in the START position, it sends signals to these systems and components:

- ELMS
- ASCPC
- EEC
- AIMS.

ELMS Power

The ELMS supplies 28v dc power from the captain's flight instrument bus to energize the engine start control relay. This lets 28v dc power go through the EEC to energize the SAV solenoid.

ASCPC

The ASCPC uses the start signal to control the pressure regulating and shutoff valve (PRSOV) and the isolation valves in the pneumatic system. During an engine start, the ASCPC closes the related PRSOV and opens the applicable isolation valve(s). See the engine air supply section for more information about the ASCPC (AMM PART I 36-11).

EEC

The EEC gets an analog start signal directly from the start/ignition selector. It also gets a digital start signal through the EDIU. These signals tell the EEC that there is a command to open the SAV.

When you put the start/ignition selector in the START position, 28v dc power goes through the EEC to energize the SAV solenoid.

The SAV logic in the EEC removes the 28v dc power from the SAV solenoid at the starter cutout speed (approximately 64 percent N2). This causes the SAV to close.

The SAV logic does not let 28v dc power energize the SAV solenoid if the N2 is more than the maximum starter engagement limit.

When the start/ignition selector moves to the NORM position, the engine start control relay de-energizes. This removes 28v dc power to the EEC.

ENGINE STARTING - FUNCTIONAL DESCRIPTION

Both channel A and channel B of the EEC get a signal of the duct pressure downstream of the SAV. The EEC uses these signals to find the SAV position.

AIMS

The AIMS controls the latching solenoid that keeps the start/ignition selector in the START position. The solenoid cannot move the selector. It only holds it in the momentary START position.

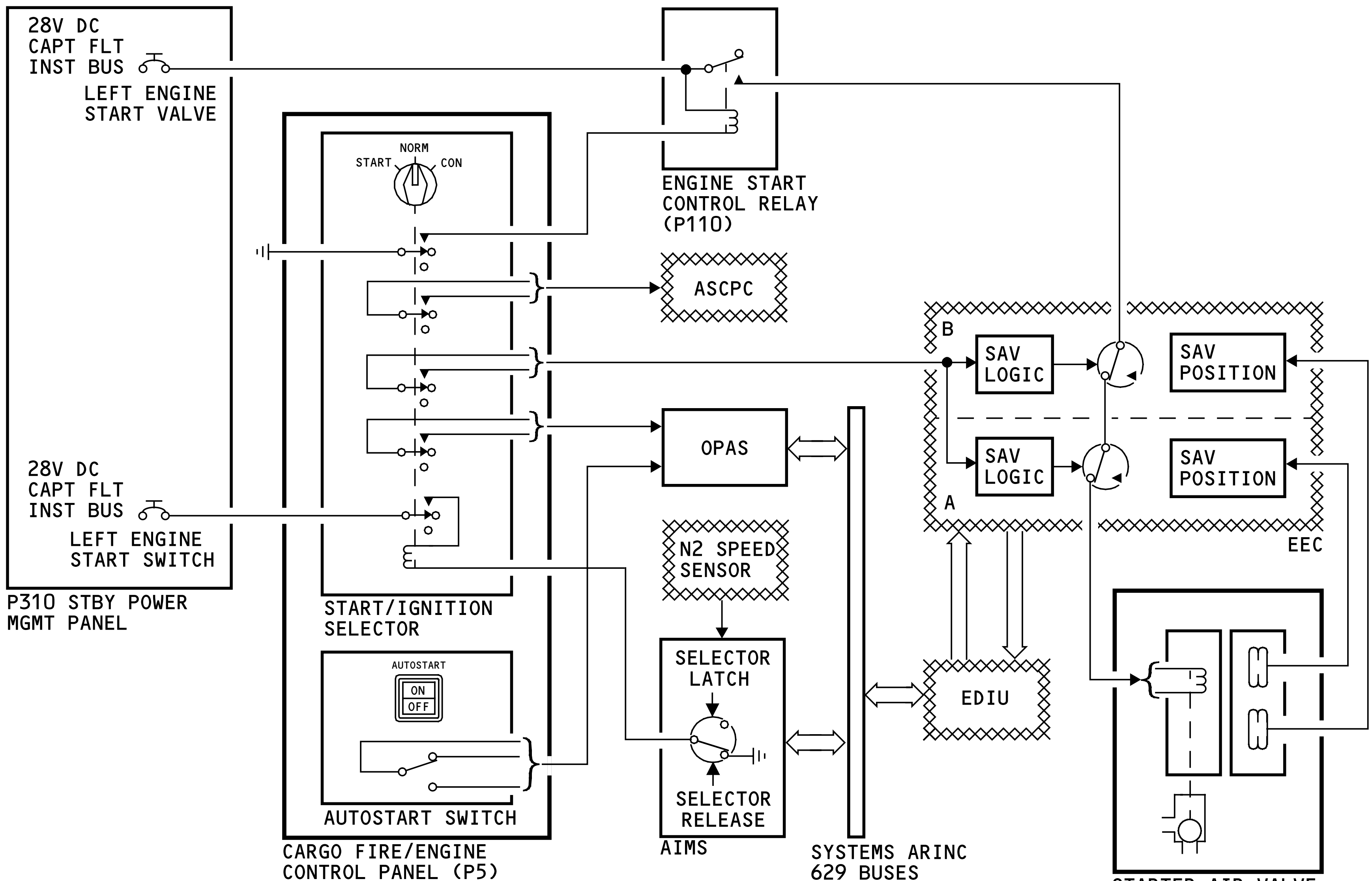
The EEC sends a digital engine start signal to the AIMS. This signal is set true when the engine start begins. When the engine start signal is true, the AIMS latches the selector by energizing the solenoid.

The EEC sets the engine start signal false when any of these conditions occur:

- The EEC aborts an autostart process
- The engine gets to the starter cutout speed (approximately 64 percent N2)

When the engine start signal is false, the AIMS releases the selector by de-energizing the solenoid. The selector automatically moves to the NORM position when the solenoid de-energizes.

If the digital engine start signal is not valid or is not available, the AIMS uses the analog N2 signal from the N2 speed sensor to control the latching solenoid. Less than 60 percent N2, the solenoid energizes. More than 60 percent N2, the solenoid de-energizes.



ENGINE STARTING - FUNCTIONAL DESCRIPTION

80-00-00-108 Rev 4 03/21/96

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Normal Autostart

When you enable an autostart, the EEC automatically starts the engine. You enable an autostart by doing these steps:

- Push the autostart switch to ON
- Turn the start selector to START
- Move the fuel control switch to RUN.

The EEC opens the starter air valve (SAV), which causes N2 to rotate.

At 16 percent N2 the EEC energizes one igniter. At 22 percent N2 the EEC opens the shutoff valve in the HMU to let fuel flow to the engine.

When the engine speed reaches approximately 56 percent N2, the EEC de-energizes the igniter. At approximately 64 percent N2, the EEC closes the SAV.

At idle, the EEC sets the AIMS engine start signal to false. This causes the AIMS to de-energize the start/ ignition selector latching solenoid. The selector returns to the NORM position.

Abnormal Autostart

If the EEC finds a problem during an autostart try, it will do another autostart try. The EEC can do three autostart tries.

Before the EEC does a second or third autostart try, it motors the engine to cool it and remove any fuel.

If an autostart problem occurs after the SAV closes, the EEC waits until the engine speed gets to the maximum starter re-engagement speed before it re-opens the SAV.

The EEC uses two igniters after the first autostart try.

Manual Start

When you do a manual start, the EEC only controls some of the start sequence. It does not monitor or control starting faults. You enable a manual start by doing these steps:

- Push the autostart switch to OFF
- Turn the start selector to START.

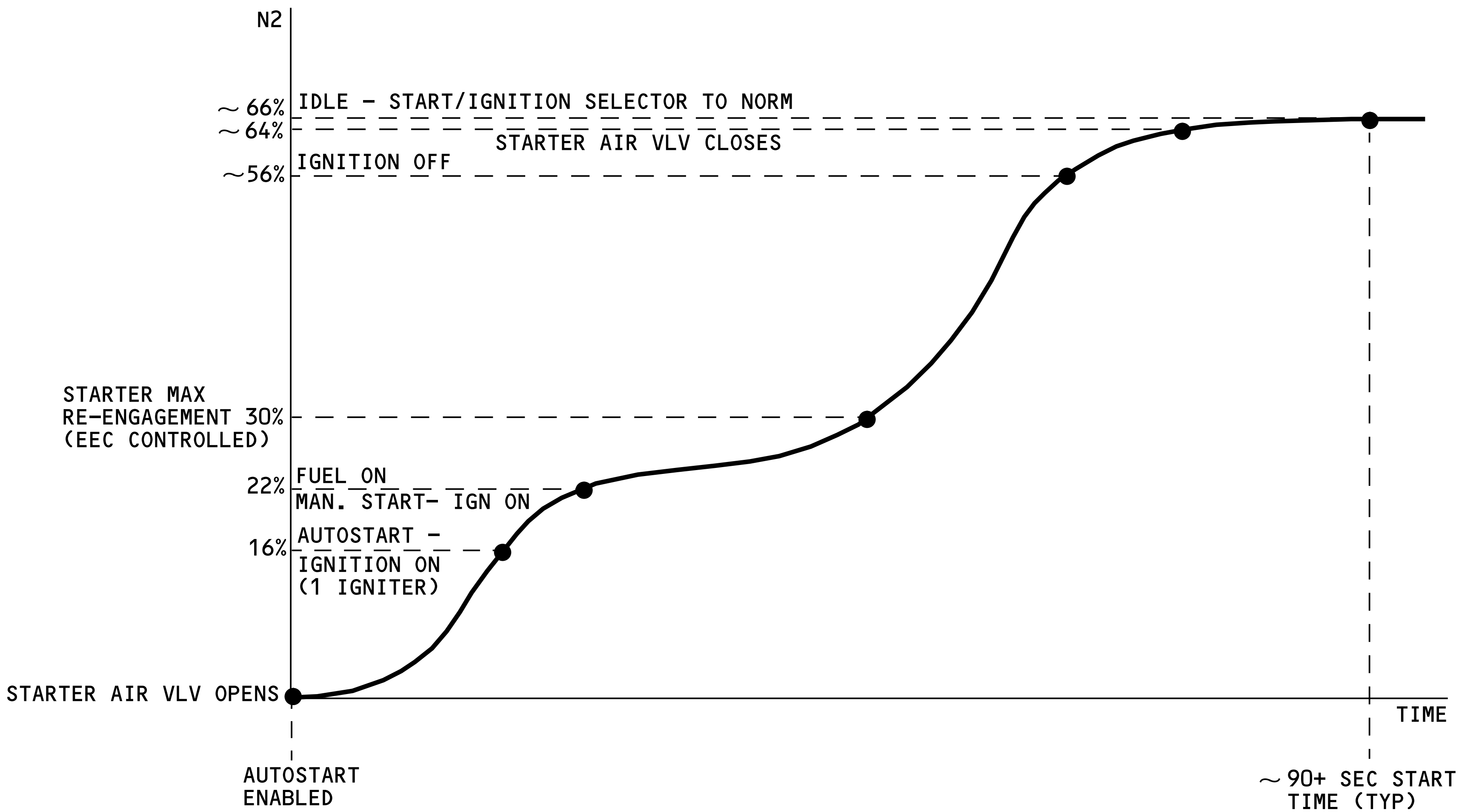
The EEC opens the SAV, which causes N2 to rotate.

At 22 percent N2 or higher, you put the fuel control switch in the RUN position. When the fuel control switch is in the RUN position, the EEC opens the shutoff valve in the HMU and energizes one igniter.

When the engine speed reaches approximately 56 percent N2, the EEC de-energizes the igniter. At approximately 64 percent N2, the EEC closes the SAV.

ENGINE STARTING - FUNCTIONAL DESCRIPTION - START PROFILE

At idle, the EEC sets the AIMS engine start signal to false. This causes the AIMS to de-energize the start/ignition selector latching solenoid. The selector goes back to the NORM position.



80-00-00-110 Rev 0 03/21/96

ENGINE STARTING - FUNCTIONAL DESCRIPTION - START PROFILE

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ENGINE STARTING - OPERATION

General

The engine starting system has these modes of operation:

- Autostart
- Manual start.

These are the flight deck controls you use for an engine start operation:

- Start/ignition selectors
- Autostart switch
- Fuel control switches.

It is important to monitor the engine parameters to find or prevent these fault conditions:

- Low starter air pressure
- No light-up
- Locked rotor(s)
- Hung start
- Hot start
- Starter shaft breakage
- Starter duty cycle exceedance.

Autostart Operation

This is a brief summary of the autostart operation procedure:

- Put the autostart switch in ON
- Put the engine start/ignition selector in START
- Put the fuel control switch in RUN.

The EEC automatically controls and monitors the autostart operation. It will stop the operation for a fault condition. If the autostart try fails, the EEC automatically does another start operation.

On the ground, the EEC permits only three tries to start the engine. If the third try fails, then the autostart operation stops.

The start/ignition selector moves to the NORM position when one of these conditions occur:

- The N2 speed gets to approximately 66 percent
- The EEC stops the autostart operation.

In the air, the autostart operation continues until the engine starts or you move the start/ignition selector to NORM.

Manual Start Operation

This is a brief summary of the manual start operation procedures:

- Put the autostart switch in OFF
- Put the engine start/ignition selector in START
- Monitor the engine parameters for the correct indications
- Put the fuel control switch in RUN at 22 percent N2.

ENGINE STARTING - OPERATION

You must monitor the manual start operation and stop the operation for a fault condition.

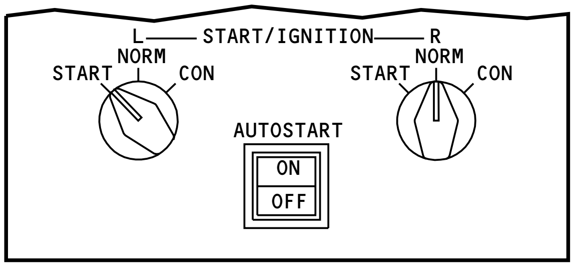
Starter Cutout

The EEC closes the starter air valve when the engine gets to approximately 64 percent N2. The valve position is shown on the air synoptic display.

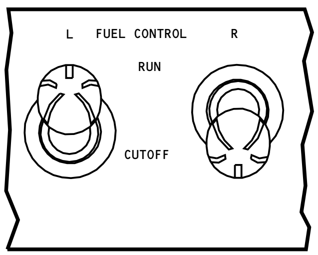
Training Information Point

The EEC does not use oil pressure as a input to find a starting fault.

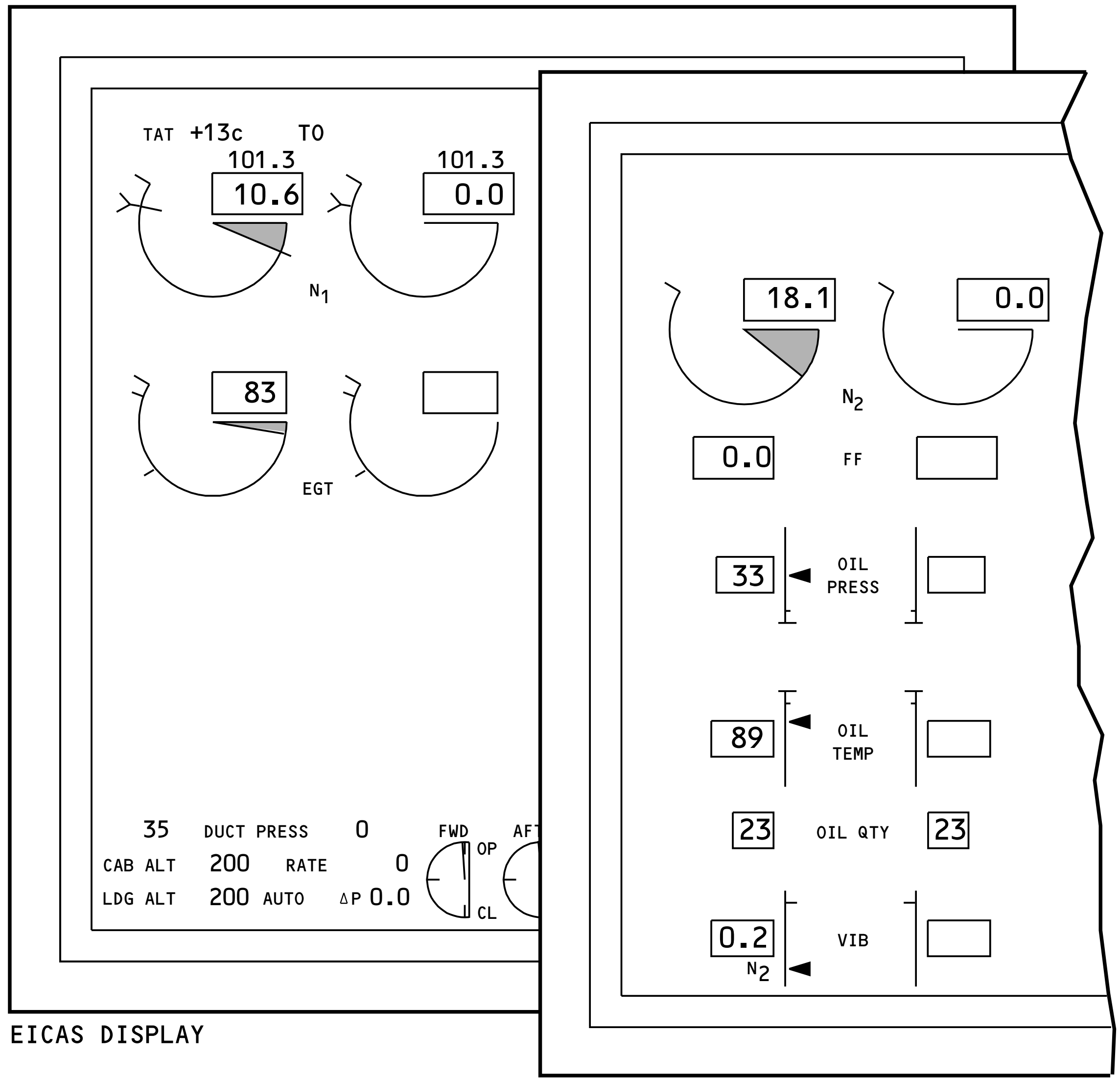
For a manual start, if the fuel control switch is put into the RUN position below 18 percent N2, the advisory message ENG AUTOSTART shows to tell you the start procedure is incorrect.



ENGINE START PANEL (P5)



FUEL CONTROL SWITCHES (P10)



EICAS DISPLAY

SECONDARY ENGINE DISPLAY

ENGINE STARTING - OPERATION

Continental Airlines, Inc

Engine Ignition

WB371

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IGNITION - INTRODUCTION

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IGNITION - INTRODUCTION

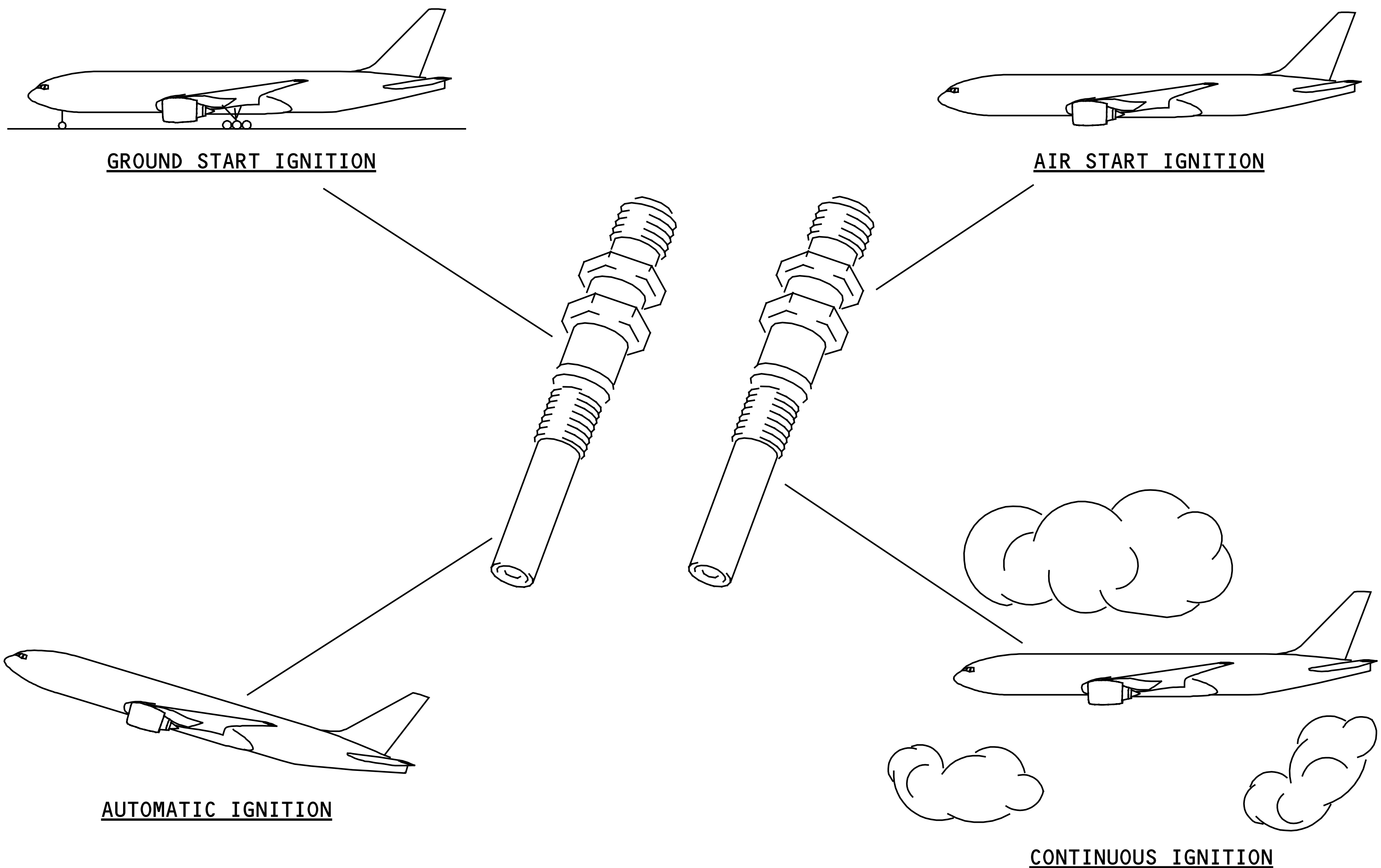
Purpose

Each engine has two ignition systems that operate independently. They supply electrical sparks in the combustion chamber to start combustion or make sure combustion continues.

The ignition system has automatic and manual operation modes on the ground and in flight.

Abbreviations and Acronyms

ACIPS	- airfoil and cowl ice protection system
AIMS	- airplane information management system
CON	- continuous
EAI	- engine anti-ice
EDIU	- engine data interface unit
EEC	- electronic engine control
ELMS	- electrical load management system
FSEU	- flap slat electronics unit
HPC	- high pressure compressor
NORM	- normal
OPAS	- overhead panel ARINC 629 system



IGNITION - INTRODUCTION

IGNITION - GENERAL DESCRIPTION

General

The ignition system for each engine contains these components:

- Ignition exciter (2)
- Ignition lead (2)
- Igniter (2).

These components control the operation of the ignition system:

- Start/ignition selector
- Fuel control switch
- EEC
- Airfoil and cowl ice protection system (ACIPS)
- Flap slat electronics unit (FSEU).

Power

The ignition system gets 115v ac power from the electrical load management system (ELMS). The fuel control switch must be in the RUN position to let the ELMS supply ignition power to the EEC. The EEC controls the power to the ignition exciters.

Autostart or Manual Start Ignition

For the first automatic or manual engine start on the ground, the EEC supplies power to one ignition exciter only. During the second attempt, the EEC selects the other ignition system. If a third attempt is necessary, the EEC selects both ignition systems.

When an autostart occurs, the EEC supplies ignition power at 16 percent N2. For a manual start, the EEC supplies power when the fuel control switch is put in the RUN position.

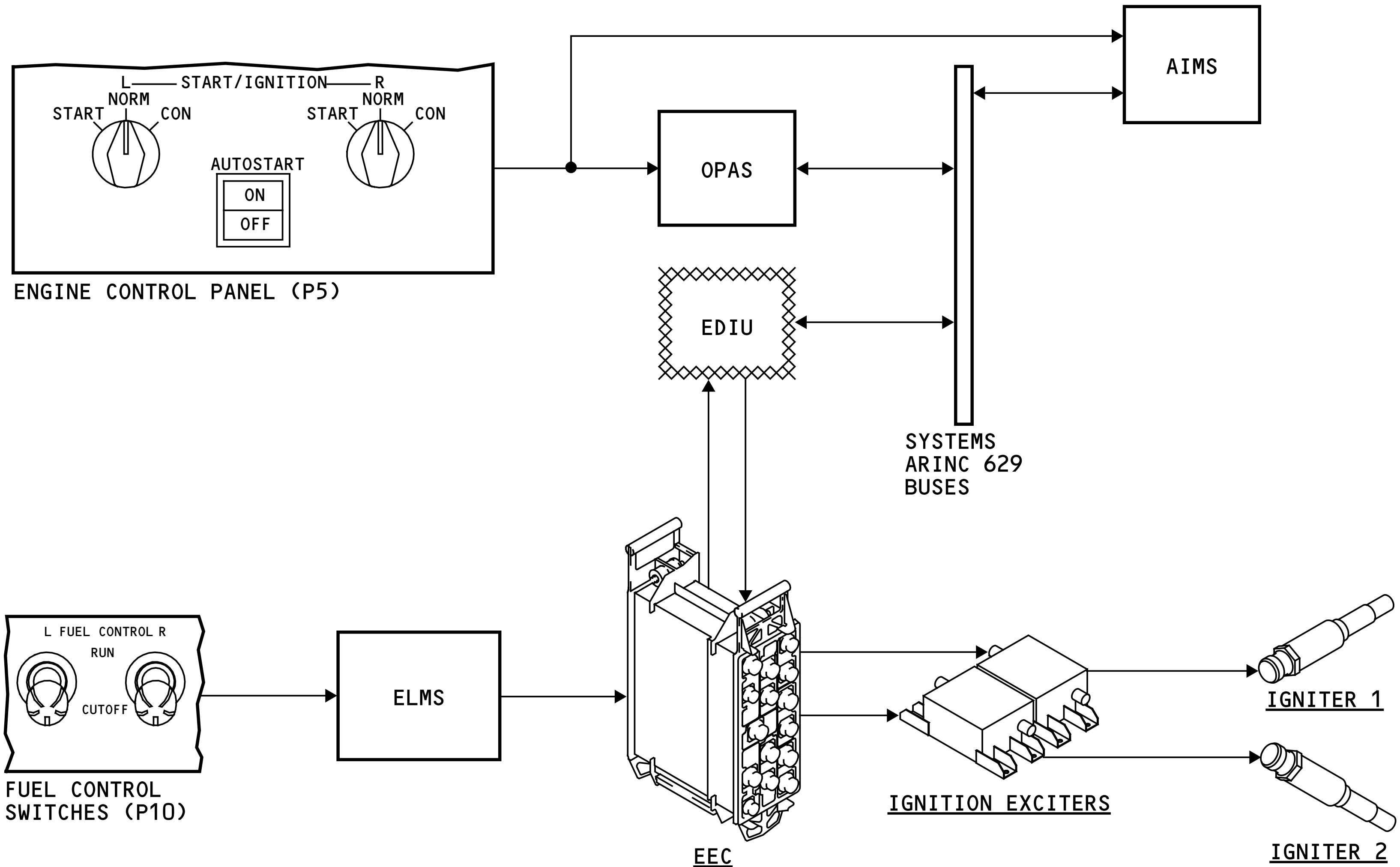
During a ground or in-flight engine start, the EEC removes power to the ignition system at approximately 56 percent N2. The start/ignition selector moves to the NORM position just before the engine gets to idle speed.

Automatic Ignition

When the start/ignition selector is in the NORM position, the EEC controls the two ignition exciters.

Continuous Ignition

When the start/ignition selector is in the CON position, the EEC controls the power to the exciters. The ignitors will fire when the EEC finds it is nesessary.



IGNITION - GENERAL DESCRIPTION

IGNITION - ENGINE COMPONENT LOCATIONS

General

The ignition system components are on the left side of the engine. You open the left thrust reverser half to get access to these components:

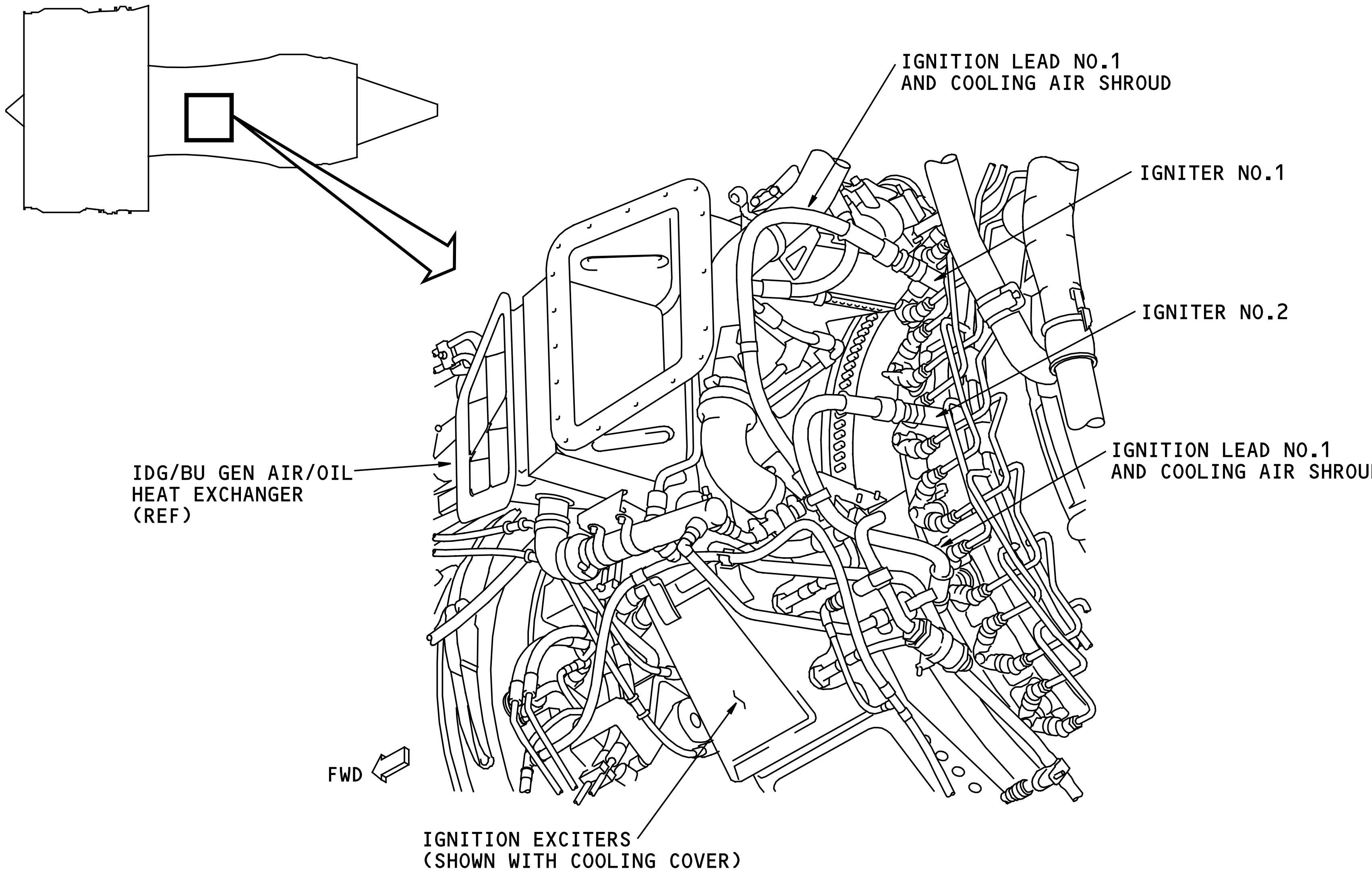
- Ignition exciter (2)
- Ignition lead (2)
- Igniter (2).

The two ignition exciters are on the left side of the high pressure compressor (HPC), above the accessory gearbox.

The upper ignition lead goes to the upper igniter at the 9:30 position. The lower ignition lead goes to the lower igniter at the 8:00 position.

Training Information Point

WARNING: MAKE SURE THAT THE IGNITION SYSTEM DOES NOT OPERATE FOR FIVE MINUTES BEFORE YOU REMOVE THE COMPONENT. IGNITION VOLTAGE IS DANGEROUSLY HIGH AND CAN CAUSE INJURY TO PERSONS.



74-00-00-104 Rev 2 06/17/96

IGNITION - ENGINE COMPONENT LOCATIONS

IGNITION - IGNITION EXCITER

General

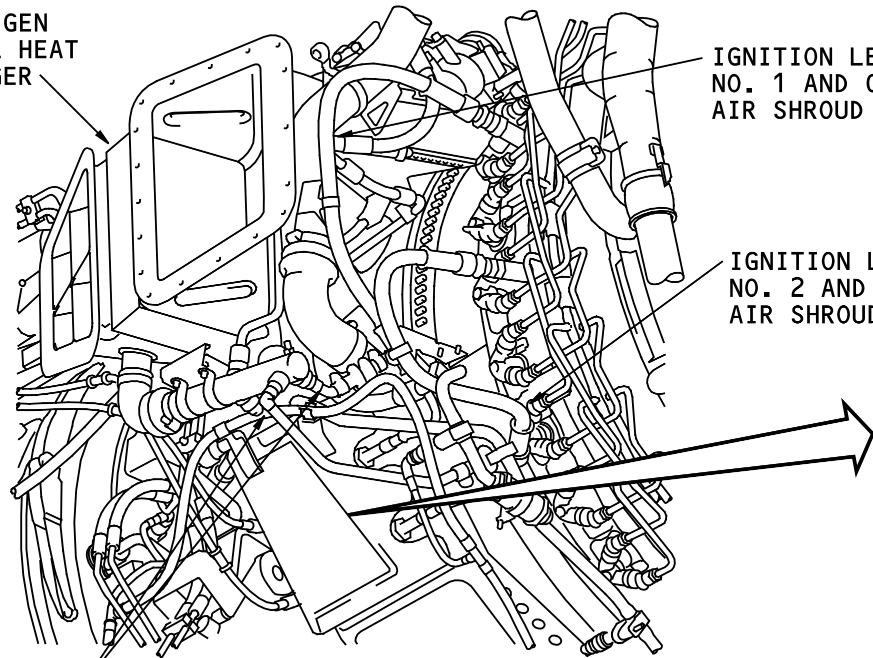
The ignition exciter changes 115v ac input power to pulsing high voltage output power. The high voltage power operates the igniter.

The exciter is a sealed unit. The input lead connects to the front of the exciter. It supplies 115v ac power to the exciter. The output lead connects to the rear of the exciter. It supplies high voltage pulses to the igniter.

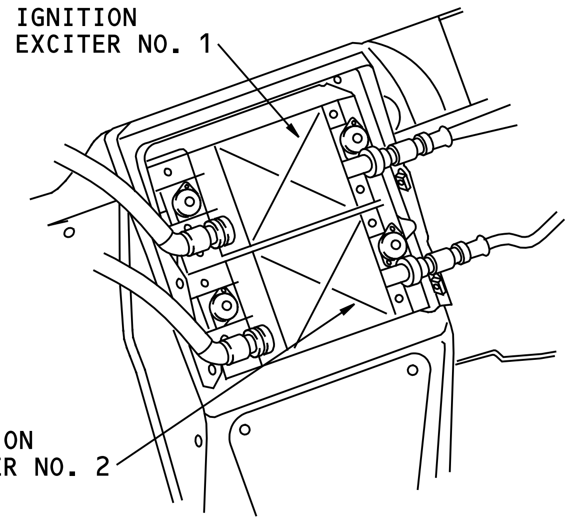
Fan air cools the ignition exciters, leads and igniters.

Functional Description

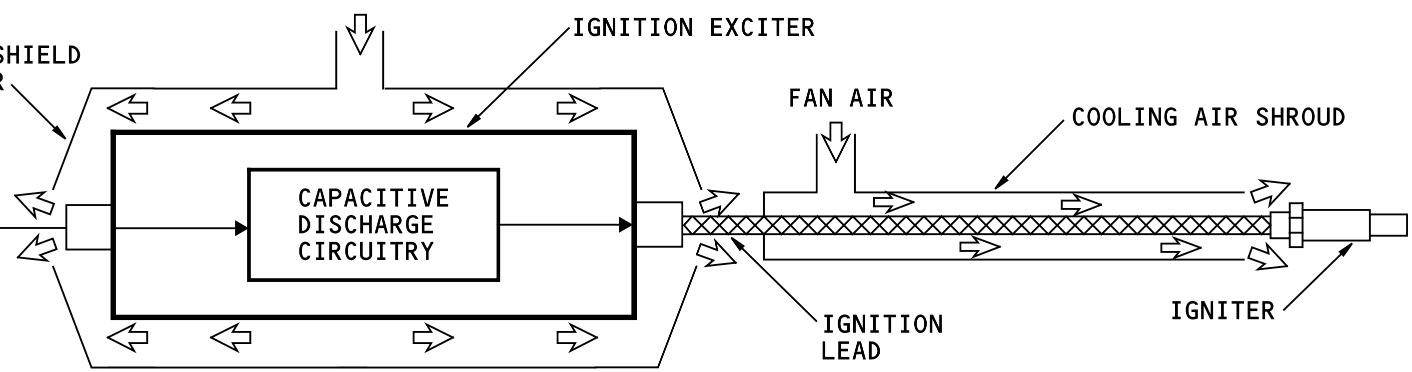
The exciter uses capacitive discharge to make high voltage output pulses. The output pulses go through the ignition lead to the igniter tip.



ENGINE HPC - LEFT SIDE



IGNITION EXCITERS
(HEATSHIELD COVER REMOVED)



IGNITION - IGNITION EXCITER

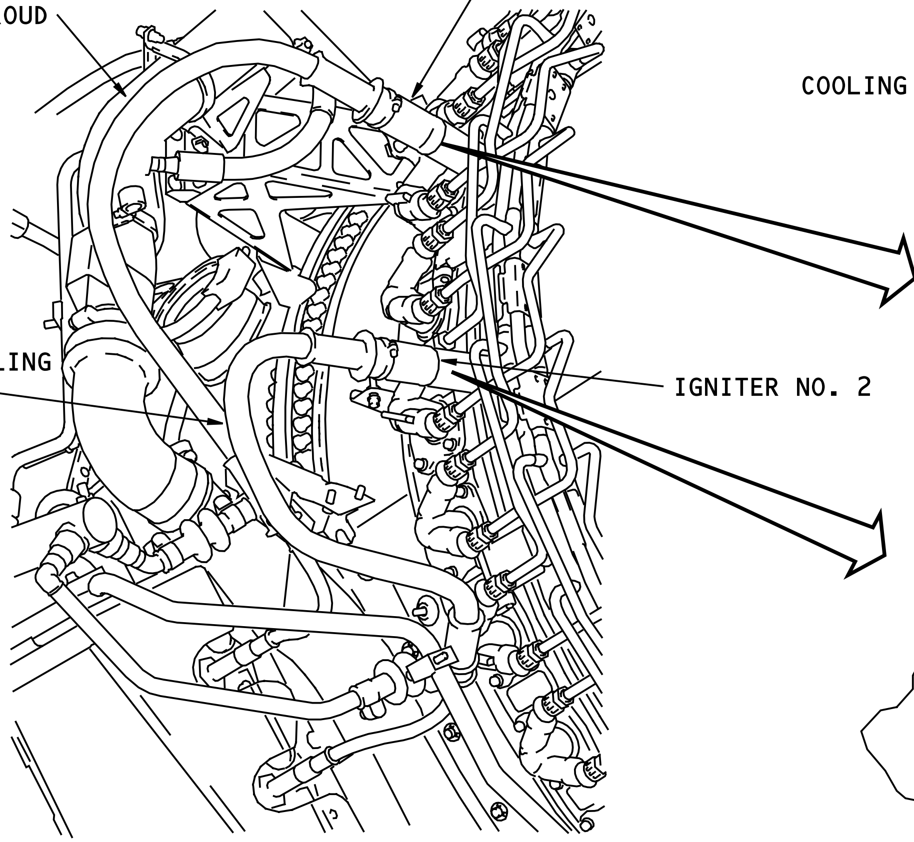
IGNITION - IGNITERS

General

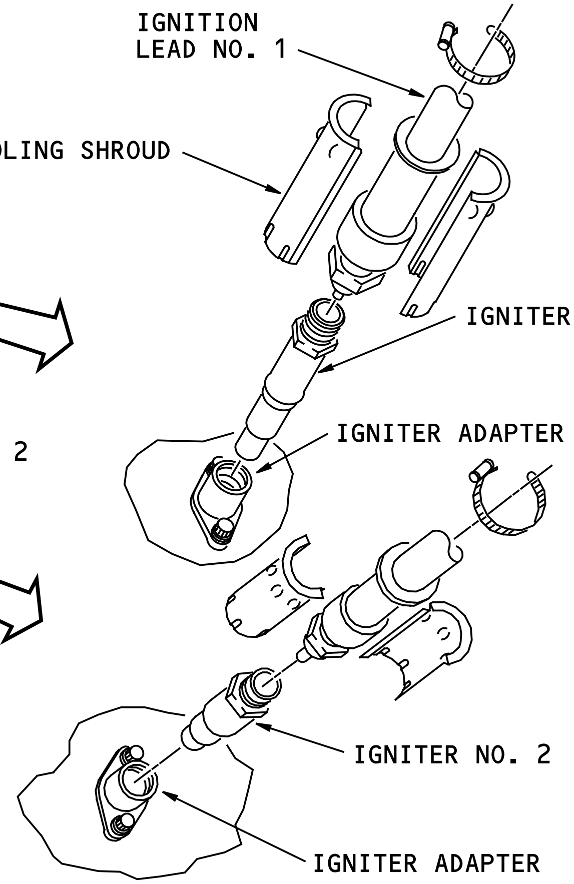
The igniters fit into threaded adapters on the combustor/diffuser assembly. The fan air that cools the ignition lead goes out through the cooling shroud. This keeps the igniter cool.

Training Information Point

To remove an igniter, you must disconnect the cooling shroud halves and the ignition lead. Do not remove the igniter adapter.



ENGINE HPC - LEFT SIDE



IGNITER PLUG INSTALLATION

74-00-00-106 Rev 1

IGNITION - IGNITERS

IGNITION - FUNCTION DESCRIPTION

General

The EEC uses 28v dc and 115v ac to control and supply power to the ignition system.

Power Sources

The normal supply of power to energize the ignition exciters is 115v ac from the left and right main ac buses. The 115v ac standby bus is the alternate power supply to energize the ignition units.

Relays in the P110 left power management panel automatically select the supply for the ignition units.

Control

When the fuel control switch is in the RUN position, the ignition/fire detection relay and the generator control/ignition relay send power to the EEC.

The EEC uses airplane and engine conditions to control power to the ignition exciters. Each channel of the EEC can control power to one or two ignition exciters. Each ignition exciter can get power through one of two EEC switches. Channel A of the EEC commands one switch and channel B commands the other switch.

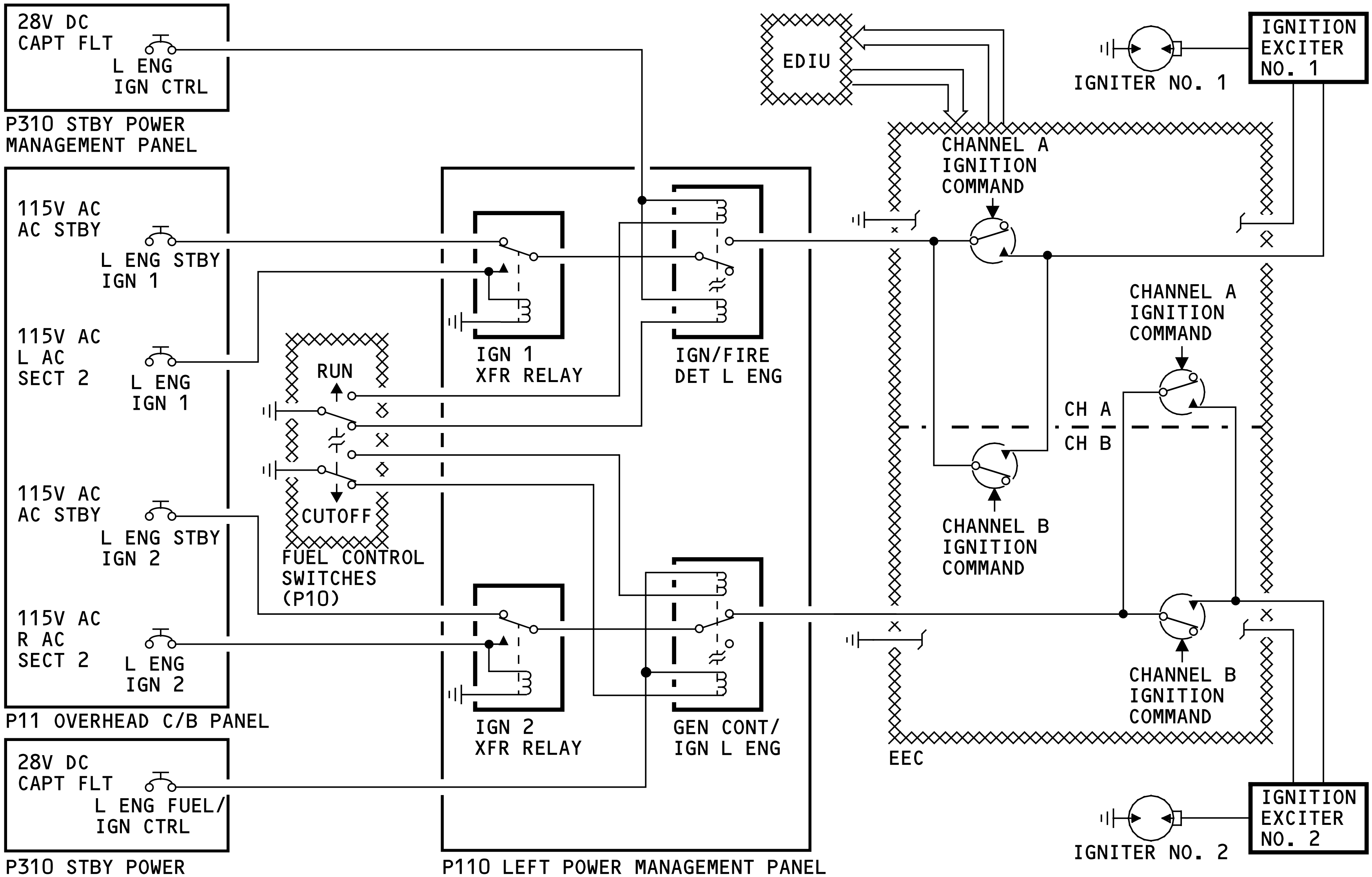
The EEC monitors the position of each switch. A failure of one switch causes the EEC channel in command to operate the switch in the other EEC channel.

For an autostart or a manual start on the ground, the EEC lets only one ignition exciter get power. The choice of the ignition exciter changes for each ground start. If the engine fails to start, the EEC supplies power to the two ignition exciters on the second try.

During a normal in-flight start, the EEC selects the two ignition exciters to get power.

When the start/ignition selector is in the NORM position, the two ignition exciters operate when the engine anti-ice is on, or the flaps are not retracted. The ACIPS supplies the engine anti-ice signal and the FSEU supplies flap position. The EDIU gets the data from the ARINC 629 systems buses and sends it to the EEC. The EEC automatically supplies power to the two ignition exciters.

When the start/ignition selector is in the CON position, the EDIU gets the switch position signal from the ARINC 629 system busses. This signal causes the EEC to operate the two ignition exciters continuously.



IGNITION - FUNCTION DESCRIPTION

74-00-00-107 Rev 2 02/08/1997

IGNITION - OPERATION

General

The EEC controls the operation of the ignition system. The EEC gets the start/ignition selector position to set these modes of operation for the ignition system:

- Engine start ignition
- Automatic ignition
- Continuous ignition.

The fuel control switch must be in the RUN position for the ignition system to operate.

Engine Start Ignition

When you do an autostart or manual start of the engine, the EEC can use one or two igniters.

On the first ground start (autostart or manual), the EEC uses one igniter. If the engine fails to start, the EEC selects the other ignition system. If the second start attempt fails, the EEC selects both ignition systems during the third attempt.

For all in-flight restarts, the EEC powers both igniter systems.

During an autostart, the EEC operates the ignition system at 16 percent N2. For a manual start, the ignition system operates when you put the fuel control switch in the RUN position.

The EEC removes power to the igniter(s) at approximatly 56% N2.

Automatic Ignition

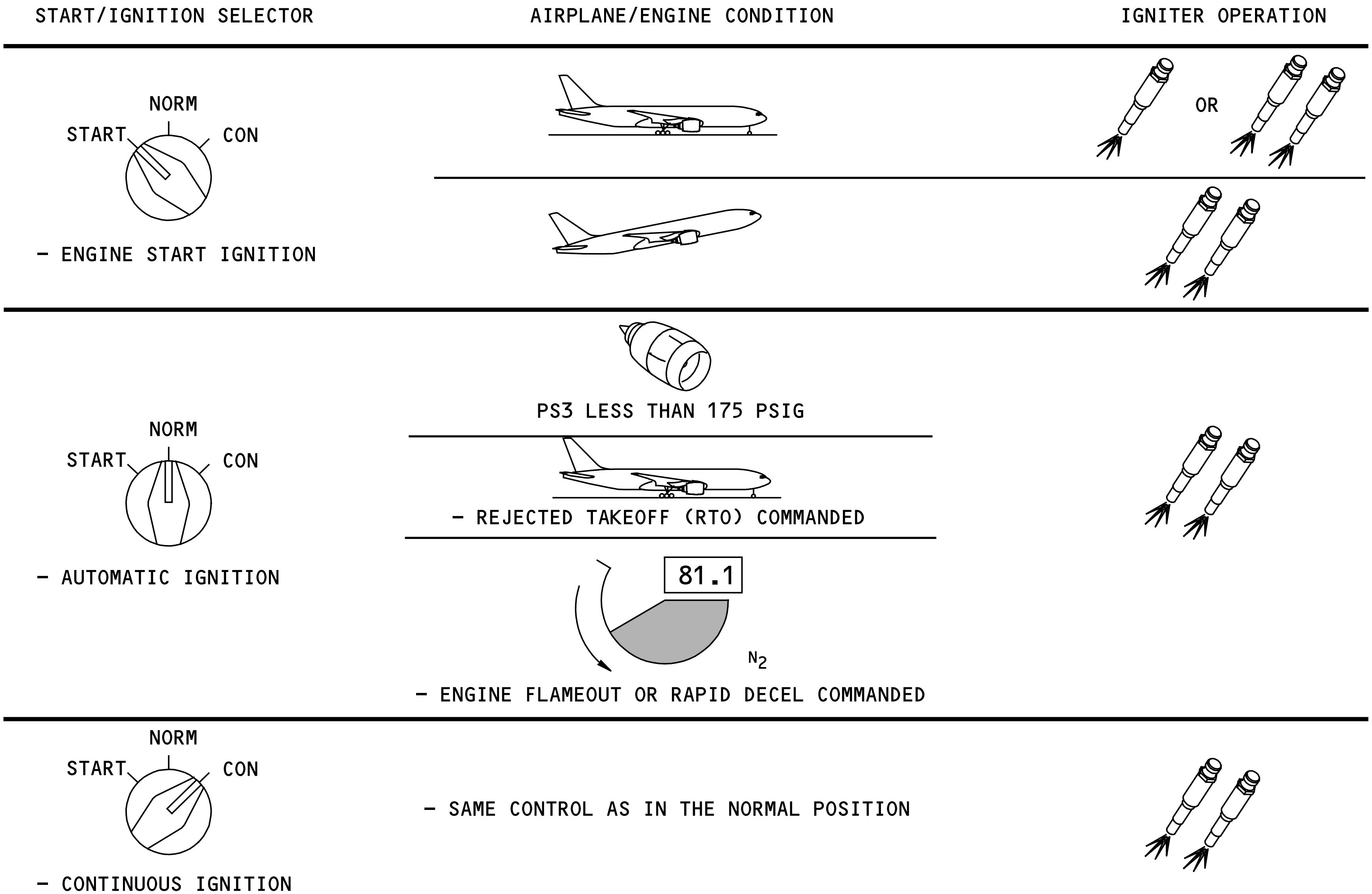
When the start/ignition selector is in the NORM position, the EEC uses the two igniters. The EEC supplies power to the igniters when any of these conditions occur:

- Rejected take off (RTO)
- PS3 is less than 175 psig
- Rapid decel to Idle at altitude
- Engine flameout.

When the engine is shut down, automatic operation of the ignition system stops.

Continuous Ignition

The EEC has full control of the exciter power when you put the start/ignition selector in the CON position. When the engine is shut down, the operation of continuous ignition stops.



IGNITION - OPERATION

Continental Airlines, Inc

Engine Exhaust

WB371

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ENGINE EXHAUST SYSTEM - INTRODUCTION

Purpose

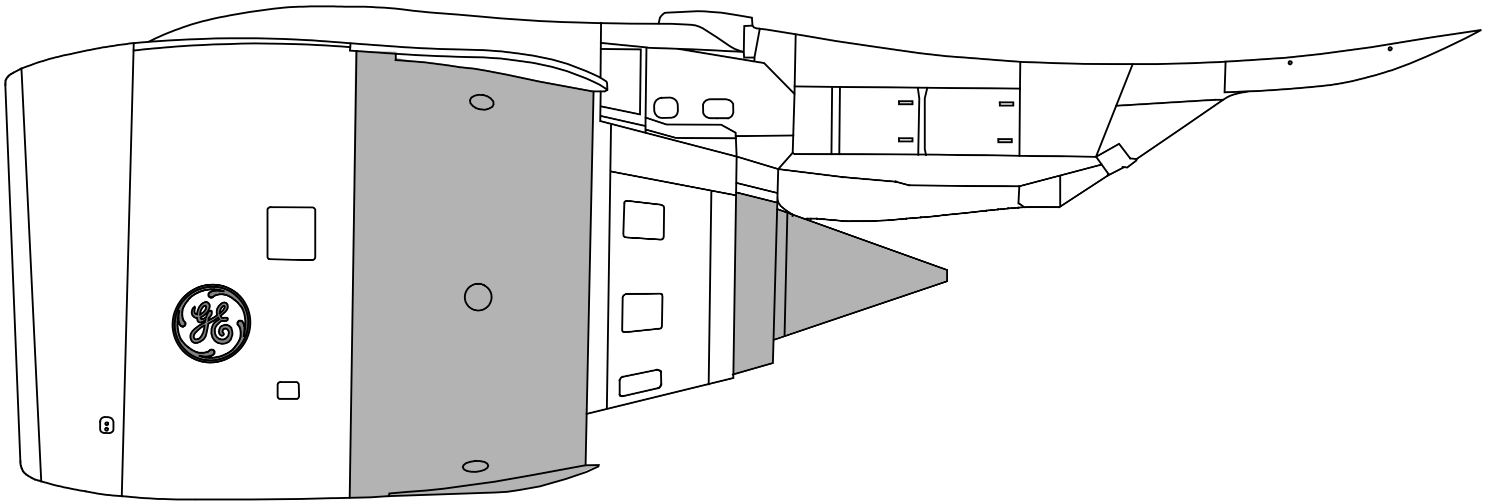
The engine exhaust system controls the direction of the engine exhaust gases.

The engine exhaust system has these subsystems:

- Turbine exhaust
- Thrust reverser (T/R)
- T/R actuation
- T/R indicating and fault detection.

Abbreviations and Acronyms

AIMS	- airplane information management system
DCV	- directional control valve
EDIU	- engine data interface unit
EEC	- electronic engine control
EICAS	- engine indication and crew alerting system
ELMS	- electrical load management system
EPR	- engine pressure ratio
GSE	- ground support equipment
IV	- isolation valve
MAT	- maintenance access terminal
PDOS	- powered door opening system
PSEU	- proximity sensor electronics unit
PSS	- proximity sensor system
rev	- reverse
RTO	- rejected takeoff
RVDT	- rotary variable differential transformer
SL	- sync lock
SLV	- sync lock valve
sync	- synchronizing
TLA	- thrust lever angle
T/R	- thrust reverser
TRA	- thrust resolver angle
TRAS	- thrust reverser actuation system



ENGINE EXHAUST SYSTEM

- TURBINE EXHAUST SYSTEM
- THRUST REVERSER SYSTEM
- THRUST REVERSER ACTUATION SYSTEM
- THRUST REVERSER INDICATING AND FAULT DETECTION SYSTEM

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ENGINE EXHAUST SYSTEM - INTRODUCTION

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ENGINE EXHAUST SYSTEM - GENERAL DESCRIPTION

General

The engine exhaust system controls the direction of the fan exhaust and turbine exhaust gases that make forward thrust and reverse thrust.

To make reverse thrust, you use the reverse thrust levers in the flight deck to control the direction of the fan exhaust gases. The pilot uses reverse thrust to help slow the airplane after landing or during a rejected takeoff (RTO).

Turbine Exhaust System

The turbine exhaust system uses the primary sleeve and forward and aft centerbodies to make an exit duct for the turbine exhaust gases. This system makes forward thrust only.

Thrust Reverser (T/R) System

The T/R system uses these components to control the direction of the fan exhaust:

- Sleeves
- Cascade segments
- Blocker doors
- Drag links.

This system makes forward and reverse thrust.

When the sleeves are forward (retracted), the fan exhaust makes forward thrust.

When the sleeves are aft (extended), the blocker doors and cascade segments turn the fan exhaust. This makes reverse thrust.

Thrust Reverser Actuation System (TRAS)

The TRAS moves the T/R sleeves. It uses hydraulic power for operation and electrical power for control.

The TRAS uses solenoids to control hydraulic power with these valves:

- Sync lock valve (SLV)
- Directional control valve (DCV)
- Isolation valve (IV)

Control stand switches energize the sync lock (SL) solenoid valve and the directional control solenoid valve. The sync lock valve supplies hydraulic power to release the sync lock. The DCV controls the direction of the hydraulic flow.

The EEC uses a thrust resolver angle (TRA) and other EEC inputs to control the isolation valve (IV). The IV supplies hydraulic pressure to the actuators.

The hydraulic actuators move the T/R sleeves to the extended or retracted position. The sync shafts keep the movement of the hydraulic actuators together. The sync lock/manual drive unit locks the sync shafts when the sleeves are in the retracted position.

ENGINE EXHAUST SYSTEM - GENERAL DESCRIPTION

The EEC monitors the T/R sleeve position with a rotary variable differential transformer (RVDT) to control the thrust lever interlock actuator and to schedule thrust. The thrust lever interlock actuator prevents the full movement of the reverse thrust lever until the T/R sleeves are in the correct position.

The test enable switch permits the operation of the TRAS for maintenance when the engine is not in operation.

The electrical load management system (ELMS) contains the TRAS relays.

Thrust Reverser Indicating and Fault Detection System

The T/R indicating and fault detection system uses the proximity sensor system and the EEC to monitor the TRAS.

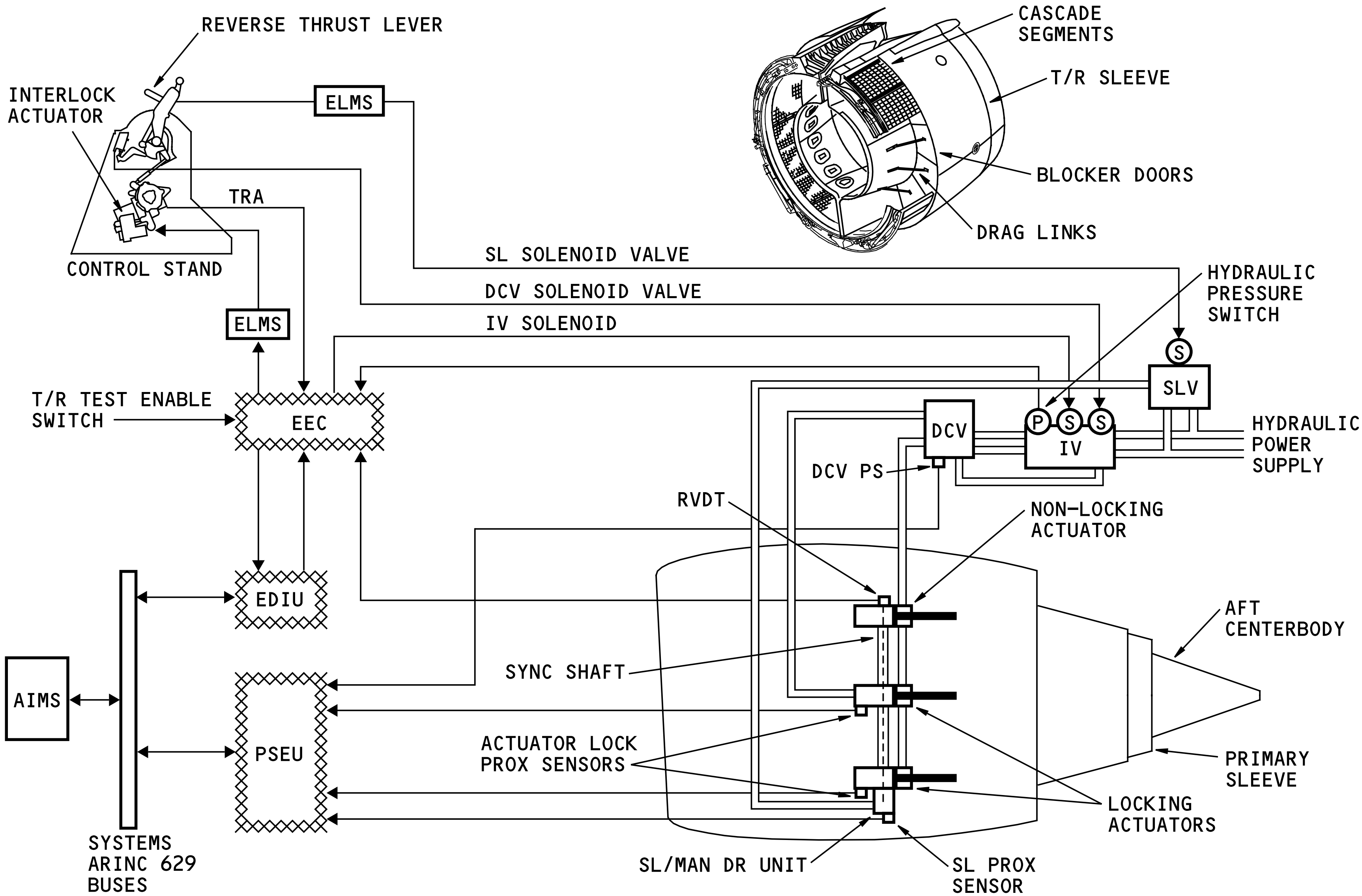
The proximity sensor electronics unit (PSEU) receives position signals from proximity sensors for these components:

- Actuator locks
- Sync locks
- DCV.

The EEC receives position signals from these components:

- RVDTs (T/R sleeve positions)
- Hydraulic pressure switch (on IV).

The EEC sends the positions of the components to the AIMS.

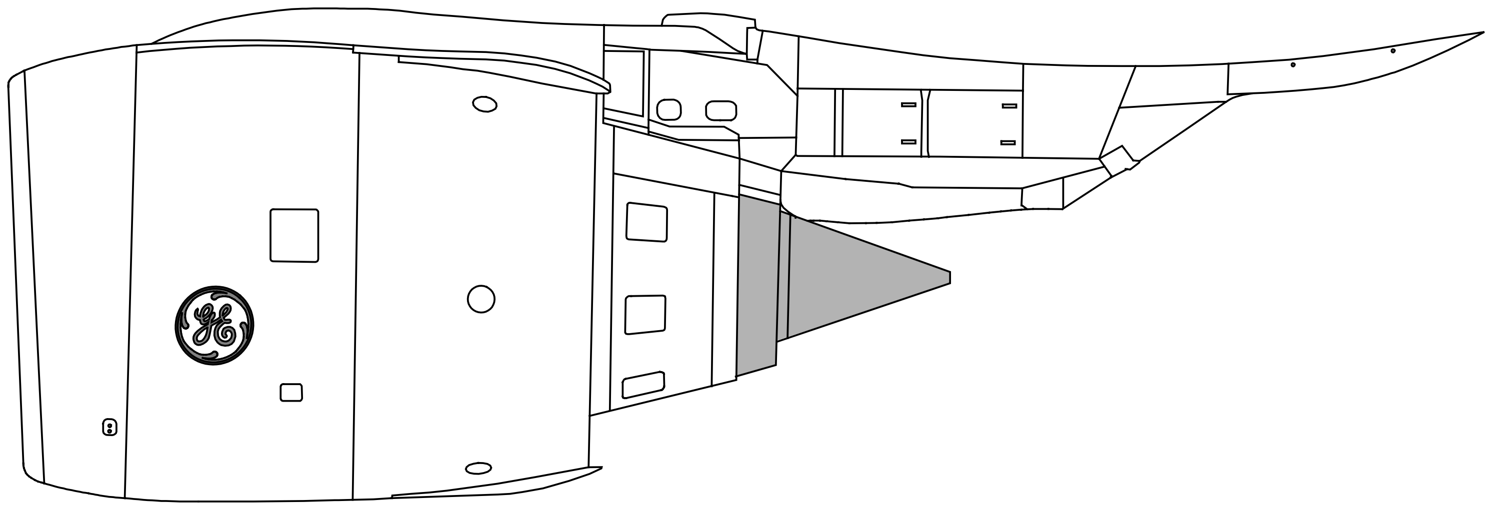


ENGINE EXHAUST SYSTEM - GENERAL DESCRIPTION

TURBINE EXHAUST SYSTEM - INTRODUCTION

Purpose

The turbine exhaust system makes an exit duct for the turbine exhaust.



ENGINE EXHAUST SYSTEM

TURBINE EXHAUST SYSTEM	THRUST REVERSER SYSTEM	THRUST REVERSER ACTUATION SYSTEM	THRUST REVERSER INDICATING AND FAULT DETECTION SYSTEM

78-11-00-101 Rev 0

TURBINE EXHAUST SYSTEM - INTRODUCTION

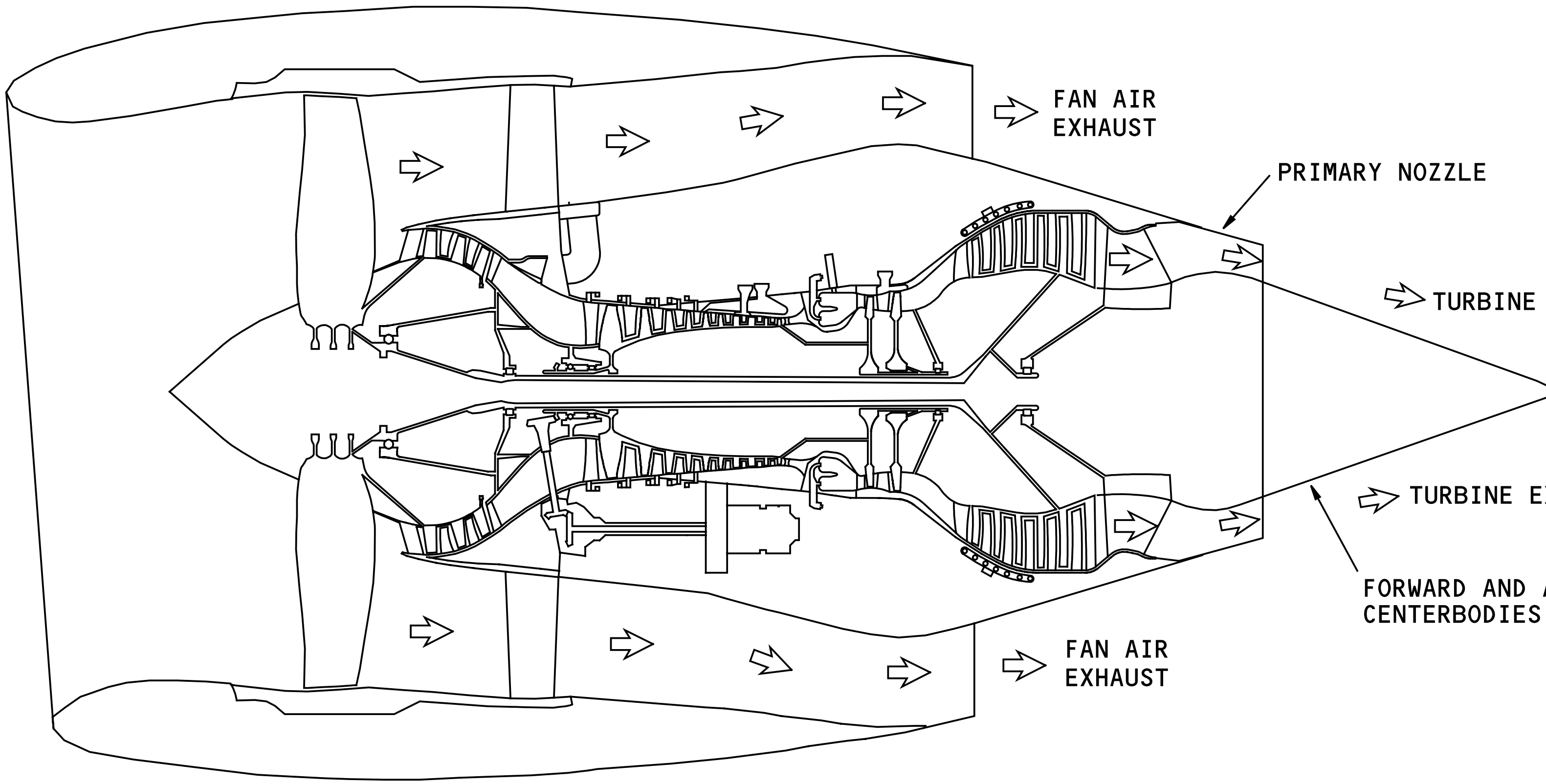
TURBINE EXHAUST SYSTEM - GENERAL DESCRIPTION

General

The turbine exhaust system controls the direction of the turbine exhaust and makes maximum thrust from the exhaust.

Physical Description

The primary nozzle makes the outer contour for the turbine exhaust. The centerbodies make the inner contour for the turbine exhaust.



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TURBINE EXHAUST SYSTEM - GENERAL DESCRIPTION

TURBINE EXHAUST SYSTEM - COMPONENTS

General

These are the turbine exhaust system components:

- Primary nozzle
- Forward centerbody.
- Aft centerbody
- Vent tube extension (not shown).

Primary Nozzle

The primary nozzle makes the outer contour for the turbine exhaust.

The primary nozzle is aft of the thrust reverser. It attaches to the turbine rear frame with 56 bolts.

Forward and Aft Centerbodies

The forward and aft centerbodies make the inner contour of the turbine exhaust.

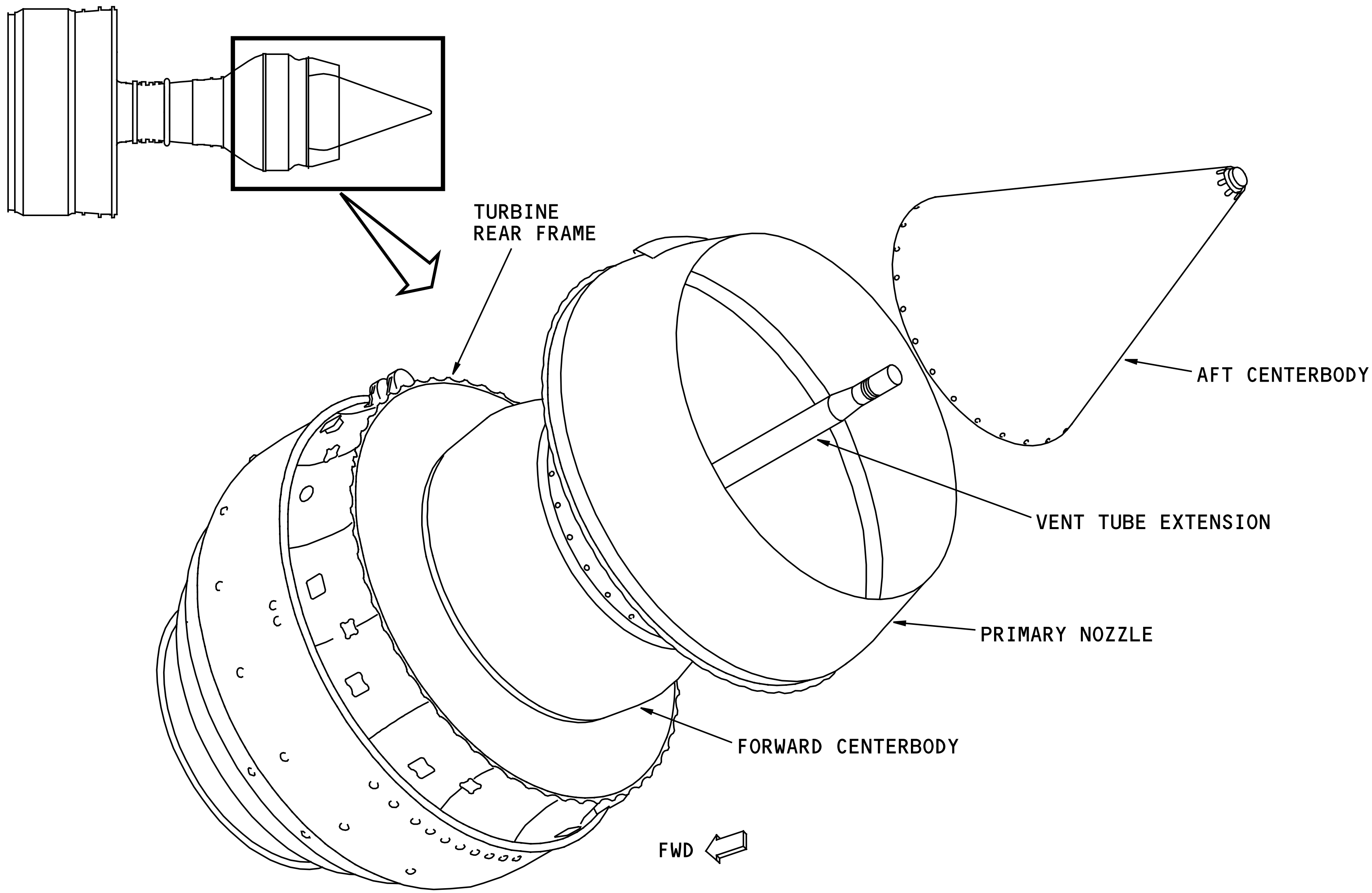
The forward center body is aft of the thrust reverser. It attaches to the turbine rear frame with 28 nuts.

The aft center body attaches to the forward center body with 24 bolts.

Vent Tube Extension

The vent tube extension sends the oil sump vent air overboard.

The vent tube extension attaches to the number 5 bearing sump cover with six bolts.

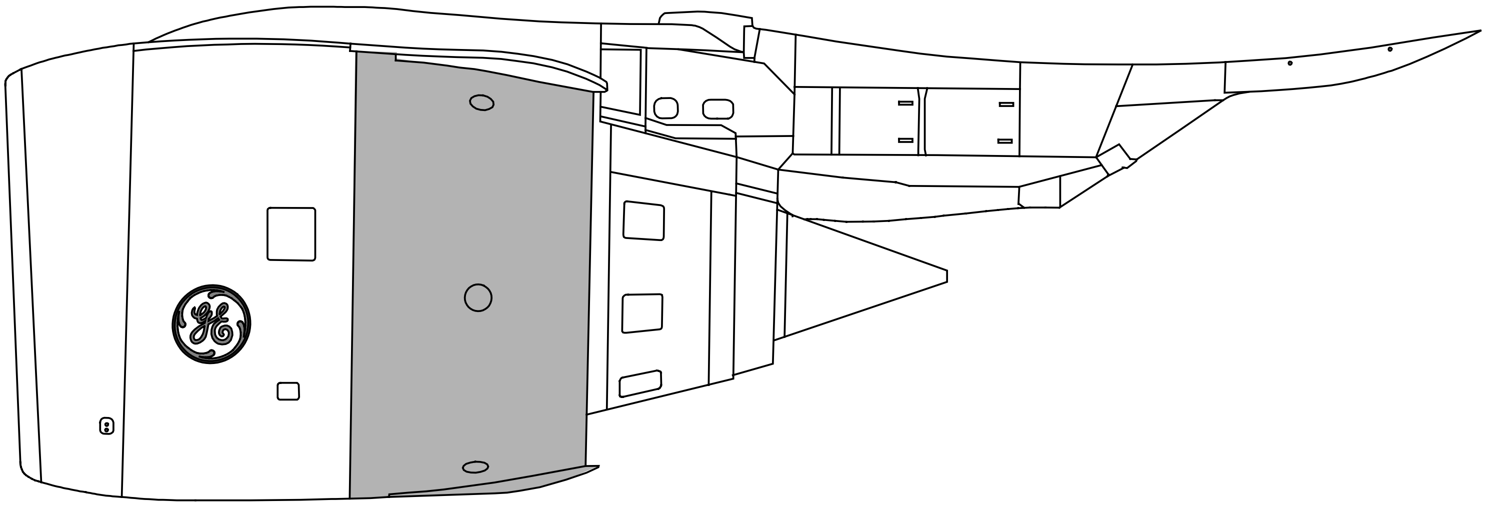


TURBINE EXHAUST SYSTEM - COMPONENTS

THRUST REVERSER SYSTEM - INTRODUCTION

Purpose

The thrust reverser (T/R) system controls the direction of the fan air exhaust to make forward or reverse thrust.



ENGINE EXHAUST SYSTEM

- TURBINE EXHAUST SYSTEM
- THRUST REVERSER SYSTEM
- THRUST REVERSER ACTUATION SYSTEM
- THRUST REVERSER INDICATING AND FAULT DETECTION SYSTEM

THRUST REVERSER SYSTEM - INTRODUCTION

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THRUST REVERSER SYSTEM - GENERAL DESCRIPTION

General

The T/R system controls the direction of the fan exhaust. It makes forward thrust or reverse thrust.

The T/R system has left and right T/R halves that attach to the engine strut. Each T/R half has these parts:

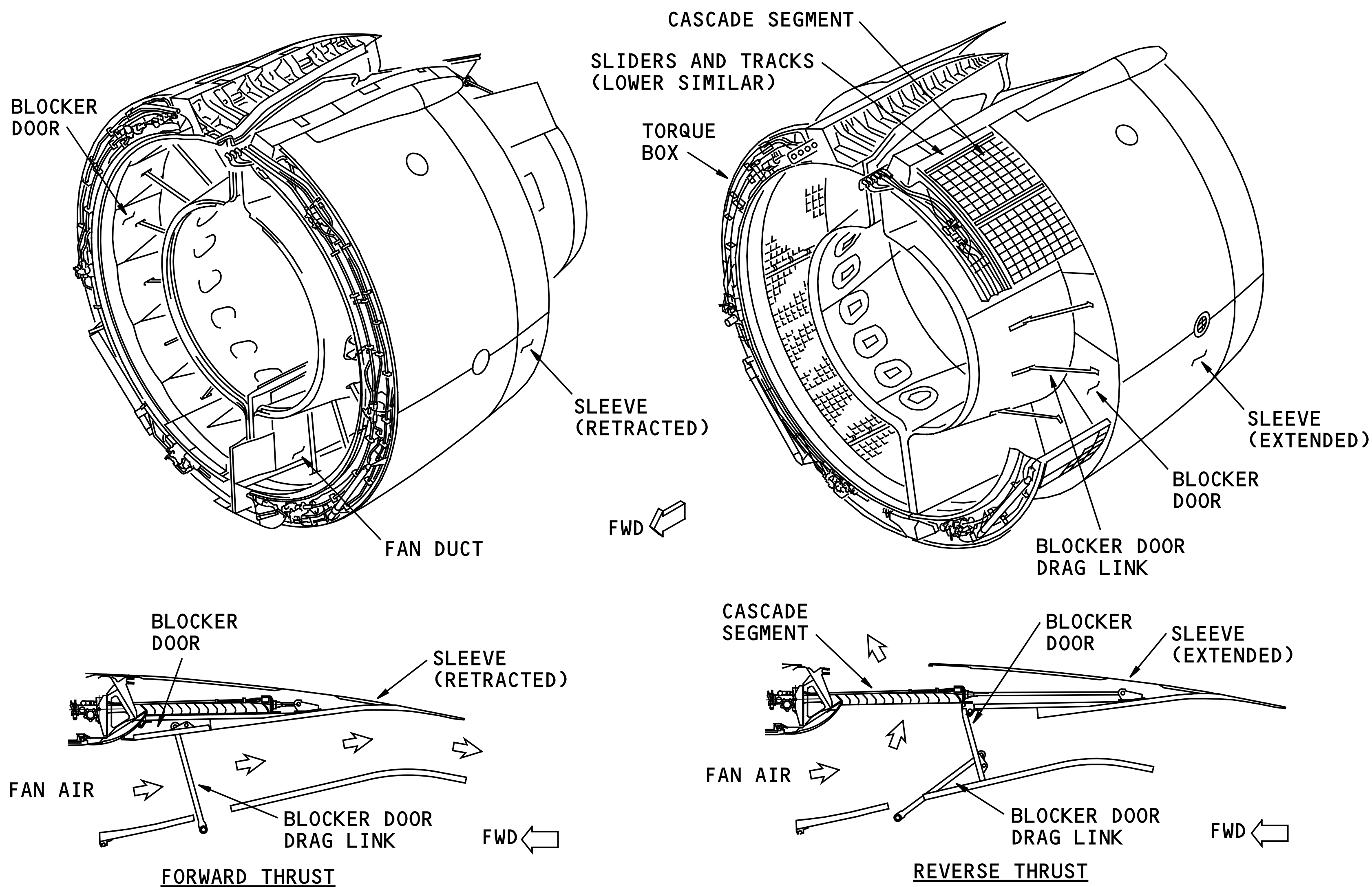
- Torque box
- Sliders and tracks
- Cascade segments
- Sleeve
- Blocker doors
- Blocker door drag links

The sleeve is part of the fan duct. It uses sliders to move forward and aft in the tracks.

Functional Description

When the T/R sleeves are in the forward (retracted) position, the fan air goes through the fan duct and comes out at the rear of the fan duct. This makes forward thrust.

When the T/R sleeves move to the aft (extended) position, the blocker door drag links move the blocker doors into the fan duct. This makes the fan air flow through the cascade segments. The segments turn the fan air and cause it to come out the sides of the T/R in a forward direction. This makes reverse thrust.



THRUST REVERSER SYSTEM - GENERAL DESCRIPTION

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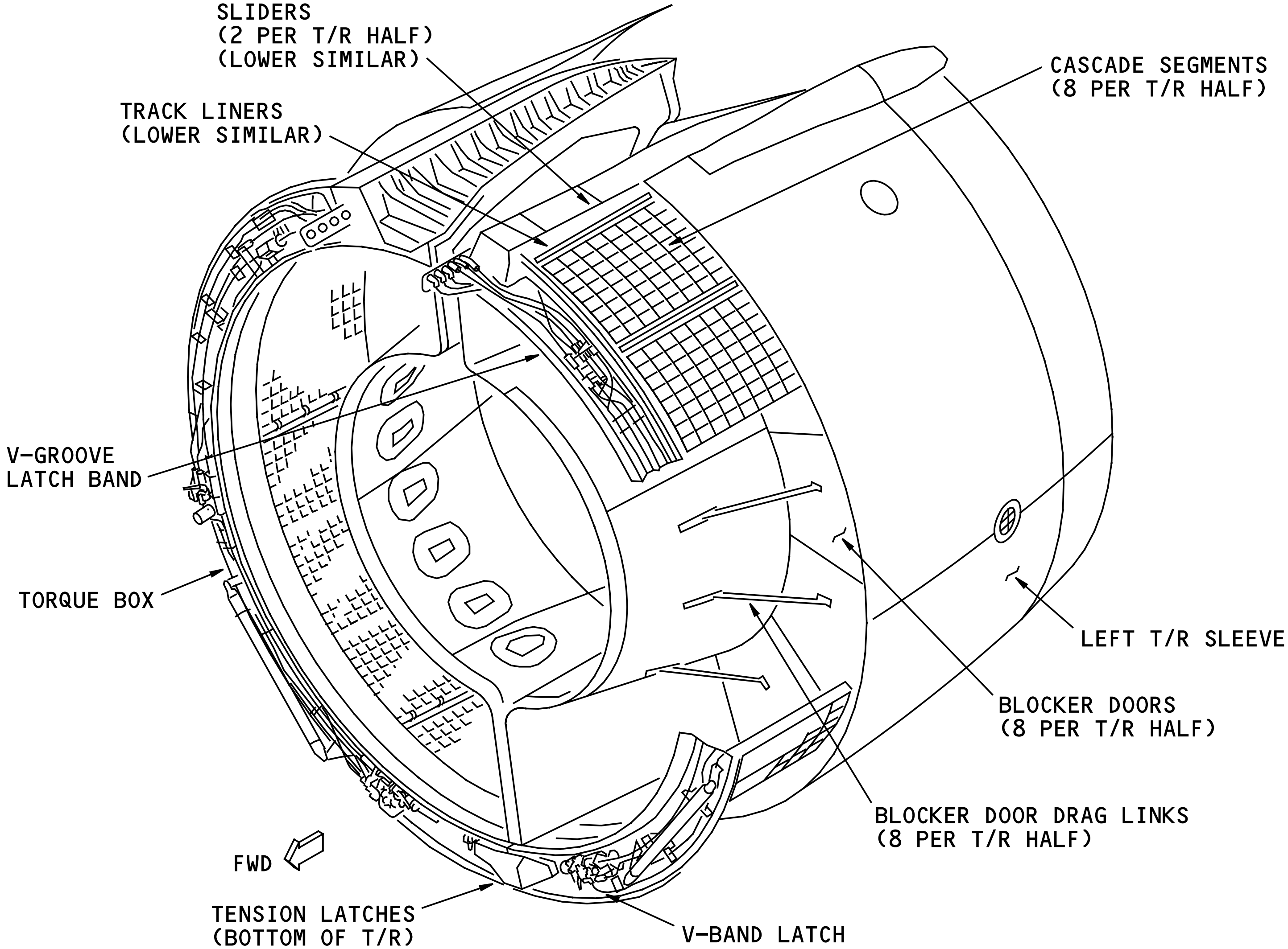
THRUST REVERSER SYSTEM - COMPONENT LOCATIONS

General

The T/R system has two T/R halves on each engine. The T/R system has the these components:

- Cascade segments
- Sleeve
- Blocker doors
- Blocker door drag links
- V-band latch
- Tension latches
- Torque box
- V-groove latch band
- Track liners
- Sliders.



78-31-00-103 Rev 1 08/28/95

THRUST REVERSER SYSTEM - COMPONENT LOCATIONS

THRUST REVERSER SYSTEM - TENSION LATCHES

General

The thrust reverser (T/R) latches hold the T/R halves together. There are four groups of latches:

- Deflection limiter (4)
- Aft cowl (3)
- T/R latch (5)
- V-groove latch band.

You open the latches from aft to forward. You close the latches from forward to aft.

Deflection Limiter Latches

There are four deflection limiter latches. These latches attach to two straps that go around the aft part of the T/R. You open the deflection limiter latches first.

CAUTION: FAILURE TO OPEN THE DEFLECTION LIMITER LATCHES BEFORE YOU OPEN THE THRUST REVERSER CAN CAUSE DAMAGE TO THE THRUST REVERSER.

Aft Cowl Latches

There are three aft cowl latches. These latches hold the aft part of the T/R together. You open the aft cowl latches after you open the deflection limiter latches.

T/R Latches

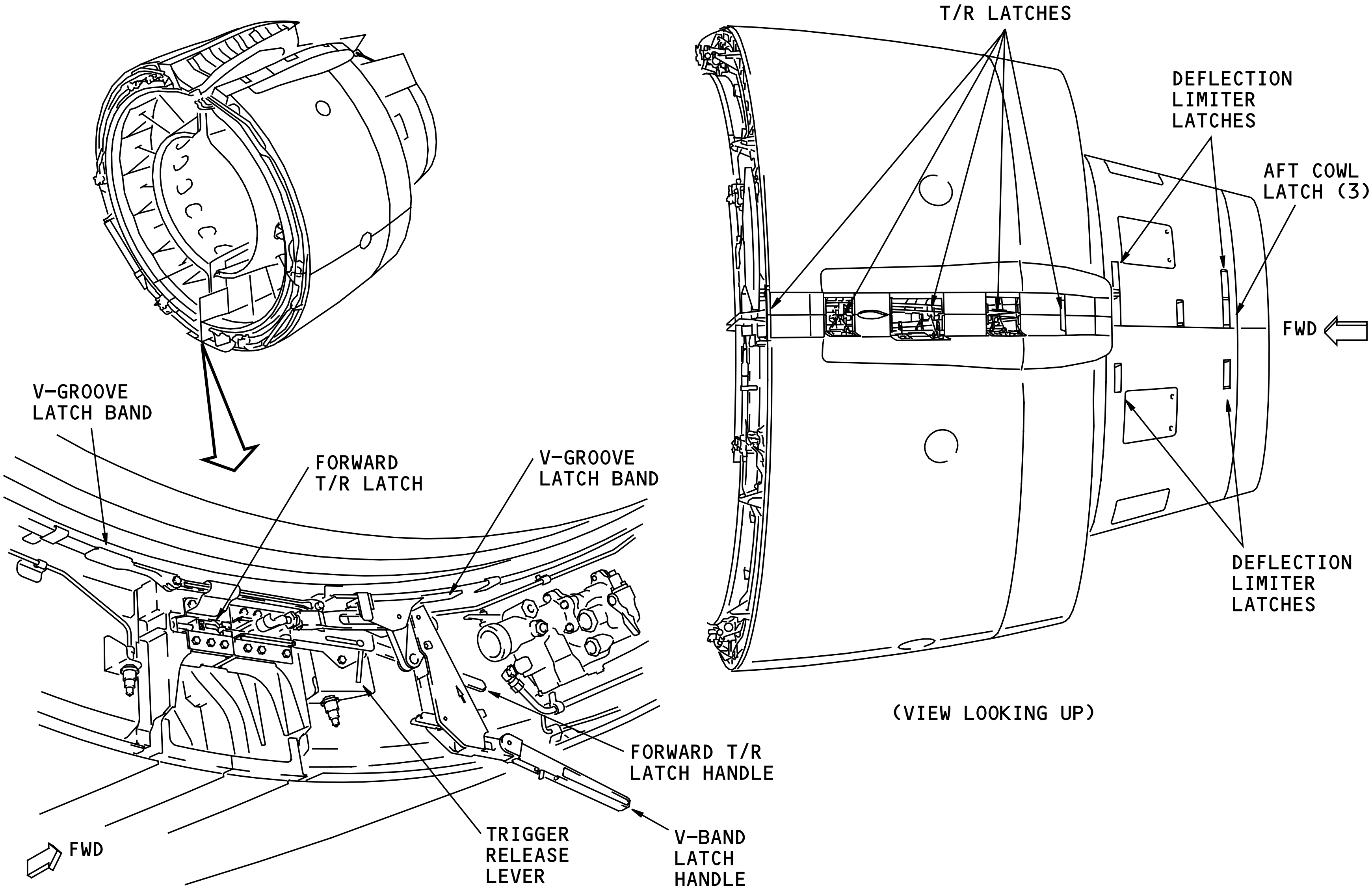
There are five T/R latches. These latches hold the forward part of the T/R together. You must open latch access doors to get access to the three middle T/R latches.

The forward latch is next to the V-band latch handle on the torque box. There is a trigger release lever on the forward latch. You move the trigger release lever to the left before you open the forward latch.

You open the T/R latches after you open the aft cowl latches.

V-groove Latch Band

The v-groove latch band supplies tension around the forward part of the T/R. This tension holds the T/R to the fan case. The v-band latch has a handle that loosens the v-groove latch band. You open the v-band latch last.



THRUST REVERSER SYSTEM - TENSION LATCHES

THRUST REVERSER SYSTEM - V-GROOVE LATCH BANDS

Purpose

The V-groove latch bands supply the tension that holds the T/R halves to the fan case. This transmits the reverse thrust loads to the fan case.

Location

The V-groove latch bands are on the forward part of the T/R halves. They are installed from the top of the T/R to the bottom of the T/R.

Physical Description

The V-groove latch bands attach to the top of the T/R with a bolt. The latch bands come together at the bottom of the T/R.

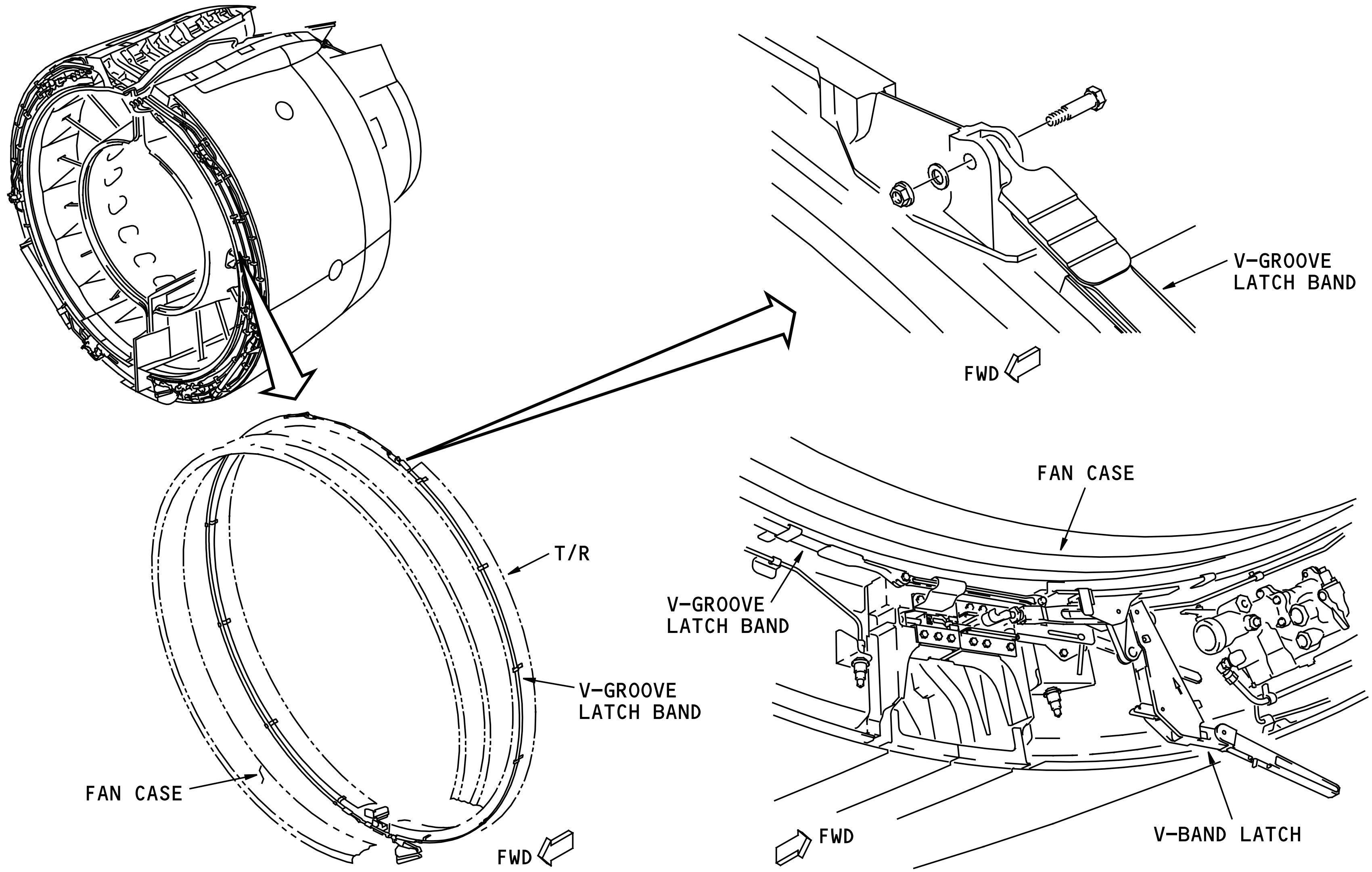
Functional Description

You use the V-band latch to connect the V-groove latch bands together. This puts the tension on the T/R halves.

Training Information Point

Chapter 71 tells you how to operate the latch assembly.

WARNING: DO THE DEACTIVATION PROCEDURE FOR THE THRUST REVERSER TO PREVENT THE OPERATION OF THE THRUST REVERSER. THE ACCIDENTAL OPERATION OF THE THRUST REVERSER CAN CAUSE INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT.



V-GROOVE LATCH BANDS

78-31-00-105 Rev 1

THRUST REVERSER SYSTEM - V-GROOVE LATCH BANDS

THRUST REVERSER SYSTEM - T/R SLEEVE

Purpose

The T/R sleeve makes two different routings for the fan air:

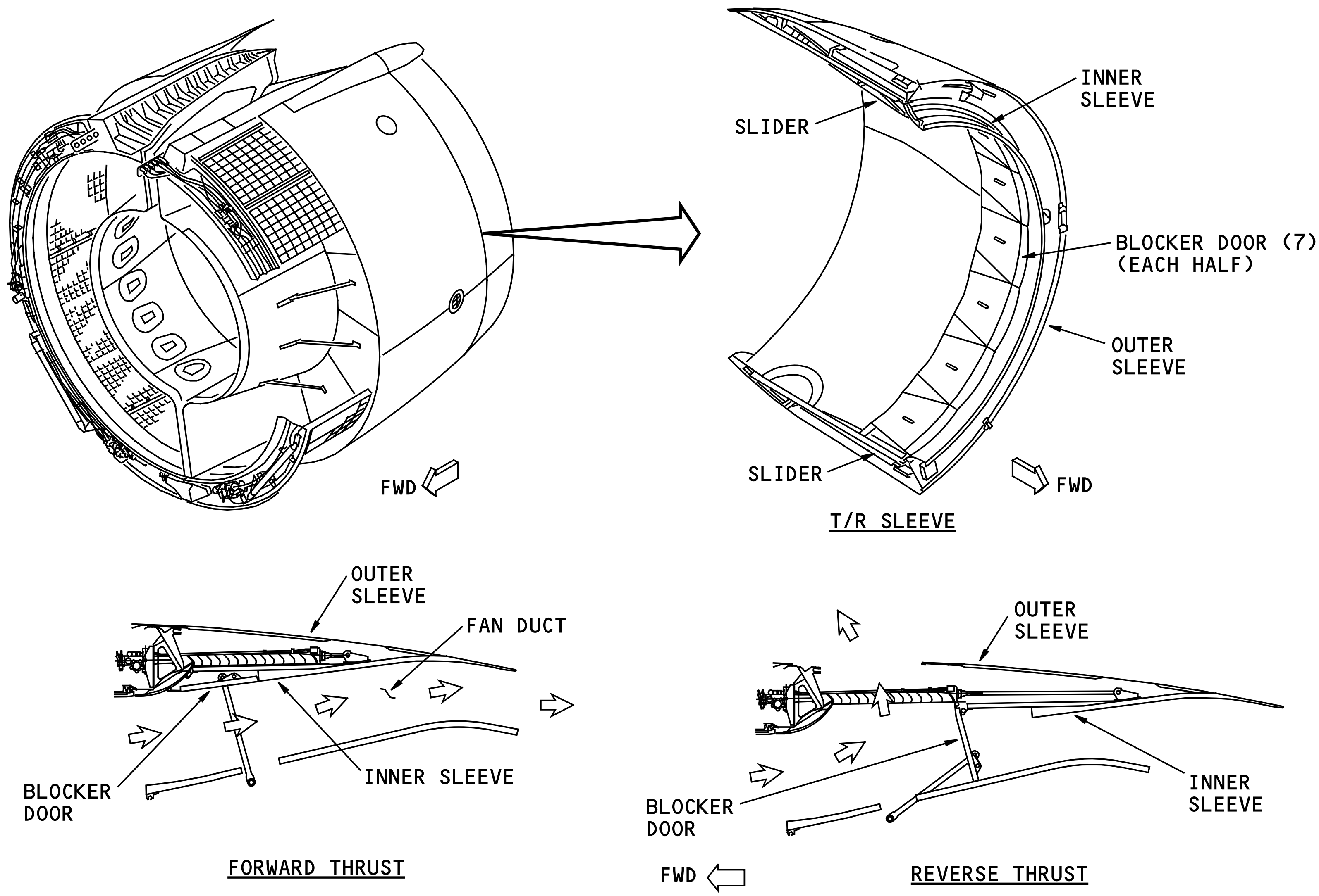
- Forward
- Reverse.

Location

The T/R sleeve is aft of the fan cowl. Sliders and tracks attach the sleeve to the structure.

Physical Description

The T/R sleeve is a composite assembly with an outer sleeve and an inner sleeve. The outer sleeve makes the exterior contour of the T/R. The inner sleeve makes the outer wall of the fan duct. Also, the inner sleeve holds the T/R blocker doors. The inner and outer sleeves come together at the aft end.



78-31-00-106 Rev 0

THRUST REVERSER SYSTEM - T/R SLEEVE

THRUST REVERSER SYSTEM - T/R SLIDERS

Purpose

The T/R sliders permit the sleeves to move forward and aft in the tracks.

location

The main and auxiliary sliders are on the top and the bottom of each sleeve.

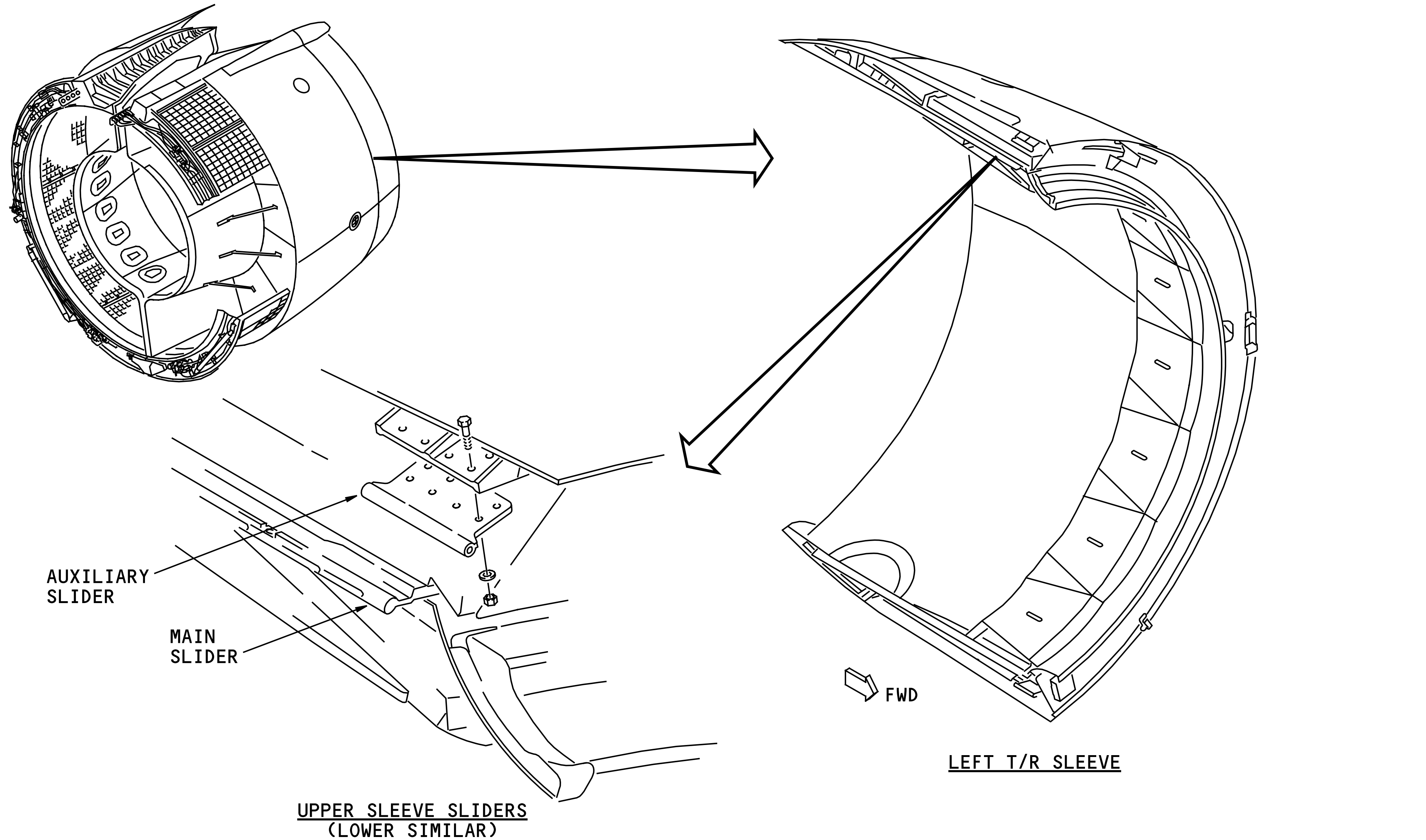
Physical Description

The sliders have a wear surface that reduces the friction between the sliders and the track liners.

Training Information Point

You must remove the sleeve to do a complete inspection of the sliders. You must also remove the sleeve to replace the sliders or the wear surfaces.

WARNING: DO THE DEACTIVATION PROCEDURE FOR THE THRUST REVERSER TO PREVENT THE OPERATION OF THE THRUST REVERSER. THE ACCIDENTAL OPERATION OF THE THRUST REVERSER CAN CAUSE INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT.



78-31-00-107 Rev 0

THRUST REVERSER SYSTEM - T/R SLIDERS

THRUST REVERSER SYSTEM - T/R TRACKS AND TRACK LINERS

Purpose

The T/R tracks and track liners hold the sliders and permit the sleeve to move forward and aft.

Location

The main and auxiliary tracks are on the upper and lower hinge beams of each T/R half.

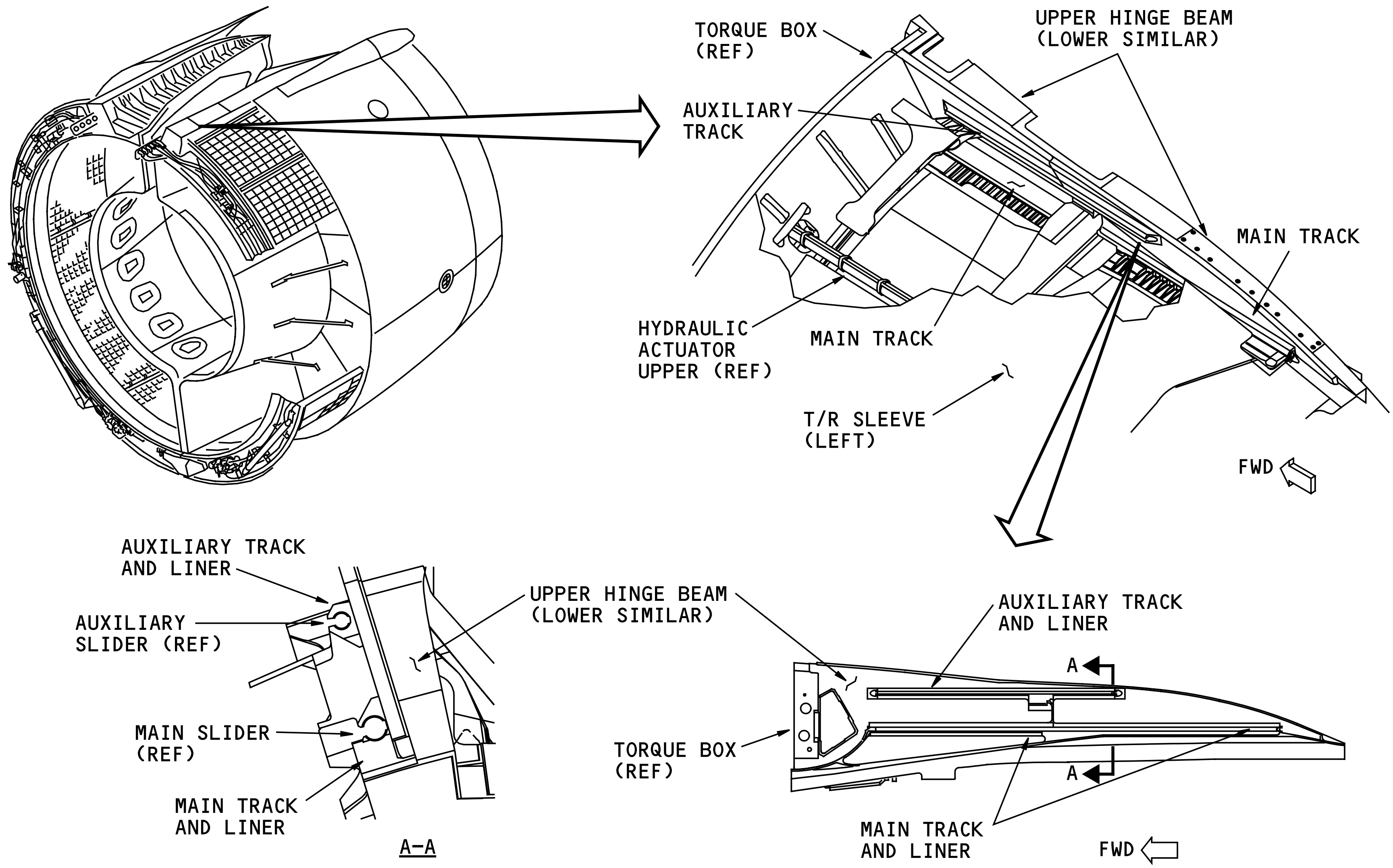
Physical Description

Each track has a track liner that holds the slider. The track liners are steel and protect the aluminum tracks.

Training Information Point

You must remove the sleeve to do a complete inspection of the track liners. You must also remove the sleeve to replace the track liners.

WARNING: DO THE DEACTIVATION PROCEDURE FOR THE THRUST REVERSER TO PREVENT THE OPERATION OF THE THRUST REVERSER. THE ACCIDENTAL OPERATION OF THE THRUST REVERSER CAN CAUSE INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT.



78-31-00-108 Rev 0

THRUST REVERSER SYSTEM - T/R TRACKS AND TRACK LINERS

THRUST REVERSER SYSTEM - T/R BLOCKER DOORS AND BLOCKER DOOR DRAG LINKS

Purpose

The T/R blocker doors and the blocker door drag links make a blockage in the fan duct to change the direction of the fan air.

Location

The blocker doors connect to the forward end of the inner T/R sleeve. The blocker door drag links connect the blocker doors to the fan duct inner wall.

Physical Description

Each sleeve has eight epoxy-graphite blocker doors.

Functional Description

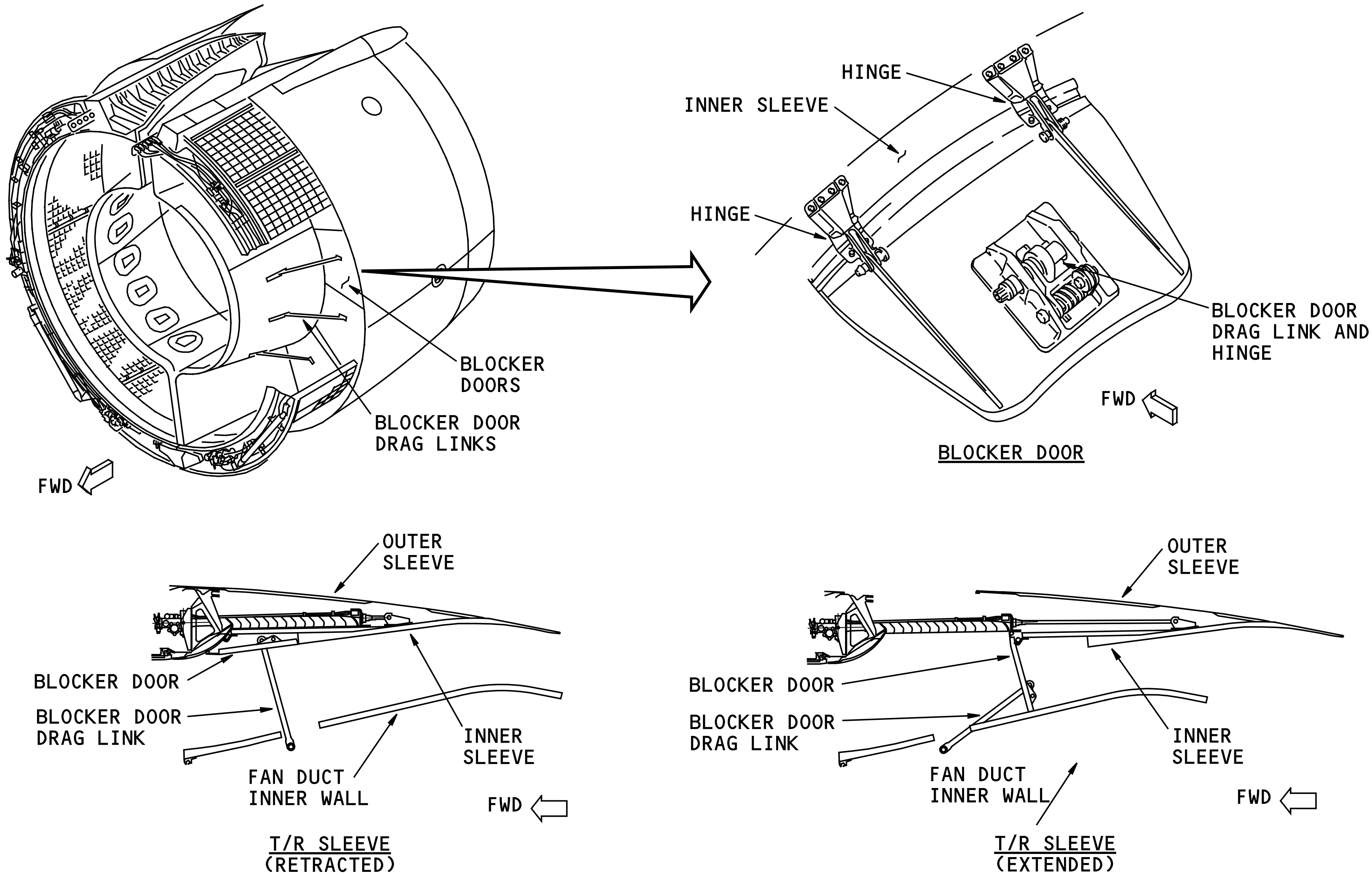
When the sleeve is in the forward (retracted) position, the blocker doors make part of the fan duct outer wall.

When the sleeve is in the aft (extended) position, the blocker door drag links move the blocker doors into the fan duct.

Training Information Point

You must extend the sleeve to inspect, remove, or install the blocker doors and blocker door drag links. Also, you must open the T/R to inspect, remove, or install the blocker door drag links at the fan duct inner wall.

WARNING: DO THE DEACTIVATION PROCEDURE FOR THE THRUST REVERSER TO PREVENT THE OPERATION OF THE THRUST REVERSER. THE ACCIDENTAL OPERATION OF THE THRUST REVERSER CAN CAUSE INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT.



78-31-00-109 Rev 1

THRUST REVERSER SYSTEM - T/R BLOCKER DOORS AND BLOCKER DOOR DRAG LINKS

THRUST REVERSER SYSTEM - T/R CASCADE SEGMENTS

Purpose

The cascade segments control the direction of the fan air when the sleeves are in the aft (extended) position and the blocker doors are in the fan duct. The cascade segments also give structural strength to the T/R.

Location

The cascade segments attach to the torque box and the cascade segment attach ring.

The T/R on each engine has 16 cascade segments. The T/R system uses the numbers 1 through 16 to identify the cascade segment locations on the engine.

Physical Description

The T/R cascade segments are graphite-epoxy assemblies.

There are ten different types of cascade segments. Each type causes the fan airflow to go out in a different direction.

Training Information Point

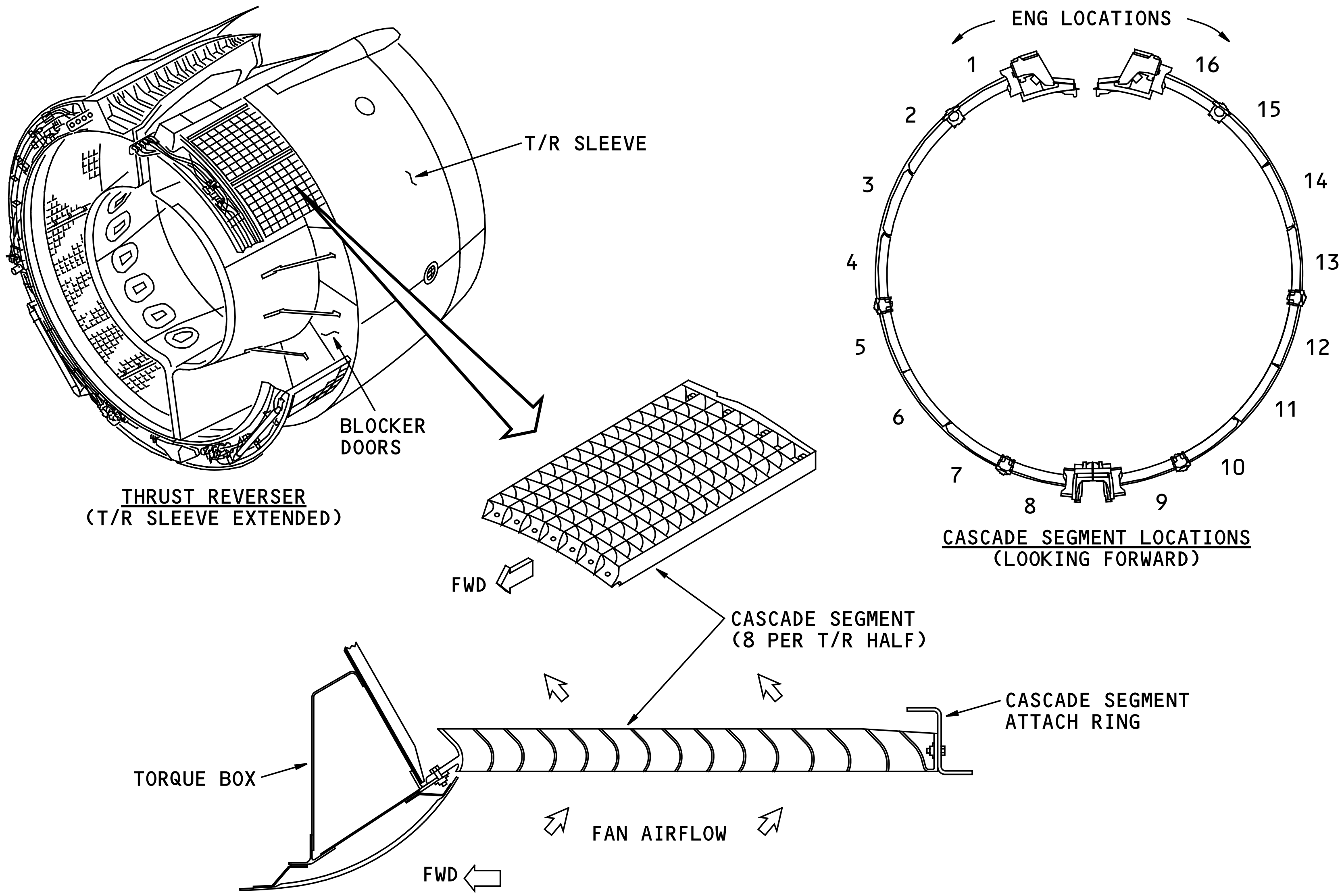
You must extend the T/R sleeve to inspect, remove, or install the T/R cascade segments.

You must install the cascade segment in its correct location.

CAUTION: MAKE SURE YOU CORRECTLY INSTALL THE CASCADE SEGMENTS ON THE THRUST REVERSER. IF YOU DO NOT DO THIS, YOU CAN CAUSE DAMAGE TO THE ENGINE.

WARNING: DO THE DEACTIVATION PROCEDURE FOR THE THRUST REVERSER TO PREVENT THE OPERATION OF THE THRUST REVERSER. THE ACCIDENTAL OPERATION OF THE THRUST REVERSER CAN CAUSE INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT.

WARNING: DO NOT LIFT OR MOVE THE THRUST REVERSER WITH LESS THAN THREE CASCADE SEGMENTS INSTALLED. MAKE SURE THERE IS NO MORE THAN TWO OPEN SPACES BETWEEN EACH CASCADE SEGMENT. IF YOU DO NOT HAVE A MINIMUM OF THREE CASCADE SEGMENTS INSTALLED WHEN YOU MOVE THE THRUST REVERSER, YOU CAN CAUSE DAMAGE TO THE THRUST REVERSER.



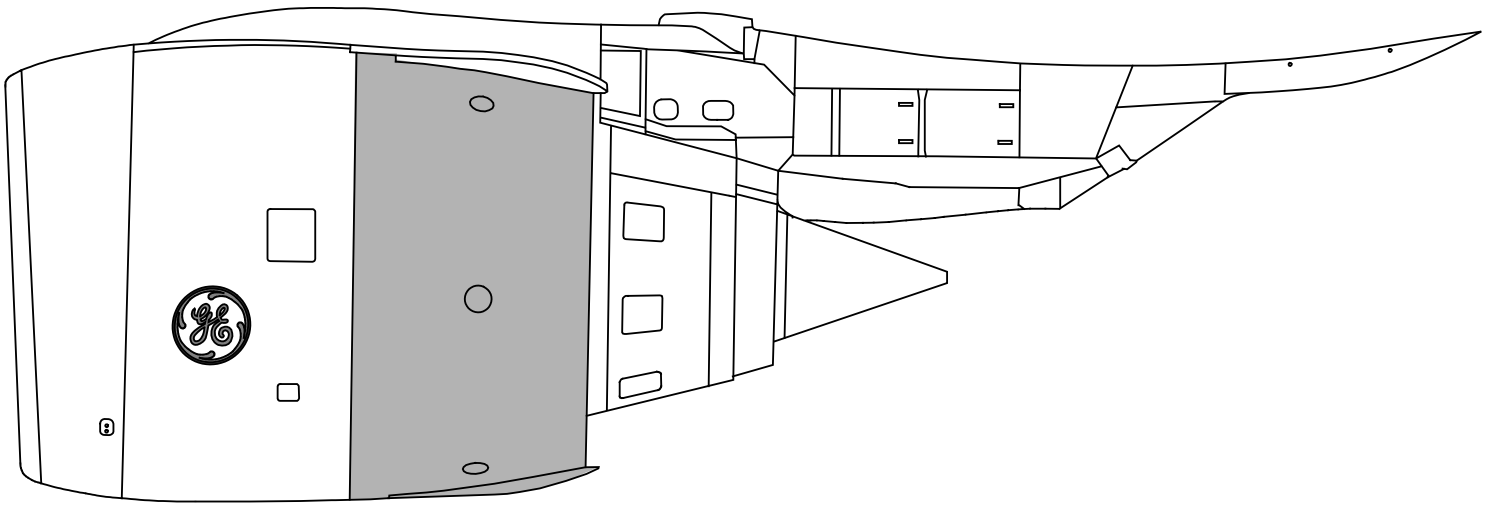
THRUST REVERSER SYSTEM - T/R CASCADE SEGMENTS

78-31-00-110 Rev 0

THRUST REVERSER ACTUATION SYSTEM (TRAS) - INTRODUCTION

General

The thrust reverser actuation system (TRAS) supplies hydraulic power to extend or retract the T/R sleeves.



ENGINE EXHAUST SYSTEM

- TURBINE EXHAUST SYSTEM
- THRUST REVERSER SYSTEM
- THRUST REVERSER ACTUATION SYSTEM
- THRUST REVERSER INDICATING AND FAULT DETECTION SYSTEM

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THRUST REVERSER ACTUATION SYSTEM (TRAS) - INTRODUCTION

TRAS - GENERAL DESCRIPTION

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TRAS - GENERAL DESCRIPTION

General

The TRAS moves the thrust reverser (T/R) sleeves. It operates on the ground only. The TRAS uses hydraulic pressure for operation and electrical power for control.

The TRAS uses these valves to control hydraulic pressure to the hydraulic actuators:

- Sync lock valve (SLV)
- Directional control valve (DCV)
- Isolation valve.

The hydraulic actuators move the T/R sleeves.

The sync shafts keep the movement of the actuators together. They also permit manual operation of the T/R sleeves for maintenance.

The sync lock/manual drive units lock the sync shafts in the retracted position.

The T/R interlock actuator prevents the maximum reverse thrust command until the T/R sleeves get near the extended position. The EEC uses T/R sleeve position data from the RVDTs to control the interlock actuator.

The T/R test enable switch permits the operation of the TRAS when the engine is not in operation. You use this switch for T/R maintenance.

Extend

To extend the T/R sleeves you put the reverse thrust lever in the reverse thrust interlock position. This causes three control signals to go to the TRAS. These are the effects of the control signals:

- The SLV opens and supplies hydraulic control pressure to release the sync locks.
- The directional control solenoid valve opens and supplies hydraulic control pressure to the DCV. This moves the DCV to permit hydraulic power to go to the extend and retract sides of the actuators.
- The isolation valve opens and supplies hydraulic pressure through the DCV to the actuators.

Hydraulic pressure to the actuators releases the locking actuators and moves the sleeves to the aft (extended) position.

Retract

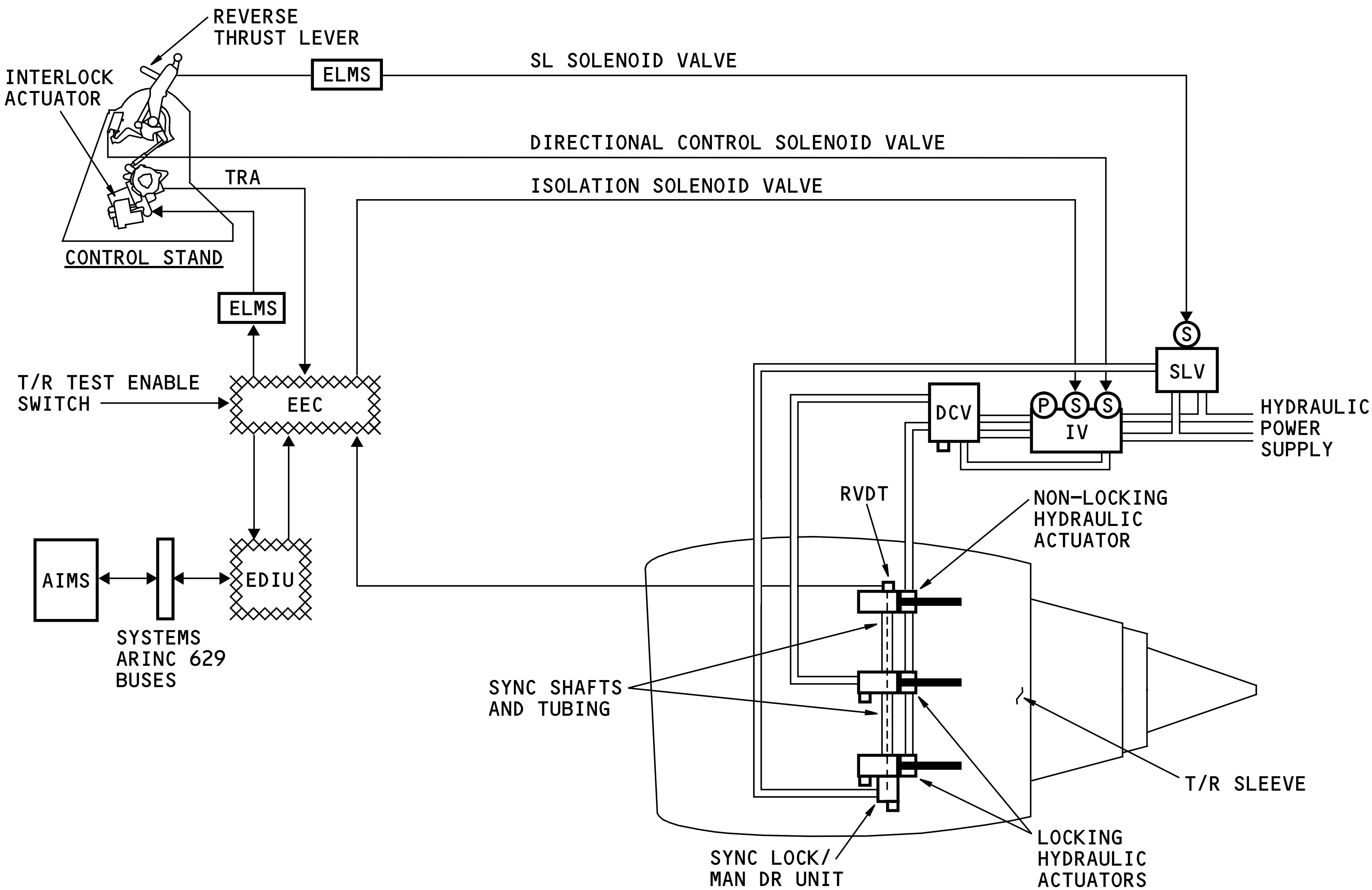
To retract the T/R sleeves you put the reverse thrust levers in the forward thrust position. This causes two control signals to go to the TRAS. These are the effects of the control signals:

- The signal to open the SLV is removed. A time delay circuit in the ELMS keeps the sync lock solenoid valve energized. This keeps the SLV open and the sync lock unlocked. The sync locks stay unlocked until the time delay is complete.

TRAS - GENERAL DESCRIPTION

- The directional control solenoid valve closes and removes the hydraulic control pressure to the DCV. This moves the DCV to permit hydraulic power to go to the retract side of the actuators.
- The EEC begins a time delay before closing the isolation valve. The isolation valve stays open and supplies hydraulic power through the DCV to the actuators. The isolation valve closes when the time delay is complete

Hydraulic power to the retract side of the actuators moves the T/R sleeves to the forward (retracted) position.



TRAS - GENERAL DESCRIPTION

TRAS - ENGINE COMPONENT LOCATIONS

General

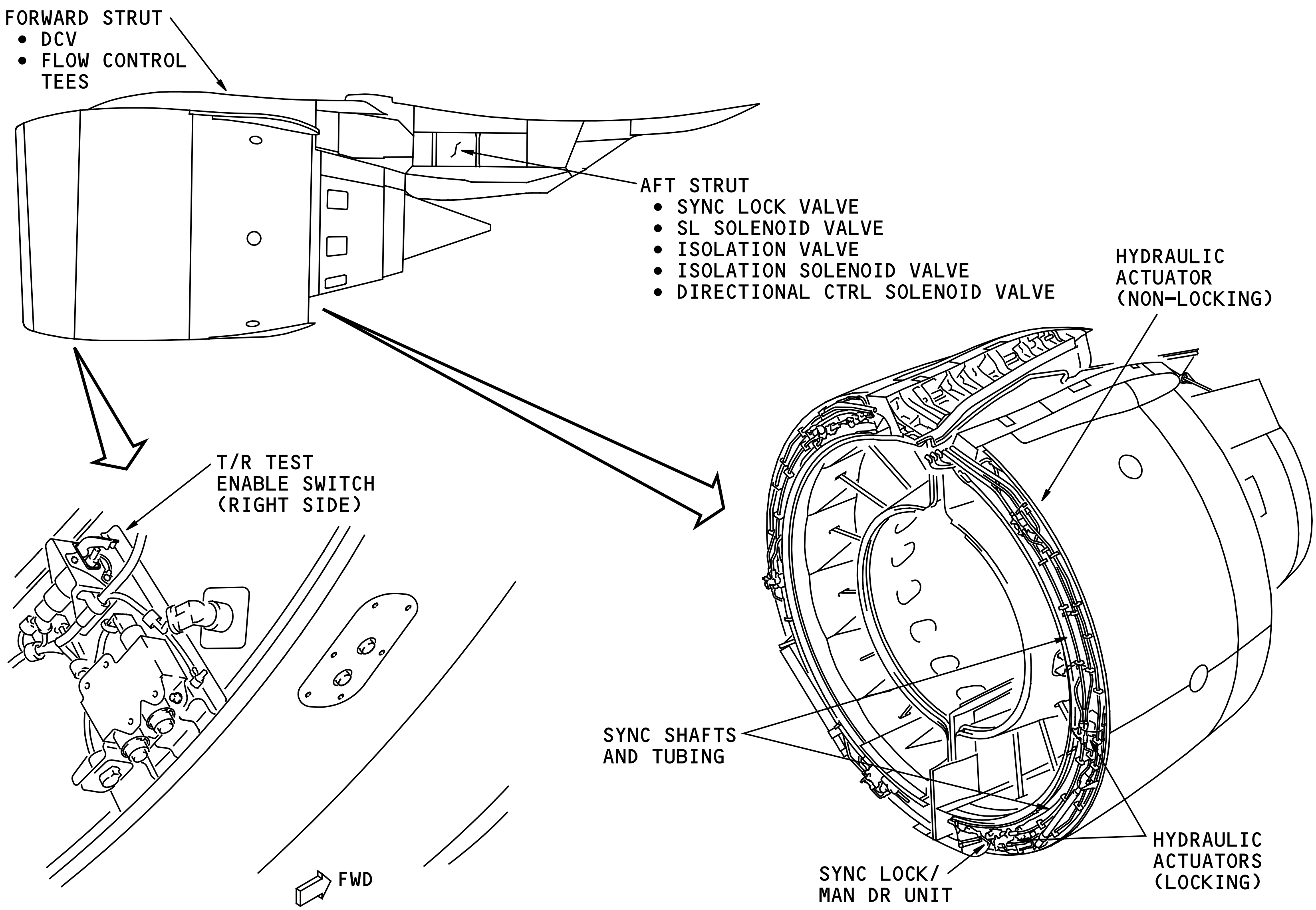
These are the TRAS components on the strut:

- DCV
- Flow control tees
- Sync lock valve
- SL solenoid valve
- Isolation valve
- Isolation solenoid valve
- Directional control solenoid valve.

These are the TRAS components on the thrust reverser (T/R):

- Hydraulic actuator (non-locking)
- Hydraulic actuator (locking)
- Sync lock/manual drive unit
- Sync shafts and tubing.

The T/R test enable switch is on the inlet cowl bulkhead.



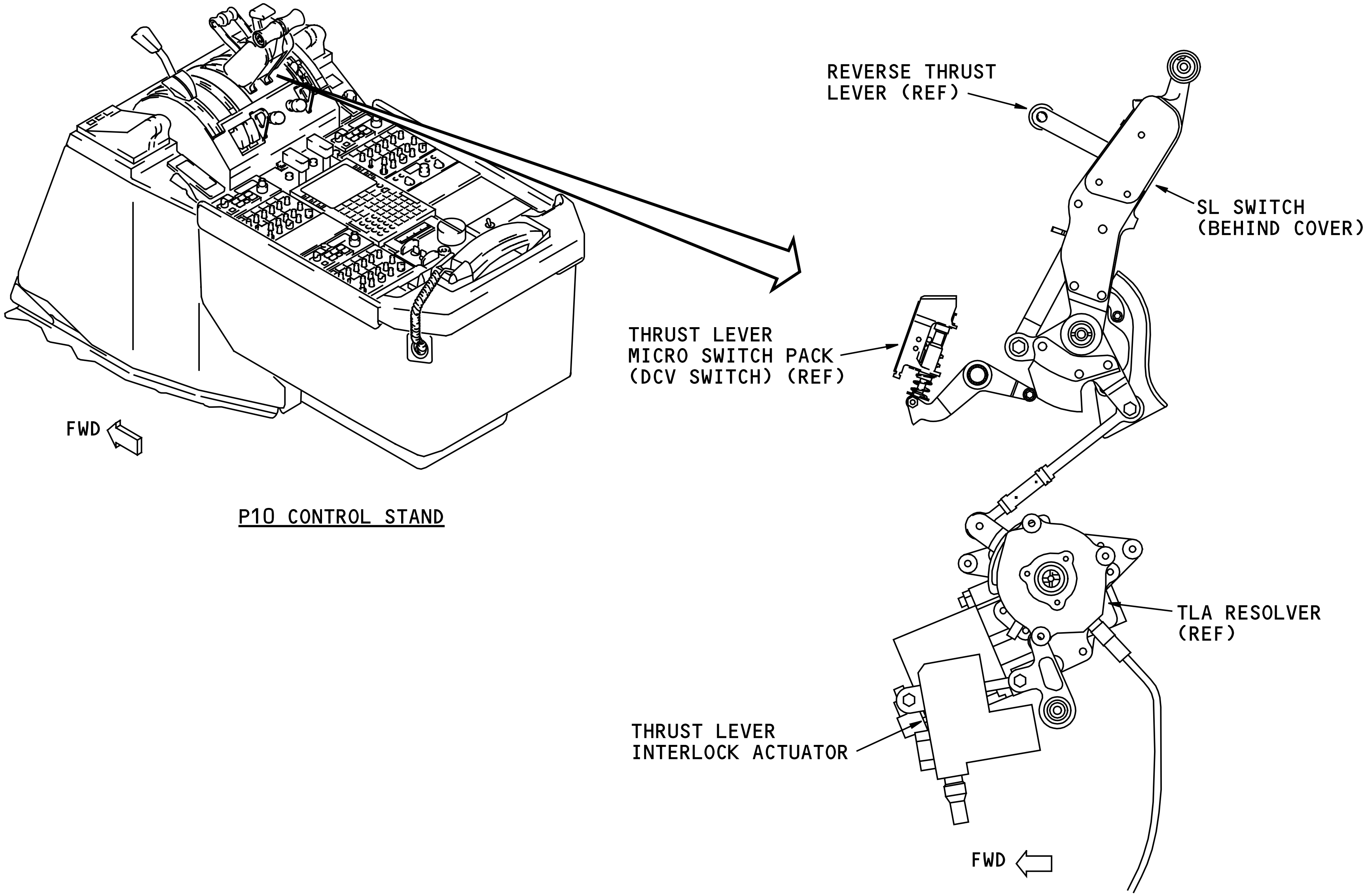
TRAS - ENGINE COMPONENT LOCATIONS

TRAS - FLIGHT DECK COMPONENT LOCATIONS

General

These are the TRAS components in the P10 control stand:

- SL switch
- Thrust lever interlock actuator.



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TRAS - FLIGHT DECK COMPONENT LOCATIONS

TRAS - SYNC LOCK SWITCH

Purpose

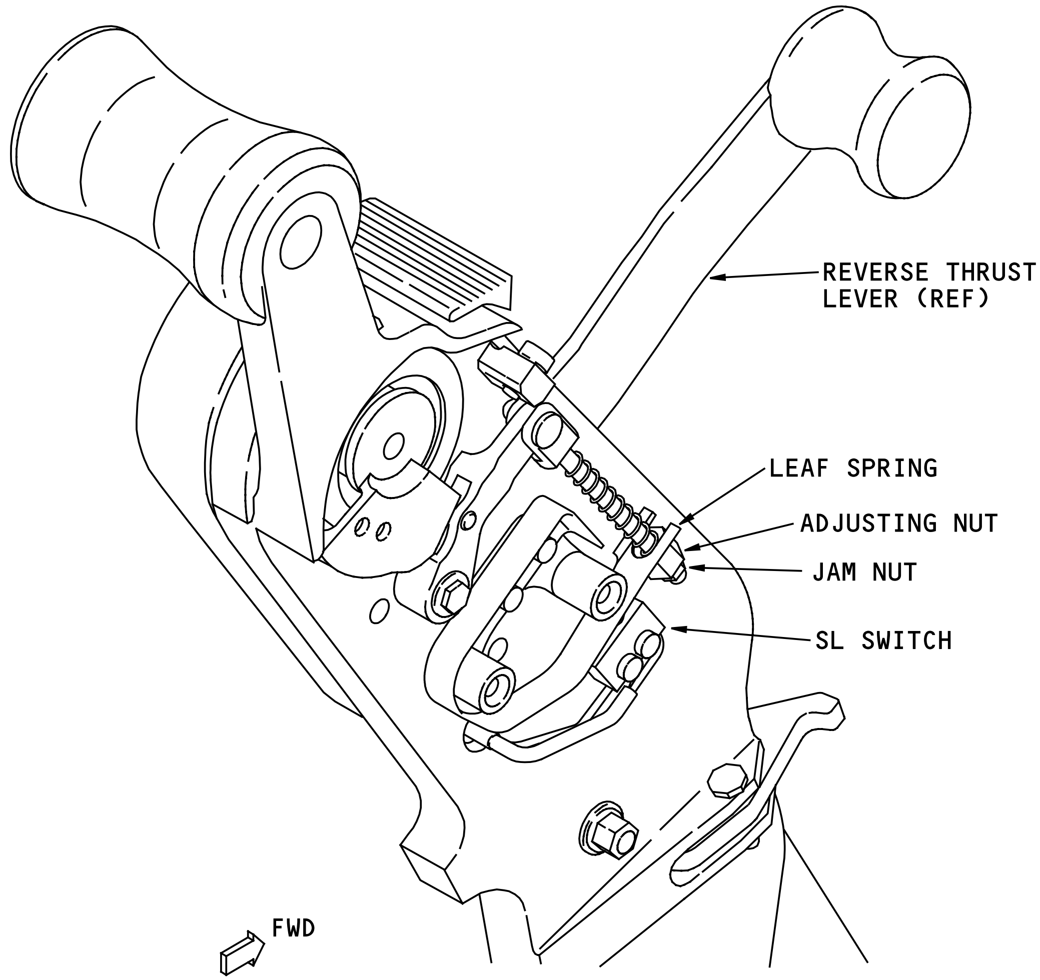
The SL switch sends the signal that causes the SL solenoid valve to energize.

Location

The SL switch is in the thrust lever. You remove the cover on the side of the thrust lever to get access to the switch.

Training Information Point

You use a protractor on the reverse thrust lever to adjust the SL switch. The SL switch is set at a specified reverse thrust lever angle. You turn the adjusting nut to make the leaf spring touch the SL switch at the specified angle.



LEFT THRUST LEVER
(SIDE COVER REMOVED - RIGHT SIMILAR)

TRAS - SYNC LOCK SWITCH

TRAS - SYNC LOCK VALVE

Purpose

The SLV supplies hydraulic control pressure to release the sync lock/manual drive unit.

Location

The SLV is in the aft strut. You must open the left access panel on the aft strut fairing to get access to the SLV.

Physical Description

The SLV has these electrical parts:

- SL solenoid valve
- Electrical connector.

The SLV has these hydraulic connections:

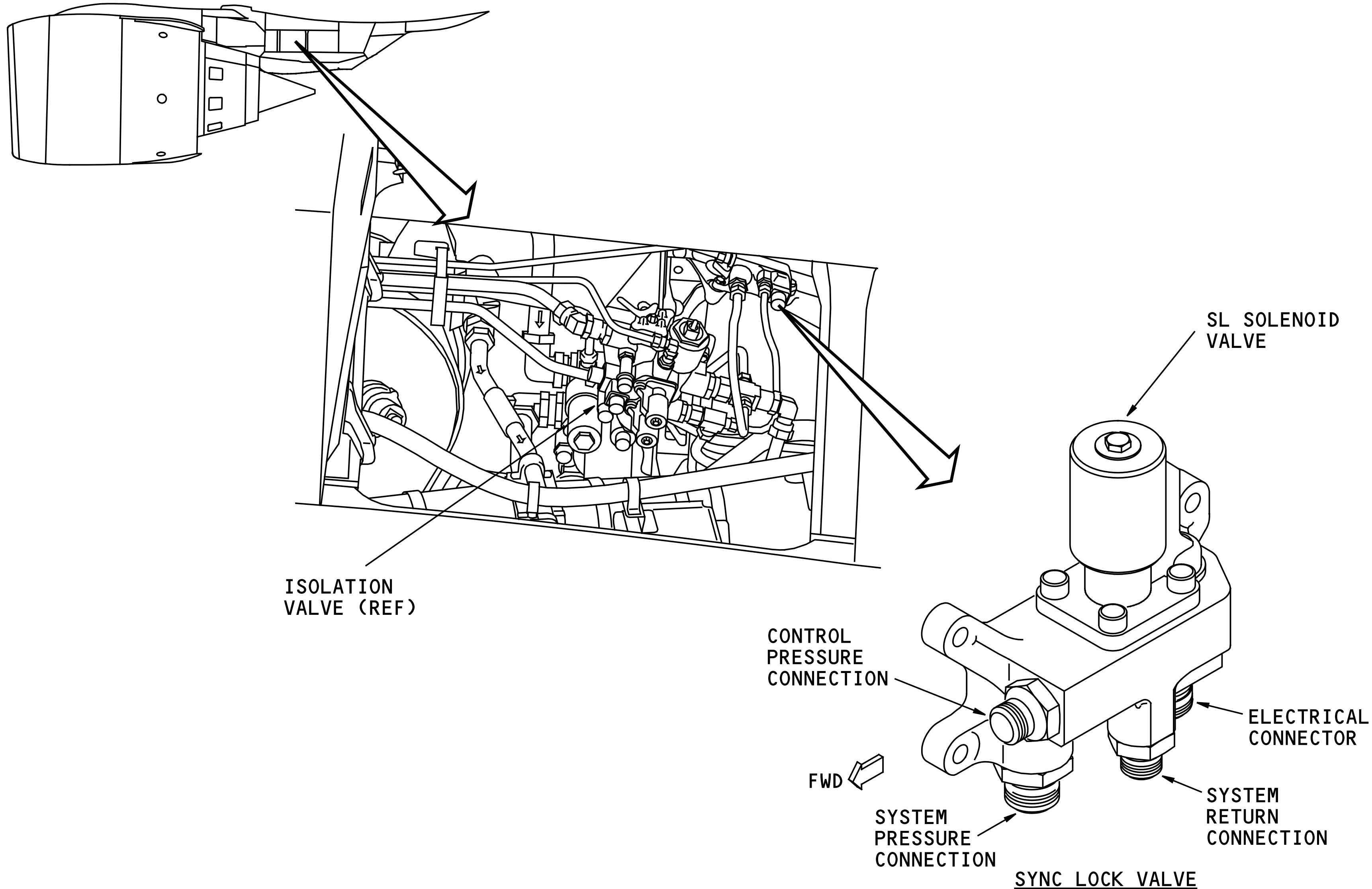
- System return
- System pressure
- Control pressure.

The SLV and the SL solenoid valve are LRUs.

SL Solenoid Valve

The SL solenoid valve attaches to the SLV. It energizes when there is a reverse thrust command. This permits system pressure to go to the control pressure port.

Control pressure from the SLV goes to the sync lock/manual drive unit and releases the lock. When there is no reverse thrust command, control pressure goes to the system return port.



78-34-00-106 Rev 1 12/19/1995

TRAS - SYNC LOCK VALVE

TRAS - SYNC LOCK/MANUAL DRIVE UNIT

Purpose

The sync lock/manual drive unit does these mechanical functions:

- Locks the sync shafts
- Moves the sync shafts during manual operation.

The sync lock/manual manual drive units prevent the movement of the sync shafts when there is no reverse thrust command. This keeps the actuators and sleeves in the forward (retracted) position.

Location

A unit attaches to the lower hydraulic actuator on each T/R half.

Physical Description

These are the parts on the sync lock/manual drive unit:

- Lock pin
- Lock release lever
- Control pressure connection
- Manual drive unit
- Proximity sensor
- Target

Lock Release lever and Lock Pin

You use the lock release lever to manually release the sync lock. The lock pin holds the lever in the not locked position.

Control Pressure Connection

The control pressure connection gets hydraulic control pressure from the SLV. This releases the sync lock when there is a reverse thrust command.

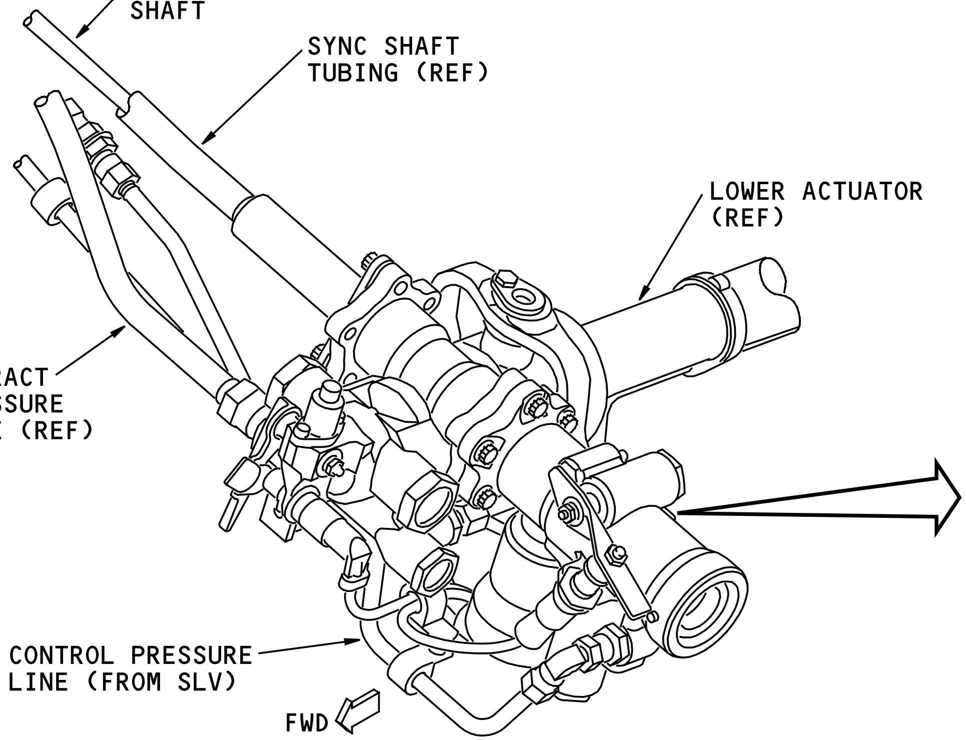
Manual Drive Unit

A 3/8 inch manual drive permits you to manually extend the T/R sleeve for maintenance.

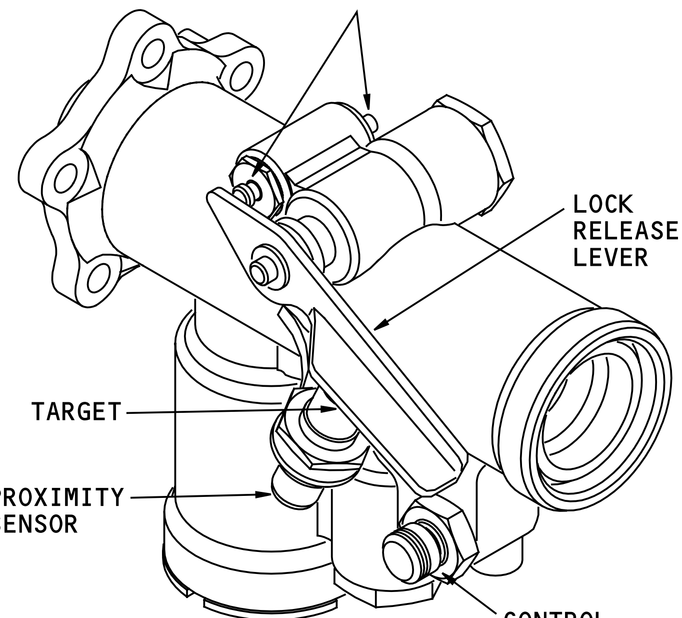
Proximity Sensor and Target

The proximity sensor uses a target on the lock release lever to send sync lock position data to the T/R indicating and fault detection system.

See section 78-36 for more information.



RIGHT T/R HALF INSTALLATION
(LEFT SIMILAR)



SYNC LOCK/MANUAL DRIVE UNIT

78-34-00-107 Rev 2 11/28/95

TRAS - SYNC LOCK/MANUAL DRIVE UNIT

TRAS - ISOLATION VALVE

Purpose

The isolation valve isolates the airplane hydraulic system from the TRAS. It also permits hydraulic power to go to the TRAS to move the T/R sleeves.

Physical Description

The isolation valve has these components:

- Hydraulic pressure switch
- Bypass valve
- Isolation shutoff valve
- Directional control solenoid valve
- Isolation solenoid valve.

The isolation valve has these hydraulic connections:

- Hydraulic system return
- Hydraulic system pressure
- Control pressure
- TRAS pressure
- TRAS return.

Hydraulic Pressure Switch

The hydraulic pressure switch sends the isolation shutoff valve position to the T/R indicating and fault detection system.

Bypass Valve

The bypass valve prevents a hydraulic lock in the TRAS when you manually extend or retract the T/R sleeve.

Isolation Shutoff Valve

The isolation shutoff valve isolates the airplane hydraulic system pressure from the TRAS.

Directional Control Solenoid Valve

The directional control solenoid valve supplies external hydraulic control pressure to operate the DCV.

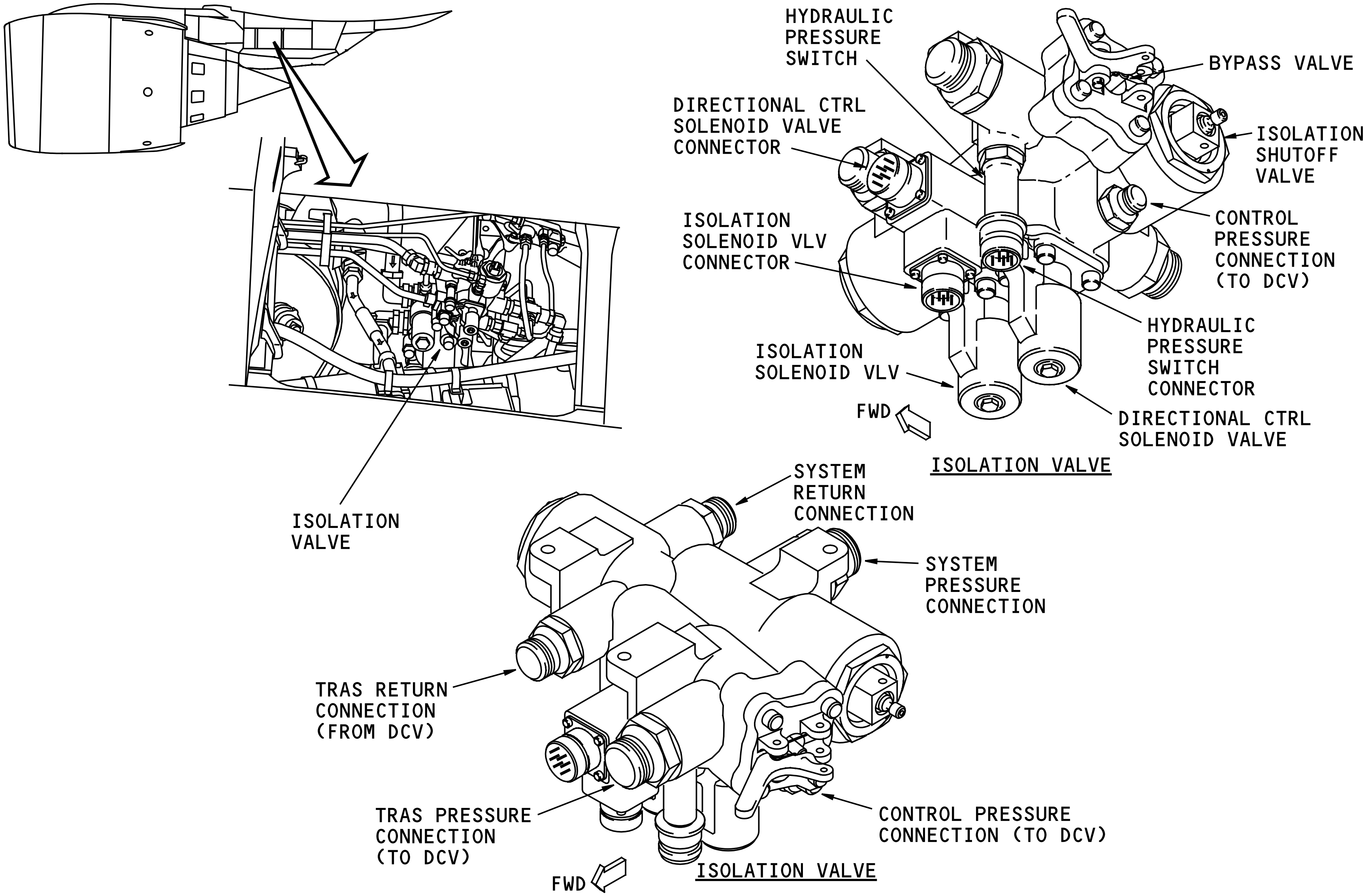
Isolation Solenoid Valve

The isolation solenoid valve supplies internal hydraulic control pressure to move the isolation shutoff valve.

Training Information Point

You use the bypass valve for ground maintenance. You use a pin to mechanically lock the isolation shutoff valve in the closed position when you do the T/R deactivation procedure. The isolation valve is an LRU. These isolation valve components are also LRUs:

- Directional control solenoid valve
- Isolation solenoid valve
- Hydraulic pressure switch.



TRAS - ISOLATION VALVE

TRAS - DIRECTIONAL CONTROL VALVE

Purpose

The DCV supplies hydraulic pressure to extend or retract the T/R actuators.

Physical Description

The DCV has a DCV proximity sensor and these hydraulic connections:

- TRAS return
- TRAS pressure
- Control pressure
- Retract pressure
- Extend pressure.

The DCV and DCV proximity sensor are LRUs.

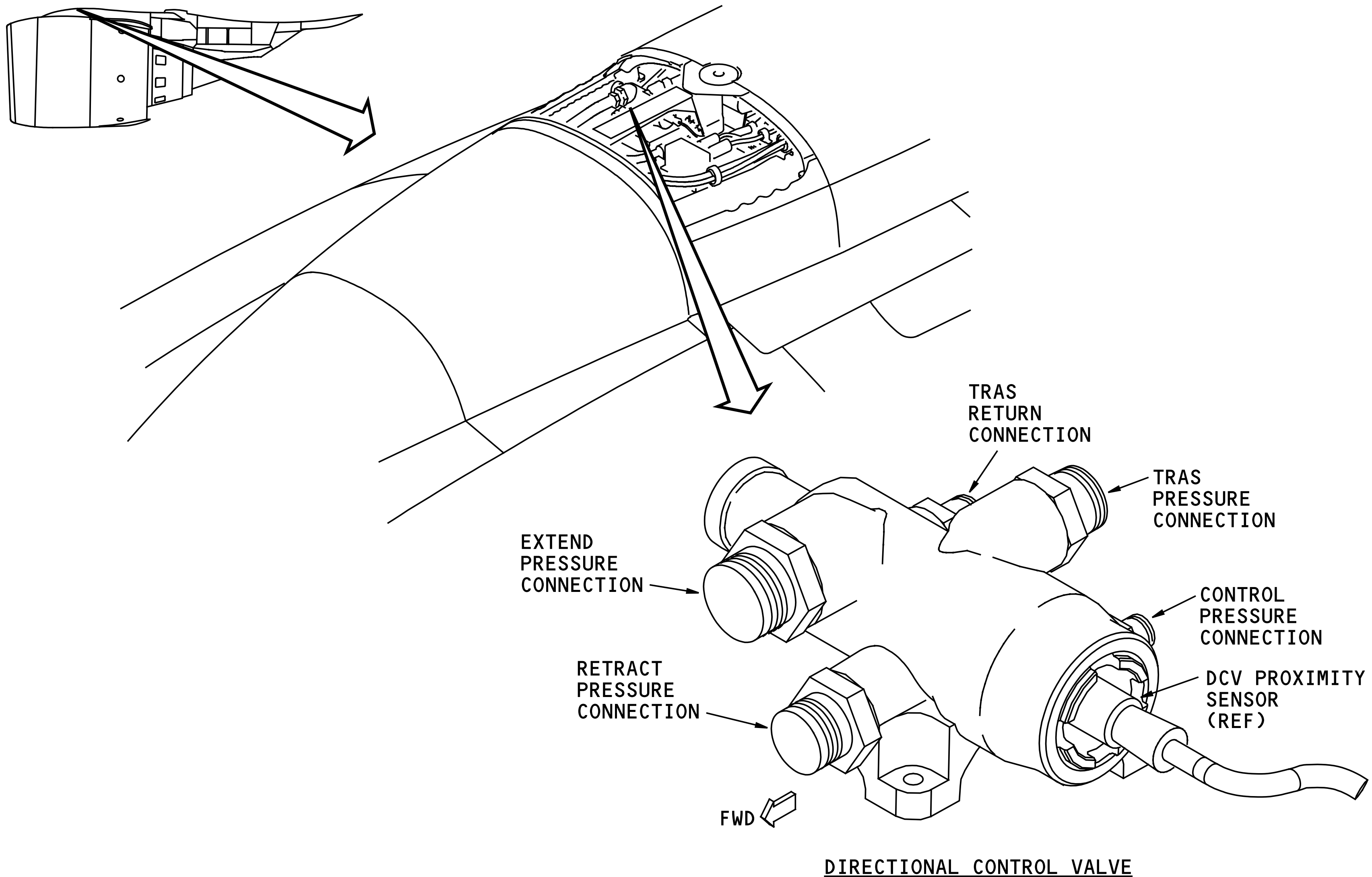
Functional Description

When there is control pressure, the DCV permits TRAS pressure to go to the extend and retract lines to the actuators.

When there is no control pressure, the DCV permits TRAS pressure to go to the retract line to the actuators. Hydraulic fluid in the extend line goes to TRAS return.

DCV Proximity Sensor

The DCV proximity sensor sends DCV position data to the T/R indicating and fault detection system.



78-34-00-109 Rev 2

TRAS - DIRECTIONAL CONTROL VALVE

TRAS - HYDRAULIC ACTUATORS, SYNC SHAFTS AND TUBING - INTRODUCTION

General

The TRAS uses six hydraulic actuators to extend and retract the T/R sleeves.

The sync shafts make sure the actuators on each sleeve move together.

Hydraulic Actuators

The actuators are linear movement actuators and attach to the torque box and the T/R sleeves. They get hydraulic power from the DCV.

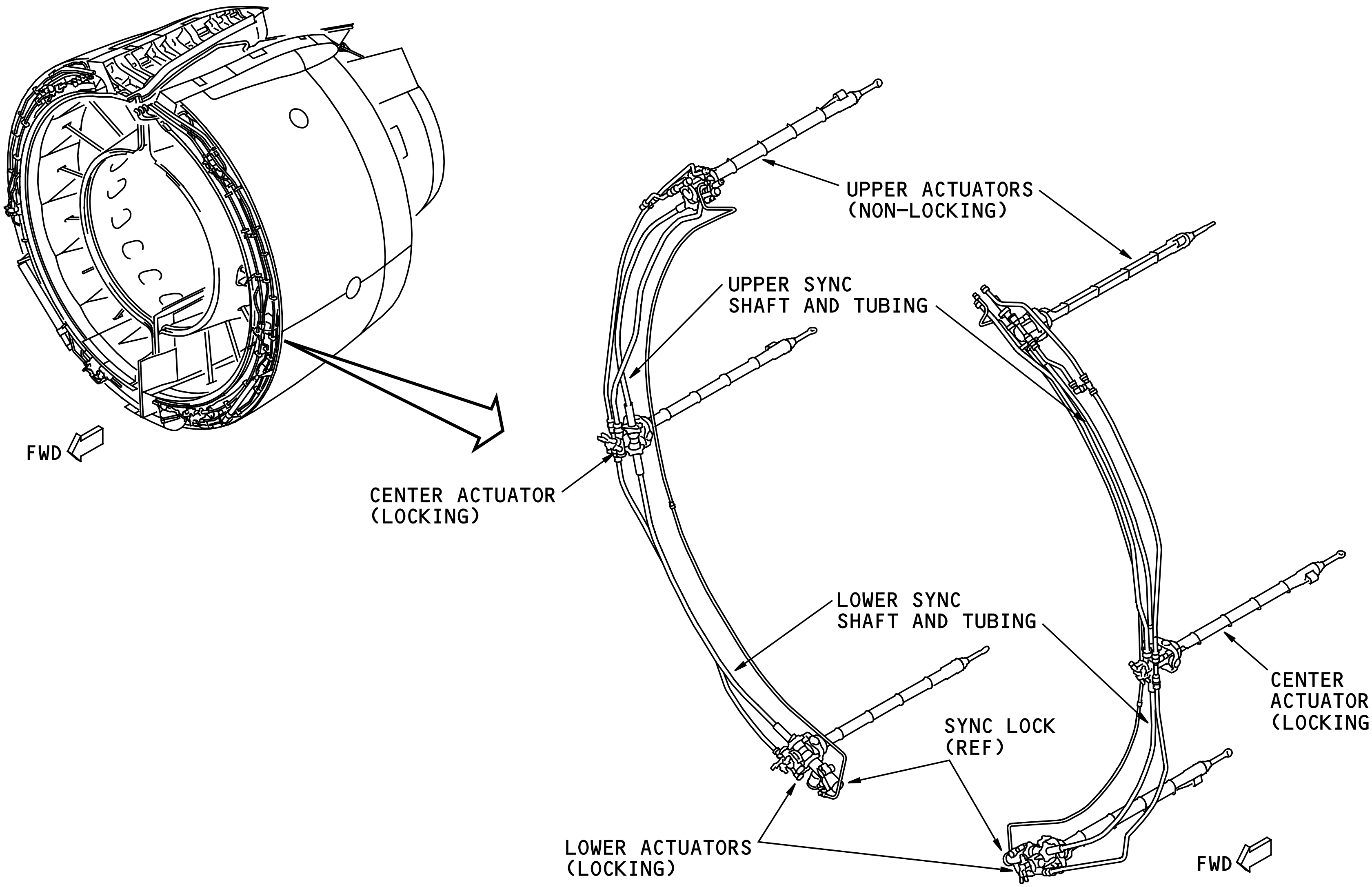
Each T/R half has two locking actuators and one non-locking actuator.

Sync Shafts and Tubing

There is an upper and lower sync shaft and tubing on each T/R half.

The sync shaft tubing contains the sync shaft. The tubing also makes a routing for the TRAS extend pressure to go from the center actuator to the upper and lower actuators.

The sync shafts connect the drive mechanisms of the actuators together. The sync shafts on the left T/R half operate independently of sync shafts on the right T/R half.



78-34-00-110 Rev 0

TRAS - HYDRAULIC ACTUATORS, SYNC SHAFTS AND TUBING - INTRODUCTION

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TRAS - LOCKING HYDRAULIC ACTUATORS

Purpose

The locking hydraulic actuators do these functions:

- Extend the T/R sleeves
- Retract the T/R sleeves
- Lock the T/R sleeves in the retracted position.

Location

Each T/R half has a center and lower locking actuator. They attach to the T/R torque box and the T/R sleeve.

You get access to the end that attaches to the sleeve through the access panels on the side of the T/R sleeve.

Physical Description

The locking actuators have these parts and connections:

- Extend pressure connections
- Retract pressure connections
- Sync shaft and tubing connections
- Gimbal assembly
- Lock release lever and lever lock pin
- Actuator lock proximity sensor.

Extend Pressure Connections

The extend pressure connection on the center actuator gets extend pressure from the DCV.

The extend pressure connection on the lower actuator has a cap. The lower actuator does not use the extend pressure connection. It gets extend pressure from the center actuator through the sync shaft tube.

Retract Pressure Connections

The upper retract pressure connection on the center actuator gets TRAS retract pressure from the upper actuator. The lower actuator gets retract pressure from the center actuator.

Sync Shaft and Tubing Connections

The sync shaft connects the drive mechanisms of the actuators together. There are connections on both the top and bottom of each actuator. The sync lock/manual drive unit connects to the sync shaft connection on the bottom of the lower actuator. The tubing makes a routing for the TRAS extend pressure.

Gimbal Assembly

A gimbal assembly attaches the head end of the actuator to the forward side of the T/R torque box. You must open the fan cowl to get access to the gimbal assembly.

Lock Release Lever and Lever Lock Pin

The lock release lever releases the locking mechanism in the actuator. The lever lock pin holds the lever in the not locked position. This permits the manual movement of the T/R sleeve.

TRAS - LOCKING HYDRAULIC ACTUATORS

Actuator Lock Proximity Sensor

The actuator lock proximity sensor sends lock position data to the T/R indicating and fault detection system.

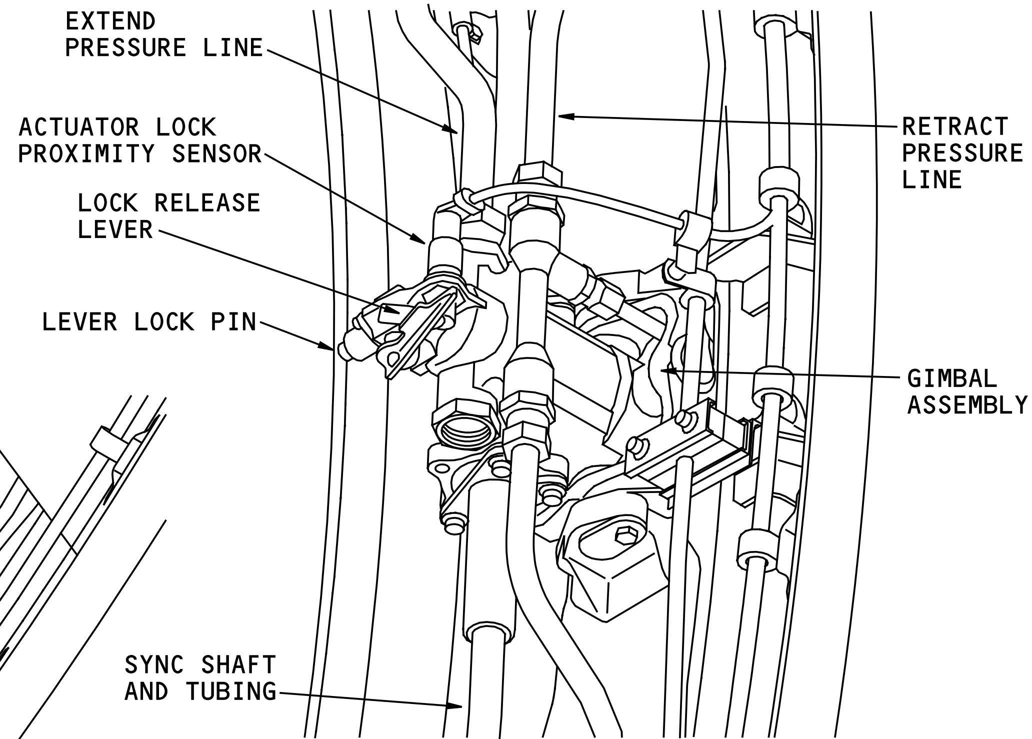
Functional Description

When there is no reverse thrust command, an internal lock mechanism locks the actuators in the retracted position.

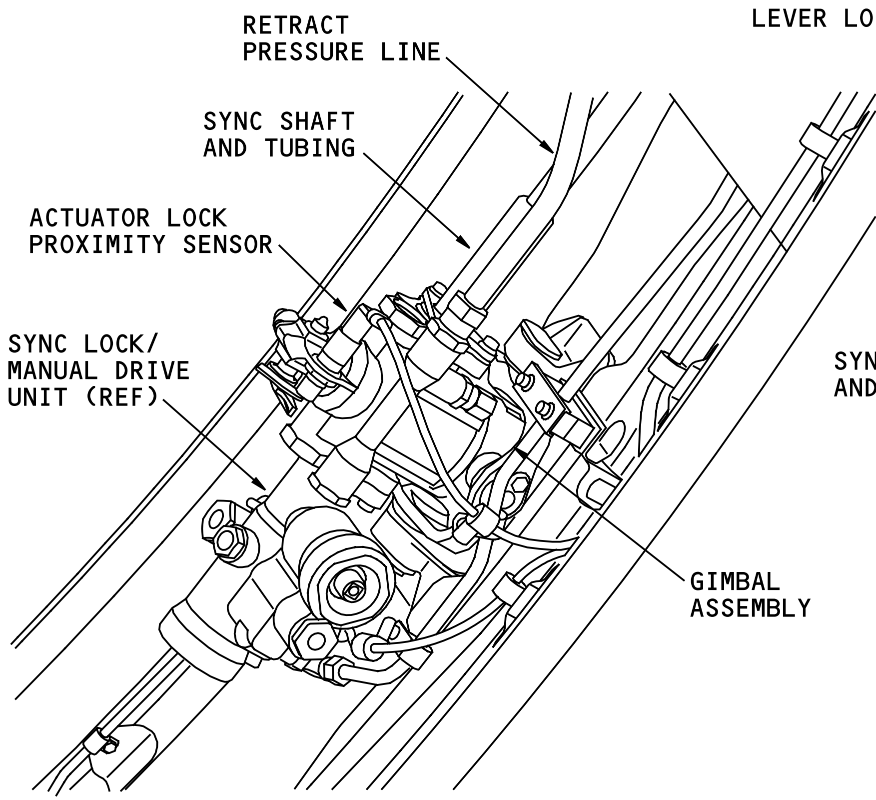
When there is a reverse thrust command, TRAS extend pressure releases the actuator lock mechanism. This permits the actuators to move the T/R sleeve to the extended position.

Training Information Point

The locking actuators are interchangeable.



CENTER ACTUATOR



LOWER ACTUATOR

78-34-00-111 Rev 3 10/23/95

TRAS - LOCKING HYDRAULIC ACTUATORS

TRAS - NON-LOCKING HYDRAULIC ACTUATORS

Purpose

The non-locking hydraulic actuators do these functions:

- Extend the T/R sleeves
- Retract the T/R sleeves
- Turn the RVDTs.

Location

Each T/R half has one non-locking actuator on the upper part of the T/R. It attaches to the torque box and the T/R sleeve.

You get access to the end that attaches to the sleeve through the access panels on the side of the T/R sleeve (not shown).

Physical Description

The non-locking actuators have these parts and connections:

- Retract pressure connections
- Sync shaft and tubing connections
- Gimbal assembly
- RVDT.

Retract Pressure Connections

The upper retract pressure connection gets TRAS retract pressure from the DCV. The lower retract pressure connection sends retract pressure to the center actuator.

Sync Shaft and Tubing Connections

The sync shaft connects the drive mechanisms of the actuators together. There are connections on both the top and bottom of each actuator. The tubing makes a routing for the TRAS extend pressure. The center actuator sends extend pressure to the upper actuator through the sync shaft tubing.

Gimbal Assembly

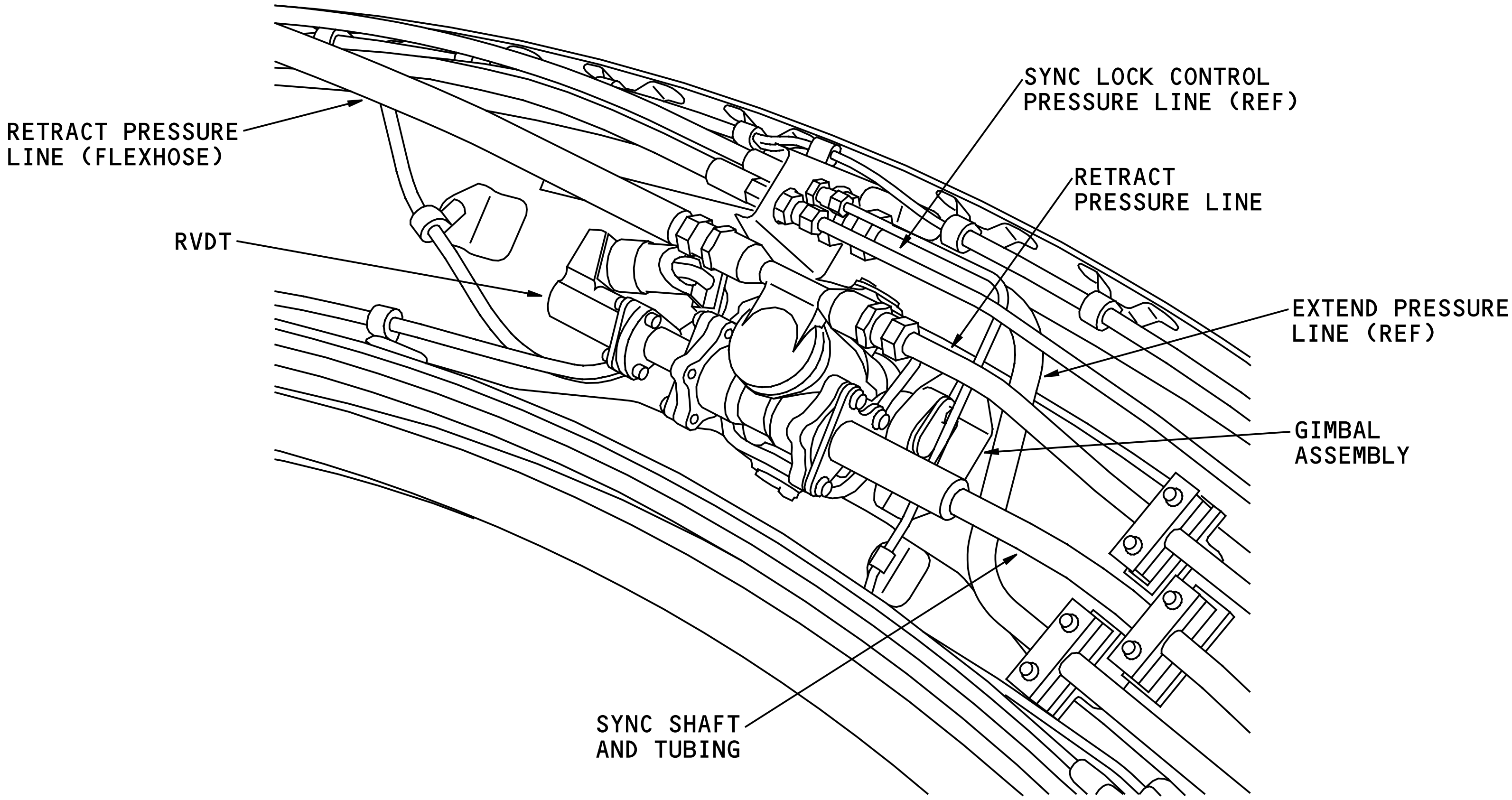
A gimbal assembly attaches the head end of the actuator to the forward side of the T/R torque box. You must open the fan cowl to get access to the gimbal assembly.

RVDT

The RVDT attaches to the upper sync shaft and tubing connection. The drive mechanism in the upper actuator turns the RVDT. The RVDT sends T/R sleeve position data to the EEC for control and indication functions.

Training Information Point

The non-Locking actuators are interchangeable.



LEFT UPPER ACTUATOR

78-34-00-112 Rev 3 10/23/95

TRAS - NON-LOCKING HYDRAULIC ACTUATORS

TRAS - THRUST LEVER INTERLOCK ACTUATOR

Purpose

The thrust lever interlock actuator keeps the movement of the reverse thrust lever to a limit when you command reverse thrust. This keeps the engine thrust command at idle until the T/R sleeves get near the extended position.

Physical Description

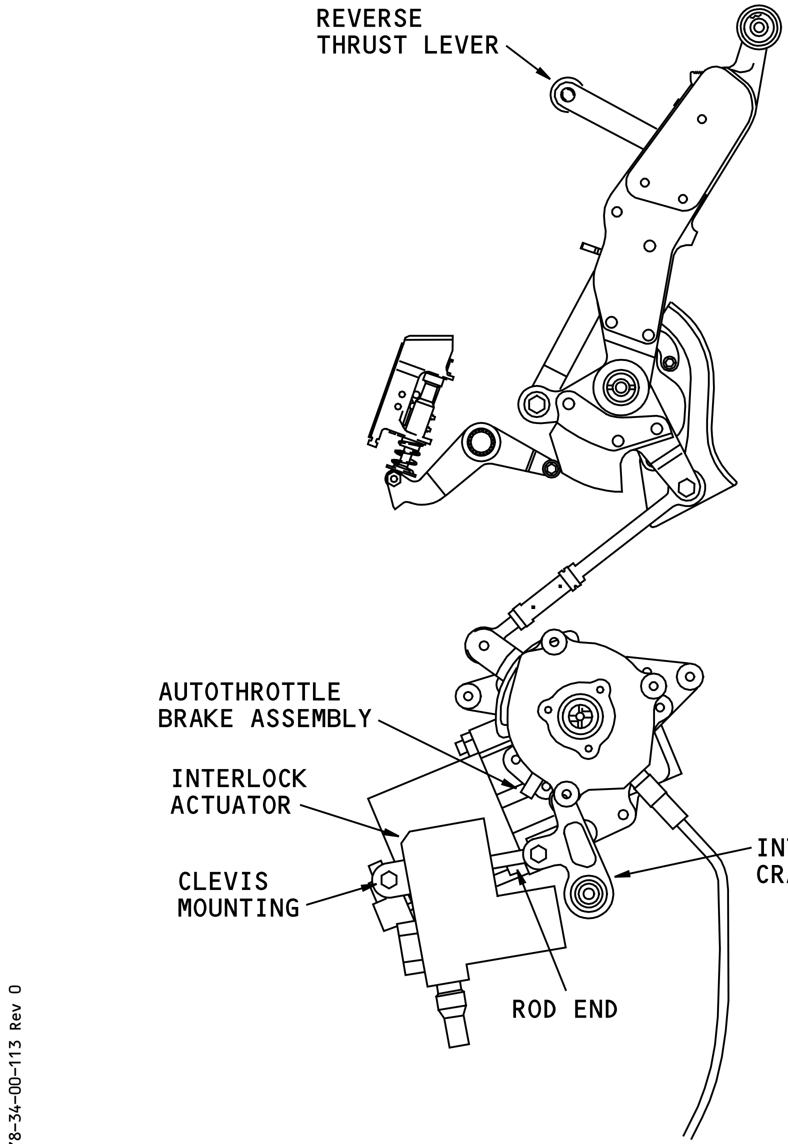
The actuator is a 28v dc linear type. It has a clevis mounting that attaches the actuator to the control stand structure. It has a rod that attaches to the interlock crank assembly.

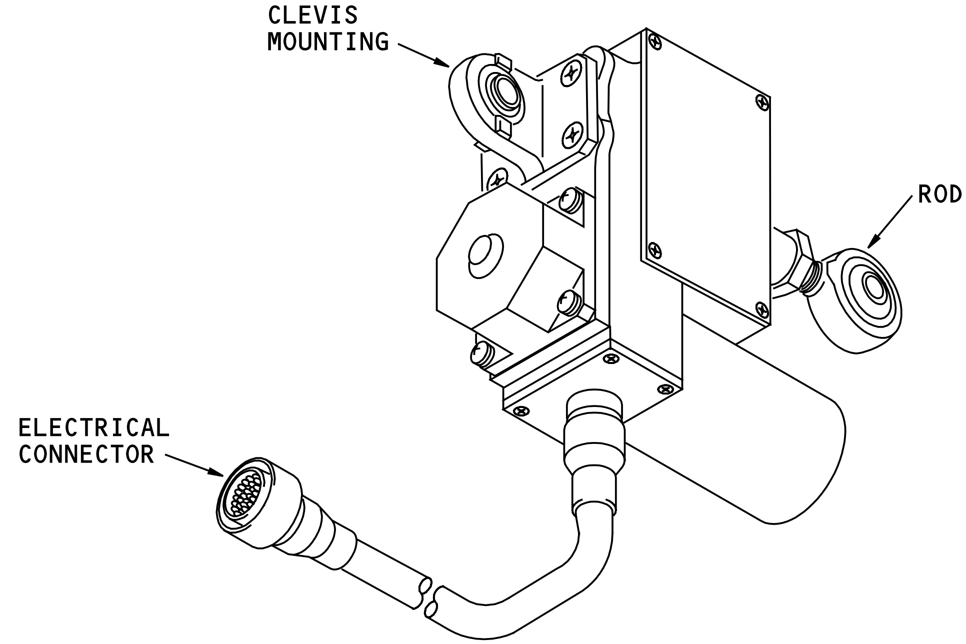
Functional Description

When you command reverse thrust, the reverse thrust lever causes the autothrottle brake assembly to turn into the interlock crank assembly. The crank assembly prevents any more movement of the autothrottle brake assembly in the reverse thrust direction. It stops the assembly at the reverse thrust interlock position.

When the T/R sleeves get near the extended position, the EEC energizes the interlock actuator to extend the rod end. This moves the interlock crank assembly and permits the autothrottle brake assembly to turn to the maximum reverse thrust position.

There is no interlock actuator limit when you command forward thrust.





INTERLOCK ACTUATOR

TRAS - THRUST LEVER INTERLOCK ACTUATOR

TRAS - FUNCTIONAL DESCRIPTION - CONTROL

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TRAS - FUNCTIONAL DESCRIPTION - CONTROL

General

When the engine fire switch is in the NORM position, the TRAS uses electrical power from the main dc bus to control the extension and retraction of the T/R sleeves.

These components must get control signals before the thrust reversers can move:

- SL solenoid valve
- Directional control solenoid valve
- Isolation solenoid valve.

These components send the control signals:

- SL switch through the SL relay
- DCV switch
- EEC.

Extend

When you move the reverse thrust lever to the reverse idle position, the SL and DCV switches move to the extend position. The SL switch sends a control signal to the SL relay. When the SL relay energizes, power goes to the SL solenoid valve. The SL solenoid valve energizes so that hydraulic control pressure can release the sync lock.

The DCV switch energizes the directional control solenoid valve. This permits hydraulic control pressure to operate the DCV. The DCV moves to the extend position.

The EEC must have these inputs to energize the isolation solenoid valve:

- TRA less than 30 degrees
- Airplane on ground
- Engine operating.

If the EEC finds the inputs to be in the proper configuration to extend the thrust reverser, the EEC energizes the isolation solenoid valve. This pressurizes the T/R system and extends the sleeves. The EEC uses data from the hydraulic pressure switch to make sure the isolation valve is in the correct position.

Retract

When you move the reverse thrust lever to the forward idle position, the isolation valve stays open. The EEC starts a 20 second time delay. The time delay keeps the isolation valve open to make sure retraction is complete. After the time delay, the EEC de-energizes the isolation valve solenoid.

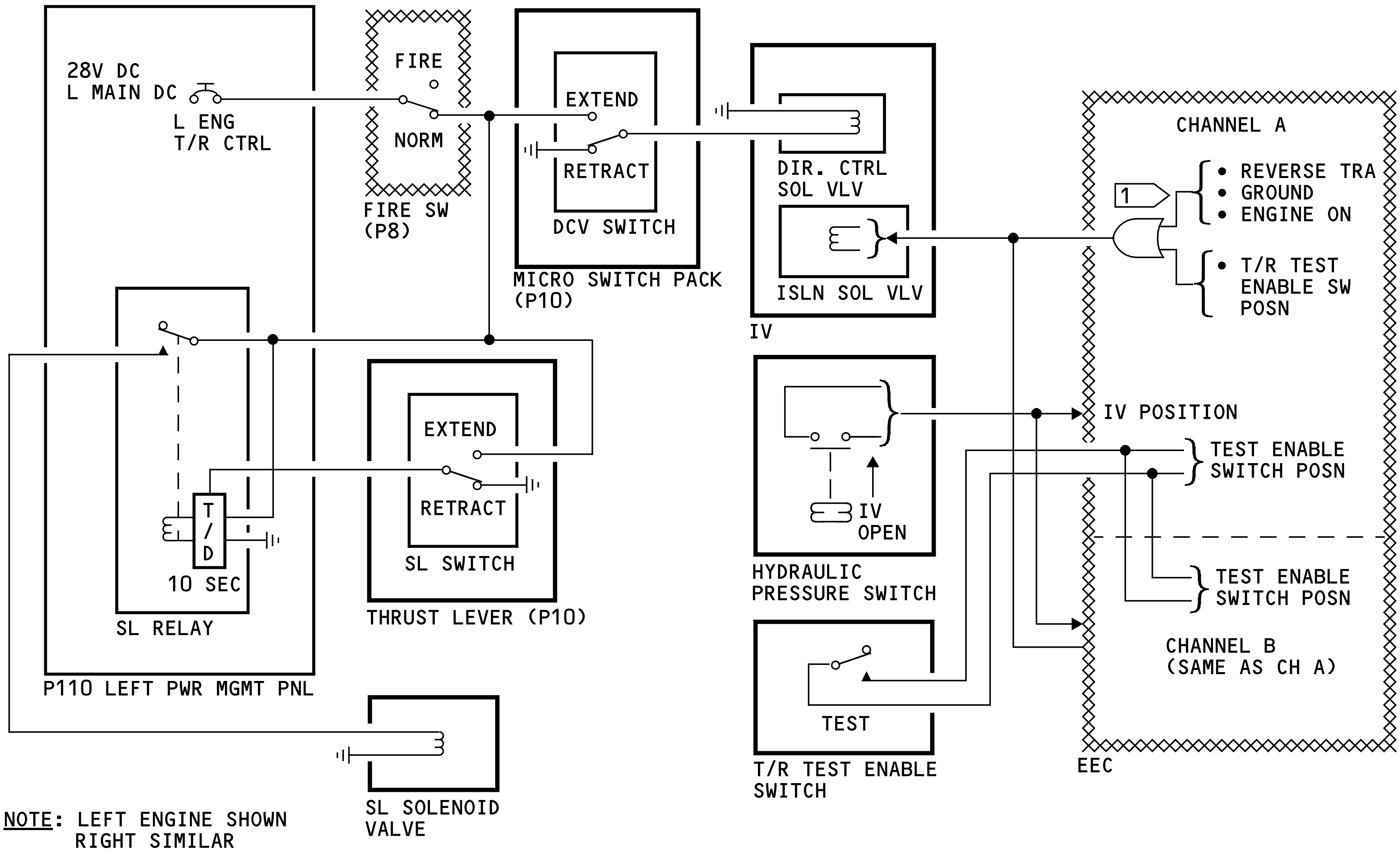
The DCV switch moves to the retract position and de-energizes the directional control solenoid valve. The DCV moves to the retract position. This permits hydraulic power to retract the hydraulic actuators.

TRAS - FUNCTIONAL DESCRIPTION - CONTROL

The SL switch moves to the retract position and de-energizes the SL relay. A 10 second time delay keeps the SL relay energized to make sure retraction is complete. When SL relay de-energizes, the SL solenoid valve closes. This locks the sync lock/manual drive unit.

Manual Operation

You use the T/R test enable switch to extend the T/R sleeves to do maintenance. You push and hold the switch with the reverse thrust levers up. This permits the EEC to energize the isolation solenoid valve when the engine is not running.



NOTE: LEFT ENGINE SHOWN
RIGHT SIMILAR

1 20 SECOND TIME DELAY
DURING RETRACTION

TRAS - FUNCTIONAL DESCRIPTION - CONTROL

TRAS - FUNCTIONAL DESCRIPTION - ACTUATION

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TRAS - FUNCTIONAL DESCRIPTION - ACTUATION

General

To extend or retract the T/R sleeves, hydraulic pressure must release the sync locks and move the hydraulic actuators.

To release the sync locks, hydraulic pressure goes through the SLV to the sync locks.

To move the T/R sleeves, hydraulic pressure goes to the actuators in this sequence:

- IV
- DCV
- Hydraulic actuators.

Flow tees hydraulically connect the components of the two T/R halves to the control components in the strut. The flow tees in the lines from the DCV also contain orifices to hydraulically synchronize the T/R halves.

Extend

This sequence occurs when there is a command to extend the T/R sleeves:

- The SL switch in the thrust lever sends a signal through a relay in the ELMS to energize the SL solenoid valve. The SL solenoid valve opens and supplies hydraulic control pressure through the SLV to the sync locks. The hydraulic control pressure moves the lock mechanisms in the sync locks to release the sync shafts.
- The DCV switch in the switch pack sends a signal to energize the directional control solenoid valve. The directional control solenoid valve opens and supplies hydraulic control pressure to the DCV. This moves an internal spool valve to the extend position.
- The EEC energizes the isolation solenoid valve. This supplies internal hydraulic control pressure to move the isolation shutoff valve to the open position. The open shutoff valve supplies hydraulic system pressure through the bypass valve to the TRAS pressure port of the isolation valve.

TRAS pressure from the isolation valve goes through DCV to the head (extend) and rod (retract) ends of the hydraulic actuators.

The TRAS extend pressure releases the lock mechanisms in the locking actuators. It also applies a force to the head (extend) end of the actuator pistons. The TRAS retract pressure applies a force on the rod (retract) end of the actuator pistons.

Because the work area of the piston head (extend) ends is larger than the rod (retract) ends, the TRAS pressure moves the actuator to the extended position.

The EEC gets sleeve position data from the RVDTs. When both sleeves are more than 60 percent extended, the EEC energizes the thrust lever interlock actuator. This permits reverse thrust greater than idle.

TRAS - FUNCTIONAL DESCRIPTION - ACTUATION

Retract

This sequence occurs when there is a command to retract the T/R sleeves:

- The SL solenoid valve stays open and supplies hydraulic control pressure through the SLV to the sync locks. The hydraulic control pressure keeps the sync locks and sync shafts released.
- The directional control solenoid valve closes. This removes hydraulic control pressure to the DCV. A spring force moves the internal spool valve to the retract position. This permits TRAS pressure to go only to the retract port of the DCV.
- The isolation solenoid valve stays energized. The internal hydraulic control pressure keeps the isolation shutoff valve open. It supplies hydraulic system pressure through the bypass valve to the TRAS pressure port of the isolation valve.

TRAS pressure from the isolation valve goes through DCV to the rod (retract) end of the hydraulic actuators. This moves the actuators to the retracted position. The head (extend) hydraulic fluid goes to TRAS return.

Time delay circuits in the EEC and the ELMS cause the SLV and isolation valve to stay open. When the time delays are complete, the valves close. This removes hydraulic pressure from the TRAS and causes the sync locks to lock the sync shafts.

When both sleeves are less than 40 percent extended, the EEC energizes the thrust lever interlock actuator. This sets the thrust lever interlock.

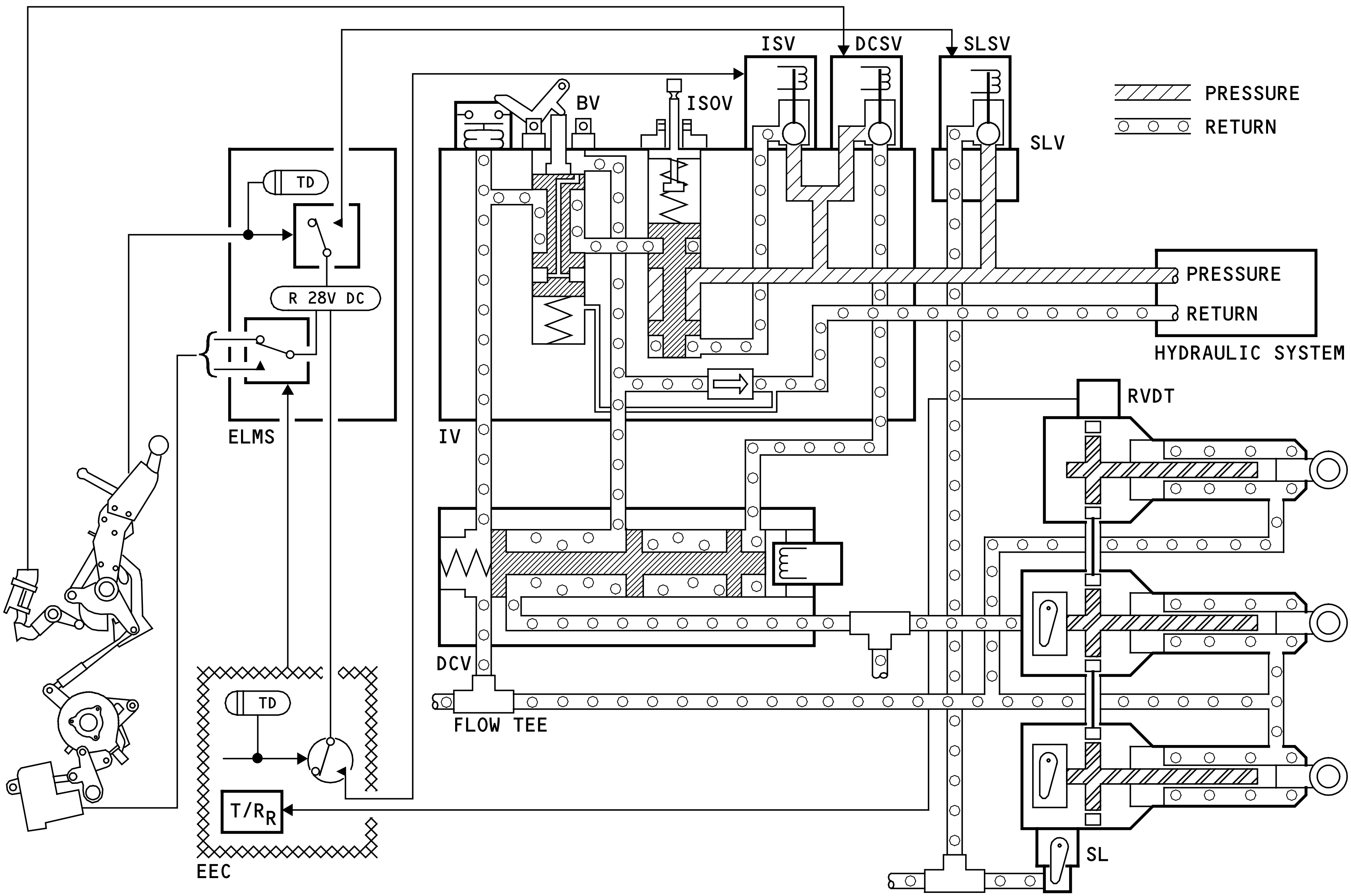
Deactivation

To deactivate the T/R for maintenance, you pull circuit breakers to keep power from the solenoid valves. You must also push the isolation shutoff valve plunger and install pin to hold it in place. This keeps the shutoff valve closed which prevents hydraulic system pressure from going into the T/R actuation system.

Manual Operation

To manually operate the T/R you must deactivate the T/R for maintenance. Then, push the bypass valve handle and install a pin to hold it in place. The bypass valve now connects the extend and retract pressure lines of the TRAS together. This permits hydraulic fluid to flow between them. You use the manual drive unit of the sync locks to extend and retract the T/R.

A small bypass line in the isolation valve body and the bypass valve lets some return pressure fluid into the system. This is needed to prevent a hydraulic lock, because the volume of fluid on the extend side of the actuators is greater than on the retract side.



78-34-00-115 Rev 2 02/14/1997

TRAS - FUNCTIONAL DESCRIPTION - ACTUATION

TRAS - FUNCTIONAL DESCRIPTION - THRUST LEVER INTERLOCK

General

Each thrust lever interlock actuator has two positions:

- Clear (no interlock)
- Set (interlock).

When the interlock actuator is in the set position, you cannot move the reverse thrust lever beyond idle. When the interlock actuator is in the clear position, you can move the reverse thrust lever beyond idle to maximum reverse.

The left main dc bus supplies power to move the interlock actuator.

Clear (No Interlock)

The EEC controls the interlock actuator through the T/R interlock relay in the left power management panel. When the EEC supplies a ground to energize the relay, power goes to the actuator motor. This moves the interlock actuator to the clear position. These conditions must be met for the EEC to energize the relay:

- Both T/R sleeves are more than 60 percent extended
- The TRA is less than 30 degrees.

After the actuator moves to the clear position, limit switches open to remove power to the motor.

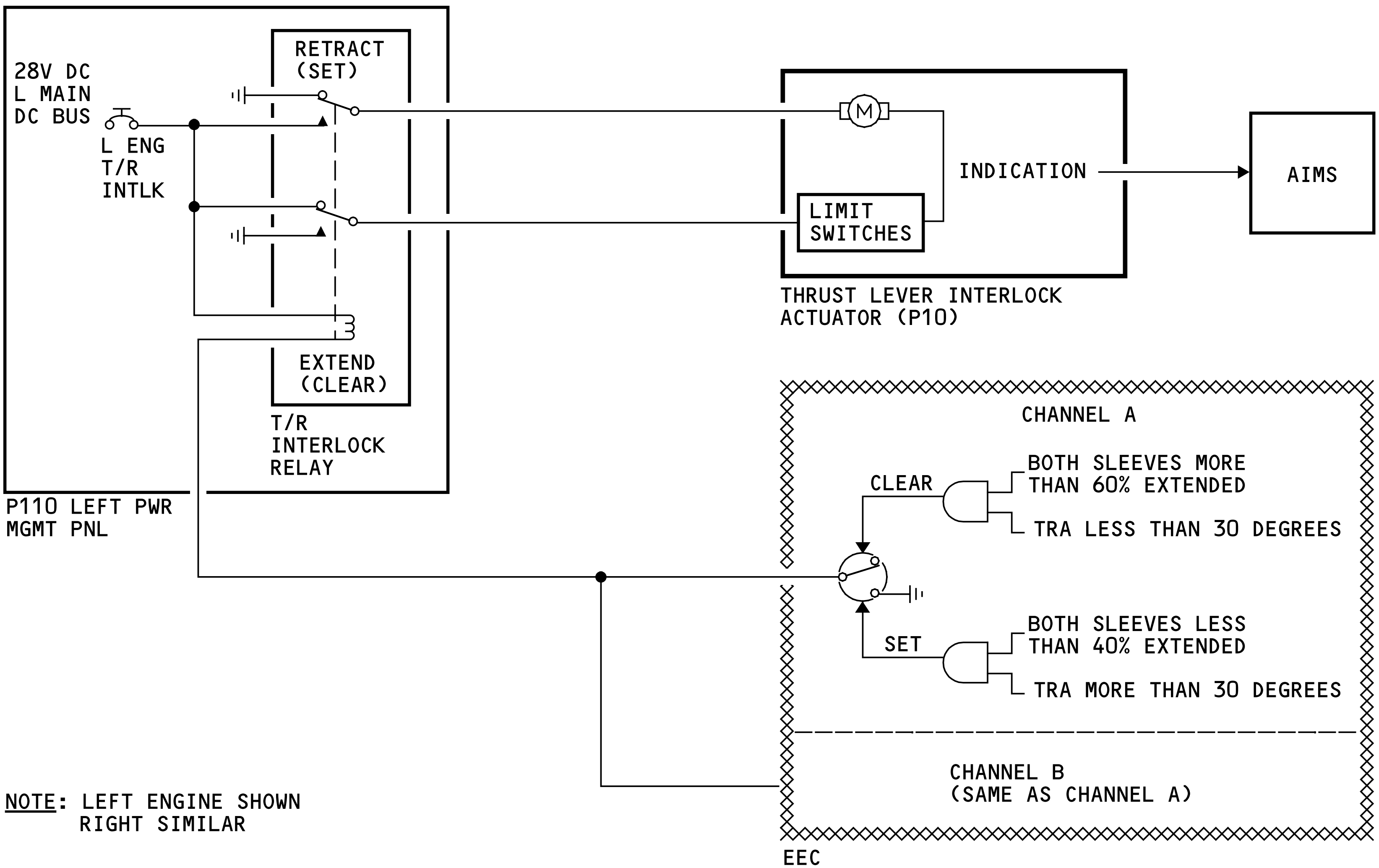
Set (Interlock)

When the EEC removes the ground to the T/R interlock relay, power goes to the actuator motor. This moves the interlock actuator to the set position. These conditions must be met for the EEC to remove the ground:

- Both T/R sleeves are less than 40 percent extended
- The TRA is more than 30 degrees.

After the actuator moves to the set position, limit switches open to remove power to the motor.

If neither of the conditions to clear or set the interlock actuator occur, the EEC does not change the position of the interlock actuator.



78-34-00-116 Rev 1

TRAS - FUNCTIONAL DESCRIPTION - THRUST LEVER INTERLOCK

TRAS - POWER EXTENSION/RETRACTION - TRAINING INFORMATION POINTS

General

To do maintenance on the T/R, you can extend or retract the T/R sleeves without operating the engines. To do this, you supply electrical and hydraulic power. Then you use the EEC maintenance switch and the T/R test enable switch.

Extend

WARNING: DO THE DEACTIVATION PROCEDURE FOR THE SPOILERS. THE SPOILERS CAN EXTEND QUICKLY AND CAUSE INJURY TO PERSONS AND DAMAGE TO EQUIPMENT.

WARNING: MAKE SURE ALL PERSONS AND EQUIPMENT ARE CLEAR OF THE AREA AFT OF THE APPLICABLE THRUST REVERSER. IF YOU DO NOT OBEY THIS INSTRUCTION, INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT CAN OCCUR WHEN THE THRUST REVERSER EXTENDS.

This is an overview of the procedure to extend the T/R sleeves:

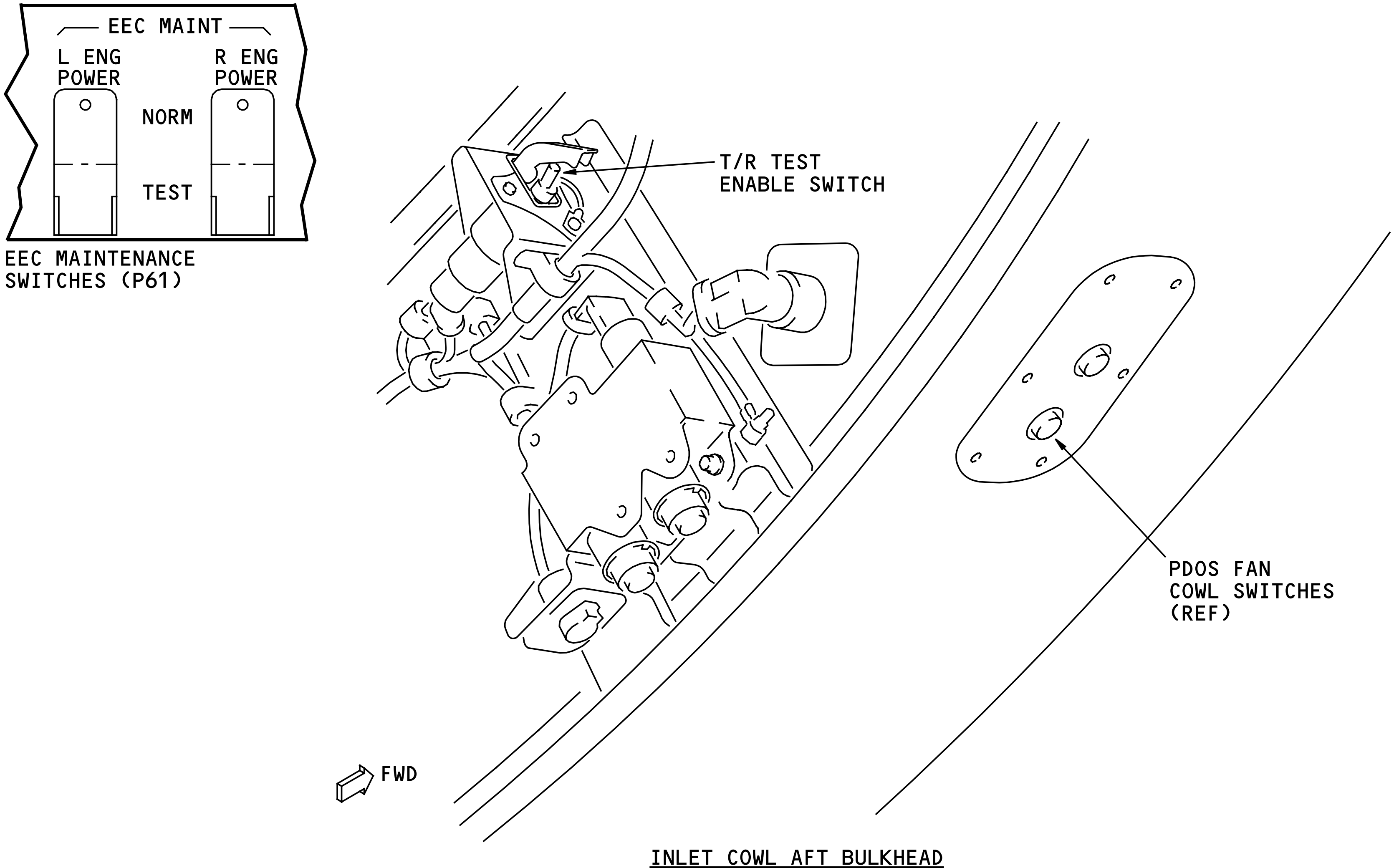
- After you supply electrical and hydraulic power, make sure the fuel control switch is in cutoff.
- Move the applicable EEC maintenance switch to the TEST position. This switch permits power to go to the EEC.
- Move the reverse thrust levers to the interlock (reverse idle) position.
- To extend the sleeve, push and hold the T/R test enable switch. This switch permits the EEC to open the IV when the engine is not running).

When the sleeve is in the fully extended position, you must deactivate the IV before you do maintenance.

Retract

You must use two people to retract the T/R sleeves. This is an overview of the procedure:

- Push and hold the T/R test enable switch.
- Move the reverse thrust levers to the forward idle position.
- When the sleeves are fully retracted, do not hold the T/R test enable switch for more than 20 seconds. If you do, EICAS and CMCS messages will show.



78-34-00-117 Rev 2

TRAS - POWER EXTENSION/RETRACTION - TRAINING INFORMATION POINTS

TRAS - DEACTIVATION - TRAINING INFORMATION POINTS

General

To deactivate the thrust reverser (T/R), you must do these two tasks:

- Make sure that hydraulic power does not go to the T/R system
- Mechanically prevent the movement of each T/R sleeve.

WARNING: DO ALL OF THE SPECIFIED TASKS IN THE CORRECT SEQUENCE TO DEACTIVATE THE THRUST REVERSER. IF YOU DO NOT OBEY THIS INSTRUCTION, INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

Hydraulic Deactivation

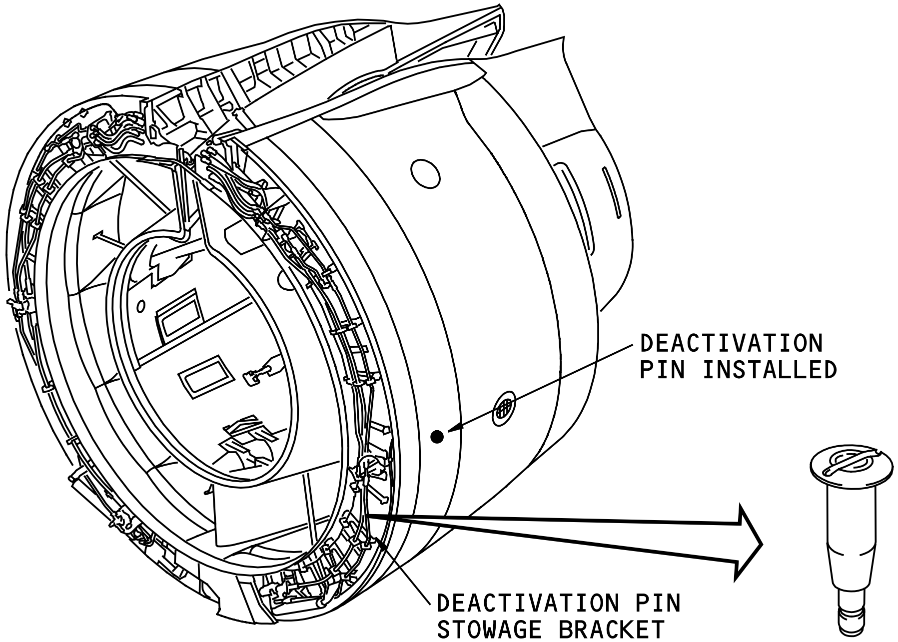
To make sure that hydraulic power does not go to the T/R system, you must put a pin in the isolation shutoff valve spool on the IV. Because the spool is spring-loaded to the out position, you push the spool in and lock it with a pin. This keeps hydraulic power away from the DCV and the hydraulic actuators.

Mechanical Deactivation

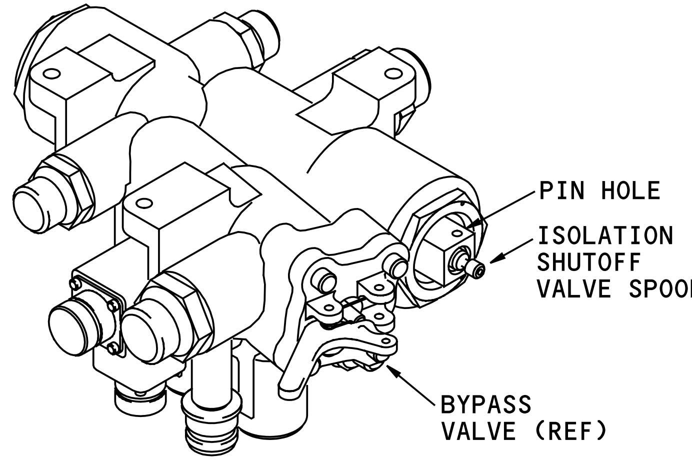
To mechanically prevent the movement of each T/R sleeve, the sleeves must be in the fully retracted position. Then, you remove the plug that is in each outer sleeve and replace it with a deactivation pin. The pins are in a bracket on the T/R torque box between the center and lower actuators of each sleeve. The pin screws in.

Activation

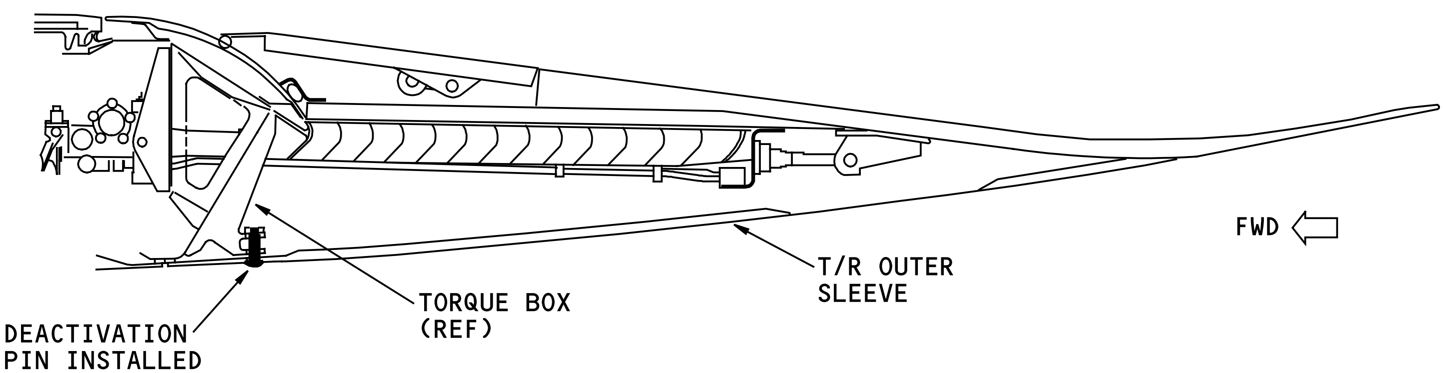
To activate the T/R system, do the deactivation procedure in the reverse order.



DEACTIVATION
PIN



ISOLATION VALVE



VIEW LOOKING DOWN

TRAS - DEACTIVATION - TRAINING INFORMATION POINTS

78-34-00-118 Rev 2 10/23/95

TRAS - MANUAL EXTENSION/RETRACTION - TRAINING INFORMATION POINTS

General

Manual operation permits you to move one sleeve at a time. To move each sleeve manually, you must unlock the related two locking actuators and the related sync lock. You also operate the bypass valve in the isolation valve.

Extend/Retract

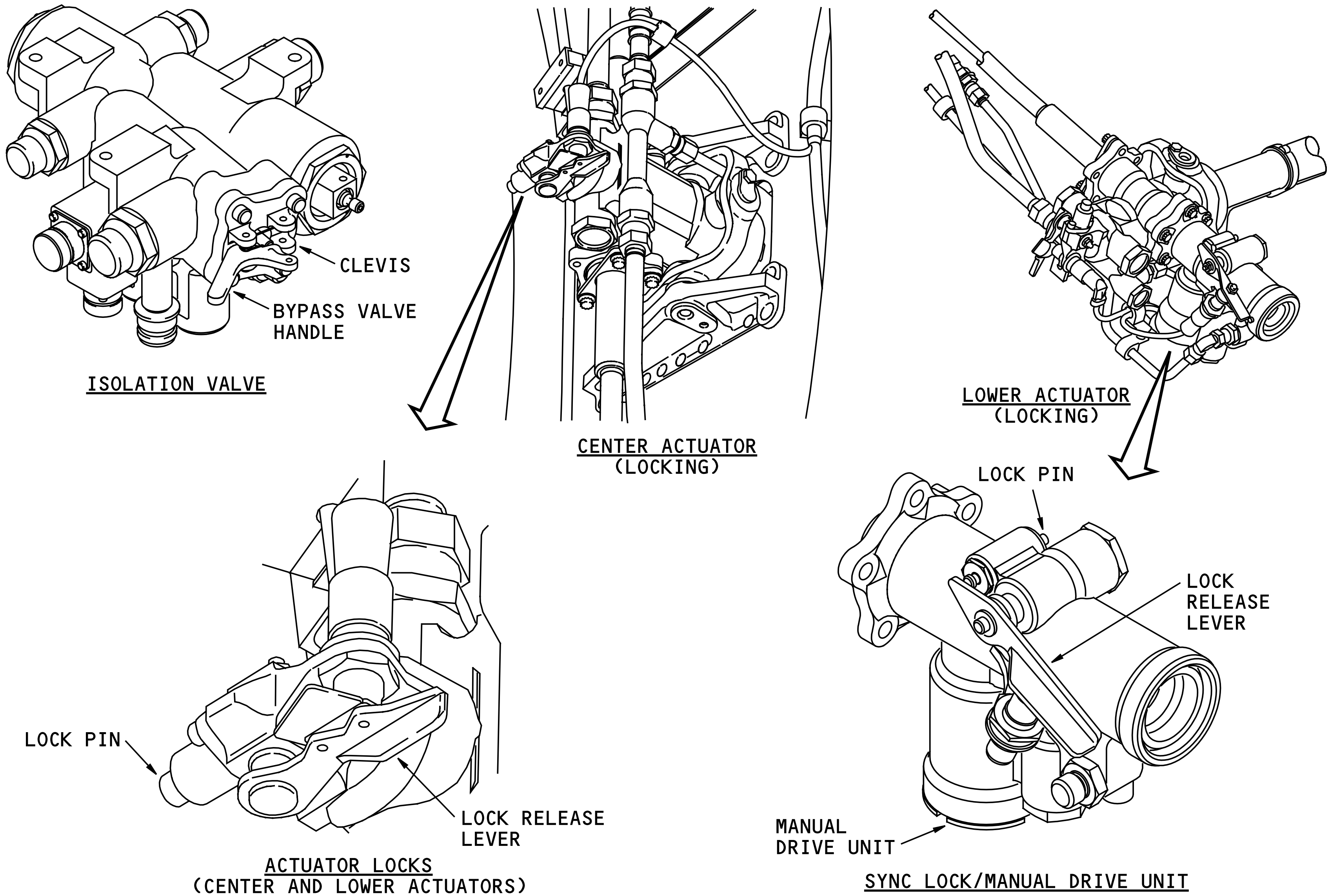
This is an overview of the procedure to manually extend the T/R sleeves:

- Deactivate the IV. (See the section on T/R deactivation for more information.)
- Move the bypass valve handle on the IV so it aligns with the clevis. Install a pin. This keeps the bypass valve open.
- Release the locks on the center actuator, lower actuator, and SL. Push the lock pins in to keep the locks released.
- Use a 3/8 inch square drive on the manual drive unit to extend the sleeve.

NOTE: The bypass valve must be open before you manually extend or retract the T/R sleeve. This will prevent a hydraulic lock, which can prevent movement of the T/R sleeve. But, you must close the bypass valve if you remove T/R components or hydraulic tubing. If you do not close the bypass valve, leakage of the hydraulic fluid from the reservoir will occur when you remove the components or tubing.

NOTE: You must push and hold the 3/8 inch drive in while you turn the manual drive unit. A clutch in the manual drive unit prevents damage to the sync shaft system.

To manually retract the sleeve, do the procedure in the reverse order.



78-34-00-119 Rev 1 10/23/95

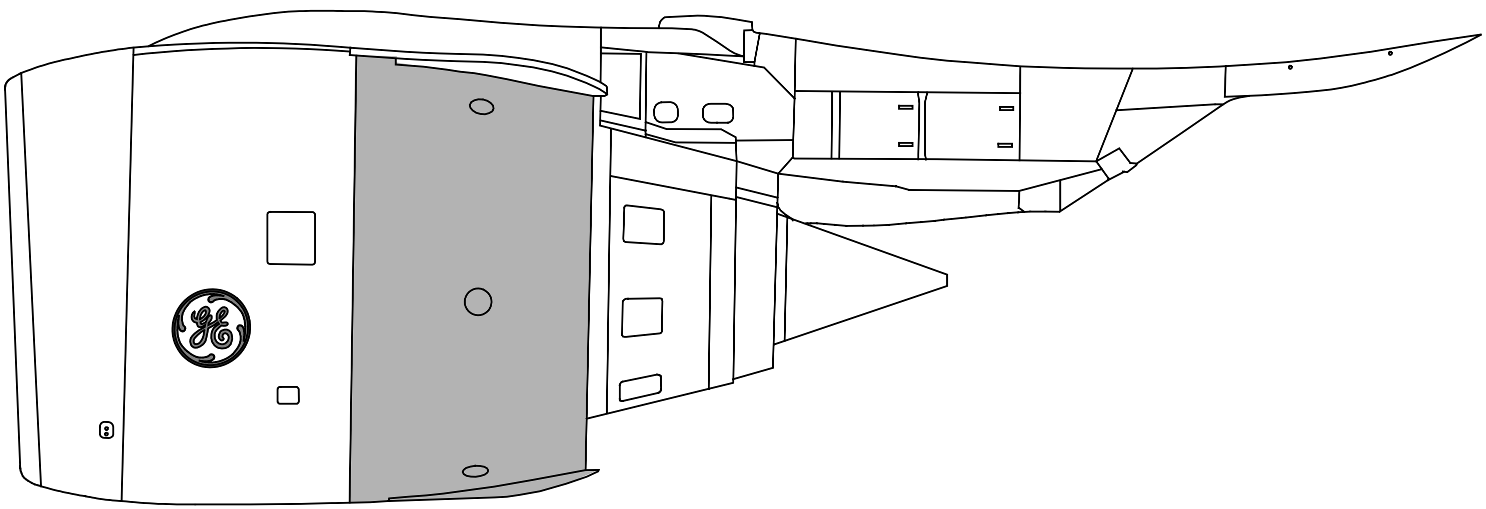
TRAS - MANUAL EXTENSION/RETRACTION - TRAINING INFORMATION POINTS

THRUST REVERSER (T/R) INDICATING AND FAULT DETECTION - INTRODUCTION

Purpose

The T/R indicating and fault detection system supplies data for these functions:

- Extend and retract control
- Flight deck indication
- Fault detection.



ENGINE EXHAUST SYSTEM

- TURBINE EXHAUST SYSTEM
- THRUST REVERSER SYSTEM
- THRUST REVERSER ACTUATION SYSTEM
- THRUST REVERSER INDICATING AND FAULT DETECTION SYSTEM

78-36-00-101 Rev 0

THRUST REVERSER (T/R) INDICATING AND FAULT DETECTION - INTRODUCTION

T/R INDICATING AND FAULT DETECTION - GENERAL DESCRIPTION

General

The T/R indicating and fault detection system monitors the TRAS. It sends T/R sleeve, lock, and valve position data to the EEC and the proximity sensor electronics unit (PSEU).

EEC Data

The T/R indicating and fault detection system sends this data to the EEC:

- T/R isolation valve (IV) position with the hydraulic pressure switch
- T/R sleeve position with the RVDT.

The EEC uses the pressure switch data to monitor the position of the IV. The EEC uses the RVDT data to make sure the T/R sleeves are in the correct position before you can increase thrust.

The EEC sends data to the AIMS for these indications:

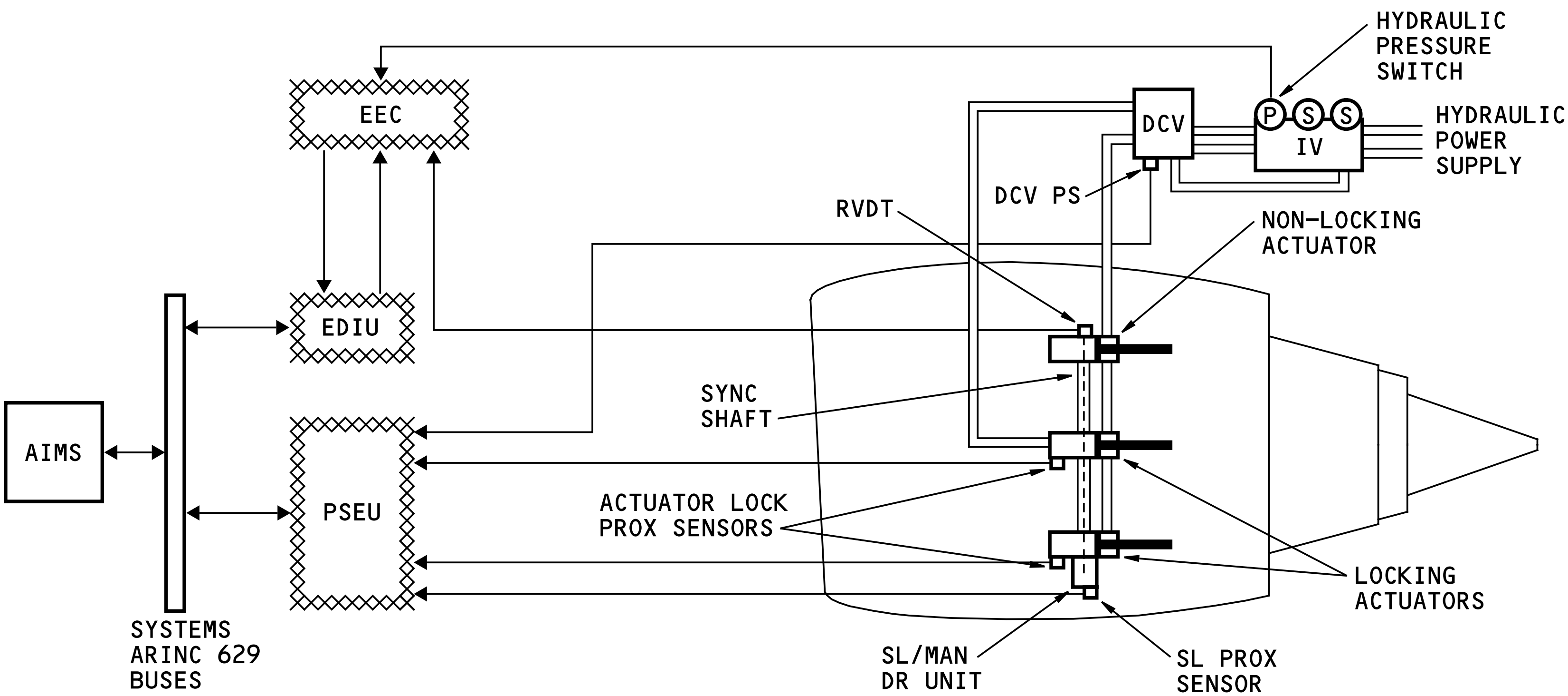
- Normal extend and retract indication
- Alert, status, and maintenance messages if the position of the isolation valve or the T/R sleeve is not correct.

PSEU Data

The T/R on each engine has seven proximity sensors. They send this data to the PSEU:

- DCV position
- Locking hydraulic actuator positions (locked or not locked)
- Sync lock positions (locked or not locked).

The PSEU sends the data to the AIMS to make alert, status, and maintenance messages for non-normal conditions.



78-36-00-102 Rev 1 09/11/1995

T/R INDICATING AND FAULT DETECTION - GENERAL DESCRIPTION

T/R INDICATING AND FAULT DETECTION - ENGINE COMPONENT LOCATIONS

General

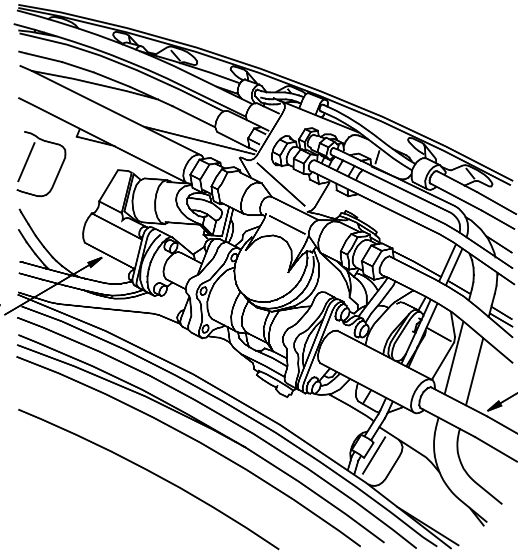
All components on the engine are on the forward torque box of the thrust reverser. You open the fan cowl to get access to these components.

Component Locations

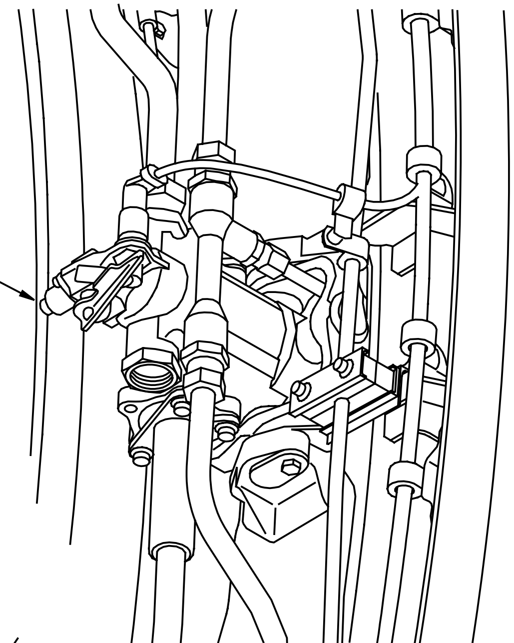
There is one RVDT on the non-locking (upper) hydraulic actuator of each thrust reverser half. The RVDT is opposite the sync shaft connection to the actuator.

The actuator lock proximity sensor is on the forward part of each locking hydraulic actuator. The sensor uses a proximity sensor and a target.

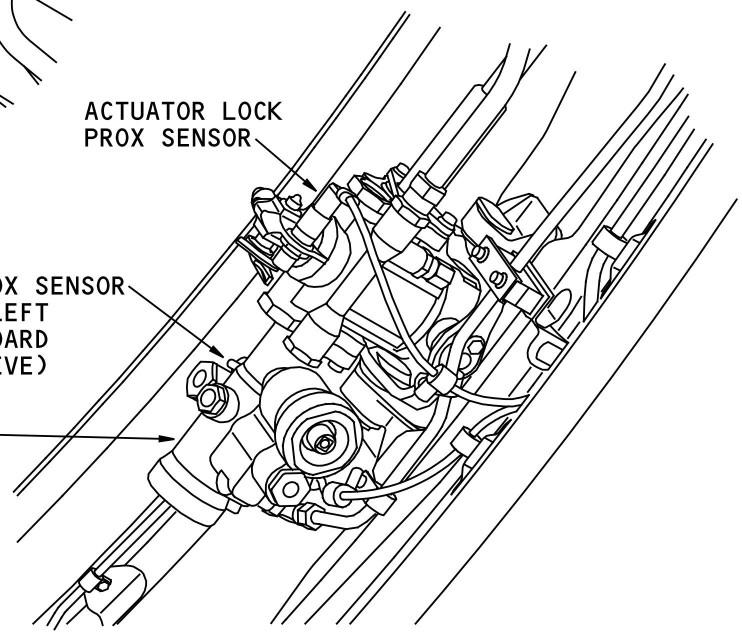
The sync lock proximity sensor is on the thrust reverser sync lock/manual drive unit. The sync lock/manual drive unit attaches to the locking (lower) hydraulic actuator on each thrust reverser. The sensor uses a proximity sensor and a target.



NON-LOCKING ACTUATOR
(LEFT UPPER)



LOCKING ACTUATOR
(LEFT CENTER)



LOCKING ACTUATOR
(LEFT LOWER)

NOTE: LEFT SLEEVE SHOWN,
RIGHT SIMILAR

78-36-00-103 Rev 1 09/11/1995

T/R INDICATING AND FAULT DETECTION - ENGINE COMPONENT LOCATIONS

T/R INDICATING AND FAULT DETECTION - HYDRAULIC PRESSURE SWITCH AND DCV PROXIMITY SENSOR

Hydraulic Pressure Switch

The hydraulic pressure switch monitors the pressure out of the isolation shutoff valve. It sends a signal to the EEC when the isolation valve is open. If the isolation valve is open when there is no command to extend or retract the reverser, the EEC sends a signal to the AIMS to show an alert or status message.

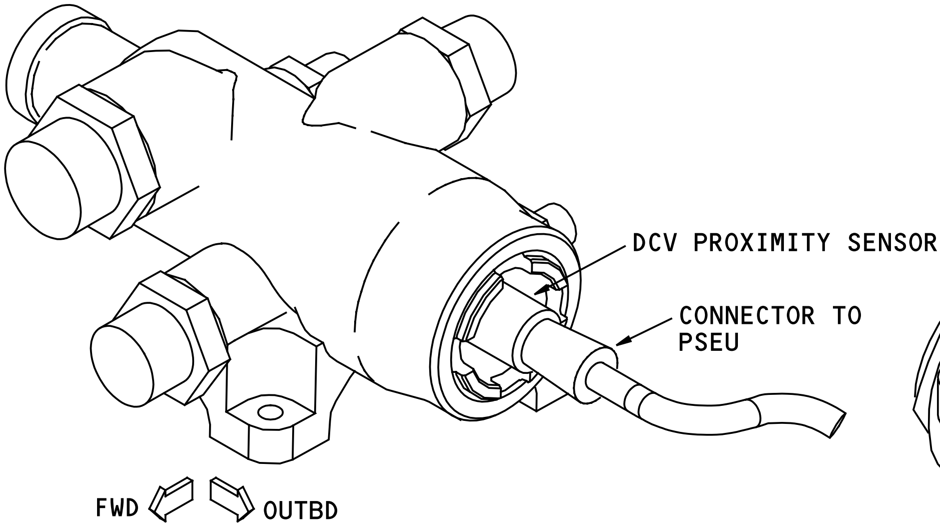
The hydraulic pressure switch is on the forward, left side of the isolation valve. It is near the hydraulic tube that connects to the DCV.

DCV Proximity Sensor

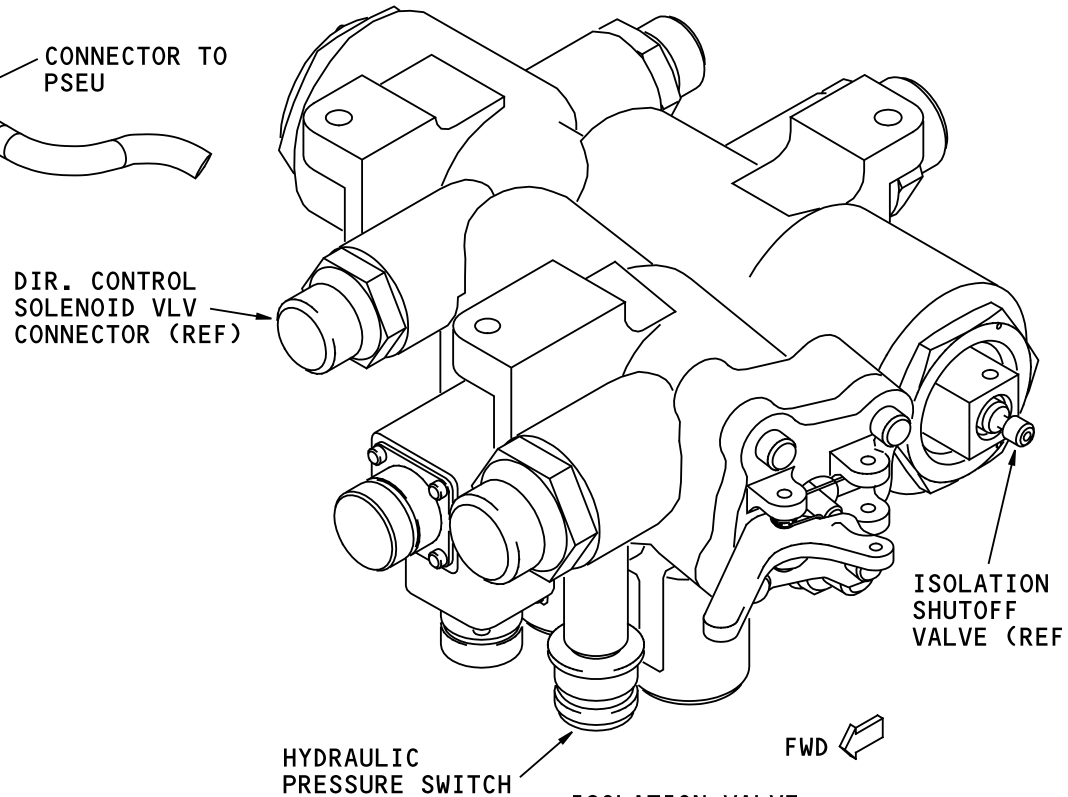
The DCV sensor monitors the position of the directional control valve. The position data goes to the PSEU. If the DCV is in the extend position when there is a retract command, the PSEU sends a signal to the AIMS for fault indication on the flight deck.

The DCV sensor is on the left side of the DCV.

The sensor monitors the position of the spool valve in the DCV (not shown). When the DCV is in the extend position, the spool valve is away from the sensor. When the DCV is in the retract position, the spool valve is near the sensor.



DIRECTIONAL CONTROL VALVE



ISOLATION VALVE

78-36-00-104 Rev 1

T/R INDICATING AND FAULT DETECTION - HYDRAULIC PRESSURE SWITCH AND DCV PROXIMITY SENSOR

T/R INDICATING AND FAULT DETECTION - ACTUATOR LOCK PROXIMITY SENSOR

General

The actuator lock sensor monitors the position of the locking sleeve in each locking hydraulic actuator. It sends the position data to the PSEU.

Each thrust reverser sleeve has two actuator lock sensors. Thus, there are four actuator lock sensors on each engine.

Location

The actuator lock sensors are on the forward end of each locking actuator. You open the fan cowls to get access to the sensors.

Physical Description

Each sensor has two parts: a proximity sensor and a target. The target is part of the lever that connects to the locking sleeve (not shown) in the actuator. The lever is also the lock release lever for the actuator.

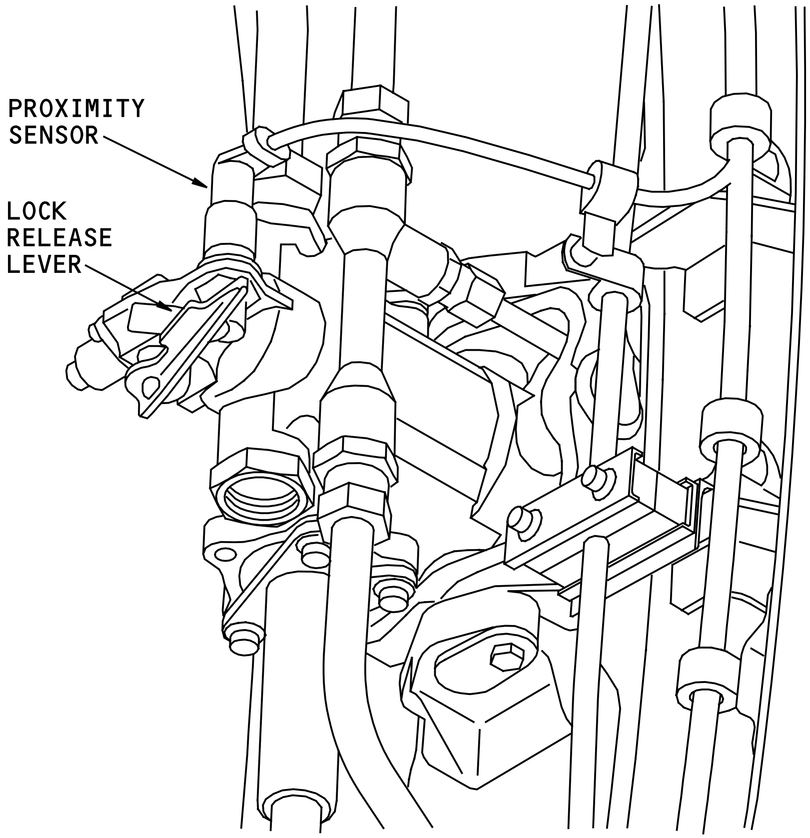
Functional Description

When the actuators get hydraulic pressure, the locking sleeve moves. The target moves away from the sensor. This sends a signal to the PSEU that the actuator is not locked.

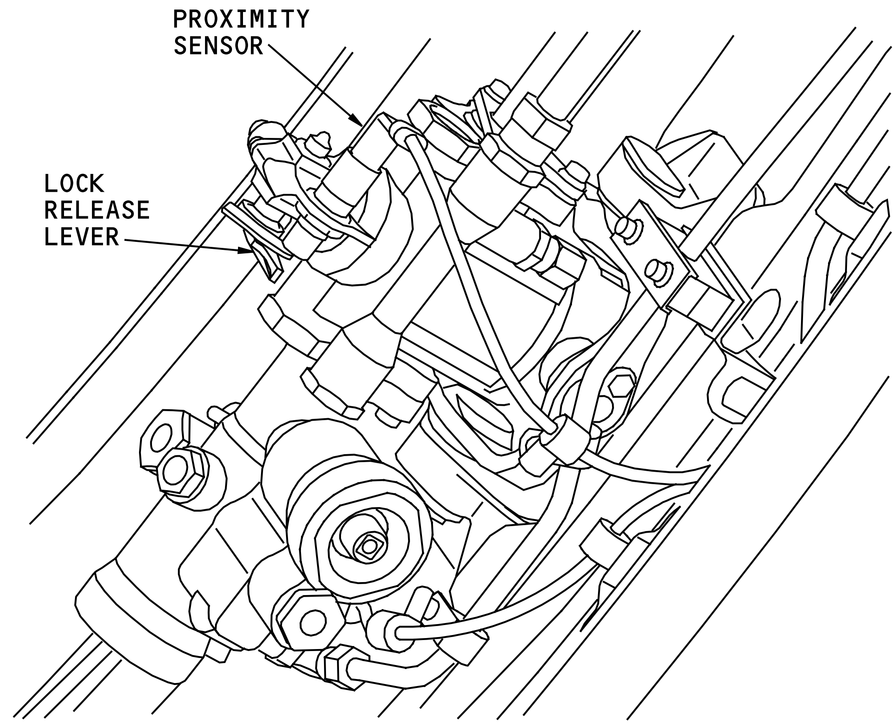
If the locking sleeve is not locked when the thrust reverser is in the retracted position, fault indication shows on the flight deck.

Training Information Point

It is not necessary to rig the actuator lock sensors.



LOCKING ACTUATOR
(LEFT CENTER)



LOCKING ACTUATOR
(LEFT LOWER)

78-36-00-105 Rev 1 09/11/1995

T/R INDICATING AND FAULT DETECTION - ACTUATOR LOCK PROXIMITY SENSOR

T/R INDICATING AND FAULT DETECTION - SYNC LOCK PROXIMITY SENSOR

General

The sync lock proximity sensor monitors the position of the sync lock which attaches to each lower locking hydraulic actuator. It sends the position data to the PSEU.

Each T/R sleeve has one sync lock sensor.

Location

One sensor is on the aft side of the sync lock on the left T/R sleeve. The other sensor is on the forward side of the sync lock on the right T/R sleeve. You open the fan cowls to get access to the sensors.

Physical Description

The sync lock proximity sensor has these parts: a proximity sensor and a target. The target attaches to a lever that connects to the lock mechanism in the sync lock. The lever is also the lock release lever for the sync lock.

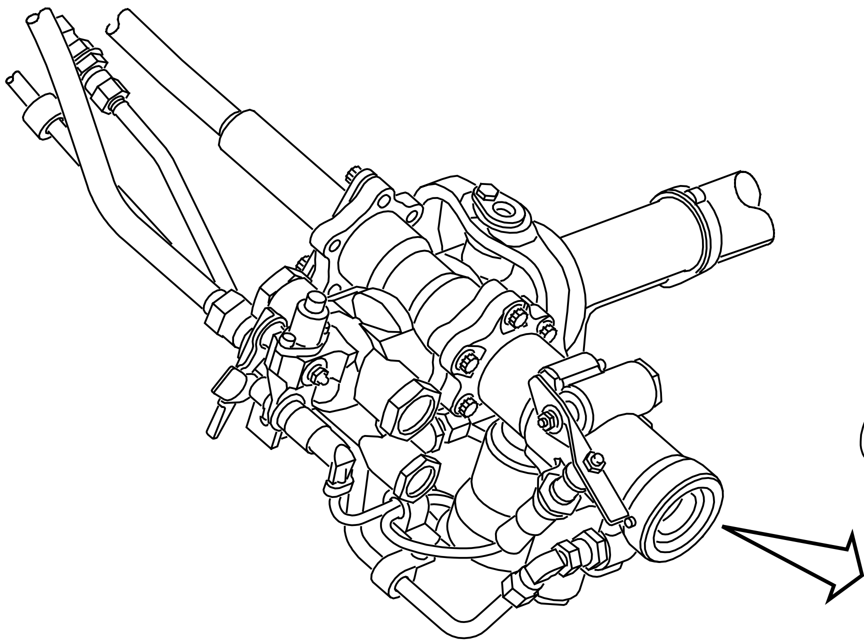
Functional Description

When the sync lock gets hydraulic power, the lock mechanism moves to the released position. Hydraulic pressure and an internal pin keep the lock mechanism in the released position. The target moves away from the sensor. This sends a signal to the PSEU that the actuator is not locked.

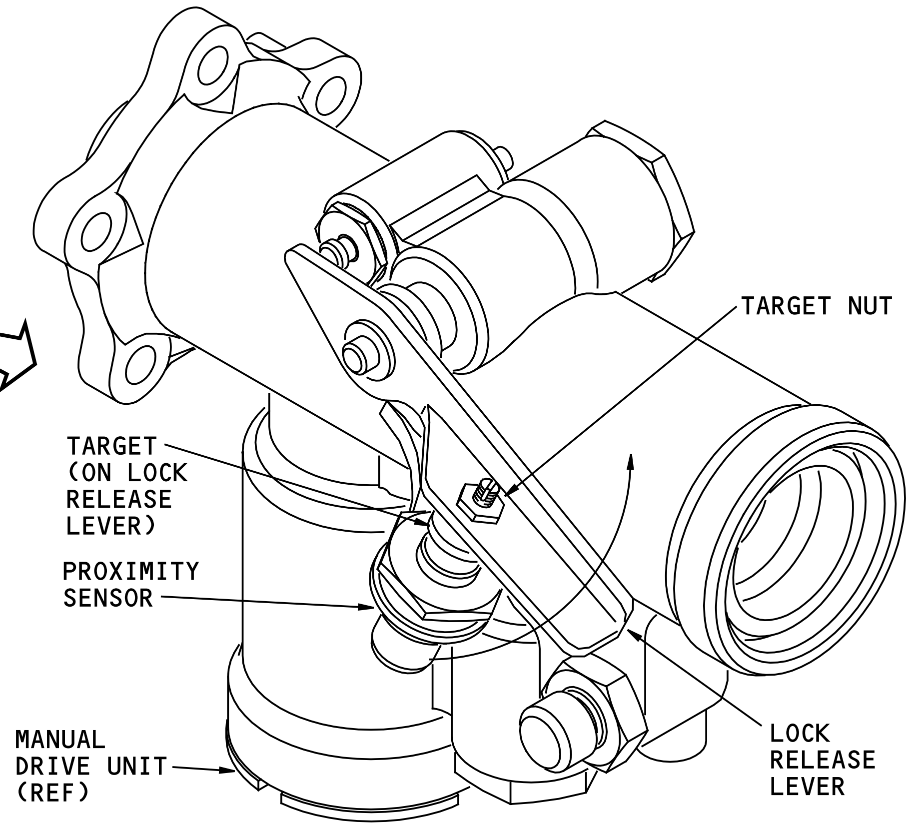
If the sync shaft is not locked when the thrust reverser is in the retracted position, fault indication shows on the flight deck.

Training Information Point

When you install a new proximity sensor, you must do a check of the gap between the proximity sensor and the target. There is a nut on the lock release lever so you can adjust the gap.



LOCKING ACTUATOR
(LOWER)



SYNC LOCK/MANUAL DRIVE UNIT

78-36-00-106 Rev 1 11/07/95

T/R INDICATING AND FAULT DETECTION - SYNC LOCK PROXIMITY SENSOR

T/R INDICATING AND FAULT DETECTION - T/R POSITION TRANSDUCER (RVDT)

General

The RVDT sends T/R sleeve position data to the EEC. The EEC will not permit more than idle thrust if the sleeves are less than 60 percent of full extension. The EEC also uses the data to supply flight deck indication of when the sleeve is not in the fully retracted position, and when the sleeve is fully extended.

There is one RVDT on the non-locking (upper) hydraulic actuator of each sleeve. Thus, each engine has two RVDTs.

Location

The RVDT attaches to the upper end of each non-locking actuator. You open the fan cowls to get access to the RVDTs.

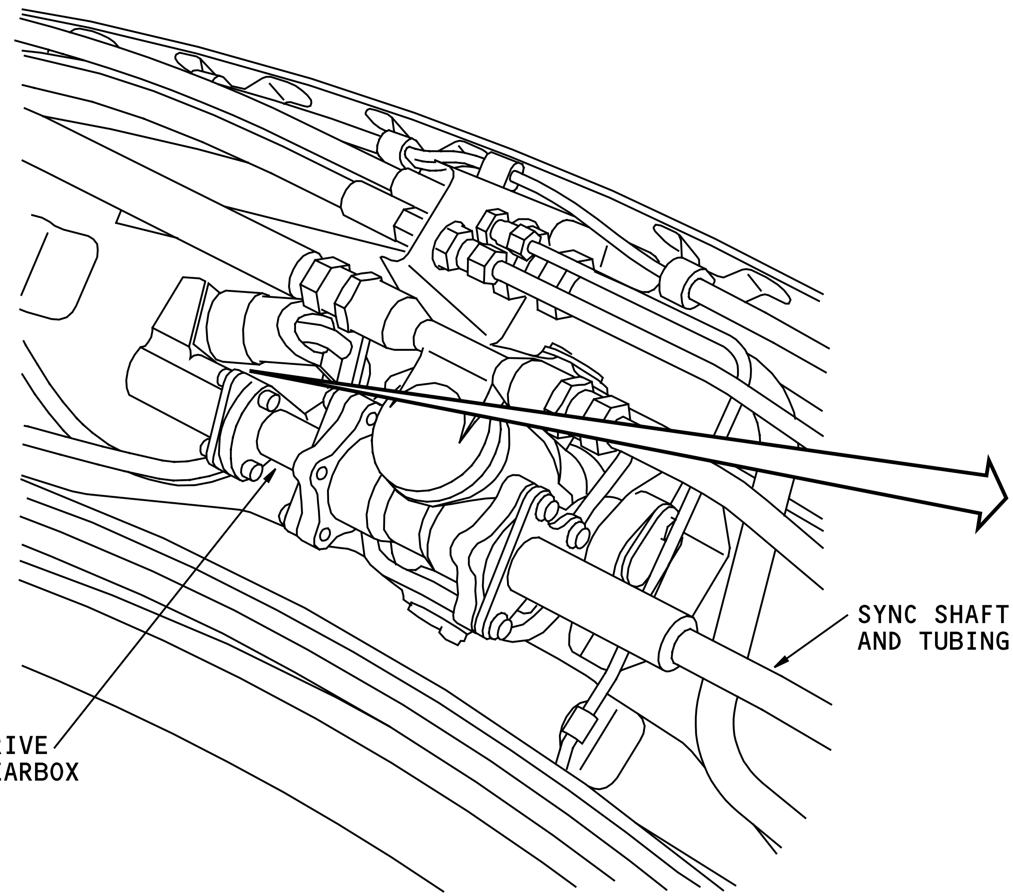
Functional Description

Each RVDT has two sets of windings and two output signals. One signal goes to each channel of the EEC.

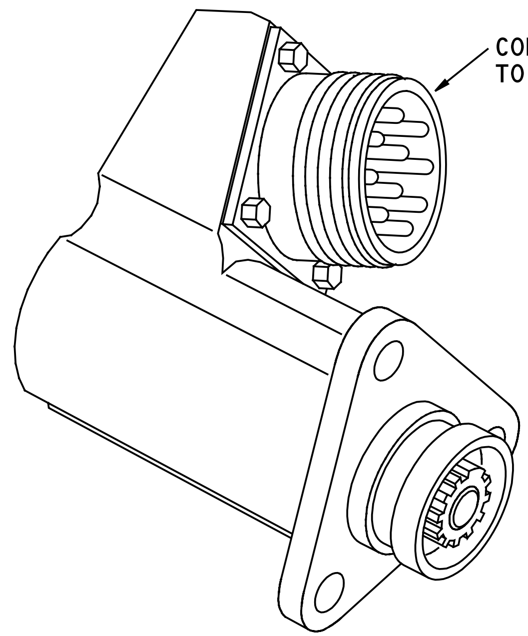
The RVDT attaches to an extension of the sync shaft through a drive gearbox. When the shaft turns, the RVDT makes a voltage that changes linearly in proportion to the sync shaft position.

Training Information Point

If you replace the RVDT and the drive gearbox together, do not turn the gearbox drive spline.



NON-LOCKING ACTUATOR (LEFT UPPER)



RVDT

78-36-00-107 Rev 2 09/11/1995

T/R INDICATING AND FAULT DETECTION - T/R POSITION TRANSDUCER (RVDT)

T/R INDICATING AND FAULT DETECTION - INDICATIONS

General

Flight deck indication of the thrust reverser (T/R) position shows on the EICAS display, status display, and EPCS maintenance page 1. Any system failure that reduces the level of safety of the system shows on both the EICAS display and the status display. There are no alert messages that show in flight. Thus, no crew action is necessary for T/R system faults.

For system faults, the CMCS has maintenance messages to aid in fault isolation.

EICAS Display

T/R position shows above the N1 data on the EICAS display.

When one T/R sleeve extension is 5 percent or more, the amber REV shows on the EICAS display. This tells the flight crew that the T/R is released and in transit.

When both sleeves are 90 percent extended, the amber REV changes to green. This tells the flight crew that the T/R is fully extended.

If the airspeed is less than 80 kts, a system failure that reduces the level of safety causes the ENG REVERSER L(R) advisory message to show.

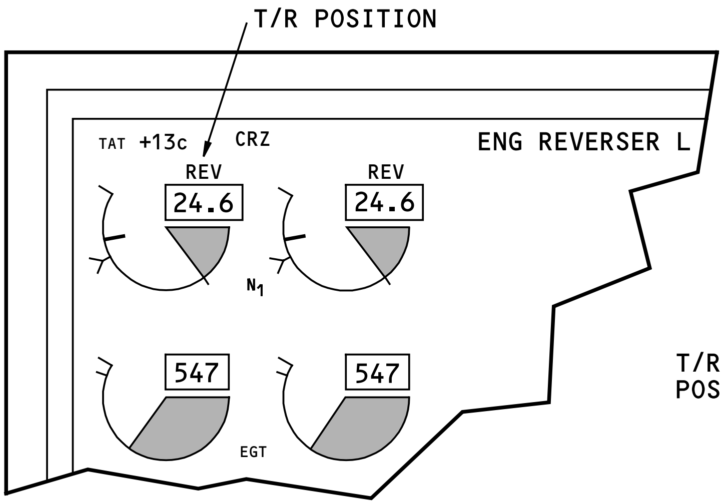
Status Display

The ENG REVERSER L(R) status message shows for any failures that may reduce the system level of safety.

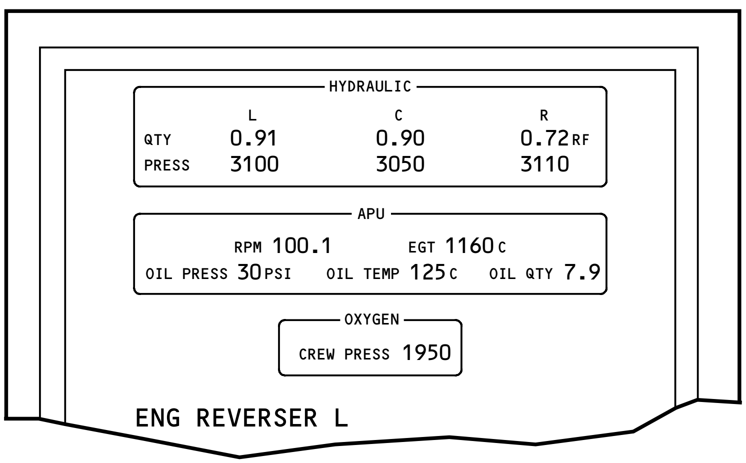
The ENG REVERSER SNSR L(R) status message shows for sensor or sensor circuit faults. This message does not show if the ENG REVERSER L(R) message shows.

EPCS Maintenance Page

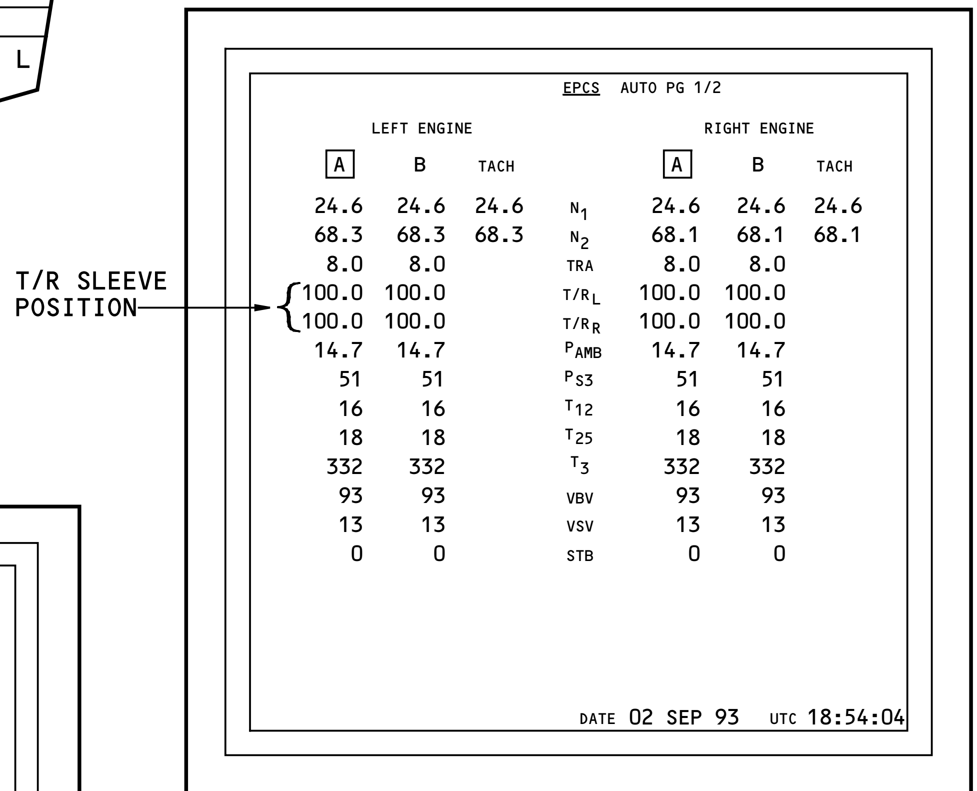
T/R sleeve position shows on the EPCS maintenance page 1. For each EEC channel, the data shows for both the left and right sleeves. The range is from zero percent (fully retracted) to 100 percent (fully extended).



EICAS DISPLAY



STATUS DISPLAY



EPCS MAINTENANCE PAGE 1

78-36-00-108 Rev 1

T/R INDICATING AND FAULT DETECTION - INDICATIONS

T/R INDICATING AND FAULT DETECTION - FUNCTIONAL DESCRIPTION - EEC INPUTS

General

The EEC gets data from thrust reverser (T/R) sensors to make sure these conditions occur:

- The isolation valve sends pressure to the hydraulic actuators only during T/R extend and retract operation
- The engine operates above idle thrust only when the T/R is in the fully extended position
- The flight deck gets proper indication of normal and non-normal T/R operation.

This data comes from the hydraulic pressure switch on the isolation valve and the RVDTs.

Hydraulic Pressure Switch

The hydraulic pressure switch signal goes to both channels of the EEC. The switch closes when the isolation valve is open. If the switch shows that the valve is open without an open command, the EEC sends a signal to the AIMS to show advisory and status messages.

If the isolation valve does not open when it gets an EEC command to open, the EEC sends a signal to the AIMS for central maintenance computing system (CMCS) maintenance messages.

T/R Position Transducer (RVDT)

Each EEC channel gets data from the RVDT on each non-locking (upper) hydraulic actuator. The EEC uses this data to:

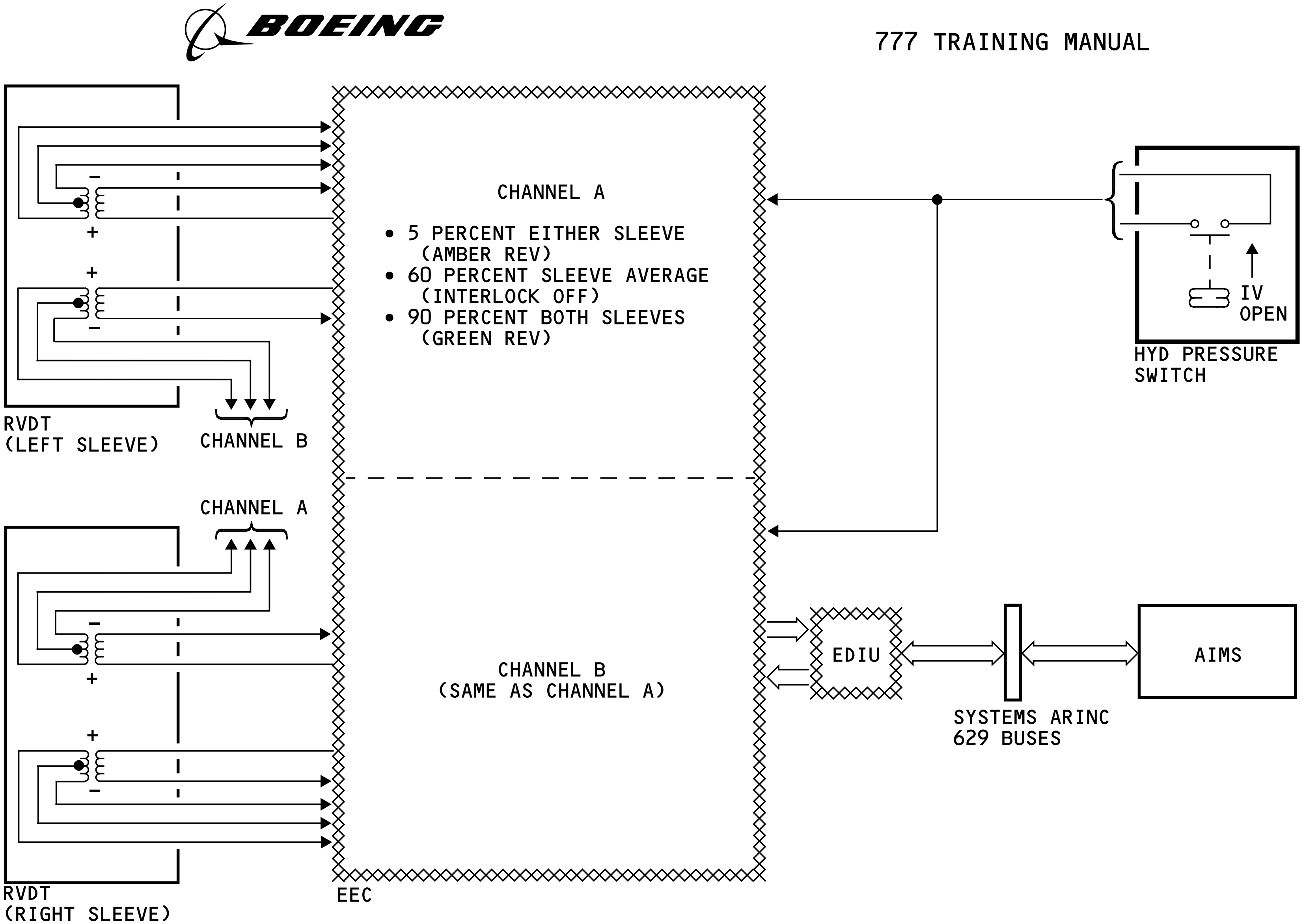
- Operate the thrust lever interlock actuator
- Send indication data to the AIMS
- Schedule reverse thrust.

When either T/R sleeve extension is 5 percent, the EEC sends a signal to the AIMS to show the amber REV on the EICAS display. This tells the flight crew that the T/R is released and in transit.

When the average of the sleeve extensions is 60 percent, the EEC sends a signal to the ELMS to operate the thrust lever interlock actuator. This permits the flight crew to command more than reverse idle thrust.

When both T/R sleeves are 90 percent extended, the EEC sends a signal to the AIMS to change the amber REV to green. This tells the flight crew that the T/R is fully extended. The EEC will permit maximum thrust based on the command from the flight crew.

The EEC does a rate and range check on the position data to make sure the RVDT data is valid.



NOTE: LEFT ENGINE SHOWN, RIGHT SIMILAR

T/R INDICATING AND FAULT DETECTION - FUNCTIONAL DESCRIPTION - EEC INPUTS

78-36-00-109 Rev 3

T/R INDICATING AND FAULT DETECTION - FUNCTIONAL DESCRIPTION - PSEU INPUTS

General

The PSEU gets data from these sensors to make sure the actuators and valves are in the correct positions:

- DCV sensor
- Actuator lock sensor
- Sync lock sensor.

The PSEU sends signals to the AIMS through the systems ARINC 629 buses.

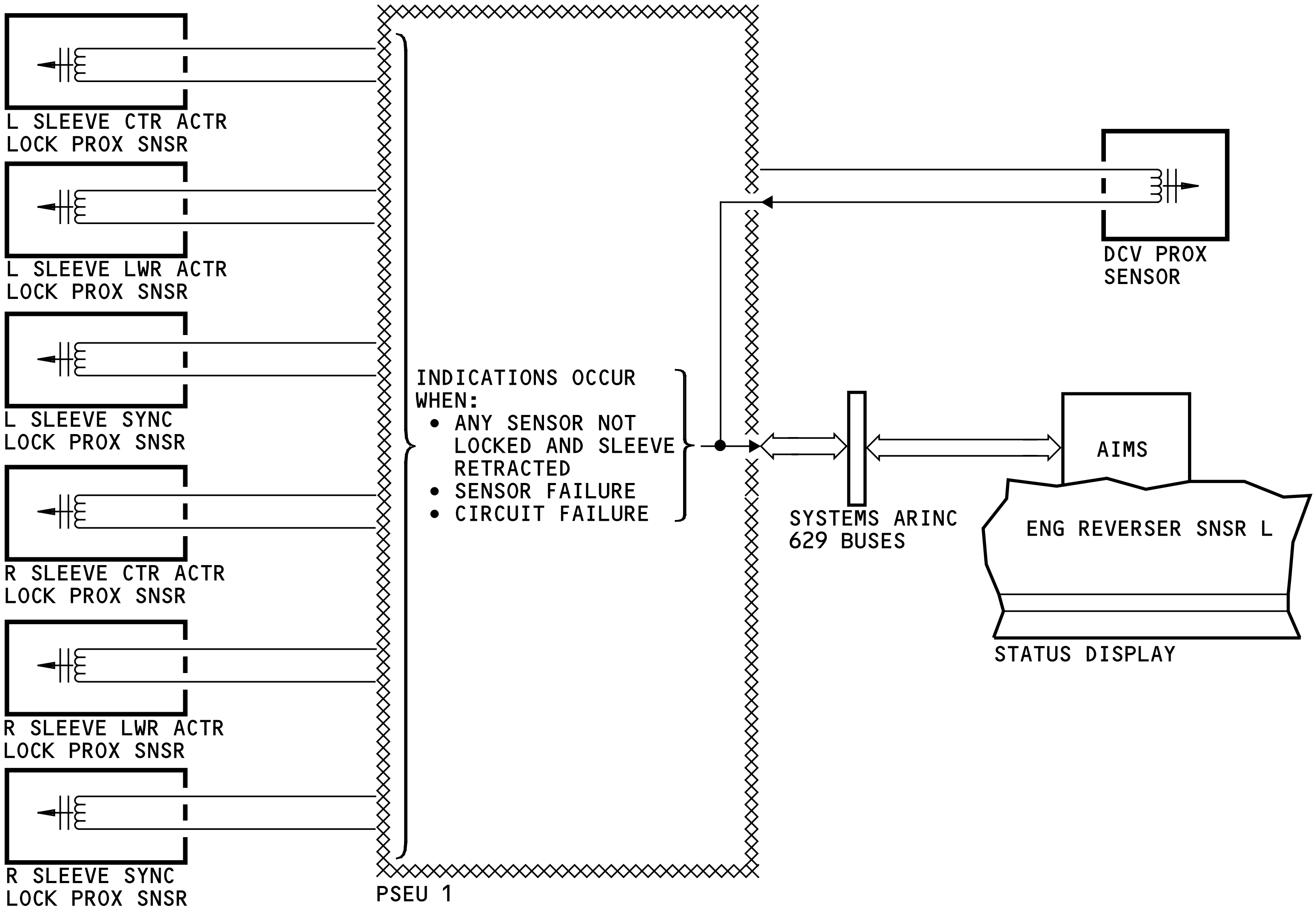
Sensors Show Not Locked

If any of the locks are not locked and the sleeve is in the retracted position, the AIMS shows advisory and status messages.

If the DCV is in the extended position without an extend command, the AIMS shows advisory and status messages.

Sensor Failure

If there is a single failure in a sensor, or in a sensor circuit, the AIMS shows the ENG REVERSER SNSR L(R) status message. The AIMS also makes a CMCS maintenance message.



NOTE: LEFT ENGINE SHOWN,
RIGHT SIMILAR

78-36-00-110 Rev 1

T/R INDICATING AND FAULT DETECTION - FUNCTIONAL DESCRIPTION - PSEU INPUTS

Continental Airlines, Inc

Auxiliary Power Unit

WB371

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Continental Airlines, Inc
Auxiliary Power Unit
WB371

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TABLE OF CONTENTS

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AUXILIARY POWER SYSTEM - INTRODUCTION

Purpose

The AlliedSignal Engines 331-500 gas turbine APU supplies the auxiliary power system with electric and pneumatic power. This permits airplane systems to operate independently of ground external power sources or the main engines. Auxiliary power is also available in the air.

Operating Limits

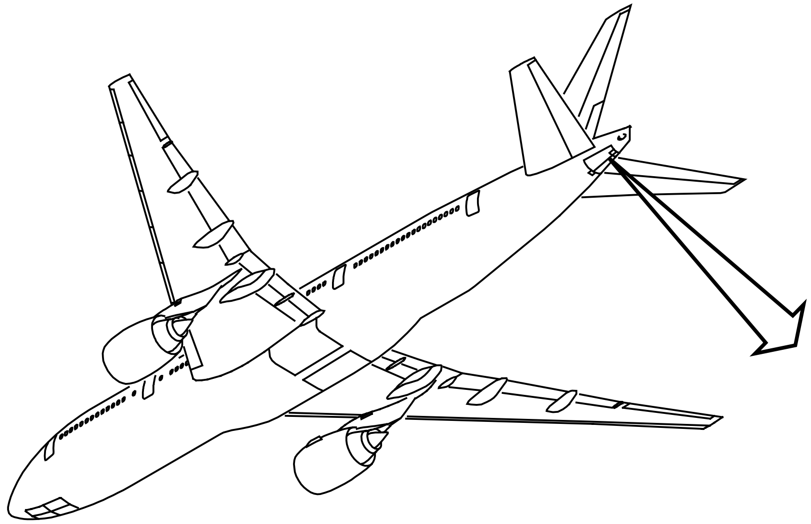
The APU generator supplies 120 KVA electrical power at any altitude. Pneumatic pressure is available up to an altitude of 22,000 feet (6700 m).

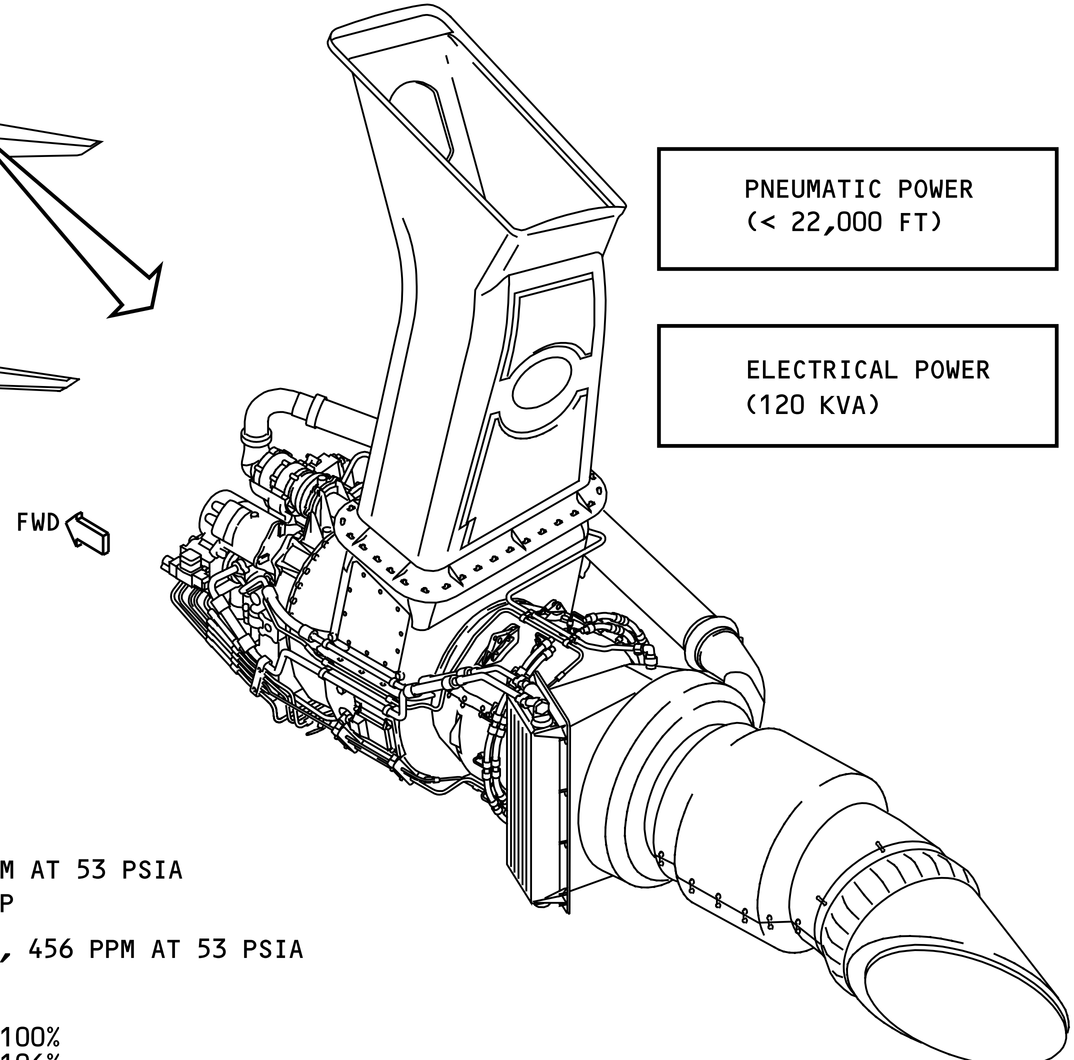
Specifications

The dimensions and weights shown do not include the air inlet duct, the exhaust duct, and the APU generator.

Abbreviations and Acronyms

ADIRU - air data inertial reference unit
ADP - air-driven pump
AIMS - airplane information management system
APU - auxiliary power unit
APUC - auxiliary power unit controller
ARINC - aeronautical radio, inc.
ASCPC - air supply and cabin pressure controller
ATS - air turbine starter
ATSCV - air turbine starter control valve
BPCU - bus power control unit
CTC - cabin temperature controller
DLODS - duct leak and overheat detection system
DMM - data memory module
dr - door
ECS - environmental control system
EDIU - engine data interface unit
EGT - exhaust gas temperature
EHSV - electrohydraulic servo valve
ELMS - electrical load management system
FODC - fire overheat detection card
GCU - generator control unit
HYDIM - hydraulic interface module
IGV - inlet guide vanes
LVDT - linear variable differential transformer
LRU - line replaceable unit
MFD - multi-function display
OPAS - overhead panel ARINC system
PPM - pounds per minute
PSI - pounds per square inch
PSIA - pounds per square inch absolute
PSID - pounds per square inch differential
PSIG - pounds per square inch gage
RPM - revolutions per minute
RVDT - rotary variable differential transformer
SCV - surge control valve
SHP - shaft horsepower
S/O - shutoff
temp - temperature
WOW - weight on wheels





DIMENSIONS
- LENGTH 74 IN (188 CM)
- WIDTH 46 IN (117 CM)
- HEIGHT 39 IN (99 CM)

DRY WEIGHT APPROX 722 LBS (327 KG)

OPERATING LIMITS
- BLEED LOAD (SEA LEVEL, 103F) 466 PPM AT 53 PSIA
- SHAFT LOAD (SEA LEVEL, 103F) 230 SHP

CONTINUOUS PERFORMANCE 202 SHP, 456 PPM AT 53 PSIA

ENGINE SPEED
- NORMAL RATED SPEED 39,044 RPM = 100%
- SPEED LIMIT 41,387 RPM = 106%

49-00-00-001 Rev 5 12/19/1995

AUXILIARY POWER SYSTEM - INTRODUCTION

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AUXILIARY POWER SYSTEM - GENERAL DESCRIPTION

General

The APU system contains these subsystems:

- APU control system (49-60)
- APU power plant (49-10)
- APU engine (49-21)
- APU and generator lubrication system (49-27)
- APU oil indicating system (49-94).
- APU engine fuel system (49-30)
- APU ignition/starting system (49-40)
- APU air (49-50)
- APU indicating system (49-70)
- APU exhaust system (49-80).

APU Control System

An APU controller controls APU system functions and is an interface with other airplane systems.

APU Power Plant

The APU is a single shaft gas turbine engine which drives an electric generator and a load compressor. A gearbox on the front of the APU supplies power to APU accessories.

The power plant has these systems and components:

- Auxiliary power unit
- APU mounts
- APU wire harness
- APU air inlet
- APU drains.

APU Engine

The APU engine has a two stage centrifugal flow compressor, a reverse flow annular combustion chamber, and a three stage axial flow turbine.

APU and Generator Lubrication System

The APU and generator lubrication system lubricates and cools the APU bearings, the gearbox, and the electric generator.

APU Oil Indication System

The oil indication system supplies APU oil temperature, pressure, and quantity for flight deck display.

APU Engine Fuel System

The APU engine fuel system supplies pressurized and metered fuel to the APU combustion chamber. It also supplies pressurized fuel to operate the inlet guide vanes and the surge control valve.

APU Ignition/Starting System

During engine start, the ignition/starting system turns the APU and supplies ignition.

AUXILIARY POWER SYSTEM - GENERAL DESCRIPTION

APU Air System

The APU air system supplies pressurized air to the airplane pneumatic system. Inlet guide vanes control the amount of air supplied to the load compressor. A surge control valve releases excess bleed air overboard. An eductor removes APU compartment air by suction through the oil cooler to cool engine oil.

APU Indicating System

The APU indicating system supplies APU EGT data for flight deck display. A data memory module keeps APU operation data.

APU Exhaust System

The APU exhaust system sends the APU exhaust gasses out of the left side of the tailcone.

AUXILIARY POWER SYSTEM

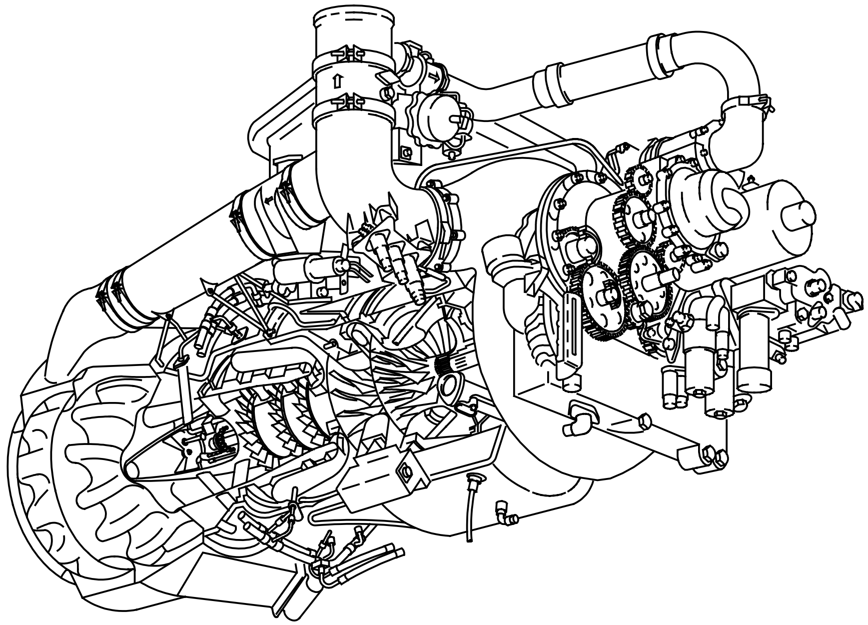
APU CONTROL SYSTEM

APU POWER PLANT

APU ENGINE

APU AND GENERATOR LUBRICATION SYSTEM

APU OIL INDICATING SYSTEM



APU ENGINE FUEL SYSTEM

APU IGNITION/STARTING SYSTEM

APU AIR SYSTEM

APU INDICATING SYSTEM

APU EXHAUST SYSTEM

49-00-00-002 Rev 4

AUXILIARY POWER SYSTEM - GENERAL DESCRIPTION

AUXILIARY POWER SYSTEM - INTERFACES

General

The APUC gets airplane system data and sends APU data to airplane systems through the left and right system ARINC 629 data buses. The APUC also sends and receives some data through other connections.

ARINC 629 Interfaces

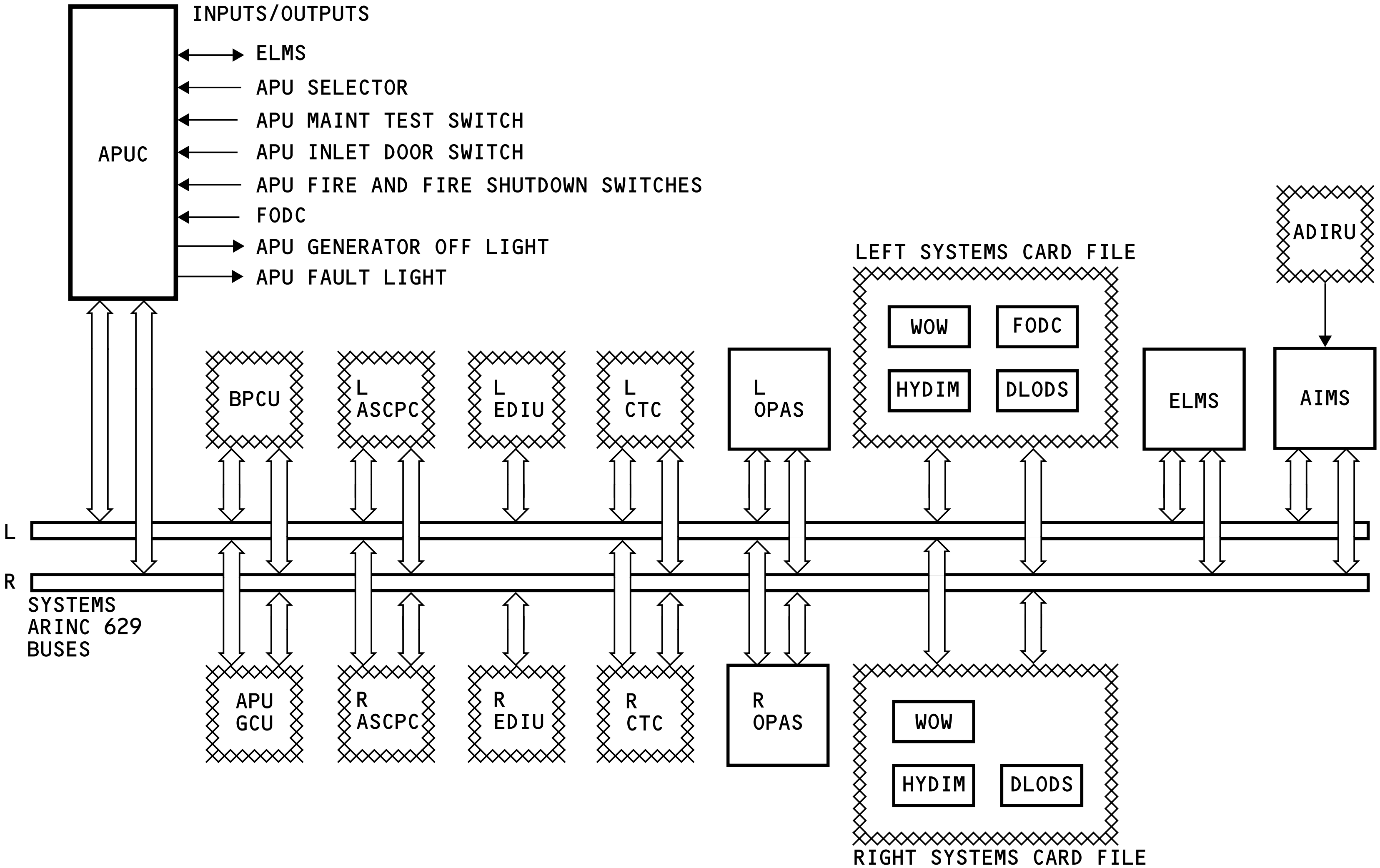
These systems have interfaces with the APUC through systems ARINC 629 buses:

- Bus power control unit (BPCU) - generator trim frequency
- APU generator control unit (GCU) - generator load
- Left and right air supply cabin pressure controller (ASCPC) - pneumatic valve positions, pack operation, and pneumatic duct pressure
- Left and right engine data interface unit (EDIU) - engine data
- Left and right cabin temperature controller (CTC) - pneumatic valve position and ECS data
- Left and right overhead panel ARINC 629 system (OPAS) - overhead panel switch/selector positions
- Left and right weight on wheels (WOW) cards - air/ ground condition
- Hydraulic interface module (HYDIM) cards - ADP operation data
- Fire overheat detection card (FODC) - APU fire
- Left, right, and center duct leak and overheat detection system (DLODS) - wing/body duct overheat
- Electrical load management system (ELMS) - start control, shutdown control, autostart, attended/ unattended mode
- Airplane information management system (AIMS) engine running status, air data (from ADIRU), airplane data, fault reporting, indications.

Other Interfaces

The APUC also has interfaces with these systems and components without ARINC 629:

- Electrical load management system (ELMS)
- The APU selector
- The APU maintenance switch
- The APU inlet door switch
- APU fire switch and fire shutdown switch
- Fire overheat detection card (FODC)
- APU generator OFF light
- APU fault light.



AUXILIARY POWER SYSTEM - INTERFACES

AUXILIARY POWER SYSTEM - COMPONENT LOCATIONS

General

The APU is in the tailcone at a 10 degree nose down attitude in relation to the tail of the airplane. A titanium firewall isolates the APU compartment from the rest of the airplane.

Ducts

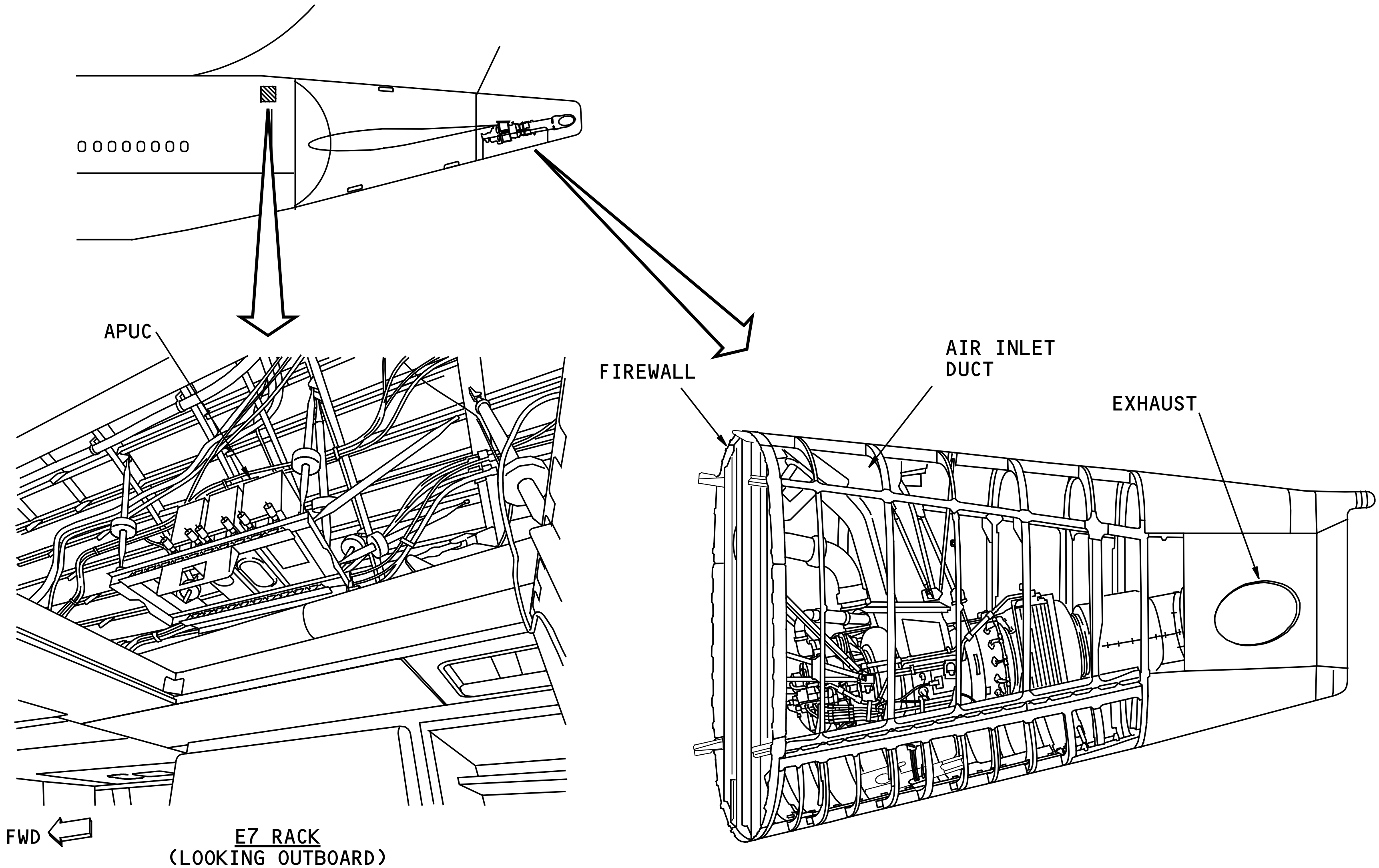
The air inlet is on the top, right side of the fuselage behind the rudder. The APU exhaust gases exit on the left side of the tail fairing.

Doors

Two APU access doors on the bottom of the APU compartment permit service and maintenance access.

APU Controller

The APU controller (APUC) is in the E7 rack in the ceiling of the aft cabin.



49-00-00-003 Rev 2 12/19/95

AUXILIARY POWER SYSTEM - COMPONENT LOCATIONS

AUXILIARY POWER SYSTEM - APU GENERATOR

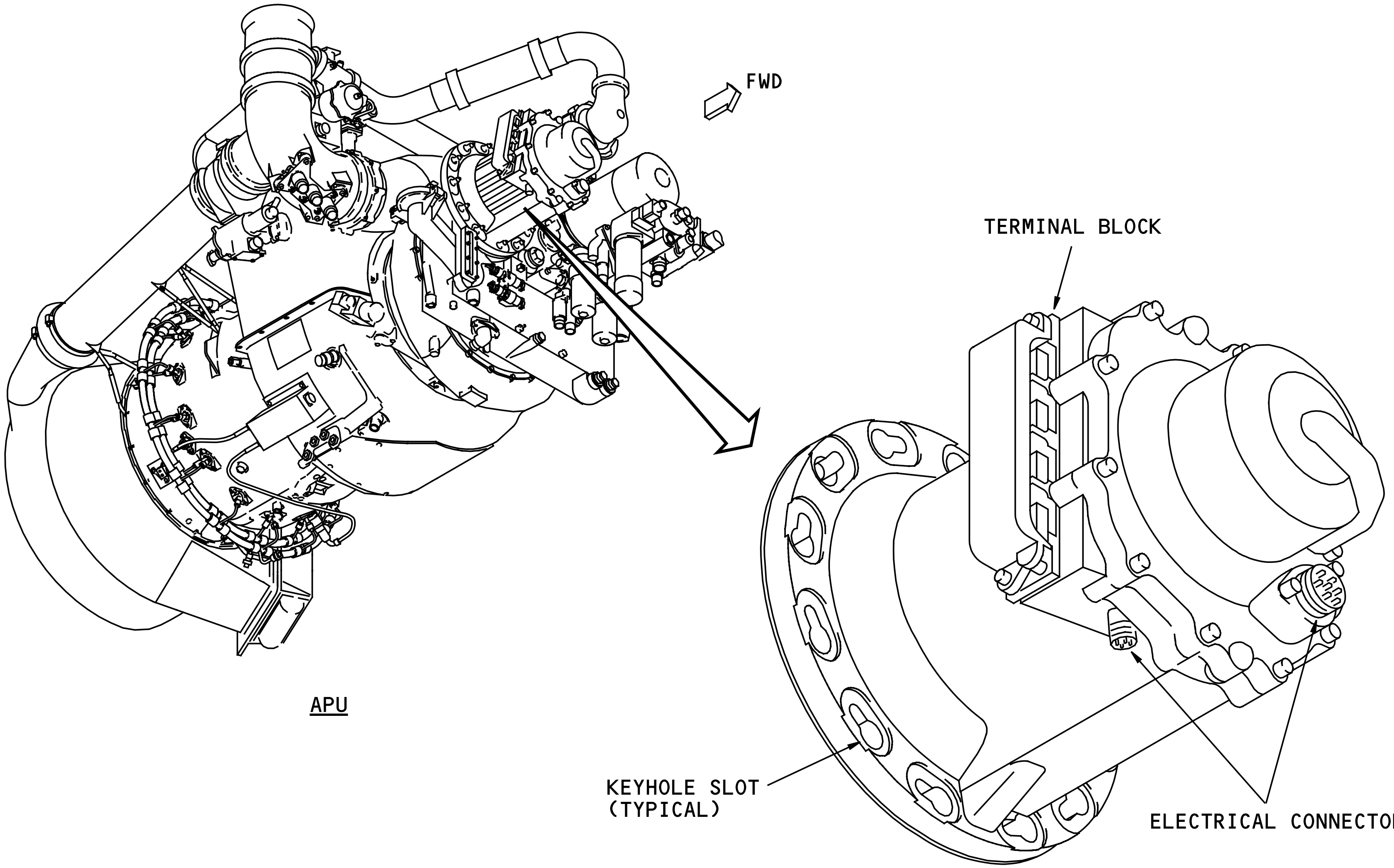
General

The APU generator is a secondary source of electrical power for airplane systems. It can supply 120 kva of ac electrical power when the airplane is on the ground or during flight. See chapter 24 for more information on the electrical system.

The APU generator attaches to the accessory pad of the APU gearbox.There is a seal plate between the APU generator and the APU gearbox.

The APU generator has a terminal block and two electrical connectors.

The APU gearbox turns the APU generator. The APU oil system lubricates the APU generator and keeps it cool.



AUXILIARY POWER SYSTEM - APU GENERATOR

AUXILIARY POWER SYSTEM - CONTROLS

APU Flight Deck Controls

These control the APU from the flight deck:

- The APU selector
- The APU maintenance switch
- The APU fire switch.

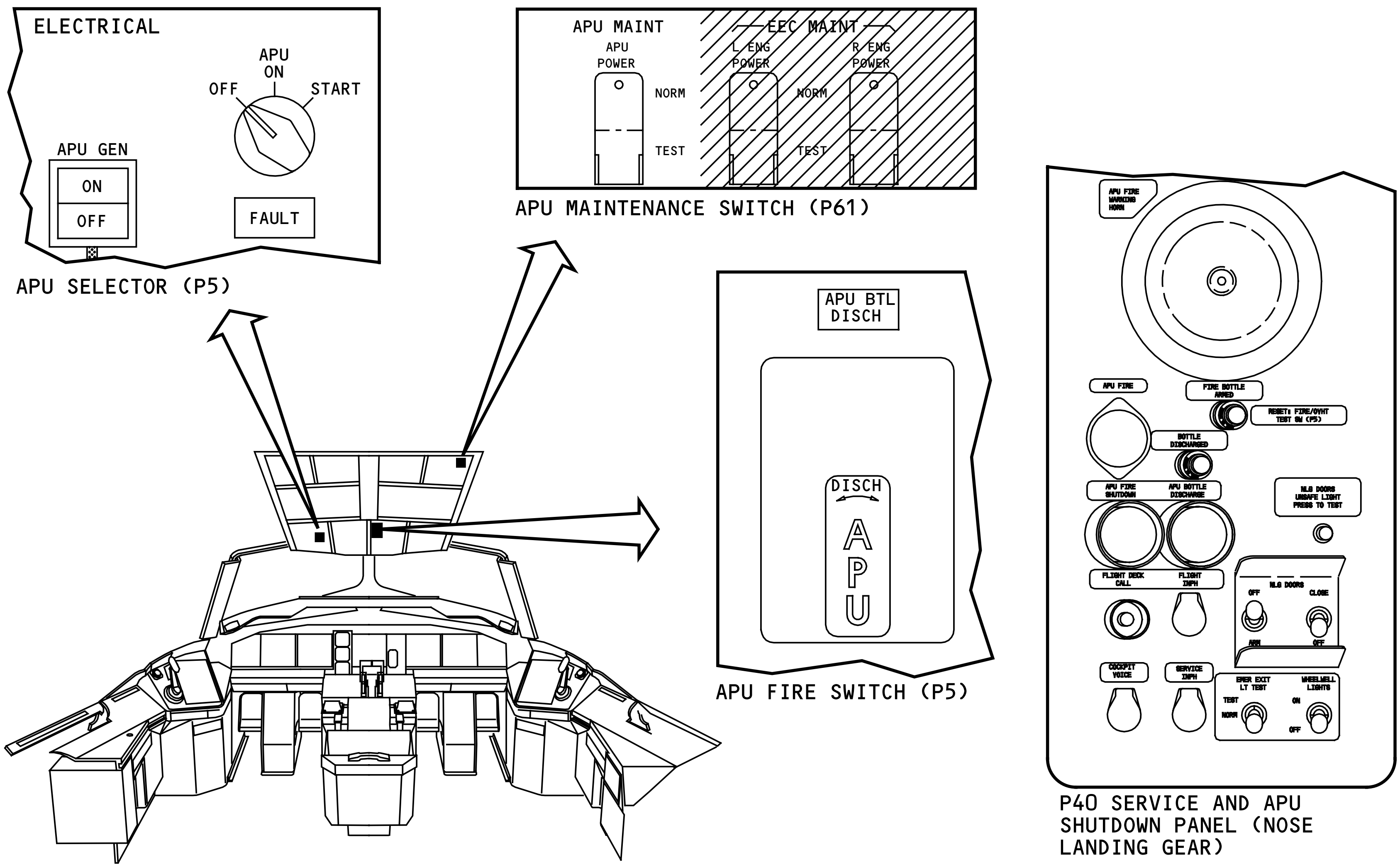
You use the APU selector on the electrical panel (P5) to start and shut down the APU.

You use the APU maintenance switch on the P61 overhead maintenance panel to supply power to the APUC when the APU selector is OFF. This permits the APUC to show APU indications on the status and maintenance page formats.

You can shutdown the APU with the APU fire switch on the cargo fire/engine control panel (P5).

Auxiliary Shutdown Control Switch

You can shutdown the APU from outside the airplane with the APU fire shutdown switch. This switch is on the P40 service and APU shutdown panel on the nose landing gear strut.



49-00-00-005 Rev 2 07/27/1995

AUXILIARY POWER SYSTEM - CONTROLS

APU CONTROL SYSTEM - INTRODUCTION

Purpose

The APU control system uses an APU controller to control these APU functions:

- Starting and ignition
- Fuel metering
- Surge control
- Inlet guide vane (IGV) control
- Data Storage
- Protective shutdown
- BITE/fault reporting
- APU indication.

System Components

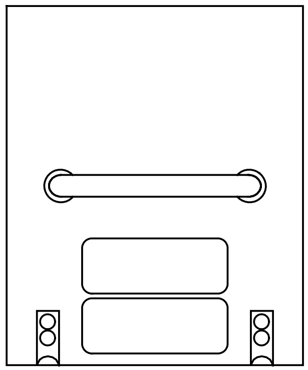
The other control system components are:

- The speed sensor (2)
- The inlet temperature sensor.

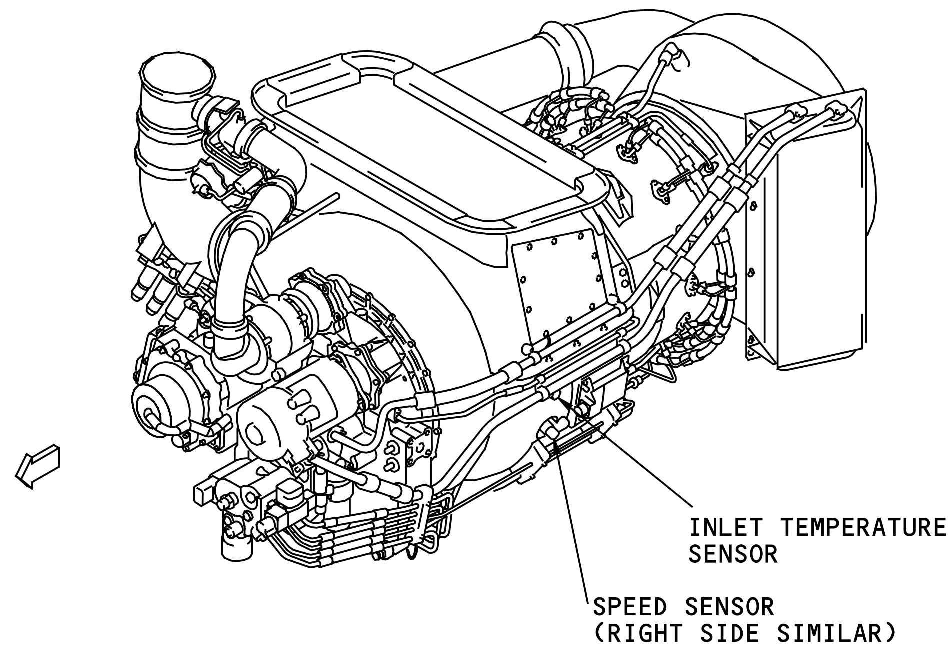
These sensors supply data to the APUC for control functions.

Location

The APUC is on the E7 rack above the aft galley. The two APU speed sensors and the inlet temperature sensor are on the sides of the APU.



STARTING AND IGNITION
FUEL METERING
SURGE CONTROL
IGV CONTROL
DATA STORAGE
PROTECTIVE SHUTDOWN
NORMAL SHUTDOWN
BITE/FAULT REPORTING
APU INDICATION



49-60-00-001 Rev 0

APU CONTROL SYSTEM - INTRODUCTION

APU CONTROL SYSTEM - APU CONTROLLER - INTRODUCTION

Purpose

The APUC controls APU functions. The APUC also contains circuits for fault detection and isolation.

APUC Modes

The APUC operates in one of these eight operating modes:

- Test mode - APUC doing power-up test
- Idle mode - APUC powered and APU is not on.
- Start - air mode - APU is doing an air start
- Start - electric mode - APU is doing an electric start
- Onspeed mode - APU RPM is more than 95 percent
- Cooldown mode - APU is in the cooldown mode
- Shutdown mode - APU RPM is less than 15 percent during APU shutdown
- Auto-shutdown mode - the APUC is doing an APU protective shutdown.

Location

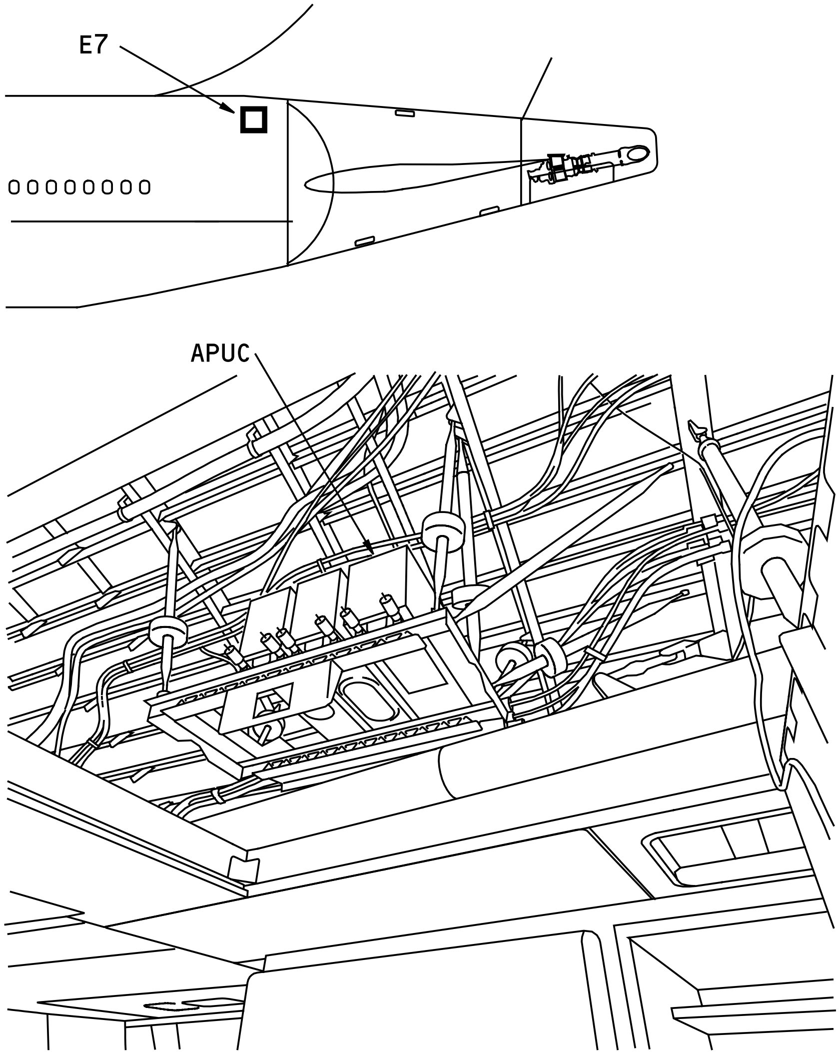
The APUC is on the E7 rack above the aft galley.

Training Information Point

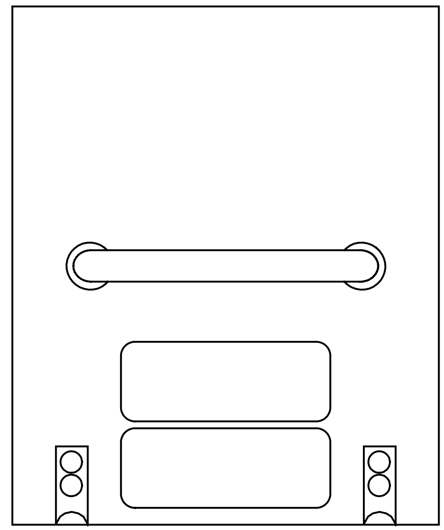
The APUC is an LRU. The circuit cards in the APUC are not LRUs.

You must remove a ceiling panel above the aft galley to get access to the APUC.

CAUTION: DO NOT REMOVE THE APUC AND THE DATA MEMORY MODULE AT THE SAME TIME. IF YOU REMOVE THE APUC AND THE DATA MEMORY MODULE AT THE SAME TIME, YOU WILL LOSE THE DATA FOR THE APU.



E7 RACK
(LOOKING OUTBOARD)



APUC MODES
- TEST
- APUC IDLE
- START - AIR
- START - ELEC
- ONSPEED
- COOLDOWN
- SHUTDOWN
- AUTO S/D

49-60-00-003 Rev 1 01/09/95

APU CONTROL SYSTEM - APU CONTROLLER - INTRODUCTION

APU CONTROL SYSTEM - APU CONTROLLER - INPUTS

General

The APUC gets inputs from both airplane systems and the APU.

The APUC receives 28v dc power from both the 28v dc battery bus and the 28v dc APU battery bus.

Airplane Systems ARINC 629 Inputs

The APUC receives these airplane system inputs through the left and right ARINC 629 system buses:

- Pneumatic duct pressure
- APU fuel shutoff valve position
- ECS data
- Main engine start/run
- Air driven pumps (ADPs) ON
- Electrical system demand
- Air/ground indication
- Date/time
- Air data
- APU bleed valve position.

Airplane Systems Discrete Inputs

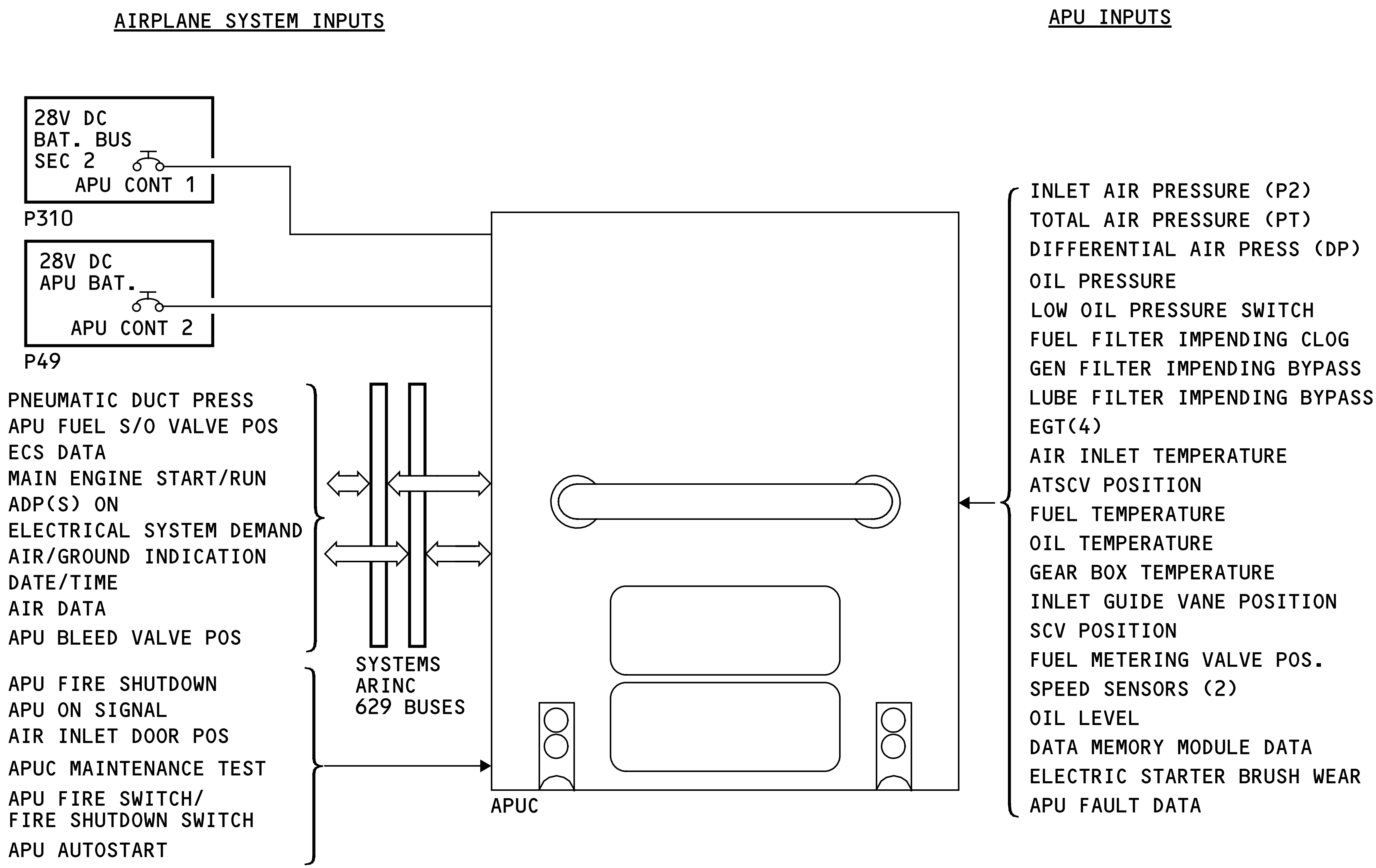
The APUC also receives other airplane systems inputs. These inputs include:

- APU fire shutdown
- APU ON signal
- Air inlet door position
- APUC maintenance test
- APU fire switch/fire shutdown switches
- APU autostart.

APU Inputs

Inputs from the APU to the APUC are:

- Inlet air pressure (P2)
- Total air pressure (PT)
- Differential air pressure (DP)
- Oil pressure
- Low oil pressure switch
- Fuel filter impending clog
- Generator filter impending bypass
- Lube filter impending bypass
- EGT (4)
- Air inlet temperature
- Fuel temperature
- Oil temperature
- Gear box temperature
- IGV position
- SCV position
- Fuel metering servo valve position
- ATSCV position
- Speed sensors (2)
- Oil level
- Data memory module data
- Electric starter motor brush wear
- APU fault data.



49-60-00-004 Rev 2

APU CONTROL SYSTEM - APU CONTROLLER - INPUTS

APU CONTROL SYSTEM - APU CONTROLLER - OUTPUTS

General

The APUC supplies APU data to airplane systems and controls some APU functions.

APUC ARINC 629 Outputs

The APUC supplies this APU data to the airplane through the left and right systems ARINC 629 buses:

- EGT
- Air inlet temperature
- APU speed
- Oil quantity
- Oil pressure
- Gearbox temperature
- Fuel temperature
- Generator load available
- APU fault data
- APU shutdown data
- IGV angle
- SCV angle
- Pressure sensor data
- Ignitor ON/OFF
- Fuel shutoff solenoid ON/OFF
- Filter clog sensor status (3)
- Low oil pressure status
- Electric starter brush wear
- Maintenance test status.

Other APUC Airplane System Outputs

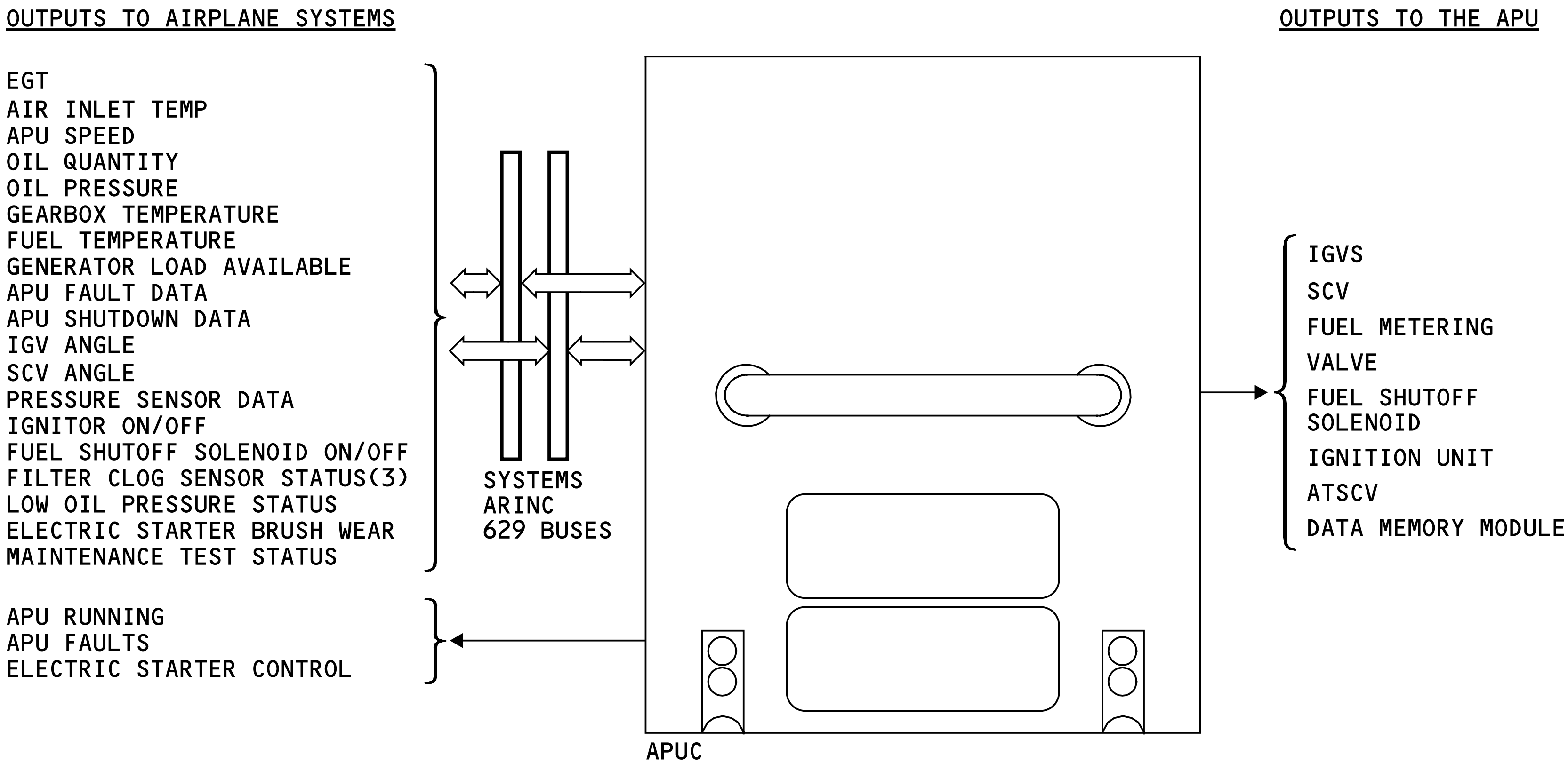
The APUC also sends these signals on non-ARINC 629 connections:

- APU running status
- APU fault indication
- APU starter control.

APUC Outputs to the APU

The APUC sends signals to control these APU components:

- IGVs
- SCV
- Fuel metering valve
- Fuel shutoff solenoid
- Ignition unit
- Air turbine starter control valve
- Data memory module.



49-60-00-005 Rev 3

APU CONTROL SYSTEM - APU CONTROLLER - OUTPUTS

APU CONTROL SYSTEM - APU CONTROLLER - FAULT MONITORING

General

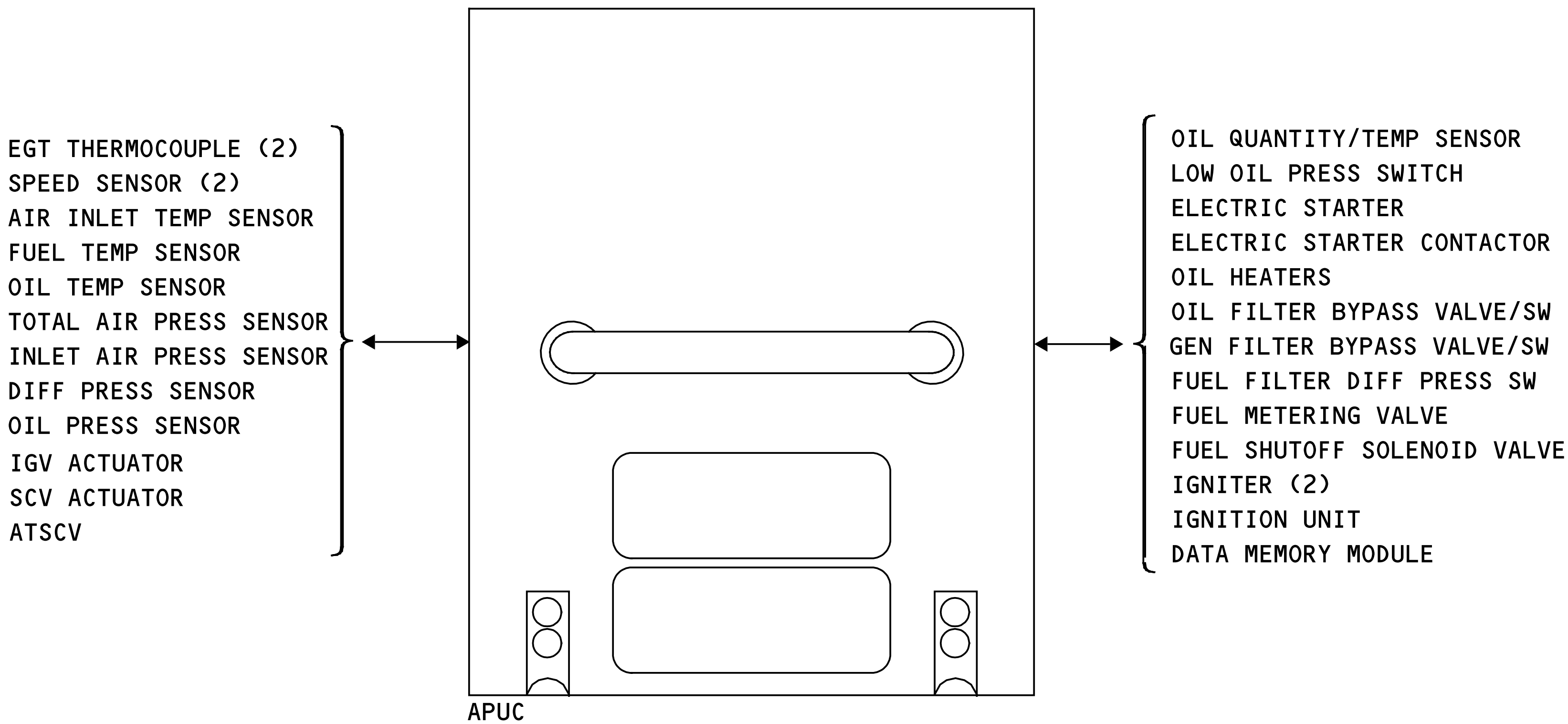
The APUC does tests of APU components and the internal functions of itself. The APUC tests some components continuously and others only when the APU is in a specific mode (power-up, power-down, shutdown).

The APUC memory holds 256 faults. When the memory is full, new faults record over the oldest faults.

APU Faults

The APUC monitors these APU components:

- EGT thermocouple (2)
- Speed sensor (2)
- Air inlet temperature sensor
- Fuel temperature sensor
- Oil temperature sensor
- Total air pressure sensor
- Inlet air pressure sensor
- Differential pressure sensor
- Oil pressure sensor
- IGV actuator
- Surge control valve actuator
- ATSCV
- Oil quantity/temperature probe
- Low oil pressure switch
- Electric starter (brush wear)
- Electric starter contactor
- APU oil heater assembly
- Oil filter bypass valve/switch
- Generator filter bypass valve/switch
- Fuel filter differential pressure switch
- Fuel metering valve
- Fuel shutoff solenoid valve
- Igniter (2)
- Ignition unit
- Data memory module.



49-60-00-006 Rev 0

APU CONTROL SYSTEM - APU CONTROLLER - FAULT MONITORING

APU CONTROL SYSTEM - SPEED SENSORS

Purpose

Two speed sensors measure APU shaft speed and supply the data to the APUC for control and display functions.

Location

The speed sensors are on each side of the compressor section.

Functional Description

The speed sensors are variable reluctance motion sensors. Each speed sensor sends a signal with a frequency in proportion to engine RPM. The APUC selects the higher of the two signals for control and display functions.

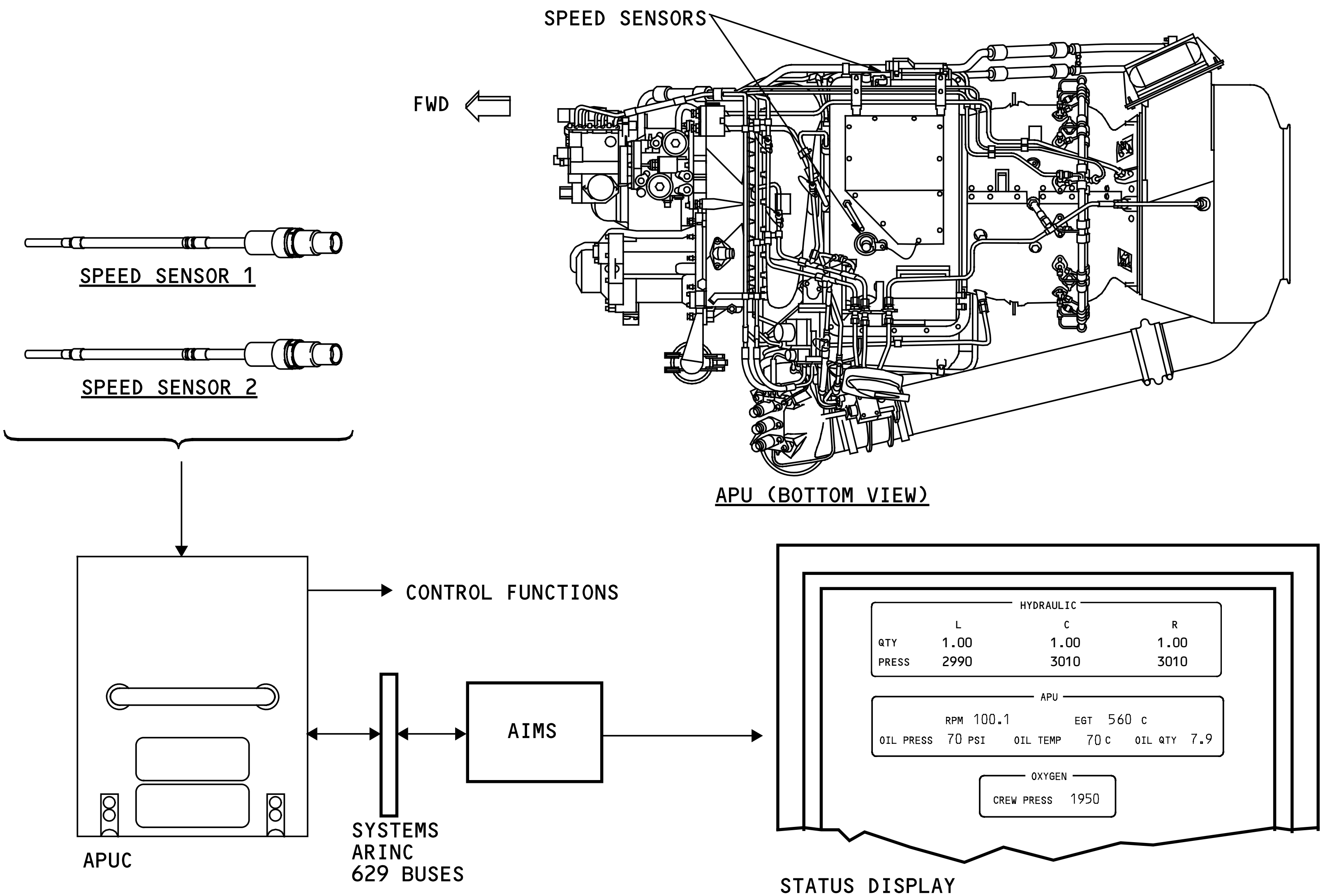
Control

The APUC uses engine speed to control these functions:

- Ignition system control
- Starter system control
- Fuel system control
- Engine speed control
- Overspeed automatic shutdown protection
- No-acceleration automatic shutdown protection.

Indications

APU engine RPM shows on the status display and the maintenance page.



49-60-00-007 Rev 2

APU CONTROL SYSTEM - SPEED SENSORS

APU CONTROL SYSTEM - INLET TEMPERATURE SENSOR

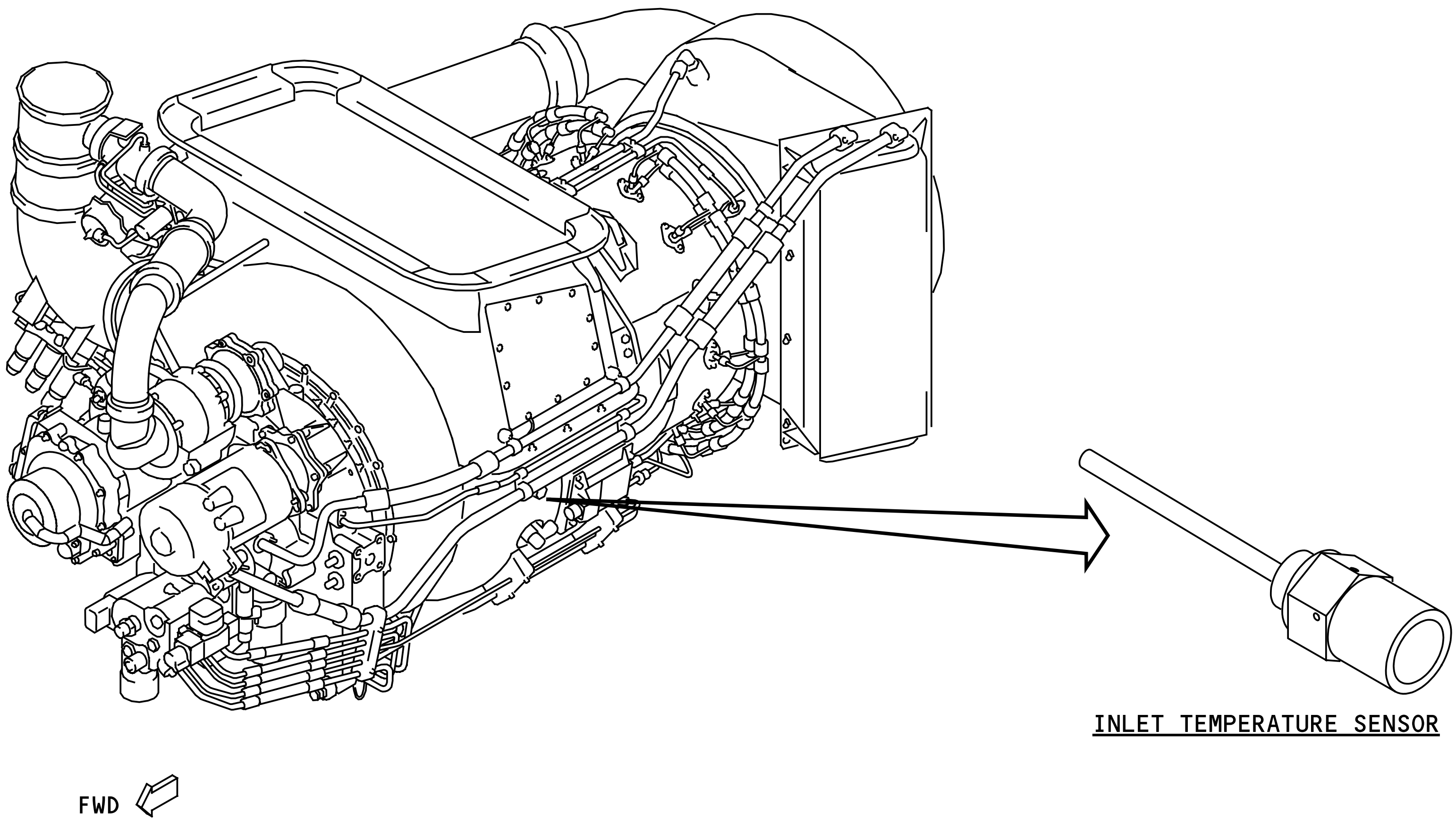
Inlet Temperature Sensor

The inlet temperature sensor supplies inlet air temperature data (T2). The APUC uses this data for these functions:

- Fuel control
- IGV control
- SCV control
- Turbine inlet temperature calculation.

The inlet temperature sensor is an RTD (resistance temperature detector) type sensor.

This sensor is on the left side of the APU.



49-60-00-008 Rev 2

APU CONTROL SYSTEM - INLET TEMPERATURE SENSOR

APU POWER PLANT - INTRODUCTION

General

The power plant has these systems and components:

- Auxiliary power unit
- APU mounts
- APU wire harness
- APU air inlet
- APU drains.

Auxiliary Power Unit

The auxiliary power unit contains these major sections:

- Accessory gearbox
- Pneumatic load compressor
- Gas turbine engine.

APU Mounts

The APU mounts hold the APU in the APU compartment and isolate the structure from APU vibration.

APU Wire Harness

The APU wire harness contains all the electrical wiring for the APU.

APU Air Inlet

The APU air inlet supplies the air for the APU engine and APU load compressor operation.

APU Drains

The APU drains permit flammable fluid to drain from the APU.

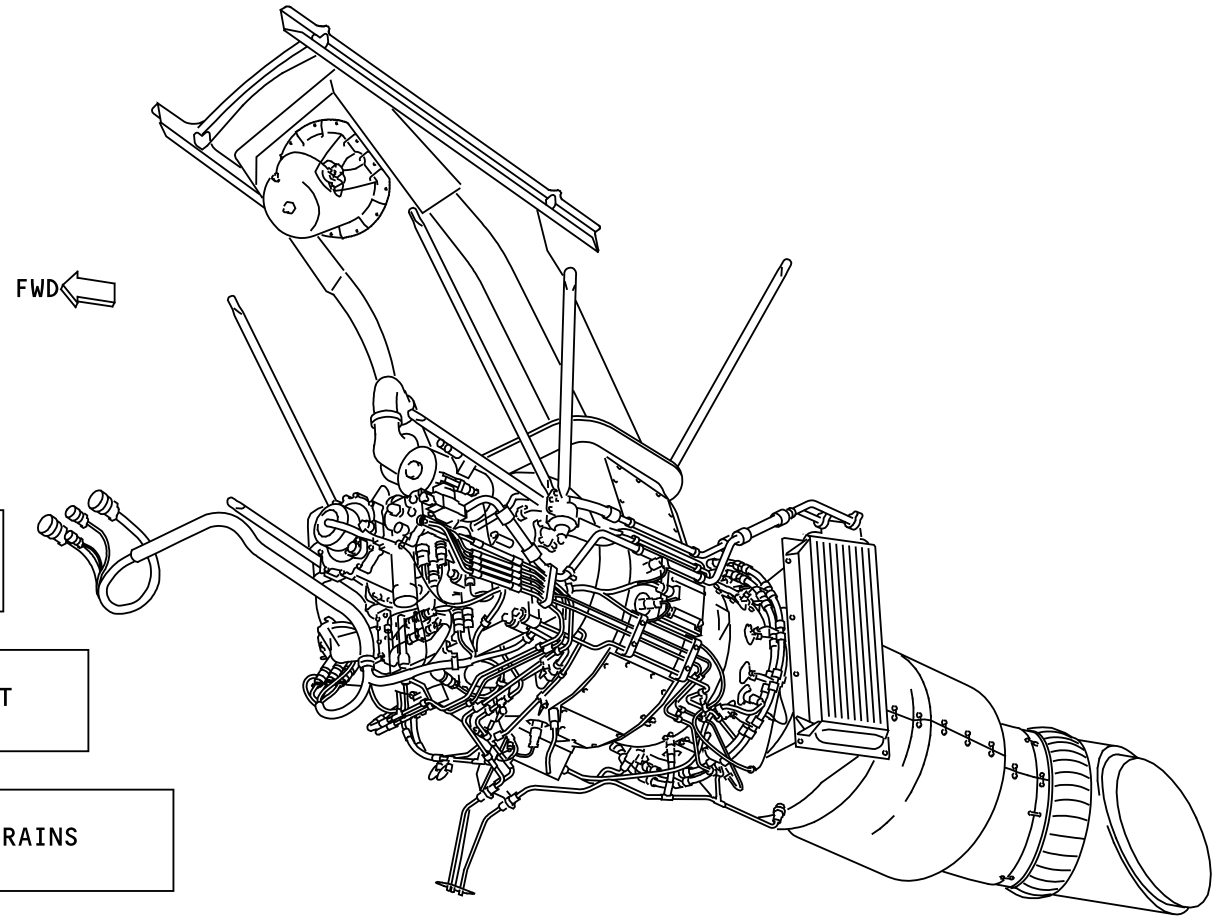
AUXILIARY POWER UNIT

APU MOUNTS

APU WIRE HARNESS

APU AIR INLET

APU DRAINS



APU POWER PLANT - INTRODUCTION

APU POWER PLANT - AUXILIARY POWER UNIT

Clustered Components

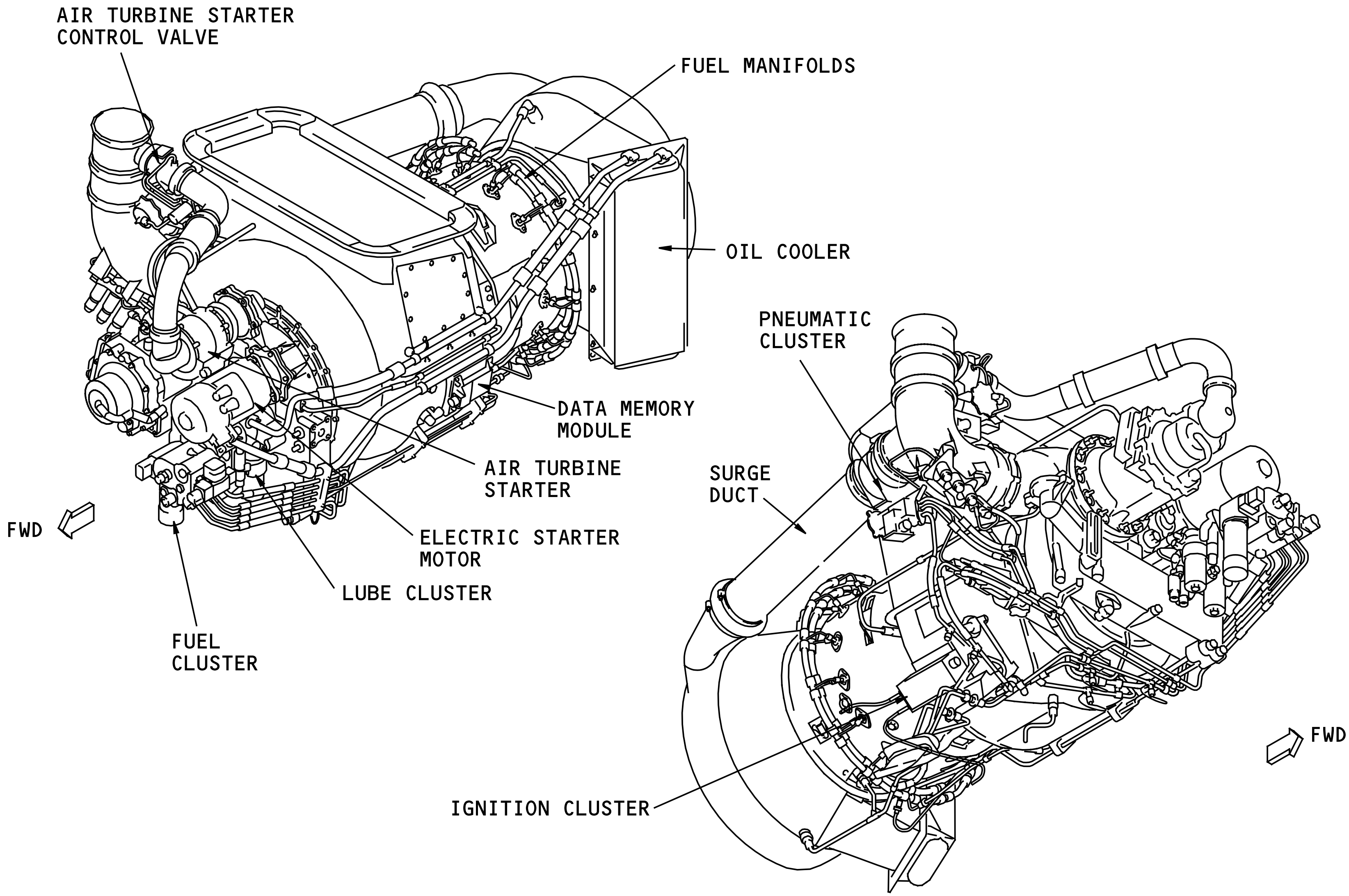
Some APU components are in functional clusters to make maintenance easier. These clusters include:

- Lube cluster
- Fuel cluster
- Pneumatic cluster
- Ignition cluster.

Other Components

These are the other main APU components:

- Air turbine starter control valve (ATSCV)
- Fuel manifolds
- Oil cooler
- Data memory module (DMM)
- Air turbine starter (ATS)
- Electric starter motor
- Surge duct.



49-10-00-002 Rev 1

APU POWER PLANT - AUXILIARY POWER UNIT

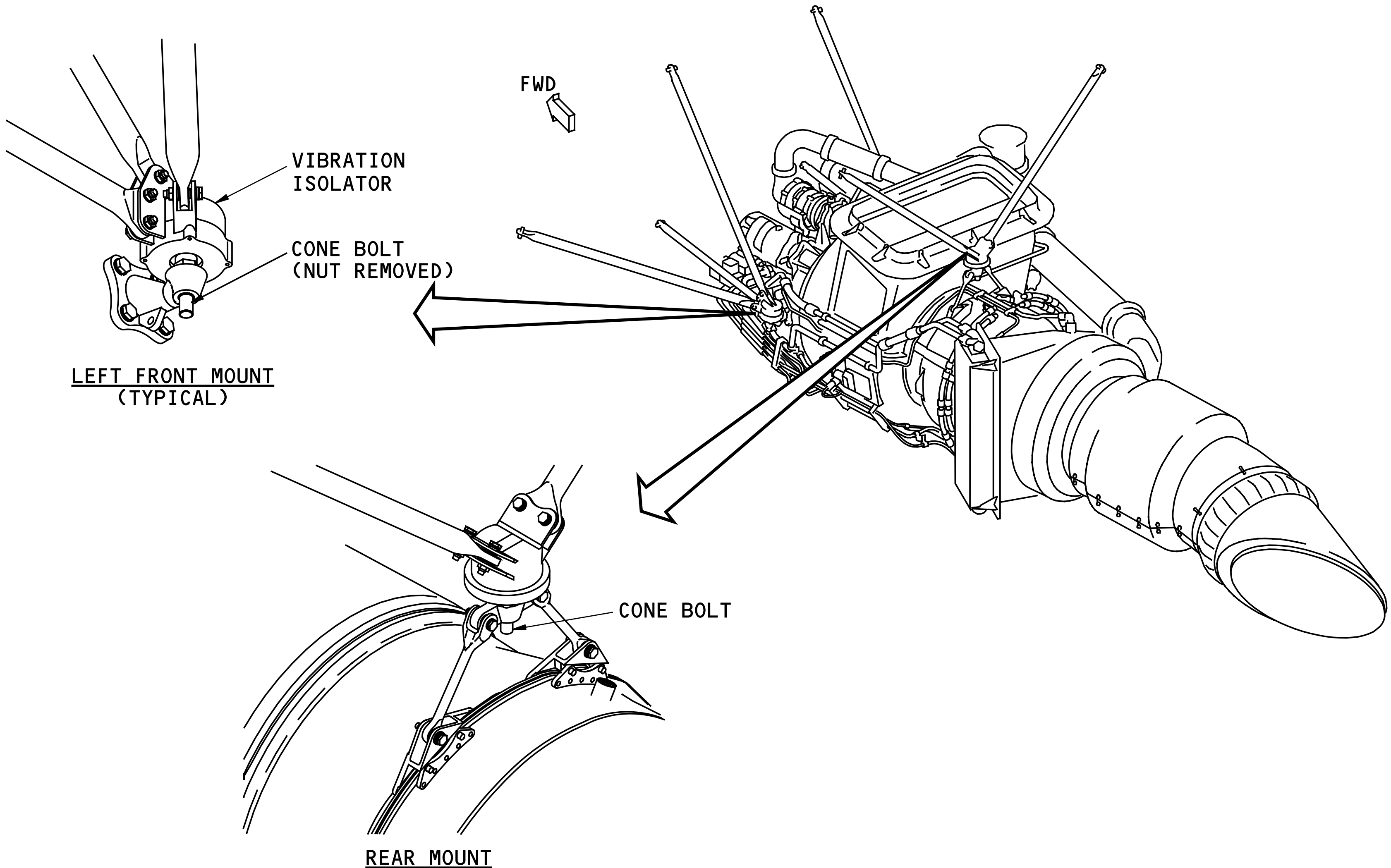
APU POWER PLANT - APU MOUNTS

Purpose

Three APU mounts hold the APU in its compartment. The mounts also isolate the structure from APU vibration.

Location

The two forward mounts attach to the APU firewall. The aft APU mount hangs from the upper tailcone structure.



APU POWER PLANT - APU MOUNTS

APU POWER PLANT - APU WIRE HARNESS

Purpose

The APU wire harness holds all the electrical wires in one assembly.

Location

The APU wire harness extends from the firewall connector to the front of the APU. From the front of the APU it goes in different directions around the APU to connect all electrical components.

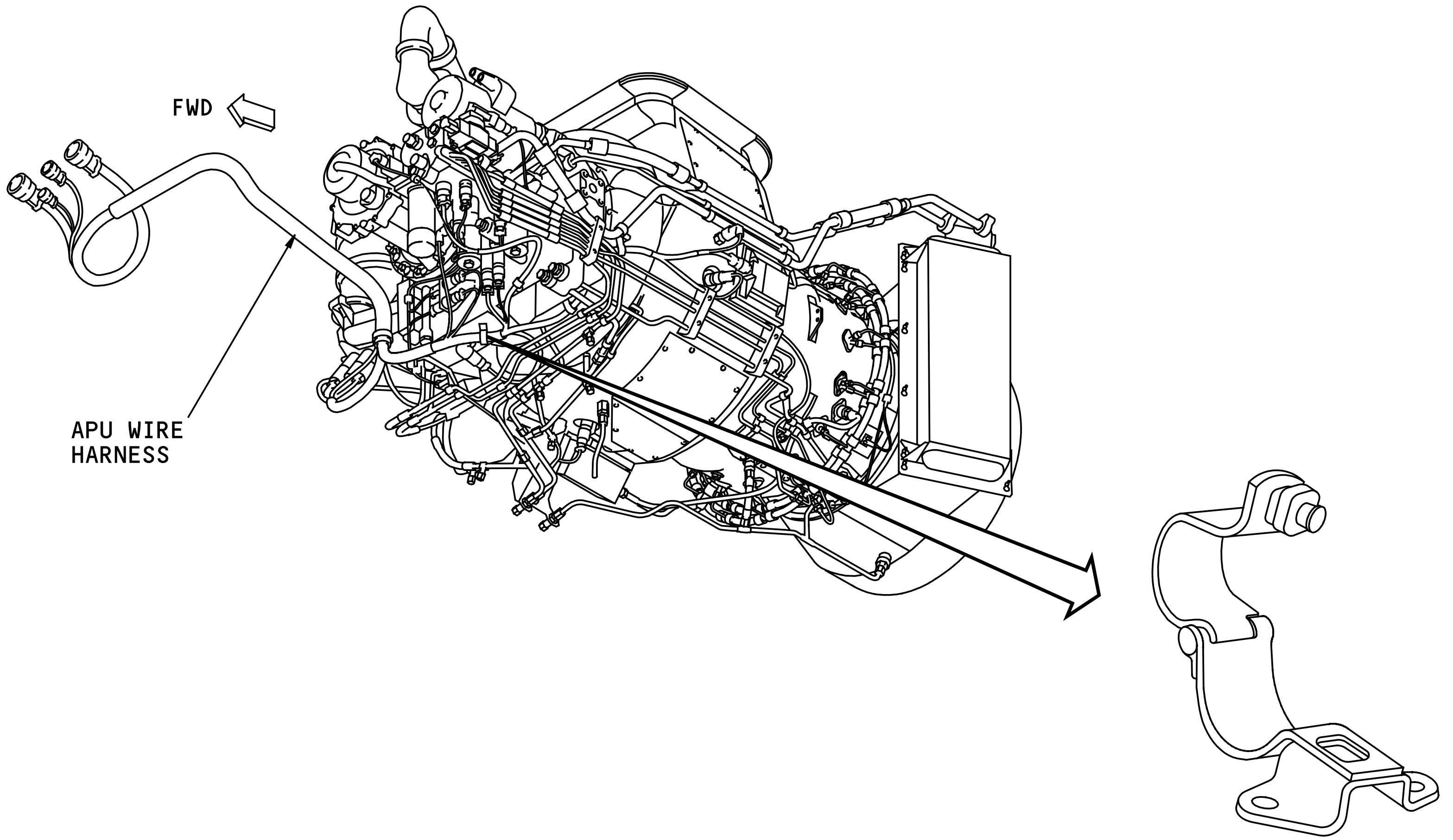
Physical Description

Shielded, twisted pair conductors keep electromagnetic interference on circuits to a minimum. APU harness connectors are threaded, stainless steel, and self-locking.

Training Information Point

Wiring routing tags on the harness show pin to pin electrical continuity.

Quick release fastener cable clamps attach the APU harness to the APU.



49-10-00-004 Rev 1

APU POWER PLANT - APU WIRE HARNESS

APU POWER PLANT - AIR INLET - INTRODUCTION

Purpose

The APU air inlet supplies air to the APU for APU engine and load compressor operation, and for oil and APU compartment cooling. These are the APU air inlet components:

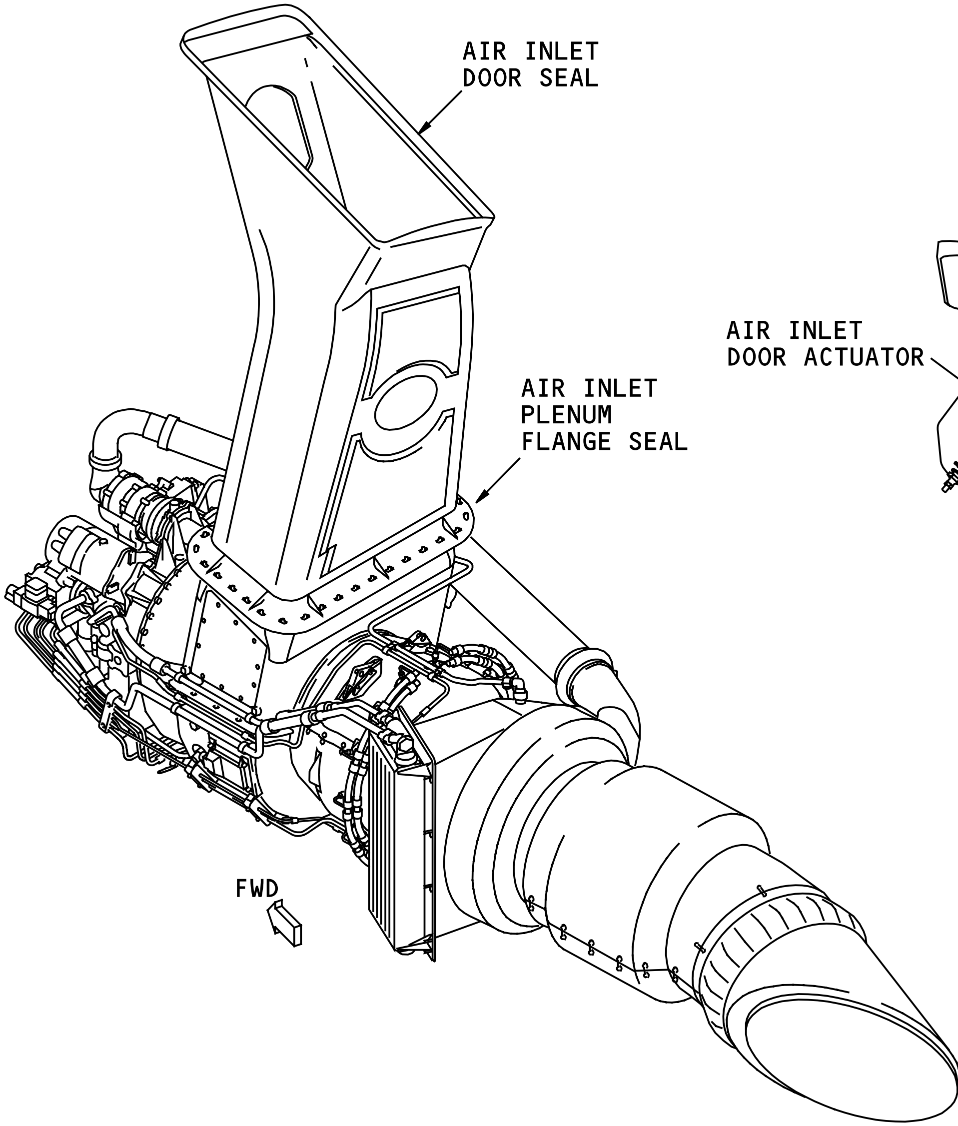
- Air inlet duct
- Air inlet plenum flange seal
- Air inlet door
- Air inlet door actuator
- Air inlet door position switch
- Air inlet door seal.

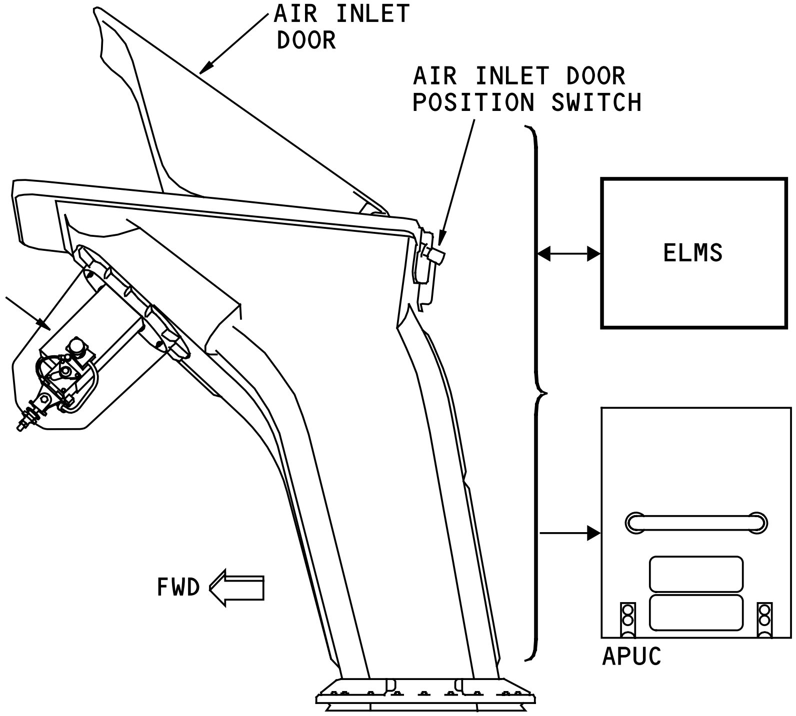
Location

The air inlet components are above the APU. The air inlet door is on the upper right side of the tailcone.

Interface

The electrical load management system (ELMS) controls the air inlet door. The APUC receives door position data for control and fault indications.





APU AIR INLET DUCT

49-10-00-005 Rev 2 12/19/95

APU POWER PLANT - AIR INLET - INTRODUCTION

APU POWER PLANT - AIR INLET - AIR INLET DUCT AND PLENUM FLANGE SEAL

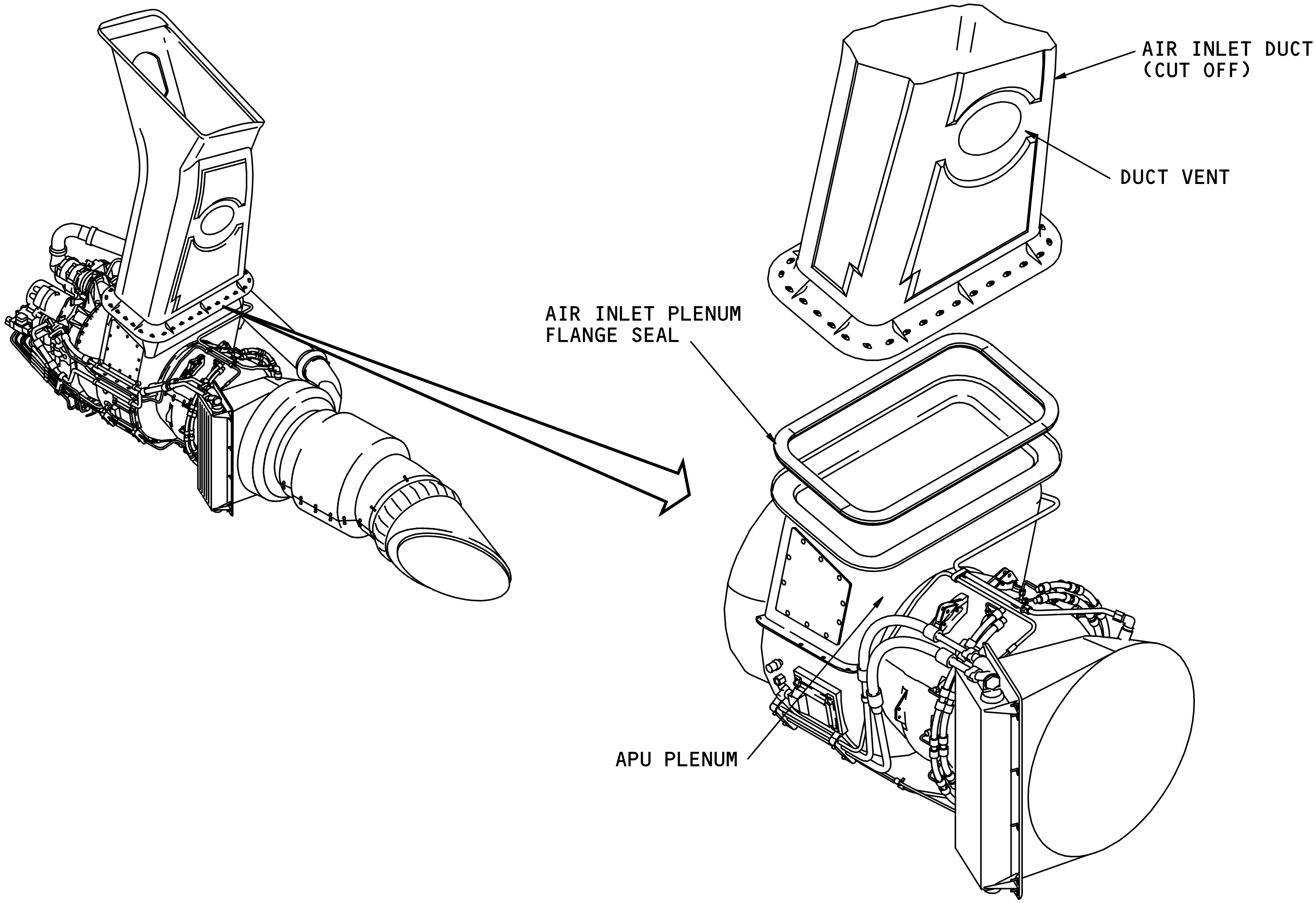
Air Inlet Duct

The air inlet duct connects the APU door to the APU plenum. The duct supplies air to the APU by the shortest, most direct path. The duct is made of composite material.

The duct vent supplies air to the APU compartment for compartment and oil cooling.

APU Air Inlet Plenum Flange Seal

The air inlet plenum flange seal closes and seals the air inlet duct where it connects with the APU plenum. The flange seal is made of a flexible fiberglass/NOMEX/ silicone material. The seal also helps to isolate APU vibration from the duct.



APU POWER PLANT - AIR INLET - AIR INLET DUCT AND PLENUM FLANGE SEAL

49-10-00-006 Rev 2 12/19/95

APU POWER PLANT - APU AIR INLET - AIR INLET DOOR COMPONENTS

Air Inlet Door

The air inlet door opens to let air into the engine and load compressor plenum.

The air inlet door is on the right, upper surface of the tail cone immediately aft of the rudder trailing edge. This position decreases the possibility of water or slush ingestion during ground and flight operations.

Air Inlet Door Seal

The air inlet door seal keeps fluids and contaminants out of the inlet duct when the door is closed. The seal is a bulb-type seal made of silicone rubber.

Air Inlet Door Actuator

The air inlet door actuator is an electric actuator that opens and closes the air inlet door.

The inlet door actuator is in a cannister assembly on the upper forward section of the air inlet duct. The cannister assembly supports the actuator and seals the operating rod slot in the duct.

Air Inlet Door Position Switch

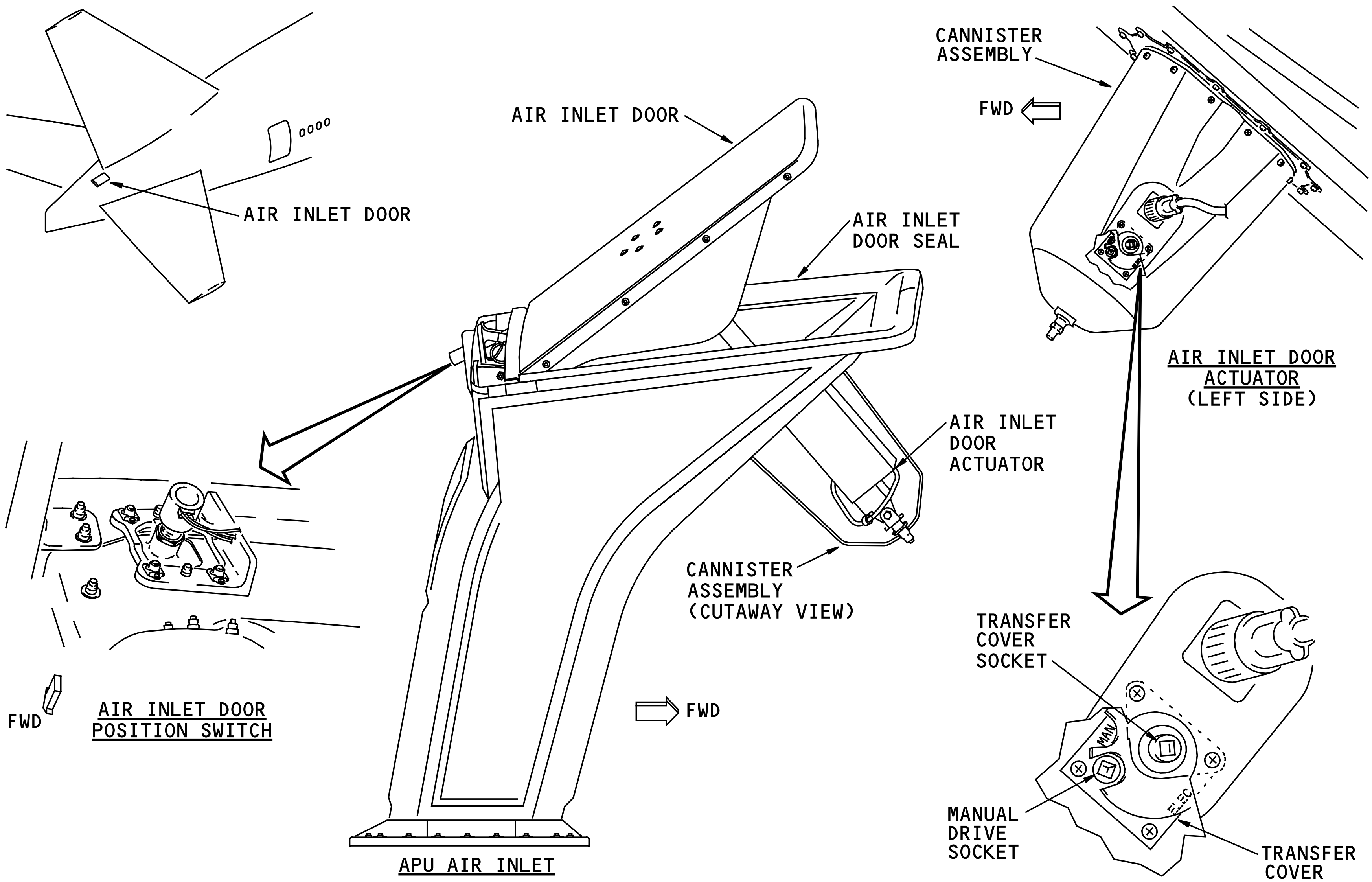
The air inlet door position switch supplies a door open or door not open signal to the ELMS and to the APUC. The switch is on the aft side of the air inlet duct.

Training Information Point

You can manually operate the air inlet door with the manual drive socket on the inlet door actuator assembly.

You must remove a cover (not shown) on the cannister assembly to get access to the transfer cover and the manual drive sockets.

You turn the transfer cover socket to select the manual mode. This uncovers the manual drive socket and disconnects the actuator electrically.



APU POWER PLANT - APU AIR INLET - AIR INLET DOOR COMPONENTS

APU POWER PLANT - APU AIR INLET - FUNCTIONAL DESCRIPTION

General

The APU air inlet door opens for APU start and run operation and closes when the APU is not running. The ELMS contains the control logic for the APU air inlet door.

APU Start

When the APU is OFF, the air inlet door is closed and sealed. When the APU selector is in the ON or START position, the ELMS energizes the control relay to open the air inlet door.

The air inlet door position switch sends a signal to the APUC and to the ELMS when the air inlet door gets to the open position. The door takes 30-40 seconds to open fully.

Normal Operation

During normal operation, an APU running signal from the APUC to the ELMS keeps the door open.

APU Shutdown

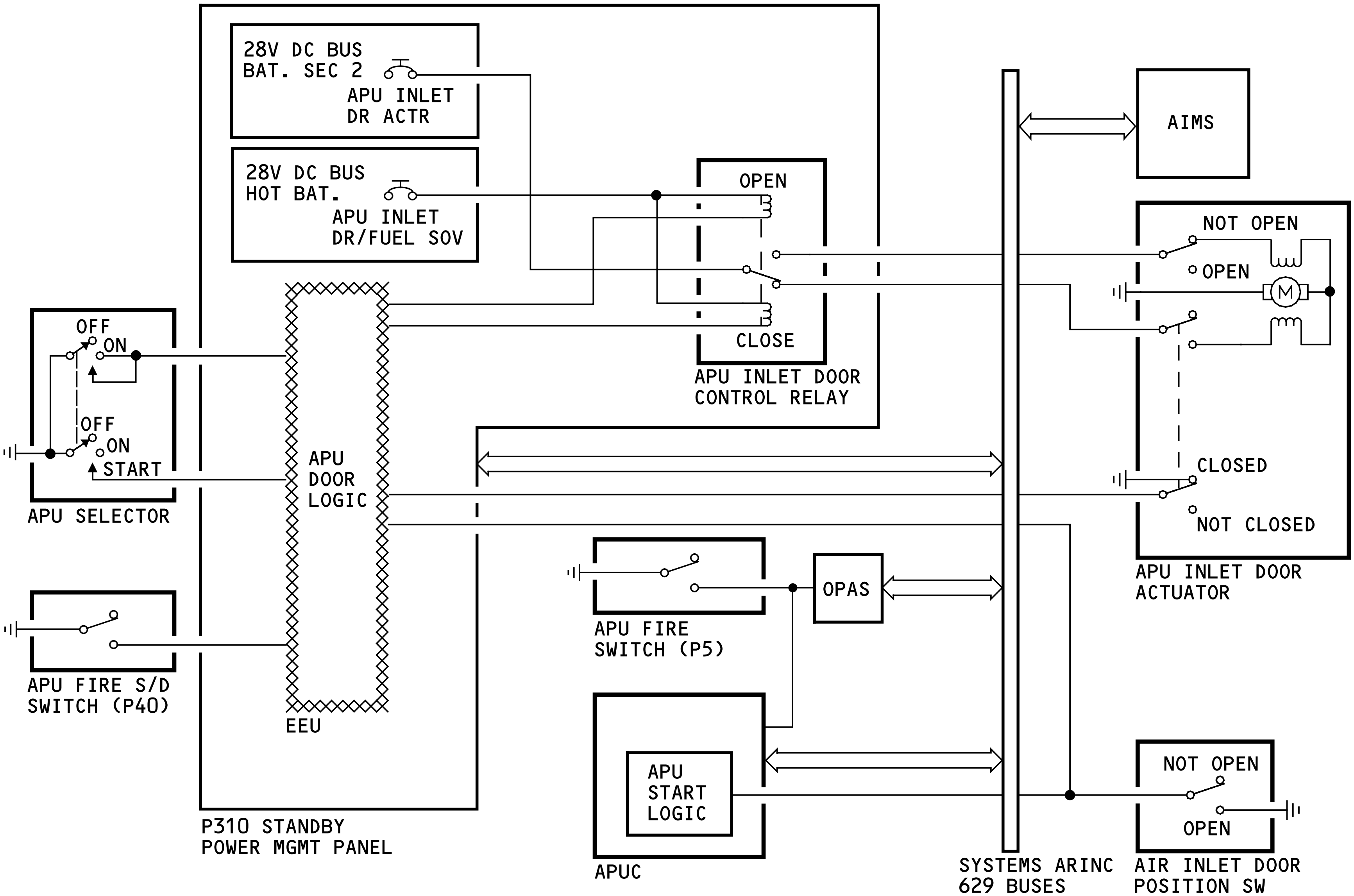
On shutdown, the ELMS energizes the control relay to close the air inlet door when the speed of the APU engine goes below 15 percent RPM. The door takes 30-40 seconds to close fully.

The APU fire switch (P5) or fire shutdown switch (P40) operation cause the air inlet door to close immediately.

Door Position Disagreement

If door position disagrees with the commanded position, the ELMS sends a signal to the AIMS to show the APU DOOR status message.

An air inlet door failure causes an automatic APU shutdown when the APU is in the unattended mode. See the auxiliary power system section for more information on the protective shutdowns (AMM PART I 49-00).



APU POWER PLANT - APU AIR INLET - FUNCTIONAL DESCRIPTION

APU POWER PLANT - APU DRAINS - INTRODUCTION

General

APU flammable fluids drain overboard through drains connected to a drain mast. These drains remove fuel or oil that leaks through seals. These drains also remove fuel that does not burn from the combustion chamber and tailpipe.

APU non-flammable fluids drain overboard through drain holes in the APU compartment doors. These drains remove fluids that go into the APU air inlet plenum from the APU air inlet. These fluids go from the APU air inlet plenum into the APU compartment through the APU plenum drain.

Flammable Fluid Drains

Flammable fluid drains through three separate tubes. The drains attach together at the bottom of the APU. They connect with a drain mast on the right APU access door when the door is closed.

Fuel that does not burn during APU start or operation goes through the APU combustor drain valve. The APU combustor drain valve is at the bottom of the combustion chamber. The drain line from the combustion chamber connects to the combustor drain valve. APU combustion chamber pressure closes the combustor drain valve when the APU operates. The valve is open when the APU is off.

Non-Flammable Fluid Drains

The APU plenum drain is at the bottom of the air inlet plenum.

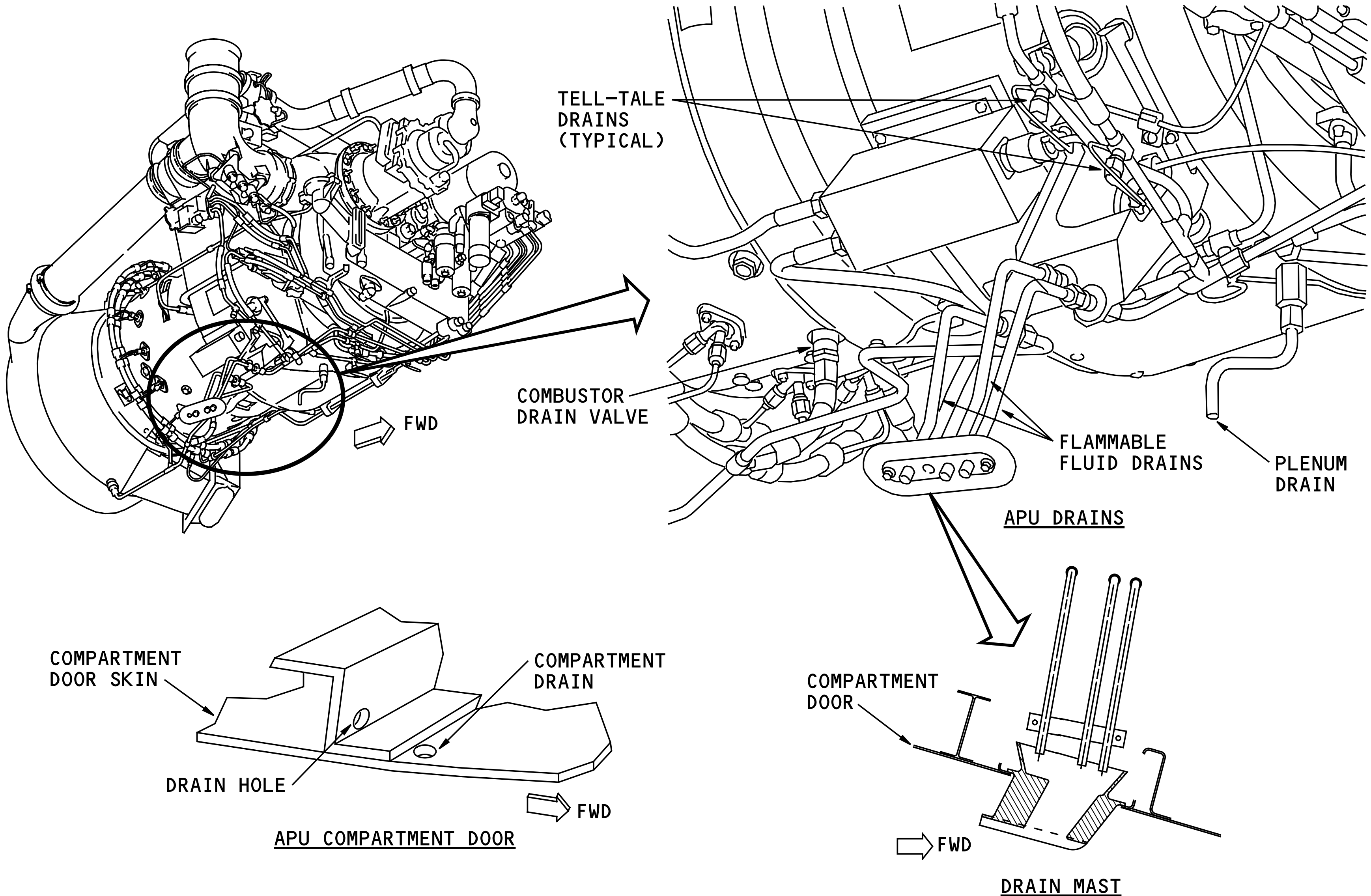
Compartment drains are along the bottom skin of the APU compartment access doors. The APU access doors and compartment structure have drain holes to permit the fluid to flow to the compartment drains.

Training Information Point

Tell-tale drains help find fuel seal failures. Three tell-tale drains are on the APU.

If fuel goes through a drain tube with a tell-tale drain, then the tell-tale drain fills with fuel. You remove the cap of the tell-tale drain to do a check for fluid. If fluid is in the tell-tale drain, the APU component that connects to the drain tube is leaking fuel.

The APU combustor drain valve is an LRU.



APU POWER PLANT - APU DRAINS - INTRODUCTION

49-10-00-009 Rev 3 03/19/1997

APU POWER PLANT - APU DRAINS - FUNCTIONAL DESCRIPTION

General

These APU drains send fuel and oil to the drain mast on the right APU access door:

- Combustion chamber fuel drain
- Eductor/Tailpipe fuel drain
- Surge control valve (SCV) actuator seal drain
- Inlet guide vane (IGV) actuator seal drain
- Forward mid-bearing seal drain
- Aft mid-bearing seal drain
- Load compressor bearing seal drain
- Fuel cluster seal drain.

Drains

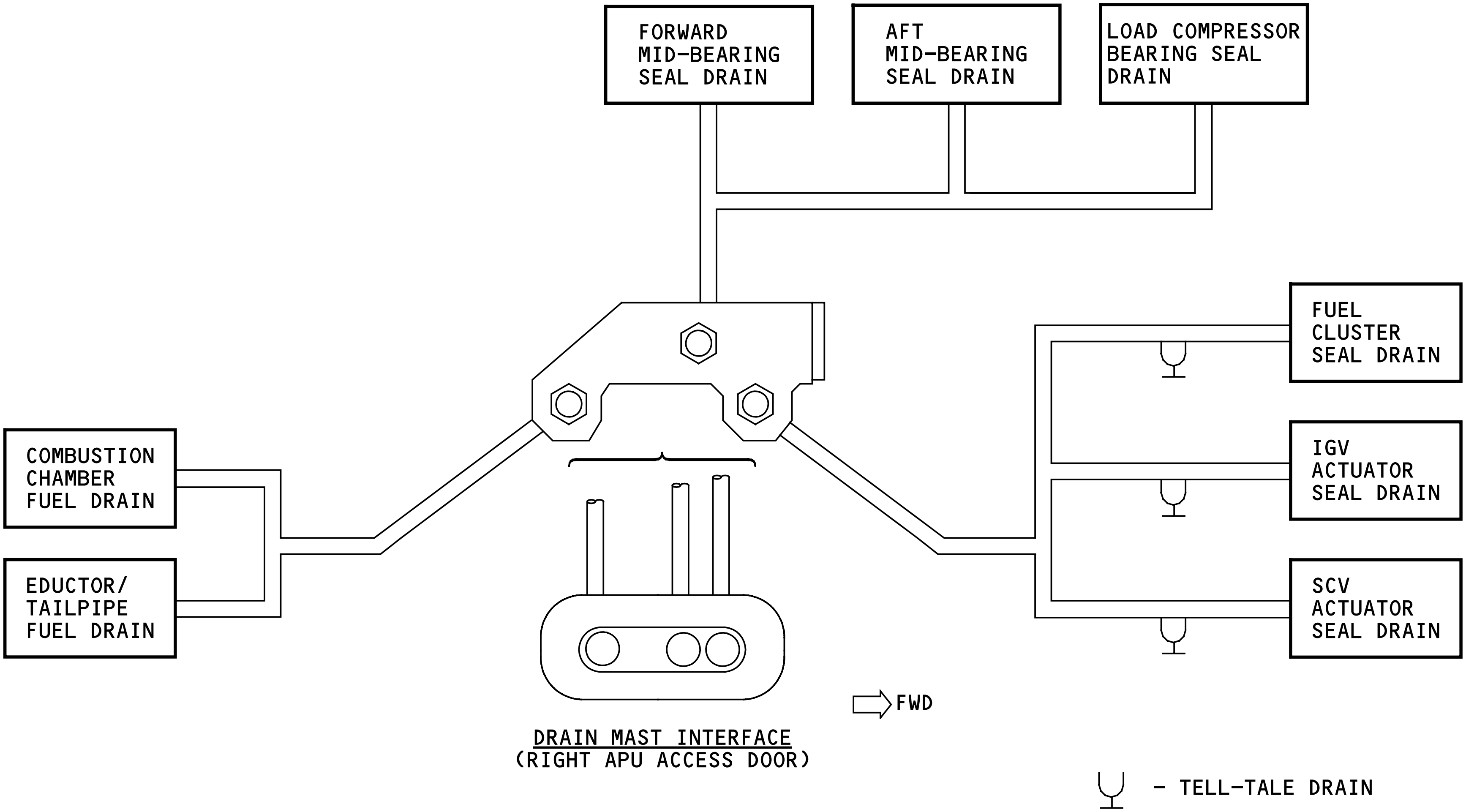
The APU drains connect directly to the drain mast.

The combustion chamber fuel drain and the eductor/tail pipe fuel drain connect together at the bottom of the APU.

The surge control valve seal drain, the IGV actuator seal drain, and the fuel cluster seal drain connect at the bottom of the APU.

The two mid-bearing seal drains and the load compressor bearing seal drain connect at the bottom of the APU.

The drain lines from the SCV actuator seal drain, the IGV actuator seal drain, and the fuel cluster seal drain have tell-tale drains. These tell-tale drains let you find the source of fluid in these drain lines and do a check of the leakage rate.



49-10-00-010 Rev 4 07/18/1997

APU POWER PLANT - APU DRAINS - FUNCTIONAL DESCRIPTION

APU ENGINE - INTRODUCTION

Purpose

The APU engine supplies power to operate the load compressor and the APU generator.

General Description

The APU gas turbine engine has these main components:

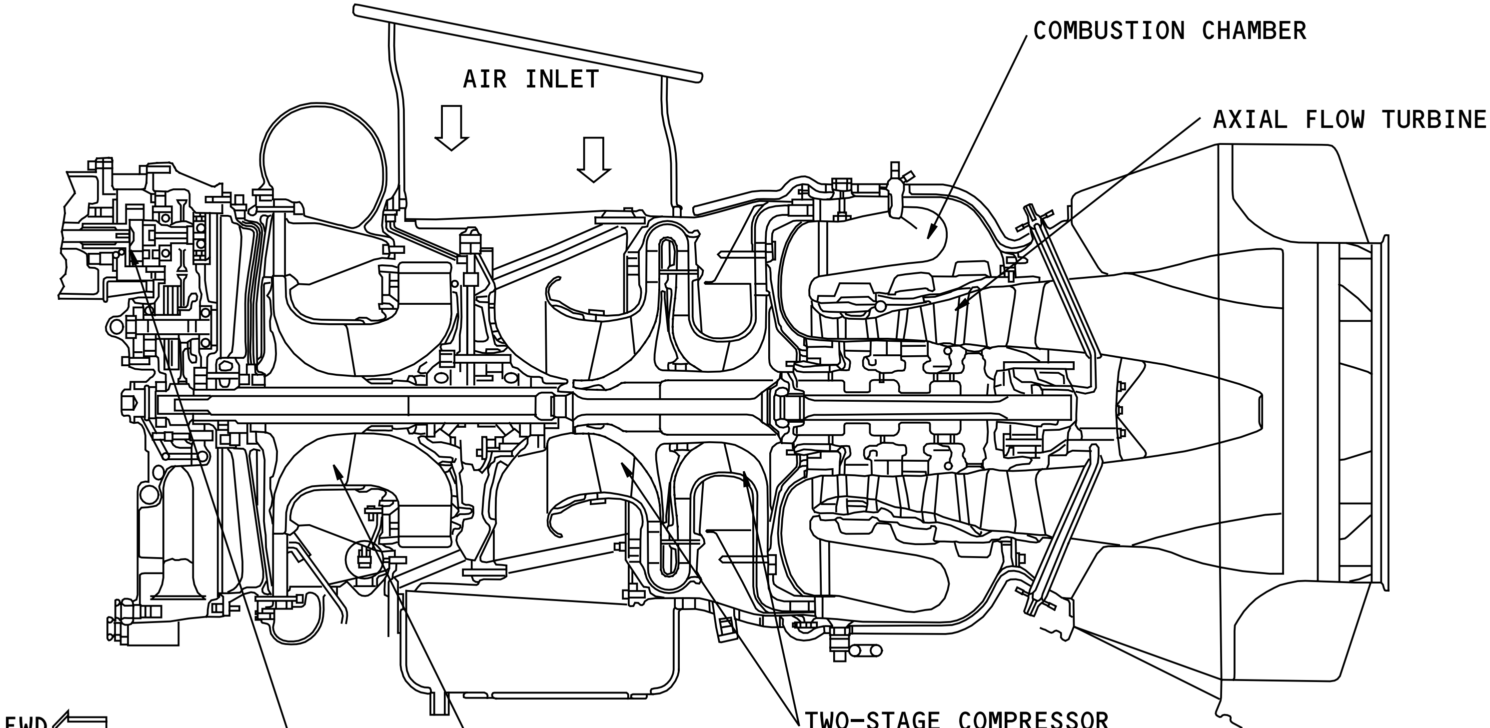
- Two-stage centrifugal compressor
- Reverse flow annular combustion chamber
- Three stage axial flow turbine.

All rotating components in the engine are on a common shaft.

The shaft turns the accessory gearbox and the load compressor. The accessory gearbox turns the APU generator and other APU components.

The engine uses air that flows through the air inlet duct.

The engine operates at a constant speed to permit a 400 hertz generator output frequency. The APU adjusts fuel flow to the engine to keep a constant speed when electrical and pneumatic loads change.



APU ENGINE

49-21-00-001 Rev 1

APU ENGINE - INTRODUCTION

APU ENGINE - TRAINING INFORMATION POINTS

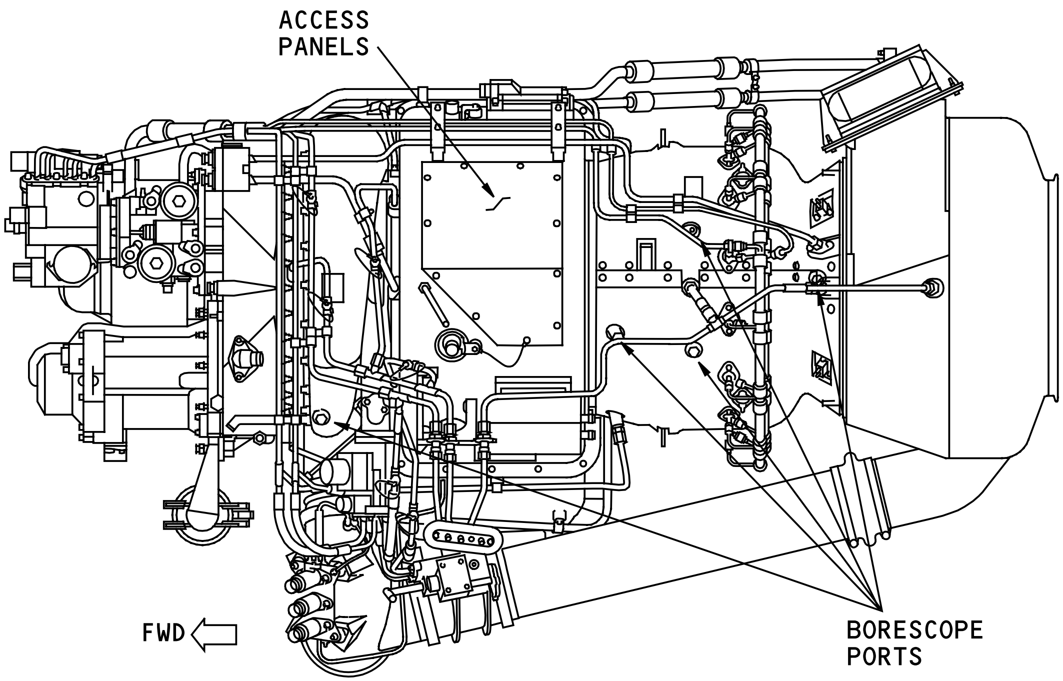
Borescope Inspection Ports

Borescope inspection ports and access panels permit inspection of these components:

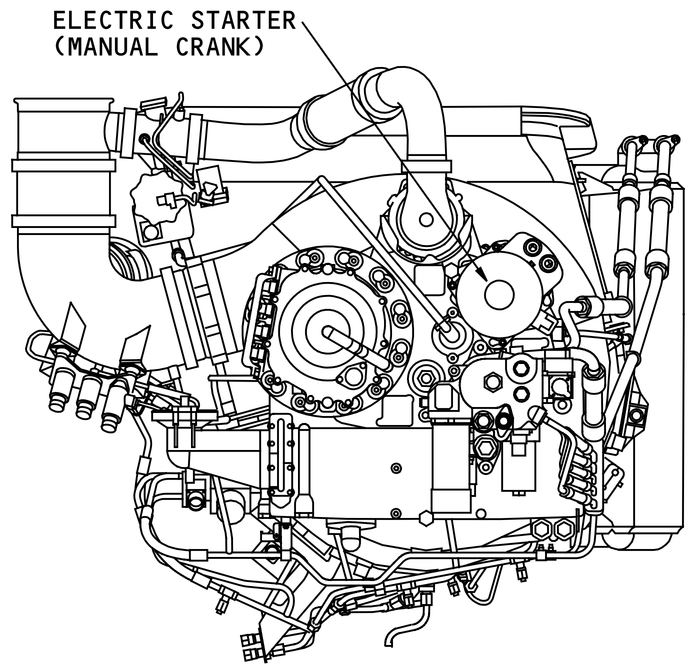
- Load compressor
- Engine compressor
- Combustion chamber
- Turbine section.

Engine Manual Rotation

You can turn the APU engine main shaft with a wrench through a drive connection on the electric starter.



APU
(BOTTOM VIEW)



APU
(FRONT VIEW)

49-21-00-002 Rev 1

APU ENGINE - TRAINING INFORMATION POINTS

APU AND GENERATOR LUBRICATION SYSTEM - INTRODUCTION

Purpose

The APU lubrication system lubricates and cools these components:

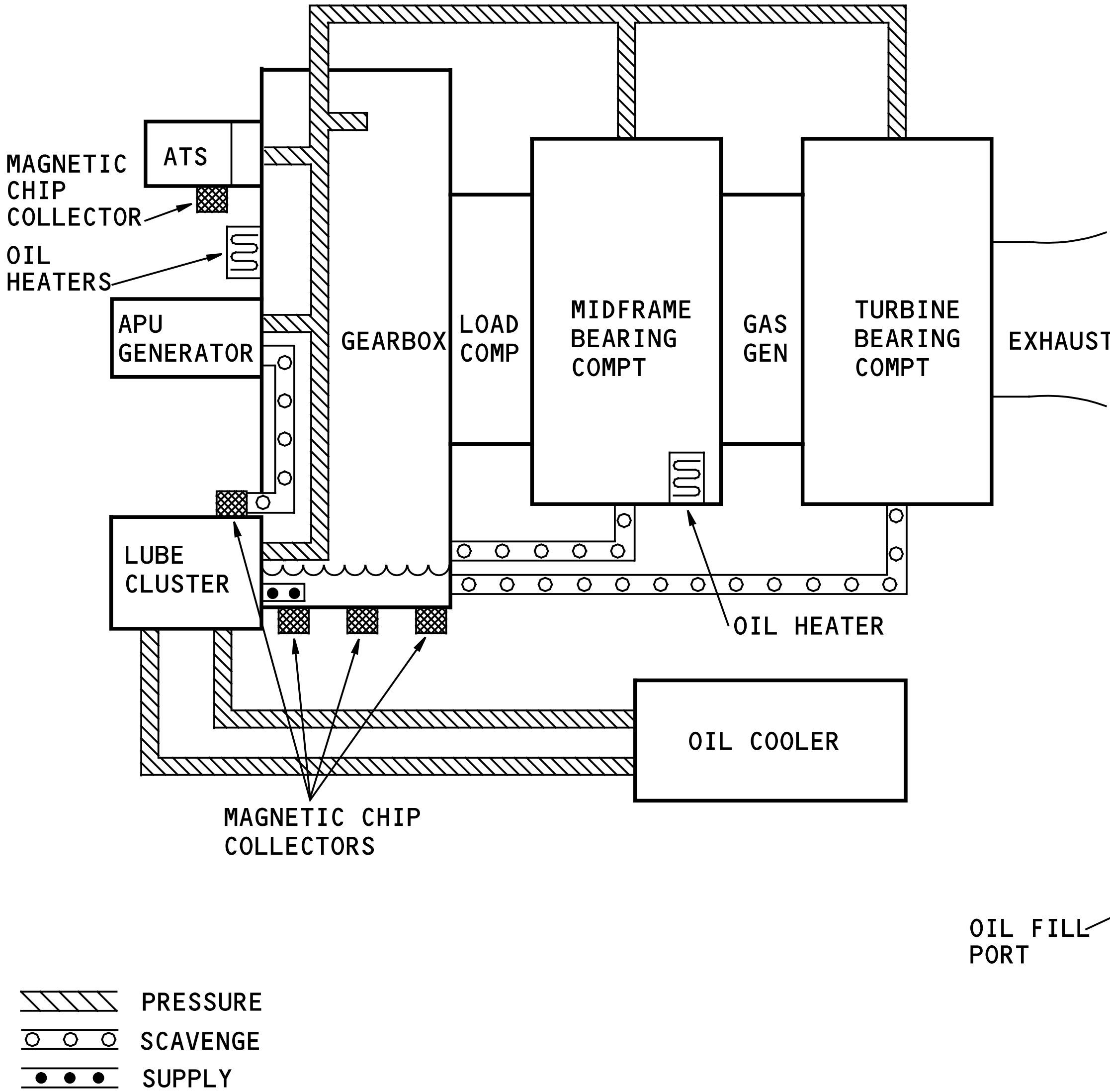
- APU generator
- Air turbine starter (ATS)
- APU bearings
- APU gearbox.

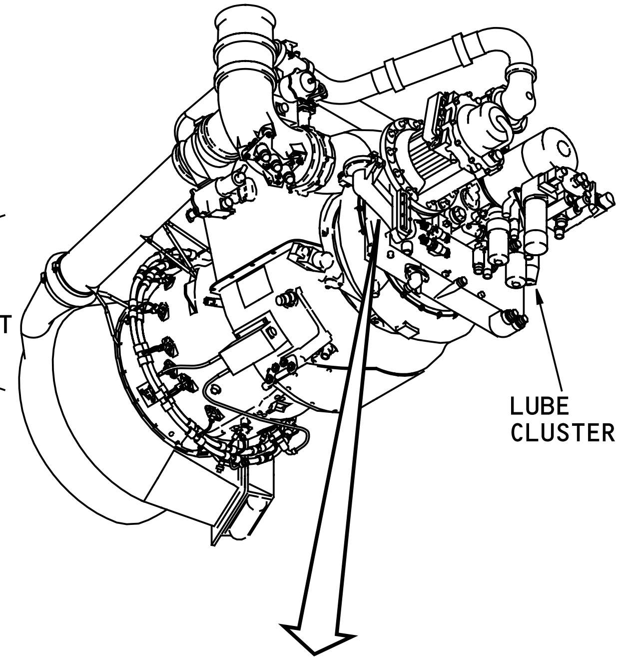
Components

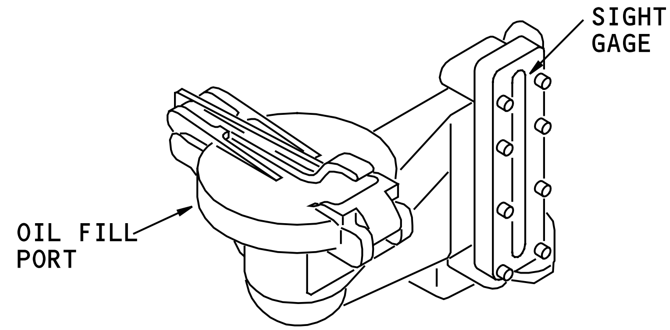
Some lubrication system components are on a common cluster on the front of the APU. These lubrication system components are not on the cluster:

- Magnetic chip collectors
- APU oil heater system components
- Oil cooler.

An 8.2 quart (7.8 liter) oil tank is inside the load gearbox. A sight gage shows the oil level. An oil fill port is adjacent to the gage.







OIL FILL PORT AND SIGHT GAGE

APU AND GENERATOR LUBRICATION SYSTEM - INTRODUCTION

49-27-00-001 Rev 3 01/09/95

APU AND GENERATOR LUBRICATION SYSTEM - LUBE CLUSTER - INTRODUCTION

General

The lube cluster contains many of the lubrication system components. It is on the gearbox on the front of the APU.

Components

The lube cluster contains lube and scavenge pump elements internally. A shaft from the gearbox turns the pumps. A pressure regulating/relief valve is also internal to the lube cluster.

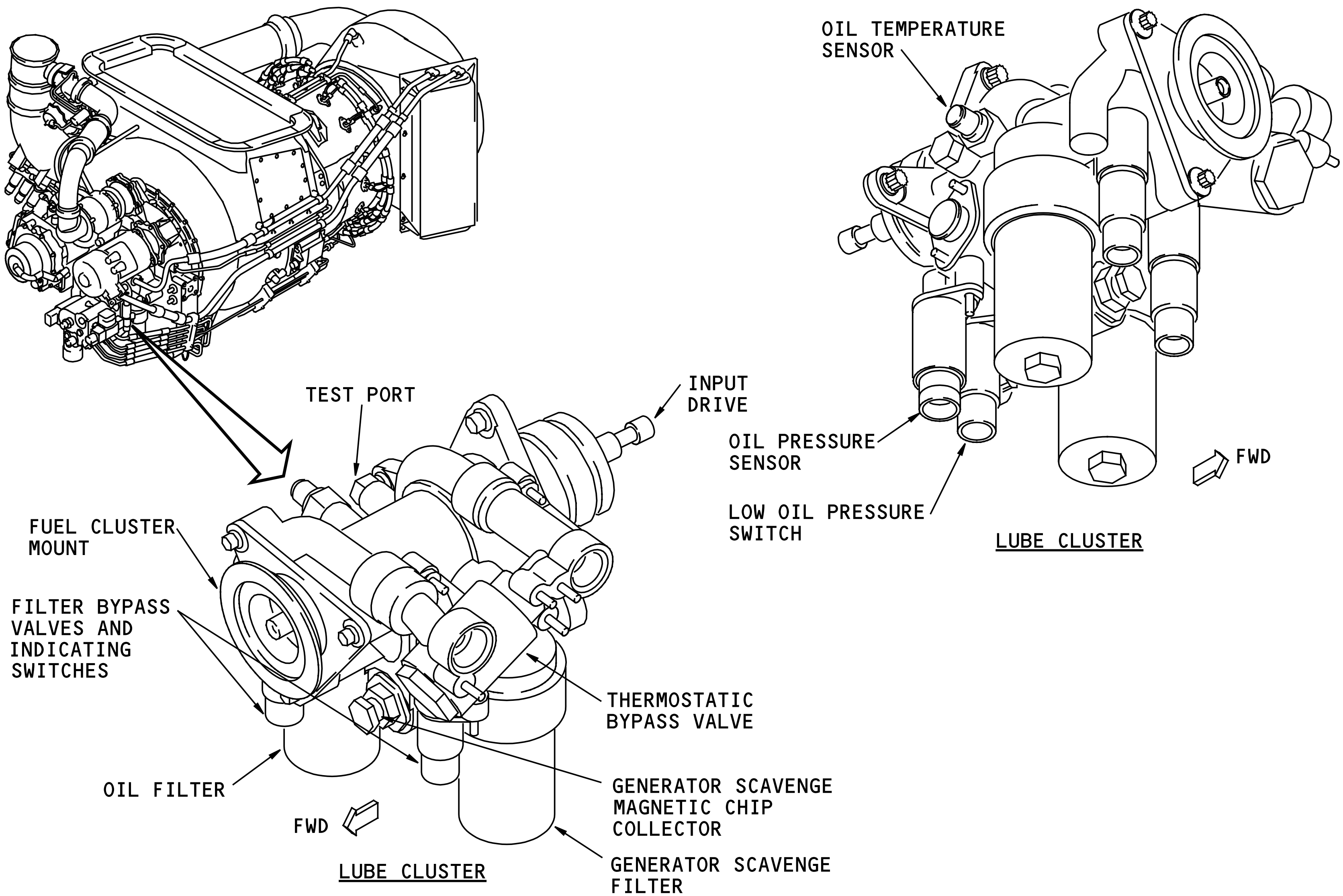
These components are on the outside of the lube cluster and are LRUs:

- Generator scavenge magnetic chip collector
- Filter bypass valve and indicating switches
- Oil and generator scavenge filters
- Low oil pressure switch
- Oil pressure sensor
- Oil temperature sensor
- Thermostatic bypass valve.

A test port permits you to attach a pressure gage to the lube cluster to do a check of the output pressure.

Training Information Point

The fuel cluster mounts to the lube cluster. To remove the lube cluster, you must first remove the fuel cluster.



APU AND GENERATOR LUBRICATION SYSTEM - LUBE CLUSTER - INTRODUCTION

49-27-00-002 Rev 3 07/20/95

APU AND GENERATOR LUBRICATION SYSTEM - MAGNETIC CHIP COLLECTORS

Purpose

Magnetic chip collectors collect metallic particles in the engine oil. This permits you to do an inspection of the APU for damage.

Location

These are the five chip collectors on the APU:

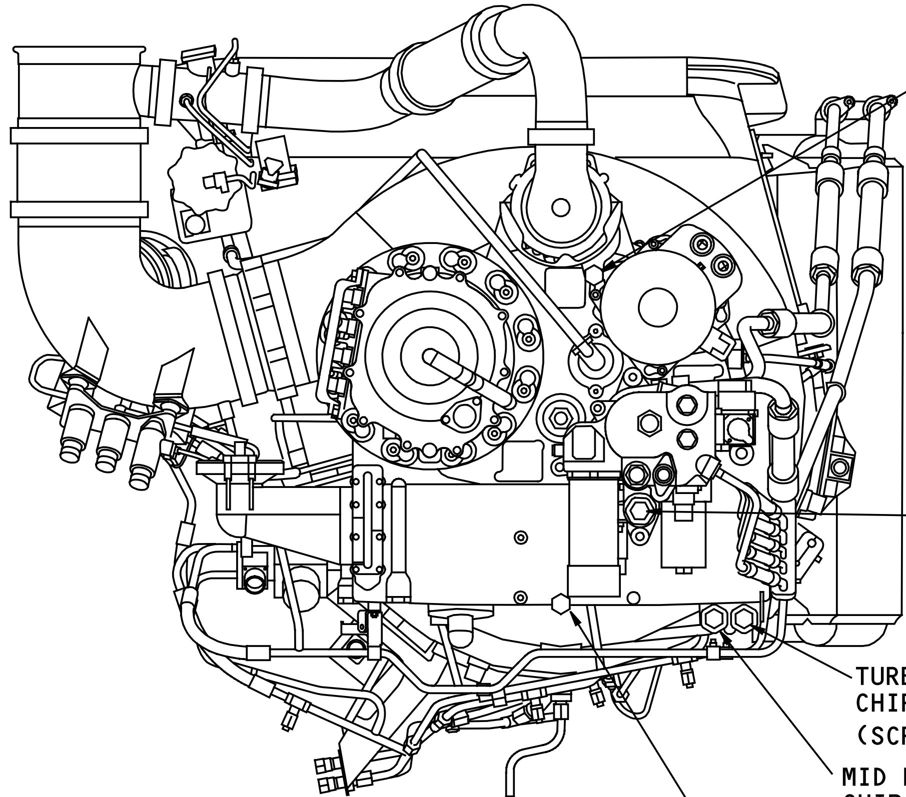
- ATS chip collector - on the lower side of the air turbine starter
- Generator scavenge chip collector - on the lube cluster
- Turbine bearing chip collector - on the left forward side of the load gearbox
- Mid-bearings chip collector - on the left forward side of the load gearbox inboard of the turbine bearing chip collector
- Sump drain chip collector - on the forward side of the load gearbox in the center.

Physical Description

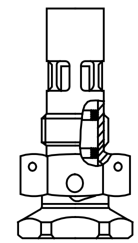
The magnetic chip collectors have magnets inside them to collect the metal chips.

All the chip collectors are the same. They are in adapters which are also removal check valves. The check valves close to prevent oil loss when you remove the chip collector.

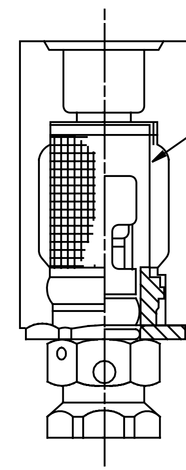
Some removal check valves are inside screens. The screens stop large metal particle movement through the lubrication system.



APU (FRONT VIEW)



MAGNETIC CHIP COLLECTOR AND ADAPTER



MAGNETIC CHIP COLLECTOR AND SCREEN

49-27-00-004 Rev 3 10/21/96

APU AND GENERATOR LUBRICATION SYSTEM - MAGNETIC CHIP COLLECTORS

APU AND GENERATOR LUBRICATION SYSTEM - OIL COOLER

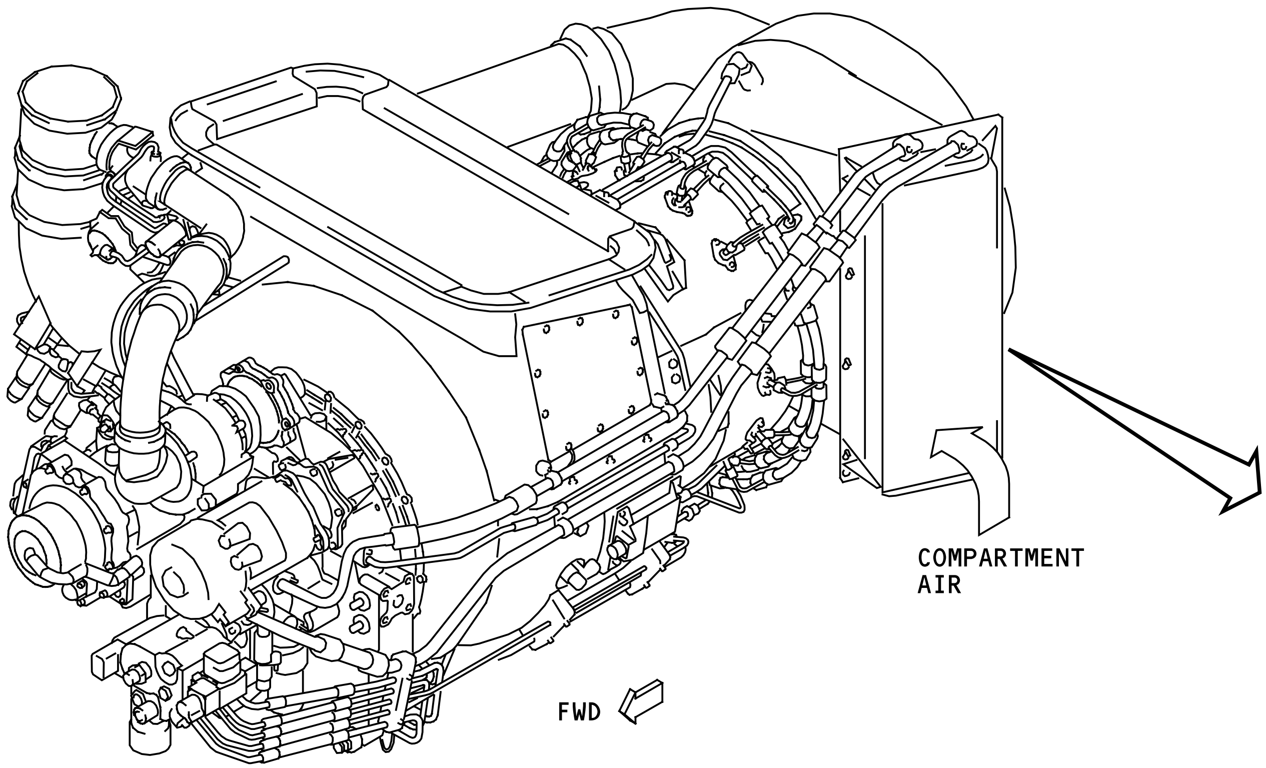
General

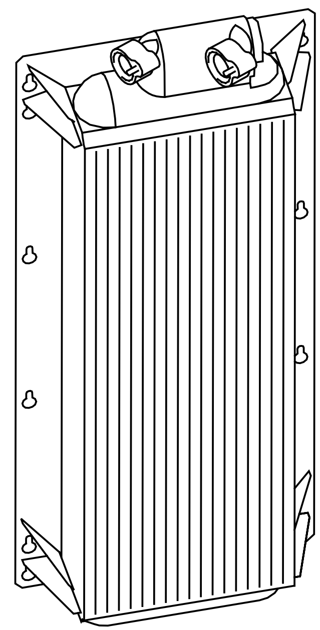
The oil cooler is a stainless steel air/oil heat exchanger. Compartment air cools the pressurized oil after the oil leaves the oil pump.

The oil cooler is on the left side of the APU turbine case. It is part of the exhaust eductor cooling system.

Functional Description

The APU exhaust causes a suction of air. This causes APU compartment air to move through the oil cooler to cool the APU oil. The cooling air then flows overboard through the exhaust duct.





OIL COOLER

49-27-00-005 Rev 1

APU AND GENERATOR LUBRICATION SYSTEM - OIL COOLER

APU AND GENERATOR LUBRICATION SYSTEM - FUNCTIONAL DESCRIPTION

General

The APU and generator lubrication system supplies pressurized oil to cool and lubricate APU components and the APU generator. A scavenge system returns the oil to the reservoir in the gearbox.

Supply

Oil pump elements in the lube cluster pump oil from the reservoir in the gearbox. Pressurized oil from the lube cluster goes to the oil cooler and then returns to the lube cluster.

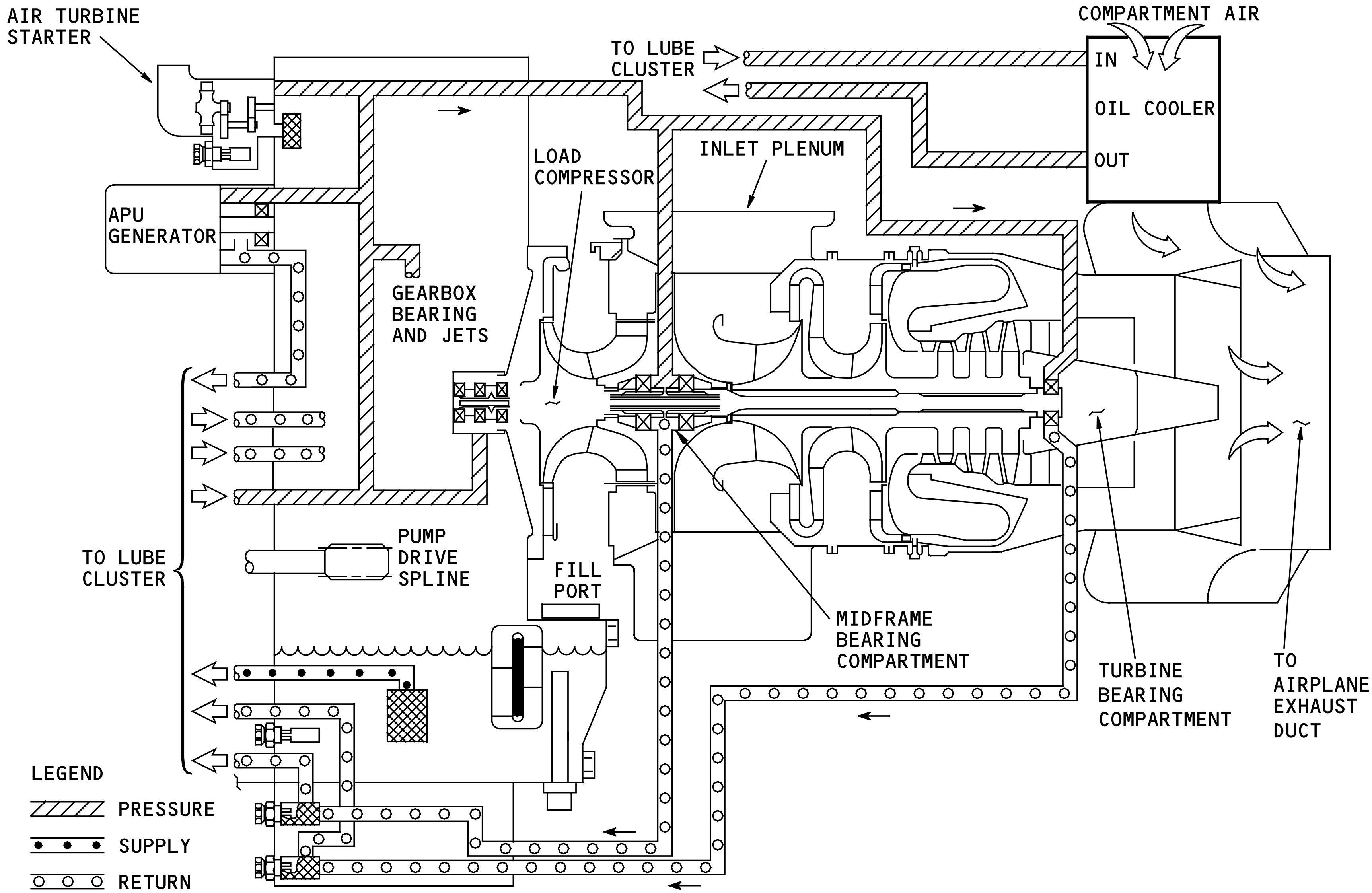
The lube cluster cleans the oil and regulates the oil pressure. Oil pressure and temperature sensors supply data to the APUC.

The oil then goes to the:

- APU generator
- Air turbine starter (ATS)
- Gearbox bearings and jets
- Load compressor bearings
- Midframe bearing compartment
- Turbine bearing compartment.

Scavenge

Scavenge pump elements in the lube cluster send the oil from the midframe and turbine bearing compartments back to the reservoir. Other scavenge pump elements send the scavenge oil from the APU generator through the scavenge filter and back to the gearbox reservoir.



49-27-00-006 Rev 2

APU AND GENERATOR LUBRICATION SYSTEM - FUNCTIONAL DESCRIPTION

APU OIL HEATER SYSTEM

Purpose

The APU oil heater system uses 115v ac electric-resistive heaters to heat the gearbox and midframe bearings. The heaters reduce bearing oil drag on start which increases starting reliability when the APU has been cold-soaked.

Location

There are three gearbox heater pads on the front face of the APU gearbox. A midframe heater probe is in a well on the bottom of the APU air inlet plenum.

Functional Description

The oil heater system operates continuously when the ground service bus has power.

The gearbox heater pads are made of aluminum. They heat the gearbox and gearbox bearings. The gearbox heater pads are self-regulating and can be as hot as 450F (232C). There are insulation pads (not shown) on the gearbox heater pads.

A probe-type stainless steel heater heats the midframe bearings.

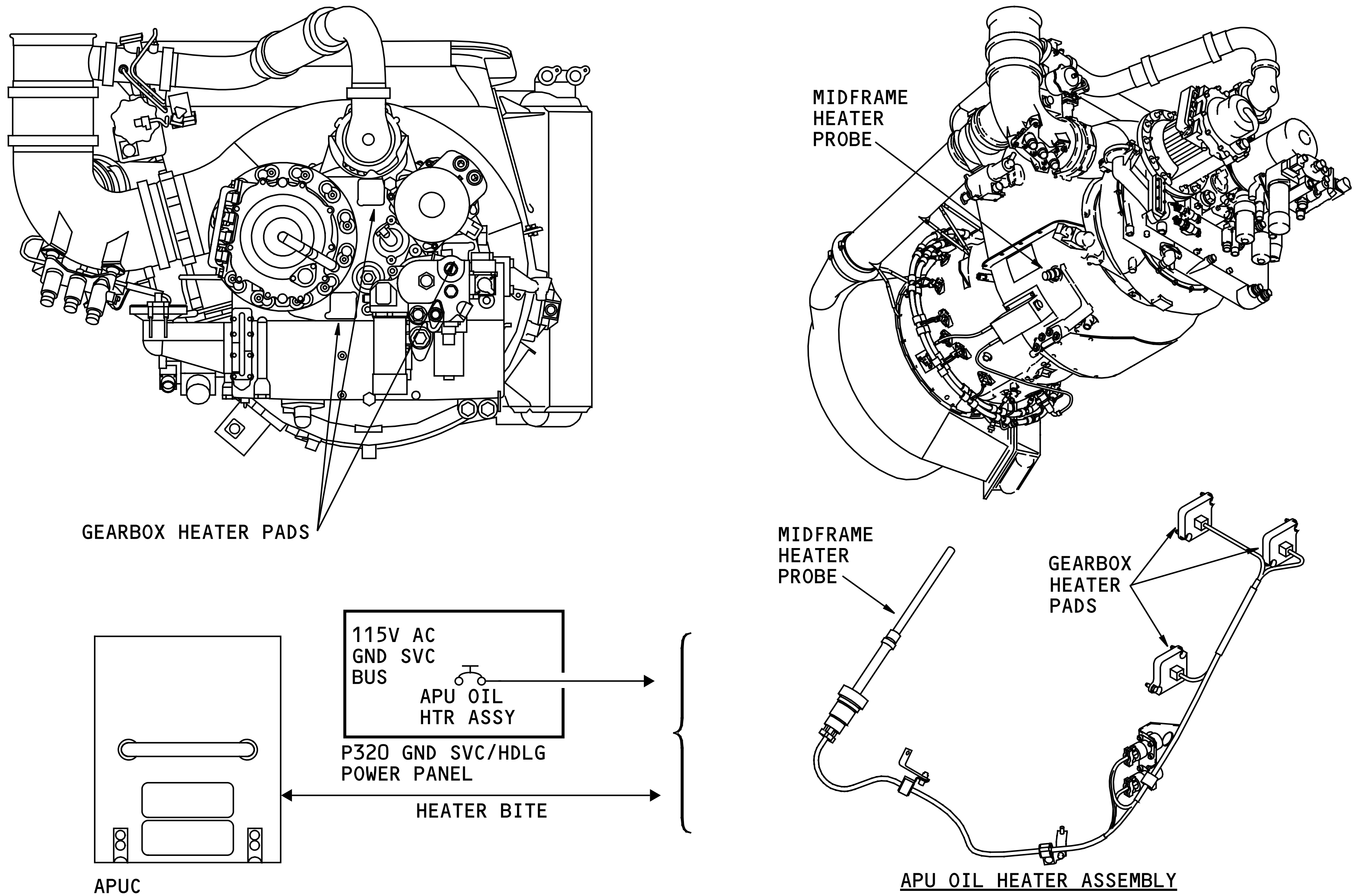
The APUC monitors the heaters for faults.

Training Information Point

The APU oil heater assembly is an LRU.

The APU CONTROL status message shows is there is an APU oil heater fault.

WARNING: DO NOT TOUCH THE APU OIL HEATER ASSEMBLY. THE GEARBOX HEATERS STAY HOT WHEN THE AIRPLANE HAS AC POWER.



APU OIL HEATER SYSTEM

APU OIL INDICATING SYSTEM - INTRODUCTION

Purpose

The APU oil indicating system supplies APU oil temperature, pressure, and quantity data for APU flight deck display and APU control functions.

Components

These are the oil indicating system components:

- Oil pressure sensor
- Low oil pressure switch
- Oil temperature sensor
- Oil quantity/sump temperature sensor.

An oil level sight gage on the gearbox shows oil level.

Location

The oil pressure sensor, the low oil pressure switch, and the oil temperature sensor are on the lube cluster. The oil quantity/sump temperature sensor and the oil level sight gage are on the APU gearbox.

General Description

The APUC receives oil indicating system inputs and supplies this data to the AIMS to show on the MFD.

Oil indicating system data shows on the status display and on the APU maintenance page.

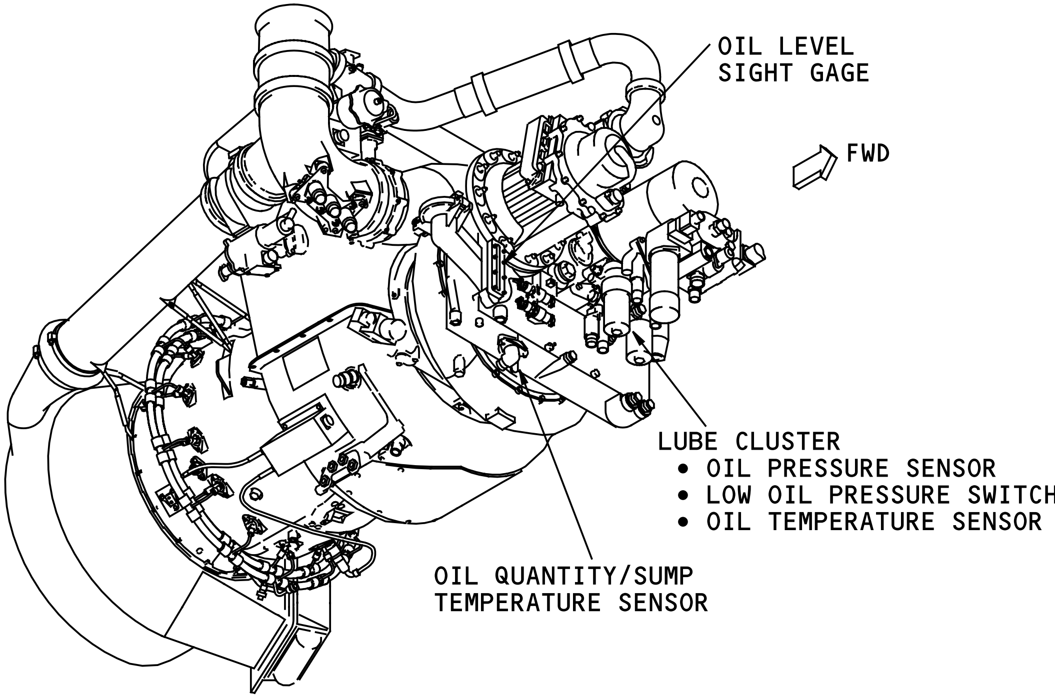
Protective Shutdowns

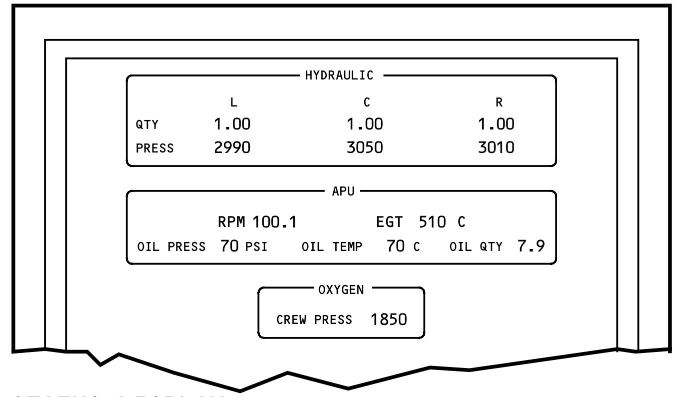
Low oil pressure, loss of oil pressure input, or high oil temperature will cause the APUC to do a protective shutdown when the APU is in the unattended mode.

Non-Normal Indications

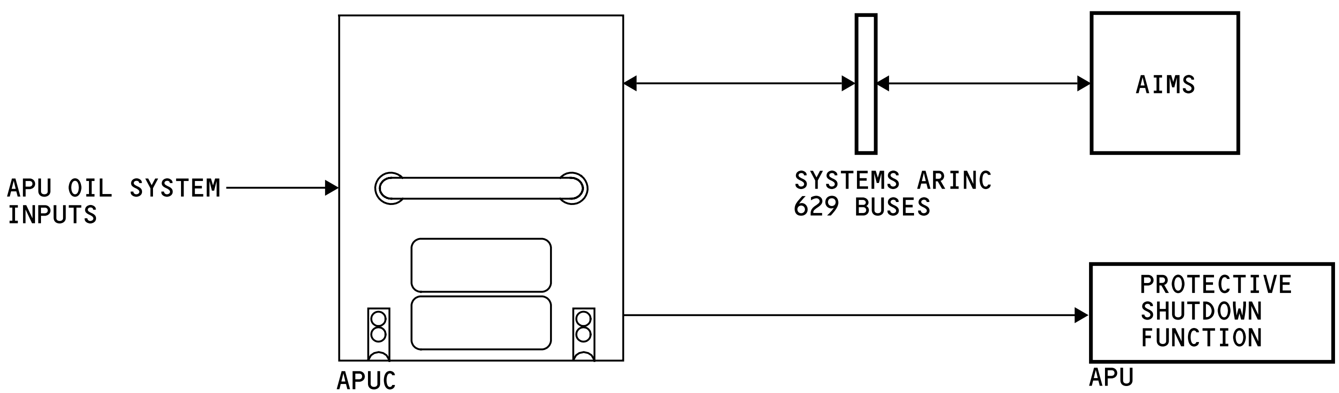
The APU OIL QTY status message shows when the APU oil quantity is 3.8 quarts (3.5 liters) or less. This message also shows for an oil quantity/sump temperature sensor failure.

The APU status message shows for an oil temperature sensor failure.





STATUS DISPLAY



APU OIL INDICATING SYSTEM - INTRODUCTION

APU OIL INDICATING SYSTEM - COMPONENTS

Oil Quantity/Sump Temperature Sensor

The oil quantity/temperature sensor is a capacitance-type sensor and is in the sump of the oil reservoir on the bottom of the APU gearbox. The sensor sends both oil quantity and oil temperature data to the APUC.

Oil Pressure Sensor

The oil pressure sensor sends oil system pressure data to the APUC. This sensor is on the lube cluster.

Low Oil Pressure Switch

The low oil pressure switch sends a low oil pressure signal to the APUC when APU oil pressure is below 30 to 40 psi. This switch is on the lube cluster.

Oil Temperature Sensor

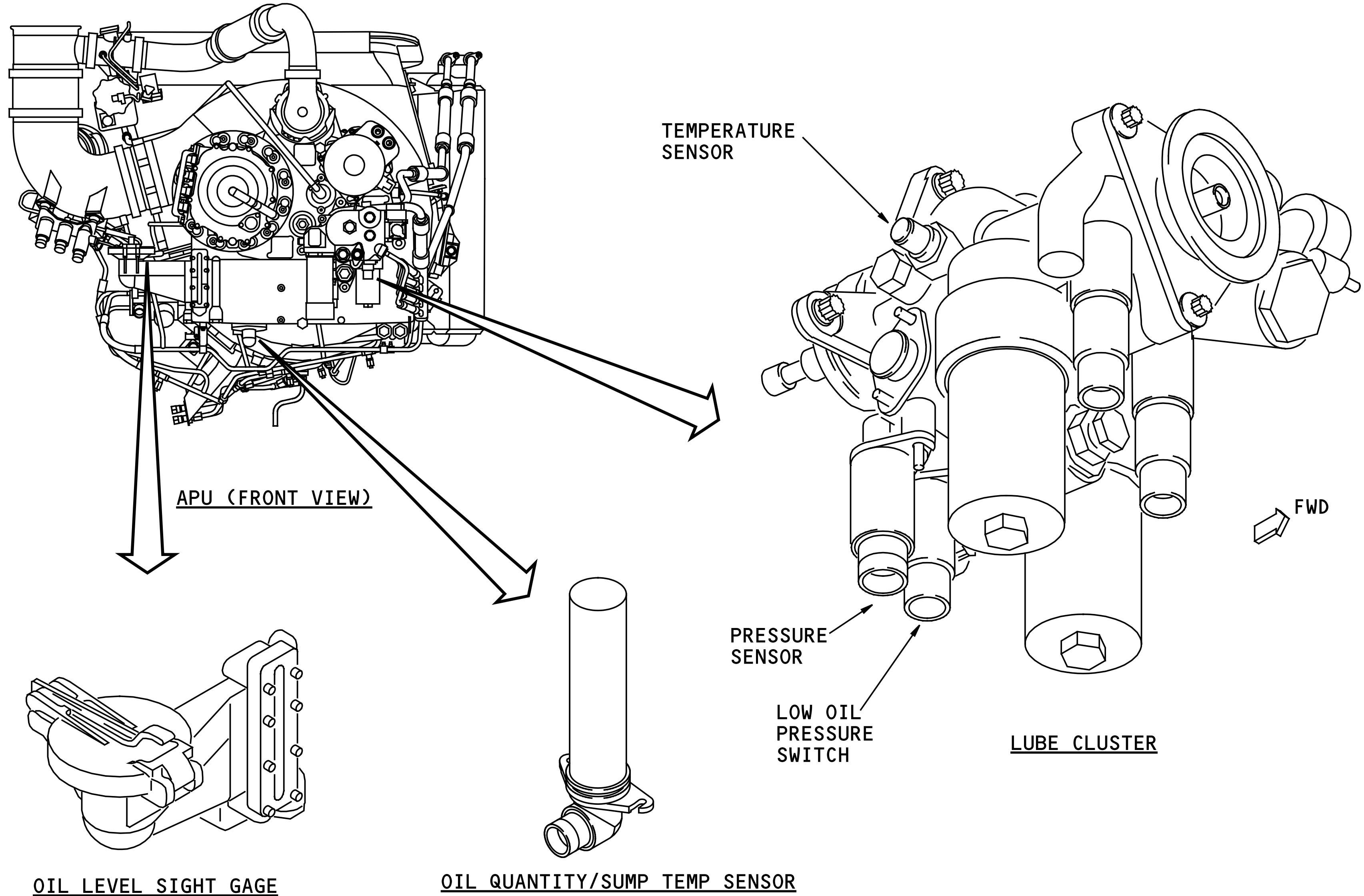
The oil temperature sensor is a resistive type sensor. It sends oil temperature data to the APUC and is on the Lube cluster.

Oil Level Sight Gage

The oil level sight gage is on the right, front of the gearbox. The sight gage is part of the oil fill port.

Training Information Point

All APU oil sensors are LRUs. The sight gage and fill port are a single LRU.



APU OIL INDICATING SYSTEM - COMPONENTS

APU FUEL SYSTEM - INTRODUCTION

Purpose

The APU fuel system supplies pressurized and metered fuel to the APU combustion chamber. It also supplies pressurized fuel to actuators for the inlet guide vanes and the surge control valve.

Interfaces

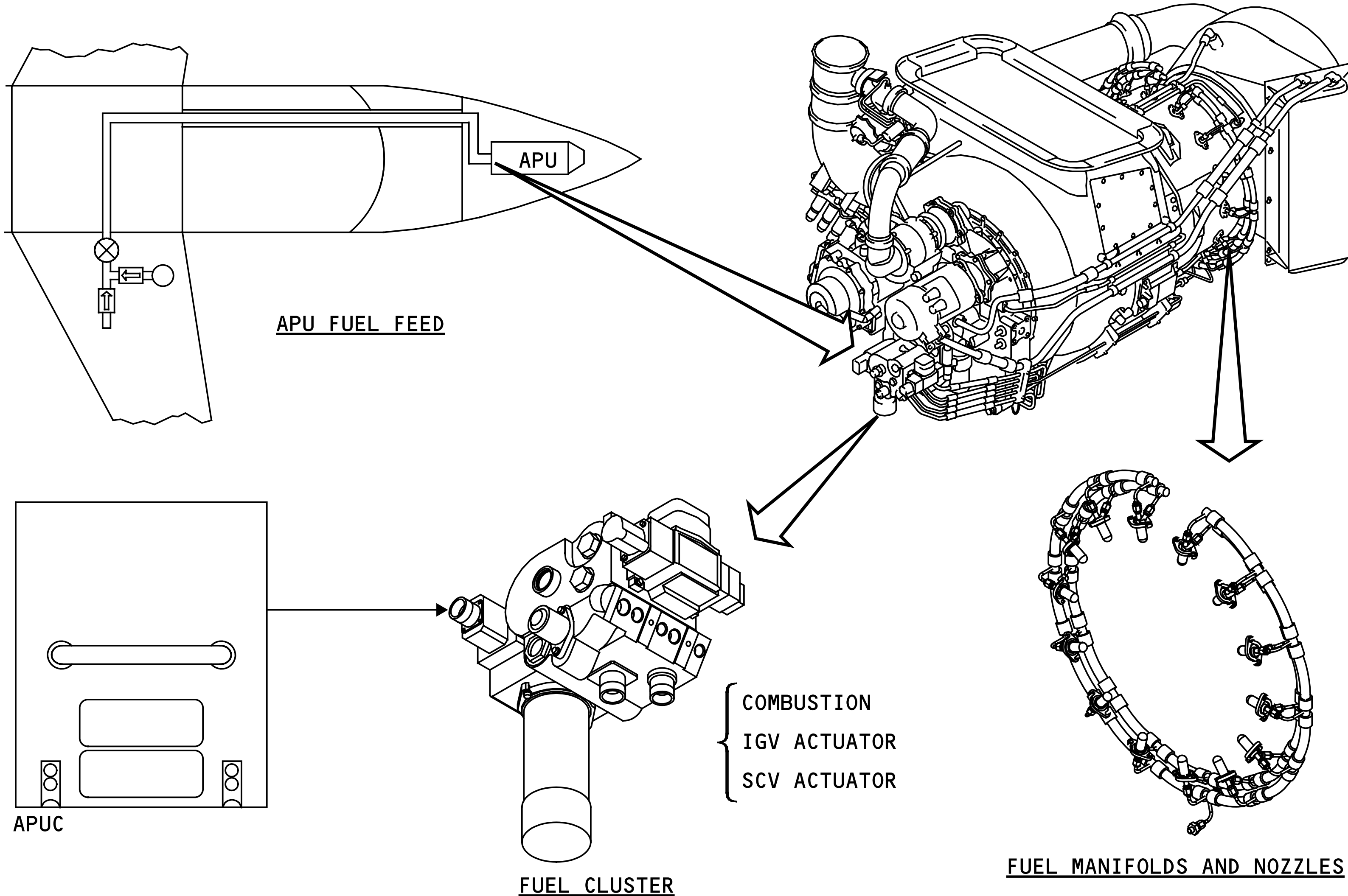
Fuel system ac boost pumps or the APU dc fuel pump in the wing supply fuel from the airplane fuel system for APU operation.

The APU controller (APUC) controls the APU fuel system.

Components

Most fuel system components are on a common fuel cluster on the forward side of the APU gearbox.

Other fuel system components are the fuel manifolds and the fuel nozzles.



APU FUEL SYSTEM - INTRODUCTION

APU FUEL SYSTEM - FUEL CLUSTER - INTRODUCTION

General

The fuel cluster contains the APU fuel control and other fuel system components. The fuel cluster is attached to the lube cluster which turns the fuel system pumps.

Training Information Point

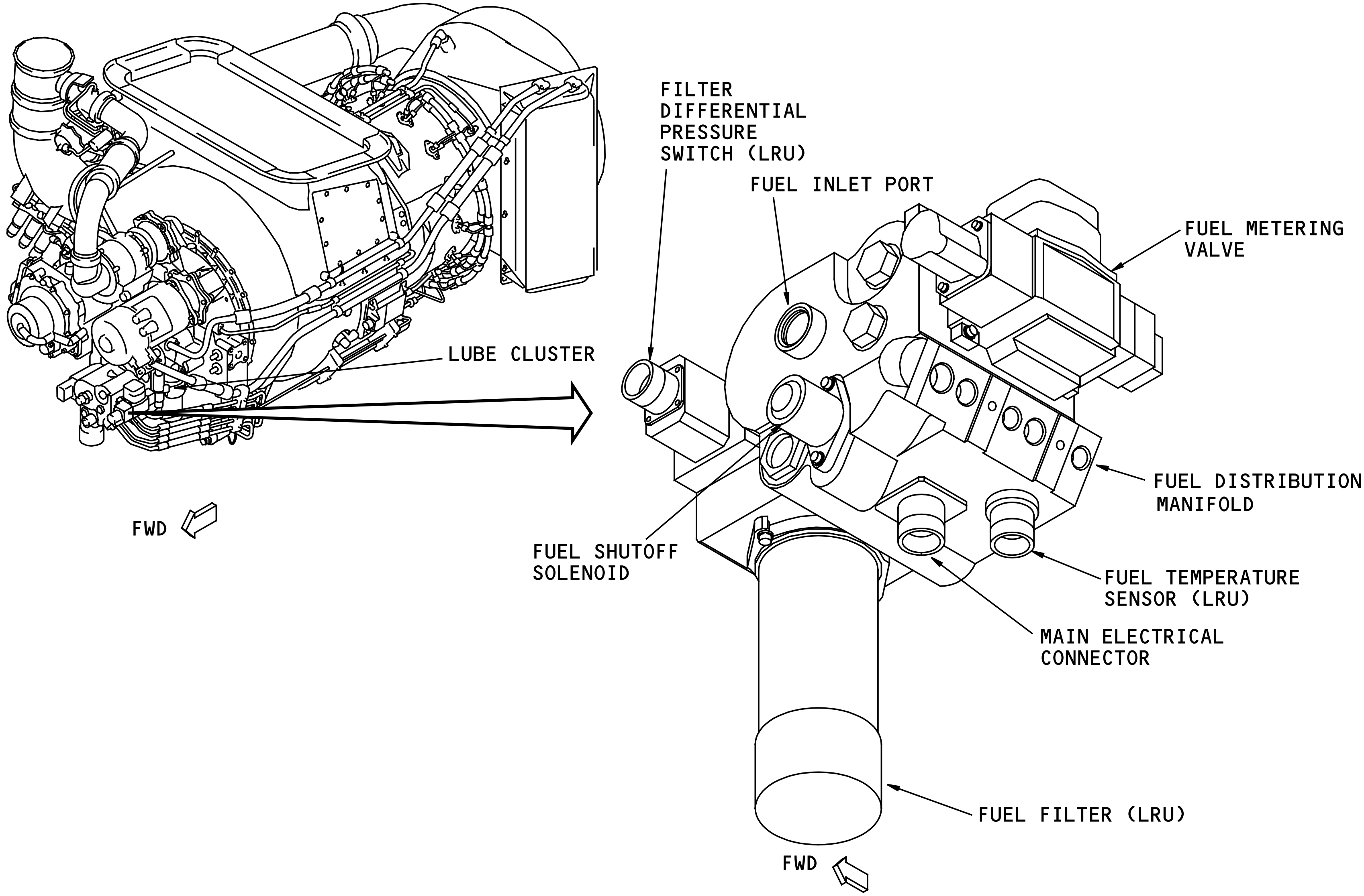
The entire fuel cluster is an LRU. These components are also LRUs:

- Fuel filter
- Fuel filter differential pressure switch
- Fuel temperature sensor.

These fuel cluster components are not LRUs:

- Fuel shutoff solenoid
- Fuel metering valve
- Fuel distribution manifold.

The fuel cluster also contains the fuel pumps and some internal pressure regulating valves.



49-30-00-002 Rev 1

APU FUEL SYSTEM - FUEL CLUSTER - INTRODUCTION

APU FUEL SYSTEM - MANIFOLDS AND NOZZLES

Fuel Manifolds

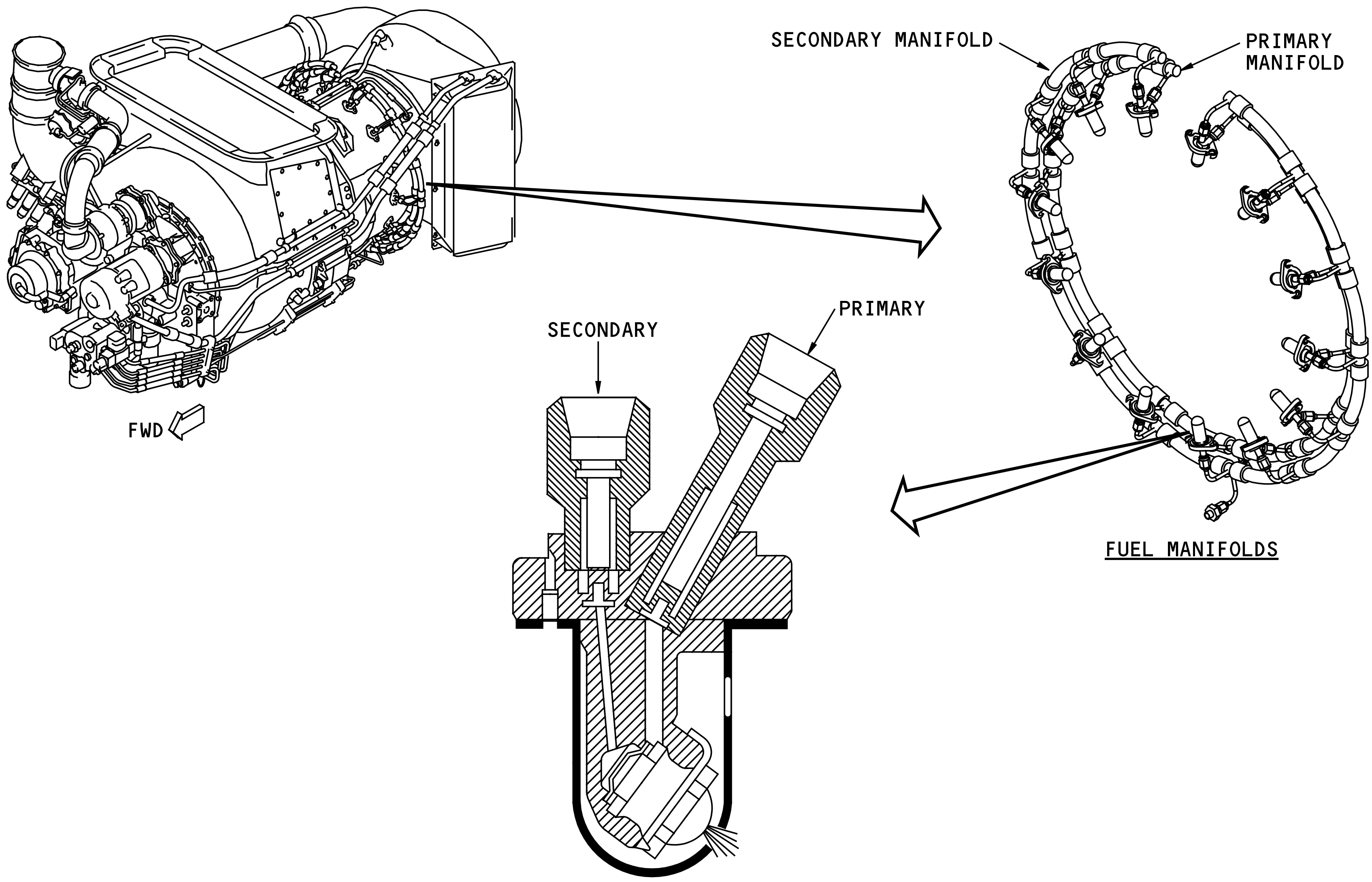
A primary fuel manifold and a secondary fuel manifold supply fuel from the fuel cluster to the fuel nozzles.

The manifolds are insulated flexible lines and are on the combustion section.

Both manifolds supply fuel when the APU is running. Only the primary manifold supplies fuel during the first part of APU start at low RPM.

Fuel Nozzles

Fourteen fuel nozzles atomize and inject fuel into the engine combustion section. The fuel nozzles are equally spaced around the combustion section.



APU FUEL SYSTEM - MANIFOLDS AND NOZZLES

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APU FUEL SYSTEM - FUNCTIONAL DESCRIPTION

General

The APU controller automatically controls the APU fuel system. The APU fuel system supplies fuel for combustion and is a pressure source for the IGV and SCV actuators.

Fuel Supply

Fuel system ac boost pumps or the APU dc fuel pump supplies fuel through the APU fuel shutoff valve. The shutoff valve opens when the APU selector is ON. The dc pump operates when ac power is not available. When ac power becomes available, the left forward boost pump turns on and the dc pump turns off.

Fuel Cluster

The fuel cluster gets the fuel from the airplane fuel system and does these functions:

- Pressurizes the fuel (fuel pump)
- Cleans the fuel (filter)
- Controls the fuel pressure (pressure regulator)
- Controls fuel flow (fuel metering valve and fuel shutoff solenoid valve)
- Divides the fuel flow (fuel flow divider)
- Monitors the fuel temperature (fuel temperature sensor).

APUC Control

The APUC has the logic to control the fuel solenoid valve and the fuel metering valve.

During APU start, the APUC energizes the fuel shutoff solenoid valve when the APU engine RPM is more than 7 percent. The APUC also controls the fuel metering valve when the RPM is more than 7 percent.

The APUC uses start-up control logic to control the fuel metering valve when the RPM is less than 95 percent. This logic schedules fuel flow to start the APU quickly and to keep the maximum EGT low. Start-up fuel flow logic uses these inputs:

- APU RPM (N)
- Inlet pressure (P2)
- Inlet temperature (T2)
- Turbine inlet temperature (T4)
- Exhaust gas temperature (EGT)
- ATS command
- Fuel temperature.

The APUC uses on-speed control logic to control the fuel metering valve when the RPM is more than 95 percent. This logic schedules fuel flow to keep APU speed at 100 percent RPM or at the correct speed for no-break power transfers. During no-break-power-transfers between the APU generator and external power, the APUC adjusts the APU speed between 96.25 percent and 104.5 percent.

APU FUEL SYSTEM - FUNCTIONAL DESCRIPTION

The on-speed control logic uses these inputs:

- APU RPM
- Fuel temperature
- Frequency trim.

Fuel Manifolds

The fuel cluster supplies metered fuel to the primary and secondary fuel manifolds for combustion.

Only the primary manifold gets fuel at low engine speeds during engine start. Both manifolds get fuel when the engine speed is more than approximately 50 percent RPM.

Servo Fuel

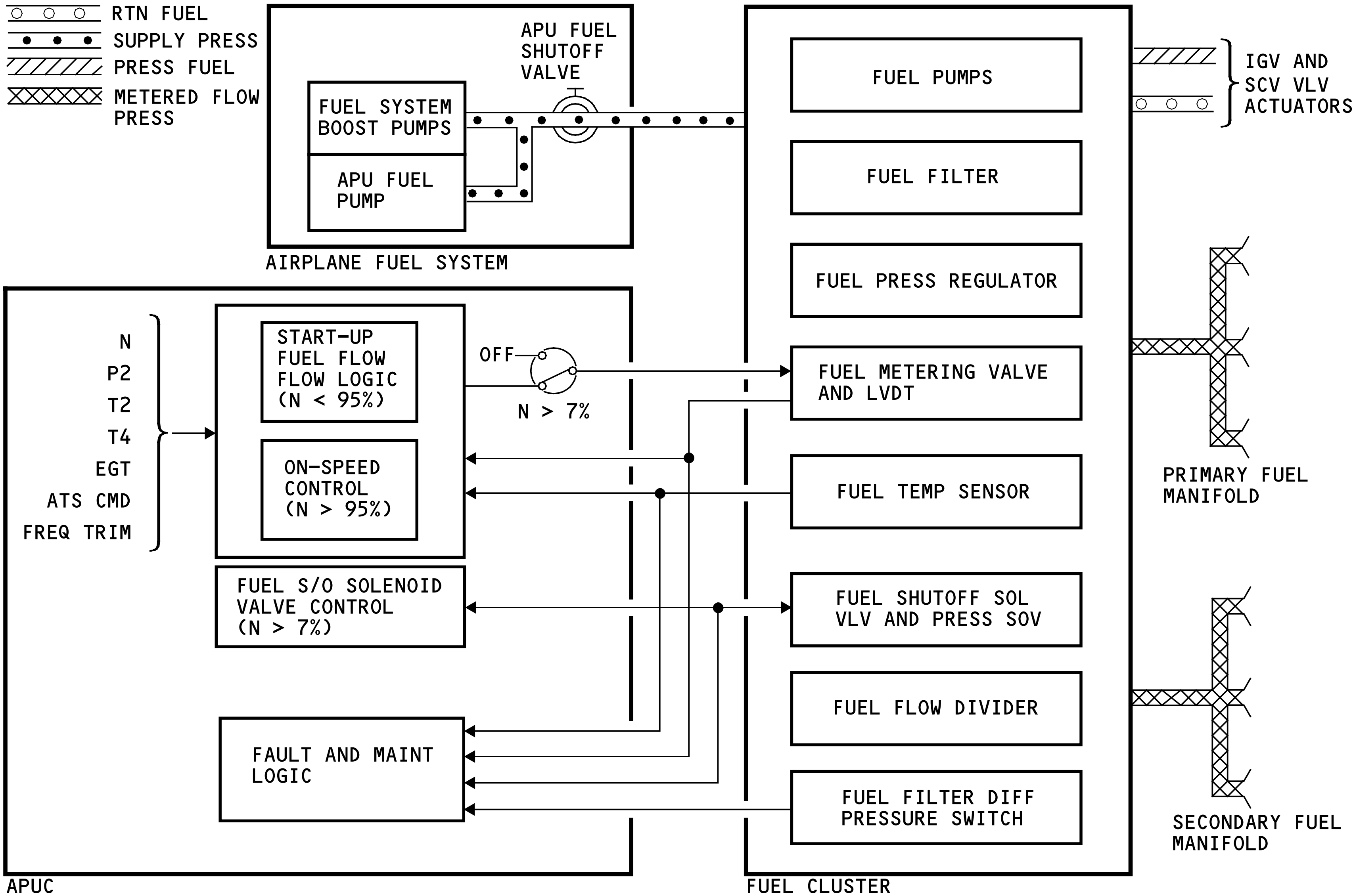
The fuel cluster also supplies pressurized fuel to operate the inlet guide vane and surge control valve actuators.

Return fuel from these actuators goes back to the pump in the fuel cluster.

APUC Monitoring

The APUC monitors these APU fuel system components:

- Fuel temperature sensor
- Fuel filter differential pressure switch
- Fuel metering valve
- Fuel shutoff valve.



APU FUEL SYSTEM - FUNCTIONAL DESCRIPTION

49-30-00-005 Rev 3

APU IGNITION/STARTING - INTRODUCTION

General

The APU ignition/starting system has these systems:

- Ignition system
- Air turbine starter system
- Electric starter system.

Ignition System

The ignition system starts the APU combustion during APU start. These components are part of the ignition cluster on the right side of the APU:

- Ignition unit
- Ignition lead (2)
- Igniter plug (2).

The APUC controls the ignition system.

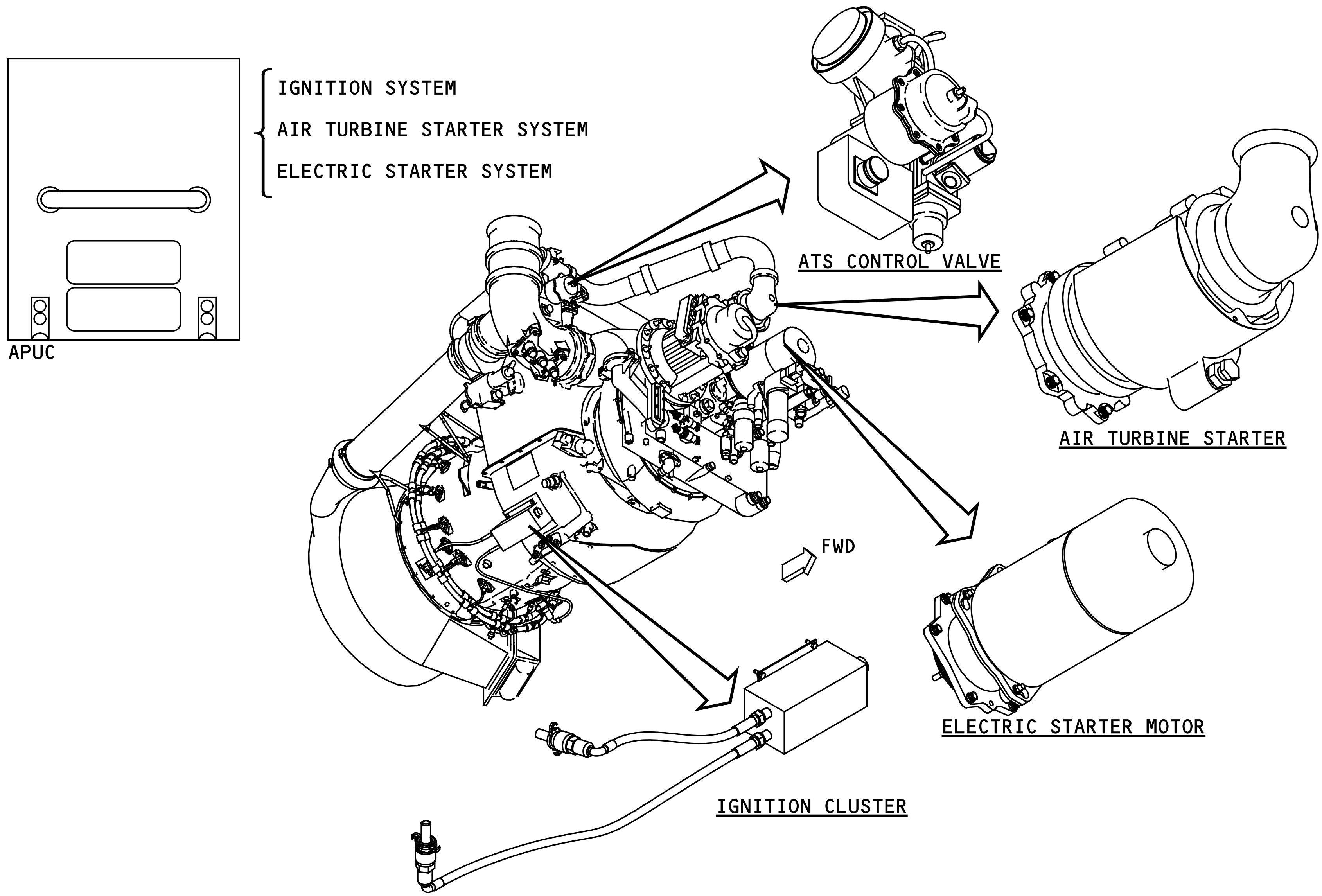
Start Systems

There are two starter motors: one pneumatic and one electric. They are on the front of the APU.

The air turbine starter system starts the APU when pneumatic pressure is available. The air turbine starter system uses an air turbine starter control valve (ATSCV) to control pneumatic flow to the air turbine starter.

The electric starter system starts the APU only when the pneumatic system is not pressurized or if there is a failure in the air turbine starter system.

The APUC controls both start systems and automatically selects between the starters.



APU IGNITION/STARTING - INTRODUCTION

49-40-00-001 Rev 1

APU IGNITION/STARTING - APU IGNITION SYSTEM - GENERAL DESCRIPTION

General

The ignition system starts the combustion of the fuel-air mixture during engine start. The APU controller controls the ignition system.

The ignition system components are part of a common cluster and are on the right side of the engine.

Ignition Unit

The ignition unit changes 28v dc power to high voltage pulsed current that goes to the ignitor plugs. The ignition unit has two channels: one for each igniter plug. Four bolts hold the ignition unit to the APU.

Ignition Leads

Ignition leads connect the ignition unit to the igniter plugs. The leads are insulated to protect against radio interference. There are connectors at each end of the ignition leads.

Igniter Plugs

Two igniter plugs supply the high energy spark for fuel/air ignition. One is on the right side and the other is on the bottom of the APU combustion section. The ignition lead connectors hold the plugs in the boss.

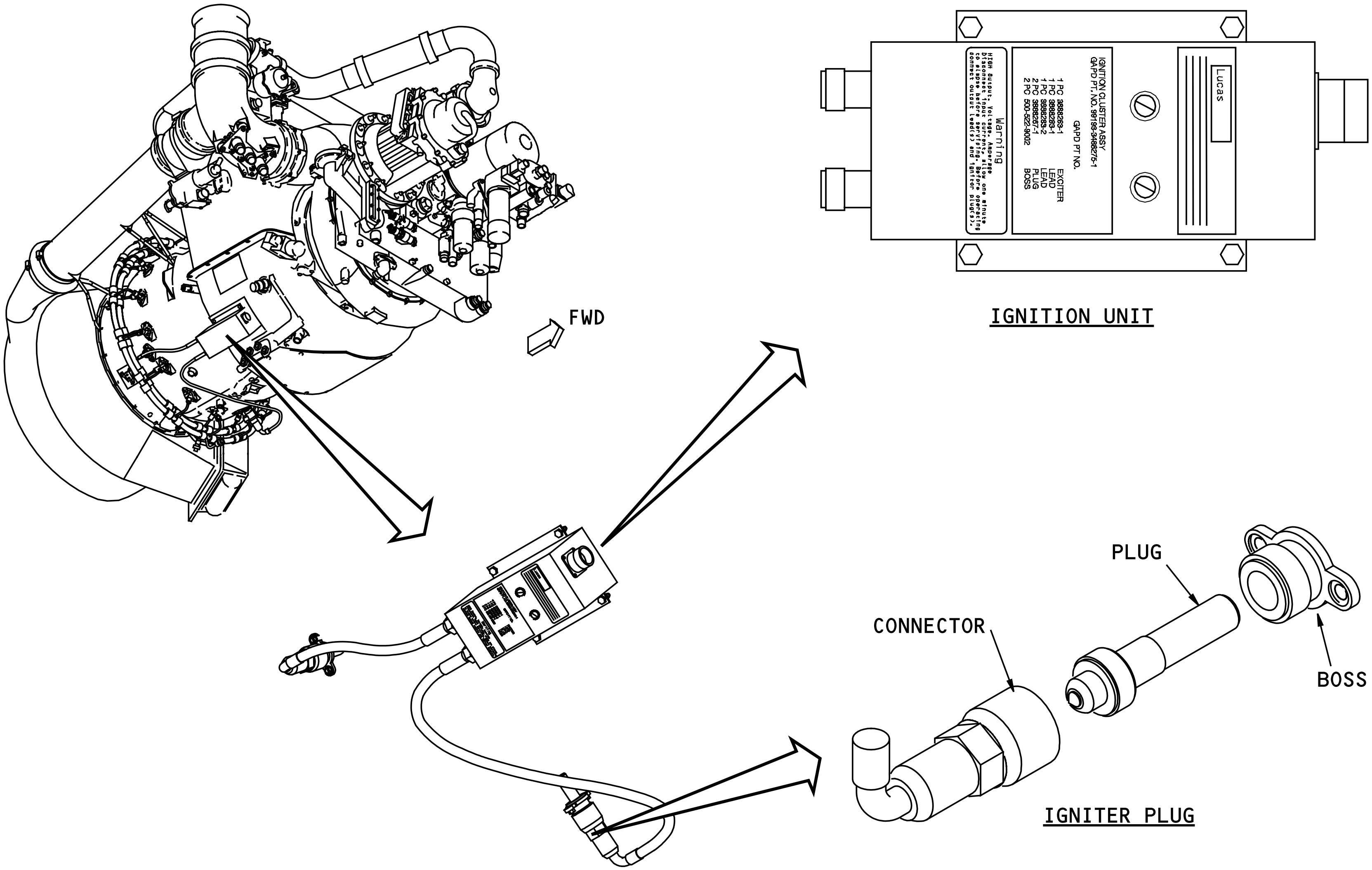
Functional Description

The APUC turns on the igniter plugs at 7 percent APU engine RPM during APU start. The APUC turns the plugs off at 50 percent RPM.

The APUC also turns the igniter plugs on if the APU engine RPM goes below 95 percent RPM during APU operation (speed droop).

Training Information Point

WARNING: DO NOT TOUCH THE IGNITION COMPONENTS UNTIL YOU RELEASE THE HIGH VOLTAGE FROM THE IGNITION UNIT. IF YOU DO NOT OBEY THIS PROCEDURE, INJURY TO PERSONS CAN OCCUR.



49-40-00-002 Rev 2

APU IGNITION/STARTING - APU IGNITION SYSTEM - GENERAL DESCRIPTION

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APU IGNITION/STARTING - APU ELECTRIC STARTER SYSTEM - GENERAL DESCRIPTION

General

The electric starter system has these components:

- The electric starter motor
- The electric starter clutch.

The electric starter system starts the APU when pneumatic power is not available or if the air turbine starter system has a failure. The APUC controls the electric starter system.

Physical Description

The electric starter motor is a 28v dc series-wound motor. Four bolts hold the motor to the gearbox adapter on the front of the APU. A ratchet on the electric starter motor shaft connects the starter motor to the electric starter clutch. The starter motor weighs 38 pounds (17 kg).

The electric starter clutch is a pawl and ratchet type mechanism which transmits the starter motor torque to the APU gearbox. The pawls turn with the APU and the ratchet wheel turns with the starter motor. Pawl springs hold the pawls against the ratchet wheel at low speeds. The pawls disengage by centrifugal force after the starter turns off. A single bolt attaches the clutch to the starter drive gear shaft. The clutch is inside the gearbox adapter.

Functional Description

During an electric start, the starter motor turns the ratchet wheel and the electric starter clutch through the three pawls. The clutch turns the APU engine through the APU gearbox.

The electric starter motor turns off at 49 percent engine RPM for low altitude starts and 55 percent engine RPM for starts above 22,000 feet (5800m). The pawls then move outward against the pawl springs by centrifugal force. This disengages the clutch from the starter motor.

During an air turbine start, the electric starter clutch turns with the APU engine. The electric starter motor and the ratchet wheel do not turn. The pawls move up the sloped edge of the ratchet teeth to permit rotation between the ratchet wheel and the clutch. At approximately 17 percent APU engine RPM, the pawls lift off of the ratchet by centrifugal force to disengage the clutch from the starter motor.

Training Information Point

A lifting lug on the top of the electric starter permits attachment of a fishpole hoist for removal and installation.

A hand crank access on the electric starter motor permits you to manually crank the engine through the starter motor.

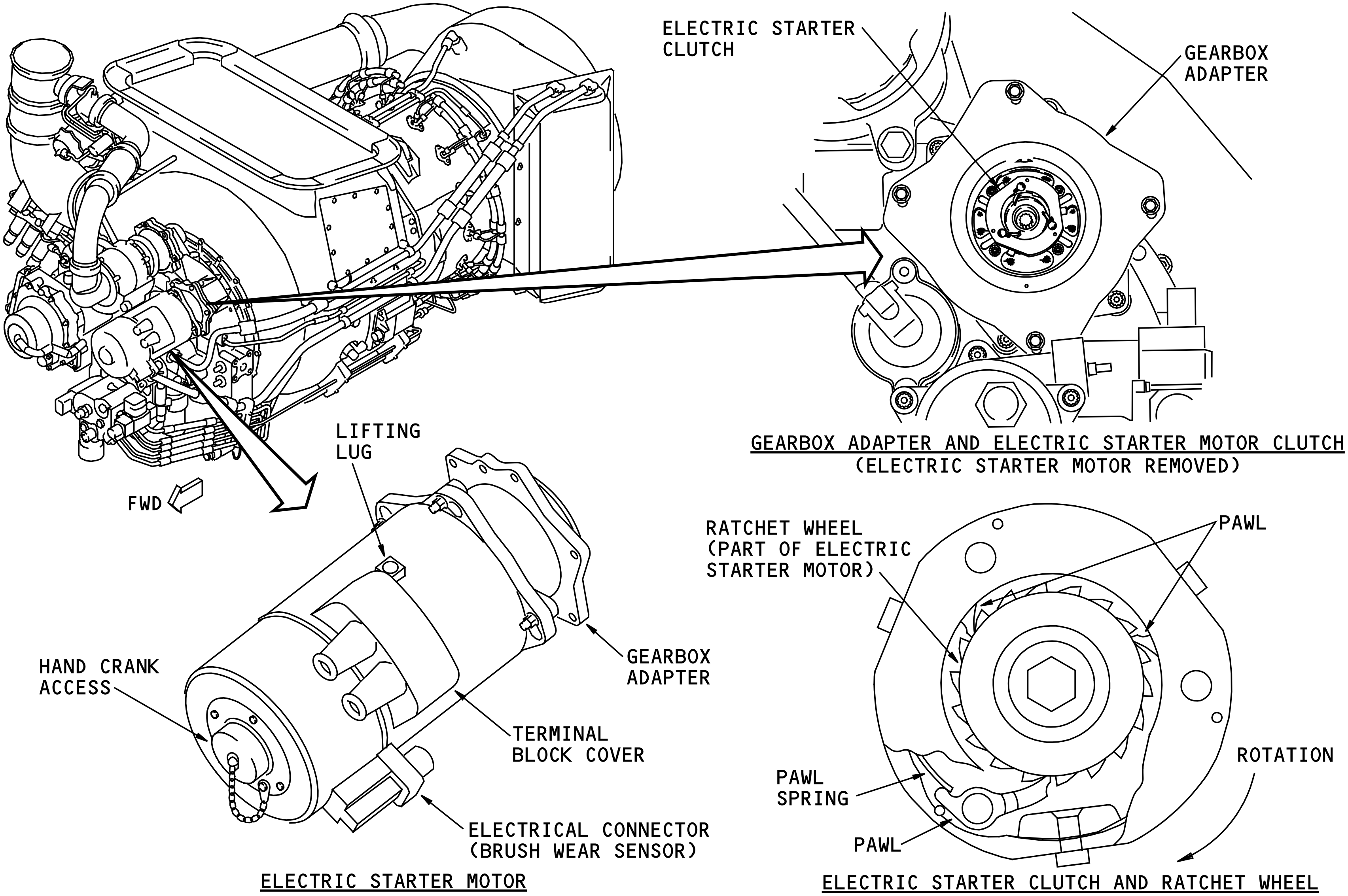
APU IGNITION/STARTING - APU ELECTRIC STARTER SYSTEM - GENERAL DESCRIPTION

You can try three APU starts in a 60 minute period with the electric starter motor.

A brush wear sensor inside the starter motor sends a signal to the APUC when the motor needs to be replaced. The APU CONTROL status message shows for this condition.

Both the electric starter motor and the electric starter clutch are LRUs.

The ATS clutch and electric starter clutch are not interchangeable.



49-40-00-003 Rev 3 10/21/1996

APU IGNITION/STARTING - APU ELECTRIC STARTER SYSTEM - GENERAL DESCRIPTION

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APU IGNITION/STARTING - AIR TURBINE STARTER SYSTEM - GENERAL DESCRIPTION

General

These are the air turbine starter system components:

- Air turbine starter
- Air turbine starter clutch
- Air turbine starter control valve (ATSCV).

The air turbine starter system starts the APU when pneumatic pressure is available.

A magnetic chip collector on the air turbine starter collects metallic particles in the oil.

Physical Description

The air turbine starter is an axial flow turbine. The starter attaches with a V-band clamp to the gearbox adapter which is on the APU gearbox. A ratchet wheel on the air turbine starter shaft connects the starter to the clutch. The APU lubrication system supplies the air turbine starter with oil for cooling and lubrication. The air turbine starter weighs 9.5 pounds (4.3 kg).

The air turbine starter clutch is a pawl and ratchet type mechanism which transmits the starter motor torque to the APU gearbox. Pawl springs hold the pawl in the ratchet wheel at low speeds. The pawls disengage by centrifugal force after the ATSCV closes and the starter speed decreases. A single bolt attaches the clutch to the starter drive gear shaft. The clutch is inside the gearbox adapter.

The ATSCV is a pneumatically actuated, solenoid-controlled butterfly valve. It is spring-loaded closed. The ATSCV is above the air turbine starter. The ATSCV weighs 6.5 lbs (2.9 kg).

Functional Description

The air turbine starter clutch is functionally equivalent to the electric starter clutch. During an air turbine start, the ATSCV opens to permit air from the pneumatic system to go to the air turbine starter. The air turbine starter turns the ratchet wheel. The ratchet wheel turns the air turbine starter clutch through the three pawls. The clutch turns the APU engine through the APU gearbox.

At 55 percent APU engine RPM, the ATSCV closes to stop the air supply to the air turbine starter. The pawls then move outward against the pawl springs by centrifugal force. This disengages the clutch from the air turbine starter motor.

During an electric start, the air turbine starter clutch turns with the APU engine. The air turbine starter and the ratchet wheel do not turn. The pawls move up the sloped edge of the ratchet teeth to permit rotation between the ratchet wheel and the clutch. At approximately 17 percent APU engine RPM, the pawls lift off of the ratchet wheel by centrifugal force to disengage the clutch from the air turbine starter.

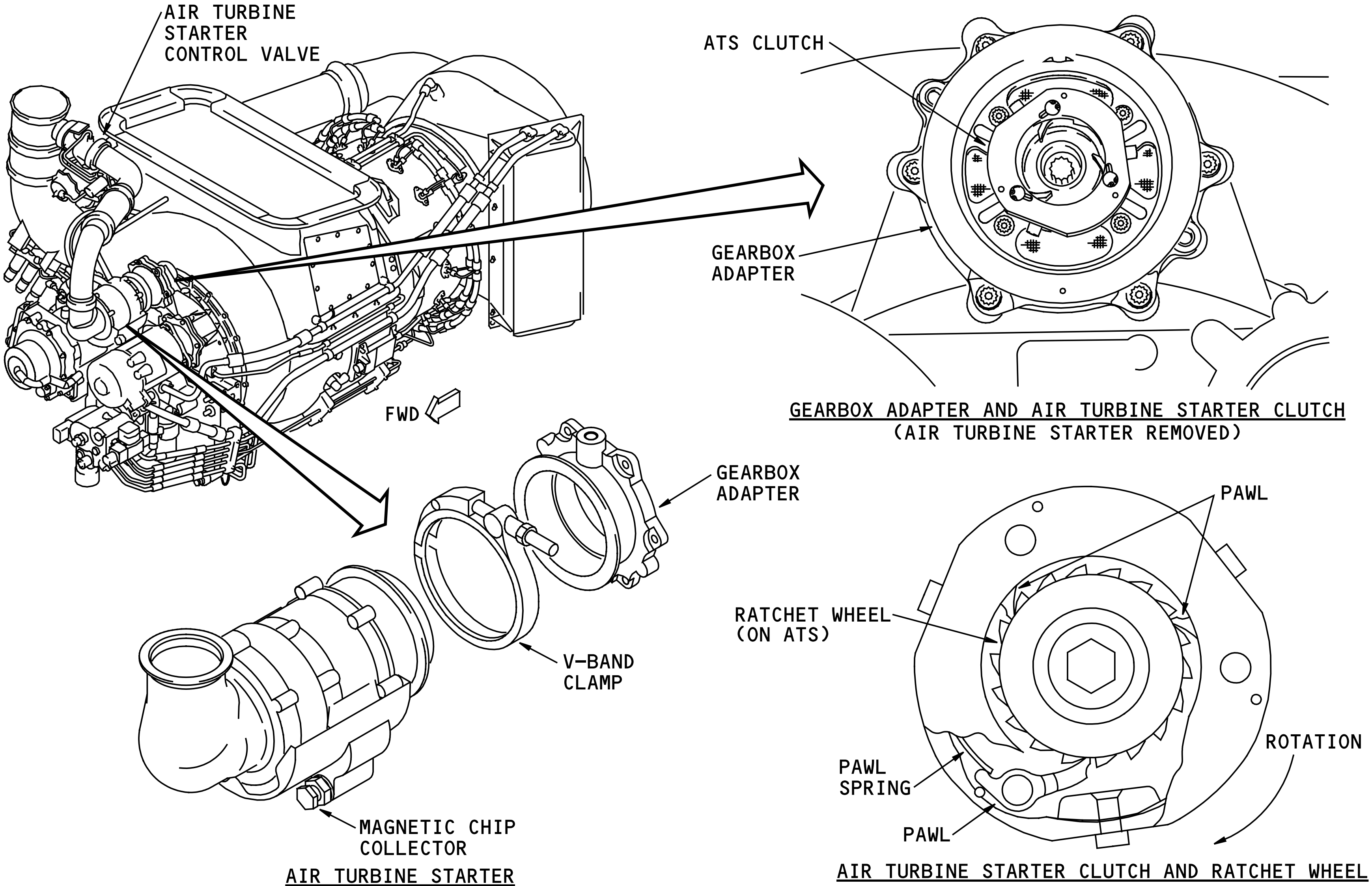
APU IGNITION/STARTING - AIR TURBINE STARTER SYSTEM - GENERAL DESCRIPTION

Training Information Point

The air turbine starter, the air turbine starter clutch, and the ATSCV are LRUs.

The air turbine starter clutch and the electric starter clutch are not interchangeable.

There is no limit to the number of APU starts you may try with the air turbine starter.



49-40-00-004 Rev 5 10/15/96

APU IGNITION/STARTING - AIR TURBINE STARTER SYSTEM - GENERAL DESCRIPTION

APU IGNITION/STARTING - AIR TURBINE STARTER SYSTEM - AIR TURBINE STARTER CONTROL VALVE

Purpose

The ATSCV controls pneumatic pressure to the air turbine starter during APU start.

Physical Description

The ATSCV is a pneumatically-actuated, solenoid-controlled, butterfly valve. It is spring-loaded closed. The ATSCV is above the air turbine starter.

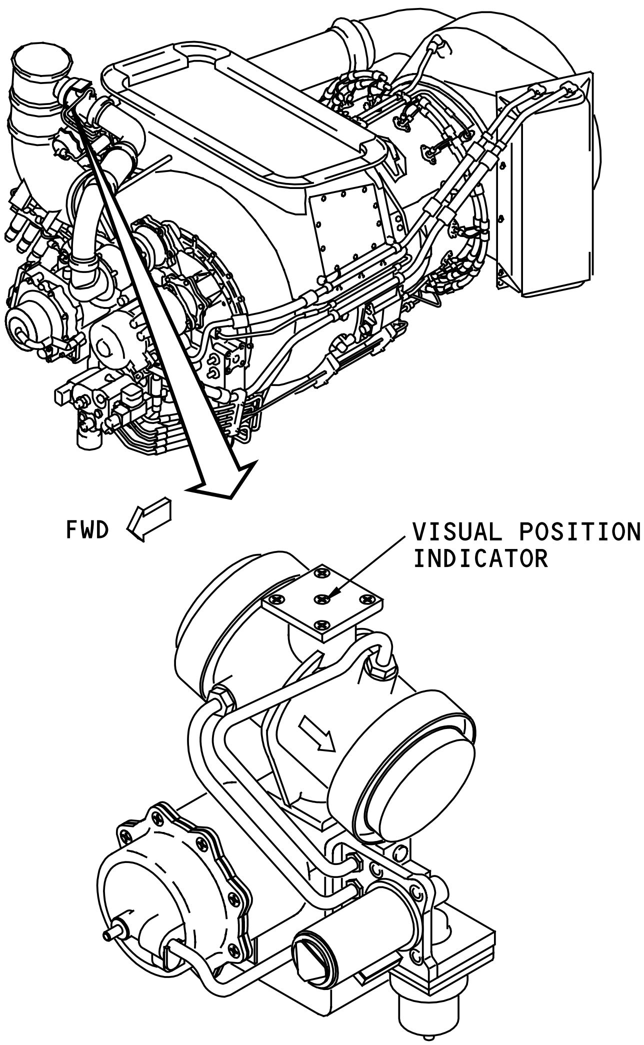
Functional Description

To start the APU air turbine starter operation, the APUC opens the solenoid valve. This permits bleed air to flow to the reference pressure regulator. The reference pressure regulator controls air pressure to chamber A of the spring and pressure balanced butterfly valve. This opens the butterfly valve. Duct pressure downstream of the butterfly valve pressurizes chamber B to balance the butterfly valve. Air output of the starter control valve is 18 to 22 psig.

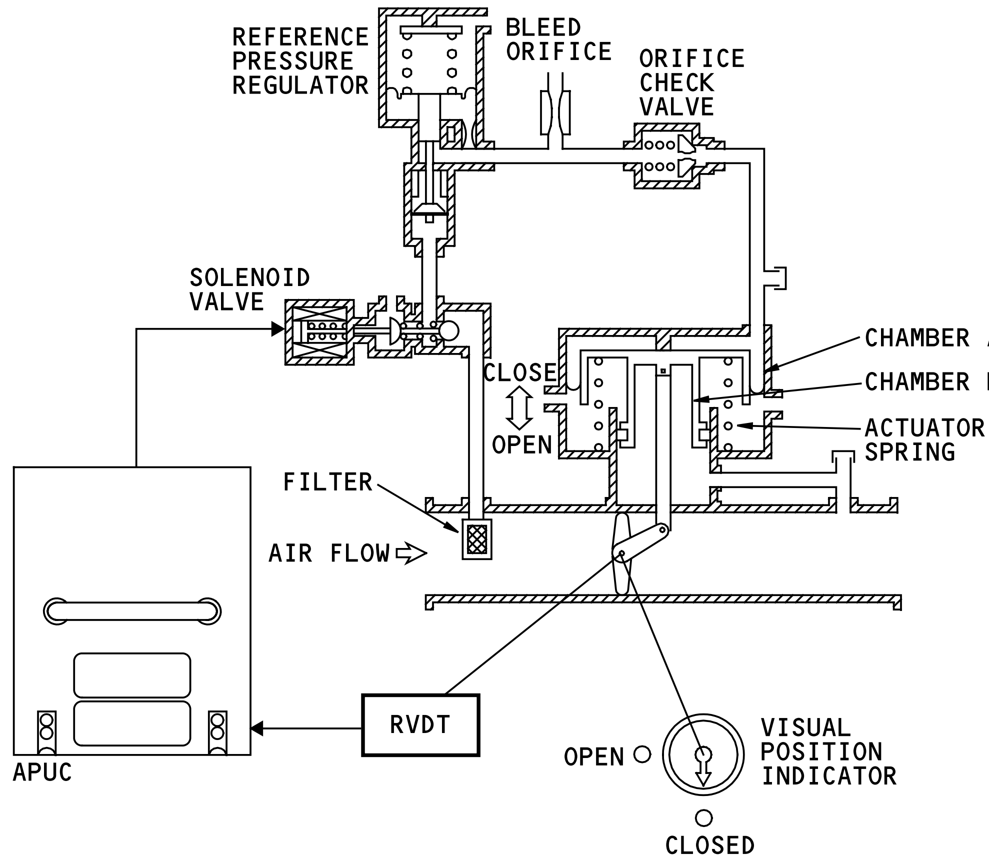
An RVDT sends butterfly valve position to the APUC for feedback.

Training Information Point

A visual position indicator shows butterfly valve position.



AIR TURBINE STARTER CONTROL VALVE



49-40-00-005 Rev 2

APU IGNITION/STARTING - AIR TURBINE STARTER SYSTEM - AIR TURBINE STARTER CONTROL VALVE

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APU IGNITION/STARTING - FUNCTIONAL DESCRIPTION

General

To start the APU, turn the APU switch to START and then release it to ON. This signals the APUC through the ELMS to start the APU.

Pneumatic Start

The APUC gets pneumatic system pressure signals through ARINC 629. If pressure is available, the APUC energizes the solenoid valve on the ATSCV. This opens the starter control valve and pressure regulated air flows to the air starter and turns the APU engine.

At approximately seven percent engine RPM, the APUC energizes the ignition unit. The ignition unit supplies the ignition power to energize the igniter plugs. The ignition turns off at approximately 50 percent engine RPM.

At approximately 55 percent engine RPM, the APUC removes power from the ATSCV solenoid valve to shut off the air turbine starter. The APU continues to increase the speed of rotation to its operating RPM (100 percent).

Electric Start

If pneumatic pressure is not available, the APUC energizes the APU crank contact relay. This supplies 28v dc power from the APU battery to the electric starter which turns the APU. At about 49 percent engine RPM, the APUC removes power from the electric starter and the APU continues to increase the speed of rotation to its operating RPM.

The ignition system operates the same during both types of starts.

Autostart

The APU will automatically start for these conditions:

- Airplane is in the air
- Power removed from the left and right transfer buses.

The ELMS contains the APU autostart logic and sends the start signal to the APUC.

To shutdown the APU after an autostart, you must first move the APU selector to ON and then back to OFF.

The ram air turbine will automatically extend during an APU autostart.

Start Failure

These conditions cause an APU start failure:

- No acceleration (no RPM increase after ignition or start command failure)
- No ignition (no EGT increase above 7 percent RPM).

These are the indications of a start failure:

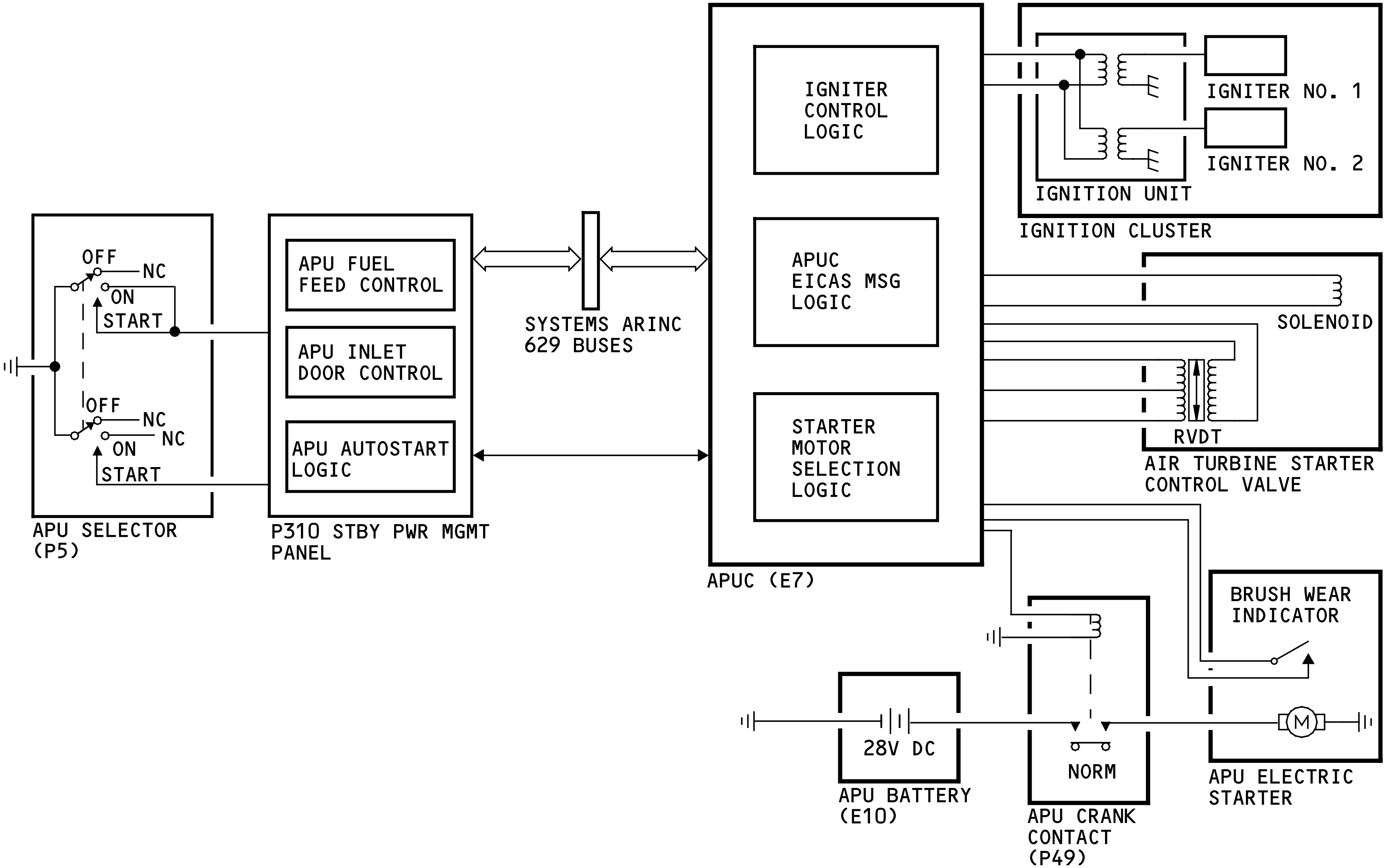
APU IGNITION/STARTING - FUNCTIONAL DESCRIPTION

- APU SHUTDOWN advisory message
- APU status message
- APU fault light.

Training Information Point

If you lift the airplane on jacks, the APU may do an autostart. To prevent this, you need to pull some circuit breakers.

See the applicable section in part two of the airplane maintenance manual for the full procedure.



APU IGNITION/STARTING - FUNCTIONAL DESCRIPTION

APU AIR - INTRODUCTION

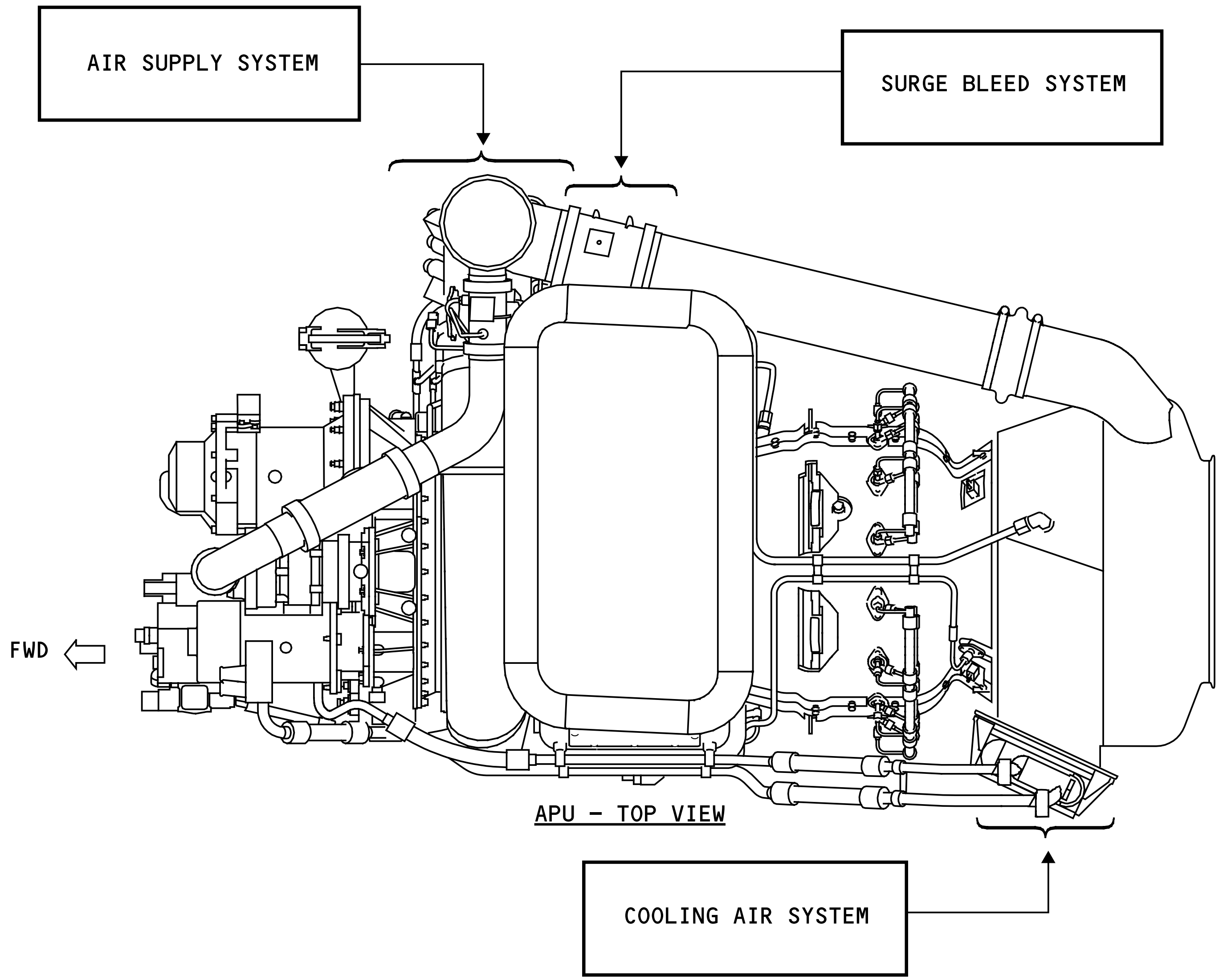
Purpose

These subsystems make up the APU Air System:

- APU cooling air system
- APU air supply system
- APU surge bleed system.

The APU air system does these functions:

- Cools the APU compartment and the APU engine oil
- Supplies compressed air to the airplane pneumatic system
- Releases excess load compressor output (surge control).



APU AIR - INTRODUCTION

APU AIR - APU COOLING AIR SYSTEM - GENERAL DESCRIPTION

General

The APU Cooling Air System cools the APU compartment and the APU engine oil. There are no moving parts in this system.

Compartment Cooling

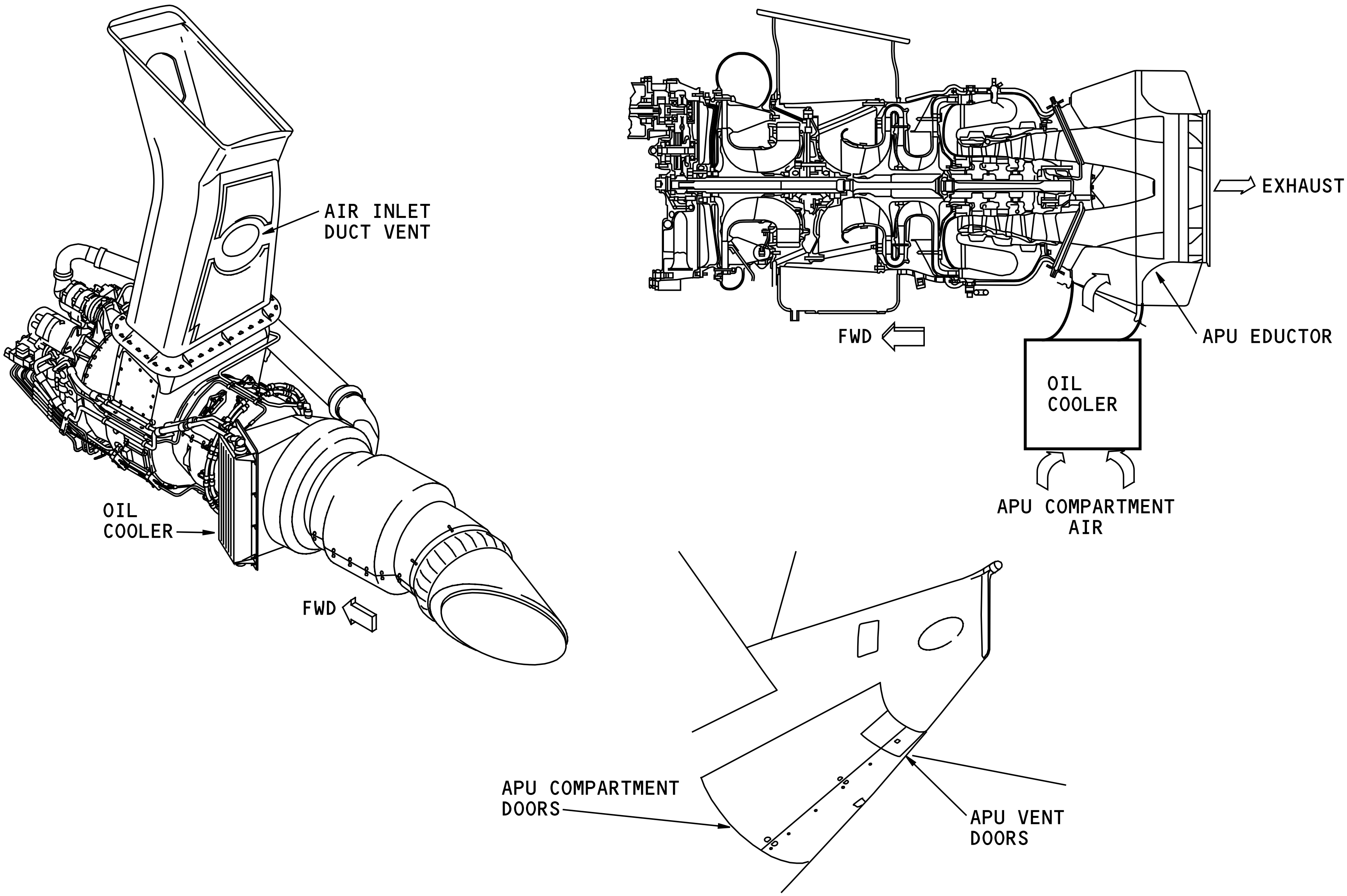
A cooling eductor behind the APU engine turbine uses high speed exhaust flow to form low pressure suction. This suction pulls a continuous cooling air flow from the compartment through the oil cooler and out through the exhaust duct.

See the APU and generator lubrication section for more information about the oil cooler (AMM PART I 49-27).

Outside air goes into the APU compartment through an opening in the back of the air inlet duct.

Training Information Point

There is a small negative pressure in the APU compartment when the APU is running. APU vent doors on the APU compartment doors permit you to equalize pressure before you open the doors.



APU AIR - APU COOLING AIR SYSTEM - GENERAL DESCRIPTION

APU AIR - APU AIR SUPPLY SYSTEM - INTRODUCTION

Purpose

The APU air supply system supplies compressed air to the airplane pneumatic system for:

- Main engine start
- Air conditioning and pressurization
- Air-driven hydraulic pump operation
- Other pneumatic system functions.

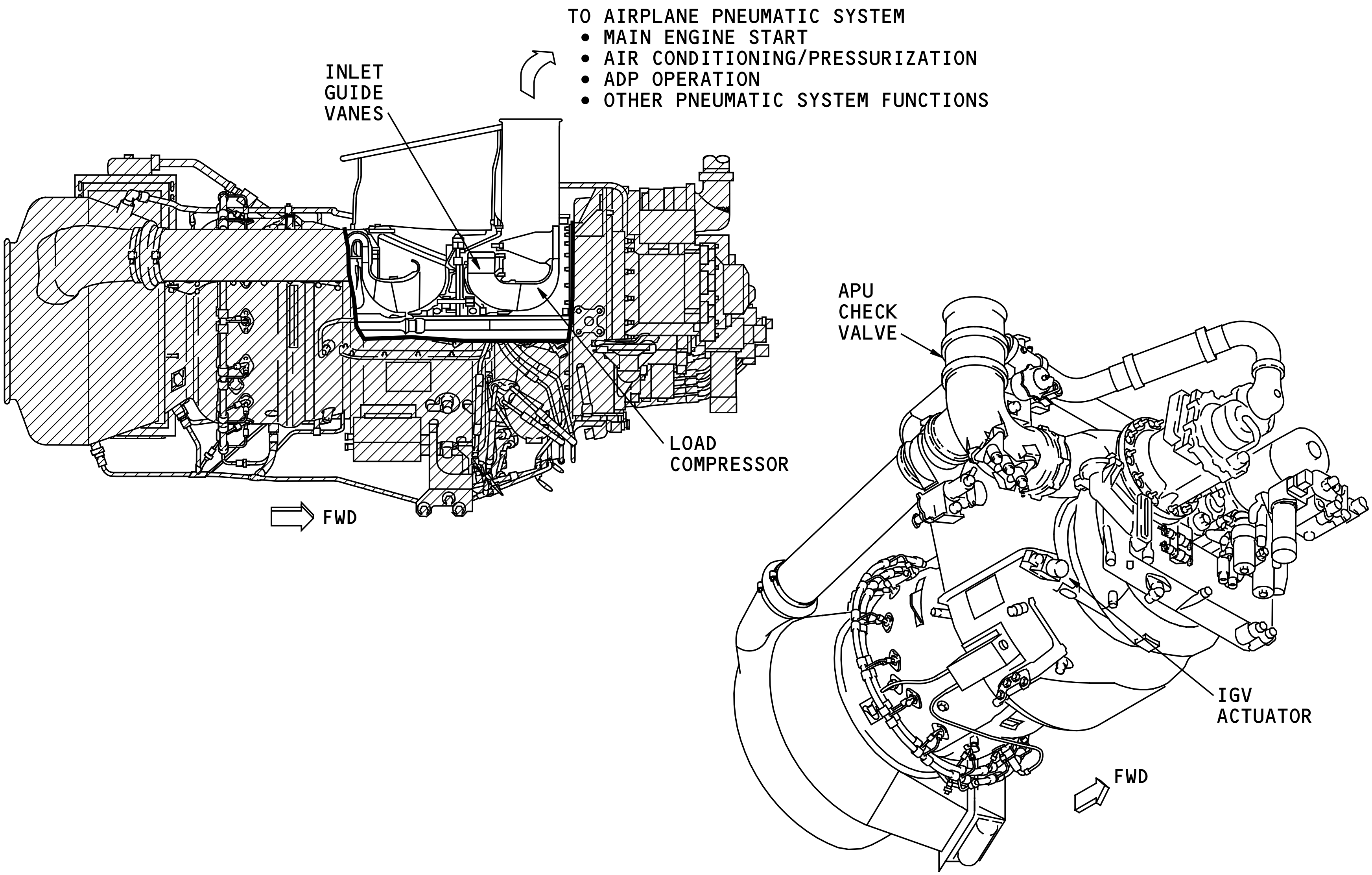
Components

Air supply components include:

- Inlet guide vanes (IGVs)
- Inlet guide vane actuator
- APU check valve.

Control

The APUC sends signals to the IGV actuator to control the IGV angle position. This controls the output of the air supply system.



APU AIR - APU AIR SUPPLY SYSTEM - INTRODUCTION

APU AIR - APU AIR SUPPLY SYSTEM - INLET GUIDE VANES

Purpose

The inlet guide vanes control the air flow to the load compressor and thus control APU air output.

Physical Description

Twenty eight inlet guide vanes (IGVs) are inside the APU around the load compressor inlet.

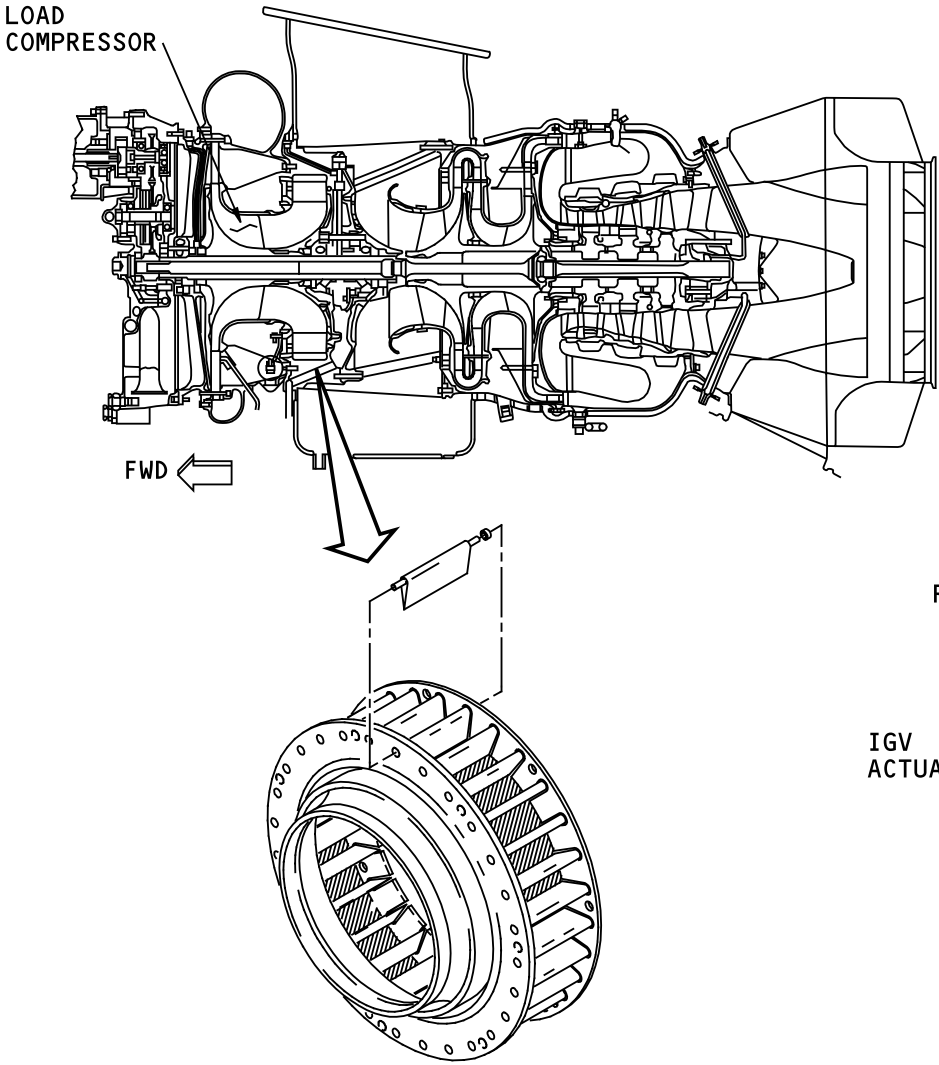
Functional Description

The guide vanes rotate between 76.2 degrees (fully closed) and -10 degrees (fully open). This angle is in relation to the airflow.

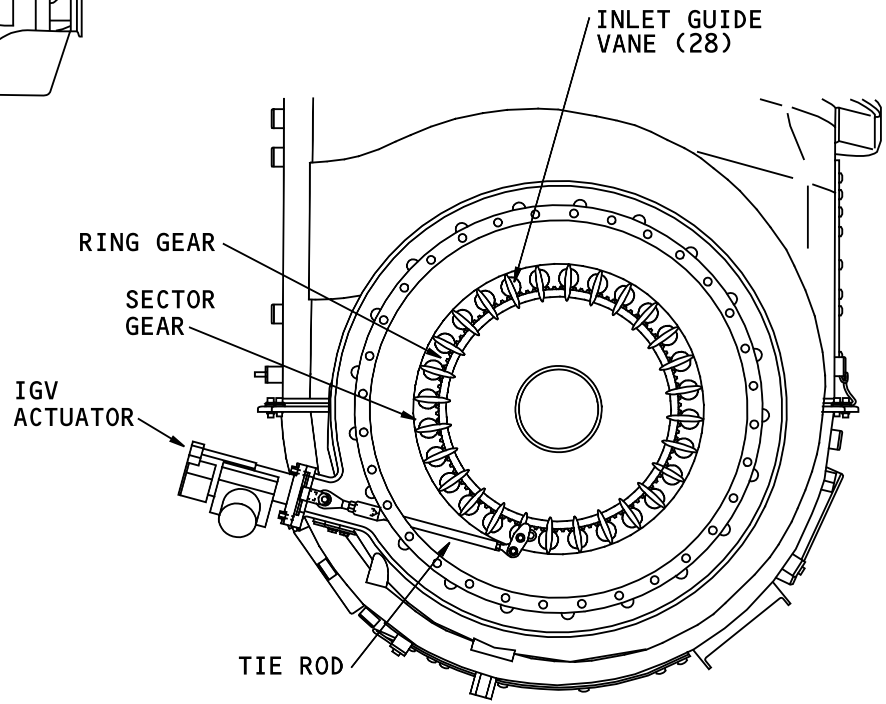
Sector gears connect each IGV to a ring gear. The IGV actuator connects to the ring gear by the tie rod.

Training Information Point

The IGV position shows on the APU maintenance page.



INLET GUIDE VANES



IGV MECHANISM - LOOKING AFT

49-50-00-004 Rev 3

APU AIR - APU AIR SUPPLY SYSTEM - INLET GUIDE VANES

APU AIR - APU AIR SUPPLY SYSTEM - IGV ACTUATOR AND CHECK VALVE

Inlet Guide Vanes Actuator

The IGV actuator uses high pressure fuel to operate the inlet guide vanes.

The APUC controls a torque motor on a two-stage servo-valve to move the actuator. An internal LVDT sends actuator position to the APUC for position feedback.

The IGV actuator connects to the IGVs through a tie rod, ring gear, and sector gears (not shown).

The IGV actuator is on the right side of the APU below the pneumatic cluster.

APU Check Valve

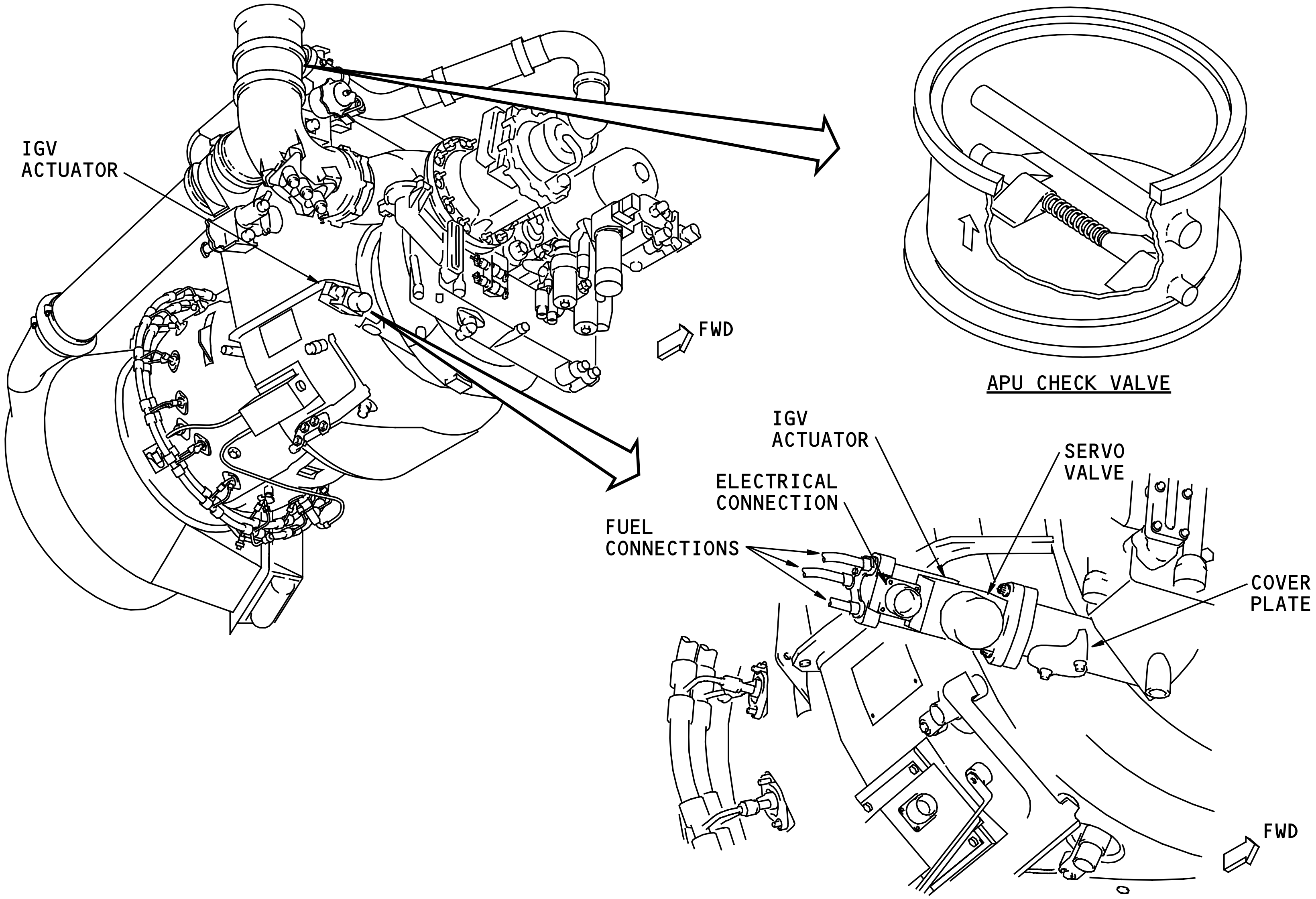
The APU check valve prevents pneumatic system flow from turning the APU load compressor in reverse.

The valve is in the pneumatic duct between the load compressor and the air turbine starter control valve (ATSCV).

The check valve is spring-loaded closed and opened by airflow from the load compressor.

Training Information Point

A cover plate supplies access to a captive bolt that connects the IGV actuator to the tie rod. You loosen this captive bolt when you remove the IGV actuator.



APU AIR - APU AIR SUPPLY SYSTEM - IGV ACTUATOR AND CHECK VALVE

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APU AIR - APU AIR SUPPLY SYSTEM - FUNCTIONAL DESCRIPTION

General

The APUC contains pneumatic mode selection logic and IGV control logic to control the inlet guide vanes. The APUC monitors pneumatic system demands and selects a pneumatic mode. The IGV control logic sends signals to the electro-hydraulic servo valve (EHSV) to change the IGV position. A linear variable differential transformer (LVDT) sends actuator position feedback signals to the APUC.

The APUC also calculates a turbine inlet temperature (T4). If T4 is too high, the APUC starts to close the IGVs to reduce the pneumatic loading. This permits electrical power output of the APU to have the highest priority.

Pneumatic Modes

The APUC uses these inputs to select a pneumatic mode:

- APU shutoff valve position
- Main engine start
- ADP operation
- A/C pack operation
- Air inlet pressure (P2).

These are the pneumatic modes:

- Idle
- Duct Pressurization
- Main Engine Start
- Air Driven Pump (ADP)
- ECS
- ADP/ECS.

The APUC selects the idle mode when the APU shutoff valve is closed and there is no pneumatic system demand. The IGVs are closed in this mode. The APUC also selects this mode any time the airplane is above 22,000 feet (6700 meters).

The APUC selects the duct pressurization mode when the APU shutoff valve is open and there is no pneumatic system demand. The IGVs open enough to pressurize the pneumatic ducts.

During a main engine start, the APUC selects the main engine start mode. The IGVs open to meet airflow requirements for a main engine start. This mode has priority over all other modes.

The APUC selects the ADP mode when one or two of the ADPs operate. The IGVs open to supply enough airflow to operate the air driven hydraulic pumps.

When one or two air conditioning packs operate, the APUC selects the ECS mode. The IGVs open the amount necessary to supply air to the airplane environmental control system.

When the ADPs and the air conditioning packs operate, the APUC selects the ADP/ECS mode and opens the IGVs the amount necessary to supply both of these systems.

APU AIR - APU AIR SUPPLY SYSTEM - FUNCTIONAL DESCRIPTION

Inlet Guide Vane Control Logic

After pneumatic mode selection, the APUC uses inlet temperature and inlet pressure data to adjust the IGV angle for the correct airflow. For the ECS and ADP/ECS modes, the APUC also uses ECS inputs and APU total operating hours to control the IGV position.

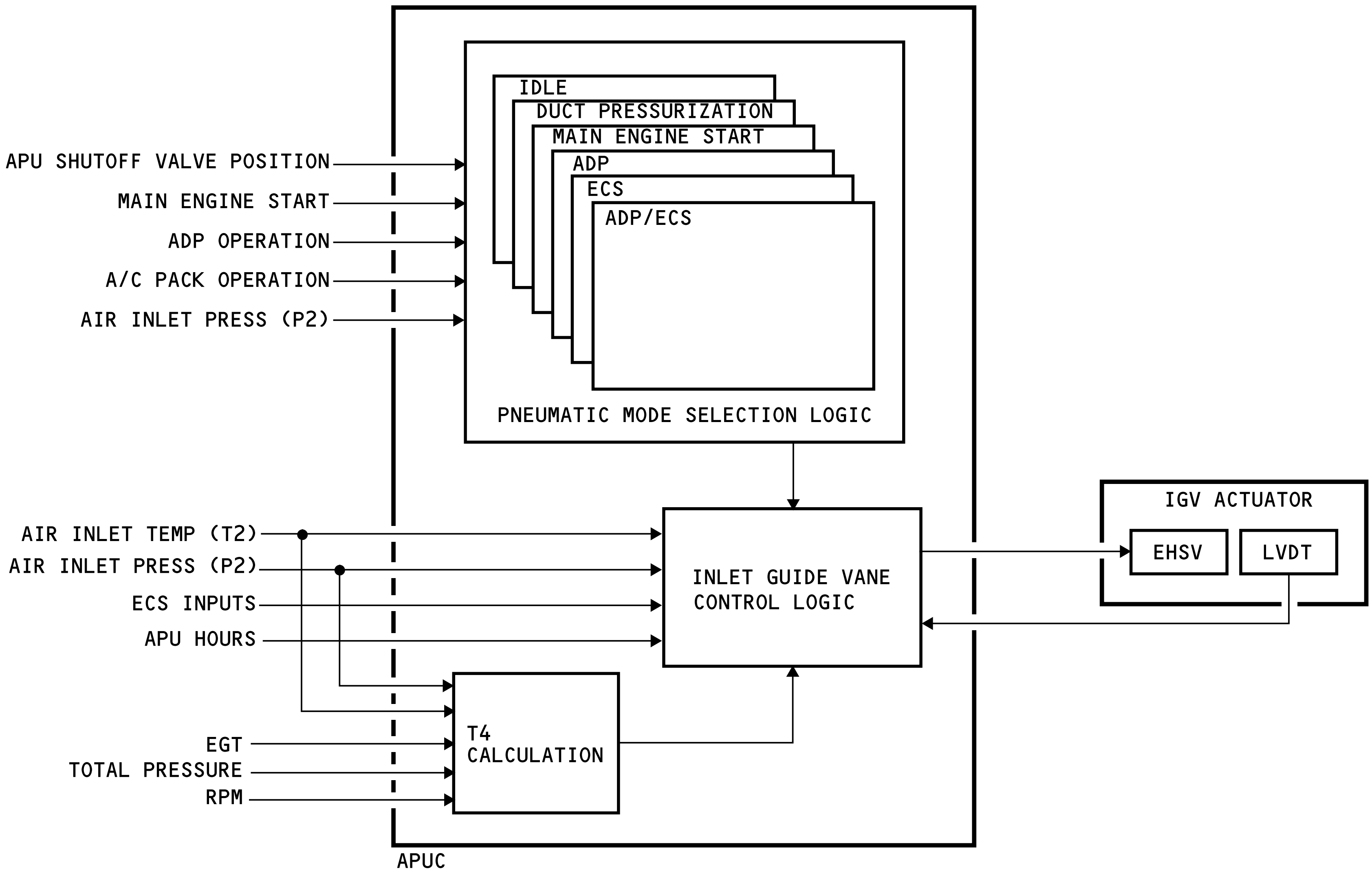
During APU start, the APUC closes the IGVs to keep APU loading to a minimum. At 95 percent RPM, the IGVs can open to supply pneumatic airflow.

Turbine Inlet Temperature Calculation

The APUC calculates turbine inlet temperature (T4) from these inputs:

- Air inlet temperature (T2).
- Air inlet pressure (P2)
- Exhaust gas temperature (EGT)
- Total pressure
- RPM.

If a heavy APU load causes a T4 increase, the APUC starts to close the IGVs. If T4 continues to increase, the APUC can close the IGVs completely. This gives APU output priority to electrical power generation.



49-50-00-006 Rev 3 10/28/1996

APU AIR - APU AIR SUPPLY SYSTEM - FUNCTIONAL DESCRIPTION

APU AIR - APU SURGE BLEED SYSTEM - INTRODUCTION

Purpose

The APU surge bleed system releases load compressor air that the aircraft pneumatic system does not use. This air flows outboard through the APU exhaust.

The APUC controls the surge bleed system.

Components

Surge bleed system components are on a common pneumatic cluster. These are the components:

- Surge control valve and actuator
- Inlet pressure sensor
- Total pressure sensor
- Differential pressure sensor.

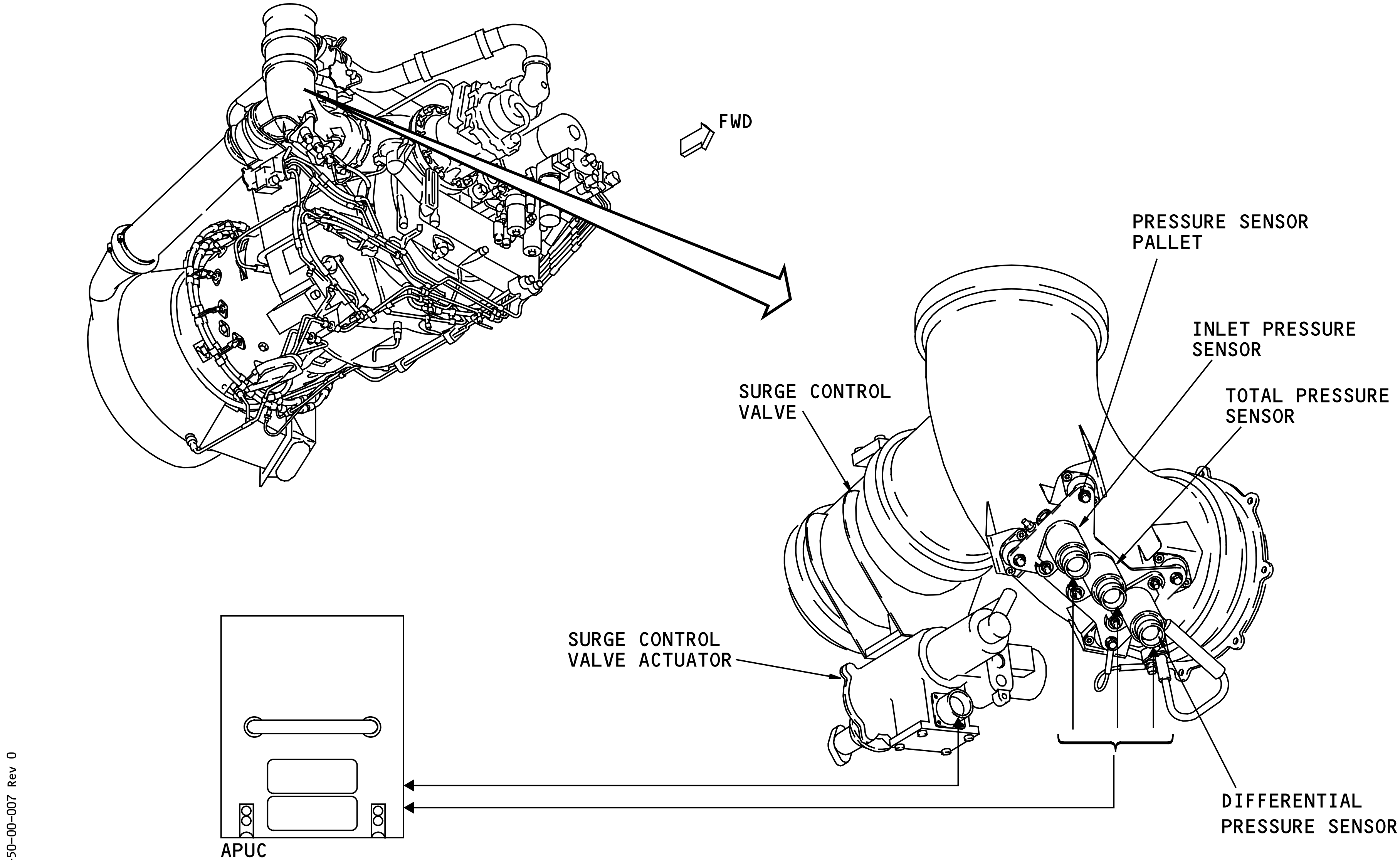
Control

The APUC controls the surge bleed system.

Training Information Point

These are the surge bleed system LRUs:

- Pneumatic cluster
- Surge control valve
- Pressure sensor pallet
- Each pressure sensor.



APU AIR - APU SURGE BLEED SYSTEM - INTRODUCTION

APU INDICATING SYSTEM - EGT INDICATING SYSTEM

Purpose

The APU EGT indicating system supplies APU exhaust gas temperature data for flight deck indication and APU control.

Component Locations

Four chromel/alumel thermocouple probes, grouped in two rakes, are on the exhaust section 90 degrees apart. The thermocouple housing is stainless steel. Each probe has two temperature sensing junctions.

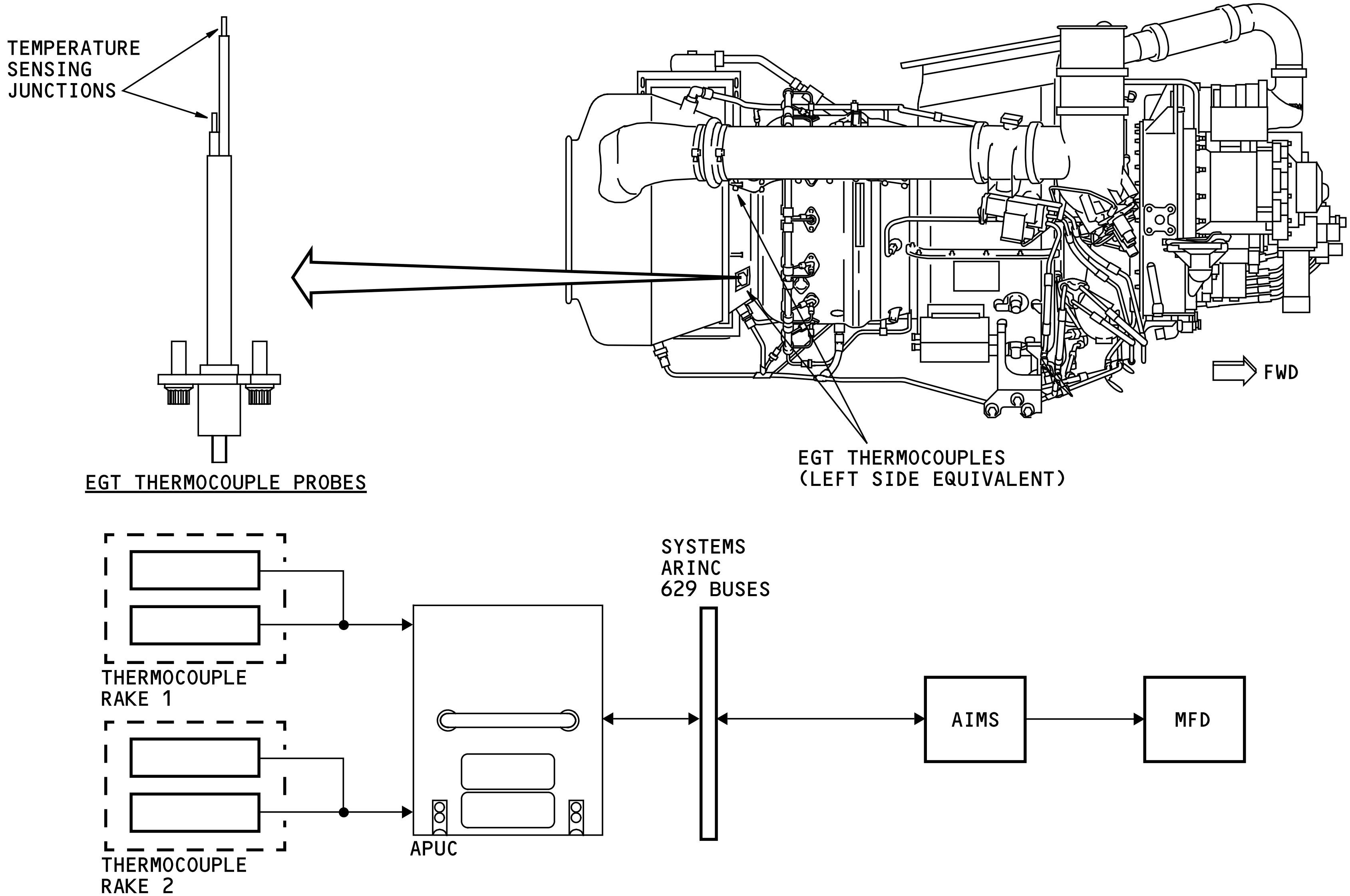
Functional Description

The APUC receives temperature inputs from the two thermocouple rakes. The APUC uses the strongest signal output (highest temperature) for indication and control.

Training Information Point

Loss of input from one rake does not cause the loss of EGT indication. Loss of EGT input from both rakes causes loss of indication. EGT overtemperature or loss of EGT from both rakes causes an APU protective shutdown in the unattended mode.

APU EGT shows on the MFD status display and the APU maintenance page.



49-70-00-001 Rev 1

APU INDICATING SYSTEM - EGT INDICATING SYSTEM

APU INDICATING SYSTEM - DATA MEMORY MODULE

Purpose

The data memory module(DMM) keeps this APU data in non-volatile memory:

- APU serial number
- APU operating hours
- Number of APU starts
- Start data
- Shutdown data
- Pneumatic system operating mode
- APU turbine life used.
- APU health data.

The DMM keeps this APU data so that APUC replacement will not cause loss of APU operation data.

General Description

The APUC controls the data flow into the DMM. The APUC reads the DMM memory during the APU start sequence and transmits updated information to the DMM during APU shutdown.

Location

The DMM is on the left side of the APU.

Training Information Point

You can read DMM data with special test equipment.

Replacement of the APUC does not cause the loss of the data stored in the DMM.

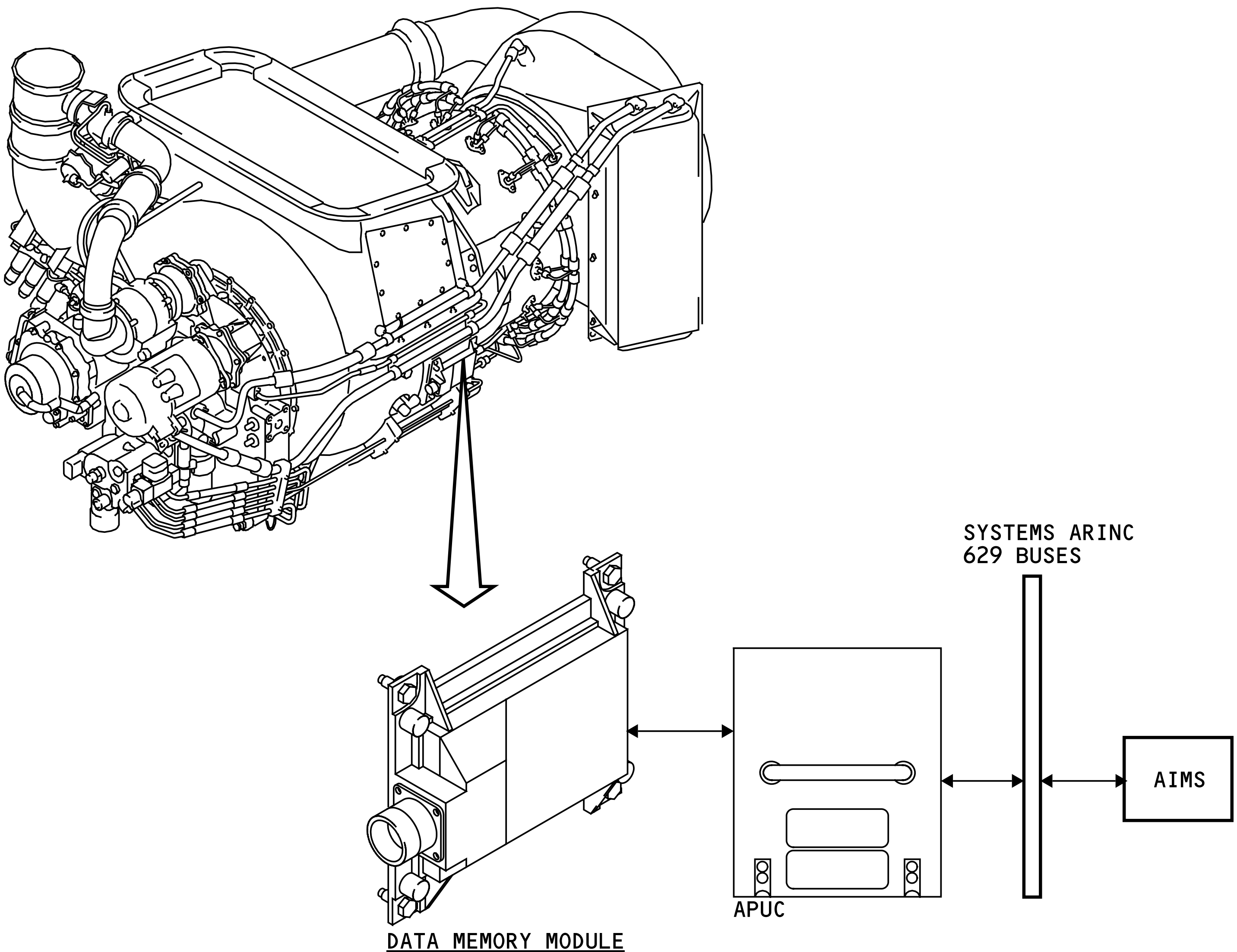
CAUTION: DO NOT REMOVE THE APUC AND THE DATA MEMORY MODULE AT THE SAME TIME. IF YOU REMOVE THE APUC AND THE DATA MEMORY MODULE AT THE SAME TIME, YOU WILL LOSE THE DATA FOR THE APU.

If you replace the DMM, make sure you obey the precaution given below.

CAUTION: YOU MUST USE A BLANK DATA MEMORY MODULE. IF YOU DO NOT USE A BLANK DATA MEMORY MODULE, LOSS OF DATA OR INCORRECT DATA CAN OCCUR.

If you replace both the APUC and the DMM, make sure you obey the precaution given below.

CAUTION: YOU MUST DO THE APU CONTROLLER INSTALLATION TEST BEFORE YOU REMOVE THE DATA MEMORY MODULE. IF YOU DO NOT DO THE INSTALLATION TEST FOR THE APU CONTROLLER BEFORE YOU REMOVE THE DATA MEMORY MODULE, YOU WILL LOSE THE DATA FOR THE APU.



APU INDICATING SYSTEM - DATA MEMORY MODULE

APU EXHAUST SYSTEM

Purpose

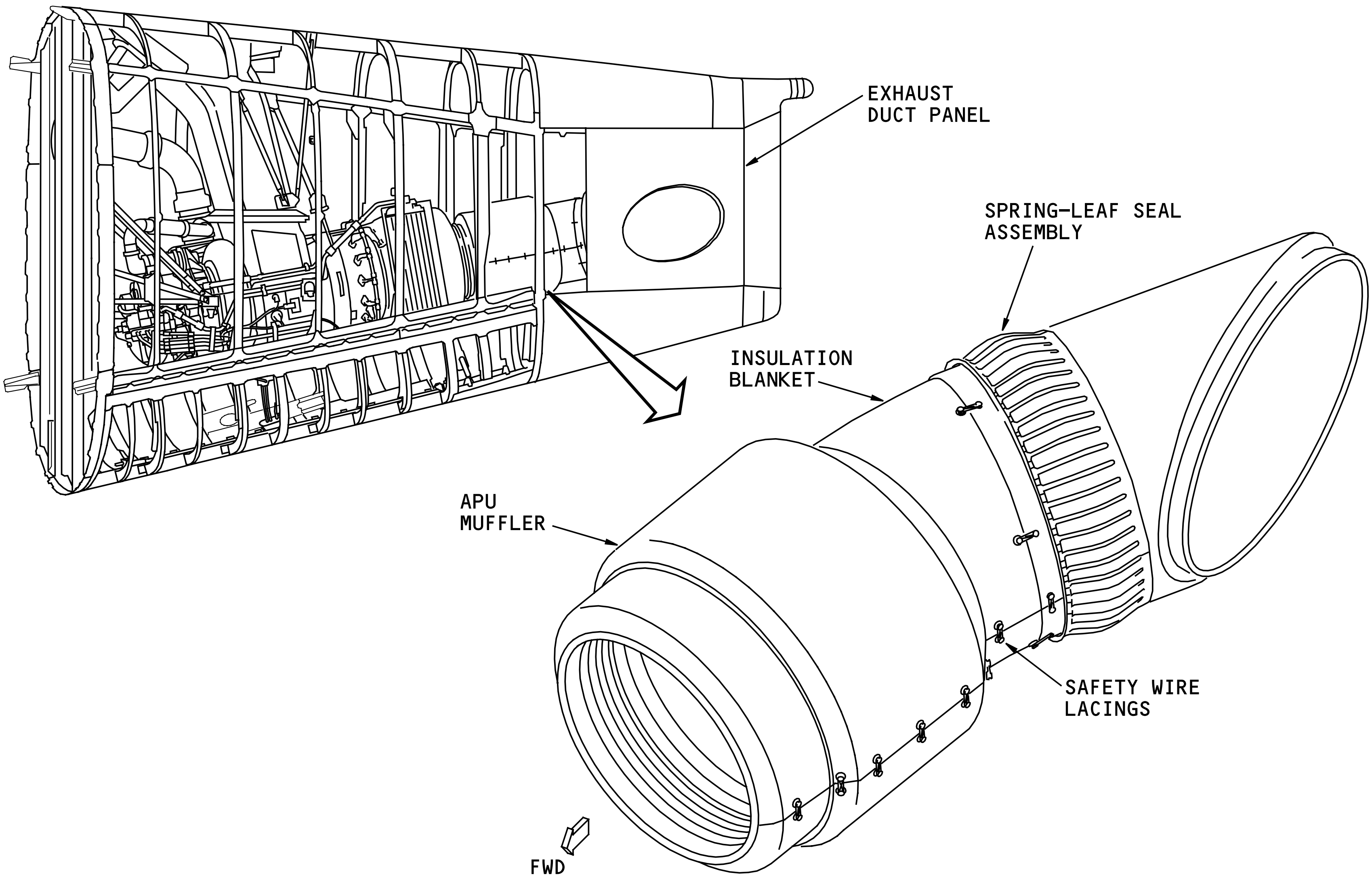
The APU exhaust system sends the APU exhaust overboard through the exhaust duct. The exhaust system prevents APU compartment damage from high exhaust gas temperatures and decreases exhaust noise levels.

Components

The stainless steel APU exhaust duct attaches to the APU turbine section with a V-Band clamp. A spring-leaf seal assembly holds the exit end of the exhaust duct in the exhaust duct panel. The 13 degree exhaust duct angle sends the exhaust out the left side of the aircraft.

An insulation blanket goes around the exhaust duct. Safety wire lacings hold the blanket together.

A muffler and acoustic assemblies in the exhaust duct decrease exhaust noise.



APU EXHAUST SYSTEM

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AUXILIARY POWER SYSTEM - OPERATION

Pre-Start

The left main fuel tank must contain a minimum of 950 pounds (430 kg) of fuel to start and operate the APU for one hour.

The battery switch on the electrical panel (P5) must be in the ON position before you can start the APU.

The APU GEN switch on the electrical panel should be in the ON position before you start the APU.

If electrical power is available, you should do a test of the fire detection system before you start the APU. You do this test with the fire/OVHT test switch on the cargo fire panel (P5).

If electrical power is available, you should also do a check of the APU oil quantity. You can see the APU oil quantity on the status display or on the APU maintenance page.

Start

You can start the APU with the electric starter motor or the air turbine starter. If pneumatic power is available, the APUC will normally select the air turbine starter to start the APU.

The APU BLEED switch on the bleed air/pressurization Panel (P5) must be in the AUTO position to do a pneumatic start.

You move the APU selector from OFF to START to start the APU. The selector moves to ON after you release it. The start is automatic.

The APU FAULT light below the APU selector will flash one time during APU start. The APU RUNNING memo message shows on the EICAS engine primary format when the APU speed is greater than 95 percent RPM.

Normal Operation

The APU operates at 100 percent RPM. The status page shows EGT, RPM, and oil system data.

Normal Shutdown

You move the APU selector to OFF to shutdown the APU. The APU stays at 100 percent RPM for 15 seconds after you move the selector. The APU then decreases speed to 70 percent RPM and stays at this speed for 80 seconds. The memo message APU COOLDOWN shows during this period. After the cooldown, the APU shuts down. The APU FAULT light flashes one time during APU shutdown.

Non-Normal Shutdown

You can also shutdown the APU with the APU fire switch on the P5 overhead panel. From outside the airplane you can shut down the APU with the APU fire shutdown switch on the P40 panel.

The APU shuts down immediately when you use the APU fire switch or the APU fire shutdown switch.

AUXILIARY POWER SYSTEM - OPERATION

The APU shuts down automatically for non-normal conditions.

APU Maintenance Switch

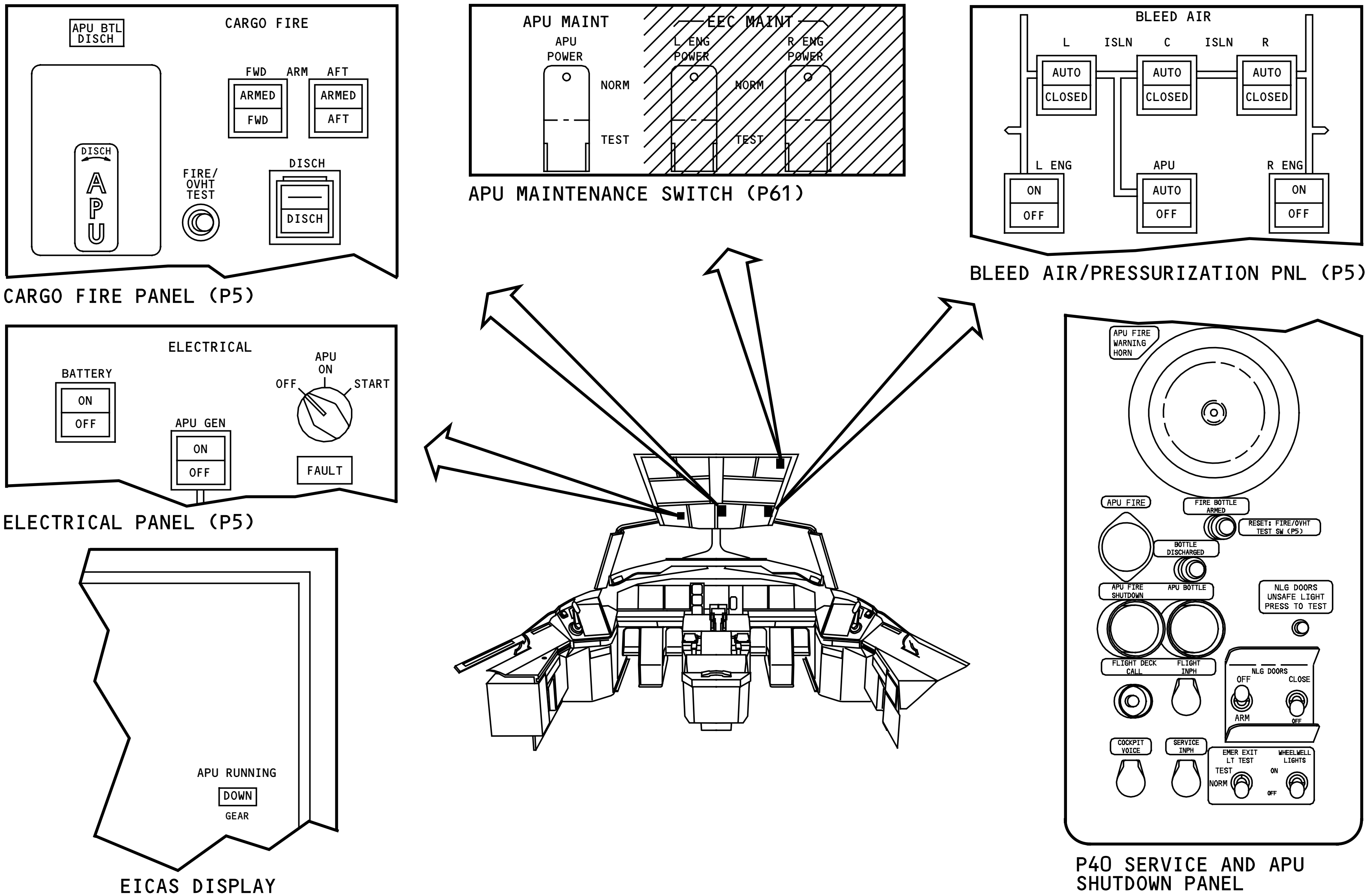
The APU maintenance switch (P61) in the TEST position supplies power to the APUC when the APU control selector is OFF. This permits the APU data to show on the status and maintenance page formats.

Training Information Point

After an emergency shutdown from the APU fire shutdown switch (P40), push the fire and overheat test switch to reset the start system.

After an APU fire switch (P5) shutdown, push the fire switch back in to reset the system.

The APU uses 675 lb (306 kg) of fuel for each hour of APU operation after the first hour.



AUXILIARY POWER SYSTEM - OPERATION

AUXILIARY POWER SYSTEM - STARTING

General

The APU can be started at any altitude.

The APU selector makes inputs to the P310 standby power management panel in the ELMS. The ELMS sends signals to the APUC.

The APUC controls the APU fuel, ignition, and starter systems during APU start.

APU Selector - ON

When you move the APU selector to ON, the APU shutoff valve and the APU air inlet door open. The APU dc fuel pump also turns on if ac power is not available. If ac power is available, fuel system boost pumps supply fuel to the APU and the APU dc pump stays OFF.

When you move the selector to START and release it, the selector moves back to ON. The APUC then selects the air turbine starter system or the electric starter system.

The APUC selects the air turbine starter system if pneumatic pressure is available. The APUC selects the electric starter system if pneumatic pressure is not available or if the air turbine start fails.

APU engine RPM must be less than 12 percent RPM and the air inlet door must be fully open before the start sequence starts.

As the APU speeds up, the pressurizing shutoff valve in the fuel cluster opens at 7 percent RPM. The igniter plugs energize immediately after the pressurizing shutoff valve opens.

During a low altitude electric start (below than 22,000 feet, (6700 meters)), the starter motor turns off at approximately 49 percent RPM. For a high altitude electric start (above 22,000 feet, 6700 meters), the starter motor turns off at 55 percent RPM.

During a pneumatic start, the ATSCV closes at 55 percent RPM.

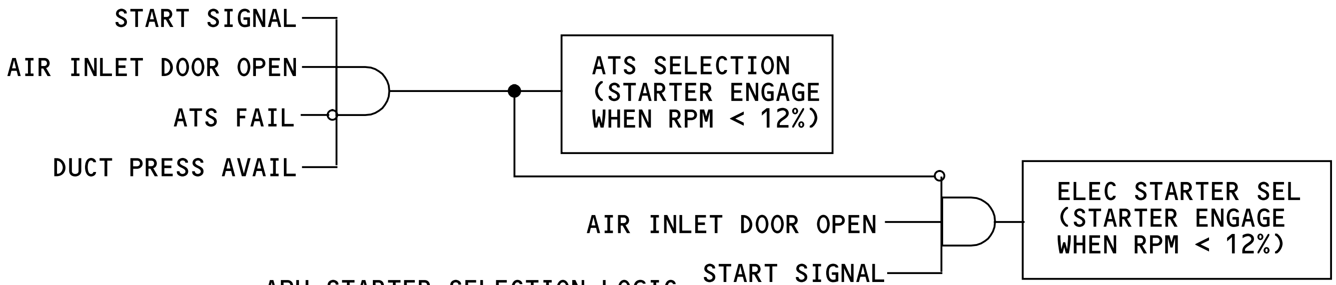
The APUC turns off the igniter plugs at 50 percent RPM.

The APU continues to speed-up. Two seconds after the APU reaches 95 percent RPM, pneumatic and electric loading become available.

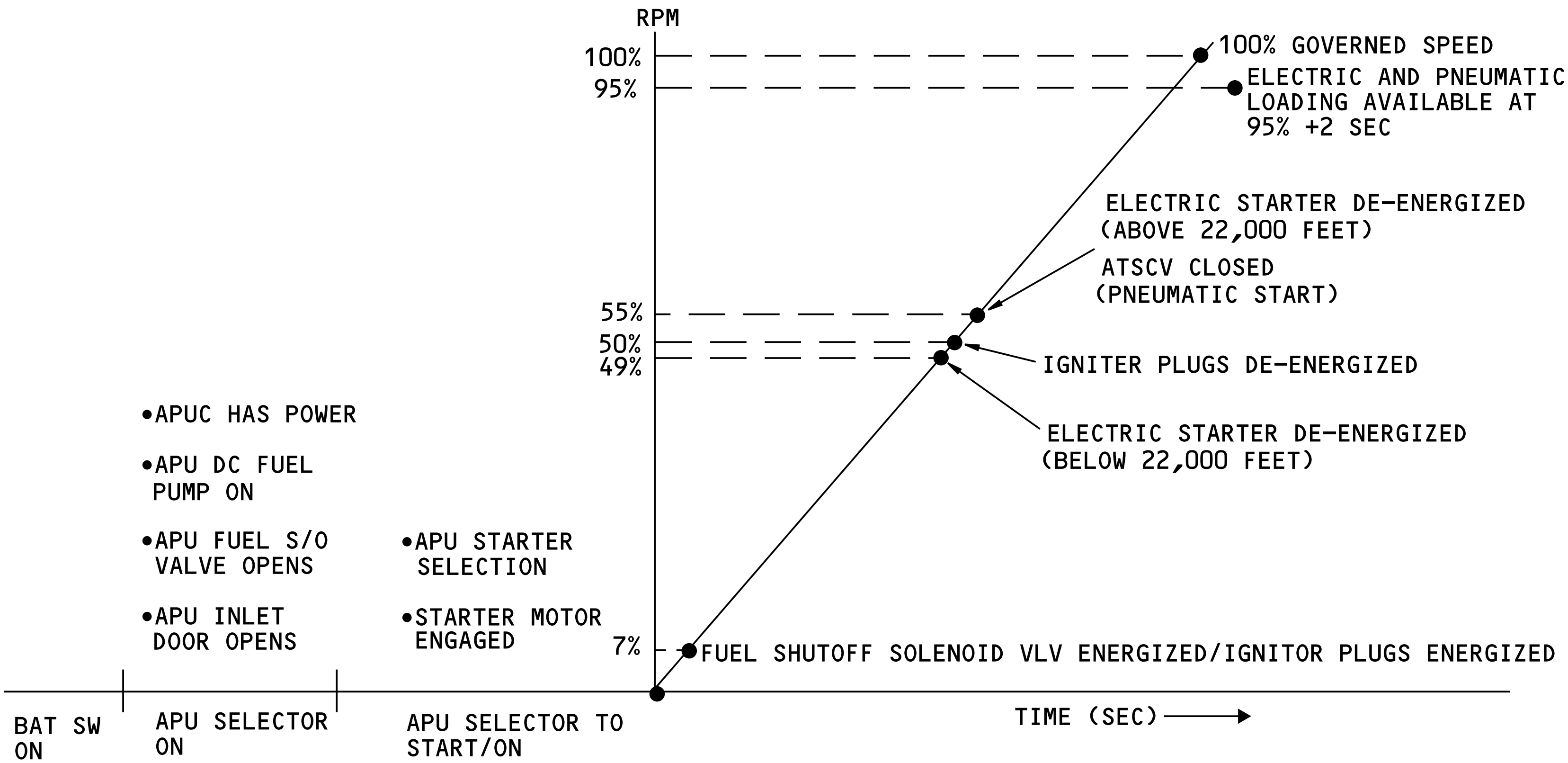
The APU speeds up to its normal operating speed of 100 percent (39,044) RPM.

Training Information Point

During an APU start, if the APU stops its acceleration for more than seven seconds, the APUC shuts down the APU.



APU STARTER SELECTION LOGIC



AUXILIARY POWER SYSTEM - STARTING

AUXILIARY POWER SYSTEM - NORMAL SHUTDOWN

General

The APUC controls the APU shutdown sequence. APU shutdown is not immediate. The APU goes through a cool-down period before shutdown.

There are different cooldown schedules for when the airplane is above 22,000 feet (6700 m) and below 22,000 feet (6700 m).

APU Selector to OFF

When you turn the APU control selector to OFF, the APUC sends a signal to the ASCPCs to close the APU shutoff valve. The APUC also closes the IGVs and opens the SCV to pneumatically unload the APU.

Thirteen seconds after you move the selector to OFF, the APUC sends a signal to the APU generator control unit (GCU) to unload the APU generator.

Above 22,000 Ft Cooldown

When the airplane is above 22,000 feet (6700 m), the APU cools down at 100 percent RPM for 105 seconds after you move the selector to OFF.

Below 22,000 Ft Cooldown

When the airplane is below 22,000 feet (6700 m), the APU stays at 100 percent RPM for 15 seconds. The APU then starts a 10 second controlled deceleration to 70 percent RPM. APU RPM stays at this speed for 80 seconds for additional cooldown.

Shutdown

After cooldown, the APUC does a test of the overspeed shutdown circuits to shut down the engine. The APUC sends a signal to the fuel shutoff solenoid valve and to the torque motor on the fuel metering valve to stop fuel flow. The APU speed then starts to decrease.

At 15 percent RPM, the air inlet door begins to close and the APU fuel shutoff valve in the left wing tank closes.

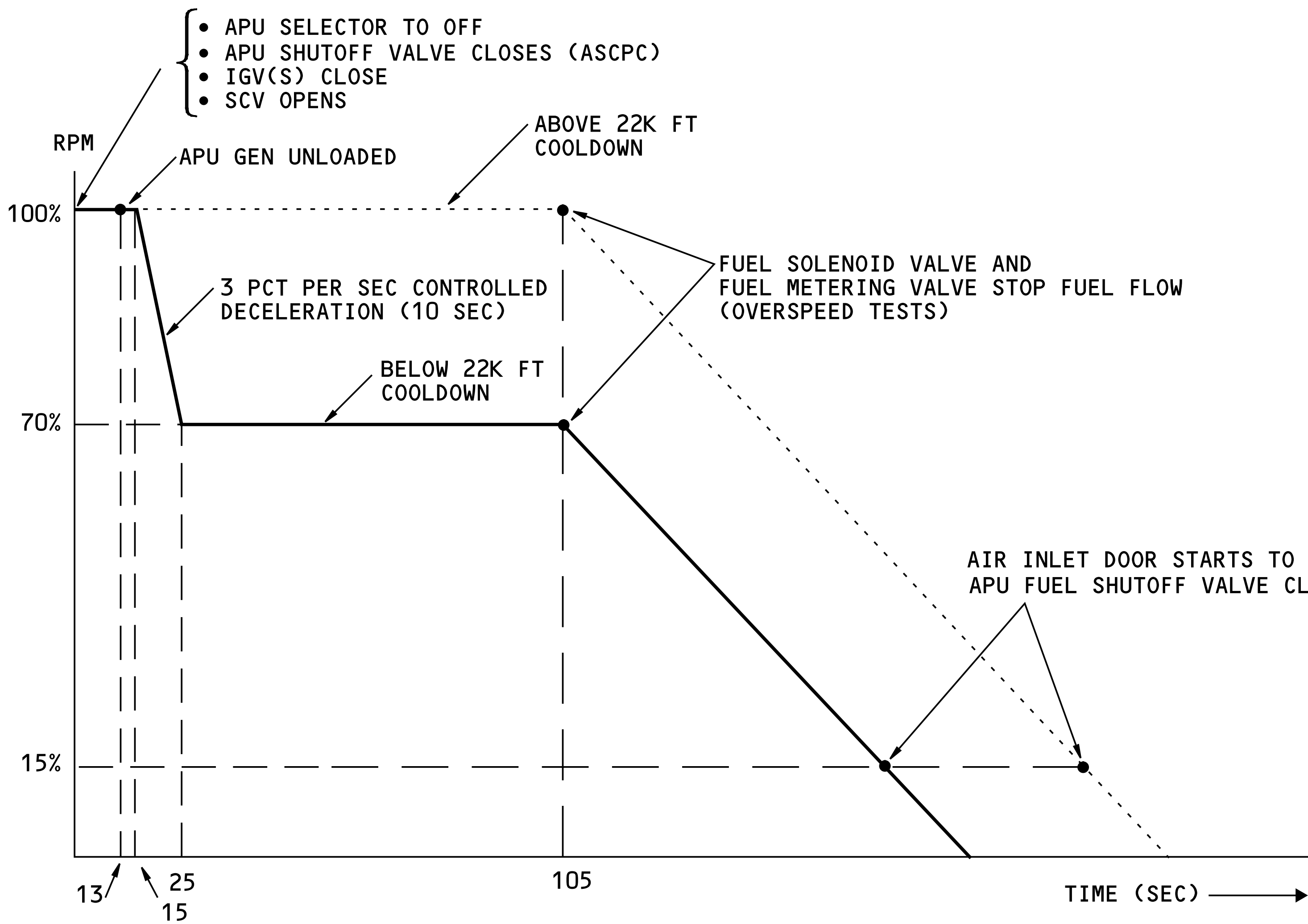
The APU speed decreases to zero.

Training Information Point

15 seconds after you move the APU selector to the OFF position, the APU COOLDOWN memo message shows. This message goes out of view after 80 seconds.

If you move the APU selector to the ON position during APU cooldown (less than 105 seconds after the selector is moved to OFF), the APU will accelerate to 100 percent and continue to operate.

If you move the APU selector to the ON position after the cooldown period has ended (more than 105 seconds after the selector is moved to OFF), the APU shutdown will continue.



AUXILIARY POWER SYSTEM - NORMAL SHUTDOWN

49-00-00-008 Rev 3 01/08/1997

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AUXILIARY POWER SYSTEM - PROTECTIVE SHUTDOWNS

General

The APUC controls the automatic protective shutdown of the APU. If the APUC finds some APU conditions or faults, it will send a protective shutdown signal.

There are two modes of APU automatic shutdown protection: the unattended mode and the attended mode.

Unattended Protective Shutdown

The unattended mode operates when the main engines are not running and the airplane is on the ground. This mode supplies protection against more types of failures than the attended mode. Any of these conditions will cause a shutdown in this mode:

- APU overspeed (more than 106 percent RPM)
- Loss of overspeed protection (loss of the two overspeed protection circuits)
- APU compartment fire
- APU inlet fire/load compressor reverse flow (T2 > 177C or low load compressor flow sensed by the total pressure sensor)
- APU speed droop (RPM less than 88 percent and no acceleration for 10 seconds)
- APUC failure
- Air inlet door failure
- Low oil pressure (less than 35 psi)
- Loss of oil pressure signal (from both the pressure sensor and the low oil pressure switch)
- High EGT (Calculated turbine inlet temperature is high. This occurs at approximately 710C EGT.)
- Loss of EGT signal (from both thermocouple rakes)
- High oil temperature (more than 156C).

Attended Protective Shutdown

The attended mode operates when at least one engine is running or if the aircraft is in the air. Only these conditions will cause a protective shutdown in the attended mode:

- APU overspeed
- Loss of overspeed protection
- APU compartment fire
- APU inlet fire/load compressor reverse flow
- APU speed droop
- APUC failure.

Indication

All protective shutdowns cause the APU SHUTDOWN advisory message to show and turn on the APU fault light on the P5 overhead panel. The APU status message also shows when there is a protective shutdown. In the attended mode, these conditions cause the APU LIMIT caution message to show:

- Low oil pressure
- High EGT
- High oil temperature.

AUXILIARY POWER SYSTEM - PROTECTIVE SHUTDOWNS

Training Information Point

You can attempt to restart the APU after you move the APU selector to OFF to unlatch the protective shutdown.

UNATTENDED MODE

- APU OVERSPEED
- LOSS OF OVERSPEED PROTECTION
- APU COMPARTMENT FIRE
- AIR INLET FIRE/LOAD COMPRESSOR REVERSE FLOW
- APU SPEED DROOP
- APUC FAILURE
- AIR INLET DOOR FAILURE
- LOW OIL PRESSURE
- LOSS OF OIL PRESSURE SIGNAL
- HIGH EGT
- LOSS OF EGT SIGNAL
- HIGH OIL TEMP

ATTENDED MODE

- APU OVERSPEED
- LOSS OF OVERSPEED PROTECTION
- APU COMPARTMENT FIRE
- AIR INLET FIRE/LOAD COMPRESSOR REVERSE FLOW
- APU SPEED DROOP
- APUC FAILURE

APUC

PROTECTIVE SHUTDOWN

APU SHUTDOWN (ADVISORY)

APU (STATUS)

APU LIMIT (CAUTION)

FAULT LIGHT (P5 OVERHEAD PANEL)

AUXILIARY POWER SYSTEM - PROTECTIVE SHUTDOWNS

49-00-00-009 Rev 6 12/16/1996

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AUXILIARY POWER SYSTEM - INDICATIONS

General

The status display and maintenance page show APU system data.

Status Display

The status display shows these data:

- APU RPM
- APU EGT in degrees C
- APU oil pressure in psi
- APU oil temperature in degrees C
- APU oil quantity in quarts.

Maintenance Page

The APU maintenance page shows the status of many APU systems and the outputs of the APU sensors. The data shown includes:

- APU pneumatic mode
- APUC mode
- Speed sensor input in percent RPM. A box shows for the highest value
- Exhaust gas temperatures corrected to standard sea level conditions in degrees C
- Exhaust gas temperatures from each of the two rakes in degrees C
- Oil pressure in psi
- Oil temperature in degrees C
- Oil quantity in quarts (LO shows when the quantity is less than 3.75)
- Inlet static pressure (P2) in psia
- Load compressor total pressure (exit pressure from the load compressor) in psia
- Load compressor differential pressure (DP) in psi (difference between the load compressor total pressure and the static pressure downstream of the load compressor)
- Compressor inlet temperature (T2) in degrees C
- Oil sump temperature in degrees C
- Surge control valve position from 90 degrees (fully closed) to 10 degrees (fully open)
- Inlet guide vane actuator position from 76 degrees (fully closed) to -10 degrees (fully open)
- Fuel metering unit fuel temperature in degrees C
- Fuel cluster fuel metering valve position from 0 percent (fully closed) to 100 percent (fully open)
- Air inlet door command - OPEN or CLOSED (from ELMS)
- Air inlet door position - OPEN or CLOSED
- Bleed corrected flow in pounds of air per minute from the load compressor
- Bleed corrected flow setpoint in pounds of air per minute (calculated by the APUC). This is the surge margin set point
- APU battery DC voltage and amperage (charging or discharging)
- APU generator AC voltage, frequency, and load in percentage of maximum load.

APU fuel feed data also shows on the maintenance page. This data includes:

- APU fuel shutoff valve data

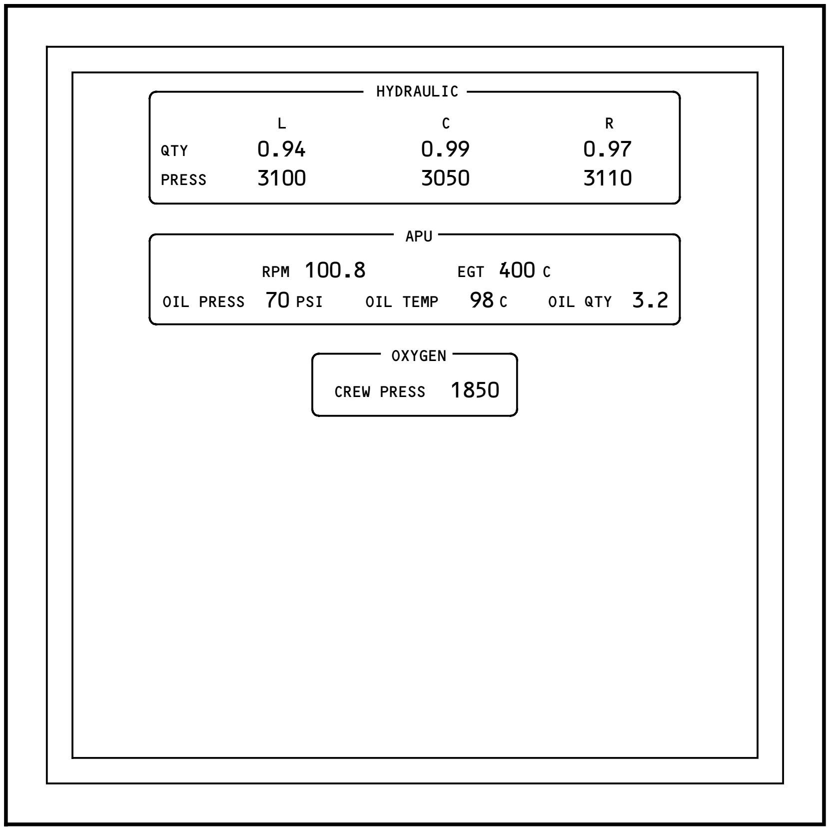
- DC fuel pump data
- AC fuel pump data.

The status codes show in digital format (1 or 0) the status of some of the APU inputs and outputs. Refer to section 49-70 in Part II of the airplane maintenance manual (AMM) for more information on the status codes.

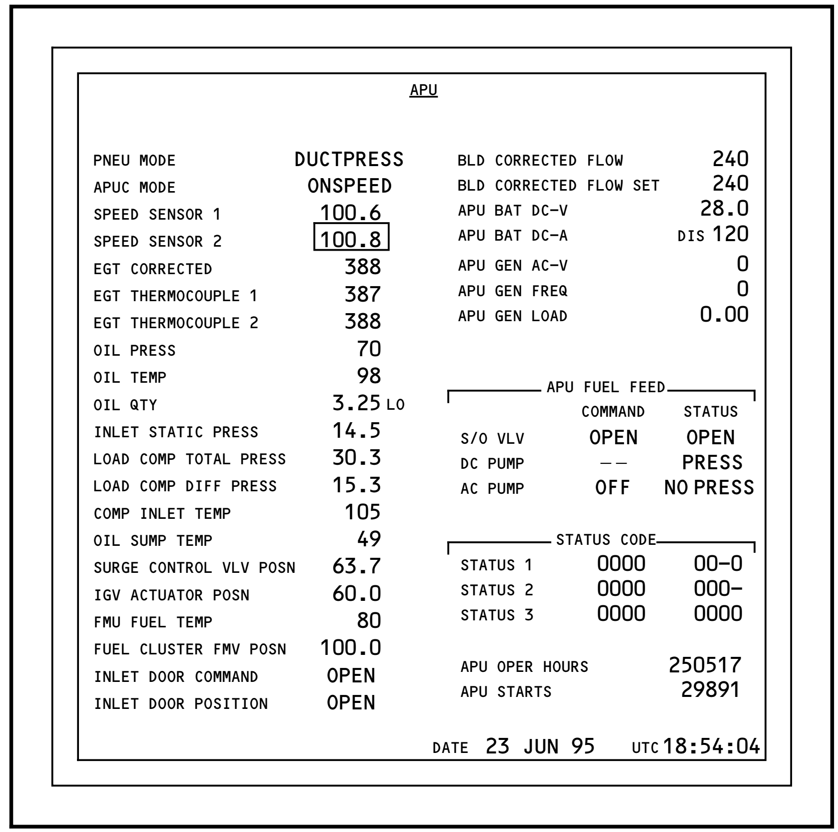
APU operating hours and the number of APU starts also shows on the maintenance page.

Training Information Point

You can use the APU maintenance switch to power the APUC when the APU selector is OFF. This permits you to read APU oil system indications on the status display without turning the APU selector to ON.



STATUS DISPLAY



APU MAINTENANCE PAGE

49-00-00-010 Rev 6 05/16/1997

AUXILIARY POWER SYSTEM - INDICATIONS

APU Access

You get access to the APU compartment through the APU doors.

You open the APU vent doors first to permit air to go into the APU compartment. This makes the pressure equal in the APU compartment and permits you to open the main APU doors when the APU is on.

Each main APU door has a latch on the forward edge of the door. You must release the latches to permit the main APU doors to open. Hold-open rods keep the doors in the open position.

APU Oil Servicing

You add oil to the APU at the oil fill port. The oil level sight gage shows full on the APU OFF side when the oil quantity is at the correct level.

The status display shows the APU oil quantity in quarts. The APU maintenance page (not shown) also shows the APU oil quantity.

This is a summary of the procedure to add oil to the APU:

- Make sure the APU selector on the P5 overhead panel is OFF and attach a DO-NOT OPERATE tag
- Open the APU access doors
- Open the oil fill cap
- Slowly add oil until the oil level is at the FULL mark on the APU OFF side of the oil level sight gage
- Close the oil fill cap
- Put the airplane back in its usual condition.

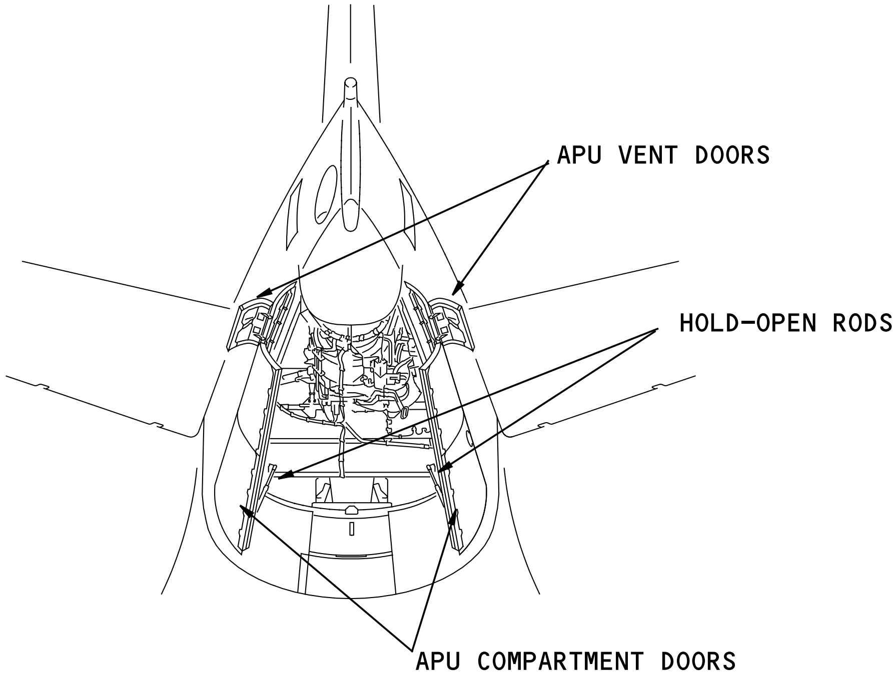
WARNING: DO NOT TOUCH THE APU GEARBOX HEATERS. THE GEARBOX HEATERS STAY HOT WHEN THE AIRPLANE HAS AC POWER. DO NOT TOUCH THE COMPONENTS OF THE OIL SYSTEM IF THE APU IS HOT. THESE COMPONENTS STAY HOTTER THAN OTHER COMPONENTS. HOT COMPONENTS CAN BURN YOU.

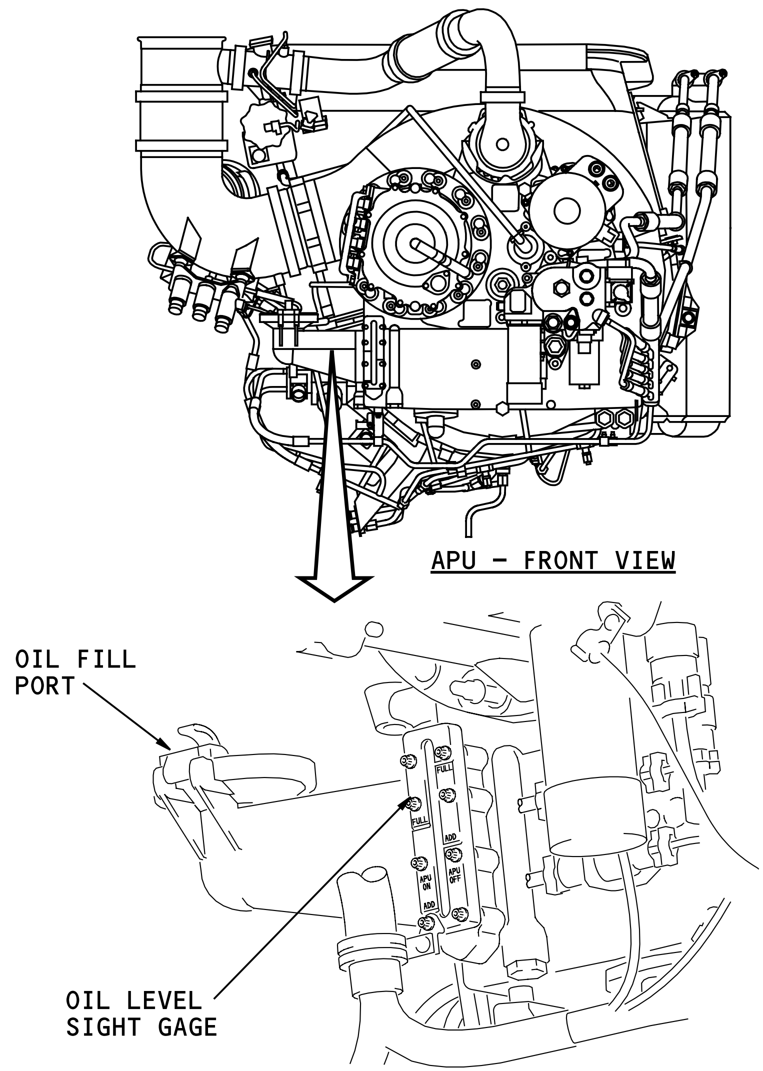
WARNING: DO NOT LET HOT OIL GET ON YOU. PUT ON PROTECTIVE CLOTHES, GOGGLES, AND EQUIPMENT, OR LET THE APU BECOME COOL. HOT OIL CAN BURN YOU.

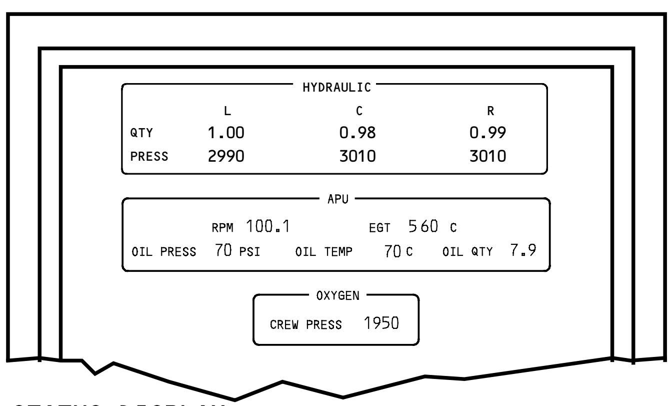
WARNING: DO NOT LET THE OIL STAY ON YOUR SKIN. YOU CAN ABSORB POISONOUS MATERIALS FROM THE OIL THROUGH YOUR SKIN.

CAUTION: DO NOT LET OIL GET ON THE APU OR OTHER COMPONENTS. IMMEDIATELY CLEAN THE OIL WHEN IT FALLS ON THEM. OIL CAN CAUSE DAMAGE TO PAINT AND RUBBER.

CAUTION: DO NOT MIX TYPES OR BRANDS OF OIL WHEN YOU ADD OR REPLACE THE OIL IN THE APU. INCORRECT OILS CAN CAUSE DAMAGE TO THE APU.







STATUS DISPLAY

49-00-00-011 Rev 3

AUXILIARY POWER SYSTEM - APU ACCESS AND SERVICING

AUXILIARY POWER SYSTEM - INTERFACES

General

The APUC gets airplane system data and sends APU data to airplane systems through the left and right system ARINC 629 data buses. The APUC also sends and receives some data through other connections.

ARINC 629 Interfaces

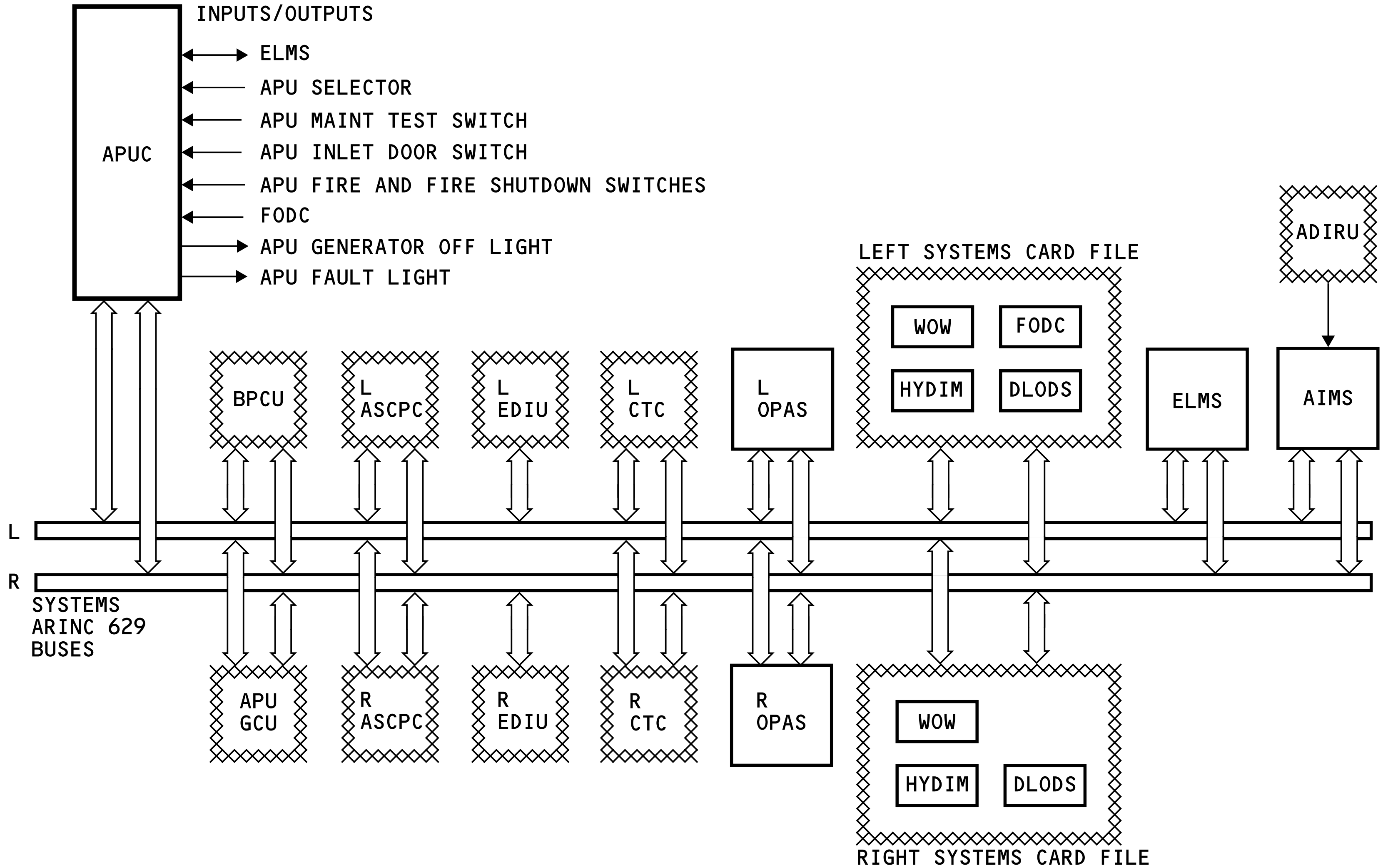
These systems have interfaces with the APUC through systems ARINC 629 buses:

- Bus power control unit (BPCU) - generator trim frequency
- APU generator control unit (GCU) - generator load
- Left and right air supply cabin pressure controller (ASCPC) - pneumatic valve positions, pack operation, and pneumatic duct pressure
- Left and right engine data interface unit (EDIU) - engine data
- Left and right cabin temperature controller (CTC) - pneumatic valve position and ECS data
- Left and right overhead panel ARINC 629 system (OPAS) - overhead panel switch/selector positions
- Left and right weight on wheels (WOW) cards - air/ground condition
- Hydraulic interface module (HYDIM) cards - ADP operation data
- Fire overheat detection card (FODC) - APU fire
- Left, right, and center duct leak and overheat detection system (DLODS) - wing/body duct overheat
- Electrical load management system (ELMS) - start control, shutdown control, autostart, attended/unattended mode
- Airplane information management system (AIMS) engine running status, air data (from ADIRU), airplane data, fault reporting, indications.

Other Interfaces

The APUC also has interfaces with these systems and components without ARINC 629:

- Electrical load management system (ELMS)
- The APU selector
- The APU maintenance switch
- The APU inlet door switch
- APU fire switch and fire shutdown switch
- Fire overheat detection card (FODC)
- APU generator OFF light
- APU fault light.



AUXILIARY POWER SYSTEM - INTERFACES

Continental Airlines, Inc

Hydraulic Power

WB371

TABLE OF CONTENTS

TABLE OF CONTENTS

HYDRAULIC POWER - INTRODUCTION

General

Three hydraulic systems supply pressurized hydraulic fluid to supply power to these airplane systems:

- Flight controls
- Landing gear actuation
- Main gear brakes
- Main and nose landing gear steering
- Leading edge slats
- Trailing edge flaps
- Thrust reversers.

These systems make up the hydraulic power system:

- Main hydraulic systems
- Ram air turbine (RAT) system
- Hydraulic indicating systems
- Ground servicing system.

Main Hydraulic Systems

The three hydraulic systems are Left, Center, and Right. The names give the location of their main components.

Ram Air Turbine System

The ram air turbine supplies an emergency source of hydraulic power to operate the flight controls. The RAT also supplies emergency electrical power.

Hydraulic Indicating System

The hydraulic indicating system shows these hydraulic system indications on the flight deck:

- System pressure
- Pump pressure
- Reservoir pressure
- Pump temperature
- Reservoir temperature
- Hydraulic reservoir quantity
- Valve positions.

Ground Servicing System

A central servicing bay permits you to fill the three hydraulic reservoirs from a single location.

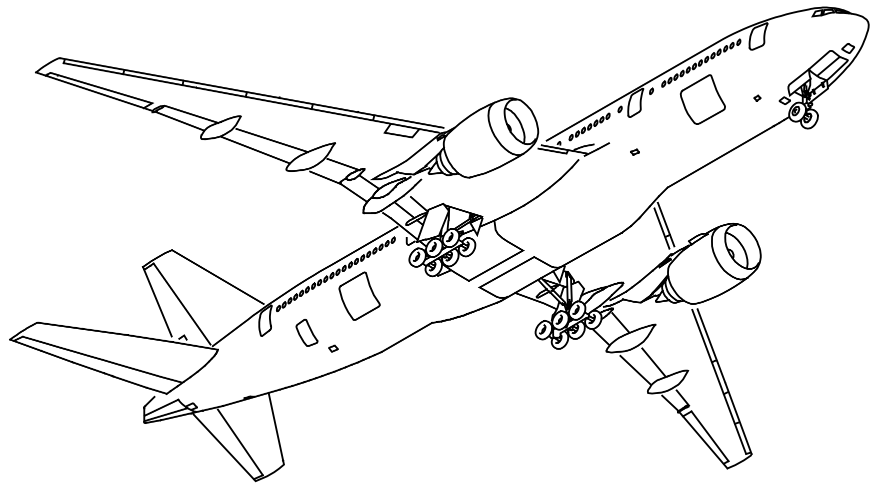
Abbreviations and Acronyms

ACMP	- alternating current motor pump
actr	- actuator
ADIRU	- air data inertial reference unit
ADP	- air driven pump
ADU	- air drive unit
AFDC	- autopilot flight director computer
AIMS	- airplane information management system
ARINC	- Aeronautical Radio, Inc.
APUC	- auxiliary power unit controller
AS	- airspeed
auto	- automatic
ASG	- ARINC signal gateway

ASCPC	- air supply and cabin pressure controller	NG	- nose gear
C	- center	NLG	- nose landing gear
capt	- captain	OPAS	- overhead panel ARINC 629 system
CD	- case drain	PCU	- power control unit
CHIS	- center hydraulic isolation system	PFC	- primary flight computer
CL	- center left	PFCS	- primary flight control system
CR	- center right	pnl	- panel
CTC	- cabin temperature controller	press	- pressure
depress	- depressurization	PSEU	- proximity sensor electronics unit
disc	- disconnect	pwr	- power
EDIU	- engine data interface unit	qty	- quantity
EDP	- engine driven pump	R	- right
EEU	- ELMS electronic unit	RAT	- ram air turbine
ELMS	- electrical load management system	rlf	- relief
eng	- engine	RPM	- revolutions per minute
FSEU	- flap slat electronics unit	rsv	- reserve
gnd	- ground	rsvr	- reservoir
HLCS	- high lift control system	rtn	- return
hyd	- hydraulic	RWW	- right wheel well
HYDIM	- hydraulic interface module	sply	- supply
isln	- isolation	stby	- standby
L	- left	svce	- service
LG	- landing gear	sys	- system
LSCU	- logic and speed control unit	temp	- temperature
LVDT	- linear variable differential transformer	TGA	- turbine gearbox assembly
MAT	- maintenance access terminal	VIGV	- variable inlet guide vanes
mgmt	- management	vlv	- valve
MLG	- main landing gear	xdcr	- transducer
MSOV	- modulating and shutoff valve		

HYDRAULIC POWER USER SYSTEMS:

- FLIGHT CONTROLS
- LANDING GEAR ACTUATION
- MAIN GEAR BRAKES
- MLG AND NLG STEERING
- LEADING EDGE SLATS
- TRAILING EDGE FLAPS
- THRUST REVERSERS

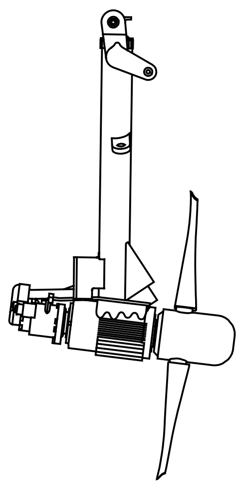


LEFT SYSTEM

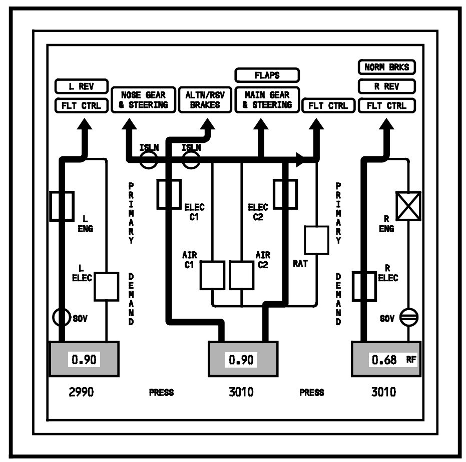
CENTER SYSTEM

RIGHT SYSTEM

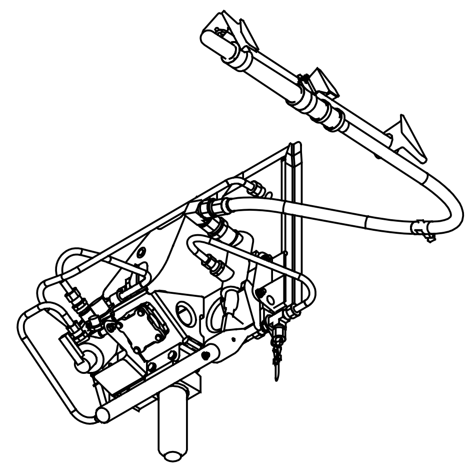
MAIN HYDRAULIC SYSTEMS



RAM AIR TURBINE SYSTEM



HYDRAULIC INDICATING SYSTEM



GROUND SERVICING SYSTEM

29-00-00-001 Rev 2

HYDRAULIC POWER - INTRODUCTION

HYDRAULIC POWER - COMPONENT LOCATIONS

General

Hydraulic system components are in these locations:

- Left and right engine aft strut fairings
- Right wheel well
- Aft wing to body fairings
- Main equipment center
- Stabilizer compartment.

Left and Right Hydraulic Systems

The left and right hydraulic system components are almost the same. Most left system components are in the left engine aft strut fairing. Most right system components are in the right engine aft strut fairing.

The components in each engine aft strut fairing include:

- A hydraulic reservoir
- An alternating current motor pump (ACMP)
- Filter modules (3)
- A reservoir pressurization module.

The left system engine-driven pump (EDP) is on the left engine. The right system EDP is on the right engine.

The system pressure transducers are in the wing structure behind each engine.

Center Hydraulic System

Most center hydraulic system components are in the right wheel well. These components include:

- A hydraulic reservoir
- ACMPs (2)
- Filter modules (3)
- A reservoir pressurization module
- A system pressure transducer
- Isolation valves.

Two air-driven pumps (ADPs) are in the left aft wing to body fairing behind the left wheel well.

The ram air turbine (RAT) is in the right aft wing to body fairing behind the right wheel well.

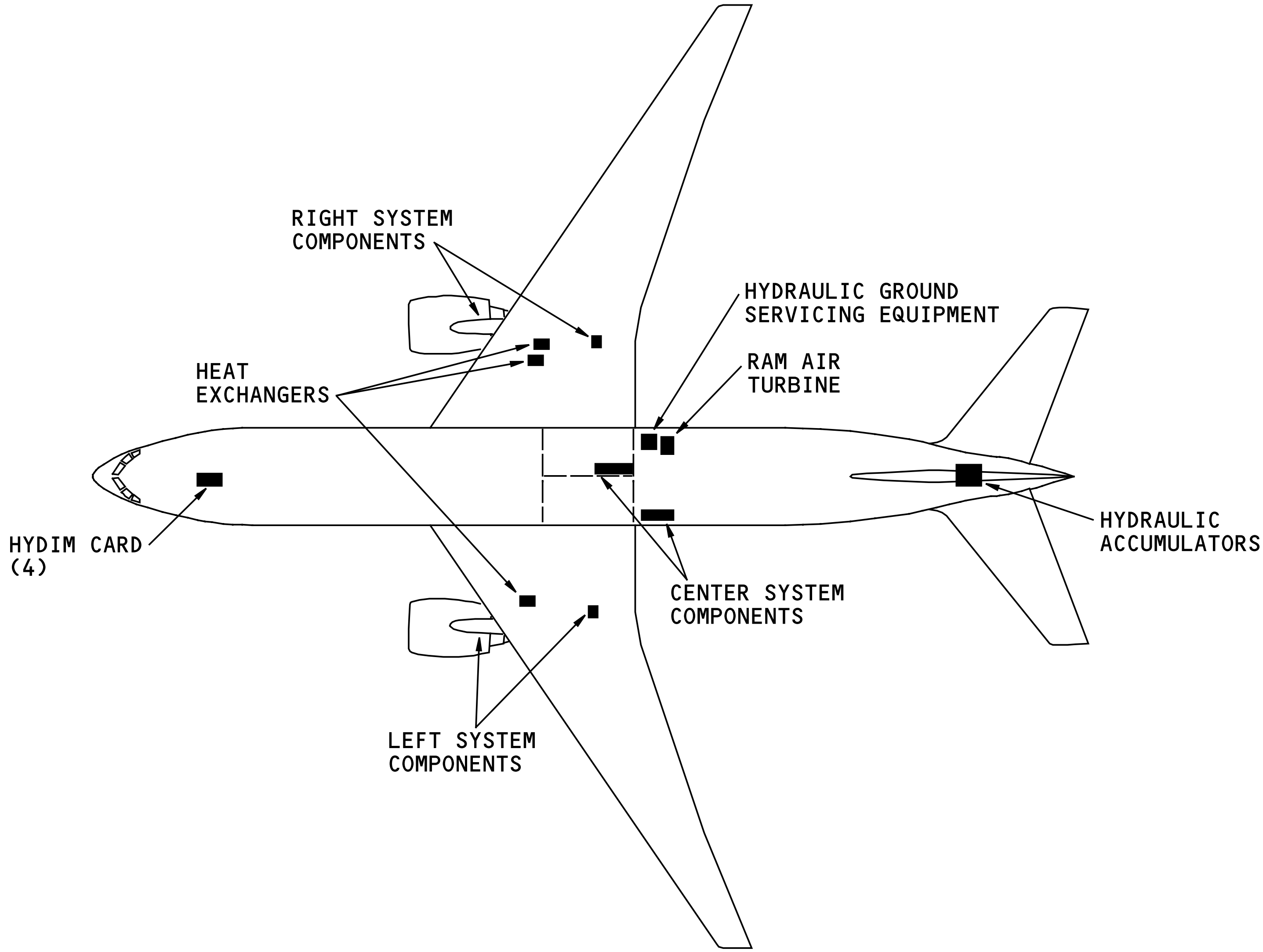
Other Hydraulic System Components

Four hydraulic interface module (HYDIM) cards are in the cardfiles in the main equipment center.

Heat exchangers are in the left and right main fuel tanks.

Hydraulic ground servicing equipment is in the ground servicing bay. The ground servicing bay is in the right aft wing to body fairing.

Hydraulic accumulators are in the stabilizer compartment.



29-00-00-002 Rev 3 02/22/95

HYDRAULIC POWER - COMPONENT LOCATIONS

MAIN HYDRAULIC SYSTEMS - INTRODUCTION

General

The left, center, and right hydraulic systems operate independently to supply hydraulic power to the airplane systems. All three systems operate at 3000 psi nominal pressure.

The hydraulic systems use BMS 3-11 hydraulic fluid.

The components and hydraulic tubing of the three systems are color coded. The left system is red, the center system is blue, and the right system is green.

Each hydraulic system has one or more primary and demand pumps. Primary pumps normally operate continuously. Demand pumps operate only when additional power is necessary.

Left and Right System

The left and right hydraulic systems are similar. These systems each have an engine-driven pump (EDP) as the primary pump and an alternating current motor pump (ACMP) as the demand pump.

The left hydraulic system supplies power for these systems:

- Primary flight control system (PFCS)
- Left thrust reverser.

The right system supplies power for these systems:

- PFCS
- Right thrust reverser
- Normal brake system.

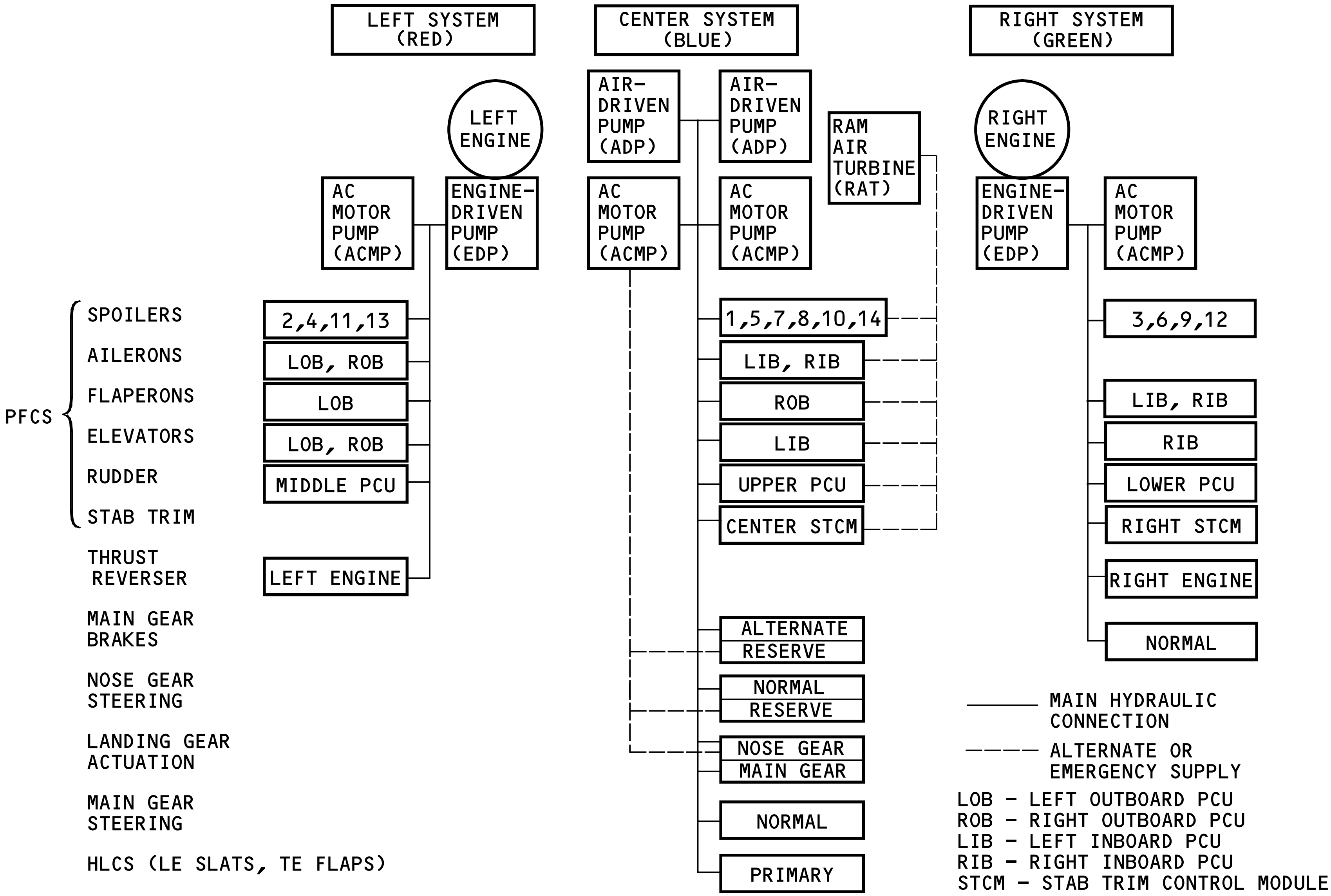
Center System

The center hydraulic system has two ACMPs as the primary pumps. Two air-driven pumps (ADPs) are the center system demand pumps. A ram air turbine (RAT) supplies an emergency source of hydraulic power to the flight controls in the center hydraulic system.

The center system also includes a center hydraulic isolation system (CHIS) for reserve brake and steering operation.

The center system supplies hydraulic power for these systems:

- PFCS
- Alternate and reserve brakes
- Normal and reserve nose gear steering
- Landing gear actuation
- Main gear steering
- High lift control system (HLCS)(LE slats, TE flaps).



29-10-00-001 Rev 5

MAIN HYDRAULIC SYSTEMS - INTRODUCTION

MAIN HYDRAULIC SYSTEMS - INTERFACES

General

Four hydraulic interface module (HYDIM) cards are the interface between the hydraulic systems and other airplane systems.

The HYDIM cards receive and transmit data through the ASG cards and the systems ARINC 629 buses. The HYDIM cards also send and get signals through hard-wires.

ARINC 629 Interfaces

The HYDIM cards have these interfaces through the left and right systems ARINC 629 buses:

- Proximity sensor electronic unit (PSEU) (2)
- Flap/slat electronic unit (FSEU) (2)
- Overhead panel ARINC 629 system (OPAS)
- Electrical load management system (ELMS) power management panels (P110, P210, and P310)
- APU controller (APUC)
- Air supply and cabin pressure controller (ASCPC) (2)
- Cabin temperature controller (CTC) (2)
- Engine data interface unit (EDIU) (2)
- Autopilot flight director computer (AFDC) (3)
- Airplane information management system (AIMS).

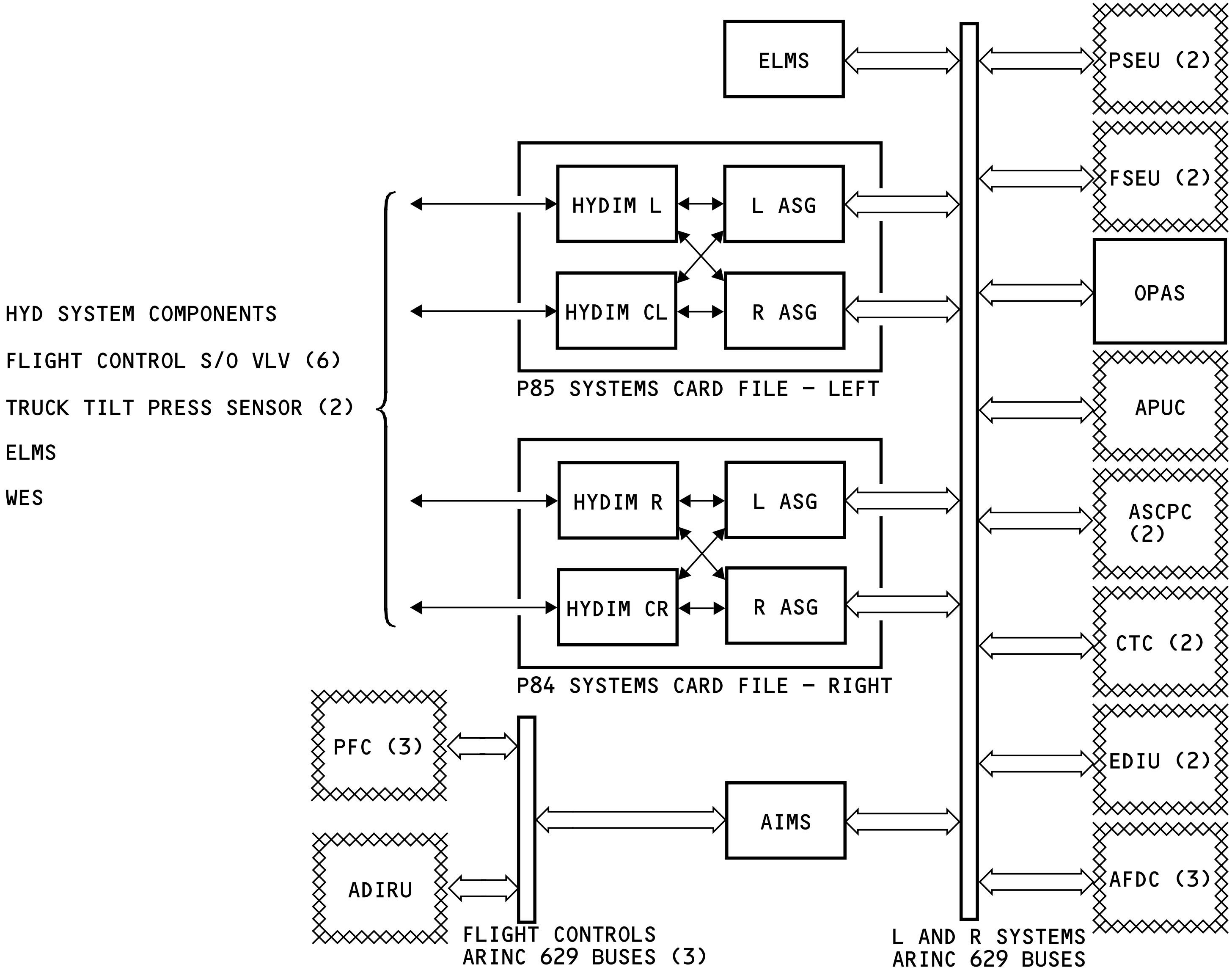
The HYDIM cards also send and receive data through AIMS and the flight controls ARINC 629 buses for these components:

- Primary Flight Computers (3)
- Air Data Inertial Reference Unit (ADIRU).

Hard-wire Interfaces

The HYDIM cards also have these interfaces through hard-wires:

- Hydraulic system components
- Flight control shutoff valve (6)
- Truck tilt pressure sensors
- ELMS
- Warning electronic system (WES).



MAIN HYDRAULIC SYSTEMS - INTERFACES

MAIN HYDRAULIC SYSTEMS - CONTROLS

General

The controls for the hydraulic system pumps and the RAT manual deployment are on the hydraulic/RAT panel. This panel is on the P5 overhead panel.

The engine fire switches on the P8 aisle stand panel also control EDP operation.

Primary and Demand Pump Controls

Each primary pump has an alternate action switch. You select the pump OFF or ON.

Each demand pump has a rotary selector. You select the pump OFF, AUTO, or ON. When you select AUTO, the pump is in the demand mode and the HYDIM cards control the operation. When you select ON, the pump operates continuously.

Fault lights for each pump turn on if there is a pump overheat or pump low pressure condition.

Rat Deploy Switch

A RAT deploy switch at the top of the panel permits manual deployment of the ram air turbine. The RAT deploy switch is a momentary switch and is guarded.

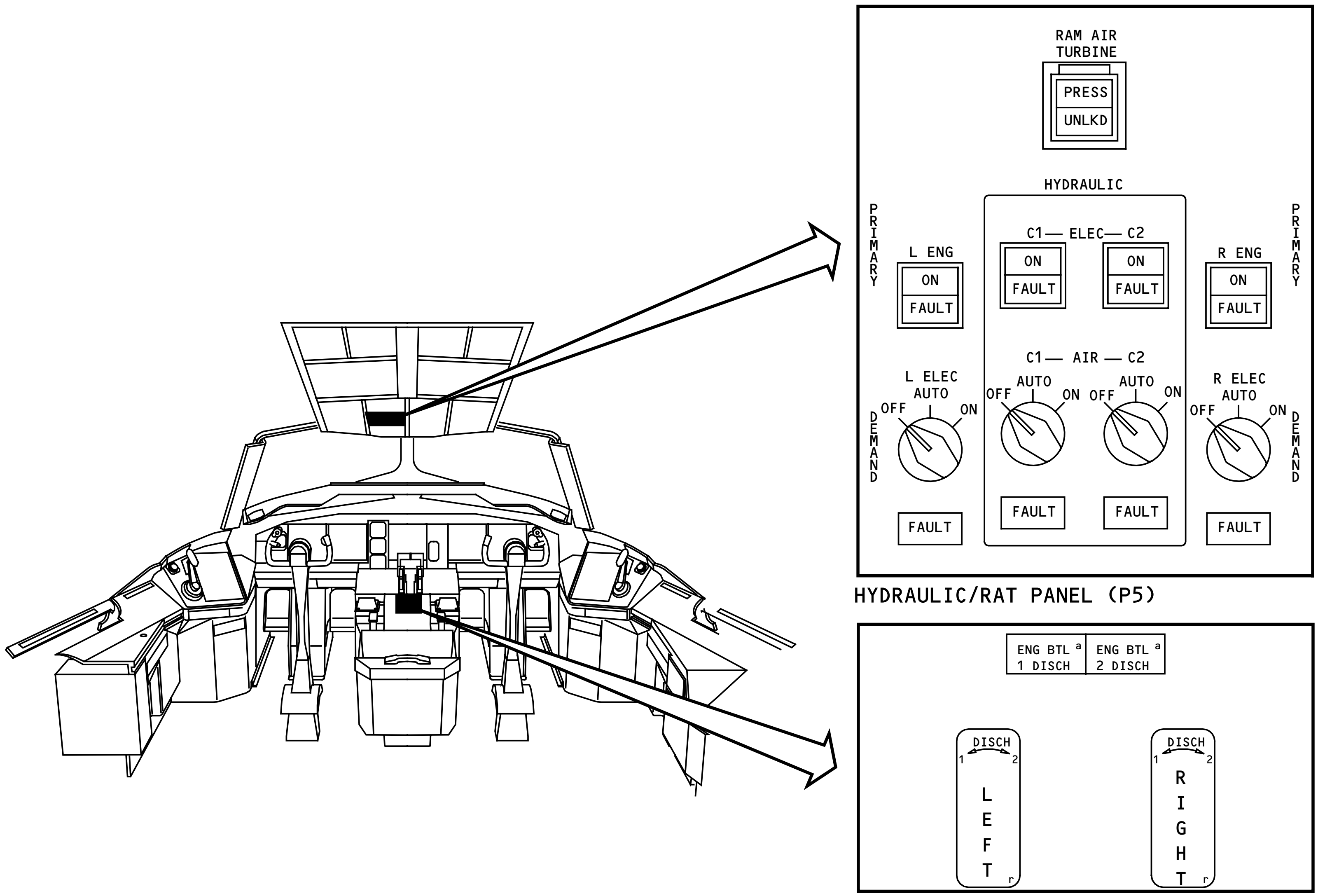
This switch also has an unlocked light and a pressure light. The unlocked light turns on when the RAT is not up and locked. The pressure light turns on when the RAT supplies hydraulic pressure.

Engine Fire Switches

The engine fire switches isolate the engine if there is an engine fire. When you operate one of the fire switches, the hydraulic fluid supply to the related pump shuts off and the pump depressurizes.

Training Information Point

Because the EDP depressurization valve gets electrical power when the EDP control switch is OFF, keep the switch in the ON position. If the switch is in the OFF position for a long period, you should open the circuit breaker for the EDP solenoid.



HYDRAULIC/RAT PANEL (P5)

ENGINE FIRE SWITCHES (P8)

29-10-00-003 Rev 0

MAIN HYDRAULIC SYSTEMS - CONTROLS

MAIN HYDRAULIC SYSTEMS - HYDRAULIC INTERFACE MODULE CARDS

General

Four hydraulic interface module (HYDIM) cards supply control, indication, and other functions to the hydraulic system. The HYDIM cards have these names:

- HYDIM left (L)
- HYDIM right (R)
- HYDIM center left (CL)
- HYDIM center right (CR).

HYDIM L controls the functions for the left system. HYDIM R controls the functions for the right system. HYDIM CL and CR control the functions for the center system.

The HYDIM cards are interchangeable. Card position in the card file determines the function of the card.

HYDIM sends and receives some signals directly through hard wires.

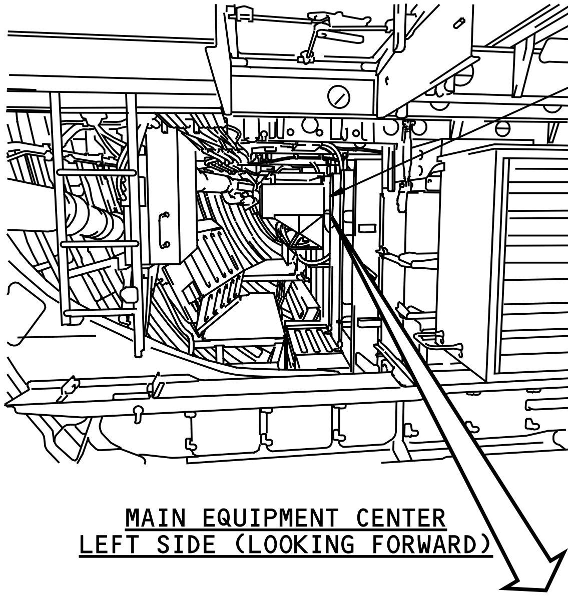
HYDIM also sends and receives signals through the left and right systems ARINC 629 buses through the ARINC signal gateway (ASG) cards.

Location

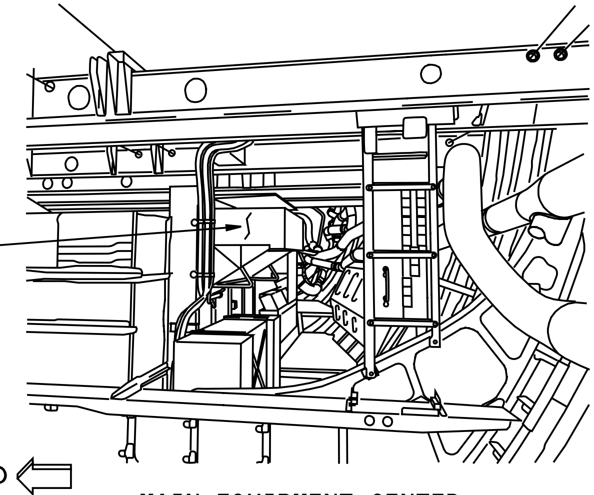
The HYDIM cards are in the P85 left systems card file and the P84 right systems card file.

Training Information Point

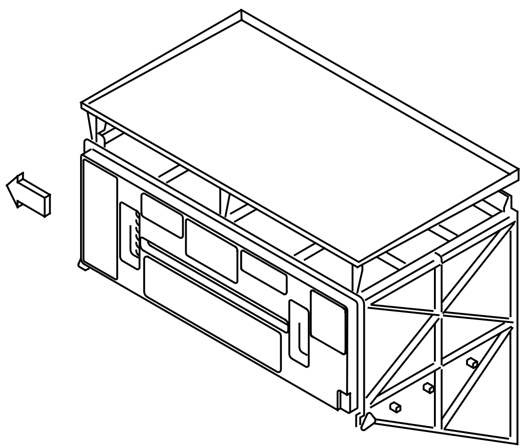
The HYDIM cards are software loadable. See the CMCS section for more information about the data load (AMM PART I 45-10).



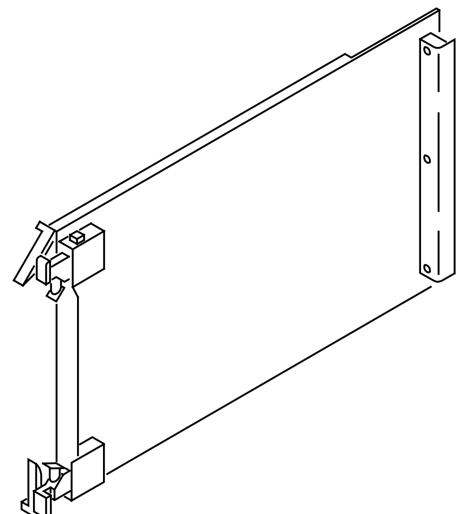
MAIN EQUIPMENT CENTER
LEFT SIDE (LOOKING FORWARD)



MAIN EQUIPMENT CENTER
RIGHT SIDE (LOOKING FORWARD)



P85 LEFT SYSTEMS CARDFILE
(P84 RIGHT SYSTEMS CARDFILE SIMILAR)



HYDIM CARD (TYPICAL)

MAIN HYDRAULIC SYSTEMS - HYDRAULIC INTERFACE MODULE CARDS

MAIN HYDRAULIC SYSTEMS - HYDRAULIC INTERFACE MODULE CARDS - FUNCTIONAL DESCRIPTION

General

Four HYDIM cards in the system card files monitor and control the hydraulic system and do other functions.

The HYDIM cards send and receive some data through ARINC 429 buses to the ARINC signal gateway (ASG) cards. The ASG cards send and receive data through the systems ARINC 629 buses.

The HYDIM cards also send and receive data through hard wires.

Control Functions

The HYDIM cards control these functions:

- Demand pump (L, R ACMP; ADP C1, C2) AUTO operation
- Reserve and NG isolation valve operation
- Landing gear auto-off (MLG and NLG selector/bypass valves)
- RAT auto deploy.

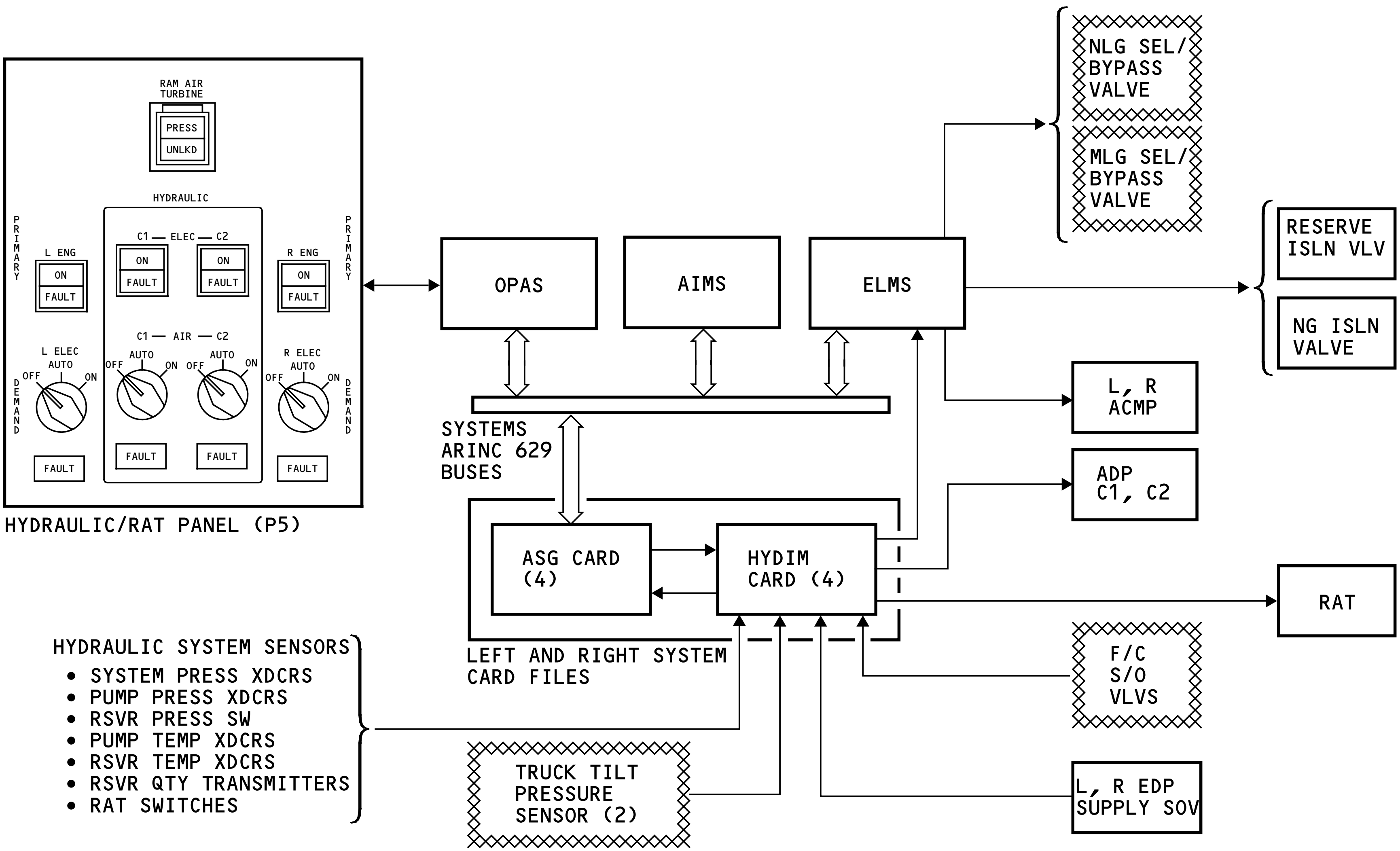
Indications

HYDIM supplies these hydraulic system indications through AIMS:

- System pressures
- Pump pressures
- Reservoir pressures
- Pump temperatures
- Reservoir fluid temperatures
- Reservoir quantities
- RAT locked status
- Valve positions.

HYDIM also does these functions:

- Hydraulic system fault detection
- Monitor EDP supply shutoff valve positions
- Monitor truck tilt pressures
- Monitor flight control shutoff valve positions.



MAIN HYDRAULIC SYSTEMS - HYDRAULIC INTERFACE MODULE CARDS - FUNCTIONAL DESCRIPTION

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MAIN HYDRAULIC SYSTEMS - HYDRAULIC SYSTEM RESERVOIRS

Purpose

The hydraulic reservoirs supply hydraulic fluid under pressure to the hydraulic pumps. The reservoirs also get the return hydraulic fluid from the airplane systems that use hydraulic power.

Physical Description

The left and right system reservoirs are the same. Each has a total volume of 12.6 gallons (47.8 liters) and normally contains 7.4 (28 liters) gallons of hydraulic fluid.

The center system reservoir has a total volume of 25.6 gallons (97 liters) and normally contains 11 gallons (41.7 liters) of hydraulic fluid.

Each reservoir has these components:

- Reservoir pressure relief valve
- Sight glasses (low and overfull)
- Reservoir sample valve
- Reservoir drain valve
- Reservoir temperature transducer
- Reservoir quantity transmitter.

Location

The left hydraulic system reservoir is in the left engine aft strut fairing.

The right hydraulic system reservoir is in the right engine aft strut fairing.

The center system reservoir is in the aft part of the right wheel well.

Functional Description

The reservoirs are pressurized by the bleed air system for positive supply to the pumps.

The reservoirs have an internal trap to make sure fluid goes to the pumps during negative-G conditions.

Each reservoir also has a standpipe. For the left and right reservoirs there are 2 gallons (7.6 liters) of fluid below the standpipe. The EDPs get a fluid supply from the standpipe. A port at the bottom of the reservoir supplies fluid to the ACMPs.

For the center hydraulic system, there are 1.2 gallons (4.5 liters) below the standpipe. The standpipe supplies the fluid to ACMP 2, to both ADPs, and to the RAT. ACMP 1 gets fluid from the bottom of the reservoir.

The reservoir pressure relief valve opens between 85 and 90 psi to protect the reservoir against over-pressurization.

MAIN HYDRAULIC SYSTEMS - HYDRAULIC SYSTEM RESERVOIRS

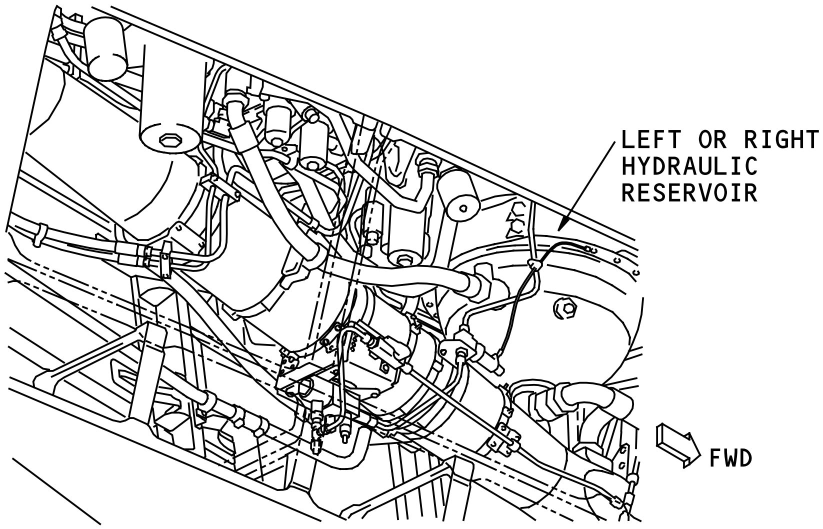
Training Information Point

You get access to the left and right reservoirs through the aft strut fairing doors on both sides of the aft engine struts.

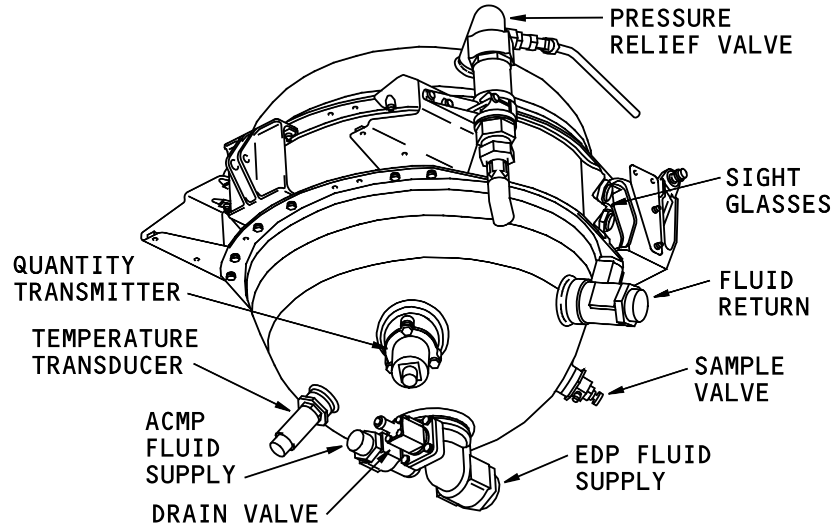
When filled to the correct level, the top sight glass shows red and the bottom sight glass shows black.

When the reservoir is in an overfull condition, both sight glasses show black.

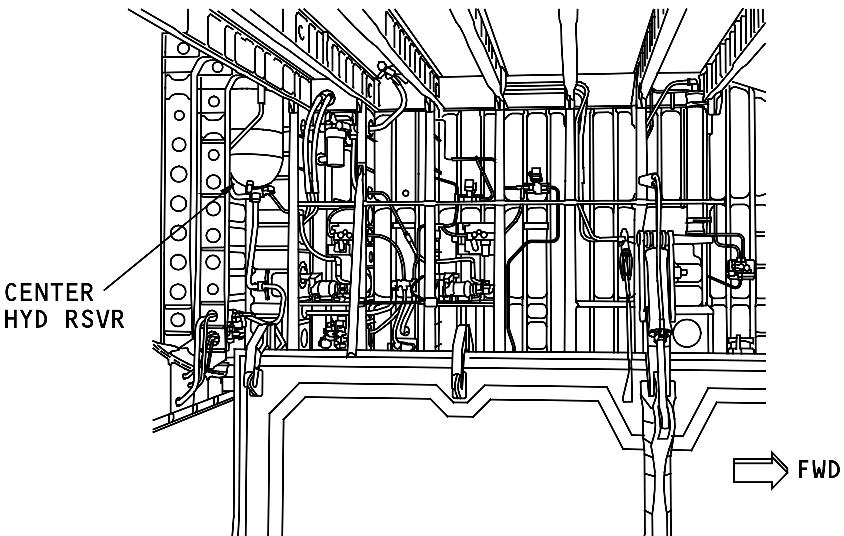
When the reservoir needs to be filled, both sight glasses show red.



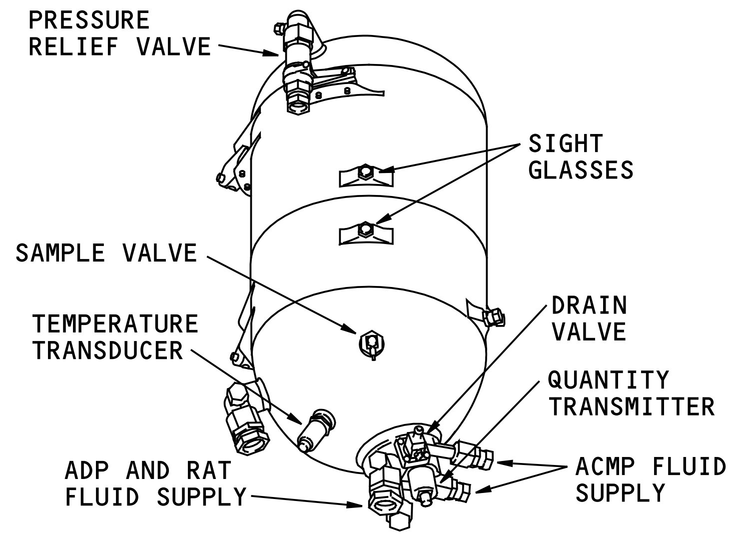
ENGINE STRUT



LEFT AND RIGHT HYDRAULIC RESERVOIR



RIGHT WHEEL WELL



CENTER HYDRAULIC RESERVOIR

MAIN HYDRAULIC SYSTEMS - HYDRAULIC SYSTEM RESERVOIRS

MAIN HYDRAULIC SYSTEMS - RESERVOIR PRESSURIZATION MODULE AND SHUTOFF VALVE

General

The reservoir pressurization modules supply airplane bleed air to the reservoirs.

The reservoir pressurization shutoff valves are manually operated valves which permit the shutoff of air pressure to the reservoir.

Each hydraulic system has a reservoir pressurization module, and a reservoir pressurization shutoff valve.

Physical Description

Each reservoir pressurization module has these components:

- Filter (2)
- Check valve (2)
- Test port
- Manual bleed valve
- Gage port.

The reservoir pressurization shutoff valves are simple manual shutoff valves. These shutoff valves are before the pressurization module in the pneumatic line to the reservoir.

Location

The modules for the left and right systems are in the engine aft struts below their reservoir.

The center system module is on the aft bulkhead in the right wheel well.

The shutoff valves are near the pressurization modules.

Operation

To depressurize a reservoir, first turn the shutoff valve to the closed position. Install the lock pin to hold the valve in the closed position.

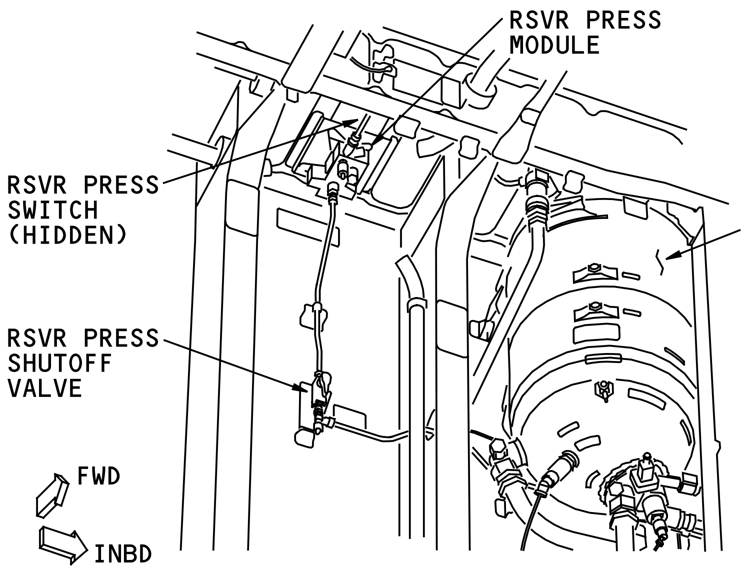
You depressurize the reservoir with the manual bleed valve on the reservoir pressurization module.

CAUTION: PUT A RAG AROUND THE AIR BLEED VALVE ON THE RESERVOIR PRESSURIZATION MODULE TO CATCH HYDRAULIC FLUID SPRAY. HYDRAULIC FLUID SPRAY CAN CAUSE INJURIES TO PERSONS.

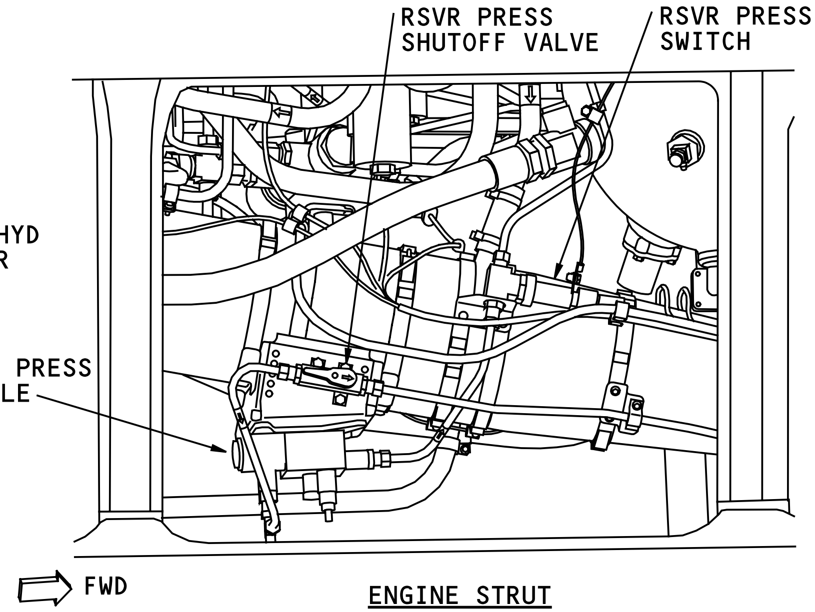
Training Information Point

A reservoir pressure switch near each of the reservoirs send reservoir pressure low or reservoir pressure not-low signals to the HYDIM cards.

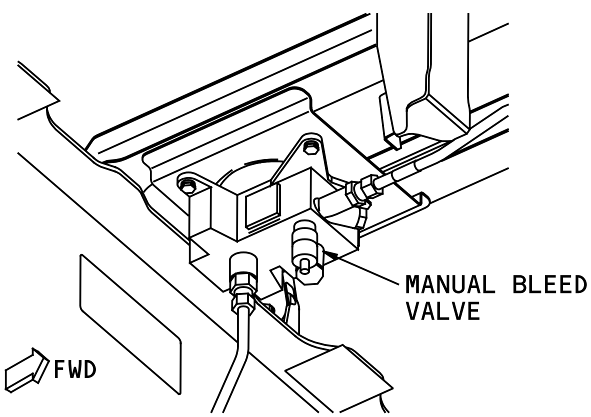
See the hydraulic indicating section for more information about the reservoir sensors (AMM PART I 29-30).



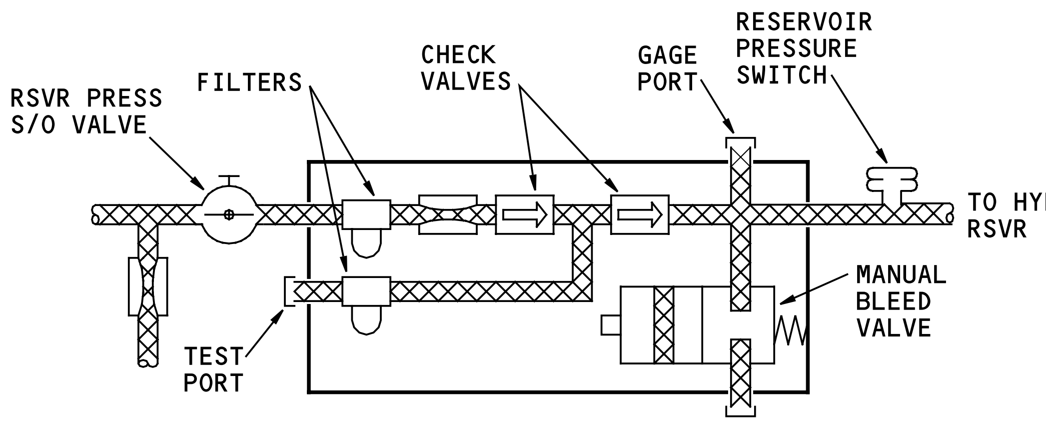
CENTER SYSTEM MODULE AND VALVE
(RIGHT W/W - AFT BULKHEAD)



ENGINE STRUT



CENTER SYSTEM RSVR PRESS MODULE



RESERVOIR PRESSURIZATION MODULE

MAIN HYDRAULIC SYSTEMS - RESERVOIR PRESSURIZATION MODULE AND SHUTOFF VALVE

29-10-00-007 Rev 5

MAIN HYDRAULIC SYSTEMS - ENGINE DRIVEN PUMP

Purpose

The engine driven pump (EDP) is the primary pump for the left and right hydraulic systems.

Physical Description

The EDP is an axial-piston, variable displacement, hydraulic pump assembly.

An internal pressure compensator controls the output pressure of the pump to approximately 3000 psi.

A depressurization solenoid valve blocks the pump output flow when you turn off the pump.

Case drain hydraulic flow cools and lubricates the engine driven pump.

A ripple damper smooths the pump pressure output.

The pump is rated at 48 gpm at 2850 psi and 3900 rpm.

The dry weight of the pump is 36 pounds (16 kg).

Location

The EDP is on the front face of the engine main gearbox on the left side of each engine.

Functional Description

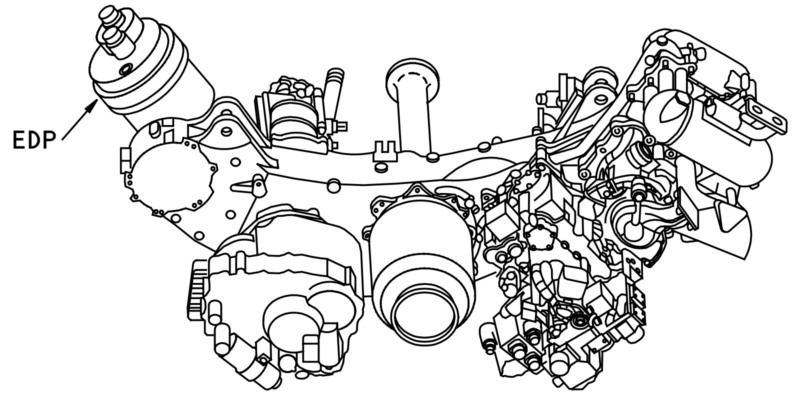
The engine main gearbox turns the EDP when the engine turns. When the depressurization solenoid valve is not energized, pump pressure output goes to the hydraulic system.

When you turn off the pump, the depressurization solenoid valve gets electrical power. This permits pressurized hydraulic fluid from the pump output line to move the blocking valve. This causes a blockage and removes the pressure from the EDP.

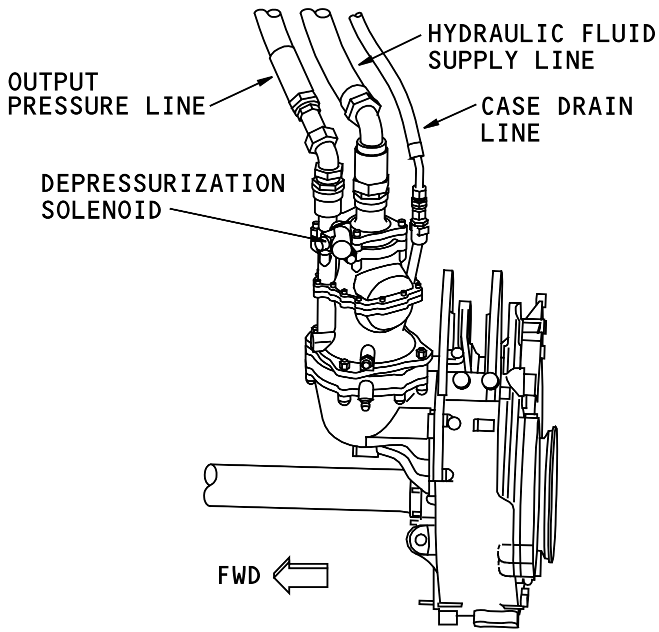
Training Information Point

You get access to the EDPs through the left thrust reverser half.

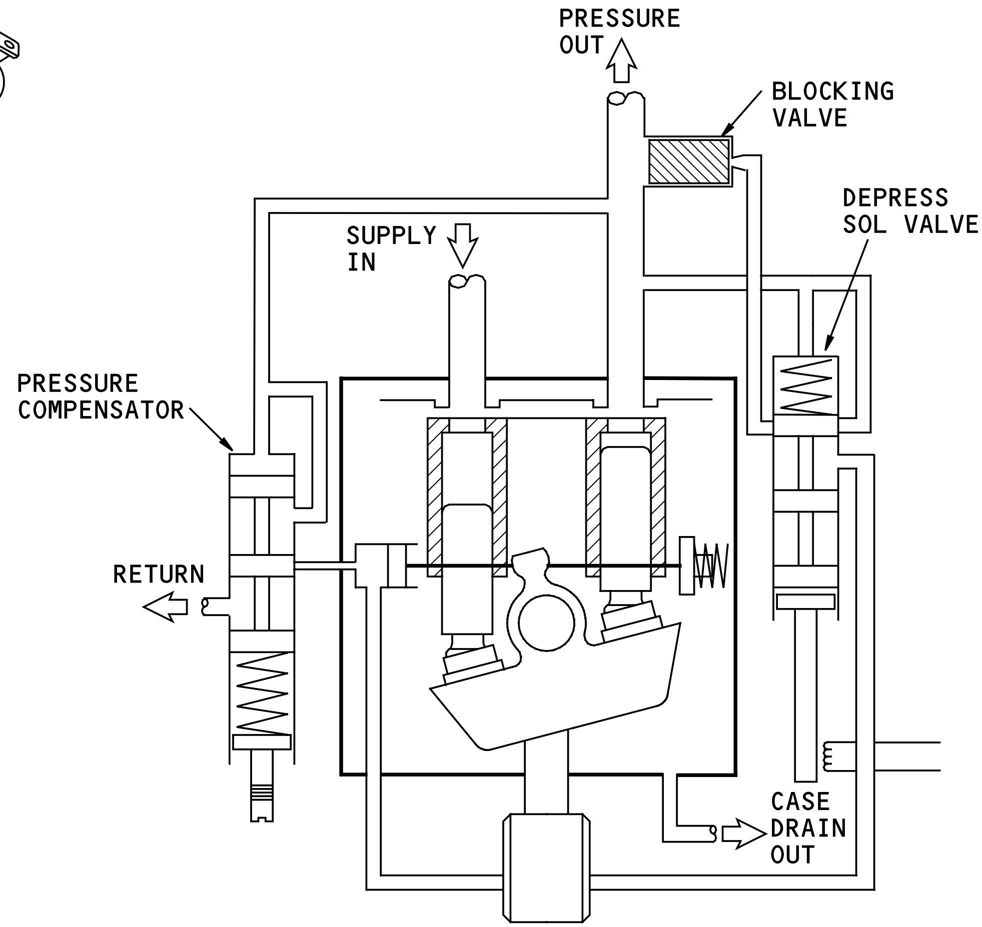
CAUTION: MAKE SURE YOU INSTALL THE O-RING IN THE SPLINE GROOVE ON THE DRIVE SHAFT OF THE ENGINE DRIVEN PUMP. THE O-RING PREVENTS LEAKAGE OF OIL FROM THE ENGINE GEARBOX.



ENGINE MAIN GEARBOX (LOOKING FORWARD)



ENGINE DRIVEN PUMP



EDP - SCHEMATIC

29-10-00-008 Rev 3

MAIN HYDRAULIC SYSTEMS - ENGINE DRIVEN PUMP

MAIN HYDRAULIC SYSTEMS - ENGINE DRIVEN PUMP - SUPPLY SHUTOFF VALVE

Purpose

The EDP supply shutoff valve stops hydraulic supply from the reservoir to the EDP when the engine fire switch is in the up position.

Physical Description

The supply shutoff valve is a two-position valve operated by a 28v dc motor. A position indicator shows the position of the valve.

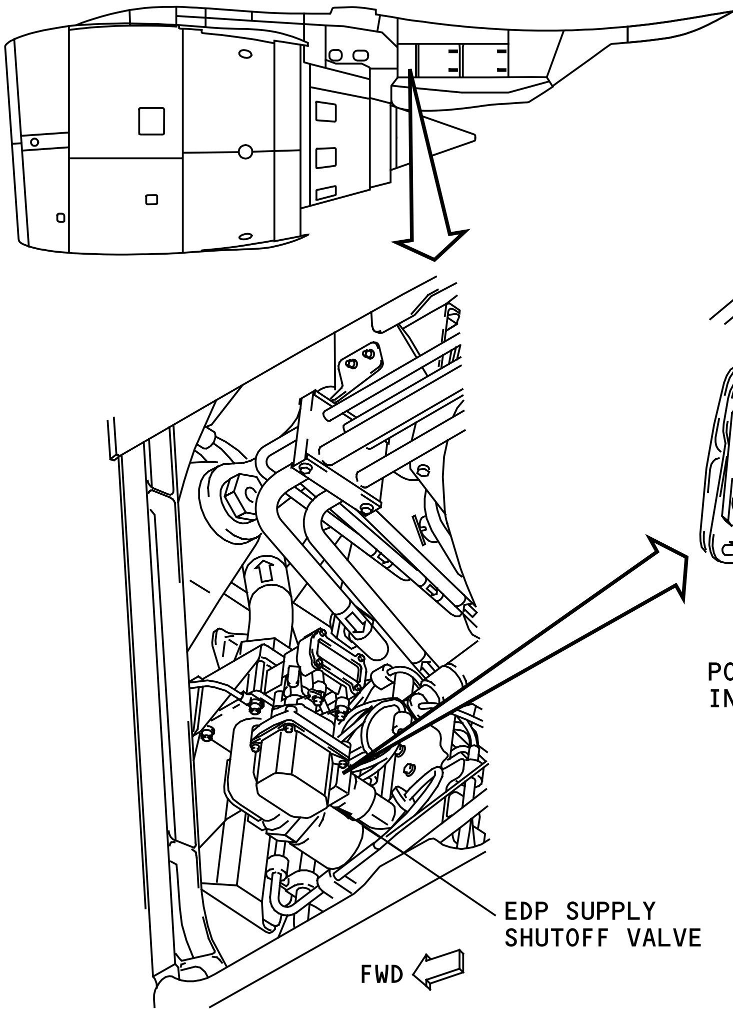
Location

There is a supply shutoff valve in the left side of each engine aft strut fairing near the hydraulic reservoir.

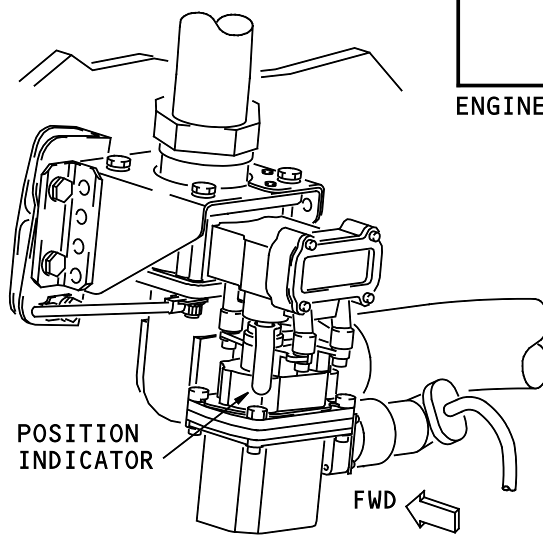
Training Information Point

Because the supply of hydraulic fluid to the pump stops when the fire switch is up, there is no pump case drain flow.

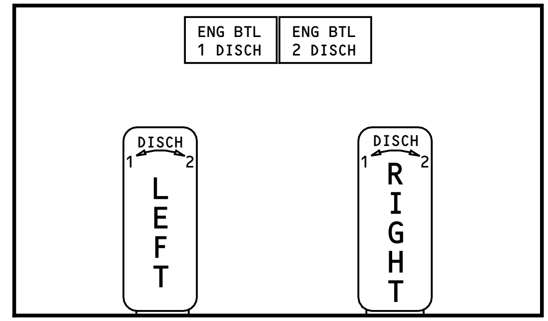
If the engine continues to turn (windmill) with the valve in the OFF position, the EDP may be damaged. You must do an inspection of the EDP filter module.



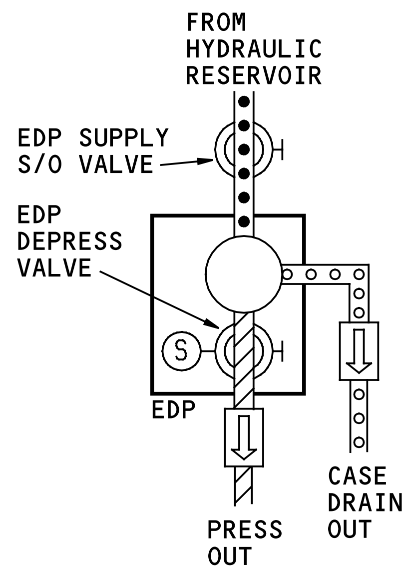
ENGINE AFT STRUT FAIRING



EDP SUPPLY SHUTOFF VALVE



ENGINE FIRE SWITCHES (P8)



29-10-00-009 Rev 6 10/21/96

MAIN HYDRAULIC SYSTEMS - ENGINE DRIVEN PUMP - SUPPLY SHUTOFF VALVE

MAIN HYDRAULIC SYSTEMS - ALTERNATING CURRENT MOTOR PUMP

Purpose

The ACMPs are the primary pumps in the center hydraulic system and the demand pumps in the left and right hydraulic systems.

Physical Description

The ACMP has an electric motor that mechanically connects to a hydraulic pump. The motor operates with three-phase, 400 Hz, 115/200v ac power. The pump is a nine piston variable-displacement hydraulic pump.

Case drain flow cools the electric motor and cools and lubricates the pump.

A ripple damper smooths the pump pressure output.

The ACMPs are rated at 6 gpm at 2850 psi.

All ACMPs are the same and weigh 27 pounds (12.3 Kg).

Location

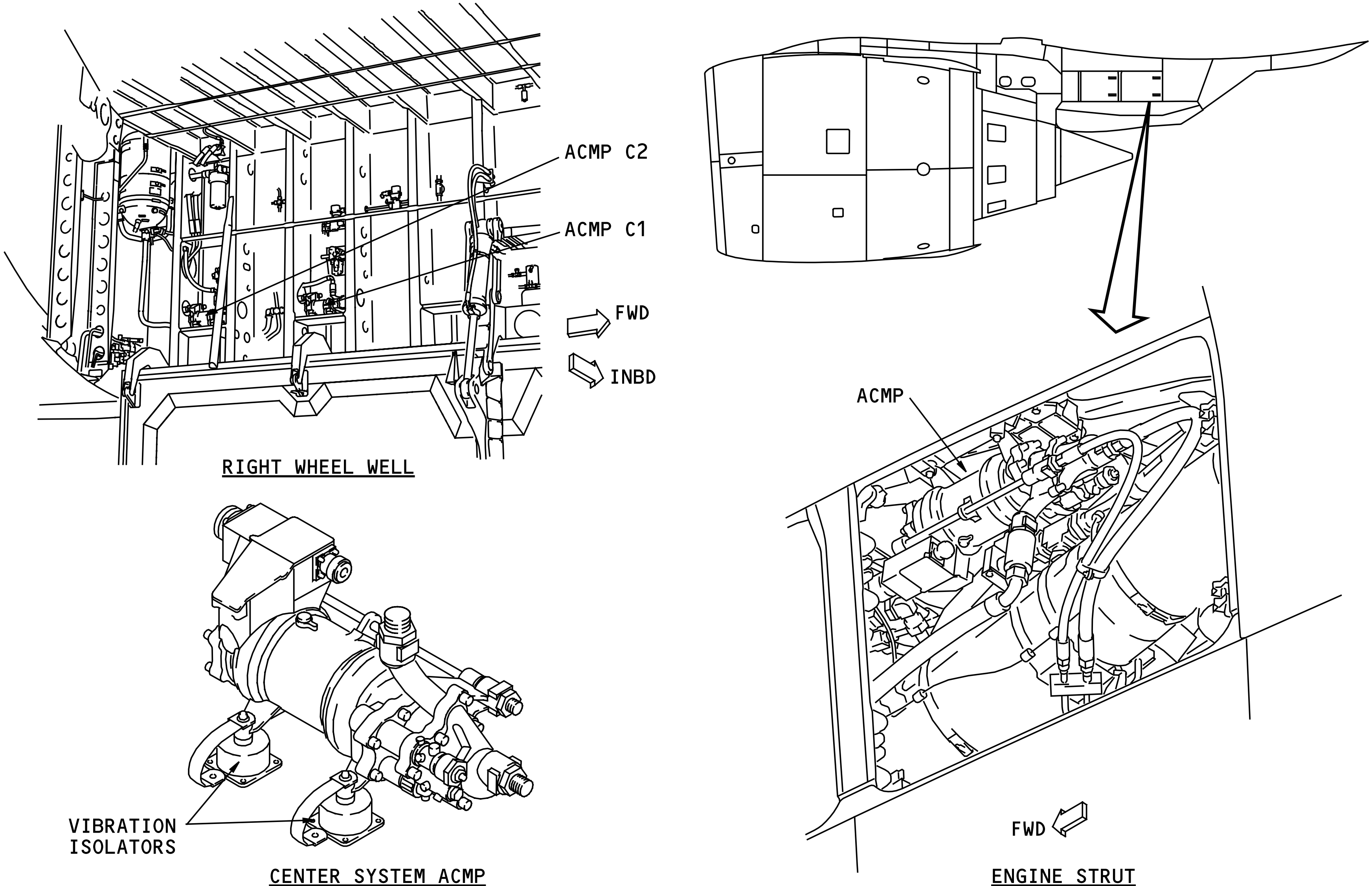
The ACMPs for the left and right hydraulic systems are in the engine struts aft of the reservoirs.

The center system ACMPs are on the keel beam in the right wheel well.

Training Information Point

The center system ACMPs attach to airplane structure through four vibration isolators.

The left and right ACMPs attach to a mounting bracket (not shown) before installation.



MAIN HYDRAULIC SYSTEMS - ALTERNATING CURRENT MOTOR PUMP

MAIN HYDRAULIC SYSTEMS - ADP ASSEMBLY - INTRODUCTION

Purpose

Two air driven pump (ADP) pumps are the demand pumps for the center hydraulic system.

General Description

Each ADP pump is part of an ADP assembly. The ADP assembly also has an air drive unit (ADU). The ADU contains these components:

- Turbine gearbox assembly (TGA)
- Modulating shutoff valve (MSOV)
- Air drive unit (ADU) heater.

A mount truss assembly attaches each ADP assembly to the airplane structure. The mount truss assembly for ADP assembly C1 is not the same as the one for ADP assembly C2.

The ADP assemblies use airplane pneumatic power to operate. An inlet duct supplies air pressure to each ADU. The MSOVs let air flow to the turbine of the TGAs. The gearbox of TGAs reduces the turbine speed and operates the pump. ADU heaters are on the ADUs to prevent ice formation. The pumps connect directly to the TGAs. The airflow from the TGAs exits the airplane through two exhaust ducts and two exhaust vents directly aft of the ADP assemblies.

The two TGAs have the same components. The turbine housing of ADP assembly C1 is different than the turbine housing for ADP assembly C2 to permit the exhaust ducts to be near each other.

Two ADP logic speed control units (LSCU), one for each ADP assembly, control the pump operation. The LSCUs supply speed control and overspeed protection to the TGAs. The LSCUs are circuit card assemblies and are LRUs.

A wiring harness for each ADP assembly connects the LSCU to the MSOV and the TGA.

The ADP pumps are the same as the engine driven pumps.

The ADP pump is rated at 53 gpm at 4315 rpm. A reserve mode permits the pump to supply 63 gpm at 5160 rpm. The pumps are LRUs.

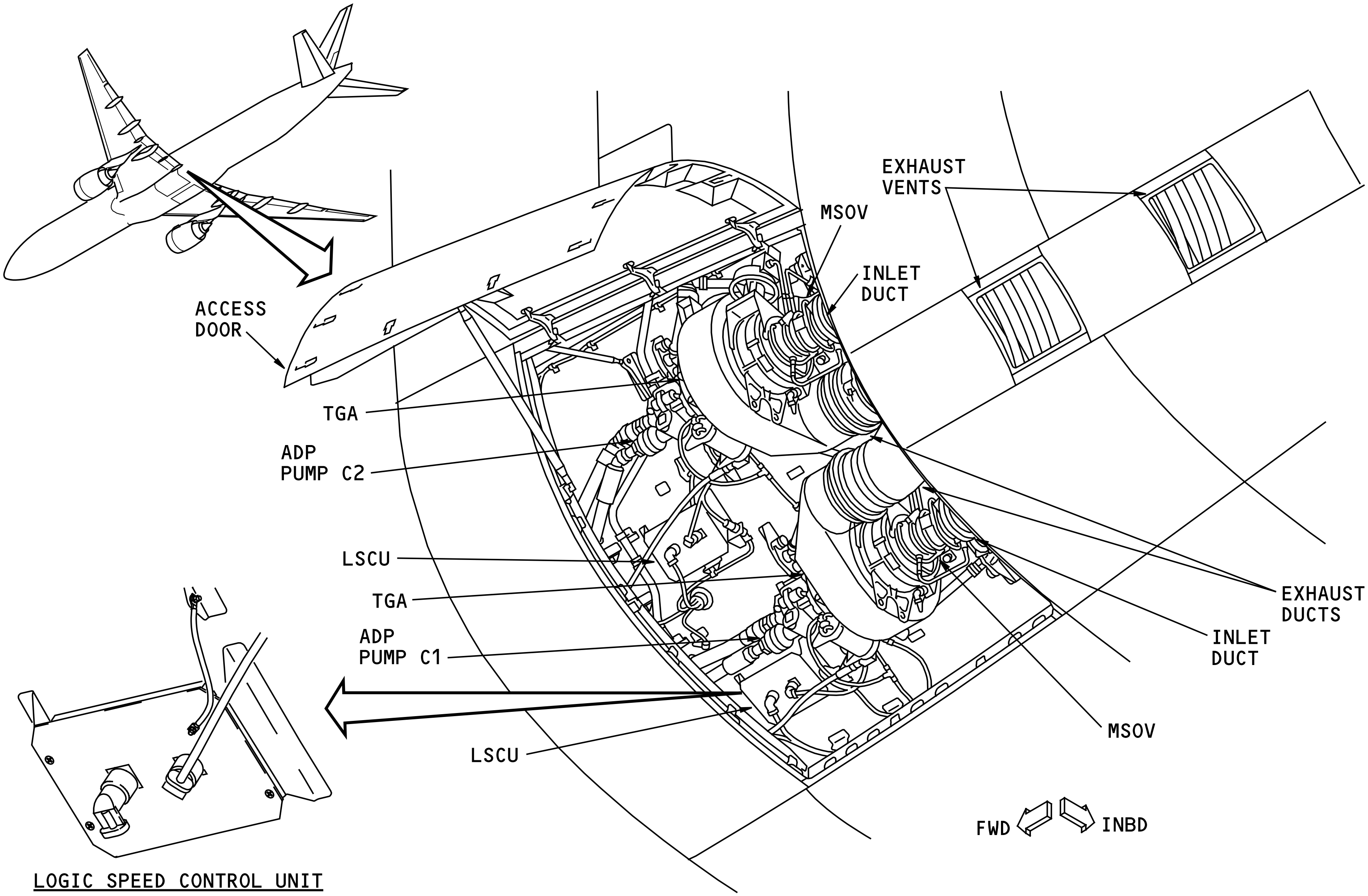
Location

The two ADP assemblies are in the left wing-to-body fairing behind the left wheel well. The LSCUs are also in this compartment.

Training Information Point

The EDPs and the ADP pumps are interchangeable. When the pump operates as an ADP pump, the depressurization solenoid does not operate.

CAUTION: MAKE SURE THE ADP ACCESS DOOR IS FULLY OPEN OR FULLY CLOSED WHEN OPERATING THE TRAILING EDGE FLAPS.



MAIN HYDRAULIC SYSTEMS - ADP ASSEMBLY - INTRODUCTION

MAIN HYDRAULIC SYSTEMS - ADP ASSEMBLY- AIR DRIVE UNIT

General

Each ADU has these components:

- Modulating shutoff valve (MSOV)
- Turbine gearbox assembly (TGA)
- ADU heater (not shown).

Modulating Shutoff Valve

The MSOV is a pneumatically-operated butterfly valve that controls airflow to the TGA. A pneumatic actuator moves the butterfly valve.

The MSOV normally operates as a two position valve, either full open or full closed. When the MSOV is open, it supplies the airflow to the turbine.

The MSOV pneumatic actuator modulates the butterfly valve position during secondary speed control.

A position indicator on the MSOV shows the position of the butterfly valve.

The MSOV attaches to the TGA with a V-band clamp. The MSOV also attaches with a V-band clamp to the inlet isolator. The inlet isolator decreases the vibration and noise from the ADP assembly. The inlet duct attaches to the inlet isolator with a V-band clamp.

Turbine Gearbox Assembly

Pneumatic power goes through the MSOV to the TGA.

The turbine in the TGA turns the gearbox. The gearbox has a planetary gearset to reduce turbine speed to operate the ADP pump.

A pneumatic actuator moves the variable inlet guide vanes (VIGVs) in the TGA assembly. The VIGVs open and close to control the airflow to the turbine. During primary speed control, the VIGVs control the turbine speed.

A position indicator shows the VIGV position.

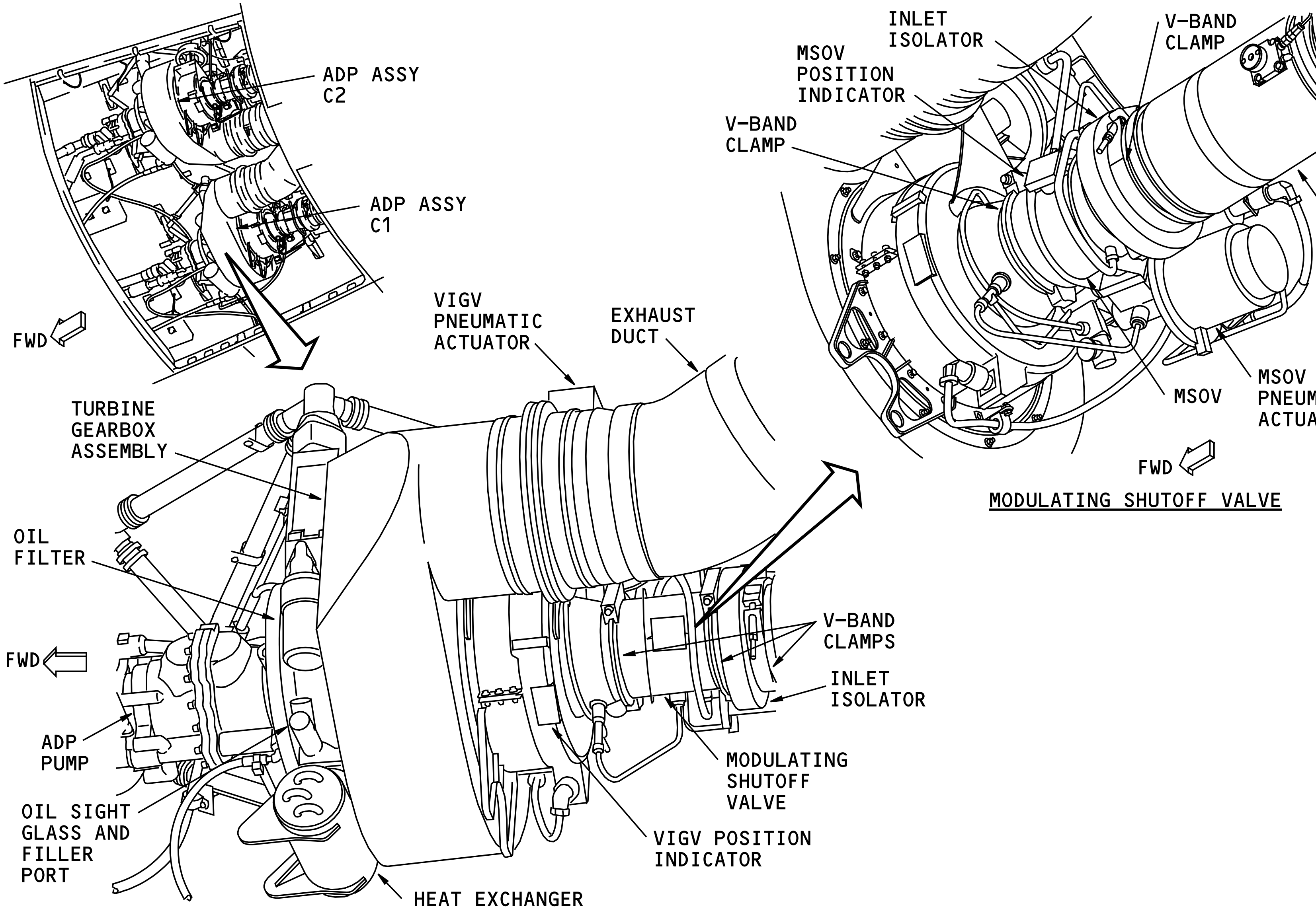
A TGA lubrication system cools and lubricates the TGA gears, bearings, and seals. An oil filter cleans the TGA oil. The oil filter has a differential pressure indicator to show the condition of the filter.

The heat exchanger on the TGA uses case drain fluid from the ADP pump to cool the TGA oil.

There is an oil sight glass and filler port on the front of the TGA.

ADU Heater

The ADU heater keeps the temperature of parts of the MSOV and the TGA higher than freezing. This prevents ADU ice formation. The ADU heater is on the ADU and is an LRU.



MAIN HYDRAULIC SYSTEMS - ADP ASSEMBLY- AIR DRIVE UNIT

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MAIN HYDRAULIC SYSTEMS - ADP ASSEMBLY - FUNCTIONAL DESCRIPTION

General

The ADP assembly gets pressurized air from the airplane pneumatic system.

Air flows through the modulating shutoff valve (MSOV) to the turbine gearbox assembly (TGA). The TGA turns the ADP hydraulic pump. The LSCU supplies primary speed control and overspeed protection.

The MSOV has these components:

- Butterfly valve
- Dual coil solenoid (auto and continuous run coils)
- Pneumatic actuator.

The TGA has these components:

- Variable inlet guide vanes (VIGVs)
- Unison ring
- Pneumatic actuator
- Electro-pneumatic servo-valve
- LVDT
- Turbine wheel
- Gearbox
- Monopole speed sensor (2)
- Pneumatic speed sensor
- Primary reserve solenoid
- Secondary speed control fluidic circuit.

Normal Operation

The signal to operate the ADP assembly comes from the HYDIM cards when the selector is in the AUTO position or from the ADP selector when the selector is in the ON position. These signals go to the LSCU.

The LSCU energizes either the auto run or continuous run coil in the MSOV. This permits air to go to the MSOV pneumatic actuator.

The actuator opens the butterfly valve and air goes through the open VIGVs to turn the turbine.

Speed Control

The ADP assembly has primary and secondary speed control circuits.

The LSCU contains the primary speed control. A monopole speed sensor on the gearbox sends ADP speed signals to the LSCU. The primary speed control circuits control the pneumatic actuator for the VIGVs. The actuator moves the VIGVs through the unison ring. This keeps the turbine within 2.5 percent of the normal operating speed. Normal turbine speed is approximately 32,000 RPM. Normal pump speed is 4315 RPM.

An LVDT supplies actuator position feedback to the LSCU.

The secondary speed control controls the position of the MSOV butterfly valve. The pneumatic speed sensor on the TGA sends a pulsed pneumatic signal in proportion to turbine speed. This signal goes to the secondary speed control fluidic circuit. This pneumatic circuit controls the MSOV pneumatic actuator.

The secondary speed control tries to keep the pump speed approximately 700 RPM higher than the primary speed control. When the system operates on the primary speed control, the secondary speed control gets an underspeed input and keeps the MSOV fully open.

If the primary speed control fails and the speed starts to increase, the MSOV starts to close to keep the pump speed at approximately 5000 RPM.

Reserve Mode

A reserve mode lets the turbine turn at a higher speed to operate the pump at 5160 RPM. This increases pump output for autoslat operation when only one ADP can operate. The HYDIM card commands reserve mode operation for 8 seconds.

For reserve mode operation, the LSCU resets the primary speed control circuit to operate the turbine at the higher RPM. The primary speed control uses the monopole speed sensor input to control the VIGVs. To operate at this higher speed, the secondary speed control must be stopped. The LSCU sends a signal to energize the solenoid in the primary reserve solenoid valve. The valve closes and blocks the pulsed pneumatic signal from the pneumatic speed sensor. Without a speed input, the secondary speed control fluidic circuit does not operate and the butterfly valve in the MSOV fully opens.

Overspeed Protection

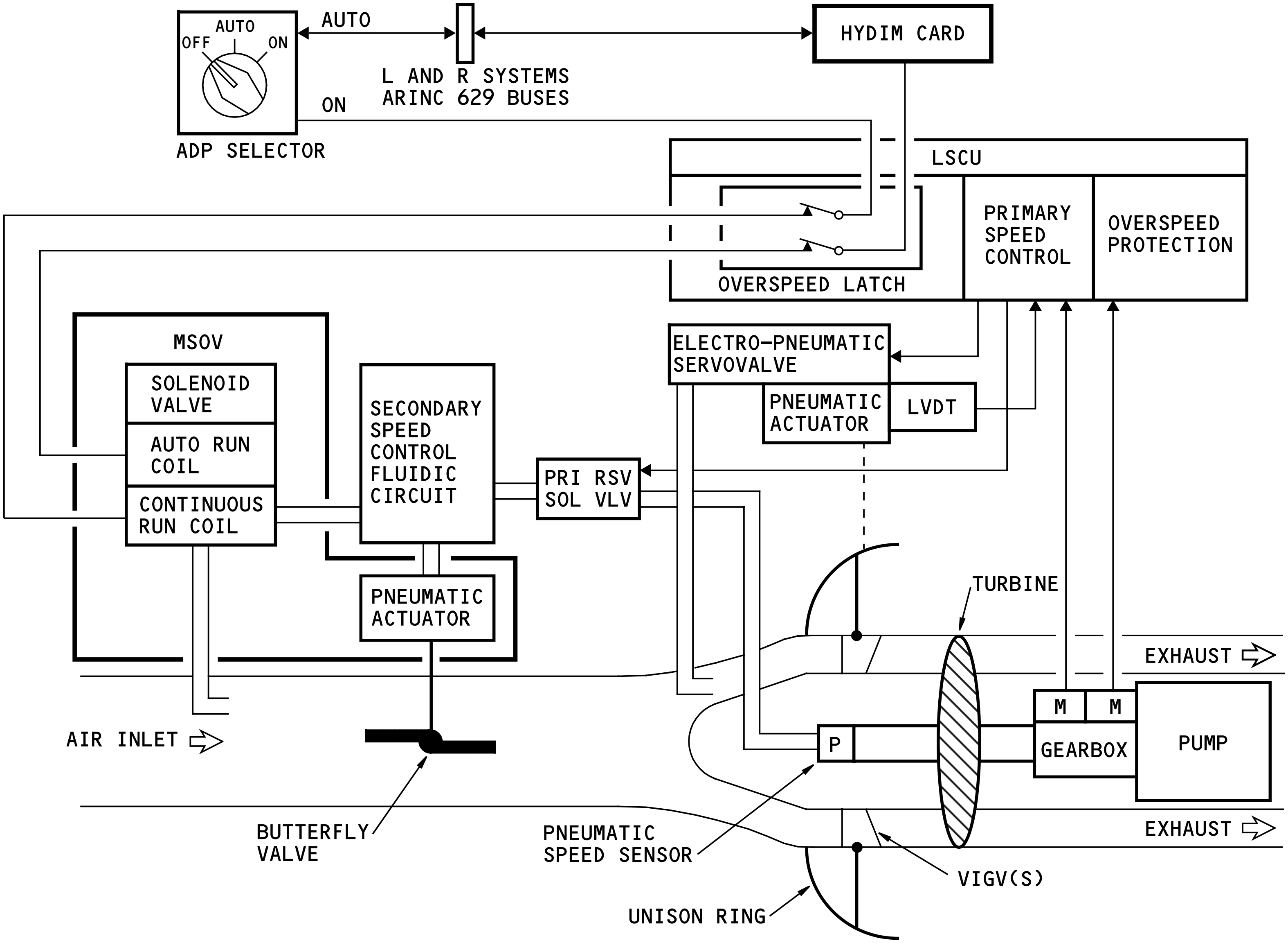
Overspeed protection keeps the ADP assembly from turning too fast.

A second monopole speed sensor on the gearbox supplies a speed signal to the LSCU. If the pump speed is more than 6590 RPM, the LSCU opens the control circuits through the overspeed latch. This removes the power from the solenoid in the MSOV and closes the butterfly valve.

Training Information Point

A containment ring protects the airplane from a turbine failure.

The overspeed shutdown system has a latching function that keeps the ADP off until it is reset by a MAT test.



MAIN HYDRAULIC SYSTEMS - ADP ASSEMBLY - FUNCTIONAL DESCRIPTION

29-10-00-013 Rev 4 10/18/96

MAIN HYDRAULIC SYSTEMS - ADU HEATERS

Purpose

The air drive unit (ADU) heaters keep the speed control components of the ADU warm to prevent icing. This increases the ADP reliability after being cold-soaked. The ADU is made of the turbine gearbox assembly (TGA) and the modulating shutoff valve (MSOV).

Physical Description

Each ADU has an electric heater assembly. Each heater assembly has four heater elements. The heater elements warm these parts of the ADU:

- MSOV pneumatic actuator
- VIGV electro-pneumatic servo valve
- Secondary speed control assembly
- MSOV solenoid.

The four heater elements are wired in series.

Location

You get access to the ADUs through the ADP access door. The ADU heaters are on the aft part of the ADP assemblies.

Indications

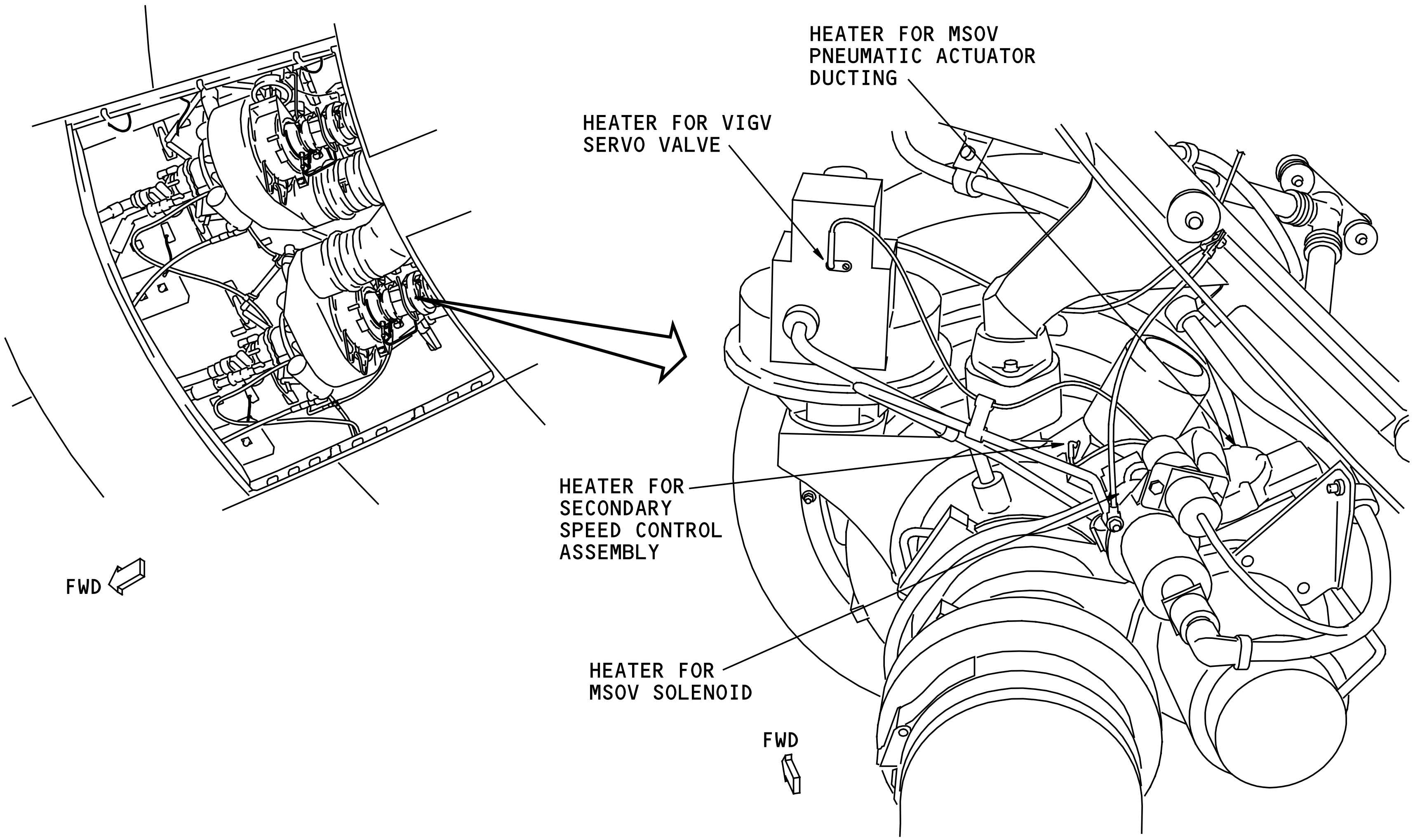
There is no indication that the ADU heaters are on.

The AIMS shows the status message HYD PUMP DEM C1 or HYD PUMP DEM C2 if there is a failure in an ADU heater element.

Training Information Point

Each ADU heater assembly is an LRU.

You can do a test of the two ADU heaters with the HEATERS operational test. You can also do a test of each of the heaters with the ADP C1 or ADP C2 operational tests.



ADP ASSEMBLY - LOOKING FORWARD

29-10-00-028 Rev 0

MAIN HYDRAULIC SYSTEMS - ADU HEATERS

MAIN HYDRAULIC SYSTEMS - ADU HEATERS - FUNCTIONAL DESCRIPTION

General

The air drive unit (ADU) heaters operate automatically to keep the temperature of the ADU speed control components higher than freezing. This prevents icing in the ADU.

The HYDIM CL card controls the heaters for both ADUs. The P210 right power management panel supplies the electrical power to operate the heaters.

Functional Description

The HYDIM CL card sends a signal to the ELMS to operate the ADU heaters for any of these conditions:

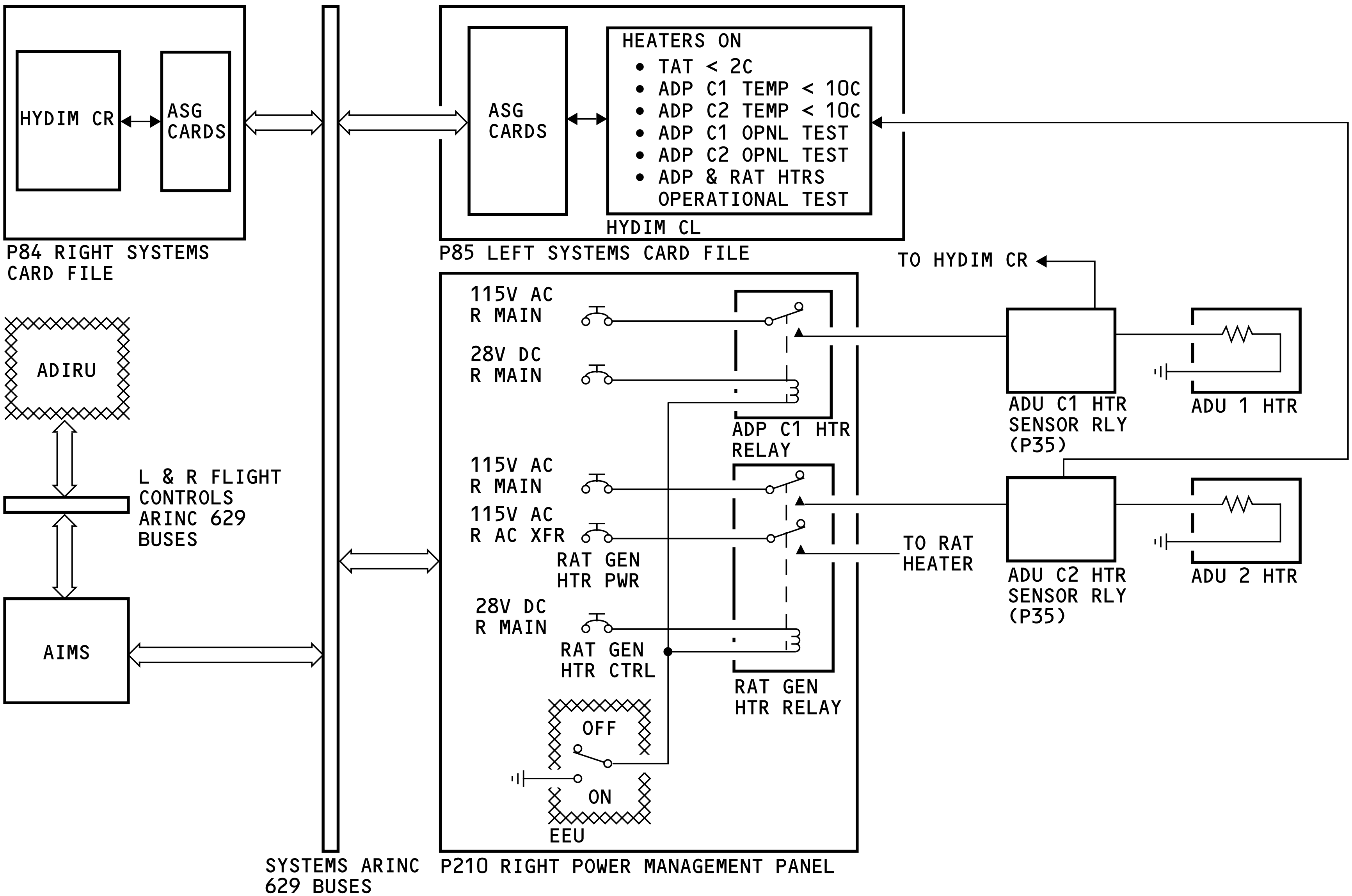
- Total air temperature is less than 2C (ADIRU input through the AIMS)
- ADP C1 case drain temperature is less than 10C
- ADP C2 case drain temperature is less than 10C
- ADP C1 operational test (MAT test)
- ADP C2 operational test (MAT test)
- Heaters operational test (MAT test).

The ON signal goes to the ELMS electronics unit (EEU) in the P210 right power management panel. The EEU energizes heater relays to supply power to the ADU heaters and also to the RAT heater.

The heaters go off 30 minutes after the total air temperature goes above 2C and both ADP case drain temperatures are more than 10C. The heaters also go off 5 seconds after a RAT deployment.

ADU heater sensor relays send the ADU heater on/off condition to the HYDIM cards. The HYDIM cards use this to monitor for correct heater operation.

The ADU heater elements connect in series. A failure of a single element causes the failure of all the elements in the assembly.



MAIN HYDRAULIC SYSTEMS – ADU HEATERS – FUNCTIONAL DESCRIPTION

29-10-00-027 Rev 3 08/07/96

MAIN HYDRAULIC SYSTEMS - AC MOTOR PUMP (ACMP) PRESSURE AND CASE DRAIN FILTER MODULE

Purpose

The ACMP pressure and case drain filter module removes particles from the hydraulic fluid after the fluid leaves the ACMP. Transducers on or near the filter module send pressure and temperature signals to the HYDIM cards.

Physical Description

Each of the four ACMPs has its own pressure and case drain filter module. All of these modules are interchangeable.

Each filter module has these components:

- Case drain filter
- Pressure filter
- Automatic filter bowl removal shutoff valve (not shown) (2)
- Differential pressure indicators (red pop-up indicator)(2)
- Check valves (2)
- Pressure transducer (center system filter modules)
- Temperature transducer.

Location

The filter module for the left hydraulic system is in the left aft engine strut fairing. The filter module for the right hydraulic system is in the right engine strut. You get access to these filter modules through the aft strut fairing doors on the right side of each engine strut.

The filter modules for the two center system ACMPs are in the right wheel well on the keelbeam.

Functional Description

Hydraulic pressure and case drain flow goes through the filters in the filter modules.

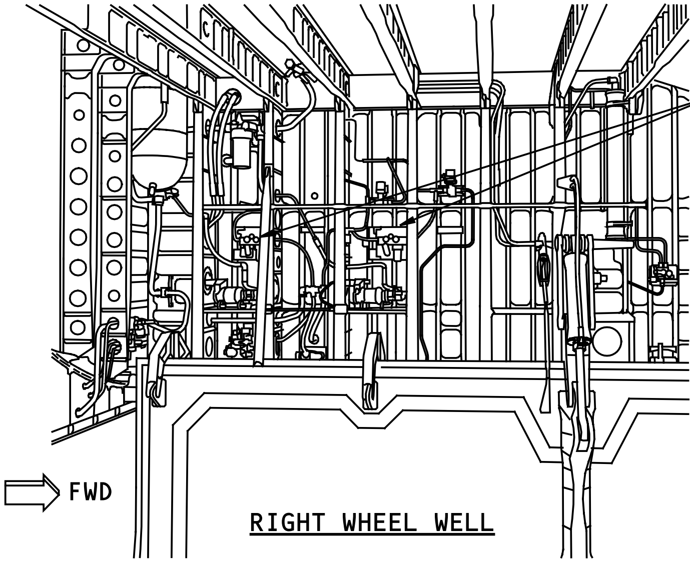
A temperature transducer in the case drain line sends temperature signals to the HYDIM cards. A pressure transducer in the pressure line sends pressure signals to the HYDIM cards.

Check valves prevent hydraulic backflow through the filter module.

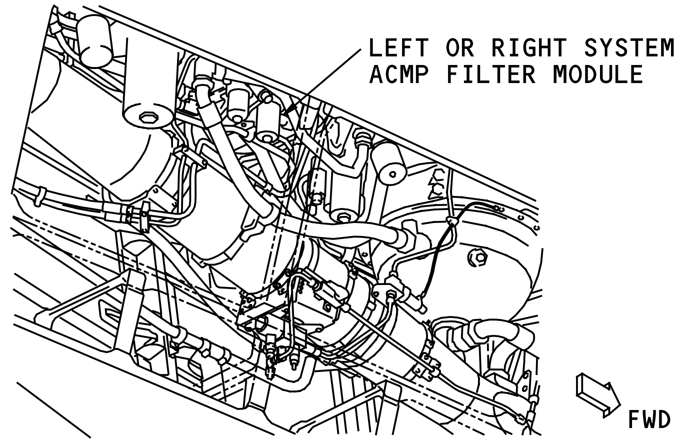
Training Information Point

You can not clean the filters and use them again.

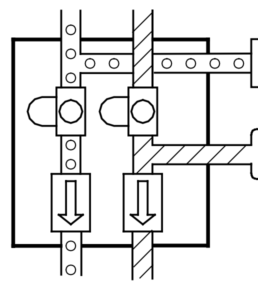
The red differential pressure indicator extends to show a clogged filter. Replace the filter and manually reset the indicator.

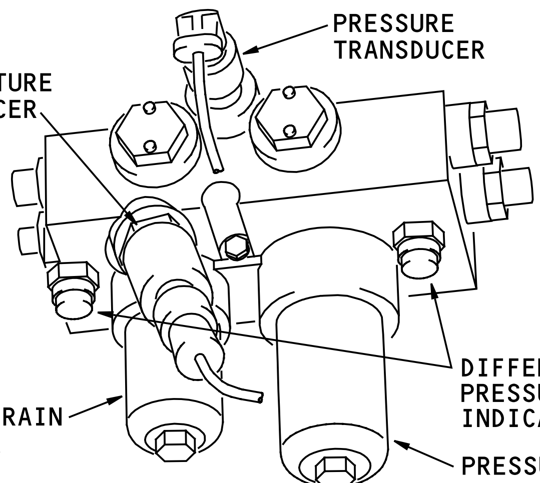


RIGHT WHEEL WELL

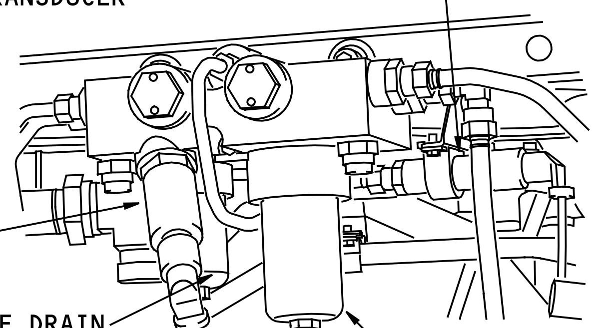


ENGINE STRUT





C SYSTEM ACMP FILTER MODULE



L OR R SYSTEM ACMP FILTER MODULE

MAIN HYDRAULIC SYSTEMS - AC MOTOR PUMP (ACMP) PRESSURE AND CASE DRAIN FILTER MODULE

29-10-00-014 Rev 3 08/03/95

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MAIN HYDRAULIC SYSTEMS - ADP AND EDP PRESSURE AND CASE DRAIN FILTER MODULES

Purpose

The pressure and case drain filter modules for the EDPs and the ADPs remove the particles from the hydraulic fluid after the fluid leaves the pumps. A pressure relief valve in the modules supplies system protection if pressure gets too high.

Transducers on the filter modules send pressure and temperature signals to the HYDIM cards.

Physical Description

The ADP filter module and the EDP filter module are interchangeable.

Each module has these components:

- Pressure filter
- Case drain filter
- Automatic filter bowl removal shutoff valve (2)
- Differential pressure indicator (red pop-up indicator) (2)
- Check valve (3)
- Pressure transducer
- Temperature transducer
- Relief valve.

The EDP filter modules and the filter module for ADP C2 also have a ground service disconnect.

Location

The filter module for the left system EDP is in the left engine aft strut fairing. The filter module for the right system EDP is in the right engine aft strut fairing.

You get access to these filter modules through the aft strut fairing doors on the left and right sides of each engine strut.

The ADP filter modules are in the left wing to body fairing forward of the ADPs. An access panel permits you to get access to the filter modules.

Functional Description

Hydraulic pressure and case drain flow go through the filters in the filter modules.

A temperature transducer in the case drain line sends temperature signals to the HYDIM cards. A pressure transducer in the pressure line sends pressure signals to the HYDIM cards.

The check valves prevent hydraulic backflow. The check valve in the pressure line also isolates the pressure transducer from system pressure.

The relief valve starts to open at 3400 psid to protect the system from over-pressure. Full flow occurs at 4100 psi. The relief valve sends the hydraulic fluid back to the reservoir through the system return lines.

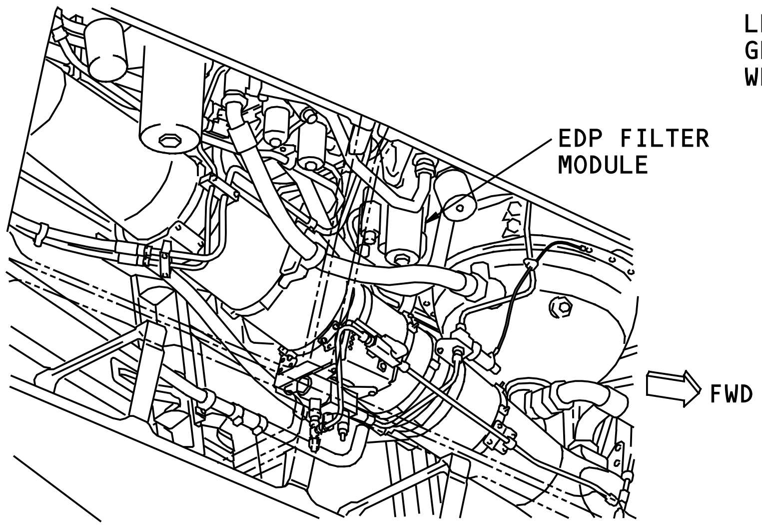
MAIN HYDRAULIC SYSTEMS - ADP AND EDP PRESSURE AND CASE DRAIN FILTER MODULES

Training Information Point

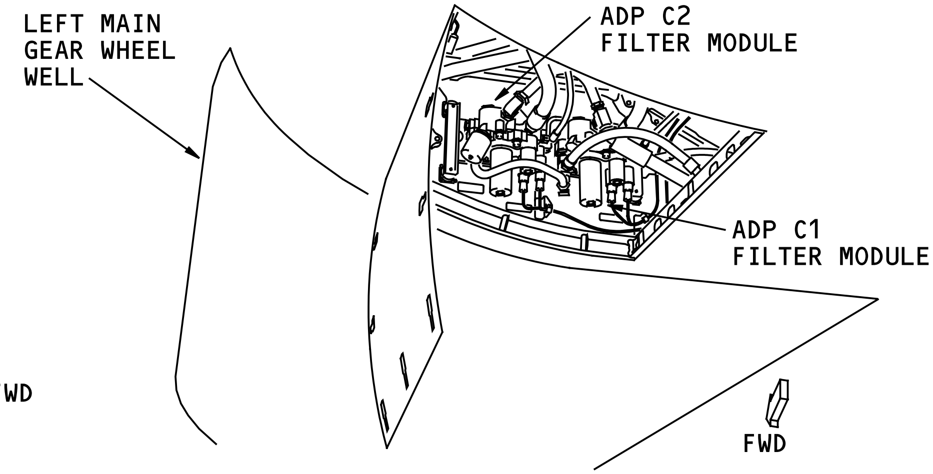
You can not clean the filters and use them again.

The red differential pressure indicator extends to show a clogged filter. Replace the filter and manually reset the indicator.

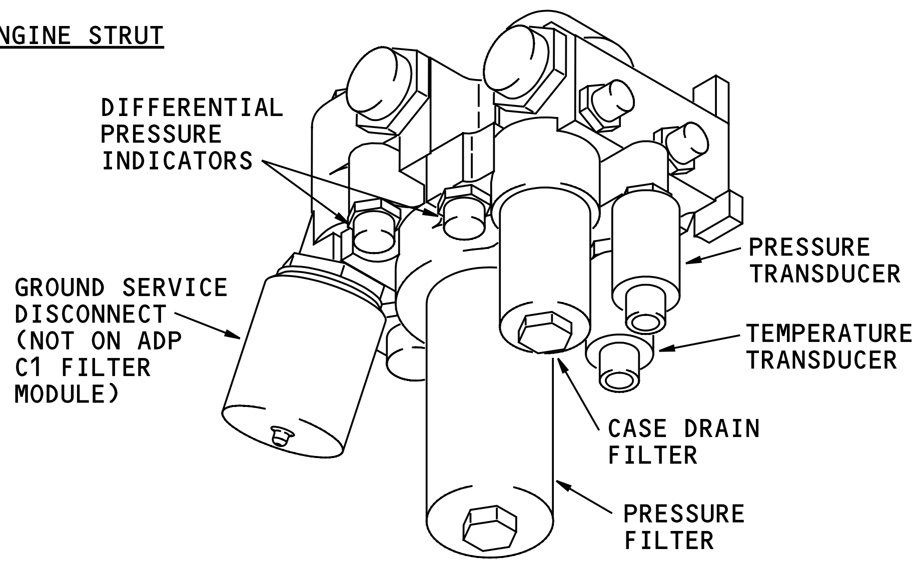
You can pressurize the hydraulic system with a ground pressure source through the ground service disconnect.



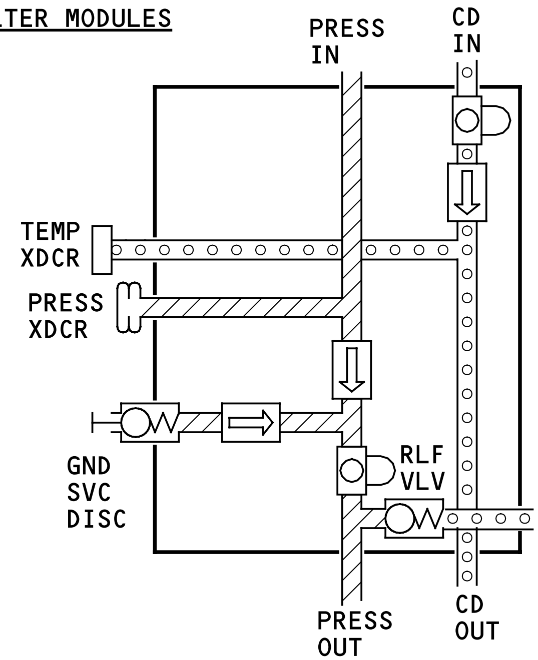
ENGINE STRUT



ADP FILTER MODULES



EDP/ADP PRESSURE AND CASE DRAIN FILTER MODULE



29-10-00-015 Rev 2

MAIN HYDRAULIC SYSTEMS - ADP AND EDP PRESSURE AND CASE DRAIN FILTER MODULES

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MAIN HYDRAULIC SYSTEMS - RETURN FILTER MODULES

Purpose

The return filter modules remove particles from the hydraulic fluid before the fluid returns to the reservoirs.

Physical Description

The left and right return filter modules are the same. The center return filter module is different than the left and right modules.

Each module has these components:

- Replaceable filter
- Automatic filter bowl removal shutoff valve
- Differential pressure indicator (red pop-up indicator)
- Check valve (2) (left and right modules only)
- Bypass relief valve with indicator
- Ground service disconnect (Left and right modules only).

Location

The return filter module for the left system is in the left engine aft strut fairing. The return filter module for the right system is in the right engine aft strut fairing. You get access to these filter modules through the aft strut fairing doors on the right side of each engine strut.

The center system return filter module is on the keelbeam in the right wheel well.

Functional Description

Return fluid from airplane hydraulic systems and the heat exchangers goes through the return filter modules before it goes into the hydraulic reservoirs again.

The left and right return filter modules have a negative pressure loop.

The negative pressure loop and the check valves permit backwards flow of fluid from the reservoir to the system without backflush of the filter.

The center hydraulic system has a negative pressure loop outside the return filter module.

Bypass relief valves open to permit continued hydraulic flow if the filter clogs. The relief valve starts to open at approximately 165 psid.

Training Information Point

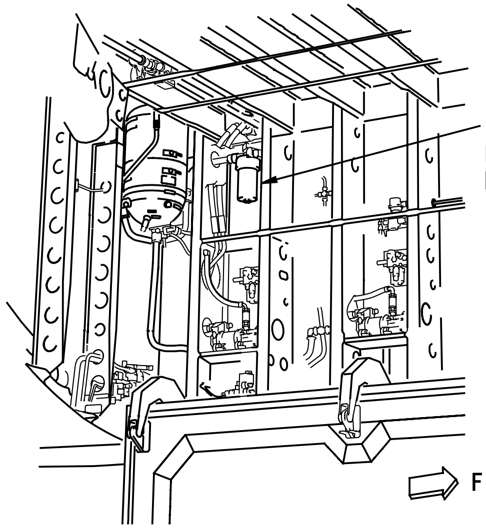
You can not clean the filters and use them again.

The red differential pressure indicator extends if the pressure difference across the filter is 48 - 62 psi. This shows a clogged filter. Replace the filter and manually reset the indicator.

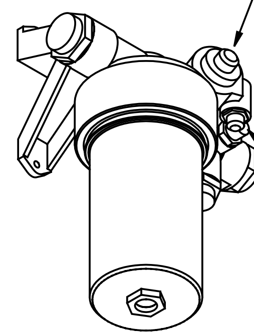
MAIN HYDRAULIC SYSTEMS - RETURN FILTER MODULES

A red indicator on the bypass relief valve extends to show the bypass valve is open.

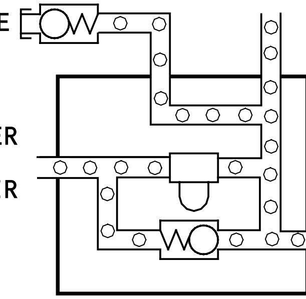
You use the ground service disconnect as the return port during ground hydraulic pressure cart operation. The center system ground service disconnect is not on the return filter module. A hydraulic tube connects the disconnect to the module.



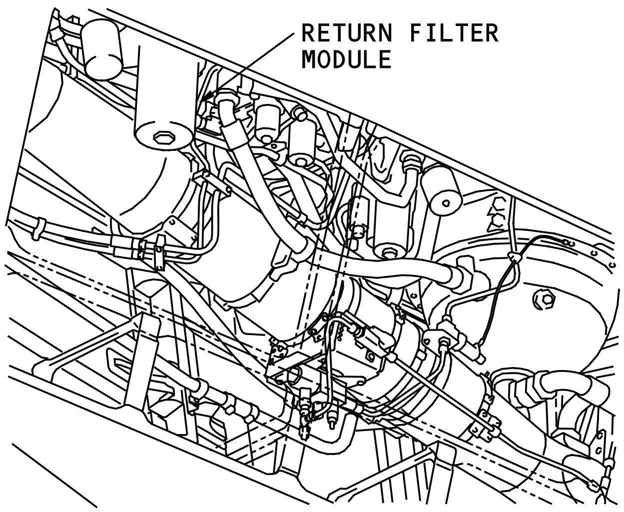
RIGHT MAIN GEAR WHEEL WELL



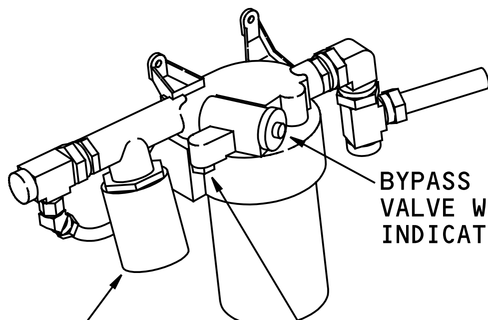
CENTER SYSTEM RETURN
FILTER MODULE



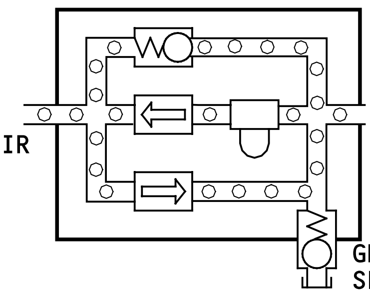
CENTER SYSTEM RETURN
FILTER MODULE



ENGINE STRUT



LEFT AND RIGHT SYSTEM
RETURN FILTER MODULE



LEFT AND RIGHT SYSTEM
RETURN FILTER MODULE

29-10-00-016 Rev 3 07/08/1996

MAIN HYDRAULIC SYSTEMS - RETURN FILTER MODULES

MAIN HYDRAULIC SYSTEMS - HEAT EXCHANGERS

Purpose

A heat exchanger in each hydraulic system cools the case drain hydraulic fluid from the EDPs and the ACMPs. This extends the service life of the fluid and the hydraulic pumps.

Physical Description

The heat exchangers use aluminum finned tubes to transfer heat from the fluid to the fuel. Fuel in the left and right main tanks cools the hydraulic fluid.

Location

The heat exchanger for the left hydraulic system is in the left main fuel tank between ribs 10 and 11.

The heat exchangers for the right hydraulic system is in the right main fuel tank between ribs 10 and 11.

The heat exchangers for the center hydraulic system is in the right main fuel tank between ribs 11 and 12.

Training Information Point

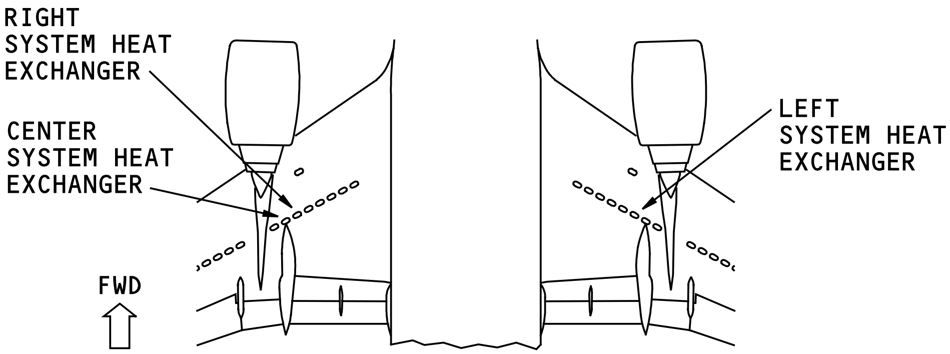
NOTE: The heat exchangers in the hydraulic system use the fuel to remove heat from the hydraulic system.

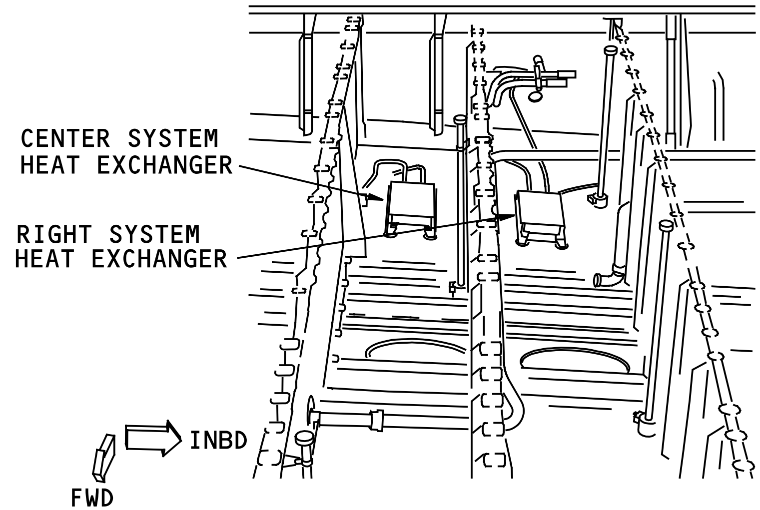
Approximately 709 gallons (2688 liters) (4794 pounds) (2175 kg) of fuel in the left and right main fuel tanks is necessary to cool the case drain flow from the left and right hydraulic systems.

Approximately 1080 gallons (4095 liters) (7303 pounds) (3313 kg) of fuel in the right main tank is necessary to cool the case drain flow from the center hydraulic system.

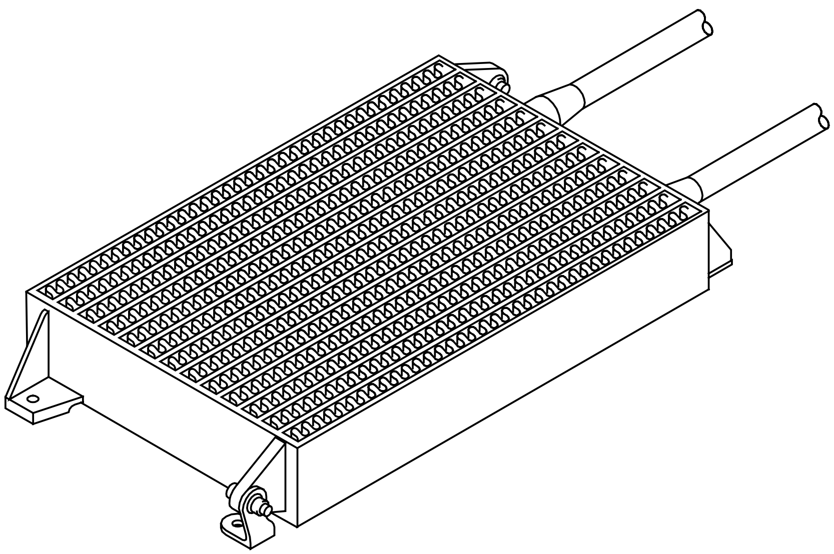
You can operate the hydraulic pumps if fuel goes below these levels if you obey the CAUTION below.

CAUTION: DO NOT OPERATE THE HYDRAULIC PUMPS AFTER THE HYDRAULIC TEMPERATURE INDICATION IS MORE THAN 100C (212F) OR AFTER THE PUMP FAULT LIGHT COMES ON. IF YOU CONTINUE TO OPERATE THE PUMPS, THE HYDRAULIC FLUID CAN BECOME TOO HOT.

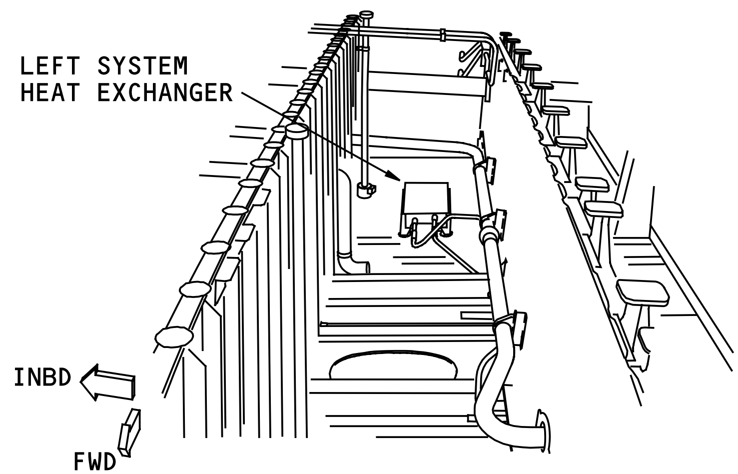




RIGHT MAIN FUEL TANK



HEAT EXCHANGER
(TYPICAL)



LEFT MAIN FUEL TANK

29-10-00-017 Rev 3

MAIN HYDRAULIC SYSTEMS - HEAT EXCHANGERS

MAIN HYDRAULIC SYSTEMS - RESERVE ISOLATION VALVE AND NOSE GEAR ISOLATION VALVE

General

The reserve isolation valve and the nose gear isolation valve supply engine burst protection to the center hydraulic system to prevent complete loss of center system fluid.

These valves permit a reserve brake and nose gear steering operation if there is a leak in the PFCS or MLG hydraulic lines. The valves also permit PFCS and MLG operation if there is a leak in the NLG or LE slat hydraulic lines.

The reserve isolation valve and the nose gear isolation valve are part of the center hydraulic isolation system (CHIS).

The reserve isolation valve isolates brakes and steering from the center hydraulic system.

The nose gear isolation valve controls ACMP C1 output to nose gear steering.

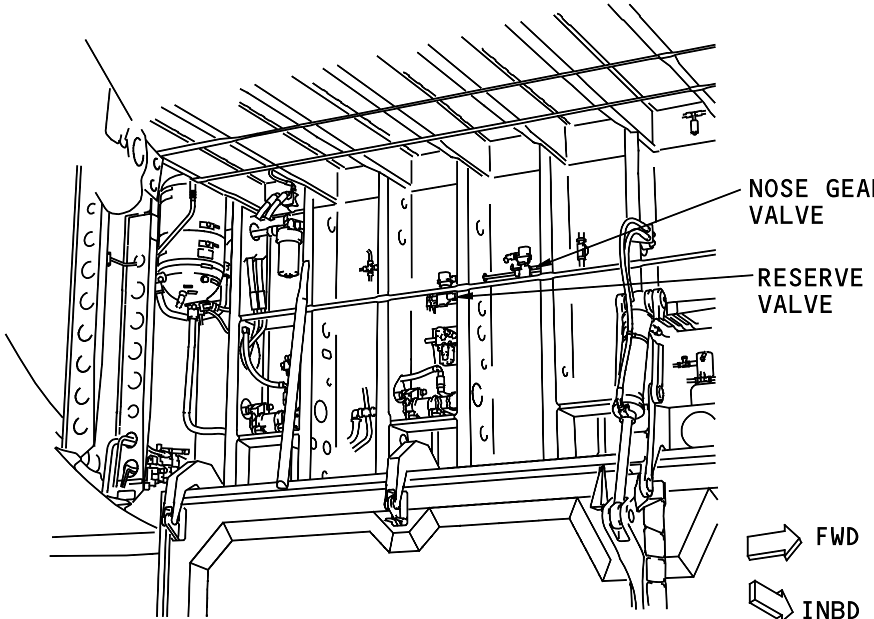
Physical Description

The reserve isolation valve and nose gear isolation valves are the same.

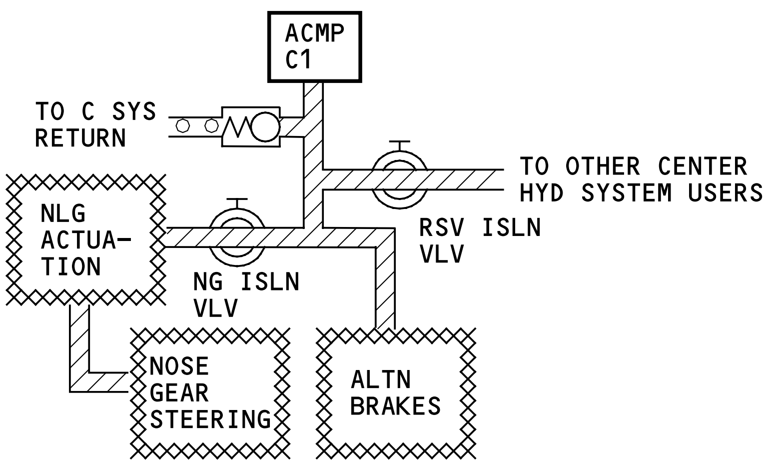
They are 28v dc motor-powered, two-position valves. They each have a position indication lever which permits you to manually operate the valve.

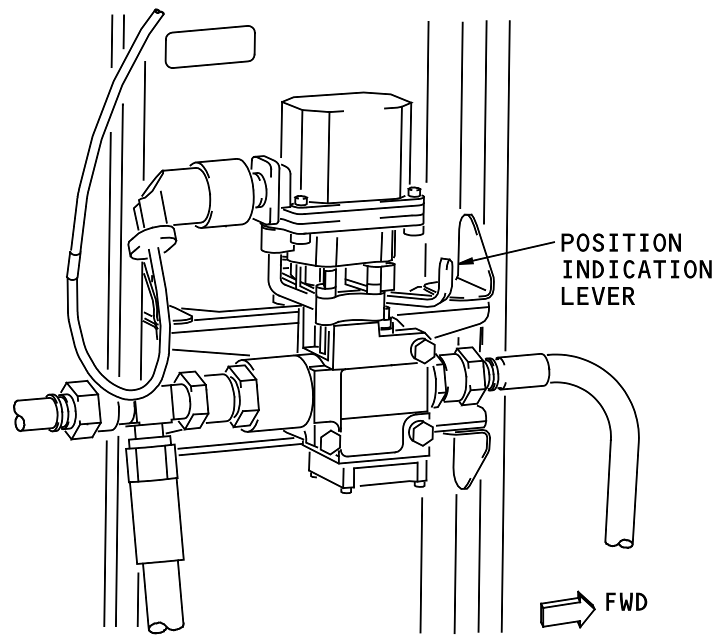
Location

Both valves are in the right wheel well on the keelbeam.



RIGHT MAIN GEAR WHEEL WELL





ISOLATION VALVE (TYPICAL)

29-10-00-018 Rev 1

MAIN HYDRAULIC SYSTEMS - RESERVE ISOLATION VALVE AND NOSE GEAR ISOLATION VALVE

MAIN HYDRAULIC SYSTEMS - CENTER SYSTEM RETURN MANIFOLD AND PRESSURE RELIEF VALVE

Return Manifold

The center system return manifold collects the return hydraulic flows from center hydraulic system components.

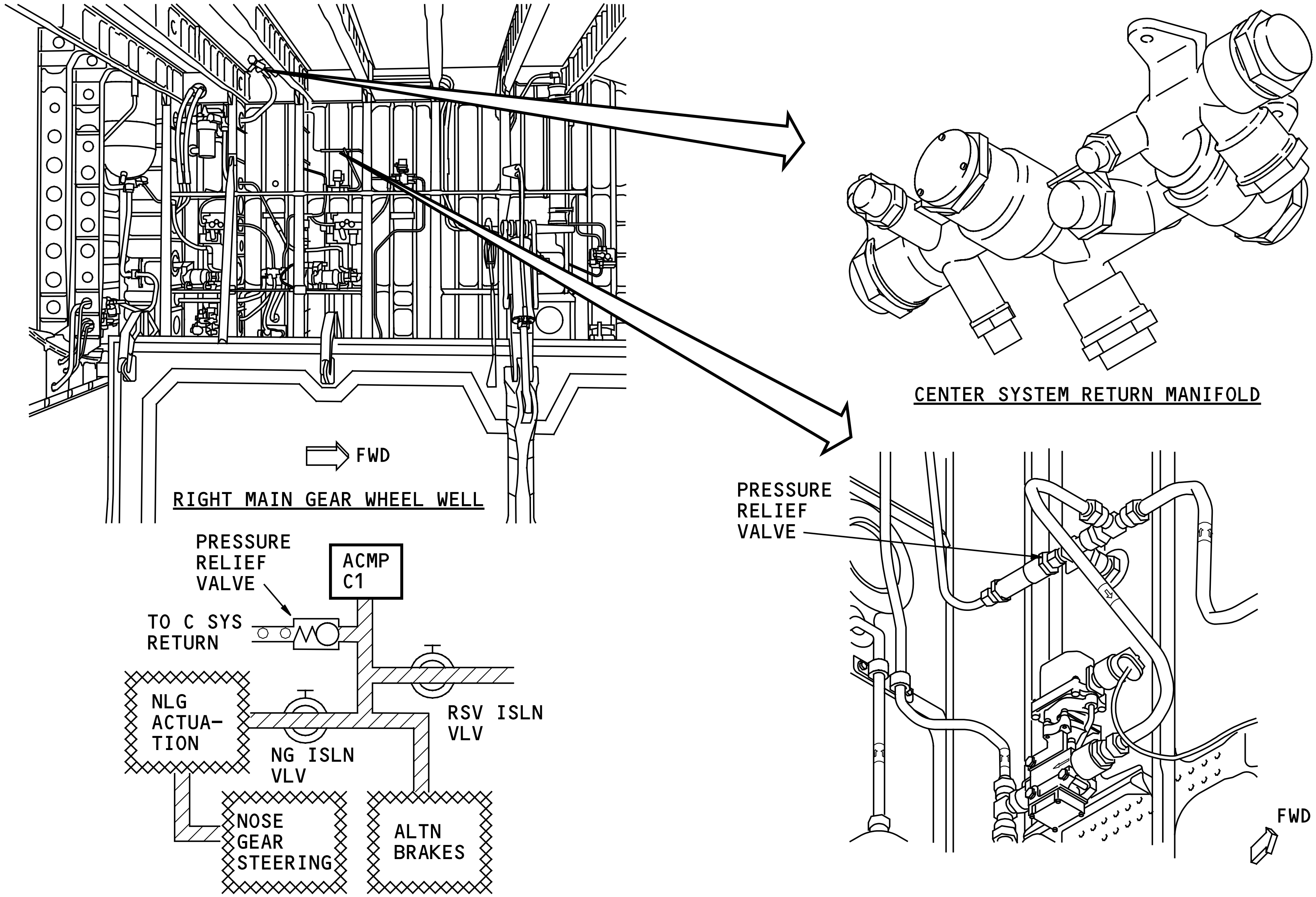
The manifold is on the ceiling in the right wheel well near the keelbeam.

Pressure Relief Valve

A center system pressure relief valve supplies overpressure protection to the part of the center system that may be isolated by the CHIS.

The relief valve is on the keelbeam in the right wheel well.

The relief valve starts to open at a pressure of 3700 - 3900 psid.



MAIN HYDRAULIC SYSTEMS - CENTER SYSTEM RETURN MANIFOLD AND PRESSURE RELIEF VALVE

MAIN HYDRAULIC SYSTEMS - HYDRAULIC ACCUMULATORS

Purpose

Four hydraulic accumulators absorb pressure changes caused by tail flight control PCU operation. This increases the life of the hydraulic system components.

Physical Description

The right and center hydraulic systems each have a single hydraulic accumulator in the pressure lines to the tail flight controls. The left hydraulic system uses two accumulators that connect in the tail flight control pressure lines. All accumulators are the same and have a volume of 50 cubic inches.

The accumulators have a hydraulic fluid side and a gas side. A fluid port connects the fluid side to the hydraulic line. You service the gas side of the accumulator with nitrogen.

Location

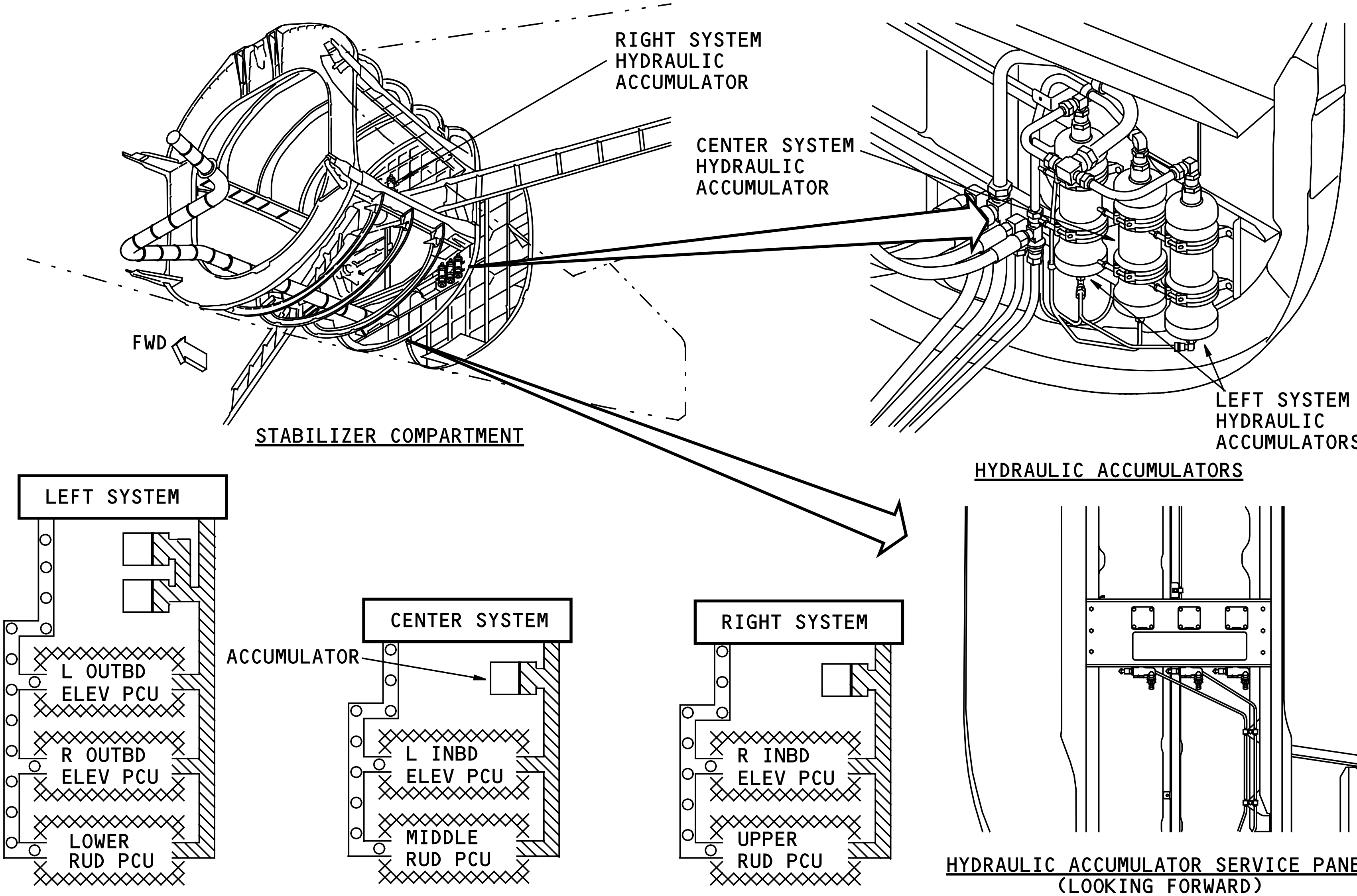
The hydraulic accumulators are on the forward side of the aft bulkhead of the stabilizer compartment. The hydraulic accumulator service panel is on the aft side of the stabilizer compartment aft bulkhead.

Training Information Point

You get access to the hydraulic accumulator service panel through the controls bay access door which is immediately forward of the APU compartment. A decal on the service panel shows servicing instructions.

WARNING: YOU MUST PREVENT ALL POSSIBLE OPERATION OF THE HORIZONTAL STABILIZER WHEN YOU WORK ON OR NEAR IT. THE HORIZONTAL STABILIZER MOVES QUICKLY AND WITH FORCE. IF THE STABILIZER MOVES WHEN PERSONS ARE IN THE TORSION BOX COMPARTMENT OR NEAR THE STABILIZER, IT CAN CAUSE INJURY TO THEM.

WARNING: DO NOT ENTER THE COMPARTMENT WITHOUT FORCED AIR VENTILATION WHEN YOU SERVICE THE HYDRAULIC ACCUMULATORS. DO NOT RELEASE NITROGEN INTO THE COMPARTMENT WHEN SERVICING THE ACCUMULATORS. NITROGEN WILL DISPLACE AIR AND REDUCE THE OXYGEN LEVEL IN THE COMPARTMENT. LACK OF OXYGEN CAN RESULT IN UNCONSCIOUSNESS OR DEATH. A SECOND MECHANIC WHO CAN OBSERVE THE WORK MUST BE LOCATED OUTSIDE THE COMPARTMENT WHEN NITROGEN IS BEING SERVICED IN A CLOSED COMPARTMENT.



29-10-00-026 Rev 2 03/07/96

MAIN HYDRAULIC SYSTEMS - HYDRAULIC ACCUMULATORS

MAIN HYDRAULIC SYSTEMS - FUNCTIONAL DESCRIPTION - ENGINE DRIVEN PUMP

General

The EDPs operate when the related engine turns.

The EDPs can be depressurized by the EDP switch or by the engine fire switch.

HYDIM L monitors the operation of the left EDP. HYDIM R monitors the operation of the right EDP.

EDP Switch Operation

When the EDP switch is in the ON position, the depressurization solenoid valve is not energized. This permits the pressure output of the EDP to go to the hydraulic system.

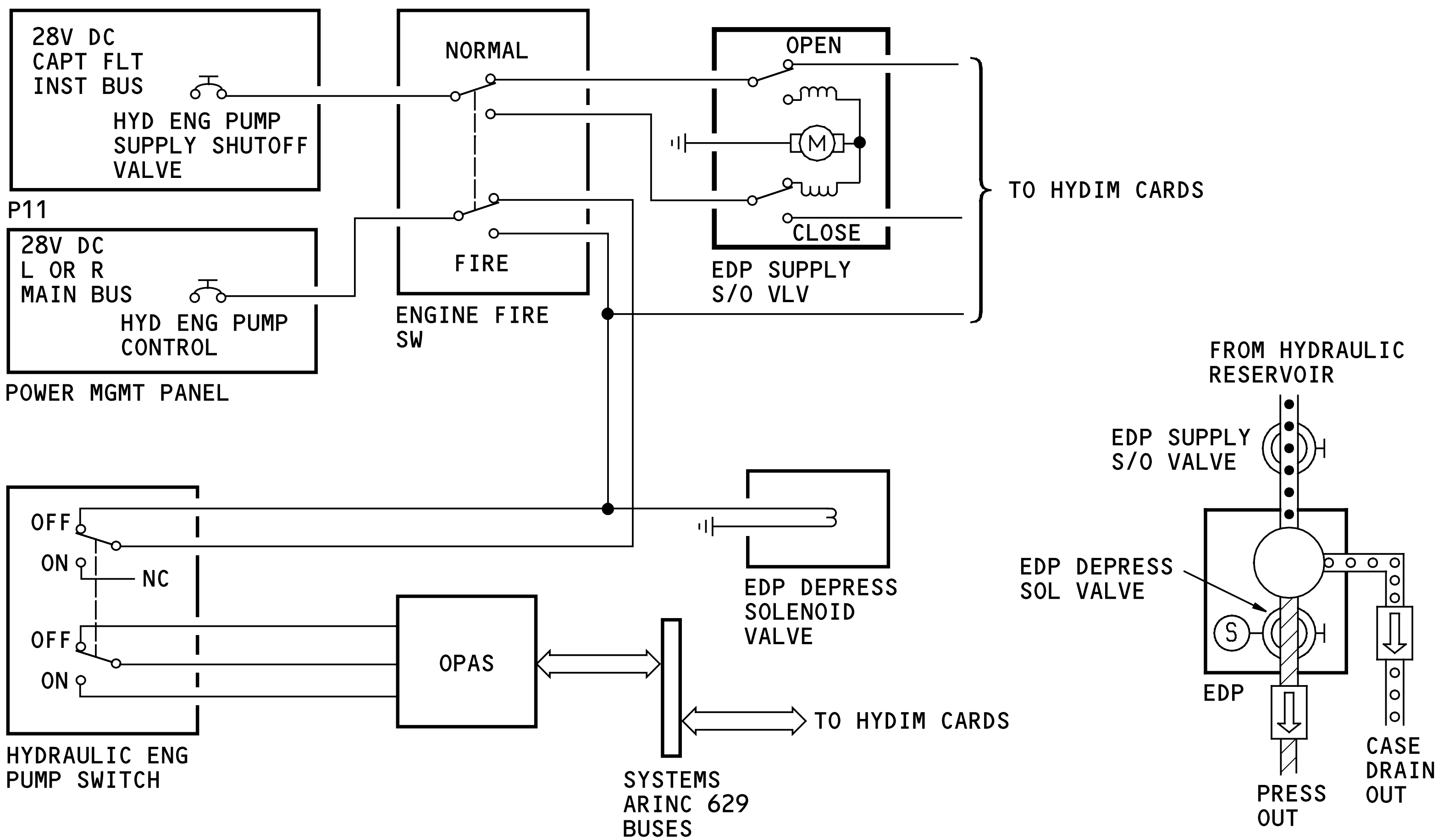
When the EDP switch is in the OFF position, power from the left 28v dc main bus (left engine) or the right 28v dc main bus (right engine) goes to EDP solenoid valve. This closes the valve to stop the pump output and depressurize the pump.

The case drain flow continues when the switch is in the OFF position.

Supply Shutoff Valve Operation

When you pull the engine fire switch, the supply shutoff valve moves to the CLOSED position. This stops the supply of hydraulic fluid to the EDP. The engine fire switch also energizes the depressurization solenoid valve to remove pressure from the EDP. There is no case drain flow in this condition.

The supply shutoff valve moves to the OPEN position when you move the engine fire switch to the stowed position.



29-10-00-020 Rev 0

MAIN HYDRAULIC SYSTEMS - FUNCTIONAL DESCRIPTION - ENGINE DRIVEN PUMP

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MAIN HYDRAULIC SYSTEMS - FUNCTIONAL DESCRIPTION - AIR DRIVEN PUMP

General

The pneumatic system supplies the pressurized air to operate the air driven pumps.

The ADP selectors are on the hydraulic/RAT panel.

The ADP selectors send pump control signals to the overhead panel ARINC 629 system (OPAS). The OPAS sends these control signals through the systems ARINC 629 buses to the HYDIM cards. The HYDIM cards use these signals to operate the pumps in the demand mode. HYDIM CR controls ADP C1 in the demand mode. HYDIM CL controls ADP C2 in the demand mode. The control circuits on each card are equivalent.

The HYDIM cards do not control the ADPs in the continuous run (ON) mode. The ADP selectors send electrical signals directly to the LSCU to operate the pump in the continuous run mode.

An LSCU for each ADP gets the input signals to open the MSOV to permit the ADP to operate.

Demand Mode

With the two ADP selectors in AUTO, the HYDIM cards start one or both of the ADPs when the center hydraulic system must supply a large hydraulic flow rate.

The HYDIM cards get the ADP selector input signal from the ARINC 629 systems buses. The HYDIM cards must also get a hardwire electrical signal from the AUTO position of the ADP selector.

The HYDIM cards prevent or stop demand mode ADP operation during main engine start on the ground.

One ADP operates during any of these conditions:

- Landing gear extension
- Flap/slat operation
- Low pressure (less than 2400 psi) in the center system or in both center system ACMPs
- Touchdown (airspeed more than 80 kts and altitude less than 30 feet)
- Air mode, flaps and slats not up, and one ADP selected OFF or does not operate (in case of autoslat demand)
- Failure of the ADU heaters on both ADPs and groundspeed is more than 80 knots (turns on ADP C1).

When an ADP turns on for low pressure, the pump turns off 15 seconds after the pressure goes above 2700 psi.

The ADP turns on during the touchdown conditions to supply pressure to operate the auto speedbrakes. The pump turns off 5 seconds after the speedbrake lever moves to the stowed position.

The HYDIM cards CL and CR make a selection of one of the two ADPs during single pump operation. They use the other ADP the next time they turn on a single pump. This equalizes the pump wear.

MAIN HYDRAULIC SYSTEMS - FUNCTIONAL DESCRIPTION - AIR DRIVEN PUMP

Both ADPs operate for these conditions:

- Autoslat operation
- Landing gear retraction
- Takeoff roll (ground mode, airspeed is more than 80 kts, and the flaps are in the takeoff position).

Both ADPs turn on during the takeoff roll to make sure that at least one of them operates if there is an engine loss. This makes sure that there is sufficient hydraulic flow to operate the rudder for the thrust asymmetry compensation function. The ADPs turn off 10 seconds after the airplane takes off.

Reserve Mode

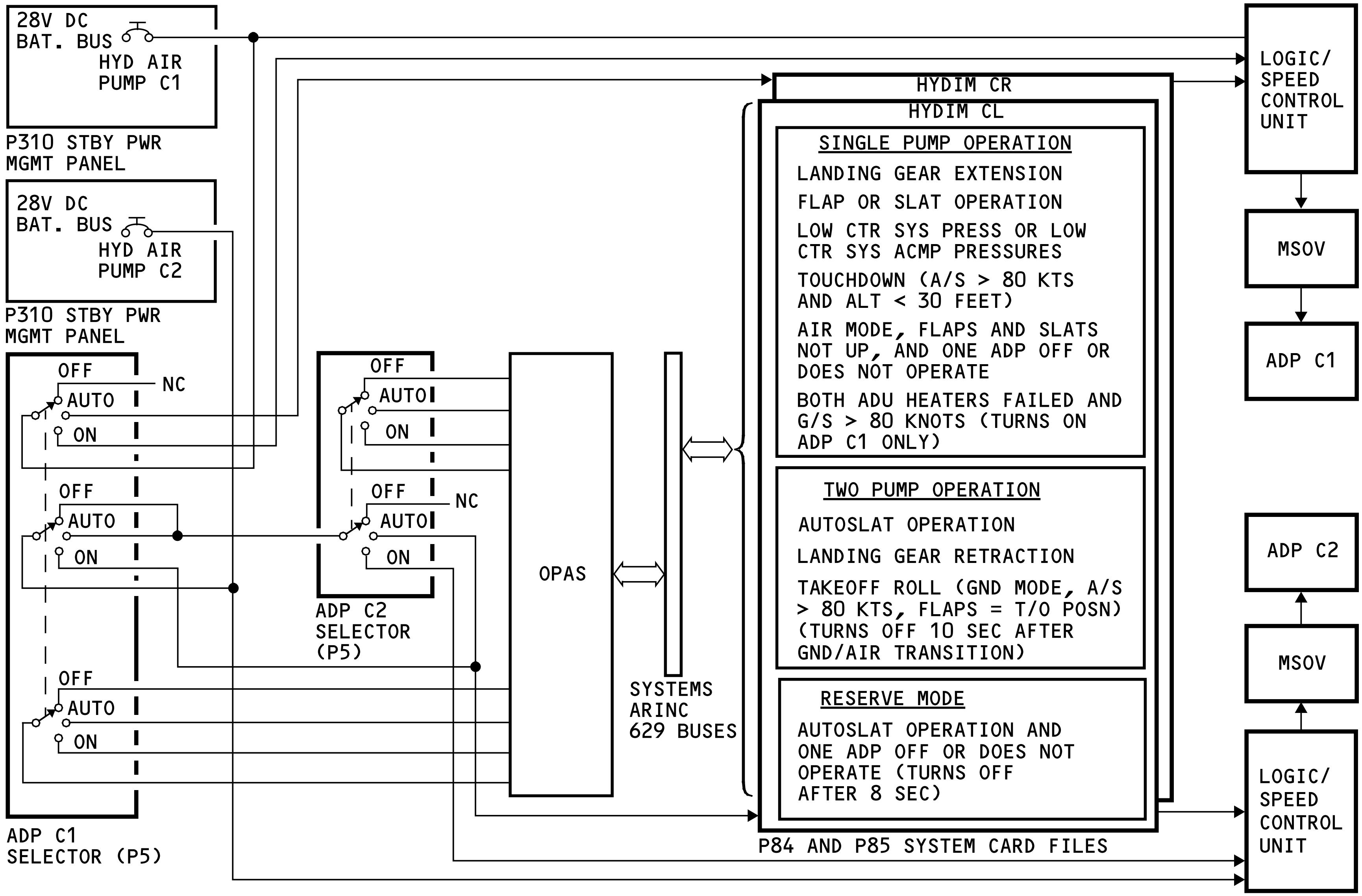
If one of the two ADPs does not operate and there is an autoslat signal, the HYDIM cards will operate the remaining ADP in the reserve mode. This permits the ADP to operate at a higher speed to make sure sufficient hydraulic flow goes to the leading edge slats. The reserve mode turns off after 8 seconds. The reserve mode operates when the selector is in AUTO or ON.

Continuous Operation

An ADP selector in the ON position sends a signal directly to the related LSCU. The LSCU then opens the MSOV to operate the ADP continuously.

Training Information Point

The ADP C1 selector must be in the OFF or AUTO position for ADP C2 to run continuously. If both ADP selectors are in the ON positions, only ADP C1 will operate.



MAIN HYDRAULIC SYSTEMS - FUNCTIONAL DESCRIPTION - AIR DRIVEN PUMP

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MAIN HYDRAULIC SYSTEMS - FUNCTIONAL DESCRIPTION - ALTERNATING CURRENT MOTOR PUMP

General

The control switches and selectors on the hydraulic control panel send pump control signals to the overhead panel ARINC 629 system (OPAS). The OPAS sends these control signals through the left and right systems ARINC 629 buses to the ELMS.

The ELMS contains the logic and electrical relays that controls the ACMPs.

Power management panels and the power panels in the ELMS control electrical power to the ACMPs.

The wiring between the power management panels and the power panels goes through the control switches and selectors. This makes sure that pumps cannot operate when their switch or selector is in the OFF position.

Primary Pump Operation

Signals from the primary pump switches for the center system ACMPs go directly to the ELMS. The HYDIM cards do not control primary pump operation.

Demand Pump Operation

Signals from the demand pump selectors for the left and right system ACMPs go to the HYDIM cards and to the ELMS.

When a demand pump selector is in the ON position, the signal goes directly to the ELMS.

When a demand pump selector is in the AUTO position, HYDIM cards control the pump operation signal to the ELMS.

When the left demand pump switch is in AUTO, the left HYDIM card turns on the left ACMP for any of these conditions:

- Left engine not running
- Touchdown - CAS is more than 60 kts and altitude is less than 30 feet (to prepare for auto speedbrake operation)
- Left EDP pressure less than 2400 psi (pump turns off 15 seconds after EDP pressure is more than 2800 psi).

When the right demand pump switch is in AUTO, the right HYDIM card turns on the right ACMP for any of these conditions:

- Right engine not running
- Altitude is less than 30 feet (prepares for wheel brake and auto speedbrake operation)
- Right EDP pressure less than 2400 psi (pump turns off 15 seconds after EDP pressure is more than 2800 psi).

ELMS Operation

The ELMS electronics unit (EEU) in the power management panel gets the pump control signal from the pump switches or HYDIM cards. The electronics unit then sends a signal to the electrical load control unit

(ELCU) in the power panel. If the switch or selector is in the OFF position, the ELCU does not get the signal. If the selector is in AUTO or ON or if the switch is in ON, the ELCU gets the signal and energizes a relay to supply electrical power to the ACMP.

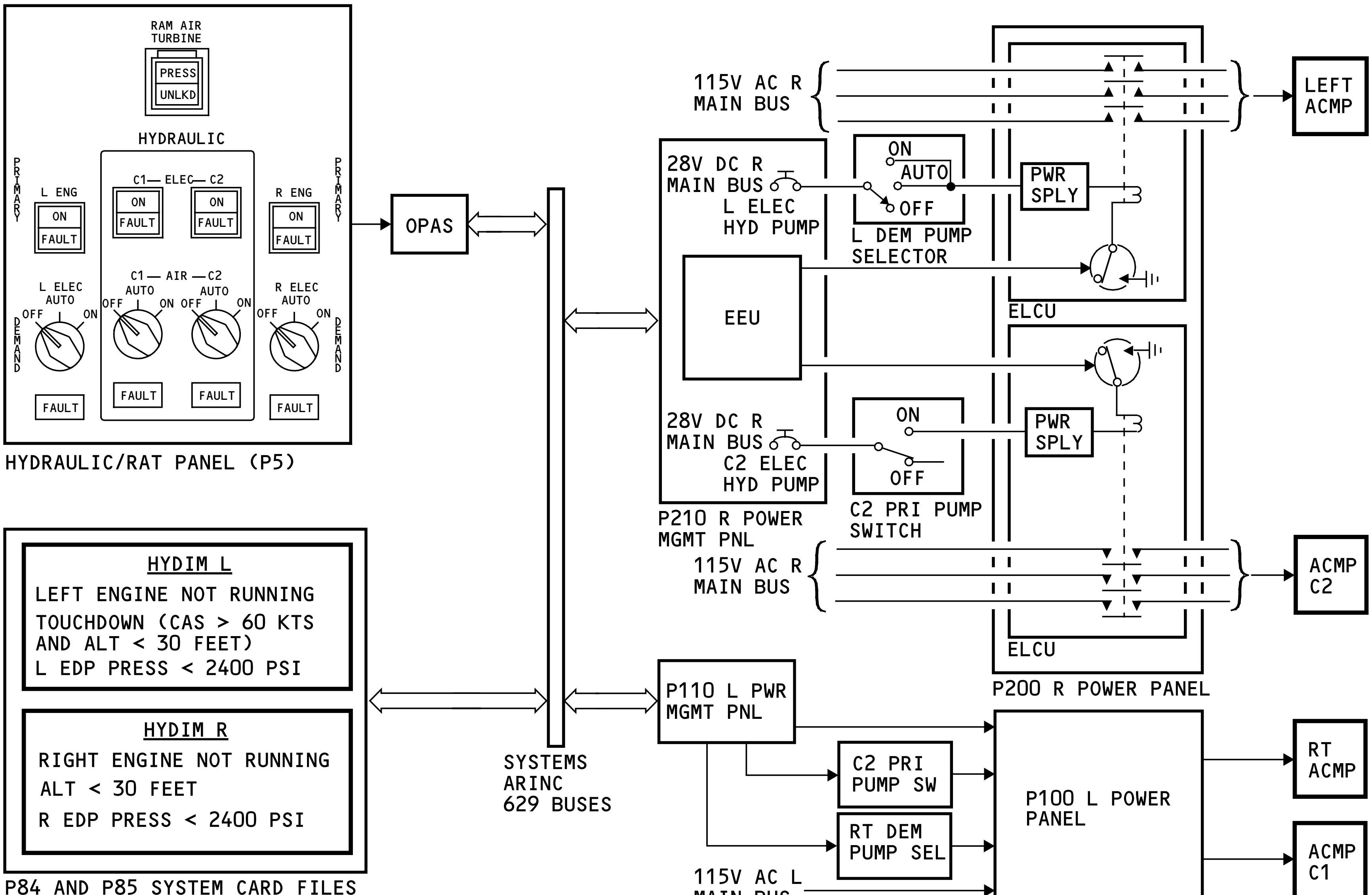
The ELMS uses time delays of approximately 1.125 seconds between ACMP starts to protect the electrical system from overload.

ELMS Load Shed

The ELMS sheds one or two of the ACMPs during some conditions.

On a single 90 kVA ground power source, the ELMS may shed ACMP C2. For this condition, the ELMS also may shed the left ACMP during engine start.

On a single 120 kVA airplane power source, the ELMS may shed ACMP C2 during fuel jettison when all ACMPs are ON.



MAIN HYDRAULIC SYSTEMS - FUNCTIONAL DESCRIPTION - ALTERNATING CURRENT MOTOR PUMP

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MAIN HYDRAULIC SYSTEMS - LEFT AND RIGHT SYSTEMS - FUNCTIONAL DESCRIPTION

General

The left and right hydraulic systems are functionally the same.

The left hydraulic system supplies pressurized hydraulic fluid to operate the left thrust reverser and the PFCS. The right hydraulic system supplies pressurized hydraulic fluid to operate the right thrust reverser, the PFCS, and the normal brake system.

Fluid Supply

The hydraulic system reservoirs contain the hydraulic fluid supply for the hydraulic pumps.

A reservoir pressurization module supplies pressurized air from the pneumatic system to pressurize the reservoir.

The reservoir supplies fluid to the EDP through a standpipe. The ACMP gets fluid from the bottom of the reservoir.

Pressurization

The EDPs are the primary pumps for the left and right hydraulic systems. The EDPs get reservoir fluid through the EDP supply shutoff valves.

The EDPs operates whenever the engines operate. A solenoid valve in each EDP controls the pressurization and depressurization of the pump.

The ACMPs are the demand pumps for the left and right hydraulic systems. The ACMPs normally operate only when there is high hydraulic system demand.

Filtration

Pressure and case drain filter modules clean the pressure flows and the case drain flows of the hydraulic pumps.

A return filter module cleans the return flow of hydraulic fluid from the user systems. The module can be bypassed if the filter clogs.

The heat exchanger cools the hydraulic fluid from ACMP and EDP case drain lines before the fluid goes back to the reservoir.

Hydraulic System Sensors

The hydraulic system sensors send pressure, temperature, and quantity signals to the HYDIM cards.

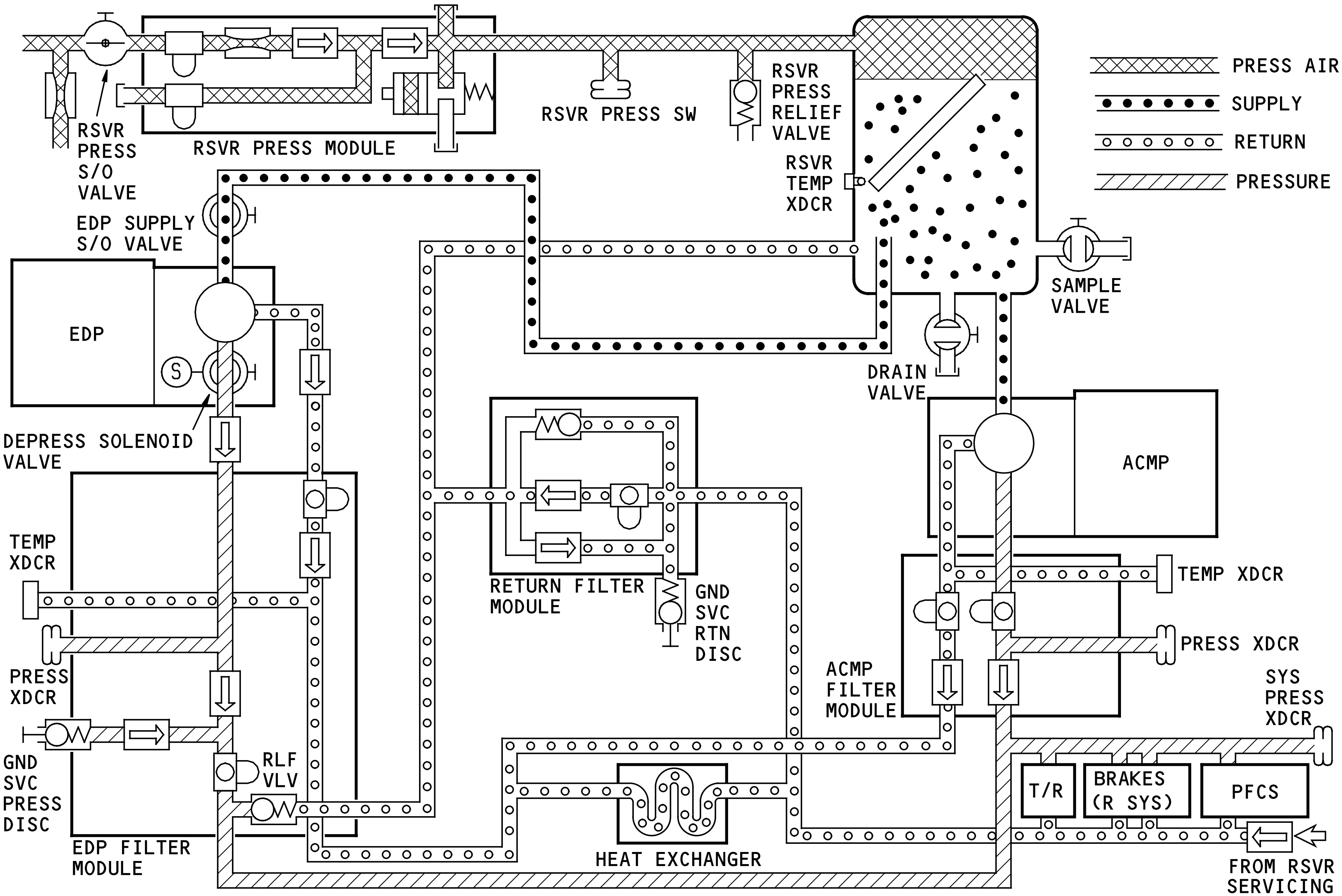
A reservoir quantity transmitter and temperature transducer are on each of the reservoirs. A hydraulic reservoir pressure switch is on the pneumatic line between the reservoir pressurization module and the reservoir.

The ACMP and EDP filter modules each have a pressure transducer to measure pump output pressure. A temperature transducer is in the case drain line of each filter module measures pump case drain fluid temperature.

A system pressure transducer measures hydraulic system pressure.

Pressure Relief

A pressure relief valve on the EDP filter module protects the system against overpressurization.



MAIN HYDRAULIC SYSTEMS - LEFT AND RIGHT SYSTEMS - FUNCTIONAL DESCRIPTION

29-10-00-023 Rev 3

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MAIN HYDRAULIC SYSTEMS - CENTER SYSTEM - FUNCTIONAL DESCRIPTION

General

The center hydraulic system supplies pressurized hydraulic fluid to operate these systems:

- Nose landing gear actuation
- Nose landing gear steering
- Alternate brakes
- Main landing gear actuation
- Main landing gear steering
- Trailing edge flaps
- Leading edge slats
- PFCS.

Fluid Supply

The center system reservoir contains the hydraulic fluid supply for the center system hydraulic pumps.

A reservoir pressurization module supplies pressurized air from the pneumatic system to pressurize the reservoir.

The reservoir supplies fluid to the ADPs, the RAT, and one of the ACMPs through a standpipe. The other ACMP gets fluid from the bottom of the reservoir.

The reservoir also supplies hydraulic fluid to the landing gear alternate extension system.

Pressurization

The ACMPs are the primary pumps in the center hydraulic system and are normally on.

The ADPs are the demand pumps in the center system. They normally operate only when the center system needs more hydraulic flow capacity.

The ram air turbine system supplies an emergency source of hydraulic power to the center hydraulic system flight controls.

Filtration

Filter modules clean the pressure and case drain output of the hydraulic pumps.

A return filter module cleans the return flow of hydraulic fluid from the user systems. The module can be bypassed.

The heat exchanger cools the hydraulic fluid from the ACMP case drains before the fluid goes back to the reservoir. ADP case drain fluid does not go through the heat exchangers.

Hydraulic System Sensors

A reservoir quantity transmitter and temperature transducer are on the reservoir. A hydraulic reservoir pressure switch is on the pneumatic line between the reservoir and the reservoir pressurization module.

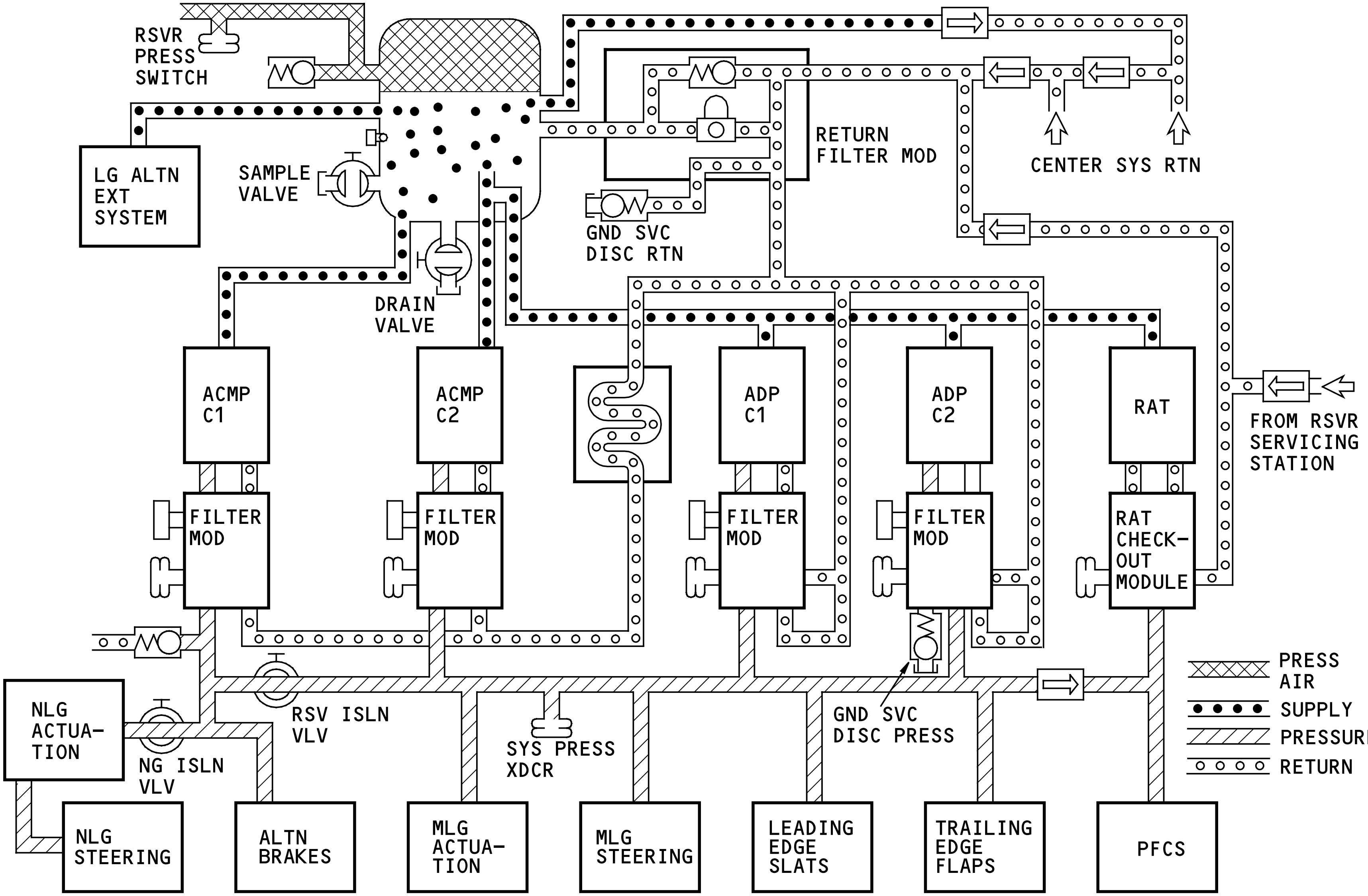
MAIN HYDRAULIC SYSTEMS - CENTER SYSTEM - FUNCTIONAL DESCRIPTION

The ACMP and ADP filter modules each have a pressure transducer to measure pump output pressure. A temperature transducer in each filter module measures pump case drain temperature.

A system pressure transducer measures hydraulic system pressure.

Pressure Relief

Pressure relief valves in each ADP filter module prevent system overpressurization. A pressure relief valve near ACMP C1 supplies overpressure protection for the CHIS.



MAIN HYDRAULIC SYSTEMS - CENTER SYSTEM - FUNCTIONAL DESCRIPTION

29-10-00-024 Rev 2 01/19/95

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MAIN HYDRAULIC SYSTEMS - CENTER HYDRAULIC ISOLATION SYSTEM - FUNCTIONAL DESCRIPTION

General

The center hydraulic isolation system (CHIS) supplies engine burst protection and a reserve brakes and steering function.

The HYDIM CL card, in the left systems card file, automatically controls CHIS operation through relays in the ELMS. The relays control the electric motors in the reserve and nose gear isolation valves.

HYDIM CL also sends a signal to the FSEUs to prevent hydraulic operation of the leading edge slats.

Hydraulic Supply

ACMP C1 gets hydraulic fluid from the bottom of the center system reservoir. All other hydraulic pumps in the center system get fluid through a standpipe in the reservoir. This gives ACMP C1 a 1.2 gallon (4.5 liter) reserve supply of hydraulic fluid.

Isolation

The reserve and nose gear isolation valves are normally open.

Both valves close if the quantity in the center system reservoir is low (less than 0.40) and the airspeed is more than 60 knots for more than one second. The HYDIM CL card also sends a signal to the FSEUs. The FSEUs do not send commands to the leading edge slats primary control valve (PCV) for this condition. This prevents hydraulic operation of the slats.

When CHIS is active, this divides the center hydraulic system into different parts. The NLG actuation and steering, and the leading edge slat hydraulic lines are isolated from center system pressure.

The output of ACMP C1 goes only to the alternate brake system.

The output of the other center hydraulic system pumps goes to the trailing edge flaps, the MLG actuation and steering and the PFCS.

If there is a leak in the NLG actuation and steering or LE slat lines, there is no further loss of hydraulic fluid. The alternate brakes, the trailing edge flaps, the MLG actuation and steering, and the PFCS continue to operate normally.

If there is a leak in the trailing edge flaps, the MLG actuation and steering, or the PFCS lines, the reservoir loses fluid down to the standpipe level (0.00 indication). This causes a loss of these systems. But, the alternate brake system continues to get hydraulic power from ACMP C1.

If there is a leak in the lines between ACMP C1 and the alternate brake system, all center hydraulic system fluid is lost.

Nose Gear Isolation Valve

The HYDIM CL reopens the nose gear isolation valve for any of these conditions:

- Airspeed is less than 60 knots
- Pump pressures for ACMP C2, ADP C1, ADP C2, and the RAT is less than 1200 psi for 30 seconds
- Left and right engine RPM is above idle, left and right EDP pressure is more than 2400 psi, and (the NLG is not up, the NLG doors are not closed, or the landing gear lever is not up) for 30 seconds.

The first condition permits the flight crew to operate the NLG steering when airspeed is less than 60 kts (decreased rudder control authority during taxi).

The second condition permits operation of the NLG actuation and steering if the hydraulic leak is in the part of the center hydraulic system isolated by the reserve isolation valve.

The third condition permits operation of the NLG actuation and steering if there has not been an engine burst and the other hydraulic systems are pressurized. The nose gear isolation valve opens when pressure is necessary at the NLG. If the NLG is not fully retracted or the NLG doors are not closed, the nose gear isolation valve opens to let the NLG complete the retraction. When the landing gear lever is moved to the DOWN position, the nose gear isolation valve opens to let the NLG extend with center system pressure.

CHIS Reset

Both valves open again automatically when the center system quantity is more than 0.70 and airspeed is less than 60 knots for five seconds.

Both valves also reset when the center system quantity is more than 0.70 and both engines and both engine driven pumps operate normally for 30 seconds.

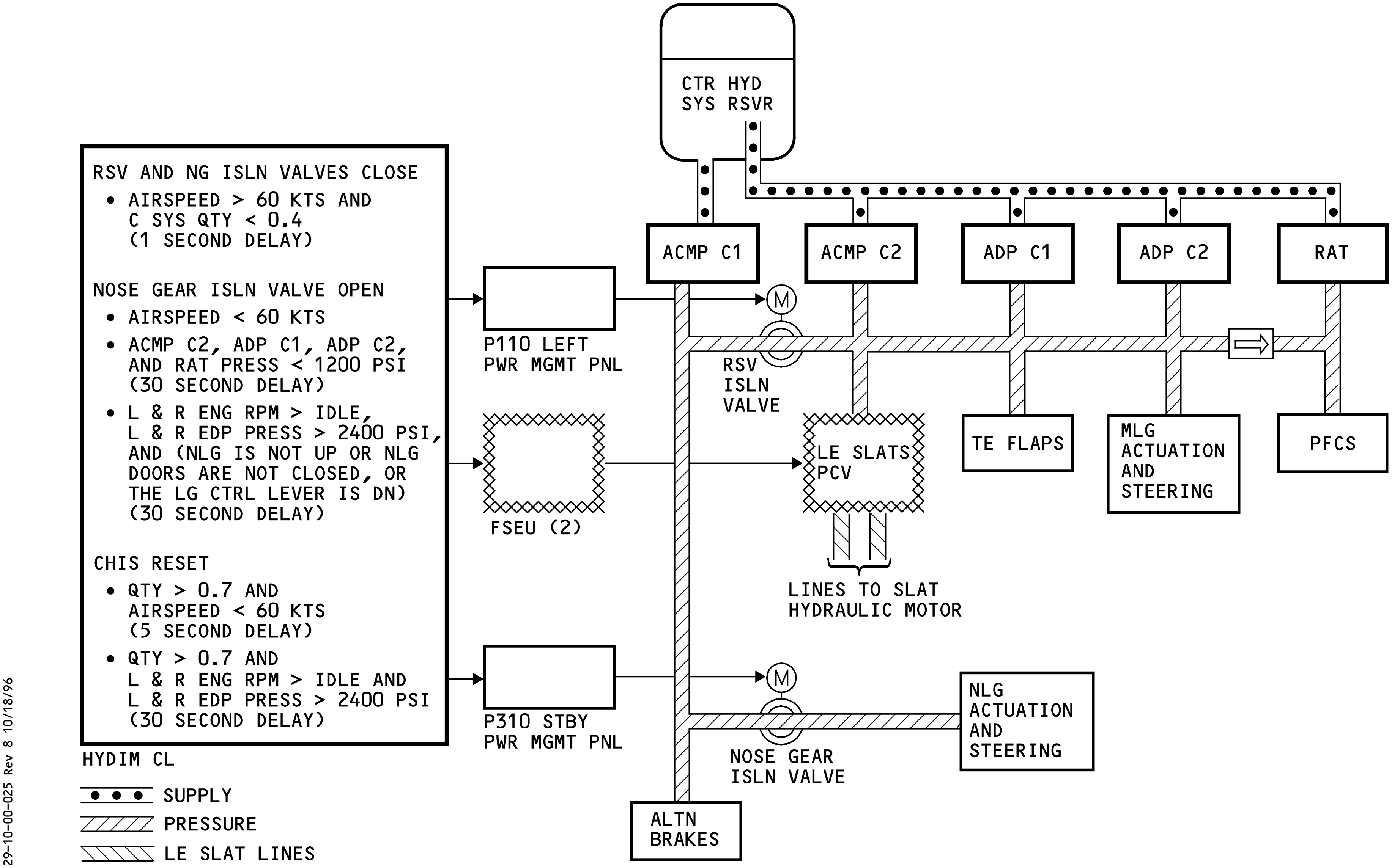
Indications

The positions of the nose gear isolation valve and the reserve isolation valve show on the hydraulic synoptic display and the hydraulic maintenance page.

The RESERVE BRAKES/STRG advisory message tells the flight crew that brakes or steering may not be available. This message shows for any of these conditions:

- The center system is isolated and ACMP C1 pressure is less than 1200 psi
- The center system is isolated and the center system pressure is more than 1200 psi
- The reserve isolation valve is not open and ACMP C1 pressure is less than 1200 psi
- The nose gear isolation valve is not open and there is no command to isolate the center system.

The HYD ISLN VALVE status message shows if one or two isolation valves are not in the commanded position.



MAIN HYDRAULIC SYSTEMS - CENTER HYDRAULIC ISOLATION SYSTEM - FUNCTIONAL DESCRIPTION

RAM AIR TURBINE SYSTEM - INTRODUCTION

General

The ram air turbine (RAT) supplies an emergency source of hydraulic power to operate the flight controls. The RAT also is an emergency source of electrical power.

The RAT extends automatically in flight with a loss of hydraulic pressure in the three hydraulic systems. You can manually extend the RAT from the flight deck.

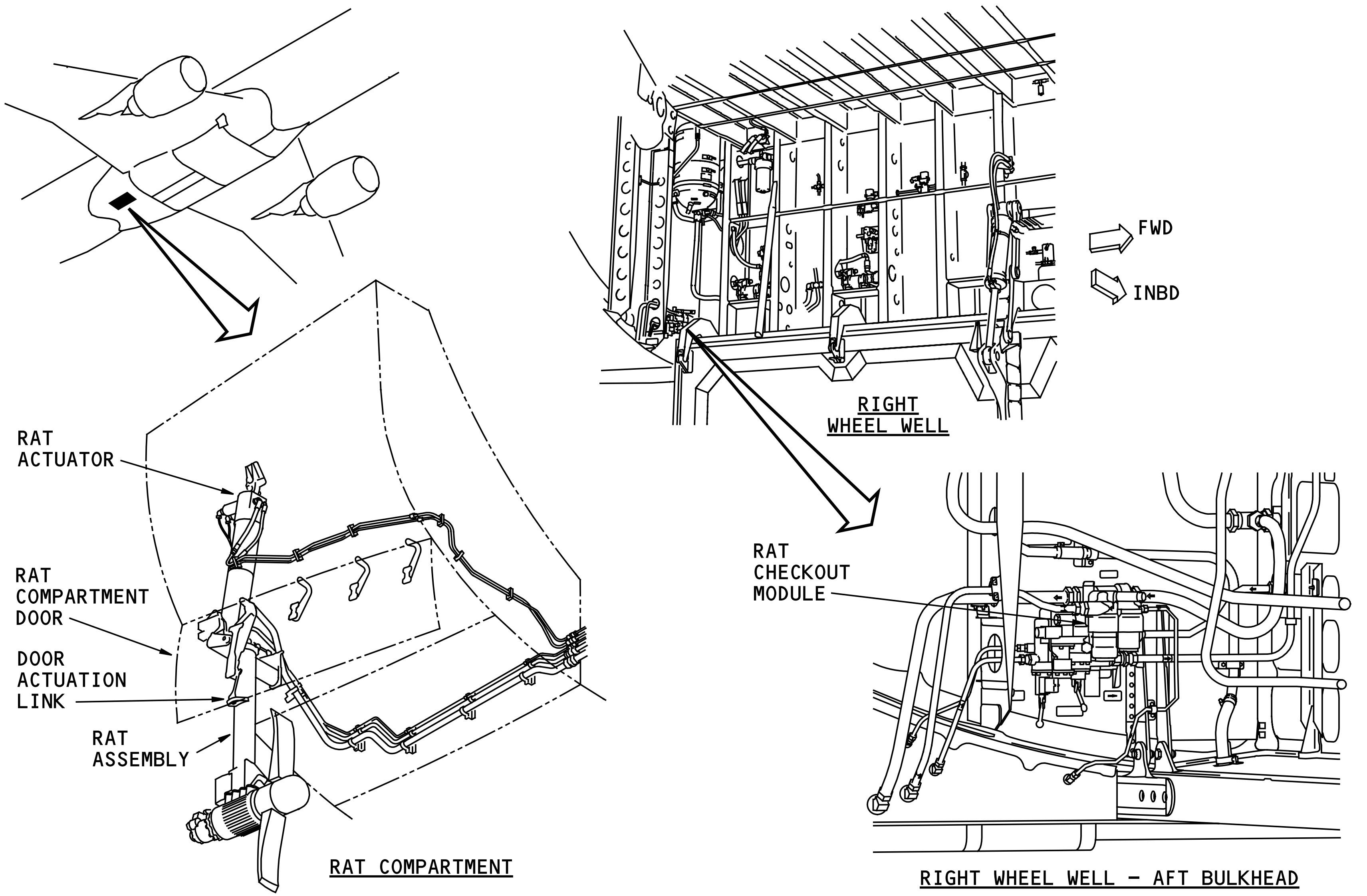
Control of RAT retraction is from the right wheel well.

Components

These are the components of the ram air turbine system:

- RAT assembly
- RAT actuator
- RAT compartment door and actuation link
- RAT stowed switch (not shown)
- RAT checkout module.

Most RAT components are in the RAT compartment behind the right wheel well. The RAT checkout module is in the right wheel well.



29-20-00-001 Rev 1

RAM AIR TURBINE SYSTEM - INTRODUCTION

RAM AIR TURBINE SYSTEM - GENERAL DESCRIPTION

General

The HYDIM cards or the ELMS control the automatic operation of the RAT.

The RAT manual switch permits manual RAT extension. Indication lights on the RAT manual switch show RAT pressure indication and RAT unlocked condition.

HYDIM Control

The two center HYDIM cards get these inputs to control automatic RAT extension:

- Airspeed (ADIRU through the AIMS)
- Groundspeed (ADIRU through the AIMS)
- Air/ground condition (WOW cards)
- Engines above idle (EDIUs)
- Hydraulic system pressures (HYDIM).

RAT Power Output

The RAT hydraulic pump supplies hydraulic power for some of the center hydraulic system flight controls.

The RAT generator supplies electrical power to the P310 standby power management panel in the ELMS. See the standby power section for more information about the RAT generator (AMM PART I 24-33).

Indications

The AIMS gets RAT position and pressure data for flight deck indication and fault detection.

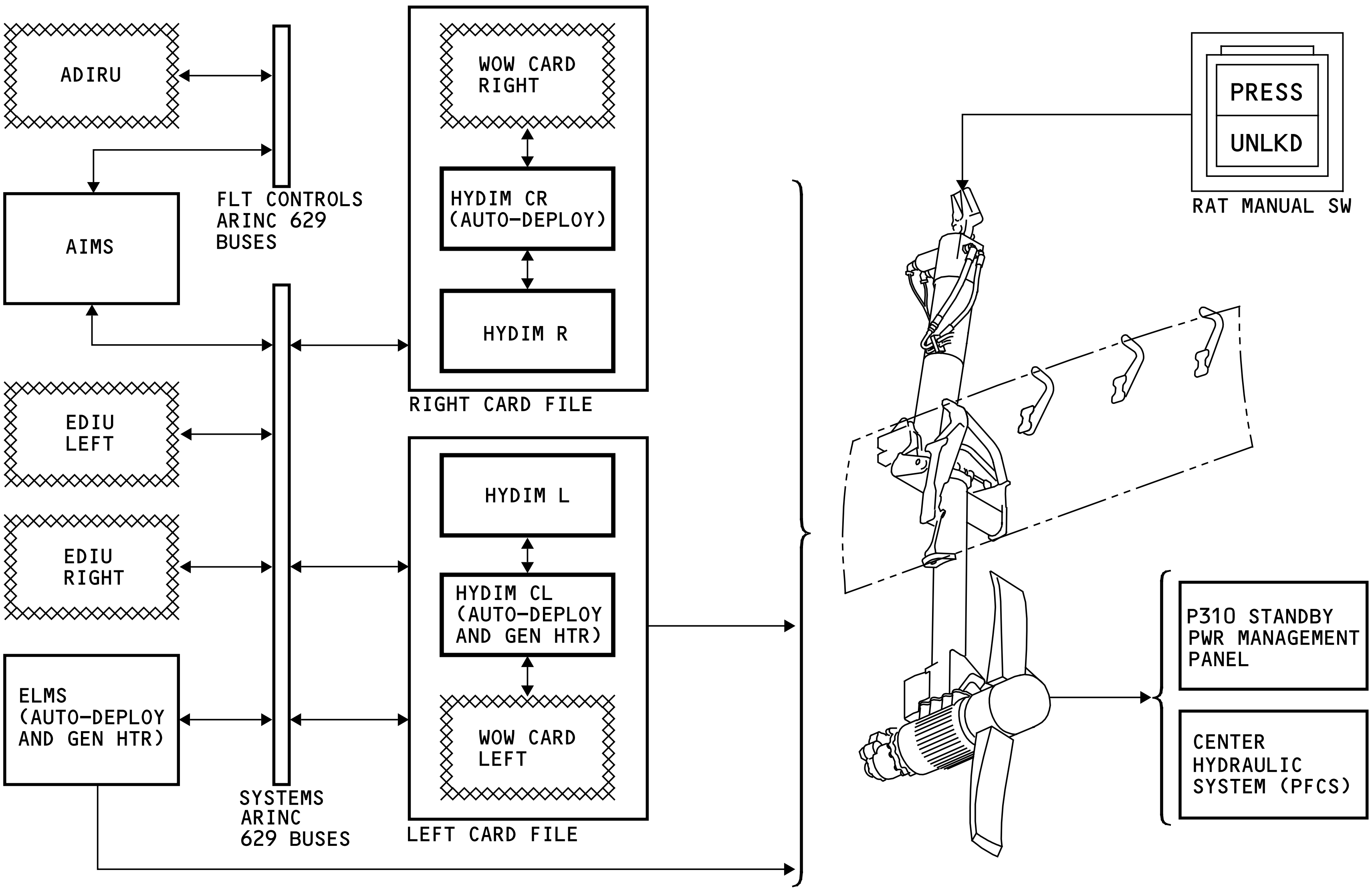
RAT pressure indication shows on the hydraulic synoptic display, the hydraulic maintenance page, and the pressure light on the RAT manual switch.

The ELMS calculates RAT speed from the RAT generator frequency. RAT speed shows on the hydraulic maintenance page.

RAT Generator Heater System

A RAT generator heater system keeps moisture from freezing inside the RAT generator. Ice inside the generator could stop RAT spin-up if the RAT is deployed at low airspeeds.

HYDIM controls the RAT generator heater system. The ELMS supplies the electrical power to operate the heaters.



RAM AIR TURBINE SYSTEM - GENERAL DESCRIPTION

29-20-00-002 Rev 6 03/16/95

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RAM AIR TURBINE SYSTEM - RAT ASSEMBLY

General

These components are part of the RAT assembly:

- RAT governor-generator assembly
- RAT hydraulic pump
- RAT strut
- RAT blade lock pin
- RAT blade locked switch
- RAT strut angle switch.

RAT Governor-Generator Assembly

The RAT governor-generator assembly has these components:

- Turbine
- Flyweight governor
- Electric generator.

A two-bladed variable pitch turbine turns the shaft of the generator and the pump. Turbine blade diameter is approximately 41.5 inches (105 cm).

The flyweight governor is inside the turbine hub. It controls turbine blade pitch to control turbine speed. Governed speed is approximately 4510 rpm.

The generator is a 115v ac, 3-phase generator rated at 7.5 KVA. A RAT generator heater system keeps ice out of the generator. See the standby power section for more information about the RAT generator (AMM PART I 24-33).

RAT Hydraulic Pump

The RAT hydraulic pump is a two-stage pressure-compensated pump. It attaches to the aft face of the governor-generator assembly.

The pump flow rate is 10 gpm at 2850 psi.

RAT Strut

The trunnion mounted strut assembly attaches the governor-generator and hydraulic pump to the airplane. Electric and hydraulic lines are in the strut.

RAT Blade Lock Pin and Blade Locked Switch

The RAT blade lock pin behind the turbine locks the turbine blades in a vertical position when the RAT is more than 9 degrees from the extended position. This keeps the blades from turning until they are clear of the structure of the airplane. It also keeps the blades from causing damage to the airplane during retraction.

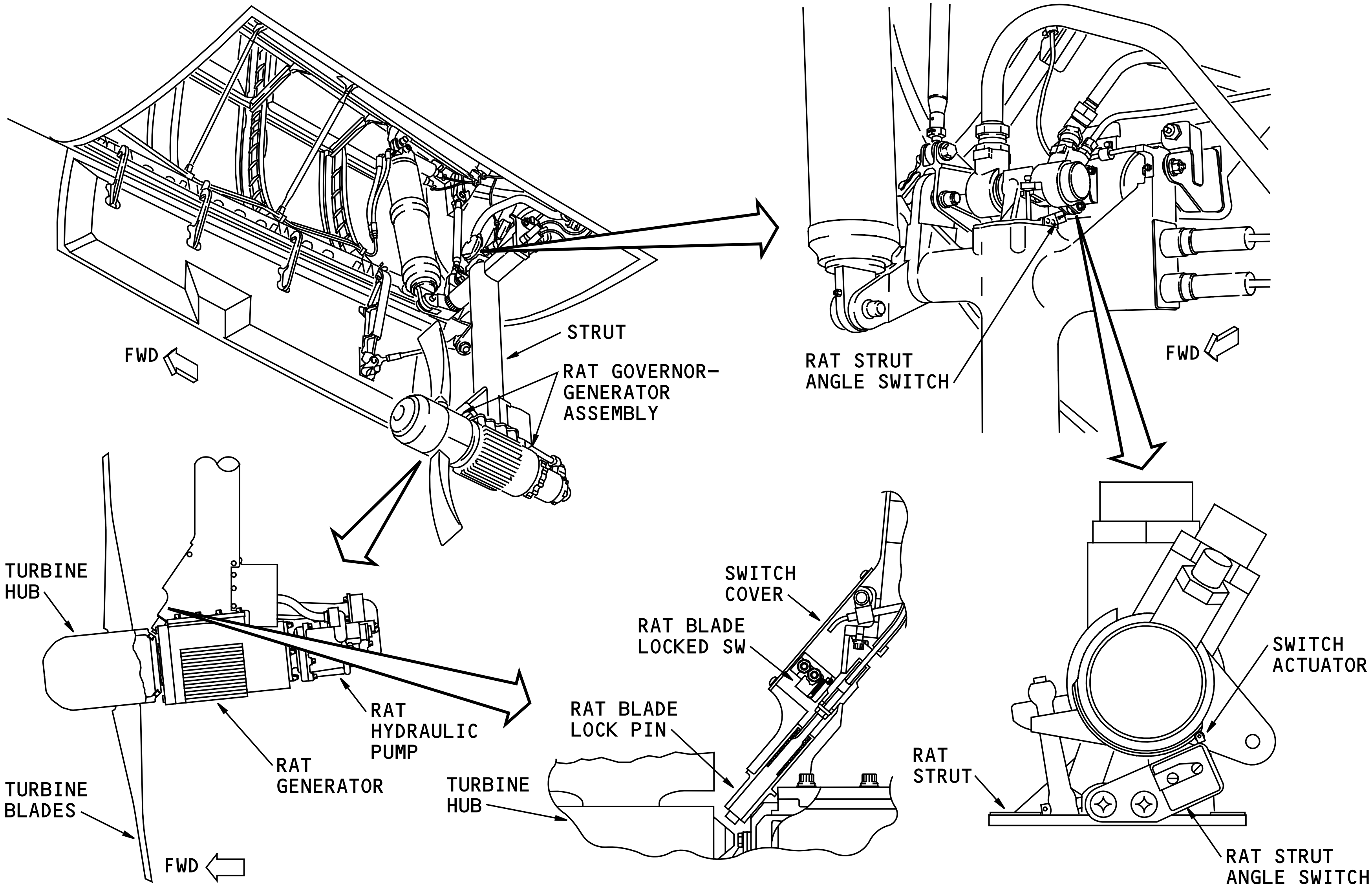
The RAT blade locked switch closes when the blade lock pin locks the turbine. This switch keeps the RAT from retracting more than 15 degrees unless the blades are locked by the blade index pin.

RAT Strut Angle Switch

The RAT strut angle switch at the top of the RAT strut permits initial RAT retraction. The switch is closed between 0 and 15 degrees of the RAT extended position.

RAM AIR TURBINE SYSTEM - RAT ASSEMBLY

It opens when the RAT is 15 degrees from the extended position to change retraction control to the RAT blade locked switch.



RAM AIR TURBINE SYSTEM - RAT ASSEMBLY

RAM AIR TURBINE SYSTEM - RAT ACTUATOR AND STOWED SWITCH

Purpose

The RAT actuator extends and retracts the ram air turbine assembly.

The RAT stowed switch gets RAT stowed position input for flight deck indication.

Physical Description

The RAT actuator is a spring-loaded hydraulic actuator. An internal spring extends the RAT. Hydraulic pressure retracts the RAT.

An internal mechanical lock keeps the actuator in the retracted position.

Two solenoids on the actuator unlock the actuator to extend the RAT.

Location

The RAT actuator and RAT stowed switch are in the RAT compartment aft of the right wheel well.

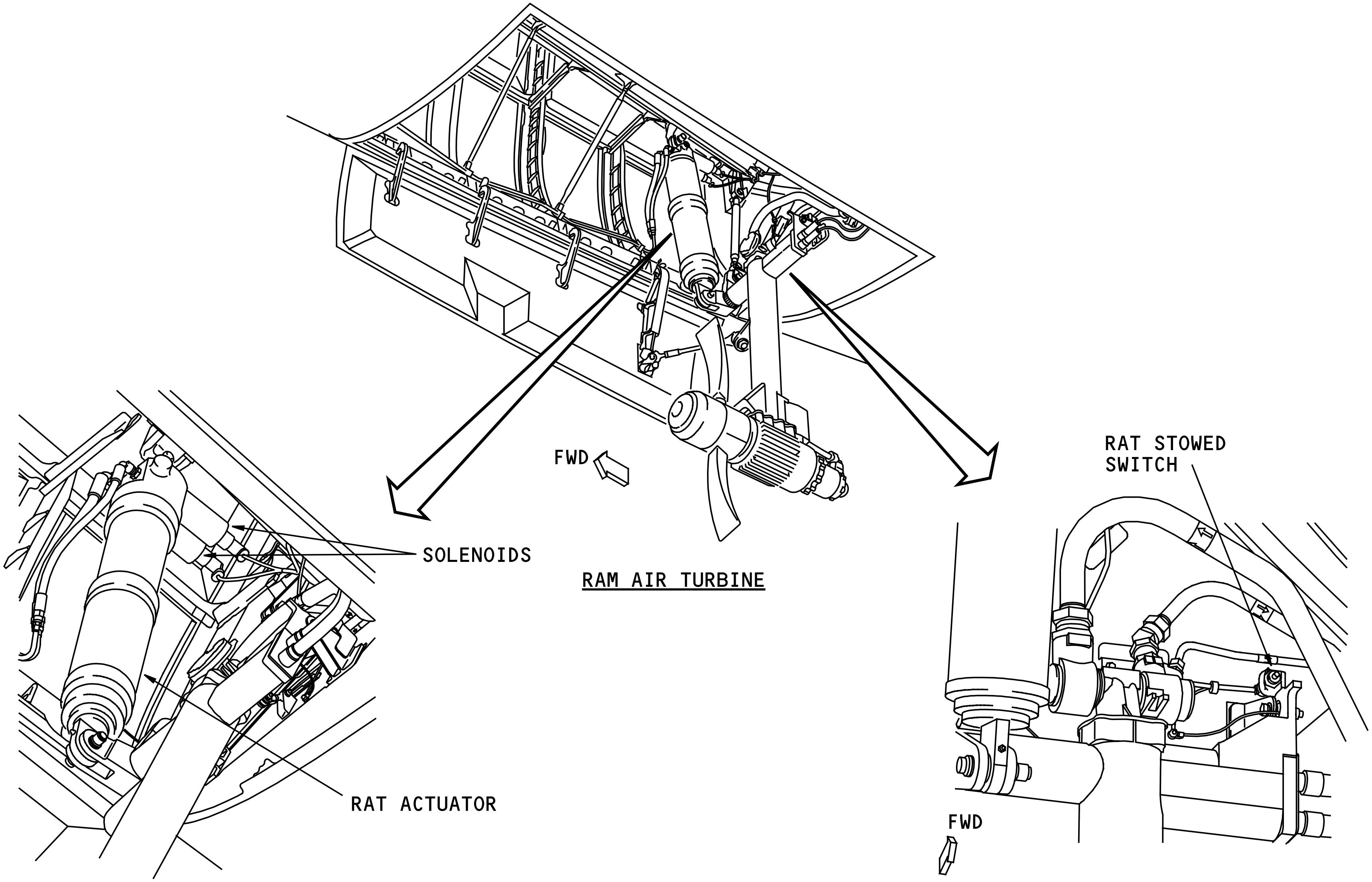
Functional Description

To extend the RAT, one or both solenoids are energized by a signal from any of these:

- HYDIM cards
- ELMS
- RAT manual switch.

This unlocks the actuator and the internal spring extends the RAT.

To retract the RAT, center system hydraulic pressure goes to the retract side of the RAT actuator. The RAT retracts and the internal lock keeps the actuator in the retracted position.



29-20-00-004 Rev 2

RAM AIR TURBINE SYSTEM - RAT ACTUATOR AND STOWED SWITCH

MAIN HYDRAULIC SYSTEMS - ADP ASSEMBLY - INTRODUCTION

Purpose

Two air driven pump (ADP) pumps are the demand pumps for the center hydraulic system.

General Description

Each ADP pump is part of an ADP assembly. The ADP assembly also has an air drive unit (ADU). The ADU contains these components:

- Turbine gearbox assembly (TGA)
- Modulating shutoff valve (MSOV)
- Air drive unit (ADU) heater.

A mount truss assembly attaches each ADP assembly to the airplane structure. The mount truss assembly for ADP assembly C1 is not the same as the one for ADP assembly C2.

The ADP assemblies use airplane pneumatic power to operate. An inlet duct supplies air pressure to each ADU. The MSOVs let air flow to the turbine of the TGAs. The gearbox of TGAs reduces the turbine speed and operates the pump. ADU heaters are on the ADUs to prevent ice formation. The pumps connect directly to the TGAs. The airflow from the TGAs exits the airplane through two exhaust ducts and two exhaust vents directly aft of the ADP assemblies.

The two TGAs have the same components. The turbine housing of ADP assembly C1 is different than the turbine housing for ADP assembly C2 to permit the exhaust ducts to be near each other.

Two ADP logic speed control units (LSCU), one for each ADP assembly, control the pump operation. The LSCUs supply speed control and overspeed protection to the TGAs. The LSCUs are circuit card assemblies and are LRUs.

A wiring harness for each ADP assembly connects the LSCU to the MSOV and the TGA.

The ADP pumps are the same as the engine driven pumps.

The ADP pump is rated at 53 gpm at 4315 rpm. A reserve mode permits the pump to supply 63 gpm at 5160 rpm. The pumps are LRUs.

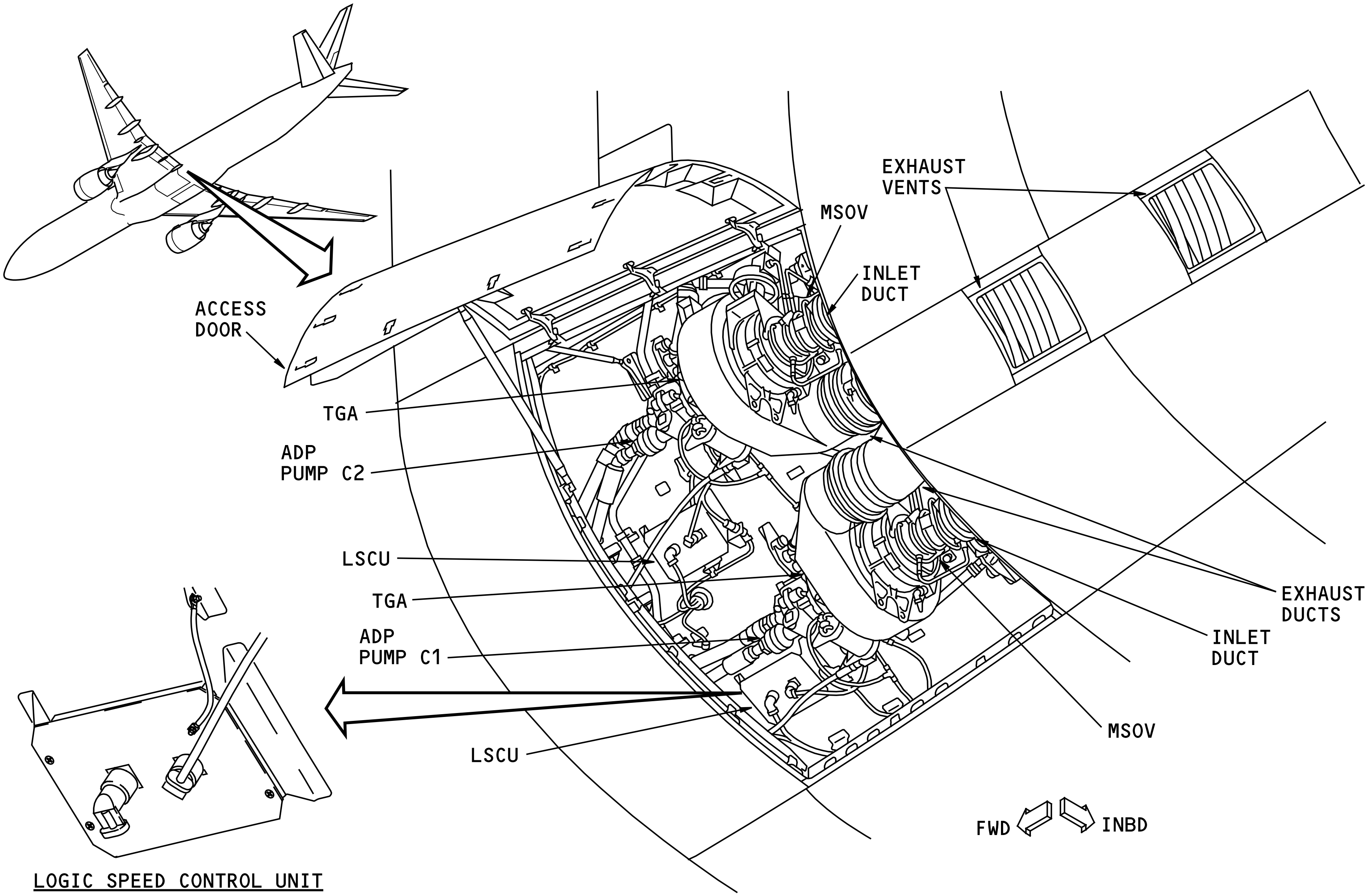
Location

The two ADP assemblies are in the left wing-to-body fairing behind the left wheel well. The LSCUs are also in this compartment.

Training Information Point

The EDPs and the ADP pumps are interchangeable. When the pump operates as an ADP pump, the depressurization solenoid does not operate.

CAUTION: MAKE SURE THE ADP ACCESS DOOR IS FULLY OPEN OR FULLY CLOSED WHEN OPERATING THE TRAILING EDGE FLAPS.



29-10-00-011 Rev 5 07/03/1997

MAIN HYDRAULIC SYSTEMS - ADP ASSEMBLY - INTRODUCTION

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RAM AIR TURBINE SYSTEM - EXTENSION - FUNCTIONAL DESCRIPTION

General

A switch on the P5 overhead panel permits manual RAT extension. The HYDIM cards or the ELMS can automatically extend the RAT.

The extend signal supplies power to either or both of the solenoids on the RAT actuator. This unlocks the RAT and permits the spring in the actuator to extend the RAT.

As the RAT gets near the fully extended position, the blade lock pin releases the turbine. The airstream turns the RAT.

Power Sources

These sources can energize the RAT actuator solenoids:

- APU battery bus
- Hot battery bus
- Captain's flight instrument bus.

HYDIM Auto-Extension

The HYDIM cards CL and CR independently control the automatic RAT extension.

CR extends the RAT for these conditions:

- Airplane is in the air mode
- Airspeed or ground speed is more than 80 knots
- Both engines are below idle rpm and center hydraulic system pressure is low or (L,C, and R hydraulic system pressures are low).

CL automatic extension conditions are almost the same as CR. CL extends the RAT for these conditions:

- Airplane is in the air mode
- Airspeed or ground speed is more than 80 knots
- Both engines are below idle rpm and center hydraulic system pump pressures are low or (left and right systems and center system pump pressures are low).

Both CL and CR energize one of the solenoids to unlock the RAT actuator.

ELMS Auto-Extension

The ELMS energizes the other solenoid on the RAT actuator to extend the RAT for these conditions:

- Airplane in the air mode
- Airplane not in the ground mode
- Left and right transfer buses have lost electrical power for 15 seconds.

Manual Extension

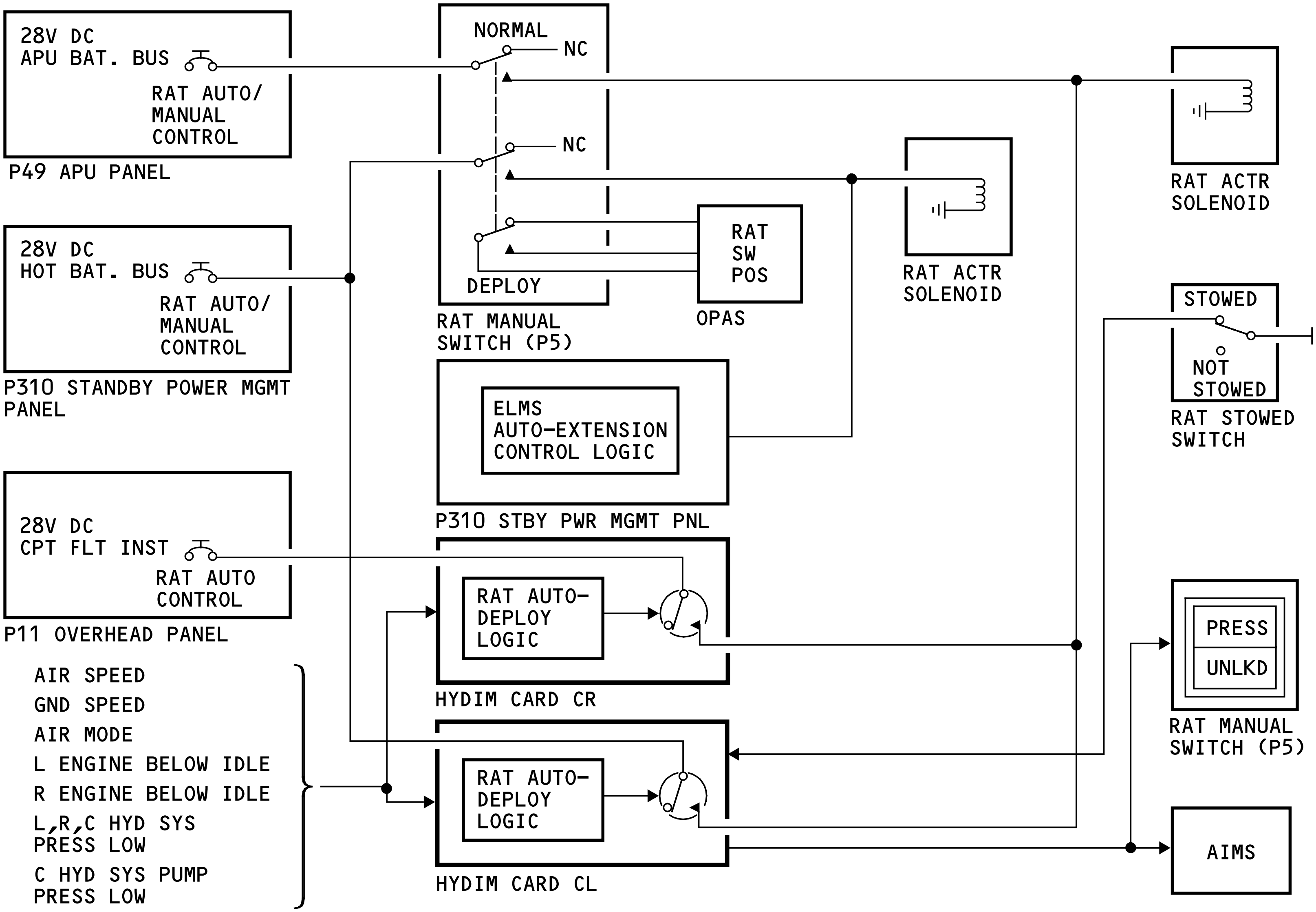
The RAT manual switch on the hydraulic/RAT panel energizes both the solenoids on the RAT actuator to extend the RAT.

RAM AIR TURBINE SYSTEM - EXTENSION - FUNCTIONAL DESCRIPTION

Indication

The RAT stowed switch in the RAT compartment sends a not-stowed signal to HYDIM CL when the RAT is not in the stowed position.

HYDIM CL turns on the RAT switch UNLKD light and sends a signal to the AIMS to show the RAT UNLOCKED advisory message.



RAM AIR TURBINE SYSTEM - EXTENSION - FUNCTIONAL DESCRIPTION

MAIN HYDRAULIC SYSTEMS - ALTERNATING CURRENT MOTOR PUMP

Purpose

The ACMPs are the primary pumps in the center hydraulic system and the demand pumps in the left and right hydraulic systems.

Physical Description

The ACMP has an electric motor that mechanically connects to a hydraulic pump. The motor operates with three-phase, 400 Hz, 115/200v ac power. The pump is a nine piston variable-displacement hydraulic pump.

Case drain flow cools the electric motor and cools and lubricates the pump.

A ripple damper smooths the pump pressure output.

The ACMPs are rated at 6 gpm at 2850 psi.

All ACMPs are the same and weigh 27 pounds (12.3 Kg).

Location

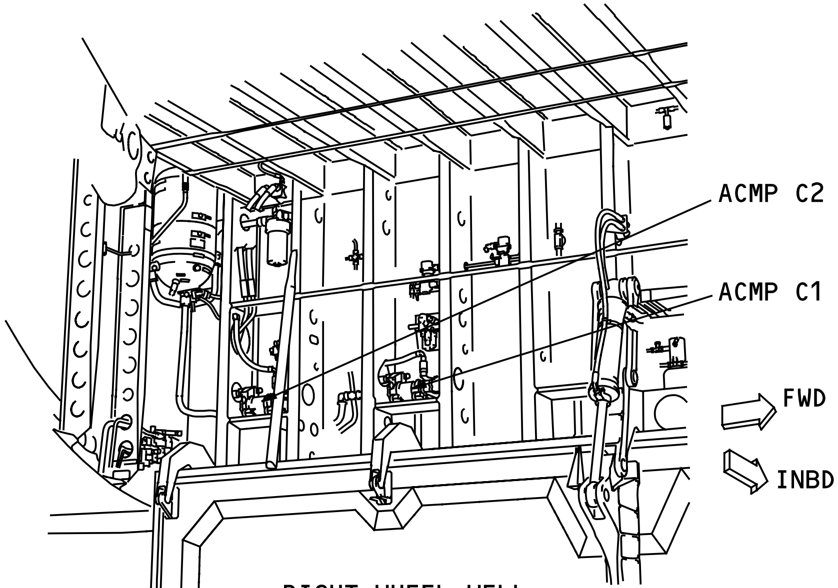
The ACMPs for the left and right hydraulic systems are in the engine struts aft of the reservoirs.

The center system ACMPs are on the keel beam in the right wheel well.

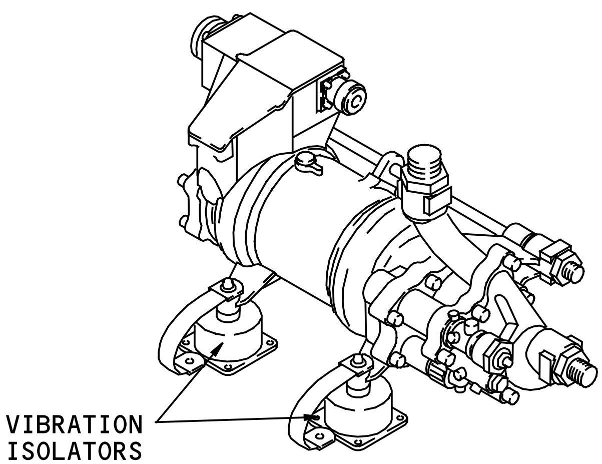
Training Information Point

The center system ACMPs attach to airplane structure through four vibration isolators.

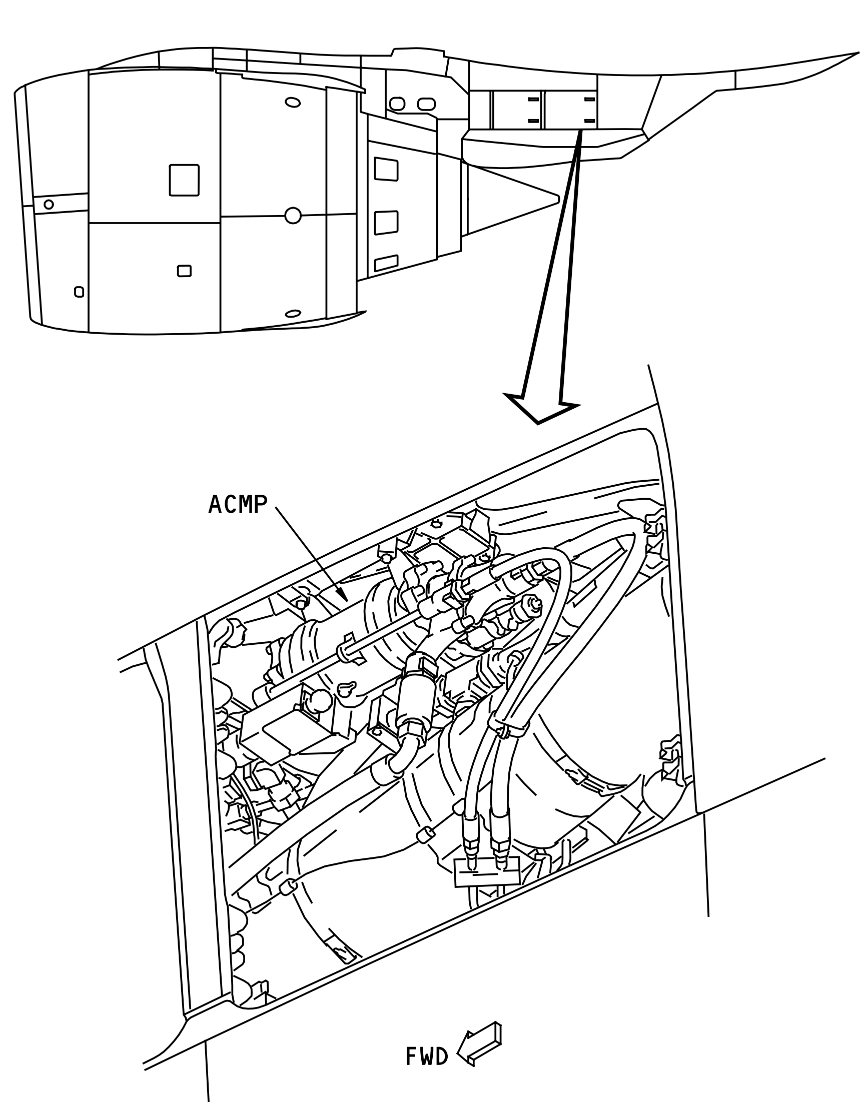
The left and right ACMPs attach to a mounting bracket (not shown) before installation.



RIGHT WHEEL WELL



CENTER SYSTEM ACMP



ENGINE STRUT

MAIN HYDRAULIC SYSTEMS - ALTERNATING CURRENT MOTOR PUMP

HYDRAULIC INDICATING SYSTEM - INTRODUCTION

General

The hydraulic indicating system monitors these values:

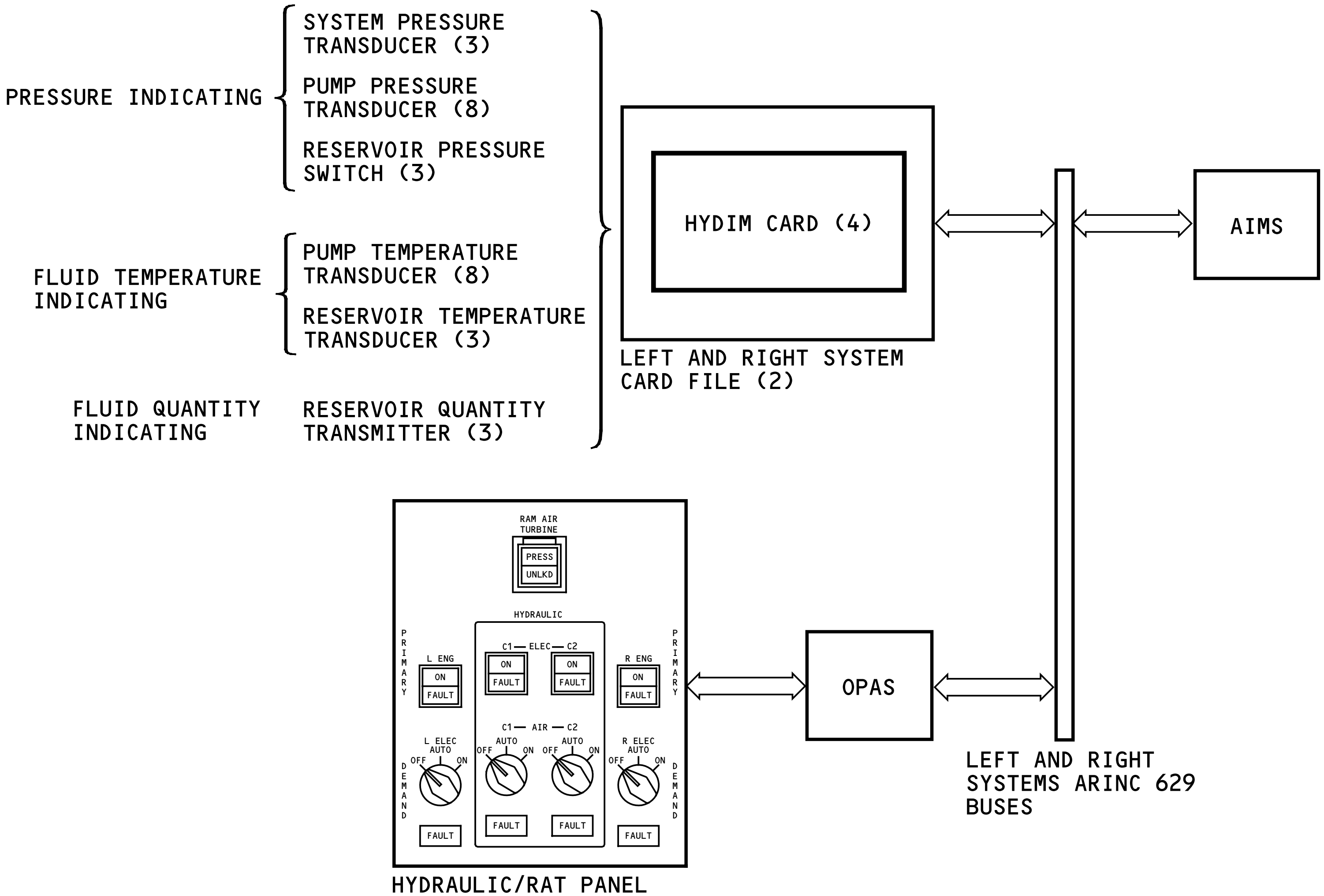
- Fluid and reservoir pressures
- Fluid temperature
- Fluid quantity.

The indicating systems get inputs from these sensors:

- Hydraulic pump pressure transducer (8)
- Hydraulic system pressure transducer (3)
- Hydraulic reservoir pressure switch (3)
- Hydraulic pump temperature transducer (8)
- Hydraulic reservoir temperature transducer (3)
- Hydraulic reservoir quantity transmitter (3).

Interface

The indicating systems sensors send data to the HYDIM cards. The HYDIM cards send the data to the AIMS for flight deck indication. The HYDIM cards also control the fault lights and the RAT indication lights on the hydraulic/RAT panel.



29-30-00-001 Rev 1

HYDRAULIC INDICATING SYSTEM - INTRODUCTION

HYDRAULIC INDICATING SYSTEM - HYDRAULIC SYSTEM PRESSURE TRANSDUCER - COMPONENT LOCATIONS

General

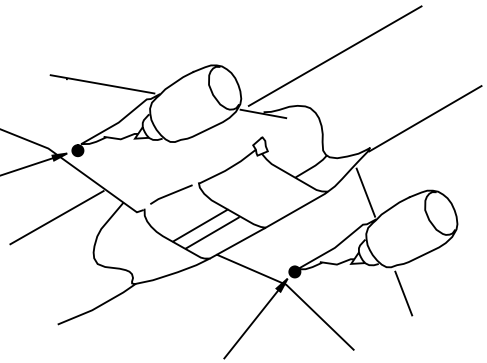
The left and right hydraulic system pressure transducers are on the rear wing spar of the left and right wings.

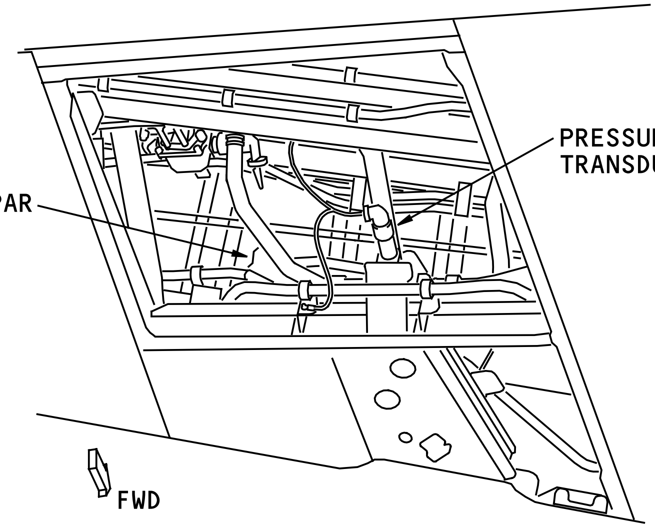
The center system pressure transducer is near the keelbeam in the right wheel well.

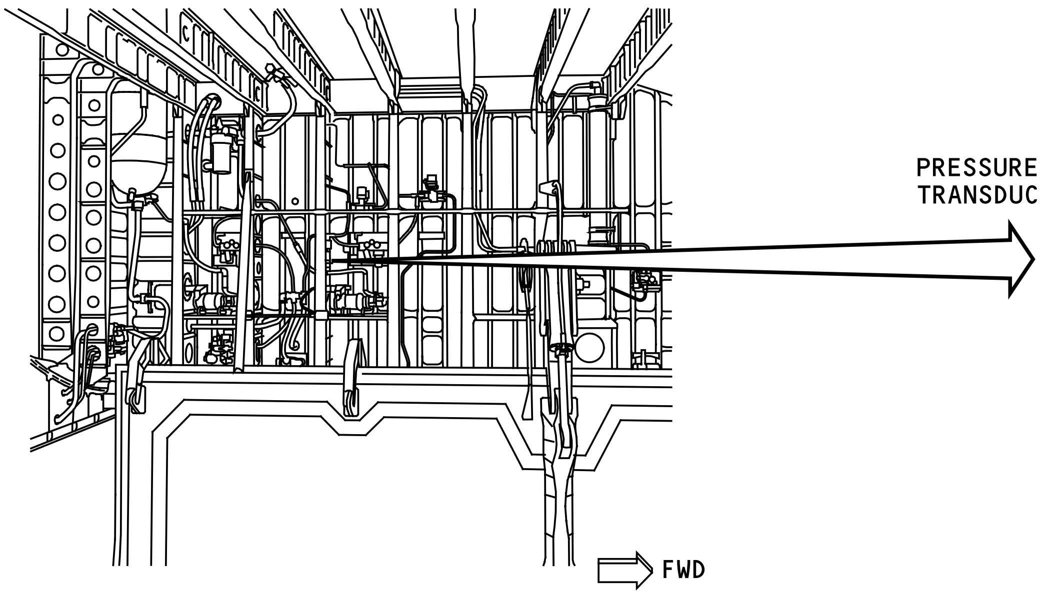
Training Information Point

The hydraulic system pressure transducers are interchangeable with the pump pressure transducers.

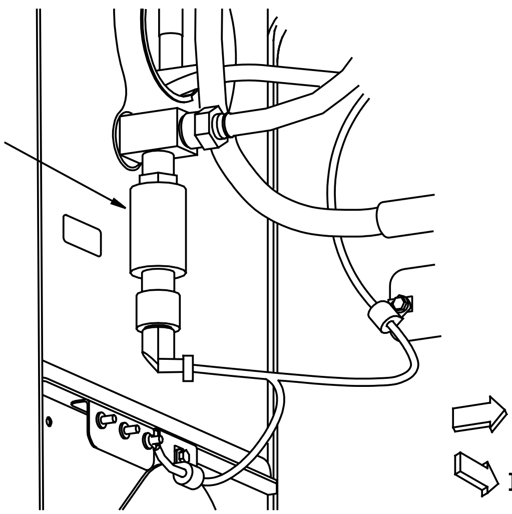
Access panels (552LB - left system, 652LB - right system) on the bottom of the wings give access to the pressure transducers.







RIGHT WHEEL WELL



CENTER SYSTEM PRESSURE TRANSDUCER

29-30-00-003 Rev 3 07/20/1995

HYDRAULIC INDICATING SYSTEM - HYDRAULIC SYSTEM PRESSURE TRANSDUCER - COMPONENT LOCATIONS

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HYDRAULIC INDICATING SYSTEM - PRESSURE INDICATING

General

These sensors in the hydraulic systems send hydraulic pressure data to the HYDIM cards:

- System pressure transducer (3)
- Pump pressure transducer (8)
- Reservoir pressure switches (3).

The HYDIM cards control the pressure indications.

Functional Description

The pressure transducers send signals in proportion to pressure between 0 and 4000 psi. The transducers make allowance for temperature changes.

The reservoir pressure switches send a reservoir low pressure signal when the reservoir pressure is 21 psia or less. They send a reservoir not low signal when reservoir pressure is 25 psia or more.

Hydraulic System Pressure Indications

Hydraulic system pressure shows on these displays:

- The status display
- The hydraulic synoptic display
- The hydraulic maintenance page.

These caution messages show if hydraulic system pressure is below 1200 psi:

- HYD PRESS SYS L
- HYD PRESS SYS C
- HYD PRESS SYS R
- HYD PRESS SYS L+C
- HYD PRESS SYS R+C
- HYD PRESS SYS L+R
- HYD PRESS SYS L+C+R.

Hydraulic Pump Pressure Indications

The maintenance page shows hydraulic pump pressure in psi.

Advisory messages show if hydraulic pump pressure is less than 1200 psi for ACMPs or 1800 psi for ADPs and EDPs. These are the advisory messages:

- HYD PRESS PRI L
- HYD PRESS PRI C1
- HYD PRESS PRI C2
- HYD PRESS PRI R
- HYD PRESS DEM L
- HYD PRESS DEM C1
- HYD PRESS DEM C2
- HYD PRESS DEM R.

These advisory messages do not show for a demand pump when the demand pump selector is in AUTO and there is no control signal from HYDIM to operate the pump.

Also, these advisory messages do not show if the system pressure is low.

HYDRAULIC INDICATING SYSTEM - PRESSURE INDICATING

Status messages show if there is a signal for a pump to operate and the pump pressure is less than 1200 psi for ACMPs or 1800 psi for ADPs and EDPs. These are the status messages:

- HYD PUMP PRI L
- HYD PUMP PRI C1
- HYD PUMP PRI C2
- HYD PUMP PRI R
- HYD PUMP DEM L
- HYD PUMP DEM C1
- HYD PUMP DEM C2
- HYD PUMP DEM R.

These status messages also show if there is a pump overheat condition.

The status and advisory low pressure messages for the EDPs do not show if the related engine speed for the EDP is less than idle.

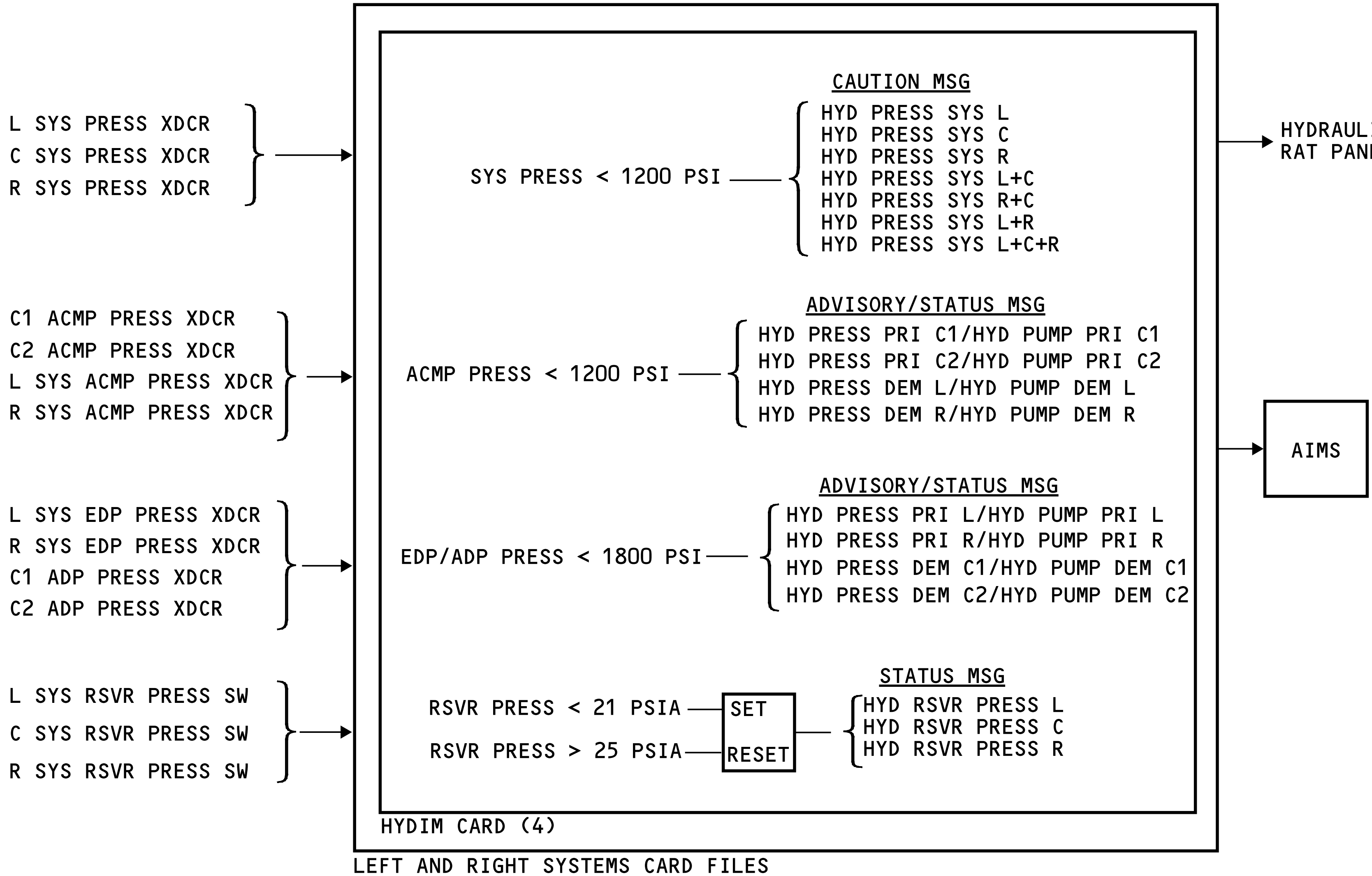
Low pump pressure also makes the pump fault light on the hydraulic control panel come on. The pump fault light does not come on for a demand pump when the demand pump selector is in AUTO and there is no control signal from HYDIM to operate the pump.

Reservoir Pressure Indications

Hydraulic reservoir pressure (LO or NORM) shows on the hydraulic maintenance page. LO shows when the pressure is 21 psia or less. NORM shows when the pressure is 25 psia or more.

These status messages show if the hydraulic reservoir pressure is low:

- HYD RSVR PRESS L
- HYD RSVR PRESS C
- HYD RSVR PRESS R.



29-30-00-004 Rev 6 11/25/1996

HYDRAULIC INDICATING SYSTEM - PRESSURE INDICATING

HYDRAULIC INDICATING SYSTEM - TEMPERATURE INDICATING

General

Temperature transducers for each hydraulic reservoir and each hydraulic pump send temperature data to the HYDIM cards. The HYDIM cards control temperature indication.

Sensor Functional Description

The temperature transducers are RTD (resistance temperature detector) type transducers. The transducer signal is from 4 to 20 milliamperes for temperatures between -54C and 149C (-63.6F to 300F).

Hydraulic Pump Temperature Indication

Hydraulic pump temperatures in degrees C show on the hydraulic maintenance page.

These advisory messages show if pump temperature is more than 105C:

- HYD OVERHEAT PRI L
- HYD OVERHEAT PRI C1
- HYD OVERHEAT PRI C2
- HYD OVERHEAT PRI R
- HYD OVERHEAT DEM L
- HYD OVERHEAT DEM C1
- HYD OVERHEAT DEM C2
- HYD OVERHEAT DEM R

These messages go away when the pump temperature is less than 75C.

These status messages show for a pump overheat condition:

- HYD PUMP PRI L
- HYD PUMP PRI C1
- HYD PUMP PRI C2
- HYD PUMP PRI R
- HYD PUMP DEM L
- HYD PUMP DEM C1
- HYD PUMP DEM C2
- HYD PUMP DEM R

These messages go away when the pump temperature is less than 100C with normal pump pressure for 10 seconds (for the EDPs) or 60 seconds (for the ACMPs and ADPs).

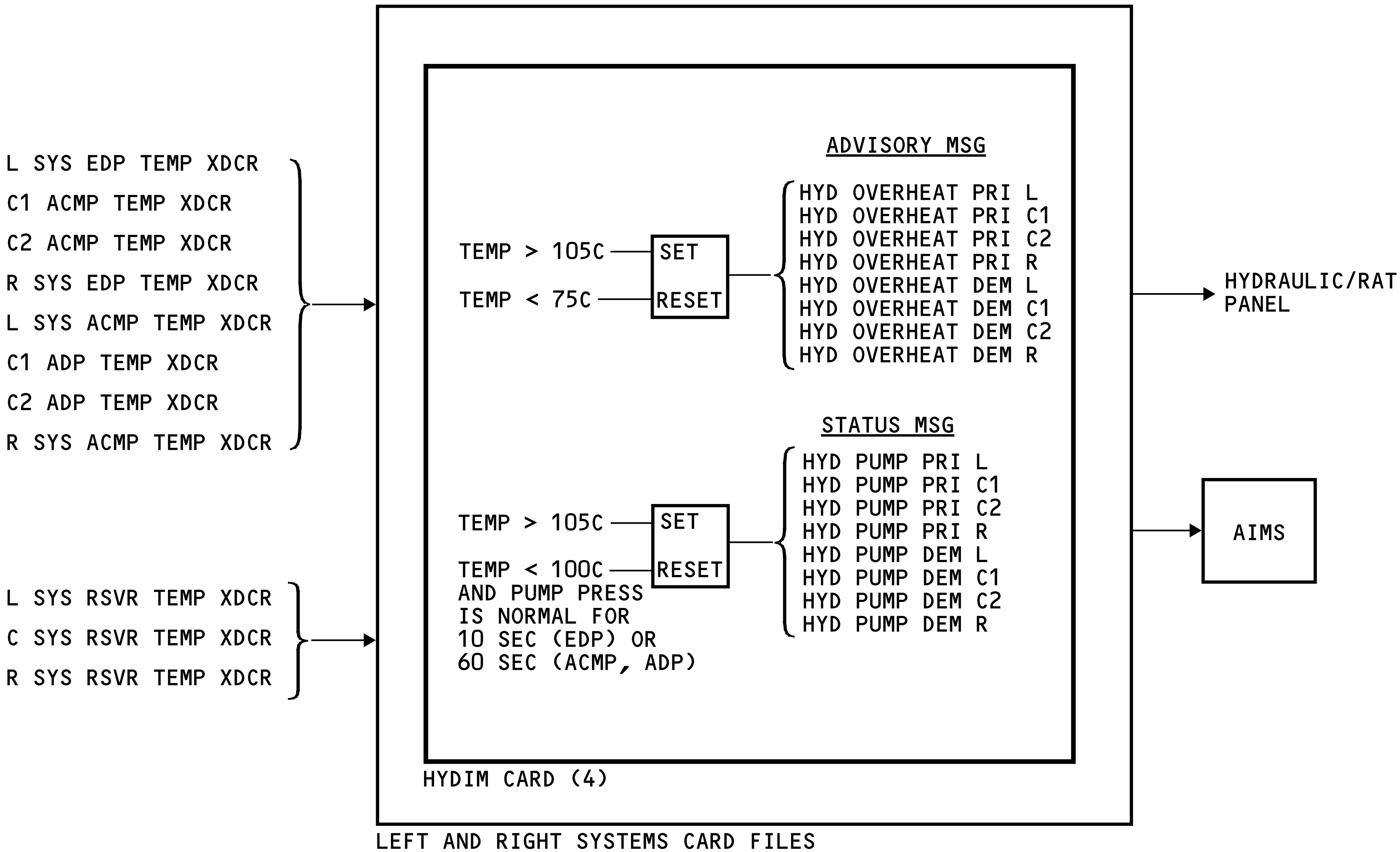
These indications also show for a pump overheat:

- Fault light on P5 hydraulic/RAT panel
- OVHT next to the pump symbol on the hydraulic synoptic display.

Hydraulic Reservoir Temperature Indication

Reservoir temperature in degrees C shows on the hydraulic maintenance page. There are no reservoir overheat indications.

CAUTION: DO NOT OPERATE THE HYDRAULIC PUMPS AFTER THE TEMPERATURE INDICATION ON EICAS IS MORE THAN 100C (212F) OR AFTER THE PUMP FAULT LIGHT COMES ON. IF YOU CONTINUE TO OPERATE THE PUMPS, THE HYDRAULIC FLUID CAN BECOME TOO HOT.



29-30-00-005 Rev 5 11/25/1996

HYDRAULIC INDICATING SYSTEM - TEMPERATURE INDICATING

HYDRAULIC INDICATING SYSTEM - FLUID QUANTITY INDICATING

General

A quantity transmitter in each of the hydraulic reservoirs measures fluid quantity. Reservoir quantity data goes to the HYDIM cards.

Functional Description

The reservoir quantity transmitters are capacitance-type transmitters. They send a signal to the HYDIM cards in proportion to reservoir fluid quantity. The HYDIM cards send reservoir quantity signals to the AIMS and to the reservoir quantity gage in the hydraulic service bay.

The reservoir quantity indication makes allowance for temperature changes to prevent nuisance refill and overfill indications.

Indication

Reservoir quantities show on these MFD formats:

- Status display
- Hydraulic synoptic display
- Maintenance page.

Quantity indication shows as a decimal number. The reservoir full level shows as 1.00.

If the reservoir quantity is 1.20 or more, an OF (overfill) shows next to the quantity indication on the status display, the hydraulic synoptic display and the hydraulic maintenance page. The OF shows only when the airplane is on the ground.

If reservoir quantity is 0.75 or less, an RF (refill) shows next to the quantity indication on the status display, the hydraulic synoptic display, and the hydraulic maintenance page. The RF shows only when the airplane is on the ground.

If reservoir quantity is 0.40 or less, a LO shows next to the quantity indication on the status display, the hydraulic synoptic display, and the hydraulic maintenance page.

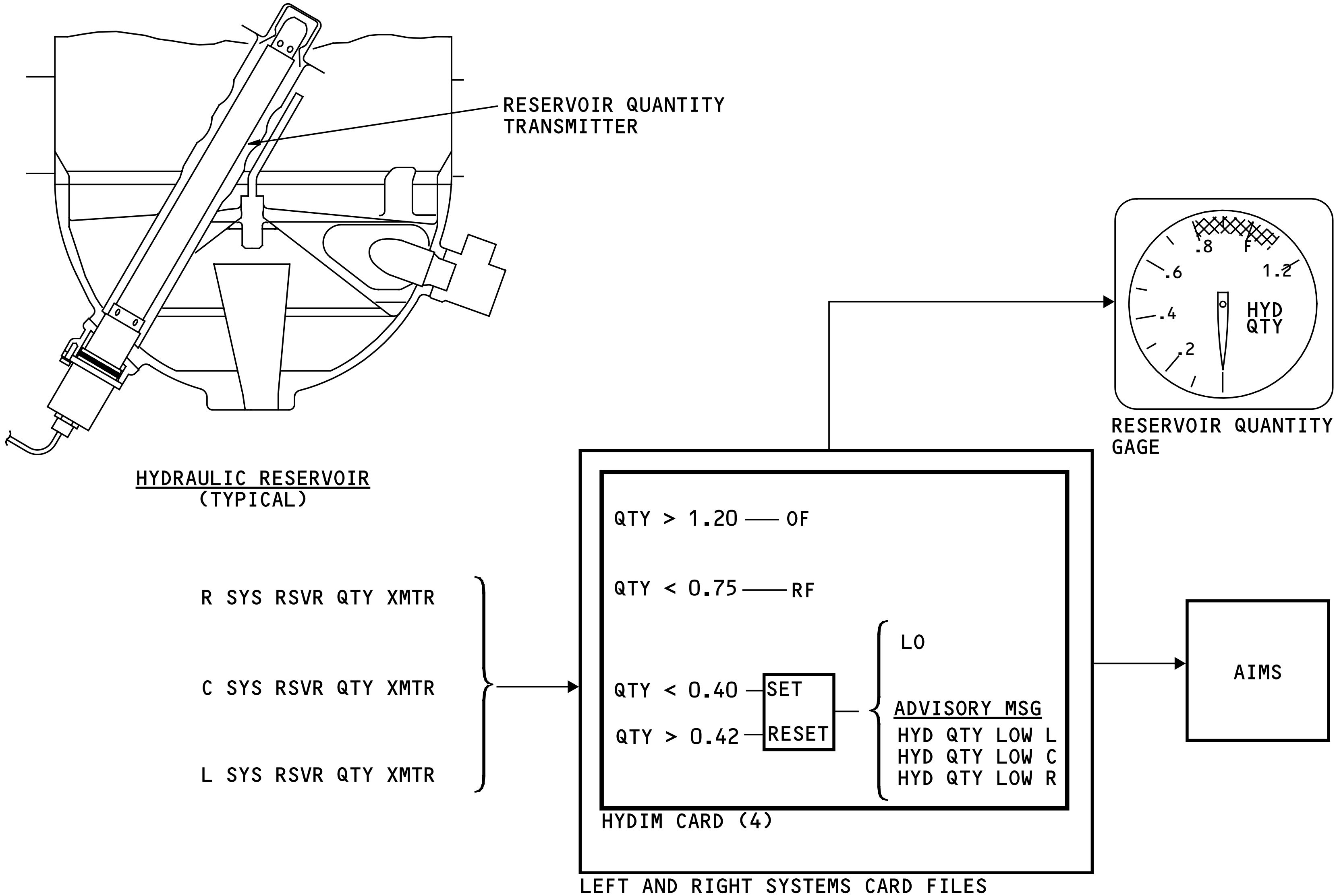
These advisory messages show if reservoir quantity is 0.40 or less:

- HYD QTY LOW L
- HYD QTY LOW C
- HYD QTY LOW R.

The advisory messages and the LO indication reset when the quantity is more than 0.42.

Training Information Point

If the reservoir fluid level is at the top of the standpipe, the quantity indication shows 0.00.



29-30-00-006 Rev 2

HYDRAULIC INDICATING SYSTEM - FLUID QUANTITY INDICATING

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MAIN HYDRAULIC SYSTEMS - TRAINING INFORMATION POINTS - GROUND SERVICING SYSTEM

General

A central fill station in the ground service bay permits you to fill the three hydraulic reservoirs from a single location.

Components

Hydraulic servicing components include:

- Manual pump handle
- Manual pump suction hose
- Pressure fill connection
- Reservoir fill manual pump
- Reservoir fill filter
- Reservoir fill quantity gage
- Reservoir fill selector valve
- Instruction placard.

You set the four-position fill selector valve to send hydraulic fluid to one of the three hydraulic systems. The valve is set to OFF after servicing.

The reservoir fill quantity gage shows the reservoir quantity of the selected hydraulic system.

The reservoir fill filter cleans the fluid that goes into the hydraulic systems.

The reservoir fill manual pump permits you to fill the hydraulic systems manually.

The pressure fill connection permits the connection of a ground service cart to fill the hydraulic systems. A cap covers the connection when not in use.

You use the manual pump suction hose during manual fill operation. One end of the hose connects to the manual pump. The other end of the hose goes in the hydraulic fluid container. When not in use, you put the end of the suction hose in a protective cover.

You use the manual pump handle to operate the manual pump. You put the pump handle next to the suction hose when not in use.

Training Information Point

To get the correct results when you do a check of the hydraulic fluid quantities or fill the reservoirs, the airplane should be in this condition:

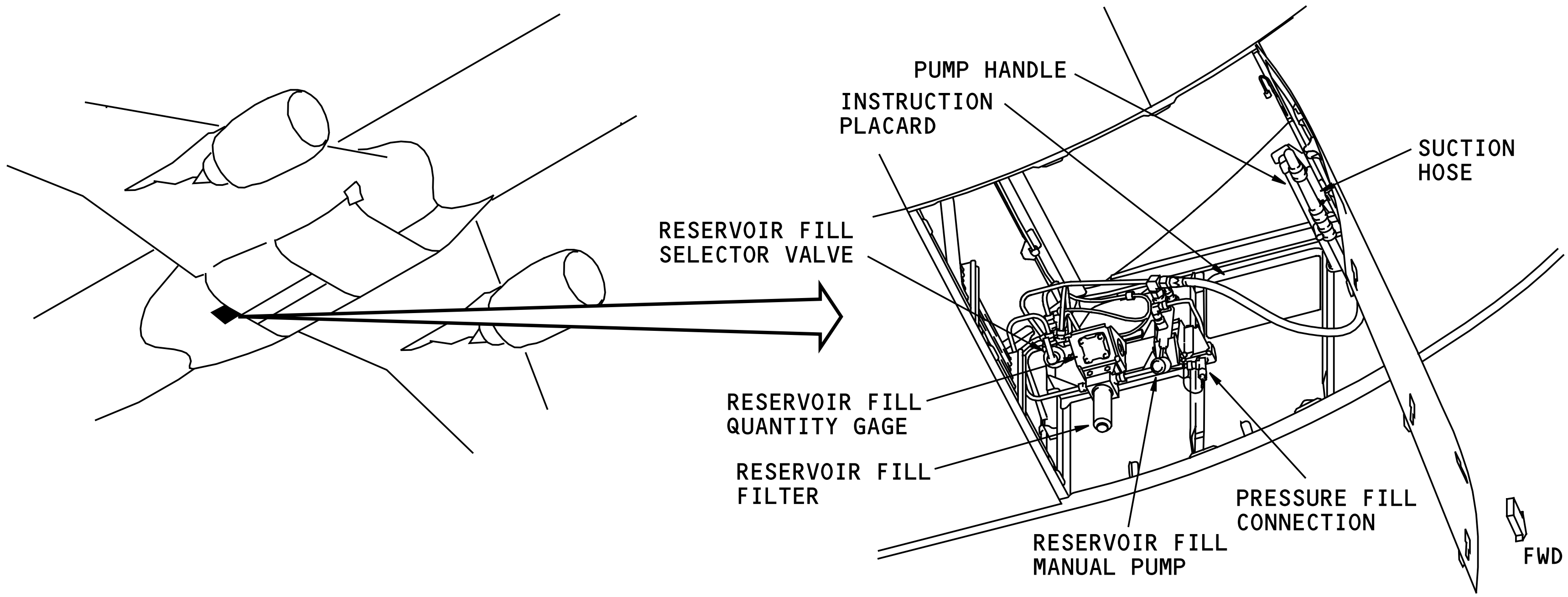
- Spoilers retracted
- Landing gear down
- Landing gear doors closed
- Thrust reversers retracted
- Parking brake accumulator pressure at least 2500 psi.

WARNING: DO NOT GET HYDRAULIC FLUID IN YOUR EYES OR ON YOUR SKIN. THE HYDRAULIC FLUID CAN CAUSE INJURY TO PERSONS. IF YOU GET THE HYDRAULIC FLUID ON YOUR SKIN, FLUSH YOUR SKIN WITH

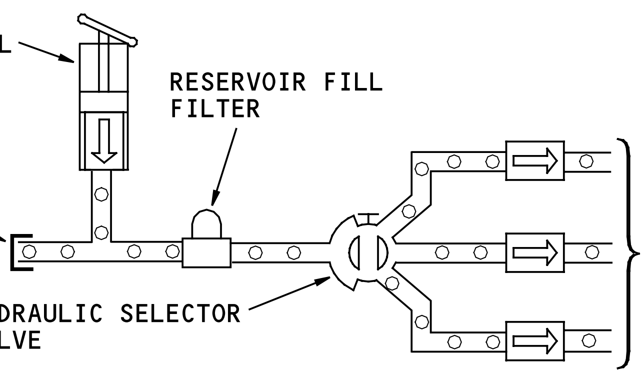
WATER. IF YOU GET THE HYDRAULIC FLUID IN YOUR EYES, FLUSH YOUR EYES WITH WATER AND GET MEDICAL AID. IF YOU GET THE HYDRAULIC FLUID IN YOUR MOUTH, GET MEDICAL AID.

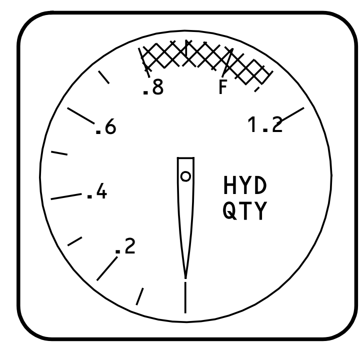
CAUTION: USE CLEAN HYDRAULIC FLUID AND CLEAN EQUIPMENT TO FILL THE HYDRAULIC SYSTEM RESERVOIR. IF YOU DO NOT DO THIS YOU CAN CAUSE CONTAMINATION OF THE HYDRAULIC SYSTEM.

CAUTION: DO NOT FILL THE RESERVOIR TO MORE THAN THE FULL LEVEL. IF YOU PUT TOO MUCH FLUID IN THE RESERVOIR AND THERE IS A CHECK VALVE FAILURE, THE FLUID CAN GO INTO THE DUCTS OF THE PNEUMATIC SYSTEM AND THE AIR CONDITIONING PACKS. IF CONTAMINATION OF THE PNEUMATIC SYSTEM OCCURS MANY TIMES, IT CAN CAUSE DAMAGE TO THE TITANIUM DUCTS. IF YOU PUT TOO MUCH FLUID IN THE RESERVOIR, THE FLUID CAN FLOW OUT OF THE RESERVOIR VENT TUBE, THROUGH THE PRESSURE RELIEF VALVE.



HYDRAULIC GROUND SERVICE BAY





RESERVOIR FILL QTY GAGE

29-18-00-001 Rev 1

MAIN HYDRAULIC SYSTEMS - TRAINING INFORMATION POINTS - GROUND SERVICING SYSTEM

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HYDRAULIC POWER - OPERATION

General

You can pressurize the hydraulic systems with a ground service cart or with the hydraulic pumps.

Ground Service Cart Pressurization

The ground pressurization connections for the left system are in the left engine strut.

The ground pressurization connections for the right system are in the right engine strut.

You get access to these connections through the aft strut fairing doors on the right side of each engine strut.

The ground pressurization connections for the center hydraulic system are in the left wing to body fairing behind the left wheel well.

You get access to these connections through the ADP filter module access door.

Hydraulic Pump Pressurization

You use the Hydraulic/RAT panel on the P5 overhead panel to turn on the hydraulic pumps.

Training Information Point

If you pressurize the hydraulic systems with the hydraulic pumps, make sure there is sufficient fuel in the main fuel tanks to cool the heat exchangers. Approximately 709 gallons (2688 liters) (4794 pounds) (2175 kg) of fuel in the left and right main fuel tanks is necessary to cool the heat exchangers in the left and right hydraulic systems. Approximately 1080 gallons (4095 liters) (7303 pounds) (3313 kg) of fuel in the right main tank is necessary to cool the center system heat exchanger.

To pressurize a hydraulic system with a ground service cart, you first need to remove the pressure from the hydraulic reservoir.

The sequence in which you pressurize or remove the pressure from the hydraulic systems can cause fluid to move between the center and right systems. This can cause a high fluid level in one system and a low fluid level in the other system.

If you set the parking brake in one of these conditions:

- The right and center system pressurized
- Only the right pressurized
- No hydraulic system pressurized

and then release the brake with only the center system pressurized, the fluid can move to the center system.

If you set the parking brake with only the center system pressurized, and then release the brake in one of these conditions:

HYDRAULIC POWER - OPERATION

- The right and center system depressurized
- Only the right system pressurized
- No hydraulic system pressurized

the fluid can move to the right system.

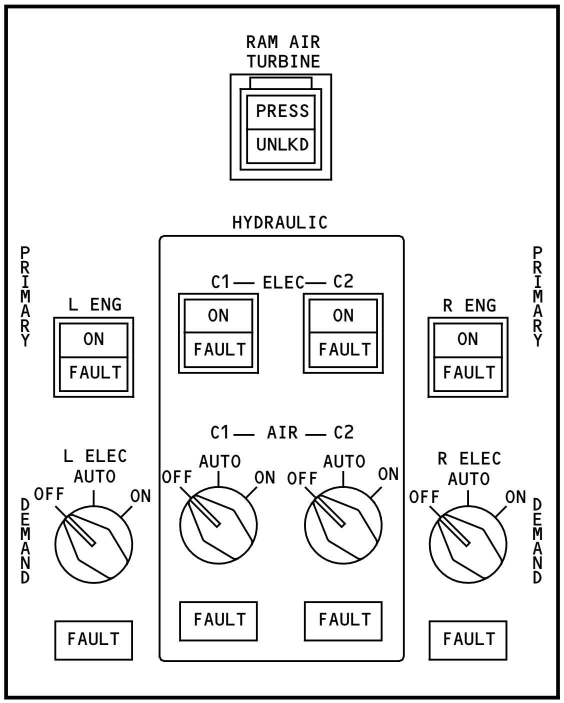
To keep the movement of fluid between the right and center hydraulic systems to a minimum, do these steps:

- Pressurize the right hydraulic system first
- Remove the pressure from the right hydraulic system last.

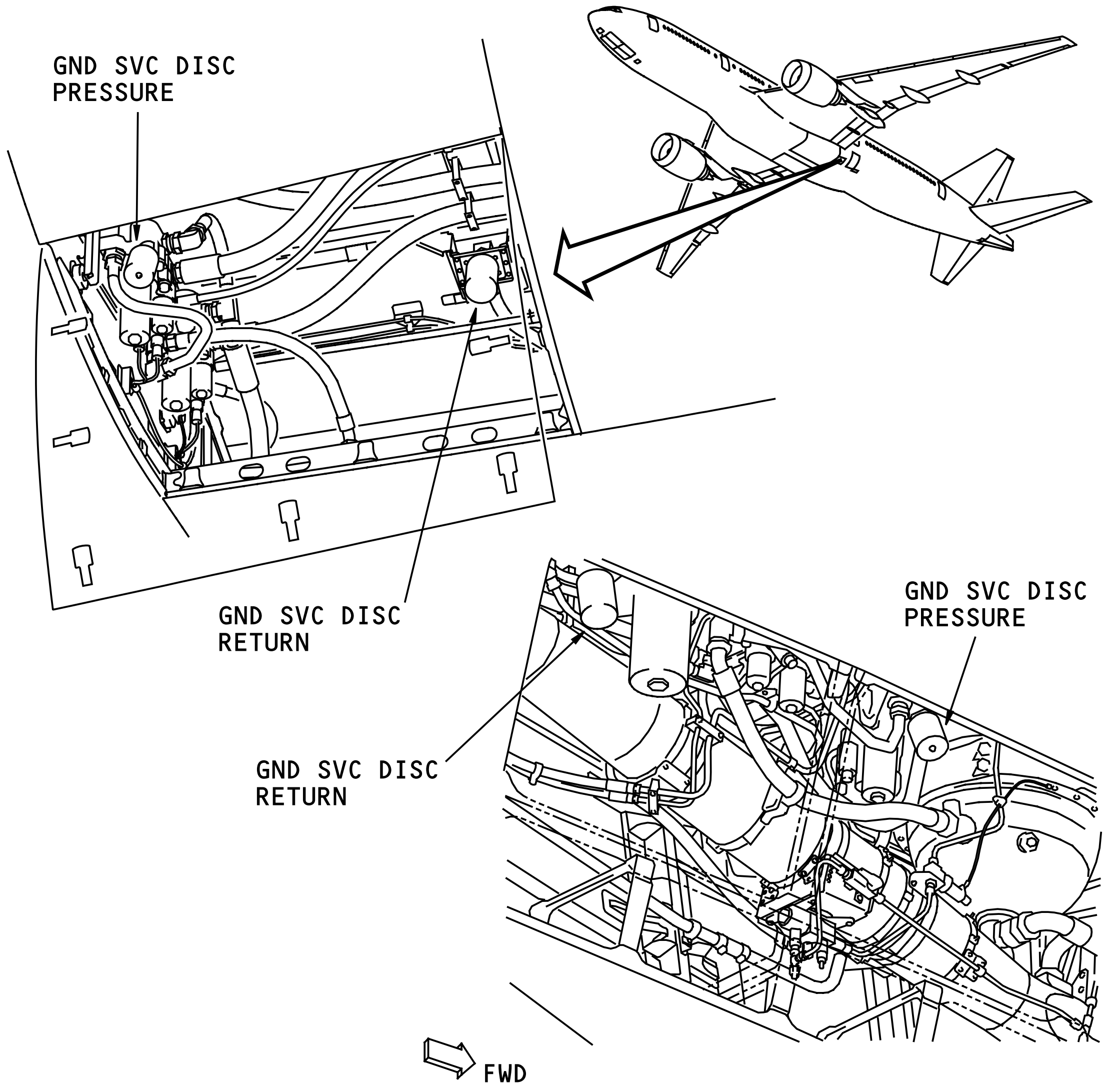
WARNING: KEEP PERSONS AND EQUIPMENT CLEAR OF THE FLIGHT CONTROL SURFACES, THE THRUST REVERSERS, THE LANDING GEAR, AND THE DOORS FOR THE MAIN LANDING GEAR. THESE COMPONENTS CAN MOVE SUDDENLY WHEN YOU SUPPLY HYDRAULIC POWER. THIS CAN CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

CAUTION: WHEN YOU PRESSURIZE THE MAIN HYDRAULIC SYSTEMS, CAREFULLY MONITOR THE HYDRAULIC INDICATING SYSTEMS IN THE FLIGHT COMPARTMENT TO MAKE SURE THE SYSTEMS OPERATE SATISFACTORILY. IF THE HYDRAULIC FLUID BECOMES TOO HOT, STOP OPERATION OF THE SYSTEM.

CAUTION: DO NOT OPERATE THE HYDRAULIC PUMPS AFTER THE HYDRAULIC TEMPERATURE INDICATION IS MORE THAN 100C (212F) OR AFTER THE PUMP FAULT LIGHT COMES ON. IF YOU CONTINUE TO OPERATE THE PUMPS, THE HYDRAULIC FLUID CAN BECOME TOO HOT.



HYDRAULIC/RAT PANEL (P5)



ENGINE STRUT - RIGHT SIDE

29-00-00-003 Rev 3

HYDRAULIC POWER - OPERATION

HYDRAULIC POWER - INDICATIONS

General

Hydraulic system data shows on these displays:

- Status display
- Hydraulic synoptic display
- Hydraulic maintenance page.

Status Display

The status display shows the pressure (psi) and the hydraulic reservoir fluid quantity (percent) for each hydraulic system.

Hydraulic Synoptic

The hydraulic synoptic display shows a real time picture of the conditions in the three hydraulic systems.

The hydraulic synoptic display shows these data for normal hydraulic system operation:

- Hydraulic system pressures (psi)
- Hydraulic reservoir fluid quantities (percent)
- Hydraulic pump status (green symbol - pump pressurized, white symbol - pump not pressurized)
- Hydraulic system valve positions (open - green, closed - white).

Green flow lines go from the reservoir symbols through the pump symbols when the pumps operate.

The synoptic display also shows these non-normal conditions:

- Pump failure (amber symbol)
- Valve failure (amber symbol)
- Pump overheat condition (amber OVHT).

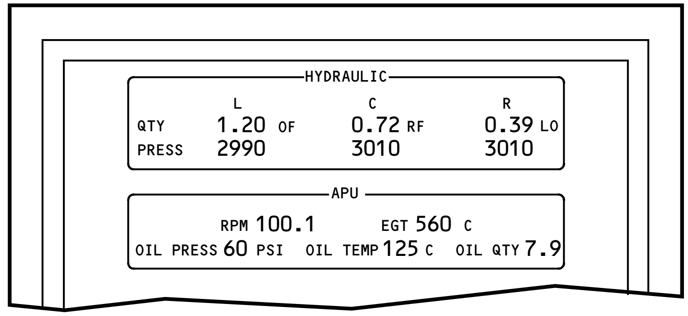
Hydraulic Maintenance Page

The hydraulic maintenance page shows for each system:

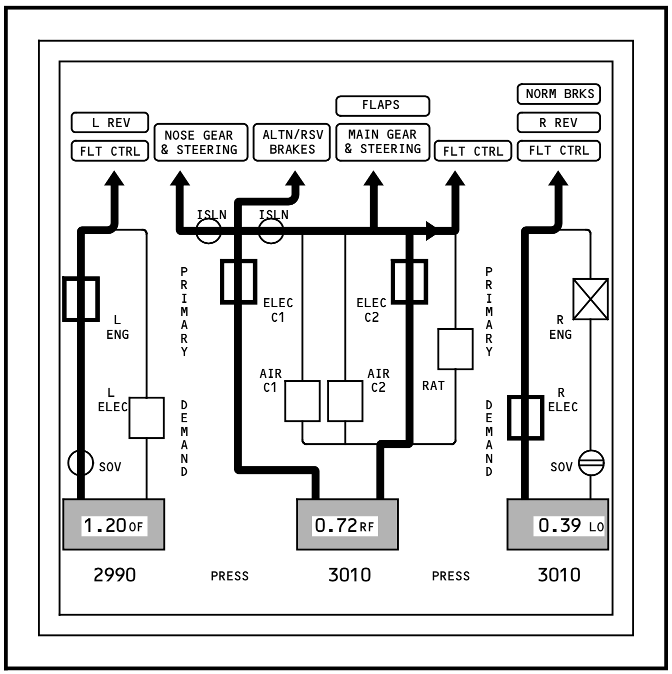
- Hydraulic system pressures (psi)
- Hydraulic primary and demand pump data (pressure in psi, temperature in degrees C, selector position, and run status)
- RAT pump data (pressure in psi, speed in RPM, and position)
- Hydraulic system reservoir data (quantity in percent, pressure in psi, temperature in degrees C)
- Flight control shutoff valve positions
- Reserve and nose gear isolation valve positions.

Training Information Point

When the hydraulic pumps are off, the system pressure indication shows the pressure in the hydraulic reservoirs.



STATUS DISPLAY



HYDRAULIC SYNOPTIC DISPLAY

HYDRAULIC

		L	C		R
			1	2	
SYSTEM PRESS:		2990	3010		3010
PRIMARY PUMP:	PRESS	3050	2980	2980	50
	TEMP	103	75	75	55
	SEL	ON	ON	ON	ON
	RUN	--	YES	YES	--
	S/O VLV	OPEN	--	--	CLOSED
DEMAND PUMP:	PRESS	50	50	40	3020
	TEMP	20	20	20	45
	SEL	AUTO	AUTO	AUTO	AUTO
	RUN	NO	NO	NO	YES
RAT PUMP:	PRESS	--	2950		--
	RPM	--	4550		--
	POS	--	NOT STOWED		--
RESERVOIR:	QTY	1.20 OF	0.72 RF		0.39LO
	PRESS	NORM	NORM		LOW
	TEMP	90	55		30
F/C S/O VLV:	TAIL	NORM	NORM		CLOSED
	WING	NORM	NORM		NORM
RESERVE ISLN:	VALVE POS	--	NORM		--
NOSE GR ISLN:	VALVE POS	--	NORM		--

HYDRAULIC MAINTENANCE PAGE

29-00-00-004 Rev 3 05/03/95

HYDRAULIC POWER - OPERATIONAL TESTS

General

These are the operational tests for the hydraulic system:

- Air Driven Pump (ADP) (C1)
- Air Driven Pump (ADP) (C2)
- Center hydraulic isolation system (CHIS) test
- Heaters test
- Landing gear auto-off relay A test
- Landing gear auto-off relay B test.

Air Driven Pump Tests

The ADP tests are interactive tests to test the operation of each ADP. These functions are tested during these tests:

- Overspeed protection
- Secondary speed control
- Reserve power
- Auto/On control
- ADP heater operation
- Pressure and temperature indication.

These tests also reset an ADP after an overspeed shutdown.

Center Hydraulic Isolation System (CHIS) Test

This test makes sure CHIS control and indications operate normally. Both isolation valves close and open during this test.

Heaters Test

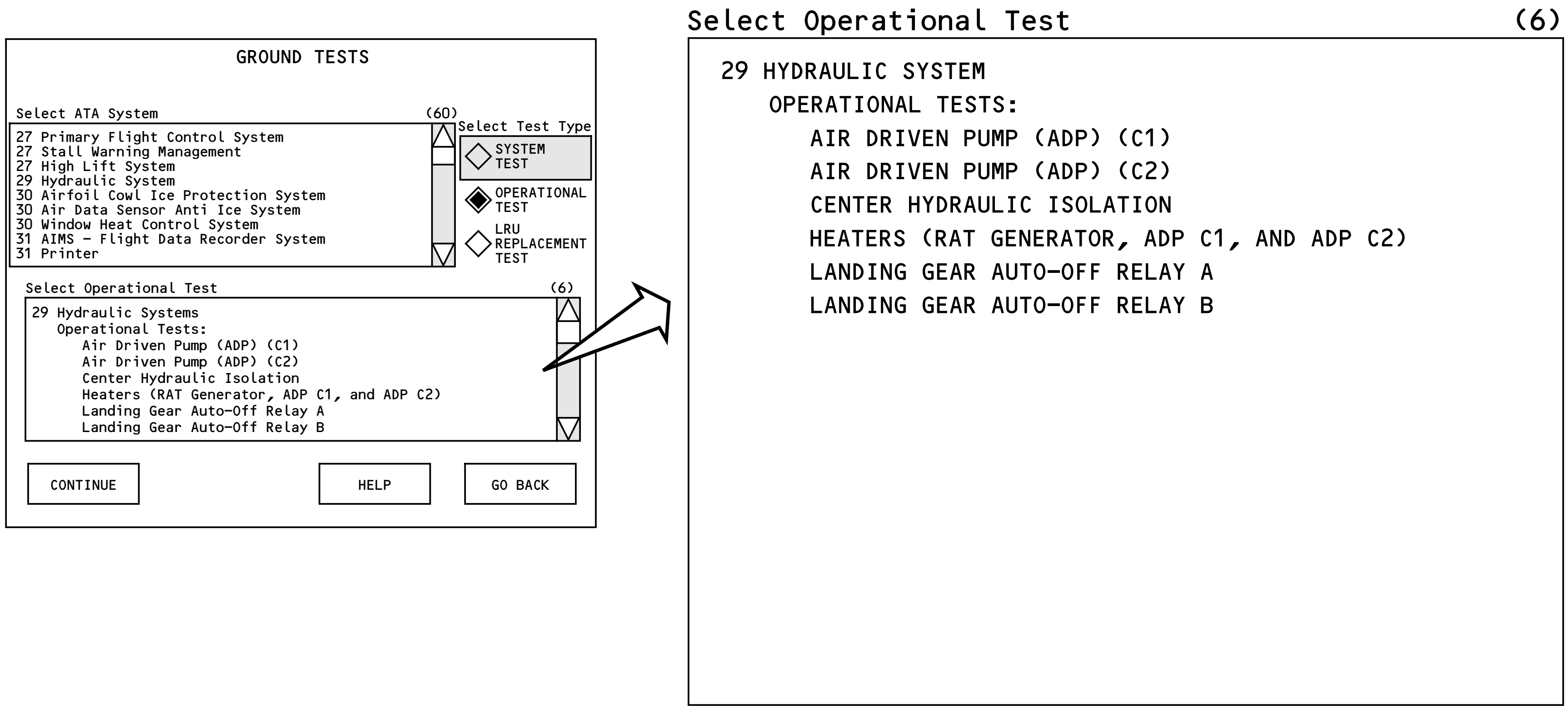
The heaters test makes sure that the RAT heater and the ADP heaters operate normally. This test starts the heaters, then stops them again.

Landing Gear Auto-Off Relay Tests

These tests make sure the landing gear auto-off relays operate correctly. The relays are energized and de-energized during the tests.

Training Information Point

Pneumatic power is necessary to do the air driven pump test.



29-00-00-006 Rev 2 01/10/96

HYDRAULIC POWER - OPERATIONAL TESTS

HYDRAULIC POWER - LRU REPLACEMENT TESTS

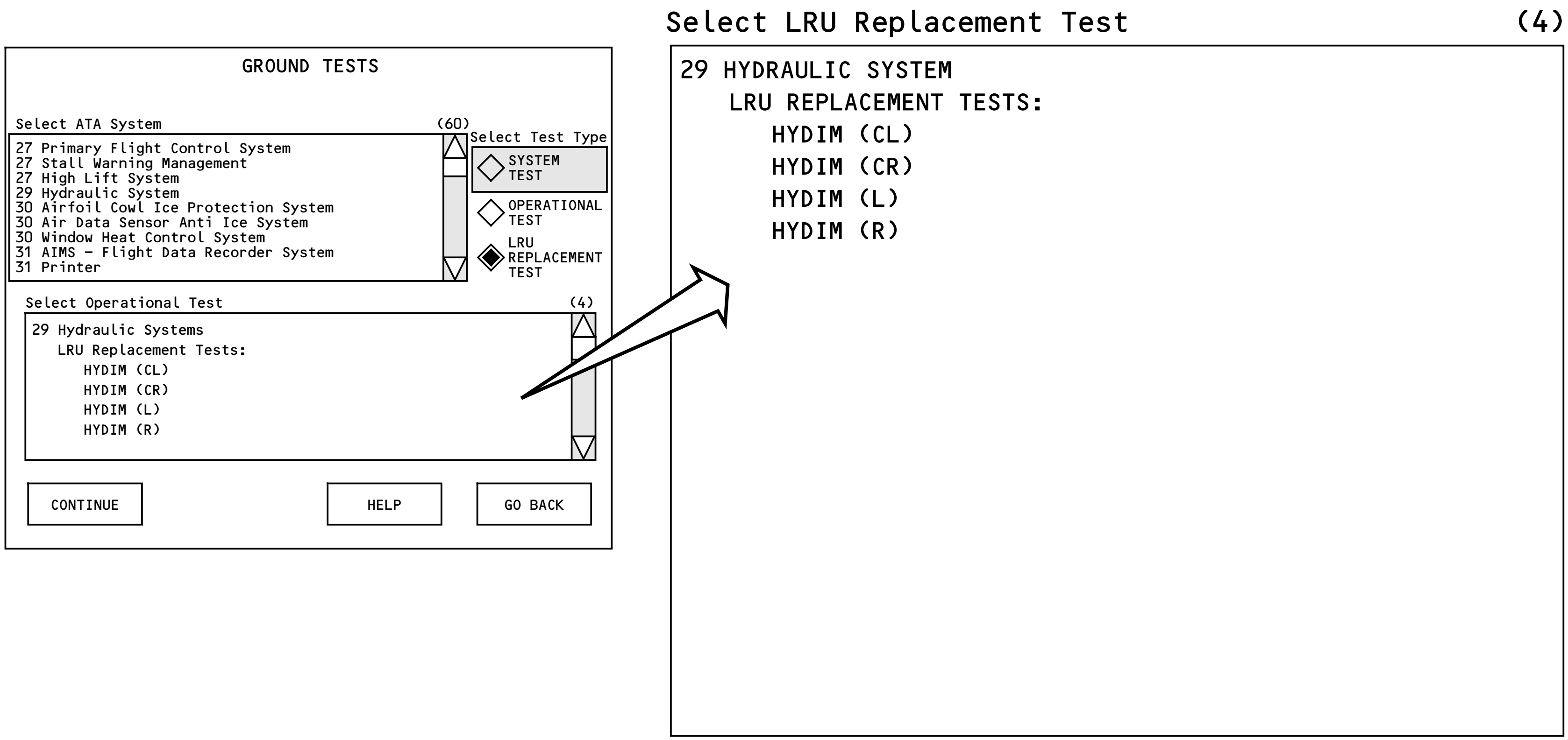
General

These are the LRU replacement tests for the hydraulic systems:

- HYDIM CL LRU replacement test
- HYDIM CR LRU replacement test
- HYDIM L LRU replacement test
- HYDIM R LRU replacement test.

HYDIM LRU Replacement Tests

A HYDIM LRU replacement test for each of the four HYDIM cards does a test of the HYDIM cards.



29-00-00-007 Rev 1 10/18/96

HYDRAULIC POWER - LRU REPLACEMENT TESTS

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MAIN HYDRAULIC SYSTEMS - HYDRAULIC SYSTEM SUMMARY

General

Three independent hydraulic systems supply hydraulic power to airplane systems.

Left Hydraulic System

An EDP is the primary pump for the left hydraulic system. An ACMP is the demand pump for the left hydraulic system.

The left hydraulic system supplies hydraulic power to these systems:

- Flight controls
- Left thrust reverser.

Right Hydraulic System

An EDP is the primary pump for the right hydraulic system. An ACMP is the demand pump for the right hydraulic system.

The right hydraulic system supplies hydraulic power to these systems:

- Flight controls
- Right thrust reverser
- Normal brake system.

Center Hydraulic System

Two ACMPs are the primary pumps for the center hydraulic system. Two ADPs are the demand pumps for the center hydraulic system. A ram air turbine is an emergency source of hydraulic pressure for the center system primary flight controls.

The center hydraulic system supplies hydraulic power to these systems:

- Flight controls
- Leading edge slats
- Trailing edge flaps
- Landing gear actuation
- Alternate and reserve brakes system
- Normal and reserve nose landing gear steering
- Main landing gear steering.

Hydraulic System Servicing

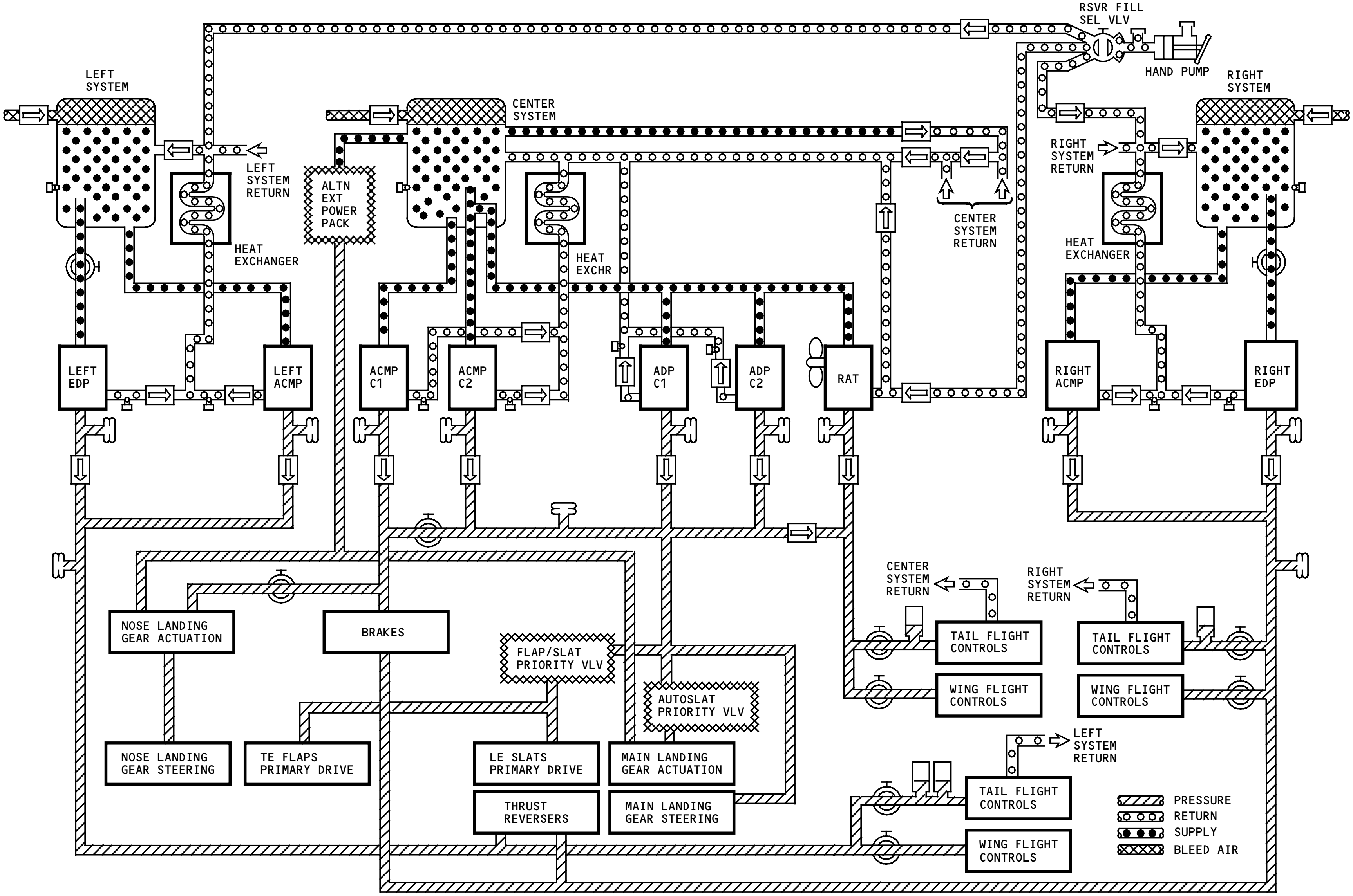
A service bay permits you to fill the three hydraulic systems from a single location.

Hydraulic System Indications

Pressure, temperature, and quantity sensors supply this hydraulic system data:

- System pressures
- Pump pressures
- Reservoir pressures
- Pump temperatures

- Reservoir temperatures
- Reservoir quantities.



MAIN HYDRAULIC SYSTEMS - HYDRAULIC SYSTEM SUMMARY

29-00-00-008 Rev 3 08/12/95

Continental Airlines, Inc

Landing Gear

WB371

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LANDING GEAR - INTRODUCTION

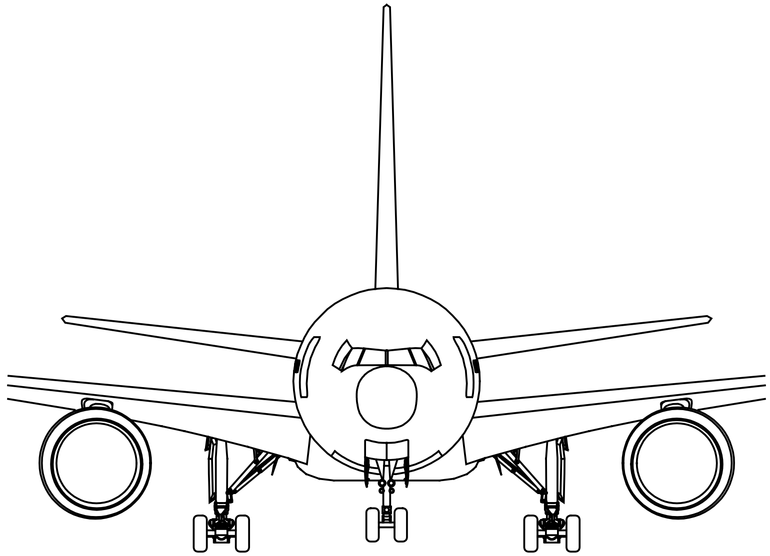
General

These are the landing gear systems (ATA chapter 32):

- Landing Gear - General (32-00, 32-10, 32-20), (32-30)
- Proximity Sensor System (PSS) (32-08)
- Landing Gear (LG) Position Indication and Warning System (32-61)
- Tail Strike System (TSS) (32-71)
- Air/Ground System (AGS) (32-09)
- Steering (32-50)
- Wheels and Brakes (32-40).

Abbreviations and Acronyms

actr - actuator
AGS - air/ground system
altn - alternate
APU - auxiliary power unit
ARINC - Aeronautical Radio, Inc.
ATA - air transport association
bat - battery
ctr - center
ctrl - control
ELMS - electrical load management system
ext - extension
fwd - forward
gnd - ground
gr - gear
hyd - hydraulic
HYDIM - hydraulic interface module
ind - indicator
L - left
LDG - landing
LG - landing gear
lk - lock
lts - lights
MFD - multi-function display
mod - module
mot - motor
NG - nose gear
MLG - main landing gear
NLG - nose landing gear
opr - operated
press - pressure
PSEU - proximity sensor electronics unit
PSI - pounds per square inch
PSS - proximity sensor system
PTT - press-to-test
R - right
ref - reference
ret - retraction
seq - sequence
sol - solenoid
stby - standby
sw - switch
sys - system
TSS - tail strike system
vlv - valve



LANDING GEAR - GENERAL

PROXIMITY SENSOR SYSTEM (PSS)

TAIL STRIKE SYSTEM

STEERING

LG POSITION INDICATING AND WARNING SYSTEM

AIR/GROUND SYSTEM (AGS)

WHEELS AND BRAKES

LANDING GEAR - INTRODUCTION

32-00-00-001 Rev 2 07/20/1995

LANDING GEAR - GENERAL - INTRODUCTION

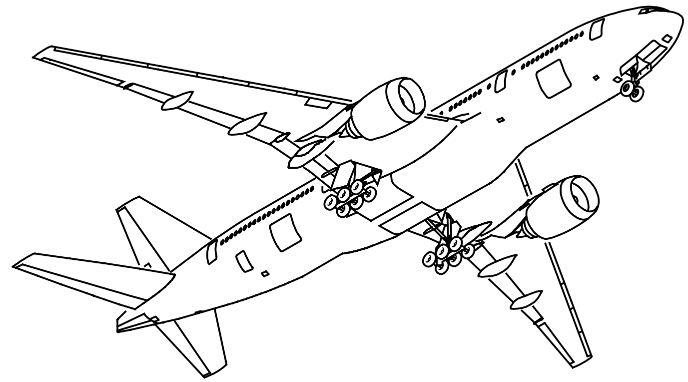
Purpose

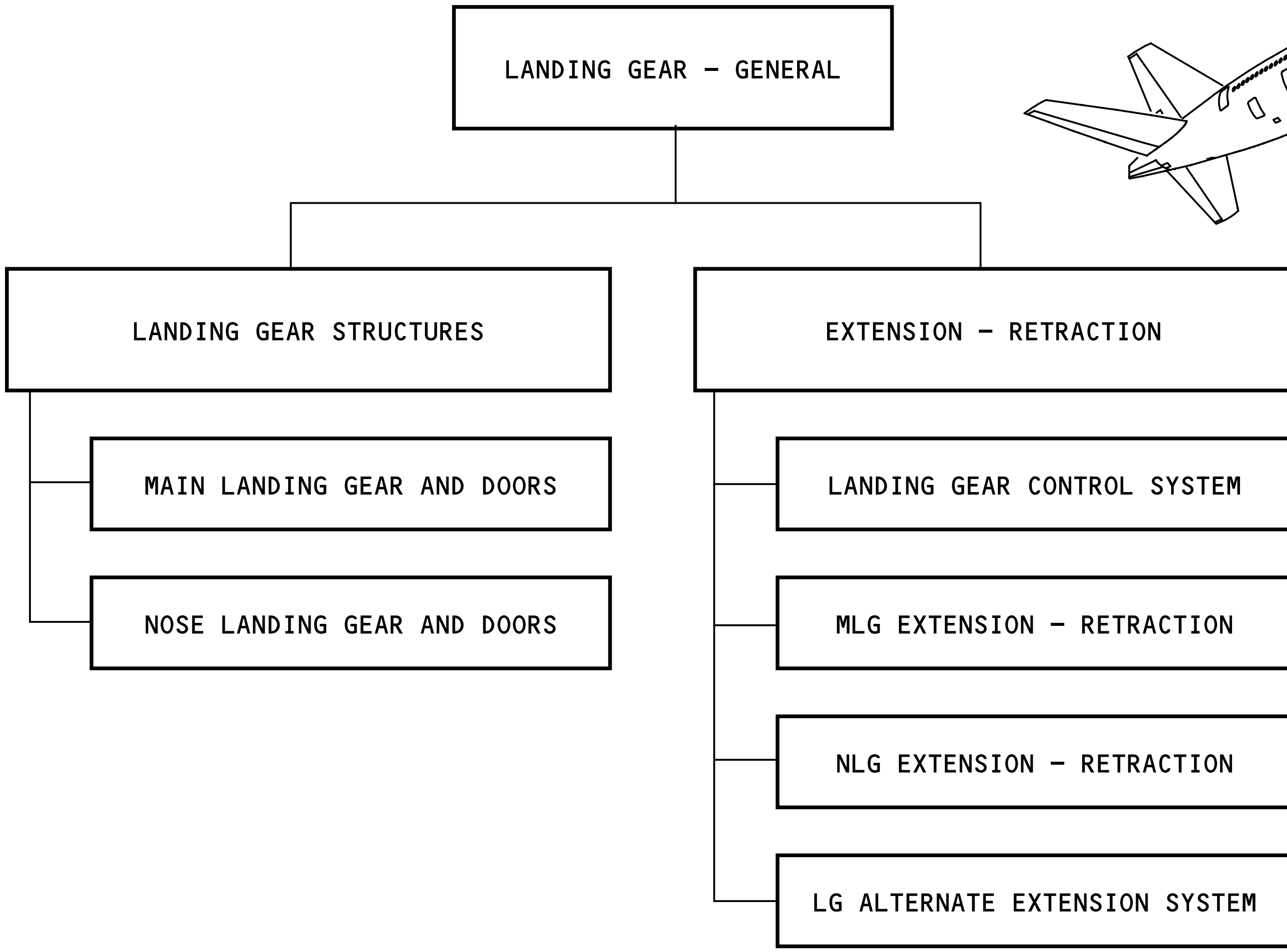
Landing gear structural components hold the weight of the airplane while the airplane is on the ground. These are the landing gear structural systems:

- The main landing gear (MLG) and doors (section 32-10)
- The nose landing gear (NLG) and doors (32-20).

Landing gear extension-retraction systems extends and retracts the landing gear to reduce airplane drag in flight. These are the landing gear extension-retraction systems:

- The landing gear control system (32-31)
- The main landing gear extension and retraction (32-32)
- The nose landing gear extension and retraction (32-34)
- The landing gear alternate extension system (32-35).





32-00-00-002 Rev 0

LANDING GEAR - GENERAL - INTRODUCTION

MAIN LANDING GEAR AND DOORS - INTRODUCTION

General

The two main landing gear absorb landing forces and hold most of the airplane weight when the airplane is on the ground.

The main landing gear doors open to permit MLG operation. The doors close to aerodynamically seal the MLG wheel wells.

Main Landing Gear

Each main landing gear has a six-wheel truck. A drag brace and a side brace hold each gear in the extended position. Lock links hold the drag brace and side brace in the extended position. Over-center toggles, on the lock links, lock the gear in the extended position.

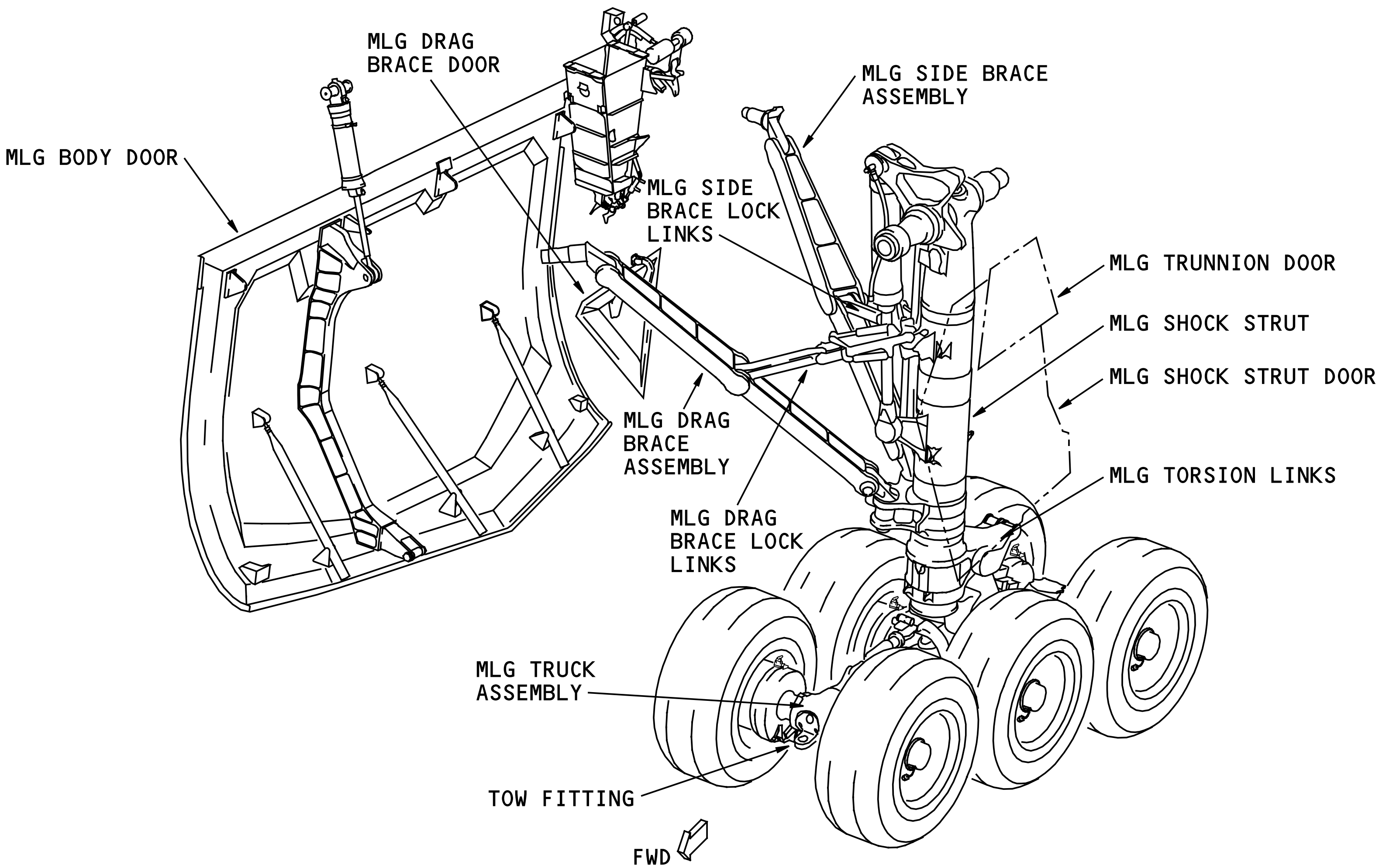
Each main landing gear has these components:

- MLG drag brace assembly
- MLG side brace assembly
- MLG side brace lock links
- MLG drag brace lock links
- MLG torsion links
- MLG truck assembly
- MLG shock strut.

Main Landing Gear Doors

These are the four doors for each main landing gear:

- MLG body door
- MLG drag brace door
- MLG shock strut door
- MLG trunnion door.



<u>LEFT MAIN LANDING GEAR AND DOORS</u>

32-10-00-001 Rev 2 03/28/96

MAIN LANDING GEAR AND DOORS - INTRODUCTION

MAIN LANDING GEAR AND DOORS - SIDE BRACE ASSEMBLY, DRAG BRACE ASSEMBLY, AND LOCK LINKS

General

The MLG side brace assembly and the MLG drag brace assembly hold the main landing gear in the extended position. They also supply lateral support to the main landing gear.

Lock links hold the braces in the down position. Toggles on the lock links hold the lock links in the locked position.

MLG Drag Brace Assembly

The MLG drag brace assembly is on the forward side of each main landing gear. The upper and lower drag braces connect by a hinge.

A spindle on the upper drag brace pivots around a fitting in the forward part of the main gear wheel well.

A spindle on the lower drag brace pivots around a fitting on the main gear shock strut.

MLG Drag Brace Lock Links

The MLG drag brace lock links hold the MLG drag brace when the gear is in the extended position. Upper and lower toggles connect to the upper and lower lock links. These toggles move to an over-center locked position when the gear is down. Two springs hold the toggles in the over-center locked position.

MLG Side Brace Assembly

The MLG side brace assembly is on the aft side of the main landing gear. Upper and lower side braces connect by a hinge.

A spindle on the upper side brace pivots around a fitting in the inboard end of the main landing gear beam.

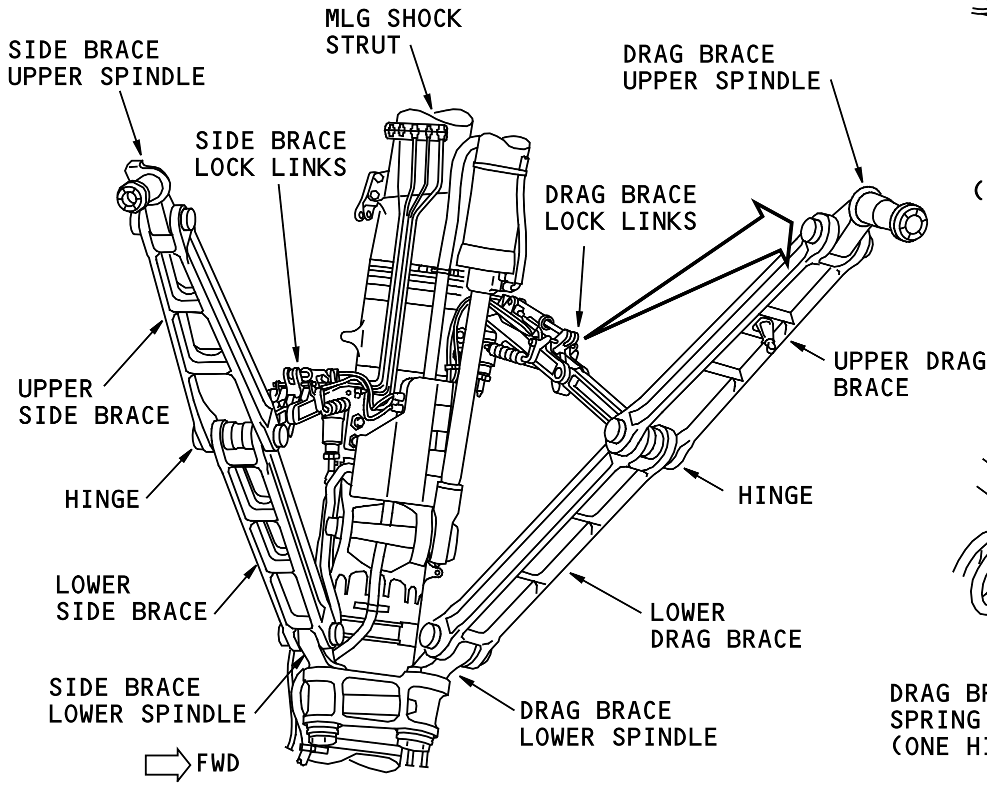
A spindle on the lower side brace pivots around a fitting on the main gear shock strut.

MLG Side Brace Lock Links

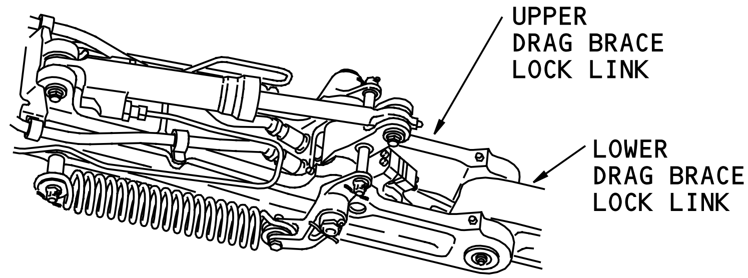
The MLG side brace lock links hold the MLG side brace when the gear is in the extended position. Upper and lower toggles connect to the upper and lower lock links. These toggles move to an over-center locked position when the gear is down. Two springs hold the toggles in the over-center locked position.

Training Information Point

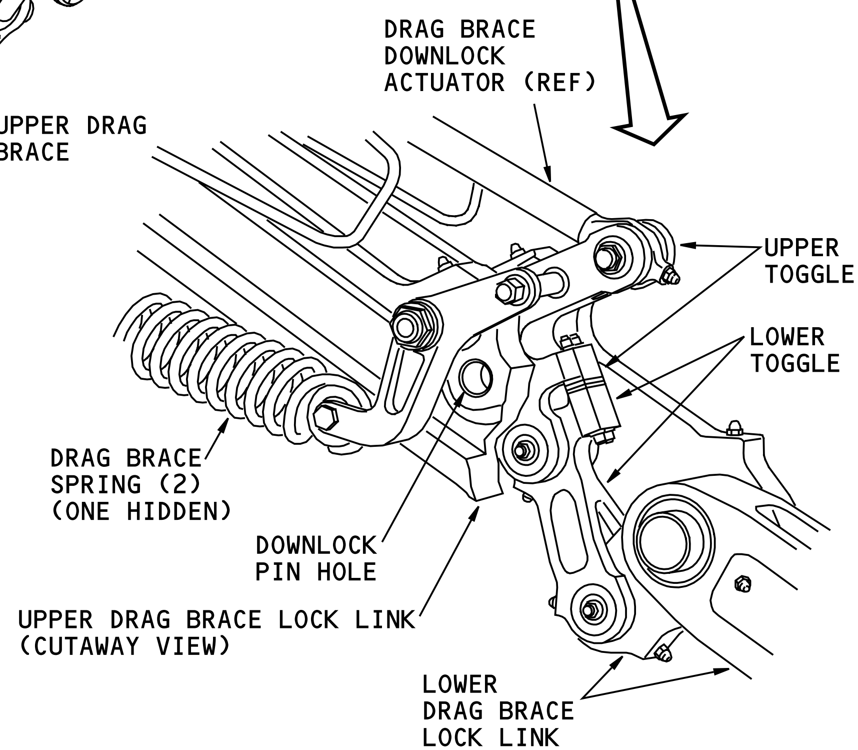
You install downlock pins in the upper side brace lock link and the upper drag brace lock link. Each pin holds the upper toggle and the upper lock link together. The pins prevent MLG retraction.



LEFT MAIN LANDING GEAR
DRAG BRACE AND SIDE BRACE



MLG DRAG BRACE LOCK LINKS
(SIDE BRACE LOCK LINKS SIMILAR)



MAIN LANDING GEAR AND DOORS - SIDE BRACE ASSEMBLY, DRAG BRACE ASSEMBLY, AND LOCK LINKS

MAIN LANDING GEAR AND DOORS - TRUCK ASSEMBLY

General

Each main landing gear truck has these components:

- Axles
- Tow fittings
- Brake rods
- Wheels and tires
- Brakes
- Truck positioner actuator
- Main gear steering components.

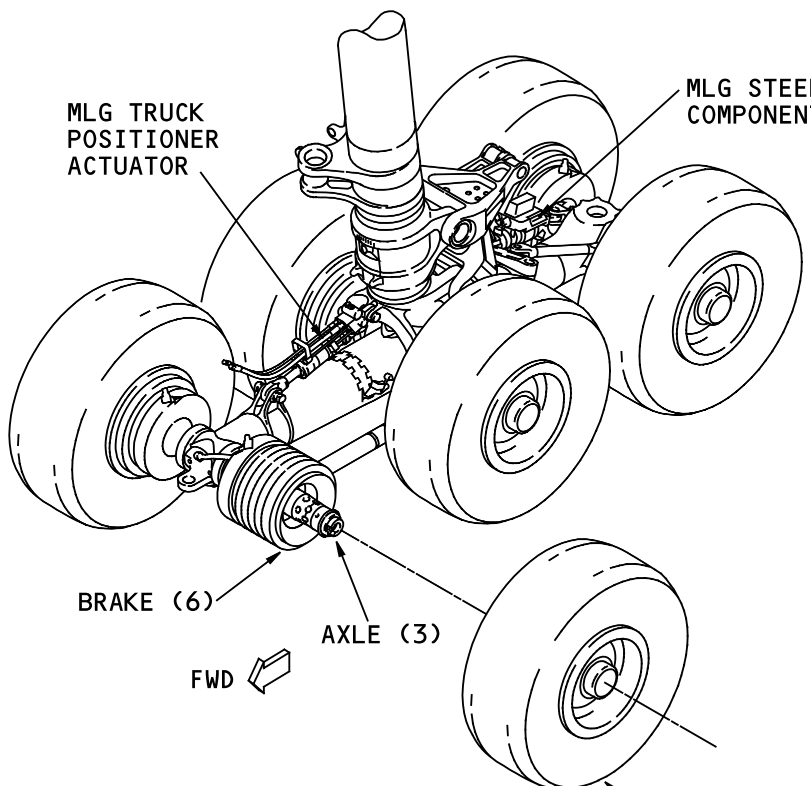
There are three axles on each MLG truck. A jacking point is under the center of the forward and aft axles.

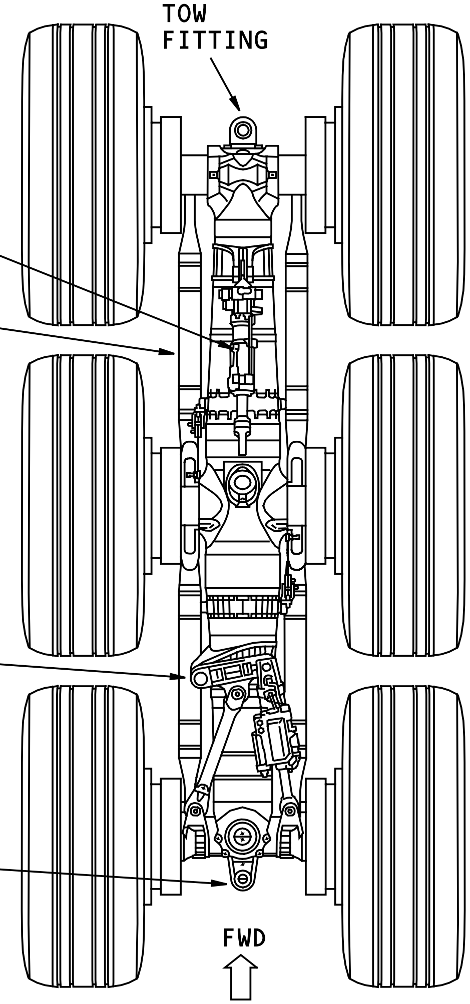
A tow fitting is on the forward part of the MLG truck. There is also a tow fitting/jackpoint on the aft part of the MLG truck.

Brake rods attach the brakes to the MLG shock strut to prevent rotation.

The truck positioner actuator tilts the MLG truck up and down when the airplane is in the air. See the MLG extension-retraction section for more information on the truck positioner actuator (AMM PART I 32-32).

The main landing gear steering components steer the aft axle eight degrees left or right. See the main gear steering section for more information (AMM PART I 32-53).





MAIN LANDING GEAR TRUCK
(TOP VIEW)

32-10-00-003 Rev 4 08/03/95

MAIN LANDING GEAR AND DOORS - TRUCK ASSEMBLY

MAIN LANDING GEAR AND DOORS - SHOCK STRUT

Purpose

The main landing gear shock struts absorb landing forces and transmit vertical loads to the airplane structure.

Physical Description

The shock struts are standard forged steel air-oil shock absorbers. They have an inner cylinder which moves inside an outer cylinder.

Compressed dry nitrogen is in the upper part of the shock strut. BMS3-32 hydraulic fluid is in the lower part of the shock strut.

Torsion links on the aft part of the shock strut connect the inner and outer cylinders.

Shock Strut Seals

A static seal and a dynamic seal keep the nitrogen and the hydraulic fluid in the shock strut. The static seal is between the lower bearing and the outer cylinder. The dynamic seal is between the lower bearing and the inner cylinder.

There are two spare static seals in the shock strut. There are also two spare dynamic seals and dynamic seal backup rings in the shock strut. The spare dynamic seals and backup rings are on the spare seal carrier. These permit change of faulty seals without removal of the inner cylinder.

Training Information Point

The dynamic seal is not the same as the spare dynamic seals. The spare dynamic seals are more flexible. This permits installation of the spare dynamic seals on to the larger diameter of the spare seal carrier.

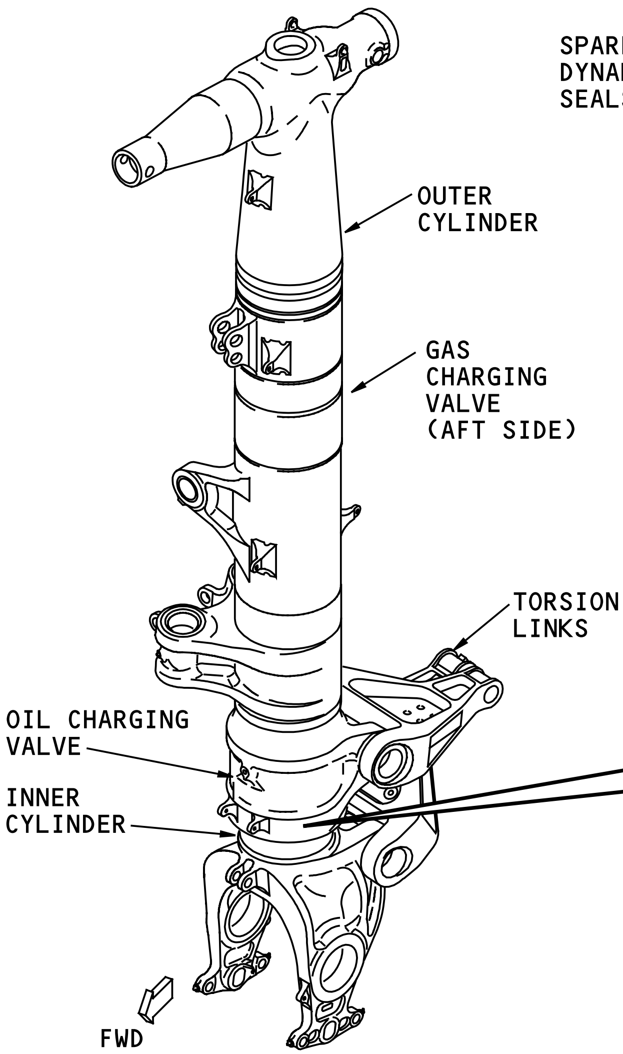
A gas charging valve (not shown) is on the aft side of the MLG shock strut near the side brace lock links.

The oil charging valve is on the front of the shock strut forward of the upper torsion link.

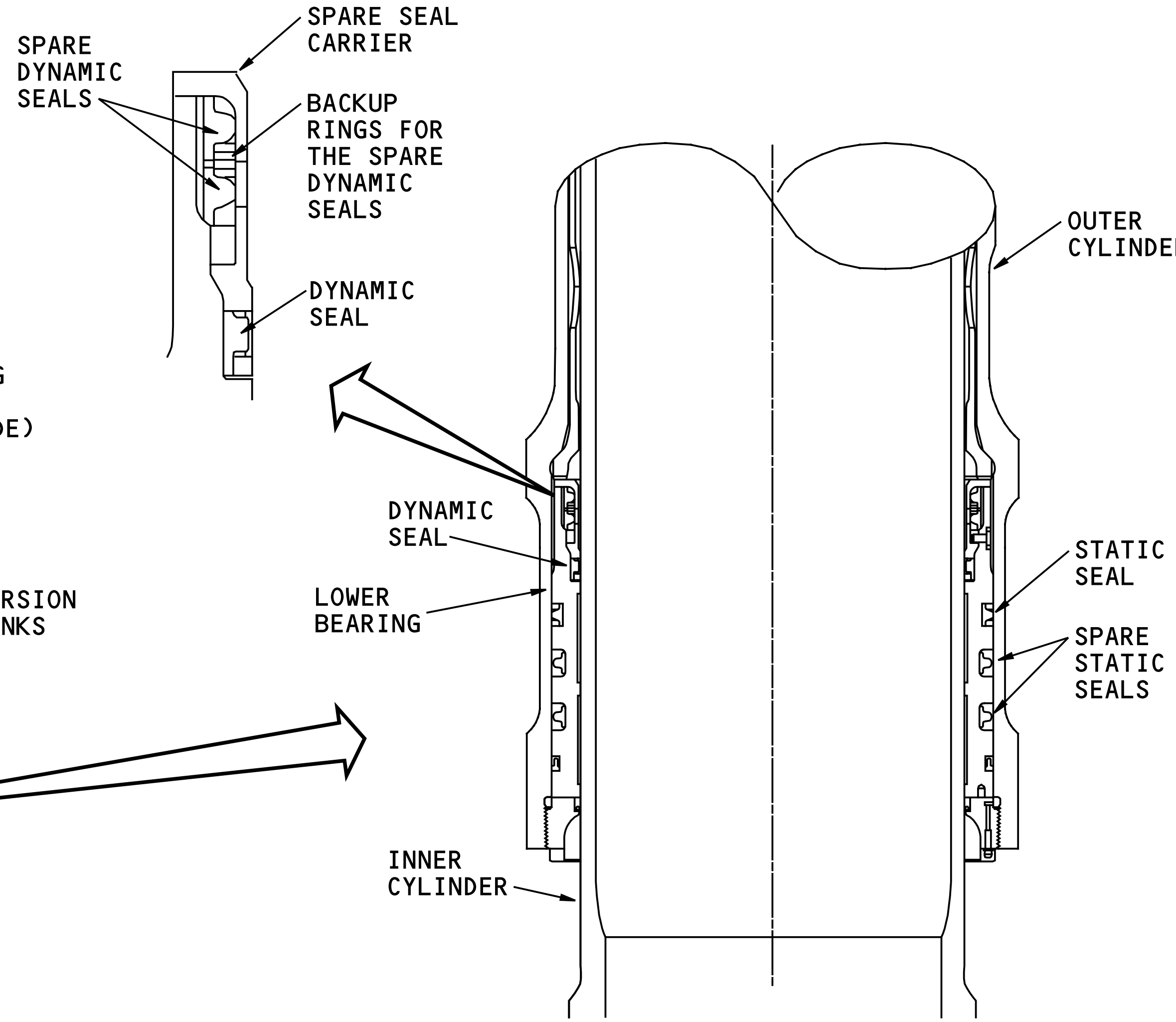
A servicing chart (not shown) is on the main landing gear shock strut door.

CAUTION: WHEN SERVICING THE SHOCK STRUT WITH FLUID, USE ONLY THE FLUID SPECIFIED ON THE NAMEPLATE. FLUIDS WHICH ARE NOT COMPATIBLE OR OF THE WRONG TYPE WILL CAUSE THE SEALS TO DETERIORATE AND RESULT IN LEAKS.

WARNING: DO NOT REMOVE THE AIR VALVE BODY UNTIL THE SHOCK STRUT HAS BEEN DEFLATED. INTERNAL PRESSURE CAN BLOW THE VALVE OUT, CAUSING INJURY TO PERSONNEL.



MAIN GEAR SHOCK STRUT



MAIN GEAR SHOCK STRUT SEALS

32-10-00-004 Rev 3 03/17/1997

MAIN LANDING GEAR AND DOORS - SHOCK STRUT

NOSE LANDING GEAR AND DOORS - INTRODUCTION

General

The nose landing gear absorbs landing forces and holds the forward part of the airplane weight when the airplane is on the ground. The nose gear also steers the airplane on the ground.

The nose landing gear doors open to permit gear operation and close to aerodynamically seal the NLG wheel well.

Nose Landing Gear

The nose landing gear is a conventional two wheel gear. A drag strut assembly holds the nose gear in the extended or retracted position. A lock link assembly moves to the over-center position to lock the drag strut in either position.

These are the nose landing gear components:

- NLG drag strut assembly
- NLG lock link assembly
- NLG torsion links
- NLG shock strut.

Nose Landing Gear Doors

Two forward and two aft doors aerodynamically seal the nose gear wheel well to reduce drag.

The forward doors attach to the outer edge of the NLG wheel well. A hydraulic actuator opens and closes the forward doors.

The aft doors attach to the outer edge of the wheel well. They connect to the shock strut and move mechanically with the gear during extension and retraction.

Training Information Point

There is a tow fitting forward of the shock strut between the nose landing gear tires.

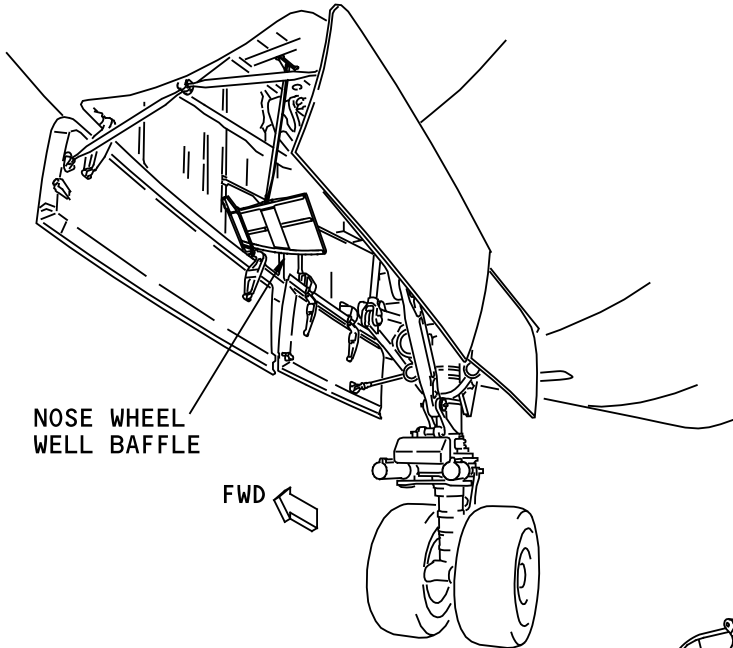
You can disconnect the torsion links to permit the nose landing gear to move greater than the normal steering limits (70 degrees).

The nose landing gear doors are made of composite materials.

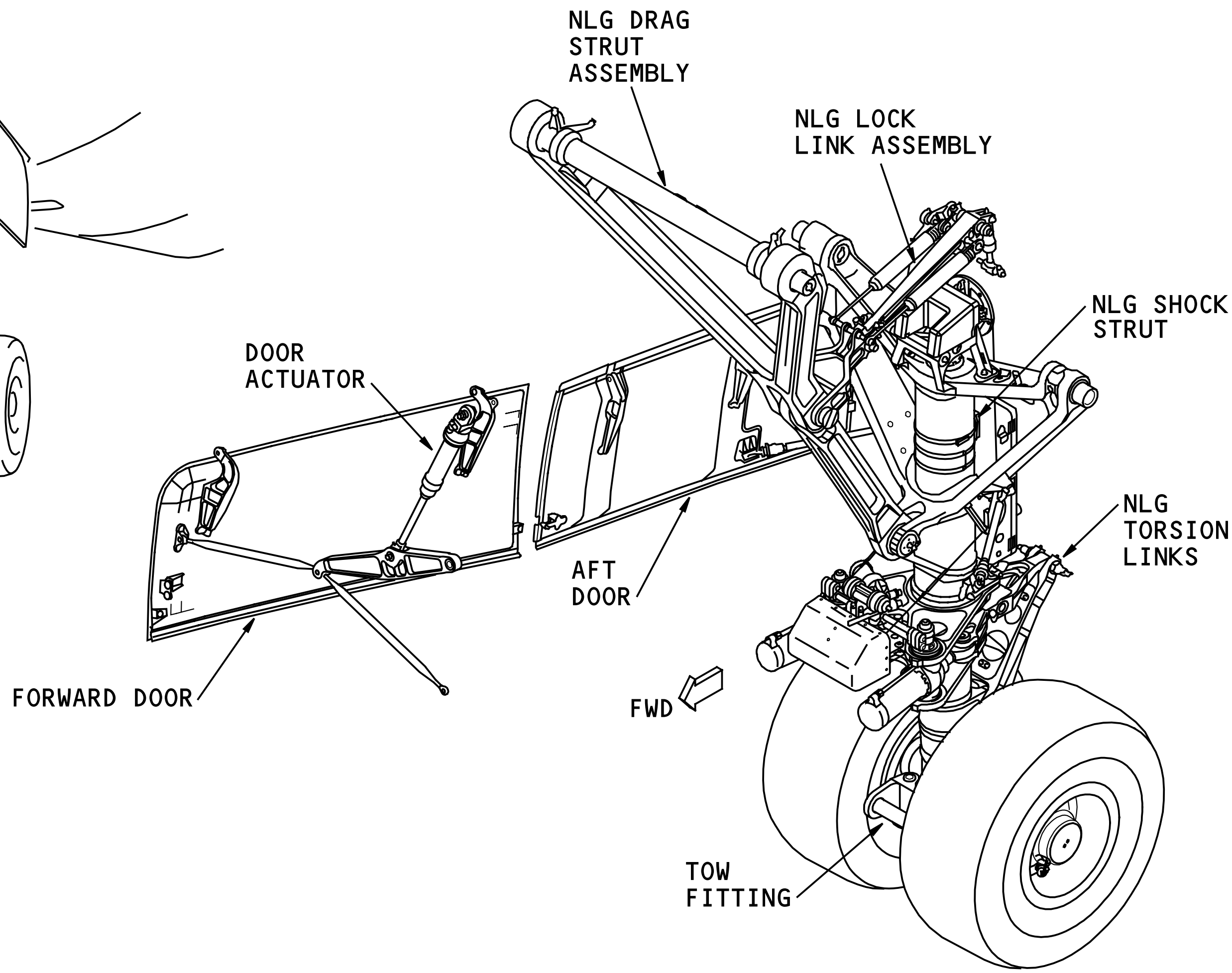
You use the alternate extension system to operate the forward NLG doors on the ground.

See the alternate extension system section for more information on the NLG door operation (AMM PART I 32-35).

Nose wheel well baffles on the left and right sides of the wheel well decreases landing gear door vibrations during gear operation.



NOSE LANDING GEAR



32-20-00-001 Rev 5 03/17/1997

NOSE LANDING GEAR AND DOORS - INTRODUCTION

NOSE LANDING GEAR AND DOORS - SHOCK STRUT

Purpose

The nose landing gear shock strut absorbs airplane landing forces and transmits vertical loads to the airplane structure.

Physical Description

The nose landing gear shock strut is a standard forged steel air-oil shock strut. It has an inner and an outer cylinder.

Compressed dry nitrogen is in the upper part of the shock strut. BMS3-32 hydraulic fluid is in the lower part of the shock strut.

Torsion links on the aft part of the shock strut connect the inner and outer cylinders.

Centering cams inside the shock strut center the nose wheels when the shock strut extends.

Shock Strut Seals

A static seal and a dynamic seal keep the nitrogen and the hydraulic fluid in the shock strut. The static seal is between the lower bearing and the outer cylinder. The dynamic seal is between the lower bearing and the inner cylinder.

There are two spare static seals, one spare dynamic seal, and backup rings for the spare dynamic seal in the shock strut. The spare seals permit change of faulty seals without removal of the inner cylinder.

Training Information Point

The dynamic seal is not the same as the spare dynamic seal. The spare dynamic seal is more flexible. This permits installation of the spare dynamic seal on to the larger diameter of the spare seal carrier.

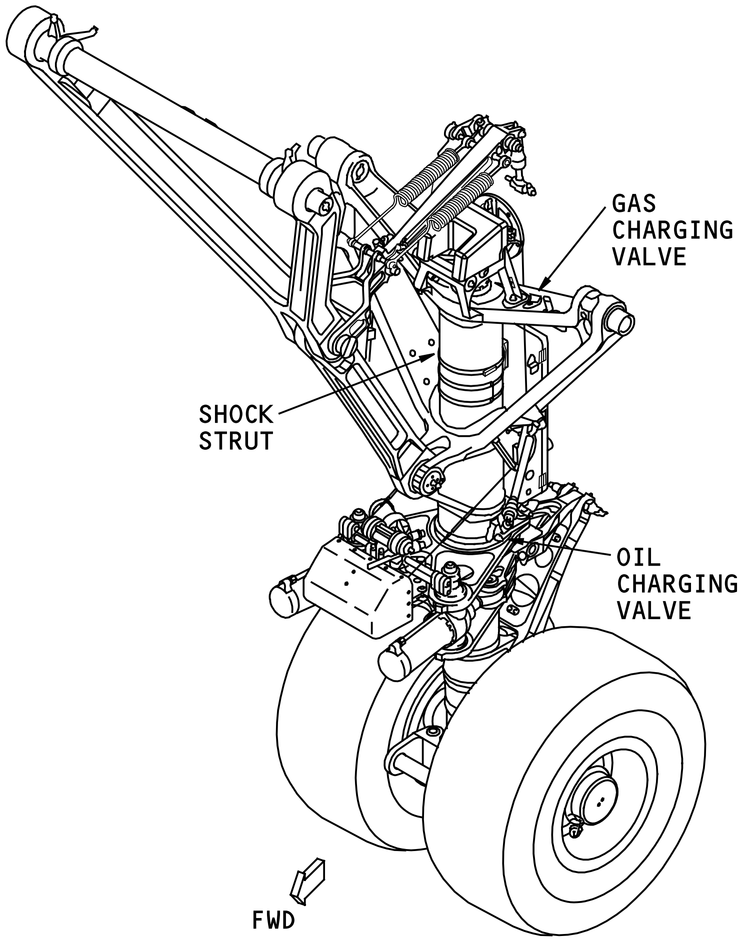
A gas charging valve is on the top of the nose landing gear shock strut.

The oil charging valve is on the left side of the shock strut.

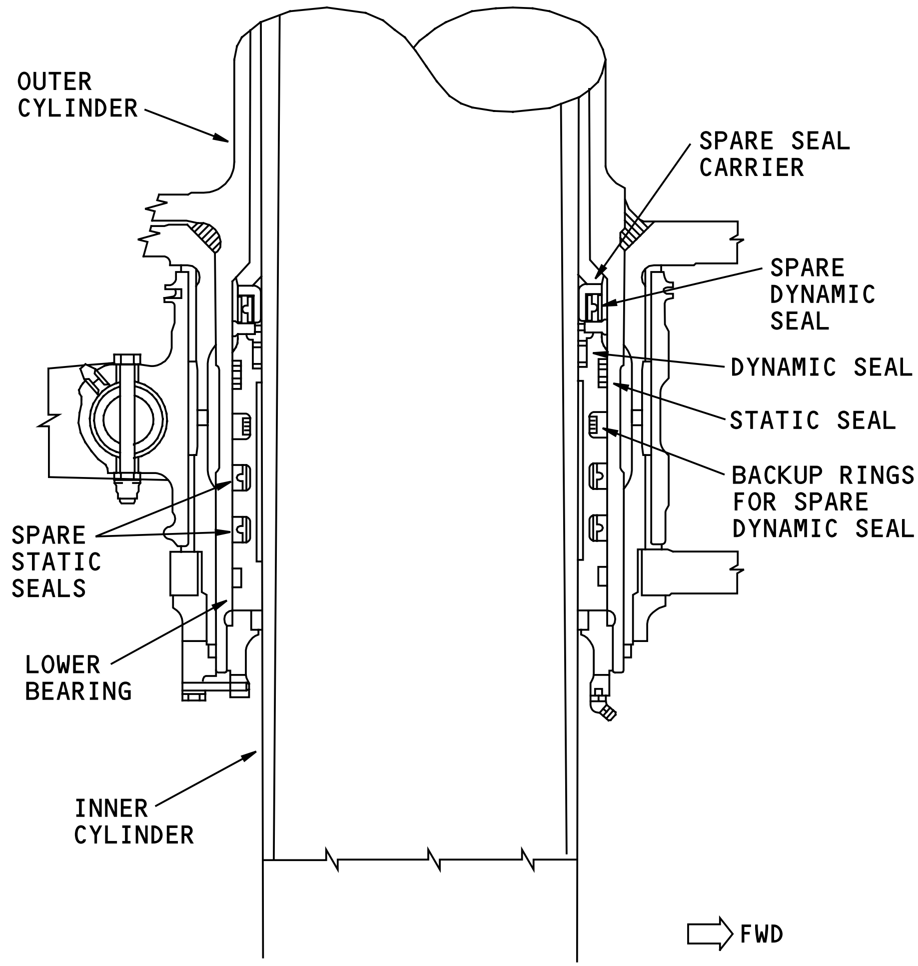
A servicing chart (not shown) is on the right aft nose landing gear door.

CAUTION: WHEN SERVICING THE SHOCK STRUT WITH FLUID, USE ONLY THE FLUID SPECIFIED ON THE NAMEPLATE. FLUIDS WHICH ARE NOT COMPATIBLE OR OF THE WRONG TYPE WILL CAUSE THE SEALS TO DETERIORATE AND RESULT IN LEAKS.

WARNING: DO NOT REMOVE THE AIR VALVE BODY UNTIL THE SHOCK STRUT HAS BEEN DEFLATED. INTERNAL PRESSURE CAN BLOW THE VALVE OUT, CAUSING INJURY TO PERSONNEL.



NOSE LANDING GEAR



NOSE LANDING GEAR SHOCK STRUT SEALS

32-20-00-002 Rev 3 03/19/1997

NOSE LANDING GEAR AND DOORS - SHOCK STRUT

NOSE LANDING GEAR AND DOORS - DRAG STRUT AND LOCK LINK ASSEMBLIES

General

Drag strut and lock link assemblies hold the nose landing gear in the extended and retracted positions.

Drag Strut Assembly

The drag strut assembly has upper and lower struts which attach by a hinge in the center.

The upper drag strut is trunnion-mounted to the side walls in the nose wheel well.

The lower drag strut attaches to a hinge on the shock strut.

Lock Link Assembly

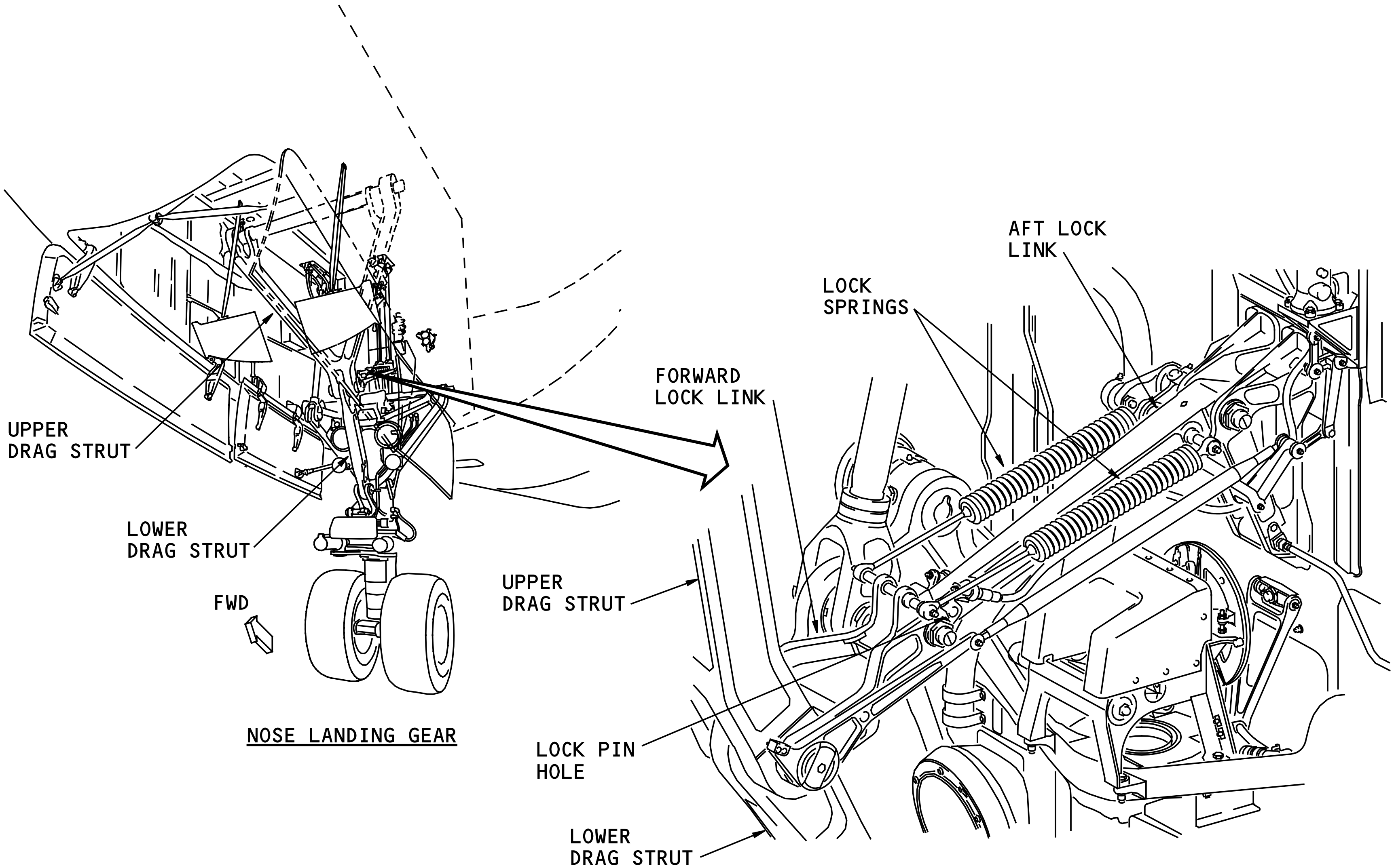
The lock link assembly has forward and aft lock links and two lock springs.

The forward and aft lock links attach by a hinge.

The lock springs help keep the lock link in the locked position.

Training Information Point

A lock pin hole in the lock link assembly permits you to install a down lock pin. Use this pin to keep the nose gear in the down and locked position.



NOSE LANDING GEAR

LOCK LINK ASSEMBLY

NOSE LANDING GEAR AND DOORS - DRAG STRUT AND LOCK LINK ASSEMBLIES

32-20-00-003 Rev 3 05/03/95

EXTENSION-RETRACTION - INTRODUCTION

General

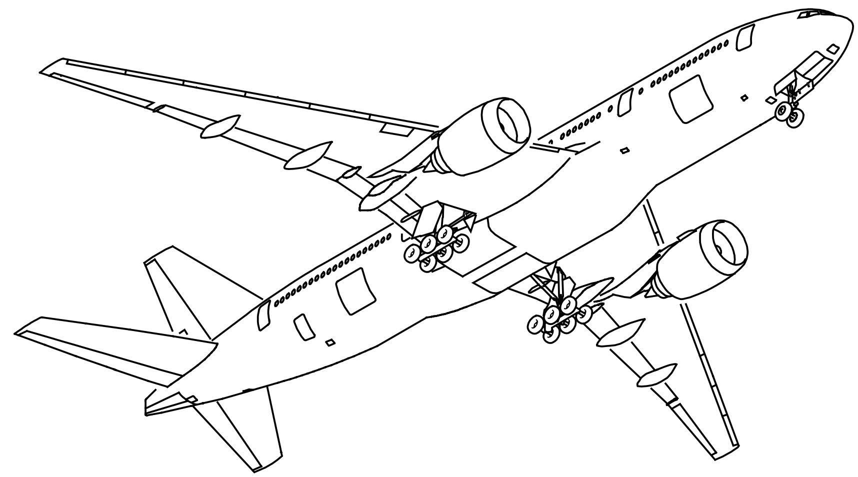
Extension and retraction lowers and raises the landing gear.

These are part of extension and retraction:

- The landing gear control system (32-31)
- The main landing gear extension and retraction (32-32)
- The nose landing gear extension and retraction (32-34)
- The landing gear alternate extension system (32-35).

EXTENSION–RETRACTION

- LANDING GEAR CONTROL SYSTEM
- MAIN LANDING GEAR EXTENSION AND RETRACTION
- NOSE LANDING GEAR EXTENSION AND RETRACTION
- LANDING GEAR ALTERNATE EXTENSION SYSTEM



32-30-00-001 Rev 2

EXTENSION–RETRACTION – INTRODUCTION

LANDING GEAR CONTROL SYSTEM - INTRODUCTION

Purpose

The landing gear control system controls the extension and retraction of the main and nose landing gears.

Components

Landing gear control system components are:

- The landing gear control lever module
- The NLG selector/bypass valve
- The MLG selector/bypass valve.

Location

The landing gear control lever is on the P2 center instrument panel.

The NLG selector/bypass valve is in the NLG wheel well.

The MLG selector bypass valve is the right MLG wheel well.

General Description

Landing gear control is electrical. A two-position (UP and DOWN) landing gear control lever controls the extension and retraction.

When the airplane is on the ground, a landing gear lever lock solenoid locks the landing gear lever in the DOWN position. A solenoid releases the lock when the airplane is in the air.

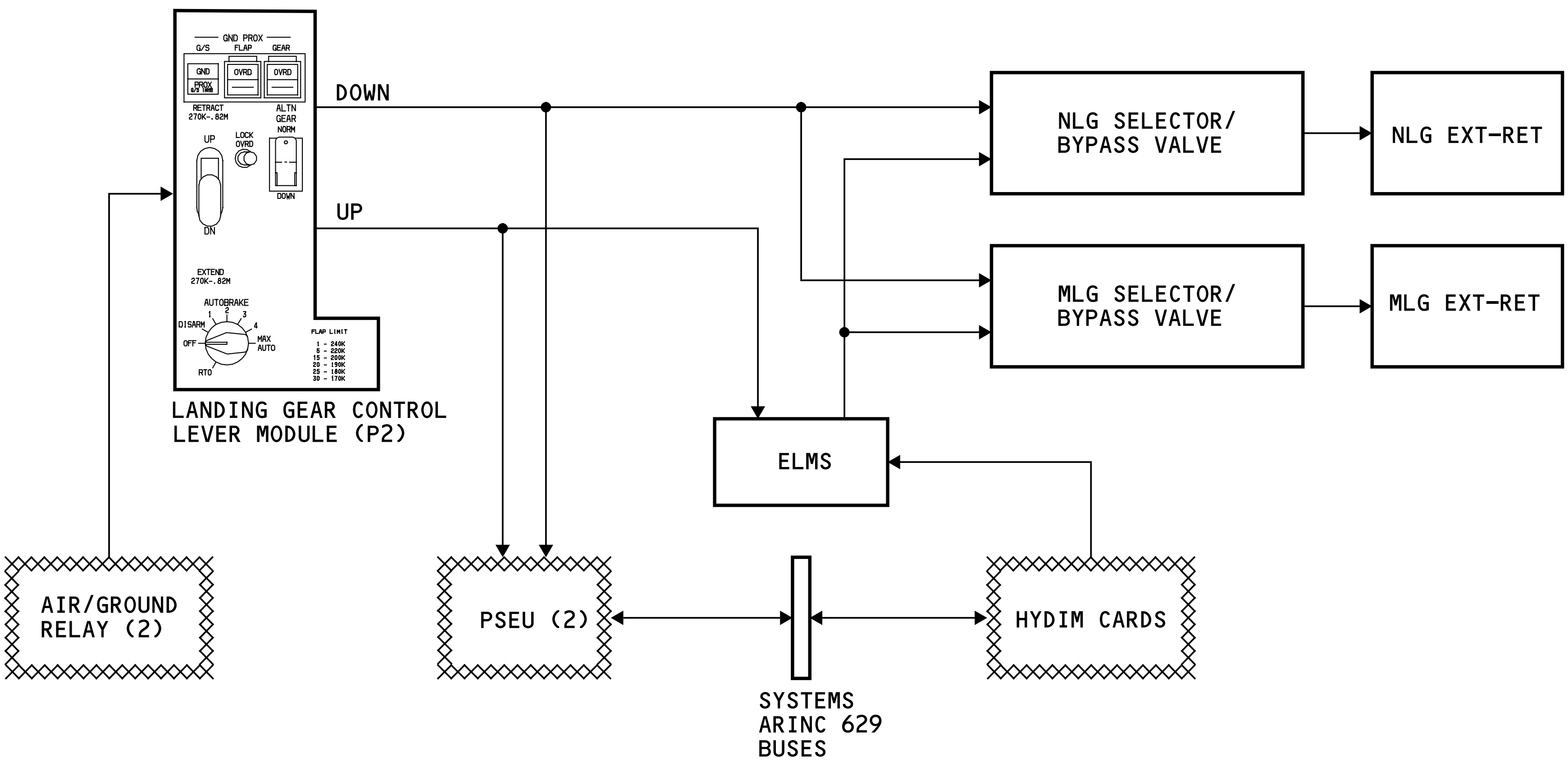
Auto-off relays in ELMS remove the gear-up signal ten seconds after the landing gear retracts. This removes the pressure from the landing gear components.

Interfaces

The proximity sensor electronics unit (PSEUs) get landing gear lever position. The PSEUs also supply landing gear position data to the HYDIM cards.

The HYDIM cards control the auto-off relays in ELMS.

Air/ground relays control the landing gear lever lock solenoid.



32-31-00-001 Rev 0

LANDING GEAR CONTROL SYSTEM - INTRODUCTION

LANDING GEAR CONTROL SYSTEM - LANDING GEAR CONTROL LEVER MODULE

Purpose

The landing gear control lever module sends signals to the landing gear selector/bypass valves to extend and retract the landing gear.

Physical Description

The module has these components:

- Lever
- Switches
- Lock mechanism.

Location

The landing gear lever is on the P2 center forward panel.

Functional Description

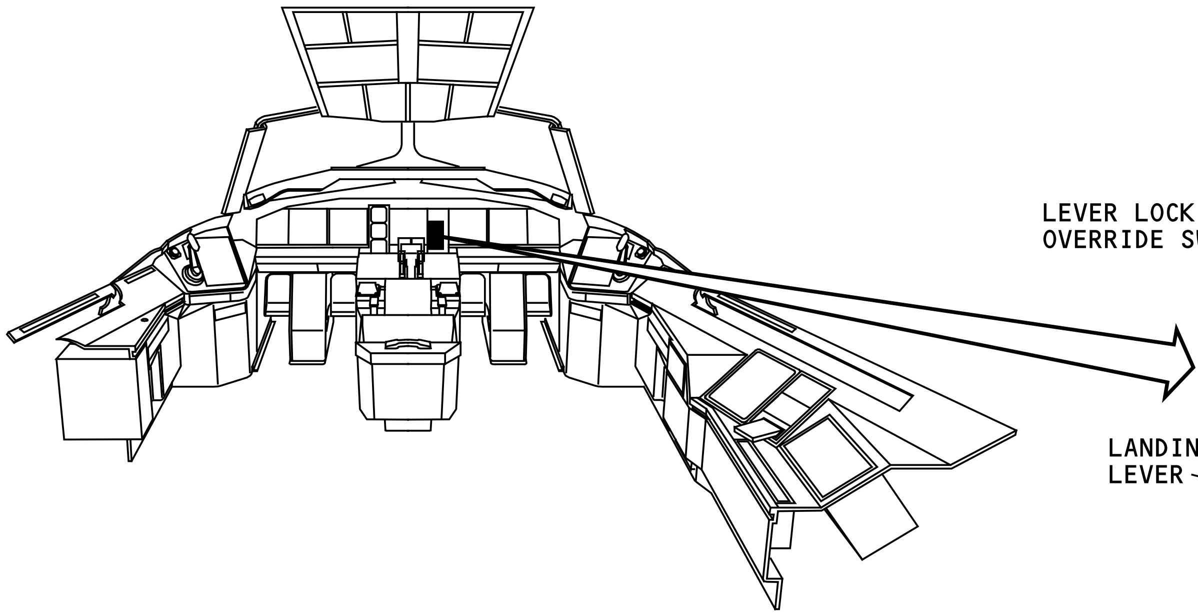
The lever has two positions with detents: UP and DN. You must first pull the lever out before you can raise or lower the lever.

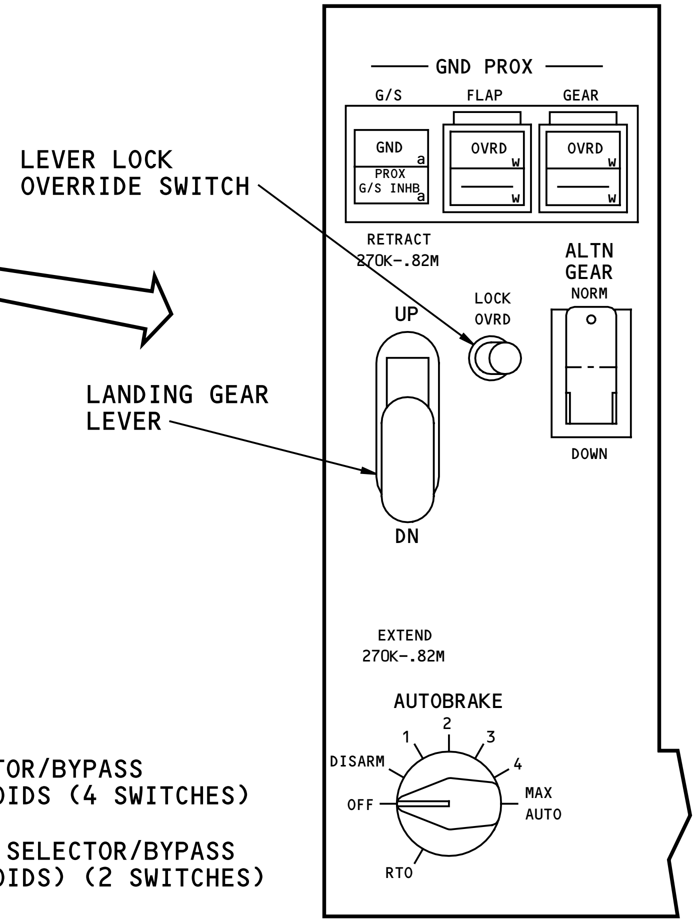
The lever has seven internal switches. Four of these switches control power and ground to the down solenoids in the NLG and MLG selector/bypass valves. Two switches go to the ELMS to control power to the up solenoids in the NLG and MLG selector/bypass valves. One switch resets the gear door release/safety valve modules after an alternate gear extension or ground door operation.

The module also has a solenoid controlled lever lock mechanism. The lever lock prevents accidental movement of the control lever from DN to UP when the airplane is on the ground. When the aircraft takes off, the solenoid gets electrical power and releases the lever lock.

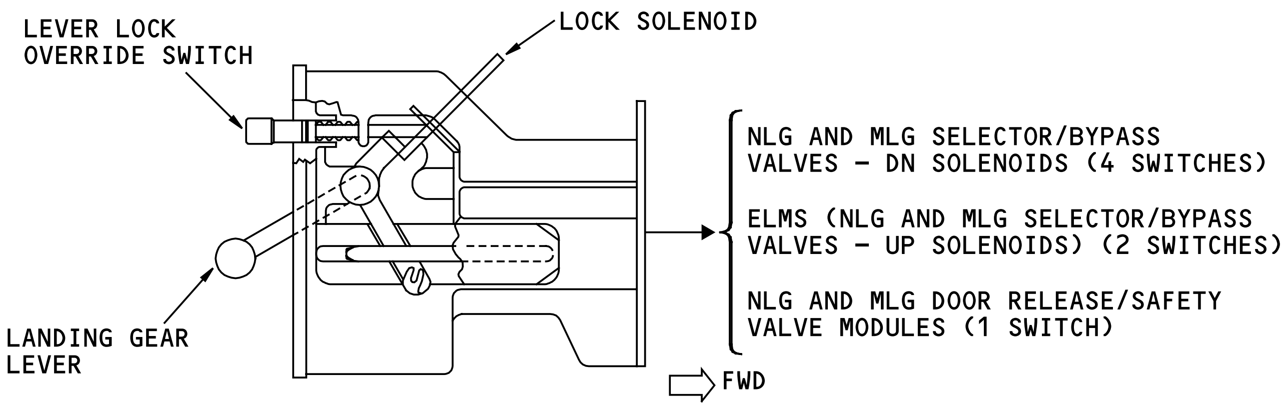
Training Information Point

You can mechanically release the landing gear lever lock with the lever lock override switch.





LANDING GEAR PANEL (P2)



LANDING GEAR CONTROL LEVER MODULE

32-31-00-002 Rev 3 07/22/1997

LANDING GEAR CONTROL SYSTEM - LANDING GEAR CONTROL LEVER MODULE

LANDING GEAR CONTROL SYSTEM - LANDING GEAR SELECTOR/BYPASS VALVES - INTRODUCTION

Purpose

The NLG selector/bypass valve controls extend and retract pressure to NLG extension and retraction components.

The MLG selector/bypass valve controls extend and retract pressure to the left and the right MLG extension and retraction components.

The NLG and MLG selector/bypass valves operate the same way. The MLG selector/bypass valve is larger to permit higher hydraulic flow.

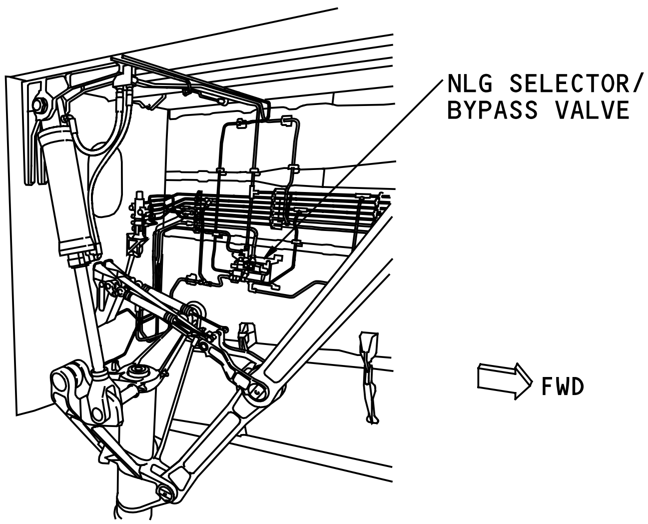
Location

The NLG selector/bypass valve is on the left bulkhead in the NLG wheel well.

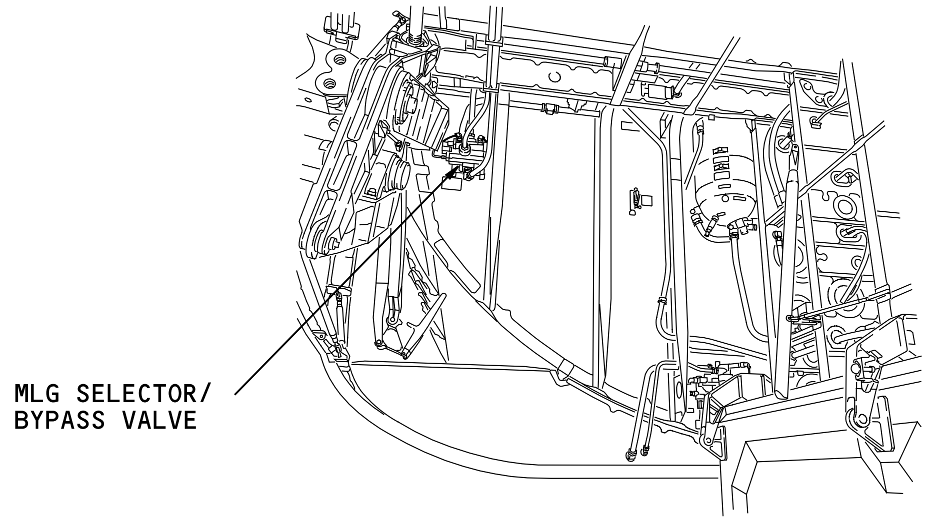
The MLG selector/bypass valve is on the aft bulkhead in the right MLG wheel well.

Training Information Point

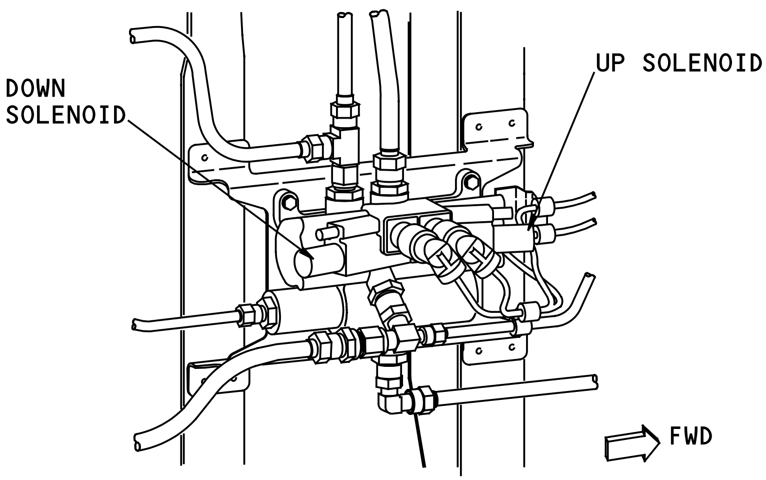
The solenoids on the selector/bypass valves are LRUs.



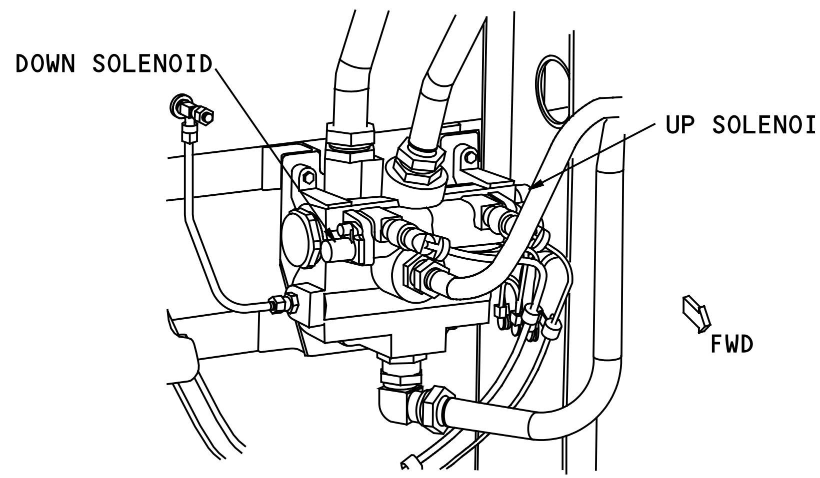
NLG WHEEL WELL



RIGHT MLG WHEEL WELL - AFT BULKHEAD



NLG SELECTOR/BYPASS VALVE



MLG SELECTOR/BYPASS VALVE

LANDING GEAR CONTROL SYSTEM - LANDING GEAR SELECTOR/BYPASS VALVES - INTRODUCTION

LANDING GEAR CONTROL SYSTEM - FUNCTIONAL DESCRIPTION

General

The landing gear control system controls landing gear extension and retraction.

Lever Lock

When the airplane is in the air, two air/ground relays in the ELMS supply a ground to energize the lever lock solenoid. This releases the lock on the landing gear control lever and permits you to move the control lever UP.

Retraction

When you put the landing gear control lever UP, two switches in the landing gear control lever module supply power to auto-off relays in ELMS. The auto-off relays supply the power to UP solenoid in each of the landing gear selector/bypass valves.

Hydraulic pressure then goes through the selector/ bypass valves to the UP lines for gear retraction.

Another switch in the landing gear control lever module resets the alternate extension system MLG and NLG door release/safety valve modules.

Auto-Off

After gear retraction, the PSEUs send signals to the HYDIM cards L and R. After a ten second delay, the HYDIM cards energize the auto-off relays in the ELMS.

This removes electrical power from the UP solenoid and the selector valve moves to OFF to remove pressure from the landing gear.

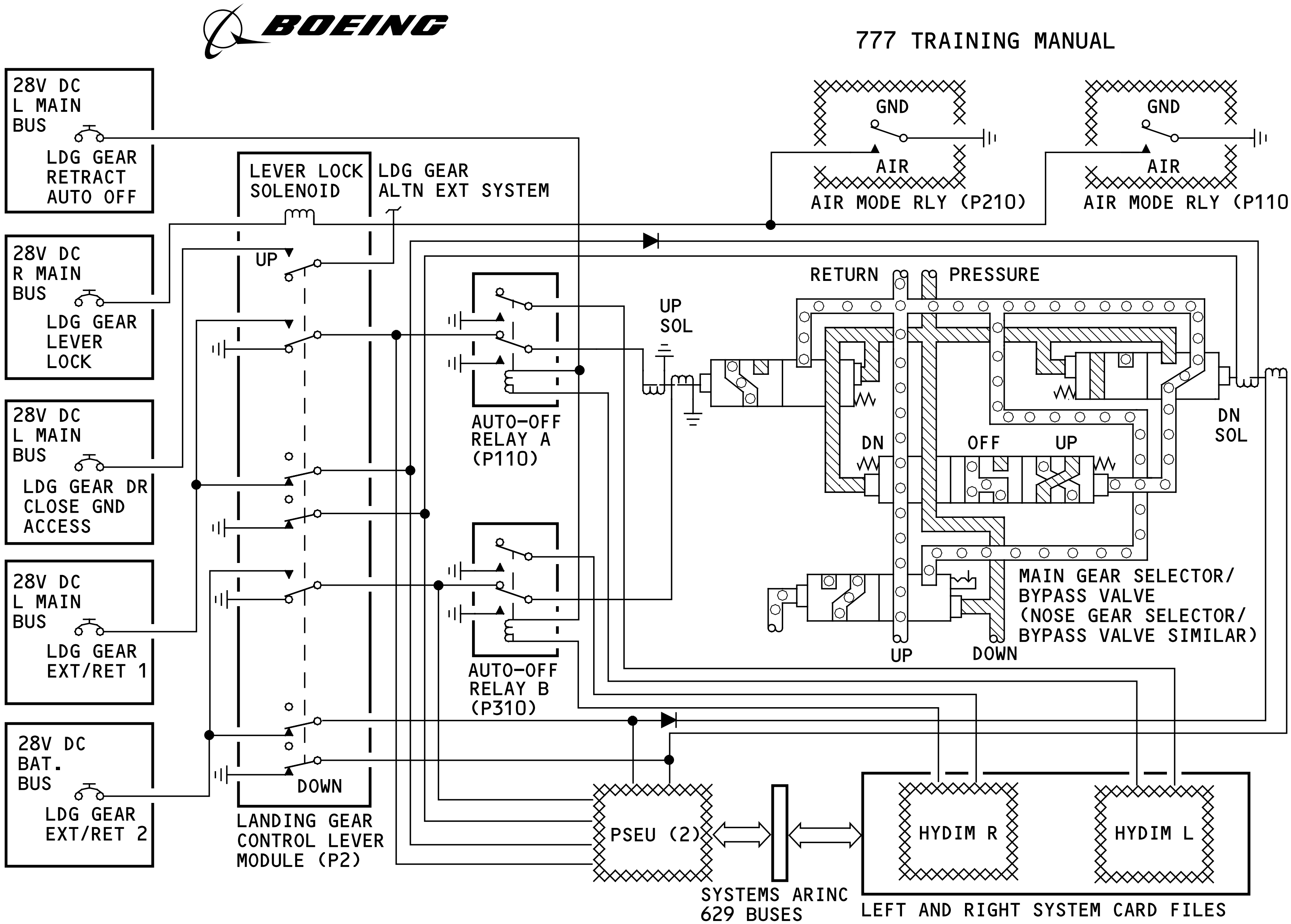
Extension

When you put the landing gear lever DOWN, four switches in the landing gear lever module close. These switches control the electrical power and the ground to the DOWN solenoid in each of the landing gear selector valves.

Hydraulic pressure goes through the landing gear selector/bypass valves to the DOWN lines for gear extension.

Down pressure stays on as long as the landing gear lever is DOWN and the center hydraulic system is pressurized.

Normal system gear extend pressure resets the bypass valves to NORMAL.



LANDING GEAR CONTROL SYSTEM - FUNCTIONAL DESCRIPTION

MLG EXTENSION-RETRACTION - INTRODUCTION

Purpose

The MLG extension and retraction system extends and retracts the main landing gear and opens and closes the main landing gear doors.

The extension and retraction system also tilts the MLG truck forward wheels up when the gear is in the extended position in flight. It tilts the MLG truck forward wheels down during gear retraction.

Components

Each MLG has these extension and retraction components:

- MLG door-operated sequence valve
- MLG uplock assembly and actuator
- MLG retract actuator
- MLG drag brace-operated sequence valve
- MLG uplock-operated sequence valve
- MLG truck positioner actuator fuses
- MLG truck positioner actuator
- MLG door priority/relief valve
- MLG door actuator
- MLG door uplock hook and door lock actuator
- MLG side brace downlock actuator
- MLG drag brace downlock actuator.

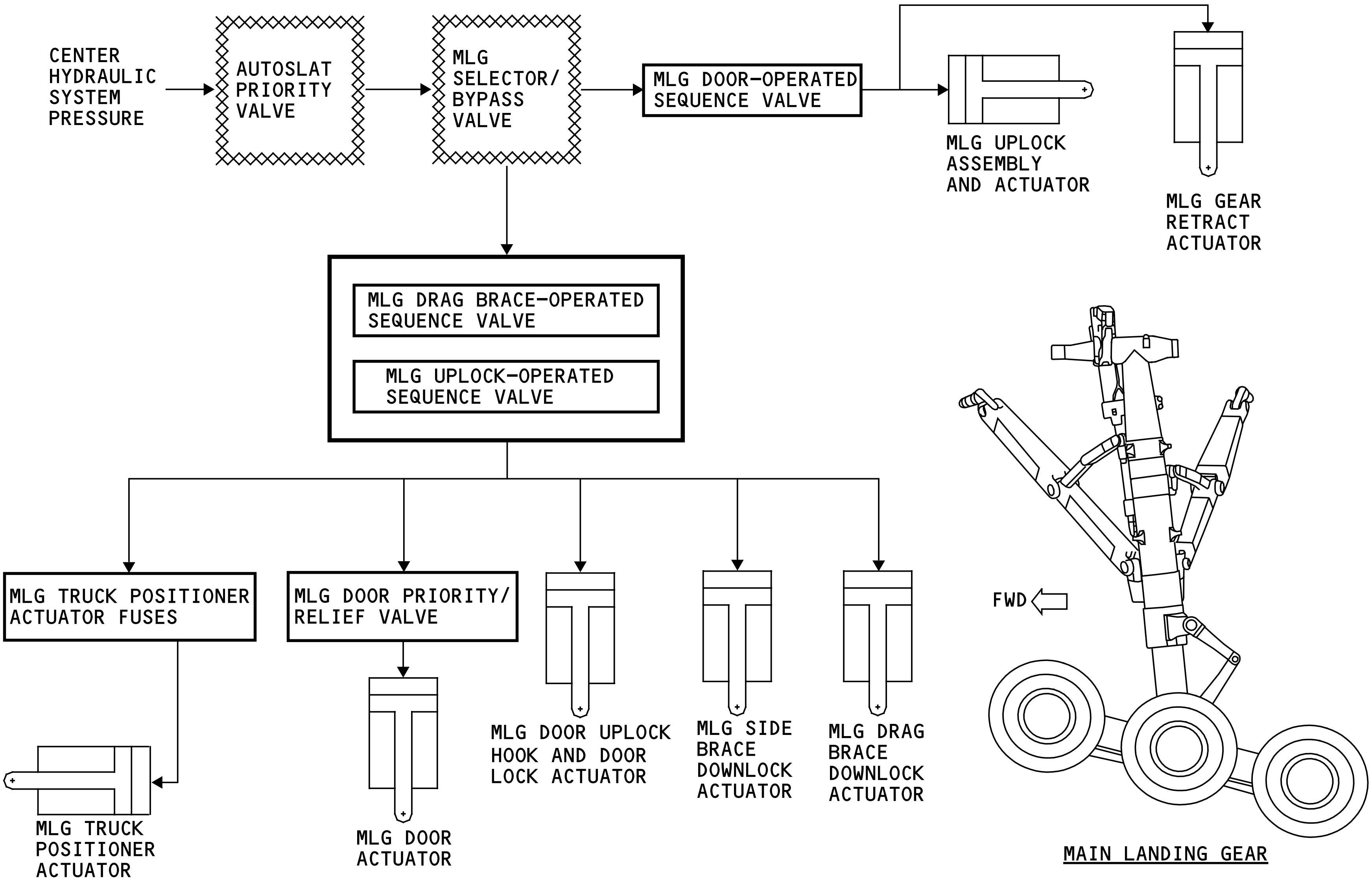
General Description

The center hydraulic system supplies pressure through the autoslat priority valve and the MLG selector/bypass valve to operate the main landing gear. See the leading edge slats section for more information about the autoslat priority valve (AMM PART I 27-81).

The door-operated sequence valve controls hydraulic pressure to the MLG uplock actuator and the MLG retract actuator.

The MLG drag brace-operated sequence valve and the MLG uplock-operated sequence valve together control hydraulic pressure to these actuators:

- MLG truck positioner actuator
- MLG door actuator
- MLG door lock actuator
- MLG side brace downlock actuator
- MLG drag brace downlock actuator.



32-32-00-001 Rev 3 03/18/1997

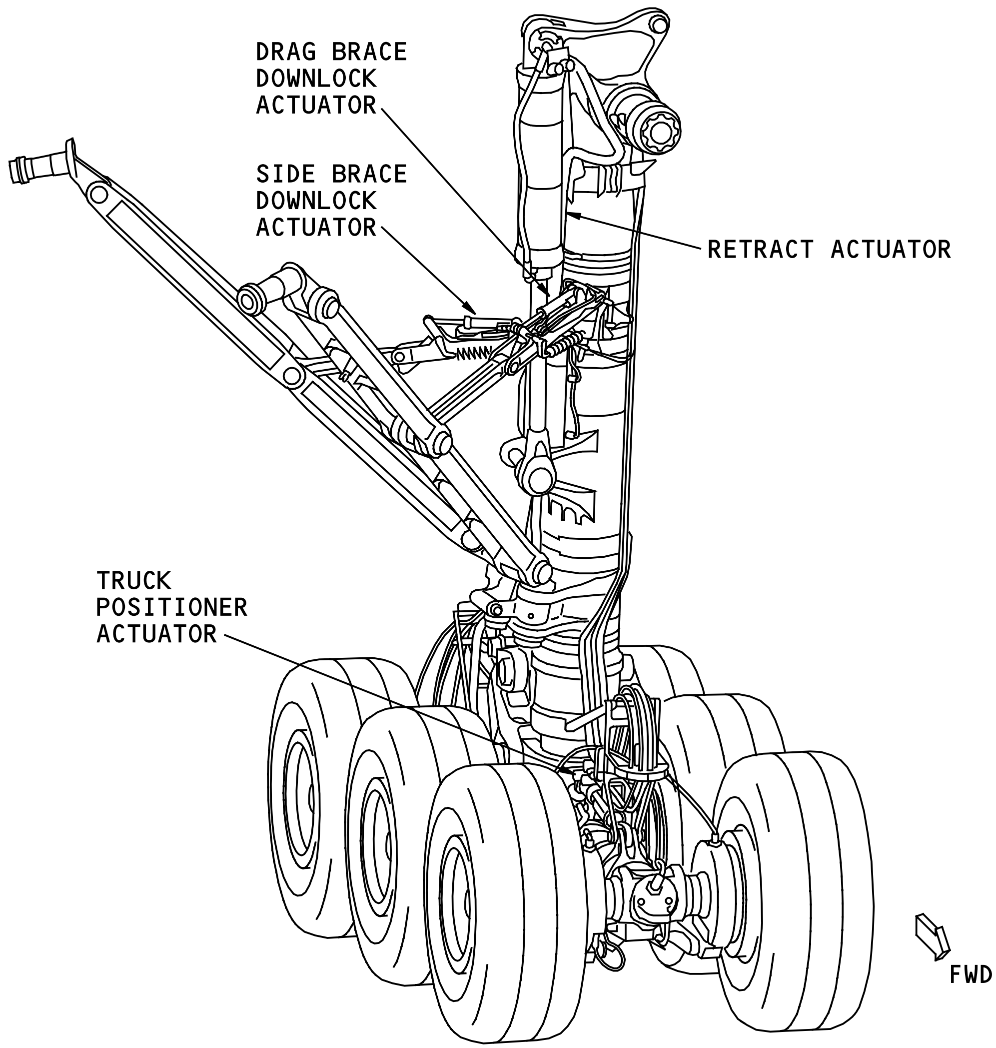
MLG EXTENSION-RETRACTION - INTRODUCTION

MLG EXTENSION-RETRACTION - GEAR COMPONENT LOCATIONS

General

These extension and retraction components are on each MLG:

- Side brace downlock actuator
- Retract actuator
- Drag brace downlock actuator
- Truck positioner actuator.



LEFT MAIN LANDING GEAR

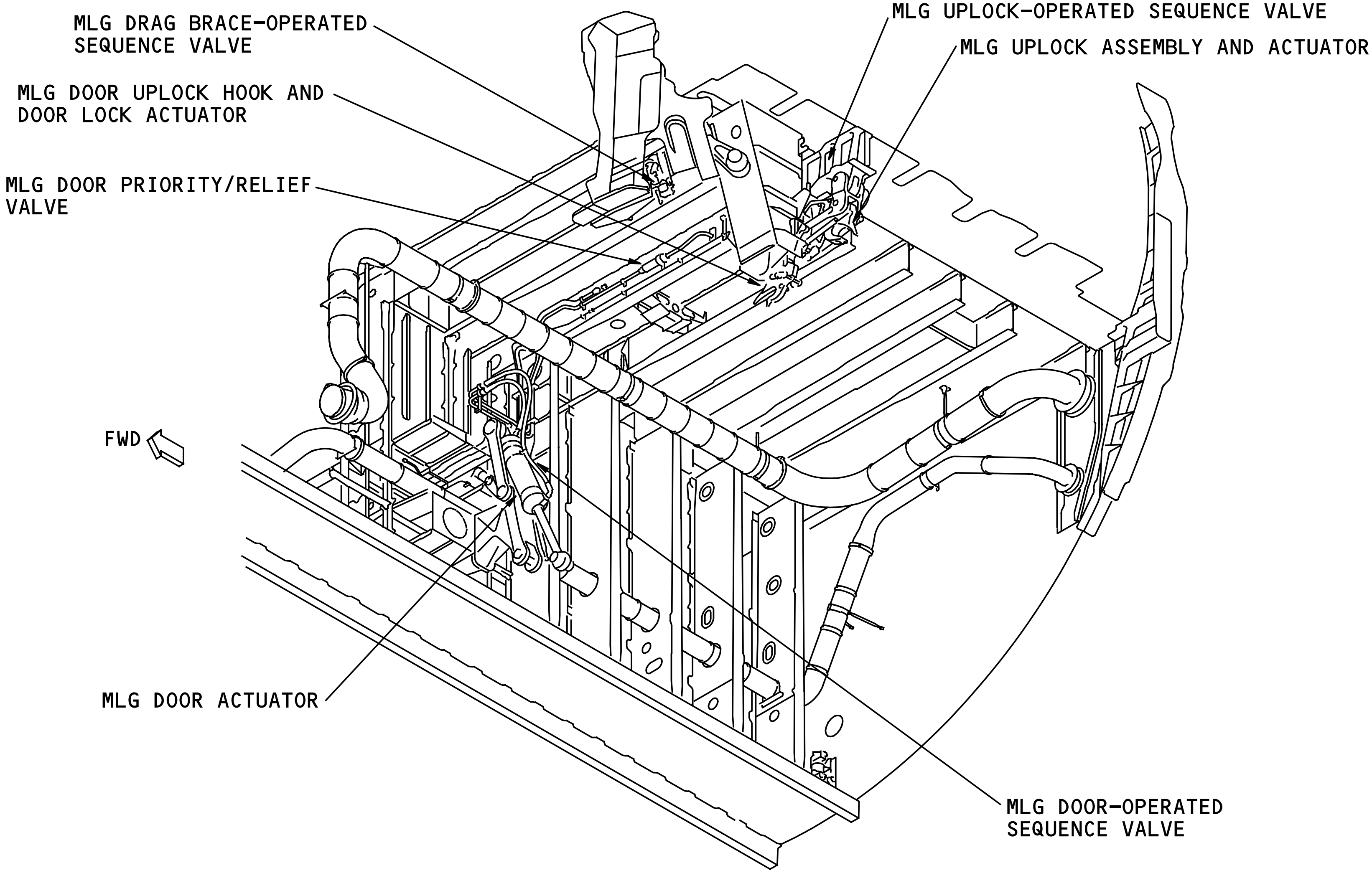
MLG EXTENSION-RETRACTION - GEAR COMPONENT LOCATIONS

MLG EXTENSION-RETRACTION - WHEEL WELL COMPONENT LOCATIONS

General

These components are in each main gear wheel well:

- MLG door priority/relief valve
- MLG door uplock hook and door lock actuator
- MLG drag brace-operated sequence valve
- MLG uplock-operated sequence valve
- MLG uplock assembly and actuator
- MLG door-operated sequence valve
- MLG door actuator.



LEFT MLG WHEEL WELL

MLG EXTENSION-RETRACTION - WHEEL WELL COMPONENT LOCATIONS

32-32-00-003 Rev 2 01/06/1997

MLG EXTENSION-RETRACTION - MLG RETRACT ACTUATOR

Purpose

The MLG retract actuator supplies the force to retract the main landing gear.

Physical Description

The retract actuator is a hydraulic piston-type actuator. The actuator retracts to raise the gear and extends when the gear extends. The actuator is not pressurized during gear extension.

A flow restrictor in the retract port union controls the gear extension rate.

Snubbers on the rod end and the head end of the actuator control actuator speed at the ends of the actuator stroke.

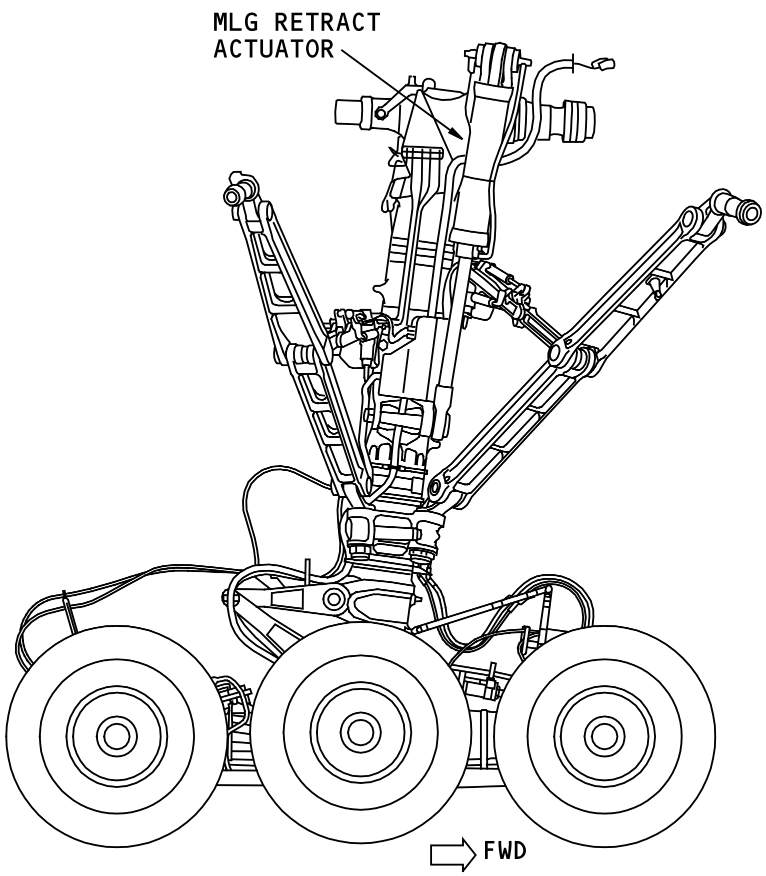
The dry weight of the retract actuator is approximately 240 pounds (109 kilograms).

Location

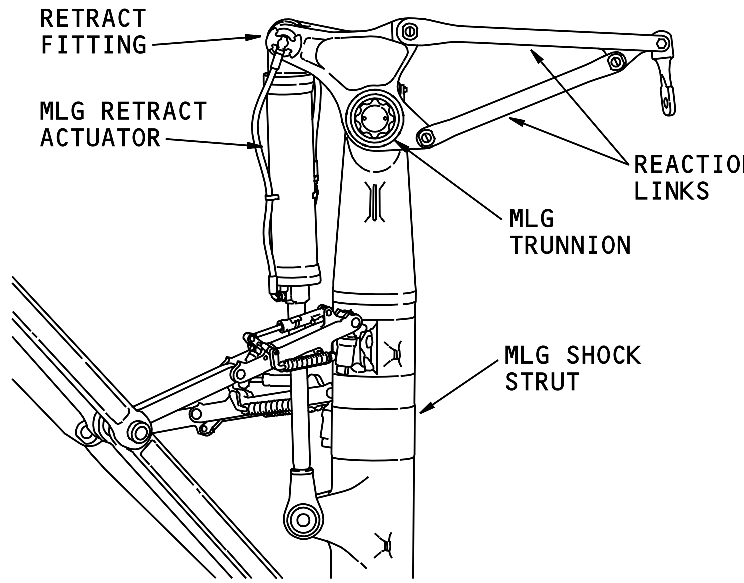
The retract actuator is inboard of the main landing gear shock strut. The rod end attaches to the inboard side of the shock strut. The head end attaches to the retract fitting mounted on the trunnion. Two reaction links connect the retract fitting to the wing rear spar.

Training Information Point

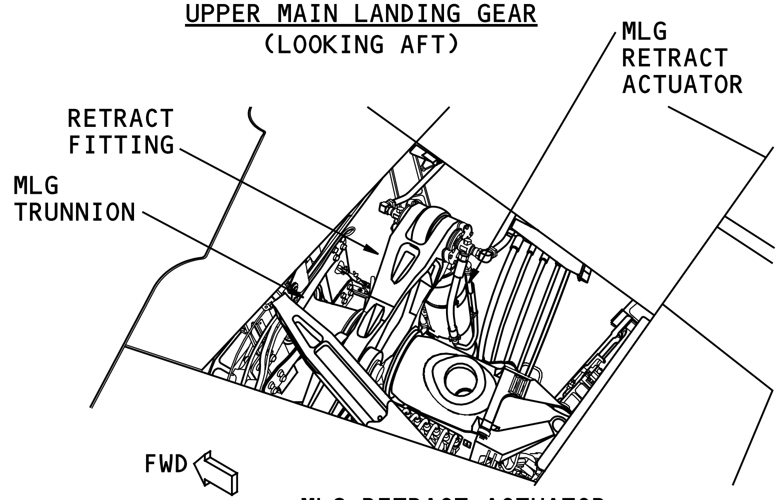
A removable wing panel permits access to the head end of the actuator from above.



LEFT MAIN LANDING GEAR
(RIGHT MLG EQUIVALENT)



UPPER MAIN LANDING GEAR
(LOOKING AFT)



MLG RETRACT ACTUATOR
(WING PANEL REMOVED)

MLG EXTENSION-RETRACTION - MLG RETRACT ACTUATOR

MLG EXTENSION-RETRACTION - MLG SIDE BRACE AND DRAG BRACE DOWNLOCK ACTUATORS

Purpose

The side brace downlock actuator locks and unlocks the over-center toggles between the side brace lock links during extension and retraction.

The drag brace downlock actuator locks and unlocks the over-center toggles between the drag brace lock links during extension and retraction.

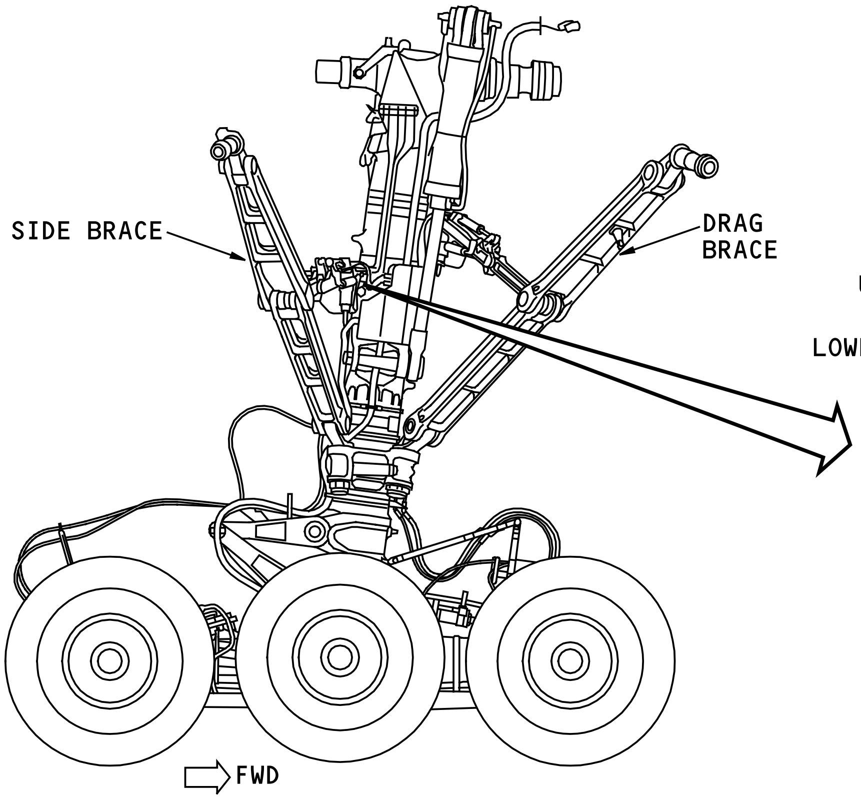
The MLG side brace downlock actuator and the MLG drag brace downlock actuator are identical and interchangeable.

Physical Description

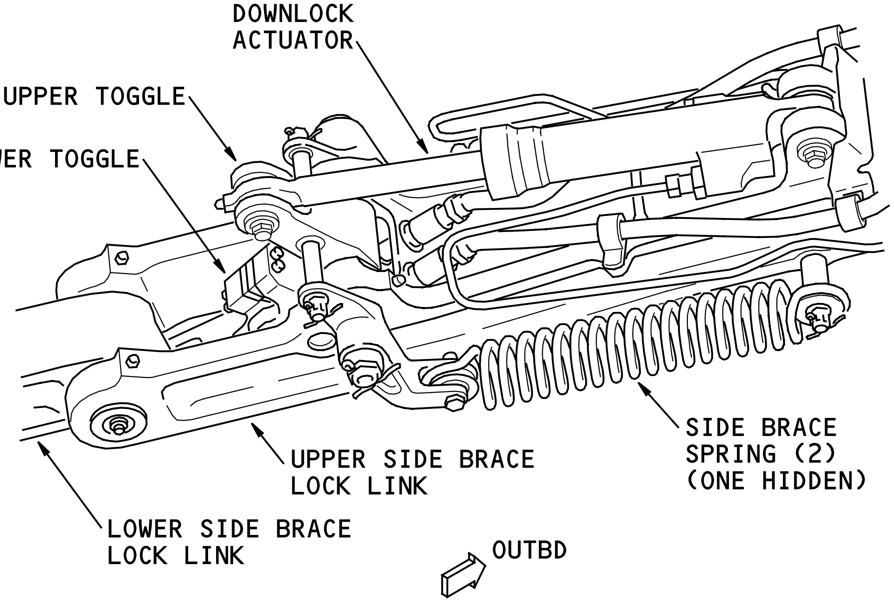
The actuators are hydraulic cylinders. They extend to lock the toggles during gear extension. They retract to unlock the toggles during gear retraction.

Location

The head ends of the actuators attach to the upper lock links. The rod ends attach to the upper toggles.



LEFT MAIN LANDING GEAR



MLG SIDE BRACE DOWNLOCK ACTUATOR
(MLG DRAG BRACE DOWNLOCK ACTUATOR SIMILAR)

32-32-00-005 Rev 1 03/26/96

MLG EXTENSION-RETRACTION - MLG SIDE BRACE AND DRAG BRACE DOWNLOCK ACTUATORS

MLG EXTENSION-RETRACTION - MLG DOOR ACTUATOR AND MLG DOOR-OPERATED SEQUENCE VALVE

Purpose

The MLG door actuator opens and closes the main gear door during gear extension and retraction.

The MLG door-operated sequence valve controls hydraulic flow to the main gear uplock actuator and to the MLG retract actuator.

Physical Description

The MLG door actuator is a hydraulic piston-type actuator. The actuator extends to open the main gear door and retracts to close the MLG door. Flow restrictors in the extend and retract port unions control the rate of door operation. Snubbers in the rod end and head end of the actuator control actuator speed at the ends of the actuator travel. The dry weight of the MLG door actuator is approximately 72 pounds (32.7 kg).

The MLG door-operated sequence valve is a two-position valve - DOOR OPEN and DOOR NOT OPEN. A mechanical linkage from the main landing gear door operates the sequence valve. The mechanical linkage includes these components:

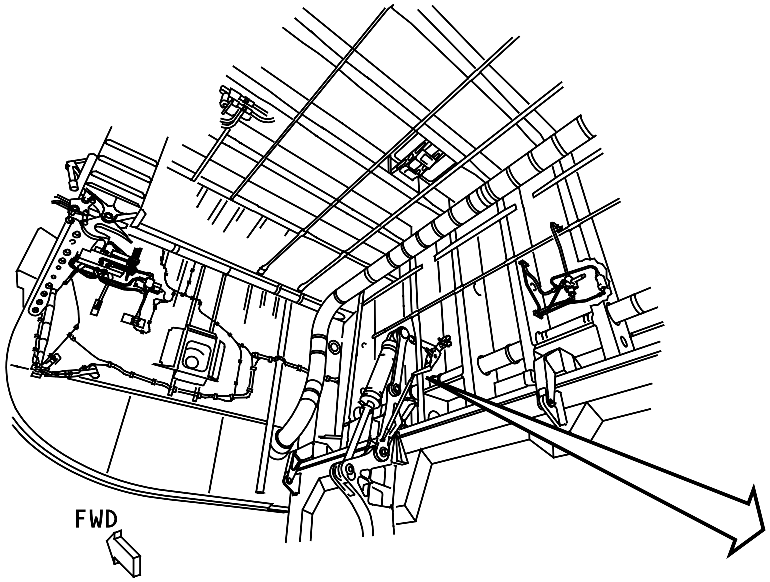
- Control rod
- Input crank
- Input link
- Intermediate crank
- Valve link (not shown).

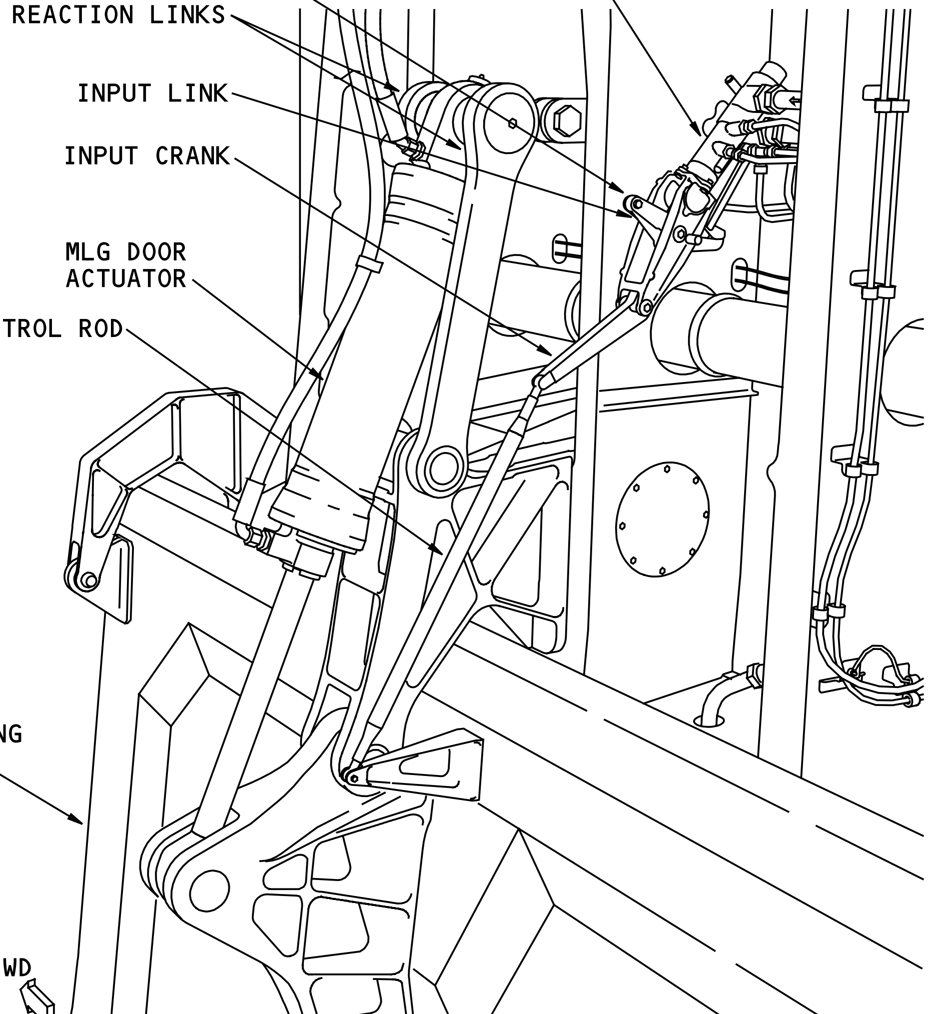
The MLG door-operated sequence valve weighs 4.6 pounds (2.1 kg).

Location

The head end of the MLG door actuator attaches to reaction links which attach to the keel beam. The rod end attaches to the landing gear door.

The MLG door-operated sequence valve is on the keel beam aft of the MLG door actuator.





MLG EXTENSION-RETRACTION - MLG DOOR ACTUATOR AND MLG DOOR-OPERATED SEQUENCE VALVE

MLG EXTENSION - MLG DOOR UPLOCK HOOK AND MLG DOOR LOCK ACTUATOR

Purpose

The MLG door uplock hook and MLG door lock actuator are part of the door uplock assembly.

The door uplock hook holds the main gear door closed.

The door lock actuator locks and unlocks the door uplock hook during landing gear door operation.

Physical Description

The uplock hook uses over-center locking to hold the door closed. Two springs keep the hook in this position.

The door lock actuator is a piston-type actuator. It retracts to unlock the uplock hook and extends to lock the uplock hook.

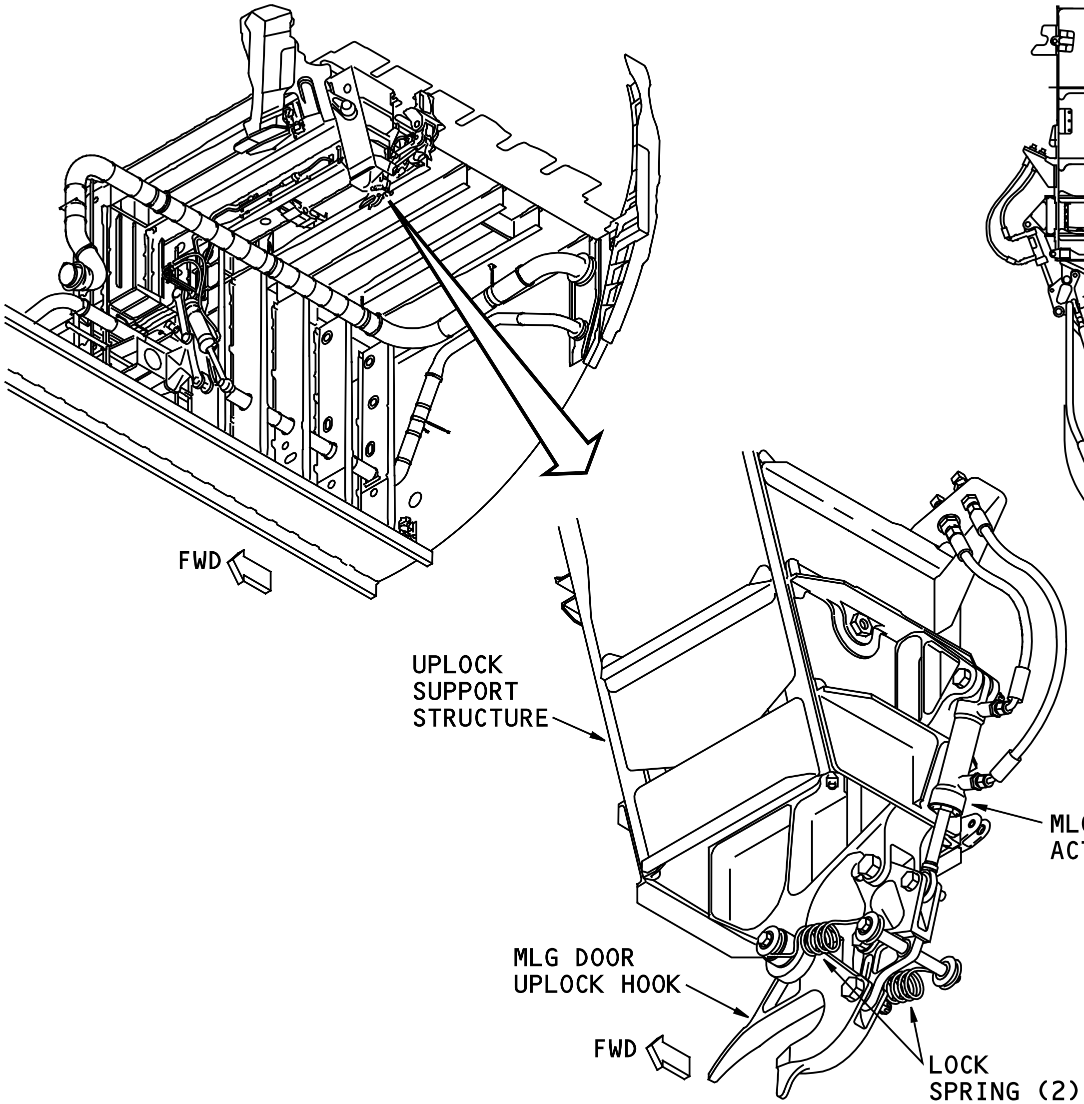
Location

The door uplock assembly is on the uplock support structure. This structure is on the outboard side of the wheel well and attaches to the wheel well ceiling.

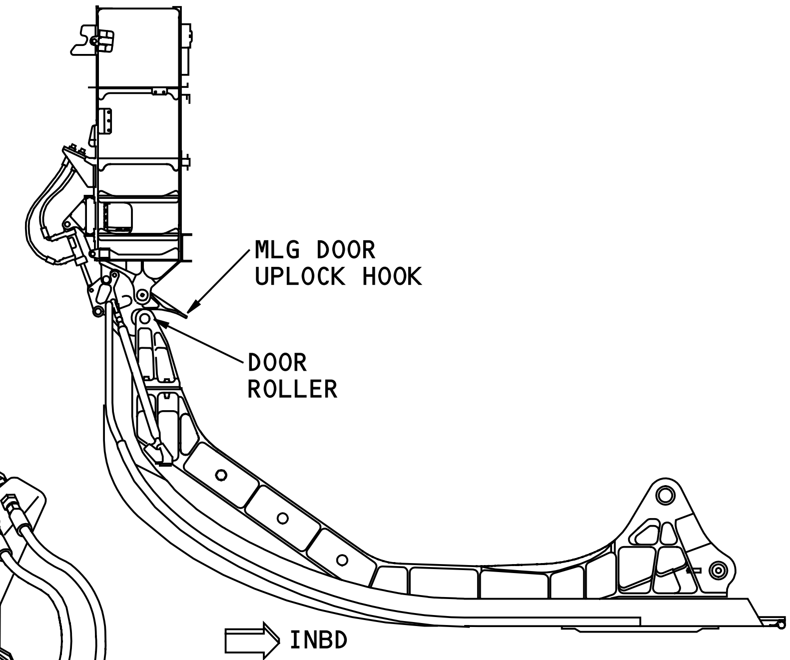
Functional Description

To open the MLG door, the door lock actuator moves the door uplock hook to the unlocked position. This permits the roller on the door to move out of the hook and the door to open.

When the door closes, the roller on the door engages the uplock hook. The motion of the door and pressure in the door lock actuator drive the uplock hook to the overcenter locked position.



DOOR UPLOCK ASSEMBLY



MLG DOOR AND UPLOCK ASSEMBLY
(LOOKING FORWARD)

MLG EXTENSION - MLG DOOR UPLOCK HOOK AND MLG DOOR LOCK ACTUATOR

32-32-00-007 Rev 2 05/28/96

MLG EXTENSION-RETRACTION - MLG UPLOCK ASSY, UPLOCK ACTUATOR, AND UPLOCK-OPERATED SEQUENCE VALVE

Purpose

The MLG uplock assembly holds the main landing gear in the UP position.

The MLG uplock actuator unlocks the main gear uplock assembly during gear extension.

The MLG uplock-operated sequence valve controls main landing gear door close operation.

Physical Description

The MLG uplock assembly uses over-center locking to keep the main landing gear up and locked. Two springs hold the uplock hook in this position.

The MLG uplock actuator is a two-position piston-type actuator. It retracts to unlock the gear and extends during gear uplock operation.

The MLG uplock-operated sequence valve is a two-position sequence valve (LOCKED AND UNLOCKED). A mechanical linkage from the uplock mechanism moves the sequence valve.

Location

The MLG uplock assembly is on the ceiling on the outboard edge of each wheel well. The uplock assembly is aft of the door uplock assembly.

The MLG uplock actuator attaches horizontally above the MLG uplock mechanism.

The MLG uplock-operated sequence valve attaches vertically above the MLG uplock mechanism.

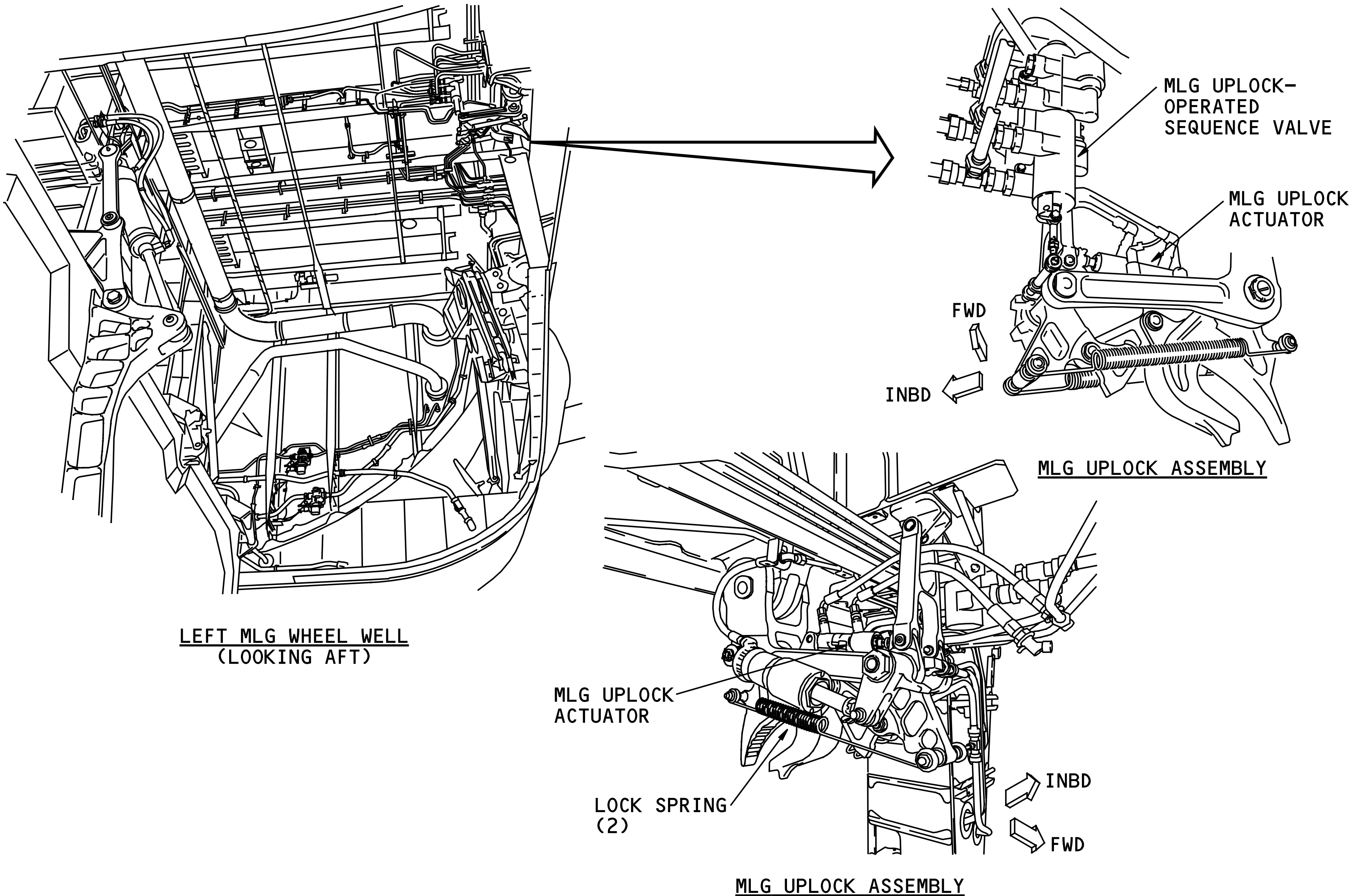
Functional Description

During gear retraction, the roller on the MLG shock strut engages the hook in the uplock assembly. The motion of the gear starts to move the uplock mechanism to the over-center locked position. This also moves the MLG uplock-operated sequence valve to the lock position.

The MLG uplock-operated sequence valve then supplies pressure to the extend side of the MLG uplock actuator. This makes sure the uplock mechanism moves to the over-center locked position.

Lock springs hold the mechanism in this position.

During gear extension, the MLG uplock actuator moves the uplock mechanism to the unlocked position. This releases the gear from the up and locked position.



32-32-00-008 Rev 4 07/22/1997

MLG EXTENSION-RETRACTION - MLG UPLOCK ASSY, UPLOCK ACTUATOR, AND UPLOCK-OPERATED SEQUENCE VALVE

MLG EXTENSION-RETRACTION - MLG DRAG BRACE-OPERATED SEQUENCE VALVE

Purpose

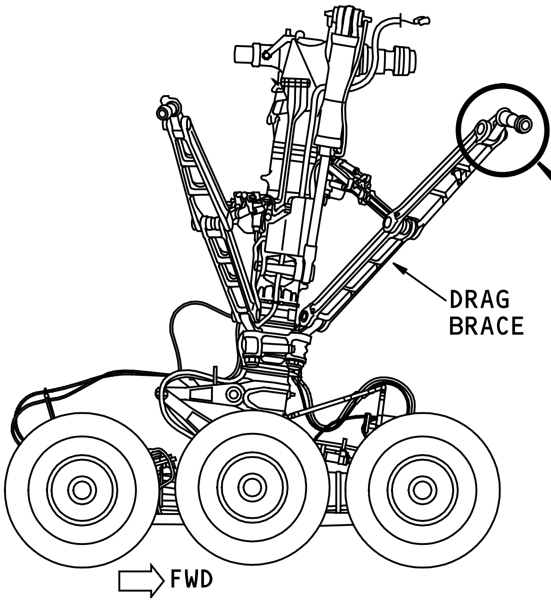
The MLG drag brace-operated sequence valve controls MLG door close operation during landing gear extension.

Physical Description

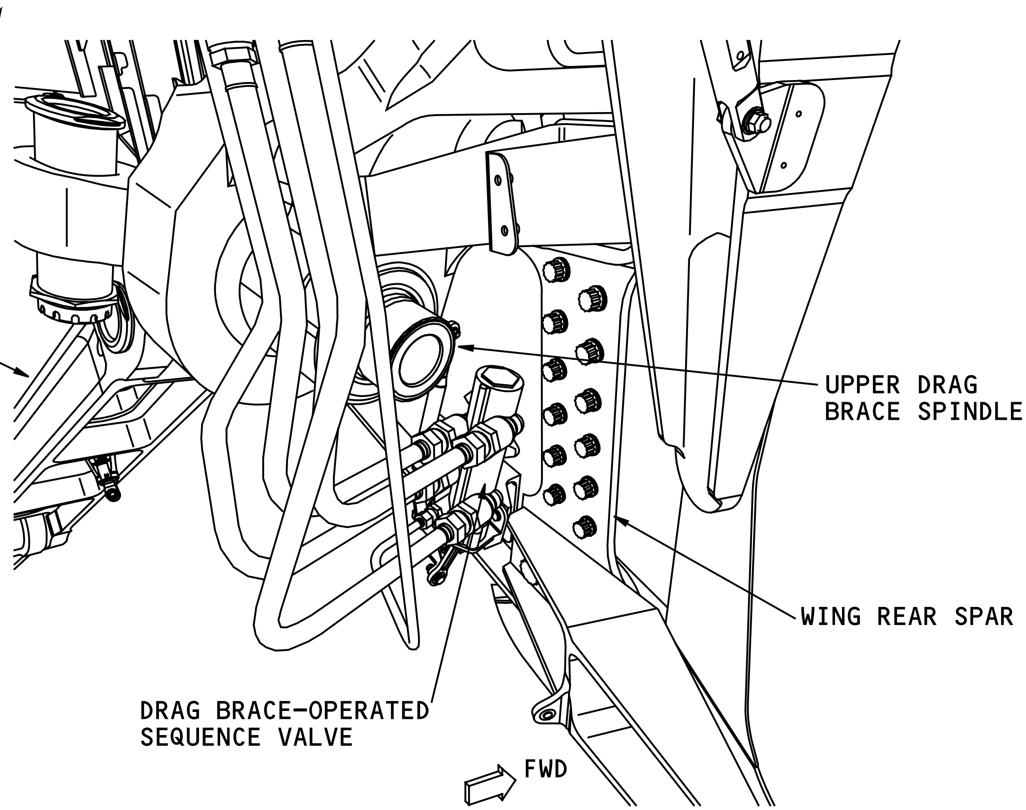
The MLG drag brace-operated sequence valve has two positions: GEAR DOWN and GEAR NOT DOWN. Linkage from the upper drag brace spindle moves the valve.

Location

The MLG drag brace-operated sequence valve is in the MLG wheel well on the wing rear spar.



LEFT MAIN LANDING GEAR



32-32-00-009 Rev 2 03/26/96

MLG EXTENSION-RETRACTION - MLG DRAG BRACE-OPERATED SEQUENCE VALVE

MLG EXTENSION-RETRACTION - MLG TRUCK POSITIONER ACTUATOR - FUNCTIONAL DESCRIPTION

General

The MLG truck positioner actuator retracts to move the MLG truck to the TILT position and extends to move the MLG truck to the STOW position.

Tilt Position

When the landing gear is down and locked, hydraulic pressure goes to both sides of the floating piston and the rod side of the main piston. This retracts the truck positioner actuator which moves the truck to 13 degrees forward wheels up (airplane in the air).

Stow Position

During gear retraction, hydraulic pressure goes between the floating piston and the rod side of the main piston. This makes the pistons move apart until the floating piston touches the rod shoulder.

Since the floating piston has a larger surface area than the main piston, the actuator extends until the floating piston touches the stops on the cylinder rod end. This moves the truck to the 5 degrees forward wheels down position.

After the landing gear is up and locked, the pressure in the truck positioner actuator keeps the gear in the STOW position.

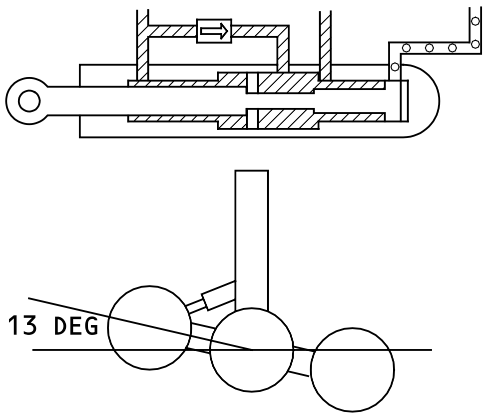
A relief valve opens to release actuator pressure increases caused by thermal expansion and touch down loads.

Training Information Point

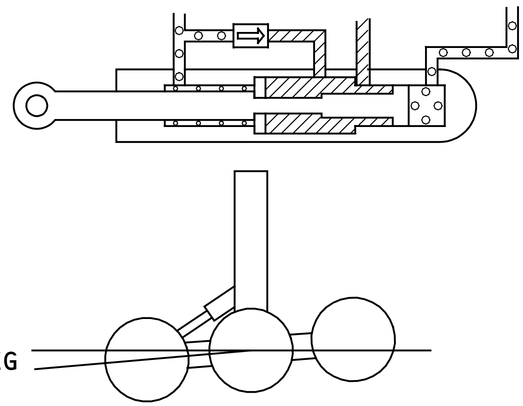
The design of the MLG truck positioner actuator permits the truck to tilt 19 degrees forward wheels down. This tilt may occur after a high rate of sink landing or when you jack the aft axle.

The maximum distance you can lift the forward axles of the MLG trucks on jacks is to a distance of 19.8 inches between the ground and the jacking point.

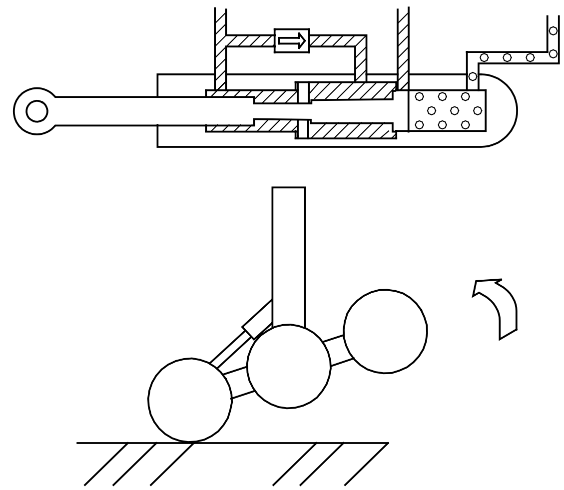
The maximum distance you can lift the aft axles of the MLG trucks on jacks is to a distance of 17.6 inches between the ground and the jacking point.



TILT POSITION



STOW POSITION



19 DEGREE DOWN POSITION

32-32-00-011 Rev 1

MLG EXTENSION-RETRACTION - MLG TRUCK POSITIONER ACTUATOR - FUNCTIONAL DESCRIPTION

MLG EXTENSION-RETRACTION - MLG TRUCK POSITIONER ACTUATOR FUSES

Purpose

The MLG truck positioner actuator fuses prevent loss of center hydraulic system fluid if there is a leak in the hydraulic lines to the MLG truck positioner actuator.

There are fuses in the tilt and stow hydraulic pressure lines that go to each MLG truck positioner actuator.

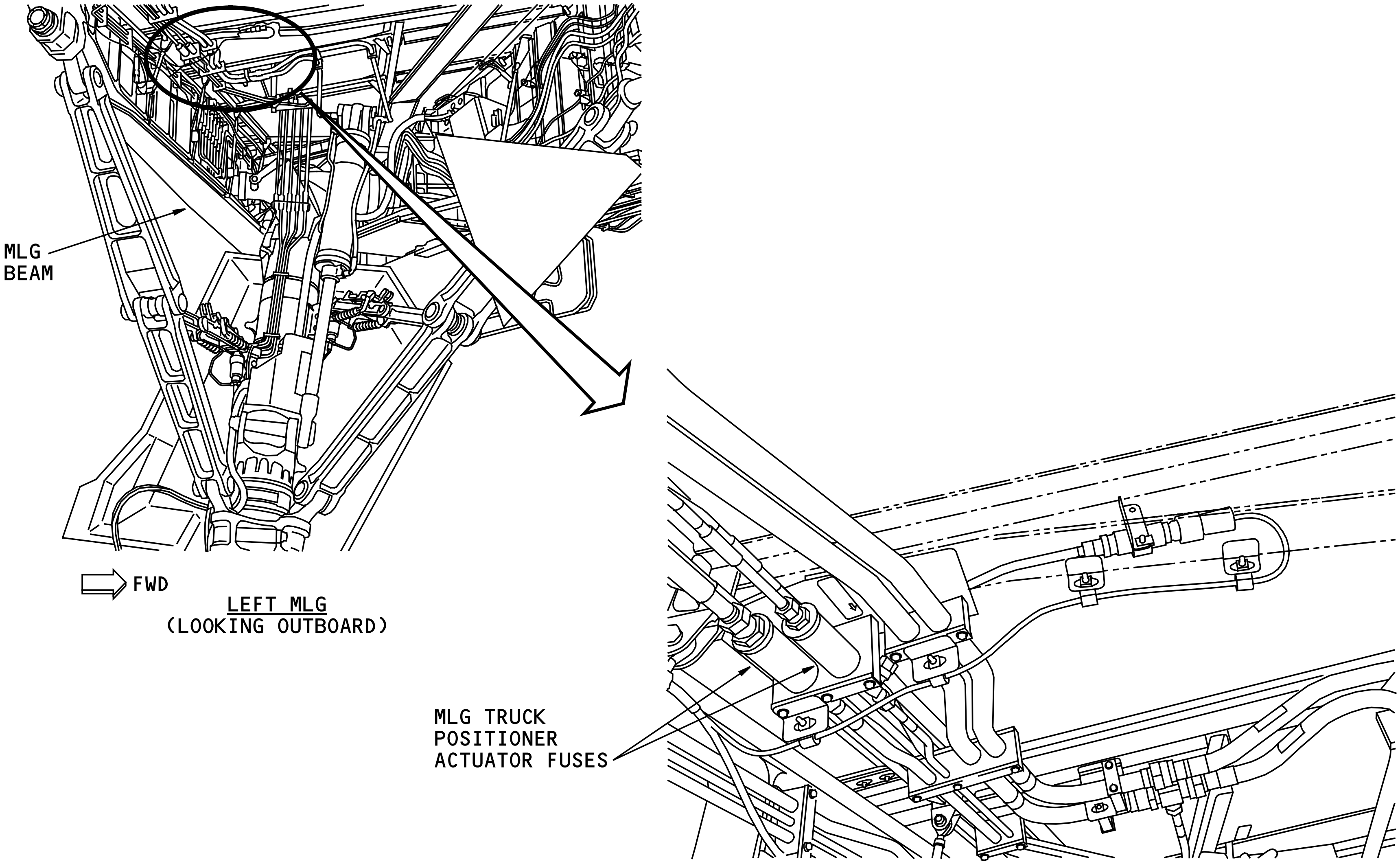
Location

The truck positioner actuator fuses are above the MLG truck near the main landing gear beam.

Training Information Point

The fuses close if 60 - 90 cubic inches of hydraulic fluid go through the fuse at a minimum rate of 0.1 gallons per minute.

The fuses reset automatically when the pressure difference across the fuse is five psi or less.



32-32-00-012 Rev 3 03/26/96

MLG EXTENSION-RETRACTION - MLG TRUCK POSITIONER ACTUATOR FUSES

MLG EXTENSION-RETRACTION - RETRACTION SEQUENCE

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MLG EXTENSION-RETRACTION - RETRACTION SEQUENCE

General

MLG retraction is the same for both left and right main gears.

These are the start positions:

- MLG - DOWN and LOCKED
- MLG door - CLOSED and LOCKED
- MLG truck positioner actuator - TILT
- MLG drag brace-operated sequence valve - DOWN
- MLG uplock-operated sequence valve - UNLOCKED
- MLG door-operated sequence valve - NOT OPEN.

Control

When you move the landing gear lever to the UP position, the MLG selector/bypass valve moves to the UP position. Hydraulic pressure then goes to the retract lines.

Gear Unlock - Truck Tilt

The pressure goes to the MLG drag brace and MLG side brace downlock actuators. These actuators start to retract to unlock the gear downlocks.

Pressure also goes through the MLG drag brace-operated sequence valve and the MLG uplock-operated sequence valve. This pressure extends the MLG truck positioner actuator to the STOW position.

Door Opens

Pressure through the sequence valves also retracts the MLG door lock actuator to unlock the main gear door. The MLG door actuator gets extend pressure through the MLG door priority/relief valve. The MLG door starts to open.

Gear Retracts

When the MLG door is almost all the way open, the MLG door-operated sequence valve moves to OPEN. Pressure then goes to the MLG retract actuator to retract the gear.

When the gear starts to retract, the MLG drag brace-operated sequence valve moves to the NOT DOWN position.

As the MLG goes into the wheel well, a roller on the landing gear strut moves the MLG uplock mechanism to the LOCKED position. This moves MLG uplock-operated sequence valve to the locked position.

This removes pressure from the MLG truck positioner actuator. Pressure trapped in the MLG truck positioner actuator keeps the MLG truck in the STOW position.

Pressure then goes to the MLG uplock actuator to make sure the MLG uplock mechanism locks.

Pressure through the MLG door-operated sequence valve also goes to brake system components for the gear

MLG EXTENSION-RETRACTION - RETRACTION SEQUENCE

retract braking function. See the wheels and brakes section for more information (AMM PART I 32-40).

Door Closes

Pressure also goes to the close side of the MLG door actuator and the lock side of the MLG door lock actuator. The door starts to close.

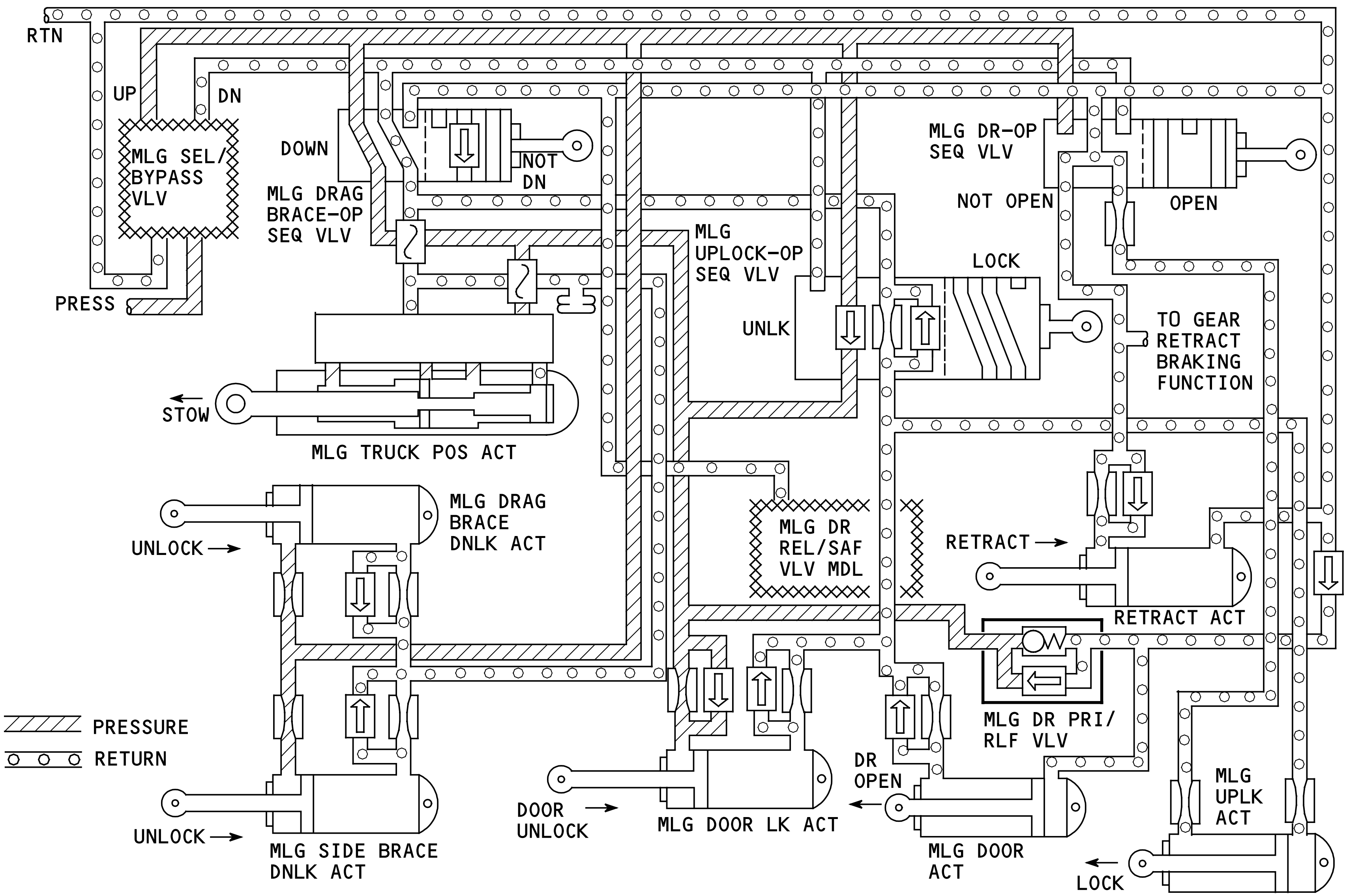
When the door is almost closed, a roller on the door starts to move the MLG door uplock mechanism to the locked position. Pressure in the MLG door lock actuator moves the uplock mechanism over-center to the locked position.

Final Position

Final main gear conditions are:

- MLG - UP and LOCKED
- MLG door - CLOSED and LOCKED
- MLG truck position actuator - STOW
- MLG drag brace-operated sequence valve - NOT DOWN
- MLG uplock-operated sequence valve - LOCKED
- MLG door-operated sequence valve - NOT OPEN.

Pressure stays in the retract lines until the auto-off function moves the MLG selector/bypass valve to OFF.



MLG EXTENSION-RETRACTION - RETRACTION SEQUENCE

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MLG EXTENSION-RETRACTION - EXTENSION SEQUENCE

General

Main gear extension is the same for both left and right main gear.

These are the start conditions:

- MLG - UP and LOCKED
- MLG door - CLOSED and LOCKED
- MLG truck positioner actuator - STOW
- MLG Drag brace-operated sequence valve - NOT DOWN
- MLG uplock-operated sequence valve - LOCKED
- MLG door-operated sequence valve - NOT OPEN

Control

When you select DOWN with the landing gear lever, the MLG selector/bypass valve moves to the down position. This permits hydraulic pressure to go to the extend lines.

Door Opens

Pressure goes through the MLG drag brace-operated sequence valve and the MLG uplock-operated sequence valve. This pressure goes to the MLG truck positioner actuator to hold the MLG truck in the STOW position.

This pressure also goes to the MLG door lock actuator to unlock the MLG door. The MLG door actuator then gets extend pressure through the MLG door priority/relief valve. The MLG door starts to open.

Gear Extends - Truck Tilts

When the MLG door is almost all the way open, the MLG door-operated sequence valve moves to OPEN. Pressure then goes to the MLG uplock actuator to unlock the MLG uplock.

The MLG extends by its own weight and by airloads. It is not pressurized during extension.

When the main landing gear is 20 degrees from fully extended, the MLG drag brace-operated sequence valve moves to DOWN.

Hydraulic pressure then retracts the MLG truck positioner actuator which moves the MLG truck to the TILT position.

Hydraulic pressure also goes to the MLG drag brace and MLG side brace downlock actuators to lock the gear down.

Door Closes

Pressure from the MLG drag brace-operated sequence valve goes through the MLG uplock-operated sequence valve and the MLG door release/safety valve module. This pressure goes to the MLG door actuator and the MLG door lock actuator. The MLG main gear door closes.

When the door is almost closed, a roller on the door starts to move the MLG door uplock mechanism to the locked position. Pressure in the MLG door lock actuator

MLG EXTENSION-RETRACTION - EXTENSION SEQUENCE

moves the uplock mechanism over-center to the locked position.

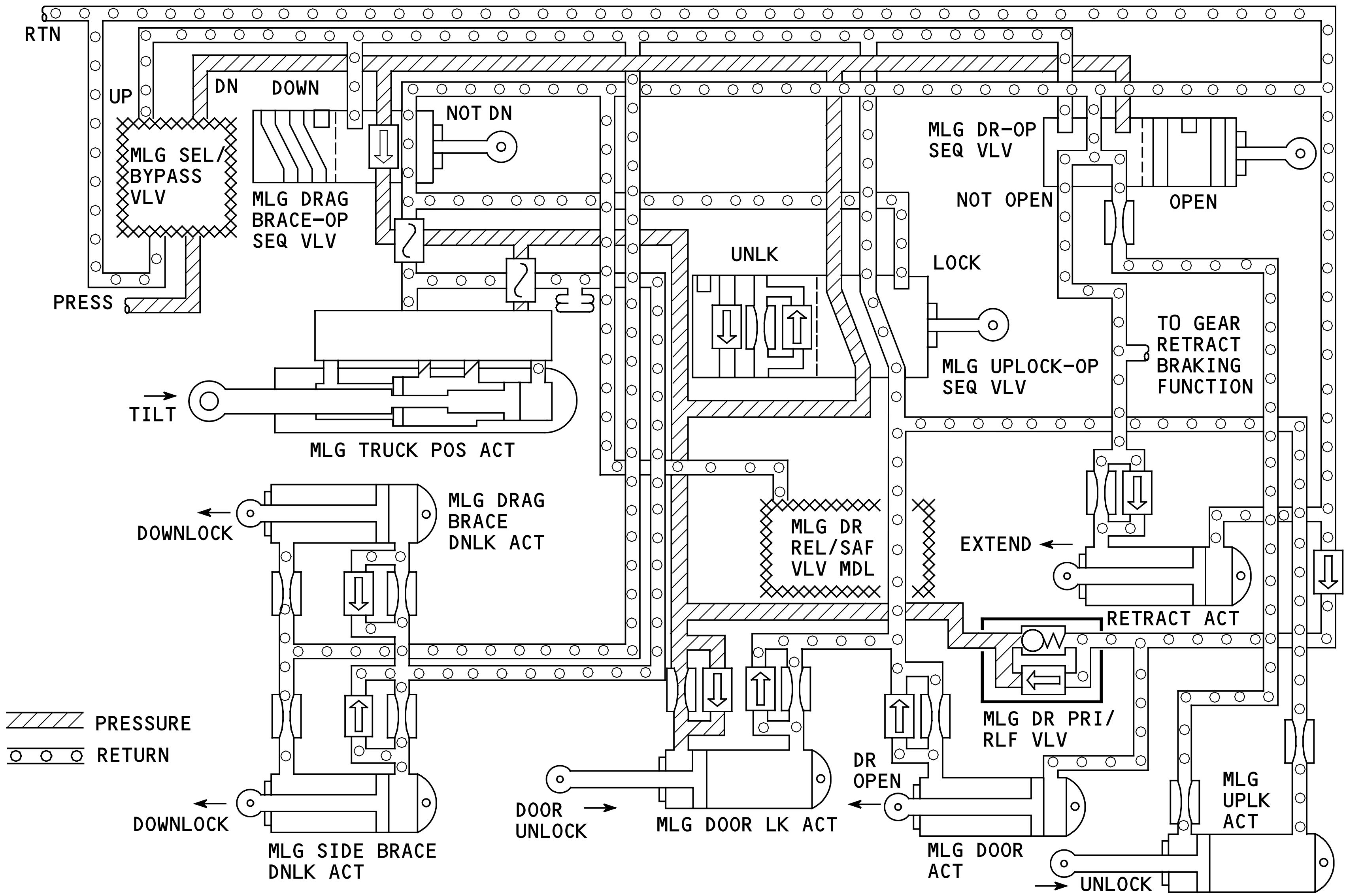
Final Condition

The final condition of the MLG is:

- MLG - DOWN and LOCKED
- MLG door - CLOSED and LOCKED
- MLG truck positioner actuator - TILT
- MLG drag brace-operated sequence valve - DOWN
- MLG uplock-operated sequence valve - UNLOCKED
- MLG door-operated sequence valve - NOT OPEN.

These actuators stay pressurized when the MLG is down and the center hydraulic system is pressurized:

- MLG door actuator
- MLG door lock actuator
- MLG truck positioner actuator
- MLG side brace actuator
- MLG drag brace actuator.



MLG EXTENSION-RETRACTION - EXTENSION SEQUENCE

NLG EXTENSION-RETRACTION - INTRODUCTION

Purpose

The NLG extension-retraction system extends and retracts the nose landing gear and opens and closes the NLG doors.

Components

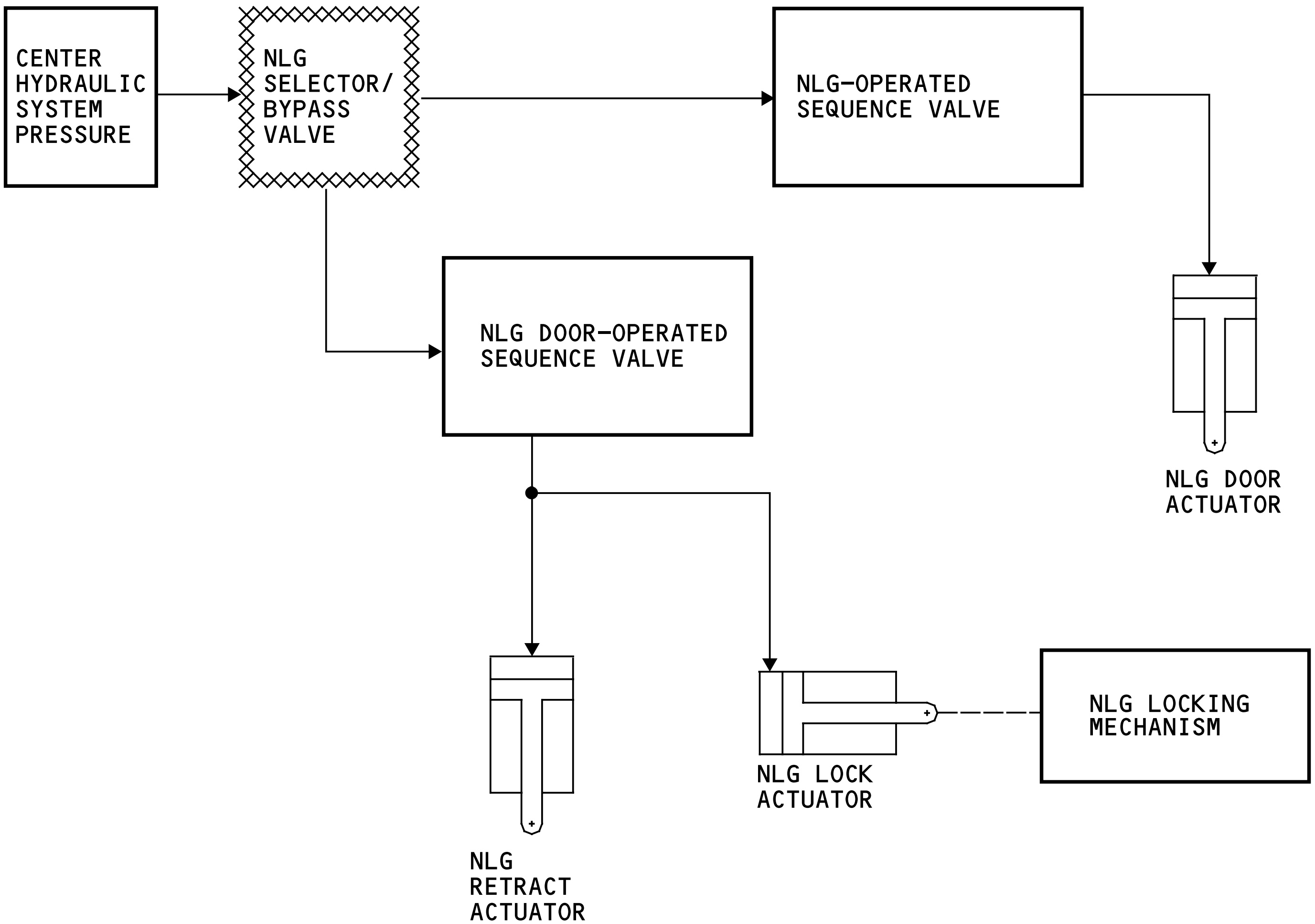
These are the NLG extension-retraction components:

- NLG-operated sequence valve
- NLG door actuator
- NLG door-operated sequence valve
- NLG retract actuator
- NLG lock actuator
- NLG locking mechanism.

General Description

The center hydraulic system supplies pressure to operate the nose landing gear. The pressure goes through the NLG selector/bypass valve. The NLG door-operated sequence valve controls hydraulic pressure to the NLG retract actuator and the NLG lock actuator.

The NLG-operated sequence valve controls hydraulic pressure to the NLG door actuator.



32-34-00-001 Rev 0

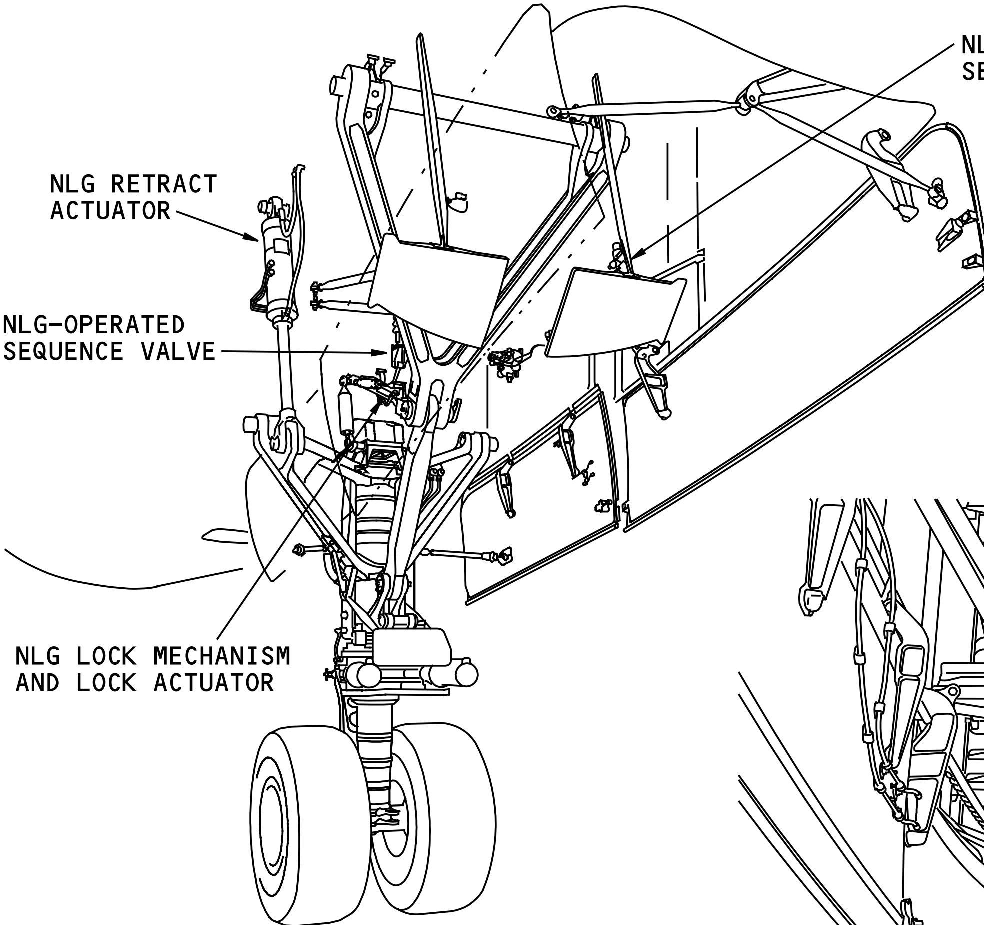
NLG EXTENSION-RETRACTION - INTRODUCTION

NLG EXTENSION-RETRACTION - COMPONENT LOCATIONS

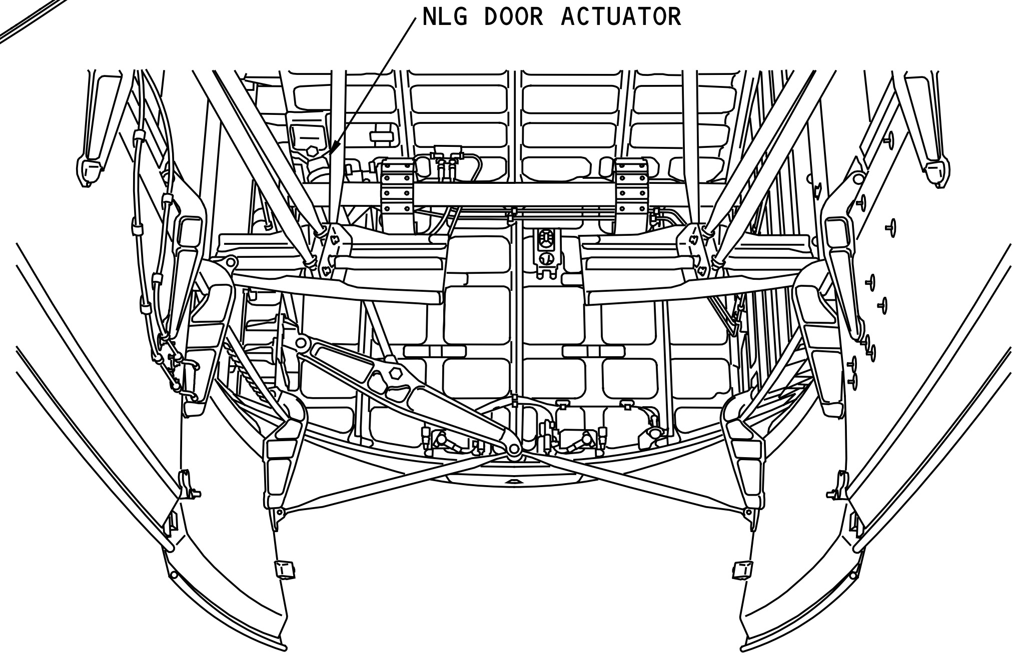
General

These are the components in the NLG wheel well:

- NLG retract actuator
- NLG-operated sequence valve
- NLG lock actuator
- NLG lock mechanism
- NLG door-operated sequence valve
- NLG door actuator.



NOSE LANDING GEAR



NLG WHEEL WELL - (LOOKING FORWARD)

NLG EXTENSION-RETRACTION - COMPONENT LOCATIONS

NLG EXTENSION-RETRACTION - NLG LOCKING MECHANISM AND NLG LOCK ACTUATOR

Purpose

The NLG locking mechanism holds the NLG in the extended or the retracted position.

The NLG lock actuator unlocks the NLG locking mechanism at the start of an extension or retraction. It also locks the mechanism when the NLG is fully extended or fully retracted.

Physical Description

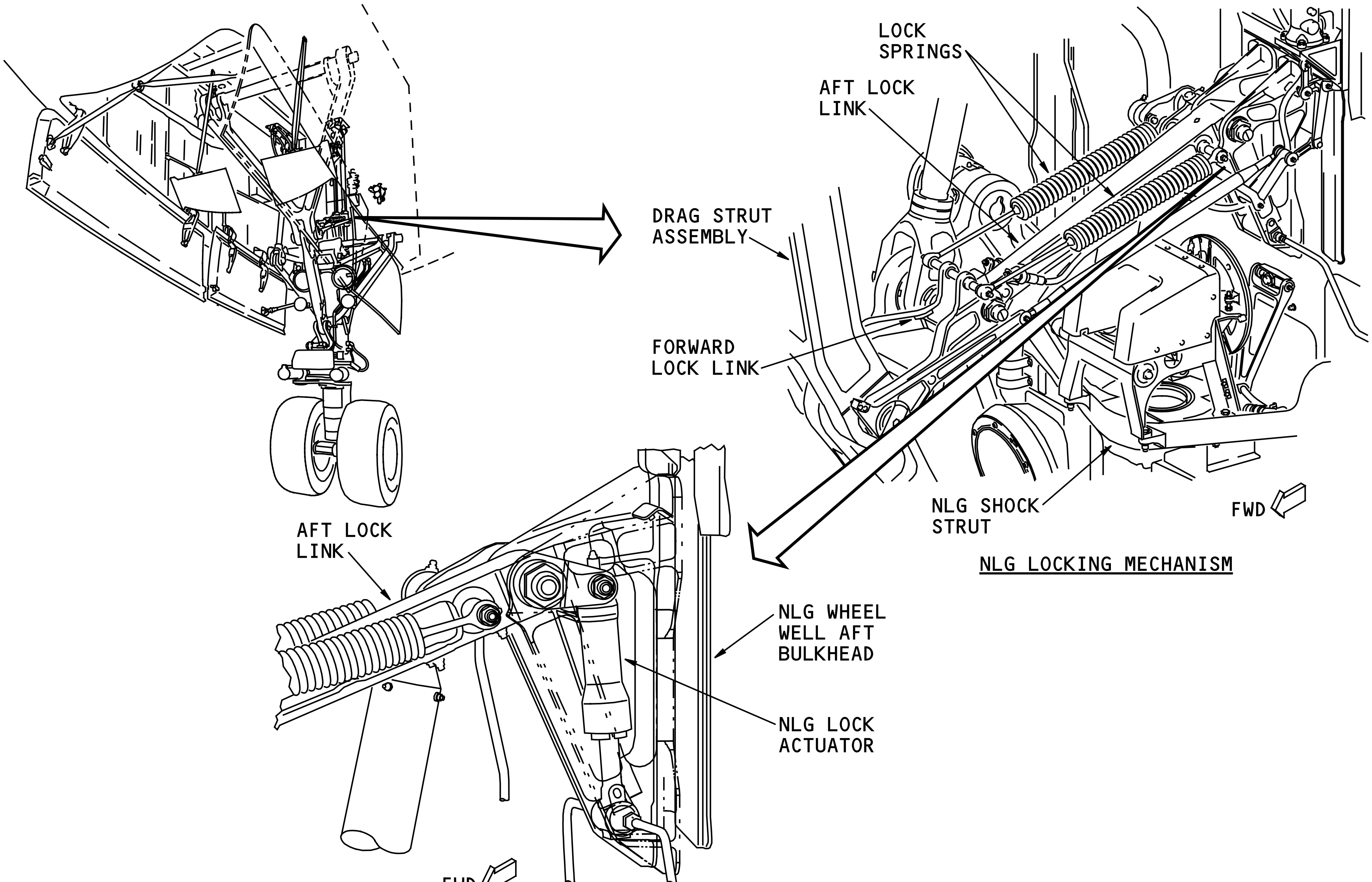
The NLG locking mechanism uses over-center locking to lock the NLG in either the extended or retracted position. The locking mechanism has a forward and an aft lock link which connect by a hinge. Two lock springs keep the lock links in position.

The NLG lock actuator is a hydraulic piston-type actuator. Flow restrictors control the hydraulic flow rate in both directions of actuator motion.

Location

The nose gear locking mechanism is directly above the nose gear shock strut. The forward lock link attaches to the drag strut hinge. The aft lock link attaches to the NLG wheel well aft bulkhead.

The NLG lock actuator is at the aft end of the NLG locking mechanism. The rod end of the actuator attaches to the NLG wheel well aft bulkhead. The head end attaches to the aft part of the locking mechanism.



32-34-00-004 Rev 2 10/18/96

NLG EXTENSION-RETRACTION - NLG LOCKING MECHANISM AND NLG LOCK ACTUATOR

NLG EXTENSION-RETRACTION - NLG LOCKING MECHANISM AND NLG LOCK ACTUATOR - FUNCTIONAL DESCRIPTION

Retraction

Before gear retraction, the NLG lock actuator retracts. This unlocks the NLG locking mechanism and permits the NLG to retract.

The hydraulic pressure stays on the retract side of the NLG lock actuator while the gear is in transit.

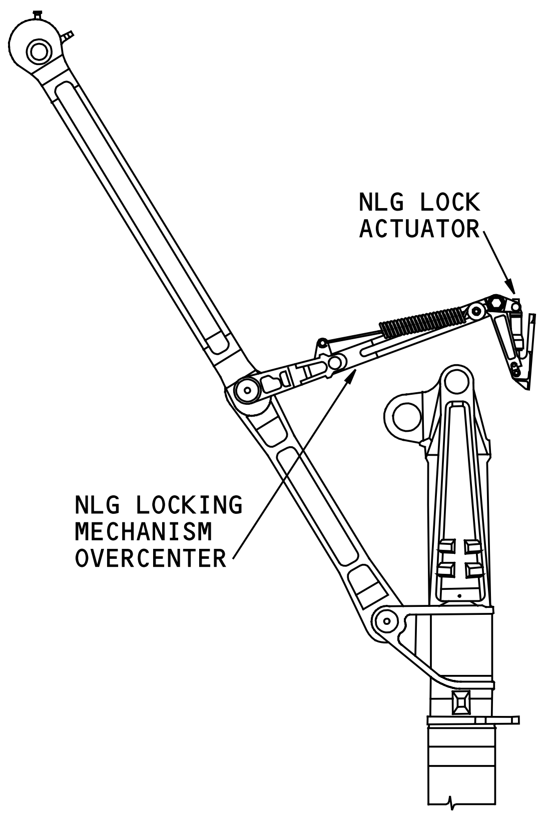
The NLG lock actuator moves the NLG locking mechanism to the lock position when the NLG is in the retracted position.

Extension

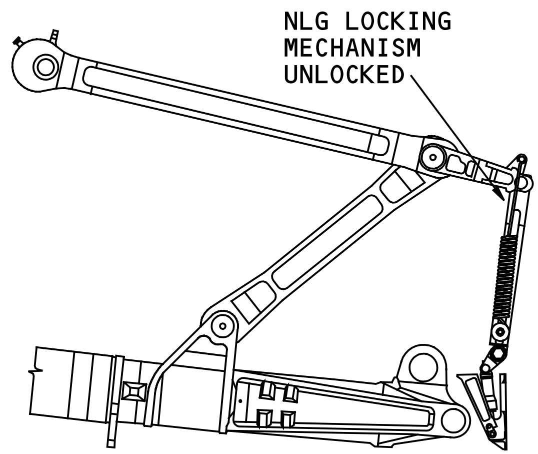
Before gear extension, the NLG lock actuator extends. This unlocks the NLG locking mechanism and permits the NLG to extend.

Hydraulic pressure stays on the extend side of the NLG lock actuator while the gear is in transit.

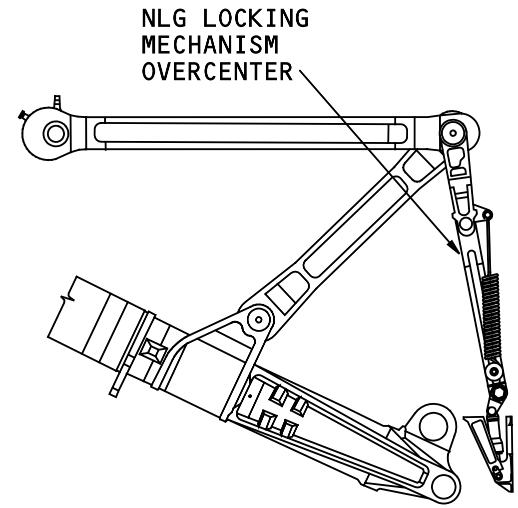
The NLG lock actuator moves the NLG locking mechanism to the lock position when the NLG is in the extended position.



NLG DOWN AND LOCKED



NLG IN-TRANSIT



NLG UP AND LOCKED

32-34-00-005 Rev 1 10/18/96

NLG EXTENSION-RETRACTION - NLG LOCKING MECHANISM AND NLG LOCK ACTUATOR - FUNCTIONAL DESCRIPTION

NLG EXTENSION-RETRACTION - NLG-OPERATED SEQUENCE VALVE

Purpose

The NLG-operated sequence valve makes sure that the doors move only if the NLG is in the retracted or the extended position. It makes sure that the doors do not move if the NLG is in-transit.

Physical Description

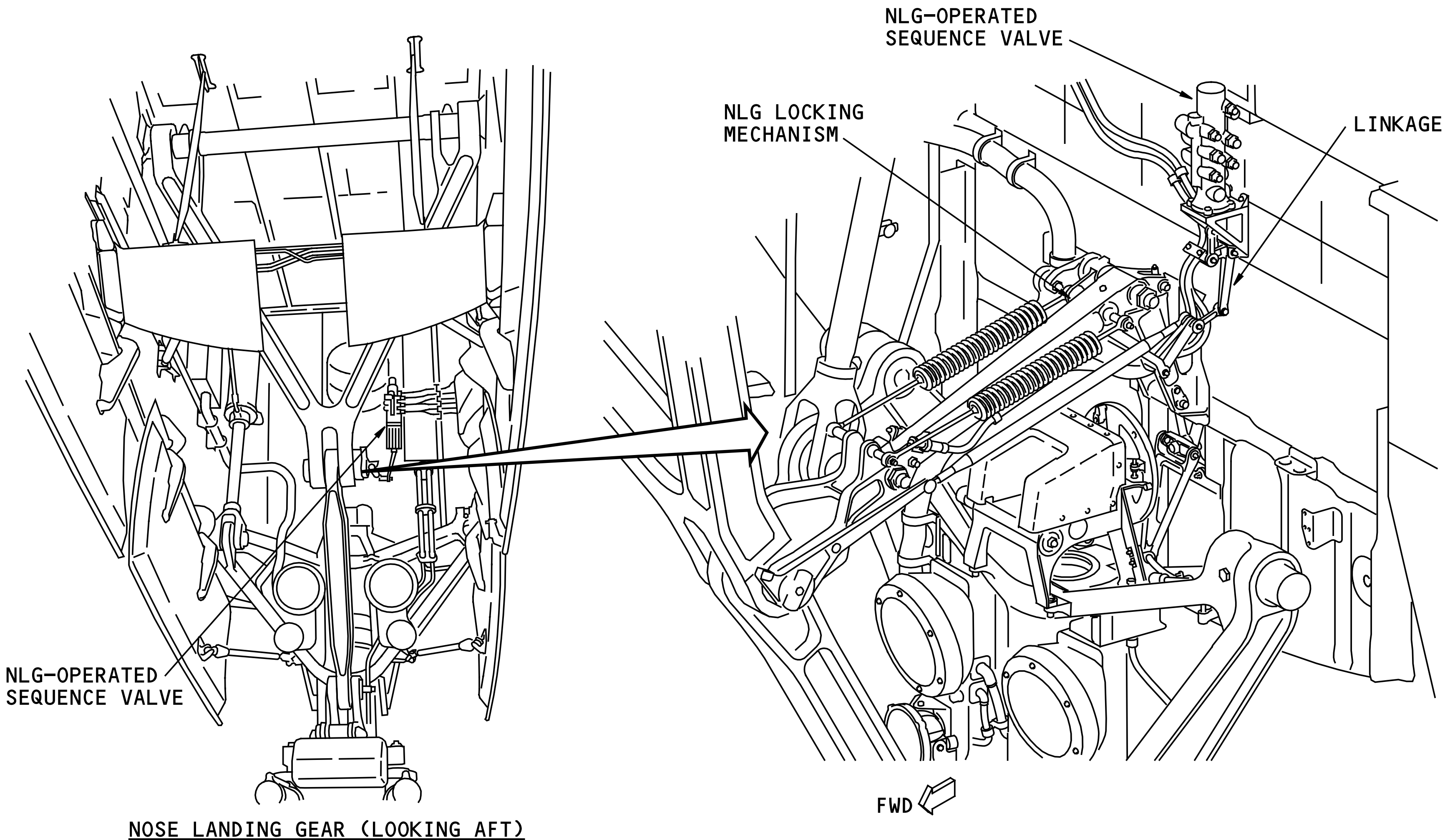
The NLG-operated sequence valve is a three position valve. The positions are:

- Gear up
- Gear in transit
- Gear down.

A linkage from the nose landing gear locking mechanism moves the sequence valve.

Location

The NLG-operated sequence valve is on the aft bulkhead in the nose wheel well.



32-34-00-006 Rev 3 08/07/95

NLG EXTENSION-RETRACTION - NLG-OPERATED SEQUENCE VALVE

NLG EXTENSION-RETRACTION - NLG DOOR ACTUATOR AND NLG DOOR-OPERATED SEQUENCE VALVE

Purpose

The NLG door actuator opens and closes the NLG forward doors. A lock in the actuator holds the doors closed.

The NLG door-operated sequence valve controls the hydraulic flow to the NLG lock and retract actuators. This makes sure the NLG extends or retracts only when the NLG doors are open.

Physical Description

The NLG door actuator is a two-position hydraulic actuator. The actuator extends to open the doors and retracts to close the doors.

Flow restrictors at the head and rod ends of the actuator control actuator speed.

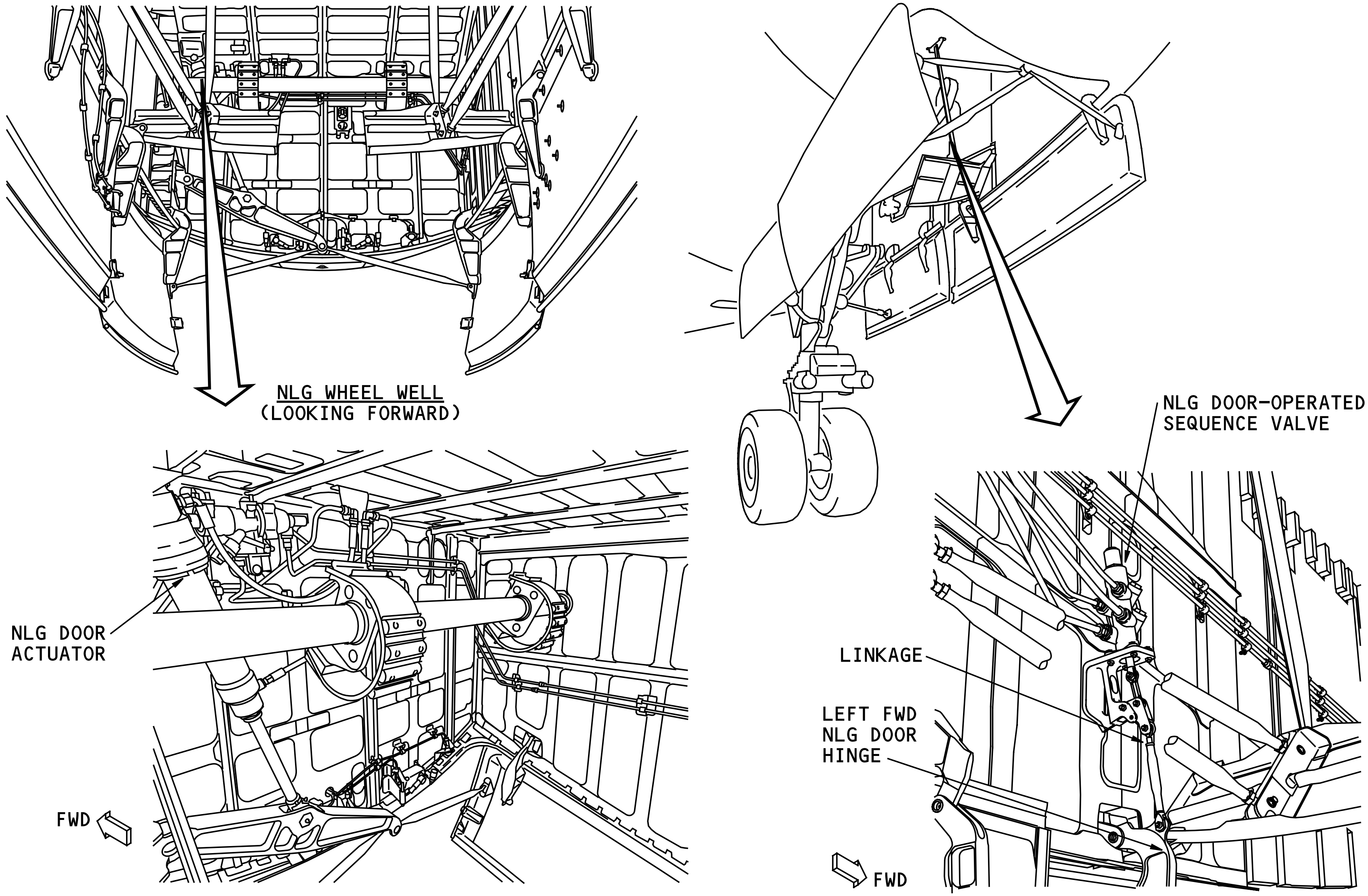
An internal lock engages when the NLG doors close. During normal operation, hydraulic pressure to open the NLG doors unlocks this lock.

The NLG door-operated sequence valve is a two position valve - OPEN and CLOSED. The sequence valve moves to the OPEN position when the doors are four degrees from the fully open position. A linkage from a hinge on the left forward NLG door operates the sequence valve.

Location

The NLG door actuator is in the forward, left side of the nose wheel well. The head end of the actuator attaches to a bracket on the wheel well ceiling. The rod end attaches to a crank. The crank moves both forward doors through rods.

The NLG door-operated sequence valve is on the left NLG wheel well wall.



32-34-00-007 Rev 3 11/13/95

NLG EXTENSION-RETRACTION - NLG DOOR ACTUATOR AND NLG DOOR-OPERATED SEQUENCE VALVE

NLG EXTENSION-RETRACTION - RETRACTION SEQUENCE

Initial Position

These are the initial positions for NLG components:

- NLG - DOWN AND LOCKED
- NLG doors - CLOSED
- NLG-operated sequence valve - GEAR DOWN
- NLG door-operated sequence valve - CLOSED.

Control

When you select UP with the landing gear control lever, the NLG selector/bypass valve moves to the up position. Hydraulic pressure then goes to the retract lines.

Gear Unlocks - Doors Open

Hydraulic pressure goes to the NLG lock actuator. The actuator starts to retract to unlock the downlock.

Pressure also goes through the NLG-operated sequence valve to the NLG door actuator. The actuator extends and opens the forward doors.

Gear Retracts

When the doors are almost fully open, the NLG door-operated sequence valve moves to OPEN. Pressure then goes to the NLG retract actuator and the NLG starts to retract.

After the NLG starts to retract, the NLG-operated sequence valve moves to the GEAR IN TRANSIT position. This keeps pressure on the open side of the door actuator.

Doors Close - Gear Locks

When the NLG is almost all the way up, the NLG-operated sequence valve moves to the UP position. Pressure now goes to the retract side of the NLG door actuator and the NLG doors start to close.

Pressure through the NLG-operated sequence valve also goes to the NLG retract actuator. This keeps the NLG up after the nose gear doors close.

The NLG lock actuator continues to retract and locks the NLG when the gear is fully up.

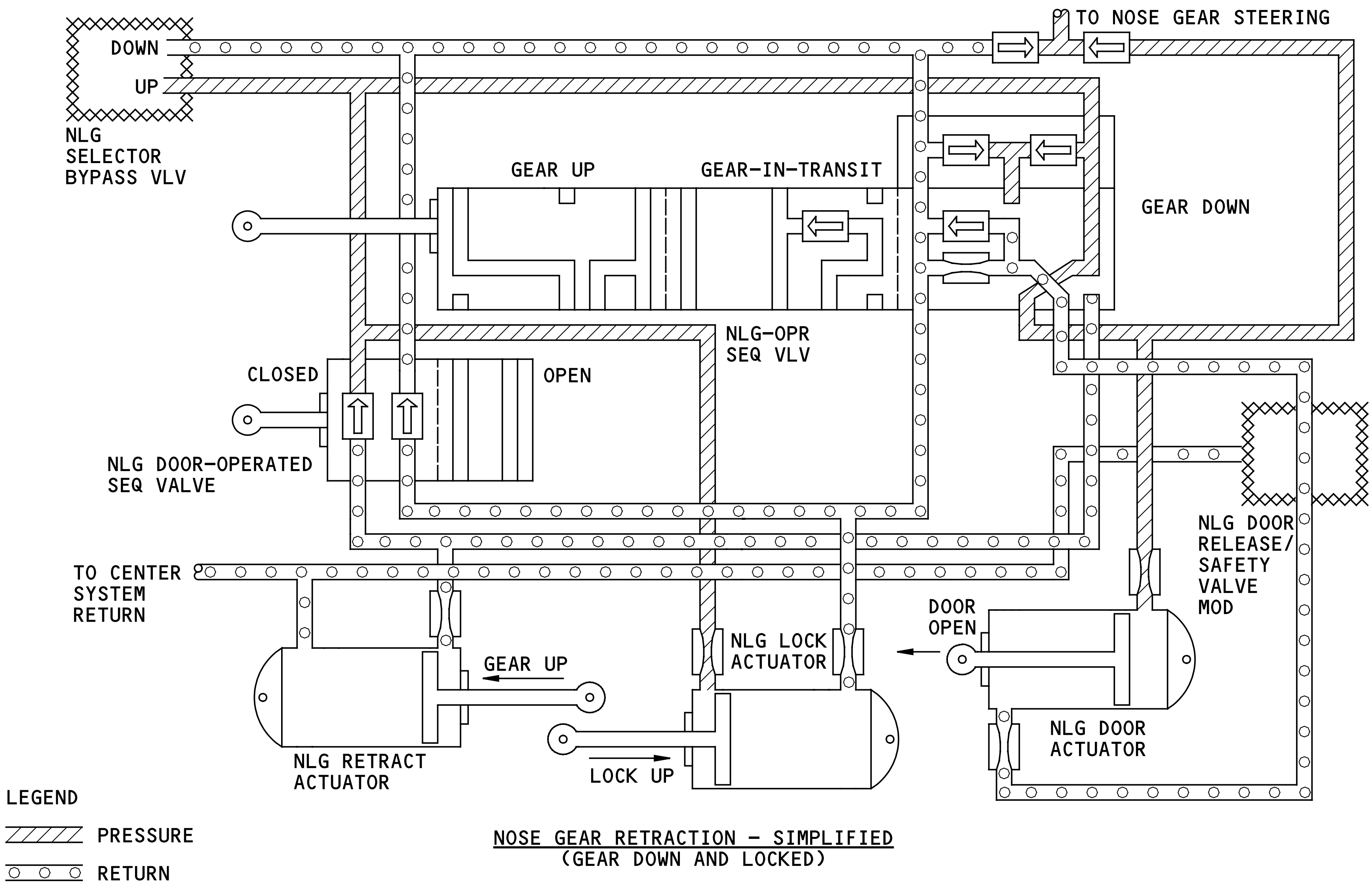
The lock inside the NLG door actuator locks the NLG when the doors are in the CLOSED position.

Final Positions

These are the final positions for nose gear components:

- NLG - UP AND LOCKED
- NLG doors - CLOSED
- NLG gear-operated sequence valve - GEAR UP
- NLG door-operated sequence valve - CLOSED.

The NLG selector/bypass valve automatically removes pressure from the NLG retract lines approximately ten seconds after the gear is up and locked.



NOSE GEAR RETRACTION - SIMPLIFIED
(GEAR DOWN AND LOCKED)

32-34-00-008 Rev 1

NLG EXTENSION-RETRACTION - RETRACTION SEQUENCE

NLG EXTENSION-RETRACTION - EXTENSION SEQUENCE

Initial Positions

These are the initial positions for the nose gear components:

- NLG - UP AND LOCKED
- NLG doors - CLOSED
- NLG-operated sequence valve - GEAR UP
- NLG door-operated sequence valve - CLOSED.

Control

When you select DOWN with the landing gear control lever, the nose landing gear selector/bypass valve moves to the DOWN position. Hydraulic pressure then goes to the extend lines.

Doors Open

Hydraulic pressure goes through the NLG-operated sequence valve to the NLG door actuator. The pressure unlocks the actuator and opens the forward nose landing gear doors.

Gear Unlocks - Gear Extends

When the nose landing gear doors are almost at the full open position, the NLG door-operated sequence valve moves to OPEN.

Pressure then goes to the extend side of the NLG lock actuator to unlock the uplock.

The NLG extends by the force of its own weight and by airloads. As the NLG starts to extend, the NLG-operated sequence valve moves to the GEAR-IN-TRANSIT position.

Doors Close

When the NLG is almost down, the NLG-operated sequence valve moves to the DOWN position. Pressure now goes to the retract side of the NLG door actuator and the doors start to close.

The NLG lock actuator continues to extend and locks the NLG when the gear is fully down.

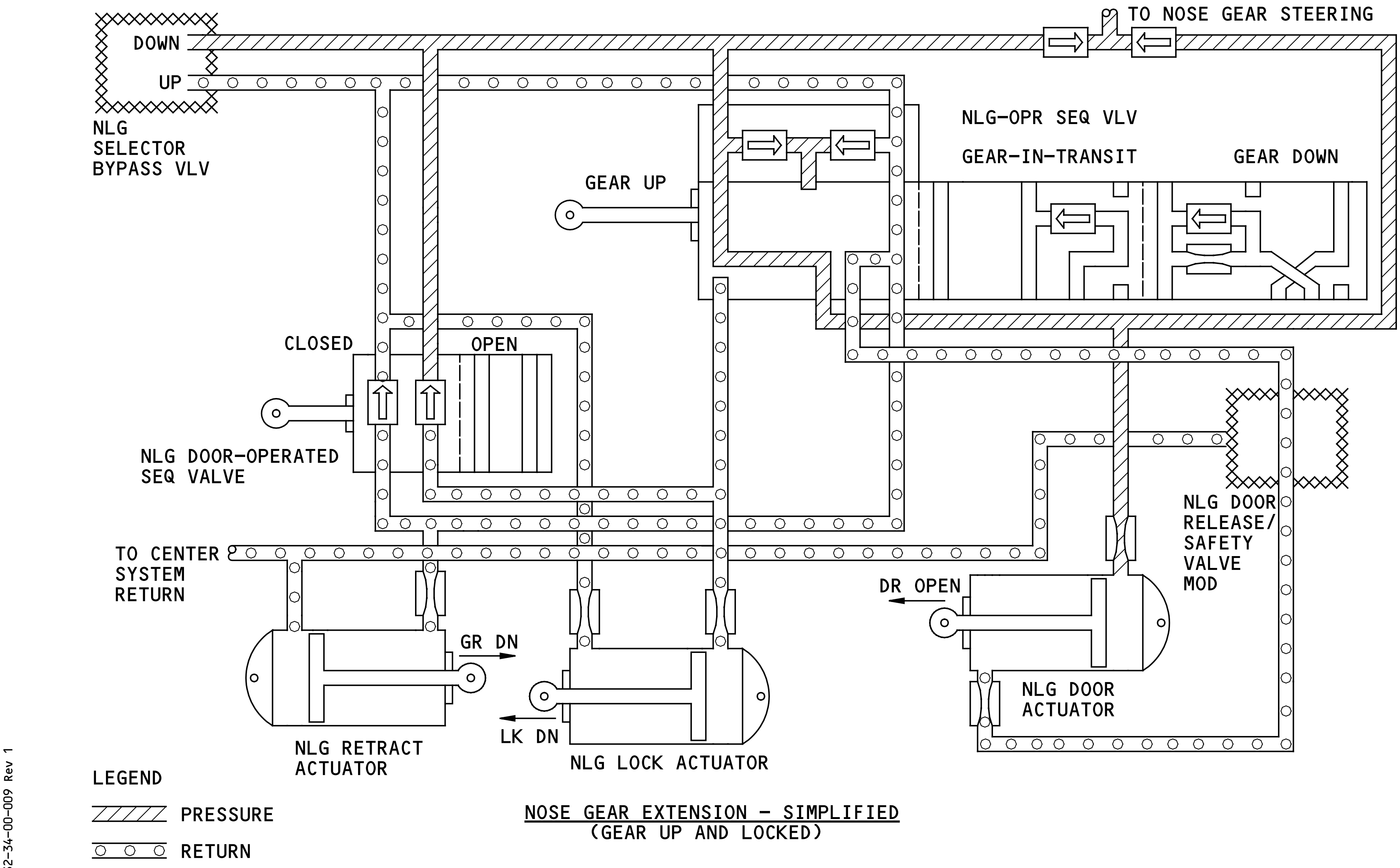
The lock inside the NLG door actuator locks when the doors are in the CLOSED position.

Final Positions

The final positions for NLG components are:

- NLG - DOWN AND LOCKED
- NLG doors - CLOSED
- NLG-operated sequence valve - GEAR DOWN
- NLG door-operated sequence valve - CLOSED.

Pressure stays in the NLG lock actuator and the NLG door actuator when the gear is down and the center hydraulic system is pressurized.



NOSE GEAR EXTENSION - SIMPLIFIED
(GEAR UP AND LOCKED)

NLG EXTENSION-RETRACTION - EXTENSION SEQUENCE

LANDING GEAR ALTERNATE EXTENSION SYSTEM - INTRODUCTION

Purpose

The alternate extension system permits you to extend the landing gear when there is no center hydraulic system pressure or if normal extension fails.

You also use the alternate extension system to open the landing gear doors on the ground.

Components

The alternate extension system components include:

- The alternate extend power pack
- The main landing gear door release/safety valve modules
- The nose landing gear door release/safety valve module
- The main landing gear alternate uplock release actuators
- The nose landing gear alternate uplock release actuator
- The alternate extend hydraulic pressure switch.

General Description

The alternate extension system operates independently of the normal extension and retraction system.

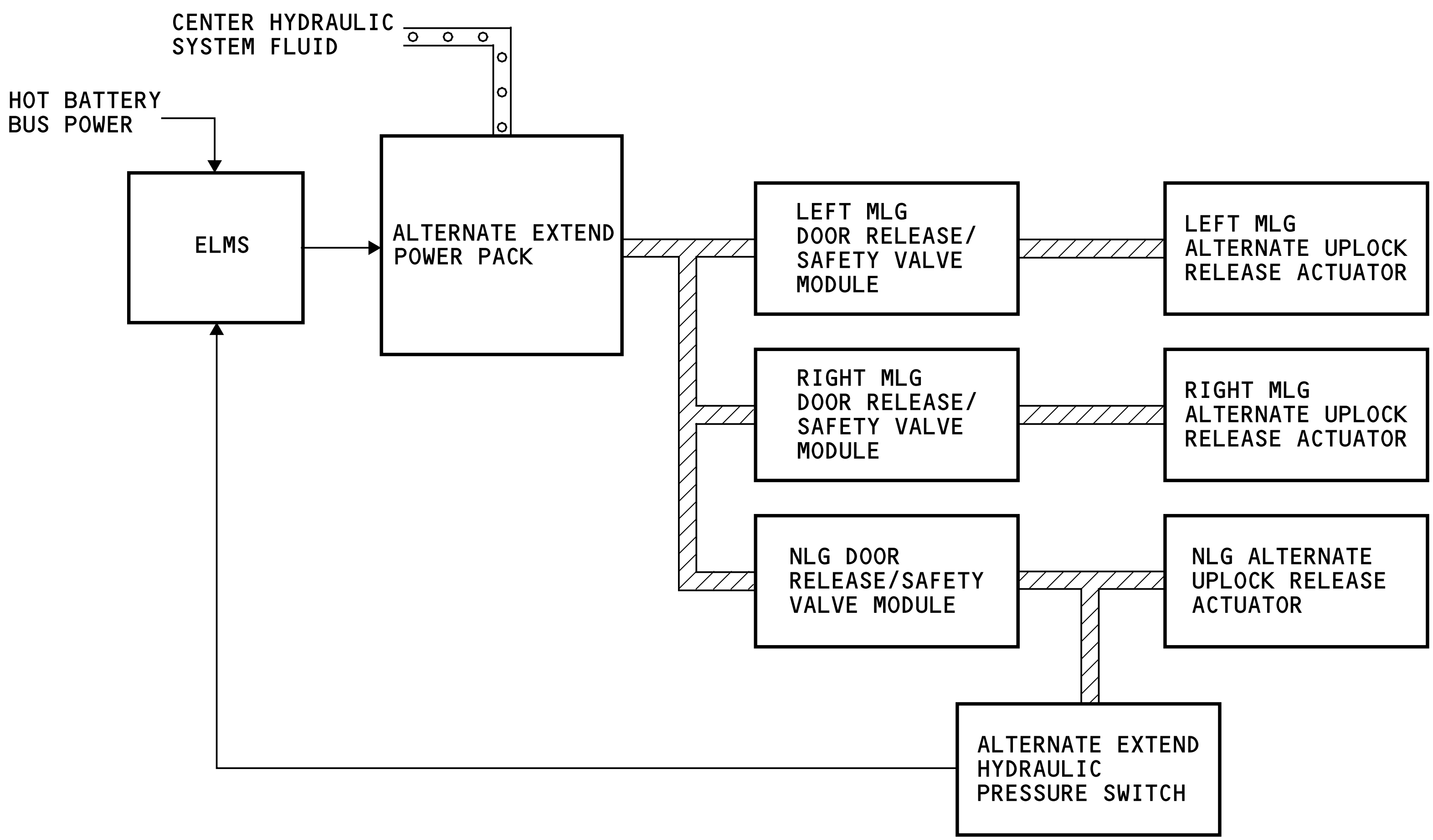
The hot battery bus supplies power to control and operate the alternate extension system. The ELMS contains relays that control the power to the alternate extend power pack.

The alternate extend power pack has a hydraulic pump operated by an electric motor. The alternate extend power pack pressurizes fluid from the center hydraulic system. This fluid then goes to door release/safety valve modules for each landing gear and unlocks the landing gear doors.

Fluid then goes to alternate uplock release actuators for each landing gear and unlocks the uplocks for the landing gear.

The landing gear doors open and the landing gear extend by airloads and their own weight. The landing gear tires may contact the landing gear doors during an alternate extension.

The alternate extend pressure switch stops operation of the power pack after the extend cycle is complete.



32-35-00-001 Rev 2 07/20/95

LANDING GEAR ALTERNATE EXTENSION SYSTEM - INTRODUCTION

LANDING GEAR ALTERNATE EXTENSION SYSTEM - COMPONENT LOCATIONS

Main Landing Gear Wheel Well

These components are in each main landing gear wheel well:

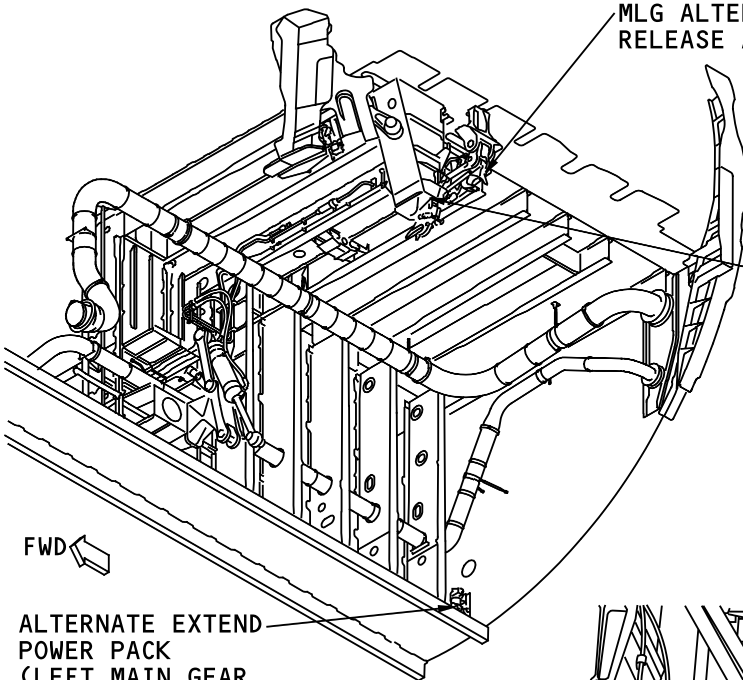
- Main landing gear door release/safety valve module
- Main landing gear alternate uplock release actuator.

The alternate extend power pack is in the left main landing gear wheel well.

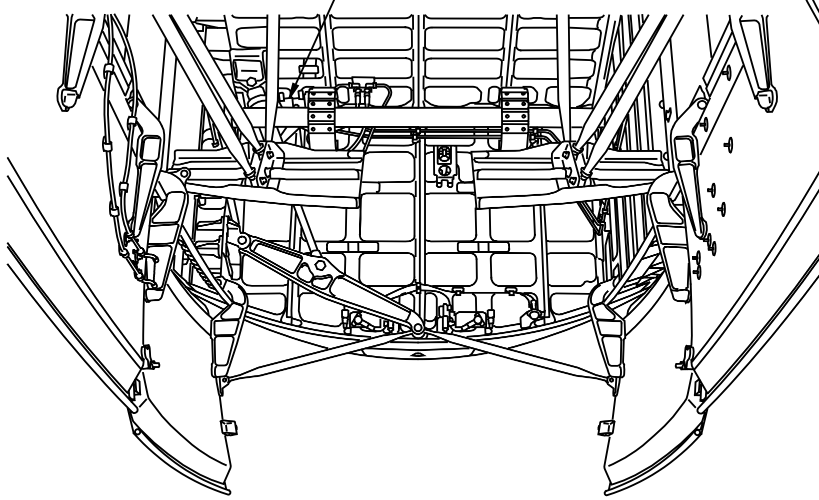
Nose landing Gear Wheel Well

These components are in the nose landing gear wheel well:

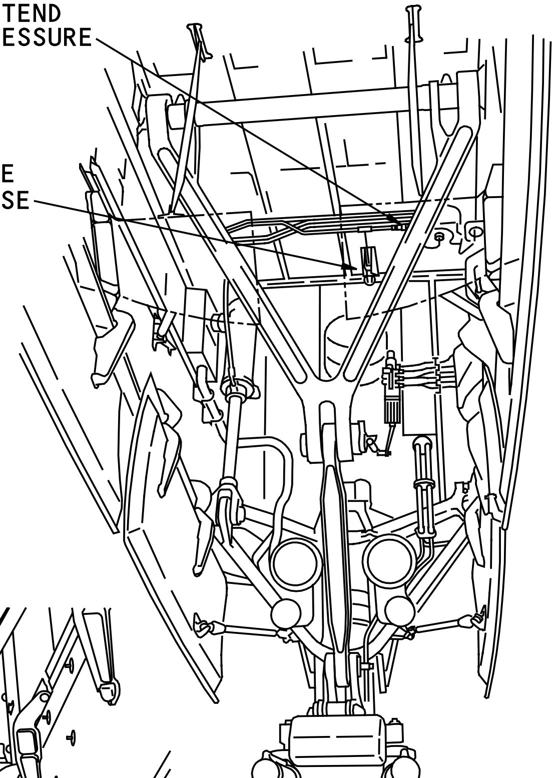
- Nose landing gear door release/safety valve module
- Nose landing gear alternate uplock release actuator
- Alternate extend hydraulic pressure switch.



LEFT MLG WHEEL WELL



NLG WHEEL WELL
(LOOKING FORWARD)



NOSE LANDING GEAR
(LOOKING AFT)

32-35-00-002 Rev 3 11/13/95

LANDING GEAR ALTERNATE EXTENSION SYSTEM - COMPONENT LOCATIONS

LANDING GEAR ALTERNATE EXTENSION SYSTEM - ALTERNATE GEAR SWITCH

General

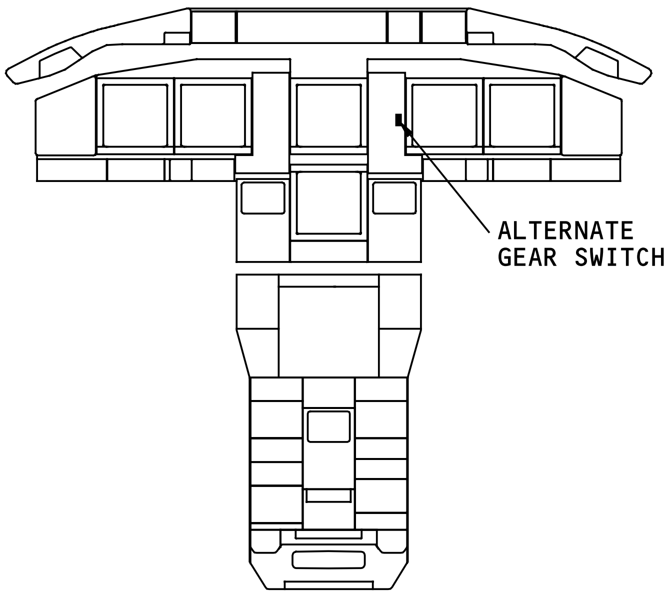
The alternate gear switch is on the landing gear panel on the P2 center forward panel.

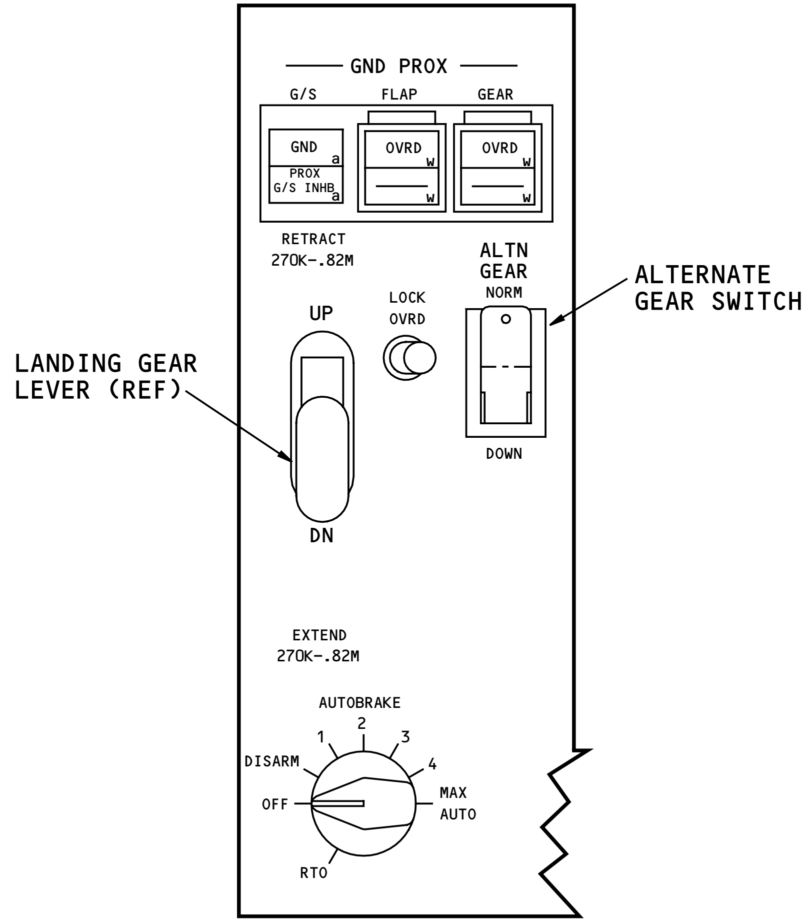
This switch is a guarded, two-position toggle switch. The positions of the switch are NORM and DOWN. The switch is spring-loaded to the NORM position.

You hold the alternate gear switch momentarily in the DOWN position to start the alternate gear extension.

Training Information Point

You can operate the alternate gear switch with the landing gear lever in the UP or DN position.





LANDING GEAR PANEL (P2)

32-35-00-003 Rev 2 10/15/96

LANDING GEAR ALTERNATE EXTENSION SYSTEM - ALTERNATE GEAR SWITCH

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LANDING GEAR ALTERNATE EXTENSION SYSTEM - GROUND DOOR OPERATION CONTROLS

Purpose

Ground door switches permit you to open and close the landing gear doors on the ground.

Location

These switches are on these two panels:

- P56 wheel well electrical service panel
- P40 service and APU shutdown panel.

Wheel Well Electrical Service Panel Switches

The wheel well electrical service panel is on the bottom of the airplane behind the main landing gear wheel wells.

These two switches on the wheel well electrical service panel control the landing gear doors:

- Arm doors switch
- All doors open/MLG doors close switch.

The arm doors switch is a two-position toggle switch. The two positions are OFF and ARM. The all doors open/MLG doors close switch is a three position switch. The positions are MLG DOOR CLOSE, OFF, and ALL DOORS OPEN. To operate the switches, you must pull them out from the OFF detent. Both switches are spring-loaded to OFF.

You must operate both switches at the same time. You move the arm doors switch to the ARM DOORS position. You move the all doors open/MLG doors close switch to the ALL DOORS OPEN position to open all landing gear doors (MLG and NLG). This operates the LG alternate extension system.

You move the arm doors switch to the ARM DOORS position and the all doors open/MLG doors close switch to the MLG DOORS CLOSE position to close the MLG doors. The doors close with center hydraulic system pressure.

Two control switches make sure that a single electrical failure does not accidentally operate the landing gear doors.

Service and APU Shutdown Panel Switches

The service and APU shutdown panel is on the aft side of the nose landing gear shock strut.

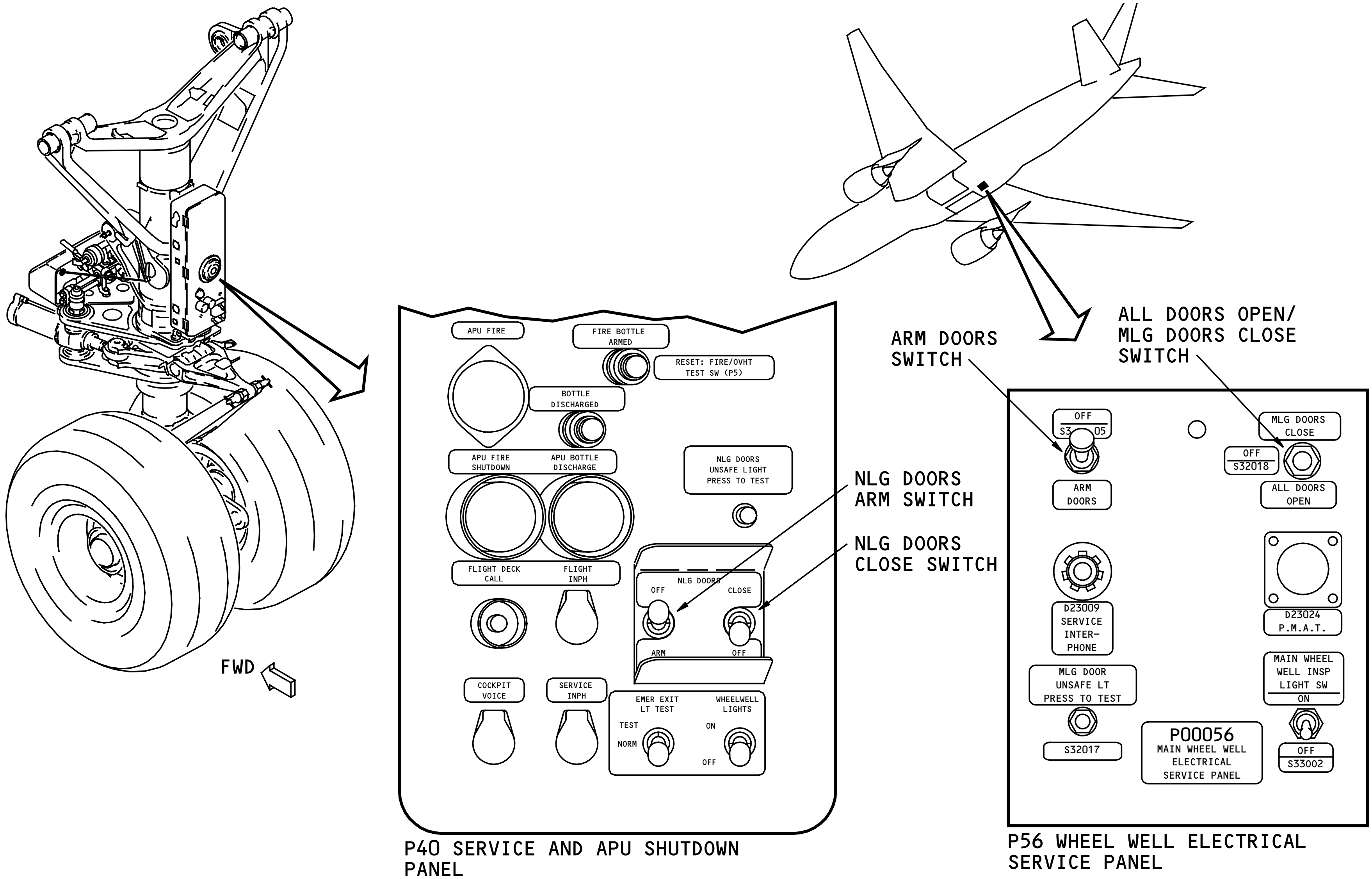
Two switches on the service and APU shutdown panel operate the nose landing gear doors:

- NLG doors arm switch
- NLG doors close switch.

These switches are two-position toggle switches. To operate the switches, you must pull them out from the OFF detent. Both switches are spring-loaded to OFF.

You must operate both switches at the same time. You move the switches to the ARM and CLOSE positions to close the NLG doors. The doors close with center hydraulic system pressure.

LANDING GEAR ALTERNATE EXTENSION SYSTEM - GROUND DOOR OPERATION CONTROLS



LANDING GEAR ALTERNATE EXTENSION SYSTEM - GROUND DOOR OPERATION CONTROLS

LANDING GEAR ALTERNATE EXTENSION SYSTEM - ALTERNATE EXTEND POWER PACK

Purpose

The alternate extend power pack supplies hydraulic pressure to the alternate extension system.

Physical Description

The power pack is an electric motor hydraulic pump. The 28v dc hot battery bus supplies power to the motor.

An oversize tube from the center hydraulic system reservoir supplies hydraulic fluid to the hydraulic pump in the power pack.

The power pack has internal hydraulic routing to let hydraulic fluid flow back into the oversize supply tube when the power pack is off.

Location

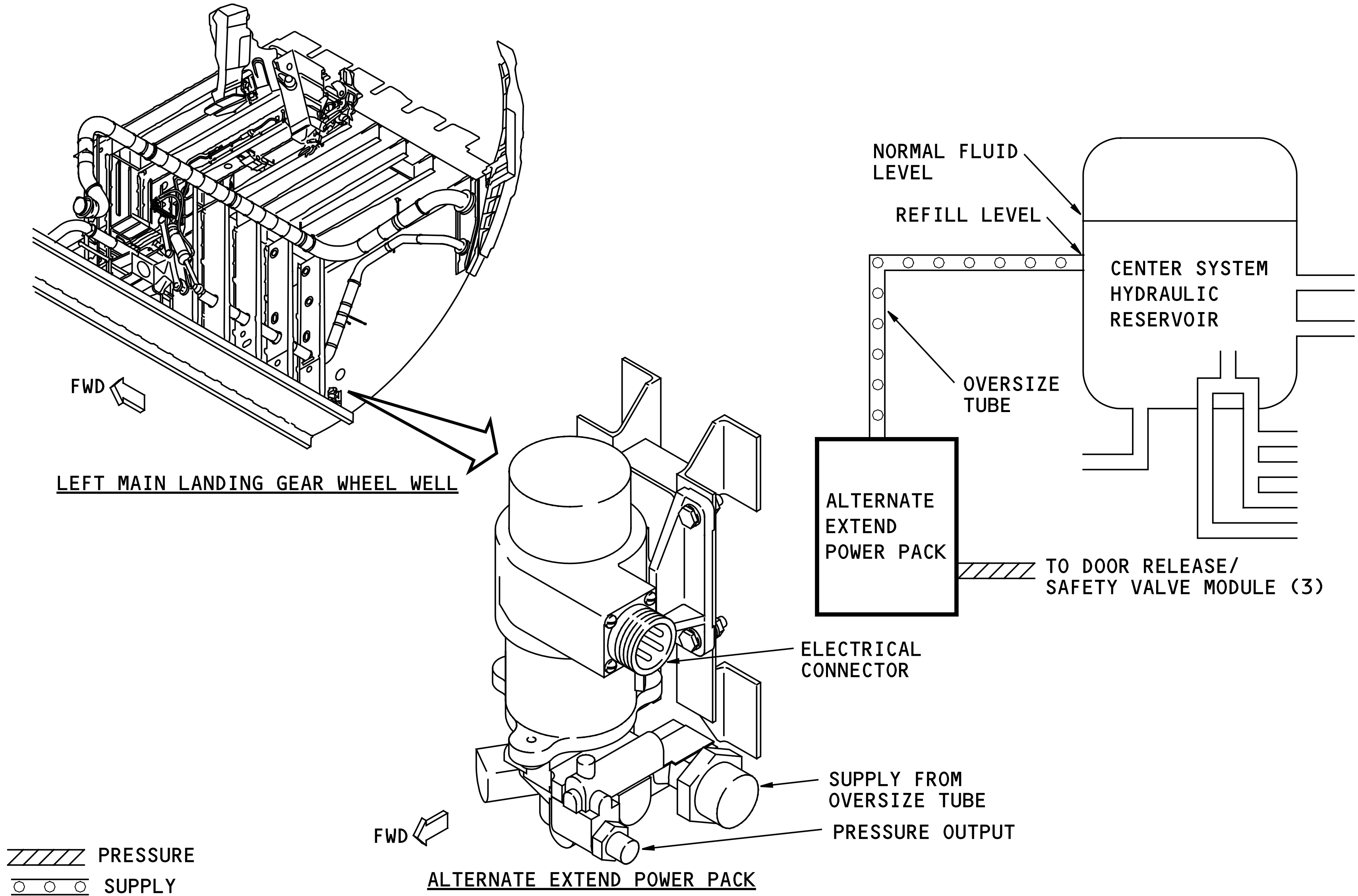
The alternate extend power pack is in the aft-inboard corner of the left main landing gear wheel well.

Training Information Point

The supply tube connects to the side of the reservoir. The connection is slightly below the reservoir refill level (0.75 reservoir fluid level). This makes sure that a hydraulic fluid leak in the alternate extension system is detected by reservoir refill indications. This also makes sure that the supply tube is filled when the reservoir is correctly serviced.

A leak in the alternate extension system does not drain all the fluid from the center hydraulic system reservoir.

The supply tube from the reservoir contains enough hydraulic fluid to do an alternate extension. The alternate extension system does function with an empty center hydraulic system reservoir.



32-35-00-005 Rev 2 10/29/1996

LANDING GEAR ALTERNATE EXTENSION SYSTEM - ALTERNATE EXTEND POWER PACK

LANDING GEAR ALTN EXTENSION SYSTEM - DOOR RELEASE/SAFETY VALVE MODULES - GENERAL DESCRIPTION

Purpose

There is one main landing gear door release/safety valve module for each main landing gear. There is one nose landing gear door release/safety valve module.

When the alternate extension system operates, the door release/safety valve modules do these functions:

- Stop the normal hydraulic system pressure to the close side of each landing gear door actuator
- Connect the close side of each door actuator to return, so the doors can open
- Extend a rod to release the landing gear door locks
- Send pressure to the alternate uplock release actuators to release the landing gear uplocks.

Each MLG door release/safety valve module extends a rod to push the gear door uplock mechanism to release the over-center lock. This permits the MLG doors to open. The NLG door release/safety valve module extends a rod to push a crank on the NLG door actuator. This crank turns to release the lock inside the NLG door actuator. This permits the NLG doors to open.

The door release/safety valve modules also have a reset function to close the doors. You use switches on the P40 and P56 panels to reset the modules. Center hydraulic system pressure closes the landing gear doors.

Location

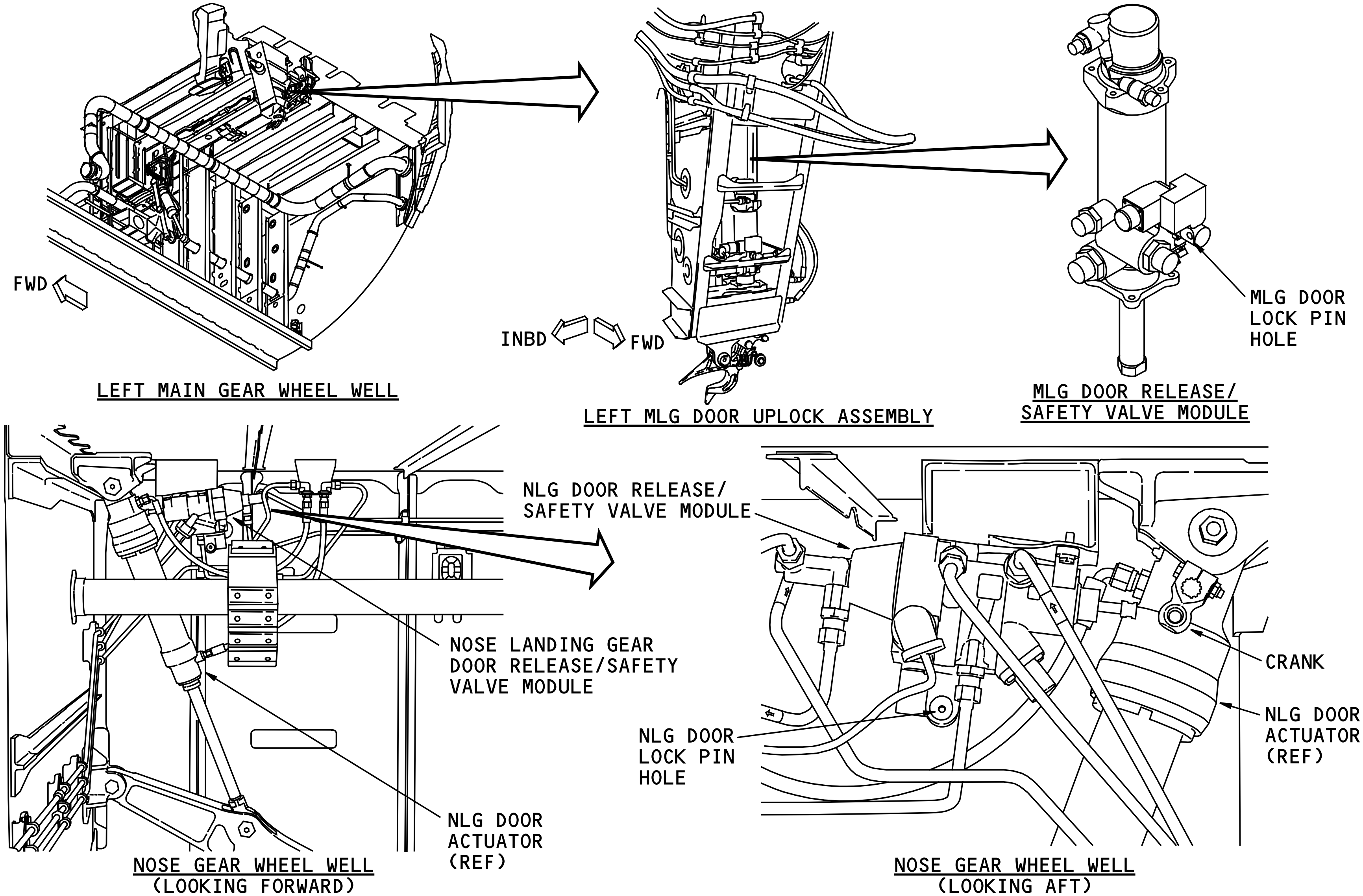
The main landing gear door release/safety valve modules are inside the door uplock assembly. A removable panel permits access to the module.

The nose landing gear door release/safety valve module is on the ceiling in the nose wheel well near the nose landing gear door actuator.

Training Information Point

The nose landing gear door release/safety valve module is not interchangeable with the main landing gear door release/safety valve modules.

You install door lock pins in the door release/safety valve modules for safety. With the pins installed, you cannot reset the modules and the doors cannot close.



32-35-00-006 Rev 3 10/28/1996

LANDING GEAR ALTN EXTENSION SYSTEM - DOOR RELEASE/SAFETY VALVE MODULES - GENERAL DESCRIPTION

LANDING GEAR ALTERNATE EXTENSION SYSTEM - ALTERNATE EXTEND HYDRAULIC PRESSURE SWITCH

Purpose

The alternate extend hydraulic pressure switch stops the alternate extend power pack when the extend cycle is complete.

Location

The alternate extend hydraulic pressure switch is on the ceiling in the NLG wheel well. It is near the NLG alternate uplock release actuator.

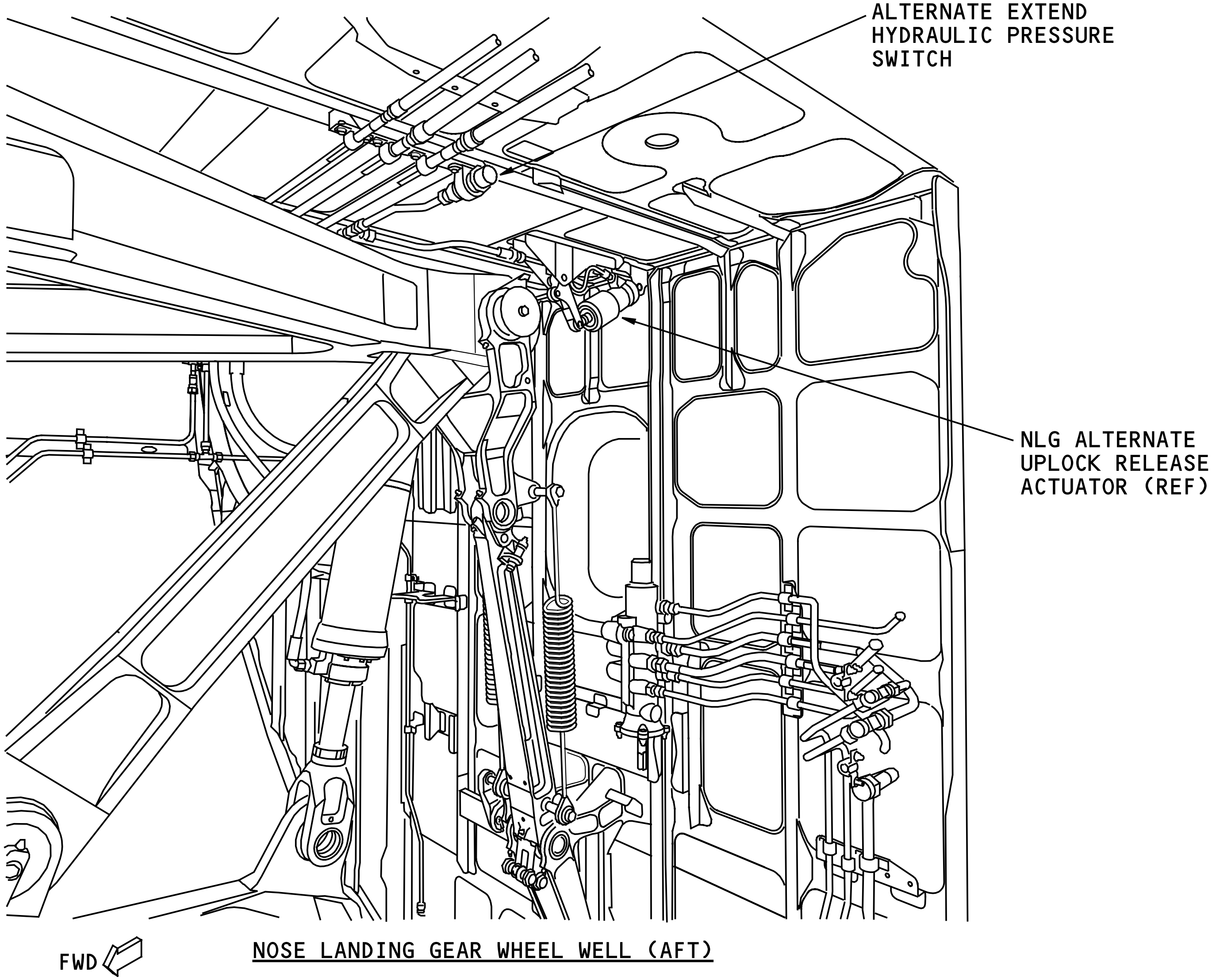
Functional Description

The pressure switch is in the hydraulic line between the NLG door release/safety valve module and the NLG alternate uplock release actuator.

The NLG alternate uplock release actuator is the farthest point in the alternate extension system from the power pack. It is the last component to get hydraulic pressure.

The switch opens when there is 2100 psi in the pressure line. This removes electrical power from the alternate extend power pack and it stops.

When the alternate extend pressure decreases below 1700 psi, the pressure switch closes to reset the alternate extension system.



NOSE LANDING GEAR WHEEL WELL (AFT)

LANDING GEAR ALTERNATE EXTENSION SYSTEM - ALTERNATE EXTEND HYDRAULIC PRESSURE SWITCH

LANDING GEAR ALTERNATE EXTENSION SYSTEM - LANDING GEAR DOOR CLOSED SWITCHES

Purpose

The landing gear door closed switches supply landing gear door position input to control landing gear door unsafe light operation.

Each main landing gear door has a MLG door closed switch. The nose landing gear forward doors have a single NLG door closed switch.

Physical Description

The switches are mechanical plunger-type switches. They operate by direct contact with the landing gear door.

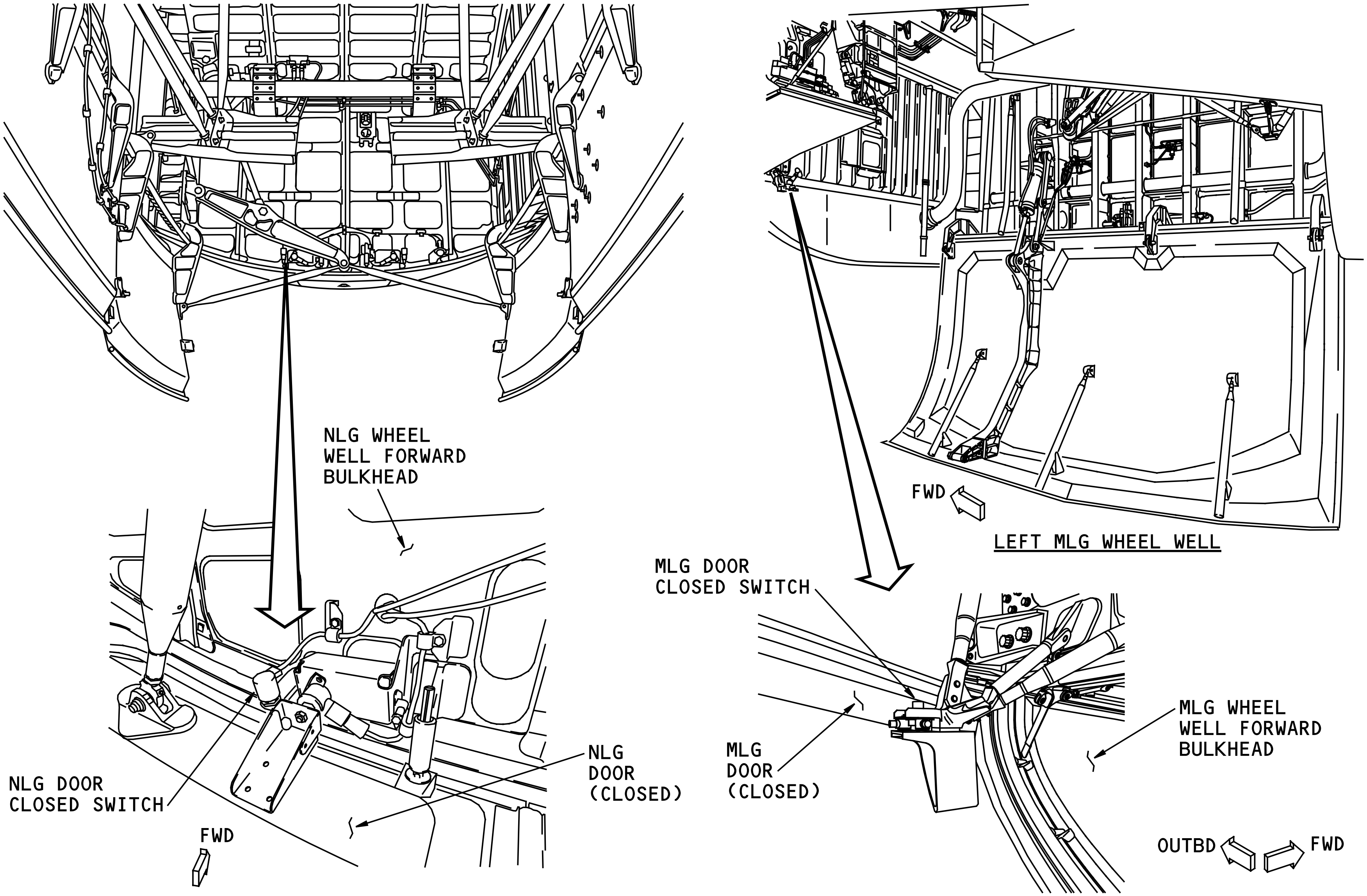
The switches open when the landing gear doors are closed. The door unsafe lights are always off when the LG doors are closed.

The switches close when the LG doors are open.

Location

The NLG door closed switch is on the forward bulkhead of the nose landing gear wheel well.

A MLG door closed switch is in the outboard forward corner of each main landing gear wheel well on the forward door stop.



32-35-00-011 Rev 3 10/28/1996

LANDING GEAR ALTERNATE EXTENSION SYSTEM - LANDING GEAR DOOR CLOSED SWITCHES

LANDING GEAR ALTERNATE EXTENSION SYSTEM - LANDING GEAR DOOR UNSAFE LIGHTS

Purpose

A red landing gear door unsafe light is in each wheel well. Each light turns on when the door is open and the wheel well is not safe to enter. The position of the safety valve in the landing gear door release/safety valve module controls the light.

Location

A main landing gear door unsafe light is on the lower part of the keel beam in each wheel well.

The nose landing gear door unsafe light is on the nose landing gear wheel well forward bulkhead above the right nose landing gear forward door.

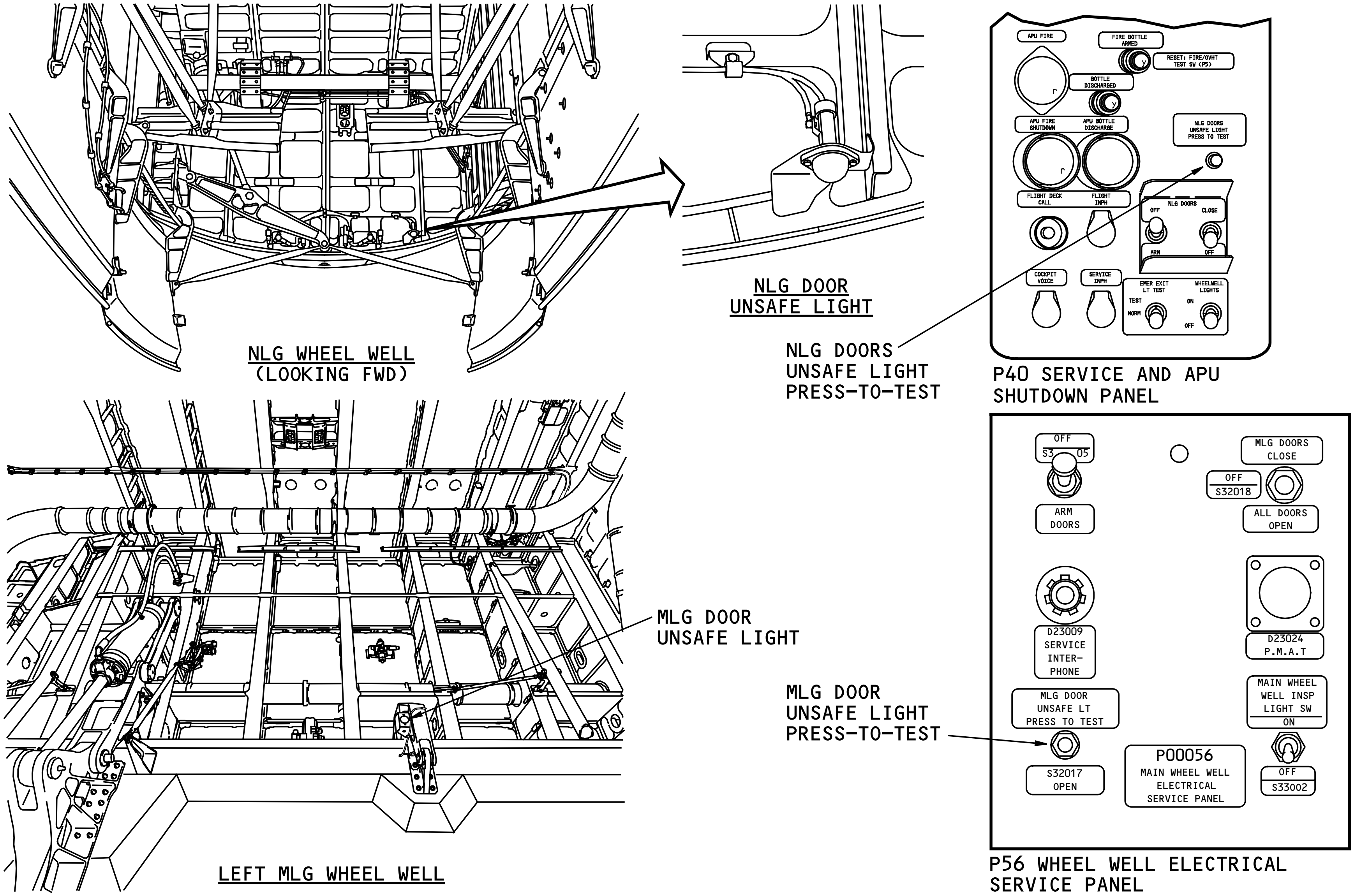
Training Information Point

A press-to-test switch on the main wheel well electrical service panel tests the operation of both main landing gear door unsafe lights.

A press-to-test switch on the service and APU shutdown panel tests the operation of the nose landing gear door unsafe light.

WARNING: MAKE SURE THE DOOR UNSAFE LIGHT IN EACH WHEEL WELL FOR THE MAIN LANDING GEAR IS OFF. IF A DOOR UNSAFE LIGHT IS ON, DO NOT GO INTO THE RELATED WHEEL WELL. WHEN A DOOR UNSAFE LIGHT IS ON, THE DOOR FOR THE RELATED MAIN LANDING GEAR IS IN A NOT SAFE CONDITION AND CAN ACCIDENTALLY CLOSE. THE DOORS CLOSE QUICKLY AND CAN CAUSE INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT.

WARNING: MAKE SURE THE DOOR UNSAFE LIGHT IN THE WHEEL WELL FOR THE NOSE LANDING GEAR IS OFF. IF THE DOOR UNSAFE LIGHT IS ON, DO NOT GO INTO THE WHEEL WELL. WHEN THE DOOR UNSAFE LIGHT IS ON, THE DOORS FOR THE NOSE LANDING GEAR ARE IN A NOT SAFE CONDITION AND CAN ACCIDENTALLY CLOSE. THE DOORS CLOSE QUICKLY AND CAN CAUSE INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT.



32-35-00-012 Rev 4 10/28/1996

LANDING GEAR ALTERNATE EXTENSION SYSTEM - LANDING GEAR DOOR UNSAFE LIGHTS

LANDING GEAR ALTERNATE EXTENSION SYSTEM - LG DOOR UNSAFE LIGHTS - FUNCTIONAL DESCRIPTION

General

The landing gear door unsafe lights come on when a landing gear door is open and the safety valve in the landing gear door release/safety valve module is in the NORMAL position.

Inputs

The 28v dc hot battery bus supplies power for operation of the landing gear door unsafe lights.

The safety latch position sensing switch in the door release/safety valve modules supply safety valve position inputs.

The door closed switches supply landing gear door position inputs.

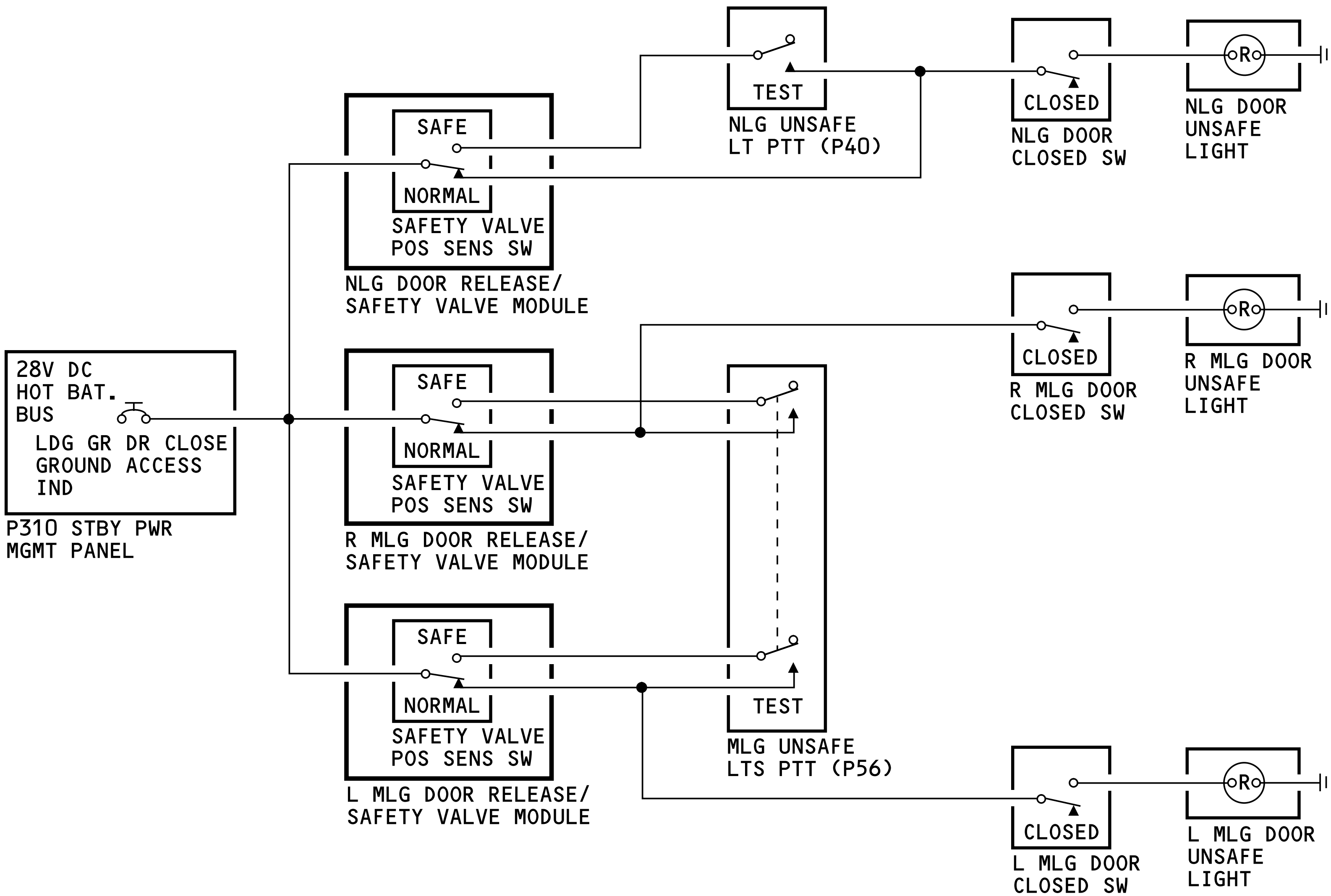
Press-To-Test

The nose landing gear press-to-test switch lets you do a test of the nose landing gear unsafe light when the nose gear door is open and the safety valve is SAFE.

The main landing gear press-to-test switch lets you do a test of both main landing gear unsafe lights when the main landing gear doors are open and the safety valves are SAFE.

Training Information Point

During normal operation of the landing gear extension-retraction system, the safety valves in the door release/safety valve modules are in the NORMAL positions. The LG door unsafe lights turn on while the LG doors are open during normal landing gear extension and retraction.



32-35-00-013 Rev 5 10/28/1996

LANDING GEAR ALTERNATE EXTENSION SYSTEM - LG DOOR UNSAFE LIGHTS - FUNCTIONAL DESCRIPTION

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LANDING GEAR ALTERNATE EXTENSION SYSTEM - FUNCTIONAL DESCRIPTION - ELECTRICAL

General

A switch on the P2 center instrument panel or switches on the wheel well electrical service panel (P56) start alternate extend power pack operation.

Alternate Extension System Operation

The alternate gear switch is a two position (NORM and DOWN) guarded toggle switch. It is a momentary switch and is spring-loaded to NORM.

When you push the alternate gear switch, the alternate extend control relays in ELMS energize. These relays have a latching circuit which keep them energized after you release the alternate gear switch.

The relays permit power from the hot battery bus to go to the alternate extend power pack.

The alternate extend power pack comes on and supplies hydraulic pressure for alternate extend operation.

After all doors and gear are unlocked, the alternate extend hydraulic pressure increases. At 2100 psi, the alternate extend hydraulic pressure switch opens and removes electrical power in the latching circuits for both alternate extend control relays. This removes electrical power from the alternate extend power pack.

Ground Door Operation

Ground door operation is almost the same as operation with the alternate gear switch.

The only difference is that you use the switches on the P56 panel to power the alternate extend control relays.

Indications

The PSEUs monitor the alternate extend control relays.

When you operate the alternate extend switch or the ground door release switches, the gear display on the EICAS expands to the multi-symbol display. The multi-symbol display shows the position of each gear. The display remains expanded until all landing gear doors are closed.

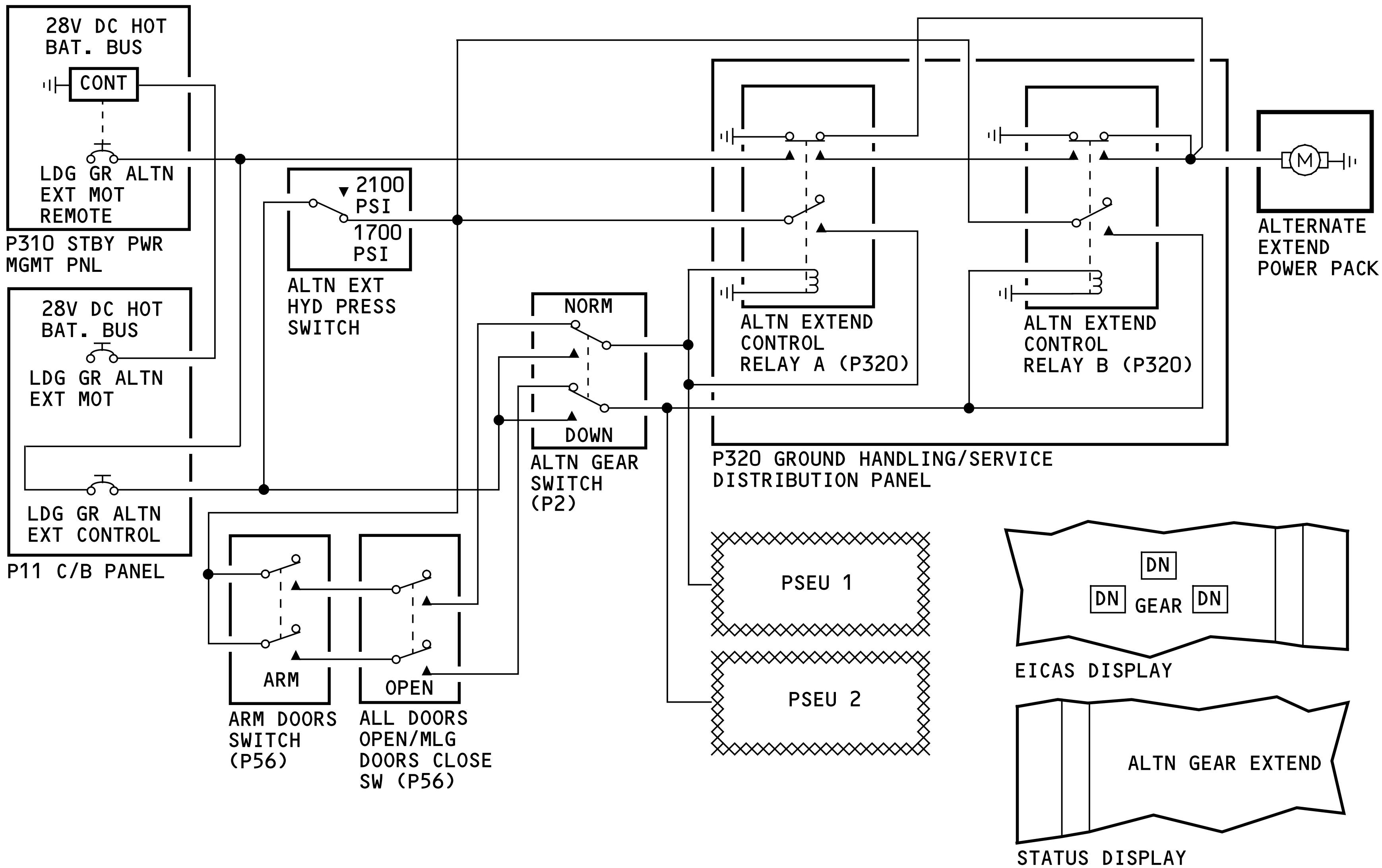
The position of each door shows on the landing gear synoptic display. The GEAR DOOR advisory message shows on the EICAS when the alternate extension system is energized. The GEAR DOOR advisory message stays displayed until all of the doors close.

If either or both relays are energized for more than 60 seconds, the ALTN GEAR EXTEND message shows on the status display. Since the normal alternate extension cycle is less than 60 seconds, this indicates a system fault.

LANDING GEAR ALTERNATE EXTENSION SYSTEM - FUNCTIONAL DESCRIPTION - ELECTRICAL

Training Information Point

To manually remove power from the alternate extension system, you pull the LDG GR ALTN EXT MOT circuit breaker on the P11 panel. This circuit breaker controls the LDG GR ALTN EXT MOT REMOTE circuit breaker on the P310 standby power management panel.



32-35-00-014 Rev 3 10/29/1996

LANDING GEAR ALTERNATE EXTENSION SYSTEM - FUNCTIONAL DESCRIPTION - ELECTRICAL

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LANDING GEAR ALTERNATE EXTENSION SYSTEM - FUNCTIONAL DESCRIPTION - HYDRAULIC

General

The alternate extend power pack pressurizes hydraulic fluid from the center hydraulic system.

Pressure goes to the MLG and the NLG selector/bypass valves. If the selector valve is in the UP or OFF position, the bypass valve moves to the BYPASS position to let the gear extend. See the landing gear control section for more information about the landing gear selector/bypass valves (AMM PART I 32-31).

The MLG and NLG alternate extend components operate the same. Each MLG and the NLG have these components:

- Landing gear door release/safety valve module
- Landing gear alternate uplock release actuator.

There is one alternate extend hydraulic pressure switch located in the NLG wheel well.

Landing Gear Door Release/Safety Valve Module

Alternate extend pressure extends the door release actuator. This actuator releases the landing gear door which then opens by gravity and airloads.

As the door release actuator extends, the safety valve moves to the SAFE position. The safety valve is latched in the SAFE position.

After it extends, the door release actuator sends pressure to the landing gear alternate uplock release actuator.

Landing Gear Alternate Uplock Release Actuator

The landing gear alternate uplock release actuator extends to unlock the landing gear uplock. This permits gravity and airloads to extend the gear. The tires may contact the door during alternate extension.

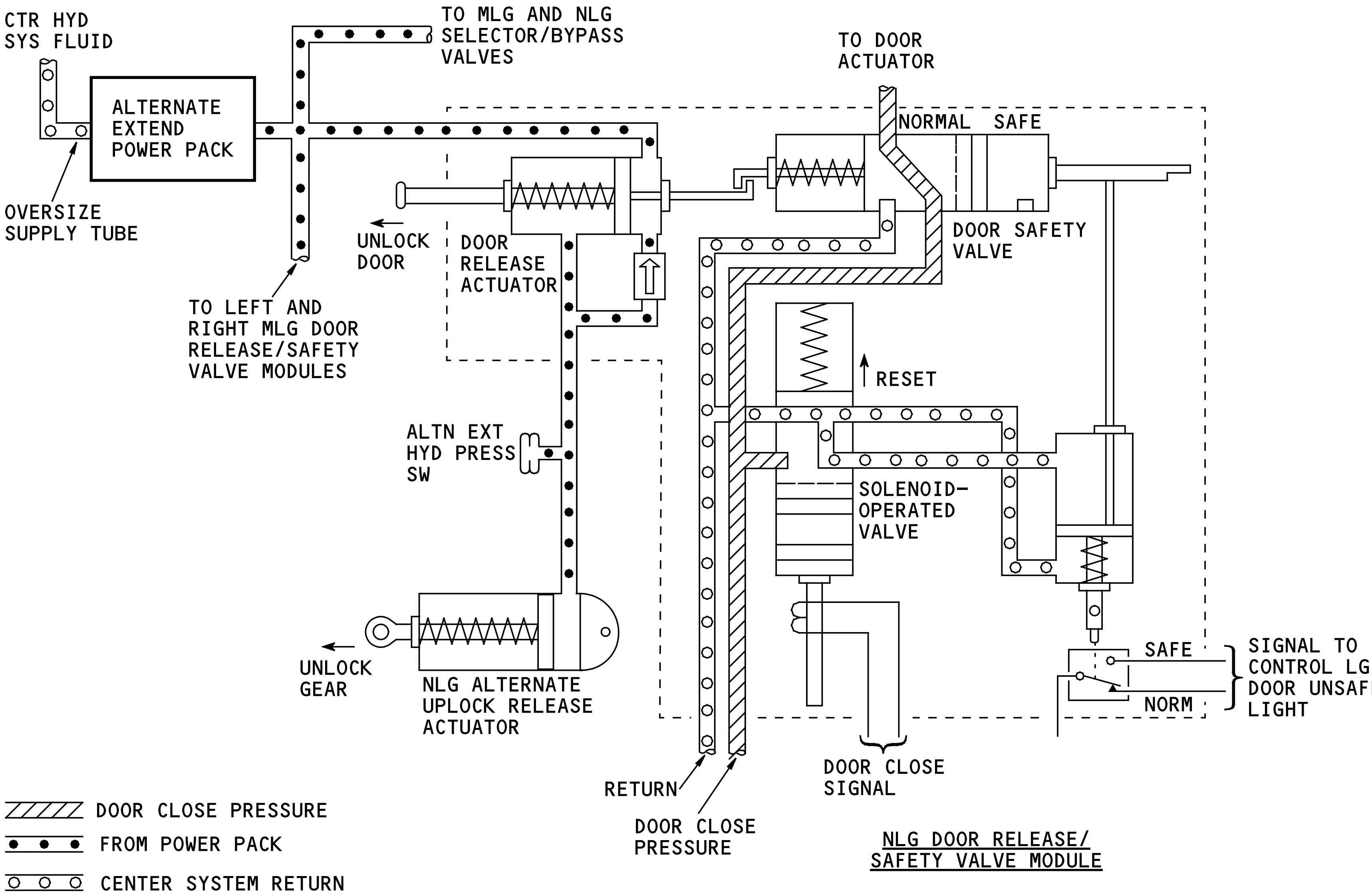
Alternate Extend Hydraulic Pressure Switch

After all doors and gear are unlocked, hydraulic pressure in the alternate extension system increases. When the pressure gets to 2100 psi, the alternate extend hydraulic pressure switch opens. This removes electrical power from the alternate extend control relays. The relays de-energize and remove electrical power from the alternate extend power pack.

Reset

When the alternate extend power pack stops, the alternate uplock release actuator and the door release actuator in the door release/safety valve reset. The springs in the actuators push the hydraulic fluid through the alternate extend power pack and into the oversize supply tube.

The door safety valve in the door release/safety valve module remains in the SAFE position until it is reset. This prevents the door from closing. The door safety valve is reset by an electric signal to the solenoid operated valve. Switches on the P40 and P56 panels, or a switch within the landing gear control lever module provide the reset signal. When the solenoid energizes, the valve permits hydraulic pressure to release the safety valve latch. The reset signal must be made while door close hydraulic pressure is available. When the valve moves to the NORMAL position, the door closes.



LANDING GEAR ALTERNATE EXTENSION SYSTEM - FUNCTIONAL DESCRIPTION - HYDRAULIC

32-35-00-015 Rev 3 10/28/1996

LANDING GEAR ALTERNATE EXTENSION SYSTEM - LANDING GEAR DOOR CLOSE OPERATION

General

You can close the landing gear doors with the door close switches or with the landing gear lever. The center hydraulic system supplies the pressure to close the landing gear doors.

MLG and NLG gear door close operation is almost the same.

Door Close Operation

You close the two main landing gear doors at the same time with switches on the P56 wheel well electrical service panel.

You close the nose landing gear doors with switches on the P40 service and APU shutdown panel.

The landing gear lever closes all the landing gear doors only after the gear have retracted. The landing gear door close signal from the landing gear lever goes through a five second time delay relay in the P320 ground handling/service distribution panel. When you move the landing gear lever to the UP position, the solenoids in the door release/safety valve modules get power five seconds later. This delay gives the selector valves time to move to the UP position. This prevents the safety valve from accidental movement to the NORMAL position before the selector valve has time to move. The delay makes sure the door release/safety valve modules are reset by the lever only after the gear retract.

For any door close signal, power from the 28v dc left main bus goes to the solenoid valves in the landing gear door release/safety valve modules.

To close the doors, the door close signal must be made at the same time door close hydraulic pressure is available.

Training Information Point

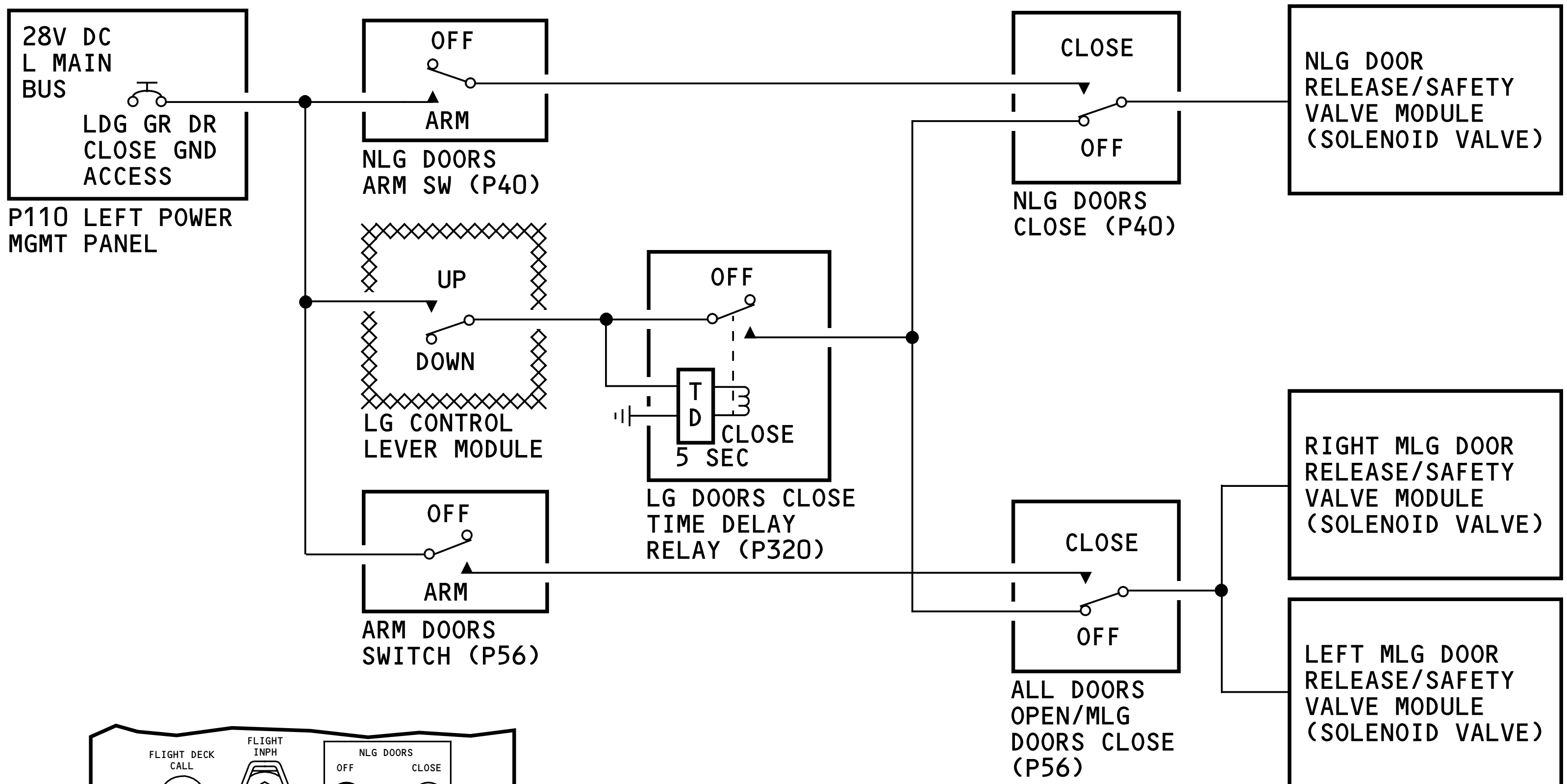
When you use the switches on the P56 panel, the main landing gear doors close in approximately 10 seconds.

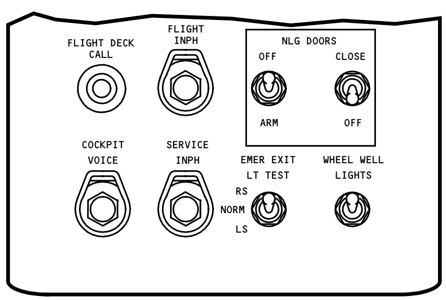
WARNING: MAKE SURE THE AREA AROUND THE DOORS FOR THE MAIN LANDING GEAR IS CLEAR OF PERSONS AND EQUIPMENT. THE DOORS CLOSE QUICKLY AND CAN CAUSE INJURY TO PERSONS OR DAMAGE TO EQUIPMENT.

When you use the switches on the P40 panel, the nose landing gear doors close in approximately 5 seconds.

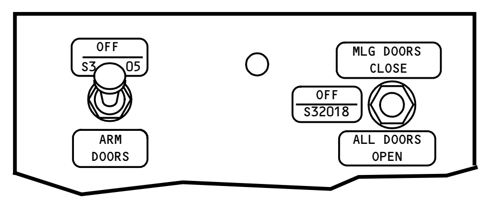
WARNING: MAKE SURE THE AREA AROUND THE DOORS FOR THE NOSE LANDING GEAR IS CLEAR OF PERSONS AND EQUIPMENT. THE DOORS CLOSE QUICKLY AND CAN CAUSE INJURY TO PERSONS OR DAMAGE TO EQUIPMENT.

Once the door close operation starts, you can not stop the operation with the switches on the remote panels.





P40 SERVICE AND APU SHUTDOWN PANEL



P56 WHEEL WELL ELECTRICAL SERVICE PANEL

32-35-00-016 Rev 2 10/28/1996

LANDING GEAR ALTERNATE EXTENSION SYSTEM - LANDING GEAR DOOR CLOSE OPERATION

LANDING GEAR ALTERNATE EXTENSION SYSTEM - BLEED VALVES

General

Four bleed valves let you bleed air from the alternate extension system. You need to bleed the alternate extension system when you replace some of the alternate extension system components.

Location

The bleed valves are near these components:

- The NLG selector/bypass valve (NLG wheel well)
- The NLG alternate uplock release actuator (NLG wheel well)
- The left and right MLG alternate uplock release actuators (left and right MLG wheel wells).

Training Information Point

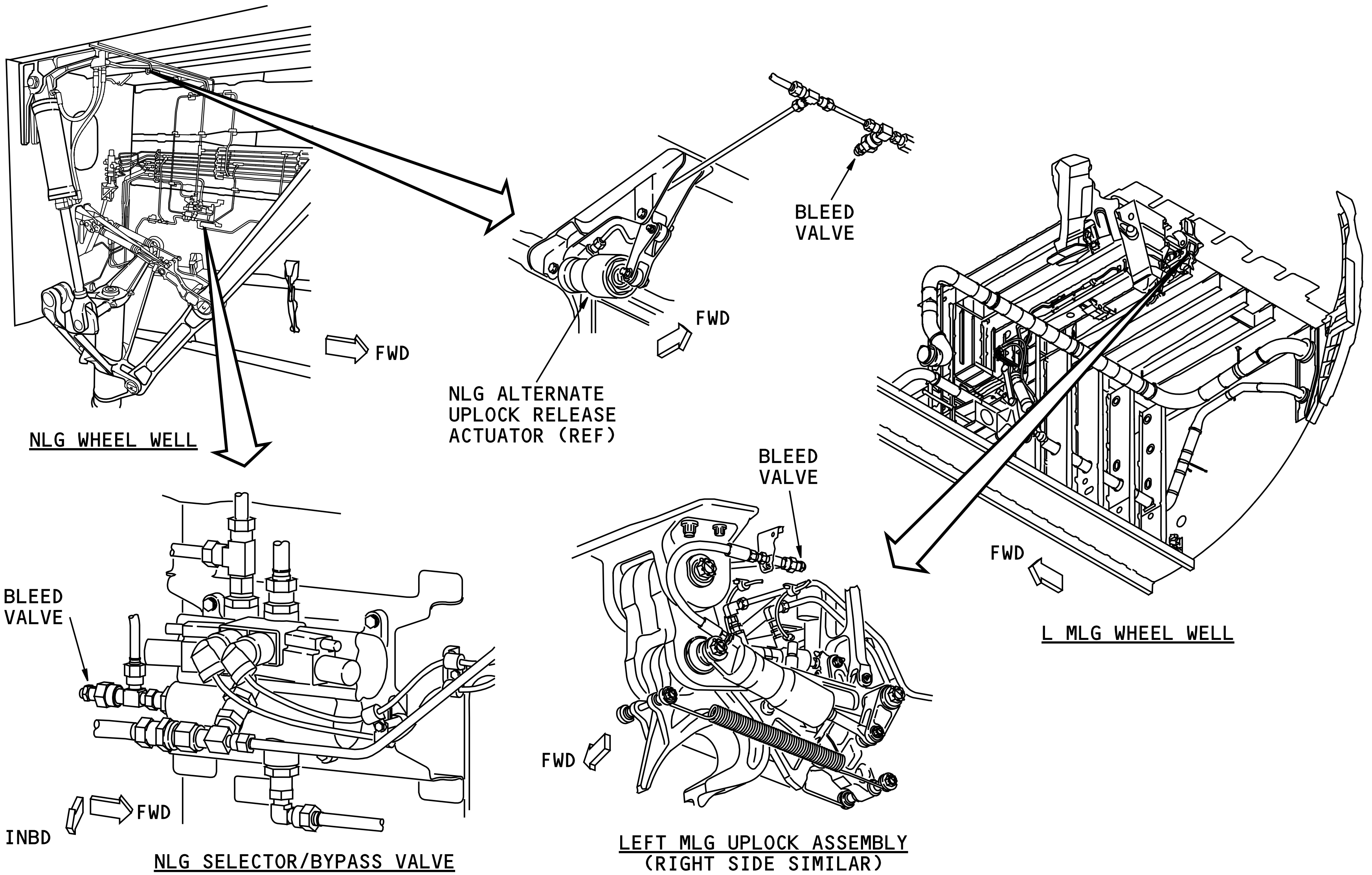
You operate the alternate extend power pack when you bleed the alternate extension system.

NOTE: The alternate extend power pack operates when you command the landing gear doors open with the ground door release system.

NOTE: The EICAS displays indicate non-normal sequencing during this test.

NOTE: The power pack remains ON until the LDG GR ALTN EXT CONTROL circuit breaker is opened. (The pressure switch that usually stops the power pack does not work since you are bleeding the system.)

CAUTION: MAKE SURE YOU DO NOT RUN THE ALTERNATE EXTEND POWER PACK FOR MORE THAN FIVE MINUTES. IF YOU RUN THE POWER PACK FOR MORE THAN FIVE MINUTES, THE POWER PACK CAN GET TOO HOT. THIS CAN CAUSE DAMAGE TO THE EQUIPMENT.



32-35-00-017 Rev 0 07/22/1997

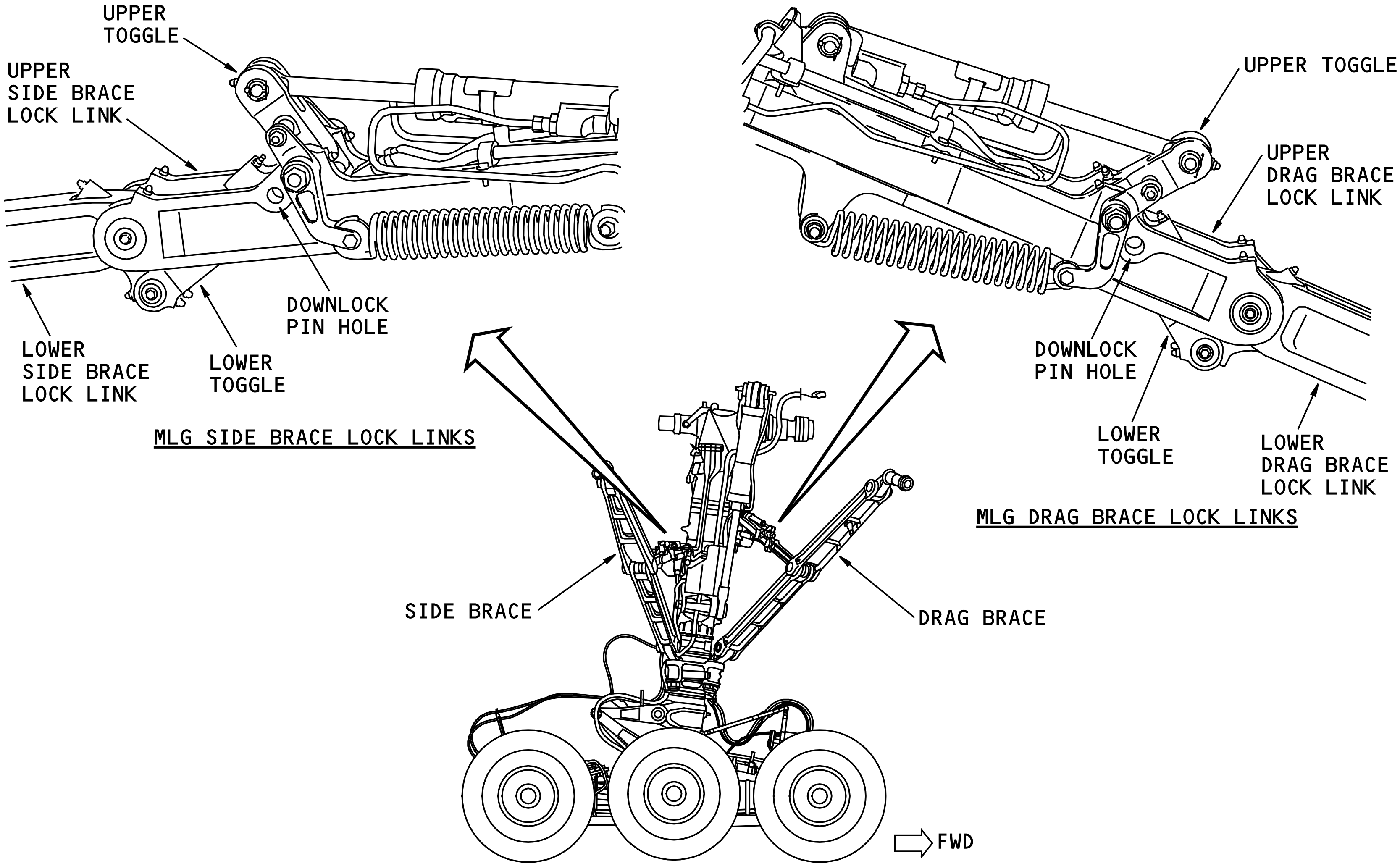
LANDING GEAR ALTERNATE EXTENSION SYSTEM - BLEED VALVES

LANDING GEAR - DOWNLOCK PINS - MAIN LANDING GEAR

General

There are two main landing gear downlock pins for each main landing gear.

The pins install in the upper side brace lock link and the upper drag brace lock link. Each pin holds the upper toggle and the upper lock link together. You install the downlock pins to prevent MLG retraction.



32-00-00-003 Rev 2 05/31/96

LANDING GEAR - DOWNLOCK PINS - MAIN LANDING GEAR

LANDING GEAR - DOOR LOCKS - MAIN LANDING GEAR

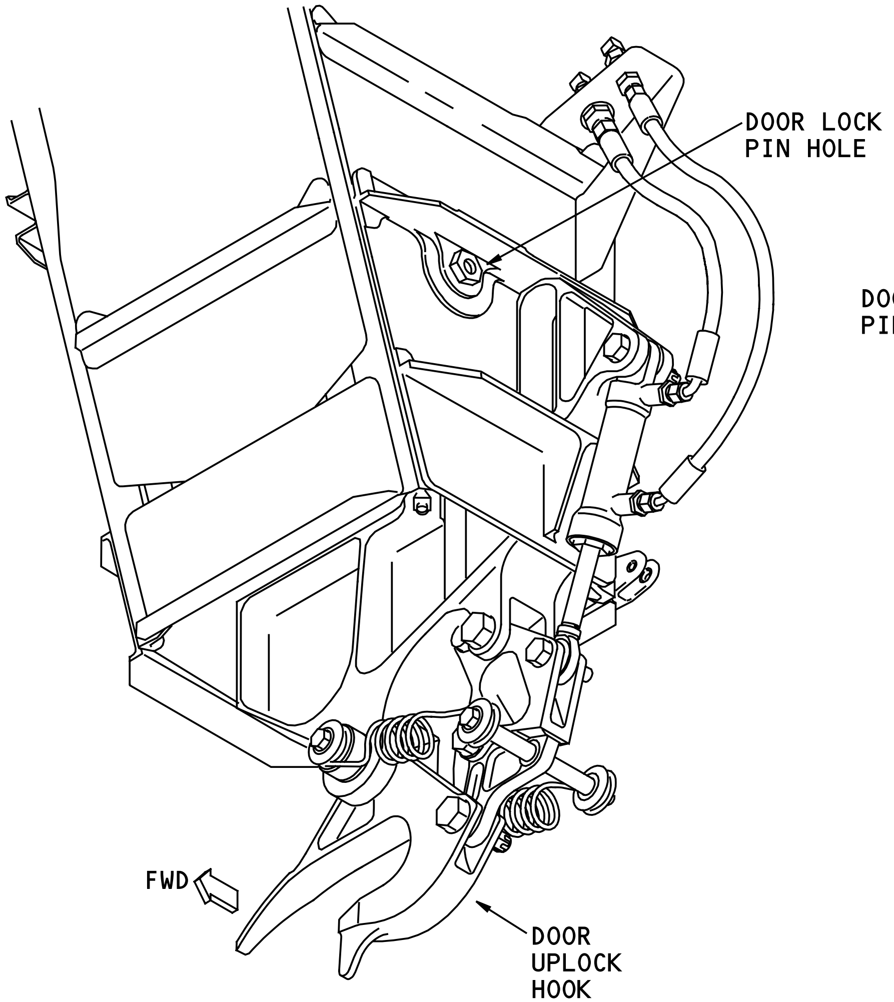
General

Door lock pins prevent the MLG doors from being closed.

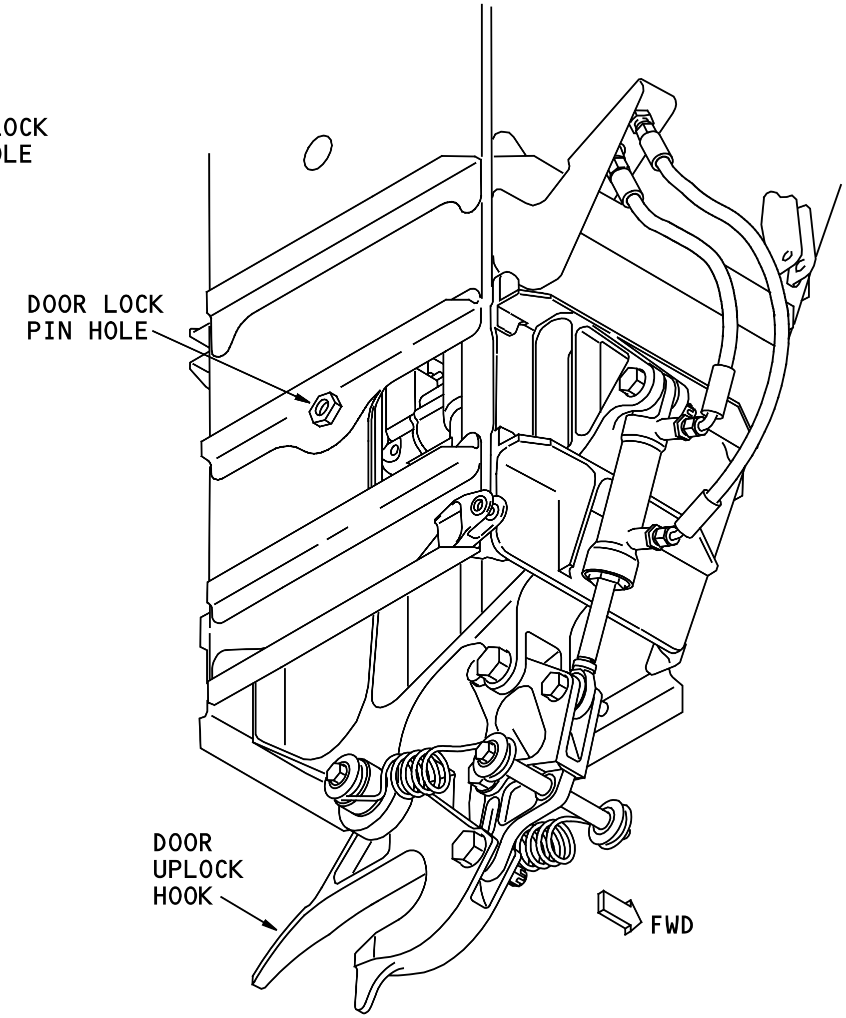
The pins go in the MLG door release/safety valve module in each main landing gear wheel well. When installed, the pins prevent the safety valve from moving to the unsafe position.

The door lock pin hole for the left MLG door is on the outboard side of the support structure for the left MLG door uplock hook.

The door lock pin hole for the right main gear door is on the aft side of the support structure for the right MLG door uplock hook.



MLG DOOR UPLOCK HOOK SUPPORT STRUCTURE - LEFT MLG



MLG DOOR UPLOCK HOOK SUPPORT STRUCTURE - RIGHT MLG

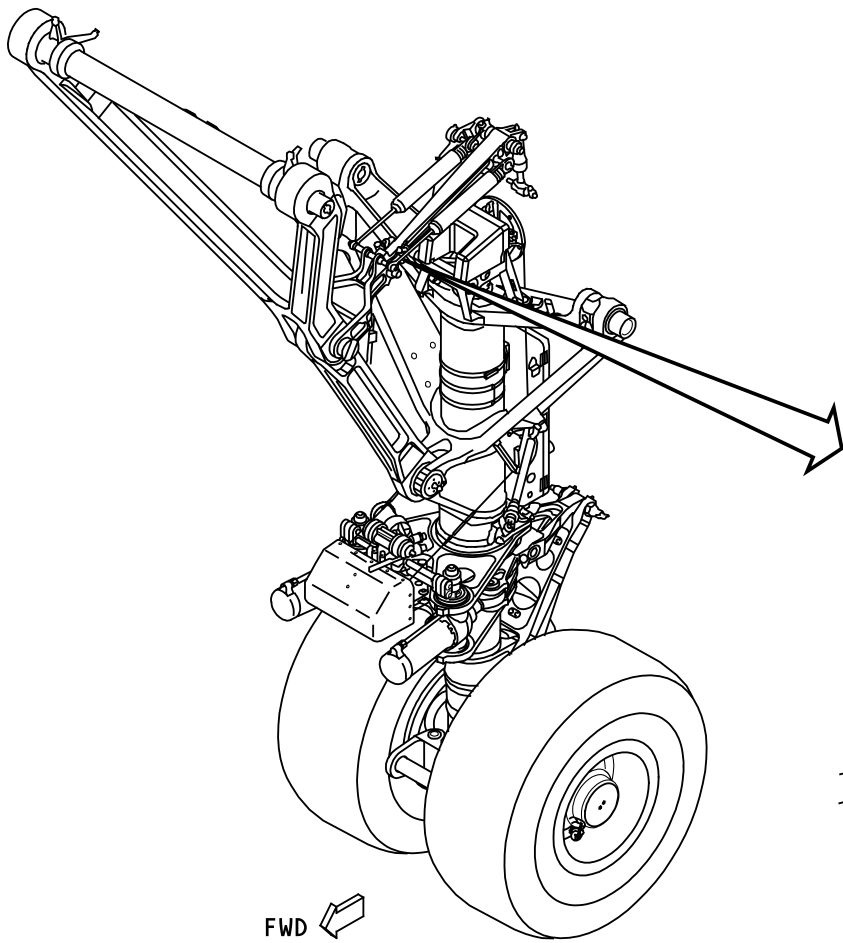
32-00-00-004 Rev 2 05/28/96

LANDING GEAR - DOOR LOCKS - MAIN LANDING GEAR

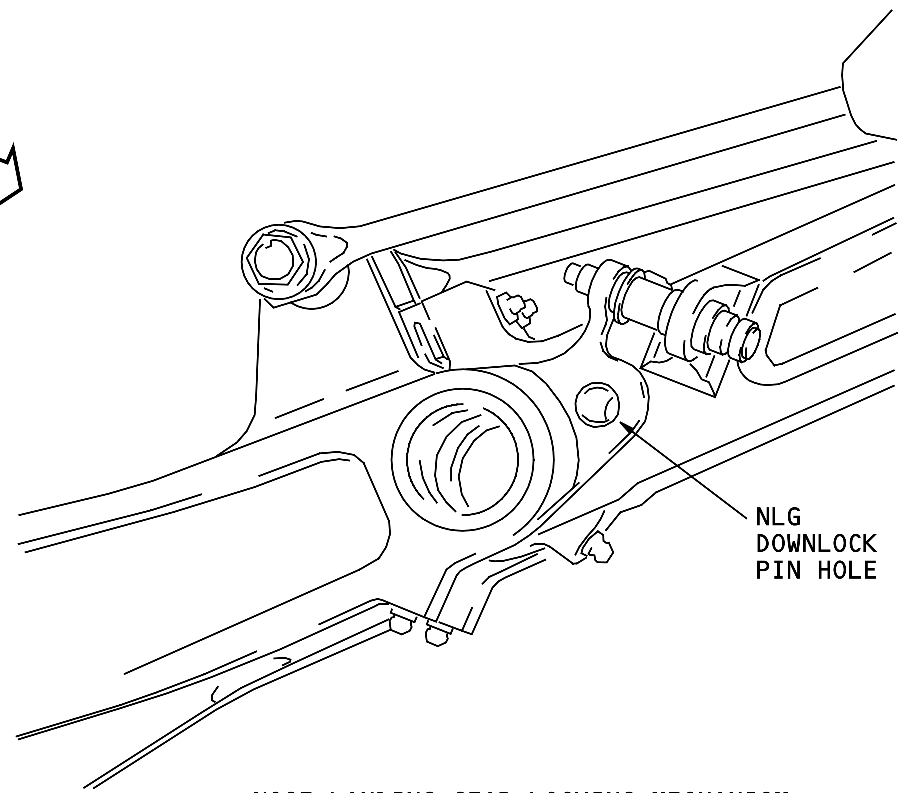
LANDING GEAR - DOWNLOCK PIN - NOSE LANDING GEAR

General

The nose landing gear downlock pin installs in the NLG lock link.



NOSE LANDING GEAR



NOSE LANDING GEAR LOCKING MECHANISM

32-00-00-005 Rev 0

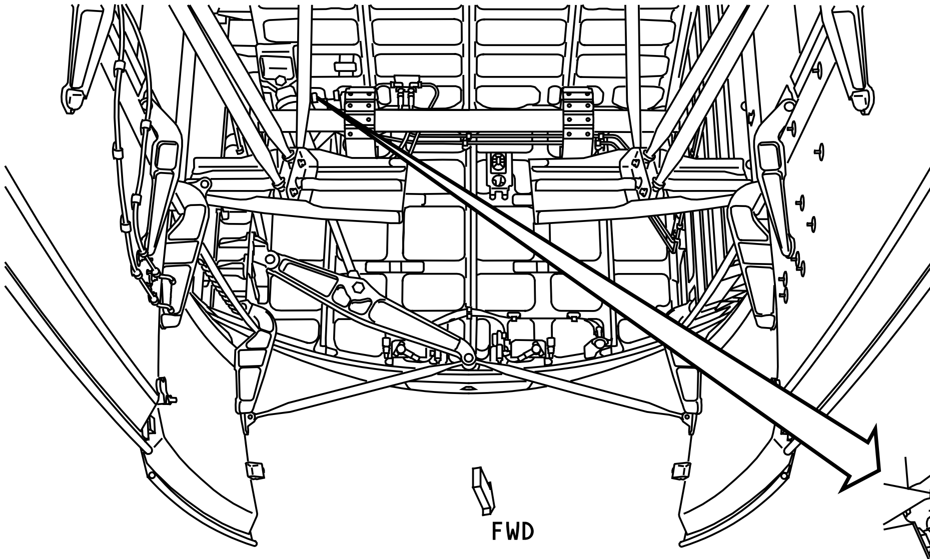
LANDING GEAR - DOWNLOCK PIN - NOSE LANDING GEAR

LANDING GEAR - DOOR LOCK - NOSE LANDING GEAR

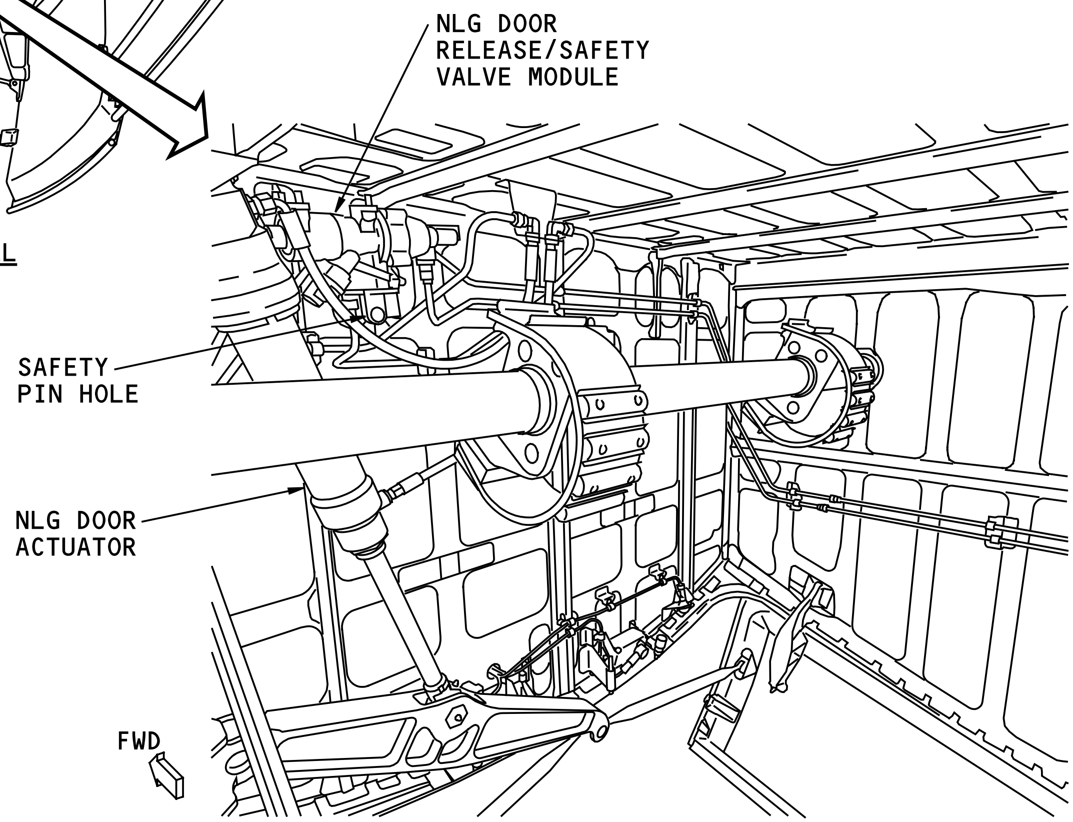
General

The NLG door lock pin prevents the nose landing gear doors from being closed.

The pin goes in the NLG door release/safety valve module on the forward bulkhead of the NLG wheel well. When installed, the pin prevents the movement of the safety valve to the unsafe position.



NOSE LANDING GEAR WHEEL WELL
(LOOKING FORWARD)



LANDING GEAR - DOOR LOCK - NOSE LANDING GEAR

Continental Airlines, Inc

Proximity Sensor System, Position Indication, Tail Strike

WB371

TABLE OF CONTENTS

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PROXIMITY SENSOR SYSTEM - INTRODUCTION

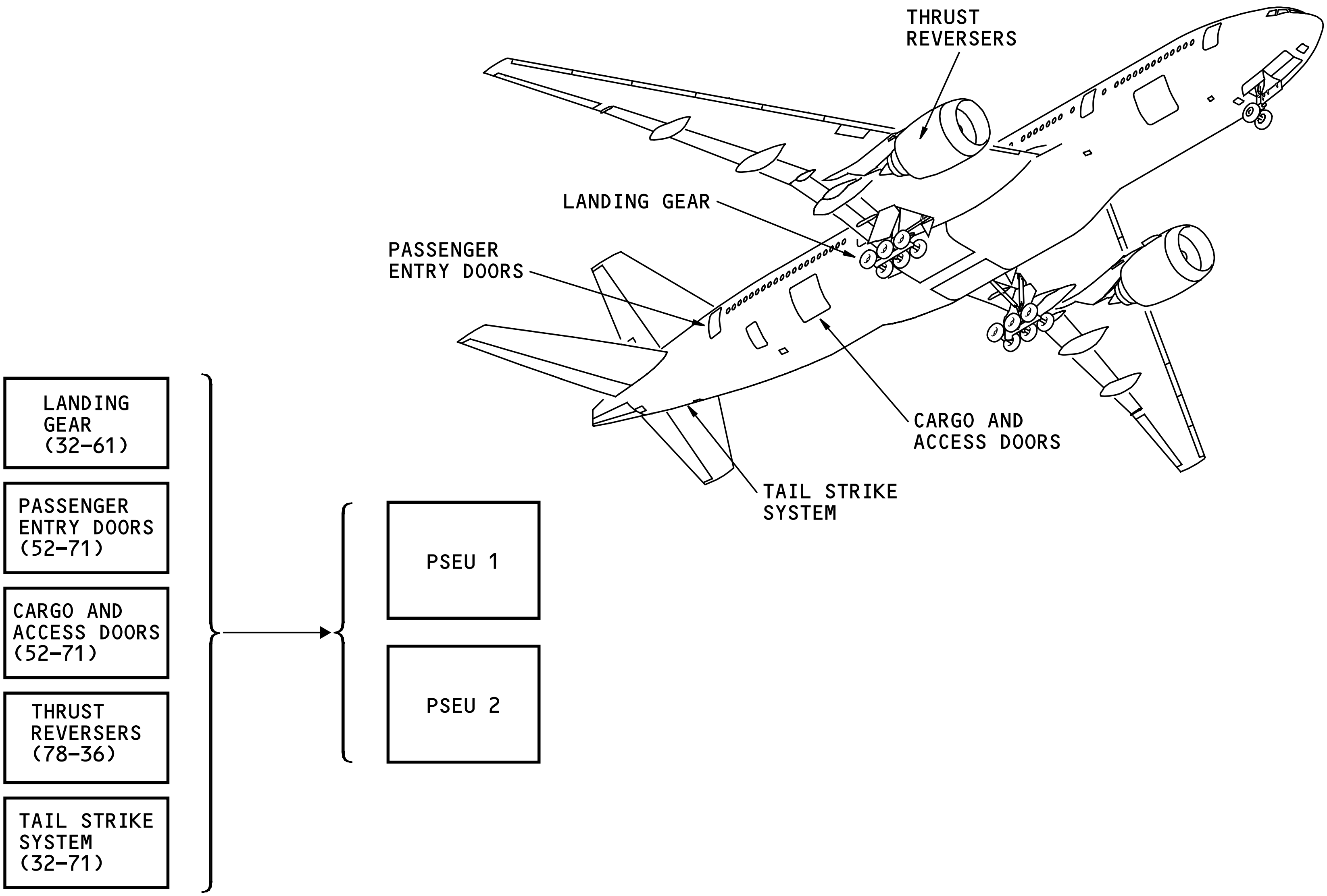
Purpose

The proximity sensor system (PSS) uses two proximity sensor electronics units (PSEUs) to supply position data for these systems:

- Landing gear (section 32-61)
- Passenger entry doors (52-71)
- Cargo doors and access doors (52-71)
- Thrust reversers (78-36)
- Tail strike system (32-71).

Abbreviations and Acronyms

AFDC	- autopilot flight director computer
AIMS	- airplane information management system
altn	- alternate
AMU	- audio management unit
ARINC	- Aeronautical Radio, inc.
bat	- battery
BITE	- built-in test equipment
BSCU	- brake system control unit
CSDS	- cargo smoke detection system
CSMU	- cabin system management unit
dn	- down
ECC	- equipment cooling controller
EEC	- electronic engine control
ELMS	- electrical load management system
EICAS	- engine indication and crew alerting system
fwd	- forward
gnd	- ground
hdlg	- handling
lvr	- lever
HYDIM	- hydraulic interface module
MLG	- main landing gear
NLG	- nose landing gear
pri	- primary
PSEU	- proximity sensor electronic unit
PSS	- proximity sensor system
ref	- reference
TCAS	- traffic alert and collision avoidance system
TSA	- tail strike assembly
WEU	- warning electronic unit
WOW	- weight on wheels



32-08-00-001 Rev 2 06/20/1997

PROXIMITY SENSOR SYSTEM - INTRODUCTION

PROXIMITY SENSOR SYSTEM - GENERAL DESCRIPTION

General

The PSS gets position data for some airplane components and supplies this data to other airplane systems for indication and control functions.

The proximity sensor system components include:

- Two proximity sensor electronics units (PSEUs)
- Proximity sensors.

Inputs

The PSEUS get position data from proximity sensors on these systems/components:

- Landing gear
- Passenger entry doors
- Cargo doors and access doors
- Thrust reversers.

The PSS also gets some discrete hardwire inputs from the tail strike system and other airplane components.

Outputs

The PSEUs supply position data through the systems ARINC 629 buses to these airplane systems:

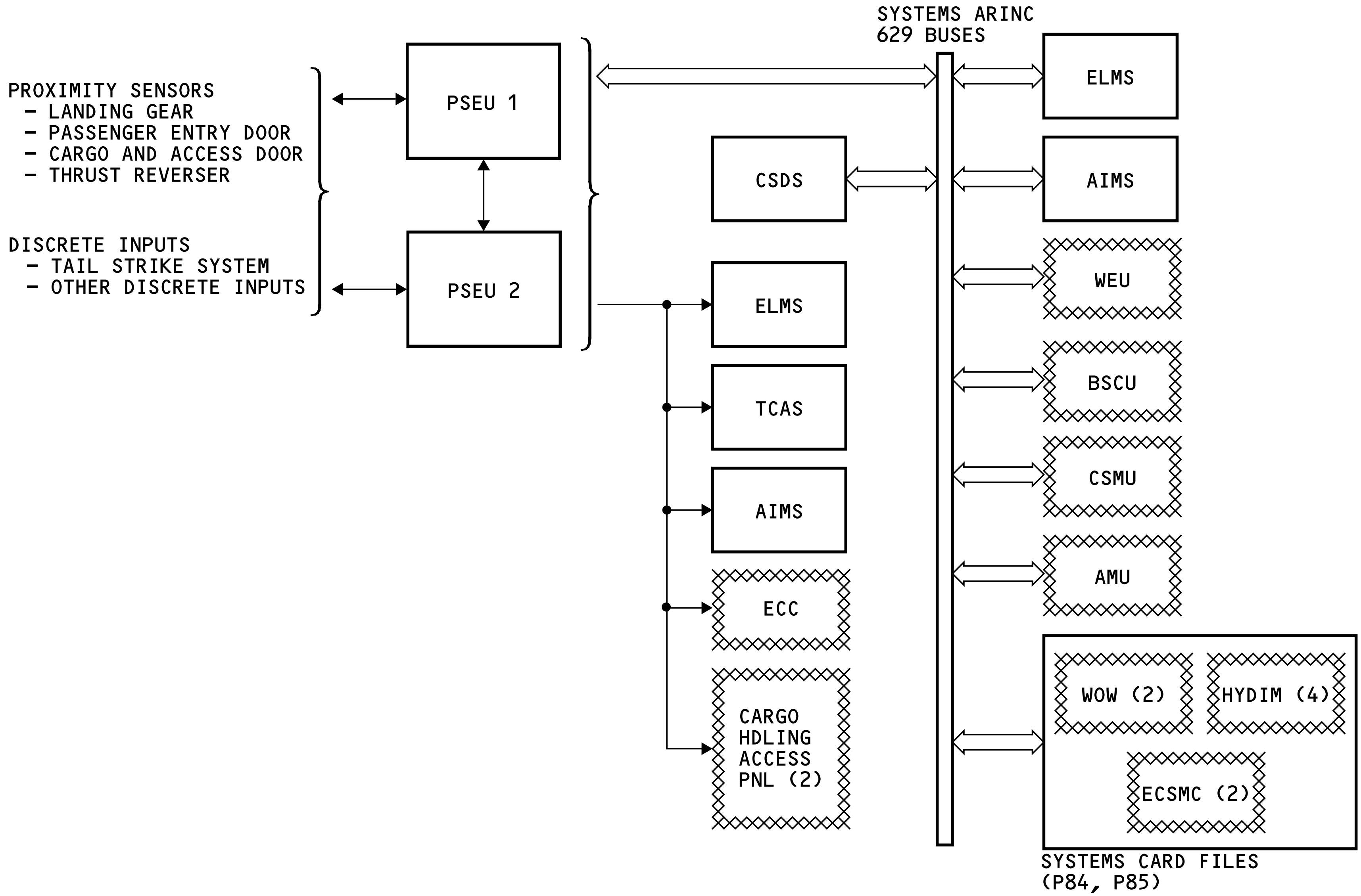
- Airplane information management system (AIMS)
- Electrical load management system (ELMS)
- Brake sytem control unit (BSCU)
- Warning electronic unit (WEU)
- Cabin system management unit (CSMU)
- Audio management unit (AMU)
- Cargo smoke detection system (CSDS).

These components in the left and right system card files get PSEU data through the ARINC signal gateway (ASG) cards:

- Weight on wheels (WOW) cards
- Hydraulic interface module (HYDIM) cards
- Environmental control system miscellaneous cards (ECSMC).

The PSEUs supply data through hardwire discretes to these systems:

- ELMS
- Traffic alert and collision avoidance system (TCAS)
- AIMS
- ECC (equipment cooling controller)
- Cargo handling access panels.



PROXIMITY SENSOR SYSTEM - GENERAL DESCRIPTION

PROXIMITY SENSOR SYSTEM - PROXIMITY SENSORS

Purpose

The proximity sensors get position input of airplane components. They supply this position data to the PSEUs.

Physical Description

There are two types of sensors:

- Flange mount
- Thread mount.

Both types of sensors are inductance-type sensors. There are approximately 96 sensors on the airplane.

Functional Description

The PSEU sends a signal to energize the magnetic core in the sensor. The inductance of the sensor changes when a steel target gets near the sensor.

The flange mount sensors send a near signal when the target is 0.24 inches (6.1 mm) from the sensor (head-on). They send a far signal when the target is 0.3 inches (7.6 mm) from the sensor (head-on).

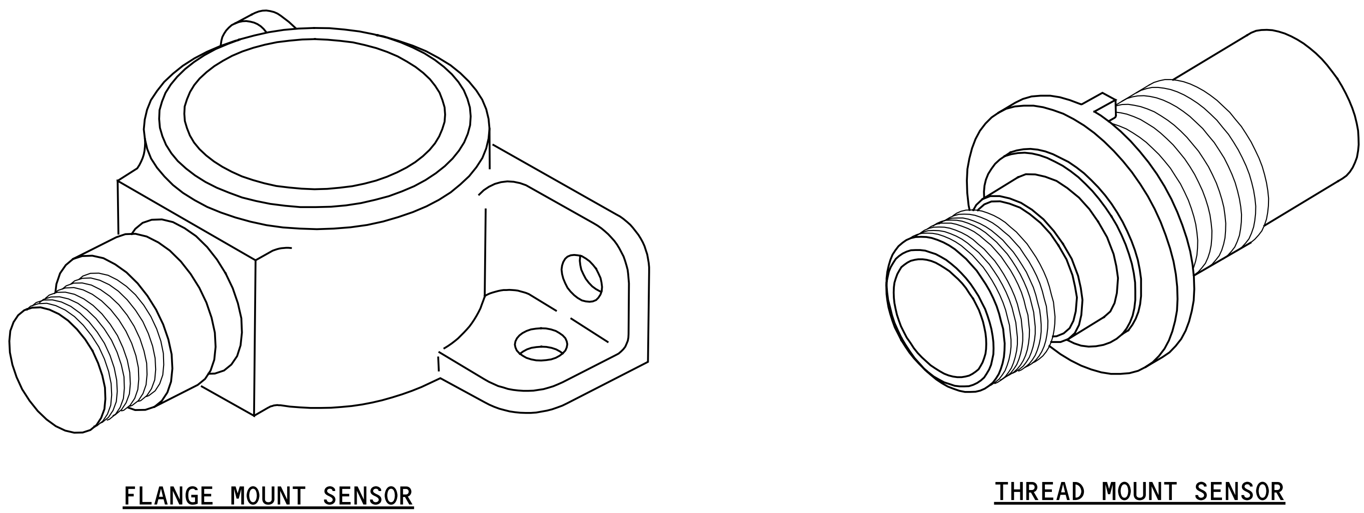
The thread mount sensors send a near signal when the target is 0.085 inches (2.2 mm) from the sensor (head-on). They send a far signal when the target is 0.12 inches (3.1 mm) from the sensor (head-on).

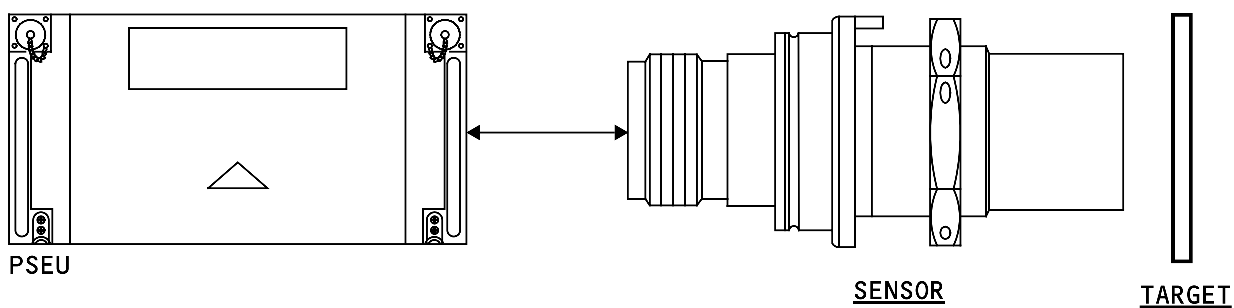
Training Information Point

The targets are made of corrosion-resistant steel. Standard target sizes are 0.05 inches (1.3 mm) thick and either 1.25 inches (31.7 mm) or 0.75 inches (19 mm) in diameter.

Some proximity sensors use non-standard targets. For example, sensors for the cargo doors and passenger entry doors use door structure for the targets.

Correct sensor-target gap is important for correct PSS operation.





32-08-00-003 Rev 1

PROXIMITY SENSOR SYSTEM - PROXIMITY SENSORS

PROXIMITY SENSOR SYSTEM - PSEU - COMPONENT LOCATION

Purpose

The PSEUs are the central components of the proximity sensor system. They get proximity sensor input and other discrete signals. The PSEUs process this data and send control and indication signals to other airplane systems.

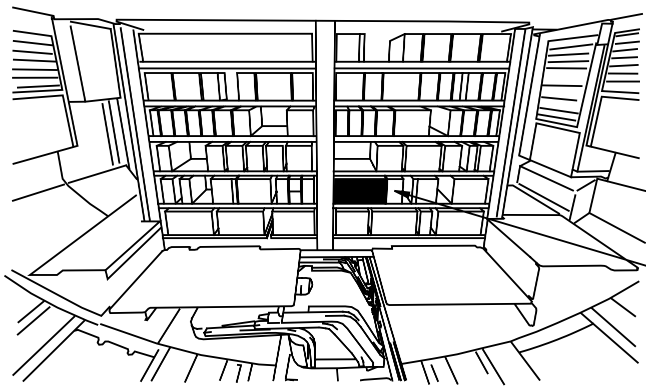
Location

The PSEUs are in the main equipment center. PSEU 1 is on the E1-5 shelf. PSEU 2 is on the E4-1 shelf.

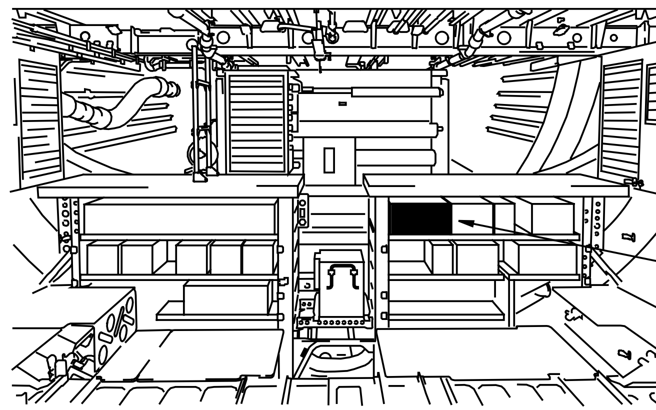
Training Information Point

The PSEUs are electrostatic discharge sensitive devices.

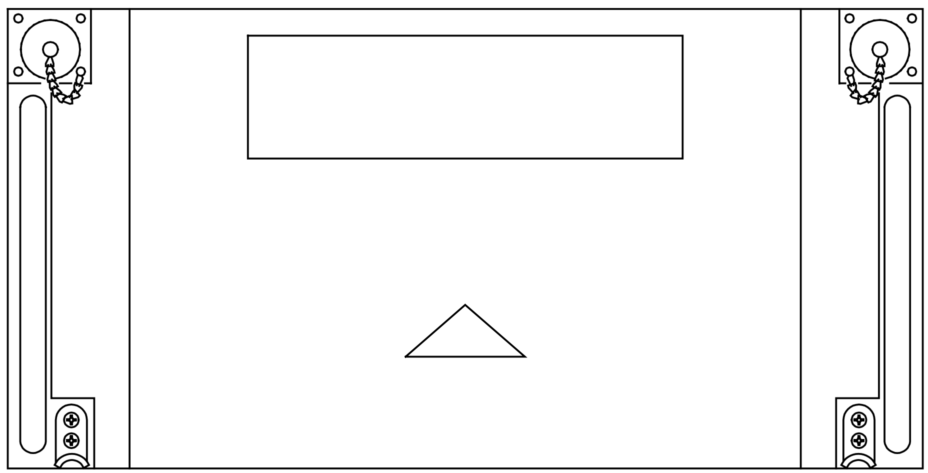
CAUTION: DO NOT TOUCH THE PSEU BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE PSEU.



MAIN EQUIPMENT CENTER (LOOKING AFT)



MAIN EQUIPMENT CENTER (LOOKING FORWARD)



PSEU (TYPICAL)

32-08-00-004 Rev 1

PROXIMITY SENSOR SYSTEM - PSEU - COMPONENT LOCATION

PROXIMITY SENSOR SYSTEM - PSEU - CIRCUIT CARDS

General

PSEU 1 contains 13 circuit cards and PSEU 2 contains 11 circuit cards.

These are the five different types of circuit cards:

- Microprocessor cards
- Proximity cards
- Driver cards
- Communication cards
- Power supply cards.

Microprocessor Card

There are two microprocessor cards in each PSEU. These cards control the operation of the PSEU. They also supply BITE functions.

The microprocessor cards are interchangeable.

Proximity Card

Each proximity card has 24 channels. Each channel controls the power to a proximity sensor and calculates the near or far condition. PSEU 1 has three proximity cards and PSEU 2 has four proximity cards.

The proximity cards are interchangeable.

Driver Card

There are three different types of driver cards. Two of these types have 18 channels and one has 10 channels. The driver cards contain the driver outputs of the PSEUs. The driver cards also supply some logic functions. PSEU 1 has three driver cards and PSEU 2 has one driver card.

Communication Card

Two communication cards are in each PSEU. The PSEU needs only one card to operate. The other card is back-up. Each contains an ARINC 629 terminal and a ARINC 429 interface to communicate with airplane systems and with the other PSEU.

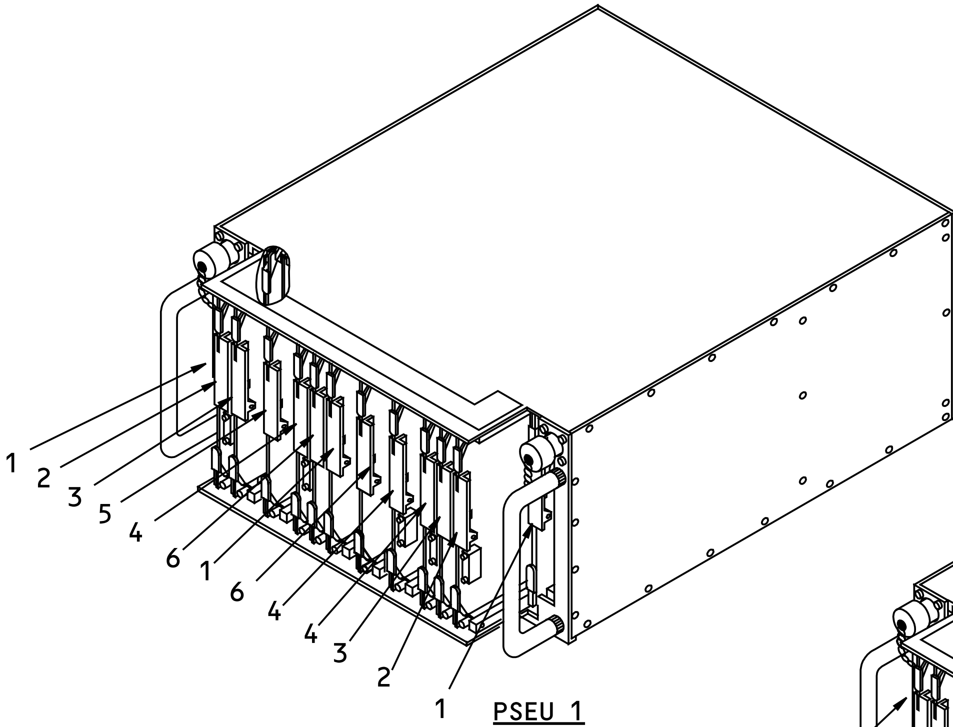
The communication cards are interchangeable.

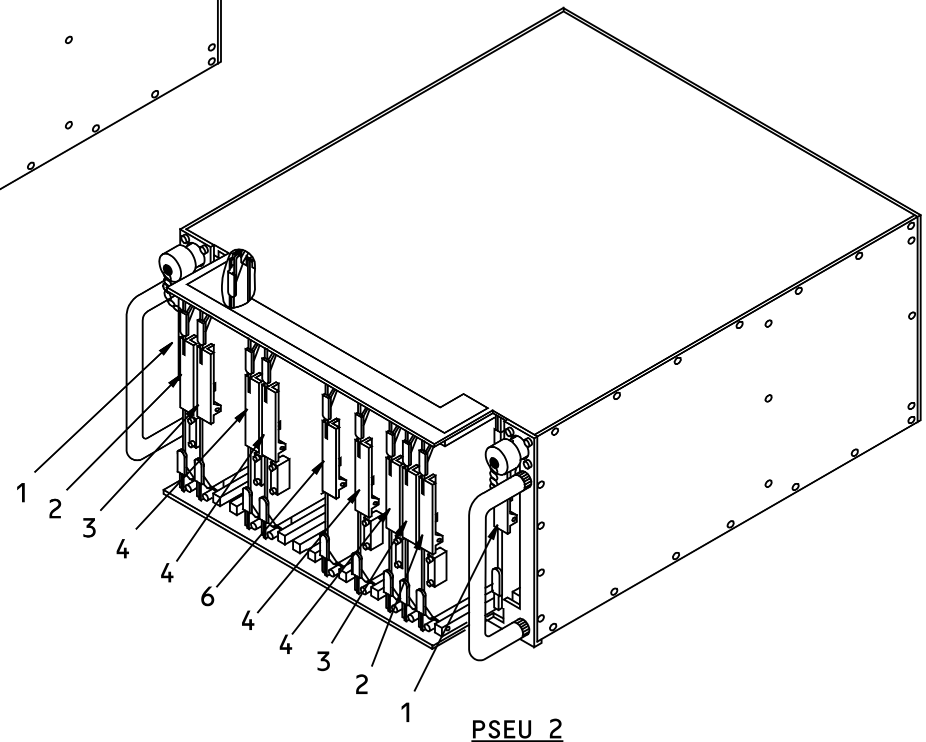
Power Supply Card

Two power supply cards in each PSEU change 28v dc power to other voltages for PSEU operation. These cards are interchangeable.

PSEU 1 has a third power supply card. This card gets power from the ground handling bus for cargo door control. This card is not interchangeable with the other two power supply cards.

1. POWER SUPPLY CARD
2. COMMUNICATION CARD
3. MICROPROCESSOR CARD
4. PROXIMITY CARD
5. 10 CHANNEL DRIVER CARD
6. 18 CHANNEL DRIVER CARD





32-08-00-005 Rev 1 11/28/95

PROXIMITY SENSOR SYSTEM - PSEU - CIRCUIT CARDS

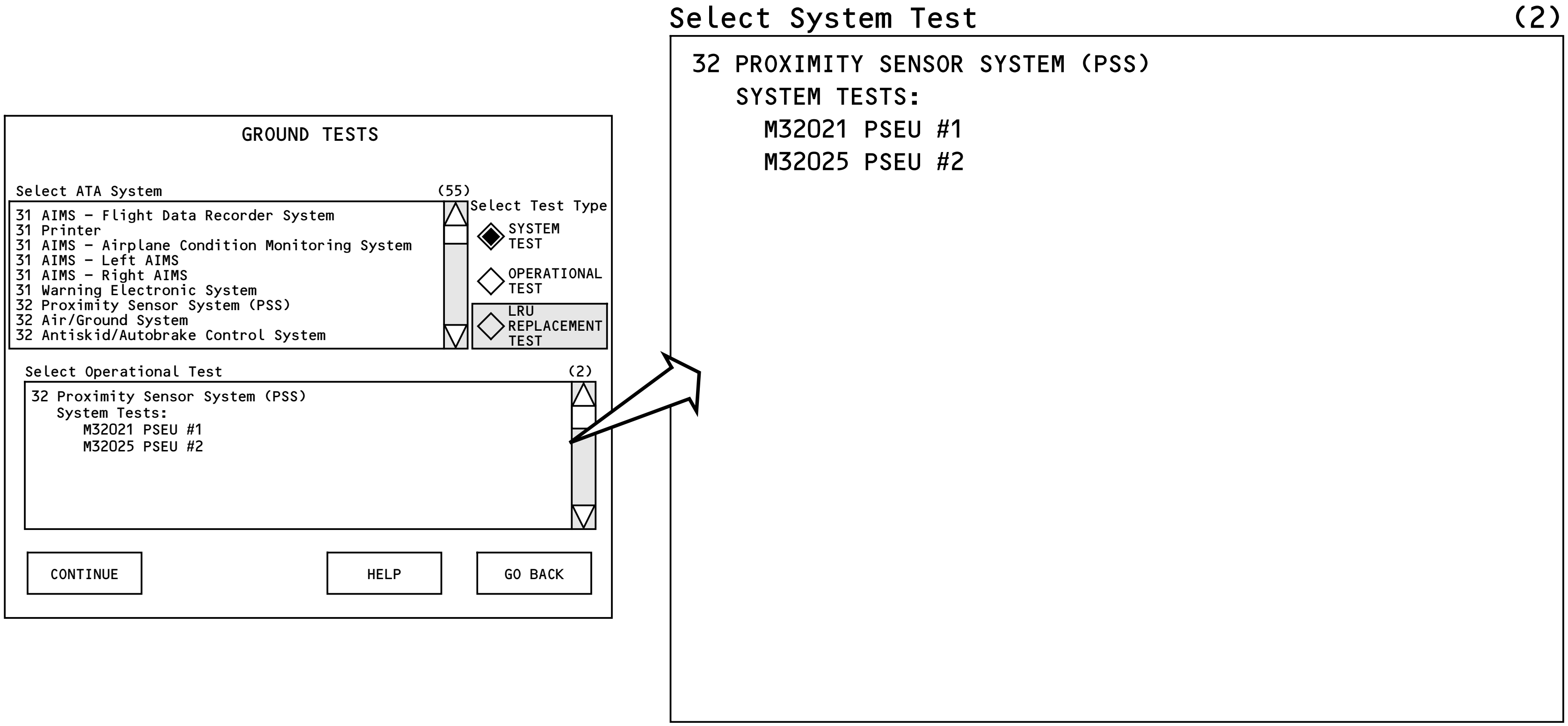
PROXIMITY SENSOR SYSTEM - SYSTEM TESTS

General

These are the system tests for the proximity sensor system:

- M32021 PSEU #1
- M32025 PSEU #2.

The system tests do a test for the correct operation and installation of the PSEUs.



32-08-00-008 Rev 1 01/11/1996

PROXIMITY SENSOR SYSTEM - SYSTEM TESTS

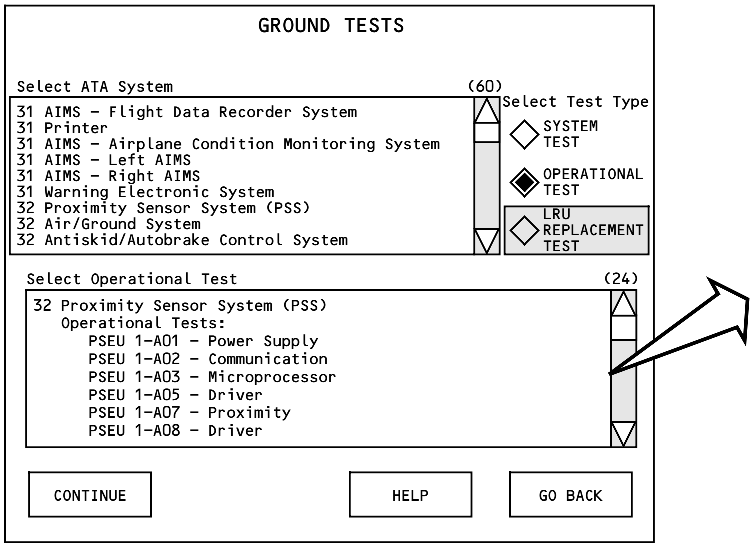
PROXIMITY SENSOR SYSTEM - OPERATIONAL TESTS

General

These are the operational tests for the proximity sensor system:

- PSEU 1-A01 - Power Supply
- PSEU 1-A02 - Communication
- PSEU 1-A03 - Microprocessor
- PSEU 1-A05 - Driver
- PSEU 1-A07 - Proximity
- PSEU 1-A08 - Driver
- PSEU 1-A09 - Power Supply
- PSEU 1-A11 - Driver
- PSEU 1-A13 - Proximity
- PSEU 1-A15 - Proximity
- PSEU 1-A16 - Microprocessor
- PSEU 1-A17 - Communication
- PSEU 1-A18 - Power Supply
- PSEU 2-A01 - Power Supply
- PSEU 2-A02 - Communication
- PSEU 2-A03 - Microprocessor
- PSEU 2-A06 - Proximity
- PSEU 2-A07 - Proximity
- PSEU 2-A11 - Driver
- PSEU 2-A13 - Proximity
- PSEU 2-A15 - Proximity
- PSEU 2-A16 - Microprocessor
- PSEU 2-A17 - Communication
- PSEU 2-A18 - Power Supply.

The operational tests do a test of the operation and installation of the PSEU circuit cards.



Select Operational Test (24)

32 PROXIMITY SENSOR SYSTEM (PSS)
OPERATIONAL TESTS:
PSEU 1-A01 - POWER SUPPLY
PSEU 1-A02 - COMMUNICATION
PSEU 1-A03 - MICROPROCESSOR
PSEU 1-A05 - DRIVER
PSEU 1-A07 - PROXIMITY
PSEU 1-A08 - DRIVER
PSEU 1-A09 - POWER SUPPLY
PSEU 1-A11 - DRIVER
PSEU 1-A13 - PROXIMITY
PSEU 1-A15 - PROXIMITY
PSEU 1-A16 - MICROPROCESSOR
PSEU 1-A17 - COMMUNICATION
PSEU 1-A18 - POWER SUPPLY
PSEU 2-A01 - POWER SUPPLY
PSEU 2-A02 - COMMUNICATION
PSEU 2-A03 - MICROPROCESSOR
PSEU 2-A06 - PROXIMITY
PSEU 2-A07 - PROXIMITY
PSEU 2-A11 - DRIVER
PSEU 2-A13 - PROXIMITY
PSEU 2-A15 - PROXIMITY
PSEU 2-A16 - MICROPROCESSOR
PSEU 2-A17 - COMMUNICATION
PSEU 2-A18 - POWER SUPPLY

32-08-00-009 Rev 1 12/19/1995

PROXIMITY SENSOR SYSTEM - OPERATIONAL TESTS

LG POSITION INDICATING AND WARNING SYSTEM - INTRODUCTION

Purpose

The landing gear position indicating and warning system shows landing gear position on the flight deck displays.

Inputs

The landing gear position indicating and warning system uses these proximity sensors to supply landing gear position data to the PSEUs:

- Left and right MLG up and locked proximity sensor (4)
- Left and right MLG side brace down proximity sensor (4)
- left and right MLG drag brace down proximity sensor (4)
- Left and right MLG door closed proximity sensor (4)
- NLG locked proximity sensor (2)
- NLG up proximity sensor (2)
- NLG down proximity sensor (2)
- Nose gear door closed proximity sensor (2).

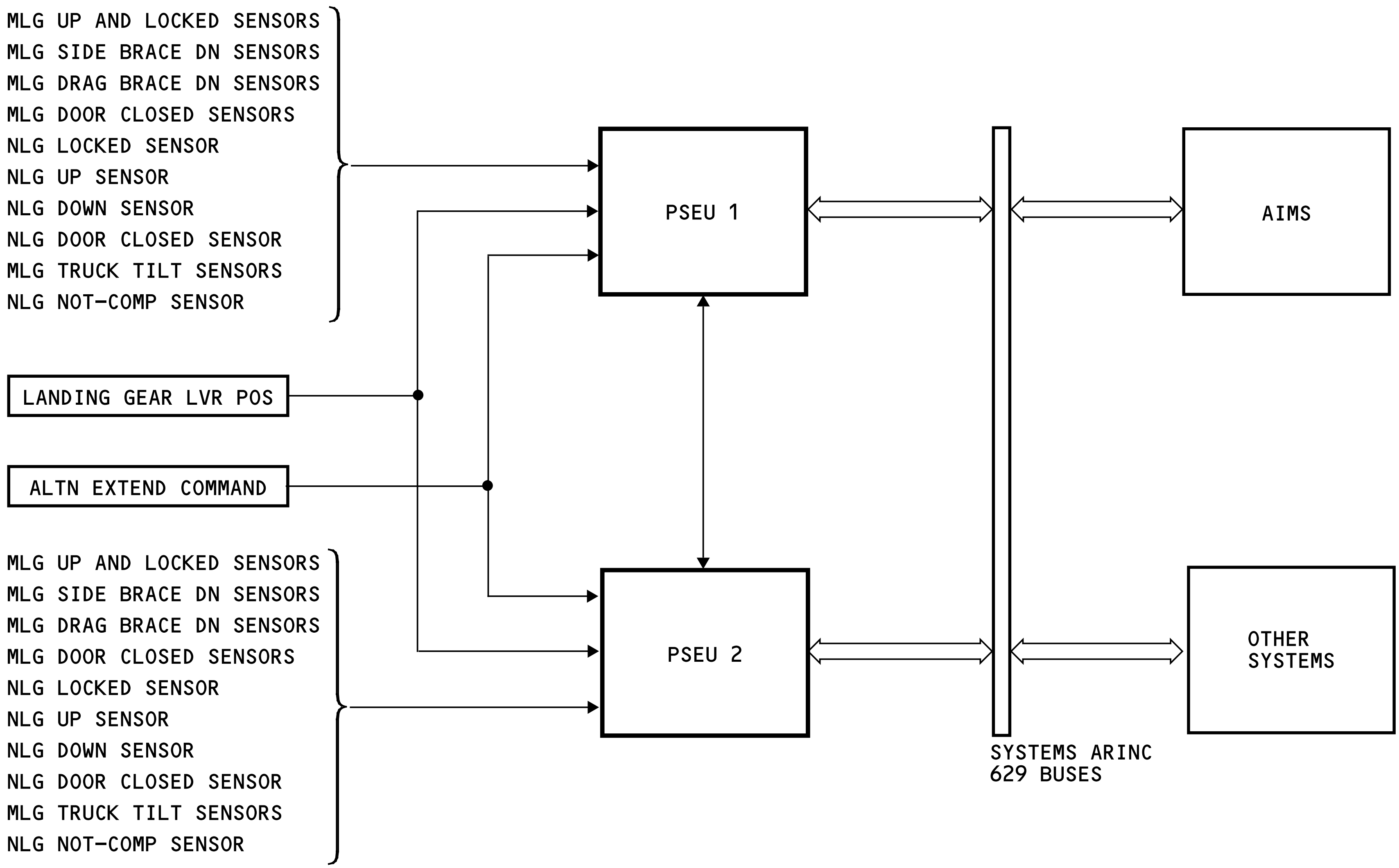
Four MLG truck tilt proximity sensors and two NLG not-compressed proximity sensors also supply data to the PSEUs.

The PSEUs also get inputs from the landing gear lever and the alternate extend command.

General Description

The landing gear position indicating and warning system is a dual redundant system. Each PSEU gets position input from a different proximity sensor in each location.

The PSEUs supply the position data through the left and right ARINC 629 buses to the AIMS and to other systems.



32-61-00-001 Rev 4 08/26/1996

LG POSITION INDICATING AND WARNING SYSTEM - INTRODUCTION

LG POSITION INDICATING AND WARNING SYSTEM - MLG UP AND LOCKED PROXIMITY SENSORS

Purpose

Two MLG up and locked sensors on each of the MLG supply uplock input to the PSEUs.

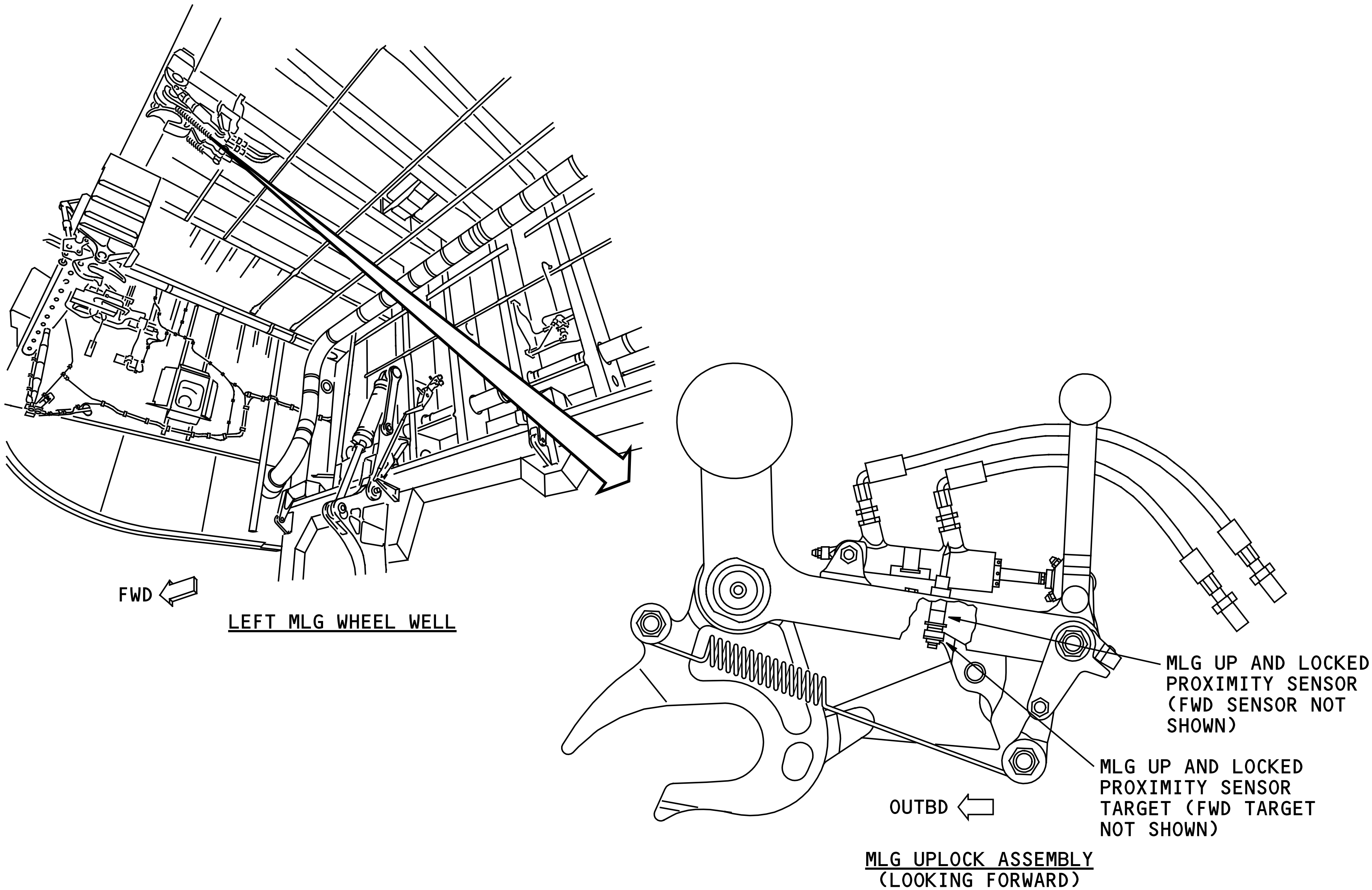
Location

The sensors are on the forward and aft sides of the MLG uplock assembly.

The proximity sensor targets are also on the uplock assembly and move with the uplock hook.

Functional Description

The targets are near the proximity sensors when the uplock assembly is in the uplocked position.



32-61-00-002 Rev 2 05/27/95

LG POSITION INDICATING AND WARNING SYSTEM - MLG UP AND LOCKED PROXIMITY SENSORS

LG POSITION INDICATING AND WARNING SYSTEM - MLG DOWN PROXIMITY SENSORS

Purpose

Main landing gear down proximity sensors supply downlock data to the PSEUs. There are four MLG down proximity sensors for each MLG.

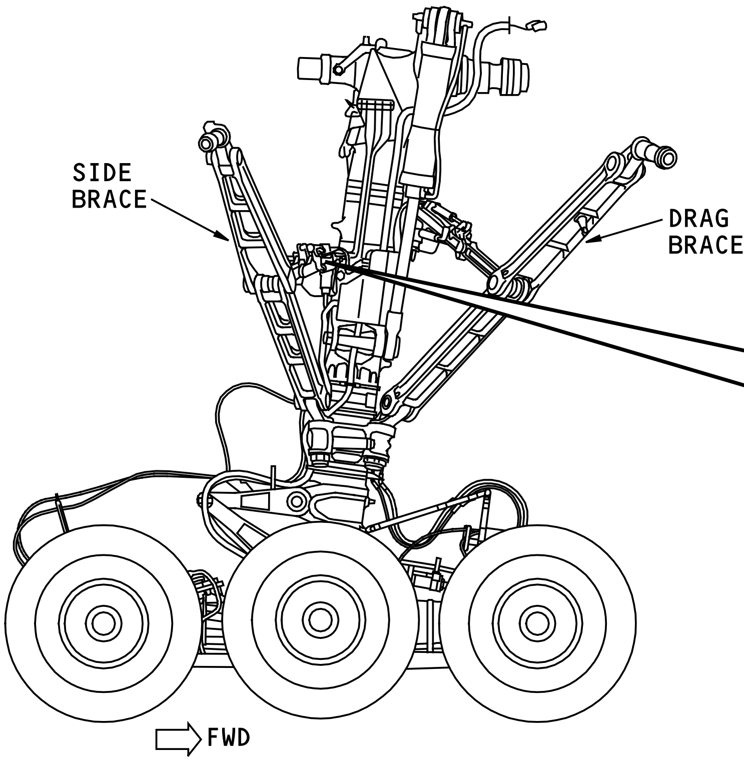
Location

The two MLG drag brace down sensors are on the upper drag brace lock link. The targets (not shown) are on the upper toggle.

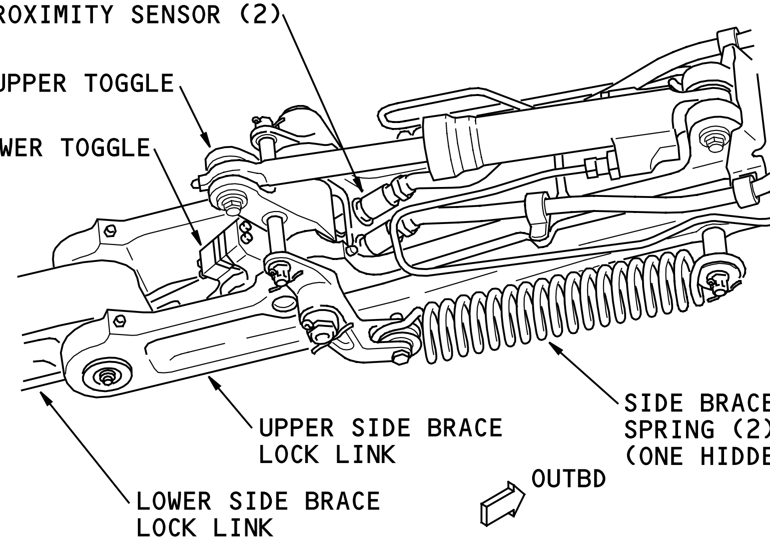
The two MLG side brace down sensors are on the upper side brace lock link. The targets (not shown) are on the upper toggle.

Functional Description

For both the drag and the side braces, the targets are near the sensors when the gear is down and the toggles are in the over-center locked position.



LEFT MAIN LANDING GEAR



MLG SIDE BRACE PROXIMITY SENSOR
(MLG DRAG BRACE PROXIMITY SENSOR SIMILAR)

32-61-00-003 Rev 4 05/31/96

LG POSITION INDICATING AND WARNING SYSTEM - MLG DOWN PROXIMITY SENSORS

LG POSITION INDICATING AND WARNING SYSTEM - MLG DOOR CLOSED PROXIMITY SENSORS

Purpose

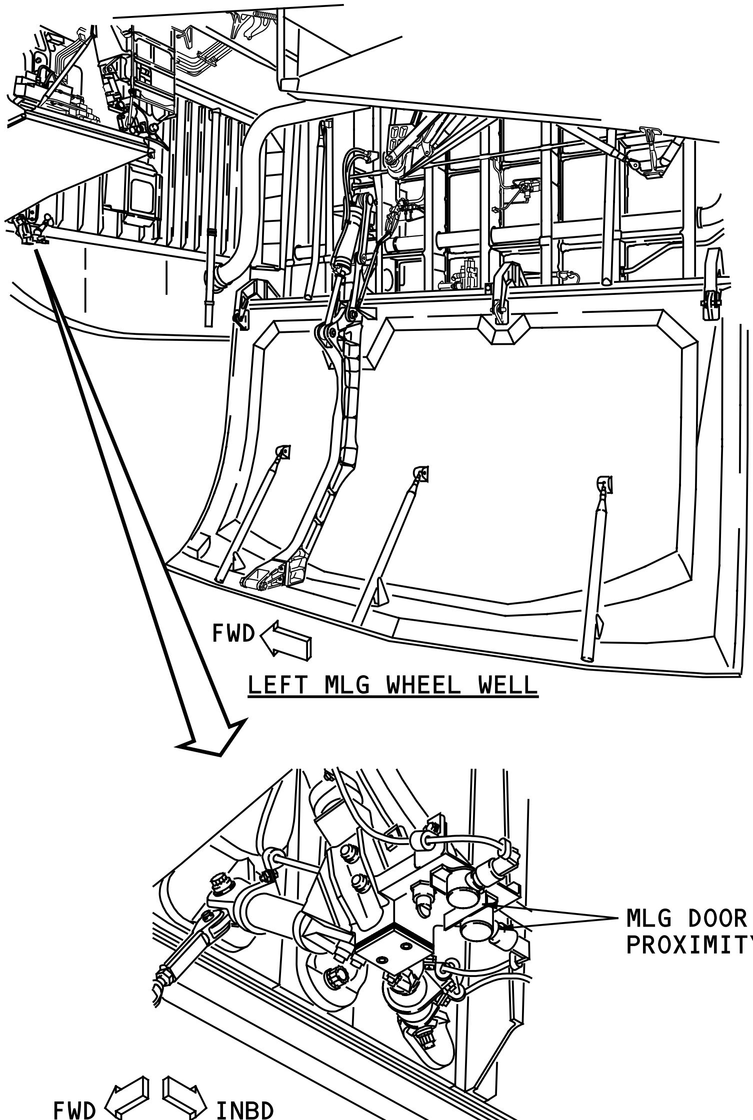
Two MLG door closed sensors for each main landing gear door supply door position data to the PSEUs.

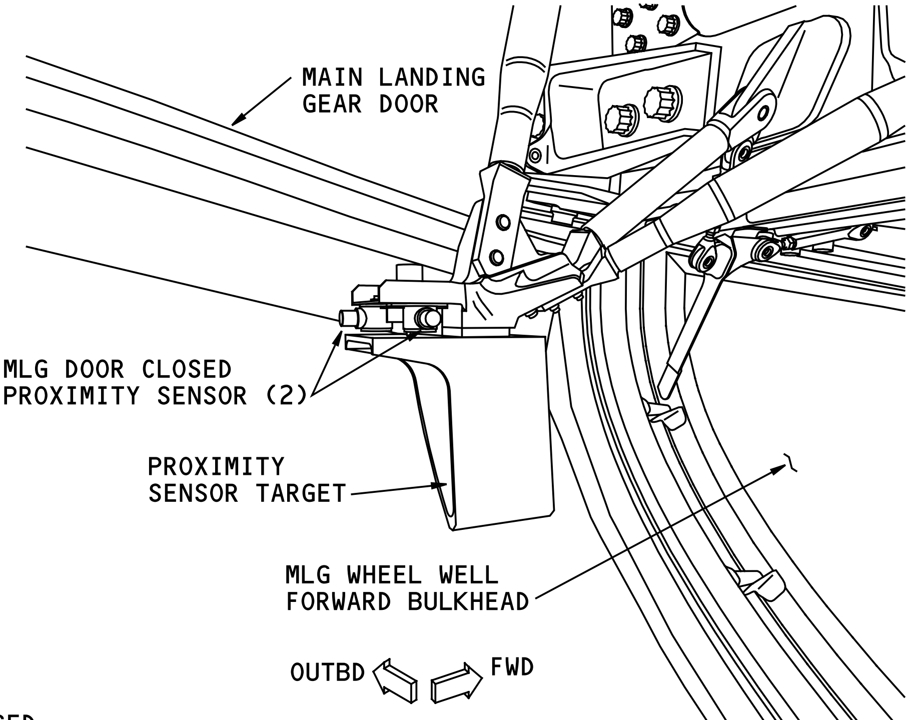
Location

The sensors are on the outboard forward corner of the wheel wells. The targets are on the main landing gear doors.

Functional Description

The targets are near the sensors when the main landing gear doors are in the closed position.





LEFT MLG WHEEL WELL - MLG DOOR CLOSED
(FORWARD-OUTBOARD CORNER)

32-61-00-004 Rev 1 07/20/1995

LG POSITION INDICATING AND WARNING SYSTEM - MLG DOOR CLOSED PROXIMITY SENSORS

LG POSITION INDICATING AND WARNING SYSTEM - NLG LOCKED PROXIMITY SENSORS

Purpose

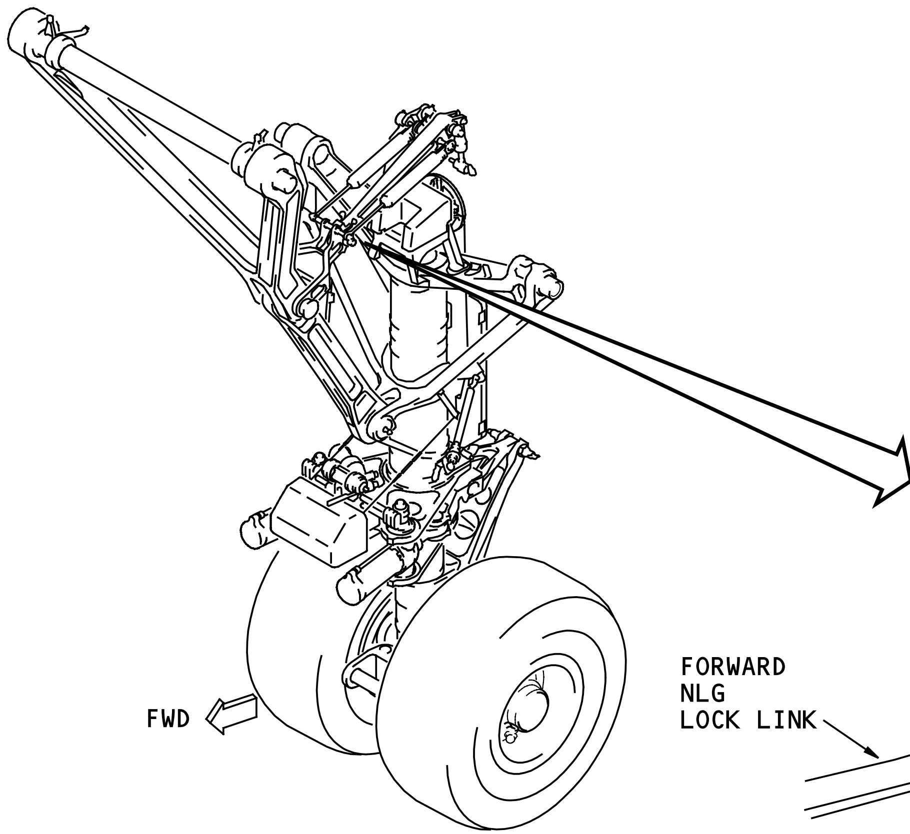
Two NLG locked sensors supply nose landing gear lock link lock position data to the PSEUs.

Location

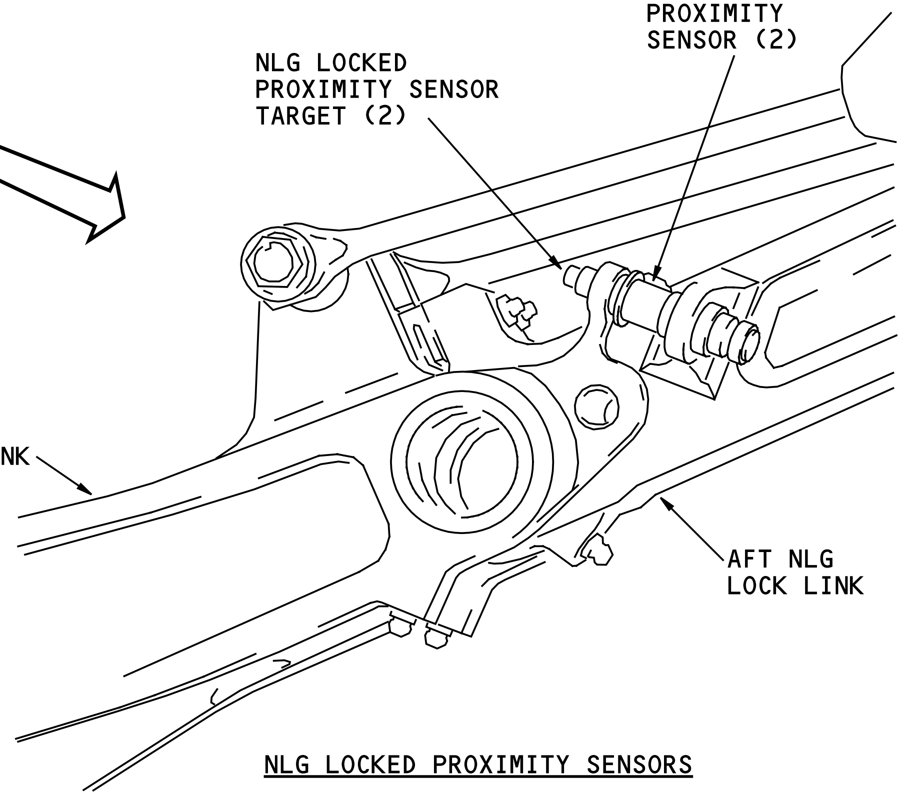
The sensors are on the aft NLG lock link. The targets are on the forward lock link.

Functional Description

The targets are near the sensors when the NLG lock link is in the locked position.



NOSE LANDING GEAR



NLG LOCKED PROXIMITY SENSORS

32-61-00-005 Rev 1

LG POSITION INDICATING AND WARNING SYSTEM - NLG LOCKED PROXIMITY SENSORS

LG POSITION INDICATING AND WARNING SYSTEM - NLG UP AND NLG DOWN PROXIMITY SENSORS

Purpose

Two NLG up sensors and two NLG down sensors supply nose gear position data to the PSEUs.

Location

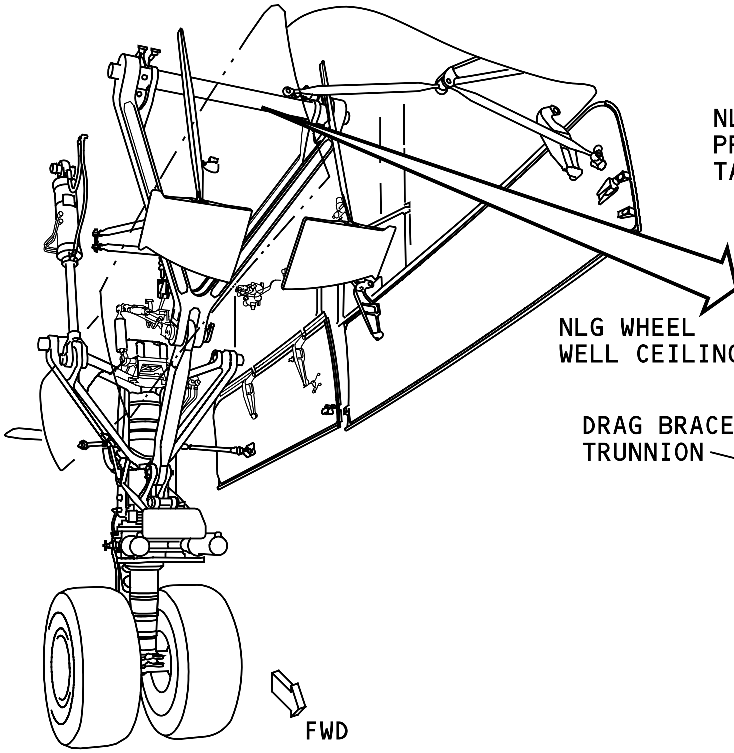
All four sensors are on the ceiling of the nose landing gear wheel well above the drag brace trunnions. The NLG down sensors are outboard. The NLG up sensors are inboard.

The targets attach to brackets which are on, and rotate with the drag brace trunnions.

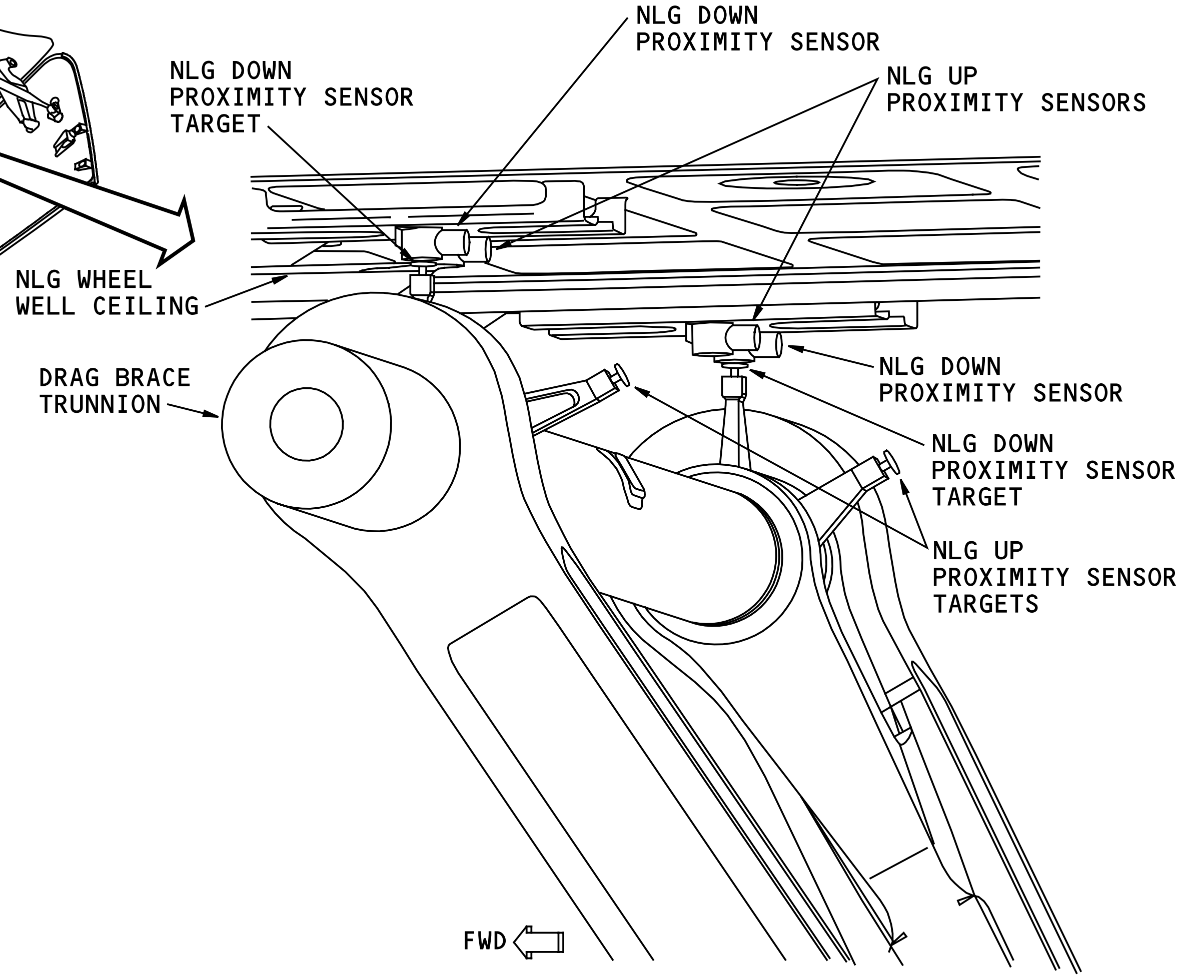
Functional Description

When the NLG is up, the NLG up targets will be near their sensors. The NLG down targets will not be near their sensors.

When the NLG is down, the NLG down targets will be near their sensors. The NLG up targets will not be near their sensors.



NOSE LANDING GEAR



NLG UP AND NLG DOWN PROXIMITY SENSORS

32-61-00-006 Rev 1 02/12/96

LG POSITION INDICATING AND WARNING SYSTEM - NLG UP AND NLG DOWN PROXIMITY SENSORS

LG POSITION INDICATING AND WARNING SYSTEM - NLG DOOR CLOSED PROXIMITY SENSORS

Purpose

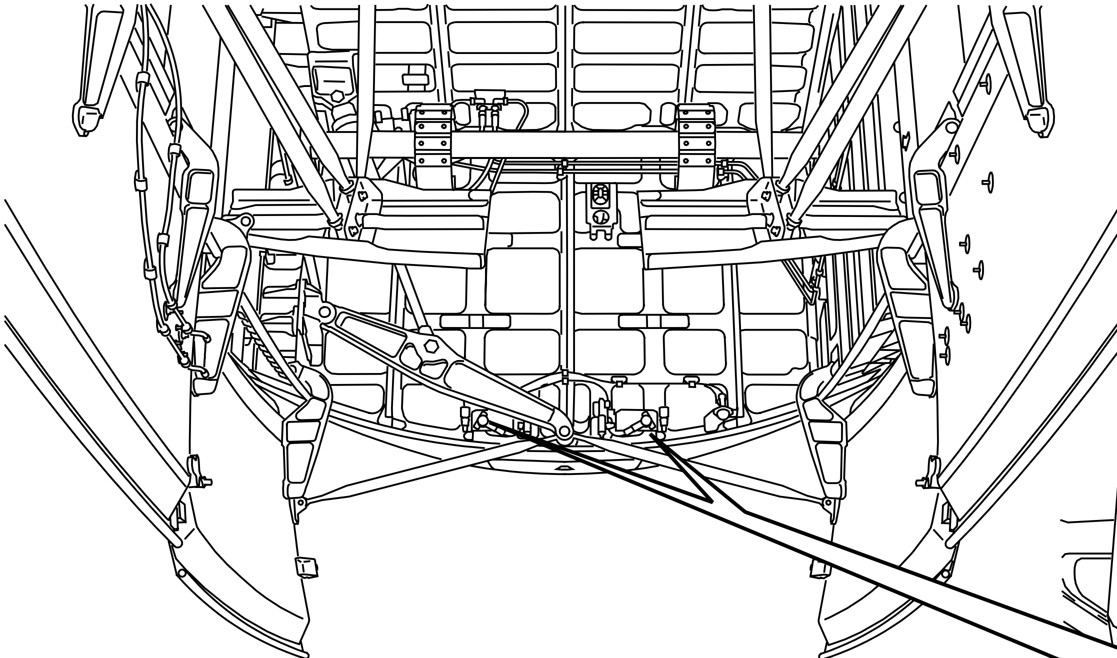
Two NLG door closed sensors supply NLG door position data to the PSEUs.

Location

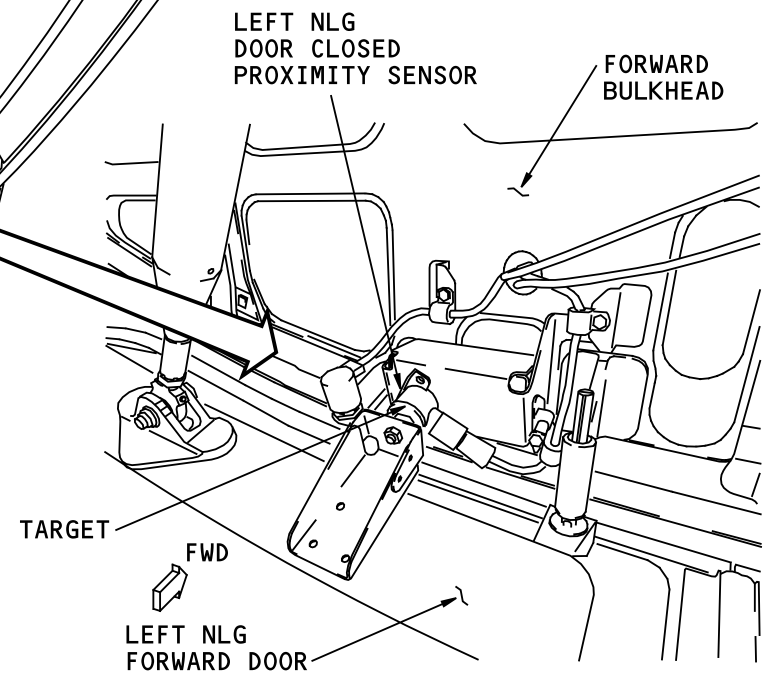
The sensors are on the forward bulkhead of the NLG wheel well. One sensor is above the left forward NLG door and the other sensor is above the right NLG door. The targets attach to the each NLG forward door.

Functional Description

The targets are near the sensors when the NLG doors are in the closed position.



NOSE LANDING GEAR WHEEL WELL
(LOOKING FORWARD)



NLG DOOR CLOSED PROXIMITY SENSOR

32-61-00-007 Rev 2 11/28/95

LG POSITION INDICATING AND WARNING SYSTEM - NLG DOOR CLOSED PROXIMITY SENSORS

LG POSITION INDICATING AND WARNING SYSTEM - MLG TRUCK TILT PROXIMITY SENSORS

Purpose

Two MLG truck tilt sensors for each main landing gear supply truck tilt position data to the PSEUs.

Physical Description

The MLG truck tilt sensors are on the sensor target bracket assemblies which include the sensor targets.

A rod connects each sensor target bracket assembly to the inner shock strut cylinder. This rod moves the target near and far as the truck tilts.

Location

One sensor target bracket assembly is on the left side of each MLG truck beam forward of the shock strut. The other sensor target bracket assembly is on the right side of each MLG truck aft of the shock strut.

Functional Description

The target is near the sensors when the MLG truck is tilted between 10 and 13 degrees forward wheels up (TILT position). The target is in the far position when the MLG truck is less than 10 degrees forward wheels up (UNTILT position).

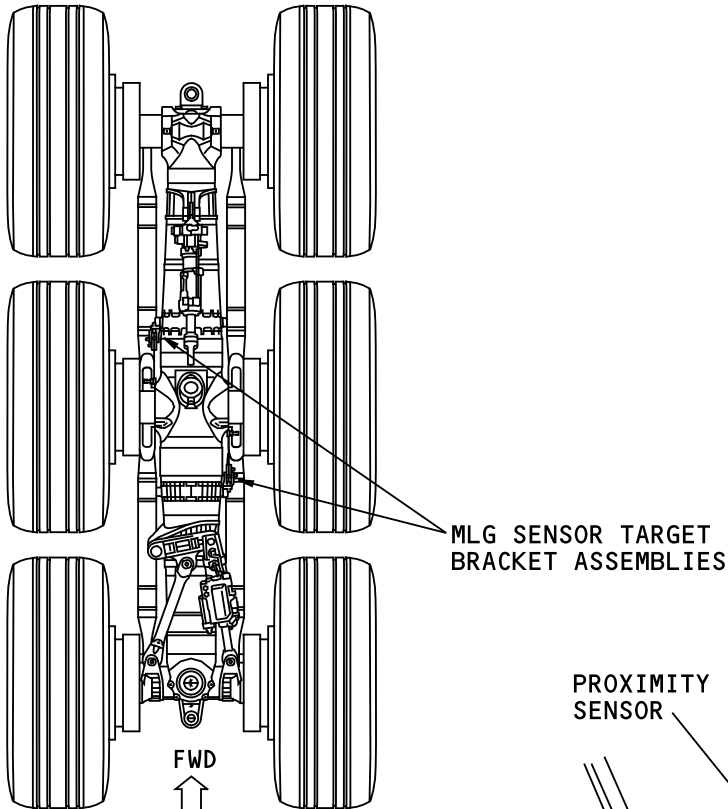
The PSEU supplies a signal that the airplane is on the ground.

Training Information Point

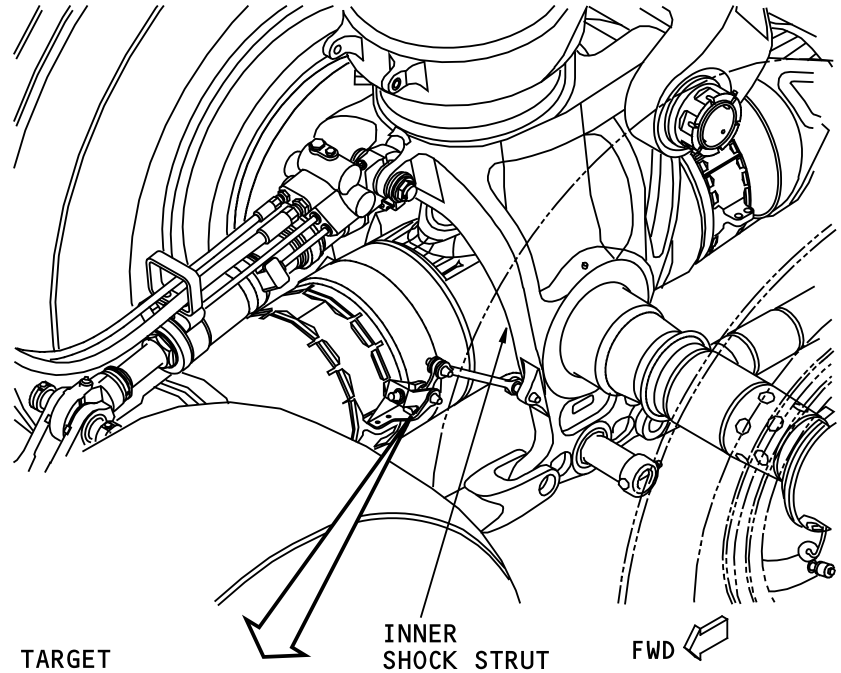
The sensor assemblies on the forward part of the MLG truck are different than the sensor assemblies on the aft part of the truck.

The truck tilt sensors are LRUs. There is no adjustment of the sensors or the target after replacement.

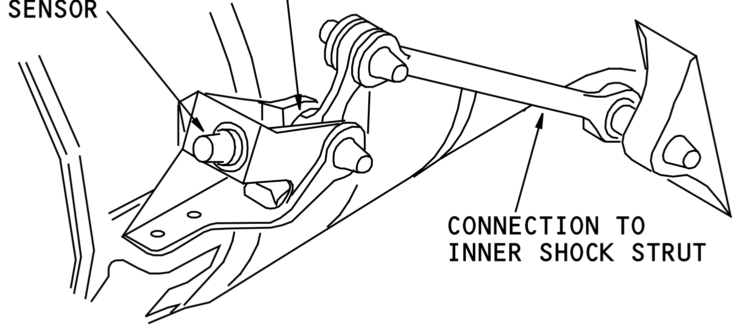
The primary flight computers (PFCs) use the truck position signal to operate the auto speedbrakes. The brake system control unit (BSCU) uses the same signal to operate the autobrakes.



MLG TRUCK
(TOP VIEW)



MLG TRUCK



MLG TRUCK TILT SENSOR AND TARGET BRACKET ASSEMBLY

32-61-00-008 Rev 2 03/05/96

LG POSITION INDICATING AND WARNING SYSTEM - MLG TRUCK TILT PROXIMITY SENSORS

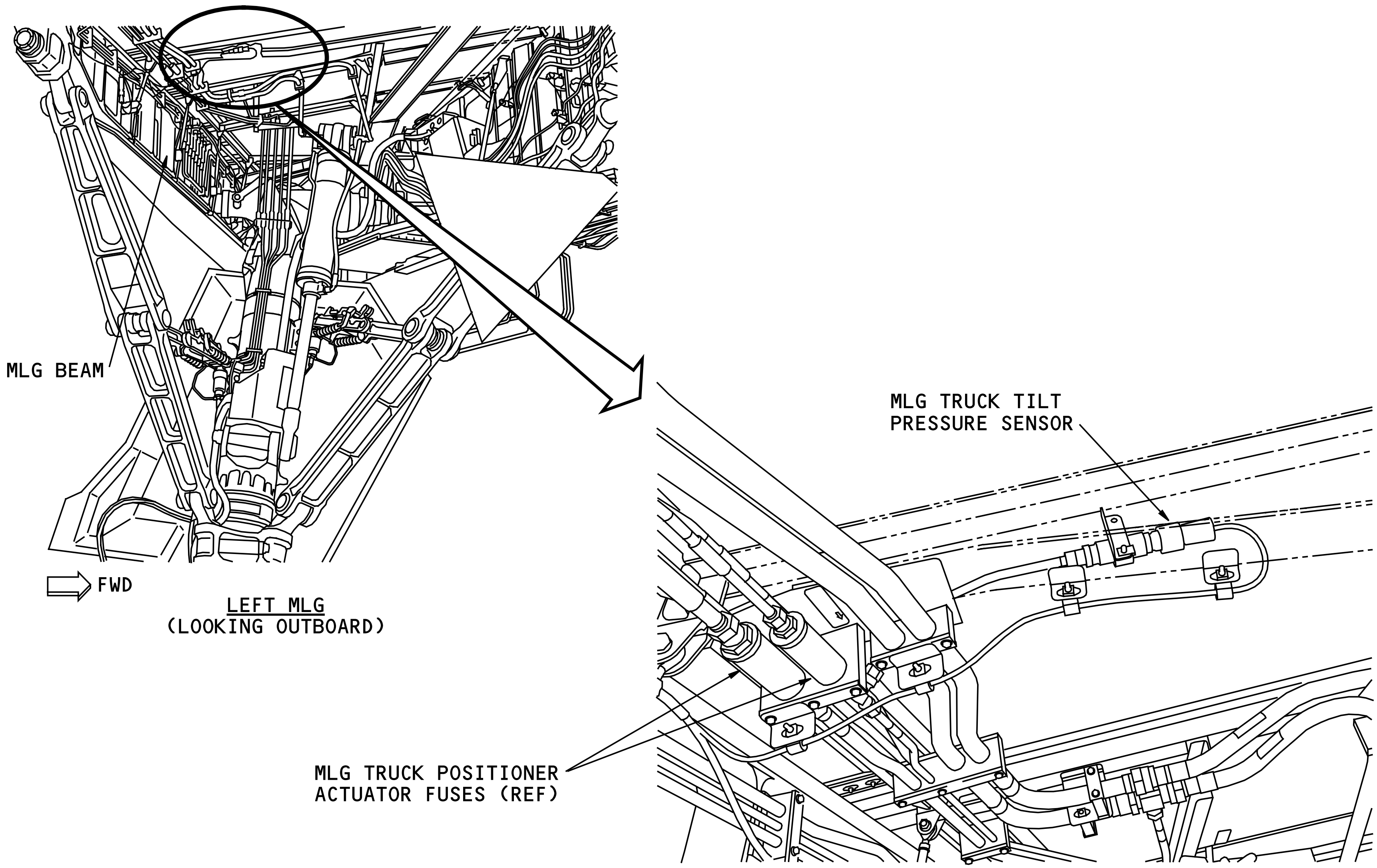
LG POSITION INDICATING AND WARNING SYSTEM - MLG TRUCK TILT PRESSURE SENSORS

Purpose

A truck tilt pressure sensor for each of the MLG truck tilt actuators sends truck tilt pressure data to the HYDIM cards. The HYDIM cards send a high pressure signal to the AIMS when the truck tilt pressure is more than 2500 psi. The HYDIM cards send a low pressure signal when the truck tilt pressure is less than 2400 psi. The AIMS sends these signals to the primary flight control computers (PFCs) to operate the auto-speedbrakes.

Location

The MLG truck tilt pressure sensors are above the MLG truck near the main landing gear beam.



LEFT MLG
(LOOKING OUTBOARD)

32-61-00-009 Rev 3 03/05/96

LG POSITION INDICATING AND WARNING SYSTEM - MLG TRUCK TILT PRESSURE SENSORS

LG POSITION INDICATING AND WARNING SYSTEM - NLG NOT-COMPRESSED PROXIMITY SENSORS

Purpose

Two NLG not-compressed sensors supply NLG shock strut compressed - not compressed data to the PSEUs.

Location

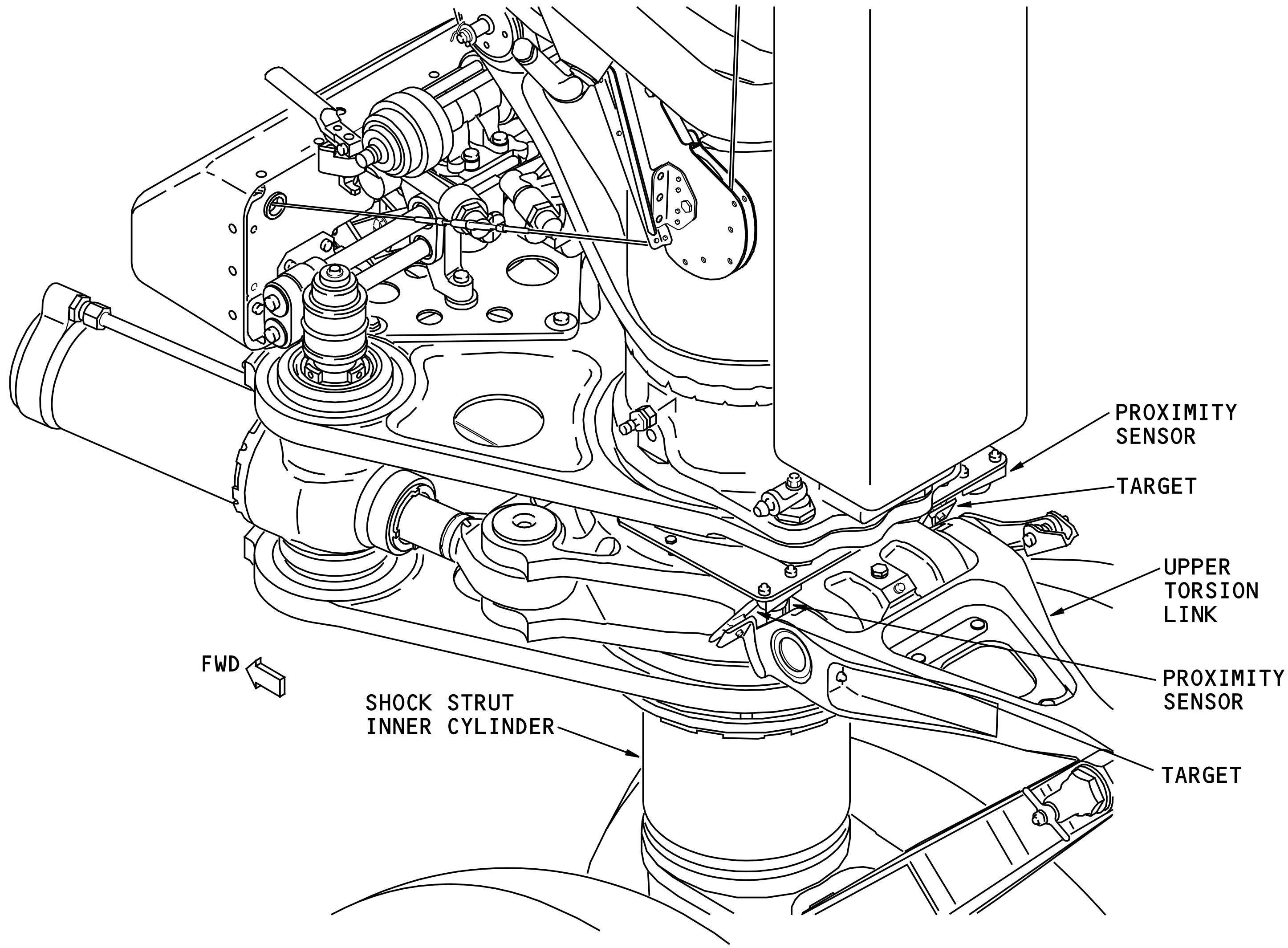
The sensors are on the aft side of the NLG shock strut. The targets attach to the upper torsion link.

Functional Description

When the airplane is on the ground, airplane weight compresses the nose landing gear. The NLG compressed targets are in the far position.

When the airplane is in the air, the inner cylinder of the NLG shock strut extends to move the torsion links to the not-compressed position. This moves the targets near the NLG not-compressed sensors.

The PSEUs supply NLG not-compressed sensor data to the ECS miscellaneous cards and to the equipment cooling controllers to operate the equipment cooling supply fans.



32-61-00-010 Rev 3 06/20/96

LG POSITION INDICATING AND WARNING SYSTEM - NLG NOT-COMPRESSED PROXIMITY SENSORS

LG POSITION INDICATING AND WARNING SYSTEM - INDICATIONS - EICAS DISPLAY

General

In normal operation, the EICAS display shows the position of the three landing gear with a single symbol format.

The format shows individual gear position for non-normal conditions.

Single-Symbol Display

The single symbol display shows the all gears down and locked condition with a green DOWN, in a box.

A white hatched box shows the gear in the in-transit condition.

An empty white box shows the loss of gear position data.

The display shows the all gears up and locked condition with a white UP, in a box. This display goes out of view approximately ten seconds after the gear moves to this position.

Multi-Symbol Display

The landing gear display shows all three gears for these conditions:

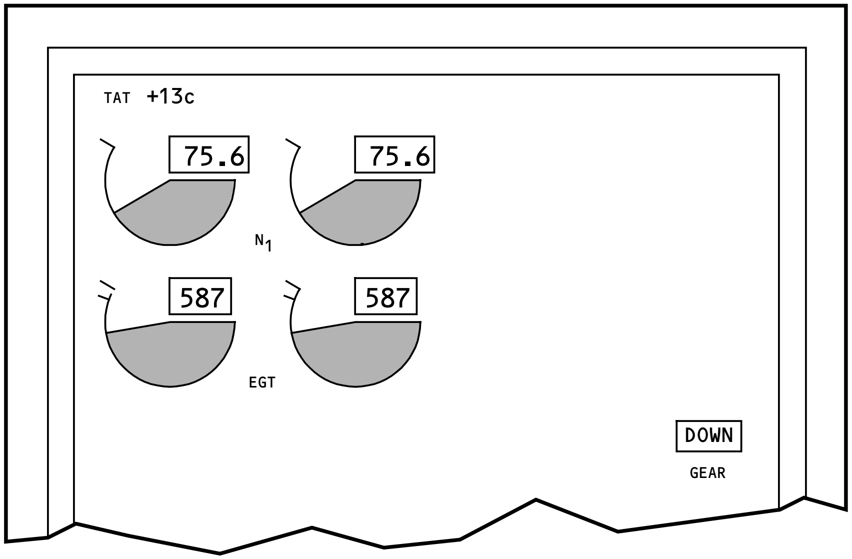
- There is a disagreement between the landing gear lever and the landing gear position for more than 40 seconds (normal actuation time is approximately 17 seconds for retraction and 23 seconds for extension)
- The landing gear doors are open (alternate extension or ground operation of the landing gear doors).

The display shows the gear down and locked condition with a green DN, in a box.

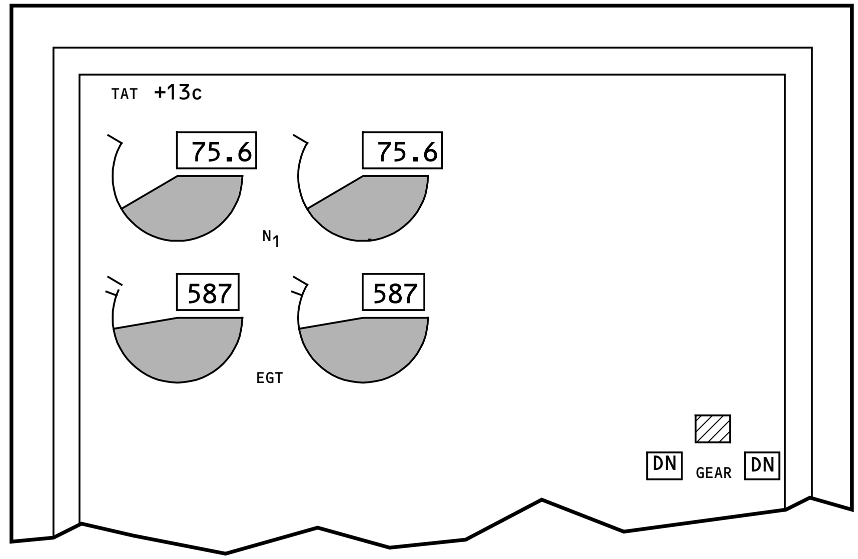
The display shows the gear in-transit condition with a white hatched box.

The display shows the gear up and locked condition with a white UP, in a box.

An empty white box shows the loss of position data for the applicable gear.



EICAS DISPLAY - SINGLE-SYMBOL DISPLAY



EICAS DISPLAY - MULTI-SYMBOL DISPLAY

SINGLE-SYMBOL DISPLAY

DOWN - (GREEN) ALL GEAR DOWN AND LOCKED

- (WHITE HATCHED) GEAR IN-TRANSIT

UP - (WHITE) ALL GEARS UP AND LOCKED
(DISPLAY BLANKS AFTER 10 SECONDS)

- INDICATION INOPERATIVE

MULTI-SYMBOL DISPLAY

DN GEAR DN } EXPANDED DISPLAY

DN - (GREEN) GEAR DOWN AND LOCKED

- (WHITE HATCHED) GEAR IN-TRANSIT

UP - (WHITE) GEAR UP AND LOCKED

- INDICATION INOPERATIVE

32-61-00-011 Rev 3

LG POSITION INDICATING AND WARNING SYSTEM - INDICATIONS - EICAS DISPLAY

LG POSITION INDICATING AND WARNING SYSTEM - INDICATIONS - ALERT AND STATUS MESSAGES

Alert Messages

These alert messages show for non-normal landing gear conditions:

- CONFIG GEAR (Warning) - any landing gear is not down and locked and the airplane is in a landing configuration (the flap lever is in a landing position or a thrust lever is at idle with the radio altitude less than 800 feet)
- GEAR DISAGREE (Caution) - disagreement between the landing gear lever and one or more gear positions 40 seconds after landing gear lever movement
- MAIN GEAR BRACE L (Caution) - one brace on the left gear is unlocked for more than 40 seconds after the landing gear lever is in the down position and the other brace on the left gear is locked
- MAIN GEAR BRACE R (Caution) - one brace on the right gear is unlocked for more than 40 seconds after the landing gear lever is in the down position and the other brace on the right gear is locked
- GEAR DOOR (Advisory) - one or more landing gear doors are not closed 40 seconds after landing gear lever movement. This message also shows after an alternate extension or after ground door operation.

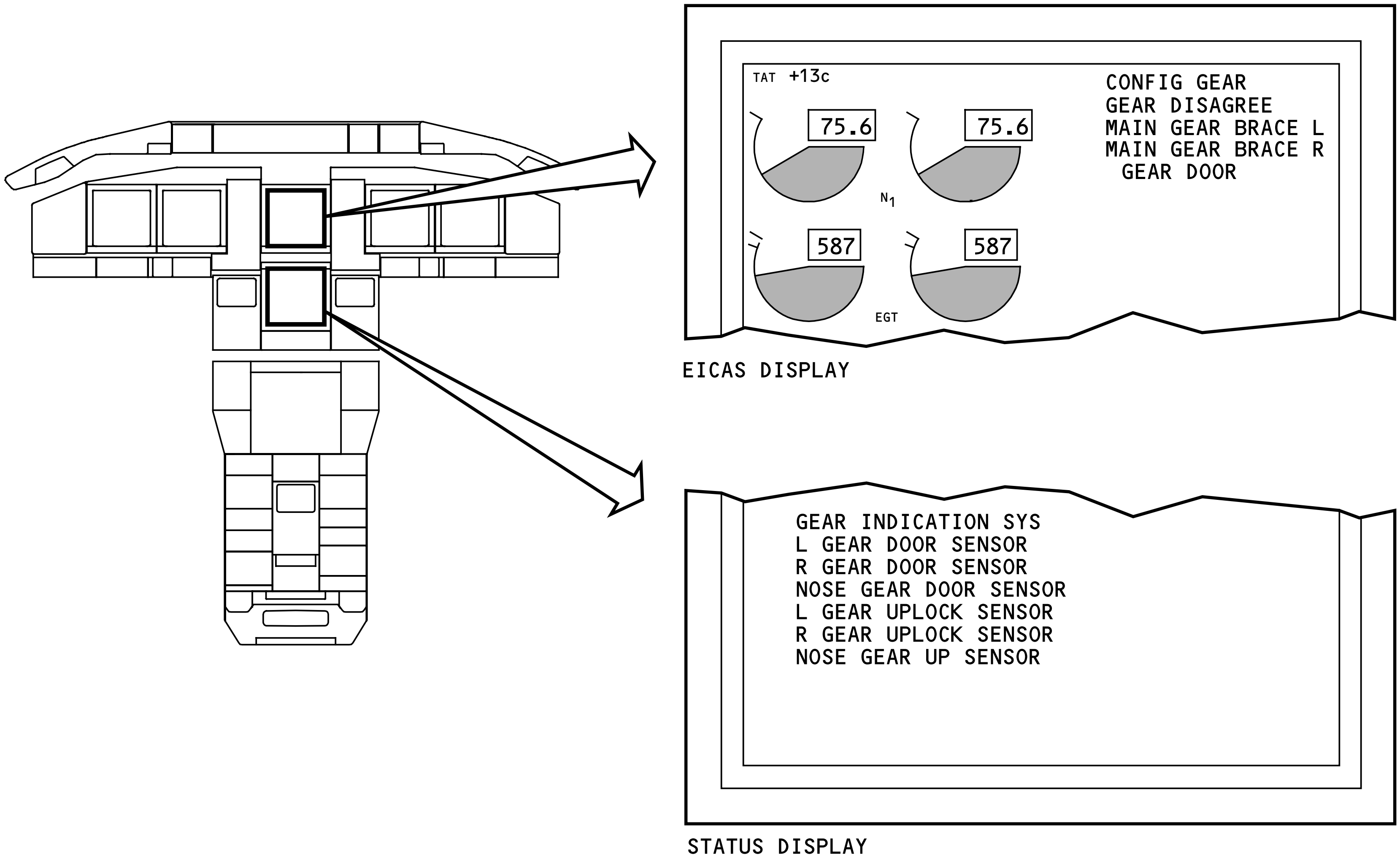
Status Messages

The GEAR INDICATION SYS status message shows for any of these conditions:

- Failure of both up sensors on the same gear
- Failure of both door sensors on the same gear
- Failure of any side brace sensor
- Failure of any drag brace sensor
- Failure of either NLG down sensor
- Failure of either NLG locked sensor
- Failure of any truck tilt sensor
- Failure of either NLG not-compressed sensor
- Invalid PSEU channel.

One or more of these status messages show for landing gear door sensor or gear uplock sensor failures:

- L GEAR DOOR SENSOR
- R GEAR DOOR SENSOR
- NOSE GEAR DOOR SENSOR
- L GEAR UPLOCK SENSOR
- R GEAR UPLOCK SENSOR
- NOSE GEAR UP SENSOR.



32-61-00-016 Rev 0 09/10/96

LG POSITION INDICATING AND WARNING SYSTEM - INDICATIONS - ALERT AND STATUS MESSAGES

LG POSITION INDICATING AND WARNING SYSTEM - INDICATIONS - MULTI-FUNCTION DISPLAY

General

The multi-function display shows landing gear position data on the landing gear synoptic display. Additional landing gear data and PSEU outputs show on the landing gear actuation/indication maintenance page.

Landing Gear Synoptic Display

The landing gear synoptic display shows the position of the landing gear doors.

The display shows a door closed condition with the word CLOSED in white, in a box.

The display shows a door not closed condition with a white hatched box.

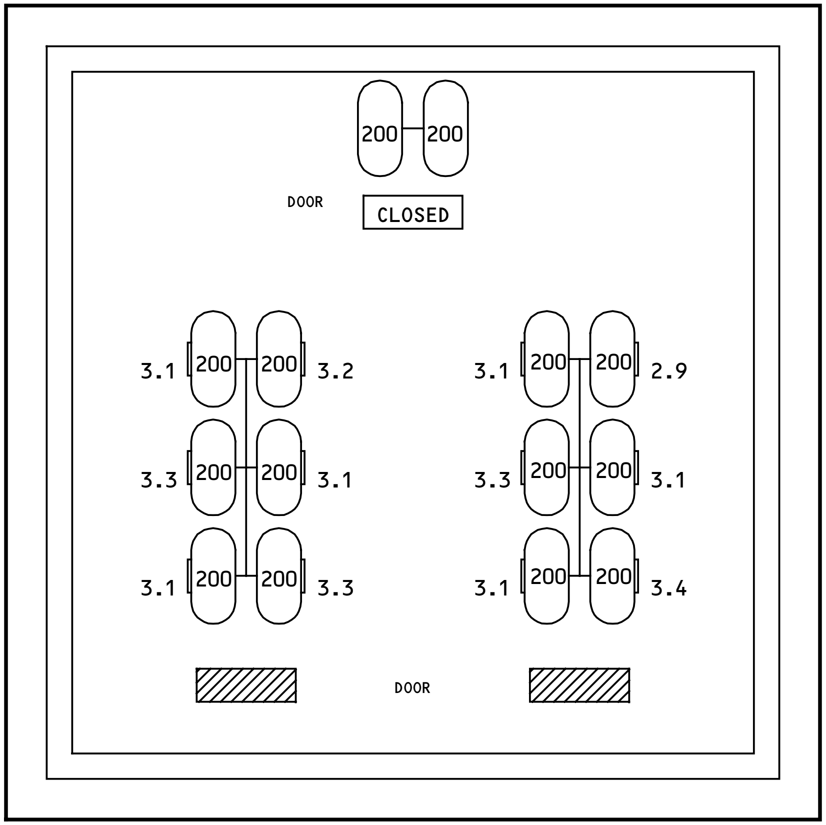
The display shows a loss of input data from both PSEUs with an empty white box.

Landing Gear Actuation/Indication Maintenance Page

The landing gear actuation/indication maintenance page shows the NEAR/FAR position for all the landing gear proximity sensors for both PSEUs.

The display shows the loss of a proximity sensor input or an invalid input as an empty space.

The display also shows the gear lever switch positions and the alternate extension system status.



LANDING GEAR SYNOPTIC DISPLAY

LANDING GEAR ACTN/INDN

		PSEU 1	PSEU 2
TAILSTRIKE		28 V	GND/OPEN
ALTN EXT CMD		NORM	DOWN
GEAR LEVER:	UP	UP	UP
	DOWN PWR	NOT DN	NOT DN
	DOWN GND	NOT DN	NOT DN
NOSE GEAR:	LOCK	FAR	FAR
	GEAR UP	NEAR	NEAR
	GEAR DOWN	FAR	FAR
	DOOR	FAR	FAR
	NOT COMP	FAR	FAR

		PSEU 1 L	PSEU 1 R	PSEU 2 L	PSEU 2 R
MAIN GEAR:	UP LOCK	NEAR	NEAR	FAR	FAR
	SIDE BRACE	FAR	NEAR	NEAR	NEAR
	DRAG BRACE	NEAR	NEAR		NEAR
	DOOR	FAR	FAR	NEAR	NEAR
	TRUCK TILT	NEAR	NEAR	NEAR	NEAR

AUTO-OFF
HYDIM L ENGAGED HYDIM R NOT ENGA

PRIORITY CMD
FSEU 1 CMD FSEU 2 NOT CMD

HYD PRESS

CENTER SYS	3000
L TRUCK TILT	3000
R TRUCK TILT	3000

AIR/GND

	L WOW	R WOW
L MLG	AIR	AIR
R MLG	AIR	AIR

DATE 02 SEP 95 UTC 19:23:09

LANDING GEAR ACTUATION/INDICATION MAINTENANCE PAGE

32-61-00-012 Rev 6 06/20/1997

LG POSITION INDICATING AND WARNING SYSTEM - INDICATIONS - MULTI-FUNCTION DISPLAY

TAIL STRIKE SYSTEM - INTRODUCTION

Purpose

The tail strike system supplies tail strike indication to the flight deck if a tail strike occurs.

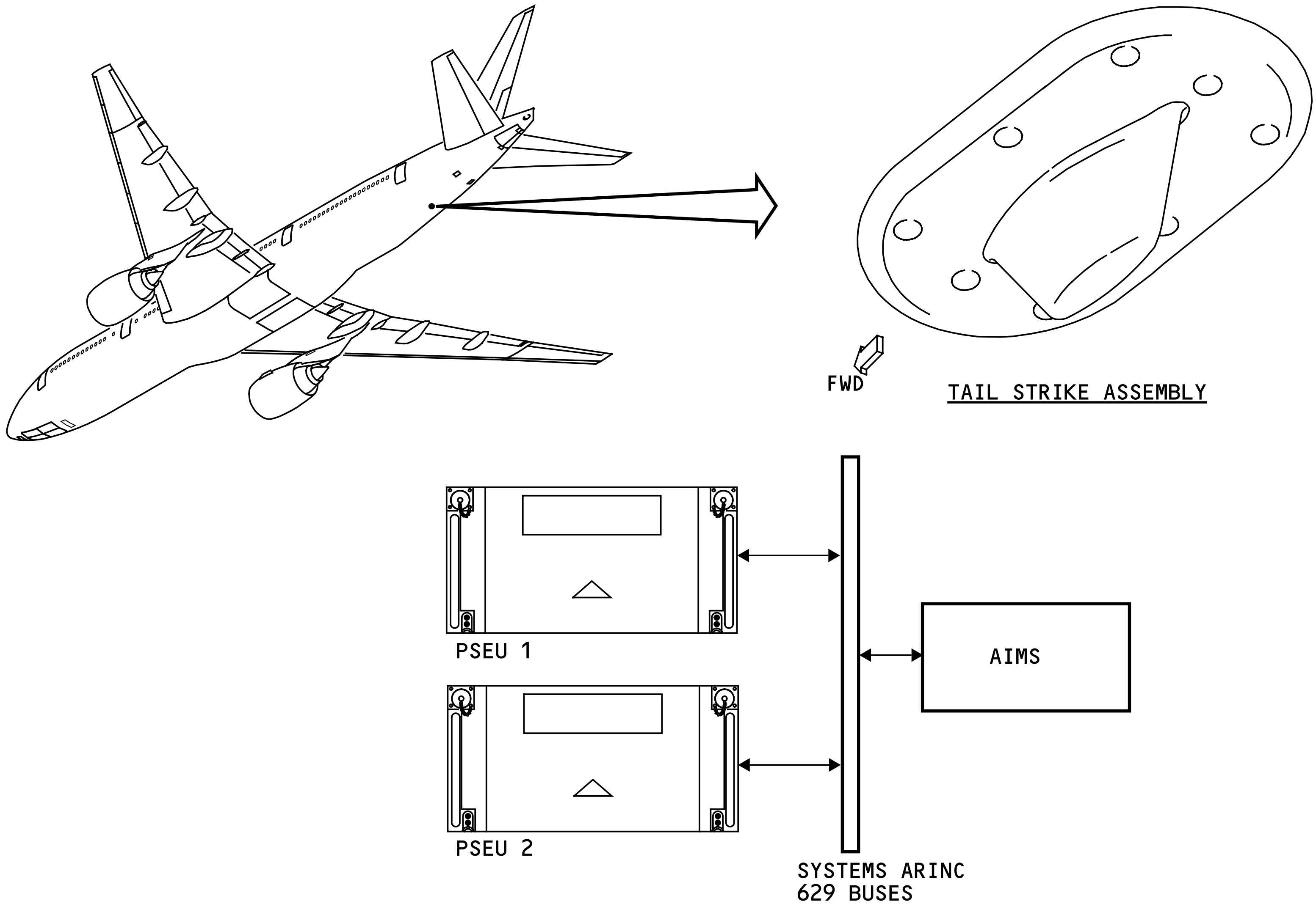
Tail Strike Assembly

The tail strike assembly (TSA) is a blade antenna shaped device. There are two wires in the assembly which are near the outside surface of the TSA.

The TSA is in the airplane tail strike area on the bottom of the aft fuselage at station 2041.75.

Interface

The two wires in the TSA make inputs to the two proximity sensor electronics units (PSEUs). The PSEUs supply tail strike data to the AIMS for flight deck display.



32-71-00-001 Rev 0

TAIL STRIKE SYSTEM - INTRODUCTION

TAIL STRIKE SYSTEM - FUNCTIONAL DESCRIPTION

General

The two wires in the TSA are on separate channels. Both wires get 28v dc power. One wire gets electrical power from the primary power circuit breaker that also supplies primary power to PSEU 1. PSEU 1 monitors this wire. The other wire gets electrical power from the circuit breaker that also supplies primary power to PSEU 2. PSEU 2 monitors this wire. Both channels are normally closed circuits.

Detection

If a tail strike occurs, the TSA contacts the ground and becomes damaged or breaks off the airplane. This damages both wires and causes both PSEUs to get open/short circuit inputs.

Indication

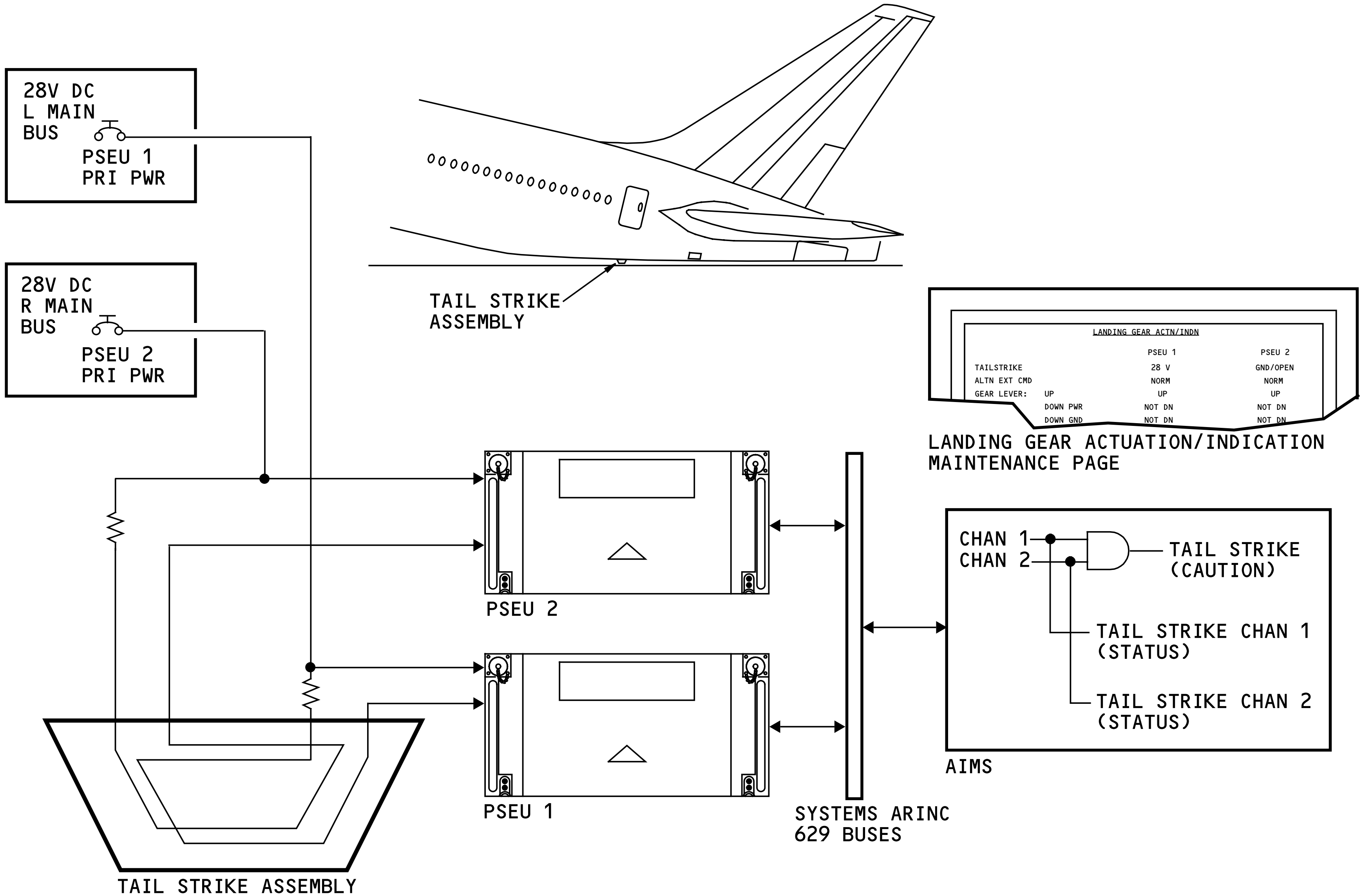
If both PSEUs get open/short circuit inputs, a TAIL STRIKE caution message shows.

The landing Gear actuation/indication maintenance page shows the status of the inputs from the tail strike system.

Training Information Point

If there is a failure (open/short circuit) in a single channel, the TAIL STRIKE CHAN 1 or TAIL STRIKE CHAN 2 status message shows.

Both of these messages also show if there is a tail strike.



TAIL STRIKE SYSTEM - FUNCTIONAL DESCRIPTION

Continental Airlines, Inc

Air/Ground Indication System

WB371

TABLE OF CONTENTS

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AIR/GROUND SYSTEM - INTRODUCTION

Purpose

The air/ground system (AGS) supplies air mode and ground mode signals to airplane systems.

Components

These are the AGS components:

- Air/Ground load sensors (4)
- Weight-on-wheels (WOW) logic cards (2)
- Air/ground relays.

General Description

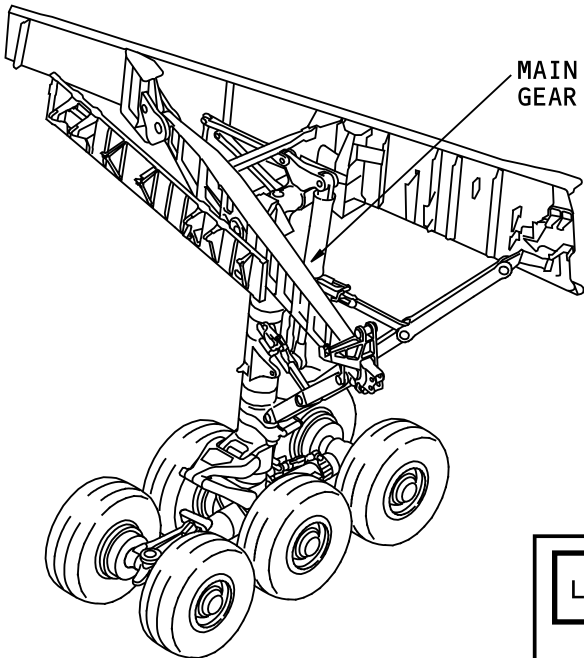
Two load sensors on each main landing gear beam send landing gear load data to the two WOW cards.

The WOW cards control air/ground relays in the ELMS. These relays supply air/ground signals to other airplane systems.

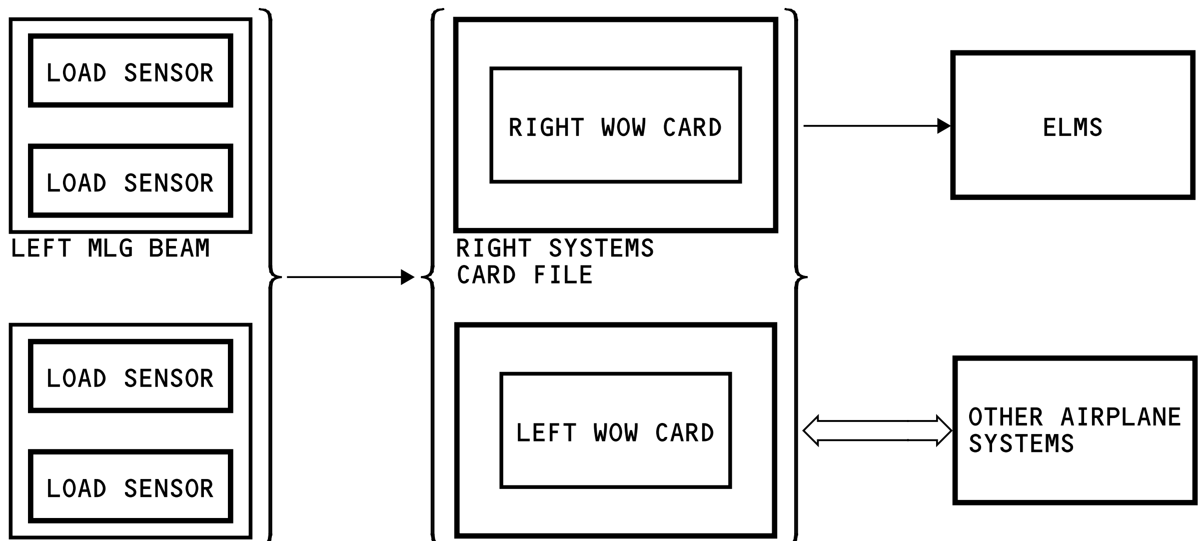
The WOW cards also send digital air/ground data through the systems ARINC 629 buses to airplane systems.

Abbreviations and Acronyms

ADF	- automatic direction finder
ADIRU	- air data inertial reference unit
A/G	- air/ground
AGS	- air/ground system
AIMS	- airplane information management system
APU	- auxiliary power unit
ASCPC	- air supply and cabin pressure controller
ASG	- ARINC signal gateway
ARINC	- Aeronautical Radio, Inc.
ATC	- air traffic control
EEC	- electronic engine control
ELMS	- electrical load management system
gnd	- ground
HF	- high frequency
HYDIM	- hydraulic interface module
ILS	- instrument landing system
MAT	- maintenance access terminal
MLG	- main landing gear
PA/CI	- passenger address/cabin interphone
PSEU	- proximity sensor electronic unit
TCAS	- traffic alert and collision avoidance system
VOR/MB	- VOR/marker beacon
WHCU	- window heat control unit
WOW	- weight-on-wheels
WX	- weather



MAIN LANDING GEAR (2)



32-09-00-001 Rev 2 03/26/96

AIR/GROUND SYSTEM - INTRODUCTION

AIR/GROUND SYSTEM - INTERFACES

General

Two WOW cards supply air/ground signals to other airplane systems through:

- Left and right systems ARINC 629 buses
- ARINC 429 buses
- Air/ground relays in the ELMS.

The WOW cards get inputs from airplane systems through:

- Left and right systems ARINC 629 buses
- ARINC 429 buses
- Hard-wire.

ARINC 629 Interfaces

These systems and components get air/ground signals through the systems ARINC 629 buses:

- Airplane information management system (AIMS)
- Airborne vibration monitor signal conditioner unit (AVMSCU) (2)
- Autopilot flight director computer (AFDC) (3)
- Audio management unit (AMU)
- APU controller (APUC)
- Air supply cabin pressure controller (ASCPC) (2)
- Backup generator converter
- Bus power control unit (BPCU)
- Cabin system management unit (CSMU)
- Cabin temperature controllers (CTC) (2)
- Control display unit (CDU) (3)
- Engine data interface unit (EDIU) (2)
- Electrical load management system (ELMS)
- Fuel quantity indication system (FQIS) processor
- Flap slat electronic unit (FSEU) (2)
- Generator control unit (GCU) (3)
- Overhead panel bus controller (OPBC)
- Passenger address/cabin interphone (PA/CI) controller
- Proximity sensor electronics unit (PSEU) (2)
- Warning electronic unit (WEU) (2).

The AIMS uses the air/ground signals for these functions:

- Central maintenance computing
- Data communications management
- Data conversion gateway
- Flight management computing
- Navigation display
- Primary flight display
- Software data loader
- Thrust management computing function.

These systems get air/ground data through the data conversion gateway function in the AIMS:

- Cabin telecommunications unit
- Flight recorder
- Global positioning system
- Ground proximity warning system
- Primary flight computer (3).

The ELMS supplies air/ground signals for these functions:

AIR/GROUND SYSTEM - INTERFACES

- APU controls
- Cargo fire extinguishing
- DC standby system
- Ground crew call horn
- Fuel jettison
- Fuel management
- Hydraulic pump control
- Passenger oxygen system.

Internal Card File Systems

These cards in the left and right systems card files get air/ground signals through ARINC 429 which go through the ASG cards:

- Airfoil and cowl ice protection system (ACIPS) card (2)
- Cargo smoke detection system (CSDS) card (2)
- Environmental control system miscellaneous card (ECSMC) (2)
- Hydraulics interface modules (HYDIM) card (4).

The duct leak overheat detection system (DLODS) also gets air/ground inputs through the systems card files.

Air/Ground Relay Interfaces

The WOW cards control air/ground relays in the ELMS. The left WOW card controls air/ground relays in the P110 power management panel. The right WOW card controls air/ground relays in the P210 and P310 power management panels.

These systems, components, and functions get air/ground signals through the air/ground relays:

- AIMS
- Air data inertial reference unit (ADIRU) on battery relay
- APU external shutdown
- ATC/TCAS control panel
- Automatic direction finder (ADF) (2)
- Brake status lights
- Brouter
- Captain's side display
- Center system tail and wing flight control shutoff valves
- Cockpit voice recorder control panel
- Distance measuring equipment (DME) interrogator (2)
- Drain line valve (2)
- Drain mast heaters (2)
- First officer's display
- HF communication transceiver (2)
- Instrument landing system (ILS) receiver (3)
- Jettison nozzle valve (2)
- Landing gear lever lock
- Maintenance access terminal (MAT)
- Radio altimeter transceiver (3)
- Traffic alert and collision avoidance system (TCAS) computer
- Voice recorder control panel
- VOR/MB receiver (2)
- Water drain line hose heater thermostat
- Wing root landing light heating
- Window heat control unit (WHCU) (2)

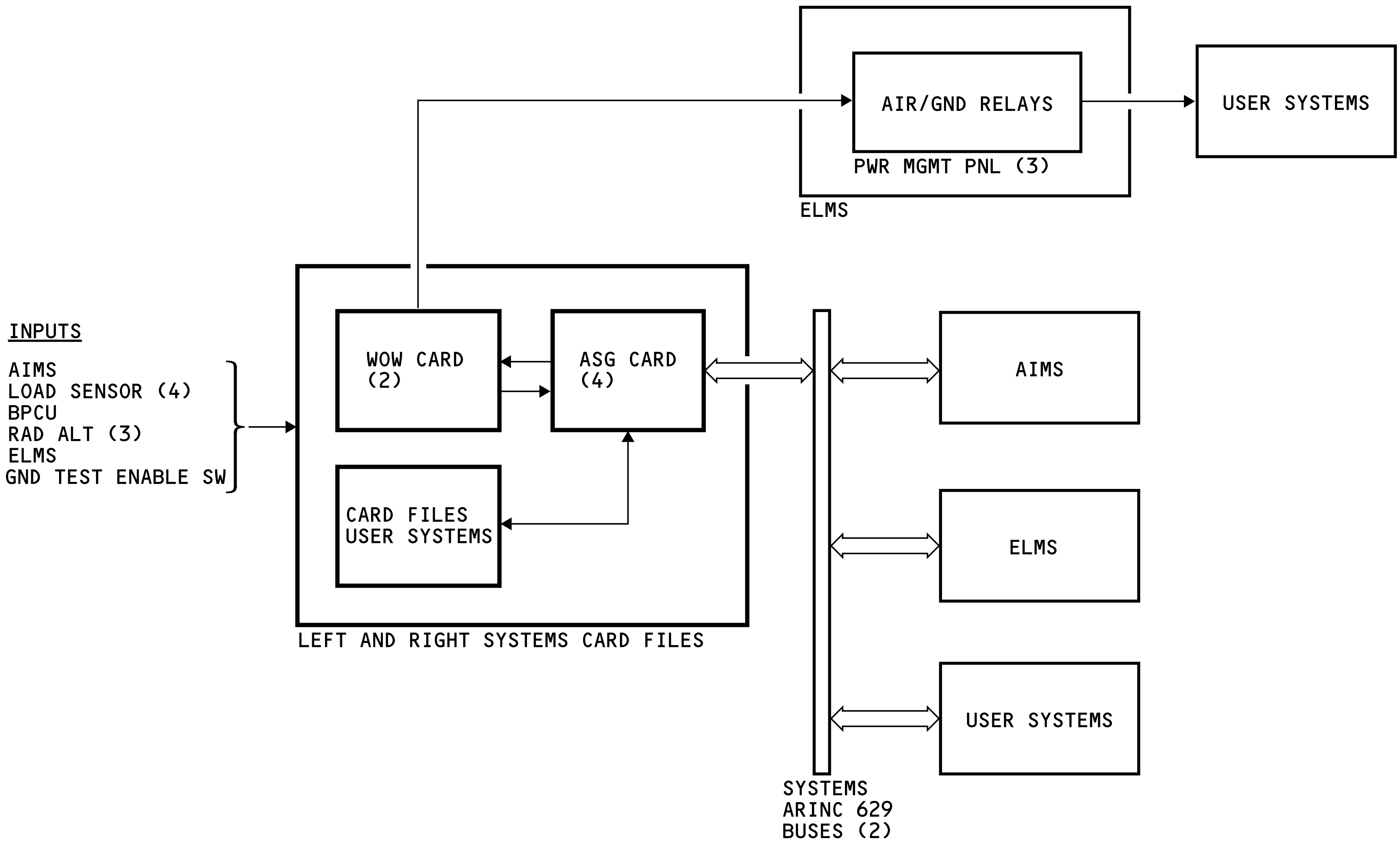
AIR/GROUND SYSTEM - INTERFACES

- WX radar transceiver.

WOW Card Inputs

The WOW cards get inputs from:

- AIMS (time and date, flight phase/leg, airplane registration number, ICAO code)
- Bus power control unit (external power available)
- ELMS (air/ground relay status)
- Ground test enable switch
- Load sensors
- Radio altimeter (3).



32-09-00-002 Rev 2 02/22/95

AIR/GROUND SYSTEM - INTERFACES

AIR/GROUND SYSTEM - WOW LOAD SENSOR

Purpose

The load sensors measure the load on the main landing gear beams to find when the airplane has weight on wheels.

Location

Two load sensors are on each main landing gear (MLG) beam. The load sensors attach to mounting brackets. Covers supply protection to the sensors. These covers attach to the MLG beam.

Functional Description

The load sensor is a variable reluctance strain measurement device.

The sensor has two pieces which attach by mounting brackets to the MLG beam structure in two places. The two pieces move independently as the MLG beam bends.

One piece has a target and the other piece has two coils. The target and coils do not touch each other.

These two pieces connect by a flexible bellows.

In the air mode, the MLG beam is in an unloaded condition and the sensor target is in the in-air position.

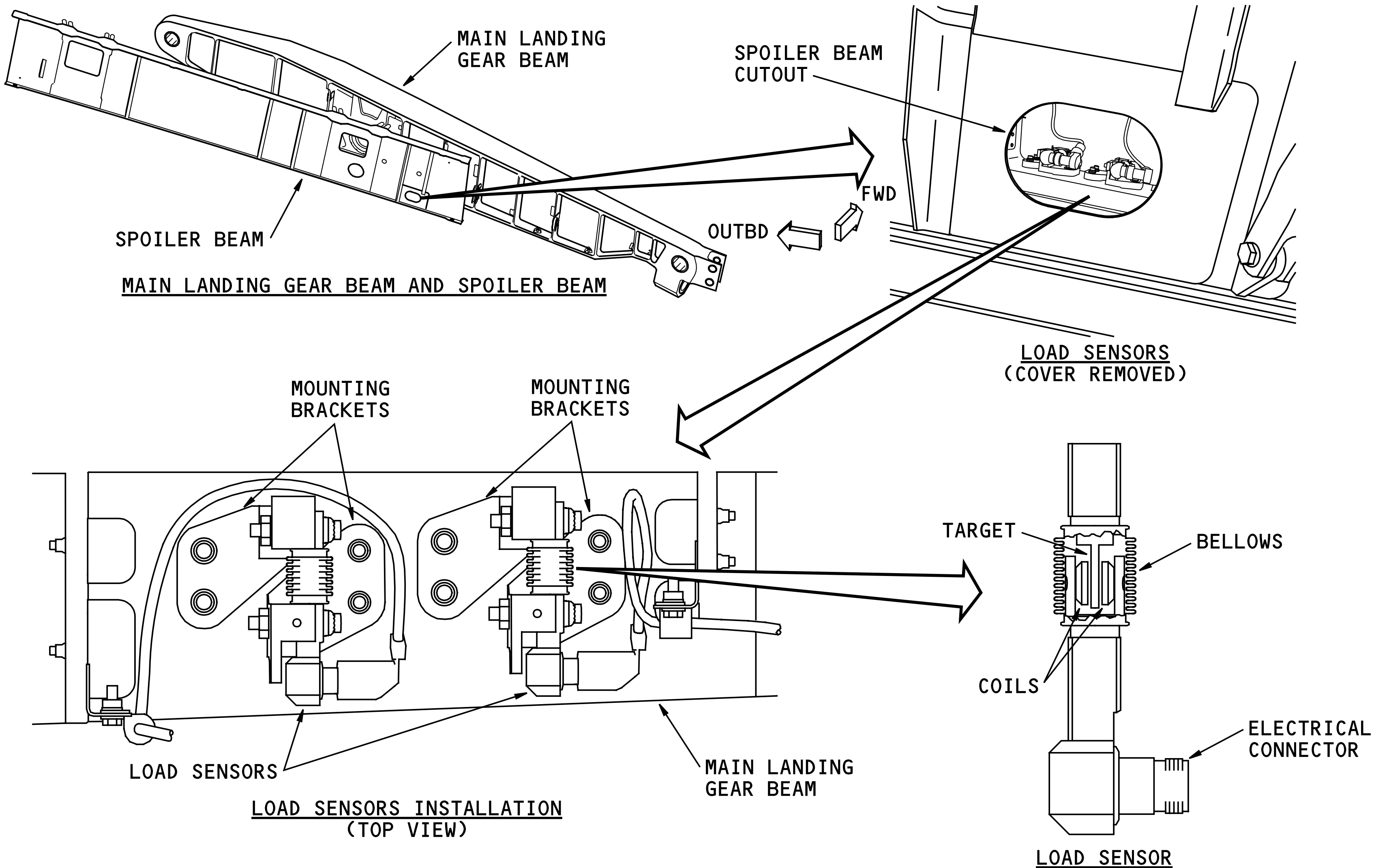
In the ground mode, airplane weight causes the MLG beam to bend. This changes the distance between the target and the coils and causes the target to be in the on-ground position.

The load sensor sends an analog signal to the WOW cards.

Training Information Point

You remove a panel from the bottom of the wing to get access to the load sensors. The panel attaches to the MLG beam and the spoiler beam.

A cutout in the spoiler beam lets you see the load sensors.



32-09-00-003 Rev 2 07/15/96

AIR/GROUND SYSTEM - WOW LOAD SENSOR

AIR/GROUND SYSTEM - WOW CARDS AND AIR/GROUND RELAYS

Purpose

Two WOW cards get the weight-on-wheels signals from the WOW sensors. The WOW cards then send air/ground data to other airplane systems. The WOW cards also control master air/ground relays in ELMS.

Air/ground relays get the signals from the WOW cards and supply air/ground analog signals to other aircraft systems.

Location

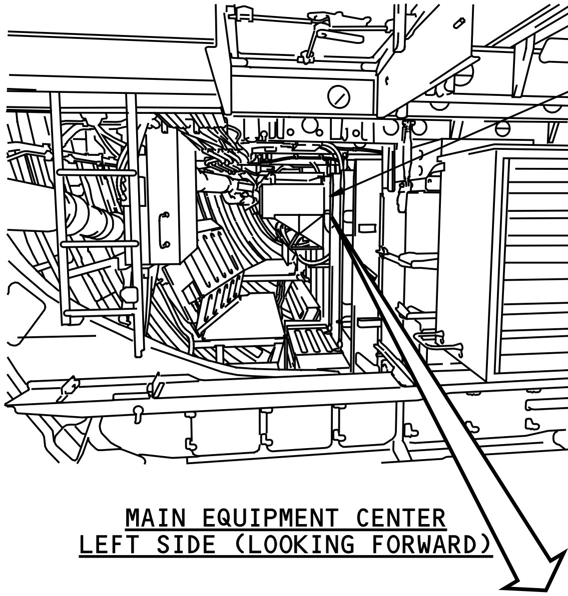
The right WOW card is in the P84 systems card file in the main equipment center. The left WOW card is in the P85 systems card file in the main equipment center.

The air/ground relays are in the ELMS P110, P210, and P310 power management panels (not shown) in the main equipment center.

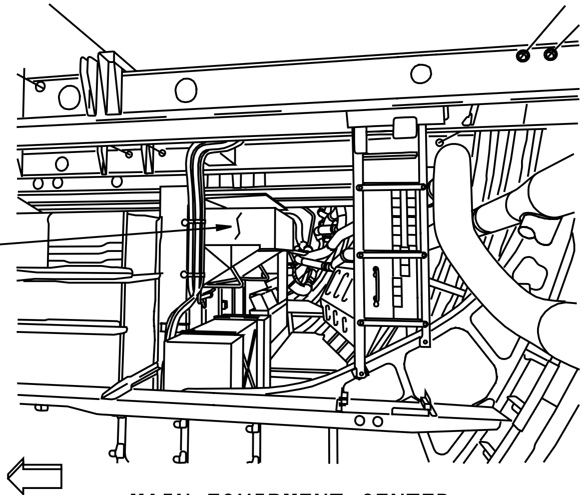
Training Information Point

The WOW cards are electrostatic sensitive.

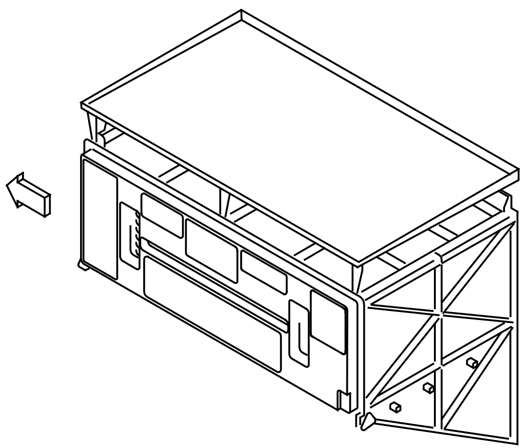
The WOW cards are software loadable. See chapter 45-10-00 for more information.



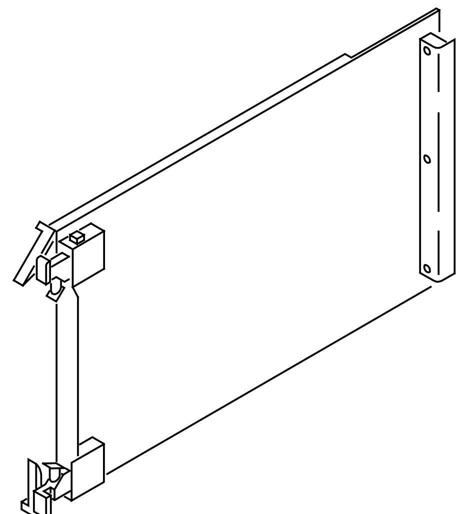
MAIN EQUIPMENT CENTER
LEFT SIDE (LOOKING FORWARD)



MAIN EQUIPMENT CENTER
RIGHT SIDE (LOOKING FORWARD)



P85 LEFT SYSTEMS CARDFILE
(RIGHT CARDFILE SIMILAR)



WOW CARD

AIR/GROUND SYSTEM - WOW CARDS AND AIR/GROUND RELAYS

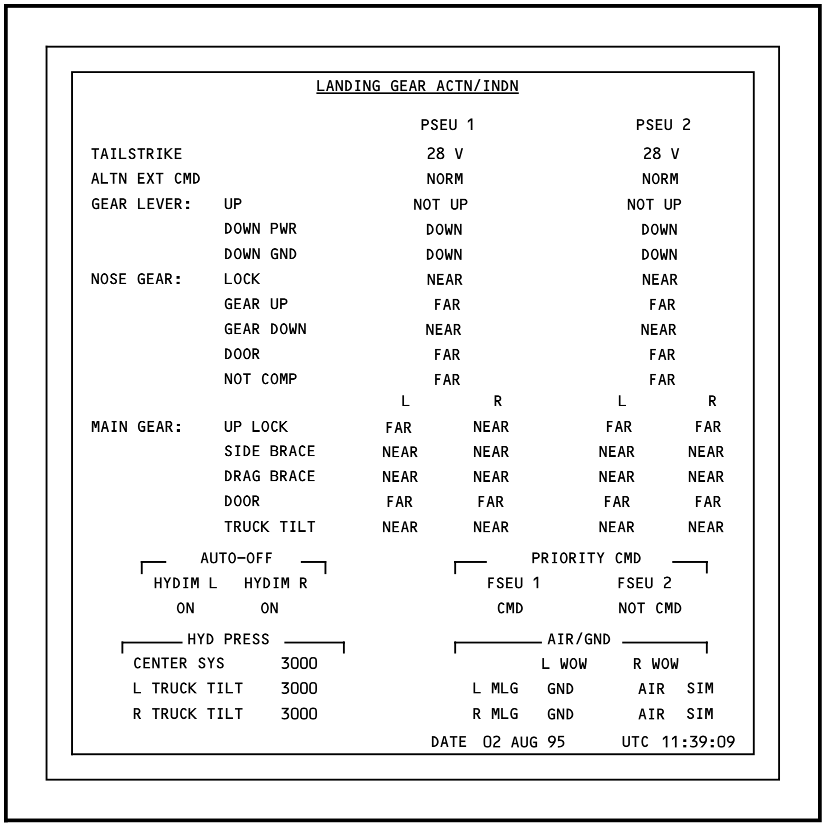
AIR/GROUND SYSTEM - INDICATION

Maintenance Page

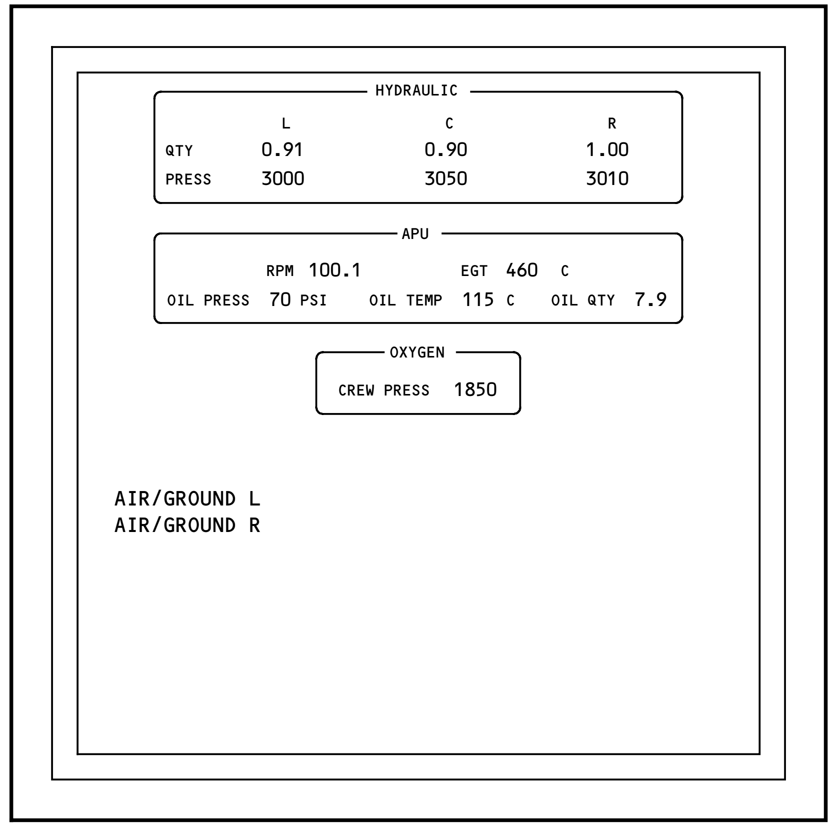
The air or ground output from each of the load sensors shows on the landing gear actuation/indication maintenance page. This page shows simulated air or ground conditions with the word SIM next to the AIR or GND indication.

Status Display

Status messages show if there is a fault in either the left or the right air/ground system.



LANDING GEAR ACTUATION/INDICATION
MAINTENANCE PAGE



STATUS DISPLAY

32-09-00-006 Rev 2 06/22/1997

AIR/GROUND SYSTEM - INDICATION

AIR/GROUND SYSTEM - SYSTEM TESTS

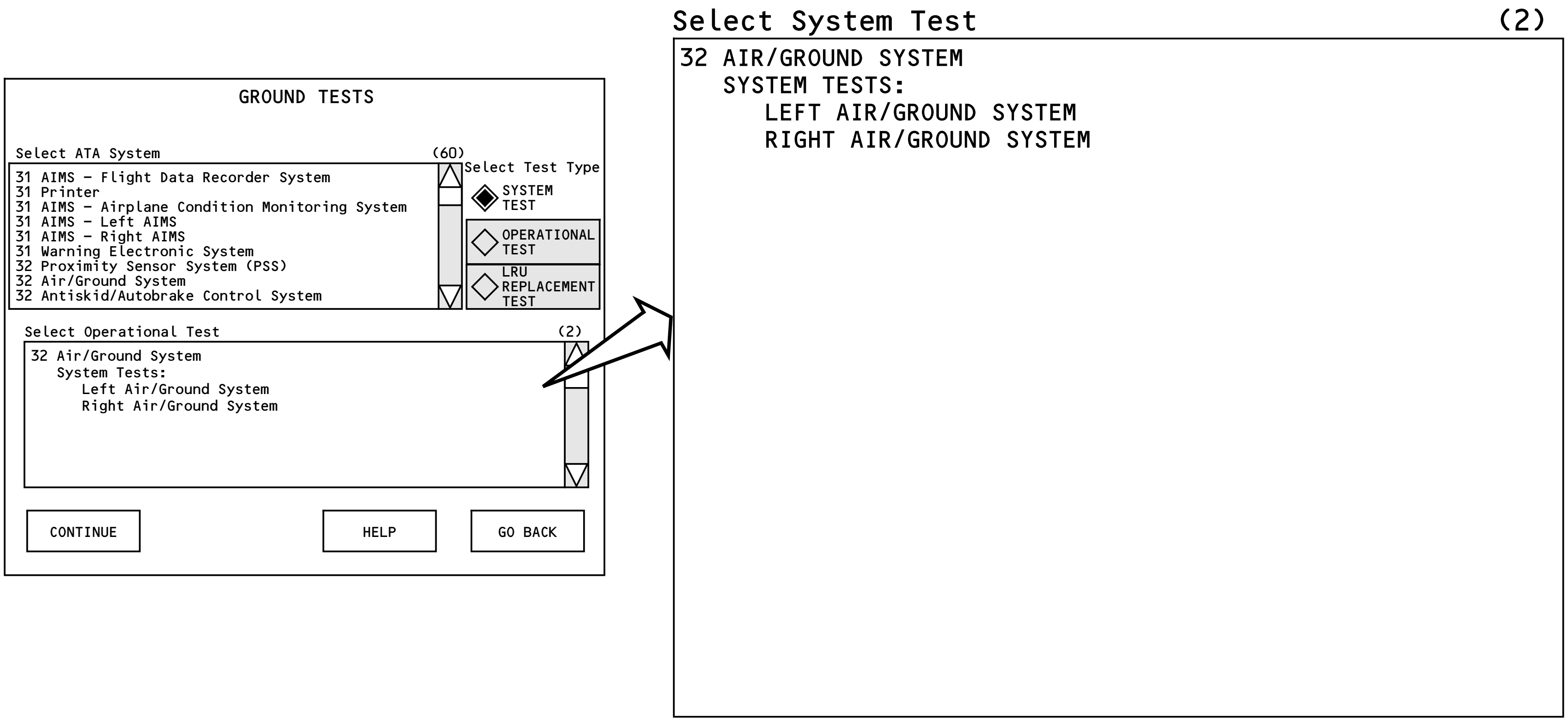
General

These are the air/ground system tests:

- LEFT AIR/GROUND SYSTEM
- RIGHT AIR/GROUND SYSTEM.

Air/Ground System Tests

There is an air/ground test for each of the air/ground systems. These tests do a check of the functions of the air/ground system components.



32-09-00-007 Rev 4 01/11/96

AIR/GROUND SYSTEM - SYSTEM TESTS

AIR/GROUND SYSTEM - SPECIAL FUNCTIONS

General

You can control air mode and ground mode simulation through these six special functions on the MAT:

- Left air simulation
- left ground simulation
- Left stop simulation
- Right air simulation
- Right ground simulation
- Right stop simulation.

The simulation functions make the outputs of the selected WOW cards (left or right) go to the simulated condition.

To simulate air mode when the airplane is on the ground, you use the air simulation function.

To simulate the ground mode if the airplane is on jacks, you use the ground simulation function.

You use the stop simulation function to stop the air or ground simulation.

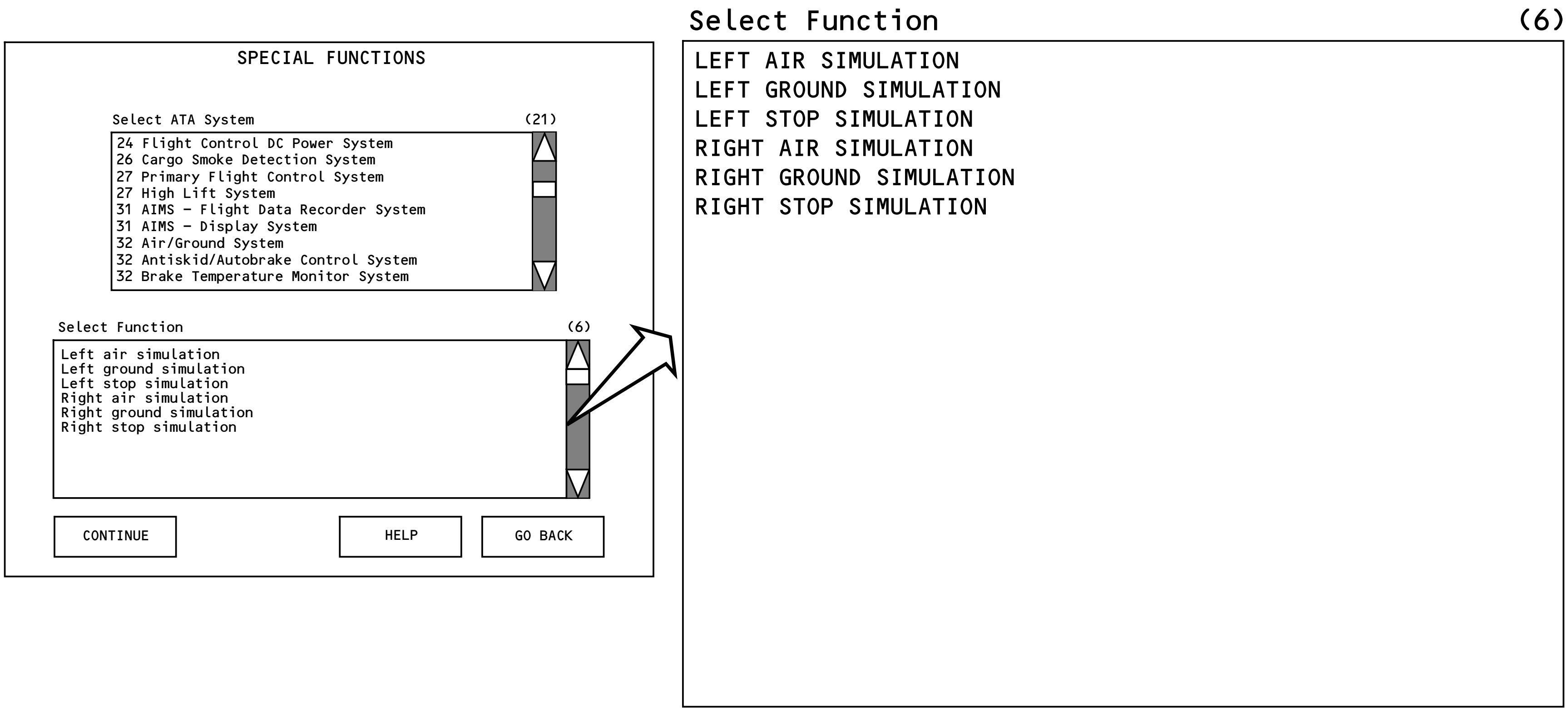
Training Information Point

To do a simulation, you must use the ground test enable switch (P61). Also, one of these two conditions must be true:

- Primary or secondary external electrical power is available
- Radio altitude is less than 2 feet (from any of the three radio altimeters).

To simulate air mode or ground mode to all the airplane systems, you must do the simulation function for the left and the right WOW cards.

WARNING: PREPARE THE SAFETY SYSTEMS FOR THE AIR MODE BEFORE YOU SIMULATE THE AIR MODE. IN THE AIR MODE, AIRPLANE SYSTEMS CAN OPERATE AND CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.



32-09-00-008 Rev 2

AIR/GROUND SYSTEM - SPECIAL FUNCTIONS

AIR/GROUND SYSTEM - AIR/GROUND RIGGING/CALIBRATION

General

After you replace a load sensor, the new sensor must be calibrated to the airplane. You calibrate all four load sensors if you replace the two WOW cards.

You can calibrate each WOW load sensor with the air/ground rigging/calibration function on the MAT. This function is in the PSEU and Air/Ground Rigging function in the Other Functions menu. There is a calibration function for each of the four load sensors.

Calibration

The screen for this function shows a rigging status ruler. The ruler shows the output of the selected load sensor in counts. The count is a measurement of the bending of the main landing gear beam.

This screen also shows the acceptable count ranges for air and ground calibrations and the limits for air and ground rigging. The calibration ranges are wider than the rigging limits.

The sensor reading must be within the rigging limits when you install a new load sensor. You use the calibration range when you replace the WOW cards or if you want to do a check of the sensors. If the sensor is not within the applicable limits, you must adjust the sensor mounting brackets before you calibrate.

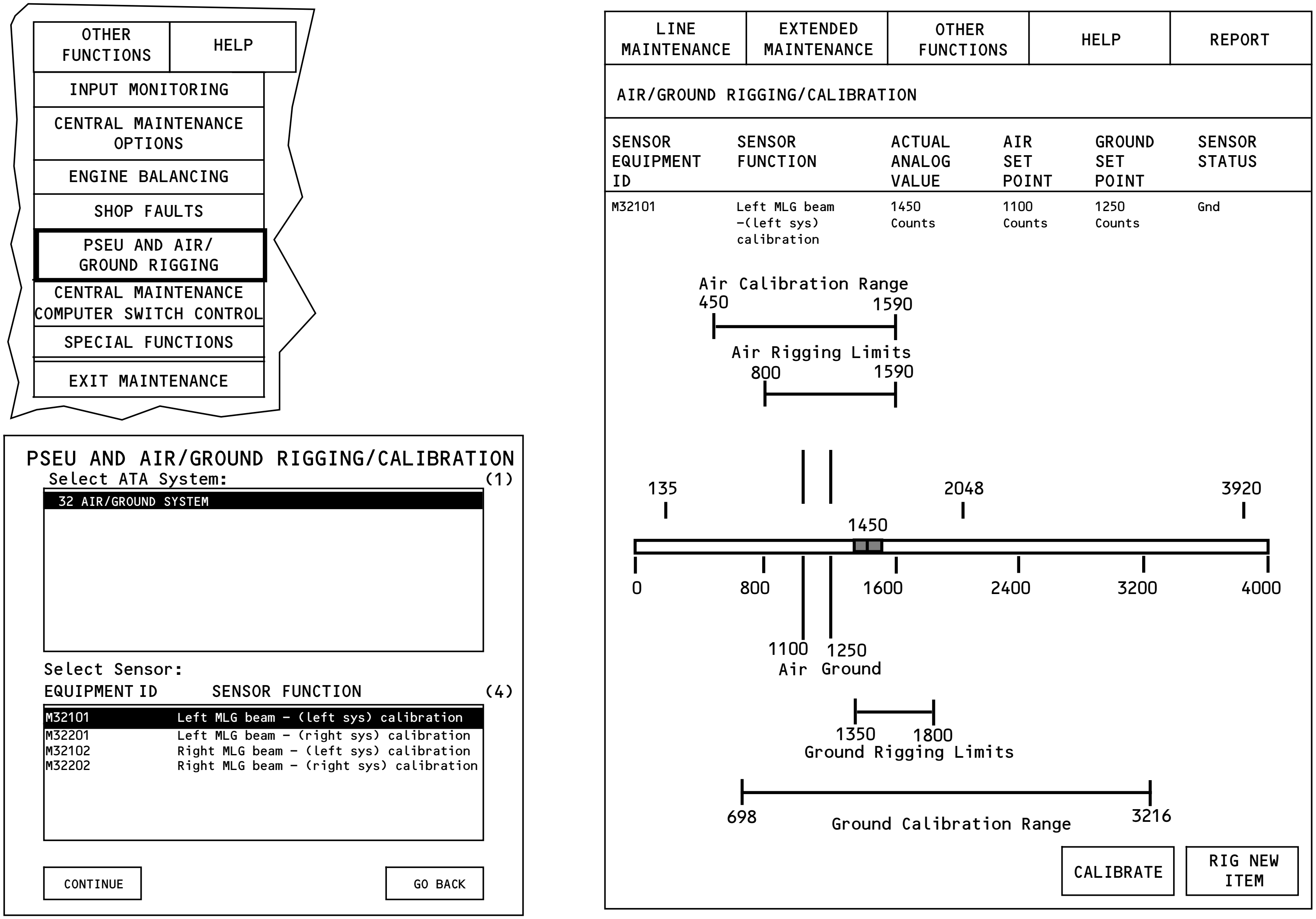
When you select calibrate at the bottom of the screen, ground calibration and air calibration buttons show.

If the airplane weight is on the landing gear, do the ground calibration.

If the airplane is on jacks, do the air calibration.

Training Information Point

The ground test enable switch must be in the ENABLE position to do this function.



AIR/GROUND SYSTEM - AIR/GROUND RIGGING/CALIBRATION

32-09-00-009 Rev 2 01/08/1997

Continental Airlines, Inc

Steering

WB371

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STEERING - INTRODUCTION

Purpose

The nose gear steering (NGS) system and the main gear steering system (MGSS) supply directional control of the airplane on the ground.

The MGSS also decreases tire scrub and the U-turn radius.

You make steering inputs through two steering tillers and the rudder pedals.

Nose Gear Steering

The nose gear steering system is a hydro-mechanical system that moves the nose landing gear up to 70 degrees left or right.

Main Gear Steering

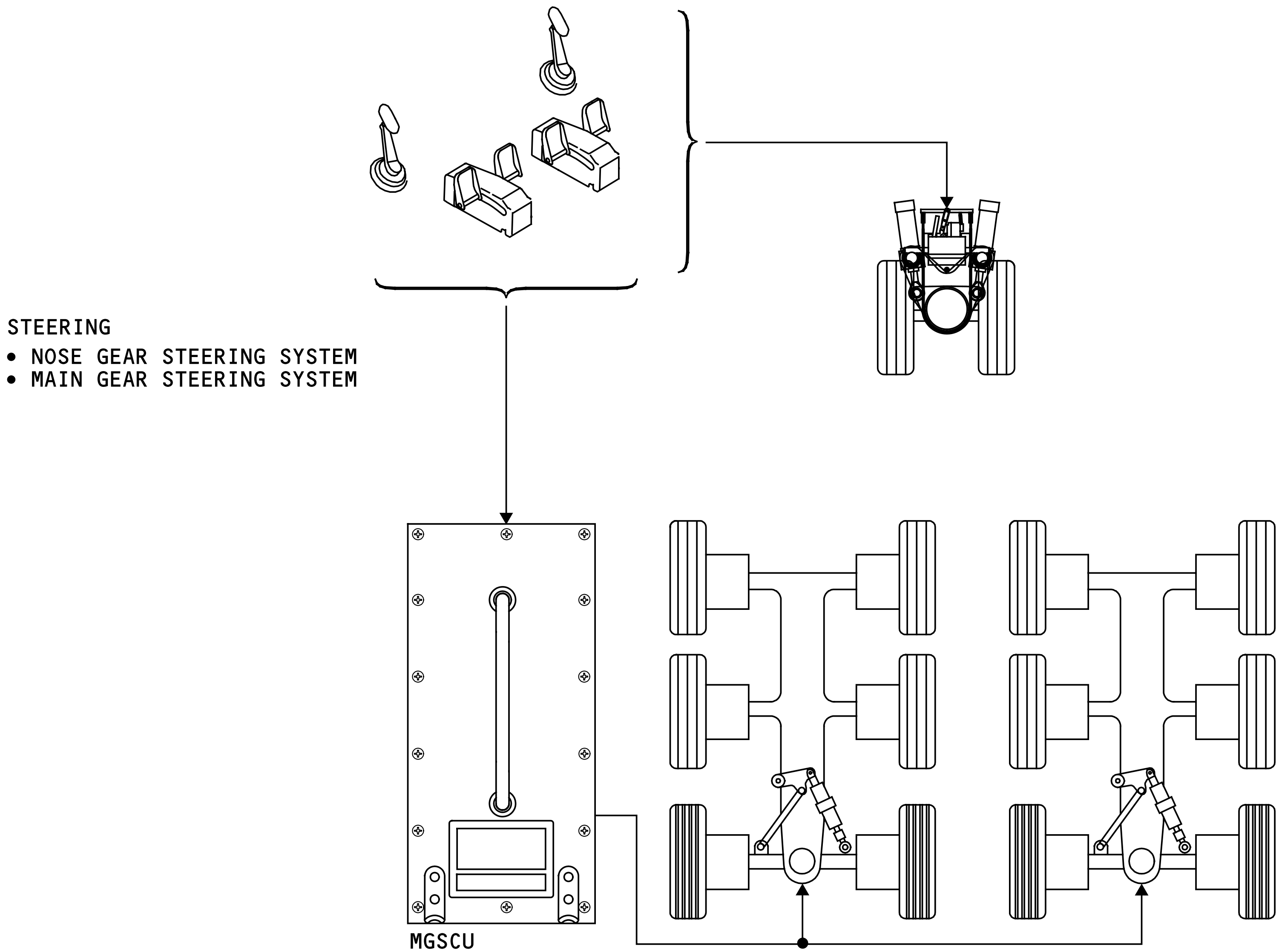
The main gear steering operates when the nose gear turns more than 13 degrees.

The aft axles on each main gear truck move up to 8 degrees in each direction.

The main gear steering system gets position inputs from the NGS. A main gear steering control unit (MGSCU) controls the main gear steering system.

Abbreviations and Acronyms

AIMS - airplane information management system
ARINC - Aeronautical Radio, Inc.
EHSV - electrohydraulic servovalve
F/O - first officer
LVDT - linear variable differential transformer
MGSCU - main gear steering control unit
MGSS - main gear steering system
MLG - main landing gear
MFD - multi-function display
NG - nose gear
NGS - nose gear steering
NLG - nose landing gear
PCA - power control actuator
pos - position
PSI - pounds per square inch
RVDT - rotary variable differential transformer
WES - warning electronic system
xdcr - transducer.



STEERING - INTRODUCTION

32-50-00-001 Rev 1

NOSE GEAR STEERING SYSTEM - INTRODUCTION

Purpose

The nose gear steering system supplies the primary ground directional control of the airplane.

Inputs

Steering inputs are from the steering tillers or the rudder pedals.

Cable Loops

Steering inputs move an upper cable loop. This loop connects to a lower cable loop. The lower cable loop makes inputs to a NLG steering metering valve module.

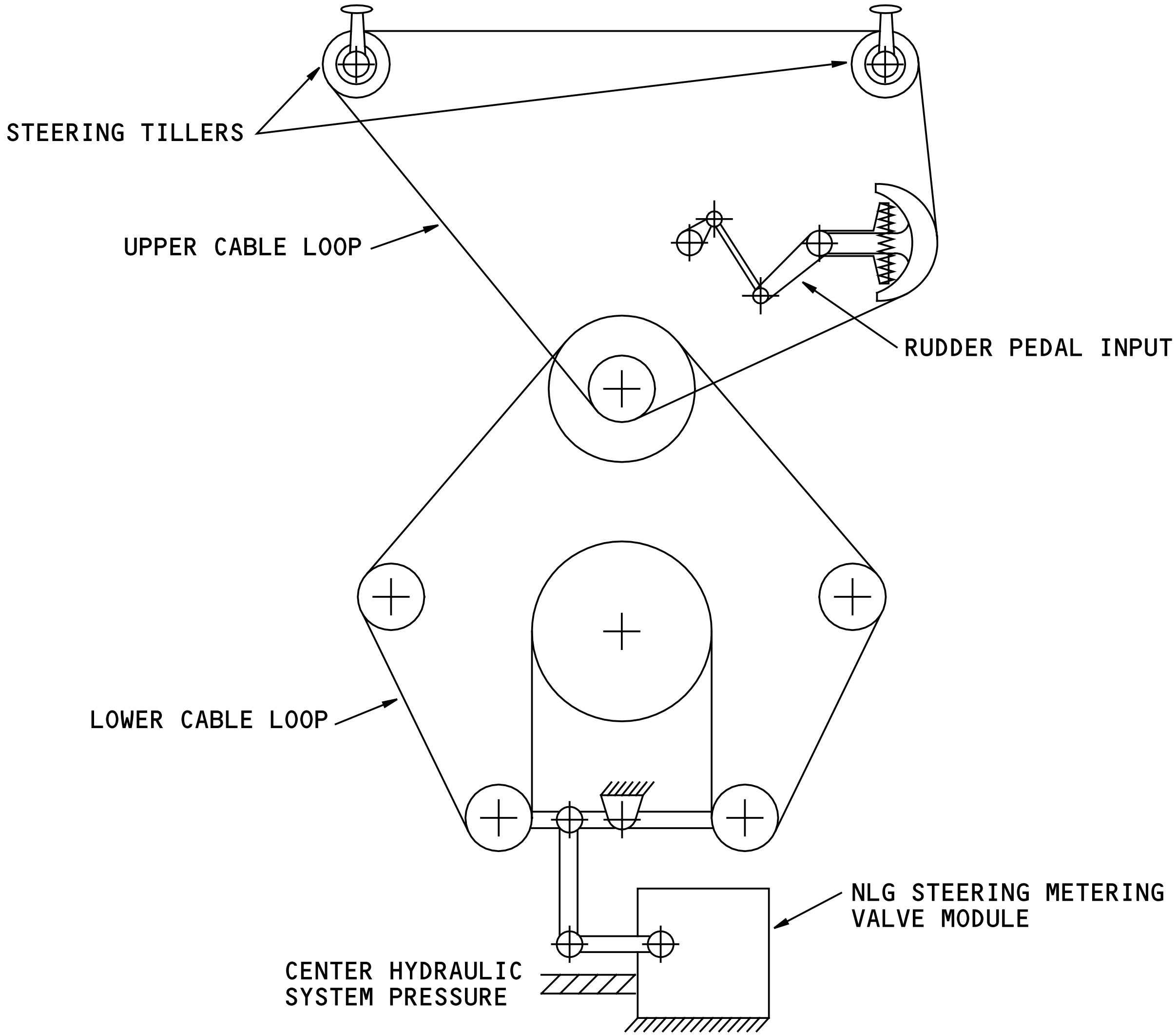
Hydraulic Supply

The center hydraulic system supplies the pressure to operate the nose gear steering system.

Limits

Steering tiller input turns the nose gear up to 70 degrees in each direction.

Rudder pedal input turns the nose gear approximately 7 degrees in each direction.



32-51-00-001 Rev 1

NOSE GEAR STEERING SYSTEM - INTRODUCTION

NOSE GEAR STEERING SYSTEM - COMPONENTS

Upper Cable Loop Components

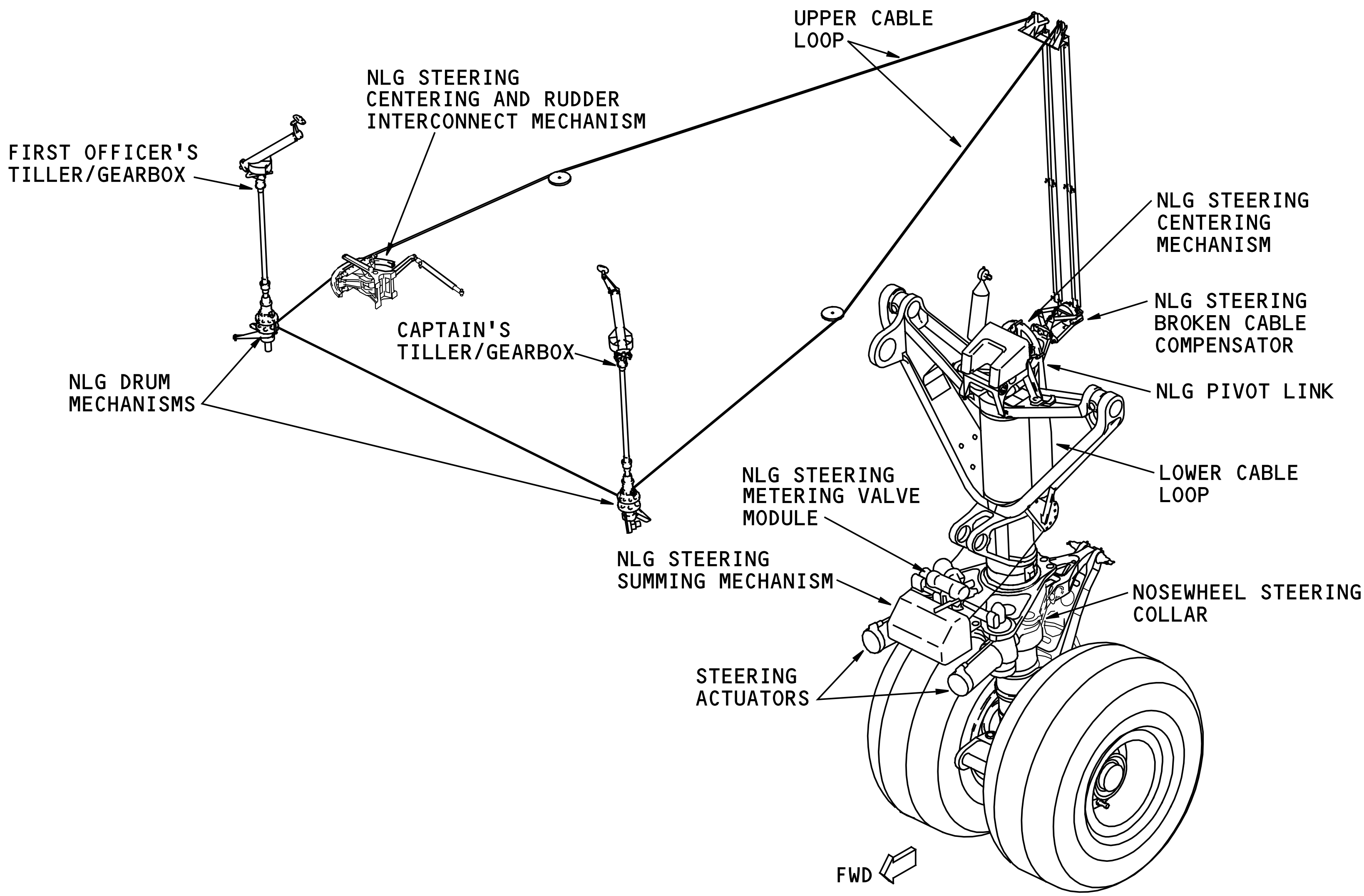
These are the nose gear steering components on the upper cable loop:

- NLG steering tiller and gearbox (2)
- NLG drum mechanism (2)
- NLG steering centering and rudder interconnect mechanism
- NLG steering broken cable compensator
- NLG steering pivot link.

Lower Cable Loop Components

These are the nose gear steering components on the lower cable loop:

- NLG steering centering mechanism
- NLG steering summing mechanism
- NLG steering metering valve module
- NLG steering actuator (2)
- Nosewheel steering collar.



32-51-00-002 Rev 2 06/20/96

NOSE GEAR STEERING SYSTEM - COMPONENTS

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NOSE GEAR STEERING SYSTEM - NLG STEERING CENTERING AND RUDDER INTERCONNECT MECHANISM

Purpose

The NLG steering centering and rudder interconnect mechanism connects the rudder pedals to the upper cable loop. It also moves the steering system to the neutral position when there are no inputs.

The NLG steering centering and rudder interconnect mechanism permits the tillers to move the upper cable loop without moving the rudder pedals. It also permits the rudder pedals to move the upper cable loop.

Physical Description

The NLG steering centering and rudder interconnect mechanism has these components:

- Cable quadrant
- Cable quadrant arm
- Rudder pedal arm
- Free arm assembly (2)
- Roller (2)
- Centering spring (4).

The cable quadrant and cable quadrant arm are one assembly. The cable quadrant attaches directly to the upper cable loop.

The rudder pedal arm is directly below the cable quadrant arm and connects through a rod to rudder system forward control components.

A roller attaches to each of the free arm assemblies. The rollers can touch the cable quadrant arm and the rudder pedal arm.

Two centering springs are above and two centering springs are below (not shown) the cable quadrant arm. The springs are connected to the two free arm assemblies.

The cable quadrant and cable quadrant arm, the rudder pedal arm, and the free arm assemblies pivot about the same point.

Location

The NLG steering centering and rudder interconnect mechanism is below the flight deck floor. You get access to the mechanism through the forward equipment center access door.

Neutral Position

When the tillers and the rudder pedals are in the neutral position, the centering springs keep or return the cable quadrant and cable quadrant arm to the centered position. This keeps the upper cable loop and the nose gear steering system in the centered position.

Tiller Inputs

Tiller inputs move the upper cable loop. The upper cable loop directly moves the cable quadrant and cable quadrant arm. The cable quadrant arm pushes on one of the two rollers. This causes one of the free arm assemblies to move and pulls on the centering springs.

The centering springs pull the other free arm assembly and roller against the rudder pedal arm.

The rudder pedal arm does not move because the rudder pedal centering force (from springs in the rudder system forward control components) is greater than the force that pulls on the centering springs. This causes the centering springs to extend.

The result is that the tiller input moves the cable quadrant to make a steering input but the rudder system does not get an input.

Rudder Pedal Inputs

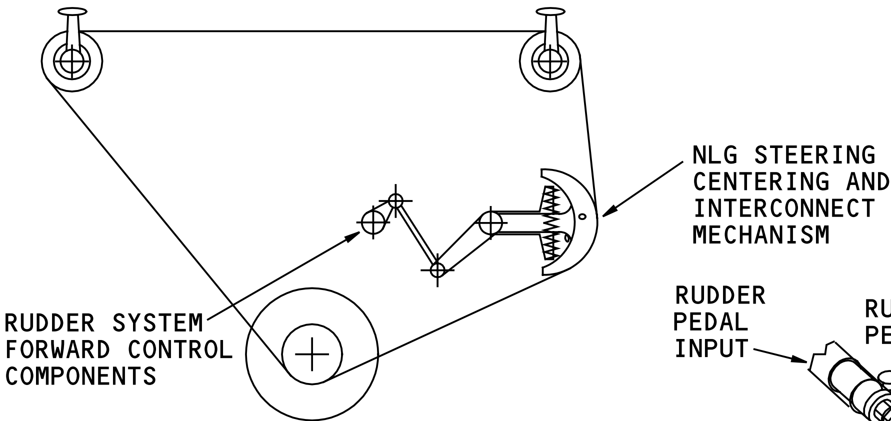
Rudder pedal inputs through the rudder system forward control components move the rudder pedal arm. This arm pushes against one of the two rollers and moves one of the free arm assemblies. The centering springs pull on the other free arm assembly and roller. If the nose landing gear is in the extended position, the roller pushes and moves the cable quadrant arm, the cable quadrant, and the upper cable loop. This results in a nose gear steering input.

The upper cable loop motion moves the steering tillers.

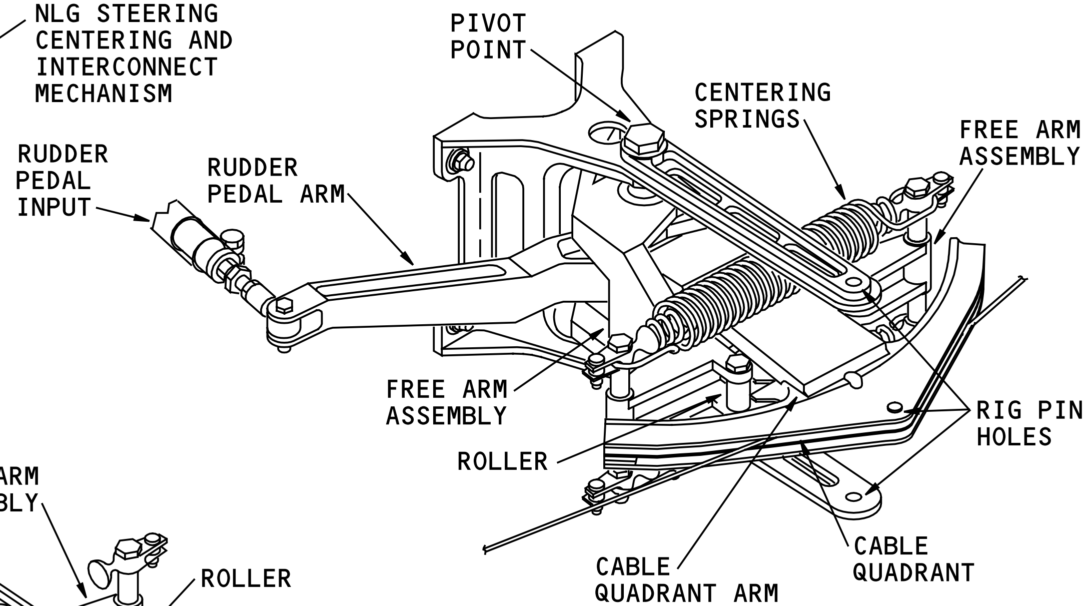
If the nose landing gear is in the retracted position, the upper cable loop is locked. This also locks the cable quadrant and quadrant arm. Rudder pedal inputs will then cause the centering springs to extend.

Training Information Point

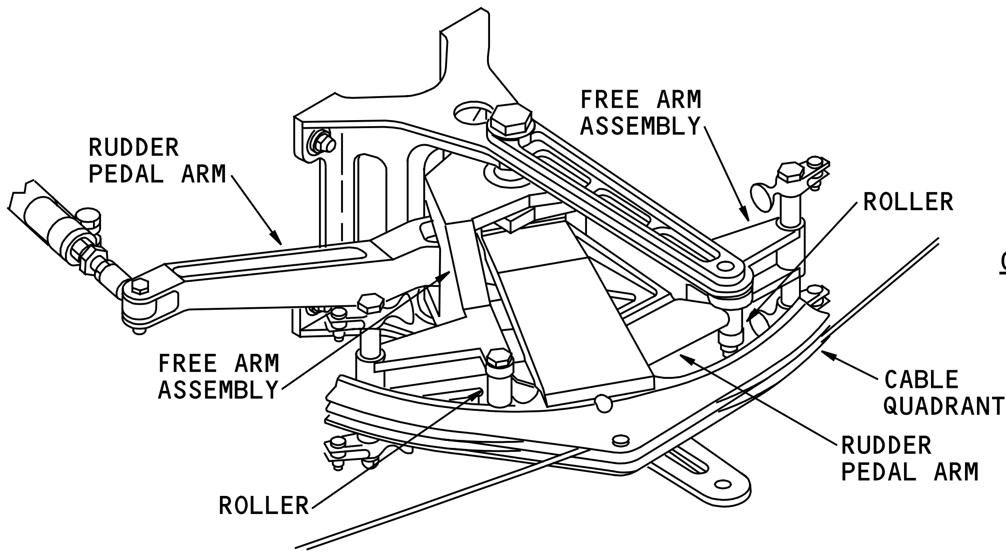
Rig pin holes in the mechanism keep the system in the neutral position during cable rigging.



UPPER CABLE LOOP



CENTERING AND RUDDER INTERCONNECT MECHANISM
(NEUTRAL POSITION)



CENTERING AND RUDDER INTERCONNECT MECHANISM
(TILLER INPUT) (CENTERING SPRINGS REMOVED)

NOSE GEAR STEERING SYSTEM - NLG STEERING CENTERING AND RUDDER INTERCONNECT MECHANISM

NOSE GEAR STEERING SYSTEM - NLG STEERING BROKEN CABLE COMPENSATOR

Purpose

The NLG steering broken cable compensator protects the steering system from inputs caused by a break in the upper cable loop.

Physical Description

These are the NLG steering broken cable compensator components:

- Two pulleys
- Two force links
- A roller
- An output cam and shaft.

The pulleys are bearing-mounted on the output shaft. A roller connects to each of the pulleys by force links. The output cam attaches to the output shaft.

Location

The NLG steering broken cable compensator is on the aft side of the nose gear wheel well rear bulkhead in the main equipment center.

The output shaft of the broken cable compensator goes through the bulkhead into the wheel well.

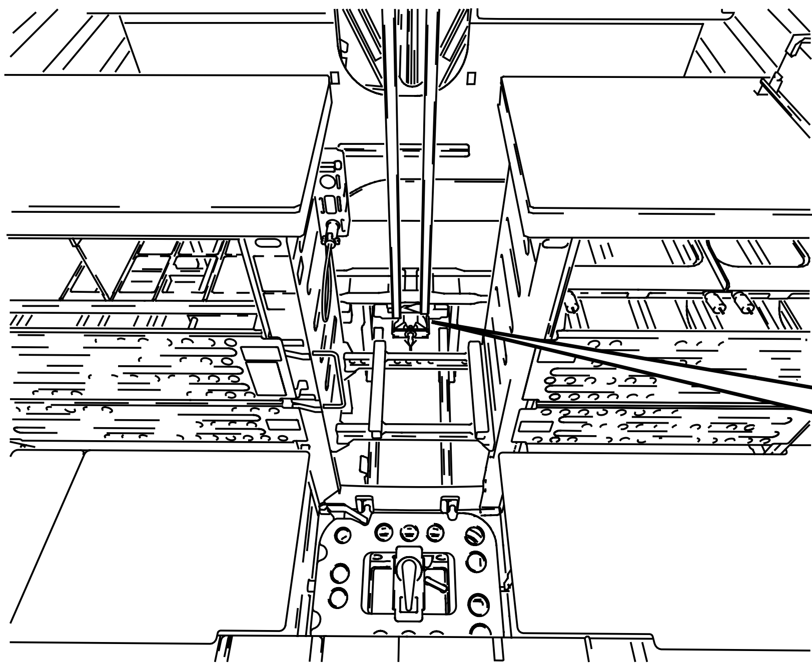
Functional Description

Tension in the upper cable loop pulls on the force links. This keeps the roller in the output cam and permits cable motion to move the output cam.

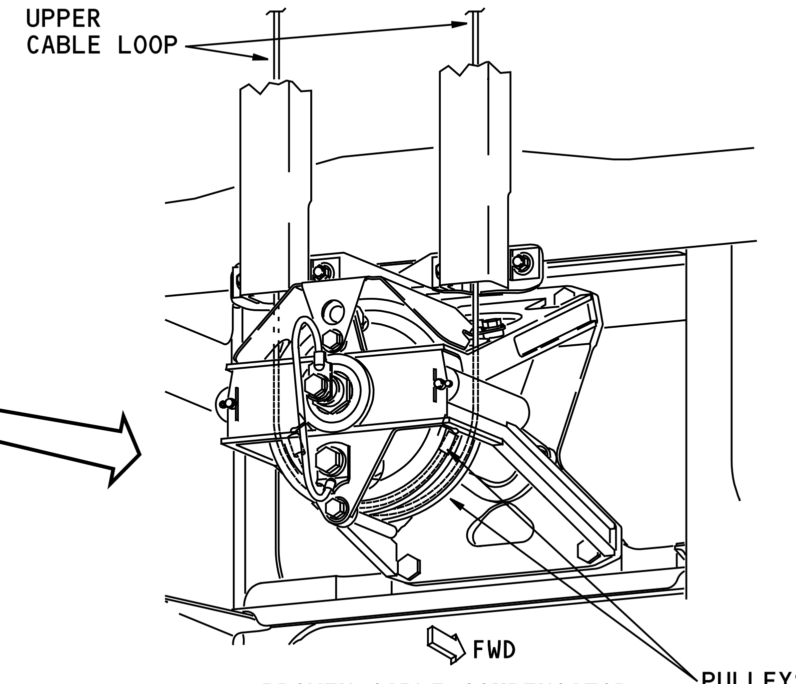
A break in the upper cable loop causes tension to be lost in one cable. Asymmetric tension moves the roller out of the cam detent. This stops all steering inputs.

Training Information Point

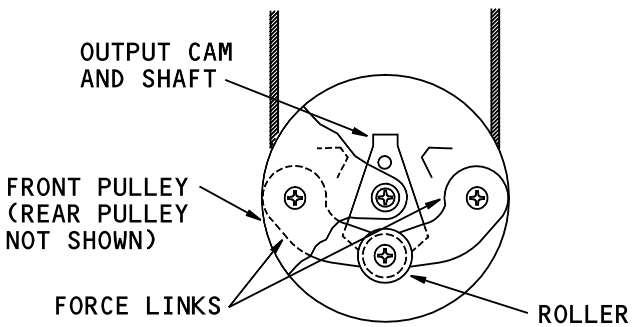
You must remove the main battery to get access to the NLG steering broken cable compensator.



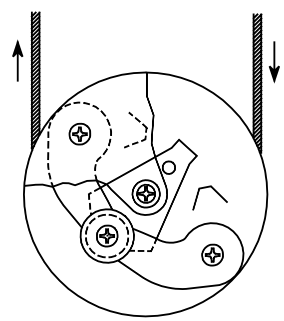
MAIN EQUIPMENT CENTER - LOOKING FORWARD
(MAIN BATTERY REMOVED)



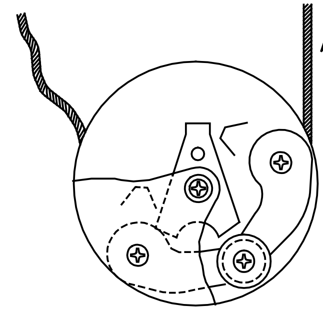
BROKEN CABLE COMPENSATOR



NO STEERING INPUT



TURN INPUT



BROKEN CABLE

NOSE GEAR STEERING SYSTEM - NLG STEERING BROKEN CABLE COMPENSATOR

32-51-00-005 Rev 2 05/03/95

NOSE GEAR STEERING SYSTEM - NLG STEERING PIVOT LINK AND NLG STEERING CENTERING MECHANISM

Purpose

The NLG steering pivot link connects the upper cable loop to the lower cable loop.

The NLG steering centering mechanism locks the NGS system in the centered position during gear retraction.

Physical Description

The hinged pivot links connect the output shaft of the NLG steering broken cable compensator to the NLG steering centering mechanism.

The NLG steering centering mechanism has these components:

- Spring cartridge
- Crank and shaft
- Driver
- Guide link
- Cam assembly
- Cam follower
- Drum.

Location

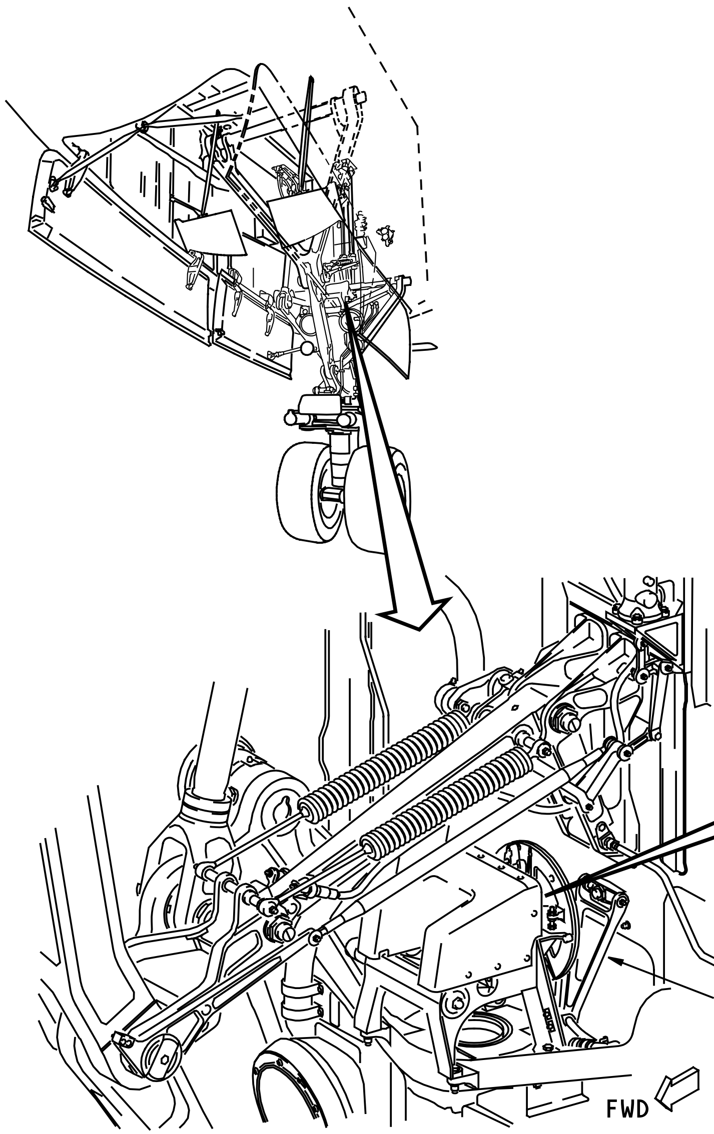
The NLG steering centering mechanism is on top of the nose landing gear.

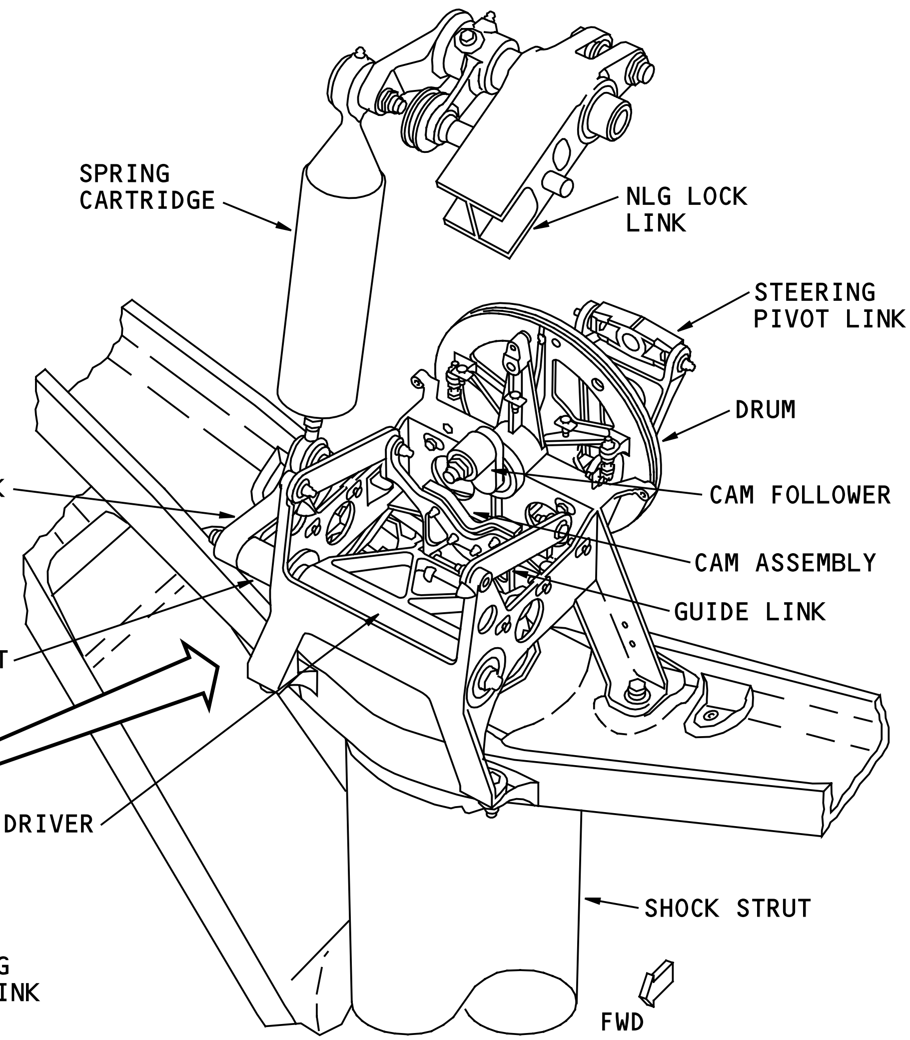
Functional Description

When the nose gear starts to retract, the movement of the nose gear lock link moves the spring cartridge.

The spring cartridge turns the shaft through the crank. This lifts the driver and cam assembly.

The driver and cam assembly moves the cam follower to the centered position. This moves the upper and lower cable loops to the neutral position.





NLG STEERING CENTERING MECHANISM (COVER REMOVED)

32-51-00-006 Rev 1 05/03/95

NOSE GEAR STEERING SYSTEM - NLG STEERING PIVOT LINK AND NLG STEERING CENTERING MECHANISM

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NOSE GEAR STEERING SYSTEM - NLG STEERING SUMMING MECHANISM AND METERING VALVE MODULE

General

The NLG steering summing mechanism adds steering tiller input and nose gear position feedback to control the NLG steering metering valve module.

The NLG steering metering valve module controls the flow of hydraulic fluid to the NLG steering actuators.

The summing mechanism is on top of the upper steering plate on the front of the nose gear. A protective cover is on the summing mechanism.

The NLG steering metering valve module is on the upper steering plate on the front of the nose gear shock strut.

NLG Steering Summing Mechanism

The NLG steering summing mechanism contains these components:

- Summing lever
- Pulley (2)
- Input rod.

The pulleys connect to each side of the summing lever. The lower cable loop winds around each pulley.

The summing mechanism pivots about its center. The input rod connects the summing mechanism to the metering valve module.

NLG Steering Metering Valve Module

The NLG steering metering valve module contains these components:

- Metering valve
- Dynamic load damper
- Bypass/relief valve (not shown)
- Compensator
- Towing shutoff valve and lever
- Swivel valve (2).

The metering valve controls hydraulic flow to the steering actuators. The valve is spring-loaded to the centered position.

The dynamic load damper supplies shimmy damping to the nose gear.

The bypass/relief valve protects the steering actuators against high hydraulic pressures. When pressure in an actuator goes above 4000 psi, the bypass/relief valve opens and permits hydraulic fluid to move between the actuators.

The compensator keeps a 250 psi backpressure in the steering metering valve module. This prevents steering actuator cavitation during shimmy damping.

A towing lever on the metering valve module controls a towing shutoff valve. In the tow position, the towing valve shuts off pressure to the nose gear steering system. This permits the nose gear to turn during towing. A towing lever pin holds the towing lever in the TOW position.

The swivel valves control hydraulic flow to the two sides of the steering actuators.

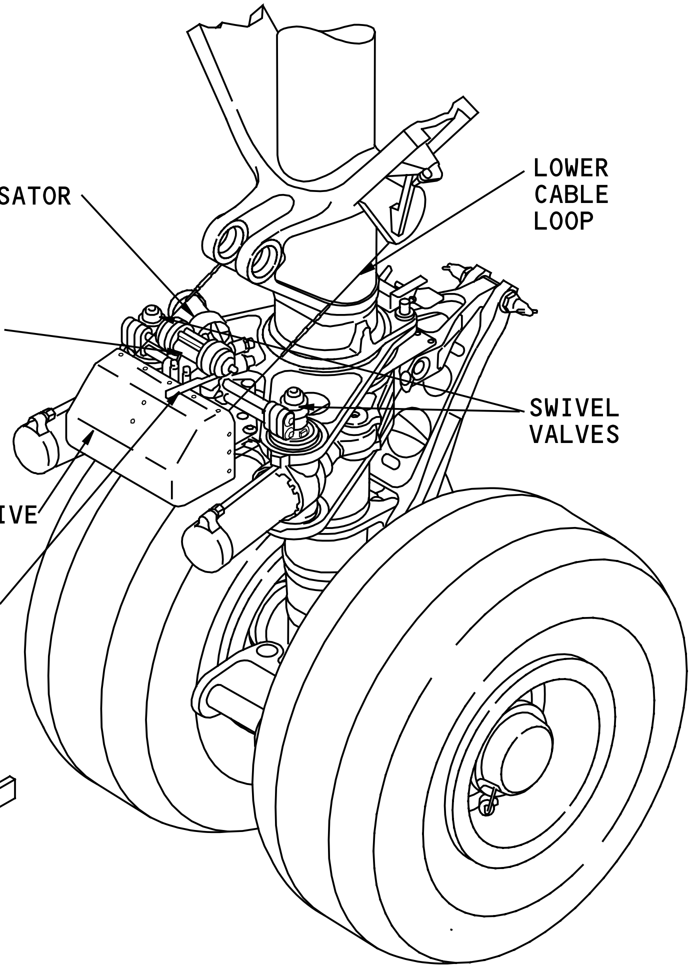
Functional Description

Tiller operation moves the summing mechanism from the neutral position. This makes an input to the metering valve module which sends pressure to the NLG steering actuators. The NLG steering actuators turn the nose gear.

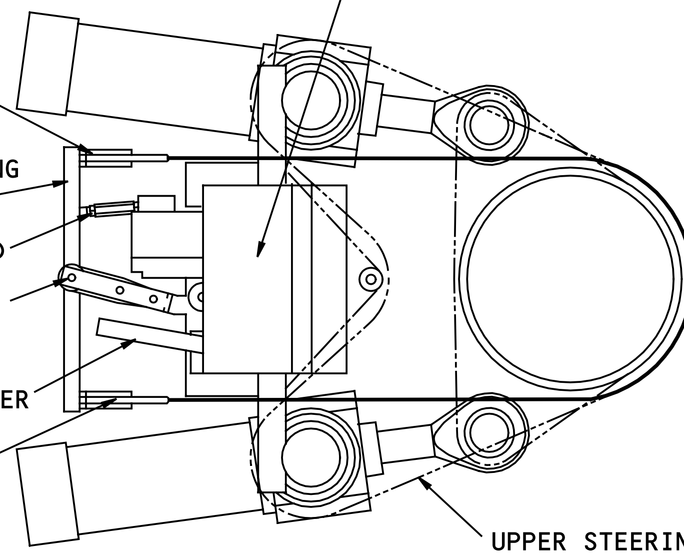
The rotation of the nose gear moves the summing mechanism back towards the neutral position. When the nose gear position agrees with the tiller position, the summing mechanism moves the metering valve to the neutral position. This shuts off the flow to the NLG steering actuators.

Training Information Point

A towing lever permits you to depressurize the nose gear steering system. This permits towing without depressurizing the center hydraulic system.



NOSE LANDING GEAR



NLG STEERING SUMMING MECHANISM - (PROTECTIVE COVER REMOVED) - TOP VIEW

32-51-00-007 Rev 0

NOSE GEAR STEERING SYSTEM - NLG STEERING SUMMING MECHANISM AND METERING VALVE MODULE

NOSE GEAR STEERING SYSTEM - FUNCTIONAL DESCRIPTION

General

The NGS system uses center hydraulic system pressure to turn the nose gear.

Steering inputs move the upper and lower cable loops. This makes an input through the summing mechanism to move the NLG steering metering valve. This permits hydraulic pressure to go through the swivel valves to the steering actuators.

The actuators get pressure on the extend side, the retract side, or both sides to move the nose gear from 0 - 70 degrees.

Rotation: 0 - 27 Degrees

One actuator gets pressure to its head end and the other actuator gets pressure to its rod end. This causes one actuator to extend and the other to retract.

This rotates the nose gear through the torsion links.

Rotation: 27 - 70 Degrees

When the nose gear turns to approximately 27 degrees, the swivel valve for the retracting actuator sends pressure to both sides of that actuator.

Both actuators now extend and permit nose gear rotation to the 70 degree limit.

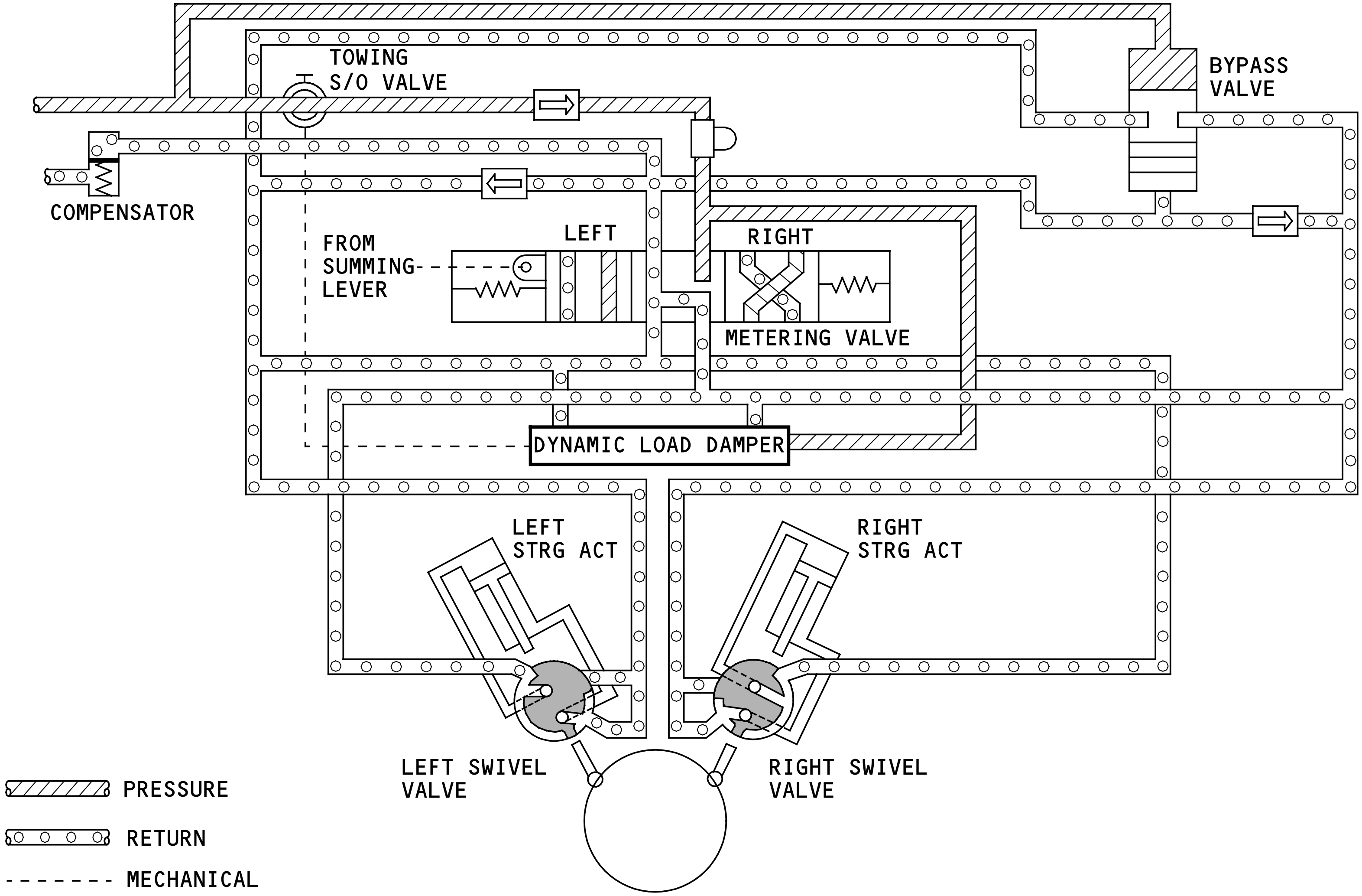
Feedback

When the nose gear gets to the commanded position, the summing mechanism moves the metering valve back to neutral. This stops hydraulic pressure to the actuators and stops nose gear movement.

Training Information Point

To tow the airplane, you move the towing lever on the metering valve module to the tow position. This closes the towing shutoff valve to stop hydraulic pressure to the metering valve module. The towing lever also moves the dynamic load damper to let fluid flow between the steering actuators. This lets an external force move the nose gear wheels.

The bypass/relief valve lets fluid flow between the steering actuators when the pressure in either actuator is approximately 4000 psi. This lets an external force move the nose gear wheels if the tow lever is not in the tow position.



32-51-00-009 Rev 2 08/17/96

NOSE GEAR STEERING SYSTEM - FUNCTIONAL DESCRIPTION

MAIN GEAR STEERING SYSTEM - INTRODUCTION

Purpose

The main gear steering system reduces tire scrub and airplane turn radius.

Main gear steering also decreases the force necessary to turn the airplane.

Components

The main gear steering system components include:

- NLG steering tiller position transducer (2)
- Main gear steering control unit (MGSCU)
- Main gear steering/locking power control actuator (2)
- Main gear steering crank (2)
- Main gear steering reaction link (2).

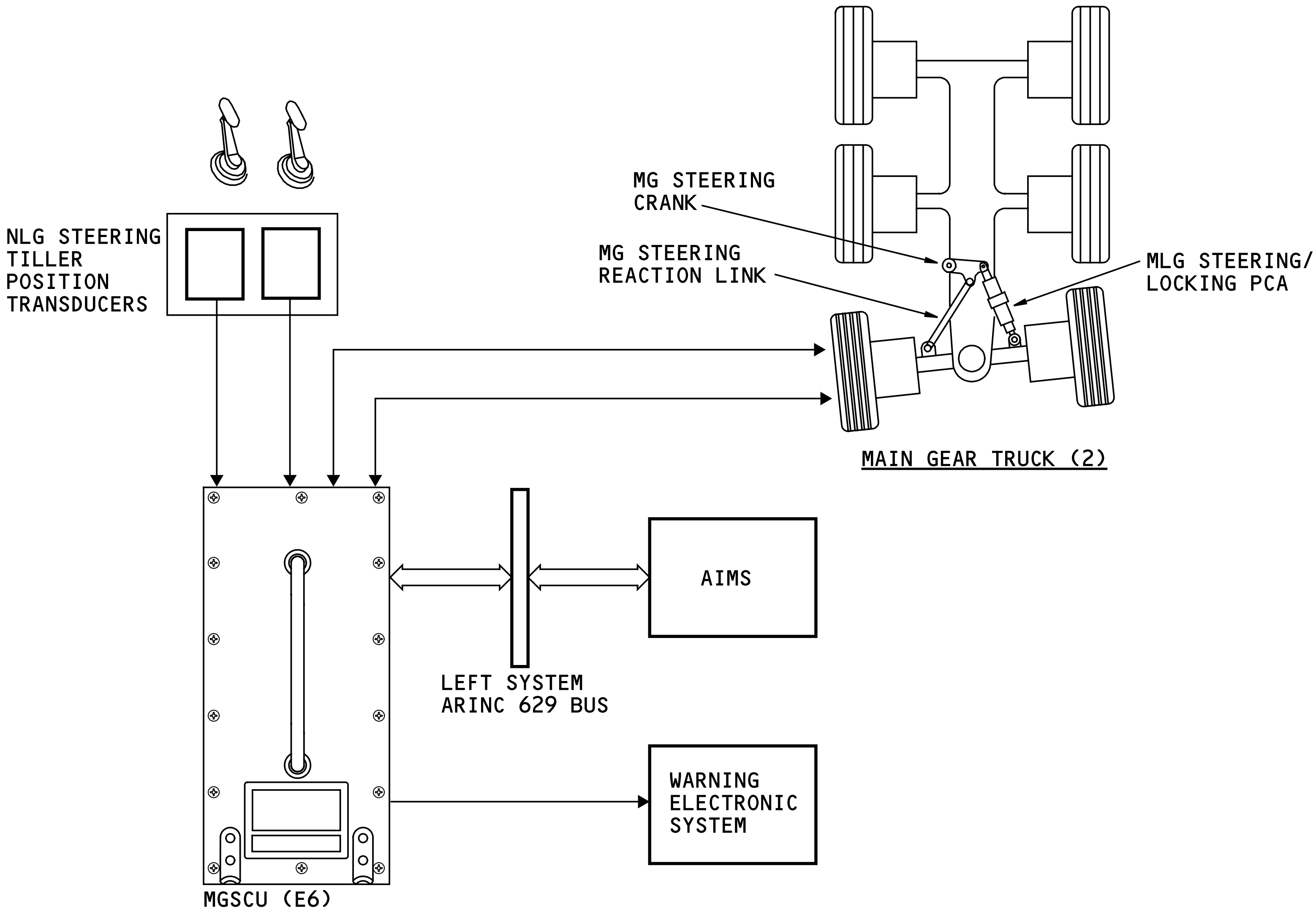
General Description

The NLG steering tiller position transducers supply steering tiller position data to the MGSCU.

The center hydraulic system supplies the hydraulic power for main gear steering operation.

The MGSCU supplies main gear steering position and fault data to the AIMS for flight deck indications.

The MGSCU also supplies aft axle lock status to the warning electronic system (WES). The WES uses this data to calculate the CONFIG GEAR STEERING takeoff configuration warning.



32-53-00-001 Rev 2 11/28/1995

MAIN GEAR STEERING SYSTEM - INTRODUCTION

MAIN GEAR STEERING SYSTEM - NLG STEERING TILLER POSITION TRANSDUCERS

Purpose

Two NLG steering tiller position transducers supply steering tiller data to the MGSCU. The MGSCU uses this data to control the main gear steering.

Physical Description

The two NLG steering tiller position transducers are the same. The transducers are rotary variable differential transformers (RVDTs).

The input shafts of the position transducer turn through a 90 degree arc with the torque shaft from the steering tiller and gearbox.

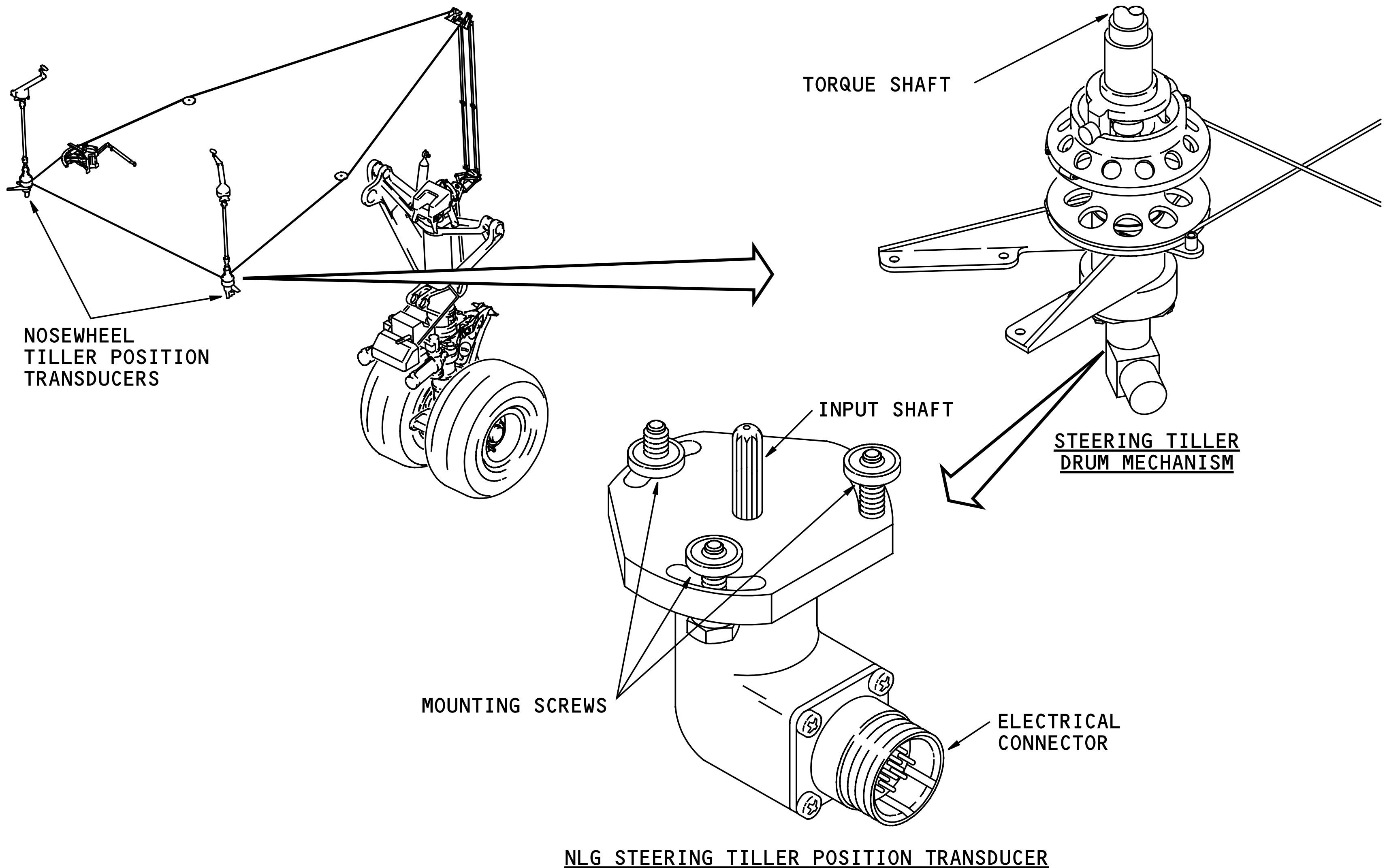
Location

A transducer is on the bottom of each steering tiller drum mechanism in the forward equipment center.

Training Information Point

Before installation, the transducer input shaft is locked in the zero (neutral) position.

The transducer input shaft is unlocked when you install the three captive mounting screws.



32-53-00-002 Rev 1 09/18/1996

MAIN GEAR STEERING SYSTEM - NLG STEERING TILLER POSITION TRANSDUCERS

MAIN GEAR STEERING SYSTEM - MAIN GEAR STEERING CONTROL UNIT

Purpose

The MGSCU gets the steering inputs from the nosegear steering tiller position transducers and controls the main gear steering/locking power control actuators.

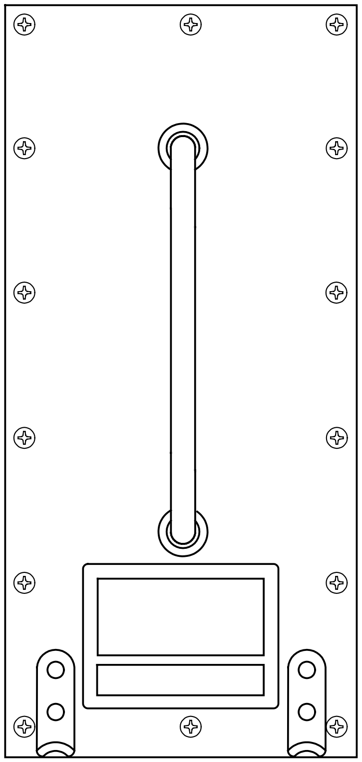
The MGSCU also monitors the main gear steering system for faults.

Location

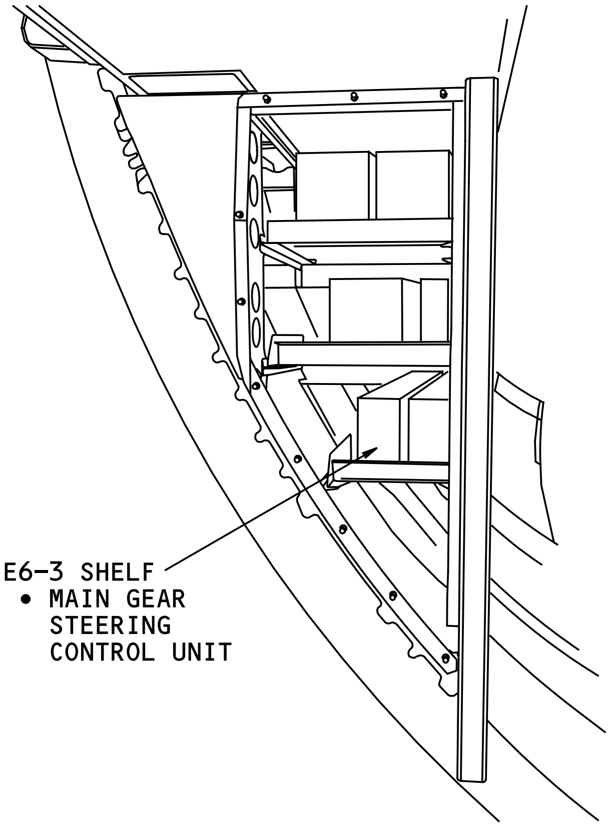
The MGSCU is on the E6-3 shelf in the aft cargo compartment.

Training Information Point

The MGSCU is electrostatic discharge sensitive.



MGSCU



AFT CARGO COMPARTMENT

32-53-00-003 Rev 1

MAIN GEAR STEERING SYSTEM - MAIN GEAR STEERING CONTROL UNIT

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MAIN GEAR STEERING SYSTEM - MAIN GEAR TRUCK COMPONENTS

General

These components are on the aft part of each main gear truck assembly:

- MLG steering/locking power control actuator (PCA)
- Reaction link
- Steering crank.

Steering/Locking Power Control Actuator

The MLG steering/locking PCA unlocks and turns the aft main gear axle. The PCA locks the aft axle when main gear steering is not used.

The MLG steering/locking PCAs are two-way actuators and have internal locks to keep them in the centered position. An LVDT in the actuator rod supplies position feedback to the MGSCU.

These are the other components in each MLG steering/locking PCA:

- Arming solenoid
- Unlock solenoid
- Electrohydraulic servo valve
- Isolation/power centering valve
- Anti-cavitation check valves
- Compensator
- Manual shutoff valve
- Lock position linear variable differential transformer (LVDT).

Reaction Link

A reaction link transmits steering forces back to the steering crank. This link connects the left side of the aft axle to the steering crank.

Steering Crank

The steering crank transmits actuator and the reaction link loads to the truck beam.

Training Information Point

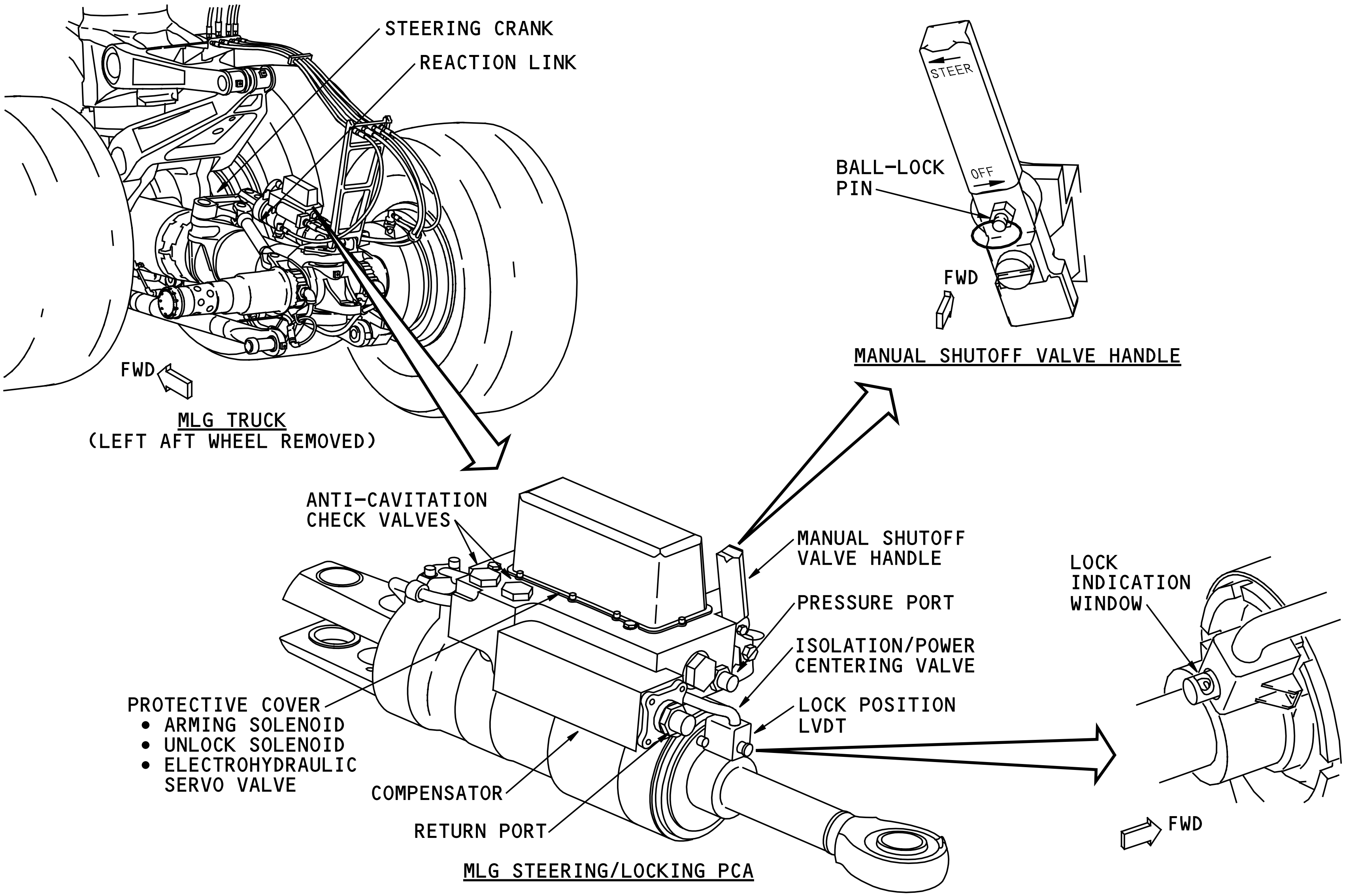
A manual shutoff valve permits you to stop the hydraulic flow to the steering locking PCA to disable the main gear steering. You operate the valve with the manual shutoff valve handle. A ball-lock pin keeps the shutoff valve in the selected position.

A valve position sensor sends shutoff valve position data to the MGSCU. The MAIN GEAR STEERING status message show when the handle is in the OFF position.

A silver indicator in the lock indication window on the unlock LVDT shows the lock/unlock condition of the PCA. If you can see the indicator, the PCA is unlocked. If you can not see the indicator, the PCA is locked.

MAIN GEAR STEERING SYSTEM - MAIN GEAR TRUCK COMPONENTS

WARNING: MAKE SURE THE MAIN LANDING GEAR STEERING SYSTEM IS ISOLATED FROM HYDRAULIC POWER BEFORE YOU DO WORK NEAR THE TIRES, WHEELS, OR BRAKES. IF YOU DO NOT DO THIS, THE AFT AXLES CAN AUTOMATICALLY TURN. THIS CAN CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.



MAIN GEAR STEERING SYSTEM - MAIN GEAR TRUCK COMPONENTS

MAIN GEAR STEERING SYSTEM - HYDRAULIC FUNCTIONAL DESCRIPTION

General

The MGSCU gets input from the two NLG steering tiller position transducers and sends signals to the steering/locking PCAs. LVDTs on the PCAs send signals back to the MGSCU.

PCA Initial Condition

Each steering/locking PCA is centered and locked. Center system hydraulic pressure is on both sides of the PCA piston. The lock collar is in the locked position.

Arm - Unlock

When steering tiller input is more than 13 degrees of NLG steering angle, the MGSCU sends a signal to energize the unlock solenoid. This moves the unlock solenoid valve to the unlock position.

The MGSCU then sends a signal to energize the arm solenoid. Hydraulic pressure now goes through the unlock solenoid valve to unlock the lock collar on the actuator. The unlock LVDT sends an actuator unlock feedback signal to the MGSCU.

Pressure through the arm solenoid also moves the isolation/power centering valve to the ON position. This permits pressure to go to the electrohydraulic servo valve (EHSV).

Main gear steering is now armed and unlocked.

Control

The MGSCU sends signals to the EHSV to extend or retract the actuator. The aft axles turn in proportion to tiller position.

Maximum aft axle angle of eight degrees occurs at a nose gear angle of 70 degrees.

The actuator position LVDT sends actuator position data to the MGSCU.

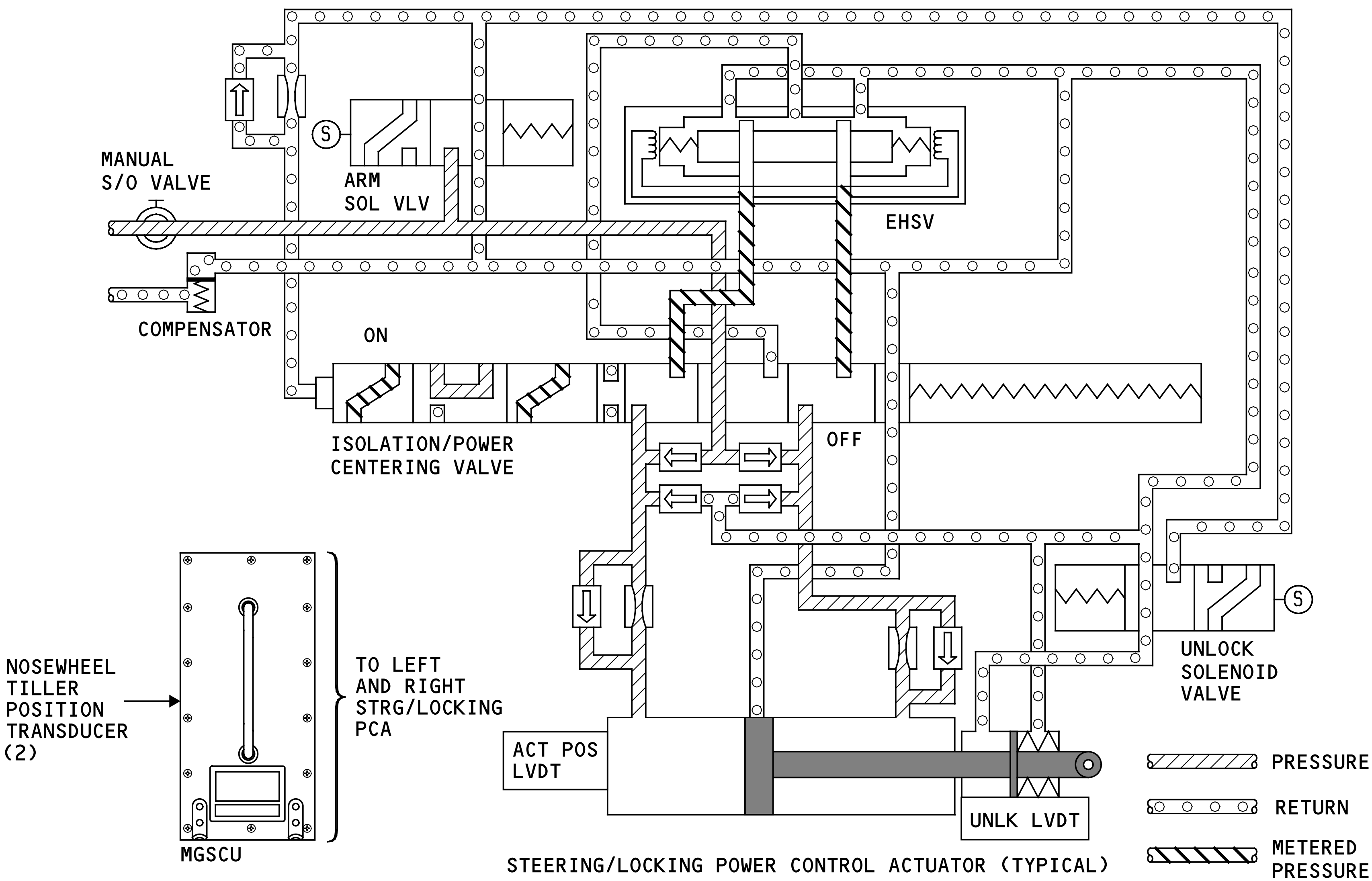
Disarm

When tiller angle is less than 9 degrees, the MGSCU removes power from the arm solenoid and the unlock solenoid. This stops hydraulic pressure to the lock collar and to the isolation/power centering valve.

A spring moves the isolation/power centering valve to the OFF position. This removes power from the EHSV and supplies pressure to both sides of the actuator. A return port in the center of the actuator (hole-in-the-wall) reduces pressure in the side of the actuator that is opposite to the actuator position. This moves and keeps the actuator in the centered position.

The spring-loaded lock collar locks the actuator after the pressure unlock solenoid removes the hydraulic pressure.

System faults will also disarm the main gear steering system.



MAIN GEAR STEERING SYSTEM - HYDRAULIC FUNCTIONAL DESCRIPTION

MAIN GEAR STEERING SYSTEM - INDICATIONS

Alert and Status Messages

The CONFIG GEAR STEERING warning message shows when a steering/locking PCA is not locked during takeoff.

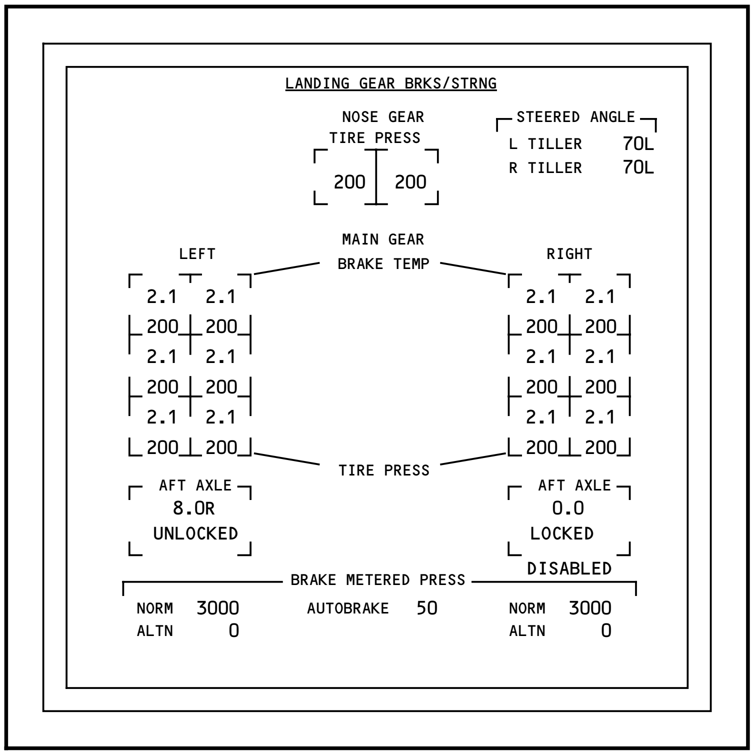
The MAIN GEAR STEERING advisory message shows if a main gear steering/locking PCA is commanded locked and is not locked.

The MAIN GEAR STEERING status message shows if there is a failure in a component in the main gear steering system or if a steering/locking PCA is disabled.

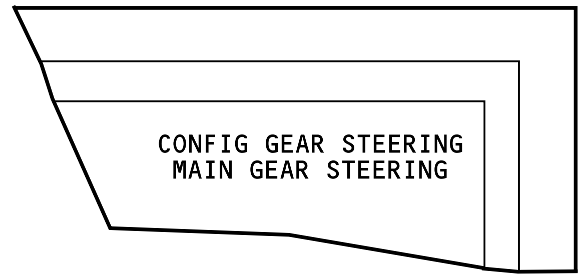
Maintenance Page Indications

The multi-function display (MFD) shows steering tiller position on the landing gear brake and steering maintenance page. The angle of the main gear aft axles and locked/unlocked status also show on this display.

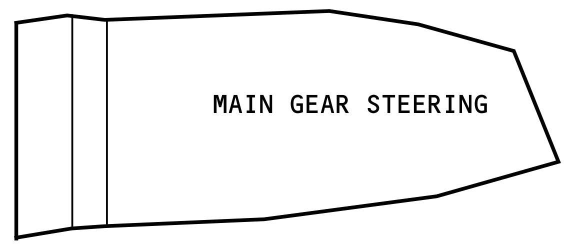
The page also shows failure or disable (manual shutoff valve closed) conditions below the aft axle angle display.



BRAKE AND STEERING MAINTENANCE PAGE



EICAS DISPLAY



STATUS DISPLAY

32-53-00-007 Rev 5 06/22/1997

MAIN GEAR STEERING SYSTEM - INDICATIONS

Continental Airlines, Inc

Wheels and Brakes

WB371

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Continental Airlines, Inc
Wheels and Brakes
WB371

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WHEELS AND BRAKES - INTRODUCTION

General

The wheels and brakes system includes:

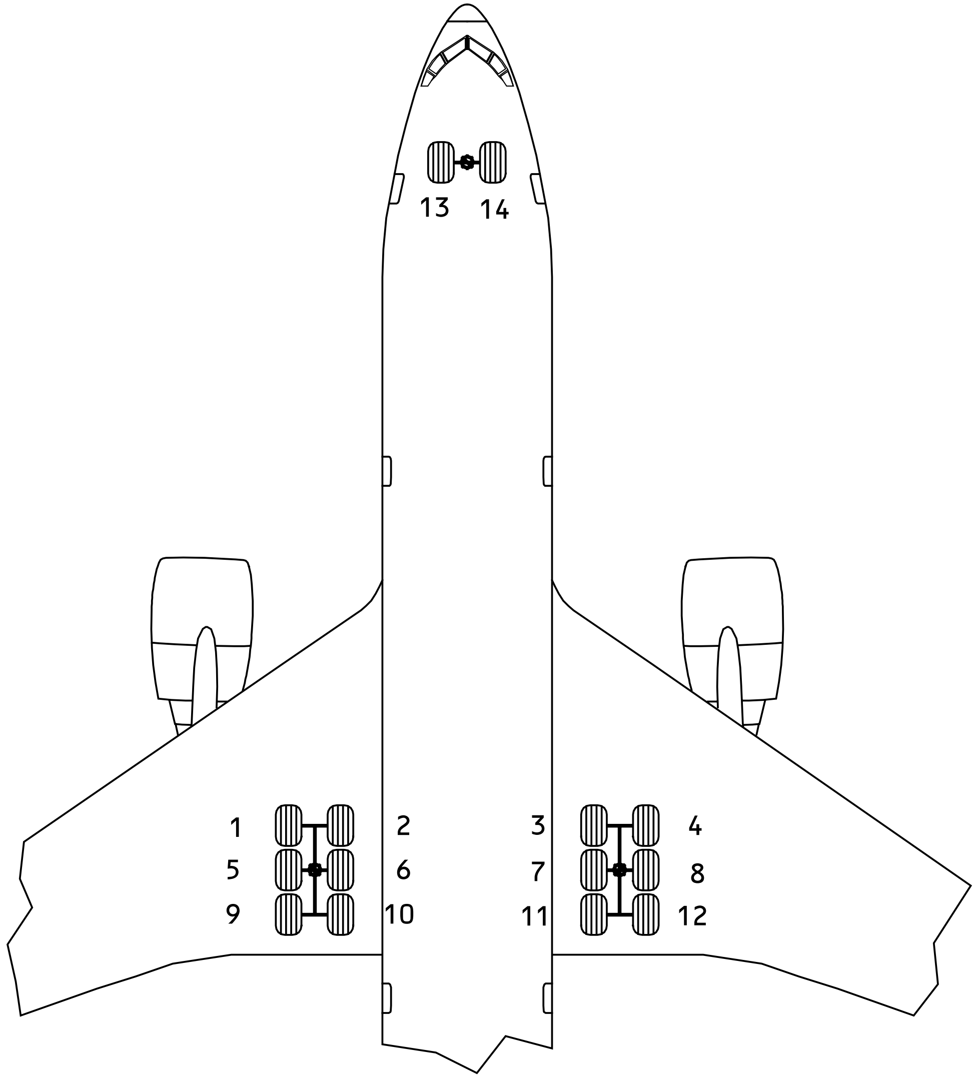
- Wheels, brakes, and tires (32-45)
- Brake hydro-mechanical control system (32-41)
- Parking brake system (32-44)
- Antiskid/autobrake systems (32-42)
- Brake temperature monitor system (BTMS) (32-46)
- Tire pressure indication system (32-49).

Abbreviations and Acronyms

A/B - autobrake
ACMP - alternating current motor pump
ADIRU - air data inertial reference unit
AIMS - airplane information management system
AIV - accumulator isolation valve
altn - alternate
ARINC - aeronautical radio, inc
ASSV - alternate source selection valve
A/S - antiskid
bat - battery
BITE - built-in test equipment
brk - brake
BSCU - brake system control unit
BTMS - brake temperature monitor system
BTMU - brake temperature monitor unit
capt - captain
ctr - center
ctrl - control
DC - direct current
decel - deceleration
ft - feet
fwd - forward
gnd - ground
gr - gear
hyd - hydraulic
ind - indication
kts - knots
ldg - landing
LG - landing gear
LRU - line replaceable unit
lt - left
mdl - module
MD&T - master dim and test
MFD - multi-function display
MLG - main landing gear
mtrd - metered
NLG - nose landing gear
press - pressure
PSEU - proximity sensor electronic unit
psi - pounds per square inch
psig - pounds per square inch gage
pwr - power
ref - reference
rel - release
rqst - request
rt - right
RTO - rejected takeoff

sec	- second
sel	- selector
sig	- signal
sol	- solenoid
spd	- speed
stby	- standby
strg	- steering
sw	- switch
sys	- system
temp	- temperature
vlv	- valve
whl	- wheel
WIU	- wheel interface unit
xdcr	- transducer.

- WHEELS AND BRAKES
  - WHEELS, BRAKES, AND TIRES
  - BRAKE HYDRO-MECHANICAL CONTROL SYSTEM
  - PARKING BRAKE SYSTEM
  - ANTISKID/AUTOBRAKE SYSTEMS
  - BRAKE TEMPERATURE MONITOR SYSTEM
  - TIRE PRESSURE INDICATION SYSTEM



WHEELS, TIRES, AND BRAKES NUMBERING SYSTEM

32-40-00-001 Rev 1

WHEELS AND BRAKES - INTRODUCTION

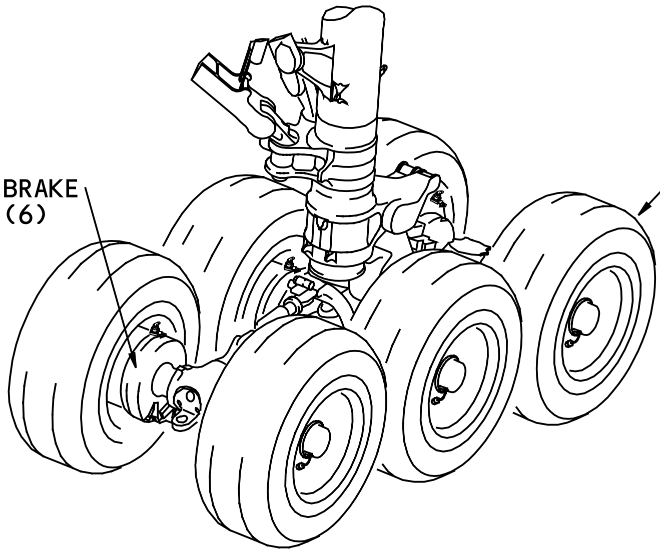
WHEELS, BRAKES, AND TIRES - INTRODUCTION

Main Landing Gear

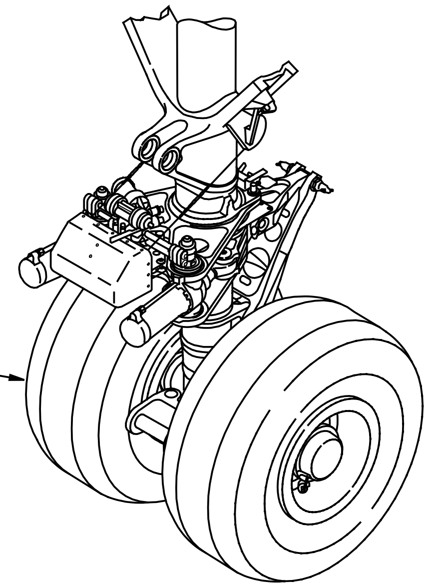
Each main landing gear has a six wheel truck. A brake assembly is in each of the 12 main landing gear wheel and tire assemblies.

Nose Landing Gear

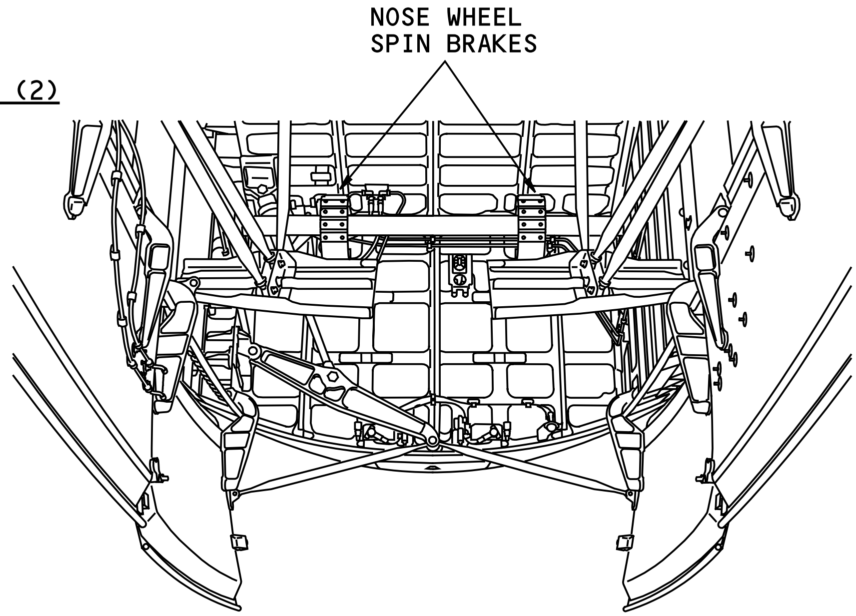
The nose landing gear has two wheel and tire assemblies. There are no hydraulic brakes for these wheels. Nose wheel spin brakes stop nose wheel rotation during retraction when the nose wheels enter the wheel well.



MAIN LANDING GEAR TRUCK (2)



NOSE LANDING GEAR



NOSE LANDING GEAR WHEEL WELL
(LOOKING FORWARD)

WHEELS, BRAKES, AND TIRES - INTRODUCTION

32-45-00-001 Rev 1 11/09/95

WHEELS, BRAKES, AND TIRES - MAIN LANDING GEAR WHEEL AND TIRE

Main Landing Gear Wheels

The main wheels are radial tire wheels. They have forged inner and outer halves. Tie bolts hold the two halves together. Brake rotor drive keys and heat shields are in the inner half of each wheel.

Each wheel also has these components:

- Tire inflation valve
- Over-pressure relief valve
- Tire pressure sensor
- Thermal fuse plug (3).

Tire Inflation Valve

A tire inflation valve is in the outer wheel half.

Over-Pressure Relief Valve

An over-pressure relief valve is in the outer wheel half. The relief valve releases tire pressure above 375-450 psig.

Tire Pressure Sensor

A tire pressure sensor is in the outer wheel half. This sensor sends tire pressure data to the tire pressure indication system.

Thermal Fuse Plugs

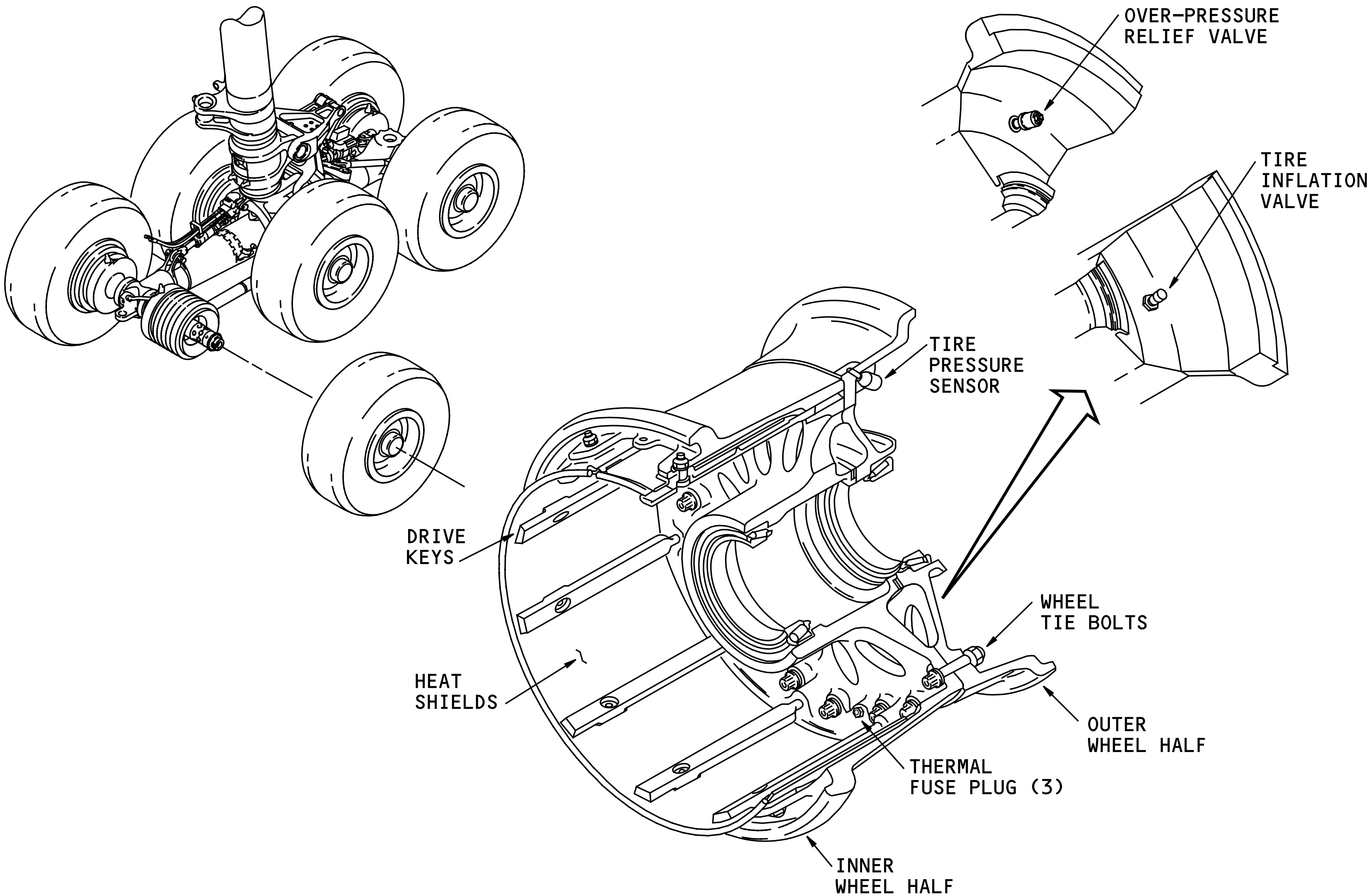
Three thermal fuse plugs in the inner wheel half prevent tire explosion caused by hot brakes. The plugs melt to release tire pressure when their temperature is approximately 360F (182C).

Training Information Point

Radial tires install only on radial tire wheels. The radial tire wheel width between the flanges is larger than bias ply tire wheels of the same size.

You must jack both ends of the main landing gear wheel truck to remove the center wheel and tire assemblies.

The main landing gear wheels can operate with one wheel tie bolt broken or missing.



32-45-00-004 Rev 3

WHEELS, BRAKES, AND TIRES - MAIN LANDING GEAR WHEEL AND TIRE

WHEELS, BRAKES, AND TIRES - MAIN LANDING GEAR WHEEL BRAKES

General

The main landing gear wheel brakes use hydraulic pressure to slow or stop the airplane during landing and taxi.

Each main landing gear wheel brake components include:

- Stators and rotors
- End plate assembly
- Pressure plate
- Self-adjusting piston (7)
- Axle bushing (2)
- Wear indicator pin (2)
- Brake disconnect (not shown)
- Hydraulic bleed port (not shown).

Physical Description

The brake assembly is a rotor-stator unit that operates using hydraulic pressure. The assembly uses carbon discs as rotors and stators.

The rotors and stators are compressed between the pressure plate and the end plate assembly to slow or stop the airplane.

Self-adjusting pistons apply brake system hydraulic pressure to the pressure plate. The pistons automatically adjust for brake wear.

Two indicator pins on the inboard side of the brake housing show brake wear.

The brake units mount on bushings which ride on replaceable landing gear axle sleeves.

The center brake attachment points connect directly to the lower strut at the same place the brake rods attach. The forward and aft brake attachment points connect to the brake rods.

The brake rods transmit brake torque to the strut. They also allow brake rotation as the truck position changes.

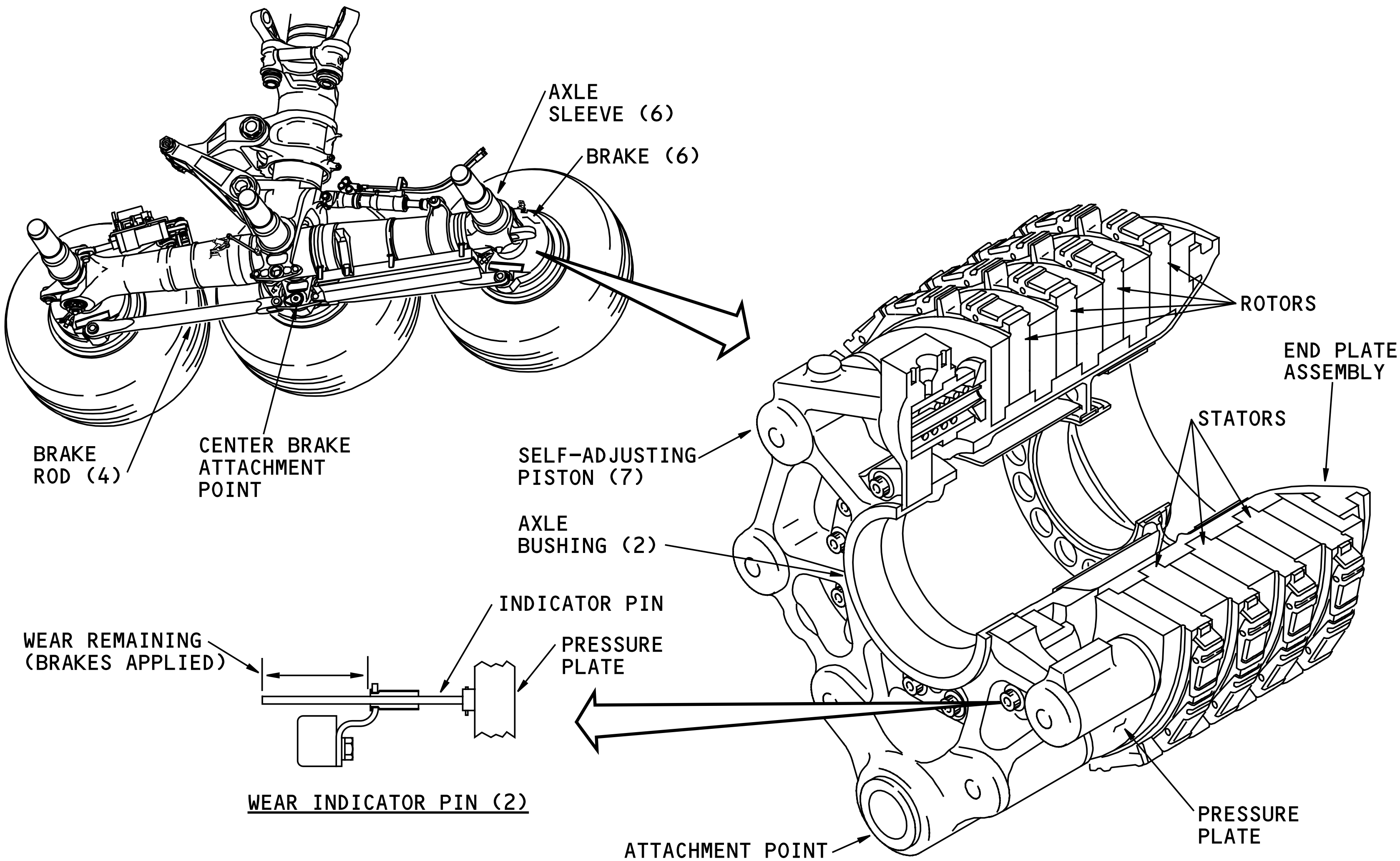
Training Information Point

You must apply the brakes to do a check of the wear indicator pins.

The brake system can operate with one brake on each six wheel truck deactivated. Brakes may be deactivated by three methods:

- Install a flight dispatch disconnect tool in the brake position on the related antiskid shuttle valve module (This deactivates normal braking only. Alternate braking is still available.)
- Disconnect the brake line
- Remove the brake.

If the brake is removed or the brake line is disconnected, the gear must remain down for two minutes before retraction.



32-45-00-005 Rev 3

WHEELS, BRAKES, AND TIRES - MAIN LANDING GEAR WHEEL BRAKES

BRAKE HYDRO-MECHANICAL CONTROL - INTRODUCTION

Purpose

The brake hydro-mechanical system supplies manual control of the main landing gear brakes.

Brake hydraulic source selection uses two valves to automatically control different pressure sources to supply these brake functions:

- Normal brakes
- Alternate brakes
- Reserve brakes
- Accumulator brakes
- Gear retract braking.

The brake pedals control the normal and the alternate brake systems.

Normal Brakes

When all the pressure sources are available, the normal brake system uses right hydraulic system pressure to operate the brakes.

Alternate Brakes

The alternate brake system uses center hydraulic system pressure to operate the brakes when right hydraulic system pressure is low.

Reserve Brakes

Reserve brakes use isolated center system pressure to pressurize the alternate brake system.

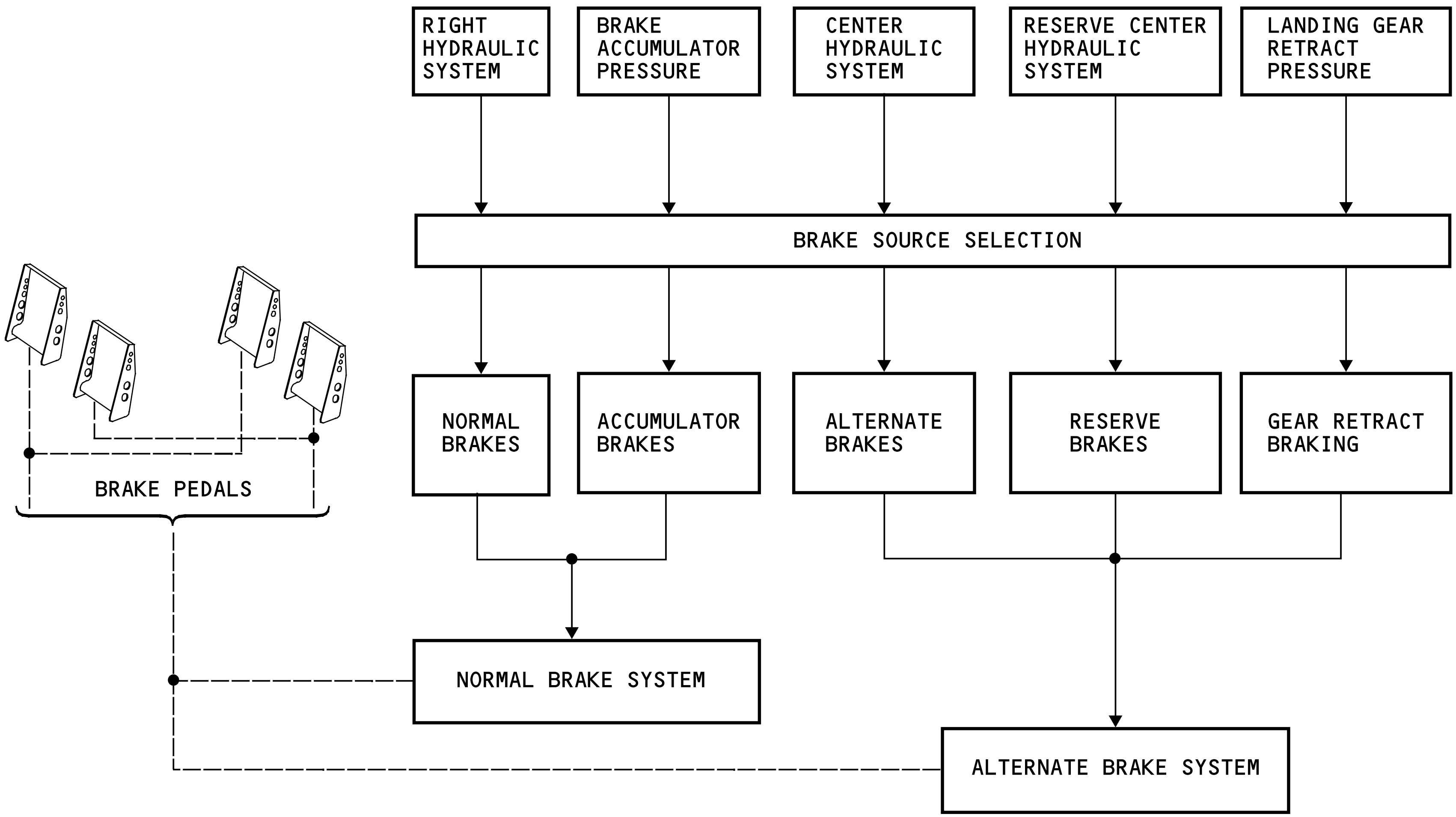
When the center hydraulic system reservoir is low, hydraulic system control isolates the output of the C1 ACMP for reserve brakes and nose wheel steering. This pump uses reserve fluid in the reservoir and pressurizes the alternate brake system.

Accumulator Brakes

When the normal, alternate, and reserve brake pressures are low, the accumulator pressurizes the normal brake system. The parking brake uses accumulator pressure when no other pressure sources are available.

Gear Retract Braking

The alternate brake system uses landing gear retract pressure to stop main gear wheel rotation during gear retraction.



32-41-00-001 Rev 0

BRAKE HYDRO-MECHANICAL CONTROL - INTRODUCTION

BRAKE HYDRO-MECHANICAL CONTROL - FLIGHT DECK COMPONENTS

Flight Deck Components

The hydro-mechanical control system includes these components on or near the flight deck:

- Brake pedal bus mechanism
- Brake cables
- Brake accumulator pressure gage
- Brake source light.

Brake Pedal Bus Mechanism

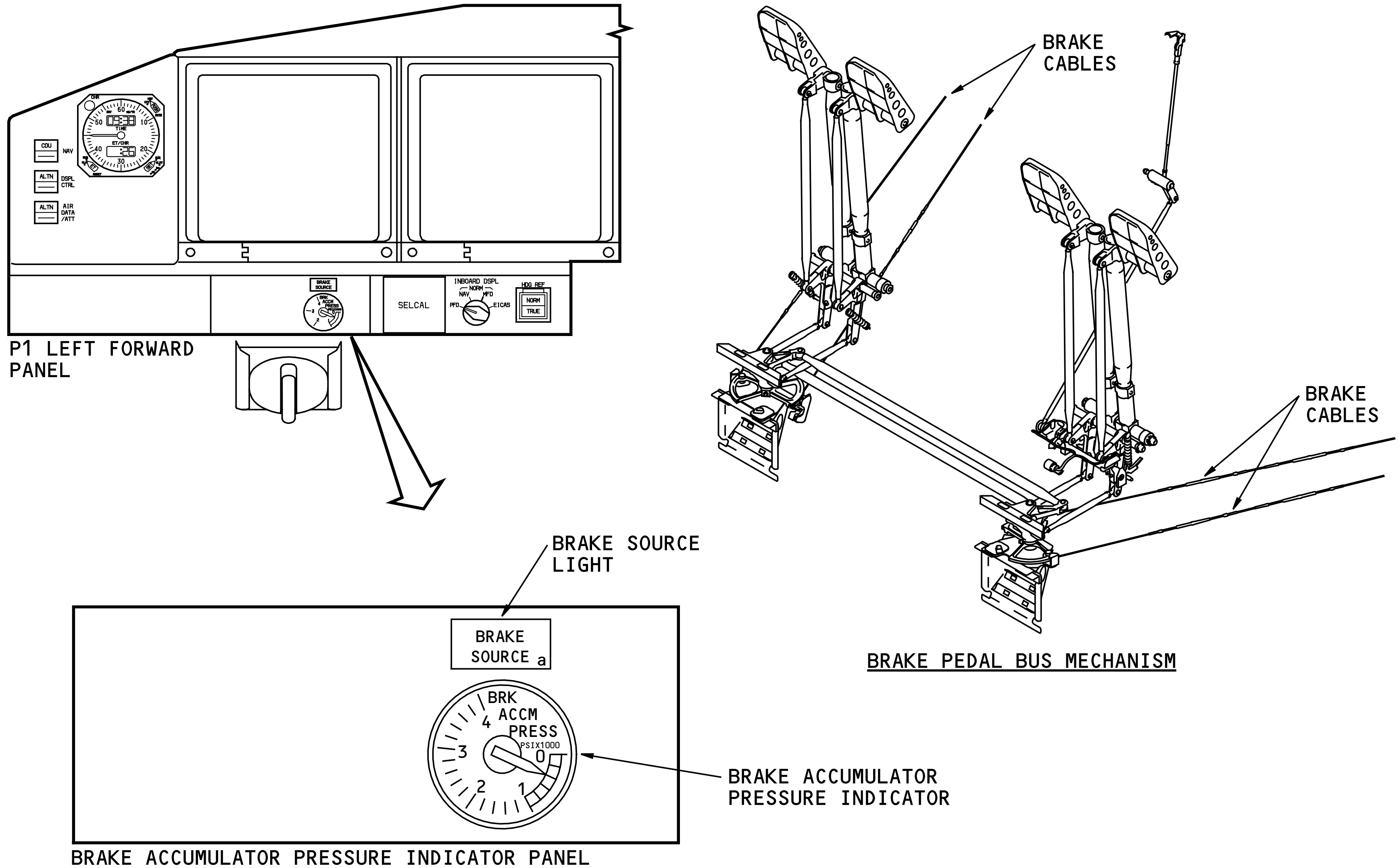
Most of the brake pedal bus mechanism components are below the flight deck floor. You get access to these components through the forward equipment center.

Brake Cables

Brake cables connect the brake pedal bus mechanism to the brake metering valves in the main landing gear wheel wells.

Brake Accumulator Pressure Gage and Brake Source Light

The brake accumulator pressure indicator and brake source light are on the P1 left forward panel.



32-41-00-002 Rev 0

BRAKE HYDRO-MECHANICAL CONTROL - FLIGHT DECK COMPONENTS

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BRAKE HYDRO-MECHANICAL CONTROL - MAIN LANDING GEAR WHEEL WELL COMPONENTS

Main Landing Gear Wheel Well Components

The hydro-mechanical control system includes these components in or near the left and right main landing gear wheel wells:

- Brake metering valves (2)
- Brake alternate source selector valve (ASSV)
- Brake accumulator isolation valve (AIV)
- Brake accumulator
- Brake accumulator servicing components
- Brake source pressure switch (2)
- Antiskid surge accumulator
- Antiskid surge accumulator servicing components.

Brake Metering Valves

The left and right brake metering valves are in the forward section of the main landing gear wheel wells.

Brake Alternate Source Selector Valve

The alternate source selector valve is in the left main landing gear wheel well inboard on the keel beam.

Brake Accumulator Isolation Valve

The accumulator isolation valve is in the right main landing gear wheel well inboard on the keel beam below the brake accumulator.

Brake Accumulator

The brake accumulator is on the keel beam in the right main landing gear wheel well.

Brake Accumulator Servicing Components

Brake accumulator servicing components are on the keel beam below and forward of the brake accumulator in the right main landing gear wheel well.

Brake Source Pressure Switch

There are two brake source pressure switches.

The normal brake hydraulic system pressure switch is in the right main landing gear wheel well on the keel beam inboard of the brake accumulator.

The alternate brake hydraulic system pressure switch is in the left main landing gear wheel well on the alternate source selector valve.

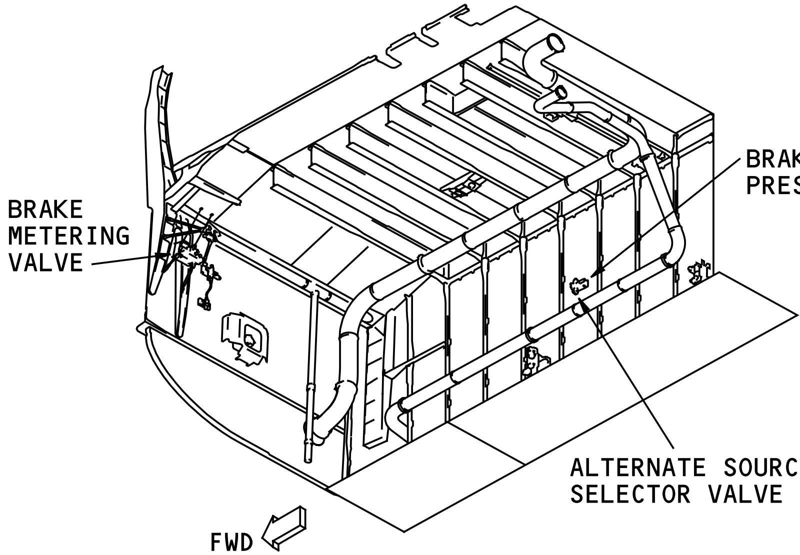
Antiskid Surge Accumulator

The antiskid surge accumulator is on the left main landing gear beam outboard of the landing gear trunnion.

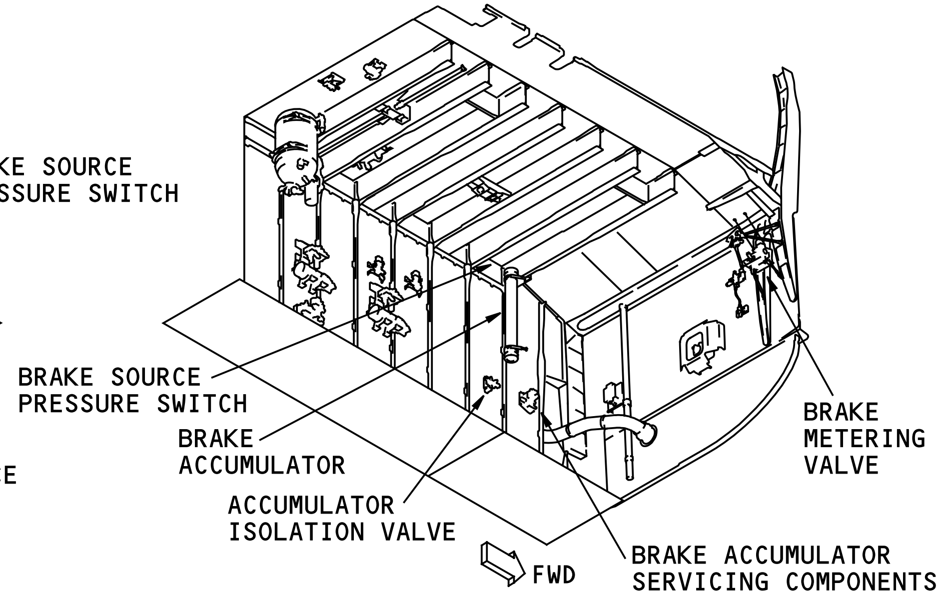
BRAKE HYDRO-MECHANICAL CONTROL - MAIN LANDING GEAR WHEEL WELL COMPONENTS

Antiskid Surge Accumulator Servicing Components

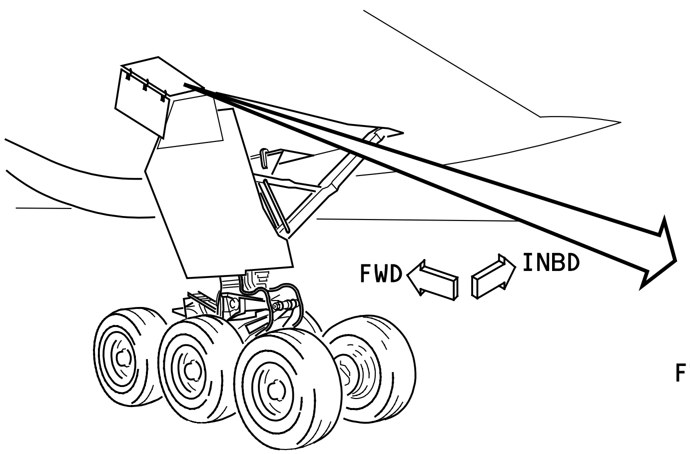
Antiskid surge accumulator servicing components are on the left main landing gear beam outboard of the antiskid surge accumulator.



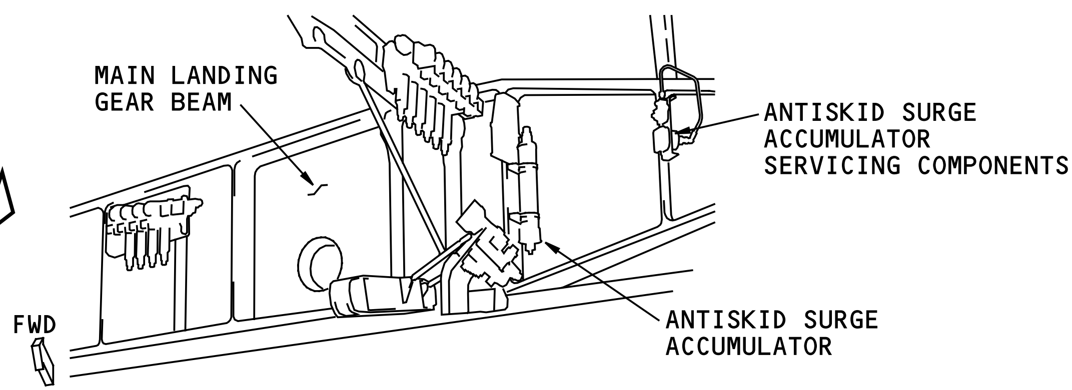
LEFT MAIN LANDING GEAR WHEEL WELL



RIGHT MAIN LANDING GEAR WHEEL WELL



LEFT MAIN LANDING GEAR



LEFT MAIN LANDING GEAR BEAM

32-41-00-003 Rev 3 10/15/1996

BRAKE HYDRO-MECHANICAL CONTROL - MAIN LANDING GEAR WHEEL WELL COMPONENTS

BRAKE HYDRO-MECHANICAL CONTROL - BRAKE PEDAL BUS MECHANISM

Purpose

The brake pedal bus mechanism sends brake pedal inputs to manually control brake system pressure.

Components

These are the brake pedal bus mechanism components:

- Captain's and first officer's rudder pedals
- Vertical control rods (4)
- Lower bellcranks (4)
- Fore-aft control rods (4)
- Brake pedal bus crank assemblies (2)
- Cable quadrants (2)
- Transverse control rods (2)
- Brake cables (4).

Location

The rudder pedals are above the flight deck floor. The vertical control rods extend through the floor into the forward equipment center.

The brake cables attach to the brake pedal bus mechanism cable quadrants with a routing through the fuselage sides to the main landing gear wheel wells.

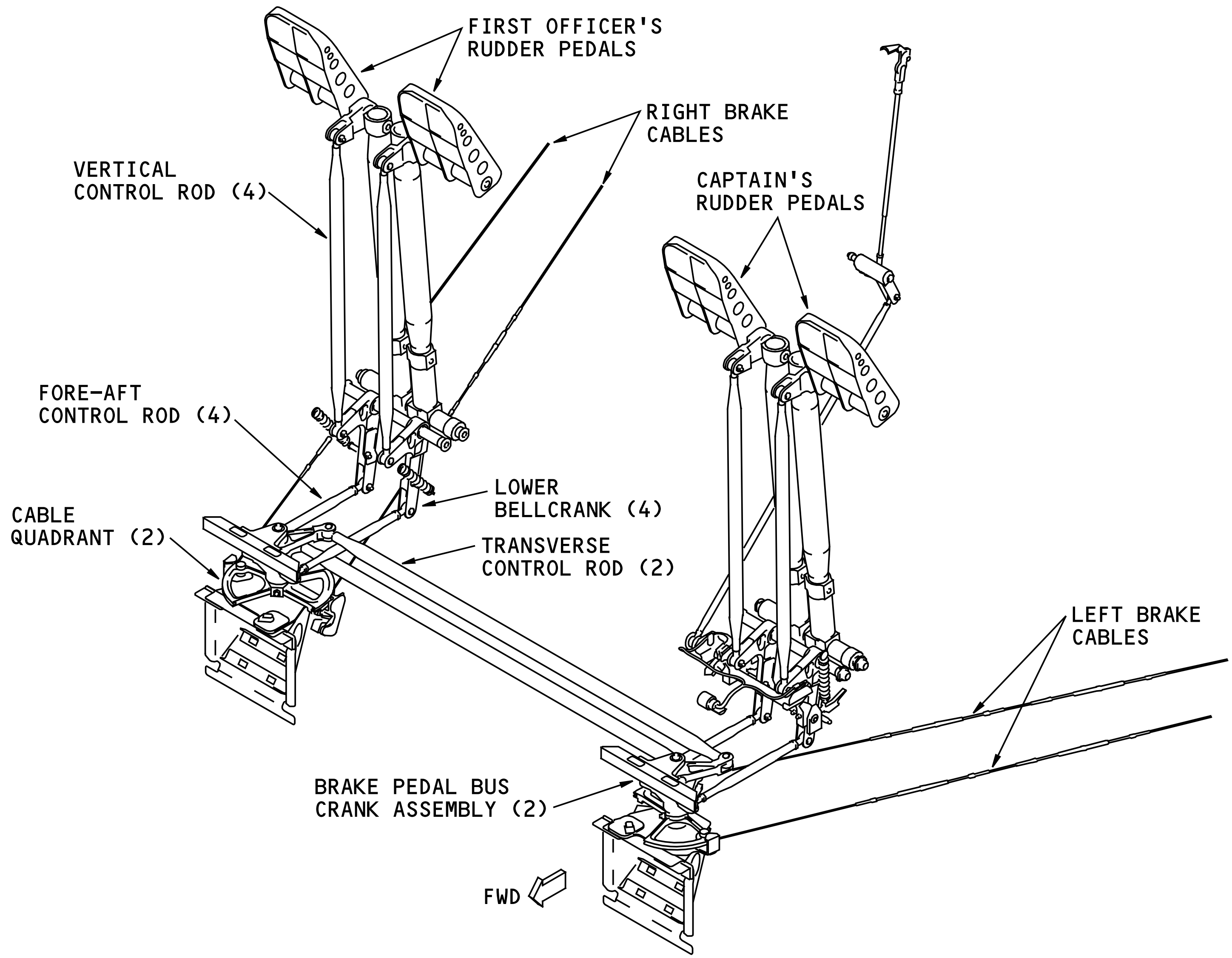
Functional Description

Two sets of brake pedals operate the brake pedal bus mechanism.

Pedal operation goes through vertical control rods to the lower bellcranks. These bellcranks connect to brake pedal bus crank assemblies and cable quadrants with fore-aft control rods.

Input to the left cable quadrant controls the left brakes with brake cables on the left side of the airplane. The right cable quadrant and cables are on the right side of the airplane and operate the same way as the left.

Transverse control rods connect the left and right brake pedal bus crank assemblies. This permits control of the left and right brakes with the captain's or the first officer's pedals.



BRAKE HYDRO-MECHANICAL CONTROL - BRAKE PEDAL BUS MECHANISM

BRAKE HYDRO-MECHANICAL CONTROL - BRAKE METERING VALVE ASSEMBLY - GENERAL DESCRIPTION

Purpose

The brake metering valve assemblies get brake pedal input and control brake pressure.

Components

Each brake metering valve assembly includes these components:

- Brake metering valve actuation/support assembly
- Normal brake metering valve
- Alternate brake metering valve.

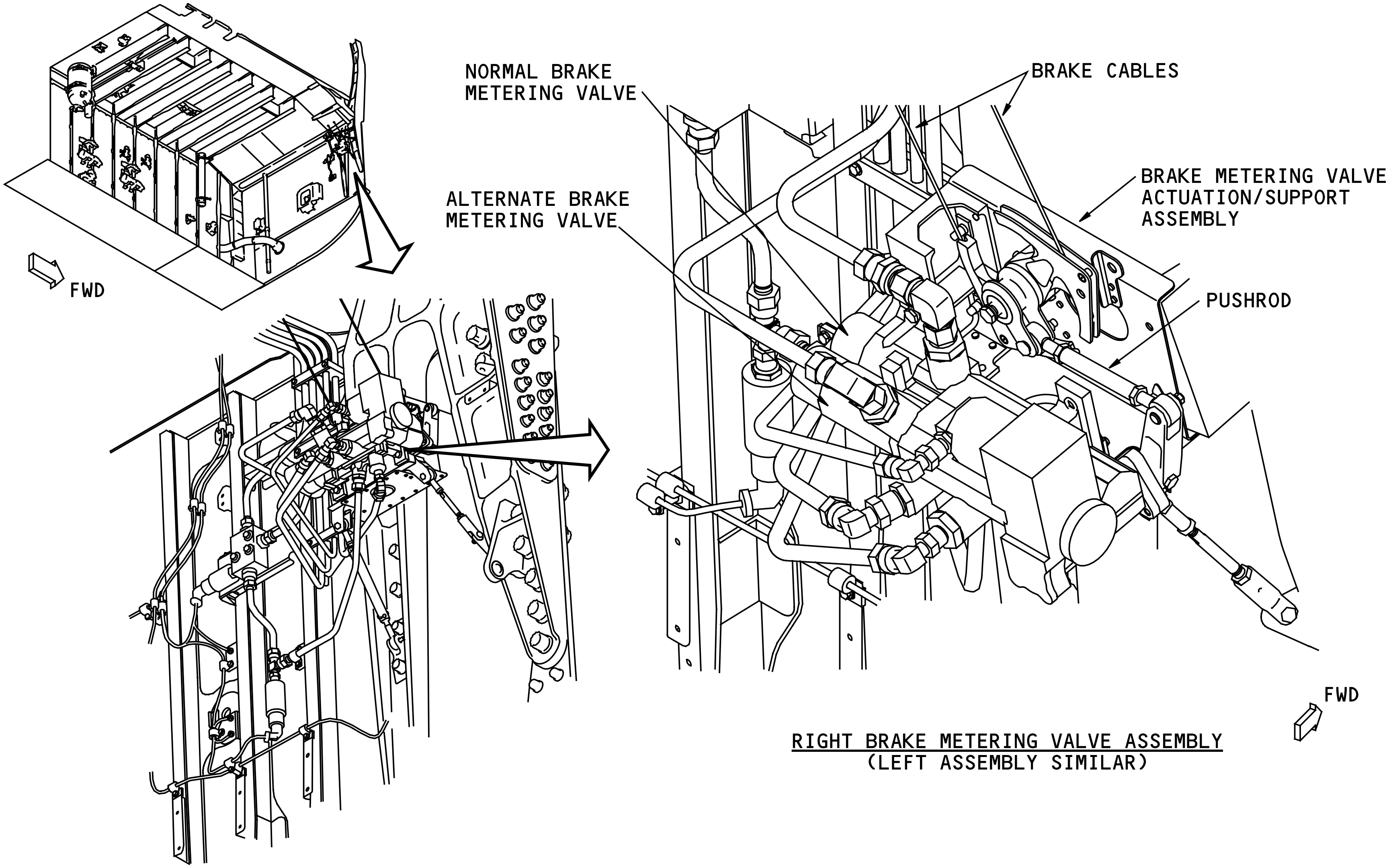
Location

Normal and alternate brake metering valves attach to each other to make the brake metering valve assembly. There is a brake metering valve in each main landing gear wheel well. Each attaches to a brake metering valve actuation/support assembly.

These brake metering valve assemblies attach to the wing rear spar side of body fitting in the forward section of each wheel well.

Training Information Point

You can replace the brake metering valve as a unit with no change in brake cable rigging. To do this, you remove the brake metering valve from the actuation/support assembly. After installation of the new valve, you can make minor adjustments with the pushrod in the actuation/support assembly.



RIGHT MAIN LANDING GEAR WHEEL WELL

RIGHT BRAKE METERING VALVE ASSEMBLY
(LEFT ASSEMBLY SIMILAR)

32-41-00-005 Rev 1

BRAKE HYDRO-MECHANICAL CONTROL - BRAKE METERING VALVE ASSEMBLY - GENERAL DESCRIPTION

BRAKE HYDRO-MECHANICAL CONTROL - BRAKE ACCUMULATOR AND SERVICING COMPONENTS

Purpose

The brake accumulator supplies brake pressure to the normal brake hydraulic system if there are no other brake sources available. It is also the pressure source for the parking brake system when the center and right hydraulic systems are off.

Components

Brake accumulator and servicing components include:

- Brake accumulator
- Charging valve
- Pressure transducer
- Pressure indicator (flight deck)
- Pressure gage (wheel well).

Location

The brake accumulator and servicing components are on the keel beam in the right main wheel well.

The brake accumulator pressure indicator is on the brake accumulator pressure indicator panel on the P1 left forward panel below the brake source light.

Physical Description

The accumulator is a gas charged unit with a floating piston that separates the gas and the fluid sides. It has a precharge of 1000 psi and a volume of 600 cubic inches. The right hydraulic system pressurizes the accumulator.

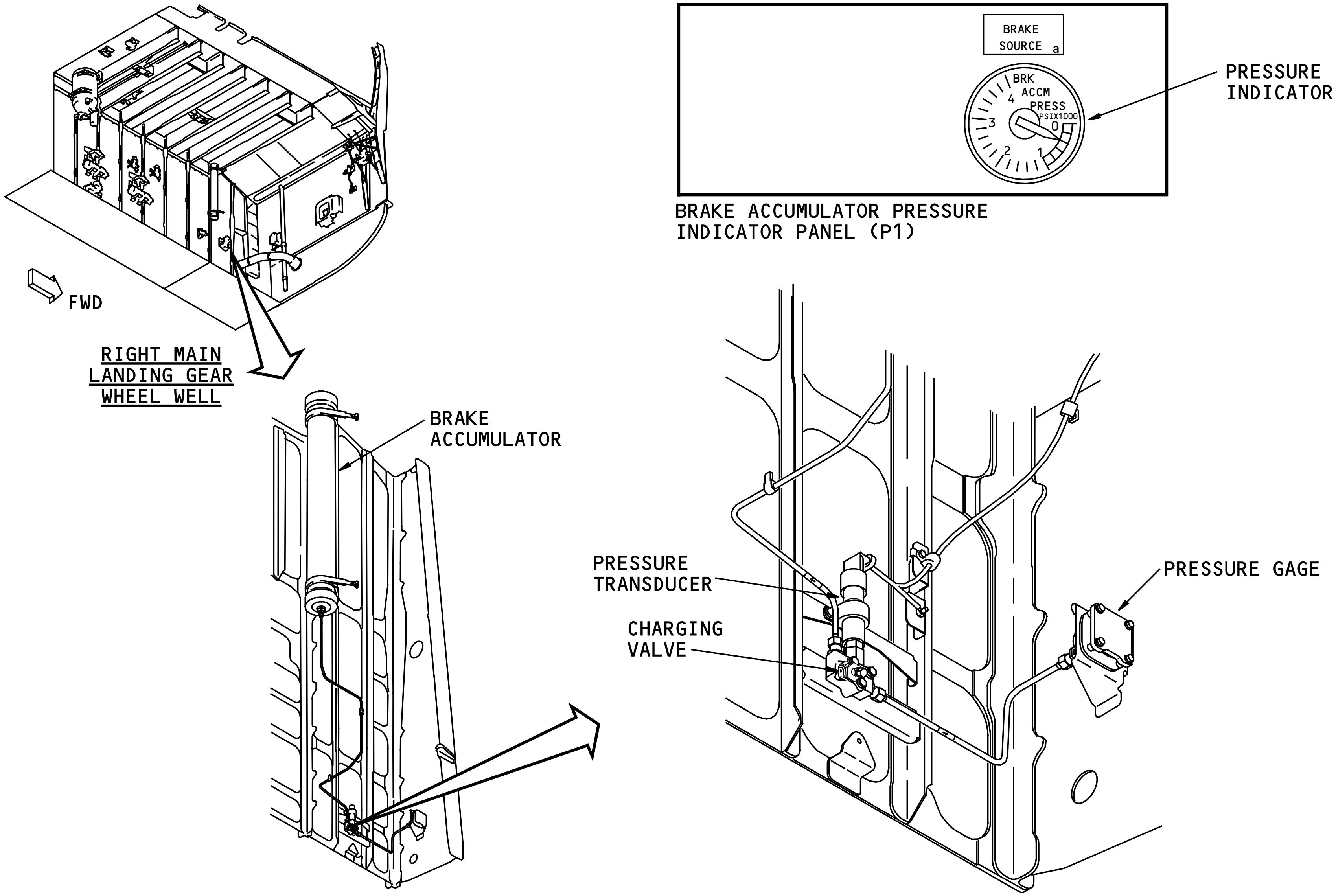
The brake accumulator pressure transducer sends the pressure signal to the pressure indicator on the flight deck.

The pressure gage in the main landing gear wheel well is a direct reading gage used for inspection and servicing.

Charging instructions are on a placard by the charging valve and transducer.

Training Information Point

With a fully charged accumulator, the brake accumulator system supplies enough pressure for six full brake applications or keeps the parking brake pressurized for eight hours.



32-41-00-007 Rev 2

BRAKE HYDRO-MECHANICAL CONTROL - BRAKE ACCUMULATOR AND SERVICING COMPONENTS

BRAKE HYDRO-MECHANICAL CONTROL - ANTISKID SURGE ACCUMULATOR AND SERVICING COMPONENTS

Purpose

The anti-skid surge accumulator absorbs brake release surges from the left normal anti-skid valve module.

Components

The anti-skid surge accumulator and servicing components include:

- Antiskid surge accumulator
- Charging valve
- Pressure gage assembly.

Location

The antiskid surge accumulator and servicing components are on the left main landing beam. They are outboard and aft of the left normal antiskid valve module.

You open an access panel outboard of the left MLG to access the antiskid surge accumulator.

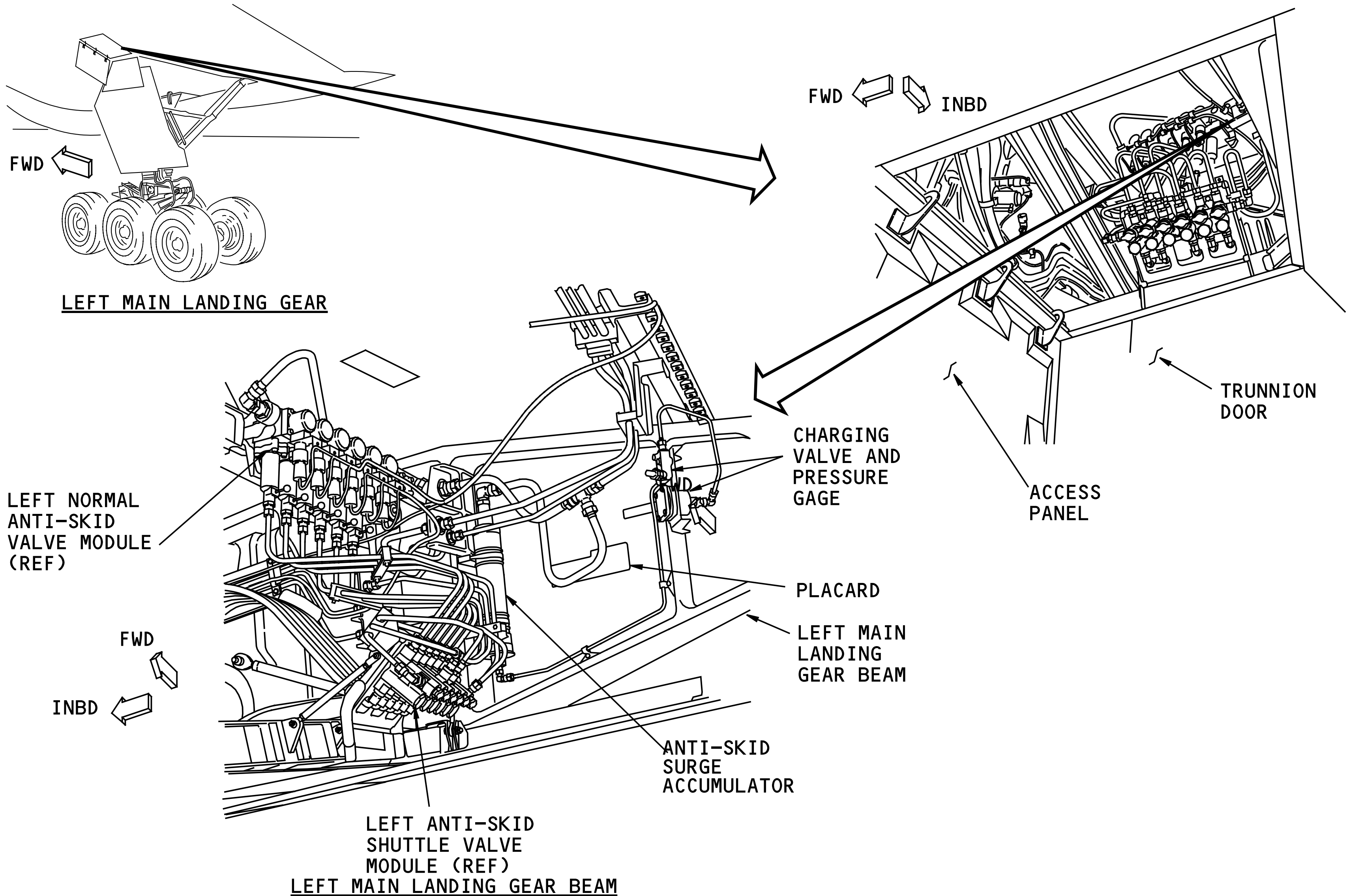
Physical Description

The accumulator is a gas charged unit with a floating piston that separates the gas and the fluid sides. It has a precharge of 150 psi and a volume of 25 cubic inches.

Charging instructions are on a placard by the charging valve and gage.

Training Information Point

The right normal antiskid valve module does not need an antiskid surge accumulator because the right hydraulic system reservoir is very near to the right normal antiskid valve module.



BRAKE HYDRO-MECHANICAL CONTROL - ANTISKID SURGE ACCUMULATOR AND SERVICING COMPONENTS

32-41-00-008 Rev 1 07/26/1995

BRAKE HYDRO-MECHANICAL CONTROL - ALTERNATE SOURCE SELECTOR AND ACCUMULATOR ISOLATION VALVES

Purpose

These two hydro-mechanical valves select and send pressure to the normal or the alternate brake hydraulic systems:

- Brake alternate source selector valve (ASSV)
- Brake accumulator isolation valve (AIV).

Location

The ASSV is on the keel beam in the left main landing gear wheel well.

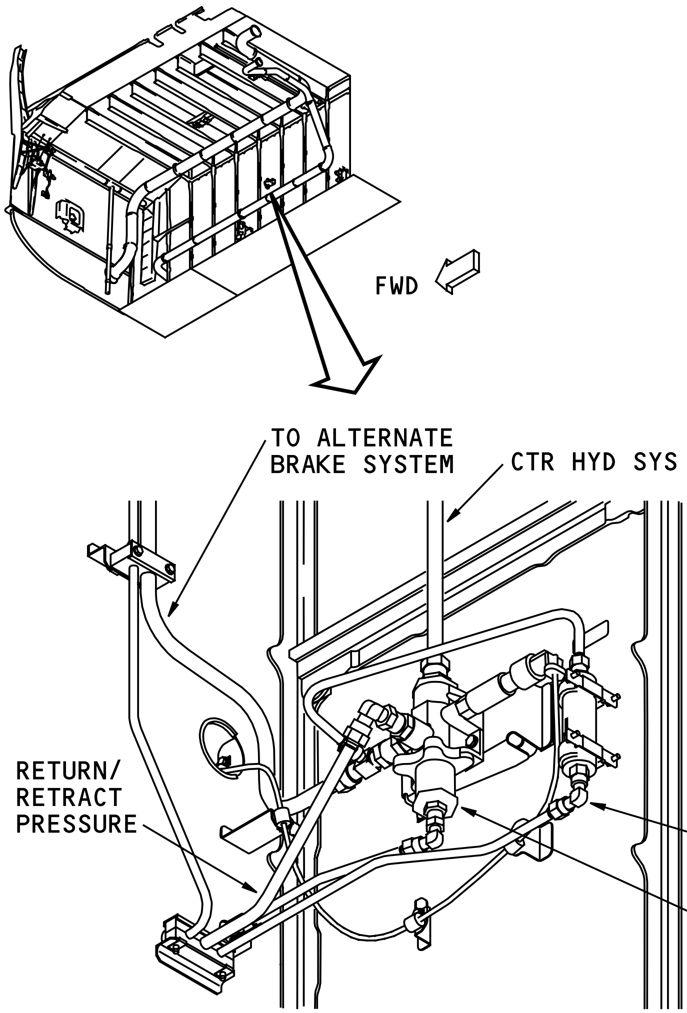
The AIV is on the keel beam below the brake accumulator in the right main landing gear wheel well.

Physical Description

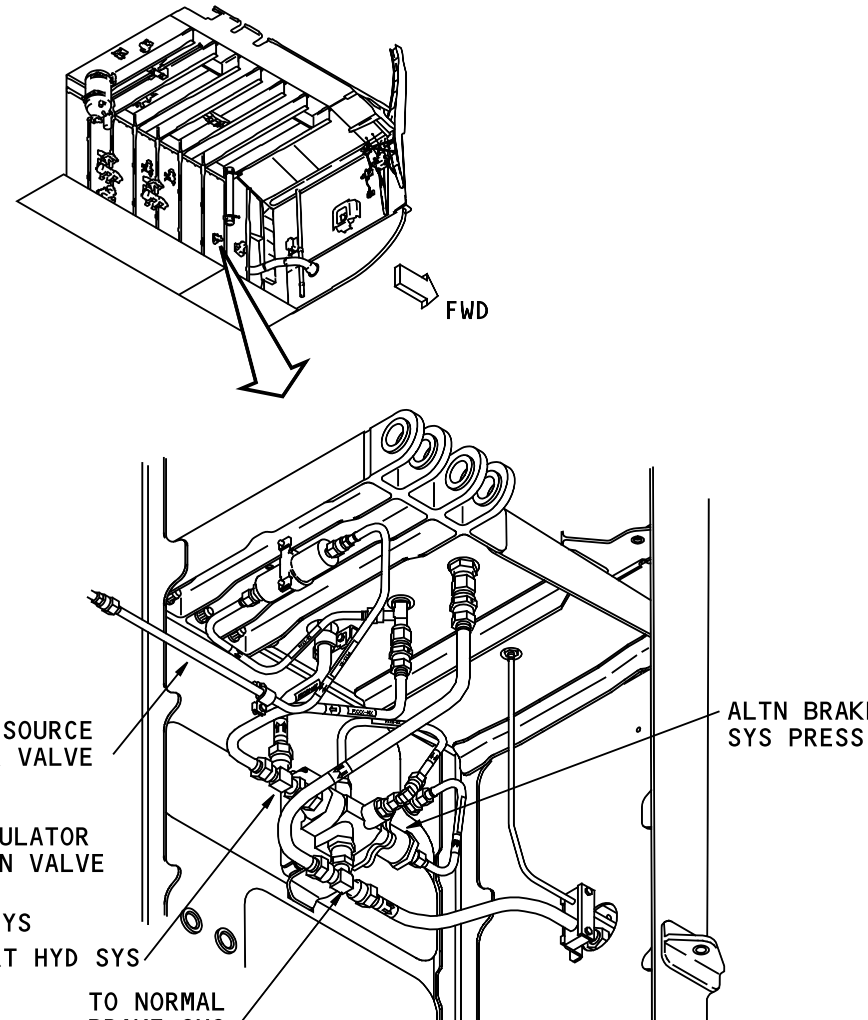
Both valves are the same and are interchangeable.

Each valve gets pressure from two sources. The pressures push on pistons in the valves that have different areas. This moves the valves to select the brake source.

The alternate source selector valve has the alternate brake hydraulic system pressure switch on the valve.



BRAKE ALTERNATE SOURCE SELECTOR VALVE
(LEFT MAIN WHEEL WELL, KEEL BEAM)



BRAKE ACCUMULATOR ISOLATION VALVE
(RIGHT MAIN WHEEL WELL, KEEL BEAM)

BRAKE HYDRO-MECHANICAL CONTROL - ALTERNATE SOURCE SELECTOR AND ACCUMULATOR ISOLATION VALVES

32-41-00-009 Rev 2 10/15/96

BRAKE HYDRO-MECHANICAL CONTROL - BRAKE SOURCE PRESSURE SWITCHES

Purpose

These two brake source pressure switches control the brake source light and send pressure signals to the BSCU and AIMS for brake control and indication:

- The normal brake hydraulic system pressure switch
- The alternate brake hydraulic system pressure switch.

The brake source light comes on when there is low right hydraulic system pressure and there is low alternate brake system pressure.

Location

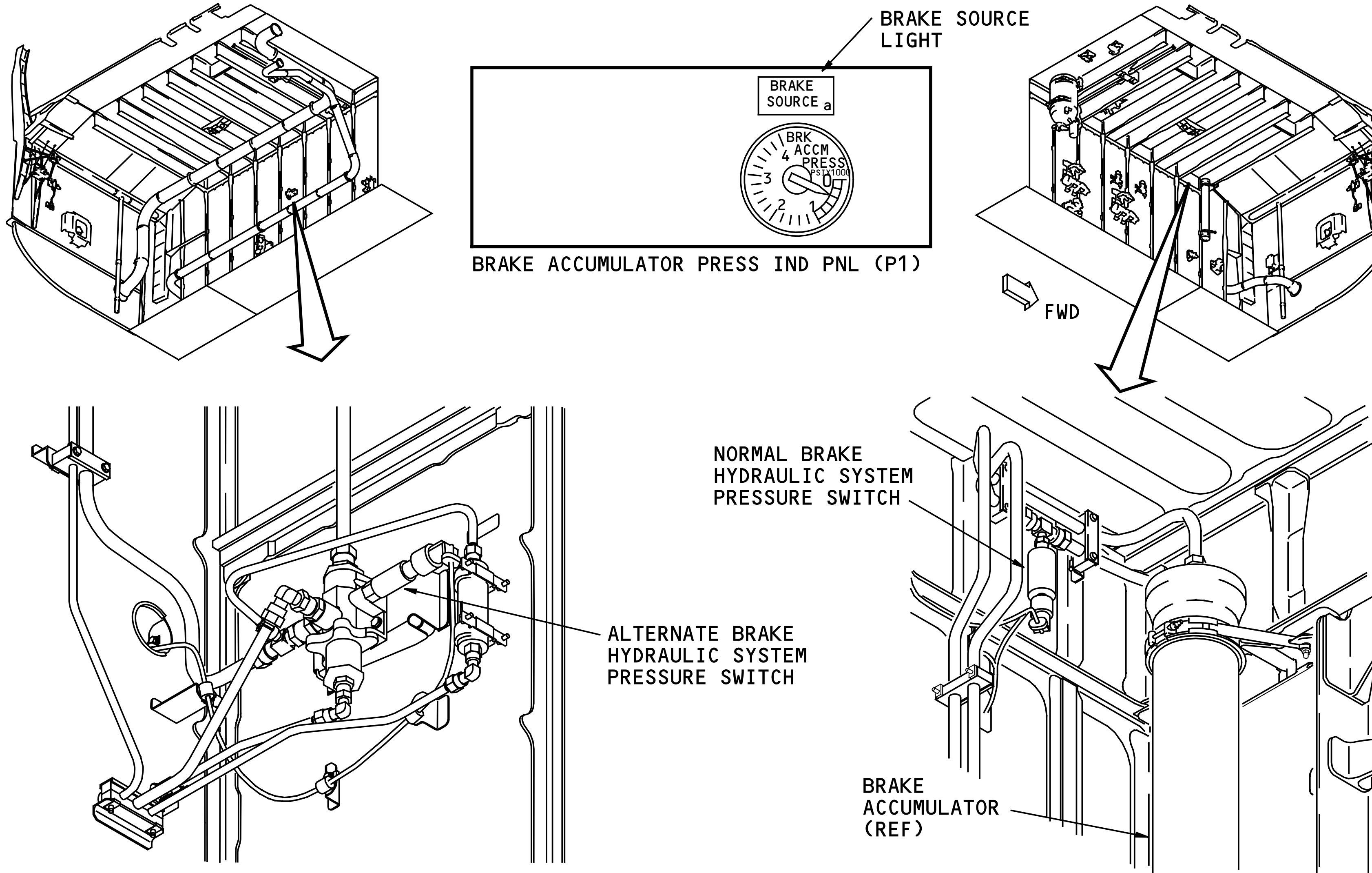
The brake source light is on the P1 left forward panel above the brake accumulator pressure gage on the flight deck.

The normal brake hydraulic system pressure switch is on the keel beam in the right main landing gear wheel well inboard and aft of the brake accumulator.

The alternate brake hydraulic system pressure switch is on the alternate source selector valve in the left main landing gear wheel well.

Physical Description

These switches are interchangeable pressure-operated switches that open at 1700 psi and close at 1200 psi.



ALTERNATE SOURCE SELECTOR VALVE
(LEFT MAIN LANDING GEAR WHEEL WELL)

RIGHT MAIN LANDING GEAR WHEEL WELL

BRAKE HYDRO-MECHANICAL CONTROL - BRAKE SOURCE PRESSURE SWITCHES

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BRAKE HYDRO-MECHANICAL CONTROL - FUNCTIONAL DESCRIPTION

General

The source selection operation supplies pressure for:

- Normal brakes
- Alternate brakes
- Reserve brakes
- Accumulator brakes
- Gear retract braking.

When the pressure in one hydraulic brake source decreases, the ASSV and AIV valves automatically change position to select the next available source and send the pressure to the brake metering valves.

Brake pedal input transmits through the brake pedal bus mechanism and cables to the left and right brake metering valves. These metering valves use this mechanical input to control the selected pressure source and pressurize the brakes.

Normal Brakes

When the right hydraulic system pressurizes, the ASSV operates to depressurize the alternate brake system. The brakes can then get metered right system hydraulic pressure from the normal brake metering valves.

The right hydraulic system pressure also charges the brake accumulator and operates the AIV.

Alternate Brakes

When right hydraulic system pressure is low, center hydraulic system pressure operates the ASSV. The ASSV sends center hydraulic system pressure to the alternate brake system. The brakes can then get metered center system hydraulic pressure from the alternate brake metering valves.

Pressure in the alternate brake system operates the AIV to isolate accumulator pressure.

Reserve Brakes

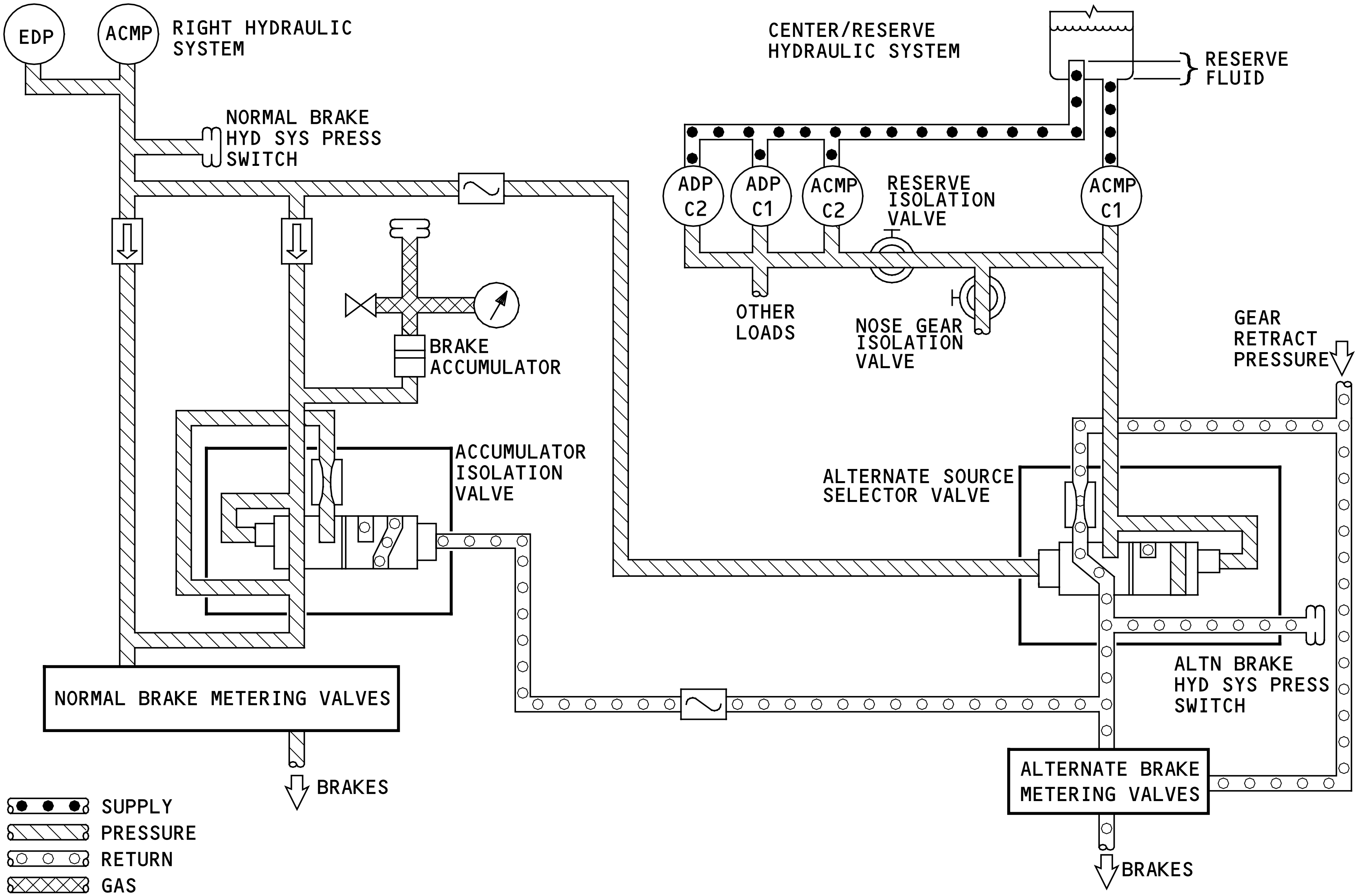
The ASSV and AIV positions and operation are the same as for alternate brakes. The only difference is that the center hydraulic system uses reserve fluid and the C1 ACMP for alternate brake system pressure.

Accumulator Brakes

When both the right and center hydraulic system pressures are low, accumulator pressure opens the AIV. The brakes then get brake accumulator pressure from the normal brake metering valves.

Gear Retract Braking

During landing gear retraction when the normal brake system has pressure, the ASSV sends main landing gear retract pressure to the alternate brake system. The gear retract pressure also operates the gear retract braking actuators on the alternate brake metering valves to pressurize the brakes.



32-41-00-012 Rev 2 10/15/1996

BRAKE HYDRO-MECHANICAL CONTROL - FUNCTIONAL DESCRIPTION

BRAKE HYDRO-MECHANICAL CONTROL - INDICATION

General

The brake source light and advisory message show when the normal and the alternate brake system pressures are low. These two switches control these indications:

- The normal brake hydraulic system pressure switch
- The alternate brake hydraulic pressure switch.

The brake accumulator pressure indicator shows brake accumulator pressure.

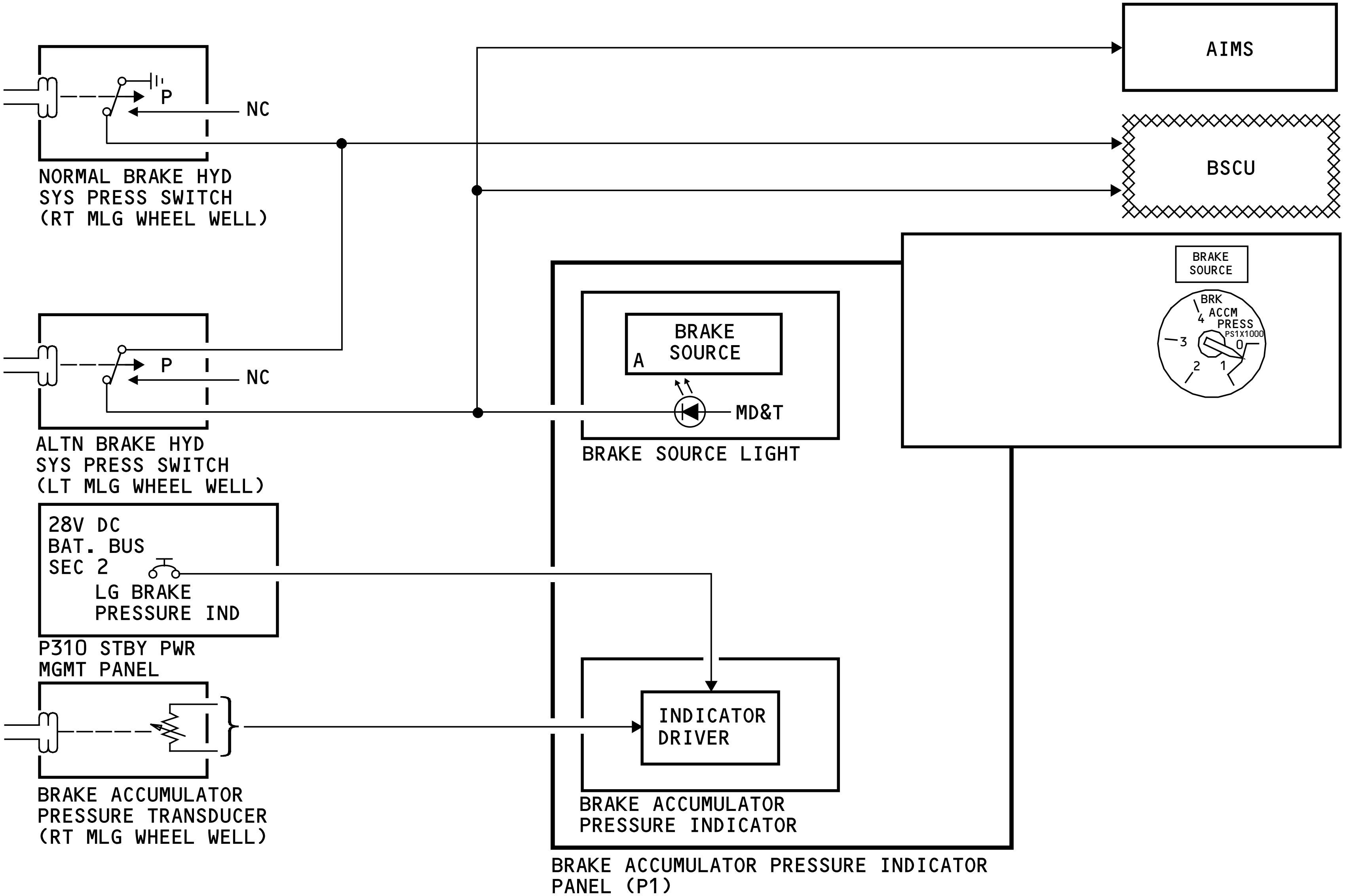
Functional Description

There is no flight deck effect when normal brake system pressure is low and the alternate brake system has pressure. The BSCU uses the normal system low pressure input for control of the antiskid and autobrake systems.

When normal and alternate brake system pressures are low, the brake source light comes on and AIMS shows the BRAKE SOURCE advisory message. The BSCU also uses these inputs for control of the antiskid and autobrake systems.

Brake accumulator pressure is the only pressure source when the brake source light is on.

The indicator driver for the brake accumulator pressure indicator uses accumulator pressure transducer input to show pressure.



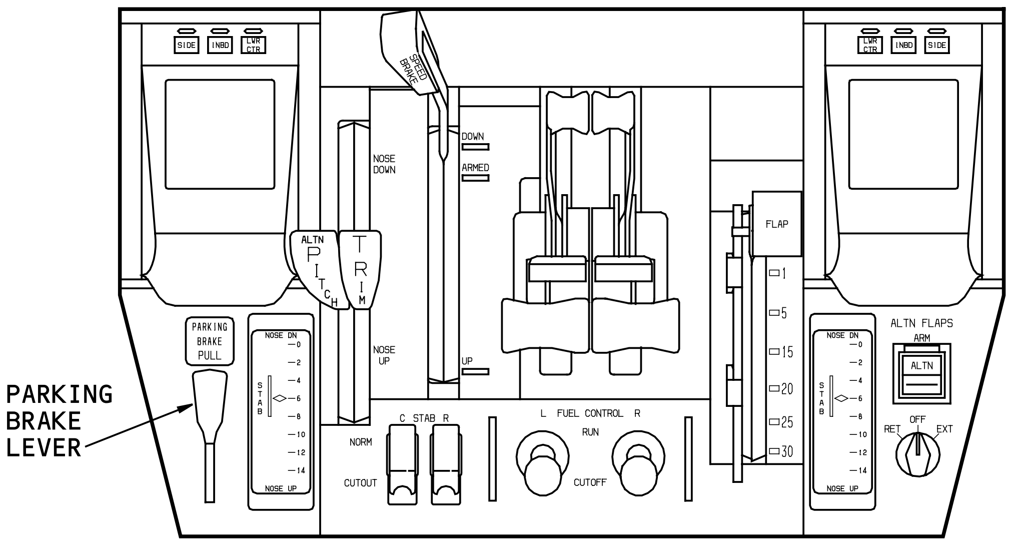
BRAKE HYDRO-MECHANICAL CONTROL - INDICATION

PARKING BRAKE SYSTEM - INTRODUCTION

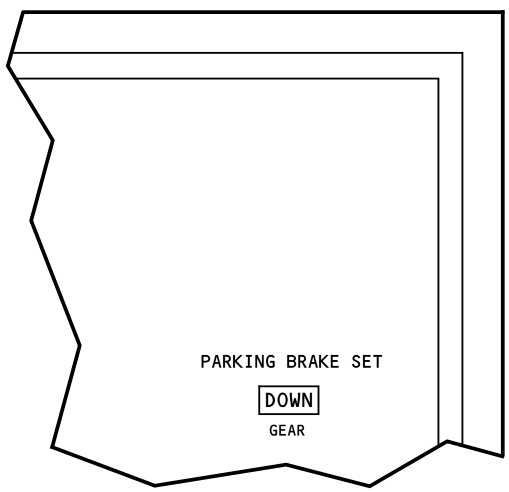
Purpose

The parking brake system uses the available brake pressure to keep the main landing gear brakes applied when the airplane is parked.

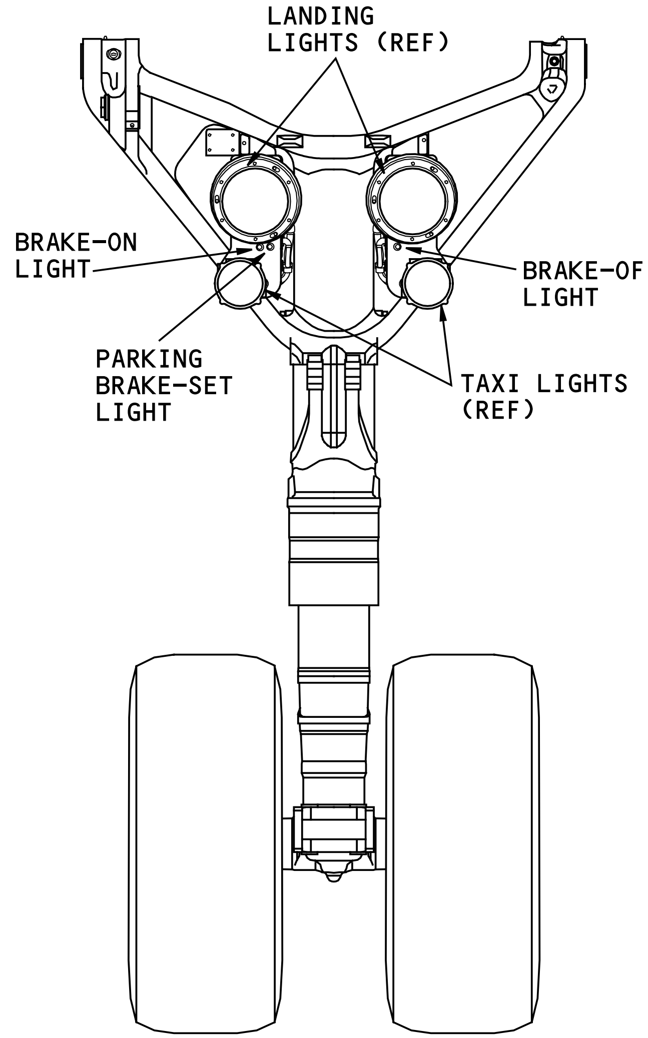
Brake status lights on the nose landing gear and the PARKING BRAKE SET memo message show the condition of the parking brake system.



P10 CONTROL STAND



EICAS DISPLAY



NOSE LANDING GEAR

32-44-00-001 Rev 3

PARKING BRAKE SYSTEM - INTRODUCTION

PARKING BRAKE SYSTEM - GENERAL DESCRIPTION

Components

These are the parking brake system components:

- Parking brake lever
- Parking brake latch mechanism
- Parking brake latch switch (2)
- Parking brake valve
- Pedal position switch (2)
- Brake metered pressure switch (2)
- Brake status indication light (3).

General Description

When you push the brake pedals and pull the parking brake lever, the latch mechanism latches the brake pedals in the brakes-applied position.

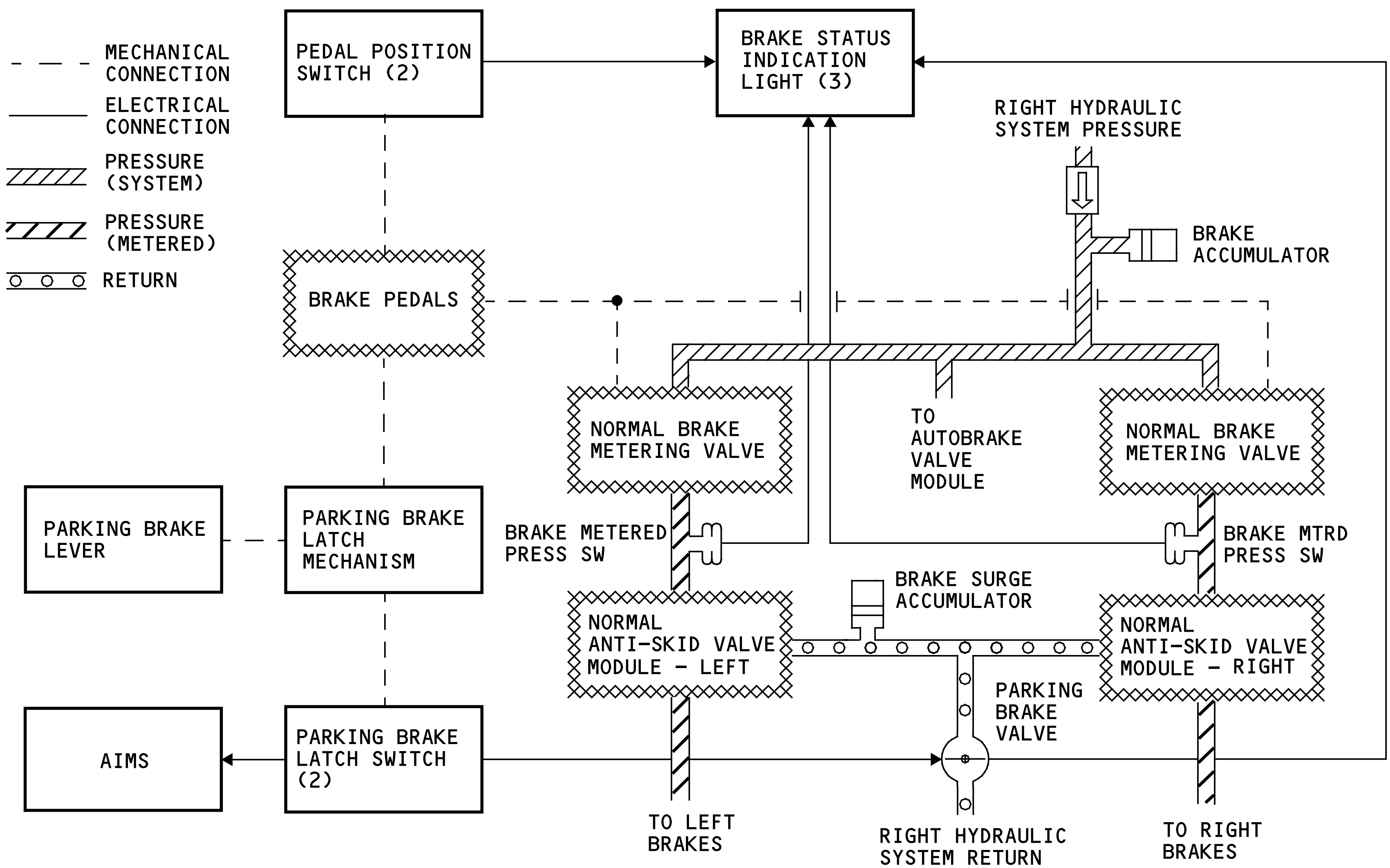
The parking brake latch switches send a signal to close the parking brake valve. They also send a signal to AIMS for flight deck indication.

The parking brake valve prevents brake pressure leakage through the normal antiskid valves.

Pedal position switches and brake metered pressure switches send signals to the brake status indication lights on the nose landing gear. These lights show people on the ground the brake system status.

Training Information Point

A fully charged (3000 psig) brake accumulator will keep the brakes pressurized at least eight hours.



32-44-00-002 Rev 2

PARKING BRAKE SYSTEM - GENERAL DESCRIPTION

PARKING BRAKE SYSTEM - PARKING BRAKE LATCH MECHANISM AND LATCH AND PEDAL POSITION SWITCHES

Purpose

The parking brake latch mechanism mechanically locks the brake pedals in the applied position.

These are the parking brake latch mechanism components:

- Latching pawls (2)
- Pawl stops (2)
- Latch spring.

Two parking brake latch switches control the parking brake valve and parking brake indications.

Two pedal position switches control the brake-off light.

Location

The parking brake latch mechanism is in the forward equipment center below the captain's rudder pedals.

The parking brake latch switches are on both sides of the latch mechanism.

The pedal position switches are on the captain's and the first officer's brake pedal cable quadrants.

Functional Description

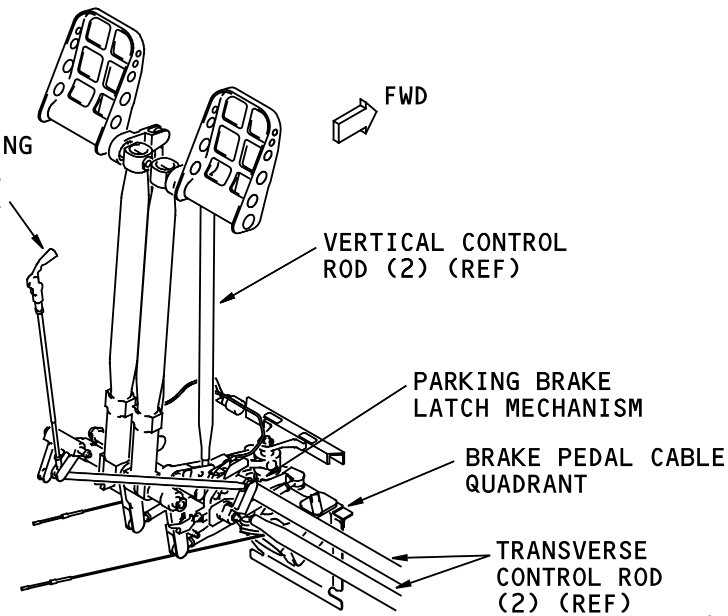
When you push on the brake pedals and pull the parking brake lever up, the latching pawls hold the brakes in the applied position. The pawls engage stops on the captain's left and right brake lower bellcranks.

The parking brake latch switches send signals to close the parking brake valve. They also send lever position data to AIMS and to the brake system control unit (BSCU) for control and indication.

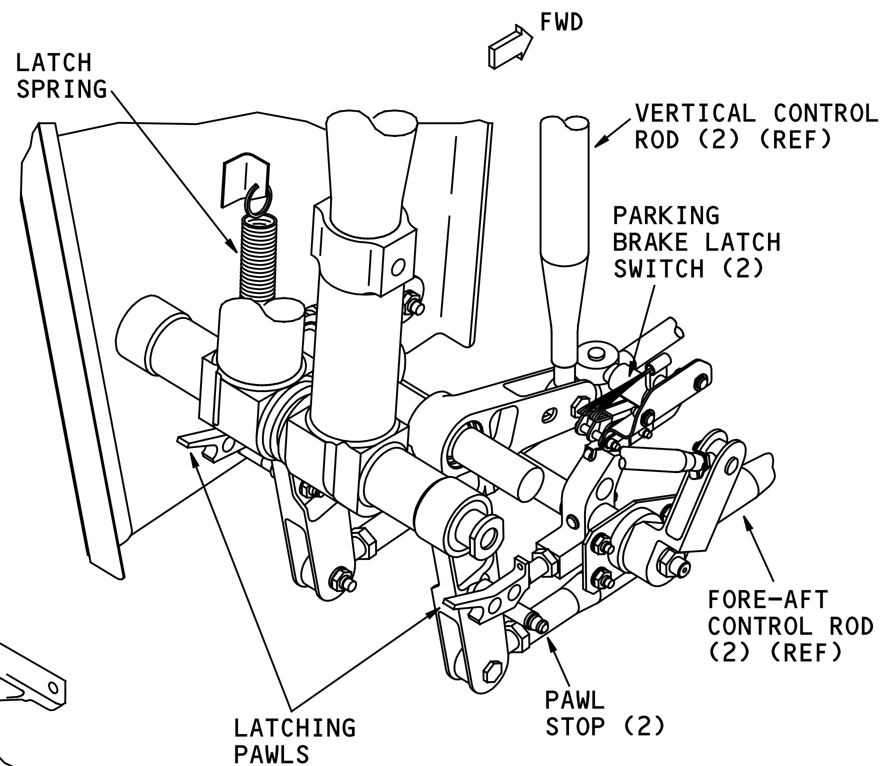
The latch spring pulls the pawls up and releases the parking brake latch when you push the pedals forward.

When you release the brake pedals, the parking brake latch switches send signals to open the parking brake valve.

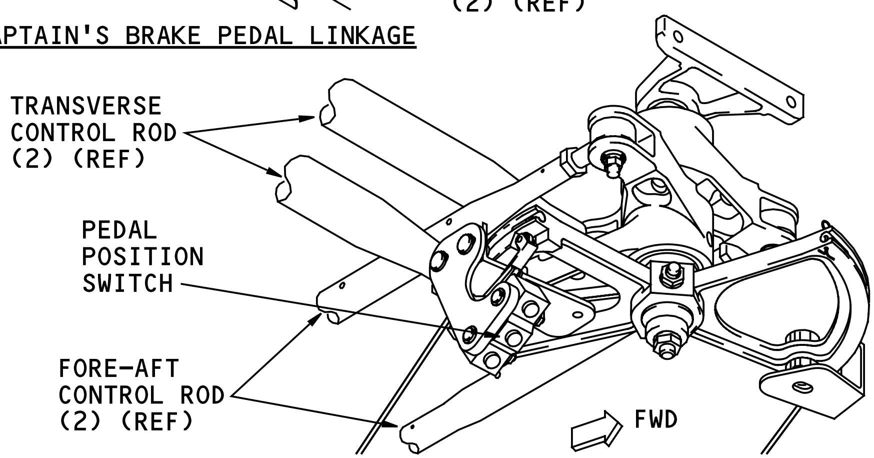
The pedal position switches turn on the brake-off light when both brake pedals are in the not-applied position.



CAPTAIN'S BRAKE PEDAL LINKAGE



PARKING BRAKE LATCH MECHANISM



CAPTAIN'S BRAKE PEDAL CABLE QUADRANT
(FIRST OFFICER'S SIMILAR)

PARKING BRAKE SYSTEM - PARKING BRAKE LATCH MECHANISM AND LATCH AND PEDAL POSITION SWITCHES

PARKING BRAKE - FUNCTIONAL DESCRIPTION - CONTROL AND PARKING BRAKE-SET LIGHT INDICATION

General

When the parking brake lever is set, one parking brake latch switch sends hot battery bus power to close the parking brake valve. The BSCU also monitors lever position through this switch.

Both parking brake latch switches send signals to the AIMS. The AIMS uses this data to monitor parking brake lever position for the warning electronics system and memo message display.

When the parking brake valve is fully closed, an internal switch uses hot battery bus power to energize the parking brake close relay.

Indication

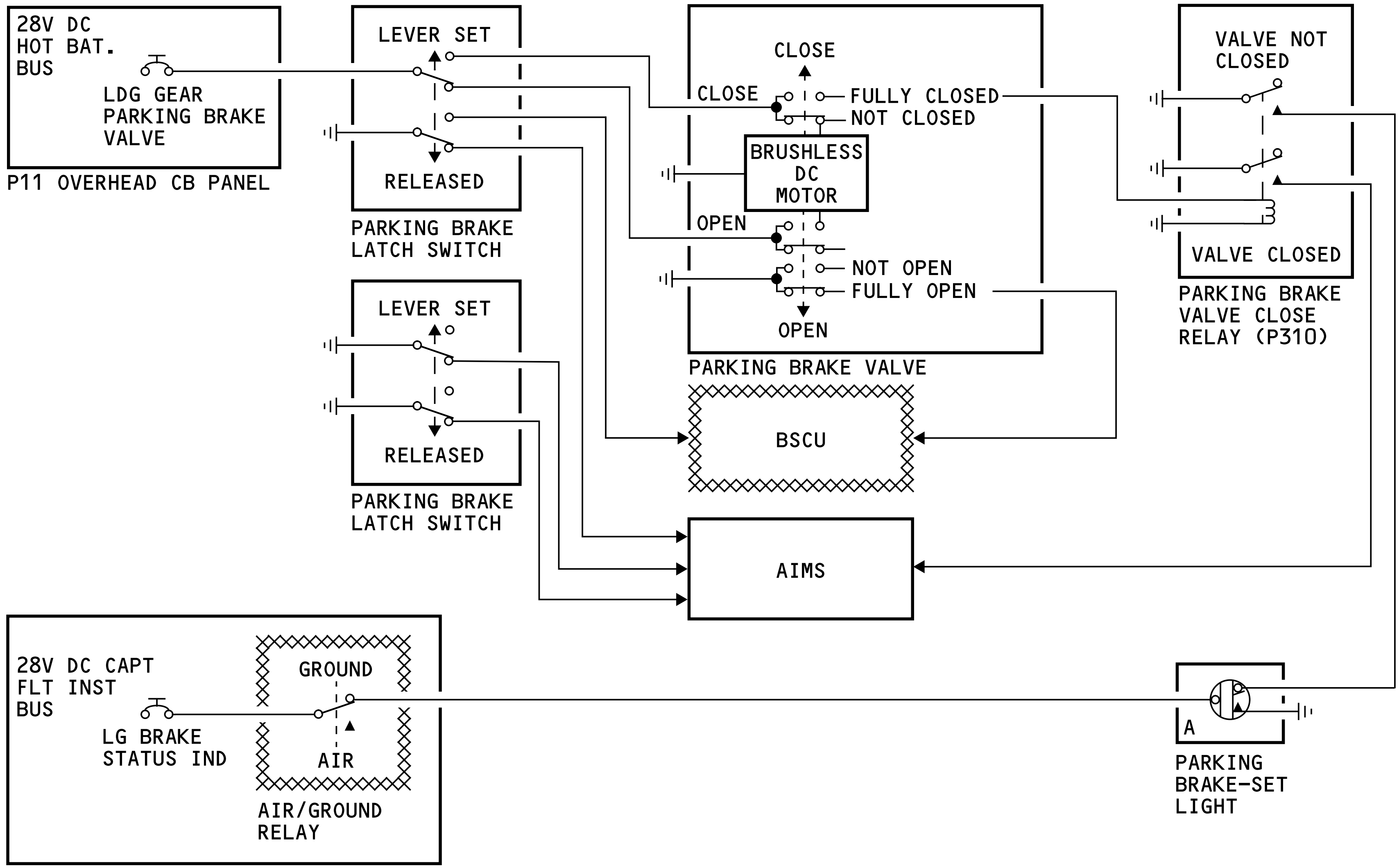
The parking brake close relay tells the AIMS to show the PARKING BRAKE SET memo message on the EICAS display. The close relay also turns on the parking brake set light on the nose gear when the airplane is on the ground.

Training Information Point

You can push-to-test the parking brake-set light.

If the parking brake valve is not fully open with the parking brake lever released, these messages will show:

- ANTISKID advisory message
- ANTISKID status message.



32-44-00-009 Rev 2 02/12/96

PARKING BRAKE - FUNCTIONAL DESCRIPTION - CONTROL AND PARKING BRAKE-SET LIGHT INDICATION

PARKING BRAKE SYSTEM - FUNCTIONAL DESCRIPTION - BRAKE-OFF AND BRAKE-ON LIGHT INDICATION

Brake-Off light Indication

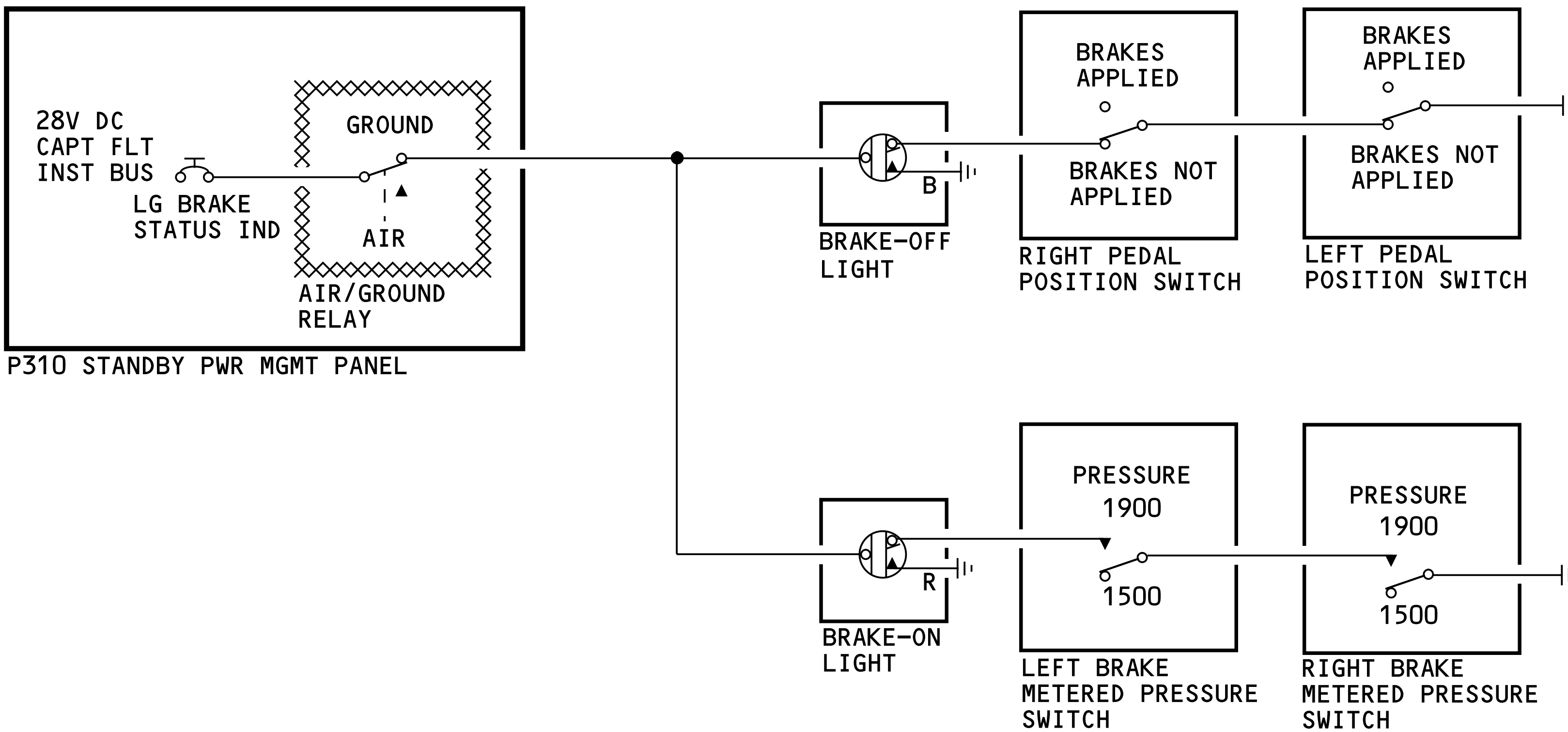
The brake-off light turns on when the airplane is on the ground and the left and right pedal position switches are in the brakes not-applied position.

Brake-On Light Indication

The brake-on light turns on when the airplane is on the ground and the left and right brake metered pressure switches get high metered brake pressure input.

Training Information Point

You can push-to-test the brake-on and the brake-off lights.



32-44-00-010 Rev 3 05/03/95

PARKING BRAKE SYSTEM - FUNCTIONAL DESCRIPTION - BRAKE-OFF AND BRAKE-ON LIGHT INDICATION

ANTISKID/AUTOBRAKE SYSTEM - INTRODUCTION

Purpose

The antiskid/autobrake system automatically controls brake metered pressure.

Antiskid System

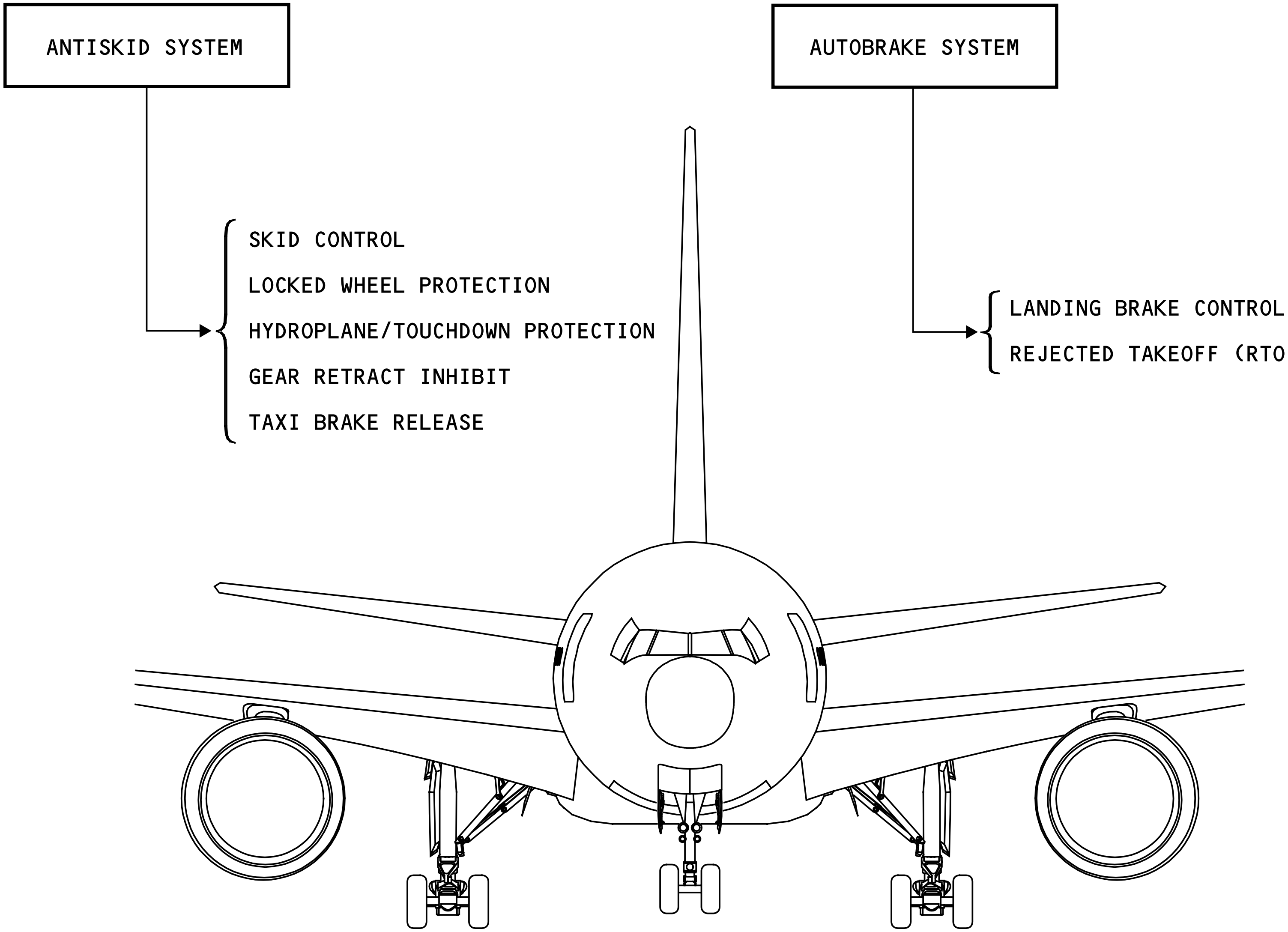
The antiskid system monitors wheel speed deceleration and controls brake pressure to prevent skid conditions. It also releases one third of the brakes during taxi to extend the brake service life.

Antiskid functions include:

- Skid control
- Locked wheel protection
- Hydroplane/touchdown protection
- Gear retract inhibit
- Taxi brake release.

Autobrake System

The autobrake system automatically supplies metered brake pressure to stop the airplane during landing or during a rejected takeoff (RTO).



32-42-00-001 Rev 0

ANTISKID/AUTOBRAKE SYSTEM - INTRODUCTION

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ANTISKID/AUTOBRAKE SYSTEM - GENERAL DESCRIPTION

General

The antiskid system limits metered brake pressure from the hydro-mechanical or the autobrake systems to prevent wheel skid. This permits maximum braking effectiveness with any runway condition.

Antiskid components for each MLG include:

- Antiskid transducer (6)
- Antiskid shuttle valve module (1)
- Normal antiskid valve module (1)
- Alternate antiskid valve module (1).

The autobrake system automatically applies the brakes to stop the airplane during landing or a rejected takeoff.

Autobrake components for the airplane include:

- Autobrake selector (1)
- Normal brake metered pressure transducer (2)
- Alternate brake metered pressure transducer (2)
- Autobrake valve module (1)
- Autobrake shuttle valve (2).

The brake system control unit (BSCU) controls antiskid and autobrake operation.

Inputs

The BSCU uses these inputs to control antiskid and autobrake operation:

- Truck tilt (PSEUs)
- Landing gear lever position (PSEUs)
- Air and inertial data (ADIRU)
- Speedbrake lever position (PFCs)
- Thrust lever position
- Parking brake valve position
- Parking brake lever position
- Right hydraulic system pressure
- Alternate brake system pressure
- Normal and alternate metered brake pressure
- Wheel speed
- Autobrake selector position.

Normal Antiskid Operation

The normal brake metering valves send metered pressure from the right hydraulic system or the accumulator through the autobrake shuttle valves to the normal antiskid valve modules. The BSCU sends signals to the normal antiskid valve modules to control the metered pressure to each brake. The metered pressure goes through the antiskid shuttle valve modules to the brakes.

An antiskid surge accumulator absorbs pressure surges in the return lines from the left normal antiskid valve module. The pressure surges can occur during antiskid operation. It is not necessary for the right normal antiskid valve to have a surge accumulator since it is near the right system reservoir.

ANTISKID/AUTOBRAKE SYSTEM - GENERAL DESCRIPTION

Alternate Antiskid Operation

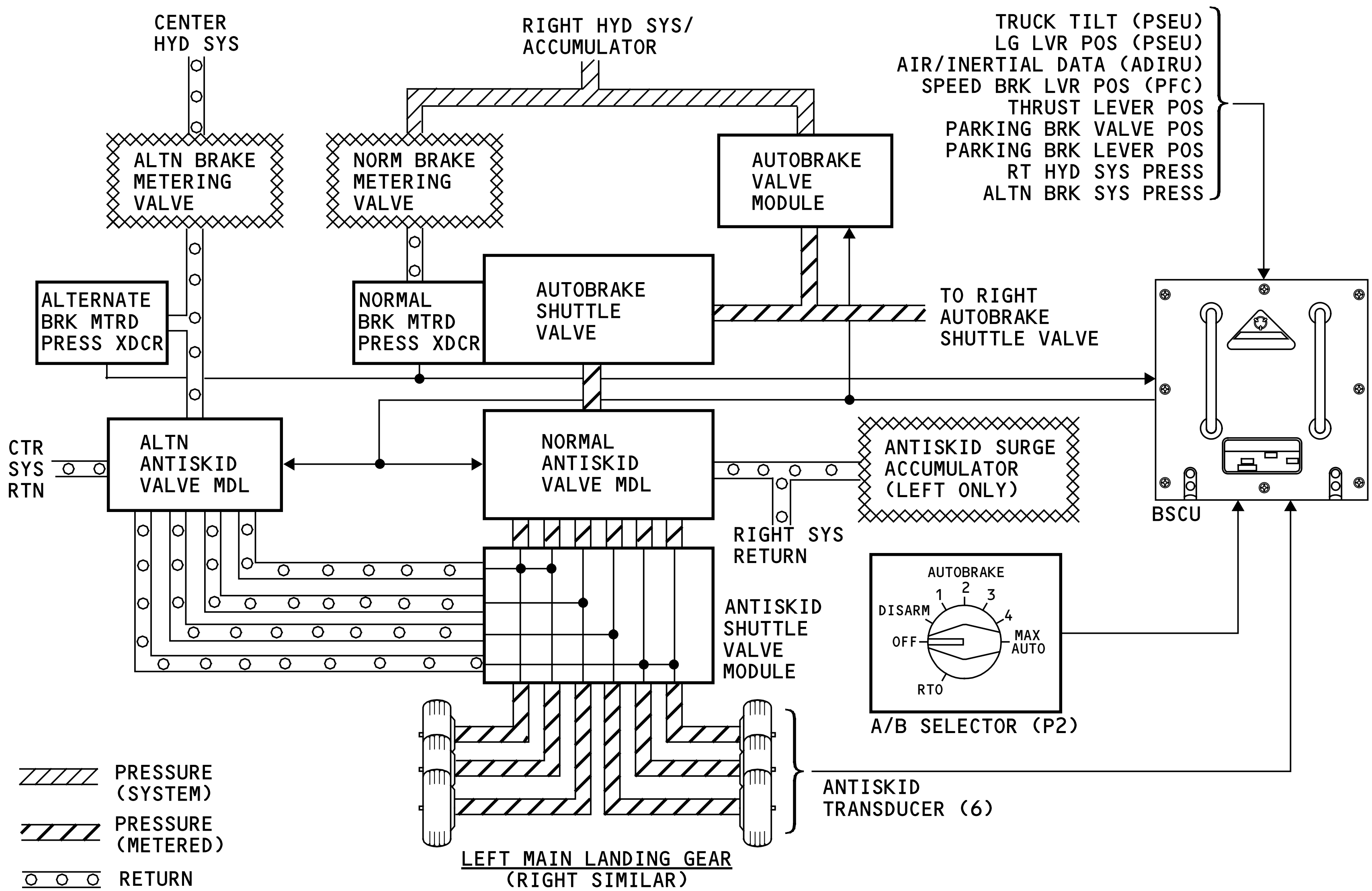
The alternate brake metering valves send metered pressure from the center hydraulic system to the alternate antiskid valve modules. The BSCU sends signals to the alternate antiskid valve modules to control the metered pressure to each aft brake and to forward-middle brake pairs. The metered pressure goes through the antiskid shuttle valve modules to the brakes.

Autobrake Operation

The BSCU sends signals to the autobrake valve module to control autobrake pressure to the normal brake system.

The autobrake valve module meters right hydraulic system pressure to the brakes. The autobrake pressure goes through the autobrake shuttle valves, the normal antiskid valves, and the antiskid shuttle valves.

The normal antiskid operates during autobrake operation.



ANTISKID/AUTOBRAKE SYSTEM - GENERAL DESCRIPTION

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ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE - GENERAL DESCRIPTION

Purpose

The autobrake system automatically applies the brakes to stop the airplane during landing or a rejected takeoff.

The BSCU controls autobrake operation. Other autobrake components include:

- The autobrake selector
- Normal brake metered pressure transducer (2)
- Alternate brake metered pressure transducer (2)
- The autobrake valve module
- The autobrake shuttle valve (2) (Not shown).

Autobrake Selector

The autobrake selector permits the pilot to select a rate of deceleration to the BSCU for landing autobrake or rejected takeoff operation.

Brake System Control Unit (BSCU) Inputs

The BSCU gets the following inputs from the left and right ARINC 629 system buses:

- PFC speed brake lever position
- PSEU truck tilt
- ADIRU groundspeed
- ADIRU deceleration
- AIMS test request.

Other inputs the BSCU gets from outside the autobrake system are:

- Wheelspeed
- Thrust lever position
- Normal/alternate brake pressure
- Antiskid faults.

Brake Metered Pressure Transducers

Two brake metered pressure transducers in the normal brake system and two in the alternate brake system send metered brake pressure data to the BSCU.

Autobrake Valve Module

The autobrake valve module sends metered right hydraulic system pressure to the autobrake shuttle valve for the normal brake system.

Autobrake Shuttle Valve (Not Shown)

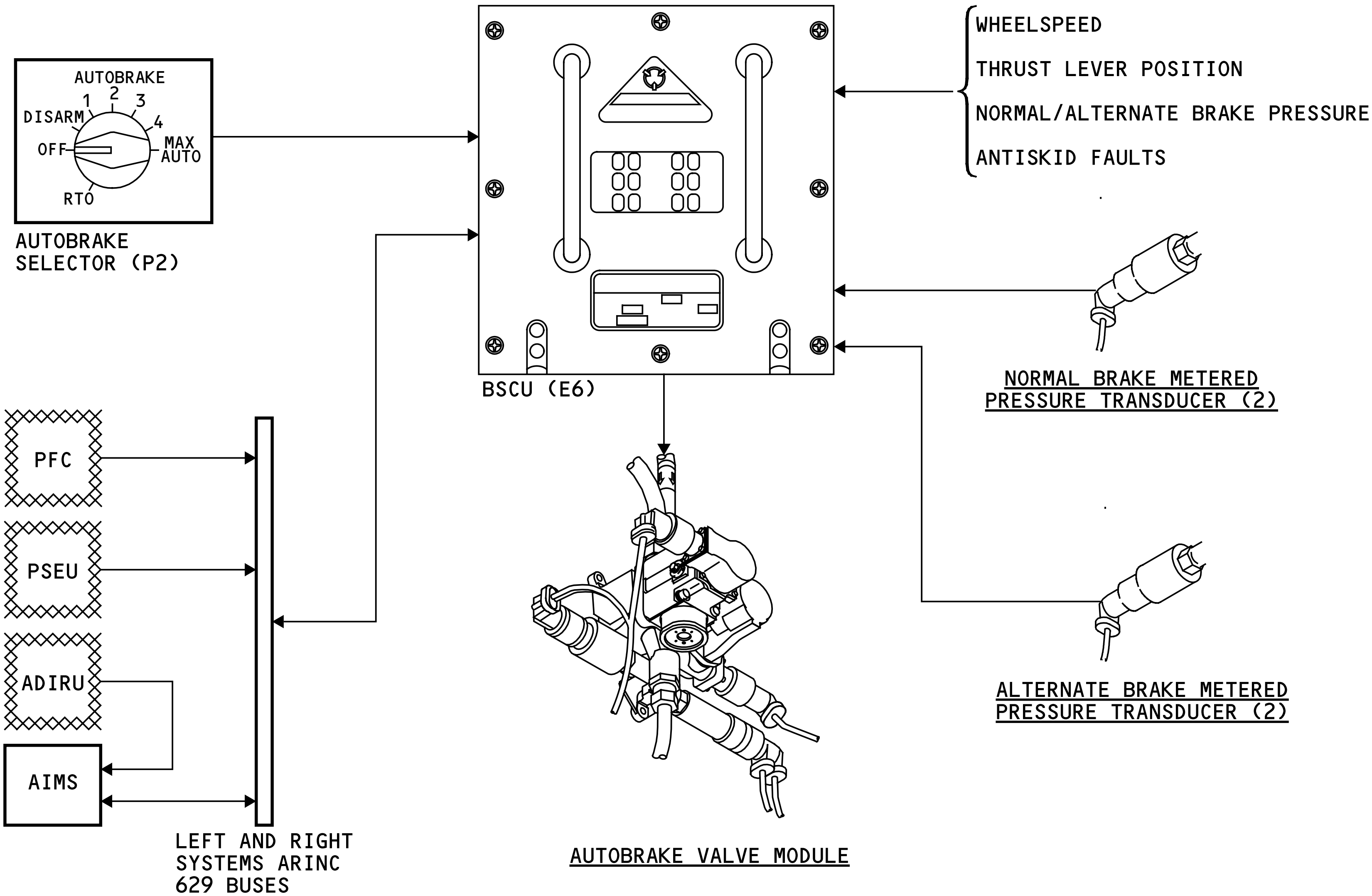
The autobrake shuttle valve sends autobrake valve module metered pressure to the normal brake system. It does this when normal brake metering valve pressure is lower than autobrake pressure.

General Description

You select an autobrake landing rate of deceleration or RTO with the autobrake selector.

ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE - GENERAL DESCRIPTION

When all conditions for arming and application are met, the BSCU controls the autobrake valve module. The autobrake valve module sends right system hydraulic pressure to the brakes through the normal brake system.



32-42-00-003 Rev 1

ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE - GENERAL DESCRIPTION

ANTISKID/AUTOBRAKE SYSTEM - COMPONENT LOCATIONS

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ANTISKID/AUTOBRAKE SYSTEM - COMPONENT LOCATIONS

General

These are the antiskid/autobrake system components:

- Autobrake selector
- Antiskid transducer (12)
- Brake system control unit (BSCU)
- Normal brake metered pressure transducer (2)
- Autobrake shuttle valve (2)
- Autobrake valve module
- Antiskid shuttle valve module (2)
- Normal antiskid module (2)
- Alternate antiskid module (2)
- Alternate brake metered pressure transducer (2).

Autobrake Selector

The autobrake selector is on the P2 center forward panel below the landing gear control lever.

Antiskid Transducer

There is an antiskid transducer for each main landing gear wheel in the each axle.

Brake System Control Unit (BSCU)

The BSCU is on the E6 rack in the aft cargo compartment.

Normal Brake Metered Pressure Transducer

The normal brake metered pressure transducers are on the autobrake shuttle valves in the left and right main wheel wells.

Autobrake Shuttle Valve

Autobrake shuttle valves are in the left and the right main gear wheel wells on the forward walls inboard of the brake metering valves.

Autobrake Valve Module

The autobrake valve module is on the keel beam in the forward section of the right main wheel well.

Antiskid Shuttle Valve Module

Antiskid shuttle valve modules are outboard of the main landing gear trunnions. They are below the normal antiskid modules.

Normal Antiskid Module

Normal antiskid modules are forward of the left and the right main landing gear beams outboard of the main landing gear trunnions.

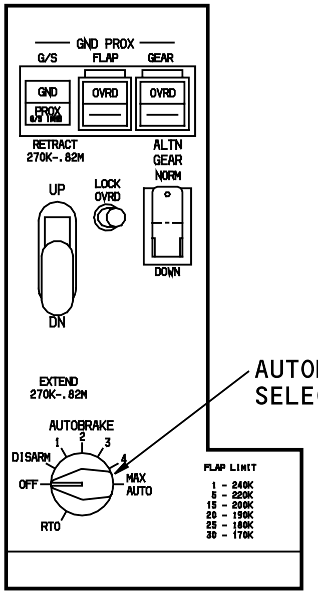
Alternate Antiskid Module

Alternate antiskid modules are on the main landing gear beams inboard of the main landing gear trunnions.

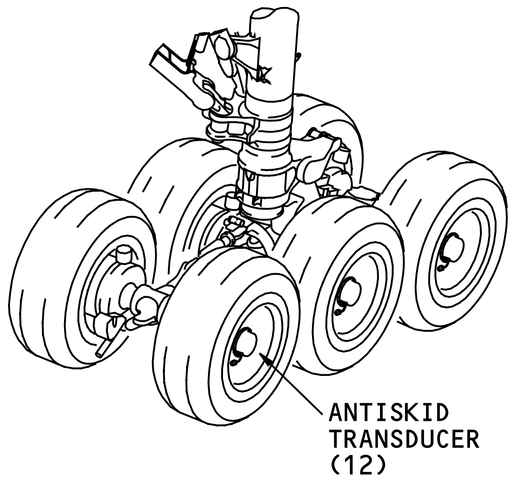
ANTISKID/AUTOBRAKE SYSTEM - COMPONENT LOCATIONS

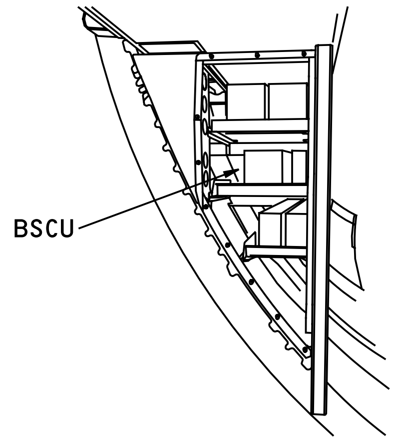
Alternate Brake Metered Pressure Transducer

The alternate brake metered pressure transducers are on the landing gear beams inboard of the alternate antiskid valves.

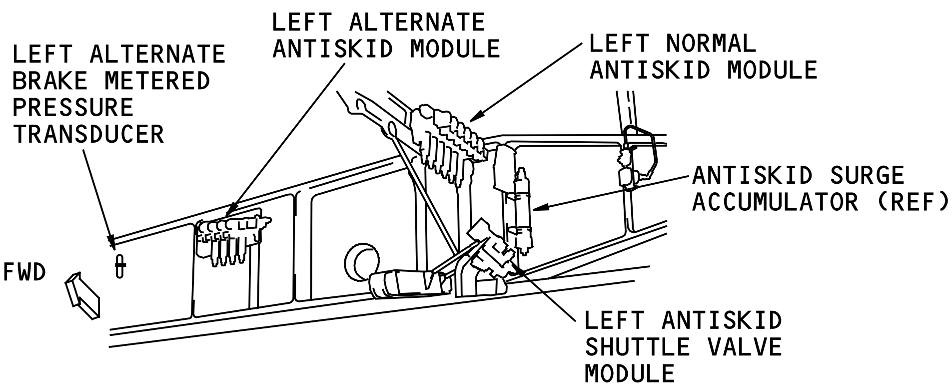


P2 CENTER FORWARD PANEL

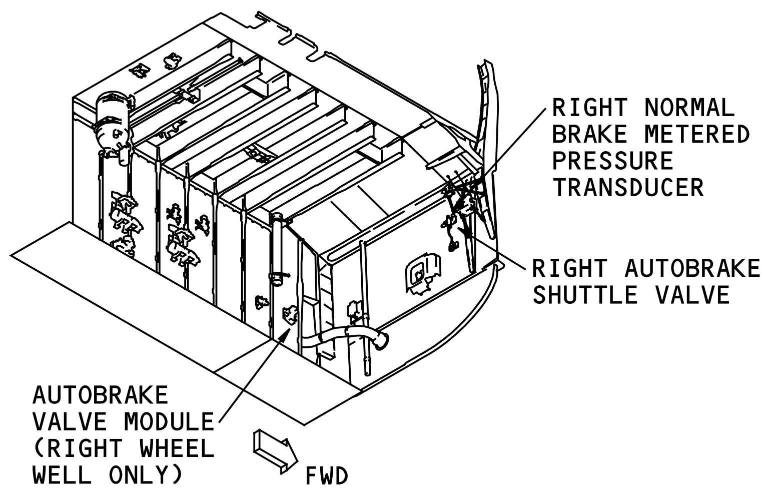




E6 RACK (AFT CARGO COMPARTMENT)



LEFT MAIN LANDING BEAM
(RIGHT SIMILAR)



RIGHT MAIN LANDING GEAR WHEEL WELL
(LEFT SIMILAR)

32-42-00-004 Rev 2

ANTISKID/AUTOBRAKE SYSTEM - COMPONENT LOCATIONS

ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE SELECTOR

Purpose

The autobrake selector permits selection of a landing autobrake deceleration rate or the rejected takeoff function.

Location

The autobrake selector is on the P2 center forward panel below the landing gear handle.

Functional Description

The autobrake selector is an eight-position selector. A latch solenoid holds the selector in all positions except OFF and DISARM. The BSCU controls the latch solenoid. If a disarm condition occurs when the selector is in 1 through MAX AUTO, the latch solenoid releases the selector to DISARM.

To move the selector from OFF to DISARM or from DISARM to OFF, push the selector when you turn it. To move the selector to the RTO position, pull the selector when you turn it.

Positions 1 through MAX AUTO set the rate of deceleration for autobrake operation after landing. For each level of deceleration, the BSCU controls the autobrake pressure to a maximum limit. The BSCU uses a 0.1 second time delay before landing autobrake application.

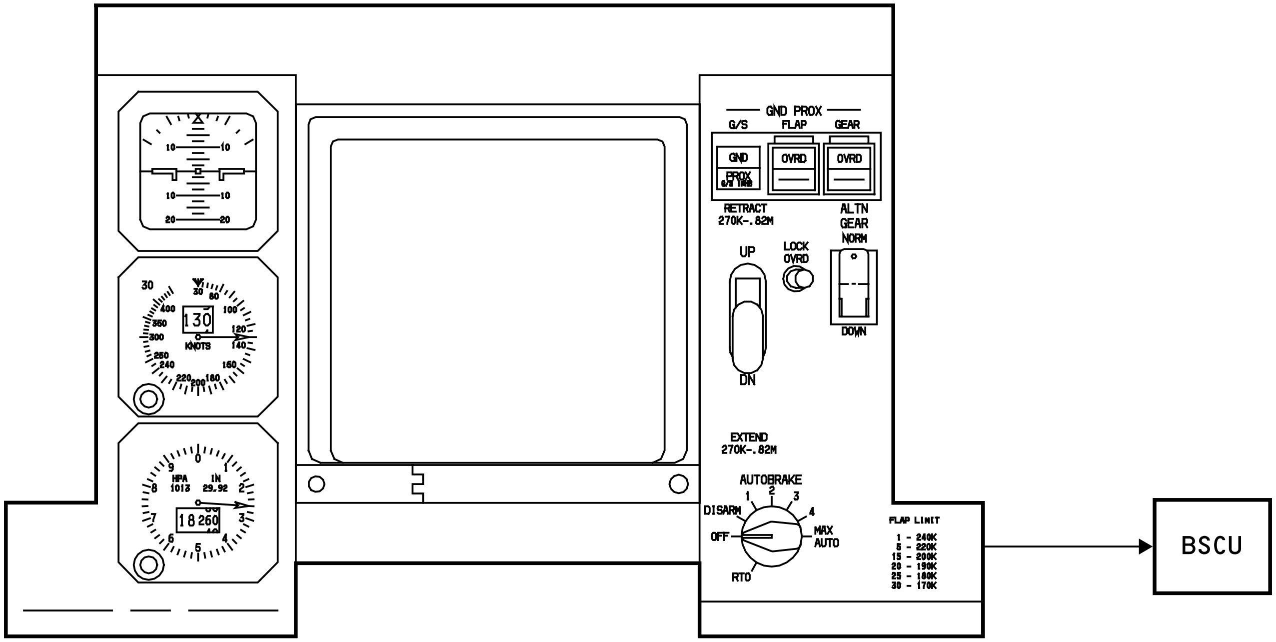
The RTO position commands maximum brake pressure for a rejected takeoff. There is no time delay before RTO autobrake application.

The latch solenoid releases the selector from the RTO position to the OFF position when the airplane goes in the air.

Training Information Point

One of these memo messages shows when the autobrake selector is in a landing autobrake position or in the RTO position:

- AUTOBRAKE 1
- AUTOBRAKE 2
- AUTOBRAKE 3
- AUTOBRAKE 4
- AUTOBRAKE MAX
- AUTOBRAKE RTO.



P2 CENTER FORWARD PANEL

SW POS	DECELERATION LEVEL (FT/SEC2)	MAX COMMAND PRESS (PSI)	DELAY AFTER GND SIG (SEC)
1	4.0	1,385	0.1
2	5.0	1,600	0.1
3	6.0	1,850	0.1
4	7.5	2,150	0.1
MAX AUTO	11.0	3,100	0.1
RTO	MAX	3,100	--

32-42-00-005 Rev 4 10/15/96

ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE SELECTOR

ANTISKID/AUTOBRAKE SYSTEM - ANTISKID TRANSDUCER

Purpose

Antiskid transducers supply wheel speed data to the BSCU to get wheel deceleration input. These data also goes to the BSCU for autobrake operation.

Location

There are twelve antiskid transducers. The antiskid transducer is in a support in each main landing gear axle.

Functional Description

Antiskid transducers are permanent magnetic devices with an internal rotor and stator.

An antiskid transducer cup attaches to the hubcap through a flexible bellows assembly. This bellows assembly makes installation adjustment allowances when it compresses. The hubcap turns with the MLG wheel. The cup connects to the antiskid transducer drive dog which turns the rotor in the antiskid transducer.

Training Information Point

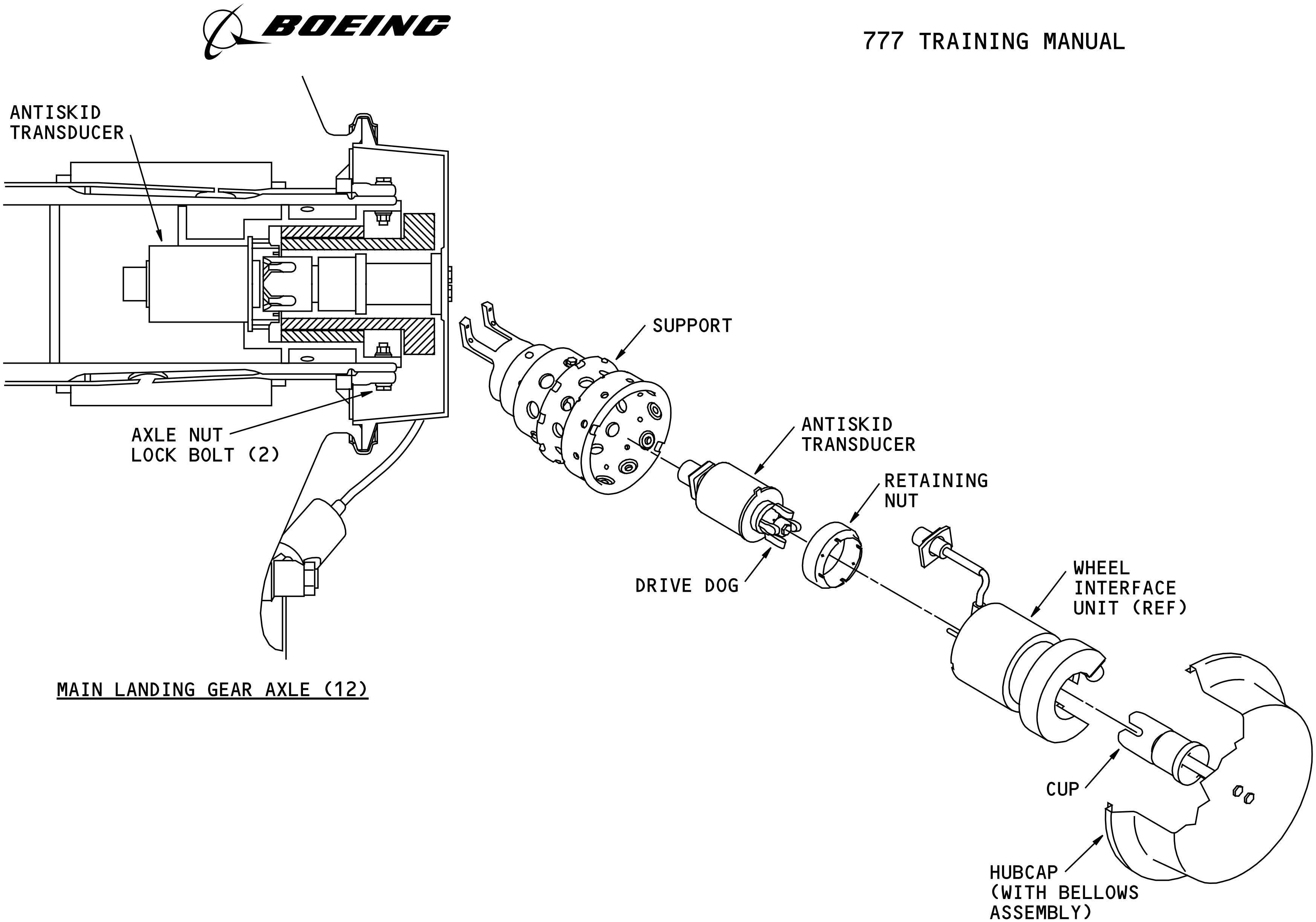
The transducer is an LRU.

The antiskid transducer is part of an in-axle assembly. These components make up the in-axle assembly:

- Wheel interface unit
- Antiskid transducer
- Support.

You remove the in-axle assembly from the axle as a unit to get access to the antiskid transducer.

The system can operate with one unserviceable transducer on each six wheel truck if no other brake on that truck is deactivated.



32-42-00-006 Rev 3 03/19/1997

ANTISKID/AUTOBRAKE SYSTEM - ANTISKID TRANSDUCER

ANTISKID/AUTOBRAKE SYSTEM - BRAKE SYSTEM CONTROL UNIT (BSCU) - INTRODUCTION

Purpose

The brake system control unit (BSCU) contains circuit cards for the antiskid and autobrake systems, and related BITE functions.

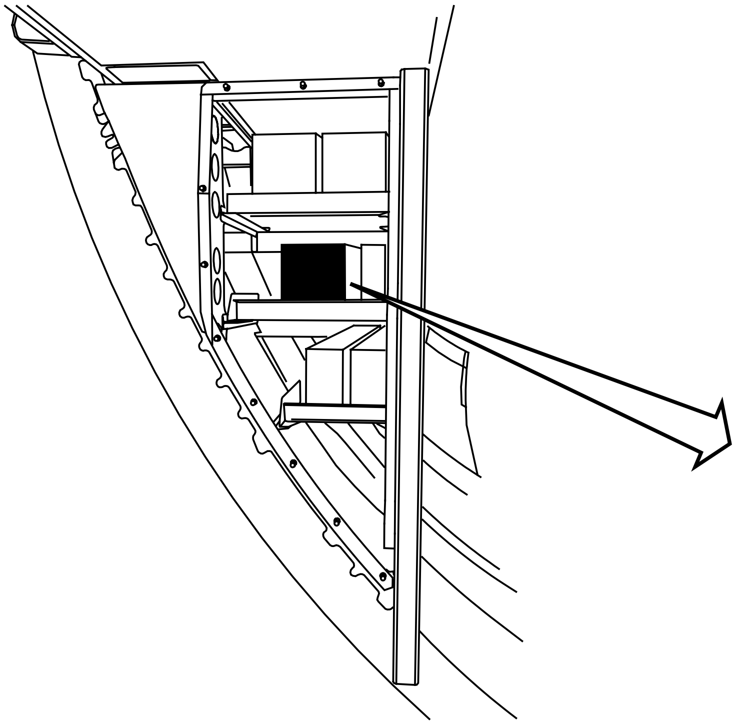
It sends brake release inputs to the antiskid valve modules and brake application inputs to the autobrake valve module.

The BSCU also:

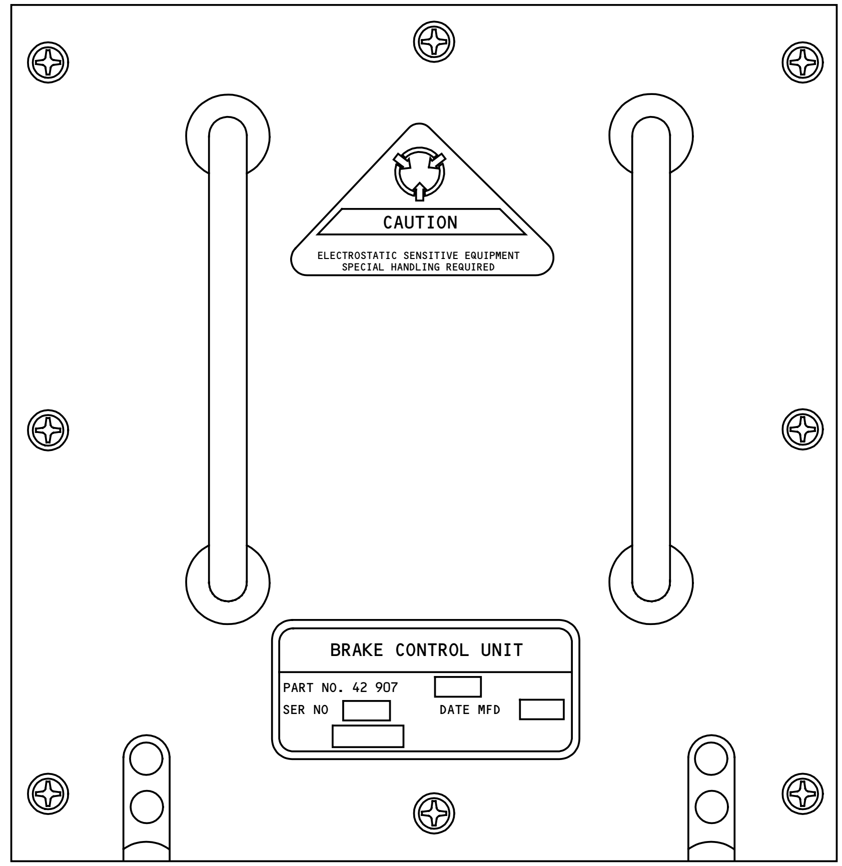
- Monitors the antiskid and autobrake systems for faults
- Communicates with other airplane systems
- Does the built-in-test functions.

Location

The BSCU is on the E6-2 shelf in the aft cargo compartment.



AFT CARGO COMPARTMENT (E6 RACK)



BSCU

32-42-00-007 Rev 2 08/27/1996

ANTISKID/AUTOBRAKE SYSTEM - BRAKE SYSTEM CONTROL UNIT (BSCU) - INTRODUCTION

ANTISKID/AUTOBRAKE SYSTEM - ANTISKID MODULES - INTRODUCTION

Purpose

There are two normal antiskid modules and two alternate antiskid modules in the antiskid system.

These modules release brake pressure to prevent wheel skids.

Location

The normal antiskid modules are near the main landing gear beams outboard of the main landing gear trunnions. An access panel permits you to get access to the normal antiskid valve modules.

The alternate antiskid modules are on the main landing gear beams inboard of the main landing gear trunnions.

Normal Antiskid Modules

There are two normal antiskid modules: one for each main landing gear. The modules are the same. Each module has six valves.

The modules are LRUs and each module contains these LRUs:

- Inlet filter (2)
- System pressure shutoff valve
- Antiskid valve (6)
- Hydraulic fuse (6).

Alternate Antiskid Modules

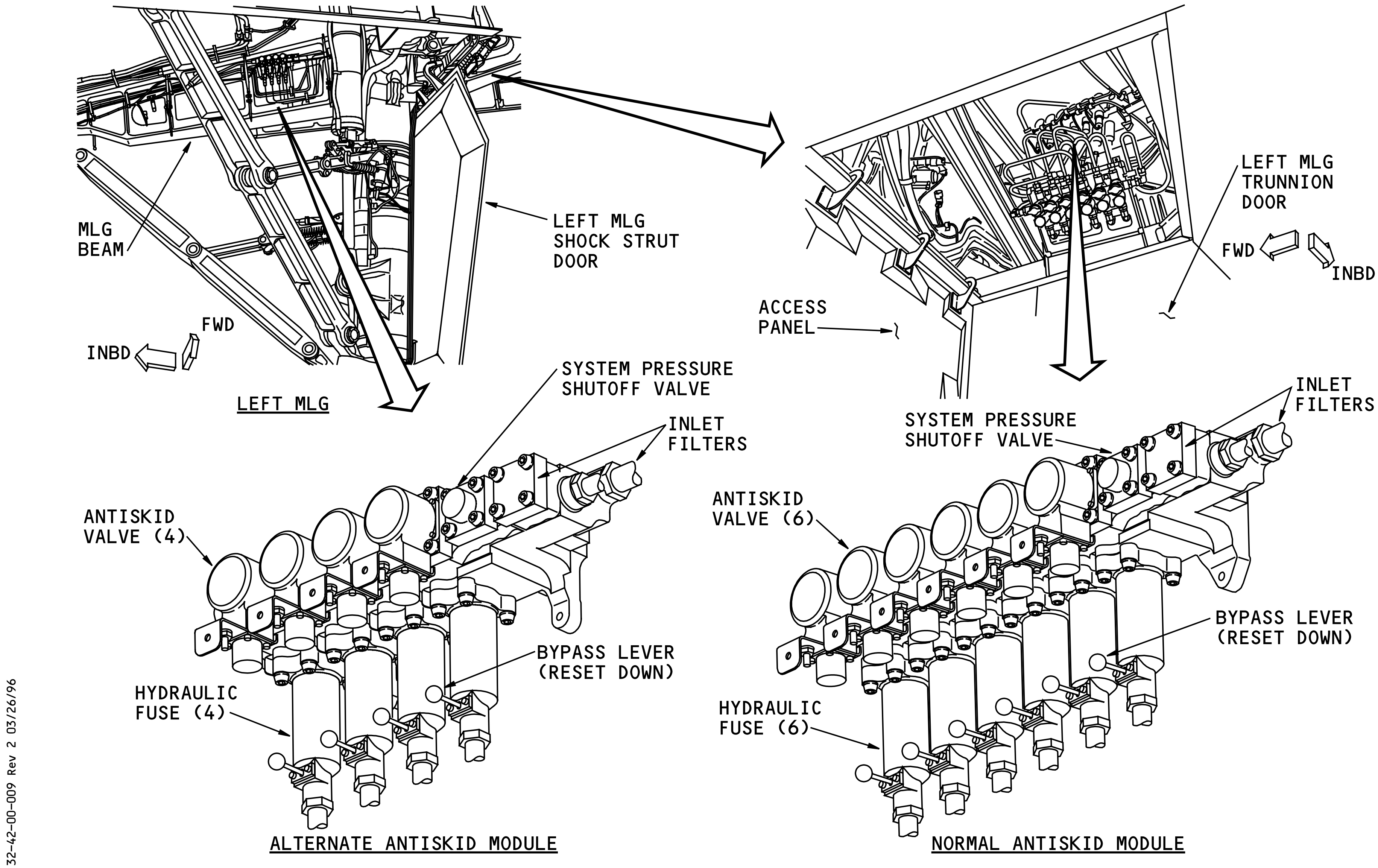
There are two alternate antiskid modules: one for each main landing gear. The modules are the same. Each module has four valves.

The modules are LRUs and each module contains these LRUs:

- Inlet filter (2)
- System pressure shutoff valve
- Antiskid valve (4)
- Hydraulic fuse (4).

Training Information Point

The system can operate with one unserviceable normal antiskid valve for each six wheel truck. You must deactivate the related brake.



ANTISKID/AUTOBRAKE SYSTEM - ANTISKID MODULES - INTRODUCTION

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ANTISKID/AUTOBRAKE SYSTEM - ANTISKID MODULES - FUNCTIONAL DESCRIPTION

General

The operation of normal and alternate antiskid modules is the same. The number of antiskid valves and hydraulic fuses is the only difference in the two modules.

The normal antiskid module controls brake pressure for six wheels independently. The alternate antiskid module controls two wheels independently and two sets of paired wheels with the other two antiskid valves.

Inlet Filters

An in-line filter screen removes contamination from brake metered pressure fluid as it enters the antiskid module.

System pressure fluid also goes through a filter as it enters the antiskid module.

System Pressure Shutoff Valve

When brake metered pressure is above 225 psig, the system pressure shutoff valve supplies system pressure, if available, to the first stage of each antiskid valve. This provides a constant 3000 psi pressure level for pressure control.

When brake metered pressure is less than 225 psig, system pressure closes the shutoff valve. This prevents wear of first stage components by constant application of system pressure. When the shutoff valve is closed, it uses metered pressure to control the first stage.

Antiskid Valve

Each antiskid valve is a three-way, unigain control valve. The valves have two stages of control:

- The first stage controls pressure in proportion to input current from the BSCU
- The second stage keeps pressure to the brakes equal to the first stage controlled pressure.

The first stage uses a current controlled flapper between two nozzles to adjust first stage pressure. One nozzle connects to system pressure and the other connects to return.

When no current goes to the valve, the flapper moves against the return nozzle. In this position, control pressure is the same as system pressure.

When full current goes to the valve, the flapper moves against the pressure nozzle. In this position, control pressure is the same as return pressure.

For each intermediate value of input current, the flapper moves between the two nozzles to adjust the control pressure (shown).

The second stage uses a spool valve that moves with first stage control pressure and a spring on one end and metered brake pressure on the other end.

When there is no metered brake pressure, the spring holds the spool in position to send initial brake metered pressure to fill the brakes before the shutoff valve opens.

When control pressure is more than metered brake pressure, the spool moves to send metered brake pressure to the brakes.

During antiskid operation, the spool operates to control brake pressure equal to first stage control pressure. It sends excess brake pressure to system return. A flow restrictor slows spool movement.

Hydraulic Fuse

Brake line fuses prevent fluid loss caused by external leakage downstream of the antiskid modules.

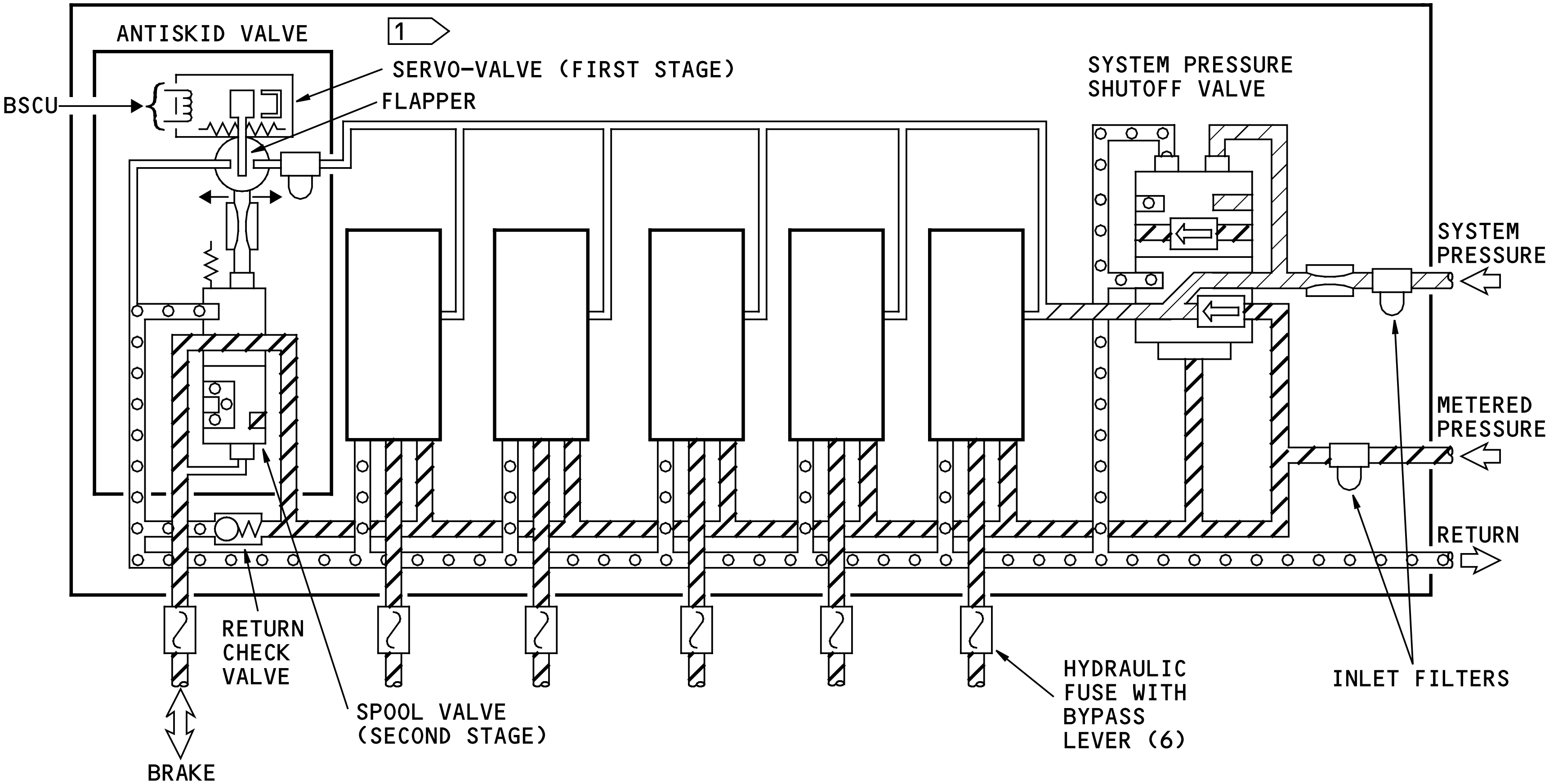
If 60 to 95 cubic inches of fluid pass through the fuse, it closes. When the pressure differential across the fuse is between 18 to 30 psi, the fuse automatically resets.

A bypass lever permits manual reset of the fuse. To reset manually, move the lever down to operate a bypass valve that equalizes pressure on each side of the fuse.

There is no indication that a fuse is set.

Return Check Valve

If the return line is blocked and metered pressure is less than return pressure, the return check valve releases brake pressure to metered pressure.



NORMAL ANTISKID MODULE (ALTERNATE ANTISKID MODULE SIMILAR)

LEGEND

PRESSURE (SYSTEM)

PRESSURE (METERED)

RETURN

1 INTERNALS SHOWN FOR ONE VALVE ONLY. OTHER VALVES ARE THE SAME.

32-42-00-010 Rev 2

ANTISKID/AUTOBRAKE SYSTEM - ANTISKID MODULES - FUNCTIONAL DESCRIPTION

ANTISKID/AUTOBRAKE SYSTEM - ANTISKID SHUTTLE VALVE MODULE

Purpose

Two shuttle valve modules automatically select the highest metered pressure source and send it to the brakes.

Components

The shuttle valve modules are the same for the left and the right. Each module is an LRU and contains these LRUs:

- Cartridge valves (6)
- Filters (6)
- A flight dispatch disconnect.

Location

The modules are forward of the left and right main landing gear beams. They are outboard of the main landing gear below the normal antiskid modules.

You get access to the modules through an access panel outboard of each main landing gear.

Functional Description

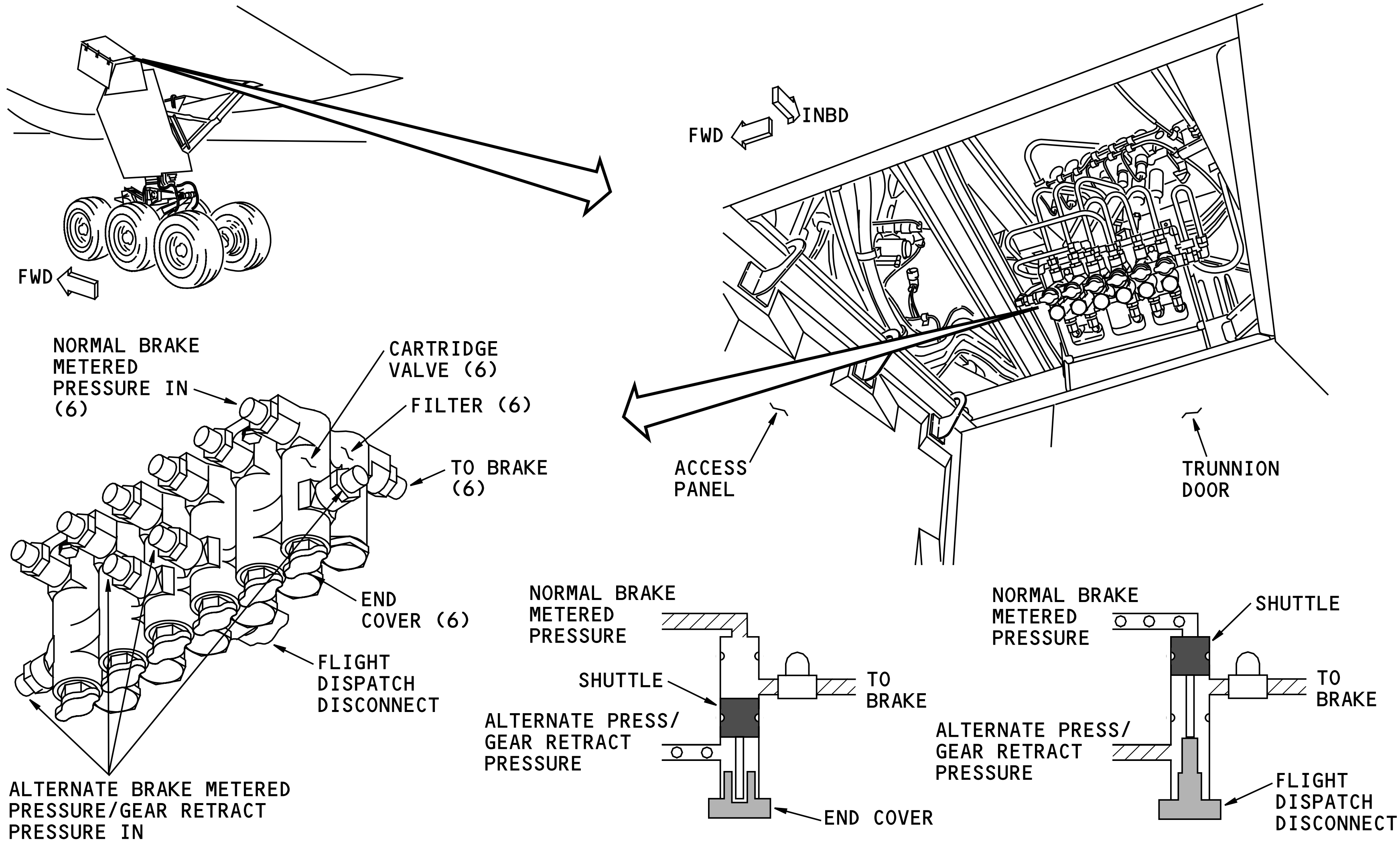
Each shuttle valve moves to a detented position to connect the input line with the higher metered pressure to the related brake line. The line with the lower pressure is blocked.

Fluid to each brake is put through a filter before it goes out of the module.

You use the shuttle valve to deactivate a brake in the normal brake system. To lock the related shuttle valve in the ALTERNATE position, you remove the end cover and install the flight dispatch disconnect. This permits gear retract pressure to the related brake with the normal brake deactivated.

Training Information Point

The system can operate with one brake on each six wheel truck deactivated.



LEFT ANTISKID SHUTTLE VALVE MODULE
(RIGHT SIMILAR)

SHUTTLE VALVE
WITH NORMAL BRAKE
METERED PRESSURE

SHUTTLE VALVE
WITH FLIGHT DISPATCH
DISCONNECT INSTALLED

ANTISKID/AUTOBRAKE SYSTEM - ANTISKID SHUTTLE VALVE MODULE

32-42-00-011 Rev 2 11/09/1995

ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE VALVE MODULE

Purpose

The autobrake valve module gets BSCU electrical signals to send right hydraulic system pressure to the normal brake system during autobrake operation.

Components

The autobrake valve module is an LRU and contains these LRUs:

- Solenoid valve
- Solenoid valve pressure switch
- Control valve
- Control valve pressure transducer.

There is also a shutoff valve inside the module.

Location

The autobrake valve module is on the keel beam in the right main landing gear wheel well.

Functional Description

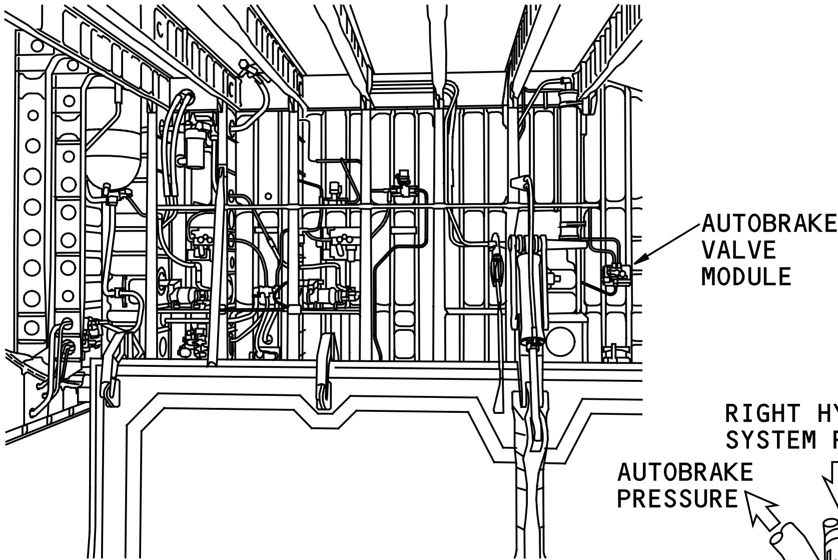
When the autobrake function does not operate, the solenoid valve is not energized. This stops hydraulic pressure downstream of the solenoid valve. During autobrake operation, the BSCU energizes the solenoid valve. This causes the solenoid valve to send right hydraulic system pressure to the shutoff valve.

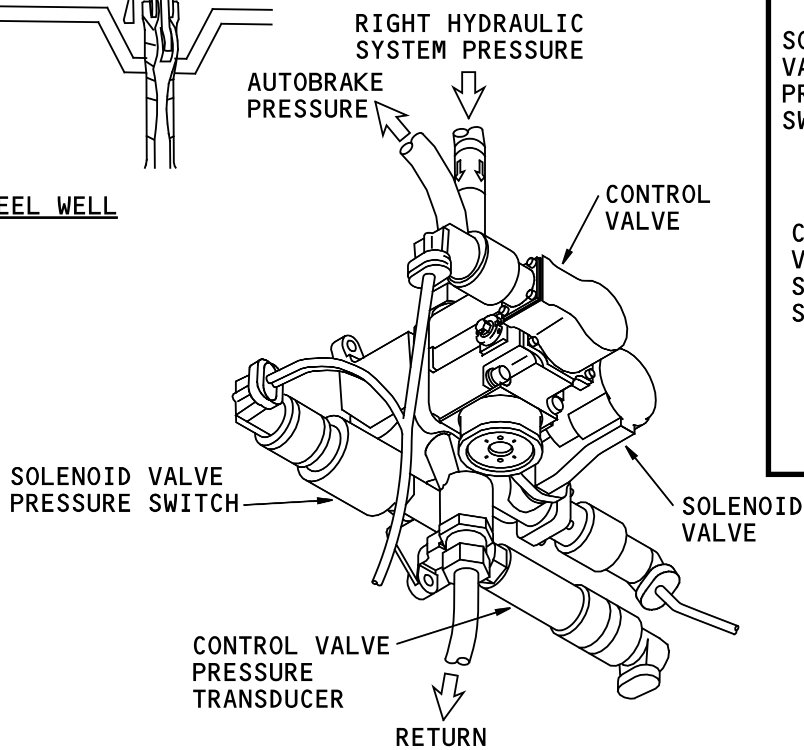
This pressure causes the shutoff valve to open and permits the system pressure to go to the control valve.

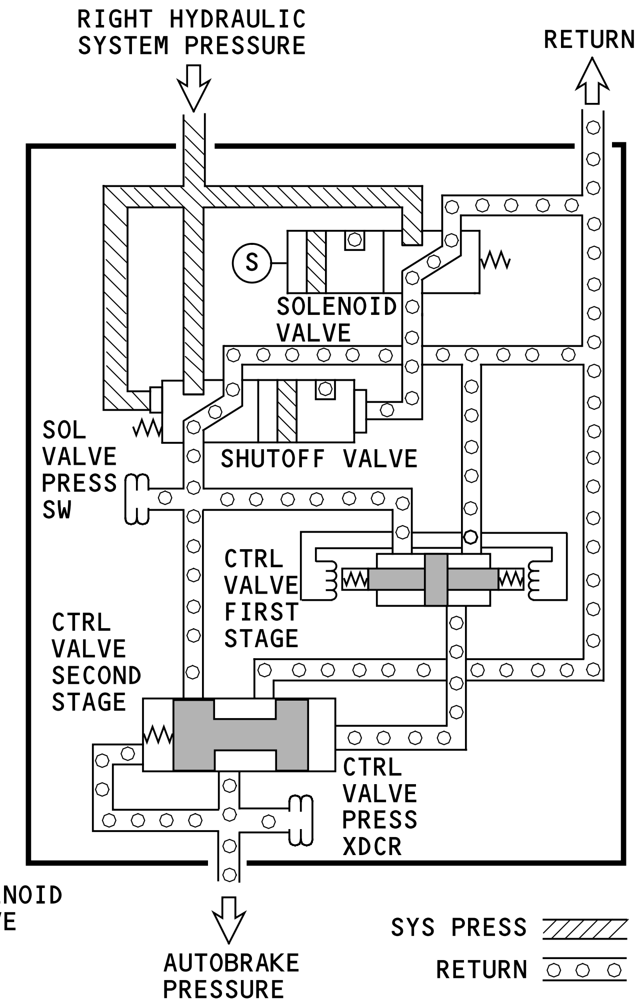
The solenoid valve pressure switch sends a signal to the BSCU when the pressure downstream of the shutoff valve is more than 750 psi. The BSCU uses this signal to find solenoid valve faults.

The control valve is a two-stage servo-operated valve. The BSCU controls this valve to let the necessary hydraulic pressure to go to the brakes.

The control valve pressure transducer sends autobrake pressure output signals to the BSCU for feedback.







ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE VALVE MODULE

ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE SHUTTLE VALVE

Purpose

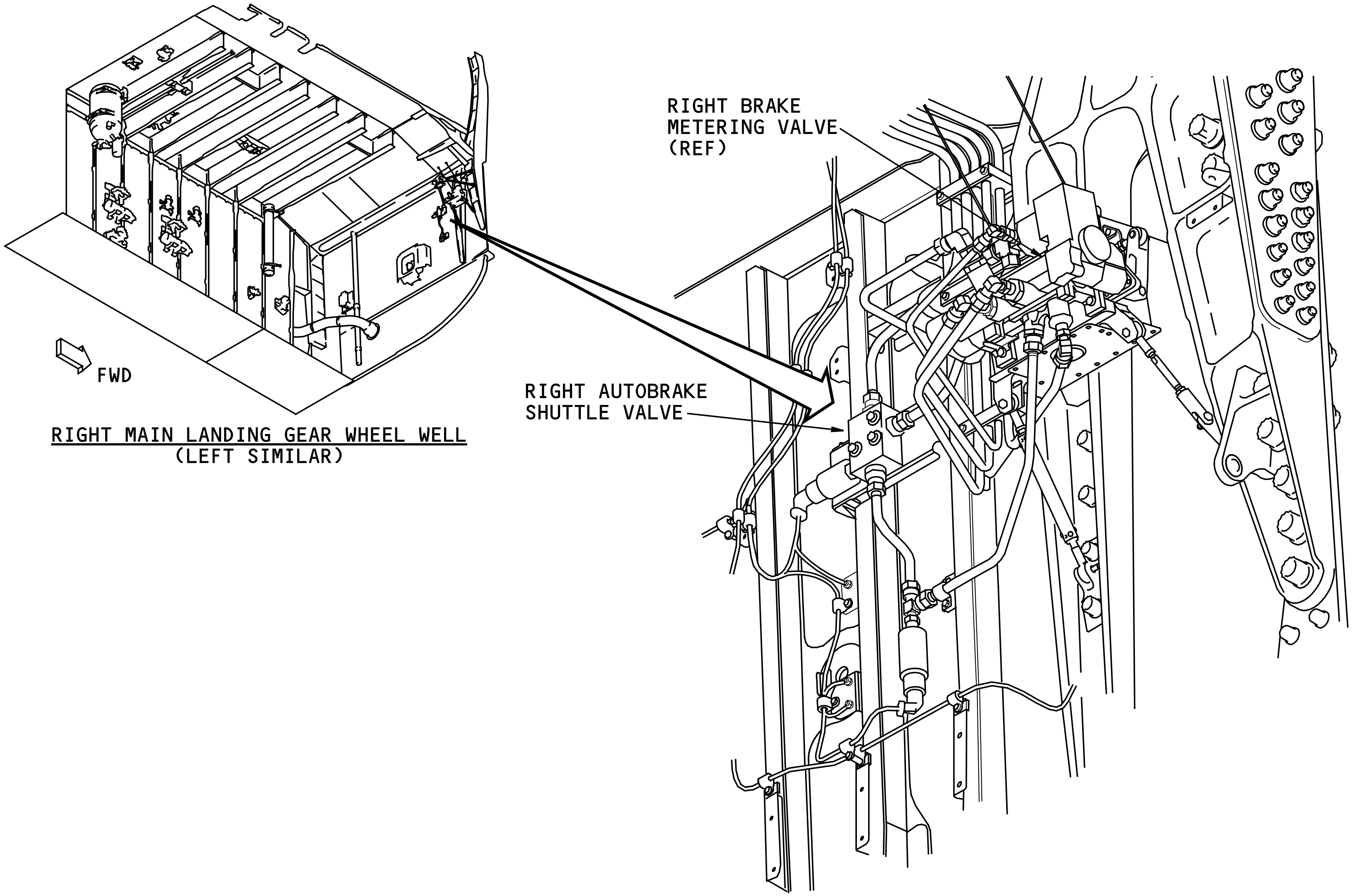
Two autobrake shuttle valves select the highest of autobrake or normal brake metered pressures and send it to the brakes.

Location

The autobrake shuttle valves are on the forward wall in the left and right main landing gear wheel wells. They are inboard of the brake metering valves.

Physical Description

The valves are un-biased shuttle valves with detents and are interchangeable.



32-42-00-013 Rev 0

ANTISKID/AUTOBRAKE SYSTEM - AUTOBRAKE SHUTTLE VALVE

ANTISKID/AUTOBRAKE SYSTEM - BRAKE METERED PRESSURE TRANSDUCERS

Purpose

Four brake metered pressure transducers send normal and alternate metered pressure information to the BSCU for anti-skid and autobrake control.

Location

The two normal brake metered pressure transducers are on the left and right autobrake shuttle valves in the main landing gear wheel wells.

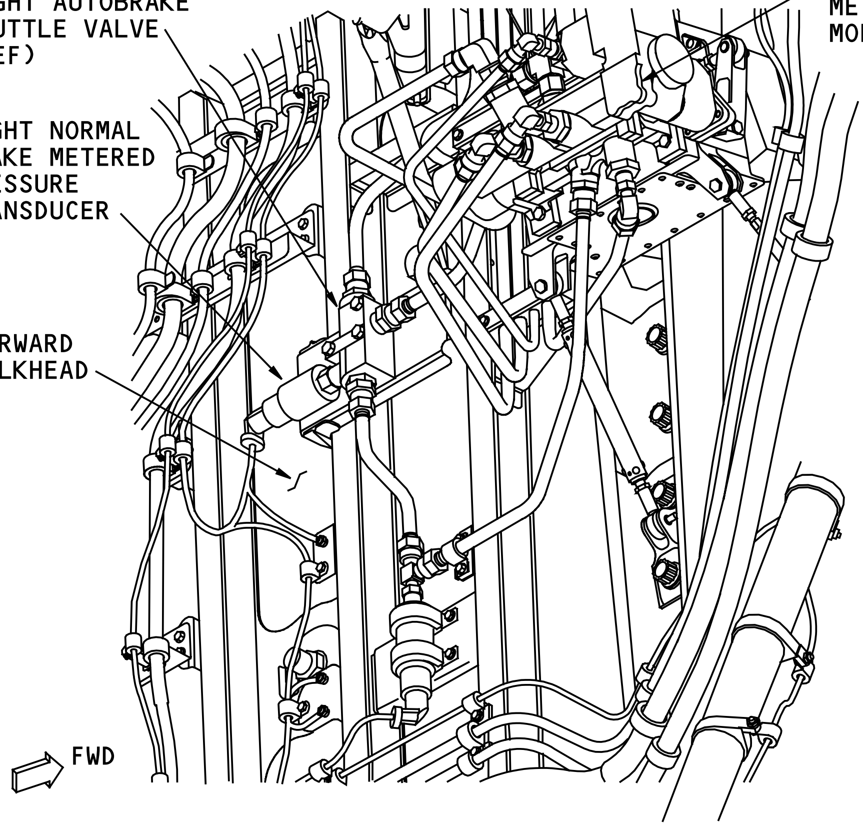
The two alternate brake metered pressure transducers are on the landing gear beams inboard of the left and right alternate antiskid modules.

Functional Description

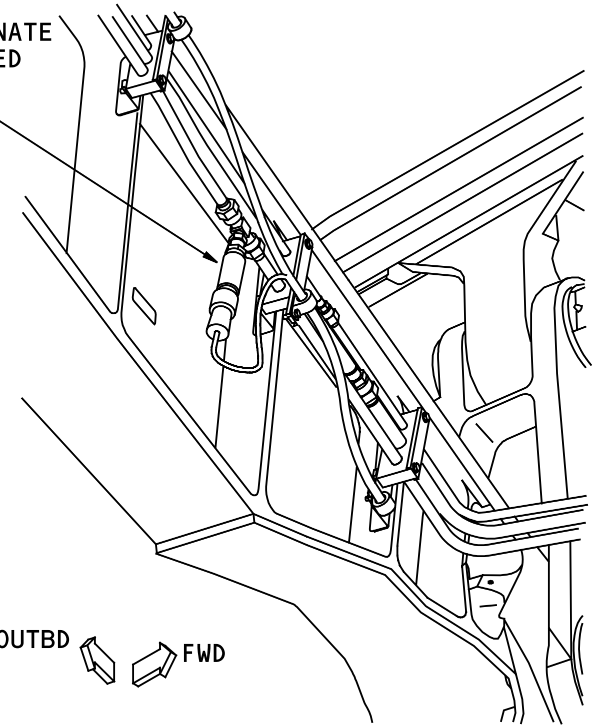
The BSCU uses inputs from the normal brake metered pressure transducers for autobrake disarm logic and for the taxi brake release function.

All four transducers supply the BSCU with metered pressure data to send to the AIMS. The data shows on the landing gear brakes/steering maintenance page.

The BSCU also sends the pressure data to the flight data recorder.



RIGHT MAIN LANDING GEAR WHEEL WELL
(LEFT SIMILAR)



RIGHT MAIN LANDING GEAR BEAM
(LEFT SIMILAR)

32-42-00-014 Rev 1

ANTISKID/AUTOBRAKE SYSTEM - BRAKE METERED PRESSURE TRANSDUCERS

ANTISKID/AUTOBRAKE SYSTEM - ANTISKID FUNCTIONAL DESCRIPTION - CONTROLLERS

General

The antiskid cards use primary and secondary controllers to supply these functions:

- Skid control
- Locked wheel protection
- Hydroplane/touchdown protection
- Gear retract inhibit
- Taxi brake release.

Each controller uses these inputs for control:

- Wheel speed from a fwd-mid-aft wheel group
- Groundspeed
- Landing gear lever position
- Taxi brake release request from the Autobrake/BITE/Comm card.

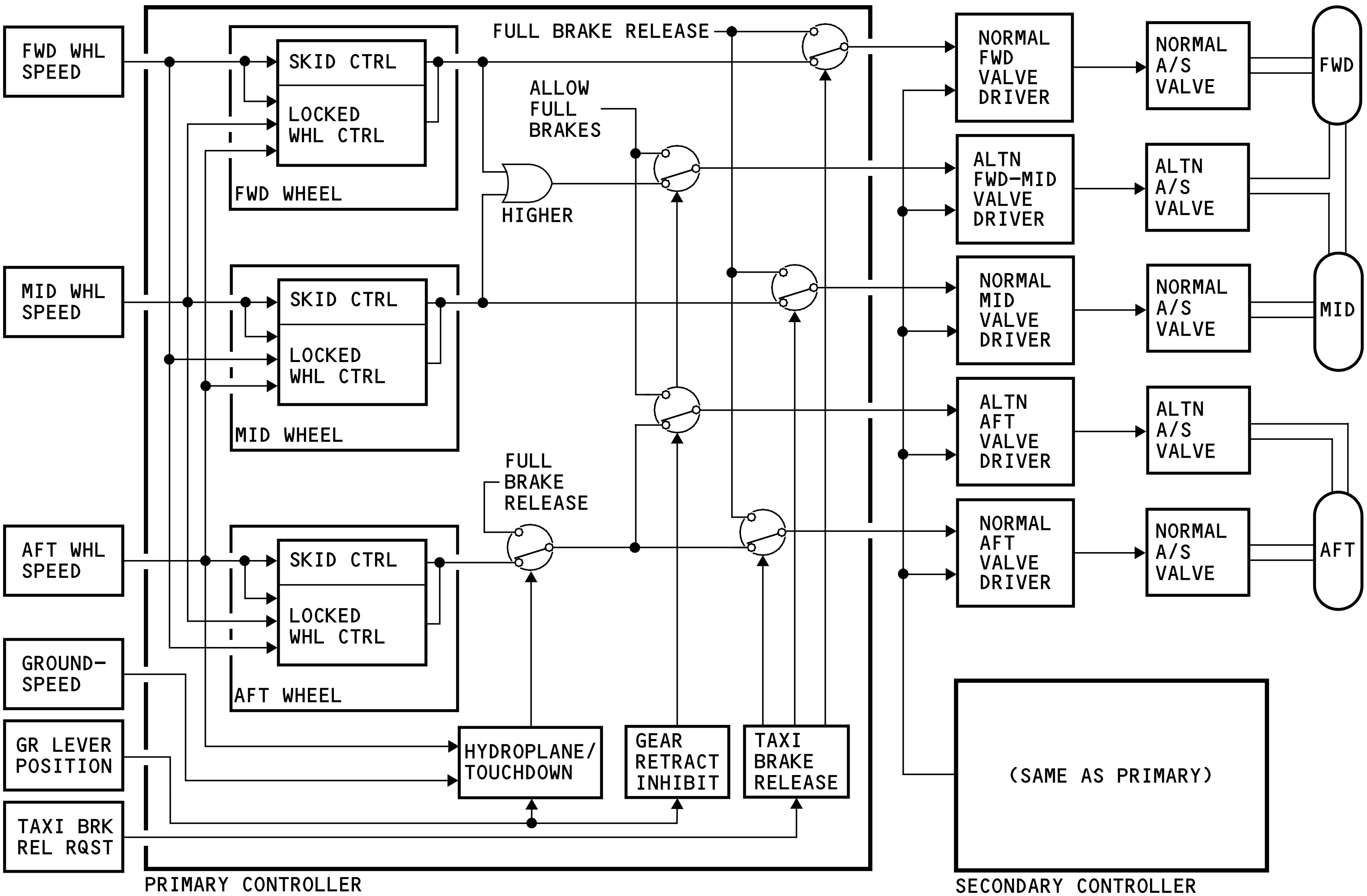
Each controller controls power output to three normal and two alternate antiskid valves with 0-55 milliampere current drivers.

The primary controller on each card uses current drivers on that same card. These drivers also get inputs from the secondary controller on the paired card.

Brake Test and Fault Monitoring (not shown)

When the controllers get a brake release test request, they use the drivers to release all pressure to the requested brake.

The Autobrake/BITE/Comm cards monitor the controllers for antiskid fault data. They send this information to the AIMS for flight deck display.



ANTISKID/AUTOBRAKE SYSTEM - ANTISKID FUNCTIONAL DESCRIPTION - CONTROLLERS

32-42-00-017 Rev 4 02/18/1997

ANTISKID/AUTOBRAKE SYSTEM - INDICATIONS

General

The primary and secondary bite cards in the BSCU send antiskid and autobrake fault data to AIMS for flight deck display.

There is one ANTISKID advisory message. It shows when there is a fault that causes loss of skid protection.

There is one AUTOBRAKE advisory message. It shows when the autobrake system is disarmed, inoperative, or RTO starts but the brakes do not apply. It also shows when the autobrake switch is OFF and the pressure in the autobrake valve module is not shutoff.

Autobrake memo messages show autobrake selector position.

Landing Gear Synoptic Display

The antiskid system shows fault and disabled data for each wheel on the landing gear synoptic display.

ASKID shows next to the applicable wheel when an antiskid fault is active and the ANTISKID advisory or status message shows. If the BSCU loses communication with the flight deck, the AIMS shows ASKID next to each wheel.

When you disable fault indications for a brake, BRAKE shows next to the applicable brake. This makes the ANTISKID advisory message go out of view. You can only disable one brake for each truck.

Landing Gear Brks/Strg Maintenance Page

When a fault and a CMC maintenance message for a wheel are active, one of these labels, shown in decreasing importance, will show next to the applicable wheel:

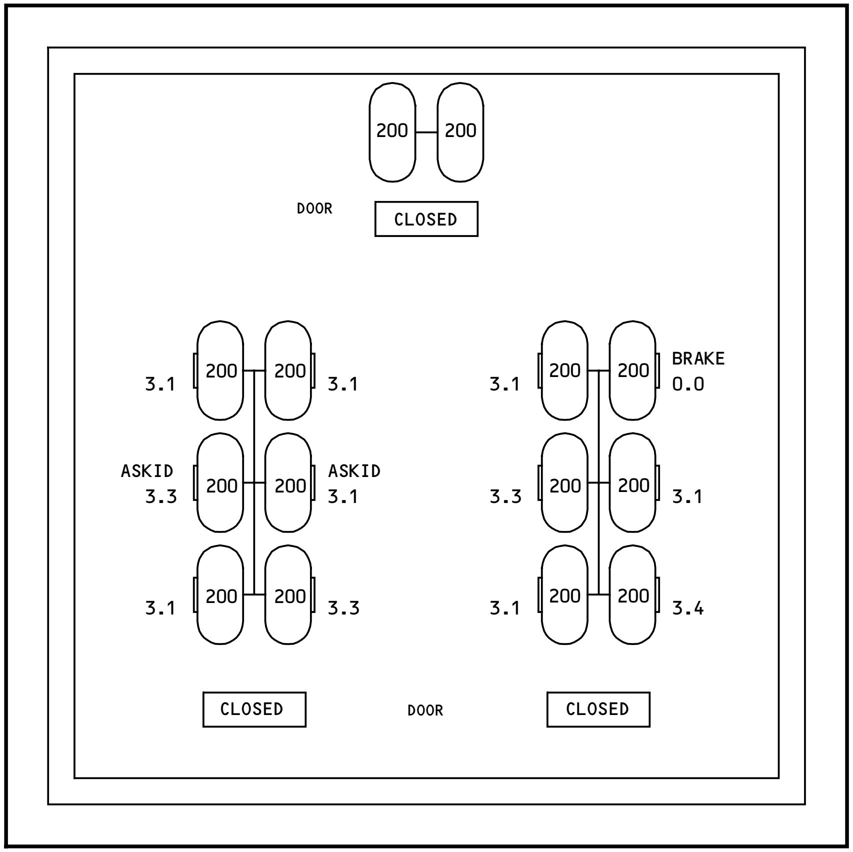
- BRAKE DEACT - brake deactivated
- ASKID PWR - power to the wheel failed
- ASKID CARD - BSCU card failed
- ASKID VALVE - normal valve and/or wiring failed
- ASKID XDCR - transducer and/or wiring failed
- ASKID ALTN - alternate valve and/or wiring failed.

Only the most important label shows for a wheel when more than one fault is active.

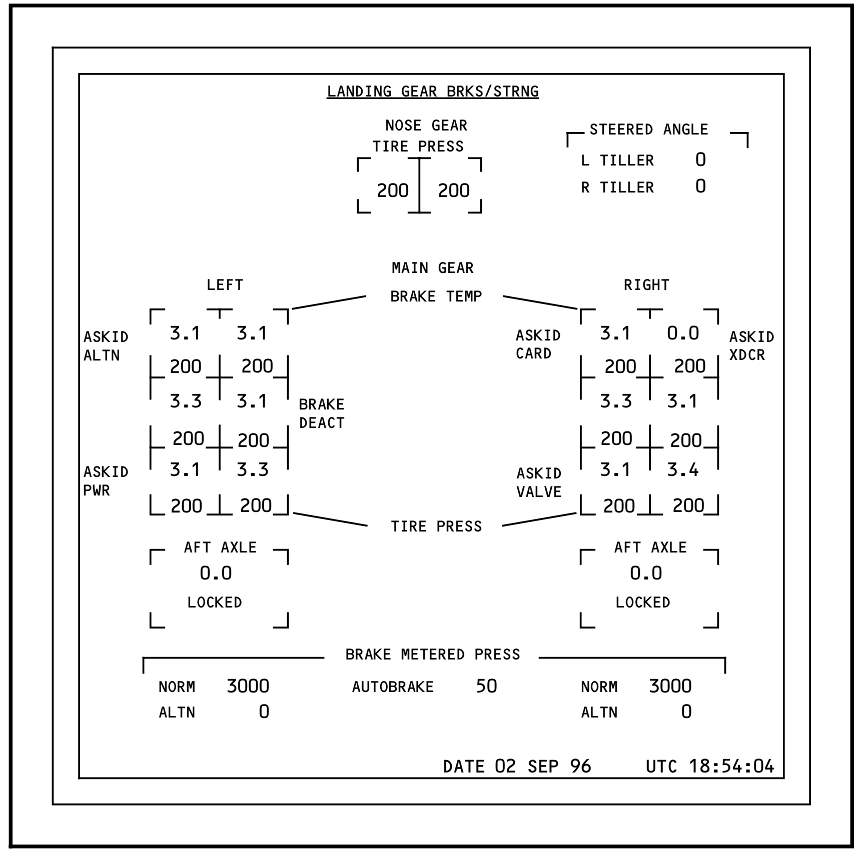
If the BSCU loses communication with the flight deck, the AIMS shows ASKID CARD next to each wheel.

Brake metered pressures for the normal and alternate brake systems show on the lower part of the page.

Autobrake pressure indication is between the brake metered pressure indications.



LANDING GEAR SYNOPTIC DISPLAY



LANDING GEAR BRKS/STRG MAINTENANCE PAGE

32-42-00-027 Rev 2 11/16/1995

ANTISKID/AUTOBRAKE SYSTEM - INDICATIONS

ANTISKID/AUTOBRAKE SYSTEM - SYSTEM TESTS

General

These are the system tests for the antiskid and autobrake systems:

- System Interface
- Antiskid Brake Release
- Autobrake Application
- Wheelspeed Transducer Spin.

System Interface

You use the system interface test to do a test of the BSCU and of the wiring to some of the LRUs in the antiskid and autobrake systems. During the test, the brakes apply and release to check the operation of the autobrake and antiskid systems. This test also does a check of the correct operation of the sensor inputs to the BSCU.

Antiskid Brake Release

The brake release test releases the brake pressure for a selected brake through its antiskid valve. You must visually make sure the brake pressure releases. To do this, monitor the movement of the wear indicator pins.

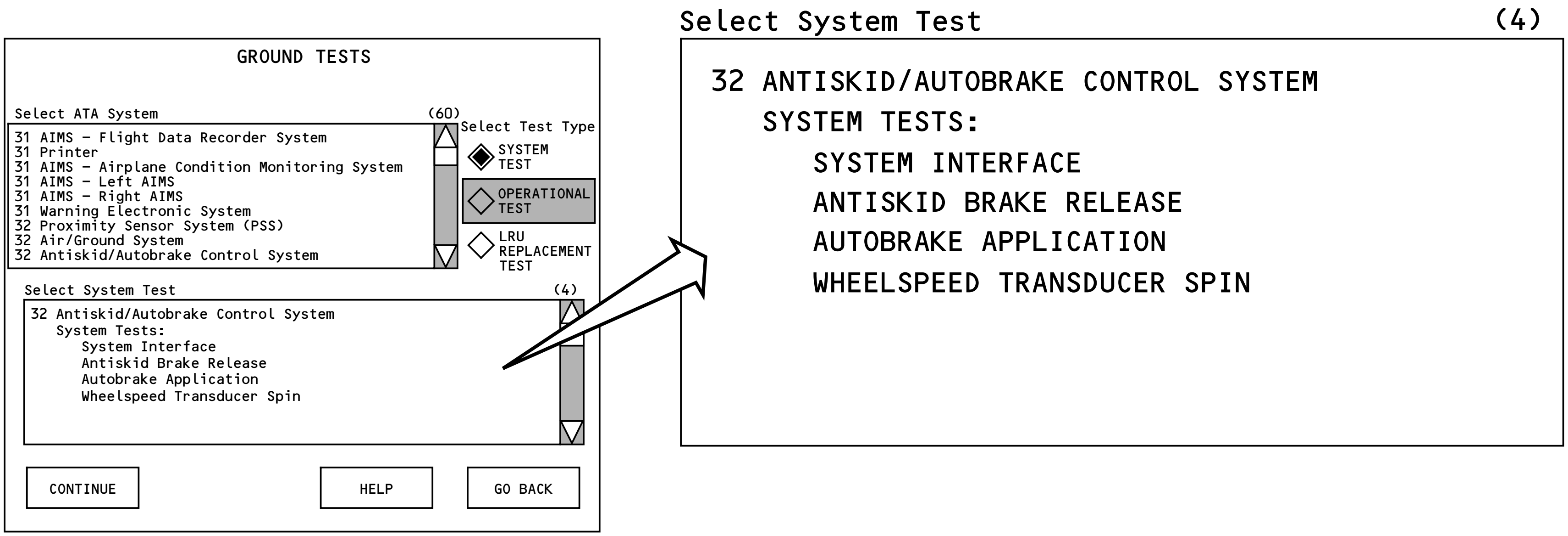
Autobrake Application

The autobrake application test does a check of the autobrake system. The test applies and releases brake pressure to all the brakes.

Wheelspeed Transducer Spin

The wheelspeed transducer spin test lets you do a test of the antiskid transducers and their wiring. You manually turn the selected antiskid transducer during this test. You must turn the transducer at 20 rpm or more during the test.

You remove the hubcap to get access to the antiskid transducer.



32-42-00-028 Rev 4 02/13/1997

ANTISKID/AUTOBRAKE SYSTEM - SYSTEM TESTS

ANTISKID/AUTOBRAKE SYSTEM - LRU REPLACEMENT TESTS

General

These are the LRU replacement tests for the antiskid and autobrake systems:

- Brake System Control Unit
- Antiskid Valve
- Autobrake Valve Module
- Wheelspeed Transducer.

Brake System Control Unit

The brake system control unit replacement test does a check of the BSCU and of the wiring to some of the LRUs in the antiskid and autobrake systems. During the test, the brakes apply and release to check the operation of the autobrake and antiskid systems.

This test is almost the same as the system interface test in the system test menu.

Antiskid Valve

The antiskid valve replacement test lets you do a test of a selected antiskid valve. The test releases the brake pressure for the selected brake. You must visually make sure the brake pressure releases.

This test is the same as the antiskid brake release test in the system test menu.

Autobrake Valve Module

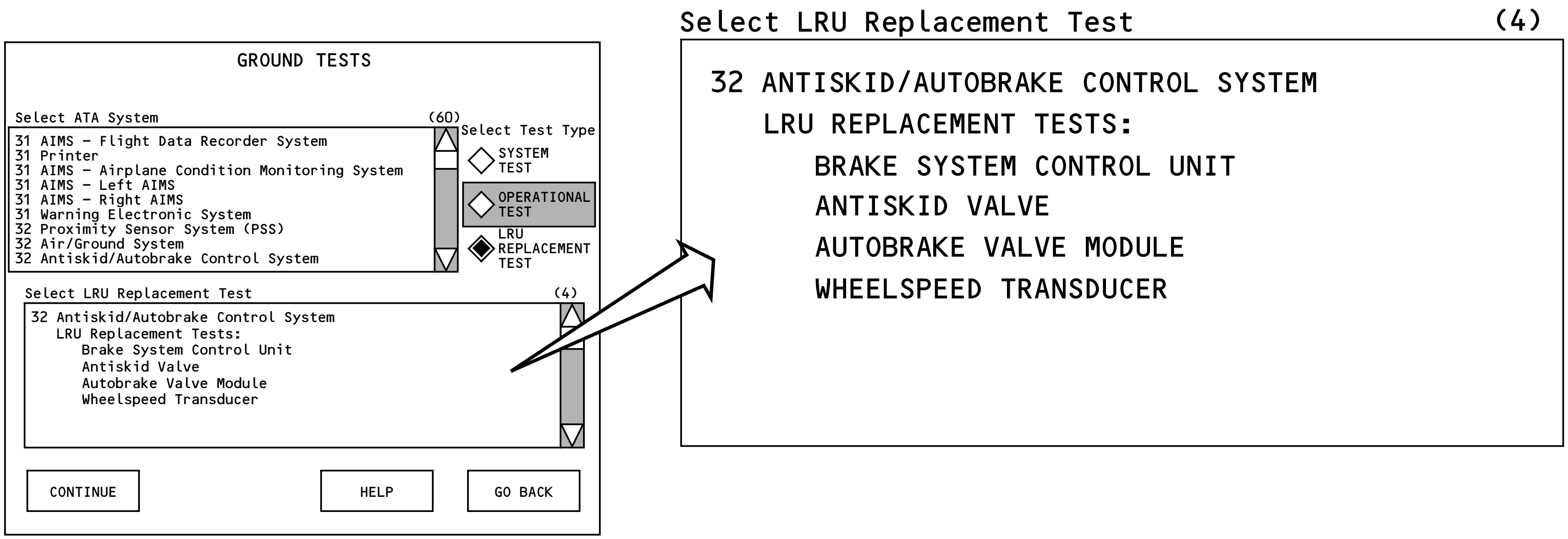
The autobrake valve module replacement test does a check of the autobrake system. The test applies and releases brake pressure to all of the brakes.

This test is the same as the autobrake application test in the system test menu.

Wheelspeed Transducer

The wheelspeed transducer replacement test lets you do a test of a selected antiskid transducer and its wiring. You manually turn the selected antiskid transducer during this test. You must turn the transducer at 20 rpm or more during the test.

This test is the same as the wheelspeed transducer spin test in the system test menu.



32-42-00-029 Rev 3 02/13/1997

ANTISKID/AUTOBRAKE SYSTEM - LRU REPLACEMENT TESTS

ANTISKID/AUTOBRAKE SYSTEM - SPECIAL FUNCTIONS

General

You use the antiskid indication disable function after you deactivate a brake. Brakes may be deactivated by three methods:

- Install a flight dispatch disconnect tool in the brake position on the related antiskid shuttle valve module (This deactivates normal braking only. Alternate braking is still available.)
- Disconnect the brake line
- Remove the brake.

You use the antiskid indication disable function to disable (remove) the ANTISKID advisory message for one MLG wheel on each MLG truck. This makes sure that the advisory message for antiskid failures on the selected wheel or wheels does not show.

The related ANTISKID status message can not be disabled.

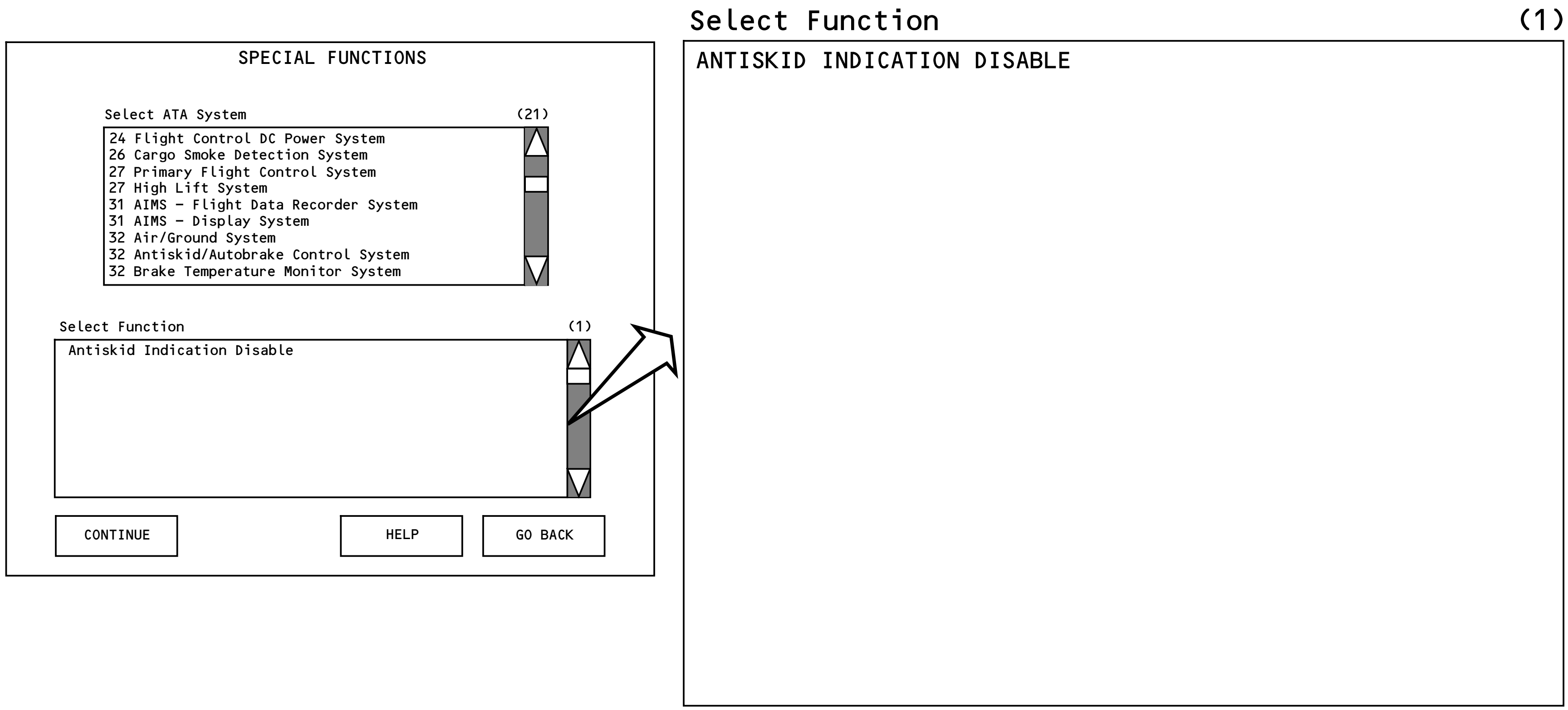
This function also lets you operate the autobrake system with an antiskid failure.

Indication

When you use the indication disable function, a BRAKE message shows on the landing gear synoptic display next to the wheel selected. A BRAKE DEACT message also shows on the brake and steering maintenance page.

Training Information Point

This special function removes the ANTISKID advisory message only for the selected brake (one per truck). If an additional brake failure occurs, the ANTISKID advisory shows again. The advisory message can not be disabled (removed) with two brakes on the same truck failed or deactivated.



32-42-00-030 Rev 2

ANTISKID/AUTOBRAKE SYSTEM - SPECIAL FUNCTIONS

BRAKE TEMPERATURE MONITORING SYSTEM - INTRODUCTION

Purpose

The brake temperature monitoring system (BTMS) gets brake temperature inputs from the twelve main gear brakes and supplies this data for flight deck indication.

Components

These are the brake temperature monitoring system components:

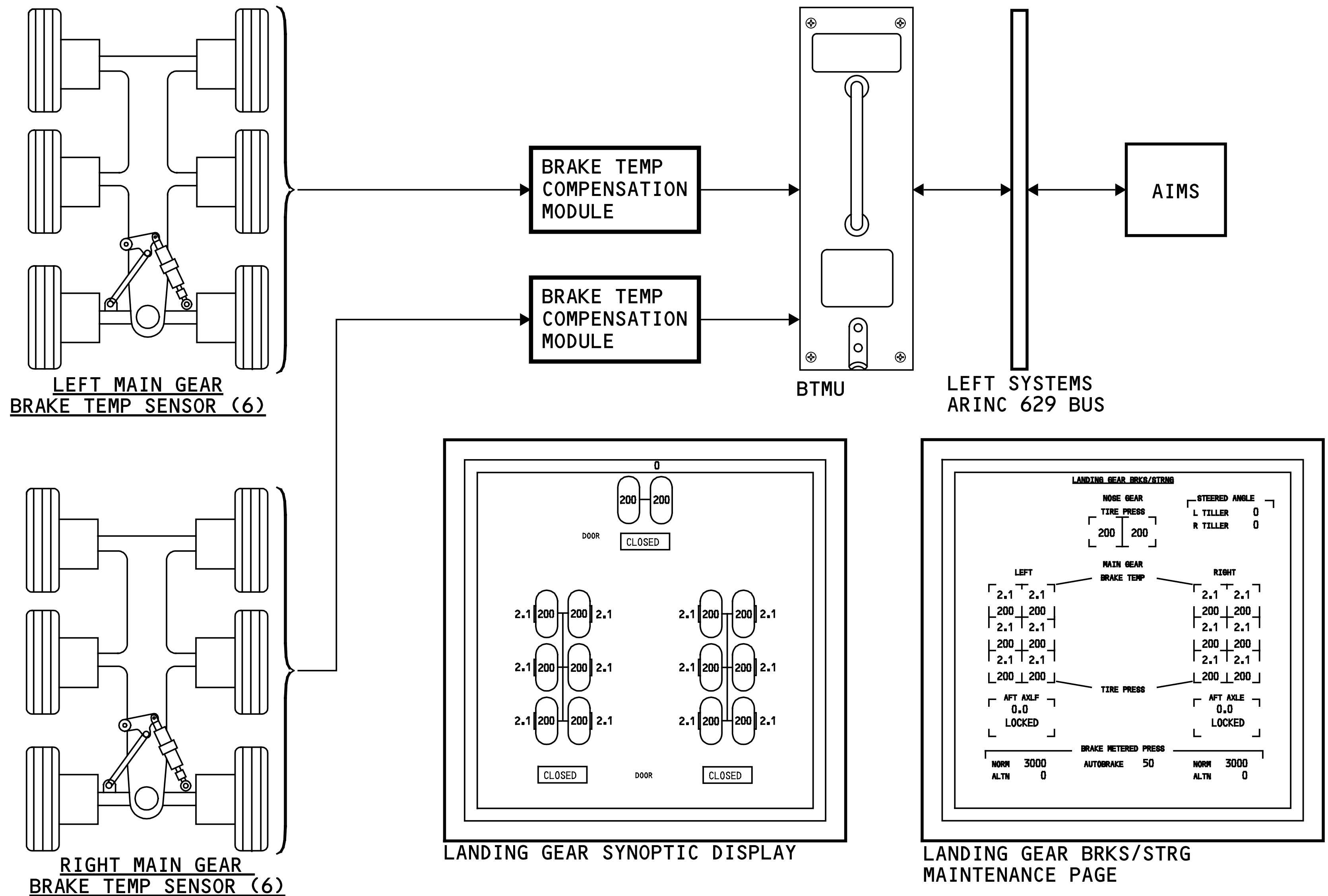
- Brake temperature sensor (12)
- Brake temperature compensation module (2)
- Brake temperature monitor unit (BTMU).

General Description

Brake temperature sensors send brake temperature data through the brake temperature compensation modules to the BTMU. The compensation modules supply a reference ambient temperature.

The BTMU sends brake temperature data to the AIMS through the left ARINC 629 system bus.

The multi-function display (MFD) shows brake temperature data on the landing gear synoptic display and on the landing gear brakes/steering maintenance page.



BRAKE TEMPERATURE MONITORING SYSTEM - INTRODUCTION

BRAKE TEMPERATURE MONITORING SYSTEM - SENSOR AND COMPENSATION MODULE

Brake Temperature Sensor

The brake temperature sensor is a thermocouple. It sends a brake temperature signal through the brake temperature compensation module to the BTMU.

A brake temperature sensor is near the bottom of the brake in each of the main gear brake assemblies.

Brake Temperature Compensation Module

The brake temperature compensation modules connect the thermocouple wire to the aircraft wiring.

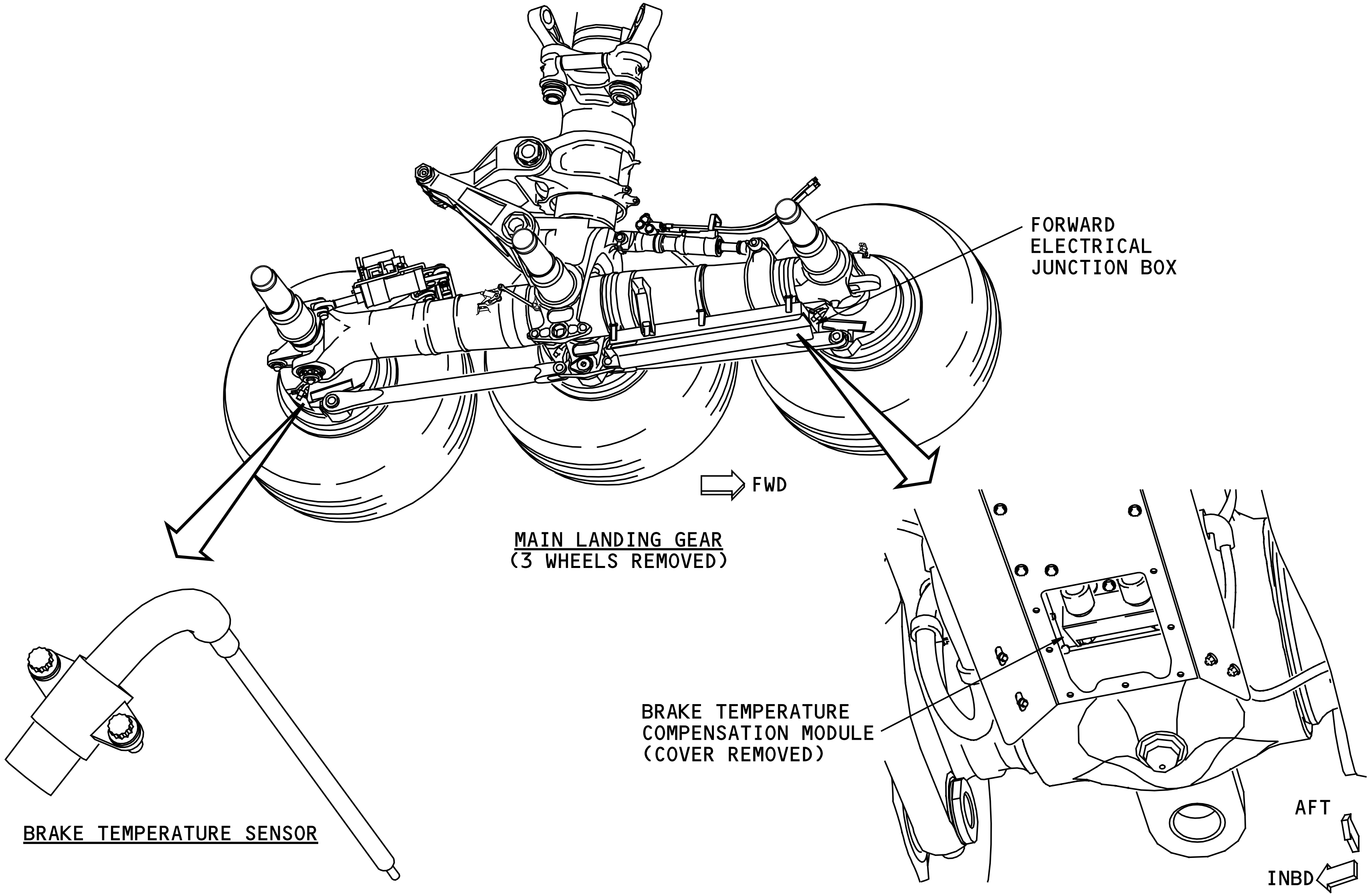
Two reference temperature sensors in each brake temperature compensation module supply reference ambient temperature signals to the BTMU. The BTMU uses this reference temperature to correct the brake temperature signals from the brake temperature sensors.

A brake temperature compensation module is in the forward electrical junction box on the bottom of each wheel truck.

Training Information Point

The brake temperature sensors are LRUs. The brake temperature compensation modules are also LRUs.

A cover on the forward electrical junction box permits easy access to the brake temperature compensation module.



32-46-00-002 Rev 3

BRAKE TEMPERATURE MONITORING SYSTEM - SENSOR AND COMPENSATION MODULE

BRAKE TEMPERATURE MONITORING SYSTEM - BRAKE TEMPERATURE MONITORING UNIT

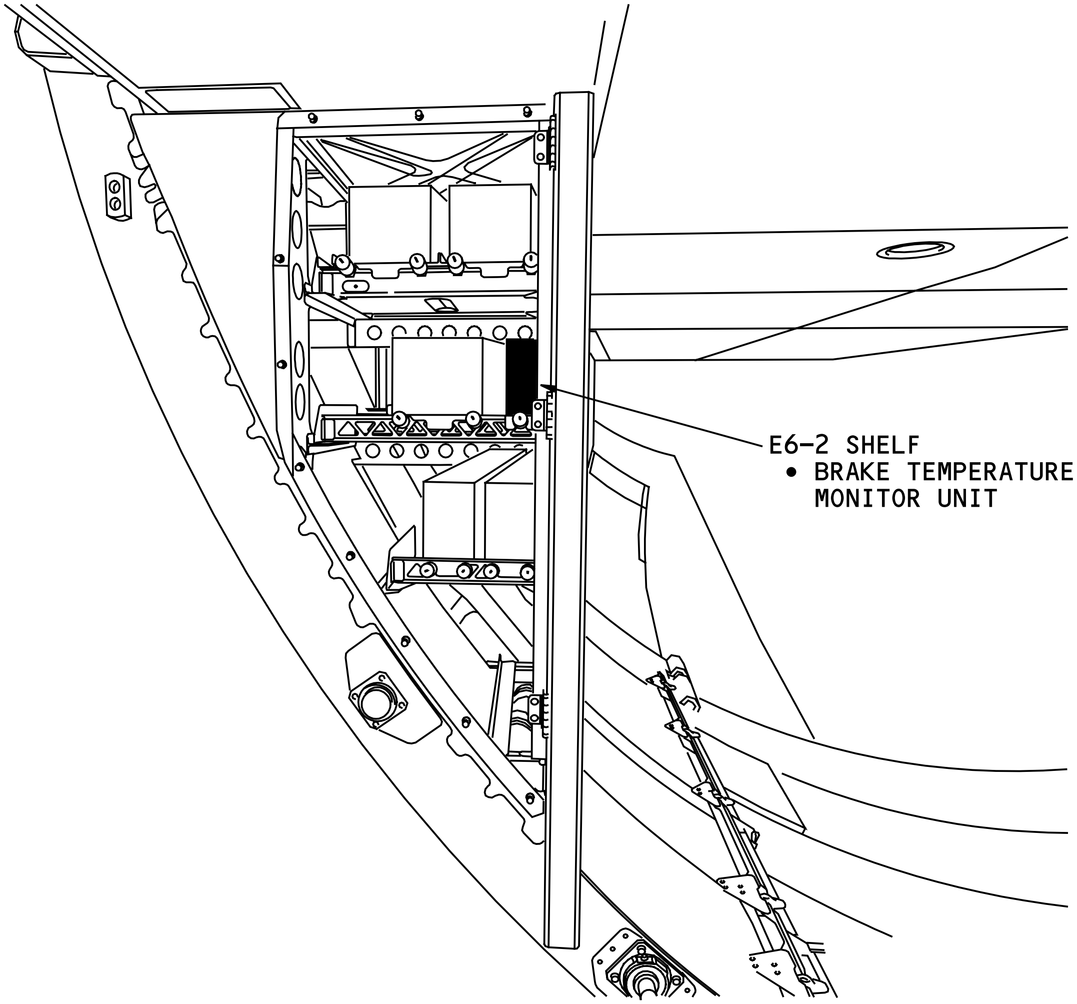
Purpose

The brake temperature monitor unit (BTMU) gets the brake temperature signals from the brake temperature sensors (through the brake temperature compensation modules) and supplies this data to the AIMS.

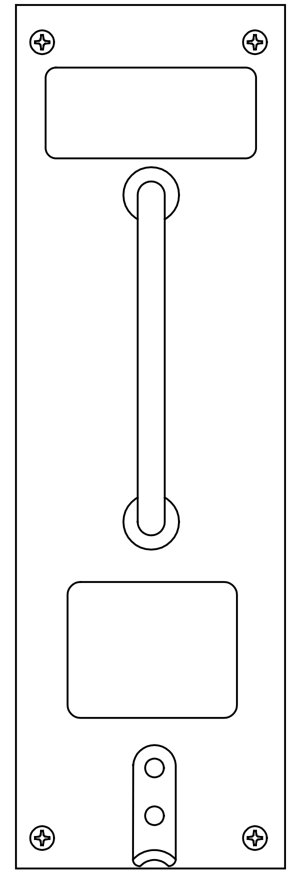
The BTMU also monitors the brake temperature monitoring system for faults.

Location

The BTMU is on the E6-2 shelf in the aft cargo compartment.



AFT CARGO COMPARTMENT
(LOOKING AFT)



BTMU

32-46-00-003 Rev 2

BRAKE TEMPERATURE MONITORING SYSTEM - BRAKE TEMPERATURE MONITORING UNIT

BRAKE TEMPERATURE MONITORING SYSTEM - FUNCTIONAL DESCRIPTION

General

The left 28v dc bus supplies the electrical power for the brake temperature monitoring system.

Brake Temperature Inputs

The brake temperature sensors in each of the wheel brakes send temperature signals to the brake temperature compensation modules.

The compensation modules supply ambient reference temperature signals.

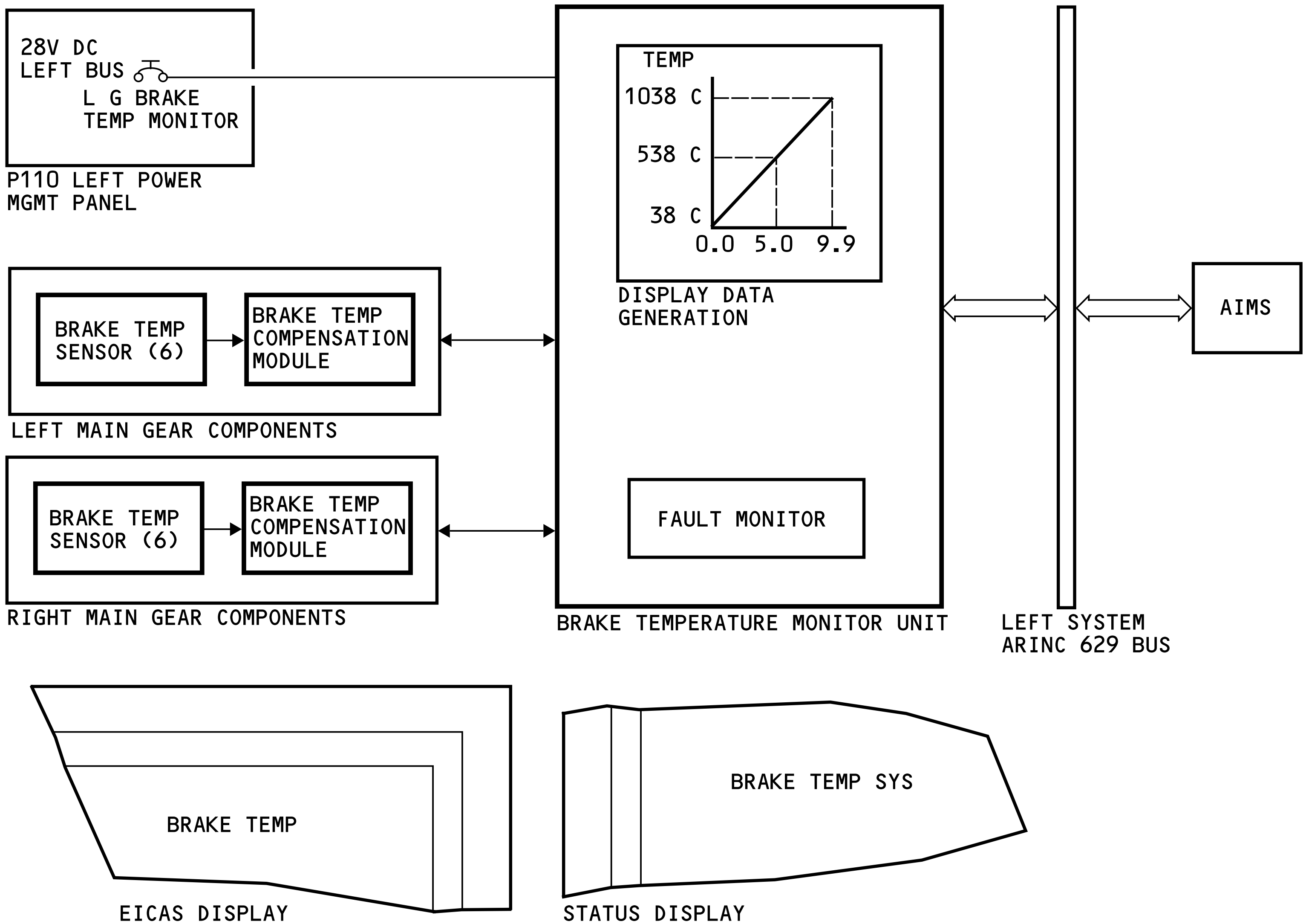
These inputs go to the brake temperature monitor unit.

BTMU Operation

The BTMU gets the brake temperature input and changes this data to a value between 0.0 and 9.9. This value goes to AIMS for flight deck display.

The BTMU also compares the brake temperature to specific advisory condition limits. The BRAKE TEMP advisory message shows when brake temperature is more than these limits.

A fault monitor in the BTMU monitors the BTMS components for faults. The status message BRAKE TEMP SYS shows when there is a loss of brake temperature indication function.



32-46-00-004 Rev 3

BRAKE TEMPERATURE MONITORING SYSTEM - FUNCTIONAL DESCRIPTION

BRAKE TEMPERATURE MONITORING SYSTEM - INDICATION

General

Brake temperature indication shows on the landing gear synoptic display and the brake and steering maintenance page.

Brake Temperature Indication

Brake temperature between approximately 38C (100F) and 1038C (1900F)shows as a number on a linear scale between 0.0 and 9.9.

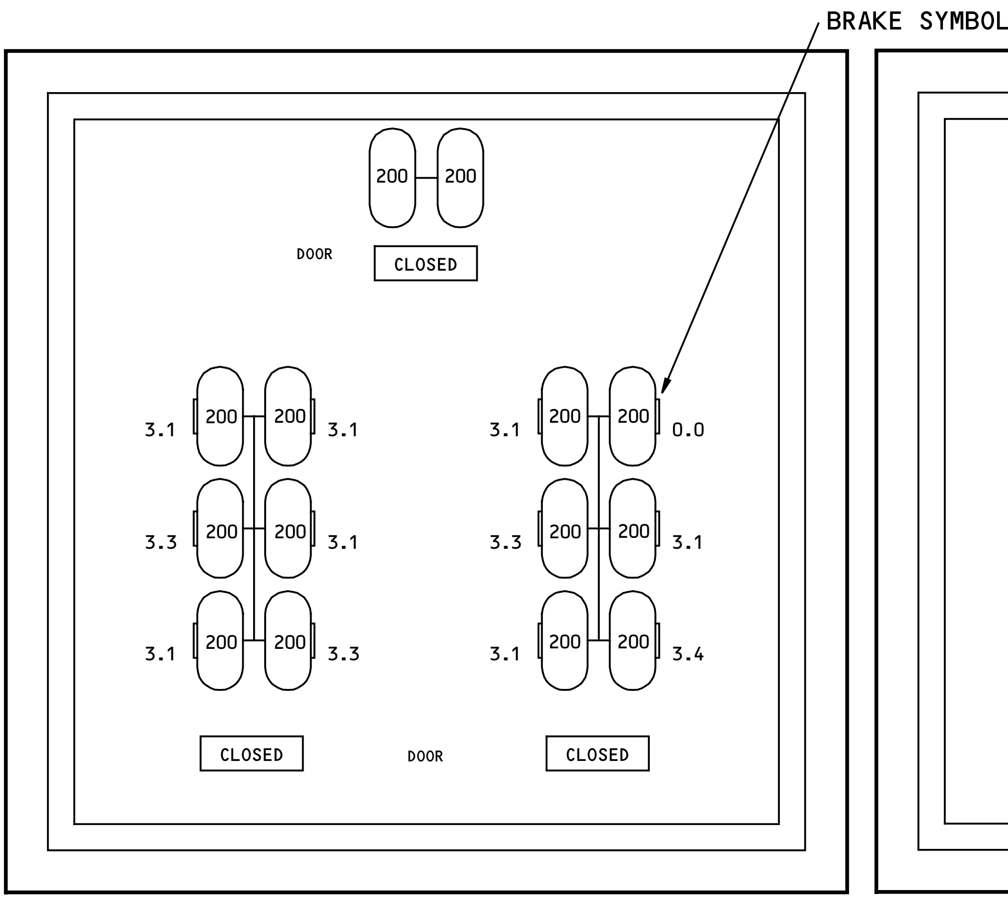
On the landing gear synoptic display, the values less than 5.0 show in white. A solid white brake symbol shows the hottest brake on each main gear truck between 3.0 and 4.9. If two brakes on one truck are the same temperature, the solid white brake symbol shows the brake that first went to that temperature.

When the brake temperature is 5.0 or more, the number changes to amber and the brake symbol changes to a solid amber. All brake temperatures above 5.0 will show this indication. The amber indication stays on until the brake temperature decreases to less than 4.0.

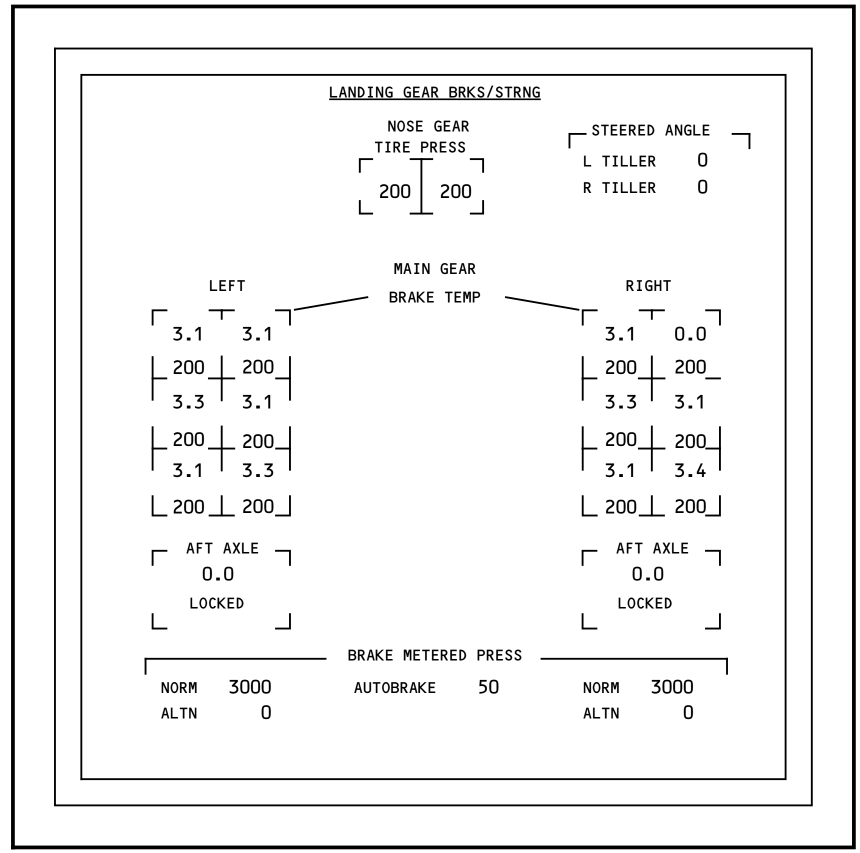
A BRAKE TEMP message shows on the EICAS display if there is an amber temperature indication.

Training Information Point

If the brake temperatures are more than 5.0, the wheel thermal fuse plugs may melt.



LANDING GEAR SYNOPTIC DISPLAY



LANDING GEAR BRKS/STRG MAINTENANCE PAGE

32-46-00-005 Rev 3

BRAKE TEMPERATURE MONITORING SYSTEM - INDICATION

TIRE PRESSURE INDICATION SYSTEM - INTRODUCTION

Purpose

The tire pressure indication system measures the tire pressures for the two nose gear and 12 main gear tires.

Components

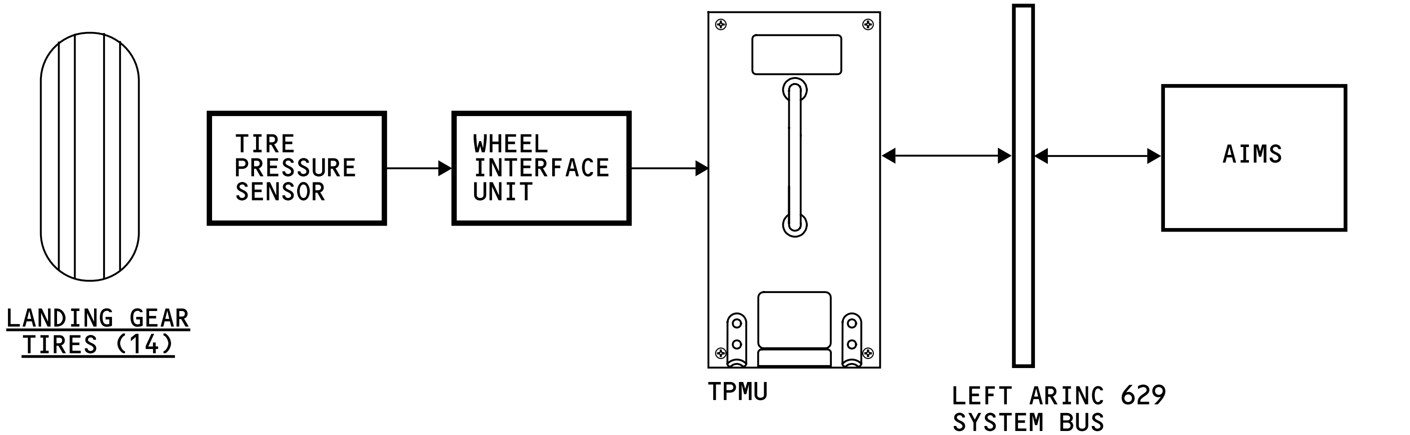
These are the tire pressure indicating system components:

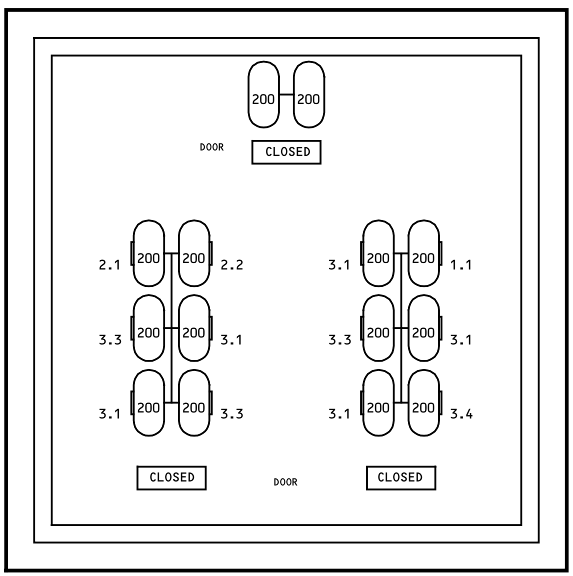
- Tire pressure sensor (14)
- Wheel interface unit (WIU) (14)
- Tire pressure monitor unit (TPMU).

General Description

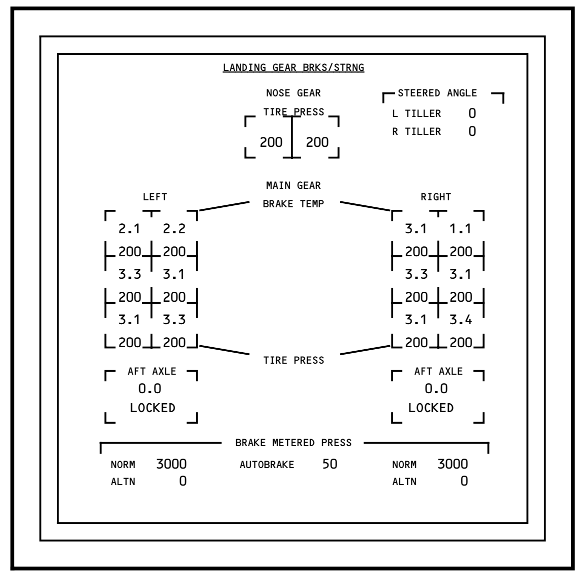
The TPMU sends tire pressure data to AIMS through the left ARINC 629 bus.

The MFD shows tire pressure data on the landing gear synoptic display and brake and steering maintenance page.





LANDING GEAR SYNOPTIC DISPLAY



BRAKE AND STEERING MAINTENANCE PAGE

TIRE PRESSURE INDICATION SYSTEM - INTRODUCTION

TIRE PRESSURE INDICATION SYSTEM - TIRE PRESSURE MONITOR UNIT

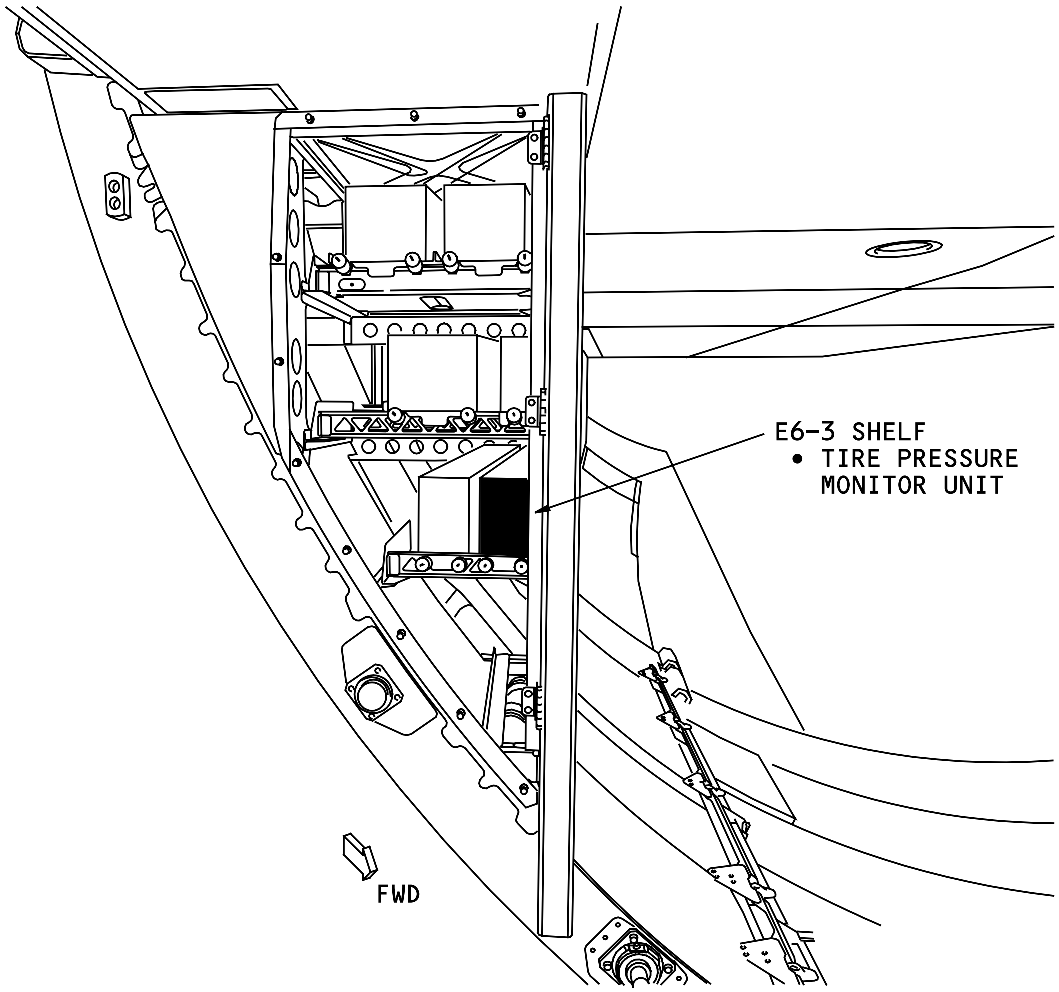
Purpose

The TPMU supplies power to the WIUs and the tire pressure sensors. It gets the tire pressure inputs and sends this data to the AIMS.

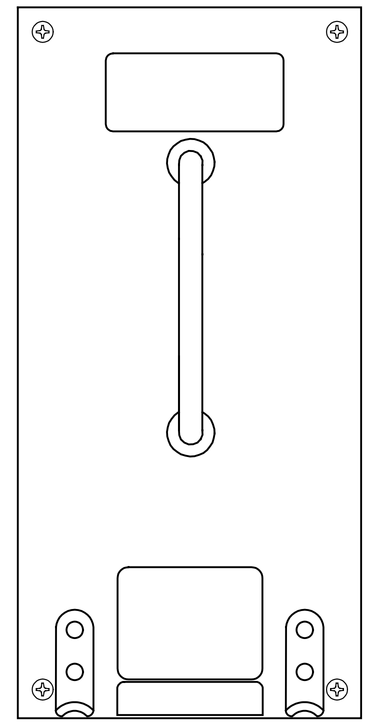
The TPMU also monitors the tire pressure indication system components for faults.

Location

The TPMU is on the E6-3 shelf in the aft cargo compartment.



AFT CARGO COMPARTMENT
(LOOKING AFT)



TPMU

32-49-00-003 Rev 1

TIRE PRESSURE INDICATION SYSTEM - TIRE PRESSURE MONITOR UNIT

TIRE PRESSURE INDICATION SYSTEM - FUNCTIONAL DESCRIPTION

Power Supply

The left 28 v dc MAIN bus supplies the electrical power to operate the tire pressure indication system.

TPMU - Tire Pressure Sensor

The TPMU supplies an excitation signal to each of the 14 wheel interface units.

The wheel interface unit sends the signal across the rotating interface of the wheel to the tire pressure sensor.

Tire Pressure Sensor - TPMU Signal

The tire pressure sensor sends a dc voltage signal that is in proportion to the tire pressure.

The wheel interface unit transmits the signal across the rotating interface of the wheel back to TPMU.

TPMU Operation

The TPMU gets the tire pressure signals and sends them to AIMS for flight deck display.

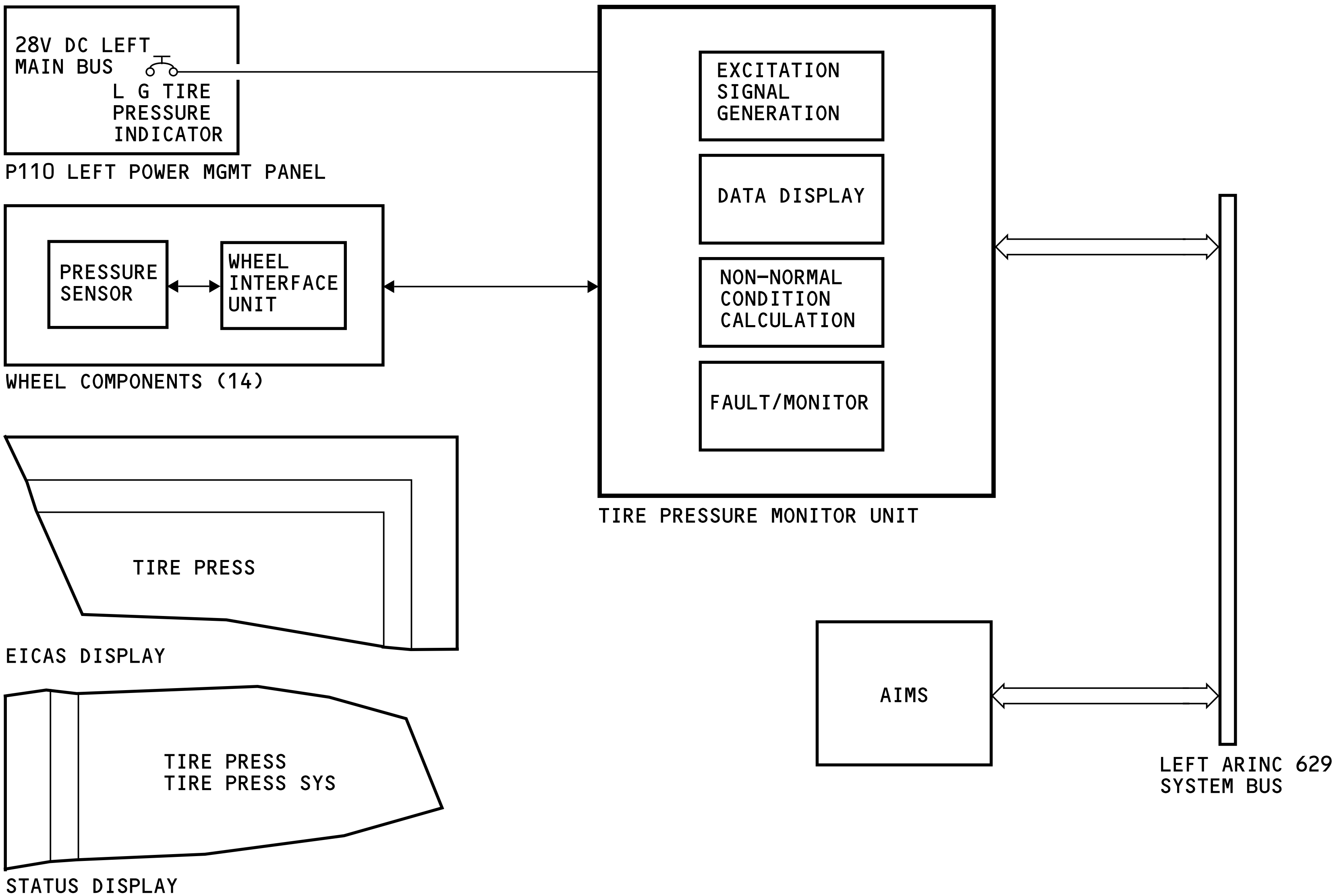
The TPMU also calculates non-normal tire pressure conditions and shows these EICAS messages:

- TIRE PRESS (Advisory) - non-normal tire pressure conditions
- TIRE PRESS (Status) - non-normal tire pressure conditions.

Non-normal tire pressure conditions include:

- Tire pressure below 100 psi
- Main gear tire pressure different from average tire pressure by 18 percent (the TPMU calculates average tire pressure by discarding the three highest and the three lowest tire pressures and averaging the middle six tire pressures)
- More than 25 percent difference in pressure between main gear tires on the same axle
- More than 12 percent difference between the nose gear tire pressures.

A fault monitor in the TPMU monitors TPIS components and interfaces for faults. The status message TIRE PRESS SYS shows if there is a fault.



32-49-00-004 Rev 1

TIRE PRESSURE INDICATION SYSTEM - FUNCTIONAL DESCRIPTION

TIRE PRESSURE INDICATION SYSTEM - INDICATIONS

General

Tire pressure indication, shows in psi on the landing gear synoptic display and the brake and steering maintenance page.

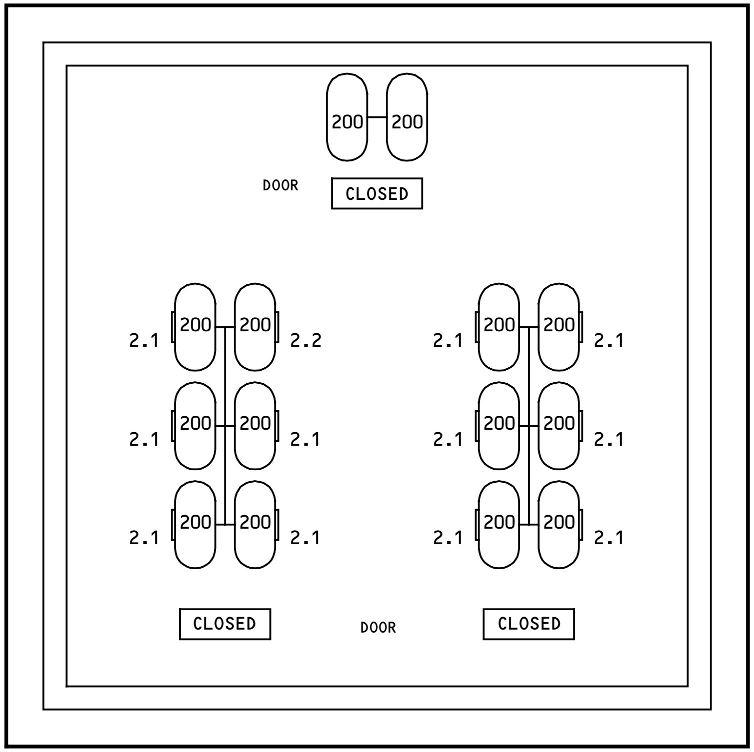
Tire Pressure Indication

The landing gear synoptic display and the brake and steering maintenance page show normal tire pressure in white.

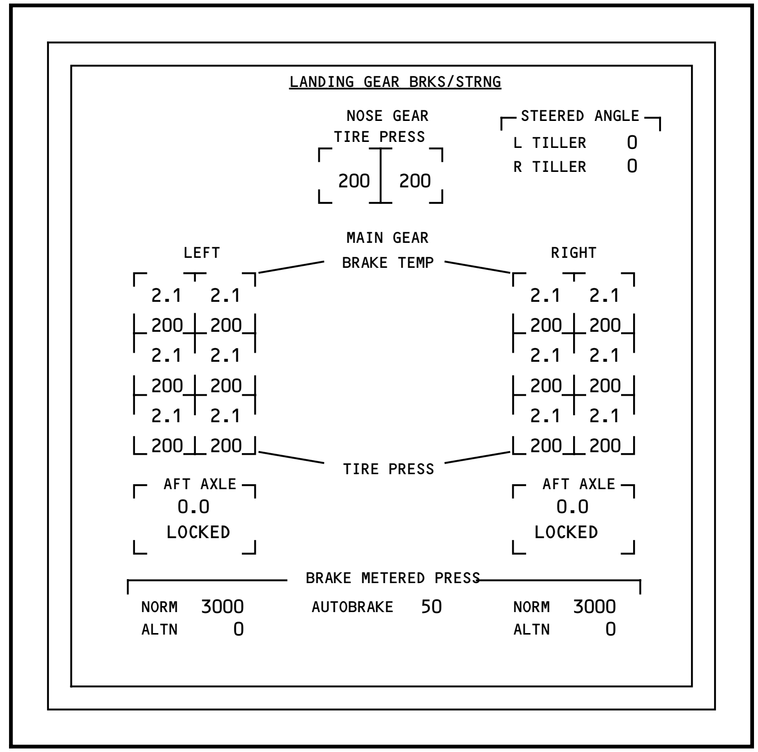
The tire pressure display changes to amber to show non-normal pressure conditions.

Non-normal conditions also cause a message to show on the EICAS display.

The tire display will go out of view if there is a Loss of pressure data or if the pressure data is invalid.



LANDING GEAR SYNOPTIC DISPLAY



BRAKE AND STEERING MAINTENANCE PAGE

32-49-00-005 Rev 2

TIRE PRESSURE INDICATION SYSTEM - INDICATIONS

LANDING GEAR - GENERAL - INTRODUCTION

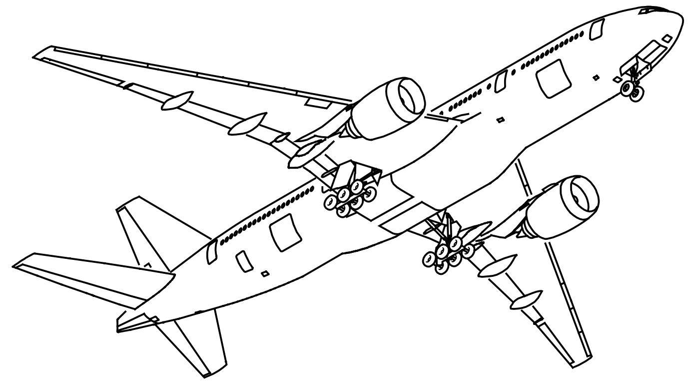
Purpose

Landing gear structural components hold the weight of the airplane while the airplane is on the ground. These are the landing gear structural systems:

- The main landing gear (MLG) and doors (section 32-10)
- The nose landing gear (NLG) and doors (32-20).

Landing gear extension-retraction systems extends and retracts the landing gear to reduce airplane drag in flight. These are the landing gear extension-retraction systems:

- The landing gear control system (32-31)
- The main landing gear extension and retraction (32-32)
- The nose landing gear extension and retraction (32-34)
- The landing gear alternate extension system (32-35).



- LANDING GEAR - GENERAL
  - LANDING GEAR STRUCTURES
    - MAIN LANDING GEAR AND DOORS
    - NOSE LANDING GEAR AND DOORS
  - EXTENSION - RETRACTION
    - LANDING GEAR CONTROL SYSTEM
    - MLG EXTENSION - RETRACTION
    - NLG EXTENSION - RETRACTION
    - LG ALTERNATE EXTENSION SYSTEM

32-00-00-002 Rev 0

LANDING GEAR - GENERAL - INTRODUCTION

Continental Airlines, Inc

Primary Flight Control System

WB371

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Primary Flight Control System
WB371

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FLIGHT CONTROLS - INTRODUCTION

General

The flight controls keep the airplane at the desired attitude during flight. They consist of movable surfaces on the wing and the empennage. The flight controls change the lift of the wing and the empennage.

There are two types of flight controls: the primary flight control system and the high lift control system.

Primary Flight Control System

The primary flight control system (PFCS) uses a fly-by-wire control system with digital and analog electronic equipment. It receives commands from the flight crew and the autopilot and causes the control surfaces to move.

The PFCS controls the attitude of the airplane during flight. The control surfaces operated by the PFCS are:

- One aileron on each wing
- One flaperon on each wing
- Seven spoilers on each wing
- One horizontal stabilizer
- One elevator on each side of the horizontal stabilizer
- One tabbed rudder.

High Lift Control System

The high lift control system (HLCS) uses a fly-by-wire control system with digital electronic equipment. It receives commands from the flight crew and causes the flaps and slats to move.

Operation of the HLCS increases the wing lift so the airplane can takeoff and land at lower speed and higher weight. The high lift devices operated by the HLCS are:

- Seven leading edge slats on each wing
- One Krueger flap on each wing
- One single slotted outboard flap on each wing
- One double slotted inboard flap on each wing.

Operation of the HLCS also causes the ailerons and the flaperons to move. They droop on both wings when the high lift devices extend.

Benefits of the Fly-By-Wire System

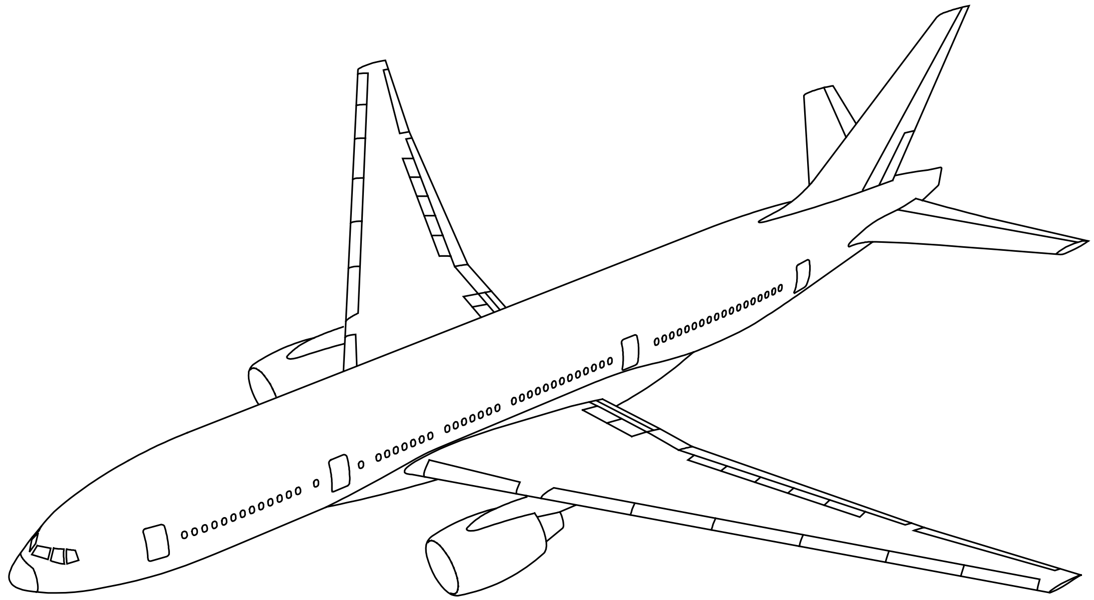
The fly-by-wire design of the flight controls permits:

- A more efficient structure design
- Increased fuel economy
- A smaller vertical fin
- A smaller horizontal stabilizer
- Reduced weight
- Improved controls and protections.

Abbreviations and Acronyms

ACE - actuator control electronics
ACMS - airplane condition monitoring system
ADIRS - air data inertial reference system
ADIRU - air data inertial reference unit

ADM	- air data module
AFDC	- autopilot flight director computer
AFDS	- autopilot flight director system
AIMS	- airplane information management system
ARINC	- Aeronautical Radio, Inc.
BAP	- bank angle protection
B/D	- backdrive
CMCS	- central maintenance computing system
CPU	- central processing unit
EDIU	- engine data interface unit
EHS	- electrohydraulic servo valve
EICAS	- engine indication and crew alerting system
FCDC	- flight controls direct current
FMCS	- flight management computer system
FSEU	- flap/slat electronics unit
HLCS	- high lift control system
LIB	- left inboard
LOB	- left outboard
LVDT	- linear variable differential transformer
MCP	- mode control panel
MFD	- multi functional display
PCU	- power control unit
PDU	- power drive unit
PFC	- primary flight computer
PFCS	- primary flight control system
PMG	- permanent magnet generator
PSA	- power supply assembly
PSEU	- proximity sensor electronic unit
RIB	- right inboard
ROB	- right outboard
RVDT	- rotary variable differential transformer
SAARU	- secondary attitude air data reference unit
SOL	- solenoid
SOV	- shutoff valve
STCM	- stabilizer trim control module
TAC	- thrust asymmetry compensation
WEU	- warning electronic unit
WOW	- weight on wheels



FLIGHT CONTROLS

PRIMARY FLIGHT CONTROL SYSTEM

- AILERONS AND FLAPERONS
- SPOILERS AND SPEEDBRAKES
- ELEVATORS
- HORIZONTAL STABILIZER
- RUDDER

HIGH LIFT CONTROL SYSTEM

- TRAILING EDGE FLAPS
- LEADING EDGE SLATS
- KRUEGER FLAPS

27-00-00-001 Rev 2

FLIGHT CONTROLS - INTRODUCTION

PRIMARY FLIGHT CONTROL SYSTEM - INTRODUCTION

Purpose

The primary flight control system (PFCS) controls the airplane flight attitude in relation to the three basic axes:

- Longitudinal
- Lateral
- Vertical.

Roll Control

The roll control uses the ailerons, flaperons, and spoilers to control the airplane attitude about the longitudinal axis. During a bank of the airplane, the aileron and flaperon on one wing move in an opposite direction from the aileron and flaperon on the other wing. The spoilers move up only on the down wing and do not move on the up wing.

Pitch Control

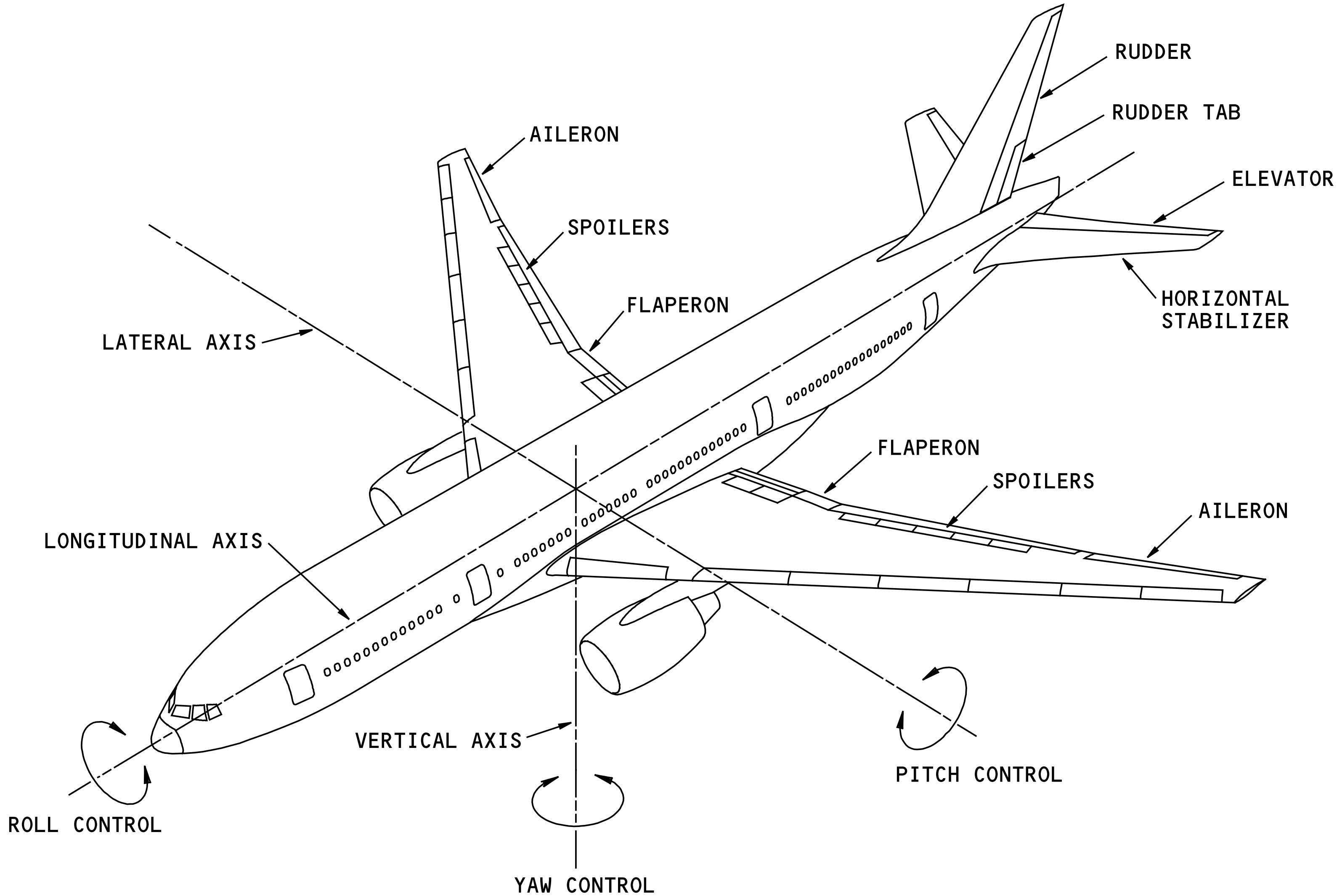
The pitch control uses the horizontal stabilizer and the elevator to control the airplane attitude about the lateral axis. The stabilizer controls long term pitch changes. The elevator supplies short term pitch control.

Yaw Control

The yaw control uses the rudder to control the airplane attitude about the vertical axis. The rudder has a tab which moves to increase the effectiveness of the rudder.

Speedbrakes

The PFCS also includes the speedbrakes. In addition to roll control, the spoilers also act as speedbrakes in the air and on the ground. They deploy on both wings to increase drag and to decrease the amount of lift the wings supply.



27-02-00-001 Rev 0

PRIMARY FLIGHT CONTROL SYSTEM - INTRODUCTION

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PFCS - GENERAL DESCRIPTION

General

The pilots or the autopilot commands control the PFCS. The pilots can override the autopilot.

Manual Operation

Position transducers change the pilots' manual commands of the control wheel, the control columns, the rudder pedals, and the speedbrake lever to analog electrical signals. These signals go to the four actuator control electronics (ACEs). The ACEs change the signals to digital format and send them to the three primary flight computers (PFCs).

The PFCs have interfaces with the airplane systems through the three flight controls ARINC 629 buses. In addition to command signals from the ACEs, the PFCs also receive data from:

- The airplane information management system (AIMS)
- The air data inertial reference unit (ADIRU)
- The secondary attitude air data reference unit (SAARU).

The PFCs calculate the flight control commands based on control laws and flight envelope protection functions. The control laws supply stability augmentation in the pitch and yaw axes and flight envelope protections in all three axes. The digital command signals from the PFCs go to the ACEs.

The ACEs change these command signals to analog format and send them to the power control units (PCUs) and the stabilizer trim control modules (STCMs). The ACEs and the PCUs form control loops which control the surfaces based on the PFCs commands.

One, two or three PCUs operate each control surface. One PCU controls each spoiler, two PCUs control each aileron, flaperon, and elevator, and three PCUs control the rudder. The PCUs contain a hydraulic actuator, an electrohydraulic servo valve, and a position feedback transducer.

When commanded, the servo valve causes the hydraulic actuator to move the control surface. The position transducer sends a position feedback signal to the ACEs. The ACEs then stop the PCU command when the position feedback signal equals the commanded position.

Two STCMs control hydraulic power to the motors and brakes of the horizontal stabilizer.

Autopilot Operation

The PFCs receive autopilot commands from all three autopilot flight director computers (AFDCs). The PFCs use the autopilot commands in the same manner as the pilots' manual commands. In addition, the PFCs supply the backdrive signals to the backdrive actuators through the AFDCs. The backdrive actuators move the control wheels, control columns, and rudder pedals in synchronization with the autopilot commands. The movement of the flight deck controls supplies visual indications to the flight crew.

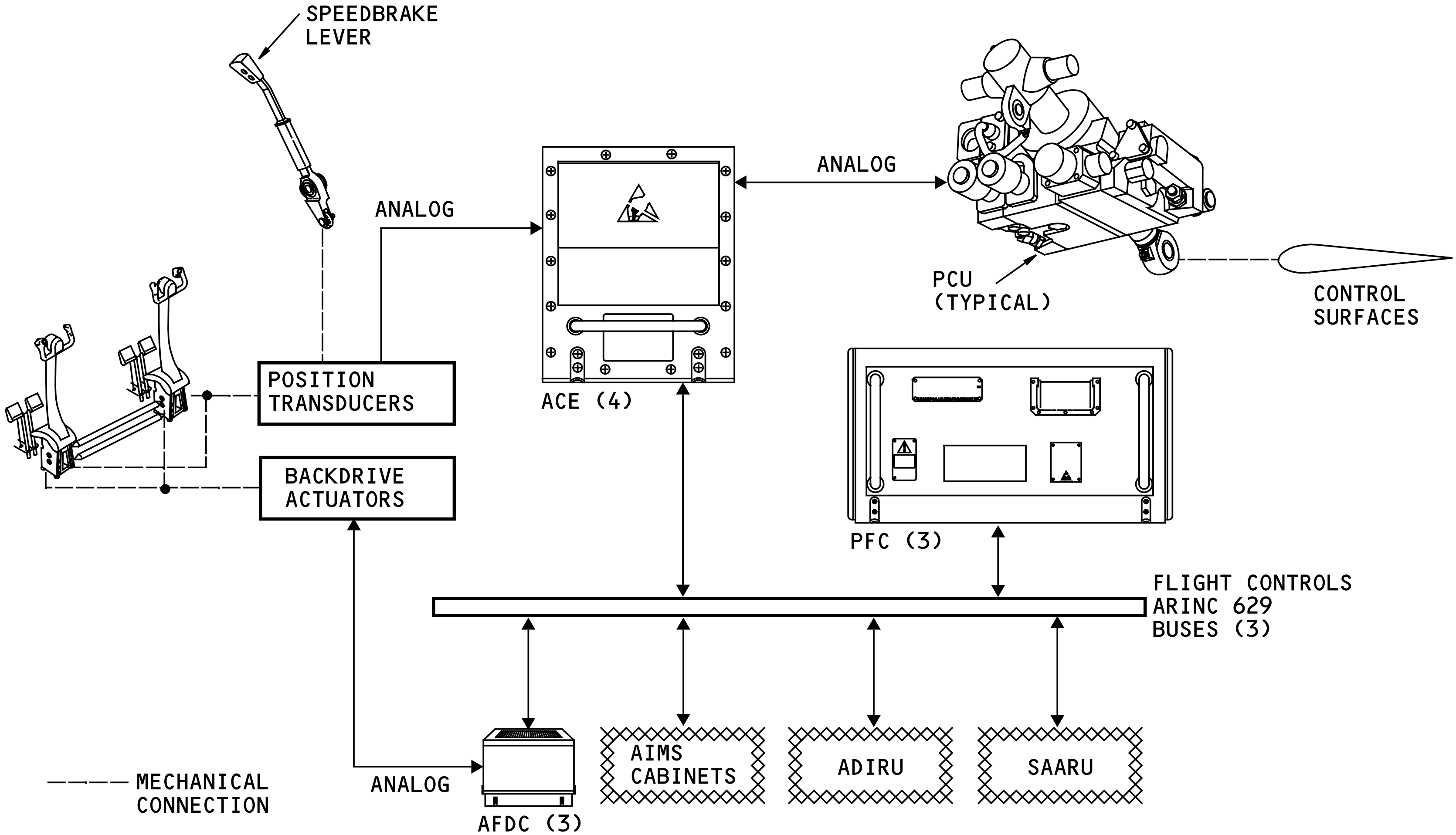
PFCS Modes of Operation

The PFCS has three modes of operation: normal, secondary, and direct.

Normal mode operates when the necessary data are available for the PFCs and the ACEs. All the control laws, protection functions, and the AFDCs operate.

When the PFCS detects the loss of important air and attitude data, the PFCS operation changes to secondary mode. The PFCs and the ACEs operate but the PFC control laws and protection functions downgrade. The autopilot cannot operate in secondary mode.

In direct mode, the PFCs are not used. The ACEs set the position of the control surfaces in direct response to analog pilot control inputs.



27-02-00-002 Rev 4

PFCS - GENERAL DESCRIPTION

PFCS - COMPONENT LOCATION

Flight Deck Controls

The control wheel, control column, and rudder pedal position transducers are below the flight deck floor in the forward equipment center. The speedbrake lever position transducers are in the control stand. The location of these transducers is shown in other sections.

Main Equipment Center

The E1, E2, and E3 racks contain most of the electronic equipment of the PFCS.

The E1 rack contains:

- The left PFC
- The L1 ACE
- The L2 ACE.

The E2 rack contains:

- The center PFC
- The center ACE
- The SAARU.

The E3 rack contains the ADIRU.

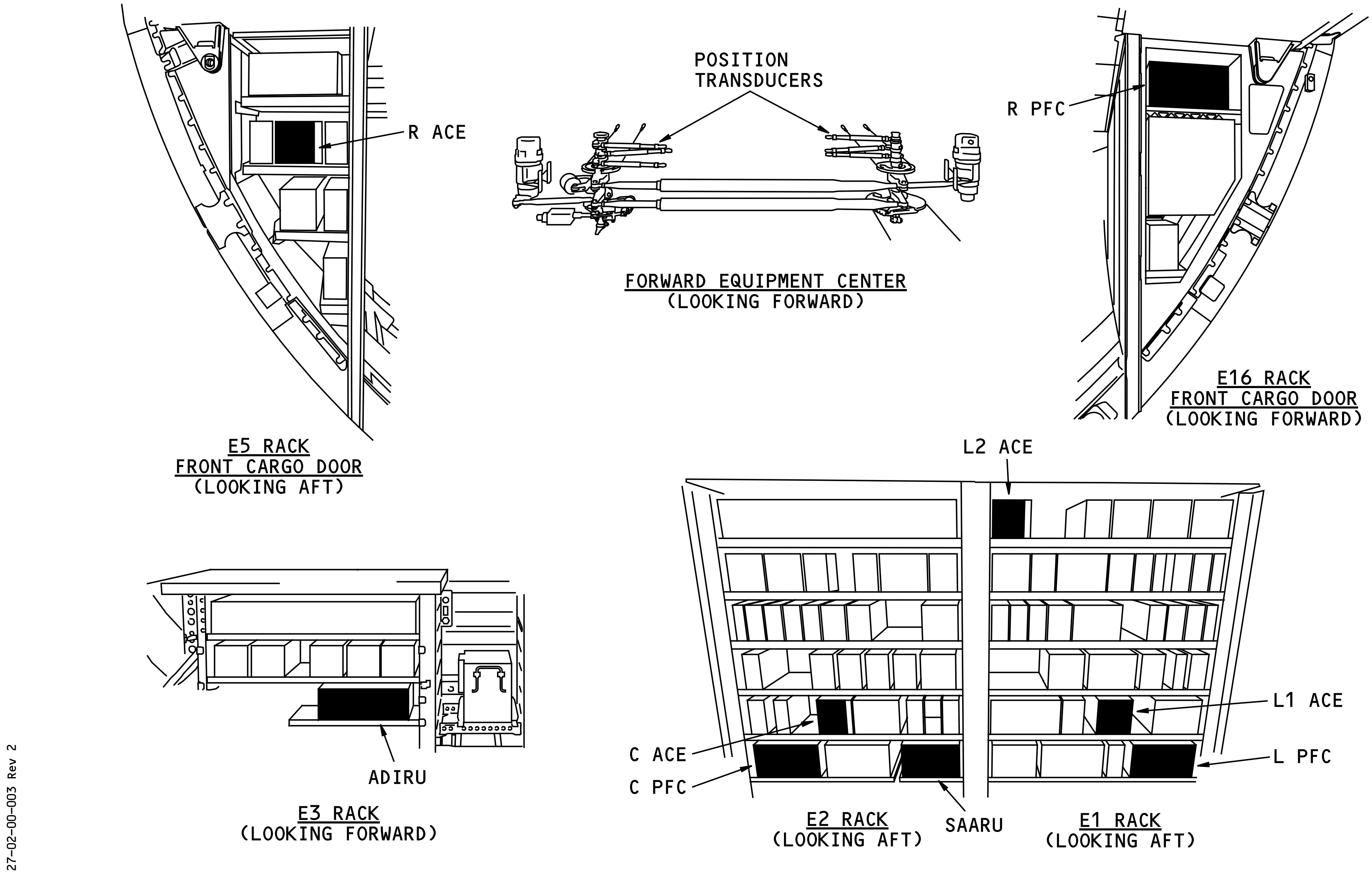
Forward Cargo Compartment

The E16 rack, forward of the forward cargo door, contains the right PFC.

The E5 rack, aft of the forward cargo door, contains the right ACE.

Control Surfaces

Each PCU connects directly to its related control surface on the wing and the empennage. The ballscrew actuator of the horizontal stabilizer is in the stabilizer compartment. The location of the PCUs and the ballscrew actuator is shown in their specified sections.



PFCS - COMPONENT LOCATION

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PFCS - FLIGHT CONTROLS ARINC 629 BUS INTERFACES

General

ARINC 629 digital data buses supply the principal means of communication among airplane systems. Three dedicated flight controls ARINC 629 buses connect the PFCS to:

- The three autopilot flight director computers (AFDC)
- The two airplane information management system (AIMS) cabinets
- The air data inertial reference unit (ADIRU)
- The secondary attitude air data reference unit (SAARU).

Physical separation of the buses, and redundant LRUs, protects against multiple failures due to one event.

PFCS Interface

The three primary flight computers (PFCs) and the four actuator control electronics (ACEs) have interfaces with the flight controls data buses.

The L PFC, C PFC and R PFC receive data from all three flight controls data buses but transmit data only on their on-side data bus. (On-side means that the relationship is with equipment of the same side. For example, the left bus is the on-side bus for the left PFC.)

Each ACE receives data from all three PFCs through the three flight controls data buses. Each ACE processes control data from its on-side PFC. If this data is not valid, the ACE processes data from an alternate PFC. The ACEs process some data from the other PFCs at all times. For example, this occurs during data validation and voted commands. The ACEs transmit only on their on-side bus.

AFDS Interface

The autopilot flight director system (AFDS) interfaces with the PFCS through the autopilot flight director computers (AFDCs). Each AFDC transmits to its on-side flight controls data bus, but receives data from all three buses. The AFDCs receive backdrive commands, engagement status, and other data from the PFCs. The AFDCs transmit pitch, roll and yaw commands and engage requests to the PFCs.

AIMS Interface

The two AIMS cabinets receive data from all three flight controls data buses, but normally transmit only to their on-side bus. During tests on the ground, the AIMS cabinets transmit also to the center bus.

The PFCS supplies information to the AIMS for:

- The primary display system (PDS), (flight, synoptic, and EICAS displays)
- The central maintenance computing system (CMCS)
- The airplane condition monitoring system (ACMS)
- The flight management computing system (FMCS)

PFCS - FLIGHT CONTROLS ARINC 629 BUS INTERFACES

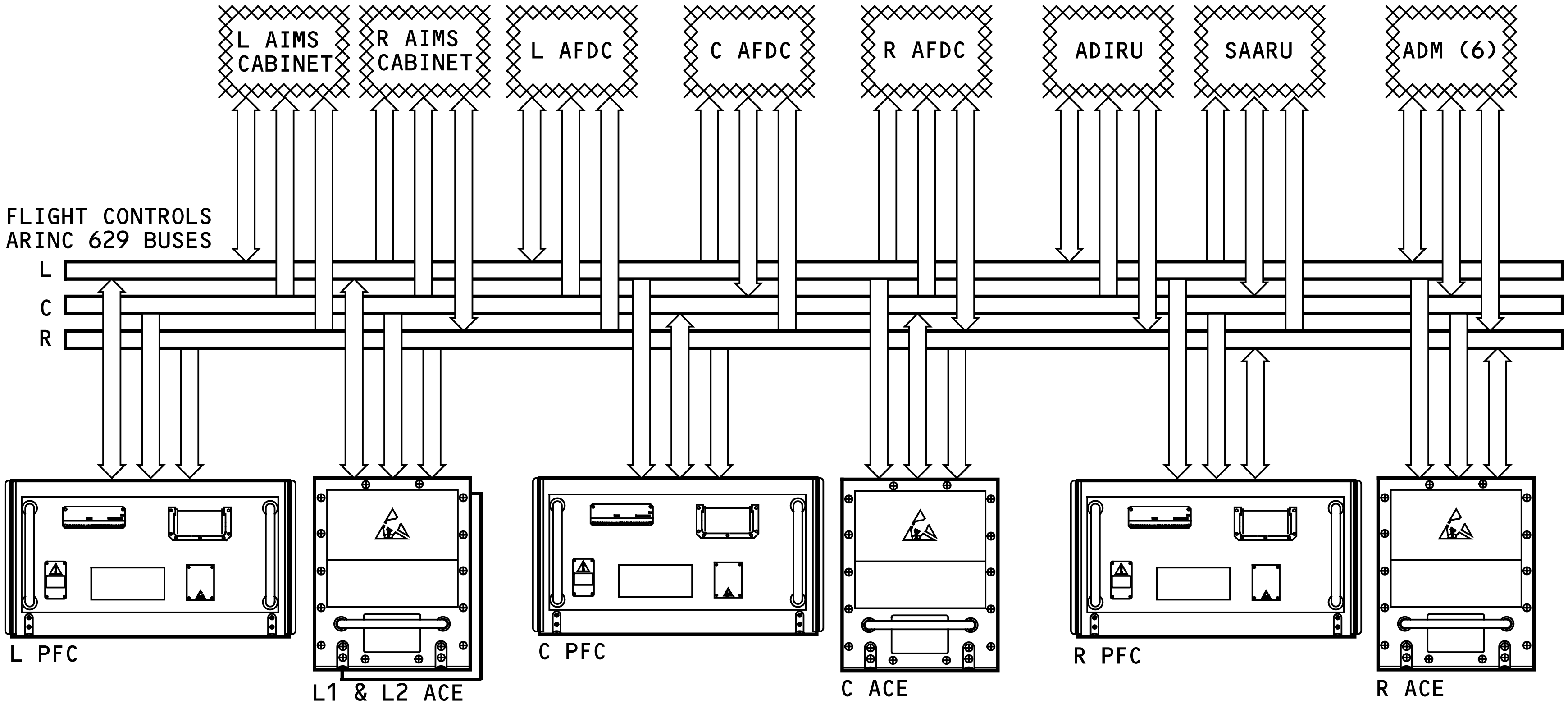
ADIRS Interface

The air data inertial reference system (ADIRS) consists of the air data inertial reference unit (ADIRU) and the secondary attitude air data reference unit (SAARU).

The ADIRU and SAARU supply air data variables and inertial data to the PFCs. The ADIRU receives data from all three buses and transmits data to the left and right flight controls data buses. The SAARU also receives data on all three buses, but transmits data only to the center flight controls data bus.

Air Data Modules

Six air data modules (ADMs) supply pitot and static air data to the ADIRU and the SAARU. The ADMs transmit these data through the flight controls ARINC 629 buses.



27-02-00-004 Rev 3

PFCS - FLIGHT CONTROLS ARINC 629 BUS INTERFACES

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PFCS - SYSTEMS ARINC 629 BUS INTERFACES

General

Many components of the PFCS transmit to and receive information from other airplane systems. Data on the systems ARINC 629 buses goes through the AIMS data conversion gateway function and then to the flight control ARINC 629 buses. The PFCS uses information from:

- The flap/slat electronics units (FSEUs)
- The proximity sensor electronics units (PSEUs)
- The left and right systems card files.

The PFCS transmits information to the left and right warning electronic units (WEUs).

The PFCS also uses radio altimeter data supplied through AIMS.

FSEU Interface

The FSEUs supply flaps and slats signals to the PFCs for the gain functions of the control laws. These signals show the retracted or not retracted condition of the flaps and the slats. The FSEUs also supply a signal to the ACEs.

PSEU Interface

The PSEUs supply truck tilt signals and associated fault messages to the PFCS. The truck tilt signals are used together with the weight on wheels and radio altimeter functions to operate the auto speedbrake.

Systems Card Files Interface

The two systems card files supply signals from the hydraulic interface module (HYDIM) cards and the weight on wheels (WOW) cards to the PFCS.

The HYDIM cards supply hydraulic systems condition signals to the PFCS. They also supply data about the truck tilt pressure sensors.

The WOW cards supply air/ground signals to the PFCS. These signals supply air/ground information to the PFCS.

WEU Interface

The PFCS sends stabilizer and rudder trim position signals to the WEUs. The WEUs supply a takeoff warning if the stabilizer is out of green band or the rudder trim is out of normal limits.

The PFCs receive stall data from the WEUs for stall protection.

Engine Data Interface Units

The left and right engine data interface units (EDIUs) receive the N1 speed and calculate the thrust for each engine. The EDIUs supply these data to the AIMS and to the PFCS for the thrust asymmetry compensation (TAC) function.

PFCS - SYSTEMS ARINC 629 BUS INTERFACES

Radio Altimeter Interface

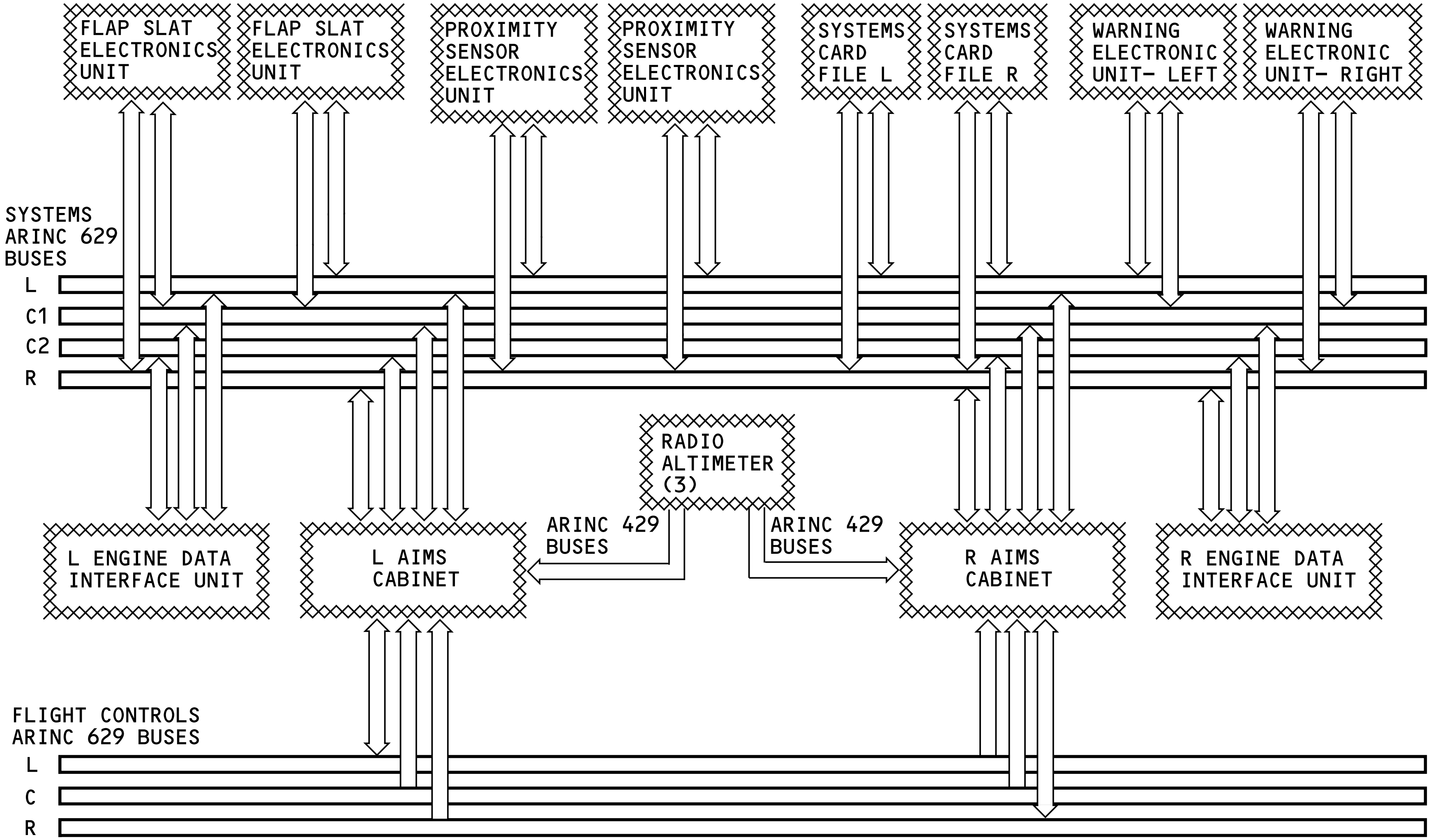
The three radio altimeters supply information to AIMS for use by the PFCS for the flare function during manual landing. The PFCS inhibits the radio altimeter test when ground speed is more than 40 knots and during flight.

Indications

The status message PFCS INTERFACE shows because of one of these faults:

- There is a disagreement with the flap discrete signals in two or more ACEs
- Only two of the four FSEU channels are available
- Only two of the four digital WES channels are available
- Only one of the two truck tilt pressure data sources is available
- Thrust data from one of the left or right EDIU channels does not agree with the others
- Data from the two WOW cards does not agree.

These conditions cause the message to show in normal, secondary, and direct modes.



PFCS - SYSTEMS ARINC 629 BUS INTERFACES

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PFCS - ANALOG INTERFACES

General

All analog interfaces with the PFCS go to the ACE. The primary inputs/outputs are:

- Rudder trim selector
- Manual trim cancel switch
- Pitch trim switches
- Flight control position transducers
- Flight control force transducers
- FSEUs
- Primary flight computers DISC/AUTO switch
- Thrust asymmetry compensation switch
- AIMS cabinets
- PCUs.

Rudder Trim Selector and Manual Trim Cancel Switch

The rudder trim selector and the manual trim cancel switch supply signals to the ACEs. These signals show the pilot commands for rudder trim.

Pitch Trim Switches

The pitch trim switches supply signals to the ACEs to show the pilot pitch trim commands.

Flight Control Position Transducers

The flight control position transducers supply electrical inputs to the ACEs. They show the position of the:

- Control wheel
- Control column
- Rudder pedals
- Speedbrake lever.

Flight Control Force Transducers

The pitch and roll force transducers supply signals to the ACEs. The signals show when the pilot applies a force to the control wheel or control column.

FSEUs

The FSEUs supply a signal to each ACE showing that the flaps and slats are retracted or not retracted.

Primary Flight Computers DISC/AUTO switch

The primary flight computers DISC/AUTO switch supplies a signal to each ACE that shows the switch position. Switch positions are AUTO or DISC.

Thrust Asymmetry Compensation Switch

The thrust asymmetry compensation (TAC) switch supplies a signal to the C ACE that shows the switch position. The switch positions are AUTO or OFF.

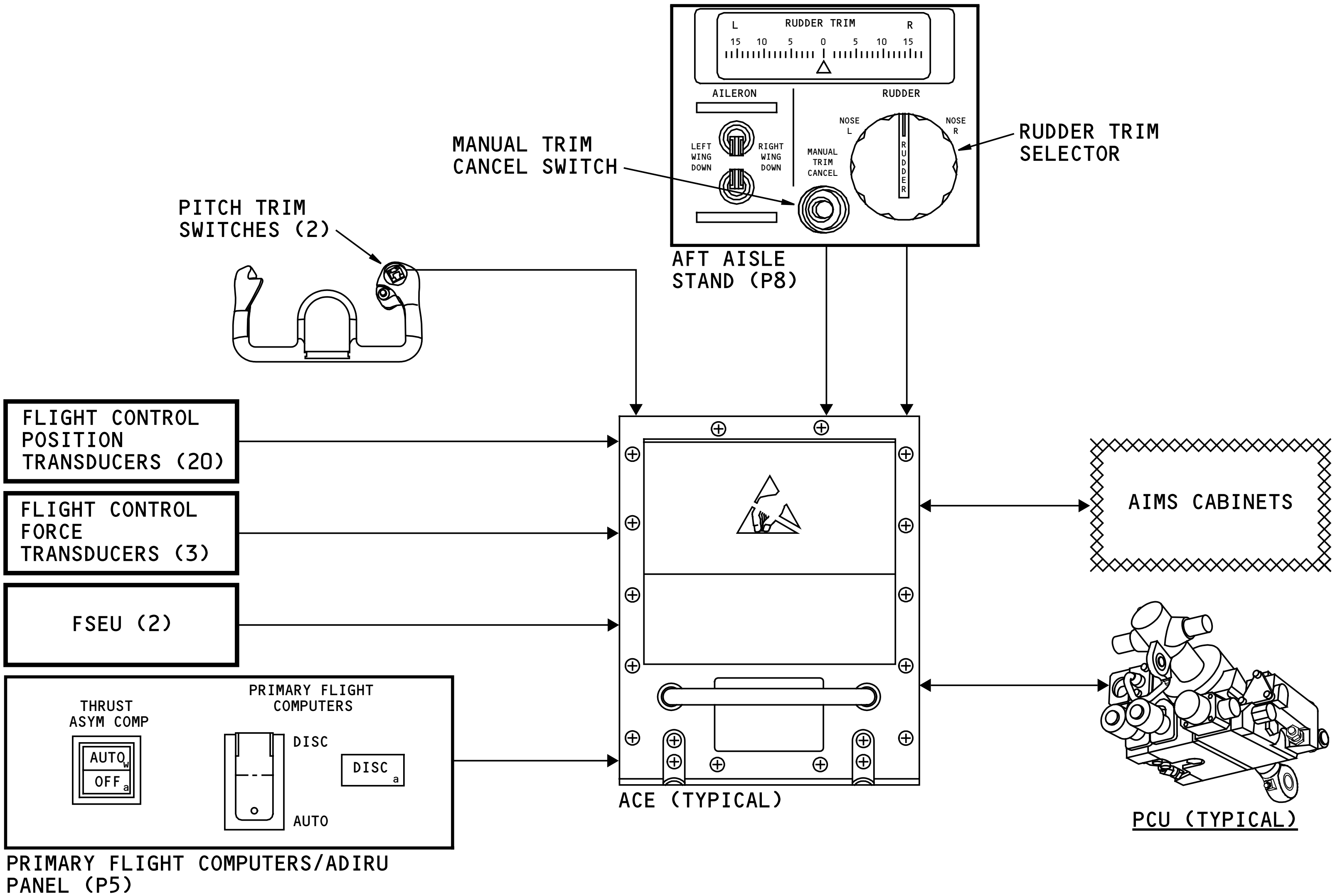
AIMS Cabinets

Each ACE supplies two signals to both AIMS cabinets. The signals show that the ACE is in the direct mode and the ACE power supply is correct.

PFCS - ANALOG INTERFACES

PCUs

The ACEs supply command signals to the PCUs. The PCUs supply position feedback signals to the ACE.



27-02-00-006 Rev 6 04/29/95

PFCS - ANALOG INTERFACES

PFCS - ELECTRICAL POWER DISTRIBUTION

General

Because the electrical power supply to the PFCS is very critical, a high level of redundant power is available.

Power Supply Assembly

Three identical power supply assemblies (PSAs) supply 28v dc to the components of their on-side portion of the PFCS. The PSAs supply electrical power to the ACEs, the PFCs, the PCUs and the STCMs. In addition, the PSAs supply power for the rudder trim, the auto speedbrake, the ADMs and the SAARU.

See the flight controls dc power section for more information (AMM PART I 24-35).

PSA Power Sources

During flight, the left PSA normally receives primary power from one permanent magnet generator (PMG) on the left engine. The right PSA receives primary power from one PMG on the right engine. The center PSA receives primary power from two PMGs, one on each engine. The PSAs change the ac variable electrical power from the PMGs to 28v dc.

If the primary power is not available or not within specified limits, the left and right PSAs change to secondary power from the left and right 28v dc buses. Secondary power to the center PSA is from the captain's flight instrument bus.

When the airplane is on the ground and no engines are running, the PSAs normally change to secondary power.

If primary and secondary power is not available or not within specified limits, the PSA changes to backup power. The left and center PSAs receive backup power from the hot battery bus. The right PSA has no backup power.

Each PSA has a dedicated flight control dc battery (FCDC BATT). It supplies the flight control components with power for one minute during PSA switching.

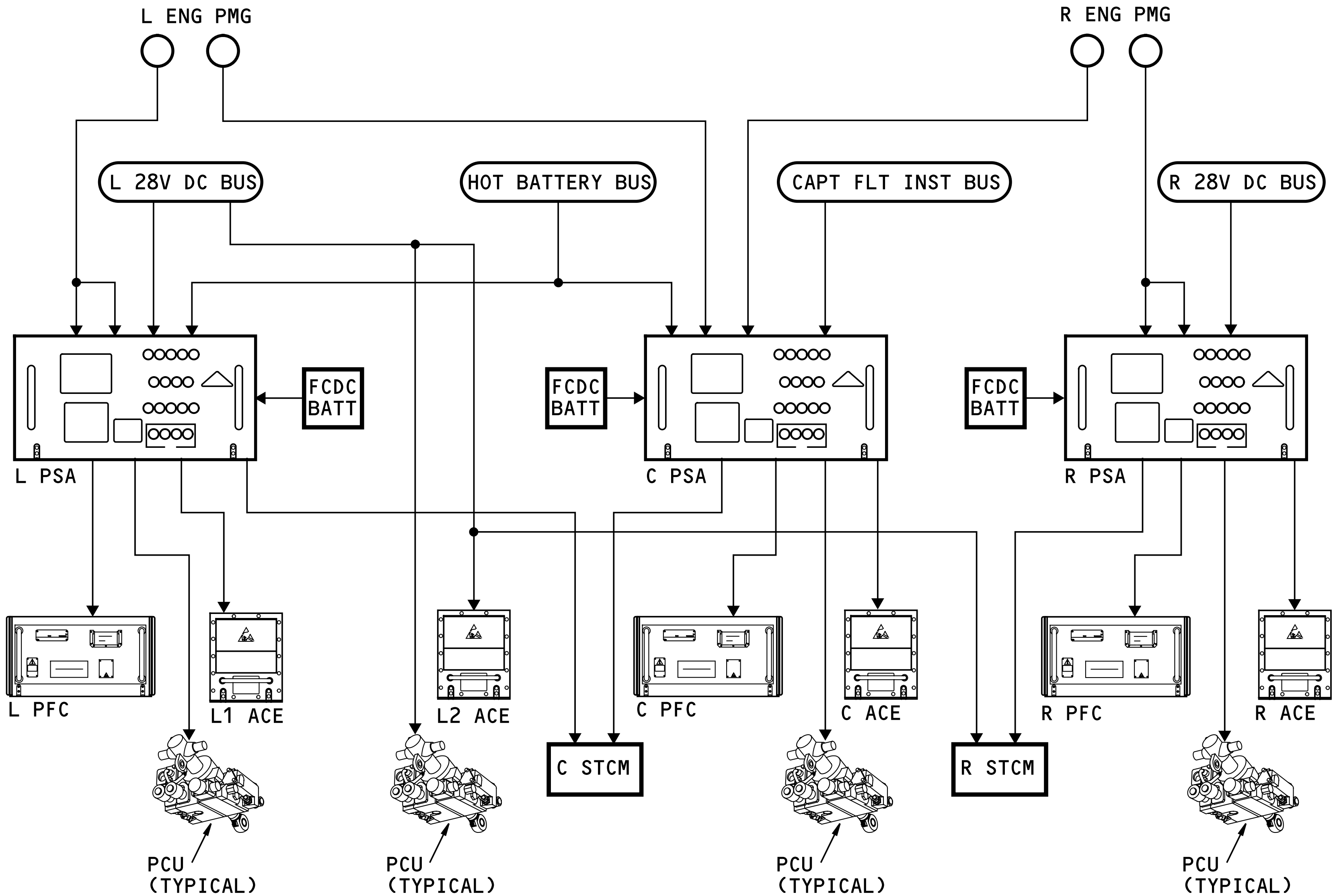
Power to L2 ACE

The L2 ACE and its related PCUs have only one power supply from the left 28v dc bus in the P110 left power management panel. In addition, the left 28v dc bus supplies power for the stabilizer commands, the elevator feel and the aileron/rudder trim module.

Training Information Point

There are circuit breakers on the front of the PSAs and the P110 left power management panel. They control power to the components of the PFCS.

If electrical power is shutdown with a PFC deactivated or removed, the FCDC battery discharges. To prevent FCDC battery discharge, open the applicable circuit breakers on the PSA. When electrical power is available, close the circuit breakers.



PFCS - ELECTRICAL POWER DISTRIBUTION

PFCS - HYDRAULIC POWER AND ACE DISTRIBUTION

Hydraulic Power Distribution

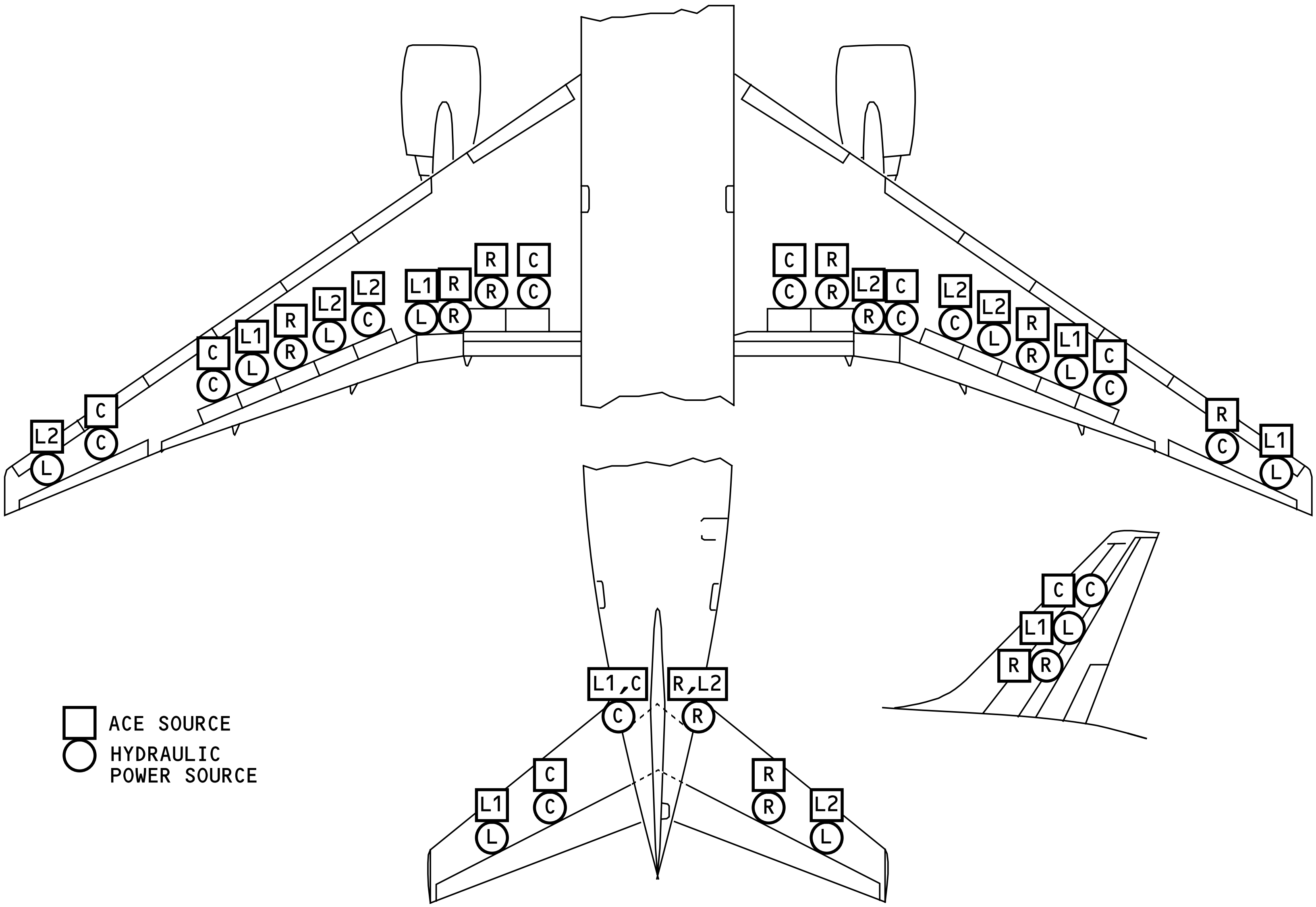
All three hydraulic systems supply power to operate the PCUs of the primary flight controls. The hydraulic distribution is:

- The left aileron: L and C
- Spoiler 1: C
- Spoiler 2: L
- Spoiler 3: R
- Spoiler 4: L
- Spoiler 5: C
- The left flaperon: L and R
- Spoiler 6: R
- Spoiler 7: C
- Spoiler 8: C
- Spoiler 9: R
- The right flaperon: R and C
- Spoiler 10: C
- Spoiler 11: L
- Spoiler 12: R
- Spoiler 13: L
- Spoiler 14: C
- The right aileron: C and L
- The left elevator: L and C
- The right elevator: R and L
- The rudder: L, C and R
- The stabilizer actuator: C and R.

ACE Distribution

The distribution of the four ACEs among the PCUs is in a manner that each PCU for a surface receives commands from a different ACE. The distribution is:

- The left aileron: L2 and C
- Spoiler 1: C
- Spoiler 2: L1
- Spoiler 3: R
- Spoiler 4: L2
- Spoiler 5: L2
- The left flaperon: L1 and R
- Spoiler 6: R
- Spoiler 7: C
- Spoiler 8: C
- Spoiler 9: R
- The right flaperon: L2 and C
- Spoiler 10: L2
- Spoiler 11: L2
- Spoiler 12: R
- Spoiler 13: L1
- Spoiler 14: C
- The right aileron: R and L1
- The left elevator: L1 and C
- The right elevator: R and L2
- The rudder: L1, C and R
- The stabilizer actuator: L1 and C for the left motor/brake, and R and L2 for the right motor/brake.



PFCS - HYDRAULIC POWER AND ACE DISTRIBUTION

27-02-00-008 Rev 0

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PFCS - ACE - FUNCTIONAL DESCRIPTION

General

The ACE is a signal converter and controls the direct mode.

The primary functions of the ACE are:

- A/D converter
- D/A converter
- Direct mode select logic
- Direct mode command calculation
- PCU servo loop control
- Excitation power supply.

The ACE operates in all three PFCS modes. Operation of the ACE in direct mode is different than in normal and secondary mode. In normal and secondary mode, the ACE relays input signals from airplane sensors to the PFC and command output signals from the PFC to the PCUs. In direct mode, the ACE processes the input signals with internal hardware and sends command output signals to the PCUs.

A/D Converter

The analog inputs from the position and force transducers go to the A/D converter which changes them from analog to digital format. The transducers send signals from:

- The control wheels
- The control columns
- The rudder pedals
- The speedbrake lever.

The pitch rate sensor is internal to the ACE. It sends analog input signals to the A/D converter and to the direct mode internal hardware. The ACE supplies the signals to the PFC for secondary mode.

The digital signals then go to the ARINC 629 buses.

D/A Converter

Digital commands from the buses go to the D/A converter which changes them from digital to analog format. They then go to the PCU servo loop to control the surfaces.

Direct Mode Select Logic

The pilots can manually switch the ACE to the direct mode. The PFC disconnect switch commands all ACEs to the direct mode.

The PFC automatically changes the ACE to the direct mode when data is not available from all three flight control buses or when internal monitors find failures. The ACE internal logic executes the command.

Direct Mode Command Calculation

In direct mode, the command calculation uses control laws contained in the ACE hardware. Position transducers, force transducers and the pitch rate sensor supply input signals. The analog command output signals go directly to the PCUs.

PFCS - ACE - FUNCTIONAL DESCRIPTION

PCU Servo Loop Control

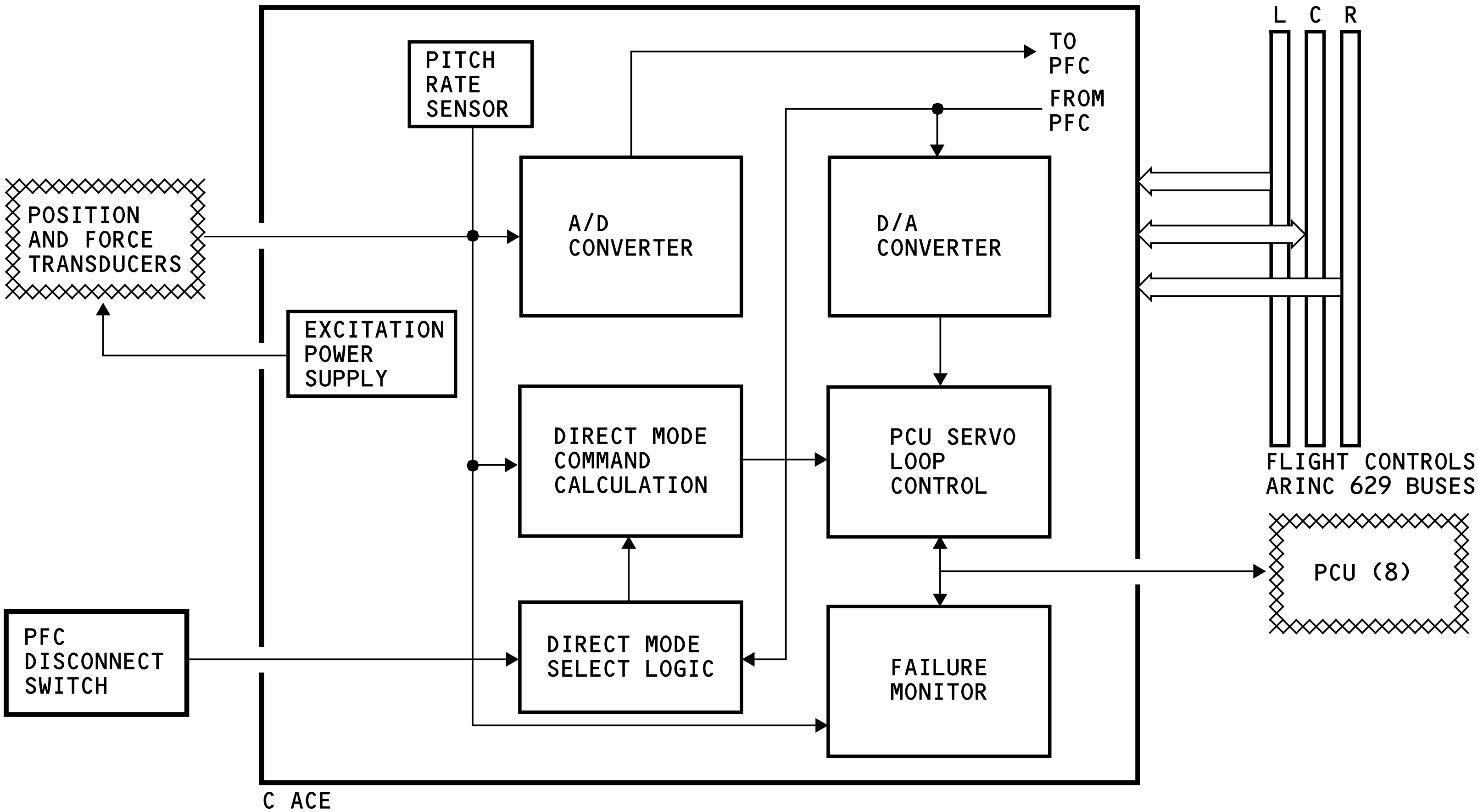
The ACE contains the servo loop control to each PCU. This servo loop operates in all three PFCS modes.

Failure Monitor

The failure monitor controls power to solenoids on the PCUs. When there is a failure, the ACE de-energizes solenoids on the effected PCUs.

Excitation Power Supply

The ACE has power supply circuits that supply 7v AC, 1800 Hz excitation power to the position and force transducers.



NOTE: CENTER ACE SHOWN. OTHERS SIMILAR.

27-02-00-010 Rev 5

PFCS - ACE - FUNCTIONAL DESCRIPTION

PFCS - PFC - COMPONENT LOCATION

Purpose

The primary flight computers (PFC) calculate surface commands for the ailerons, flaperons, speedbrakes, spoilers, elevators, rudder and stabilizer.

These are the functions of the PFC:

- Calculate control surface commands using pilot and autopilot inputs
- Calculate commands for variable elevator feel and backdrive actuators
- Supply stability augmentation
- Supply flight envelope protection
- Send signals for flight deck annunciations
- Send signals for maintenance messages.

Physical Description

The PFC weighs approximately 38 pounds (17 kg). The PFC is passively cooled.

There are thirty-two program pins on each PFC. The program pins supply the following information:

- Airplane type
- Airplane model
- Channel Identification (L,C,R)
- Parity (odd).

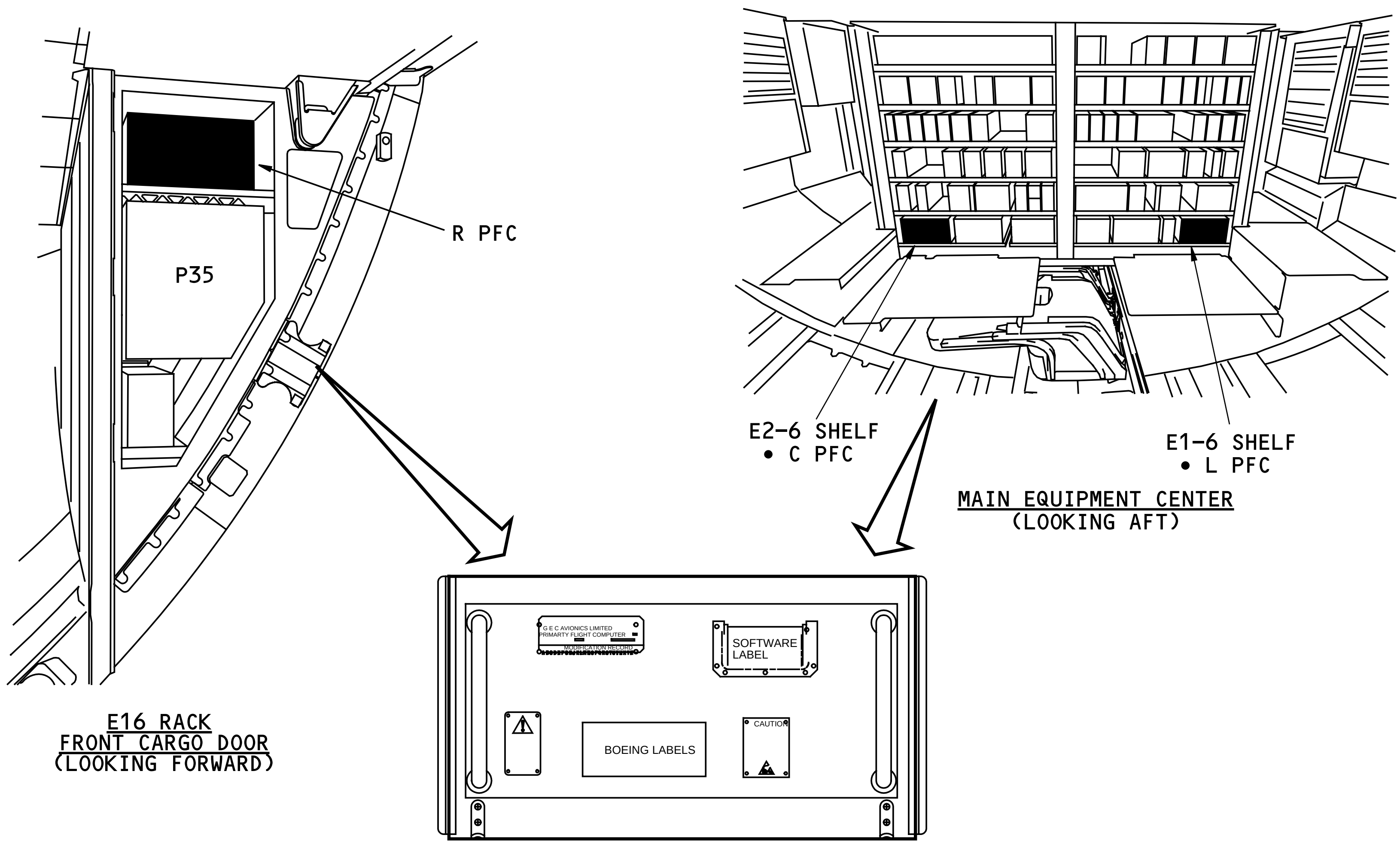
You load the software of the PFC through the maintenance access terminal (MAT). There are no software options.

Location

The three identical and interchangeable PFCs are:

- L PFC (left)
- R PFC (right)
- C PFC (center).

The L and C PFCs are in the main equipment center. The L PFC is on the E1-6 shelf and the C PFC on the E2-6 shelf. The R PFC is in the E16 rack aft of the front cargo door.



E16 RACK
FRONT CARGO DOOR
(LOOKING FORWARD)

MAIN EQUIPMENT CENTER
(LOOKING AFT)

PFC (TYPICAL)

27-02-00-011 Rev 2

PFCS - PFC - COMPONENT LOCATION

PFCS - PFC - FUNCTIONAL DESCRIPTION

General

Each PFC has three independent lanes. The CPU of each lane is of different manufacture and part number. The lanes have identical software and capabilities. This is done to get the necessary redundancy. You use the MAT to load PFC software.

When the airplane initially gets electrical power on the ground, the PFCs do tests between lanes and between PFCs. These tests check the compatibility of software, hardware, airplane type and airplane model. Any lane or PFC that fails the tests is declared a failure.

Each lane has:

- An input signal monitor
- A set of control laws
- A cross-lane monitor
- A PFC output selector.

The PFC operates in two modes: normal and secondary. In normal mode, all the functions of the PFC operate. The PFC selects the secondary mode when there is a loss of important air and attitude sensor data from the ADIRU and SAARU. The secondary mode is a degraded mode in which only specified functions of the PFC operate.

Lane Functions

The three lanes can become any one of these three lanes:

- Command lane
- Standby lane
- Monitor lane.

The command lane transmits its command output signals to the flight controls ARINC 629 buses. The command lane also has a lane monitoring function to find and isolate failures in the standby and monitor lanes.

The standby lane transmits test data only. The standby lane becomes the command lane and transmits its command output signals to the buses when a failure causes the command lane to shut down. The standby lane does monitoring functions to find and isolate failures in the command and monitor lanes.

The monitor lane transmits test data only. The monitor lane command output signals are used internally to find failures in the command and standby lanes. The monitor lane becomes the standby lane when the command lane shuts down.

Lane Selection

When the airplane initially gets electrical power, each PFC starts a lane selection procedure. This procedure automatically sets the function of each lane in each PFC. Each PFC must select a different lane for its command lane.

At the end of each flight, the lane selection in each PFC changes to decrease the exposure time for potentially latent failures.

Input Signal Monitor

Each lane gets input signals from sensors on the captain's and first officer's sides of the flight deck. Dual and triple sensors on each side supply input signals. The input signal monitor of each lane sets which input signal to use by mid-value selection and averaging.

The mid-value selection compares the signal values of each side and selects the signal that has the middle value. The input signal monitor then averages the mid-values from the captain's and the first officer's sides.

This selection causes each independent process software to receive the same input signal. This selection also removes signals that are out of tolerance.

Control Laws

Each lane has a set of control laws to calculate the proposed command output signals. The command lane sends proposed commands to the other two PFCs.

Cross-Lane Monitor

The cross-lane monitor does a check of the validity of the proposed signals generated by all three lanes. If a cross-lane monitor finds a lane fault, it temporarily inhibits the transmission of the lane's data on the flight controls ARINC 629 buses. The monitor lets the faulty lane try to operate as many as four times during a flight. If the lane still cannot operate without failure, then the monitor latches the failed lane so it can no longer operate.

If the command lane fails, the cross-lane monitor shuts it down and causes the standby lane to do the function of the command lane. If a second lane is defective, the PFC shuts down.

PFC Output Selector

Each lane has a PFC output selector to supply a common set of PFC command output signals for use by the ACEs. This function makes sure that all PFC generated command output signals are identical to each other. The PFC output selector operates only in the command lane.

The PFC output selector gets the proposed command output signals from all three PFCs. The PFC output selector compares the three proposed signals and makes a selection by the mid-value process. Only the PFC output selector of the command lane then transmits the selected command output signal to the flight controls ARINC 629 buses and the ACEs.

PFC Self Test

At the end of each flight, the PFCs do an automatic PFC self test to find component failures and confirm failures found in flight.

PFCS - PFC - FUNCTIONAL DESCRIPTION

Lane Availability and Indications

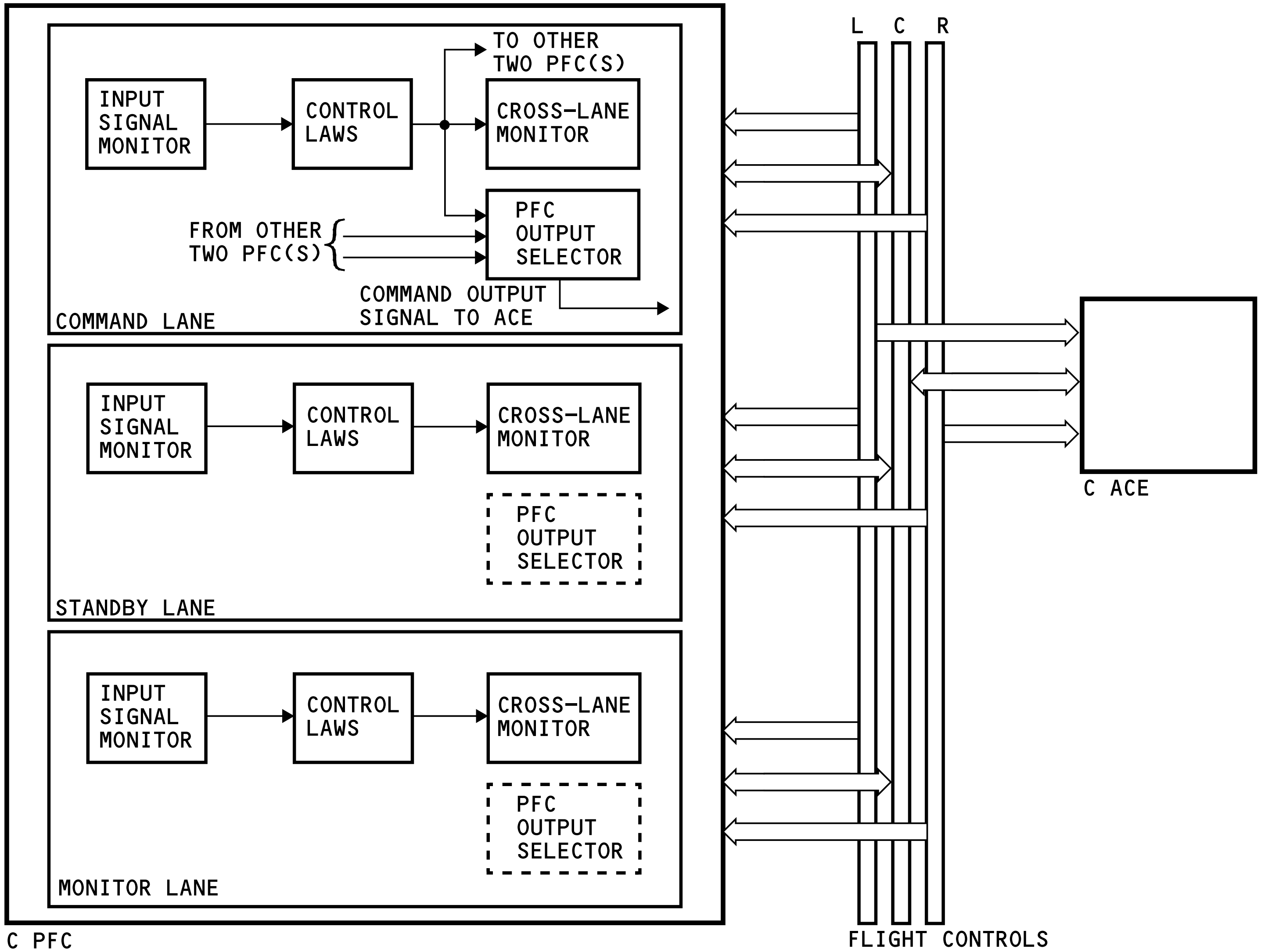
The three PFCs supply a total of nine lanes on the airplane. When there is no failure, the lane availability is referred to as the 3-3-3 lane configuration. If a PFC has a failed lane, the lane availability is 2. The PFC shuts down if there is a second lane failure or if all three lanes fail. In that case, the lane availability is 1 or 0.

The table below shows the indication on the primary display system and the operating mode for each combination of lane availability.

LANE AVAILABILITY	PFCS MODE	MESSAGE	MESSAGE TYPE
3-3-3	NORMAL	NONE	NONE
3-3-2	NORMAL	NONE	NONE
3-2-2	NORMAL	PFC CONTROL LANES	STATUS
3-3-1/0	NORMAL	PFC CHANNEL	STATUS
3-2-1/0	NORMAL	FLIGHT CONTROL SYS	STATUS
3-1/0-1/0	NORMAL	FLIGHT CONTROL SYS	STATUS
2-2-2	NORMAL	FLIGHT CONTROL SYS	STATUS
2-2-1/0	NORMAL	FLIGHT CONTROL SYS	STATUS
2-1/0-1/0	NORMAL	FLIGHT CONTROL SYS	STATUS
1/0-1/0-1/0	DIRECT	PRI FLIGHT COMPUTERS AUTO SPEEDBRAKE THRUST ASYM COMP FLIGHT CONTROL SYS AUTO SPEEDBRAKE THRUST ASYM COMP	CAUTION ADVISORY ADVISORY STATUS STATUS STATUS

The system operates normally with one PFC lane failed, in the 3-3-2 configuration. There is no flight deck indication in this configuration.

The EICAS caution message FLIGHT CONTROL MODE indicates that the PFCS is in secondary mode.



<u>NOTE</u>: CENTER PFC AND ACE RELATIONSHIP SHOWN. OTHERS SIMILAR.

27-02-00-012 Rev 9 07/13/95

PFCS - PFC - FUNCTIONAL DESCRIPTION

PFCS - PFC DISCONNECT SWITCH

Purpose

The PFC disconnect switch lets the pilot select the direct mode of operation.

Physical Description

The PFC disconnect switch is a guarded toggle switch with two positions: AUTO and DISC. The switch is guarded in the AUTO position. An amber PFC disconnect (DISC) light is next to the switch.

Location

The PFC disconnect switch and light are on the P5 panel in the flight deck.

Functional Description

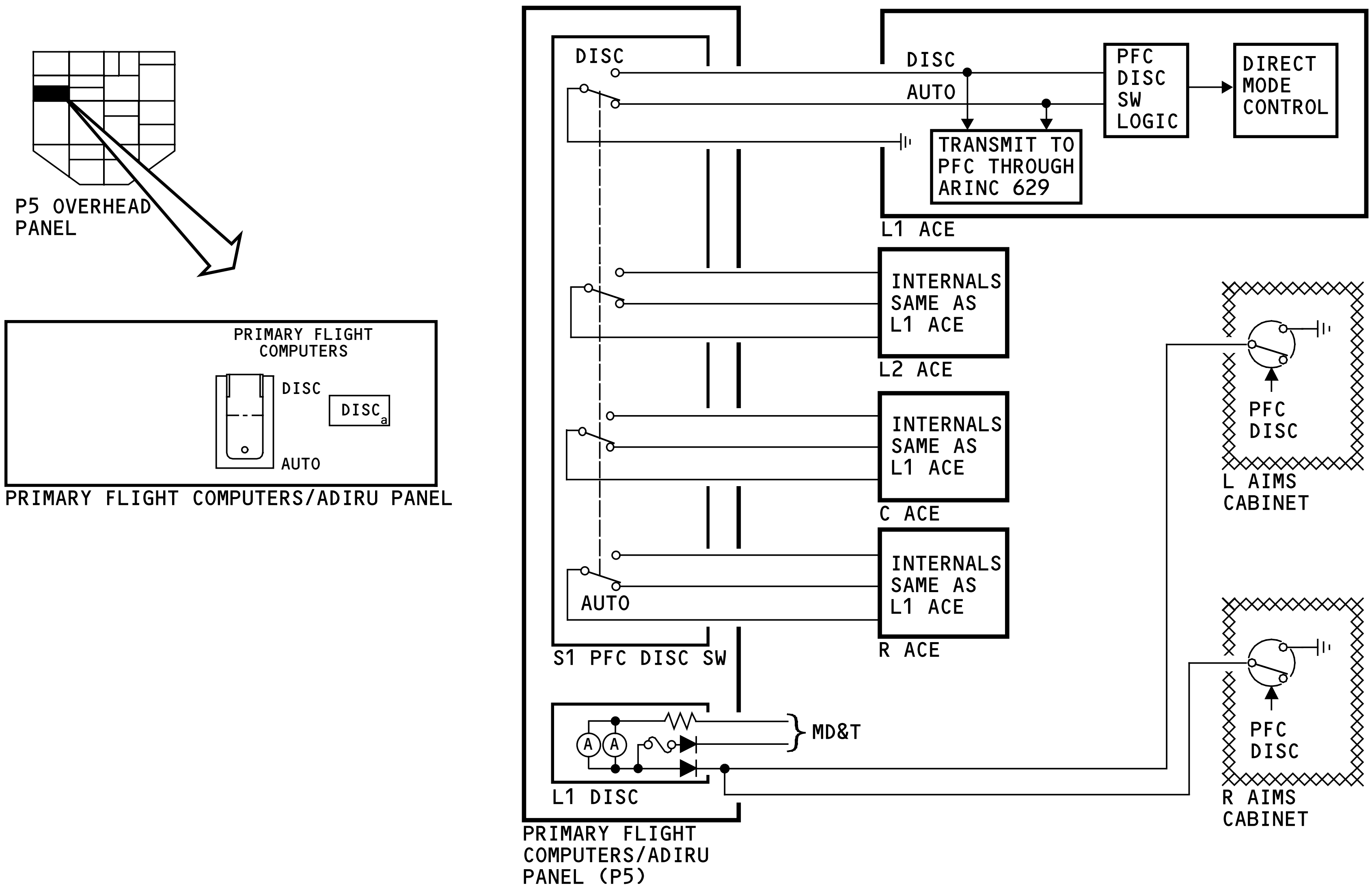
The PFC disconnect switch sends a discrete signal to each ACE. The ACE then transmits this signal to its on-side PFC through the flight controls ARINC 629 buses.

When the PFC disconnect switch is in the AUTO position, PFCS mode selection is automatic. The pilots can set the switch to DISC to select the direct mode of operation.

The amber DISC light shows when the PFCS is in direct mode, regardless of how the direct mode was engaged.

Indications

The EICAS caution message PRI FLIGHT COMPUTERS shows that all the ACEs that have power are in the direct mode and the PFC is not in the hydraulic OFF self-test mode. The message shows when the PFC disconnect switch is in the DISC position.



PFCS - PFC DISCONNECT SWITCH

PFCS - OPERATIONAL MODES - FUNCTIONAL DESCRIPTION

General

These are the three modes of PFCS operation:

- Normal
- Secondary
- Direct.

During the PFCS normal and secondary mode operation, both the PFCs and the ACEs are in operation. In the secondary mode, the PFC's operation downgrades. During the direct mode, only the ACEs operate in response to direct analog inputs.

The PFCS selects the mode of operation. On the ground with ground speed less than 40 knots, the PFCs automatically select the highest mode available based on the inputs from the ADIRU and SAARU. In flight, the pilots cycle the PFC disconnect switch on the P5 panel, or move it back to the AUTO position to cause the selection of the highest mode available.

During PFCS mode changes, there is a smooth change to the new commands.

Normal Mode

The PFCS selects the normal mode when all these conditions are met:

- The PFC disconnect switch, on the P5 panel, is in the AUTO position
- The needed input data is available
- At least one PFC and three ACEs are in normal mode.

All the control laws, the protection functions, and the stability augmentation of the PFCs are active in the normal mode. The autopilot operates only in normal mode.

Secondary Mode

The PFCS selects the secondary mode when it detects the loss of important air and attitude sensor data from both the ADIRU and the SAARU. The PFCS also selects the secondary mode when two ACEs are in direct mode.

A simplified set of control laws operate the PFCS in secondary mode. The protection functions are not available. Gain schedules and limits are a function of flap data discretes from the ACEs. Pitch stability augmentation uses pitch rate data from the ACEs. Yaw damper augmentation uses inertial data from the ADIRU and the SAARU if available.

Direct Mode

The PFCS selects the direct mode when there are failures that make the normal and secondary modes unreliable. If three ACEs are in direct mode, the PFCS switches the last ACE to the direct mode. The PFC disconnect switch also causes the selection of the direct mode.

The PFCs do not control the surfaces in the direct mode. Position transducer signals from the control wheels, columns and pedals go directly to the ACEs which use them to control the PCUs. The protection functions are not available.

When the PFCS is in direct mode, whether automatically or manually, the DISC amber light shows next to the PFC disconnect switch.

Manual Switching

The PFCS goes to the direct mode of operation when the pilots move the PFC disconnect switch to the DISC position.

If the pilots cycle the PFC disconnect switch or move it again to the AUTO position, the PFCS goes from the direct mode to the highest mode available. The PFCS selects the mode based on the validity of available data.

If the PFCS is in the secondary or direct modes and the normal mode becomes available, the PFCS may select the normal mode. To do this in the air, you must cycle the PFC disconnect switch. If the airplane is on the ground and ground speed is less than 40 knots, then the PFCS selects the normal mode automatically.

Indications

The EICAS caution message FLIGHT CONTROL MODE shows when the PFCS is in secondary mode.

The EICAS caution message PRI FLIGHT COMPUTERS shows when all ACEs under power are in direct mode and the PFC is not in the hydraulic OFF self-test mode.

On the status display, the status message FLIGHT CONTROL SYS shows when the PFCS does not operate at minimum dispatch requirement levels. This message shows because of one or more of these faults:

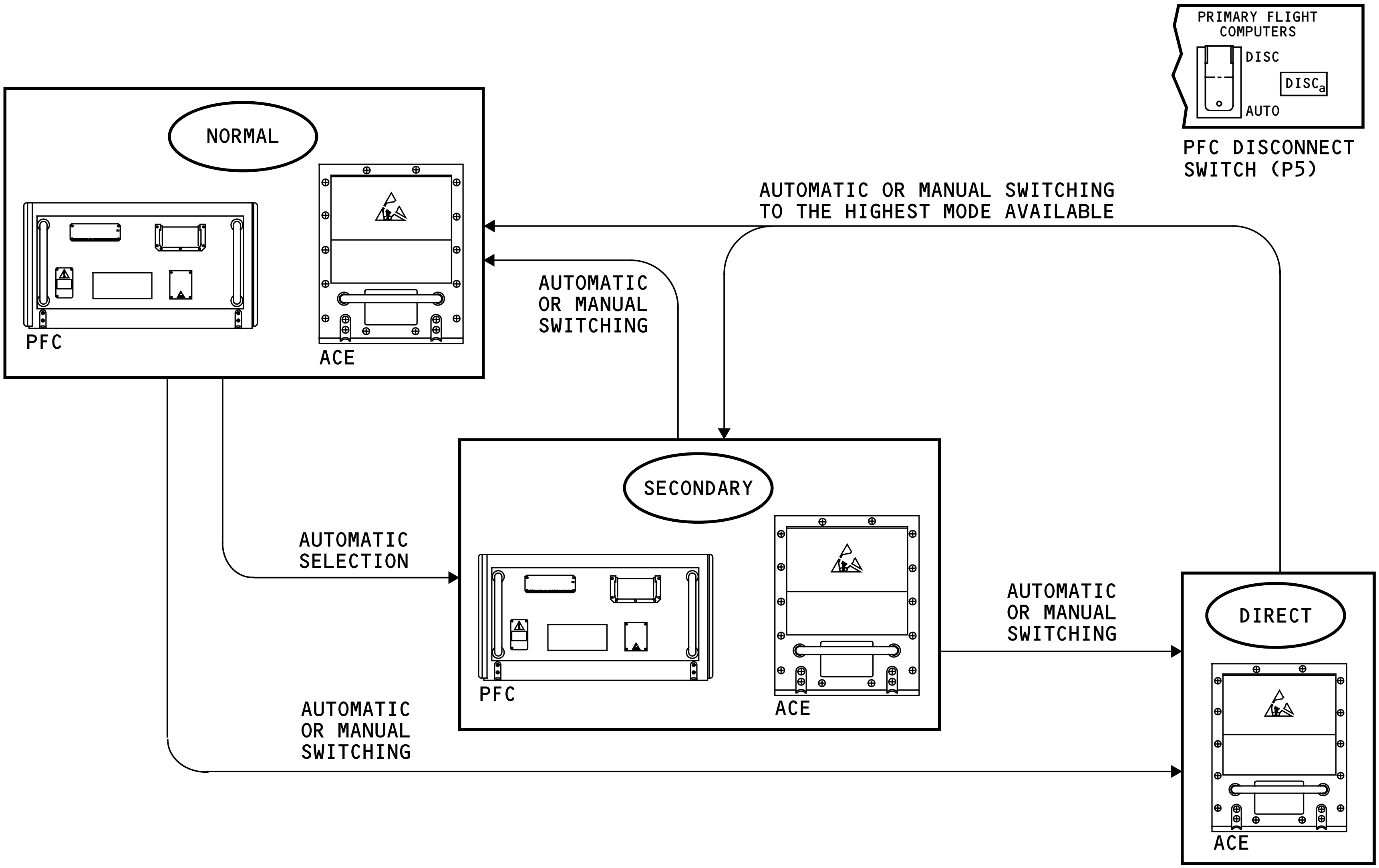
- Failure of a column, wheel, pedal, or speedbrake lever position transducer
- Failure of a rudder, elevator, aileron, flaperon, or spoiler PCU
- Failure of a STCM
- Failure of an elevator feel actuator
- Failure of a PFC and at least one lane in another PFC
- Failure of an ACE or at least one ACE is in direct mode
- Failure of the stabilizer control
- Failure of the actuator confidence test
- Failure of a PSA, a flight controls ARINC 629 bus, or a WES channel.

The EICAS caution message FLIGHT CONTROLS shows when the flight control system has lost substantial capabilities. Any one of these faults causes the message to show:

- The stabilizer is not operative
- Two elevator PCUs and one stabilizer path are not operative

PFCS - OPERATIONAL MODES - FUNCTIONAL DESCRIPTION

- The wheel, column, or pedal position transducers for the captain and first officer disagree by more than 15 percent of full range with the airplane on the ground
- The elevator force fight equalization function is defective.



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PFCS - OPERATIONAL MODES - FUNCTIONAL DESCRIPTION

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PFCS - FUNCTIONAL DESCRIPTION

General

The primary flight control system supplies roll, pitch and yaw control to set the desired airplane attitude.

At the end of each flight, the PFCs do internal tests and select the function of each lane.

At the completion of power-up and with the hydraulic systems pressurized, the PFCs command the surfaces to slowly move to agree with the command from the control wheels, control columns and rudder pedals.

On the ground without the engines running, the system receives electrical power from a secondary source. When the engines start, the system automatically switches to the PMGs as its primary power source.

Roll Control

The roll control causes the ailerons, flaperons and spoilers to move. When the pilots move a control wheel, six position transducers send analog signals to the PFCs through the ACEs. The PFCs select the signal to process. The control laws, protection functions and stability augmentation of the PFCs, calculate the command output signals. After selection of one signal among the three supplied by the PFCs, the PFCs send the command output signal to the ACEs. The ACEs then command the control surface PCUs. PCU position transducers send feedback signals to the ACEs.

The PFCs also control:

- The aileron lockout during cruise
- The aileron and flaperon droop when the flaps extend.

Speedbrake Control

When the pilots move the speedbrake lever, four position transducers send analog signals to the PFCs through the ACEs. The PFCs then calculate the command output signals. After selection of one signal, the PFCs send the selected signal to the ACEs. The ACEs then command the spoiler PCUs. PCU position transducers send feedback signals to the ACEs.

Pitch Control

The pitch control causes the elevators and the horizontal stabilizer to move. When the pilots move a control column, six position transducers send analog signals to the PFCs through the ACEs. The PFCs process these signals and command the elevator PCUs in the same manner as the roll control.

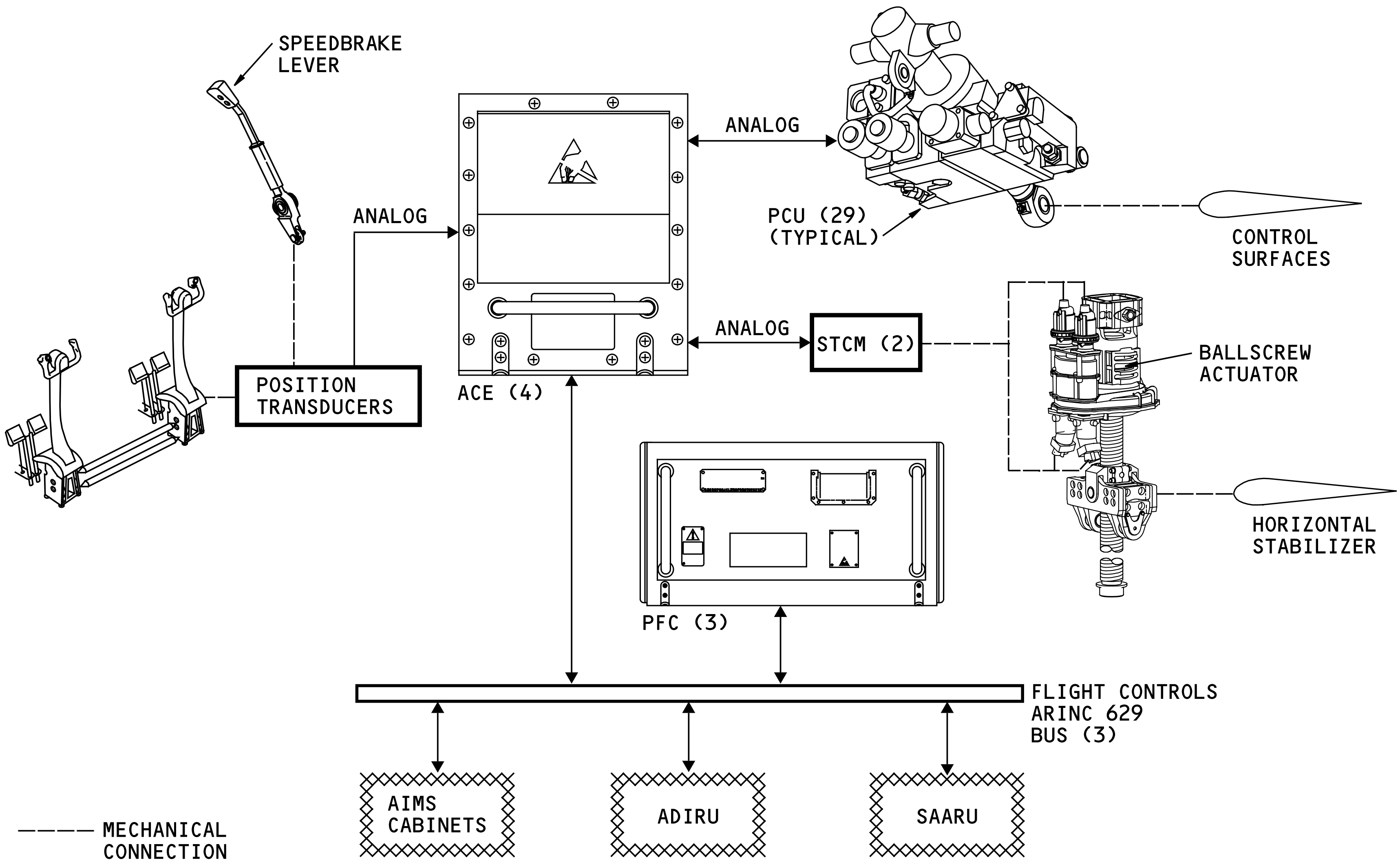
When there is a command to the elevator that lasts longer than a calculated time, the elevator offload function of the PFCs send stabilizer command signals to the ACEs. The ACEs then command the stabilizer trim control modules (STCMs) which hydraulically control the stabilizer ballscrew actuator. The movement of the stabilizer then causes the elevator to fair.

PFCS - FUNCTIONAL DESCRIPTION

Yaw Control

The yaw control causes the rudder to move. When the pilots move the control pedals, four position transducers send analog signals to the PFCs through the ACEs. The PFCs process these signals and command the rudder PCUs in the same manner as the roll control. The PFCs also control changes in the rudder ratio, gust suppression and wheel-rudder cross-tie functions.

The PFCs control the rudder trim when the pilots move the rudder trim selector or the manual trim cancel switch. The thrust asymmetry compensation (TAC) function automatically controls the rudder trim to correct for asymmetrical thrust of the engines.



27-02-00-016 Rev 4

PFCS - FUNCTIONAL DESCRIPTION

PFCS - AUTOPILOT - GENERAL DESCRIPTION

General

With the autopilot engaged, the PFCS receives command inputs from the AFDCs. The PFCS processes these commands in the same manner as manual inputs from the pilots.

The autopilot function of autopilot flight director system (AFDS) supplies automatic control of the:

- Altitude
- Vertical speed
- Flight path angle
- Heading
- Track
- Airspeed
- Approach
- Go-around.

The AFDS does not have servos to move the primary flight control surfaces. The autopilot commands go to the PFCs. The PFCs use these commands to supply surface commands to the ACEs. The PFCs also supply backdrive commands to the AFDCs.

Autopilot Components

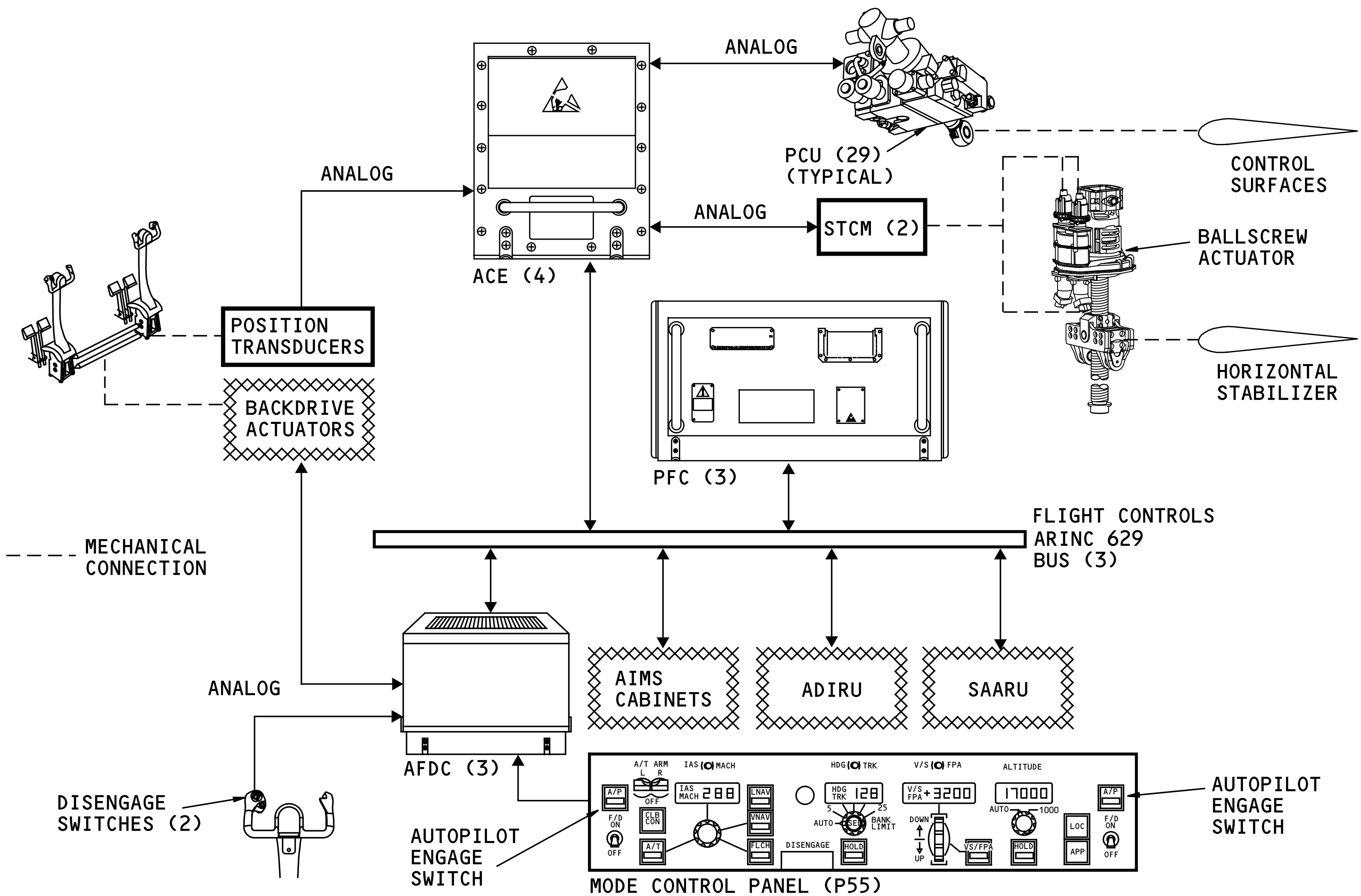
The components of AFDS are:

- One mode control panel (MCP)
- Three autopilot flight director computers (AFDCs)
- Six backdrive actuators
- Two control wheel disengage switches.

Autopilot Engagement

There are two autopilot engage switches on the MCP. When the pilot pushes either momentary action switch, the PFCs receive a request to engage the autopilot function. If conditions are correct, the PFCs permit all the available AFDCs to engage in the pitch and roll axes during cruise.

The autopilot yaw axis engages only during the approach and autoland phase of flight. In yaw, the autopilot can control adverse yaw (engine out) and crab angle.



PFCS - AUTOPILOT - GENERAL DESCRIPTION

PFCS - AUTOPILOT - FUNCTIONAL DESCRIPTION

General

The autopilot flight director computers (AFDCs) calculate roll, pitch and yaw commands to control the airplane automatically. Based on pilot selection, the AFDCs also calculate pitch/roll engage request, yaw engage request and other discrete signals.

Normal Operation

The autopilot commands and discrete engage signals go from the AFDCs to the PFCs through the flight controls ARINC 629 buses. Each PFC receives these inputs from the three AFDCs. The PFC selects a command signal by mid-value selection. This process selects the middle value of the three, not the average value.

The PFC selects the discrete signals by majority selection.

The PFCs filter and limit the autopilot command signals before their use in the control laws. The PFCs process and change the autopilot command signals to surface commands and backdrive commands. The surface commands from the PFCs go to the ACEs to move the flight control surfaces.

Autopilot commands go to the rudder only during automatic approach and landings.

In manual control (no autopilot engaged), the PFCs supply bank angle protection through use of the AFDS wheel backdrive actuators.

Backdrive Operation

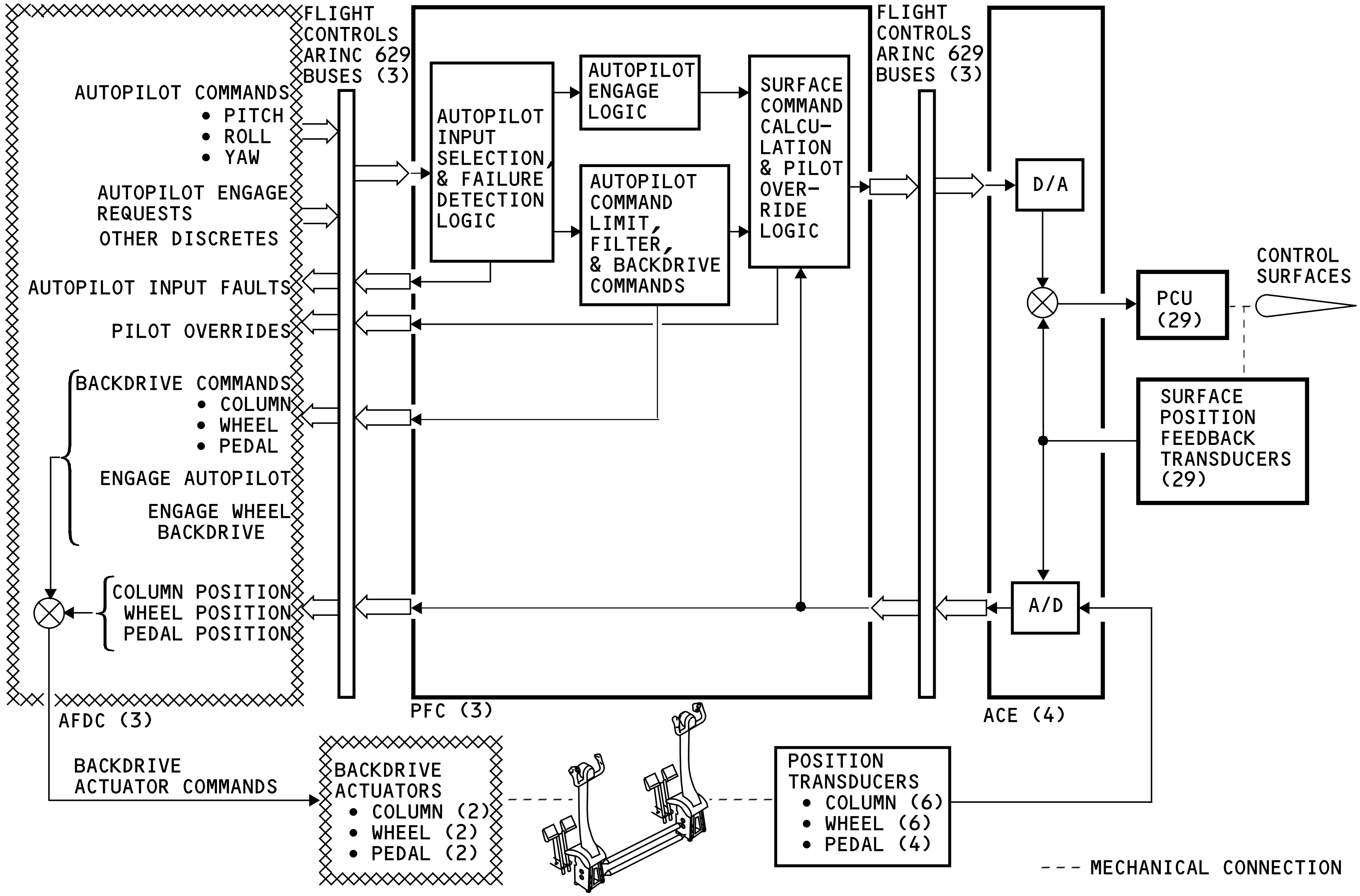
The PFCs send column, wheel and rudder pedal backdrive commands to the AFDCs to operate the backdrive actuators. In cruise, one wheel and one column backdrive actuator operate. Actuator selection alternates at each autopilot engagement. In autoland all backdrive actuators operate. When commanded, the actuators move the control columns, control wheels and rudder pedals to a position that represents the AFDC commands. These movements supply tactile and visual feedback to the pilots.

Position transducers on the columns, control wheels and rudder pedals supply position feedback to the PFCs and AFDCs through the ACEs. The AFDCs use the signal to make sure that the backdrive actuators operate correctly.

Non-normal Operation

For both command and discrete signals, if an input is not valid or failed, the PFC removes it from the calculation. If a second input is not valid, the PFC uses the remaining input. This permits the system to operate with a single AFDC.

When the PFC detects a pilot override in any axis, it disengages all engaged AFDCs.



PFCS - AUTOPILOT - FUNCTIONAL DESCRIPTION

PFCS - FLIGHT CONTROL SHUTOFF VALVES - LOCATION

Purpose

The flight control shutoff valves (SOV) permit the maintenance technicians to stop hydraulic power to the primary flight control actuators.

When 28v dc power is available, the flight control SOVs for the left and right systems can operate in the air or on the ground. The flight control SOVs for the center system can operate only on the ground.

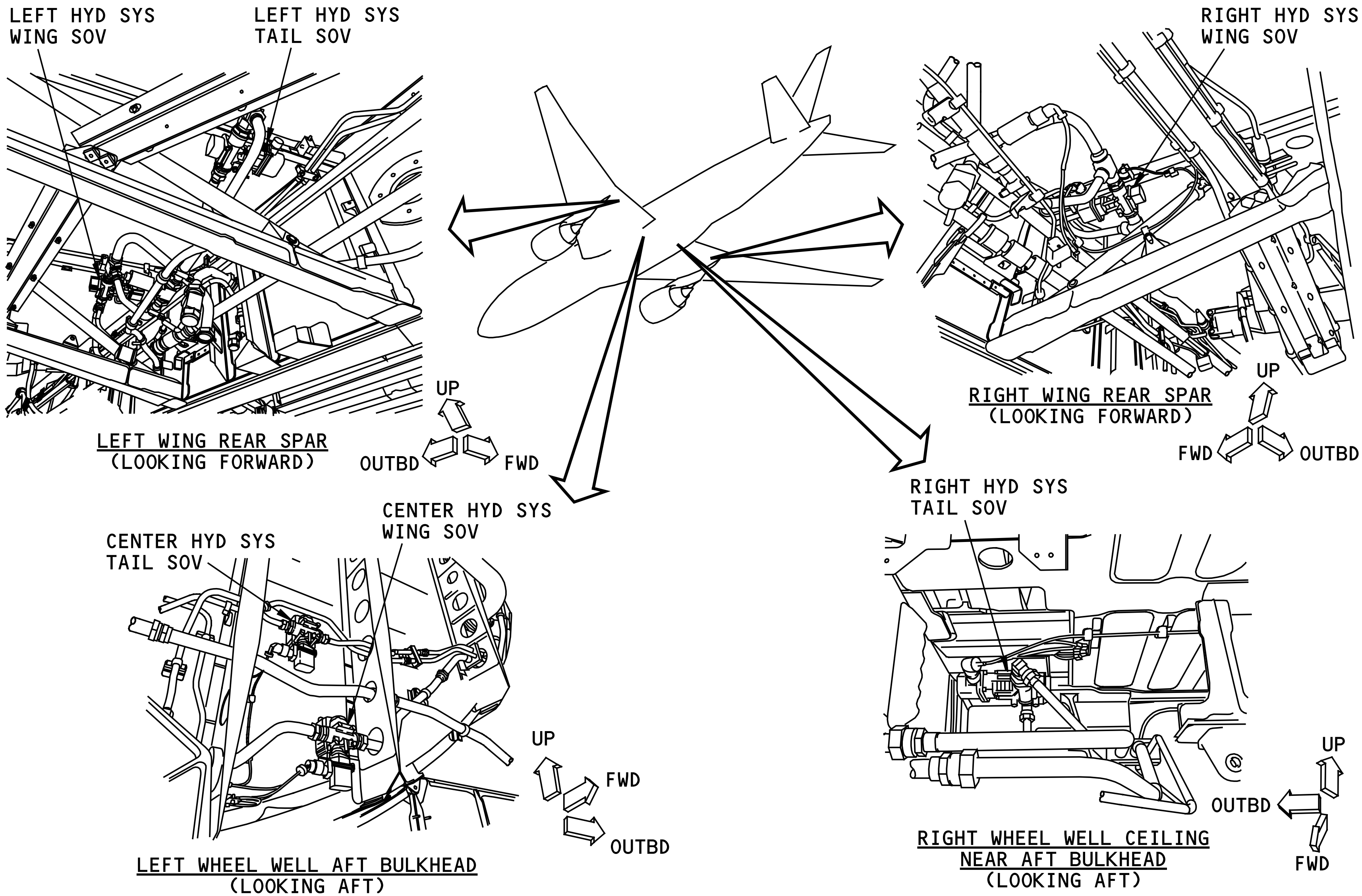
Location

The flight control SOVs for the left hydraulic system are on the left wing, aft of the rear spar, and inboard of the left flaperon. The wing SOV is outboard of the tail SOV.

The flight control SOVs for the center hydraulic system are on the aft bulkhead of the left landing gear wheel well. The tail SOV is the top one, the wing SOV is the bottom one.

The wing shutoff valve for the right hydraulic system is on the right wing, aft of the rear spar, and inboard of the right flaperon.

The tail shutoff valve for the right hydraulic system is on the ceiling of the right landing gear wheel well, near the aft bulkhead.



PFCS - FLIGHT CONTROL SHUTOFF VALVES - LOCATION

PFCS - FLIGHT CONTROL SHUTOFF VALVES - CONTROLS AND DISPLAYS

Controls

The control switches for the flight control SOVs are on the P61 overhead maintenance panel.

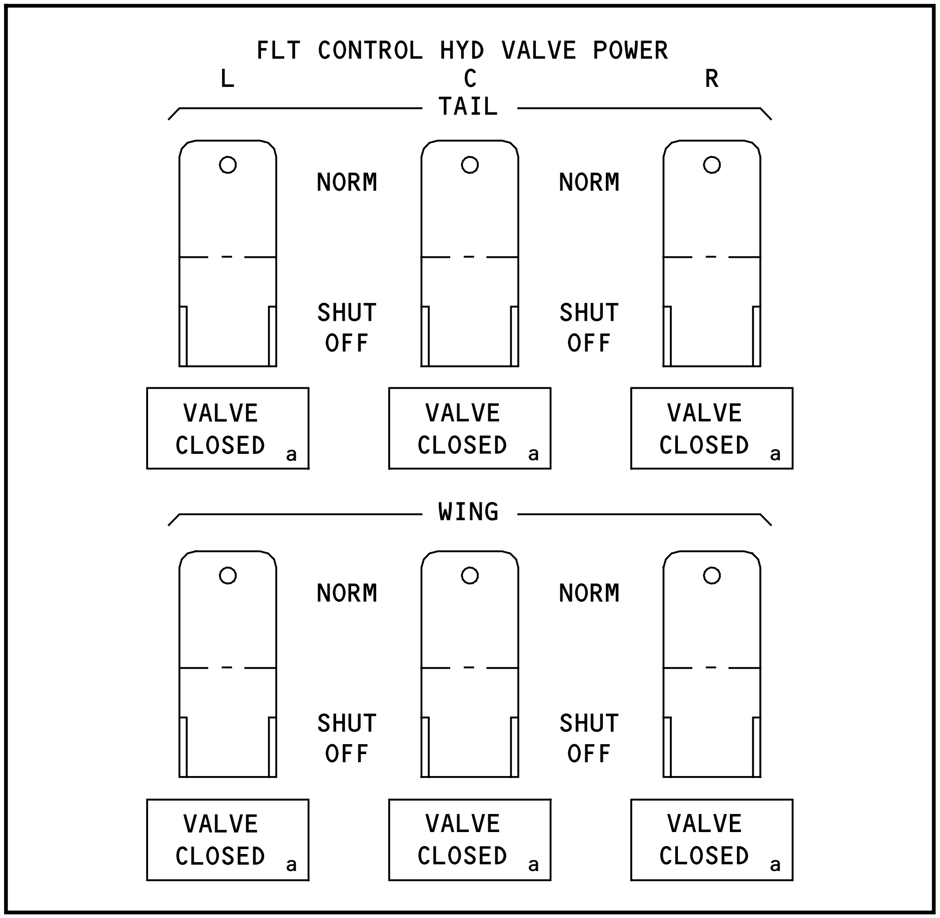
There are six guarded toggle switches. Three are for the tail SOVs and three are for the wing SOVs.

Each toggle switch has two positions: NORM and SHUTOFF. In the NORM position, the switch commands the valve to open. In the SHUTOFF position, the switch commands the valve to close.

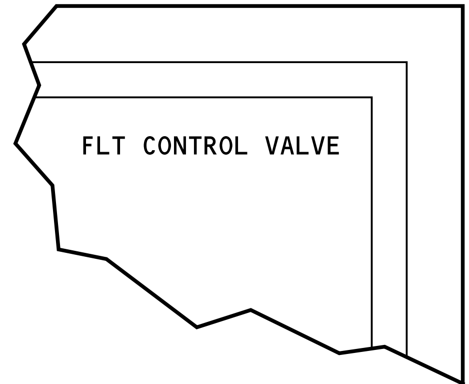
Displays

Below each toggle switch, there is an amber VALVE CLOSED light. The light shows when the valve is not open.

An advisory message FLT CONTROL VALVE shows on the EICAS display when one or more flight control shutoff valves are not open.



FLIGHT CONTROL HYDRAULIC POWER PANEL
(P61)



EICAS DISPLAY

27-02-00-021 Rev 1

PFCS - FLIGHT CONTROL SHUTOFF VALVES - CONTROLS AND DISPLAYS

PFCS - FLIGHT CONTROL SHUTOFF VALVES - FUNCTIONAL DESCRIPTION

General

This description is for the tail flight control SOV for the center system. The other flight control SOVs operate in a similar manner. This does not include the left and right SOVs which do not use air/ground signals.

The 28v dc left and right main buses supply power to the flight control SOVs.

Functional Description

The valve has two positions: open and closed. A 28v dc electric motor opens and closes the valve. Two limit switches stop power to the motor at the end of the valve movement. A position indicating switch sends a signal to the HYDIM cards when the valve leaves the open position. This switch stops the signal to the HYDIM cards when the valve is fully open.

A pair of contacts in one of the air/ground relays controls power to close the valve on the center SOVs.

Operation

When the control switch is in the NORM position, the valve opens. When the valve is fully open, the related amber light VALVE CLOSED does not show. The advisory message FLT CONTROL VALVE does not show on the EICAS display.

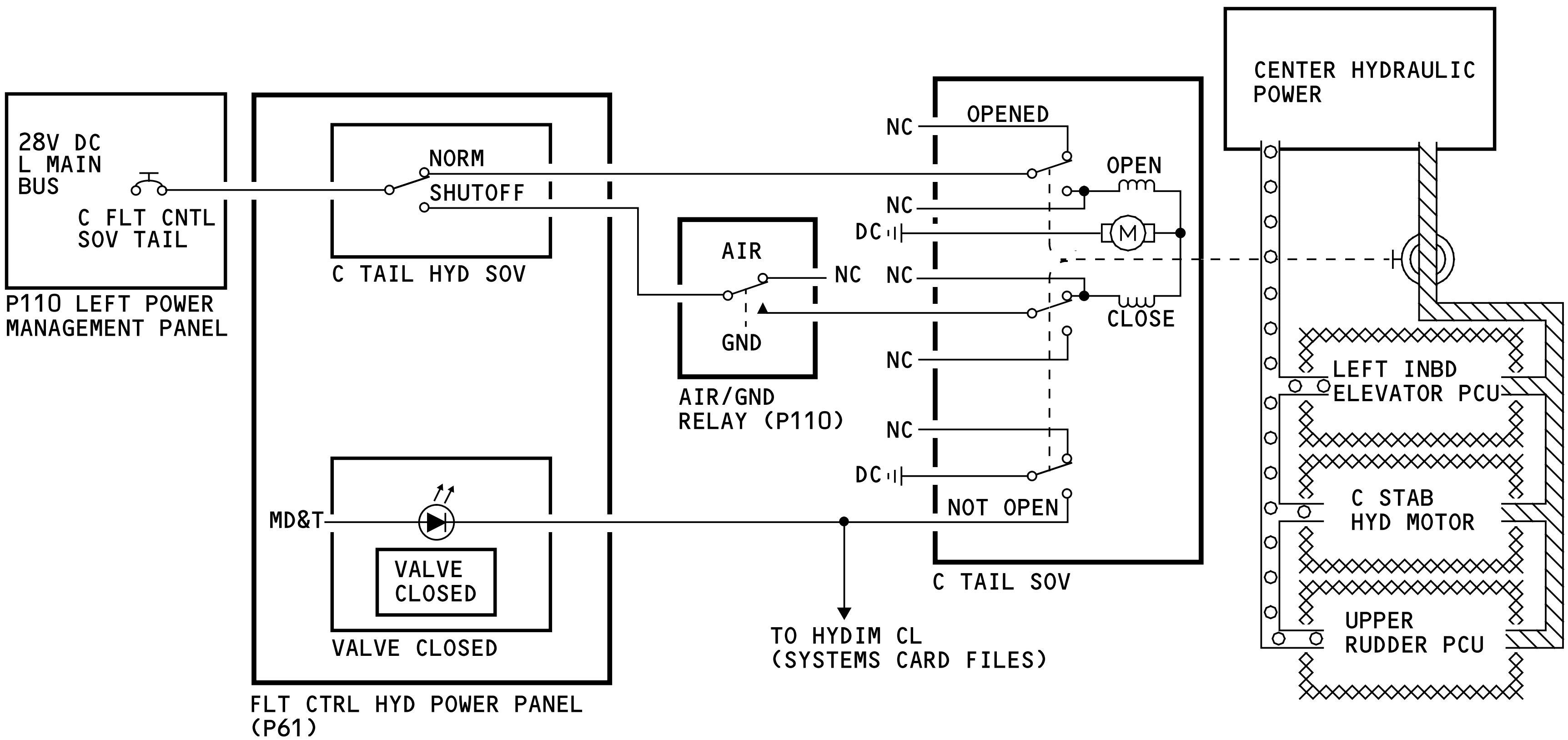
When the control switch is in the SHUTOFF position, the valve closes when the airplane is on the ground. As the valve leaves the open position, the amber VALVE CLOSED light shows on the P61 panel. The advisory message FLT CONTROL VALVE shows on the EICAS display.

Training Information Point

Ground maintenance personnel use the flight control SOVs to isolate certain portions of the flight controls during troubleshooting and other maintenance work.

Only the center flight control SOVs use an air/ground signal. This signal prevents closure of the valves when the airplane is in the air.

The left and right flight control SOVs can be closed in the air or on the ground.



NOTE: TAIL SOV FOR CENTER HYDRAULIC SYSTEM SHOWN.
THIS IS TYPICAL OF THE OTHER SHUTOFF VALVES.
ONLY THE CENTER FLIGHT CONTROL SOV USES THE
AIR/GROUND RELAY.

27-02-00-022 Rev 3

PFCS - FLIGHT CONTROL SHUTOFF VALVES - FUNCTIONAL DESCRIPTION

PFCS - INDICATIONS - FLIGHT CONTROLS SYNOPTIC DISPLAY

General

The flight controls synoptic display gives the flight crew a graphical overview of the flight control system. The display includes individual positions and failures for each flight control surface.

Normal Conditions

Under normal conditions the indications are white. The pointer on the labeled scales shows the position of the control surfaces.

The spoiler position indicators fill white from the bottom up.

The stabilizer and the rudder trim indicators show the stabilizer and rudder position in degrees. The direction of rudder trim is next to the indicator.

Defective Conditions

When a surface does not operate, a defective condition indicator replaces the scale and pointer or the moving band. The color of this indicator is amber.

Unknown Conditions

When the status of a control surface is unknown, the pointer does not show on the scale. In the case of the spoilers, there is no moving band.

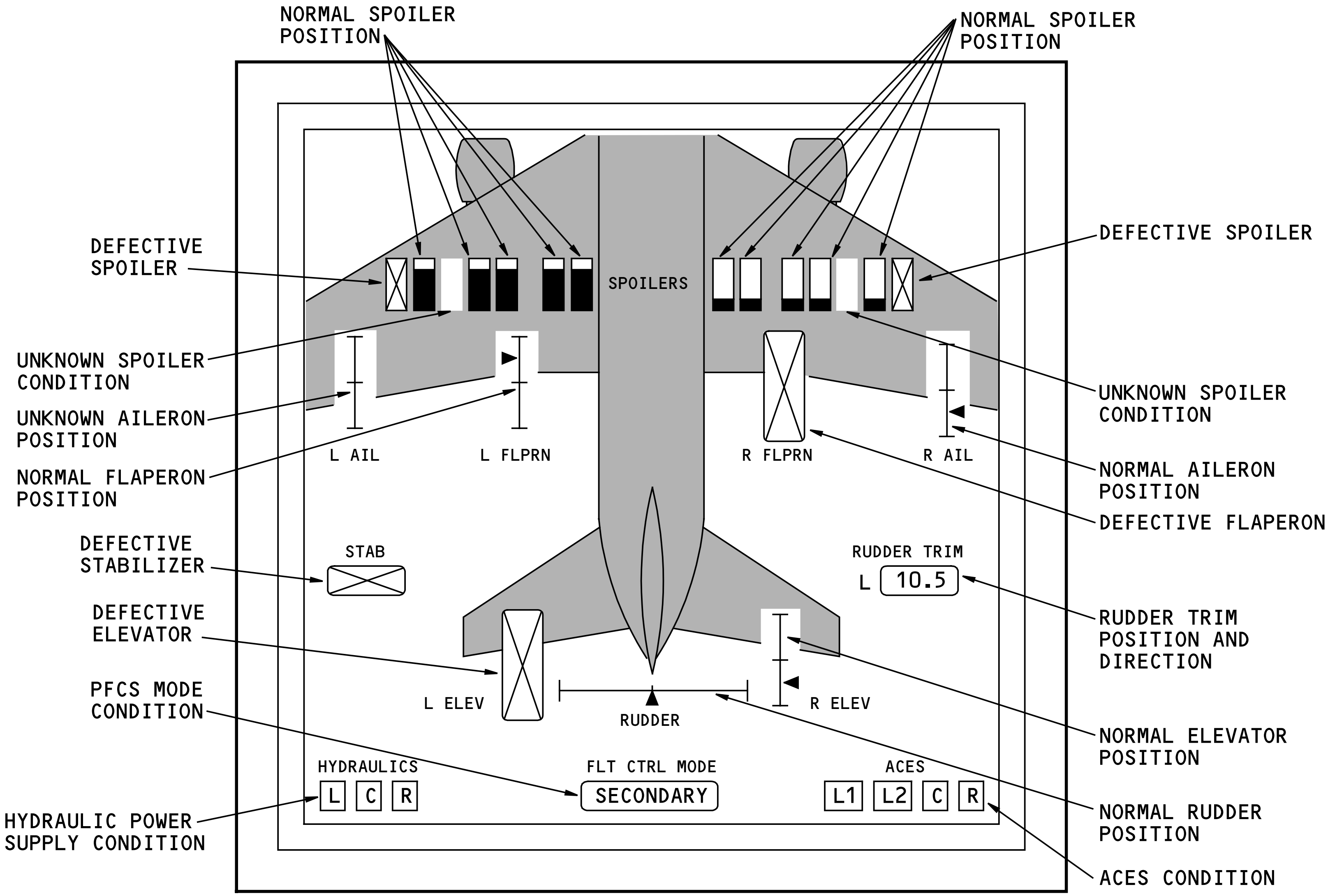
Other System Information

At the bottom of the synoptic display, individual indicators show the condition of:

- The hydraulic power supply systems
- The PFCS mode of operation
- The ACE operation.

The PFCS mode condition shows in green when in normal mode. In secondary or direct mode, the indication shows in amber.

The condition of the hydraulic power supply systems or the ACEs shows only when there is a failure of one of the systems or ACE. The indicator for the failed system or ACE is amber. The others are green.



27-02-00-024 Rev 4 04/19/1997

PFCS - INDICATIONS - FLIGHT CONTROLS SYNOPTIC DISPLAY

PFCS - INDICATIONS - MAINTENANCE PAGE - CONTROLS AND VARIABLES

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PFCS - INDICATIONS - MAINTENANCE PAGE - CONTROLS AND VARIABLES

General

There are three PFCS maintenance pages. Page one contains data for the control inputs and variables.

Maintenance personnel use the maintenance pages to do maintenance functions such as rigging or do a check of the discrete inputs and outputs of the PFCS components.

These are the three different display modes:

- Real time mode
- Manual event mode
- Auto event mode.

The word MANUAL or AUTO at the top of the page identifies the manual event or the auto event page. The message that caused the auto event is at the bottom left of the page. The time of the event is at the bottom right.

Variables and Controls

The top of the page shows:

- Roll rate in degrees per second
- Yaw rate in degrees per second
- Altitude in feet
- Roll angle in degrees
- Angle of attack in degrees
- CAS in knots
- ADIRU pitch rate in degrees per second
- ACE pitch rate in degrees per second for each ACE.

Directly below, the page shows the column, wheel and pedal position for the captain's and the first officer's controls. The position shows the displacement, in inches, of each LVDT.

The page then shows the column and wheel force for the captain's and the first officer's controls. The indication shows the force in lb.

The speedbrake lever position is in degrees of RVDT rotation for each of the four RVDTs.

The rudder trim and elevator feel show the actuator extension in inches. Rudder trim position 1 refers to the rudder trim actuator position RVDT. Position 2 refers to the rudder trim position transducer. Elevator feel position 1 refers to the left feel actuator position. Position 2 refers to the right feel actuator.

The gust suppression differential pressure shows in psid. The modal suppression shows in units of gravitational acceleration (g).

An X shows next to the indication if any of the above position, force or pressure transducer signals is invalid.

The lower part of the page shows the PFCS mode of operation and the autopilot engagement status. Up to three protection mode activity messages can show at the lower right of the page. These messages will only show if they are active and they will show in this priority order:

PFCS - INDICATIONS - MAINTENANCE PAGE - CONTROLS AND VARIABLES

- TAC
- Stall protection
- Bank angle protection
- Overspeed protection
- Flare compensation.

The NORMAL or SECONDARY messages show if the PFC is in the normal or secondary mode. When the PFCS is in direct mode, the PFC mode shows SECONDARY.

Training Information Point

Only the pitch rate measured by the ACE internal pitch rate sensors shows. Because there are no ACE external pitch rate sensors, the external fields show dashes.

FLIGHT CONTROL AUTO PG 1/3

ROLL RATE	-0.70	YAW RATE	+2.39	ALTITUDE	2000
ROLL ANGLE	-0.18	ANGLE OF ATTACK	+5.23	CAS	257

ADIRU		PITCH RATE	L1	L2	C	R
PITCH RATE	+0.15	ACE INT XDCR	+0.15	+0.15	+0.15	+0.15
		EXT XDCR	-----	-----	-----	-----

	CAPT			F/O		
	COLUMN	WHEEL	PEDAL	COLUMN	WHEEL	PEDAL
POSITION 1	+0.16	+0.57	-0.42	+0.16	+0.57	-0.42
2	+0.16	+0.57	-0.42	+0.16	+0.57	-0.42
3	+0.16	+0.57		+0.16	+0.57	
FORCE 1	+54.3	+16.8		+54.3	+16.8	
2	+54.3			+54.3		

	SPD BRK HANDLE	RUD TRIM	ELEVATOR FEEL		SUPPRESSION GUST		SUPPRESSION MODAL
POSITION 1	+0.00	+0.05	+1.00	UPR	+1.2	L	+0.06
2	+0.00	+0.05	+1.00	LWR	+1.2	R	+0.06
3	+0.00						
4	+0.00						

PFC MODE: NORMAL

AUTOPILOT: DISENGAGED

PROT MODE ACTIVITY:
BANK ANGLE PROT
OVERSPEED PROT ACT

STABILIZER

DATE 17 JAN 91 UTC 18:44:33

PFCS - INDICATIONS - MAINTENANCE PAGE - CONTROLS AND VARIABLES

27-02-00-025 Rev 8 07/10/1997

PFCS - INDICATIONS - MAINTENANCE PAGE - SURFACE POSITION

General

The second PFCS maintenance page contains surface position information and actuator hydraulic data.

The graphic shows the maintenance page in auto event mode caused by a stabilizer fault.

Hydraulic System Pressure

The hydraulic pressure for each of the three systems shows in psi.

If a hydraulic system signal is invalid, the field is blank.

Surface Position

The surface position is in inches of displacement of the LVDT of each PCU. Surface position data shows for:

- Spoilers
- Flaperons
- Ailerons
- Rudder
- Elevators.

The stabilizer position is in degrees of rotation of the RVDT of each stabilizer position module.

Differential Pressure Indication

PCU FORCE shows the flaperons actuator force in pounds. DELTA PRESS shows the differential pressure across the PCU actuator piston. The data shows in psi for the rudder and the elevators.

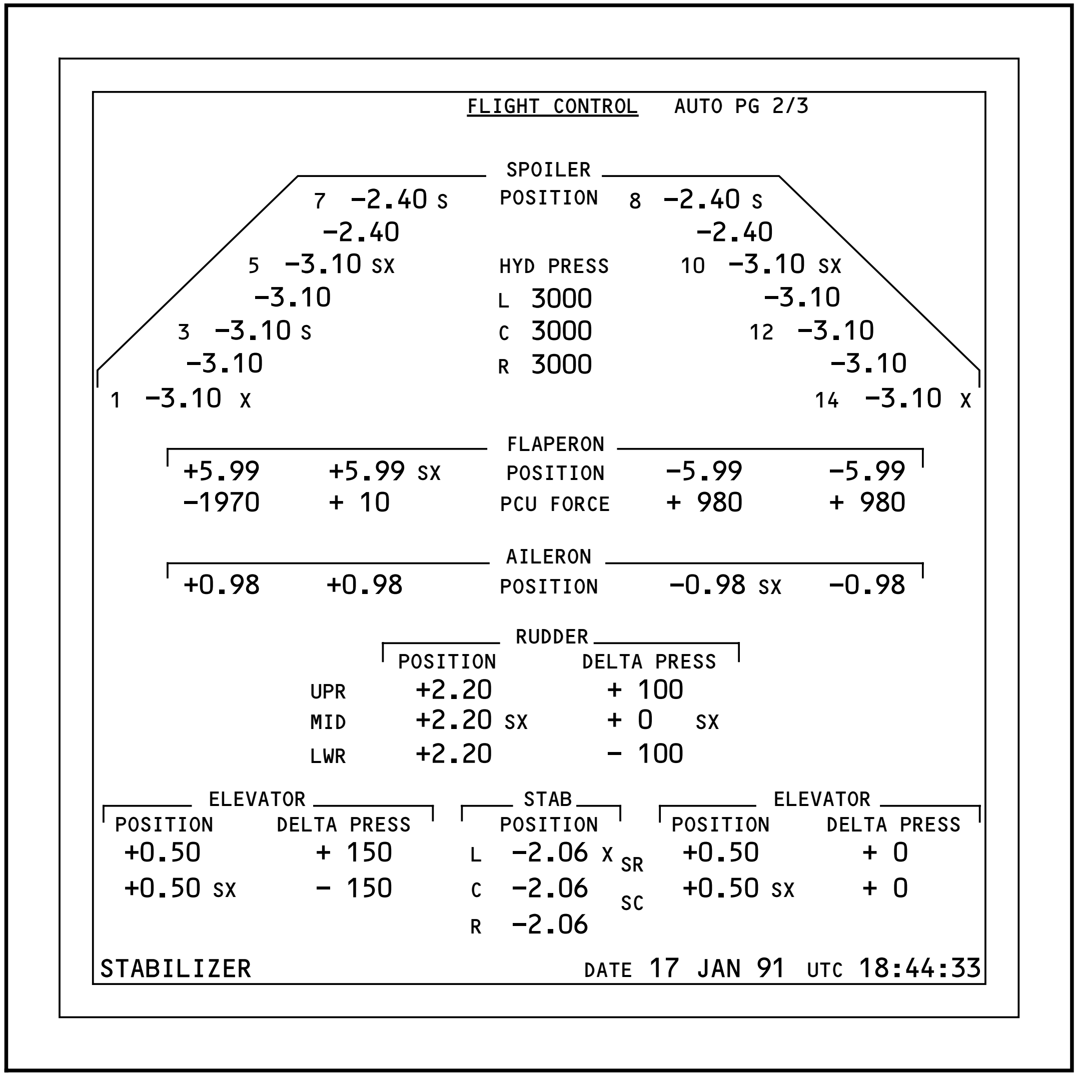
Failure Indications

When a PCU is shutdown, an amber S shows adjacent to the surface position indication.

If a PCU position signal is invalid, an amber X shows adjacent to the surface position indication or adjacent to the S if the PCU is also shutdown.

When the stabilizer position signal is invalid, an amber X shows adjacent to the stabilizer position.

An amber SR or SC shows adjacent to the stabilizer position indication if there is a shutdown of either the right or center STCM.



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PFCS - INDICATIONS - MAINTENANCE PAGE - SURFACE POSITION

PFCS - INDICATIONS - MAINTENANCE PAGE - ANALOG DISCRETES

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PFCS - INDICATIONS - MAINTENANCE PAGE - ANALOG DISCRETES

General

The third PFCS maintenance page contains the status of analog discretes. Normal indications are white. Failure indications are amber.

The graphic shows the maintenance page in auto event mode caused by a stabilizer fault.

ACE Discrete Indications

For each of the four ACEs, the page shows the status of the discrete signals.

The FSEU trailing edge and leading edge retracted signal shows as a YES or NO. If the signal is defective, the field becomes blank.

The PFC disconnect switch position status shows as AUTO or DISC. If the switch signal is invalid, OPEN or CLOSED shows in amber if the contacts are defective in the open or closed position. If the switch is defective and does not supply a signal, the field is blank.

The ACE mode of operation shows as NORMAL or DIRECT. If the ACE mode signal is invalid, the indication shows FAULT in amber.

The indication for the rudder manual trim cancel switch signal is in the L1 column. The indication shows as YES if the switch is pushed or NO if released. If the switch signal is invalid, the indication shows FAULT in amber.

The indication for the rudder trim armed signal is in the R column. The indication shows as YES if armed and NO if not armed. If the armed signal is invalid, the indication shows FAULT in amber.

The rudder trim rate signal is in the R column. The indication shows FAST or SLOW dependent on the condition. If the trim rate signal is invalid, the indication shows FAULT in amber.

The rudder trim direction is in the L1 column. The indication shows LEFT or RIGHT dependent on the rudder direction command. The indication shows NO if there is no rudder trim command. The indication shows L&R in amber if the trim command is for both directions at the same time. The indication shows FAULT in amber if the trim signal is not valid.

The rudder trim brake released indication is in the R column. The indication shows YES when the brake is released or NO when it is not. If the signal is not valid, the field is blank.

The pitch trim arm and control signal indications show in these columns:

- L1 for captain arm
- C for captain control
- L2 for first officer arm
- R for first officer control.

The indication shows UP or DOWN depending on which direction the pilot moves the trim switches. The indication shows NO if the pilot does not move the trim switches. The indication shows UP&DN in amber if the switches signal both up and down commands. If the signal is not valid, the field is blank.

The indication for the STCM brake release pressure is in the C and R columns. The indication shows YES if the brake is released or NO if it is not. If the signal is not valid, the field is blank.

The indication for the STCM hydraulic shutoff relay power is in the C and R columns. The indication shows YES if the relay has power or NO if it does not. If the signal is not valid, the field is blank.

The elevator feel engaged signal is in the L2 and C columns. The indication shows YES or NO depending on the engaged status of the elevator feel actuator. If the signal is not valid, the field is blank.

The auto speedbrake limit switch signal is on the L1 column. The indication shows YES if the auto speedbrake actuator is in the retracted position. It shows NO if the actuator is not retracted. If the signal is not valid, the field is blank.

The TAC switch position signal shows in the C column. The signal can be OFF or AUTO. If the signal is not valid, the field becomes blank.

AIMS Discrete Indications

The AIMS monitors the alternate pitch trim lever arm and control switches for activity and direction. The indication in the ACTIVE columns shows YES when the pilot makes a lever command or NO when there is no command. If the signal is not valid, the indication shows FAULT in amber.

The indication in the DIRECTION column shows UP or DOWN dependent on the direction of the alternate pitch trim command. If the signal is not valid, the indication shows FAULT in amber.

FLIGHT CONTROL AUTO PG 3/3

ACE ANALOG DISCRETES:	L1	L2	C	R
FSEU 1 TE & LE RETRACTED	YES	YES	YES	YES
FSEU 2 TE & LE RETRACTED	NO	NO	NO	NO
PFC DISCONNECT SWITCH	AUTO	AUTO	AUTO	AUTO
ACE MODE	DIRECT	NORM	NORM	NORM
RUD MTC SWITCH PUSHED	YES	--	--	--
RUD TRIM ARMED	--	--	--	YES
RUD TRIM RATE	--	--	--	FAST
RUD TRIM DIRECTION	LEFT	--	--	--
RUD TRIM BRK RELEASED	--	--	--	YES
CAPT PITCH TRIM ARM	UP	--	--	--
CAPT PITCH TRIM CTRL	--	--	UP	--
F/O PITCH TRIM ARM	--	NO	--	--
F/O PITCH TRIM CTRL	--	--	--	NO
STCM BRK RELEASE PRESS	--	--	YES	YES
STCM HYD SO RLY POWER	--	--	YES	YES
ELEV FEEL ENGAGED	--	YES	YES	--
SPDBRK ACTR RETRACTED	YES	--	--	--
TAC SWITCH POSITION	--	--	AUTO	--

	L		R	
AIMS ANALOG DISCRETES:	ACTIVE	DIRECTION	ACTIVE	DIRECTION
ALTN PITCH TRIM LEVER ARM	YES	UP	YES	UP
ALTN PITCH TRIM LEVER CTRL	YES	UP	YES	UP

STABILIZER DATE 17 JAN 91 UTC 18:44:33

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PFCS - INDICATIONS - MAINTENANCE PAGE - ANALOG DISCRETES

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PFCS - SYSTEM TESTS

General

The PFCs control the operation of the MAT tests. There are 54 system tests for the PFCS.

These are the tests:

- Actuator Confidence
- Actuator Control Electronics Monitors
- Air/Ground System to PFC Interface
- Alternate Pitch Trim Levers
- Column Force Transducer
- Column Position
- Elevator Feel System
- Flap/Slat Electronics Unit Interface to ACE
- Flap/Slat Electronics Unit to PFC Interface
- Gust Suppression Pressure Transducers
- Left Aileron Actuator Confidence
- Left Aileron Alignment
- Left Aileron Position
- Left Elevator Actuator Confidence
- Left Elevator Alignment
- Left Elevator Oscillation Monitor
- Left Elevator Position
- Left Flaperon Actuator Confidence
- Left Flaperon Alignment
- Left Flaperon Position
- Modal Suppression Accelerometer
- Pedal Position
- PFC Disconnect Switch
- Primary Flight Computer Reset
- Primary Flight Computer (C) Lane Reset
- Primary Flight Computer (L) Lane Reset
- Primary Flight Computer (R) Lane Reset
- Primary Flight Computer Self Test
- Radio Altimeter Test Inhibit to PFC Interface
- Right Aileron Actuator Confidence
- Right Aileron Alignment
- Right Aileron Position
- Right Elevator Actuator Confidence
- Right Elevator Alignment
- Right Elevator Oscillation Monitor
- Right Elevator Position
- Right Flaperon Actuator Confidence
- Right Flaperon Alignment
- Right Flaperon Position
- Rudder Actuator Confidence
- Rudder Alignment
- Rudder Position
- Rudder Trim System
- Speedbrake System
- Spoiler 1, 7, 8, 14 System
- Spoiler 2, 13 System
- Spoiler 3, 6, 9, 12 System
- Spoiler 4, 11 System
- Spoiler 5, 10 System
- Stabilizer System
- Transmitter Reset Test
- Warning Electronic System to PFC Interface
- Wheel Force Transducer
- Wheel Position.

Actuator Confidence Test

This test checks the proper operation of the power control unit servo valve monitors and for proper operation of the bypass, blocking, and pressure reducing functions of the primary power control units and the motor-operated valve in each of the stabilizer control modules.

Actuator Control Electronics Monitors

This test is to make sure the internal monitors necessary for flight safety in the L1, L2, C and R actuator control electronics operate correctly.

Air/Ground System to PFC Interface

This test does a check of the proper operation of the weight on wheel (WOW) system interface to the primary flight computers (PFCs). The test resets latches associated with the WOW system interface.

Alternate Pitch Trim Levers

This test checks for proper operation of the switches for the alternate pitch trim levers. This test can reset latches for the alternate pitch trim levers.

Column Force Transducer

This test checks for proper operation of the force transducers for the pilot and co-pilot control columns. This test can reset latches for control column force transducers. This test is similar to the wheel force transducer test.

Column Position

This test checks for proper operation of the transducers for the pilot and co-pilot control columns. This test can reset latches for control column transducers. This test is similar to the pedal position test and the wheel position test.

Elevator Feel System

This test checks for proper operation of the elevator feel units. This test can reset latches for the elevator feel units. This test can also set the configuration of either elevator feel unit to 3 different elevator feel settings.

Flap/Slat Electronics Unit Interface to ACE

This test checks for proper operation of the interface between the FSEUs and the ACEs. This test can also set the configuration of either FSEU to its flaps and slats retracted state or its flaps and slats not retracted state for fault isolation purposes. This test can reset latches associated with the analog wiring between the ACEs and the FSEUs.

Flap/Slat Electronics Unit to PFC Interface

This test checks for proper operation of the flap slat electronic units. This test can reset latches for the flap slat electronic units.

PFCS - SYSTEM TESTS

Gust Suppression Pressure Transducers

This test checks the proper operation of the gust suppression transducers. This test can reset latches for the gust suppression transducers.

Left Aileron Actuator Confidence

This test checks the proper operation of the bypass and blocking/damped functions of the left aileron power control units. This test is similar to the actuator confidence tests for the other surfaces.

Left Aileron Alignment

This procedure aligns the power control units for the left aileron. This procedure can also check alignment of the left aileron power control units. This test is similar to the alignment tests for the other surfaces.

Left Aileron Position

This test checks for proper operation of the position transducers for the left aileron. This test can reset latches for left aileron position transducers. This test is similar to the position test for the other surfaces.

Left Elevator Oscillation Monitor

This test checks that the left elevator power control units are operating within the allowable oscillatory force fight tolerances. This test can reset oscillatory force fight latches for the left elevator. This test is similar to the right elevator oscillation monitor test.

Modal Suppression Accelerometer

This test checks for proper operation of the two modal suppression accelerometers. This test can reset latches for the modal suppression accelerometers.

PFC Disconnect Switch

This test checks for proper operation of the PFC DISC switch. This test can reset latches for the PFC DISC switch.

Primary Flight Computer Reset

This test resets a primary flight computer to operational capability after a channel does not operate because the other primary flight computers prevent it.

Primary Flight Computer (C) Lane Reset

This test restores the center primary flight computer to operational capability after a center primary flight computer lane becomes inoperative due to external interface faults or from a maintenance operation. This test is similar to the lane reset tests for the other PFCs.

PFCS - SYSTEM TESTS

Primary Flight Computer Self Test

This test checks internal primary flight computer functions and cross channel functions of the primary flight control computers.

Radio Altimeter Test Inhibit to PFC Interface

This test makes sure that the primary flight computer can put the radio altimeters in test inhibit mode.

Rudder Trim System

This test checks for proper operation of the rudder trim actuator and the rudder trim switch. This test can reset latches for the rudder trim actuator.

Speedbrake System

This test checks for proper operation of the speedbrake lever transducers, the auto speedbrake thrust reverse switch, and the auto speedbrake actuator limit switch. It will reset latches for the speedbrake lever transducers, the auto speedbrake thrust reverse switch, the radio altimeter and the landing gear truck tilt switch.

Spoiler 1,7,8,14 System

This test checks for proper operation of spoiler pairs 1,14 and 7,8. This test can reset latches for spoiler pairs 1,14 and 7,8. This test is similar to the system tests for the other spoiler surfaces.

Stabilizer System

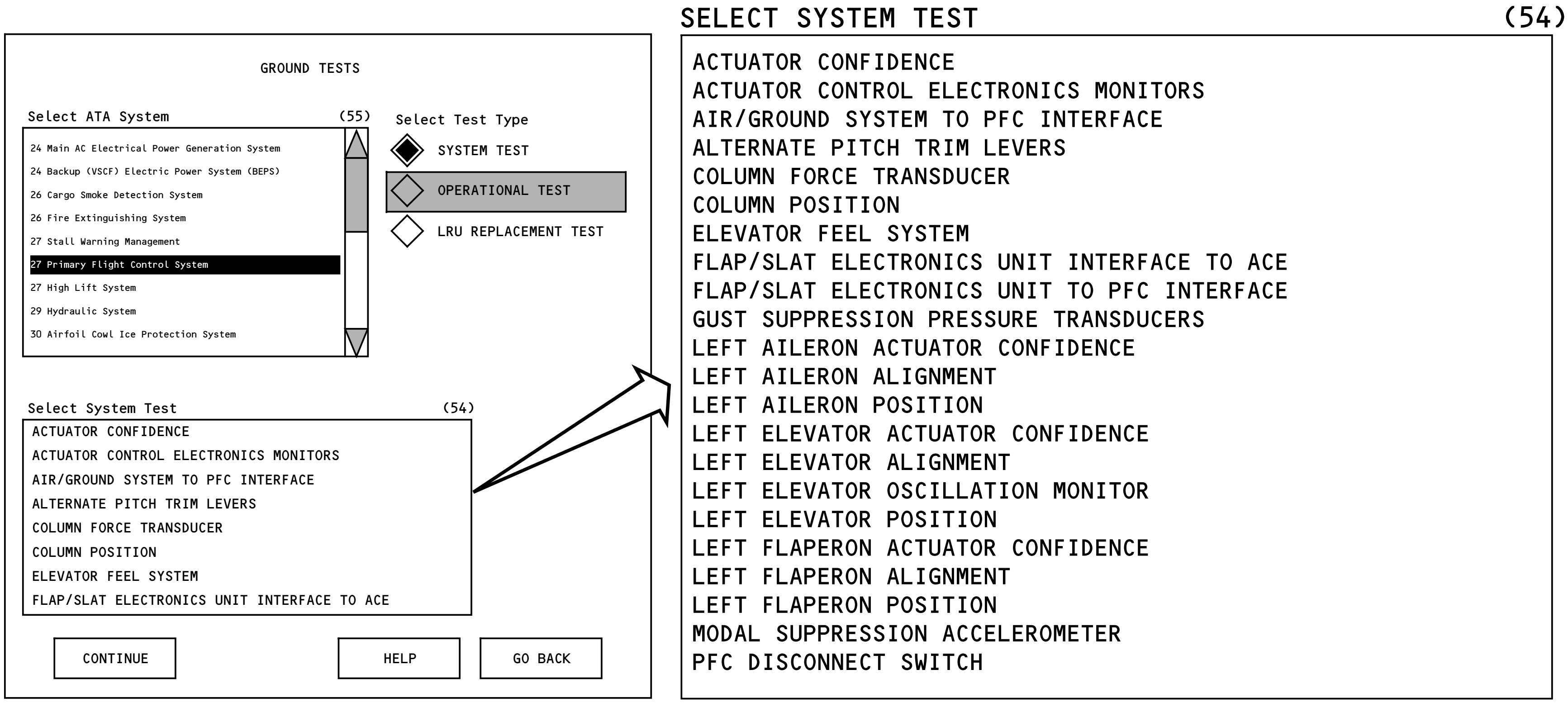
This test checks for proper operation of the stabilizer position transducers, the stabilizer arm and control solenoid operated valves, the stabilizer rate valves, the stabilizer hydraulic shut off valves and the stabilizer brake. This test can reset fault latches for the stabilizer position transducers, it can also reset stabilizer control module disengage latches.

Transmitter Reset Test

This test resets the latches for the primary flight computers ARINC 629 bus transmitters.

Warning Electronic System to PFC Interface

This test resets latches in the primary flight computer caused by the warning electronic system.



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PFCS - SYSTEM TESTS

PFCS - LRU REPLACEMENT TESTS

General

These are the LRU replacement tests for the PFCSs and the ACEs:

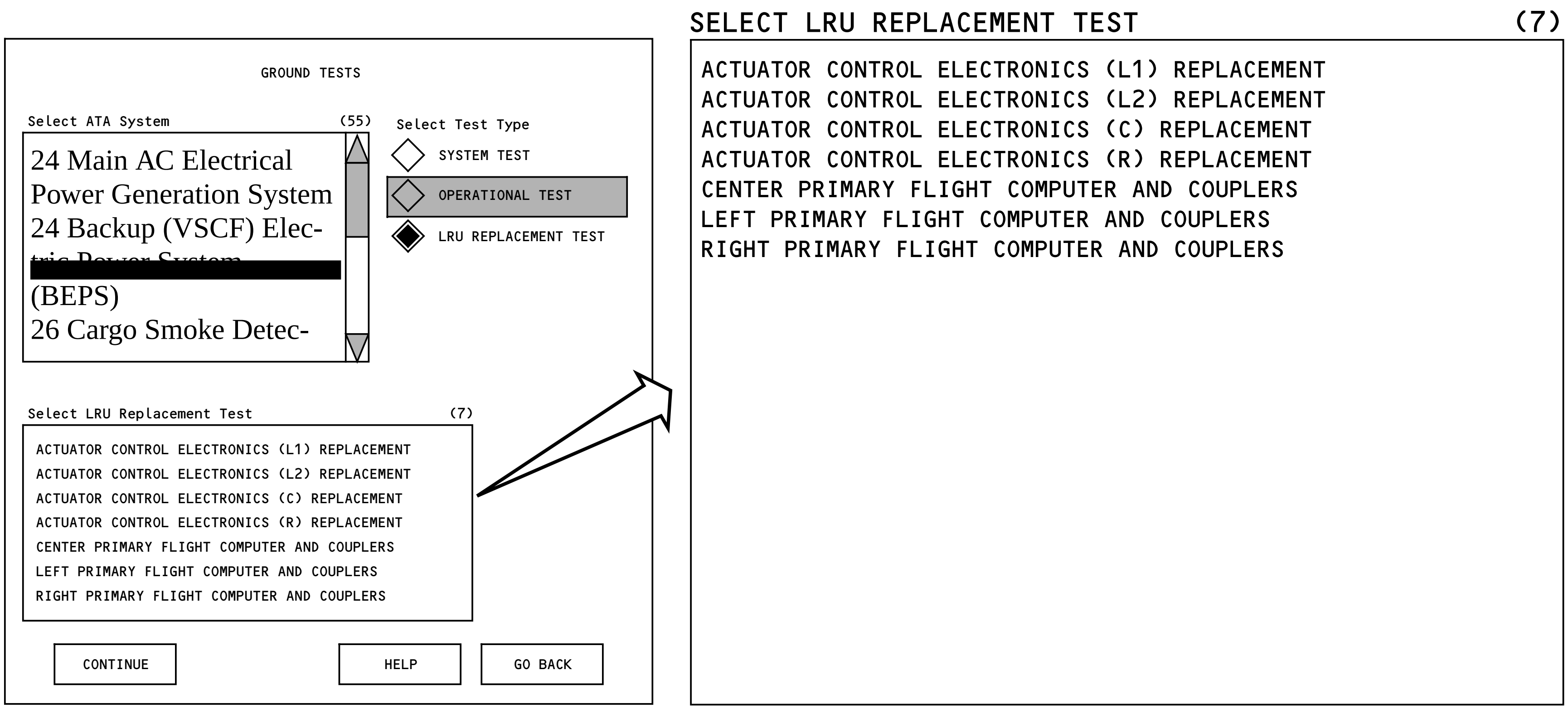
- Actuator Control Electronics (L1) Replacement
- Actuator Control Electronics (L2) Replacement
- Actuator Control Electronics (C) Replacement
- Actuator Control Electronics (R) Replacement
- Center Primary Flight Computers and Couplers
- Left Primary Flight Computers and Couplers
- Right Primary Flight Computers and Couplers.

Actuator Control Electronics (L1) Replacement

This test is to make sure the L1 actuator control electronics has been replaced correctly. This test also resets any fault latches in the primary flight computer caused by the actuator control electronics. This test is similar to the replacement test for the other ACEs.

Center Primary Flight Computer and Couplers Replacement

This test does a check of the proper installation of the center primary flight computer and all associated ARINC 629 couplers. This test is similar to the replacement test for the other PFCs.



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PFCS - LRU REPLACEMENT TESTS

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AILERON AND FLAPERON CONTROL - INTRODUCTION

General

The ailerons and flaperons control the flight attitude of the airplane about the longitudinal axis. They also increase the wing lift with the high lift system during takeoff, approach and landing.

The ailerons are on the wing outboard trailing edge.

The flaperons are standard inboard ailerons which also operate as flaps. They are between the inboard and the outboard flaps on the wing trailing edge.

Roll Control

During roll control, the aileron and flaperon on one wing move up, and the aileron and flaperon of the other wing move down.

The pilots manually command a roll correction with the rotation of the control wheels. When engaged, the autopilot automatically commands the ailerons and the flaperons. During autopilot operation, actuators backdrive the control wheels.

The spoilers also supply roll control. See the spoiler and speedbrake control section for more information (AMM PART I 27-61).

Aileron Lockout

On the ground and during flight below cruise speed, the ailerons and flaperons are fully operational. At cruise speed, the ailerons fair to the wing surface and lock out. The flaperons supply roll control.

Aileron and Flaperon Droop

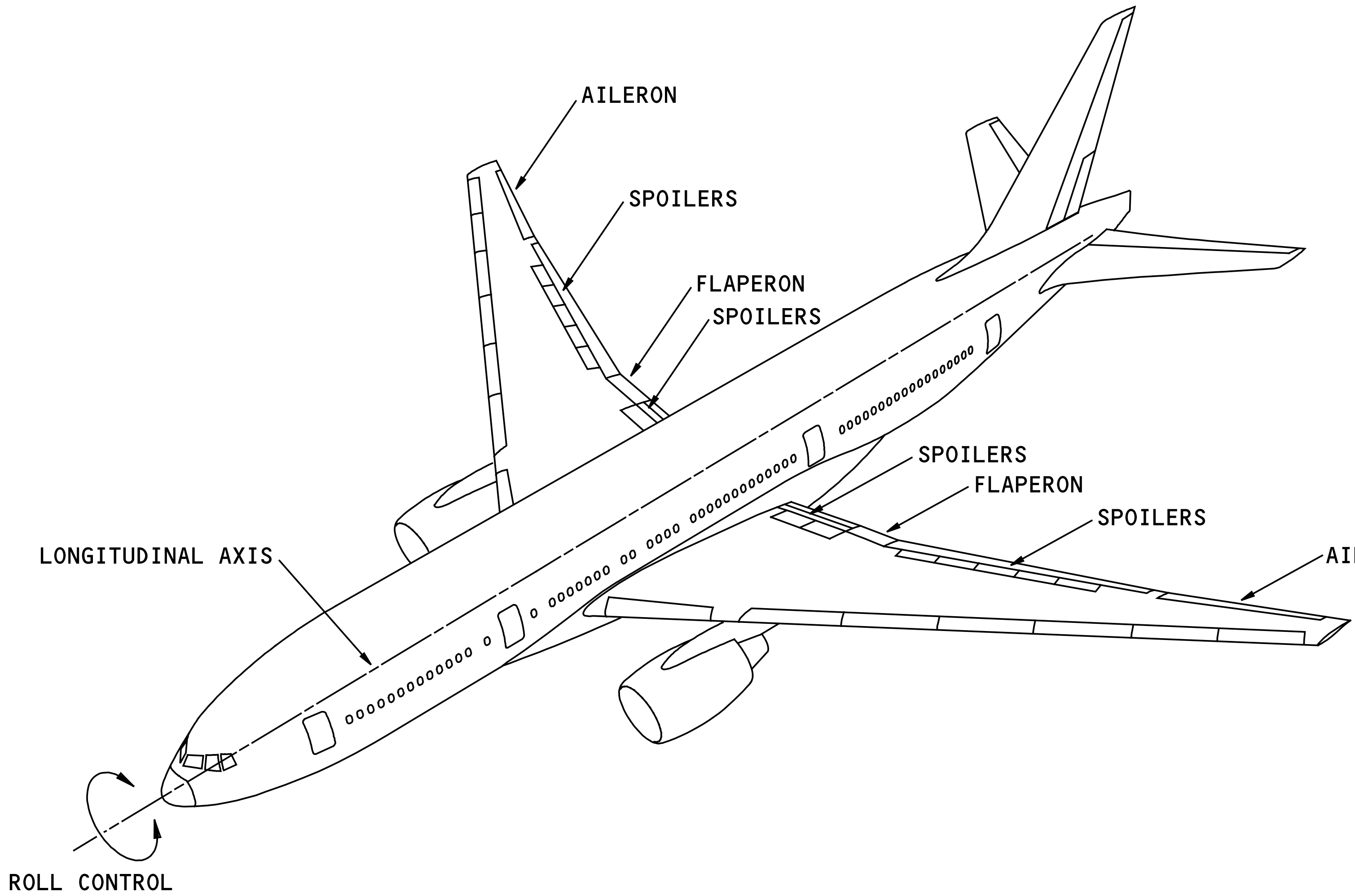
During extension of the flaps, the ailerons and flaperons droop to increase the lift of the wing. The ailerons and flaperons of both wings move down. When drooped, the ailerons and flaperons are fully operational for roll control.

Abbreviations and Acronyms

ACE	- actuator control electronics
ACMS	- airplane condition monitoring system
ADIRS	- air data inertial reference system
ADIRU	- air data inertial reference unit
ADM	- air data module
AFDC	- autopilot flight director computer
AFDS	- autopilot flight director system
AIMS	- airplane information management system
ARINC	- Aeronautical Radio, Inc.
BAP	- bank angle protection
B/D	- backdrive
CAS	- calibrated airspeed
CMCS	- central maintenance computing system
CPU	- central processing unit
EHSV	- electrohydraulic servo valve
EICAS	- engine indication and crew alerting system
FCDC	- flight controls direct current

AILERON AND FLAPERON CONTROL - INTRODUCTION

FMCS - flight management computing system
FSEU - flap/slat electronics unit
HLCS - high lift control system
LAM - landing attitude modification
LIB - left inboard
LOB - left outboard
LRU - line replaceable unit
LVDT - linear variable differential transformer
MCP - mode control panel
MEC - main equipment center
Mdive - maximum design dive Mach number
MFD - multi-function display
Mmo - maximum operating Mach number
PCU - power control unit
PDU - power drive unit
PFC - primary flight computer
PFCS - primary flight control system
PFD - primary flight display
PMG - permanent magnet generator
PSA - power supply assembly
PSAS - pitch stability augmentation system
PSEU - proximity sensor electronics unit
RIB - right inboard
ROB - right outboard
RVDT - rotary variable differential transformer
SAARU - secondary attitude air data reference unit
sol - solenoid
SOV - shutoff valve
STCM - stabilizer trim control module
TED - trailing edge down
TEU - trailing edge up
Vdive - maximum design dive speed
Vmo - maximum operating limit speed
WEU - warning electronic unit
WOW - weight-on-wheels



AILERON AND FLAPERON CONTROL - INTRODUCTION

AILERON AND FLAPERON CONTROL - GENERAL DESCRIPTION

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AILERON AND FLAPERON CONTROL - GENERAL DESCRIPTION

General

The pilots manually command the ailerons and flaperons; the autopilot automatically commands them.

Manual Operation - Control Wheels

The flight crew uses two conventional control wheels to control roll. A wheel jam breakout mechanism supplies a mechanical link between the control wheels. If a control wheel jams, the other continues to control.

Six position transducers change the flight crew commands of the control wheel to analog electrical signals. These signals go to the four actuator control electronics (ACEs). The ACEs change the signals to digital format and send them to the three primary flight computers (PFCs) through the flight controls ARINC 629 buses.

The PFCs use the control wheel position data, along with data from the ADIRU and AIMS, to calculate control surface commands. The PFCs send the digital commands to the ACEs, which change them to analog signals. The ACEs send the analog position commands to the power control units (PCUs) which move the control surfaces. The position transducers on the actuator pistons supply position feedback to the ACEs.

Manual Operation - Aileron Trim

The aileron trim switches and the trim actuator permit the flight crew to trim out unwanted control wheel forces. When the pilots move the aileron trim switches on the aisle stand, the switches send a signal to the aileron trim actuator. The trim actuator moves the control wheels and the position transducers through the feel and centering mechanism. This changes the neutral position of the control wheels. The transducers send a signal to the ACEs and PFCs to move the ailerons and flaperons.

When the autopilot is engaged or the bank angle protection (BAP) is active, the aileron trim does not operate.

Autopilot Operation

When engaged, the autopilot flight director computers (AFDCs) control the roll rate and attitude of the airplane. The AFDCs supply roll commands to the PFCs through the flight controls ARINC 629 buses. The PFCs use these inputs to calculate position commands for the ailerons and flaperons in a similar manner as for the manual operation.

The PFCs also calculate wheel backdrive commands. The PFCs send these commands to the AFDCs, which calculate control wheel movement commands for the backdrive actuator. The backdrive actuator moves the wheels the same amount as the pilot would move them manually for the same surface movement. The flight crew can override the autopilot through the use of enough force on the wheel to overcome the backdrive actuator.

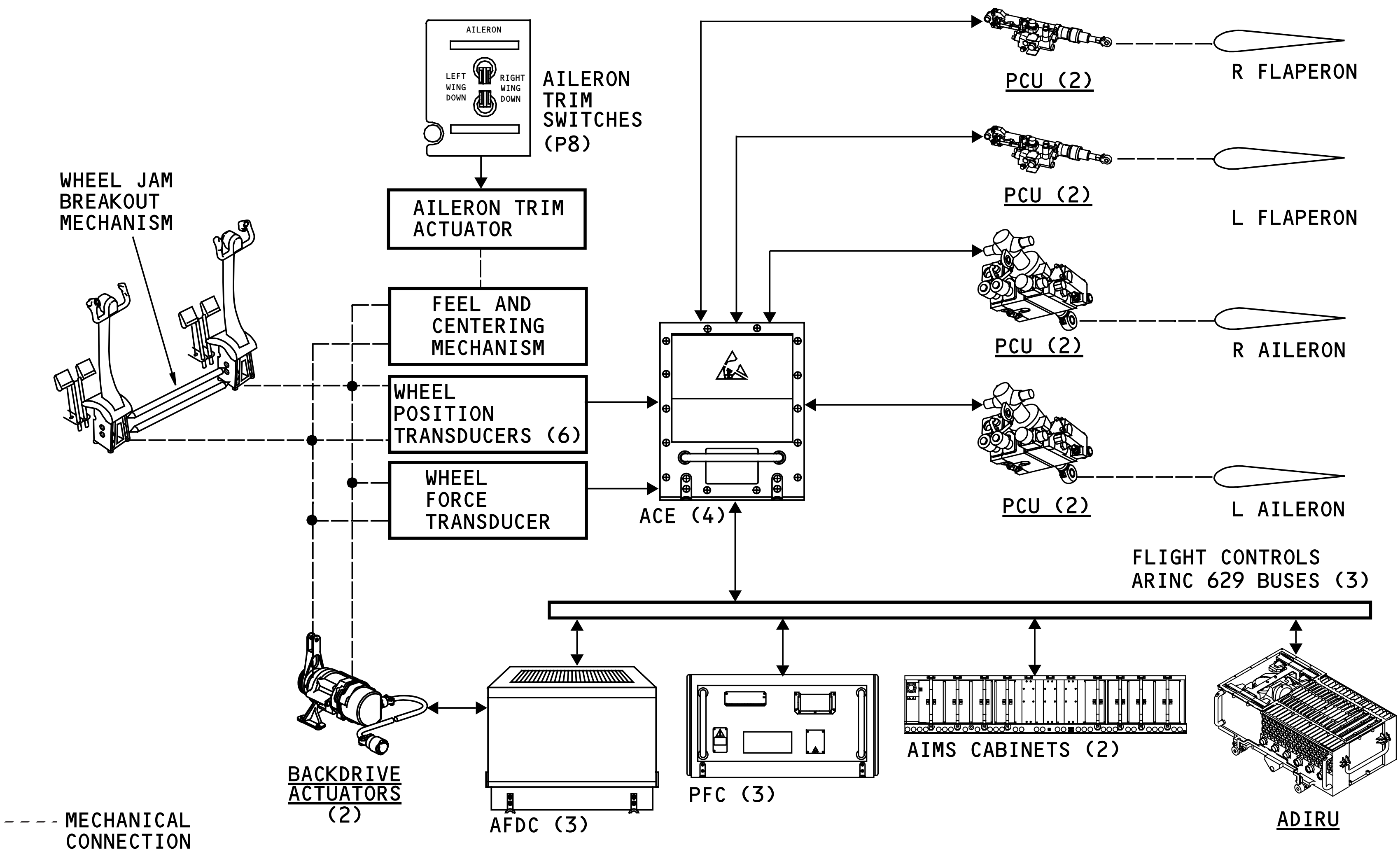
AILERON AND FLAPERON CONTROL - GENERAL DESCRIPTION

The AFDCs prevent the aileron trim operation when the autopilot is engaged.

Bank Angle Protection

A bank angle protection (BAP) function in the PFCs supplies protection in both manual and autopilot operation when the bank angle is more than 35 degrees.

The AFDCs prevent the aileron trim operation when the bank angle protection (BAP) is active.



27-11-00-002 Rev 2

AILERON AND FLAPERON CONTROL - GENERAL DESCRIPTION

AILERON AND FLAPERON CONTROL - COMPONENT LOCATIONS

General

The aileron and flaperon control components are in three areas:

- The wings
- The flight deck
- Below the flight deck floor.

See the primary flight controls section for more information about the location of PFCS electronic components (AMM PART I 27-02).

Wing Components

The aileron and flaperon control surfaces and their PCUs are on the wings. Two PCUs directly connect to each surface. Access to the aileron PCUs is by hinged access panels on the lower wing. Access to the flaperon PCUs is by removable lower skin panels.

Flight Deck Components

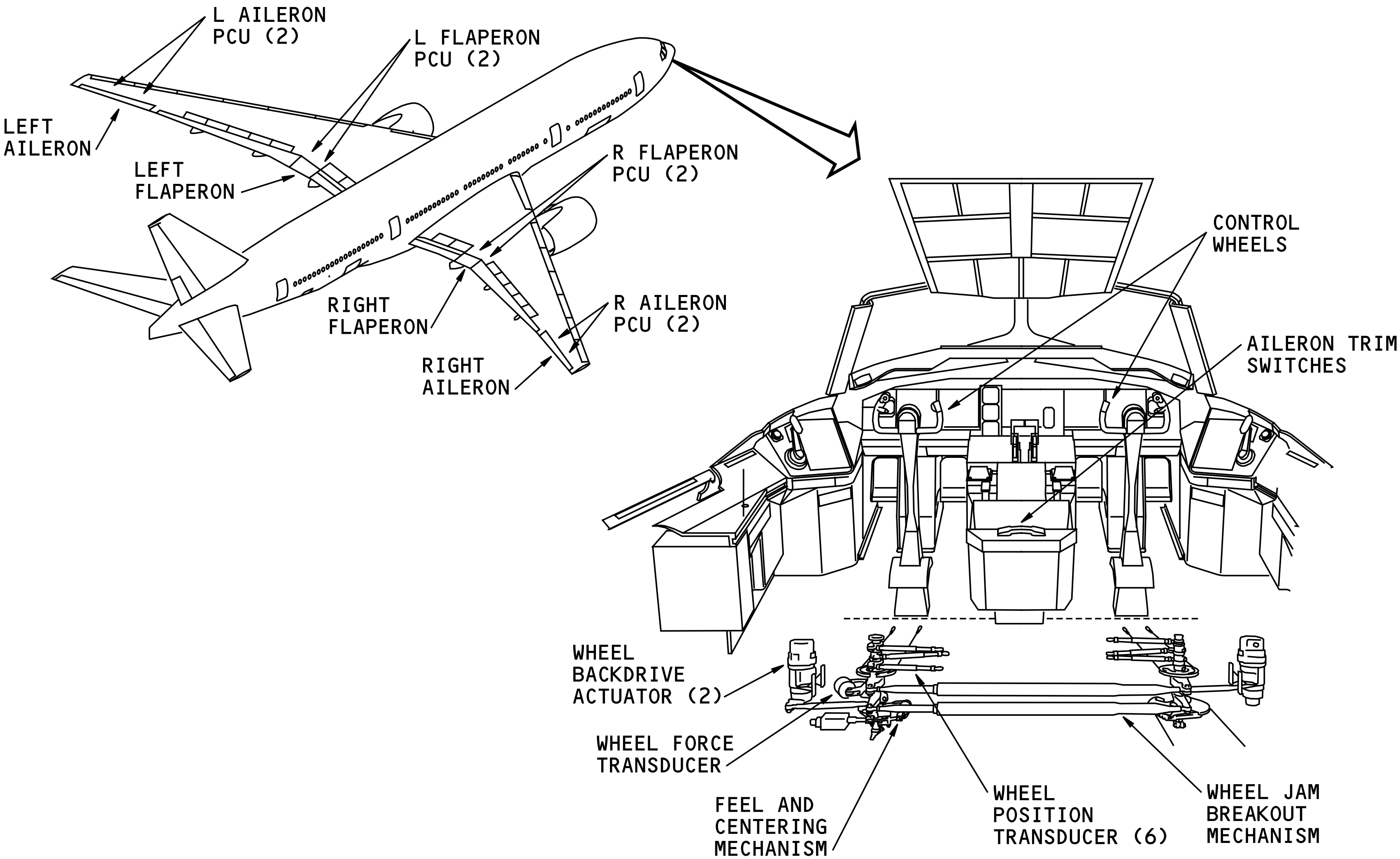
The control wheels and aileron trim switches are in the flight deck. The aileron trim switches are on the P8 aft aisle stand panel.

Components Below the Flight Deck

The rest of the forward controls are below the flight deck floor and above the nose gear wheel well. These are the:

- Wheel position transducers
- Wheel force transducer
- Wheel cable drums
- Feel and centering mechanism
- Wheel jam breakout mechanism
- Wheel backdrive actuators.

Access to these components is through the main equipment center (MEC), and then forward along the nose gear wheel well.



27-11-00-003 Rev 3

AILERON AND FLAPERON CONTROL - COMPONENT LOCATIONS

AILERON AND FLAPERON CONTROL - ANALOG AND DISCRETE INTERFACES

General

All of the aileron and flaperon control electrical interfaces within the PFCS go through the ACEs. Each ACE has interfaces with these components:

- Wheel position transducers
- Wheel force transducer
- Aileron PCUs
- Flaperon PCUs.

The aileron trim switches and trim actuator have mechanical interfaces with the aileron and flaperon control system.

Aileron Trim Switches and Trim Actuator

Two trim switches supply power to the trim actuator. The trim actuator moves the control wheels and the wheel position transducers by rotation of the feel and centering mechanism.

Wheel Position Transducers

There are six position transducers, three for each control wheel. Each transducer is a linear variable differential transformer (LVDT) that sends analog signals to the ACEs. These analog signals represent the control wheel position and its movement.

Wheel Force Transducer

There is one force transducer, with two LVDTs, that sends analog signals to the ACEs. These signals show the amount of force the pilots apply to the control wheels.

Aileron PCUs

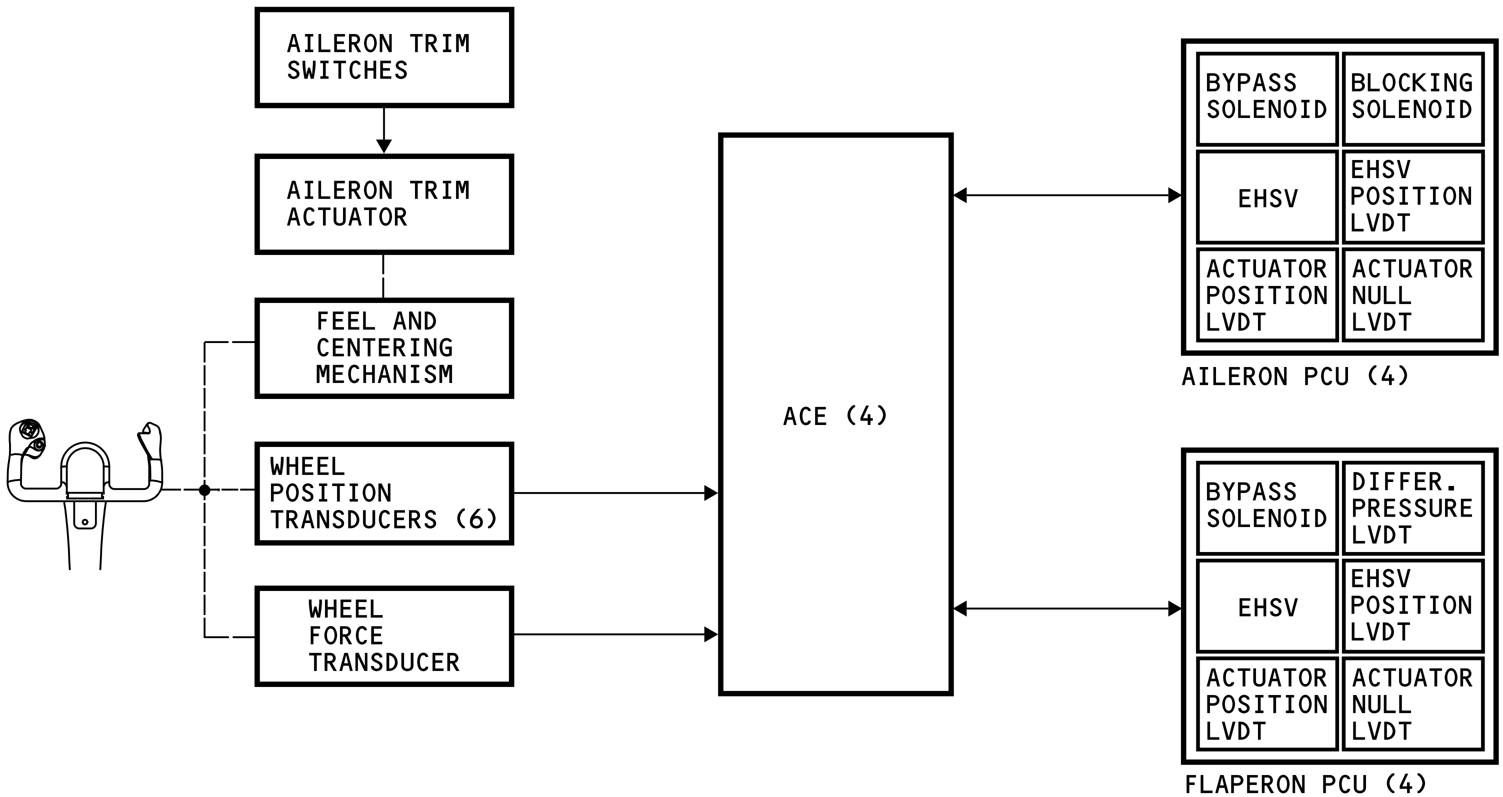
Each of the four aileron PCUs receives analog and discrete electrical signals from the ACEs. The discrete signals are for the bypass and blocking solenoids. The analog signal is for the electrohydraulic servo valve (EHSV).

Each of the four aileron PCUs sends analog feedback signals to the ACEs. These signals are from the EHSV position LVDT, the actuator position LVDT and the null LVDT.

Flaperon PCUs

Each of the four flaperon PCUs receives analog and discrete electrical signals from the ACEs. The discrete signals are for the bypass solenoid. The analog signal is for the EHSV.

Each of the four flaperon PCUs sends analog feedback signals to the ACEs. These signals are from the EHSV position LVDT, the actuator position LVDT and the null LVDT. A differential pressure LVDT sends signals about the difference of pressure between both sides of the PCU piston.



27-11-00-004 Rev 2 06/26/96

AILERON AND FLAPERON CONTROL - ANALOG AND DISCRETE INTERFACES

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AILERON AND FLAPERON CONTROL - FORWARD CONTROLS

General

The forward controls of the aileron and flaperon control system include:

- Control wheels
- Wheel drums and shaft assemblies
- Wheel jam breakout mechanism
- Wheel position and force transducers
- Wheel backdrive actuators
- Wheel damper
- Feel and centering mechanism
- Travel stops.

The forward controls are below the flight deck.

Control Wheels

Each pilot has a control wheel. The control wheels turn to supply manual input to the aileron and flaperon control.

Wheel Cable Drums and Shaft Assemblies

A pair of control cables connects each control wheel to a cable drum. The left and right cable drums bearing mount on their drive shaft assembly. The cable drums indirectly move the shaft assemblies through the force limiters and the force transducer. There is a lost motion device on each wheel cable drum.

Wheel Jam Breakout Mechanism

The wheel jam breakout mechanism has two identical force limiters and two lost motion devices. If the control wheel jams, the force limiters allow the other control wheel to continue roll control. The upper force limiter connects the two wheel cable drums. The lower force limiter connects the right and left shaft assemblies. The lost motion devices allow the control wheel cable drums to move the left or right shaft assembly in case of failure.

Wheel Position and Force Transducers

Six wheel position transducers, on the airframe structure, connect to cranks at the top of the left and right shaft assemblies.

The wheel force transducer connects the left cable drum to the left crank.

Wheel Backdrive Actuators

Two wheel backdrive actuators connect to the cranks on the left and right shaft assemblies. The backdrive actuators are part of the autopilot system. See the autopilot flight director system section for more information on the backdrive actuators (AMM PART I 22-11).

AILERON AND FLAPERON CONTROL - FORWARD CONTROLS

Wheel Damper

The left shaft assembly connects to a wheel damper. The wheel damper absorbs control wheel vibrations.

Feel and Centering Mechanism

The feel and centering mechanism is at the bottom of the left shaft assembly. The aileron trim actuator connects directly to the feel and centering mechanism.

Travel Stops

Travel stops are at the bottom of the shaft assemblies. They limit the shaft assemblies, cable drums and position transducers movement to 65 degrees of control wheel travel.

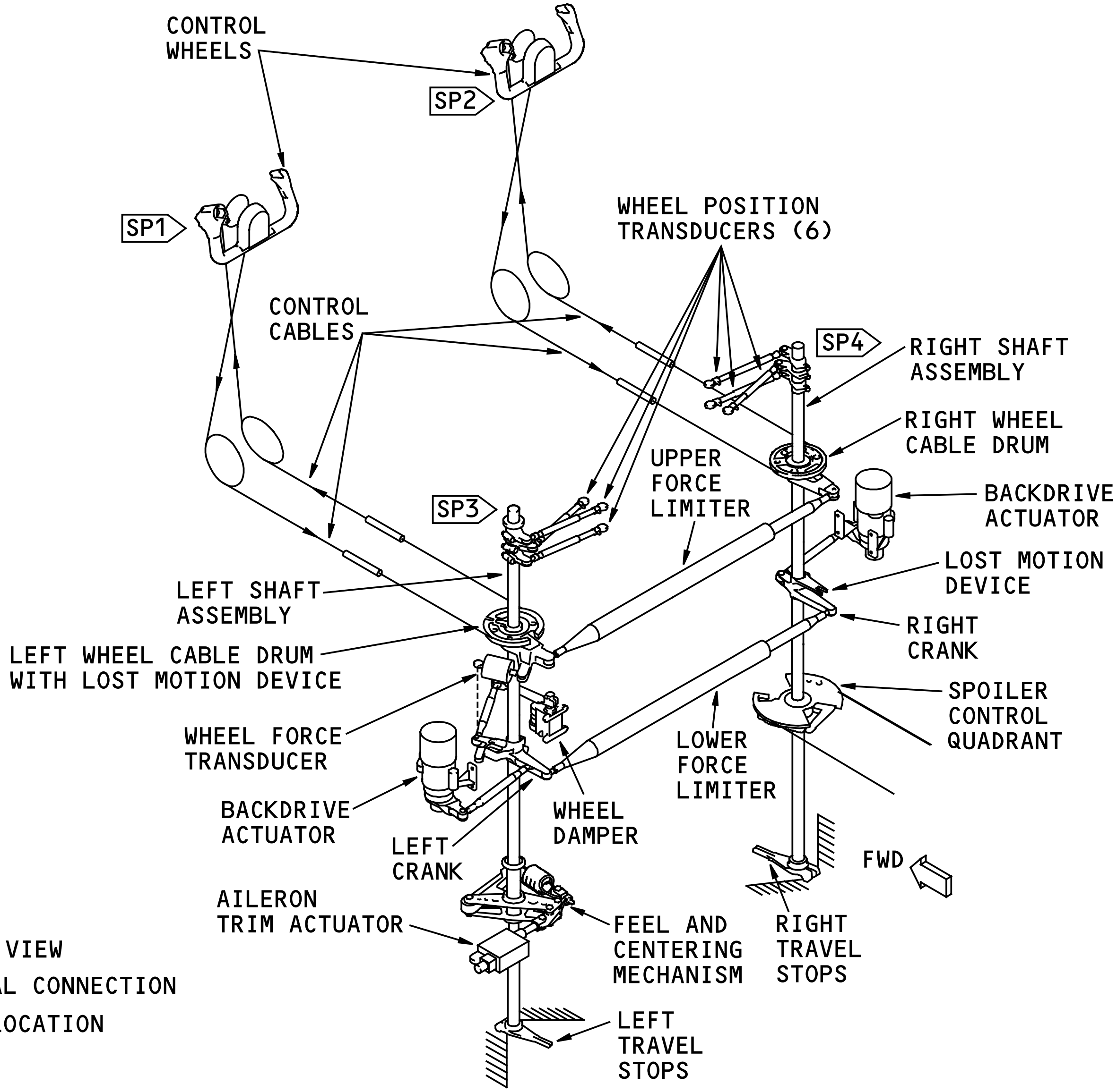
Spoiler Control Quadrant

The spoiler control quadrant is at the bottom of the right shaft assembly. The spoiler control quadrant connects by a pair of cables to the controls of spoilers 4 and 11.

See the spoiler and speedbrake control section for more information (AMM PART I 27-61).

Training Information Point

You use four rig pins to adjust the system.



NOTE: EXPANDED VIEW
------- MECHANICAL CONNECTION
SPX RIG PIN LOCATION

27-11-00-005 Rev 5 03/19/96

AILERON AND FLAPERON CONTROL - FORWARD CONTROLS

AILERON AND FLAPERON CONTROL - WHEEL CABLE DRUM

Purpose

The wheel cable drums transmit the wheel cable motion to the force transducer and upper force limiter.

Physical Description

The wheel cable drums are cast assemblies. The right and left drums are not the same. Both drums have attachment points for the upper force limiter, which is part of the wheel jam breakout mechanism.

The left drum has an additional attachment point for the wheel force transducer. The left drum is bearing mounted on a sleeve which is spline mounted on the left shaft assembly. If there is a failure, the sleeve and left drum can connect through a lost motion device. The lost motion device permits connection after a control wheel rotation of 7.8 degrees in either direction.

The right drum is bearing mounted on the right shaft assembly. The right drum has a peg on the bottom side which is part of the lost motion device. If there is a failure, the lost motion device lets the right drum connect to the right shaft assembly after a control wheel rotation of 2.9 degrees in either direction.

Location

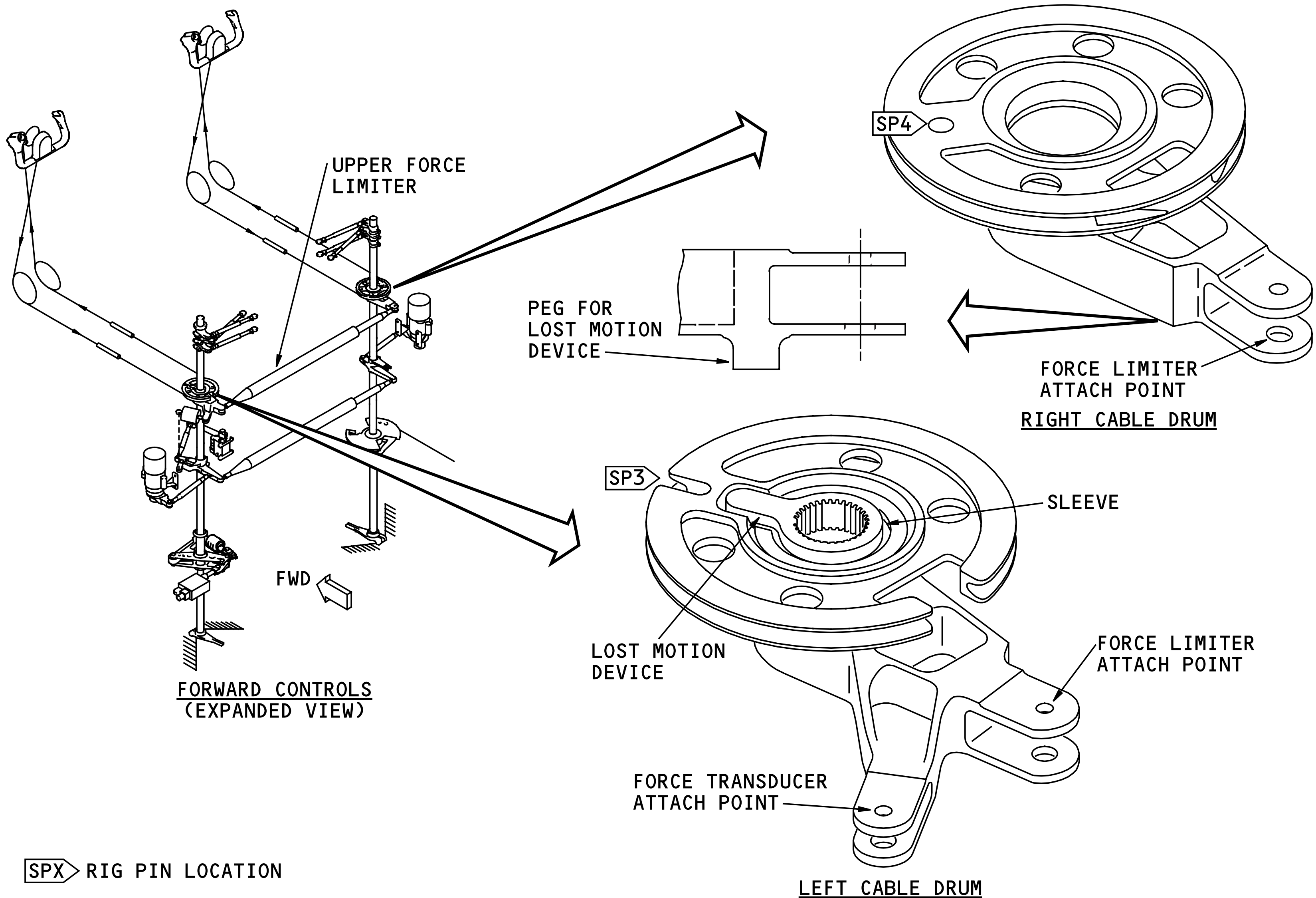
The wheel cable drums are on the shaft assemblies. They are between the flight deck floor and the nose gear well. Access to the drums is through the MEC, along the nose gear wheel well, or through the flight deck floor access panels.

Functional Description

When the pilots move the control wheels, the wheel cables turn the wheel drums.

Training Information Point

Each wheel cable drum has a rig pin hole.



27-11-00-007 Rev 3 03/19/96

AILERON AND FLAPERON CONTROL - WHEEL CABLE DRUM

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AILERON AND FLAPERON CONTROL - WHEEL JAM BREAKOUT MECHANISM

Purpose

The wheel jam breakout mechanism supplies a load path for roll control. In normal operation, the mechanism permits either pilot to make roll control commands. If there is a jam of a control wheel, the breakout mechanism permits the pilot to operate the other control wheel. If the cable or connection breaks, the other control wheel still operates.

Physical Description

The wheel jam breakout mechanism has two identical force limiters and two lost motion devices.

Force Limiter

Each force limiter is a pogo. It contains an inner and outer rod and a spring. It takes a 50 lb (23 kg) force at the control wheel to breakout the force limiters.

The upper force limiter attaches directly to the two wheel cable drums. The lower force limiter attaches to the two cranks on the left and right shaft assemblies.

Lost Motion Devices

There is a lost motion device on the left and right cable drums.

If there is a failure, the left cable drum motion device connects the drum to the left shaft assembly after a control wheel rotation of 7.8 degrees.

The lost motion device on the right drum is a peg and notch type mechanism. The right wheel cable drum has a peg on the bottom surface which inserts in the slot of the right crank, directly below it. If there is a failure, the right lost motion device connects the right wheel cable drum to the right crank after a control wheel rotation of 2.9 degrees.

Location

The wheel jam breakout mechanism is between the flight deck floor and the nose gear wheel well. Access is through the MEC, then along the left side of the nose gear wheel well.

Functional Description - Normal Operation

In normal operation, the two force limiters supply the load path for roll control.

Movement of the left wheel cable drum goes through the upper force limiter to move the right cable drum and the right control wheel. The movement also goes through the force transducer to the left crank. The left crank moves the left shaft assembly. It also moves the right crank and the right shaft assembly through the lower force limiter.

Movement of the right wheel cable drum goes through the upper force limiter to move the left cable drum and the left control wheel. The rotation of the left cable drum moves both shaft assemblies in the same manner as above.

AILERON AND FLAPERON CONTROL - WHEEL JAM BREAKOUT MECHANISM

Functional Description - Failure Mode

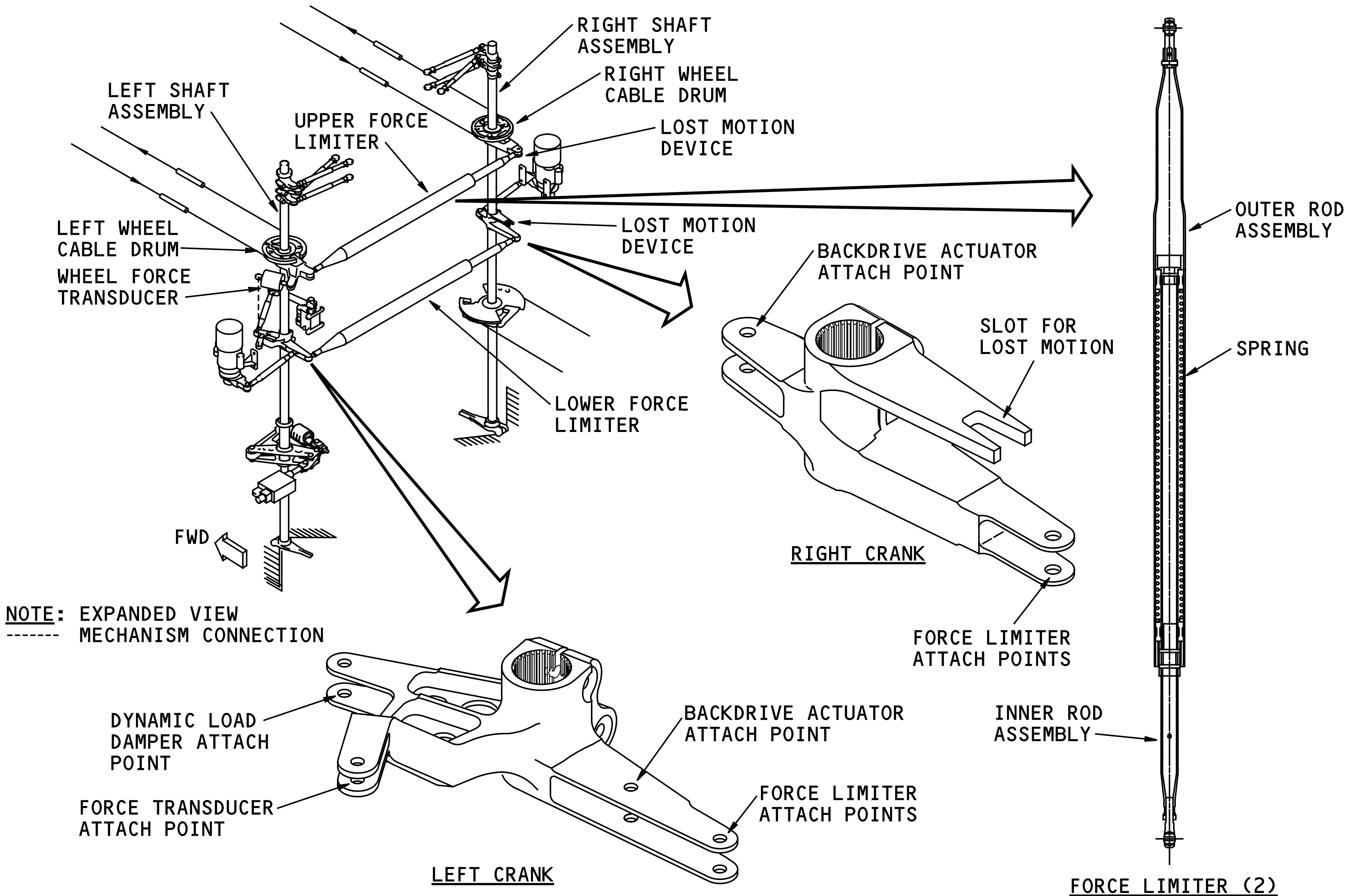
The wheel jam breakout mechanism permits the pilot to continue roll command if either wheel jams or a connection breaks.

If a right control wheel jams, the captain can operate the left wheel after overriding the 50 lb (23 kg) force of the breakout mechanism and the force of the feel and centering mechanism.

If the left control wheel jams, the first officer can operate the right control wheel after overriding only the force of the breakout mechanism. The right lost motion device engages after 2.9 degrees of control wheel movement. The lost motion device then turns the right shaft assembly.

If a control cable breaks between the control wheel and the cable drum, the pilot operates the other control wheel to control roll.

If a connection with the force transducer breaks, control roll through the motion device on the right cable drum. The right lost motion device engages after 2.9 degrees of control wheel movement.



AILERON AND FLAPERON CONTROL - WHEEL JAM BREAKOUT MECHANISM

27-11-00-008 Rev 2 03/19/96

AILERON AND FLAPERON CONTROL - WHEEL DAMPER

Purpose

The wheel damper absorbs control wheel vibrations and brings the wheel control system to rest with minimum oscillation.

Physical Description

The wheel damper is an LRU and weighs approximately 1.6 lb (0.7 kg).

The wheel damper is the same as the pedal damper and the two column dampers. There are four of these dampers on the airplane.

The wheel damper is on the structure of the left shaft assembly mechanism. A damper crank and a control rod connect the damper shaft to the left crank. The control rod is not adjustable.

The wheel damper has an input shaft. The wheel damper uses a fluid to absorb vibrations that go to the shaft. A window on the wheel damper shows the position of the fluid level indicator.

The damper crank, on the damper shaft, has a pair of rivets. These shear out in case of a jam of the wheel damper.

Location

The wheel damper is on the mechanism of the left shaft assembly, between the flight deck floor and the left side of the nose gear wheel well. Access is through the MEC, then along the left side of the nose gear wheel well.

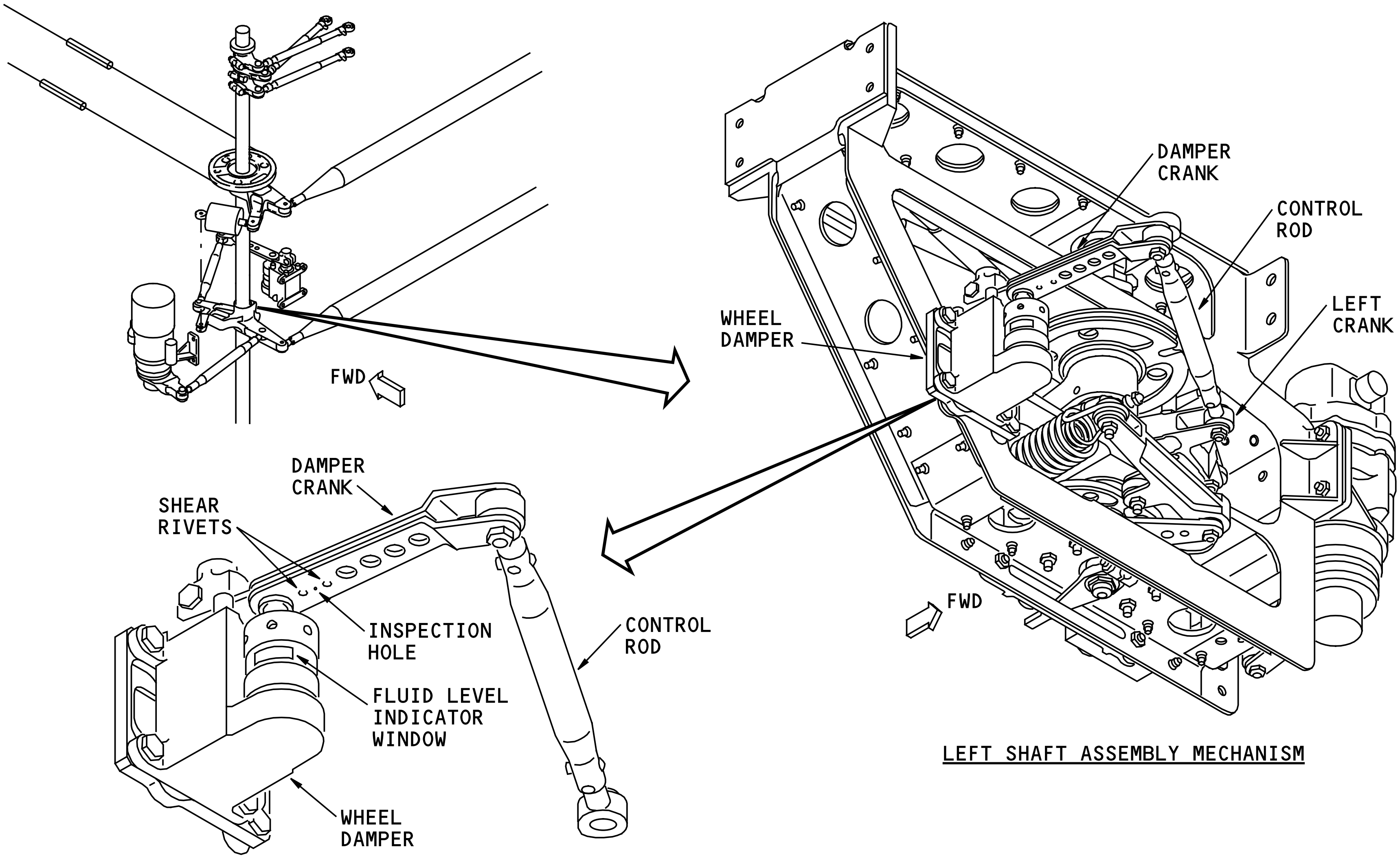
Functional Description

As the left shaft assembly turns, it turns the shaft of the wheel damper which absorbs the vibration of the wheel control system. The wheel damper adds a small force to the wheel control system.

Training Information Point

Put a pin through the inspection hole in the damper crank to check the rivet condition.

If the fluid level indicator shows a green band width of 1/16 inch or less, the fluid level is low. Then it is necessary to replace the wheel damper.



LEFT SHAFT ASSEMBLY MECHANISM

WHEEL DAMPER WITH DAMPER CRANK

27-11-00-030 Rev 3 10/08/96

AILERON AND FLAPERON CONTROL - WHEEL DAMPER

AILERON AND FLAPERON CONTROL - AILERON FEEL AND CENTERING MECHANISM

Purpose

The aileron feel and centering mechanism supplies feel and centering forces to the aileron and flaperon control system. The aileron trim actuator supplies aileron trim control. The aileron trim moves the neutral position of the ailerons, the flaperons and the control wheels.

Physical Description

The aileron feel and centering mechanism consists of a single cam and roller unit. The cam attaches by a spline to the left shaft assembly and turns with it. The follower assembly has a roller which rolls on the cam surface. Two cranks hold the follower assembly. The cranks are bearing mounted on the left shaft assembly. A fitting attaches the two cranks together and to the trim actuator rod end. Two extension springs, between the fitting and the follower assembly, keep the roller on the cam.

The aileron trim actuator is a line replaceable unit (LRU). It is a 28v dc electrical, fixed rate motor which moves a non-reversible acme screw. The actuator attaches to the structure. The rod end of the actuator connects to the fitting of the feel and centering assembly.

Location

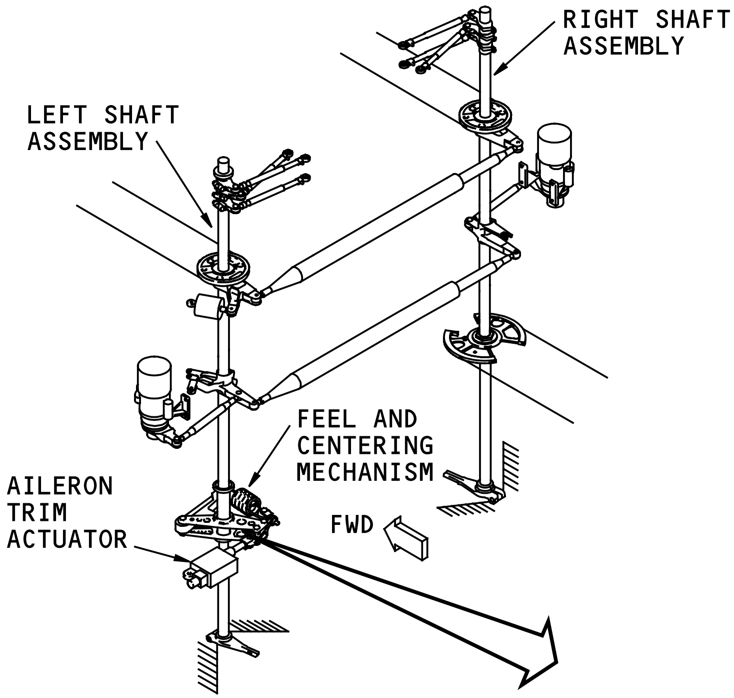
The aileron feel and centering mechanism is at the bottom of the left shaft assembly, between the flight deck floor and the nose gear wheel well. Access is through the MEC, then along the left side of the nose gear wheel well.

Functional Description

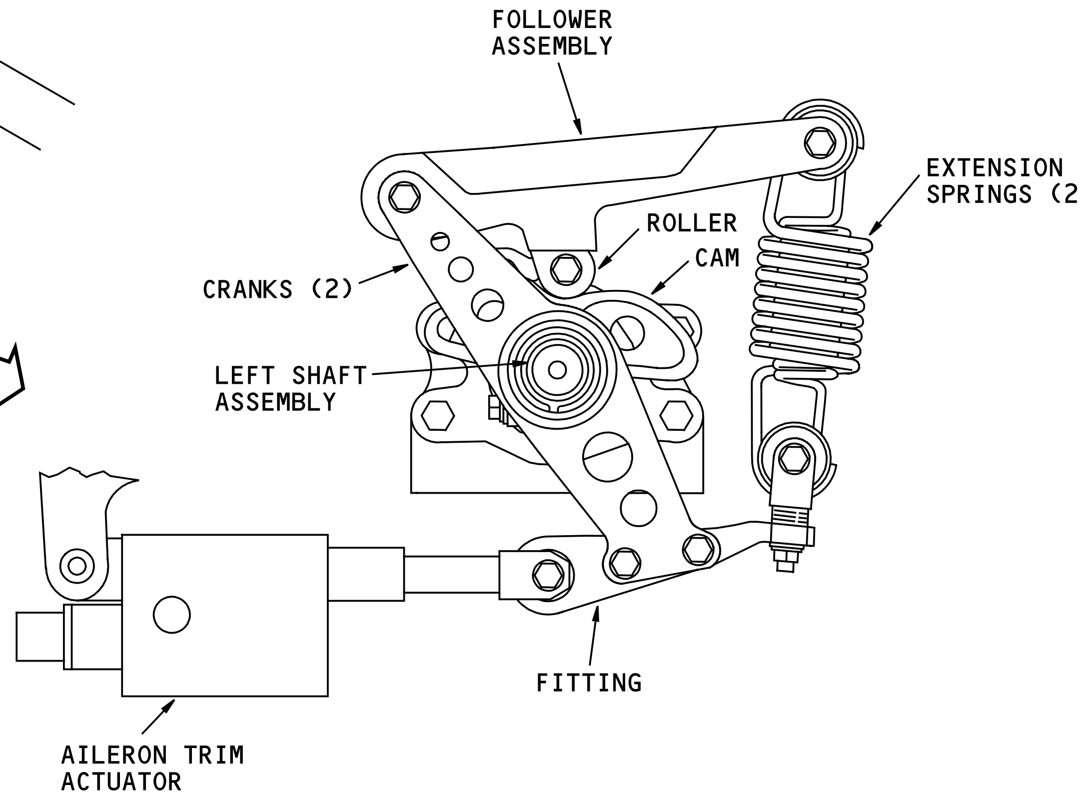
As the left shaft assembly and cam turn, the cam follower moves, which extends the two extension springs. The springs supply a feel force to the control wheels. The feel force varies from 5 lb (2 kg) to a maximum of 14 lb (6 kg) at 65 degrees of control wheel travel.

When the pilots release the control wheels, the springs force the cam follower back to the cam detent. This returns the system to the neutral trimmed position. The neutral, or zero feel force position, changes with trim input.

During trim operation, the aileron trim actuator moves the fitting assembly and cranks, which then move the cam follower assembly. Since the extension springs keep the cam follower in the cam detent, the trim actuator causes the cam and the left shaft assembly to turn. This also turns the right shaft assembly, the control wheels and the control wheel position transducers. The control wheels are backdriven and the ailerons and flaperons move.



NOTE: EXPANDED VIEW



27-11-00-009 Rev 0

AILERON AND FLAPERON CONTROL - AILERON FEEL AND CENTERING MECHANISM

AILERON AND FLAPERON CONTROL - AILERON TRIM

Purpose

The pilots use the aileron trim switches to adjust the trim of the airplane about the longitudinal axis.

Location

Dual aileron trim switches are on the aft end of the P8 aft aisle stand. The aileron trim indicator placards are on top of each control column.

Functional Description

The pilot controls the roll trim with the two aileron trim switches. The switches command the aileron trim actuator. One switch does the arm function and the other does the control function. The pilot must operate both switches at the same time to supply power to the trim actuator.

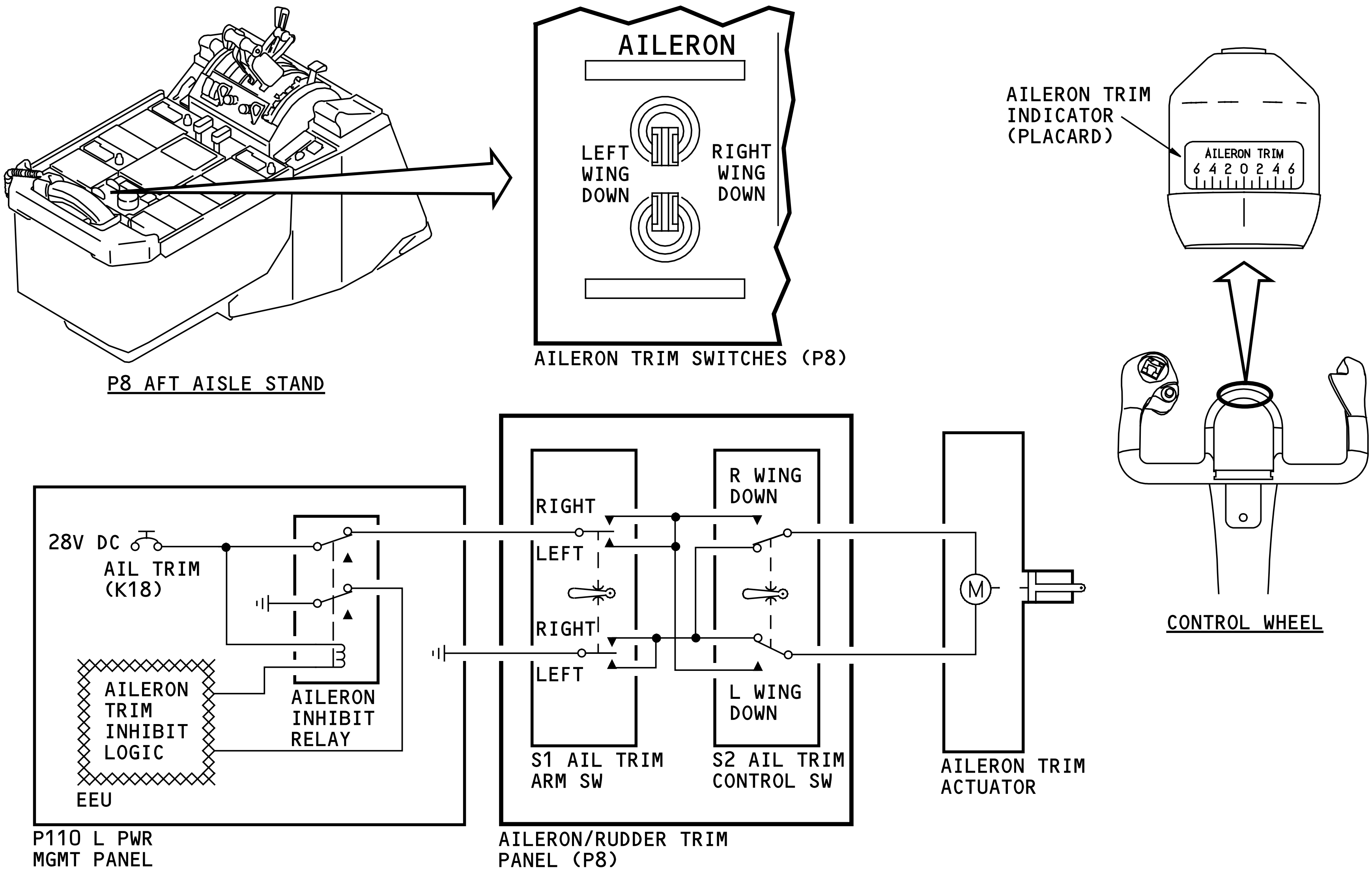
The electrical load management system (ELMS) controls the electrical power to the aileron trim switches through the aileron trim inhibit relay. The ELMS electronic unit (EEU) receives wheel backdrive actuator engagement signals from the AFDCs.

When none of the wheel backdrive actuators is engaged, ELMS keeps the aileron trim inhibit relay deenergized. Electrical power then goes to the aileron trim switches. The arm switch supplies electrical power and motor ground to the control switch which then supplies the direction of the motor rotation.

When one or both wheel backdrive actuator is engaged, the ELMS energizes the aileron trim inhibit relay which stops power to the aileron trim switches. This prevents the operation of the aileron trim during autopilot operation and bank angle protection (BAP) activation.

The aileron trim actuator moves the control wheels at a rate of 2.6 degrees per second. The roll trim authority is 30 degrees of control wheel rotation in both directions.

The aileron trim indicator placards show the amount of trim in units. Each unit indicates 5 degrees of control wheel rotation.



AILERON AND FLAPERON CONTROL - AILERON TRIM

AILERON AND FLAPERON CONTROL - WHEEL POSITION TRANSDUCERS

Purpose

The six control wheel position transducers measure the position of the control wheels. The transducers send analog electrical signals to the ACEs.

Physical Description

Each position transducer is an LVDT. The ACEs supply 7v ac, 1800 Hz excitation power.

The six wheel position transducers are identical to the six column position transducers and the four pedal position transducers. There are 16 of these identical position transducers on the airplane.

Three wheel position transducers are on the right shaft assembly and three are on the left shaft assembly. The position transducers attach at one end to the lateral control support bracket assembly. They attach to the transducer crank at the other end.

Each transducer crank attaches to its shaft assembly with a spline. The spline has a missing tooth to help locate the crank on the shaft. Each transducer crank has two shear rivets to allow override of a jammed position transducer.

Each position transducer has an electrical cable which connects to the ACE connector bracket. This bracket has three receptacles, one for each position transducer. Each receptacle is identified by a placard. The order in which each position transducer connects to the receptacles of the connector bracket determines the transducer-to-ACE relationship.

Location

The six wheel position transducers are between the flight deck floor and the nose gear wheel well. Access is by the access hatch of the MEC, then along the left side of the nose gear wheel well.

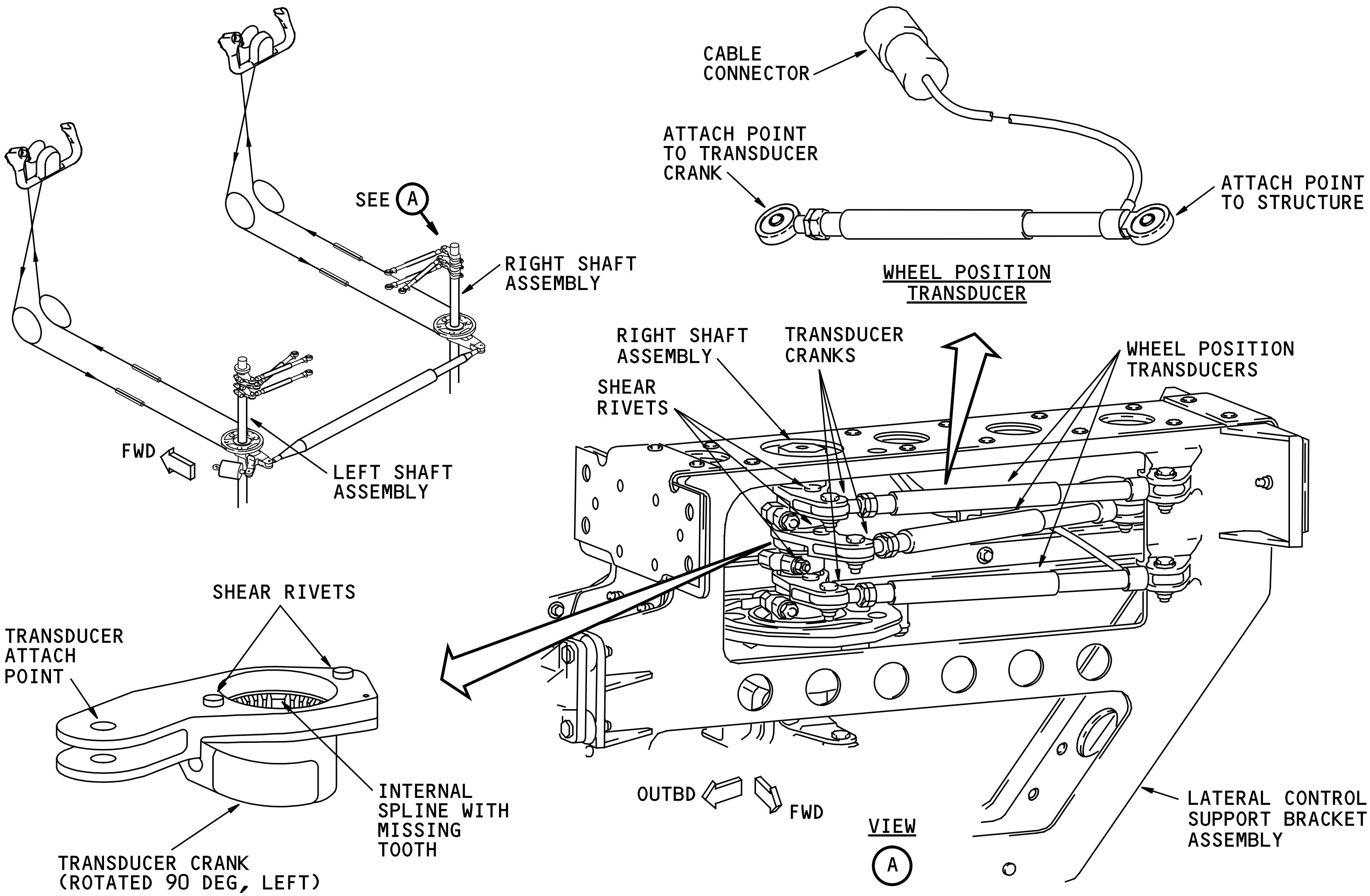
Functional Description

When the right and left shaft assemblies rotate in response to a control wheel command, the control wheel position transducers extend or retract. Each position transducer sends an analog electrical signal to one ACE.

Indications

On the status display, the status message CONTROL WHEEL XDCR indicates that one of the six wheel position transducers is defective.

When two or more wheel position transducers are defective, the status message FLIGHT CONTROL SYS shows.



27-11-00-011 Rev 2 01/19/95

AILERON AND FLAPERON CONTROL - WHEEL POSITION TRANSDUCERS

AILERON AND FLAPERON CONTROL - WHEEL FORCE TRANSDUCER

Purpose

The wheel force transducer measures the total force from the captain and the first officer to the control wheels. The wheel force transducer sends analog electrical signals to the ACEs. The PFCs use these signals for the bank angle protection function.

Physical Description

The wheel force transducer is a spring with two electrically isolated LVDTs inside. The ACEs supply 7v ac, 1800 Hz excitation power.

The wheel force transducer is different from the two elevator force transducers.

The wheel force transducer attaches to the wheel left cable drum and to the left crank of the left shaft assembly.

Each LVDT has a separate cable which connects to the ACE connector bracket. This bracket has two receptacles, one for each LVDT of the force transducer. The order in which each LVDT connects to the connector bracket determines the interface of the LVDT with the ACE.

Location

The wheel force transducer is on the left shaft assembly, between the flight deck floor and the nose gear wheel well. Access is through the MEC, then along the left side of the nose gear wheel well.

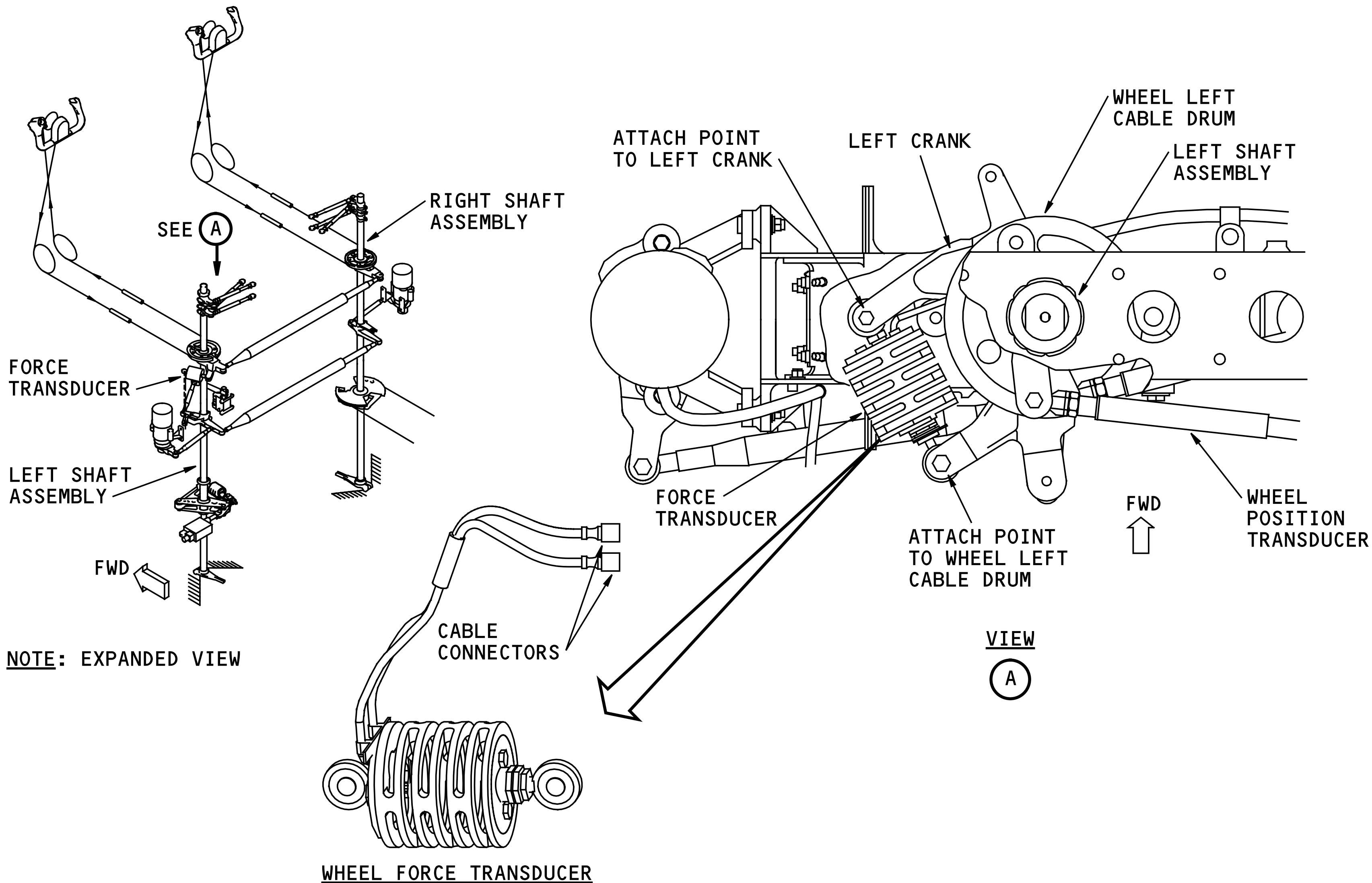
Functional Description

When the pilot applies a force to the control wheel, the wheel force transducer spring extends or compresses. The LVDTs measure the spring movement.

The signal from one LVDT goes to the L2 ACE, and the other to the C ACE.

Indications

When both LVDTs of the wheel force transducer fail, the status message BANK ANGLE PROTECT shows.



27-11-00-012 Rev 2 03/19/96

AILERON AND FLAPERON CONTROL - WHEEL FORCE TRANSDUCER

AILERON AND FLAPERON CONTROL - AILERON PCU - LOCATION

Purpose

The aileron PCUs move the ailerons. Electrical command signals from the ACEs operate the aileron PCUs. Each aileron has two PCUs.

Location

The two PCUs are outboard on the wing rear spar. Access to the PCUs is by two hinged panels on the lower wing.

The kick link connects the PCU to the rear spar fittings. The actuator rod connects to the aileron at the aileron surface attach fitting. The reaction link connects to the aileron at the aileron attach fitting at the hinge line.

Two electrical connectors of different sizes connect to the upper side of the PCU.

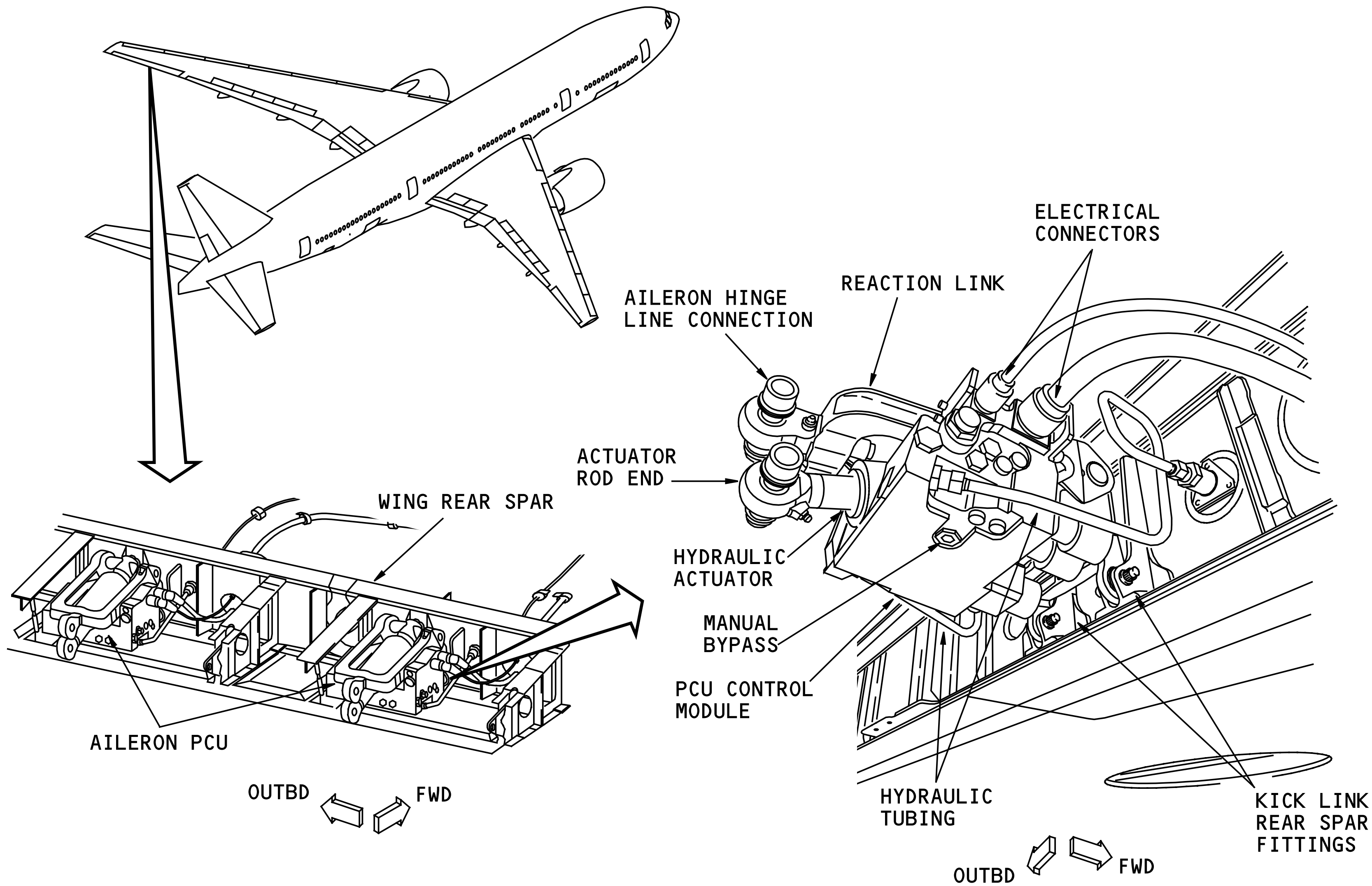
Hydraulic tubing connects to ports, one on each side of the PCU. This tubing has fuses and check valves to help prevent the loss of hydraulic fluid if there is damage to the PCUs or hydraulic tubing. The fuses and check valves in the left hydraulic system are inboard of spoilers 1 and 14 in each wing. The fuses and check valves in the center hydraulic system are outboard of spoilers 1 and 14 in each wing.

Training Information Point

Removal and installation of the aileron PCU is in one assembly with the reaction link and the kick link.

To move the actuator for maintenance, depressurize the hydraulic systems. You get access to the manual bypass on the under side of the PCU. Turn the manual bypass to the bypass position while moving the aileron. After release of the manual bypass, it closes.

During installation of the aileron PCU, it is necessary to adjust the actuator null LVDT. Remove the LVDT access cover to adjust the LVDT.



27-11-00-013 Rev 5 10/08/96

AILERON AND FLAPERON CONTROL - AILERON PCU - LOCATION

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AILERON AND FLAPERON CONTROL - AILERON PCU - FUNCTIONAL DESCRIPTION

General

The aileron PCU operates in three different modes:

- Normal
- Bypass
- Blocking/Damped.

In the normal mode, the ACE energizes both the bypass and blocking solenoids with flight below cruise speed. Above cruise speed, the ACE de-energizes the blocking solenoid.

In the bypass mode, the ACE de-energizes the bypass solenoid.

In the blocking/damped mode, the ACE de-energizes both the bypass and the blocking solenoids.

PCU Operational Matrix

The table below shows the various conditions of the PCU valves in the three modes of operation.

SOLENOID CONDITIONS	PCU MODES OF OPERATION		
	NORMAL	BYPASS	BLOCKING/ DAMPED
BYPASS SOLENOID	E	D	D
BLOCKING SOLENOID	E/D	E	D
LEGEND: E = ENERGIZED D = DE-ENERGIZED			

Normal Mode

During operation below cruise speed, the PCU is in normal mode when the ACE energizes both the bypass and the blocking solenoid valves.

Hydraulic system pressure moves the mode selector valve to the normal position and opens the extension check and relief valve. Under these conditions, an electrical command to the EHSV results in the actuator extension or retraction.

Aileron Lockout

With flight at or above cruise speed, the PFCs command, through the ACEs, the ailerons to fair and to lock out. The ACEs energize the bypass solenoid valve but de-energize the blocking solenoid valve of all the aileron PCUs. The PCUs are in normal mode. The PFC command signals to the EHSV keep the ailerons in the faired position.

Bypass Mode

The PCU is in the bypass mode when the ACE de-energizes the bypass solenoid valve and energizes the blocking solenoid valve. This happens when there is a single hydraulic or electrical failure on the PCU.

The bypass solenoid valve blocks hydraulic pressure to the mode selector valve. However, pressure trapped between the bypass check valves and the thermal relief valve moves the mode selector valve to the bypass position. This pressure also keeps the extension check and relief valve open.

Under these conditions, the mode selector valve blocks control pressure from the EHSV to the actuator cylinder. It also allows free hydraulic flow between both sides of the piston on the failed PCU. The adjacent PCU controls the aileron movement and backdrives the failed PCU.

During rapid backdrive of the failed PCU, the compensator/relief valve supplies fluid to the actuator through the anti-cavitation check valves.

If there is a subsequent failure on the adjacent PCU, its ACE de-energizes its bypass solenoid valve. With both PCUs in the bypass mode, the airloads cause the aileron trailing edge to move up approximately 15 degrees from the faired (neutral) position.

Blocking/Damped Mode

The PCU is in the blocking/damped mode when the ACEs de-energize both the bypass and the blocking solenoid valves. This happens when the PCU has no power or the PCU has a failure at or above cruise speed.

In the blocking/damped mode, there is no hydraulic pressure on the mode selector valve. Its internal spring moves the valve to the blocking/damped position. The mode selector valve blocks control pressure from the EHSV to the actuator cylinder. It also connects both sides of the actuator through a restriction. Also, the extension check and relief valve closes.

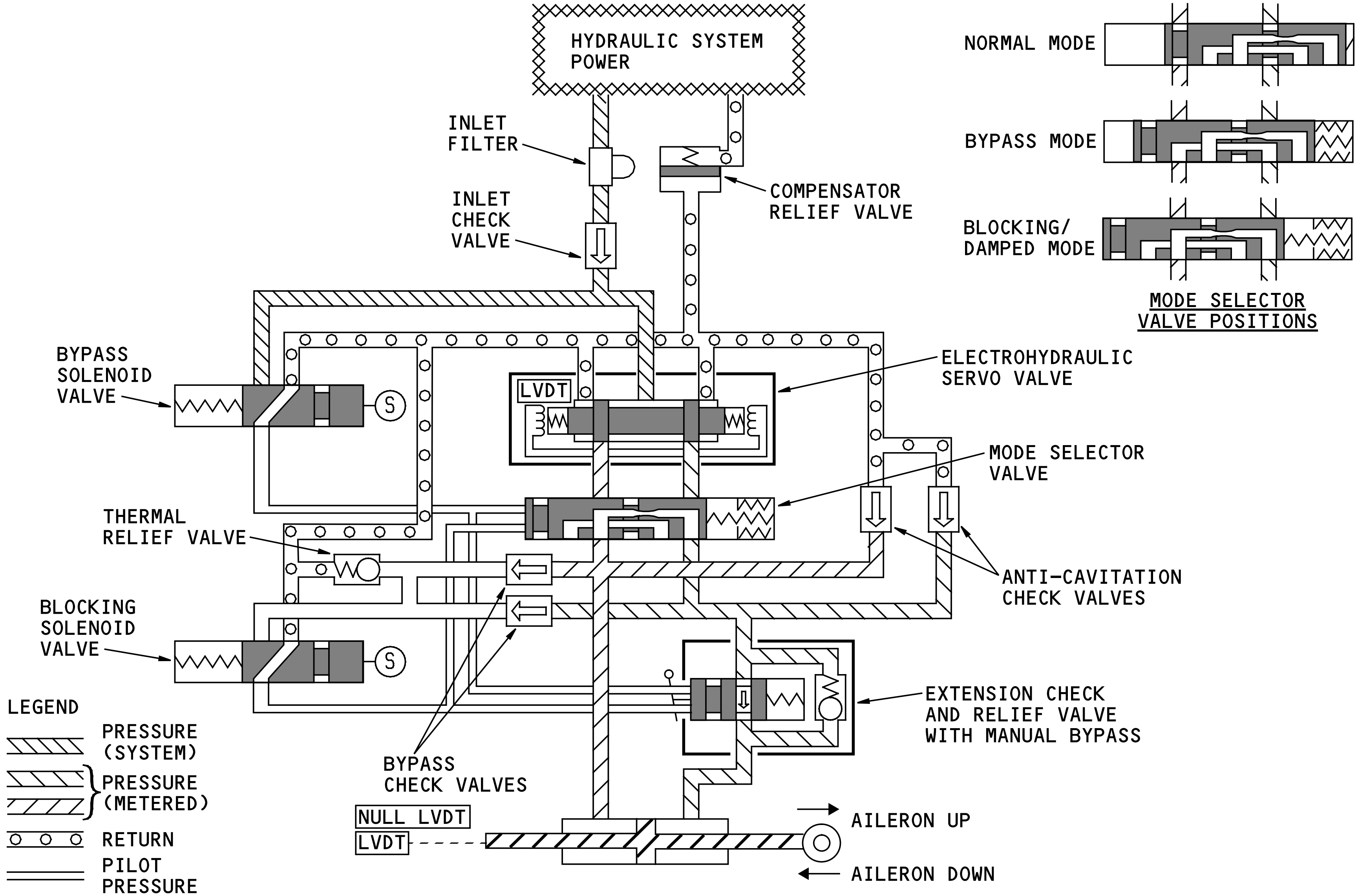
Under these conditions, the actuator cannot extend but can retract very slowly.

During flight at or above cruise speed, when both PCUs of an aileron are in the blocking/damped mode, the closed extension check and relief valve prevents the aileron upward movement caused by aerodynamic lift.

On the ground, with no electrical or hydraulic power on the aileron PCUs, the PCUs are in the blocking/damped mode. The ailerons cannot move up but can move down. Turn the manual bypass to move the ailerons and the PCUs in the up direction.

Indications

The status message FLIGHT CONTROL SYS shows on the status display when one or more aileron actuator is failed or the actuator confidence test has failed.



AILERON AND FLAPERON CONTROL - AILERON PCU - FUNCTIONAL DESCRIPTION

27-11-00-015 Rev 4 06/26/96

AILERON AND FLAPERON CONTROL - FLAPERON PCU - LOCATION

Purpose

The flaperon PCUs move the flaperons. Electrical command signals from the ACEs actuate the flaperon PCUs. Each flaperon has two PCUs.

Location

The two PCUs are on the rear spar of the inboard wing. Access to the PCUs is by a removable lower skin panel below each PCU.

The head end bearing assembly connects the PCU to the rear spar structural fitting. The actuator rod connects to the flaperon surface fitting.

One electrical connector connects to the PCU.

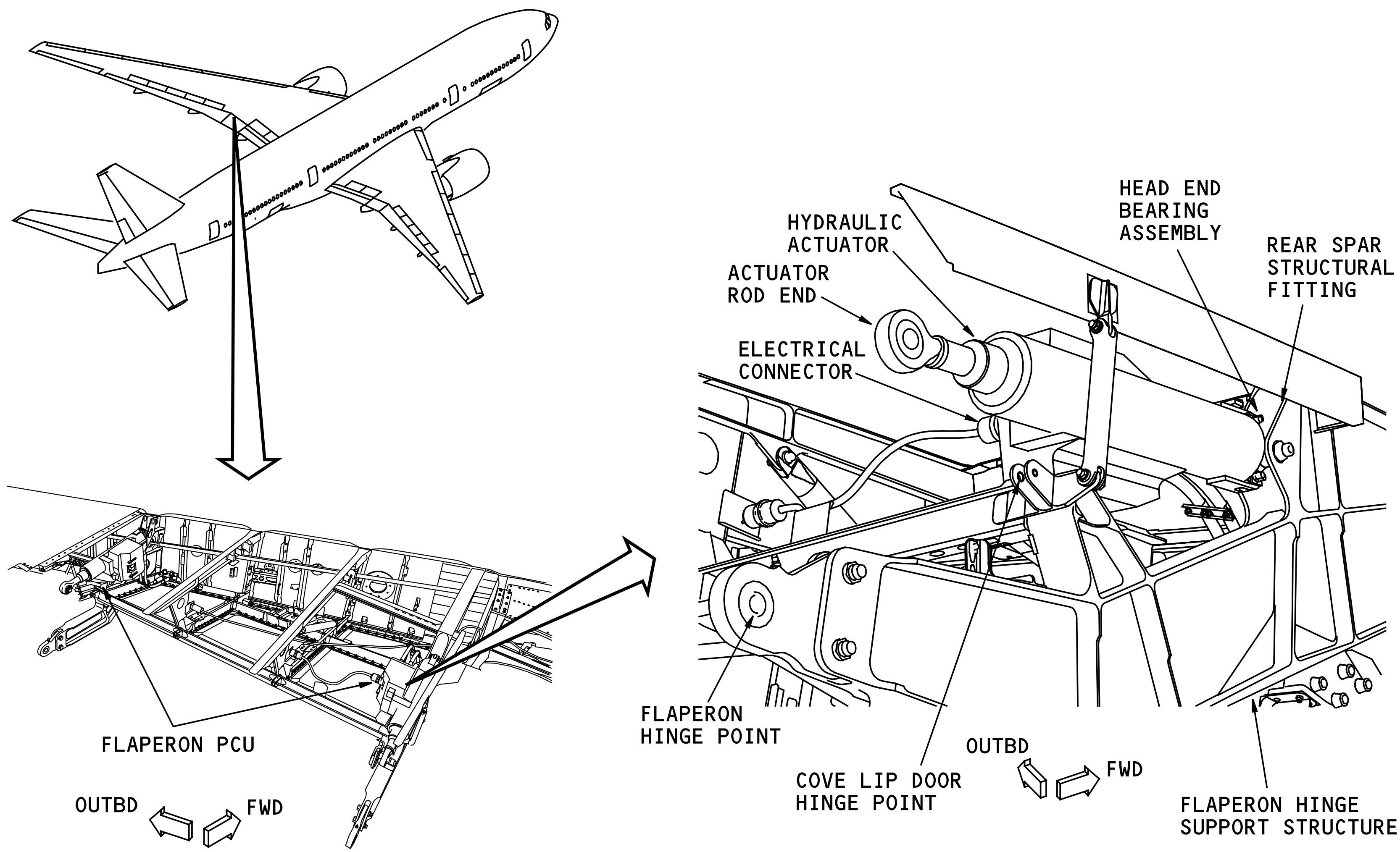
Hydraulic tubing connects to ports near the forward end of the PCU. The hydraulic tubing from these hoses have fuses and check valves to help prevent the loss of hydraulic fluid if there is damage to the PCUs or hydraulic tubing caused by the loss of a flaperon. The hydraulic fuses and check valves for the left and right hydraulic system are near the left flaperon. The fuse and check valve for the center hydraulic system are near the right flaperon.

Training Information Point

The head end bearing assembly stays in place when you remove and install the flaperon PCU.

Installation of the PCUs is with the control modules facing each other. One PCU is up-side-down in relation to its adjacent PCU.

During the adjustment of the flaperon surface, it is necessary to adjust the actuator null LVDT. Remove the LVDT access cover to adjust the LVDT.



27-11-00-016 Rev 3

AILERON AND FLAPERON CONTROL - FLAPERON PCU - LOCATION

AILERON AND FLAPERON CONTROL - FLAPERON PCU - PHYSICAL DESCRIPTION

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AILERON AND FLAPERON CONTROL - FLAPERON PCU - PHYSICAL DESCRIPTION

Physical Description

All four flaperon PCUs are identical. Each flaperon PCU weighs approximately 43 lb (19 kg).

The flaperon PCU contains a hydraulic actuator with a control module. The control module contains:

- An electrohydraulic servo valve (EHSV)
- A bypass solenoid valve
- A mode selector valve
- A differential pressure sensor
- Two relief valves
- An inlet check valve
- An inlet filter.

Hydraulic Actuator

The actuator piston has an LVDT that sends position feedback signals to the ACE. The actuator piston also has a null LVDT to adjust the null position of the actuator during adjustment of the flaperon surface.

EHSV

The EHSV controls the hydraulic power to the extend and retract sides of the actuator. The EHSV has an LVDT that sends EHSV position feedback signals to the ACE.

Bypass Solenoid Valve

The bypass solenoid valve controls the pilot pressure from the hydraulic system to the mode selector valve.

Mode Selector Valve

Pilot pressure from the bypass solenoid valve commands the mode selector valve in one of two positions:

- Normal
- Bypass.

Differential Pressure Sensor

The differential pressure sensor measures the pressure difference across the actuator piston. The sensor operates an LVDT which sends signals to the ACE.

Relief Valves

The two relief valves protect the actuator from high pressure due to thermal effects or excessive loading conditions.

Inlet Check Valve

The inlet check valves keeps the hydraulic fluid in the actuator when the hydraulic system experiences pressure fluctuations due to system demands.

Inlet Filter

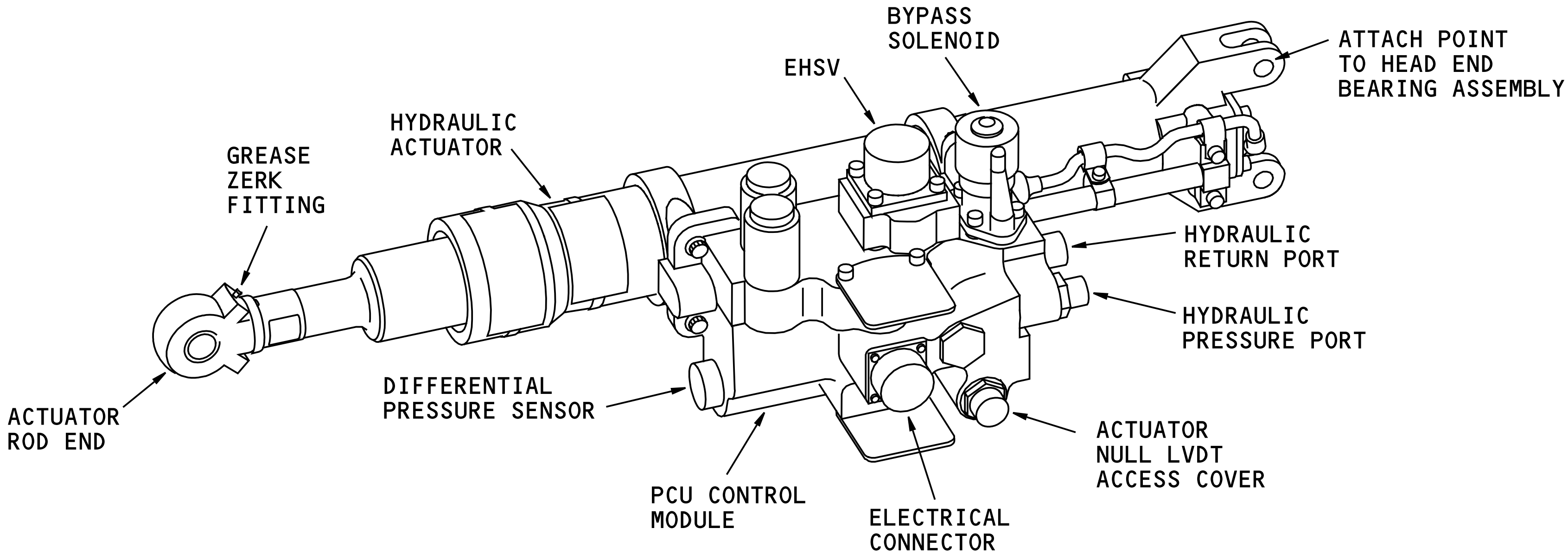
The inlet filter protects the actuator from solids in the hydraulic fluid.

AILERON AND FLAPERON CONTROL - FLAPERON PCU - PHYSICAL DESCRIPTION

Training Information Point

Only the bearing in the actuator rod end, where it attaches to the flaperon, requires lubrication.

All the other bearings are teflon coated. They do not require lubrication.



27-11-00-017 Rev 2

AILERON AND FLAPERON CONTROL - FLAPERON PCU - PHYSICAL DESCRIPTION

AILERON AND FLAPERON CONTROL - FLAPERON PCU - FUNCTIONAL DESCRIPTION

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AILERON AND FLAPERON CONTROL - FLAPERON PCU - FUNCTIONAL DESCRIPTION

General

The flaperon PCU operates in two different modes:

- Normal
- Bypass.

In normal mode, the ACE energizes the bypass solenoid valve.

In bypass mode, the ACE de-energizes the bypass solenoid valve.

PCU Operational Matrix

The table below shows the conditions of the PCU bypass valve in the two modes of operation.

VALVE CONDITIONS	PCU MODES OF OPERATION	
	NORMAL	BYPASS
BYPASS SOLENOID	E	D
LEGEND: E = ENERGIZED	D = DE-ENERGIZED	

Normal Mode

The PCU is in normal mode when the ACE energizes the bypass solenoid valve.

Hydraulic system pressure moves the mode selector valve to the normal position. Under these conditions, an electrical command from the ACE to the EHSV results in the actuator extension or retraction.

Bypass Mode

The PCU is in bypass mode when the ACE de-energizes the bypass solenoid. This happens when there is a single hydraulic or electrical failure on the PCU.

The bypass solenoid valve blocks pressure to the mode selector valve which moves to the bypass position.

Under these conditions, the mode selector valve blocks control pressure from the EHSV to the actuator cylinder. It also permits free hydraulic flow between both sides of the failed PCU and the return line. The adjacent PCU controls the flaperon movement and backdrives the failed PCU.

If both PCUs of the same flaperon are in bypass mode, the flaperon can move freely in both directions. In flight, the airloads then cause the flaperon to move up a maximum of 10 degrees.

When the airplane has no power on the ground, the weight of the flaperon causes it to slowly move down to the actuator stop.

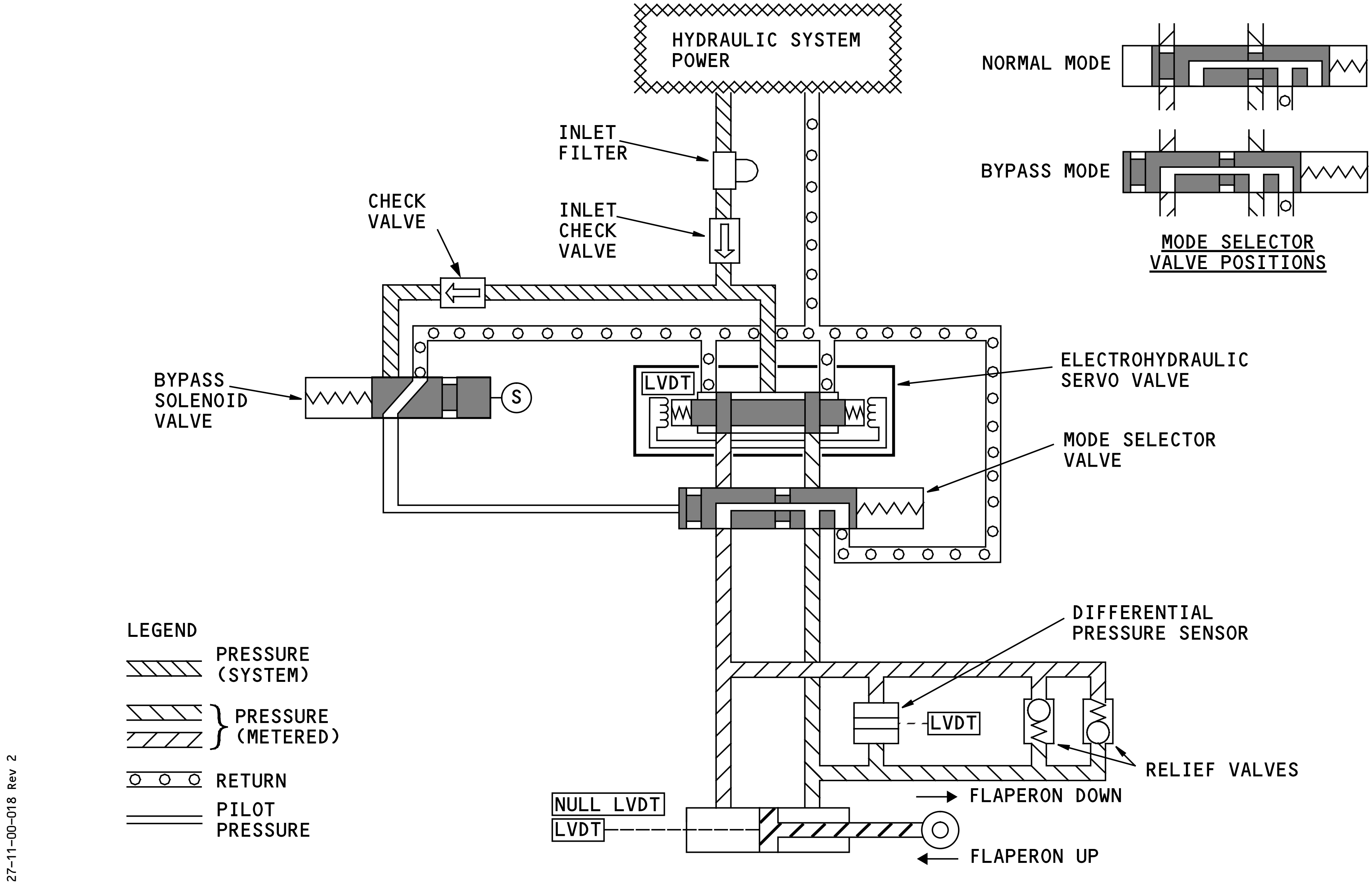
Indications

The EICAS status message ACTUATOR PRESS SNSR shows when the differential pressure sensor on one of the flaperon

AILERON AND FLAPERON CONTROL - FLAPERON PCU - FUNCTIONAL DESCRIPTION

PCUs is defective. The rudder also uses the same message.

The status message FLIGHT CONTROL SYS shows on the status display when one or more flaperon actuator is failed or the actuator confidence test has failed.



AILERON AND FLAPERON CONTROL - FLAPERON PCU - FUNCTIONAL DESCRIPTION

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AILERON AND FLAPERON CONTROL - AILERON AND FLAPERON PCU - PCU MODES

General

The PFCs and the ACEs control the mode of operation of the aileron PCUs. The ACEs control the bypass solenoid of the PCUs. The PFC sends commands to the ACEs to control the blocking solenoids in all three PFCS modes.

The ACEs control the mode of operation of the flaperon PCUs.

Aileron PCU Modes

The aileron PCU has three modes:

- Normal
- Bypass
- Blocking/Damped.

The aileron PCU is in the normal mode when there is no failure in the PCU and there is no failure in its on-side ACE. In the normal mode, the ACE energizes the bypass and blocking solenoids below cruise speed. At or above cruise speed, the ailerons are locked out. The ACEs keep the bypass solenoid energized but the PFCs send a command to de-energize the blocking solenoid on all the PCUs. The PCUs are still in the normal mode.

The aileron PCU is in the bypass mode when there is an electrical or hydraulic failure with the PCU or its ACE during flight below cruise speed. The ACE then de-energizes the bypass solenoid. The adjacent PCU, still in the normal mode, moves the aileron and backdrives the failed PCU. If both PCUs on the same aileron are in the bypass mode during flight, the aerodynamic lift moves the aileron trailing edge by about 15 degrees up from the faired position.

The aileron PCU is in the blocking/damped mode when there is a failure with the PCU or its ACE during flight at or above cruise speed. The ACE de-energizes the bypass solenoid of the PCU. The aileron lock out function of the PFC causes the ACEs to de-energize the blocking solenoid of all the PCUs. Under these conditions, the failed PCU is in the blocking/damped mode while the other PCUs are locked out in the normal mode. If both PCUs on the same aileron are in the blocking/damped mode, the aerodynamic lift cannot move the aileron up.

If there is a loss of the center and left hydraulic system power during the time the ailerons are locked out, the PFCs send a command signal to the ACEs to keep the blocking solenoids de-energized. All the ailerons PCUs stay in the blocking/damped mode. This prevents the sudden aileron upfloat and undesired roll of the airplane when the ailerons unlock later in the flight.

On the ground, with no electrical or hydraulic power on the aileron PCUs, the PCUs are in the blocking/damped mode. The aileron cannot move up but it can move down with an outside force.

Flaperon PCU Modes

The flaperon PCUs operate in two modes:

- Normal
- Bypass.

The flaperon PCU is in the normal mode when there is no failure in the PCU or its ACE. The ACE then energizes the bypass solenoid.

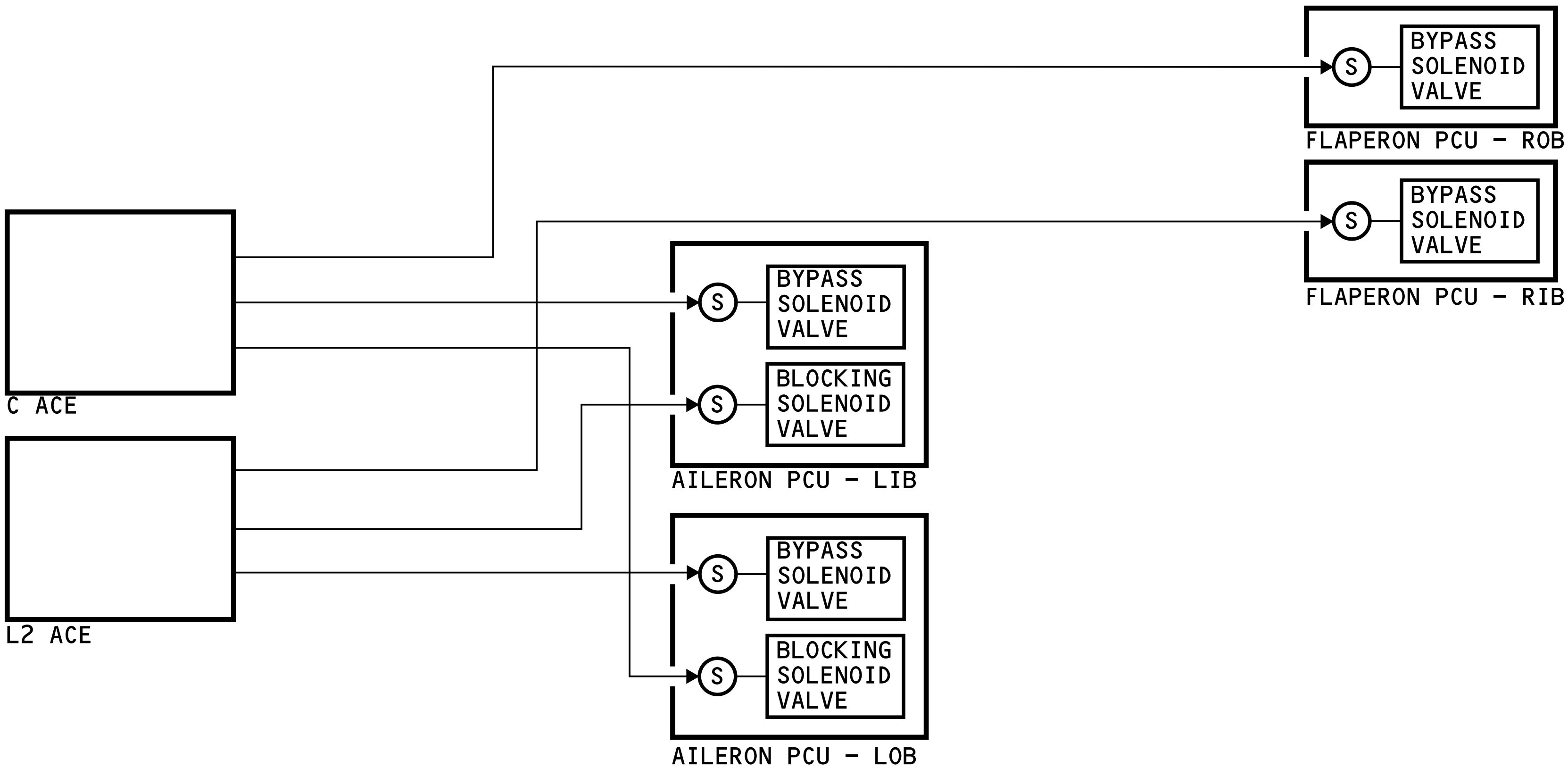
The flaperon PCU is in the bypass mode when there is an electrical or hydraulic failure with the PCU or its ACE. The ACE then de-energizes the bypass solenoid. If both PCUs on a flaperon are in the bypass mode, the flaperon can move freely. In flight, the aerodynamic lift then causes the flaperon to move 10 degrees up from the faired position.

When the airplane is on the ground with airspeed less than 85 knots and at least one engine running near takeoff thrust, the flaperon bypass logic of the PFC normal mode operates. This function sends a command signal to the ACEs to put all the flaperon PCUs in the bypass mode. At low airspeed, the weight of the flaperon causes the flaperons to droop. Also, the flaperons can possibly flutter. As the airspeed increases, the airloads gradually float the flaperons to the neutral position.

When the airspeed is approximately 100 knots, the PFCs send a command signal to the ACEs to put all the flaperon PCUs in the normal mode. The PFCs then send commands to the ACEs to gradually move the flaperons to the drooped position.

<u>Training Information Point</u>

During an engine test run on the ground with thrust near takeoff level, the flaperon behind the engine can possibly flutter. This is a usual condition.



27-11-00-029 Rev 4 06/26/96

AILERON AND FLAPERON CONTROL - AILERON AND FLAPERON PCU - PCU MODES

AILERON AND FLAPERON CONTROL - AILERON SURFACES

Purpose

The ailerons have two purposes. The ailerons supply low speed roll control of the airplane. The flaperons and the flight spoilers help this function. Ailerons also move down (droop) to supplement the high lift system.

Physical Description

The ailerons are light weight composite materials structures. The skin is reinforced graphite/epoxy bonded to a core of Nomex honeycomb. The overall dimensions are approximately 27 in by 259 in (0.7 m x 6.6 m). Each aileron weighs 165 lb (75 kg).

Two adjustable tungsten balance weights prevent flutter if hydraulic power is lost. The aileron attaches to the outboard rear spar with 6 hinges. Jumpers and static dischargers supply electrostatic protection to airplane systems.

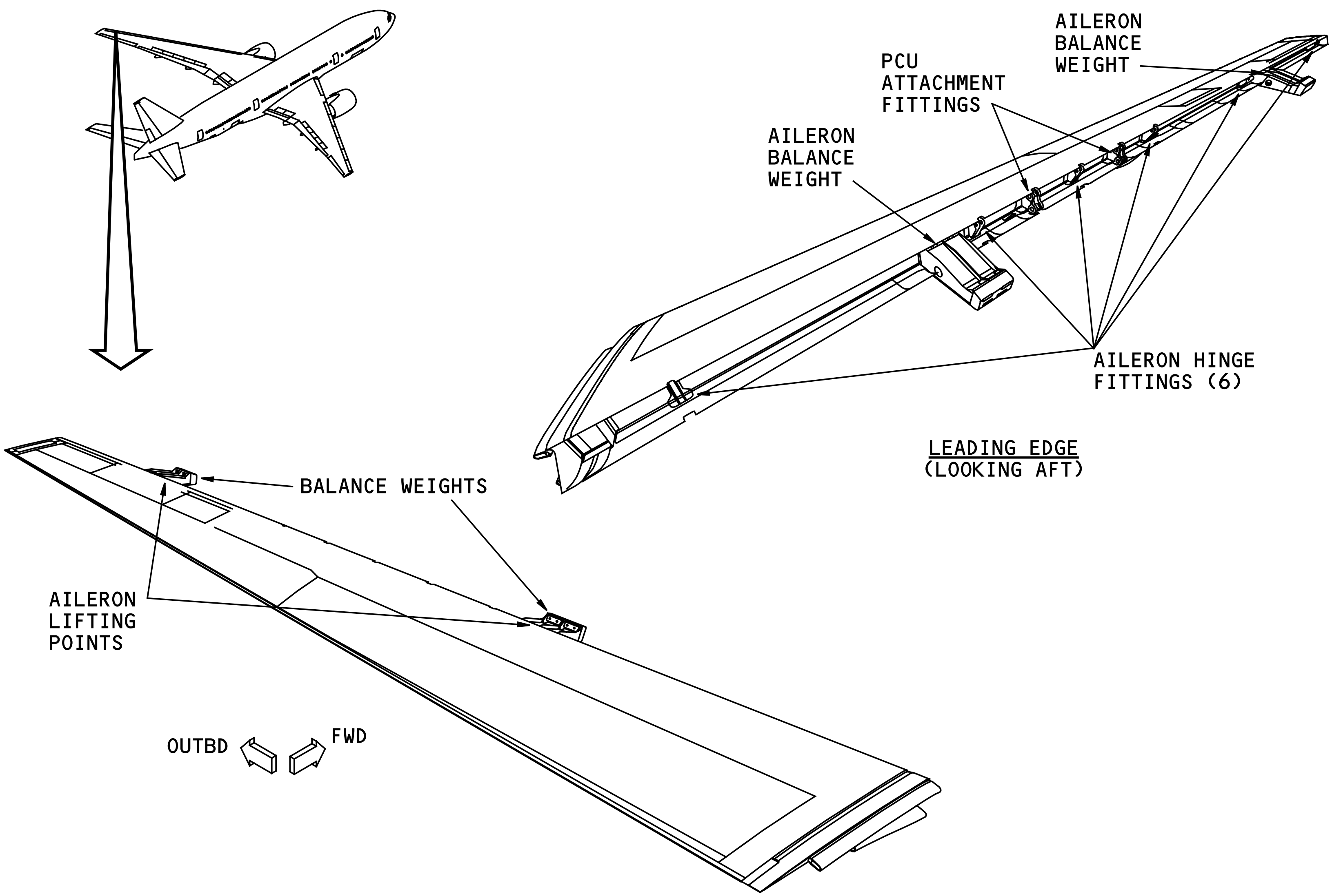
Functional Description

The aileron surface deflection limits are at the PCU internal stops. The ailerons have a maximum movement of 33 degrees trailing edge up (TEU) and 19 degrees trailing edge down (TED) for conditions without loads. You measure the aileron movement in relation to the wing fixed trailing edge.

When there are loads, the maximum PFC and ACE command signals move the ailerons to a nominal position of 30 degrees TEU and 15 degrees TED. Aileron trim authority is 30 degrees of control wheel rotation. You adjust the aileron PCUs on the ground so the aileron control surfaces are about 2 degrees below the wing fixed trailing edge.

Training Information Point

Two hoist attach points are on the upper surface of the aileron front spar for aileron removal and installation.



27-11-00-019 Rev 3

AILERON AND FLAPERON CONTROL - AILERON SURFACES

AILERON AND FLAPERON CONTROL - FLAPERON SURFACES

Purpose

The flaperons have a dual purpose on the 777 airplane. First, flaperons supply roll control of the airplane, assisted by the ailerons and the flight spoilers. Second, flaperons move down (droop) to help the high lift system during takeoff, approach, and landing.

Physical Description

The flaperons are light weight composite materials structures. The skin is carbon fiber reinforced plastic bonded to a core of Nomex honeycomb. The overall dimensions are approximately 62 in by 95 in (1.6 m x 2.4 m). Each flaperon weighs about 110 lb (50 kg).

The flaperon attaches to the airplane structure with 2 hinges. An aluminum strip diverts lightning strikes on the flaperon trailing edge.

A cove lip door at the leading edge of the flaperon supplies a gap when the flaperon is full down to make aerodynamic performance better. The cove lip door attaches to the airplane structure and to the flaperon with two main hinge fittings.

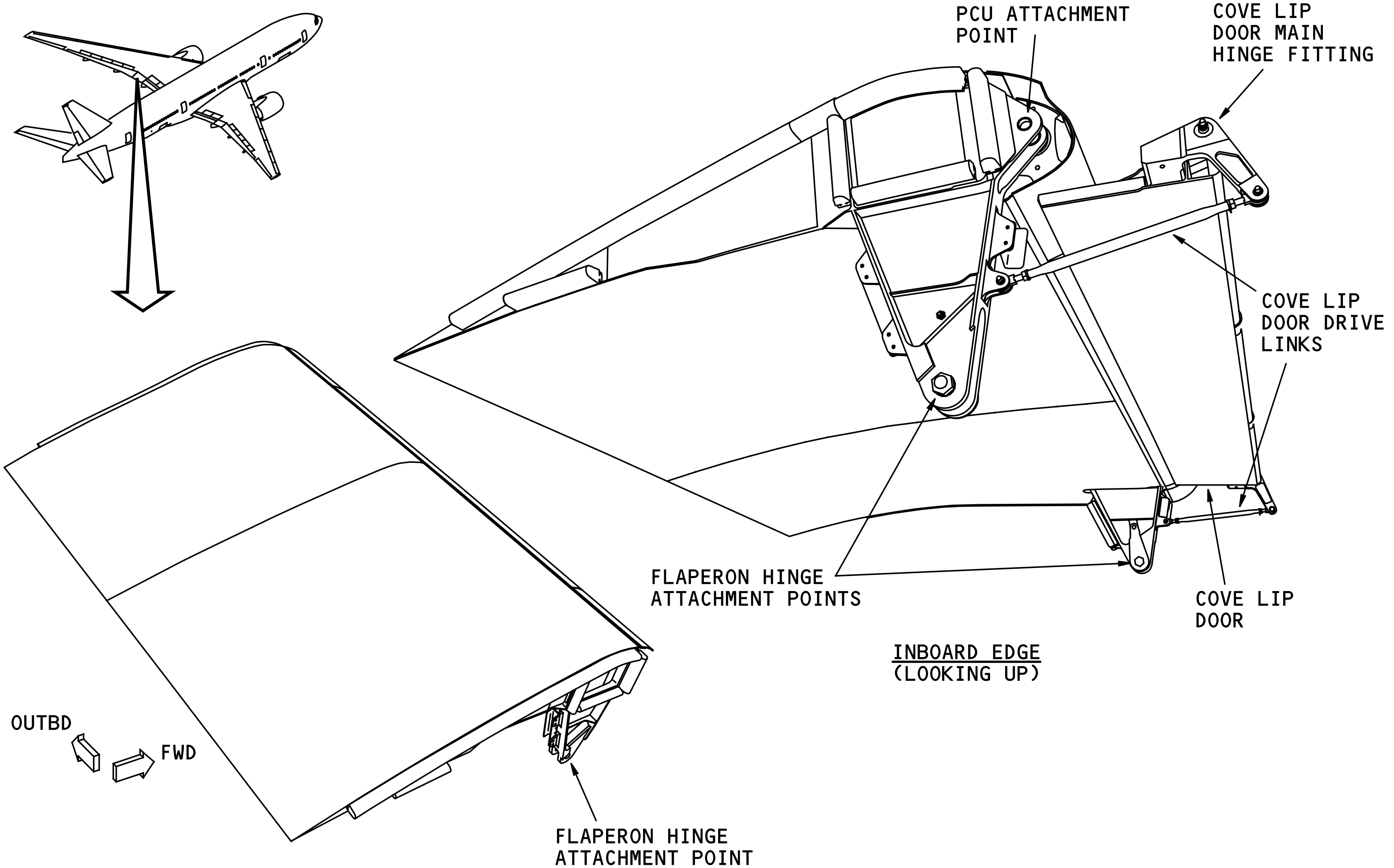
Functional Description

When the flaperon moves down, a mechanical linkage pulls the drive link attachment point of the fitting aft. This rotates the cove lip door up, which supplies a gap along the leading edge of the flaperon.

The flaperon surface deflection limits are at the PCU internal stops. The flaperons have a maximum movement of 11 degrees trailing edge up (TEU) and 37 degrees trailing edge down (TED) for conditions without loads. When there are loads, the maximum PFC and ACE command signals move the flaperons to a nominal position of 10 degrees TEU and 30 degrees TED.

Training Information Point

The flaperon PCU attachment fittings supply lifting points for the flaperons.



27-11-00-020 Rev 2

AILERON AND FLAPERON CONTROL - FLAPERON SURFACES

AILERON AND FLAPERON CONTROL - FUNCTIONAL DESCRIPTION

General

The roll control system for the ailerons and flaperons uses input command signals from the wheel position transducers and the force transducer.

The ACEs receive the input signals and transmit them to the PFCs. The ACEs supply output command signals to the PCUs of the ailerons and the flaperons.

Wheel Position Transducers

The C ACE and R ACE each receive signals from two wheel position transducers. The L1 ACE and L2 ACE each receive signals from one wheel position transducer. After they change the signals to digital format, the ACEs send these signals to the PFCs.

Each PFC receives input signals from all six wheel position transducers. These signals come from the ACEs through the flight controls ARINC 629 buses. Each PFC selects which signal to process by mid-value selection and averaging.

Force Transducers

The two LVDTs of the wheel force transducer send signals to the L2 ACE and the C ACE. The ACEs transmit these signals to their on-side PFCs.

Aileron PCUs

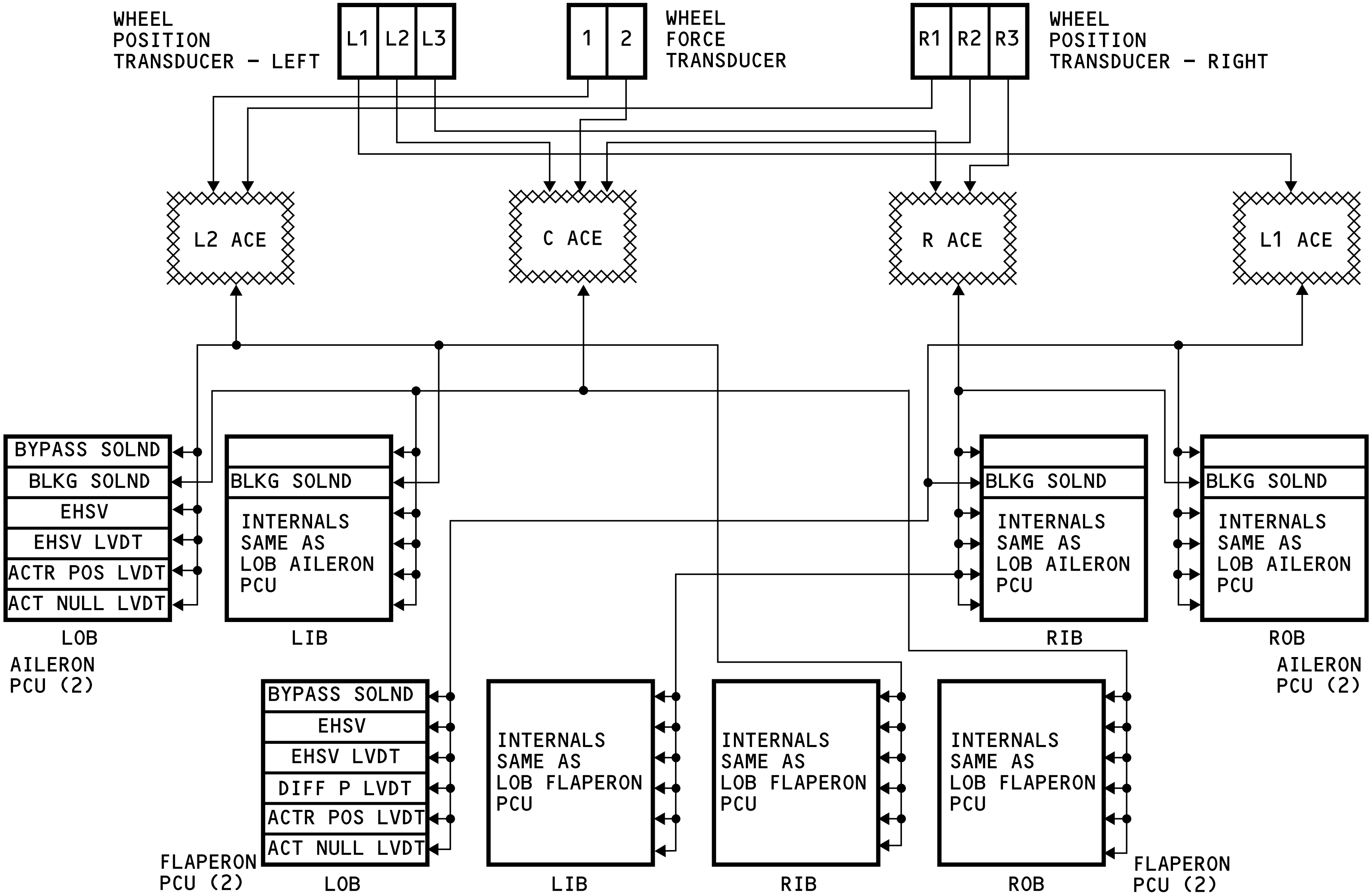
Each ACE sends output command signals to the two PCUs of the same aileron. Two output command signals go to the EHSV and the bypass solenoid of one PCU on the assigned aileron. Another output command signal goes to the blocking solenoid of the adjacent PCU on the same aileron. The PCU sends feedback signals to its assigned ACE from:

- The EHSV position LVDT
- The actuator piston position LVDT
- The actuator null LVDT.

Flaperon PCUs

Each ACE sends output command signals to one flaperon PCU. The output command signals go to the EHSV and the bypass solenoid. The PCU sends feedback signals to its assigned ACE from:

- The EHSV position LVDT
- The differential pressure LVDT
- The actuator piston position LVDT
- The actuator null LVDT.



AILERON AND FLAPERON CONTROL - FUNCTIONAL DESCRIPTION

AILERON AND FLAPERON CONTROL - FUNCTIONAL DESCRIPTION - ACE SERVO LOOP

General

The ACE contains a servo loop circuit to produce the command signals for the PCUs.

In normal and secondary mode, the PFC sends the command signals to the ACE. In direct mode the ACE calculates the command signals.

Servo Loop Operation

The ACEs use the aileron and flaperon command signals through a servo loop. The command signals then go to the EHSV of the PCUs. The ACEs also use the command signals to monitor for failures.

The movement of the EHSV sends hydraulic pressure to extend or retract the actuator.

The EHSV LVDT measures the movement of the EHSV and supplies a feedback signal to the ACEs. The ACEs use this feedback signal in the failure monitor.

The actuator position LVDT measures the movement of the actuator and supplies a feedback signal to the ACEs through the actuator null LVDT.

The actuator null LVDT is in series with the actuator position LVDT. The actuator null LVDT modifies the signal from the actuator position LVDT.

The actuator position LVDT supplies a feedback signal to the ACEs to close the servo loop. The ACEs use this feedback signal to monitor for failure. The signal also goes to the PFC.

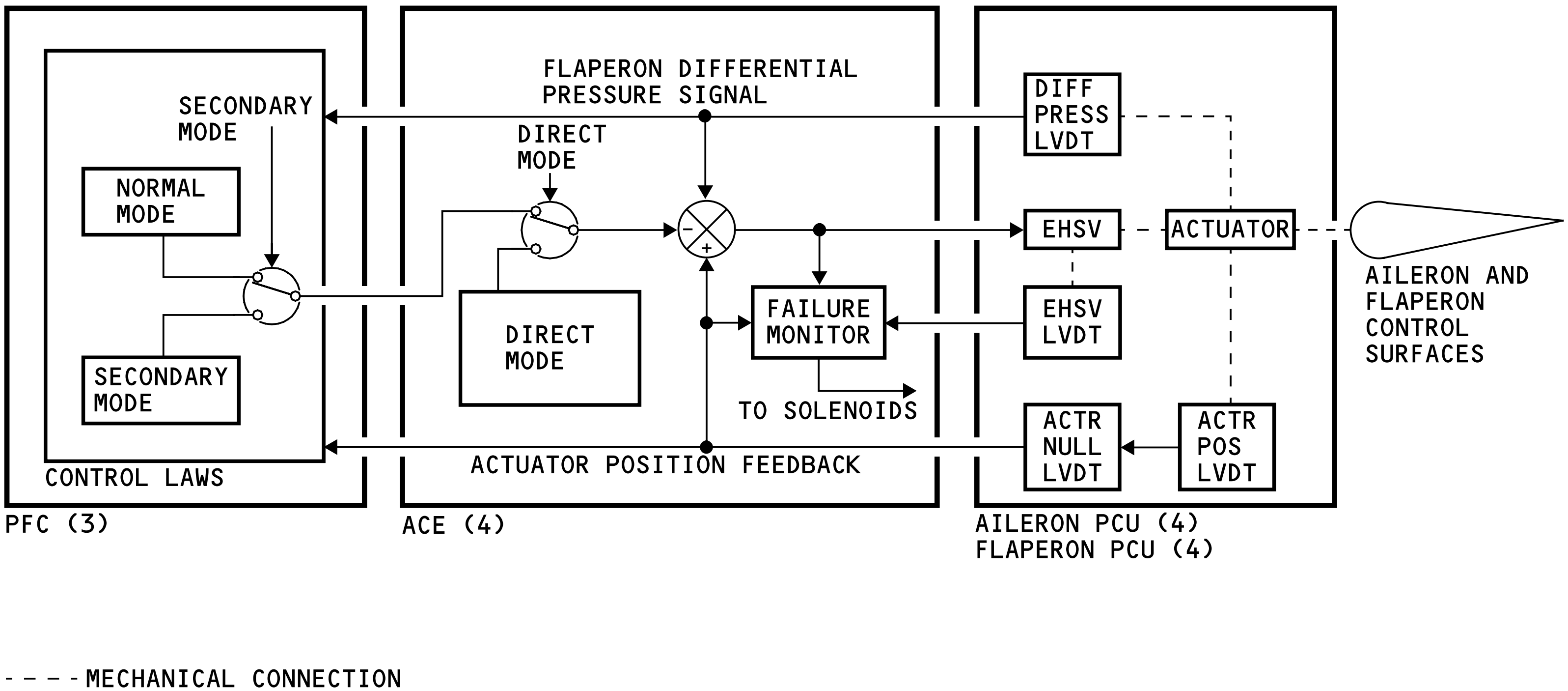
On the flaperon PCUs only, a differential pressure LVDT measures the differential pressure across the actuator piston. The signal from the differential pressure LVDT goes to the ACEs for the servo loop. The signal also goes to the PFCs for force fight equalization.

Failure Monitor

The ACE has a failure monitor to do a check of the correct operation of the PCU. The monitor uses the ACE command signal and the feedback signals from the EHSV LVDT and the actuator LVDT. When the failure monitor finds a fault with the PCU or the ACE, it de-energizes the bypass solenoid of the PCU.

Training Information Point

After installation of the aileron or the flaperon PCU, you do a MAT test and adjust the actuator null LVDT to have the control surface at the rig position.



27-11-00-022 Rev 5 01/08/96

AILERON AND FLAPERON CONTROL - FUNCTIONAL DESCRIPTION - ACE SERVO LOOP

AILERON AND FLAPERON CONTROL - AILERON AND FLAPERON DROOP

Purpose

The ailerons and flaperons of both wings move down (droop) to help the high lift system when the flaps are extended. When drooped, the ailerons and flaperons still operate for roll control.

Functional Description

The PFCs and the ACEs command the ailerons and flaperons to droop based on the flap position.

Both ailerons and flaperons droop in normal mode of operation of the PFCS. Only the flaperons droop in secondary and direct mode.

Normal Mode

In normal mode, the ailerons droop at a different rate and schedule than the flaperons.

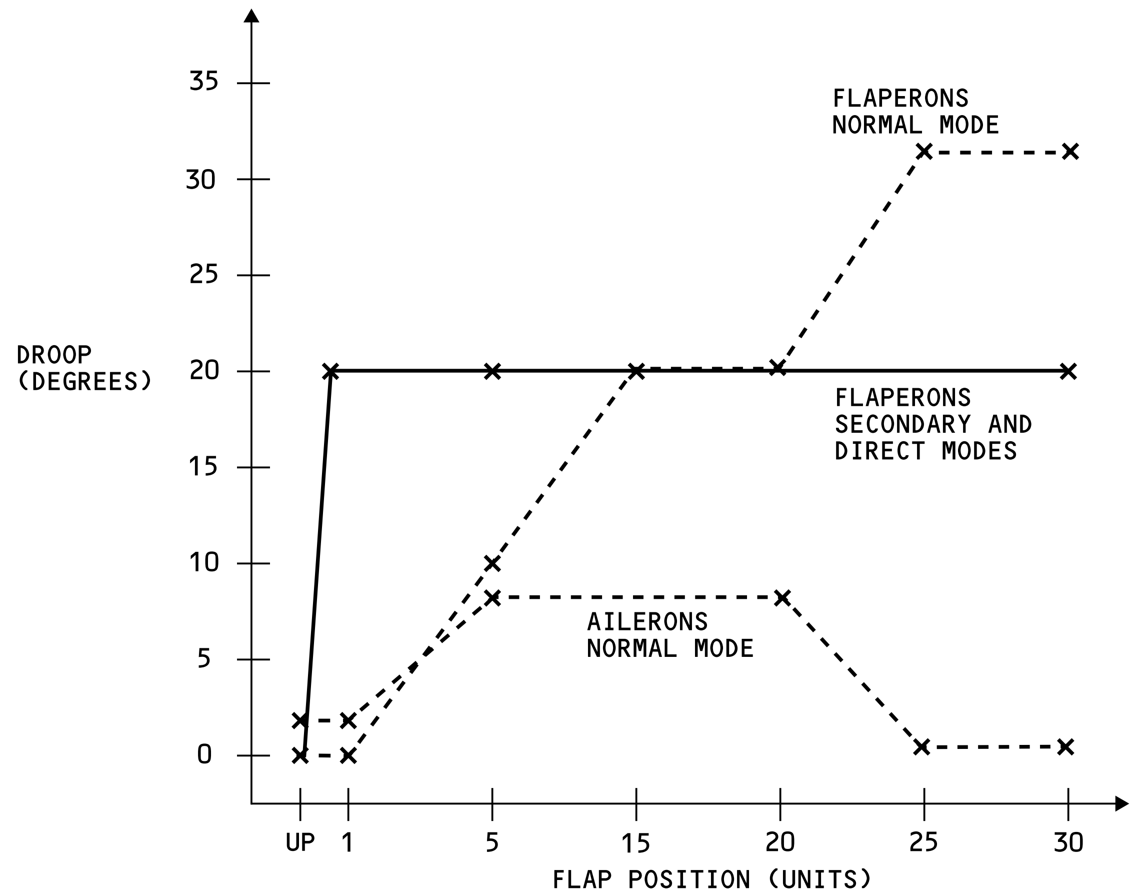
When the flaps are retracted, the ailerons are at the 2 degrees TED rig position in relation to the wing fixed trailing edge. With the flaps at the takeoff position (5 to 20), the ailerons droop by 8 degrees TED. With the flaps at the landing position (25 and 30), the ailerons move to 0.6 degrees TED.

The flaperons droop to 10 degrees TED when the flaps are at the 5 position. They droop to 20 degrees TED when the flaps are at the 15 or 20 position. They droop to 31 degrees TED when the flaps are at the landing position (25 or 30).

On the ground, the PFCs remove the flaperon droop command in proportion to the speedbrake lever movement from 17 to 55 degrees. When the speedbrake lever goes back to the DOWN position, the flaperons gradually droop to the position commanded by the flaps.

Secondary and Direct Modes

In the secondary and direct modes, the flaperons droop to a constant value of 20 degrees when the flaps and slats are not retracted. The ailerons do not droop.



27-11-00-026 Rev 3 03/04/1997

AILERON AND FLAPERON CONTROL - AILERON AND FLAPERON DROOP

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AILERON AND FLAPERON CONTROL - BANK ANGLE PROTECTION

Purpose

The bank angle protection (BAP) function of the PFC helps prevent the airplane from rolling to large bank angles. However, the pilot can always override the control wheel forces and remain in full control of roll.

Functional Description

When the bank angle exceeds the nominal value of 35 degrees, BAP increases the control wheel force to the pilot.

BAP operates only in PFCS normal mode and is available in both manual operation and in autopilot.

When the BAP function is active, the ELMS prevents the operation of the aileron trim.

BAP does not operate when the pitch attitude is more than 75 degrees (positive or negative). When the airspeed is between the maximum operating speed (Vmo/Mmo) and the maximum design dive speed (Vdive/Mdive), the BAP roll activation value decreases linearly from 35 to 20 degrees.

Manual Operation

The PFCs calculate backdrive actuator commands based on:

- Roll attitude
- Roll rate
- Mach number
- Computed airspeed
- Pitch attitude
- Wheel force.

When the bank angle is more than 35 degrees, the PFC BAP function sends a backdrive command to the AFDCs. The AFDCs send this command to one of the wheel backdrive actuators. The actuator motor applies a torque to turn the control wheels proportionally as the bank angle increases from 35 to 60 degrees.

If the pilot does not move the control wheel, the backdrive actuator moves the control wheels in the opposite direction to the airplane bank. This decreases the airplane bank to 30 degrees. BAP automatically disengages when the bank angle is less than 35 degrees and the pilot takes control of the wheel.

If the pilot wants to maintain or increase the bank angle more than 35 degrees, the pilot must apply a force to the control wheels to override the torque of the backdrive actuator. The wheel force transducer senses the pilot override force and sends a signal to the PFCs. The PFCs use this signal to limit the torque of the backdrive actuator and the force at the control wheels.

Autopilot Operation

In autopilot operation, the BAP function becomes active when the bank angle is more than 35 degrees or the roll rate is more than 15 degrees per second. BAP stops the autopilot roll commands and takes over control of the roll.

The PFC BAP function sends a backdrive command through the AFDCs to one of the wheel backdrive actuators. The backdrive actuator moves the control wheels to decrease the airplane bank below 35 degrees. When the airplane bank is at 35 degrees and the autopilot requests to engage roll control, BAP becomes inactive and returns roll control to the autopilot.

Indications

Indications for BAP are shown on the:

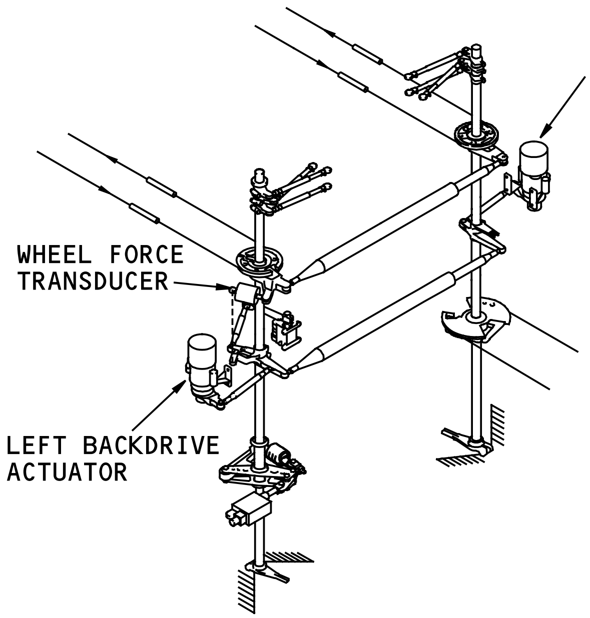
- Multi-function display (MFD) status display
- Primary flight display (PFD)
- Flight control maintenance page.

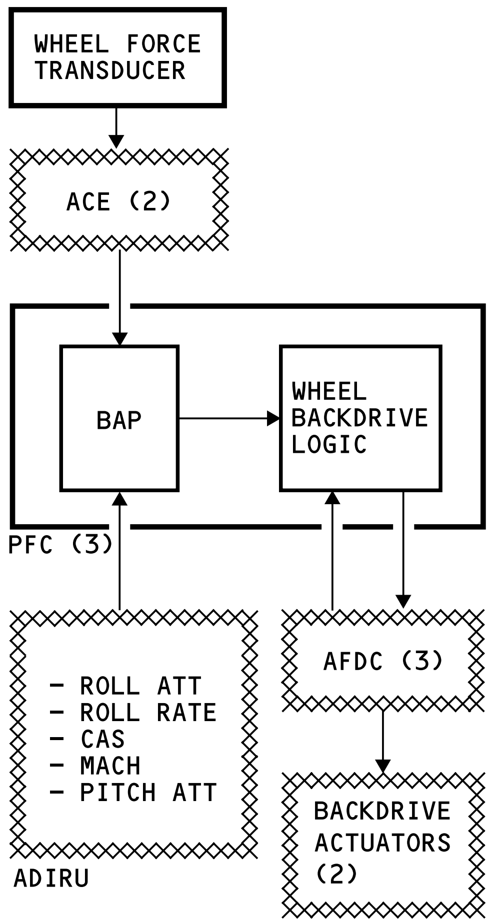
On the MFD format, the status message BANK ANGLE PROTECT indicates one of these faults:

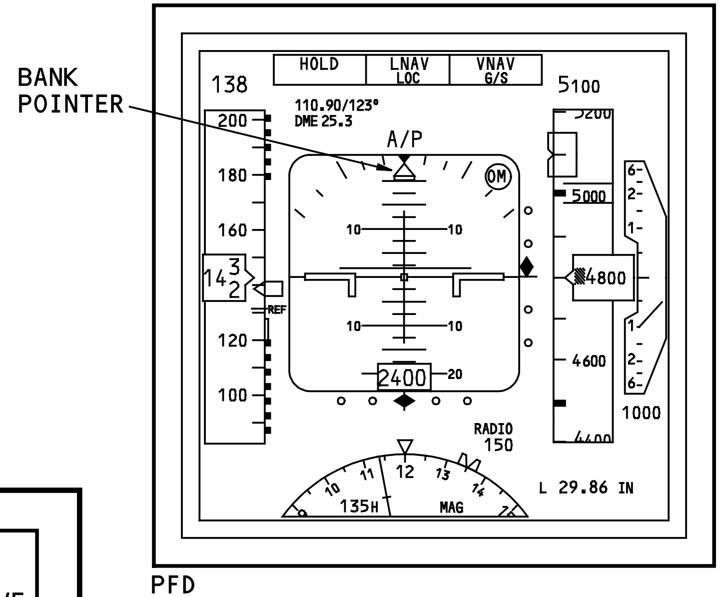
- Both wheel backdrive actuators are defective
- The wheel force transducer is defective
- The right and left AFDCs are inoperative.

On the PFD, the bank pointer changes to amber when the bank angle is 35 degrees or more.

Page 1 of the flight control maintenance pages has a protection mode activity which shows when BAP is active.







AILERON AND FLAPERON CONTROL - BANK ANGLE PROTECTION

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SPOILER AND SPEEDBRAKE CONTROL - INTRODUCTION

General

The spoilers help the ailerons and flaperons control airplane roll about the longitudinal axis. They also supply speedbrake control to reduce lift and increase drag for descent and landing.

There are seven spoilers on each wing. The five outboard spoilers are forward of the outboard flap. The two inboard spoilers are forward of the inboard flap.

Each spoiler has an assigned number, from left to right, of 1 through 14. Each spoiler is part of a symmetrical pair, for example, spoiler pair 4 and 11. One ACE and one hydraulic source control a pair.

Roll Control

During roll control, the spoilers on one wing move up and the spoilers on the other wing stay down.

The pilots manually control roll with the rotation of the control wheels. When engaged, the autopilot automatically commands the spoilers. During autopilot operation, the backdrive actuators backdrive the control wheels.

In roll control, all spoilers except for 4 and 11, are fly-by-wire. Spoilers 4 and 11 receive mechanical signals for roll control.

Spoiler Lockout

Symmetrical spoiler pairs fair and lock out if one actuator in the pair fails. Spoilers 5 and 10 fair and lock out as a function of altitude and airspeed.

Speedbrake Control

During speedbrake control, the spoilers on both wings move symmetrically.

The pilots manually command speed brake control with a conventional speedbrake lever on the aisle stand. The autopilot does not control the speedbrake function.

In speedbrake control, all spoilers are fly-by-wire, including spoilers 4 and 11.

Auto Speedbrake Control

The auto speedbrake system supplies automatic extension or retraction of the speedbrakes during landings and refused takeoffs.

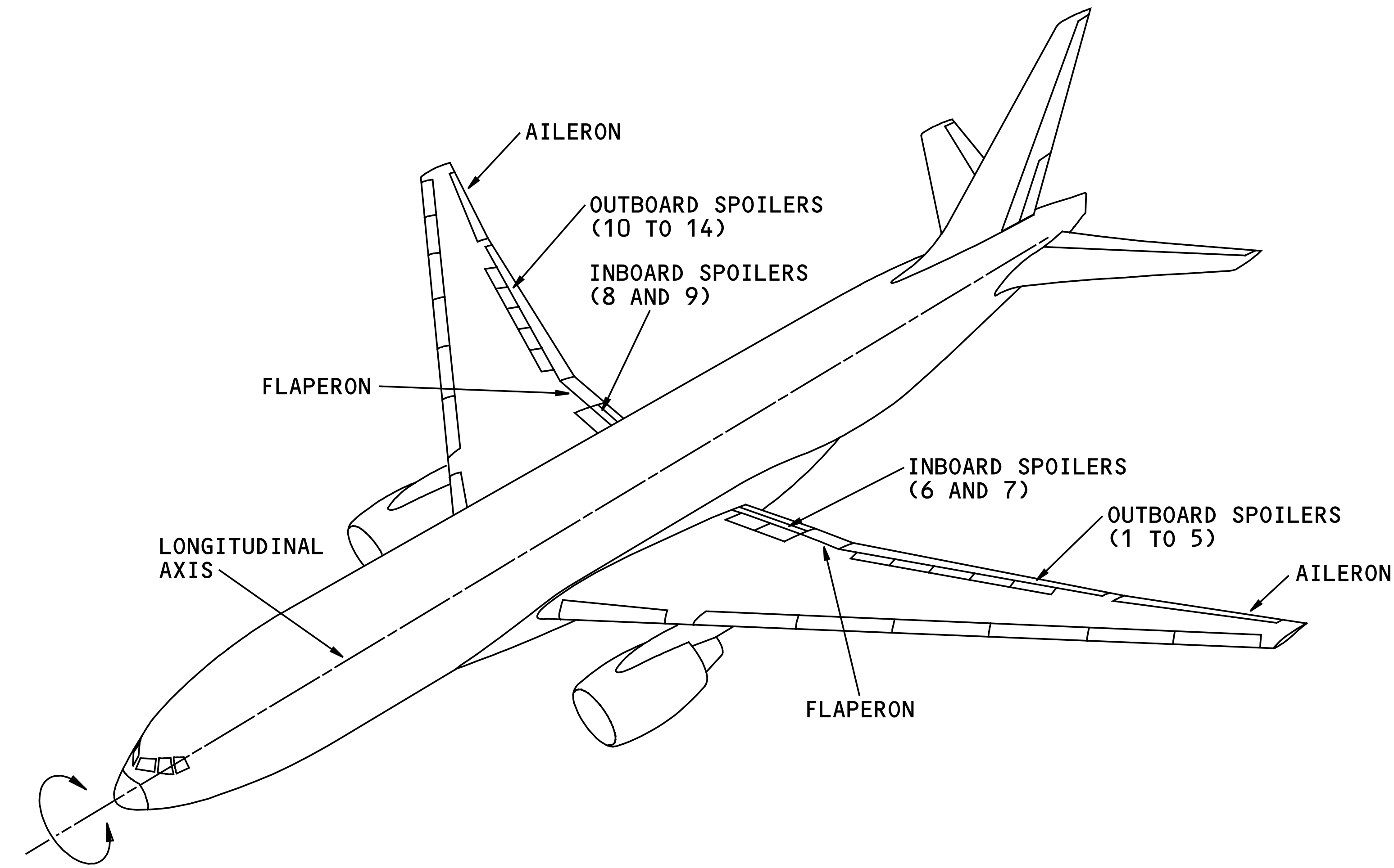
To arm the system, the pilots must either place the speedbrake lever in the armed position or command reverse thrust.

See the auto speedbrake control section for more information (AMM PART I 27-62).

SPOILER AND SPEEDBRAKE CONTROL - INTRODUCTION

Abbreviations and Acronyms

- ACE - actuator control electronics
- ADIRS - air data inertial reference system
- ADIRU - air data inertial reference unit
- AFDC - autopilot flight director computer
- AFDS - autopilot flight director system
- AIMS - airplane information management system
- ARINC - Aeronautical Radio, Inc.
- BAP - bank angle protection
- B/D - backdrive
- CAS - computed airspeed
- CMCS - central maintenance computing system
- EHSV - electrohydraulic servo valve
- EICAS - engine indication and crew alerting system
- FMCS - flight management computer system
- FSEU - flap/slat electronics unit
- IB - inboard
- LIB - left inboard
- LOB - left outboard
- LRU - line replaceable unit
- LVDT - linear variable differential transformer
- MCP - mode control panel
- MEC - main equipment center
- MFD - multi-function display
- OB - outboard
- PCU - power control unit
- PFC - primary flight computer
- PFCS - primary flight control system
- PFD - primary flight display
- RBL - right buttock line
- RIB - right inboard
- ROB - right outboard
- RTO - refused takeoff
- RVDT - rotary variable differential transformer
- SOV - shutoff valve
- TEU - trailing edge up



27-61-00-001 Rev 6 03/04/1998

SPOILER AND SPEEDBRAKE CONTROL - INTRODUCTION

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SPOILER AND SPEEDBRAKE CONTROL - GENERAL DESCRIPTION

General

In roll control, the pilots manually command the spoilers and the autopilot automatically commands them. In speedbrake control, the pilots manually command the spoilers.

Roll Control - Manual Operation

The flight crew uses two conventional control wheels to control roll. All spoilers, except 4 and 11, have an electrical command path. Spoilers 4 and 11 have a mechanical command path in roll control.

Electrical Command Path

Six wheel position transducers change the flight crew control wheel commands to analog electrical signals. These signals go to the four actuator control electronics (ACEs). The ACEs change the signals to digital format and send them to the three primary flight computers (PFCs) through the flight controls ARINC 629 buses.

The PFCs use the control wheel position data, with data from the ADIRU and AIMS, to calculate control surface commands. The PFCs send the digital commands to the ACEs, which change them to analog signals. The ACEs send the analog position commands to the power control units (PCUs) which move the spoilers. The position transducers on the actuator pistons supply position feedback to the ACEs.

Mechanical Control Path

For spoilers 4 and 11, a cable system connects the control wheels to the spoiler PCUs. Cable movement supplies a mechanical input to the PCUs which move the spoilers. The movement of the PCU housing supplies mechanical position feedback.

Roll Control - Autopilot Operation

When engaged, the autopilot flight director computers (AFDCs) control the roll rate and attitude of the airplane. They supply roll commands to the PFCs through the flight controls ARINC 629 buses. The PFCs use these inputs to calculate position commands for the spoilers.

The PFCs also calculate wheel backdrive commands. The PFCs send these commands to the AFDCs, which calculate control wheel movement commands for the backdrive actuator. The backdrive actuator moves the control wheels the same amount as the pilot would move them manually for the same surface movement. This supplies the mechanical signal to move spoilers 4 and 11.

To override the autopilot, the flight crew applies more force on the control wheel than the backdrive actuator force.

Speedbrake Control

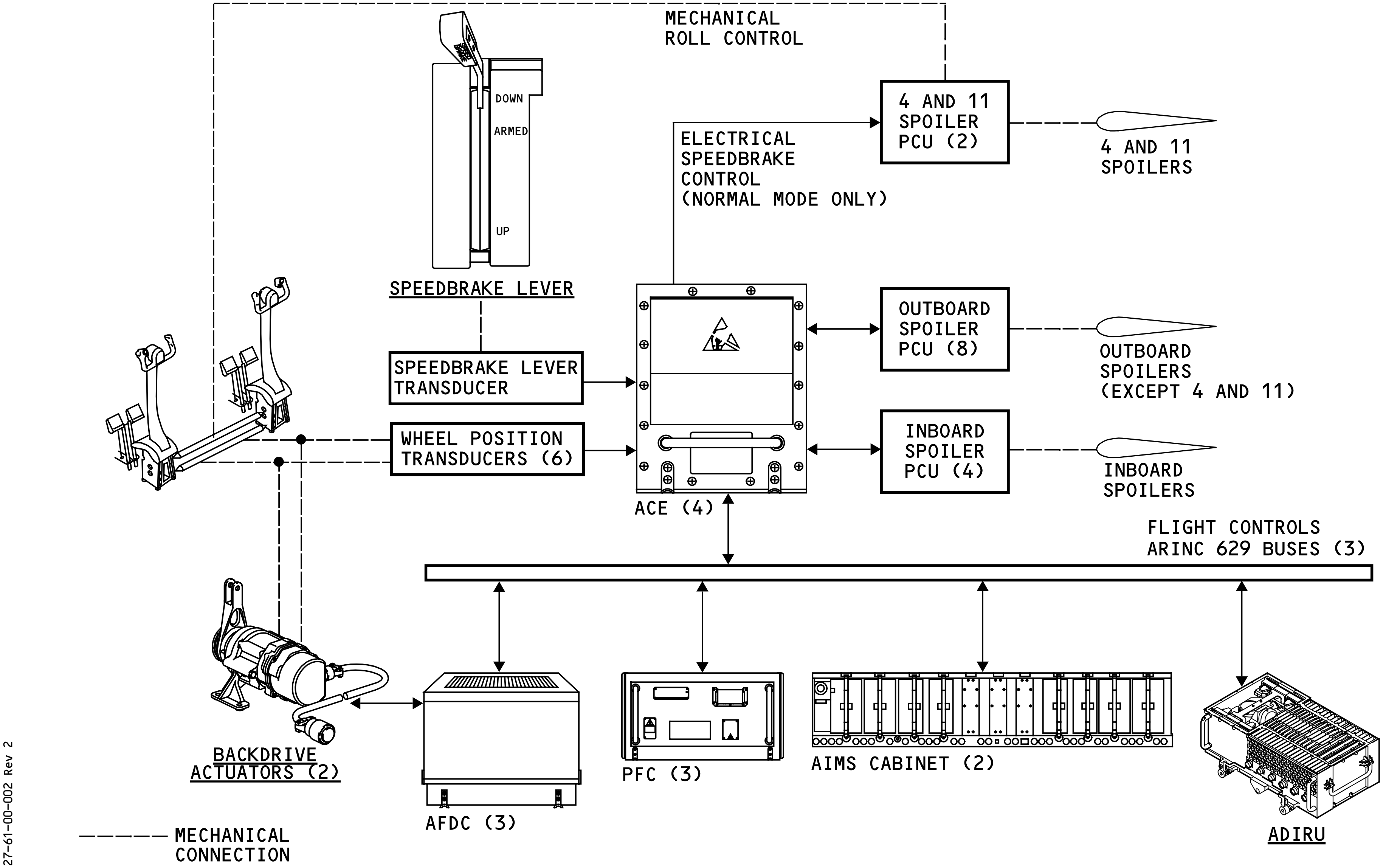
The speedbrake lever transducers change the speedbrake lever movements to analog electrical signals.

SPOILER AND SPEEDBRAKE CONTROL - GENERAL DESCRIPTION

These signals go to the four ACEs. The ACEs change the signals to digital format and send them to the three PFCs through the flight controls ARINC 629 buses.

The PFCs use the speedbrake lever position along with data from the ADIRU and AIMS, to calculate speedbrake commands. The PFCs mix these speedbrake commands with the spoiler roll commands. The PFCs send the mixed digital commands to the ACEs, which change them to analog signals. Except for spoilers 4 and 11, the ACEs send the analog position commands to the spoiler PCUs. The position transducers on the actuator pistons supply position feedback to the ACEs.

For spoilers 4 and 11, speedbrake control is only available in normal mode. When the pilot moves the speedbrake lever more than 54 degrees, the PFC commands the ACE to send an ON/OFF electrical signal to the two spoiler PCUs.



SPOILER AND SPEEDBRAKE CONTROL - GENERAL DESCRIPTION

SPOILER AND SPEEDBRAKE CONTROL - FLIGHT DECK COMPONENT LOCATIONS

General

Many spoiler and speedbrake control components are in the flight deck and below the flight deck floor.

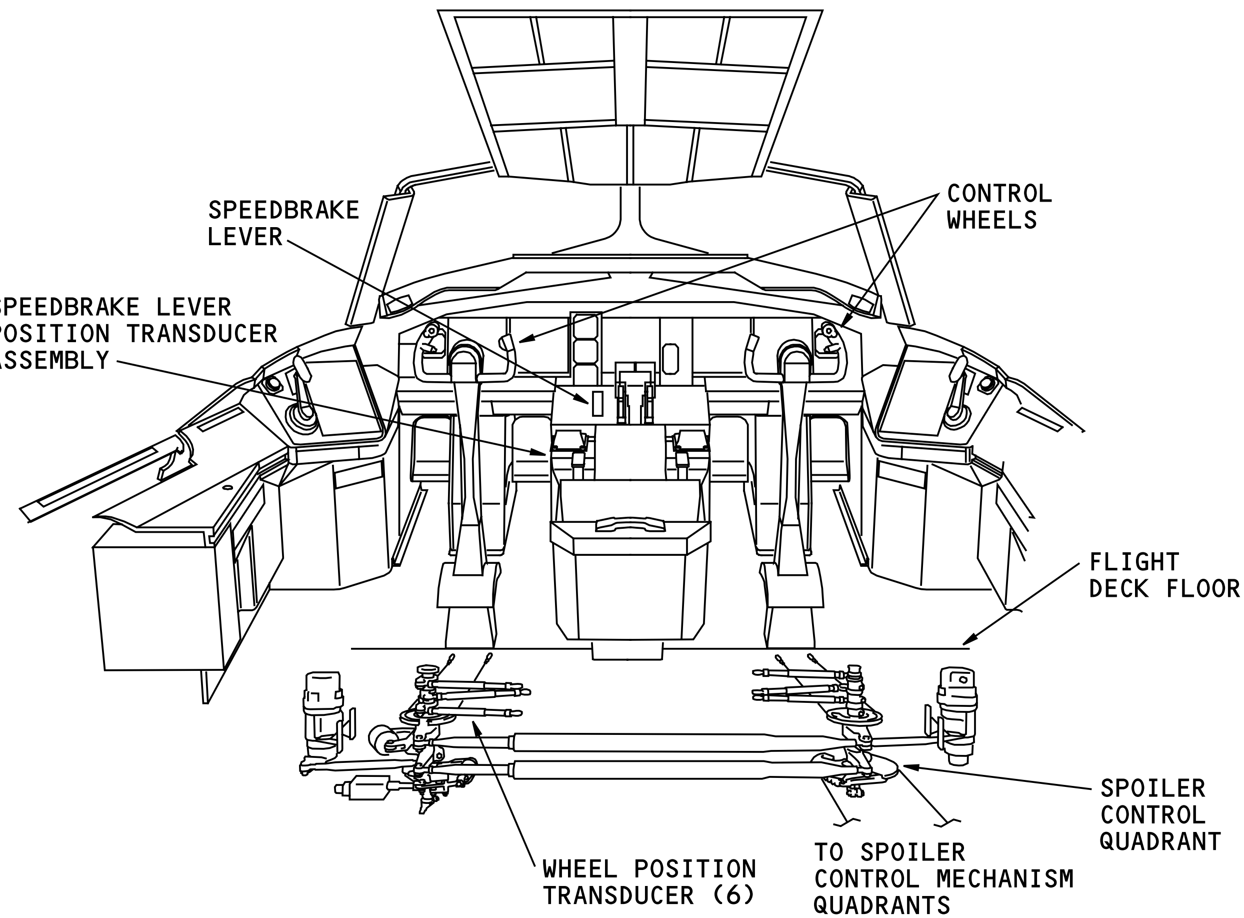
Flight Deck Components

The control wheels and speedbrake lever are in the flight deck. The speedbrake lever is on the captain's side of the control stand. The speedbrake lever transducer is in the control stand.

Components Below the Flight Deck

The spoiler forward controls are below the flight deck floor and above the nose gear wheel well. These include the wheel position transducers and the spoiler control quadrant.

Access to these components is by panels in the flight deck floor. Access is also through the main equipment center (MEC), and then forward along the nose gear wheel well.



27-61-00-003 Rev 2 01/08/96

SPOILER AND SPEEDBRAKE CONTROL - FLIGHT DECK COMPONENT LOCATIONS

SPOILER AND SPEEDBRAKE CONTROL - WING CENTER SECTION AND WING COMPONENT LOCATIONS

General

Several spoiler and speedbrake control components are in the wing center section and in the wings.

Wing Center Section Components

The control cables for spoilers 4 and 11 connect the forward quadrant to the spoiler control mechanism quadrants and to the spoiler PCU quadrants. The cables go below the flight deck and passenger compartment floor, along RBL 21, to the wing center section.

The spoiler control mechanism quadrants are in the wing center section of the airplane, above the slant pressure deck and below the passenger floor. The cables go from the control mechanism quadrants through the overwing floor beams, and out along the wing rear spar to the spoiler PCU quadrants.

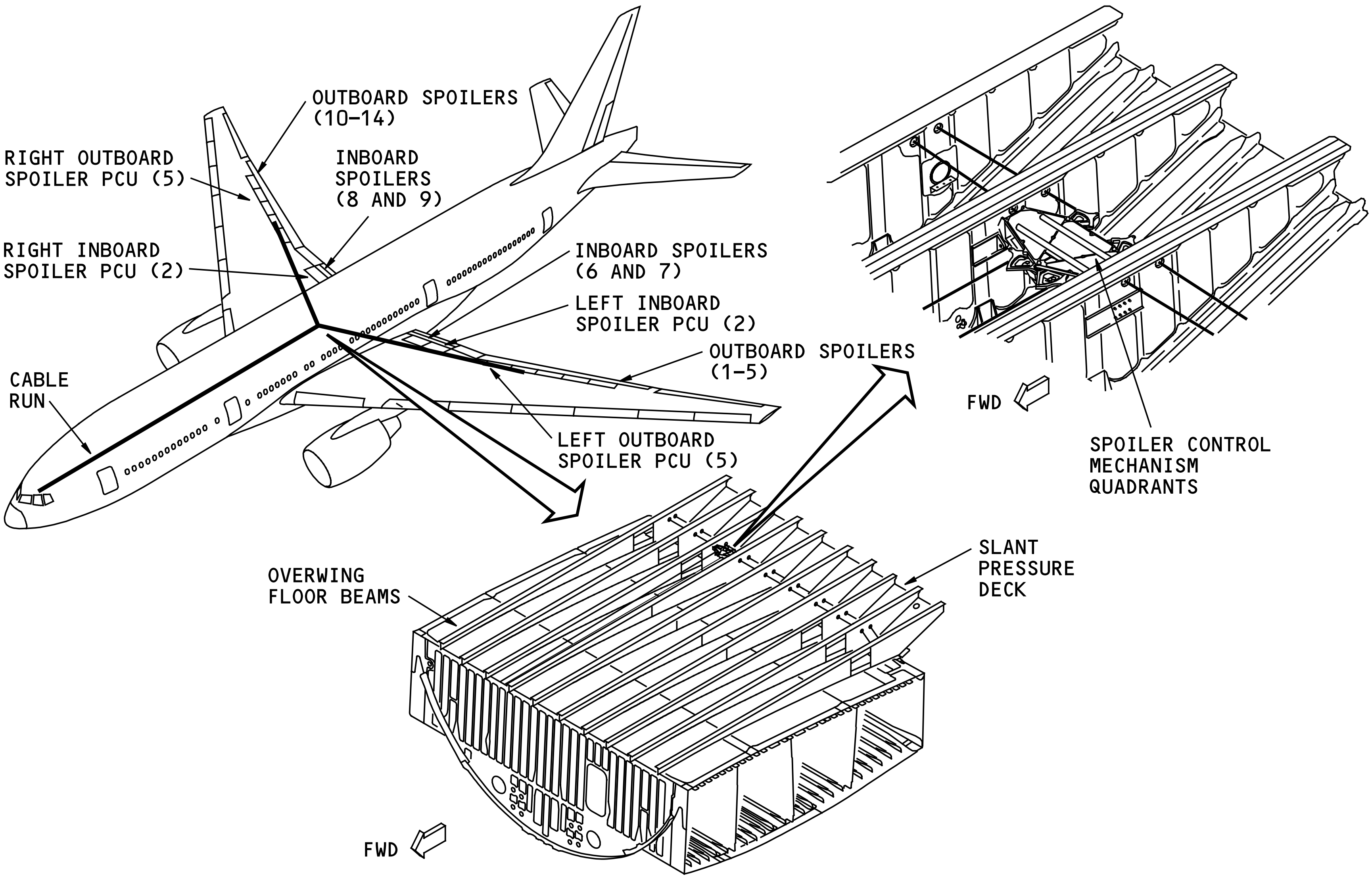
To get access to the control mechanism quadrants, you remove the floor panels in the passenger compartment.

Wing Components

The spoiler control surfaces and their PCUs are on the wings. One PCU connects to each surface.

The spoiler PCU quadrants for spoilers 4 and 11 are next to the PCUs.

To get access to the PCUs and quadrants, there are access panels on the lower wing.



SPOILER AND SPEEDBRAKE CONTROL - WING CENTER SECTION AND WING COMPONENT LOCATIONS

SPOILER AND SPEEDBRAKE CONTROL - ELECTRICAL INTERFACES

General

All of the roll and speedbrake control electrical interfaces with the PFCS go through the ACEs. The ACEs have interfaces with these components:

- Wheel position transducers
- Speedbrake lever transducer
- Inboard spoiler PCUs
- Outboard spoiler PCUs

Wheel Position Transducers

There are six position transducers, three for each control wheel. Each transducer is a linear variable differential transformer (LVDT) that sends analog signals to the ACEs. These analog signals represent the control wheel position and its movement.

See the aileron and flaperon control section for more information about the wheel position transducers (AMM PART I 27-11).

Speedbrake Lever Transducers

The speedbrake lever transducer contains four rotary variable differential transformers (RVDTs). These RVDTs send analog signals of the speedbrake lever position to the ACEs.

Inboard Spoiler PCUs

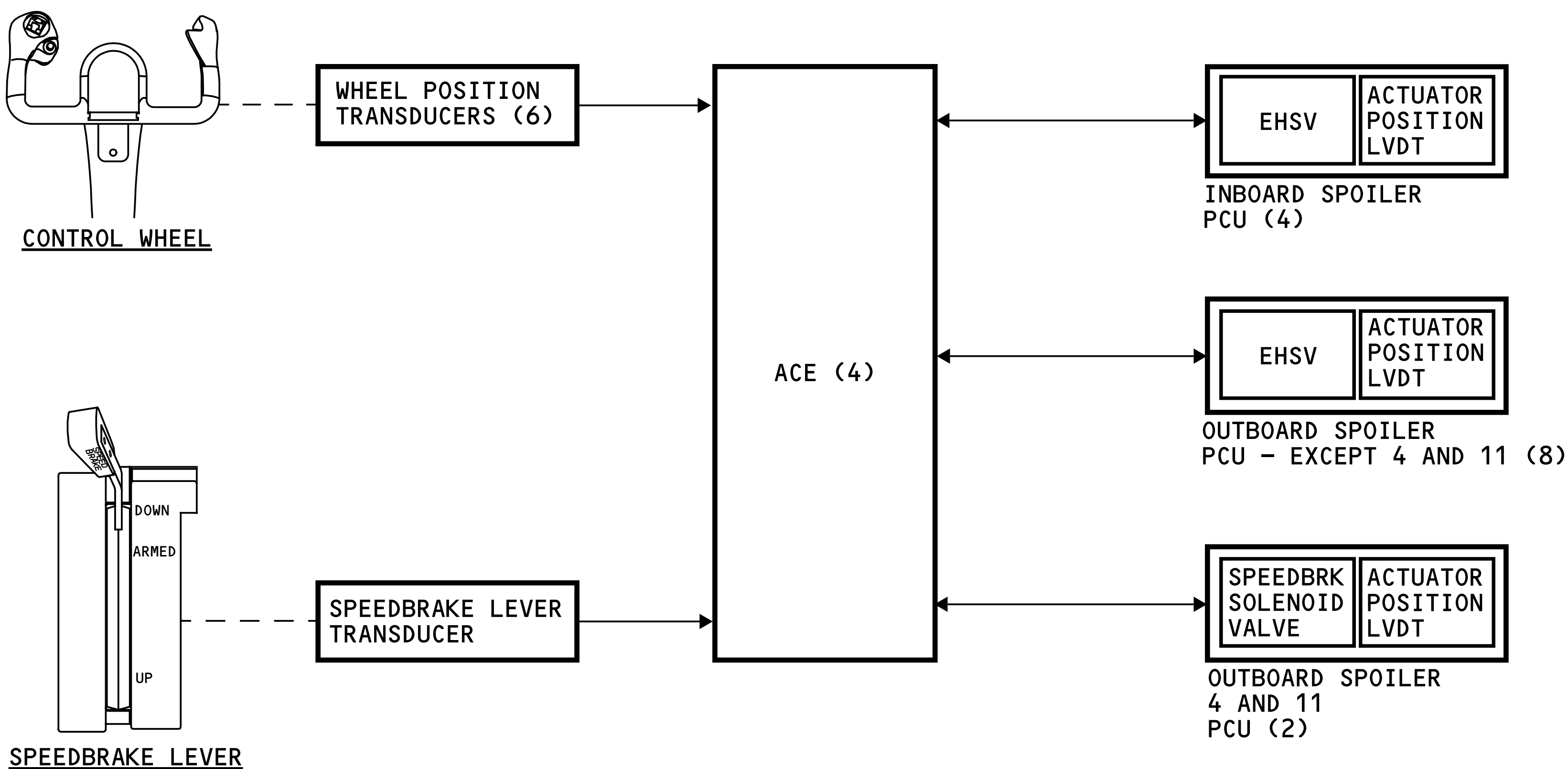
Each of the four inboard spoiler PCUs receives analog electrical signals from the ACEs. The analog signal goes to the electrohydraulic servo valve (EHSV).

Each of these PCUs sends an analog feedback signal to the ACEs from the actuator position LVDT.

Outboard Spoiler PCUs

Each outboard spoiler PCU receives analog electrical signals from the ACEs. For the outboard spoiler PCUs other than 4 and 11, the electrical signal is for the EHSV. For the spoiler 4 and 11 PCUs, the signal goes to the speedbrake solenoid valve.

All ten of the outboard spoiler PCUs send analog feedback signals to the ACEs. These signals are from the actuator position LVDTs.



27-61-00-005 Rev 5 02/11/1998

SPOILER AND SPEEDBRAKE CONTROL - ELECTRICAL INTERFACES

SPOILER AND SPEEDBRAKE CONTROL - MECHANICAL INTERFACES

General

The roll control mechanical interface for spoilers 4 and 11 is a cable system. The cable goes from the control wheels to the spoiler PCUs through these components:

- Forward spoiler quadrant
- Spoiler control mechanism quadrants
- Spoiler PCU quadrant.

Forward Spoiler Quadrant

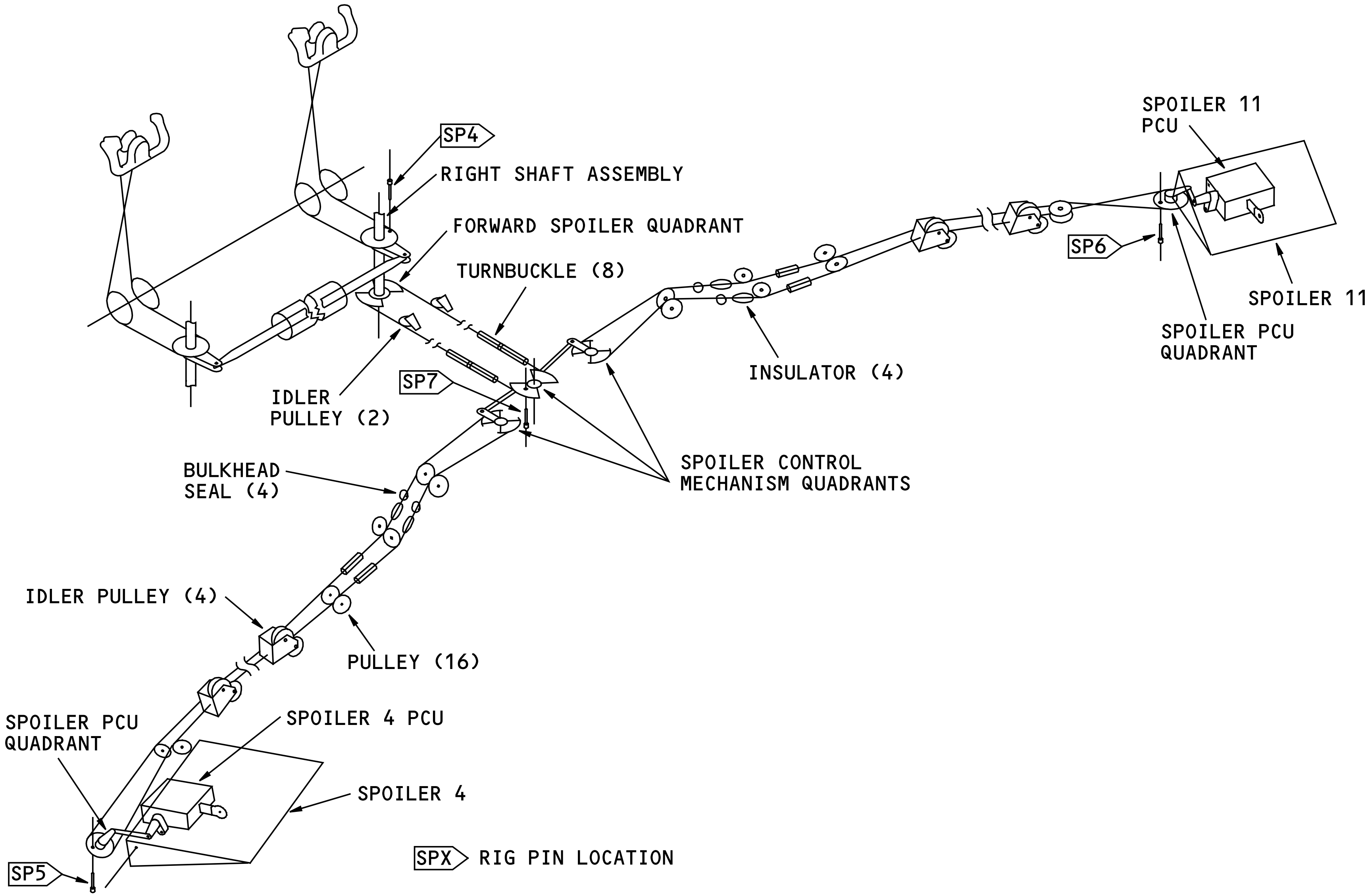
The forward spoiler quadrant connects to the lower end of the right control wheel shaft assembly. Cables connect the forward quadrant to the spoiler control mechanism quadrants through a series of idler pulleys and turnbuckles.

Spoiler Control Mechanism Quadrants

The three spoiler control mechanism quadrants link together to form a travel mechanism assembly. The central mechanism quadrant connects to the cables from the forward spoiler quadrant. The left and right mechanism quadrants connect to the central quadrant with two control rods. Cables go from the left and right quadrants out to the spoiler PCU quadrant on each wing. Pulleys and idler pulleys supply protection to the cables from wing bending. Insulators supply protection from lightning strikes.

Spoiler PCU Quadrants

The spoiler PCU quadrants connect to the PCUs with a mechanical input rod. The rod controls the position of the PCU main control valve.



27-61-00-006 Rev 3

SPOILER AND SPEEDBRAKE CONTROL - MECHANICAL INTERFACES

SPOILER AND SPEEDBRAKE CONTROL - SPEEDBRAKE LEVER AND SPEEDBRAKE LEVER TRANSDUCER

General

Pilots use the speedbrake lever to command the spoilers in speedbrake operation during descent and landing.

The speedbrake components in the control stand are the speedbrake lever, and the speedbrake lever position transducers. See the auto speedbrake control section for more information about the speedbrake components in the control stand (AMM PART I 27-62).

Physical Description

The speedbrake lever has a DOWN detent, an ARMED position for auto speedbrake control, and an UP position for full spoiler deflection.

The speedbrake lever transducer has four individual RVDTs with a common rotor input. The rotor attaches to the clutch output shaft with a spline. Each RVDT has a separate cable and connector. The ACEs supply 7v ac, 1800 Hz excitation power.

Location

The speedbrake lever is on the captain's side of the control stand. The speedbrake lever transducers are in an assembly inside the control stand on the captain's side. Access is through a panel on the left side of the control stand.

Functional Description

When the pilots lift the speedbrake lever out of its detent position, and then pull the lever aft, it moves a rod and crank assembly in the control stand. This movement turns the clutch and the input rotor of the transducers. The four RVDTs measure the rotor movement and supply an analog electrical signal to the four ACEs.

Indications

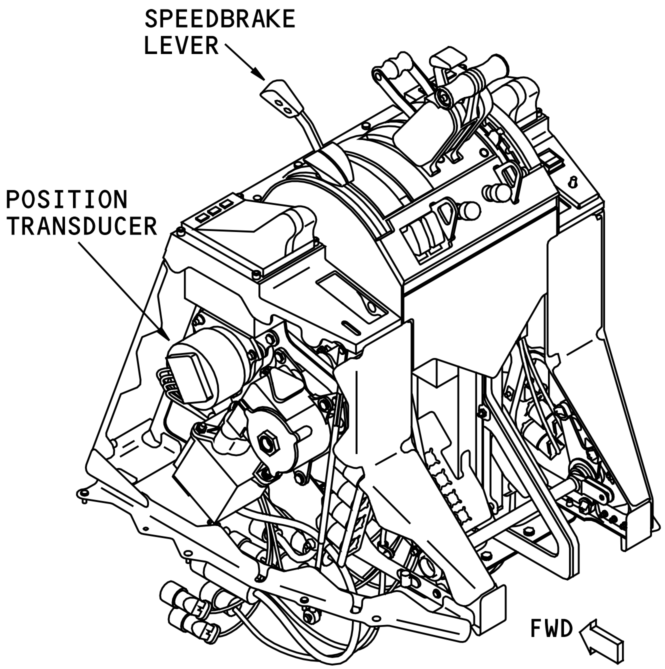
The EICAS warning message CONFIG SPOILERS indicates that the speedbrake lever is not in its down detent when either the left or right engine thrust exceeds the takeoff threshold and the airplane is on the ground.

The EICAS caution message SPEEDBRAKE EXTENDED indicates that the speedbrake lever is more than the armed position with the airplane above 15 feet of radio altitude and one of these conditions:

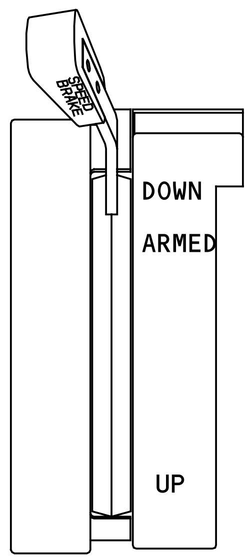
- Airplane below 800 feet radio altitude
- Flaps at landing position
- Either thrust lever is more than 5 degrees above the idle stop.

The EICAS memo message SPEEDBRAKE ARMED indicates that the speedbrakes are armed.

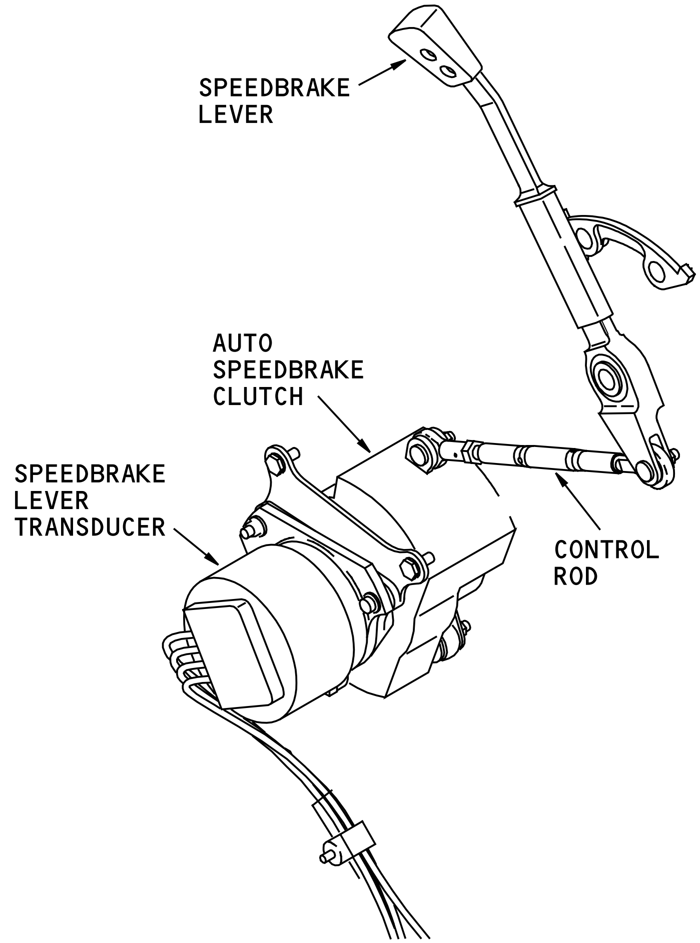
On the MFD status display, the message SPEEDBRAKE LEVER XDCR shows when one of the four speedbrake lever transducers has failed.



CONTROL STAND



SPEEDBRAKE LEVER



SPEEDBRAKE CONTROL ASSEMBLY

27-61-00-009 Rev 4

SPOILER AND SPEEDBRAKE CONTROL - SPEEDBRAKE LEVER AND SPEEDBRAKE LEVER TRANSDUCER

SPOILER AND SPEEDBRAKE CONTROL - CABLE-CONTROLLED SPOILER PCU - PHYSICAL DESCRIPTION

General

The cable-controlled PCUs move the outboard spoilers 4 and 11 in roll and speedbrake control. Mechanical command signals from the control wheels, and electrical command signals from the speedbrake lever control the PCUs. Each spoiler has one PCU.

Location

The cable-controlled PCUs are on the rear spar of the inboard wing. Access to the PCUs is through two hinged panels on the lower wing.

Trunnion pillow blocks connect the PCUs to the rear spar structural fitting. Each PCU actuator rod connects to its spoiler actuator fitting.

An electrical connector is near the cap end of the PCU. Hydraulic tubing connect to two ports next to the electrical connector.

Physical Description

The two cable-controlled spoiler PCUs are identical. Each weighs approximately 20 lb (9 kg).

The PCUs contain an unbalanced hydraulic actuator with a control module. The control module contains:

- A main control valve
- A speedbrake solenoid valve
- A speedbrake mode valve
- An extension check and relief valve with manual bypass
- An inlet filter.

The actuator piston has an LVDT that sends position feedback signals to the ACE.

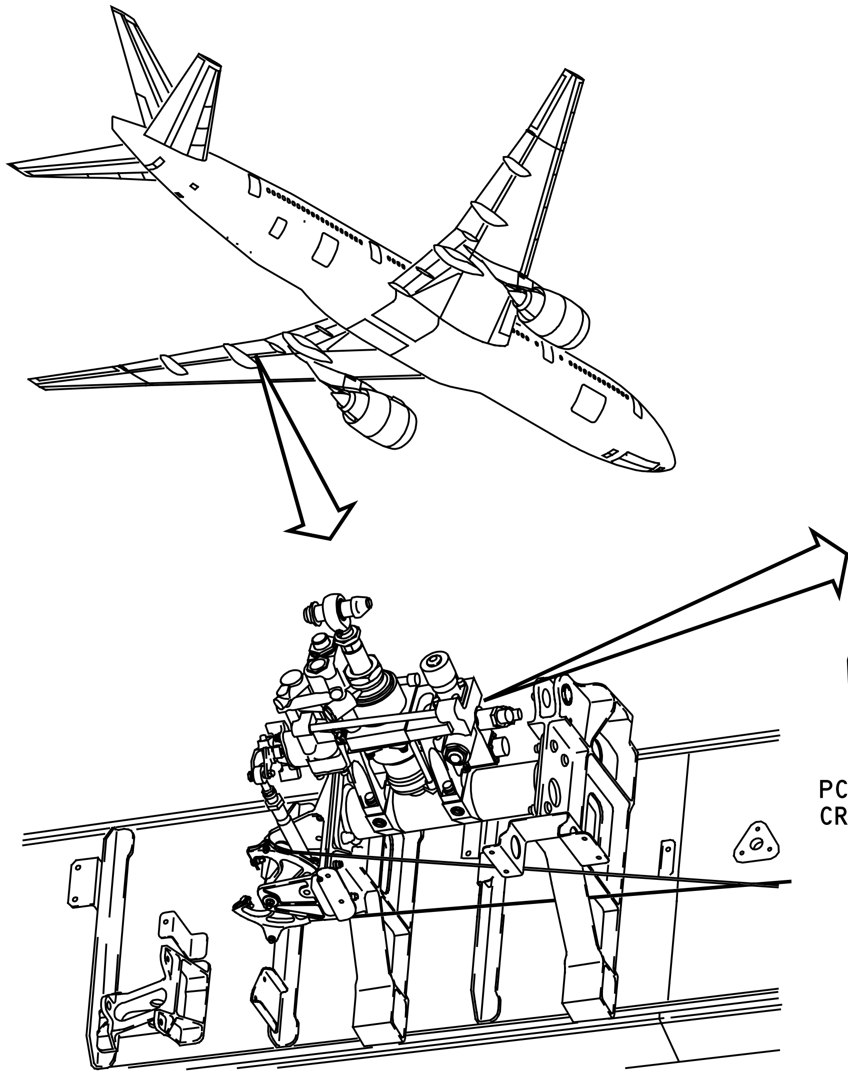
Training Information Point

Use the manual bypass to extend the PCU for maintenance.

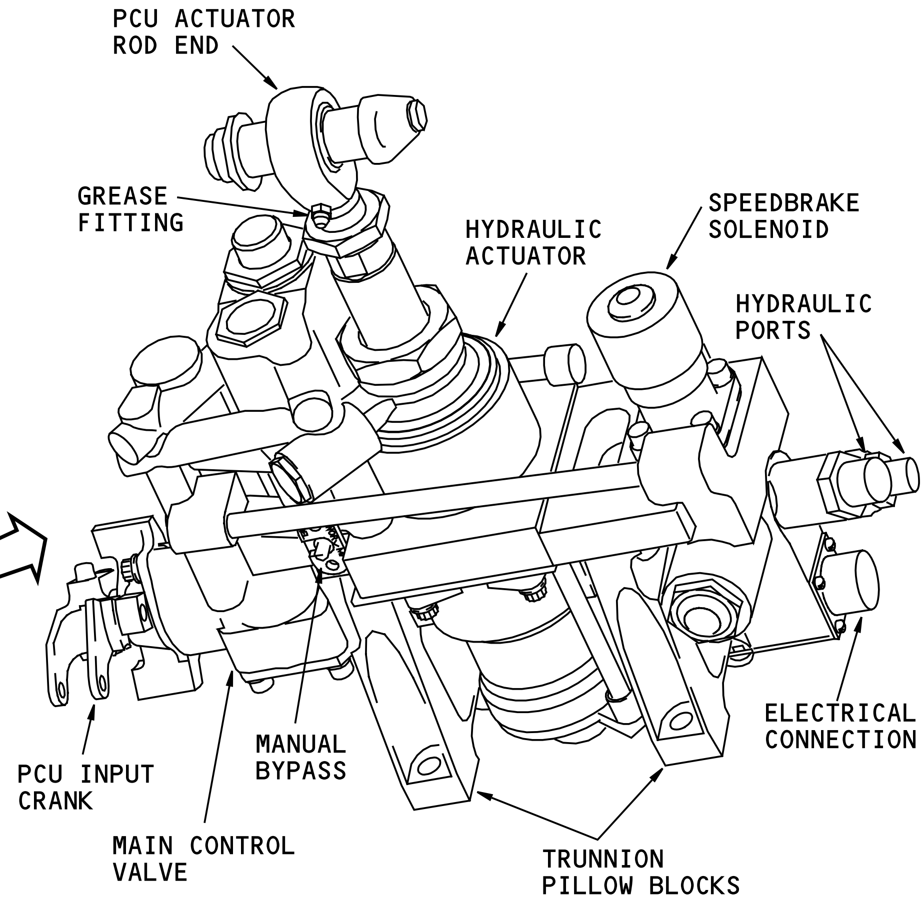
Install a spoiler PCU lock when the panel is in the up position.

Use the spoiler PCU rod end adjustment to rig the PCU.

The rod end of the actuator has a grease fitting.



SPOILER 4 PCU INSTALLATION



SPOILER 4 PCU

27-61-00-011 Rev 3

SPOILER AND SPEEDBRAKE CONTROL - CABLE-CONTROLLED SPOILER PCU - PHYSICAL DESCRIPTION

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SPOILER AND SPEEDBRAKE CONTROL - CABLE-CONTROLLED SPOILER PCU - FUNCTIONAL DESCRIPTION

General

The cable-controlled spoiler PCU operates in two different modes:

- Roll control
- Speedbrake control.

In roll control mode, the cable system supplies a mechanical input to the main control valve.

In speedbrake control mode, speedbrake lever movement causes the ACEs to energize the speedbrake solenoid. This bypasses the main control valve and sends a hardover command to the actuator.

The actuator LVDT supplies a position feedback signal to the ACEs.

Roll Control Mode

The PCU is in roll control mode when the ACE does not energize the speedbrake solenoid valve.

When there is no roll or speedbrake command, a spring forces the main control valve to the fully retracted position. Hydraulic fluid pressurizes the actuator to retract. The extension check valve stays closed. Its internal check valve permits the retract pressure to the actuator.

When the pilot turns the control wheel, the spoiler PCU quadrant moves the main control valve. This sends hydraulic system pressure through the speedbrake mode valve to the actuator, and results in the actuator extension or retraction. When the command is to extend, the extension check valve opens and permits flow to return. When the command is to retract, the hydraulic pressure flow goes through the closed extension check valve. The angular output movement of the PCU about the trunnion supplies mechanical loop feedback to the main control valve.

Speedbrake Control Mode

The PCU is in speedbrake control mode when the ACE energizes the speedbrake solenoid.

When the pilot moves the speedbrake lever more than 54 degrees, the ACE energizes the speedbrake solenoid. This moves the solenoid valve. Hydraulic pressure then moves the speedbrake mode valve to the speedbrake position. Under these conditions, hydraulic pressure goes directly through the speedbrake mode valve to the actuator. The extension check valve opens and permits flow to return. This results in full actuator extension.

When the pilot moves the speedbrake lever to less than 45 degrees, the ACE de-energizes the speedbrake solenoid. With no electrical input, internal springs force the speedbrake solenoid valve and the speedbrake mode valve to the closed position. This puts the PCU in the roll control mode of operation. If there is no roll command, the main control valve pressurizes the actuator to retract. Hydraulic pressure flows through the closed extension check valve.

Operation Without Hydraulic Pressure

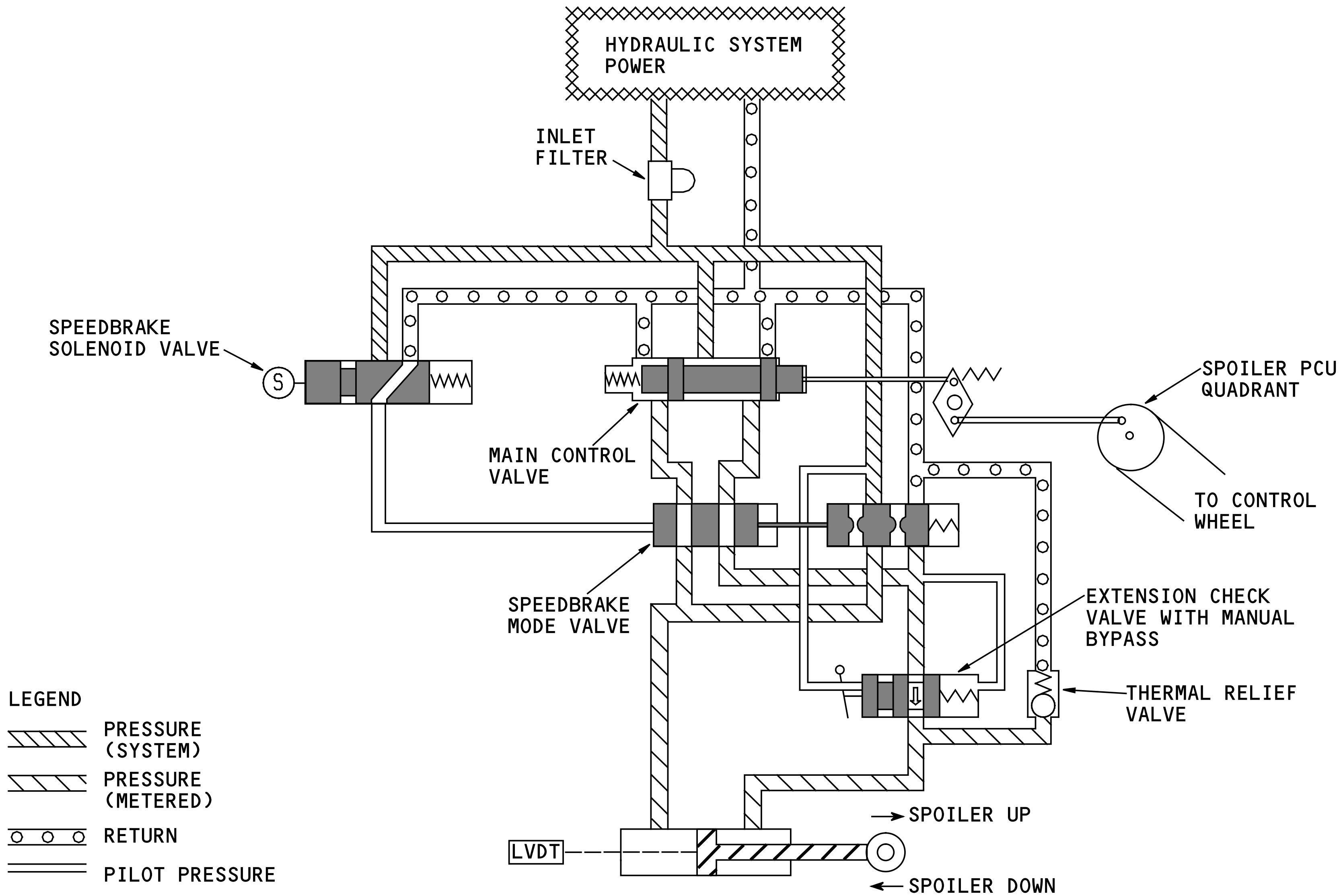
Without hydraulic pressure to the PCU, the extension check valve closes and prevents extension of the PCU actuator.

If the spoiler panel is raised at the time of hydraulic power loss, the airload on the spoiler causes hydraulic fluid to flow through the speedbrake mode valve and the main control valve. This permits the actuator to retract.

The thermal relief valve cracks open at about 3700 psid and closes at approximately 3100 psid.

Manual Operation

You can open the extension check valve with the manual bypass. With the extension check valve open, you can raise the spoiler without hydraulic power. You can lower the spoiler panel with the extension check valve closed.



27-61-00-012 Rev 2 01/19/95

SPOILER AND SPEEDBRAKE CONTROL - CABLE-CONTROLLED SPOILER PCU - FUNCTIONAL DESCRIPTION

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SPOILER AND SPEEDBRAKE CONTROL - INBOARD AND OUTBOARD SPOILER PCU - PHYSICAL DESCRIPTION

General

Except for spoilers 4 and 11, the inboard and outboard spoiler PCUs move their spoiler panel with electrical command signals from the ACEs. Each spoiler has one PCU.

Location - Inboard Spoiler PCUs

The inboard spoiler PCUs are on the inboard wing spoiler beams. Access to the PCUs is by hinged panels on the lower wings.

Trunnion pillow blocks connect the PCUs to the spoiler beam structure. Each PCU actuator rod connects to its spoiler panel clevis fitting.

An electrical connector attaches forward and left of the cap end of the PCU.

Two hydraulic tubes connect to ports at the cap end of the PCU.

Location - Outboard Spoiler PCUs

The outboard spoiler PCUs are on the outboard wing rear spars. Access to the PCUs is by hinged panels on the lower wings.

Trunnion pillow blocks connect the PCUs to the rear spar structures. Each PCU actuator rod connects to its spoiler panel clevis fitting.

An electrical connector and two hydraulic tubes attach at the forward, left end of the PCU.

Physical Description

The inboard spoiler PCUs weighs about 25.2 lb (11 kg) each. The outboard spoiler PCUs weigh about 14.5 lb (6.4 kg) each. The electrically-controlled inboard and outboard spoilers PCUs are functionally identical.

The spoiler PCUs contains a hydraulic actuator with a control module. The inboard PCUs have a balanced actuator. The outboard PCUs have an unbalanced actuator. The control module contains:

- An electrohydraulic servo valve (EHSV)
- An extension check and relief valve with manual bypass
- An inlet filter.

The actuator piston has an LVDT that sends position feedback signals to the ACE.

Training Information Point

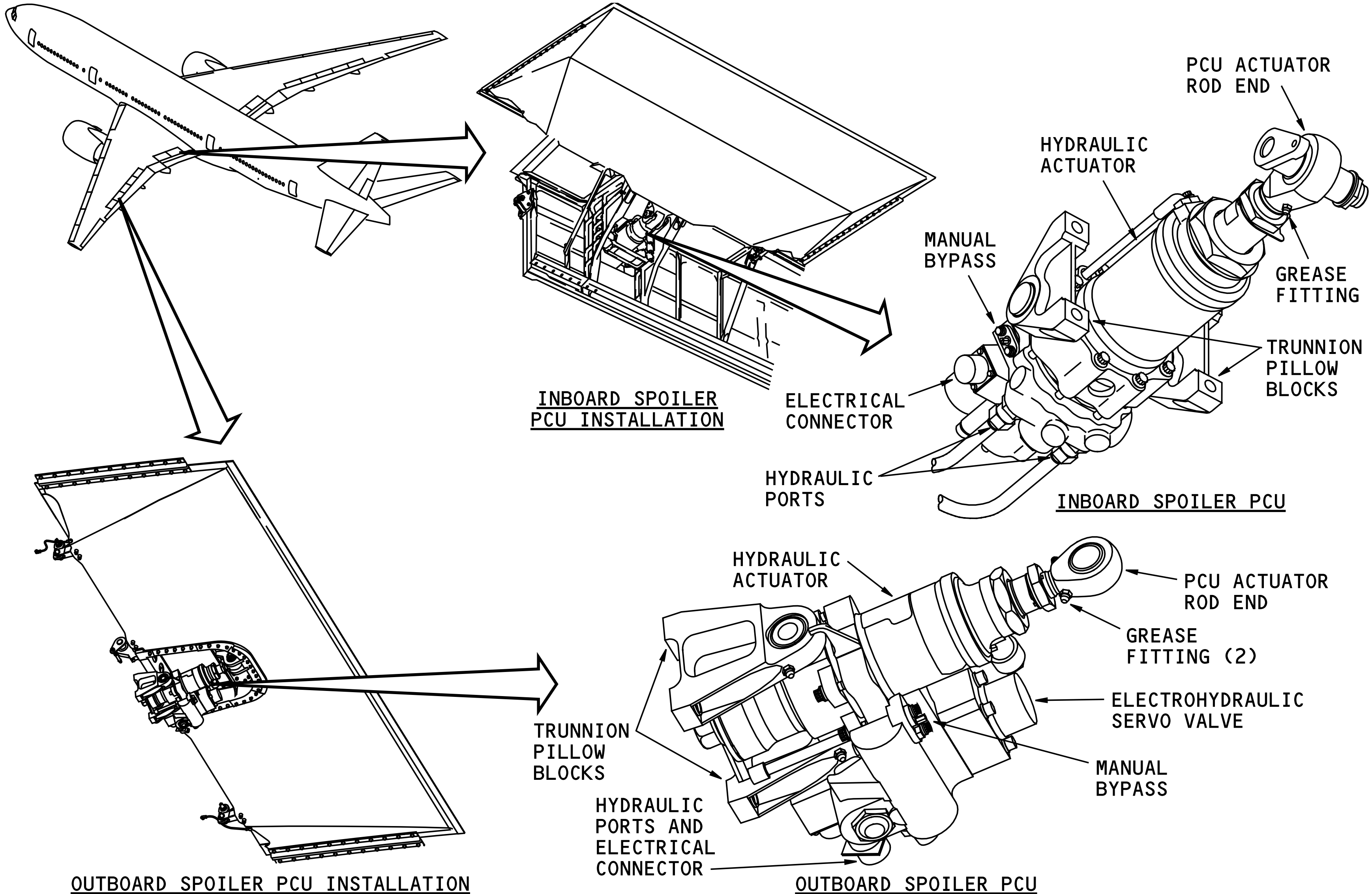
Use the manual bypass to extend the PCU for maintenance.

Install a spoiler PCU lock when the panel is in the up position.

Use the spoiler PCU rod end adjustment to rig the PCU.

SPOILER AND SPEEDBRAKE CONTROL - INBOARD AND OUTBOARD SPOILER PCU - PHYSICAL DESCRIPTION

The rod end of the actuator has a grease fitting.



27-61-00-013 Rev 2

SPOILER AND SPEEDBRAKE CONTROL - INBOARD AND OUTBOARD SPOILER PCU - PHYSICAL DESCRIPTION

SPOILER AND SPEEDBRAKE CONTROL - INBOARD AND OUTBOARD SPOILER PCU - FUNCTIONAL DESCRIPTION

General

The inboard and outboard spoiler PCUs, except for spoilers 4 and 11, have only one mode of operation.

Normal Operation

When the ACE energizes the EHSV to the extend or retract position, hydraulic system pressure moves the actuator. During a retraction command, the extension check valve stays closed and permits retract pressure to the actuator. During an extension command, the extension check valve opens and permits flow to return. The actuator LVDT supplies a position feedback signal to the ACEs. The ACEs use this signal to adjust the extend command current.

A spring forces the EHSV to the fully retracted position when there is no electrical signal. This permits hydraulic pressure through the closed extension check valve to keep the actuator retracted.

Operation Without Hydraulic Pressure

Without hydraulic pressure to the PCU, the closed extension check valve prevents extension of the PCU.

If the spoiler panel is up at the time of hydraulic power loss, the airload on the spoiler causes hydraulic fluid to flow through the extension check valve and the EHSV. This permits the actuator to retract.

The thermal relief valve cracks open at about 3700 psid and closes at about 3100 psid.

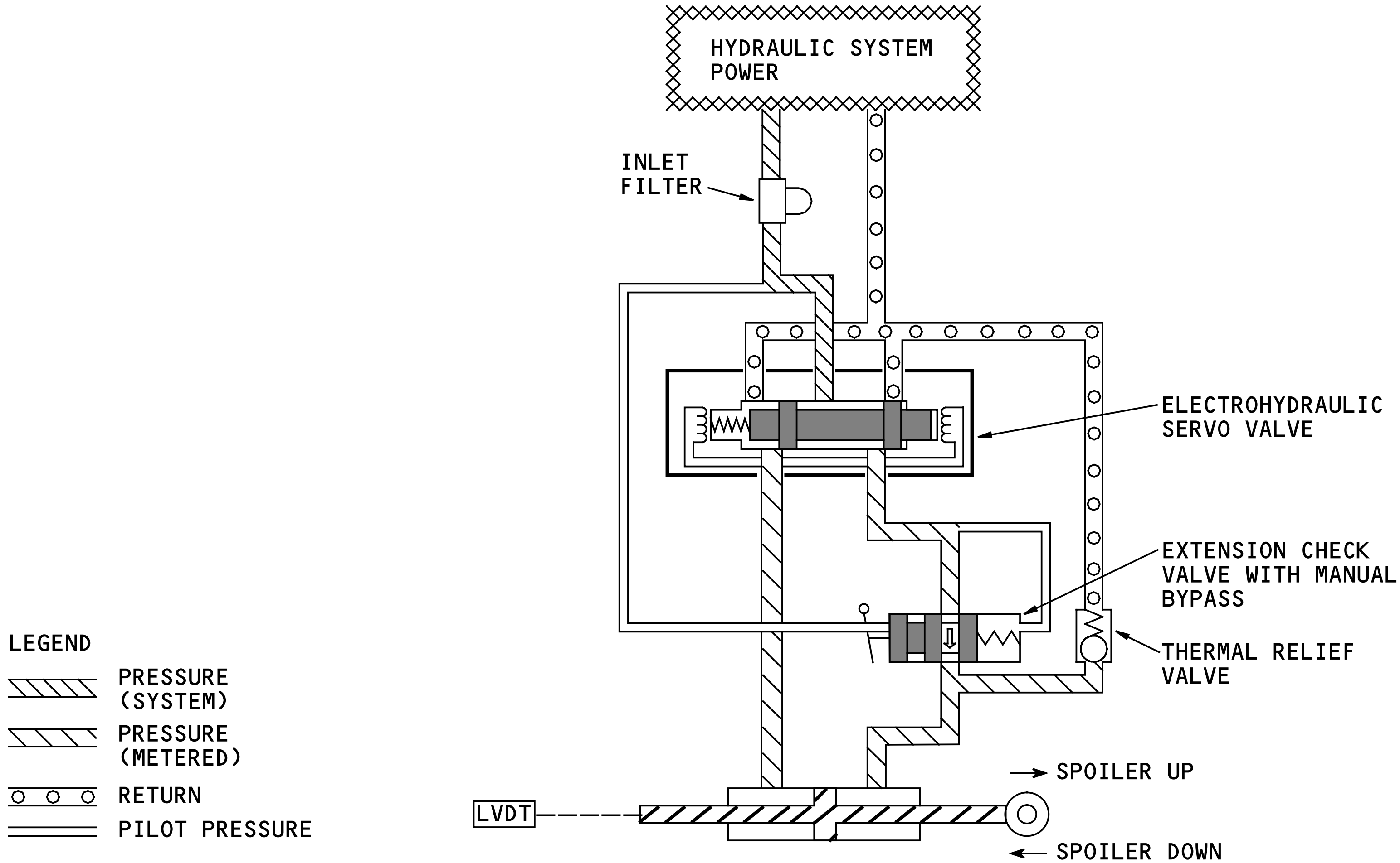
Manual Operation

You can open the extension check valve with the manual bypass. With the extension check valve open, you can raise the spoiler without hydraulic power. You can lower the spoiler panel with the extension check valve closed.

Indications

The advisory message SPOILERS shows when one or more pair of spoilers is shut down.

The status message FLIGHT CONTROL SYS shows when one or more spoiler actuator fails.



NOTE: BALANCED ACTUATOR SHOWN FOR INBOARD PCU ONLY
UNBALANCED ACTUATOR FOR OUTBOARD PCU NOT SHOWN

27-61-00-014 Rev 4 06/20/1997

SPOILER AND SPEEDBRAKE CONTROL - INBOARD AND OUTBOARD SPOILER PCU - FUNCTIONAL DESCRIPTION

SPOILER AND SPEEDBRAKE CONTROL - SPOILER SURFACES

Purpose

The spoilers supply roll control in flight and speedbrake control during descent and landing.

Physical Description

The four inboard and ten outboard spoilers are light-weight composite materials structures. The skin is reinforced graphite/epoxy bonded to a core of Nomex honeycomb.

The inboard spoilers weigh about 47 lb (21 kg) each. The outboard spoilers weigh about 30 lb (14 kg) each.

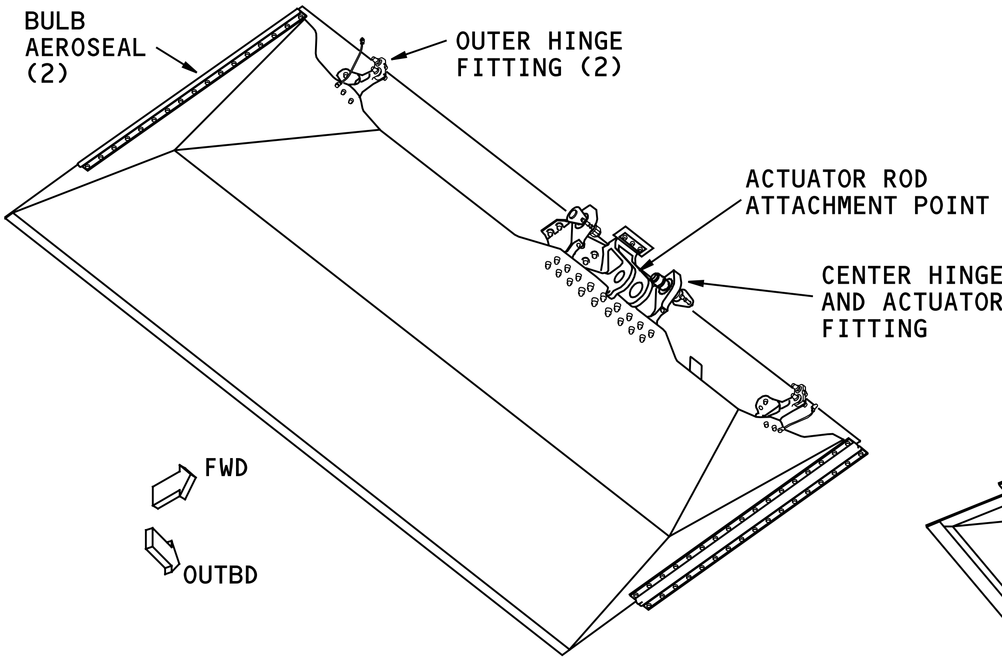
The overall dimensions of the inboard spoiler are approximately 42 in by 80 in (1.1 m x 2.0 m). Each spoiler attaches to the outboard rear spar with two outer hinge fittings, and one center hinge. The PCU actuator rod end connects to the actuator fitting.

The overall dimensions of the outboard spoiler are approximately 28 in by 78 in (0.7 m x 2.0 m). Each spoiler attaches to the spoiler beam with two outer hinge fittings, and one center hinge. The PCU actuator rod end connects to the actuator fitting.

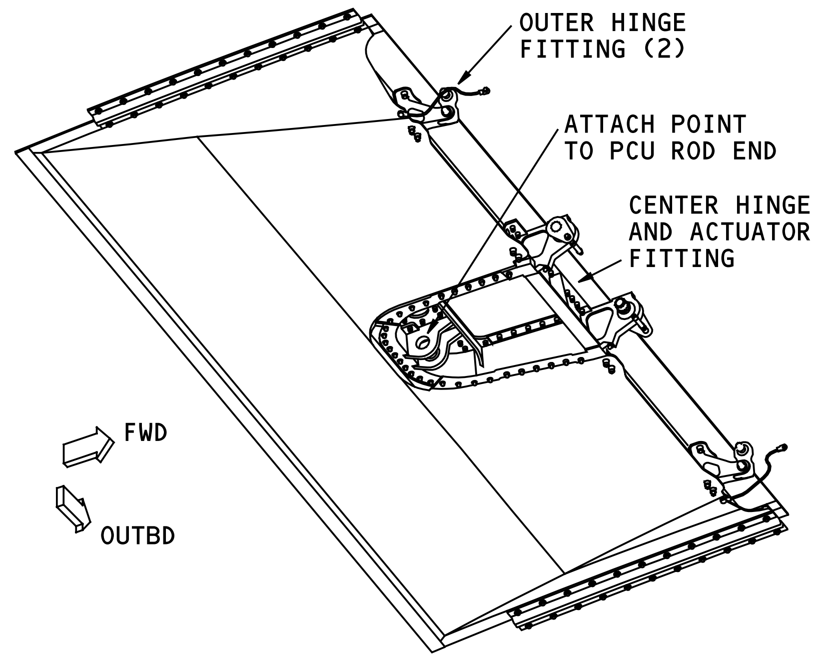
Rubber bulb aeroseals attach to the inboard and outboard edges of all spoiler panels.

Functional Description

The inboard and outboard spoilers have a maximum movement of 60 degrees trailing edge up (TEU), except for spoilers 4 and 11 which are limited to 45 degrees TEU.



INBOARD SPOILER
(VIEW LOOKING UP)



OUTBOARD SPOILER
(VIEW LOOKING UP)

27-61-00-015 Rev 1

SPOILER AND SPEEDBRAKE CONTROL - SPOILER SURFACES

SPOILER AND SPEEDBRAKE CONTROL - FUNCTIONAL DESCRIPTION

General

The roll and speedbrake control system for the inboard and outboard spoilers uses input command signals from the:

- Wheel position transducers
- Force transducer
- Speedbrake lever transducer assembly.

The ACEs receive the input signals and transmit them to the PFCs. The ACEs supply output command signals to the spoiler PCUs.

The roll control system for the cable-controlled spoilers uses input commands from the cable system. The speedbrake control system for these spoilers uses electrical command signals from the ACEs.

Wheel Position Transducers

The C ACE and R ACE each receive signals from two wheel position transducers. The L1 ACE and L2 ACE each receive signals from one wheel position transducer. After they change the signals to digital format, the ACEs send these signals to the PFCs through the flight controls ARINC 629 buses.

Each PFC receives input signals from all six wheel position transducers. Each PFC selects which signal to use by mid-value selection and averaging.

Force Transducer

The two LVDTs of the force transducer send signals to the L2 ACE and the C ACE. The ACEs transmit these signals to the PFCs.

Speedbrake Lever Transducer

The four speedbrake lever transducer RVDTs send signals to the four ACEs. The ACEs transmit these signals to the PFCs.

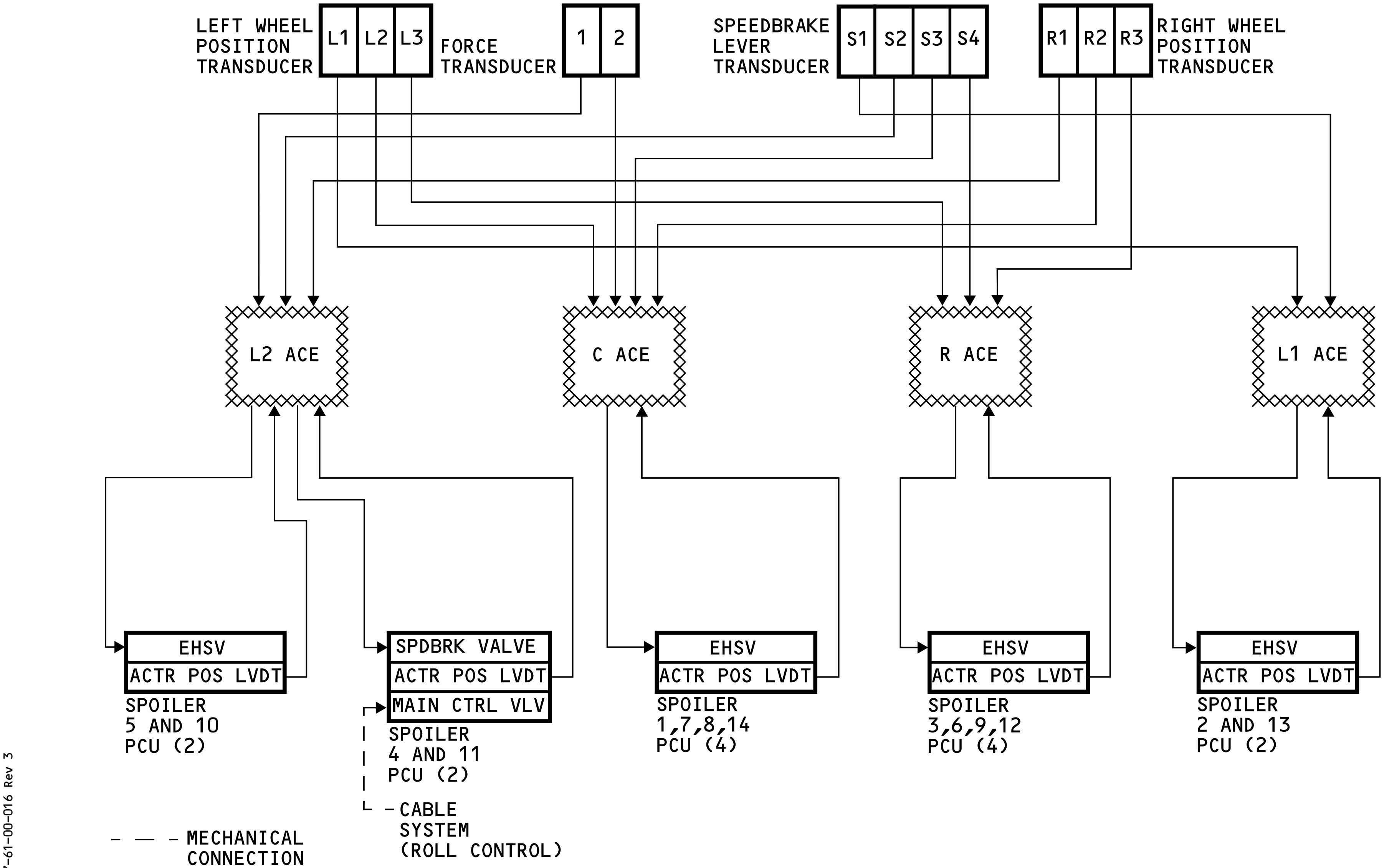
Electrically-Controlled PCUs

Each ACE sends command signals to the EHSV of the assigned spoiler PCUs. The PCU sends feedback signals to its assigned ACE from the actuator piston position LVDT.

Cable-Controlled PCUs

The L2 ACE sends speedbrake control command signals to the PCUs of spoilers 4 and 11. The speedbrake command signal goes to the speedbrake solenoid valve. The PCU sends feedback signals to its assigned ACE from the actuator piston position LVDT.

The cable system supplies mechanical roll command input to the main control valve of spoiler 4 and 11 PCUs.



SPOILER AND SPEEDBRAKE CONTROL - FUNCTIONAL DESCRIPTION

SPOILER AND SPEEDBRAKE CONTROL - FUNCTIONAL DESCRIPTION - ACE SERVO LOOP

General

The ACE contains a control servo loop circuit for all the electrically-controlled PCUs. This control servo loop circuit is also for the cable-controlled PCUs in speedbrake operation.

In normal and secondary modes of operation of the PFCS, the PFC sends mixed roll and speedbrake command signals to the ACE for the electrically-controlled PCUs. In direct mode, the ACE calculates the mixed command signals to these PCUs.

In normal mode of operation of the PFCS, the PFC sends speedbrake command signals to the cable-controlled PCUs (spoiler 4 and 11). In secondary and direct modes, there is no speedbrake command signal from the PFCs and ACEs to these PCUs.

Servo Loop Operation

The ACEs send the command signals to the EHSV of the electrically-controlled PCUs. In normal mode, they also go to the speedbrake solenoid valves of the cable-controlled PCUs. The ACEs monitor the PCU command signals for failures.

The actuator position LVDT measures the movement of the actuator and supplies a feedback signal to the ACEs to close the servo loop, and to monitor faults. This signal also goes to the PFC.

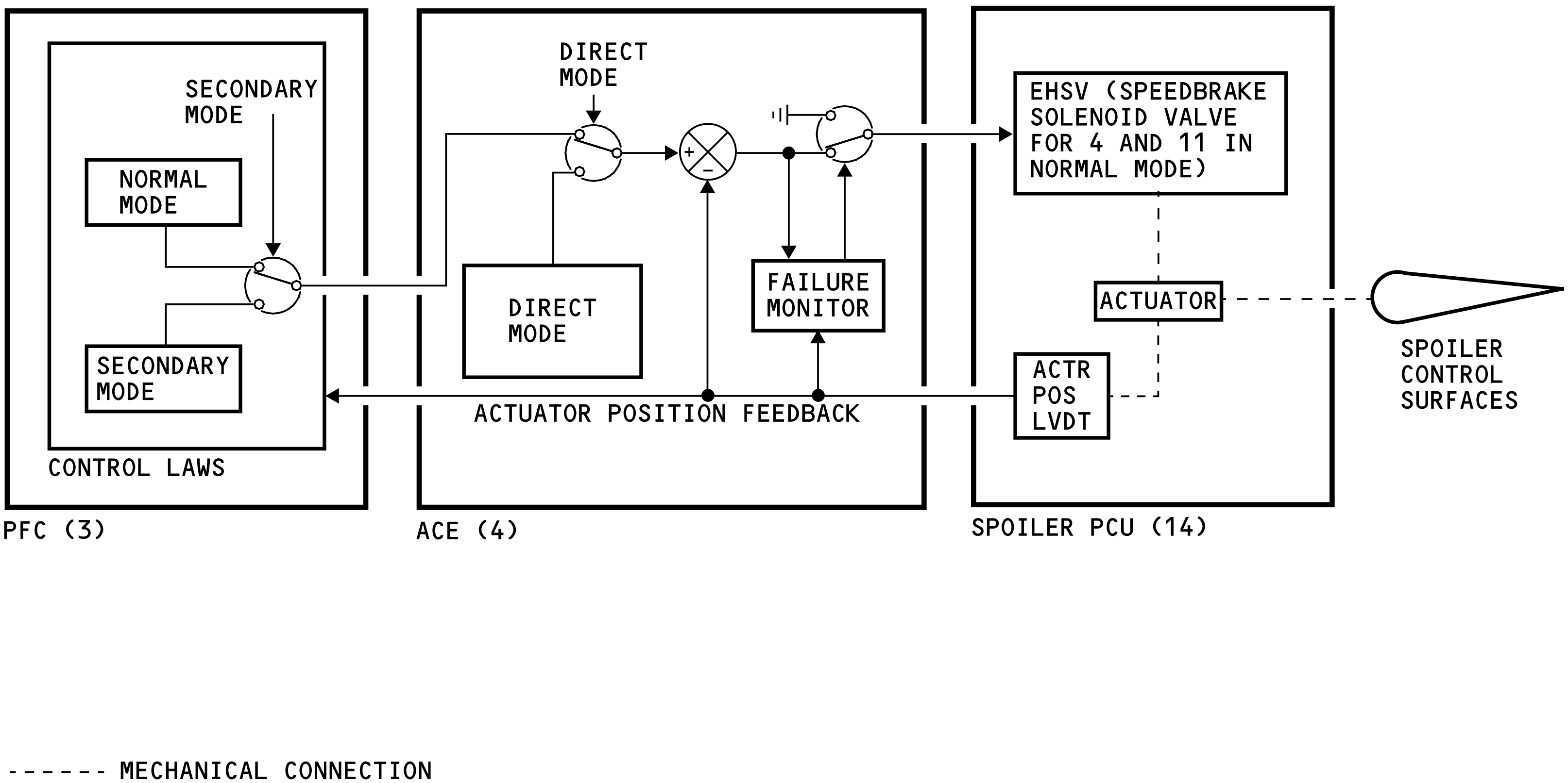
Failure Monitor

The ACE has a failure monitor to do a check of the correct operation of the PCU. The monitor uses the ACE command signal and the feedback signal from the actuator position LVDT.

If the ACE finds a failed spoiler PCU, it connects to ground the EHSV of both PCUs of the spoiler pair. The EHSV of each PCU has a mechanical and magnetic bias to command the actuator to retract when there is no electrical command to the EHSV.

Indications

The EICAS advisory message SPOILERS shows when one or more pair of spoilers does not operate. This condition causes the message to show in normal, secondary, and direct modes.



27-61-00-017 Rev 1 01/08/96

SPOILER AND SPEEDBRAKE CONTROL - FUNCTIONAL DESCRIPTION - ACE SERVO LOOP

AUTO SPEEDBRAKE CONTROL - GENERAL DESCRIPTION

General

The auto speedbrake controls the automatic movement of the speedbrake lever during airplane operation on the ground. The pilots use the auto speedbrake during landing and refused takeoff (RTO). Extension of the auto speedbrake causes all spoilers to deploy to their maximum position.

Auto Speedbrake Control

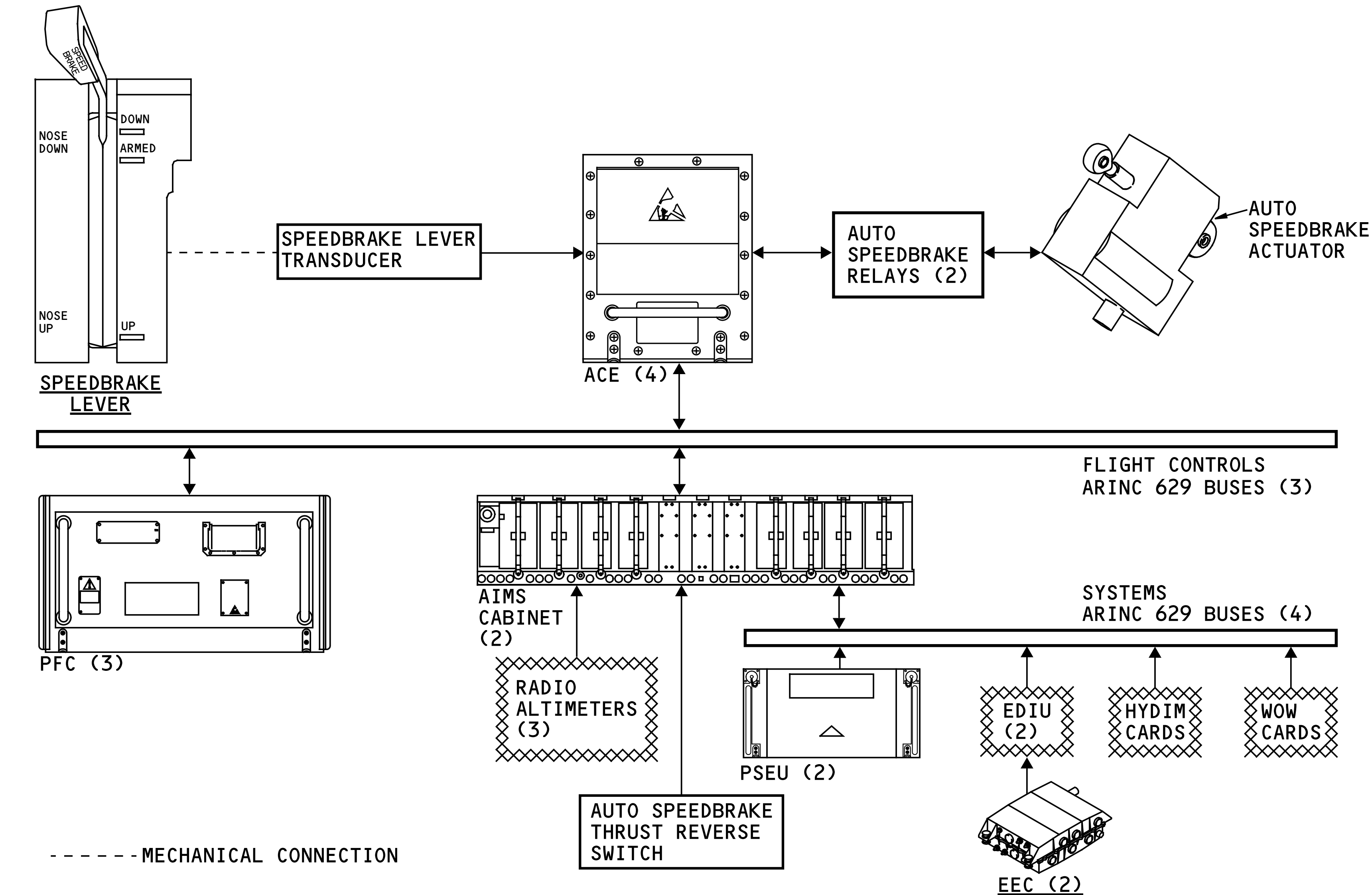
The PFCs control the automatic extension and retraction of the speedbrake lever. The PFC logic requires that a series of conditions be met to command the auto speedbrake actuator to operate.

When the pilot moves the speedbrake lever out of its DOWN detent to the ARM position, the speedbrake lever transducer supplies a signal to the PFCs through the ACEs. When the pilot operates the engine thrust reverser, the auto speedbrake thrust reverse switch supplies a signal to the PFCs through the AIMS cabinets.

The main landing gear truck tilt sensors supply signals to the proximity sensor electronic units (PSEUs). The electronic engine controls (EECs) supply signals through the engine data interface units (EDIUs) to show the position and validity of the thrust resolver angles. The hydraulic interface module (HYDIM) cards supply signals about the hydraulic pressure status of the truck tilt actuators. The weight-on-wheels (WOW) cards supply signals that the airplane is on the ground. The radio altimeters supply the airplane altitude near the ground. All these signals go through the AIMS to the PFCs.

When the extension or retraction conditions are met, the PFCs send command signals to the ACEs. The ACEs then control the auto speedbrake relays which control power to the auto speedbrake actuator. This causes the auto speedbrake actuator to extend or retract.

The auto speedbrake clutch transmits the movement from either the speedbrake lever or the auto speedbrake actuator to the speedbrake lever transducer. The auto speedbrake clutch permits the pilot to move the speedbrake lever and override the commands of the auto speedbrake actuator at anytime.



AUTO SPEEDBRAKE CONTROL - GENERAL DESCRIPTION

AUTO SPEEDBRAKE CONTROL - COMPONENT LOCATIONS

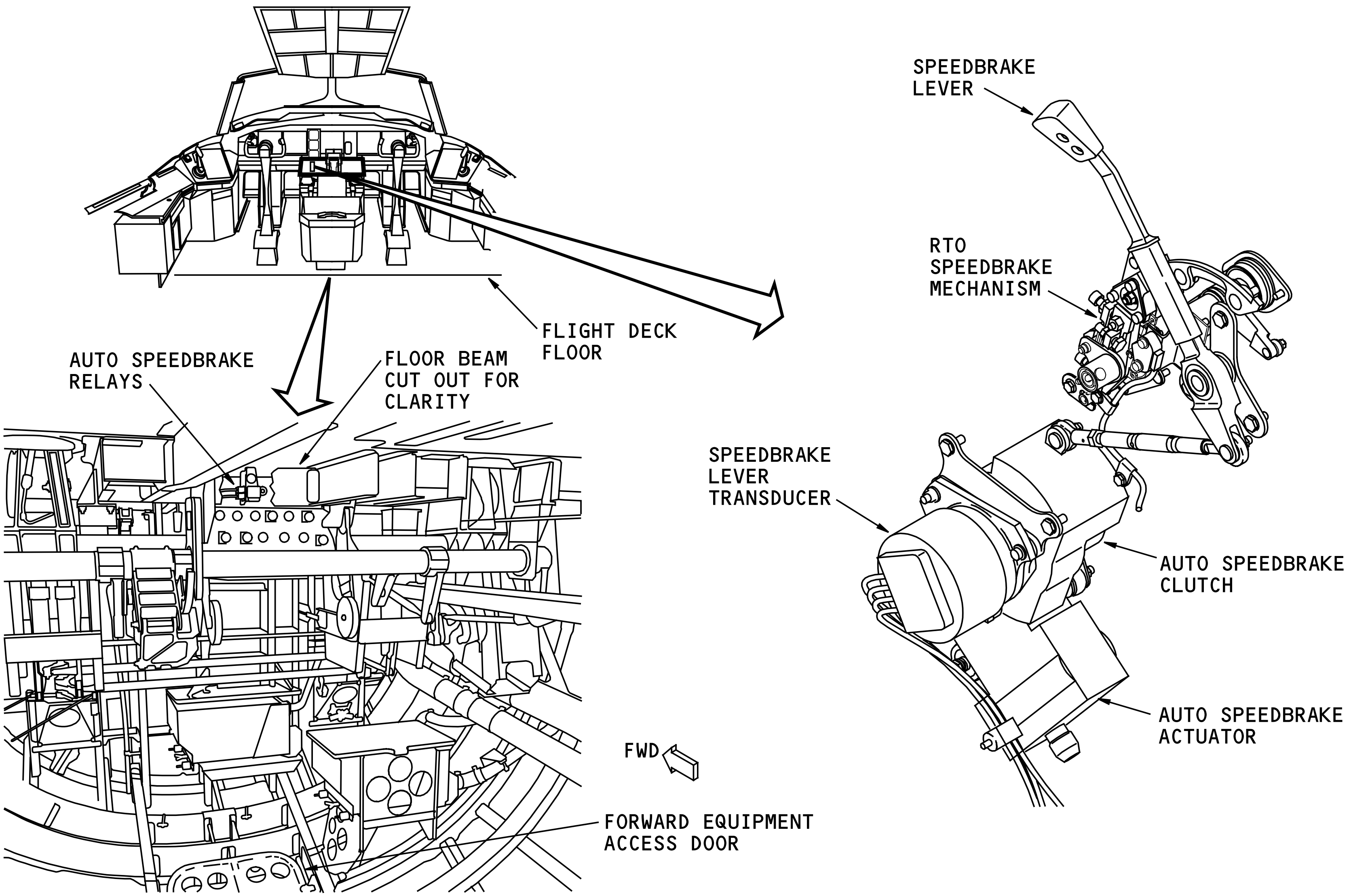
General

The auto speedbrake components are on the left side of the control stand in the flight deck. These components include:

- The auto speedbrake clutch
- The auto speedbrake actuator
- The RTO speedbrake mechanism.

Remove the left panel of the control stand to access the auto speedbrake components.

The two auto speedbrake relays are on a bracket below the control stand. Access to the relays is through the forward equipment access door.



27-62-00-002 Rev 1 03/04/1997

AUTO SPEEDBRAKE CONTROL - COMPONENT LOCATIONS

AUTO SPEEDBRAKE CONTROL - INTERFACES

General

The electrical interfaces with the PFCS for the auto speedbrake go through the ACEs. The ACEs have interfaces with these components:

- The speedbrake lever transducer
- The auto speedbrake thrust reverse switch
- The auto speedbrake actuator
- The auto speedbrake relays.

Speedbrake Lever Transducer

The speedbrake lever transducer supplies a signal that the speedbrake lever is in the ARMED position or beyond.

See the spoiler and speedbrake control section for more information about the speedbrake lever transducer (AMM PART I 27-61).

Auto Speedbrake Thrust Reverse Switch

The auto speedbrake thrust reverse switch supplies an electrical signal to the ACEs when there is movement of one or both thrust reverser levers. The signal goes from the auto speedbrake thrust reverse switch to the AIMS cabinets which transmit it to the ACEs through the flight controls ARINC 629 buses.

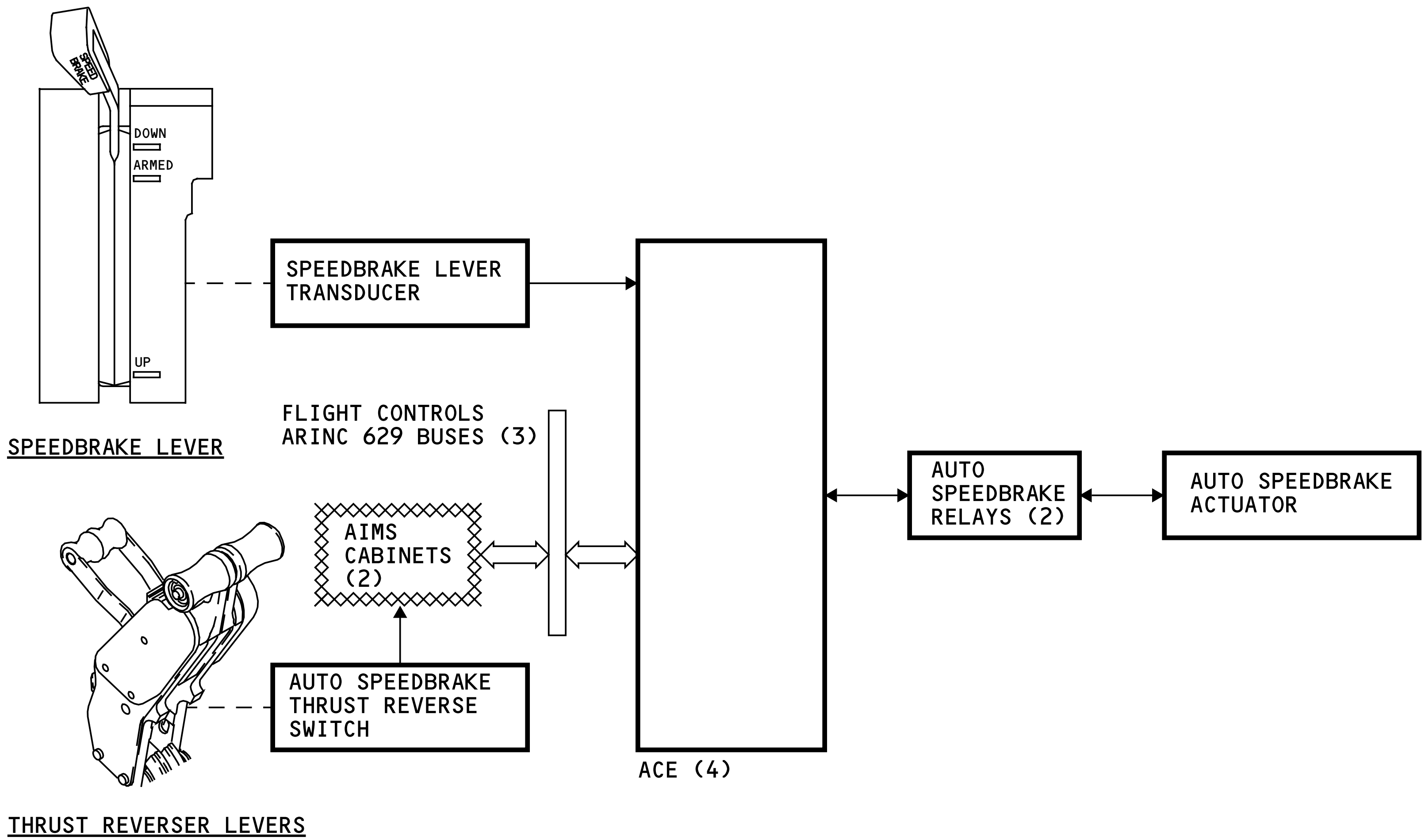
Auto Speedbrake Actuator

The auto speedbrake actuator receives electrical power through the auto speedbrake relays. Switches in the auto speedbrake actuator supply the actuator position feedback to the L1 and R ACEs.

Auto Speedbrake Relays

The auto speedbrake relays receive the command signals from the L1 and R ACEs. When both relays are energized, they supply electrical power to extend the auto speedbrake actuator. Extension of the actuator rod causes the speedbrake lever to move from the ARMED position to the UP position.

When both auto speedbrake relays are de-energized, they supply electrical power to retract the auto speedbrake actuator. Retraction of the actuator causes the speedbrake lever to move from the UP position to the DOWN position.



27-62-00-003 Rev 5

AUTO SPEEDBRAKE CONTROL - INTERFACES

AUTO SPEEDBRAKE CONTROL - AUTO SPEEDBRAKE CLUTCH

Purpose

The auto speedbrake clutch transmits the movement of the speedbrake lever or the auto speedbrake actuator to the speedbrake lever transducer. The auto speedbrake clutch prevents movement of the speedbrake lever without an input from the pilot or the auto speedbrake actuator.

The auto speedbrake clutch supplies friction for pilot feel. It also has a detent when the speedbrake lever reaches the ARMED position. The auto speedbrake clutch permits the pilot to move the speedbrake lever and to override the auto speedbrake actuator at anytime.

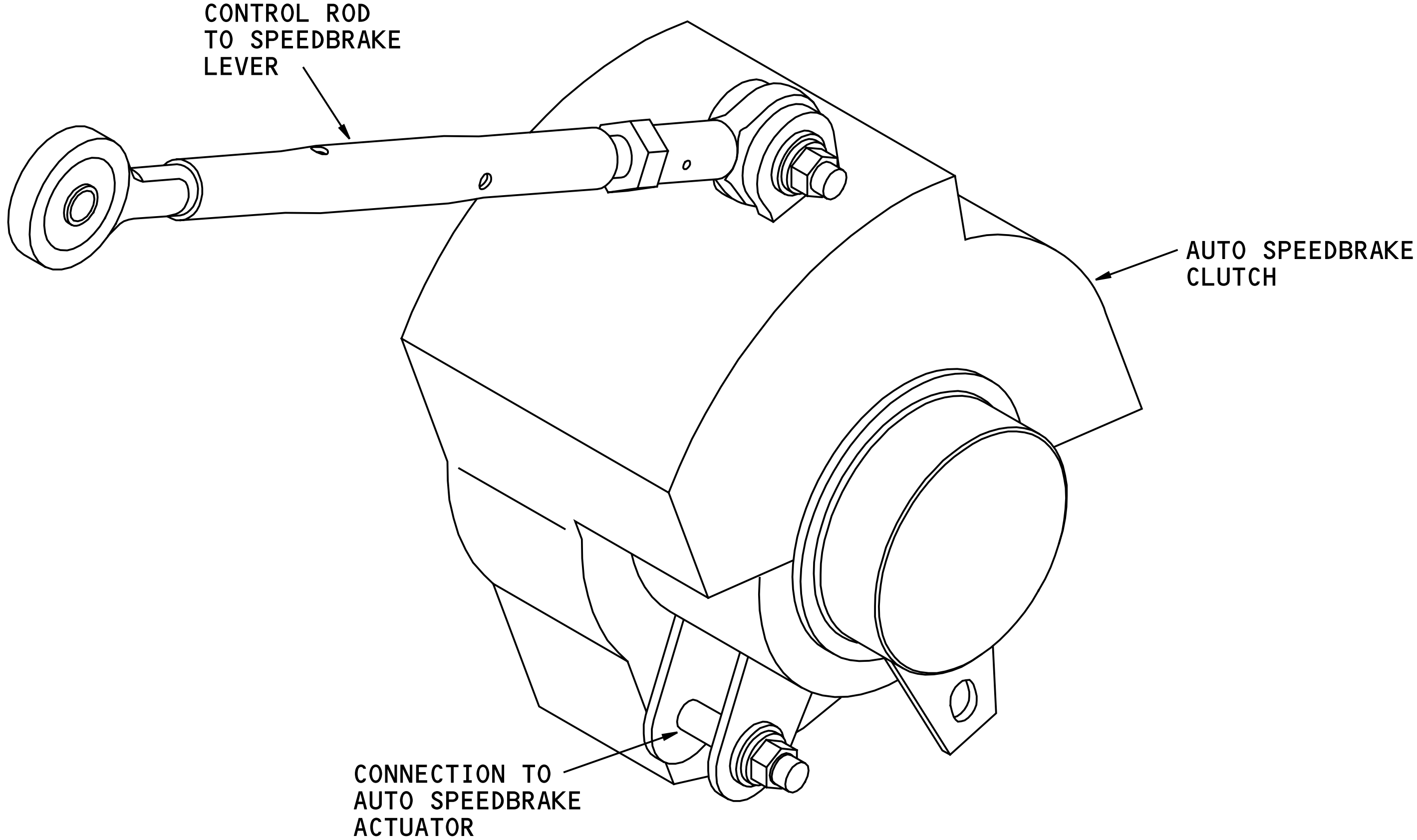
Physical Description

The auto speedbrake clutch attaches to the left support frame of the control stand. The speedbrake lever control rod attaches to the top lever of the auto speedbrake clutch. The auto speedbrake actuator attaches to the lower aft lever of the auto speedbrake clutch. The output shaft of the auto speedbrake clutch has a spline which connects to the shaft of the speedbrake lever transducer.

The auto speedbrake clutch is an LRU. It is not necessary to adjust the clutch. The clutch weighs about 2 lb (1.8 kg).

Location

The auto speedbrake clutch is on the left side of the control stand in the flight deck. Remove the left panel of the control stand to get access to the auto speedbrake clutch.



27-62-00-004 Rev 0

AUTO SPEEDBRAKE CONTROL - AUTO SPEEDBRAKE CLUTCH

AUTO SPEEDBRAKE CONTROL - RTO SPEEDBRAKE MECHANISM

Purpose

When the pilot commands reverse thrust, the RTO speedbrake mechanism lifts the speedbrake lever out of the DOWN detent and actuates the auto speedbrake thrust reverse switch. The PFC uses the auto speedbrake thrust reverse switch signal to command the auto speedbrake actuator to move the speedbrake lever to the UP position.

Physical Description

The RTO speedbrake mechanism consists of a pair of cam followers, each actuated by a thrust lever cam. Either cam follower turns the speedbrake lever lifter drive segment. The lifter drive segment connects with the speedbrake lever lifter assembly. A return spring returns the lifter to the down position when the thrust reverser lever moves to the idle position.

A switch adjust screw at the rear of the lifter assembly operates the auto speedbrake thrust reverse switch.

Location

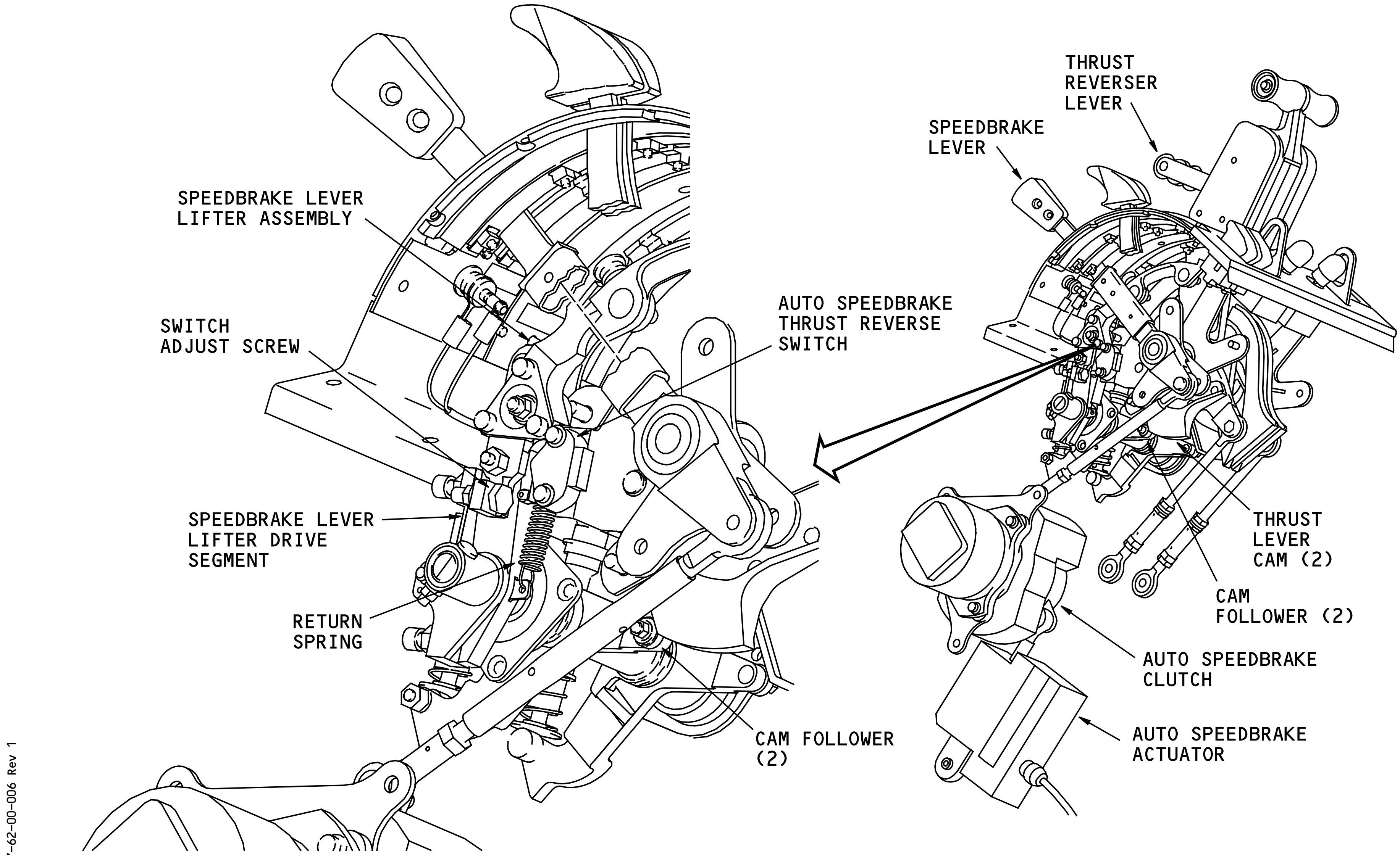
The RTO speedbrake mechanism is on the left frame of the thrust lever assembly in the control stand. Remove the left access panel of the control stand to access the RTO speedbrake mechanism.

Functional Description

When the pilot moves either or both thrust reverser levers, one or both thrust lever cams cause the cam followers to turn. This also turns the speedbrake lever lifter drive segment and causes the speedbrake lever lifter assembly to move. As the speedbrake lever lifter assembly turns, it lifts the speedbrake lever out of the DOWN detent. The switch adjust screw at the rear of the lifter assembly then contacts and actuates the auto speedbrake thrust reverse switch.

Training Information Point

The switch adjust screw at the back of the speedbrake lever lifter assembly is adjustable.



AUTO SPEEDBRAKE CONTROL - RTO SPEEDBRAKE MECHANISM

AUTO SPEEDBRAKE CONTROL - FUNCTIONAL DESCRIPTION

General

The PFCs control the extension and retraction of the auto speedbrake actuator. The auto speedbrake operates only when the PFCs are in normal mode. The PFCs send extend command signals to the L1 and R ACEs. These ACEs control two auto speedbrake relays.

The L1 ACE energizes the auto speedbrake control relay and the R ACE energizes the auto speedbrake arm relay. Both relays need to be energized to command the auto speedbrake actuator to extend. Both relays need to be de-energized to command the auto speedbrake actuator to retract.

If one relay is energized while the other is de-energized, the auto speedbrake actuator stops.

Auto Speedbrake Actuator

Two sets of limit switches control electrical power to the motor. The actuator position controls the limit switches. As the actuator starts to extend, the fully retracted switch operates. The fully extended switch operates only when the actuator has fully extended. The reverse happens during retraction.

The fully retracted switch has contacts that supply the L1 ACE and PFCs with the actuator status.

Auto Speedbrake Operation During Landing

During landing, the auto speedbrake operates when all these conditions occur:

- The main landing gear is on the ground
- The speedbrake lever is in the ARMED position
- Both left and right thrust resolver angles are not at the takeoff position
- Both thrust resolver angle signals are valid.

Before landing, the pilots arm the speedbrake lever. During the flare, the pilots move both thrust levers to idle. At touch down, the auto speedbrake actuator fully extends the speedbrake lever. This commands all spoilers to fully deploy.

The auto speedbrake retracts to the DOWN position if any of the above conditions changes after the auto speedbrake has fully extended.

The auto speedbrake retracts to the ARMED position if any of the above conditions changes when the auto speedbrake has partially extended.

Auto Speedbrake Operation During RTO

During a refused takeoff (RTO), the auto speedbrake operates when all these conditions happen:

- The main landing gear is on the ground
- Either engine thrust reverser is operated

AUTO SPEEDBRAKE CONTROL - FUNCTIONAL DESCRIPTION

- The thrust resolver angle signal that is operated is valid.

The auto speedbrake also operates during RTO when all these conditions happen:

- The main landing gear is on the ground
- The auto speedbrake thrust reverser switch is closed
- The auto speedbrake thrust reverser switch signal is valid
- There is no disagreement fault between the auto speedbrake thrust reverser switch and the thrust resolver angle signal.

During a RTO, when the pilot moves at least one of the thrust reverser levers, the auto speedbrake extends the speedbrake lever. This commands all spoilers to fully deploy.

The auto speedbrake retracts to the DOWN position if any of the above conditions changes after the auto speedbrake has extended.

Main Landing Gear On Ground

One of the conditions for the auto speedbrake actuator to extend is that the main landing gear is on the ground.

The PFCs determine that the main landing gear is on the ground from a combination of signals received through the AIMS.

During approach, the main landing gear is extended and the main gear trucks tilted by hydraulic pressure. On touch down, the main landing gear is on the ground when the main gear trucks are not tilted with hydraulic pressure on the truck tilt actuators. The radio altimeter signals verify that the main landing gear is on the ground.

The weight-on-wheel cards supply signals when the airplane is on the ground. These signals verify that the main landing gear is on the ground during RTO.

Indications

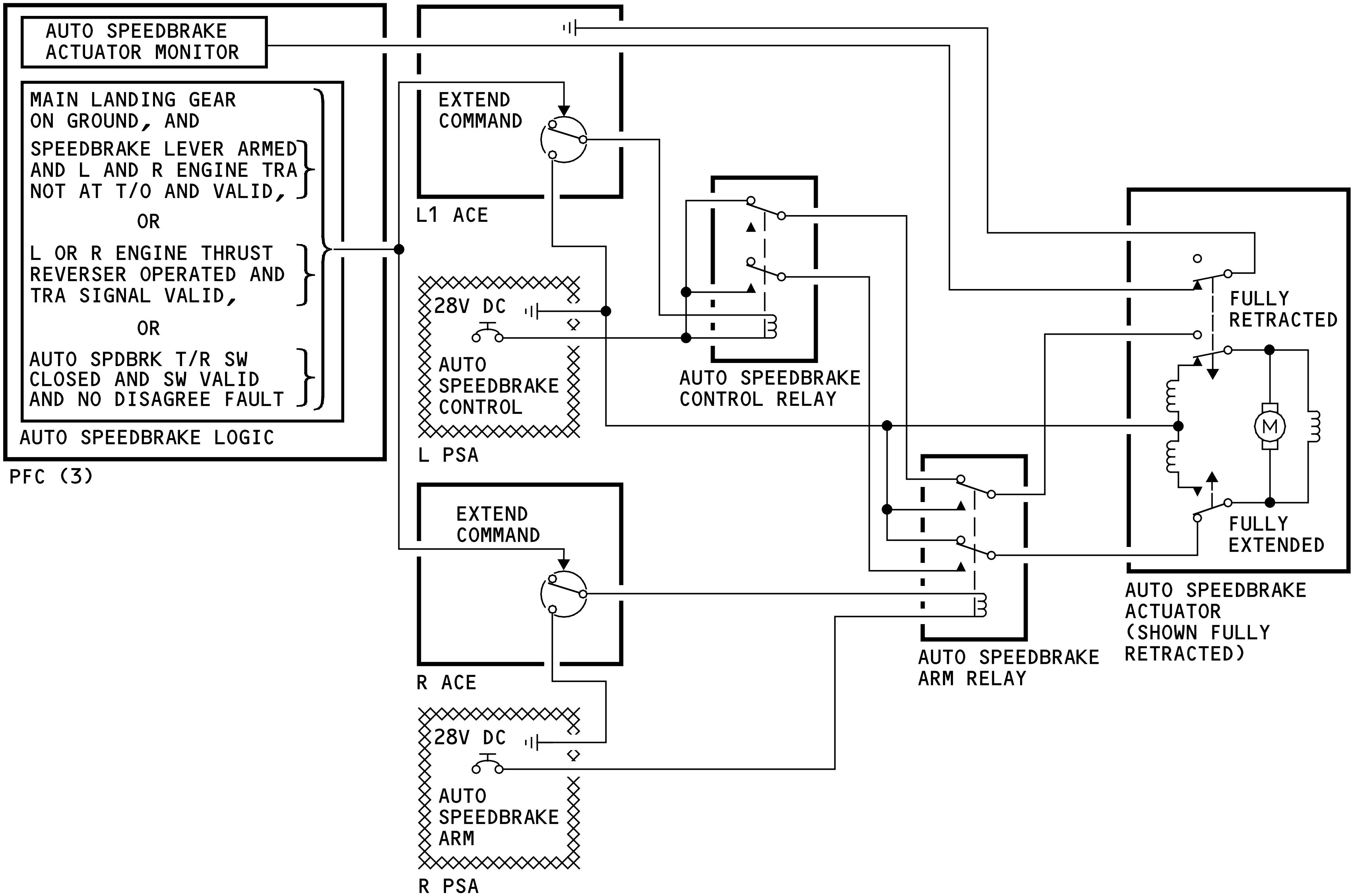
The EICAS advisory and status messages AUTO SPEEDBRAKE indicate that the auto speedbrake is defective and does not operate. This happens when one of these conditions is present:

- Either L1 ACE or R ACE is defective
- The auto speedbrake actuator does not retract within 2 seconds of command
- The auto speedbrake actuator stays retracted for 2 seconds after a command to extend
- Loss of data from one thrust resolver angle with the related engine running
- Loss of data from both thrust resolver angles
- Loss of valid data of the truck tilt pressure transducers from both the L and R HYDIM cards
- Loss of valid truck tilt position data from either PSEU 1 or PSEU 2
- The center hydraulic system is failed

AUTO SPEEDBRAKE CONTROL - FUNCTIONAL DESCRIPTION

- The truck tilt pressure is low with the main landing gear down and locked and the center hydraulic system pressure is high
- The radio altitude data is not valid
- The PFCS is not in normal mode.

Although the operation of the auto speedbrake is available only in normal mode, these conditions cause the message to show in normal, secondary and direct mode.



AUTO SPEEDBRAKE CONTROL - FUNCTIONAL DESCRIPTION

27-62-00-007 Rev 3

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RUDDER CONTROL - INTRODUCTION

General

The rudder controls the flight attitude of the airplane about the vertical axis.

The rudder hinges on the rear spar of the vertical stabilizer. A rudder tab increases the effect of the rudder. The rudder tab moves further in the same direction as the rudder.

Yaw Control

The pilots make a manual yaw correction with the rudder pedals. The autopilot does not control the rudder during most phases of flight. When the autopilot is engaged during the approach and landing phases of flight, the autoland function commands the rudder. The backdrive actuators then backdrive the rudder pedals.

Rudder Ratio

During flight, the rudder ratio function reduces the movement of the rudder as the airspeed increases. The primary flight computers (PFCs) command the rudder ratio function of the yaw control.

Yaw Damper

The PFCs control the conventional yaw damper and turn coordination functions of the rudder.

Wheel-Rudder Cross-Tie

The wheel-rudder cross-tie function moves the rudder in response to control wheel inputs when the airspeed is less than 210 knots. This makes roll and yaw control better during one-engine-out operation. It also lets the pilot control yaw caused by an engine failure with the control wheel.

Gust Suppression

A gust suppression function reduces the effects of air gusts on the vertical stabilizer.

Modal Suppression Function

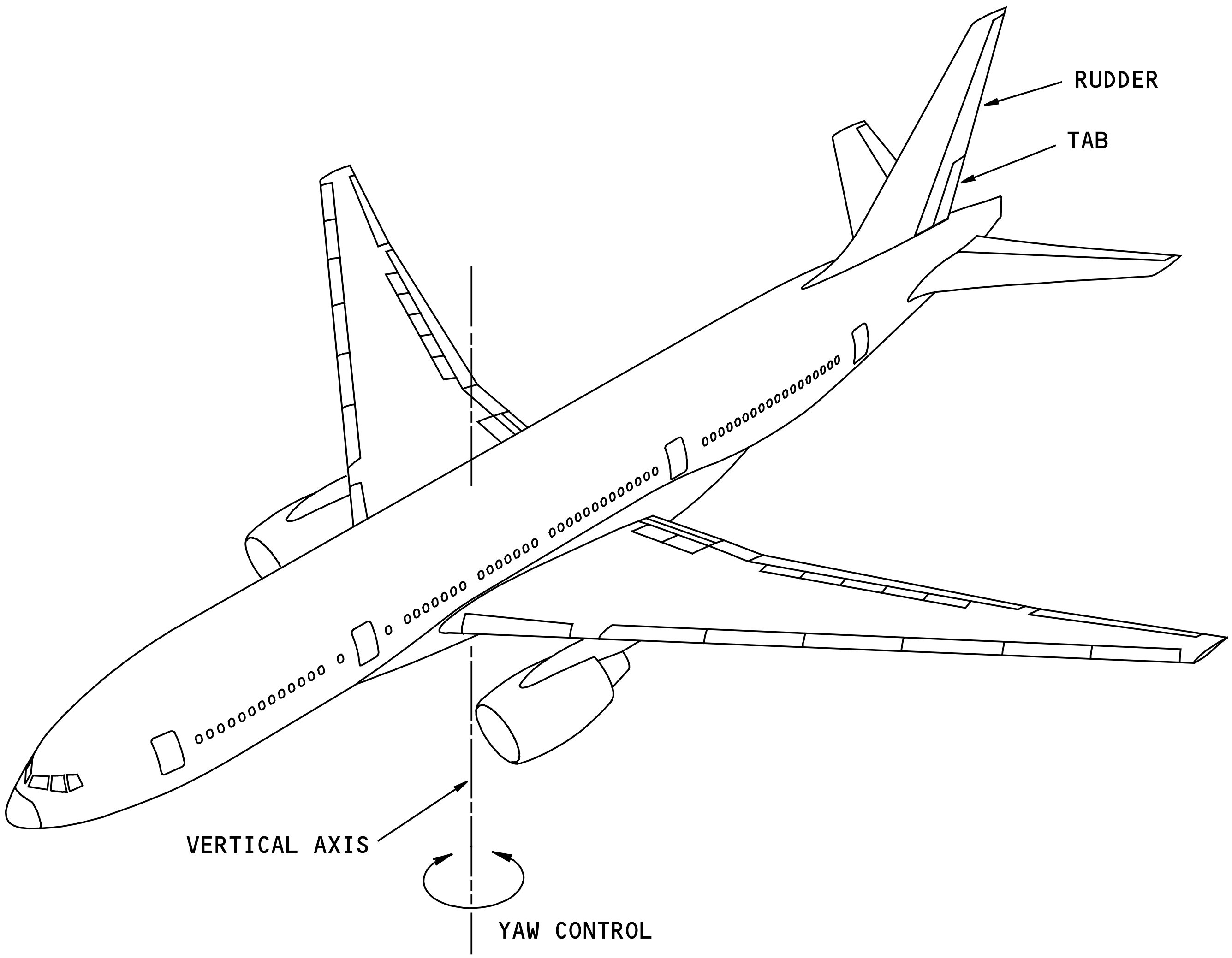
A modal suppression function reduces the forward and aft body lateral movements.

Abbreviations and Acronyms

ACE	- actuator control electronics
ACMS	- airplane condition monitoring system
ADIRS	- air data inertial reference system
ADIRU	- air data inertial reference unit
AFDC	- autopilot flight director computer
AFDS	- autopilot flight director system
AIMS	- airplane information management system
ARINC	- Aeronautical Radio, Inc.
CAS	- computed airspeed
CMCS	- central maintenance computing system
CPU	- central processing unit

RUDDER CONTROL - INTRODUCTION

EDIU	- engine data interface unit
EEC	- electronic engine control
EHSV	- electrohydraulic servo valve
EICAS	- engine indication and crew alerting system
FSEU	- flap/slat electronics unit
GSE	- ground support equipment
HLCS	- high lift control system
LRU	- line replaceable unit
LVDT	- linear variable differential transformer
MEC	- main equipment center
MFD	- multi-function display
PCU	- power control unit
PFC	- primary flight computer
PFCS	- primary flight control system
PFD	- primary flight display
PSAS	- pitch stability augmentation system
PSEU	- proximity sensor electronic unit
RVDT	- rotary variable differential transformer
SAARU	- secondary attitude air data reference unit
TAC	- thrust asymmetry compensation
WEU	- warning electronic unit
WOW	- weight-on-wheels



27-21-00-001 Rev 2

RUDDER CONTROL - INTRODUCTION

RUDDER CONTROL- GENERAL DESCRIPTION

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RUDDER CONTROL- GENERAL DESCRIPTION

General

The pilots manually command the rudder; the autopilot automatically commands it.

Manual Operation - Rudder Pedals

The flight crew uses two conventional rudder pedals to control yaw.

Four rudder pedal position transducers change the flight crew rudder pedal commands to analog electrical signals. These signals go to the four actuator control electronics (ACEs). The ACEs change the signals to digital format and send them to the three primary flight computers (PFCs) through the flight controls ARINC 629 buses.

The PFCs use position data from the rudder pedals, data from the air data inertial reference unit (ADIRU) and the airplane information management system (AIMS), to calculate control surface commands. The PFCs send the digital commands to the ACEs, which change them to analog signals. The ACEs send the analog position commands to the power control units (PCUs), which move the rudder. The position transducers on the PCU actuator pistons supply position feedback to the ACEs.

Two gust suppression pressure transducers measure wind gusts on the vertical stabilizer. The transducer signals go to the ACEs and then to the PFCs through the flight controls ARINC 629 buses. The PFCs command the rudder PCUs to move. This movement of the rudder reduces the effect of the side gust.

Two modal accelerometers measure the lateral movement of the aft fuselage. The accelerometer signals go to the ACEs and then to the PFCs through the flight control ARINC 629 buses. The PFCs calculate command signals for the ACEs to move the rudder PCUs to decrease the lateral movement of the forward and aft cabin.

The PFCs operate the yaw damper and rudder ratio functions.

Manual Operation - Rudder Trim

The rudder trim control, on the aisle stand, and the trim actuator let the flight crew trim out unwanted rudder pedal forces. When the pilots move the rudder trim control, the switch sends a signal to the ACEs and the PFCs. The PFCs and the ACEs command the rudder trim actuator to move the rudder pedals and the position transducers through the feel and centering mechanism. The rudder pedal position transducers send a signal to the ACEs and PFCs to move the rudder.

The rudder trim indicator, also on the aisle stand, shows the position of the rudder trim. The rudder trim actuator position transducer sends a feedback signal to the ACEs and the PFCs. The PFCs then command the trim indicator through AIMS.

RUDDER CONTROL- GENERAL DESCRIPTION

The rudder manual trim cancel switch, on the aisle stand, sends a signal to the ACEs and the PFCs to command the rudder trim to zero.

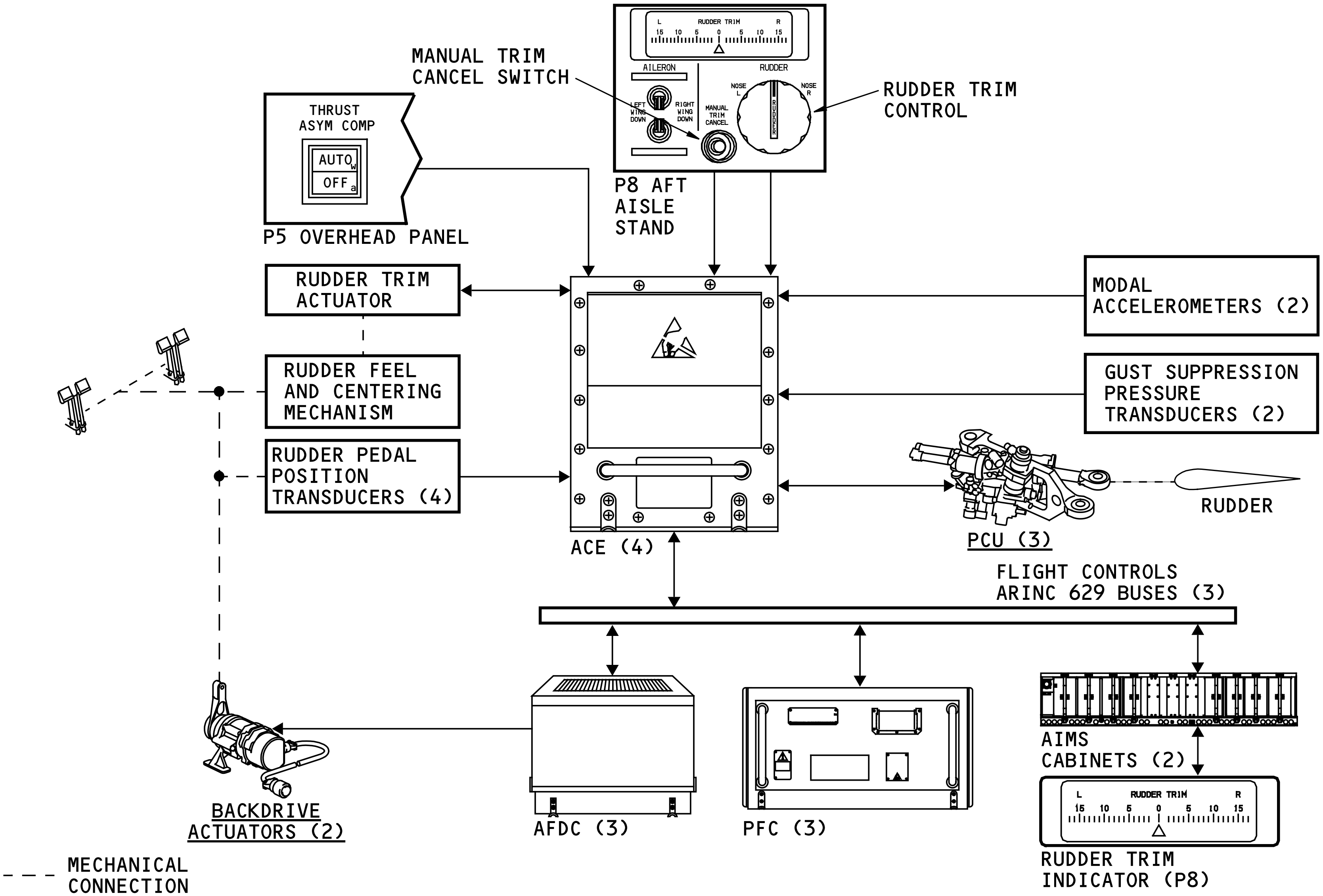
When the thrust asymmetry compensation (TAC) switch on the P5 panel is in the AUTO position, the PFCs automatically control the rudder trim. This control is to make allowance for asymmetrical thrust from the engines. The TAC function does not operate when the TAC switch is in the OFF position. The manual trim cancel switch does not remove any rudder trim caused by TAC.

Autopilot Operation

When autoland is active, the autopilot flight director computers (AFDCs) control the yaw attitude of the airplane for crosswind and engine-out conditions. The AFDCs supply yaw commands to the PFCs through the flight controls ARINC 629 buses. The PFCs use these inputs to calculate position commands for the rudder.

The PFCs also calculate rudder pedal backdrive commands. The PFCs send these commands to the AFDCs, which transmit rudder movement commands to the backdrive actuators. The backdrive actuators move the rudder pedals to a position to match the autopilot rudder command.

To override the autopilot, the flight crew applies more force on the rudder pedals than the backdrive actuator force. A pilot override disengages the autopilot.



RUDDER CONTROL– GENERAL DESCRIPTION

RUDDER CONTROL- COMPONENT LOCATIONS

General

The rudder control components are in three areas:

- The vertical stabilizer
- The flight deck
- Below the flight deck floor.

Tail Components

The rudder control surface and the rudder PCUs are on the vertical stabilizer. The rudder tab is aft of the rudder. Three PCUs directly connect to the rudder. Access to the PCUs is by access panels on the left side of the vertical stabilizer.

The two gust suppression pressure transducers are near the leading edge of the vertical stabilizer at about half span.

The two modal accelerometers are in the aft fuselage.

Flight Deck Components

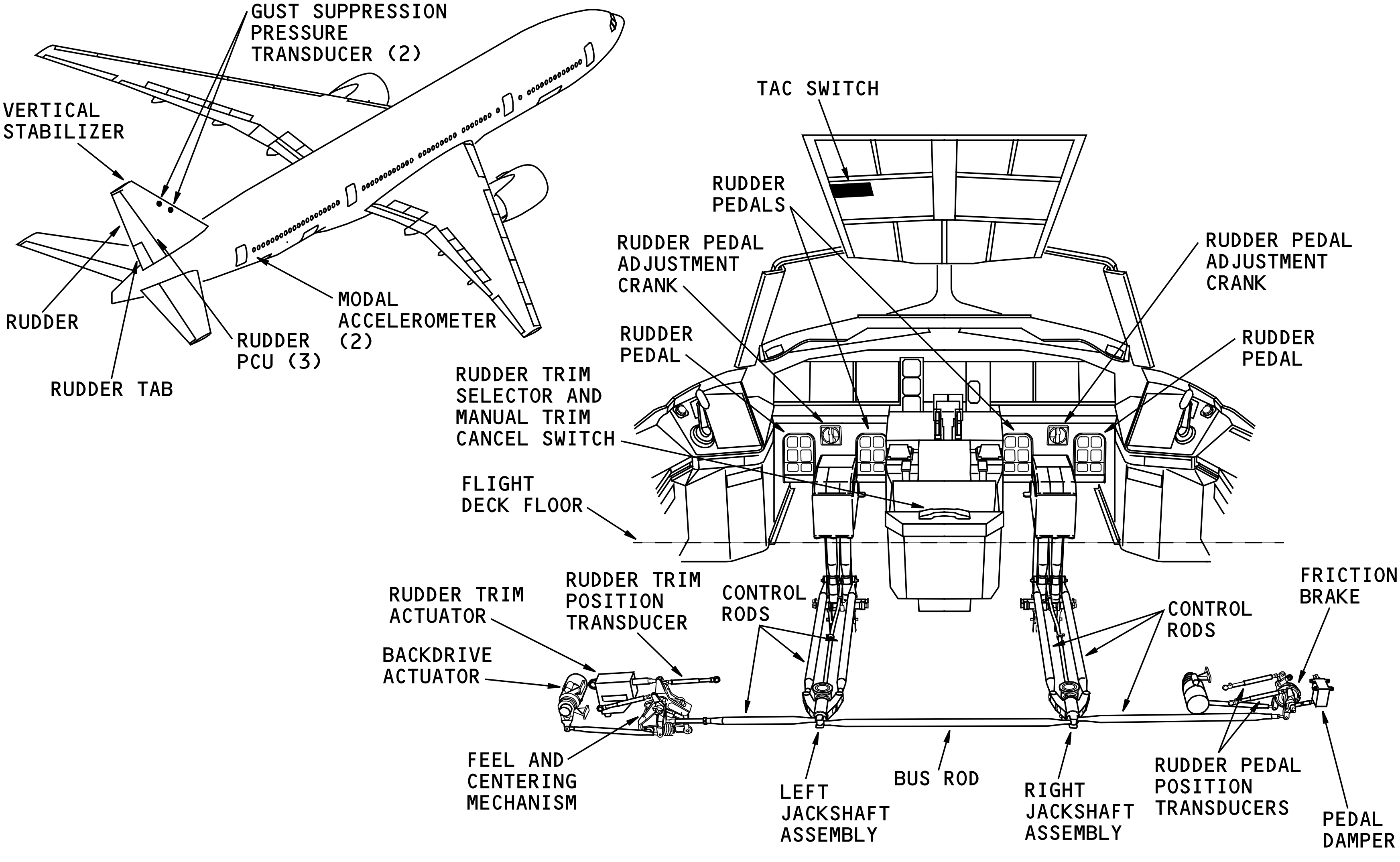
The rudder pedals, the rudder pedal adjustment cranks, the rudder trim selector and the manual trim cancel switch are in the flight deck. The rudder trim selector and the manual trim cancel switch are on the P8 aft aisle stand. The TAC switch is on the P5 overhead panel.

Components Below the Flight Deck

The rest of the forward controls are below the flight deck floor and above the nose gear wheel well. These are the:

- Control rods
- Left and right jackshaft assemblies
- Bus rod
- Rudder Feel and centering mechanism
- Rudder trim actuator
- Rudder trim position transducer
- Rudder pedal position transducers
- Pedal damper
- Friction brake
- Backdrive actuators.

Access to these components is through the forward equipment center.



NOTE: CONTROL WHEELS AND CONTROL COLUMNS NOT SHOWN FOR CLARITY.

27-21-00-003 Rev 2 03/31/95

RUDDER CONTROL- COMPONENT LOCATIONS

RUDDER CONTROL - ANALOG AND DISCRETE INTERFACES

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RUDDER CONTROL - ANALOG AND DISCRETE INTERFACES

General

All of the rudder control electrical interfaces in the PFCS go through the ACEs. The ACEs have interfaces with these components:

- Thrust asymmetry compensation switch
- Rudder pedal position transducers
- Rudder trim selector
- Manual trim cancel switch
- Rudder trim actuator
- Rudder trim position transducer
- Gust suppression pressure transducers
- Modal accelerometers
- Rudder PCUs.

The rudder trim actuator connects mechanically with the rudder pedal control system.

Thrust Asymmetry Compensation Switch

The thrust asymmetry compensation (TAC) switch supplies a discrete signal to the C ACE. When the TAC switch is in the AUTO position, the PFCs automatically control the rudder trim actuator to make allowance for asymmetric thrust. TAC does not operate when the TAC switch is in the OFF position.

Rudder Pedal Position Transducers

There are four rudder pedal position transducers, two for each rudder pedal set. Each transducer is a linear variable differential transformer (LVDT) that sends analog signals to the ACEs. These analog signals are in proportion to the rudder pedal position and their movement.

Rudder Trim Selector, Manual Trim Cancel Switch, Trim Actuator and Position Transducer

The rotary trim selector and the manual trim cancel switch supply discrete signals to the L1 and R ACEs. The ACEs transmit these signals to the PFCs. The PFCs then command through the ACEs the rudder trim actuator to move the rudder pedals and the position transducers. The rudder trim actuator sends a feedback signal to the ACE. The rudder trim position transducer also sends a trim position signal to the ACE.

Gust Suppression Pressure Transducers

Two gust suppression pressure transducers, in the vertical stabilizer, supply analog signals to the L1 and C ACEs. These signals represent the differential pressure across the vertical stabilizer. This is a measure of the aerodynamic force.

Modal Accelerometers

Two modal accelerometers, in the aft body, supply analog signals to the L2 and R ACEs. These signals represent the lateral acceleration of the aft body movement.

RUDDER CONTROL - ANALOG AND DISCRETE INTERFACES

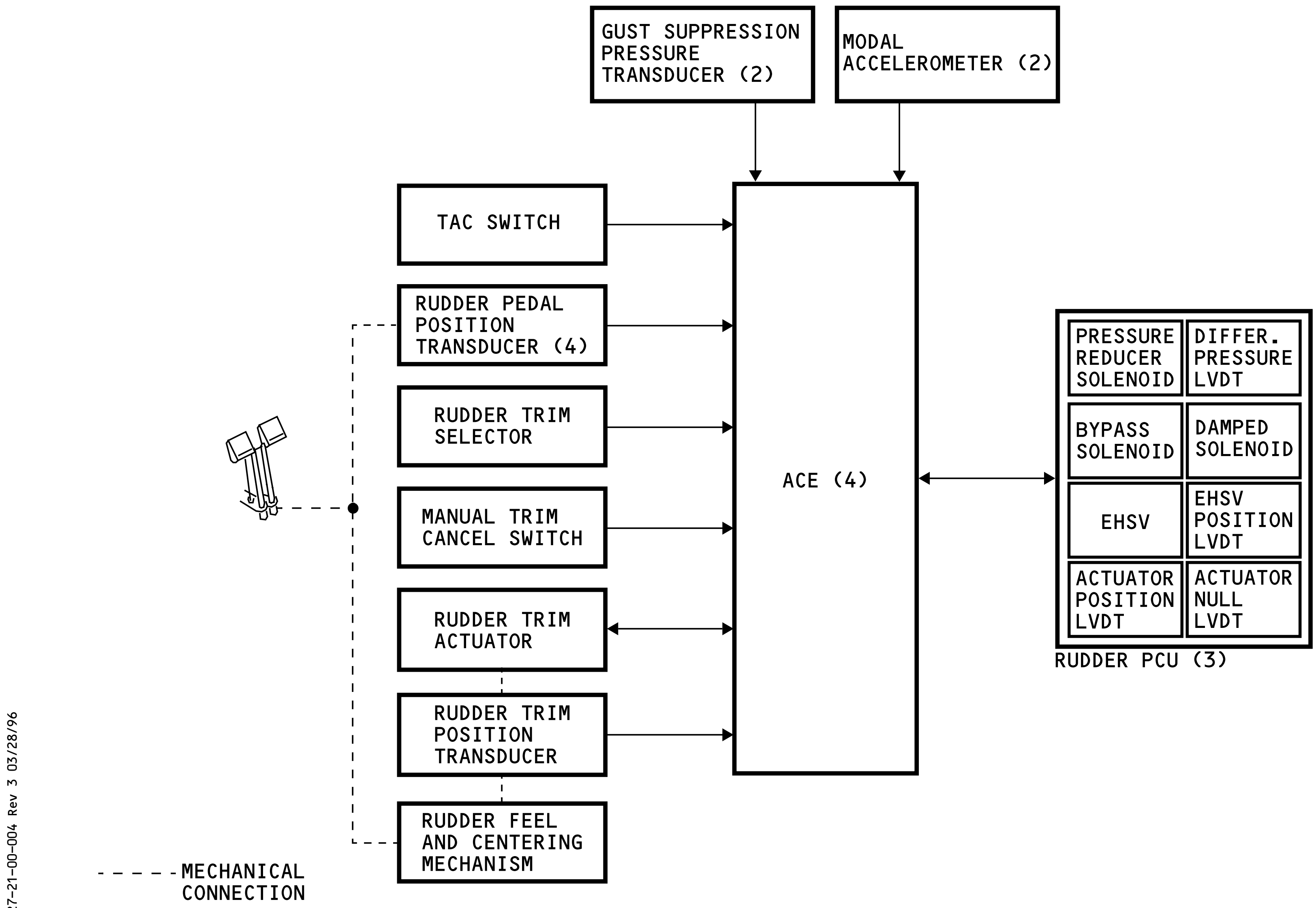
Rudder PCUs

Each of the three rudder PCUs receives analog and discrete electrical signals from the ACEs. The discrete signals go to:

- The pressure reducer solenoid
- The bypass solenoid
- The damped solenoid.

The analog signal goes to the electrohydraulic servo valve (EHSV).

Each of the three rudder PCUs sends analog feedback signals to the ACEs. These signals are from the EHSV position LVDT, the actuator position LVDT, the actuator null LVDT and the differential pressure LVDT.



RUDDER CONTROL - ANALOG AND DISCRETE INTERFACES

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RUDDER CONTROL - FORWARD CONTROLS

General

The forward controls of the rudder control system include:

- The rudder pedal arms and jackshaft assemblies
- The rudder pedal position transducers
- The backdrive actuators
- The feel and centering mechanism
- The rudder trim actuator
- The friction brake
- The pedal damper
- The connection to the nose wheel steering
- The travel stops.

Rudder Pedal Arms and Jackshaft Assemblies

The rudder pedal arms connect by control rods to the jackshaft assemblies. The two jackshaft assemblies connect with a bus rod. Each jackshaft assembly contains a rudder pedal adjustment mechanism to permit each pilot to adjust the pedals to the most comfortable position.

Each jackshaft assembly connects with control rods and cranks to the left and right shaft assemblies.

There is no jam override mechanism for the rudder pedals. However, the control rods that connect the pedals to the jackshaft assemblies each have a one-way pogo. These supply some relief from jams that may occur as a result of a bird strike through the forward bulkhead.

Rudder Pedal Position Transducers

Four rudder pedal position transducers, installed on the airframe structure, connect to cranks on the left and right shaft assemblies.

Backdrive Actuators

Two backdrive actuators connect to a crank on the left and right shaft assemblies. The backdrive actuators are part of the autopilot system.

See the autopilot flight director system section for more information on the backdrive actuators (AMM PART I 22-11).

Feel and Centering Mechanism

The feel and centering mechanism is on the left shaft assembly.

Rudder Trim Actuator

The rudder trim actuator connects to the feel and centering mechanism. The rudder trim position transducer connects to the lever of the rudder feel and centering mechanism.

Friction Brake

A friction brake connects with a crank to the right shaft assembly. The friction brake supplies a resistance to the movement of the rudder pedal control mechanism.

Pedal Damper

A pedal damper connects with a crank to the right shaft assembly. The damper absorbs oscillations of the rudder pedal control mechanism.

Connection to Nose Wheel Steering

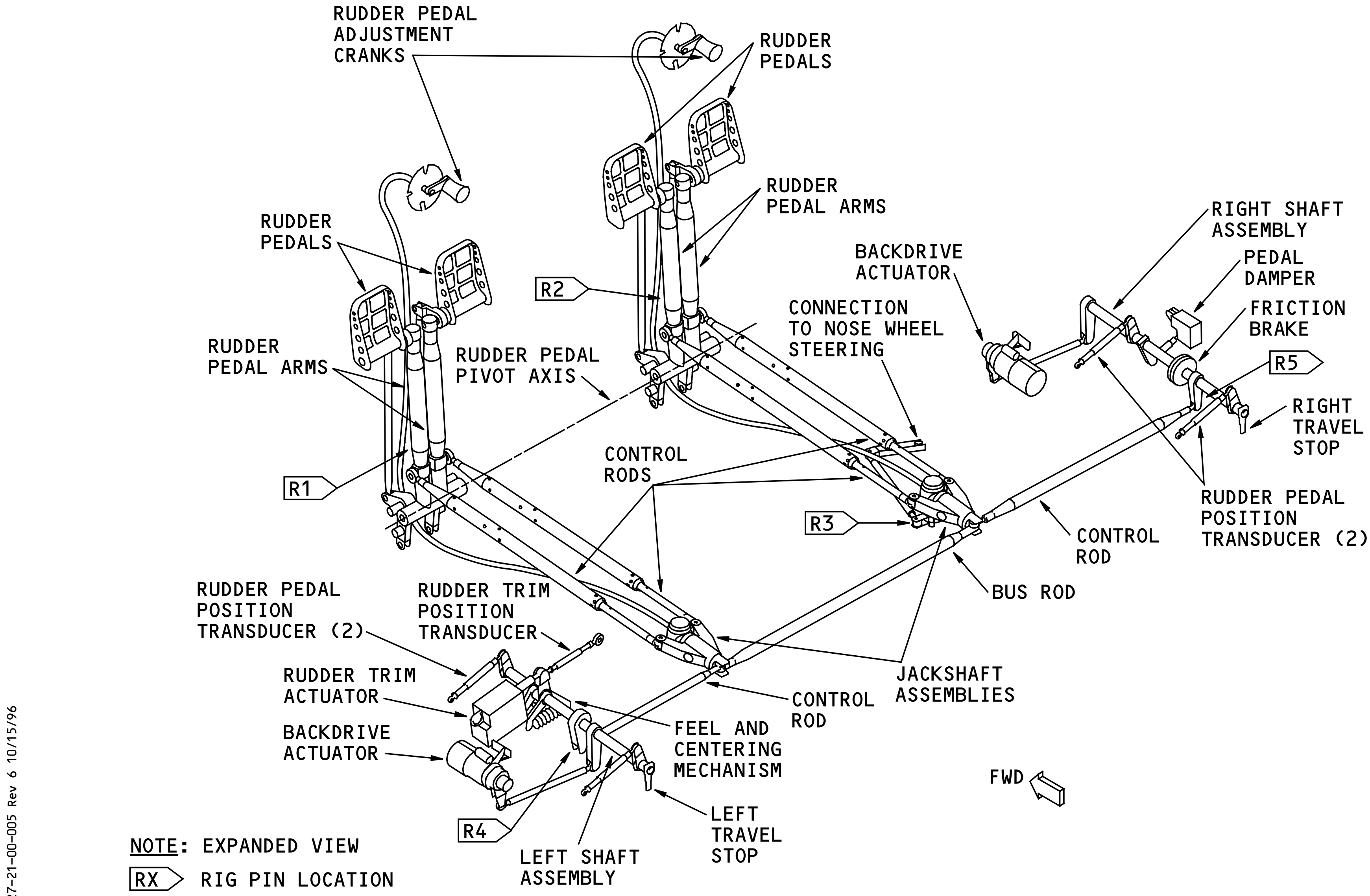
A crank and a connecting rod, from the right jackshaft assembly, supply the rudder pedal command to the nose wheel steering system. See the nose gear steering system section for more information (AMM PART I 32-51).

Travel Stops

Travel stops are at the aft end of the left and right shaft assemblies. They keep the movement of the rudder control system to a limit of 3.5 inches of rudder pedal movement in both directions.

Training Information Point

Rig pins lock the rudder forward controls during adjustment of the rudder control system.



RUDDER CONTROL - FORWARD CONTROLS

RUDDER CONTROL - FEEL AND CENTERING MECHANISM

Purpose

The rudder feel and centering mechanism supplies feel and centering forces to the yaw control system. The rudder trim actuator supplies rudder trim control. The rudder trim moves the neutral position of the rudder and the rudder pedals.

Physical Description

The feel and centering mechanism has a single cam and roller unit. The cam attaches by a spline to the left shaft assembly and turns with it. The follower assembly has a roller which rolls on the cam surface. An arm supports the follower assembly. The arm pivots on a lever bearing mounted on the left shaft assembly. The lever attaches to the trim actuator rod end. Two springs, between the lever and the arm of the follower assembly, keep the roller on the cam.

The rudder trim actuator attaches to the structure of the left shaft assembly. The rod end of the actuator connects to the lever of the feel and centering mechanism. The rudder trim position transducer also connects to the lever of the feel and centering mechanism.

Location

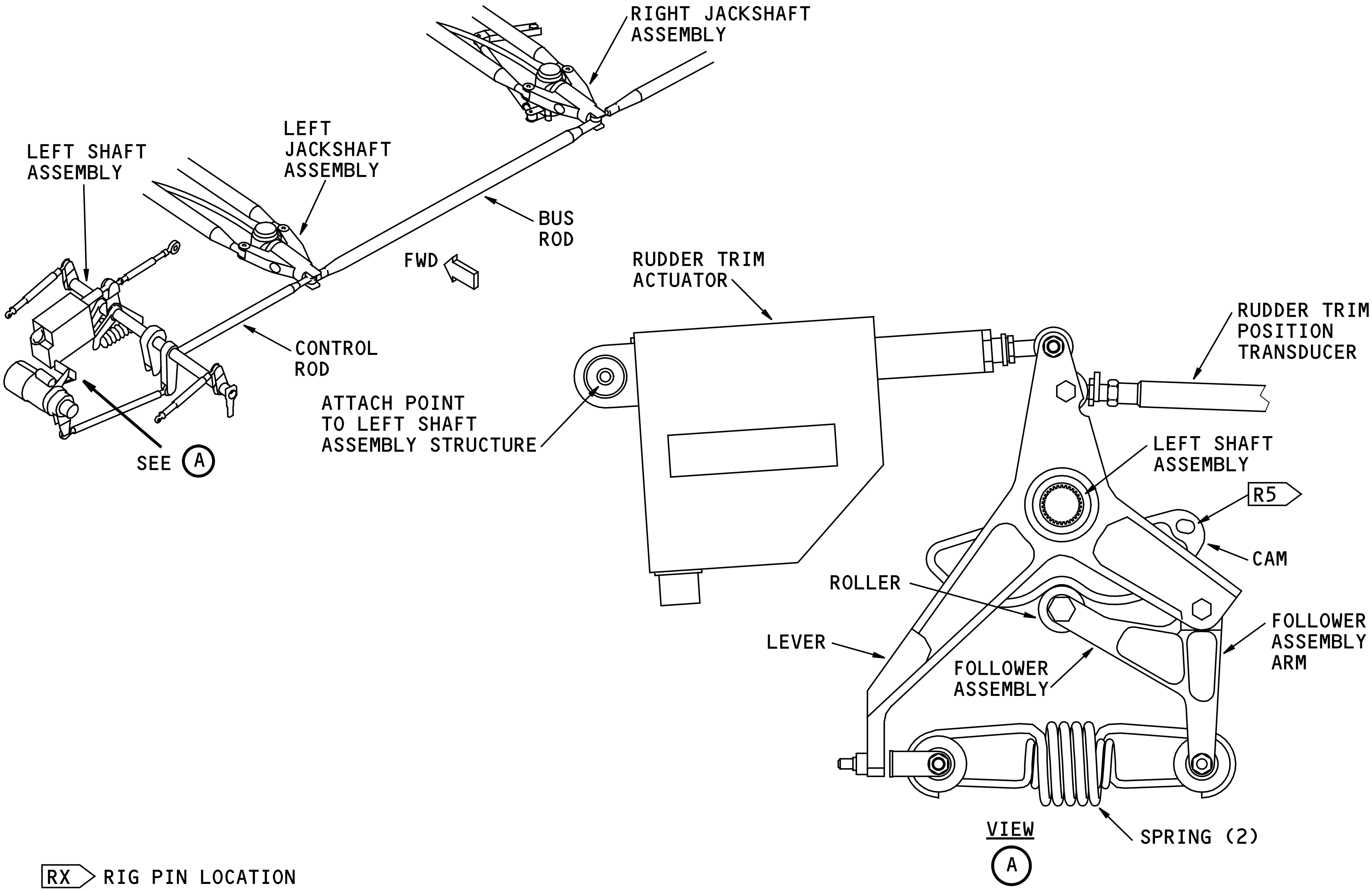
The feel and centering mechanism is in the mechanism of the left shaft assembly, between the flight deck floor and the nose gear wheel well. Access is through the MEC, then along the left side of the nose gear wheel well.

Functional Description

As the left shaft assembly and the cam turn, the cam follower moves, which extends the two springs. The springs supply a feel force to the rudder pedals. The feel force varies from 19.5 lb (8.8 kg) at breakout to a maximum of 50 lb (22.7 kg) at full displacement of the rudder pedals.

When the pilots release the rudder pedals, the springs force the cam follower back to the cam detent. This returns the system to the neutral trimmed position. The neutral, or zero feel force position, varies with trim input.

During trim operation, the rudder trim actuator moves the lever and the rudder trim position transducer, which then moves the arm and the cam follower assembly. Since the springs keep the cam follower in the cam detent, the trim actuator causes the cam and the left shaft assembly to turn. This also moves the rudder pedals and the rudder pedal position transducers.



27-21-00-009 Rev 1 03/27/95

RUDDER CONTROL - FEEL AND CENTERING MECHANISM

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RUDDER CONTROL - RUDDER TRIM CONTROLS AND TRIM ACTUATOR

Purpose

The pilots use two controls to adjust the trim of the airplane about the vertical axis. The two controls are the rudder trim control and the manual trim cancel switch.

The rudder trim control commands the direction and rate of rudder trim. The manual trim cancel switch commands the rudder to the center position and cancels any rudder trim input by the pilot. The manual trim cancel switch does not remove any rudder trim caused by TAC.

The rudder trim actuator extends and retracts to execute the pilot trim commands.

The rudder trim indicator shows the position of the rudder trim actuator.

Location

The two rudder trim controls are on the aft end of the P8 aft aisle stand. The rudder trim position indicator is in front of the trim switches.

The trim actuator is under the flight deck floor.

Trim Controls Physical Description

The rudder trim selector is a self-centering, dual-torque switch. It supplies the L1 and R ACEs with these electrical signals:

- Arm
- Trim direction (left or right)
- Trim rate.

The manual trim cancel switch is a momentary push button switch. It sends an electrical signal to the R ACE.

Trim Control Operation

When the pilot turns the rudder trim selector less than 25 degrees, the trim actuator does not move. When the pilot turns the trim selector more than 25 degrees, the trim actuator moves at 0.5 unit per second in the direction selected. When the pilot turns the trim selector more than 40 degrees with greater force, the trim actuator moves at 2 units per second in the direction selected.

When the pilot pushes on the manual trim cancel switch, it causes the rudder trim actuator to center the rudder control system at 2 units per second.

Rudder Trim Actuator Physical Description

The rudder trim actuator is a line replaceable unit (LRU). It weighs 4.1 lb (1.9 kg). Electrical commands limit the stroke of the actuator to 3 inches. Mechanical stops limit the actuator stroke to 3.2 inches.

RUDDER CONTROL - RUDDER TRIM CONTROLS AND TRIM ACTUATOR

Rudder Trim Position Indicator Physical Description

The rudder trim position indicator is an LRU. It weighs 1.7 lb (0.8 kg).

The rudder trim pointer shows the position of the rudder trim actuator. The indicator scale shows 17 units of actuator trim in both directions. Each unit of pointer movement is equivalent to about 1 degree of rudder movement at low airspeed.

Indications

The warning message CONFIG RUDDER shows on the EICAS display when all of these conditions occur:

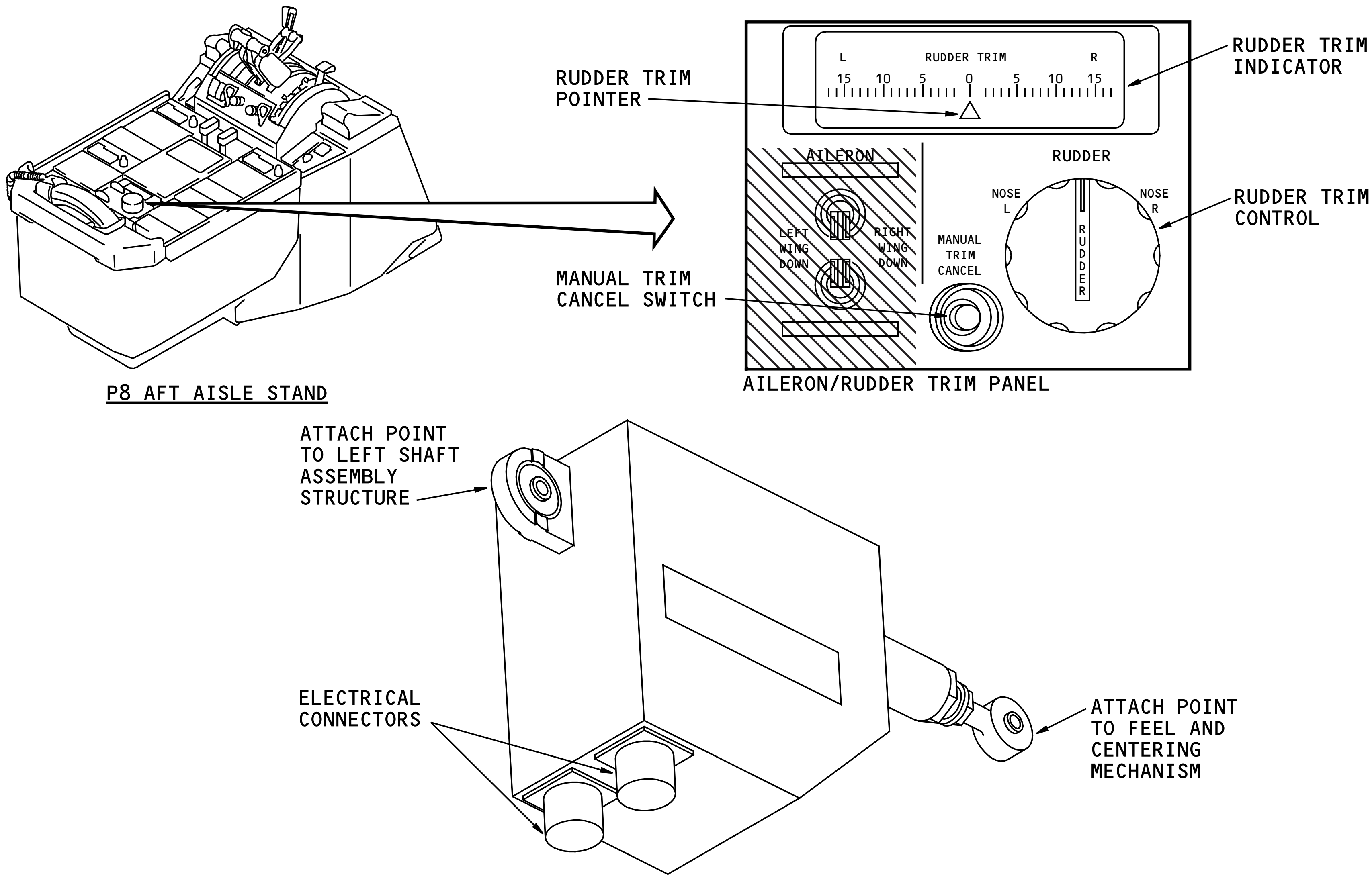
- The rudder trim is not within 2 units from center
- Either the left or right engine thrust is more than the takeoff threshold
- The airplane is on the ground.

The status message FLIGHT CONTROL SYS shows on the status display when the rudder trim system is defective.

Training Information Point

In case of a power supply failure to the indicator, the indicator pointer, scale, and nomenclature are not visible. In case of input signal loss, the indicator pointer is not visible but the scale and nomenclature stay visible.

There is an adjustment on the trim actuator rod end. You adjust the rudder trim actuator to make sure that the manual trim cancel switch function moves the trim actuator to the zero trim position.



RUDDER CONTROL - RUDDER TRIM CONTROLS AND TRIM ACTUATOR

27-21-00-010 Rev 5 07/02/1997

RUDDER CONTROL - RUDDER PEDAL POSITION TRANSDUCERS

Purpose

The four rudder pedal position transducers measure the position of the rudder pedals. The transducers send analog electrical signals to the ACEs.

Physical Description

Each position transducer is an LVDT. The ACEs supply 7v ac, 1800 Hz excitation power.

The four rudder pedal position transducers are identical to the six wheel position transducers, the six column position transducers and the rudder trim position transducer.

Two rudder pedal position transducers are on the right shaft assembly and two are on the left shaft assembly. The position transducers attach at one end to the support structure of the shaft assembly mechanisms. They attach to the transducer crank at the other end.

Each transducer crank attaches to its shaft assembly with a spline. The spline has a missing tooth to help locate the crank on the shaft. Each transducer crank has two shear rivets to allow override of a jammed position transducer.

Each position transducer has an electrical cable which connects to the ACE connector bracket. This bracket has two receptacles, one for each position transducer. The order in which each position transducer connects to the connector bracket determines the transducer-to-ACE relationship.

Location

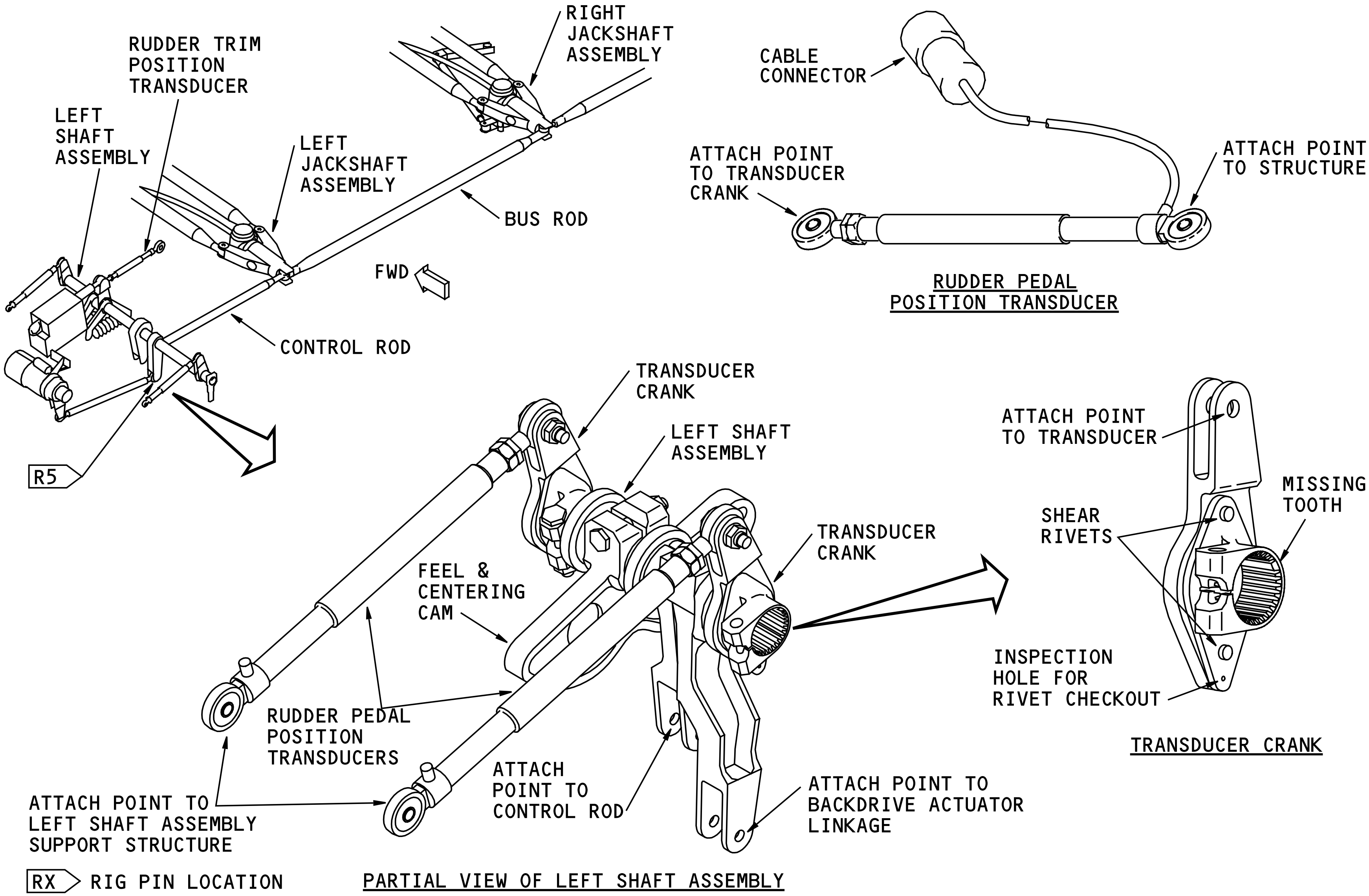
The four rudder pedal position transducers are outboard of the nose gear wheel well. Access is through the MEC, then along either side of the nose gear wheel well.

Functional Description

When the right and left shaft assemblies rotate in response to a rudder pedal command, the rudder pedal position transducers extend or retract. Each position transducer sends an analog electrical signal to one ACE.

Indications

When one or more pedal position transducer is defective, the status message FLIGHT CONTROL SYS shows.



RUDDER CONTROL - RUDDER PEDAL POSITION TRANSDUCERS

27-21-00-011 Rev 3 03/27/95

RUDDER CONTROL - MODAL ACCELEROMETERS

Purpose

The modal accelerometers measure the lateral acceleration of the aft fuselage. They send an analog signal to the ACEs.

The modal suppression function of the primary flight control system helps improve the quality of passenger ride in the forward and aft sections of the cabin.

Physical Description

There are two identical modal accelerometers. They are LRUs. Each accelerometer weighs about 0.8 lb (0.36 kg).

An electrical cable connects to a connector on each modal accelerometer.

Each modal accelerometer attaches to a support bracket.

Location

The modal accelerometers are on a cabin floor beam of the aft fuselage. One accelerometer is at each outboard side of the beam.

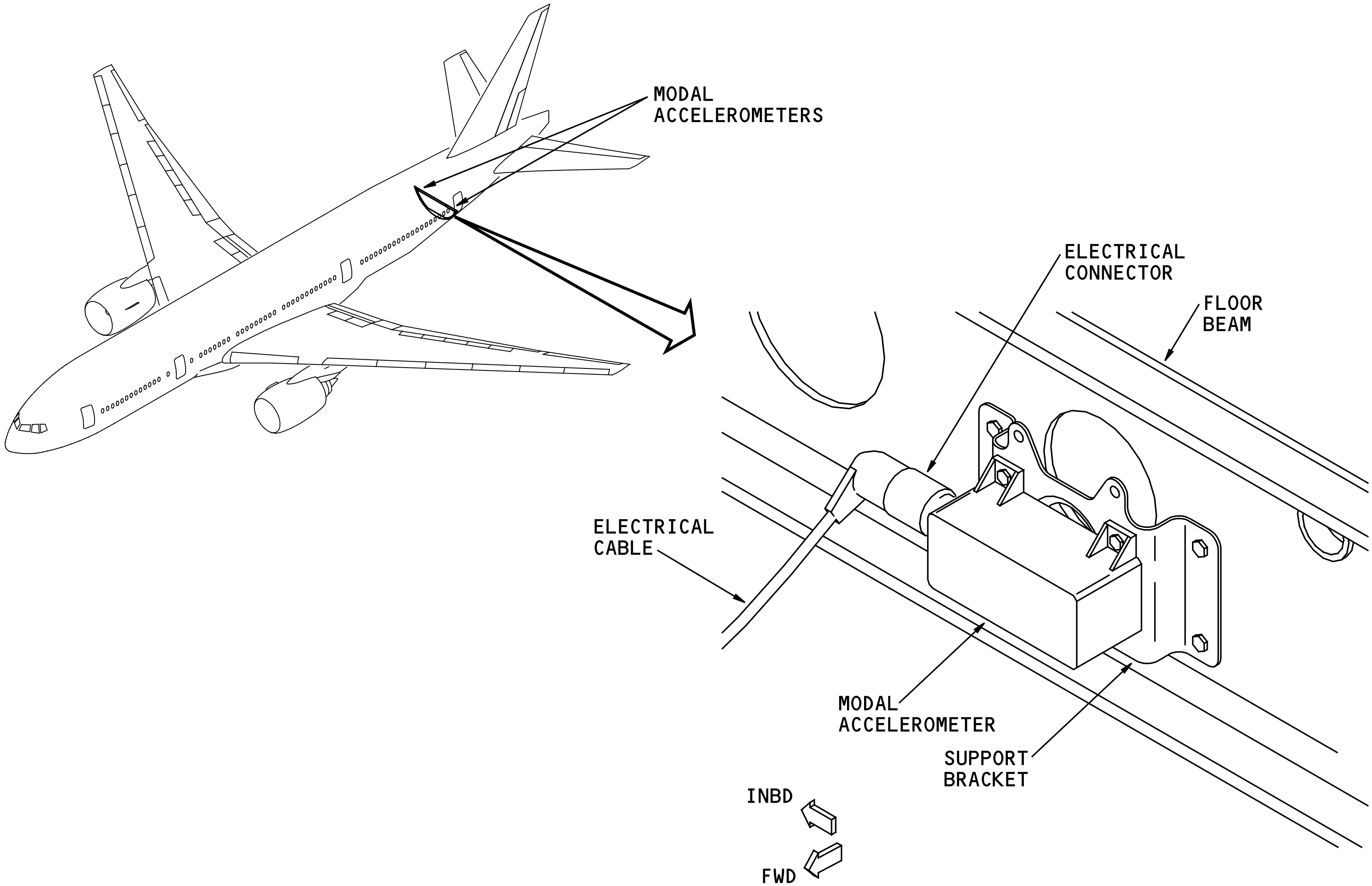
To get access to the modal accelerometers, it is necessary to remove the sidewall liners of the bulk cargo compartment. The modal accelerometers are outboard of the sidewall stanchions of the bulk cargo compartment.

Functional Description

Lateral movement of the aft fuselage causes a change of the analog signal from the modal accelerometer to the ACE.

Indications

There is no flight deck indication if one or both modal accelerometers are defective.



RUDDER CONTROL - MODAL ACCELEROMETERS

RUDDER CONTROL - GUST SUPPRESSION PRESSURE TRANSDUCERS

Purpose

The gust suppression pressure transducers measure the pressure difference between both sides of the vertical stabilizer. They also supply an electrical analog signal to the ACEs.

The gust suppression function helps improve the quality of passenger ride in the aft portion of the fuselage.

Physical Description

There are two identical pressure transducers and four identical pressure ports. The transducers and the ports are LRUs. Each transducer weighs about 2 lb (0.9 kg).

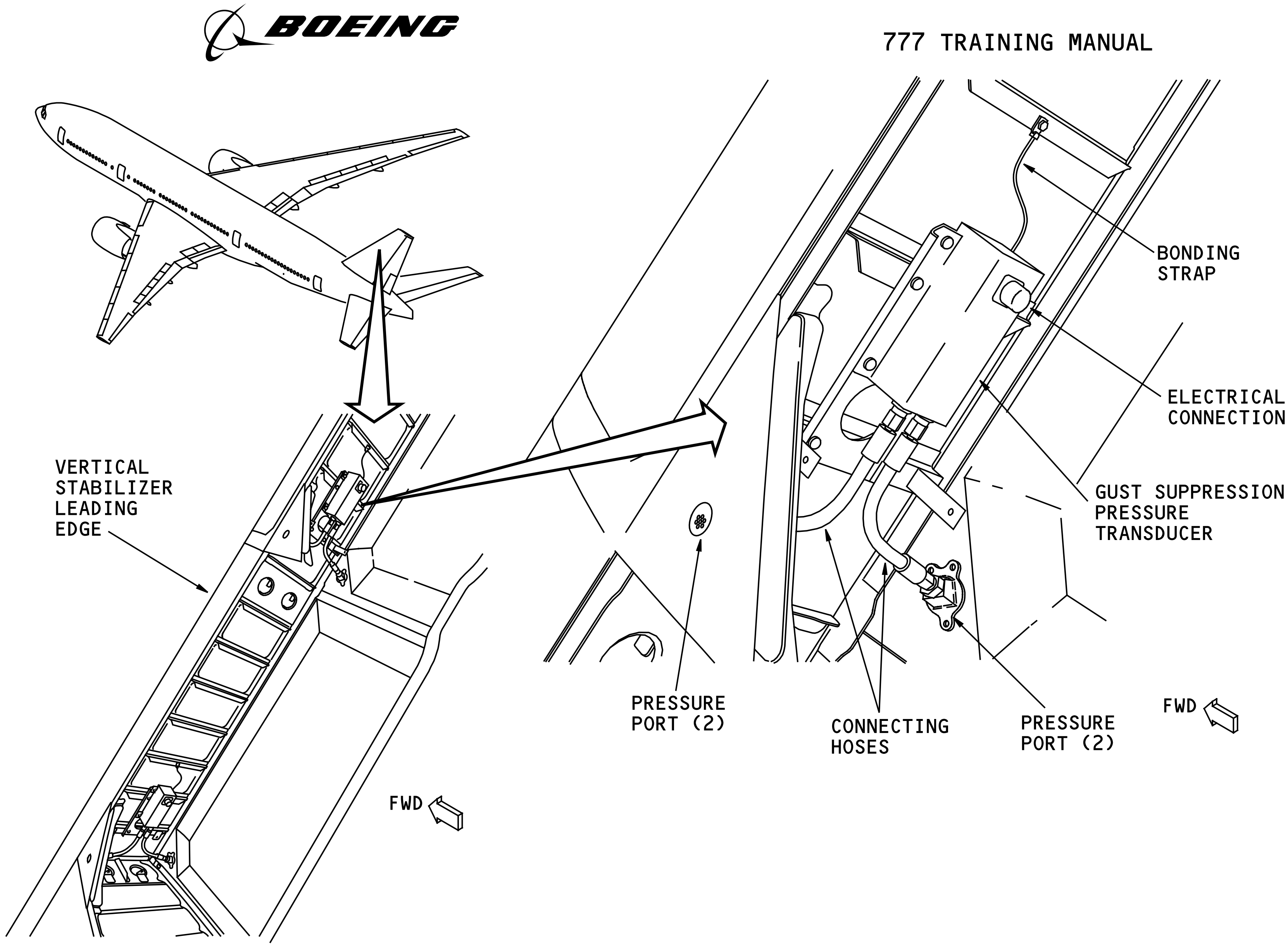
Each pressure transducer connects to two pressure ports. The ports are symmetrically positioned, one on each side of the vertical stabilizer. Non metallic hoses connect the ports to the pressure transducers. An electrical cable connects to one connector on the differential pressure transducer.

There is about 6 ft (1.83 m) separation between the two pressure transducers and their associated ports.

Location

The gust suppression pressure transducers are near the vertical stabilizer leading edge, on the aft side of the auxiliary spar. The ports are on the composite skin panels of the vertical stabilizer. The pressure transducers are above the pressure ports to permit drainage of moisture from the tubes and the ports.

To get access to each transducer, remove a skin panel of approximately 30 in x 48 in (0.76 m x 1.22 m) on the left side of the vertical fin.



27-21-00-014 Rev 2

RUDDER CONTROL - GUST SUPPRESSION PRESSURE TRANSDUCERS

RUDDER CONTROL - RUDDER PCU - INTRODUCTION

Purpose

Three rudder PCUs move the rudder. Electrical signals from the ACEs command the rudder PCUs. Each rudder PCU operates with hydraulic power from a different hydraulic system.

Location

The rudder PCUs are on the rear spar of the vertical stabilizer. Remove three panels on the left side of the vertical stabilizer to access the PCUs. Each panel is approximately 20 in x 20 in (0.5 m x 0.5 m).

Physical Description

The kick link connects the PCU to the rear spar fitting. The actuator rod and the reaction link connect to the rudder PCU fitting.

Two electrical connectors of different sizes connect to the lower side of the PCU.

Hydraulic tubing connects to ports on the upper side of the PCU.

The right hydraulic system supplies power to the lower rudder PCU, the left hydraulic system to the middle PCU, and the center hydraulic system to the upper PCU.

A rate fuse is on the center hydraulic system supply line to the upper PCU. A check valve is on the return line from the upper PCU to the center system.

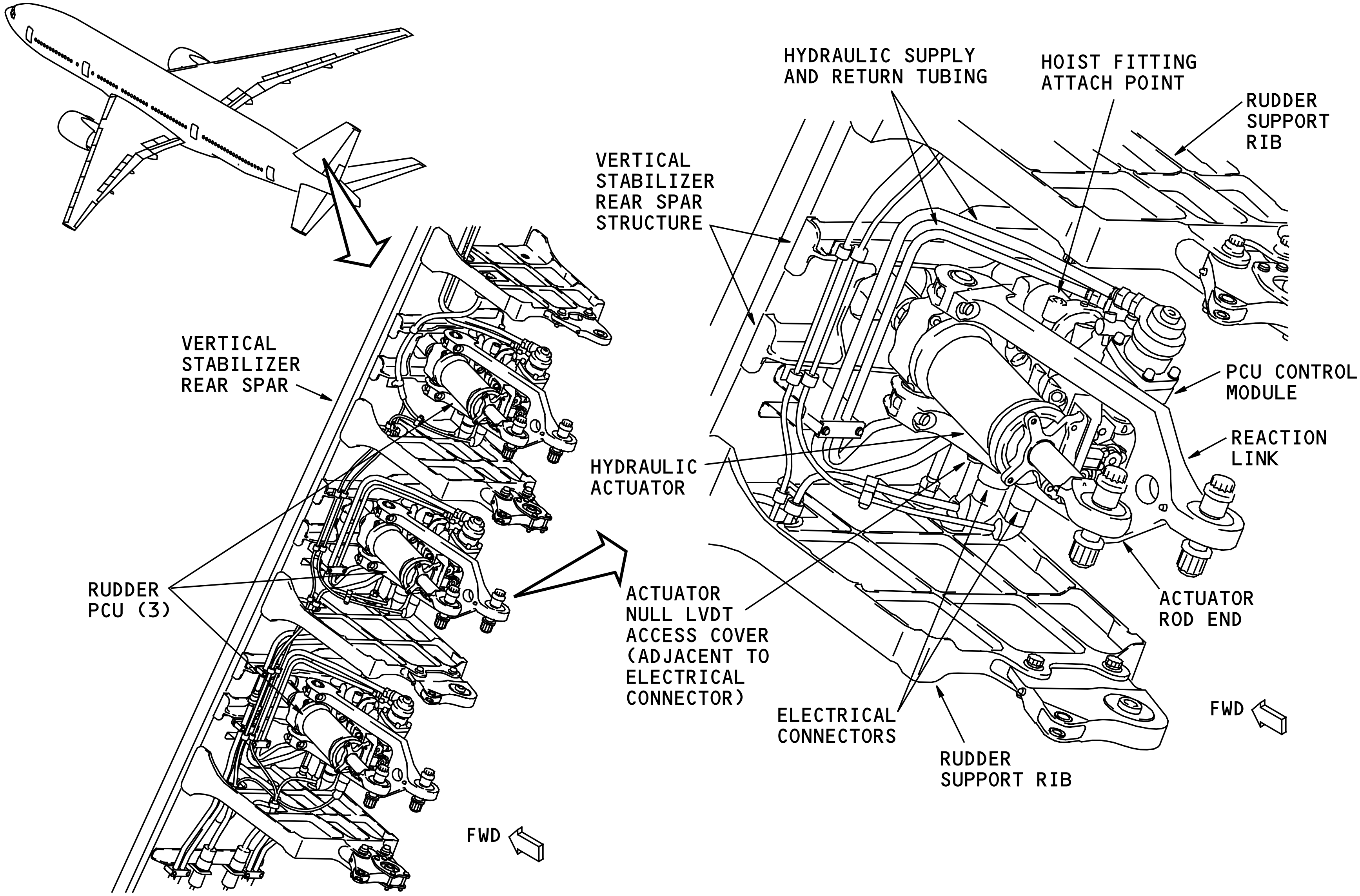
Training Information Point

Remove and install the rudder PCU as one assembly with the reaction link. The rudder PCU disconnects from the kick link which stays on the airplane.

Install a hoist swivel fitting to the hoist attach point of the PCU. Use a ground support equipment (GSE) hoist to support the PCU during removal and installation.

After installation of the rudder PCU, the actuator null LVDT requires adjustment. Remove the null LVDT access cover to adjust the null LVDT.

Put the nose gear steering tow lever in the tow position before you move the rudder pedals to operate the rudder system.



27-21-00-015 Rev 3 12/18/1995

RUDDER CONTROL - RUDDER PCU - INTRODUCTION

RUDDER CONTROL - RUDDER PCU - PHYSICAL DESCRIPTION

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RUDDER CONTROL - RUDDER PCU - PHYSICAL DESCRIPTION

Physical Description

All three rudder PCUs are identical. Each rudder PCU, with its reaction link, weighs approximately 98 lb (44.5 kg).

The rudder PCU contains a hydraulic actuator with a control module. The control module contains:

- An electrohydraulic servo valve (EHSV)
- A pressure reducer solenoid valve
- A bypass solenoid valve
- A damped solenoid valve
- A mode selector valve
- A differential pressure sensor
- Two bypass check valves
- Two relief valves
- A thermal relief valve
- A compensator/relief valve
- Two anti-cavitation check valves
- An inlet check valve
- An inlet filter.

Hydraulic Actuator

The actuator piston has an LVDT that sends actuator position feedback signals to the ACE. The actuator piston also has a null LVDT to adjust the null position of the actuator piston LVDT during installation of the PCU.

EHSV

The EHSV controls the hydraulic power to the extend and retract sides of the actuator. The EHSV has an LVDT that sends EHSV position feedback signals to the ACE.

Pressure Reducer Solenoid Valve

The pressure reducer solenoid valve commands the pressure reducer valve to decrease the hydraulic pressure to 1850 psi. Reduced pressure on the actuator decreases the probability of leak and fatigue loads during normal operation.

If there is a PCU or hydraulic failure, the hydraulic pressure to one or both of the other two PCUs increases to the nominal hydraulic system pressure (3000 psi). The hydraulic pressure also increases to the nominal system pressure on all three PCUs during takeoff and landing.

Bypass Solenoid Valve

The bypass solenoid valve controls the pilot pressure from the hydraulic system to the mode selector valve.

Damped Solenoid Valve

The damped solenoid valve controls the pilot pressure from the actuator to the mode selector valve.

RUDDER CONTROL - RUDDER PCU - PHYSICAL DESCRIPTION

Mode Selector Valve

Pilot pressure from the bypass or the damped solenoid valves commands the mode selector valve in one of three positions:

- Normal
- Bypass
- Damped.

Differential Pressure Sensor

A differential pressure sensor measures the pressure difference between both sides of the actuator piston. The sensor operates an LVDT which sends signals to the ACE.

Bypass Check Valves

The two bypass check valves permit pressure from either side of the actuator to reach the damped solenoid valve.

Relief Valves

The two relief valves protect the actuator in case of high pressure due to a hardover of an adjacent PCU.

Thermal Relief Valve

The thermal relief valve protects the actuator from thermal expansion of the hydraulic fluid.

Compensator/Relief Valve

The compensator/relief valve holds a small quantity of fluid above the hydraulic system return pressure. This fluid is available to the actuator to prevent cavitation.

Anti-cavitation Check Valves

The two anti-cavitation check valves permit return fluid from the compensator to flow to the actuator. This prevents cavitation of the actuator during rapid backdriving of the PCU.

Inlet Check Valve

The inlet check valve keeps the hydraulic fluid in the actuator when the hydraulic system power is lost.

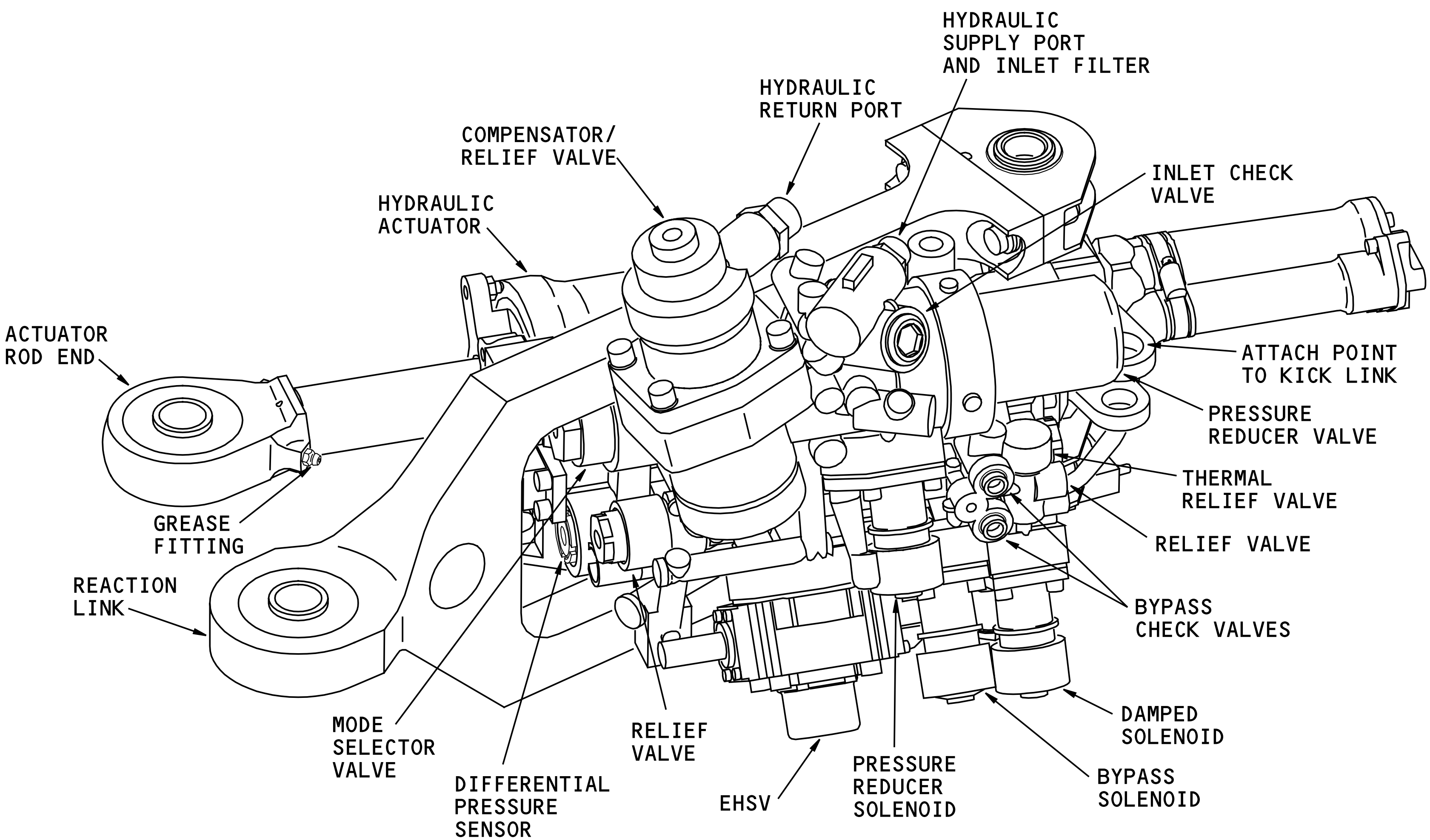
Inlet Filter

The inlet filter protects the actuator from solids in the hydraulic fluid.

Training Information Point

Only the bearings in the actuator rod end and the reaction link, where they attach to the rudder, require lubrication.

All other bearings on the actuator and reaction link are teflon coated bearings. They do not require lubrication.



27-21-00-016 Rev 7

RUDDER CONTROL - RUDDER PCU - PHYSICAL DESCRIPTION

RUDDER CONTROL - RUDDER PCU - FUNCTIONAL DESCRIPTION

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RUDDER CONTROL - RUDDER PCU - FUNCTIONAL DESCRIPTION

General

The rudder PCU operates in three different modes:

- Normal
- Bypass
- Damped.

In the normal mode, the ACE energizes the bypass solenoid. The pressure reducer and the damped solenoid may or may not be energized.

In the bypass mode, the ACE de-energizes the bypass solenoid. The damped solenoid stays energized. The pressure reducer solenoid may or may not be energized.

In the damped mode, the ACE de-energizes the bypass solenoid and the pressure reducer solenoid. The damped solenoid is also de-energized.

PCU Operational Matrix

The table shows the various conditions of the PCU valve solenoids in the three modes of operation of the PCUs:

SOLENOID CONDITIONS	PCU MODES OF OPERATION		
	NORMAL	BYPASS	DAMPED
PRESSURE REDUCER SOLENOID	E/D	E/D	D
BYPASS SOLENOID	E	D	D
DAMPED SOLENOID	E/D	E	D
LEGEND: E = ENERGIZED D = DE-ENERGIZED			

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Normal mode

The PCU is in normal mode when the ACE energizes the bypass solenoid. Hydraulic pilot pressure then moves the mode selector valve to the normal position.

For the conditions of the other PCUs, the ACE may or may not energize the pressure reducer solenoid and the damped solenoid. The status of the damped solenoid does not affect the operation in the normal mode.

When the pressure reducer solenoid is energized, the pressure reducer valve regulates the pressure to the EHSV to a lower nominal value. When the pressure reducer solenoid is de-energized, the pressure reducer valve allows full hydraulic system pressure to the EHSV.

Under these conditions, an electrical command to the EHSV results in the actuator extension or retraction.

Bypass Mode

The PCU is in bypass mode when the ACE de-energizes the bypass solenoid. The damped solenoid stays energized. This happens when there is a single hydraulic or electrical failure on the PCU or its ACE.

The bypass solenoid valve then blocks hydraulic pilot pressure to the mode selector valve. However, pressure from the actuator, trapped between the bypass check valves and the thermal relief valve, goes through the damped solenoid valve. This pilot pressure moves the mode selector valve to the bypass position.

Under these conditions, the mode selector valve blocks control pressure from the EHSV to the actuator cylinder. It also connects together both sides of the actuator.

When the PCU is in bypass mode, the other two PCUs backdrive it. These two PCUs then operate at full hydraulic system pressure.

During rapid backdrive of the PCU in bypass mode, the compensator/relief valve supplies fluid to the actuator through the anti-cavitation check valves.

Damped Mode

The PCU is in damped mode when the ACEs de-energize the bypass, pressure reducer and damped solenoids. This happens when the PCU has no power or there is a double or triple PCU or ACE failure.

In damped mode, there is no hydraulic pilot pressure on the mode selector valve. Its internal spring moves the valve to the damped position. The mode selector valve blocks control pressure from the EHSV to the actuator cylinder. It also connects both sides of the actuator piston through a restriction.

During rudder operation with a double failure, the good PCU moves the rudder very slowly.

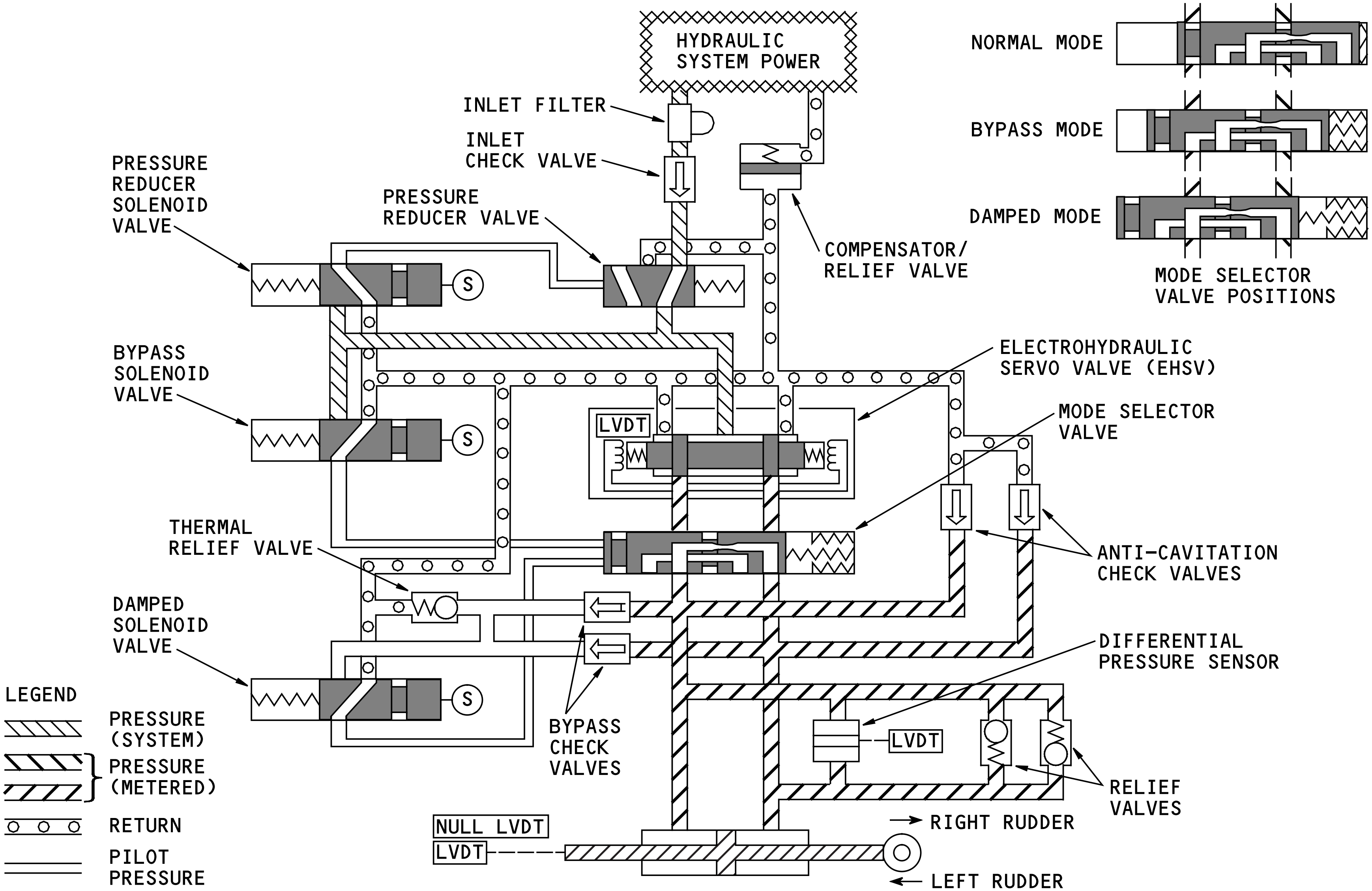
Training Information Point

On the ground with no power on the PCUs, all three PCUs are in damped mode. The rudder can move slowly when an outside force pushes on it.

Indications

The EICAS status message ACTUATOR PRESS SNSR shows that the differential pressure sensor on one of the rudder PCUs is defective. The flaperon also uses the same message.

The EICAS status message FLIGHT CONTROL SYS shows that one or more rudder PCU is not operative.



RUDDER CONTROL - RUDDER PCU - FUNCTIONAL DESCRIPTION

RUDDER CONTROL - RUDDER PCU - FUNCTIONAL DESCRIPTION - PCU MODES

General

The ACEs control the three modes of operation of the rudder PCUs. Each ACE controls the bypass solenoid of its on-side PCU. It also controls the pressure reducer and damped solenoid of one adjacent PCU.

In normal mode of the PFCS, the PFCs command the ACEs to control the pressure reducer solenoid of all the rudder PCUs. In secondary and direct mode of the PFCS, each ACE controls individually the pressure reducer solenoids.

Normal Mode

A rudder PCU operates in normal mode when there is no failure on the PCU and its on-side ACE.

If the PFCS is in normal mode, the rudder PCU operates with reduced hydraulic pressure during cruise flight and when there is no failure with any rudder PCU or ACE. The PFCs command the PCUs to operate with full system pressure when one of these conditions occurs:

- A failure of one or more PCU
- The airplane is below 500 feet above ground
- The flaps are extended.

If the PFCS is in secondary and direct mode, the ACEs command the PCUs to operate with reduced system pressure when there is no failure of a PCU or ACE.

Bypass Mode

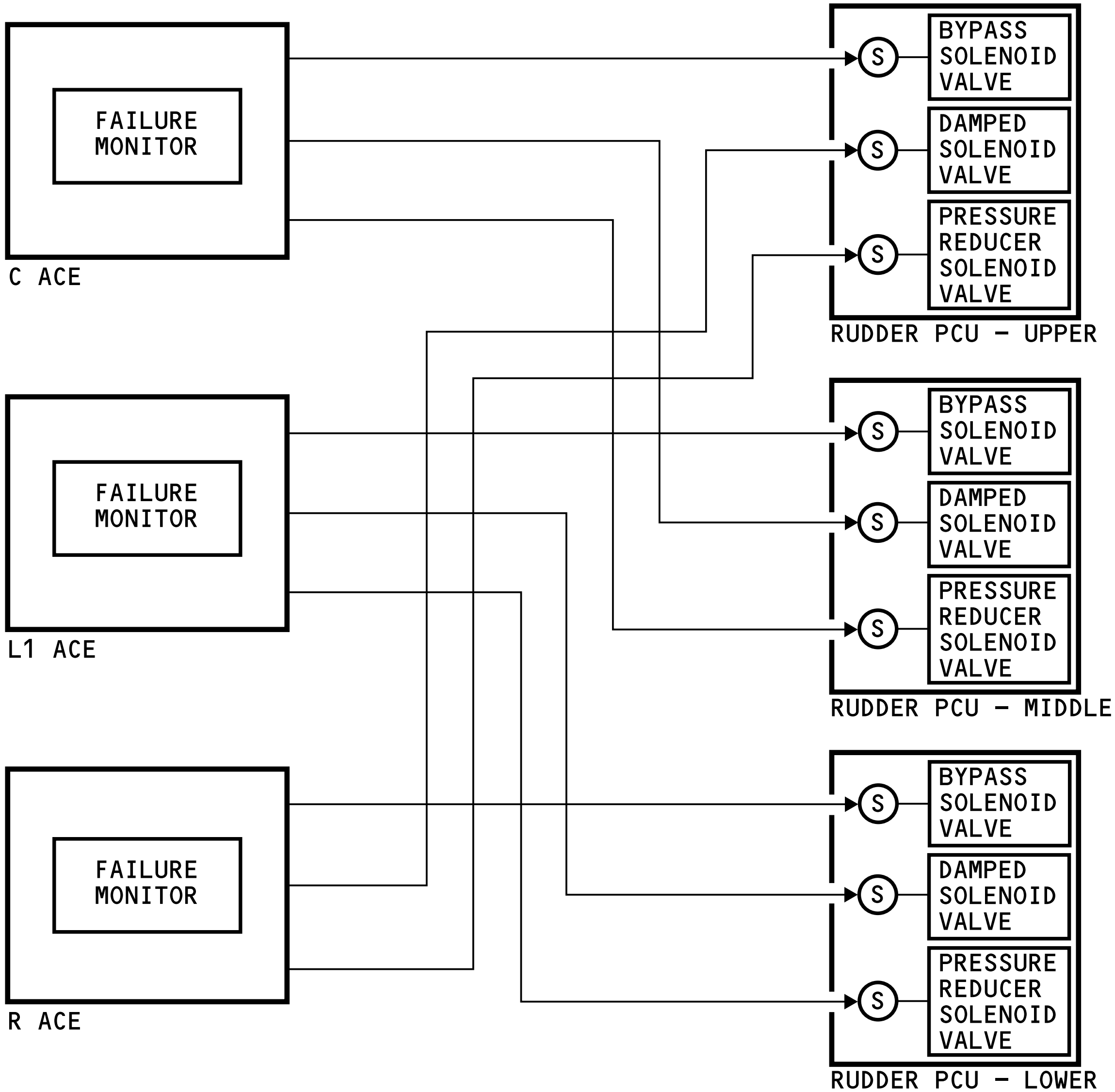
If the PCU has an electrical or hydraulic failure or there is a failure of its ACE, the ACE de-energizes the bypass solenoid. The PCU is then in bypass mode. The ACE also de-energizes the damped solenoid of the adjacent PCU which it also controls.

If the PFCS is in normal mode, the PFCs command all the ACEs to also de-energize the pressure reducer solenoid of all the PCUs. The two PCUs without failure then continue to operate with full hydraulic system pressure.

If the PFCS is in secondary or direct mode, the ACE de-energizes the pressure reducer solenoid of the adjacent PCU which it controls. In this case, one PCU is in bypass mode, one PCU operates in normal mode with full pressure and one PCU is in normal mode with reduced pressure.

Damped Mode

If there is a failure of a second PCU or its ACE, the ACE de-energizes the bypass solenoid of its on-side PCU. The ACE also de-energizes the pressure reducer and damped solenoid of one adjacent PCU. In this case, one PCU is in bypass mode, one PCU is in damped mode and one PCU operates with full hydraulic system pressure.



27-21-00-027 Rev 0 01/19/95

RUDDER CONTROL - RUDDER PCU - FUNCTIONAL DESCRIPTION - PCU MODES

RUDDER CONTROL - RUDDER ASSEMBLY

Purpose

The rudder supplies control of the airplane in the yaw direction. The rudder tab pivots on the lower trailing edge of the rudder.

Physical Description

The rudder is a light weight composite material structure. The skin is reinforced graphite/epoxy bonded to a core of Nomex honeycomb. The overall dimensions are approximately 98 in by 442 in (2.5 m by 11.2 m). The rudder weighs approximately 577 lb (262 kg).

A counterbalance at the tip of the rudder prevents flutter.

The rudder attaches to the vertical stabilizer with 10 hinges. Three PCUs attach to the rudder and move it. Jumpers and static dischargers supply electrostatic protection to airplane systems.

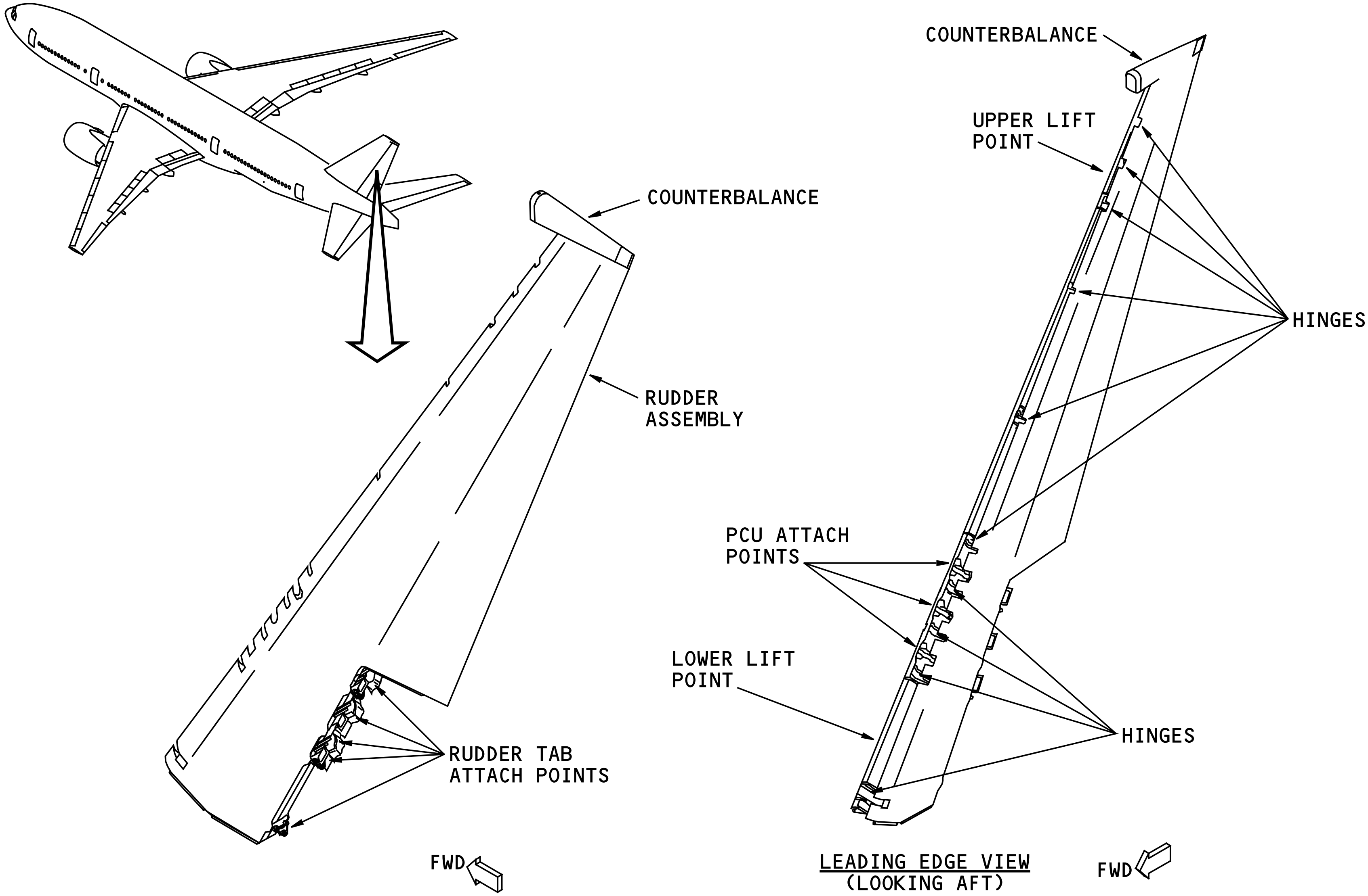
Functional Description

The rudder PCUs have internal stops that limit the rudder surface deflection. The rudder has a maximum movement of 27 degrees in both directions at low airspeed under no load conditions.

Under loads, the maximum PFCs and ACEs command signals move the rudder to a nominal position of 25 degrees in both direction at low air speed.

Training Information Point

Two hoist attach points are on the rudder. They are near the top and bottom rudder hinges. Remove a small hinge line seal panel to get access to the hoist attach points.



27-21-00-018 Rev 1

RUDDER CONTROL - RUDDER ASSEMBLY

RUDDER CONTROL - RUDDER TAB ASSEMBLY

Purpose

The rudder tab pivots on the lower trailing edge of the rudder. It moves in the same direction of the rudder to increase its effect.

Physical Description

The rudder tab is a light weight composite material structure. The skin is reinforced graphite/epoxy bonded to a core of Nomex honeycomb. The overall dimensions are approximately 50 in by 128 in (1.3 m by 3.2 m). The rudder tab weighs approximately 110 lb (50 kg).

The rudder tab attaches to the rudder by 5 hinges. Three adjustable control rods command the movement of the rudder tab based on the rudder movement. Three fairings cover the control rod connections to the rudder tab.

The rudder index plate, on the upper skin of the tail cone, shows the position of the rudder tab in relation to the airplane centerline.

Functional Description

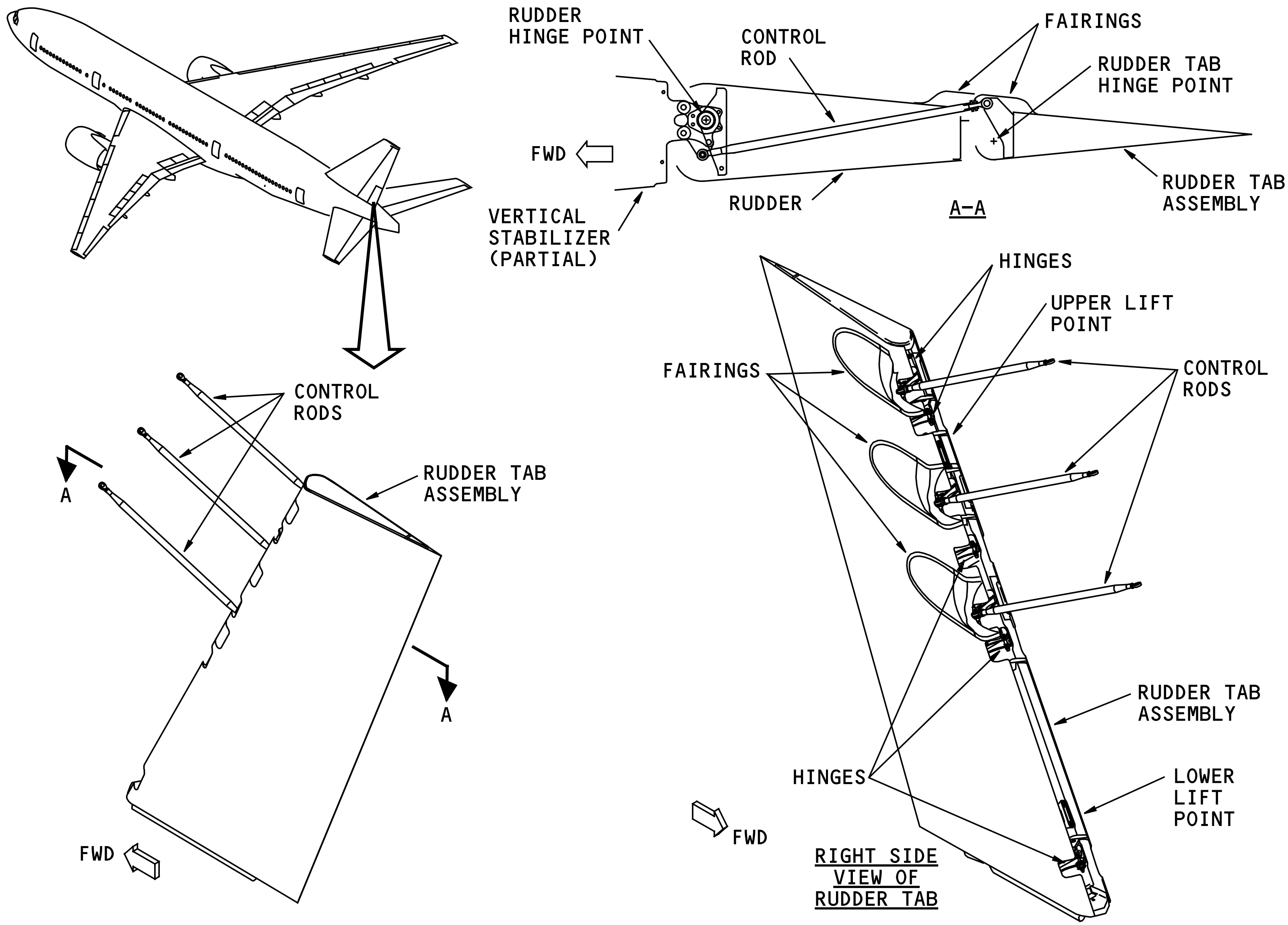
The rudder tab has a maximum movement of 27 degrees in both directions in relation to the rudder. For each degree of movement of the rudder, the rudder tab also moves one degree.

At full movement of the rudder (27 degrees), the rudder tab moves 27 degrees in relation to the rudder. This results in a 54 degree tab movement in relation to the centerline of the airplane.

Training Information Point

Two hoist attach points are on the rudder tab. They are near the top and bottom tab hinges. Remove a small hinge line seal panel and one fairing to get access to the hoist attach points.

When the airplane is on the ground with the rudder at center, the rudder tab control rods deflect the rudder tab to the left ofthe airplane centerline. This deflection is necessary for thermal expansion of the rudder tab control rods.



RUDDER CONTROL - RUDDER TAB ASSEMBLY

27-21-00-019 Rev 0

RUDDER CONTROL - FUNCTIONAL DESCRIPTION

General

The rudder control system uses input command signals from the rudder pedal position transducers.

The ACEs receive the input signals and transmit them to the PFCs. The ACEs supply output command signals to the rudder PCUs.

Rudder Pedal Position Transducers

Each ACE receives the signals from one rudder pedal position transducer. The L1 ACE and C ACE receive signals from the rudder pedal position transducers on the left shaft assembly. The L2 ACE and the R ACE receive signals from the rudder pedal position transducers on the right shaft assembly. After they change the signals to digital format, the ACEs send these signals to the PFCs through the flight controls ARINC 629 buses.

Each PFC receives input signals from all four rudder pedal position transducers. The PFC selects by mid-value selection and averaging which signal to process.

Gust Suppression Pressure Transducers

The C ACE receives signals from the upper gust suppression pressure transducer and the L1 ACE receives signals from the lower one.

Modal Accelerometers

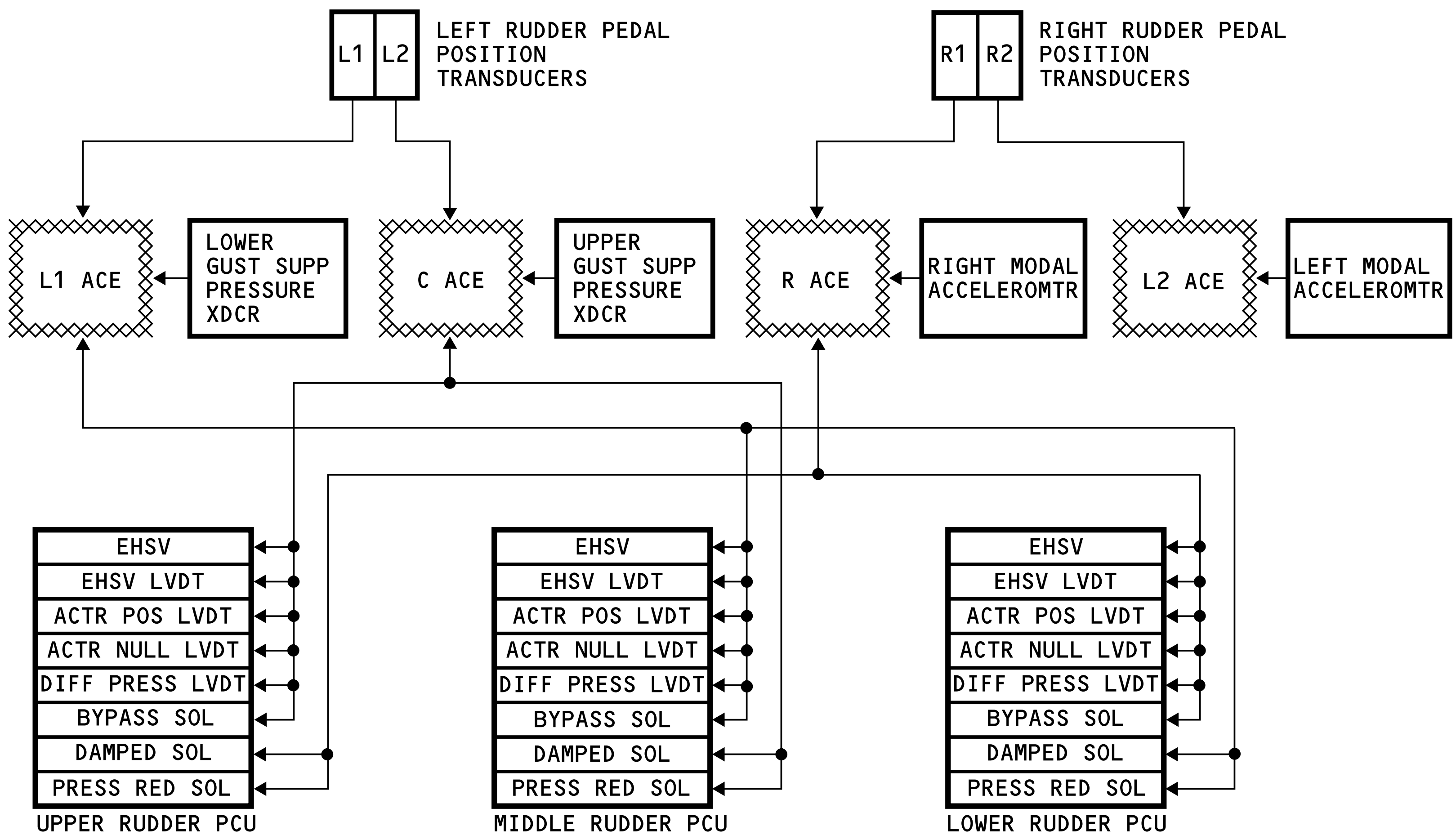
The R ACE receives signals from the right modal accelerometer and the L2 ACE receives signal from the left one.

Rudder PCUs

The L1 ACE, C ACE and R ACE send output command signals to their assigned rudder PCU and one adjacent rudder PCU.

The output command signals go from the ACE to the EHSV and the bypass solenoid of the assigned rudder PCU. The output command signals also go to the damped solenoid and the pressure reducer solenoid of one adjacent rudder PCU. The PCU sends feedback signals to its assigned ACE from:

- The EHSV position LVDT
- The actuator piston position LVDT
- The actuator null LVDT
- The differential pressure LVDT.



27-21-00-020 Rev 5 03/19/96

RUDDER CONTROL - FUNCTIONAL DESCRIPTION

RUDDER CONTROL - FUNCTIONAL DESCRIPTION - ACE SERVO LOOP

General

The ACE contains a servo loop circuit to control the command signals for the PCUs.

In normal and secondary mode, the PFC sends the command signals to the ACE. In direct mode, the ACE calculates the command signals.

Servo Loop Operation

The rudder command signals go through a servo loop in the ACEs. The command signals then go to the EHSV of the PCUs. The ACEs also use the command signals to monitor for failures.

The movement of the EHSV sends hydraulic pressure to extend or retract the actuator.

The EHSV LVDT measures the movement of the EHSV and supplies a feedback signal to the ACEs. The ACEs use this feedback signal to monitor failures.

The actuator position LVDT measures the movement of the actuator and supplies a signal to the actuator null LVDT.

The actuator null LVDT is in series with the actuator position LVDT. The actuator null LVDT modifies the signal from the actuator position LVDT.

The actuator null LVDT supplies a feedback signal to the ACEs to close the servo loop. The ACEs use this feedback signal to monitor for failures. This signal also goes to the PFC.

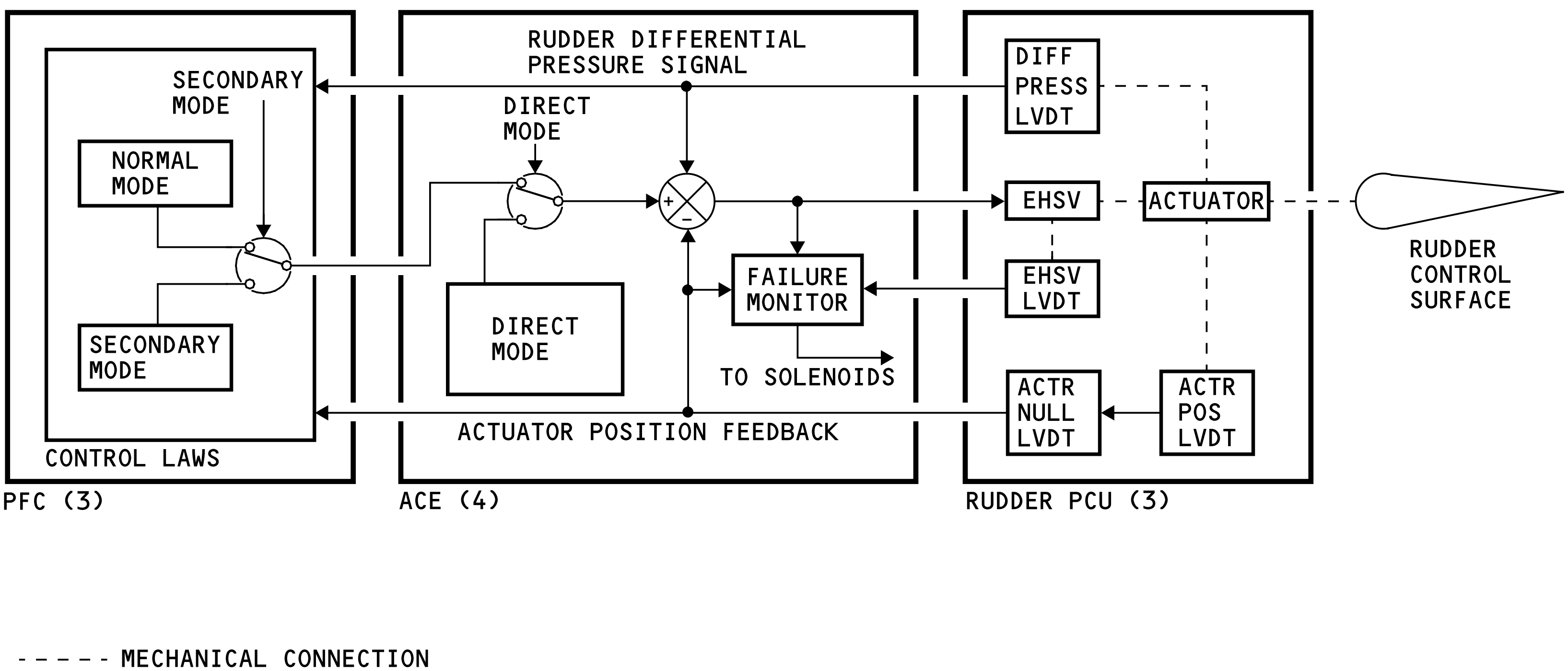
The differential pressure LVDT measures the differential pressure across the actuator. The signal from the differential pressure LVDT goes to the ACEs for the servo loop. The signal also goes to the PFCs for force fight equalization.

Failure Monitor

The ACE has a failure monitor to check the proper operation of the PCU. The monitor uses the ACE command signal and the feedback signals from the EHSV LVDT and the actuator LVDT. When the failure monitor finds a fault with the PCU or the ACE, it de-energizes the PCU bypass, damped and pressure reducer solenoids.

Training Information Point

During installation of the rudder PCU, the actuator null LVDT requires adjustment. Remove the LVDT access cover to adjust the LVDT.



27-21-00-021 Rev 3 01/08/96

RUDDER CONTROL - FUNCTIONAL DESCRIPTION - ACE SERVO LOOP

RUDDER CONTROL - FUNCTIONAL DESCRIPTION - RUDDER TRIM

General

The rudder trim selector and the manual trim cancel switch send discrete electrical signals to the L1 ACE and the R ACE. The ACEs transmit these signals to the PFCs via the flight controls ARINC 629 buses.

The L1 and R ACEs, and the PFCs operate the rudder trim function as a two channel system. The L1 ACE supplies rudder trim actuator engagement and servo loop control. The R ACE supplies rudder trim actuator engagement, arm, and brake status control.

In normal mode, when the thrust asymmetry compensation (TAC) function is active, the PFCs automatically control the rudder trim actuator through the L1 and R ACEs.

During normal and secondary modes of operation, the PFCs use pilot inputs from the rudder trim selector and the manual trim cancel switch to control the rudder trim actuator. The PFCs transmit the commands back to the ACEs which then control the rudder trim actuator.

During direct mode of operation, the ACEs execute the requests from the rudder trim selector and directly command the rudder trim actuator.

Rudder Trim Switches

The rudder trim selector has three pairs of contacts. The 15 degree contacts send an arm status discrete signal directly to the rudder trim actuator. The 25 degree contacts signal the L1 ACE to operate the rudder trim actuator at low rate of speed in the direction selected. The 40 degree contacts signal the R ACE to operate the rudder trim actuator at high rate of speed.

The MANUAL TRIM CANCEL switch signals the R ACE to remove any pilot commanded trim. The rudder trim actuator moves at high rate of speed.

Rudder Trim Actuator

The rudder trim actuator contains:

- A 28v dc electric motor with multiple speed electronic control
- An electromagnetic brake to lock the actuator when the brake is de-energized
- A tachometer to supply speed rate feedback signals to the servo loop internal to the actuator
- An actuator position RVDT.

The rudder trim actuator position RVDT sends position signals to the L1 ACE and the PFCs for servo loop control. These signals also go to the AIMS cabinets which control the rudder trim position indicator.

Rudder Trim Position Transducer

The rudder trim position transducer sends position signals to the R ACE and the PFCs. The PFCs monitor these signals and compare them with the rudder trim actuator position RVDT.

RUDDER CONTROL - FUNCTIONAL DESCRIPTION - RUDDER TRIM

Normal and Secondary Mode Control

During normal and secondary modes of operation of the PFCS, the PFCs control the rudder trim actuator through the L1 and R ACEs.

When the pilot turns the rudder trim selector, command signals from the 15 degree switch go to the rudder trim actuator. When the pilot turns the rudder trim selector further or pushes on the manual trim cancel switch, the switch command signals go to the PFCs through the L1 and R ACEs.

The rudder trim actuator supplies arm and brake status signals to the R ACE and the PFCs. The engage command from the PFCs, through L1 and R ACEs, causes the electromagnetic brake to release. The PFCs monitor the status of the brake release. With the brake released, the PFCs supply a servo loop command to the rudder trim actuator through the L1 ACE. The signal from the rudder trim actuator position RVDT closes the servo loop in the L1 ACE.

The tachometer supplies rate feedback to the speed control within the rudder trim actuator.

The PFCs compare the signals from the rudder trim actuator RVDT with the signals from the rudder trim position transducer. If the signals do not agree, the PFCs stop the operation of the rudder trim.

Rudder Trim Operation in Normal and Secondary Mode

With the rudder trim selector at less than 25 degree rotation, the PFCs and ACEs do not command the brake to release. Also they do not send a servo loop command. The rudder trim actuator then does not move.

When the pilot turns the rudder trim selector to 25 degree or more, the rudder trim actuator operates. The rudder trim actuator rate is a function of the rudder trim selector position. The trim rate of the rudder is also a function of the rudder ratio.

When the pilot moves the rudder trim selector to about 25 degrees, the PFCs and ACEs cause the rudder trim actuator to move at a rate of 0.5 unit per second.

With the selector turned to about 40 degrees, the PFCs and ACEs cause the rudder trim actuator to move at a rate of 2 units per second.

The manual trim cancel switch causes the rudder trim actuator to remove manual trim inputs at a rate of 2 units per second. The manual trim cancel switch does not remove trim commands caused by TAC.

In normal mode, when TAC is active, the PFCs and the L1 and R ACEs cause the rudder trim actuator to move at a rate as much as 6 units per second.

On the ground, the PFCs limit the rudder trim actuator movement to 17 units of rudder trim. In flight, the PFCs let the trim actuator move to its mechanical stops. This causes a maximum of about 22.5 units of rudder trim at low airspeed. Because the rudder trim indicator limit is 17 units, the indicator shows 17 units for a trim condition of 17 units or more.

If the R ACE does not operate, automatic trim by the TAC function does not operate. The pilot can control manual trim with the rudder trim selector. The PFCs then control the rudder trim actuator through the L1 ACE. In this condition, the rudder trim operates at 0.5 units per second. The 40 degree selector position and the manual trim cancel switch do not operate.

If the L1 ACE does not operate, the PFCs stop the operation of the rudder trim.

Direct Mode Control

During direct mode operation, the ACEs directly control the rudder trim actuator.

With the rudder trim selector at less than 25 degree position, the ACEs do not command the brake to release. Also the L1 ACE does not send a servo loop command. The rudder trim actuator then does not move.

When the selector is at 25 or 40 degree position, the ACEs cause the rudder trim actuator to move the rudder. The trim rate is at 1.4 units per second with the flaps and slats not retracted and 0.6 units per second with the flaps and slats retracted.

The manual trim cancel switch function is not operative in direct mode.

Indications

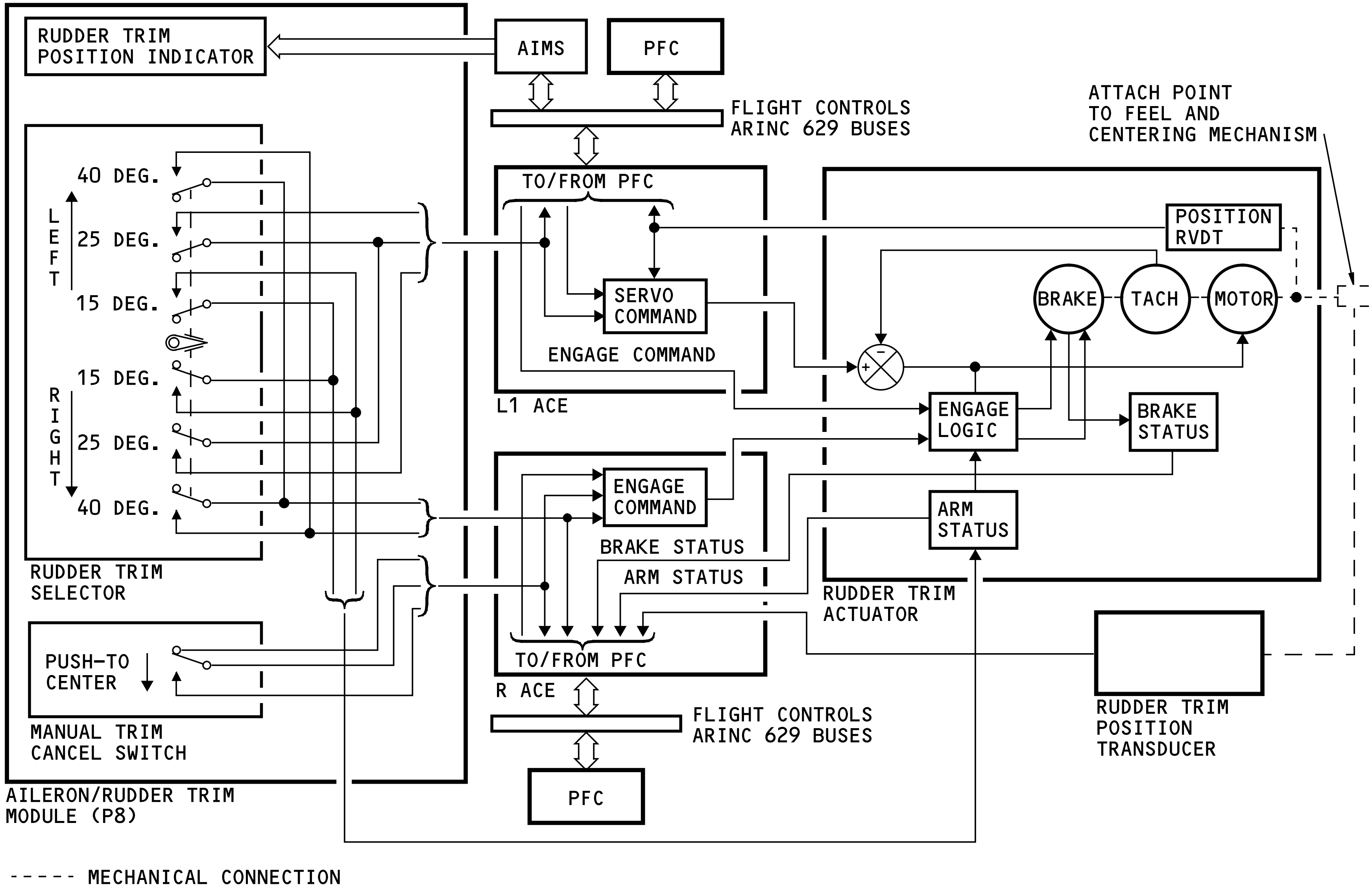
The warning message CONFIG RUDDER shows on the EICAS display when all of these conditions happen:

- The rudder trim is not within 2 units from center
- Either the left or right engine thrust is more than the takeoff threshold
- The airplane is on the ground
- TAC is not active.

The advisory message THRUST ASYM COMP shows when the rudder trim system is defective.

The status message FLIGHT CONTROL SYS shows when the rudder trim system has failed.

The rudder trim indicator on the center aisle stand is blank when the rudder trim system is defective.



27-21-00-025 Rev 7 03/27/95

RUDDER CONTROL - FUNCTIONAL DESCRIPTION - RUDDER TRIM

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RUDDER CONTROL - FUNCTIONAL DESCRIPTION - THRUST ASYMMETRY COMPENSATION

General

The thrust asymmetry compensation (TAC) helps control the airplane during asymmetrical engine thrust conditions. The TAC protection function operates in the PFCS normal mode only.

The pilot can disarm the TAC function with the TAC switch on the P5 panel.

Input Signals

The TAC function receives thrust data for the two engines from the engine data interface units (EDIU). The EDIUs use the N1 rotational speed signals from the electronic engine controls (EECs) to calculate the thrust values. The EECs also send other engine data to the EDIUs to make sure the N1 signal is accurate. The EDIUs send the engine thrust data to the PFCs through the AIMS.

TAC also uses the CAS signal from the ADIRU, flap position from the FSEUs and the TAC switch position from the C ACE.

Functional Description

The TAC function arms manually or automatically. TAC arms manually when you move the TAC switch from OFF to AUTO and all these conditions occur:

- All the signals used by TAC are satisfactory
- The rudder trim can operate
- The PFCS is in normal mode
- The L1 ACE and R ACE are not in direct mode.

When the TAC switch is in the AUTO position, the TAC function arms automatically. The conditions for TAC automatic arm are the manual arm conditions and these conditions:

- The PFCs find that the airplane is on the ground
- CAS is less than 70 knots
- One or both engines are running with the thrust levers at the idle position or the engines are not running.

The TAC function disarms when the TAC switch is in the OFF position. It also disarms for any one of these conditions:

- Any signal used by TAC is not satisfactory
- The rudder trim is defective
- The PFCS is not in normal mode
- The L1 ACE or R ACE is in direct mode
- The L1 ACE or R ACE status signal is not available.

The TAC function is active when it is armed and all of these conditions occur:

- CAS is more than 70 knots
- The thrust reversers do not have a command to deploy
- The thrust difference between the two engines is more than 6000 lbs, about 10 percent of the maximum rated thrust.

RUDDER CONTROL - FUNCTIONAL DESCRIPTION - THRUST ASYMMETRY COMPENSATION

When TAC is active, the PFCs use the difference between the thrust signals from the EDIUs to calculate rudder and rudder trim commands. The TAC function initially calculates a high rate rudder command to make allowance for the yaw moment caused by the thrust difference. This command goes to the ACEs to move the rudder PCUs.

The TAC function also sends rudder trim commands to the ACEs. The rudder trim actuator movement then backdrives the rudder pedals and the pedal position transducers. The PFCs make allowance for the input signals from the pedal position transducers to keep a near constant rudder PCU command.

The PFCs limit the TAC authority to 60 percent of available rudder.

If TAC is active when there is a command for thrust reverser deployment during landing or refused takeoff, the PFCs automatically ramp the TAC trim commands to zero trim. The trim actuator ramps to zero at a speed of 6 units per second.

When TAC is active, the pilot can use the rudder pedals or the rudder trim switches. The PFCs add these command signals to the TAC commands to control the rudder PCUs. If the pilot pushes on the manual trim cancel switch, the PFCs send a command to the rudder trim actuator to remove any input made with the rudder trim selector. The TAC command to the rudder trim actuator is not removed.

If TAC is active during autoland operation of the autopilot, the engine out correction of the autopilot is disabled. This is done so this function of the autopilot does not control during TAC operation. If the pilot moves the pedals, TAC stays active but the autopilot disengages.

The TAC function stops to be active when the thrust difference between the two engines is less than 3 percent of the maximum rated thrust.

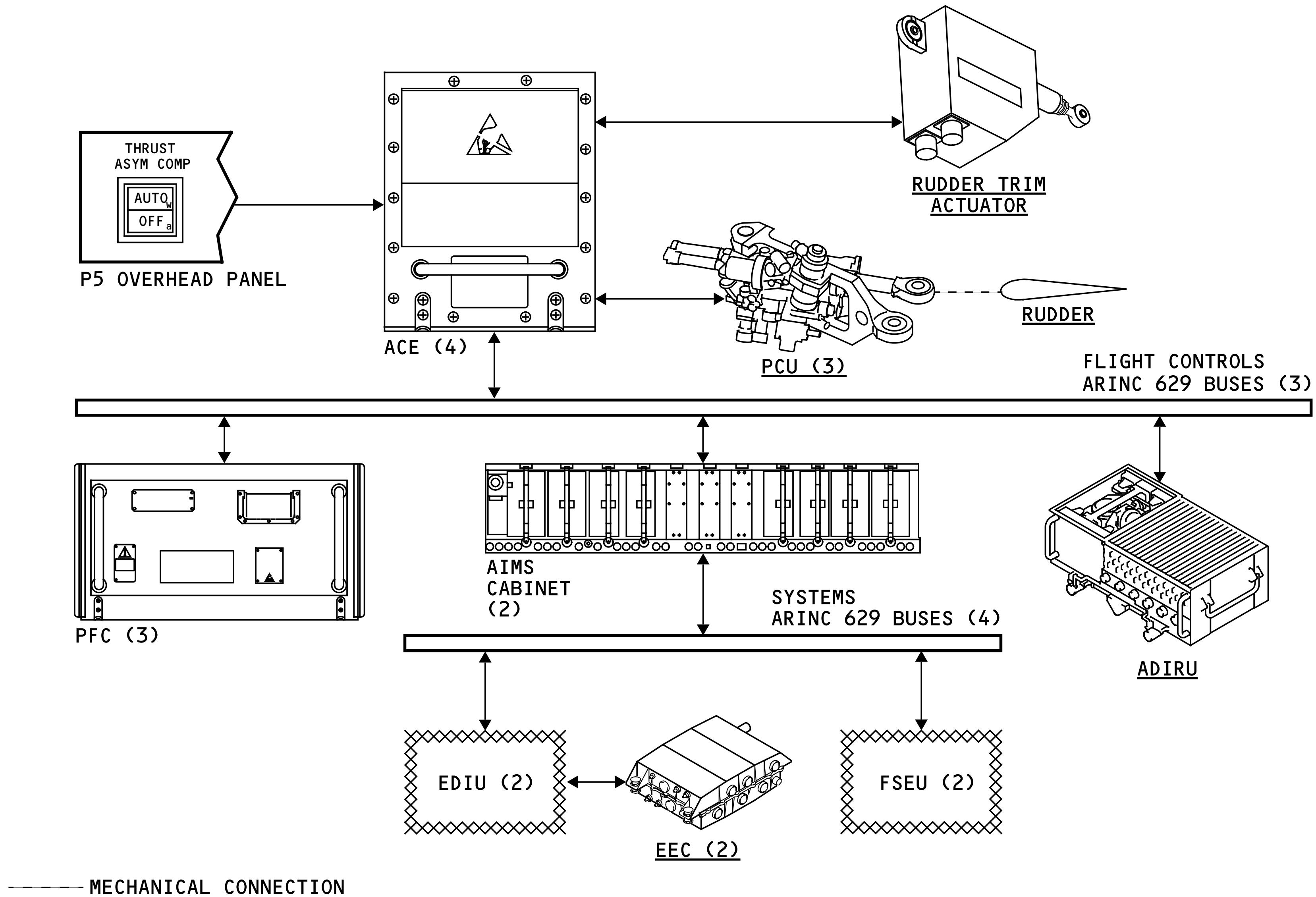
If the airspeed data becomes unreliable, the TAC function uses the flap position signal to limit the gain of the rudder and rudder trim command.

<u>Indications</u>

The amber OFF light shows in the TAC switch on the P5 panel and the advisory and status messages THRUST ASYM COMP show when one of these conditions occurs:

- The rudder trim is defective
- Loss of the thrust data from 2 of 3 channels in one EDIU
- Loss of left and right engine running data
- The two engines are not running in the air
- The R, L1 or C ACE is failed or in direct mode
- The PFCS is not in normal mode
- The TAC switch is in the OFF position
- The TAC switch position signal is lost.

When the TAC function is armed after it was disarmed, the above indications do not show.



27-21-00-029 Rev 4 01/08/96

RUDDER CONTROL - FUNCTIONAL DESCRIPTION - THRUST ASYMMETRY COMPENSATION

ELEVATOR CONTROL - INTRODUCTION

General

The elevators supply short-term correction of the pitch attitude of the airplane. This movement is around the lateral axis of the airplane.

There is one elevator panel on each side of the aft fuselage. Hinges attach the elevator to the rear spar of the horizontal stabilizer. Two hydraulic power units move each elevator panel.

Pitch Control

The pilots manually command pitch correction with forward and aft movement of the control column.

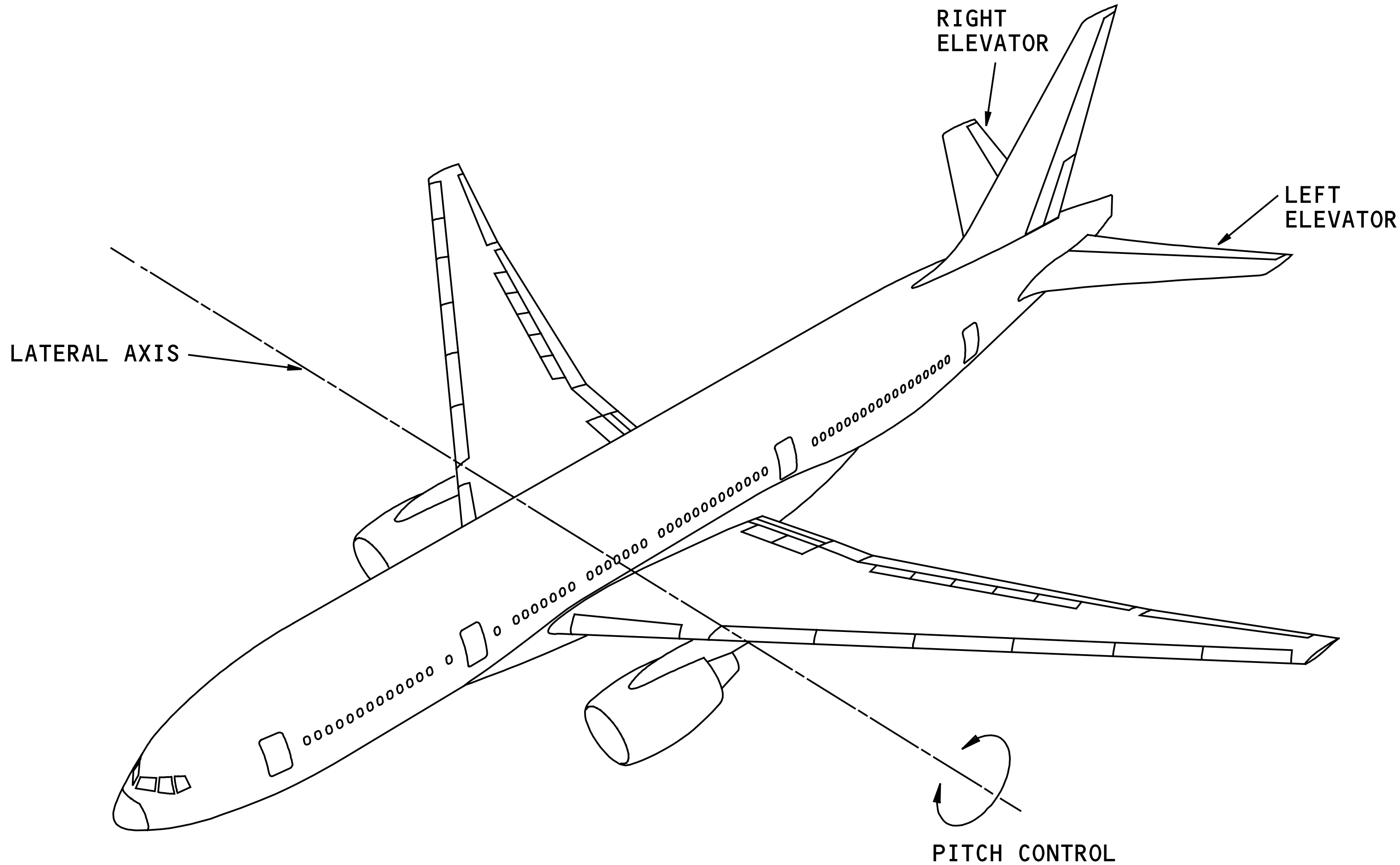
When engaged, the autopilot automatically commands the elevators. During autopilot operation, actuators backdrive the control columns.

Elevator Off-load Function

The elevator off-load function transfers manual and autopilot commanded elevator deflection to the stabilizer. The stabilizer movement allows the elevators to move to the neutral position.

Abbreviations and Acronyms

ACE	- actuator control electronics
ADIRS	- air data inertial reference system
ADIRU	- air data inertial reference unit
AFDC	- autopilot flight director computer
AFDS	- autopilot flight director system
AIMS	- airplane information management system
AOA	- angle of attack
ARINC	- Aeronautical Radio, Incorporated.
CMCS	- central maintenance computing system
CPU	- central processing unit
EHSV	- electrohydraulic servo valve
EICAS	- engine indication and crew alerting system
FSEU	- flap/slat electronics unit
LIB	- left inboard
LOB	- left outboard
LVDT	- linear variable differential transformer
MAT	- maintenance access terminal
MFD	- multi-function display
PCU	- power control unit
PFC	- primary flight computer
PFCS	- primary flight control system
RIB	- right inboard
ROB	- right outboard
SAARU	- secondary attitude and air data reference unit
TED	- trailing edge down
TEU	- trailing edge up



27-30-00-001 Rev 0

ELEVATOR CONTROL - INTRODUCTION

ELEVATOR CONTROL - GENERAL DESCRIPTION

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ELEVATOR CONTROL - GENERAL DESCRIPTION

General

The pilots manually command the elevators and the autopilot automatically commands them.

Manual Operation

The flight crew uses two conventional control columns to command pitch. They connect to torque tubes joined by a break-out mechanism. This allows one control column to move if the other jams.

The flight crew can make manual commands to the elevator in the normal mode with the pitch trim switches. This is possible only if the airplane is in the air.

Six position transducers change flight crew control column commands to analog electrical signals. These signals go to the four actuator control electronics (ACEs) that change the signal to digital format. The digital signals go to the primary flight computers (PFCs) through the ARINC 629 buses.

The PFCs use data from these sources to calculate control surface commands:

- Column position
- Air data inertial reference unit (ADIRU)
- Airplane information management system (AIMS).

The PFCs send digital commands to the ACEs, which change them to analog signals. The ACEs then send the analog surface position commands to the power control units (PCUs). The PCUs move the elevators. The position transducers on the PCU hydraulic pistons send actuator position feedback to the PFCs through the ACEs.

The PFCs use data from the ADIRU to calculate elevator feel commands. The feel command goes through the ACE to the left and right feel actuators on the elevator feel units. The feel actuators supply to the column a variable feel based on airspeed.

The ACEs get analog signals from the force transducers and send them to the PFCs. The PFCs use these signals to verify control column null position.

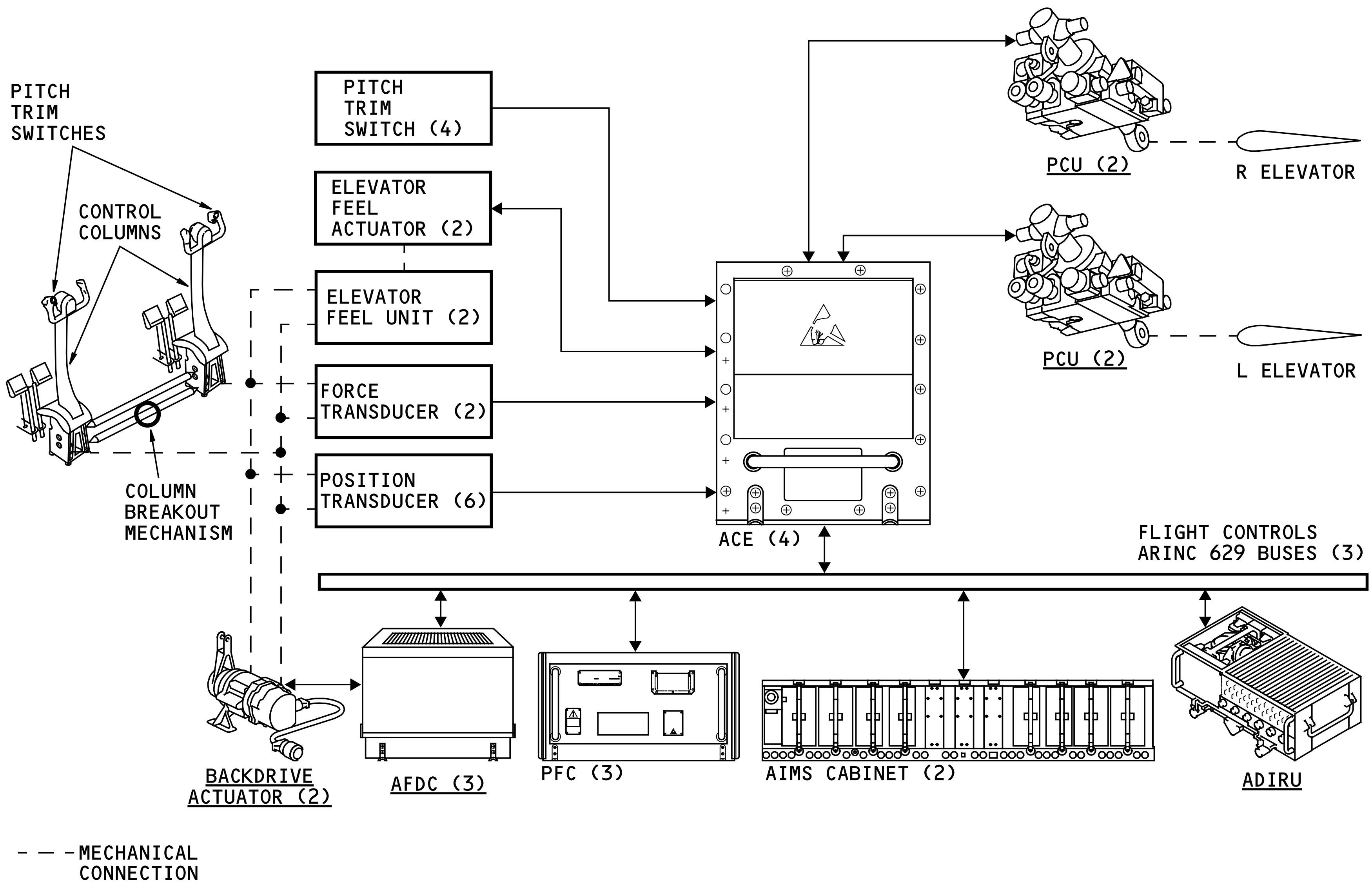
Autopilot Operation

When engaged, the autopilot flight director computers (AFDCs) control airplane pitch. The AFDCs supply pitch commands to the PFCs through the flight controls ARINC 629 buses. The PFCs process these commands to supply position commands for the elevators. These position commands go through the ACEs to the PCUs.

The PFCs also supply column backdrive commands. The PFCs send these commands to the AFDCs, which supply column movement commands to the backdrive actuators. The backdrive actuators move the control columns the same amount as the pilot would move them manually for the same surface movement. This gives the flight crew visual feedback when the AFDS moves the flight control surfaces. The flight crew can override the autopilot with sufficient force on the control column to overcome the backdrive.

Protection Functions

Overspeed and stall protection functions in the PFCs supply flight envelope protection in both manual and autopilot operation. The overspeed protection supplies a pitch-up elevator command. The stall protection supplies a pitch-down elevator command.



27-30-00-002 Rev 1 07/10/1997

ELEVATOR CONTROL - GENERAL DESCRIPTION

ELEVATOR CONTROL - COMPONENT LOCATIONS

General

Pitch control components are in these areas:

- The flight deck
- Below the flight deck floor
- The tail.

Flight Deck Components

The control columns are in the flight deck.

Components Below the Flight Deck

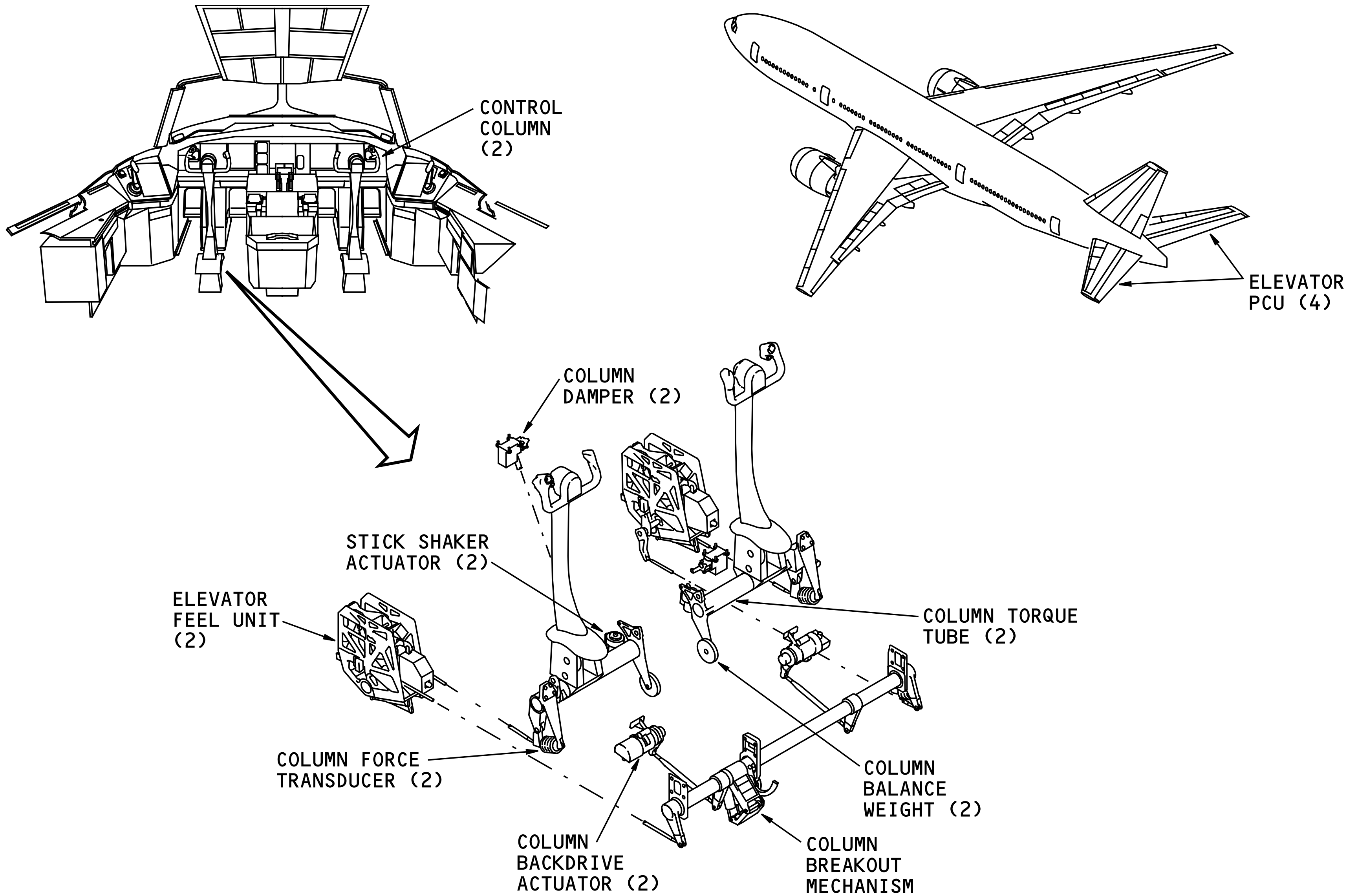
These forward controls are below the flight deck floor and above the nose gear wheel well:

- Column torque tubes
- Column balance weights
- Column dampers
- Stick shaker actuators
- Column force transducers
- Elevator feel units
- Column backdrive actuators
- Column breakout mechanism.

Access to these components is through the forward equipment center door.

Tail Components

The elevators and their PCUs are on the rear spar of the horizontal stabilizer. Two PCUs connect to each elevator. Access to the PCUs is by panels under the stabilizer.



ELEVATOR CONTROL - COMPONENT LOCATIONS

27-30-00-003 Rev 1 07/18/1997

ELEVATOR CONTROL - ANALOG AND DISCRETE INTERFACES

General

All pitch control analog interfaces within the PFCS go through the ACEs. Each ACE has interfaces with these components:

- Column position transducers
- Column force transducers
- Elevator feel actuators
- Elevator PCUs.

Column Position Transducers

There are six position transducers, three for each control column. The transducers send control column position and movement data to the ACEs.

Column Force Transducers

Two column force transducers measure the forces applied to the control column. The transducers send this data to the ACEs.

Elevator Feel Actuators

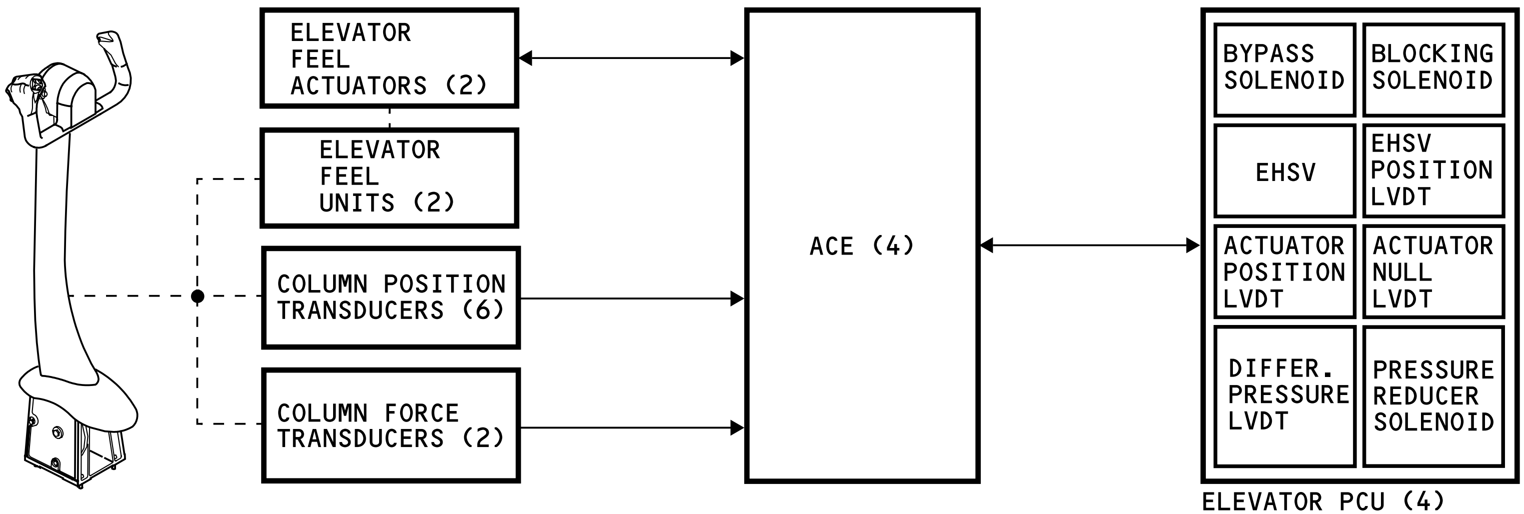
An elevator feel actuator is in each of the elevator feel units. They supply a feel force to the columns through the feel units. The ACEs command the elevator feel actuators. The elevator feel actuators also send position feedback signals to the ACEs.

Elevator PCUs

Each of the four elevator PCUs receive analog and discrete electrical signals from the ACEs. The discrete signals are for the bypass, blocking, and pressure reducer solenoids. The analog signal is for the electrohydraulic servo valve (EHSV).

Each of the four elevator PCUs sends these analog feedback signals to the ACEs:

- EHSV position LVDT
- Actuator position LVDT
- Actuator null LVDT
- Differential pressure LVDT.



27-30-00-004 Rev 2 07/18/1997

ELEVATOR CONTROL - ANALOG AND DISCRETE INTERFACES

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ELEVATOR CONTROL - FORWARD CONTROLS

General

These are the forward controls of the pitch control system:

- Control columns
- Column torque tubes
- Column force transducers
- Compliance springs
- Column dampers
- Column balance weights
- Elevator feel units
- Elevator feel actuators
- Column position transducers
- Column breakout mechanism
- Backdrive actuators
- Stick shaker actuators
- Travel stops.

Control Columns

The two control columns are conventional in design and serve as the interface between the pilots and the flight controls. Forward and aft movement of the control columns command the movement of the elevators through flight control system electronics.

Each control column connects to a torque tube.

Column Torque Tubes

Each column torque tube moves when the control column moves. These are the components on the torque tube:

- Force transducer
- Compliance spring
- Column damper
- Column balance weight
- Column stick shaker.

The torque tubes connect to the elevator feel and centering mechanisms with a control rod.

Elevator Feel Units

The two elevator feel units supply feel forces to the pilots and column position data to the ACEs. Each feel unit has a feel and centering mechanism.

The elevator feel actuators on each elevator feel unit change the feel force on the control column.

Each elevator feel unit connects to the column breakout mechanism with a control rod.

Column Position Transducers

Three column position transducers are on each feel unit.

Column Breakout Mechanism

The column breakout mechanism connects the two control column systems together. The mechanism also makes it possible to move one control column should the other jam.

ELEVATOR CONTROL - FORWARD CONTROLS

Backdrive Actuators

Two backdrive actuators connect to cranks on the left and right sides of the column breakout mechanism. The backdrive actuators are part of the autopilot system.

See the autopilot flight director system section for more information on the backdrive actuators (AMM PART I 22-11).

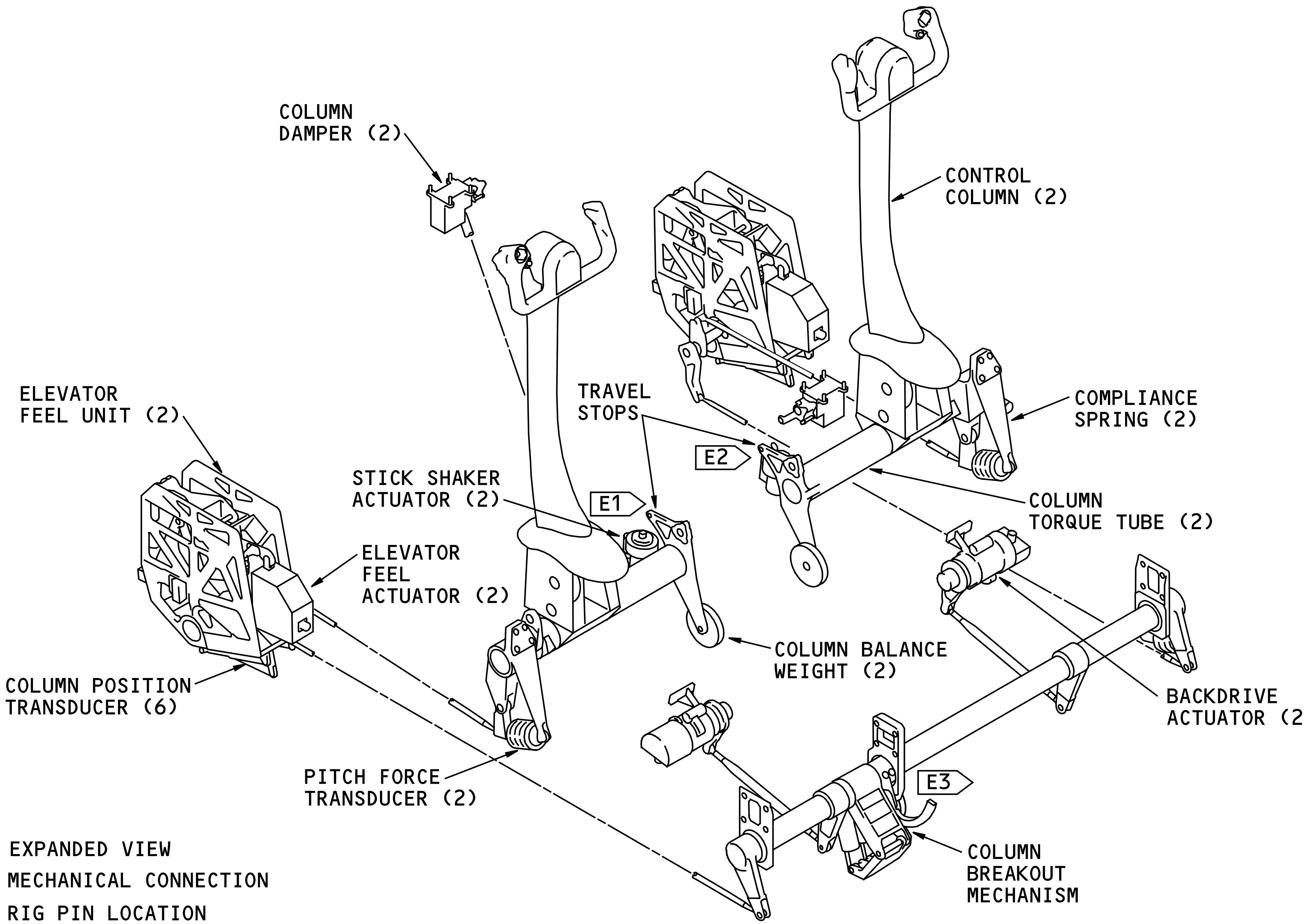
Stick Shaker Actuator

One stick shaker actuator is on each column torque tube.

See the warning electronic system section for more information on the stick shaker actuators and stall warning function (AMM PART I 31-51).

Travel Stops

Travel stops are on the column torque tubes. They limit control column travel to 9.6 degrees forward and 10.5 degrees aft.



27-30-00-005 Rev 4

NOTE: EXPANDED VIEW
------- MECHANICAL CONNECTION
EX RIG PIN LOCATION

ELEVATOR CONTROL - FORWARD CONTROLS

ELEVATOR CONTROL - ELEVATOR FEEL UNIT

Purpose

Two elevator feel units supply feel forces to the control columns. They also supply a centering function that returns the control column to neutral.

Physical Description

The two elevator feel units are similar but not interchangeable.

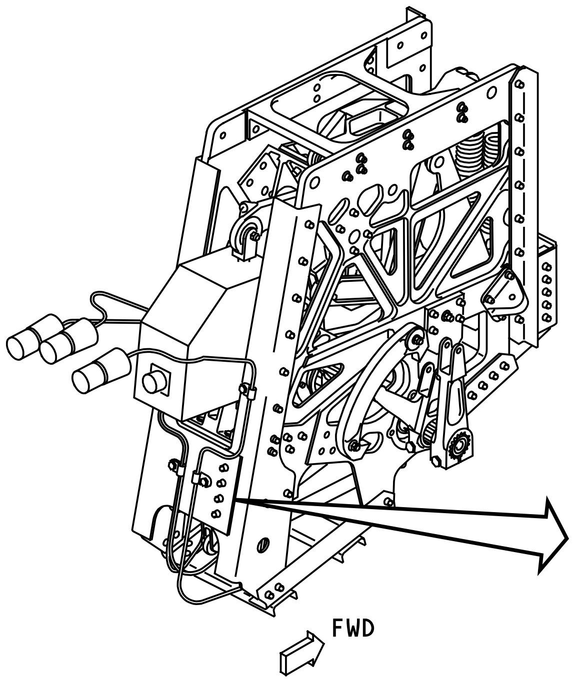
Each elevator feel unit has a single cam and roller unit. The cam attaches by a spline to the shaft of the feel unit. The input crank, connected to the column torque tube, turns the shaft and the cam. The follower assembly has a roller which rides on the cam. A centering arm, which pivots on the elevator feel unit structure, supports the follower assembly and attaches to the feel springs. Two feel springs, between the centering arm and the spring arm, keep the roller on the cam. The two feel springs provide the feel force and the centering function. The output crank also attaches to the shaft of the feel unit. The output crank connects to the aft torque tube with a control rod.

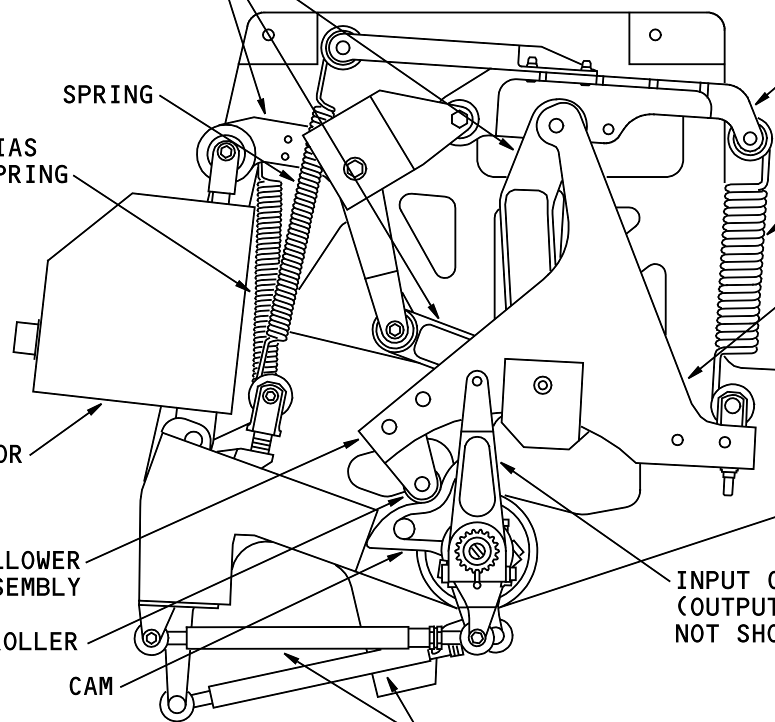
An elevator feel actuator and three column position transducers are on each elevator feel unit.

The elevator feel actuator connects to the variable feel mechanism. This mechanism consists of levers and a linkage which connect to the spring arm. A spring connects to the mechanism to take up any play in the mechanism. A bias spring, near the feel actuator, forces the feel actuator to fully retract when it does not operate.

Location

The two elevator feel units are under the flight deck. Access is by the forward equipment door or from the MEC.





ELEVATOR FEEL UNIT
(STRUCTURE NOT SHOWN FOR CLARITY)

ELEVATOR CONTROL - ELEVATOR FEEL UNIT

ELEVATOR CONTROL - ELEVATOR FEEL ACTUATOR

Purpose

The feel actuators change the geometry of the elevator feel units to change the feel force at the control columns.

Physical Description

The two actuators are identical and interchangeable LRUs.

The feel actuator has a 28v dc reversible electric motor. The actuator extends 2.5 inches (63.5) maximum. Each actuator weighs about 4.27 lb (1.6 kg).

The actuator attaches to the elevator feel unit structure. The actuator rod end attaches to the input lever of the variable feel mechanism.

Location

The elevator feel actuators are on the aft side of the elevator feel units.

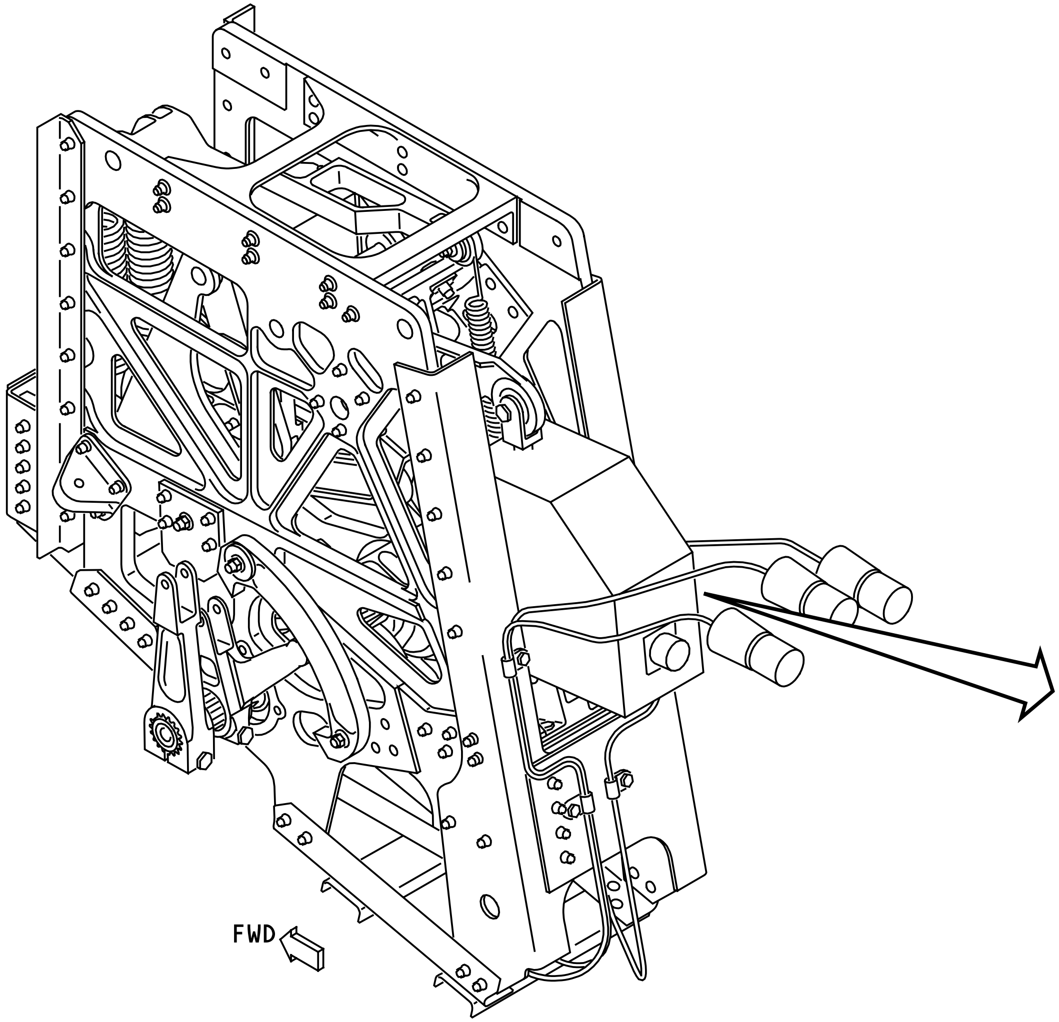
Functional Description

When the elevator feel actuator extends, it changes the configuration of the feel mechanism in the feel unit. When the column moves, this causes an increase in the extension of the feel springs. This increases the feel force at the columns.

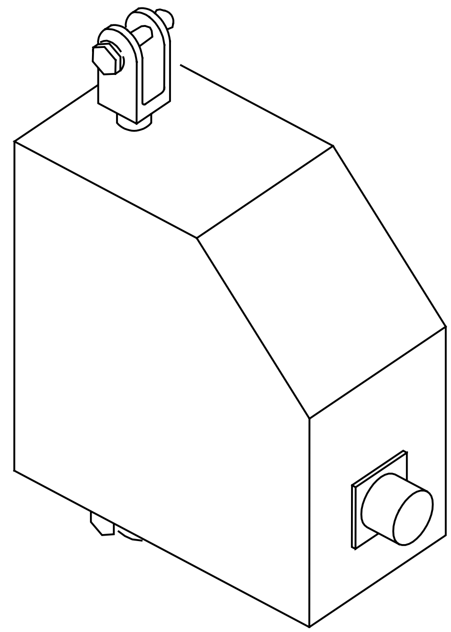
The rod end of the actuator moves in response to the commands from the ACEs. The L2 ACE sends commands to the left feel actuator and the C ACE sends commands to the right feel actuator. An RVDT in the feel actuator supplies a position feedback signal to the PFCs through the ACE.

Indications

The status message FLIGHT CONTROL SYS shows when one, or more, elevator feel actuator is defective.



ELEVATOR FEEL UNIT



FEEL ACTUATOR

ELEVATOR CONTROL - ELEVATOR FEEL ACTUATOR

ELEVATOR CONTROL - ELEVATOR FEEL - FUNCTIONAL DESCRIPTION

General

The elevator feel unit supplies a feel force to the control columns. The elevator feel actuator changes the feel force. The feel at the control column increases with the amount of column movement and the speed of the airplane.

Feel and Centering

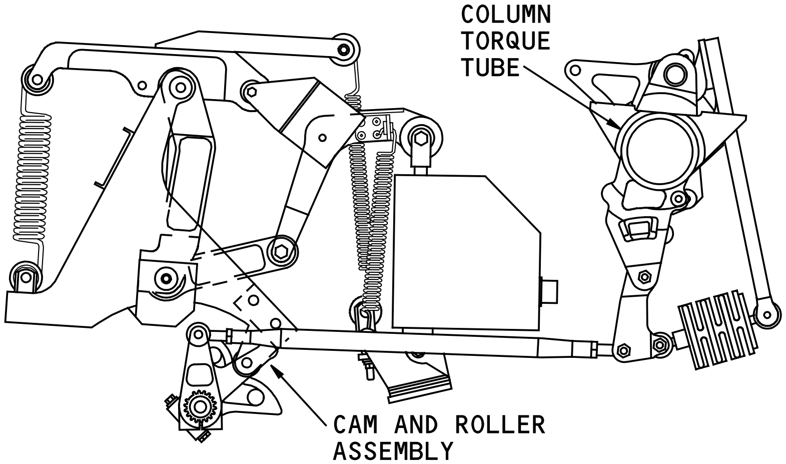
When the pilot moves the control column, the cam in the elevator feel unit rotates. This causes the cam follower to move and the centering arm to extend the feel springs. At low airspeed, the feel force at the control column is from 6.4 lb (2.9 kg) at breakout to a maximum of 43.3 lb (19.6 kg) at column maximum travel.

When the pilot releases the control column, the feel springs force the cam follower back to the cam detent. This returns the elevator control system to the neutral position.

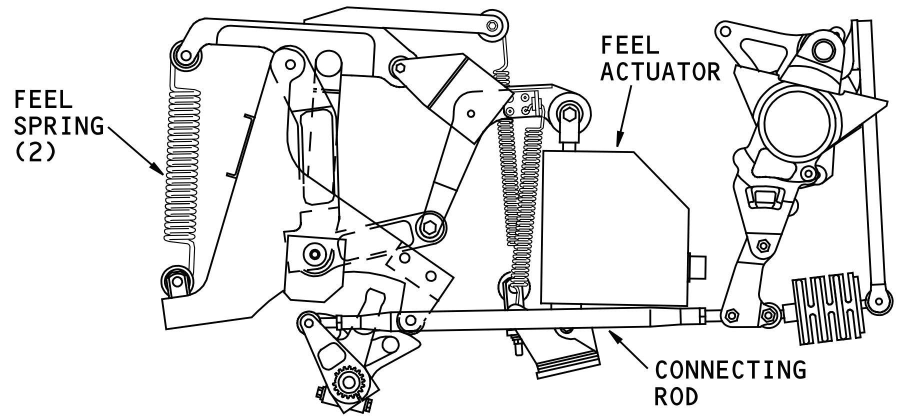
Variable Feel

As the speed of the airplane increases, the feel actuator extends gradually. This causes the levers of the variable feel mechanism to move the mechanism pivot point. The feel springs extend further with the mechanism in this position. When the pilot moves the column, the increased spring extension causes an increase of the column feel force.

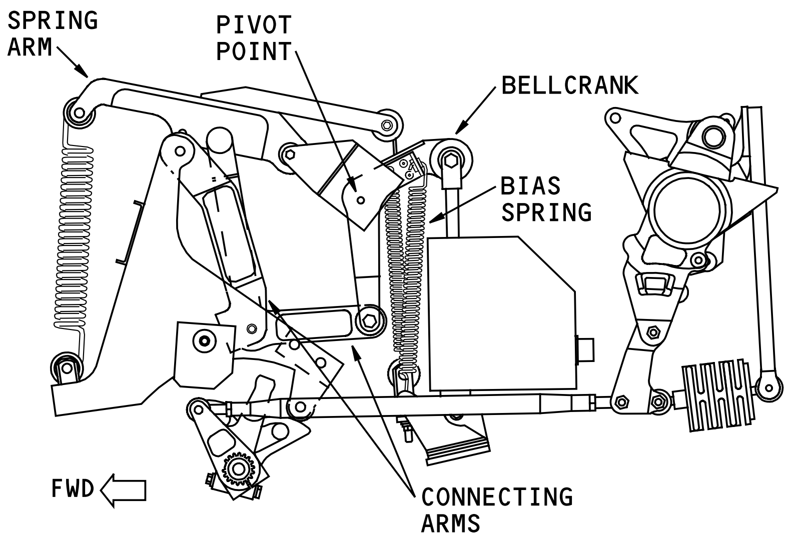
The feel actuator extends and retracts as the airspeed increases and decreases. This causes the column feel force, at full travel, to change from 43.3 lb (19.6 kg) at low airspeed to approximately 100 lb (45.4 kg) at high airspeed.



CONTROL COLUMN-NEUTRAL, FEEL ACTUATOR RETRACTED



CONTROL COLUMN INPUT, FEEL ACTUATOR RETRACTED



CONTROL COLUMN INPUT, FEEL ACTUATOR EXTENDED

27-30-00-012 Rev 2 01/09/96

ELEVATOR CONTROL - ELEVATOR FEEL - FUNCTIONAL DESCRIPTION

ELEVATOR CONTROL - COLUMN BREAKOUT MECHANISM

Purpose

The column breakout mechanism makes it possible to control the elevators if a jam occurs in a control column, the column torque tubes, or an elevator feel unit.

Physical Description

The column breakout mechanism has a cam on the right torque tube. The cam follower assembly roller is on the left torque tube. Two springs keep the roller on the cam. The two torque tubes have connections for the elevator feel unit and backdrive actuator rods.

Location

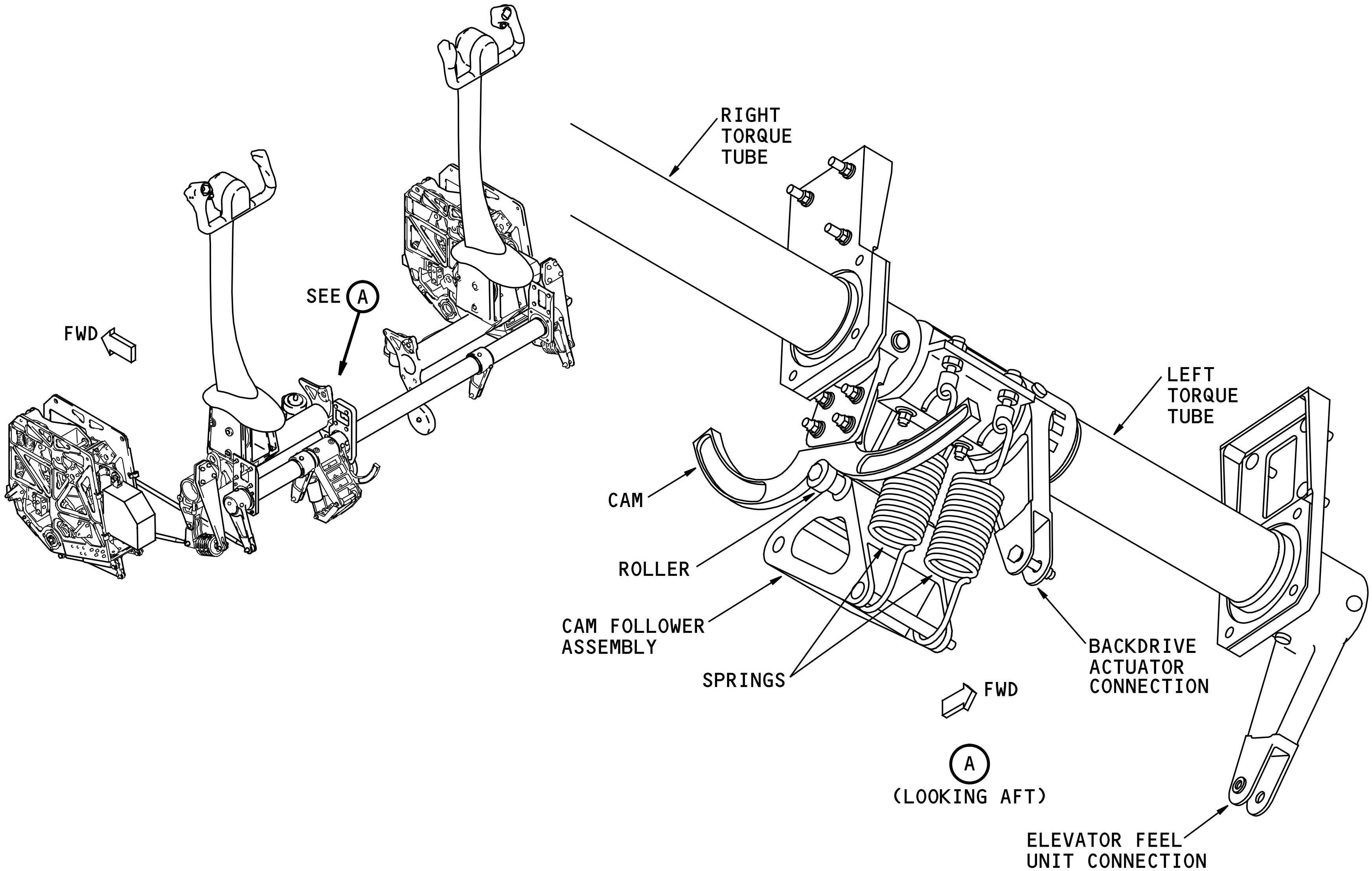
The breakout mechanism is under the flight deck, aft of the column torque tubes. Access is through the forward equipment center door.

Functional Description

During normal operation, the two torque tubes of the column breakout mechanism are held together by the springs of the cam and roller mechanism. This supplies a load path to transfer control column force from one side to the other. During normal operations, movement of one control column will cause approximately the same movement of the other column.

If a jam occurs in the elevator control mechanism on either pilot's side, the other side will be free to move. The roller then moves out of the cam detent which allows control column movement on the side opposite the jam.

A force at the control column of approximately 50 lb (23 kg) is necessary to move the roller out of the detent position.



27-30-00-014 Rev 2 03/28/96

ELEVATOR CONTROL - COLUMN BREAKOUT MECHANISM

ELEVATOR CONTROL - ELEVATOR PCU - INTRODUCTION

Purpose

The elevator PCUs move the elevators. Electrical signals from the ACEs command the elevator PCUs. Each elevator has two PCUs.

Location

The two PCUs are side by side on the rear spar of the horizontal stabilizer. To get access to each PCU, remove a 24 by 24 inch (Approx.) panel on the bottom of the stabilizer.

The kick link connects the PCU to the rear spar fitting. The actuator rod and the reaction link connect to the elevator structure at the PCU fitting.

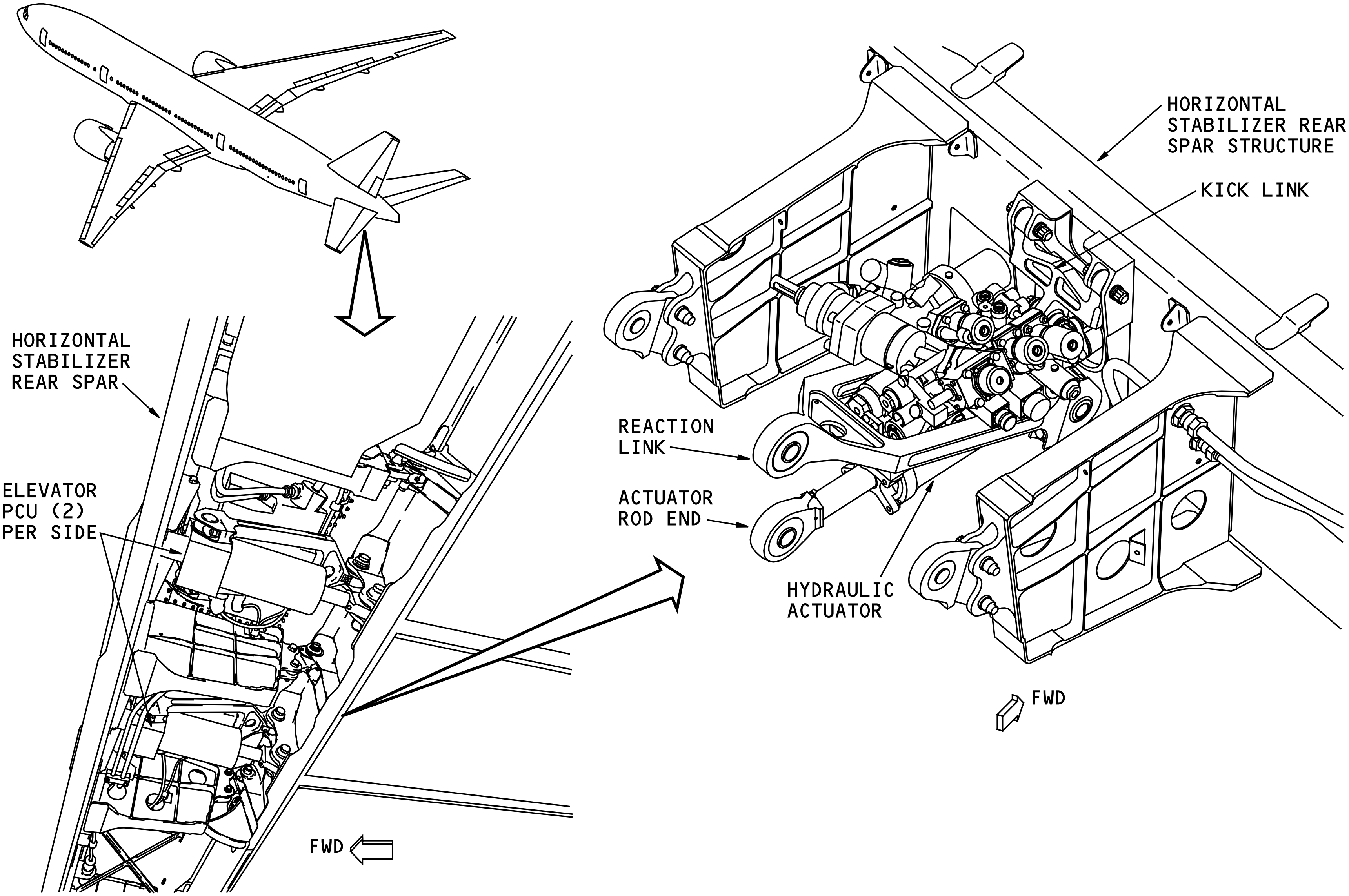
Two electrical connectors of different sizes connect to the upper side of the PCU.

Hydraulic tubing connects to ports on the upper side of the PCU.

Training Information Point

Remove and install the elevator PCU as one assembly with the reaction link. The elevator PCU disconnects from the kick link which stays on the airplane.

Use the cradle hoist ground service equipment (GSE) to support the PCU during removal and installation.



27-30-00-015 Rev 0

ELEVATOR CONTROL - ELEVATOR PCU - INTRODUCTION

ELEVATOR CONTROL - ELEVATOR PCU - PHYSICAL DESCRIPTION

Physical Description

All four elevator PCUs are identical. Each elevator PCU, with its reaction link, weighs about 85 lb (41 kg).

The outboard PCUs are powered by the left hydraulic system. The left inboard is powered by the center system and the right inboard is powered by the right system.

Each elevator PCU contains a hydraulic actuator with a control module. The control module contains:

- An electrohydraulic servo valve (EHSV)
- A pressure reducer solenoid valve which controls the pressure reducer valve
- A bypass solenoid valve
- A pressure sag check valve
- A blocking solenoid valve with two solenoid coils
- A mode selector valve with manual bypass
- A differential pressure sensor
- Two bypass check valves with restrictors
- A thermal relief valve
- A compensator/relief valve with quantity indicator
- A manual test valve for the compensator/relief valve
- Two anti-cavitation check valves with restrictors
- An inlet check valve
- An inlet filter.

Hydraulic Actuator

The actuator piston has an LVDT that sends actuator position feedback signals to the ACE. The actuator piston also has a null LVDT to adjust the null position of the actuator piston LVDT during installation of the PCU.

EHSV

The EHSV controls the hydraulic power to the extend and retract sides of the actuator. The EHSV has an LVDT that sends EHSV position feedback signals to the ACE.

Pressure Reducer Solenoid Valve

The ACE that commands the adjacent PCU controls the pressure reducer solenoid valve. The pressure reducer solenoid valve commands the pressure reducer valve to decrease the hydraulic pressure to 2140 psi. Reduced pressure on the actuator decreases the probability of a leak and decreases fatigue loads during normal operation.

In case of failure of a PCU or its hydraulic source, the hydraulic pressure to the other PCU increases to the nominal hydraulic system pressure of 3000 psi. This permits the other PCU to increase its capacity.

ELEVATOR CONTROL - ELEVATOR PCU - PHYSICAL DESCRIPTION

Bypass Solenoid Valve

The on-side ACE commands the bypass solenoid valve. The bypass solenoid valve controls the pilot pressure from the hydraulic system to the mode selector valve.

Pressure Sag Check Valve

The pressure sag check valve prevents pressure decreases from affecting the position of the mode selector valve.

Blocking Solenoid Valve

The on-side ACE controls one coil of the blocking solenoid valve, the ACE commanding the adjacent PCU controls the other coil. The blocking solenoid valve controls the pilot pressure from the actuator to the mode selector valve.

Mode Selector Valve

Pilot pressure from the bypass or the blocking solenoid valves commands the mode selector valve to one of these positions:

- Normal
- Bypass
- Blocking.

Differential Pressure Sensor

A differential pressure sensor measures the pressure difference between both sides of the actuator piston. The sensor operates an LVDT which sends signals to the ACE.

Bypass Check Valves with Restrictors

The two bypass check valves permit pressure from either side of the actuator to reach the damped solenoid valve. The restrictors prevent pressure fluctuations from affecting the position of the mode selector valve.

Thermal Relief Valve

The thermal relief valve protects the actuator from thermal expansion of the hydraulic fluid.

Compensator/Relief Valve with Quantity Indicator

The compensator/relief valve holds a small quantity of fluid at a pressure slightly above the hydraulic system return pressure. This fluid is available to the actuator to prevent cavitation.

The indicator shows the quantity of fluid in the compensator.

Manual Test Valve

You use the manual test valve to test the proper operation of the compensator/relief valve. With the

ELEVATOR CONTROL - ELEVATOR PCU - PHYSICAL DESCRIPTION

manual test valve open, the compensator/relief valve pressure decreases. Check that the quantity indicator moves to the empty position.

Anti-Cavitation Check Valves with Restrictors

The two anti-cavitation check valves permit return fluid from the compensator/relief valve to flow to the actuator. This prevents cavitation of the actuator during rapid backdriving of the PCU. The restrictors maintain elevator panel stiffness in case a check valve fails open.

Inlet Check Valve

The inlet check valve keeps the hydraulic fluid in the actuator when the hydraulic system power is lost.

Inlet Filter

The inlet filter protects the actuator from solids in the hydraulic fluid.

Training Information Point

A manual bypass valve permits movement of the PCU manually. Hydraulic power must be off before you use the manual bypass valve.

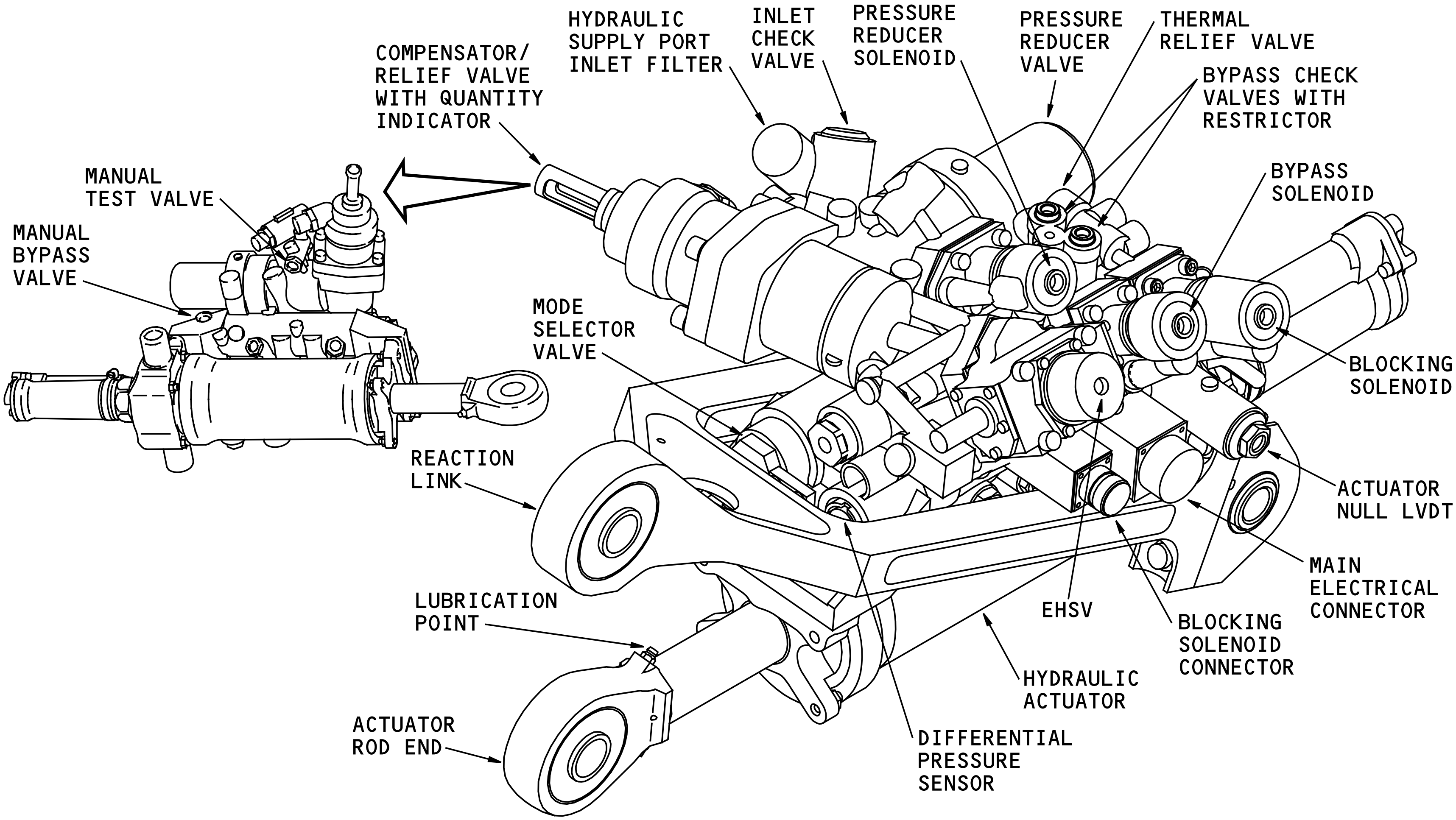
To move the elevator for maintenance, access the manual bypass valve. Turn the valve on both PCUs with the special tool while moving the elevator. After release of the manual bypass, it closes.

After installation of the elevator PCU, the actuator null LVDT requires adjustment. Remove the null LVDT access cover to adjust the actuator null LVDT.

During periodic inspection, you use the manual test valve to check the proper function of the compensator/relief valve. Remove hydraulic power from the PCU then move the manual test valve to release pressure internal to the compensator/relief valve. Do a check to see that the compensator/relief valve indicator moves all the way to its empty position.

The bearings in the actuator rod end and the reaction link require lubrication.

All other bearings on the actuator and the reaction link are teflon coated. They do not require lubrication.



27-30-00-016 Rev 2 06/20/1997

ELEVATOR CONTROL - ELEVATOR PCU - PHYSICAL DESCRIPTION

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ELEVATOR CONTROL - ELEVATOR PCU - FUNCTIONAL DESCRIPTION

General

The elevator PCU operates in three different modes:

- Normal
- Bypass
- Blocking.

In the normal mode, the ACE energizes the bypass solenoid and at least one of the coils of the blocking solenoid. The ACE energizes or de-energizes the pressure reducer solenoid.

In the bypass mode, the ACE de-energizes the bypass solenoid and energizes at least one of the coils of the blocking solenoid. The ACE energizes the pressure reducer solenoid.

In the blocking mode, the ACE de-energizes:

- The bypass solenoid
- Both coils of the blocking solenoid
- The pressure reducer solenoid.

The solenoid of the blocking valve has two coils. When both coils are de-energized, the valve is in its relaxed state. When one or both coils of the solenoid is energized, the valve moves.

PCU Operational Matrix

The table below shows the various conditions of the PCU valve solenoids in the three modes of operation.

SOLENOID CONDITIONS	PCU MODES OF OPERATION		
	NORMAL	BYPASS	BLOCKING
BYPASS SOLENOID	E	D	D
BLOCKING SOLENOID COIL 1	E	E/D	D
BLOCKING SOLENOID COIL 2	E/D	E	D
PRESSURE REDUCER SOLENOID	E/D	E	D
LEGEND:	E = ENERGIZED	D = DE-ENERGIZED	

Normal mode

The PCU is in the normal mode when the ACE energizes the bypass solenoid and at least one coil of the blocking solenoid. In the normal mode, the ACE energizes the pressure reducer solenoid when there is no failure of the ACE or the PCU.

With the bypass and blocking solenoids energized, hydraulic pressure moves the mode selector valve to the normal mode position. An electrical command to the EHSV results in the actuator extension or retraction.

When the ACE energizes the pressure reducer solenoid, the pressure reducer valve reduces the hydraulic pressure to 2140 psi. When there is a failure of the adjacent PCU, the ACE de-energizes the pressure reducer solenoid. The actuator then operates with full hydraulic system pressure (3000 psi).

ELEVATOR CONTROL - ELEVATOR PCU - FUNCTIONAL DESCRIPTION

Bypass Mode

The PCU is in the bypass mode when the ACE de-energizes the bypass solenoid and energizes one coil of the blocking solenoid.

This happens when there is a failure on the PCU or the ACE in control of the PCU.

Under these conditions, the bypass solenoid valve blocks hydraulic pressure to the mode selector valve. However, pressure trapped between the bypass check valves and the thermal relief valve moves the mode selector valve to the bypass position.

The mode selector valve blocks control pressure from the EHSV to the actuator cylinder. It also connects both sides of the actuator through a restriction.

During rapid backdrive of the failed PCU, the compensator/relief valve supplies fluid to the actuator through the anti-cavitation check valves.

Blocking Mode

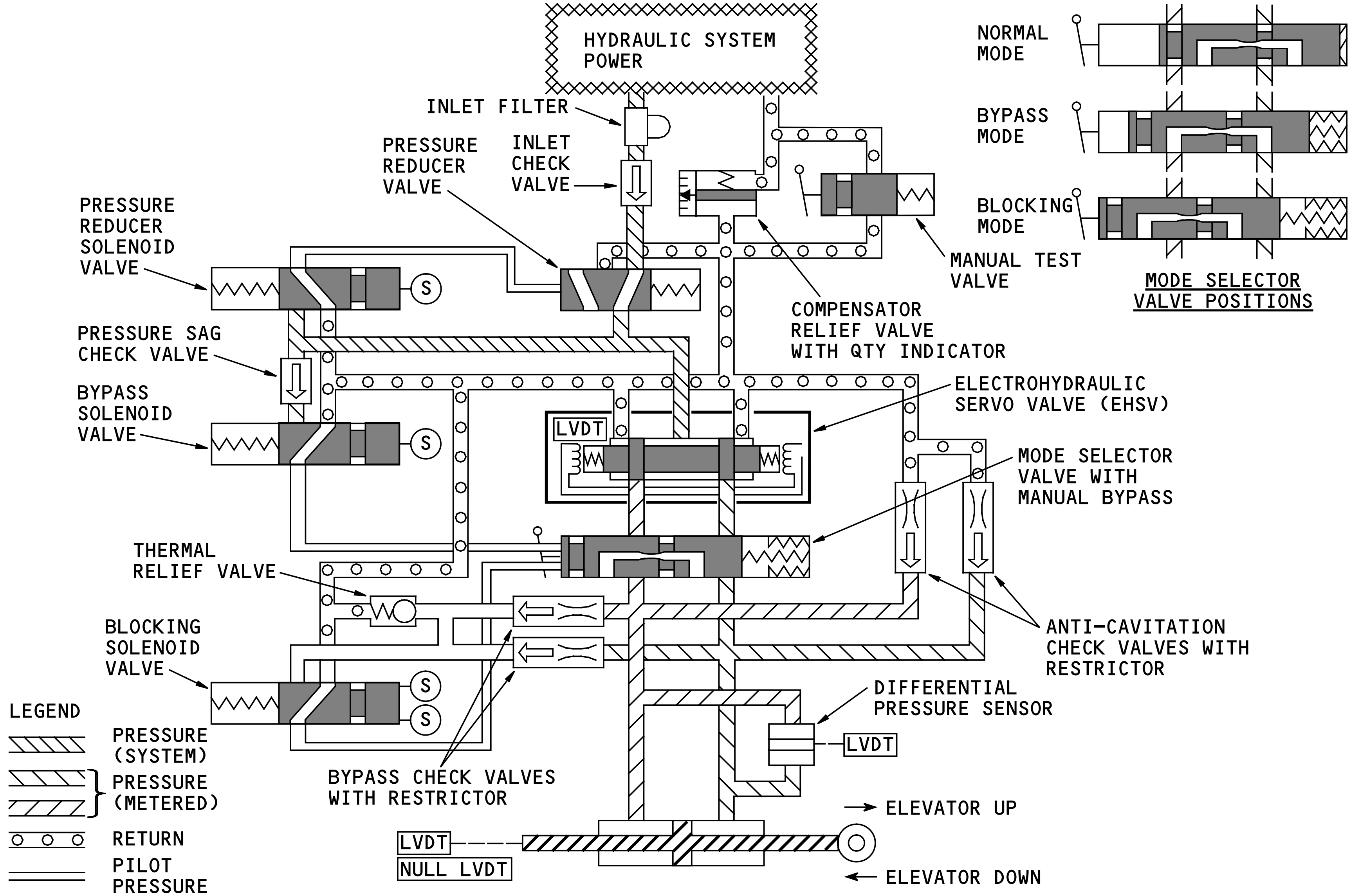
The PCU is in the blocking mode when the ACE de-energizes the bypass solenoid and both coils of the blocking solenoid. The ACE also de-energizes the pressure reducer solenoid. This happens when the PCU has no electrical and hydraulic power. Also, the PCU is in the blocking mode when there is a failure of both adjacent PCUs or their ACEs and the elevator is near the faired position.

In the blocking mode, there is no hydraulic pressure on the mode selector valve. Its internal spring moves the valve to the blocking position. The mode selector valve blocks control pressure from the EHSV to the actuator cylinder. It also blocks hydraulic flow between both sides of the actuator piston.

Under these conditions, the actuator cannot move. When both PCUs on an elevator are in blocking mode, they lock the elevator in its position.

Indications

The status message FLIGHT CONTROL SYS shows when one or more elevator actuator has failed.



ELEVATOR CONTROL - ELEVATOR PCU - FUNCTIONAL DESCRIPTION

27-30-00-017 Rev 3 03/28/96

ELEVATOR CONTROL - ELEVATOR PCU - FUNCTIONAL DESCRIPTION - PCU MODES

General

The ACEs control the mode of operation of the elevator PCU.

Normal Mode

An elevator PCU operates in the normal mode when there is no failure on the PCU and there is no failure of its on-side ACE.

If the adjacent PCU is also in the normal mode, the ACEs energize both coils of the blocking solenoid and the pressure reducer solenoid. When these conditions are true, both PCUs operate with reduced hydraulic pressure.

Bypass Mode

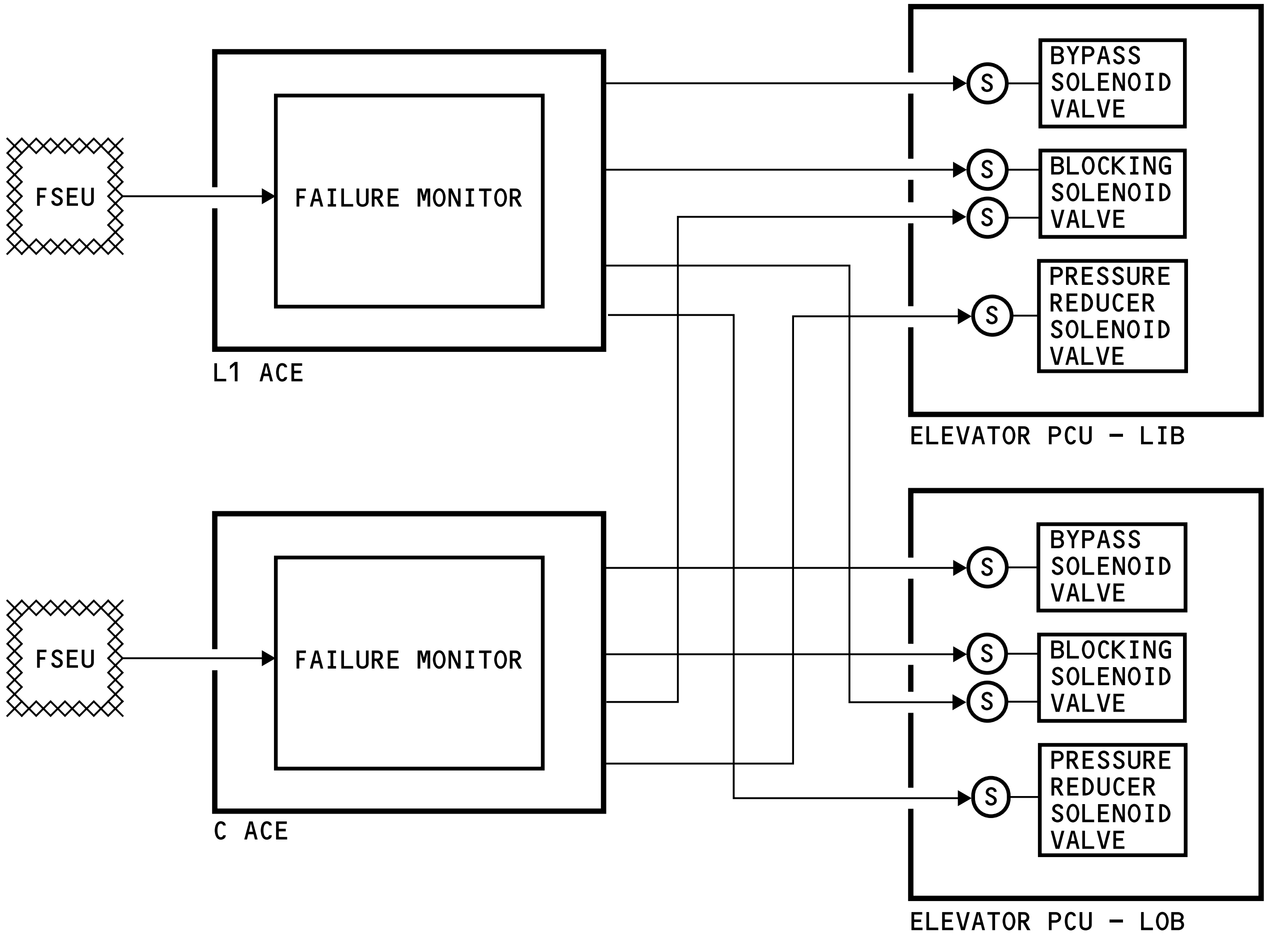
If the PCU has an electrical or hydraulic failure or there is a failure of its ACE, the ACE de-energizes the bypass solenoid. The PCU is then in the bypass mode. The ACE also de-energizes the pressure reducer solenoid of the adjacent PCU. The adjacent PCU then operates in normal mode with full hydraulic system pressure.

When the elevator position is less than two degrees from neutral with flaps retracted, or five degrees with flaps extended, it is near to being faired. When the elevator is near to being faired, the ACE also de-energizes one coil of the blocking solenoid on the failed and the adjacent PCU. This prepares the two PCUs to go into the blocking mode should there be a failure on the adjacent PCU or its ACE.

Blocking Mode

If there is a failure with the second PCU or its ACE when the elevator is near to being faired, all PCU solenoids de-energize. When it is not near to faired, the energized blocking solenoids on each PCU stay energized.

As soon as the airloads move the elevator panel near to faired, both blocking solenoids de-energize. At this time, a hydraulic lock in the PCUs keeps the elevator in the faired position.



27-30-00-018 Rev 1 06/20/1997

ELEVATOR CONTROL - ELEVATOR PCU - FUNCTIONAL DESCRIPTION - PCU MODES

ELEVATOR CONTROL - ELEVATOR ASSEMBLY

Purpose

The elevators supply short-term pitch control of the airplane.

Physical Description

The elevators are light weight composite material structures. The skin is reinforced graphite/epoxy bonded to a core of Nomex honeycomb. The overall dimensions are approximately 70 inches by 403 inches (1.7 m by 10.2 m). Each elevator panel weighs approximately 327 lb (148 kg).

The elevator attaches to the stabilizer rear spar with seven hinges. There are four PCU attach fittings on each elevator. Jumpers and static dischargers supply electrostatic protection.

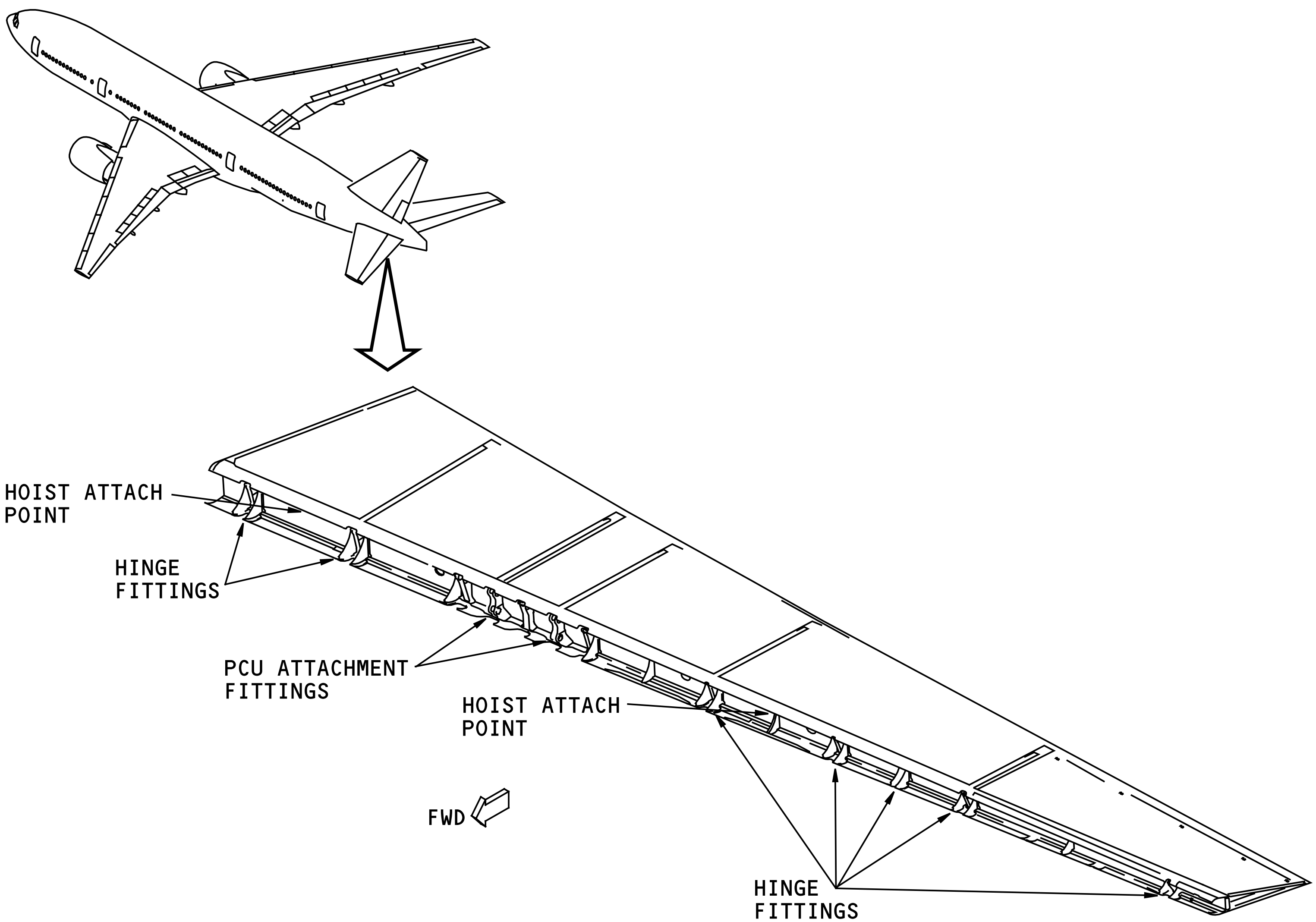
Functional Description

The elevator surface deflection limits are at the PCU internal stops. The elevators have a maximum movement of 33 degrees trailing edge up (TEU) and 27 degrees trailing edge down (TED) under no load conditions.

Under load conditions, the maximum PFC and ACE command signals move the elevators to a nominal position between 30 degrees TEU and 25 degrees TED. You adjust the elevator PCUs on the ground with the stabilizer at the neutral position. You adjust the PCUs so the elevator control surfaces are at neutral in reference to an index plate on the tail section of the fuselage.

Training Information Point

Two hoist attach points are on each elevator. They are on the upper leading edge spar flange. One is between the inboard hinge fittings. The other is between the hinge fittings outboard of the PCU fittings. Two fasteners at each attach point are removed so the GSE lifting tool may be attached. A clamp on the trailing edge to supplies the third lifting point.



27-30-00-021 Rev 2

ELEVATOR CONTROL - ELEVATOR ASSEMBLY

ELEVATOR CONTROL - FUNCTIONAL DESCRIPTION

General

The pitch control system for the elevators uses input command signals from the control column position transducers and the force transducers.

The ACEs receive the input signals and transmit them to the PFCs. The ACEs supply output command signals to the elevator feel actuators and the elevator PCUs.

Control Column Position Transducers

The C and R ACEs each receive signals from two control column position transducers. L1 and L2 ACEs receive signals from only one transducer. After they change the signals to digital format, the ACEs send these signals to the PFCs through the flight controls ARINC 629 buses.

Force Transducers

Each ACE receives one input from the four force transducer LVDTs. The ACEs change and transmit these signals to the PFCs.

Elevator Feel Actuators

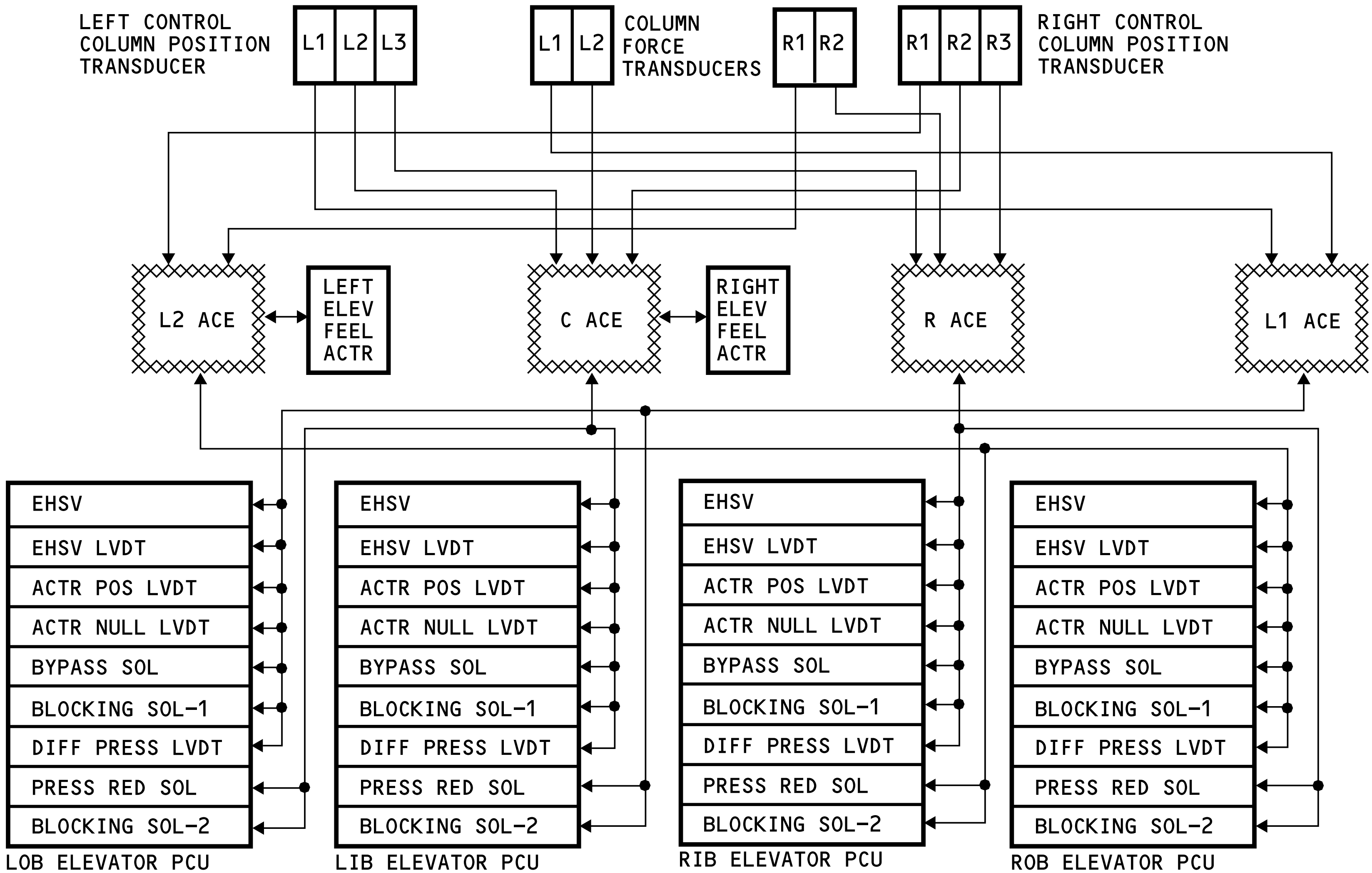
The L2 ACE controls the left elevator feel actuator and the C ACE controls the right one.

Elevator PCUs

Each ACE sends output commands to the assigned elevator PCU. It also sends control signals to the adjacent PCU on the same elevator. The pitch command goes to the EHSV. A control signal goes to the bypass and number one blocking solenoid. It sends pressure reducing and blocking solenoid signals to the adjacent PCU on the same elevator.

The PCU sends feedback signals to its assigned ACE from:

- The EHSV position LVDT
- The actuator piston position LVDT
- The actuator null LVDT
- The differential pressure LVDT.



27-30-00-019 Rev 2 07/18/1997

ELEVATOR CONTROL - FUNCTIONAL DESCRIPTION

ELEVATOR CONTROL - FUNCTIONAL DESCRIPTION - ACE SERVO LOOP

General

The ACE contains a servo loop circuit to give the command signals to the PCUs.

In normal and secondary mode, the PFC sends the command signals to the ACE. In direct mode, the ACE calculates the command signals.

Servo Loop Operation

The elevator command signals go through a servo loop in the ACEs. The command signals then go to the EHSV of the PCUs. The ACEs also use the command signals to monitor for failures. The movement of the EHSV sends hydraulic pressure to extend or retract the actuator.

The EHSV LVDT measures the movement of the EHSV and supplies a feedback signal to the ACEs. The ACEs use this feedback signal to monitor failures.

The actuator position LVDT measures the movement of the actuator and supplies a signal to the actuator null LVDT.

The actuator null LVDT is in series with the actuator position LVDT. The actuator null LVDT modifies the signal from the actuator position LVDT.

The actuator null LVDT supplies a feedback signal to the ACEs to close the servo loop. The ACEs use this feedback signal to monitor for failures. This signal also goes to the PFC.

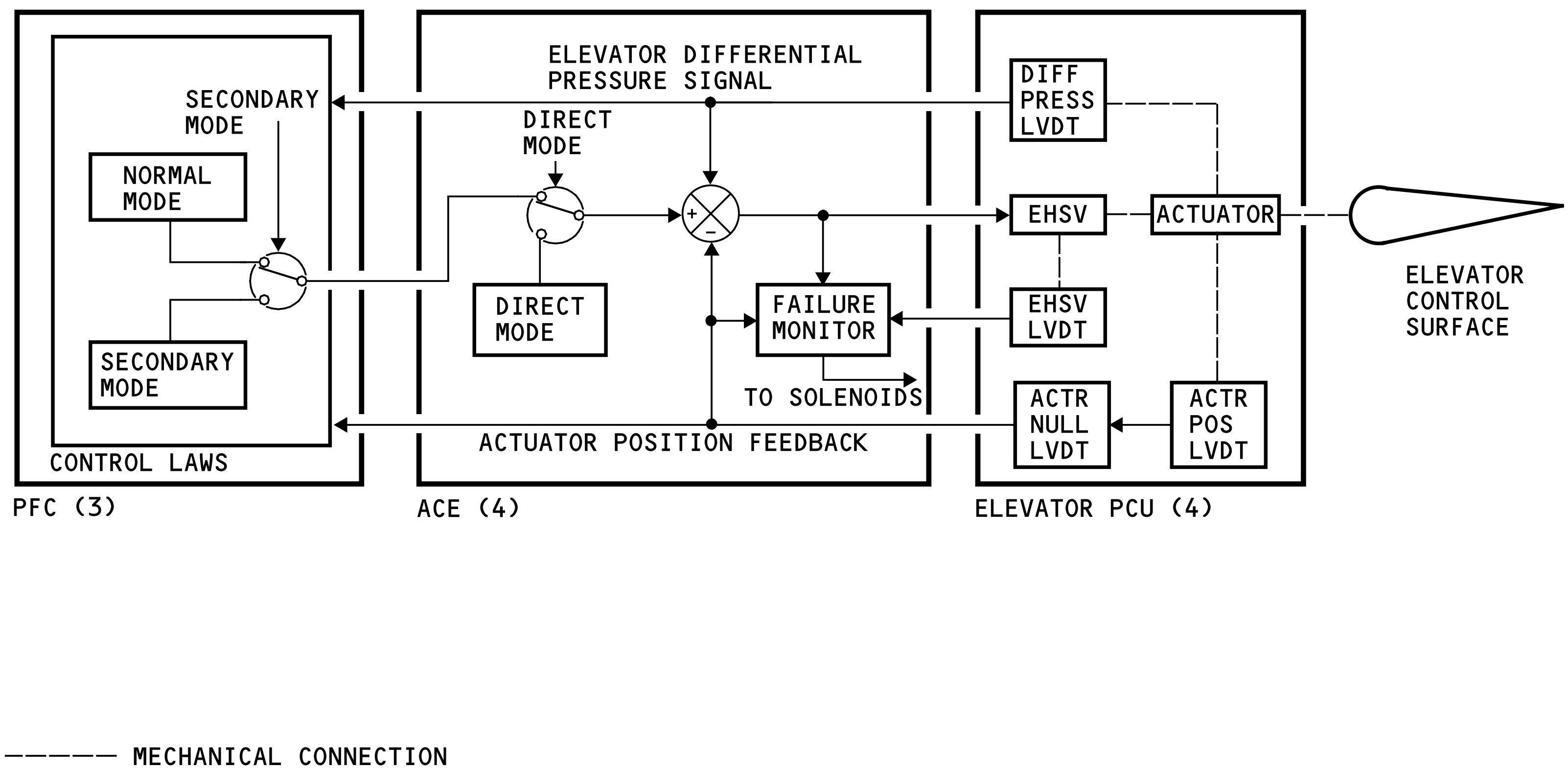
A differential pressure LVDT measures the differential pressure across the actuator. The signal from the differential pressure LVDT goes to the ACEs for the servo loop. The signal also goes to the PFCs for force fight equalization.

Failure Monitor

The ACE has a failure monitor to check the proper operation of the PCU. The monitor uses the ACE command signal and the feedback signals from the EHSV LVDT and the actuator LVDT. When the failure monitor finds a fault with the PCU or the ACE, it de-energizes the PCU bypass, blocking and pressure reducer solenoids.

Training Information Point

During installation of the elevator PCU, it is necessary to adjust the actuator null LVDT. Remove the null LVDT access cover to adjust the null LVDT.



27-30-00-020 Rev 3 12/08/95

ELEVATOR CONTROL - FUNCTIONAL DESCRIPTION - ACE SERVO LOOP

ELEVATOR CONTROL - FUNCTIONAL DESCRIPTION - ELEVATOR FEEL

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ELEVATOR CONTROL - FUNCTIONAL DESCRIPTION - ELEVATOR FEEL

General

The PFCS controls the elevator feel actuators and works with the elevator feel unit to supply resistance to the movement of the control column.

The PFCs control elevator feel in the normal and secondary modes and the L2 and C ACEs control it in the direct mode.

Elevator Feel Actuator

The elevator feel actuator contains a brushless 28v dc reversible motor, and a 7v RVDT to supply an actuator position signal.

Normal Mode

In the normal mode, the PFC calculates elevator feel commands as a function of airspeed. As airspeed increases, it commands the actuator to extend. As airspeed decreases, the PFC commands the actuator to retract. This results in more or less resistance (feel) to movement of the control column. The command goes to the feel actuator through the ACE.

During takeoff, the feel actuators disengage above 40 knots. The feel actuators engage to provide variable feel 5 seconds after the ground-to-air transition. On the ground with airspeed below 40 knots, the feel actuators engage to permit the flight crew to do a check of the feel forces during the freedom of controls check.

Secondary Mode

In the secondary PFCS mode, the PFC calculates feel commands as a function of flaps and slats position. The FSEUs supply through the ACEs a discrete flaps and slats retracted signal. When the flaps and slats are not retracted, a low feel command is made. When the flaps and slats are retracted, a high feel command is made.

Direct Mode

The ACE uses the FSEU discrete flaps and slats retracted signal to calculate feel actuator commands in the direct mode. When the flaps and slats are not retracted, it makes a low feel command. When the flaps and slats are retracted, it makes a high feel command.

Failure Monitor

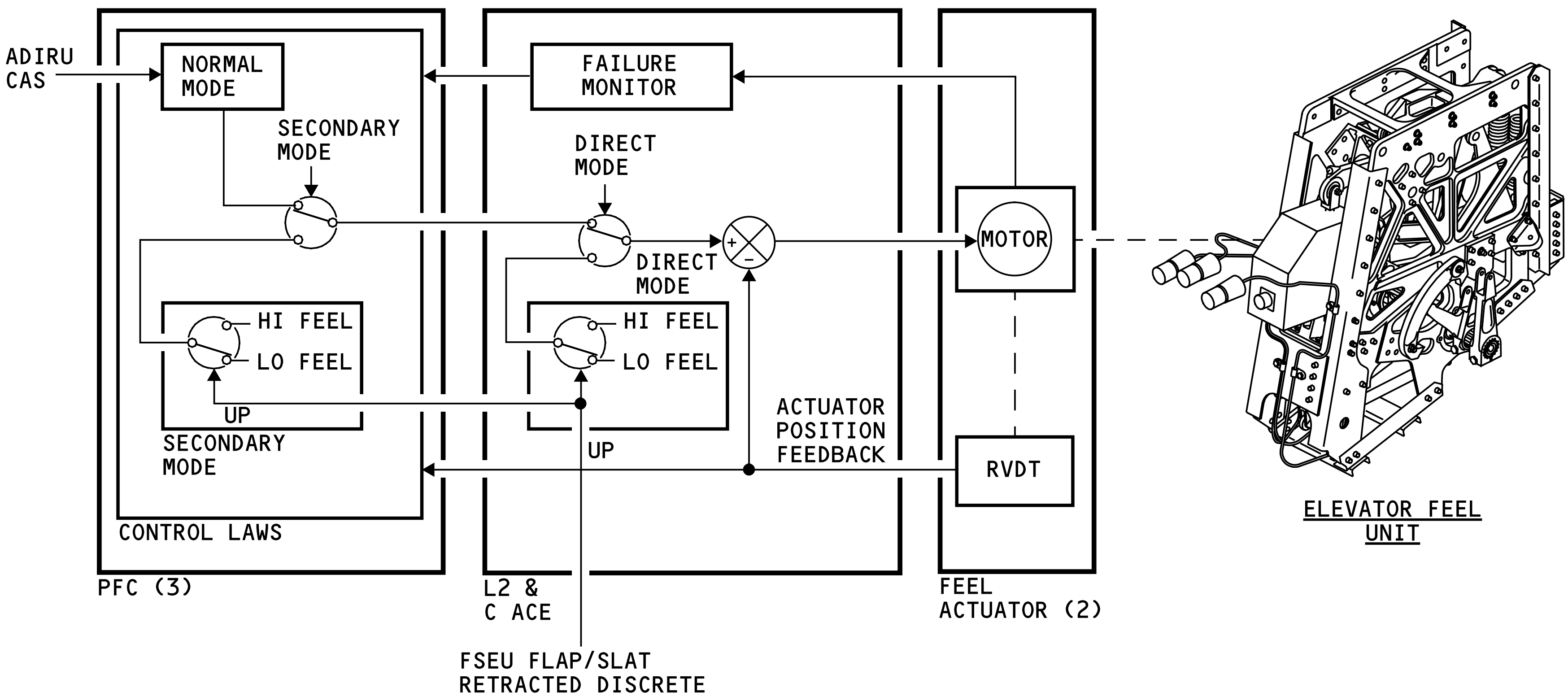
In normal mode, if the PFC detects a difference between the output and the feed back signals from one of the feel actuators, it shuts off the signal to that actuator. The failed actuator is spring loaded to a zero force input.

The PFC then commands the other actuator with a doubled signal that compensates for the failed actuator. Because of this, the feel force at the control columns remains the same.

ELEVATOR CONTROL - FUNCTIONAL DESCRIPTION - ELEVATOR FEEL

Indications

The status message FLIGHT CONTROL SYS shows that there is a failure in one or more elevator feel actuators.



27-30-00-025 Rev 1 01/08/96

ELEVATOR CONTROL - FUNCTIONAL DESCRIPTION - ELEVATOR FEEL

Continental Airlines, Inc

Horizontal Stabilizer Control

WB371

TABLE OF CONTENTS

HORIZONTAL STABILIZER CONTROL - INTRODUCTION

General

The horizontal stabilizer supplies long-term correction of the pitch attitude of the airplane. This movement is around the lateral axis of the airplane.

Stabilizer Control

The elevator off-load function automatically sets the position of the stabilizer during manual flight or in autoflight. In this mode, the PFCs monitor elevator deflection and transfer pitch changes to the stabilizer. Once the stabilizer goes to its commanded position, the elevator moves to neutral.

The pilots command the stabilizer to move with either the pitch trim switches on the control wheels or the alternate pitch trim levers on the control stand.

The pilots stop unwanted stabilizer movement with the stabilizer cutout switches on the aisle stand.

Stabilizer Operation

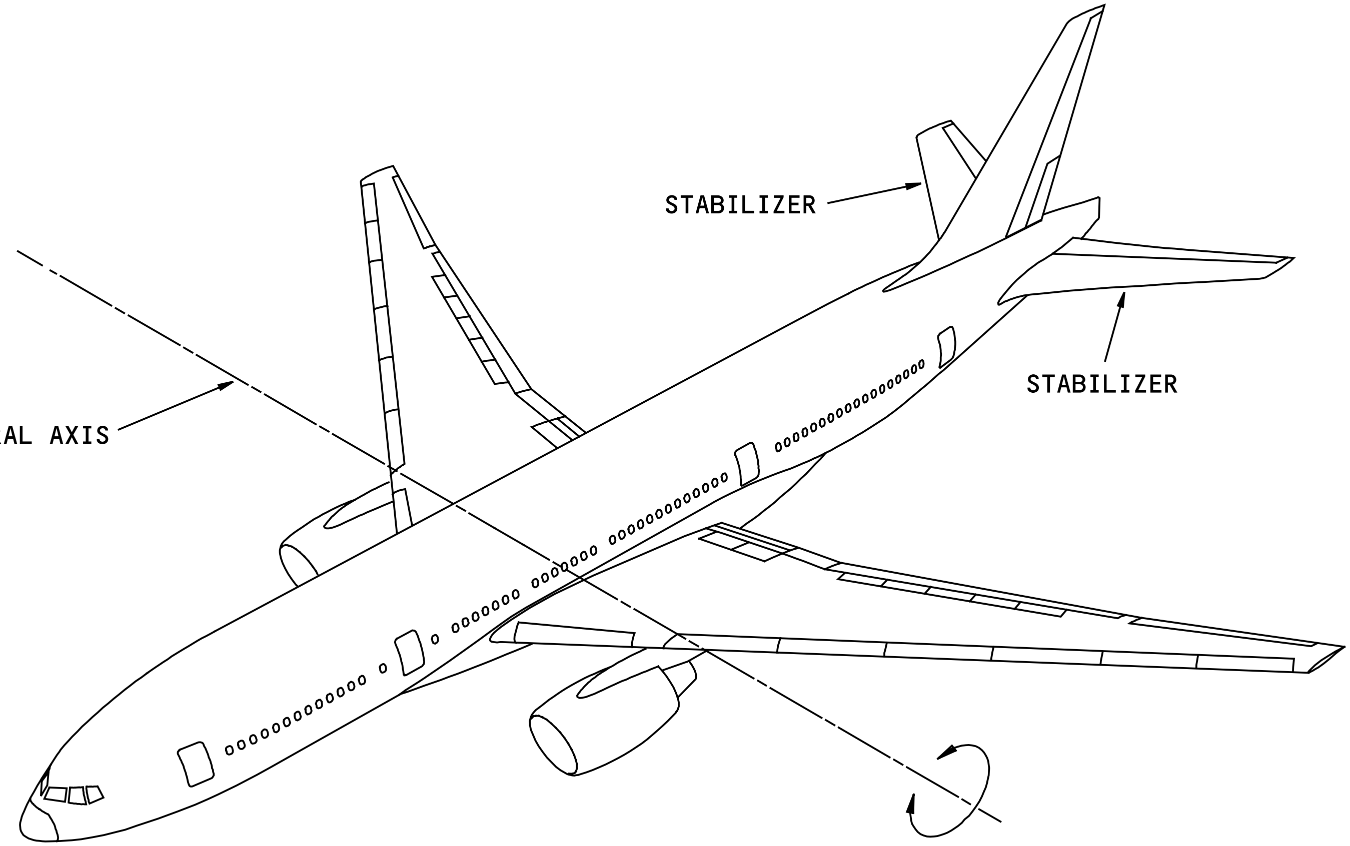
Two hydraulic motors with two speeds move the horizontal stabilizer through a jackscrew mechanism. Four rates of horizontal stabilizer movement are available.

Abbreviations and Acronyms

ACE	- actuator control electronics
ADIRS	- air data inertial reference system
ADIRU	- air data inertial reference unit
AFDC	- autopilot flight director computer
AFDS	- autopilot flight director system
AIMS	- airplane information management system
AOA	- angle of attack
ARINC	- Aeronautical Radio, Incorporated.
CMCS	- central maintenance computing system
CPU	- central processing unit
EHSV	- electrohydraulic servo valve
EICAS	- engine indication and crew alerting system
FMCS	- flight management computing system
LIB	- left inboard
LOB	- left outboard
LTA	- left trim arm
LTC	- left trim control
LVDT	- linear variable differential transformer
MAT	- maintenance access terminal
MFD	- multi-function display
PCU	- power control unit
PFC	- primary flight computer
PFCS	- primary flight control system
PSA	- power supply assembly
RIB	- right inboard
ROB	- right outboard
RTA	- right trim arm
RTC	- right trim control
RVDT	- rotary variable differential transformer

HORIZONTAL STABILIZER CONTROL - INTRODUCTION

SAARU	- secondary attitude air data reference unit
SPM	- stabilizer position module
STCM	- stabilizer trim control unit
TED	- trailing edge down
TEU	- trailing edge up



27-41-00-001 Rev 1

HORIZONTAL STABILIZER CONTROL - INTRODUCTION

HORIZONTAL STABILIZER CONTROL - GENERAL DESCRIPTION

General

The PFCS commands automatic movement of the stabilizer. The pilots manually command the stabilizer to move.

Flight Deck Controls

The pilots operate two pitch trim switches for manual pitch trim control. The switch modules are on the outboard side of each control wheel. They send electrical pitch trim signals to the ACEs.

Two alternate pitch trim levers are on the captain's side of the control stand. These levers mechanically control stabilizer movement.

Two guarded cutout switches on the aisle stand control hydraulic shutoff valves on the stabilizer trim control modules (STCMs). When the pilot moves the switches to the cutout position, hydraulic pressure is shut off to the hydraulic motors.

Two stabilizer position indicators on the control stand show the position of the stabilizer. A green band on the indicator shows the correct stabilizer position for takeoff. See the horizontal stabilizer position indication section for more information (AMM PART I 27-48).

Stabilizer Controls

Two stabilizer trim control modules (STCMs) receive commands from the ACEs and the alternate pitch trim levers to control the hydraulic pressure to the motors and brakes.

Two hydraulic motors that use different hydraulic system power sources, cause the ballscrew actuator to rotate. Two hydraulic brakes work with the motors and are powered by the same hydraulic systems. The brakes release and the motor runs with hydraulic pressure. With low pressure, the brakes set and the motors do not run. This prevents movement of the stabilizer.

The horizontal stabilizer is a one piece, negative lift airfoil. It pivots at its rear spar. A ballscrew actuator, attached to the front spar, moves the stabilizer leading edge to a maximum of 4 degrees up and 11 degrees down.

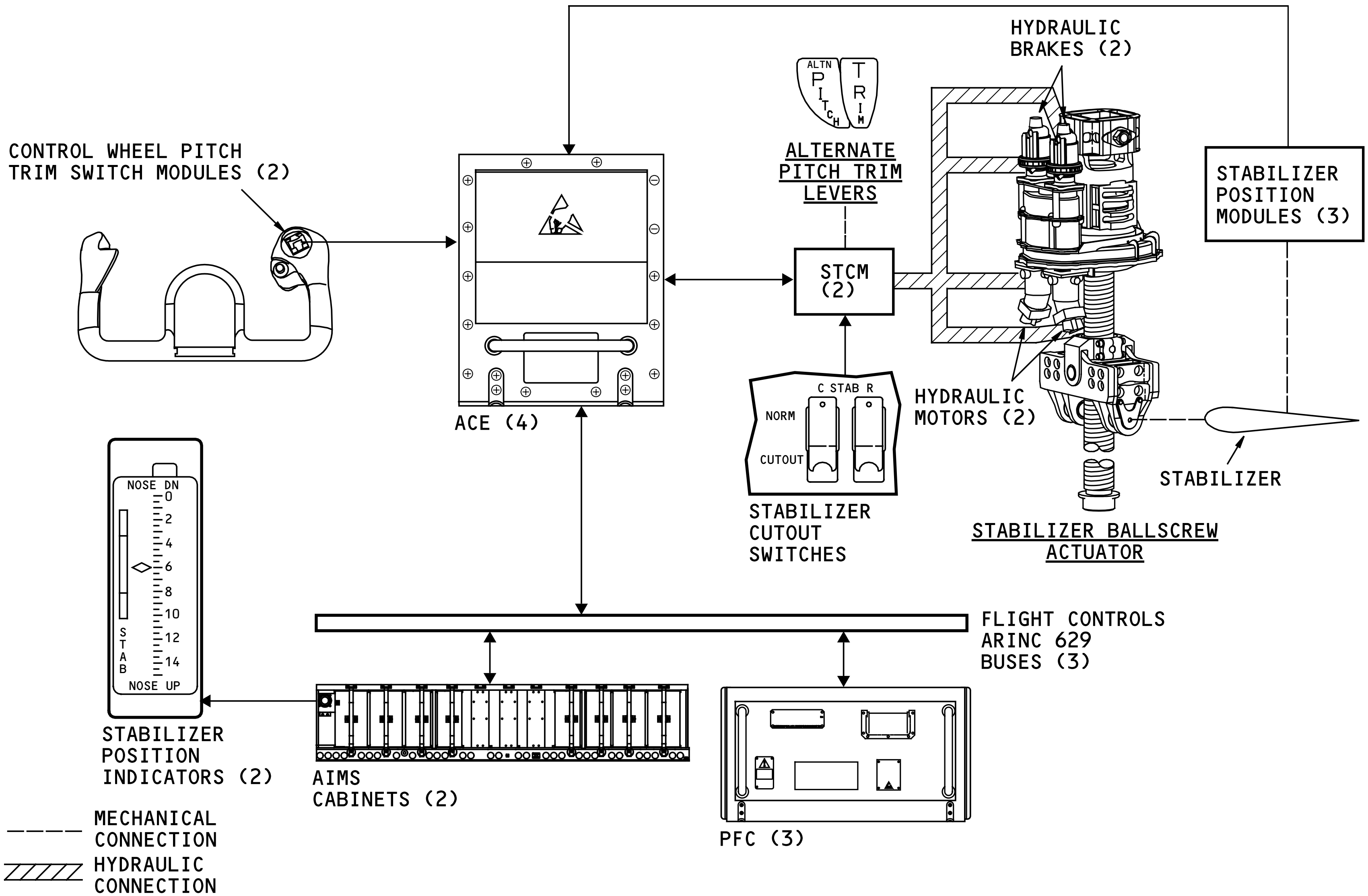
Cables transmit the stabilizer movement to three stabilizer position modules (SPMs) in the stabilizer compartment. The SPMs supply stabilizer position data to the ACEs.

Column Cutout

When the pilot moves the control column in the opposite direction of the pitch commanded by the pitch trim switches, the PFCs cut out the pitch command to the STCMs. This stops the stabilizer movement.

Stabilizer Automatic Cutout

In case of uncommanded pitch trim, the PFCs command the hydraulic shutoff valves on the STCMs to close.



27-41-00-002 Rev 3

HORIZONTAL STABILIZER CONTROL - GENERAL DESCRIPTION

HORIZONTAL STABILIZER CONTROL - COMPONENT LOCATIONS - FLIGHT DECK AND BELOW

General

Stabilizer system components are in the flight deck and below the flight deck.

Flight Deck Components

Two pitch trim switches are on the outboard side of each control wheel. The switches have three positions: nose-up, nose-down, and off.

Two alternate pitch trim levers are on the P10 control stand. They connect by cables to mechanical valves on the STCMs.

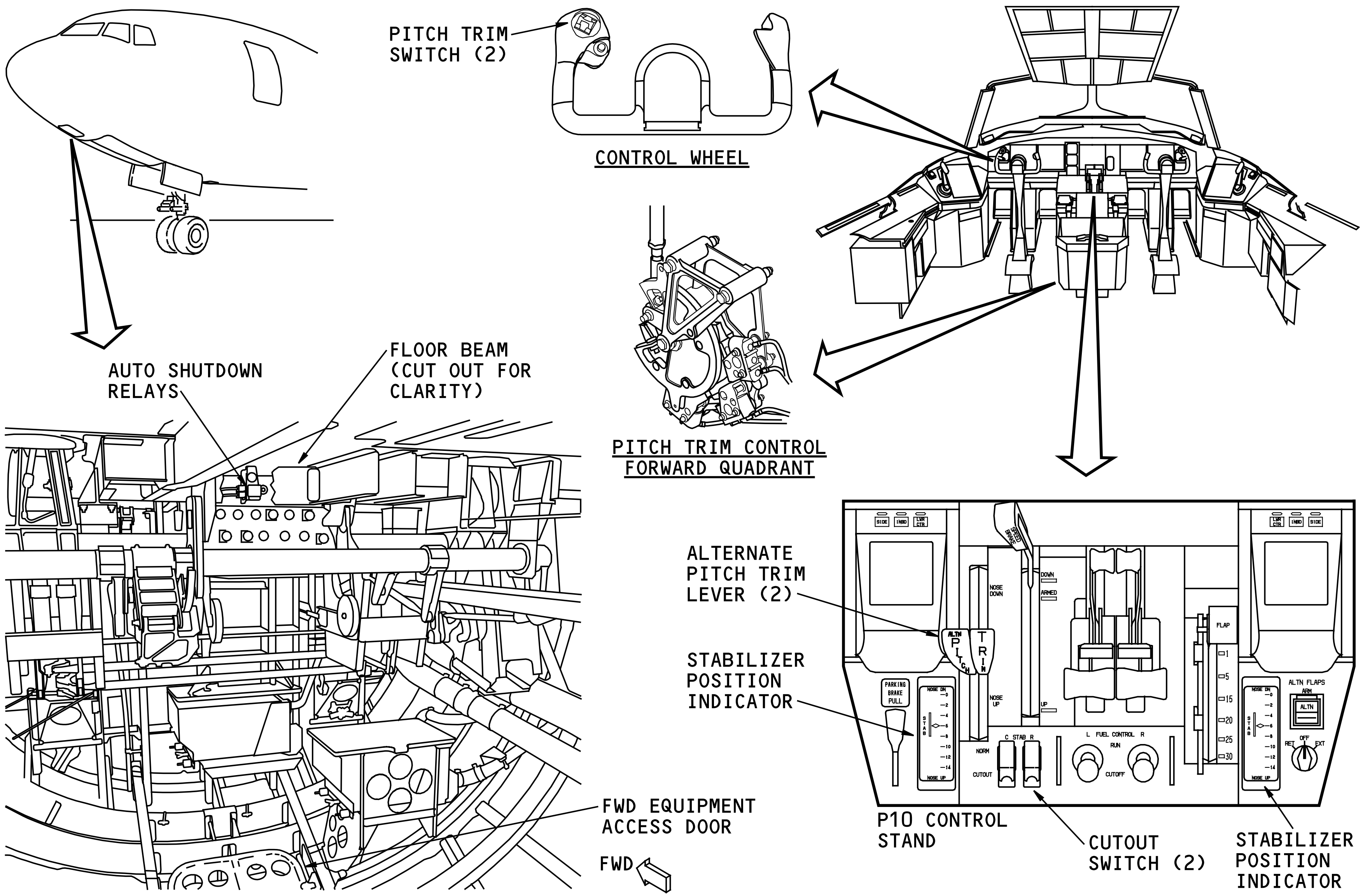
Two guarded stabilizer cutout switches are on the P10 control stand. Each switch removes hydraulic power from a hydraulic motor and brake when put in the CUTOUT position.

Two stabilizer position indicators are on the P10 control stand. They both have a green band to show when the stabilizer is in the proper position for take-off.

Components Below the Flight Deck

The auto shutdown relays are between flight deck floor beams in the forward equipment center.

The pitch trim control forward quadrants are below the control stand. Access is through the forward equipment center.



HORIZONTAL STABILIZER CONTROL - COMPONENT LOCATIONS - FLIGHT DECK AND BELOW

HORIZONTAL STABLIZER CONTROL - COMPONENT LOCATIONS - TAIL

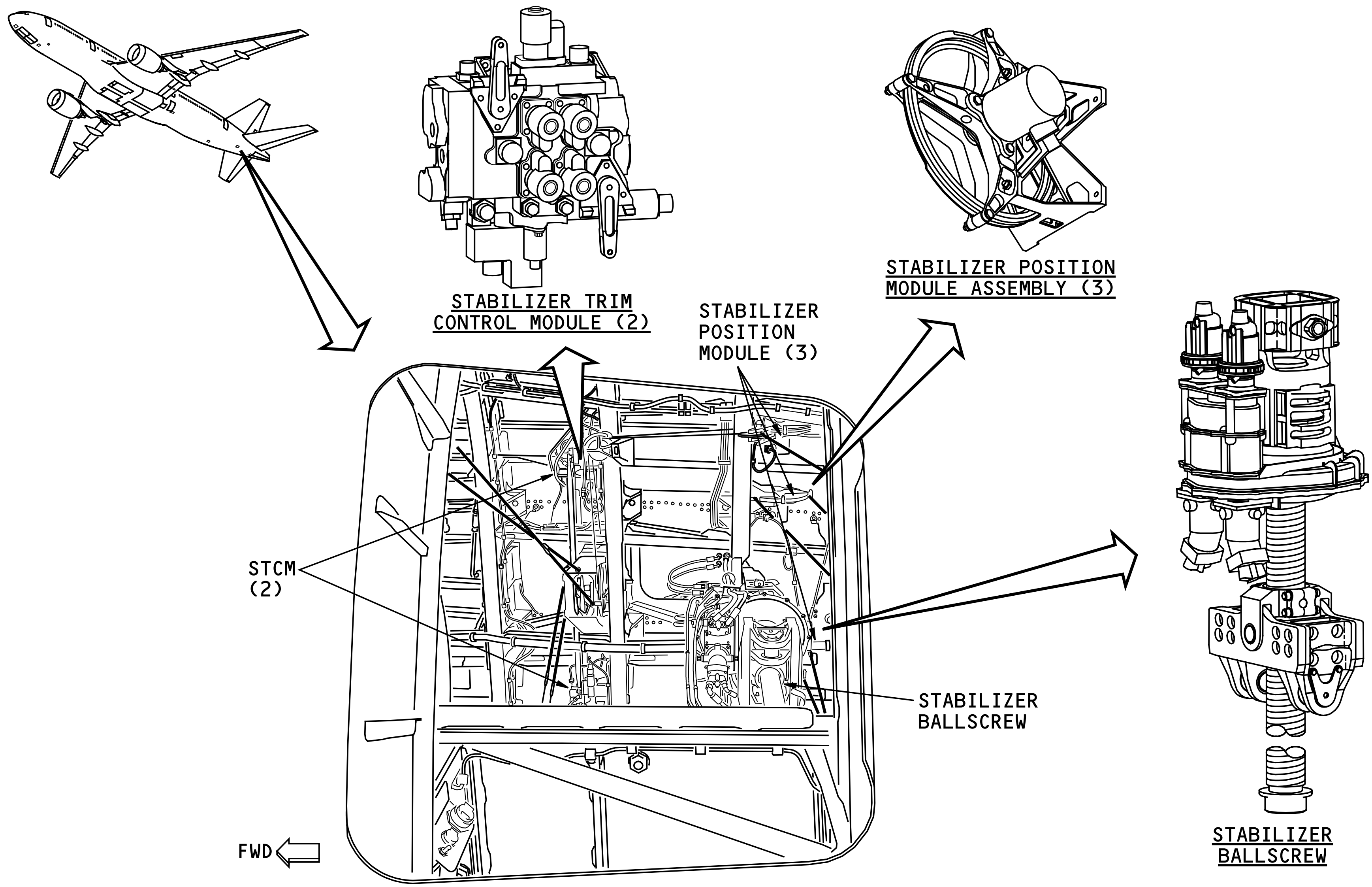
Tail Components

The stabilizer is a single unit. It attaches to the aft fuselage by hinges on the stabilizer rear spar. The forward stabilizer structure attaches to a ball nut on the stabilizer ballscrew. The stabilizer ballscrew is on the airplane structure in the stabilizer compartment. Access to this area is by a service access door on the left side of the lower aft fuselage.

Also in the stabilizer compartment are the three stabilizer position modules (SPMs) assemblies and the two stabilizer trim control modules (STCMs).

Cables connect to the forward end of the stabilizer structure and mechanically transmit stabilizer movement to the stabilizer position modules.

The STCMs are immediately aft of the pressure bulkhead near the ceiling of the stabilizer compartment.



VIEW LOOKING UP WITH THE SERVICE ACCESS DOOR OPEN

HORIZONTAL STABLIZER CONTROL - COMPONENT LOCATIONS - TAIL

27-41-00-025 Rev 0 10/08/96

HORIZONTAL STABILIZER CONTROL - ANALOG AND DISCRETE INTERFACES

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HORIZONTAL STABILIZER CONTROL - ANALOG AND DISCRETE INTERFACES

General

All the analog interfaces for the stabilizer pitch control within the PFCS go through the ACEs. Each ACE has interfaces with these components:

- Alternate pitch trim lever switches
- Control wheel pitch trim switches
- Stabilizer position indicators
- Auto shutdown relays
- Stabilizer trim control modules (STCM)
- Stabilizer position modules.

Alternate Pitch Trim Lever Switches

The alternate pitch trim lever switches on the alternate pitch trim forward quadrants send discrete signals to the AIMS. The signals represent pitch up or pitch down commands.

Control Wheel Pitch Trim Switch Modules

The pitch trim switches on each control wheel send pitch up, pitch down or off discrete signals to the ACEs.

Stabilizer Position Indicators

The two stabilizer position indicators receive analog signals from the AIMS that show stabilizer position.

Stabilizer Cutout Switches

Each stabilizer cutout switch controls a motor-operated shutoff valve in an STCM.

Auto Shutdown Relays

The ACEs can send discrete signals to the auto shutdown relays to close the motor-operated shutoff valves in the STCMs.

Stabilizer Trim Control Modules

Each of the two STCMs receive discrete signals from the ACEs and the auto shutdown relays. The discrete signals are for the:

- Control and arm trim solenoids
- Rate control solenoids
- Motor operated shutoff valves.

The pressure switches send discrete signals back to the ACEs.

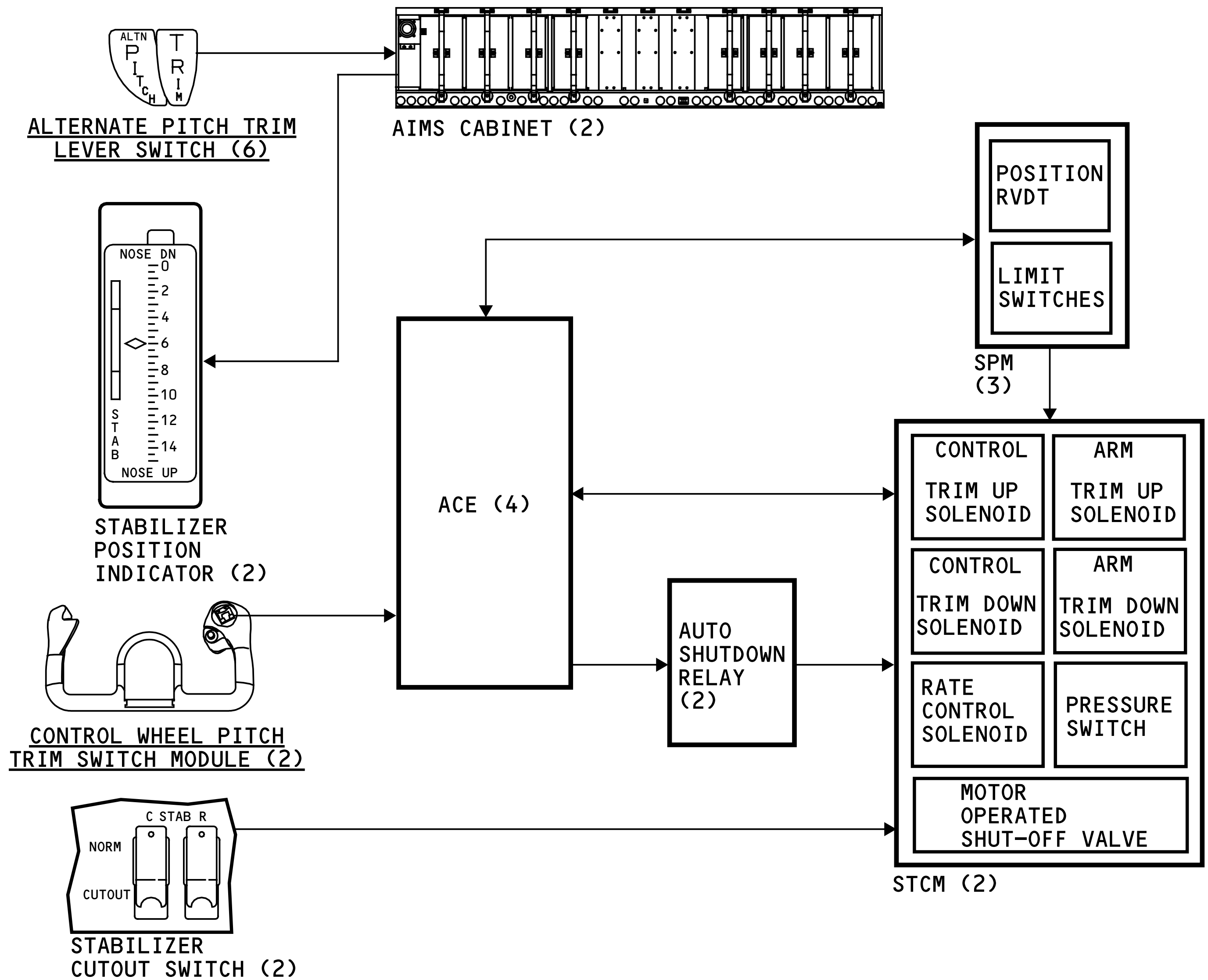
Stabilizer Position Module

Three stabilizer position modules contain a position RVDT and limit switches.

The RVDTs send an analog signal to the ACEs that represents the stabilizer position.

HORIZONTAL STABILIZER CONTROL - ANALOG AND DISCRETE INTERFACES

The ACEs send discrete signals through the limit switches to the STCMs.



27-41-00-004 Rev 1

HORIZONTAL STABILIZER CONTROL - ANALOG AND DISCRETE INTERFACES

HORIZONTAL STABILIZER CONTROL - ALTERNATE PITCH TRIM LEVERS AND FORWARD QUADRANT ASSEMBLY

Purpose

The alternate pitch trim levers give the pilots mechanical control of pitch trim. The forward quadrant assembly transmits the movement from the levers to the control cables.

Physical Description

Two alternate pitch trim levers supply arm and control mechanical commands to the STCMs. The two levers are independent of each other. Springs move the levers back to the center position. Each lever connects by rod to its own forward quadrant.

Each quadrant has three alternate pitch trim lever switches. Cams on the quadrants operate the switches. A pair of cables connects each quadrant to the aft control module in the stabilizer compartment.

Location

The two alternate pitch trim levers are on the captain's side of the P10 control stand. The forward quadrant assembly is just below the levers in the aisle stand.

Functional Description

To command pitch trim, the pilot moves both alternate pitch trim levers together in the same direction. The pilot moves the levers forward to command nose down trim, aft for nose up trim. Movement of the left lever supplies the control command, the right lever supplies the arm command.

Movement of the alternate pitch trim levers causes rotation of the forward quadrants and movement of the two pairs of cables.

The forward quadrant rotation causes cams to move the three alternate pitch trim lever switches on each quadrant. The switches send these discrete signals to the AIMS:

- Up command
- Down command
- Actuation command.

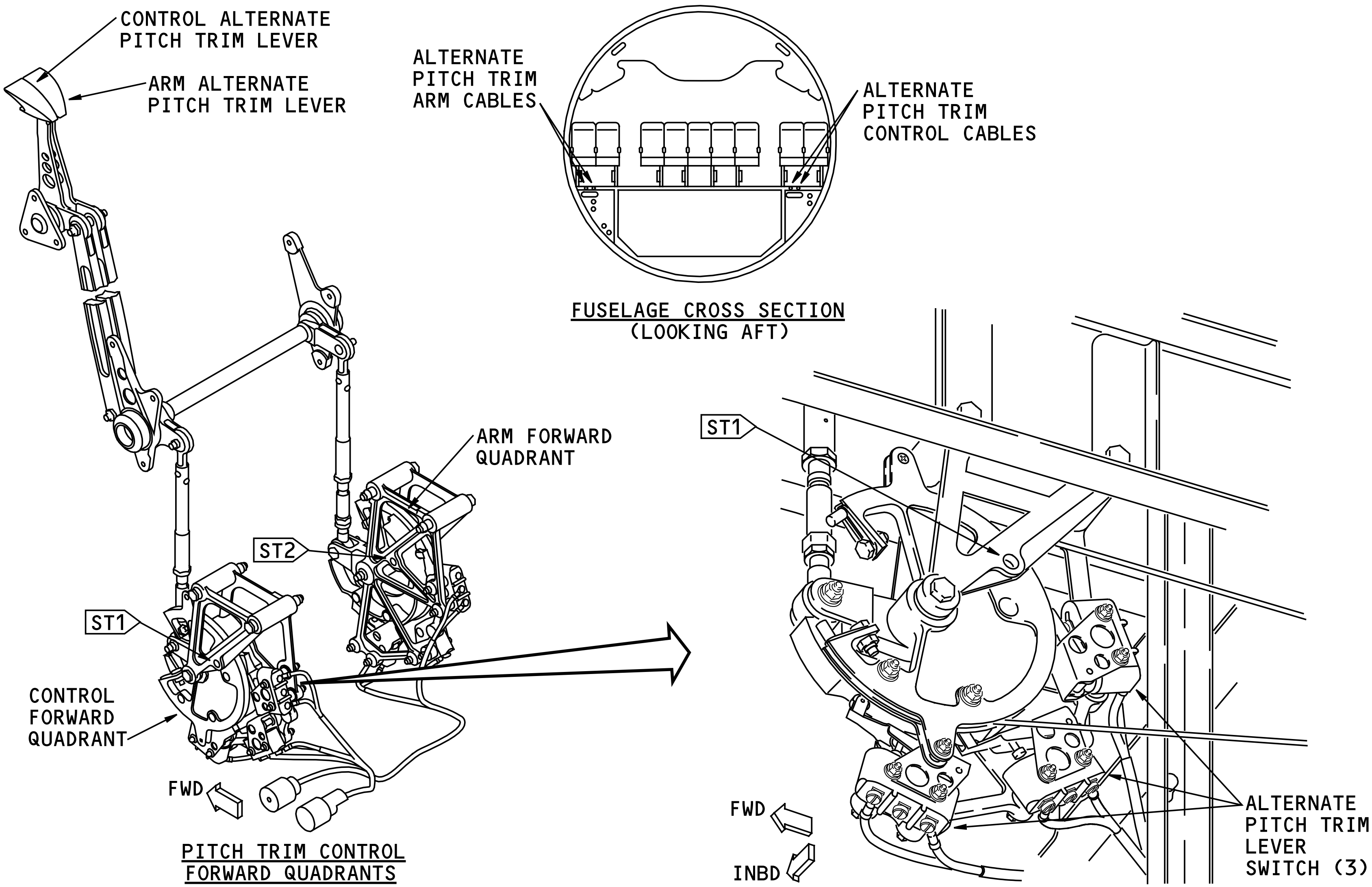
Training Information Point

There is a rig pin hole in the forward quadrants and on the support structure.

Indications

The status message ALT PITCH TRIM LEV shows when one alternate pitch trim lever switch is defective.

The status message FLIGHT CONTROL SYS shows when two or more alternate pitch trim lever switches are defective.



STX RIG PIN LOCATION

HORIZONTAL STABILIZER CONTROL - ALTERNATE PITCH TRIM LEVERS AND FORWARD QUADRANT ASSEMBLY

27-41-00-006 Rev 2 01/08/96

HORIZONTAL STABILIZER CONTROL - AFT STABILIZER QUADRANT ASSEMBLY

Purpose

The aft stabilizer quadrant assembly receives control movement from the two pairs of cables from the forward quadrant assembly. The aft stabilizer quadrant assembly transfers this movement to the input cranks on the STCMs.

Physical Description

The aft stabilizer quadrant assembly has an arm and a control quadrant on which the two alternate trim cable pairs attach. The arm quadrant is forward of the aft stabilizer quadrant assembly. The control quadrant is inside the quadrant assembly. Each quadrant connects to its own shaft by a spline which also connects to its output lever.

Control rods connect the output levers of the aft stabilizer quadrant assembly to the input cranks on the STCMs.

A travel limit drum assembly is at the aft of the quadrant assembly. The drum rotates on bearings on the aft quadrant assembly structure. A cable pair connects the drum assembly to the stabilizer structure.

Location

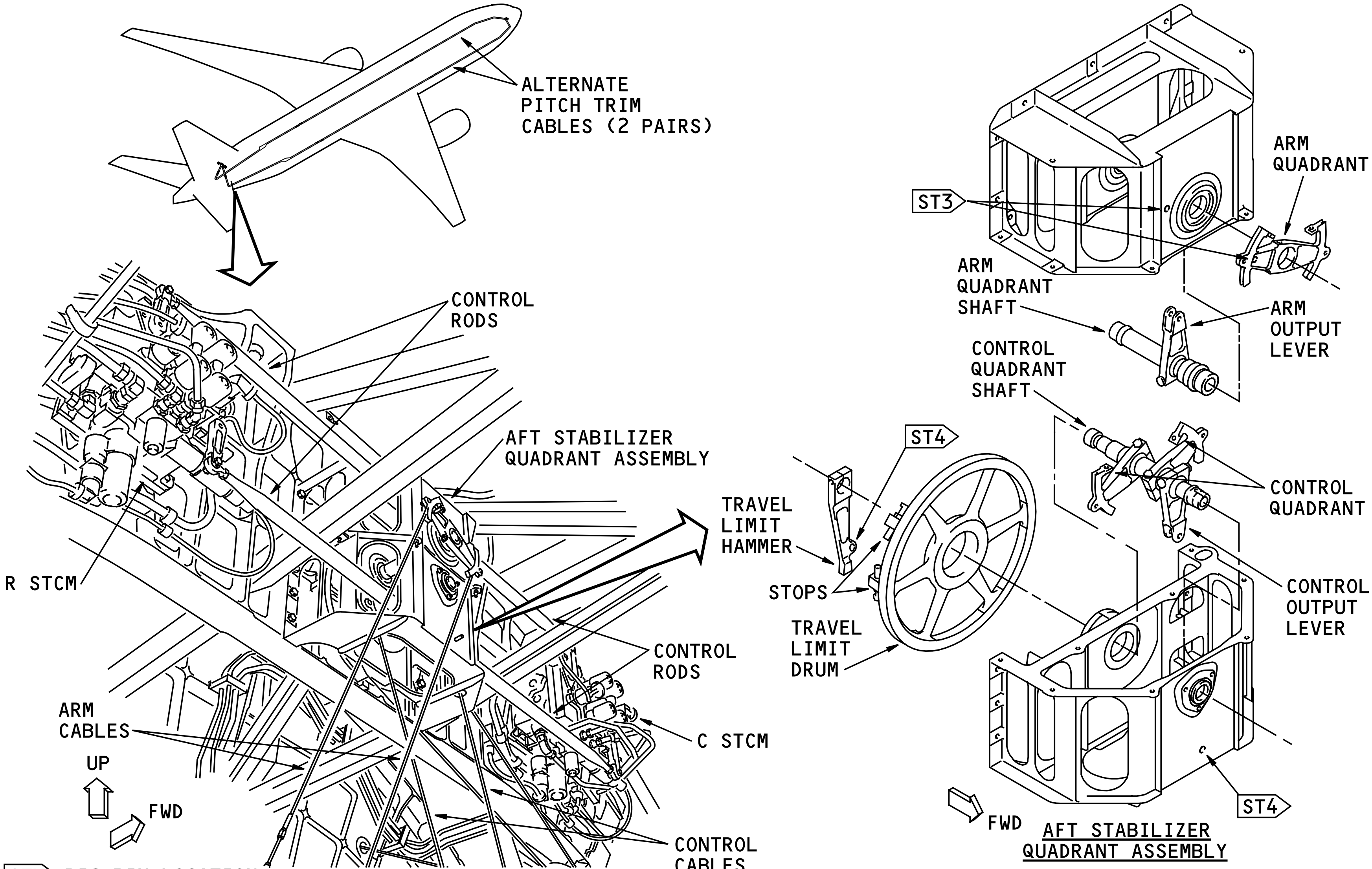
The aft stabilizer quadrant assembly is in the stabilizer compartment, near the ceiling just aft of the pressure bulkhead. The two STCMs are on either side of the quadrant assembly.

Functional Description

As the alternate pitch trim cable pairs move, in response to a movement of the alternate pitch trim levers, the arm and control quadrants rotate. Splined shafts transfer this rotation to the output levers. Control rods transfer the movement to the input cranks on the STCMs.

Training Information Point

There are rig pin holes in the arm quadrant, the travel limit hammer and aft stabilizer quadrant assembly structure.



HORIZONTAL STABILIZER CONTROL - AFT STABILIZER QUADRANT ASSEMBLY

HORIZONTAL STABILIZER CONTROL - AFT STABILIZER QUADRANT ASSY - TRAVEL LIMIT DRUM ASSEMBLY

Purpose

When the horizontal stabilizer is operated from the alternate pitch trim levers, the travel limit drum assembly stops the stabilizer at the up and down limits. These limits prevent contact between the stabilizer ballnut and the ballscrew stops.

Physical Description

The travel limit drum turns on bearings on the aft quadrant assembly structure. A cable pair connects the drum assembly to brackets attached on the front spar of the stabilizer. This cable also operates the left stabilizer position module. Stops on the drum assembly contact the travel limit hammer when the stabilizer reaches its travel limits. The travel limit hammer connects by splines to the control quadrant shaft of the aft stabilizer quadrant assembly.

Location

The travel limit drum assembly is at the aft side of the aft stabilizer quadrant assembly.

Functional Description

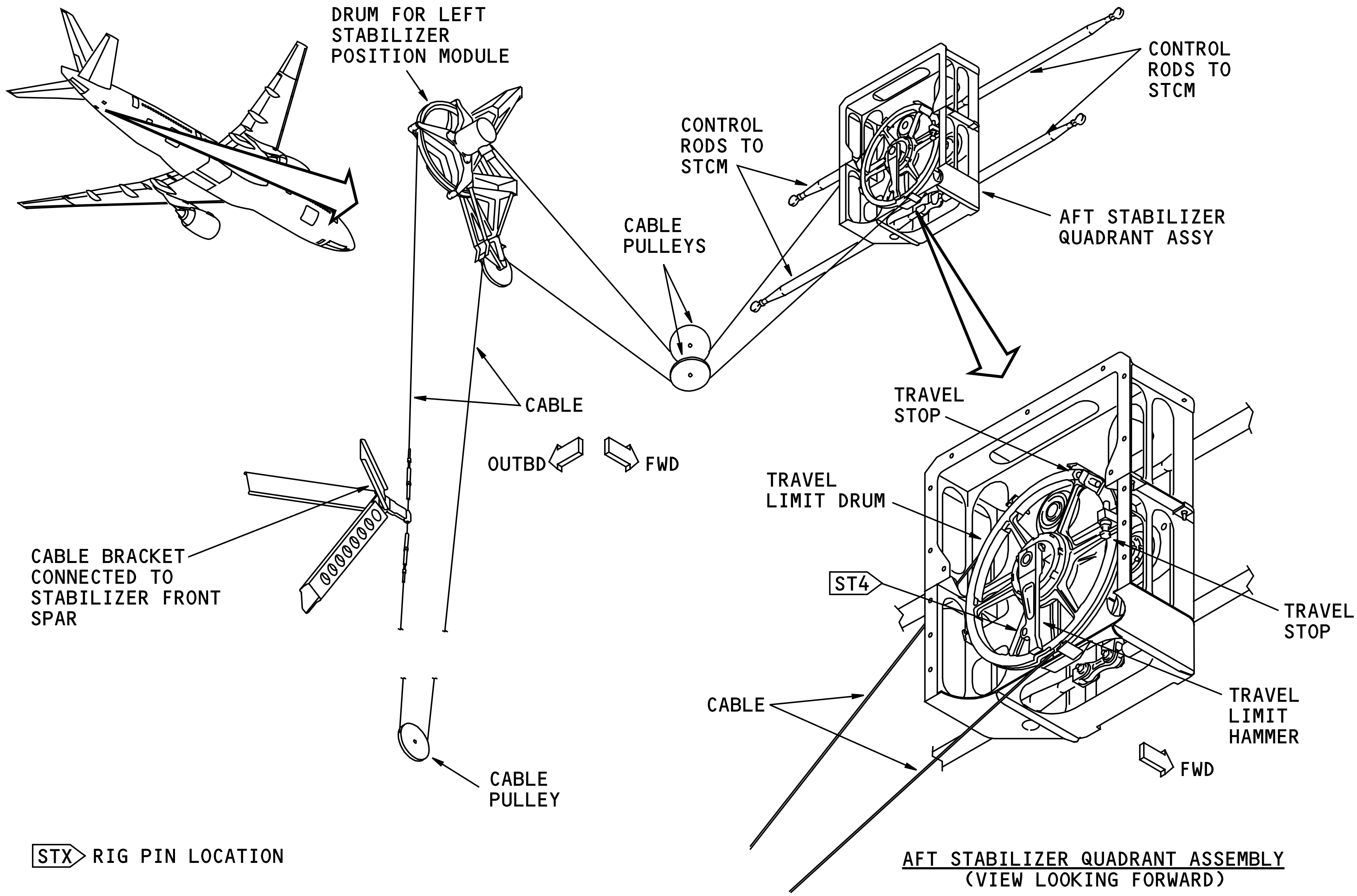
When you move the alternate pitch trim levers, the control quadrant shaft moves the travel limit hammer from its neutral position. The STCMs command causes the stabilizer to move. The pair of cables connected to the stabilizer front spar also moves. The cable movement causes the rotation of the travel limit drum assembly.

As the stabilizer reaches its up or down limit, stops on the drum contact the hammer and move it back to its neutral position. This moves the control lever of the alternate pitch trim levers to the neutral position and stops the stabilizer command.

Training Information Point

There is a rig pin hole in the travel limit hammer.

The travel stops on the travel limit drum assembly are adjustable.



27-41-00-026 Rev 0 12/16/1996

HORIZONTAL STABILIZER CONTROL - AFT STABILIZER QUADRANT ASSY - TRAVEL LIMIT DRUM ASSEMBLY

HORIZONTAL STABILIZER CONTROL - CUTOUT SWITCHES

Purpose

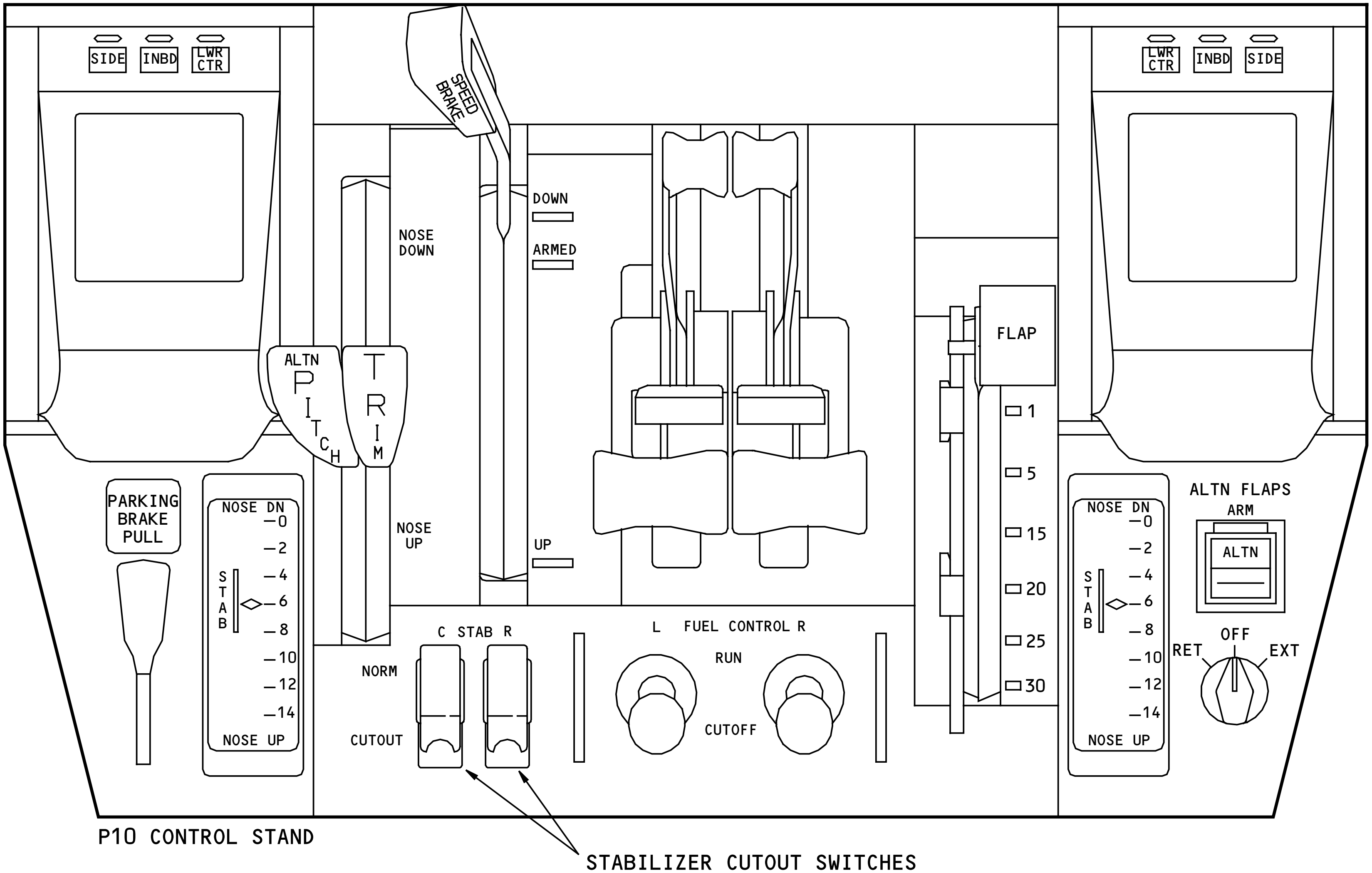
The two stabilizer cutout switches stop the stabilizer movement when they are in the CUTOUT position. The pilots use these switches in the unlikely event there is uncommanded stabilizer movement. You can move the switches to the CUTOUT position separately to control either the center or right STCM shutoff valves. These valves control hydraulic power to the stabilizer motors and brakes.

Physical Description

The cutout switches are two toggle switches, each guarded with a safety cover. To move the switches to the CUTOUT position, the pilot must raise the safety guards. The guards move the switches back to the NORM position when they are closed.

Location

The switches are on the aft, left hand side of the P10 control stand.



27-41-00-008 Rev 2 11/25/1996

HORIZONTAL STABILIZER CONTROL - CUTOUT SWITCHES

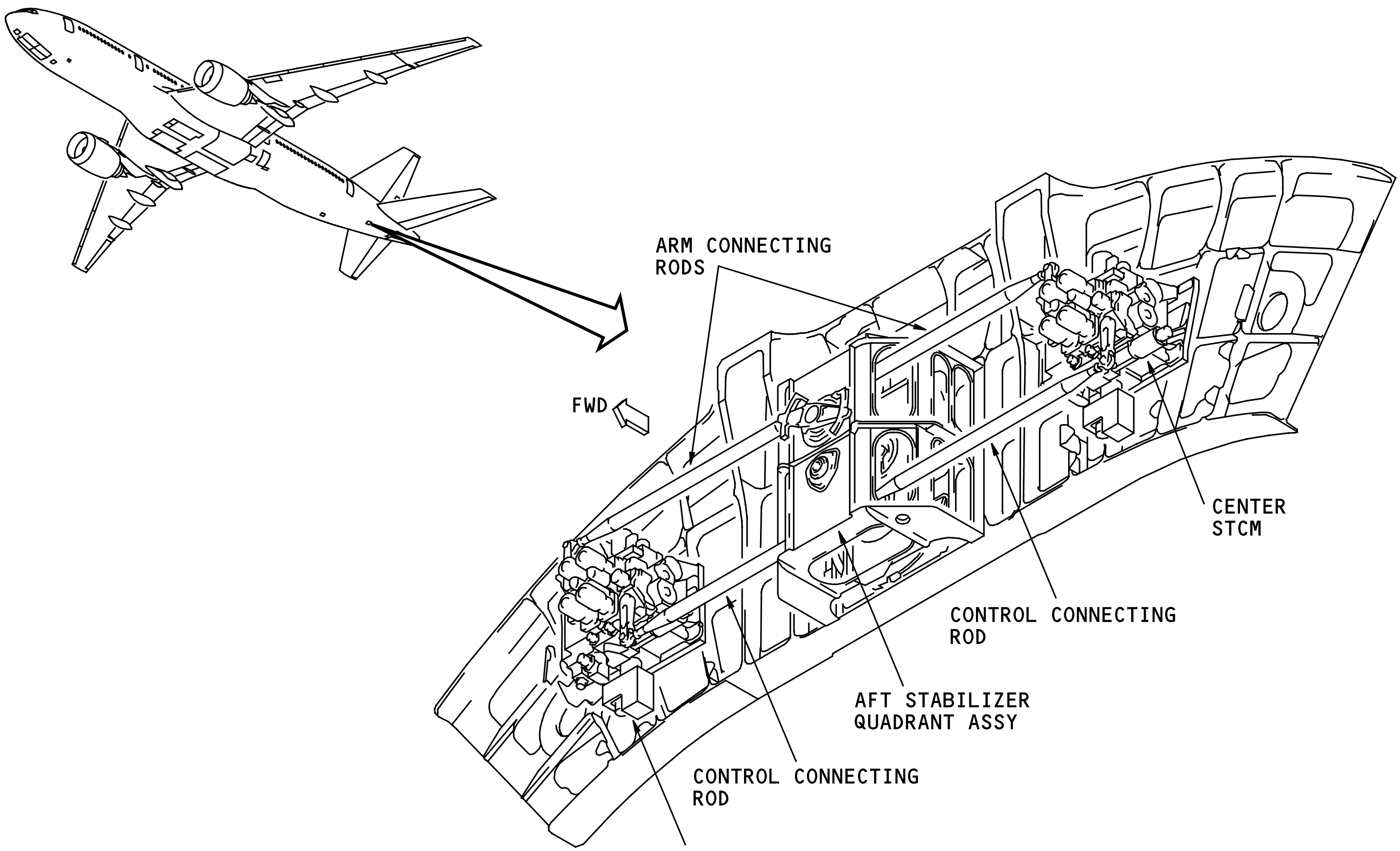
HORIZONTAL STABILIZER CONTROL - STCM - INTRODUCTION

Purpose

There are two stabilizer trim control modules. Each module controls hydraulic pressure to a hydraulic motor and brake. The STCMs receive electrical signal commands from the ACEs and mechanical commands from the alternate pitch trim levers.

Location

The two STCMs are near the ceiling of the stabilizer compartment just aft of the pressure bulkhead. Access to the compartment is by a hatch on the lower left side of the empennage.



27-41-00-009 Rev 1 02/25/1997

HORIZONTAL STABILIZER CONTROL - STCM - INTRODUCTION

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HORIZONTAL STABILIZER CONTROL - STCM - PHYSICAL DESCRIPTION

General

The two STCMs are on the airplane structure. Between the STCMs is the control module. Control rods transfer movement in the control module to the STCMs.

Electrical connectors of different sizes connect to the STCMs.

Hydraulic tubing connects to STCM input and output ports.

The center hydraulic system supplies power to the center STCM (located on the left side). The right hydraulic system supplies power to the right STCM.

The two STCMs are identical. Each STCM weighs approximately 29 lb (13 kg).

Each STCM contains an arming and control valve which controls hydraulic power to the hydraulic motor and brake. Movement of the two valves allows hydraulic pressure to release the hydraulic brake and to drive the motor in the commanded direction.

These components control the operation of the STCM:

- Motor operated shutoff valve
- Nose down control solenoid
- Nose down arm solenoid
- Arm input crank
- Rate control solenoid
- Nose up arm solenoid
- Nose up control solenoid
- Pressure switch
- Control input crank
- Brake bypass valve.

Motor Operated Shutoff Valve

The motor operated shutoff valve controls hydraulic power to the STCM. The cutout switches on the control stand, and the ACEs control power to the electric motor of the shutoff valve.

The motor operated shutoff valve has a manual override lever which is also a position indicator.

Nose Up and Nose Down, Arm and Control Solenoids

The ACEs control the nose up and nose down, arm and control solenoids. These solenoids operate valves which control hydraulic pilot pressure to move the arming and control valves.

Arm and Control Input Cranks

The arm and control input cranks connect to an arm and control manual valve in the STCM. The manual valves control hydraulic pilot pressure to move the arming and control valves.

Rate Control Solenoid

The ACEs control the trim rate solenoid. The solenoid operates a two position valve. It allows either full or restricted hydraulic flow to the hydraulic motor. This controls the rotation speed of the motor.

Pressure Switch

The pressure switch monitors the hydraulic pressure to the brake. The switch closes when the STCM sends hydraulic pressure to release the brake. The discrete brake release signal goes to the ACE.

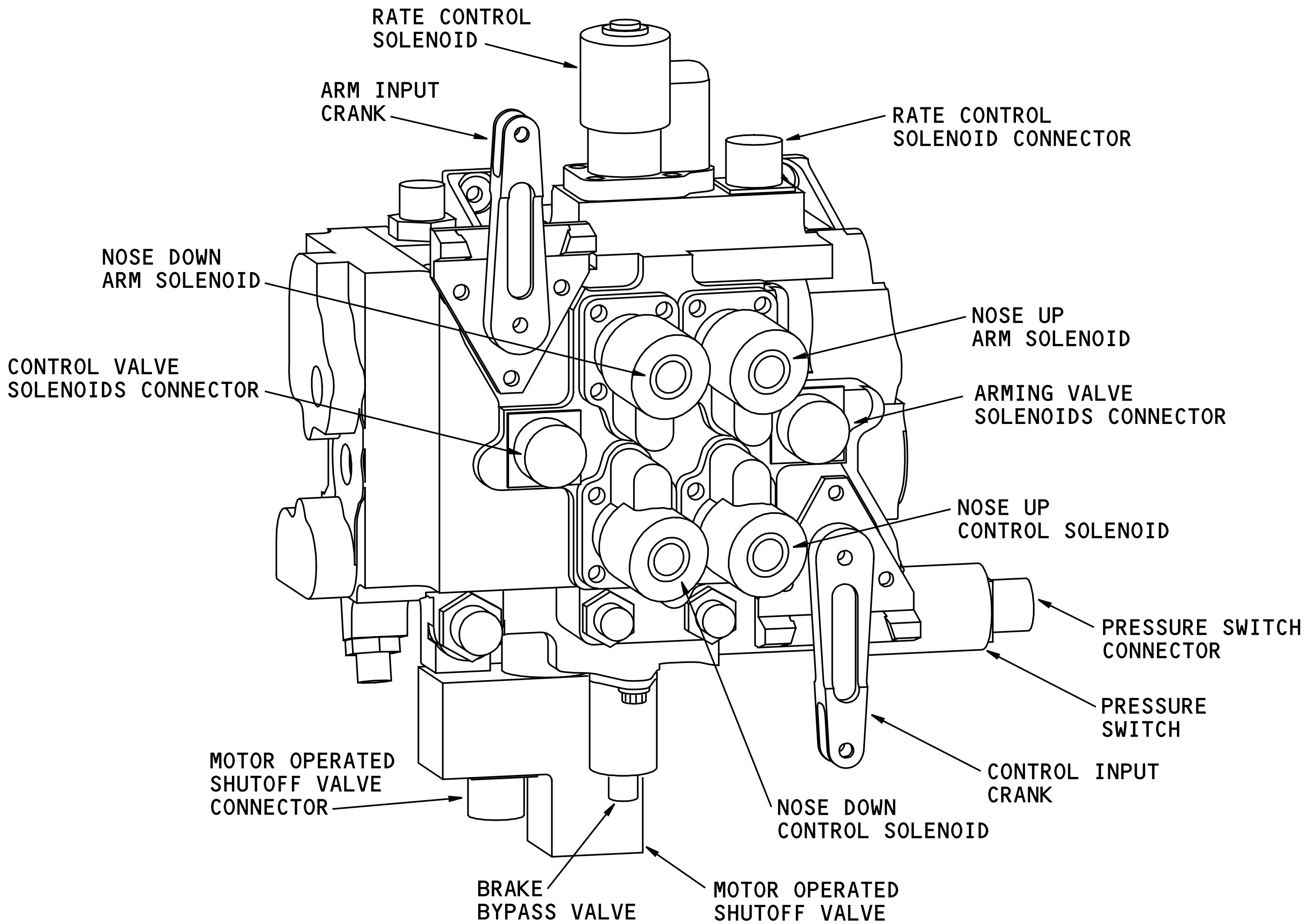
Brake Bypass Valve

Maintenance personnel use the brake bypass valve to periodically test the operation of the hydraulic brake. When you push on the brake bypass valve button, the valve shuts off hydraulic pressure to the brake. While you hold the button, you verify that the brake stops and holds the hydraulic motor. When released, a spring moves the brake bypass valve back to the open position.

Training Information Point

These are the LRUs on the STCMs:

- Rate control solenoid
- Nose up and down arm solenoids
- Nose up and down control solenoids
- Pressure switch
- Motor operated shutoff valve.



27-41-00-010 Rev 3 05/02/95

HORIZONTAL STABILIZER CONTROL - STCM - PHYSICAL DESCRIPTION

HORIZONTAL STABILIZER CONTROL - STCM - FUNCTIONAL DESCRIPTION

General

The STCM controls hydraulic power to the motor and brake of the stabilizer ballscrew actuator. It operates in two different modes of operation:

- Electrical
- Mechanical.

An inlet filter and check valve are in the hydraulic power supply line to the motor operated shutoff valve. In either mode of operation, the shutoff valve normally controls hydraulic power to the trim rate solenoid valve. The cutout switches on the control stand and the PFCs control the motor operated shutoff valve.

The PFC commands, through the ACE, the trim rate solenoid valve to high or low flow based on airspeed and flap position. A spring returns the trim rate solenoid valve to the high flow position when the solenoid is de-energized.

Arming and Control Valves

The arming and control valves have three positions:

- Null
- Trim up
- Trim down.

Hydraulic pilot pressure controls the position of the arming and control valves. This pilot pressure comes from one or both of these sources:

- The trim up and down, arm and control solenoid valves
- The arm and control manual valves.

Springs in the arming and control valves center and hold them in the null position when there is no hydraulic pressure. With the two valves in the null position, they stop hydraulic pressure to the brake and motor of the stabilizer ballscrew actuator.

The arming and control valves must move together in the same direction to permit hydraulic pressure to the hydraulic brake and motor.

When both arming and control valves move to the trim up position, hydraulic power goes to release the brake and drive the hydraulic motor in the nose up direction.

When both arming and control valves move to the trim down position, hydraulic power goes to release the brake and drive the hydraulic motor in the nose down direction.

Two anti-cavitation check valves supply hydraulic fluid to the motor. They prevent motor cavitation in the unlikely event of brake slip and backdrive of the motor.

Electrical Operation

When the trim up and trim down, arm and control solenoid valves are de-energized, they allow hydraulic pilot pressure on both sides of the arming and control valves. The two valves are in the null position.

When their solenoids are both energized, the trim up arm and control solenoid valves operate. They stop hydraulic pilot pressure to the trim up side of the arming and control valves and port it to the system return line. Both arming and control valves move to the trim up position and permit pressure to the brake and motor.

When the solenoids of the trim down arm and control solenoid valves are both energized, the same process occurs. But in this case, the arming and control valves move to the trim down position and permit hydraulic pressure to the brake and motor.

Mechanical Operation

The arm and control input cranks connect to the arm and control manual valves. These valves control hydraulic pilot pressure to the arming and control valves.

The arm and control manual valves have three positions:

- Null
- Trim up
- Trim down.

Springs in the arm and control manual valves center them in the null position when there is no force on the input cranks. With the two valves in the null position, they permit hydraulic pilot pressure to both sides of the arming and control valves.

Because they are directly upstream of the arming and control valves, the manual valves have first priority of control over the trim up and down, arm and control solenoid valves. This permits the pilot to manually override any electrical command to the stabilizer.

When the arm and control input cranks move to the trim up position, they command the manual valves to move to the trim up position. The manual valves stop hydraulic pilot pressure to the trim up side of the arming and control valves and port it to the system return line. Both arming and control valves move to the trim up position and permit pressure to the brake and motor.

When the input cranks move to the trim down position, the same process occurs. But in this case, the arming and control valves move to the trim down position and permit hydraulic pressure to the brake and motor.

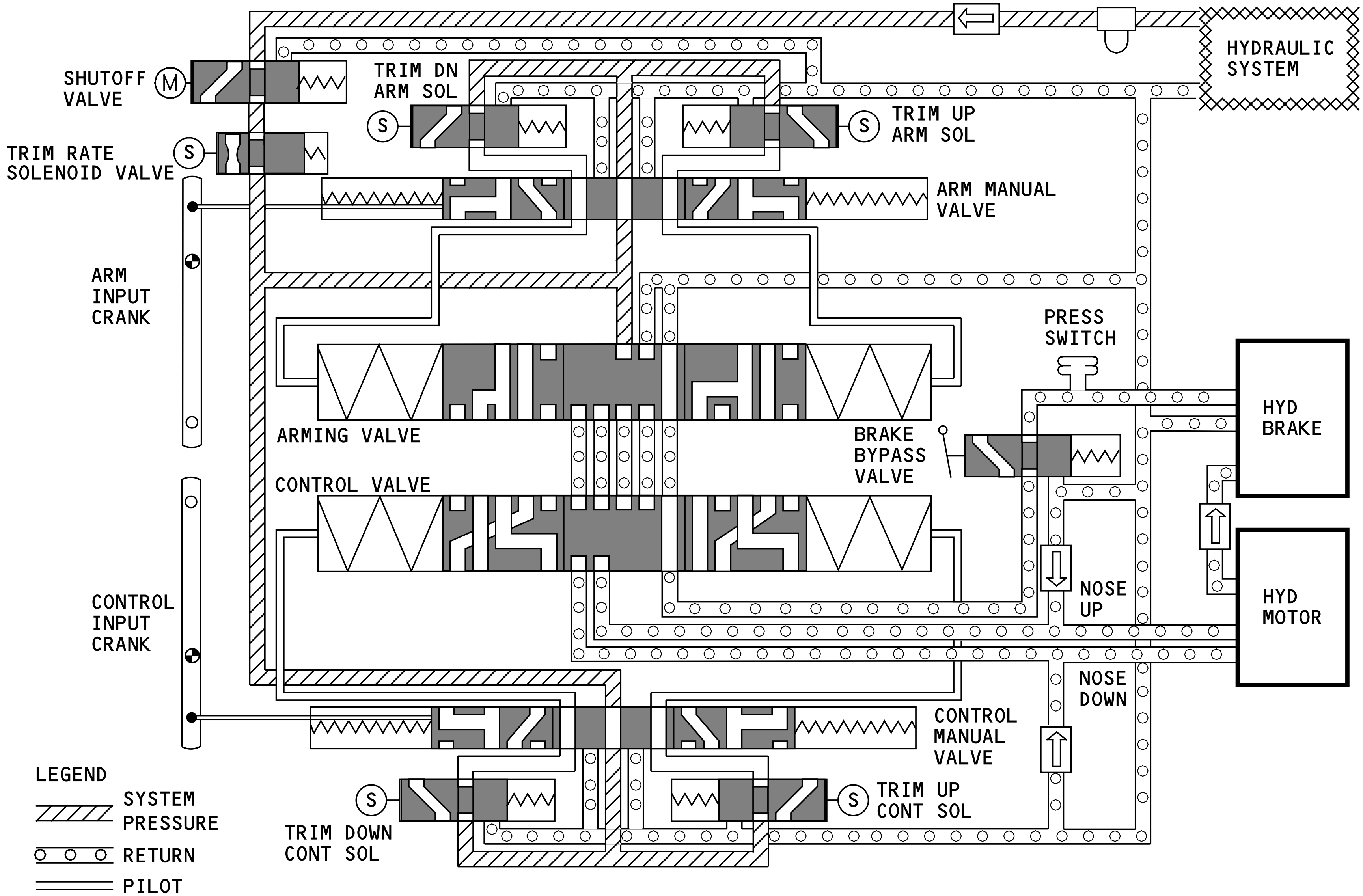
Brake Bypass Valve

The manually operated brake bypass valve permits maintenance personnel to test the effectiveness of the hydraulic brake. When activated, the valve blocks hydraulic pressure to the brake and ports it to the system return line. This prevents brake release when the hydraulic motor is pressurized.

HORIZONTAL STABILIZER CONTROL - STCM - FUNCTIONAL DESCRIPTION

Pressure Switch

The pressure switch closes at 1000 psi. It sends a discrete signal to the ACEs to indicate the pressure status to the brake.



27-41-00-011 Rev 0

HORIZONTAL STABILIZER CONTROL - STCM - FUNCTIONAL DESCRIPTION

HORIZONTAL STABILIZER CONTROL - POSITION MODULES

Purpose

The stabilizer position modules perform two functions. Limit switches within the modules electrically limit the travel of the stabilizer. An RVDT in each module sends an analog signal that represents stabilizer position. This signal goes to the ACEs.

Physical Description

There are three identical stabilizer position modules. The modules are on assemblies which include a pulley bracket base, a cable drum, and the stabilizer position module.

The module weighs approximately 1.6 lb (0.7 kg).

Location

The modules attach to airplane structure near the ceiling in the stabilizer compartment.

Functional Description

Three cables attach to the leading edge of the stabilizer and go around the cable drums. The cables go around pulleys attached to the structure at the bottom of the stabilizer compartment. The cables also attach to the cable drums of the stabilizer position module assemblies. When the stabilizer moves, the cable drums turn the splined shaft in the position module.

Internal gears within the module, cause rotation of an RVDT. It sends a variable analog signal to the ACEs. The signal represents the stabilizer position.

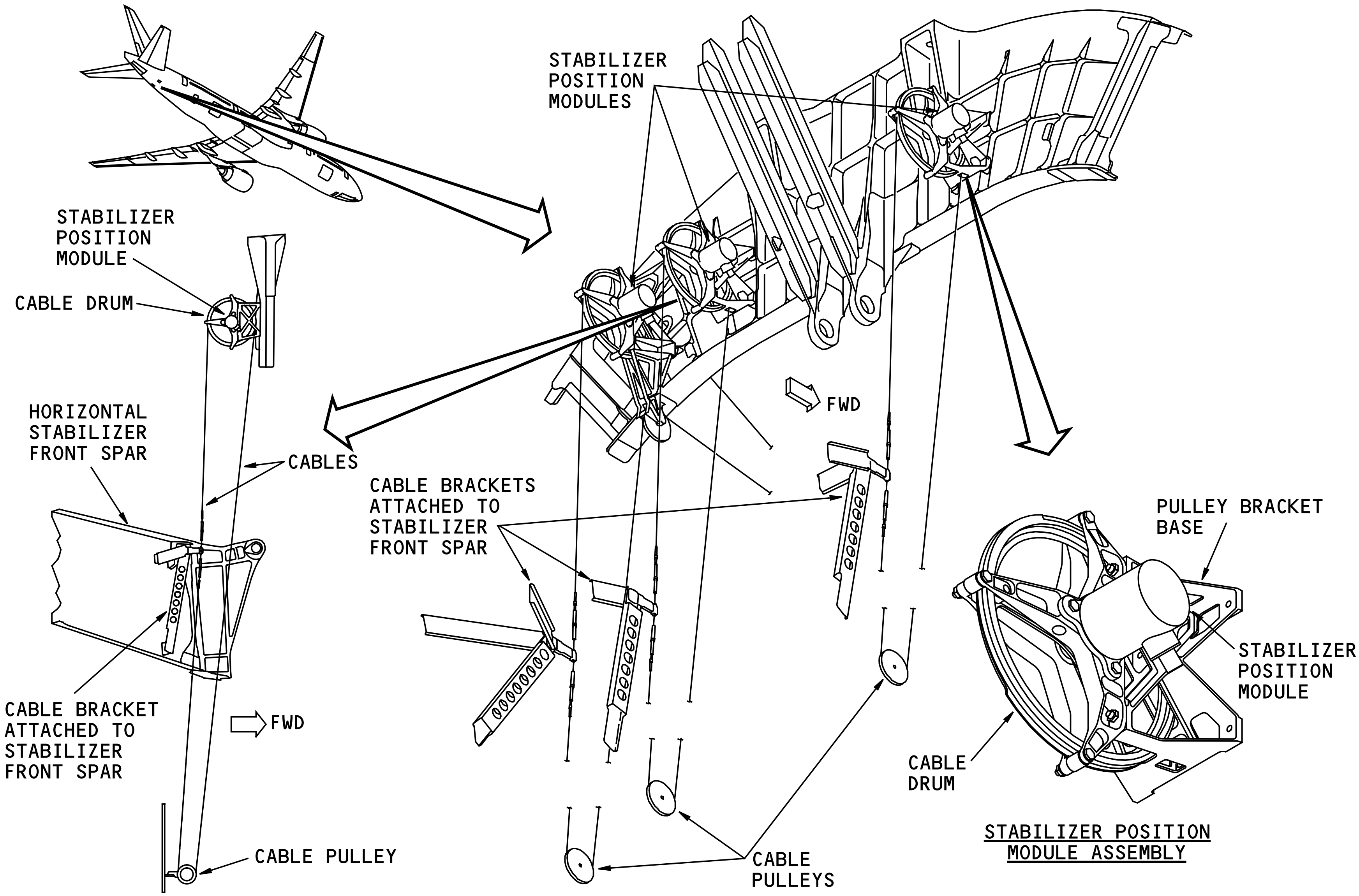
See the horizontal stabilizer position indication section for more information about the stabilizer position modules (AMM PART I 27-48).

Rotation of the shaft also causes two switches to open and close. As the stabilizer reaches +3.75 degrees nose down, the nose down control switch opens. This removes the control signal to the STCM and stops stabilizer movement.

The nose up control switch opens at -10.75 degrees to stop stabilizer travel in the nose up direction.

Training Information Point

No rigging is necessary for removal and installation of the module.



27-41-00-015 Rev 4 12/16/1996

HORIZONTAL STABILIZER CONTROL - POSITION MODULES

HORIZONTAL STABILIZER CONTROL - POSITION INDICATORS

Purpose

The stabilizer position indicators show the pilots stabilizer position in units of pitch trim.

The indicators also show the pilots if the stabilizer is in a safe position for take-off.

Physical Description

The two identical stabilizer position indicators are LRUs.

The stabilizer trim pointer shows the position of the stabilizer. The indicator scale has 15 units. Each unit of pointer movement is equivalent to about one degree of stabilizer movement.

Also on the indicator is a green band that shows take-off range. The PFCS calculates green band position from information entered into the FMCS during preflight. The information is sent through the ARINC 629 buses to the AIMS and then to the position indicators.

Location

The stabilizer position indicators are on the aft end of the P10 control stand.

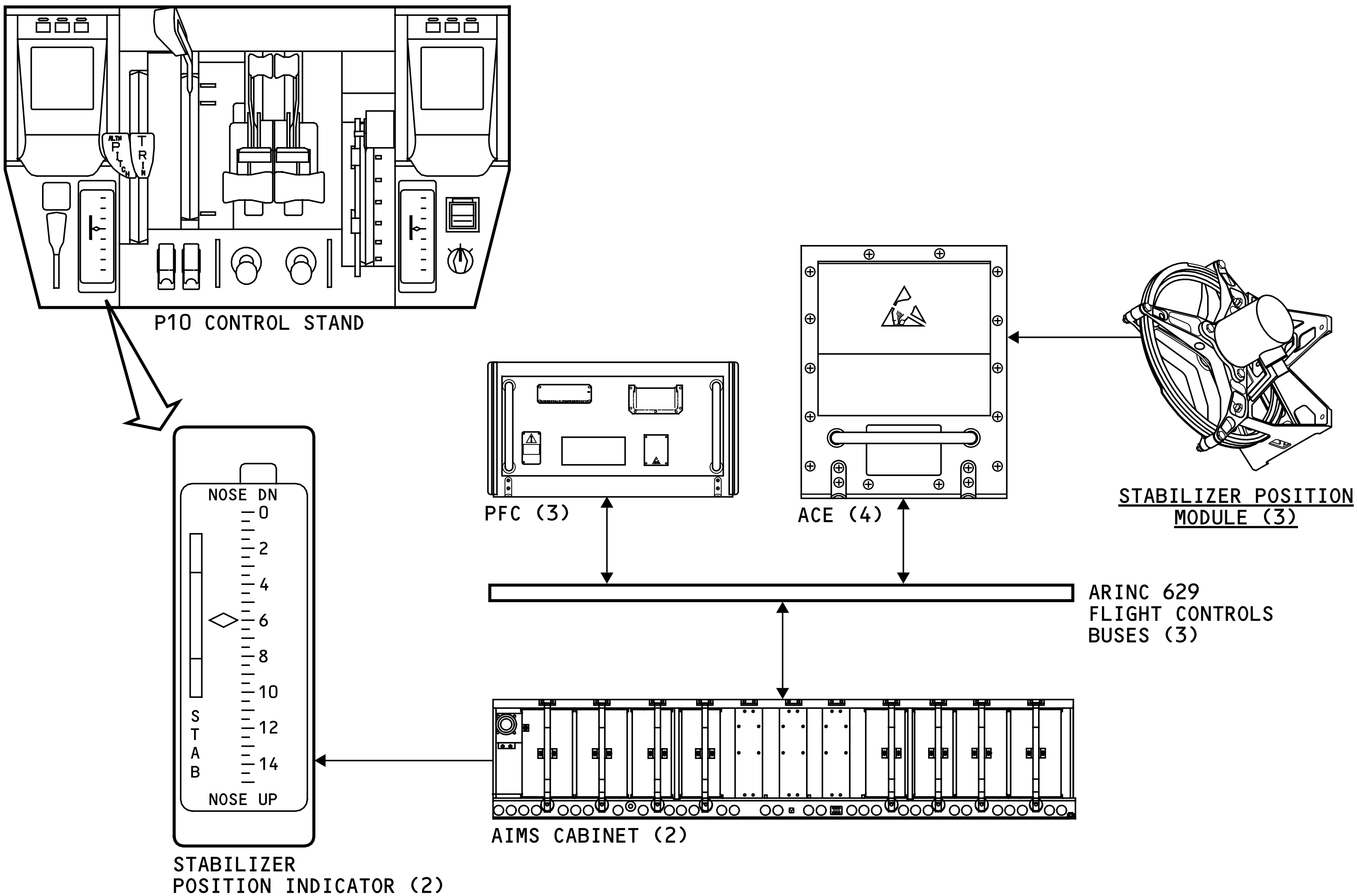
Functional Description

The analog signal from the RVDTs in the position modules go to the ACEs. These signals represent the stabilizer position.

The ACEs change the analog signal to digital and send them to the PFCs and the AIMS.

The AIMS uses ARINC 429 buses to transmit the digital signal to the stabilizer position indicator for display.

The PFCS uses center of gravity, aircraft gross weight and the take-off thrust setting information from FMCS to show the green band.



27-41-00-016 Rev 0

HORIZONTAL STABILIZER CONTROL - POSITION INDICATORS

HORIZONTAL STABILIZER CONTROL - STABILIZER ASSEMBLY

Purpose

The horizontal stabilizer supplies long-term pitch control of the airplane.

Physical Description

The stabilizer is a light-weight composite material structure. The main torque boxes are carbon fiber construction with aluminum trailing edge hinge ribs. Steel hinge plates with fiberglass honeycomb panel fairings attach to the trailing edge of these ribs.

Forward of the main torque boxes are auxiliary boxes formed by aluminum sheet metal ribs that have covers made of fiberglass honeycomb panels.

The leading edges and the tips of the stabilizer are aluminum skinned honeycomb panels.

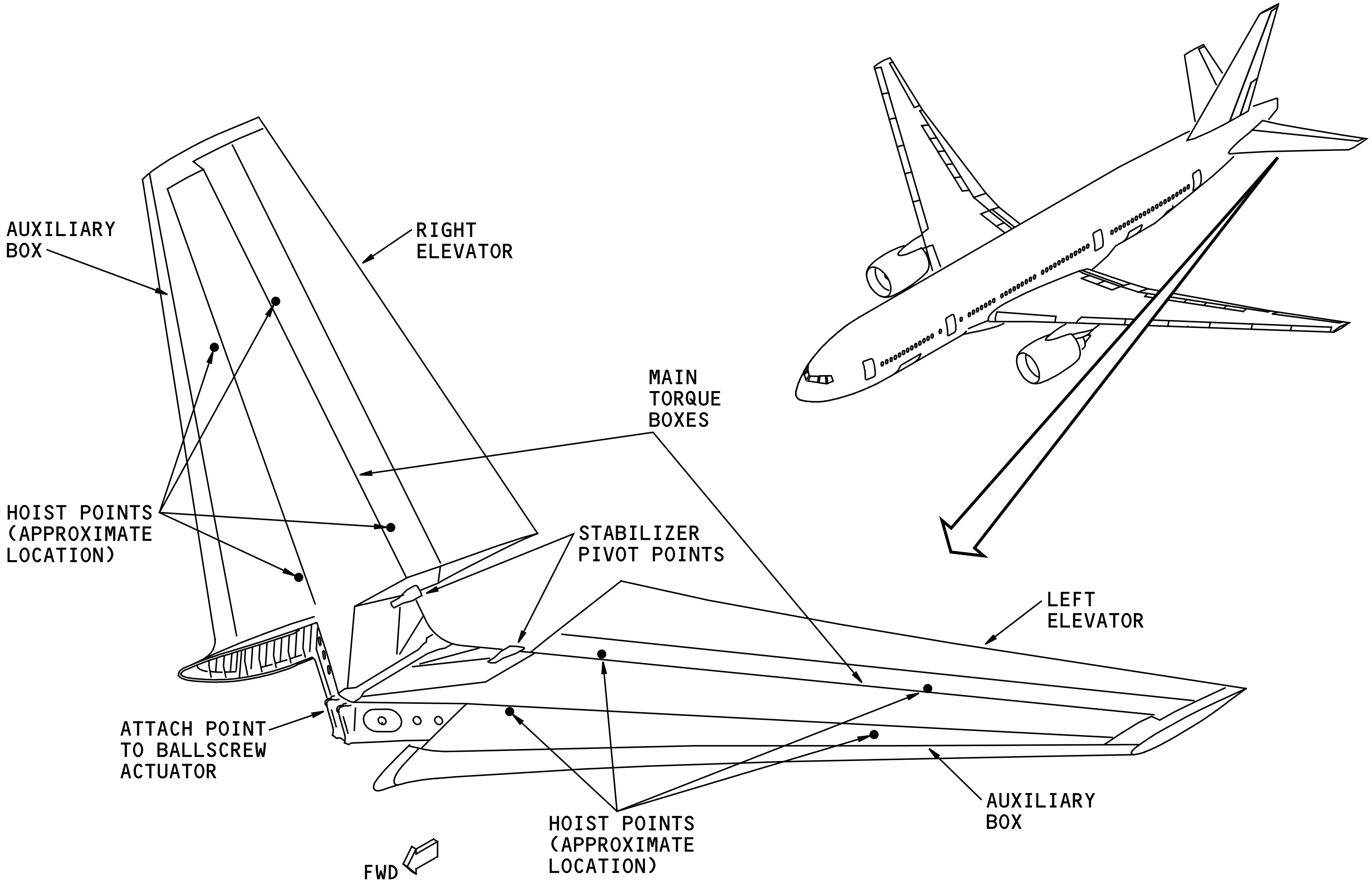
The horizontal stabilizer assembly weights approximately 6100 lbs (2765 kg). This includes the weight of the elevators and the PCUs. The horizontal stabilizer assembly measures about 71 feet wide by 34 feet long (21.6 meters by 10.4 meters).

There are four hoist points on the upper and lower surfaces on each side of the horizontal stabilizer assembly.

Functional Description

The stabilizer moves 15 degrees:

- 4 degrees leading edge up (4 degrees airplane nose down trim) from neutral
- 11 degrees leading edge down (minus 11 degrees airplane nose up) from neutral.



27-41-00-017 Rev 2 01/08/96

HORIZONTAL STABILIZER CONTROL - STABILIZER ASSEMBLY

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HORIZONTAL STABILIZER CONTROL - FUNCTIONAL DESCRIPTION - INTRODUCTION

General

The stabilizer control system uses input command signals from the captain's and first officer's pitch trim switches.

The ACEs receive the input signals and supply output command signals to the STCMs. The ACEs also receive feedback signals from the SPMs.

The stabilizer cutout switches and the auto shutdown relays send signals to the STCMs to close the motor operated shutoff valves.

The system also operates with mechanical commands from the alternate pitch trim levers directly to the STCMs.

Pitch Trim Switches

Each ACE receives a signal from a pitch trim switch. The L1 ACE receives the arm signal from the captain's arm switch and the L2 ACE from the first officer's arm switch. The C ACE receives the control signal from the captain's control switch and the R ACE from the first officer's control switch.

Stabilizer Cutout Switches and Auto Shutdown Relays

The stabilizer cutout switches directly control power to close the motor operated shutoff valve on the STCMs.

Two ACEs control the auto shutdown relays individually. When commanded, each relay sends power to close a motor operated shutoff valve on an STCM.

Stabilizer Trim Control Modules

The center STCM requires the operation of the C and L1 ACEs.

The C ACE sends command signals through the auto shutdown relay to close the shutoff valve of the center STCM. The shutoff valve also receives command signals directly from the center stabilizer cutout switch. The center STCM also receives from the C ACE the control up or down command signals. These signals initially go through the limit switches of the center SPM before they command the control solenoids.

The center STCM receives arm up or down command signals and the rate solenoid signals from the L1 ACE.

The right STCM requires the operation of the R and L2 ACEs.

The R ACE sends command signals through the auto shutdown relay to close the shutoff valve of the right STCM. The shutoff valve also receives command signals directly from the right stabilizer cutout switch. The right STCM also receives the control up and down command signals from the R ACE. These signals initially go through the limit switches of the right SPM before they command the control solenoids.

HORIZONTAL STABILIZER CONTROL - FUNCTIONAL DESCRIPTION - INTRODUCTION

The right STCM receives arm up or down command signals and the rate solenoid signals from the L2 ACE.

The brake pressure switch of the center STCM sends a feedback signal to the C ACE, the switch from the right STCM to the R ACE.

The alternate pitch trim levers mechanically operate the arm and control manual valves of both STCMs.

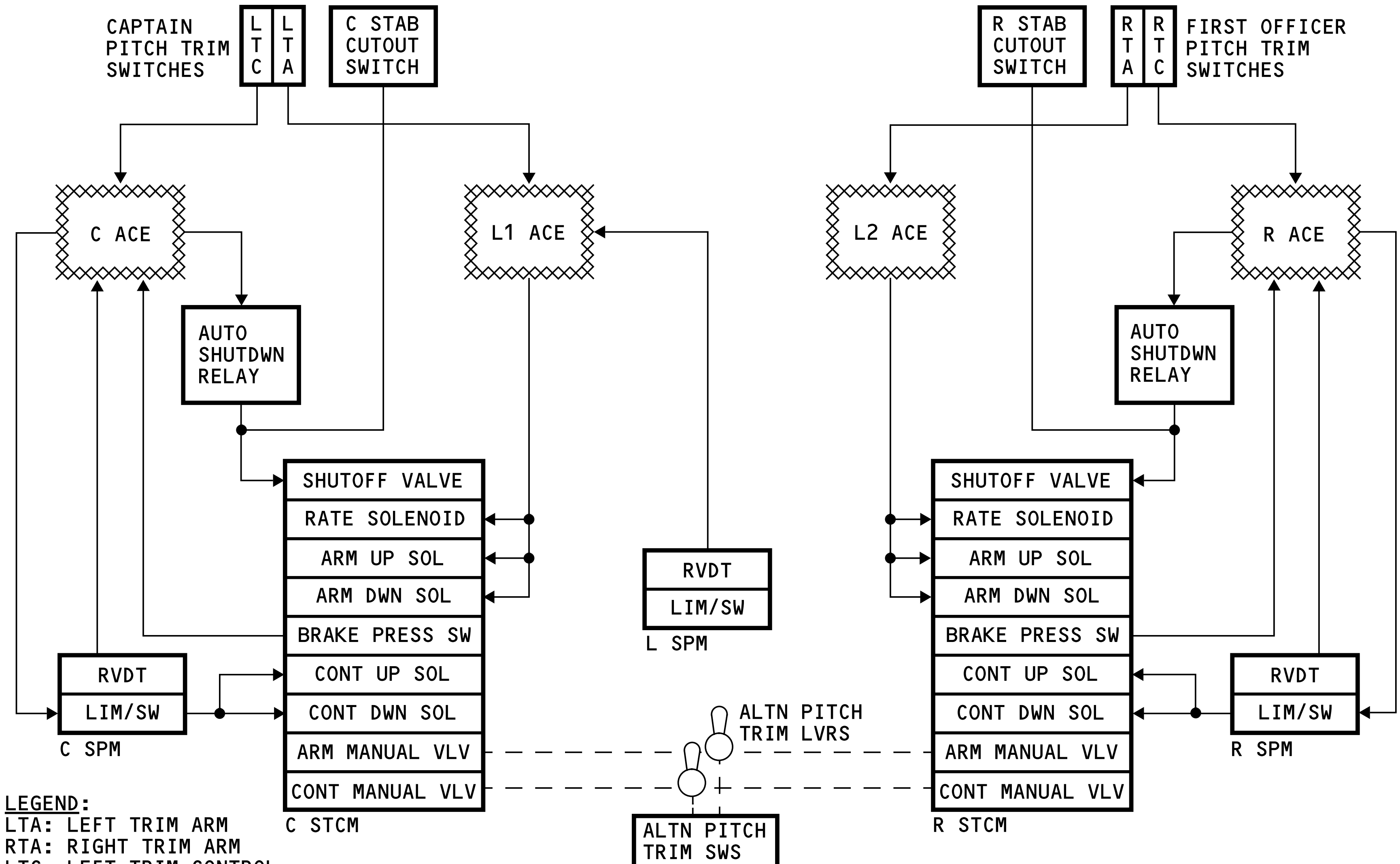
Stabilizer Position Modules

The RVDT of the left SPM sends a stabilizer position feedback signal to the L1 ACE, the RVDT of the center SPM to the C ACE, and the RVDT of the right SPM to the R ACE.

The limit switches in the center SPM control the signal from the C ACE to the center STCM. The limit switches in the right SPM control the signal from the R ACE to the right STCM. The limit switches of the left SPM are not used.

Alternate Pitch Trim Switches

The alternate pitch trim levers move alternate pitch trim switches which send signals to the AIMS cabinets.



LEGEND:
LTA: LEFT TRIM ARM
RTA: RIGHT TRIM ARM
LTC: LEFT TRIM CONTROL
RTC: RIGHT TRIM CONTROL

27-41-00-018 Rev 2 04/29/95

HORIZONTAL STABILIZER CONTROL - FUNCTIONAL DESCRIPTION - INTRODUCTION

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HORIZONTAL STABILIZER CONTROL - FUNCTIONAL DESCRIPTION - HYDRAULIC CUTOUT AND AUTO SHUTDOWN

General

The stabilizer cutout switches and auto shutdown relays supply power to the shutoff valves in the STCMs. These valves control hydraulic power to the stabilizer motor and brake.

Cutout Switches

With the cutout switch in the CUTOUT position, 28v dc power goes directly to the close side of the shutoff valve motor. As the valve completes its travel to the closed position, limit switches in the motor assembly move to the ready-to-open position.

With the cutout switch back to the NORM position, power goes through the de-energized shutdown relay to drive the valve back to the open position. The motor limit switches then return to the ready-to-close position.

Auto Shutdown Relays

The PFCs command the ACEs to energize the auto shutdown relays for:

- An uncommanded stabilizer movement
- A no stabilizer motion fault
- An STCM defective response.

The PFCs monitor the left and right STCMs individually for stabilizer operation. If a PFC finds a system malfunction, it commands the ACE to energize the left or right stabilizer auto shutdown relay in relation to the STCM that has a defect. The ACE then latches the auto shutdown relay. The energized auto shutdown relay supplies power to close its shutoff valve.

Indications

Unscheduled stabilizer motion when there is an auto shutdown failure causes a STABILIZER warning message to show.

A FLIGHT CONTROLS caution message shows if both stabilizer channels are defective.

A STABILIZER C or a STABILIZER R advisory message shows if the center or right channel shuts down or if one of the cutout switches is in the CUTOUT position.

The advisory message STABILIZER CUTOUT shows when both cutout switches are in the CUTOUT position.

Training Information Point

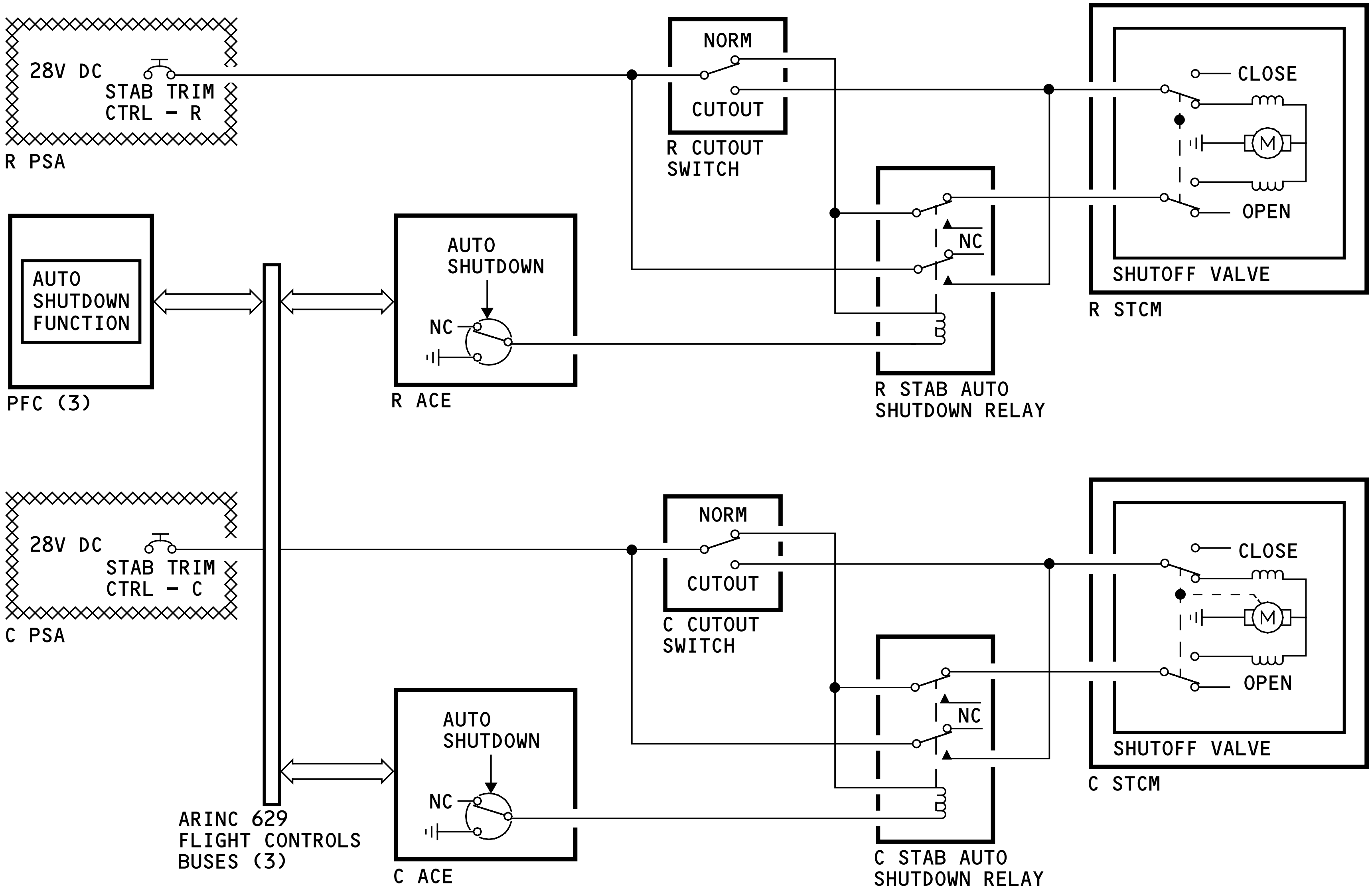
Maintenance personnel can use the stabilizer cutout switches to do fault isolation of stabilizer system malfunctions.

A maintenance action is necessary to unlatch the auto shutdown relays. After correction of the fault, the stabilizer system ground test unlatches the PFC auto shutdown commands to the ACEs when the system passes the test.

You can also use the PFC disconnect switch on the P5 panel with the C and R cutout switches to unlatch the auto shutdown relays. Because the ACE latch can be manually reset only in direct mode, the PFC disconnect switch first must be in the DISC position. With the cutout switch of the shutdown STCM in the CUTOUT position, the auto shutdown relay de-energizes. The ACE monitors the power removal from the auto shutdown relay and resets its auto shutdown latch.

When the cutout switch moves back to the NORM position, the auto shutdown relay stays de-energized and permits the STCM shutoff valve to open. This permits the pilot to control the stabilizer in direct mode.

If the stabilizer motion fault continues when the PFC disconnect switch moves back to the NORM position, the PFCs immediately command the ACEs to energize and latch the auto shutdown relays.



27-41-00-019 Rev 4 12/16/1996

HORIZONTAL STABILIZER CONTROL - FUNCTIONAL DESCRIPTION - HYDRAULIC CUTOUT AND AUTO SHUTDOWN

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HORIZONTAL STABILIZER CONTROL - FUNCTIONAL DESCRIPTION - STABILIZER ELECTRICAL CONTROL

General

The ACEs send the electrical commands to control the stabilizer. In normal and secondary modes, the PFC calculate the commands and send them to the ACEs. In the direct mode, the ACEs uses the commands from the pitch trim switches.

The STCM must have both an arm and a control signal from its two ACEs to operate the stabilizer ball screw assembly.

Normal Mode

In normal mode, the pitch trim switch signals operate in pairs. The signals from both the control and arm pitch trim switches are necessary from the captain (left) or the first officer (right) for the PFC logic to calculate a command for the ACEs.

In the air, a command from the pitch trim switches causes a command to the elevator. Only the elevator offload function of the PFCs can control the stabilizer while the airplane is in the air. The command can be for single or dual path, low or high rate.

On the ground, an input from the pitch trim switches causes a PFC stabilizer command to the ACEs. This command is for dual path at high rate.

When the flaps are retracted, the PFC logic stops the movement of the stabilizer at:

- +2.25 degrees of airplane nose down trim
- -10.25 degrees of airplane nose up trim.

When the flaps are extended, the SPM limit switches stop the stabilizer at +3.75 degrees of nose down trim. The PFC logic still stops the movement of the stabilizer at -10.25 degrees of airplane nose up trim.

If there is an ACE or an ARINC 629 flight control bus failure, the PFC permits a single pitch trim switch, arm or control, to command pitch trim as long as the signal path from the switch to the PFC is valid.

Secondary Mode

In secondary mode, the pitch trim switch signals also operate in pairs. Both arm and control signals are necessary for the PFC logic to calculate a command.

An input by the pitch trim switches always causes a stabilizer command for single path at high rate. The PFCs alternate which stabilizer path operates.

The stabilizer limits are the same as in the normal mode.

Direct Mode

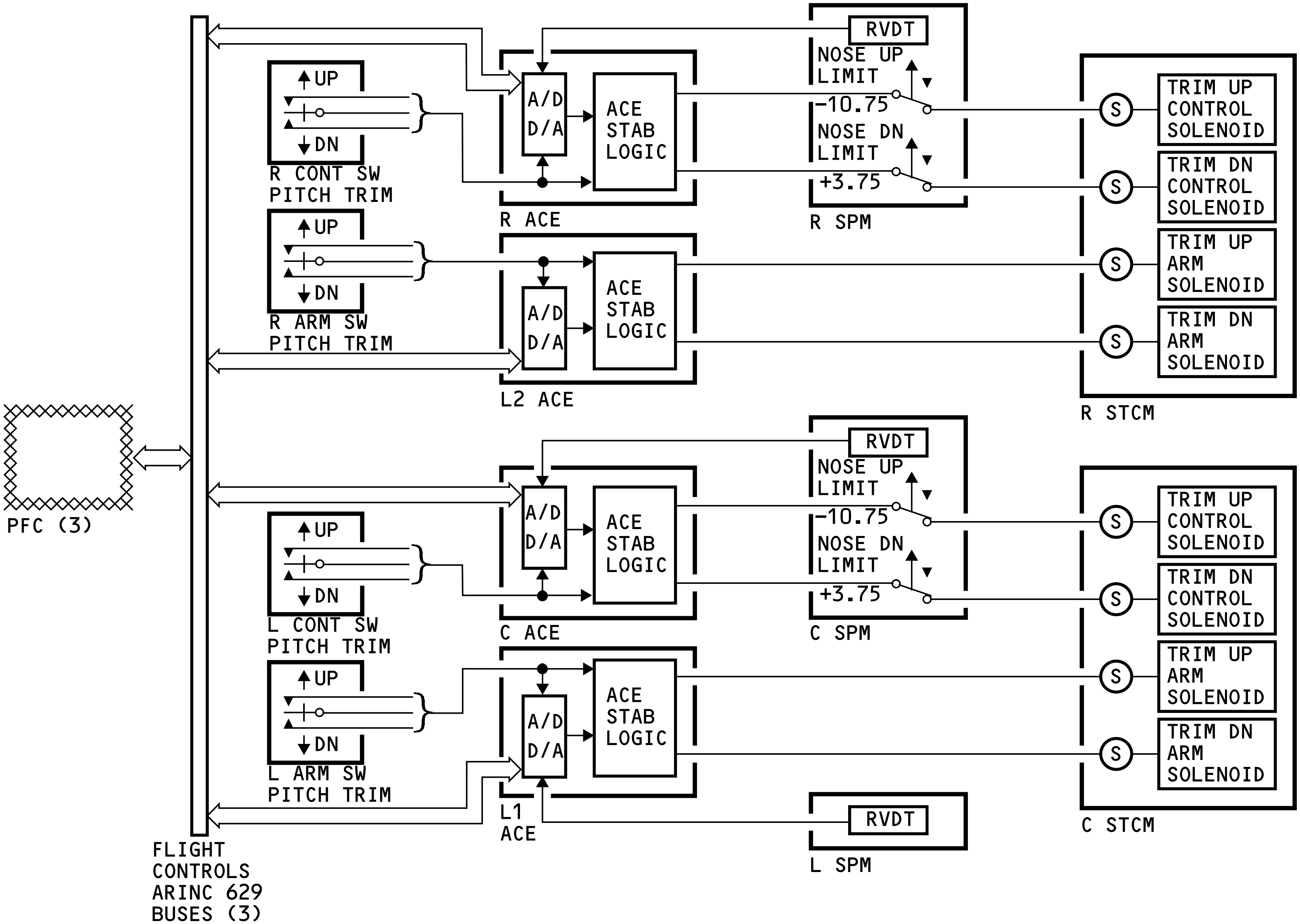
In direct mode, the pitch trim switch signals operate individually through the ACE to which they connect. Pitch trim switch arm and control signals are necessary to the two ACEs that connect to the STCM. The captain's input causes a command to the C STCM while the first officer's input causes a command to the R STCM. The command is always at high rate.

The limit switches in the SPM that connect the ACE and the STCM stop the movement of the stabilizer at:

- +3.75 degrees of airplane nose down trim
- -10.75 degrees of airplane nose up trim.

If both pilots make a pitch trim switch command at the same time and in the same direction, the ACEs send commands in dual path. The two STCMs operate both motors and brakes. The stabilizer then moves at full speed.

If both pilots make a pitch trim switch command at the same time but in opposite direction, the ACEs send commands in dual path in opposite rotation. The two STCMs operate both motors and brakes. The stabilizer then does not move, or may move slowly if one motor turns faster than the other.



27-41-00-024 Rev 3 01/08/96

HORIZONTAL STABILIZER CONTROL - FUNCTIONAL DESCRIPTION - STABILIZER ELECTRICAL CONTROL

HORIZONTAL STABILIZER CONTROL - TRIM LIMITS

General

Structural stops and the travel limiter limit stabilizer movement mechanically. Electrical limit switches and the stabilizer position limit function in the PFCs limit stabilizer movement electrically.

Structural Stops

On the upper and lower portions of the stabilizer ball screw are structural stops that limit stabilizer travel to +4 degrees airplane nose down trim and -11 degrees airplane nose up trim.

Travel Limiter

Within the aft stabilizer quadrant assembly of the alternate stabilizer trim mechanism there are hammer and stops that keep stabilizer travel to a limit.

The mechanism forces the control lever of the alternate pitch trim levers back to the null position when the stabilizer reaches its travel limits.

The travel limits for operation with the alternate pitch trim levers are: +3.88 degrees airplane nose down trim and -10.88 degrees airplane nose up trim.

Limit Switches

In each of the three stabilizer position modules are two limit switches. One switch opens to stop stabilizer movement in the airplane nose up trim direction and the other stops stabilizer movement in the airplane nose down trim direction.

In the normal mode of operation, the limit switches restrict nose down trim if the flaps are not retracted. The PFCs control airplane nose down trim when the flaps are retracted.

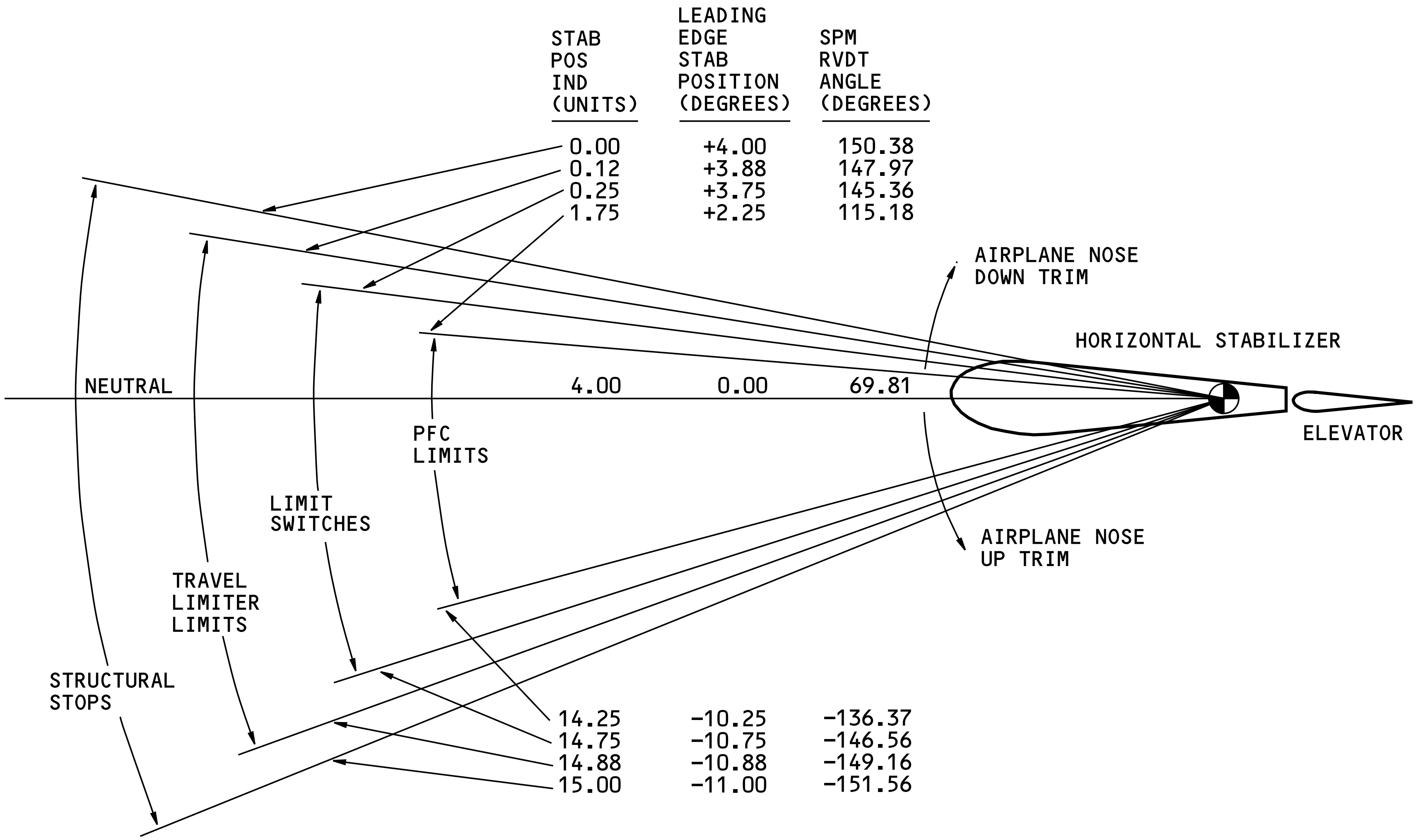
The limit switch trim limits are +3.75 degrees nose down and -10.75 degrees nose up.

PFC Limits

In the normal and secondary mode the PFCs supply limits to stabilizer movement.

With flaps retracted the PFCs limit stabilizer travel to +2.25 degrees airplane nose down to -10.25 degrees airplane nose up.

If the flaps are not retracted, the nose up PFC limitation remains at -10.25 degrees. The limit switches control the nose down limit at +3.75 degrees.



NOTE: THE SPM RVDT ANGLES IN DEGREES ARE NOMINAL VALUES. THEY ARE SHOWN FOR REFERENCE ONLY.

27-41-00-023 Rev 2 10/23/96

HORIZONTAL STABILIZER CONTROL - TRIM LIMITS

HORIZONTAL STABILIZER POSITION INDICATION - GENERAL DESCRIPTION

Purpose

The stabilizer position indication system measures the position of the stabilizer and sends this information to the ACEs. The ACEs send the information to the PFCs for stabilizer position calculation and control. The PFCs send the stabilizer position signals to the AIMS which controls the position indicators.

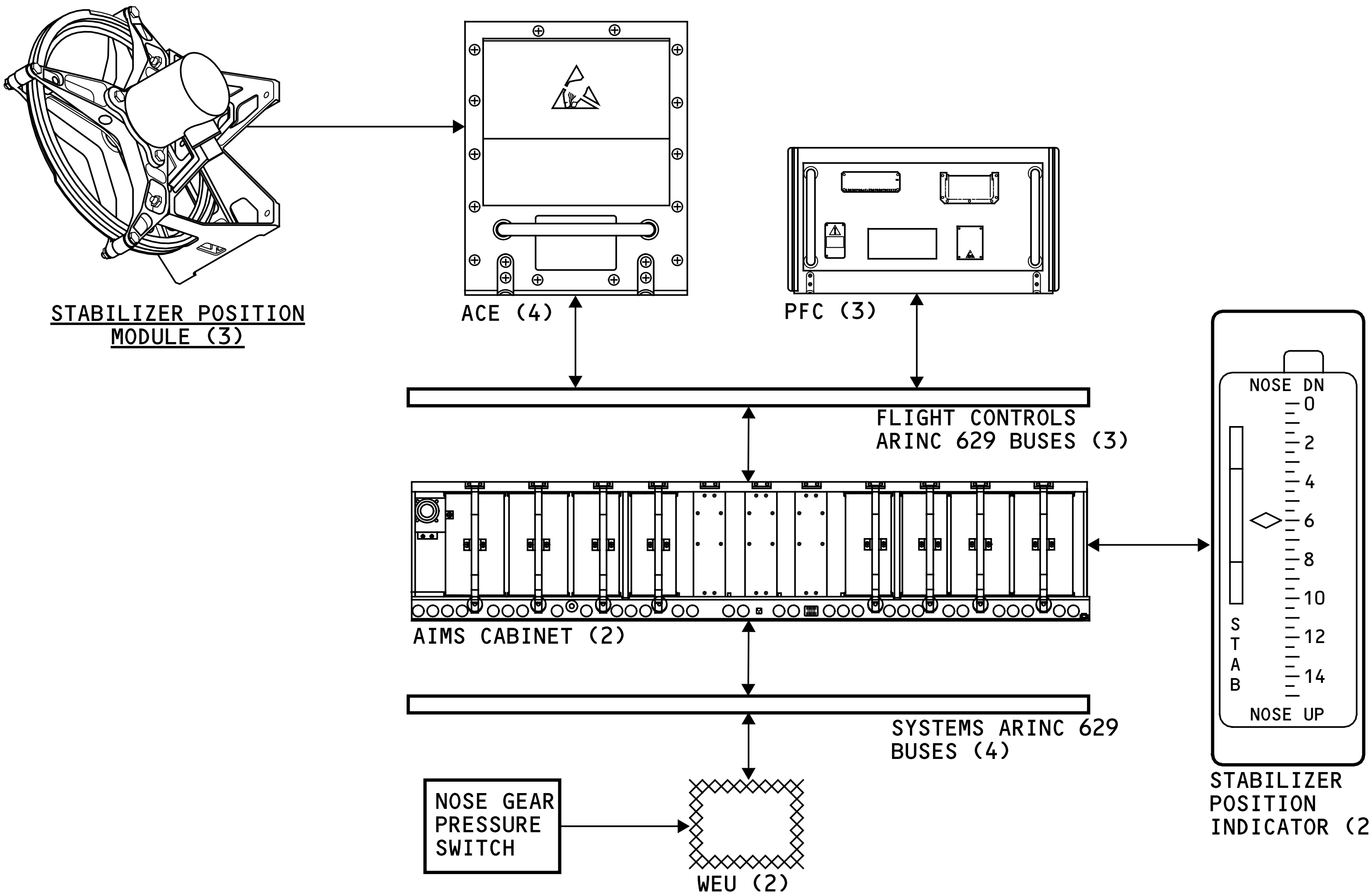
Stabilizer Position Indication

The three stabilizer position modules send signals to three ACEs. The ACEs change the signals from analog to digital and send them to the PFCs.

The PFCs use the position module signals to control the stabilizer position. The PFCs then send the stabilizer position signals to the AIMS. The AIMS sends them through the ARINC 429 bus to the stabilizer position indicators.

The AIMS also sets the green band display on each position indicator. The WEUs calculate which of the three green band segments to show on the position indicators. The WEUs use airplane weight, center of gravity position and engine thrust rating to calculate the green band display. The WEUs use a discrete signal from the nose gear pressure switch to verify the green band calculation. The calculated signals then go from the WEUs to the AIMS which selects and shows the green band on the stabilizer position indicators.

The stabilizer position indicating system operates in normal, secondary, and direct modes.



27-48-00-001 Rev 2 01/19/95

HORIZONTAL STABILIZER POSITION INDICATION - GENERAL DESCRIPTION

HORIZONTAL STABILIZER POSITION INDICATION - NOSE GEAR PRESSURE SWITCH

Purpose

The WEUs use a discrete signal from the nose gear pressure switch to make sure the stabilizer indicator green band calculation is correct.

Physical Description

The switch is a two position pressure sensing switch that sends an electrical discrete signal to the WEUs.

Location

The nose gear pressure switch is on the top of the nose gear strut.

Functional Description

The pressure switch receives pressure from the nose landing gear strut and sends a discrete to the WEUs. If the center of gravity of the airplane is forward, the pressure in the nose landing gear strut increases. This causes the pressure switch to close.

If the center of gravity of the airplane is aft, the pressure in the nose landing gear strut decreases. This causes the pressure switch to open.

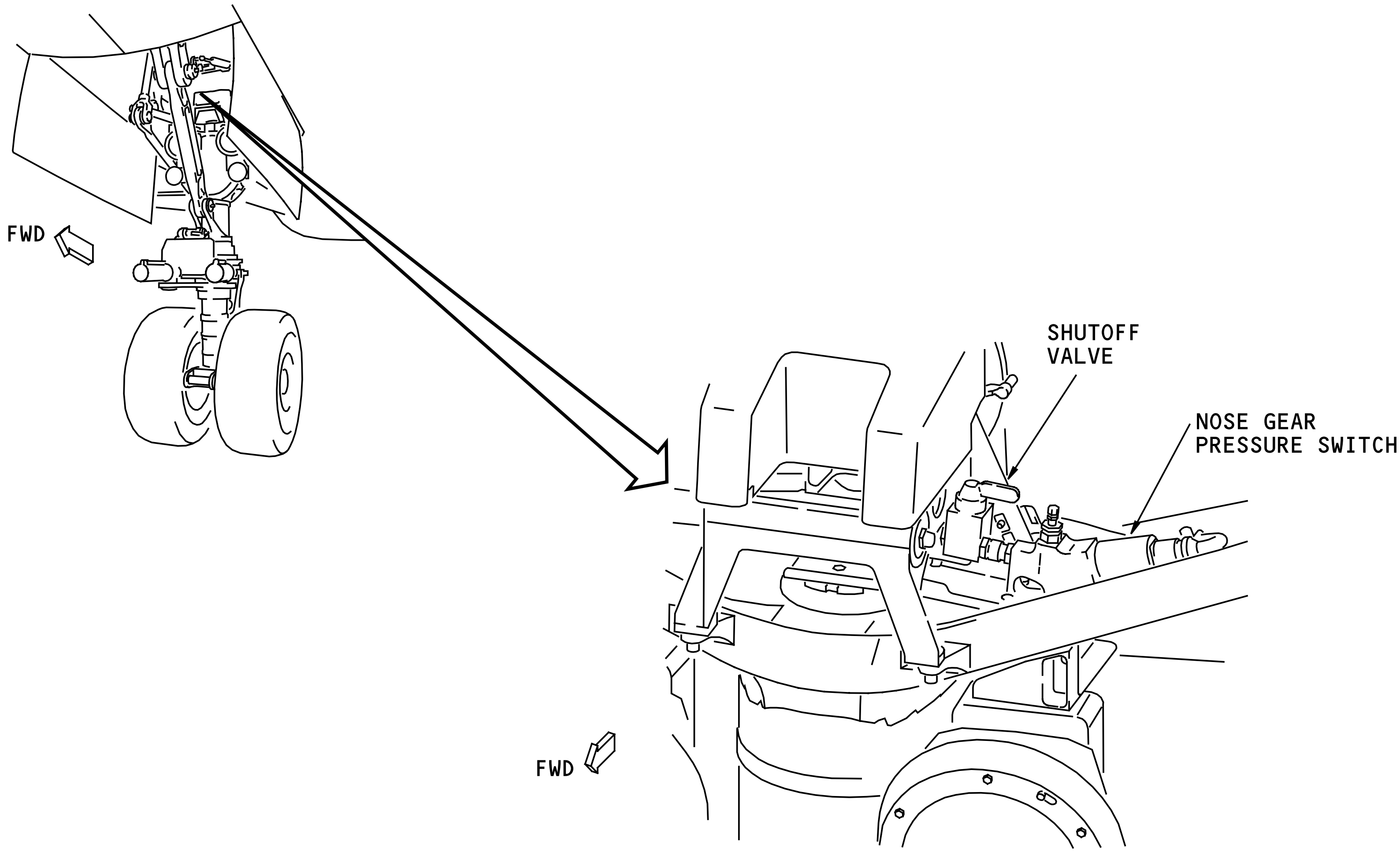
The WEUs calculate the green band display for the stabilizer trim indicators to show the safe range of stabilizer trim for take-off. The WEUs use the discrete signal from the pressure switch to verify the green band calculation.

Indications

Disagreement between the green band calculation and the pressure switch discrete causes the STAB GREENBAND advisory message to show.

Training Information Point

To remove the pressure switch move the shutoff valve to the closed position and lock it with a rig pin. This isolates the switch from strut pressure.



27-48-00-004 Rev 0 03/16/95

HORIZONTAL STABILIZER POSITION INDICATION - NOSE GEAR PRESSURE SWITCH

Continental Airlines, Inc

High Lift Control

WB371

TABLE OF CONTENTS

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HIGH LIFT CONTROL - INTRODUCTION

General

The high lift control system (HLCS) improves the takeoff and landing performance of the airplane. The HLCS includes the trailing edge flaps and the leading edge slats.

Trailing Edge Flaps

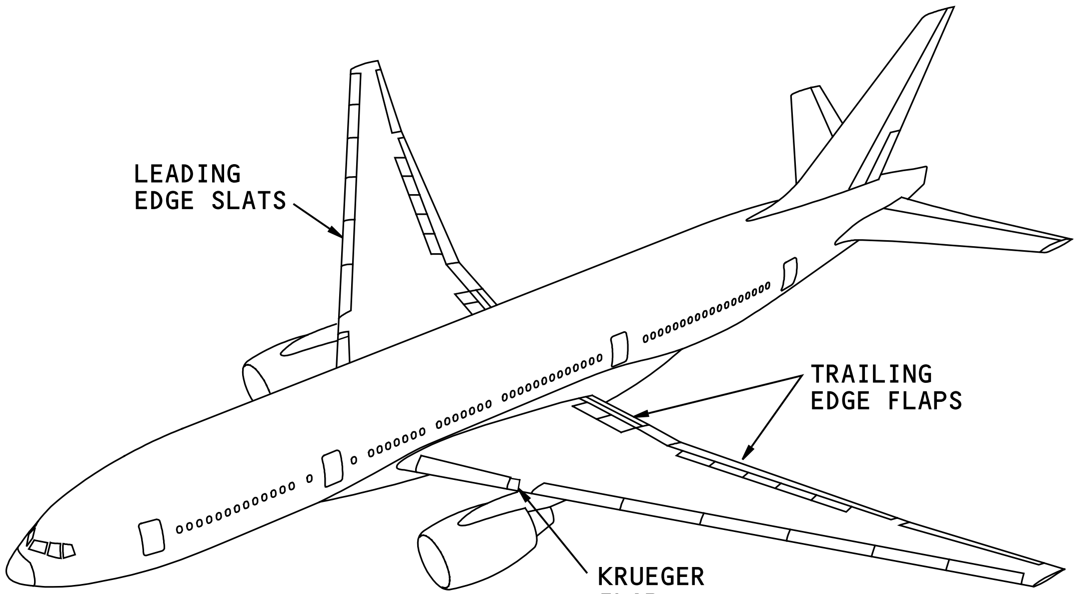
During takeoff, the trailing edge flaps increase the lift of the wing. During landing, the flaps increase the lift and drag. The flaps are not used during cruise. There is one double-slotted inboard flap and one single-slotted outboard flap on each wing.

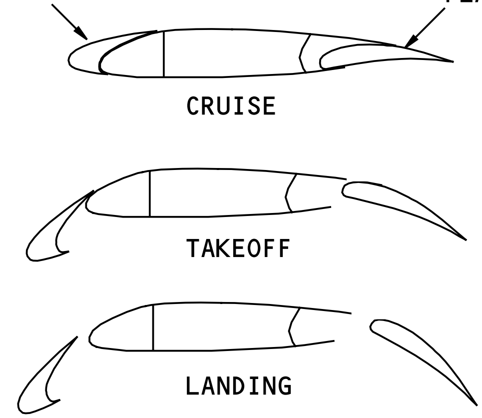
Leading Edge Slats and Krueger Flaps

During takeoff and landing, the leading edge slats and Krueger flaps increase the lift of the wing. These surfaces are not used during cruise. There are seven slats and one Krueger flap on each wing.

Abbreviations and Acronyms

ACE	- actuator control electronics
ACMS	- airplane condition monitoring system
ADIRU	- air data inertial reference unit
AIMS	- airplane information management system
altn	- alternate
ARINC	- Aeronautical Radio, Inc.
CMCS	- central maintenance computing system
EICAS	- engine indication and crew alerting system
FMCS	- flight management computing system
FSEU	- flap/slat electronics unit
HLCS	- high lift control system
HYDIM	- hydraulic interface module
LVDT	- linear variable differential transformer
MAT	- maintenance access terminal
PDU	- power drive unit
PFCS	- primary flight control system
PSEU	- proximity switch electronic unit
RVDT	- rotary variable differential transformer
SAARU	- secondary attitude air data reference unit
sec	- secondary
WEU	- warning electronic unit
WOW	- weight-on-wheels





27-03-00-001 Rev 2

HIGH LIFT CONTROL - INTRODUCTION

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HIGH LIFT CONTROL - GENERAL DESCRIPTION

General

The HLCS controls the operation of the:

- Trailing edge flaps
- Leading edge slats
- Krueger flaps.

The HLCS has these three modes of operation:

- Primary
- Secondary
- Alternate.

In the primary mode, hydraulic power moves the flaps and slats. In the secondary and alternate modes, electrical power moves the flaps and slats.

In the primary and secondary modes, the control is closed-loop. Closed-loop control stops the command when a feedback signal equals the command. In the alternate mode, the control is open-loop. Open-loop control stops the commands only when you stop the input or when the surfaces are at a limit.

Primary Mode

The flap lever position sensors send input signals to the flap/slat electronic units (FSEUs). The FSEUs use the flap lever position to calculate the flap and slat commands. The FSEUs also receive data from the systems ARINC 629 buses.

The FSEUs send the flap and slat commands to the flap and slat primary control valves. These valves supply hydraulic pressure to the flap and slat power drive units (PDUs). Hydraulic motors in the PDUs then move the flap and slat mechanisms.

The flap/slat priority valve controls the amount of hydraulic flow to the flap and slat primary control valves. The flap/slat priority valve gives priority of hydraulic power to the primary flight control system (PFCS) over the HLCS.

As the flaps and slats move, position sensors send a position feedback signal to the FSEUs. The FSEUs stop the flap and slat commands when the position feedback signals equal the commanded position.

The flap and slat skew sensors monitor the alignment of the flaps and slats. If the flaps or slats are out of alignment, the skew sensors send a signal to the FSEUs. The FSEUs then prohibit movement of the failed system in the primary and secondary modes.

The primary mode also uses the autoslat priority valve if the airplane approaches a stall condition. This valve gives the slats priority of the hydraulic power over the main landing gear system during an autoslat command.

Secondary Mode

In the secondary mode, the FSEUs receive input signals from the flap lever position sensor. The FSEUs then energize secondary/alternate control relays. These relays energize bypass solenoids in the primary control valves to stop hydraulic power to the hydraulic motors. These relays also control electrical power to the flap and slat electric motors in the PDUs. The electric motors then move the flap and slat mechanisms.

As the flaps and slats move, position sensors send a position feedback signal to the FSEUs. The FSEUs command the relays to stop the electric motors when the flaps and slats are at the commanded position.

The secondary mode also uses the flap and slat skew sensors. If the flaps are out of alignment, the FSEUs prohibit movement of the flaps in the secondary mode. This is also true for the slats.

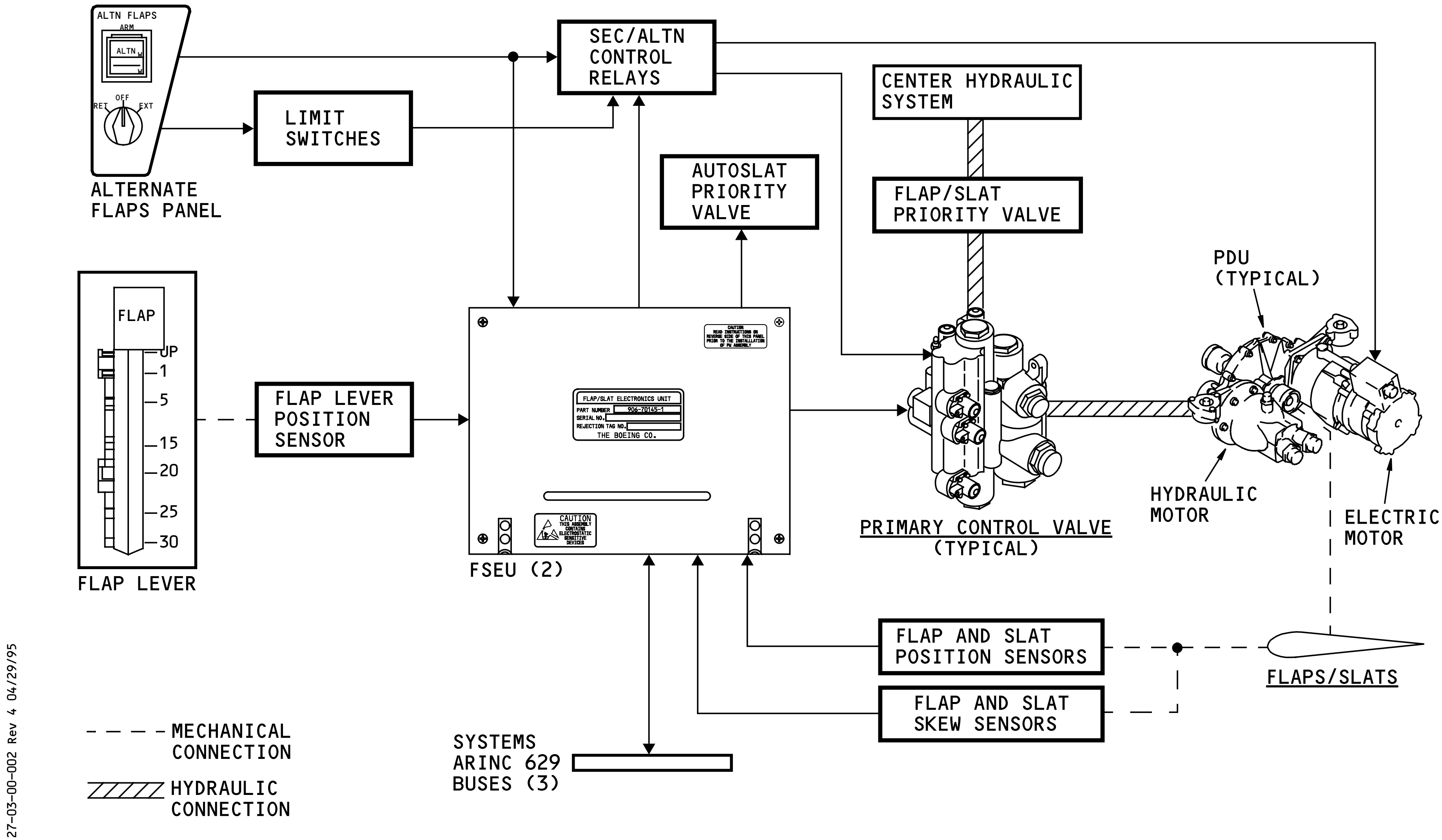
Alternate Mode

The pilots manually control the alternate mode with the switches on the alternate flaps panel. The arm switch on this panel sends a discrete to the FSEUs to disengage the primary and secondary modes. This switch also energizes two of the secondary/alternate control relays. These two relays energize bypass solenoids in the primary control valves to stop hydraulic power to the hydraulic motors. The primary control valves also create a hydraulic loop to permit the hydraulic motors to be backdriven.

The alternate flaps selector sends commands through limit switches to energize the other secondary/ alternate control relays. These relays control electrical power to the flap and slat electric motors on the PDUs. The limit switches remove electrical power from these relays when the flaps and slats are at their limits.

The electric motors then move the flap and slat mechanisms. The flaps and slats move until the pilot moves the alternate flaps selector to OFF, or the flaps and slats are at their limits.

The alternate mode control does not use the flap and slat position sensors or skew sensors. But, the FSEUs continue to receive signals from these sensors for EICAS messages and position indication.



HLCS - GENERAL DESCRIPTION

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HIGH LIFT CONTROL - INTERFACES - SYSTEM REDUNDANCY

General

The HLCS has two identical lanes for the primary mode and the secondary mode. One lane has control of the HLCS. The other lane monitors the HLCS. The FSEUs automatically transfer control to the other lane after a post-flight self test of the FSEUs or after disengagement from the alternate mode. The FSEUs also switch control to the other lane if:

- A component fails in the control lane
- The command and feedback disagree.

Each lane has these components:

- An FSEU
- Two RVDTs in the flap lever position sensor
- Flap primary control valve solenoid coils
- Slat primary control valve solenoid coils
- Flap position sensors
- Slat position sensors.

The following components are not in the HLCS lanes:

- The flap and slat skew sensors
- The autoslat priority valves
- The secondary/alternate control relays

FSEUs

One FSEU is in each lane. Only the FSEU in the control lane sends the flap and slat commands to the flap and slat primary control valves.

Flap Lever Position Sensor

Each lane uses two of the four RVDTs in the flap lever position sensor.

Flap and Slat Primary Control Valve Solenoid Coils

The flap and slat primary control valves have dual-coil solenoids. Each lane controls one of the coils in each solenoid.

Flap and Slat Position Sensors

Each wing has two flap position sensors and two slat position sensors. Each lane uses one flap position sensor and one slat position sensor from each wing.

Flap and Slat Skew Sensors

There are four pairs of flap skew sensors and three pairs of slat skew sensors on each wing. One FSEU receives inputs from half of the skew sensors, and the other FSEU receives inputs from the other half.

Autoslat Priority Valve

Either FSEU can control the autoslat priority valves.

Secondary/Alternate Control Relays

Either FSEU can control the secondary/alternate control relays.

HIGH LIFT CONTROL - INTERFACES - SYSTEM REDUNDANCY

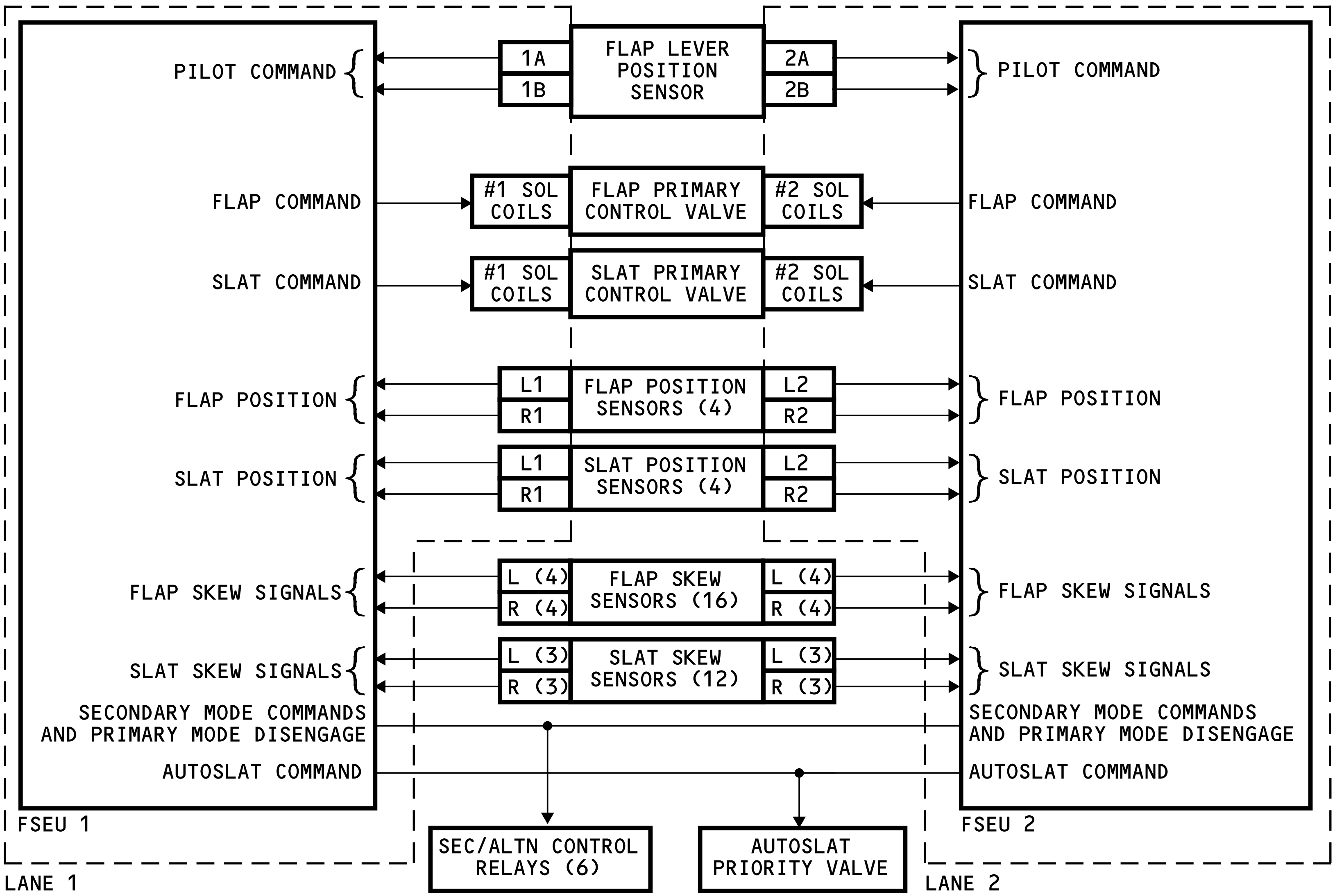
Fault Annunciation

The status message FLAP/SLAT CONTROL 1 shows if:

- A component fails in lane 1
- The command and feedback disagree in lane 1.

The same logic is true for the FLAP/SLAT CONTROL 2 status message in lane 2.

The caution message FLAP/SLAT CONTROL shows if both lanes fail.



27-03-00-003 Rev 5 10/15/96

HIGH LIFT CONTROL - INTERFACES - SYSTEM REDUNDANCY

HIGH LIFT CONTROL - INTERFACES - SYSTEMS ARINC 629 BUSES

General

The FSEUs connect the HLCS to many other airplane systems through the systems ARINC 629 buses. Some of these systems use these components:

- Two warning electronics units (WEUs)
- Two airplane information management system (AIMS) cabinets
- Two systems card files.

FSEU Interface

The FSEUs connect to three of the systems ARINC 629 buses. FSEU 1 transmits and receives data on the left and center 1 buses through separate connections. FSEU 1 receives data through two more connections for redundancy.

The connections for FSEU 2 are almost the same as the connections for FSEU 1. The difference is that the FSEU 2 communicates with the right and C1 buses instead of the left and C1 buses.

WEU Interface

The WEUs transmit data for the autoslat function.

AIMS Interface

The FSEUs supply information to the AIMS for:

- The flap/slat position indications on EICAS
- The flap/slat maintenance page
- The central maintenance computing system (CMCS)
- The protection functions in the primary flight control system (PFCS)
- And many other systems and functions.

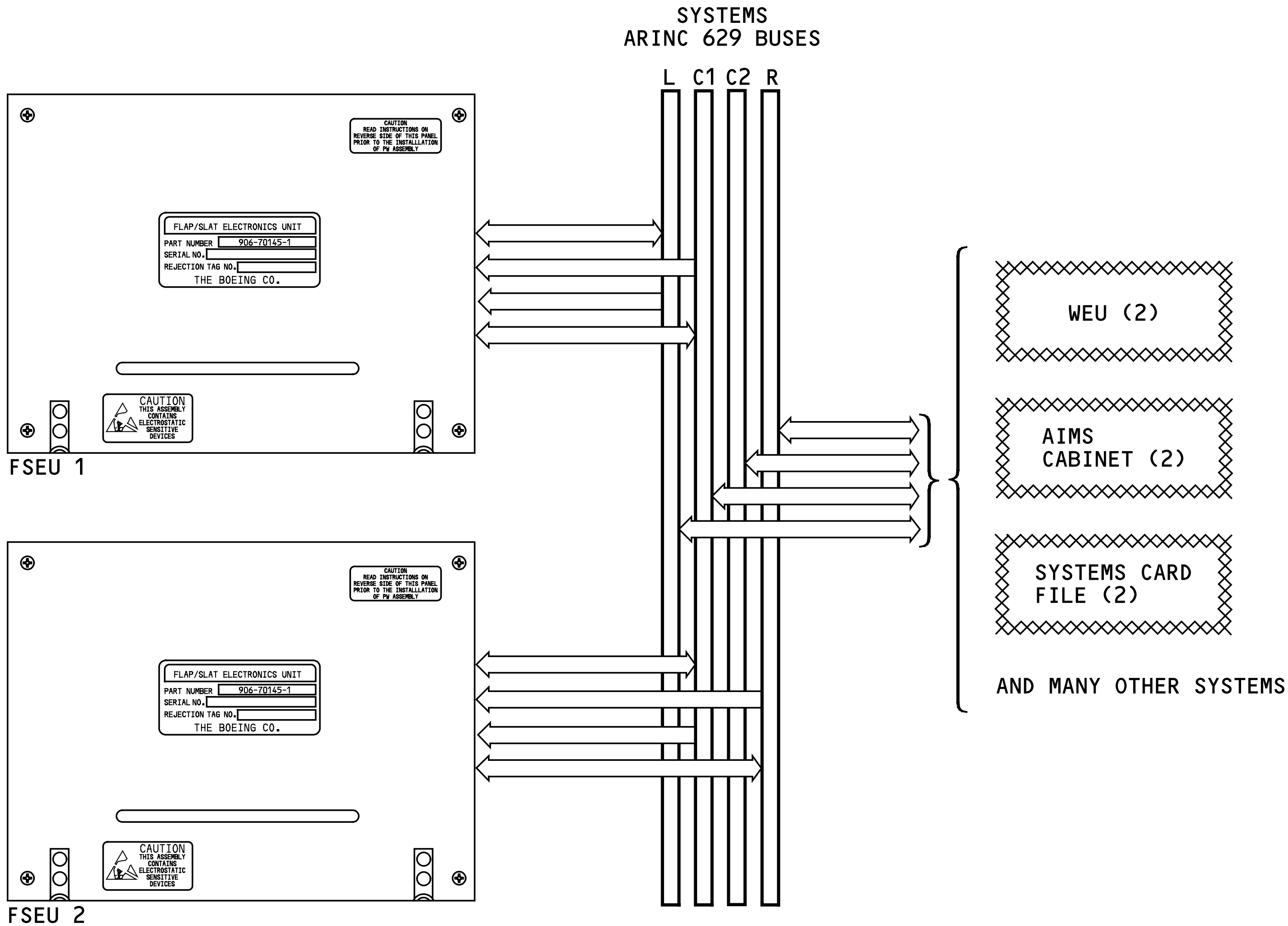
Information that the FSEUs receive from the AIMS cabinets include air data from the ADIRU and SAARU and data from many other systems.

Systems Card File Interface

The hydraulic interface module (HYDIM) and the weight on wheels (WOW) cards are in the systems card file.

The HYDIM cards supply hydraulic pressure data to the FSEUs. The center hydraulic isolation system command from the HYDIM cards disables the slats in the primary mode. The FSEUs also send the flap and slat commands to the HYDIM cards.

The WOW cards supply air/ground data to the FSEUs.



27-03-00-004 Rev 1

HIGH LIFT CONTROL - INTERFACES - SYSTEMS ARINC 629 BUSES

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HIGH LIFT CONTROL - INTERFACES - ANALOG AND DISCRETE SIGNALS

General

These components electrically control the flaps and slats in the primary, secondary, and alternate modes:

- FSEUs
- Flap lever position sensor
- Alternate flaps arm switch
- Alternate flaps selector
- Flap and slat primary control valves
- Autoslat priority valve
- Secondary/alternate control relays
- Flap and slat position sensors
- Flap and slat skew sensors.

The ACEs receive flap position discrete signals from the FSEUs for some of the functions in the PFCS.

FSEUs

The two FSEUs use analog and discrete inputs to calculate the flap and slat commands in the primary and secondary modes. They also use digital information on the systems ARINC 629 buses.

Flap Lever Position Sensor

The flap lever position sensor sends the flap lever commands to the FSEUs.

Alternate Flaps Arm Switch

The alternate flaps arm switch sends a discrete to the FSEUs to disengage the primary and secondary modes. This switch also controls two relays, which control power to a solenoid in the flap and slat primary control valves.

Alternate Flaps Selector

The alternate flaps selector controls the grounds for four relays, which control power to the flap and slat electric motors. The wiring for these grounds is through the flap and slat limit switches.

Flap and Slat Limit Switches

The flap and slat limit switches stop the movement of the flaps and slats in the alternate mode. When the flaps and slats are at their limits, the limit switches remove the grounds for some of the sec/altn control relays.

Secondary/Alternate Control Relays

The secondary/alternate control relays control power to the flap and slat electric motors in the secondary and alternate modes. These relays also control a solenoid in the flap and slat primary control valves to stop the hydraulic operation of the flaps and slats.

HIGH LIFT CONTROL - INTERFACES - ANALOG AND DISCRETE SIGNALS

Flap and Slat Electric Motors

The flap and slat electric motors move the flap and slat drive systems in the secondary and alternate modes. They receive electrical power through the sec/altn control relays.

Flap and Slat Primary Control Valves

The flap and slat primary control valves control the direction and speed of the flap and slat movement. The FSEUs control most of the solenoids in the flap and slat primary control valves. The sec/altn control relays control one solenoid in the flap and slat primary control valves. These two solenoids stop the hydraulic operation of the flaps and slats.

Autoslat Priority Valve

The autoslat priority valve limits the flow of hydraulic fluid to the main landing gear system. The FSEUs control a solenoid in this valve during autoslat operation.

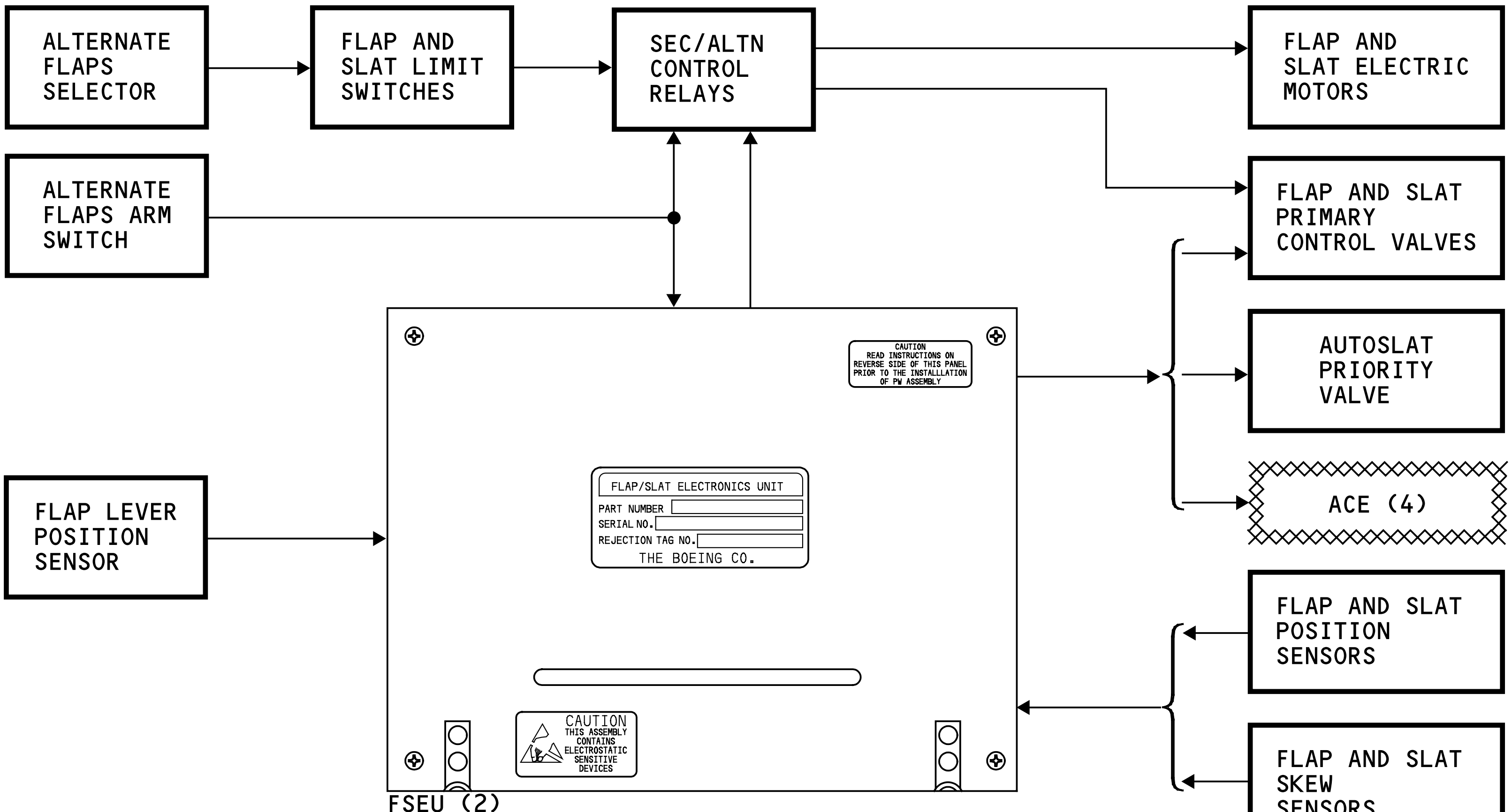
Flap and Slat Position Sensors

The flap and slat position sensors supply flap and slat position signals to the FSEUs. The FSEUs use this data for:

- Control feedback
- Position indication
- Fault monitoring.

Flap and Slat Skew Sensors

The flap and slat skew sensors supply signals to the FSEUs. The FSEUs use these signals to monitor the alignment of the flaps and slats.



27-03-00-005 Rev 3 03/14/1996

HIGH LIFT CONTROL - INTERFACES - ANALOG AND DISCRETE SIGNALS

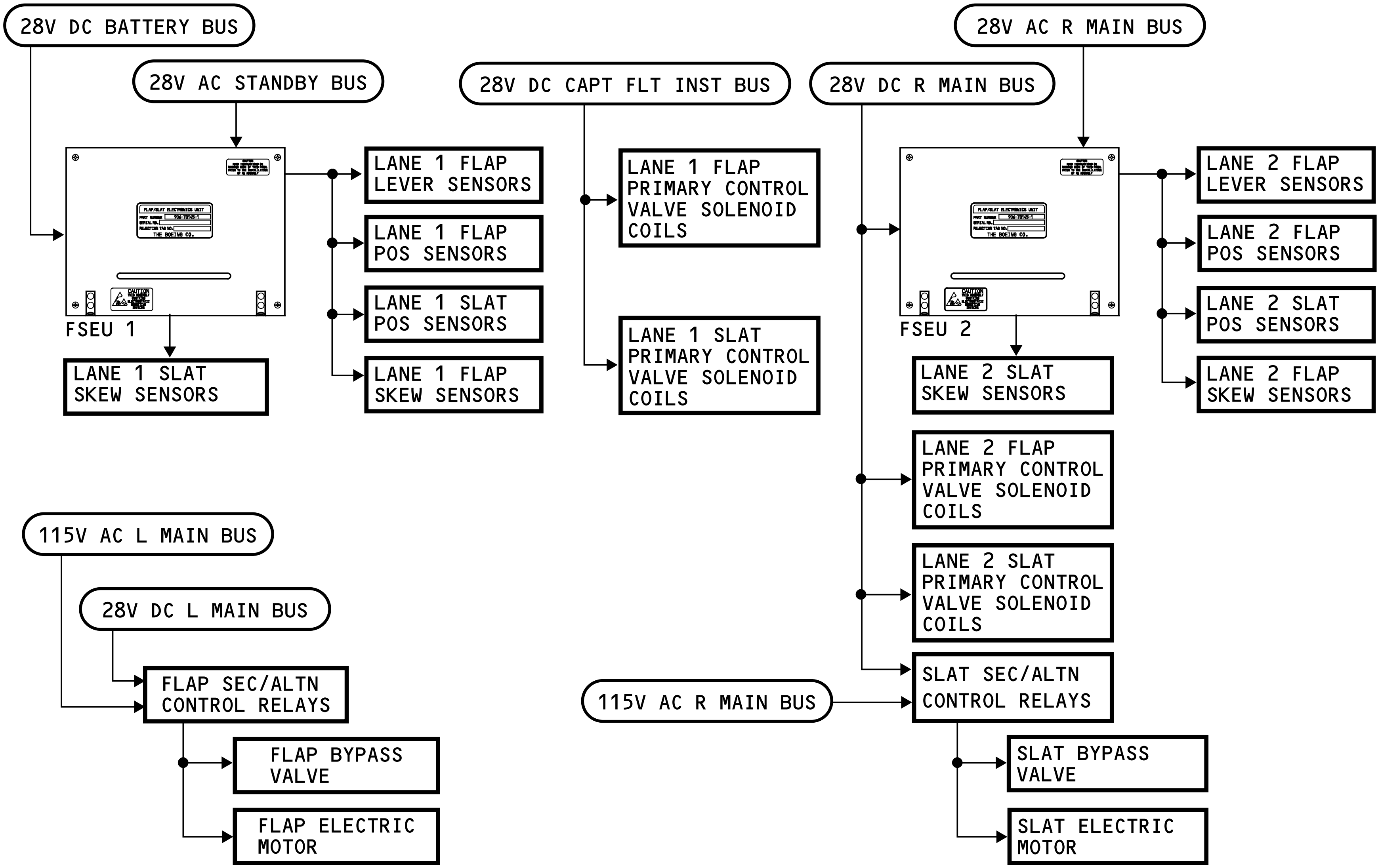
HIGH LIFT CONTROL - INTERFACES - ELECTRICAL POWER

General

Multiple buses supply electrical power to the HLCS. The HLCS receives electrical power from the:

- 28v dc battery bus
- 28v dc captain's flight instrument bus
- 28v ac standby bus
- 28v dc right main bus
- 28v ac right main bus
- 28v dc left main bus
- 115v ac left main bus
- 115v ac right main bus.

These buses permit the separation of electrical power between lane one and lane two. The components in lane one get power from separate buses than the components in lane two.



27-03-00-006 Rev 3 12/08/95

HIGH LIFT CONTROL - INTERFACES - ELECTRICAL POWER

HIGH LIFT CONTROL - MODE SELECTION

General

The flaps and slats operate in one of three modes:

- Primary mode
- Secondary mode
- Alternate mode.

The FSEUs change the operational mode for any of these conditions:

- There are component failures
- There are position failures
- The center hydraulic reservoir quantity is low
- The secondary mode auto test is active
- The airplane is in a ground maintenance condition
- You use the alternate flaps arm switch.

The primary and secondary flap modes are independent of the primary and secondary slat modes. Thus, the flaps may be in the secondary mode while the slats are in the primary mode. This supplies the fastest system response to the flap lever commands.

The alternate flap mode is not independent of the alternate slat mode. Thus, when the alternate mode engages, both the flaps and slats are in the alternate mode.

Primary Mode Selection

If there is a component failure in the control lane, it causes a lane change. The flaps and slats continue to operate in primary mode.

These are the four types of component failures that cause a lane change:

- Flap lever position sensor failure
- Solenoid coil failure on the primary control valve for the flaps or the slats
- Flap or slat position sensor failure
- FSEU failure.

During normal conditions, the flaps and slats operate in the primary mode. If a component fails in lane 1 and lane 1 is in control, lane 2 becomes the control lane. In this condition, the flaps and slats stay in the primary mode. This failure condition causes the FLAP/SLAT CONTROL 1 status message to show.

If lane 2 is in control when a component fails in lane 2, lane 1 becomes the control lane and the FLAP/SLAT CONTROL 2 status message shows.

If there is a detected component failure in the standby lane while the control lane operates properly, the applicable status message, FLAP/SLAT CONTROL 1 or 2, shows. The control lane remains in control.

HIGH LIFT CONTROL - MODE SELECTION

Secondary Mode Selection

After a lane change, if the original failure or an additional one prevents the flaps or slats to operate in primary mode, the FSEU in control changes to the secondary mode operation for the flaps or the slats.

If the failures are with flap components only, only the primary flap mode disengages and the flaps operate in secondary mode. The slats operation continues in the primary mode. This condition causes the FLAPS PRIMARY FAIL caution message to show. The same is true for the slats. But in this case, the SLATS PRIMARY FAIL caution messge shows.

If the failures affected both the flaps and slats, such as both FSEUs, both the primary flap mode and the primary slat mode disengage. This condition causes both the FLAPS PRIMARY FAIL and SLATS PRIMARY FAIL caution messages to show.

After the flaps and slats fully retract, the secondary mode disengages and the primary mode engages. Then the FLAPS PRIMARY FAIL and/or the SLATS PRIMARY FAIL message erases.

The FSEU in control engages the secondary mode for the flaps or slats if there is a flap or slat disagree in primary mode. There is a disagree when the flaps or slats do not move when commanded or move too slowly. The FSEU in control disengages the primary mode for the flaps or the slats and engage the secondary mode. This condition causes the FLAPS PRIMARY FAIL or the SLATS PRIMARY FAIL caution message to show.

When the center hydraulic system pressure is low, it does not permit the hydraulic motors to operate the flaps and slats. The FSEU in control engages the secondary mode for the flaps and slats. The operation stays in the secondary mode until the flaps and slats are in the retracted position or until the center hydraulic system pressure is more than 2000 psi after it was less than 1000 psi.

Flaps and Slats Drive Shutdown

If there are component failures that affect the operation of both flaps and slats, the flaps and slats can no longer operate in primary and secondary mode. The FLAP/SLAT CONTROL caution message shows. In addition, the FLAP/SLAT CONTROL 1 and the FLAP/SLAT CONTROL 2 status messages also show.

The FSEUs declare and latch a flaps or slats drive shut down for any one of these position failures:

- Disagreement in secondary mode (the flaps or slats do not move with a secondary mode command or move too slowly)
- Asymmetry (the flaps or slats on one wing do not align with the flaps or slats on the other wing)
- Skew (a flap or slat on one wing is out of alignment).

HIGH LIFT CONTROL - MODE SELECTION

If there is a secondary mode disagree, an asymmetry or a skew, the FSEUs disengage both the primary and secondary modes and shut down the drive system for the flaps or the slats.

A shut down of the slats drive with the slats at the UP position, at the sealed position, or between, causes the flaps operation to be limited to the 20-unit position. If the slats are at the gapped position when the slats drive shuts down, the flaps can operate to the full extend. A shut down of the flaps drive will not let the slats extend to the gapped position.

The shut down of the flaps or the slats drive causes the FLAPS DRIVE or the SLATS DRIVE caution message to show.

Alternate Mode Selection

The only way to engage and disengage the alternate mode is to use the alternate flaps arm switch. When the pilot pushes on the alternate flaps arm switch, the primary and secondary modes disengage in both FSEUs and the alternate mode engages. This causes the FLAP/SLAT CONTROL caution message to show.

When the pilot releases the alternate flaps arm switch, the alternate mode disengages and the FSEUs try to engage the primary mode. If the primary mode is disabled, the FSEUs try to engage the secondary mode. If the secondary mode is also disabled, you must use the alternate mode to move the flaps and slats.

Center Hydraulic Quantity

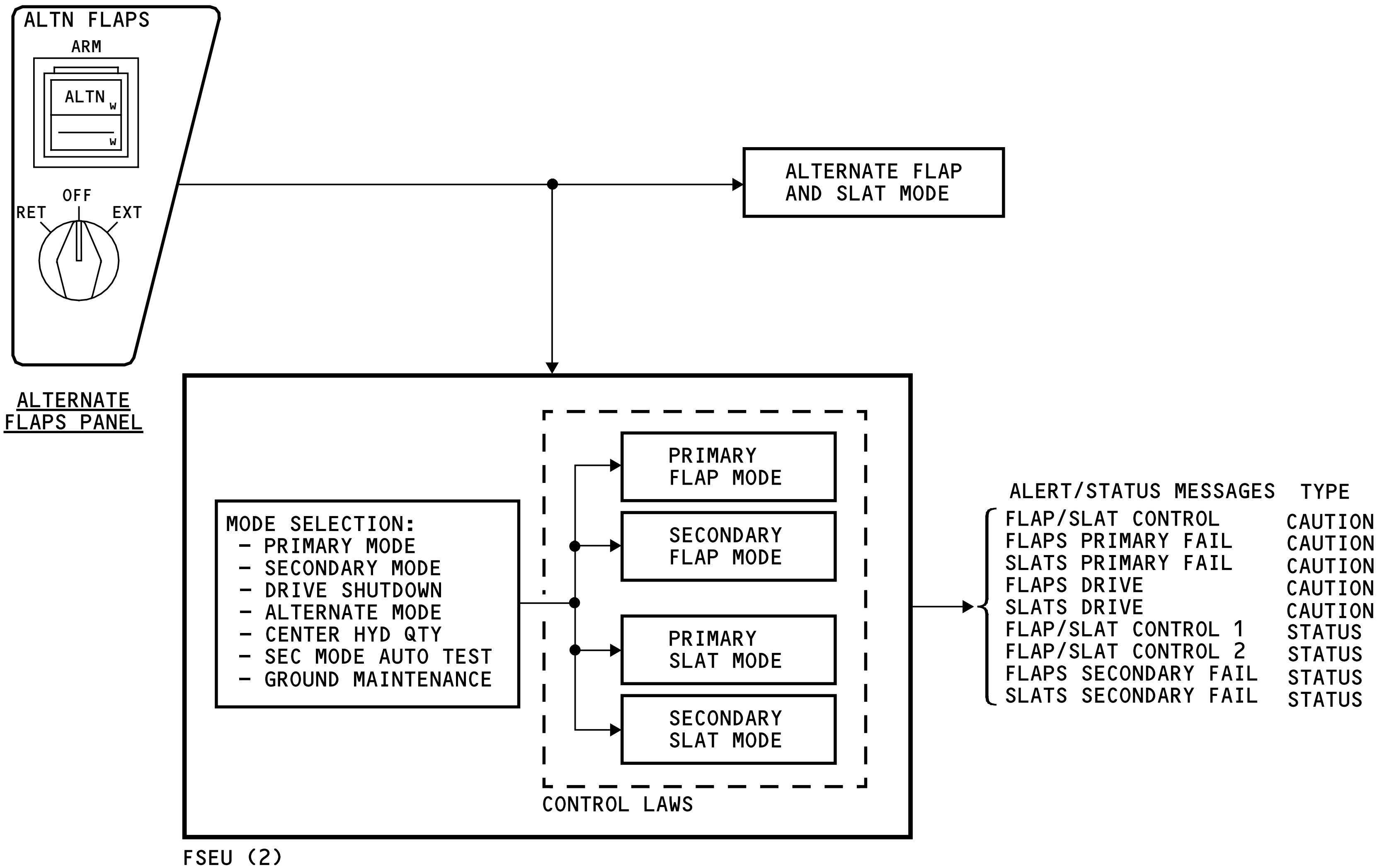
If the hydraulic quantity in the center hydraulic system reservoir is low, the FSEUs disengage the primary slat mode. The FSEUs then engage the secondary mode for the slats only. If both engines continue to operate for more than 10 seconds, then the primary mode re-engages.

Secondary Mode Auto Test

During the secondary mode auto test, both the primary flap mode and the primary slat mode disengage. The secondary mode engages for both the flaps and slats. If the flaps and/or slats fail to extend during the test, the FLAPS SECONDARY FAIL and/or SLATS SECONDARY FAIL status message shows.

Ground Maintenance Condition

The FSEUs inhibit the secondary mode operation when the airplane is in a ground maintenance condition. You must use the secondary mode inhibit override function on the MAT to enable the secondary mode in this condition.



27-03-00-018 Rev 6 07/10/1997

HIGH LIFT CONTROL - MODE SELECTION

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HIGH LIFT CONTROL - PRIMARY MODE FLAP AND SLAT SEQUENCE

General

The flaps and slats extend and retract in sequence. The extension and retraction sequence is different between the three modes.

Flap and Slat Positions

In the primary mode, the flap lever commands the flaps and slats to move to the commanded position. At flap lever positions UP and 1, the flaps are fully retracted. At flap lever positions 5 through 30, the flap positions are the same as the flap lever positions.

The slats have three positions: up, sealed, and gapped. The slats are at the sealed position when the flap lever is at 1, 5, 15, or 20. The slats are at the gapped position when the flap lever is at 25 or 30.

Flap load relief is available in the primary mode. Load relief operation is described later.

Flap lever detent up is for cruise. Detent 1 is for climb-out and approach. Detents 5, 15, and 20 are the takeoff settings. Detents 25 and 30 are the landing settings.

Flap and Slat Extension and Retraction

During extension from the retracted position, the slats extend to the sealed position while the flaps stay retracted. When the slats are at the sealed position, the flaps begin to extend. When the flaps are at the 20 unit position, the flaps stop moving. The slats then extend to the gapped position. When the slats are in the gapped position, the flaps move to the fully extended position.

The retraction sequence is the reverse of the extension.

Extension and Retraction Time

The extension time is the same as the retraction time.

It takes 54 seconds to move the slats and flaps from the UP position to the 30-unit position. The detailed times are:

- 11 seconds to move the slats from the retracted position to the sealed position
- 24 seconds to move the flaps from the retracted position to the 20-unit position
- 6 seconds to move the slats from the sealed position to the gapped position
- 13 seconds to move the flaps from the 20-unit position to the 30-unit position.

Flap Operation With Slats Drive Shutdown

When the slats fail to move to the commanded position in primary and secondary mode, the FSEUs shutdown the slats drive. With a slats drive shutdown, the flaps continue to operate in primary mode. The flaps move to their commanded position independently of the slat

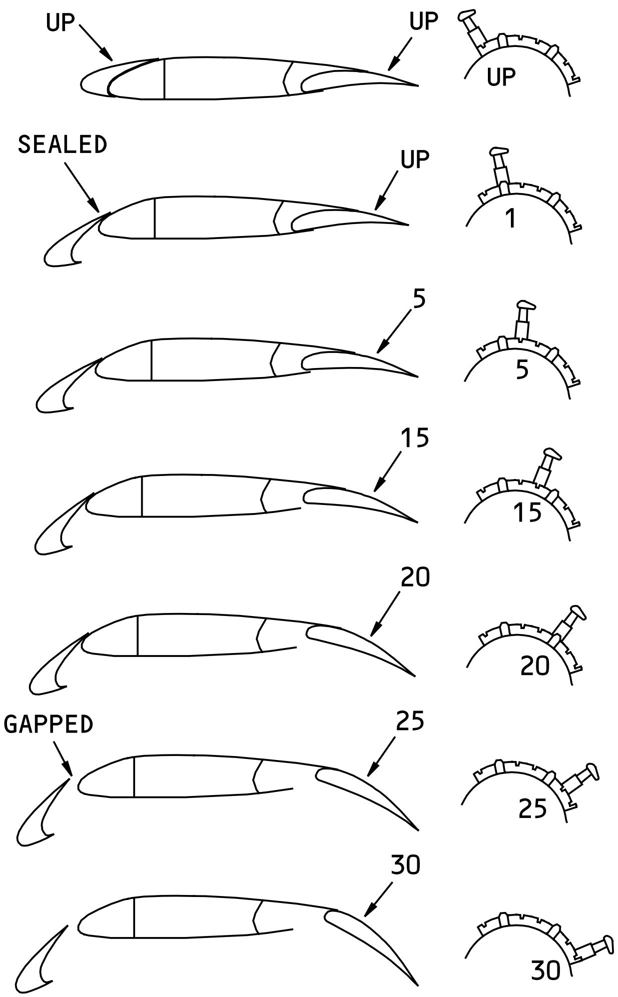
HIGH LIFT CONTROL - PRIMARY MODE FLAP AND SLAT SEQUENCE

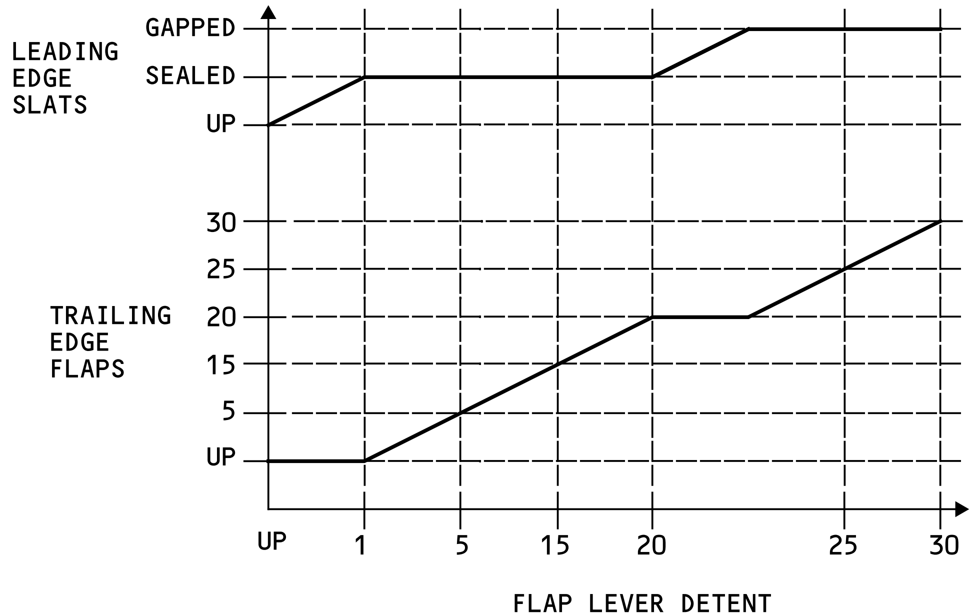
position. If the slats are not at the gapped position when the slats drive shutdown occurs, the flaps cannot move more than the 20-unit position. If the slats are at the gapped position when the slats drive shutdown occurs, the flaps can move more than the 20-unit position.

Training Information Point

CAUTION: YOU MUST WAIT 30 MINUTES AFTER 12 MINUTES OF OPERATION IN THE PRIMARY MODE. THE FLAP NO-BACK BRAKE CAN BECOME TOO HOT.

CAUTION: MAKE SURE THE ADP ACCESS DOOR IS FULLY OPEN OR FULLY CLOSED WHEN YOU MOVE THE TRAILING EDGE FLAPS. THE FLAPS CAN HIT THE DOOR IF IT IS NOT FULLY OPEN OR CLOSED. THIS CAN CAUSE DAMAGE TO EQUIPMENT.





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HIGH LIFT CONTROL - PRIMARY MODE FLAP AND SLAT SEQUENCE

HIGH LIFT CONTROL - SECONDARY MODE FLAP AND SLAT SEQUENCE

General

The sequence of the flap and slat extension and retraction in the secondary mode is almost the same as in the primary mode.

Flap and Slat Positions

In the secondary mode, the flap lever commands the flaps and slats to move to the commanded position. The flap positions are the same as in the primary mode.

The slats extend to the gapped position when the flap lever is at any position except up.

Slat load relief is available in secondary mode. The slats retract to the sealed position when the airspeed is more than 239 knots. Load relief operation is described later.

Flap and Slat Extension and Retraction

During extension, the slats extend to the gapped position before the flaps extend. When the slats are at the gapped position, the flaps extend to the commanded position.

The sequence of the flap and slat retraction is the reverse of the flap and slat extension.

Extension and Retraction Time

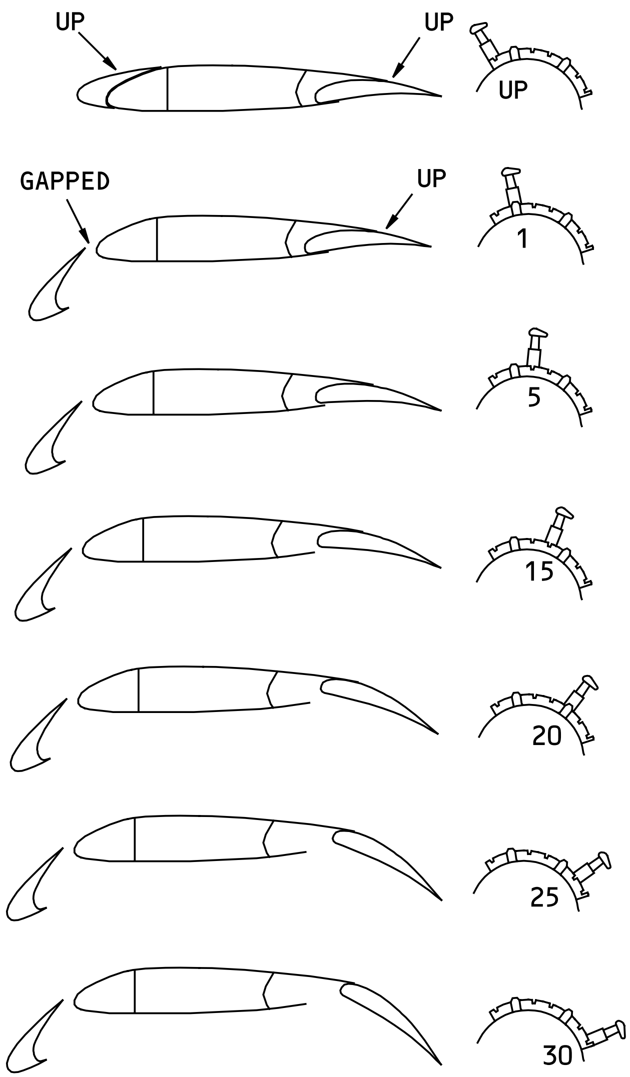
The extension time is the same as the retraction time.

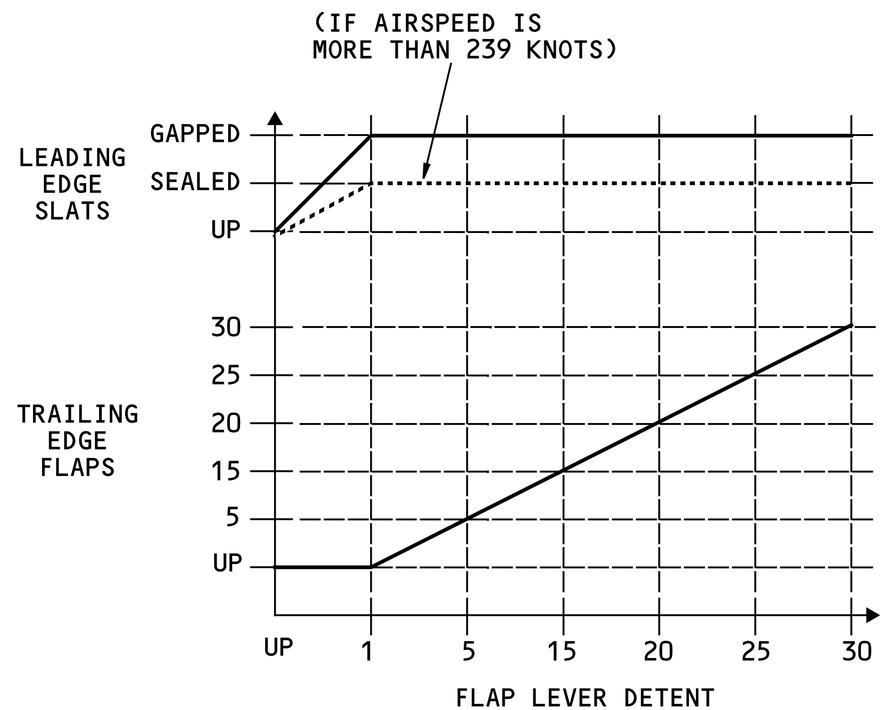
It takes 5 minutes and 8 seconds to move the slats and the flaps from the UP position to the 30-unit position. The detailed times are:

- 1 minute and 25 seconds to move the slats from the retracted position to the gapped position
- 3 minutes and 43 seconds to move the flaps from the retracted position to the 30-unit position.

Flap Operation With Slats Drive Shutdown

When the slats fail to move to the commanded position in primary and secondary mode, the FSEUs shutdown the slats drive. With a slats drive shutdown, the flaps continue to operate in primary mode. The flaps move to their commanded position independently of the slat position. If the slats are not at the gapped position when the slats drive shutdown occurs, the flaps cannot move more than the 20-unit position. If the slats are at the gapped position when the slats drive shutdown occurs, the flaps can move more than the 20-unit position.





27-03-00-011 Rev 6 06/20/1997

HIGH LIFT CONTROL - SECONDARY MODE FLAP AND SLAT SEQUENCE

HIGH LIFT CONTROL - ALTERNATE MODE FLAP AND SLAT SEQUENCE

General

The alternate flaps arm switch sets the alternate mode. The alternate flaps selector controls the direction of the flap and slat movement.

Extension

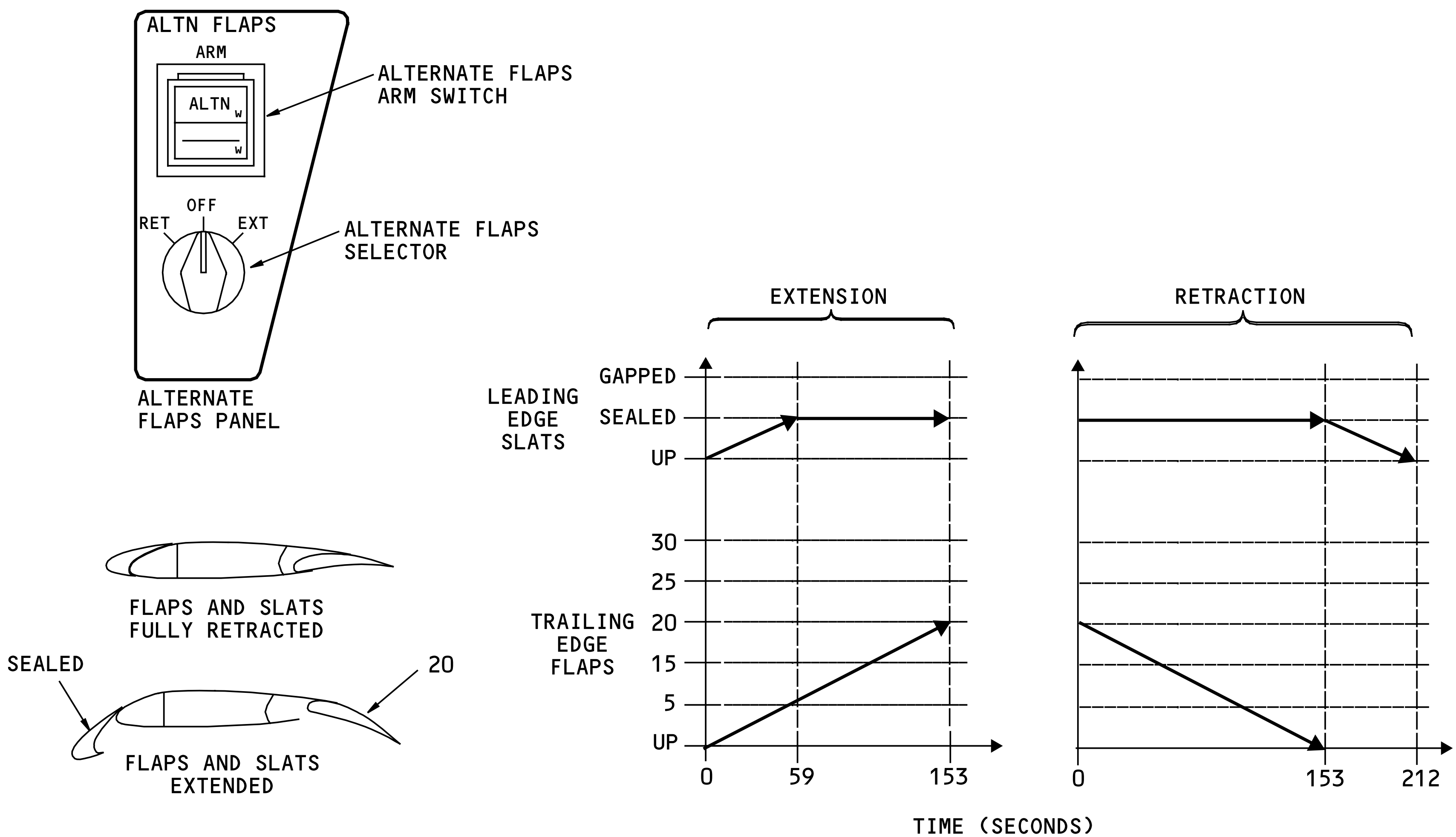
When the arm switch is set to ARM and the selector is set to EXT, the slats move to the sealed position and the flaps move to the 20 unit position. They move at the same time. It takes 2 minutes and 33 seconds.

A detent holds the selector in the EXT position. If the selector is set to OFF while the flaps and slats move, the movement stops.

Retraction

When the arm switch is set to ARM and the selector is set to RET, the flaps retract first, then the slats. Flap retraction takes 2 minutes and 33 seconds. The slats take 59 seconds. Total flap and slat retraction time is 3 minutes and 32 seconds.

A detent holds the selector in the RET position. If the selector is set to OFF while the flaps and slats move, the movement stops.



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HIGH LIFT CONTROL - ALTERNATE MODE FLAP AND SLAT SEQUENCE

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HIGH LIFT CONTROL - INDICATIONS - POSITION DISPLAYS

General

The flap and slat position display is on the EICAS display or the EICAS compacted engine display. There are three different displays for the flaps and slats:

- Primary
- Secondary
- Alternate.

Only one display shows at a time.

Primary Mode Display

The primary mode display shows when both the flaps and slats are in the primary mode. This display shows the position of both the flaps and slats. The display is black when the flaps and slats are fully retracted. When the flaps or slats extend, a white tape fills the display from the top down.

A command bar and detent number show the flap lever position. When you move the flap lever, the flap lever detent number and command bar show. While the flaps and slats move, the command bar and detent number are magenta. When the flaps and slats are in the flap lever commanded position, the command bar and detent number change to green.

The primary mode display goes out of view 10 seconds after the flaps and slats are fully retracted.

Secondary Mode Display

The secondary mode display shows when either the flaps or slats are in the secondary mode. This display has separate indications for:

- The left wing flaps
- The right wing flaps
- The left wing slats
- The right wing slats.

The two upper indications show the slat positions. The two lower indications show the flap positions. All four indications are black when the flaps and slats are fully retracted. When the slats extend, a white tape fills the upper indications from the bottom up. When the flaps extend, a white tape fills the lower indications from the top down.

The secondary mode display shows a command bar and detent number. These operate the same as for the primary mode display.

After the flaps and slats are fully retracted, the secondary mode display goes out of view and the primary mode display shows. After 10 seconds, the primary mode display also goes out of view.

If the flaps (or slats) drive system fails, the related indications change from white to amber.

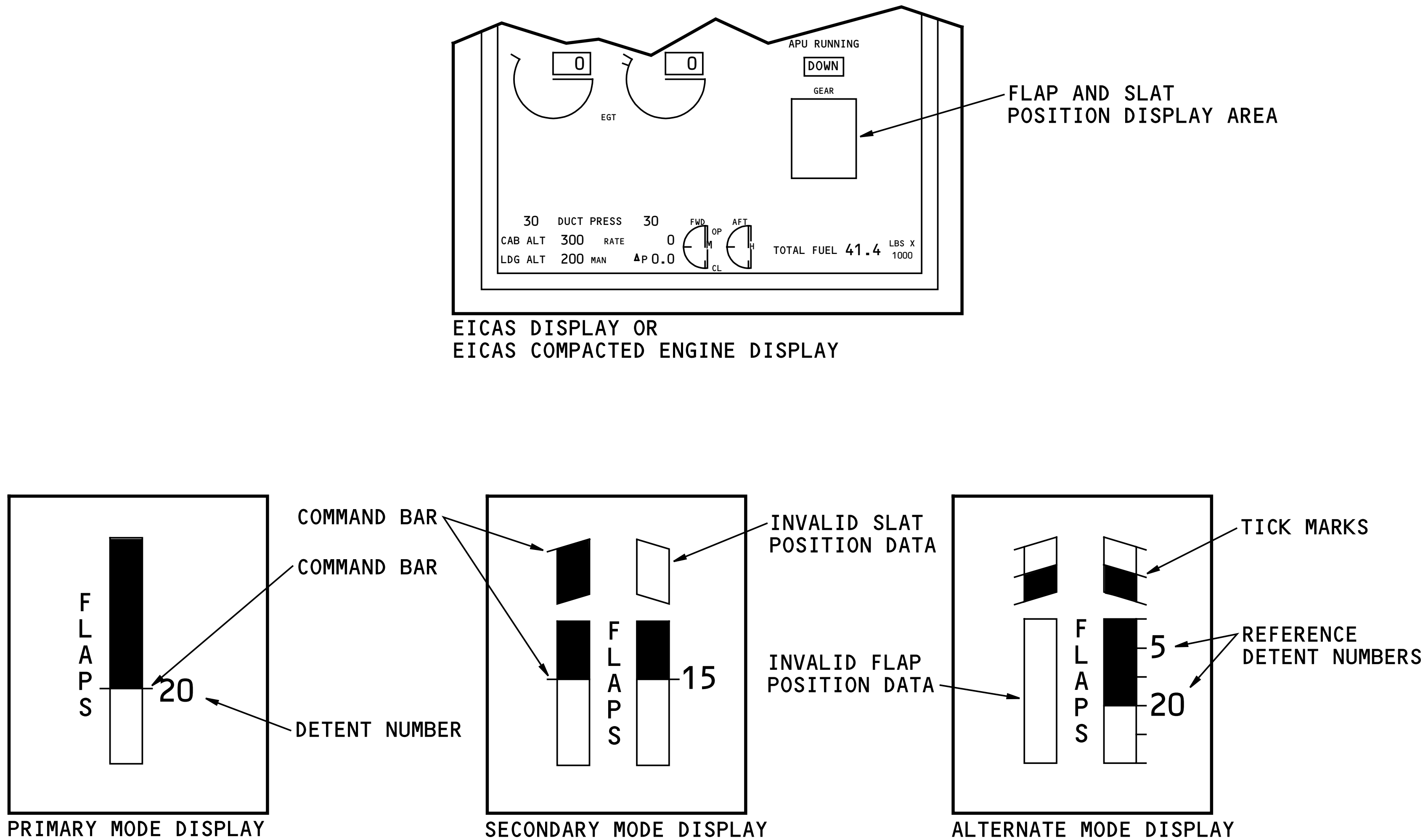
If the left (or right) slat position data is invalid, the left (or right) upper tape and command bar go out of view. If the left (or right) flap position data is invalid, the left (or right) lower tape and command bar go out of view. If the flap lever position data is invalid, the detent number goes out of view.

Alternate Mode Display

The alternate mode display shows when you push the alternate flaps arm switch.

The alternate mode display has almost the same format as the secondary mode display. The difference is that the alternate mode display does not have the command bar, but has tick marks and reference detent numbers to identify the flap and slat positions.

If the left (or right) slat position data is invalid, the left (or right) upper tape and tick marks go out of view. If the left (or right) flap position data is invalid, the left (or right) lower tape, tick marks, and reference detent numbers go out of view.



27-03-00-013 Rev 5 03/19/96

HIGH LIFT CONTROL - INDICATIONS - POSITION DISPLAYS

HIGH LIFT CONTROL - INDICATIONS - MAINTENANCE PAGE FORMAT

General

The high lift maintenance page format contains data from each FSEU. This includes the following data:

- Systems ARINC 629 data buses
- Flap lever position sensors
- Slat commands
- Slat position sensors
- Slat skew sensors
- Flap commands
- Flap position sensors
- Flap skew sensors.

There are three different display modes:

- Real time mode
- Manual event mode
- Auto event mode.

The word MANUAL or AUTO at the top of the page identifies the manual or auto event page. The message that caused the auto event is at bottom left of the page. The time of the event is at the bottom right.

Systems ARINC 629 Data Buses

The top of the page shows data that each FSEU receives from the systems ARINC 629 data buses. The first row shows the control status of each FSEU. The status of the FSEU is one of the following:

- IN CONTROL; the FSEU is in control of the HLCS
- ALTN ARM; the alternate mode is armed
- LOADING; the FSEU is loading software
- TEST; the FSEU is in test
- FAULT; the FSEU has detected a lane fault
- STANDBY; none of the other status words are applicable.

The page then shows the airspeed in knots and the center hydraulic system pressure in psi. If this data is invalid, there is no indication.

Below these are the status of the commands for autoslat, load relief, and to the autoslat priority valves. At the bottom of this list is the air/ground status.

Flap Lever Position Sensor

The top left of the page shows the voltage of each RVDT in the flap lever position sensor. If some of this data is invalid, there is no indication for the bad value.

Slat Commands

The left center of the page shows the status of the slat commands from the FSEU in control. The status of the slats drive command is one of the following:

- PRI EXT; the slats are commanded to extend in the primary mode
- PRI RET; the slats are commanded to retract in the primary mode

- SEC EXT; the slats are commanded to extend in the secondary mode
- SEC RET; the slats are commanded to retract in the secondary mode.

The status of the slat drive mode is one of the following:

- LO SPD; the slats are moving at low speed in the primary mode
- HI SPD; the slats are moving at high speed in the primary mode
- CLUTCH; the electric motor clutch is engaged.

The status of the shutoff valve command is either OPEN or CLOSED.

Slat Position Sensors

The right center of the page shows the position of the slat position sensors in degrees of sensor rotation. If some of this data is invalid, there is no indication for the bad value.

Slat Skew Sensors

The center of the page shows the status of the slat skew sensors. The page shows one of the following for each sensor:

- NEAR; the target is near the sensor
- FAR; the target is far from the sensor
- FAIL; the sensor is defective.

If some of this data is invalid, there is no indication for the bad value.

Flap Commands

The bottom left of the page shows the status of the flap commands from the FSEU in control. The status of the flap drive command is one of the following:

- PRI EXT; the flaps are commanded to extend in the primary mode
- PRI RET; the flaps are commanded to retract in the primary mode
- SEC EXT; the flaps are commanded to extend in the secondary mode
- SEC RET; the flaps are commanded to retract in the secondary mode.

The status of the flaps drive mode is one of the following:

- LO SPD; the flaps are moving at low speed in the primary mode
- HI SPD; the flaps are moving at high speed in the primary mode
- CLUTCH; the electric motor clutch is engaged.

The status of the shutoff valve command is either OPEN or CLOSED.

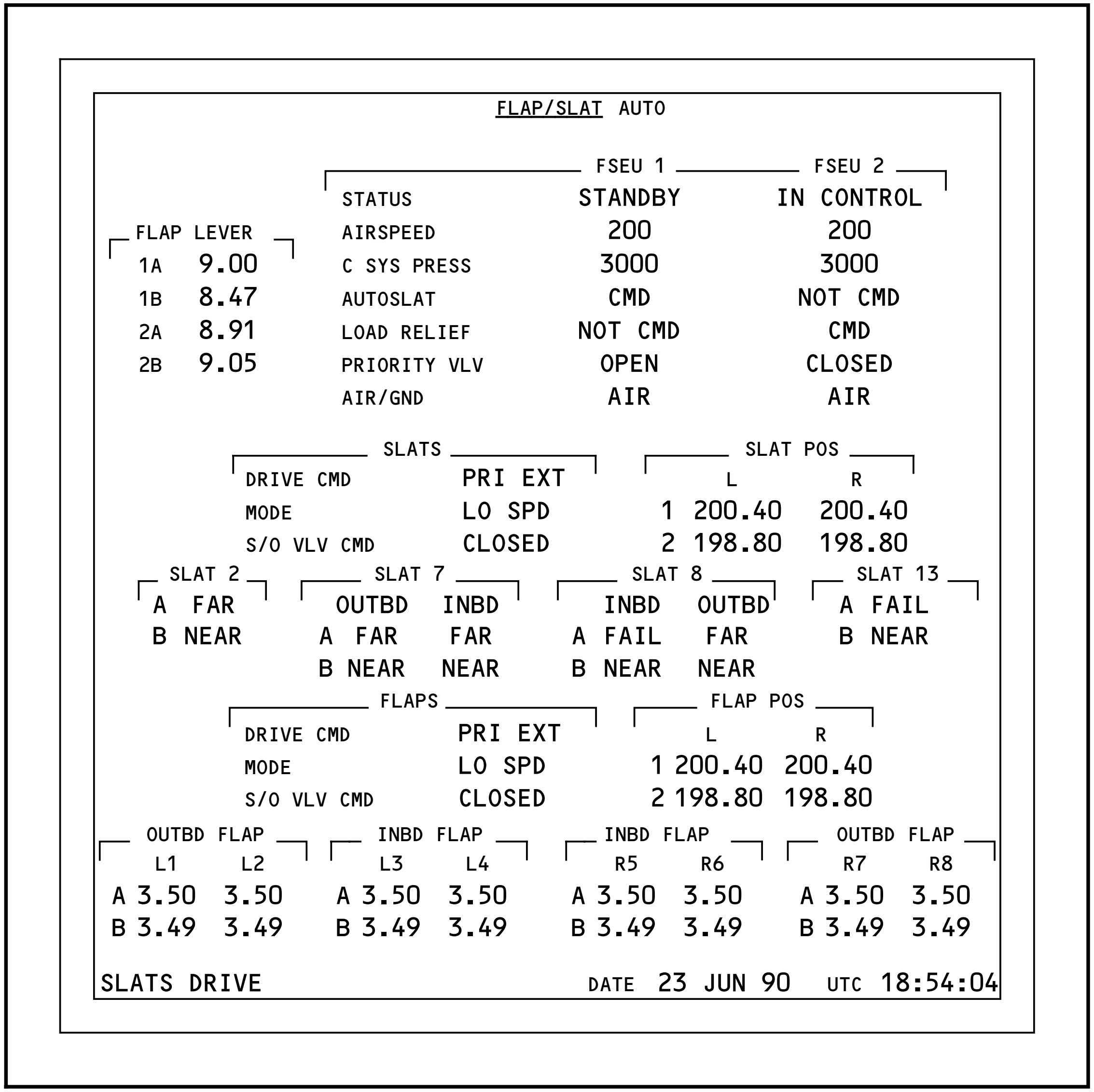
HIGH LIFT CONTROL - INDICATIONS - MAINTENANCE PAGE FORMAT

Flap Position Sensors

The bottom right of the page shows the position of the flap position sensors in degrees of sensor rotation. If some of this data is invalid, there is no indication for the bad value.

Flap Skew Sensors

The bottom of the page shows the voltage of the flap skew sensors in volts. If some of this data is invalid, there is no indication for the bad value.



27-03-00-014 Rev 3 03/14/96

HIGH LIFT CONTROL - INDICATIONS - MAINTENANCE PAGE FORMAT

HIGH LIFT CONTROL - SYSTEM TESTS

General

The FSEUs control the operation of the MAT tests. All the MAT tests for the HLCS are interactive tests. You are able to select which FSEU to control each of the tests. There are no MAT operational tests for the HLCS.

The system tests for the HLCS include:

- Primary System Test - FSEU 1
- Primary System Test - FSEU 2
- Secondary System Test - FSEU 1
- Secondary System Test - FSEU 2.

All of these tests can test the flaps only, the slats only, or both. Also, all of these tests will cause the flaps and slats to move.

Primary System Test - FSEU 1 (FSEU 2)

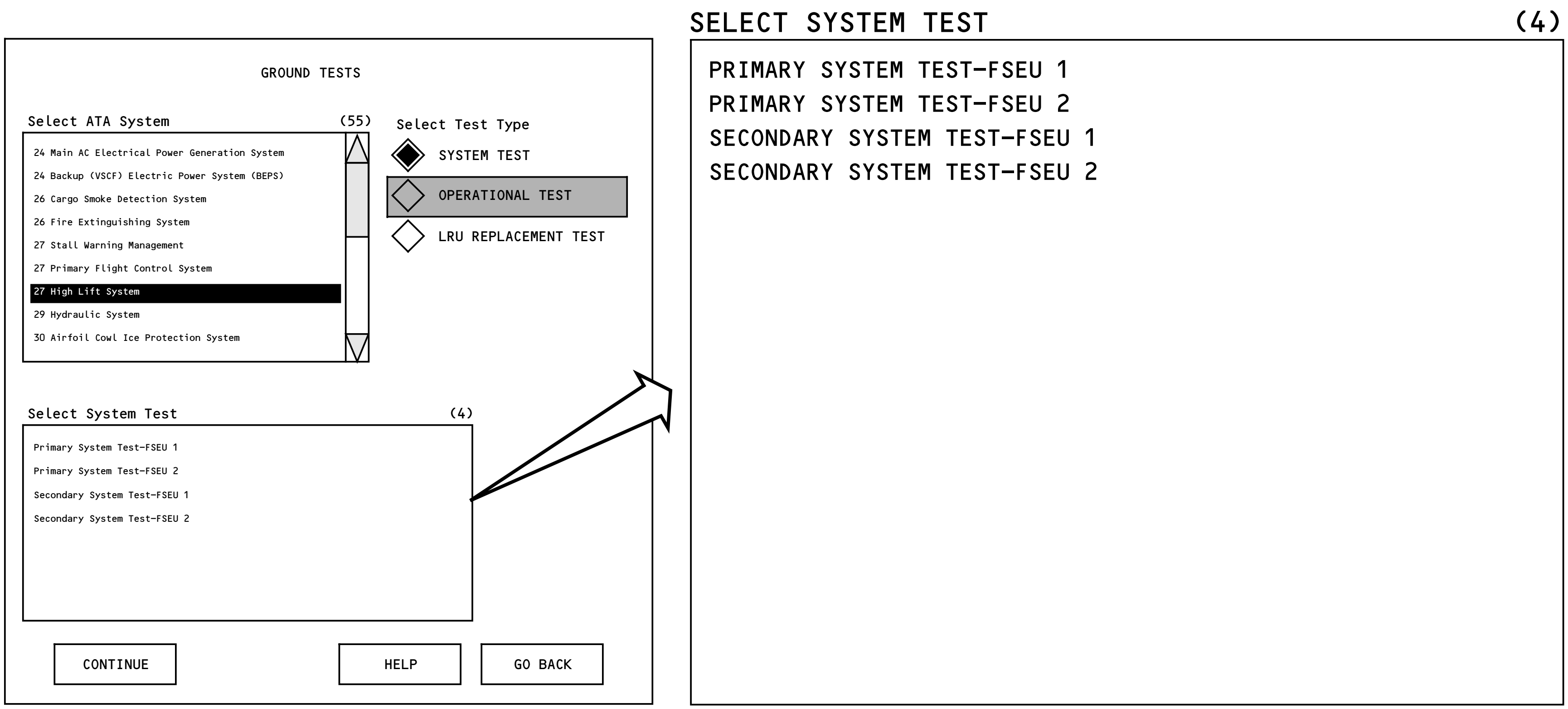
This test makes sure that FSEU 1 (FSEU 2) can control the HLCS correctly in hydraulic mode.

Secondary System Test - FSEU 1 (FSEU 2)

This test makes sure that FSEU 1 (FSEU 2) can control the HLCS correctly in electric mode.

Training Information Point

The MAT tests for the HLCS use a ground test software in the FSEUs that is different than the test software used during flight. If the MAT test fails, the maintenance message will be different than the maintenance message reported by the flight test software.



27-03-00-015 Rev 3 03/31/1998

HIGH LIFT CONTROL - SYSTEM TESTS

HIGH LIFT CONTROL - LRU REPLACEMENT TESTS

General

The LRU replacement tests for the HLCS include:

- FSEU 1
- FSEU 2
- Flaps primary control valve test - FSEU 1
- Flaps primary control valve test - FSEU 2
- Slats primary control valve test - FSEU 1
- Slats primary control valve test - FSEU 2
- Inboard slat skew test - FSEU 1
- Inboard slat skew test - FSEU 2.

FSEU 1 (FSEU 2)

This test makes sure that FSEU 1 (FSEU 2) is operating correctly.

Slats Primary Control Valve Test-FSEU 1 (FSEU 2)

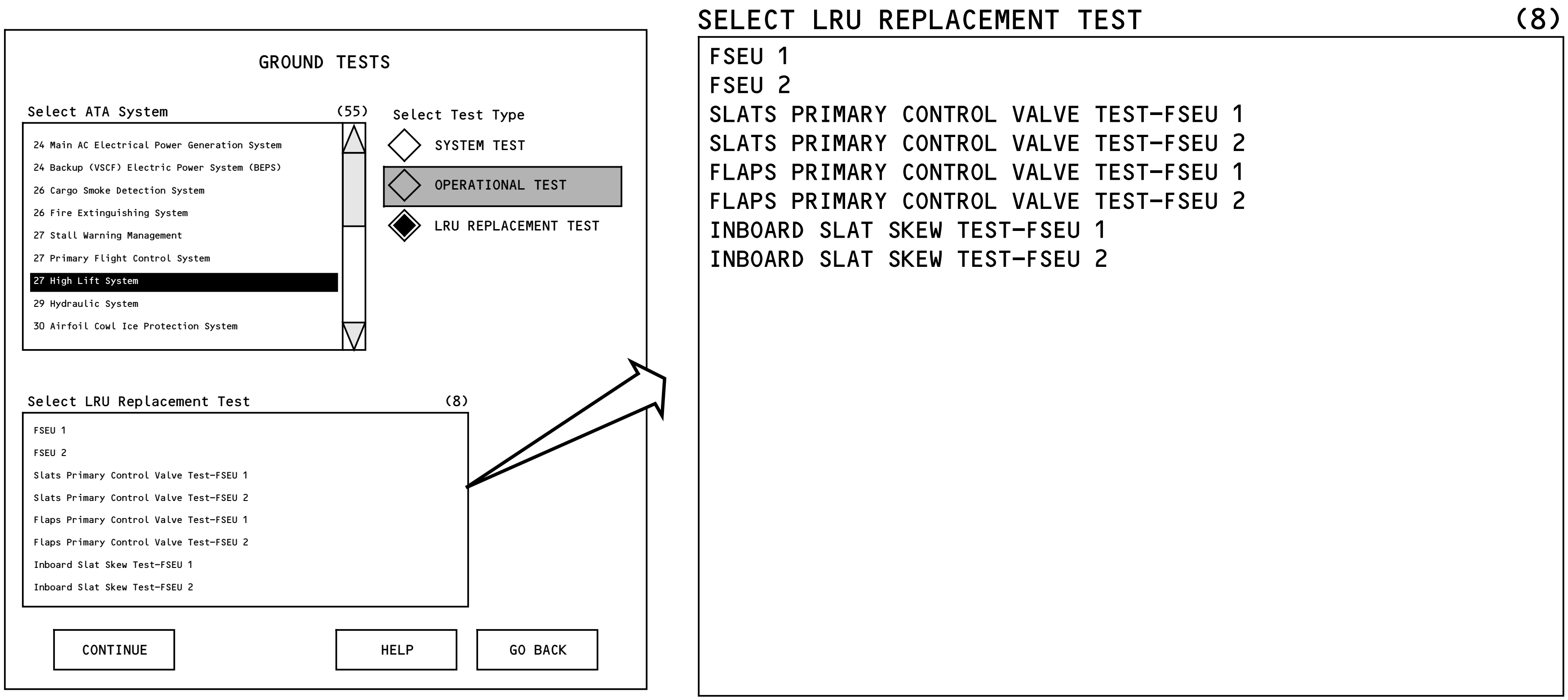
This test makes sure that FSEU 1 (FSEU 2) controls the slats primary control valve correctly. During this test, the slats will move.

Flaps Primary Control Valve Test-FSEU 1 (FSEU 2)

This test makes sure that FSEU 1 (FSEU 2) controls the flaps primary control valve correctly. During this test, the flaps will move.

Inboard Slat Skew Test-FSEU 1 (FSEU 2)

This test makes sure that FSEU 1's (FSEU 2's) inboard slat skew/loss sensors operate correctly. During this test, the slats will move.



27-03-00-016 Rev 2 03/31/1998

HIGH LIFT CONTROL - LRU REPLACEMENT TESTS

HIGH LIFT CONTROL - SPECIAL FUNCTIONS

General

The secondary mode inhibit override function permits movement of the slats and flaps with the PDU electric motors while on the ground.

You can select which FSEU controls the flaps and slats when you use this function.

The FSEUs inhibit the secondary mode operation when the airplane is in a ground maintenance condition. Three conditions are necessary for the ground maintenance condition to occur. First, the center hydraulic system pressure must be low. Second, either:

- The airplane is on the ground, or
- The ground speed is less than 40 knots.

Third, either:

- Both engines are not running, or
- One engine is not running and external power is available.

Operation

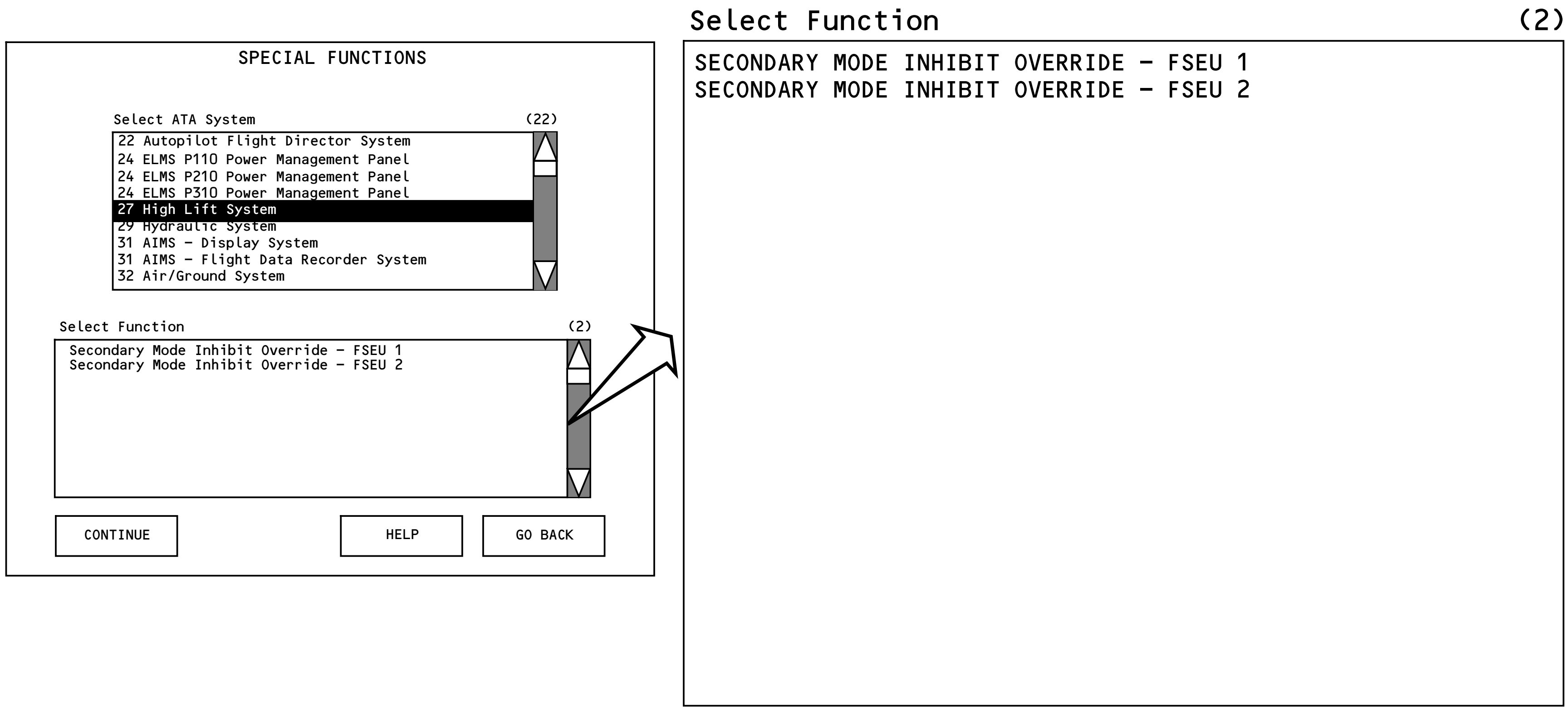
When you use this function, the FSEUs permit the use of the PDU electric motors to move the flaps and slats. You can then use the flap lever to control the position of the flaps and slats.

After you enable the secondary mode inhibit override, you have 15 seconds to move the flaps and slats using the flap lever. After 15 seconds, the secondary mode inhibit override stops. If the surfaces are in motion when the inhibit override stops, the surfaces continue to move to the commanded position.

If you use the secondary mode inhibit override when there is no failure of the primary mode, the flaps and slats operate the same as the primary mode. The FSEU sends commands to the electric motors of the flaps and slats power drive units. The flaps/slats sequence is the same as in primary mode (slats sealed with flap lever position 1 through 20, slats gapped with flap lever position 25 and 30). The flaps/slats indication on the EICAS display shows the primary mode display.

If you use the secondary mode inhibit override when there is a failure of the primary mode, the flaps/slats operate the same as the secondary mode. The FSEU sends commands to the electric motors of the flaps and slats power drive units. The flaps/slats sequence is the same as in secondary mode (slats gapped with flap lever position 1 through 30). The flaps/slats indication on the EICAS display shows the secondary mode display.

For example, you could cause a failure of the primary mode if on the ground you move the flap lever with the center hydraulic system depressurized before you enable the secondary mode inhibit override.



27-03-00-017 Rev 1

HIGH LIFT CONTROL - SPECIAL FUNCTIONS

Continental Airlines, Inc

Trailing Edge Flaps

WB371

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TABLE OF CONTENTS

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TRAILING EDGE FLAPS - INTRODUCTION

General

The trailing edge (TE) flaps improve the takeoff and landing performance of the airplane. When the flaps extend, they increase the lift of the wing. They also help to decrease the airspeed during landings and approaches.

The flaps are part of the high lift control system (HLCS). The HLCS electrically controls the flaps with a fly-by-wire system.

During takeoff and landing, the pilots use the flap lever to command the flaps to move to an extended position. During cruise, the pilots command the flaps to retract to the up position.

Each wing has an inboard flap and an outboard flap. The inboard flap is double-slotted and has a main flap and an aft flap. The outboard flap is single-slotted and is one piece.

Flap Operation

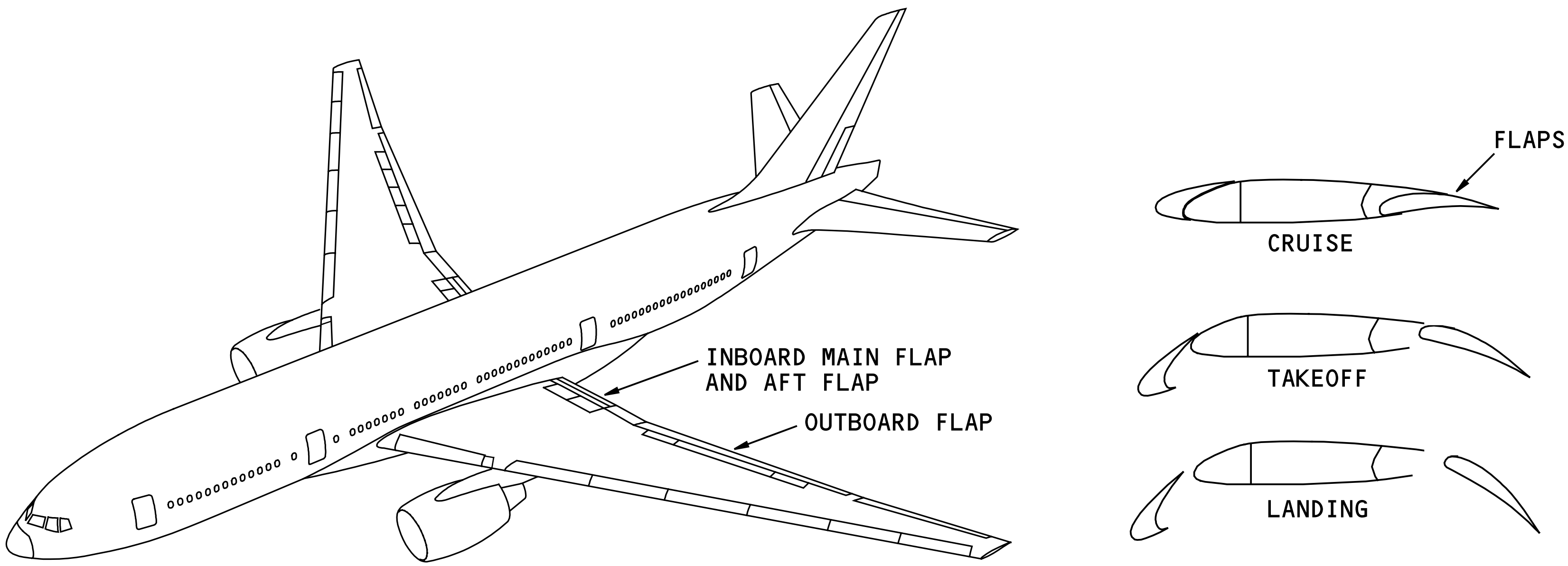
The flaps operate in sequence with the slats. At cruise speed and altitude, flap extension is inhibited.

The load relief function retracts the flaps to prevent structural damage to the flaps at high airspeeds.

The flaps are monitored for skew or asymmetry. When the system detects a skew or asymmetry, the flap drive shuts down.

Abbreviations and Acronyms

AIMS	- airplane information management system
altn	- alternate
ARINC	- Aeronautical Radio, Inc.
EICAS	- engine indication and crew alerting system
EXT	- extend
FSEU	- flap/slat electronics unit
HLCS	- high lift control system
LVDT	- linear variable differential transformer
MAT	- maintenance access terminal
PDU	- power drive unit
retr	- retract
RVDT	- rotary variable differential transformer
sec	- secondary
TE	- trailing edge



27-51-00-001 Rev 3

TRAILING EDGE FLAPS - INTRODUCTION

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TRAILING EDGE FLAPS - GENERAL DESCRIPTION

General

The flaps operate in one of three modes:

- Primary mode
- Secondary mode
- Alternate mode.

The primary mode uses hydraulic power to operate the flaps. The secondary and alternate modes use electrical power to operate the flaps.

Primary Mode

The primary mode has a closed-loop control system. The pilot commands the flaps with the flap lever. The flap lever position sensor sends input signals to the FSEUs. The FSEUs use the flap lever position to calculate the flap commands. The FSEUs also receive data from the systems ARINC 629 buses.

The FSEUs send the flap commands to the flap primary control valve. This valve supplies hydraulic power to the flap power drive unit (PDU). The hydraulic motor on the PDU then moves the flap mechanisms.

The flap/slat priority valve controls the amount of hydraulic flow to the flap primary control valve. The flap/slat priority valve gives priority of hydraulic power to the primary flight control system (PFCS) over the HLCS.

As the flaps move, the flap position sensors send feedback signals to the FSEUs. The FSEUs stop the flap commands when the feedback signals equal the commanded position.

The FSEUs use the flap skew sensors to shutdown the primary mode (and the secondary mode) if there is a flap skew or asymmetry.

Secondary Mode

The FSEUs use the secondary mode when the primary mode disengages. The secondary mode is only available in the air or during special maintenance functions.

The secondary mode also has a closed-loop control system. The pilot commands the flaps with the flap lever. The FSEUs use the flap lever position to calculate the flap commands. The FSEUs then energize the secondary/alternate control relays. One relay energizes the bypass solenoid in the flap primary control valve and the clutch in the electric motor unit. This stops hydraulic power to the hydraulic motor and lets free flow through it. The electric motor clutch connects the motor shaft to the PDU gearbox. The other relays control electrical power to the flap electric motor on the flap PDU. The electric motor then moves the flap mechanisms.

As the flaps move, the flap position sensors send feedback signals to the FSEUs. The FSEUs command the relays to stop the electric motor when the flaps are at the commanded position.

TRAILING EDGE FLAPS - GENERAL DESCRIPTION

The FSEUs use the flap skew sensors to shutdown the secondary mode if there is a flap skew or asymmetry.

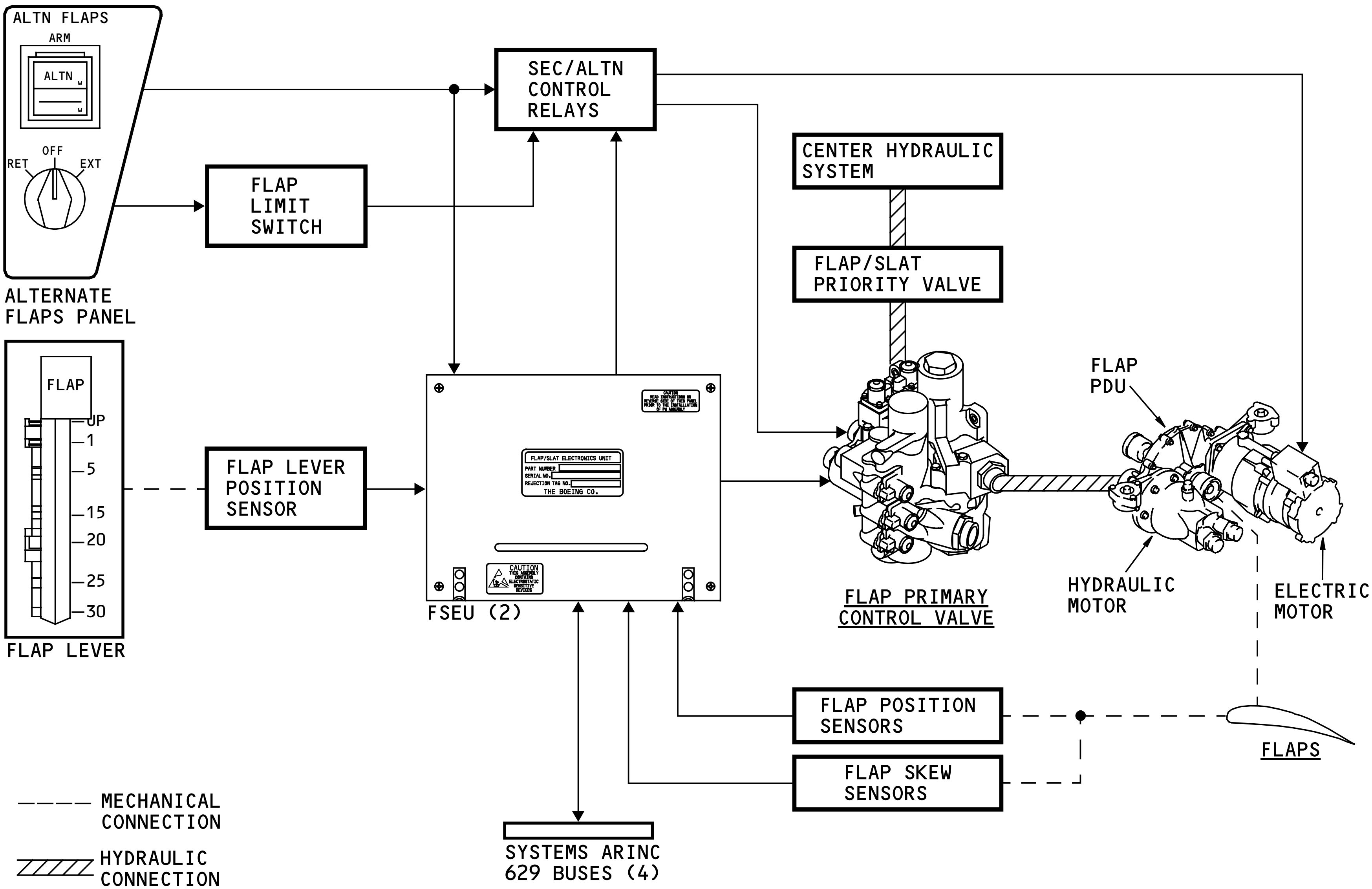
Alternate Mode

The alternate mode has an open-loop control system. The pilot uses the switches on the alternate flaps panel to command the flaps. An arm switch sends a discrete signal to the FSEUs to disengage the primary and secondary modes. This switch also energizes one of the secondary/alternate control relays. This relay energizes the bypass solenoid in the flap primary control valve and the clutch in the electric motor unit. This stops hydraulic power to the hydraulic motor and lets free flow through it. the electric motor clutch connects the motor shaft to the PDU gearbox.

The alternate flaps selector sends commands through the flap limit switch to energize the other secondary/ alternate control relays. These relays control electrical power to the flap electric motor in the PDU. The electric motor then moves the flap mechanisms.

The flaps move until the pilot moves the alternate flaps selector to the OFF position or the flap limit switch stops the motor when the flaps are at the limit.

There is no automatic shutdown of the alternate mode if there is a flap skew or asymmetry.



TRAILING EDGE FLAPS - GENERAL DESCRIPTION

TRAILING EDGE FLAPS - GENERAL DESCRIPTION - FLAP DRIVE SYSTEM

General

These are the components of the flap drive system:

- Flap PDU
- Torque tubes
- Torque tube supports
- Position sensor gearboxes
- Angle gearboxes
- Transmission assemblies
- No-back brakes.

Flap PDU

The flap PDU receives hydraulic power through the primary control valve and electric power through the flap extend/retract relays. Hydraulic and electric motors on the PDU move the flap drive system.

Torque Tubes

The torque tubes transmit power from the PDU to the transmission assemblies.

Torque Tube Supports

The torque tube supports hold the torque tubes.

Position Sensor Gearboxes

The position sensor gearboxes contain the flap position sensors and limit switch. The sensors send flap position signals to the FSEUs. The limit switch removes electrical power from the electric motor when the flaps move to their limit during operation in the alternate mode.

Angle Gearboxes

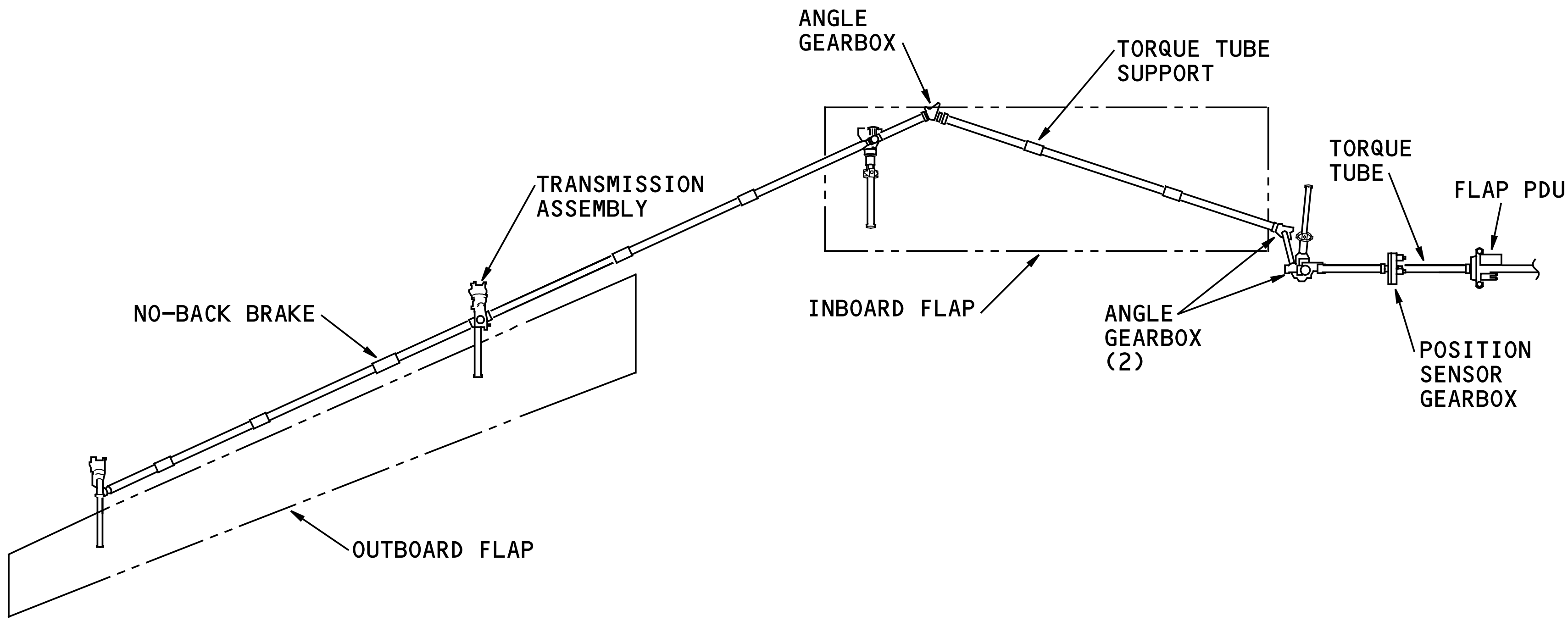
The angle gearboxes connect torque tubes that are at different angles to each other.

Transmission Assemblies

The transmission assemblies receive power from the torque tube to move the flap surfaces. There are two transmissions for each flap surface.

No-back Brakes

The no-back brakes prevent air loads from backdriving the flap mechanisms. There is one no-back brake on each wing. The no-back brakes attach to the torque tubes between the two transmission assemblies for the outboard flaps.



27-51-00-003 Rev 1 03/19/1996

NOTE: LEFT FLAPS ARE SHOWN
(RIGHT FLAPS ARE SIMILAR)

TRAILING EDGE FLAPS - GENERAL DESCRIPTION - FLAP DRIVE SYSTEM

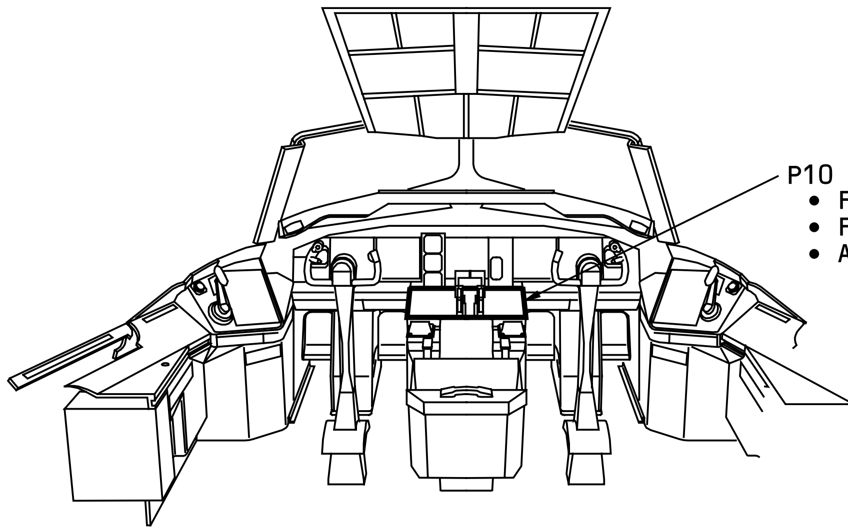
TRAILING EDGE FLAPS - COMPONENT LOCATIONS - 1

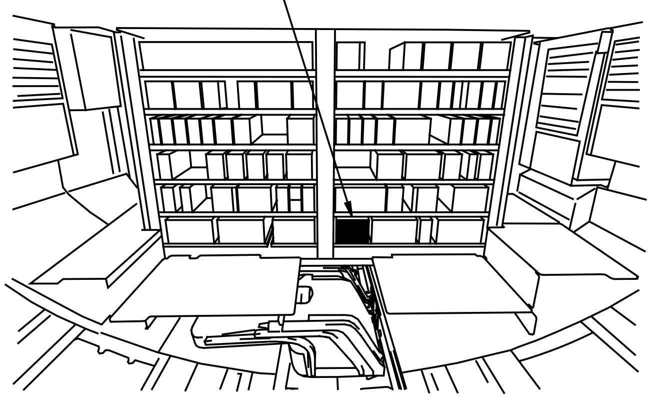
Flight Deck Controls

The flap lever and the alternate flaps panel are on the P10 control stand. The flap lever position sensor is inside the control stand.

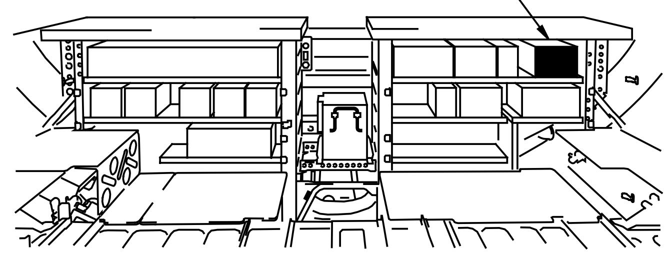
Main Equipment Center

The FSEU 1 is on the E1-6 shelf. The FSEU 2 is on the E4-1 shelf.





MAIN EQUIPMENT CENTER
(LOOKING AFT)



MAIN EQUIPMENT CENTER
(LOOKING FORWARD)

27-51-00-004 Rev 0

TRAILING EDGE FLAPS - COMPONENT LOCATIONS - 1

TRAILING EDGE FLAPS - COMPONENT LOCATIONS - 2

General

The flap components are in these areas:

- The main landing gear wheel wells
- The wings.

Main Landing Gear Wheel Well Components

The flap primary control valve and the flap/slat priority valve attach to the keel beam in the right wheel well.

The flap PDU attaches to the top of the keel beam. Access to the flap PDU is through the left or right wheel well.

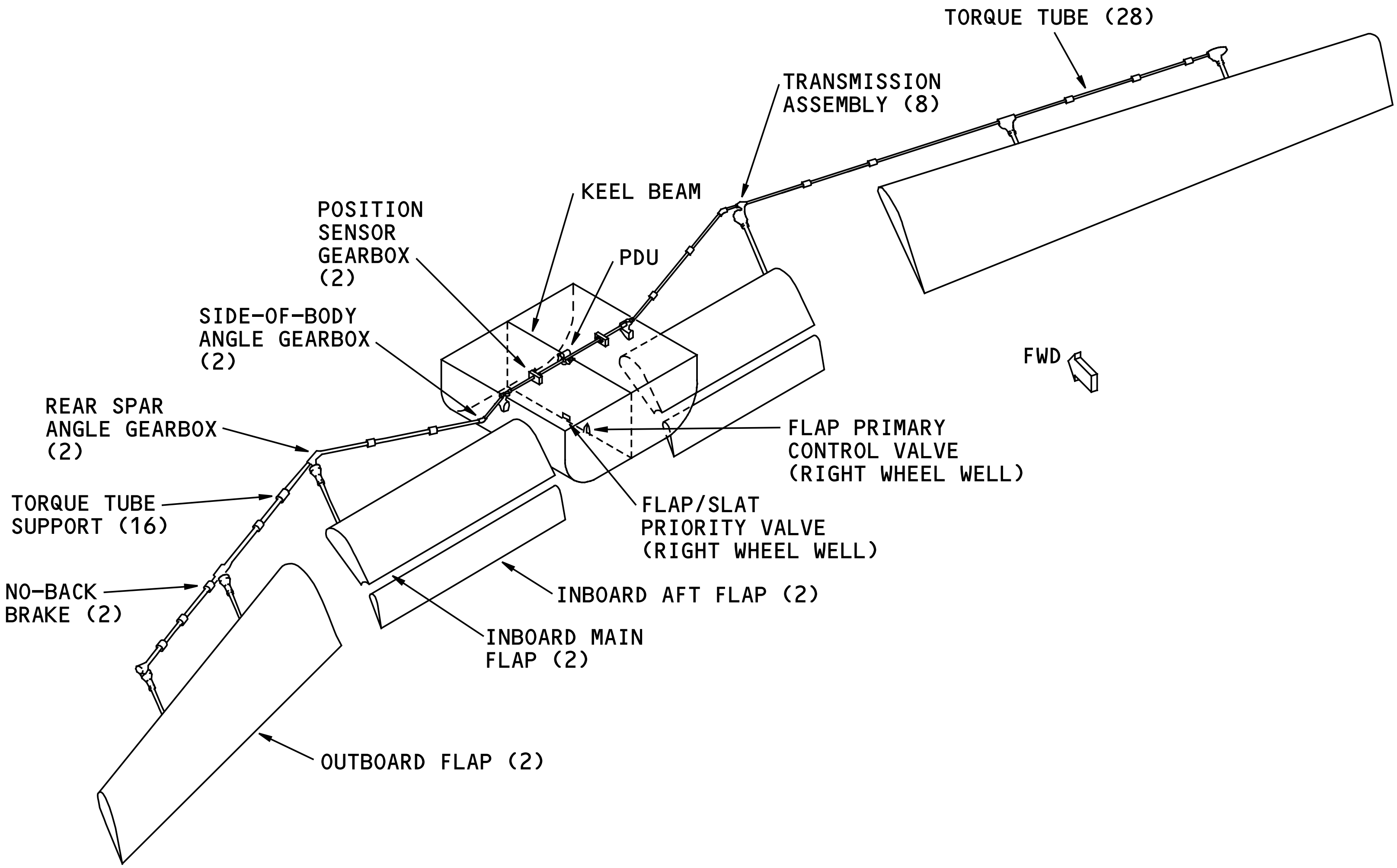
The flap position sensor gearboxes attach to brackets on the floor beams. One of these gearboxes is in the right wheel well and the other is in the left wheel well.

The inboard flap inboard transmissions, side-of-body angle gearboxes, and some of the torque tubes are also in the wheel wells.

Wing Components

The outboard flaps, inboard main flaps, and inboard aft flaps are on the wings. Most of the flap transmissions and ballscrews are under the wings. Remove the flap support fairings under the wing or extend the flaps to get access to the transmissions and ballscrews.

The rear spar angle gearboxes, the no-back brakes, and some of the torque tubes attach to the rear spar of the wings. Access to the gearboxes is through panels under the wings. Extend the flaps to get access to the torque tubes and the no-back brakes.



27-51-00-005 Rev 2 07/13/95

TRAILING EDGE FLAPS - COMPONENT LOCATIONS - 2

TRAILING EDGE FLAPS - FLAP LEVER AND FLAP LEVER POSITION SENSOR

Purpose

The pilots use the flap lever to control the position of the flaps and slats in the primary and secondary modes. The flap lever position sensor sends input position signals to the FSEUs.

Physical Description

The flap lever has detent positions at UP, 1, 5, 15, 20, 25, and 30. Gates at detents 1 and 20 help the flight crew to identify these positions during climb-out and go-around.

The flap lever connects with a crank and a control rod to the brake mechanism. The flap lever position sensor attaches to the brake mechanism. The position sensor has a splined shaft with a missing tooth to help align the position sensor with the brake mechanism.

The flap lever position sensor has four internal rotary variable differential transformers (RVDTs). The assembly is an LRU, but the RVDTs are not LRUs.

Location

The flap lever is on the right side of the P10 control stand. The brake mechanism and the flap lever position sensor are in the control stand.

Functional Description

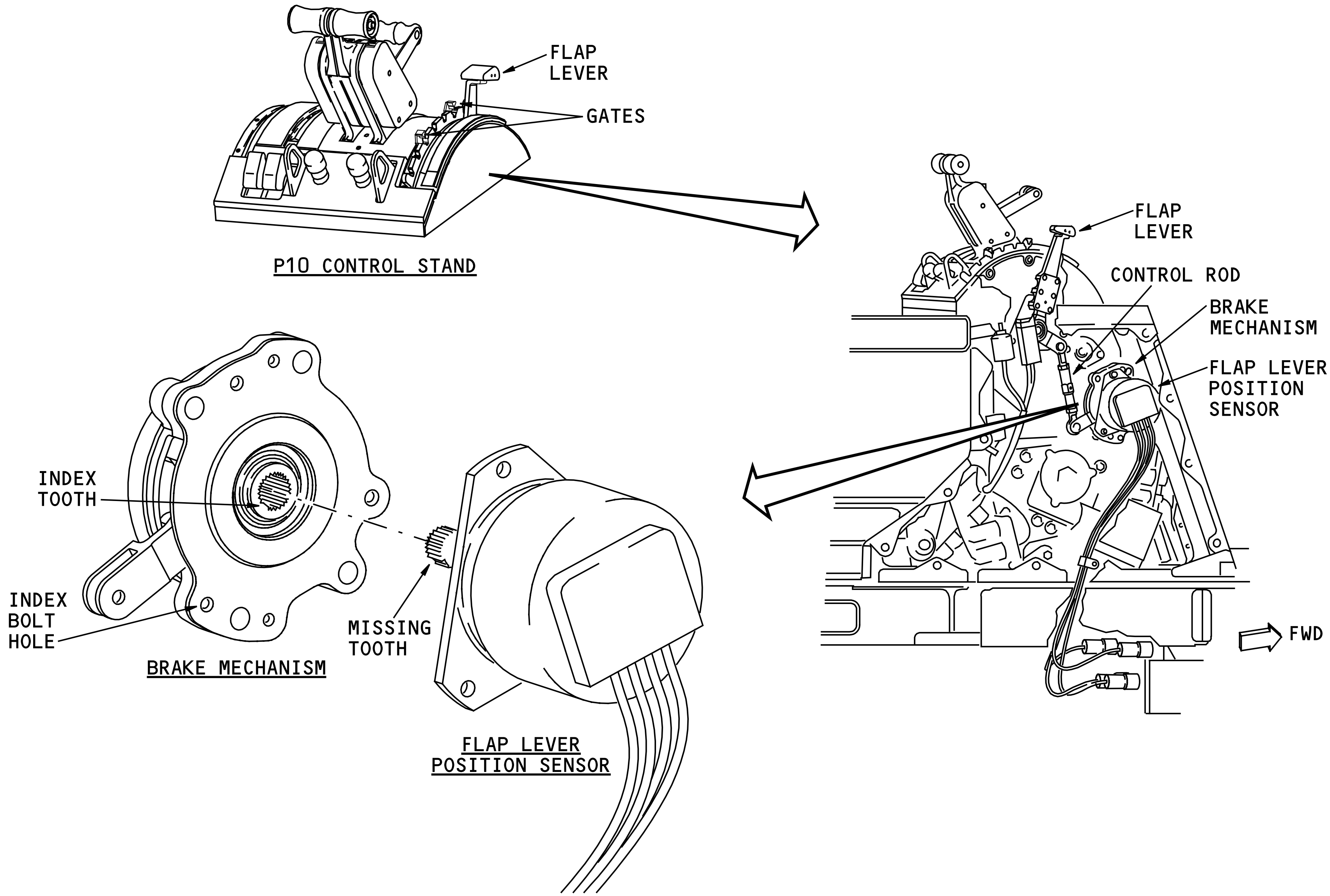
When the pilots move the flap lever, the control rod turns the spline in the brake mechanism. The spline then drives the position sensor. If the control rod disconnects, the brake mechanism prevents movement of the RVDTs.

Training Information Point

After you install the flap lever position sensor, do the LRU replacement test. To do this test, move the flap lever to each detent and check the value of each RVDT on the high lift maintenance page.

During installation of the brake mechanism, adjust the control rod to align the index tooth with the index bolt hole.

If you replace only the flap lever position sensor without removal of the brake mechanism, it is not necessary to adjust the control rod.



TRAILING EDGE FLAPS - FLAP LEVER AND FLAP LEVER POSITION SENSOR

TRAILING EDGE FLAPS - ALTERNATE FLAPS PANEL

Purpose

The two switches on the alternate flaps panel are:

- The alternate flaps arm switch
- The alternate flaps selector.

These switches control the flaps and slats in the alternate mode.

Physical Description

The alternate flaps arm switch is a guarded, alternate action switch. When you push the switch, ALTN shows.

The alternate flaps selector has these detents

- OFF
- RET
- EXT.

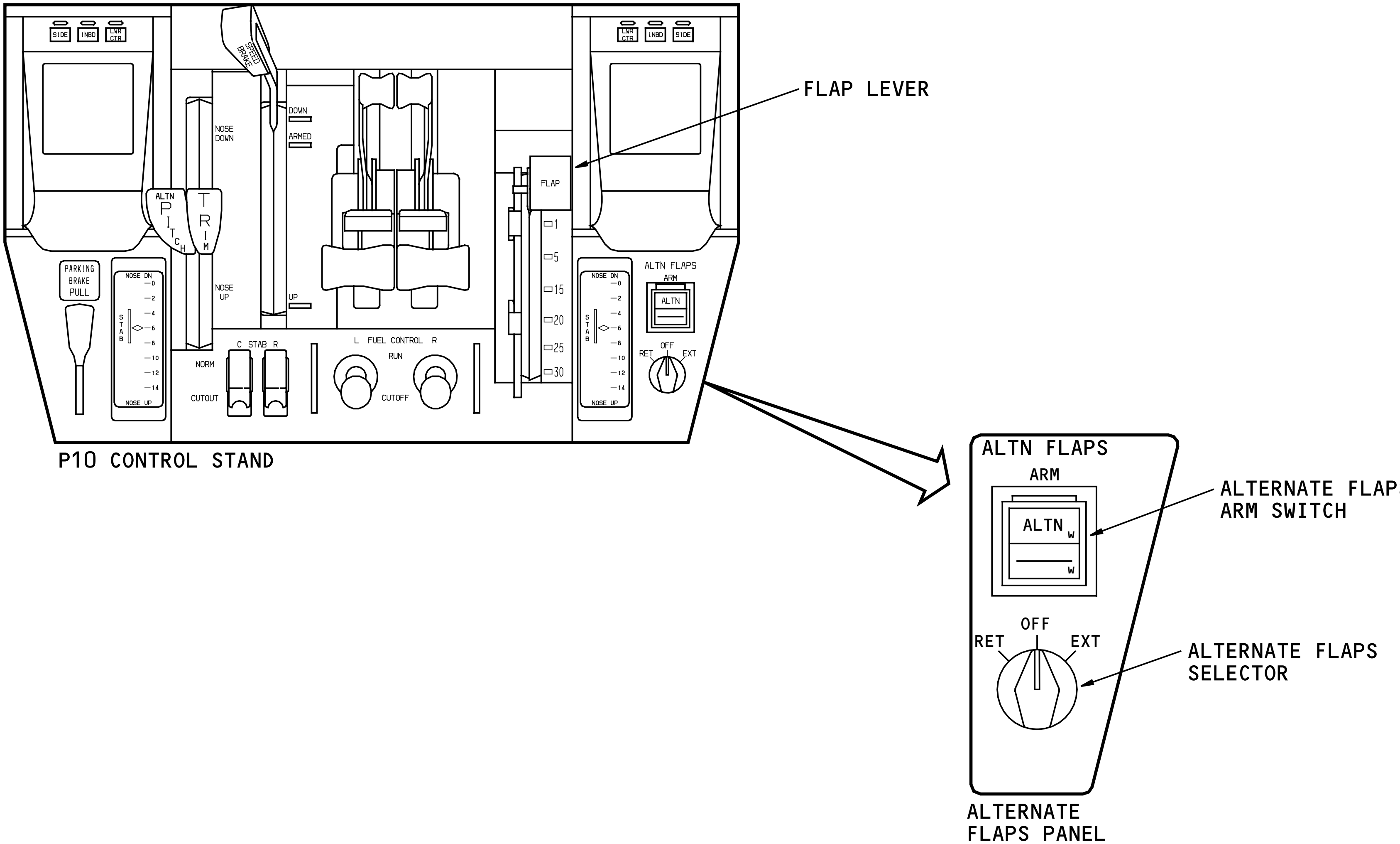
Location

The alternate flaps panel is on the right side of the P10 control stand.

Operation

To engage the alternate mode, push the alternate flaps arm switch. To extend the flaps and slats in the alternate mode, turn the alternate flaps selector to the EXT position. Turn the selector to the OFF position to stop the movement of the flaps and slats. To retract the flaps and slats, turn the selector to the RET position.

To disengage the alternate mode, push the alternate flaps arm switch again.



TRAILING EDGE FLAPS - ALTERNATE FLAPS PANEL

27-51-00-007 Rev 1 06/04/95

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TRAILING EDGE FLAPS - FLAP/SLAT ELECTRONICS UNIT (FSEU)

General

The two flap/slat electronics units (FSEUs) control the flaps and slats in the primary and secondary modes. Only one FSEU is in control of the flaps and slats at a time. The other FSEU does not send commands to the flaps and slats. The FSEUs automatically transfer control to the other FSEU after a post-flight self-test of the FSEUs or after disengagement from the alternate mode. There is also an automatic transfer after a fault in the FSEU in control.

Physical Description

The two FSEUs are the same and interchangeable. Each FSEU contains two independent channels: the control channel and the monitor channel. The two channels have different microprocessors, made by different manufacturers. The microprocessors have different part numbers. The two channels have the same capabilities and operate with the same software.

Program pins on each FSEU supply information on FSEU location and software. Cooling for both FSEUs is passive.

Channel Functions

The control channel and the monitor channel of each FSEU has:

- A set of HLCS sensor inputs
- An analog to digital (A/D) converter
- A set of control laws
- A failure monitor
- A cross-channel monitor
- A lane monitor
- Separate interfaces with the ARINC 629 buses.

HLCS Sensor Inputs

Each channel receives inputs from the HLCS sensors. Failure of a sensor can cause the control to change to the other FSEU.

A/D Converter

The FSEU changes the analog inputs to digital format before using them in the control laws.

Control Laws

The FSEUs use control laws to calculate the commands for the flaps and slats in the primary and secondary modes. Each channel sends the commands to output drivers. Both channels must agree on the commands to permit the FSEU to supply a ground for the flap and slat solenoids or relays.

Failure Monitor

Each channel monitors the HLCS for these conditions:

- Flap position failure
- Slat position failure
- Slat loss.

TRAILING EDGE FLAPS - FLAP/SLAT ELECTRONICS UNIT (FSEU)

If the FSEU detects one of these conditions, the FSEU stops the commands to the failed surface.

Cross-Channel Monitor

The cross-channel monitor compares the commands from the control and monitor channels. The output command signals to control the flaps and slats go to the opposite channel for comparison. If the commands disagree, then the FSEU stops all commands. Control then changes to the other FSEU.

The alternate arm switch position signals to the FSEU directly disable the output commands. If this switch is in the ARMED position, the FSEU stops all commands.

Lane Monitor

The lane monitor compares the input signals to both channels in each FSEU. The lane monitor receives the inputs from the other FSEU in two ways.

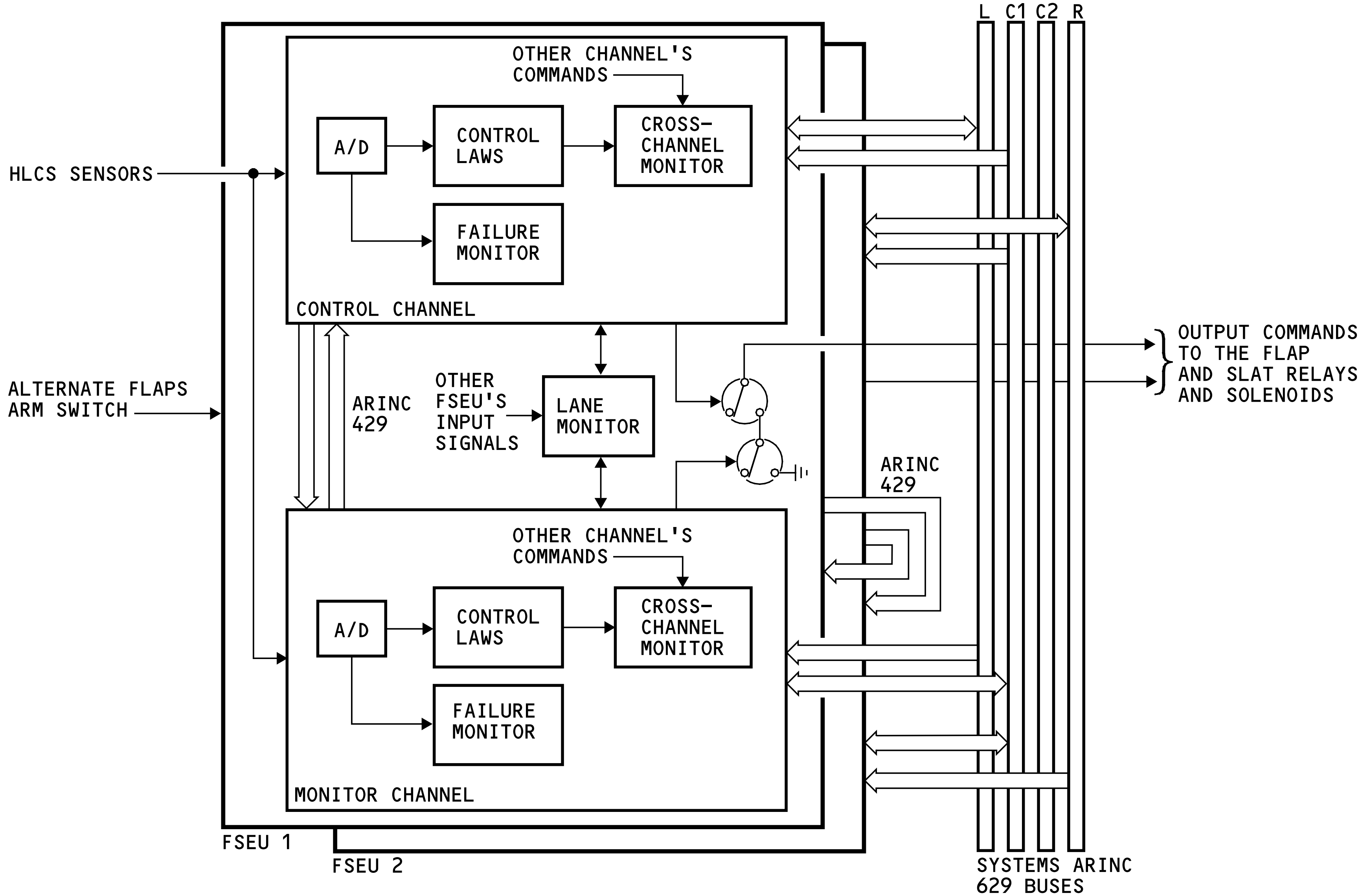
One way is through the cross-lane ARINC 429 buses. The other way is through the systems ARINC 629 buses. If the input signals to the FSEU in control fails, then the control changes to the other FSEU.

ARINC 629 Buses

Each channel transmits and receives data from the systems ARINC 629 buses. Each channel transmits its own commands, and receives commands from the other channel and from the other FSEU. Each channel receives data from two of the systems buses for redundancy.

Training Information Point

Use the maintenance access terminal (MAT) to load the software for the FSEUs. After you load the software, push the alternate flaps arm switch to the ARMED then NOT ARMED position. This removes any EICAS messages for the HLCS.



27-51-00-008 Rev 5 12/12/95

TRAILING EDGE FLAPS - FLAP/SLAT ELECTRONICS UNIT (FSEU)

TRAILING EDGE FLAPS - FLAP PRIMARY CONTROL VALVE

Purpose

The flap primary control valve controls hydraulic power to the hydraulic motor. In the primary mode, this valve controls the direction and speed of movement of the flap drive system. In the secondary and alternate modes, this valve prevents hydraulic power to the hydraulic motor.

Physical Description

The primary control valve is an LRU. These components on the primary control valve are LRUs:

- The shutoff solenoid
- The extend solenoid
- The retract solenoid
- The low-speed solenoid
- The bypass solenoid.

The low-speed solenoid is different than the other solenoids, but it is interchangeable with the low-speed solenoid on the slat primary control valve. All the other solenoids are interchangeable and they are interchangeable with the other solenoids on the slat primary control valve. The flap primary control valve is similar to, but not interchangeable with, the slat primary control valve.

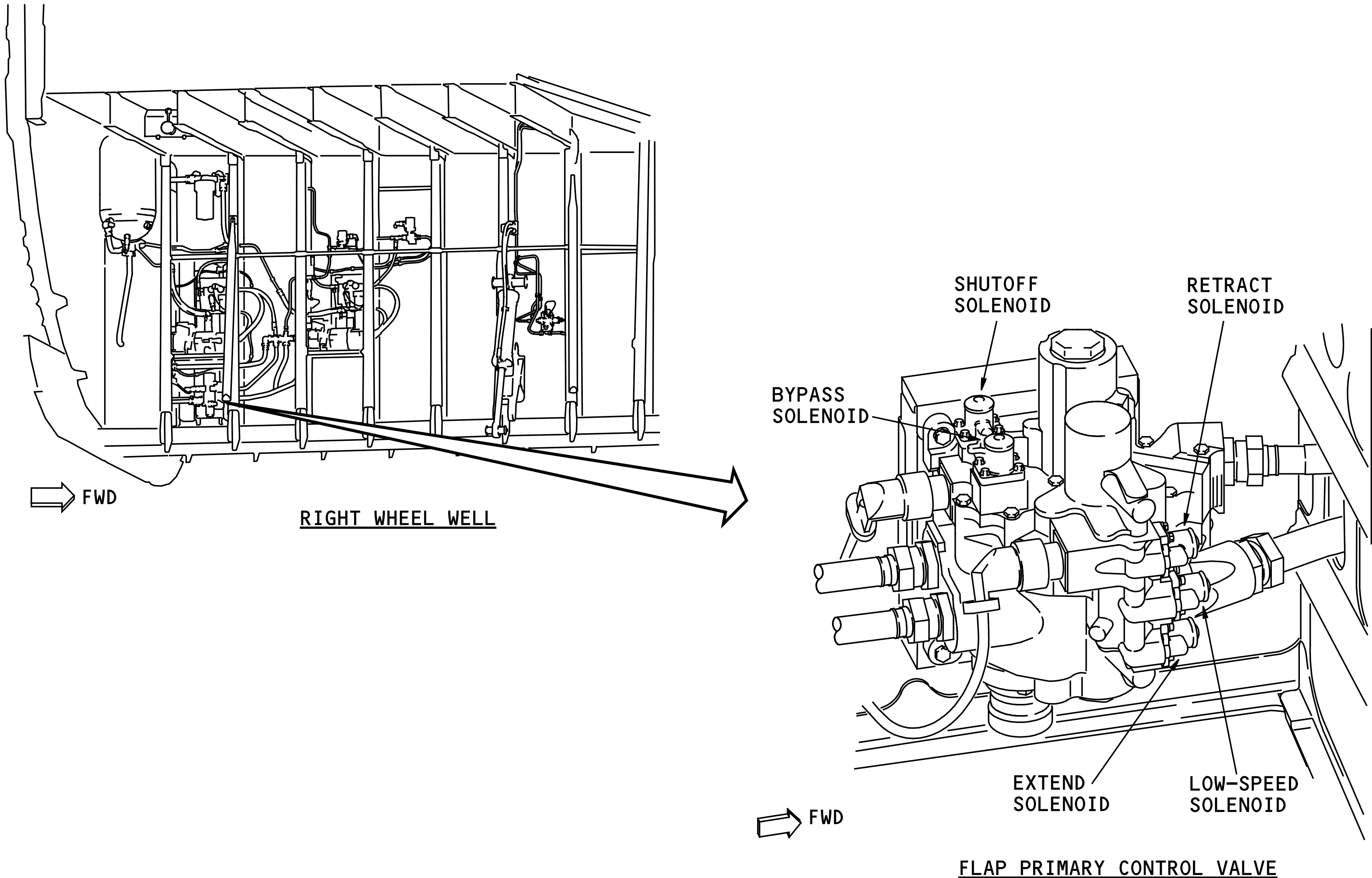
Location

The flap primary control valve attaches to the keel beam in the right wheel well.

Training Information Point

There is a small difference in the location of the mounting holes for the flap and slat primary control valves. This helps prevent the slat primary control valve from being installed where the flap primary valve should be. The reverse is also true.

The low-speed solenoid has a longer valve and different mounting hole locations. This helps prevent the low-speed solenoid from being installed where a different type of solenoid should be. This also helps prevent a different solenoid from being installed where the low-speed solenoid should be.



27-51-00-009 Rev 2 07/13/95

TRAILING EDGE FLAPS - FLAP PRIMARY CONTROL VALVE

TRAILING EDGE FLAPS - PRIMARY CONTROL VALVE - FUNCTIONAL DESCRIPTION

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TRAILING EDGE FLAPS - PRIMARY CONTROL VALVE - FUNCTIONAL DESCRIPTION

General

The primary control valve has these components:

- Shutoff valve
- Shutoff solenoid valve
- Low-speed solenoid valve
- Low speed piston
- Flow regulator
- Retract solenoid valve
- Extend solenoid valve
- Selector valve
- Bypass solenoid valve
- Bypass valve.

The FSEUs electrically control the solenoid valves in the primary control valve. All the solenoid valves are normally de-energized.

Shutoff Valve and Shutoff Solenoid Valve

The shutoff valve supplies hydraulic pressure and hydraulic flow to the selector valve.

The shutoff valve has three positions: closed, open, and low-speed. The shutoff valve is spring-loaded and hydraulically controlled to the closed position. It moves to the open or low-speed positions when the shutoff solenoid valve removes pressure from one side of the valve.

The shutoff solenoid valve controls the pilot pressure to the shutoff valve. The shutoff valve solenoid has two coils. When both coils are de-energized, the shutoff solenoid valve lets pilot pressure close the shutoff valve. When either coil is energized, the shutoff solenoid valve removes pilot pressure from the shutoff valve. Hydraulic system pressure then lets the shutoff valve open.

When the shutoff valve is closed, it removes hydraulic pressure from the selector valve. When the shutoff valve is open, hydraulic system pressure goes to the selector valve to move the flaps at their normal rate. When the shutoff valve is in the low-speed position, the hydraulic flow to the selector valve is restricted.

Low-Speed Solenoid Valve, Low Speed Piston, and Flow Regulator

The low-speed solenoid valve, the low speed piston, and the flow regulator help to decrease the speed of the flap drive system.

The low-speed solenoid valve has two coils. It controls hydraulic pressure to the low speed piston. The low speed piston is a hydraulic piston that is spring-loaded to the retracted position.

When the FSEUs energize the low-speed solenoid valve, the low speed piston extends. This limits the position of the shutoff valve to the low-speed position.

When the FSEUs de-energize the low-speed solenoid valve, the pressure in the low speed piston decreases. An internal spring then forces the low speed piston to retract. This lets the shutoff valve move to the open position.

The flow regulator limits the flow of hydraulic fluid to 25 gpm at high speed, and 5 gpm at low speed.

Selector Valve

The selector valve controls the direction of operation of the hydraulic motor.

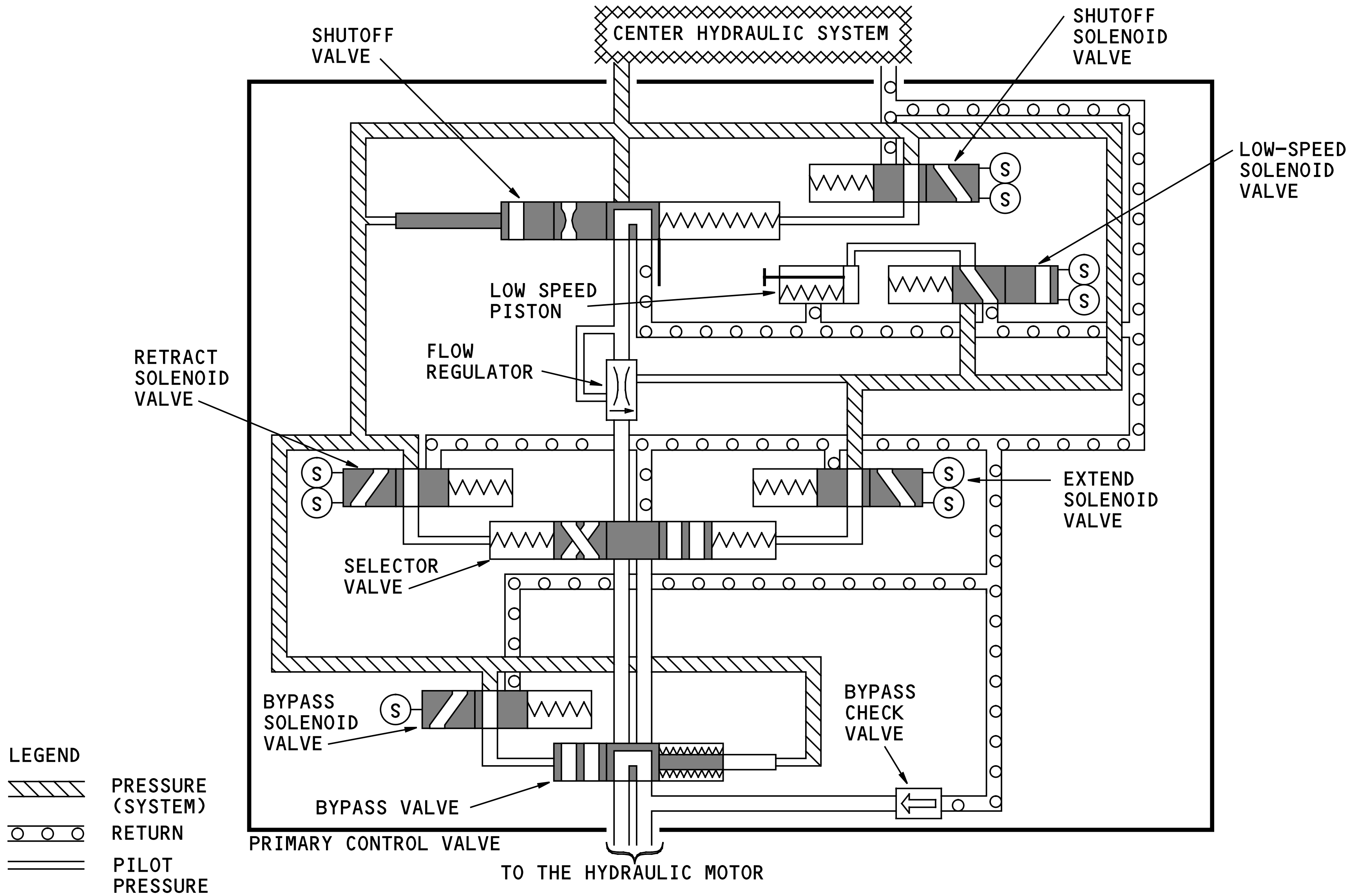
The selector valve is spring-loaded and hydraulically balanced to the center position and normally has pressure on both sides of the valve. The selector valve moves to the extend position when the extend solenoid valve removes pilot pressure from the extend side of the selector valve. The selector valve moves to the retract position when the retract solenoid valve removes pilot pressure from the retract side of the selector valve.

Bypass Valve and Bypass Solenoid Valve

The bypass valve isolates the hydraulic motor from hydraulic system pressure. The bypass valve also prevents a hydraulic lock and permits backdrive of the hydraulic motor.

A dual-coil bypass solenoid valve controls pilot pressure to the bypass valve, but only one coil of the solenoid is used. When the FSEUs energize the bypass solenoid valve, it removes pilot pressure from the open side of the bypass valve. This closes the bypass valve, which connects the hydraulic lines to both sides of the hydraulic motor.

The bypass valve is spring-loaded and hydraulically controlled to the closed position. The open side of the valve has a larger surface area for the pilot pressure than the close side of the valve. When the center hydraulic system pressure is low, springs automatically force the bypass valve to close. When the center hydraulic system pressure is high, the bypass valve opens.



27-51-00-010 Rev 3

TRAILING EDGE FLAPS - PRIMARY CONTROL VALVE - FUNCTIONAL DESCRIPTION

TRAILING EDGE FLAPS - FLAP/SLAT PRIORITY VALVE

Purpose

The flap/slat priority valve gives priority of hydraulic power to the primary flight controls over the flaps and slats. This priority valve makes sure that the primary flight control PCUs receive sufficient hydraulic power when both air driven pumps (ADPs) are not operating.

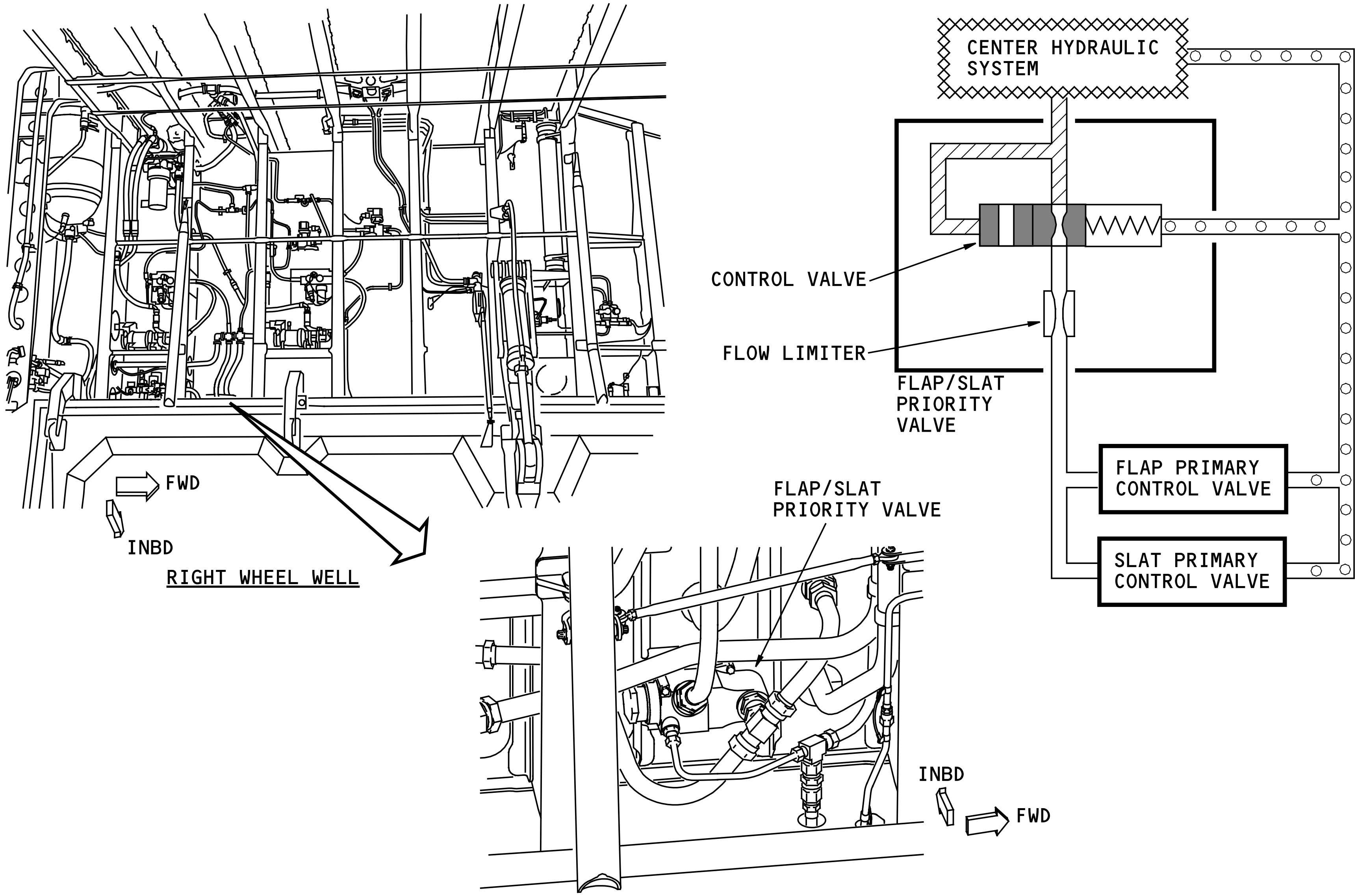
Location

The flap/slat priority valve is at the bottom of the keel beam in the right wheel well.

Physical Description

The flap/slat priority valve has a flow limiter and a control valve. When the pressure in the center hydraulic system is high, the control valve fully opens. The maximum flow through the flow limiter is then 43 gpm.

When the system pressure decreases, the control valve restricts the flow to the flap and slat primary control valves. In the fully restricted position, the control valve limits the flow to 0.4 gpm. Restriction of the flap/slat flow permits the control valve to modulate the system pressure to 1750 psi during high demand conditions.



27-51-00-033 Rev 0

TRAILING EDGE FLAPS - FLAP/SLAT PRIORITY VALVE

TRAILING EDGE FLAPS - FLAP POWER DRIVE UNIT (PDU)

Purpose

The flap PDU turns the flap torque tubes during operation in all three modes. The flap PDU has these LRUs:

- A hydraulic motor
- An electric motor
- A gearbox.

Information on the hydraulic motor and the electric motor is shown later.

Location

The flap PDU is above the keel beam in the main landing gear wheel wells. Access to the hydraulic and electric motors is through the right wheel well. Access to the gearbox is through the left wheel well.

Gearbox

The gearbox transmits the power from the hydraulic or electric motors to the torque tubes.

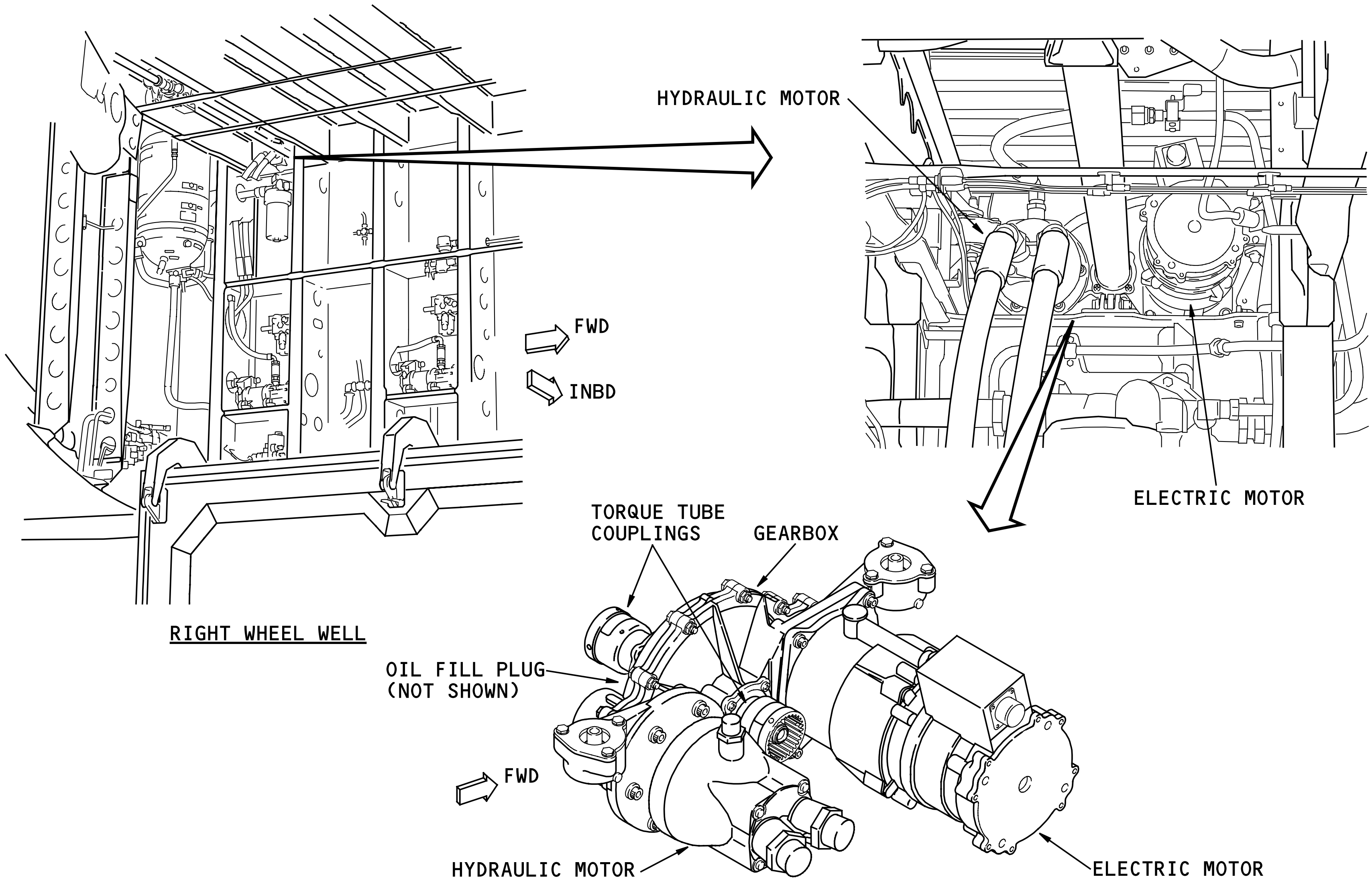
The hydraulic motor or the electric motor rotates gears in the gearbox. These gears increase the torque from the motors. The gearbox turns the torque tube couplings on both sides of the PDU. These couplings turn the torque tubes.

During high-speed operation in the primary mode, the gearbox turns the torque tubes at 550 rpm. During low-speed operation, the gearbox turns the torque tubes at 110 rpm.

During operation in the secondary and alternate modes, the gearbox turns the torque tubes at 74 rpm.

Training Information Point

The gearbox contains oil and it is necessary to do servicing at specified times. You get access to the oil fill plug through the left wheel well.



TRAILING EDGE FLAPS - FLAP POWER DRIVE UNIT (PDU)

27-51-00-011 Rev 1

TRAILING EDGE FLAPS - FLAP LIMIT SWITCH

Purpose

The flap limit switch limits the position of the flaps during alternate mode operation. The flap limit switch also prevents retraction of the slats in the alternate mode until the flaps are fully retracted.

Location

The flap limit switch is on the right flap position sensor gearbox in the right wheel well.

Functional Description

The limit switch is one LRU. It has two internal switches, up and 20.

The up switch controls the sequence of flap and slat retraction in the alternate mode. To do this, the up switch controls the electrical power to the flap and slat electric motors.

During retraction, the up switch permits retraction of the flaps but removes electrical power from the slat electric motor. When the flaps retract to the up position, the up switch removes power from the flap electric motor and permits retraction of the slats.

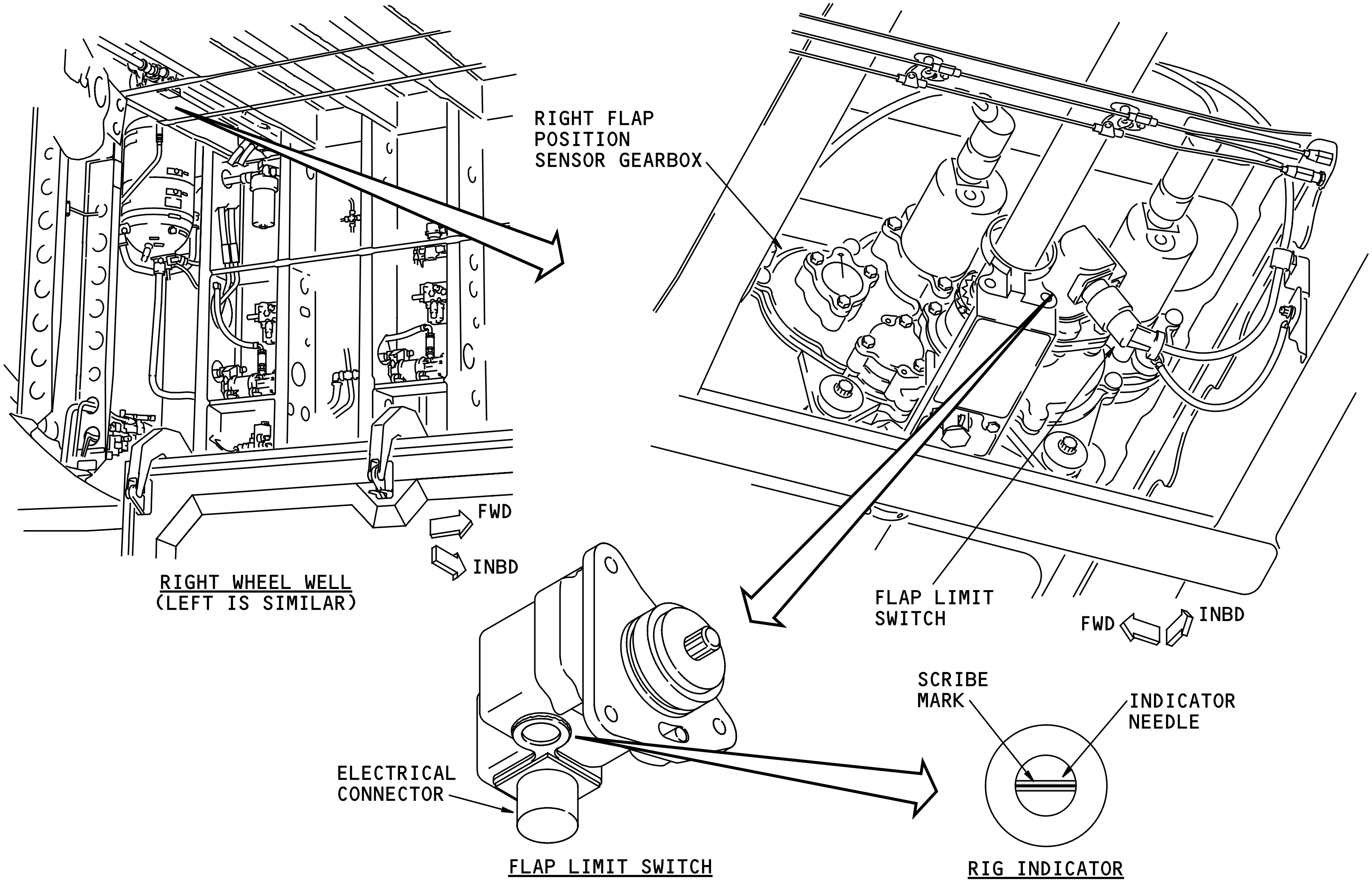
When the flaps extend to the 20 position, the 20 switch removes electrical power from the flap electric motor.

Training Information Point

The flap limit switch is interchangeable with the slat limit switch.

You install the flap limit switch with the trailing edge flaps in the retracted position. The limit switch rig indicator has a fixed scribe mark and an indicator needle. The indicator needle moves up or down in relation to the scribe mark as the shaft of the limit switch turns. Make sure you align the center of the indicator needle in the rig indicator with the scribe mark when you install the limit switch.

To retract the slats with the flaps extended and disabled, you must install a jumper wire on the electrical connector for the flap limit switch. This permits the slats to fully retract with the flaps extended.



TRAILING EDGE FLAPS - FLAP LIMIT SWITCH

27-51-00-013 Rev 4 03/19/96

TRAILING EDGE FLAPS - ANGLE GEARBOXES

Purpose

The angle gearboxes connect torque tubes that are at different angles to each other. There are six angle gearboxes:

- Two side-of-body angle gearboxes
- Two rear spar angle gearboxes
- Angle gearboxes on the output of the inboard transmissions for the inboard flap (transmissions 4 and 5).

Location

The side-of-body angle gearboxes are on the inboard flap support assemblies in the main landing gear wheel wells. Access is through the wheel wells.

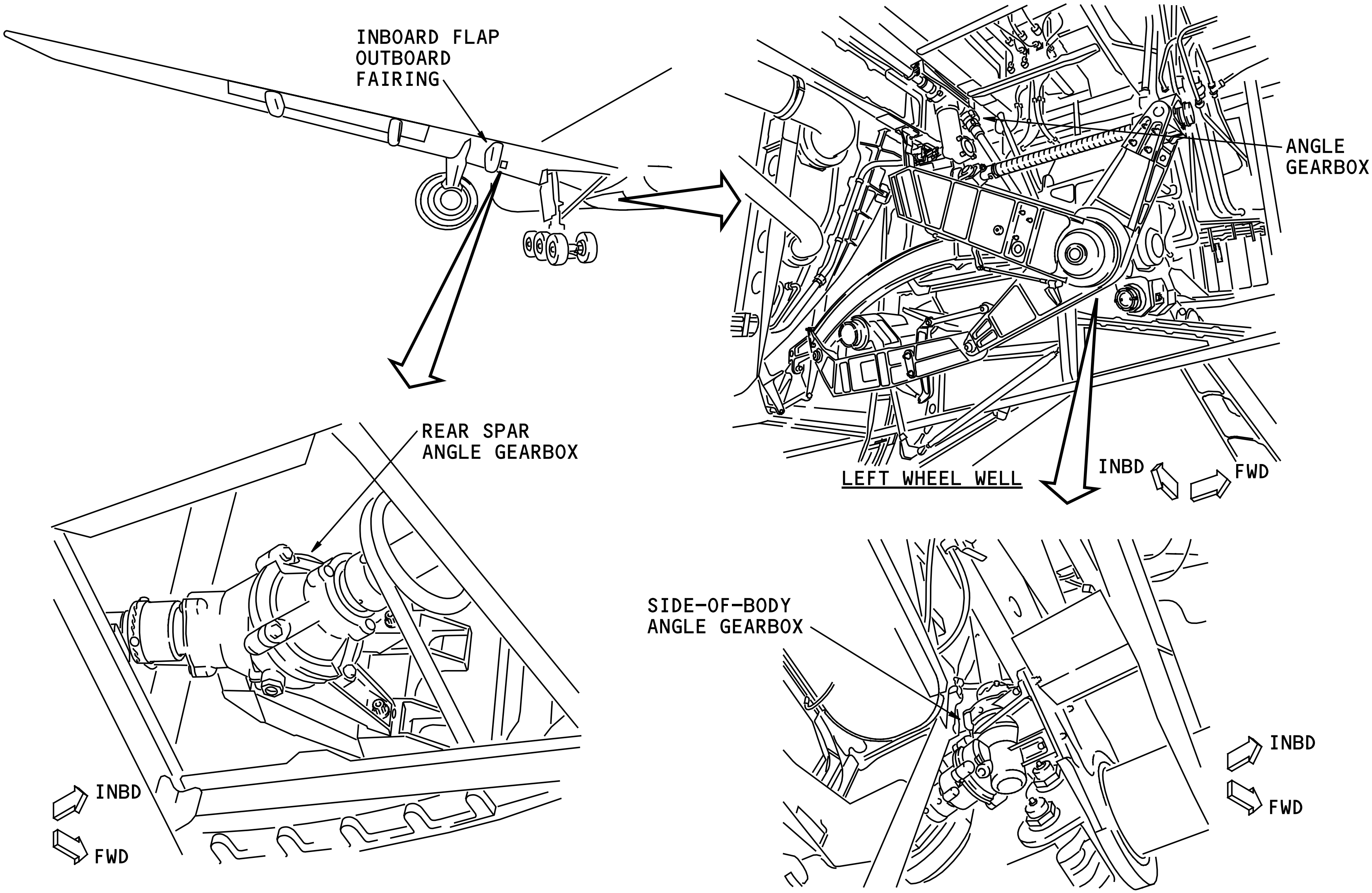
The rear spar angle gearboxes are on the rear spar of each wing, near the main landing gear beam. Access is through removable panels under the wings.

The other two angle gearboxes are on the output side of the inboard flap inboard transmissions (4 and 5).

Physical Description

The angle gearboxes are filled with grease and sealed.

The side-of-body angle gearbox weighs 10 lb (4.5 kg). The rear spar angle gearbox weighs 11 lb (5 kg). The angle gearboxes on transmissions 4 and 5 each weigh about 12.5 lb (5.7 kg).



27-51-00-015 Rev 3 03/19/96

TRAILING EDGE FLAPS - ANGLE GEARBOXES

TRAILING EDGE FLAPS - NO-BACK BRAKE

Purpose

The no-back brake helps prevent flap retraction if there is a PDU or torque tube failure.

Location

There is one no-back brake attached to the rear spar of each wing. The no-back brakes are between the two transmissions for the outboard flap on each wing.

Physical Description

The no-back brakes are spring-loaded, skewed-roller, ratchet brakes. They supply a resistive torque during retraction only.

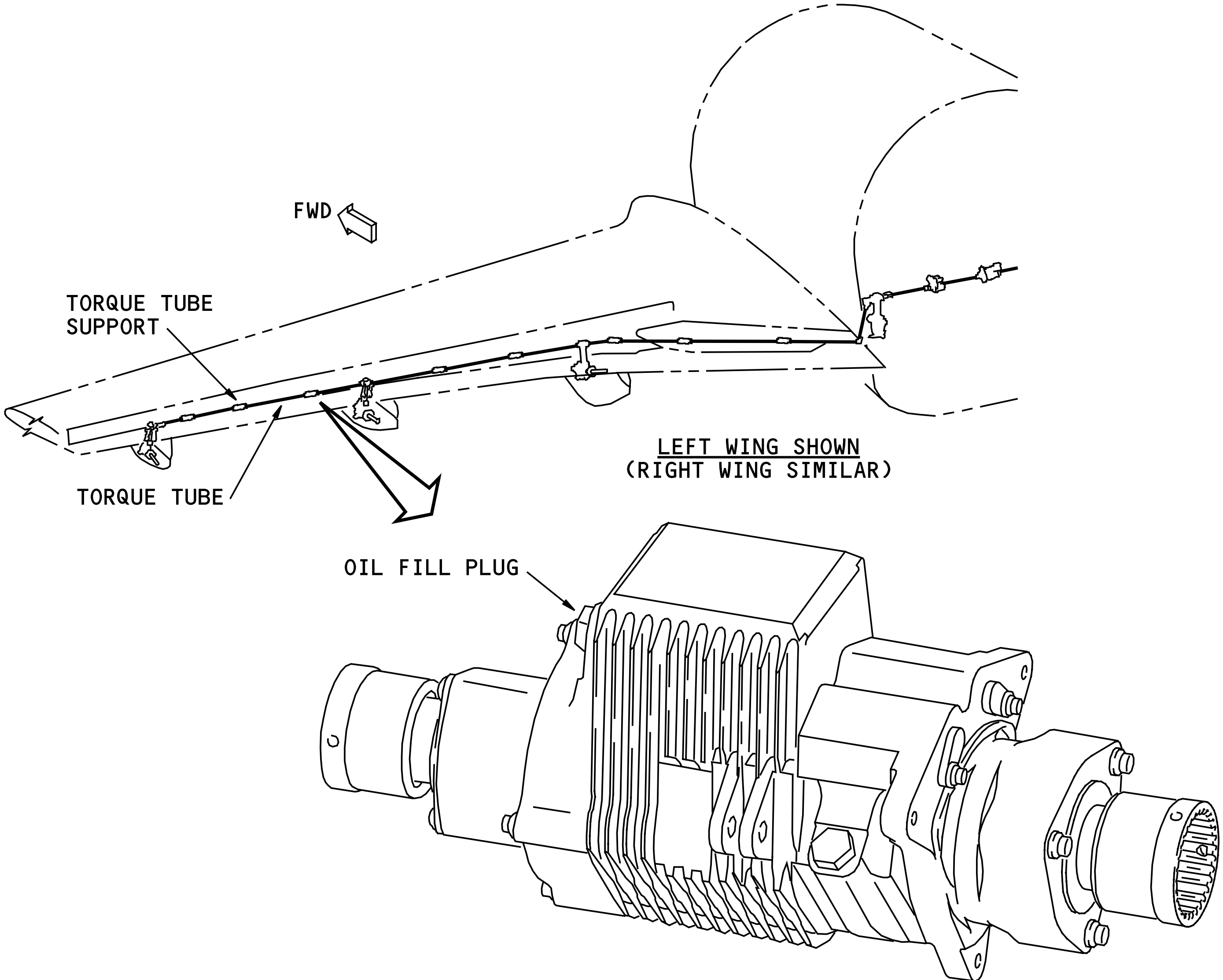
The no-back brakes are filled with oil and sealed. They each weigh 20 lb (9 kg).

Training Information Point

When you operate the flap drive system, observe this caution:

CAUTION: DO NOT OPERATE THE FLAPS CONTINUOUSLY FOR MORE THAN 12 MINUTES IN PRIMARY MODE WITHOUT A 30 MINUTE COOLING OFF PERIOD FOR THE NO-BACK BRAKES. THE NO-BACK BRAKES CAN BECOME TOO HOT.

The no-back brake contains oil and it is necessary to do servicing. Use the oil fill plug.



TRAILING EDGE FLAPS - NO-BACK BRAKE

TRAILING EDGE FLAPS - INBOARD FLAP INBOARD TRANSMISSION ASSEMBLY

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TRAILING EDGE FLAPS - INBOARD FLAP INBOARD TRANSMISSION ASSEMBLY

Purpose

There are two transmission assemblies for each flap surface, an inboard transmission assembly and an outboard transmission assembly.

The inboard flap inboard transmission assembly receives power from the torque tubes to move the inboard flap. This assembly has these components:

- A transmission
- A ballscrew
- A gimbal.

The transmission assembly weighs approximately 95 lb (43 kg).

Location

There is one inboard flap inboard transmission assembly in each main landing gear wheel well.

Transmission

The transmission connects to the torque tubes. Gears in the transmission transmit the power from the torque tubes to the U-joint. The U-joint then turns the ballscrew.

The transmission has a torque brake and a no-back brake. The torque brake prevents excessive loads on the ballscrew if the flap does not move freely. The torque brake is a ball ramp type brake with a torque trip indicator. The trip indicator must be manually reset if it activates.

The no-back brake is a skewed roller type brake. It engages by compression load in the ballscrew caused by airloads on the flap. It prevents flap movement if the PDU or torque tubes fail.

Ballscrew

The transmission turns the ballscrew through a U-joint. The ballscrew has a ballscrew nut which connects to the gimbal. As the ballscrew turns, the ballscrew nut moves the gimbal.

The ballscrew has stops at both ends. The ballscrew nut does not touch the stops during normal operation of the flaps.

Gimbal

The gimbal moves the flap surface. The gimbal connects to the ballscrew nut, and moves as the ballscrew turns.

Training Information Point

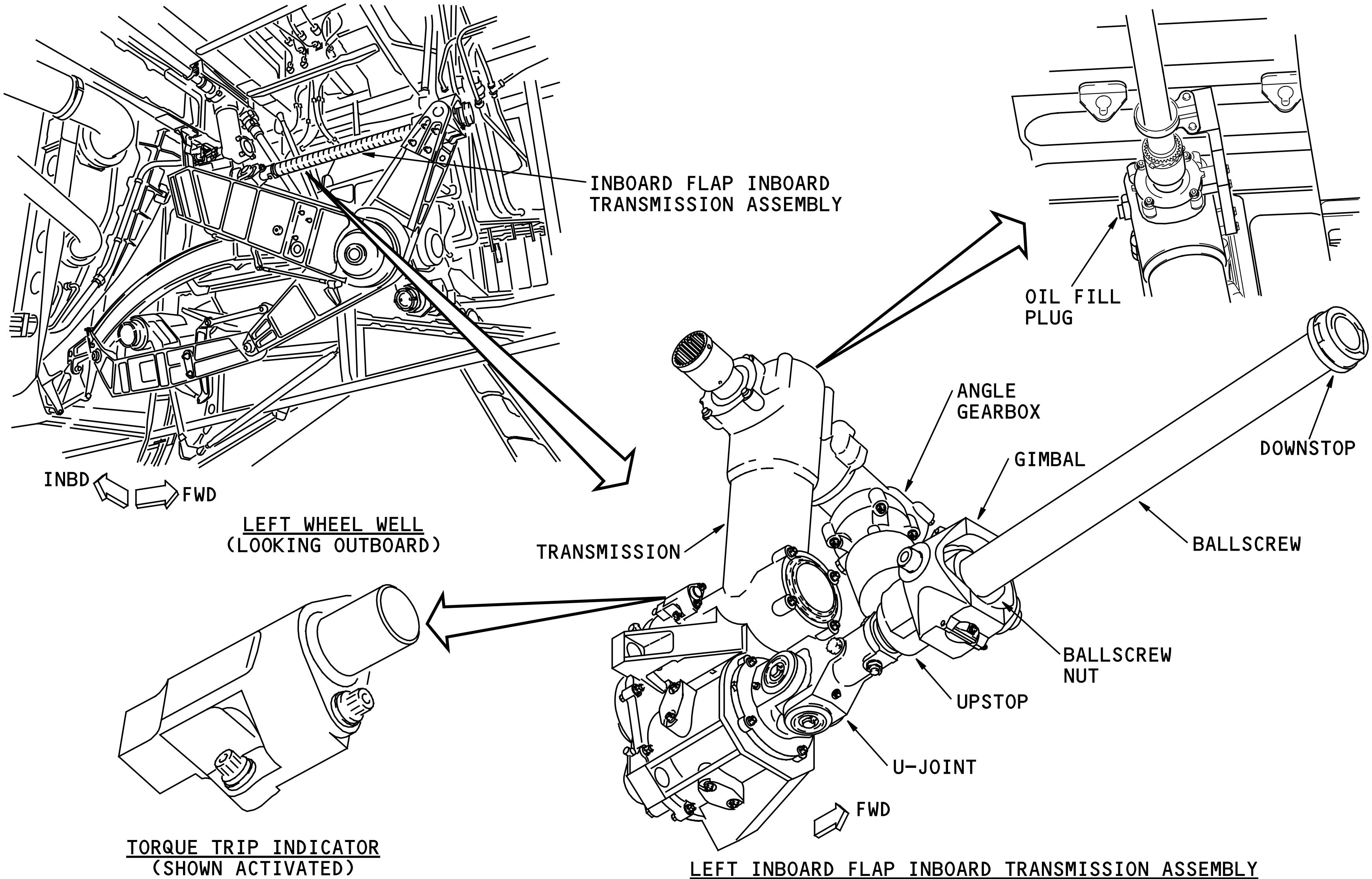
If you disconnect the ballscrew from the transmission at the U-joint, make sure that the ballscrew nut stays on the ballscrew.

The transmission contains oil and it is necessary to do servicing. Use the oil fill plug.

TRAILING EDGE FLAPS - INBOARD FLAP INBOARD TRANSMISSION ASSEMBLY

When manually operating the flap drive system, observe this caution:

CAUTION: DO NOT LET THE BALLSCREW NUTS HIT THE UPSTOPS OR THE DOWNSTOPS. YOU CAN CAUSE DAMAGE TO THE SHEAROUT IN THE POSITION SENSOR GEARBOX.



27-51-00-017 Rev 3 03/19/96

TRAILING EDGE FLAPS - INBOARD FLAP INBOARD TRANSMISSION ASSEMBLY

TRAINING EDGE FLAPS - INBOARD FLAP INBOARD SUPPORT MECHANISM

Purpose

The flap transmission, ballscrew, and gimbal use the flap support mechanism to extend and retract the inboard flap and aft flap.

Location

There is one inboard flap inboard support mechanism in each main landing gear wheel well.

Functional Description

During extension, the gimbal turns the drive arm about its fixed point. The drive arm moves the flap carrier beam. This beam attaches to the main flap support which attaches to the main flap. As the carrier beam moves, the main flap extends. The main flap roller and track control the position of the main flap as is extends.

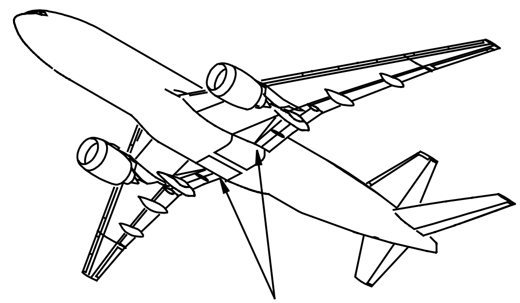
The drive arm also moves the aft flap pushrods to extend the aft flap. Rollers and a track control the rotation of the aft flap as it extends. The aft flap extends beyond the trailing edge of the main flap only at flap positions greater than 20.

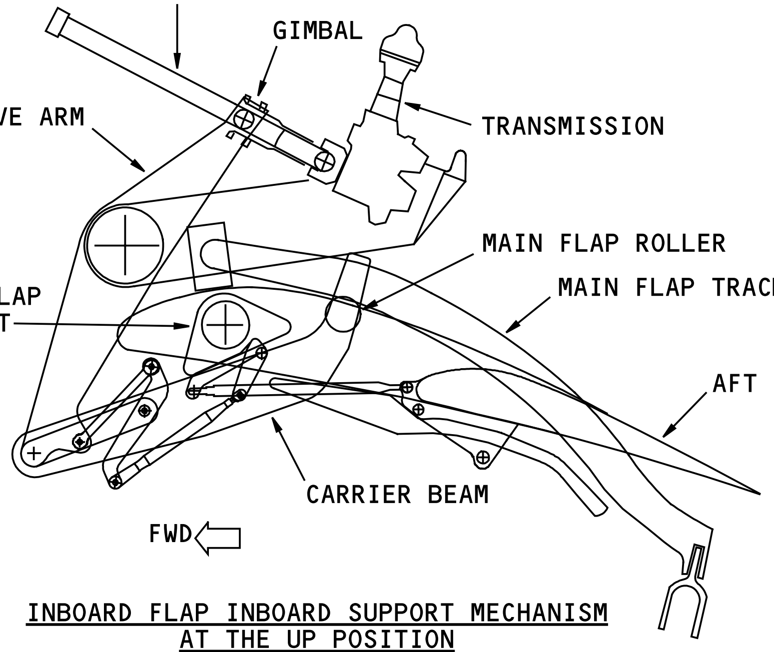
Retraction is the opposite of extension.

Training Information Point

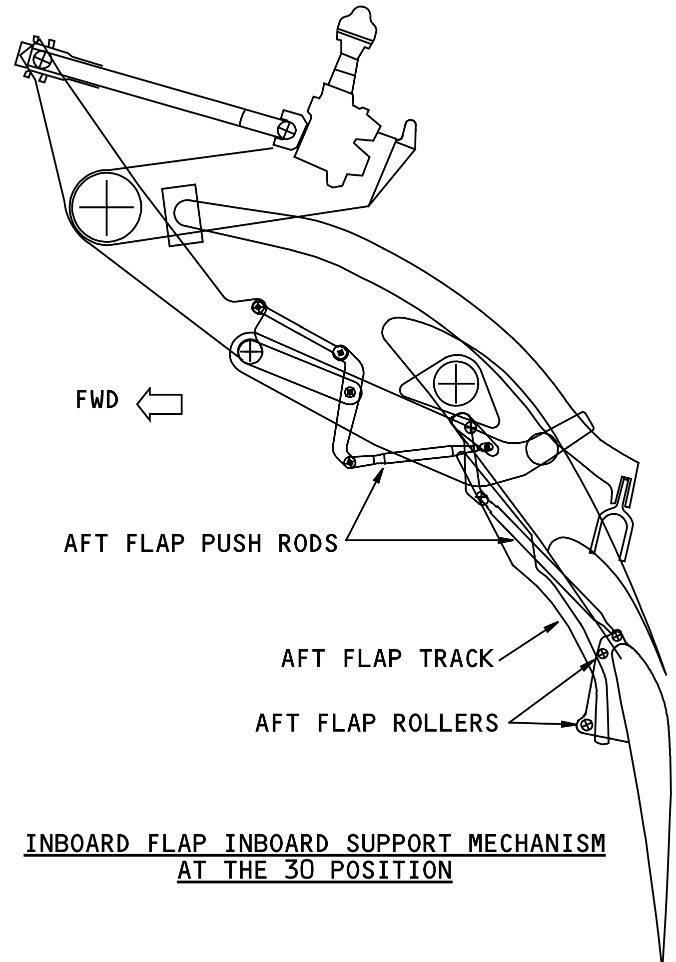
When manually operating the flap drive system, observe this caution:

CAUTION: DO NOT LET THE BALLSCREW NUTS HIT THE UPSTOPS OR THE DOWNSTOPS. YOU CAN CAUSE DAMAGE TO THE SHEAROUT IN THE POSITION SENSOR GEARBOX.





INBOARD FLAP INBOARD SUPPORT MECHANISM
AT THE UP POSITION



INBOARD FLAP INBOARD SUPPORT MECHANISM
AT THE 30 POSITION

27-51-00-018 Rev 2

TRAILING EDGE FLAPS - INBOARD FLAP INBOARD SUPPORT MECHANISM

TRAILING EDGE FLAPS - INBOARD FLAP OUTBOARD TRANSMISSION ASSEMBLY

Purpose

The inboard flap outboard transmission assembly receives power from the torque tubes to move the inboard flap.

Location

The inboard flap outboard transmission assembly is just inboard of the engines. Access to the assembly is through the fixed and moveable flap support fairings.

Physical Description

The transmission assembly is similar to the inboard flap inboard transmission assembly, but they are not interchangeable.

The transmission assembly weighs approximately 98 lb (45 kg).

Functional Description

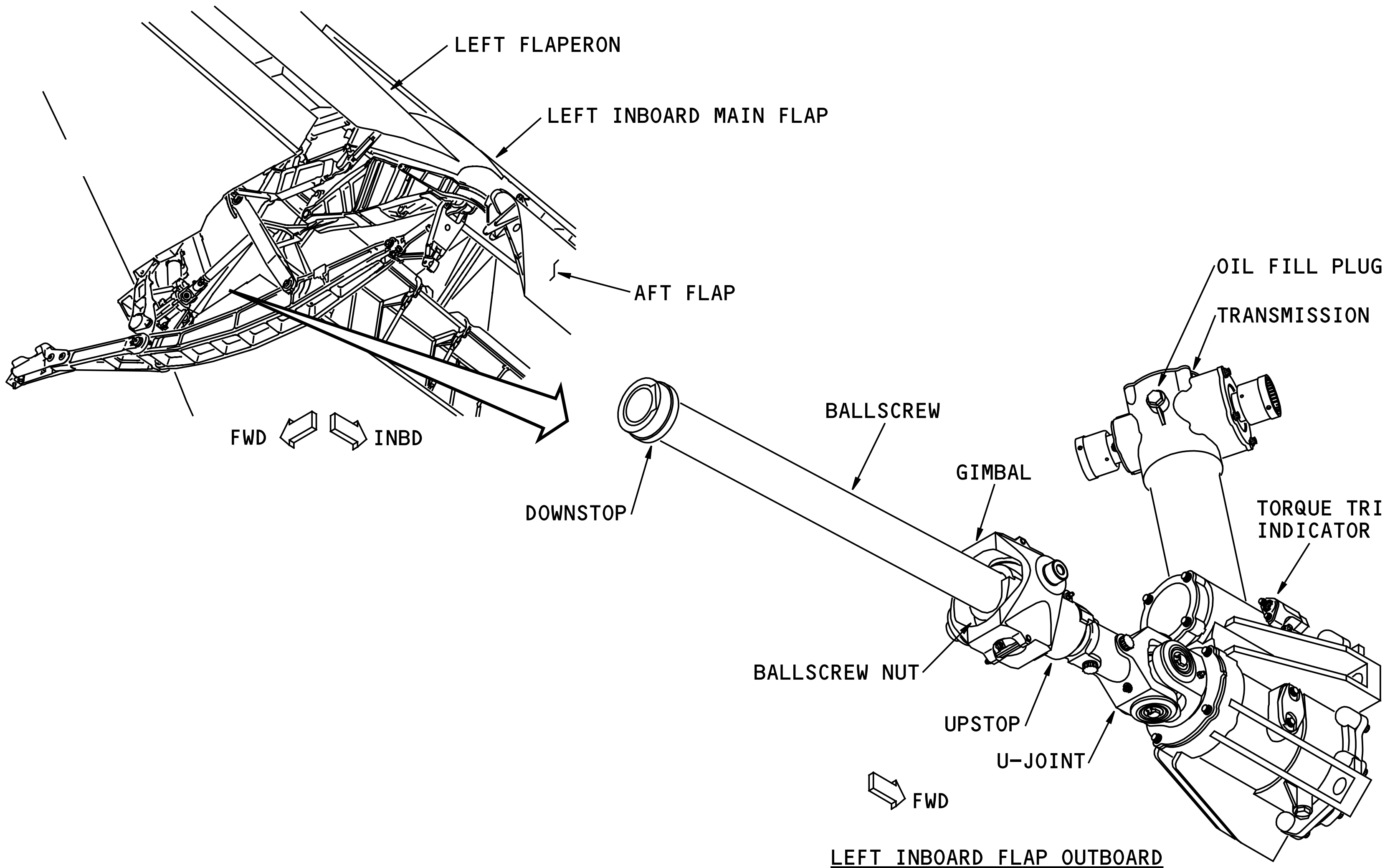
The inboard flap outboard transmission assembly operation is similar to the inboard flap inboard transmission assembly.

Training Information Point

The transmission contains oil and it is necessary to do servicing at specified times. Use the oil fill plug.

When manually operating the flap drive system, observe this caution:

CAUTION: DO NOT LET THE BALLSCREW NUTS HIT THE UPSTOPS OR THE DOWNSTOPS. YOU CAN CAUSE DAMAGE TO THE SHEAROUT IN THE POSITION SENSOR GEARBOX.



LEFT INBOARD FLAP OUTBOARD
TRANSMISSION ASSEMBLY

27-51-00-019 Rev 1

TRAILING EDGE FLAPS - INBOARD FLAP OUTBOARD TRANSMISSION ASSEMBLY

TRAILING EDGE FLAPS - INBOARD FLAP OUTBOARD SUPPORT MECHANISM

Purpose

The flap transmission, ballscrew, and gimbal use the flap support mechanism to extend and retract the inboard flap and the aft flap.

Location

The inboard flap outboard support mechanism is inboard of the engines. Access requires the removal of the fixed and moveable flap support fairings.

Functional Description

During extension, the gimbal turns the drive arm about its fixed point. The drive arm moves the flap carrier to extend the main flap. The drive arm also moves the compression strut. This strut rotates the aft tension beam which uses the pivot link to control the rotation of the main flap.

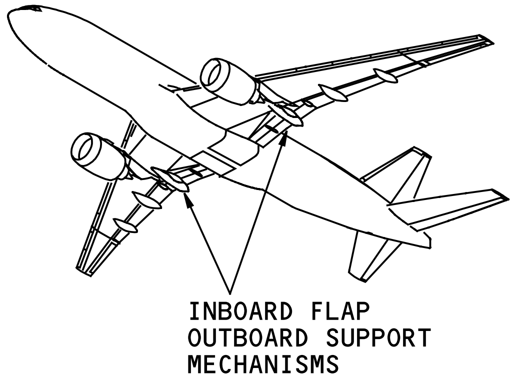
The drive arm also moves the aft flap pushrods to extend the aft flap. Rollers and a track control the rotation of the aft flap as it extends. The aft flap extends beyond the trailing edge of the main flap only at flap positions greater than 20.

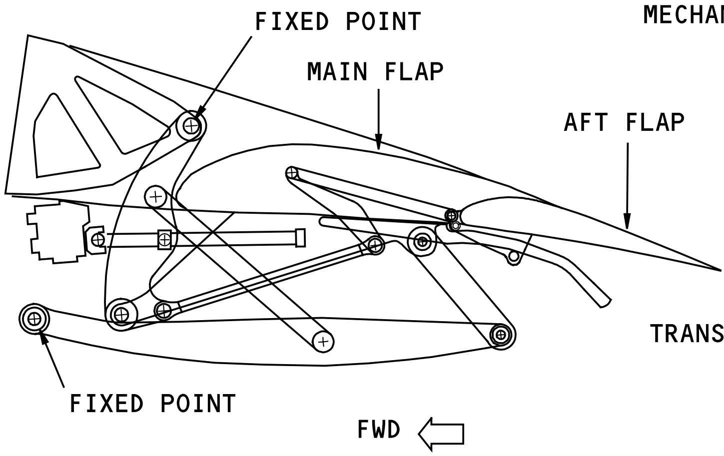
Retraction is the opposite of extension.

Training Information Point

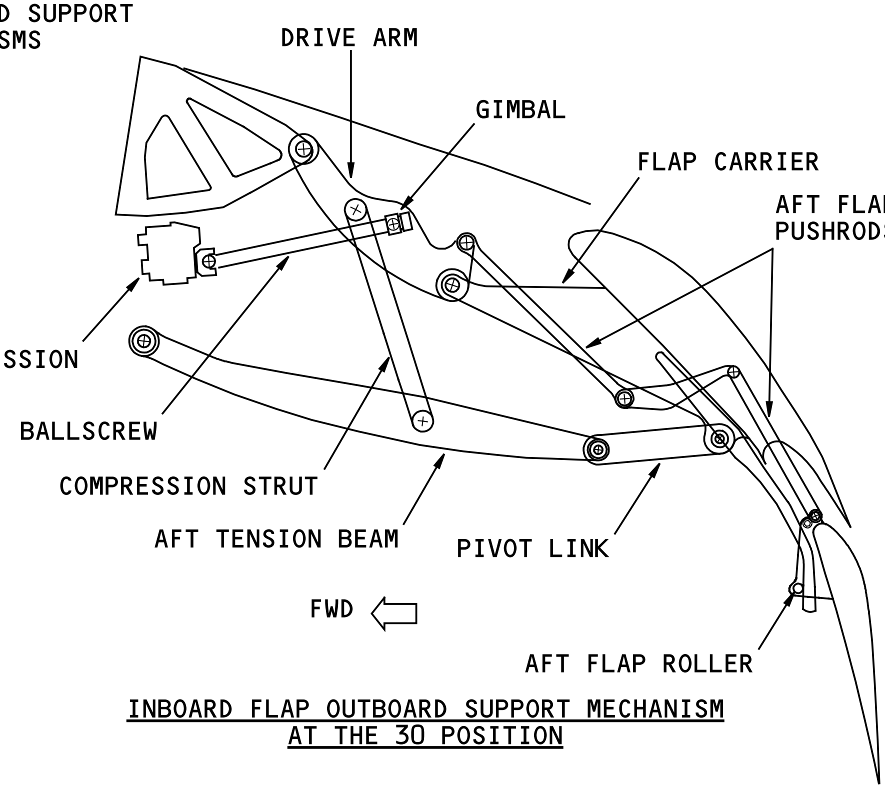
When manually operating the flap drive system, observe this caution:

CAUTION: DO NOT LET THE BALLSCREW NUTS HIT THE UPSTOPS OR THE DOWNSTOPS. YOU CAN CAUSE DAMAGE TO THE SHEAROUT IN THE POSITION SENSOR GEARBOX.





INBOARD FLAP OUTBOARD SUPPORT MECHANISM
AT THE UP POSITION



INBOARD FLAP OUTBOARD SUPPORT MECHANISM
AT THE 30 POSITION

27-51-00-020 Rev 2 12/18/95

TRAILING EDGE FLAPS - INBOARD FLAP OUTBOARD SUPPORT MECHANISM

TRAILING EDGE FLAPS - OUTBOARD FLAP INBOARD TRANSMISSION ASSEMBLY

Purpose

The outboard flap inboard transmission assembly receives power from the torque tubes to move the outboard flap.

Location

The outboard flap inboard transmission assembly is just outboard of the engines. Access to the assembly is through the fixed and moveable flap support fairings.

Physical Description

The transmission assembly is similar to the inboard flap inboard transmission assembly, but they are not interchangeable.

The transmission assembly weighs about 80 lb (36 kg).

Functional Description

The outboard flap inboard transmission assembly operation is similar to the assemblies for the inboard flap.

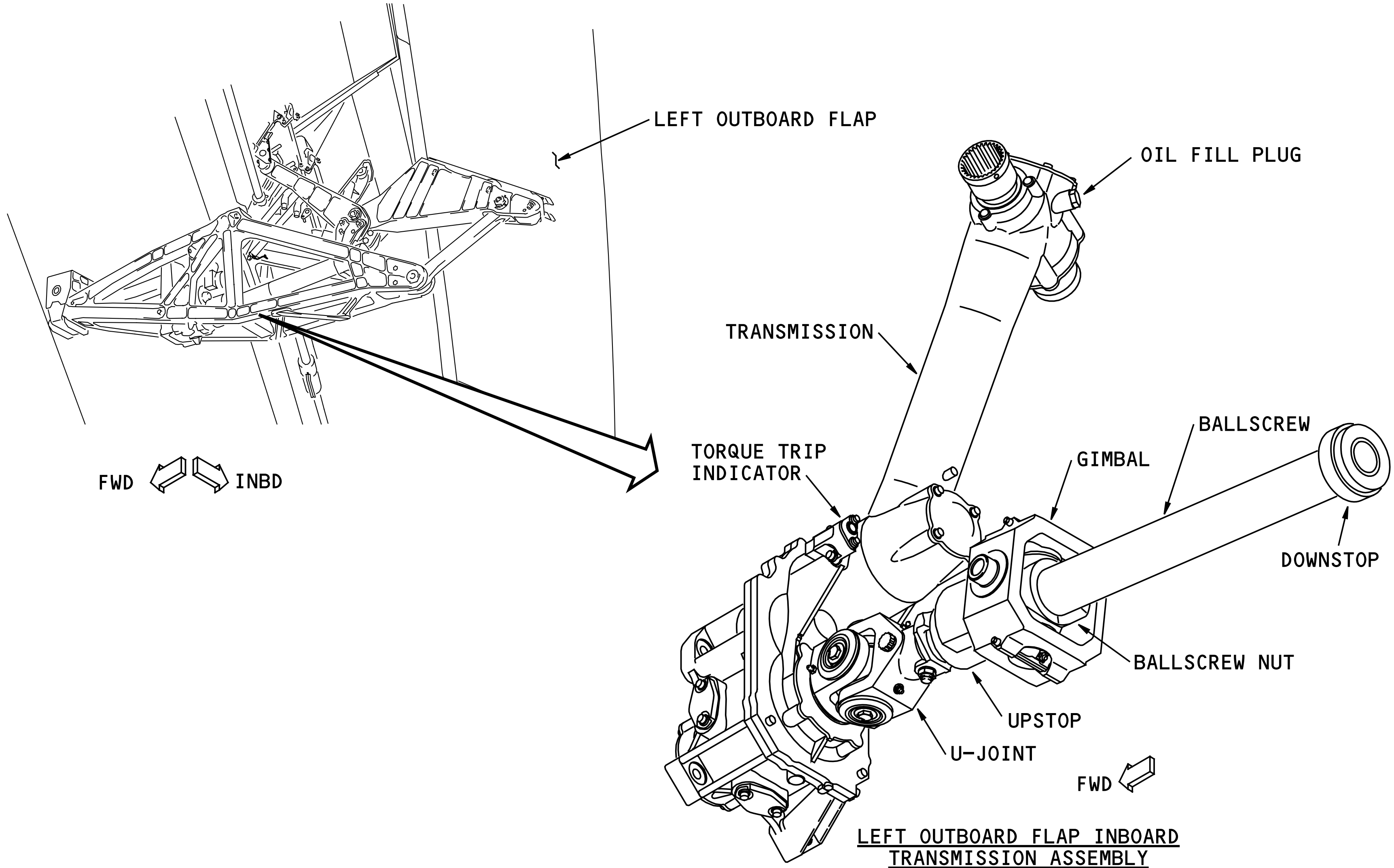
Training Information Point

The transmission contains oil and it is necessary to do servicing. Use the oil fill plug.

Before you remove the transmission assembly, remove the flap skew sensors to prevent damage to them.

When manually operating the flap drive system, observe this caution:

CAUTION: DO NOT LET THE BALLSCREW NUTS HIT THE UPSTOPS OR THE DOWNSTOPS. YOU CAN CAUSE DAMAGE TO THE SHEAROUT IN THE POSITION SENSOR GEARBOX.



LEFT OUTBOARD FLAP INBOARD TRANSMISSION ASSEMBLY

27-51-00-021 Rev 2 03/19/96

TRAILING EDGE FLAPS - OUTBOARD FLAP INBOARD TRANSMISSION ASSEMBLY

TRAILING EDGE FLAPS - OUTBOARD FLAP OUTBOARD TRANSMISSION ASSEMBLY

Purpose

The outboard flap outboard transmission assembly gets power from the torque tubes to move the outboard flap.

Location

The outboard flap outboard transmission assembly is near the outboard end of the outboard flap. Access to the assembly is through the fixed and moveable flap support fairings.

Physical Description

The transmission assembly is similar to the inboard flap inboard transmission assembly, but they are not interchangeable.

The transmission assembly weighs approximately 65 lb (30 kg).

Functional Description

The outboard flap outboard transmission assembly operation is similar to the assemblies for the inboard flap.

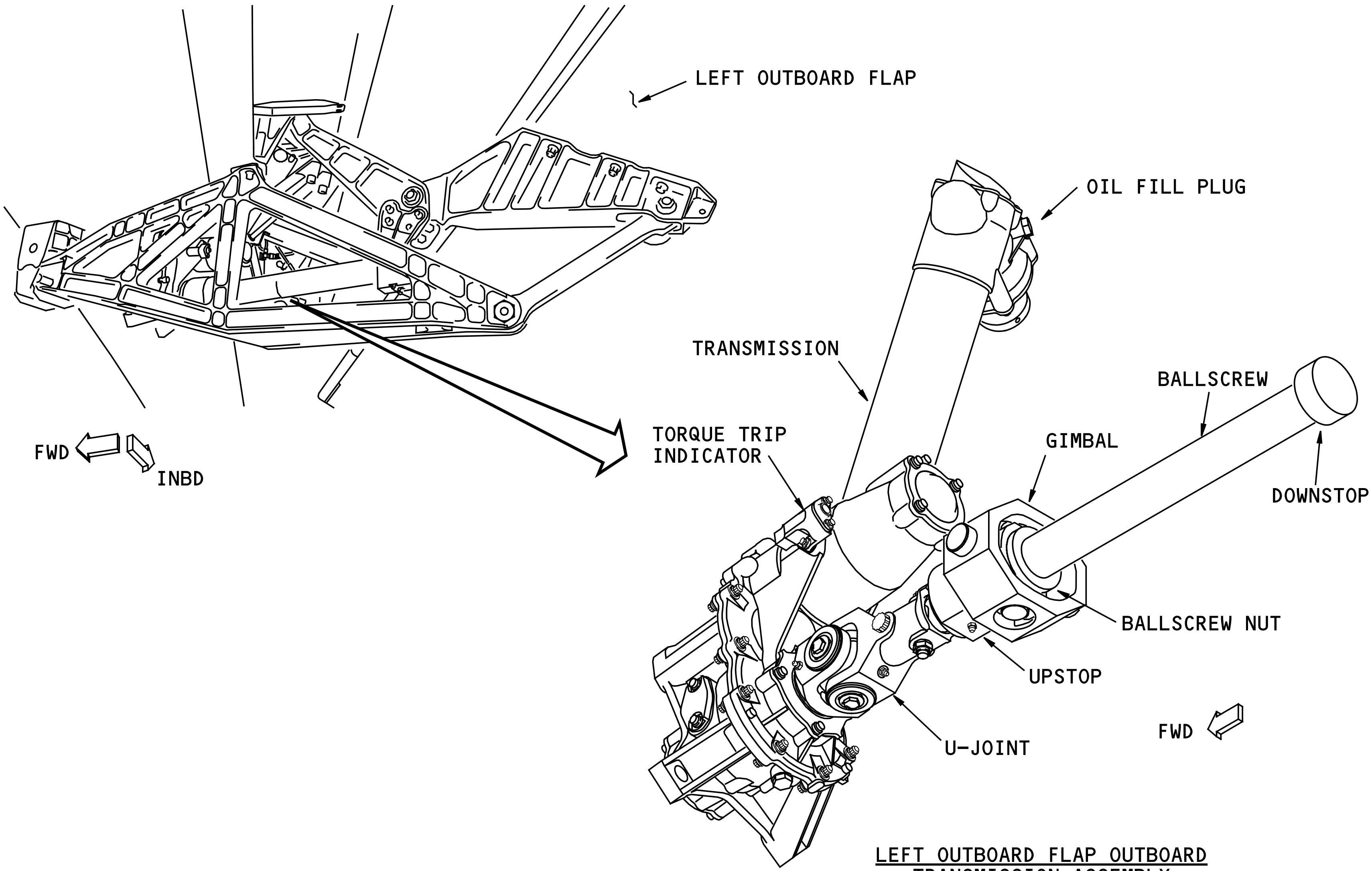
Training Information Point

The transmission contains oil and it is necessary to do servicing at specified times. Use the oil fill plug.

Before removing the transmission assembly, remove the flap skew sensors to prevent damage to them.

When manually operating the flap drive system, observe this caution:

CAUTION: DO NOT LET THE BALLSCREW NUTS HIT THE UPSTOPS OR THE DOWNSTOPS. YOU CAN CAUSE DAMAGE TO THE SHEAROUT IN THE POSITION SENSOR GEARBOX.



LEFT OUTBOARD FLAP OUTBOARD
TRANSMISSION ASSEMBLY

27-51-00-022 Rev 2

TRAILING EDGE FLAPS - OUTBOARD FLAP OUTBOARD TRANSMISSION ASSEMBLY

TRAILING EDGE FLAPS - OUTBOARD FLAP SUPPORT MECHANISMS

Purpose

The flap transmission, ballscrew, and gimbal use the flap support mechanism to extend and retract the outboard flap.

Location

The outboard flap support mechanisms are near the ends of the outboard flap. To get access to the assemblies, remove the fixed and moveable flap support fairings.

Functional Description

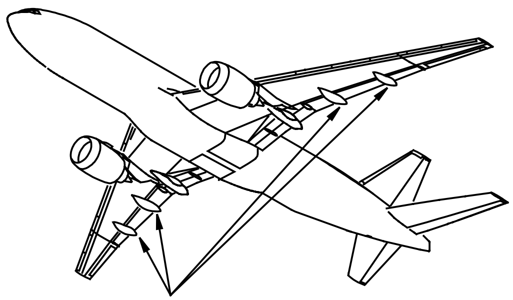
During extension, the gimbal turns the drive arm about the fixed point. The drive arm moves the flap carrier to extend the outboard flap. The pivot link controls the rotation of the flap.

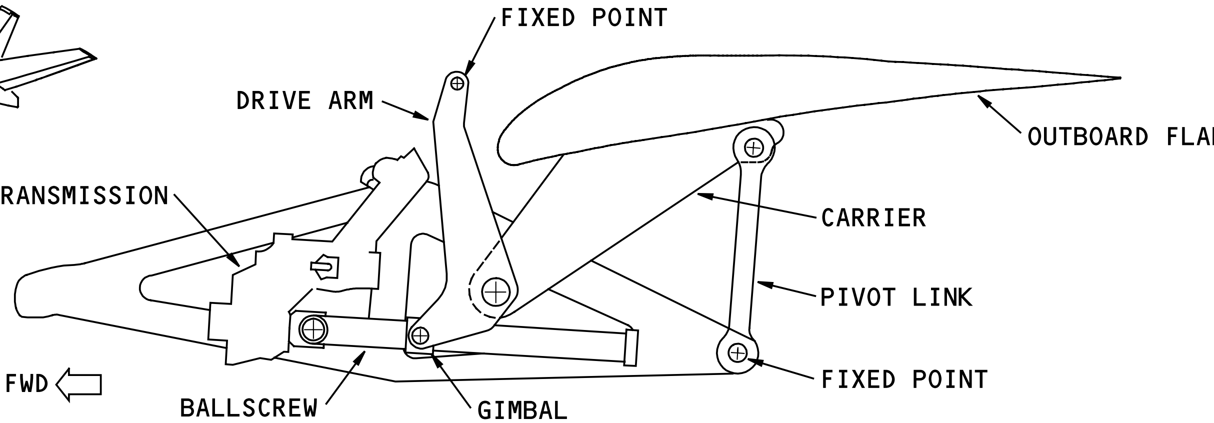
Retraction is the opposite of extension.

Training Information Point

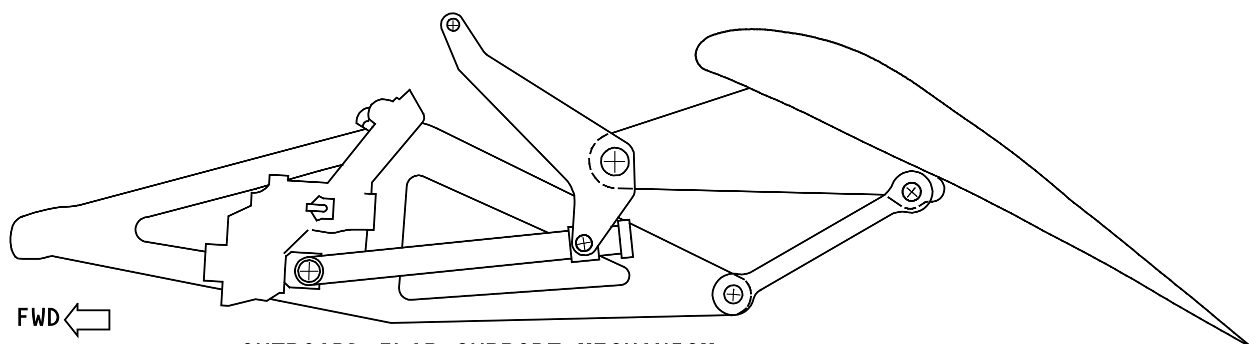
When manually operating the flap drive system, observe this caution:

CAUTION: DO NOT LET THE BALLSCREW NUTS HIT THE UPSTOPS OR THE DOWNSTOPS. YOU CAN CAUSE DAMAGE TO THE SHEAROUT IN THE POSITION SENSOR GEARBOX.





OUTBOARD FLAP SUPPORT MECHANISM
AT THE UP POSITION



OUTBOARD FLAP SUPPORT MECHANISM
AT THE 30 POSITION

27-51-00-023 Rev 2 03/19/96

TRAILING EDGE FLAPS - OUTBOARD FLAP SUPPORT MECHANISMS

TRAILING EDGE FLAPS - OUTBOARD FLAP AUXILIARY SUPPORTS

Purpose

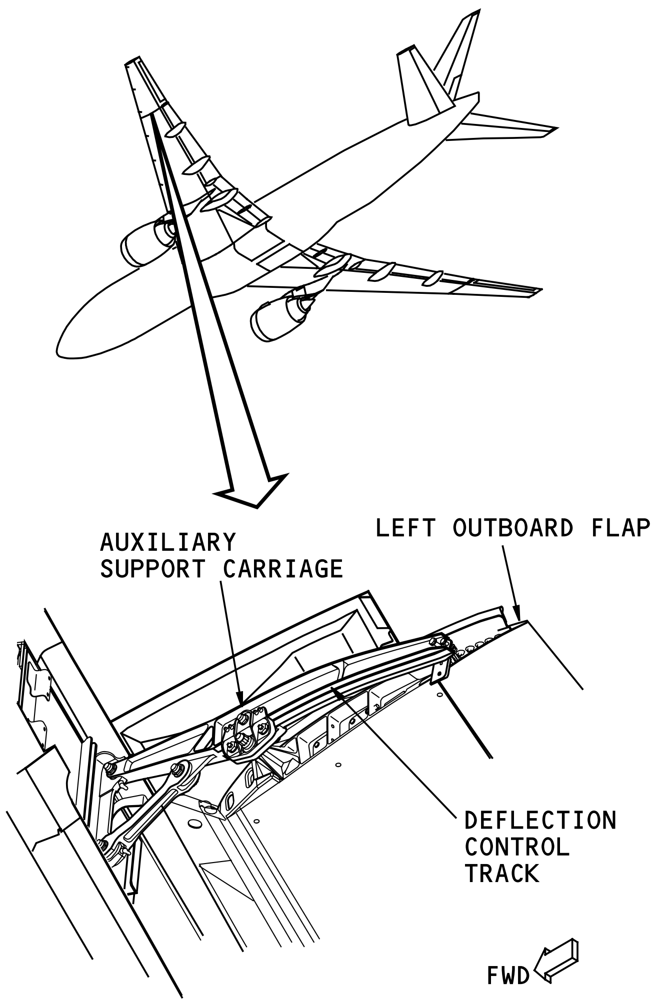
The outboard flap auxiliary supports make sure that the outboard flap deflection is similar to the wing deflection. When the flaps are extended, the outboard flap auxiliary supports prevent the ends of the flap from deflecting above the wing. When the flaps are retracted, the outboard flap auxiliary supports keep the flaps aligned with the wing.

Location

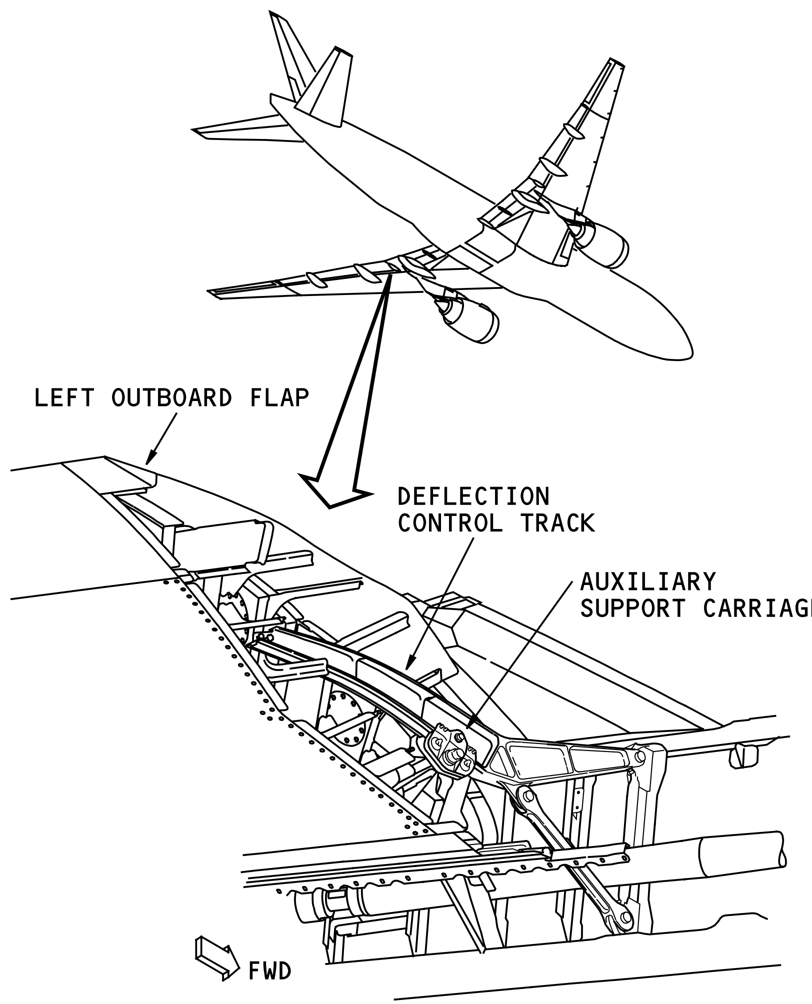
There is one support at each end of the outboard flap. Access to the supports is through access panels under the wing.

Physical Description

Each outboard flap auxiliary support has a deflection control track and a carriage. The carriage attaches to the flap structure. Rollers in the carriage move along the track.



OUTBOARD END OF LEFT OUTBOARD FLAP



INBOARD END OF LEFT OUTBOARD FLAP

27-51-00-024 Rev 1

TRAILING EDGE FLAPS - OUTBOARD FLAP AUXILIARY SUPPORTS

TRAILING EDGE FLAPS - INBOARD FLAP SUPPORT FAIRINGS

Purpose

The inboard flap support fairings cover the flap support mechanisms which are outside of the wing to body fairing and below the wing. The fairings supply an aerodynamic enclosure.

Physical Description

All the fairings are composite materials. They attach to their support structure by bearing points and by linkages.

The fairings have access panels to permit access to the components inside the fairings.

Location

The inboard flap has two flap support fairings on each wing. One is inboard near the wing to body fairing and one is outboard. There is also a center track fairing for the inboard aft flap.

Functional Description

The inboard support fairing has a forward fairing attached to the inboard main flap and an aft fairing attached to the inboard aft flap. The forward and aft fairings move with the main and aft flaps.

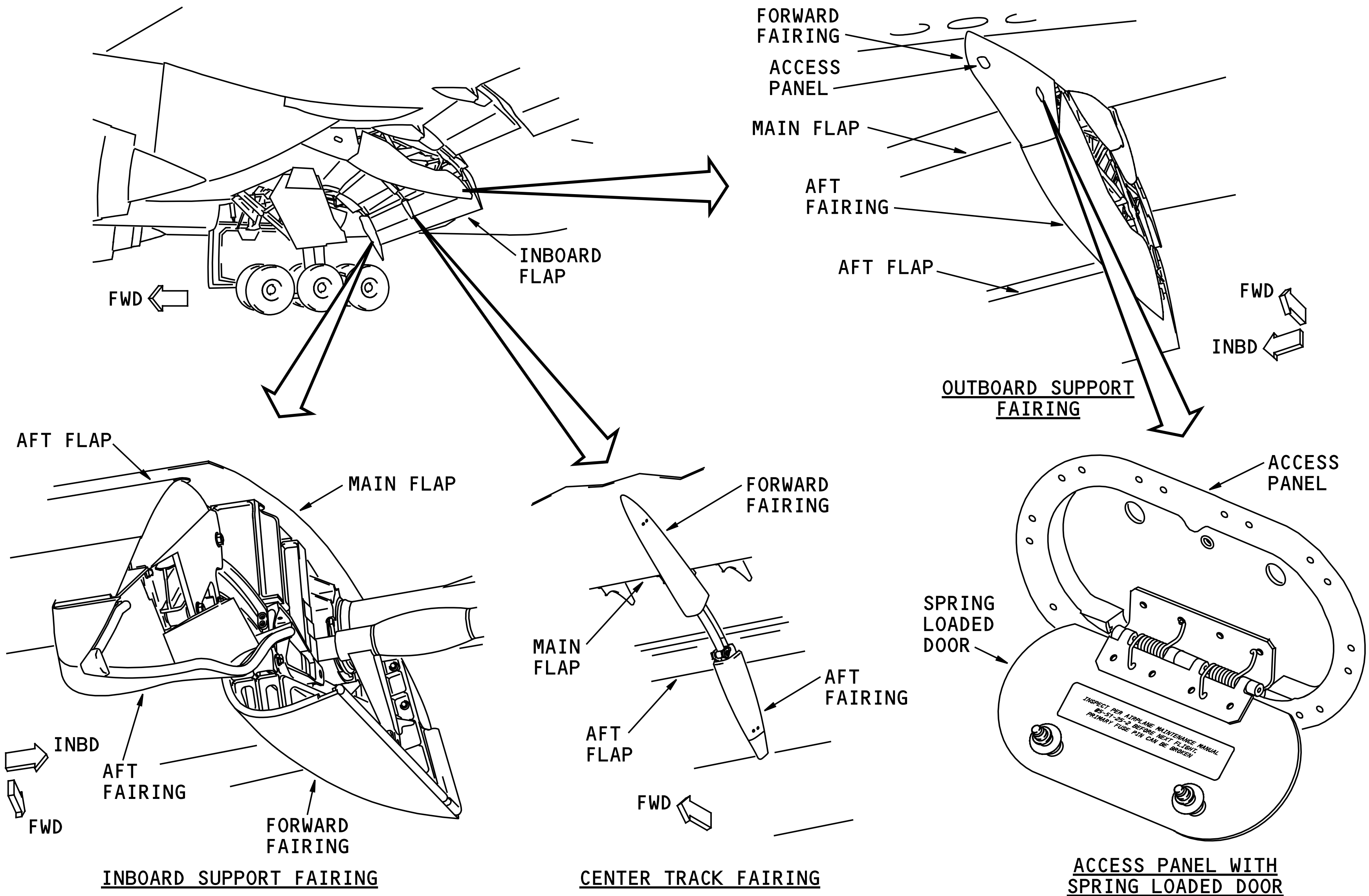
The center track fairing has a forward fairing attached to the inboard main flap and an aft fairing attached to the aft flap. The forward and aft fairings move with the main and aft flaps.

The outboard support fairing has a forward fairing attached to the wing lower surface and an aft fairing attached to the outboard flap support mechanism. The outboard support fairing moves down during the inboard flap extension to supply the clearance for the main and aft flap movement.

Training Information Point

There is a spring loaded door on the access panel on the outboard side of the outboard forward fairing for the inboard flap. This door is not for access to any components. It opens automatically to show that the primary fuse pin has sheared. The primary fuse pin connects the outboard support structure of the inboard flap to the wing. When the primary fuse pin shears, the load transfers to the secondary fuse pin. This causes the flap structure to move and to operate a mechanism that releases the door latch. Springs open the door and keep it open.

If you see this door open on the outboard forward fairing for the inboard flap, it is necessary to make an inspection of the fuse pins and make applicable corrections.



TRAILING EDGE FLAPS - INBOARD FLAP SUPPORT FAIRINGS

TRAILING EDGE FLAPS - FUNCTIONAL DESCRIPTION - PRIMARY MODE CONTROL

General

Only one FSEU commands the flaps in the primary mode.

In the primary mode, the FSEU controls:

- Flap retraction and extension
- Flap/slat sequence
- Cruise inhibit
- Flap load relief
- Low-speed control
- Shutoff control.

For redundancy, both channels in the FSEU must agree on the flap command. Each channel controls switches that are connected in series. Both channels must send the same command to the switches for the FSEU to energize the commanded solenoid.

The two coils in each solenoid of the primary control valve get electrical power from different power sources. Each FSEU controls the ground for one of the coils in each solenoid.

Flap Retraction and Extension

The FSEU compares the flap lever position to the flap position. The flaps retract if the flap lever position is less than the flap position. The flaps extend if the flap lever position is greater than the flap position.

Flap/Slat Sequence

This function controls the sequence of the retraction and extension of the flaps and slats. See the high lift control section for more information about the primary mode flap and slat sequence (AMM PART I 27-03).

Cruise Inhibit

This function prevents flap extension during cruise. This happens when the airspeed is more than 265 knots or the altitude is above 20,300 feet.

Flap Load Relief

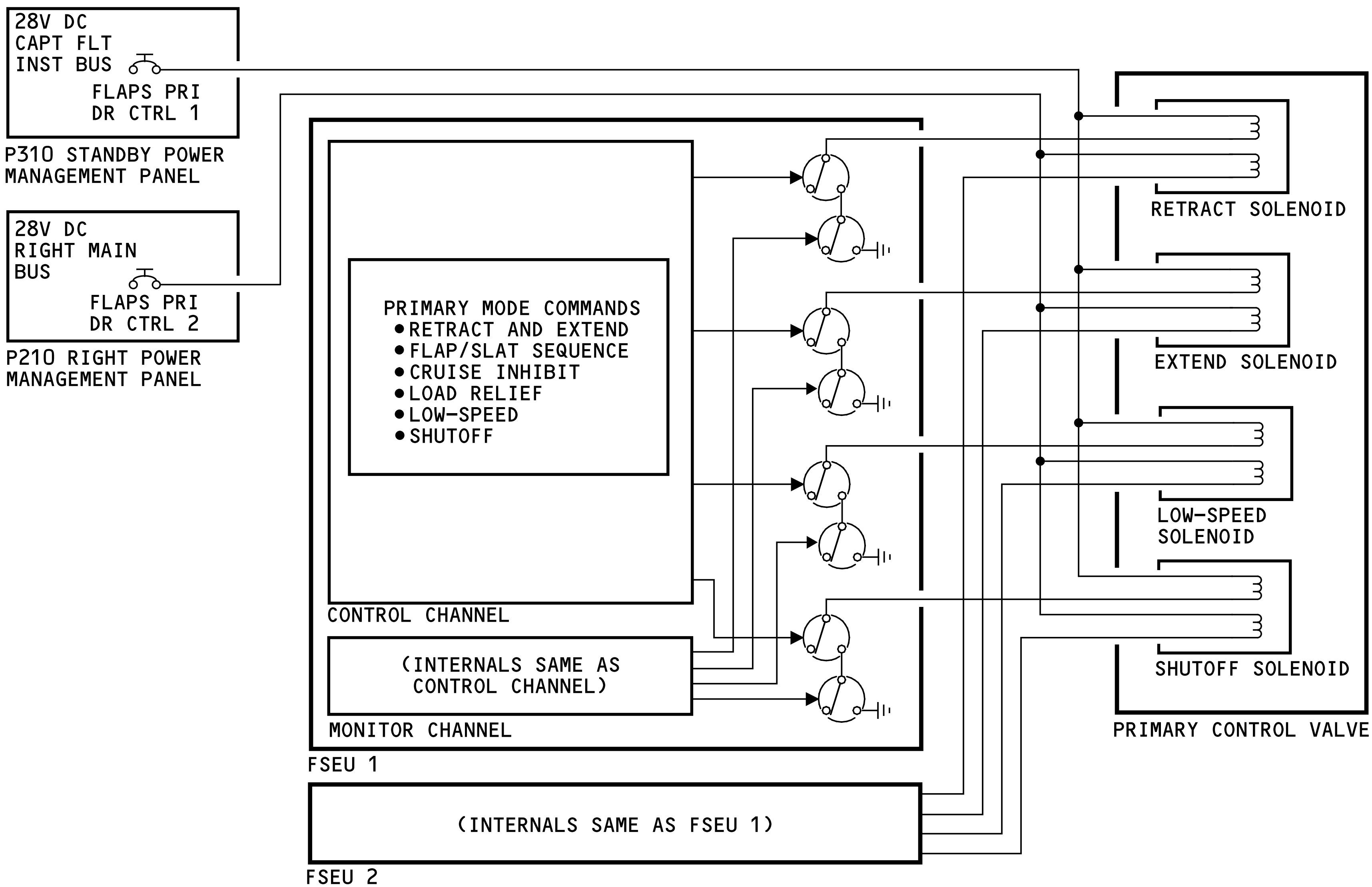
This function commands the flaps to retract if the airspeed increases above the flap load relief limit.

Low-Speed Control

This function reduces the speed of flap movement as the flaps approach the commanded position. The FSEU energizes the low-speed solenoid when the flaps are less than approximately seven torque tube turns from the commanded position.

Shutoff Control

The FSEU energizes the shutoff solenoid valve to open when there is a retract or extend command.



27-51-00-027 Rev 6

TRAILING EDGE FLAPS - FUNCTIONAL DESCRIPTION - PRIMARY MODE CONTROL

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TRAILING EDGE FLAPS - LOAD RELIEF - FUNCTIONAL DESCRIPTION

General

The flap load relief function prevents damage to the flaps and their support structures from large aerodynamic forces.

Flap load relief limits the position of the flaps as a function of airspeed. This function initiates when the airspeed is more than one knot more than the flap placard speeds.

Flap load relief operates only in the primary mode. It compares the flap lever command position to the airspeed.

Load relief is active if the airspeed increases above the load relief limit for more than one half second. Load relief then retracts the flaps or prevents the flaps from extending to the commanded position. Flap load relief retracts the flaps to these positions:

- 25
- 20
- 15
- 5.

The flap load relief command resets when the airspeed decreases below a set value. The load relief command also resets when the pilot moves the flap lever to or below the flap load relief position.

Load Relief - 25

Load relief retracts the flaps to 25 if the flap lever is at 30 and the airspeed is more than 171 knots. The load relief command resets if the airspeed decreases to less than 165 knots.

Load Relief - 20

Load relief retracts the flaps to 20 if the flap lever is at 30 or 25 and the airspeed is more than 186 knots. The load relief command resets if the airspeed decreases to less than 180 knots.

Load Relief - 15

Load relief retracts the flaps to 15 if the flap lever is at 30, 25, or 20 and the airspeed is more than 196 knots. The load relief command resets if the airspeed decreases to less than 190 knots.

Load Relief - 5

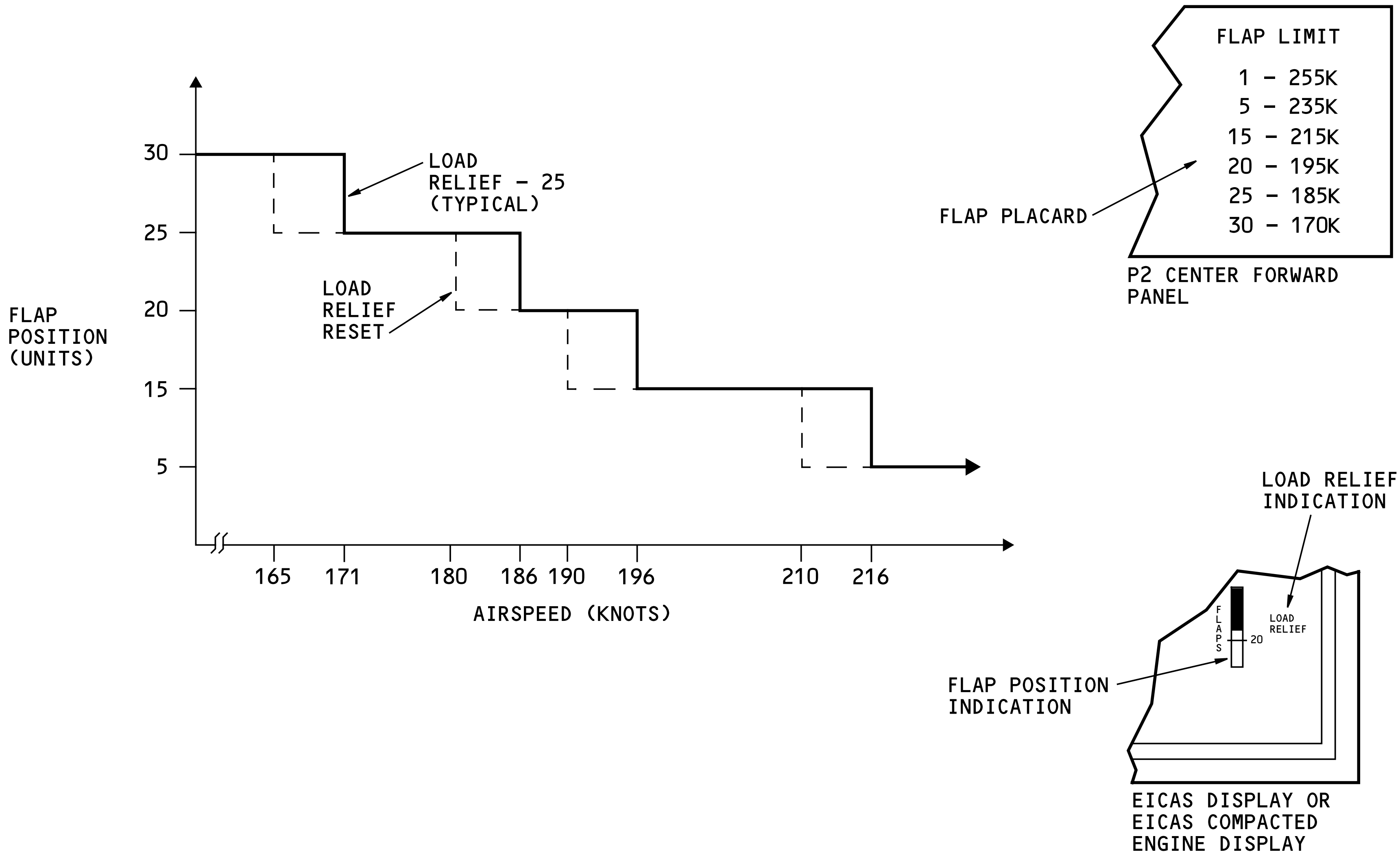
Load relief retracts the flaps to 5 if the flap lever is at 30, 25, 20, or 15 and the airspeed is more than 216 knots. The load relief command resets if the airspeed decreases to less than 210 knots.

Indication

When flap load relief is active, the LOAD RELIEF message shows on the EICAS display or on the EICAS compacted engine display.

TRAILING EDGE FLAPS - LOAD RELIEF - FUNCTIONAL DESCRIPTION

The flap position indication shows the position of the flaps. During load relief, the command bar and detent number change to magenta and do not agree with the flap position.



27-51-00-029 Rev 5 06/20/1997

TRAILING EDGE FLAPS - LOAD RELIEF - FUNCTIONAL DESCRIPTION

TRAILING EDGE FLAPS - FUNCTIONAL DESCRIPTION - SECONDARY MODE CONTROL

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TRAILING EDGE FLAPS - FUNCTIONAL DESCRIPTION - SECONDARY MODE CONTROL

General

Only one FSEU commands the flaps in the secondary mode.

The FSEU controls:

- Secondary mode engage
- Retraction and extension
- Flap/slat sequence
- Cruise Inhibit
- Secondary mode auto test.

For redundancy, both channels in the FSEU must agree on the flap command.

In the secondary mode, the FSEUs energize relays. The relays control the electrical power to the electric motor, clutch, and bypass solenoid. The alternate mode operation also uses these relays.

Secondary Mode Engage

When the FSEU engages the secondary mode, it energizes the bypass/clutch relay.

See the high lift control section for more information about the mode selection (AMM PART I 27-03).

This relay has three functions. First, the bypass/clutch relay supplies power to the bypass solenoid in the primary control valve. This prevents hydraulic operation in the primary mode.

Second, this relay supplies power to the clutch in the electric motor. This permits the electric motor to move the flap drive system.

Third, the bypass/clutch relay supplies power to the extend and retract relays. These relays do not energize until the FSEUs supply the grounds for them.

Retraction and Extension

The FSEU compares the flap lever position to the flap position. The flaps retract if the flap lever position is less than the flap position. The flaps extend if the flap lever position is greater than the flap position.

Either FSEU can energize the extend and retract relays to move the flaps. These relays supply 115v ac power to the electric motor.

Flap/Slat Sequence

This function controls the sequence of the retraction and extension of the flaps and slats. See the high lift control section for more information about the secondary mode flap and slat sequence (AMM PART I 27-03).

Cruise Inhibit

This function prevents flap extension during cruise. This happens when the airspeed is more than 265 knots or the altitude is above 20,300 feet.

TRAILING EDGE FLAPS - FUNCTIONAL DESCRIPTION - SECONDARY MODE CONTROL

Secondary Mode Auto Test

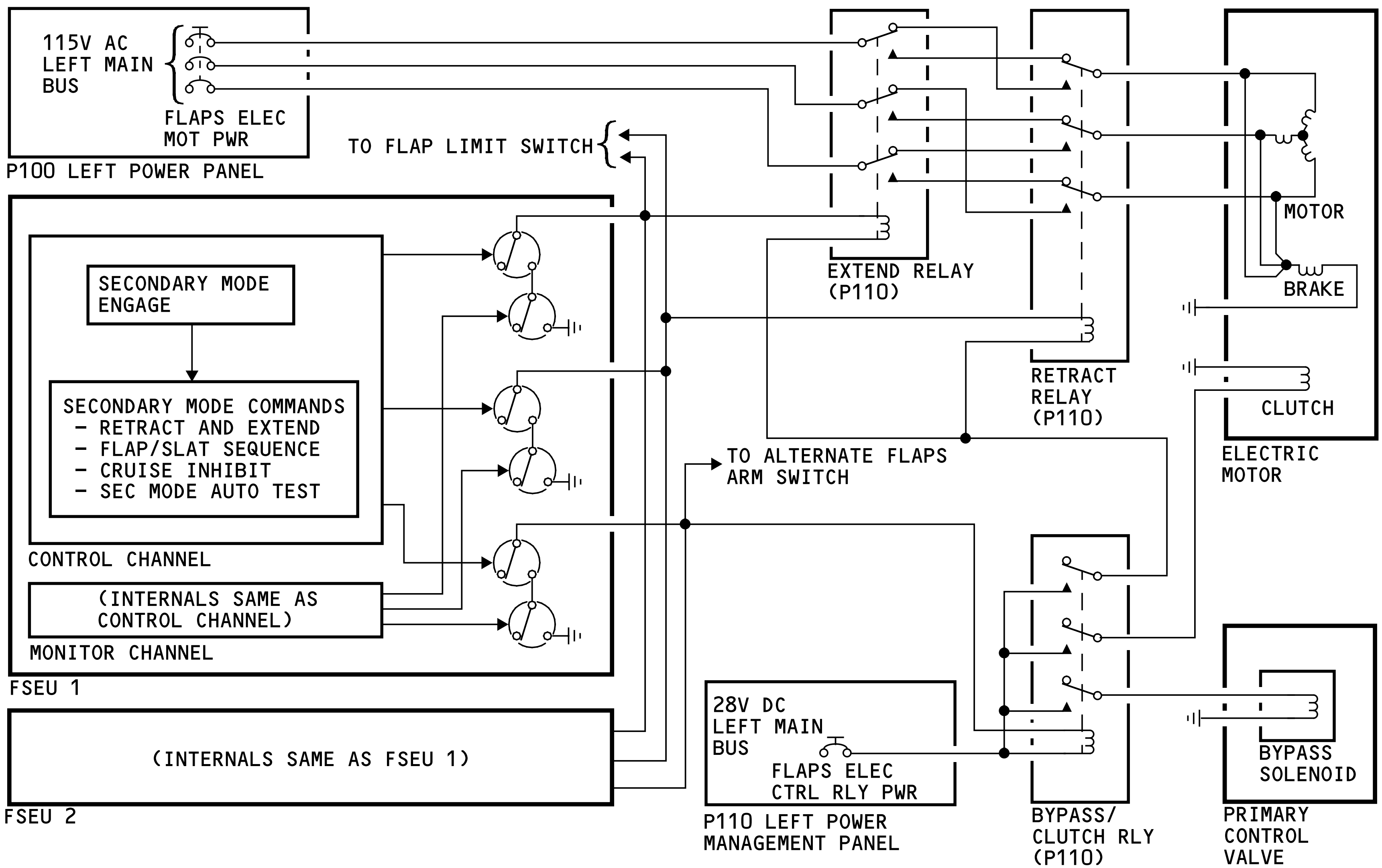
The secondary mode auto test checks the operation of the secondary mode. After 100 flight cycles, the FSEUs begin the test when the flaps are commanded to extend. The test does the following:

- Disengages the primary mode
- Engages the electric motor clutch
- Extends the flaps for two seconds using the electric motor.

One flight cycle is when all of these conditions occur for two seconds:

- Airplane not on the ground
- Airspeed is greater than 70 knots
- Flap lever is at up
- Flaps are at up.

If the flaps fail to extend during the secondary mode auto test, the FLAPS SECONDARY FAIL status message shows.



TRAILING EDGE FLAPS - FUNCTIONAL DESCRIPTION - SECONDARY MODE CONTROL

TRAILING EDGE FLAPS - FUNCTIONAL DESCRIPTION - ALTERNATE MODE CONTROL

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TRAILING EDGE FLAPS - FUNCTIONAL DESCRIPTION - ALTERNATE MODE CONTROL

General

The alternate mode operation of the flaps is almost the same as the alternate mode operation of the slats.

See the leading edge slats section for more information about the slats alternate mode control (AMM PART I 27-81).

In the alternate mode, the alternate flap/slat switches energize relays. The relays control the electrical power to the electric motor, clutch, and bypass solenoid.

In the alternate mode, these functions occur:

- Primary and secondary mode disengage
- Extend and retract control
- Flap/slat sequence.

Primary and Secondary Mode Disengage

When you push the alternate flaps arm switch, the FSEUs receive an alternate arm discrete. The FSEUs use this discrete to disengage the primary and secondary modes.

The alternate flaps arm switch also supplies a ground for the bypass/clutch relay. The operation of the bypass/clutch relay in the alternate mode is the same as in the secondary mode.

Extend and Retract Control

When the alternate flaps selector is in the extend (EXT) position, it supplies a ground for the extend relay to extend the flaps. When this relay energizes, it supplies 115v ac power to the electric motor. The flap limit switch de-energizes this relay when the flaps move to their extend limit. In the alternate mode, this limit is at the flap 20 position.

When the alternate flaps selector is in the retract (RET) position, it supplies a ground for the retract relay to retract the flaps. When this relay energizes, it supplies 115v ac power to the electric motor. The flap limit switch de-energizes this relay when the flaps move to the up position.

When the alternate flaps selector is in the off position, the grounds for the extend and retract relays is removed. This de-energizes the relays and stops the flap movement.

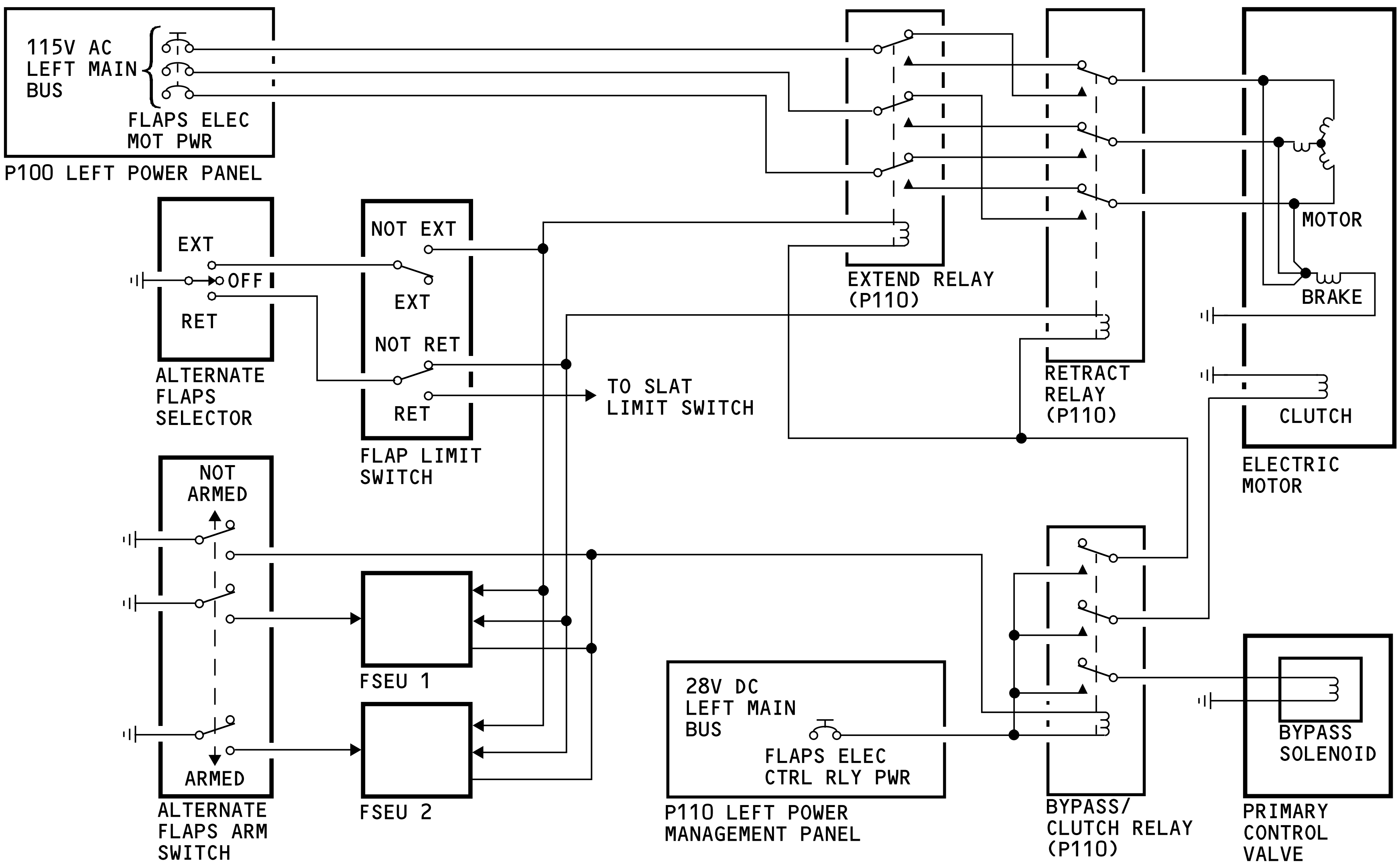
Flap/Slat Sequence

During extension, both the flaps and slats extend at the same time.

During retraction, the flap limit switch prevents retraction of the slats until the flaps are fully retracted.

TRAILING EDGE FLAPS - FUNCTIONAL DESCRIPTION - ALTERNATE MODE CONTROL

See the high lift control section for more information about the alternate mode flap and slat sequence (AMM PART I 27-03).



27-51-00-032 Rev 4 06/22/1995

TRAILING EDGE FLAPS - FUNCTIONAL DESCRIPTION - ALTERNATE MODE CONTROL

FLAP POSITION INDICATION - FLAP POSITION SENSORS AND GEARBOX

Purpose

The flap position sensor gearboxes transmit the flap torque tube position to the flap position sensors. The flap position sensors supply flap position data to the FSEUs for flap control, flap position indication, and failure detection.

Location

The flap position sensor gearboxes attach to the floor beams in the left and right main gear wheel wells. The gearboxes are between the flap PDU and the inboard flap inboard transmissions. The flap position sensors are on the flap position sensor gearboxes. The gearbox in the right wheel well also has the flap limit switch.

Physical Description

The flap position sensor gearboxes have a rig indicator that shows when the flaps are at the UP position. The indicator has a mark that turns with the flap drive. When the mark aligns with the fixed index, the flap drive is at the UP position.

There is a manual drive connection on each gearbox that permits you to manually drive the flaps. The manual drive input shaft has a shearout feature. Remove the manual drive cover to get access to the manual drive input shaft.

The flap position sensors are resolvers and they each have a rig indicator. The rig indicator has two marks that turn when the position sensor shaft turns. The two marks are in line when the flap drive line is at the UP position. All of these sensors are interchangeable with each other and with the slat position sensors.

Training Information Point

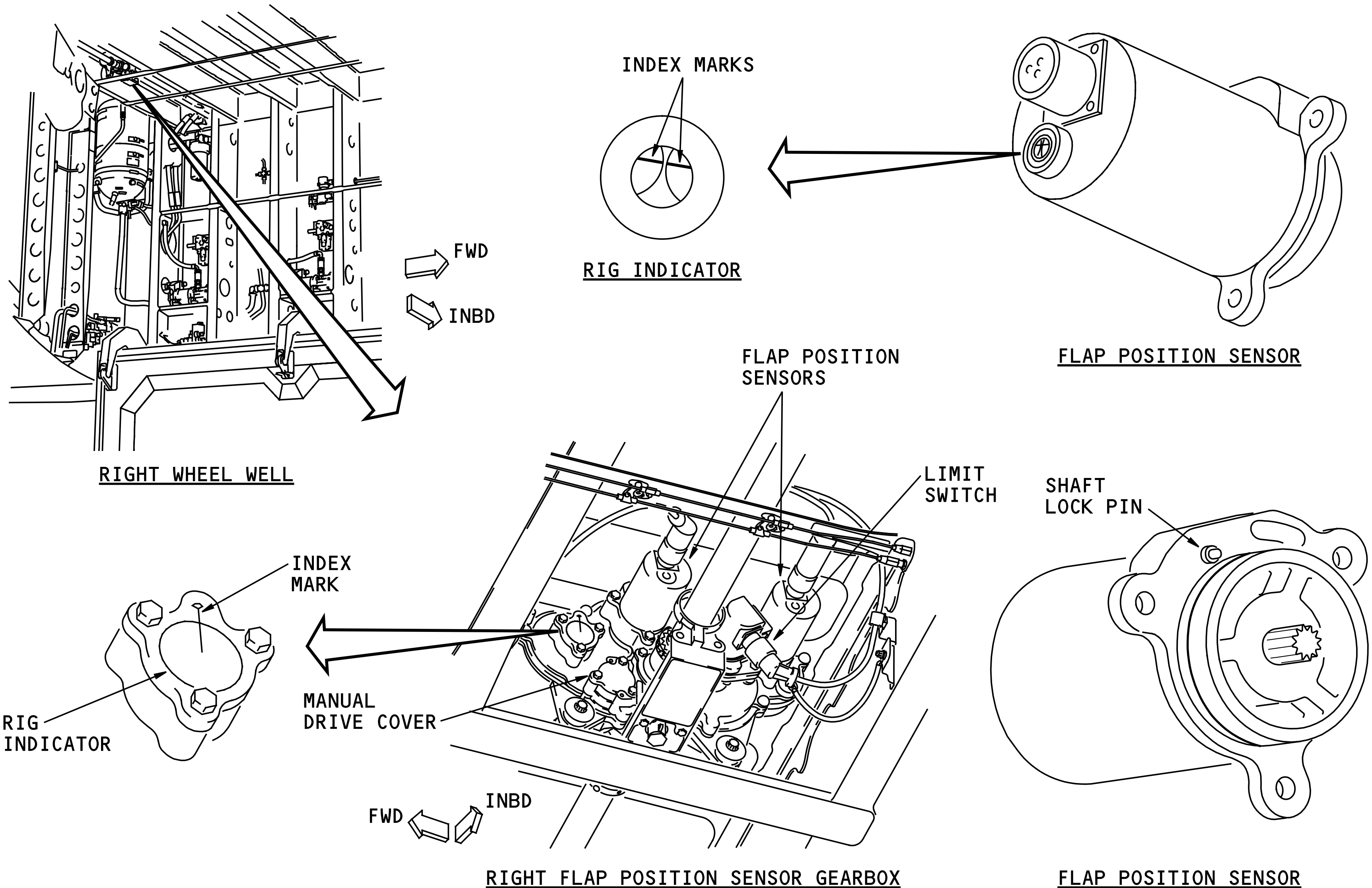
Install the flap position sensor gearboxes with the flaps at the UP position. Make sure the index mark for the rig indicator aligns with the fixed index.

Install the flap position sensor with the flap drive line in the UP position. Make sure that the index marks on the position sensor are aligned when you install the sensor. If the index marks on the position sensor are not aligned, you must push the shaft lock pin to turn the shaft. The shaft lock pin is next to the shaft.

When you manually operate the flap drive system, observe these cautions:

CAUTION: DO NOT TURN THE MANUAL DRIVE WITH MORE THAN 1200 POUND-INCHES TORQUE OR FASTER THAN 400 RPM. YOU CAN CAUSE DAMAGE TO THE POSITION SENSOR GEARBOX AND THE TORQUE TUBES.

CAUTION: DO NOT LET THE BALLSCREW NUTS HIT THE UPSTOPS OR THE DOWNSTOPS. YOU CAN CAUSE DAMAGE TO THE SHEAROUT IN THE POSITION SENSOR GEARBOX.



FLAP POSITION INDICATION - FLAP POSITION SENSORS AND GEARBOX

27-58-00-002 Rev 4 10/16/96

FLAP SKEW DETECTION - GENERAL DESCRIPTION

Purpose

The flap skew detection system monitors the position of the flaps. The FSEUs stop the primary and secondary mode flap operation if there is a skew, an asymmetry or a secondary mode disagree condition.

The flaps are in a skew condition if the inboard end of a flap does not align with its outboard end.

The flaps are in an asymmetry condition if the left flaps do not align with the right flaps.

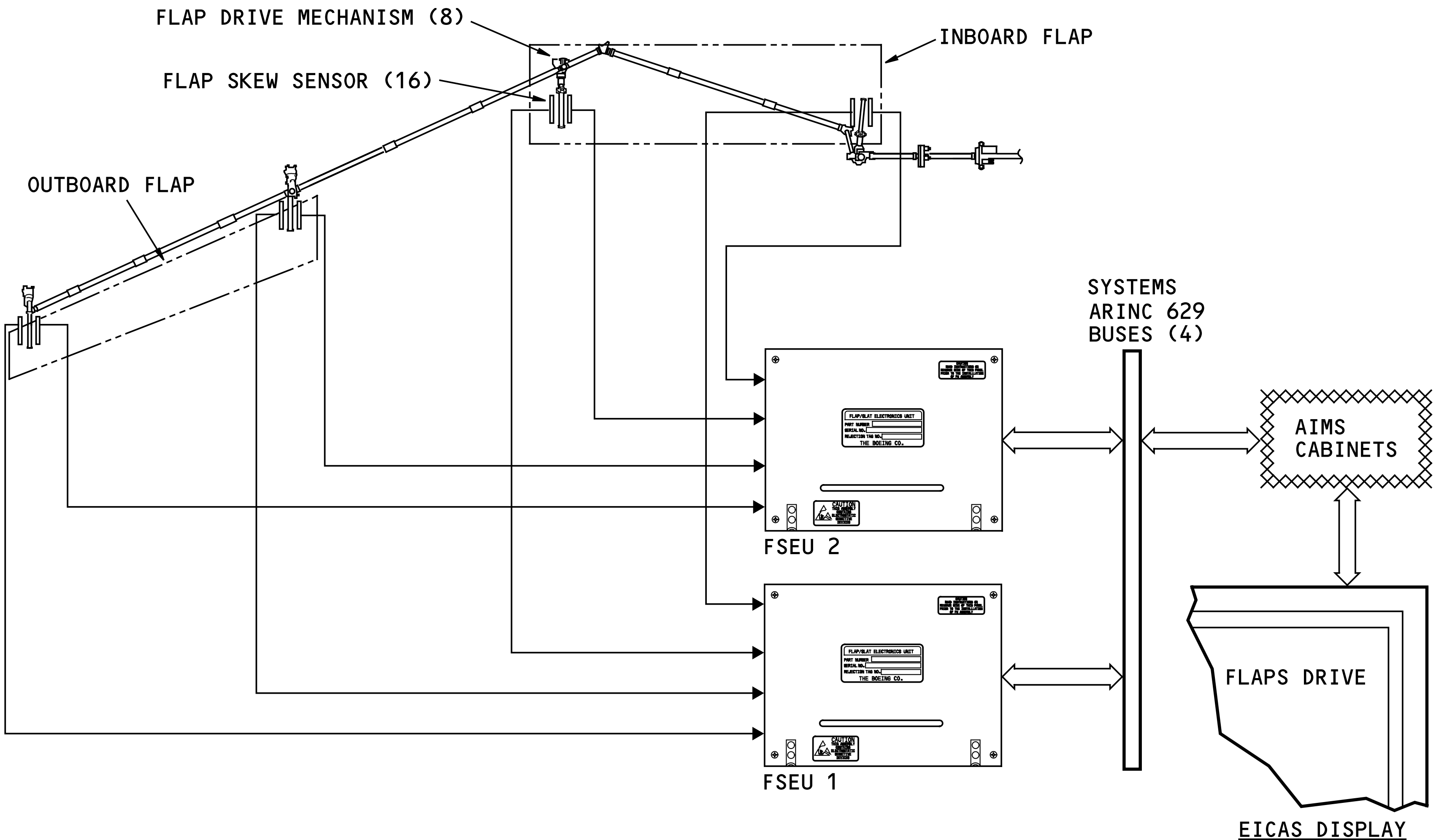
There is a secondary mode disagree if the flaps do not move or move too slowly after a command to move in secondary mode.

There is no automatic shutdown of the alternate mode if there is a flap skew, asymmetry, or secondary mode disagree.

Interface

There are 16 flap skew sensors. Each FSEU has interfaces with one sensor at each flap drive mechanism.

If the flaps are in a skew, an asymmetry or a secondary mode disagree condition, the FSEUs stop the flap drive in primary and secondary modes. The FSEUs also send a signal to the AIMS to show the FLAPS DRIVE caution EICAS message. If this happens, the flap position display on EICAS changes to the secondary mode display and the flap position indication shows in amber.



27-59-00-001 Rev 3

FLAP SKEW DETECTION - GENERAL DESCRIPTION

FLAP SKEW DETECTION - FLAP SKEW SENSORS

Purpose

The flap skew sensors monitor the position of the flaps at each flap drive mechanism.

Location

The flap skew sensors attach to the flap drive arm and the flap drive mechanism support. Access to these sensors is by extending the flaps to 30. Access to the sensors on the inboard flap inboard drive mechanism is through the main gear wheel wells.

Physical Description

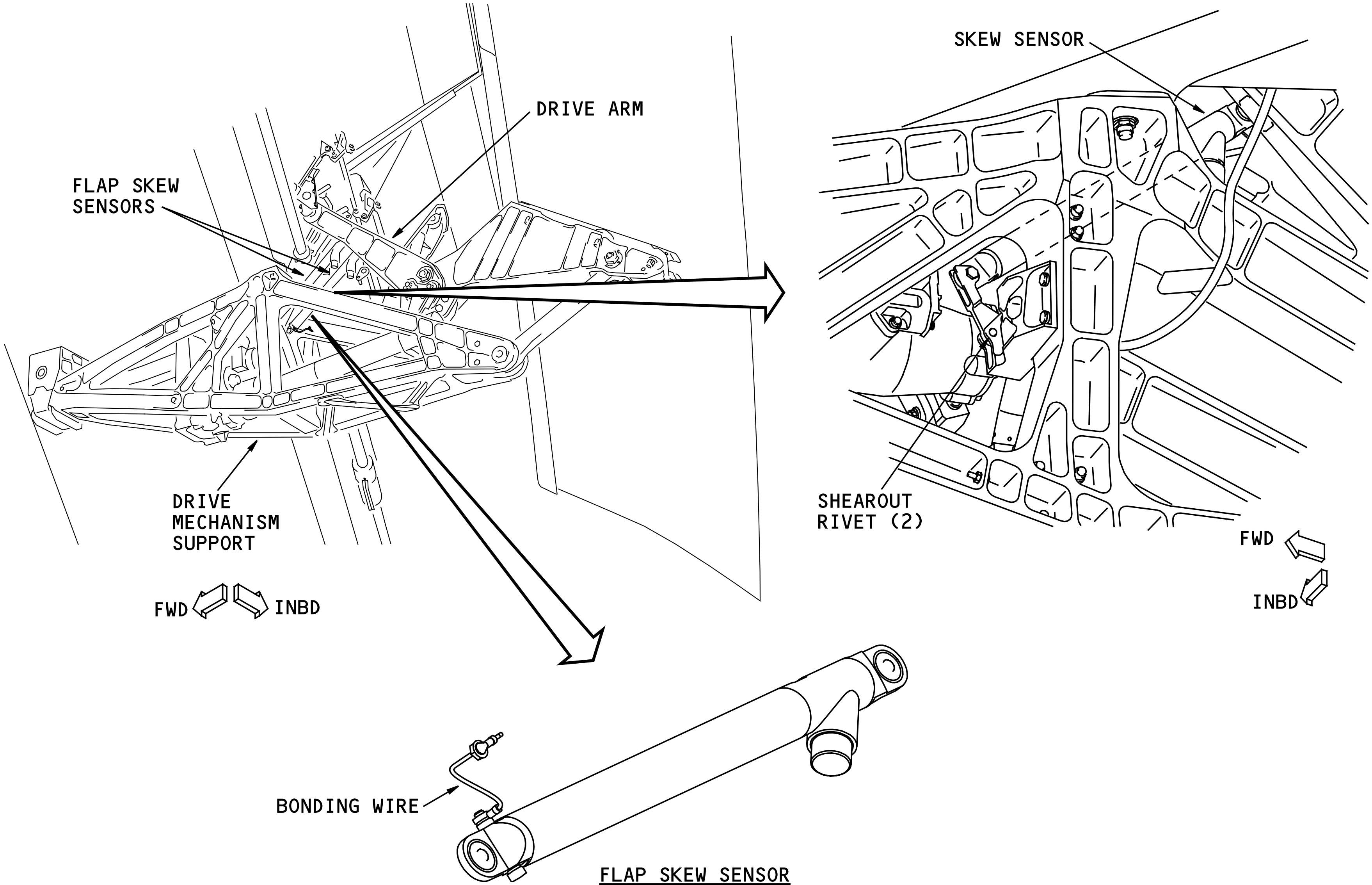
The flap skew sensors are linear variable differential transformers (LVDTs). Each sensor is a separate LRU.

The mounting bracket for each sensor has a shearout to prevent structural damage if the LVDT fails mechanically.

Training Information Point

The flap skew sensors do not need to be rigged after installation.

The electrical connectors for the outboard sensors on flap drive mechanisms 1, 2, 3, 6, 7, and 8 have a 45 degree bend. The connectors can be damaged if you install them on the wrong sensor.



FLAP SKEW DETECTION - FLAP SKEW SENSORS

27-59-00-002 Rev 4 01/19/95

FLAP SKEW DETECTION - FUNCTIONAL DESCRIPTION

General

There are 16 flap skew sensors. Each FSEU receives data from one of the skew sensors at each flap drive mechanism.

Both channels in the FSEUs use the flap skew data for failure detection. The FSEUs monitor for flap position failures and for sensor failures.

Flap Drive Shutdown

When both FSEUs find a failure, they stop the flap drive. There is a flap drive shutdown for any one of these conditions:

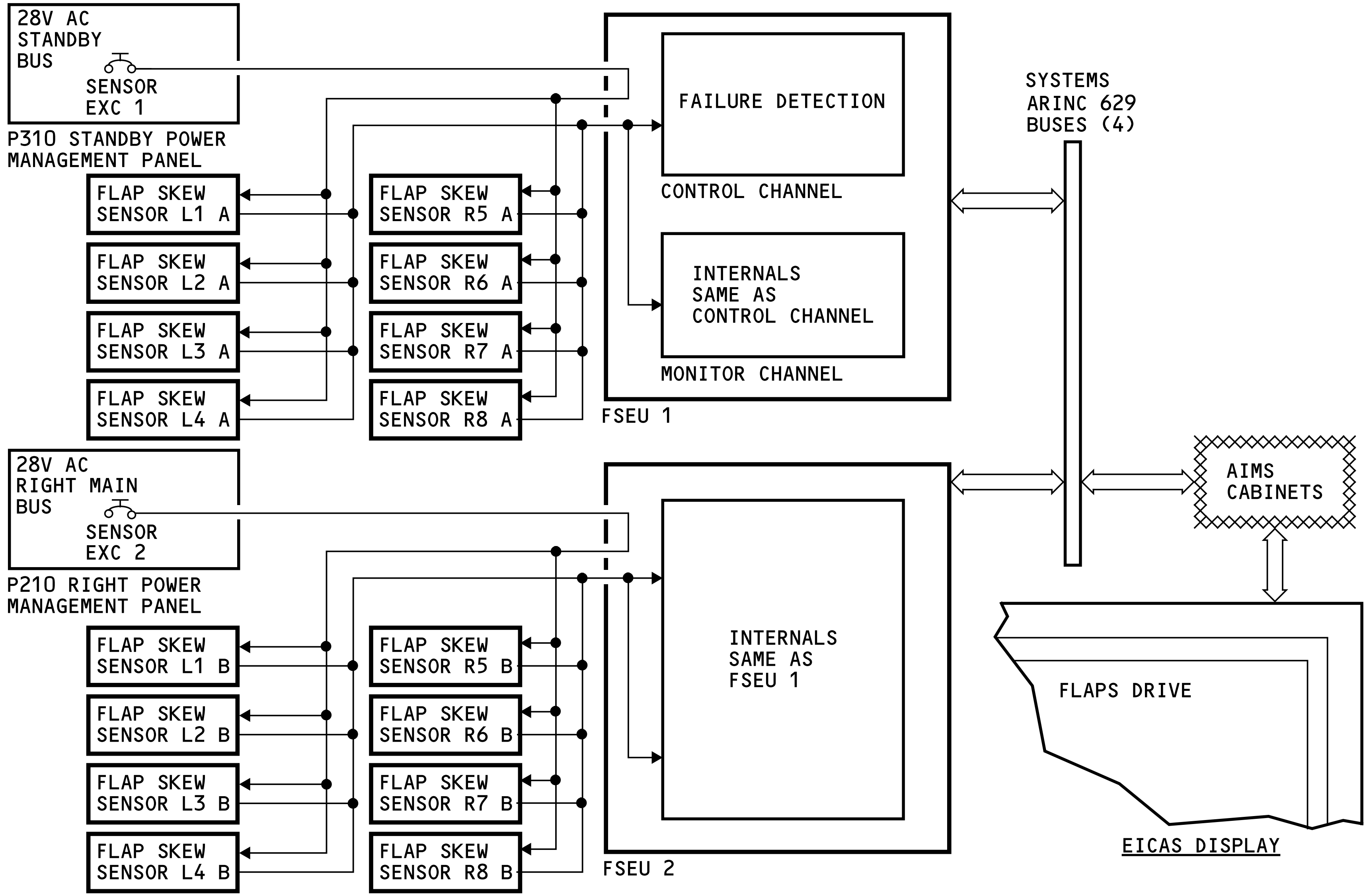
- Skew sensors on symmetrical flap drive mechanisms do not agree (asymmetry or skew)
- The left and right flap position sensors do not agree (asymmetry)
- The flaps do not move within 10 seconds after a flap command in the secondary mode or the flaps move too slowly (secondary mode disagree).

If there is a flap skew, asymmetry, or secondary mode disagree, the FSEUs latch the shutdown of the primary and secondary modes. The FSEUs also send signals to AIMS to show the FLAPS DRIVE caution message. The flap positon display changes to the secondary mode display and the flap position indication shows in amber.

To reset the latch, cycle the alternate flaps arm switch or do the primary system test on the MAT.

Skew Sensor Failure

If one of the flap skew sensors fail, the FSEUs send a signal to the AIMS to show the FLAP/SLAT SKEW SNSRS status message.



FLAP SKEW DETECTION - FUNCTIONAL DESCRIPTION

Continental Airlines, Inc

Leading Edge Devices

WB371

TABLE OF CONTENTS

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LEADING EDGE SLATS - INTRODUCTION

General

The leading edge (LE) slats improve the takeoff and landing performance of the airplane. When the slats extend, they increase the lift of the wing. They also increase the angle of attack (AOA) at which the wing stalls.

The slats are part of the high lift control system (HLCS). The HLCS electrically controls the slats with a fly-by-wire system.

During takeoff and landing, the pilots use the flap lever to command the slats to extend to the sealed or gapped positions. After takeoff, the pilots use the flap lever to command the slats to retract to the up position.

Each wing has an inboard slat, a krueger flap, and six outboard slats.

Slat Operation

The slats operate in sequence with the flaps. At cruise speed and altitude, slat extension is inhibited.

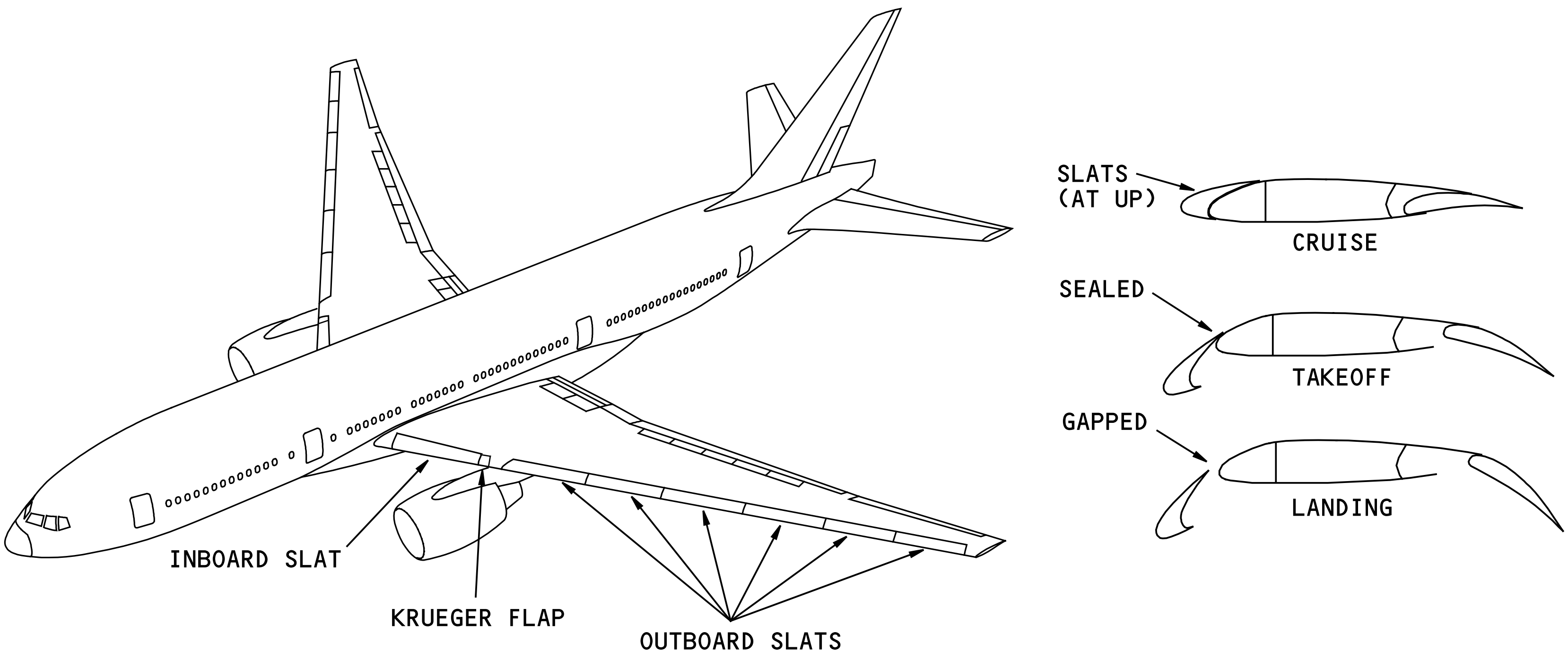
During secondary mode operation, the load relief function retracts the slats at high airspeed.

The autoslat function extends the slats to improve the airplane stall performance near stall conditions.

The slats are monitored for skew or asymmetry. When there is a skew or asymmetry, the slat drive shuts down.

Abbreviations and Acronyms

ADP	- air driven pump
AIMS	- airplane information management system
altn	- alternate
AOA	- angle of attack
ARINC	- Aeronautical Radio, Inc.
ASCPC	- air supply and cabin pressure controller
EICAS	- engine indication and crew alerting system
EXT	- extend
FSEU	- flap/slat electronics unit
HYDIM	- hydraulic interface module
HLCS	- high lift control system
LE	- leading edge
LVDT	- linear variable differential transformer
MAT	- maintenance access terminal
PDU	- power drive unit
retr	- retract
sec	- secondary
WEU	- warning electronic unit



27-81-00-001 Rev 2

LEADING EDGE SLATS - INTRODUCTION

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LEADING EDGE SLATS - GENERAL DESCRIPTION

General

The LE slats and krueger flaps operate in one of these three modes:

- Primary mode
- Secondary mode
- Alternate mode.

The primary mode uses hydraulic power to operate the slats. The secondary and alternate modes use electrical power to operate the slats.

Primary Mode

The primary mode has a closed-loop control system. The pilot commands the slats with the flap lever. The flap lever position sensor sends input signals to the FSEUs. The FSEUs use the flap lever position to calculate the slat commands. The FSEUs also receive data from the systems ARINC 629 buses.

The FSEUs send the slat commands to the slat primary control valve. This valve supplies hydraulic power to the slat power drive unit (PDU). The hydraulic motor on the PDU then moves the slat mechanisms.

The flap/slat priority valve controls the amount of hydraulic flow to the slat primary control valve. The flap/slat priority valve gives priority of hydraulic power to the primary flight control system (PFCS) over the HLCS.

As the slats move, the slat position sensors send feedback signals to the FSEUs. The FSEUs stop the slat commands when the feedback signals equal the commanded position.

The FSEUs use data from the systems ARINC 629 buses for the autoslat function. This function commands the autoslat priority valve to limit the flow of hydraulic fluid to the main landing gear system. This gives priority of the hydraulic power to the slats during autoslat operation. The autoslat priority valve also gives priority of hydraulic power to the HLCS over the main landing gear system during normal operations.

The FSEUs use the slat skew sensors to detect a slat skew and the position sensors to detect a slat asymmetry. In either condition, the FSEUs stop the slat drive.

Secondary Mode

The FSEUs use the secondary mode when the primary mode disengages. The secondary mode is only available in the air or during special maintenance functions.

The secondary mode also has a closed-loop control system. The pilot commands the slats with the flap lever. The FSEUs use the flap lever position to calculate the slat commands. The FSEUs then energize the secondary/alternate control relays. One relay energizes the bypass solenoid in the slat primary control valve and the clutch in the electric motor unit. This stops hydraulic power to the hydraulic motor and lets free flow through it. The electric motor clutch connects the motor shaft to the PDU gearbox. The other relays control electrical power to the slat electric motor on the slat PDU. The electric motor then moves the slat mechanisms.

As the slats move, the slat position sensors send feedback signals to the FSEUs. The FSEUs command the relays to stop the electric motor when the slats are at the commanded position.

The FSEUs use the slat skew sensors to detect a slat skew and the position sensors to detect an asymmetry or disagreement. In either condition, the FSEUs stop the slat drive.

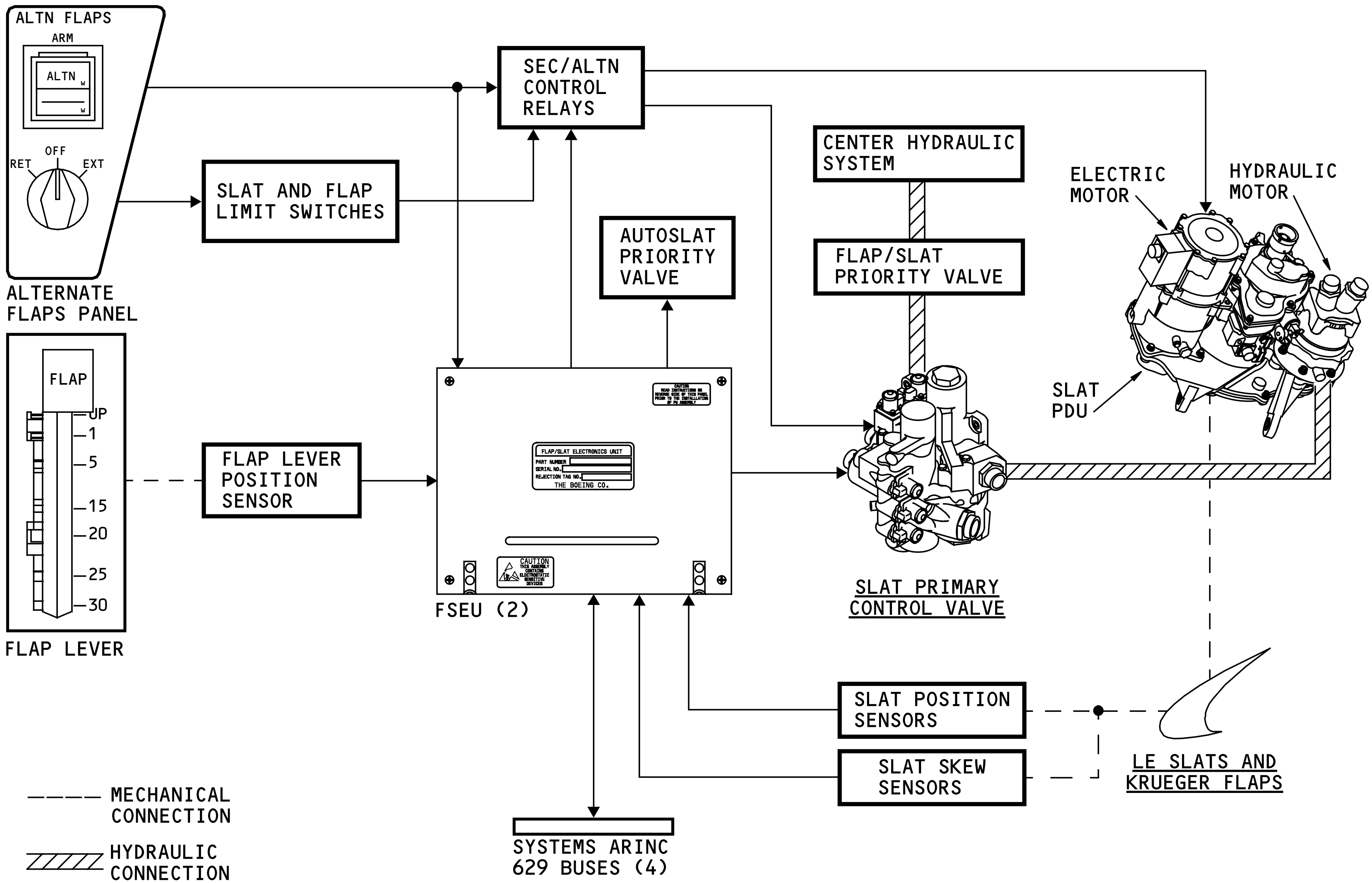
<u>Alternate Mode</u>

The alternate mode has an open-loop control system. The pilot uses the switches on the alternate flaps panel to command the slats. An arm switch sends a discrete signal to the FSEUs to disengage the primary and secondary modes. The switch also energizes one of the secondary/alternate control relays. This relay energizes the bypass solenoid in the slat primary control valve and the clutch in the electric motor. This stops hydraulic power to the hydraulic motor and lets free flow through it. The electric motor clutch connects the motor shaft to the PDU gearbox.

The alternate flaps selector sends commands through the slat and flap limit switches to energize the other secondary/alternate control relays. The relays control electrical power to the slat electric motor in the PDU. The electric motor then moves the slat mechanisms.

The slats move until the pilot moves the alternate flaps selector to the OFF position or the slat limit switch stops the motor when the slats are at their limits.

There is no automatic shutdown of the alternate mode if there is a slat skew or asymmetry.



27-81-00-002 Rev 5 03/28/96

LEADING EDGE SLATS - GENERAL DESCRIPTION

LEADING EDGE SLATS - GENERAL DESCRIPTION - SLAT DRIVE SYSTEM

General

There are six outboard slats, one inboard slat, and one krueger flap on each wing. The slats are numbered 1 through 14, left outboard to right outboard.

These are the components of the slat drive system:

- Slat PDU
- Torque tubes
- Torque tube supports
- Angle gearboxes
- Driveline offset gearboxes
- No-back brake offset gearboxes
- Krueger flap offset gearboxes
- Rotary actuators
- Slat main tracks.

Slat PDU

The slat PDU gets hydraulic power through the primary control valve and electric power through the slat extend/retract relays. Hydraulic and electric motors on the PDU move the slat drive system. The slat PDU also contains the slat limit switch. The switch removes electrical power from the electric motor when the slats move to their limit during operation in the alternate mode.

Torque Tubes

The torque tubes transmit power from the PDU to the slat actuation assemblies.

Torque Tube Supports

The torque tube supports hold the torque tubes in place.

Angle Gearboxes

The angle gearboxes connect torque tubes that are at different angles to each other.

Offset Gearboxes

The driveline offset gearboxes connect torque tubes that are offset from each other.

The no-back brake offset gearboxes transfer power from the torque tubes to the slat rotary actuators. These gearboxes also help prevent airloads from retracting the slats.

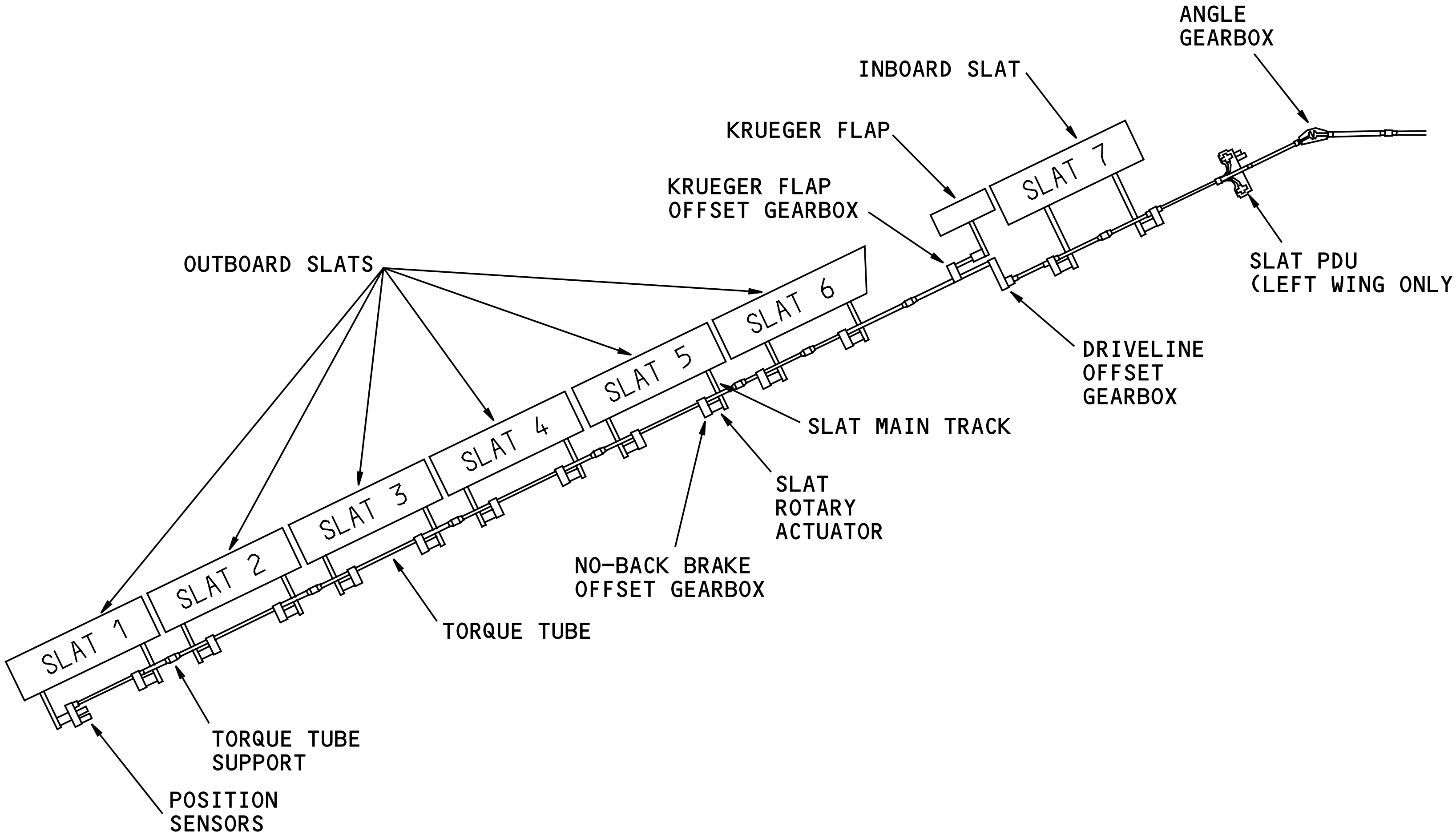
The krueger flap offset gearboxes transfer power from the torque tubes to the krueger flap rotary actuators.

Rotary Actuators

The slat rotary actuators move the slat main tracks. The krueger flap rotary actuators move the krueger flap.

Slat Main Tracks

As the slat rotary actuators turn, the slat main tracks move the slats.



<u>NOTE</u>: THE LEFT SLATS ARE SHOWN
(THE RIGHT SLATS ARE SIMILAR)

27-81-00-003 Rev 2 03/13/96

LEADING EDGE SLATS - GENERAL DESCRIPTION - SLAT DRIVE SYSTEM

LEADING EDGE SLATS - COMPONENT LOCATIONS

General

The slat components are in these areas:

- The main landing gear wheel wells
- The forward cargo compartment
- The wings.

Main Landing Gear Wheel Well Components

The slat primary control valve is on the keel beam in the left main landing gear wheel well. The autoslat priority valve is on the ceiling in the right main landing gear wheel well.

Forward Cargo Compartment Components

The floor angle gearboxes and some of the torque tubes are above and to the sides of the aft section of the forward cargo compartment. Remove the cargo lining in the aft section of the forward cargo compartment to get access.

Wing Components

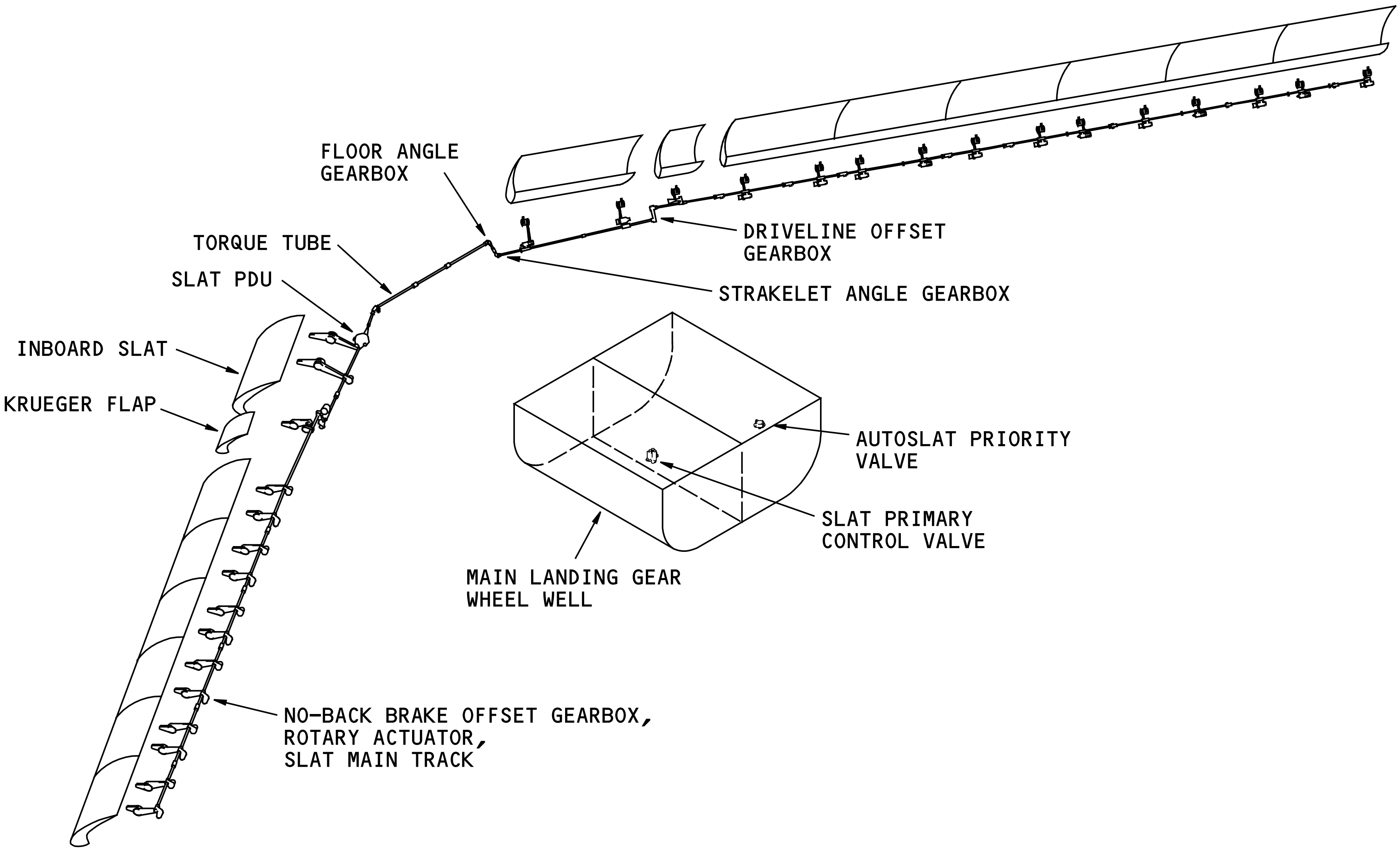
The slat PDU and one of the strakelet angle gearboxes are in the left wing root. The other strakelet angle gearbox is in the right wing root. Remove the access panels under the wings to get access to these components.

In the fixed leading edge of the wings are the following components:

- No-back brake offset gearboxes
- Rotary actuators
- Slat main tracks
- Some of the torque tube supports
- Driveline offset gearboxes.

Remove the access panels under the wings to get access to these components.

The inboard slats, krueger flaps, and outboard slats are on the leading edge of the wings. The krueger flap is between the inboard slat and the engine strut.



27-81-00-004 Rev 5

LEADING EDGE SLATS - COMPONENT LOCATIONS

LEADING EDGE SLATS - SLAT PRIMARY CONTROL VALVE

Purpose

The slat primary control valve controls hydraulic power to the hydraulic motor. In the primary mode, this valve controls the direction and speed of movement of the slat drive system. In the secondary and alternate modes, this valve prevents hydraulic power to the hydraulic motor.

Physical Description

The primary control valve is an LRU. These components on the primary control valve are LRUs:

- The shutoff solenoid
- The extend solenoid
- The retract solenoid
- The low-speed solenoid
- The bypass solenoid.

The low-speed solenoid is different than the other solenoids, but it is interchangeable with the low-speed solenoid on the flap primary control valve. All the other solenoids are interchangeable and they are interchangeable with the other solenoids on the flap primary control valve. The slat primary control valve is similar to, but not interchangeable with, the flap primary control valve.

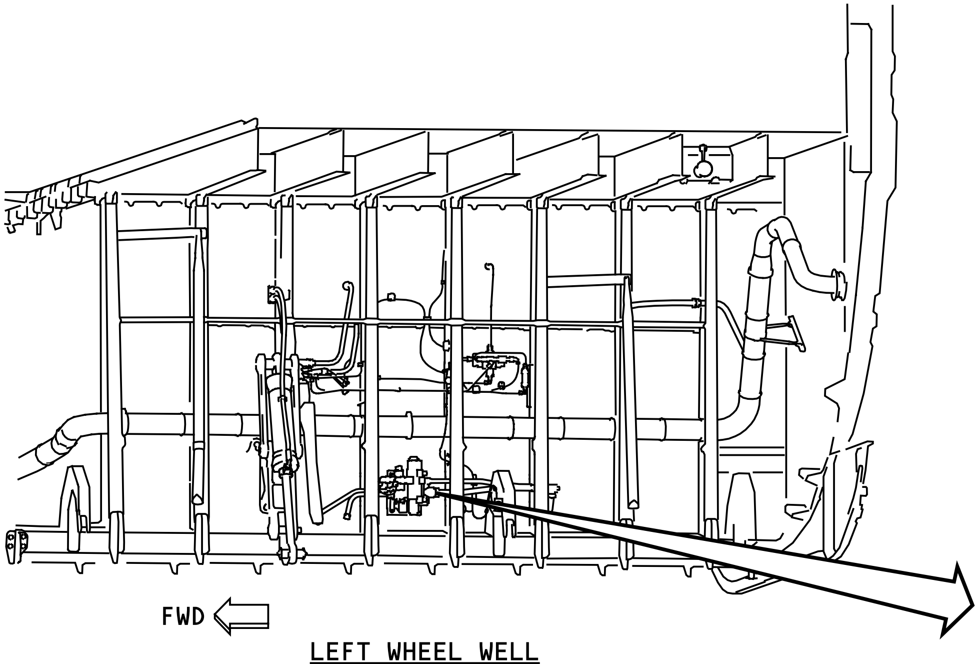
Location

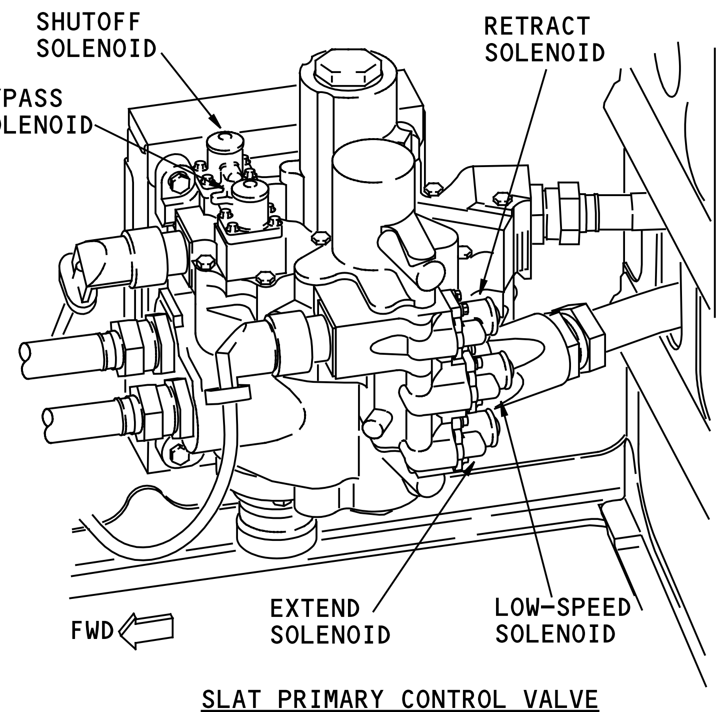
The slat primary control valve attaches to the keel beam in the left main landing gear wheel well.

Training Information Point

There is a small difference in the location of the mounting holes for the flap and slat primary control valves. This helps prevent the slat primary control valve from being installed where the flap primary valve should be. The reverse is also true.

The low-speed solenoid has a longer valve and different mounting hole locations. This helps prevent the low-speed solenoid from being installed where a different type of solenoid should be. This also helps prevent a different solenoid from being installed where the low-speed solenoid should be.





27-81-00-005 Rev 2 08/12/95

LEADING EDGE SLATS - SLAT PRIMARY CONTROL VALVE

LEADING EDGE SLATS - PRIMARY CONTROL VALVE - FUNCTIONAL DESCRIPTION

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LEADING EDGE SLATS - PRIMARY CONTROL VALVE - FUNCTIONAL DESCRIPTION

General

The primary control valve has these components:

- Shutoff valve
- Shutoff solenoid valve
- Low-speed solenoid valve
- Low-speed piston
- Flow regulator
- Retract solenoid valve
- Extend solenoid valve
- Selector valve
- Bypass solenoid valve
- Bypass valve.

The FSEUs electrically control the solenoid valves in the primary control valve. All the solenoid valves are normally de-energized.

Shutoff Valve and Shutoff Solenoid Valve

The shutoff valve supplies hydraulic pressure and hydraulic flow to the selector valve.

The shutoff valve has three positions: closed, open, and low-speed. The shutoff valve is spring-loaded and hydraulically controlled to the closed position. It moves to the open or low-speed positions when the shutoff solenoid valve removes pressure from one side of the valve.

The shutoff solenoid valve controls the pilot pressure to the shutoff valve. The shutoff valve solenoid has two coils. When both coils are de-energized, the shutoff solenoid valve lets pilot pressure close the shutoff valve. When either coil is energized, the shutoff solenoid valve removes pilot pressure from the shutoff valve. Hydraulic system pressure then lets the shutoff valve open.

When the shutoff valve is closed, it removes hydraulic pressure from the selector valve. When the shutoff valve is open, hydraulic system pressure goes to the selector valve to move the slats at their normal rate. When the shutoff valve is in the low-speed position, the hydraulic flow to the selector valve is restricted.

Low-Speed Solenoid Valve, Low-Speed Piston and Flow Regulator

The low-speed solenoid valve, the low-speed piston and the flow regulator help to decrease the speed of the flap drive system.

The low-speed solenoid valve is a dual-coil solenoid valve that controls hydraulic pressure to the low-speed piston. The low-speed piston is a hydraulic piston that is spring-loaded to the retracted position.

When the FSEUs energize the low-speed solenoid valve, the low-speed piston extends. This limits the position of the shutoff valve to the low-speed position.

When the FSEUs de-energize the low-speed solenoid valve, the pressure in the low-speed piston decreases. An internal spring then forces the low-speed piston to retract. This lets the shutoff valve move to the open position.

The flow regulator limits the flow of hydraulic fluid to 35 gpm at high speed, and 7 gpm at low-speed.

Selector Valve

The selector valve controls the direction of operation of the hydraulic motor.

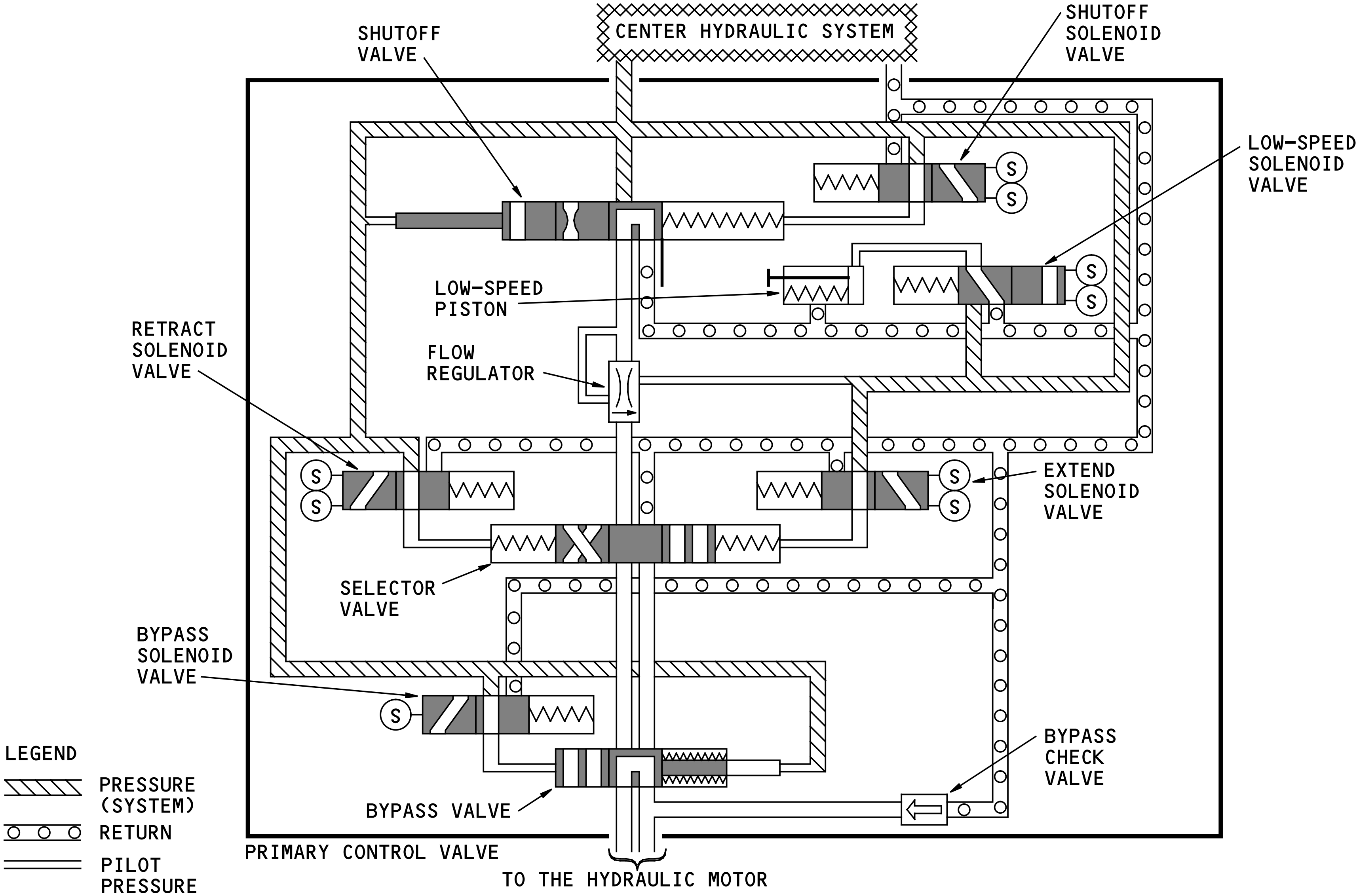
The selector valve is spring-loaded and hydraulically balanced to the center position and normally has pressure on both sides of the valve. The selector valve moves to the extend position when the extend solenoid valve removes pilot pressure from the extend side of the selector valve. The selector valve moves to the retract position when the retract solenoid valve removes pilot pressure from the retract side of the selector valve.

Bypass Valve and Bypass Solenoid Valve

The bypass valve isolates the hydraulic motor from hydraulic system pressure. The bypass valve also prevents a hydraulic lock and permits backdrive of the hydraulic motor.

A dual-coil bypass solenoid valve controls pilot pressure to the bypass valve, but only one coil of the solenoid is used. When the FSEUs energize the bypass solenoid valve, it removes pilot pressure from the open side of the bypass valve. This closes the bypass valve, which connects the hydraulic lines to both sides of the hydraulic motor.

The bypass valve is spring-loaded and hydraulically controlled to the closed position. The open side of the valve has a larger surface area for the pilot pressure than the close side of the valve. When the center hydraulic system pressure is low, springs automatically force the bypass valve to close. When the center hydraulic system pressure is high, the bypass valve opens.



27-81-00-006 Rev 3

LEADING EDGE SLATS - PRIMARY CONTROL VALVE - FUNCTIONAL DESCRIPTION

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LEADING EDGE SLATS - SLAT POWER DRIVE UNIT (PDU)

Purpose

The slat PDU turns the slat torque tubes during operation in all three modes. The slat PDU has these LRUs:

- A hydraulic motor
- An electric motor
- A limit switch
- A gearbox.

Information on the hydraulic motor, the electric motor, and the limit switch is shown later.

Location

The slat PDU is in the left wing root. Remove the access panel or open the small access panel under the wing to get access.

Gearbox

The gearbox transmits the power from the hydraulic or electric motors to the torque tubes.

The hydraulic motor or the electric motor rotates gears in the gearbox. These gears increase the torque from the motors. The gearbox turns the torque tube couplings on both sides of the PDU. These couplings turn the torque tubes.

The gearbox contains a ball ramp torque brake to limit the output torque from either side of the PDU. When the torque brake activates, a torque trip indicator shows. There is a separate torque trip indicator for the PDU output to the left wing slats and to the right wing slats. The torque trip indicators have the labels LEFT WING and RIGHT WING. The indicators are reset manually.

The slat PDU has a rig pin that locks the PDU gearbox in the slats UP position. A ground lockpin next to the rig pin locks the rig pin in the rig position.

The gearbox also contains a stroke control mechanism to stop the PDU output if one of the motors on the PDU fails to stop. The stroke control mechanism stalls the hydraulic or electric motors within two torque tube rotations of the maximum normal slat positions.

During high-speed operation in the primary mode, the gearbox turns the torque tubes at 640 rpm. During low-speed operation, the gearbox turns the torque tubes at 128 rpm.

During operation in the secondary and alternate modes, the gearbox turns the torque tubes at 85 rpm.

Training Information Point

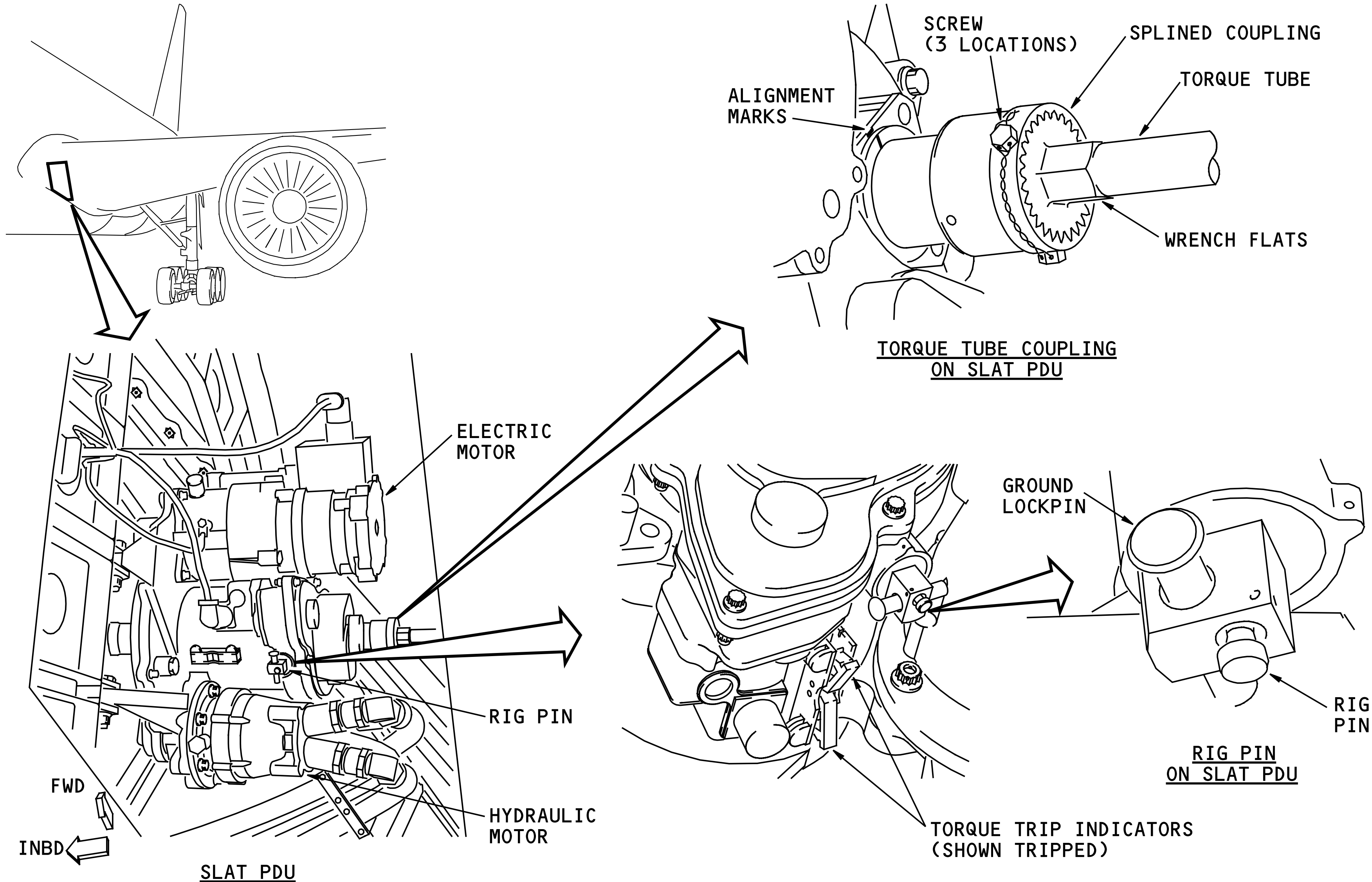
Wrench flats on the torque tube between the PDU and slat 7 let you manually rotate the slat system.

To install the rig pin in the slat PDU, retract the slats to the UP position. See that the alignment mark on the output shaft aligns with the fixed index mark on the PDU. If the alignment mark does not align with the

LEADING EDGE SLATS - SLAT POWER DRIVE UNIT (PDU)

index mark, use the wrench flats on the torque tube to turn the PDU in the extend direction, then in the retract direction until the marks align. Push the rig pin in the PDU and hold it while you lock it with the ground lockpin.

The gearbox contains oil and it is necessary to do servicing at specified times. Use the oil fill plug.



27-81-00-007 Rev 4 03/21/96

LEADING EDGE SLATS - SLAT POWER DRIVE UNIT (PDU)

LEADING EDGE SLATS - SLAT LIMIT SWITCH

Purpose

The slat limit switch limits the position of the slats during alternate mode operation.

Location

The limit switch is on the slat PDU.

Physical Description

The limit switch is one LRU. It has two internal switches, retracted and extended.

Functional Description

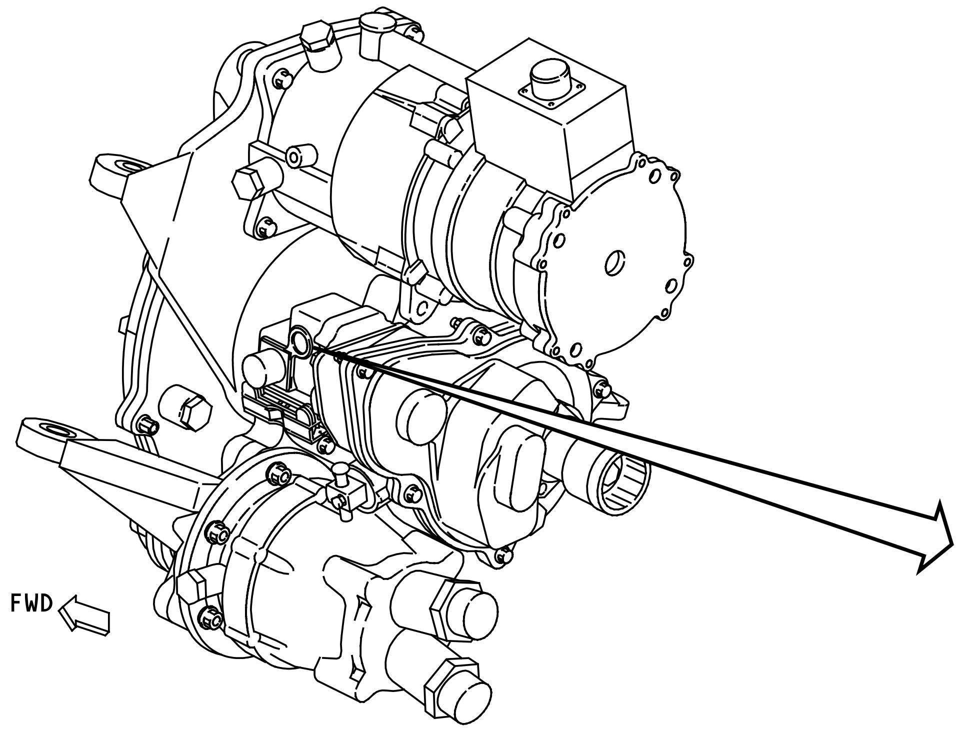
When the slats retract to the up position, the retracted switch removes electrical power from the slat electric motor.

When the slats extend to the sealed position, the extended switch removes electrical power from the slat electric motor.

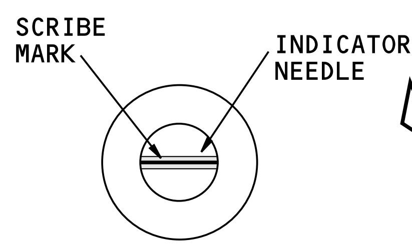
Training Information Point

The slat limit switch is interchangeable with the flap limit switch.

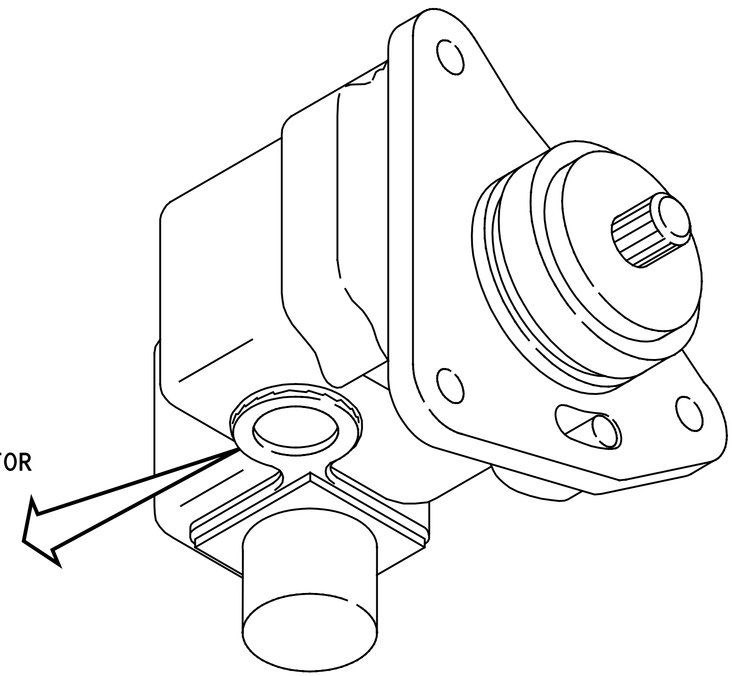
Install the slat limit switch with the slat PDU in the rigged position. The limit switch rig indicator has a fixed scribe mark and an indicator needle. The indicator needle moves up or down in relation to the scribe mark as the shaft of the limit switch turns. Make sure the center of the indicator needle in the rig indicator aligns with the scribe mark when you install the limit switch.



SLAT PDU



RIG INDICATOR



SLAT LIMIT SWITCH

27-81-00-009 Rev 2 03/19/96

LEADING EDGE SLATS - SLAT LIMIT SWITCH

LEADING EDGE SLATS - AUTOSLAT PRIORITY VALVE

Purpose

The autoslat priority valve controls the flow of hydraulic fluid to the main landing gear (MLG) system. This valve gives priority of center hydraulic system power to the slats during autoslat operation and to the flaps and slats during landing gear operation.

Location

The autoslat priority valve is on the ceiling of the right MLG wheel well.

Physical Description

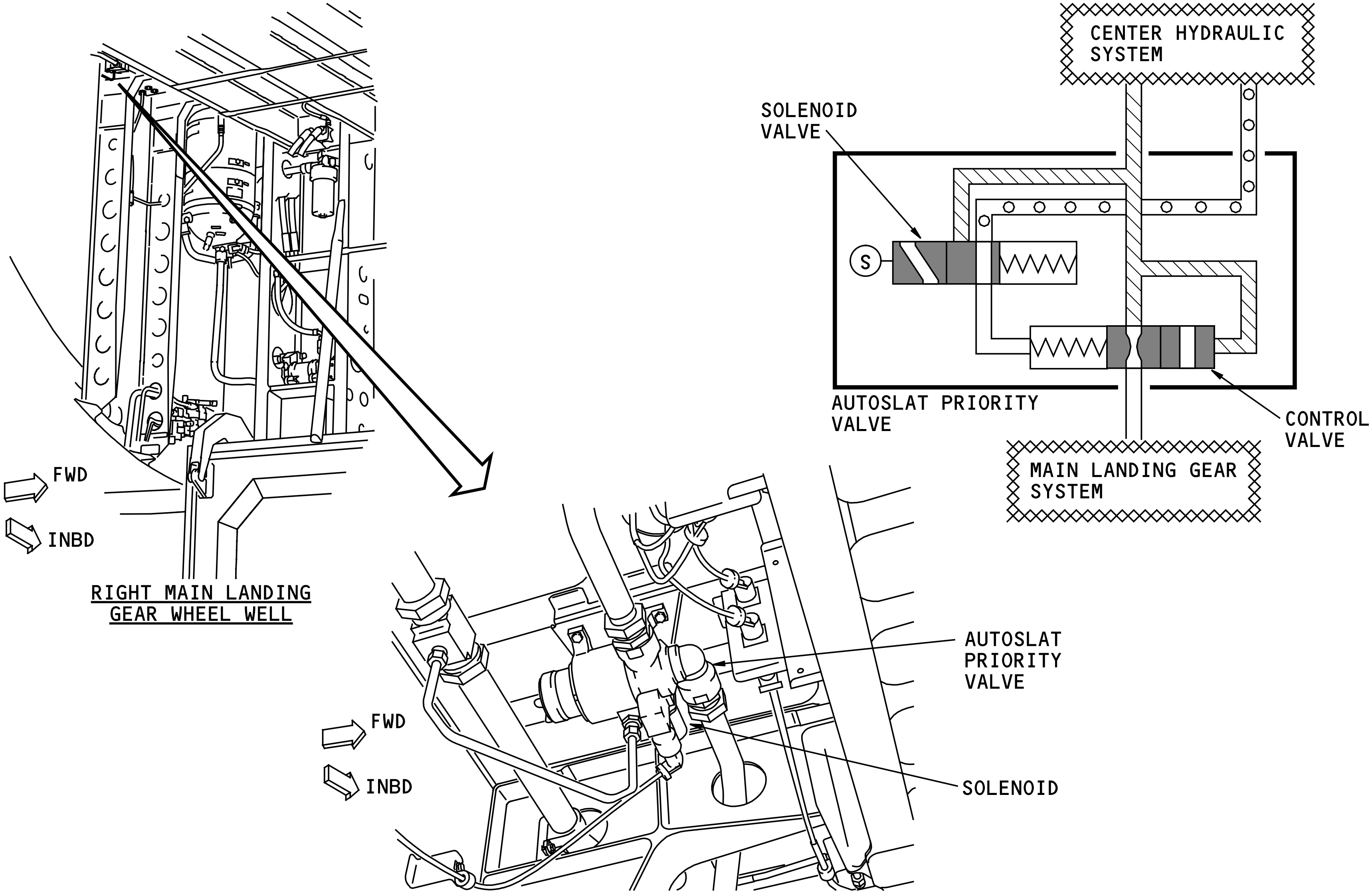
The autoslat priority valve includes a solenoid valve and a control valve.

Functional Description

The control valve receives pilot pressure from the solenoid valve and from the center hydraulic system. When the solenoid valve de-energizes, the control valve permits full hydraulic flow to the MLG system.

During autoslat operation, the solenoid valve energizes. This moves the control valve to the reduced flow position. This reduces the hydraulic flow to the MLG system and gives priority of the hydraulic power to the slats.

If the center hydraulic system pressure is less than approximately 2550 psi, springs force the control valve to the reduced flow position. This reduces the hydraulic flow to the MLG system and gives priority of the hydraulic power to the flaps and slats.



27-81-00-010 Rev 1 01/19/95

LEADING EDGE SLATS - AUTOSLAT PRIORITY VALVE

LEADING EDGE SLATS - ANGLE GEARBOXES

Purpose

The angle gearboxes connect torque tubes that are at different angles to each other. There are four separate angle gearboxes:

- Two floor angle gearboxes
- Two strakelet angle gearboxes.

Location

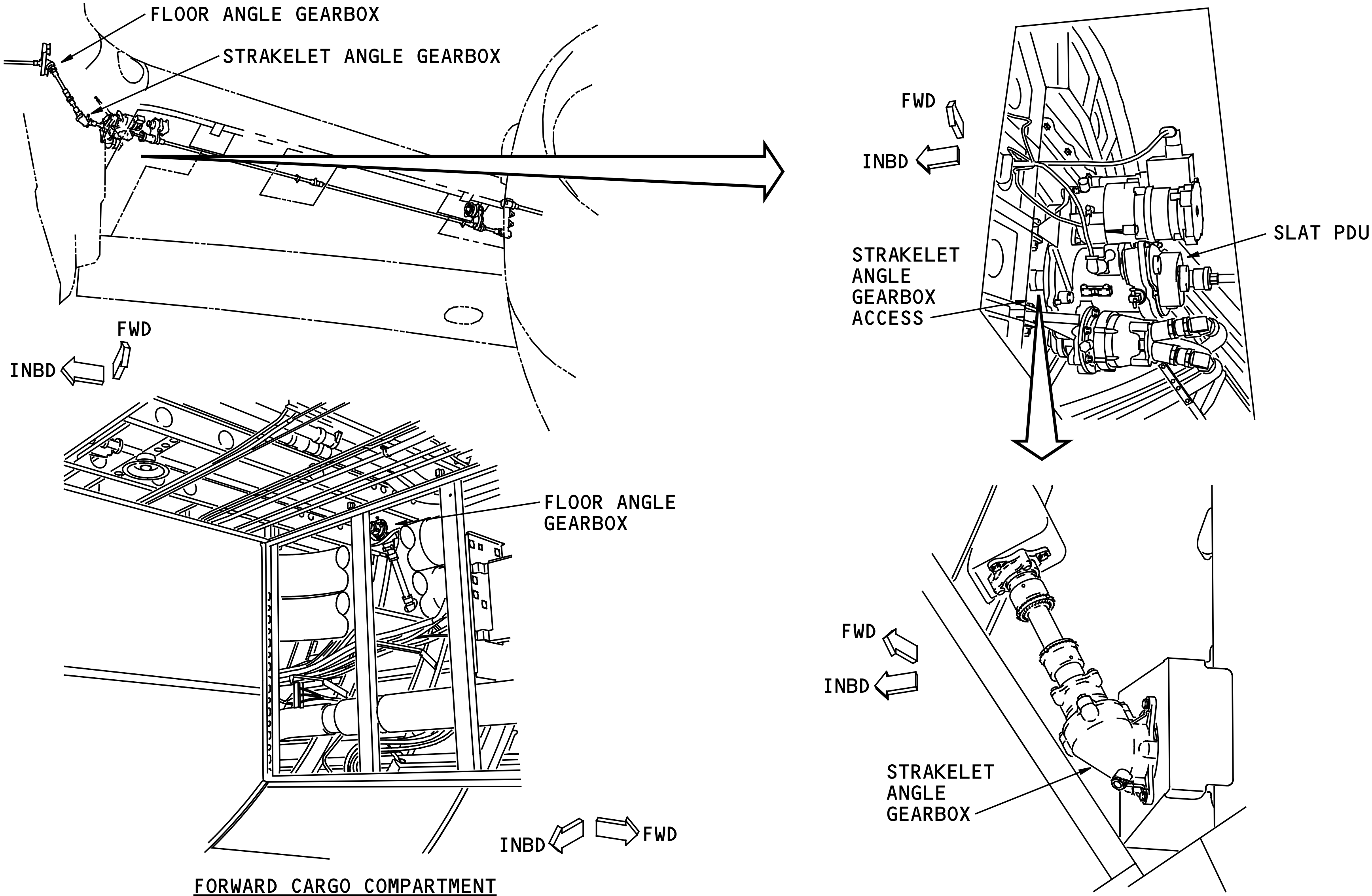
The floor angle gearboxes are just aft and outboard of the forward cargo compartment. Remove the cargo lining in the aft section of the forward cargo compartment to get access.

The strakelet angle gearboxes are on the inboard side of the first rib in the fixed leading edge of the wings. Remove the access panel under the inboard end of the wing to get access.

Physical Description

The angle gearboxes are filled with grease and sealed.

Both of the floor angle gearboxes are identical and both of the strakelet angle gearboxes are identical. Each gearbox weighs approximately 12 lb (5.5 kg).



LEADING EDGE SLATS - ANGLE GEARBOXES

LEADING EDGE SLATS - DRIVELINE OFFSET GEARBOXES

Purpose

The two driveline offset gearboxes connect torque tubes that are offset from each other.

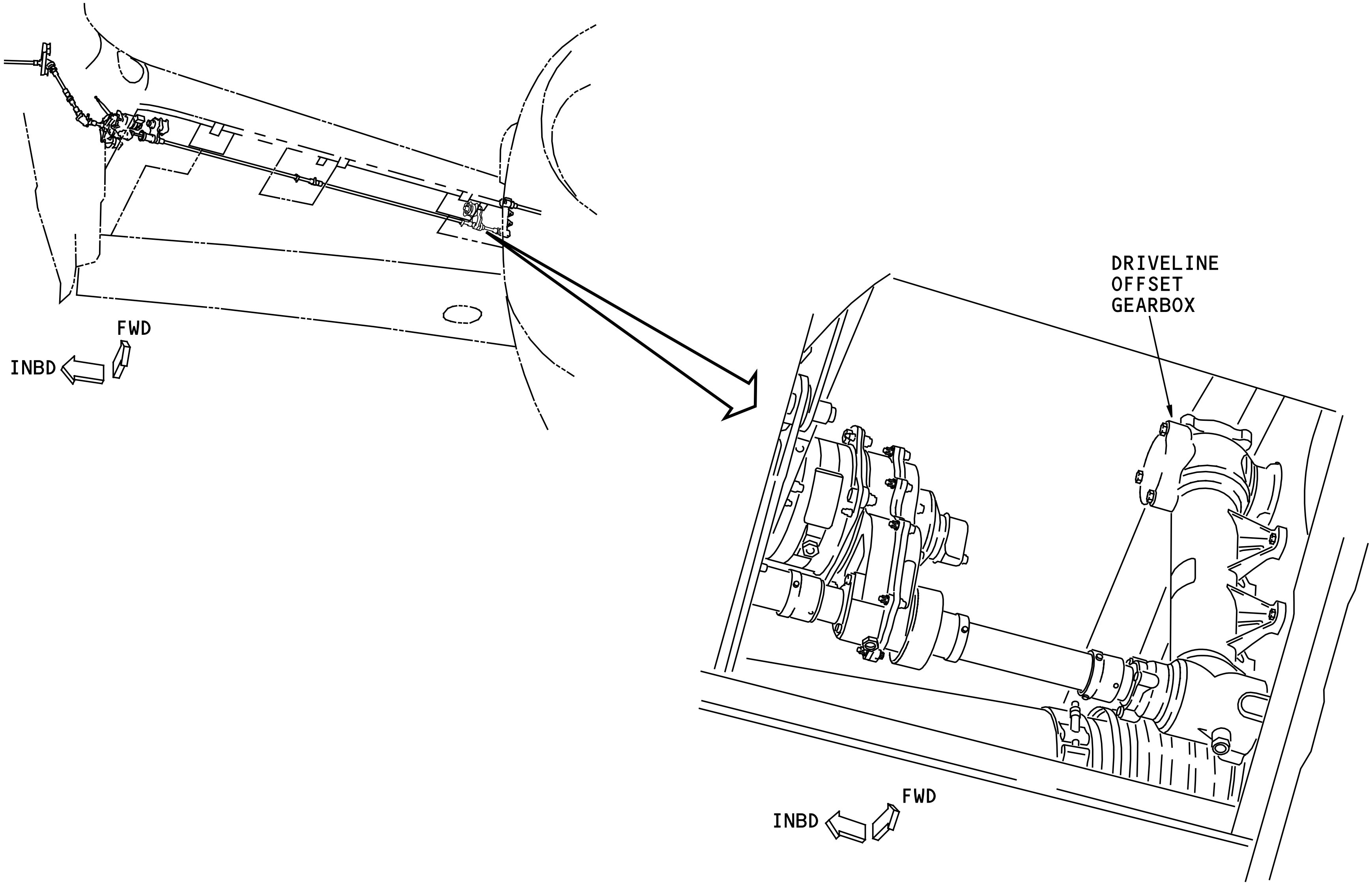
Location

There is one driveline offset gearbox in the fixed leading edge of each wing, between the inboard slat and the krueger flap. Remove the access panel under the wings to get access.

Physical Description

The gearboxes are filled with grease and sealed.

Both of the driveline offset gearboxes are identical. Each gearbox weighs approximately 28 lb (12.7 kg).



27-81-00-013 Rev 2 01/19/95

LEADING EDGE SLATS - DRIVELINE OFFSET GEARBOXES

LEADING EDGE SLATS - NO-BACK BRAKE OFFSET GEARBOXES

Purpose

The no-back brake offset gearboxes get power from the torque tubes to operate the rotary actuators.

Location

The no-back brake offset gearboxes are in the fixed leading edge of the wings. Remove the access panels under the leading edge of the wings to get access.

Physical Description

There are two no-back brake offset gearboxes for each slat. The gearboxes for the inboard slats are similar to the gearboxes for the outboard slats. The gearboxes at the outboard end of the wings are different than the other gearboxes and contain the slat position sensors.

The no-back brake offset gearbox has a no-back brake to help prevent slat retraction if the PDU or a torque tube fails. The no-back brake offset gearbox also has a shearout to prevent excessive loads on the pinion gear if the slat does not move freely.

The no-back brake offset gearboxes are filled with oil and sealed.

The no-back brake offset gearboxes for the inboard slats weigh approximately 16 lb (7 kg). The no-back brake offset gearboxes for the outboard slats weigh approximately 11 lb (5 kg).

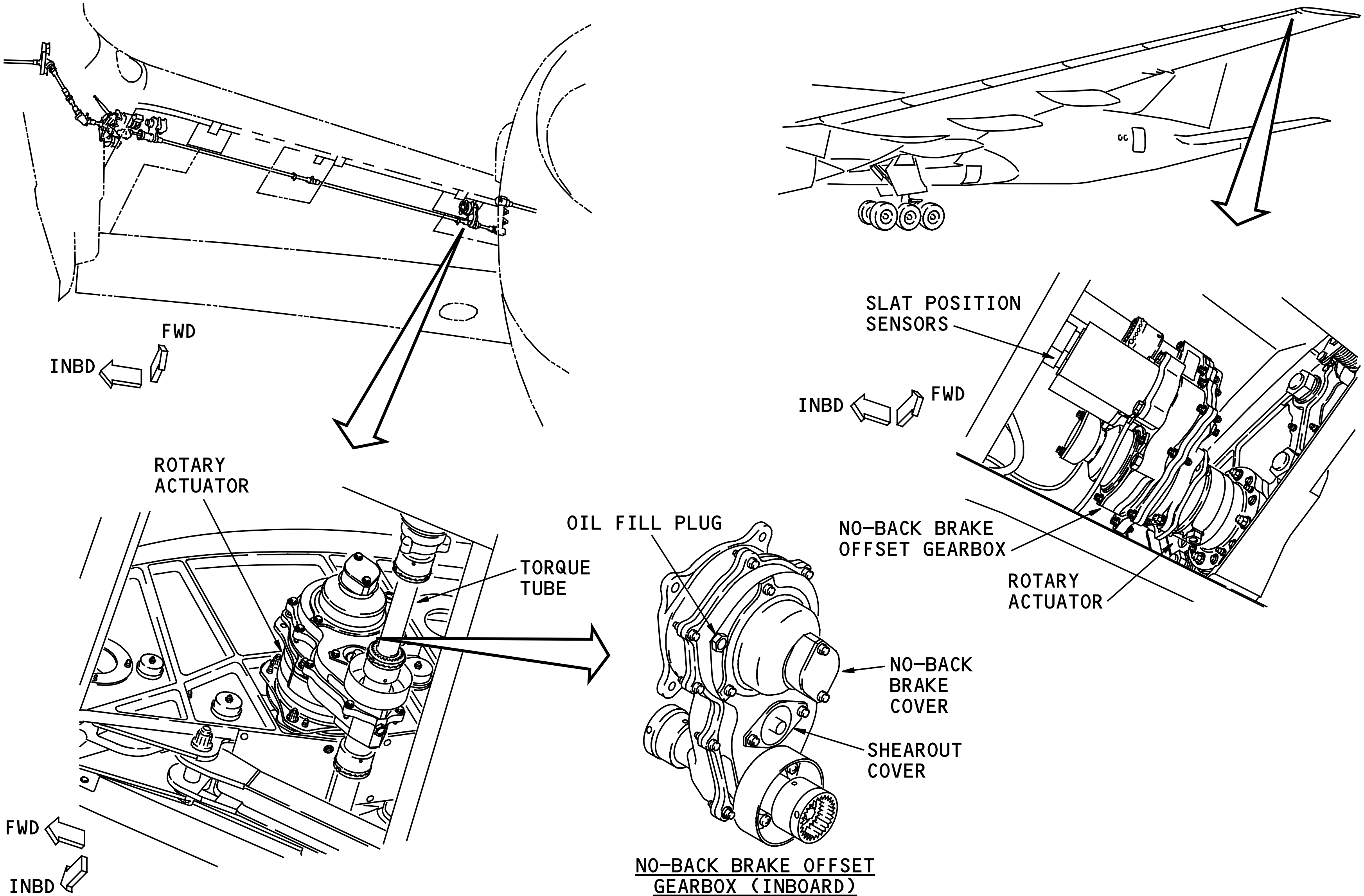
Training Information Point

To do a check of the no-back brake in the no-back brake offset gearbox, manually apply a backdrive torque to the gearbox. To do this, remove the no-back brake cover and connect a manual drive.

CAUTION: DO NOT REMOVE THE OFFSET GEARBOX IF IT HAS A BROKEN SHEAROUT UNTIL YOU REPLACE THE SHEAROUT. THE NO-BACK BRAKE CAN HOLD A HIGH TORQUE AFTER THE FAILURE OF THE SHEAROUT. YOU CAN CAUSE DAMAGE TO THE ROTARY ACTUATOR AND OFFSET GEARBOX.

If you do a check or replace the shearout in the no-back brake offset gearbox, you must drain all the oil in the gearbox. Then remove the shearout cover to gain access to the shearout.

The no-back brake offset gearbox contains oil and it is necessary to do servicing at specified times. Use the oil fill plug.



LEADING EDGE SLATS - NO-BACK BRAKE OFFSET GEARBOXES

LEADING EDGE SLATS - ROTARY ACTUATORS

Purpose

The rotary actuators get power from the no-back brake offset gearboxes to turn the pinion gears.

Location

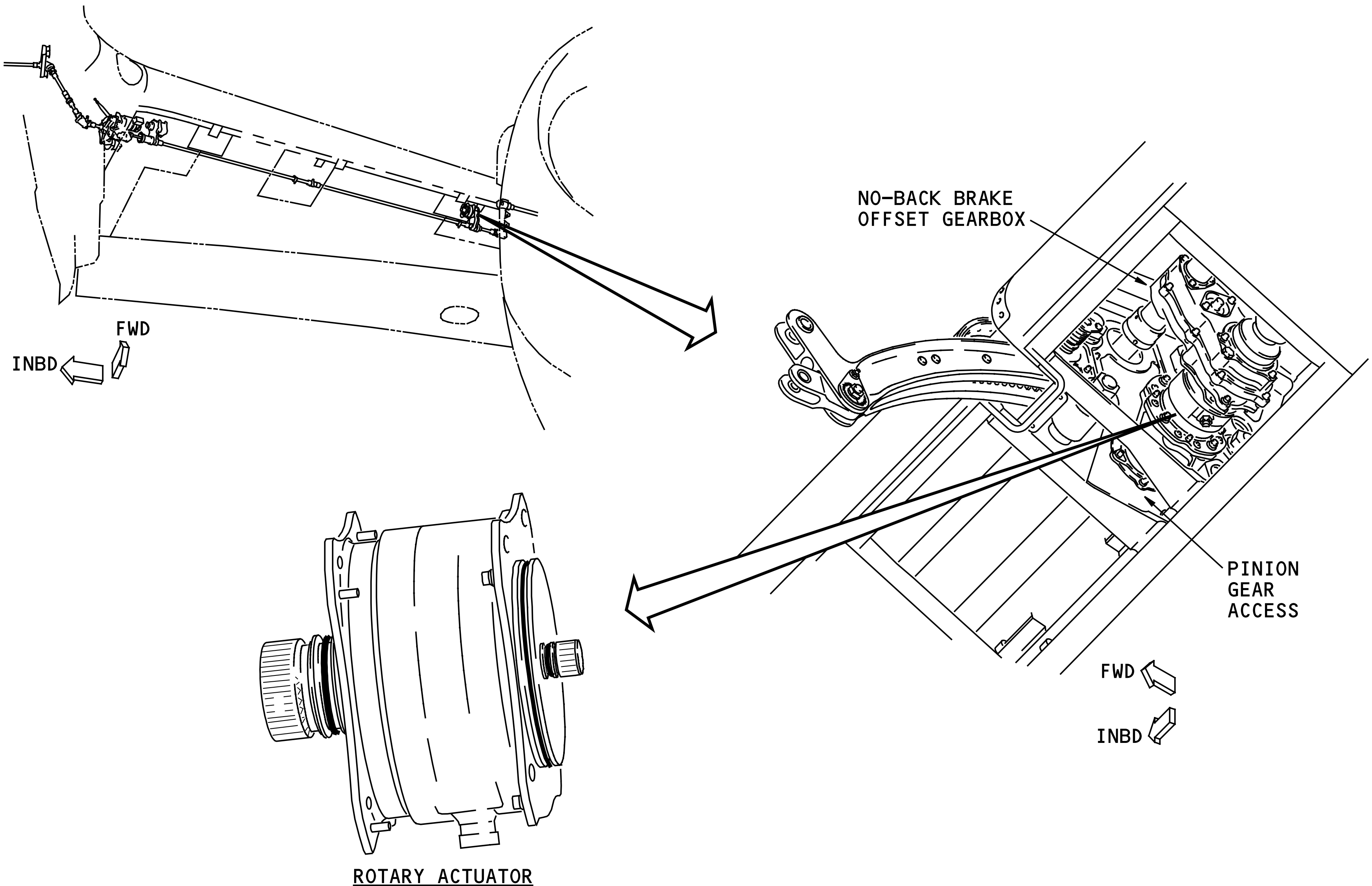
The rotary actuators are in the fixed leading edge of the wings. Remove the access panels under the leading edge of the wings to get access.

Physical Description

There are two rotary actuators for each slat. The rotary actuators for the inboard slats are similar to the rotary actuators for the outboard slats.

The rotary actuators are filled with grease and sealed.

The rotary actuators for the inboard slats weigh approximately 14 lb (6 kg). The rotary actuators for the outboard slats weigh approximately 6.8 lb (3 kg).



27-81-00-015 Rev 3 01/19/95

LEADING EDGE SLATS - ROTARY ACTUATORS

LEADING EDGE SLATS - PINION GEARS AND SLAT MAIN TRACKS

Purpose

The pinion gears receive power from the rotary actuators to move the slat main track. The slat main tracks move the slats.

Location

The pinion gears and main tracks are in the fixed leading edge of the wings. Remove the access panel under the leading edge of the wings to get access.

Pinion Gears

There are two pinion gears for each slat surface. The pinion gears for the inboard slats are different than the pinion gears for the outboard slats.

The pinion gears weigh approximately 4 lb (2 kg) for the outboard slats and 11 lb (5 kg) for the inboard slats.

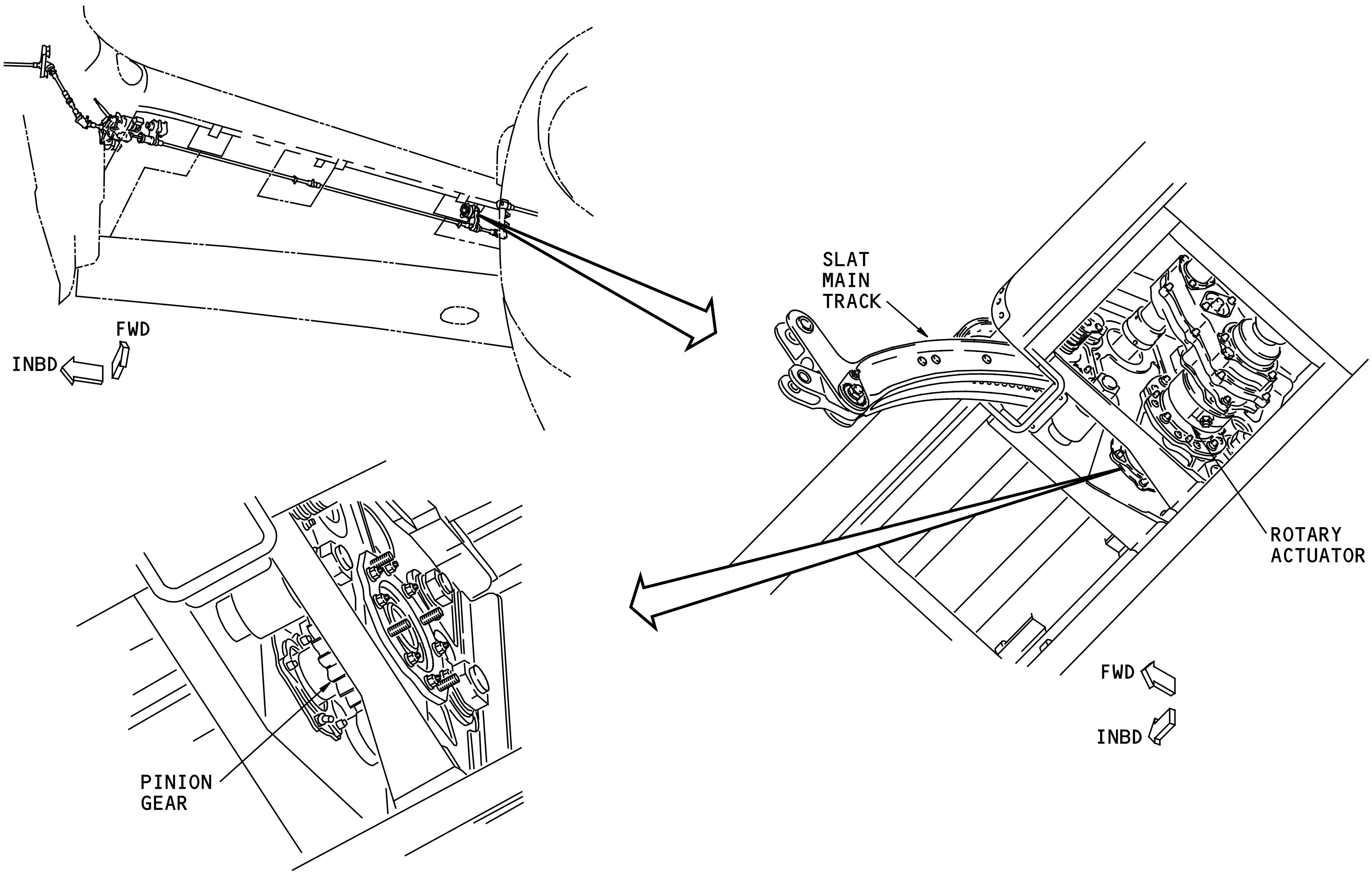
Slat Main Track

There are three slat main tracks (only two are driven by rotary actuators) for each inboard slat and two slat main tracks for each outboard slat. The slat main tracks for the inboard slats are different than the slat main tracks for the outboard slats.

The slat main tracks have stops at both ends to prevent over-travel of the slat surface. During normal slat operation, the main track does not touch the stops.

Training Information Point

The center main track of the inboard slats does not have stops. Make sure that you hold the center main track so it does not fall when you remove the inboard slat.



27-81-00-016 Rev 3 01/19/95

LEADING EDGE SLATS - PINION GEARS AND SLAT MAIN TRACKS

LEADING EDGE SLATS - AUXILIARY ARM AND TRACK

Purpose

The auxiliary arm and track control the rotation of the inboard slats as the slats extend.

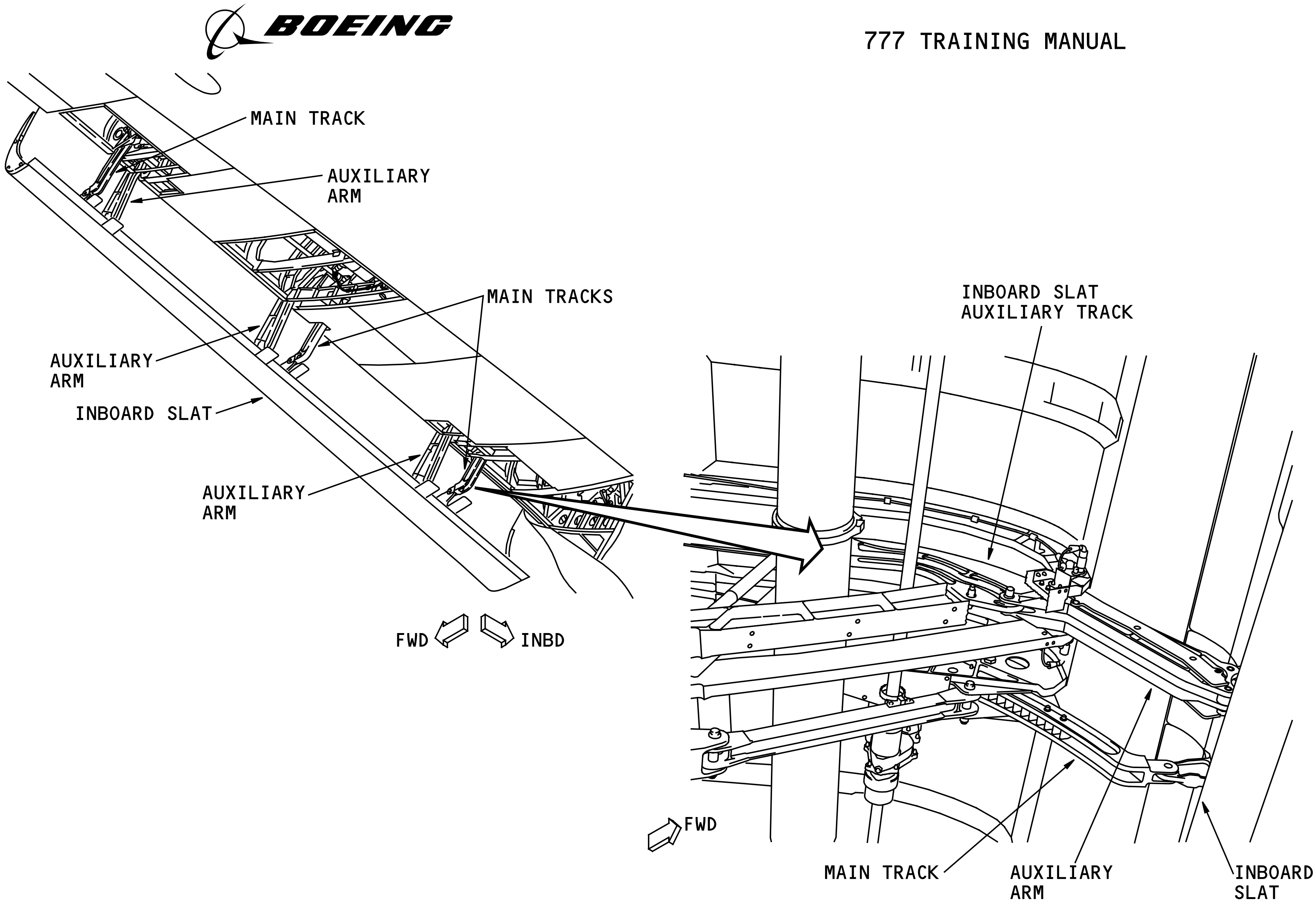
There are three auxiliary arms and tracks for each inboard slat. The outboard slats do not use auxiliary arms or tracks.

Location

The auxiliary arms attach to the slats. The auxiliary tracks are in the fixed leading edge of the wings. Remove the access panels under the wing to get access.

Physical Description

The auxiliary arms have rollers which move in grooves in the auxiliary tracks. As the slats move, the auxiliary arms force the slats to rotate.



LEADING EDGE SLATS - AUXILIARY ARM AND TRACK

LEADING EDGE SLATS - KRUEGER FLAP OFFSET GEARBOX, TORQUE TUBE, AND ROTARY ACTUATOR

General

The krueger flaps seal the gap between the inboard slat and the engine strut. This increases the effect of the slats. There is one krueger flap offset gearbox, torque tube, and rotary actuator for each krueger flap.

Location

The krueger flap is between the inboard slat and the engine strut, along the leading edge of each wing. The krueger flap actuation assembly is in the fixed leading edge of the wings, between the engine and the inboard slat. Remove the access panel on the upper side of the wing or extend the slats to get access.

Krueger Flap

The krueger flaps are made of aluminum skins and aluminum castings. The width of the krueger flaps is approximately 30 inches (0.76 m) and it weighs approximately 19 lb (9 kg).

The krueger flap has two positions: retracted and extended. It moves to the extended position when the slats are in the sealed or gapped positions. It moves to the retracted position when the slats are at the up position.

Offset Gearbox

The offset gearbox connects to the slat drive torque tubes. Gears in the offset gearbox transmit the power from the torque tubes to the rotary actuator.

The offset gearbox is filled with grease and sealed. The offset gearbox weighs approximately 8 lb (4 kg).

Torque Tube

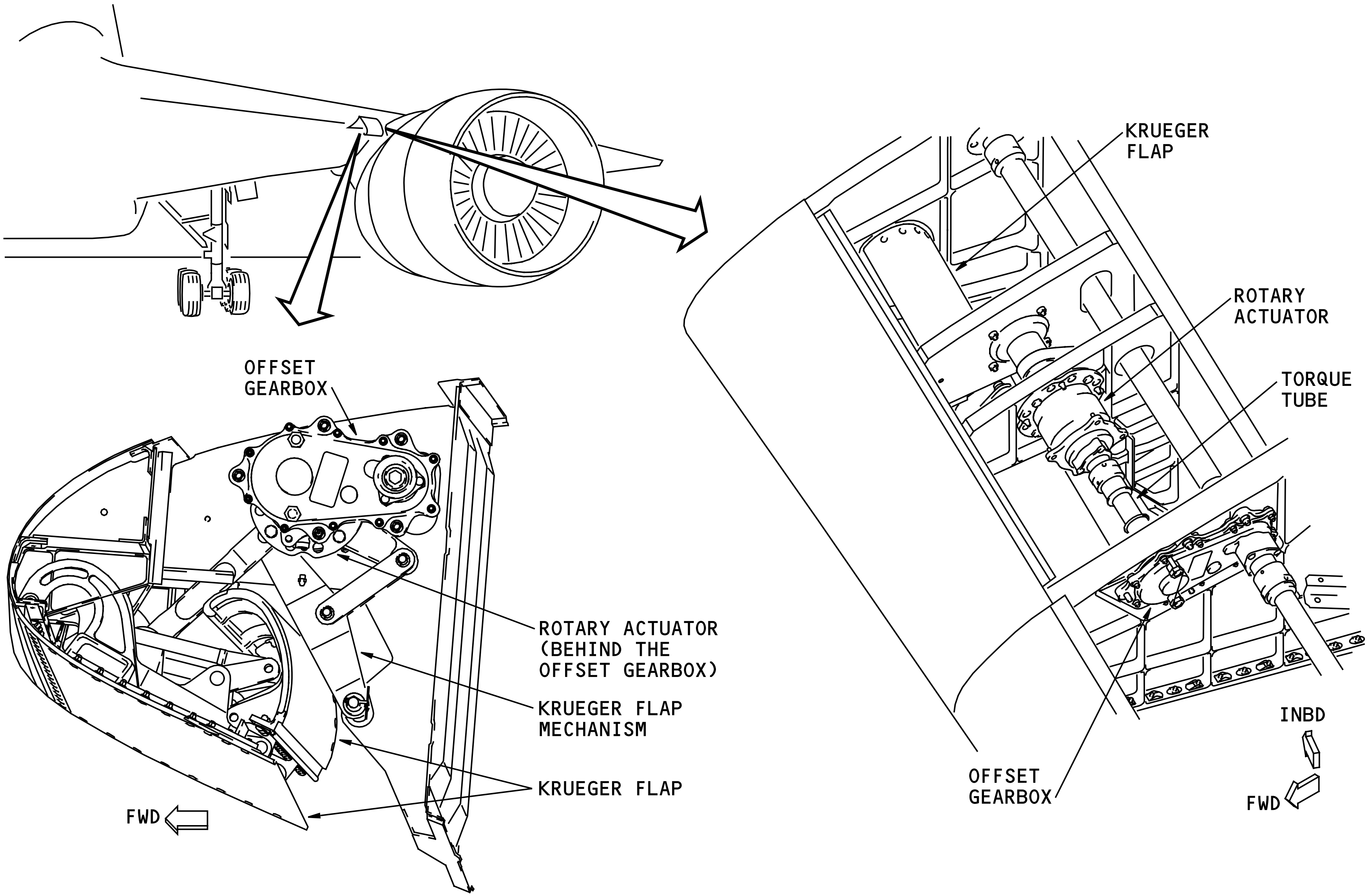
The torque tube transmits the power from the gearbox to the rotary actuator.

The end fittings are bolted on to the ends of the torque tube.

Rotary Actuator

The offset gearbox turns the rotary actuator. The rotary actuator moves the krueger flap mechanism.

The rotary actuator is filled with grease and sealed. The rotary actuator weighs approximately 6 lb (3 kg).



27-81-00-019 Rev 3 04/29/95

LEADING EDGE SLATS - KRUEGER FLAP OFFSET GEARBOX, TORQUE TUBE, AND ROTARY ACTUATOR

LEADING EDGE SLATS - KRUEGER FLAP MECHANISM

Purpose

The krueger flap mechanism moves the krueger flap.

Location

The krueger flap mechanism is in the fixed leading edge of the wings, between the engine and the inboard slat. Remove the access panel on the upper side of the wing to get access.

Functional Description

There is one krueger flap mechanism for each krueger flap.

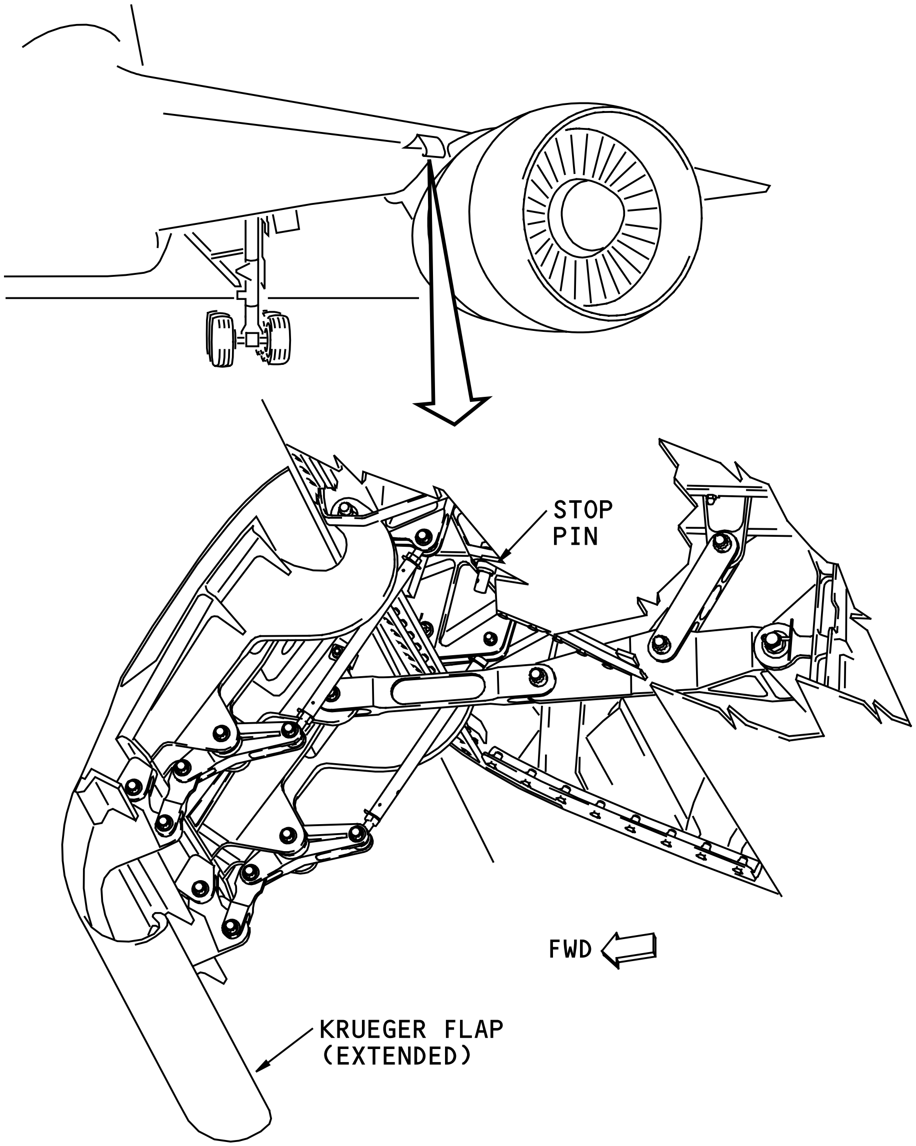
The krueger flap mechanism attaches to the rotary actuator. As the rotary actuator rotates, the links in the krueger flap mechanism move. These links force the krueger flap to extend or retract.

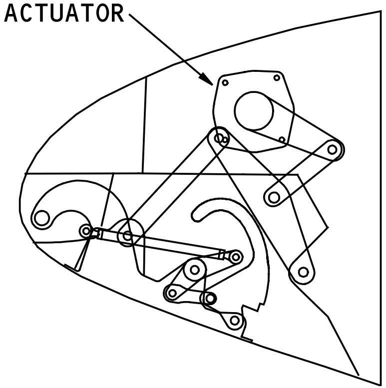
As the slats extend to the sealed position, the krueger flap moves to the extended position. As the slats extend to the gapped position, the geometry of the links in the krueger flap mechanism prevent more movement of the krueger flap.

Training Information Point

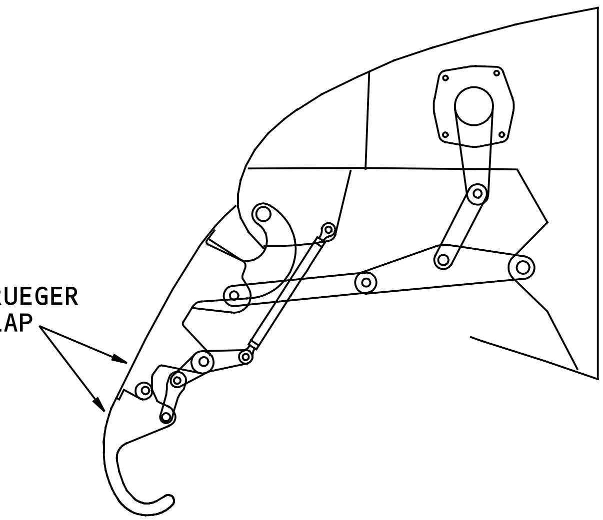
When you rig the LE slat system, preload the krueger flap rotary actuator with the slats in the retracted position.

Adjust the stop pin to align the krueger flap with the leading edge of the wing.





KRUEGER FLAP MECHANISM - RETRACTED



KRUEGER FLAP MECHANISM - EXTENDED

LEADING EDGE SLATS - KRUEGER FLAP MECHANISM

LEADING EDGE SLATS - FUNCTIONAL DESCRIPTION - PRIMARY MODE CONTROL

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LEADING EDGE SLATS - FUNCTIONAL DESCRIPTION - PRIMARY MODE CONTROL

General

Only one FSEU commands the slats in the primary mode.

In the primary mode, the FSEU controls:

- Slat retraction and extension
- Flap/slat sequence
- Cruise inhibit
- Hydraulic isolation (CHIS)
- Autoslat extension
- Low-speed control
- Shutoff control.

For redundancy, both channels in the FSEU must agree on the slat command. Each channel controls switches that are connected in series. Both channels must send the same command to the switches for the FSEU to energize the commanded solenoid.

The two coils in each solenoid of the primary control valve receive electrical power from different power sources. The FSEU controls the ground for one of the coils in each solenoid.

The FSEU also controls the solenoid in the autoslat priority valve.

Slat Retraction and Extension

The FSEU compares the flap lever position to the slat position. The slats retract if the flap lever position is less than the slat position. The slats extend if the flap lever position is greater than the slat position.

Flap/Slat Sequence

This function controls the sequence of the retraction and extension of the flaps and slats.

See the high lift control section for more information about the primary mode flap and slat sequence (AMM PART I 27-03).

Cruise Inhibit

This function prevents slat extension during cruise. This happens when the airspeed is more than 265 knots or the altitude is above 20,300 feet.

Hydraulic Isolation (CHIS)

If the hydraulic quantity in the center hydraulic system reservoir is below 0.40, the FSEUs disengage the primary slat mode. The FSEUs then engage the secondary mode for the slats only. If both engines continue operating for more than 10 seconds, then the primary mode re-engages.

See the main hydraulic system section for more information about the center hydraulic isolation system (AMM PART I 29-10).

LEADING EDGE SLATS - FUNCTIONAL DESCRIPTION - PRIMARY MODE CONTROL

Autoslat Extension

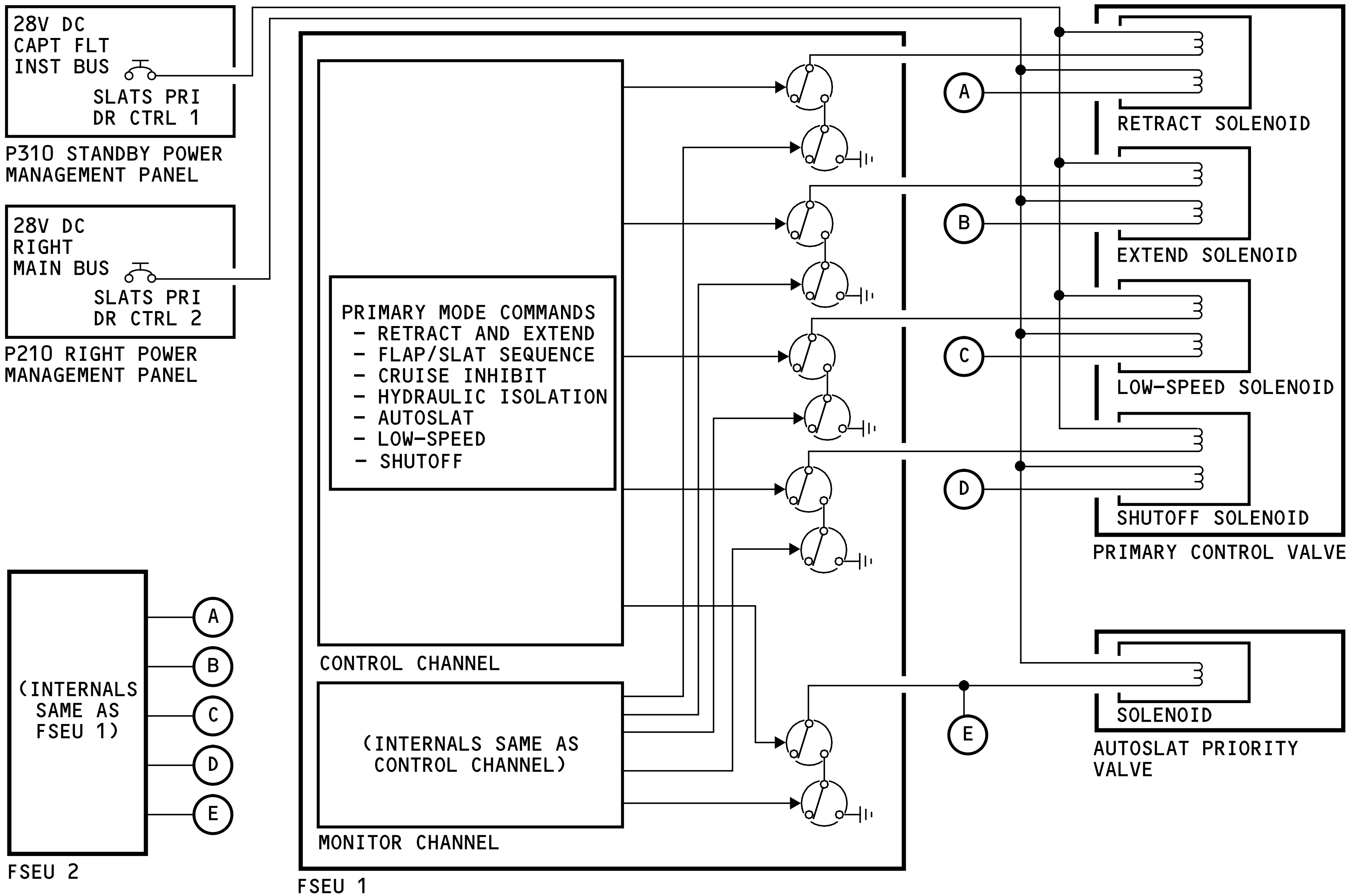
This function commands the slats to extend if the airplane approaches a stall condition. To make sure the slats receive enough hydraulic power, the FSEUs also command the autoslat priority valve to reduce the hydraulic flow to the main landing gear system.

Low-Speed Control

This function reduces the speed of slat movement as the slats approach the commanded position. The FSEU energizes the low-speed solenoid when the slats are less than approximately seven torque tube turns from the commanded position.

Shutoff Control

The FSEU energizes the shutoff solenoid valve to open when there is a retract or extend command.



LEADING EDGE SLATS - FUNCTIONAL DESCRIPTION - PRIMARY MODE CONTROL

LEADING EDGE SLATS - FUNCTIONAL DESCRIPTION - AUTOSLAT EXTENSION

General

The autoslat extension function improves the wing stall performance if the airplane approaches a stall condition. This function also makes sure the slats get enough hydraulic power when the autoslat function is active.

Autoslat

The autoslat function operates only in the primary mode and when the slats are in the sealed position. This function does not operate if the airspeed is more than 239 knots.

The warning electronics unit (WEU) sends an autoslat request to the FSEUs if the airplane approaches a stall condition. If the flap lever is in the 1, 5, 15, or 20 unit positions at this time, the FSEUs command the slats to extend to the gapped position. At this same time, the FSEUs energize the solenoid in the autoslat priority valve. This reduces the hydraulic flow to the landing gear systems. Thus, more hydraulic power can go to the slats.

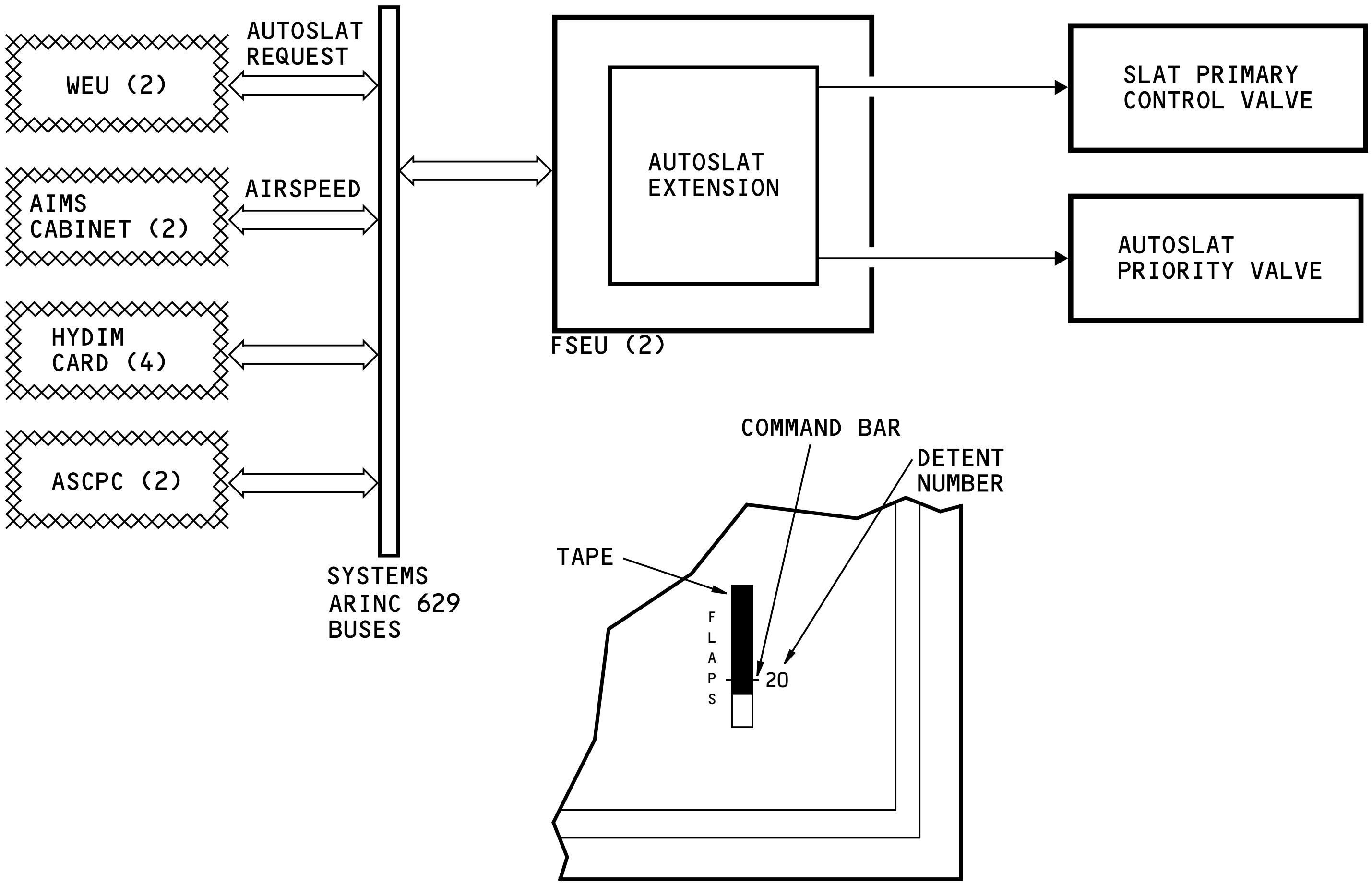
The WEU also sends an autoslat request to the HYDIM cards and the air supply-cabin pressure controllers (ASCPCs). The HYDIM cards turn on both air driven pumps (ADPs). The ASCPCs operate some pneumatic valves to make sure the ADPs get enough air power.

See the main hydraulic system section for more information about the center hydraulic system (AMM PART I 29-10). See the pneumatic chapter for more information about the ASCPCs and the pneumatic system (AMM PART I 36).

Five seconds after the WEU removes the autoslat request, the FSEUs command the slats back to their commanded position and de-energize the solenoid in the autoslat priority valve.

Indication

There are no messages to show that the autoslat function is active. The only indication is on the flap/slat position indication on the EICAS display and the EICAS compacted engine display. The tape in the indication extends beyond the commanded position. The color of the command bar and the detent number change to magenta.



27-81-00-025 Rev 5 01/08/96

LEADING EDGE SLATS - FUNCTIONAL DESCRIPTION - AUTOSLAT EXTENSION

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LEADING EDGE SLATS - FUNCTIONAL DESCRIPTION - SECONDARY MODE CONTROL

General

The operation of the slats in the secondary mode is the same as for the flaps.

See the trailing edge flaps section for more information about the flaps secondary mode control (AMM PART I 27-51).

Only one FSEU commands the slats in the secondary mode. The FSEU controls:

- Secondary mode engage
- Retraction and extension
- Flap/slat sequence
- Cruise inhibit
- Slat Load relief
- Secondary mode auto test.

For redundancy, both channels in the FSEU must agree on the slat command.

In the secondary mode, the FSEUs energize relays. The relays control the electrical power to the electric motor, clutch, and bypass solenoid. The alternate mode also uses these relays.

Secondary Mode Engage

When the FSEU engages the secondary mode, it energizes the bypass/clutch relay.

See the high lift control section for more information about the mode selection (AMM PART I 27-03).

This relay has three functions.

First, the bypass/clutch relay supplies power to the bypass solenoid in the primary control valve. This stops hydraulic operation in the primary mode.

Second, this relay supplies power to the clutch in the electric motor. This permits the electric motor to move the slat drive system.

Third, the bypass/clutch relay supplies power to the extend and retract relays. These relays do not energize until the FSEUs supply the grounds for them.

Retraction and Extension Control

The FSEU compares the flap lever position to the slat position. The slats retract if the flap lever position is less than the slat position. The slats extend if the flap lever position is greater than the slat position.

Either FSEU can energize the extend and retract relays to move the slats. These relays supply 115v ac power to the electric motor.

Flap/Slat Sequence

This function controls the sequence of the retraction and extension of the flaps and slats. See the high lift control section for more information about the the secondary mode flap and slat sequence (AMM PART I 27-03).

Cruise Inhibit

This function prevents slat extension during cruise. This happens when the airspeed is more than 265 knots or the altitude is above 20,300 feet.

Slat Load Relief

This function commands the slats to retract if the airspeed increases above the slat load relief limit.

Secondary Mode Auto Test

The secondary mode auto test does a test of the operation of the secondary mode. After 100 flight cycles, the FSEUs begin the test when the slats are commanded to extend. The test does these things:

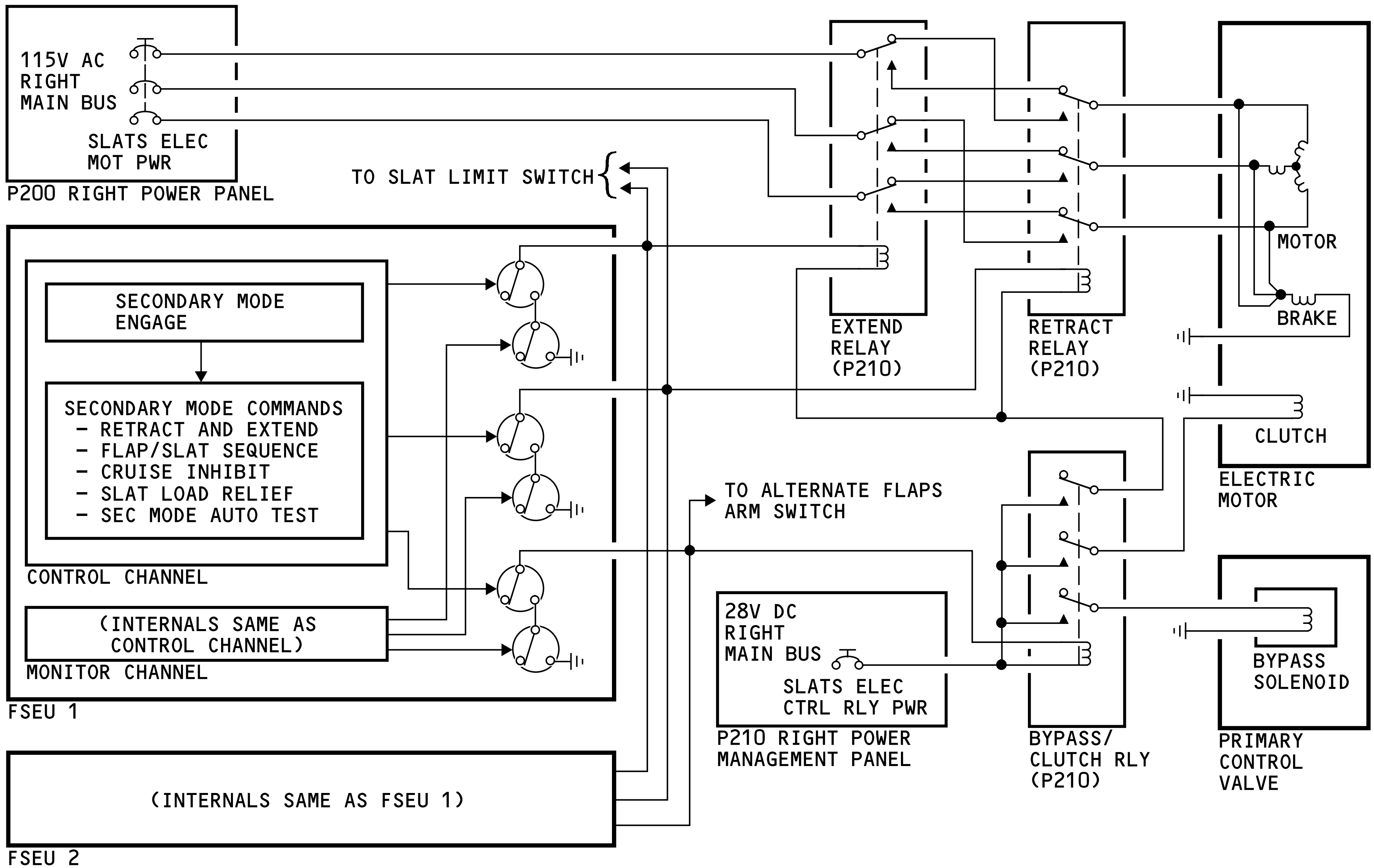
- Disengages the primary mode
- Engages the electric motor clutch
- Extends the slats for two seconds using the electric motor.

One flight cycle is when all of these conditions occur for two seconds:

- Airplane not on the ground
- Airspeed is greater than 70 knots
- Flap lever is at up
- Slats are at up.

When the slats extend for two seconds in the secondary mode, the test stops and the primary mode engages again. The slats then move to the commanded position in the primary mode.

If the slats fail to extend within four seconds during the secondary mode auto test, the SLATS SECONDARY FAIL status message shows.



27-81-00-026 Rev 7 06/22/1995

LEADING EDGE SLATS - FUNCTIONAL DESCRIPTION - SECONDARY MODE CONTROL

LEADING EDGE SLATS - FUNCTIONAL DESCRIPTION - SECONDARY MODE LOAD RELIEF

General

The slat load relief function prevents damage to the slats and their support structures from large aerodynamic forces. Slat load relief limits the position of the slats as a function of airspeed.

Slat load relief operates in the secondary mode only.

Load Relief - Secondary Mode

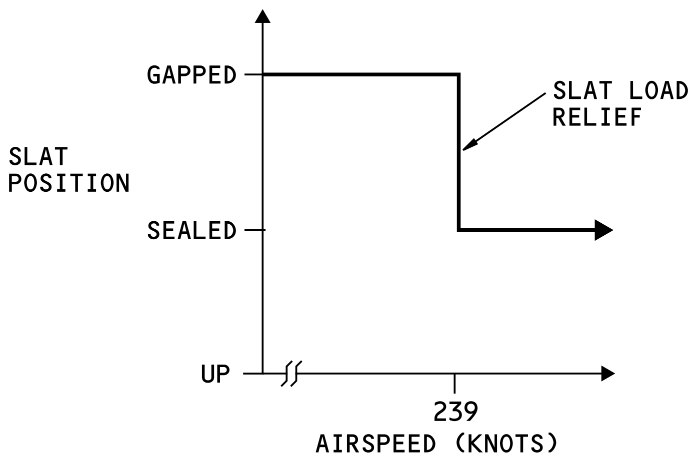
In the secondary mode, load relief is active if the flap lever is not in the up position and the airspeed is more than 239 knots. If the flap lever is not in the up position, the slats retract to the sealed position.

The load relief command resets if the airspeed is less than 239 knots or the pilot moves the flap lever to up. If the flap lever is not in the up position, the slats extend to the gapped position.

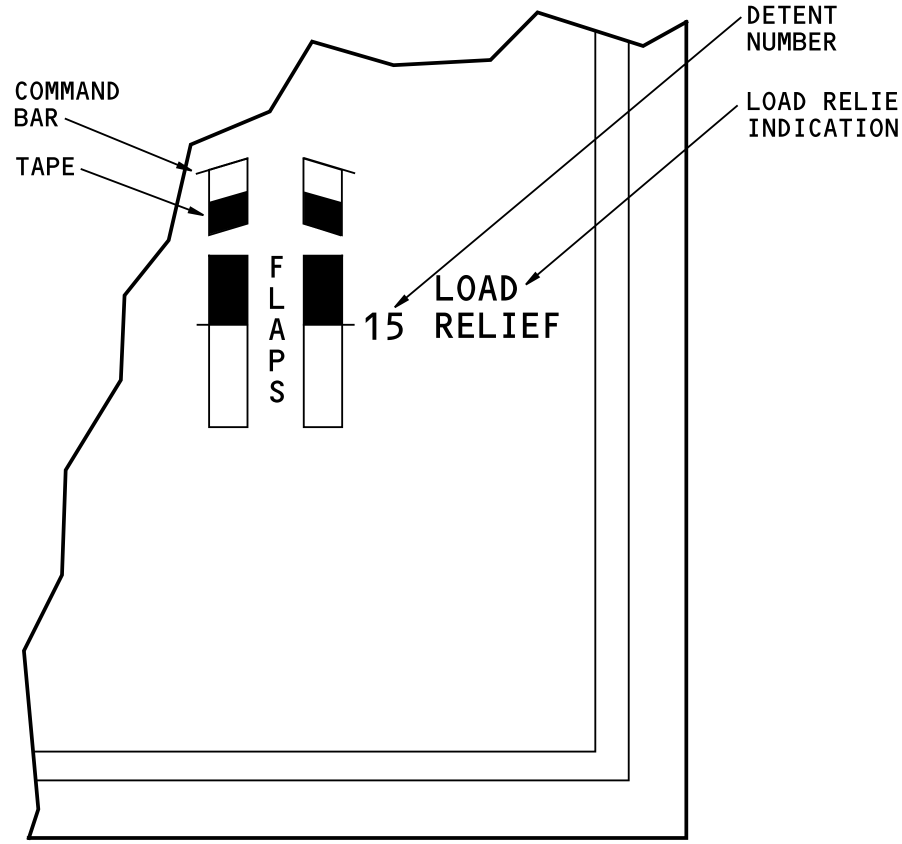
Indication

When slat load relief is active, the LOAD RELIEF message shows on the EICAS display and the EICAS compacted engine display.

The flap/slat position indication shows the position of the flap lever and the actual position of the slats. During slat load relief, the command bar and detent number change from green to magenta and the tape shows the actual position of the slats.



SLAT LOAD RELIEF - SECONDARY MODE



SECONDARY MODE DISPLAY (EICAS)

27-81-00-024 Rev 8 06/20/1997

LEADING EDGE SLATS - FUNCTIONAL DESCRIPTION - SECONDARY MODE LOAD RELIEF

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LEADING EDGE SLATS - FUNCTIONAL DESCRIPTION - ALTERNATE MODE CONTROL

General

The alternate mode operation of the slats is almost the same as the alternate mode operation of the flaps.

See the trailing edge flaps section for more information about the flaps alternate mode control (AMM PART I 27-51).

In the alternate mode, the alternate flap/slat switches energize relays. The relays control the electrical power to the electric motor, clutch, and bypass solenoid.

The alternate mode has these functions:

- Primary and secondary mode disengage
- Extend and retract control
- Flap/slat sequence.

Primary and Secondary Mode Disengage

When you push the alternate flaps arm switch, the FSEUs receive an alternate arm discrete. The FSEUs use this discrete to disengage the primary and secondary modes.

The alternate flaps arm switch also supplies a ground for the bypass/clutch relay. The operation of the bypass/clutch relay in the alternate mode is the same as in the secondary mode.

Extend and Retract Control

When the alternate flaps selector is in the extend (EXT) position, it supplies a ground for the extend relay to extend the slats. When this relay energizes, it supplies 115v ac power to the electric motor. The slat limit switch de-energizes this relay when the slats move to their extend limit. In the alternate mode, this limit is at the sealed position.

When the alternate flaps selector is in the retract (RET) position, it supplies a ground for the retract relay to retract the slats. When this relay energizes, it supplies 115v ac power to the electric motor. The slat limit switch de-energizes this relay when the slats move to the up position.

When the alternate flaps selector is in the OFF position, the grounds for the extend and retract relays are removed. This de-energizes the relays and stops the slat movement.

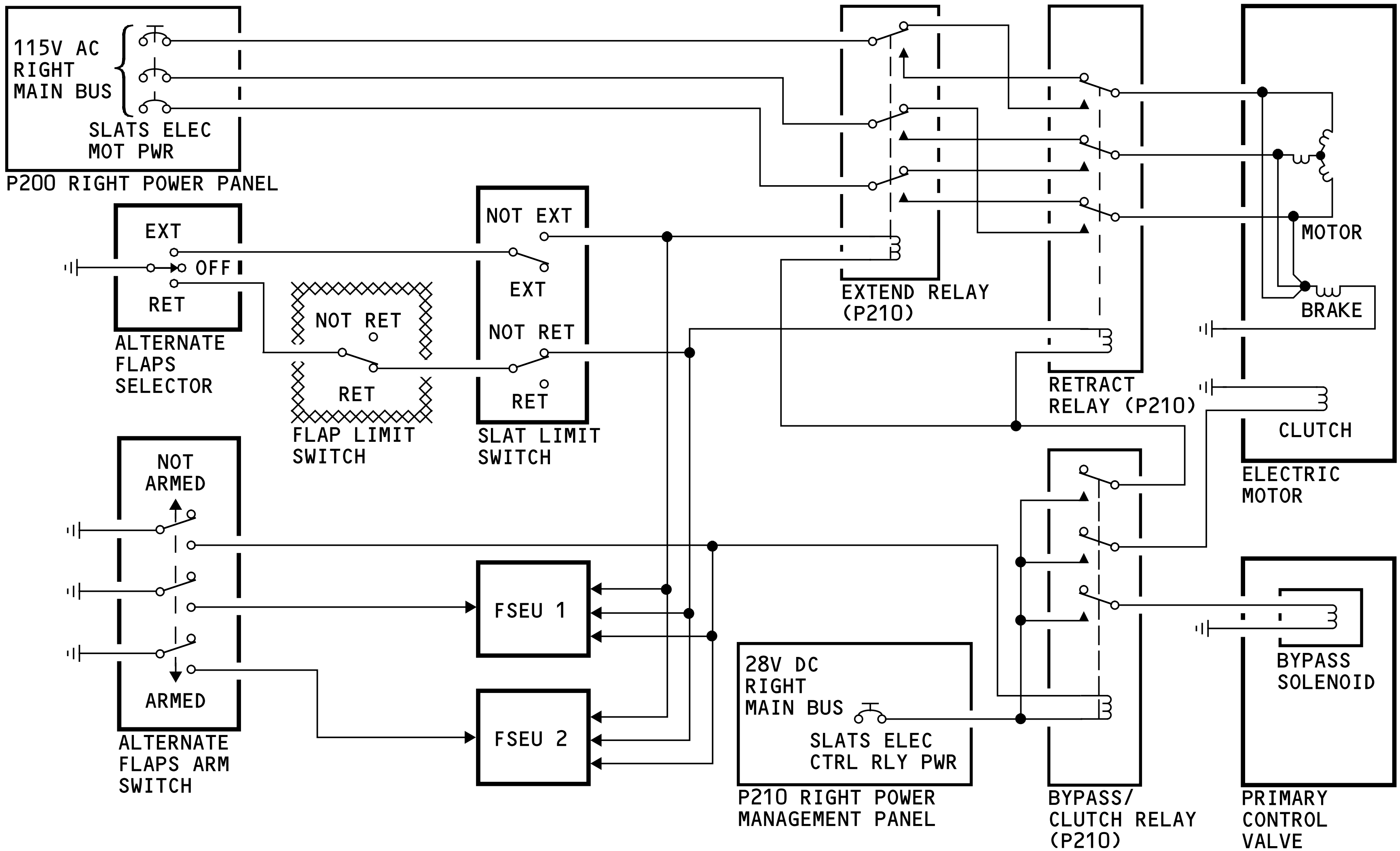
Flap/Slat Sequence

During extension, both the flaps and slats extend at the same time.

During retraction, the slats do not retract until the flaps are fully retracted. The flap limit switch controls this sequence.

LEADING EDGE SLATS - FUNCTIONAL DESCRIPTION - ALTERNATE MODE CONTROL

See the high lift control section for more information about the alternate mode flap and slat sequence (AMM PART I 27-03).



LEADING EDGE SLATS - FUNCTIONAL DESCRIPTION - ALTERNATE MODE CONTROL

SLAT POSITION INDICATION - GENERAL DESCRIPTION

Purpose

The slat position indication system measures the position of the slats and sends this data to the FSEUs. The FSEUs use this data for:

- Slat control
- Flap/slat position indication
- Failure detection.

Slat Control

The FSEUs use the slat position data during the slat operation in the primary and secondary modes. These modes have closed loop control of the slats. Closed-loop control stops the slat command when the slat position equals the command.

Flap/Slat Position Indication

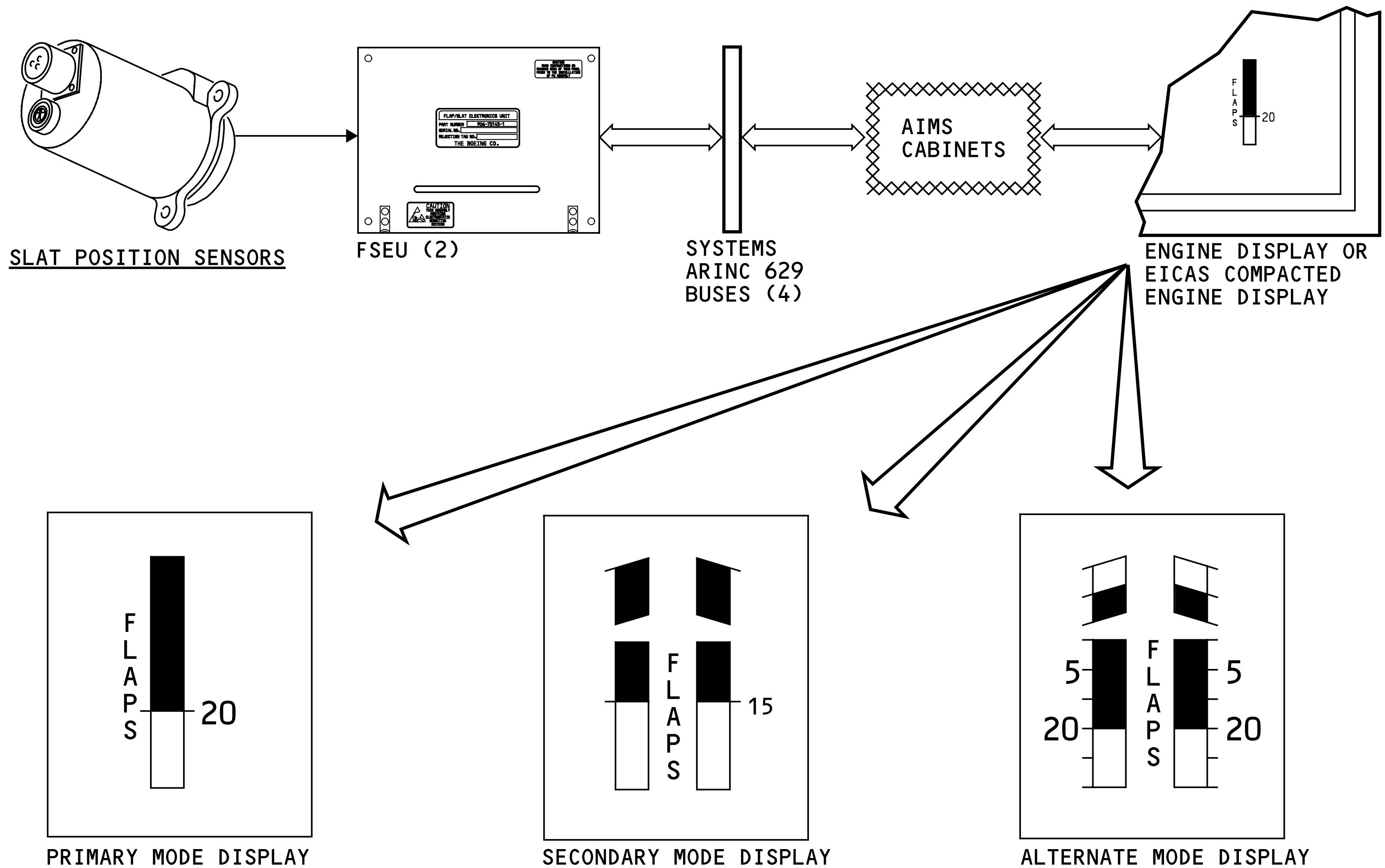
The FSEUs send the slat position data to the airplane information management system (AIMS). The AIMS uses this data to display the flap/slat position indication on the EICAS display or the EICAS compacted engine display.

The FSEUs send the slat position data to the AIMS whenever the data is valid. This permits flap/slat position indication in all three HLCS modes. The three flap/slat position indications are:

- Primary mode display
- Secondary mode display
- Alternate mode display.

Failure Detection

Monitors in the FSEUs compare the slat position data to the slat commands. These monitors find failures in the HLCS and the slat drive system.



27-88-00-001 Rev 2 01/08/96

SLAT POSITION INDICATION - GENERAL DESCRIPTION

SLAT POSITION INDICATION - SLAT POSITION SENSORS

Purpose

The slat position sensors supply slat position data to the FSEUs for slat control, flap/slat indication, and failure detection.

Location

The slat position sensors are on the two no-back brake offset gearboxes at the outboard ends of the slat torque tubes. Remove the access panel under the wing to get access.

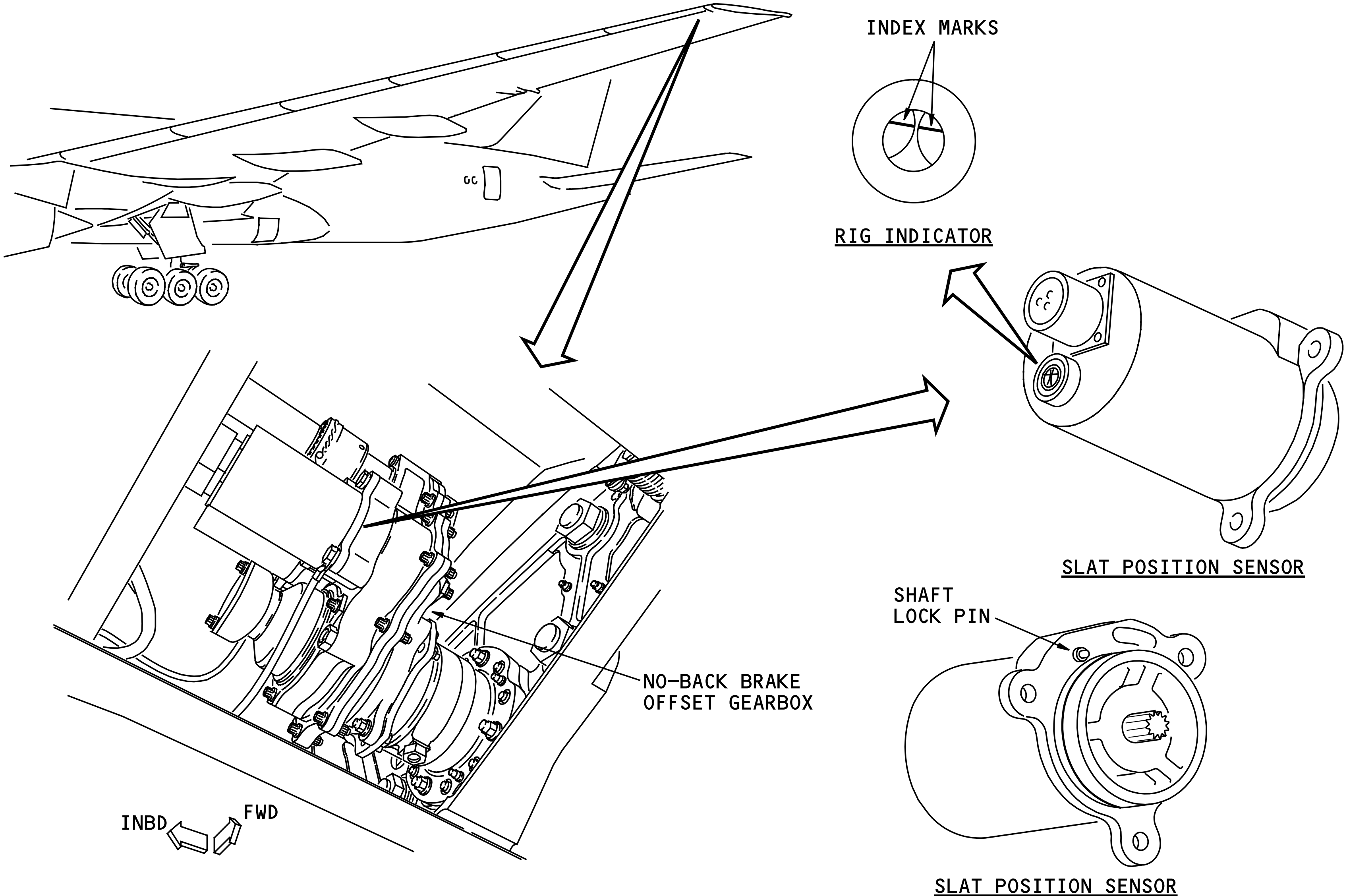
Physical Description

There are two slat position sensors on each of the no-back brake offset gearboxes at the outboard end of the wings. The slat position sensors are resolvers and they each have a rig indicator. The rig indicator has two marks that rotate when the position sensor shaft rotates. The two marks are in line when the slat drive line is at the UP position. All of these sensors are interchangeable with each other and with the flap position sensors.

Training Information Point

Install the slat position sensors with the slats rigged at the up position. Make sure the index marks for the rig indicator are aligned.

If the index marks on the position sensor are not aligned, you must push the shaft lock pin to turn the shaft.



27-88-00-002 Rev 3 03/28/96

SLAT POSITION INDICATION - SLAT POSITION SENSORS

SLAT SKEW DETECTION - GENERAL DESCRIPTION

Purpose

The slat skew detection system monitors the relative position of all the slats except for slats 1 and 14. The system does not monitor the outboard end of slats 2 and 13 and the inboard end of slats 6 and 9 for skew. The FSEUs stop the primary and secondary mode slat operation if there is a skew, an asymmetry or a secondary mode disagree condition.

Except for slats 1 and 14, the slats are in a skew when the inboard end of one or more slats is not aligned with its outboard end.

There is slat asymmetry condition when the slats on the left wing do not align with the slats on the right wing.

There is a secondary mode disagree when the slats do not move or move too slowly after a command to move in secondary mode.

Interface

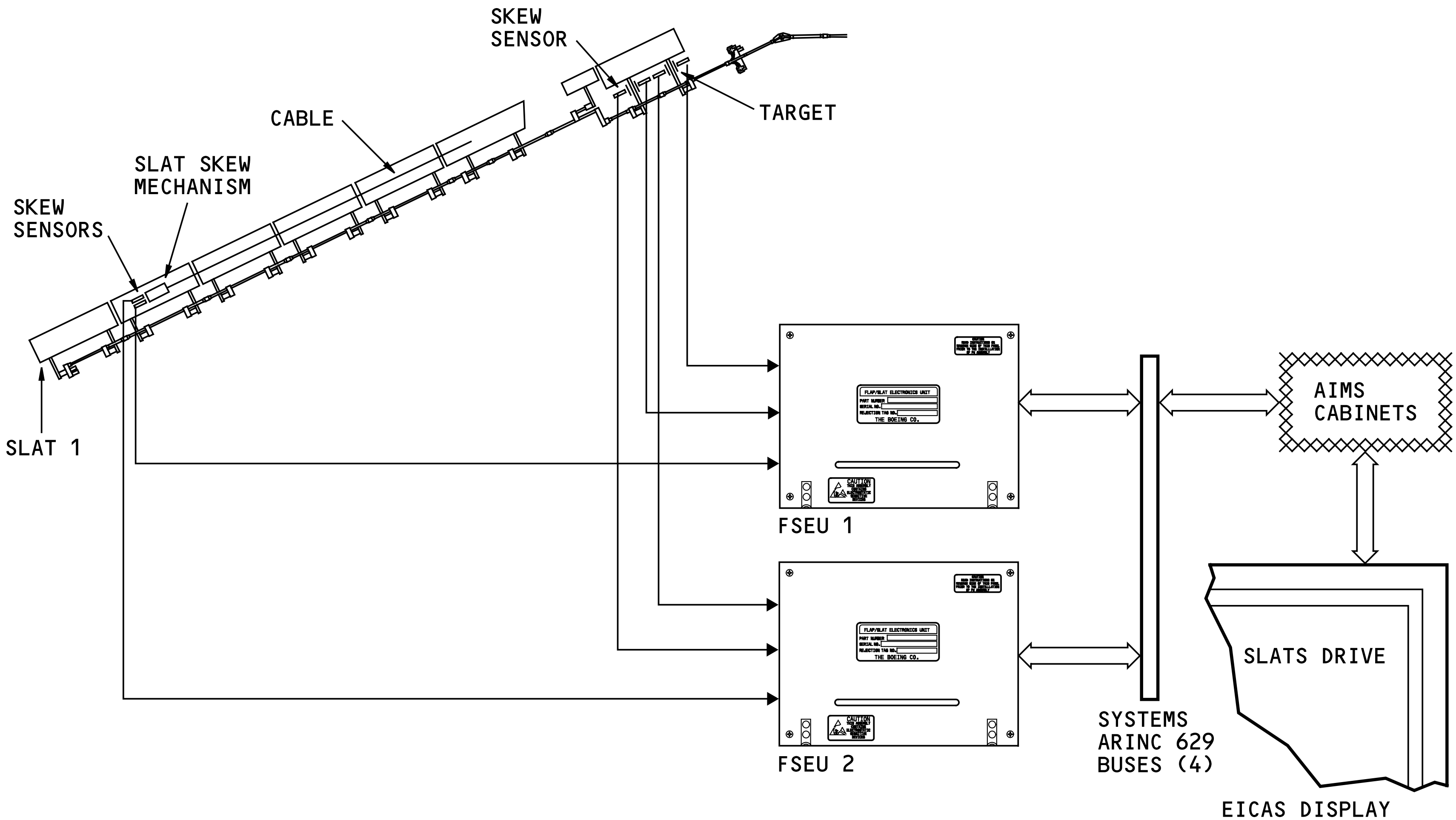
The slat skew detection system has 12 proximity sensors, two for the outboard slats and four for the inboard slat on each wing.

The sensors for the inboard slat do a check of the position of targets on the inboard slat auxiliary arms. The sensors for the outboard slats are on the slat skew mechanism. This mechanism attaches to a cable that is in slats 2 through 6 in the left wing and slats 9 through 13 in the right wing. If an outboard slat (except for the most outboard slat) moves out of alignment, the cable pulls a target on the mechanism away from the sensors.

Each FSEU has interfaces with one sensor at each skew sensor location to check for a skew condition. If a skew condition exists, the FSEUs stop the primary and secondary mode slat operation.

The slats are in a skew condition if a group of slats, a single slat, or the end of a slat is not in the correct position.

If the slats are in a skew, an asymmetry or a secondary mode disagree condition, the FSEUs stop the slat drive in primary and secondary modes. The FSEUs also send a signal to AIMS to show the SLATS DRIVE caution message. The slat position display changes to the secondary mode display and the slat position indication shows in amber.



NOTE: THE LEFT SLATS ARE SHOWN
(RIGHT SLATS ARE SIMILAR)

27-89-00-001 Rev 3

SLAT SKEW DETECTION - GENERAL DESCRIPTION

SLAT SKEW DETECTION - INBOARD SLAT SKEW SENSORS AND TARGETS

Purpose

The inboard slat skew sensors and targets monitor the relative position of the inboard slats.

Location

The inboard slat skew targets attach to the inboard and outboard auxiliary arms of the inboard slat. The skew sensors attach to the support structure of the inboard and outboard auxiliary tracks in the fixed leading edge of the wing. Remove the access panel under the wing to get access.

Physical Description

The slat skew sensors are proximity sensors. Each sensor is a separate LRU and is interchangeable with the skew sensors for the outboard slats.

The targets are made of an aluminum housing with four magnet zones and four cover plates. The magnets are spaced so that the sensors are in target-near condition when the slats are in the up, sealed, and gapped positions.

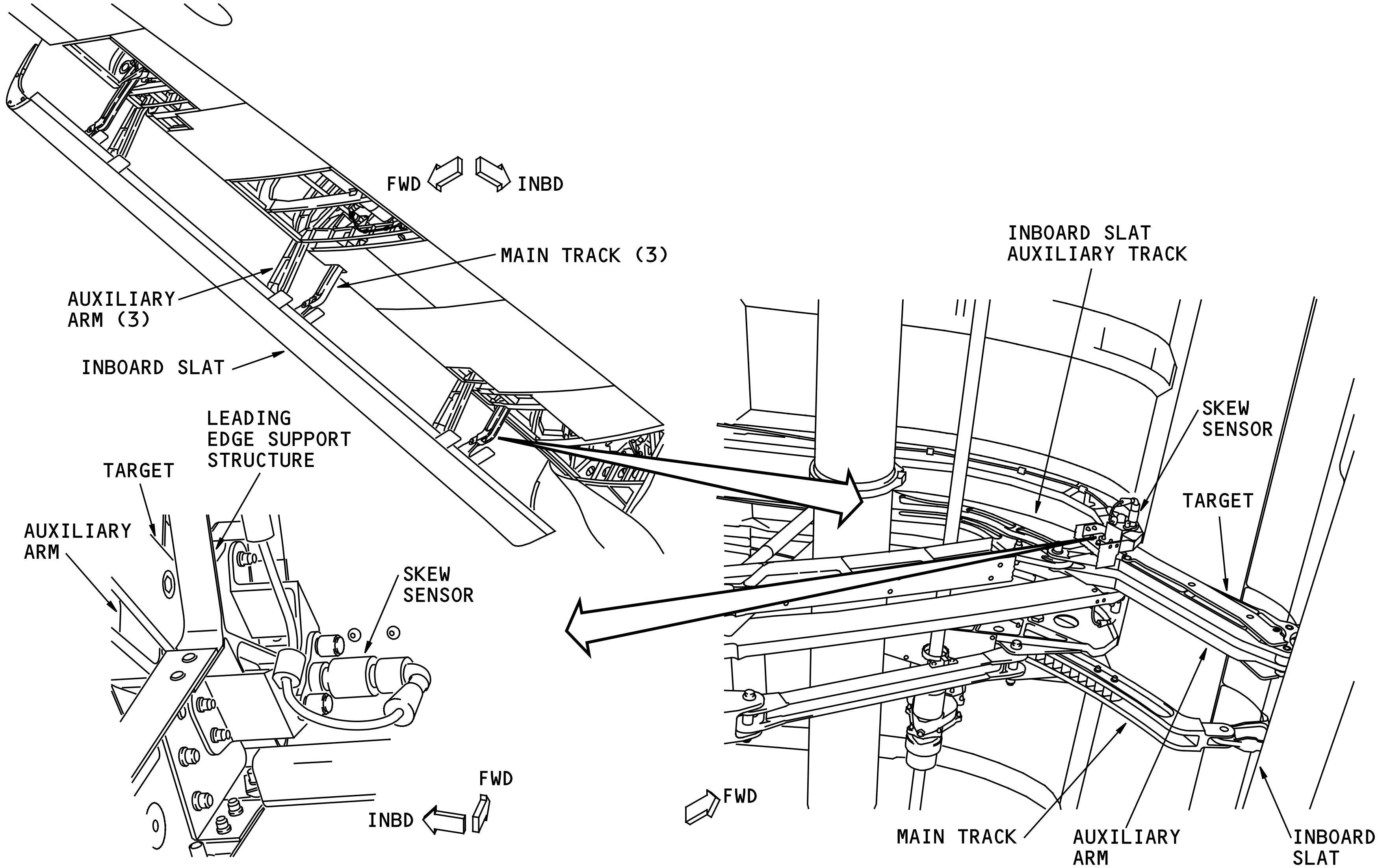
Functional Description

The FSEUs monitor the impedance of the skew sensors. The impedance has a relation to the position of the targets to the sensors. As the slats move, the targets move with them and the impedance of the skew sensors change.

The FSEUs detect a target-near condition when a magnet zone is directly in front of the sensor. When no part of a magnet zone is in front of the sensor, the FSEUs detect a target-far condition. The FSEUs use this data for skew monitoring and failure detection.

Training Information Point

It is not necessary to rig the inboard slat skew sensors and targets after installation.



INBOARD SLAT SKEW SENSOR INSTALLATION

SLAT SKEW DETECTION - INBOARD SLAT SKEW SENSORS AND TARGETS

SLAT SKEW DETECTION - OUTBOARD SLAT SKEW MECHANISM AND CABLE

Purpose

The outboard slat skew mechanisms and cables monitor the position of all the outboard slats except slats 1 and 14, the outboard end of slats 2 and 13, and the inboard end of slats 6 and 9.

Location

The outboard slat skew mechanisms are in slat 2 and slat 13. The left cable attaches to slat 6 and to the slat skew mechanism in slat 2. The right cable attaches to slat 9 and to the slat skew mechanism in slat 13. The routing of the cables is along the inside of the slat cove skins. Remove the cove skin panels to get access to the mechanisms and cables.

Physical Description

The slat skew mechanism has two proximity sensors, a target, two latches, and internal springs. A cable attaches to the slat skew mechanism.

When the cable pulls on the skew mechanism, the target moves to the far position. The latches lock the target in the far position. The internal springs permit some movement of the cable before the latch sets. This adjusts for minor changes of slat position caused by wing flex, temperature changes, and normal slat movement.

The proximity sensors measure the magnetic field of the target. When the position of the target changes, the impedance of the sensors change.

Each proximity sensor is a separate LRU and is interchangeable with the skew sensors for the inboard slats. But they are not interchangeable with the landing gear proximity sensors.

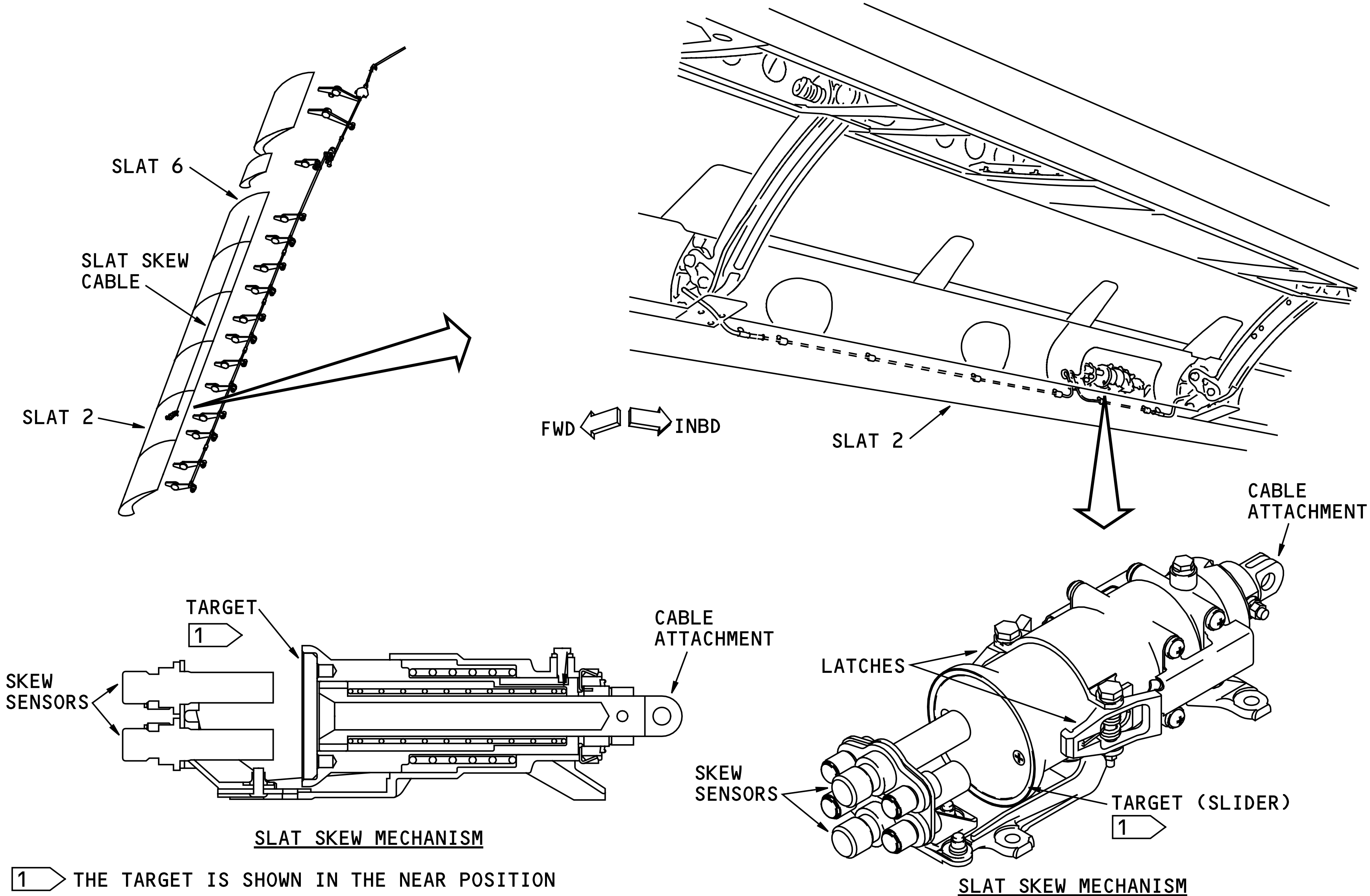
Functional Description

The FSEUs monitor the impedance of the skew sensors. If one of the outboard slats (except for the most outboard slat) do not align with all the others, the slat that is out of alignment pulls on the cable. This pulls on the skew mechanism, which moves the target to the far position. As the target moves away from the sensors, the impedance of the skew sensors change. The FSEUs use this data for skew monitoring and failure detection.

Training Information Point

It is necessary to rig the cable after installation of the skew mechanism or cable.

WARNING: KEEP ALL PERSONNEL CLEAR OF THE SPACE BETWEEN THE SLIDER AND THE SENSORS ON THE SLAT SKEW MECHANISM. WHEN YOU RELEASE THE LATCHES, THE SLIDER WILL QUICKLY MOVE OUTBOARD. THIS CAN CAUSE INJURY TO PERSONNEL AND DAMAGE TO EQUIPMENT.



1 THE TARGET IS SHOWN IN THE NEAR POSITION

SLAT SKEW DETECTION - OUTBOARD SLAT SKEW MECHANISM AND CABLE

SLAT SKEW DETECTION - FUNCTIONAL DESCRIPTION

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SLAT SKEW DETECTION - FUNCTIONAL DESCRIPTION

General

There are 12 slat skew sensors. Each FSEU receives data from one of the skew sensors at each slat skew sensor location.

Both channels in the FSEUs use the slat skew data for:

- The inboard slat skew monitor
- The outboard slat skew monitor
- Failure detection.

Inboard Slat Skew Monitor

The inboard slat skew monitor receives data from the inboard and outboard skew sensors for slats 7 and 8. This monitor also receives data from the slat position sensors to predict the condition of the skew sensors.

The inboard slats are in a skew condition if:

- The condition of the inboard and outboard skew sensors for slat 7 (or 8) disagree with each other, or
- The condition of the inboard and outboard skew sensors for slat 7 (or 8) both disagree with the predicted condition.

Outboard Slat Skew Monitor

The outboard slat skew monitor receives data from the skew sensors in slats 2 and 13. Normally, these sensors are in the target-near condition. The outboard slats are in a skew condition (or a slat is lost) if these sensors are in the target-far condition.

Slats Drive Shutdown

The failure detection function in the FSEUs receives input from these sensors:

- The slat skew sensors
- The slat position sensors
- The flap lever position sensors.

When both FSEUs find a failure, they stop and shutdown the slats drive. There is a slats drive shutdown when any of these conditions occurs:

- The inboard or outboard slat skew monitors find a failure (slat skew or lost slat)
- The left slat position sensors do not agree with the right slat position sensors (slat asymmetry)
- The slats do not move within five seconds after a slat command in the secondary mode (disagree).

If there is a slat skew, asymmetry, or secondary mode disagree condition, the FSEUs latch the shutdown of the primary and secondary modes. The FSEUs also send signals to AIMS to show the SLATS DRIVE caution message. The slat position display changes to the secondary mode display and the slat position indication shows in amber.

A slats drive shutdown still permits the flaps to operate in primary or secondary mode. The flaps then

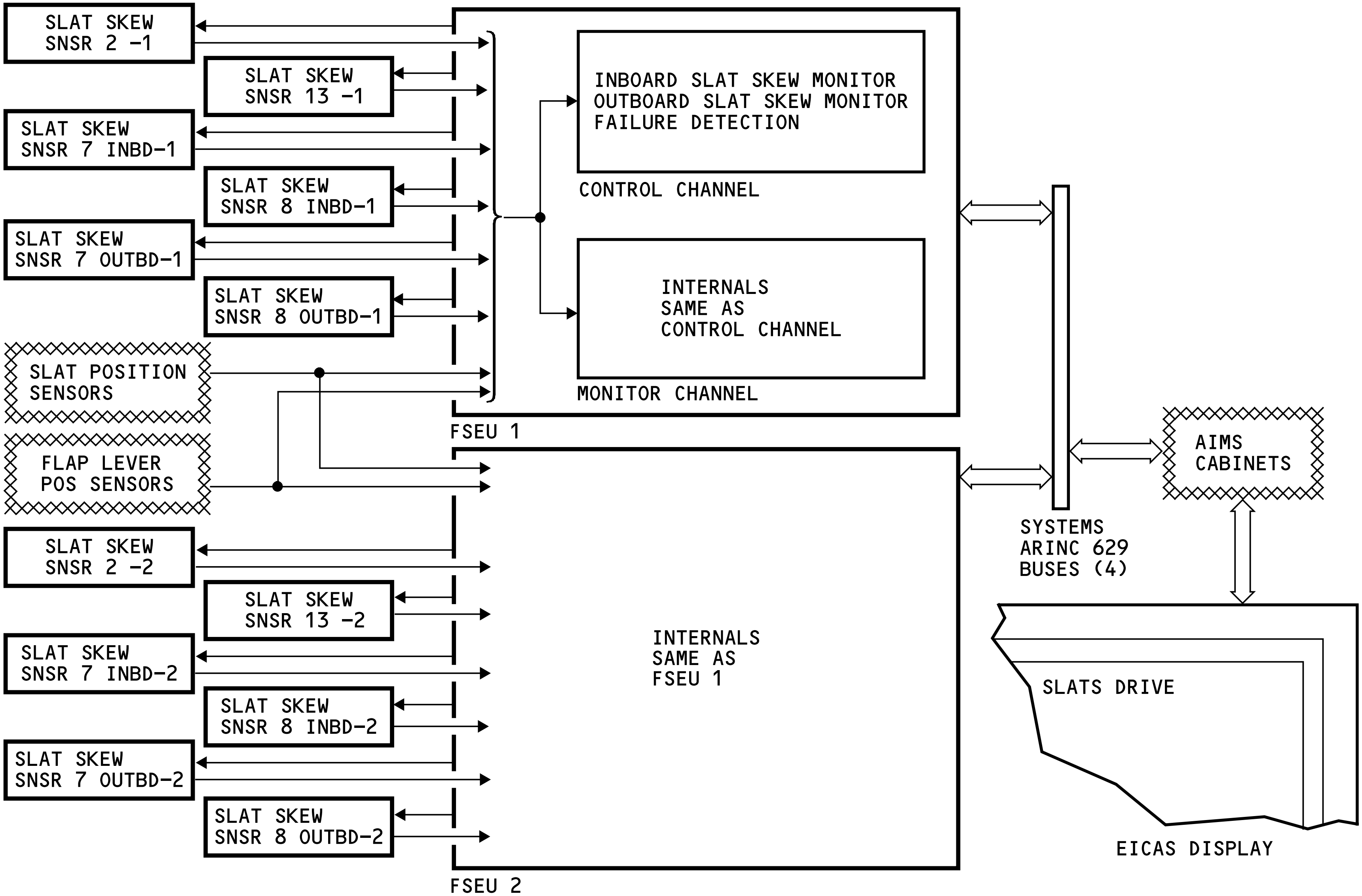
SLAT SKEW DETECTION - FUNCTIONAL DESCRIPTION

move to their commanded position independently of the slat position. If the slats are not at the gapped position when the slats drive shutdown occurs, the flaps cannot move more than the 20-unit position. If the slats are at the gapped position when the slats drive shutdown occurs, the flaps can move more than the 20-unit position.

To reset the latch, cycle the alternate flaps arm switch or do the primary system test on the MAT.

Skew Sensor Failure

If one or more of the slat skew sensors fails, the FSEUs send a signal to the AIMS to show the FLAP/SLAT SKEW SNSRS status message.



SLAT SKEW DETECTION - FUNCTIONAL DESCRIPTION

Continental Airlines, Inc

Pneumatics

WB371

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Continental Airlines, Inc

Pneumatics

WB371

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PNEUMATIC - GENERAL DESCRIPTION

General

The pneumatic system has these three sections:

- Engine air supply
- Air supply distribution
- Indicating.

Two air supply cabin pressure controllers (ASCPC) give control, indication and BITE for all sections of the pneumatic system and for the pressurization system. See the air pressurization section for more information on the pressurization system (AMM PART I 21-30).

The controllers also set the amount of air that the air conditioning packs use (flow schedules) and give backup control to the cabin temperature controllers for air conditioning pack flow control and trim air control. See the air conditioning chapter for more information on air conditioning backup control (AMM PART I 21).

The left ASCPC controls the left engine air supply and the right ASCPC controls the right engine air supply. Both controllers control the isolation valves and APU shutoff valve.

Engine Air Supply

The engine air supply part of the pneumatic system can operate at any one of three levels (modes) of control:

- Digital (primary control)
- Analog (backup control)
- Pneumatic.

See the engine air supply section for more information about the engine air supply (AMM PART I 36-11).

The engine air supply system supplies the users with bleed air from two stages of the high pressure compressor (HPC). Low pressure bleed air comes from the 4th stage of the HPC. High pressure bleed air comes from the 10th stage of the HPC. These are the specified limits for pressure, temperature, and flow:

- Pressure - 0 through 75 psig (mode dependent)
- Temperature - 380F (193C) or 250F (121C) (mode dependent)
- Flow - 10 lbs/sec maximum (engine bleed airflow management).

The ASCPCs monitor the user systems to make decisions about how much air to supply. The ASCPCs manage engine bleed airflow three ways:

- Sheds user loads through an ARINC 629 signal (aft and bulk cargo heat, wing anti-ice)
- Sheds user loads by direct control (air conditioning packs, air conditioning trim air)
- Keeps engine bleed airflow to a limit.

The ASCPCs also monitor the user systems to make decisions about the temperature of air to supply. The ASCPCs manage engine bleed air temperature in two ways:

- Controls the flow of fan air though the precooler

- Keeps engine bleed air flow to a limit.

The ASCPCs use the pressure regulating and shutoff valve controller (PRSOVC) and the high pressure and fan air controller (HPFAC) to control the engine bleed air. The PRSOVC and HPFAC usually adjust the positions of the pressure regulating and shutoff valve (PRSOV) and the high pressure shutoff valve (HPSOV) as necessary to regulate pressure and flow. The HPFAC adjusts the position of the fan air modulating valve (FAMV) as necessary to regulate temperature. See the engine air supply section for more information about the engine air supply (AMM PART I 36-11).

Air Supply Distribution

The air supply distribution system supplies air from the sources to the user systems. The ASCPCs monitor the condition of the airplane, air sources and user systems to make decisions about which source to use and where the air is needed. The ASCPCs open and close the isolation valves and APUSOV as necessary to distribute the air to the user systems.

Indicating

Eight sensors monitor the air in the pneumatic system (right side sensors not shown):

- Manifold flow sensor (2)
- Manifold pressure sensor (2)
- Manifold dual temperature sensor (2)
- Intermediate pressure sensor (2).

RVDTs monitor valve position for these valves:

- Left, right, and center isolation valves
- APU shutoff valve
- Left and right fan air modulating valves.

The left and right ASCPCs monitor the sensors for flow, pressure, and temperature data. The ASCPCs monitor the RVDTs for valve position data. The ASCPCs use the data to control these components:

- Three isolation valves
- APU shutoff valve
- Two pressure regulating and shutoff valve controllers (PRSOVC)
- Two high pressure fan air controllers (HPFAC).

The ASCPCs send information to the airplane information management system (AIMS). The AIMS gives EICAS messages and synoptic and maintenance information.

Interfaces

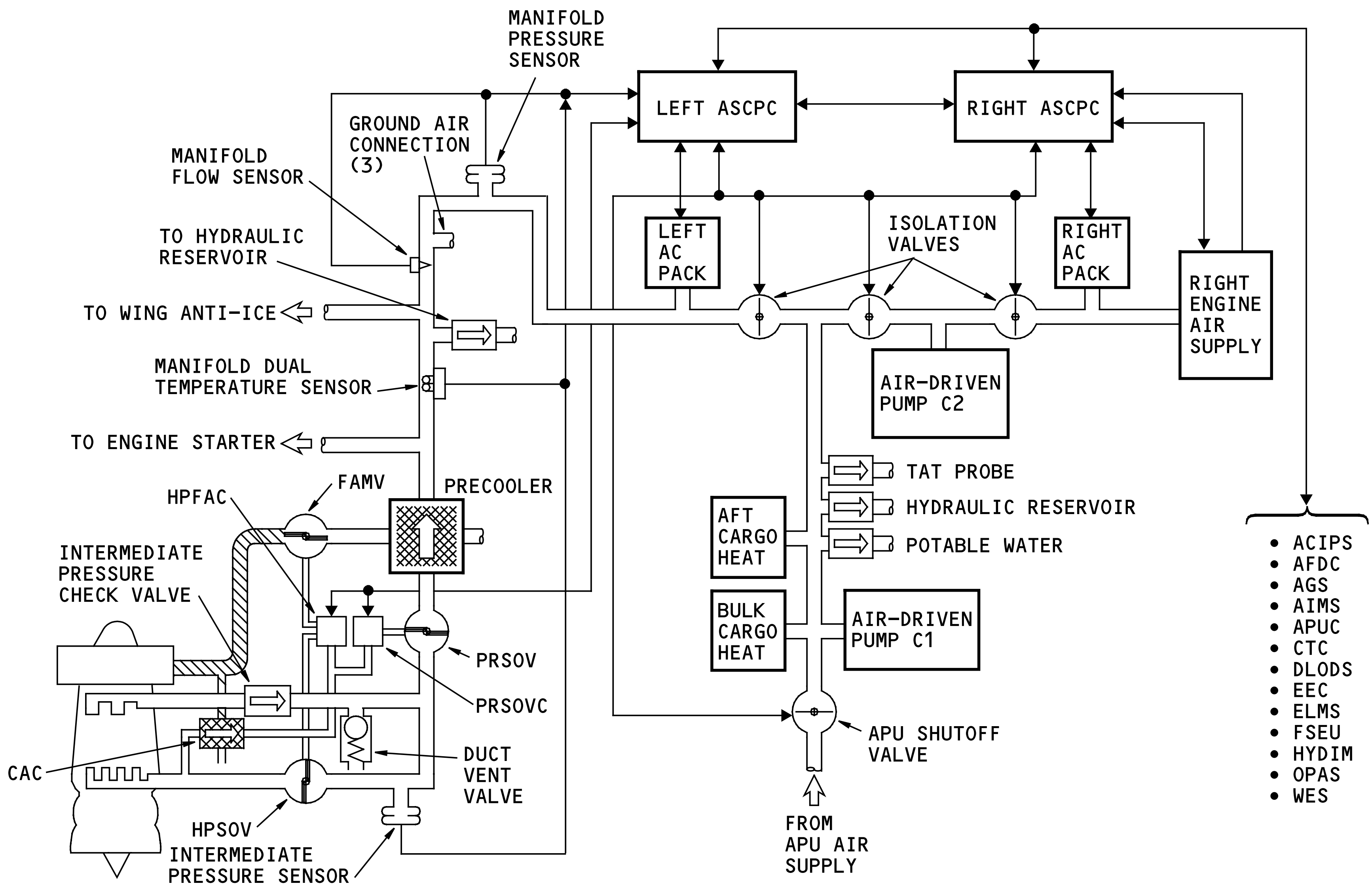
The pneumatic system has interfaces with these systems and components:

- Left and right cabin temperature controllers (CTC)
- Overhead panel ARINC 629 system (OPAS)
- Electronic engine control (EEC)
- Airplane information management system (AIMS)
- Electrical load management system (ELMS)
- Warning electronic system (WES)
- Auxiliary power unit controller (APUC)

PNEUMATIC - GENERAL DESCRIPTION

- Flap slat electronics unit (FSEU)
- ARINC signal gateway (ASG)

See the section on the ASCPC for more information on interfaces.



36-00-00-002 Rev 7 10/09/96

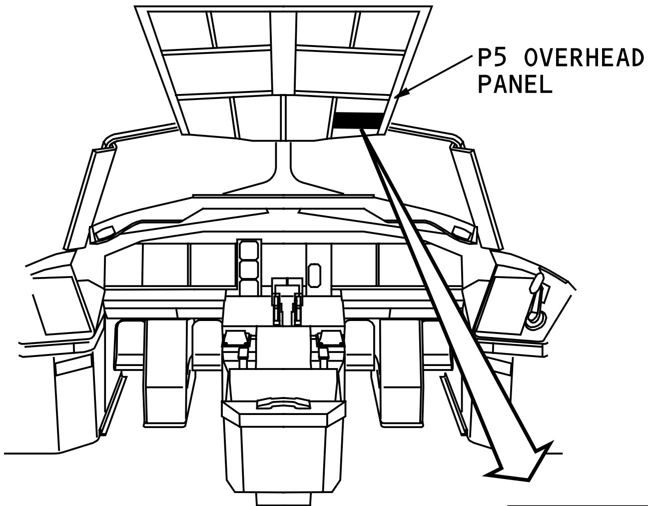
PNEUMATIC - GENERAL DESCRIPTION

PNEUMATIC - COMPONENT LOCATIONS

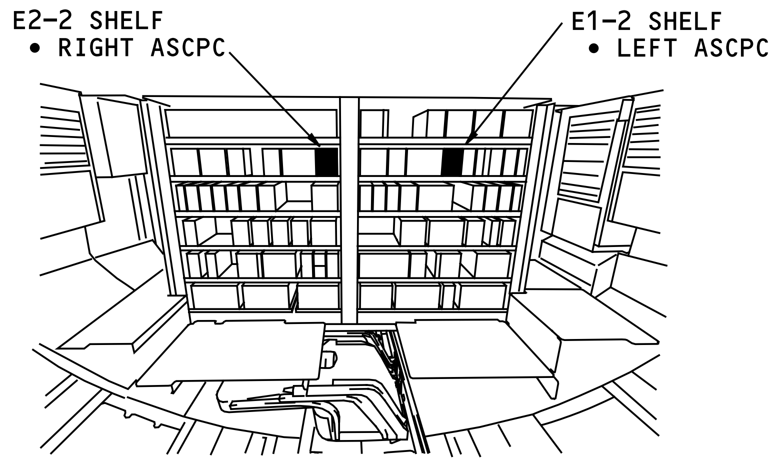
Component Locations

Two ASCPCs are in the main equipment center. The left ASCPC is on the E1-2 shelf. The right ASCPC is on the E2-2 shelf.

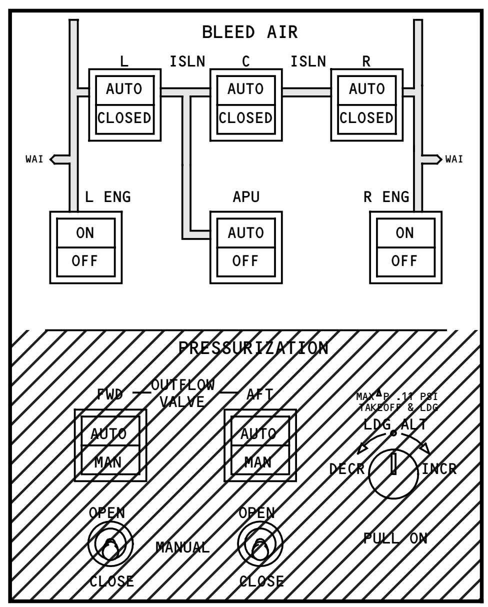
The bleed air/pressurization panel is on the P5 overhead panel. Switches on the bleed air part of the panel give control and indications for the pneumatic system.



FLIGHT DECK



MAIN EQUIPMENT CENTER
(LOOKING AFT)



BLEED AIR/PRESSURIZATION PANEL

PNEUMATIC - COMPONENT LOCATIONS

36-00-00-003 Rev 2

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ENGINE AIR SUPPLY - GENERAL DESCRIPTION

General Description

The engine air supply system has three levels of control:

- Digital (primary mode)
- Analog (backup mode)
- Pneumatic.

The ASCPC supplies the primary and backup modes. The high pressure fan air controller (HPFAC) and the pressure regulating and shutoff valve controller (PRSOVC) are set to let the engine air supply system operate without ASCPC control. This is the pneumatic mode.

For usual operation, all functions that have a relation to the primary mode and some functions for the backup mode operate at the same time. The primary mode and backup modes work together to supply the most efficient control for the engine air supply system.

If the primary mode fails, all functions for the backup and the pneumatic modes operate together. The backup and the pneumatic modes give a limited amount of control, protection, and indications for the engine air supply system.

If the primary and backup modes fail, the pneumatic mode sets the engine air supply system to the default condition. In the default condition, the engine air supply system supplies air in the pneumatic mode with no protection or indications.

The primary mode is described below. See engine air supply functional description section for more information.

Bleed Port Selection

The ASCPC selects the lowest possible bleed air source while still satisfying the needs of the users systems. Selection is based on pressure, flow, altitude, air conditioning pack operation, and engine starting. The manifold pressure sensor, the intermediate pressure sensor and the EEC monitor the pneumatic duct pressure. The pneumatic duct pressure data goes to the ASCPC. If pressure goes below specified values, the ASCPC sends a command to the HPFAC. The HPFAC adjusts the position of the high pressure shutoff valve (HPSOV) so that high pressure air adds to low pressure air.

Pressure Control

The ASCPC controls the engine air supply pressure. The manifold pressure sensor and the intermediate pressure sensor monitor the pneumatic duct pressure. The pneumatic duct pressure data goes to the ASCPC. The ASCPC then sends a command to the HPFAC and the PRSOVC. The HPFAC adjusts the HPSOV and the PRSOVC adjusts the pressure regulating shutoff valve (PRSOV). The valves open and close as necessary to control the pressure.

The duct vent valve (DVV) releases high pressure to prevent overpressure indication when the engine is on and the bleed system is set to off.

ENGINE AIR SUPPLY - GENERAL DESCRIPTION

Temperature Control

The ASCPC controls the engine air supply temperature. The manifold dual temperature sensors monitor the pneumatic duct temperature. The pneumatic duct temperature data goes to the ASCPC. The ASCPC then sends a signal to the HPFAC. The HPFAC adjusts the fan air modulating valve (FAMV) to control the temperature.

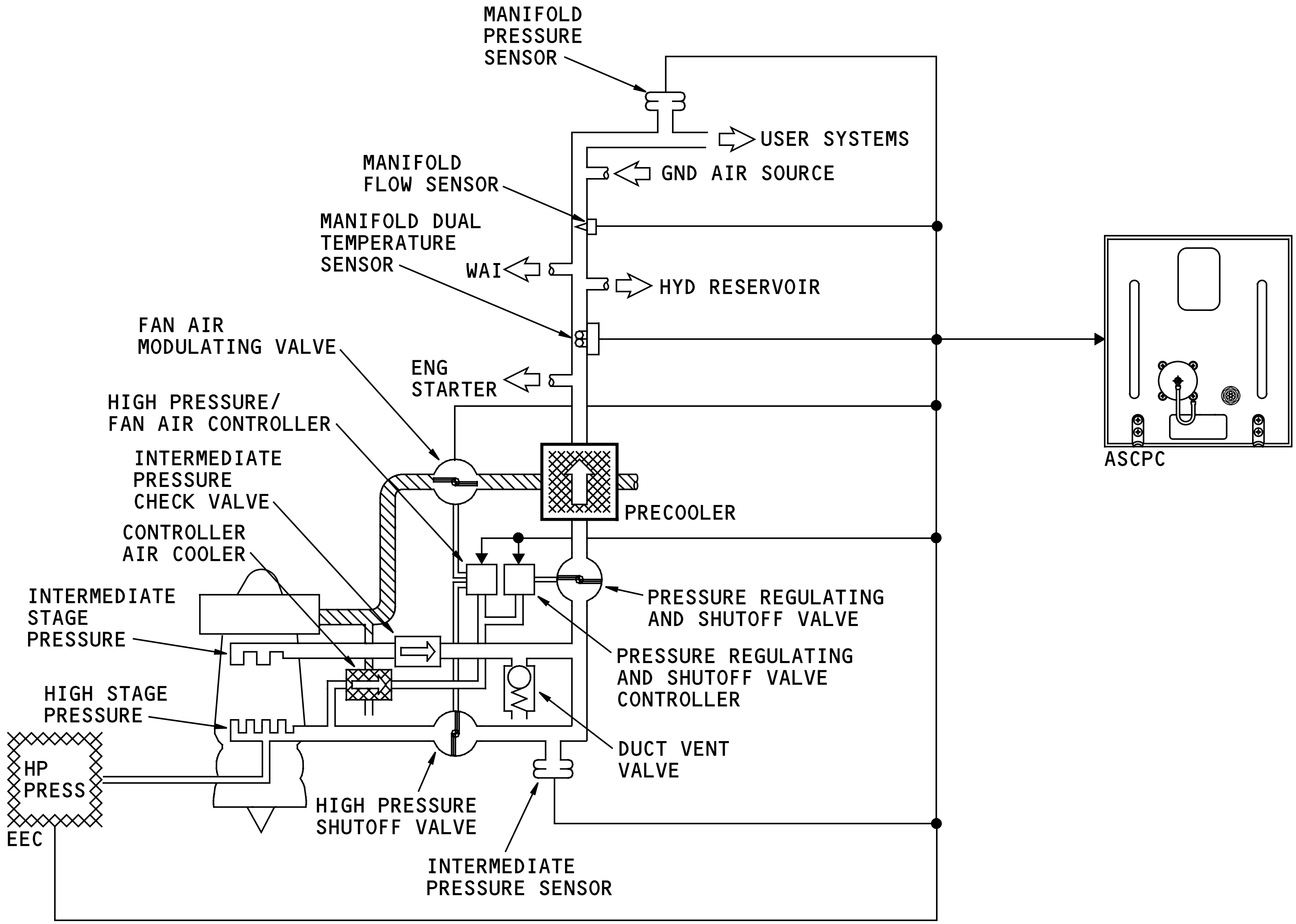
If the temperature of the bleed air gets above the usual limits, a signal goes to the PRSOVC. The PRSOVC adjusts the PRSOV as necessary to decrease the amount of hot bleed air supplied.

Flow Control

The ASCPC keeps the amount of bleed air that flows from the engine to a limit. The ASCPC uses inputs from these components or systems to monitor engine bleed airflow:

- Manifold flow sensor (FS)
- Engine anti-ice (EAI) system (not shown)
- Wing anti-ice (WAI) system (not shown).

The ASCPC uses the PRSOVC to control the flow. The PRSOVC adjusts the position of the PRSOV to regulate the bleed air flow into the air supply distribution system.



36-11-00-002 Rev 2 09/16/96

ENGINE AIR SUPPLY - GENERAL DESCRIPTION

ENGINE AIR SUPPLY SYSTEM - INTERMEDIATE PRESSURE CHECK VALVE

Purpose

The intermediate pressure check valve (IPCV) prevents air in the HP/IP manifold from going into the fourth stage bleed air source.

Physical Description

The IPCV is a pneumatically-operated check valve. The IPCV has these parts:

- Valve body
- Flapper
- Flapper stop
- Hinge pin.

The flow direction arrow is part of the valve body.

Location

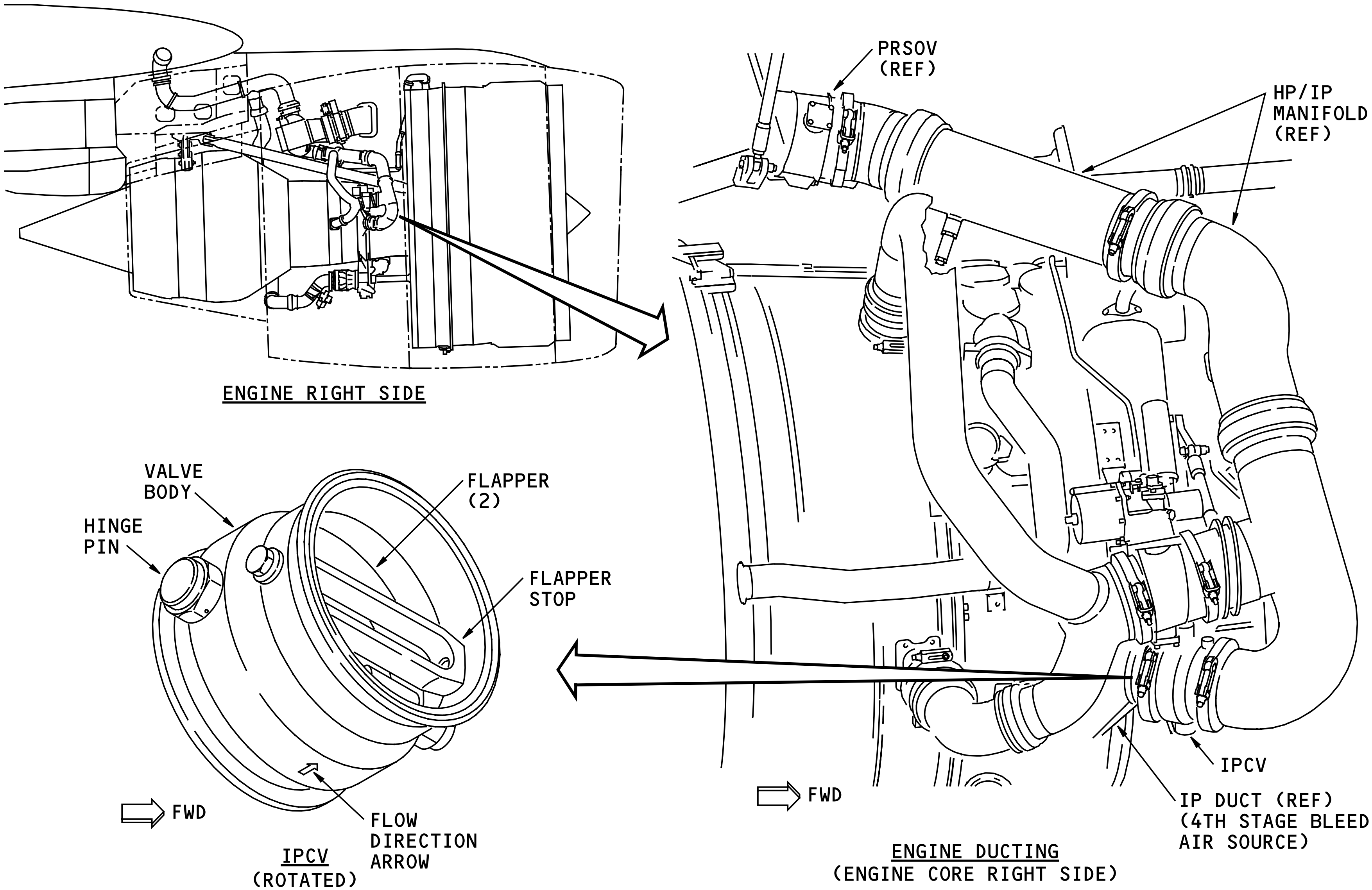
There is one IPCV on the right side of each engine. The valve is next to the fourth stage bleed air source at the 3:00 position in the engine ducting.

Functional Description

The flappers hinge around the hinge pin. The flapper stop keeps the flappers from opening too far. Fourth stage bleed air pressure and engine manifold pressure control the position of the flappers.

Training Information Point

A male and a female flange prevents the IPCV from incorrect installation. A flow direction arrow on the valve also helps prevent incorrect installation.



36-11-00-007 Rev 4 03/28/95

ENGINE AIR SUPPLY SYSTEM - INTERMEDIATE PRESSURE CHECK VALVE

ENGINE AIR SUPPLY SYSTEM - HIGH PRESSURE SHUTOFF VALVE / PRESSURE REGULATING & SHUTOFF VALVE

Purpose

The high pressure shutoff valve (HPSOV) controls the direction of flow and the pressure of the bleed air from the high stage of the high pressure compressor.

The pressure regulating and shutoff valves (PRSOV) control the direction of flow and the air pressure to the pneumatic distribution system.

Physical Description

The HPSOV and PRSOV are the same. They are of the spring loaded closed, pneumatically-operated type of valve. The valves have these parts:

- Pneumatic connector
- Manual override and position indicator assembly
- Flow direction arrow
- Valve body
- Valve disc
- Actuator.

The valves do not have any electrical parts.

Location

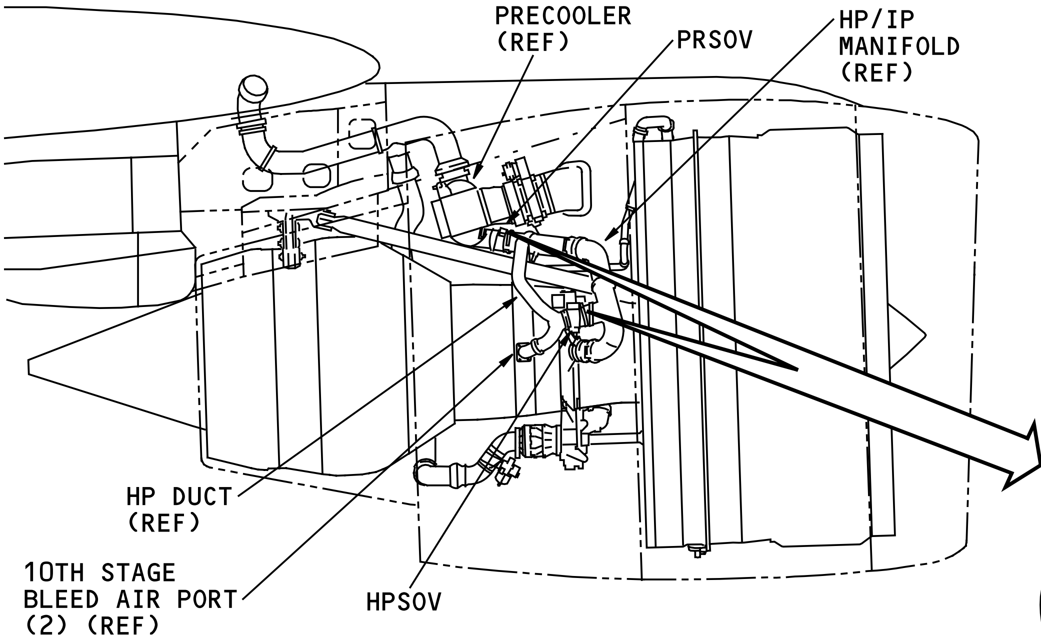
The HPSOV is on the right side of the engine core at the 2:30 position. The HPSOV is in the engine ducting between the HP duct and the HP/IP manifold downstream of the tenth stage bleed air ports.

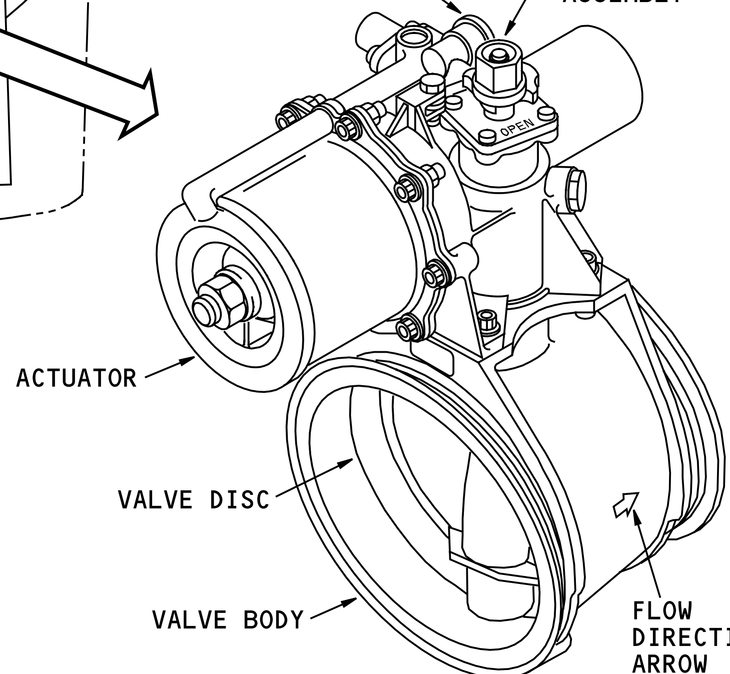
The PRSOV is above the engine core forward and below the precooler at the 12:00 position. It is between the HP/IP manifold and the precooler. The actuator side of the valve faces to the left. You can see the valve from either side of the engine. But you get access for removal/installation from the left side of the engine.

Training Information Point

Use the manual override and position indicator assembly to lock the valve in the closed position.

Each valve has a flow direction arrow and alignment marks (not shown). The arrow and alignment marks help install the valves correctly. A male flange and a female flange prevent incorrect installation.





36-11-00-008 Rev 2 02/17/95

ENGINE AIR SUPPLY SYSTEM - HIGH PRESSURE SHUTOFF VALVE / PRESSURE REGULATING & SHUTOFF VALVE

ENGINE AIR SUPPLY SYSTEM - PRESSURE REGULATING AND SHUTOFF VALVE CONTROLLER

Purpose

The pressure regulating and shutoff valve controller (PRSOVC) supplies control pressure to the PRSOV.

Location

The PRSOVC is on the left side of the engine fan case at the 7:00 position.

Physical Description

The PRSOVC is an electropneumatic controller. The PRSOVC has these parts:

- Two reference pressure regulators
- Torque motor
- Electrical connector
- Two pneumatic line connectors
- Filter (internal)
- Heater.

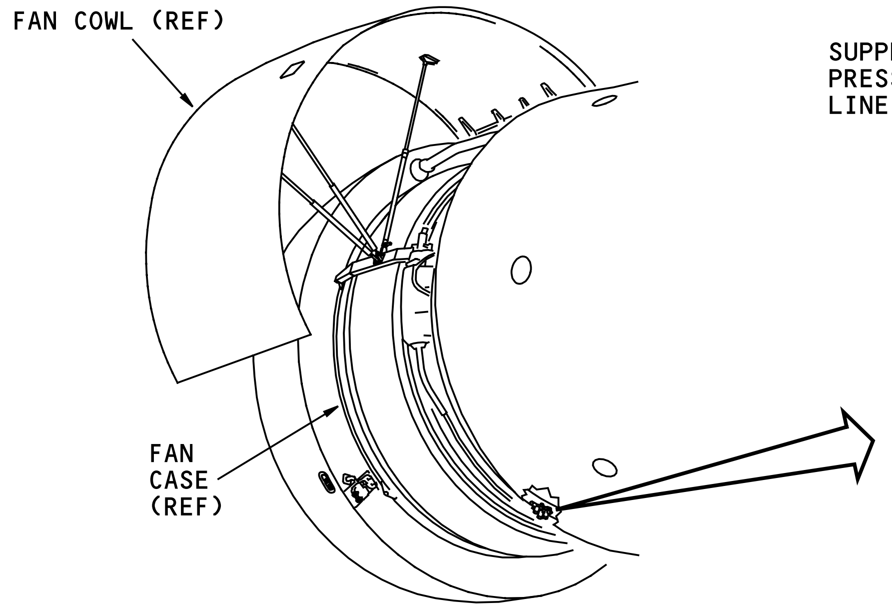
The reference pressure regulators set control pressure to a fixed value. The regulators are in series with each other. The torque motor adjusts the control pressure to values less than the reference pressure regulators. The torque motor always lets control pressure go to the PRSOV if it has no electrical power (fail safe on).

The heater prevents the controller from freezing.

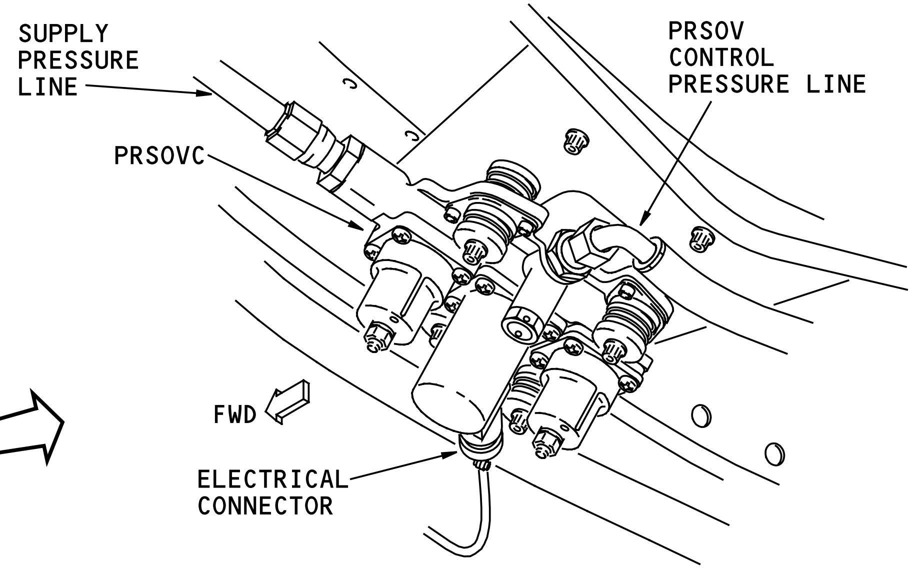
Training Information Point

The mounting bolt hole pattern on the PRSOVC helps you install it correctly. The two pneumatic line connectors are of different sizes. This also helps you install the PRSOVC correctly.

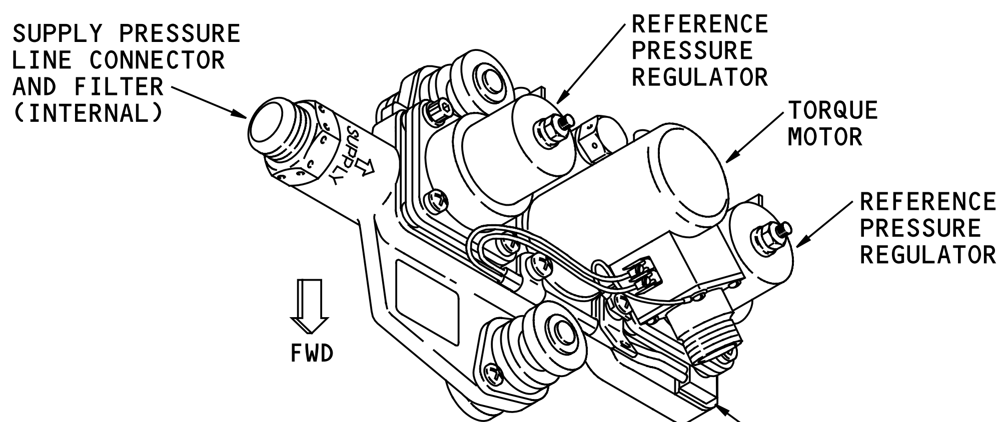
The filter is line replaceable.



ENGINE LEFT SIDE



FAN CASE



PRSOVC

ENGINE AIR SUPPLY SYSTEM - PRESSURE REGULATING AND SHUTOFF VALVE CONTROLLER

36-11-00-010 Rev 2 01/18/95

ENGINE AIR SUPPLY SYSTEM - PRECOOLER

Purpose

The precooler decreases the engine bleed air temperature.

Location

The precooler is attached to bottom of the engine strut above the high pressure turbine section of the engine.

Physical Description

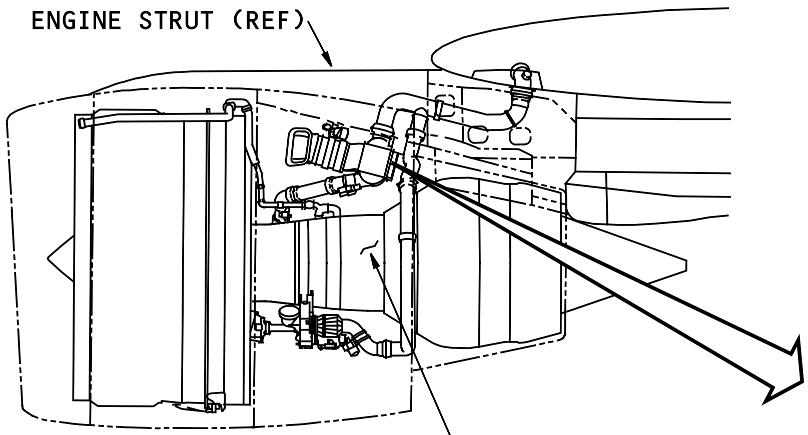
The precooler is a cross flow air-to-air heat exchanger. The precooler weights approximately 169.2 pounds (76.8 kg).

Functional Description

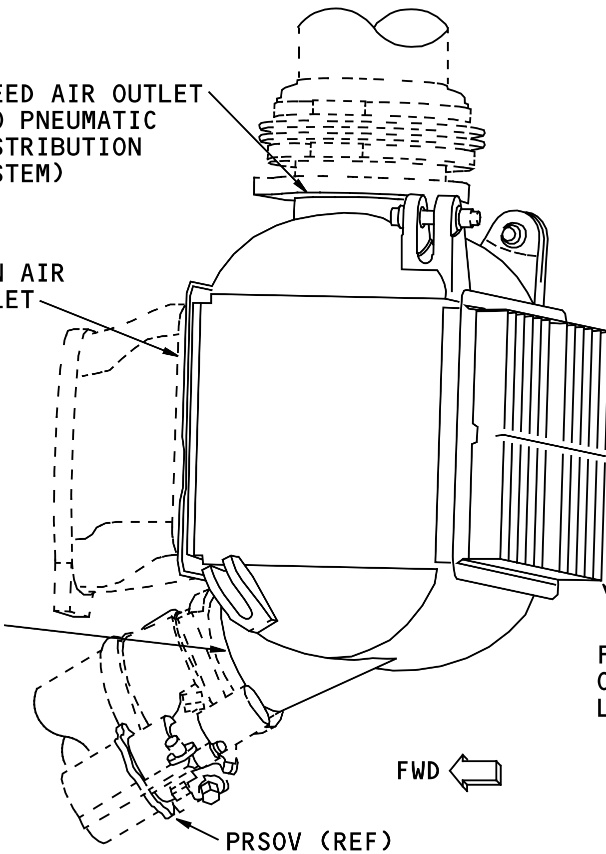
Engine bleed air flows through the precooler coils. Fan air flows over the precooler coils. This decreases the temperature of the engine bleed air.

Training Information Point

You can remove the precooler with special ground support equipment. The equipment permits you to remove the precooler with the engine on the wing.



ENGINE LEFT SIDE



PRECOOLER

36-11-00-011 Rev 2 01/19/95

ENGINE AIR SUPPLY SYSTEM - PRECOOLER

ENGINE AIR SUPPLY SYSTEM - FAN AIR MODULATING VALVE

Purpose

The fan air modulating valve (FAMV) controls the quantity of fan air that goes to the precooler.

Location

The FAMV is between the engine strut and the engine. The valve attaches to the FAMV inlet ducting forward of the precooler.

Physical Description

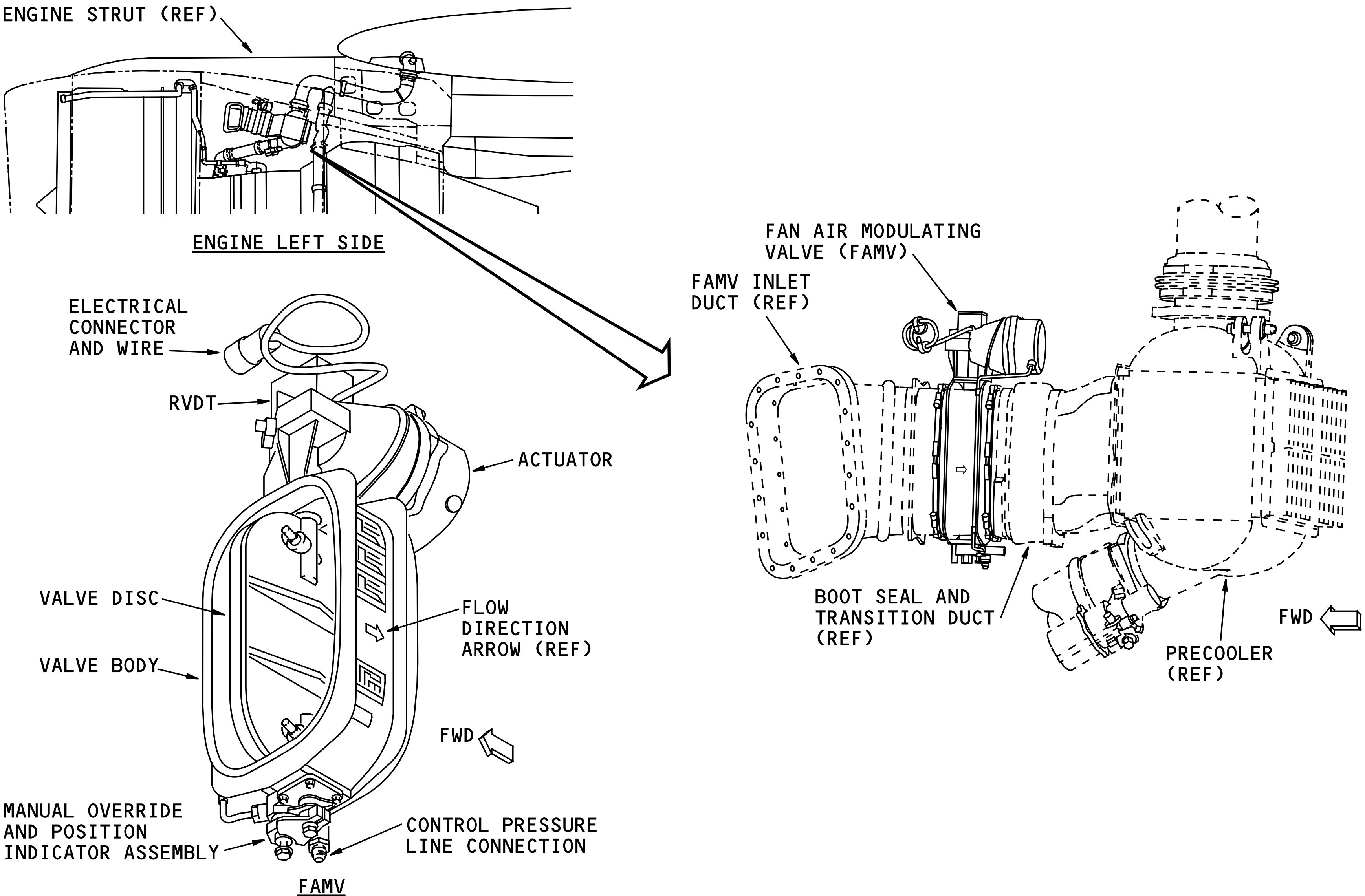
The FAMV is spring-loaded to the open position. It is pneumatically controlled and operated. The FAMV has these parts:

- Electrical lead and connector
- Actuator
- Control pressure line connection
- Manual override and position indicator assembly
- Valve body
- Valve disc
- RVDT.

Training Information Point

The FAMV has a flow direction arrow to help install it correctly.

The manual override and position indicator assembly locks the FAMV in the open or closed position. The valve must be locked in the closed position for removal or installation.



ENGINE AIR SUPPLY SYSTEM - FAN AIR MODULATING VALVE

36-11-00-012 Rev 1 02/17/95

ENGINE AIR SUPPLY SYSTEM - FAMV - TRAINING INFORMATION POINTS

General

The manual override and valve position indicator assembly lets you manually lock the valve closed or open and gives actual valve position.

Location

The assembly attaches to the valve body opposite from the actuator.

Physical Description

The assembly has these parts:

- Valve shaft
- Position indicator
- Lock plunger
- Locking cam.

Functional Description

The position indicator and locking cam attach to the valve shaft. As the valve shaft turns so does the indicator and locking cam.

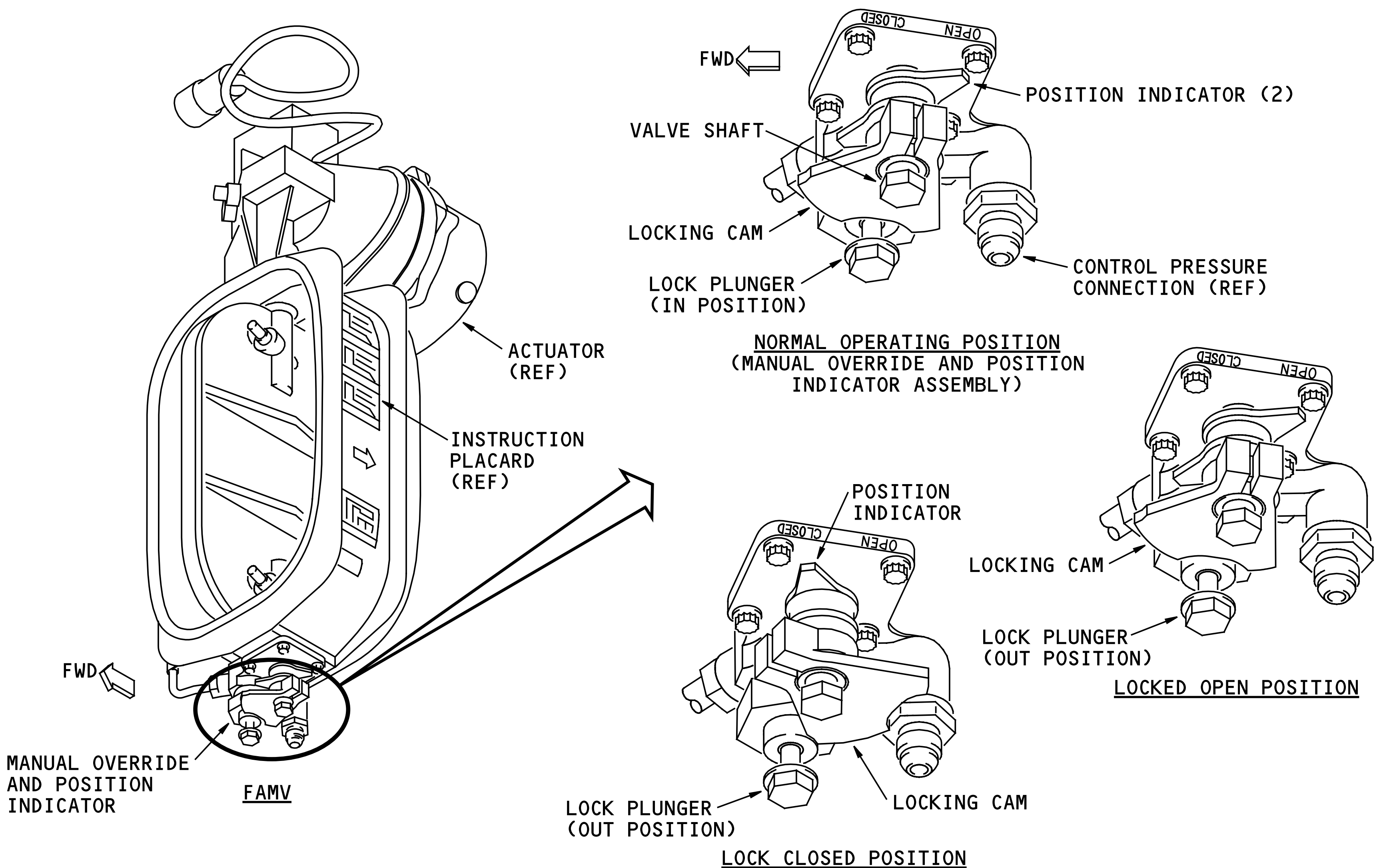
The locking cam has two slots. One is for the valve locked OPEN position and one is for the valve locked CLOSED position.

The lock plunger has two positions: in and out. The in position lets control pressure go to the valve actuator and permits free movement of the valve. The out position blocks control pressure, vents pressure from the valve actuator, and stops movement of the lock cam and valve. The plunger is spring-loaded out. The plunger is also threaded so you can push it in and turn it until it stays in (position for usual valve operation).

Operation

When the valve is in the open position, you turn the lock plunger counterclockwise (CCW) until it moves out to lock the valve open. To lock the valve closed, you first turn the lock plunger CCW until it moves out. Then push the plunger in and turn the valve shaft towards CLOSED position. The lock cam holds the plunger down as you turn the valve shaft to the closed position. The plunger moves out and stops movement of the cam and valve shaft when the valve is in the closed position.

You unlock the valve from the locked OPEN or CLOSED positions when you push the lock plunger in and turn it clockwise. The plunger must be torqued to make sure control pressure does not leak when you unlock the valve for usual operation.



ENGINE AIR SUPPLY SYSTEM - FAMV - TRAINING INFORMATION POINTS

ENGINE AIR SUPPLY SYSTEM - HIGH PRESSURE AND FAN AIR CONTROLLER

Purpose

The high pressure and fan air controller (HPFAC) regulates the control pressure that goes to the FAMV actuator and the HPSOV actuator.

Location

The HPFAC is inside the fan hub frame area of the engine at the 1:00 position.

Physical Description

The HPFAC is an electropneumatic controller. The controller has these parts:

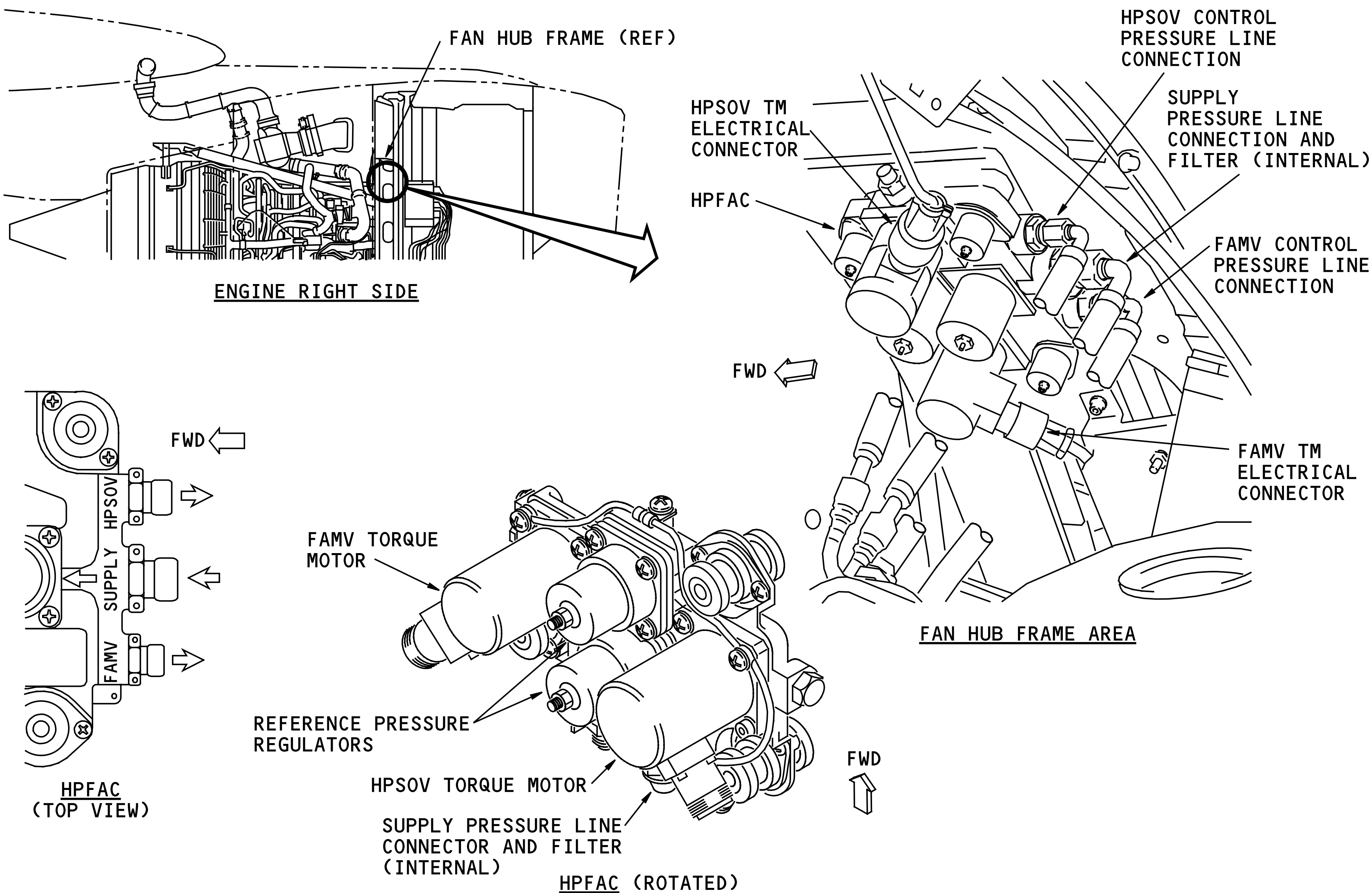
- Two electrical connectors (FAMV and HPSOV)
- Two control pressure line connectors (FAMV and HPSOV)
- One supply pressure line connector and filter
- Two torque motors (TM) (FAMV & HPSOV)
- Two reference pressure regulators (FAMV and HPSOV).

The reference pressure regulators set control pressure to a fixed value. The regulators are in series with each other. The torque motors regulate the control pressure to values less than the reference pressure regulators. The heater prevents the controller from freezing.

Training Information Point

The mounting bolt hole pattern on the HPFAC helps install it correctly. Three pneumatic line connectors are of different sizes on the HPFAC. This makes sure you connect the lines correctly. Two electrical connectors are of different sizes to help install the HPFAC correctly.

The filter is line replaceable.



36-11-00-014 Rev 2 02/17/95

ENGINE AIR SUPPLY SYSTEM - HIGH PRESSURE AND FAN AIR CONTROLLER

ENGINE AIR SUPPLY SYSTEM - CONTROLLER AIR COOLER

General

There are two controller air coolers (CAC) on each engine. There is one for the engine air supply part of the pneumatic system and there is one for the engine anti-ice system (not shown). See the engine anti-ice section for more information about the engine anti-ice CAC (AMM PART I 30-21).

The engine air supply controller air cooler decreases the temperature of the engine bleed air (HP10) that goes to these controllers:

- Pressure regulating and shutoff valve controller (PRSOVC)
- High pressure and fan air controller (HPFAC).

Physical Description

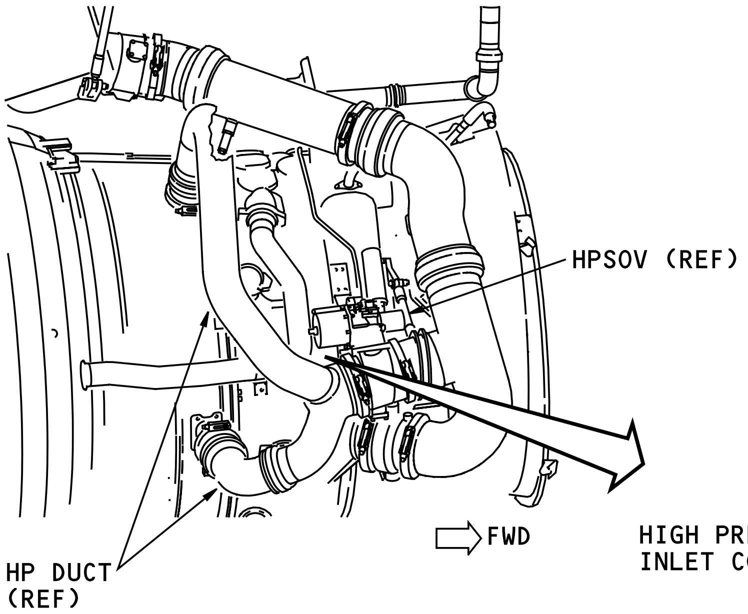
The controller air cooler is an air-to-air heat exchanger. It has three pneumatic line connectors, two high pressure and one low pressure (fan air).

Location

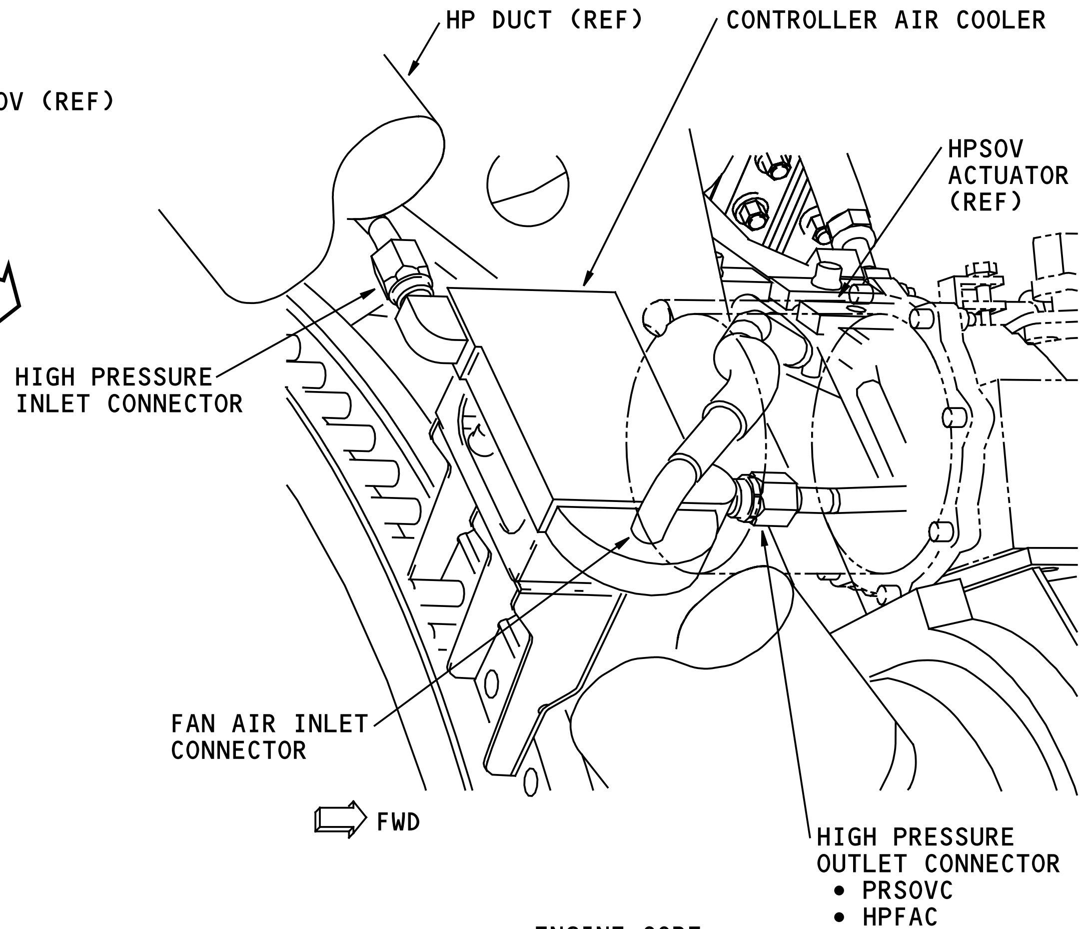
The controller air cooler is on the right side of the engine core at the 2:30 position. The cooler is under the actuator of the HPSOV.

Functional Description

Hot air from the high stage compressor section and cool fan air flows through the controller air cooler. The cool air carries heat away from the hot air. This decreases the temperature of the hot air.



ENGINE CORE - RIGHT SIDE



ENGINE CORE

36-11-00-015 Rev 3

ENGINE AIR SUPPLY SYSTEM - CONTROLLER AIR COOLER

ENGINE AIR SUPPLY SYSTEM - DUCT VENT VALVE

Purpose

The duct vent valve (DVV) releases air pressure from the engine duct when there is too much pressure in the duct. It prevents an overpressure condition if there is leakage through the HPSOV when the both HPSOV and PRSOV are closed. If the HPSOV is not fully closed, the flow out of the DVV is not sufficient to prevent an overpressure condition.

Location

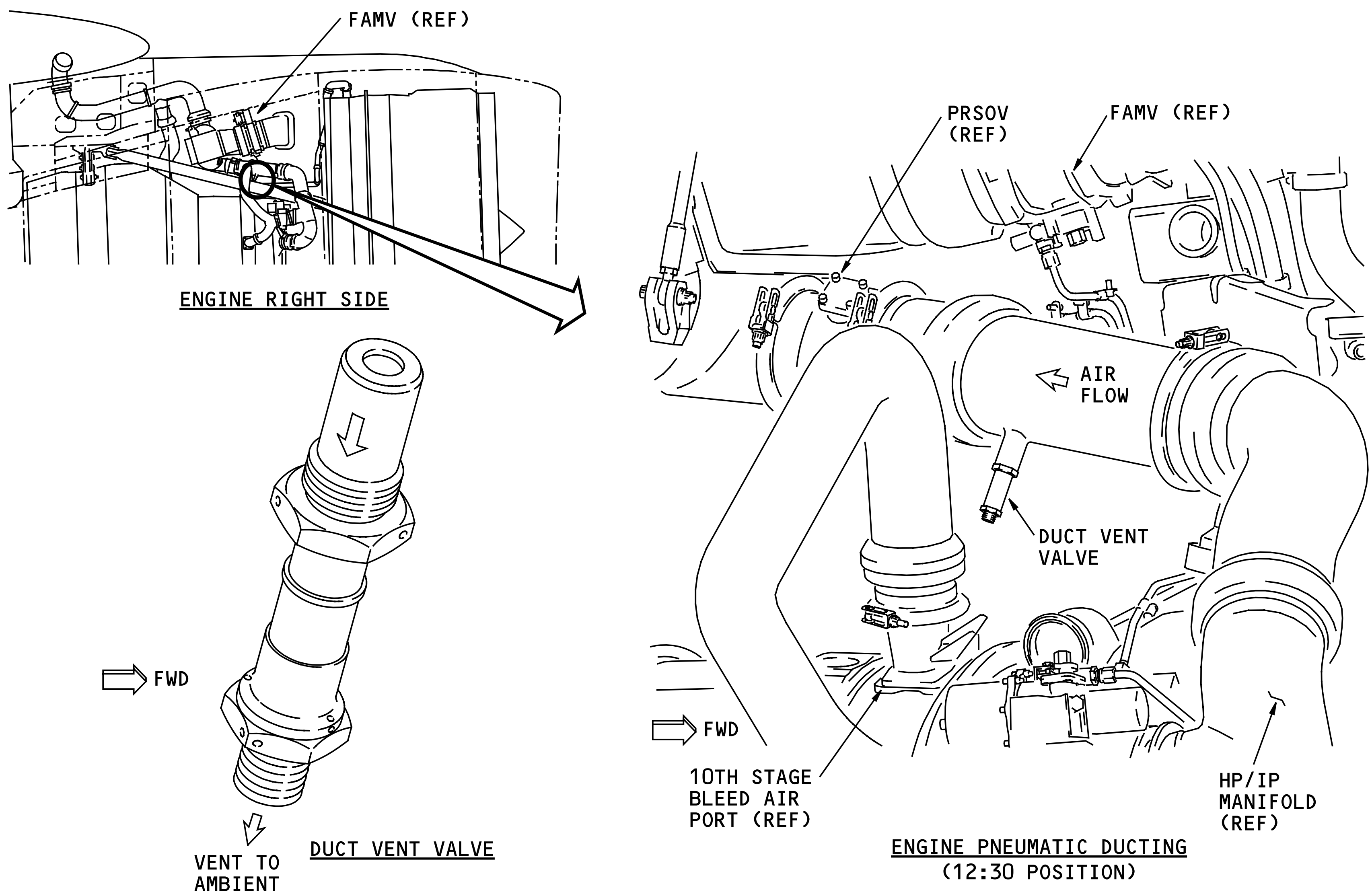
The DVV attaches to the engine HP/IP manifold on the right side of the engine core near the 12:30 position. The valve is forward of the PRSOV and below the FAMV adjacent to one of the tenth stage bleed air ports.

Physical Description

The DVV is a spring-loaded closed pressure relief valve. The valve is pneumatically actuated. The valve has a flow direction arrow on it.

Functional Description

The DVV opens when the pressure in the HP/IP manifold is more than 185 psig. The valve releases the air into the engine compartment at a flow of 6 to 8 lbs/min (2.72 to 3.63 kg/min). The valve resets at 145 psig.



36-11-00-016 Rev 5 03/28/95

ENGINE AIR SUPPLY SYSTEM - DUCT VENT VALVE

ENGINE AIR SUPPLY SYSTEM - AIR SUPPLY CABIN PRESSURE CONTROLLER - PHYSICAL DESCRIPTION

Location

The left and right air supply cabin pressure controllers (ASCPC) are in the MEC on the E1 and E2 racks.

Physical Description

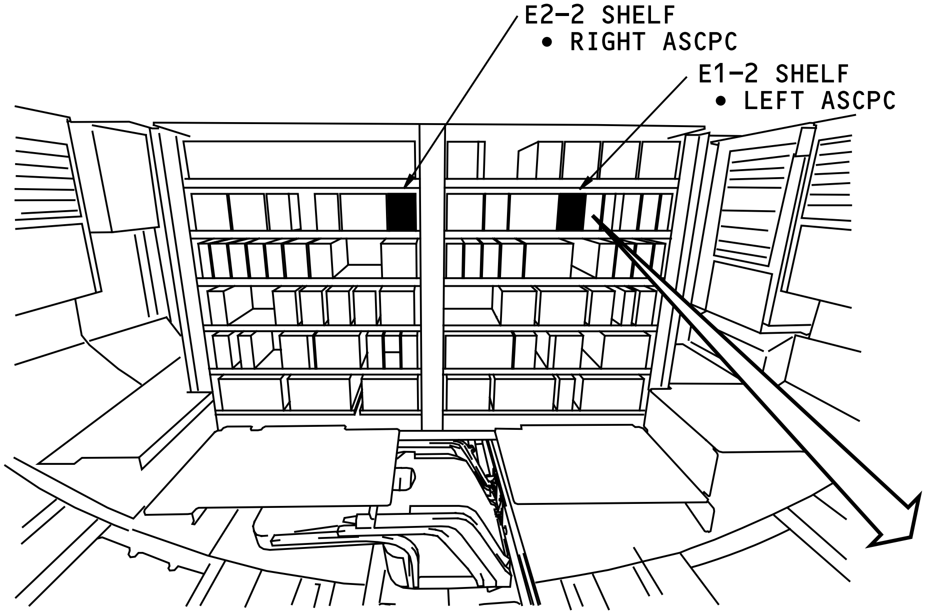
The ASCPCs have test and cabin pressure sense ports on the front. The test port is for in-shop service. The cabin pressure sense port lets the controllers monitor cabin pressure.

The ASCPCs use operational program software (OPS) that you can load.

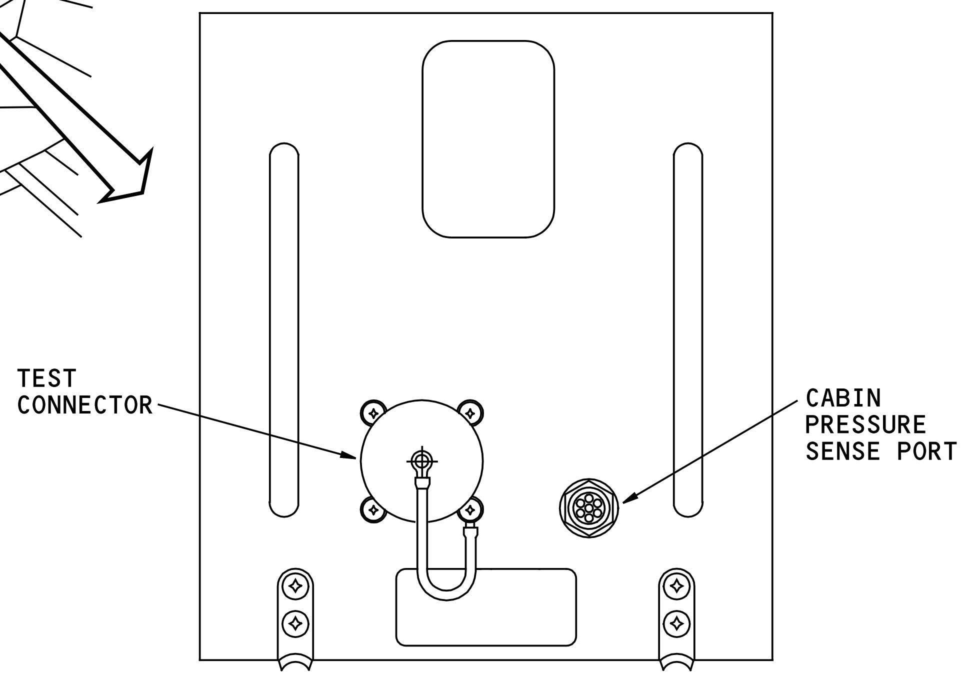
Training Information Point

The ASCPCs are LRUs. The circuit cards inside the ASCPC are not lRUs.

The left and right ASCPCs are interchangeable.



MAIN EQUIPMENT CENTER
(LOOKING AFT)



AIR SUPPLY CABIN PRESSURE CONTROLLER
(TYPICAL)

36-11-00-017 Rev 2

ENGINE AIR SUPPLY SYSTEM - AIR SUPPLY CABIN PRESSURE CONTROLLER - PHYSICAL DESCRIPTION

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ENGINE AIR SUPPLY SYSTEM - AIR SUPPLY CABIN PRESSURE CONTROLLER - PURPOSE

Purpose

The left and right air supply cabin pressure controllers (ASCPC) give control for these systems:

- Pneumatic (engine air supply and air supply distribution)
- Pressurization
- Air conditioning (pack flow schedule and backup pack control).

The controllers also give indications, have BITE, and have interfaces with other airplane systems to give engine bleed air flow management. See the engine bleed air flow management page in this section for more information about flow management.

Control Modes

The ASCPCs have two modes: digital and analog. The ASCPCs use the digital control mode for these systems:

- Engine air supply
- Air supply distribution
- Pressurization
- Pack flow schedule
- Backup pack flow control.

The ASCPCs use analog control mode as a backup to digital mode for the engine air supply system.

The digital mode of the ASCPCs controls in any one of three ways:

- At the same time
- Primary
- Backup control.

These are the systems controlled by the ASCPCs:

SYSTEM	ASCPC	CONTROL
L ENGINE AIR SUPPLY	L	PRIMARY
R ENGINE AIR SUPPLY	R	PRIMARY
AIR SUPPLY DISTRIBUTION	L & R	SAME TIME
PRESSURIZATION & PACK FLOW SCHEDULE	L	PRIMARY
PRESSURIZATION & PACK FLOW SCHEDULE	R	BACKUP
L PACK FLOW CONTROL	L	BACKUP TO L CTC
R PACK FLOW CONTROL	R	BACKUP TO R CTC

For the systems listed in the above table, the digital control mode supplies these functions:

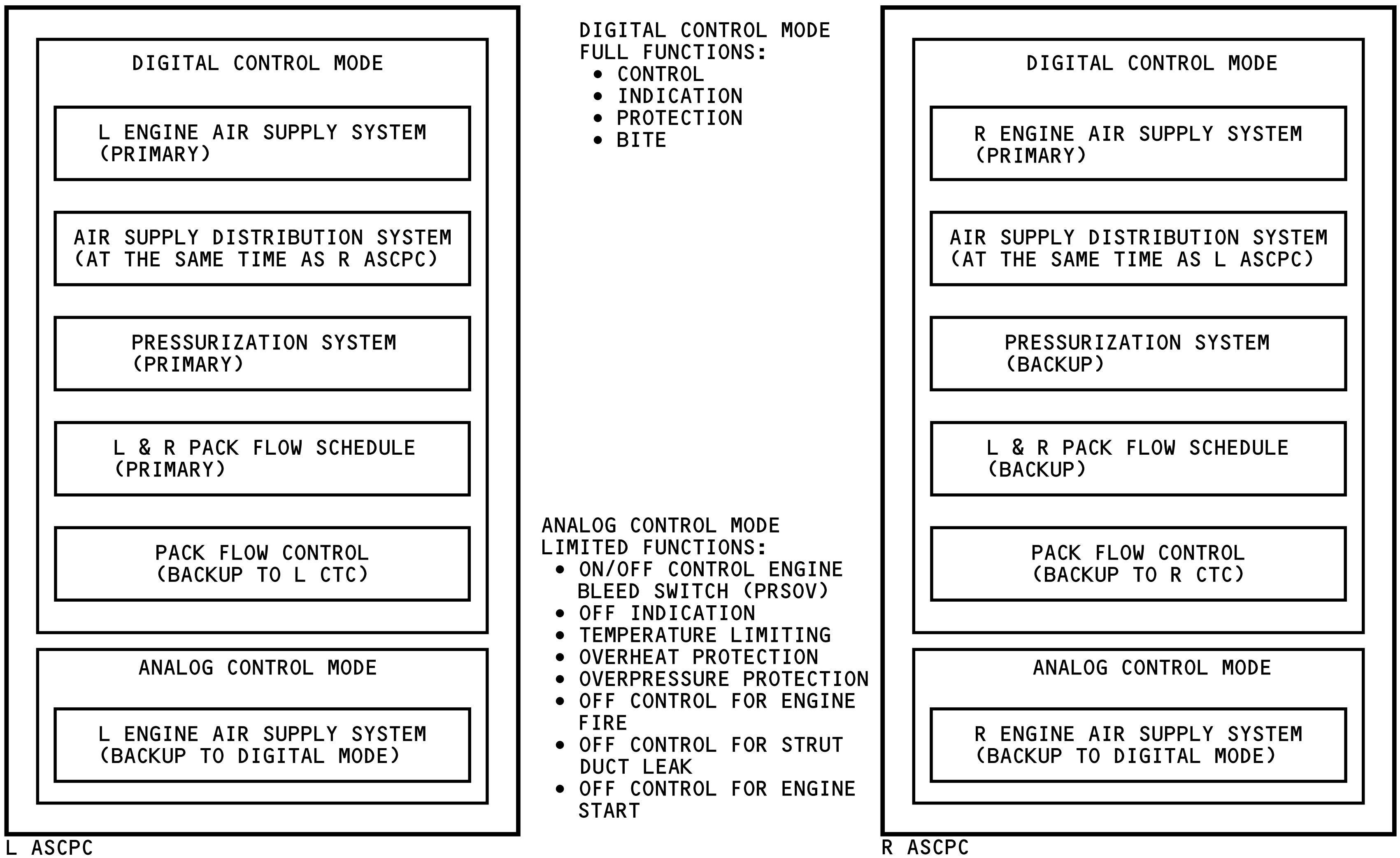
- Control
- Indication
- Protection
- BITE.

For the engine air supply system, the analog control mode gives these functions:

- ON/OFF control through the engine bleed air switch (PRSOV only)
- OFF indications
- Temperature limiting through the PRSOV

ENGINE AIR SUPPLY SYSTEM - AIR SUPPLY CABIN PRESSURE CONTROLLER - PURPOSE

- Overheat protection
- Overpressure protection
- OFF control through the engine fire switch
- OFF control through the duct leak detection system
- OFF control for the engine start condition.



36-11-00-018 Rev 2

ENGINE AIR SUPPLY SYSTEM - AIR SUPPLY CABIN PRESSURE CONTROLLER - PURPOSE

ENGINE AIR SUPPLY SYSTEM - FUNCTIONAL DESCRIPTION - 1

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ENGINE AIR SUPPLY SYSTEM - FUNCTIONAL DESCRIPTION - 1

General

The left air supply cabin pressure controller (ASCPC) controls the left engine air supply system. The right ASCPC controls the right engine air supply system.

The engine air supply system has three modes:

- Primary (Digital)
- Backup (Analog)
- Pneumatic.

The ASCPC gives the primary and the backup modes of operation. The pneumatic mode is controlled by the reference pressure regulators in the HPFAC and the PRSOVC.

For usual operation, all of the functions of the primary mode operate and some of the functions of the backup mode operate at the same time.

If the primary mode does not operate, all of the functions for the backup and pneumatic modes operate at the same time.

If the primary and backup modes do not operate, the pneumatic mode controls the engine air supply without input from the flight deck or the ASCPC.

Primary Mode

The primary mode gives complete control and indications for the engine air supply system.

The operation monitor function in the ASCPC enables the primary mode if it finds no software or power supply faults related to the primary mode.

The primary mode uses the HPFAC and the PRSOVC to do these functions:

- On/off control
- Bleed source selection
- Pressure regulation
- Overpressure protection
- Temperature regulation
- Temperature limiting
- Overtemperature protection
- Flow limiting.

The primary mode gives power to these items:

- HPFAC
- FAMV RVDT
- PRSOVC
- Manifold flow sensor
- Manifold pressure sensor
- Manifold dual temperature sensor (TM 2)

The primary mode gets information directly from these sources:

- FAMV RVDT
- Manifold flow sensor
- Manifold pressure sensor
- Manifold dual temperature sensor (TM 2)
- Backup mode (IP data)

ENGINE AIR SUPPLY SYSTEM - FUNCTIONAL DESCRIPTION - 1

- AIMS
- DLODS
- Engine bleed air switch
- Engine fire switch
- Backup mode.

Information comes to the primary mode on the left and right ARINC 629 systems buses. These are the data sources and uses of this information in the primary mode:

- ACIPS - engine and wing anti-ice air flow rates for flow limiting
- ADIRU - primary source of altitude for bleed source selection
- AGS - airplane air/ground information for on/off control, temperature regulation and BITE
- AIMS - engine on/off information for engine air supply on/off
- CTC - request for lower precooler out temperature for temperature control
- CTC - request for high stage pressure increase for bleed air source selection
- CTC - pack inlet pressure for pressure regulation and overpressure functions
- CTC - pack flow information for flow limiting
- DLODS - strut/wing duct leak information for on/off
- EEC - high stage pressure for overpressure protection
- EEC - alternate ambient pressure source for bleed source selection
- FSEU - slat position for flow limiting
- HYDIM - ADP C1 and C2 on/off for flow limiting
- OPAS - position of the engine bleed air switches and the engine start selectors for on/off control
- WES - airplane stall for flow limiting.

These are some of the data sources and uses for information given directly to the primary mode:

- Engine bleed air switch - in/out position for on/off control function
- Engine start selector - START position information for on/off control function
- Engine fire switch - in/out position for on/off control function.

The backup mode gives information about its inputs to the primary mode.

The primary mode also has a BITE function.

<u>Backup Mode</u>

The backup mode monitors the primary mode for its on/off status and controls the engine air supply system when the primary mode is off.

The backup mode has functions that operate when the primary or backup modes are in control. Other backup mode functions only operate when the primary mode is off.

These backup functions operate when the primary or the backup mode is in control:

ENGINE AIR SUPPLY SYSTEM - FUNCTIONAL DESCRIPTION - 1

- On/off control - engine bleed air switch, engine fire switch, engine start selector
- Overtemperature protection.

These backup functions operate only when the primary mode is off:

- On/off control - strut/wing duct leak
- Overpressure protection
- Temperature limiting.

The backup mode controls the position of the PRSOV for these functions:

- On/off control
- Overpressure protection
- Temperature limiting.

With the engine air supply in backup control, the PRSOV and the HPSOV operate in the pneumatic mode to do pressure regulation and bleed source selection. The FAMV goes to the full open position.

The backup mode gives power to these items:

- PRSOVC
- Manifold dual temperature sensor (TM 1)
- Intermediate pressure sensor.

The backup mode gets information directly from these sources:

- Manifold dual temperature sensor (TM 1)
- Intermediate pressure sensor
- AIMS
- DLODS
- Engine bleed air switch
- Engine start selector
- Engine fire switch.

These are some of the data sources and uses in the backup mode:

- AIMS - engine on/off information for engine air supply on/off
- DLODS - strut/wing duct leak information for on/off.

<u>Pneumatic Mode</u>

The pneumatic mode does not use the ASCPC for control. It does not use electric power.

The pneumatic mode gives these functions for the engine bleed air supply system:

- Bleed source selection
- Pressure regulation.

The HPFAC is mechanically set to cause the FAMV to go full open. The HPFAC also causes the HPSOV to give bleed source selection and pressure regulation at a fixed value.

The PRSOVC is mechanically set to cause the PRSOV to give pressure regulation at a fixed value.

ENGINE AIR SUPPLY SYSTEM - FUNCTIONAL DESCRIPTION - 1

The engine bleed air system cannot be shut off unless the engine is stopped.

BITE

BITE for the ASCPC has:

- Continuous BIT
- Ground test.

Continuous BIT has these functions:

- Operates when the ASCPC has power and the ground test is not on
- Uses the HPFAC and PRSOVC to do a preflight test of the FAMV, PRSOV, and HPSOV and the related circuits.

Continuous BIT and ground tests do a check of the pneumatic system LRUs for correct operation. The preflight test and the ground test take approximately 20 seconds.

The preflight test operates when the related engine completes its start. To operate the ground test, select the appropriate test from the MAT.

Indications

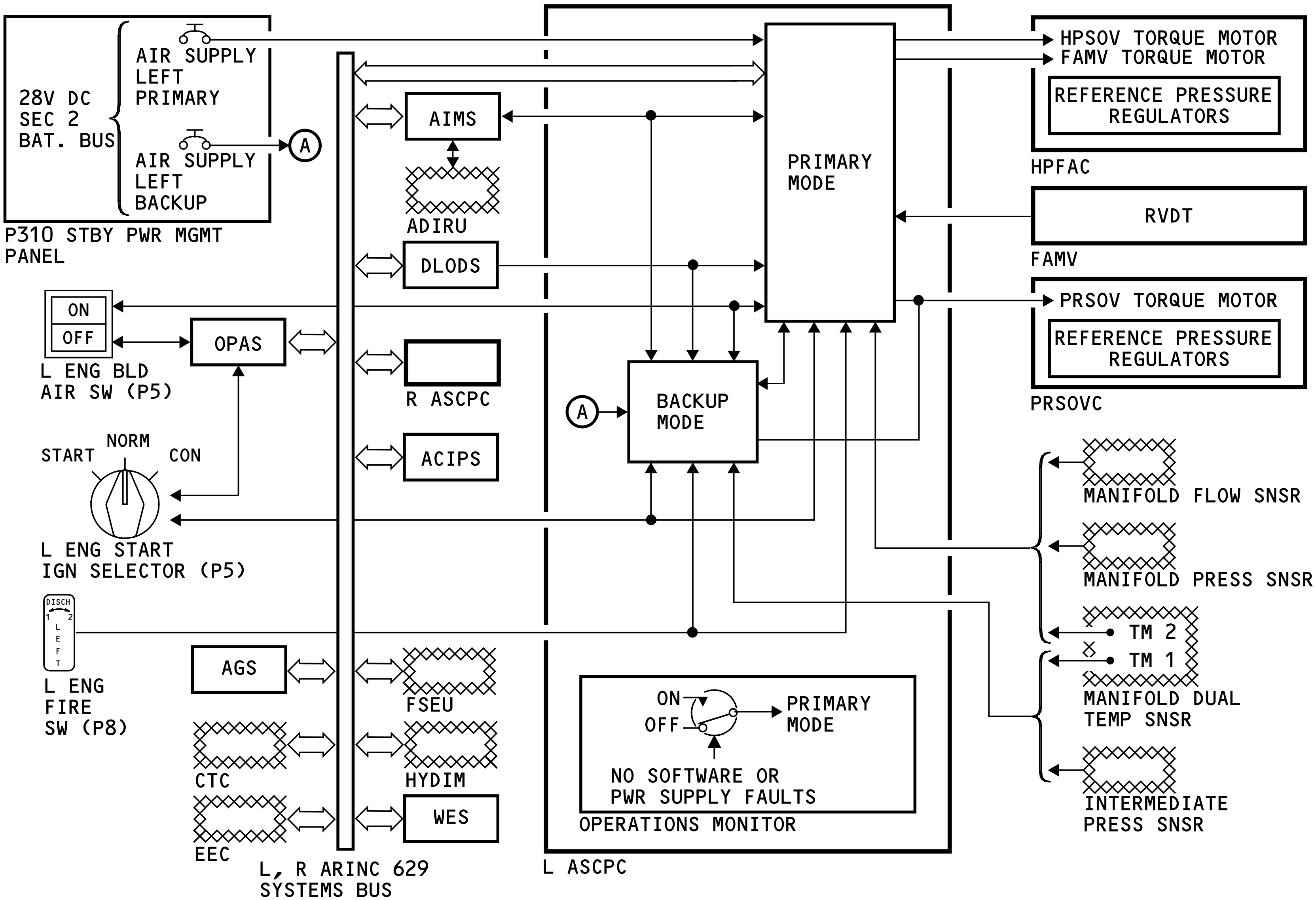
A status message (not shown) shows if the primary mode fails. No flight deck effects show if the backup or pneumatic mode fails.

See the indicating system section for more information about indications (AMM PART I 36-20).

Training Information Point

If the primary mode is off for the left or right ASCPC, it can affect the dispatch of the airplane. If a primary mode is off in one ASCPC, you must make sure the primary mode operates in the other ASCPC and that the backup mode operates in both ASCPCs.

See part II of the airplane maintenance manual for the dispatch deviations guide (DDG) maintenance procedure you use to check the condition of the backup mode.



36-11-00-024 Rev 4 12/16/1996

ENGINE AIR SUPPLY SYSTEM - FUNCTIONAL DESCRIPTION - 1

ENGINE AIR SUPPLY SYSTEM - FUNCTIONAL DESCRIPTION - 2

General

The primary and backup modes of the ASCPC and the pneumatic mode controls the engine air supply differently. The modes set the position of the HPSOV and PRSOV for these functions:

- On/off and reverse flow control - primary and backup modes
- Bleed source selection - primary and pneumatic modes
- Pressure regulation - primary and pneumatic modes
- Overpressure protection - primary and backup modes.

On/Off Control - Primary Mode

The following description is based on these conditions: the engine is on and set to idle.

When the engine bleed switch is set to the out (OFF) position, the primary mode commands the HPSOV and the PRSOV to close and the FAMV to open.

The primary mode also closes one or both of the valves, PRSOV and HPSOV if any of these conditions occur:

- Engine fire switch set to out (PRSOV, HPSOV)
- ASCPC looking for location of the duct leak (PRSOV)
- Source loss (PRSOV)
- This engine start on ground (PRSOV)
- Ground air source supplies air (PRSOV)
- Engine off (HPSOV)
- TM sensor failed (HPSOV)
- HPSOV clamp logic (HPSOV).

The primary mode latches the PRSOV and the HPSOV close if any of these conditions occur:

- Engine strut duct leak
- Wing duct leak
- Engine bleed overtemperature, 490F (254C)
- Engine bleed overpressure, 242 psig
- PRSOV failed closed
- Bleed pressure loss.

When the PRSOV is set to close or latched close, these indications show in the flight deck:

- OFF light (not shown) in the related engine bleed switch
- ENG BLEED OFF L (R) advisory message (not shown).

When the engine bleed switch is set to the in (ON) position, the primary mode commands the HPSOV and the PRSOV to open. The FAMV is usually set towards closed.

Source Loss Condition Logic

The source loss condition logic lets the ASCPCs sense when there is not sufficient air pressure to the ADPs for landing gear retraction immediately after takeoff. Source loss can occur in the left or right parts of the pneumatic distribution system.

ENGINE AIR SUPPLY SYSTEM - FUNCTIONAL DESCRIPTION - 2

There are two sets of conditions that cause the ASCPCs to set the left source loss condition to true. The first set is true if all of these conditions occur:

- Landing gear is down
- Less than 180 seconds since takeoff
- Left engine is off.

The second set is true if all of these conditions occur:

- Landing gear is down
- Less than 180 seconds since takeoff
- Left duct pressure is less than 20 psig and right duct pressure is more than 20 psig.

The conditions that cause a right source loss are equivalent.

See the distribution section for more information about the configuration of the pneumatic distribution system during source loss (AMM PART I 36-20).

Bleed Pressure Loss Condition Logic

The bleed pressure loss condition logic lets the ASCPCs sense when a pneumatic duct breaks. Engine starter duct failure is the primary reason for this logic.

There are two sets of conditions that cause the ASCPCs to set the left bleed pressure loss condition to true. The first set is true if all of these conditions occur for more than 10 seconds:

- Left duct pressure is less than 13 psig
- Left pack inlet pressure is less than 13 psig
- Right duct pressure is more than 13 psig
- Left PRSOV is open
- Right PRSOV is open
- No duct leak signal from the duct leak and overheat detection system (DLODS)
- Landing gear is up
- Less than 180 seconds after takeoff.

The second set is true if all of these conditions occur for more than 10 seconds:

- Left duct pressure is less than 13 psig
- Left pack inlet pressure is less than 13 psig
- Right PRSOV is open
- Left PRSOV is closed
- Landing gear is up or more than 180 seconds after takeoff
- Left engine bleed air flow is more than 2.0 lbs/sec
- No left engine start.

The conditions that cause a right bleed pressure loss are equivalent.

See the distribution section for more information about the configuration of the pneumatic distribution system during bleed pressure loss (AMM PART I 36-20).

ENGINE AIR SUPPLY SYSTEM - FUNCTIONAL DESCRIPTION - 2

On/Off Control - Backup Mode

The backup mode provides on/off control differently from the primary mode. The backup mode only sets the PRSOV to open or close. It does not control the position of the HPSOV or the FAMV.

The backup mode sets the PRSOV to closed for the applicable engine if any these conditions occur:

- Engine bleed air switch set to out
- Engine fire switch set to out (pulled)
- Engine start selected
- Engine is off.

The backup mode latches the PRSOV closed if any of these conditions occur:

- Engine strut duct leak
- Engine bleed overtemperature, 490F (254C)
- Engine bleed overpressure, 242 psig.

The backup mode gives the same flight deck indications as the primary mode when the PRSOV is set to close or latched closed.

Bleed Source Selection - Primary Mode

The bleed source selection function makes sure there is sufficient pressure downstream of the HPSOV for the systems that use engine bleed air. This is the same as the logic for the pressure regulation function.

The primary mode sets the position of the HPSOV to provide control of the bleed air source. When the intermediate pressure air source is not sufficient for the downstream systems, HP air is used.

These are three possible combinations for the engine bleed air source:

- HP air is the only source
- IP air is the primary source. HP air adds air as necessary
- IP air is the only source.

The primary mode uses the IP sensor to get data about the pressure downstream of the HPSOV. The IP data is used to calculate the position of the HPSOV necessary to keep the setpoint pressure. These are the duct pressure setpoints:

- 40 psig when the altitude is less than or equal to 27,000 feet (8230m)
- Decreasing value, 40 through 32.5 pisg when the altitude is more than 27,000 feet (8230m) and is less than or equal to 43,000 feet (13,106m)
- 32.5 psig when the altitude is more than 43,000 feet (13,103m).

The value of the setpoint pressure is biased by any of these conditions:

- CTC request for more pressure - 6 psig bias
- Engine cross bleed start - 9 psig bias.

ENGINE AIR SUPPLY SYSTEM - FUNCTIONAL DESCRIPTION - 2

The setpoint pressure increases by the amount of the highest request.

If the quantity of the intermediate pressure air is enough to supply the user systems, the HPSOV closes.

See the functional description part of the air conditioning - pack cooling and mix manifold temperature control section for the conditions that cause the CTC to request more pressure (AMM PART I 21-52).

Bleed Source Selection - Backup and Pneumatic Modes

The pneumatic mode automatically gives bleed source selection when the backup mode or the pneumatic mode controls the engine air supply.

Similar to the primary mode, the pneumatic mode provides three combinations for the source of engine bleed air:

- HP air alone
- IP air with HP air added as necessary
- IP air alone.

The pneumatic mode uses the HPFAC reference pressure regulators to control HPSOV position. The regulators are set to provide the HPSOV with the necessary control pressure so that the valve regulates to a setpoint of 55 +/- 15 psig. This setpoint is designed to make sure pressure downstream of the HPSOV is more than sufficient for the systems that use engine bleed air.

If IP air pressure is less than the setpoint, then HP is the only source for engine bleed air.

If IP air pressure is more than the setpoint but can not provide the necessary air flow to keep pressure downstream of the HPSOV above the setpoint, the HPSOV adds HP air as necessary.

If IP air provides the necessary air flow and keeps pressure downstream of the HPSOV to a value more than the setpoint, the HPSOV closes.

HPSOV Clamp Logic

HPSOV clamp logic closes the HPSOV when the HP air source pressure is high. Pneumatic distribution duct failure is the primary reason for the HPSOV clamp logic. The logic gets pressure information about the HP air source from the EEC. The set pressure changes with airplane altitude.

This is an example of the airplane altitudes and the HP air pressure values that cause the HPSOV to close:

- -2,000 feet (-610m) through 20,000 feet (6,100m) the set pressure is 270 psia
- > 20,000 feet (6,100m) through 43,000 feet (13,115m) the value decreases with altitude
- > 43,000 feet (13,115m) the value is 120 psia.

ENGINE AIR SUPPLY SYSTEM - FUNCTIONAL DESCRIPTION - 2

Pressure Regulation - Primary Mode

The pressure regulation function uses the HPSOV and PRSOV to control duct pressure. The HPSOV gives pressure regulation when the HP source gives air. The PRSOV gives pressure regulation when the HPSOV is closed. The HPSOV and the PRSOV regulate to different values.

Primary mode control of the HPSOV is the same as for the bleed source selection function.

The position of the PRSOV controls duct pressure to the usual setpoint value of 50 psig.

Pressure Regulation - Backup and Pneumatic Modes

The pneumatic mode automatically gives pressure regulation when the backup mode or the pneumatic mode controls the engine air supply.

The pneumatic mode uses the reference pressure regulators in the PRSOVC to give pressure regulation. The regulators are set to give the PRSOV the necessary control pressure so that the valve regulates to a usual setpoint of 60 +/- 15 psig. This setpoint is designed to make sure pressure downstream of the PRSOV is more than sufficient for the systems that use engine bleed air.

Overpressure Protection - Primary and Backup Modes

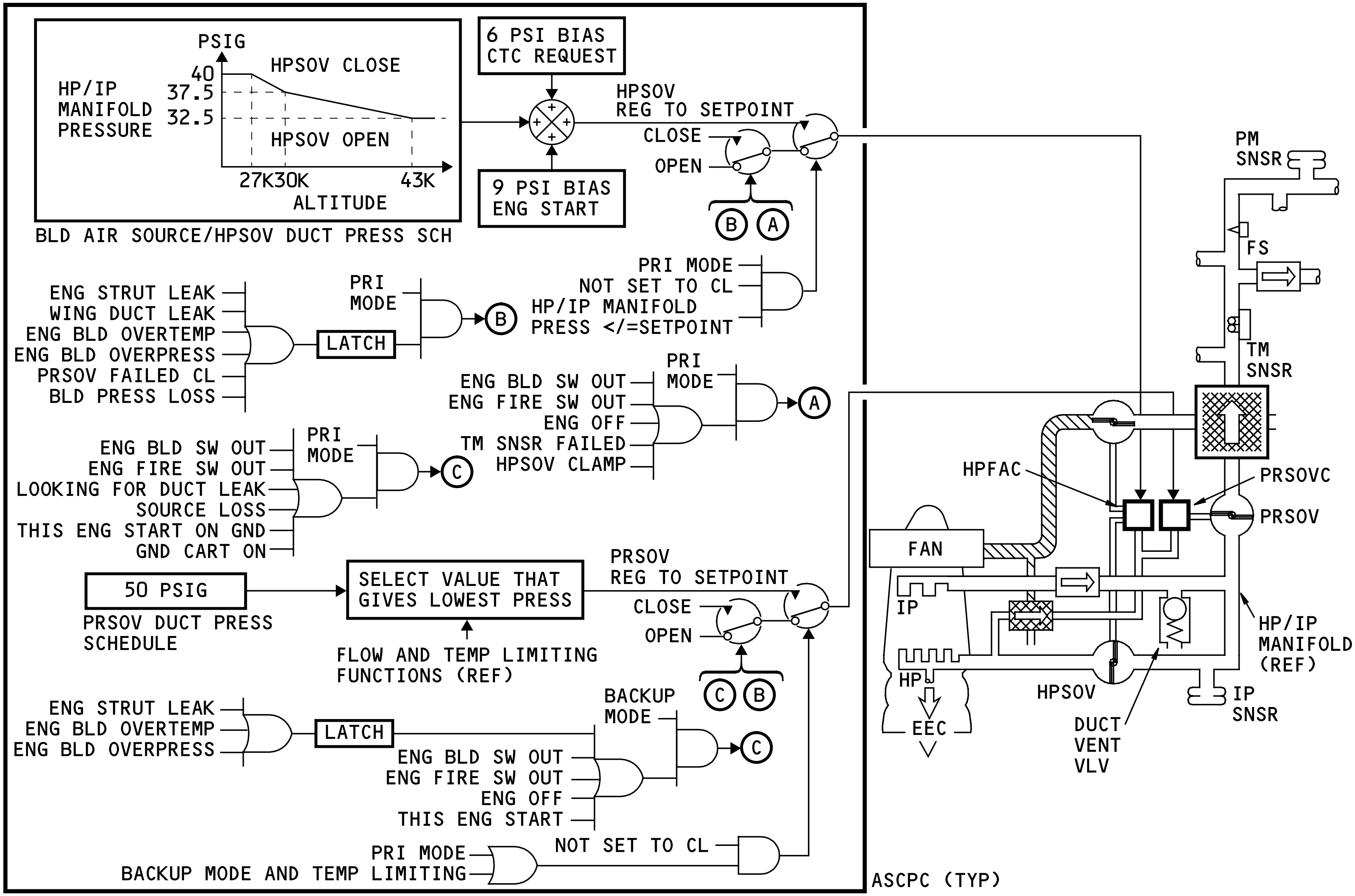
The logic used by the primary and backup modes for overpressure protection is similar. Both modes monitor the pressure in the HP/IP manifold. If the pressure is 242.5 psig or more for 5 seconds, the engine air supply latches off. The primary mode inhibits the latch if the landing gear is retracting.

These components give pressure information used by the overpressure protection function:

- Intermediate pressure (IP) sensor - HP/IP manifold pressure to the primary and backup modes
- EEC - gives pressure information about the HP source to the primary mode only.

Training Information Point

When a latched condition occurs, do not put the applicable engine bleed switch to out and then back to in. This will reset the latched condition and any active fault will disappear. Use the Fault Isolation Manual to troubleshoot a latched condition.



ENGINE AIR SUPPLY SYSTEM - FUNCTIONAL DESCRIPTION - 2

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ENGINE AIR SUPPLY SYSTEM - FUNCTIONAL DESCRIPTION - 3

General

The ASCPC changes the position of the FAMV and the PRSOV for temperature control. The primary and backup modes use torque motors in the HPFAC and the PRSOVC to change the amount of control air to the valves.

The primary mode can change the position of the fan air modulating valve (FAMV) to give the usual temperature regulation function. The primary and backup modes can change the position of the pressure regulating and shutoff valve (PRSOV) to give these functions:

- Temperature limiting - primary and backup modes
- Overtemperature protection - primary and backup modes
- Flow limiting - primary mode.

The pneumatic mode gives no temperature control of any type and does not give flow limiting. When the backup mode or the pneumatic mode gives control, the FAMV goes to the default position of fully open.

Temperature Regulation

The primary mode usually controls the precooler outlet temperature to one of these fixed values:

- 380F (193C): usual value
- 250F (121C): if the CTC requests lower temperature and wing anti-ice off.

Element 2 in the manifold temperature sensor (TM2) gives the temperature information to the primary mode. If element 2 fails, the primary mode gets temperature information from element 1 (TM1) through the backup mode.

The primary mode usually uses the FAMV to control the precooler out temperature. The position of the FAMV is set to control the amount of fan air allowed through the precooler. The fan air cools the engine bleed air as it goes through the precooler.

The primary mode sets the usual temperature of 380F (193C) to make sure sufficient heat is in the air for the wing anti-ice system.

If the wing anti-ice system is off, the primary mode can set the temperature to 250F (121C) if the related cabin temperature controller (CTC) tells the ASCPC that a lower temperature is necessary.

See the functional description part of the air conditioning pack cooling and mix manifold temperature control section for more information about CTC request for lower precooler out temperature (AMM PART I 21-52).

Temperature Limiting

The primary and backup modes give the same temperature limiting function. When the precooler out temperature is 450F (232C) or more, the applicable mode sets the position of the PRSOV to limit the amount of bleed air allowed through the precooler.

ENGINE AIR SUPPLY SYSTEM - FUNCTIONAL DESCRIPTION - 3

Temperature information comes from TM2 for the primary mode or TM1 for the backup mode.

When the precooler out temperature is equal to or more than 450F (232C), the primary and backup modes command the PRSOV towards closed to limit bleed air flow. When bleed air flow is limited, the bleed air temperature usually goes down.

Overtemperature Protection

The engine bleed air overtemperature protection function is enabled at the same time by the primary and backup modes. Temperature information comes from TM2 for the primary mode or TM1 for the backup mode.

If the precooler out temperature is more than 490F (254C), the primary and backup modes command the PRSOV to the fully closed position.

Flow Limiting

The primary mode limits the flow of engine bleed air to 10 lbs/sec (4.5 kg/sec). The limit includes the amount of air used or measured by these systems or components:

- Wing anti-ice (WAI)
- Engine anti-ice (EAI)
- Air supply distribution, flow sensor (FS).

The primary mode calculates the total amount of engine bleed air used based on the inputs. If the flow is more than 10 lbs/sec (4.5 kg/sec), the primary mode commands the PRSOV towards closed to limit bleed air flow.

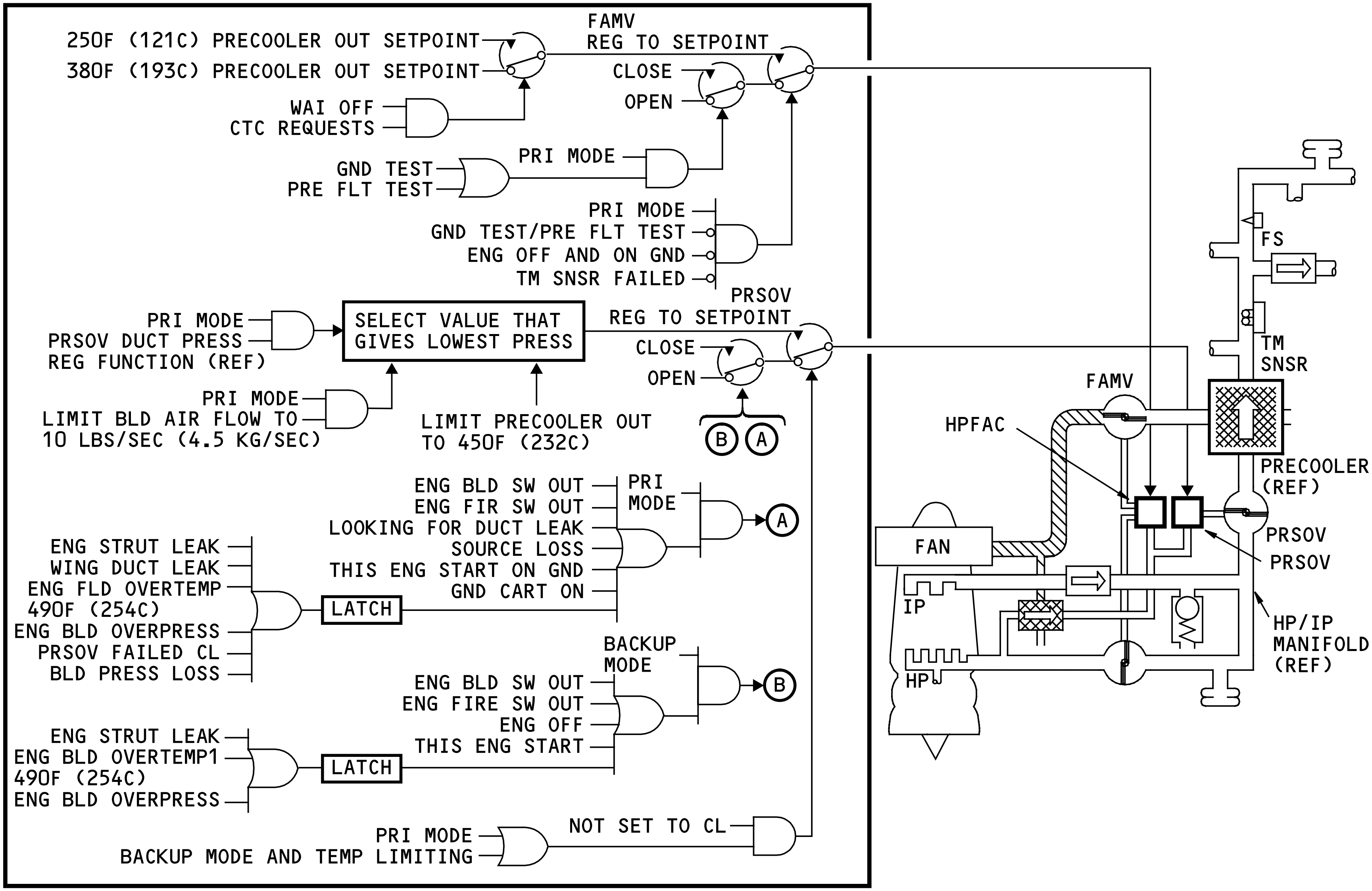
See the wing anti-ice section for more information about WAI (AMM PART I 30-11).

See the engine anti-ice section for more information about EAI (AMM PART I 30-21).

See the indicating system section for more information about the flow sensor (FS) (AMM PART I 36-20).

BITE

During the ground test or the preflight test, the FAMV will be closed and open to do a test of the valve and its related circuit.



ASCPC (TYP)

ENGINE AIR SUPPLY SYSTEM - FUNCTIONAL DESCRIPTION - 3

AIR SUPPLY DISTRIBUTION - INTRODUCTION

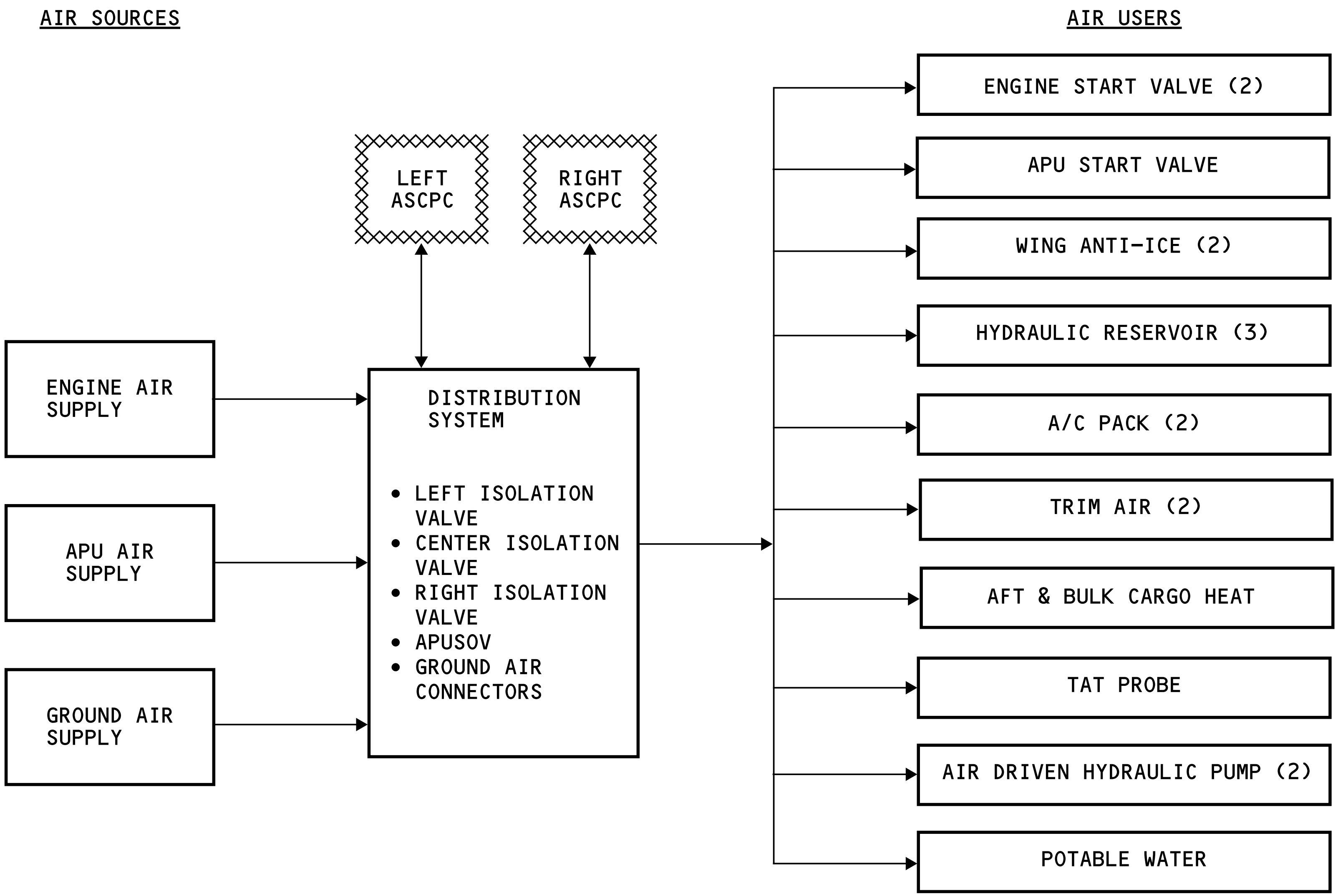
Purpose

The air supply distribution system supplies air from the air sources to users. The system also isolates the air sources from each other.

General

The air supply distribution system supplies compressed air from the engines, APU, and ground carts to user systems. The left and right air supply cabin pressure controllers (ASCPCs) control three isolation valves and the APUSOV in the distribution system. Both controllers control the valves at the same time. The valves then supply air to these components and systems:

- Engine start valve
- APU start valve
- Wing anti-ice
- Hydraulic reservoirs
- Air conditioning packs
- Aft and bulk cargo heat
- Trim air
- Total air temperature probe
- Air driven hydraulic pumps
- Potable water.



36-12-00-001 Rev 1

AIR SUPPLY DISTRIBUTION - INTRODUCTION

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AIR SUPPLY DISTRIBUTION - GENERAL DESCRIPTION

General

The air supply distribution system has these parts:

- Large main distribution ducts (wing, body)
- Small ducts
- Left isolation valve
- Center isolation valve
- Right isolation valve
- APU shutoff valve (APUSOV)
- Three high pressure ground connectors.

The large main distribution ducts connect to the engines and the APU. The smaller ducts connect the user systems to the main distribution ducts.

You use switches on the bleed air/pressurization panel to set the mode of control for the isolation valves and APUSOV. AUTO and CLOSED are the positions for the isolation valve switches. AUTO and OFF are the positions for the APUSOV switch. The switches also have annunciator lights that give you information about the system.

The left and right ASCPCs control the isolation valves and the APUSOV. The controllers use inputs from these systems/components to calculate when a valve should be open or closed:

- ELMS
- OPAS
- AIMS
- APU fire switch
- DLODS
- APUC
- ADIRU.

The ELMS tells the ASCPCs when the airplane is on standby power. The ASCPCs use this when calculating APUSOV position.

The OPAS is the interface between the ARINC 629 buses and the bleed air/pressurization panel. The ASCPCs get information about switch position and control the annunciator lights through the OPAS and the ARINC 629 buses. The ASCPCs use switch position when calculating valve positions.

The AIMS gives information about the system through the primary display system.

The APU fire switch gives switch position information directly to the ASCPCs. The ASCPCs use this when calculating valve positions.

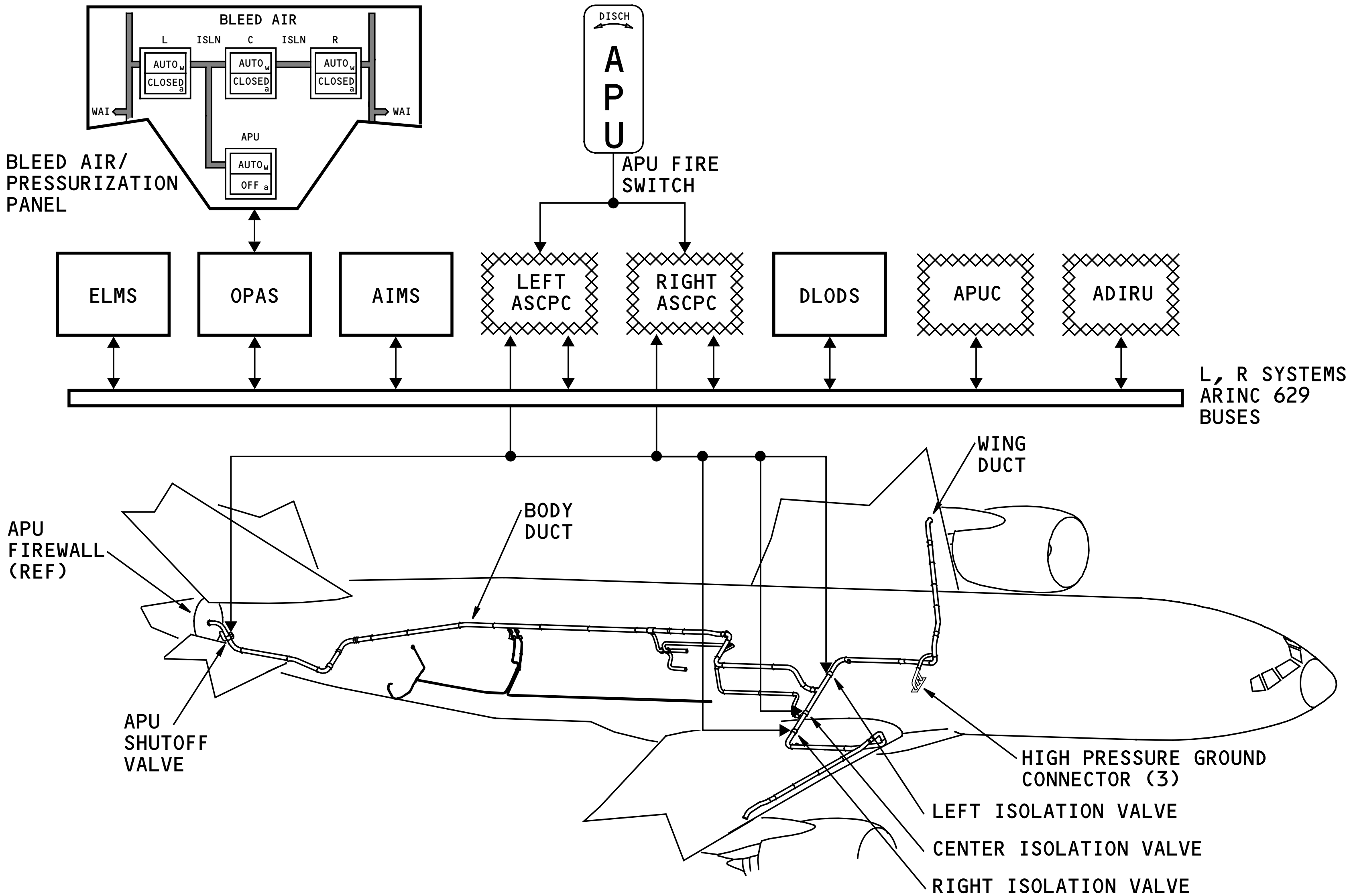
The DLODS monitors the pneumatic distribution ducts for leaks and sends a signal if there is a leak. The ASCPCs calculate valve positions to isolate the leak based on the duct leak signal from DLODS.

The APUC gives APU on or off information to the ASCPCs. It also sends a signal to open the APUSOV for an air start of the APU. The ASCPCs use APUC information when calculating valve positions.

AIR SUPPLY DISTRIBUTION - GENERAL DESCRIPTION

The ADIRU gives airplane altitude information to the ASCPCs. The ASCPCs use altitude information when they do a test of the system.

BITE circuits in the ASCPCs monitor the condition of the system. You use the MAT to do ground tests of the system.



36-12-00-002 Rev 1

AIR SUPPLY DISTRIBUTION - GENERAL DESCRIPTION

AIR SUPPLY DISTRIBUTION - ISOLATION VALVES

Purpose

The isolation valves control the air flow direction in the pneumatic manifold from both engines, the APU, and the ground air supply.

Physical Description

Each isolation valve has these parts:

- Actuator
- Solenoid
- Valve body
- Electrical connector
- Manual override and position indicator assembly
- Rotary variable differential transformer (RVDT).

Location

The left isolation valve is aft of the left environmental control system (ECS) access door. You open the access panel 195QL to get access to the left isolation valve.

The center isolation valve is aft of the right ECS access door. You open the access panel 196NR to get access to the center isolation valve.

The right isolation valve is aft of the right ECS door. You open the access panel 196QR to get access to the right isolation valve.

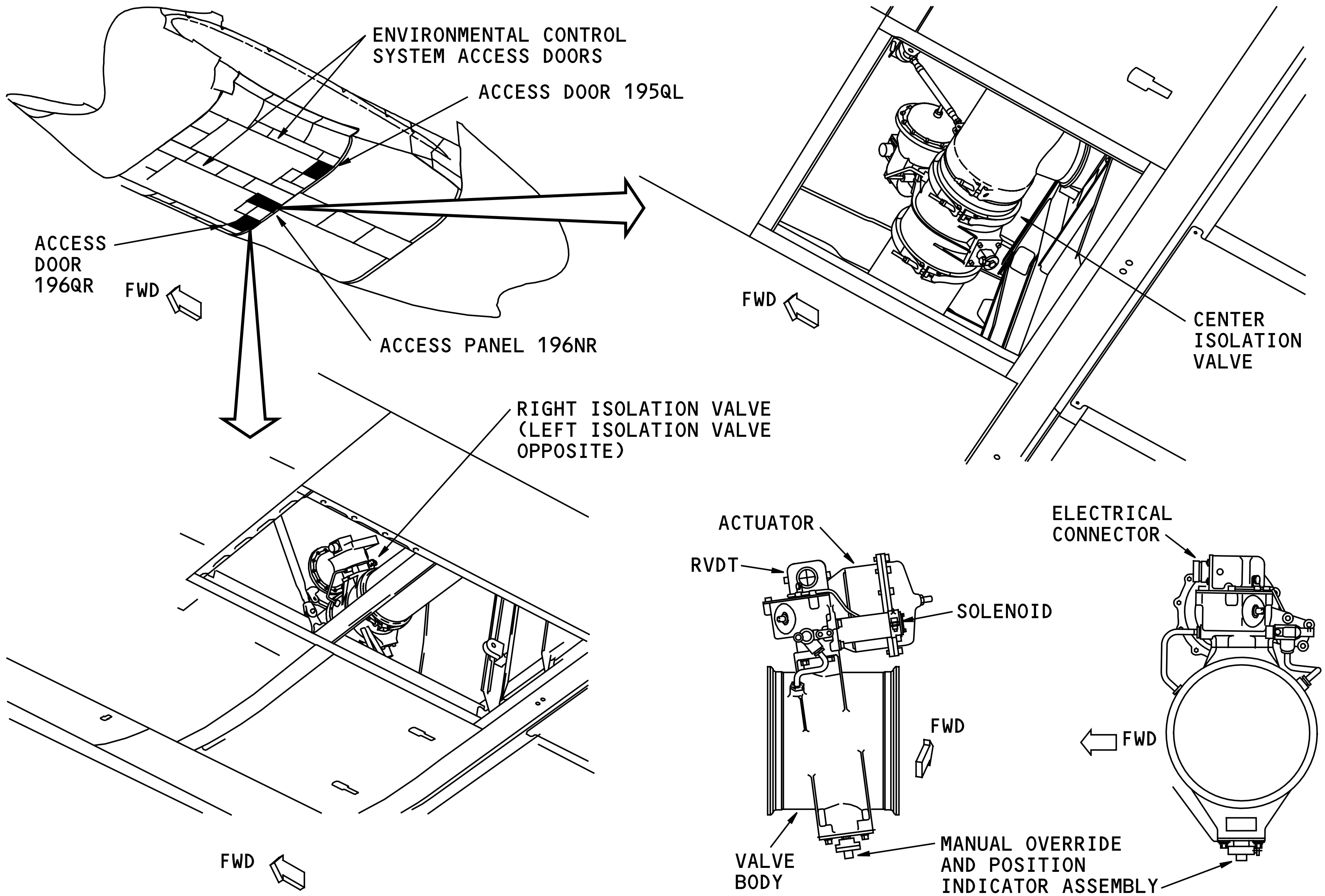
Functional Description

The isolation valves are two-position valves that are spring-loaded closed. The valves are electrically controlled and pneumatically actuated.

Training Information Point

Install the isolation valves with the placard in view and the electrical connection accessible.

The isolation valves are identical and interchangeable with each other and with the APU shutoff valve.



36-12-00-005 Rev 1

AIR SUPPLY DISTRIBUTION - ISOLATION VALVES

AIR SUPPLY DISTRIBUTION - APU SHUTOFF VALVE

Purpose

The APU shutoff valve (APUSOV) controls the flow of bleed air from the APU into the pneumatic manifold.

Location

The APUSOV is in the lower aft section of the airplane just forward of the APU firewall.

Physical Description

The APUSOV has these parts:

- Actuator
- Manual override and position indicator assembly
- Valve body
- Electrical connector
- Rotary variable differential transformer (RVDT)
- Solenoid.

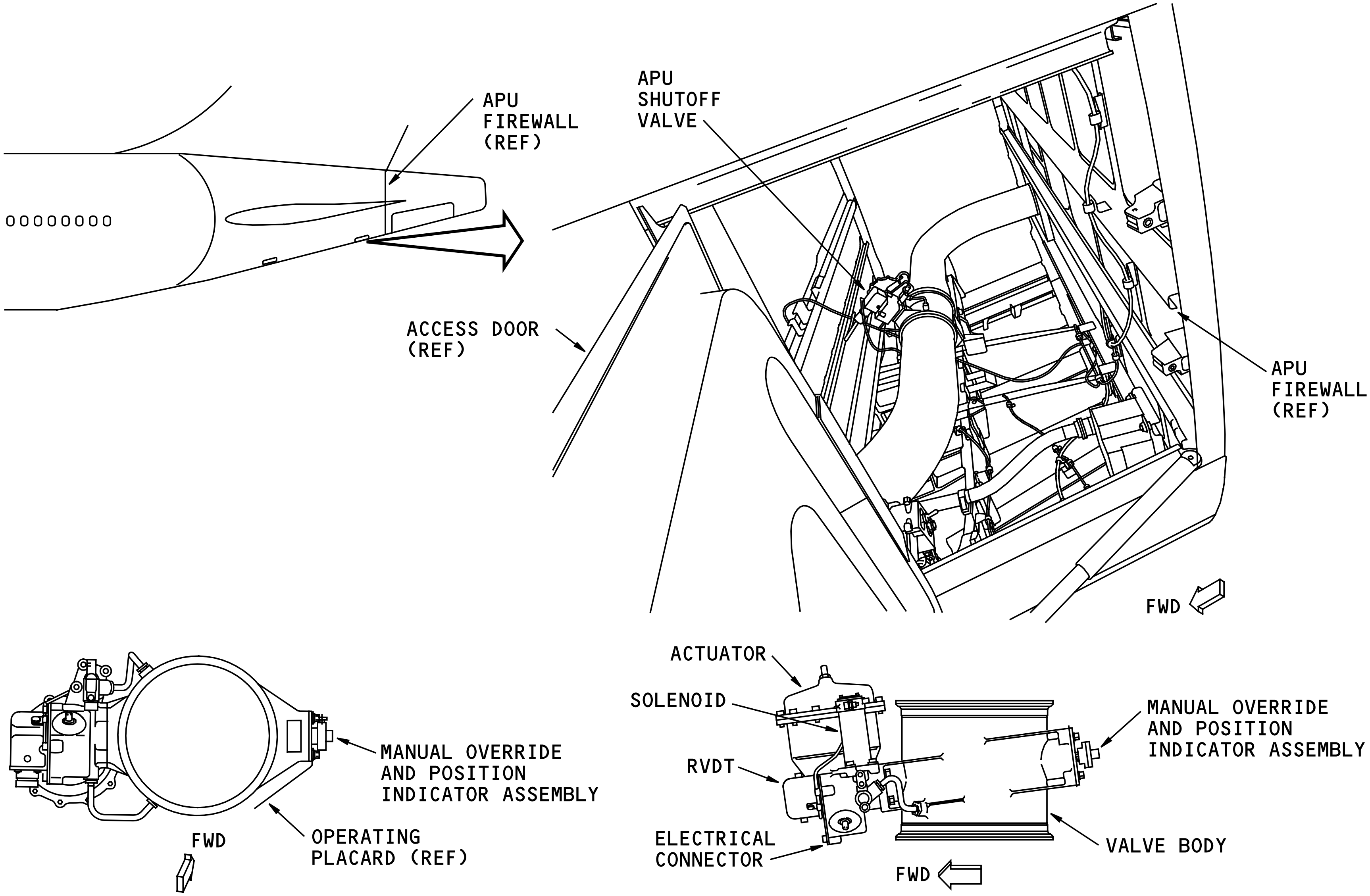
Functional Description

The APUSOV is a two position valve that is spring loaded closed. The valve is electrically controlled and pneumatically actuated.

Training Information Point

The APU shutoff valve should have the operating placard in view and the electrical connection accessible.

The APU shutoff valve is identical and interchangeable with the isolation valves.



36-12-00-006 Rev 1

AIR SUPPLY DISTRIBUTION - APU SHUTOFF VALVE

AIR SUPPLY DISTRIBUTION - ISOLATION/APU SHUTOFF VALVES - TRAINING INFORMATION POINTS

Purpose

The manual override and position indicator assembly lets you lock the valve closed or open and lets you see the position of the valve.

Location

The assembly is on the opposite side of the valve body as the actuator.

Physical Description

The manual override and position indicator assembly has these parts:

- Retainer plate
- Knob bolt
- Valve shaft hex
- Lock knob/position indicator
- OPEN / CLOSED placards.

Functional Description

The knob bolt lets you unlock or lock the lock knob/position indicator to the valve shaft.

The lock knob/position indicator shows you the actual valve disc position. You also use the indicator to lock the valve disc closed or open. The lock knob/position indicator has two positions: LATCH (in) and UNLATCH (out).

The retainer plate holds the lock knob/position indicator and valve shaft so they can not move when the lock knob/position indicator is in the LATCH position (pushed in position).

The hex part of the valve shaft lets you move the valve to OPEN or CLOSED.

Operation

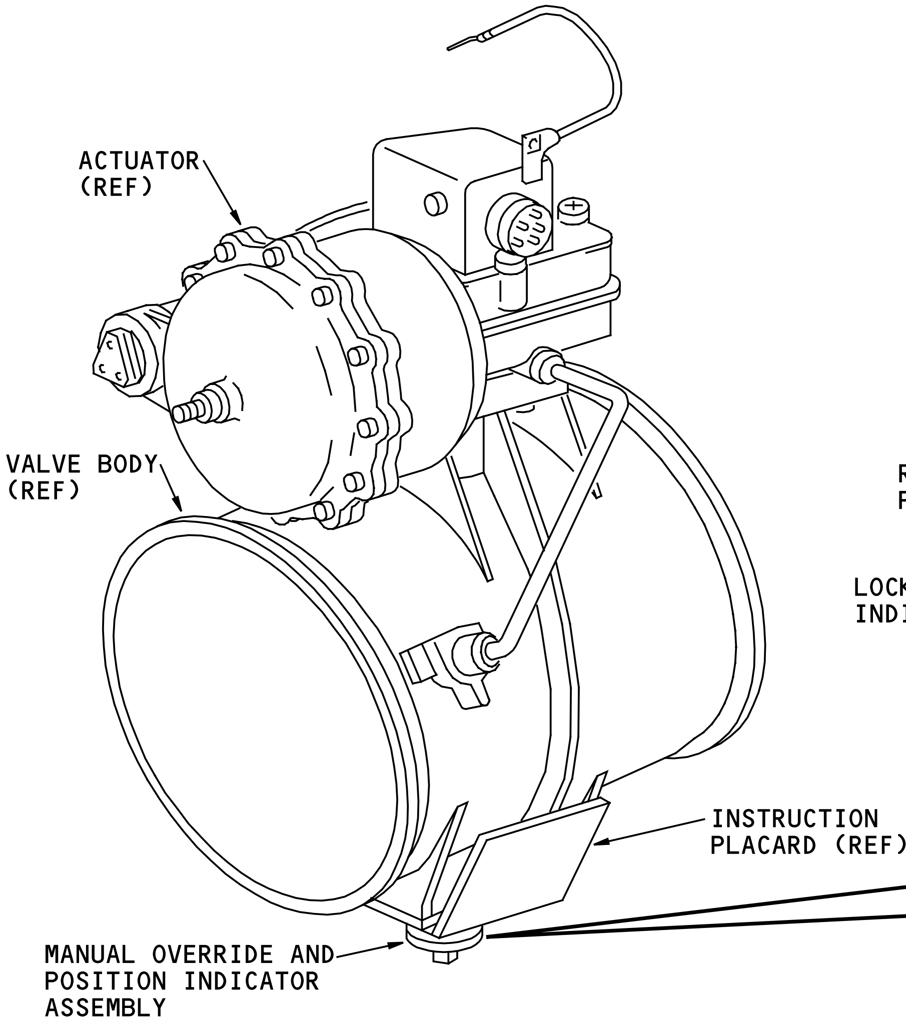
Usually the lock knob/position indicator is locked by the knob bolt to the UNLATCH position. This lets the valve open and close freely.

When you loosen the knob bolt (UNLOCK), the lock knob/position indicator freely moves in or out along the valve shaft. This lets you set the lock knob/position indicator to any one these positions:

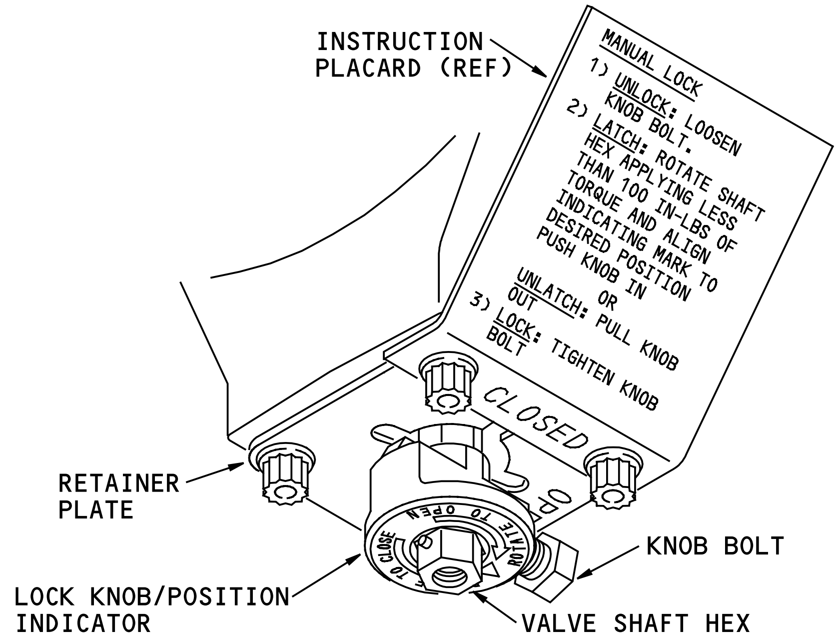
- LATCH: valve open
- LATCH: valve closed
- UNLATCH: valve free movement.

To keep the lock knob/position indicator in one of the above positions you tighten the knob bolt (LOCK).

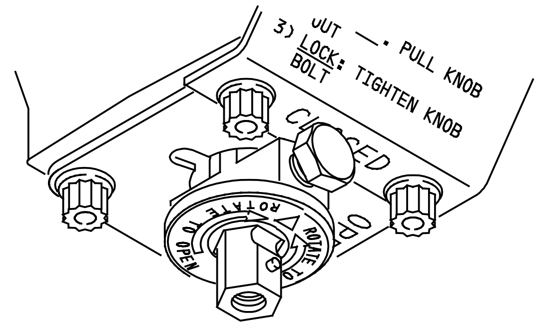
You use standard hand tools to manually lock or unlock the isolation and APU shutoff valves. The valve shaft and knob bolt are sized for a 7/16 inch wrench.



ISOLATION VALVE/APUSOV



MANUAL OVERRIDE AND
POSITION INDICATOR ASSEMBLY
(UNLATCH)



MANUAL OVERRIDE AND
POSITION INDICATOR ASSEMBLY
(LATCH)

AIR SUPPLY DISTRIBUTION - ISOLATION/APU SHUTOFF VALVES - TRAINING INFORMATION POINTS

AIR SUPPLY DISTRIBUTION - HIGH PRESSURE GROUND CONNECTOR

Purpose

The high pressure ground connectors let an external air source connect to the main pneumatic distribution system. Check valves in the connectors prevent loss of pressurized air.

Location

The high pressure ground connectors are in the under wing fuselage area, forward of the ECS access door, 195EL. You open the access door 195BL to get access to the high pressure ground connectors.

Physical Description

The high pressure ground connector has these parts:

- Check valve
- Connector
- Flange.

Training Information Point

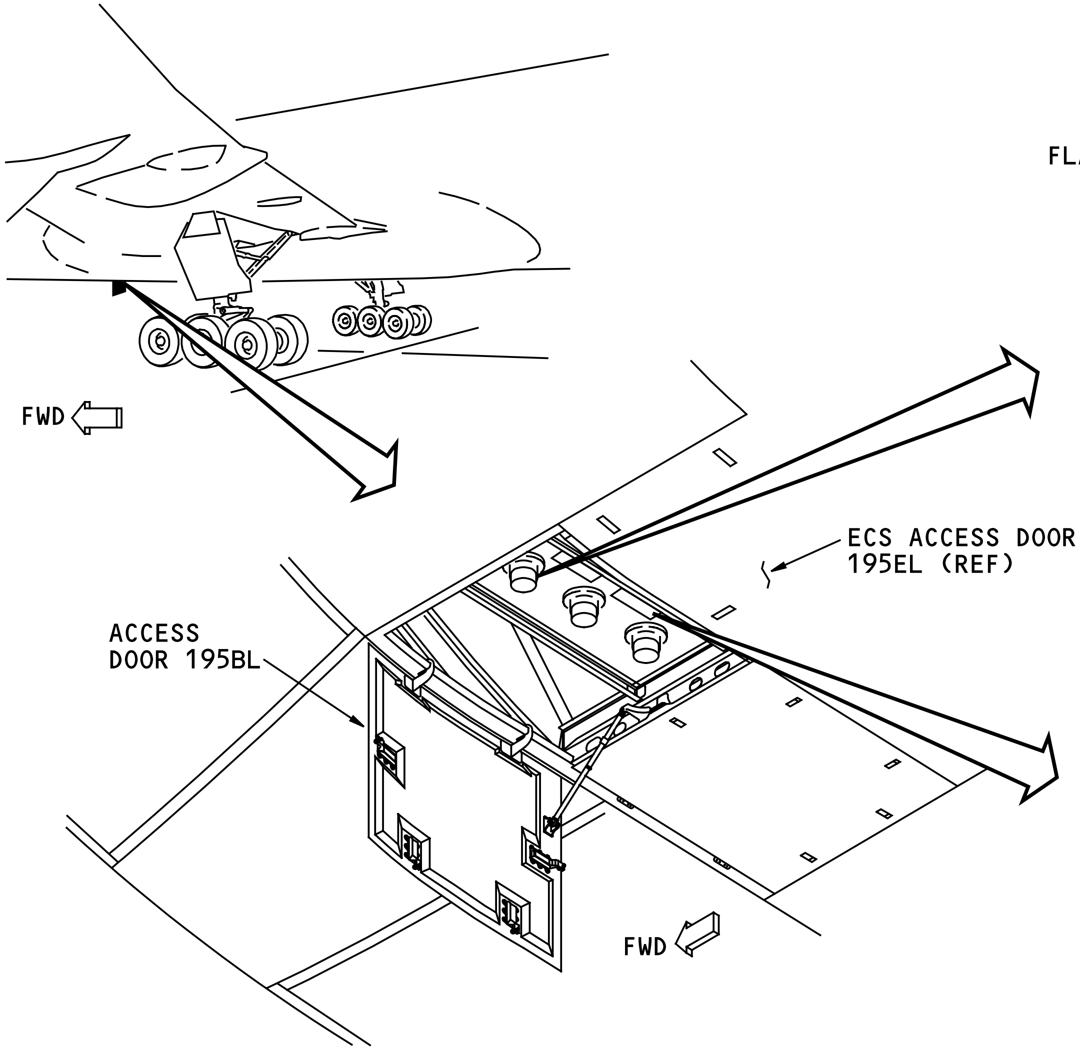
WARNING: DO NOT SUPPLY GREATER THAN 50 PSIG AND/OR 232C (450F) TO THE PNEUMATIC SYSTEM. IF YOU SUPPLY TO MUCH PRESSURE AND/OR TEMPERATURE DAMAGE TO EQUIPMENT AND INJURY TO PERSONAL CAN OCCUR.

CAUTION: TO PREVENT DAMAGE TO AIR CONDITIONING SYSTEM COMPONENTS, APPLY ELECTRICAL POWER BEFORE YOU APPLY PNEUMATIC POWER AND REMOVE PNEUMATIC POWER BEFORE YOU REMOVE ELECTRICAL POWER.

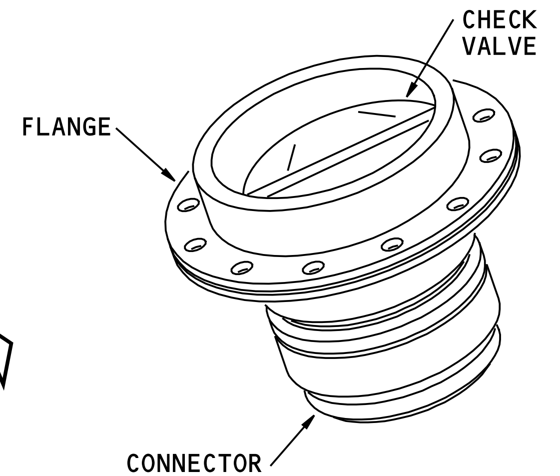
The air conditioning packs will operate without any protective functions if you pressurize the pneumatic system before you apply electrical power.

Before you depressurize the pneumatic system, make sure the air conditioning packs are off. If you depressurize the pneumatic system with the packs on, the packs will not do the normal pack shutdown on the ground sequence.

See the pack flow control section for more information on air conditioning pack start and shutdown sequences (AMM PART I 21-51).



UNDER WING FUSELAGE AREA



HIGH PRESSURE GROUND CONNECTOR
(TYPICAL)

WARNING

ENSURE THAT THE GROUND CART HOSE IS DEPRESSURIZED PRIOR TO REMOVAL. REFER TO AMM 36-00-00 / 201.

CAUTION

DO NOT EXCEED 50 PSIG AND/OR 232 C (450 F)

ENSURE APU, LEFT AND RIGHT ENGINES ARE NOT RUNNING PRIOR TO GROUND CART HOOK - UP

PLACARDS

AIR SUPPLY DISTRIBUTION - HIGH PRESSURE GROUND CONNECTOR

36-12-00-008 Rev 1 08/28/1995

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AIR SUPPLY DISTRIBUTION - FUNCTIONAL DESCRIPTION - ISOLATION VALVES AND APUSOV

General

The left, center and right bleed isolation (L,C,R ISLN) switches and the APU bleed switch have two positions: in (AUTO) and out. The isolation switches have a CLOSED light. The APU bleed switch has an OFF light.

The AUTO position lets the ASCPCs set the position of the valves. The out position commands the ASCPCs to close the related valve. The CLOSED and OFF lights give indication for non-normal conditions.

These are the usual positions of the valves when the switches are set to AUTO and both engine air supply systems are on:

- Left isolation valve - open
- Center isolation valve - closed
- Right isolation valve - open
- APUSOV - closed.

The digital (primary) mode of both ASCPCs control the valves at the same time. The valves have a solenoid with two coils, one for each controller. A RVDT gives valve position information directly to one of the two ASCPCs. The other ASCPC monitors valve position through the ARINC 629 buses.

If the digital mode for both ASCPCs fail, the valves go to a default position. With duct pressure available, the valves open. With no duct pressure, a spring in the actuator closes the valves.

The left controller supplies BITE for the solenoid coils and RVDTs that connects to it. The right controller supplies BITE for the solenoid coils and RVDTs that connects to it.

The left ASCPC gets 28v dc for control and operation of the valves from the section 2 battery bus (not shown). The right ASCPC gets 28v dc for control and operation of the valves from the first officer's flight instrument bus (not shown).

See the engine air supply section for more information on ASCPC power (AMM PART I 36-11).

See the DC generation section for more information about DC power (AMM PART I 24-30).

Valve Functional Description

The internal parts for the left isolation valve is shown, the other isolation valves and the APUSOV have the same parts.

Air pressure to operate the valve comes from one of the two sides of the valve. The side of the valve that has the higher pressure supplies the air that goes through the shuttle valve to the switcher valve. The ASCPCs use the coils in the solenoid to control switcher valve position.

To open the valve, the ASCPCs remove power from the solenoid coils. The switcher valve spring moves to the position that lets air pressure go to the actuator. Pressure more than 10 psi opens the valve.

The RVDT sends a valve position signal to the ASCPC.

To close the valve, the ASCPCs energize the solenoid coils. The switcher valve moves to block pressure from the shuttle valve and releases pressure from the actuator. The spring in the actuator closes the valve.

The ASCPCs have control logic that sets the valves to one of these configurations:

- Open
- Closed
- Latched closed.

See the pages in this section about isolation valve and APUSOV control logic for more information on valve configurations.

Indications

These are the flight deck effects that have a relation to the position of the isolation valves and the APUSOV:

- Left, center, right bleed isolation CLOSED lights
- APU bleed OFF light
- Advisory message, BLEED ISLN CLOSED L,C,R
- Advisory message, BLEED ISLN OPEN L,C,R (not shown)
- Advisory message, BLEED OFF APU.

A status message, (not shown) also shows if a valve is not in its set position.

The CLOSED light lets the flight crew know that the valve is closed due to a non-normal condition of the valve or the pneumatic system. The OFF light lets the flight crew know that APU bleed air is not available due to a non-normal condition of the valve or the pneumatic system.

The advisory messages let the flight crew know that the related valve is:

- Not in the position set by the ASCPCs or
- Selected to a non-normal mode of control (related switch set to out).

The ASCPC logic that causes the CLOSED or OFF light, is different from that used to cause the related closed or off message. This means that the light and the related message do not always show at the same time.

The primary mode of the left ASCPC has the logic that calculates when to supply the indications related to the left and center isolation valves. The primary mode of the right ASCPC supplies the indications related to the right isolation valve and the APUSOV.

Valve Closed/Off Indications

The ASCPCs usually use RVDT valve position information and non-normal condition information to calculate when to show the valve closed/off indications. If the RVDT circuit fails, the ASCPCs use non-normal condition information to calculate when to show the valve closed/off indications.

The applicable bleed isolation CLOSED light comes on if any of these non-normal conditions occur:

- A bleed isolation switch is set to out
- An isolation valve is latched closed
- A valve is set to close as the ASCPCs try to find the location of a duct leak (wing, body)
- An isolation valve fails closed and the RVDT circuit functions correctly
- Source loss condition (L for L ISLN val, R for R ISLN val, L or R for C ISLN val).

The source loss condition logic lets the ASCPCs sense when there is not sufficient air pressure to the ADPs for landing gear retraction, immediately after takeoff.

There are two sets of conditions that cause the ASCPCs to set the left source loss condition to true. The first set is true if all of these conditions occur:

- Landing gear down
- Less than 180 seconds since takeoff
- Left engine off.

The second set is true if all of these conditions occur:

- Landing gear down
- Less than 180 seconds since takeoff
- Left duct pressure less than 20 psig and right duct pressure more than 20 psig.

The conditions that cause the right source loss condition to be true are equivalent to the conditions that cause the left source loss.

The APU bleed OFF light turns on if any of these non-normal conditions occur:

- APU bleed switch set to out
- APU shutoff valve latched closed
- Left wing or body duct leak
- APU shutoff valve failed close and the RVDT circuit functions correctly
- APU fire switch pulled.

For each valve there are two sets of conditions that cause the related closed or off advisory message, BLEED ISLN CLOSED L, C, R or BLEED OFF APU. The first set causes the applicable message if all of these conditions occur:

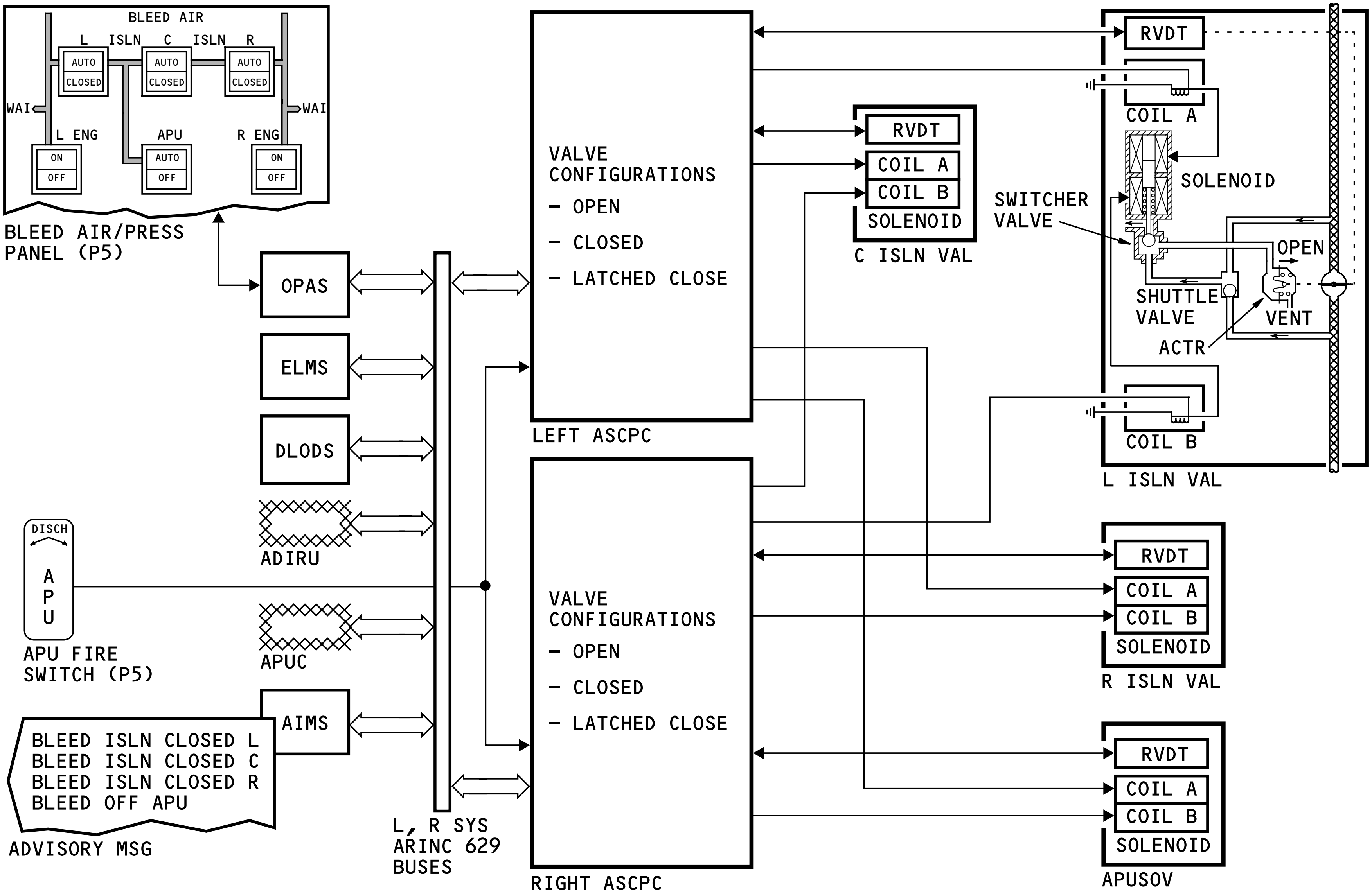
- Bleed isolation switch (L, R, C, APU) set to out
- Related valve is in the closed position or has a failed RVDT circuit.

The second set causes the applicable message if all of these conditions occur:

- Related valve fails in the closed position
- The RVDT circuit functions correctly.

Isolation Valve Open Indication Logic

The applicable advisory message, BLEED ISLN OPEN L,C,R shows if the RVDT circuit for the related valve operates correctly and the related valve fails in an open position.



AIR SUPPLY DISTRIBUTION - FUNCTIONAL DESCRIPTION - ISOLATION VALVES AND APUSOV

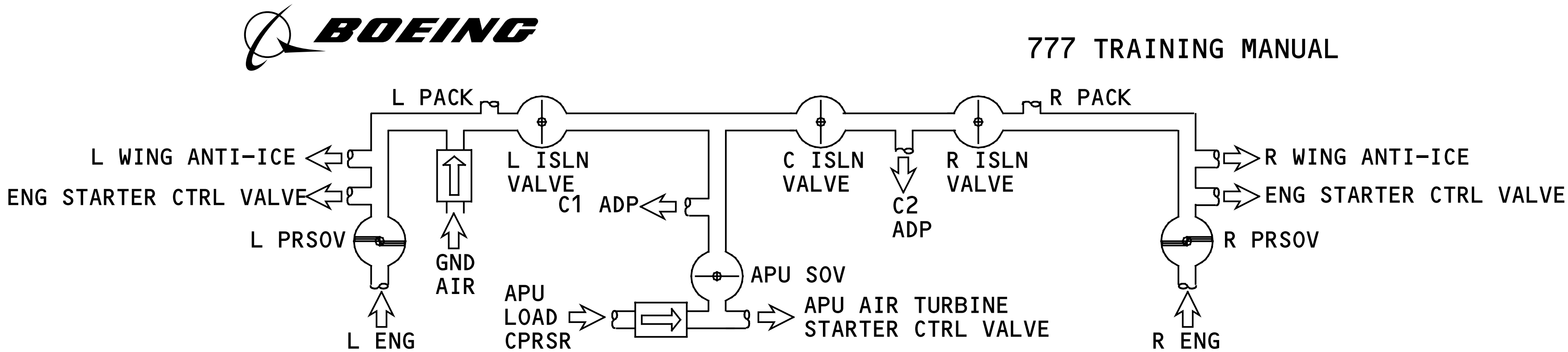
AIR SUPPLY DISTRIBUTION - FUNCTIONAL DESCRIPTION - SUMMARY - NORMAL CONDITIONS

Functional Description

The ASCPC controls the air supply distribution system.
It controls the position of these valves:

- Left isolation valve
- Center isolation valve
- Right isolation valve
- APU shutoff valve
- Left PRSOV
- Right PRSOV.

The table shows different configurations of the valves for normal conditions.



NORMAL CONDITIONS (ALL BLEED AIR SWS SET TO AUTO/ON POSITION)	ASCPC SET POSITIONS					
	L PRSOV	L ISLN VALVE	APU SOV	C ISLN VALVE	R ISLN VALVE	R PRSOV
BOTH ENG ON & (APU ON OR OFF) & GND AIR OFF	OPEN	OPEN	CLOSED	CLOSED	OPEN	OPEN
BOTH ENG ON & (APU ON OR OFF) & GND AIR ON	CLOSED	OPEN	CLOSED	OPEN	OPEN	CLOSED
BOTH ENG OFF & APU ON & GND AIR OFF	CLOSED	OPEN	OPEN	OPEN	OPEN	CLOSED
L ENG ON & (APU ON OR OFF) & GND AIR OFF	OPEN	OPEN	CLOSED	OPEN	OPEN	CLOSED
R ENG ON & (APU ON OR OFF) & GND AIR OFF	CLOSED	OPEN	CLOSED	OPEN	OPEN	OPEN
L ENG START - (R ENG ON) (APL ON GND & APU ON & GND AIR OFF)	CLOSED	OPEN	OPEN	OPEN	CLOSED	OPEN
R ENG START - (L ENG ON) (APL ON GND & APU ON & GND AIR OFF)	OPEN	CLOSED	OPEN	OPEN	OPEN	CLOSED
APU PNEU START (BOTH ENG ON & GND AIR OFF)	OPEN	OPEN	OPEN	CLOSED	OPEN	OPEN
APU PNEU START (L ENG ON & GND AIR OFF)	OPEN	OPEN	OPEN	OPEN	OPEN	CLOSED
APU PNEU START (R ENG ON & GND AIR OFF)	CLOSED	OPEN	OPEN	OPEN	OPEN	OPEN
APU PNEU START (GND AIR ON)	CLOSED	OPEN	OPEN	OPEN	OPEN	CLOSED
L ENG START, CROSS BLD R ENG TO L ENG [APL IN AIR OR (APL ON GND & APU OFF & GND AIR OFF)]	CLOSED	OPEN	CLOSED	OPEN	OPEN	OPEN
R ENG START, CROSS BLD L ENG TO R ENG [APL IN AIR OR (APL ON GND & APU OFF & GND AIR OFF)]	OPEN	OPEN	CLOSED	OPEN	OPEN	CLOSED

AIR SUPPLY DISTRIBUTION - FUNCTIONAL DESCRIPTION - SUMMARY - NORMAL CONDITIONS

36-12-00-014 Rev 3 03/11/1997

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General

The ASCPCs monitor for non-normal conditions that affect the distribution of the air to the ADPs and other air user systems. The ADPs are most important. If a non-normal condition occurs, the ASCPCs limit the effect, by isolating parts of the pneumatic distribution system.

The table shows the different configurations of the isolation, APU shutoff, and the pressure regulating and shutoff valves for non-normal conditions.

Source Loss Condition

The source loss condition logic lets the ASCPCs sense when there is not sufficient air pressure to the ADPs for landing gear retraction immediately after takeoff.

There are two sets of conditions that cause the source loss condition. One set is true if all of these conditions occur:

- Landing gear down
- Less than 180 seconds since takeoff
- Left engine off.

The second set is true if all of these conditions occur:

- Landing gear down
- Less than 180 seconds since takeoff
- left duct pressure less than 20 psig and right duct pressure more than 20 psig.

Bleed Pressure Loss Condition

The bleed pressure loss condition logic lets the ASCPCs sense when a pneumatic duct comes apart. Possible engine starter duct failure is the primary reason for this logic.

There are two sets of conditions that cause the ASCPCs to set the left bleed pressure loss condition to true. One set is true if all of these conditions occur for more than 10 seconds:

- Left duct pressure is less than 13 psig
- Left pack inlet pressure is less than 13 psig
- Right duct pressure is more that 13 psig
- Left PRSOV is open
- Right PRSOV is open
- No duct leak signal from the duct leak and overheat detection system (DLODS)
- Landing gear is up
- Takeoff less than 180 seconds.

The second set is true if all of these conditions occur for more than 10 seconds:

- Left duct pressure is less than 13 psig
- Left pack inlet pressure is less than 13 psig
- Right PRSOV is open
- Left PRSOV is closed

- Landing gear is up or (takeoff more than 180 seconds)
- Left engine bleed air flow is more than 2.0 lbs/sec
- No left engine start.

Bleed Leak Conditions

Ducts in the pneumatic distribution system are monitored by the duct leak and overheat detection system (DLODS) for air leaks that cause an overheat condition. The DLODS provides the ASCPCs with this general location information:

- Bleed leak in the strut area L (R)
- Bleed leak in the wing area L (R)
- Bleed leak in the body area.

The DLODS can not tell the ASCPCs the duct that caused the overheat. One overheat condition can be caused by different ducts. This is an example. An overheat in the left pack area can be caused by a duct that connects any of these components:

- L PRSOV to L Pack and L ISLN valve
- L ISLN valve to C ISLN valve and APUSOV
- C ISLN valve to R ISLN valve and C2 ADP
- R ISLN valve to R Pack and R PRSOV.

The ASCPC closes a valve or valves to isolate a leak then waits to see if the leak conditions goes away.

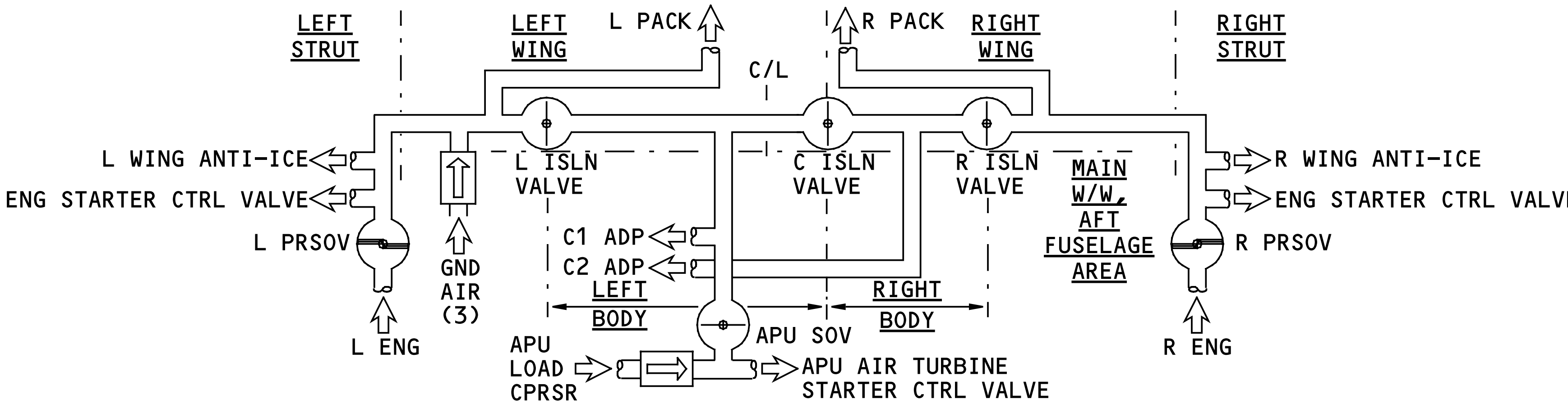
A strut leak is a leak in the ducting at any of these areas:

- The engine strut
- The wing, between the engine strut and the inboard slat.

A wing duct leak is a leak in the ducting next to the inboard slat or in the under fuselage area forward of the main wheel wells.

A body duct leak is a leak in the ducting in the main wheel wells or aft fuselage area, aft of the ECS bays. There is a left and right body duct. The left body duct connects to the left wing duct between the left and center isolation valves and connects to the C1 ADP and the APU. The right body duct connects to the right wing duct between the right and center isolation valve and connects to the C2 ADP.

See the duct leak and overheat detection section for more information (AMM PART I 26-18).



NON-NORMAL CONDITIONS (ALL BLEED AIR SWS SET TO AUTO/ON POSITION, BOTH ENG ON, APU ON, GND AIR OFF)	ASCPC SET POSITIONS					
	L PRSOV	L ISLN VALVE	APU SOV	C ISLN VALVE	R ISLN VALVE	R PRSOV
L SOURCE LOSS	CLOSED	CLOSED	CLOSED	OPEN	OPEN	OPEN
L BLEED PRESSURE LOSS	CLOSED 1	CLOSED 1	CLOSED	OPEN	OPEN	OPEN
BLEED LEAK STRUT L > 5 SEC	CLOSED 1	CLOSED 1	CLOSED	OPEN	OPEN	OPEN
BLEED LEAK L > 5 SEC AND < 51 SEC	OPEN	CLOSED 2	CLOSED 2	CLOSED 2	OPEN	OPEN
BLEED LEAK L > 50 SEC AND < 96 SEC	CLOSED 2	CLOSED 2	CLOSED	CLOSED 3	OPEN	OPEN
BLEED LEAK L > 95 SEC < 141 SEC	CLOSED 3	CLOSED 3	CLOSED	CLOSED 2	CLOSED 2	OPEN
BLEED LEAK L > 140 SEC AND < 186 SEC	CLOSED 3	CLOSED 3	CLOSED	CLOSED 3	CLOSED 2	CLOSED 2
BLEED LEAK L > 185 SEC	CLOSED 1	CLOSED 1	CLOSED 1	CLOSED 1	CLOSED 1	OPEN
BLEED LEAK BODY > 5 SEC AND < 51 SEC	OPEN	CLOSED 2	CLOSED 2	CLOSED 2	OPEN	OPEN
BLEED LEAK BODY > 50 SEC AND < 96 SEC	OPEN	OPEN	CLOSED	CLOSED 2	CLOSED 2	OPEN
BLEED LEAK BODY > 95 SEC	OPEN	CLOSED 1	CLOSED 1	CLOSED 1	CLOSED 1	OPEN

1 = LATCHED WHEN CONDITION BECOMES TRUE
2 = LATCHED IF BLEED LEAK STOPS FOR THIS CONDITION
3 = OPENS IF BLEED LEAK STOPS FOR THIS CONDITION
NOTE: CONDITIONS FOR L SYS SHOWN, R SYS SIMILAR

AIR SUPPLY DISTRIBUTION - FUNCTIONAL DESCRIPTION - SUMMARY - NON-NORMAL CONDITIONS

36-12-00-015 Rev 3 04/10/1997

INDICATING SYSTEM - INTRODUCTION

General

The indicating system supplies the left and right air supply cabin pressure controllers (ASCPC) with air flow, pressure, and temperature data. The ASCPCs use the data for control of the pneumatic system and flight deck indications.

The pneumatic indicating system has these components:

- Manifold pressure sensor (PM)
- Manifold flow sensor (FS)
- Manifold dual temperature sensor (TM)
- Intermediate pressure sensor (PI).

The indicating system uses information from these components in the air conditioning system:

- Pack flow sensor (ASCPC pack inlet differential pressure sensor)
- ASCPC compressor discharge temperature sensor
- ASCPC pack discharge temperature sensor.

The ASCPCs also get pressure, temperature and air flow rate information from the cabin temperature controllers.

The RVDTs are not part of the indication system but they do give valve position data to the ASCPCs. These valves in the pneumatic system use RVDTs:

- Isolation valves (left, center, right)
- APU shutoff valve (APUSOV)
- Fan air modulating valve (FAMV).

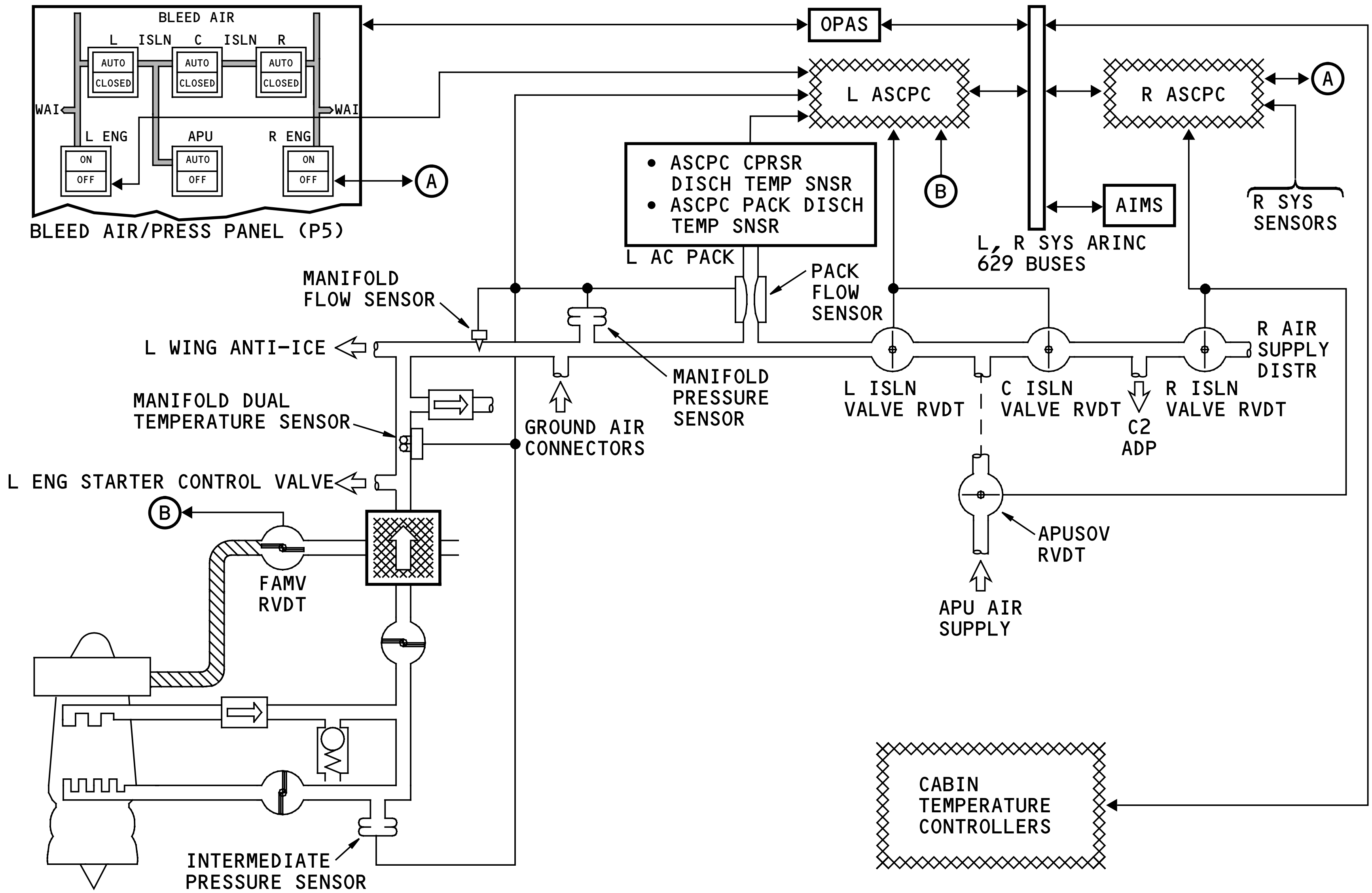
The ASCPC uses the data from the sensors and RVDTs to control the air supply flow, pressure, and temperature. The ASCPCs also use sensors to calculate open/close position data for valves that do not have RVDTs. The ASCPCs send the data to the AIMS and OPAS for flight deck indications. The ASCPCs also send the data to the cabin temperature controllers (CTC). The CTCs use the data for control and flight deck indications.

See the pack flow control section for more information on pack flow control and indication (AMM PART I 21-51).

See the pack flow cooling and mix manifold temperature control section for more information (AMM PART I 21-52).

See the engine air supply section for more information on the FAMV (AMM PART I 36-11).

See the air supply distribution section for more information on the isolation valves and the APUSOV (AMM PART I 36-12).



INDICATING SYSTEM - INTRODUCTION

INDICATING SYSTEM - MANIFOLD PRESSURE SENSOR

Purpose

The manifold pressure sensors monitor the pressure in the air supply distribution system.

Location

There are two manifold pressure sensors. One attaches to airplane structure forward and outboard of the left ECS bay near the distribution duct. The other one is opposite, on the right side of the airplane.

Physical Description

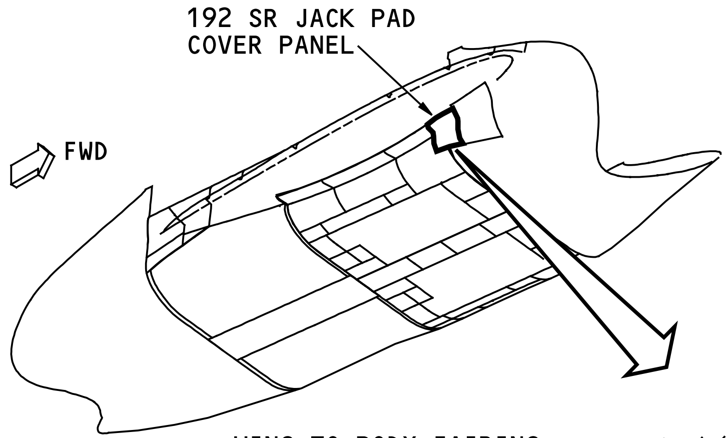
The pressure sensor is an electronic strain gage type. The sensor has these parts:

- Housing
- Electrical connector
- Vent hole (3)
- Pneumatic connector.

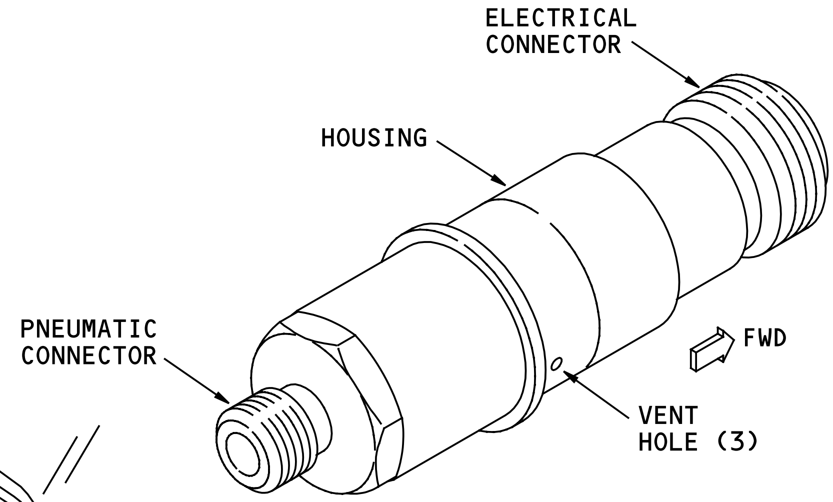
Training Information Point

You attach the sensor with band clamps around the housing. Do not attach the sensor so that the clamps cover the vents.

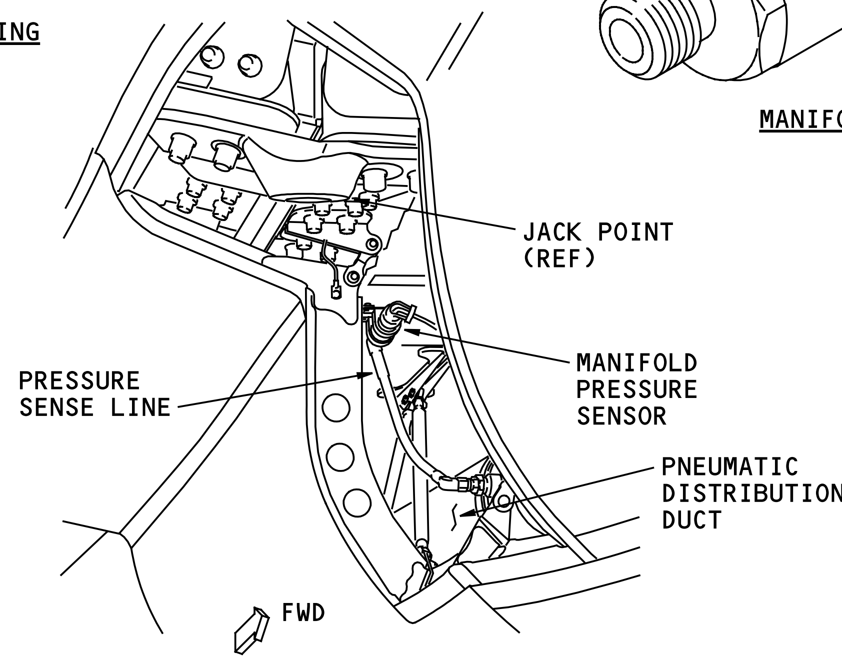
You remove the access panel 191SL (left wing primary jack point access panel) to get access to the left manifold pressure sensor. You remove access panel 192SR (right wing primary jack point access panel) to get access to the right manifold pressure sensor.



WING-TO-BODY FAIRING



MANIFOLD PRESSURE SENSOR
(ROTATED)



RIGHT WING PRIMARY JACK POINT AREA

NOTE: RIGHT INSTALLATION
SHOWN, LEFT SIMILAR

36-20-00-004 Rev 3 08/28/1995

INDICATING SYSTEM - MANIFOLD PRESSURE SENSOR

INDICATING SYSTEM - INTERMEDIATE PRESSURE SENSOR

Purpose

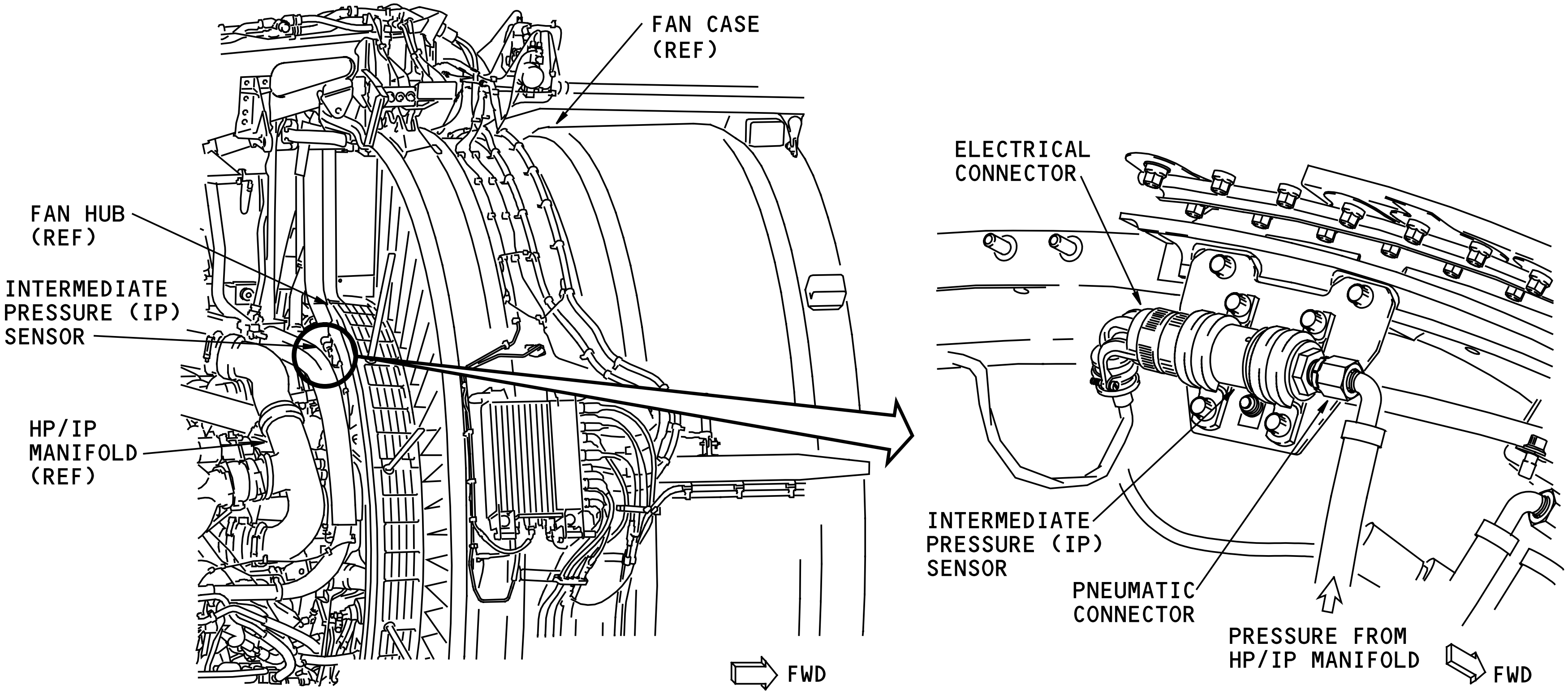
The intermediate pressure sensor (IP) monitors the pressure in the HP/IP manifold.

Location

There is one IP sensor on each engine fan hub at the 12:45 position.

Training Information Point

You open the right fan cowl and thrust reverser to get access to the IP sensor.



ENGINE RIGHT SIDE

ENGINE FAN HUB
(12:45 POSITION)

36-20-00-005 Rev 3 10/07/1997

INDICATING SYSTEM - INTERMEDIATE PRESSURE SENSOR

INDICATING SYSTEM - MANIFOLD FLOW SENSOR

Purpose

The manifold flow sensor monitors the flow rate of the air in the air supply distribution system.

Location

There are two manifold flow sensors in the distribution system ducts. One is in the left wing under the fixed leading edge. The other one is in the right wing under the fixed leading edge.

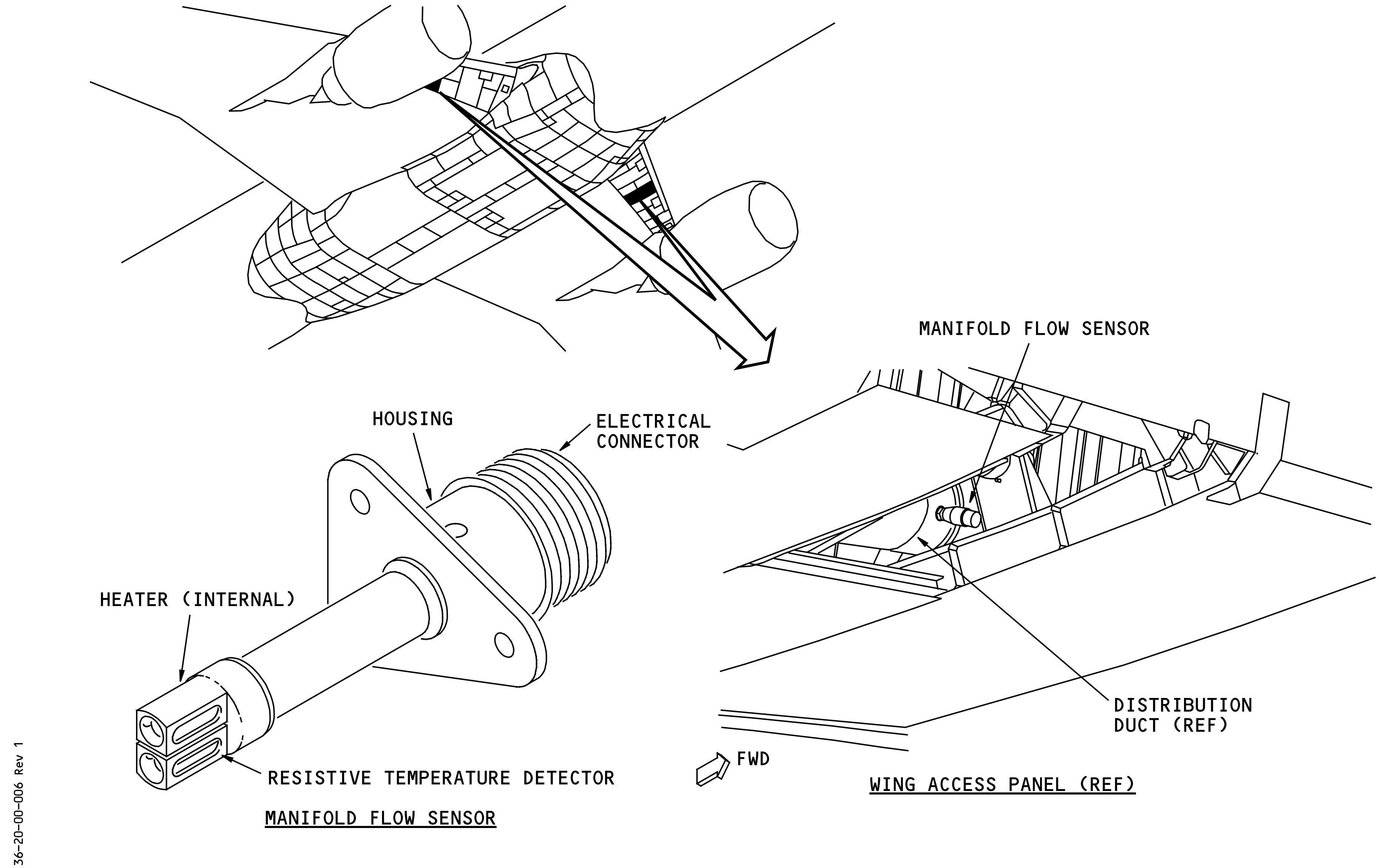
Physical Description

The sensor is an electrically heated unit. The sensor has these parts:

- Housing
- Electrical connector
- Resistive temperature detector
- Internal heater (not shown).

Training Information Point

You open access panel 511JB on the left wing to get access to the left manifold flow sensor. You open access panel 611JB on the right wing to gain access to right manifold flow sensor.



INDICATING SYSTEM - MANIFOLD FLOW SENSOR

INDICATING SYSTEM - MANIFOLD DUAL TEMPERATURE SENSOR

Purpose

The manifold dual temperature sensor monitors the air temperature downstream of the precooler.

Location

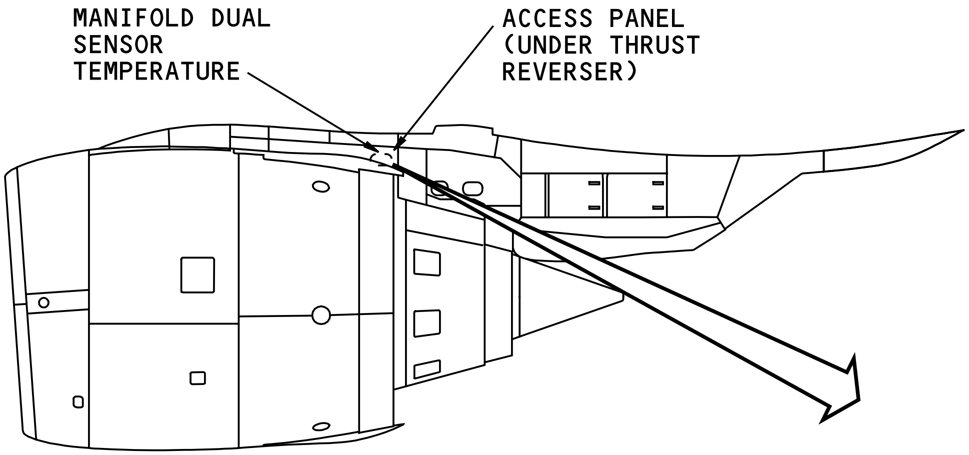
The temperature sensor is in the distribution duct downstream of the precooler in the engine strut.

Physical Description

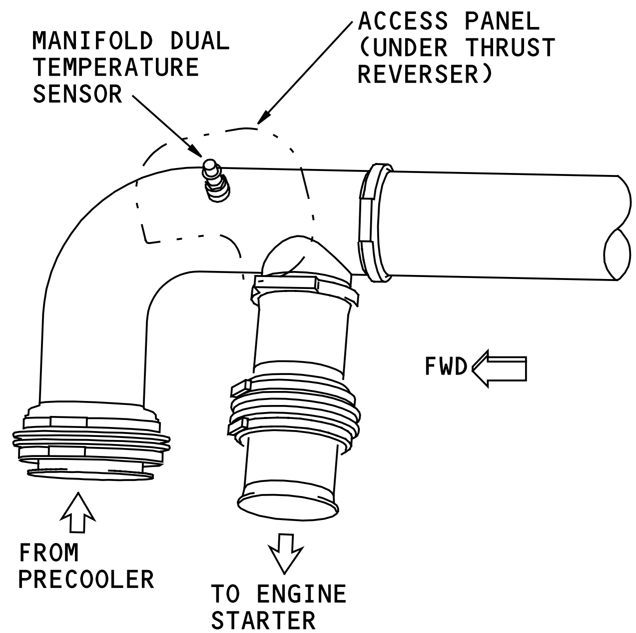
The temperature sensor is a dual sensor. Internally it has two separate sensing elements (not shown). The sensor has a housing and an electrical connector.

Training Information Point

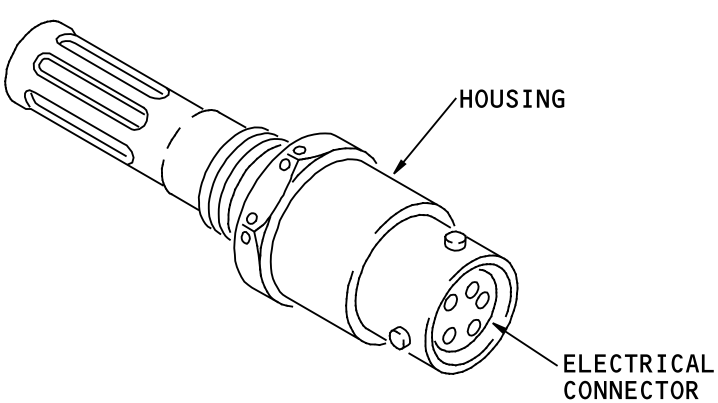
For the left temperature sensor, you open the left fan cowl and thrust reverser on the left engine. Then you remove access panel 432GL on the engine strut to gain access. For the right temperature sensor, you open the left fan cowl and thrust reverser on the right engine. Then you remove access panel 442GL on the engine strut to gain access.



ENGINE LEFT SIDE



DISTRIBUTION DUCT
(ENGINE STRUT AREA)



MANIFOLD TEMPERATURE SENSOR

36-20-00-007 Rev 3 08/13/96

INDICATING SYSTEM - MANIFOLD DUAL TEMPERATURE SENSOR

INDICATING SYSTEM - FUNCTIONAL DESCRIPTION

General

The ASCPC gives indications about the pneumatic system and its components. The ASCPC also give indications about the air conditioning packs to the cabin temperature controllers (CTC).

The digital (primary) mode of the ASCPC uses these sensors to monitor the system for control and indication purposes:

- Manifold pressure sensor (PM)
- Manifold flow sensor (FS)
- Manifold dual temperature sensor (sensor element TM2)
- Pack flow sensor (ASCPC pack inlet differential pressure sensor)
- ASCPC compressor discharge temperature sensor
- ASCPC pack discharge temperature sensor.

See the pack flow control section for more information on pack flow indication and control (AMM PART I 21-51).

See the pack cooling and mix manifold temperature control section for more information on pack cooling and mix manifold temperature indication and control (AMM PART I 21-52).

The analog (backup) mode of the ASCPC uses these sensors to monitor the system for control and indication purposes:

- Manifold dual temperature sensor (sensor element TM1)
- Intermediate pressure (IP) sensor.

Information monitored by the backup mode goes to the primary mode through an internal ASCPC interface.

The primary mode of the ASCPCs monitor valve positions through RVDTs in these valves:

- Left isolation valve
- Center isolation valve
- Right isolation valve
- APU shutoff valve (APU SOV)
- Left fan air modulating valve (FAMV)
- Right fan air modulating valve (FAMV).

Indications

The primary mode of the ASCPCs send signals to the AIMS two ways, directly and through the ARINC 629 buses. The AIMS shows information in these places:

- Air synoptic display - valve position and duct pressure
- Air supply maintenance page - valve position, pressure, temperature and air flow rates
- Ice protection maintenance page - duct pressure
- EICAS display - messages and duct pressure
- Secondary engine display - duct pressure
- Status display - messages
- Performance maintenance page - duct pressure.

INDICATING SYSTEM - FUNCTIONAL DESCRIPTION

The backup mode of the ASCPCs send signals to the AIMS directly. The AIMS shows a message on EICAS for an engine bleed air off condition.

EICAS advisory messages show when any of these conditions occur:

- An isolation valve not in the commanded position or a bleed isolation switch is set to out
- APU SOV not in the commanded position or APU bleed switch is set to out
- Left PRSOV is close for non-normal condition(s)
- Right PRSOV is close for non-normal condition(s).

Status messages show when any of these conditions occur:

- ASCPC incompatible software
- ASCPC primary mode failure
- Isolation valve failure
- APU SOV failure
- HPSOV failure
- PRSOV failure
- FAMV failure
- Manifold dual temperature sensor failure
- Manifold pressure sensor failure
- Manifold flow sensor failure
- Intermediate pressure sensor failure
- ASCPC pack inlet differential pressure sensor failure
- ASCPC compressor discharge temperature sensor failure
- ASCPC pack discharge temperature sensor failure.

See the pneumatic section for more information on conditions that cause messages related to the pneumatic system operation (AMM PART I 36-00).

The primary and backup modes of the left ASCPC directly control the left engine bleed OFF light. The primary and backup modes of the right ASCPC directly controls the right engine bleed OFF light. The applicable ASCPC sends a signal directly to the AIMS to cause the related BLEED OFF ENG L (R) advisory message (not shown).

The primary mode of the left ASCPC controls the CLOSED lights for the left and center isolation valves through the ARINC buses and OPAS. The primary mode of the right ACSPC controls the APU OFF light and the CLOSED lights for the right isolation valve through the ARINC buses and OPAS. The applicable ASCPC sends signals through the ARINC buses to the AIMS to cause the related advisory messages (not shown) and for status messages (not shown).

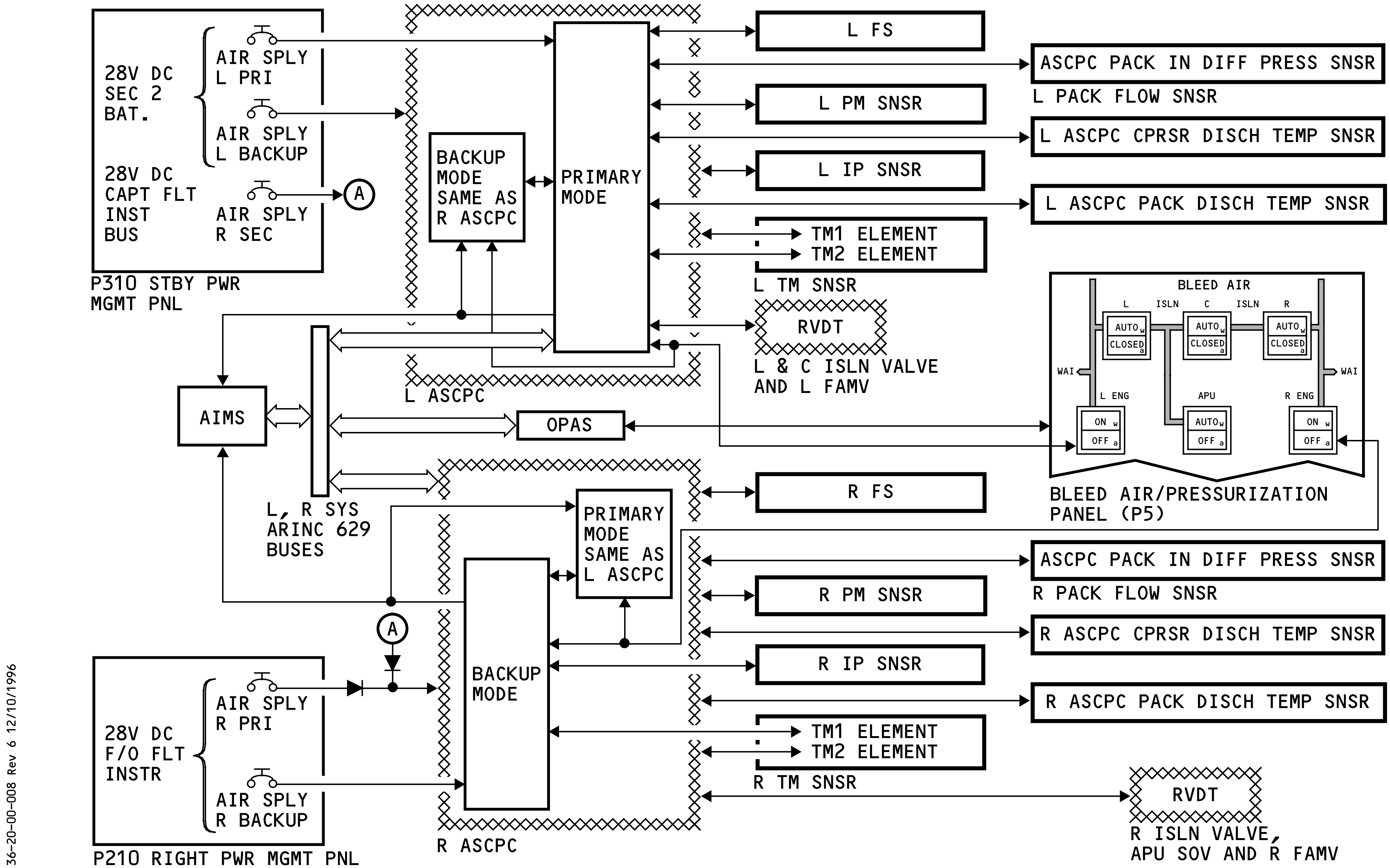
See the engine air supply section for more information about conditions that cause indications to the engine air supply system (AMM PART I 36-11).

See the air supply distribution section for more information about conditions that cause indications to the isolation valves and the APUSOV systems (AMM PART I 36-12).

INDICATING SYSTEM - FUNCTIONAL DESCRIPTION

Training Information Point

If the primary mode of an ASCPC fails, then all indications controlled by that mode for the related ASCPC do not show.



INDICATING SYSTEM - FUNCTIONAL DESCRIPTION

PNEUMATIC - OPERATION

Bleed Air/Pressurization Panel

Switches on the bleed air/pressurization panel (P5) have interfaces with the left and right ASCPCs to give control and supply indications for the pneumatic system. These switches control and give indications for the pneumatic sources:

- Left engine bleed switch (L ENG)
- APU bleed switch (APU)
- Right engine bleed switch (R ENG).

These switches control and give indications for the pneumatic distribution:

- Left isolation valve (L ISLN)
- Center isolation valve (C ISLN)
- Right isolation valve (R ISLN).

See the indicating section for more information about the indicating system (AMM PART I 36-20).

Engine Bleed Switches

The L ENG and the R ENG switches have an annunciator light that comes on when the pressure regulation and shutoff valve (PRSOV) is set to off by the related ASCPC. The switches have two positions:

- In (usual position)
- Out (non-normal).

The ON position (switch in) lets the related engine bleed air system supply air when the engine is running.

The switch out position sets the related engine bleed air system so it does not supply air and turns on the OFF light in the switch. The OFF light gives an indication that the PRSOV is set to OFF and does not relate to the actual position of the PRSOV.

When the switch is in, the OFF light comes on if the engine is off or if any of the these protective shutdown, non-normal conditions occurs:

- Wing or strut duct overheat (wing bleed loss)
- Bleed air overtemperature
- Bleed air overpressure
- Engine fire switch pulled.

When the OFF light is on, the BLEED OFF ENG L(R) advisory message usually shows. This message does not show if the engine is off or if the OFF light comes on because of wing or strut overheat. See the duct leak and overheat detection section for more information (AMM PART I 26-18).

See the engine air supply section for more information on engine bleed air control and operation (AMM PART I 36-11).

APU Bleed Switch

The APU switch has an annunciator light that comes on when the APUSOV is closed because of a non-normal condition. The APU switch has two positions:

- In (usual position)
- Out (non-normal).

The AUTO position (switch in) lets the APU shutoff valve (APUSOV) OPEN/CLOSE as necessary to supply air to the pneumatic distribution system.

See the air supply distribution section for more information about the APU shut off valve OPEN/CLOSE position control (AMM PART I 36-12).

The switch out position sets the APU shutoff valve to close. With the switch set to out, the OFF light in the switch comes on when the valve closes.

When the switch is in, the OFF light comes on when the valve is closed and any of the these non-normal conditions occurs:

- Wing or body duct overheat
- APUSOV failed closed
- APU fire switch pulled.

When the OFF light comes on, the BLEED OFF APU advisory message usually shows. This message does not show if the APU is off. See the duct leak and overheat detection system section for more information (AMM PART I 26-18).

Isolation Bleed Switches

The isolation bleed switches have an annunciator light that comes on when the related isolation valve is closed because of a non-normal condition. The switches have two positions:

- In (usual position)
- Out (non-normal position.)

The AUTO position (switch in) lets the related isolation valve, left, center, or right OPEN/CLOSE as necessary to control the direction of air flow in the pneumatic distribution system.

The switch out position sets the related isolation valve to close. The CLOSED annunciator light in the switch comes on when the valve is closed.

The AUTO position with CLOSED indication (switch in) can occur when the related valve is closed and any of the these non-normal conditions occurs:

- Wing or body duct overheat
- Related isolation valve failed closed
- Left (right) bleed source loss.

When the CLOSED light comes on because the related valve is failed closed or the related switch is set to out, the advisory message, BLEED ISLN CLOSED L (C, R) shows.

See the air supply distribution section for more information on the isolation valve OPEN/CLOSE position control (AMM PART I 36-12).

Training Information Point

Annunciator lights and EICAS messages on the bleed air/ pressurization panel usually relate to valve positions that the left and right ASCPCs control and monitor.

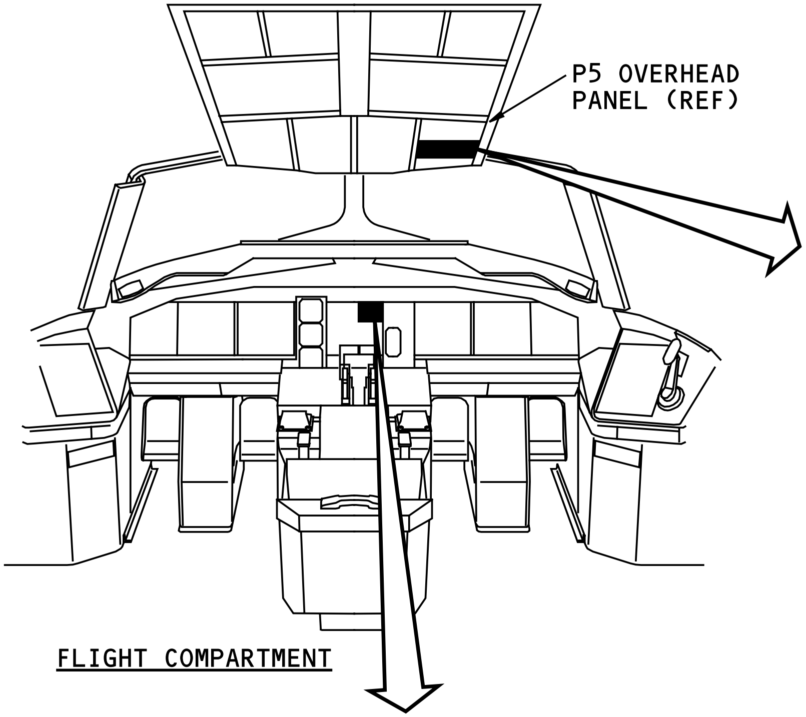
The isolation valves and APUSOV have RVDTs that the ASCPCs use to calculate when to turn on the related CLOSED or OFF lights. If a RVDT fails, the ASCPCs calculate when to turn on or show the related indications without the use of the failed RVDT. The calculation for the lights is based on the ASCPC set position for the related valve. The calculation for the message is based on switch position for the related valve.

The PRSOVs do not have any direct feedback to the ASCPC, no RVDTs, no limit switches and no proximity switches. The ASCPCs calculate the related valve position for all indications based on set position.

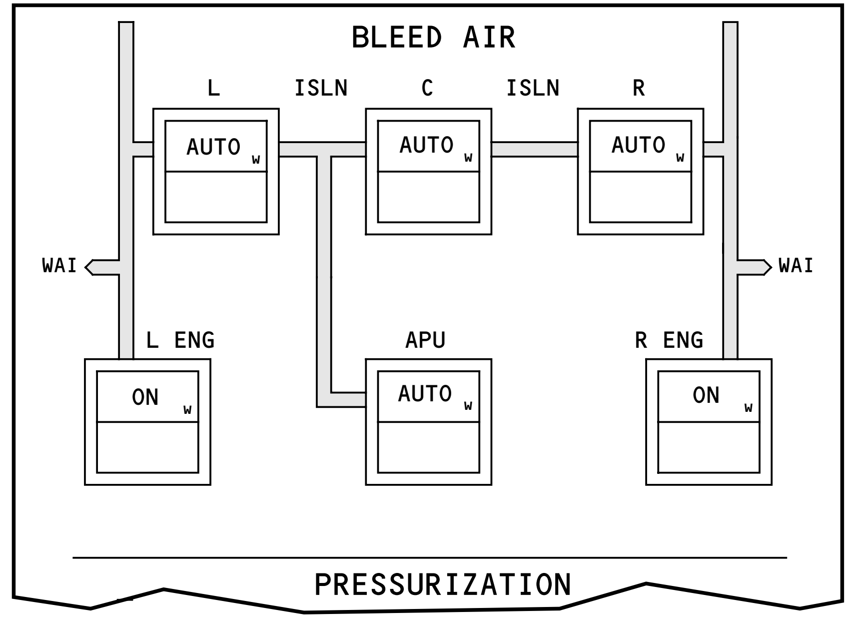
The primary control (digital) part of the ASCPCs usually gives control and indications for the related engine bleed air system, the isolation valves and APUSOV. If primary control fails in one controller, the other controller controls the isolation valves and APUSOV. All indications that are related to the ASCPC that has the failed primary control are lost. These are the indications lost related to the bleed air/ pressurization panel:

BLEED AIR/PRESSURIZATION PANEL	
FAILED PRIMARY CONTROL	INDICATIONS LOST FOR THESE VALVES
LEFT ASCPC	L ISLN
	C ISLN
RIGHT ASCPC	R ISLN
	APUSOV

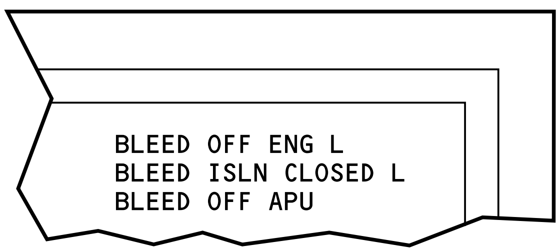
The backup control (analog) part of the ASCPCs that has a failed primary control gives limited engine bleed air control and engine OFF indications.



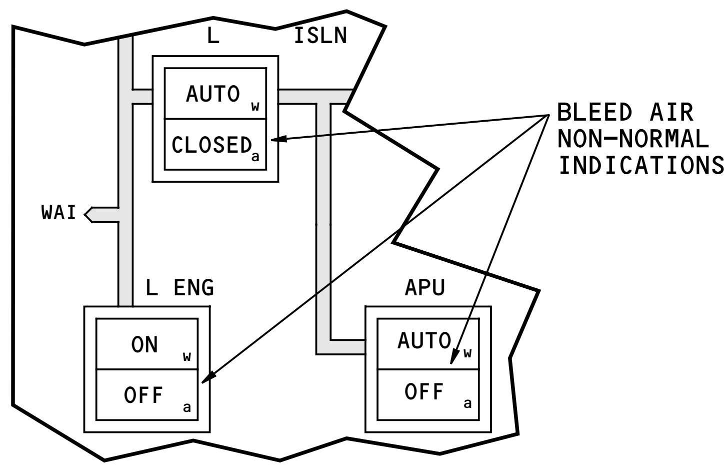
FLIGHT COMPARTMENT



BLEED AIR/PRESSURIZATION PANEL (P5)



EICAS DISPLAY - ADVISORY MESSAGES



PNEUMATIC - OPERATION

36-00-00-004 Rev 6

PNEUMATIC - INDICATIONS - EICAS DISPLAY AND SECONDARY ENGINE DISPLAY

General

You can see duct pressure for the left and right parts of the pneumatic distribution system on these displays:

- EICAS display
- Secondary engine display
- Air synoptic display (not shown)
- Air supply maintenance page (not shown)
- Ice protection maintenance page (not shown)
- Performance maintenance page (not shown).

The synoptic display and the maintenance pages are described later in this section.

The units of duct pressure are psig. The color of the pressure readout changes from white to amber when pressure is less than 11 psig. No pressure will show if any of these conditions occurs:

- Related ASCPC primary (digital) control fails
- Fault in the indication circuit.

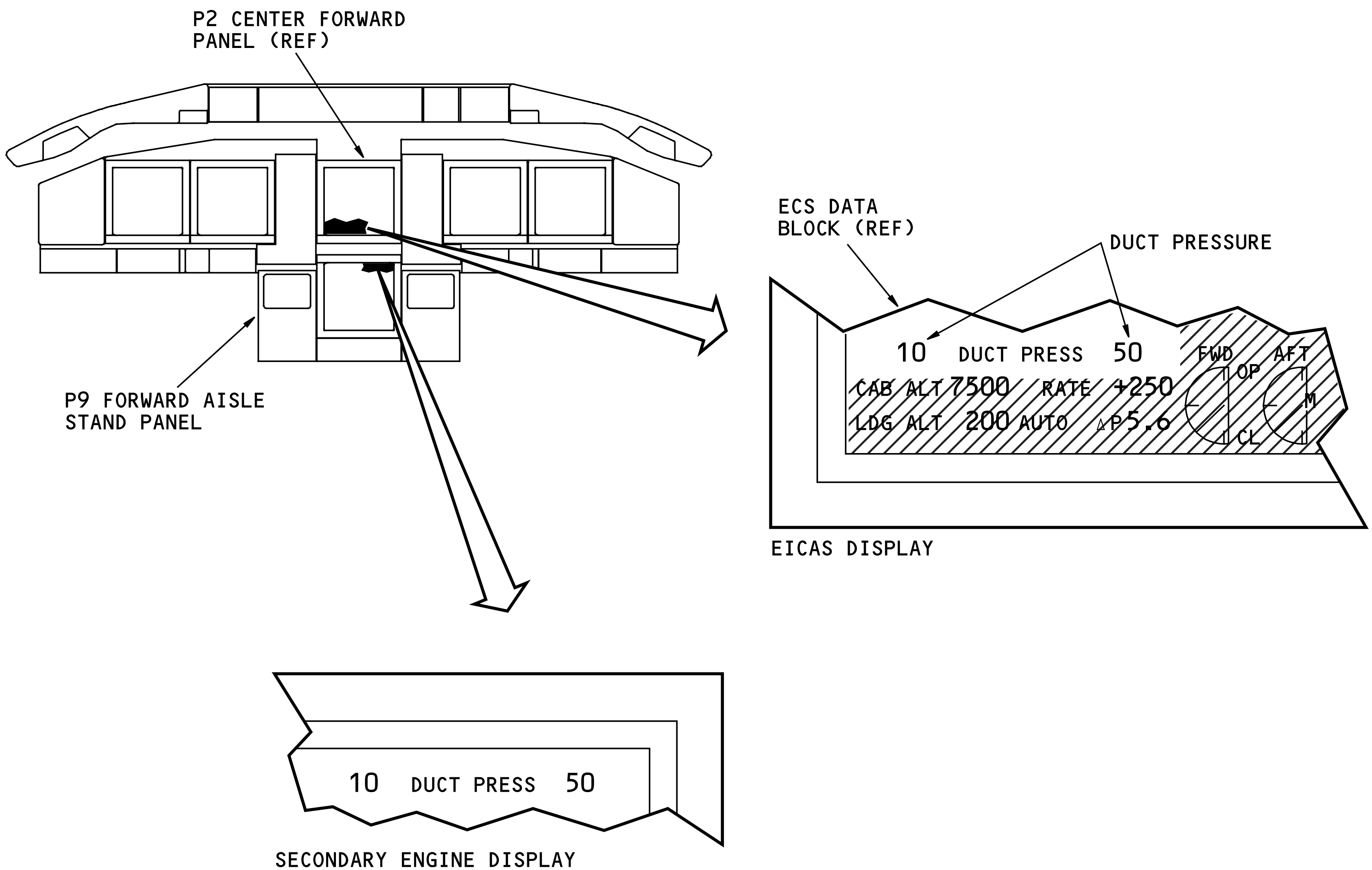
EICAS Display

Duct pressure shows in the ECS data block part of the EICAS display. This block shows if any of these conditions occur:

- Loss of landing altitude, FMC to ASCPCs
- Loss of automatic pressurization control
- Loss of automatic fwd or aft pressurization outflow valve control
- MAN selected for outflow valve control
- Exceedance for cabin altitude or cabin differential pressure
- Duct pressure less than 11 psig and the related engine is on
- Air synoptic display shows.

Secondary Engine Display

Duct pressure shows on the secondary engine display if one or both engines are off and the related engine fire switch is not pulled.



36-00-00-005 Rev 3

PNEUMATIC - INDICATIONS - EICAS DISPLAY AND SECONDARY ENGINE DISPLAY

PNEUMATIC - INDICATIONS - AIR SYNOPTIC DISPLAY

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Air Synoptic Display

The lower part of the air synoptic display gives information about the pneumatic system, air conditioning zone temperature control system, cargo heat systems, and air user system.

See the air conditioning chapter for more information about the temperature control and cargo heat systems (AMM PART I 21).

For the pneumatic system the display shows:

- Air flow direction and user systems
- Isolation valve position
- Duct pressure (manifold duct pressure)
- Engine bleed valve (PRSOV) calculated position
- APU shutoff valve position
- Air source status (engine, APU and ground).

Green flow bars show air flow direction and identify which sources and users are on.

Valve positions show as one of the following symbols:

- Open (white circle with flow bar in-line with duct)
- Closed (white circle with flow bar 90 degrees to duct)
- Failed open (amber valve open symbol with amber X)
- Failed closed (amber valve closed symbol with amber X)
- Selected closed (amber valve closed symbol with amber X) for isolation and APU shutoff valves only
- Invalid (white circle with no flow bar).

The units of duct pressure are psig. The color of the pressure readout changes from white to amber when pressure is less than 11 psig. No pressure will show if any of these conditions occurs:

- Related ASCPC primary (digital) control fails
- Fault in the indication circuit.

Air source status for the engines is not shown on the air synoptic display. Air source status for the APU shows by color change of the APU symbol. The APU symbol is white for APU off and green for APU on. The ground air symbol shows if manifold duct pressure is more than 11 psig and all of the following are true:

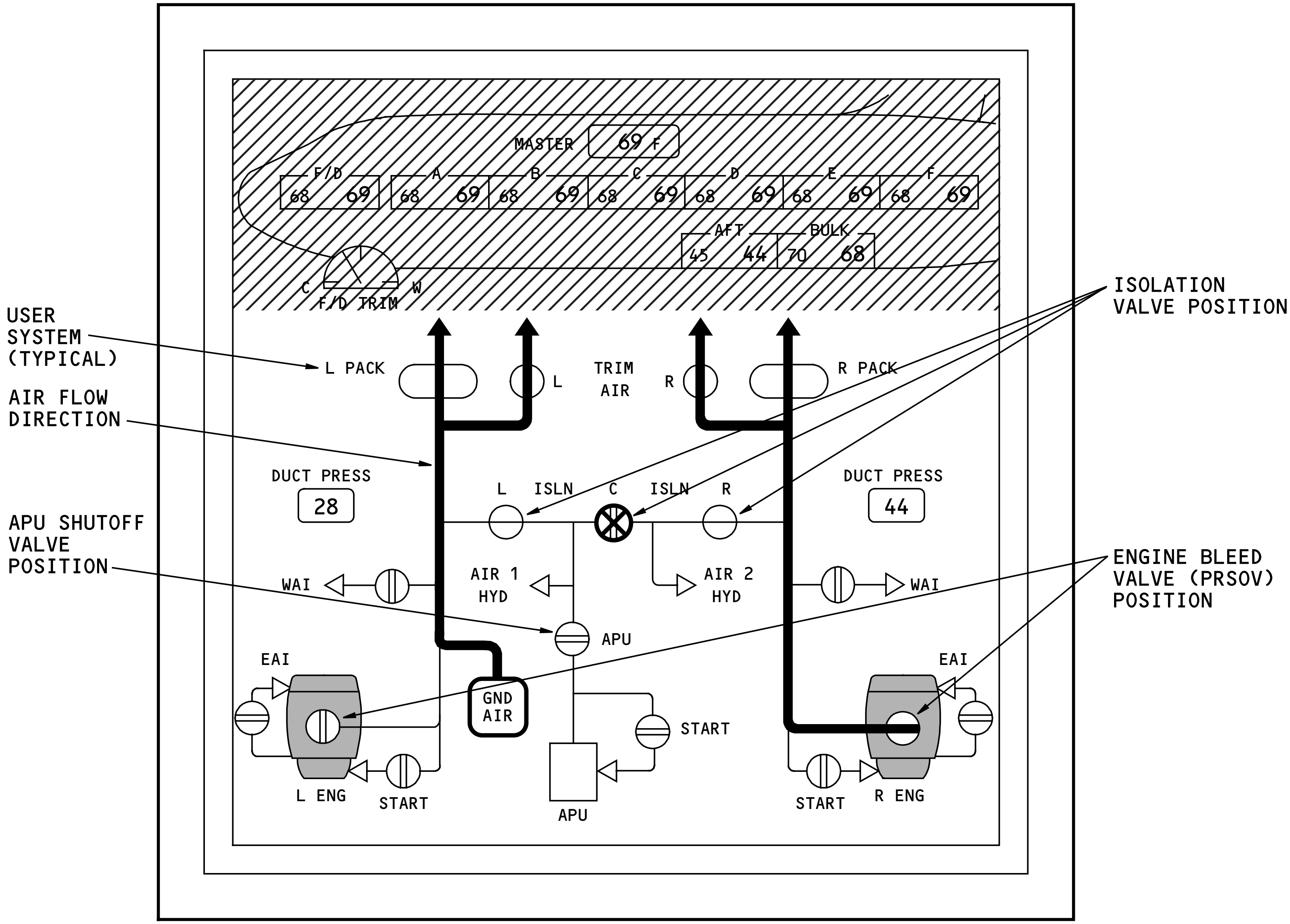
- Airplane on the ground
- No active engine or APU bleed air sources or any active bleed sources isolated from ground air source
- User system on (pack, trim air, WAI, starter, ADP).

Training Information Point

The related ASCPC calculates engine bleed valve (PRSOV) position. Actual valve position does not always agree with the position shown on the air synoptic display. If you must make sure that the PRSOV is open or closed, do a check the position indicator on the valve.

PNEUMATIC - INDICATIONS - AIR SYNOPTIC DISPLAY

The positions of the isolation valves and the APUSOV, are usually based on actual valve position measured by RVDTs. If a RVDT fails, the related valve position is calculated by the related ASCPC. If the related ASCPC has a failed primary control, then valve position information will show as invalid.



PNEUMATIC - INDICATIONS - AIR SYNOPTIC DISPLAY

36-00-00-006 Rev 7 03/16/95

PNEUMATIC - INDICATIONS - AIR SUPPLY MAINTENANCE PAGE

Air Supply Maintenance Page

The upper part of the air supply maintenance page contains information about the pneumatic system. The primary control (digital) part of left and right ASCPCs and the EEC supply the information. The ASCPCs supply most of the information. This information comes from the EECs:

- STARTER VLV position
- ENG HIGH STAGE PRESS
- ENG N1 FAN SPEED.

Valve positions are shown as OPEN or CLOSED. Pressure values are shown in psig. Temperature values are shown in degrees F. Flow rate values are shown in lbs/min.

Flight phase may be any one of these:

- Initialization (INIT)
- GND
- TAKEOFF
- CLIMB
- CRUISE
- DESCENT
- LANDING.

Either ASCPC can give the flight phase information; the left is the primary source.

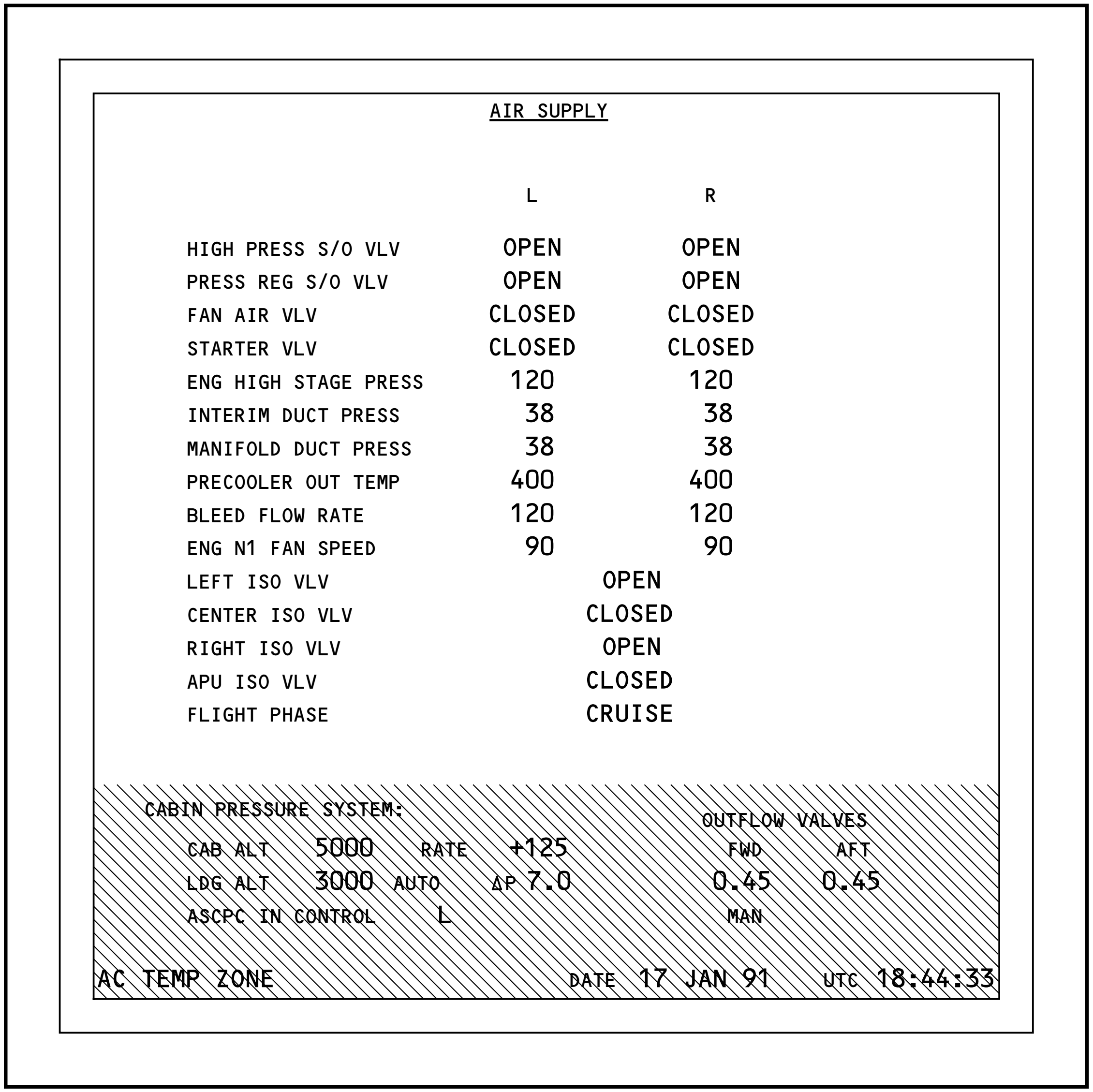
If any information is not available, the indication is blank.

Training Information Point

The related ASCPC calculates valve position information for the PRSOV and the HPSOV. Actual valve position does not always agree with the position shown. If you must make sure that the PRSOV or the HPSOV is open or closed, do a check of the position indicator on the valve.

The positions of the isolation valves and the APUSOV, are usually based on actual valve position measured by RVDTs. If a RVDT fails, the related valve position is calculated by the related ASCPC.

If an ASCPC has a failed primary control, then all information that normally comes from that controller will not show. The left ASCPC gives indications for the left part of the pneumatic system plus the center isolation valve. The right ASCPC gives indications for the right part of the pneumatic system plus the APU isolation valve (APUSOV).



36-00-00-007 Rev 3

PNEUMATIC - INDICATIONS - AIR SUPPLY MAINTENANCE PAGE

PNEUMATIC - SYSTEM TESTS

General

These are the pneumatic system tests that show when you select ATA 36 Air Supply System:

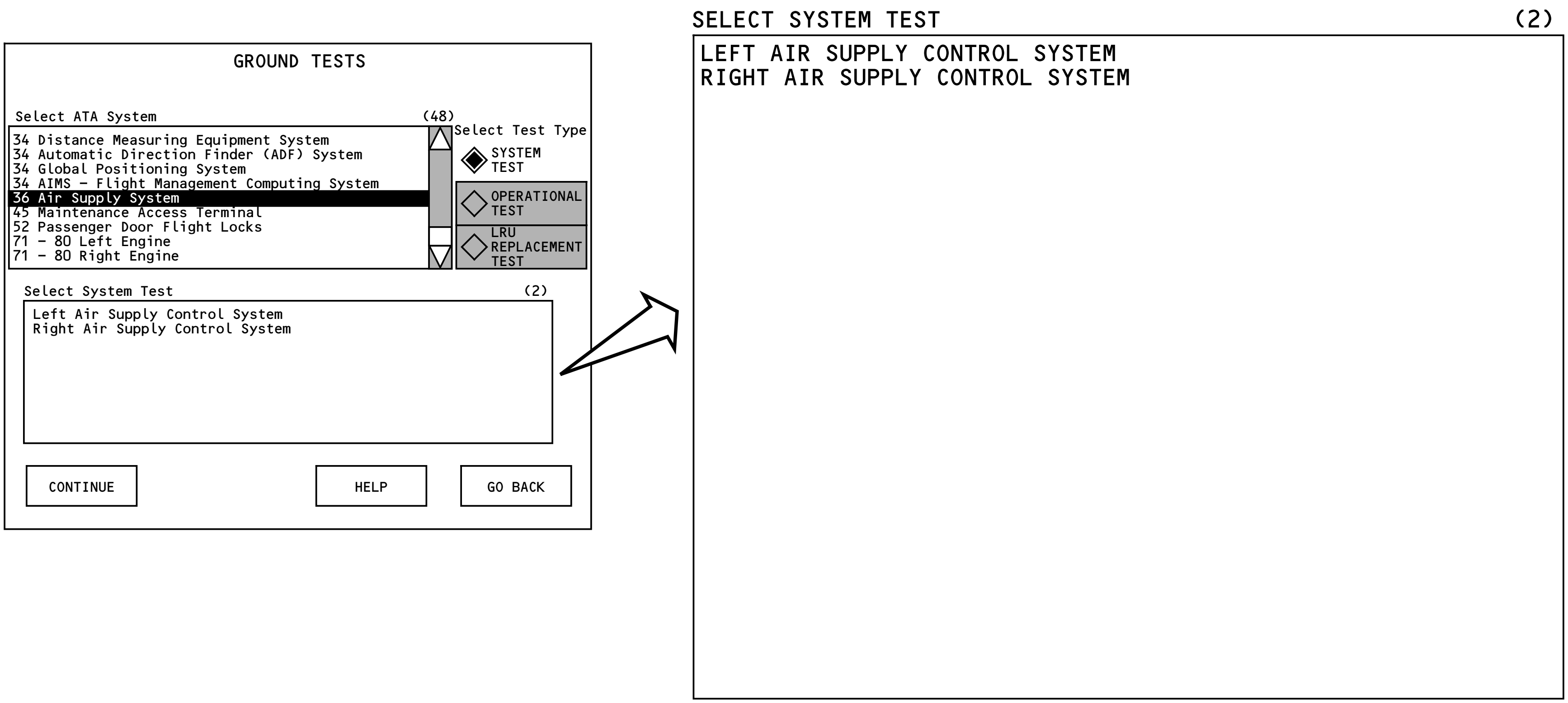
- Left air supply control system
- Right air supply control system.

Left and Right Air Supply Control System

These tests make sure that the electrical circuits for these air supply control system LRUs operate correctly:

- Valves
- Controllers
- Interfaces.

You must remove pressure in the pneumatic ducts for this test. During the test, the torque motors and solenoids move. The tests each take less than 1 minute.



36-00-00-008 Rev 0 08/22/1996

PNEUMATIC - SYSTEM TESTS

Continental Airlines, Inc

Air Conditioning

WB371

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AIR CONDITIONING - INTRODUCTION

General

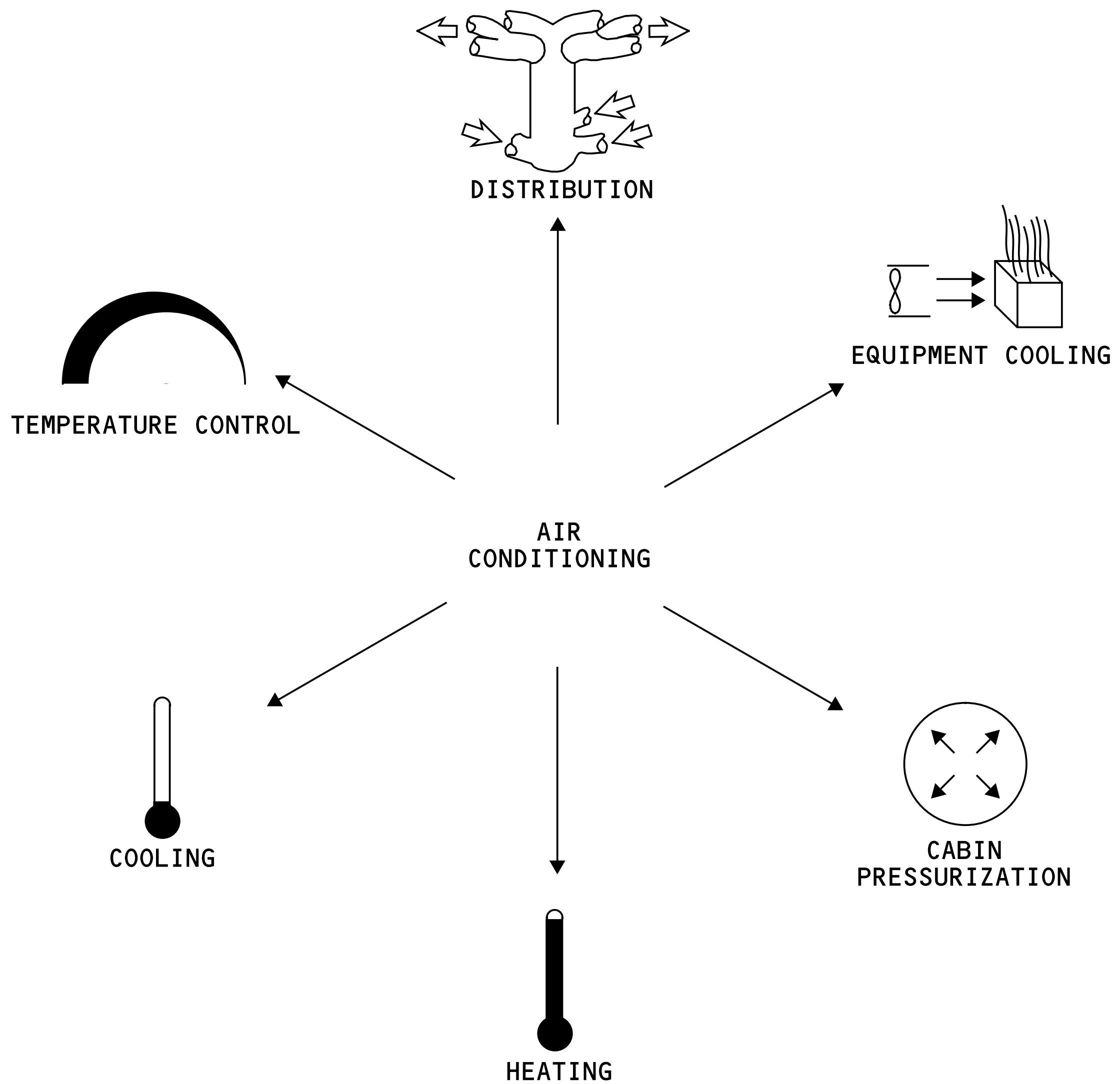
The air conditioning system controls the interior environment of the airplane for flight crew, passengers, and equipment. The air conditioning system includes these subsystems:

- Air Distribution
- Equipment cooling
- Cabin pressurization
- Heating
- Cooling
- Temperature control.

Abbreviations and Acronyms

A/C	- air conditioning
ADIRS	- air data inertial reference system
ADIRU	- air data inertial reference unit
AGS	- air/ground system
AIMS	- airplane information management system
ARINC	- Aeronautical Radio, Inc.
ASCPC	- air supply cabin pressure controller
ASG	- ARINC signal gateway
CACP	- cabin area control panel
capt	- captain
cgo	- cargo
ckt	- circuit
clg	- cooling
CMCS	- central maintenance computing system
CRA	- crew rest area
CSS	- cabin services system
CSCP	- cabin system control panel
CTC	- cabin temperature controller
ctrl	- control
CUR	- current
E/E	- electrical and electronic
ECS	- environmental control system
ECSMC	- environmental control system miscellaneous card
elex	- electronics
ELMS	- electrical load management system
ENRGZ	- energize
eqpt	- equipment
exh	- exhaust
F/O	- first officer
fwd	- forward
gly	- galley
htr	- heater
IMMTE	- integrated mix manifold temperature error
LLAR	- lower lobe attendants rest
MFD	- multi-function display
manf	- manifold
mgmt	- management
OPAS	- overhead panel arinc 629 system
OVHT	- overheat
pnl	- panel
pwr	- power
recirc	- recirculation
rly	- relay

snsr	-	sensor
SOV	-	shutoff valve
TAT	-	total air temperature
TCV	-	temperature control valve
temp	-	temperature
util	-	utility
vlv	-	valve
WOW	-	weight-on-wheels



AIR CONDITIONING - INTRODUCTION

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AIR CONDITIONING - GENERAL DESCRIPTION - CONTROL

General

These flight deck panels let you control the air conditioning system:

- Air conditioning panel
- Bleed air/pressurization panel
- Cargo temperature select panel
- Sidewall panels (Capt. and F/O foot and shoulder heater controls).

These passenger compartment panels let you control the air conditioning system:

- Cabin system control panel (CSCP)
- Cabin area control panels (CACPs)
- Galley heat controls in the galleys.

These components in the MEC control the functions of the air conditioning system:

- Two cabin temperature controllers (CTCs)
- Two air supply cabin pressure controllers (ASCPCs)
- Two environmental control system miscellaneous cards (ECSMCs)
- Two equipment cooling controllers (ECCs).

Cabin Temperature Controller

The CTCs control these functions of the air conditioning system:

- Pack flow, regulation (on) or off
- Pack cooling/mix manifold temperature
- Trim air, regulation (on) or off
- Zone temperature
- Recirculation air.

Air Supply Cabin Pressure Controller

The ASCPCs control these functions:

- Pack flow schedule
- Pack flow, on or off
- Backup pack flow (CTC failed)
- Trim air, on or off
- Pressurization system
- Pneumatic system.

Environmental Control System Miscellaneous Cards

The ECSMCs control these functions of the air conditioning system:

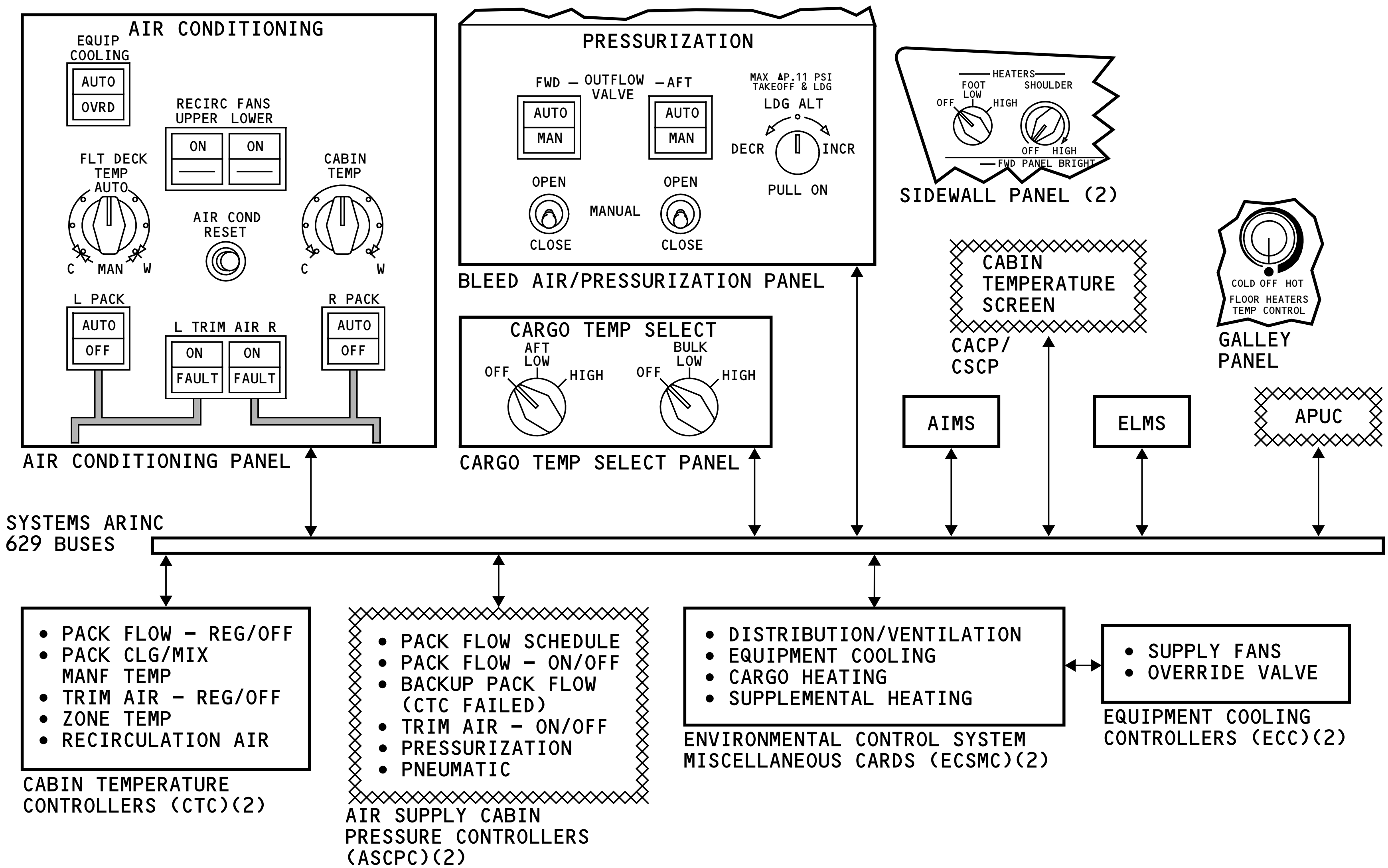
- Air distribution and ventilation
- Equipment cooling
- Cargo heating
- Supplemental heating.

Equipment Cooling Controller

The ECCs control the supply fans and override valve in the equipment cooling system.

Interfaces

The air conditioning controls have interfaces with each other, the AIMS, the electrical load management system (ELMS), and the auxiliary power unit controller (APUC).



AIR CONDITIONING - GENERAL DESCRIPTION - CONTROL

AIR CONDITIONING - FLIGHT DECK CONTROLS

General

These flight deck panels give the flight crew control of the air conditioning subsystems:

- Air conditioning panel on the P5 overhead panel
- Bleed air/pressurization panel on the P5 overhead panel
- Cargo temperature select panel on the P61 overhead maintenance panel.

Cargo Temperature Select Panel

These controls are on the cargo temperature select panel:

- Aft cargo temperature selector
- Bulk cargo temperature selector.

Air Conditioning Panel

These controls are on the air conditioning panel:

- Equipment cooling switch
- Upper and lower recirculation fan switches
- Flight deck temperature control
- Cabin temperature control
- Air conditioning reset switch
- Left and right pack switches
- Left and right trim air switches.

Sidewall Panels

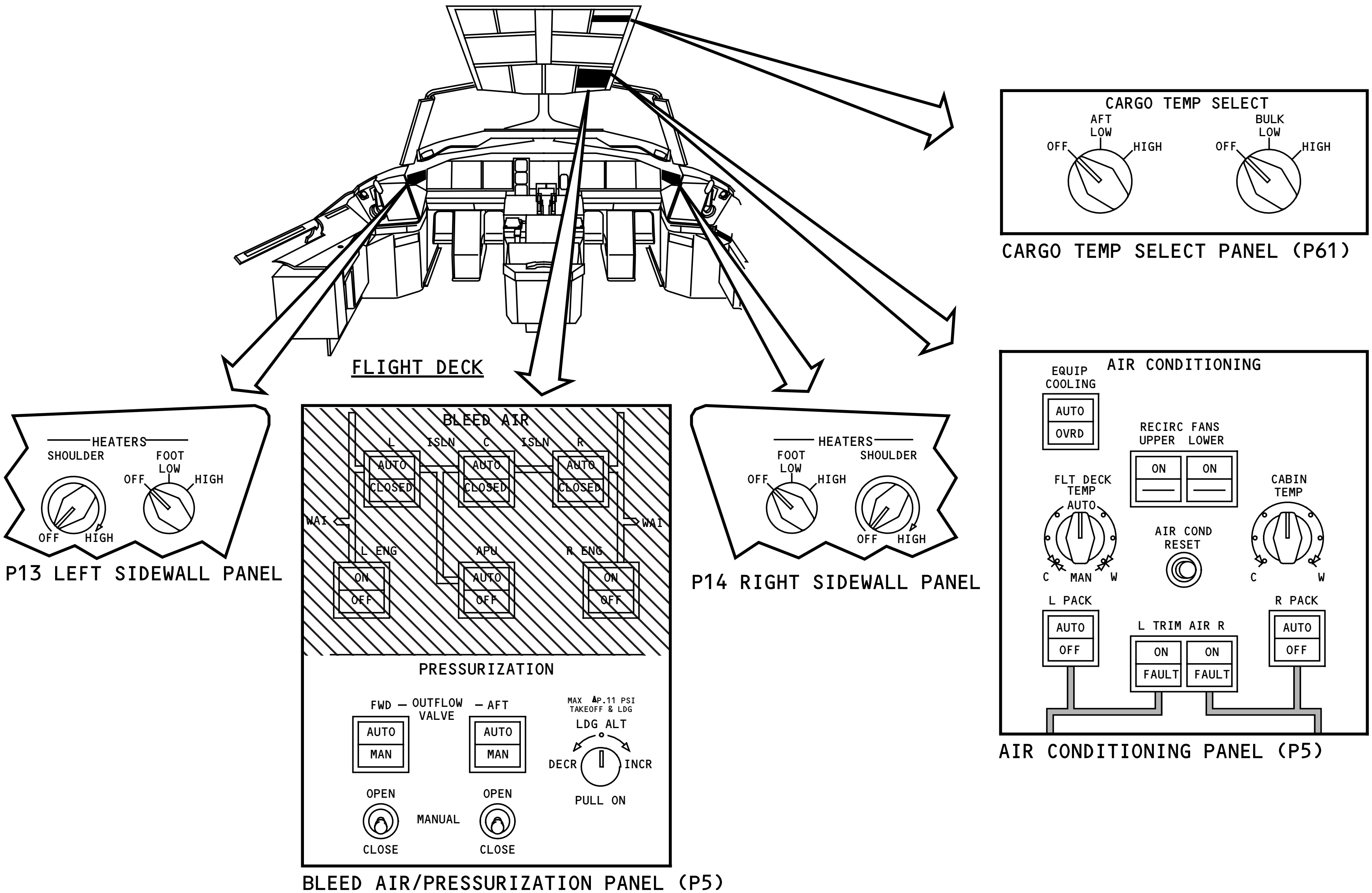
These controls, related to the air conditioning system are on the left and right sidewall panels:

- Captain's foot heater selector (left sidewall panel)
- Captain's shoulder heater control (left sidewall panel)
- First office's foot heater selector (right sidewall panel)
- First office's shoulder heater control (right sidewall panel).

Bleed Air/Pressurization Panel

These controls are on the pressurization part of the bleed air/pressurization panel:

- Forward and aft outflow valve AUTO switches
- Forward and aft outflow valve manual switches
- Landing altitude selector.



AIR CONDITIONING - FLIGHT DECK CONTROLS

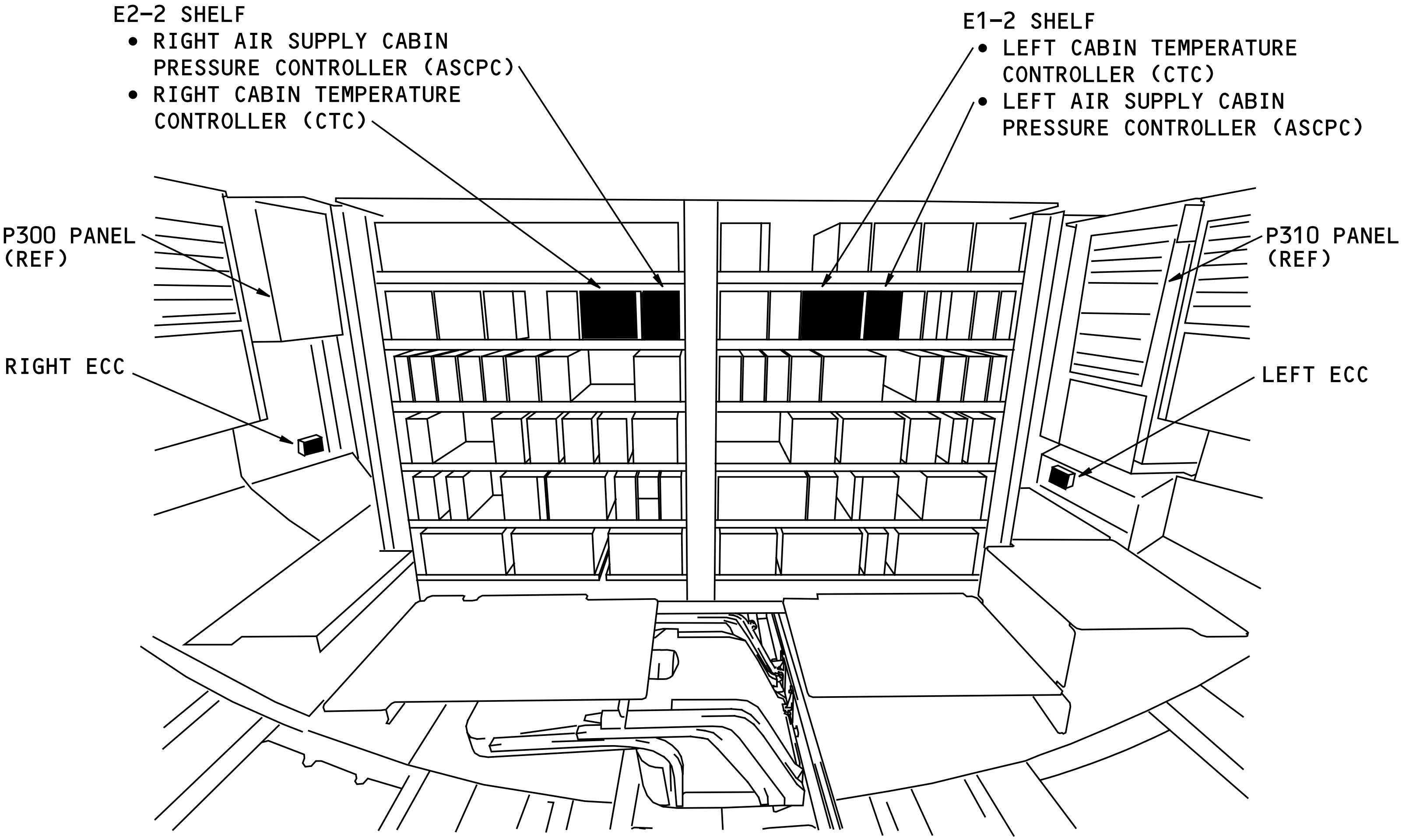
AIR CONDITIONING - CONTROLLERS

General

The air conditioning system uses these controllers:

- Cabin temperature controllers (CTCs)
- Air supply cabin pressure controllers (ASCPCs)
- Equipment cooling controllers (ECCs).

These controllers are in the main equipment center.



MAIN EQUIPMENT CENTER
(LOOKING AFT)

21-00-00-005 Rev 2 01/25/95

AIR CONDITIONING - CONTROLLERS

AIR CONDITIONING - ECS MISCELLANEOUS CARDS - INTRODUCTION

Purpose

The environmental control system miscellaneous cards (ECSMCs) give control, indication, and BIT for some functions of these systems:

- Equipment cooling system
- Air conditioning distribution system
- Air conditioning supplemental heating system
- Cargo compartment heating systems.

Location

The left and right system card files each contain one of the ECSMCs. The system card files are in the main equipment center.

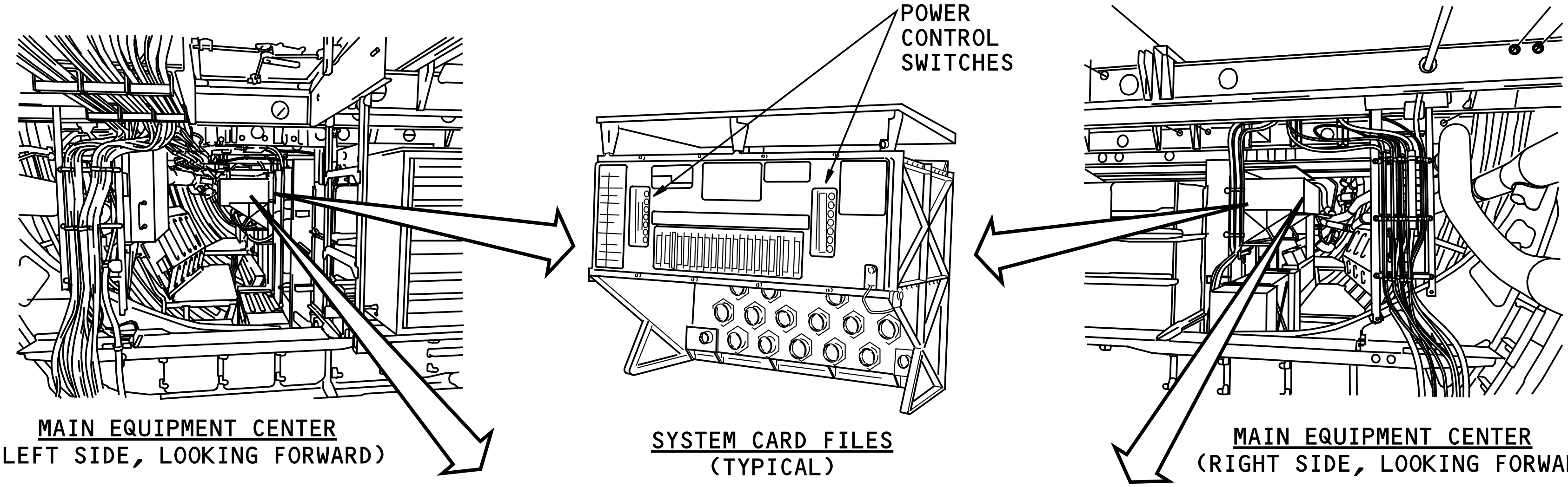
Interfaces

The left and right ECSMCs have interfaces with the left and right systems ARINC 629 buses through the ASG cards.

Training Information Point

The left and right ECSMCs are interchangeable. You can use the MAT to install new software in the cards.

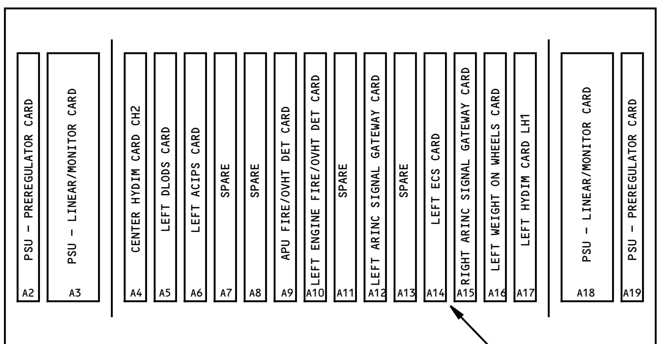
There is a switch on each card file to remove power from the ECSMC when you remove or install the ECSMC. See the indication and recording systems chapter for more information about the systems card files (AMM PART I 31-09).



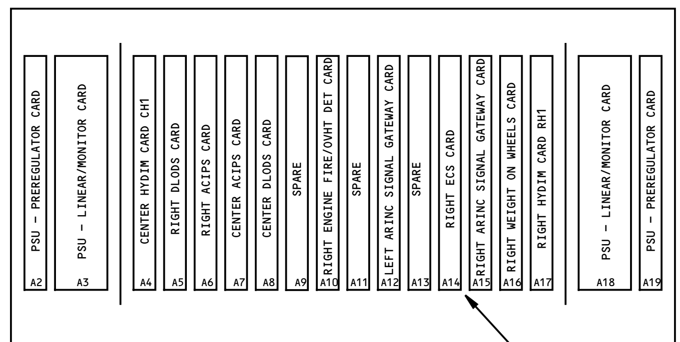
MAIN EQUIPMENT CENTER
(LEFT SIDE, LOOKING FORWARD)

SYSTEM CARD FILES
(TYPICAL)

MAIN EQUIPMENT CENTER
(RIGHT SIDE, LOOKING FORWARD)



P85 LEFT SYSTEMS CARD FILE (TYP)



P84 RIGHT SYSTEMS CARD FILE (TYP)

LEFT ECS
MISCELLANEOUS
CARD

RIGHT ECS
MISCELLANEOUS
CARD

21-00-00-004 Rev 3 02/27/1997

AIR CONDITIONING - ECS MISCELLANEOUS CARDS - INTRODUCTION

AIR CONDITIONING - ECS MISCELLANEOUS CARDS - GENERAL DESCRIPTION

Primary and Back-up Control/Indication

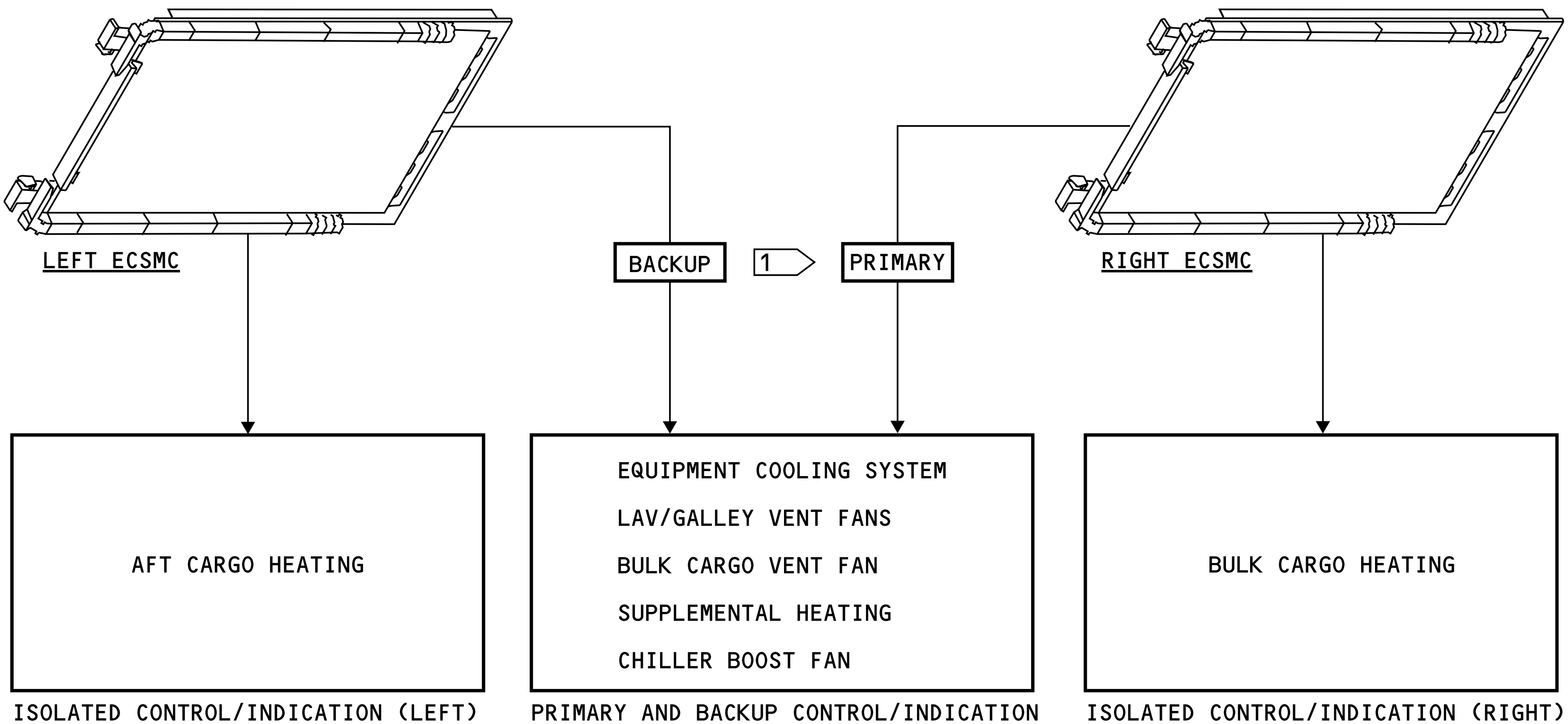
When the card files first get power, the right ECS miscellaneous card (ECSMC) is primary and the left ECSMC is backup. The primary and backup configuration changes at each air-ground transition. The primary card gives control and indication for these functions:

- Equipment cooling (includes ground crew call horn and SATCOM backup cooling)
- Lavatory/galley ventilation
- Bulk cargo ventilation
- Chiller exhaust boost ventilation
- L and R door area supplemental heating
- Forward and aft galley area supplemental heating
- Flight crew rest area heating
- Captain and first officer supplemental heating.

Isolated Control/Indication

The left ECSMC gives control and indication for the aft cargo heating system. The left card also monitors duct pressure and air flow in part of the equipment cooling system (not shown).

The right ECSMC gives control and indication for the bulk cargo heating system. The right card also monitors duct pressure and air flow in part of the equipment cooling system (not shown). See the equipment cooling system for more information about the ECSMC (AMM PART I 21-27).



1 AT CARD FILE POWER-UP, THE RIGHT CARD IS PRIMARY AND THE LEFT CARD IS BACKUP. EVERY AIR-GROUND TRANSITION CHANGES THE PRIMARY/BACKUP CONFIGURATION.

AIR CONDITIONING - ECS MISCELLANEOUS CARDS - GENERAL DESCRIPTION

AIR CONDITIONING - GENERAL DESCRIPTION - AIR FLOW

General

These are the primary parts of the air conditioning (A/C) system that have an effect on the supply of fresh air or the recirculation of conditioned air:

- Pack flow control
- Pack cooling and mix manifold temperature control
- Zone temperature control
- Recirculation
- Air distribution.

The primary parts of the A/C system have these functions:

- Control fresh air flow for airplane pressurization and ventilation
- Control the flight deck and passenger cabin temperature
- Recirculate cabin air for ventilation.

Pack Flow Control

This part of the A/C system controls the quantity of fresh air that flows into the airplane. It also controls when the ozone converter removes ozone. These are the primary components shown:

- Pack flow sensors
- Upper and lower flow control valves
- Pack inlet temperate sensor.

The quantity of fresh air necessary for ventilation is more than for pressurization. The ventilation quantity is based on a fixed value for the crew and allowable leakage, and on the number of passenger seats.

Usually the left and right flow control systems provide the same quantity of fresh air. Fresh air flow changes when airplane conditions change. For example during takeoff, the quantity decreases to make sure a sufficient quantity of engine bleed air goes to the air driven pumps (ADPs). This type of change usually does not last for very long. See the pack flow control section for more information about the control of fresh air into the airplane (AMM PART I 21-51).

When an airplane operates above 26,000 feet (7930 meters) for long periods of time, it is necessary to remove ozone from the fresh air. The upper and lower flow control valves let fresh air flow through the ozone converter or bypass it. Above 26,000 feet (7930 meters), air flows through the converter. Below 24,000 feet (7315 meters), air bypasses the converter. See the ozone control section for more information about the ozone converter (AMM PART I 21-73).

Pack Cooling and Mix Manifold Temperature Control

This part of the A/C system removes water as necessary and controls the temperature of the fresh air before it flows into the air distribution part of the air conditioning system. The primary components are the left and right packs.

The usual control for the left pack makes sure that it supplies air at a temperature that gives the necessary cooling for the flight deck. If the mix manifold needs more cooling than the flight deck, the left pack supplies air at a temperature that gives the necessary cooling for the mix manifold.

The control for the right pack makes sure that it supplies air at a temperature that gives the necessary cooling for the mix manifold. See the pack cooling and mix manifold temperature control section for more information about the control of the packs (AMM PART I 21-52).

Zone Temperature Control

This part of the A/C system increases the temperature of the conditioned air that flows into the occupied areas of the airplane. It also gives pressure regulation and on/off control for the trim air part of the system. These are the primary components:

- Trim air pressure regulating and shutoff valves
- Trim air pressure sensors
- Zone trim air modulating valves
- Temperature sensors.

The system calculates the necessary pack outlet temperatures to satisfy the cooling needs of the flight deck and the mix manifold. The system also calculates the heating necessary for each temperature control zone. These are the temperature control zones:

- Flight deck zone
- Passenger cabin zones (6).

Air from the pneumatic system adds heat to a zone that needs warmer air. The trim air pressure regulating and shutoff valve gives on/off control and keeps trim air pressure at a necessary limit. See the trim air pressure regulation and shutoff control section for more information about the trim air PRSOV (AMM PART I 21-62). The zone trim air modulating valves control the heat added to the conditioned air for each zone. See the zone temperature control and indication section for more information about the zone temperature control system (AMM PART I 21-61).

Recirculation

This part of the A/C system recycles approximately 50 percent of the cabin air for ventilation purposes. This reduces the quantity of fresh air needed from the pneumatic system for ventilation. These are the primary components:

- Upper recirculation fans and filters
- Lower recirculation fans and filters.

See the recirculation section for more information about the recycling of cabin air (AMM PART I 21-25).

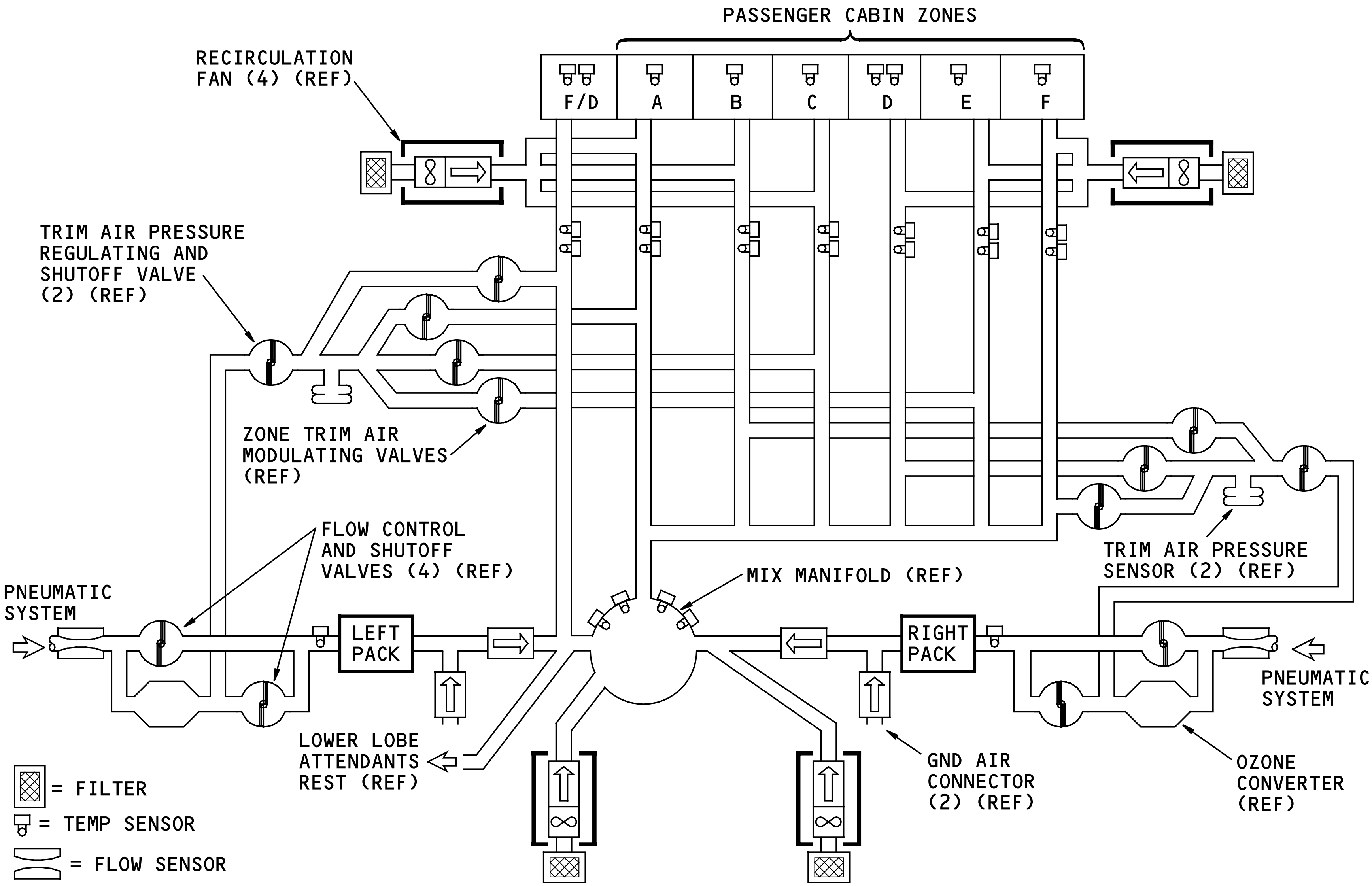
AIR CONDITIONING - GENERAL DESCRIPTION - AIR FLOW

Air Distribution

This part of the A/C system moves conditioned air from the packs or ground air sources to the temperature control zones. These are the primary components:

- Ground air connector (2)
- Mix manifold
- Distribution ducts/risers.

See the distribution section for more information about the air distribution systems (AMM PART I 21-20).



AIR CONDITIONING - GENERAL DESCRIPTION - AIR FLOW

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CTC Functions

The CTCs control air flow into the air conditioning packs and control the mix manifold temperature. Two identical control channels in each CTC give redundancy.

With the APU off and the pack switches in AUTO, the CTCs use flow schedule data from the ASCPCs to control pack air flow. If the APU supplies air to the packs, the CTCs tell the APUC the amount of air necessary. Then, the CTCs do not use the flow schedule from the ASCPCs.

For some conditions when pack air flow is too low, the CTCs send bleed bias signals to the ASCPCs.

ASCPC Functions

The ASCPCs set the flow schedule for the CTCs, give backup pack flow control, and control the engine bleed air system.

The ASCPCs get information about bleed air users and about airplane operating conditions from the left and right system ARINC 629 buses. The ASCPCs use the information to set the pack air flow schedule and send the flow schedule data to the CTCs. The left ASCPC is primary for this function and the right ASCPC is the backup.

The ASCPCs cause the pack flow control valves to close for some conditions. The ASCPC is redundant with the CTC for these conditions.

The ASCPCs are also able to keep the pack outlet temperature in limits by controlling the pack air flow. This is called backup pack flow control. Backup pack flow control is a degraded mode of operation that maintains cabin pressurization but does not give accurate temperature control. The packs operate in this mode if the CTCs do not have electrical power.

If an ASCPC gets a bleed bias signal from the CTC, the ASCPC adjusts the engine bleed air system. This decreases the engine bleed air temperature or increases the HPSOV regulation set point.

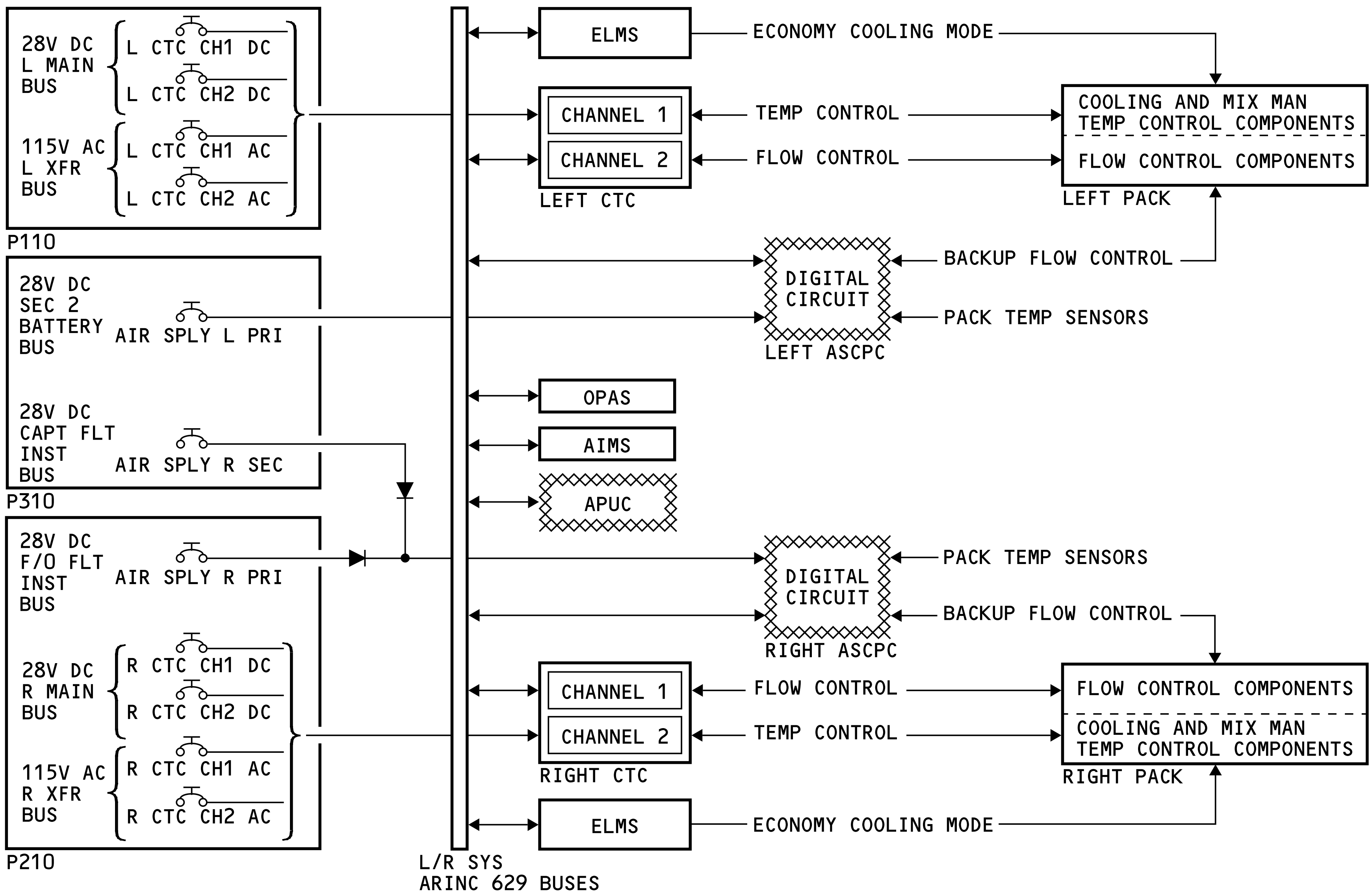
See the pack flow control section for more information about the ASCPC functions that have a relation to the air conditioning pack flow control (AMM PART I 21-51).

Electrical Power

The CTCs get electrical power from the 28v dc main buses and the 115v ac transfer buses. The ASCPC digital circuits get 28v dc power from the section 2 battery bus, the captain's flight instrument bus and the first officer's flight instrument bus. The left ASCPC can operate on battery power. The right ASCPC can operate on standby power from the captain's and first officer's flight instrument buses. The CTCs can not operate with only battery or standby power.

Economy Cooling Mode

For some conditions when pack air flow is too low, the CTC adjusts the pack temperature control components to help increase flow. An ARINC 629 signal from the CTC to ELMS puts the pack into the economy cooling mode.



AIR CONDITIONING - COOLING - GENERAL DESCRIPTION - CONTROL

21-50-00-003 Rev 4 03/21/96

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AIR CONDITIONING - PACK FLOW CONTROL - INTRODUCTION

Purpose

The flow control system controls the quantity of air that goes from the pneumatic system into the air conditioning packs. These are the functions of the pack flow control system:

- Pack air on/off control
- Pack air flow regulation
- Ozone converter bypass
- Backup pack flow control
- Engine air supply system bias.

The CTCs and the ASCPCs have logic that control the pack air flow. The ASCPCs have the backup pack flow control.

Components

The pack flow control system has these components:

- Pack flow sensor
- Upper flow control and shutoff valve
- Lower flow control and shutoff valve
- Primary heat exchanger inlet temp sensor.

The systems for the left and right packs are the same.

Pack Air On/Off Control

With the air conditioning pack switch off, the two flow control and shutoff valves close. With the pack switch in AUTO, the flow control valves control pack air flow. The valves close if the pack fails, has an overheat condition, or if a higher priority bleed user is on.

Pack Air Flow Regulation

The flow control system makes decisions about the amount of air the packs can have. These decisions take into account the needs of other bleed air users and airplane operating conditions.

Ozone Converter Bypass

The ozone converter decreases the amount of atmospheric ozone that goes into the cabin. Ozone is in the atmosphere at high altitudes. The ozone converter is serviceable for a longer time if it operates only at high altitudes. At low altitudes the lower flow control valve closes and the upper valve controls flow. At high altitude the upper valve closes and the lower valve controls flow.

Backup Pack Flow Control

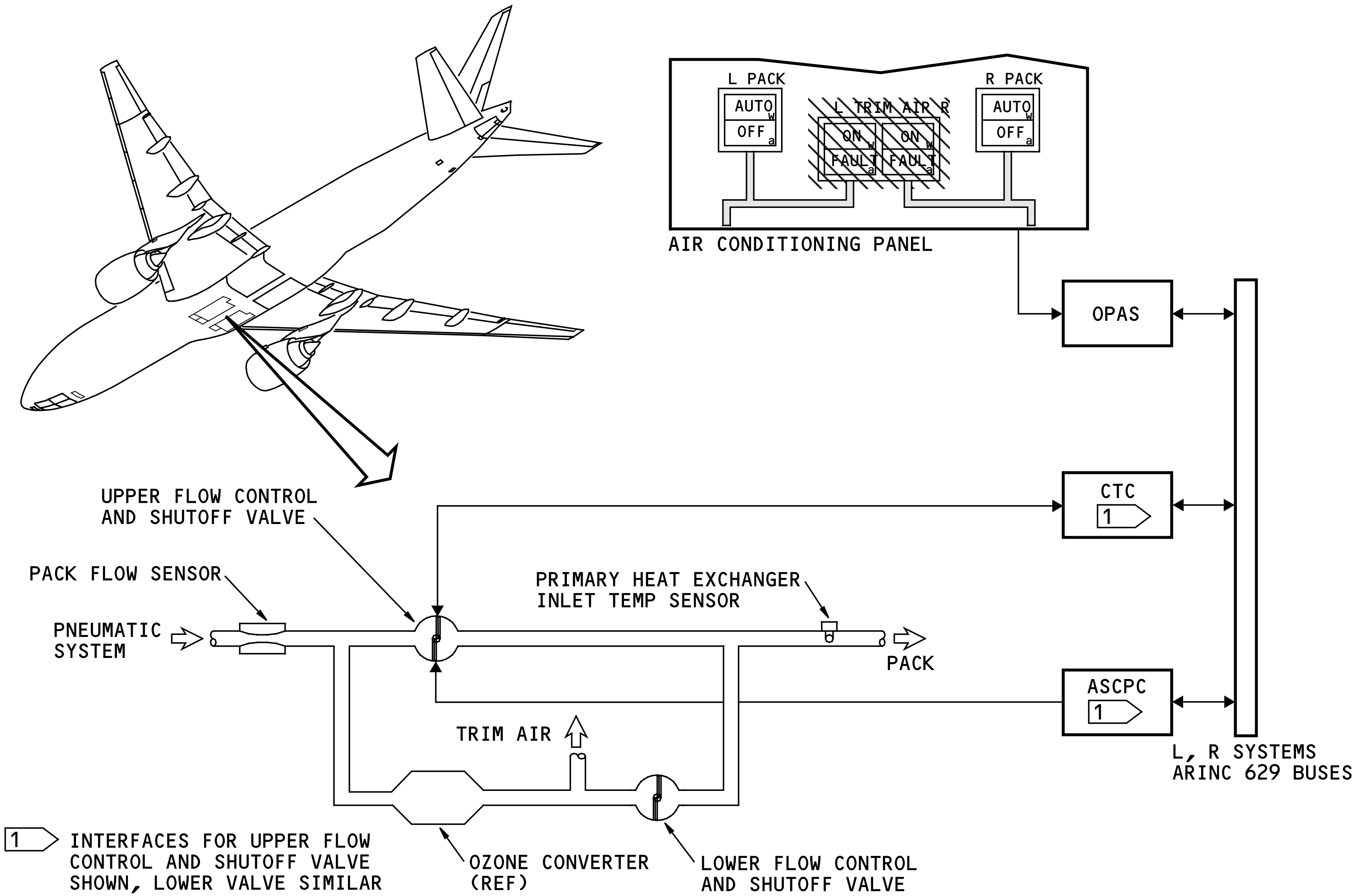
If only battery or standby power are available, the packs operate in a backup mode. The flow control system adjusts the pack air flow to keep the pack outlet temperature in limits.

Engine Bleed System Bias

For some low flow conditions, the flow control system sends signals to the pneumatic system. These signals adjust the engine bleed air temperature or HPSOV set-

AIR CONDITIONING - PACK FLOW CONTROL - INTRODUCTION

point. Lower bleed air temperature lets the pack operate with less restriction to air flow. A higher HPSOV set point lets the pneumatic system supply more air at low engine power settings.



AIR CONDITIONING - PACK FLOW CONTROL - INTRODUCTION

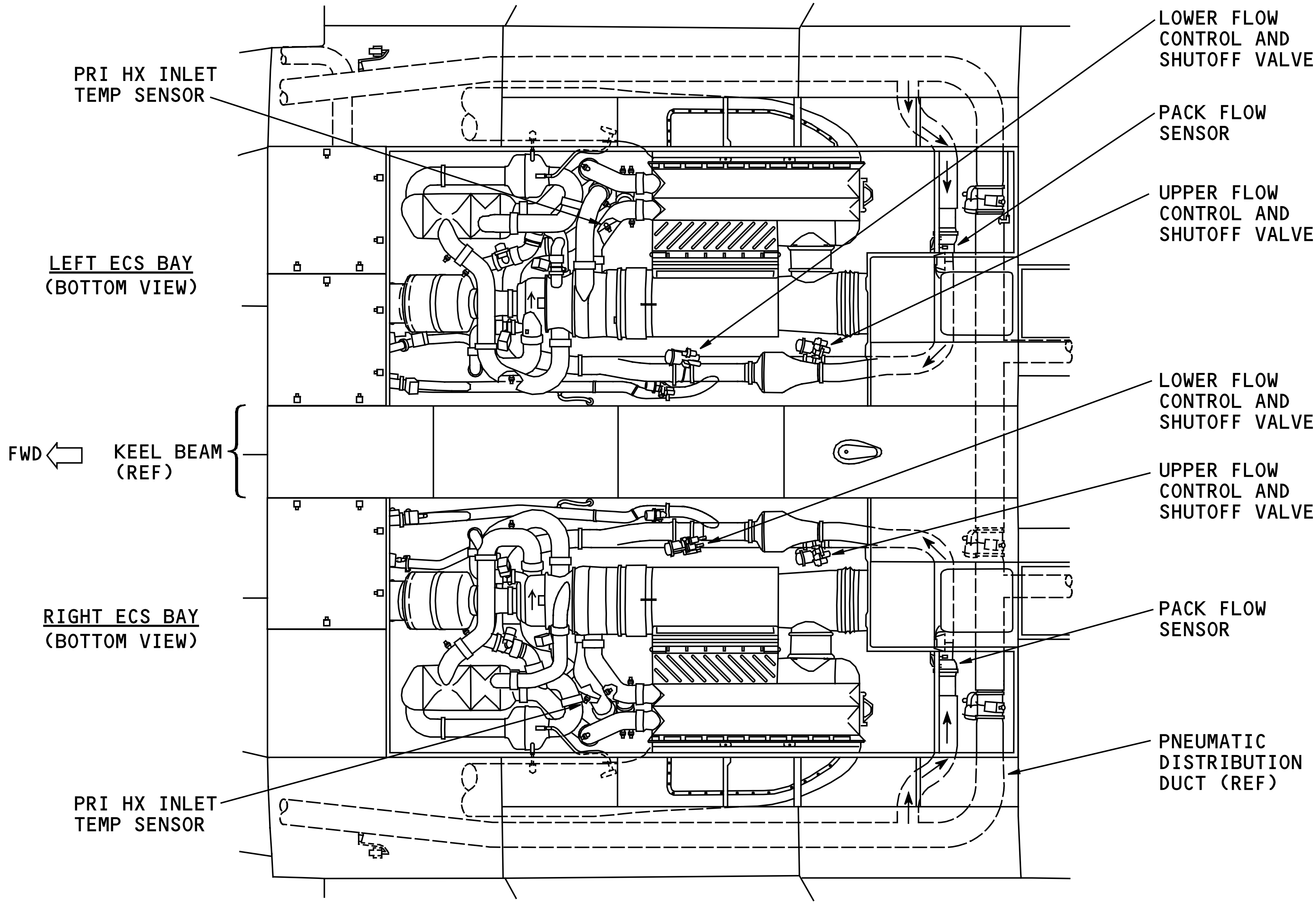
AIR CONDITIONING - PACK FLOW CONTROL - COMPONENT LOCATIONS

Component Locations

Each pack has these flow control components in the ECS bay:

- Primary heat exchanger inlet temperature sensor
- Lower flow control and shutoff valve
- Pack flow sensor
- Upper flow control and shutoff valve.

The components are interchangeable between packs.



21-51-00-002 Rev 3 07/15/1997

AIR CONDITIONING - PACK FLOW CONTROL - COMPONENT LOCATIONS

AIR CONDITIONING - PACK FLOW CONTROL - FLOW CONTROL AND SHUTOFF VALVES

Purpose

The flow control and shutoff valves control the air flow to the packs.

Physical Description

The upper and lower flow control and shutoff valves are interchangeable. These are the parts of the valve:

- A proximity switch
- A locking plug
- A locking crank/position indicator
- A pneumatic actuator
- A disc
- Two torque motors.

Functional Description

The flow control and shutoff valves operate by a pneumatic actuator which moves the disc in the valve. If there is no air pressure from the pneumatic system, a spring in the actuator closes the valve.

With no power to the torque motors, the connections to ambient air pressure close. Supply pressure pushes the valve open against the force of the spring in the actuator.

With power applied, the torque motors bleed air from one side of the pneumatic actuator. This permits the spring to move the valve disc to decrease the flow rate.

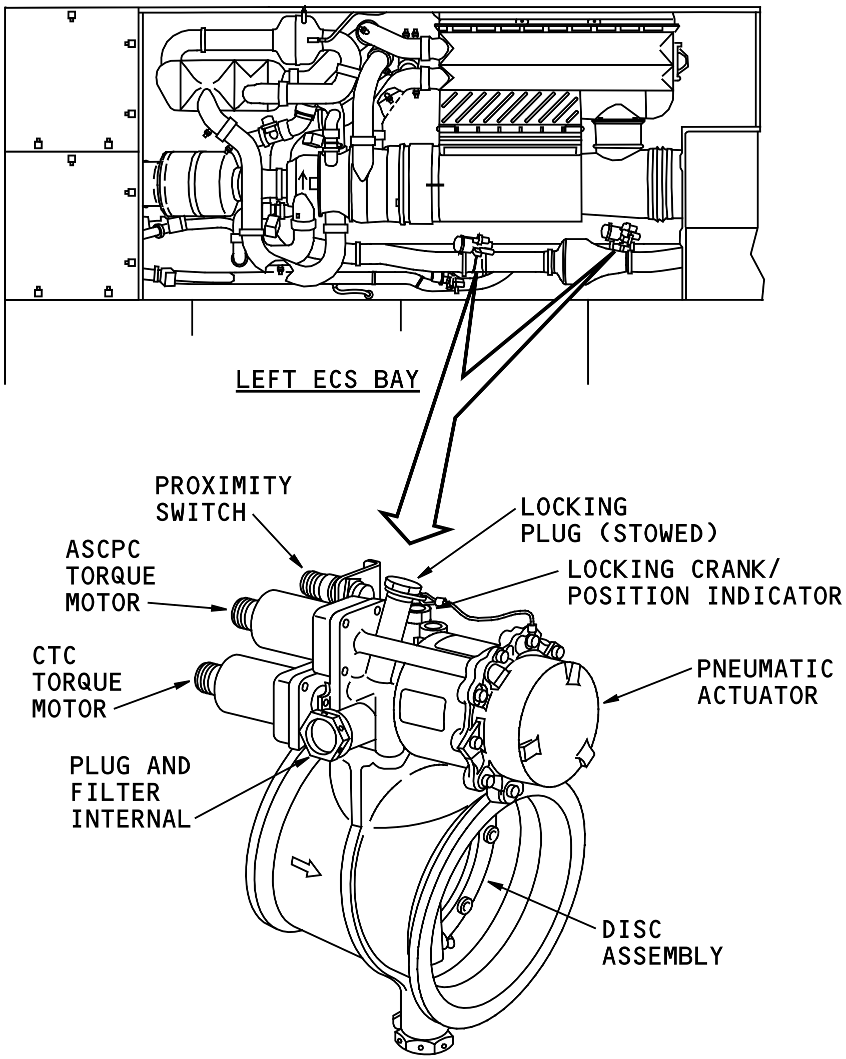
One torque motor connects to the CTC. The other torque motor connects to the ASCPC. Each torque motor can independently control the actuator. The CTC gives normal control of the valve. The ASCPC gives backup pack flow control if the CTC can not operate.

A proximity switch sends a signal to the CTC when the valve is closed.

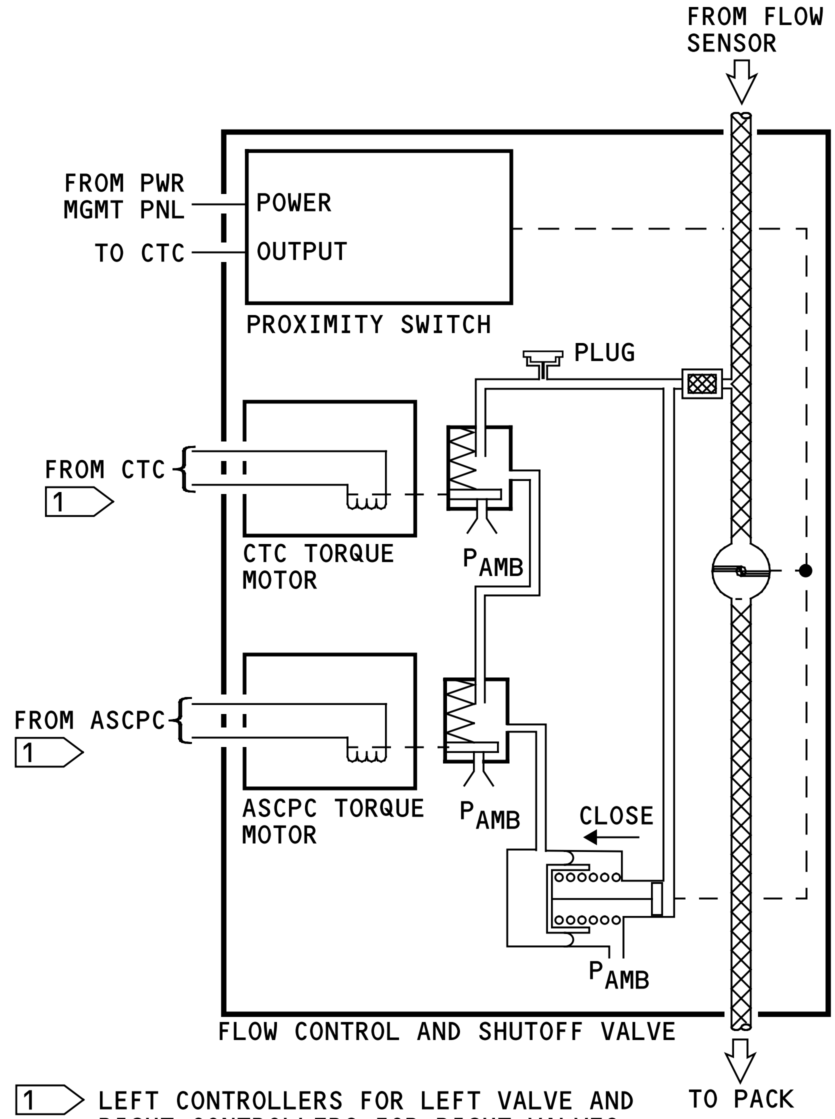
Training Information Point

You use the locking plug and locking crank to lock the valve closed.

The filter is an LRU.



FLOW CONTROL AND SHUTOFF VALVE
(TYPICAL)



1 LEFT CONTROLLERS FOR LEFT VALVE AND RIGHT CONTROLLERS FOR RIGHT VALVES.

AIR CONDITIONING - PACK FLOW CONTROL - FLOW CONTROL AND SHUTOFF VALVES

21-51-00-003 Rev 4 10/23/96

AIR CONDITIONING - PACK FLOW CONTROL - FLOW SENSOR

Purpose

The pack flow sensor supplies two types of air pressure information, pack inlet and pack inlet differential to the related CTC and ASCPC. The controllers use the pressure information to help calculate the rate of air flow from the pneumatic system into the airplane.

Physical Description

There are two pack flow sensors, one for each air conditioning pack/trim air system. Each sensor has these parts:

- High pressure (inlet) line (2)
- Inlet pressure sensor
- Differential pressure sensor (2)
- Electrical connector (3)
- Bracket (pressure sensor attachment)
- Titanium body
- Low pressure (venturi) line (2).

The titanium body is in the shape of a venturi. The pressure sensors attach to a bracket that attaches to the body. The pressure sensors use lines to connect to the body.

Location

The pack flow sensors are in the aft part of the left and right ECS bays. You get access through these blowout doors:

- 195QL left pack flow sensor
- 196QR right pack flow sensor.

Functional Description

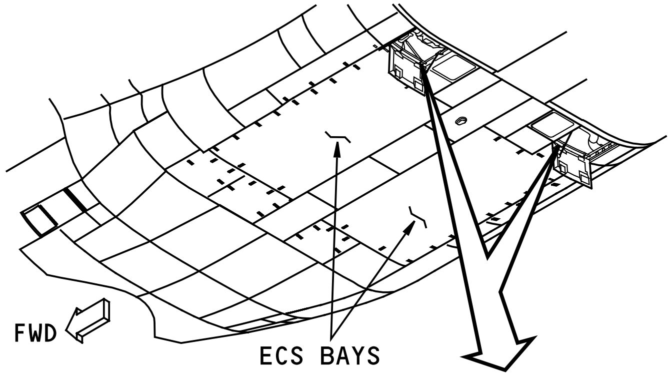
The CTC differential pressure sensor gives an output in proportion to the pressure difference across the venturi part of the pack flow sensors body. The inlet pressure sensor gives an output in proportion to the pack inlet air pressure. These outputs go to the CTC.

Power for the CTC differential pressure sensor and inlet pressure sensor comes from the power management panel that supplies the pack.

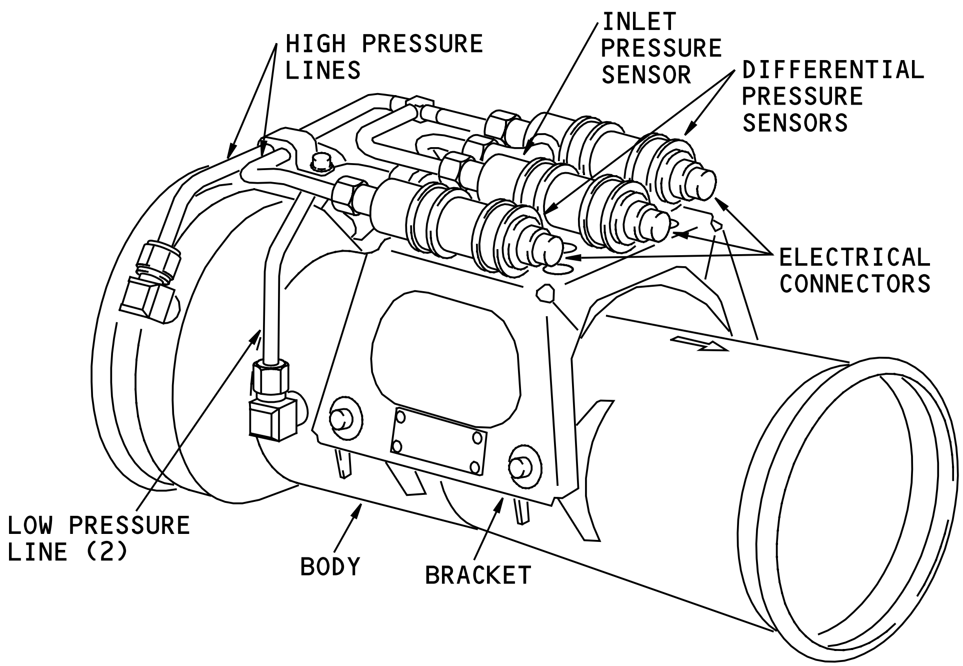
The ASCPC differential pressure sensor is the same as the CTC differential pressure sensor. The ASCPC gets differential pressure information and gives power to its differential pressure sensor.

Training Information Point

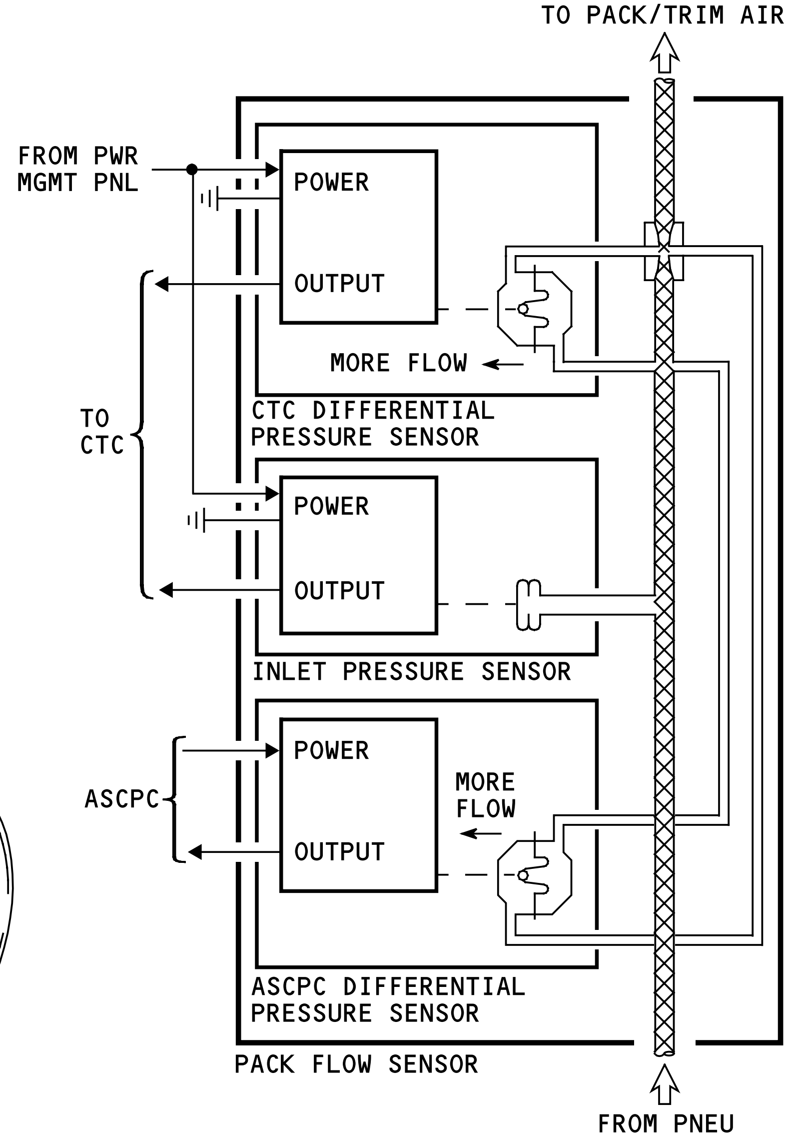
The pack flow sensor is an LRU. The individual inlet and differential pressure sensors are not LRUs.



UNDERWING FUSELAGE AREA



PACK FLOW SENSOR



AIR CONDITIONING - PACK FLOW CONTROL - FLOW SENSOR

AIR CONDITIONING - PACK FLOW CONTROL - PRIMARY HEAT EXCHANGER INLET TEMPERATURE SENSOR

General

The primary heat exchanger (PRI HX) inlet temperature sensor monitors the PRI HX inlet temperature.

Temperature data goes to the cabin temperature controller (CTC). It uses the data with data from the flow sensor to calculate pack mass air flow.

See the zone temperature control and indication section for more information about the CTC (AMM PART I 21-61).

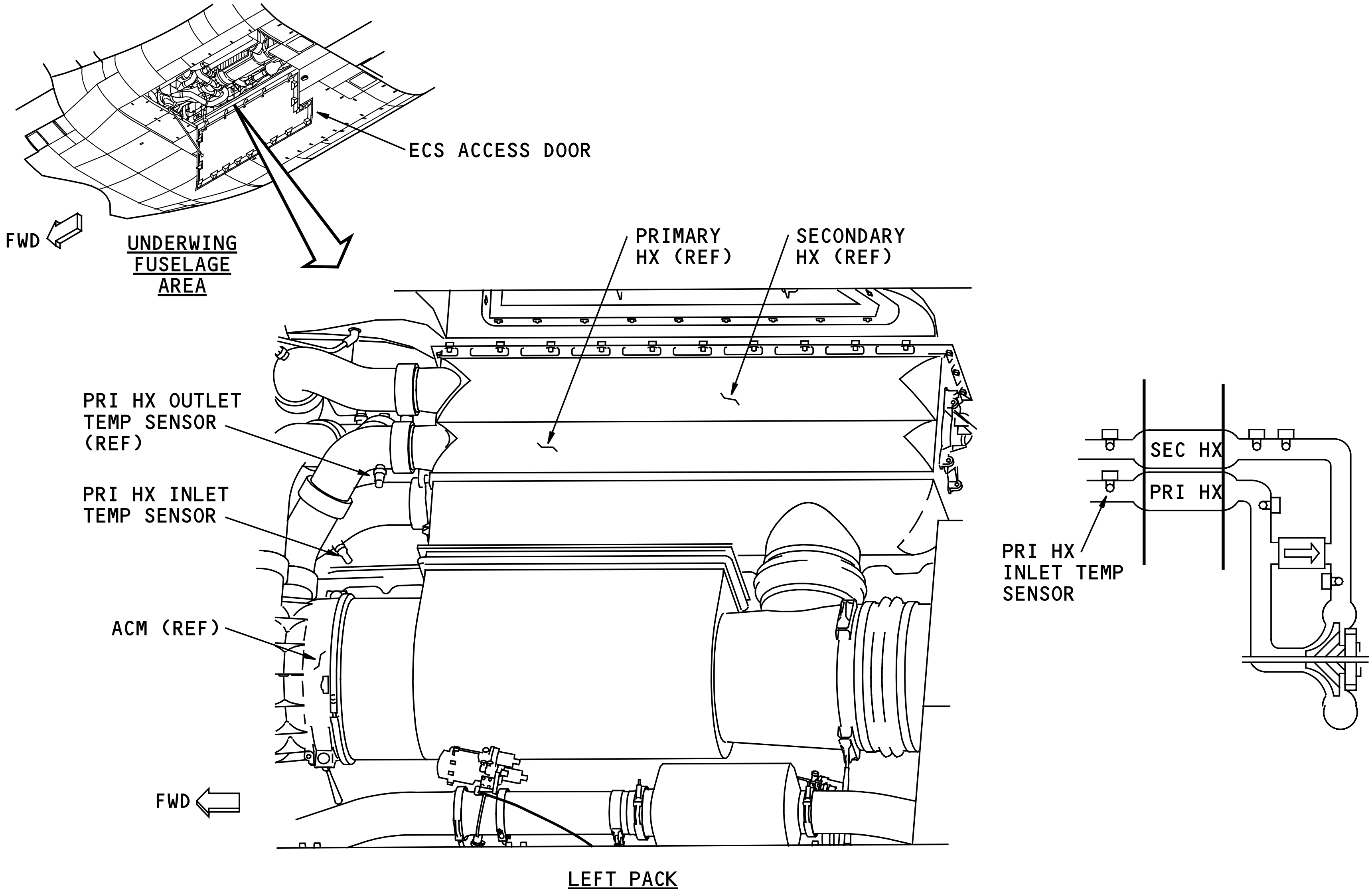
Physical Description

The sensor is a single element resistance temperature device (RTD). Threads on the sensor connect it to the boss in the duct. The sensor electrical connector is also threaded.

Training Information Point

This sensor is interchangeable with the other high temperature sensors in the pack.

See the pack cooling and mix manifold temperature control section for more information about sensors on the pack (AMM PART I 21-52).



AIR CONDITIONING - PACK FLOW CONTROL - PRIMARY HEAT EXCHANGER INLET TEMPERATURE SENSOR

General

The air supply cabin pressure controller (ASCPC) sets the flow schedule that the cabin temperature controllers (CTC) use to control air flow into the packs. Flow schedule 1 gives the largest air flow to the air conditioning packs and is the usual flow schedule.

Schedules 2, 3, and 4 give less and less air to the packs. Schedule 0 stops the air flow into the packs. The ASCPC sets these schedules when necessary to reduce the engine bleed air load or to make more air available to other systems.

These flow schedules operate only when the engines supply air to the packs. APU flow gets control a different way.

Schedules 1, 2, and 3 give a constant volumetric air flow to the packs. The related mass air flow decreases as cabin altitude increases. The chart shows the total air flow for two packs. For most conditions, the two packs operate at the same schedule.

Flow Schedule 1

The amount of air that flow schedule 1 supplies is related to the number of passenger seats in the airplane. The schedule 1 maximum is calculated for 440 seats. The schedule 1 minimum is calculated for 348 seats. Airplanes with less than 348 seats use the schedule 1 minimum.

Total flow from the two packs in flow schedule 1 increases approximately 67 lb/min for each inoperative recirculation fan.

Flow Schedule 2

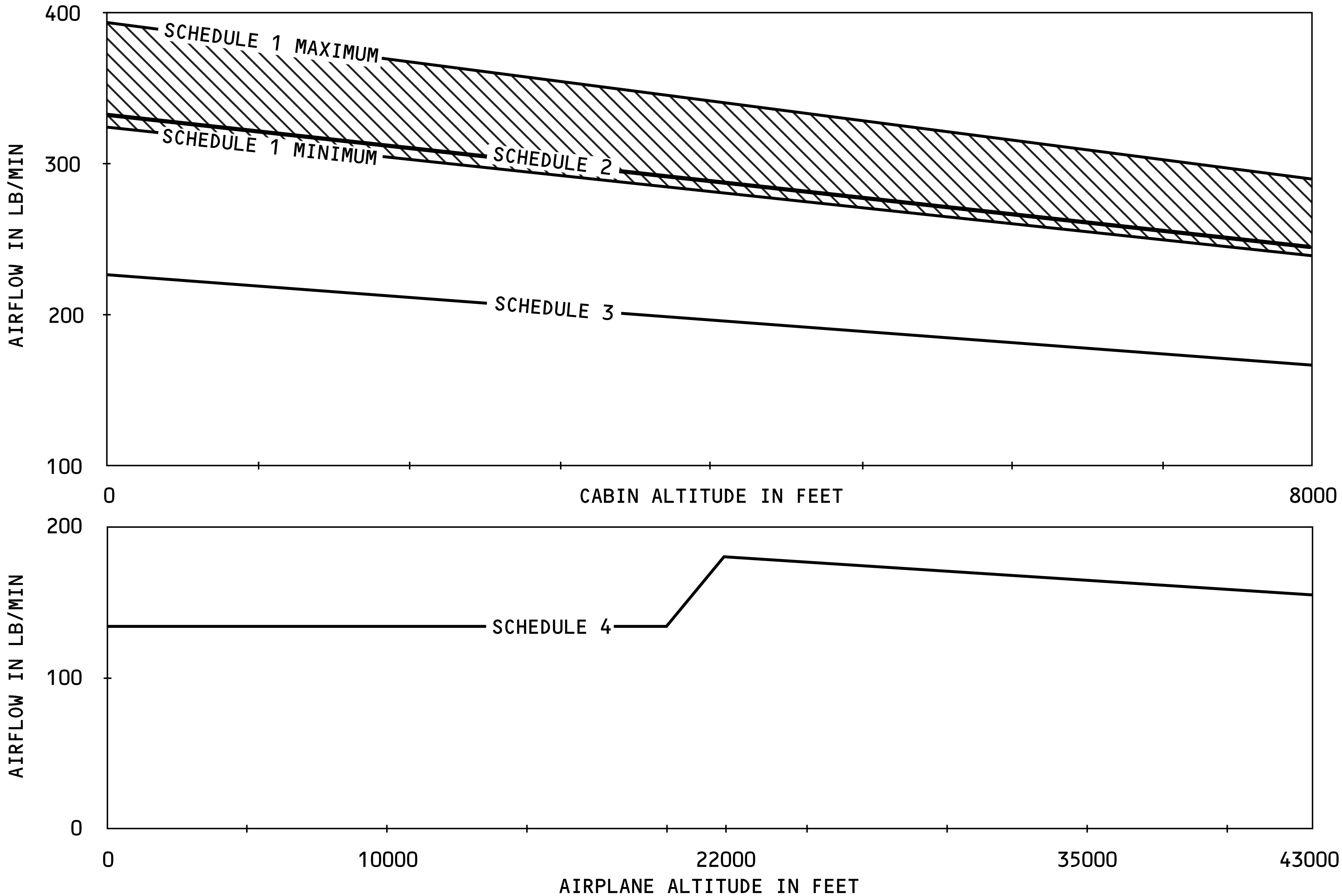
Flow schedule 2 is the same for all airplanes. However, when the ASCPC sets schedule 2, the actual flow rate is the schedule 2 or the schedule 1 rate, whichever is less.

Flow Schedule 3

Flow schedule 3 is the same for all airplanes. The flow rate is not related to the number of seats in the airplane.

Flow Schedule 4

Flow schedule 4 gives the minimum flow to pressurize the airplane and to operate the air cycle machine. The flow rate has a relation to the airplane altitude.



AIR CONDITIONING - PACK FLOW CONTROL - FUNCTIONAL DESCRIPTION - PACK FLOW SCHEDULES

AIR CONDITIONING - PACK FLOW CONTROL - FUNCTIONAL DESCRIPTION - ASCPC FLOW SCHEDULES

General

The ASCPC sets the flow schedules for the left and right CTCs. The left ASCPC is primary for this function, and the right ASCPC is the backup. The CTCs use the flow schedule data to calculate the amount of air to send to the packs.

The ASCPC has an ARINC 629 interface with other systems and LRUs. These interfaces give the ASCPC data about airplane operating conditions and about other bleed air users. The ASCPC uses these inputs to set the pack air flow schedules.

The ASCPC sends the selected flow schedules to the CTCs through the left and right ARINC 629 systems buses (not shown).

Flow Schedules

Flow schedule 1 gives the greatest airflow to the air conditioning packs and is the usual flow schedule.

Schedules 2, 3, and 4 give less and less air to the packs. In general, these schedules are in effect for one or more of these conditions:

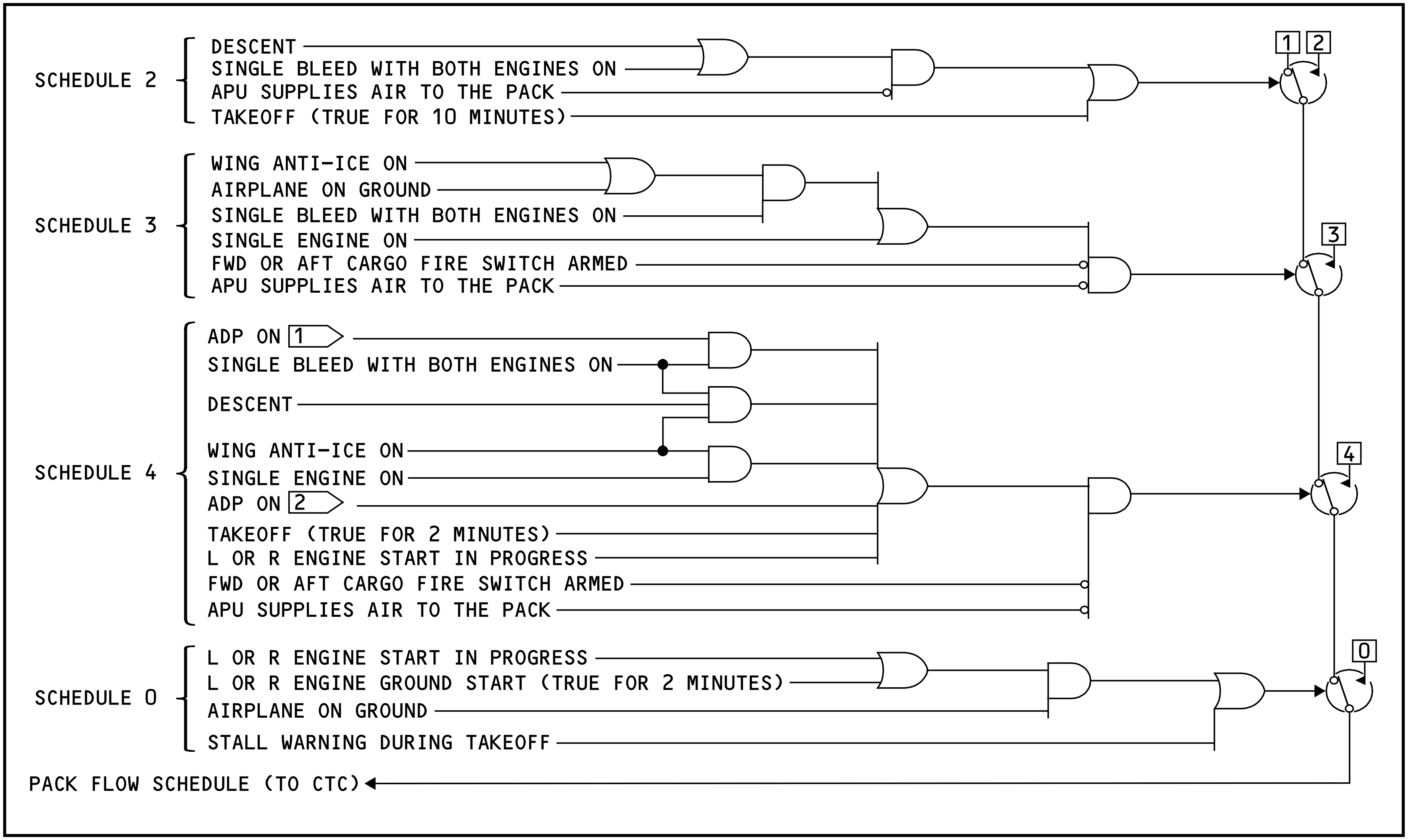
- The amount of bleed air available is less than usual
- More than the usual number of bleed air user systems are on
- Takeoff or single engine operation.

When the APU supplies air to the pack, schedules 3 and 4 are not used. Also, if the forward or aft cargo fire switches are armed, schedules 3 and 4 are not used.

Schedule 0 stops the air flow into the packs. During an engine start on the ground, the packs shut off to make air available to the starter. The packs stay off for 2 minutes to allow time to start the two engines. For a stall warning during takeoff, schedule 0 makes sure the air driven hydraulic pumps get enough air for auto-slat deployment.

Training Information Point

If you start just one engine, the pack does not operate until two minutes after the start. The pack OFF light stays on during the two minutes.



ASCPC

1 C2 ADP FOR LEFT PACK FLOW SCHEDULE
C1 ADP FOR RIGHT PACK FLOW SCHEDULE

2 C1 ADP FOR LEFT PACK FLOW SCHEDULE
C2 ADP FOR RIGHT PACK FLOW SCHEDULE

AIR CONDITIONING - PACK FLOW CONTROL - FUNCTIONAL DESCRIPTION - ASCPC FLOW SCHEDULES

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Upper/Lower Valve Selection

If the airplane altitude is low, the cabin temperature controllers (CTCs) use the upper flow control and shutoff valves to control air flow into the packs. These are the altitudes:

- Below 26,000 feet (7930 meters) on climb
- Below 24,000 feet (7315 meters) on descent.

If the airplane altitude is high, the CTC use the lower flow control and shutoff valves to control air flow into the packs. These are the altitudes:

- 26,000 feet (7930 meters) or above on climb
- 24,000 feet (7315 meters) or above on descent.

If one of the valves fails, the CTC controls the other valve at all altitudes.

Flow Regulation

The CTC calculates four flow rates. The flow schedule from the ASCPC tells the CTC which flow rate to use. The usual air flow rate for the left and right packs is the same. The flow rate of one pack can be 10 percent more or 10 percent less than the other pack.

If the right CTC decreases its pack flow rate to keep pack operation in limits, the right CTC sends a signal to the left CTC. The left CTC adds this R CTC flow bias signal to the flow rate for the left pack. The total is the flow command. A single pack has a flow command limit of 81% of the total flow into the airplane. See the pack cooling and mix manifold temperature control section for more information about the functional description of the packs (AMM PART I 21-52).

The CTC compares the flow command with the measured pack flow. The difference makes a drive signal for the flow control and shutoff valve. The valve moves until the measured pack flow equals the flow command.

Flow Rate Adjustments

If any recirculation fans are inoperative when the CTC uses schedule 1, the CTC increases the flow rate. The total flow into the airplane increases 67 lbs/min for each fan that is off, 33.5 lbs/min per pack. This keeps the total airplane ventilation rate constant.

If the forward or aft cargo fire switch is armed, the CTC sets the schedule 2 flow rate (except when schedule 0 is active). The ASCPC does not send schedules 3 or 4 if a cargo fire switch is armed. Schedule 2 supplies sufficient fresh air for the airplane occupants and keeps smoke out of the passenger compartment and flight deck.

The CTC closes the flow control and shutoff valve for these conditions:

- Flow schedule 0 from the ASCPC
- Pack outlet overheat
- Compressor discharge overheat
- Pack failure.

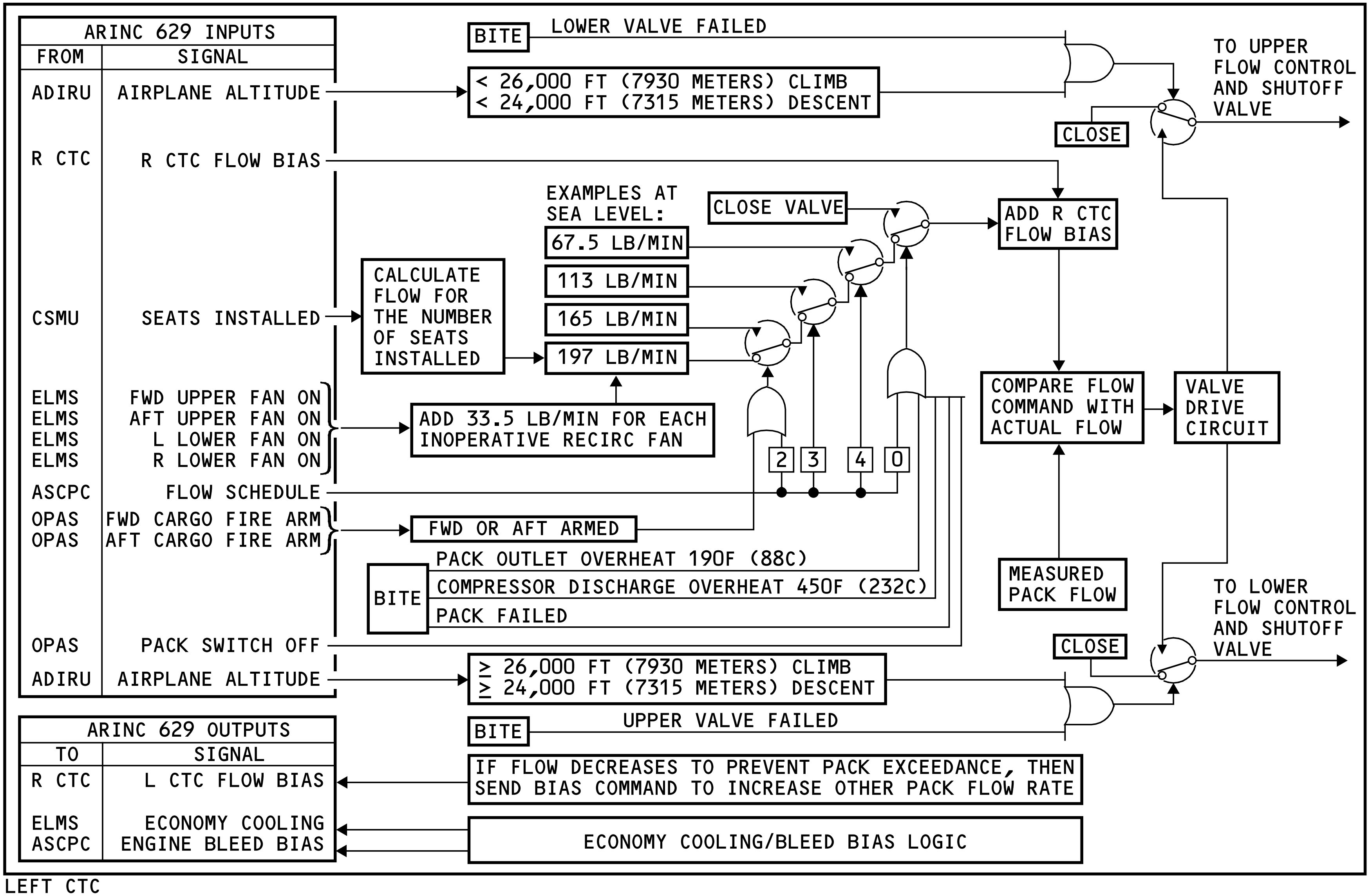
Other Flow Control Functions

At times, the air flow into the pack is not enough even with a flow control and shutoff valve full open. For some low flow conditions, the pack operates in economy cooling mode to help increase the air flow. An ARINC 629 input signal to the ELMS puts the pack into the economy cooling mode. See the pack cooling and mix manifold temperature control section for more information about the economy cooling mode (AMM PART I 21-52).

The CTC can also tell the ASCPC to adjust the engine bleed air supply system to help increase pack air flow. ARINC 629 signals tell the ASCPC to reduce the engine bleed air temperature or increase the HPSOV set point. See the engine air supply section for more information about the engine bleed bias (AMM PART I 21-52).

APU Demand

When the APU supplies the air for pack operation, the CTCs do not use the flow schedules from the ASCPCs. The CTCs set the flow control valve to fully open. The CTCs send an APU DEMAND signal to the APU controller (APUC) to tell it the amount of air necessary for the ventilation and the heating or the cooling of the airplane. See the zone temperature control and indication section for more information on APU DEMAND (AMM PART I 21-61).



21-51-00-010 Rev 4 03/07/1997

AIR CONDITIONING - PACK FLOW CONTROL - FUNCTIONAL DESCRIPTION - CTC FLOW CONTROL

AIR CONDITIONING - PACK FLOW CONTROL - FUNCTIONAL DESCRIPTION - START-UP AND SHUTDOWN

General

The flow control and shutoff valves open and close at specified rates. The rates are different for different conditions. When one valve starts to open, the OFF light in the pack switch goes out. When the two valves close, the OFF light comes on.

Pack Start-up

When you put the pack switch to AUTO, the flow control and shutoff valve opens. The valve opens at a rate that gives efficient air cycle machine acceleration. The air flow increases to 60 lb/min in 5 seconds, then increases to the schedule rate in 15 more seconds.

Normal Pack Shutdown On The Ground

When you put the pack switch to OFF, the flow control and shutoff valve closes. The valve closes at a rate that permits condensed water to evaporate from the pack.

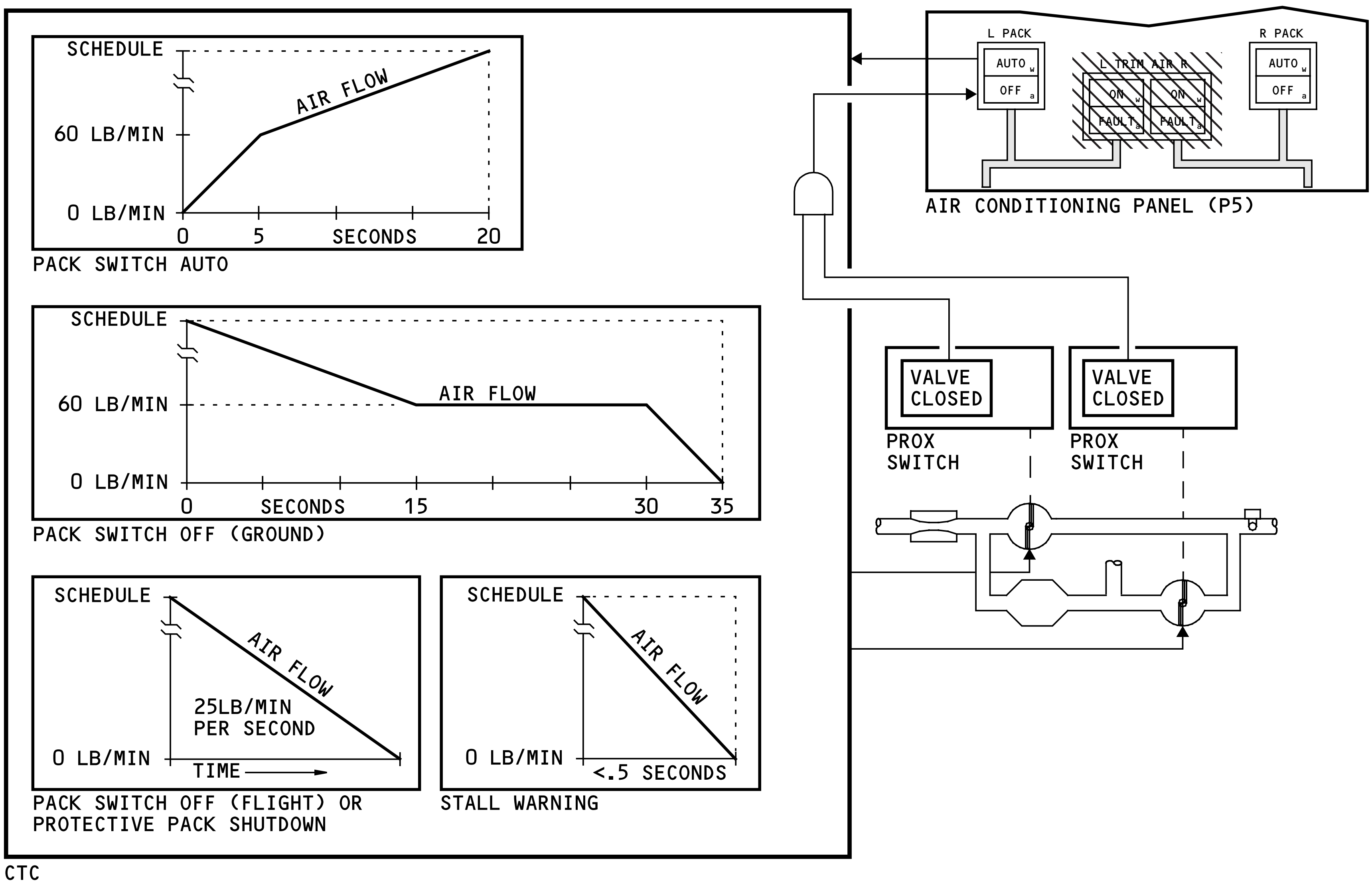
The air flow decreases to 60 lb/min in 15 seconds, stays at 60 lb/min for 15 seconds, then goes to 0 in 5 seconds. This sequence lets the pack temperature increase. Water condensation stops, and any water left in the pack evaporates.

Pack Shutdown In Flight Or Protective Pack Shutdown

If you put the pack switch OFF in flight, the flow control and shutoff valve closes slowly. The pack air flow decreases by 25 lb/min per second as the valve closes. The valve closes at this same rate for a protective pack shutdown from an overheat condition or a pack failure.

Stall Warning

The valve closes quickly for a stall warning condition. Air flow goes to 0 in less than 1/2 second



21-51-00-012 Rev 1 07/18/1997

AIR CONDITIONING - PACK FLOW CONTROL - FUNCTIONAL DESCRIPTION - START-UP AND SHUTDOWN

AIR CONDITIONING - PACK FLOW CONTROL - FUNCTIONAL DESCRIPTION - ASCPC FLOW CONTROL

General

The ASCPC is a backup to the CTC for these functions:

- Backup pack flow control
- Pack shutdown.

Backup Pack Flow Control

The CTC gives a CTC status signal to the ASCPC. If the status signal is not valid or if the CTC fails, the ASCPC gives backup flow control. The upper flow control valve closes and the lower valve controls air flow into the pack.

The ASCPC keeps the flow rate at 150 pounds per minute as long as the pack outlet temperature is more than 40F (4C). If the pack outlet temperature is low, the ASCPC increases the flow to 200 pounds per minute. After 30 seconds, if the temperature is still low, the ASCPC increases the flow to 250 pounds per minute.

If the pack outlet temperature becomes more than 110F (43C), the ASCPC decreases the flow rate in a similar way.

Pack Shutdown

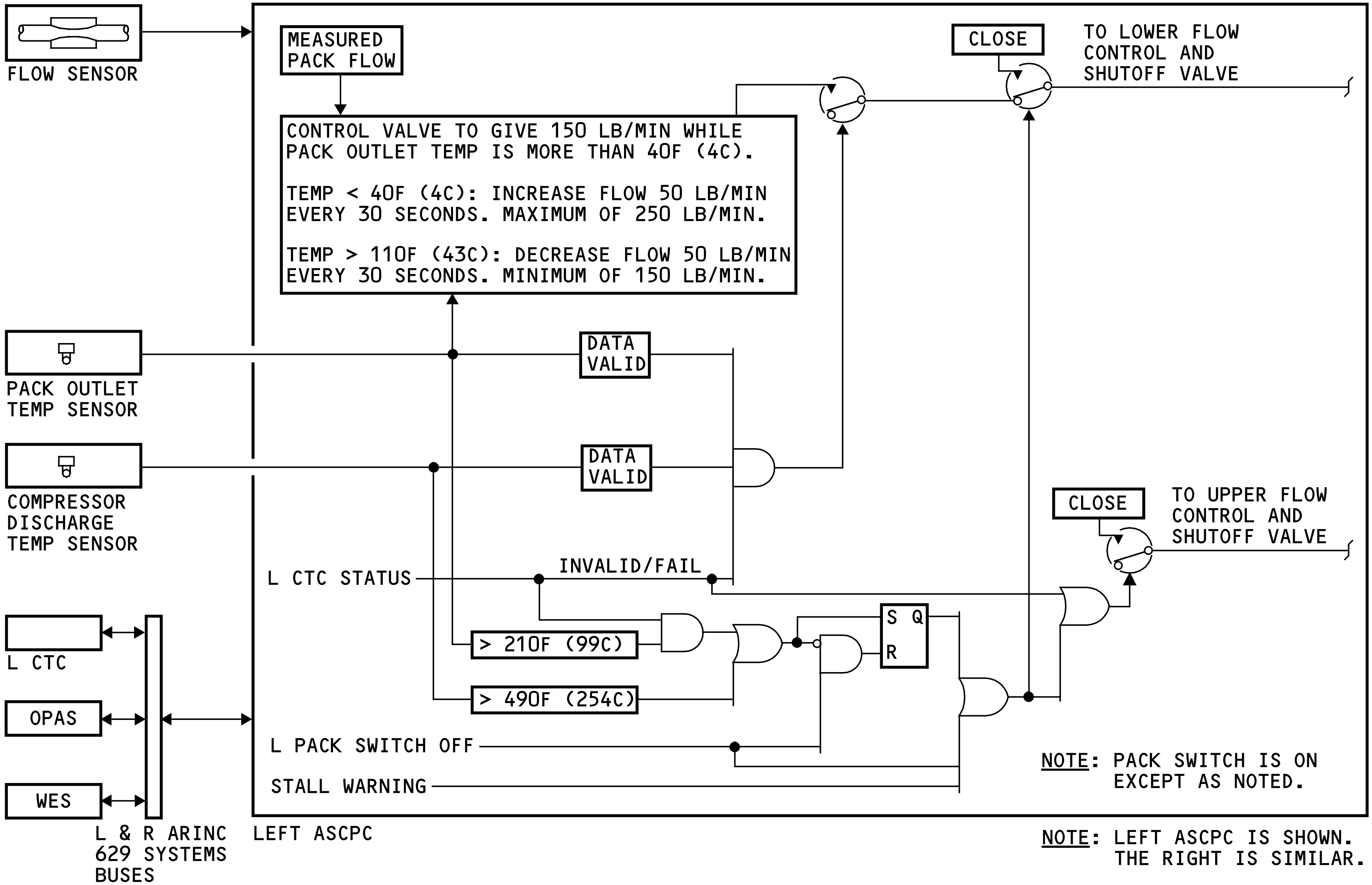
The backup flow control mode must have valid data from the pack outlet temperature sensor and the compressor discharge temperature sensor. If the temperature data is not valid, the ASCPC closes the flow control and shutoff valves.

The ASCPC also closes the flow control and shutoff valves for these conditions:

- Pack outlet overheat with CTC status invalid or failed
- Compressor discharge overheat
- Pack switch OFF
- Stall warning.

For all conditions except the first, the ASCPC pack shutdown function is redundant with the CTC shutdown function.

The overheat shutdown function resets when you put the pack switch OFF then ON, if the overheat condition no longer exists.



21-51-00-011 Rev 1 04/27/95

AIR CONDITIONING - PACK FLOW CONTROL - FUNCTIONAL DESCRIPTION - ASCPC FLOW CONTROL

AIR CONDITIONING - OZONE CONTROL

Purpose

Ozone control keeps ozone concentrations in the air flow to a satisfactory limit when the airplane is at higher altitudes.

Physical Description

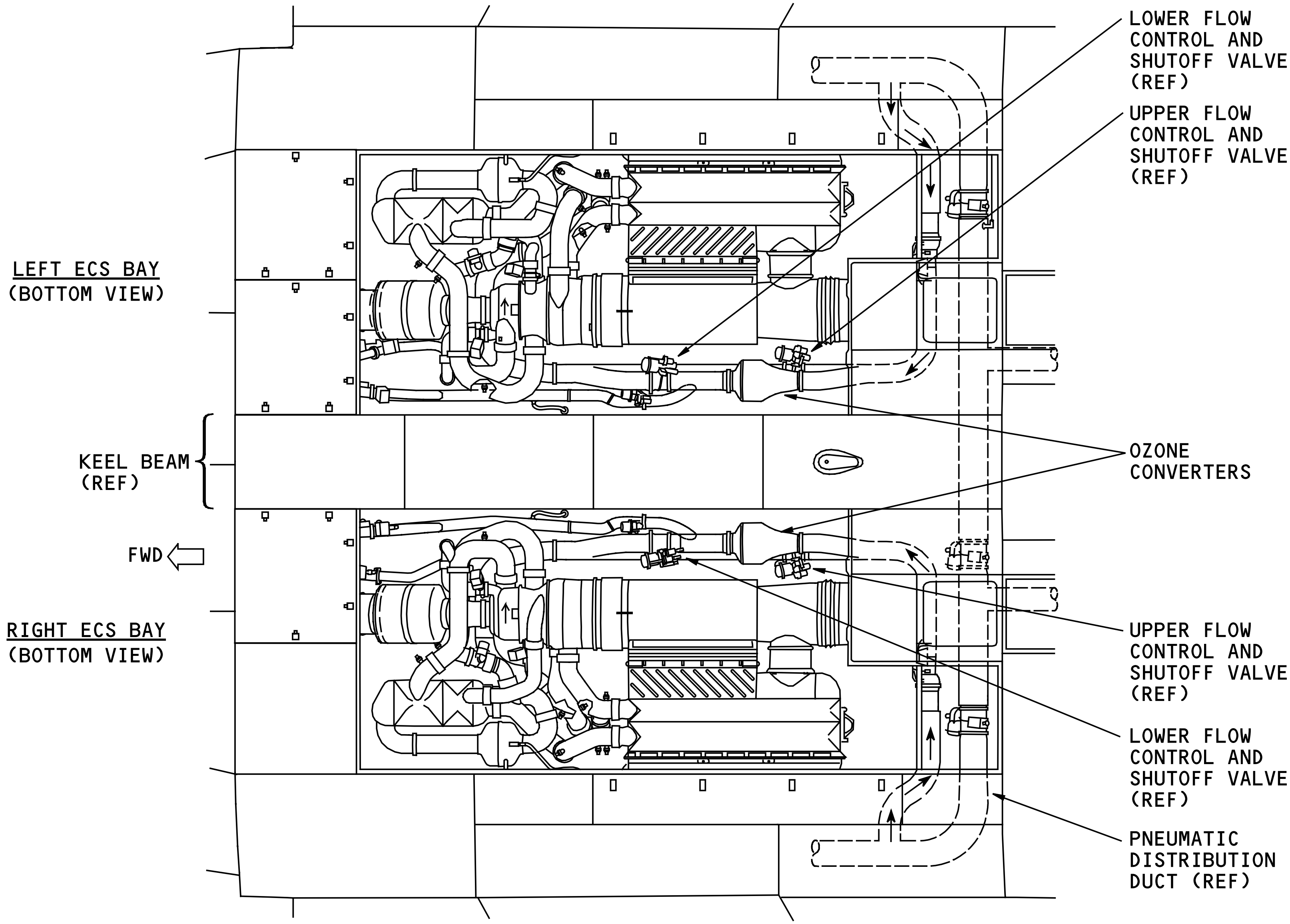
The ozone converter has no moving parts. It contains a catalytic material through which the air flows.

Location

An ozone converter is part of each pack in the ECS bay. It attaches to the lower air ducts that supply each pack. The converter is aft of the lower flow control valve and below the upper flow control valve.

Functional Description

The ozone converter is a catalytic device that removes ozone concentrations. Air goes through the converter before it flows into the pack. A chemical reaction in the converter changes ozone molecules to oxygen molecules.



AIR CONDITIONING - OZONE CONTROL

AIR CONDITIONING - PACK CLG AND MIX MANIFOLD TEMP CTRL - INTRODUCTION

Purpose

Pack cooling and mix manifold temperature control operates the pack to control pack discharge air temperature to a value that supplies sufficient cooling air to the flight deck and the mix manifold.

General Description

The air conditioning (A/C) pack has components that give these functions:

- Ram air and heat exchanger cooling
- Air cycle machine cooling
- Water removal.

Air from the flow control system usually flows through the pack in this sequence:

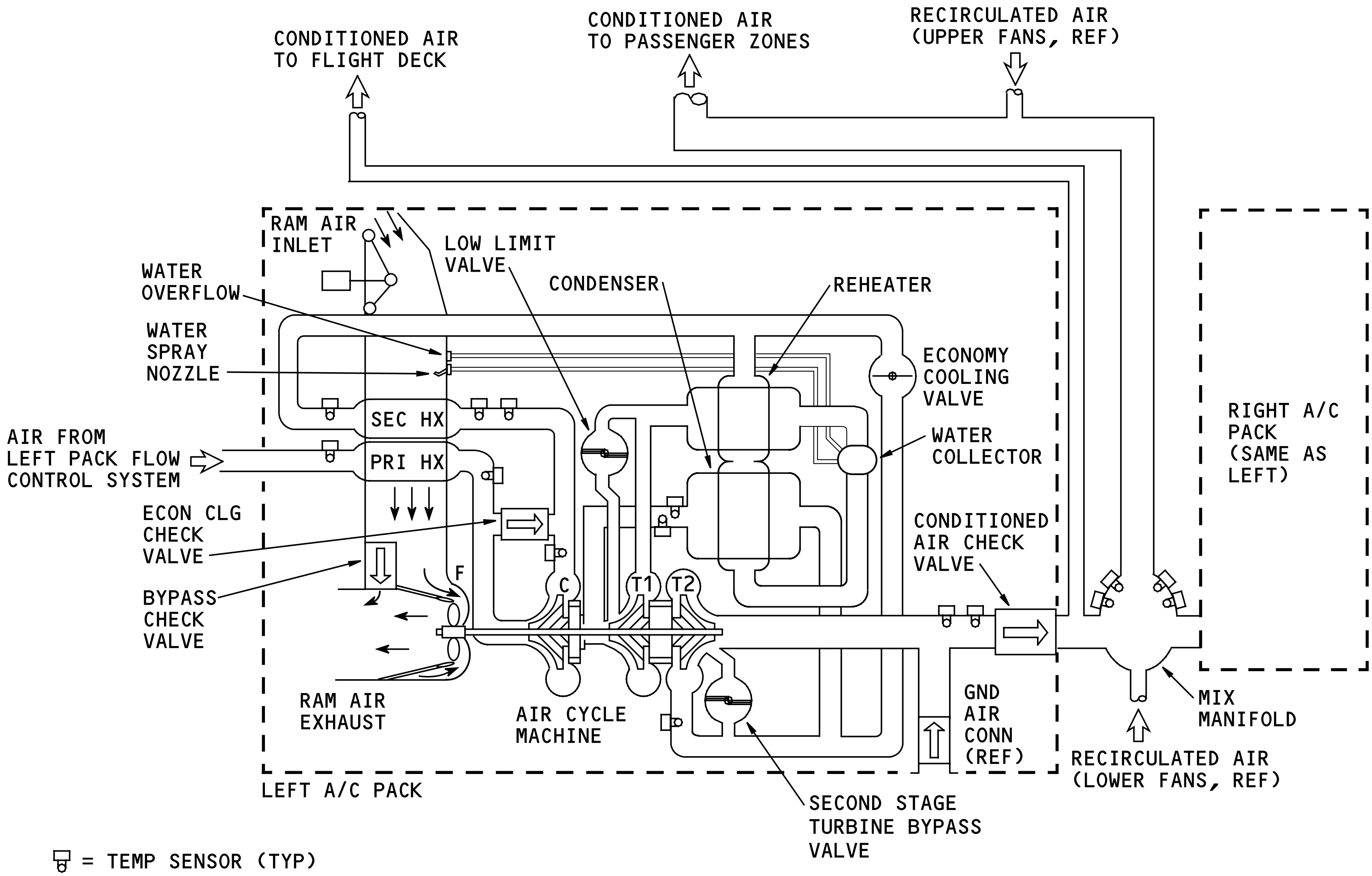
- Primary heat exchanger (PRI HX)
- Air cycle machine (ACM) compressor
- Secondary heat exchanger (SEC HX)
- Over the reheater and condenser cores
- Water collector
- Reheater
- ACM turbine 1
- Condenser
- ACM turbine 2
- Conditioned air check valve
- Mix manifold.

Air from the pack mixes with recirculated air in the mix manifold. This air moves through the distribution system to the passenger cabin zones. The flight deck gets air directly from the left pack.

The ram air part of the pack keeps the compressor outlet temperature in limits. It also gives pack outlet temperature control.

The right pack operates the same as the left pack.

See the functional description page on pack cooling and mix manifold temperature control in this section for more information about pack operation (AMM PART I 21-52).



21-52-00-001 Rev 5 02/27/1997

AIR CONDITIONING - PACK CLG AND MIX MANIFOLD TEMP CTRL - INTRODUCTION

Component Locations

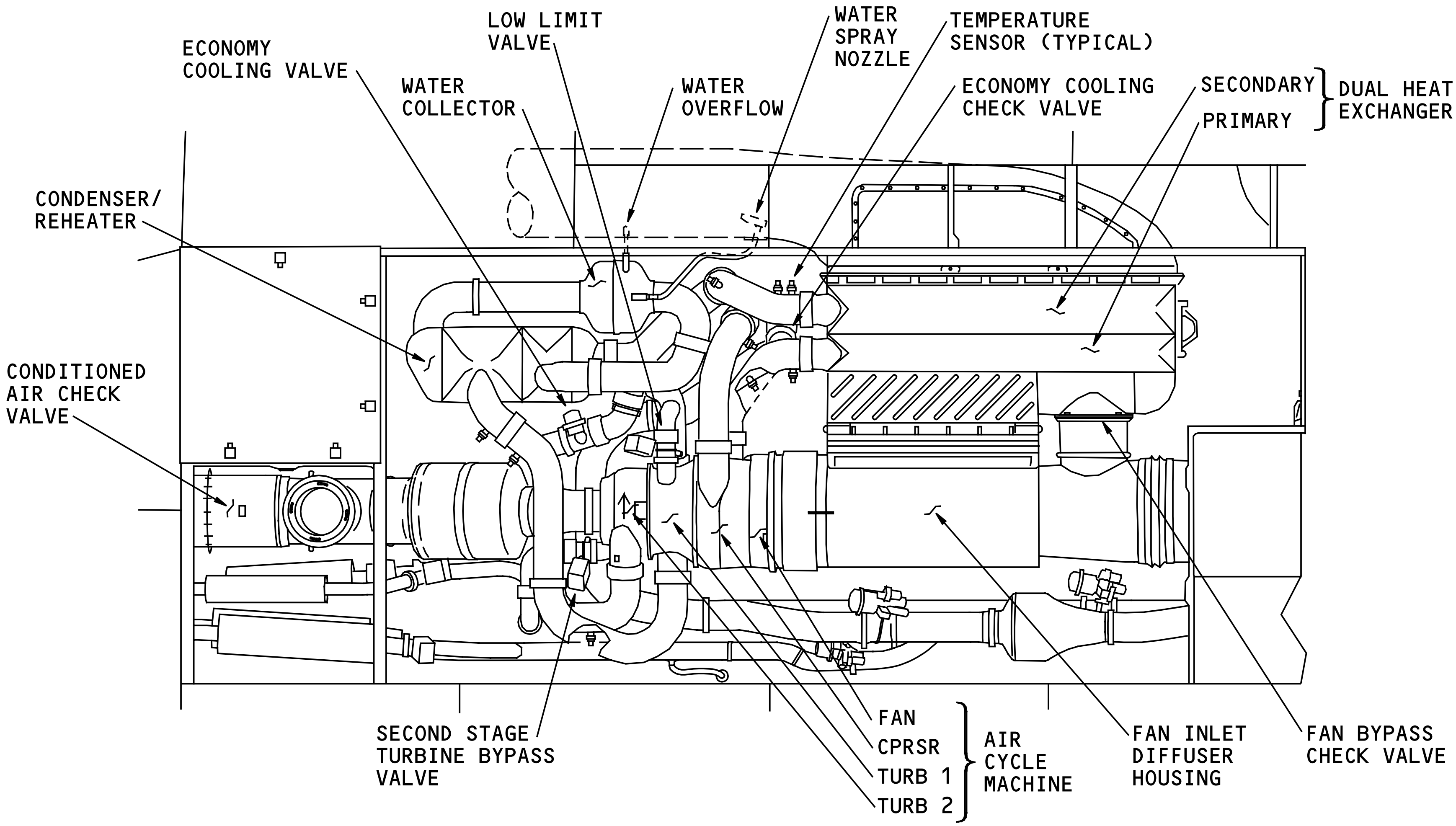
Most of the pack cooling and mix manifold temperature control components are in the ECS bay. Four mix manifold temperature sensors are in the aft part of the forward cargo compartment (not shown). The left and right ECS bays have a pack, a conditioned air check valve, and ram air system components (not shown).

The ram air system component locations are described in another part of this section.

Each pack has these components:

- Economy cooling valve
- Water collector
- Low limit valve
- Water overflow
- Water spray nozzle
- Temperature sensors (10 places)
- Economy cooling check valve
- Dual heat exchanger
- Fan bypass check valve
- Fan inlet and diffuser housing
- Air cycle machine (ACM)
- Second stage turbine bypass valve
- Condenser/reheater.

All of the components in the left and right packs are the same except for five of the ducts that connect the pack components together. The orientation of the components in one pack is a mirror image of the other. The airflow is also a mirror image. The difference in the ducts lets the inlets to the dual heat exchangers always be on the top and the outlets on the bottom.



LEFT ECS BAY
(LEFT PACK)

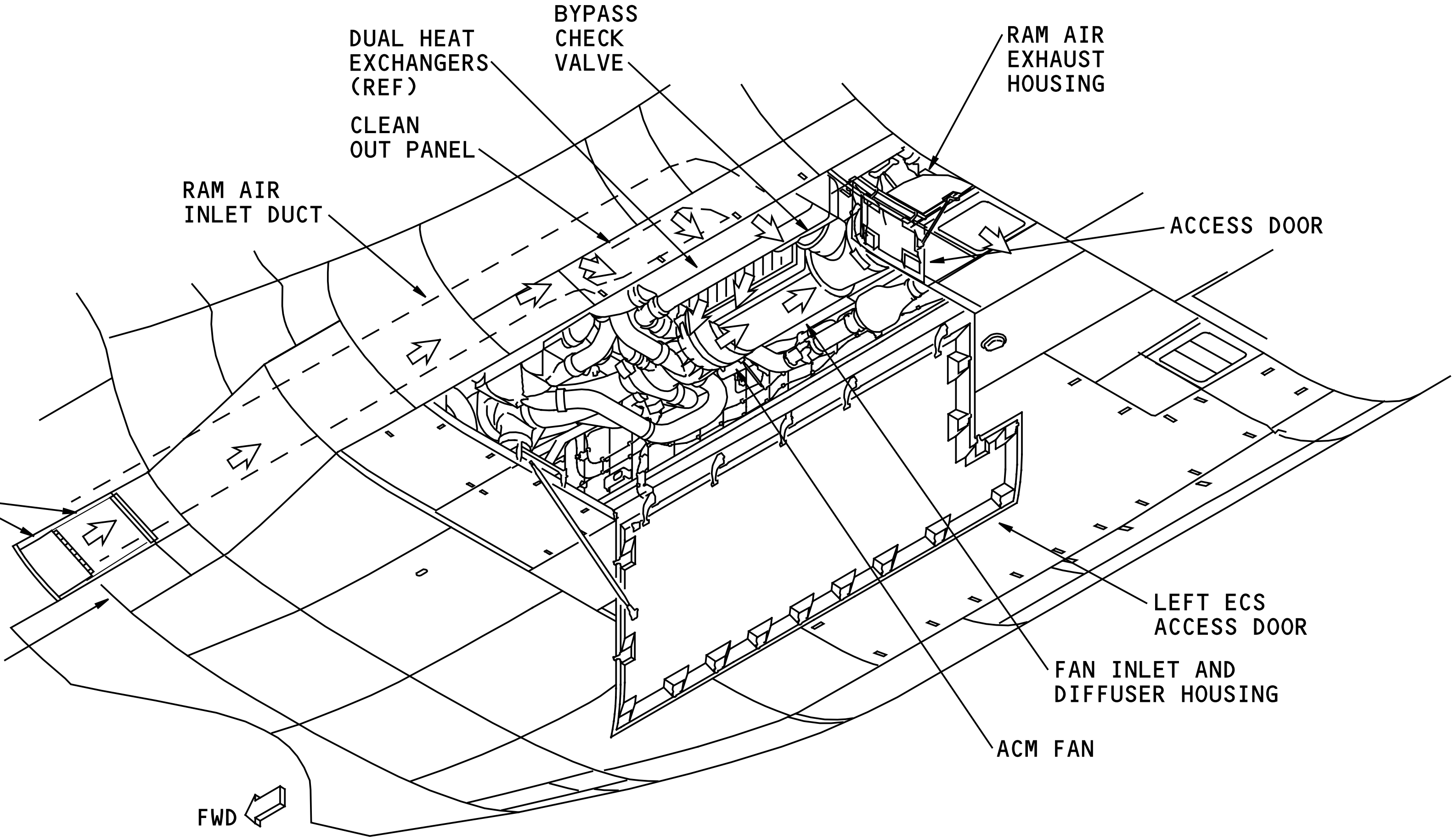
21-52-00-002 Rev 5 10/28/1996

AIR CONDITIONING - PACK CLG AND MIX MANIFOLD TEMP CTRL - COMPONENT LOCATIONS

Component Locations

All of the ram air components of the left and right air conditioning packs are in the underwing fuselage area. Each pack has these ram air components:

- Ram air inlet door (two sections)
- Ram air inlet door actuator (not shown)
- Ram air inlet duct
- Ram air inlet duct clean out panel
- Fan bypass check valve
- Fan inlet and diffuser housing
- Fan section of the ACM
- Ram air exhaust housing.



UNDERWING FUSELAGE AREA

NOTE: LEFT RAM AIR SYSTEM
SHOWN, RIGHT SIMILAR

21-52-00-019 Rev 1 10/21/96

AIR CONDITIONING - PACK CLG AND MIX MANIFOLD TEMP CTRL - RAM AIR - COMPONENT LOCATIONS

AIR CONDITIONING - PACK CLG AND MIX MANIFOLD TEMP CTRL - DUAL HEAT EXCHANGER

Purpose

The dual heat exchanger removes heat from pneumatic system air and from air compressed by the air cycle machine.

Physical Description

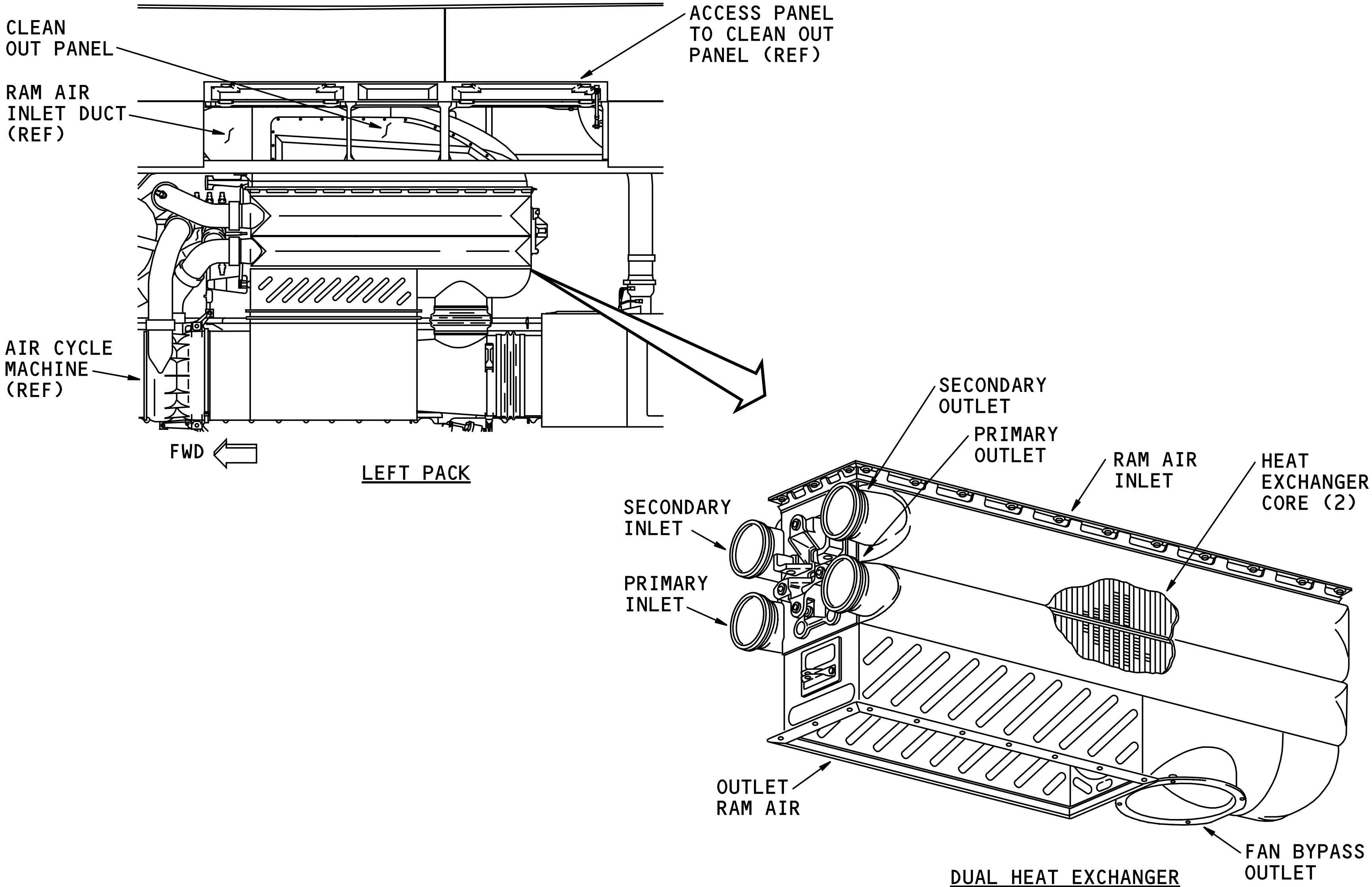
The dual heat exchanger has a primary and secondary heat exchanger core. There are inlets and outlets for the pneumatic system air and the ram air.

You remove and install the dual heat exchanger as a single unit. It weights 194 Lb (88 Kg).

The heat exchanger for the left pack and the right pack are identical. The orientation of the heat exchanger in one pack is a mirror image of the other. The airflow is also a mirror image. The pneumatic system air inlets are always on the top and the outlets are on the bottom. The ram air always flows from outboard to inboard.

Training Information Point

A panel outboard of each ECS access door gives access to the heat exchanger cleanout panels. Use high pressure water or air to loosen dirt.



AIR CONDITIONING - PACK CLG AND MIX MANIFOLD TEMP CTRL - DUAL HEAT EXCHANGER

AIR CONDITIONING - PACK CLG AND MIX MANIFOLD TEMP CTRL - AIR CYCLE MACHINE

Purpose

The air cycle machine (ACM) compresses air in the compressor stage and expands air in the two turbine stages.

Physical Description

The air cycle machine has one compressor stage and two isolated turbine stages. These stages turn on the same shaft. A fan in the ram air flow also connects to this shaft.

Air bearings hold the shaft of the air cycle machine in position when the shaft turns.

Functional Description

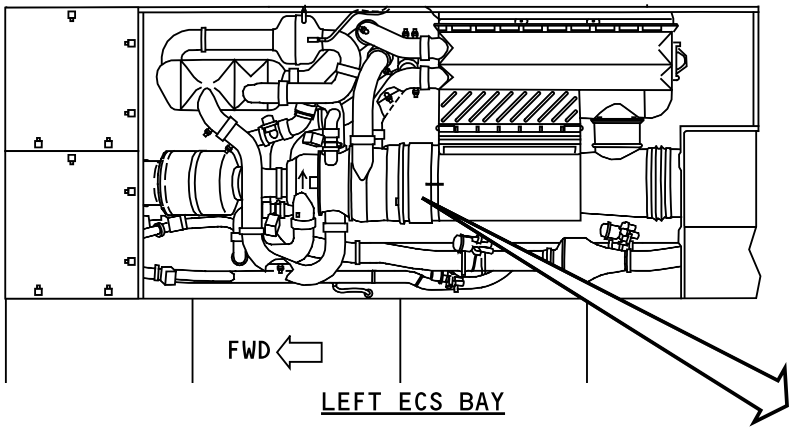
The compressor compresses the air from the primary heat exchanger. The compressed air flows out to other pack components.

Each turbine receives air from different points in the pack. The air expands and decreases in temperature as it goes through the turbine. The energy released in the turbines turns the shaft of the air cycle machine.

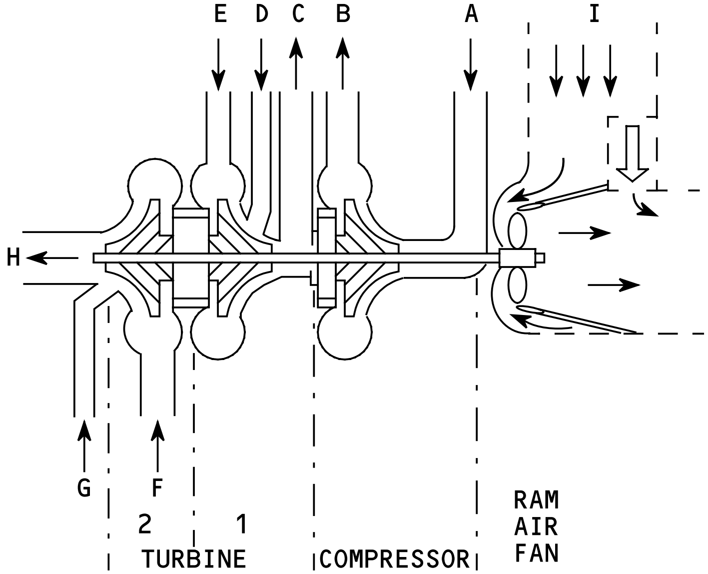
The ram air fan moves ambient air through the ram air ducts when the airplane is on the ground.

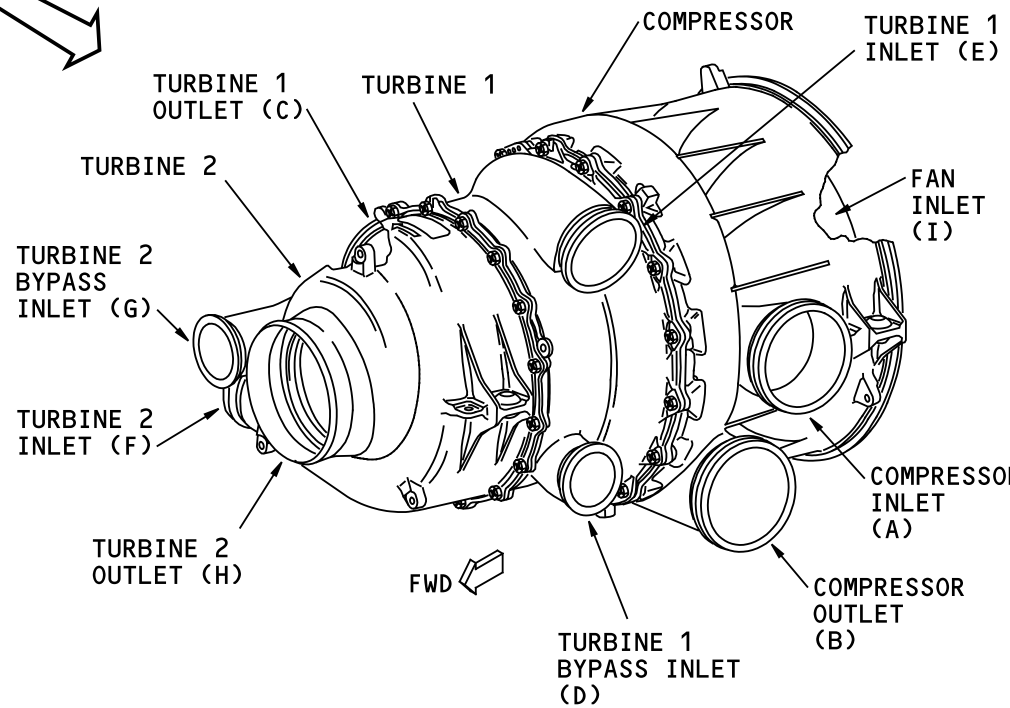
Training Information Point

There is a direction arrow near a placard on the ACM that shows the direction to rotate the ACM before you do a torque check. Damage can occur if you manually turn the ACM in the incorrect direction. The placard has the maximum allowable torque.



LEFT ECS BAY





AIR CYCLE MACHINE

21-52-00-005 Rev 2 03/23/95

AIR CONDITIONING - PACK CLG AND MIX MANIFOLD TEMP CTRL - AIR CYCLE MACHINE

Purpose

The condenser/reheater has two functions. It cools the air in the pack before it goes through the water collector. This lets the moisture in the air collect in the water collector. The condenser/reheater heats pack air to add energy to the air. The heated air helps operate the turbine in the air cycle machine.

Physical Description

The condenser/reheater has condenser and reheater heat exchanger cores. These cores are within a container through which pack air flows. The condenser/reheater weighs approximately 70 lb (32kg).

Functional Description

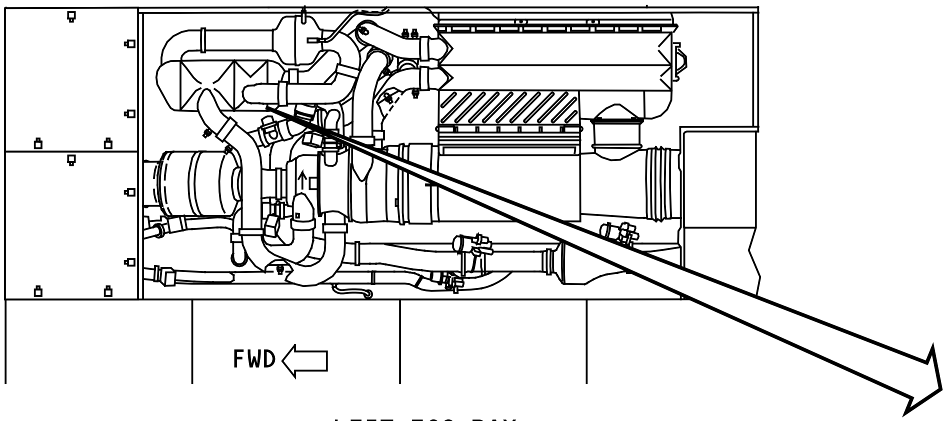
Air comes into the condenser/reheater from the secondary heat exchanger at A. This air flows over both heat exchanger cores. The heat exchangers absorb heat from this air. The decrease in air temperature condenses water so that the water collector can remove it from the air. The air flows out of the condenser/reheater at B.

The air from the water collector goes into the reheater at C. This air absorbs heat from the air that flows over the reheater core. The air flows out of the reheater at D.

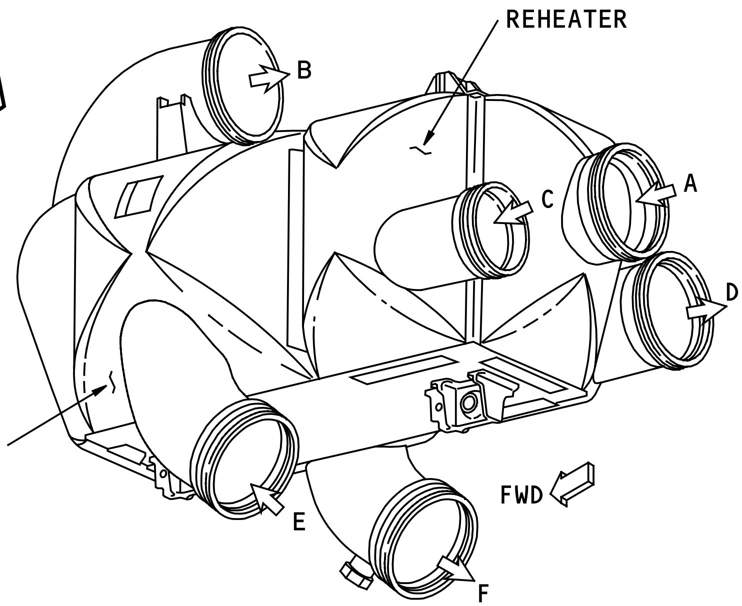
The air from turbine 1 goes into the condenser at E. This air absorbs heat from the air that flows over the condenser core. The air flows out of the condenser at F.

Training Information Point

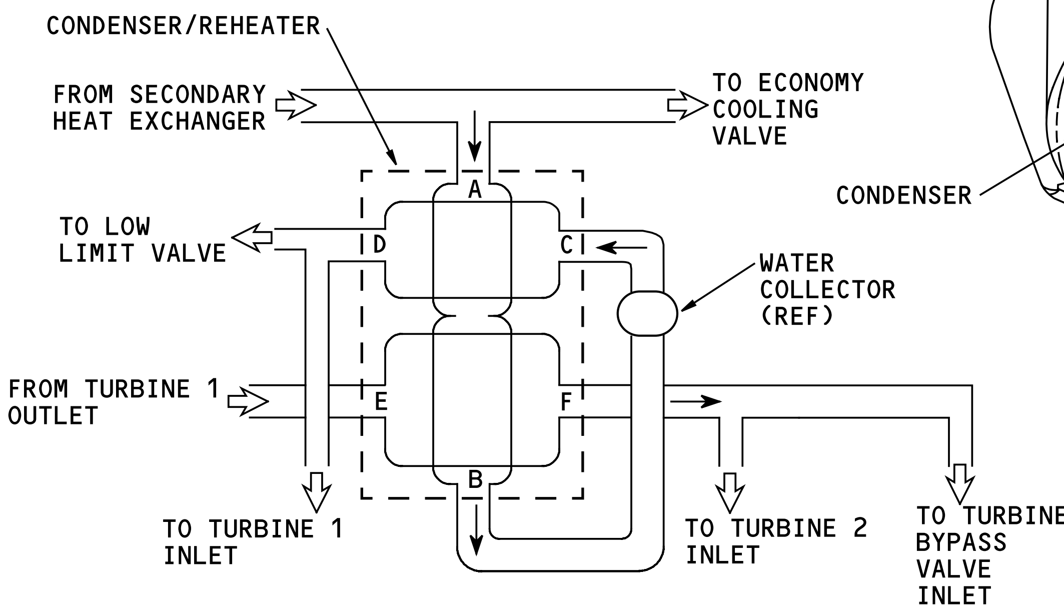
Remove and install the condenser/reheater with the water collector as an assembly. This balances the condenser/reheater weight on the hoist adapter.



LEFT ECS BAY



CONDENSER/REHEATER



AIR CONDITIONING - PACK CLG AND MIX MANIFOLD TEMP CTRL - CONDENSER/REHEATER

AIR CONDITIONING - PACK CLG AND MIX MANIFOLD TEMP CTRL - WATER COLLECTOR AND SPRAY NOZZLE

Purpose

The water collector removes water from pack air. The spray nozzle sprays the water into the air in the ram air inlet duct. The overflow lets water dump directly into the ram air inlet duct if the water collector has too much water in it.

Physical Description

The water collector is a device with no movable parts. Internal vanes are set to push air into a circular flow.

The spray nozzle has no moving parts. The nozzle has these parts:

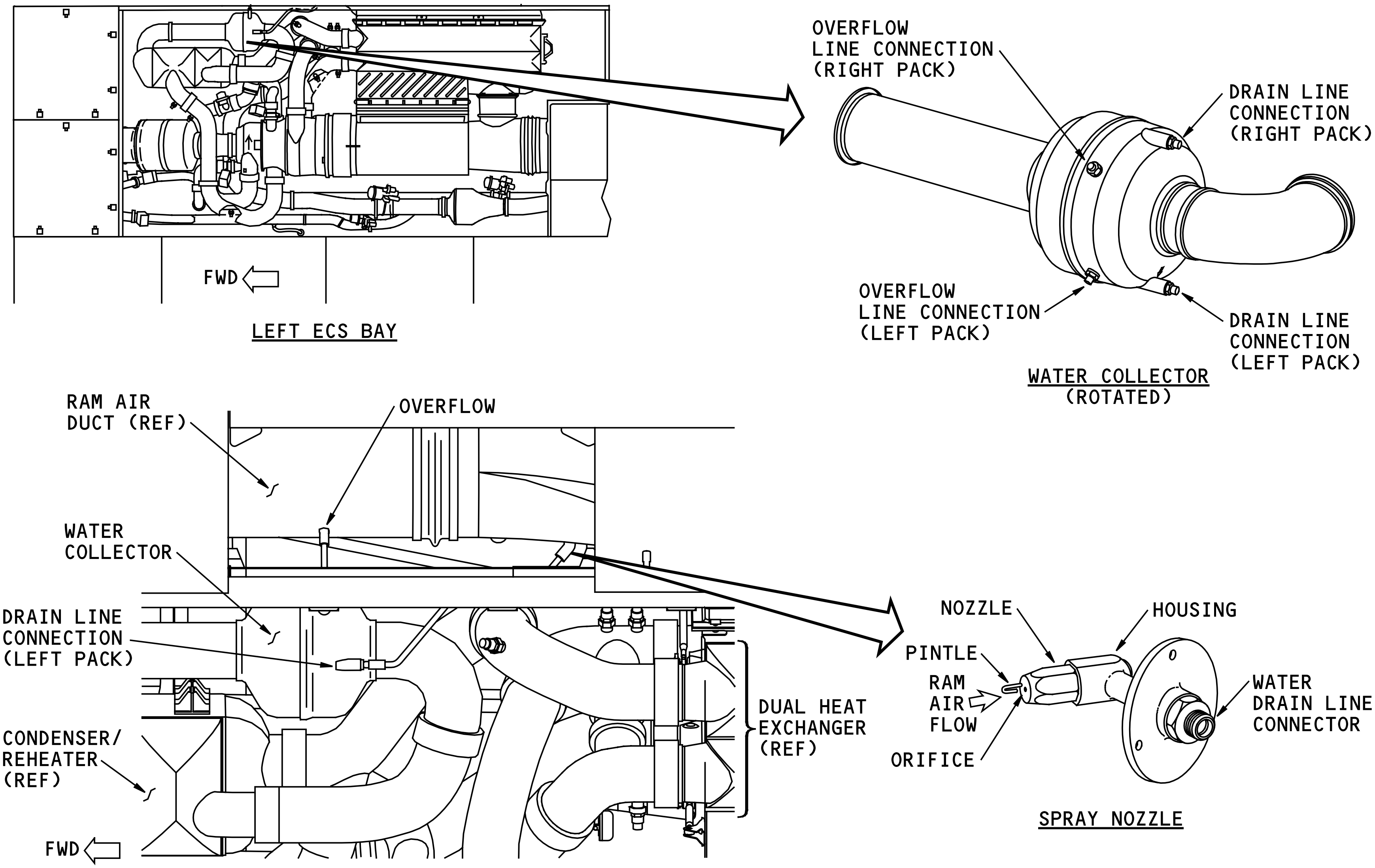
- Pintle
- Nozzle
- Housing
- Water drain line connector.

Location

A water collector and spray nozzle are outboard of the condenser/reheater in each ECS bay.

Functional Description

Air in the water collector turns in a circular flow. This pushes condensed water out of the air. A collector removes the water. Air pressure sends the water to the spray nozzle. The nozzle sprays the water in the incoming ram air near the secondary heat exchanger. The water added to the ram air inlet duct increases the heat removal by the secondary heat exchanger.



21-52-00-007 Rev 2 03/23/95

AIR CONDITIONING - PACK CLG AND MIX MANIFOLD TEMP CTRL - WATER COLLECTOR AND SPRAY NOZZLE

Purpose

The low limit valve controls the amount of reheater air that goes around the first stage turbine of the ACM. The CTC uses this valve to limit the output air temperature of the first stage turbine above 34F (1C) so water in the air does not freeze.

The second stage turbine bypass valve controls the amount of condenser air that goes around the second stage turbine of the ACM. The CTC uses turbine bypass valve to control pack outlet temperature.

These valves function together with the ram air doors to control the output temperature of the pack.

Physical Description

The valve has these parts:

- Position indicator
- Disc
- Valve body
- Manual open/close knob
- Electrical actuator
- Electrical connector (not shown).

The low limit valve and the second stage turbine bypass valve are the same. Each uses a disc which rotates to adjust air flow. The disc is driven by a motor that can be turned in both directions. The motor uses 115v ac to operate the valve.

An RVDT gives an electrical indication of the disc position. An indicator on top of the electrical actuator gives a visual indication of disc position.

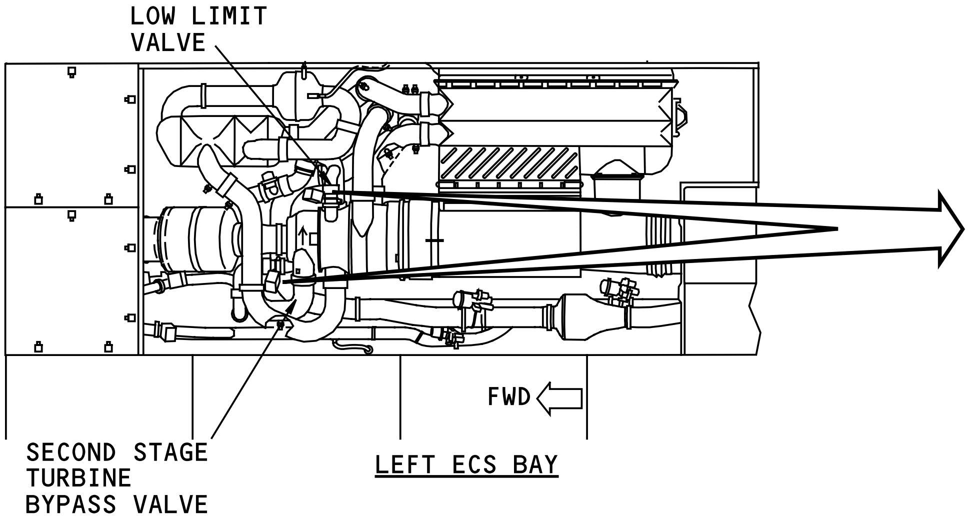
Functional Description

The CTC controls the operation of the low limit valve and the second stage turbine bypass valve. Both valves operate the same. A close or open signal from the CTC turns the motor in the necessary direction.

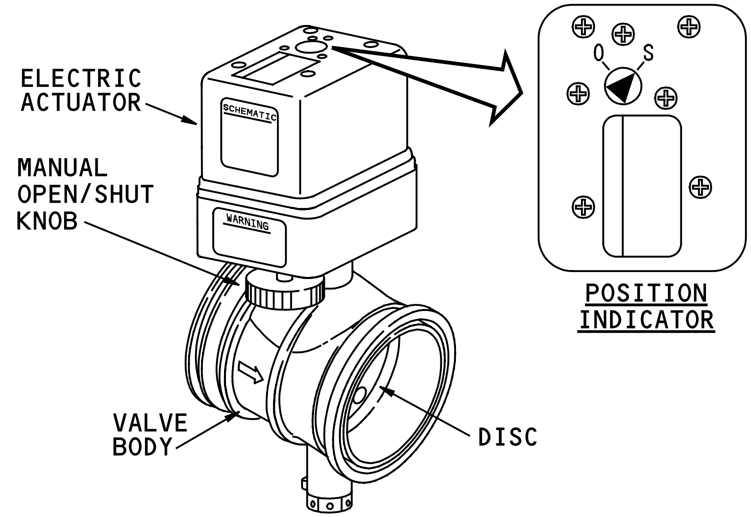
The RVDT in each valve sends the position of the valve to the CTC. The CTC use the position information for control and valve position indication.

Training Information Point

Manually open or shut the valve with the manual open/shut knob. You must disconnect the electrical connector first. The valve will move to the commanded position when the valve gets power if you do not remove the electrical connector.

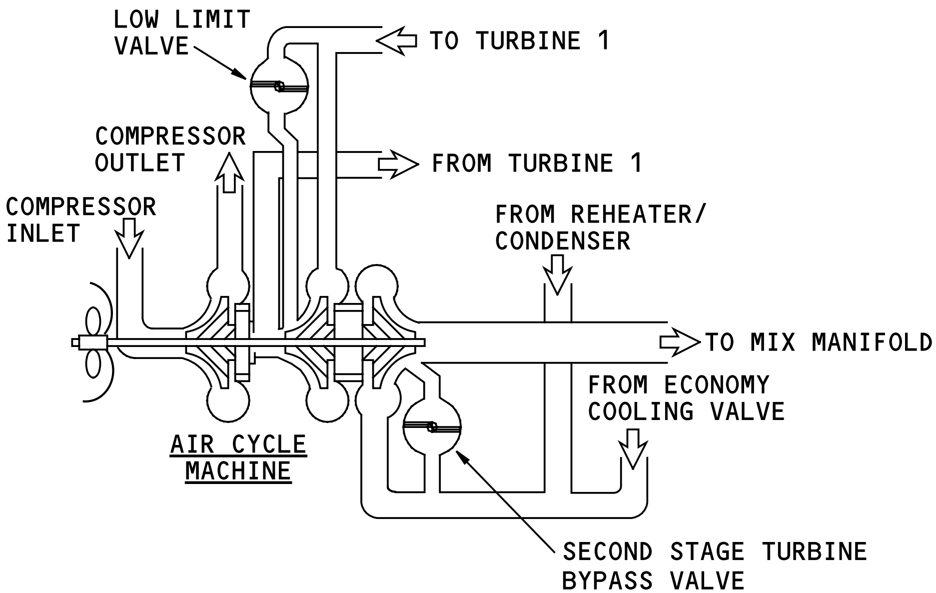


LEFT ECS BAY

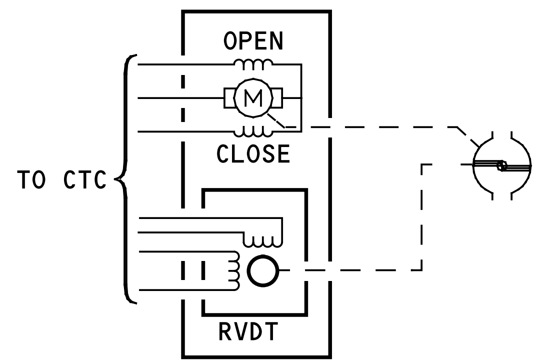


POSITION
INDICATOR

LOW LIMIT AND SECOND STAGE
TURBINE BYPASS VALVE



AIR CYCLE
MACHINE



VALVE SCHEMATIC

21-52-00-008 Rev 2 03/23/95

AIR CONDITIONING - PACK CLG AND MIX MANIFOLD TEMP CTRL - LOW LIMIT AND TURBINE BYPASS VLVS

AIR CONDITIONING - PACK CLG AND MIX MANIFOLD TEMP CTRL - ECONOMY COOLING VALVE

General

The economy cooling valve opens to let air go around the air cycle machine turbine 1 and the water separation parts of the pack. The valve opens when the pack functions in the economy cooling mode or the standby cooling mode. See the functional description of the packs in this section for more information about these modes.

Physical Description

The economy cooling valve has these parts:

- Locking crank/position indicator
- Pneumatic actuator
- Locking plug
- Plug and filter
- Solenoid
- Electrical connector
- Valve body
- Disc.

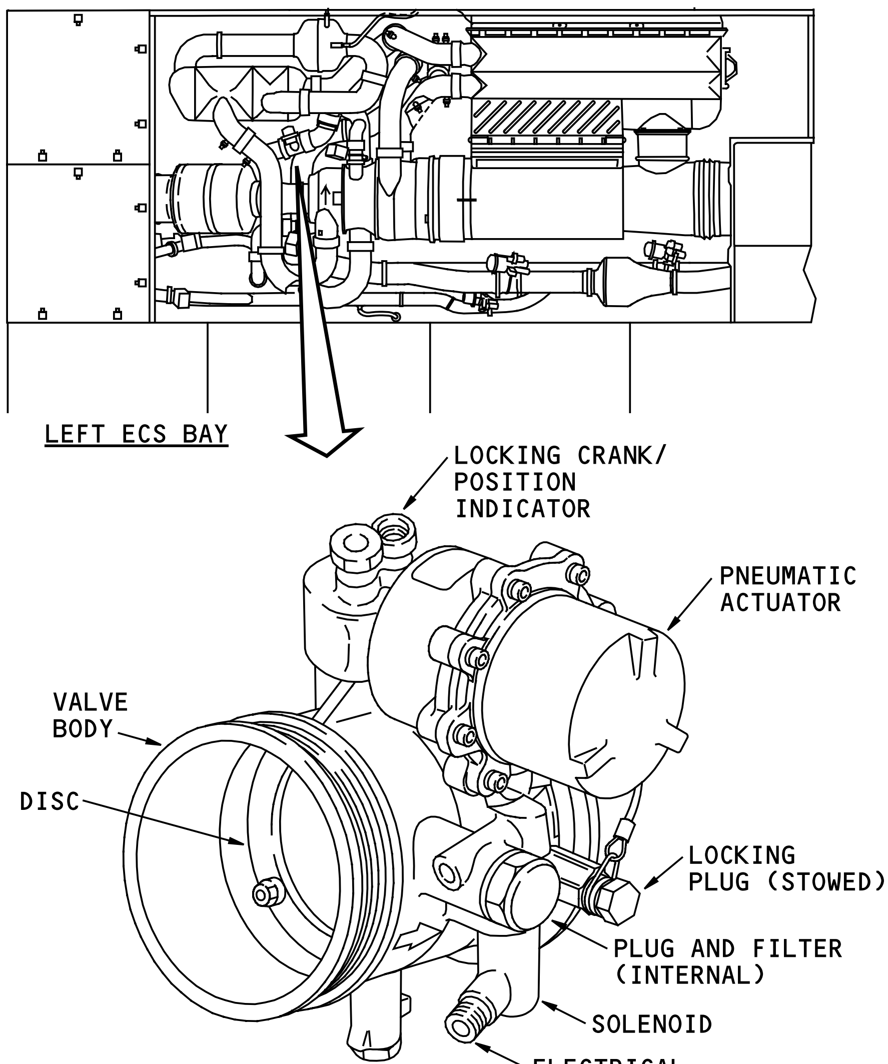
A pneumatic actuator moves the disc to open or close the valve.

Functional Description

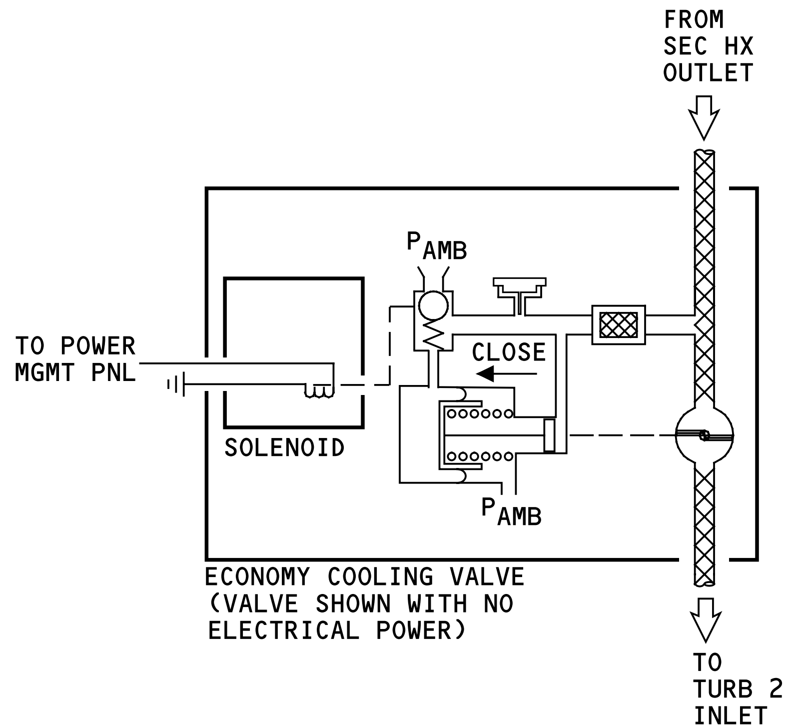
The economy cooling valve is electrically controlled and pneumatically actuated. The valve is spring-loaded closed. With no power to the solenoid, control pressure in the actuator opens the valve. When the solenoid energizes, control pressure bleeds from the actuator and the valve closes.

Training Information Point

Use the locking plug to manually lock the valve to the closed position.



ECONOMY COOLING VALVE



ECONOMY COOLING VALVE
(VALVE SHOWN WITH NO
ELECTRICAL POWER)

21-52-00-009 Rev 3 03/23/95

AIR CONDITIONING - PACK CLG AND MIX MANIFOLD TEMP CTRL - ECONOMY COOLING VALVE

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Purpose

The pack cooling temperature sensors monitor the air temperatures at eight different locations in the pack.

These are the pack cooling temperature sensors:

- Primary heat exchanger outlet temperature sensor
- Compressor discharge temperature sensors 1 and 2 (CTC)
- Secondary heat exchanger outlet temperature sensor
- Compressor discharge temperature sensor (ASCPC)
- Condenser inlet temperature sensors 1 and 2
- Pack discharge temperature sensor (CTC)
- Pack discharge temperature sensor (ASCPC)
- Secondary turbine inlet temperature sensor.

The primary heat exchanger inlet temperature sensor supplies data for flow control. See the pack flow control section for more information about flow control (AMM PART I 21-51).

The cabin temperature controller (CTC) uses the pack cooling temperature data for control, BIT, and indications. See the zone temperature control and indication section for more information about the CTC (AMM PART I 21-61).

Physical Description

The sensors have an electrical connection and a threaded housing. The sensors install into a threaded boss on the air conditioning duct. There are single element resistance/temperature sensors and single element thermistor sensors.

These sensors are single element resistance/temperature sensors:

- Primary heat exchanger outlet temperature sensor
- Compressor discharge temperature sensors 1 and 2 (CTC)
- Compressor discharge temperature sensor (ASCPC)
- Secondary heat exchanger outlet temperature sensor.

These sensors are single element thermistor sensors:

- Condenser inlet temperature sensors 1 and 2
- Secondary turbine inlet temperature sensor
- Pack discharge temperature sensor (CTC)
- Pack discharge temperature sensor (ASCPC).

Location

The sensors are in air ducts in the ECS bay.

Training Information Point

These sensors are interchangeable:

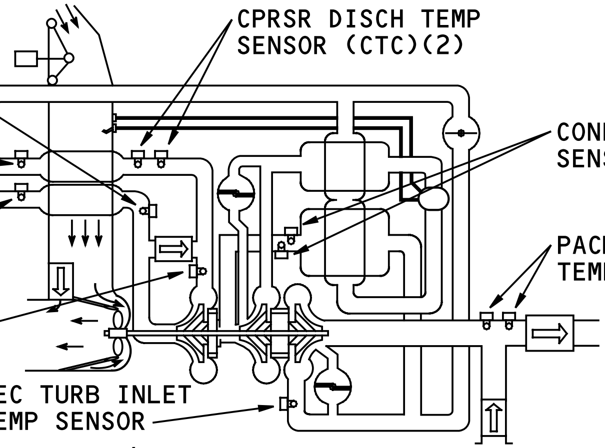
- Primary heat exchanger outlet temperature sensor
- Compressor discharge temperature sensor (2) (CTC)
- Compressor discharge temperature sensor (ASCPC)
- Secondary heat exchanger outlet temperature sensor.

The primary heat exchanger inlet temperature sensor is also interchangeable with the above sensors.

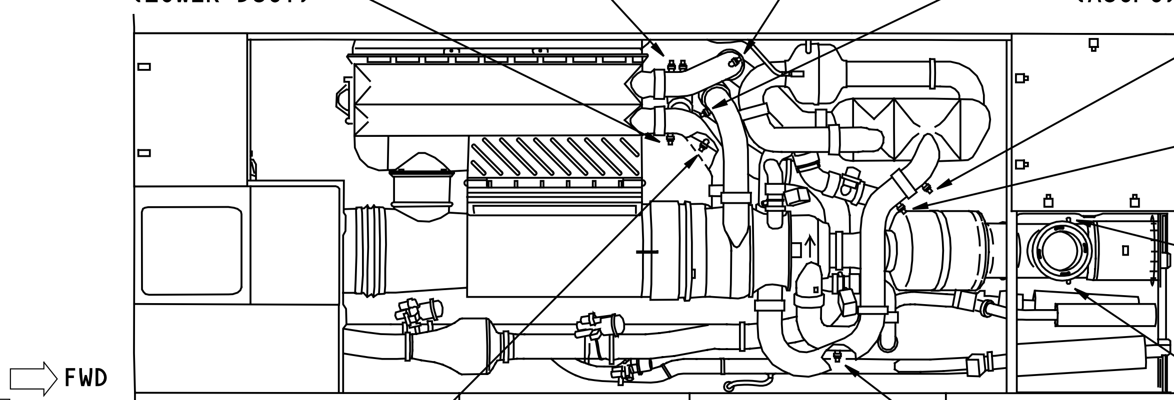
These sensors are interchangeable:

- Condenser inlet temperature sensor (2)
- Secondary turbine inlet temperature sensor.

The ASCPC and CTC pack discharge temperature sensors are interchangeable.



LEFT A/C PACK SCHEMATIC
(RIGHT SIMILAR)



LEFT ECS BAY
(RIGHT SIMILAR)

21-52-00-011 Rev 3 03/23/95

AIR CONDITIONING - PACK CLG AND MIX MANIFOLD TEMP CTRL - PACK COOLING TEMP SENSORS

Purpose

The mix manifold temperature sensors monitor air temperatures at the mix manifold. There are four mix manifold outlet temperature sensors.

Physical Description

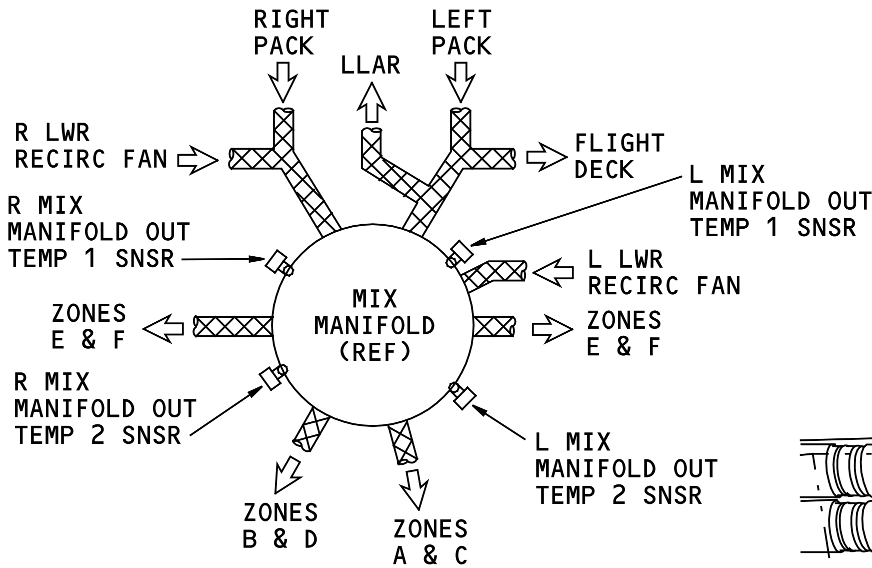
The sensors are single element thermistor devices. The sensor housing has an external hex wrench fitting and threads for installation in the mix manifold.

Location

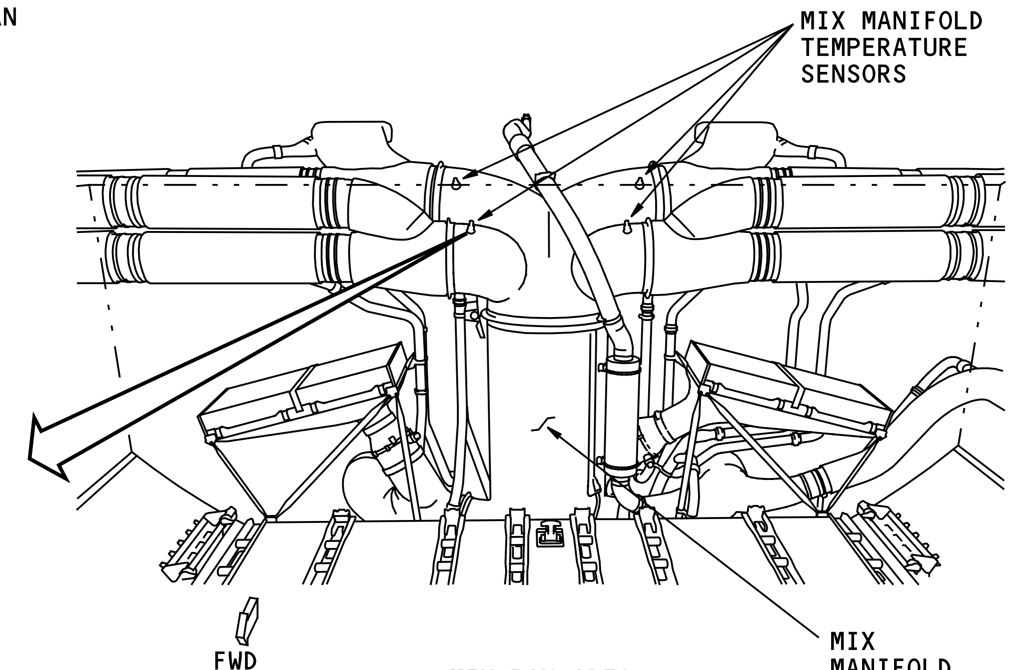
The sensors are in the top of the mix manifold. Open the flexible neoprene liner at the aft end of the forward cargo compartment to get access to the mix manifold area.

Training Information Point

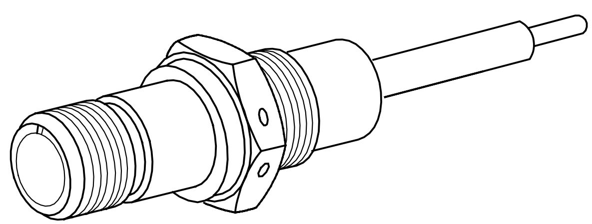
The mix manifold temperature sensors are interchangeable. The mix manifold temperature sensors are also interchangeable with the cabin zone duct temperature sensors.



MIX MANIFOLD SCHEMATIC



MIX BAY AREA
(FORWARD CARGO COMPARTMENT)
(LOOKING AFT)



MIX MANIFOLD TEMPERATURE SENSOR
(TYPICAL)

21-52-00-013 Rev 5 10/28/1997

AIR CONDITIONING - PACK CLG AND MIX MANIFOLD TEMP CTRL - MANIFOLD TEMP SENSORS

Purpose

The ram air inlet door controls the flow of ram air supplied to the dual heat exchanger. This is to control the amount of air used to cool the dual heat exchanger. This functions with other components to control air temperature from the pack.

Physical Description

The ram air inlet door is a two part assembly. The forward part has a hinge attached at a permanent position at the ram air inlet.

The aft part has a free hinge attached on the aft side of the forward part. The aft side of the aft part mounts on rollers.

The actuator turns a torque tube that attaches to the aft part of the door behind the hinge.

Location

The ram air inlet doors are on the bottom of the airplane forward of the ECS bay doors.

Functional Description

A close or open signal from the CTC operates the actuator motor in the necessary direction.

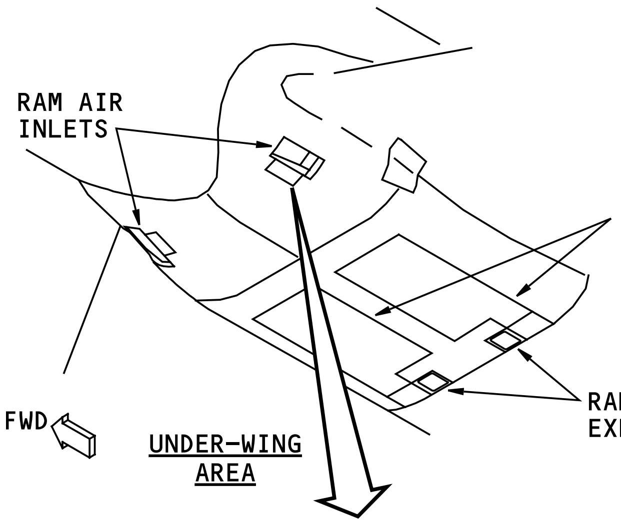
A rotary variable differential transformer (RVDT) in the actuator sends the position of the door to the CTC.

Training Information Point

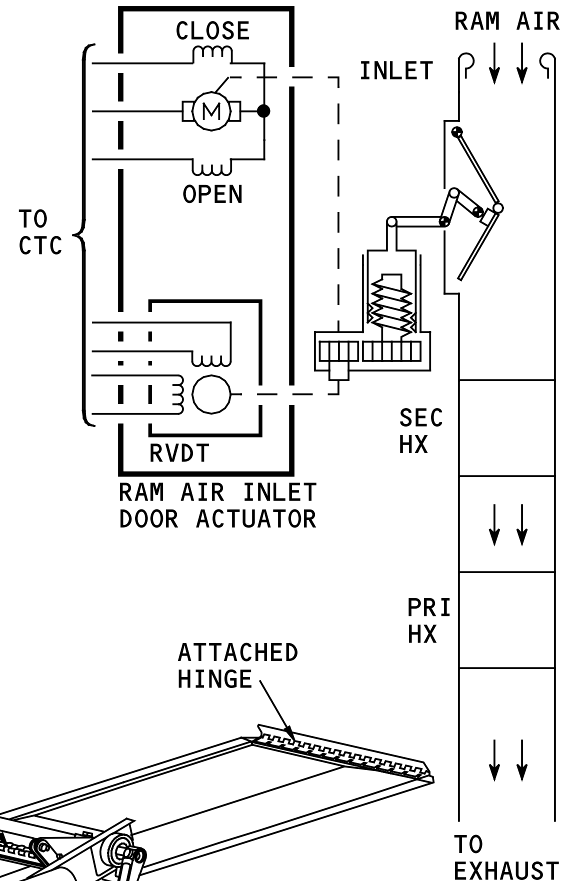
When you change a component of the ram air inlet system, measure the closed position of the door. If it is necessary, adjust the actuator to get the correct measurement.

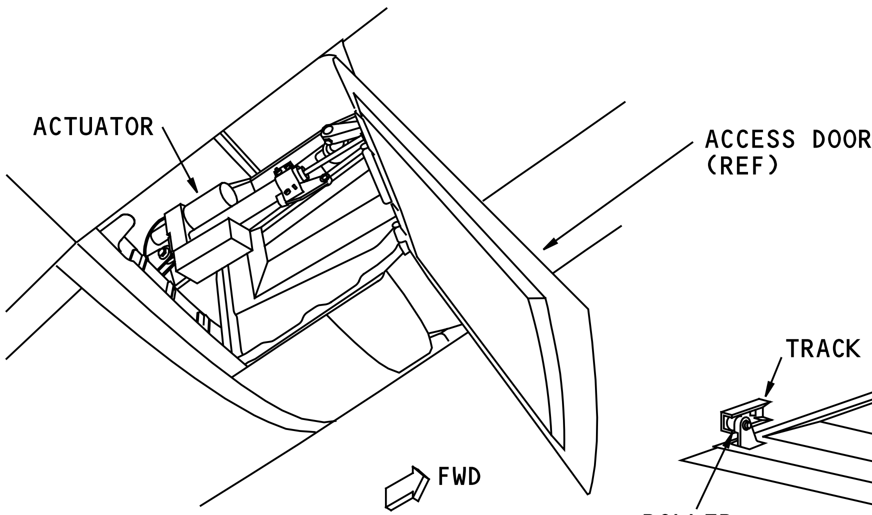
WARNING: MAKE SURE THAT PERSONNEL ARE CLEAR OF THE RAM AIR INLET DOOR, LINKAGE AND ACTUATOR BEFORE YOU DO THIS SPECIAL FUNCTION. POSSIBLE INJURY TO PERSONNEL CAN OCCUR.

The ram air inlet doors are normally open with the airplane on the ground. You use a MAT special function to close the ram air door if necessary.

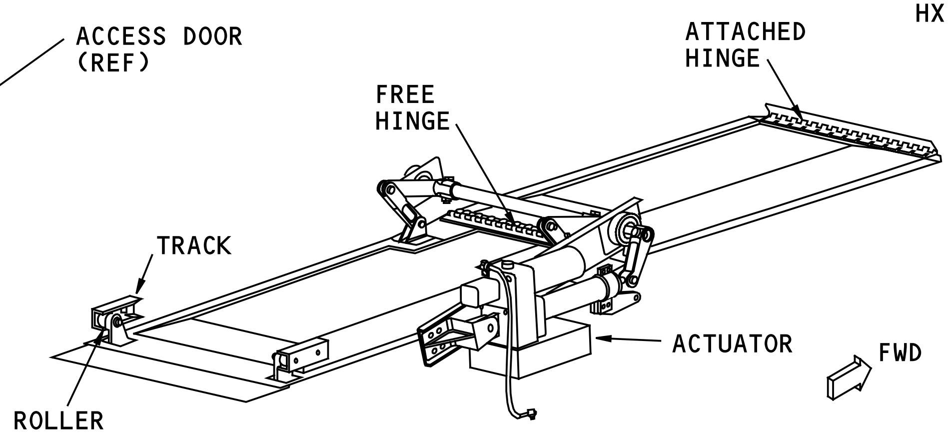


UNDER-WING AREA





RAM AIR INLET
ACTUATOR ACCESS DOOR



RAM AIR INLET DOOR AND ACTUATOR

21-52-00-014 Rev 2 10/29/1996

AIR CONDITIONING - PACK CLG AND MIX MANIFOLD TEMP CTRL - RAM AIR INLET DOOR AND ACTUATOR

Purpose

The fan inlet diffuser housing connects the dual heat exchanger to the ACM fan and ram air exhaust duct.

The fan bypass check valve permits air to go around the ACM fan at higher ram air flow.

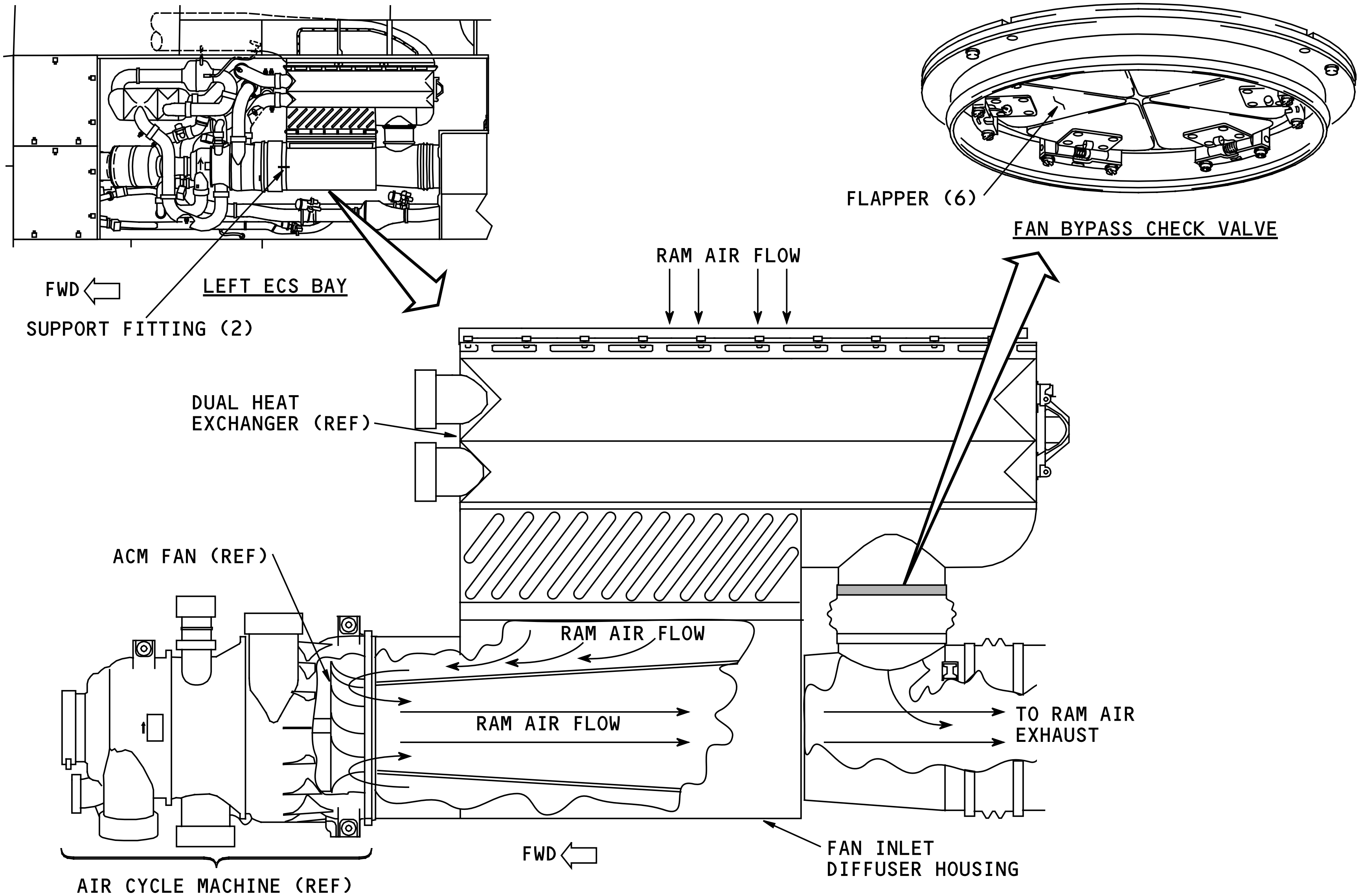
Physical Description

The fan inlet diffuser housing is a metal container with flexible connections at the ram air inlet and fan bypass. An inner assembly separates the air flow that goes to and from the ACM fan.

The fan bypass check valve is a flapper-type valve.

Training Information Point

The fan inlet diffuser housing has a strap that attaches to the upper support fitting and to airplane structure (not shown). The strap supports the housing when the ACM or dual heat exchanger is removed. Make sure you install this strap when you install the fan inlet diffuser housing.



21-52-00-016 Rev 2 10/16/1996

AIR CONDITIONING - PACK CLG AND MIX MANIFOLD TEMP CTRL - FAN INLET DIFFUSER HOUSING AND CK VLV

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General

The CTCs control the related air conditioning pack. The CTCs usually set the packs to keep the temperature in the mix manifold to a calculated value and to keep pack outlet temperatures within 10F (5.5C) of each other.

The calculated temperature value for the mix manifold is called integrated mix manifold temperature error (IMMTE) reference. The IMMTE reference is based on cooling and heating requirements of the zones that usually get conditioned air from the mix manifold. The right CTC usually calculates this reference. The left CTC follows the right CTC. The left can make the calculation if the right CTC fails. See the zone temperature control and indication section for more information about the calculation of the IMMTE reference (AMM PART I 21-61).

The left and right CTCs can control the related pack outlet temperature to different values. This occurs when the flight deck needs more cooling than the request by the IMMTE reference. If the flight deck needs more cooling, the left CTC controls the left pack outlet temperature to satisfy the flight deck requirements. The right CTC controls the right pack outlet to satisfy the IMMTE reference.

The left and right CTCs control the temperature of air from the related pack by direct adjustment of these components:

- Second stage turbine bypass valves (TBV)
- Low limit valves (LLV)
- Ram air door actuators.

The CTCs use the economy cooling valve (ECV) to bypass the water removal part of the pack. The CTC opens the ECV when water removal is not necessary or when the CTC must increase airflow into the airplane. The CTC controls the economy cooling valve through the ELMS electronics (ELEX) unit.

For usual control, the CTCs set the speed and direction of valve/actuator movement based on the difference between actual (RVDT) and desired position. Desired position is a CTC calculated position for valve/actuator based on these conditions:

- Pack on or off, pre-positioning for off
- Pack control, usual or backup.

When a pack is on, the desired position for a valve or an actuator is usually set to a preset schedule for each valve/actuator. The schedules for the ram air door actuators, TBV, and LLV do these functions:

- Keeps the use of ram air to a minimum
- Adjust ram air flow to keep ACM fan surge margins
- Keeps the compressor outlet temperatures within limits.

The position schedules for the ram air door actuators and the TBV and LLV automatically adjusts for low (less than.5 MACH) and high (more than or equal to.5 MACH) airspeeds. The schedule for the ram air door actuators also adjusts for the economy cooling mode.

Ram Air Door Actuator

CTC control of the ram air inlet actuator has these functions. The functions are listed with the most important first and the least important last:

- Limit closed position if the LLV or the TBV fails (ACM surge protection)
- Limit compressor outlet temperature (prevents compressor overheat)
- Keep the mix manifold temperature equal to or more than 35F (2C) if the TBV is full open (prevents water freezing in mix manifold)
- Control pack outlet temperature to satisfy the IMMTE reference (valve/actuator preset schedules).

A rotary variable differential transformer (RVDT) in the actuator sends the door position to the CTC.

Second Stage Turbine Bypass Valve

CTC control of the second stage turbine bypass valve has these functions. The functions are listed with the most important first and the least important last:

- Limit open position if ram air door actuator fails (ACM surge protection)
- TBV full open if ACM fails (standby cooling, lets the pack continue to operate)
- Change position to control pack flow if flow control valve is full open and pack in economy cooling mode (lets pack satisfy pack flow schedule)
- Keep the mix manifold temperature more than or equal to 35F (2C) (prevents water freezing in mix manifold)
- Control pack outlet temperature to the IMMTE reference (valve/actuator preset schedules).

An RVDT in the valve sends the valve position to the related CTC.

Low Limit Valve

CTC control of the low limit valve has these functions. The functions are listed with the most important first and the least important last:

- Keep condenser inlet temperature more than or equal to 34F (1C) (prevents water freezing in the hot side of the condenser)
- Control pack outlet temperature if TBV is full open and the mix manifold temperature less than the IMMTE reference or less than 35F (2C).

Economy Cooling Valve

The CTC tells the electrical load management system (ELMS) electronics unit to open or close the economy cooling valve (ECV). The ELMS electronics unit uses the economy cooling valve relay to set the position of the ECV. To open the valve, ELMS removes electrical power from the relay. This causes air pressure in the pack to open the valve. To close the valve, ELMS energizes the relay which gives 28v dc to a solenoid in the ECV. This causes air pressure in the pack to close the valve.

Sensors - Temperature and RVDT

The CTCs monitor pack temperature sensors and valve/ actuator RVDTs. The CTCs use this information for control, BIT and indications for the related air conditioning pack.

See the zone temperature control and indication section for more information about the pack temperature sensors (AMM PART I 21-61).

Indication - Standby Cooling

When the related CTC sets the related pack to operate in the standby cooling mode, the AIMS shows these two indications:

- EICAS advisory message PACK MODE L (R)
- STBY COOLING message on the air synoptic display.

The STBY COOLING message shows next to the related pack symbol.

See the cooling section for more information about the pack indications (AMM PART I 21-50). See the pack cooling and mix manifold temperature control section for more information about standby cooling (AMM PART I 21-52).

Pack Off Positioning

The CTC sets the positions of the ram air door actuators, LLV, TBV and ECV when a pack is off. These are the related positions for a pack when the airplane is in the air:

- Ram air inlet is at 0.98 percent of heating (98 percent closed)
- LLV is at 0.00 percent of heating (full closed)
- TBV is at 0.15 percent of heating (part open)
- ECV is closed.

These are the related positions for a pack when the airplane is on the ground:

- Ram air inlet is at 0.00 percent of heating (full open)
- LLV is at 0.00 percent of heating (full closed)
- TBV is at 0.00 percent of heating (full closed)
- ECV is closed.

ASCPC Interface

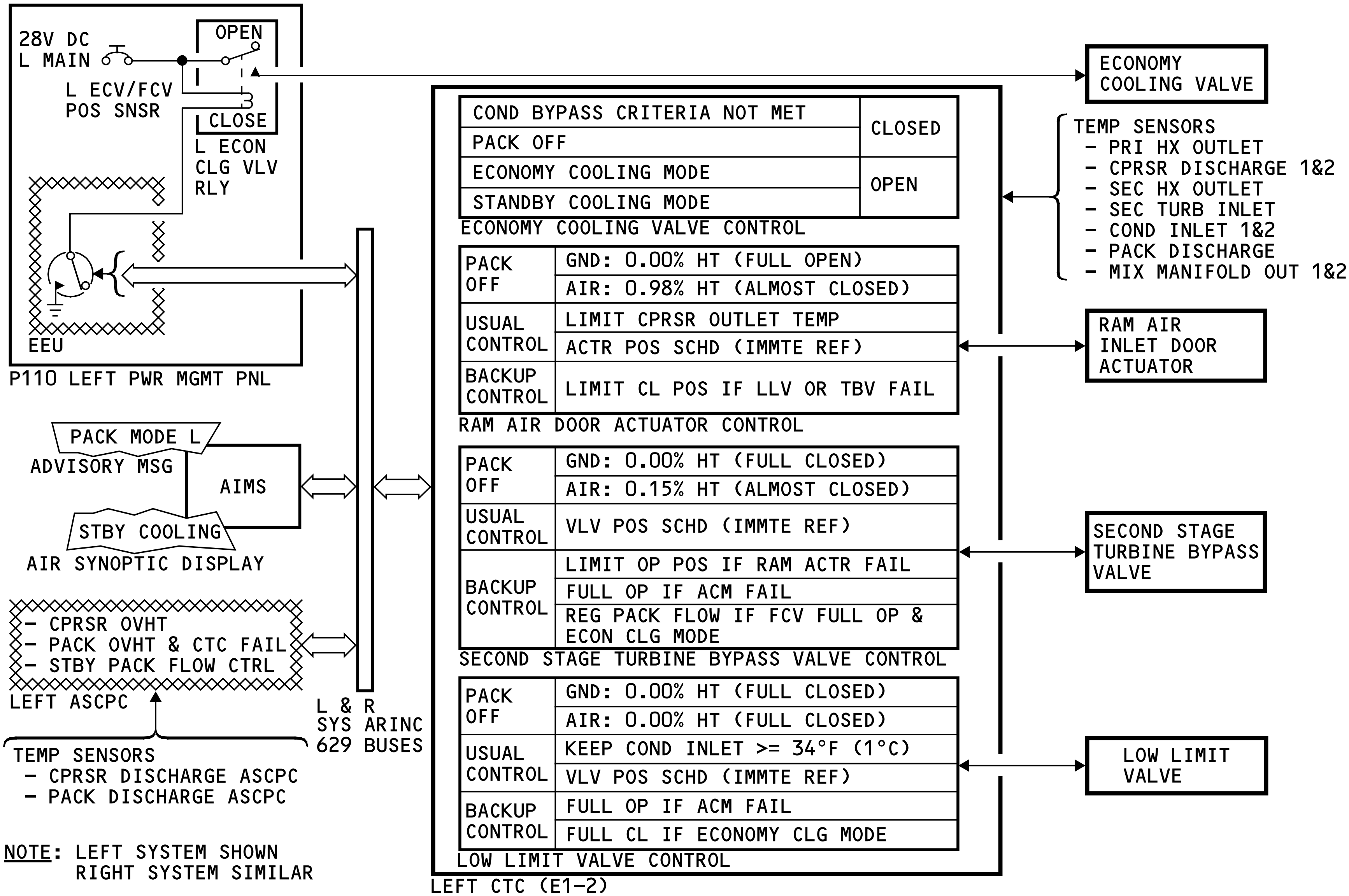
The ASCPCs monitor the compressor and pack discharge temperatures. The ASCPCs have there own temperature sensors, they do not use the same sensors as the CTCs.

The related ASCPC uses the compressor and pack discharge temperature information to set the related pack to off if any of these conditions occur:

- Compressor overheat more than 490F (254C) for 5 seconds
- Pack overheat, 210F (99C) for 10 seconds and the related CTC has failed.

The related ASCPC also uses the temperature information to keep discharge temperatures in limits when it gives backup pack flow control.

See the pack flow control section for more information about backup pack flow control (AMM PART I 21-51).



21-52-00-017 Rev 7 12/02/1996

AIR CONDITIONING - PACK CLG AND MIX MANIFOLD TEMP CTRL - FUNCTIONAL DESCRIPTION - CONTROL

General

The left CTC controls the left pack, and the right CTC controls the right pack.

In full air cycle machine (ACM) operation, the CTC controls the pack internal air temperatures and the pack output air temperature by adjustment of these components:

- Second stage turbine bypass valve (TBV)
- Low limit valve (LLV)
- Ram air door actuator.

These components operate in sequence to keep the necessary air temperature from the pack. This temperature is called the integrated mix manifold temperature error (IMMTE) reference. The CTC uses the TBV for primary control of pack output air temperature. The LLV and the ram air door actuator operate if the TBV is full open and the CTC still must increase pack outlet temperature. This keeps the necessary ram air flow to a minimum.

The right CTC is the primary controller of the mix manifold temperature. The left CTC usually follows the right in this condition. This type of operation makes the left and right pack outlet temperatures stay within 10F (5.5C) of each other. If the right pack is off or is in an overtemperature condition, the left CTC takes control of the mix manifold temperature.

The left and right CTCs can also control pack outlet temperatures to different values if it is necessary for the flight deck to have more cooling than the mix manifold.

The CTC usually uses the economy cooling valve (ECV) to help keep the scheduled air flow through the pack when the airplane is at high altitudes and low pneumatic duct pressure (economy cooling mode). The valve can be used to bypass the ACM if the ACM fails (STBY COOLING mode).

Compressor Outlet Temperatures Control

The CTC usually uses the ram air part of the system to control air temperature at the compressor outlet. The CTC can adjust pack air flow to limit compressor outlet temperature or stop pack operation to give protection. The CTC controls compressor out temperature in these limits:

COMPRESSOR OUT TEMP F (C) < 25,000FT	COMPRESSOR OUT TEMP F (C) > 25,000FT	CTC RESPONSE
< 340 (171)	< 400 (204)	MODULATE RAM AIR DOORS FOR PACK OUT TEMP CTRL
>= 340 (171)	>= 400 (204)	RAM AIR DOORS FULL OPEN
>= 355 (179) (*1)	>= 415 (213) (*1)	REQUEST LOWER PRECOOLER OUT TEMP FROM ASCPC (250F, 121C)
>= 355 (179)	>= 415 (213)	DECREASE PACK FLOW (LOWEST VALUE >= SCHEDULE 4)
>= 450(232) > 10 SEC	>= 450(232) > 10 SEC	CLOSE FCV & LATCH PACK OFF (*2)
*1) SINGLE PACK OPERATION OR PACK FAILURE OR ACM FAILED.		
*2) RESET WITH PACK SW OR AIR COND RESET SW		

See the pack flow control section for more information about the pack flow schedules and control (AMM PART I 21-51).

See the air conditioning section for more information about the air conditioning reset switch (AMM PART I 21-00).

Condenser Inlet Temperatures Control

The CTC usually uses the LLV to prevent the formation of ice in the condenser. The CTC can adjust pack air flow to keep the condenser from freezing. The CTC always controls the condenser inlet temperature so that it does not go to a value less than 34F (1C).

Pack Outlet Temperatures Control

The CTC usually uses the TBV, ECV, and the ram air part of the system to control the pack outlet air temperature. The CTC can adjust pack air flow to limit pack outlet temperature or stop pack operation to give protection. The CTC controls pack outlet temperature within these limits:

PACK OUTLET TEMP F (C)	CTC RESPONSE
< 160 (71)	MODULATE TBV & RAM AIR DOORS FOR PACK OUT TEMP CTRL
>= 160 (71) < 180 (82)	MODULATE PACK TO FULL COLD: * AIR DOORS TOWARDS FULL OPEN * TBV TOWARDS FULL CLOSED
>= 180 (82) (*1)	REQUEST LOWER PRECOOLER OUT TEMP FROM ASCPC (250F, 121C)
>= 180 (82)	DECREASE PACK FLOW (LOWEST VALUE >= SCHEDULE 4)
>= 190 (88) > 10 SEC	CLOSE FCV & LATCH PACK OFF (*2)
*1) SINGLE PACK OPERATION OR PACK FAILURE OR ACM FAILED	
*2) RESET WITH PACK SW OR AIR COND RESET SW	

To prevent ice in the mix manifold, the CTC controls the pack valves and ram air doors to keep the mix manifold outlet temperature to a value more than 35F

(2C). If the temperature at the mix manifold outlet decreases to a value less than this level, the CTC increases pack outlet temperature.

See the pack flow control section for more information about the pack flow schedules and control (AMM PART I 21-51).

See the air conditioning section for more information about the air conditioning reset switch (AMM PART I 21-00).

Economy Cooling Mode

The CTC selects the economy cooling mode if the all of these conditions occur:

- ACM operates
- One or both condenser inlet temperature senors operate
- ECV operates
- Pack flow is less than the scheduled value or ambient temperature is less than 20F (-7C)
- Conditions for ACM not failed - condenser bypass are true.

The conditions for ACM not failed - condenser bypass change with altitude. The chart shows five examples.

ACM NOT FAILED - CONDITIONS FOR CONDENSER BYPASS	
ALTITUDE	AMBIENT TEMP F (C)
<= 0	<= 14 (-10)
10,000	<= -9 (-23)
20,000	<= -18 (-28)
>= 30,000	<= -24 (-31)
IF AMBIENT TEMP <= INDICATED VALUE, THEN CONDENSER BYPASS CAN OCCUR.	

In the economy cooling mode, air goes directly from the secondary heat exchanger to turbine two of the ACM. The CTC sets the second stage turbine bypass valve to control pack output temperature and the low limit valve to keep the condenser inlet above 34F (1C).

The CTC keeps a pack in the economy cooling mode until any one of these conditions is true:

- Conditions for condenser bypass are not true
- TBV full closed, ram air doors more than 80 percent open and pack outlet temperature 5F (2.7C) more than IMMTE
- Pack flow schedule 4 is active
- Actual pack flow less than 100 ppm or more than two times the value of pack flow schedule 2.

There are no flight deck effect when the pack operates in the economy cooling mode.

Non-Normal Operations

In addition to compressor and pack outlet overheat conditions, these cause non-normal operations:

- ACM failure
- Pack temperature sensor failures
- Economy cooling value failure
- Low limit valve failure
- Turbine bypass valve failure
- Ram air door failures
- Single pack operation.

Standby Cooling Mode

These faults cause the related pack to operate in the standby cooling mode:

- ACM failure
- Condenser inlet temperature sensors 1 and 2 fail
- Economy cooling valve failed open.

There are two ways the pack can operate when in the standby cooling mode: heat exchanger cooling or condenser bypass. The related CTC sets how the pack operates in the standby cooling mode based on which of these components have failed:

- Heat exchanger cooling occurs if the ACM fails
- Condenser bypass occurs if both condenser sensors, 1 and 2 fail or if the economy cooling valve fails in the open position.

These indications show when a pack operates in the standby cooling mode: the advisory message PACK MODE L (R) shows and the message STBY COOLING shows next to the related pack symbol on the air synoptic display.

See the air conditioning section for more information about the air synoptic display (AMM PART I 21-00).

ACM Failure (Heat Exchanger - STBY COOLING mode)

If an ACM failure occurs, the pack continues to operate in the STBY COOLING mode only if the ACM failed - condenser bypass criteria is met or when the other pack cannot meet the minimum flow necessary for schedule 4. If not, the pack stops. The pack can start again if the above conditions make it necessary.

The conditions for ACM failed - condenser bypass change with altitude. The chart shows five examples.

ACM FAILED - CONDITIONS FOR CONDENSER BYPASS	
ALTITUDE	AMBIENT TEMP F (C)
<= 0	<= 35 (2)
10,000	<= 25 (-4)
20,000	<= 18 (-8)
>= 30,000	<= 12 (-11)
IF AMBIENT TEMP <= INDICATED VALUE, THEN CONDENSER BYPASS CAN OCCUR.	

When the pack operates in the heat exchanger - STBY COOLING mode, the related CTC sets these valves fully open:

- Economy cooling valve
- Low limit valve
- Turbine bypass valve.

In this mode, the CTC adjusts the position of the ram air doors to control the pack outlet air temperature, heat exchanger cooling only. If the pack can not hold the necessary temperature (pack out temperature 5F (2.7C) greater than IMMTE) and the TBV is not full open, the CTC sends a signal to the ASCPC for a lower precooler outlet temperature, (250F, 121C).

See the engine air supply section for more information about the precooler out temperature control and bleed air control (AMM PART I 36-11).

Condenser Sensor/Economy Cooling Valve Failure (Condenser Bypass - STBY COOLING mode)

If both condenser inlet temperature sensors 1 and 2 fail or if the economy cooling valve fails open, the pack continues to operate in the STBY COOLING mode only if the ACM not failed - condenser bypass criteria is met. If not, the pack stops. The pack can start again if the condenser bypass criteria is met. When the pack operates in the condenser bypass - STBY COOLING mode, the related CTC controls the pack outlet temperature with these pack components:

- Economy cooling valve, set to full open
- Low limit valve, set to full close
- Second stage turbine bypass valve, modulating
- Ram air doors, modulating.

Pack Sensor Failures

These sensors have an effect on pack operation if they fail:

- Pack inlet differential pressure sensor, part of the pack flow sensor (not shown)
- Compressor out temperature sensors 1 and 2
- Condenser inlet temperature sensors 1 and 2.

The CTC has these two sources for pack inlet differential pressure: the pack flow sensor and the related ASCPC. If both sources fail, the pack stops.

See the pack flow control section for more information about the pack flow sensor (AMM PART I 21-51).

The CTC has three sources for compressor out temperature: compressor out temperature sensors 1 and 2 and the related ASCPC. If all sources fail, the pack stops.

The CTC has two sources for condenser inlet temperature, condenser inlet temperature sensors 1 and 2. If both fail, the pack operates in the standby cooling mode or stops.

See the zone temperature control and indication section for more information about the effects of other failed sensors on the air conditioning system (AMM PART I 21-61).

Ram Air Door Failure

If the temperature cannot stay within limits if there is a ram air door failure, the CTC decreases pack flow. The amount of decrease in flow has a relation to the temperature limits. The minimum flow is schedule 4. The serviceable pack increases flow to keep total fresh air ventilation constant.

If the ram air door RVDT fails, the CTC moves the actuator to the full open position. The CTC sends a command to the actuator for the correct amount of time to set the door to full open. After this, the CTC identifies the condition as an actuator failure.

Low Limit and Second Stage Turbine Bypass Valve Failures

If a low limit valve failure occurs, the CTC adjusts pack flow to keep condenser inlet temperature at or above 34F (1C). If a second stage turbine bypass valve failure occurs, the CTC sets the position of the ram air doors to control the pack outlet temperature. If the pack can not hold the necessary temperature, the CTC adjusts pack flow to control air temperature to the mix manifold.

If the low limit or second stage turbine bypass valve RVDT fails, the CTC moves the related valve to the 60 percent open position. The CTC times the movement of the valve to set it at 60 percent open. After this the CTC identifies the condition as a valve failure.

Single Pack Operation

In single pack operation, the CTC controls the TBV, LLV, ECV, and ram air doors actuators as usual to keep the necessary temperature in the mix manifold (IMMTE reference). The CTC also increases pack air flow to keep it close to the usual amount when two packs are on. The maximum flow has a limit so it is not more than the value set for flow schedule 2.

If the CTC can not keep pack flow or temperature (pack out temperature 5F (2.7C) more than IMMTE reference) at the necessary value, it can select one or all of these conditions to increase pack flow and to help control the pack out temperature:

- Operate the pack in the economy cooling mode if the conditions for this mode permit it
- Tell the ASCPC to supply a lower precooler outlet temperature (250F, 121C) if the turbine bypass valve is not full open
- Adjust the position of the second stage turbine bypass valve to control flow and temperature
- If the second stage turbine bypass valve is fully open, or a lower precooler out temperature is not available (wing anti-ice if on) or does not let the pack operate to the necessary temperature, the CTC tells the ASCPC to supply a higher pneumatic pressure (6 psi bias for HPSOV control).

When the CTC must choose to control pack flow or pack out temperature, pack flow is usually first in the order of control. Pack overheat protection control, always overrides pack flow control.

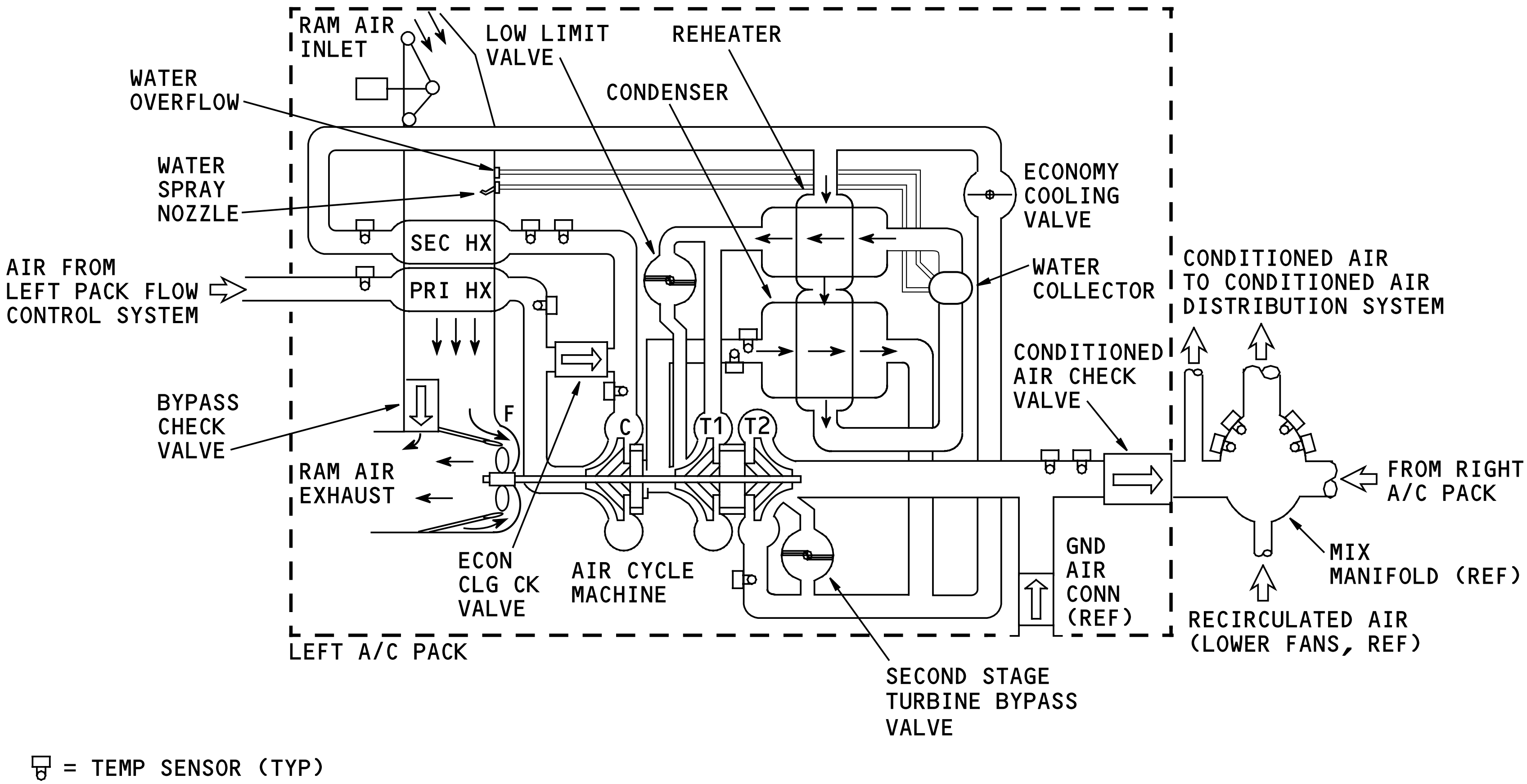
See the pack flow control section for more information about the pack flow schedules (AMM PART I 21-51).

Single pack operation can cause the related lower recirculation fan (not shown) to stop if these conditions occur:

- Airplane on the ground
- Pack at maximum cooling
- Mix manifold temperature 12F (6.7C) > IMMTE reference.

When a fan is set to off, this helps the related pack meet the necessary IMMTE reference by reducing the amount of cabin air put in to the mix manifold.

See the recirculation system section for more information about the recirculation fan control (AMM PART I 21-25).



21-52-00-018 Rev 10 10/17/96

AIR CONDITIONING - PACK CLG AND MIX MANIFOLD TEMP CTRL - FUNCTIONAL DESCRIPTION - PACKS

AIR CONDITIONING - COOLING - OPERATION

General

The air conditioning panel has these controls for pack operation:

- Left and right pack switches
- Air conditioning reset switch.

Location

The air conditioning panel is on the P5 overhead panel in the flight deck.

Pack Control

The L PACK and R PACK switches are alternate-action switches. AUTO shows when you push the switch in for selection of automatic pack operation.

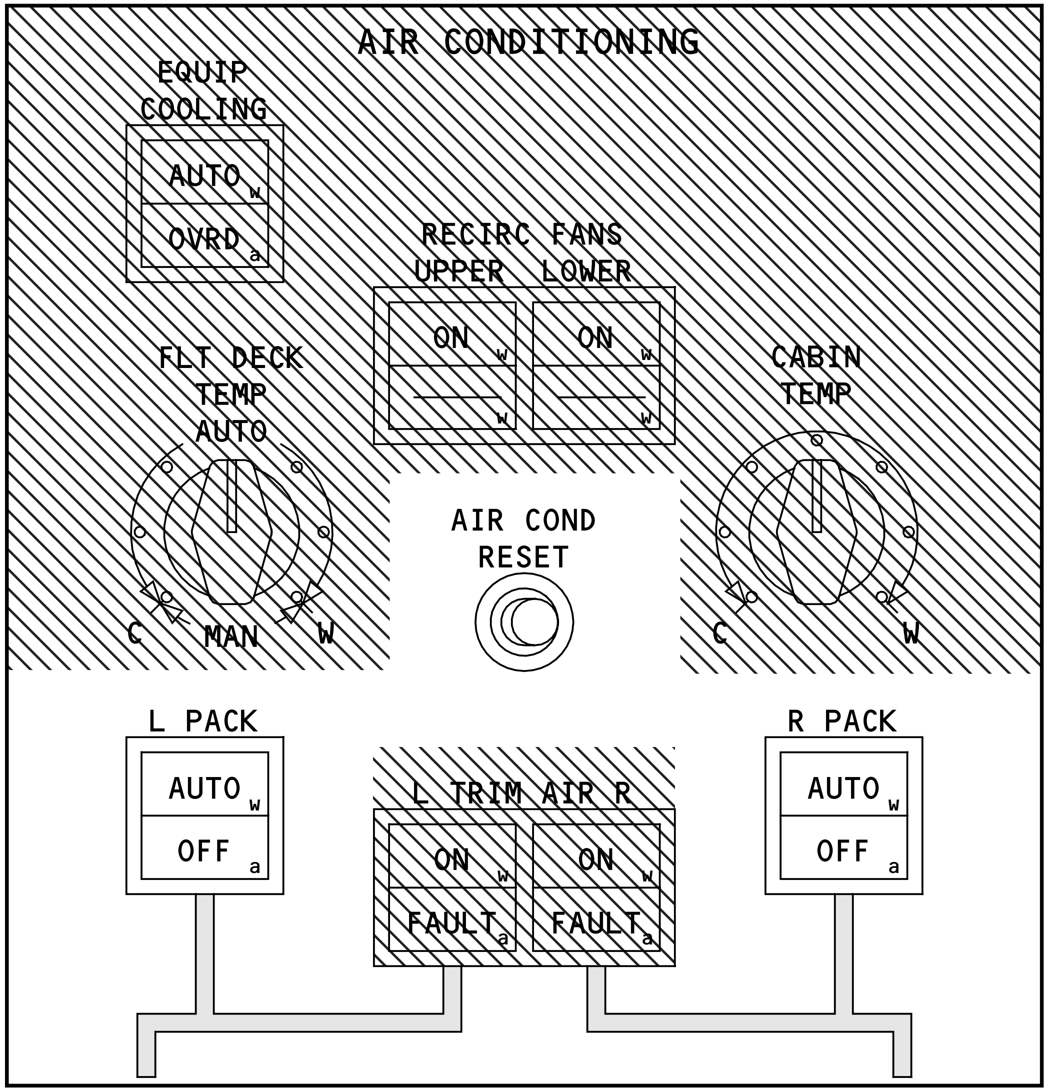
The OFF indication is not a function of switch position. It shows when the flow control and shutoff valves are closed.

Air Conditioning Reset Control

The AIR COND RESET switch is a momentary-action switch. This switch starts the system after a failure.

Training Information Point

The left and right main buses supply power for the OFF indications on the pack switches. If these buses have no power, the OFF indication does not show.



AIR CONDITIONING PANEL

AIR CONDITIONING - COOLING - OPERATION

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AIR CONDITIONING - COOLING - AIR SYNOPTIC DISPLAY AND AIR CONDITIONING MAINTENANCE PAGE

Air Synoptic Display

The top part of the air synoptic display shows information about the air conditioning system.

Green flow bars show air flow through the left and right packs. These symbols show the status of the packs:

- Pack on - green oval
- Pack off or pack status data invalid - white oval
- Pack failed - amber oval with amber X.

The STBY COOLING message and an advisory message PACK MODE L (R) show when a pack is on and has any of these faults:

- Air cycle machine (ACM) failed
- Both condenser inlet temperature sensors failed
- Economy cooling valve failed open.

If the pack stops, the STBY COOLING message shows.

Air Conditioning Maintenance Page

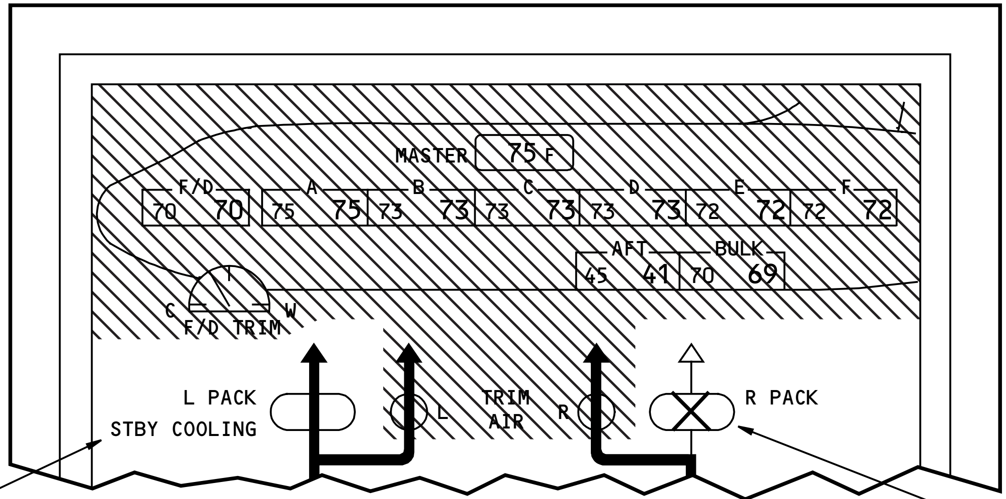
All the temperatures on the air conditioning maintenance page are in degrees F.

The air conditioning maintenance page has this information:

- MIX MANIFOLD TEMP - Temperature in the mix manifold
- FLOW SCHEDULE - Right air conditioning pack flow schedule: 0,1,2,3, or 4. Usual left pack flow schedule is the same as the right
- PACK FLOW-VOLUME - Pack flow rate in cubic feet per minute
- PACK FLOW-MASS - Pack flow rate in pounds per minute
- PRI HX IN TEMP - Temperature at the inlet of the primary heat exchangers
- PRI HX OUT TEMP - Temperature at the outlet of the primary heat exchangers
- CPRSR OUT TEMP - Temperature at the outlet of the air cycle machine compressors
- SEC HX OUT TEMP - Temperature at outlet of the secondary heat exchangers
- CONDENSER IN TEMP - Temperature at the inlet of the condensers
- STG 2 TURB IN TEMP - Temperature at the inlet of turbine 2 in the air cycle machines
- TRIM AIR PRESS - The difference, in psid, between cabin pressure and trim air pressure
- PACK CTRL CH - Shows the channel in control for the left and right cabin temperature controllers
- PACK IN PRESS - Pressure, in psia, at the inlet to the air conditioning packs
- LOW LIM VLV POS - Position of the low limit valve (0.00 is closed, 1.00 is open)
- TURB BYP VLV - Position of the turbine bypass valve in percent heat (0.00 is closed, 1.00 is open)
- RAM AIR INLET - Position of the ram air inlet in percent heat (0.00 is open, 1.00 is closed)

- RAM AIR EXIT - The ram air exit is a fixed opening; the position display is blank
- ECON COOL VLV - Open or closed position of the economy cooling valve
- LOWER FLOW CTRL VLV - Open or closed position of the lower flow control valve
- UPPER FLOW CTRL VLV - Open or closed position of the upper flow control valve.

See the primary display system for more information about the air conditioning maintenance page (AMM PART I 31-61).



AIR SYNOPTIC DISPLAY (TYPICAL)

MIX MANIFOLD TEMP	70		FLOW SCHEDULE	1	
	L	R		L	R
PACK FLOW-VOLUME	3999	0	PACK CTRL CH	1	2
PACK FLOW-MASS	300.0	0.0	PACK IN PRESS	46.0	46.0
PACK OUT TEMP	38	68	LOW LIM VLV POS	0.10	0.00
PRI HX IN TEMP	385	68	TURB BYP VLV	0.25	0.15
PRI HX OUT TEMP	350	68	RAM AIR INLET	0.35	0.98
CPRSR OUT TEMP	400	68	RAM AIR EXIT		
SEC HX OUT TEMP	300	68	ECON COOL VLV	CLSD	CLSD
CONDENSER IN TEMP	59	68	LOWER FLOW CTRL VLV	OPEN	CLSD
STG 2 TURB IN TEMP	77	68	UPPER FLOW CTRL VLV	CLSD	CLSD
TRIM AIR PRESS	5.0	5.0			

PACK R DATE 5 FEB 97 UTC 18:54:04

AIR CONDITIONING MAINTENANCE PAGE (TYPICAL)

21-50-00-006 Rev 3 03/07/1997

AIR CONDITIONING - COOLING - AIR SYNOPTIC DISPLAY AND AIR CONDITIONING MAINTENANCE PAGE

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AIR CONDITIONING - COOLING - GROUND TESTS

General

These are the cooling ground tests that show when you select ATA 21 Cabin Temperature Control System:

- Left pack actuators
- Left system air on
- Left system air off
- Right pack actuators
- Right system air on
- Right system air off.

Left and Right Pack Actuators

This test makes sure that the related cabin temperature controller can control these air conditioning pack LRUs:

- Ram air inlet door
- Turbine bypass valve
- Low limit valve.

During this test, the related pack operation stops, and the ram air doors move. The test takes approximately 3-5 minutes.

This test shows for these ground test types:

- System test
- Operational test
- LRU replacement test.

Left and Right System Air On

This test makes sure that the related cabin temperature controller can control these air conditioning pack and trim air LRUs:

- Upper flow control valve
- Lower flow control valve
- Economy cooling valve
- Air cycle machine
- Trim air pressure regulation and shutoff valve.

During this test, the related pack operation stops, and the ram air doors move. The test takes approximately 5-10 minutes.

This test shows for these ground test types:

- System test
- Operational test
- LRU replacement test.

Left and Right System Air Off

This test makes sure that the related cabin temperature controller can control these air conditioning pack LRUs:

- Ram air inlet door
- Turbine bypass valve
- Low limit valve.

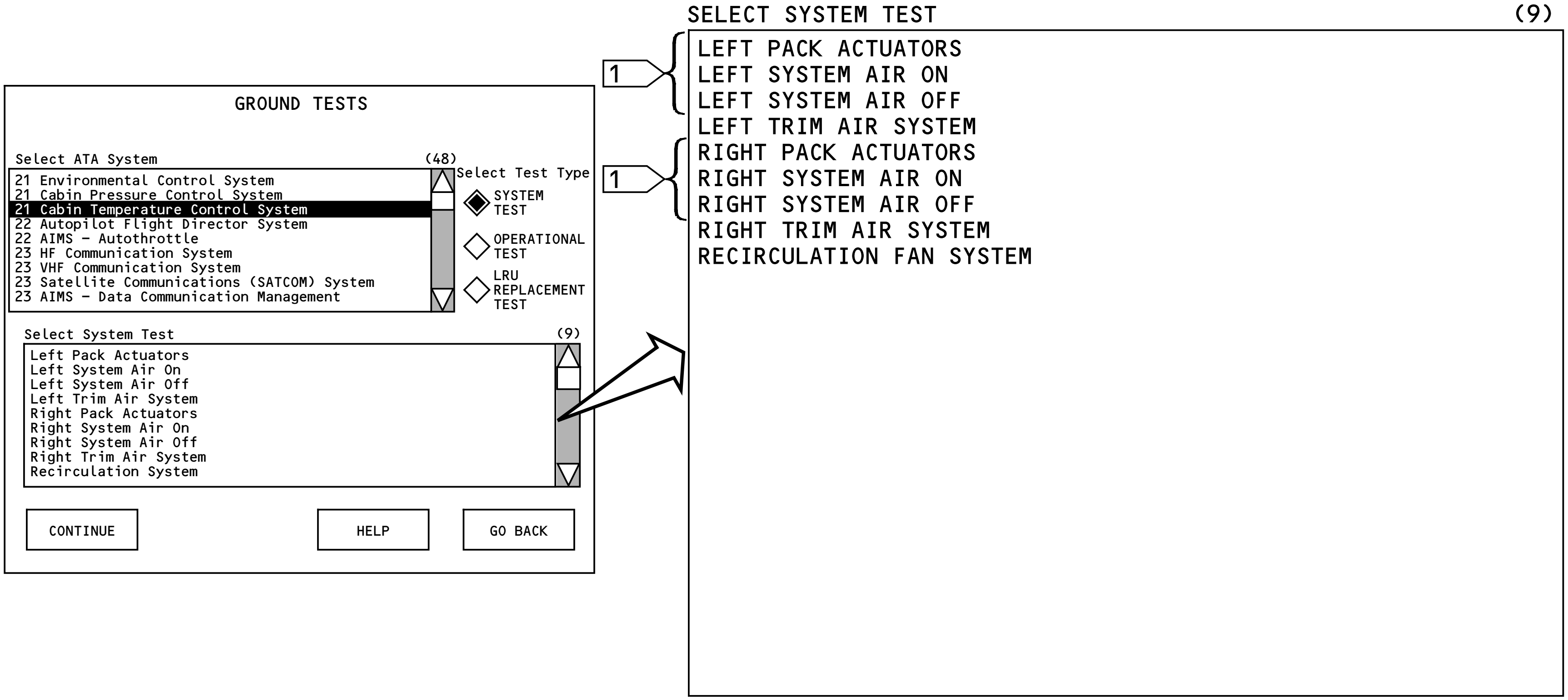
AIR CONDITIONING - COOLING - GROUND TESTS

This test also makes sure that the related cabin temperature controller can control the trim air system on that side.

During this test, the related pack and trim air operation stops, and the ram air doors move. The test takes approximately 2-3 minutes.

This test shows for these ground test types:

- System test
- Operational test
- LRU replacement test.



NOTE: SYSTEM TESTS SHOW.
OPERATIONAL AND LRU REPLACEMENT TESTS ARE SIMILAR.

1 THESE ARE THE AIR CONDITIONING - COOLING TESTS.

21-50-00-008 Rev 2 08/17/96

AIR CONDITIONING - COOLING - GROUND TESTS

AIR CONDITIONING - TEMPERATURE CONTROL - INTRODUCTION

Purpose

The temperature control system controls the temperature in these locations:

- Flight deck
- Passenger cabin.

The system sets the target temperature for the air conditioning packs. The system also sets the amount of air necessary from the APU when the APU supplies air to the packs.

The system has these parts:

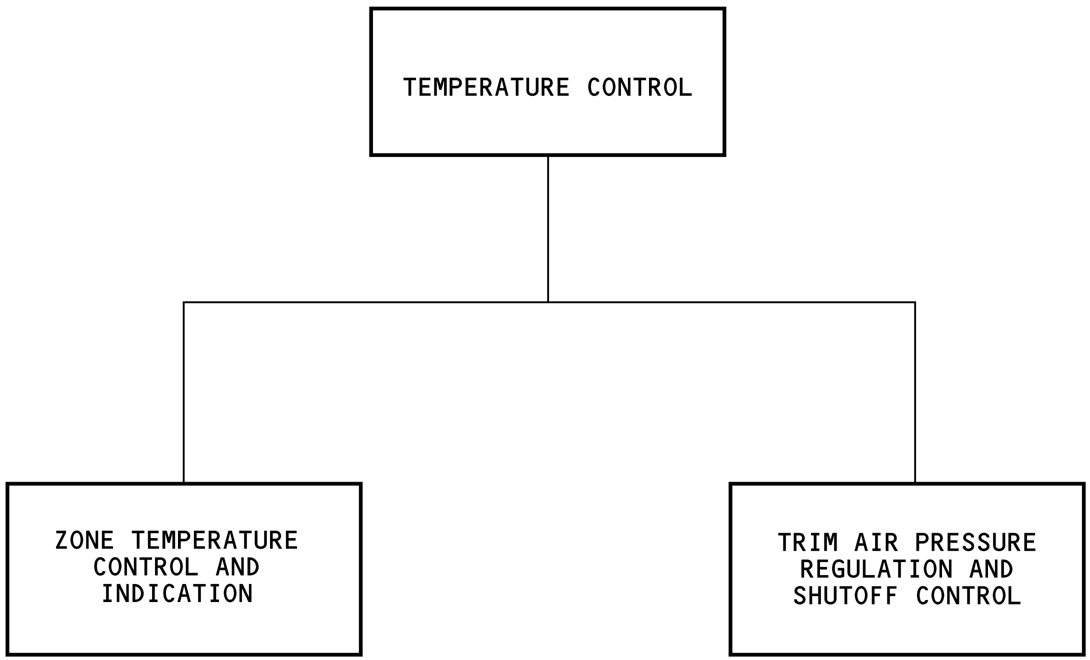
- Zone temperature control and indication
- Trim air pressure regulation and shutoff control.

Zone Temperature Control and Indication

The zone temperature control and indication system adjusts flight deck and passenger cabin zone temperatures to set values.

Trim Air Pressure Regulation and Shutoff Control

The trim air pressure regulation and shutoff control adjusts, monitors, and distributes trim air supply pressure to the trim air modulating valves.



21-60-00-001 Rev 3 02/25/1997

AIR CONDITIONING - TEMPERATURE CONTROL - INTRODUCTION

AIR CONDITIONING - TEMPERATURE CONTROL - GENERAL DESCRIPTION - CONTROL

General

The cabin temperature controllers (CTCs) adjust the trim air temperature components. The CTCs control these components to get the necessary air pressure and temperatures in the cabin zones and flight deck. The controls are on these panels:

- Air conditioning panel on the P5 overhead panel in the flight deck
- Cabin system control panel (CSCP) in the passenger cabin
- Cabin area control panels (CACP) in the passenger cabin.

The system has an interface with the ECSMCs. The cards give information about the condition of the lavatory/ galley vent fans. If both fans are off, the CTCs do not use the sensors in the zones to control zone temperatures. See the zone temperature control and indication section for more information about the control of zone temperatures with failed sensors (AMM PART I 21-61).

Trim Air Pressure Regulation and Shutoff Control

The trim air pressure regulation and shutoff valve controls trim air supply pressure to a set value. The trim air pressure sensor gives trim air duct pressure information to the CTC. The CTC uses it for control and indication. The air supply cabin pressure controller (ASCPC) supplies alternative control of the trim air pressure regulation and shutoff valve.

Zone Temperature Control

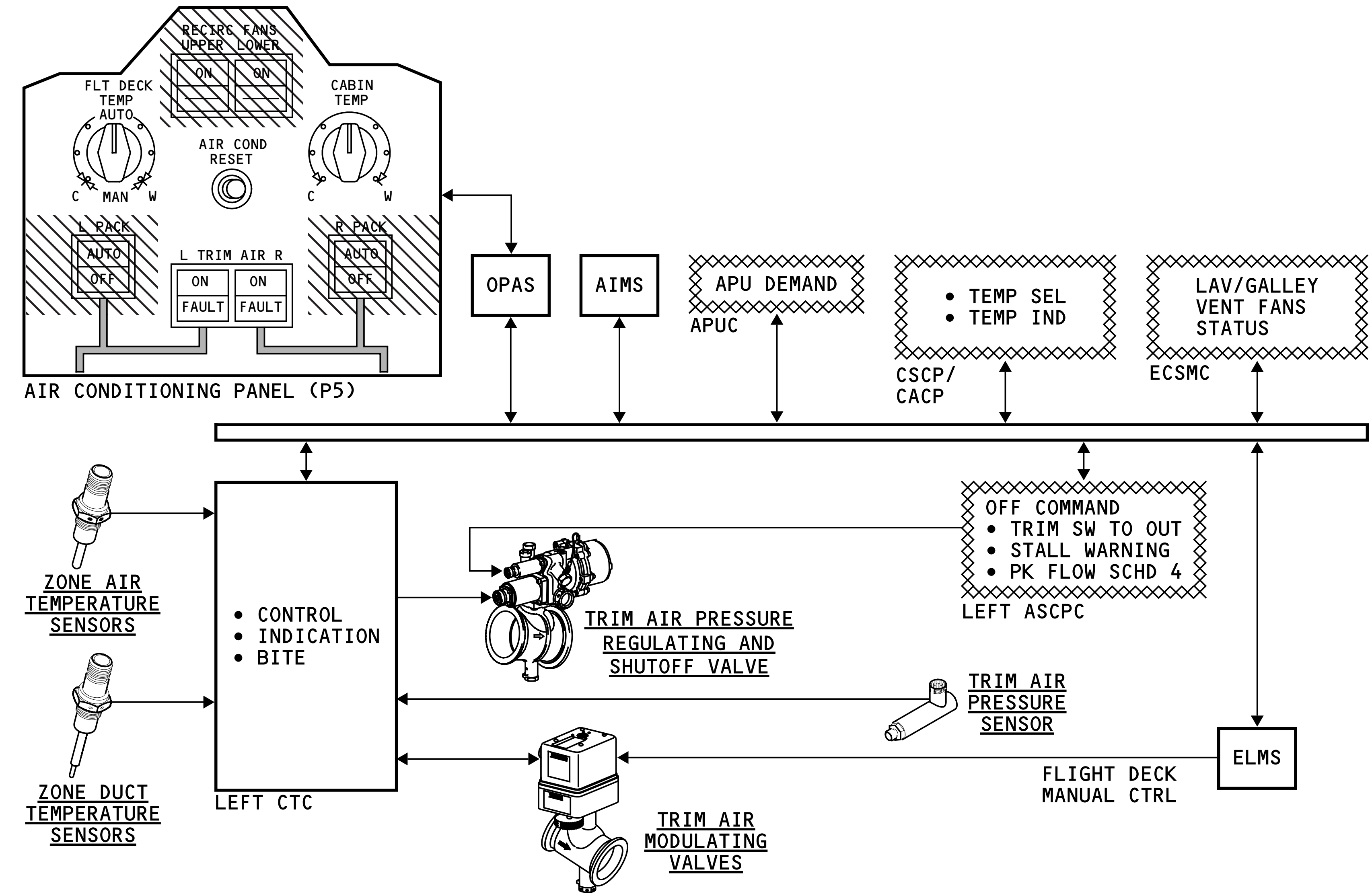
The trim air modulating valves adjust the flow of warm air added to the cold air that goes to the temperature control zones.

The FLT DECK TEMP control let the flight crew set the target temperatures for the flight deck zone. The CABIN TEMP control let the flight crew set the master temperature for all of the passenger zones. The minimum selectable temperature is 65F (18C) and the maximum is 85F (29C).

The CSCP and the CACP let the attendants adjust the target temperature for the cabin by area. The area temperature can be set 10F (6C) more or less than the master. The temperatures can not be set less than 65F (18C) or more than 85F (29C).

Zone air temperature sensors and zone duct temperature sensors give temperature information to the CTC. The CTC use the information for control and indication.

The CTC has an interface with the APU controller (APUC). When the APU supplies air for pack operation and temperature control, the CTC tells the APUC the amount of air to supply. The CTC uses the APU DEMAND signal to tell the APUC the amount of air that is needed. See the zone temperature control and indication section for more information about the APU DEMAND signal (AMM PART I 21-61).



NOTE: LEFT SYSTEM SHOWN, RIGHT SIMILAR

AIR CONDITIONING - TEMPERATURE CONTROL - GENERAL DESCRIPTION - CONTROL

AIR CONDITIONING - TEMPERATURE CONTROL - GENERAL DESCRIPTION - MECHANICAL

Trim Air Pressure Regulation and Shutoff Control

A left side and a right side trim air pressure regulating and shutoff valves make sure the trim air supply is between 2 and 8.5 psi above cabin pressure. The usual pressure is 5 psi above cabin pressure. This allows sufficient flow and keeps pneumatic system noise to a minimum. The trim air pressure sensors give trim air pressure information to the cabin temperature controllers (not shown) for control and indication.

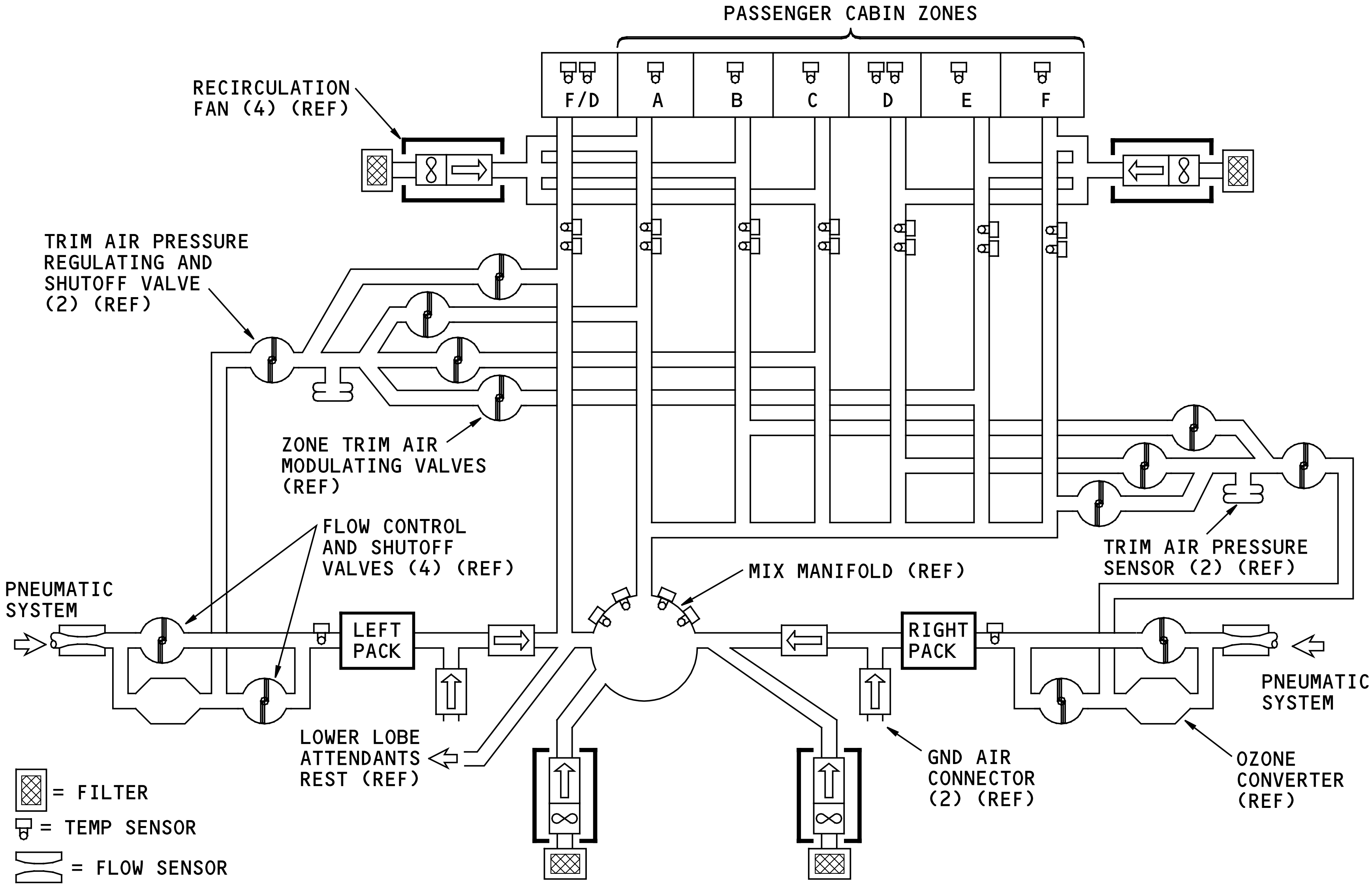
Zone Temperature Control

The cabin temperature controllers use the packs to control cooling for the flight deck and the mix manifold.

The trim air modulating valves control the quantity of trim air supplied to each zone. Trim air for the passenger zones mixes with the air from the mix manifold. Trim air for the flight deck mixes with the air from the left pack.

Each trim air modulating valve adjusts the amount of trim air to control the zone temperature. Zones that need a higher temperature get more trim air. Zones that need a lower temperature get less trim air.

The zone air temperature sensors and zone duct temperature sensors give air temperature information to the cabin temperature controllers (not shown) for control and indication.



21-60-00-003 Rev 5 10/28/1997

AIR CONDITIONING - TEMPERATURE CONTROL - GENERAL DESCRIPTION - MECHANICAL

AIR CONDITIONING - TRIM AIR PRESS REGULATION AND SHUTOFF CTRL - INTRODUCTION

General

Trim air pressure regulation and shutoff control system adjusts, monitors and distributes trim air supply pressure to the trim air modulating valves.

The related CTC controls and monitors the operation of this part of the air conditioning system. The CTCs use the trim air PRSOV to keep the trim air supply pressure between 2 and 8.5 psi above cabin pressure. The usual pressure is 5 psi above cabin pressure.

The related ASCPC gives backup off control for the trim air PRSOV. The ASCPCs are the usual sources for cabin pressure data.

The remote cabin pressure sensor is a backup source for cabin pressure data.

The trim air switches enable trim air operation when they are set to ON. The switches turn off the trim system when they are in the out position. The FAULT light turns on and the advisory message TRIM AIR L (R) shows when any of these conditions occur:

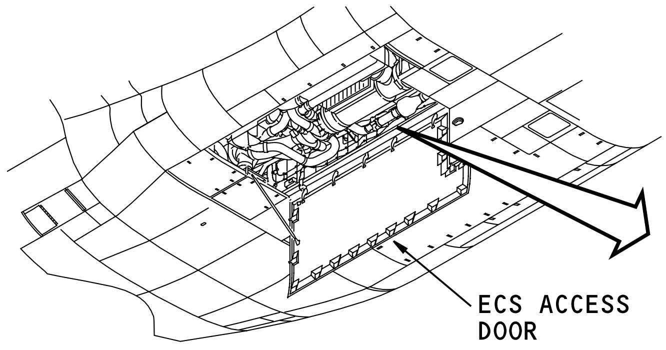
- Related zone duct overheat
- Related trim air switch set to out
- Related trim air system has a fault (trim air PRSOV, controller, pressure sensor).

See the zone temperature control and indication section for more information about the zone temperature control system (AMM PART I 21-61).

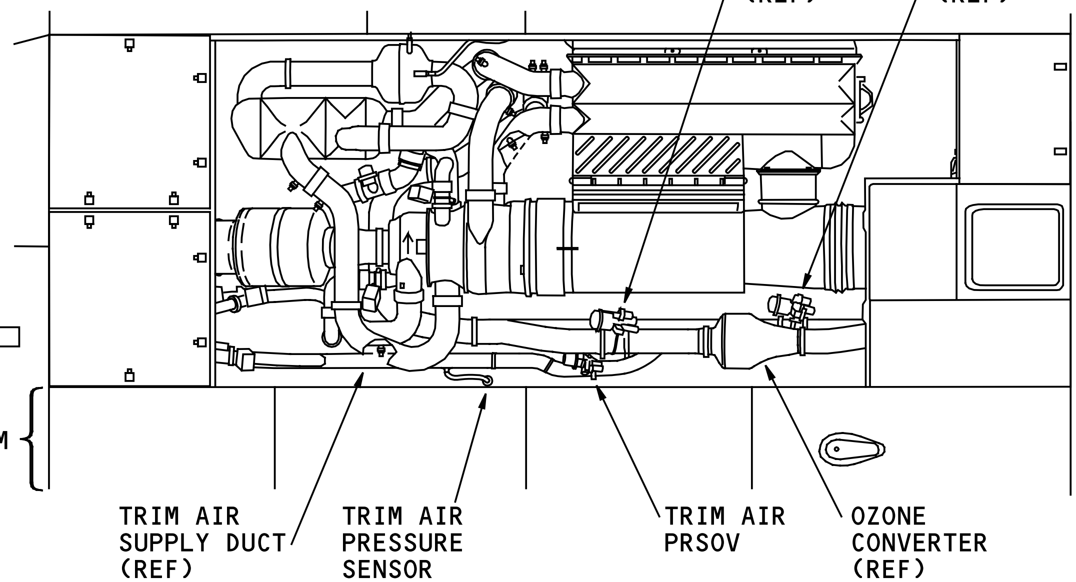
Location of Components

These components are in each ECS bay:

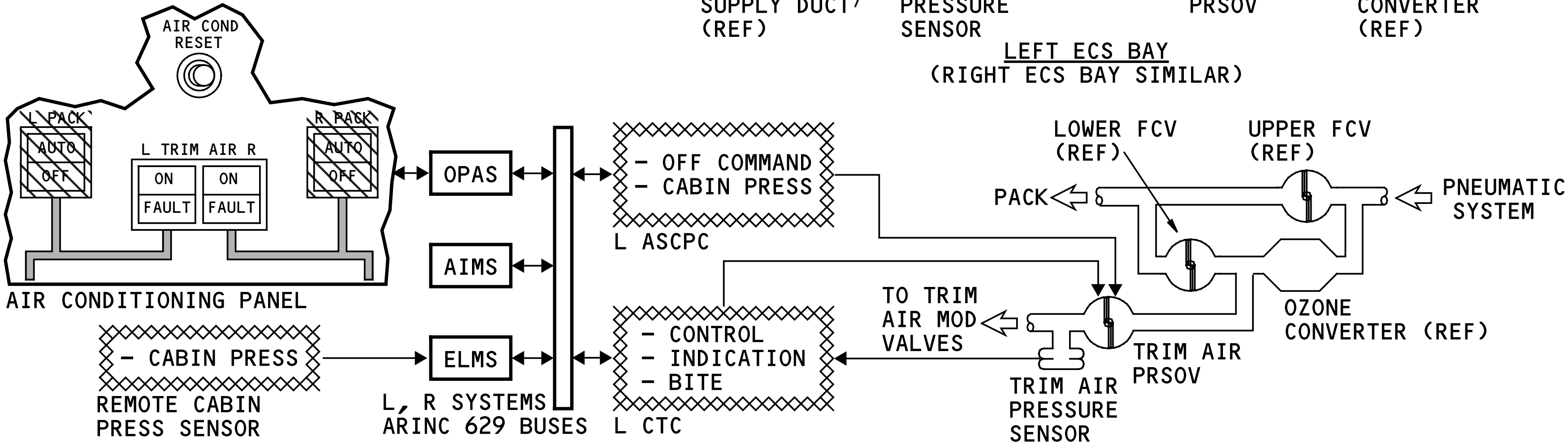
- Trim air pressure regulating and shutoff valve (PRSOV)
- Trim air pressure sensor (on the keel beam, forward of the trim air pressure regulating and shutoff valve).



UNDER FUSELAGE AREA
(TYPICAL)



LEFT ECS BAY
(RIGHT ECS BAY SIMILAR)



TRIM AIR PRESSURE REGULATION AND CONTROL SCHEMATIC

21-62-00-001 Rev 2 04/10/1997

AIR CONDITIONING - TRIM AIR PRESS REGULATION AND SHUTOFF CTRL - INTRODUCTION

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General

The CTC uses the trim air pressure regulating and shutoff valve (PRSOV) to give shutoff control and to control the pressure of the air that goes to the trim air modulating valves. The CTC can also use the valve to give backup zone temperature regulation. See the zone temperature control and indication section for more information about the zone temperature control system (AMM PART I 21-61).

Location

The left and right trim air PRSOVs are in the related ECS bays next to the keel beam. You open the related ECS access door to get access to the valves.

Physical Description

These are the parts of the valve:

- Pneumatic actuator
- Locking crank/position indicator
- Shutoff solenoid
- Torque motor
- Valve disc
- Valve body
- Plug and filter (internal)
- Locking plug.

The valve is electrically controlled and pneumatically operated. This valve is not spring-loaded open or closed. The valve is fail safe off, if no power goes to the torque motor.

Functional Description

Control air pressure pushes on the open side of the pneumatic actuator to move the valve to open. Supply air pressure pushes on the close side of the pneumatic actuator to move the valve towards close. A change in the amount of the control air pressure makes the valve control trim air pressure downstream of the valve. The CTC uses the torque motor to set the amount of control air that goes to the pneumatic actuator.

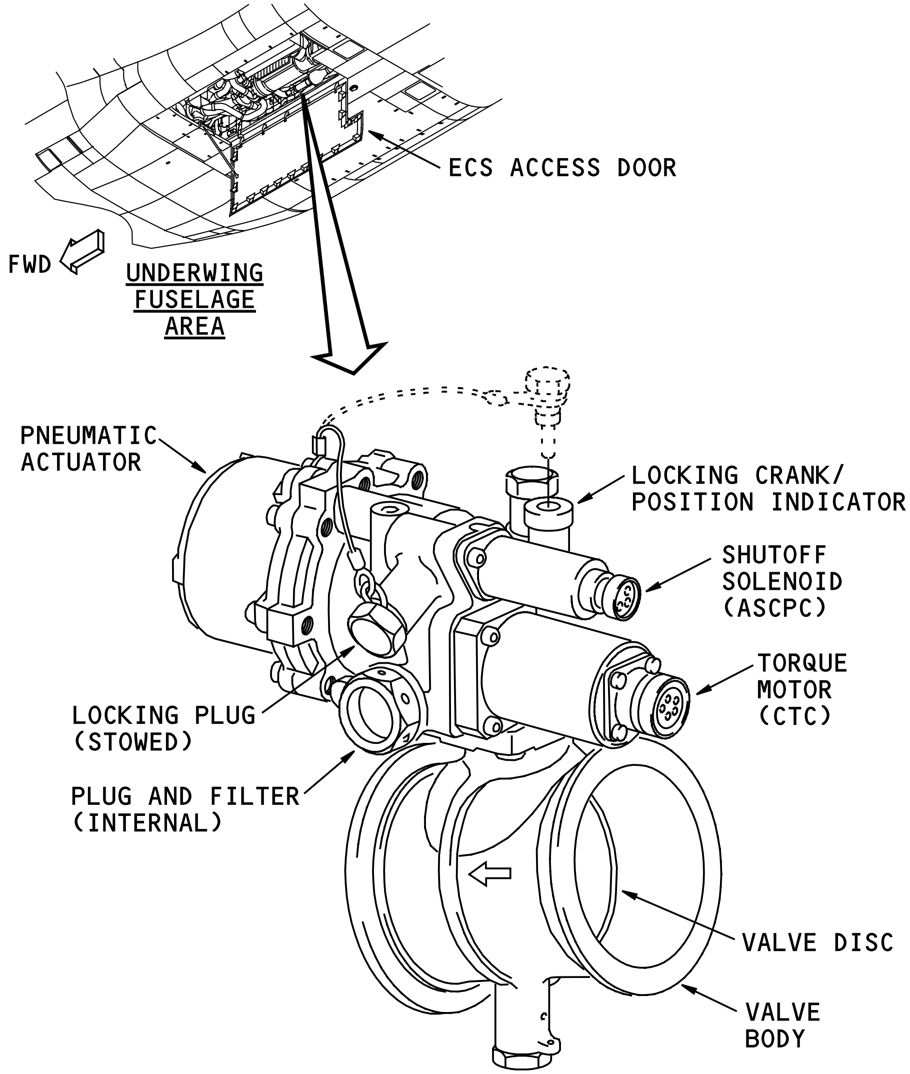
The torque motor operates like a spring-loaded-closed modulating valve. With no current to the torque motor, it is spring-loaded to stop control air and vents control pressure from the open side of the pneumatic actuator. This lets supply pressure move the actuator to close the trim air PRSOV (fail safe off). The amount of current that goes to the torque motor is directly related to the value to which the trim air PRSOV controls trim air pressure to. When the CTC increases current to the torque motor, control pressure to the pneumatic actuator increases, the valve disc opens more and downstream pressure increases.

The ASCPC uses the solenoid to give backup shutoff control for the trim air PRSOV. With no voltage to the solenoid, it is spring-loaded to let control pressure go from the torque motor to the open side of the pneumatic actuator. With 28v dc to the solenoid, it stops control air and vents control pressure from the open side of the pneumatic actuator.

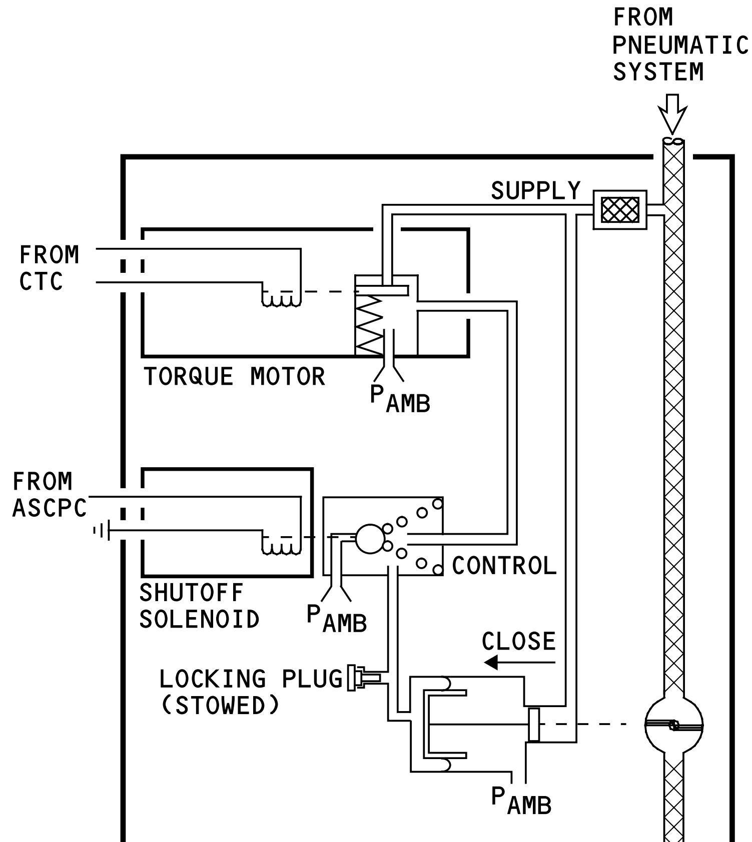
See the page on the functional description of the trim air pressure regulation and shutoff control section for more information on trim air pressure control.

Training Information Point

You can use the locking plug and locking crank/position indicator to lock the trim air PRSOV closed. When you remove the locking plug from its stowed position, control pressure is vented.



TRIM AIR PRSOV



TRIM AIR PRSOV SCHEMATIC
(SHOWN WITHOUT POWER)

21-62-00-002 Rev 4 10/18/96

AIR CONDITIONING - TRIM AIR PRESS REGULATION AND SHUTOFF CTRL - TRIM AIR PRSOV

Purpose

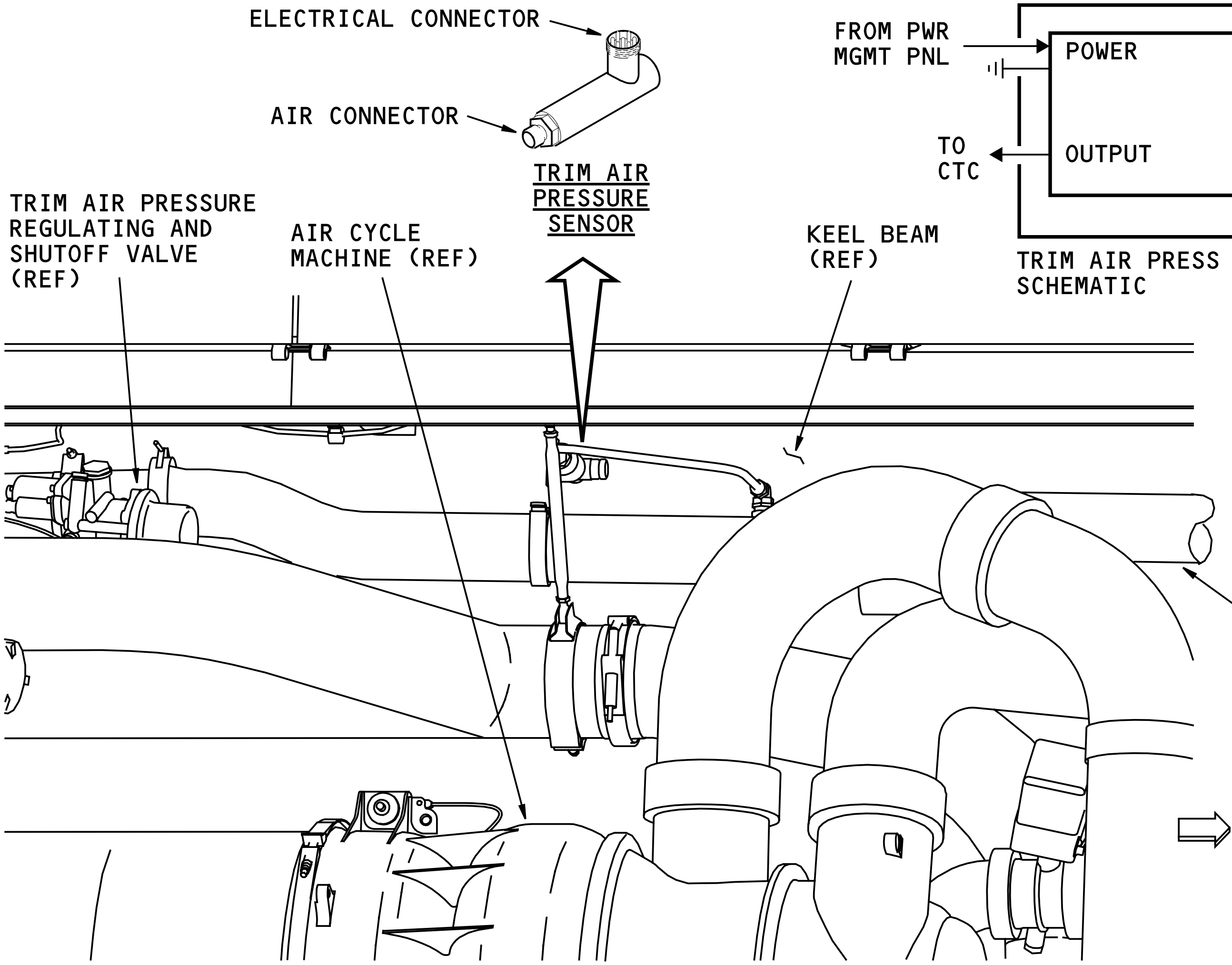
The trim air pressure sensor monitors air pressure at the outlet of the trim air pressure regulating and shutoff valve.

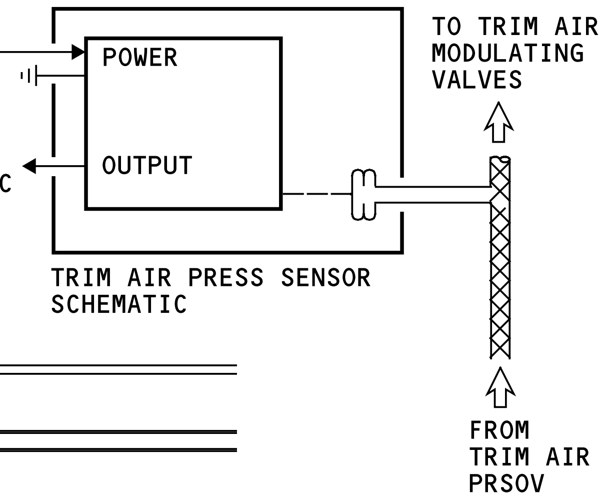
Physical Description

The sensor is an electronic device. It connects to the air duct through a small pressure line.

Location

The sensor mounts on the keel beam adjacent to the trim air pressure regulating and shutoff valve.





TRIM AIR PRESS SENSOR SCHEMATIC

LEFT ECS BAY
(TYPICAL)

21-62-00-003 Rev 1

AIR CONDITIONING - TRIM AIR PRESS REGULATION AND SHUTOFF CTRL - TRIM AIR PRESSURE SENSOR

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CTC Control

The left cabin temperature controller (CTC) gives usual control of the trim air pressure regulating and shutoff valve (PRSOV). The left CTC uses information about airplane conditions to calculate the position of the trim air PRSOV. These components and systems give information to the left CTC:

- AIR COND RESET switch, resets latched conditions in the CTCs
- L TRIM AIR switch, in or out position
- Remote cabin pressure sensor, backup source for cabin pressure
- AGS, airplane on the ground condition used during the ASCPC preflt test
- AIMS, ground test conditions and indications
- WES, stall condition
- Left trim air pressure sensor, trim air supply duct pressure
- ASCPCs, primary source for cabin pressure and alternative close control for the trim air PRSOV.

The left trim air PRSOV opens only if all of these conditions occur:

- One or both air conditioning packs are on
- Pack flow schedule 4 is not selected
- Airplane is not in a stall condition
- Left trim air switch is set to the ON position
- Left trim air pressure sensor is not failed
- One of both channels of the left CTC operates
- No duct overheat condition in zones B, C, E, or F/D.

The usual pressure regulation value for the trim air PRSOV is 5 psi above cabin pressure.

The CTC can adjust the regulation value between 2 - 8.5 psi above cabin pressure. The CTC can adjust the regulation value as necessary to control zone temperature. The CTC does this only when a trim air modulating valve fails more than 10 percent open. See the zone temperature control and indication section for more information about the control of the trim air modulating valves (AMM PART I 21-61).

Duct Overheat

A duct overheat (190F, 88C) for zones that get conditioned air from the mix manifold causes the related trim air PRSOV to latch closed. A duct overheat (190F, 88C) for the flight deck zone can operate one of these two ways:

- If the left pack outlet temperature is less than 160F (71C), then the trim air PRSOV is latched closed
- If the left pack outlet temperature is equal to or more than 160F (71C), then the trim air PRSOV closes but does not latch.

This type of control makes sure the left trim system does not latch off when the left pack gives air to the flight deck at a high temperature. See the pack cooling and mix manifold temperature control section for more information about the temperature control function of the air conditioning pack (AMM PART I 21-52).

ASCPC Control

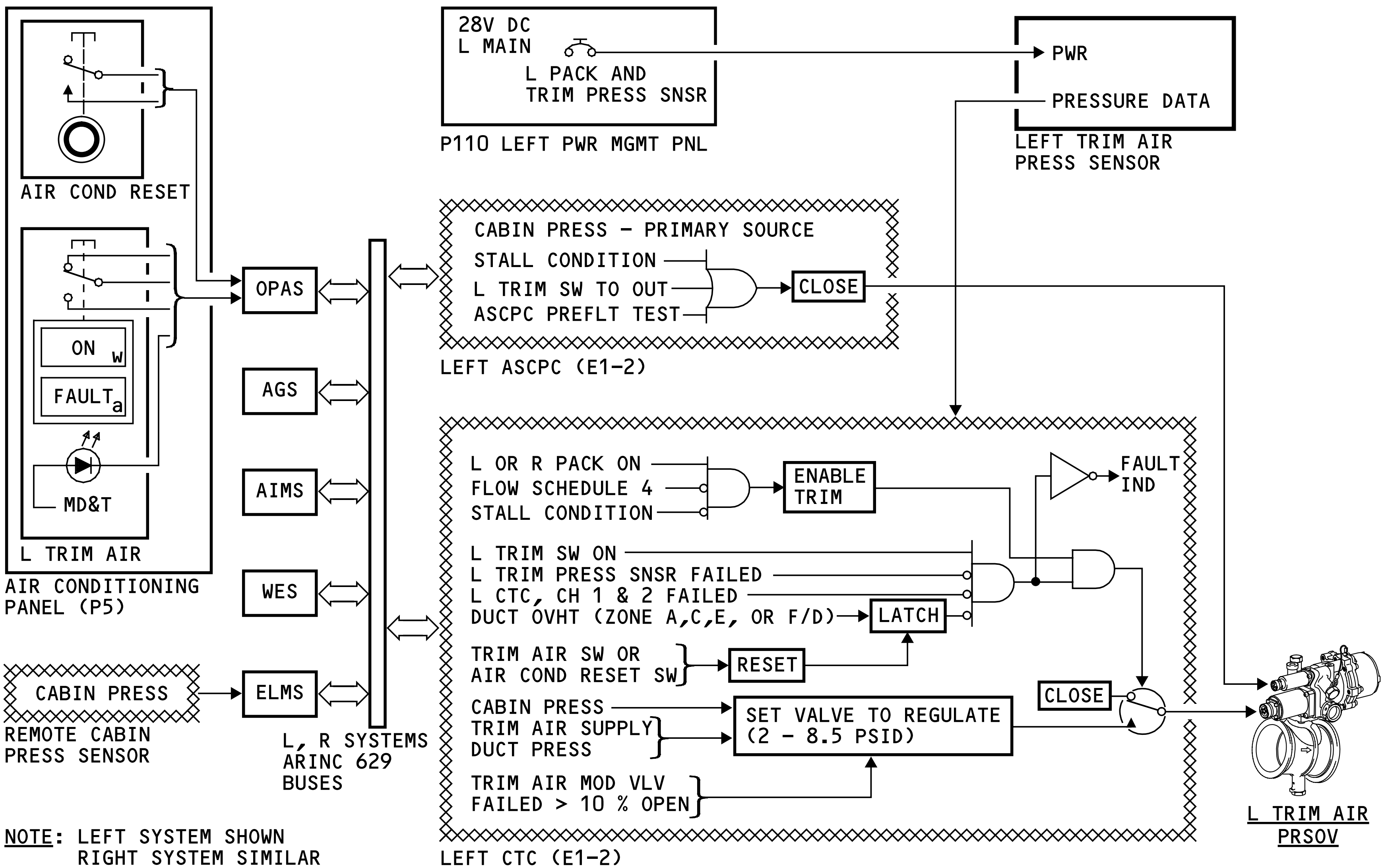
The air supply cabin pressure controller (ASCPC) can close the trim air pressure regulating and shutoff valve to decrease the load on the pneumatic system. The ASCPC closes the valve if any of these conditions occur:

- Airplane is in a stall condition
- Left trim air switch is set to the out position.

For the trim air system, the stall condition has a maximum time limit of 8 seconds. After 8 second the trim system returns to normal operation.

ASCPC Preflight Test

Immediately after an engine start, the ASCPCs send flow schedule 1 to the CTCs. The CTCs set the trim air pressure regulating and shutoff valves to the open position while the ASCPC does a test of its control over these valves. When the ASCPC completes this test (15 sec), the CTC sets the valves to the correct position, and the ASCPC releases control.



NOTE: LEFT SYSTEM SHOWN
RIGHT SYSTEM SIMILAR

AIR CONDITIONING - TRIM AIR PRESS REGULATION AND SHUTOFF CTRL - FUNCTIONAL DESCRIPTION

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Purpose

The zone temperature control and indication system adjusts flight deck and passenger cabin zone temperatures to set values. Mufflers in the trim air duct distribution ducts decreases noise in the trim air system.

General Description

The left and right cabin temperature controllers (CTCs) monitor and give temperature control for all zones. The left controller monitors and controls these zones:

- Flight deck (F/D)
- Passenger zone A
- Passenger zone C
- Passenger zone E.

The right controller monitors and controls these zones:

- Passenger zone B
- Passenger zone D
- Passenger zone F.

The CTCs use the air conditioning packs for cooling and the trim air modulating valves to adjust the temperature in zones that need more heat. See the air conditioning chapter for more information about the pack cooling and mix manifold temperature control system (AMM PART I 21-52).

You use the flight deck temperature control on the air conditioning panel to control the flight deck temperature. AUTO lets you set the target temperature between 65F (18C) and 85F (29C). MAN selection lets you manually adjust the temperature in the flight deck.

You use the cabin temperature control on the air conditioning panel to select the (master) target temperature for all zones in the passenger cabin area. You use the cabin temperature screen on the cabin area control panels or cabin system control panel to bias the target temperature for passenger cabin areas. You can adjust the temperature 10F (6C) above or below the master target value. The bias does not let you select a temperature below 65F (18C) or above 85F (29C).

For the passenger cabin zones there is an auto comfort correction feature. This feature biases up the cabin master target temperature when the airplane is in a cruise condition. The temperature is biased up a maximum of 4F (2C).

Interfaces

The CTCs use sensors in the zones and in the air conditioning distribution ducts to monitor air temperature in these areas. The temperature data is used for control and indication.

The CTCs use RVDTs in the modulating valves to monitor valve position. Valve position data is used for control and indication.

AIR CONDITIONING - ZONE TEMP CTRL AND INDICATION - INTRODUCTION

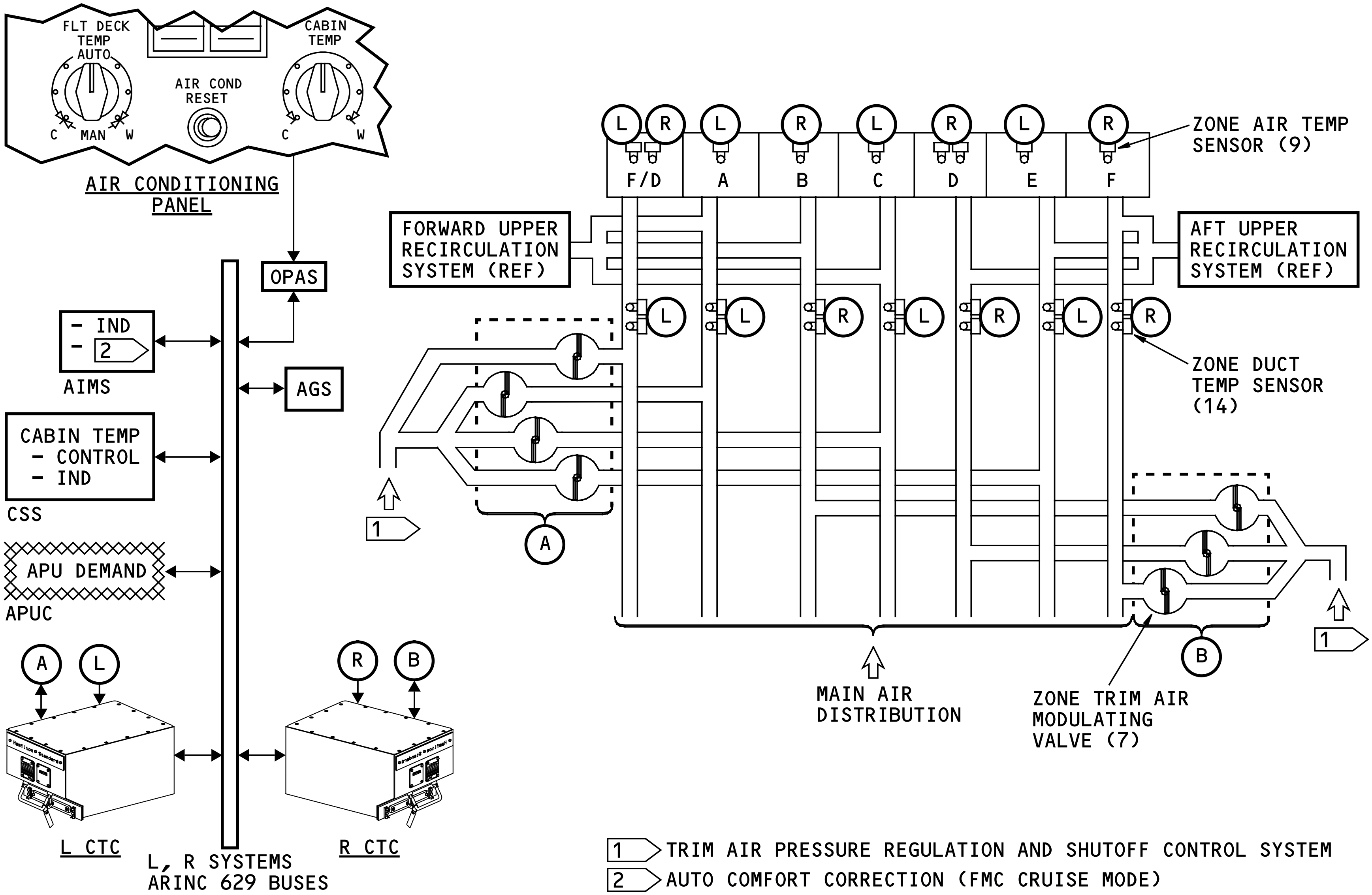
The CTCs get air ground information from the air ground system. The CTCs use this information to calculate the APU DEMAND signal.

AIMS give these functions for the zone temperature control system:

- Indication
- Airplane at cruise, FMC data
- Ground test.

A status message shows if a CTC fails. AIMS also gives maintenance messages that relate to sensor and valve faults.

The CTCs give the APU controller (APUC) an APU DEMAND signal when the APU supplies air for pack operation on the ground. The signal is used to control the quantity of air necessary for ventilation and heating or cooling in the airplane.



1 TRIM AIR PRESSURE REGULATION AND SHUTOFF CONTROL SYSTEM
2 AUTO COMFORT CORRECTION (FMC CRUISE MODE)

AIR CONDITIONING - ZONE TEMP CTRL AND INDICATION - INTRODUCTION

Location

The left and right cabin temperature controllers (CTC) are in the main equipment center on the E1 and E2 racks.

Physical Description

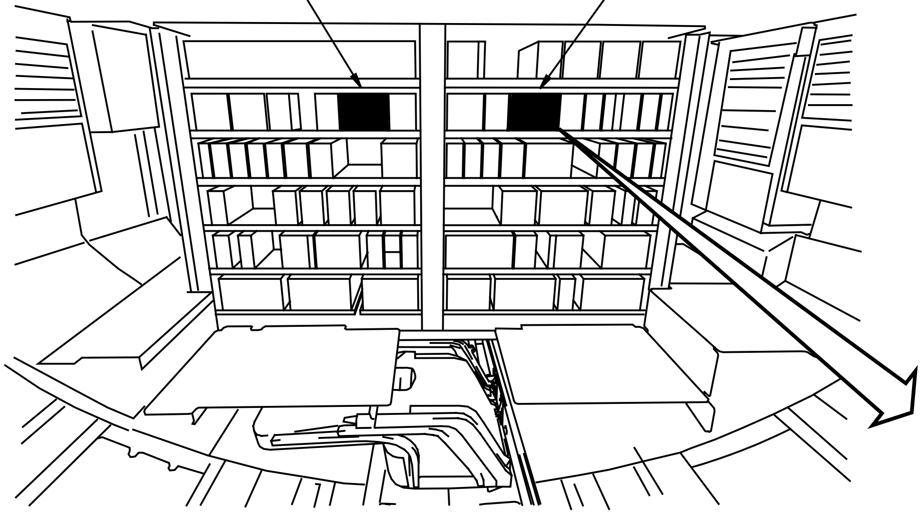
The CTCs weigh 25 lbs (11.5 kg) each. The controllers have two test connectors on the front. The connectors are for shop service.

The CTCs use operational program software (OPS) that you can load.

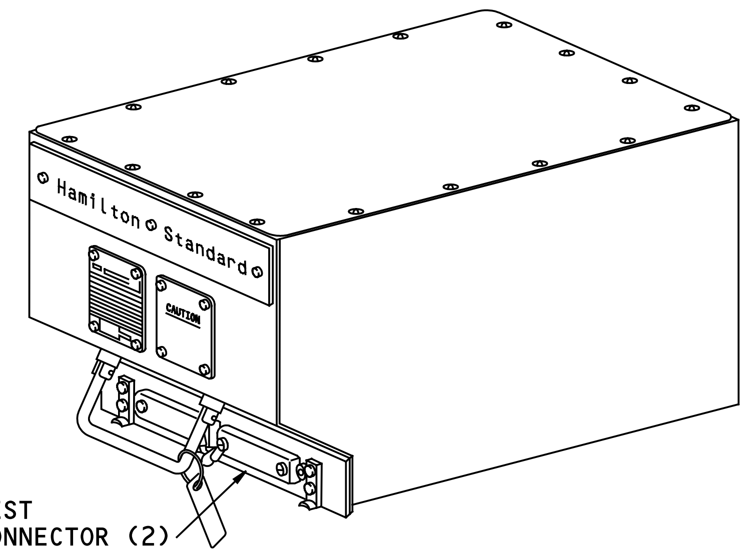
Training Information Point

The CTCs are LRUs. The circuit cards in the CTCs are not LRUs.

The Left and right CTCs are interchangeable.



MAIN EQUIPMENT CENTER
(LOOKING AFT)



CABIN TEMPERATURE CONTROLLER
(TYPICAL)

21-61-00-002 Rev 1 03/17/95

AIR CONDITIONING - ZONE TEMP CTRL AND INDICATION - CTC - PHYSICAL DESCRIPTION

Purpose

The zone trim air modulating valves control the flow of air from the pneumatic system to each zone. The mufflers reduce the noise in the flight deck and passenger cabin caused by the flow of trim air.

Location

The valves and the mufflers are in the forward part of the left and right ECS bays. There is one valve and one muffler for each temperature control zone.

You get access to the mufflers and the valves through the left and right ground conditioned air panels and the ECS bay doors.

Physical Description

Each valve has these parts:

- Electrical actuator
- Valve body
- Manual open/shut knob
- Electrical connector.

All of the trim air modulating valves are the same. Each has an internal disc in the valve body. The electrical actuator has these internal parts:

- Motor
- RVDT and position indicator
- Gears.

The motor controls disc position. The RVDT gives an electrical indication of the disc position and a visual indication of disc position.

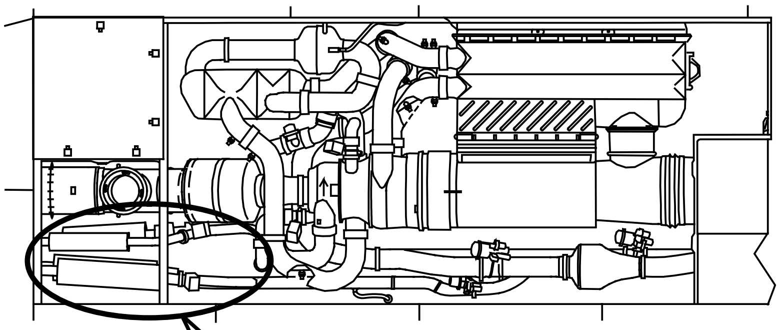
Functional Description

A close or open signal from the CTC operates the actuator motor in the necessary direction.

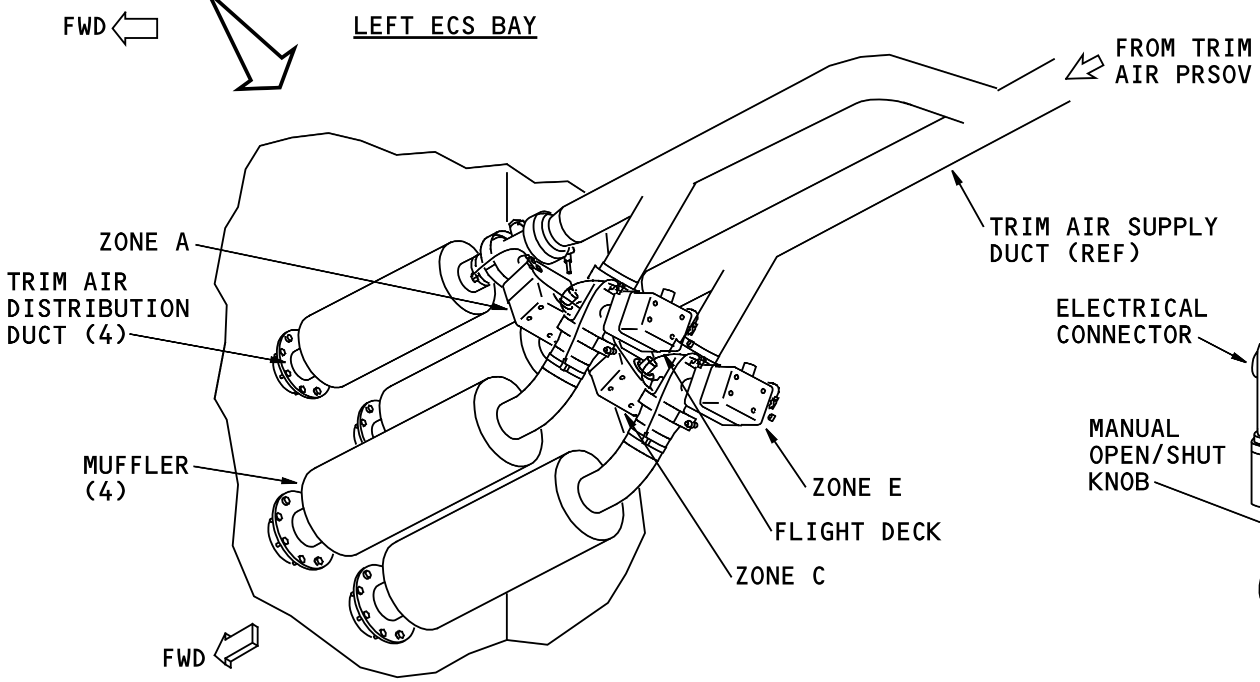
The RVDT gives valve position to the CTC.

Training Information Point

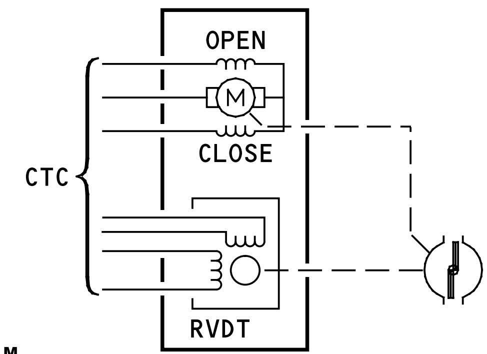
Manually open or shut the valve with the manual open/shut knob. You must disconnect the electrical connector first. If you do not remove the electrical connector the valve will move to the commanded position when the valve gets power.



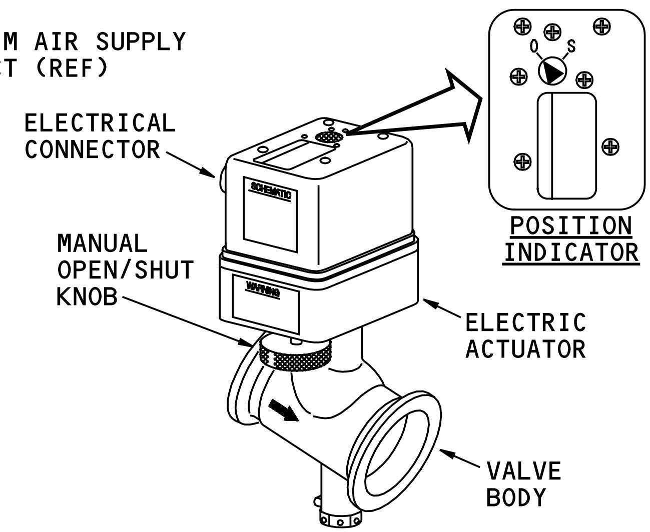
LEFT ECS BAY



ZONE TRIM AIR
MODULATING VALVES AND MUFFLERS
(LEFT ECS BAY)



VALVE SCHEMATIC



ZONE TRIM AIR MODULATING VALVE
(TYPICAL)

NOTE: LEFT ECS BAY SHOWN, RIGHT SIMILAR

AIR CONDITIONING - ZONE TEMP CTRL AND INDICATION - ZONE TRIM AIR MODULATING VALVES AND MUFFLERS

21-61-00-003 Rev 1 03/07/1997

Purpose

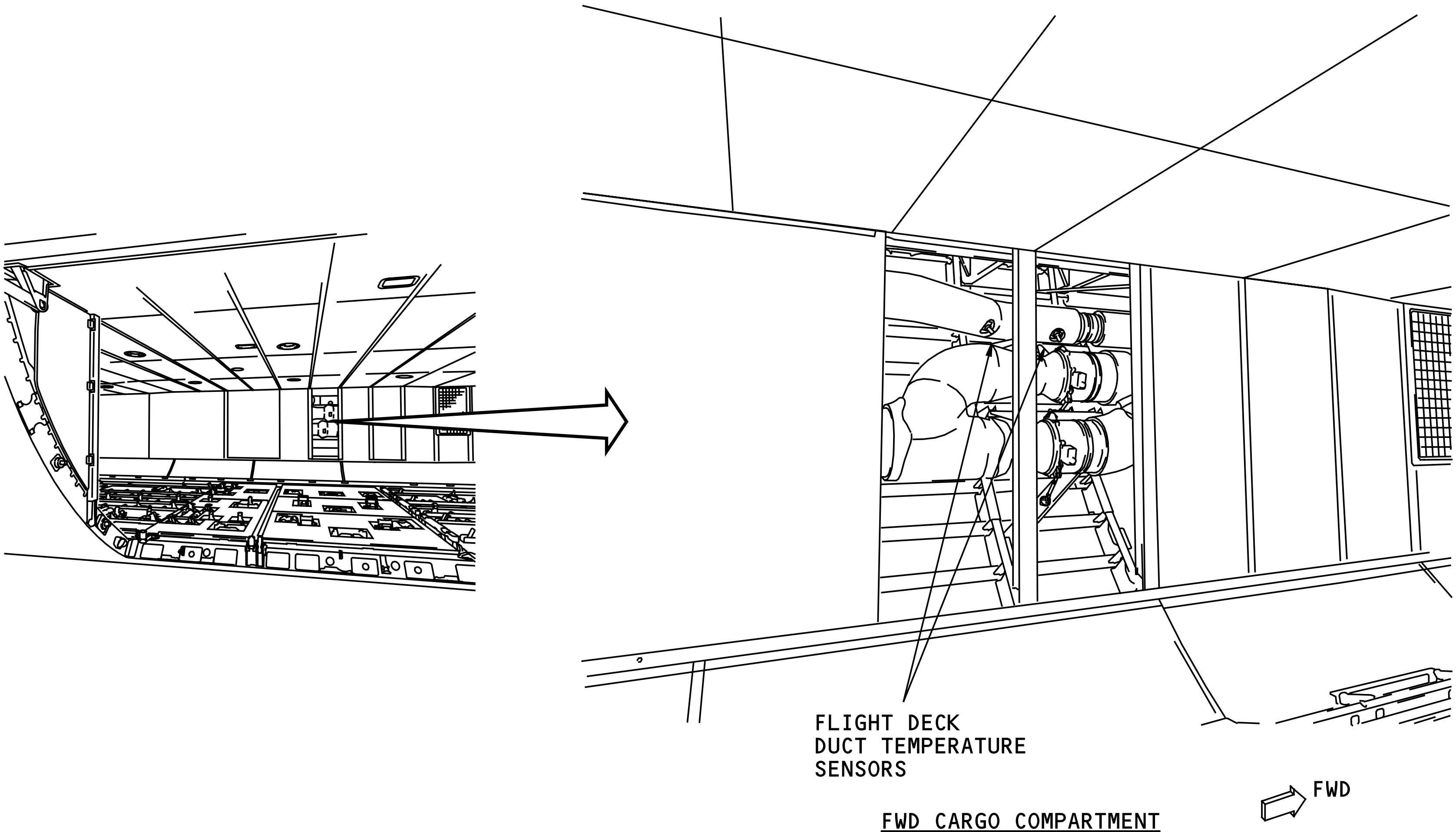
The flight deck zone duct temperature sensors monitor air temperature within the air distribution duct.

Physical Description

The sensors are solid state electronic devices.

Location

The flight deck zone duct temperature sensor is along the duct that supplies conditioned air to the flight deck.



21-61-00-004 Rev 0

AIR CONDITIONING - ZONE TEMP CTRL AND INDICATION - FLIGHT DECK ZONE DUCT TEMP SENSORS

AIR CONDITIONING - ZONE TEMP CTRL AND INDICATION - CABIN ZONE DUCT TEMP SENSORS

Purpose

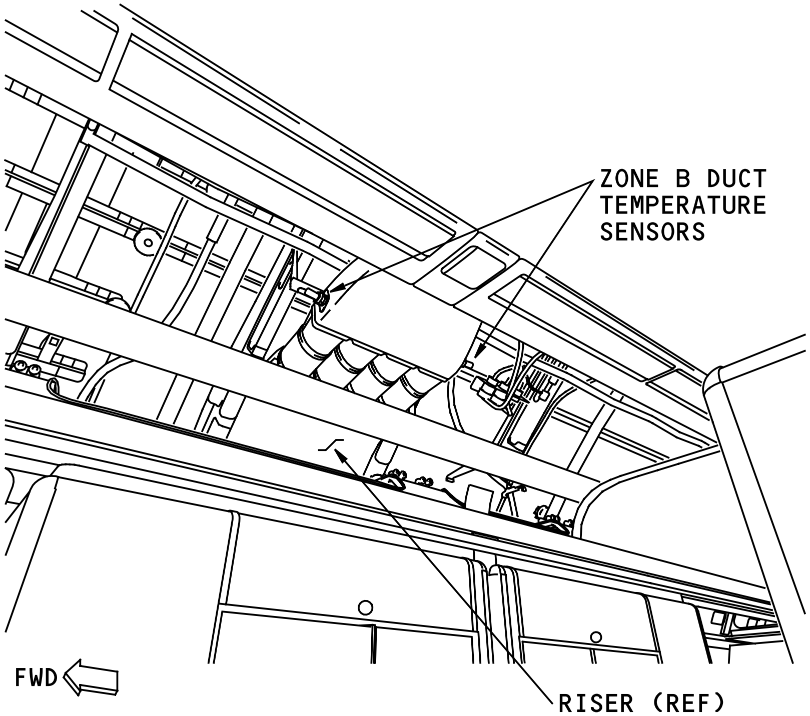
The cabin zone duct temperature sensors monitor air temperature within the air distribution ducts.

Physical Description

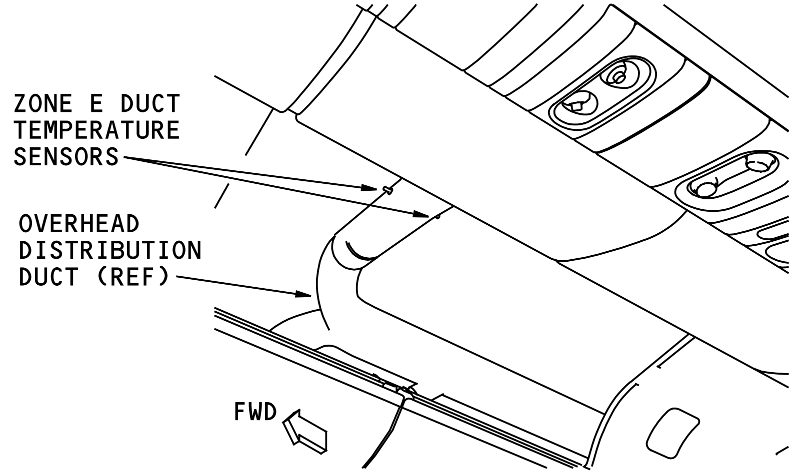
The sensors are solid state electronic devices.

Location

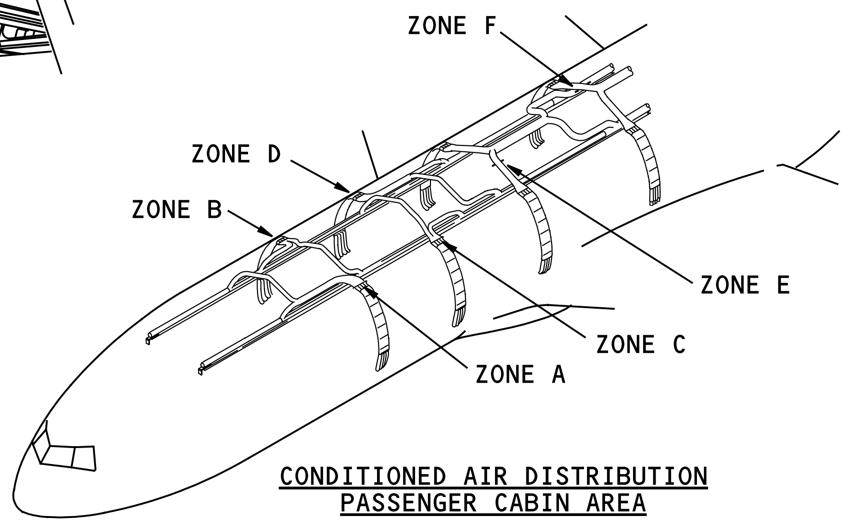
The cabin zone duct temperature sensors are in the ducts that supply conditioned air to the cabin zones. The sensors for zones A, B, C, and D are at the top of the related risers. The sensors for zones E and F are at the top of the distribution duct.



PASSENGER CABIN CEILING AREA
OUTBOARD CEILING PANEL REMOVED
(TYPICAL) 1



PASSENGER CABIN CEILING AREA
INBOARD CEILING PANEL REMOVED
(TYPICAL) 2



CONDITIONED AIR DISTRIBUTION
PASSENGER CABIN AREA

1 ZONE B SHOWN, ZONES A, C AND D SIMILAR
2 ZONE E SHOWN, ZONE F OPPOSITE

21-61-00-005 Rev 3 10/29/1997

AIR CONDITIONING - ZONE TEMP CTRL AND INDICATION - CABIN ZONE DUCT TEMP SENSORS

AIR CONDITIONING - ZONE TEMP CTRL AND INDICATION - FLIGHT DECK ZONE AIR TEMP SENSORS

Purpose

The cabin temperature controllers (CTCs) use the flight deck zone temperature sensors to monitor the flight deck temperature.

Physical Description

The sensors are dual element thermistors. Each sensor has a threaded housing with an electrical connection.

The sensors are interchangeable with the ones in passenger cabin zones.

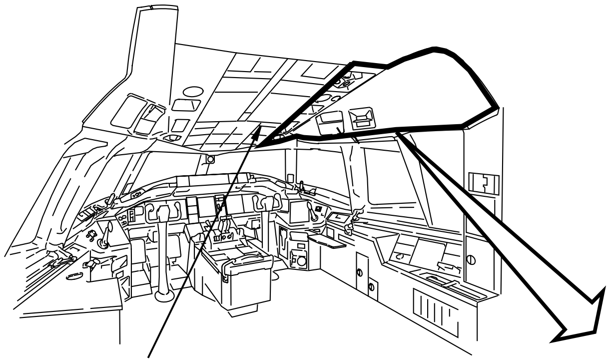
Location

The sensors are in an air inlet plenum that connects to the lavatory/galley ventilation system. This inlet is in the flight deck ceiling, to the right of the P11 circuit breaker panel.

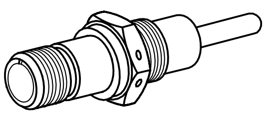
Training Information Point

One sensor supplies temperature information to the left CTC for usual flight deck temperature control. The other supplies temperature information to the right CTC. The right CTC can control the mix manifold temperature to supply cooling air for the flight deck when the left pack is off.

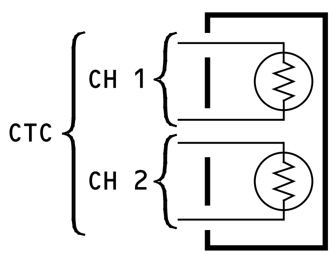
The sensors have dual elements so that one element supplies data to channel 1 of the related CTC and the other supplies data to channel 2.



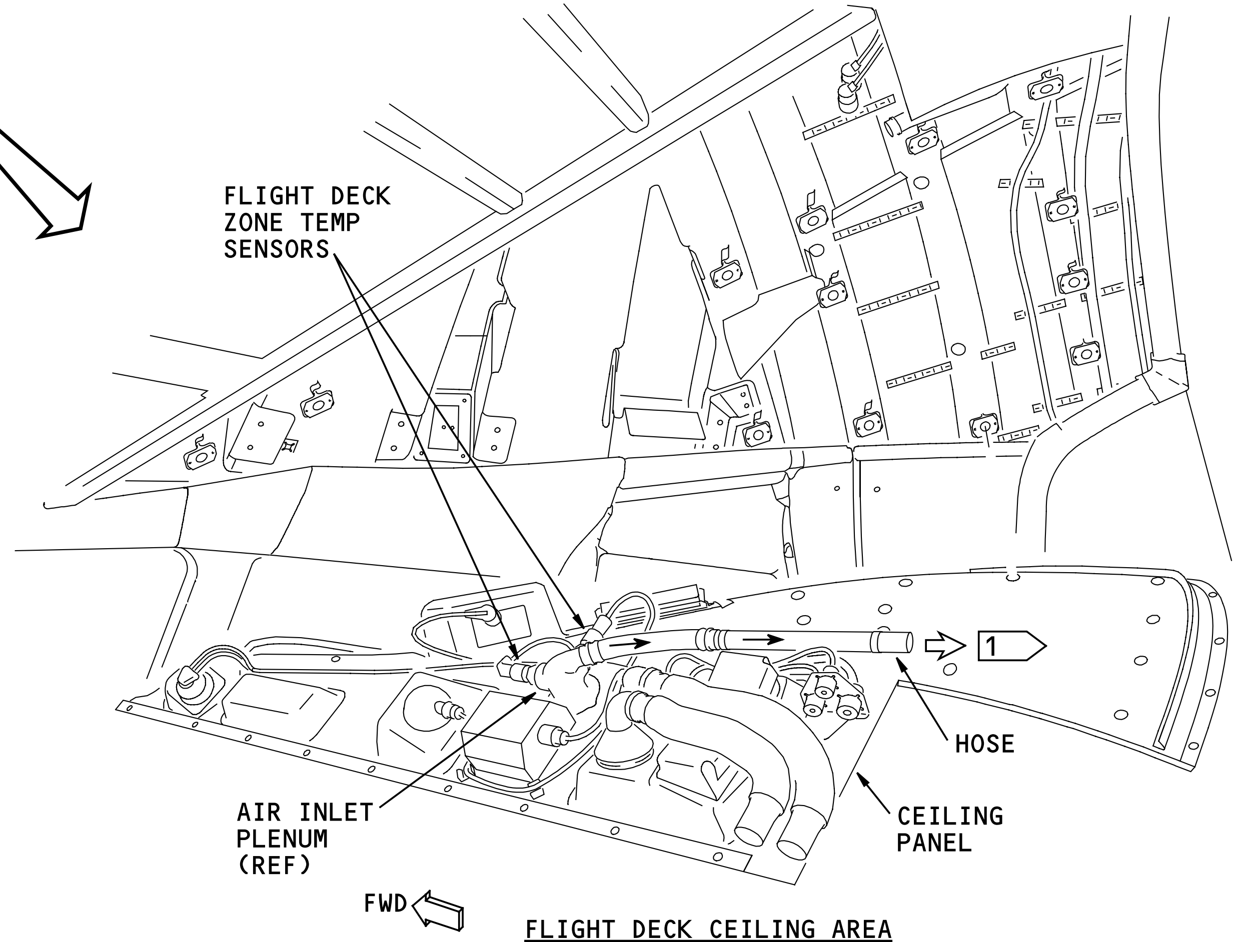
FLIGHT DECK



TEMPERATURE SENSOR
(TYPICAL)



TEMPERATURE SENSOR CIRCUIT
(TYPICAL)



FLIGHT DECK CEILING AREA
(RIGHT SIDE)

1 TO LAVATORY/GALLEY VENTILATION SYSTEM

AIR CONDITIONING - ZONE TEMP CTRL AND INDICATION - FLIGHT DECK ZONE AIR TEMP SENSORS

21-61-00-006 Rev 2 01/24/96

Purpose

The cabin temperature controllers (CTC) use the cabin zone temperature sensors to monitor the temperature of air pulled from the zones by the ventilation system.

Physical Description

The sensors are thermistors with two elements. Each sensor has a threaded housing with an electrical connection.

The sensors are interchangeable with the ones in the flight compartment.

Location

The sensors are in the same area as the left outboard passenger service units (PSUs). Each sensor is in a plenum that attaches to a zone air temperature sensor panel. The plenum has an air inlet grille on the lower side of the panel. The plenum has a hose that connects it to the lavatory/galley ventilation system on the upper side of the panel. The sensors are at these station locations:

- Zone A: station 464
- Zone B: station 629
- Zone B: station 673 (wiring provisions only)
- Zone C: station 821 (wiring provisions only)
- Zone C: station 901
- Zone D (forward): station 1021
- Zone D (aft): station 1122
- Zone E: station 1364
- Zone F: station 1796.

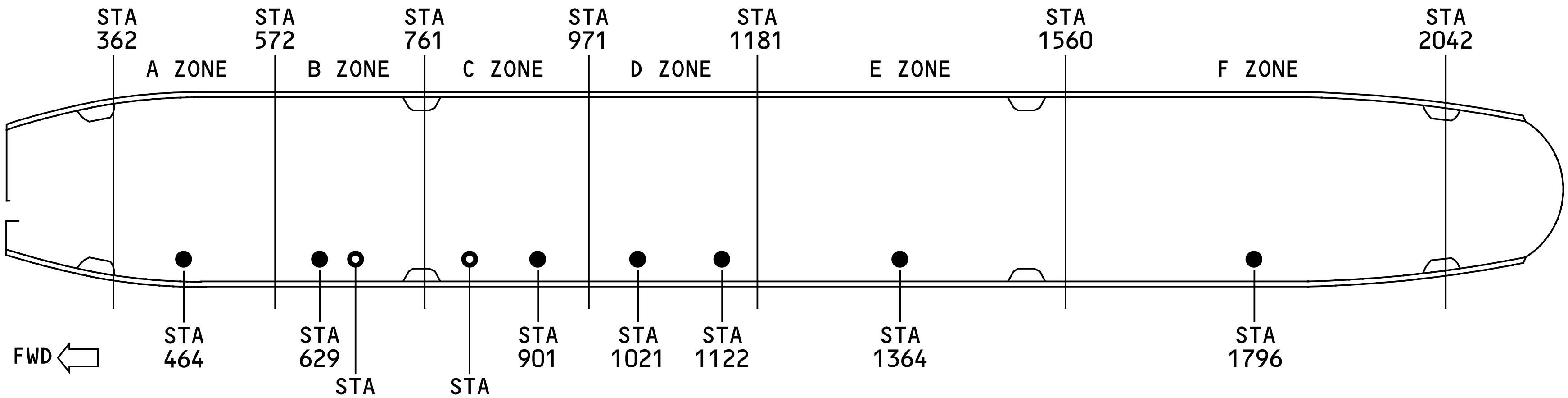
Training Information Point

Cabin temperature control zones can have one or two temperature sensors. A second sensor permits different interior configurations. Galleys, lavatories, closets, and partitions can prevent one sensor from accurately measuring the temperature in a zone. When there are two sensors in one zone, the cabin temperature controllers use an average of the temperature information from the sensors.

Any zone can have two sensors. Zone D always has two sensors. Zones B and C have wiring for a second sensor. If you install a second sensor, you must also load a new operational program configuration (OPC) software in the CTCs.

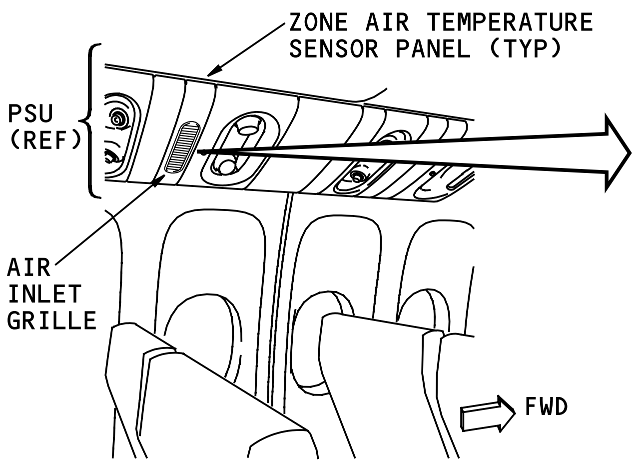
Sensors in these zones connect to the left CTC: A, C and E. Sensors in these zones connect to the right CTC: B, D and F.

The sensors have two elements so that one element supplies data to channel 1 of the related CTC and the other element supplies data to channel 2.

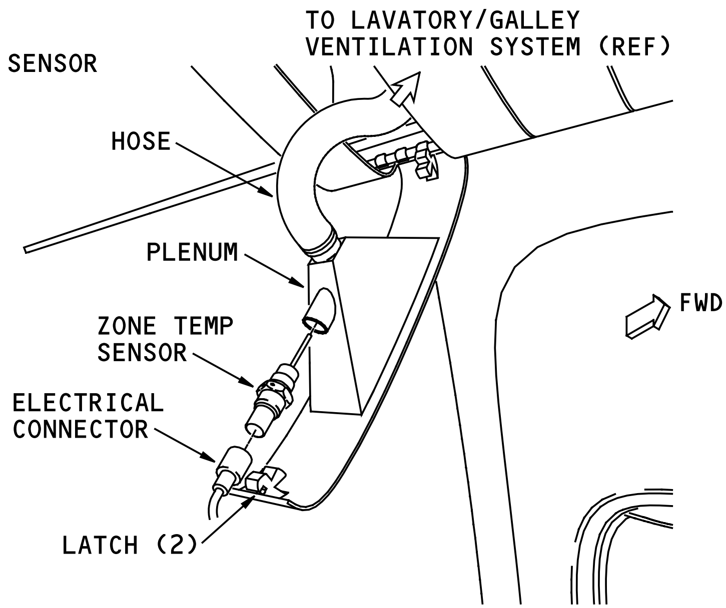


CABIN TEMPERATURE CONTROL ZONES

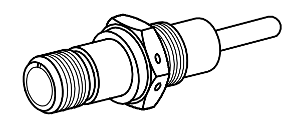
● CABIN ZONE TEMP SENSOR
○ PROVISIONS (WIRES) FOR CABIN ZONE TEMP SENSOR



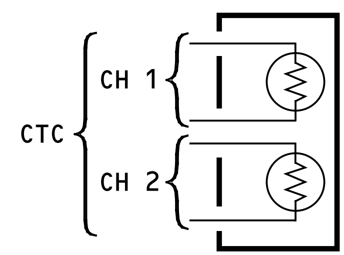
PASSENGER COMPARTMENT
(LEFT SIDE)



ZONE AIR TEMPERATURE SENSOR PANEL
(TYPICAL)



TEMP SENSOR
(TYPICAL)



TEMP SENSOR CIRCUIT
(TYPICAL)

AIR CONDITIONING - ZONE TEMP CTRL AND INDICATION - CABIN ZONE AIR TEMP SENSORS

General

The flight crew uses the flight deck temperature control on the P5 overhead panel to set the target temperature for the flight deck. The low temperature value (C on the control) is 65 F (18 C). The high temperature value (W on the control) is 85 F (29 C).

The manual area on the flight deck temperature control is spring-loaded to MAN. In the W or C positions the flight deck temperature control sets the position of the flight deck trim air modulating valve.

Automatic Mode

The left CTC controls the flight deck trim air modulating valve to keep the zone temperature at the target value. The valve open and close commands go from the left CTC through the contacts of the auto/manual control flight deck trim air relay. The RVDT of the flight deck trim air modulating valve gives valve position to the left CTC. Flight deck sensors send actual temperature data to both CTCs.

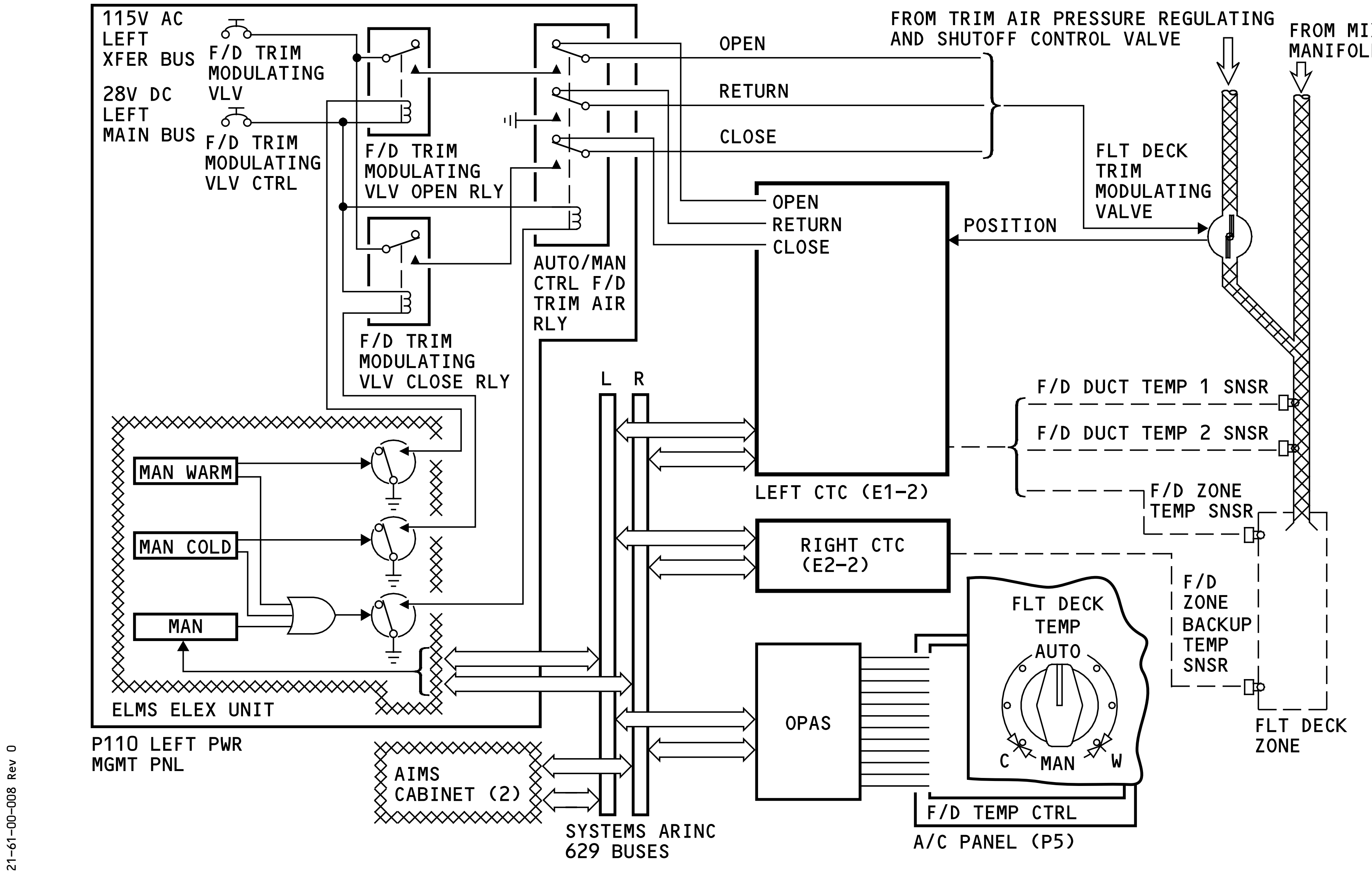
Manual Mode

With the flight deck temperature control in MAN the electrical load management system (ELMS) electronics (ELEX) unit removes control of the flight deck trim air modulating valve from the CTC.

In the W position the ELMS ELEX unit supplies power to the open coil of the flight deck trim air modulating valve.

In the C position the ELMS ELEX unit supplies power to the close coil of the flight deck trim air modulating valve.

When released, the flight deck temperature control moves back to the MAN position. In this position no power is at the contacts of the auto/manual control flight deck trim air relay. This keeps the trim air modulating valve in the set position.



AIR CONDITIONING - ZONE TEMP CTRL AND INDICATION - FLIGHT DECK FUNCTIONAL DESCRIPTION

General

The cabin temperature control on the air conditioning panel sets the master temperature value for all cabin areas. The low temperature value (C on the control) is 65F (18C). The high temperature value (W on the control) is 85F (29C).

The number of cabin areas will not always be the same as the number of temperature control zones. Each cabin area may have one or more temperature control zones. The number of cabin areas is set by the CSS configuration database. See the cabin services system section for more information about the configuration database (AMM PART I 23-39).

The cabin temperature screen on the cabin system control panel (CSCP) or on the cabin area control panels (CACP) lets you adjust the temperature in each cabin area. You can set the temperature in each area plus or minus 10F (6C) from the master temperature value set on the air conditioning panel. You cannot set the temperature in the cabin areas below 65F (18C) or above 85F (29C).

Cabin Zone Temperature Control

The CTCs calculate a zone target temperature for each temperature control zone. The zone target temperature is used in other calculations for the control of these components:

- Zone trim air modulating valves
- Zone trim air PRSOV (backup control if the modulating valve fails open)
- Second stage turbine bypass valve (A/C pack component)
- Low limit valve (A/C pack component)
- Ram air actuator (A/C pack component).

The CTCs use these inputs to calculate the zone target temperatures:

- Selected master temperature from the CABIN TEMP control
- Bias to the master temperature (± 10F, 6C) from the CABIN TEMPERATURE screen
- Airplane at cruise data from the FMCF of AIMS, auto comfort correction bias.

The zone target temperatures shows on these screens:

- Cabin temperature screen, CSCP/CACP
- Air synoptic display
- Air conditioning maintenance page.

The airplane at cruise condition causes the CTCs to adjust the cabin temperature up. This function is called the auto comfort correction. The correction makes sure the cabin stays at a comfortable temperature when the airplane skin get cold.

Zone air temperature sensors send the CTCs actual compartment temperature data. The CTCs set the actual compartment temperatures equal to the average of elements 1 and 2. If there are two sensors in a temperature control zone, the appropriate CTC averages the data from both sensors.

If both elements of the zone air temperature sensor fails, the CTCs use the duct temperature sensors as an alternate. This is called the alternate mode. The alternate mode does not give the best control. The cabin area temperature may need adjustment to keep the temperature at a comfortable level.

The lavatory/galley ventilation system pulls cabin air across the zone air temperature sensors. If the lavatory/galley ventilation system is off, the CTCs use the alternate mode to calculate the necessary duct temperatures for all temperature control zones.

Zone Duct Temperature Control

The CTCs calculate a zone duct target temperature for each temperature control zone. The target temperature has a high and a low limit. The high limit is 160F (71C) and the low limit changes with altitude. These are the low limits:

- 35F (1.7C) when the airplane is less than 29,000 feet (8845 meters)
- Decreases to 29F (-1.7C) when the airplane is at 31,000 feet (9455 meters)
- Decreases to 21F (-6C) when the airplane is at 35,000 feet (10,675 meters) or above.

The CTCs use zone duct temperature data to control the position of the trim air modulating valves. The CTCs use the data to calculate the necessary A/C pack outlet temperatures. See the zone temperature control and indication - zone temperature calculation page in this section for more information about the calculation of the trim air modulating valve position and the calculation of the necessary A/C pack outlet temperature. The CTCs also used the data to control one or both of the trim air PRSOVs when a trim air modulating valve fails open. See the trim air pressure regulation and shutoff control section for more information about the control of the trim air PRSOV (AMM PART I 21-62).

Zone duct temperature sensors send the CTCs duct temperature data. The CTCs set the duct temperature equal to the average of sensors 1 and 2. The CTCs make a zone duct temperature error signal for each temperature control zone. The CTCs move the trim air modulation valves to supply the quantity of trim air to keep the duct temperature at the target value.

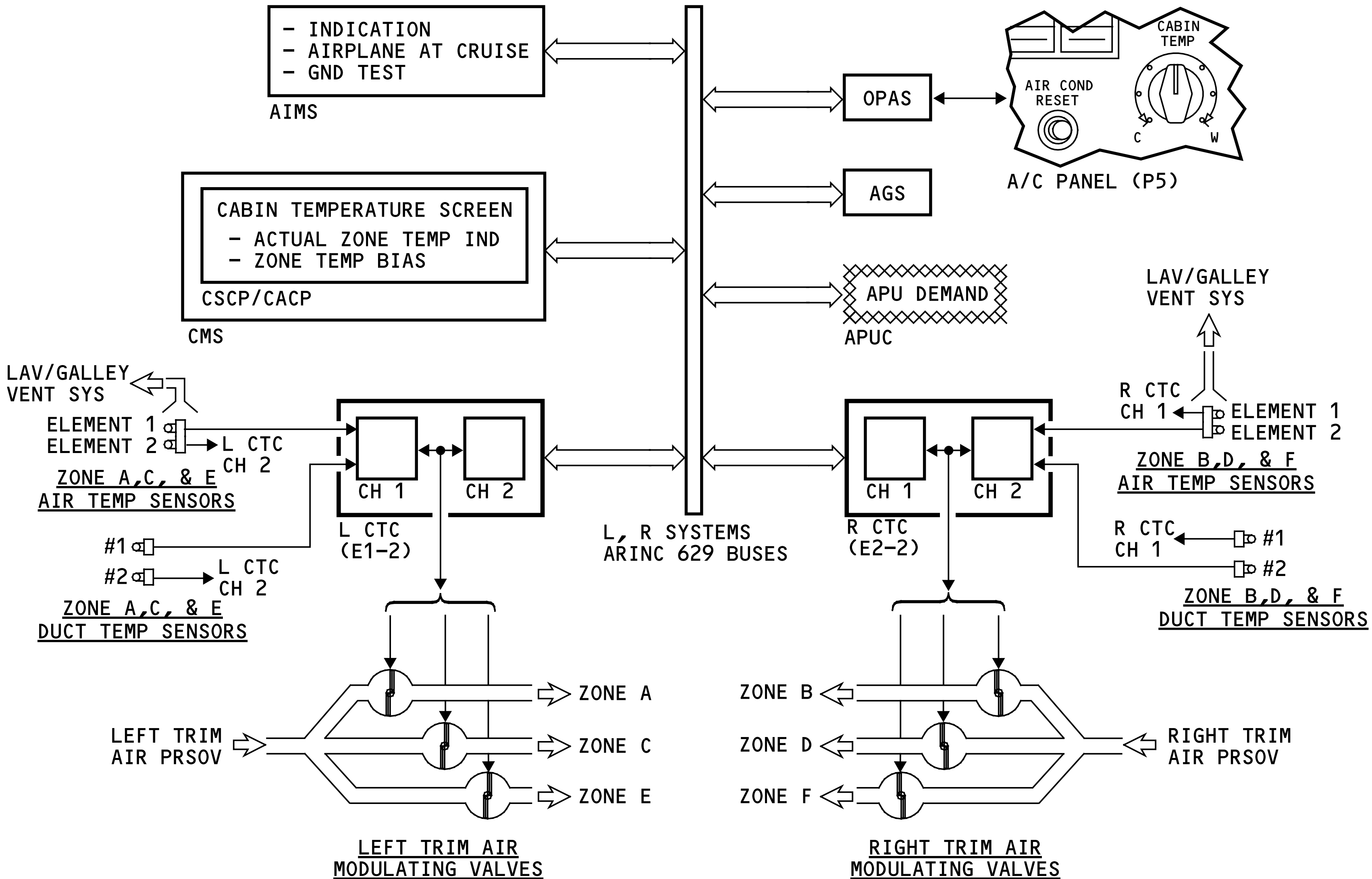
APU DEMAND

When the APU gives air for pack operation on the ground, the right CTC calculates the quantity of air necessary for ventilation and for heating or cooling. The CTC compares these inputs to calculate the APU demand signal:

- Zone duct temperature error signal for the most cooling
- Zone duct temperature error signal for the most heating

- Passenger seat count
- A preset minimum limit.

The CTC calculates the APU demand signal and sends it to the APUC. The APUC controls the quantity of air to the packs and the trim air system.



AIR CONDITIONING - ZONE TEMP CTRL AND INDICATION - CABIN ZONE FUNCTIONAL DESCRIPTION

21-61-00-009 Rev 1 04/10/1997

AIR CONDITIONING - TEMPERATURE CONTROL - FUNCTIONAL DESCRIPTION

General

Warm trim air from the pneumatic system mixes with cold air from the mix manifold to keep each zone temperature at its target value. The cabin temperature controllers (CTCs) use the trim air pressure regulating and shutoff valves (PRSOVs) to keep the trim air pressure between 2 and 8.5 psi above cabin pressure. The CTCs control the trim air modulating valves to add the necessary quantity of warm air for zone temperature control.

The CTCs use sensors in the ducts and at zone locations to monitor air temperature for control.

The CTCs sets the packs to supply the coldest air necessary for the zone that needs the lowest mix manifold temperature. Zones that need higher temperatures get pack air mixed with trim air. The CTCs set each trim air modulating valve to keep the related zone at its target temperature.

Normal Function

The flight crew sets target temperatures for the flight deck and the master temperature for the passenger cabin. The minimum selectable temperature is 65F (18C) and the maximum is 85F (29C). The cabin crew can adjust the target temperature for each zone in the passenger cabin. This temperature can be 10F (6C) higher or lower than the master temperature set by the flight crew.

Immediately after an engine start the ASCPCs sends flow schedule 1 to the CTC. The CTC sets the trim air pressure regulating and shutoff valves to the open position while the ASCPC tests its control over these valves. When the ASCPC completes this test, the CTC sets the valves to the correct position, and the ASCPC releases control. The usual pressure for the trim air PRSOVs is 5 psi above cabin pressure.

The CTC closes the trim air pressure regulating and shutoff valves for these conditions:

- CTC channel 1 and 2 failed
- Pack flow at flow schedule 4
- Stall recovery
- Trim air pressure sensor failed
- Trim air switch set to OFF
- Duct temperature greater than 190F (88C).

Both trim air pressure regulating and shutoff valves function if at least one pack operates.

When the APU supplies air for pack operation and airplane ventilation, the CTCs tell the APUC the quantity of air to supply with the APU DEMAND signal. See the zone temperature control and indication section for more information about the APU DEMAND signal (AMM PART I 21-61).

Non-Normal Function

These conditions cause non-normal operations:

- Loss of left side trim
- Loss of right side trim

- Overheat conditions (190F, 88C)
- Single trim modulating valve failure.

Loss of Left Side Trim

If there is a failure of the left side trim system, the left CTC sets the left pack to hold the flight deck target temperature. The right CTC sets the right pack to hold the necessary mix manifold temperature.

The left CTC decreases or increases the flight deck target temperature up to a maximum of 10F (6C) for any of these conditions:

- Average cabin zone temperature is 2F (1C) above or below the average target temperature
- Single cabin zone temperature is 5F (3C) above or below its target temperature.

This type of control lets the cabin area have priority over the flight deck. It does this when the right pack and right trim system does not keep the cabin areas at the necessary temperatures.

Loss of Right Side Trim

If there is a failure of the right side trim system, The right CTC sets the right pack to hold the necessary mix manifold temperature. The left pack follows the right pack until flight deck trim modulating valve is closed. The left CTC then controls the left pack to keep the flight deck at the target temperature down to a minimum of 65F (18C).

The left CTC does not keep the flight deck at its target temperature if the right pack operates at full heat and any of these conditions occur:

- Average cabin zone temperature is 5F (3C) below the average reference temperature
- Single cabin zone temperature is 5F (3C) below its target temperature.

When the right pack does not keep the cabin area at the necessary temperature, the left CTC increases the flight deck target temperature up to a maximum of 10F (6C).

Overheat Conditions

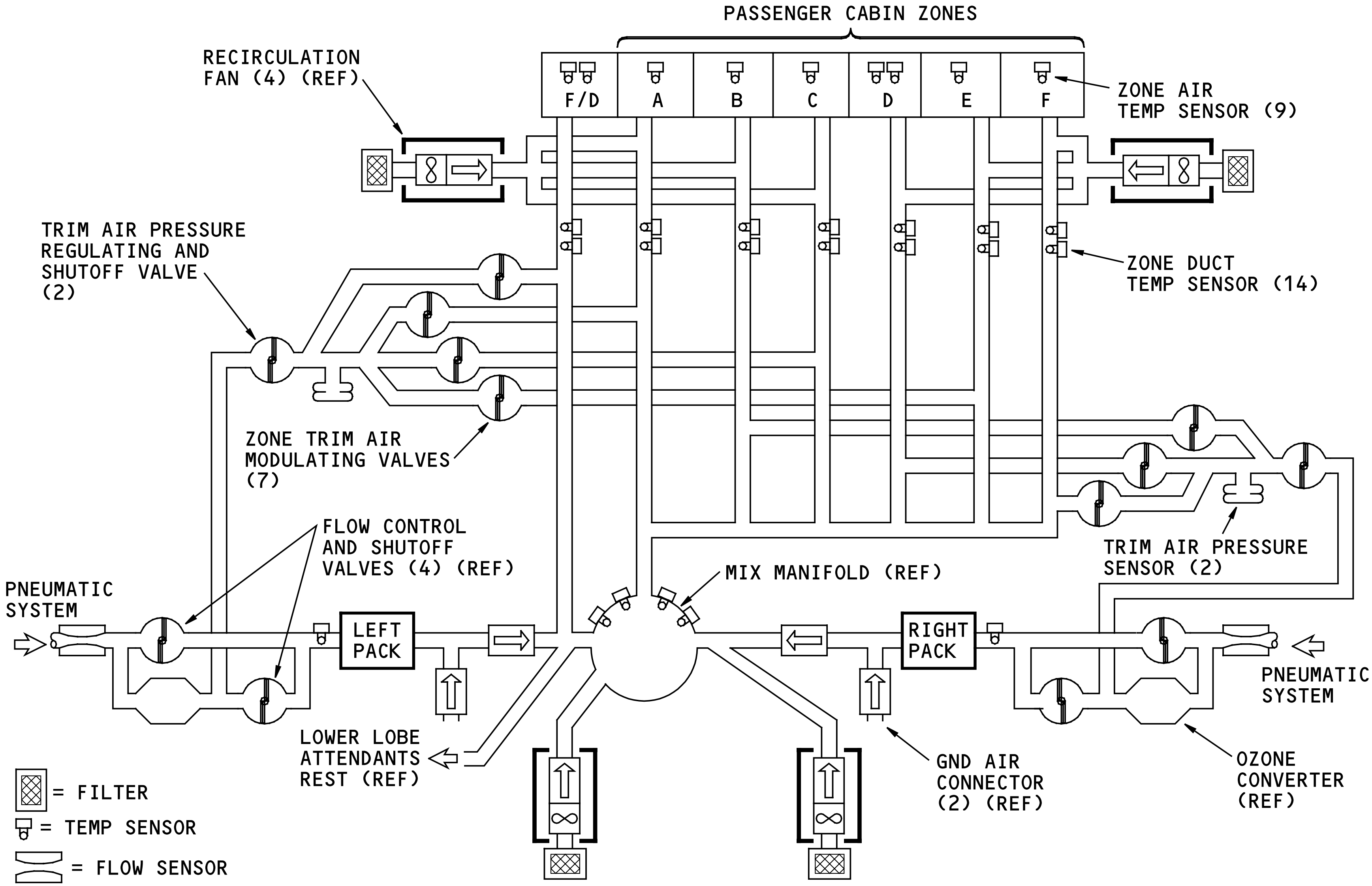
The applicable CTC starts to close the trim air modulating valve if the related zone duct air temperature increases to 160F (71C). The related trim air pressure regulating and shutoff valve latches closed if duct temperature increases to 190F (88C) for 10 seconds.

Single Trim Modulating Valve Failure

If a trim air modulating valve is not fully closed and has a failure, the applicable CTC controls the pressure reference for the related trim air pressure regulating and shutoff valve to keep zone duct temperature to a limit (zone duct temperature backup control mode). The applicable CTC does not use this mode if the valve is less than 10 degrees open (1 percent heating) and has a failure.

AIR CONDITIONING - TEMPERATURE CONTROL - FUNCTIONAL DESCRIPTION

If the RVDT in a valve has a failure, The applicable CTC operates the valve with no position feedback. This type of control is called open loop control. The applicable CTC looks at temperature change downstream of a valve to monitor movement.



AIR CONDITIONING - TEMPERATURE CONTROL - FUNCTIONAL DESCRIPTION

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AIR CONDITIONING - TEMPERATURE CONTROL - OPERATION - FLIGHT DECK

General

The air conditioning panel has these controls for temperature control operation:

- Left and right trim air switches
- Flight deck temperature control
- Cabin temperature control
- Air conditioning reset switch.

Location

The air conditioning panel is on the P5 overhead panel in the flight deck.

Trim Air Control

L and R TRIM AIR switches are alternate-action switches. ON shows when you push the switch in for automatic operation of the trim system.

The applicable FAULT light and the applicable advisory message TRIM AIR L (R) (not shown) are not a function of switch position. They show when any of these conditions occur:

- The related trim air switch is set to the out position
- The related trim air PRSOV is latched closed.

The left trim air PRSOV is latched closed if any of these conditions occur:

- Flight deck zone duct overheat (190F, 88C)
- Passenger cabin zone A duct overheat (190F, 88C)
- Passenger cabin zone C duct overheat (190F, 88C)
- Passenger cabin zone E duct overheat (190F, 88C)
- Left trim air PRSOV fault
- Left CTC fault (both channels)
- Left trim air pressure sensor fault.

The right trim air PRSOV is latched closed if any of these conditions occur:

- Passenger cabin zone B duct overheat (190F, 88C)
- Passenger cabin zone D duct overheat (190F, 88C)
- Passenger cabin zone F duct overheat (190F, 88C)
- Right trim air PRSOV fault
- Right CTC fault (both channels)
- Right trim air pressure sensor fault.

Air Conditioning Reset Control

The AIR COND RESET switch is a momentary-action switch. This switch starts the system after a failure.

Flight Deck Temperature Control

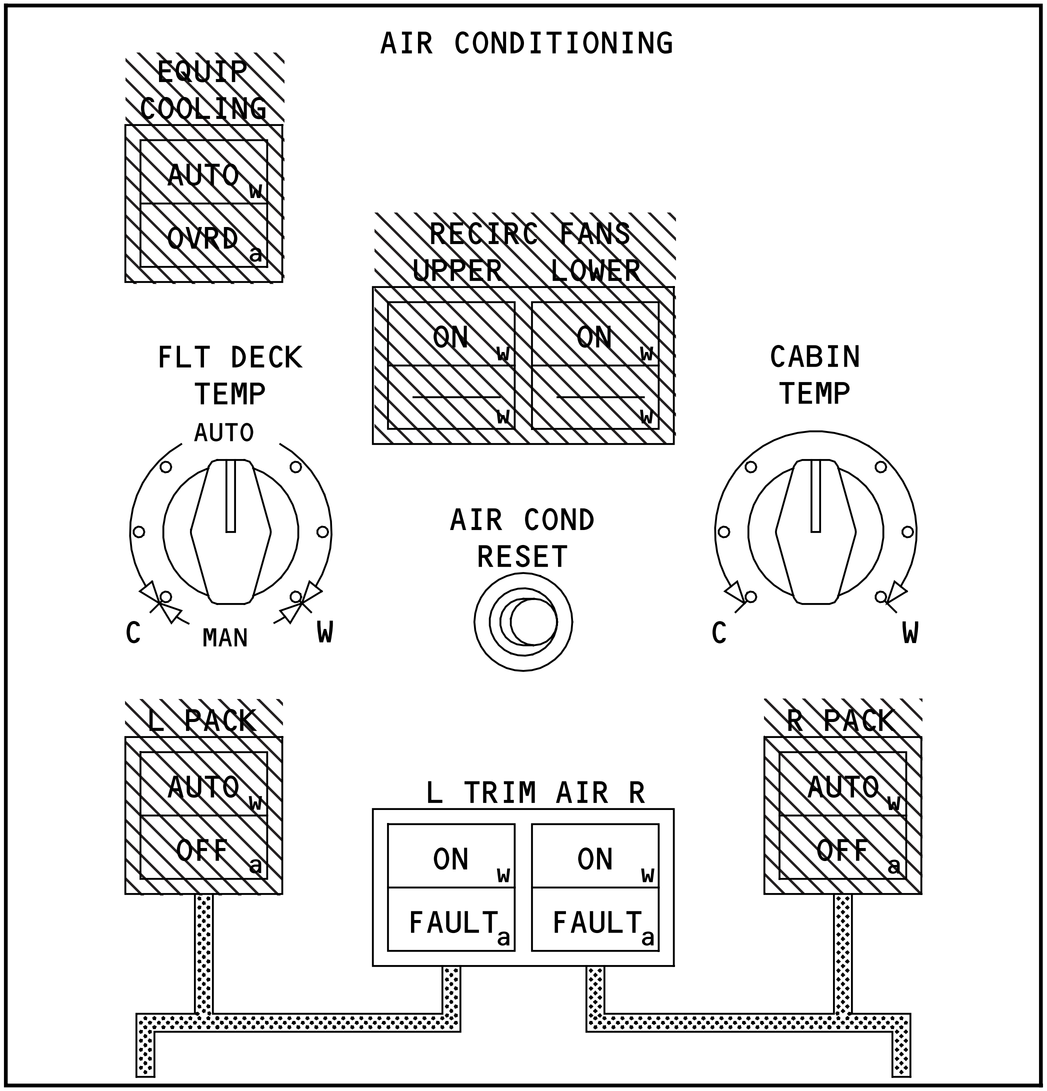
The FLT DECK TEMP control lets the flight crew set the temperature for the flight deck. The control can be set to MAN or to AUTO. The MAN position lets the flight crew manually adjust the temperature to any value. The AUTO position lets the left CTC control the temperature to a target value. The minimum selectable target temperature is 65F (18C) and the maximum is 85F (29C).

AIR CONDITIONING - TEMPERATURE CONTROL - OPERATION - FLIGHT DECK

Cabin Temperature Control

The CABIN TEMP control lets the flight crew set the master target temperature for the passenger compartment. The minimum selectable target temperature is 65F (18C) and the maximum is 85F (29C).

The left and right main buses power the FAULT indications on the trim air switches. If these buses have no power, the FAULT indication does not show.



AIR CONDITIONING PANEL

21-60-00-006 Rev 1 03/19/1997

AIR CONDITIONING - TEMPERATURE CONTROL - OPERATION - FLIGHT DECK

AIR CONDITIONING - TEMPERATURE CONTROL - OPERATION - CABIN CONTROLS

Cabin Controls

The flight attendants use the cabin system control panel (CSCP) or the cabin area control panel (CACP) to set temperatures for each passenger zone. The cabin temperature selection on the cabin controls main menu selects the cabin temperature screen.

Operation

The left and right arrows on the screen select a zone. The temperature of that zone in degrees C and degrees F is at the lower left area of the screen. The up and down arrows in the lower right area of the screen select the target temperature for that zone.

ECS Inactive

The ECS NO COMMUNICATION pop-up window shows when all of these conditions occur:

- The cabin temperature screen shows
- The CTCs do not give temperature data for more than 5 seconds.

The pop-up window goes away when the cabin temperature window does not show or when the CTCs send temperature data.

Invalid Temperature Information from ECS

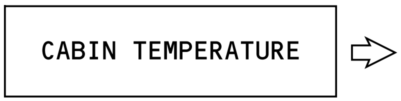
The INVALID DATA message shows in the actual temperature boxes or in the target temperature box when any of these conditions occur:

- Applicable data is not supplied
- Applicable data is not in limits.

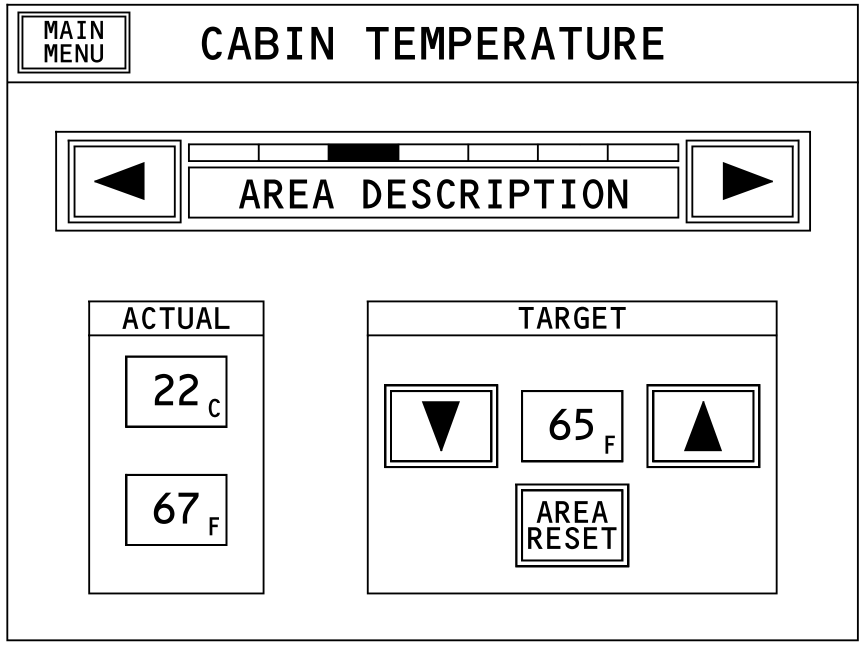
The message goes away when the temperature data is supplied and is in limits.

Training Information Point

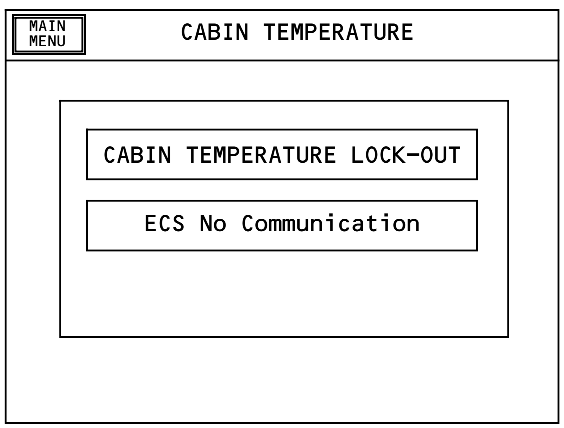
The CSS configuration database sets the text for the AREA DESCRIPTION and sets the number of areas. The text has a limit of 40 characters. The number of areas has a limit of 15. The usual number of areas is 3. See the cabin services system section for more information about the configuration database (AMM PART I 23-39).



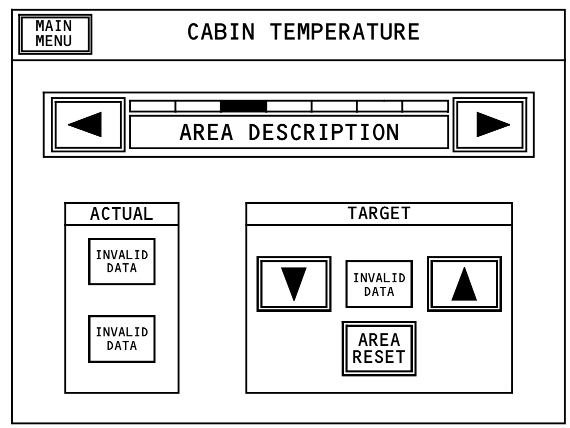
CABIN CONTROLS
MAIN MENU



CSCP/CACP SCREEN (TYPICAL)



ECS NO COMMUNICATION POP-UP WINDOW (TYPICAL)



INVALID DATA (TYPICAL)

AIR CONDITIONING - TEMPERATURE CONTROL - OPERATION - CABIN CONTROLS

21-60-00-007 Rev 2 03/19/1997

AIR CONDITIONING - TEMPERATURE CONTROL - AIR SYNOPTIC DISPLAY AND AIR CONDITIONING MAINT PAGE

General

All temperatures on the air synoptic display and the air conditioning maintenance page are in degrees F.

Air Synoptic Display

The top part of the MFD air synoptic display shows these cabin temperature indications:

- The MASTER box shows the cabin temperature set by the flight crew.
- The number at the left in the F/D box is the flight deck target temperature set by the flight crew. The number at the right is the actual flight deck temperature.
- The number at the left in the zone boxes A-F is the target zone temperature set by the cabin crew. The number at the right in each box is the actual zone temperature.

The flight deck trim air modulating valve position shows on the indication on the left of the display.

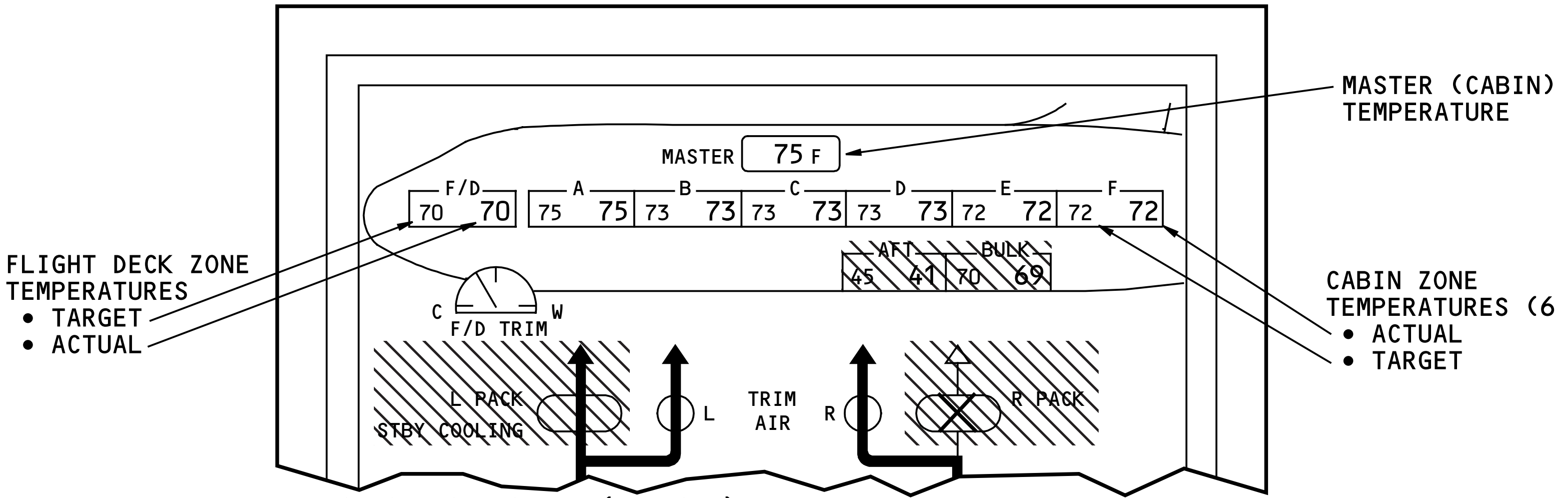
Normal flow of left and right trim air shows as open valve symbols and flow arrows.

Air Conditioning Maintenance Page

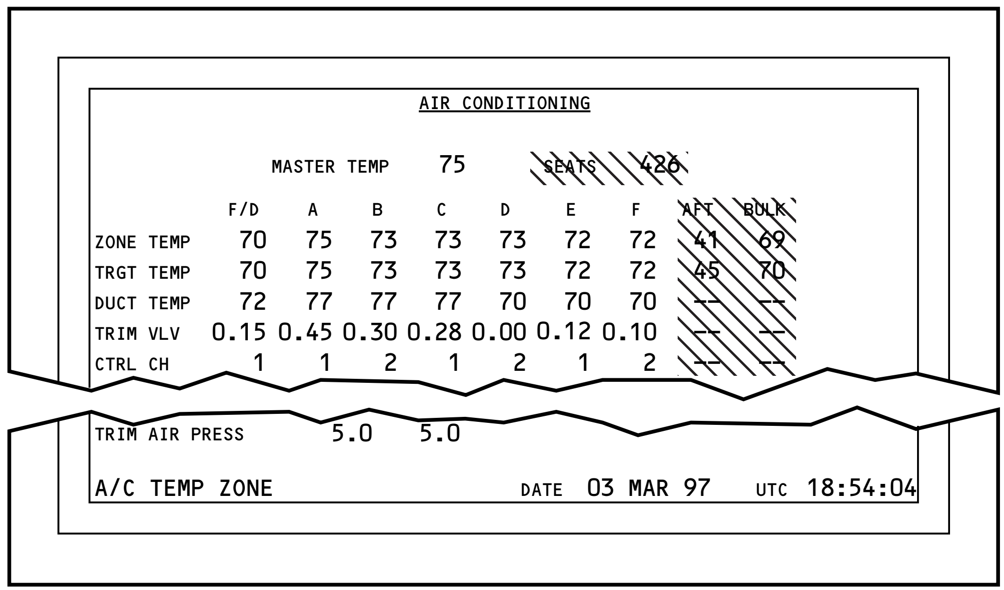
The top part of the air conditioning maintenance page shows these cabin temperature indications:

- MASTER TEMP - Temperature selected on the cabin temperature control on the P5 panel
- ZONE TEMP - Actual temperature in each zone
- TRGT TEMP - Target (selected) temperature for each zone
- DUCT TEMP - Temperature measured in each zone distribution duct
- TRIM VLV - Position of each trim air modulating valve in percent heat (0.00 is closed, 1.00 is open)
- CTRL CH - Shows which CTC channel is in control. Left CTC controls zones F/D, A, C, & E. Right CTC controls zones B, D, & F
- TRIM AIR PRESS - The difference, in psid, between cabin pressure and trim air pressure.

See the primary display system section for more information about the air synoptic display and the air conditioning maintenance page (AMM PART I 31-61).



AIR SYNOPTIC DISPLAY (TYPICAL)



AIR CONDITIONING MAINTENANCE PAGE (TYPICAL)

21-60-00-008 Rev 2 03/19/1997

AIR CONDITIONING - TEMPERATURE CONTROL - AIR SYNOPTIC DISPLAY AND AIR CONDITIONING MAINT PAGE

AIR CONDITIONING - TEMPERATURE CONTROL - GROUND TESTS

General

These are the temperature control ground tests that show when you select ATA 21 Cabin Temperature Control System:

- Left cabin temperature controller
- Right cabin temperature controller
- Left trim air system
- Right trim air system.

Left and Right Cabin Temperature Controller

These tests make sure that the related cabin temperature controller can change control between channels 1 and 2. This test also does a continuous built-in-test.

The test takes approximately 1-2 minutes.

This test shows for these ground test types:

- Operational test
- LRU replacement test.

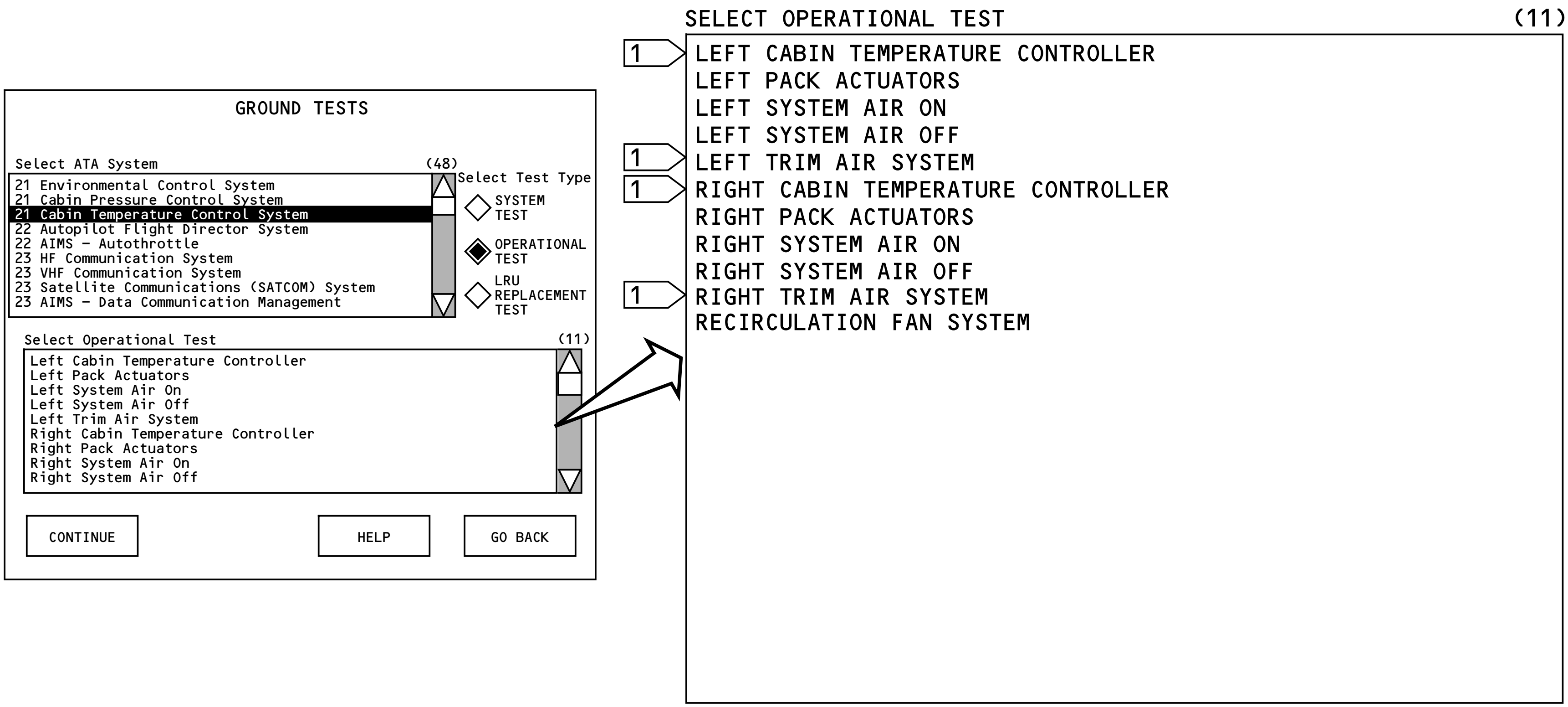
Left and Right Trim Air System

This test makes sure that the related cabin temperature controller can control the trim air modulating valves of the trim air system on that side.

You must pressurize the pneumatic system for this test. During this test, the related trim air modulating valves open one at a time. The test takes approximately 2-3 minutes.

This test shows for these ground test types:

- System test
- Operational test
- LRU replacement test.



NOTE: OPERATIONAL TESTS SHOW.
LRU REPLACEMENT TESTS ARE THE SAME.
SYSTEM TESTS DO NOT INCLUDE LEFT AND RIGHT CABIN TEMPERATURE CONTROLLER.

1 THESE ARE THE AIR CONDITIONING - TEMPERATURE CONTROL TESTS.

21-60-00-010 Rev 1 08/17/96

AIR CONDITIONING - TEMPERATURE CONTROL - GROUND TESTS

AIR CONDITIONING - DISTRIBUTION - INTRODUCTION

General

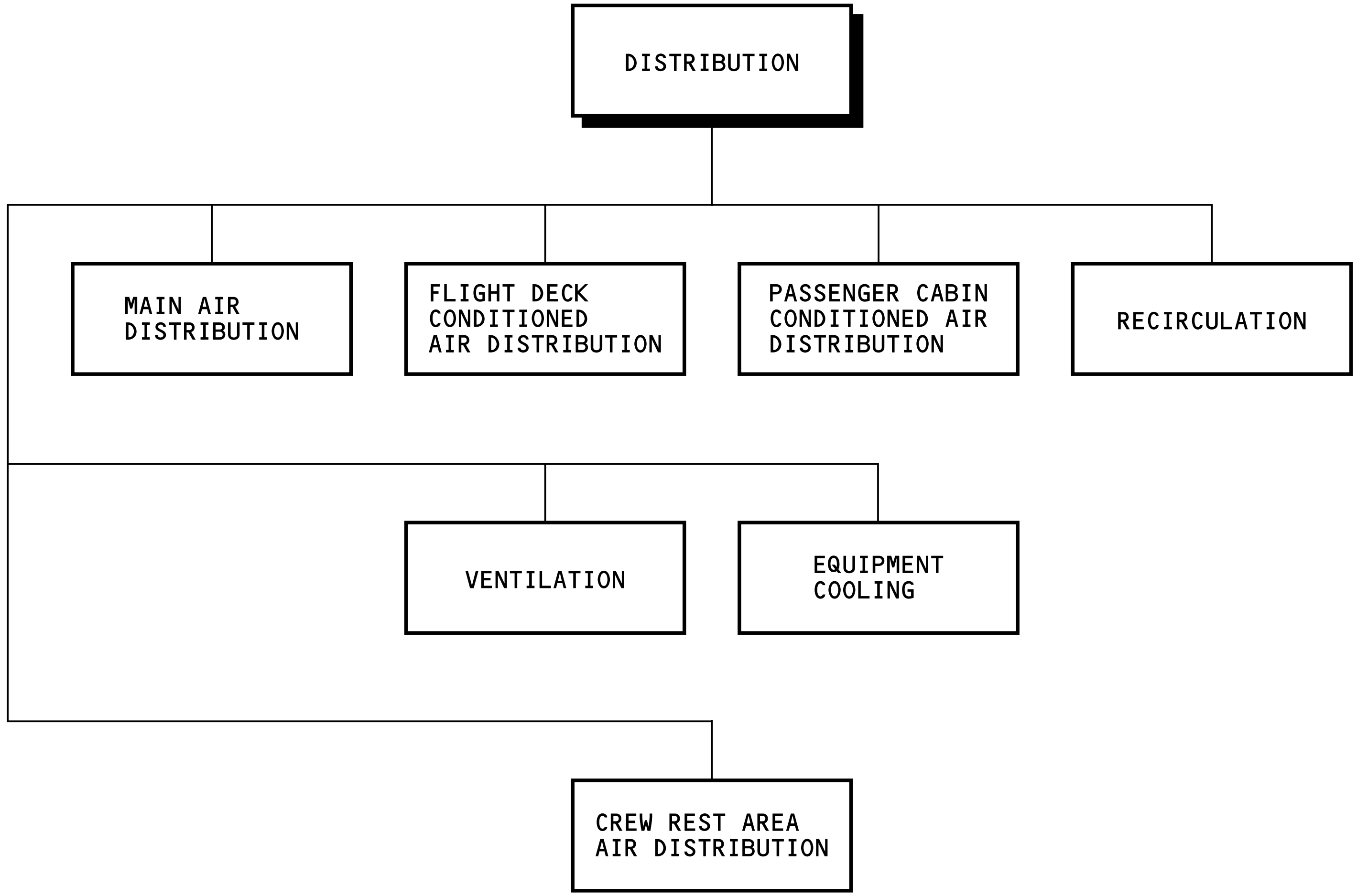
The distribution system has these parts:

- Main air
- Flight deck conditioned air
- Crew rest area air
- Passenger cabin conditioned air
- Recirculation
- Ventilation
- Equipment cooling.

The distribution system lets air from the packs and mix manifold flow to locations in the flight deck, crew rest area, and passenger compartment. The ventilation part of the system removes odors from the lavatories and galleys. The equipment cooling part of the system cools electrical and electronic equipment.

See the distribution - ventilation section for more information about the ventilation in the airplane (AMM PART I 21-26).

See the equipment cooling section for more information about the forward and aft equipment cooling systems (AMM PART I 21-27).



21-20-00-001 Rev 6 10/28/1997

AIR CONDITIONING - DISTRIBUTION - INTRODUCTION

AIR CONDITIONING - DISTRIBUTION - GENERAL DESCRIPTION

General

The distribution system includes ducts and fans that move conditioned and recirculated air through the airplane.

Main Air Distribution

Air from the packs flow through the main air distribution ducts to these locations:

- Flight deck distribution
- Mix manifold.

Mix Manifold

The usual flow of air from the mix manifold goes to the passenger cabin conditioned air distribution. The mix manifold also gives air to the flight deck conditioned air distribution if the left air conditioning pack is off. See the main air distribution section for more information about the mix manifold (AMM PART I 21-21).

Flight Deck Conditioned Air Distribution

The flight deck distribution duct lets conditioned air go from the left pack to the flight deck and to the flight crew rest area. See the flight deck conditioned air distribution section for more information about air distribution to the flight deck and to the flight crew rest area (AMM PART I 21-22).

Lower Lobe Attendants Rest Conditioned Air Distribution

An air distribution duct for the optional lower lobe attendants rest attaches to the left pack outlet duct, upstream of the mix manifold.

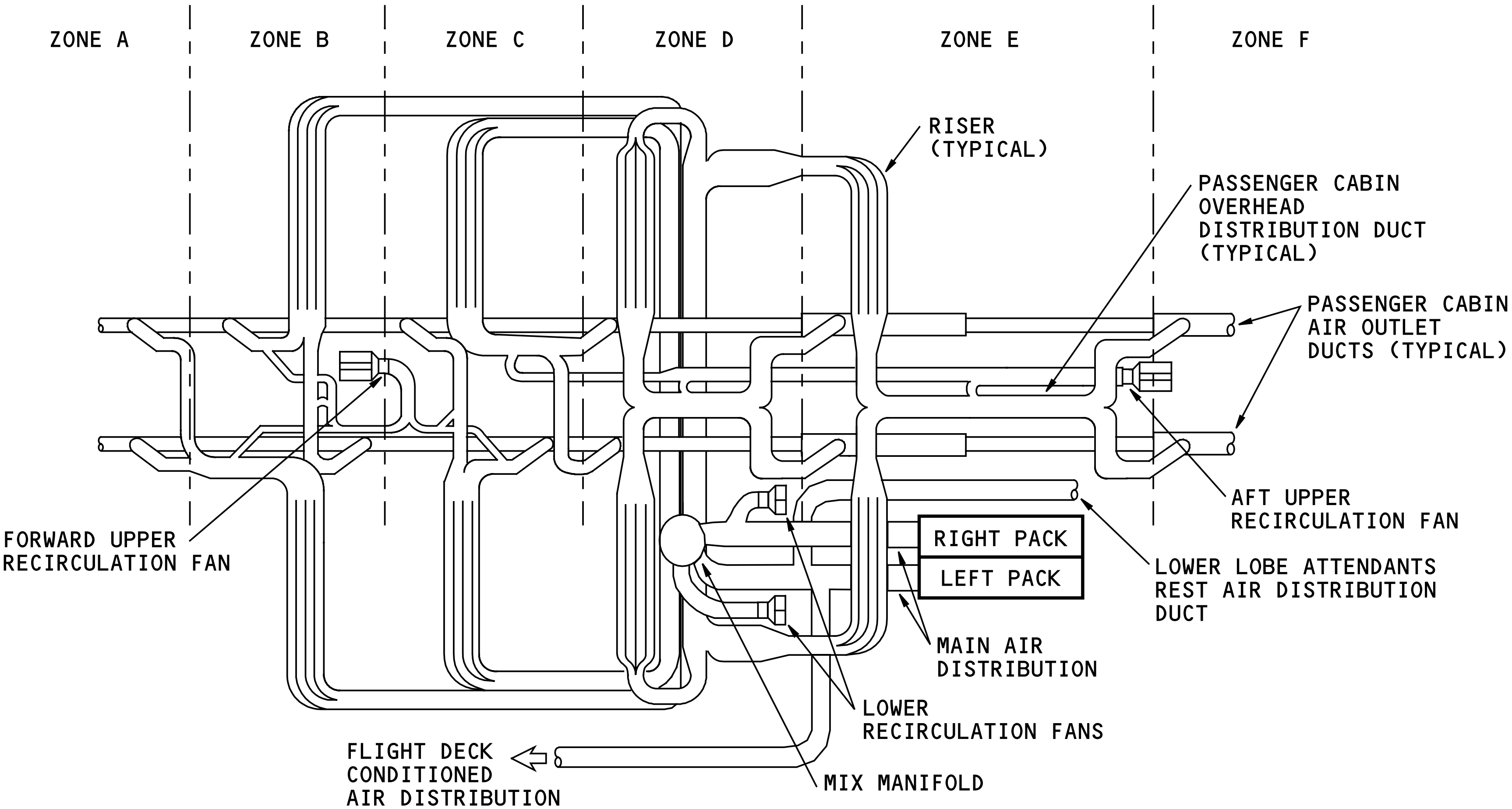
Passenger Cabin Conditioned Air Distribution

Eight risers carry air from the mix manifold, below the passenger cabin floor to the overhead distribution ducts above the passenger cabin ceiling. The overhead distribution ducts carry the air to the air outlet ducts in each of the passenger zones. See the passenger cabin conditioned air distribution section for more information about air distribution to the passenger cabin (AMM PART I 21-23).

Recirculation

Air from the lower recirculation fans mix with the conditioned air in the mix manifold. Air from the upper recirculation fans mix with the conditioned air in the overhead distribution ducts. See the recirculation system section for more information about the recirculation air distribution (AMM PART I 21-25).

PASSENGER CABIN CONDITIONED AIR DISTRIBUTION



21-20-00-002 Rev 5 10/28/1997

AIR CONDITIONING - DISTRIBUTION - GENERAL DESCRIPTION

AIR CONDITIONING - MAIN AIR DISTRIBUTION - DUCT

General

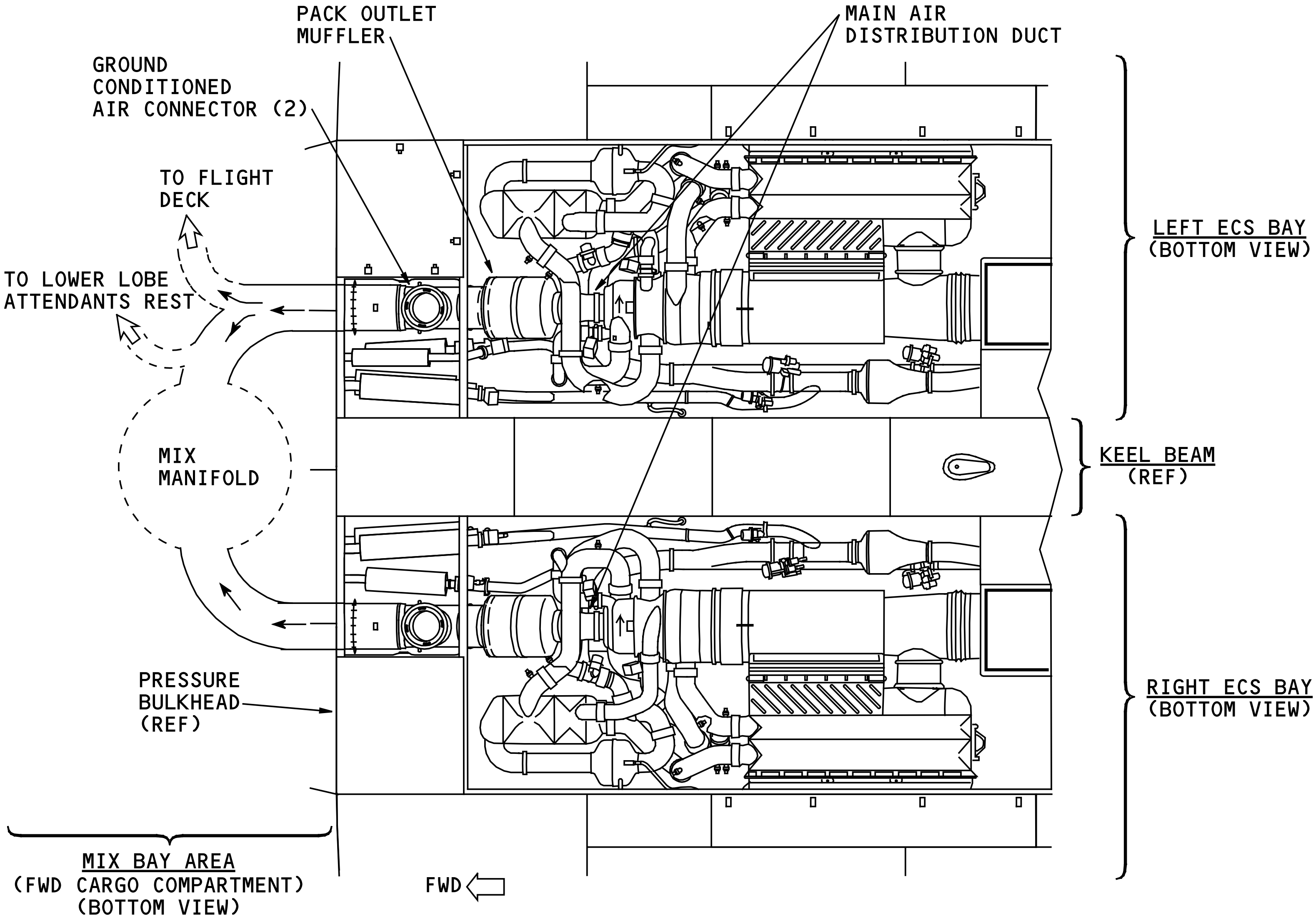
The main air distribution system moves air from the pack or ground conditioned air connector to the mix manifold. It then goes to the flight deck conditioned air distribution duct and to the lower lobe attendants rest air distribution duct.

Pack Outlet Muffler

A muffler in the pack outlet duct decreases noise in the main air distribution system.

Ground Conditioned Air Connector

The ground conditioned air connector lets ground carts supply conditioned air to the cabin zones and the flight deck. A check valve in the connector closes the opening when the pack supplies conditioned air.



21-21-00-001 Rev 6 10/07/1997

AIR CONDITIONING - MAIN AIR DISTRIBUTION - DUCT

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AIR CONDITIONING - MAIN AIR DISTRIBUTION - MIX MANIFOLD

Purpose

The mix manifold mixes fresh air from the main air distribution duct (ground conditioned air or pack air) and cabin air from the lower recirculation system.

The manifold usually gives air to the passenger cabin conditioned air distribution ducts. The manifold can also give air to the lower lobe attendants rest air distribution duct and to the flight deck conditioned air distribution duct when the left air conditioning pack is off.

Location

The mix manifold is aft of the forward cargo compartment in the mix bay area. You remove the cargo compartment end wall to get access to the manifold.

Physical Description

The outer diameter of the mix manifold is approximately 26 inches (66 cm) and is approximately 85 inches (216 cm) high. The manifold has a lower and upper part. The lower part has these features:

- A connection that is the same for the right main air distribution duct and right lower air recirculation system
- A connection for the left main air distribution duct
- A connection for the left lower air recirculation system
- Ice collection screen (internal)
- Water collector (internal)
- Water drain (3 places).

The ice collection screen is in the bottom part of the manifold. It collects ice that can form when the fresh air from the packs or a ground conditioned air source mix with hot humid recirculated air.

The manifold has three water drains at these locations:

- Forward side
- Aft side (not shown)
- Bottom (not shown).

The water drains let water move from inside the manifold to the bilge area below the manifold.

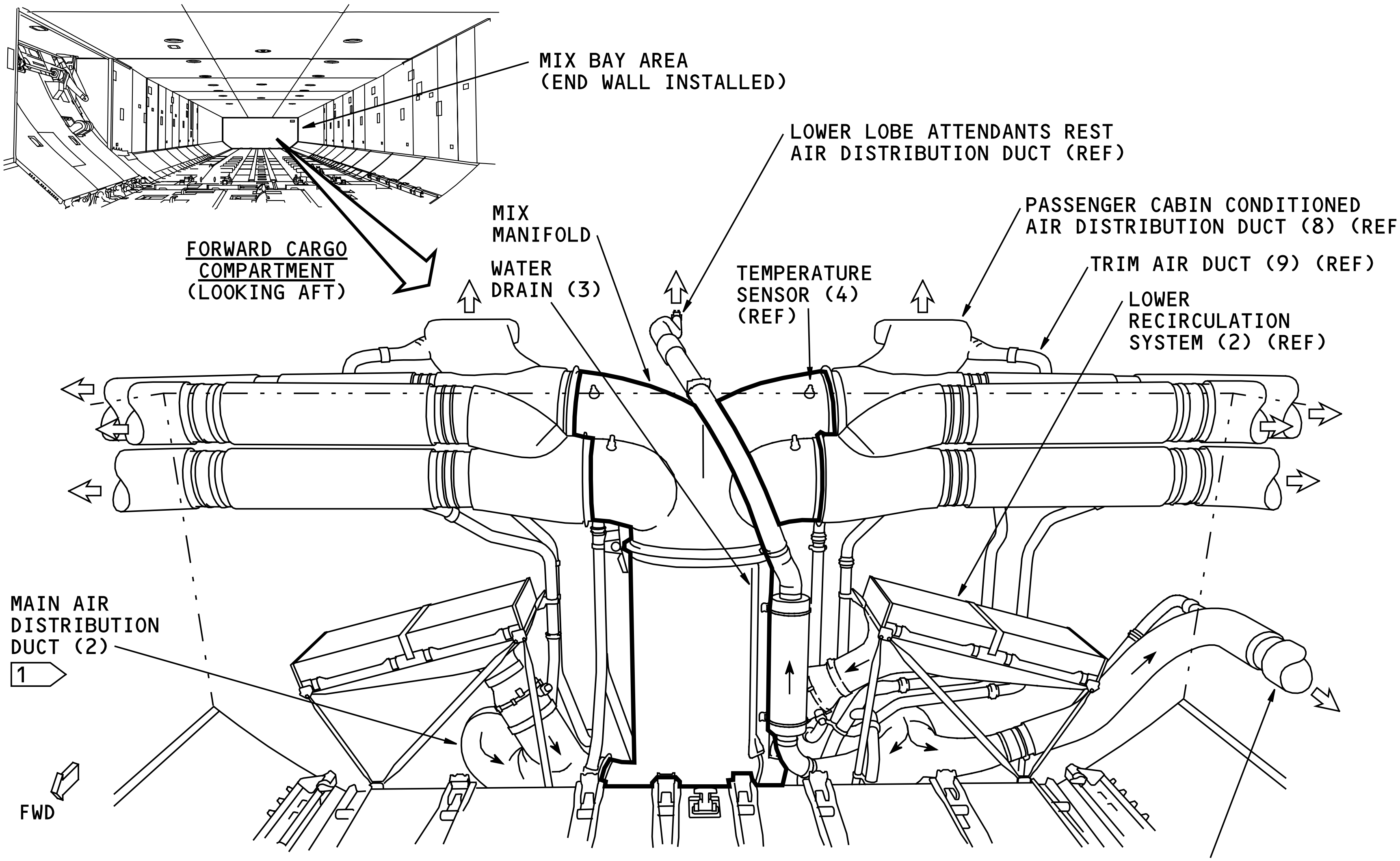
The upper part has these features:

- Four connectors for the passenger cabin conditioned air distribution ducts
- Temperature sensors for the air conditioning pack and mix manifold temperature control system.

See the pack cooling and mix manifold temperature control section for more information about the mix manifold temperature sensors (AMM PART I 21-52).

The manifold is kevlar.

The left main air distribution duct (air from left pack or a ground conditioned air source) gives air to the mix manifold, to the lower lobe attendants rest air distribution duct and to the flight deck conditioned air distribution duct.



1 GROUND CONDITIONED AIR OR PACK AIR

AIR CONDITIONING - MAIN AIR DISTRIBUTION - MIX MANIFOLD

AIR CONDITIONING - FLIGHT DECK CONDITIONED AIR DISTRIBUTION

Purpose

The flight deck conditioned air distribution system moves air from the left pack to the flight compartment. If the left pack is off, the system moves air from the mix manifold to the flight compartment.

Conditioned air for the flight crew rest area comes from the flight deck conditioned air distribution system.

Physical Description

The flight deck conditioned air distribution system has these components:

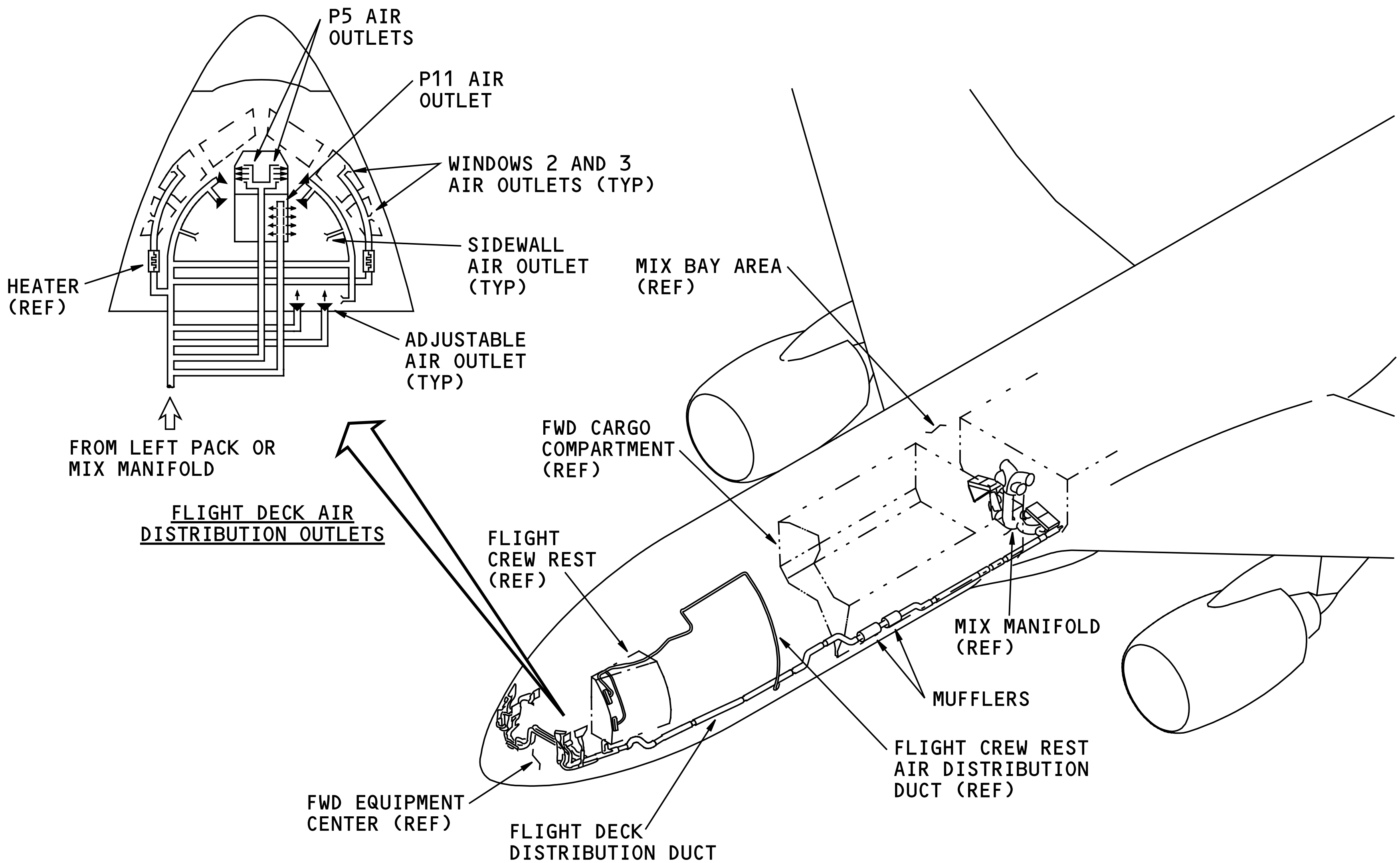
- Ducts
- Muffler (2)
- P5 air outlet (2)
- P11 air outlet
- Windows 2 and 3 air outlet (4)
- Sidewall air outlet (3)
- Adjustable air outlet (6).

Location

Components are in these areas:

- Mix bay
- Forward cargo compartment, left sidewall area
- Left side of the main equipment center
- Forward equipment center
- Flight deck.

There are ducts in all areas. Two mufflers are in the left sidewall area of the forward cargo compartment, aft of the cargo door. Air outlets are in the flight compartment.



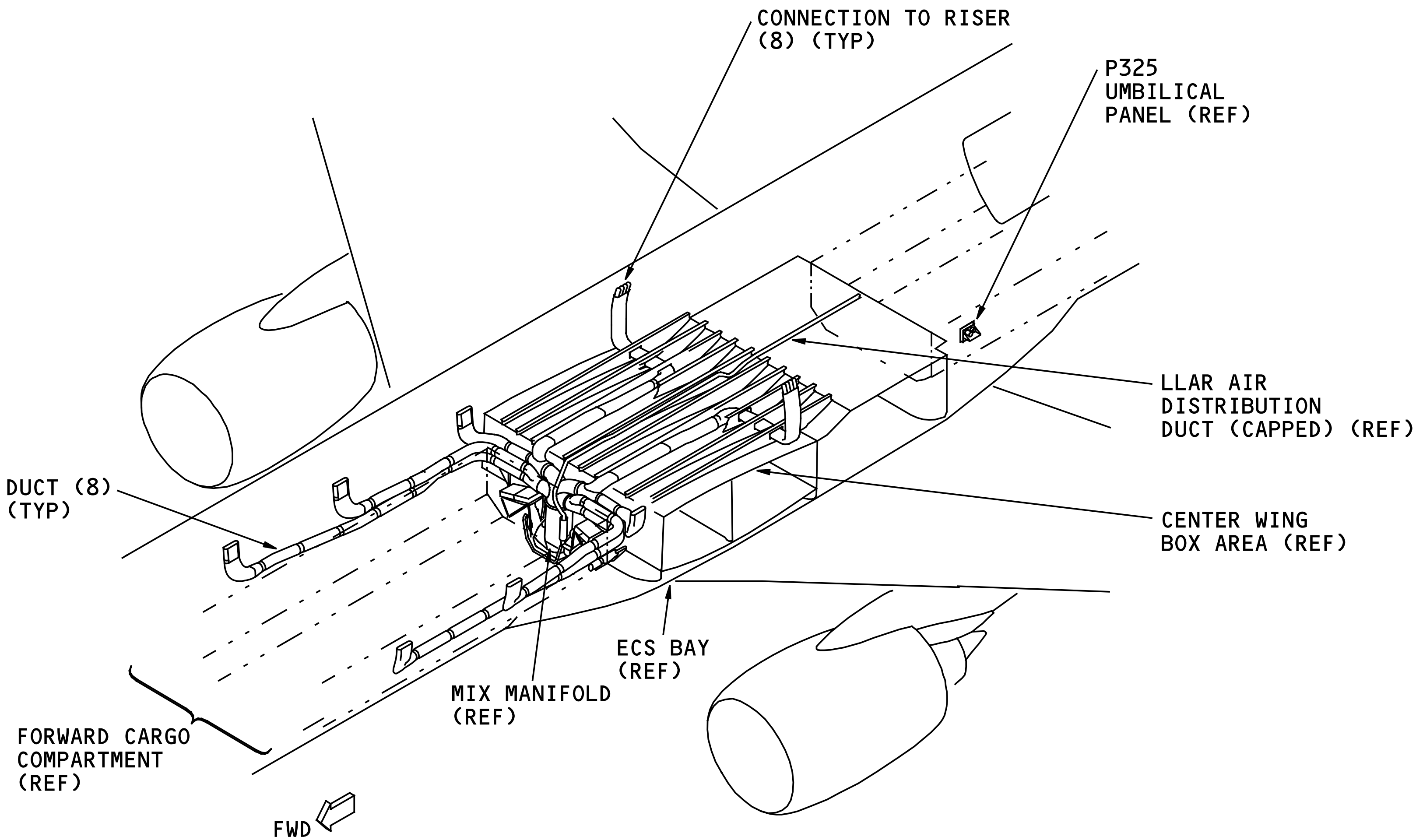
AIR CONDITIONING - FLIGHT DECK CONDITIONED AIR DISTRIBUTION

AIR CONDITIONING - PASSENGER CABIN CONDITIONED AIR DISTRIBUTION - LOWER LOBE AREA

General

The passenger cabin air distribution system moves air from the mix manifold to the passenger cabin area.

In the lower lobe area, conditioned air moves from the mix manifold through eight ducts that connect to risers. Six of the ducts are outboard of the forward cargo compartment, three on each side. Two of the ducts are above the center wing box area.



21-23-00-001 Rev 3 10/28/1997

AIR CONDITIONING - PASSENGER CABIN CONDITIONED AIR DISTRIBUTION - LOWER LOBE AREA

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AIR CONDITIONING - PASSENGER CABIN CONDITIONED AIR DISTRIBUTION - PASSENGER CABIN AREA

General

In the cabin area, the system moves conditioned air to the passenger cabin from the ducts in the lower lobe area (not shown).

The system has these components in the cabin area:

- Risers
- Overhead distribution ducts
- Air outlets.

Riser

There are eight risers, four on each side of the cabin. The risers connect the conditioned air ducts (not shown) in the lower lobe area to conditioned air ducts above the passenger cabin ceiling. To decrease noise, each riser has four round ducts that have insulation over them. The insulation also decreases the collection of water on the outside of the ducts. The risers are identified by the zone that they give air to. These are the risers:

- Zone A, first riser on the left
- Zone B, first riser on the right
- Zone C, second riser on the left
- Zone D, second riser on the right
- Zone E, third set of risers
- Zone F, fourth set of risers.

Overhead Distribution Ducts

The overhead distribution ducts connect the risers to the conditioned air outlet ducts. The ducts have different sizes and shapes. Insulation on the ducts decrease noise and the collection of water on the outside of the ducts. The ducts have connections for the upper recirculation system (not shown) and the door area heating system (not shown). See the recirculation section for more information about the upper recirculation system (AMM PART I 21-25). See the supplemental heating section for more information about the door heating system (AMM PART I 21-45).

Air Outlet Ducts

There are two air outlet ducts for each passenger cabin temperature control zone. Each zone has a duct above the left and right passenger aisles. The air outlet ducts control the flow of conditioned air into the passenger cabin zones. The air outlets ducts collect water that can be in the air from the recirculation system. Insulation on the ducts decrease noise and the collection of water on the outside of the ducts. Each duct has these parts:

- Flow straightener
- Baffle tube
- Antifungal felt
- Plenum sidewall
- Plenum duct.

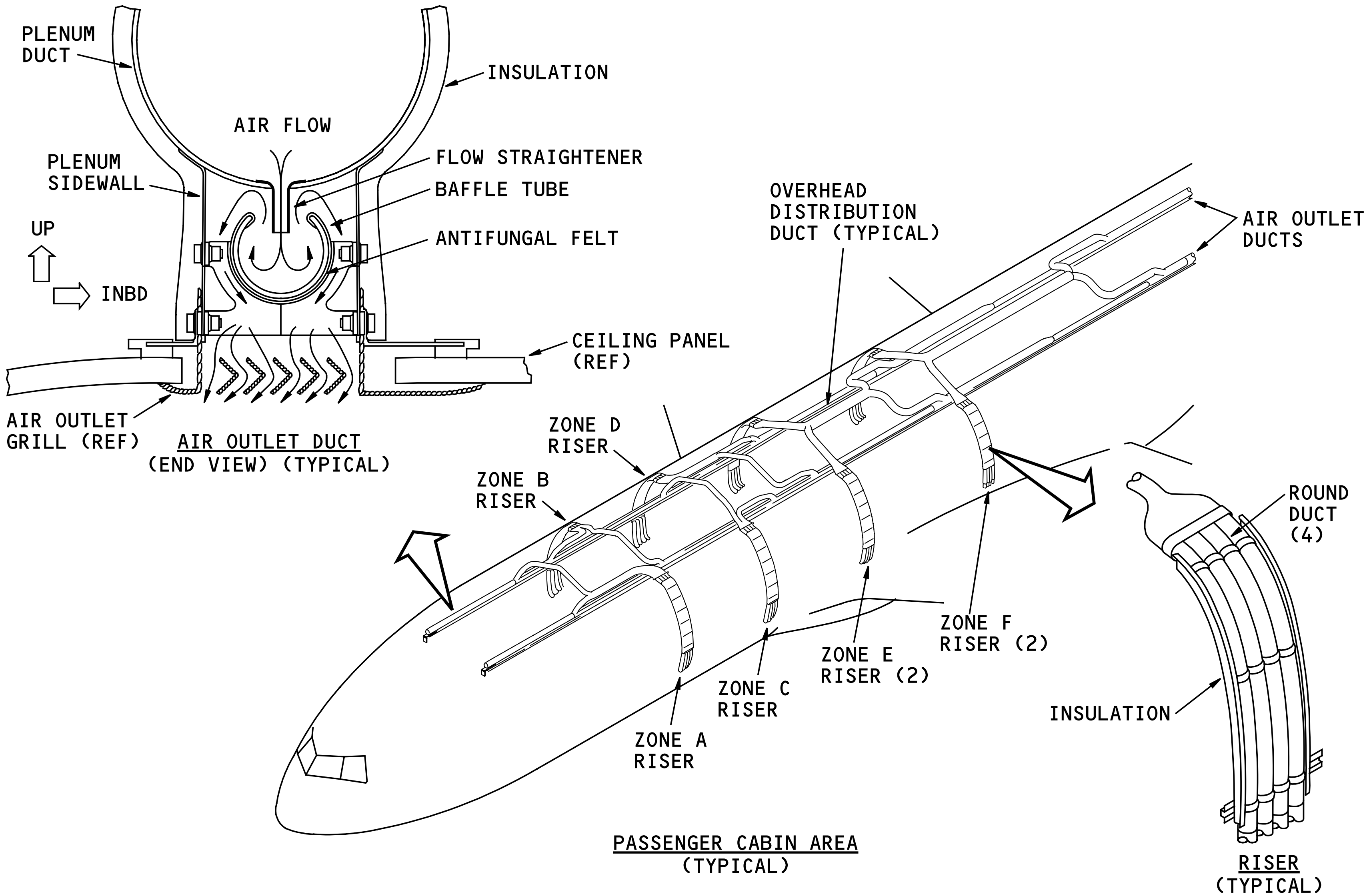
Ceiling panels and the air outlet grill attach to the lower part of the air outlet duct. See the passenger compartment section for more information about the ceiling panels and the air outlet grill (AMM PART I 25-20).

Return Air Grills

Return air grills (not shown) below the sidewall panels in the passenger cabin let air move from the passenger cabin area to the lower lobe area. Cabin air in the lower lobe can flow out of the airplane through the outflow valves or into these systems:

- Lower recirculation system
- Forward equipment cooling system
- Bulk cargo ventilation system.

See the passenger compartment section for more information about the return air grills and sidewall panels (AMM PART I 25-20).



21-23-00-002 Rev 1 10/28/1997

AIR CONDITIONING - PASSENGER CABIN CONDITIONED AIR DISTRIBUTION - PASSENGER CABIN AREA

AIR CONDITIONING - RECIRCULATION - INTRODUCTION

Purpose

The recirculation system puts cabin air back in the air conditioning distribution system.

General Description

Upper recirculation fans, above the passenger compartment ceiling pull in cabin air and put the air back in the overhead distribution ducts. Lower recirculation fans, aft of the forward cargo compartment pull in cabin air and put the air in the mix manifold.

The upper and lower recirculation fan switches on the air conditioning panel enable the operation of these fans.

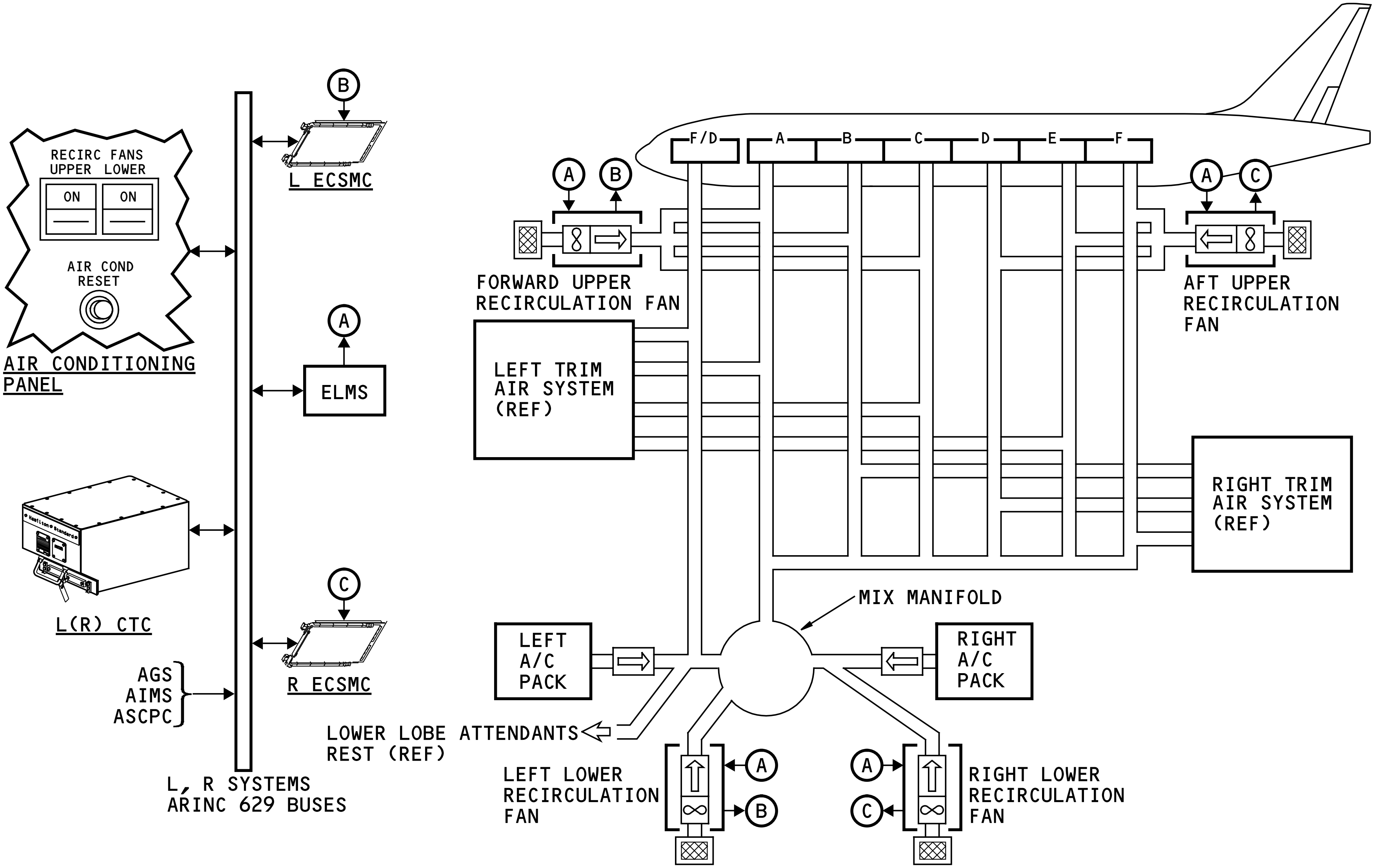
The right cabin temperature controller (CTC) supplies usual control for all recirculation fans. The left CTC supplies backup control.

The left and right ECSMCs monitor for fan overheat conditions.

ELMS controls power to the fans.

The CTCs get information about airplane conditions from these systems/components:

- Air ground system (AGS)
- Electrical load management system (ELMS), load shed and power status
- Airplane information management system (AIMS), cruise clamp information
- Air supply cabin pressure controllers (ASCPC), pack flow schedule.



AIR CONDITIONING - RECIRCULATION - INTRODUCTION

21-25-00-001 Rev 3 10/28/1997

AIR CONDITIONING - RECIRCULATION - LOWER RECIRCULATION FANS AND FILTERS

Purpose

The lower recirculation fans put cabin air back in the distribution system. The air goes through filters at the inlets of the fans.

Physical Description

The fans are axial flow type with a three-phase electric motor. A check valve is part of the fan.

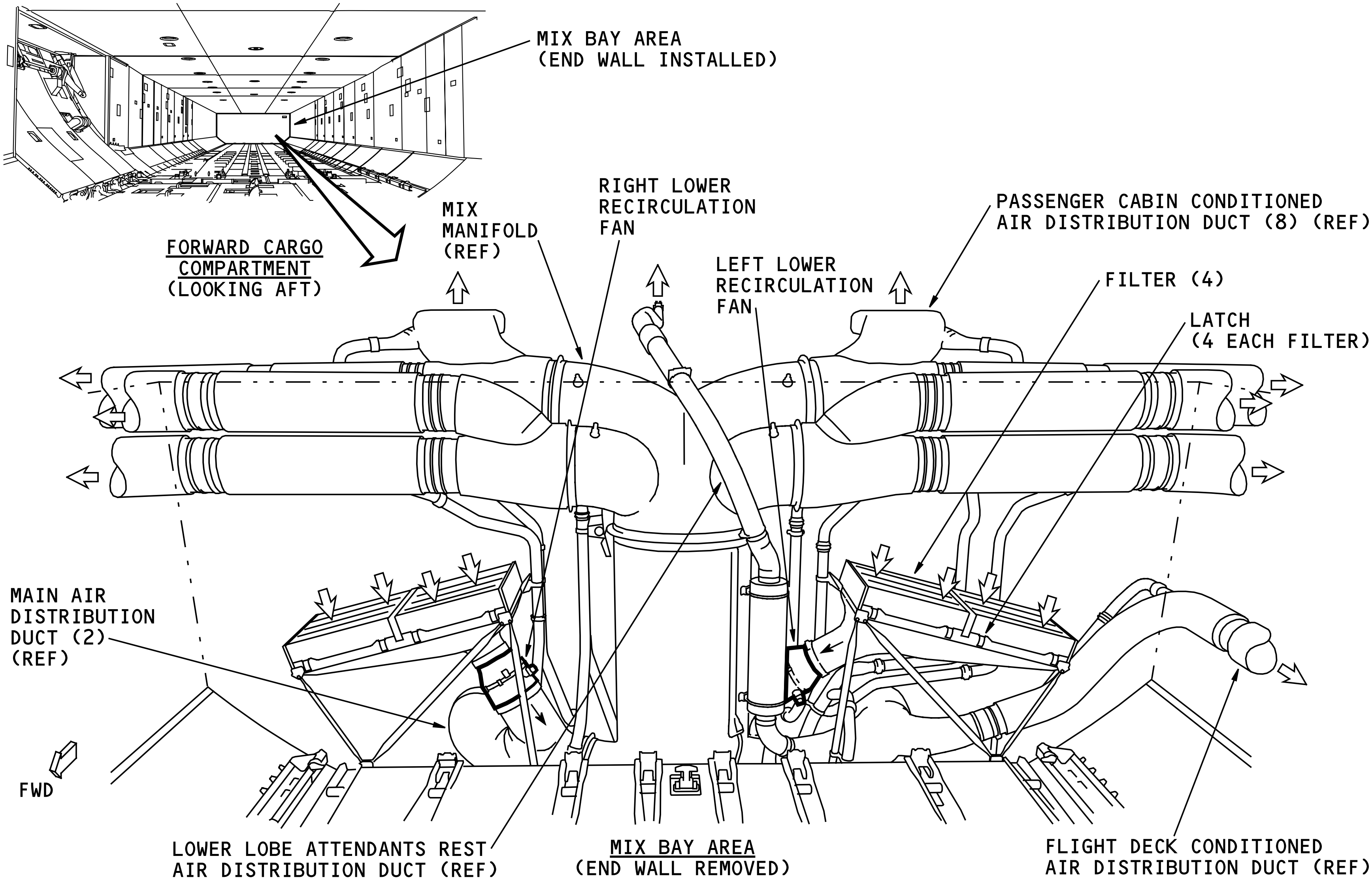
There are four interchangeable lower recirculation fan filters. The filters are a paper type. The filters for the upper and lower recirculation fans are interchangeable.

Location

The fans and filters are aft of the forward cargo compartment in the mix bay area. You remove the cargo compartment end wall to get access to the fans and filters.

Training Information Point

The fans are interchangeable with each other.



AIR CONDITIONING - RECIRCULATION - LOWER RECIRCULATION FANS AND FILTERS

21-25-00-002 Rev 5 10/28/1997

AIR CONDITIONING - RECIRCULATION - UPPER RECIRCULATION FANS AND FILTERS

Purpose

The upper recirculation fans put cabin air back in the overhead conditioned air distribution ducts. The air goes through filters at the inlets of the fans.

Physical Description

The fans are axial flow type with a three-phase electric motor. A check valve is part of the fan.

There are four interchangeable upper recirculation fan filters. The filters are a paper type. The filters for the upper and lower recirculation fans are interchangeable.

Location

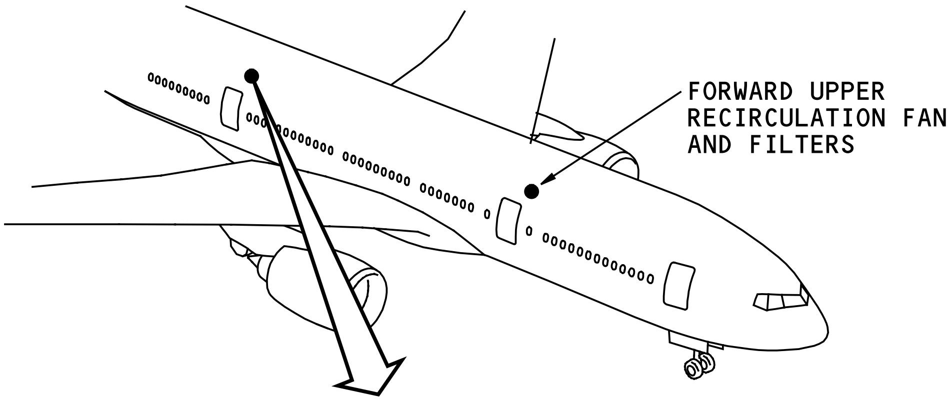
The upper recirculation fans and filters are on the right side of the airplane above the passenger compartment ceiling.

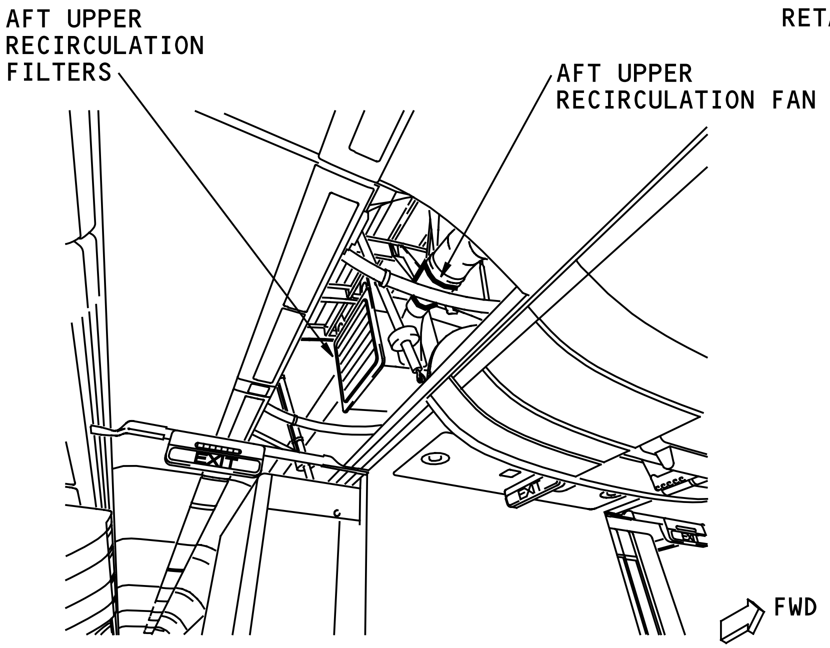
The forward upper recirculation fan and filters are adjacent to door 2 above the center overhead bins.

The aft upper recirculation fan and filters are adjacent to door 3 above the center overhead bins.

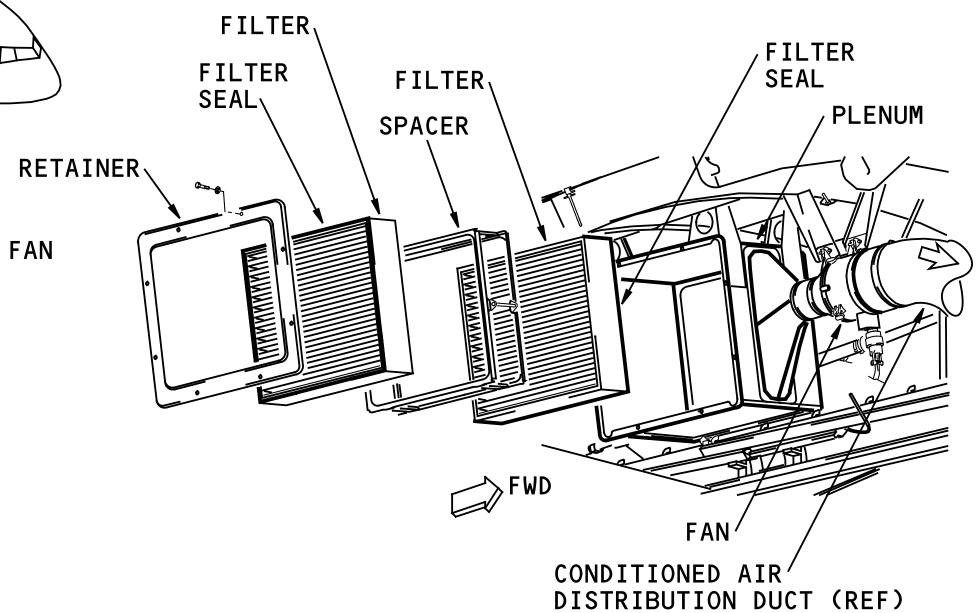
The fans attach to the outlet of a filter plenum assembly and to an overhead passenger cabin conditioned air distribution duct.

The filters are attached inside the filter plenum assembly.





AREA ABOVE THE CENTER OVERHEAD BINS
NEAR DOOR 3 RIGHT
(TYPICAL)



AFT UPPER RECIRCULATION FILTERS AND FAN
(TYPICAL)

AIR CONDITIONING - RECIRCULATION - UPPER RECIRCULATION FANS AND FILTERS

AIR CONDITIONING - RECIRCULATION - FUNCTIONAL DESCRIPTION

Functional Description - Normal

When the two recirculation fan switches on the P5 are ON, the OPAS sends signals to the CTCs. This sets the fans for automatic operation. The right CTC is the primary controller for the recirculation fans. If both channels of the right CTC fail, the left CTC controls the fans.

The CTC sends fan on signals to the ELMS electronic units (EEUs) in the left and right power management panels. The EEUs supply grounds to energize the recirculation fan relays. The relays supply power to each recirculation fan. The CTC turns the fans on and off with a 5 second delay between fans. This helps prevent a sudden load.

Functional Description - Overheat

The ECSMCs monitor overheat switches in the recirculation fans. The left ECSMC monitors the left lower and forward upper fans. The right ECSMC monitors the right lower and aft upper fans (not shown). If an overheat switch opens, the ECSMC sends an overheat signal to the CTC. The CTC latches the fan off. The CTC also latches the related fans off if there is a loss of data from an ECSMC.

Operation - Normal

The lower and upper recirculation fan switches are alternate-action switches. When the switches are off, the recirculation fans are off. When the switches are on, operation of the recirculation fans is automatic.

The upper and lower fans usually operate continuously on the ground and in flight. Single pack ground operation with high ambient temperature may cause a lower fan to stop. The CTC turns off the fan on the same side as the unserviceable pack. This decreases the amount of warm air put into the mix manifold and helps cool the airplane.

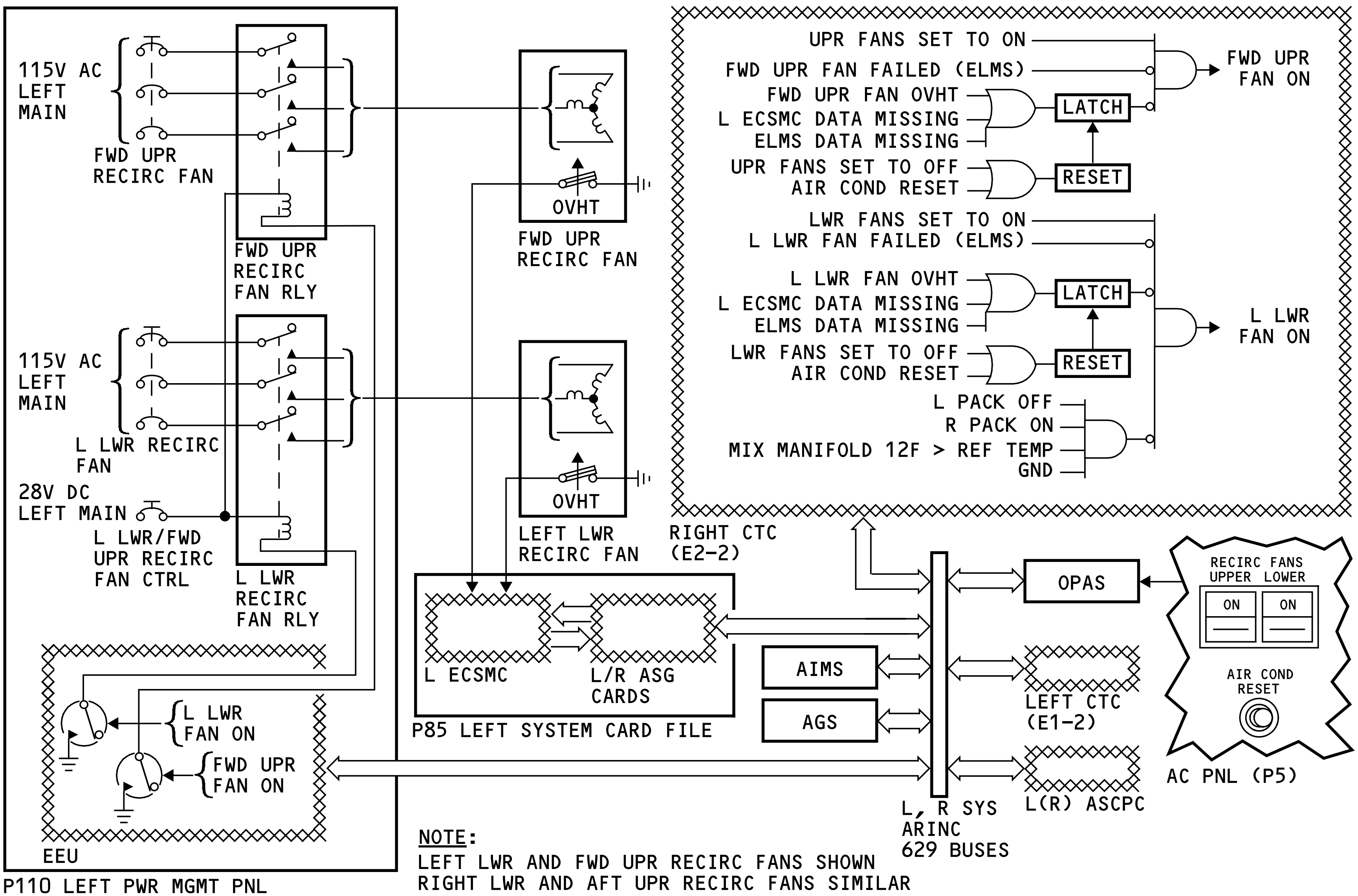
See the pack cooling and mix manifold temperature control section for more information (AMM PART I 21-52).

Operation - Non-normal

If the forward or aft cargo fire arm switches are in the ARMED position, the ELMS and the CTC turn off the lower fans.

If an upper or lower fan has a failure and pack flow schedule 1 is in effect, the pack flow rate increases 67 lbs/min (33.5 lbs/min per pack). This keeps the total cabin ventilation rate constant. The increased bleed air flow causes a small increase in fuel consumption, approximately .3% for each failed fan.

A status message shows if a recirculation fan has a failure. If the fan latches off because of an overheat condition, you can cycle the recirculation fan switch OFF then ON to release the latch. You can also use the AIR COND RESET switch to release the latch.



NOTE:
LEFT LWR AND FWD UPR RECIRC FANS SHOWN
RIGHT LWR AND AFT UPR RECIRC FANS SIMILAR

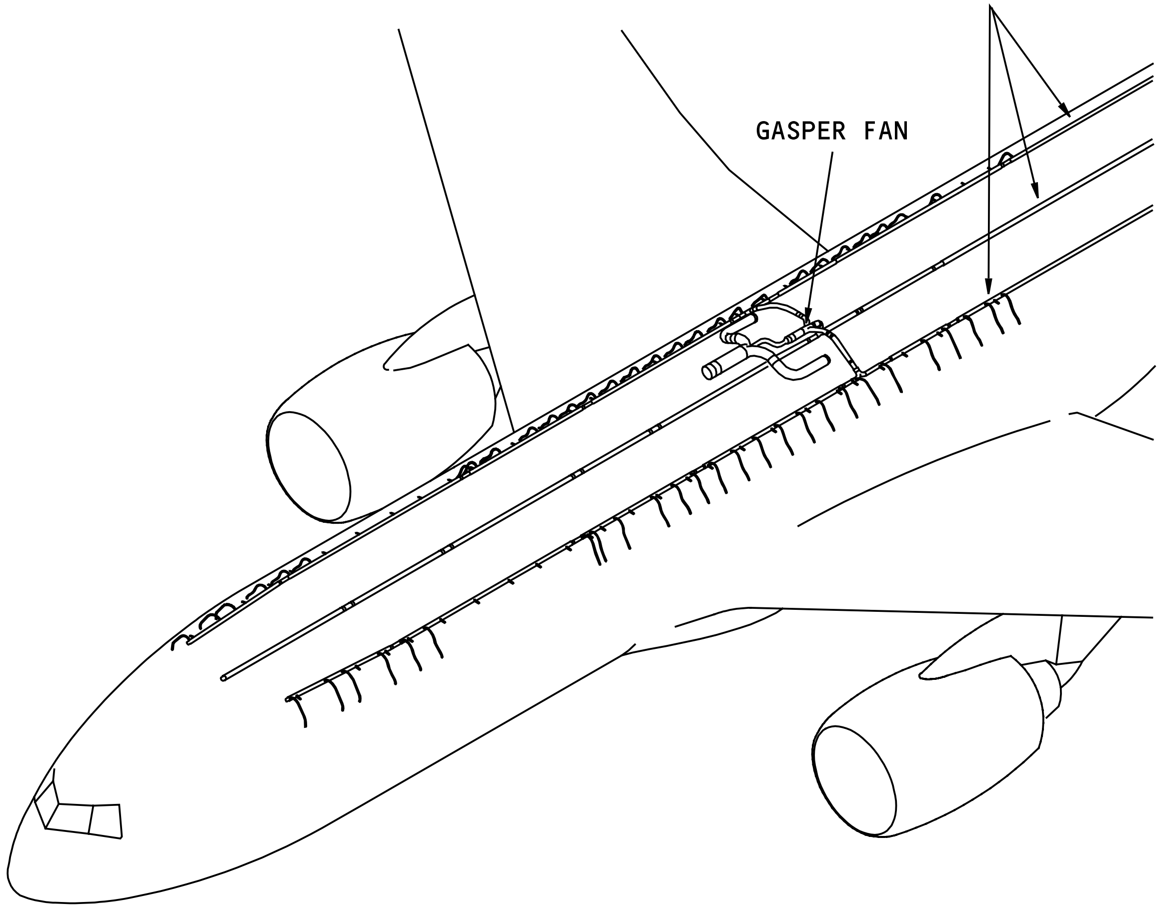
AIR CONDITIONING - RECIRCULATION - FUNCTIONAL DESCRIPTION

21-25-00-004 Rev 5 09/07/96

AIR CONDITIONING - GASPER AIR DISTRIBUTION - INTRODUCTION

Purpose

The gasper air distribution system supplies additional air flow to each passenger seat through outlets in the passenger service units.



21-24-00-001 Rev 0

AIR CONDITIONING - GASPER AIR DISTRIBUTION - INTRODUCTION

AIR CONDITIONING - GASPER AIR DISTRIBUTION - GASPER FAN AND OUTLETS

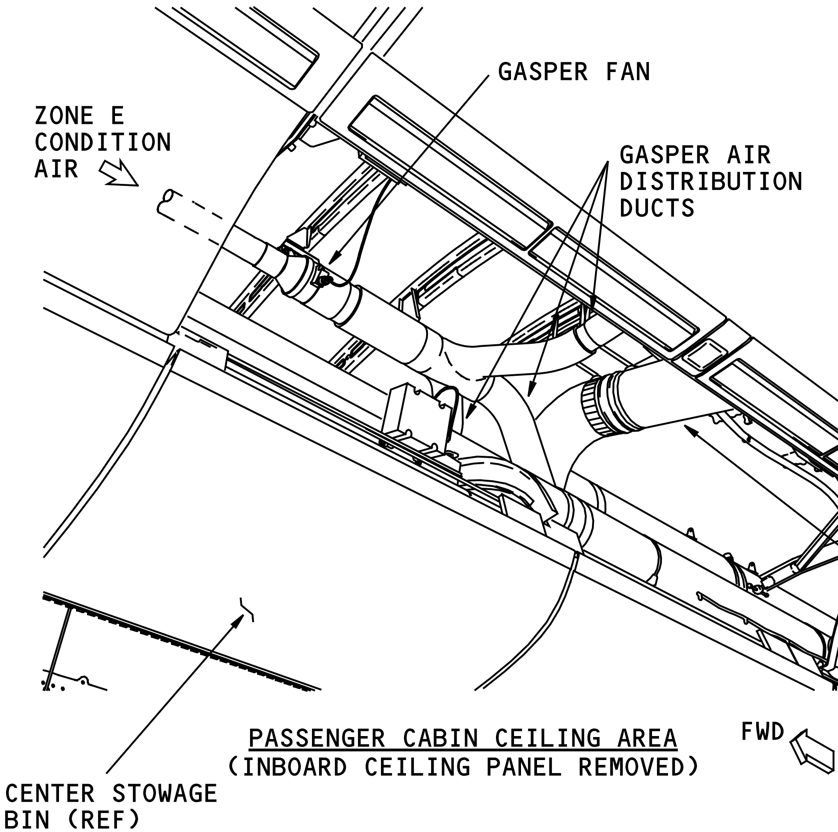
General Description

The gasper fan pulls air from the zone E part of the passenger cabin conditioned air distribution system. The fan moves this air to gasper air outlets at each group of passenger seats. The air moves from the fan to the outlets through three gasper air distribution ducts: left, center and right. The fan supplies approximately 640 cfm of total airflow, this is equal to a flow of 3 cfm to each air outlet with 50 percent of the outlets open.

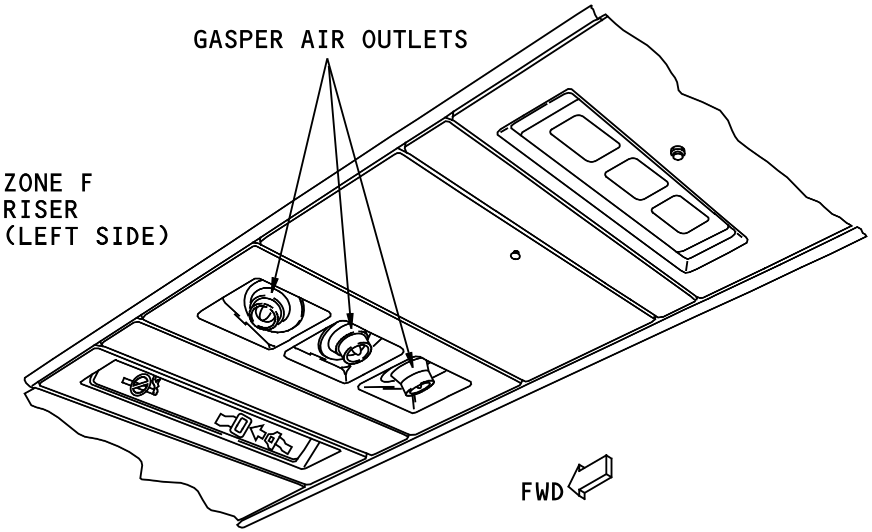
The gasper switch on the air conditioning panel (not shown) enables the operation of the gasper fan. The ECSMCs (not shown) control fan operation.

Location

The gasper fan and the distribution ducts are in the ceiling area of the passenger cabin. The fan is approximate 52 inches (132 cm) forward of the left zone F riser, above the center stowage bins. The ducts are adjacent to the related passenger service units.



PASSENGER CABIN CEILING AREA
(INBOARD CEILING PANEL REMOVED)



PASSENGER SERVICE UNIT
(ABOVE EACH GROUP
OF PASSENGER SEATS)

21-24-00-002 Rev 1 04/18/1997

AIR CONDITIONING - GASPER AIR DISTRIBUTION - GASPER FAN AND OUTLETS

Functional Description

When the gasper fan switch on the P5 is on, a signal goes to the environmental control system miscellaneous card (ECSMC) in each of the system card files. This sets the fan control for automatic operation.

The ECSMC that is in control sends a fan ON signal to the left power management panel. A switch in the electrical load management system (ELMS) electronics (ELEX) unit supplies a ground to energize the gasper fan relay. This relay supplies power to the gasper fan.

Fault Monitoring

ELMS monitors fan current and relay status during operation. ELMS sends these signals to the ECSMCs:

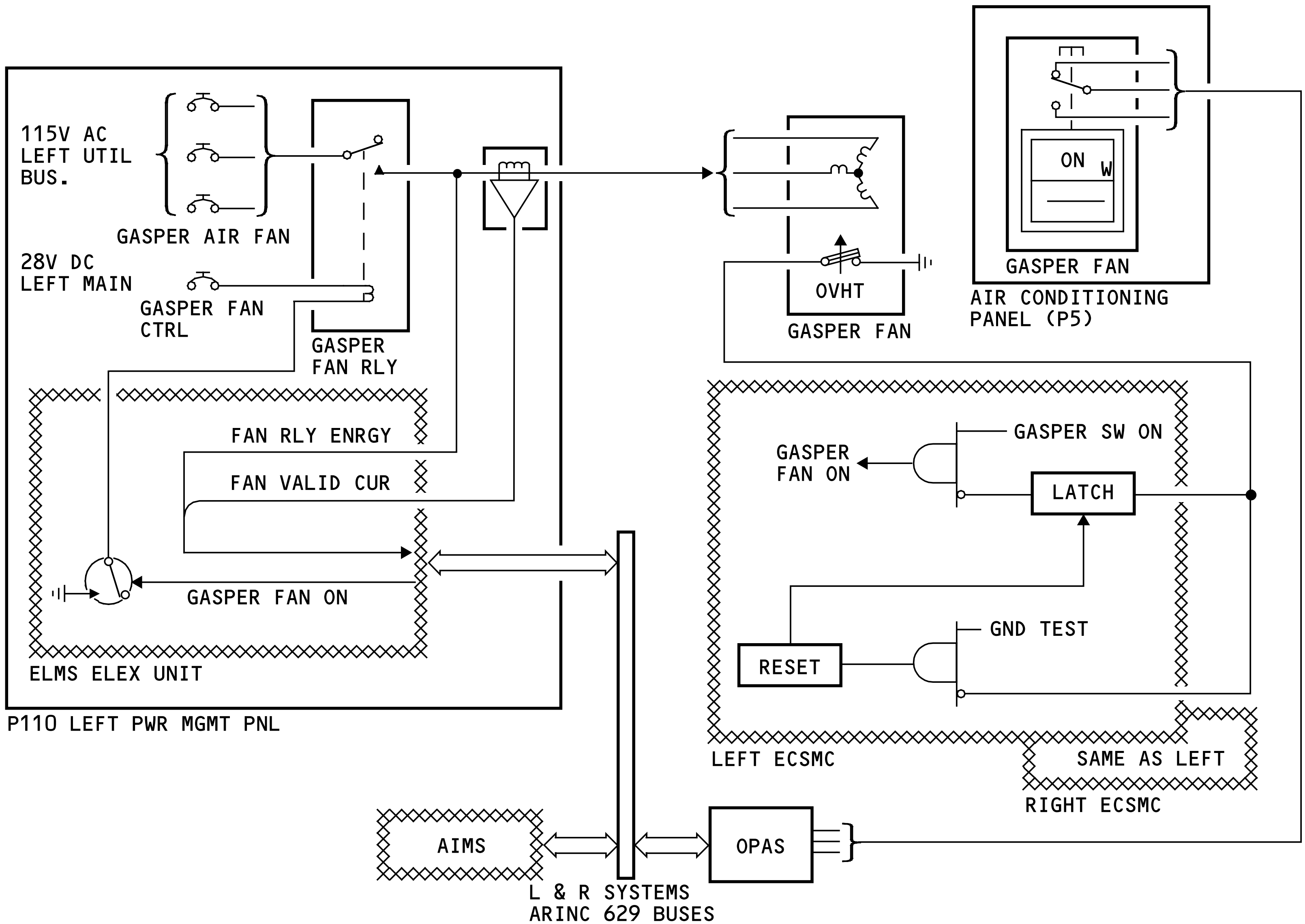
- Valid fan current
- Fan relay energized.

A switch in the gasper fan supplies an indication to the ECSMC. If the fan becomes too hot or does not start or stop on command, the ECSMCs send a signal to AIMS. The central maintenance computing function makes a maintenance message.

Fan Overheat

If the fan overheats, the ECSMCs latch the gasper fan off. The fan stays off until both of these conditions are true:

- Mat ground test
- Not overheat.



AIR CONDITIONING - GASPER AIR DISTRIBUTION - FUNCTIONAL DESCRIPTION

AIR CONDITIONING - VENTILATION - GENERAL DESCRIPTION - MECHANICAL

Purpose

The ventilation system has these functions:

- Removes odors from the lavatories and galleys
- Causes air flow across the zone temperature sensors for the flight, passenger, and cargo compartments
- Causes air flow through electrical and electronic equipment
- Removes warm air from above the passenger compartment ceiling and from the galley chiller units in the forward part of the airplane
- Supplies air flow into the bulk cargo compartment.

These are the types of ventilation:

- Galley chiller unit ventilation
- Bulk cargo ventilation
- Lavatory/galley ventilation.

Galley Chiller Unit Ventilation

The chiller boost fan removes warm air from galley chillers and the area above the passenger compartment ceiling. Only chillers in the passenger compartment ceiling area above the galleys and forward of the wings connect to the fan.

The air from the chiller boost fan goes to the mix bay area. The lower recirculation fans (not shown) move the air from the mix bay into the mix manifold part of the air conditioning distribution system.

Holes in the duct let hot air from the chiller exhaust go into the ceiling when the fan is off.

The chiller boost fan operates automatically.

Bulk Cargo Ventilation

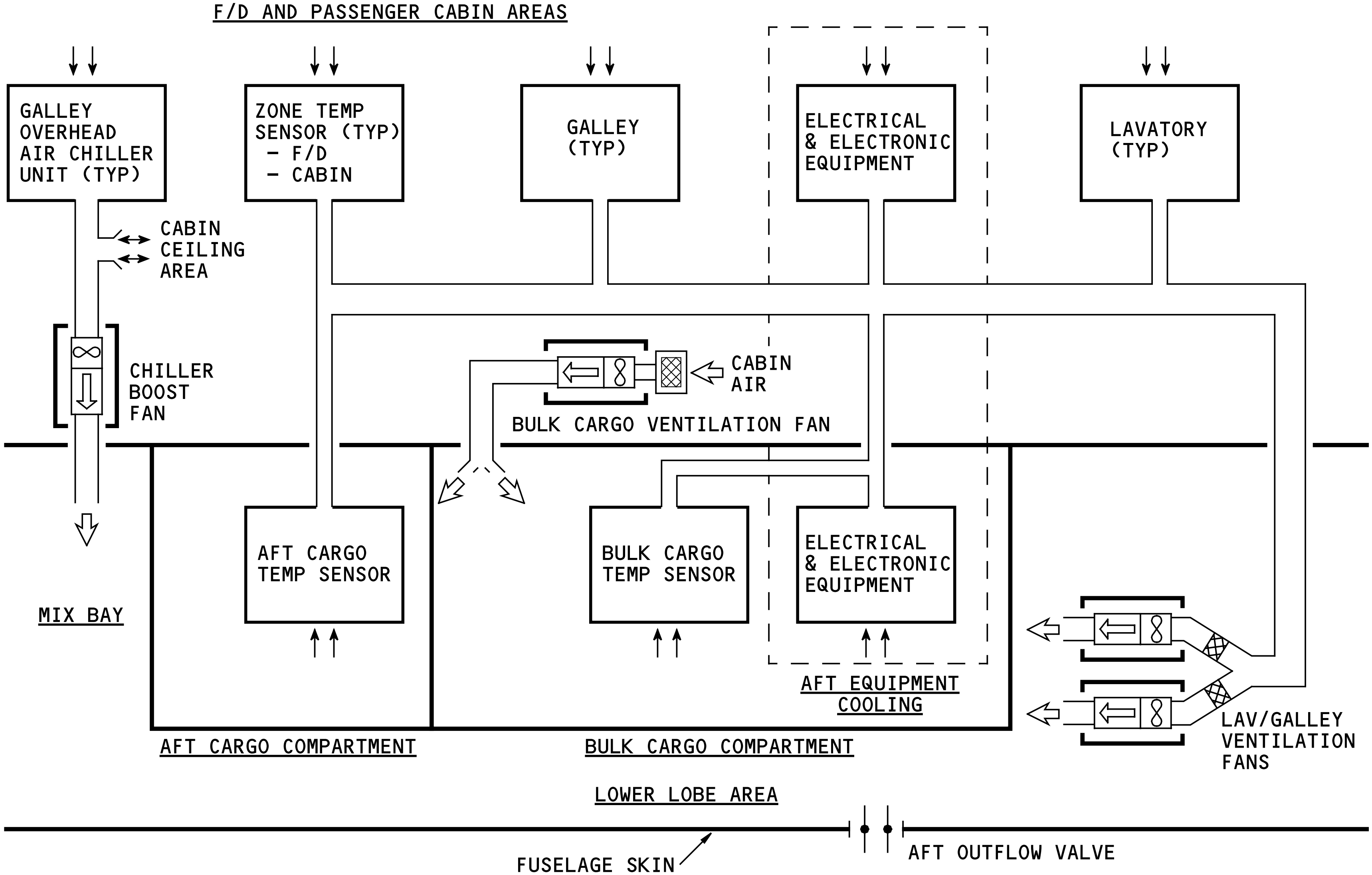
The bulk cargo ventilation fan increases the ventilation when there are animals in the bulk cargo compartment. The fan pulls air from the passenger compartment and moves it into the bulk cargo compartment. The fan operates when the bulk cargo heating system is set to HIGH.

Lavatory/Galley Ventilation

There are two lavatory/galley ventilation fans. Only one fan operates at a time. The right fan is primary and the left fan is the backup. At airplane power up, the left fan comes on, is tested, and goes off. The right fan then comes on, is tested, and stays on. The fan that operates pulls air from these areas and components:

- Lavatories
- Galleys
- Zone temperature sensors
- Cargo temperature sensors
- Electrical and electronic equipment.

The air from the lavatory/galley ventilation fan goes to the area next to the aft pressurization outflow valve.



AIR CONDITIONING - VENTILATION - GENERAL DESCRIPTION - MECHANICAL

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AIR CONDITIONING - VENTILATION - GENERAL DESCRIPTION - ELECTRICAL

General

The environmental control system miscellaneous cards (ECSMCs) in the system card files control the ventilation fans. At power-up, the right ECSMC controls the fans. The left ECSMC gives backup. Each time the airplane goes from air to ground, the card in control changes.

Interfaces

The ECSMCs make decisions about operation and indications for the ventilation fans based on these inputs:

- Airplane in the air or on the ground (WOW)
- Fan overheat switches
- AC power available for fan operation (ELMS)
- Fan load shed status (ELMS)
- Fan control relay status, energized or not (ELMS)
- Valid current for fan on or off status (ELMS)
- Bulk cargo heat selector position, OFF, LOW, HIGH (OPAS)
- Forward and aft cargo fire switches, ARMED or not armed (OPAS)
- Equipment cooling switch position (OPAS)
- Left and right air conditioning packs on or off (CTC)
- Total air temperature (TAT) (ADIRU).

The ECSMCs interface with AIMS. The primary display system gives a status message for a failed ventilation fan. The central maintenance computing function gives a maintenance message for any failed fan and lets you do a ground test for the ventilation fans.

The ECSMCs interface with the CTCs. The ECSMCs give on/off information about the lavatory/galley ventilation fans. If both fans are off, the CTCs use an alternate mode to calculate the necessary duct and mix manifold temperatures for zone temperature control. See the zone temperature control and indication section for more information about the alternate mode (AMM PART I 21-61).

Lavatory/Galley Ventilation

Control of the fans is automatic and requires no crew action for fan operation.

There are two lavatory/galley ventilation fans. Only one fan operates at a time. The right fan is primary and the left fan is the backup. At airplane power up, the left fan comes on, is tested, and goes off. The right fan then comes on, is tested, and stays on.

Galley Overhead Air Chiller Unit Ventilation

Control of the chiller boost fan is automatic and no crew action for fan operation is necessary.

The fan comes on when these conditions occur:

- Airplane is on the ground
- One or two packs are on
- TAT is more than 45F (7C)

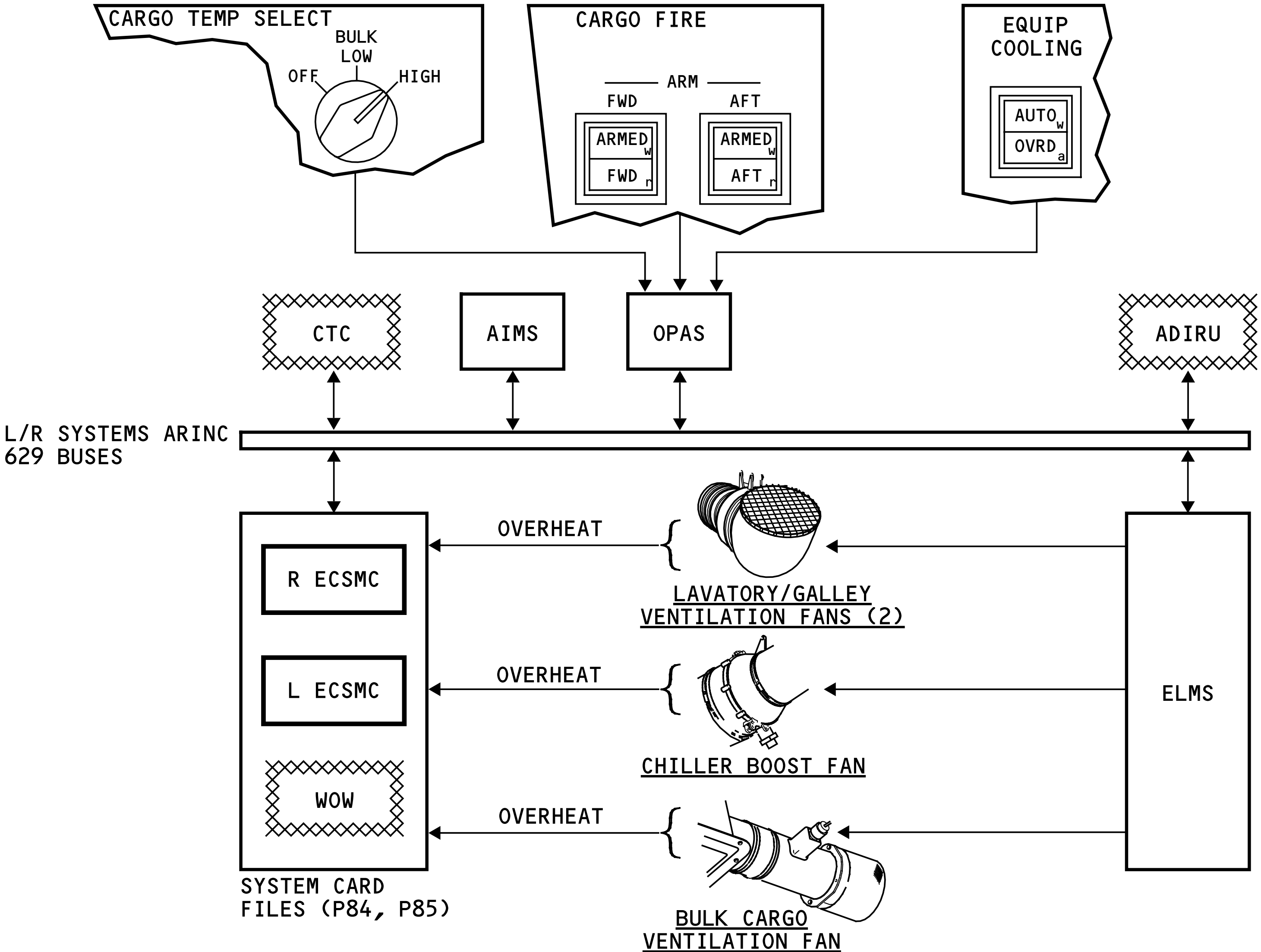
- FWD cargo fire switch is not armed.

The fan will go off when the airplane is in the air.

Bulk Cargo Ventilation

The bulk cargo ventilation fan operates when the crew sets the bulk cargo heating system to HIGH.

Selection of the equipment cooling switch to the OVRD position or the selection of the aft cargo fire switch to ARMED inhibits the operation of the fan.



AIR CONDITIONING - VENTILATION - GENERAL DESCRIPTION - ELECTRICAL

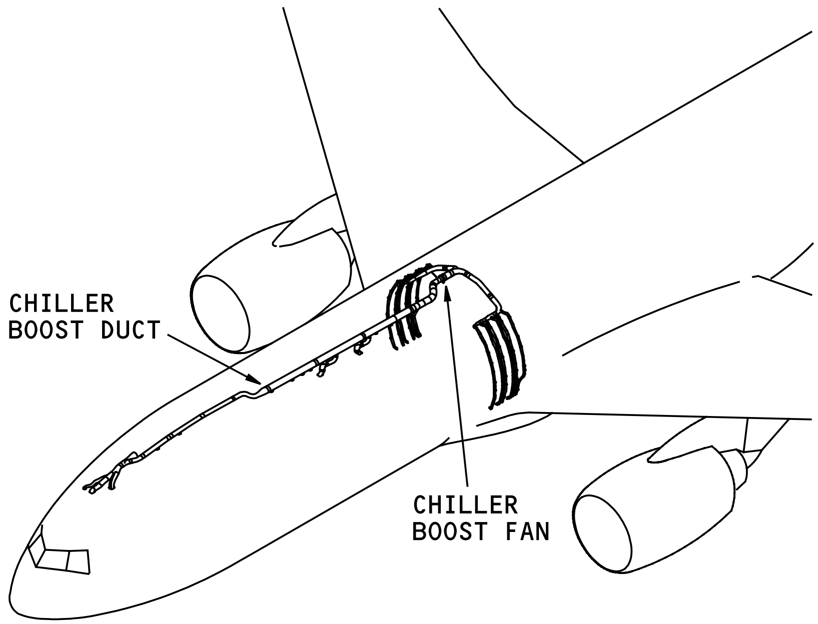
AIR CONDITIONING - VENTILATION - CHILLER BOOST FAN

Purpose

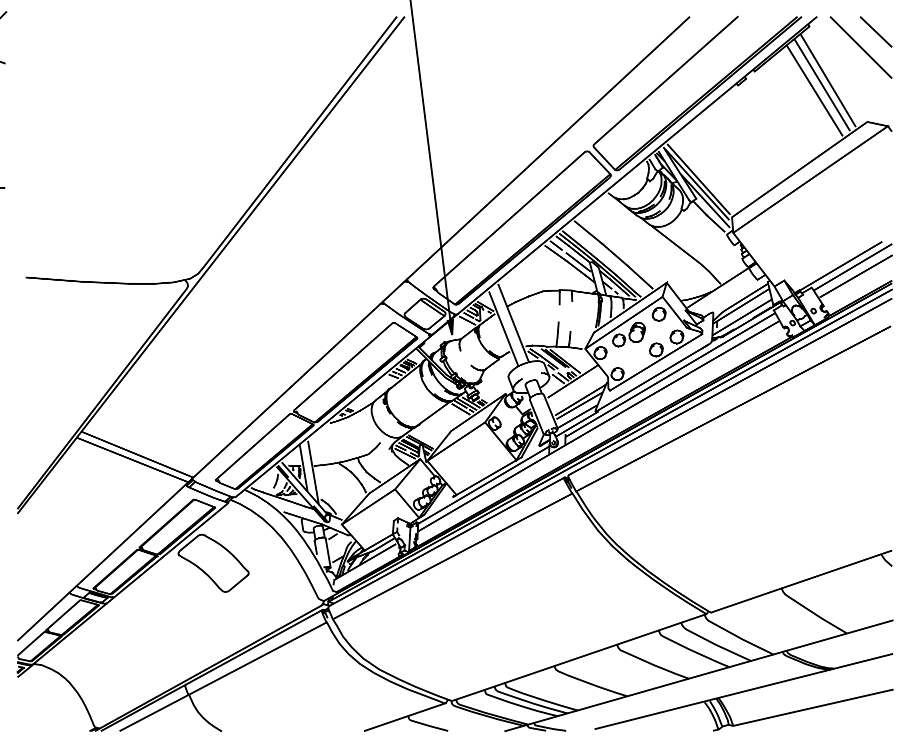
The chiller boost fan removes the warm air that comes from the forward galley chillers. This air vents around the area of the mix manifold.

Location

The fan is at station 957 above the center overhead bins. This location is adjacent to the seventh window aft of door 2 in the passenger cabin.



CHILLER BOOST
DUCT ROUTING



AREA ABOVE THE CENTER OVERHEAD BINS
AT STATION 957

21-26-00-004 Rev 1

AIR CONDITIONING - VENTILATION - CHILLER BOOST FAN

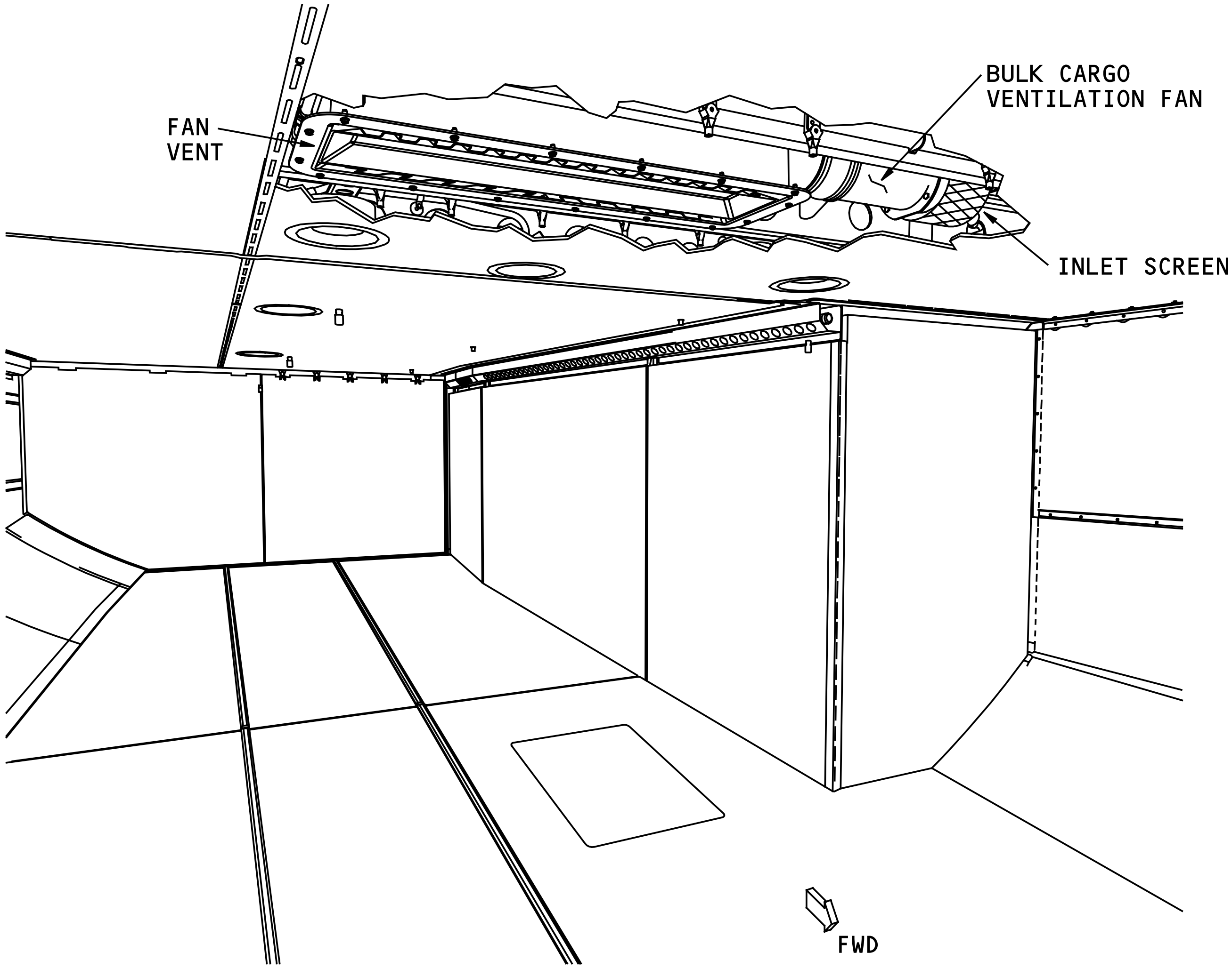
AIR CONDITIONING - VENTILATION - BULK CARGO VENTILATION FAN

Purpose

The bulk cargo ventilation fan pulls air from the passenger cabin above into the bulk cargo compartment.

Location

Access to the fan is through the ceiling liner of the bulk cargo compartment.



NOTE: CEILING CUT AWAY
TO SHOW DETAILS

BULK CARGO COMPARTMENT

21-26-00-005 Rev 1 04/15/1997

AIR CONDITIONING - VENTILATION - BULK CARGO VENTILATION FAN

AIR CONDITIONING - VENTILATION - LAVATORY GALLEY VENTILATION FANS, INLET DUCT AND SCREEN

Purpose

The lavatory galley ventilation fans pull air from the lavatories and galleys in the passenger cabin. A single ventilation duct (not shown) above the ceiling connects the lavatories and galleys to the fans. The fans are aft of the bulk cargo compartment end wall. Hoses (not shown) from the ventilation duct pull air across the zone temperature sensors in these areas:

- Passenger cabin
- Aft and bulk cargo compartments
- Flight deck.

Lavatory Galley Ventilation Fans

The lavatory galley ventilation fans are aft of the bulk cargo compartment endwall. The fans pull air from the lavatories and galleys. The fans have these components:

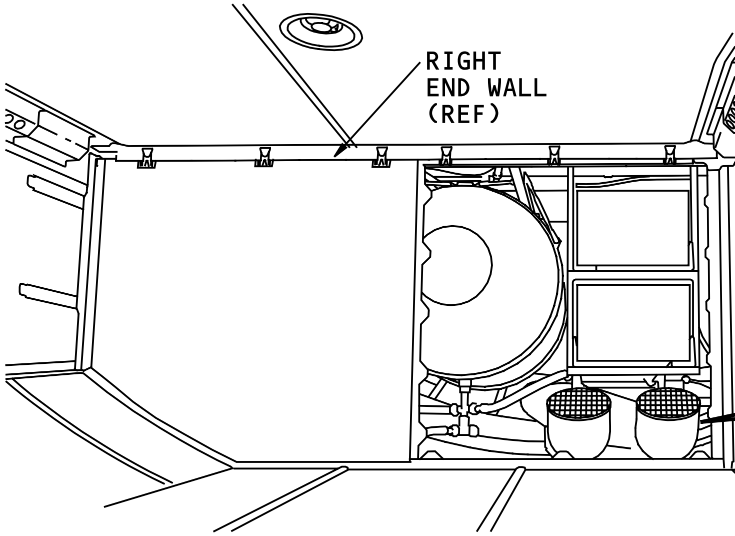
- Fan rotation arrow
- Flow direction arrow
- Stator housing assembly and check valve
- Electrical connector
- Inlet housing assembly.

Inlet Duct and Screen

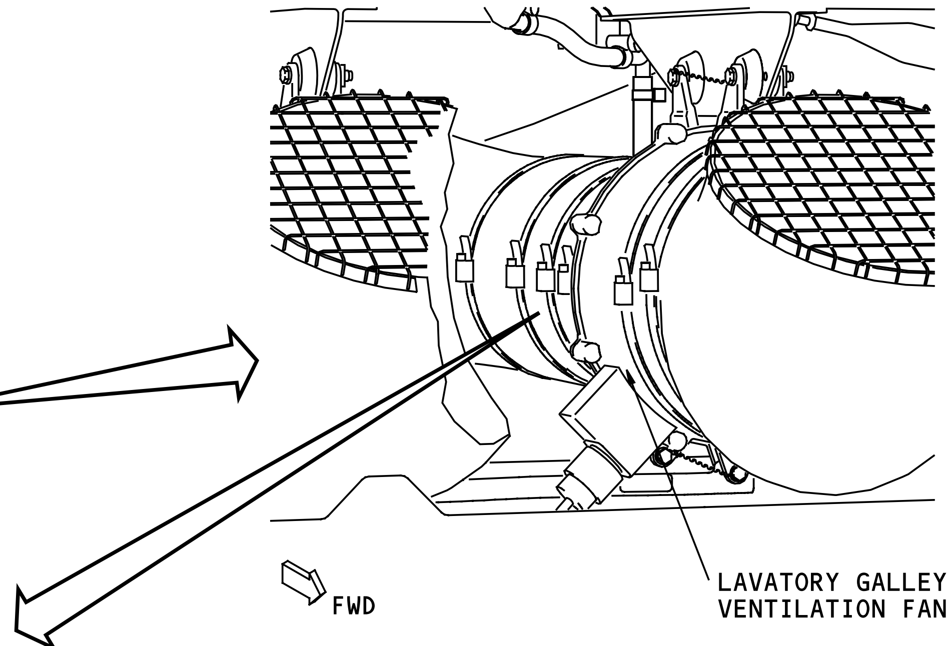
There is an inlet duct and screen on the aft side of the two lavatory galley ventilation fans. The screen prevents unwanted material from going through the lavatory galley ventilation fans.

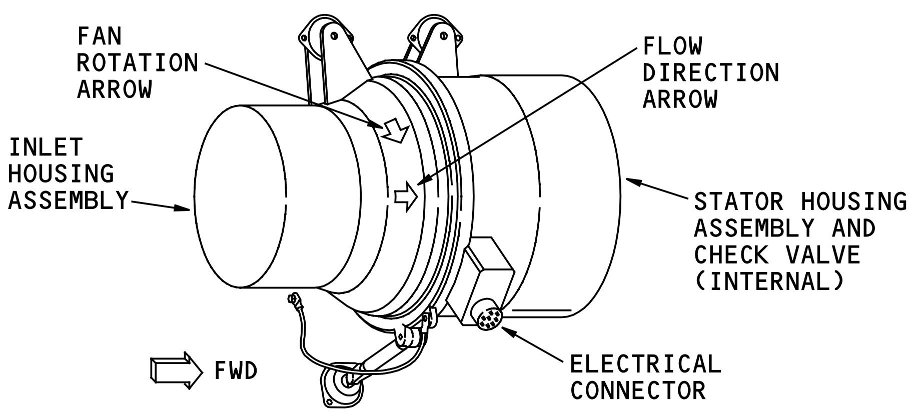
Training Information Point

The lavatory galley ventilation fans are interchangeable with the lower recirculation fans and the chiller boost fan.

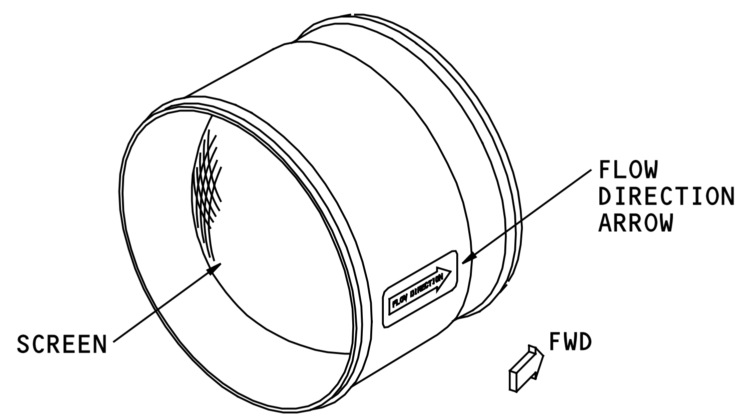


BULK CARGO COMPARTMENT
(LOOKING AFT WITH LEFT END WALL REMOVED)
(TYPICAL)





LAVATORY GALLEY VENTILATION FAN



INLET DUCT AND SCREEN

21-26-00-003 Rev 3 03/05/1997

AIR CONDITIONING - VENTILATION - LAVATORY GALLEY VENTILATION FANS, INLET DUCT AND SCREEN

AIR CONDITIONING - VENTILATION - GALLEY VENTILATION FILTERS

Purpose

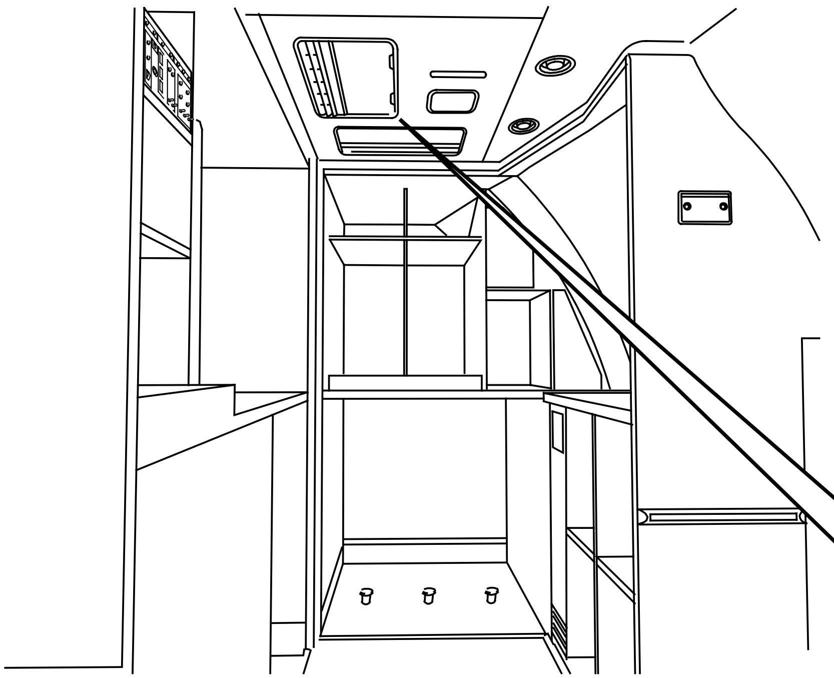
The galley ventilation filters remove particles from the galley air before the air goes into the ventilation duct. The air then moves through the ventilation duct to the lavatory galley ventilation fans.

Location

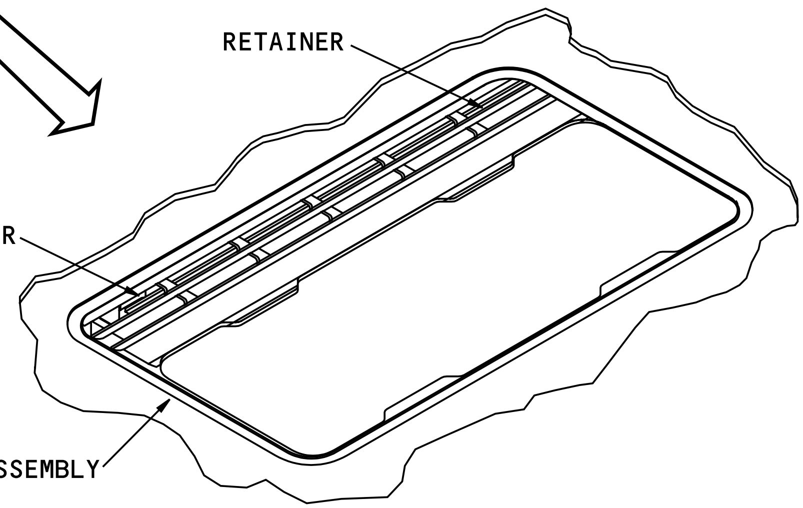
Each ventilation inlet at the galleys has a ventilation filter.

Training Information Point

Galley ventilation filters are line replaceable. Remove the lens assembly and the retainer to remove the filter.



GALLEY (TYP)



GALLEY VENTILATION FILTER

21-26-00-008 Rev 0 08/17/96

AIR CONDITIONING - VENTILATION - GALLEY VENTILATION FILTERS

AIR CONDITIONING - DISTRIBUTION - OPERATION

General

The cargo temperature select panel has the control for the bulk cargo ventilation system. The ventilation system uses the bulk cargo heat selector.

The air conditioning panel has these controls for distribution:

- Equipment cooling control
- Upper and lower recirculation fan controls
- Air conditioning reset control.

These ventilation systems have no flight deck controls, their control is automatic:

- Galley chiller unit ventilation
- Lavatory/galley ventilation (aft equipment cooling).

See the distribution - ventilation section for more information about the ventilation systems that do not have controls in the flight deck (AMM PART I 21-26).

Bulk Cargo Ventilation Operation

The bulk cargo heat selector is a three position selector. The selector enables the bulk cargo heating and ventilation systems. The HIGH position enables the ventilation system. The LOW or OFF position sets the ventilation system off. See the aft and bulk cargo compartment heating section for more information about the bulk cargo heating system (AMM PART I 21-44). See the ventilation section for more information about the bulk cargo ventilation system (AMM PART I 21-26).

Equipment Cooling Operation

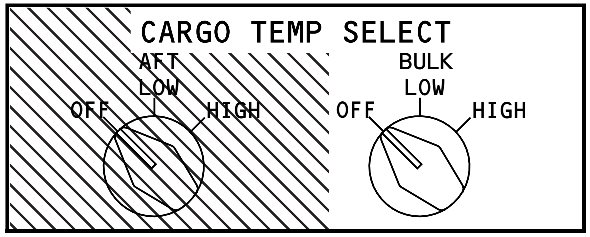
The equipment cooling switch sets the mode of operation for the forward equipment cooling system. The AUTO position on the switch shows that the system is set to automatic operation. The OVRD indication shows that the system is in the override mode of operation. See the equipment cooling section for more information about the operation of the forward equipment cooling system (AMM PART I 21-27).

Recirculation Fan Operation

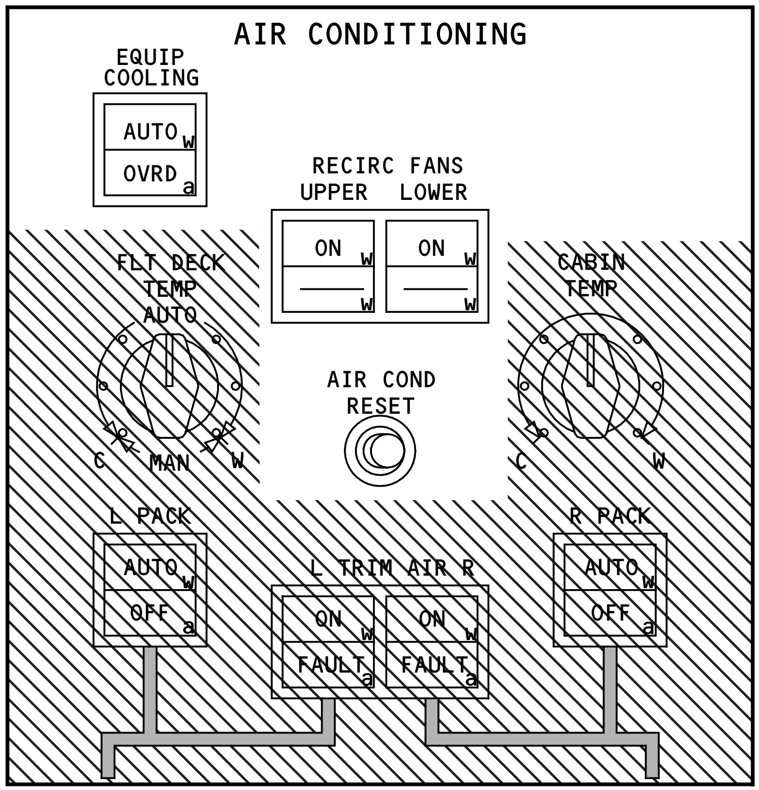
The UPPER and LOWER RECIRC FANS switches are alternate-action switches. The ON indication on the switch shows the fan is set to automatic operation. When the ON indication does not show, the fan is off. See the recirculation section for more information about the recirculation fans (AMM PART I 21-25).

Air Conditioning Reset Operation

The AIR COND RESET switch is a momentary-action switch. This switch starts the system after a failure.



CARGO TEMPERATURE SELECT PANEL (P61)



AIR CONDITIONING PANEL (P5)

AIR CONDITIONING - DISTRIBUTION - OPERATION

21-20-00-003 Rev 1 03/04/1997

AIR CONDITIONING - DISTRIBUTION - GROUND TESTS

General

These are the air conditioning distribution ground tests that show when you select ATA 21 Environmental Control System:

- Chiller boost fan
- Lavatory/galley ventilation fan.

This is the distribution ground test that shows when you select ATA 21 Cabin Temperature Control System:

- Recirculation fan system.

Chiller Boost Fan

This test makes sure that the chiller boost fan installation is correct.

The test takes approximately 1-2 minutes.

This test shows for these ground test types:

- System test
- LRU replacement test.

Lavatory/Galley Ventilation Fan

This test makes sure that these LRU installations are correct:

- Left lavatory/galley ventilation fan
- Right lavatory/galley ventilation fan
- Bulk cargo compartment ventilation fan.

During this test, there will be airflow from the lavatory/galley ventilation fans. The test takes approximately 2-3 minutes.

This test shows for these ground test types:

- System test
- LRU replacement test.

Recirculation Fan System

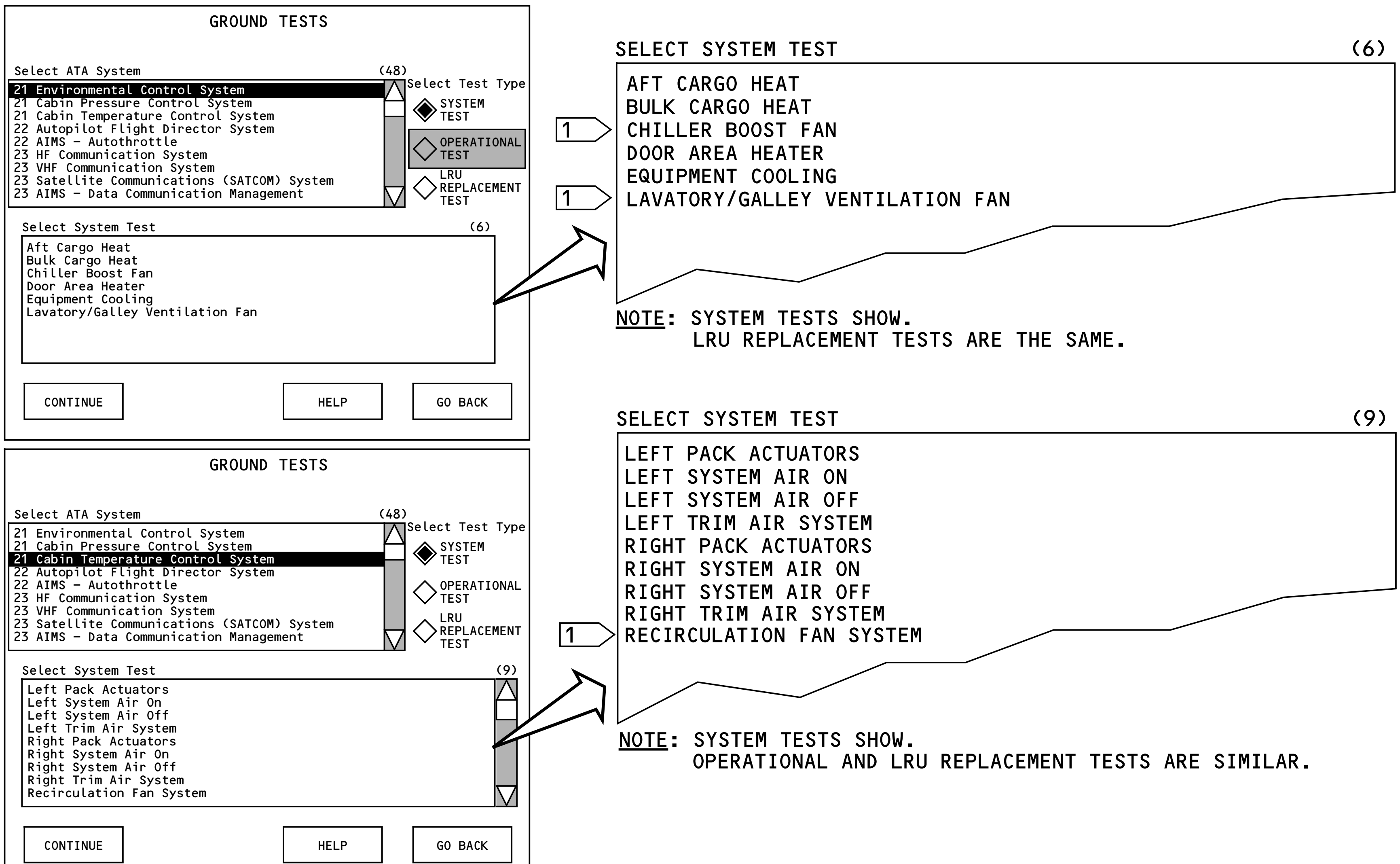
This test makes sure that the cabin temperature controller can control these LRUs:

- Forward upper recirculation fan
- Aft upper recirculation fan
- Left lower recirculation fan
- Right lower recirculation fan.

The electrical load management system P110 and P210 energize these fans. The test takes approximately 2-3 minutes.

This test shows for these ground test types:

- System test
- Operational test
- LRU replacement test.



1 THESE ARE THE AIR CONDITIONING - DISTRIBUTION TESTS.

AIR CONDITIONING - DISTRIBUTION - GROUND TESTS

AIR CONDITIONING - HEATING - INTRODUCTION

Purpose

Heat sources add heat to cabin areas and cargo compartments to keep temperatures at necessary levels.

Crew Rest Area Heating

An in-line electric heater keeps the flight crew rest area warm. See the crew rest area heating system section for more information about the crew rest area heating (AMM PART I 21-41).

Forward Cargo Heating

The forward cargo compartment uses warm air from the equipment cooling system to keep temperature in limits. See the forward cargo compartment heating section for more information about the forward cargo compartment heating (AMM PART I 21-43).

Aft and Bulk Cargo Heating

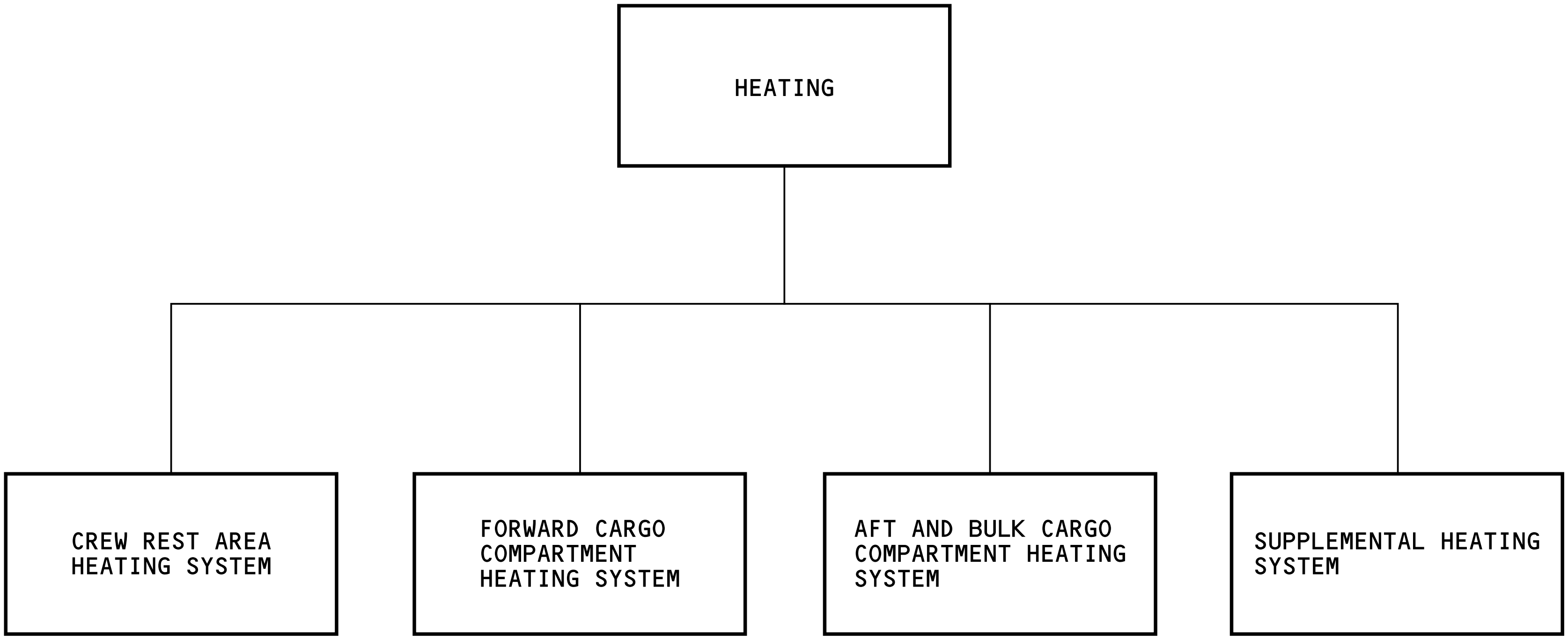
The aft and bulk cargo compartments use air from the pneumatic system to keep temperature in limits. See the aft and bulk cargo compartment heating section for more information about the aft and bulk cargo compartment heating (AMM PART I 21-44).

Supplemental Heating

These areas use electric heaters to keep temperature in limits.

- Flight deck foot and shoulder heaters
- Door heaters
- Galley heaters.

See the supplemental heating section for more information about the supplemental heating system (AMM PART I 21-45).



21-40-00-001 Rev 3 03/05/1997

AIR CONDITIONING - HEATING - INTRODUCTION

AIR CONDITIONING - FORWARD CARGO COMPARTMENT HEATING - INTRODUCTION

Purpose

The forward cargo compartment heating system keeps the compartment temperature above freezing.

General Description

The forward cargo heating system interfaces with the forward equipment cooling system. These systems include the components and the necessary logic to give cargo heating.

The forward cargo heating system has these components:

- Ducts.

The duct moves air from the forward equipment cooling exhaust duct into the compartment.

The equipment cooling system uses these valves to control the movement of exhaust air:

- Equipment vent valve
- Forward cargo heat valve.

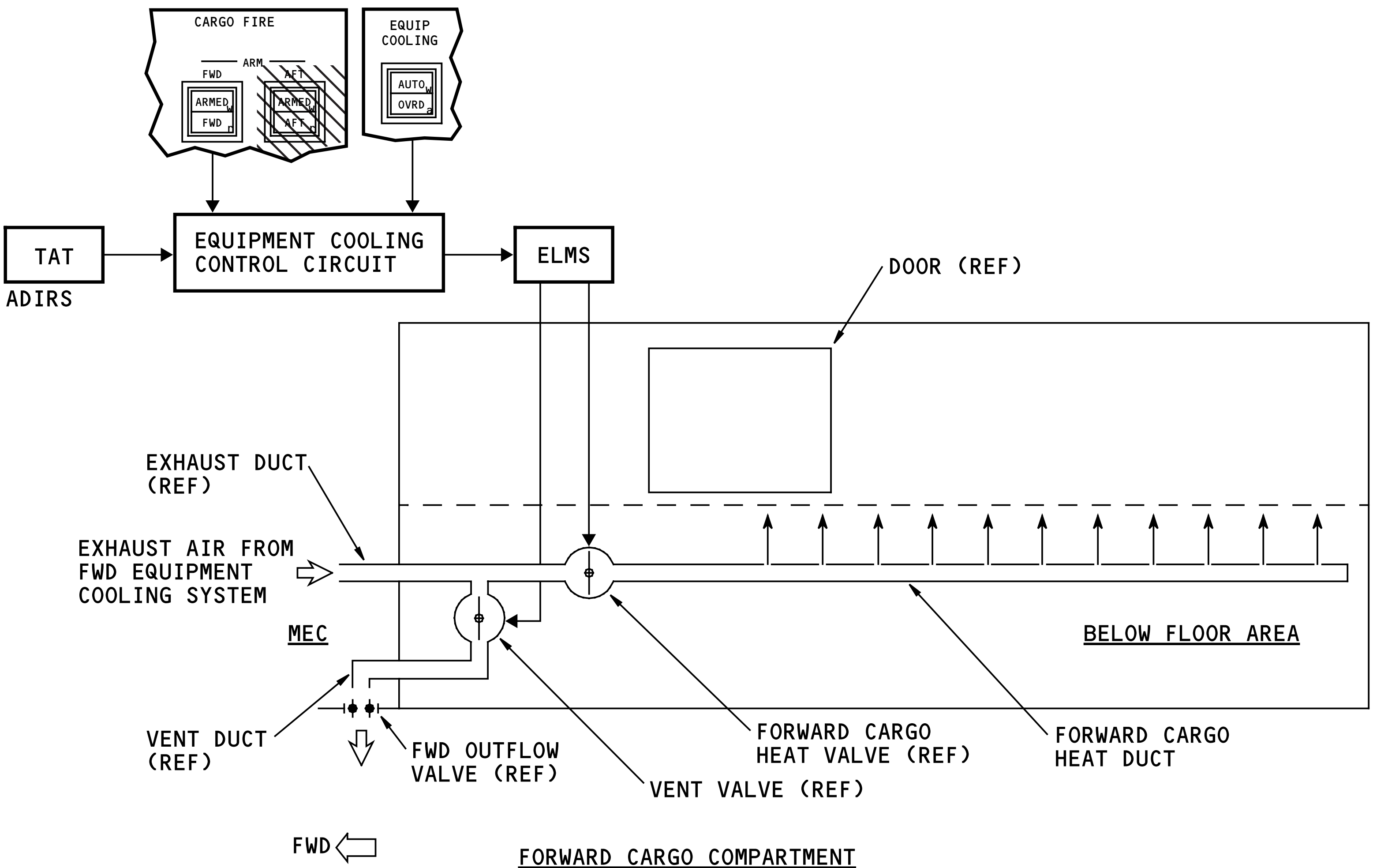
The equipment vent valve and the forward cargo heat valve control the movement of exhaust air into the forward cargo heat duct or into the vent duct. The cargo heat duct supplies air equally into the compartment. The overboard exhaust duct controls the movement of exhaust air to the area near the forward pressurization outflow valve.

On the ground, the forward cargo heat valve normally moves between the open and the closed position as ambient temperature changes. The valve closes when the temperature at the TAT probe is more than 55F (13C). It opens when the temperature is less than 50F (10C).

The forward cargo heat valve is open in the air.

The position of the heat valve changes so that its position is opposite the position of the vent valve. For example, when the vent valve is open the heat valve is closed.

See the equipment cooling section for more information about the control and operation of the equipment cooling vent and forward cargo heating (AMM PART I 21-27).



FORWARD CARGO COMPARTMENT
(TYPICAL)

21-43-00-001 Rev 4 12/23/1997

AIR CONDITIONING - FORWARD CARGO COMPARTMENT HEATING - INTRODUCTION

AIR CONDITIONING - FORWARD CARGO COMPARTMENT HEATING - HEAT DUCT

Purpose

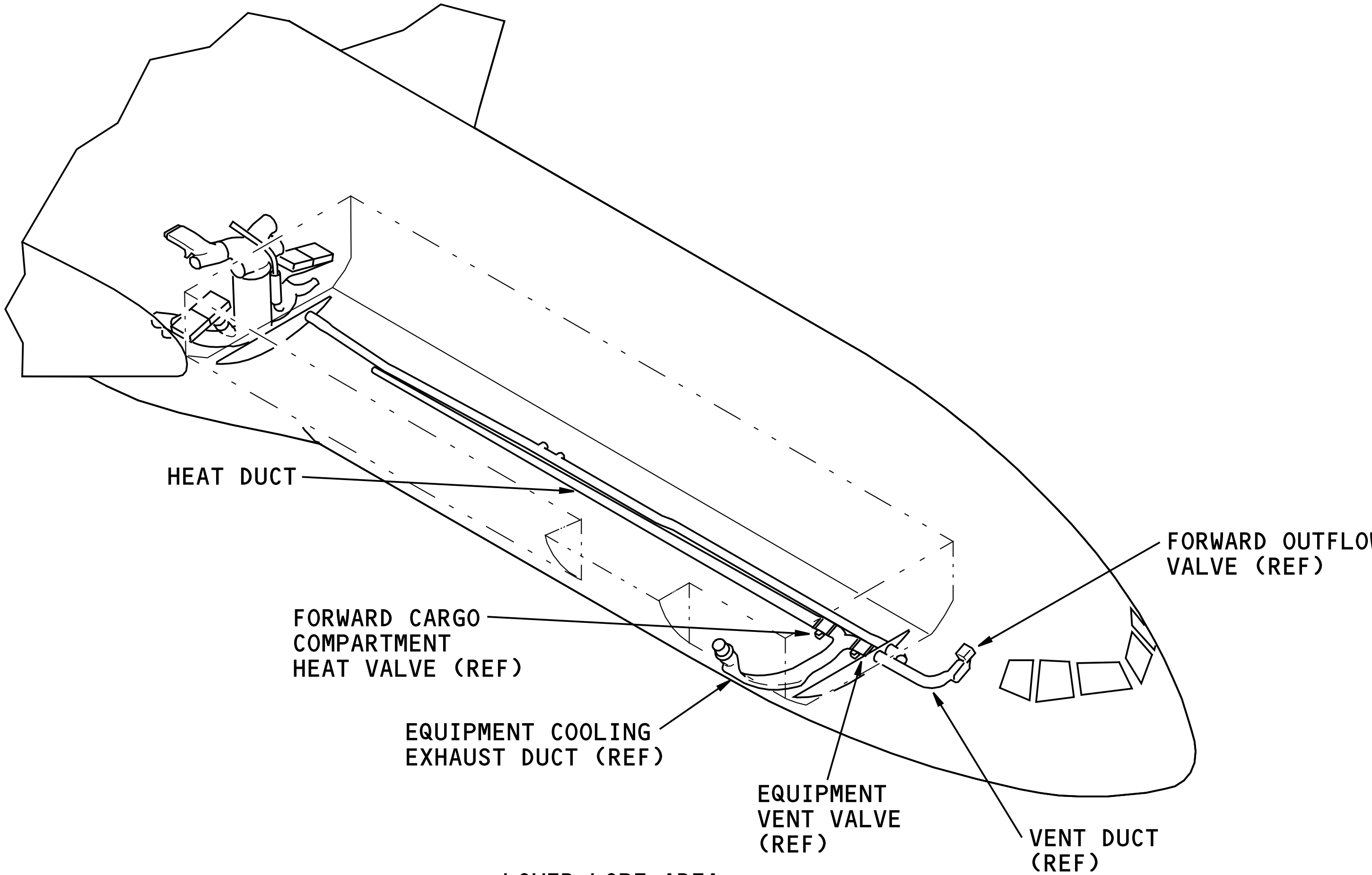
The forward cargo heat duct supplies equipment exhaust air into the forward cargo compartment.

Location

The forward cargo heat duct is below the floor of the forward cargo compartment, on the left side.

Physical Description

The rigid type duct connects to the forward cargo compartment heat valve. The diameter of the duct decreases aft of the valve. Near the valve, the diameter is approximately nine inches (23 cm). At the end of the duct, the diameter is approximately four inches (10 cm). The duct has holes on the inboard and outboard sides. There are more holes on the inboard side than on the outboard side. The holes supply air into the forward cargo compartment.



LOWER LOBE AREA
(TYPICAL)

21-43-00-002 Rev 3 12/23/1997

AIR CONDITIONING - FORWARD CARGO COMPARTMENT HEATING - HEAT DUCT

AIR CONDITIONING - AFT AND BULK CARGO COMPARTMENT HEATING - INTRODUCTION

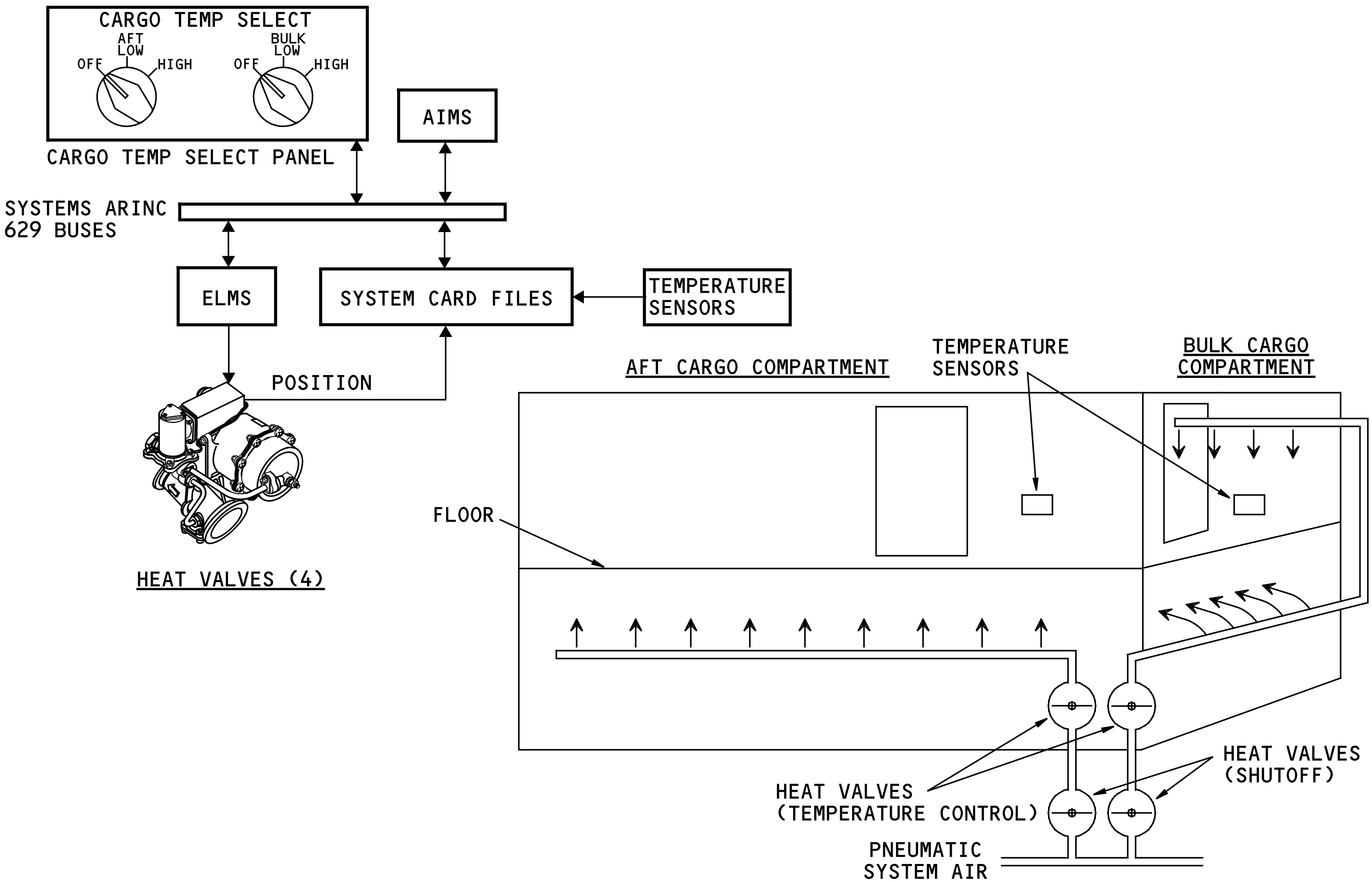
Purpose

Aft and bulk cargo compartment heating controls the amount of pneumatic system air supplied to heat these cargo compartments.

General Description

The aft and bulk cargo compartments receive warm air from the pneumatic system. The aft and bulk cargo compartments each have two heat valves. One functions as a shutoff valve. The other functions as a temperature control valve. These valves open or close to supply more or less warm air to keep compartment temperatures within limits.

The cargo temperature select panel on the flight deck gives manual control of the temperature for the aft and bulk cargo compartments. Operation of the valves is from environmental control system miscellaneous cards (ECSMCs) in the system card files.



21-44-00-001 Rev 0

AIR CONDITIONING - AFT AND BULK CARGO COMPARTMENT HEATING - INTRODUCTION

AIR CONDITIONING - AFT AND BULK CARGO COMPARTMENT HEATING - HEAT VALVES

Purpose

The aft and bulk cargo heat valves control the amount of air added from the pneumatic system to heat these compartments. Each cargo compartment has two heat valves that do these functions:

- Shutoff
- Temperature control.

Physical Description

The aft and bulk cargo heat valves have these parts:

- Relief valve
- Flow assembly
- Electrical solenoid valve
- Optical switch assembly
- Actuator assembly.

Location

The aft and bulk cargo heat valves are in the left side wall where the aft and bulk cargo compartments come together.

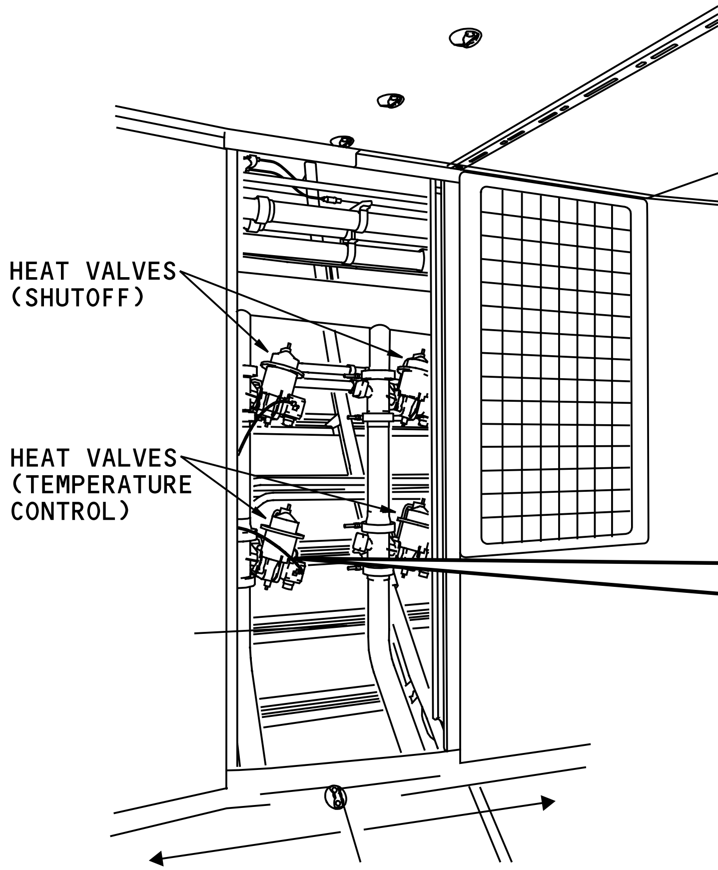
Functional Description

With no power to the solenoid valve, the butterfly valve (not shown) in the flow assembly is closed. When the solenoid gets power and pneumatic air is available to the valve, the butterfly valve will fully open.

The optical switch assembly tells the ECSMC when the valve is completely open or closed.

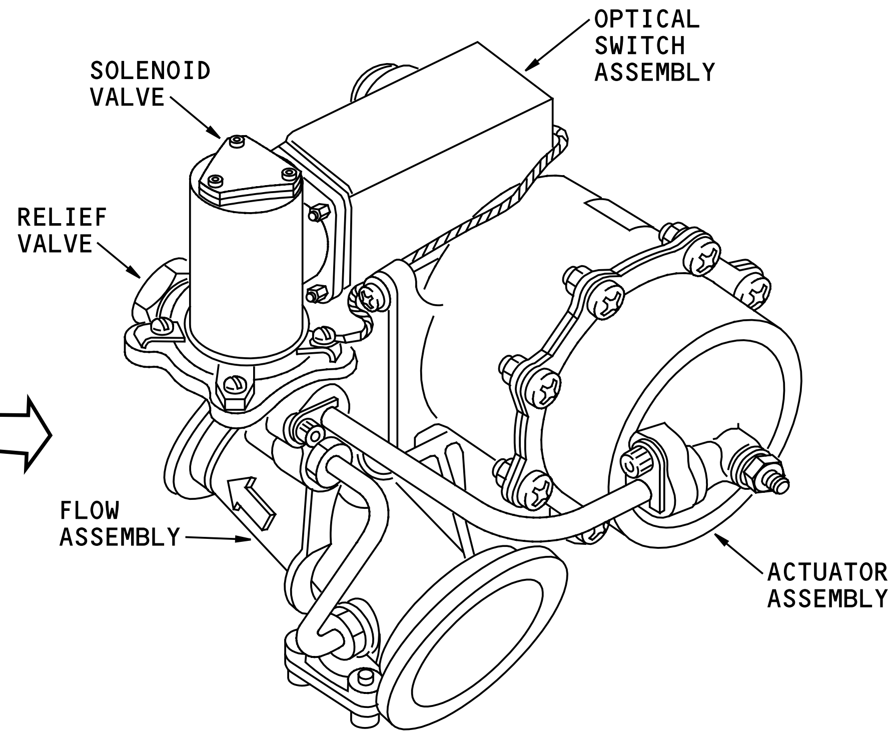
Training Information Point

The aft and bulk cargo heat valves are all the same.



BULK CARGO
COMPARTMENT

AFT CARGO
COMPARTMENT



AFT & BULK CARGO HEAT VALVE

21-44-00-002 Rev 3 02/09/1998

AIR CONDITIONING - AFT AND BULK CARGO COMPARTMENT HEATING - HEAT VALVES

AIR CONDITIONING - AFT AND BULK CARGO COMPARTMENT HEATING - TEMPERATURE SENSORS

Purpose

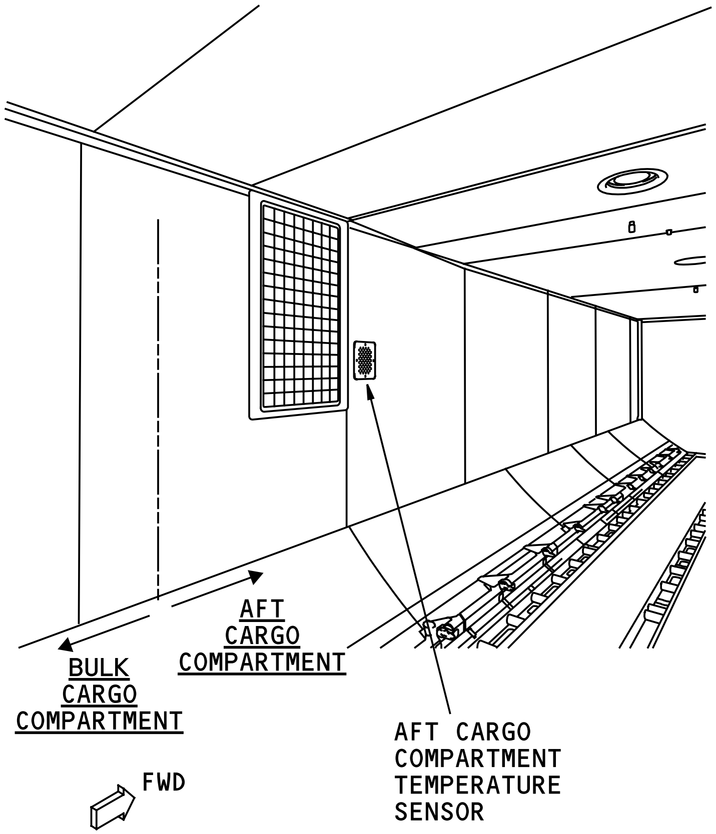
The aft and bulk cargo compartment temperature sensors monitor the temperature in the related compartment. The ECS miscellaneous cards (ECSMCs) use these temperatures to control the amount of heat added to the cargo compartments.

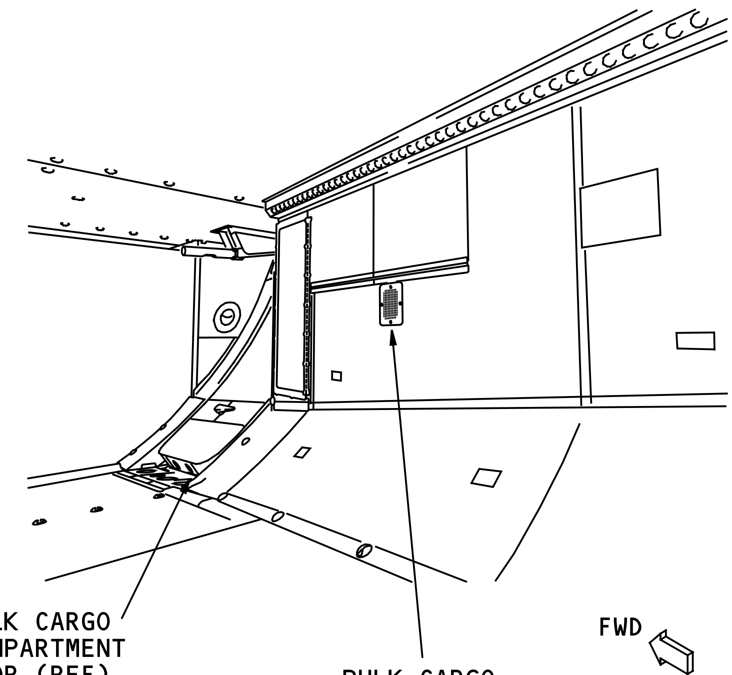
Physical Description

These sensors are solid state electronic devices.

Location

The aft cargo compartment temperature sensor is on the left side wall of the aft cargo compartment. The bulk cargo compartment temperature sensor is on the right side wall of the bulk cargo compartment.





21-44-00-003 Rev 0

AIR CONDITIONING - AFT AND BULK CARGO COMPARTMENT HEATING - TEMPERATURE SENSORS

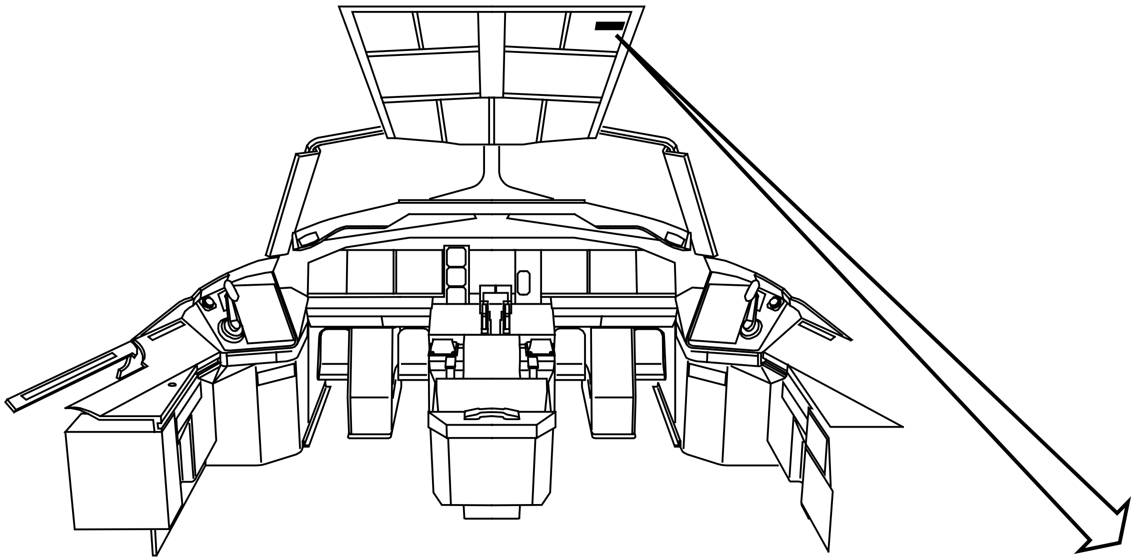
AIR CONDITIONING - AFT AND BULK CARGO COMPARTMENT HEATING - TEMPERATURE SELECTORS

Purpose

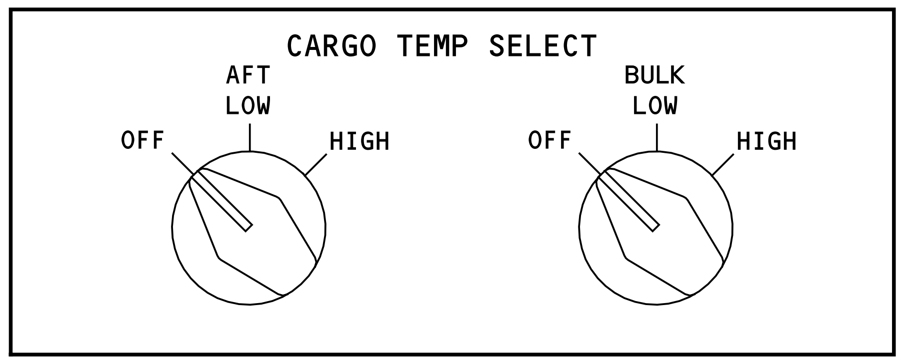
The cargo temperature selectors give manual control of the aft and bulk cargo compartment temperatures. Each cargo compartment has a selector on the cargo temperature select panel.

Location

The cargo temperature selector panel is on the P61 overhead maintenance panel.



FLIGHT DECK



CARGO TEMPERATURE SELECT PANEL (P61)

21-44-00-004 Rev 0

AIR CONDITIONING - AFT AND BULK CARGO COMPARTMENT HEATING - TEMPERATURE SELECTORS

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AIR CONDITIONING - AFT AND BULK CARGO COMPARTMENT HEATING - FUNCTIONAL DESCRIPTION

General

The aft and bulk cargo temperature selectors set the temperature range for these compartments.

Each cargo compartment has two heat valves that do these functions:

- Shutoff
- Temperature control.

Valve Open

The open signal for the aft cargo heat valves comes from the left environmental control system miscellaneous card (ECSMC) in the left system card file. The open signal for the bulk cargo heat valves comes from the right ECSMC in the right system card file.

An open signal for the aft cargo heat valves goes to the left power management panel. An open signal for the bulk cargo heat valves goes to the right power management panel. Switches in the electrical load management system (ELMS) electronics (ELEX) unit supply a ground to energize the related cargo heat shutoff valve relay and cargo heat temperature control relay. These relays apply power to the open solenoid on the related valve.

When the heat valves are enabled, the shutoff valve is open. The temperature control valve cycles open and closed to keep the temperature in the cargo compartment to within 5F (3C) of the selected temperature.

Indication

An optical sensor monitors valve position. An open and closed discrete from each valve goes to the related ECSMC for control.

A sensor in each compartment supplies temperature data to the related ECSMC.

Operation

Cargo temperature selectors for aft and bulk cargo compartments set cargo compartment temperatures for HIGH, LOW, or OFF. The HIGH selection sets the compartments to 70F (21C). The LOW selection sets the compartments to 45F (7C).

Inhibits

The operation of the valves is not enabled if any of these conditions occur:

- The temperature in the aft cargo compartment is more than 90F (32C) and the shutoff or temperature control valve is closed
- The airplane is on the ground with a cargo door open
- The cargo heat selector is set to off
- The aft cargo fire system is armed

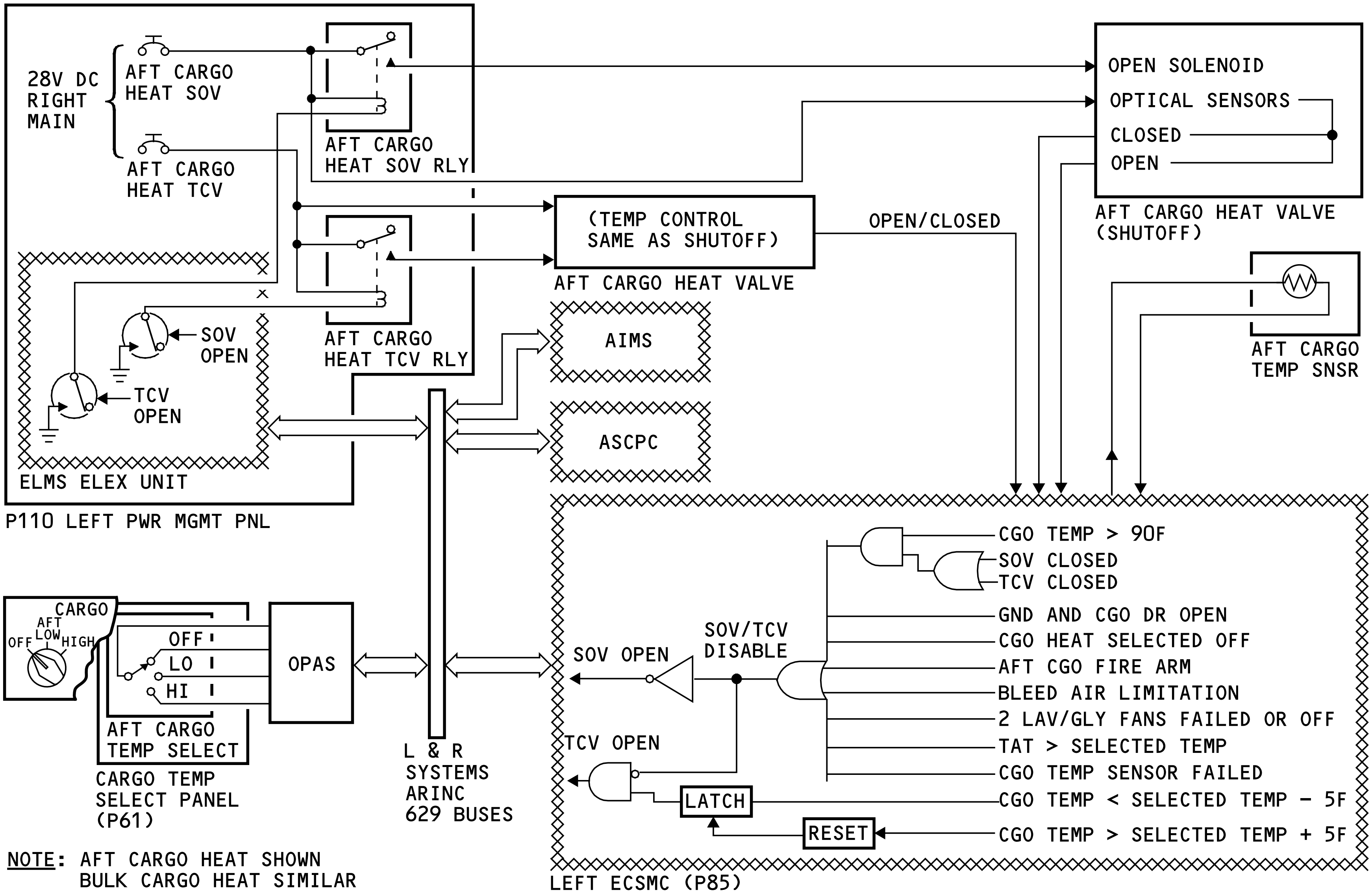
- The two lavatory/galley ventilation fans are failed off
- TAT is more than the selected temperature
- The cargo temperature sensor is failed
- Limitations on the use of bleed air.

If the cargo compartment temperature is more than 90F (32C) and the SOV and the TCV are not closed, the system latches the two valves closed.

Limitations on the Use of Bleed Air

The cargo heat valves are commanded closed for certain airplane conditions to minimize the use of bleed air. These are the conditions:

- Engine start
- Takeoff
- Autoslat extension
- Only one engine is running and one or more wing anti-ice valve is open.



NOTE: AFT CARGO HEAT SHOWN
BULK CARGO HEAT SIMILAR

AIR CONDITIONING - AFT AND BULK CARGO COMPARTMENT HEATING - FUNCTIONAL DESCRIPTION

AIR CONDITIONING - SUPPLEMENTAL HEATING - INTRODUCTION

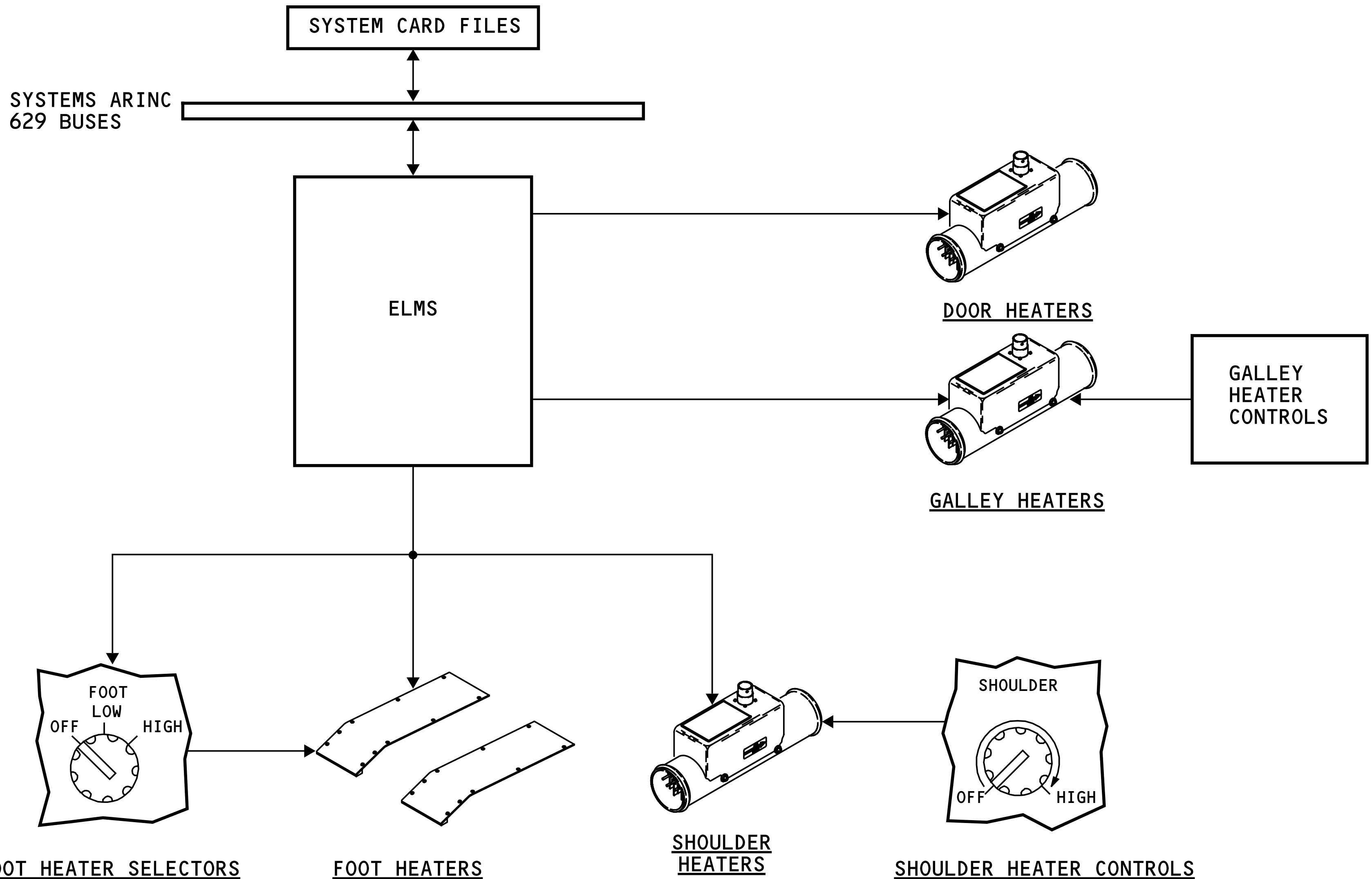
General

In locations where the heat from trim air is not sufficient, auxiliary heaters add more heat. Heaters supply heat to these areas.

- Flight crew feet
- Flight crew shoulders
- Doors
- Galleys.

The foot heater selectors and shoulder heater controls on the flight deck give manual control of these heaters. A manual control for the galley heaters is on each galley complex. The door heaters have no manual control.

Automatic operation of the heaters is from environmental control system miscellaneous cards (ECSMCs) in the system card files.



21-45-00-001 Rev 0

AIR CONDITIONING - SUPPLEMENTAL HEATING - INTRODUCTION

AIR CONDITIONING - SUPPLEMENTAL HEATING - FLIGHT DECK FOOT HEATERS

Purpose

Flight deck foot heaters add heat to the foot areas of the flight crew.

Physical Description

These are electrical heaters.

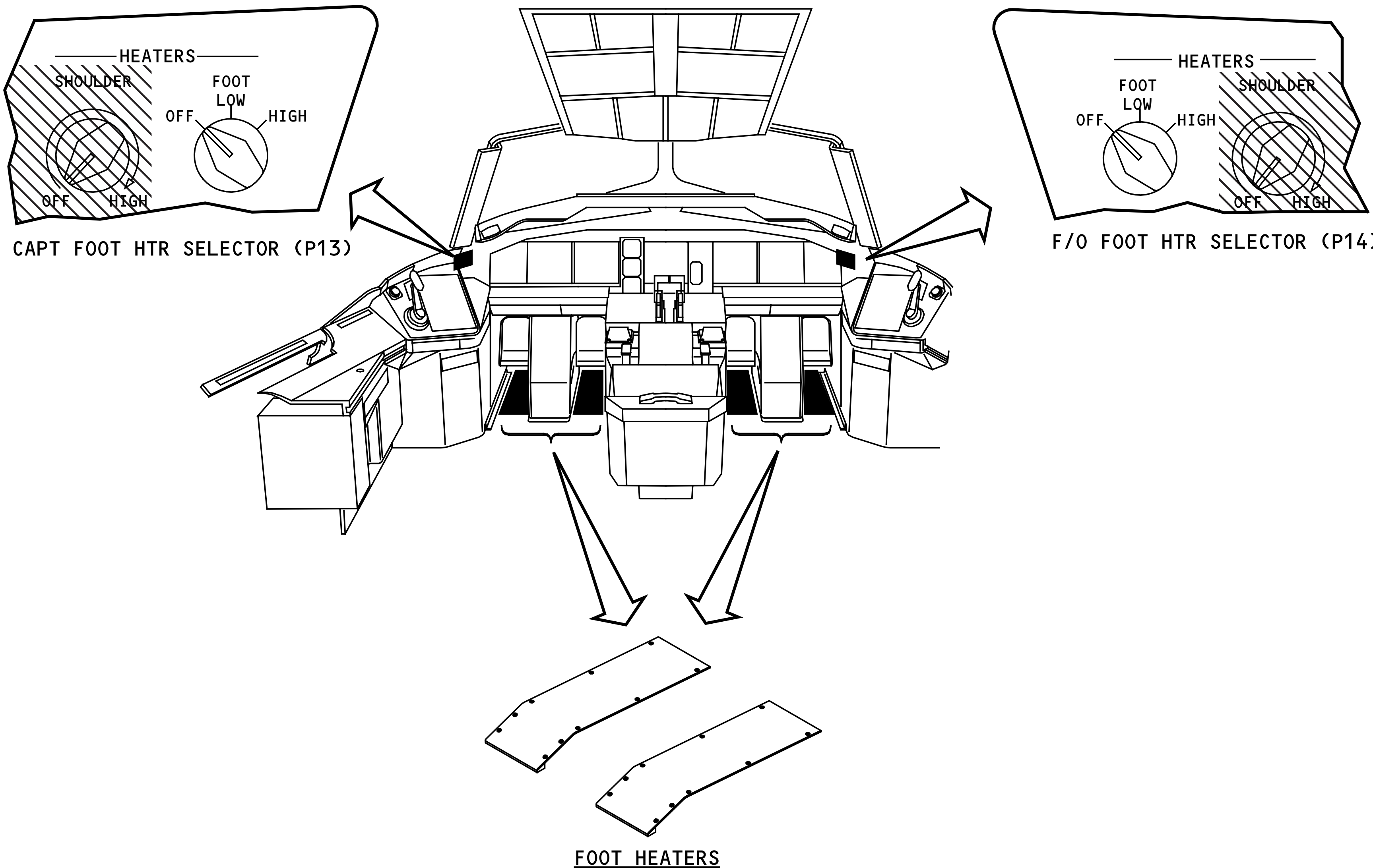
Location

One set of foot heaters is on the floor under each set of rudder pedals.

The captain foot heater selector is on the P13 sidewall panel - captain. The first officer foot heater selector is on the P14 sidewall panel - first officer.

Operation

The foot heater selectors permit selection of a high or low heat.



AIR CONDITIONING - SUPPLEMENTAL HEATING - FLIGHT DECK FOOT HEATERS

AIR CONDITIONING - SUPPLEMENTAL HEATING - FLIGHT DECK SHOULDER HEATERS

Purpose

Flight deck shoulder heaters add heat to the air supplied to the shoulder areas of the flight crew.

Physical Description

These are electrical heaters.

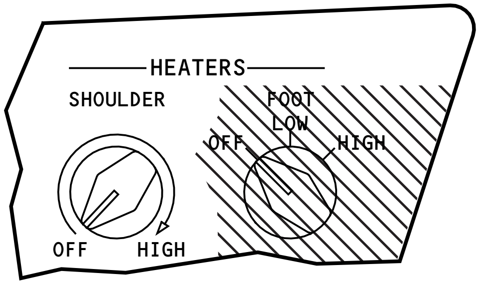
Location

One heater is on each side of the nose wheel well in the main equipment center.

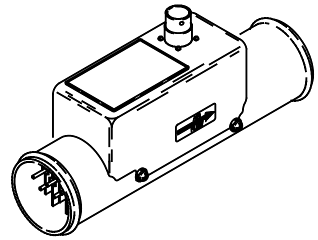
The captain shoulder heater control is on the P13 sidewall panel - captain. The first officer shoulder heater control is on the P14 sidewall panel - first officer.

Operation

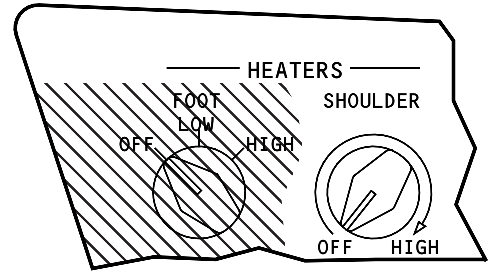
The shoulder heater controls set the level of heat from the shoulder heaters.



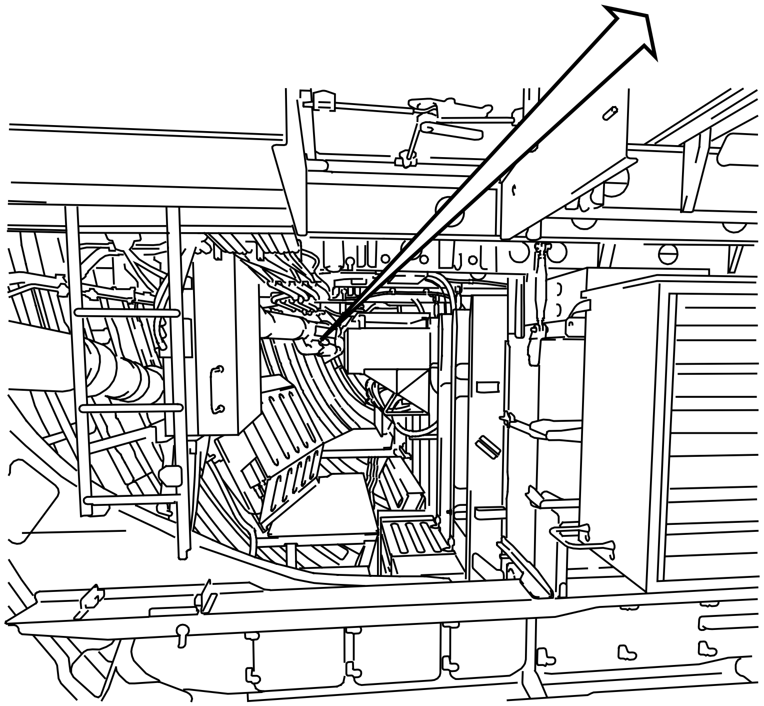
CAPTAIN SHOULDER HTR CTRL (P13)



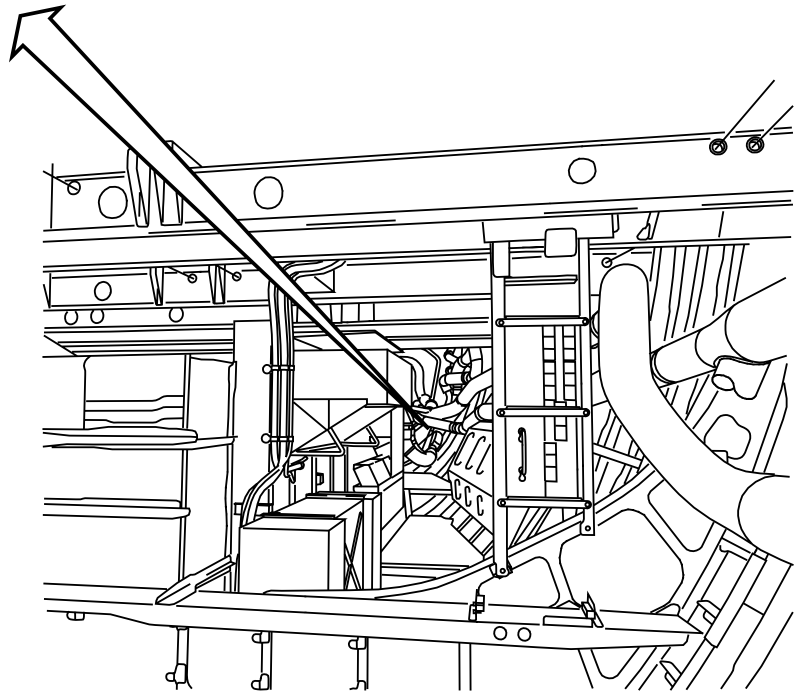
SHOULDER HEATER



F/O SHOULDER HTR CTRL (P14)



MAIN EQUIPMENT CENTER
(LEFT SIDE, LOOKING FORWARD)



MAIN EQUIPMENT CENTER
(RIGHT SIDE, LOOKING FORWARD)

21-45-00-003 Rev 0

AIR CONDITIONING - SUPPLEMENTAL HEATING - FLIGHT DECK SHOULDER HEATERS

AIR CONDITIONING - SUPPLEMENTAL HEATING - DOOR AREA HEATERS

Purpose

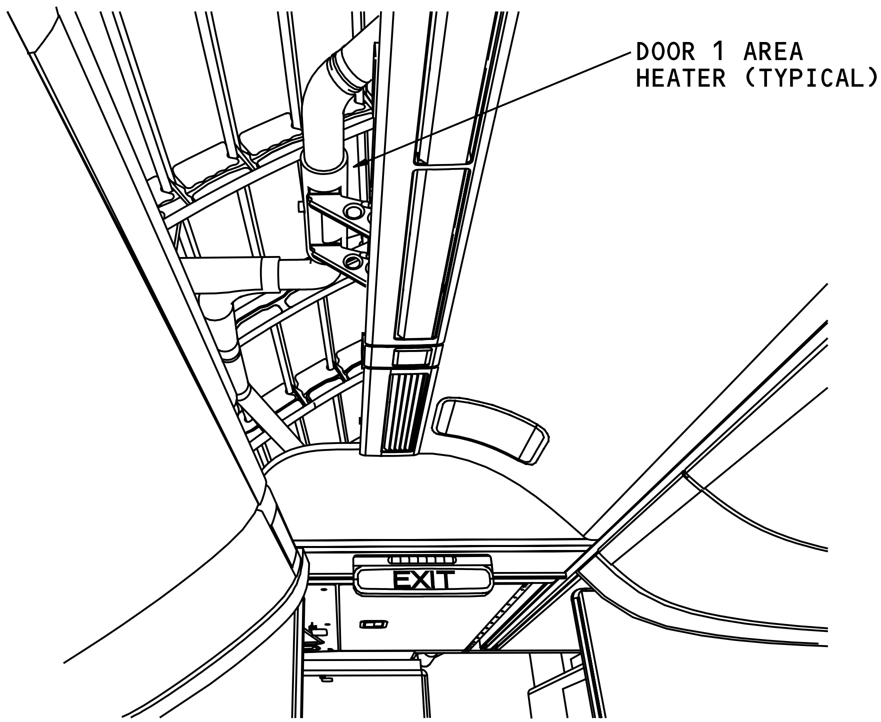
Door area heaters add heat around the sides of each passenger door.

General Description

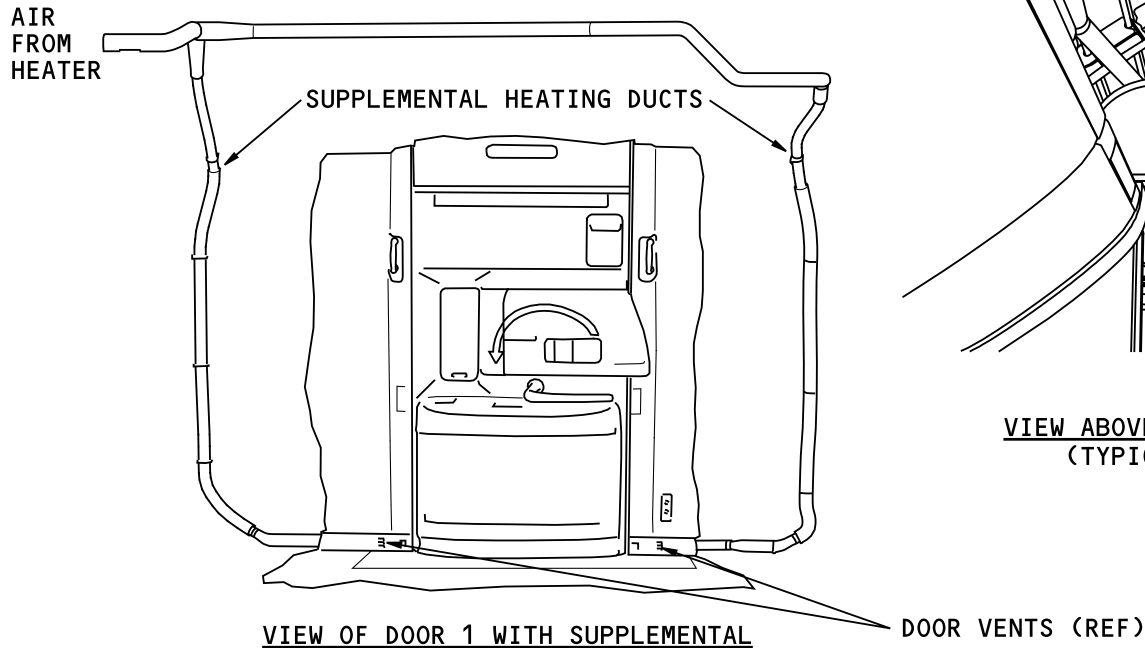
One electric heater is above the ceiling near each of these doors.

- Door 1 heaters are aft of the doors
- Door 2 and 3 heaters are above the doors
- Door 4 heaters are forward of the doors.

Door 2 heaters get air from the ducts that carry air from the forward recirculation fan. Door 3 heaters get air from the ducts that carry air from the aft recirculation fan. Doors 1 and 4 heaters get air from the ducts that carry conditioned air.



VIEW ABOVE OUTBOARD CEILING PANEL
(TYPICAL) (PANEL REMOVED)



VIEW OF DOOR 1 WITH SUPPLEMENTAL
HEATING DUCTS SHOWN
(TYPICAL)

21-45-00-004 Rev 2 08/26/1996

AIR CONDITIONING - SUPPLEMENTAL HEATING - DOOR AREA HEATERS

AIR CONDITIONING - SUPPLEMENTAL HEATING - GALLEY HEATERS

Purpose

Galley heaters add heat around the sides of each galley.

Physical Description

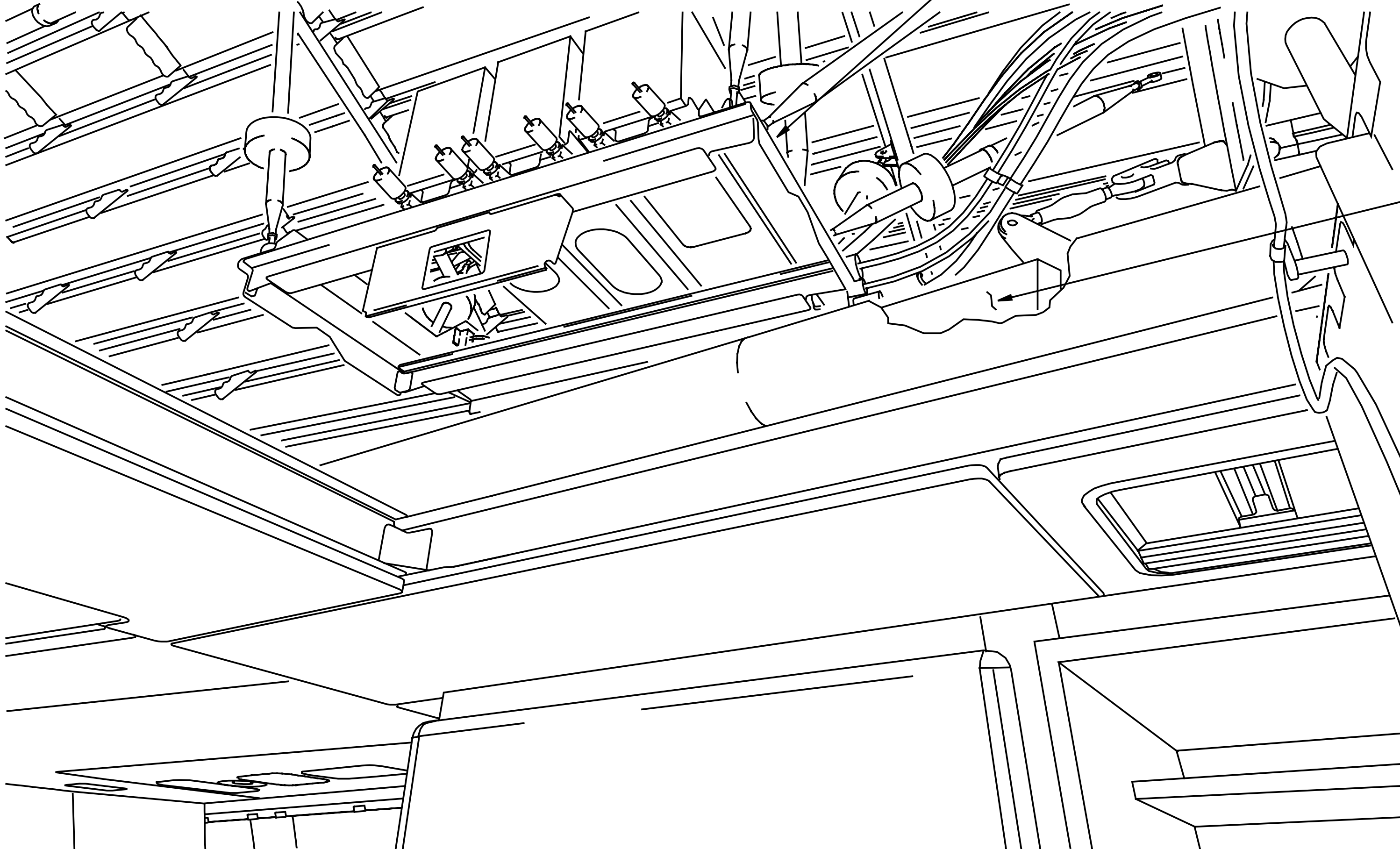
These are electrical heaters.

Location

Galley heaters are at these locations:

- One heater is above the forward galley (not shown)
- Two heaters are above the aft galley.

A heater control is on each galley complex. This control sets the amount of heat from the heater.



AFT GALLEY

NOTE: RIGHT AFT GALLEY HEATER SHOWN
OTHER GALLEY HEATERS SIMILAR

21-45-00-005 Rev 1 06/22/1997

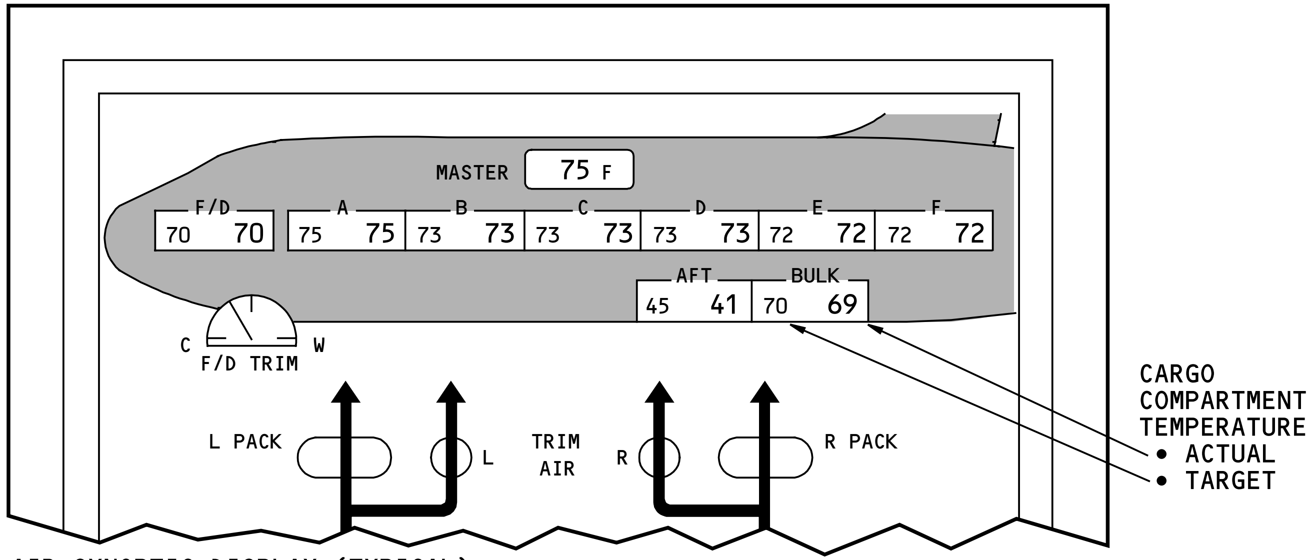
AIR CONDITIONING - SUPPLEMENTAL HEATING - GALLEY HEATERS

AIR CONDITIONING - HEATING - AIR SYNOPTIC DISPLAY AND MAINTENANCE PAGE

General

The air synoptic display and the maintenance page show this cargo compartment temperature data:

- Target temperature, set on the flight deck
- Actual compartment temperature.



AIR SYNOPTIC DISPLAY (TYPICAL)

AIR CONDITIONING

MASTER TEMP 75 SEATS 426

	F/D	A	B	C	D	E	F	AFT	BULK
ZONE TEMP	70	75	73	73	73	72	72	41	69
TRGT TEMP	70	75	73	73	73	72	72	45	70
DUCT TEMP	72	77	77	77	70	70	70	--	--
TRIM VLV	0.15	0.35	0.35	0.35	0.00	0.10	0.10	--	--
CTRL CH	1	1	2	1	2	1	2	--	--

AIR CONDITIONING MAINTENANCE PAGE (TYPICAL)

AIR CONDITIONING - HEATING - AIR SYNOPTIC DISPLAY AND MAINTENANCE PAGE

21-40-00-002 Rev 2 02/27/1997

AIR CONDITIONING - HEATING - GROUND TESTS

General

These are the heating ground tests that show when you select ATA 21 Environmental Control System:

- Aft cargo heat
- Bulk cargo heat
- Door area heater.

Aft Cargo Heat

This test makes sure that these LRU installations are correct:

- Aft cargo heat shutoff valve
- Aft cargo heat temperature control valve
- Aft cargo compartment temperature sensor.

You must pressurize the pneumatic system for this test. During this test, hot air comes out of the aft cargo heat duct. This test takes approximately 2-5 minutes.

This test shows for these ground test types:

- System test
- LRU replacement test.

Bulk Cargo Heat

This test makes sure that these LRU installations are correct:

- Bulk cargo heat shutoff valve
- Bulk cargo heat temperature control valve
- Bulk cargo ventilation fan
- Bulk cargo compartment temperature sensor.

You must pressurize the pneumatic system for this test. During this test, hot air comes out of the bulk cargo heat duct. This test takes approximately 2-5 minutes.

This test shows for these ground test types:

- System test
- LRU replacement test.

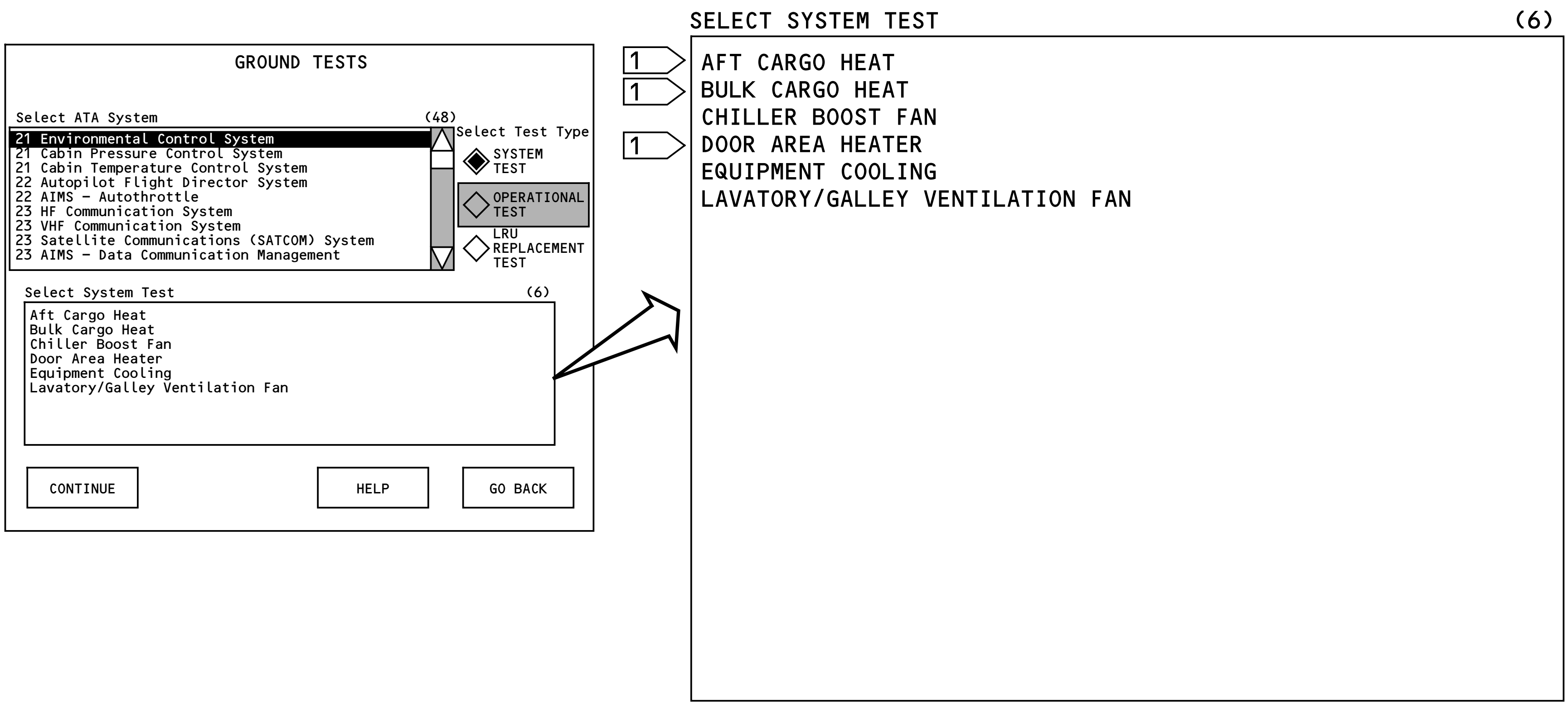
Door Area Heater

This test makes sure that all passenger door area heater installations are correct.

This test takes approximately 2-5 minutes.

This test shows for these ground test types:

- System test
- LRU replacement test.



NOTE: SYSTEM TESTS SHOW.
LRU REPLACEMENT TESTS ARE THE SAME.

1 THESE ARE THE AIR CONDITIONING - HEATING TESTS.

AIR CONDITIONING - HEATING - GROUND TESTS

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Air Synoptic Display

The top part of the air synoptic display shows information about the air conditioning system.

- The MASTER box shows the passenger compartment target temperature set by the flight crew. It has a minimum of 65F (18C) and a maximum of 85F (29C).
- The number at the left in the F/D box is the flight deck target temperature set by the flight crew. It has a minimum of 65F (18C) and a maximum of 85F (29C) when AUTO is selected. If the selector is in the MAN position, no value shows. The number at the right is the actual flight deck temperature.
- The number at the left in the zone boxes A-F is the zone target temperature set by the flight crew or the cabin crew. It has a minimum of 65F (18C) and a maximum of 85F (29C). The number at the right in each box is the actual zone temperature.
- The number at the left in the AFT and BULK boxes is the temperature set on the flight deck for that cargo compartment. They can be set to 45F (7C) or 70F (21C) or to off. The number at the right in each box is the actual cargo compartment temperature. If the selector is in the OFF position, no value shows.

Target and actual temperatures show in degrees F.

The flight deck trim air modulating valve position shows on the indication on the left of the display. If the valve position signal is not valid, the valve position pointer does not show.

Green flow bars show air flow through the left and right packs. These symbols show the status of the packs:

- Green oval - pack on
- White oval - pack off or pack status data invalid
- Amber oval with amber X - pack failed.

The STBY COOLING message on the air synoptic display and an advisory message PACK MODE L (R) (not shown) show when a pack is on and has any of these faults:

- ACM failure
- Condenser inlet temperature sensors 1 and 2 fail
- Economy cooling valve failed open.

If the pack stops, the STBY COOLING message and the advisory message PACK MODE L (R) do not show. See the pack cooling and mix manifold temperature control section for more information about the standby cooling mode (AMM PART I 21-52).

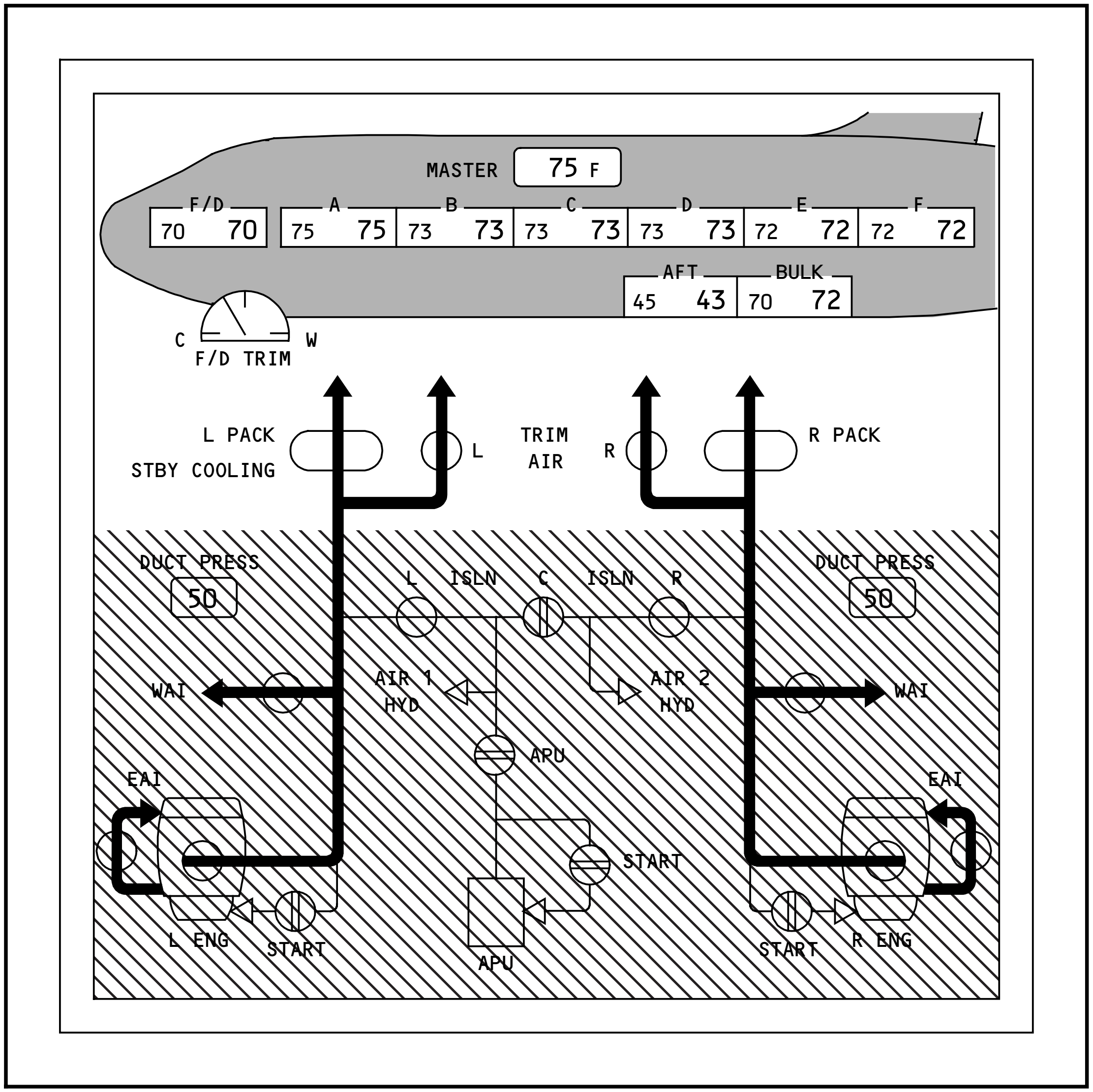
Green flow bars show air flow through the trim air pressure regulating and shutoff valves. Valve positions show as one of these symbols:

- White circle with one bar in-line with duct - open
- White circle with two bars 90 degrees to duct - closed
- Amber valve open symbol with amber X - failed open
- Amber valve closed symbol with amber X - failed closed

AIR CONDITIONING - AIR SYNOPTIC DISPLAY

- White circle with no bars - valve position data not valid.

See the primary display system section for more information about the air synoptic display (AMM PART I 31-61).



AIR SYNOPTIC DISPLAY

AIR CONDITIONING - AIR SYNOPTIC DISPLAY

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Air Conditioning Maintenance Page

All temperatures on the air conditioning maintenance page are in degrees F.

The air conditioning maintenance page has this information:

- MASTER TEMP - Temperature selected on the cabin temperature control on the P5 panel
- SEATS - Number of passenger seats installed, used by the CTCs to calculate pack air flow rates
- TRGT TEMP - Target (selected) temperature for each zone and for the aft and bulk cargo compartments
- ZONE TEMP - Actual temperature in each zone and in the aft and bulk cargo compartments
- DUCT TEMP - Temperature measured in each zone distribution duct
- TRIM VLV - Position of each trim air modulating valve in percent heat (0.00 is closed, 1.00 is open)
- LOWER RECIR FAN - On or off status of the left and right lower recirculation fans
- UPPER RECIR FAN - On or off status of the left and right upper recirculation fans
- MIX MANIFOLD TEMP - Temperature in the mix manifold
- FLOW SCHEDULE - Right air conditioning pack flow schedule: 0,1,2,3, or 4. Usual left pack flow schedule is the same as the right
- PACK FLOW-VOLUME - Pack flow rate in cubic feet per minute
- PACK FLOW-MASS - Pack flow rate in pounds per minute
- PRI HX IN TEMP - Temperature at the inlet of the primary heat exchangers
- PRI HX OUT TEMP - Temperature at the outlet of the primary heat exchangers
- CPRSR OUT TEMP - Temperature at the outlet of the air cycle machine compressors
- SEC HX OUT TEMP - Temperature at outlet of the secondary heat exchangers
- CONDENSER IN TEMP - Temperature at the inlet of the condensers
- STG 2 TURB IN TEMP - Temperature at the inlet of turbine 2 in the air cycle machines
- TRIM AIR PRESS - The difference, in psid, between cabin pressure and trim air pressure
- PACK CTRL CH - Shows the channel in control for the left and right cabin temperature controllers
- PACK IN PRESS - Pressure, in psia, at the inlet to the air conditioning packs
- LOW LIM VLV POS - Position of the low limit valve (0.00 is closed, 1.00 is open)
- TURB BYP VLV - Position of the turbine bypass valve in percent heat (0.00 is closed, 1.00 is open)
- RAM AIR INLET - Position of the ram air inlet in percent heat (0.00 is open, 1.00 is closed)
- RAM AIR EXIT - The ram air exit is a fixed opening; the position display is blank
- ECON COOL VLV - Open or closed position of the economy cooling valve
- LOWER FLOW CTRL VLV - Open or closed position of the lower flow control valve

- UPPER FLOW CTRL VLV - Open or closed position of the upper flow control valve.

See the primary display system section for more information about the air conditioning maintenance page (AMM PART I 31-61).

AIR CONDITIONING

MASTER TEMP 75 SEATS 426

	F/D	A	B	C	D	E	F	AFT	BULK
ZONE TEMP	70	75	75	75	72	72	72	45	70
TRGT TEMP	70	75	75	75	72	72	72	45	70
DUCT TEMP	72	77	77	77	70	70	70	--	--
TRIM VLV	0.15	0.35	0.35	0.35	0.00	0.10	0.10	--	--
CTRL CH	1	1	2	1	2	1	2	--	--

LEFT LOWER RECIR FAN	ON	FWD UPPER RECIR FAN	ON
RIGHT LOWER RECIR FAN	ON	AFT UPPER RECIR FAN	ON
MIX MANIFOLD TEMP	70	FLOW SCHEDULE	1

	L	R		L	R
PACK FLOW-VOLUME	2700	2700	PACK CTRL CH	1	2
PACK FLOW-MASS	200.0	200.0	PACK IN PRESS	55.0	55.0
PACK OUT TEMP	68	68	LOW LIM VLV POS	0.10	0.10
PRI HX IN TEMP	385	385	TURB BYP VLV	0.15	0.15
PRI HX OUT TEMP	350	350	RAM AIR INLET	0.35	0.35
CPRSR OUT TEMP	400	400	RAM AIR EXIT		
SEC HX OUT TEMP	300	300	ECON COOL VLV	CLSD	CLSD
CONDENSER IN TEMP	59	59	LOWER FLOW CTRL VLV	OPEN	OPEN
STG 2 TURB IN TEMP	77	77	UPPER FLOW CTRL VLV	CLSD	CLSD
TRIM AIR PRESS	5.0	5.0			

A/C TEMP ZONE DATE 23 JUN 90 UTC 18:54:04

AIR CONDITIONING MAINTENANCE PAGE (TYPICAL)

21-00-00-008 Rev 4 02/27/1997

AIR CONDITIONING - AIR CONDITIONING MAINTENANCE PAGE

Continental Airlines, Inc

Equipment Cooling System

WB371

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TABLE OF CONTENTS

AIR CONDITIONING (A/C) - EQUIPMENT COOLING - INTRODUCTION

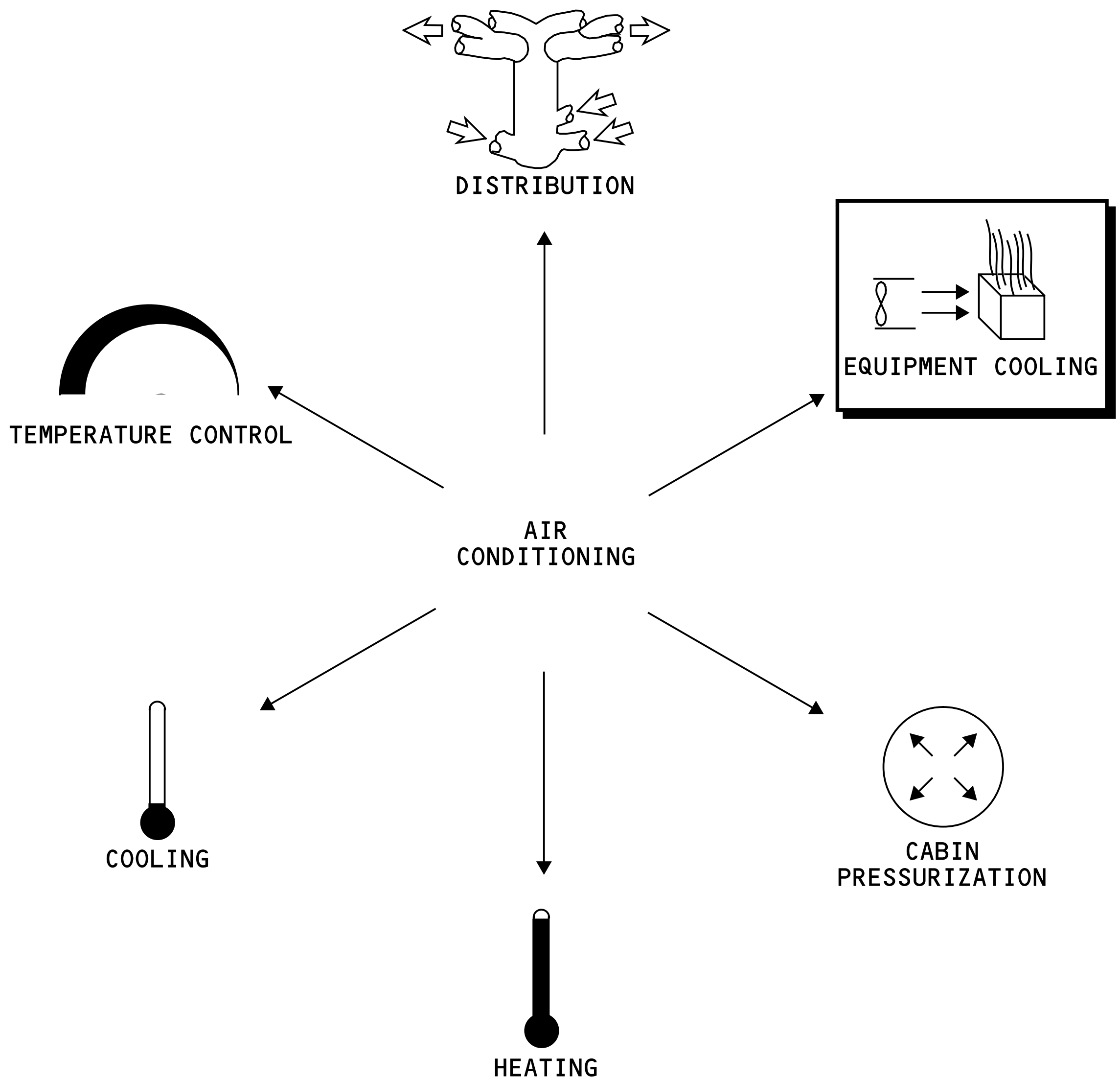
Purpose

The equipment cooling system keeps the electronic and electrical equipment cool. Equipment in the forward part of the airplane and equipment in the aft part of the airplane have separate cooling systems.

Abbreviations and Acronyms

ADIRU	- air data inertial reference unit
AIMS	- airplane information management system
AGS	- air ground system
bat	- battery
BIT	- built-in-test
cgo	- cargo
clg	- cooling
CSS	- cabin services system
conv	- converter
ctrl	- control
det	- detection
ECS	- environmental control system
ECSMC	- ECS miscellaneous card
E/E	- electrical and electronic
EEU	- ELMS electronic unit
EICAS	- engine indication and crew alerting system
ELCU	- electronic load control unit
elec	- electronic
ELMS	- electrical load management system
eqpt	- equipment
F/D	- flight deck
FEC	- forward equipment center
flt	- flight
fwd	- forward
gnd	- ground
ht	- heat
IFE	- inflight entertainment
LSCF	- left system card file
mgmt	- management
MEC	- main equipment center
mot	- motor
OPAS	- overhead panel ARINC 629 system
ovrd	- override
pnl	- panel
pos	- position
press	- pressure
PSEU	- proximity sensor electronic unit
pwr	- power
RSCF	- right system card file
SATCOM	- satellite communications
smk	- smoke
stby	- standby
sys	- system
TAT	- total air temperature
temp	- temperature
typ	- typical
vlv	- valve
VSCF	- variable speed constant frequency

wxr - weather radar
xdcr - transducer



AIR CONDITIONING (A/C) - EQUIPMENT COOLING - INTRODUCTION

A/C - EQUIPMENT COOLING - AFT SYS - GENERAL DESCRIPTION - MECHANICAL

Purpose

The aft part of the equipment cooling system gives pull-through cooling for equipment in the aft part of the airplane that needs active cooling. The system also gives backup cooling for SATCOM equipment.

General Description

The aft part of the system has these components:

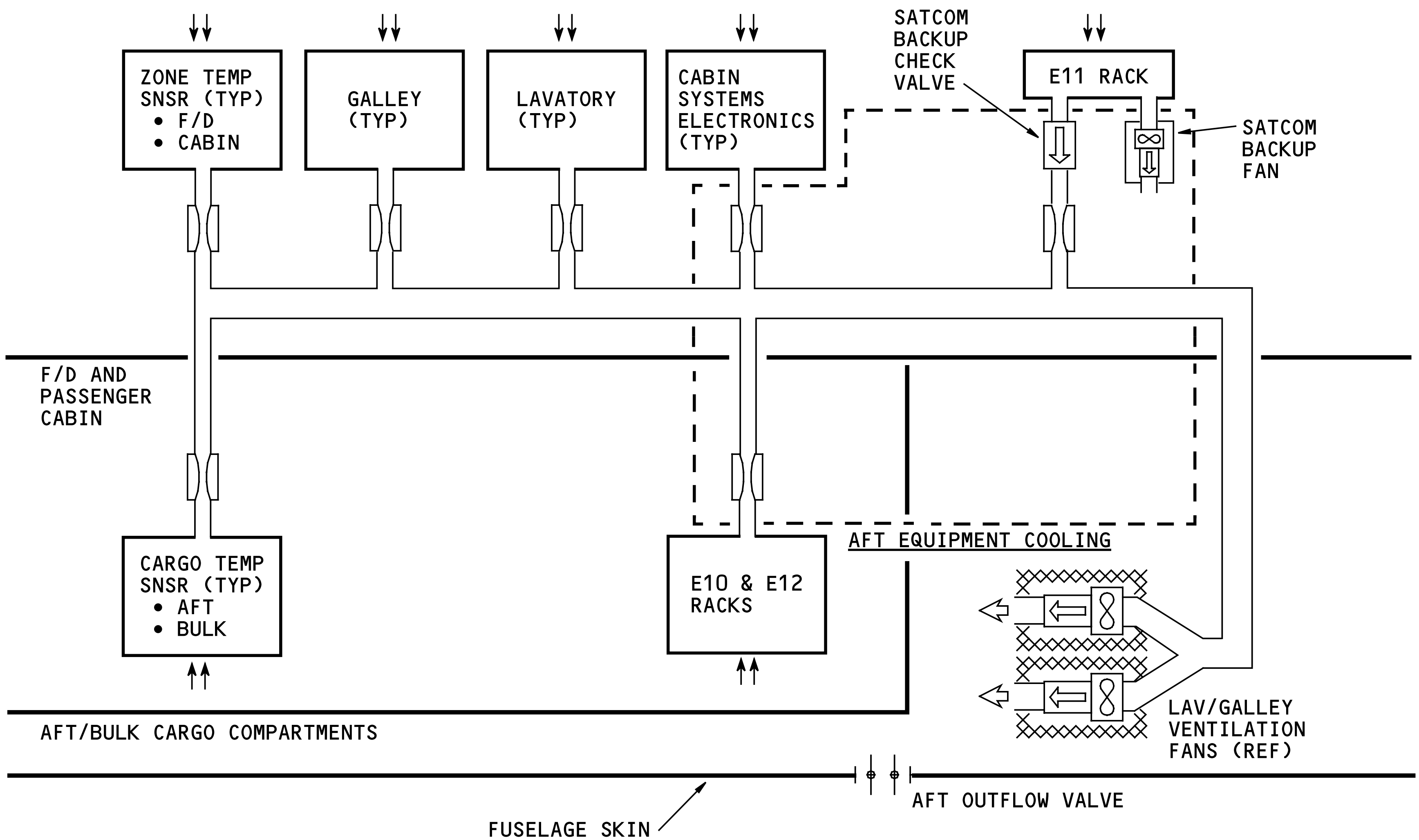
- Satellite communications (SATCOM) backup fan
- SATCOM check valve
- Ducts and hoses.

The system has interfaces with the lavatory/galley ventilation system. The ventilation system pulls cabin air though the equipment to cool it.

The lavatory/galley ventilation fans are part of the air conditioning system. One fan operates at a time.

See the ventilation system for more information about the lavatory/galley vent fans (AMM PART I 21-26).

The SATCOM fan comes on if both lavatory/galley ventilation fans do not operate. It pulls cabin air through the SATCOM equipment on the E11 rack.



A/C - EQUIPMENT COOLING - AFT SYS - GENERAL DESCRIPTION - MECHANICAL

A/C - EQUIPMENT COOLING - PASSENGER COMPARTMENT COMPONENT LOCATIONS

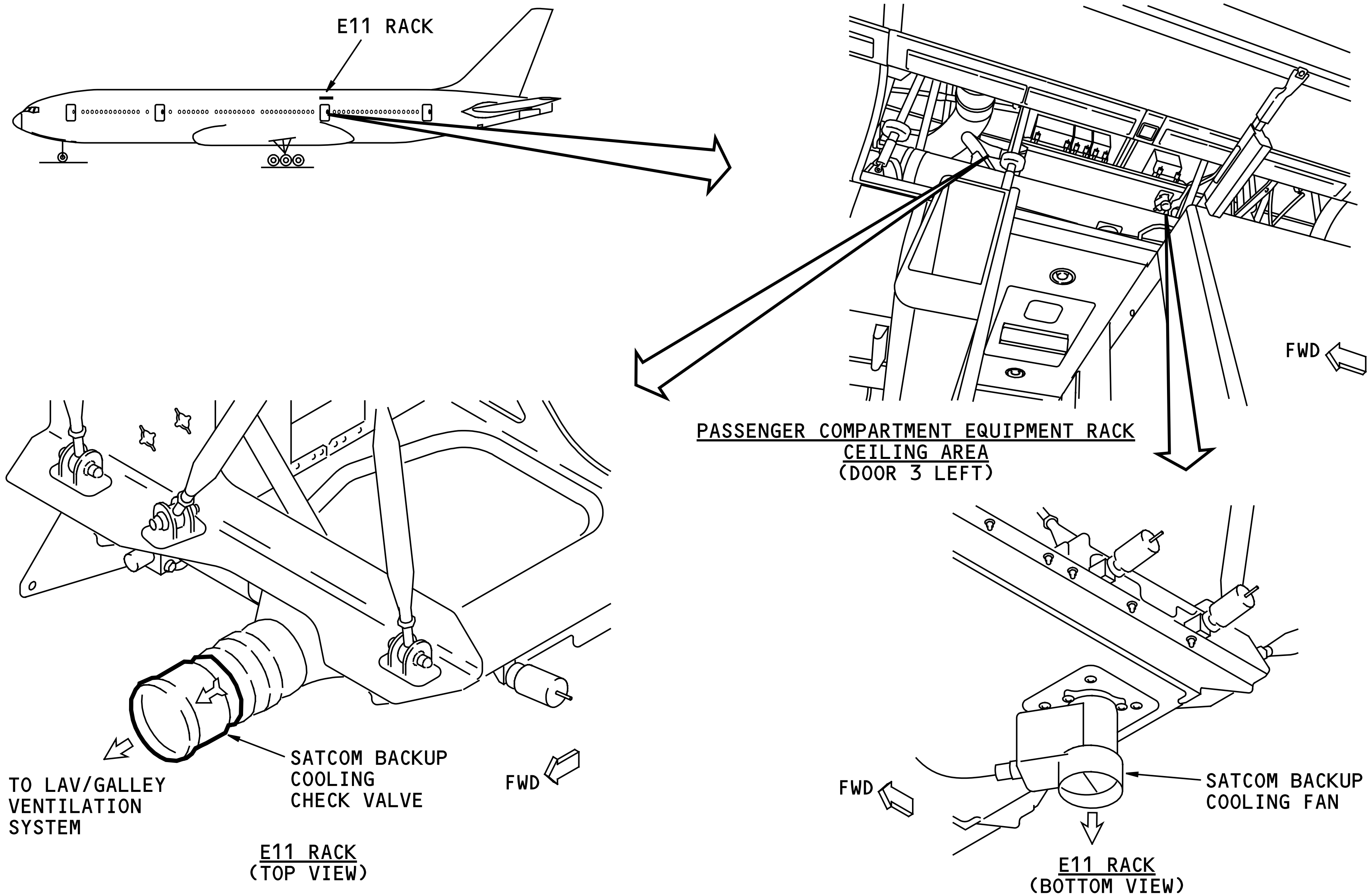
Component Locations

These components are above the passenger compartment ceiling:

- Satellite communications (SATCOM) backup cooling fan
- SATCOM backup cooling check valve.

The SATCOM backup cooling fan attaches to the bottom aft side of the E11 rack. The rack is near door 3 left, above the passenger compartment ceiling.

The SATCOM backup cooling check valve is in the vent duct that connects the rack to the lavatory/galley ventilation system. The duct is on the forward end of the equipment rack.



A/C - EQUIPMENT COOLING - PASSENGER COMPARTMENT COMPONENT LOCATIONS

A/C - EQUIPMENT COOLING - SATCOM BACKUP COOLING FAN AND CHECK VALVE

Purpose

The SATCOM backup cooling fan pulls air through the E11 rack if the lavatory/galley ventilation system does not operate.

The SATCOM backup cooling check valve makes sure that the fan pulls air through the SATCOM equipment on the rack and not out of the duct to the lavatory/galley ventilation system.

Location

The SATCOM fan and check valve are above the passenger compartment ceiling.

The SATCOM backup cooling fan attaches to the bottom aft side of the E11 rack. The E11 rack is near door 3 left.

The SATCOM backup cooling check valve is in the vent duct that connects the rack to the lavatory/galley ventilation system. The duct is on the opposite end of the equipment rack as the fan.

Physical Description

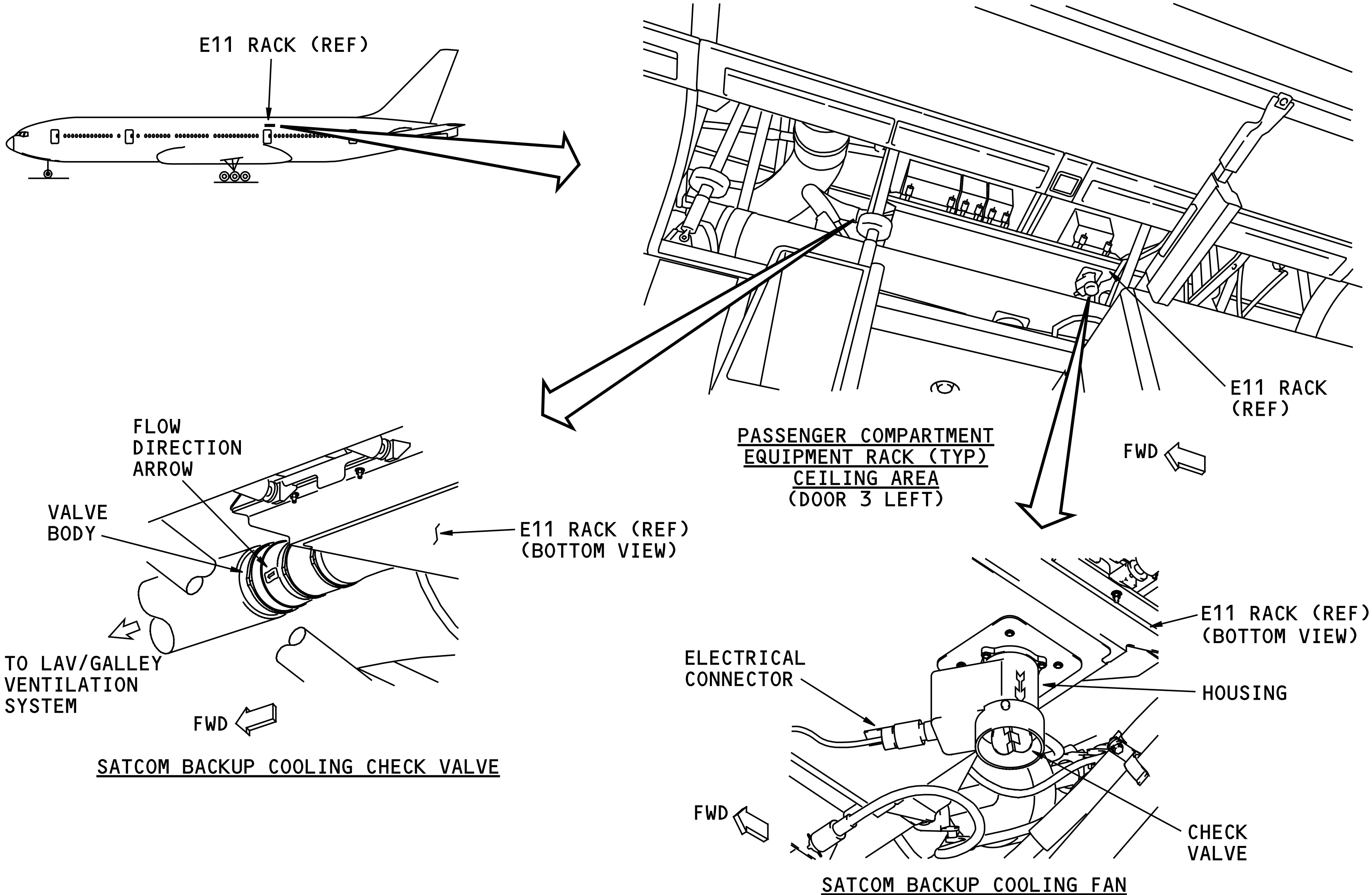
The SATCOM backup cooling fan has these components:

- Fan assembly (not shown)
- Housing
- Check valve
- Electrical connector.

The SATCOM backup cooling check valve has a valve body and a set of flapper doors (not shown).

Training Information Point

The check valve has a small inlet and a larger outlet and has an air flow direction arrow on it to help install the valve correctly.



21-27-00-018 Rev 2 02/09/1998

A/C - EQUIPMENT COOLING - SATCOM BACKUP COOLING FAN AND CHECK VALVE

A/C - EQUIPMENT COOLING - FWD SYS - MECHANICAL - GENERAL DESCRIPTION

General

The forward part of the equipment cooling system cools the equipment that needs active cooling and removes smoke from the flight deck. The system also gives cooling to some rack-installed passively cooled equipment.

The forward equipment cooling system uses cabin air to cool electrical and electronic equipment. The system has two parts: supply and vent (exhaust). The supply part gives blow-through cooling (supply fans). The vent part gives pull-through cooling (vent fan). The system uses cabin differential pressure and the override valve to remove smoke from the flight deck.

The inflight entertainment (IFE) cooling system uses cabin air to give pull-through cooling for the entertainment equipment. Exhaust air from the system goes into the exhaust part of the forward equipment cooling system. See the general description page in this section for more information about IFE cooling system.

Forward Equipment Cooling Components

The forward part of the system has these components:

- Vent fan
- Forward cargo heat valve
- Vent valve
- Air filter
- Supply fan (2)
- Override valve
- Duct pressure sensor (4)
- Low flow sensor (2)
- Converter supplemental cooling check valve
- Equipment cooling controller (2) (not shown).

The left and right ECS miscellaneous cards (ECSMCs) (not shown) give control, BIT, and indications for the system. The right card gives primary control when the airplane gets power and the left gives backup control. When the airplane changes from air to ground, the card that is in control changes. Two equipment cooling controllers (ECC) (not shown) control the supply fans and the override valve.

The low flow sensors supply both flow and temperature information.

The converter supplemental cooling check valve is part of the equipment cooling system. The converter supplemental cooling fan is part of the electrical system. See the AC generation section for more information on the converter (AMM PART I 24-20).

The smoke detector is part of the fire protection system. See the electrical and electronic cooling smoke detection section for more information about the equipment cooling smoke detector (AMM PART I 26-19).

The forward part of the equipment cooling system has two modes of operation: auto and override (OVRD).

A/C - EQUIPMENT COOLING - FWD SYS - MECHANICAL - GENERAL DESCRIPTION

Forward Equipment Cooling Auto Mode

One supply fan operates. The right fan is primary. The left fan gives automatic backup. The fan that operates pulls air through the air filter and pushes it through the override valve.

The override valve is closed to ambient and open (NORM position) to let the air from the supply fan go to these areas:

- Forward cargo compartment: E5 and E16 racks
- Main equipment center (MEC): E1, E2, E3, and E4 racks
- Forward equipment center: weather radar (WXR)
- Flight deck: instrument, center aisle stand and overhead panels and the maintenance access terminal (MAT).

The vent fan pulls air from these areas:

- Main equipment center (MEC): E1, E2, E3, and E4 racks
- Flight deck: instrument, center aisle stand and overhead panels and the MAT.

When electrical power is available, the vent fan operates most of the time. The fan is off for engine start. This logic helps to keep fumes from outside the aft pressurization outflow valve out of the airplane during engine start.

The air from the vent fan goes to the vent valve and the forward cargo heat valve. Only one of the valves is open at a time. When the total air temperature (TAT) goes above 55F (12.8C), the vent valve opens and the cargo heat valve closes. The air goes to the area near the forward outflow valve in the MEC. When TAT goes below 50F (10C), the forward cargo heat valve opens and the vent valve closes. The air goes to heat the forward cargo compartment.

Forward Equipment Cooling Override Mode

The override mode cools the equipment without the supply and vent fans. This mode uses cabin differential pressure to cause airflow through the equipment. The override mode gives sufficient cooling when the airplane is pressurized and above 25,000 feet (7625 meters). The flight crew also selects this mode when they want to clear smoke from the flight compartment.

Any of these conditions causes the system to operate in the override mode:

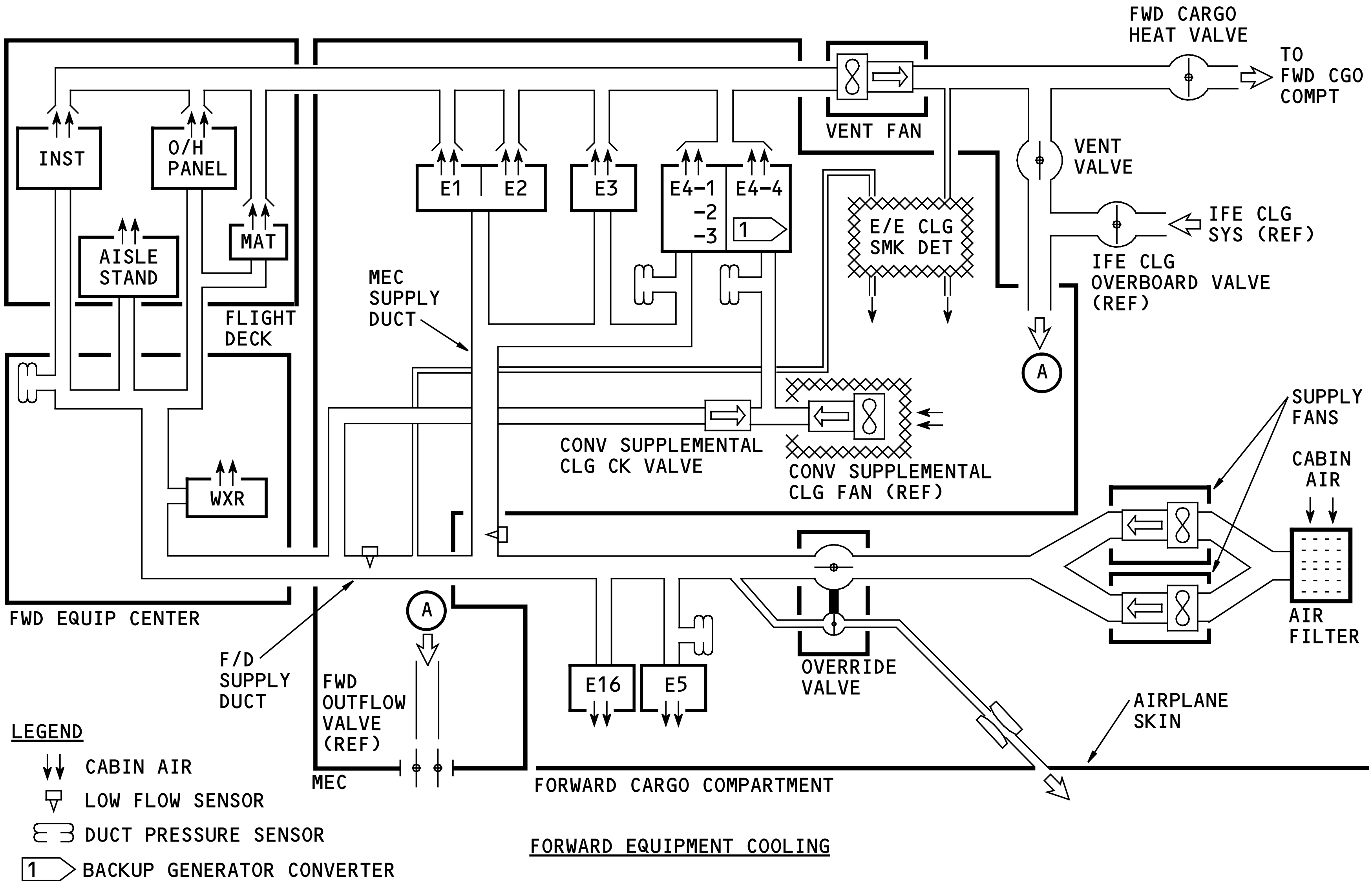
- Equipment cooling switch on the air conditioning panel (not shown) set to OVRD
- Low flow in MEC and F/D supply ducts and airspeed more than 150 knots
- Left and right supply fans failed off
- Smoke in supply or vent duct
- Forward cargo fire extinguishing system armed.

The override mode causes these effects:

A/C - EQUIPMENT COOLING - FWD SYS - MECHANICAL - GENERAL DESCRIPTION

- The bulk cargo ventilation fan goes off (only with equipment cooling switch in the OVRD position)
- Both supply fans stop
- The override valve goes to the OVRD position which opens the supply duct to ambient
- Cabin differential pressure pushes cabin air through the components and out of the airplane
- The converter supplemental cooling fan comes on
- The vent fan stops
- The forward cargo heat valve closes if it is open (low flow does not cause the valve to change position)
- The vent valve closes if it is open (low flow does not cause the valve to change position).

The override mode also causes the IFE cooling system to stop operation.



FORWARD EQUIPMENT COOLING

A/C - EQUIPMENT COOLING - FWD SYS - MECHANICAL - GENERAL DESCRIPTION

A/C - EQUIPMENT COOLING - ELECTRICAL - GENERAL DESCRIPTION

General

Equipment cooling control components supply automatic or manual mode selection (AUTO/OVRD), indications, and BIT for the system. These are the control components:

- Equipment cooling switch
- Left and right environmental control system miscellaneous cards (ECSMC)
- Left and right equipment cooling controllers (ECC).

The equipment cooling switch gives indication for mode selection and lets you manually set the mode of operation to AUTO or OVRD.

The left and right ECSMCs give automatic control (AUTO or OVRD), indications (AIMS and equipment cooling switch), and BIT for the equipment cooling system. The cards control:

- Which supply fan is primary and which is backup
- When the supply and the vent fans operate.
- The direction of air flow for the equipment cooling exhaust air. Directs the air to the cargo compartment for heating or vents the air overboard
- When to set the system to the override mode
- When to turn on the SATCOM cooling fan
- When to give indications for mode selection and malfunctions.

The left and right equipment cooling controllers (ECCs) usually control the left and right equipment cooling supply fans and the override valve with inputs from the ECSMCs. The ECCs take control of the fans and valve if the airplane is in the air and the ECCs find low flow for an extended time (6.5 min in supply fan mode or 20 min in OVRD mode).

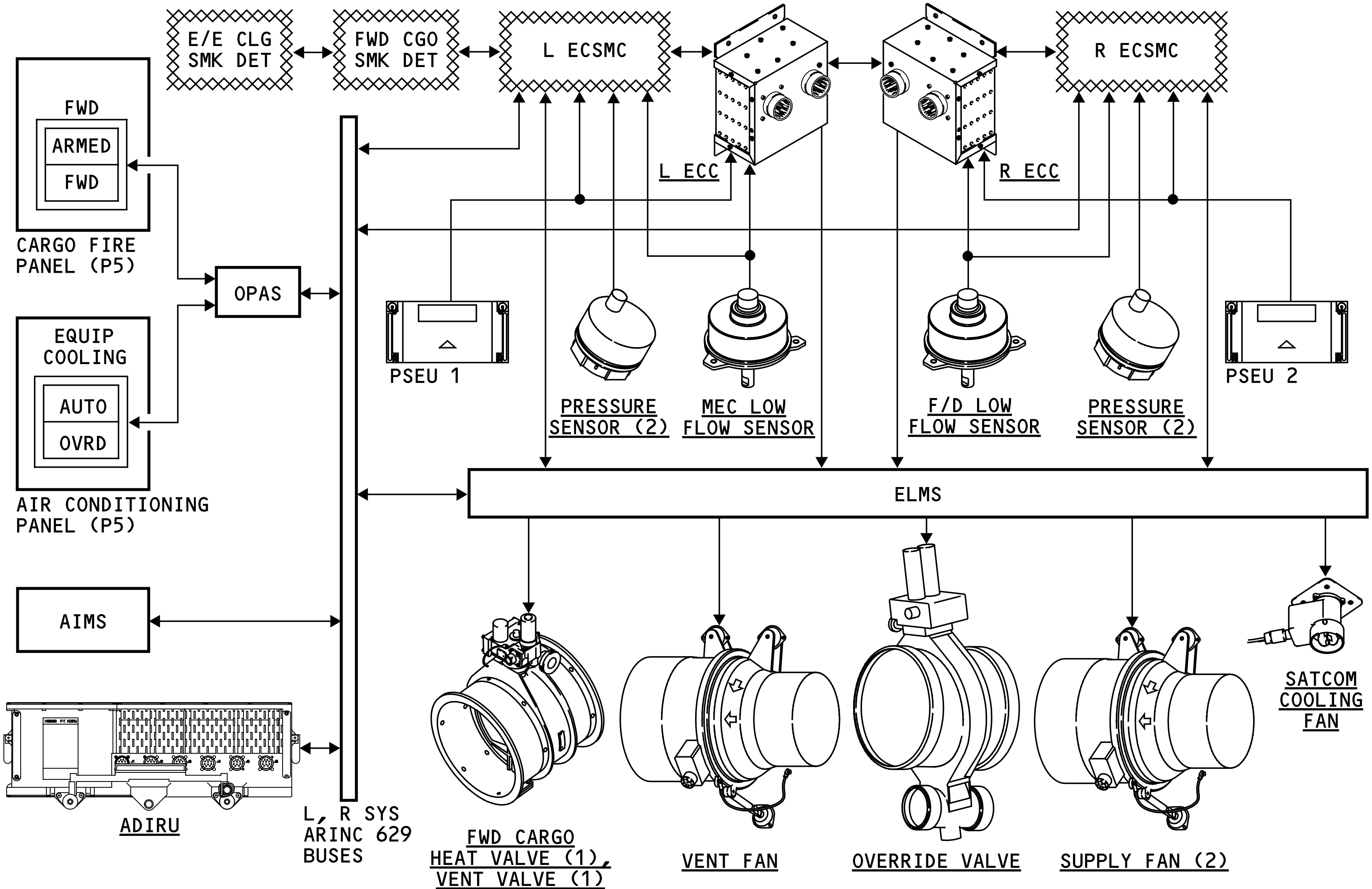
Interfaces

The ECSMCs have three types of input/output interfaces with system components and with other systems. One is through the left and right system ARINC 629 buses. These are the ARINC 629 interfaces:

- OPAS
- AIMS
- ELMS.

The second type is through hard-wired inputs to ELMS. The third type is by hard-wired inputs/outputs from system components and the PSEUs 1 and 2.

See the INTERFACES page in this section for more information about the system components that are hard-wired to the ECSMCs.



A/C - EQUIPMENT COOLING - ELECTRICAL - GENERAL DESCRIPTION

21-27-00-030 Rev 3 05/19/1997

A/C - EQUIPMENT COOLING - AIR FILTER

Purpose

The air filter removes particles from the air before the air cools the equipment.

Physical Description

The filter is a nonwoven fabric and is made of polyester and glass fibers.

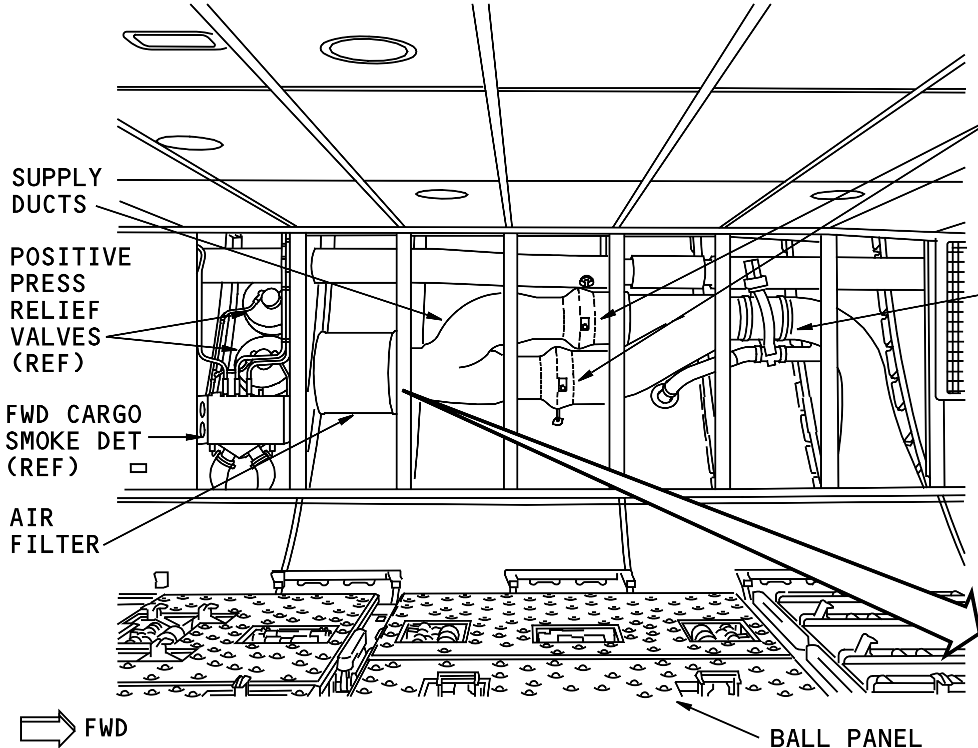
Location

The air filter is outboard of the left sidewall panel. It is near the forward ball panel in the forward cargo compartment.

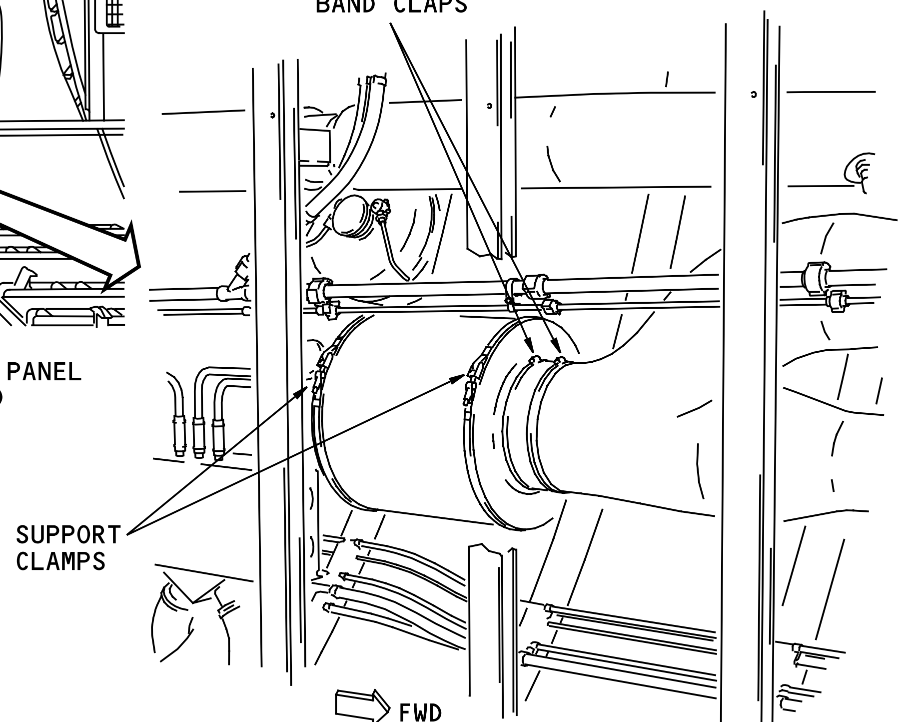
Training Information Point

Remove the sidewall lining to get access to the air filter.

You clean the filter with detergent. You can also blow air from the inside out to clean the filter. You remove two band clamps that attach to the duct and two support clamps to remove the filter from the airplane.



FORWARD CARGO COMPARTMENT
(LOOKING AT LEFT SIDEWALL AREA)



FILTER

A/C - EQUIPMENT COOLING - AIR FILTER

A/C - EQUIPMENT COOLING - SUPPLY FANS

Purpose

The two supply fans give air to the supply part of the forward equipment cooling system for blow-through cooling.

Physical Description

The supply fan has these components:

- Stator housing assembly
- Check valve (not shown)
- Electrical connector
- Electric motor (not shown)
- Inlet housing assembly.

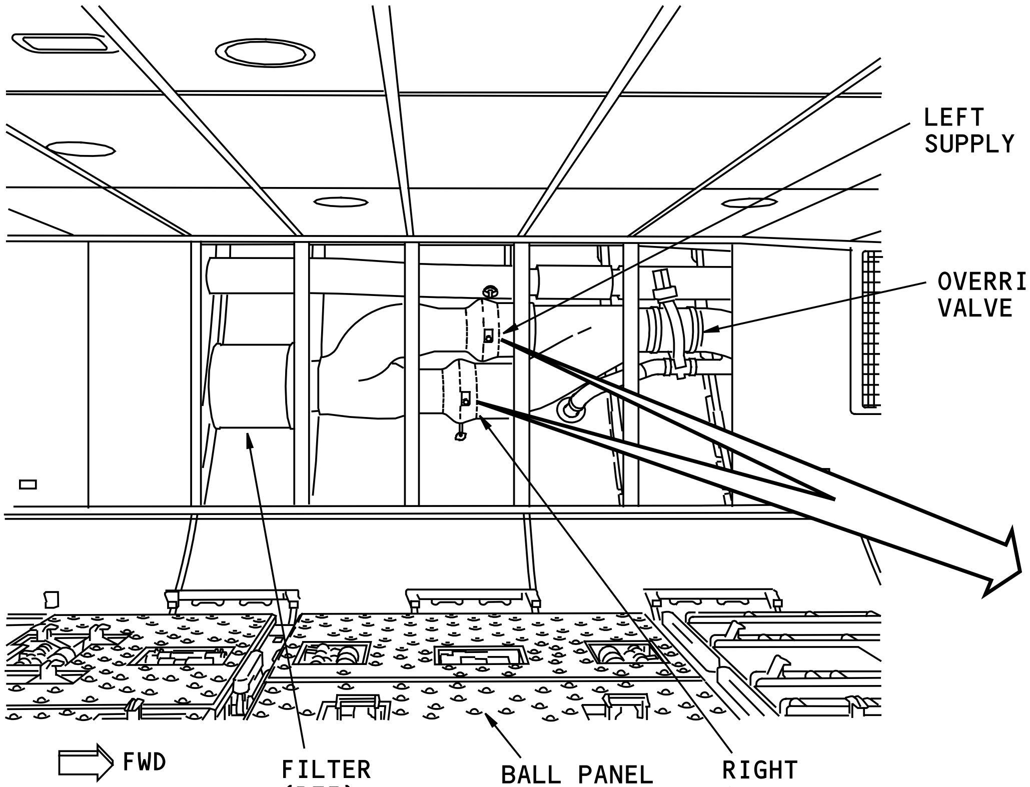
Location

The two supply fans are outboard of the left sidewall panel near the forward ball panel in the forward cargo compartment. The supply fans are between the override valve and the air filter. The left supply fan is above the right supply fan.

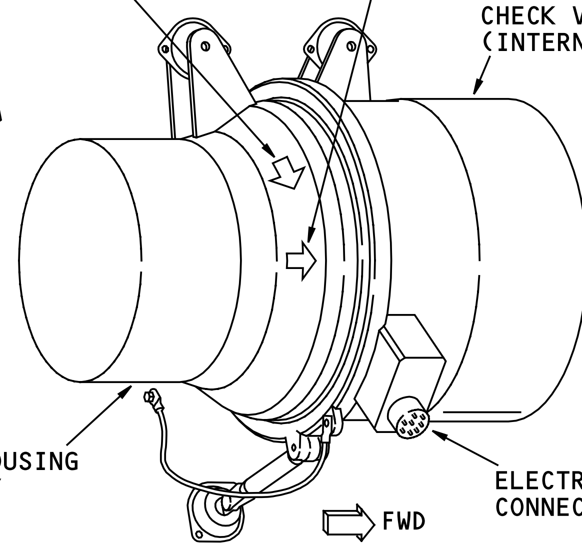
Training Information Point

One fan operates at a time. The right fan is primary and the left fan is backup.

The fans have flow and rotation arrows. The arrows help install the fans correctly.



FORWARD CARGO COMPARTMENT



SUPPLY FAN

21-27-00-010 Rev 3

A/C - EQUIPMENT COOLING - SUPPLY FANS

A/C - EQUIPMENT COOLING - OVERRIDE VALVE

Purpose

The override valve permits differential cabin pressure to remove smoke and cool the electronic and electrical components.

Location

The override valve is outboard of the left sidewall panel near the forward ball panel in the forward cargo compartment.

Physical Description

The override valve has these three primary components:

- Actuator
- Cooling valve
- Smoke removal valve.

The actuator has these components:

- Electric motor (2)
- Position indicator
- Electrical connector (2)
- Manual override knob.

Each motor can operate the override valve.

The cooling valve has a valve body and a butterfly plate assembly (not shown).

The smoke removal valve has a valve body and a butterfly plate assembly (not shown).

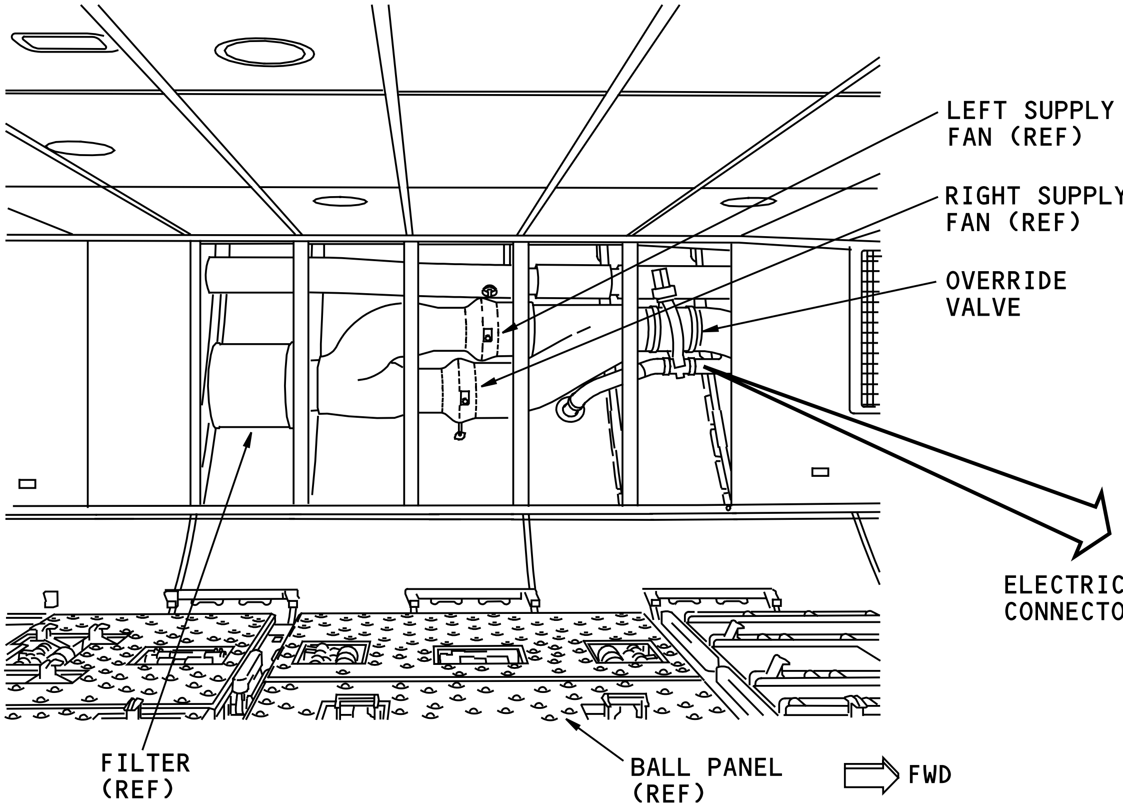
Functional Description

A shaft connects the two valves. When one valve is open the other is closed. The override valve has two positions: normal and override. In the normal position, the cooling valve is open and the smoke removal valve is closed. In the override position, the cooling valve is closed and the smoke removal valve is open.

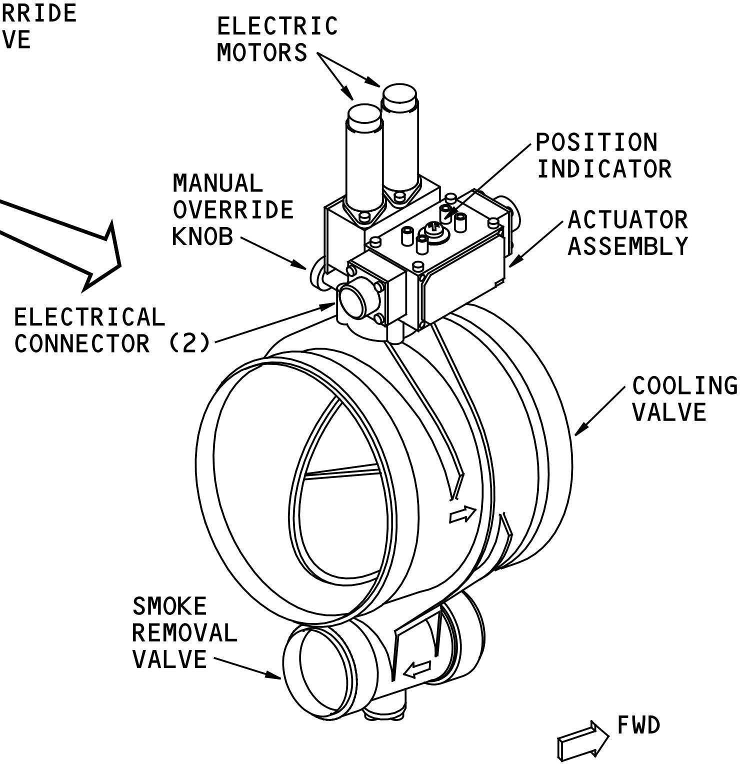
Training Information Point

The override valve has two air flow direction arrows. The arrows help you install the valve correctly.

A position indicator shows the position of the valve. You can use the manual override knob to change the position of the override valve when there is no electric power to the valve.



FORWARD CARGO COMPARTMENT



OVERRIDE VALVE

21-27-00-011 Rev 3

A/C - EQUIPMENT COOLING - OVERRIDE VALVE

A/C - EQUIPMENT COOLING - DUCT PRESSURE SENSORS

Purpose

Four duct pressure sensors tell the ECSMCs the pressure at each sensor location.

Physical Description

Each duct pressure sensor has these components:

- Sense port
- Electrical connector
- Sensor housing.

Location

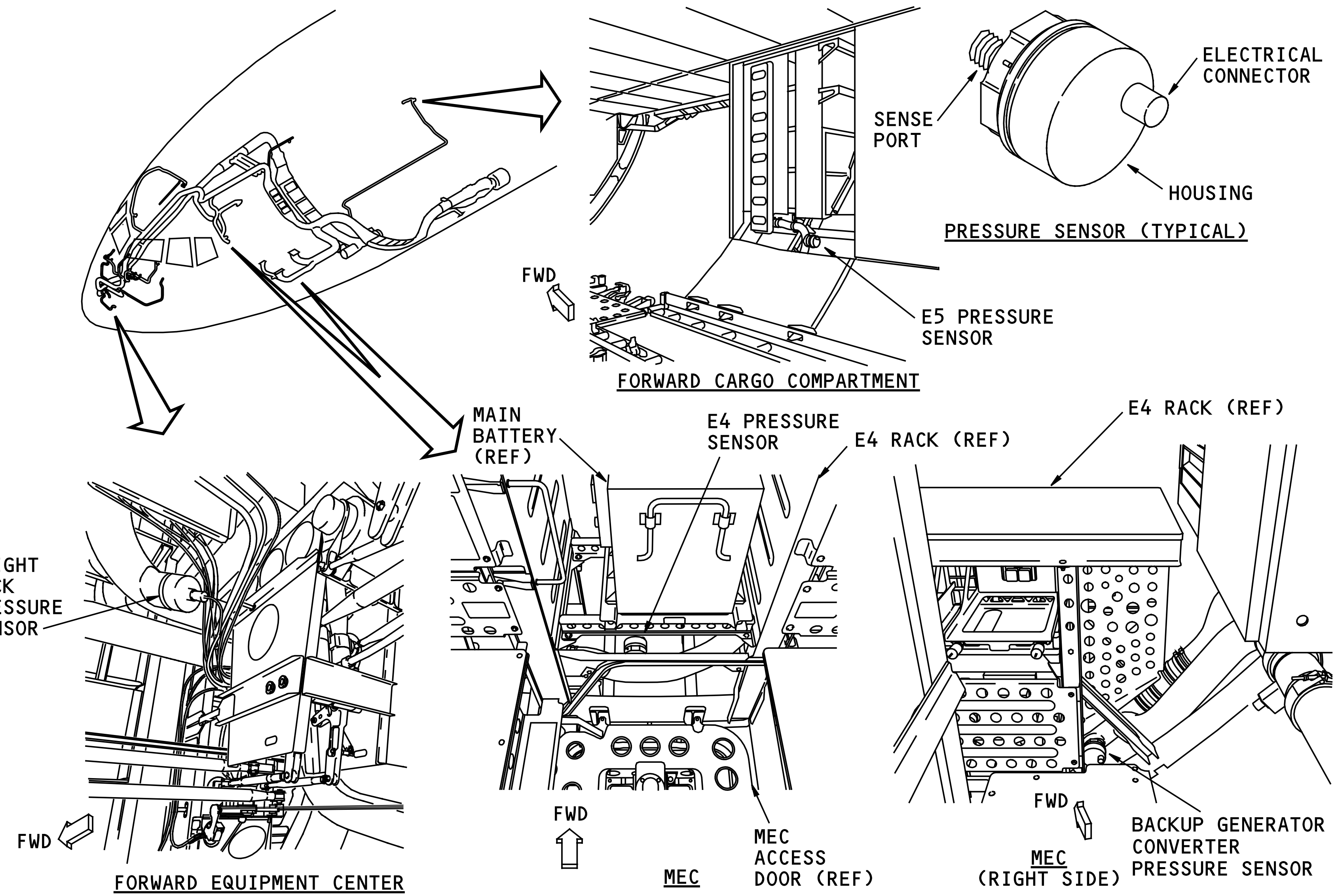
These are the four duct pressure sensor locations.

The sensor for the E5 rack is aft and below the E5 rack. Access is through the forward cargo compartment right sidewall panel, aft of the cargo door.

The duct pressure sensor for the backup generator converter (E4-4 shelf) is to the right side and below the E4 rack.

The duct pressure sensor for the E4-1, E4-2 and E4-3 shelves is just forward of the MEC access door, below the main battery.

The duct pressure sensor for the flight deck is in the forward equipment center. It is directly forward of the cutout for the forward access door



21-27-00-012 Rev 1

A/C - EQUIPMENT COOLING - DUCT PRESSURE SENSORS

A/C - EQUIPMENT COOLING - LOW FLOW SENSORS

Purpose

The two low flow sensors tell the ECSMCs if there is low air flow or high air temperature in the equipment cooling air.

Physical Description

The low flow sensor has these components:

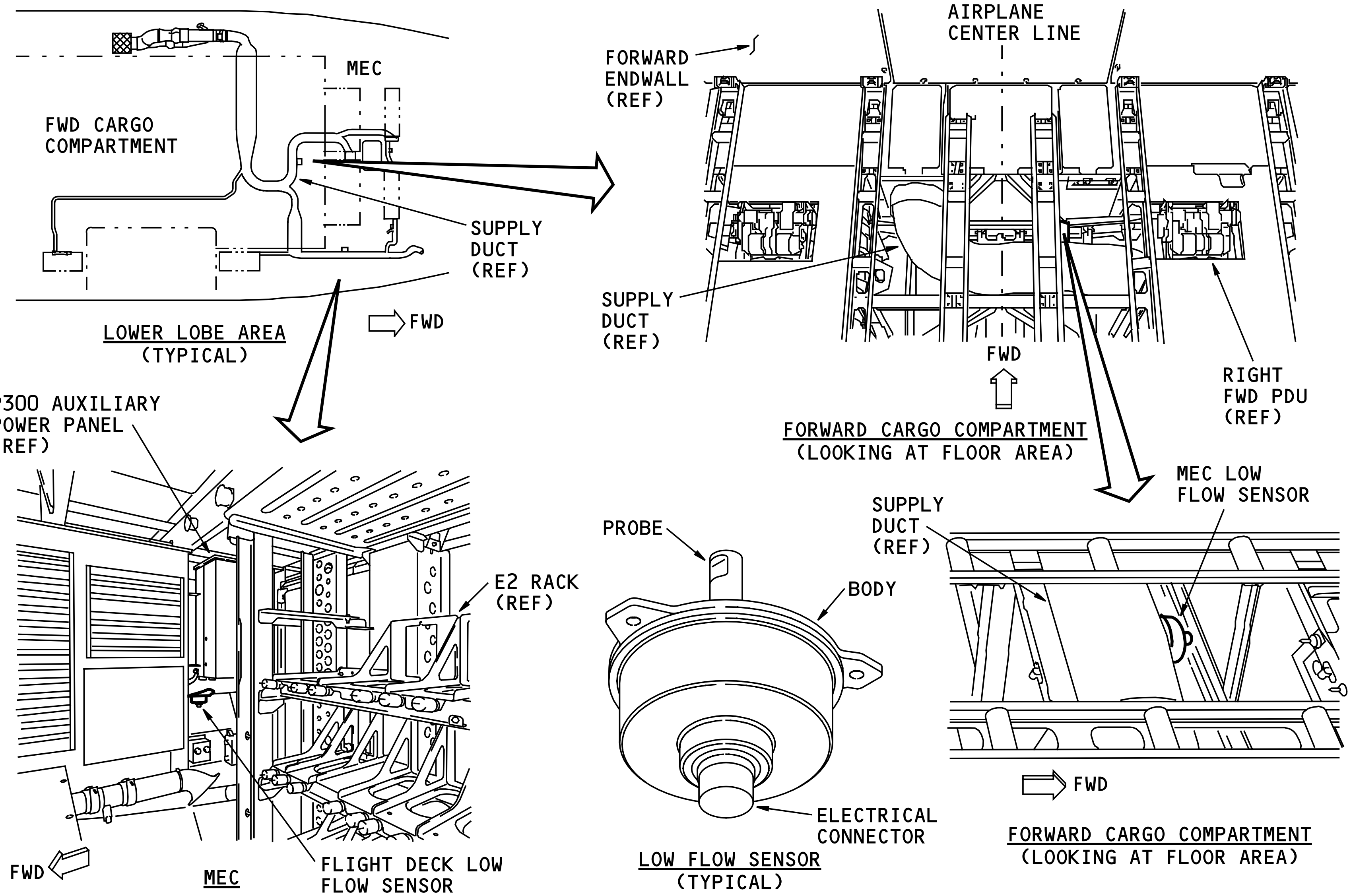
- Probe
- Body
- Electrical connector.

Location

The flight deck low flow sensor is in the MEC. The sensor is below and outboard of the forward corner of the P300 auxiliary power panel.

The MEC low flow sensor is in the forward cargo compartment below the floor. The sensor is inboard of the forward right powered drive unit.

Remove the floor panel inboard of the right forward powered drive unit (PDU) to get access to the MEC low flow sensor.



21-27-00-013 Rev 1 04/24/1997

A/C - EQUIPMENT COOLING - LOW FLOW SENSORS

A/C - EQUIPMENT COOLING - CONVERTER SUPPLEMENTAL COOLING CHECK VALVE (VSCF)

Purpose

The converter supplemental cooling check valve makes sure the air from the converter supplemental cooling fan goes to E4-4 shelf and does not go into the equipment cooling supply duct.

Physical Description

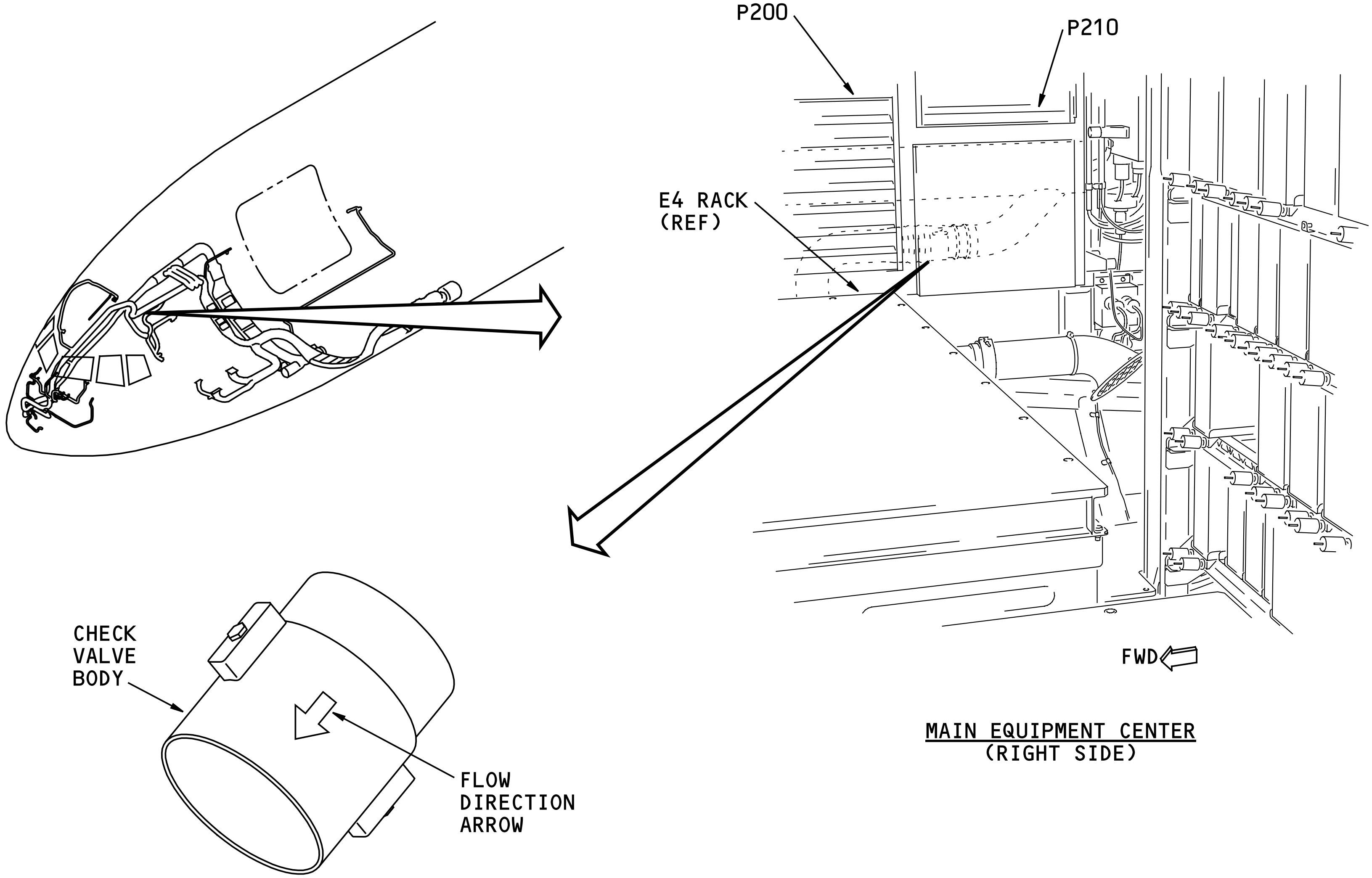
The check valve is a flapper-type valve. The valve is spring-loaded to the closed position.

Location

The check valve is on the right side of the MEC behind the P210 panel. The valve is in the supply duct that gives air to the E4-4 shelf.

Training Information Point

The check valve has an air flow direction arrow on the valve to help you install the valve correctly.



MAIN EQUIPMENT CENTER
(RIGHT SIDE)

CONVERTER SUPPLEMENTAL COOLING CHECK VALVE

21-27-00-014 Rev 3 04/29/96

A/C - EQUIPMENT COOLING - CONVERTER SUPPLEMENTAL COOLING CHECK VALVE (VSCF)

A/C - EQUIPMENT COOLING - VENT FAN

Purpose

The vent fan pulls air from the vent part of the forward equipment cooling system to give cooling. It sends the air to the forward cargo heat valve and the vent valve.

Physical Description

The vent fan has these components:

- Stator housing assembly
- Check valve (not shown)
- Electrical connector
- Electric motor (not shown)
- Inlet housing assembly.

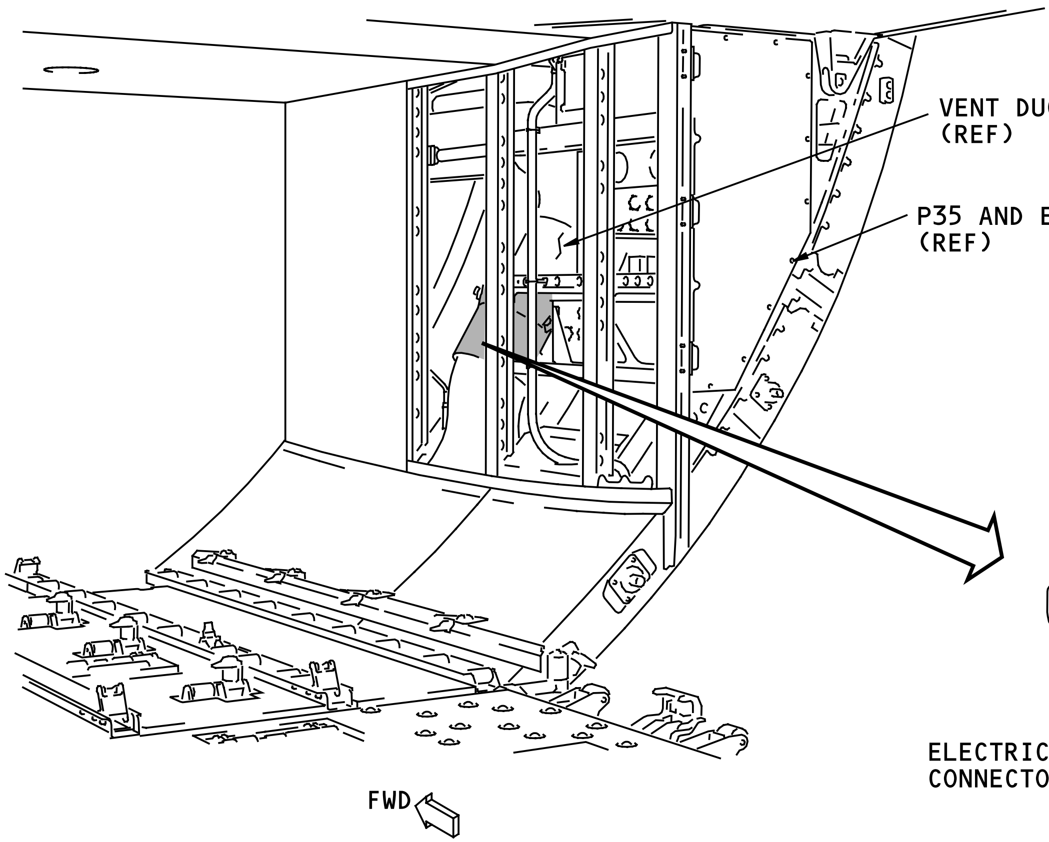
Location

The vent fan is in the forward cargo compartment forward of the P35 and the E16 rack in the right sidewall area.

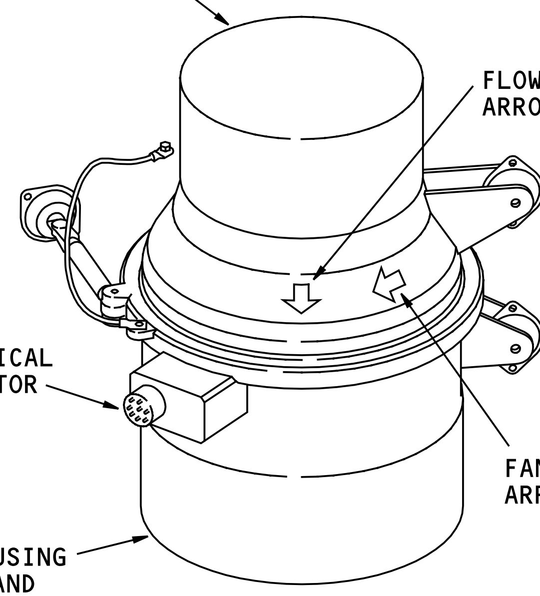
Training Information Point

Remove the sidewall panel to get access to the vent fan.

The vent fan has an air flow direction arrow on the fan to help you install the fan correctly.



FORWARD CARGO COMPARTMENT



VENT FAN

21-27-00-015 Rev 2

A/C - EQUIPMENT COOLING - VENT FAN

A/C - EQUIPMENT COOLING - VENT VALVE AND FORWARD CARGO HEAT VALVE

zPurpose

The vent valve lets equipment cooling vent (exhaust) air go to the area near the forward pressurization outflow valve.

The forward cargo heat valve lets equipment cooling vent (exhaust) air flow to the forward cargo compartment.

Physical Description

The valves have these components:

- Valve body
- Actuator
- Electrical connector
- Position indicator
- Manual override knob.

The diameter of the valve body is nine inches (23 cm).

Location

The valves are in the floor area of the forward cargo compartment, forward of the ball panels, below the left powered drive units.

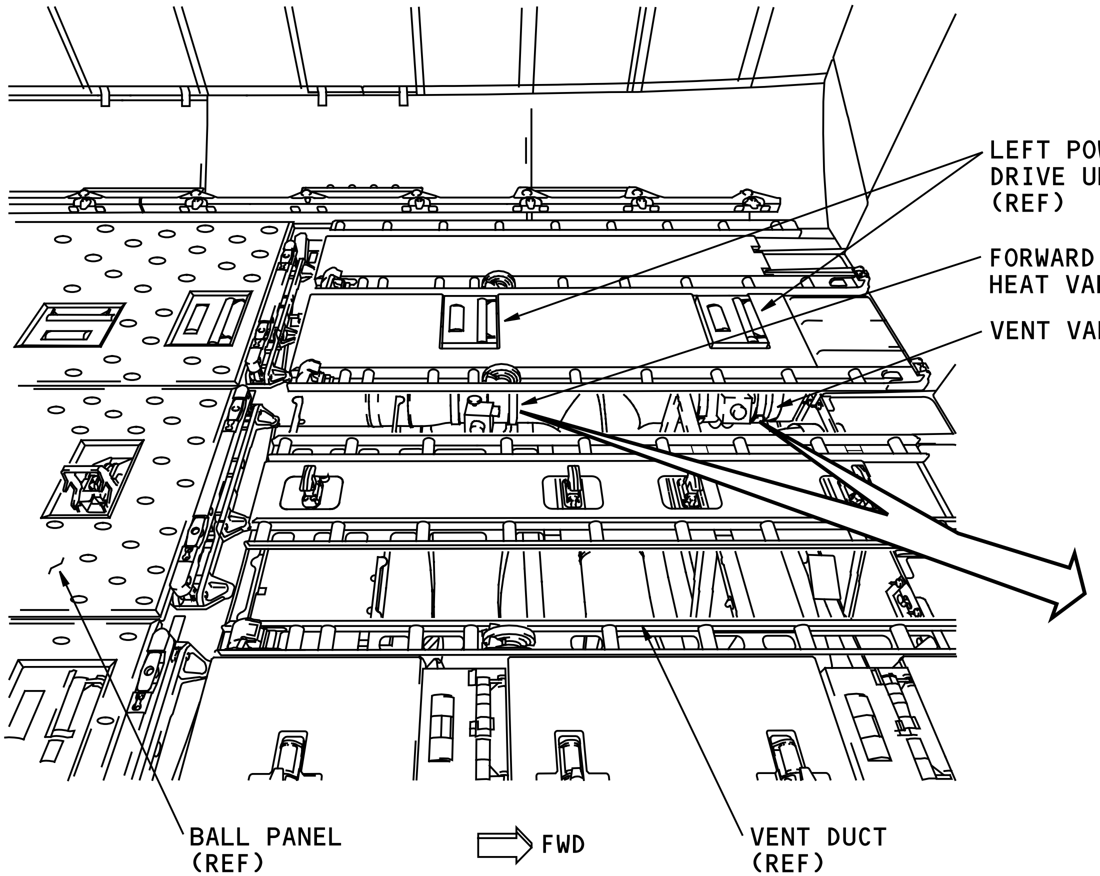
The vent valve is the forward most valve and the forward cargo heat valve is the aft valve.

Training Information Point

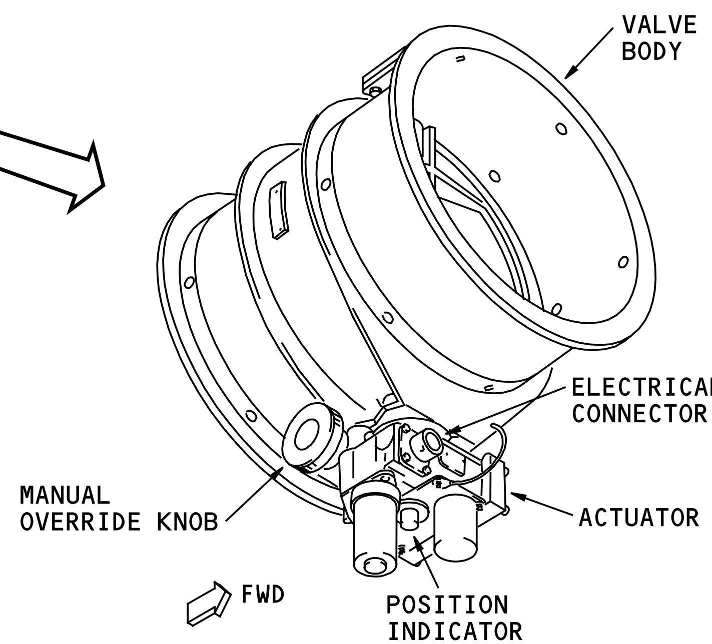
Remove the floor panel inboard of the left forward powered drive unit to get access to the valves.

Install the valves with the manual override knob up. This permits better access to the manual override knob.

The valves are interchangeable.



FORWARD CARGO COMPARTMENT



VENT VALVE/FORWARD CARGO HEAT VALVE

21-27-00-016 Rev 2 04/24/1997

A/C - EQUIPMENT COOLING - VENT VALVE AND FORWARD CARGO HEAT VALVE

A/C - EQUIPMENT COOLING - DUCTING

General

The equipment cooling system has these ducts:

- Supply ducts
- Smoke clearance duct
- Exhaust ducts
- Vent duct.

The supply ducts give cabin air to equipment and areas that need blow-through cooling.

The smoke clearance duct moves smoke from the supply part of the system or vents the system for differential cooling when necessary.

The exhaust ducts move air from equipment and areas that need pull-through cooling.

The vent duct moves air from the exhaust duct to the area next to the forward pressurization outflow valve.

Physical Description

There are different types of equipment cooling ducts. Some are flexible and some are rigid. The ducts can have different shapes; round, oval, and rectangle.

Location

The supply ducts are in these locations:

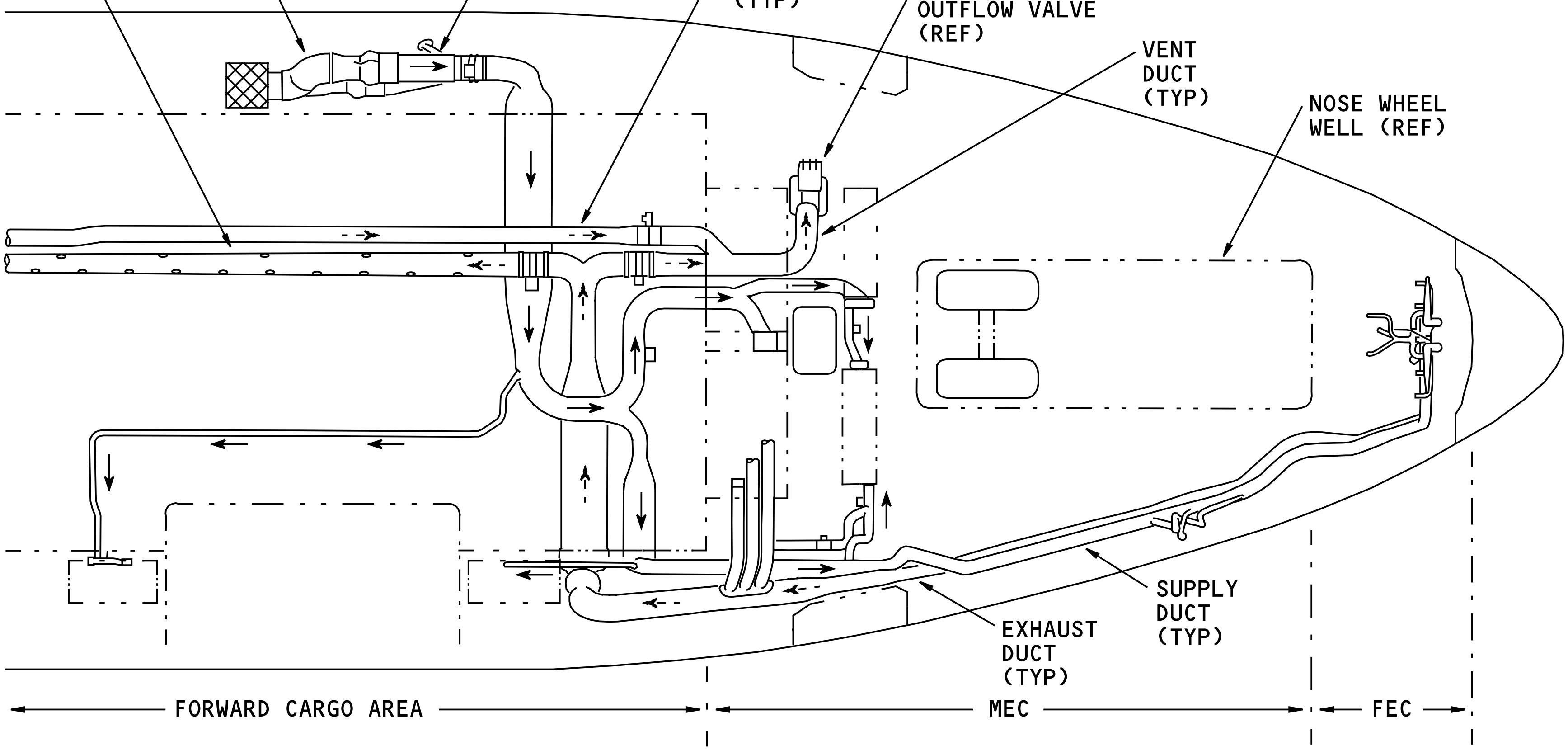
- Forward cargo compartment, left sidewall area
- Forward cargo compartment, under the floor area
- Forward cargo compartment, right sidewall area
- Main equipment center (MEC)
- Forward equipment center (FEC)
- Flight deck (not shown).

The smoke clearance duct is in the left sidewall area of the forward cargo compartment.

The exhaust ducts are in these locations:

- Flight deck (not shown)
- Forward equipment center (FEC)
- Main equipment center (MEC)
- Forward cargo compartment, right sidewall area
- Forward cargo compartment, under the floor area.

The vent duct is under the floor of the forward cargo compartment and the MEC.



LOWER LOBE AREA

21-27-00-040 Rev 0 04/24/1997

A/C - EQUIPMENT COOLING - DUCTING

A/C - EQUIPMENT COOLING - CONTROLLER

Purpose

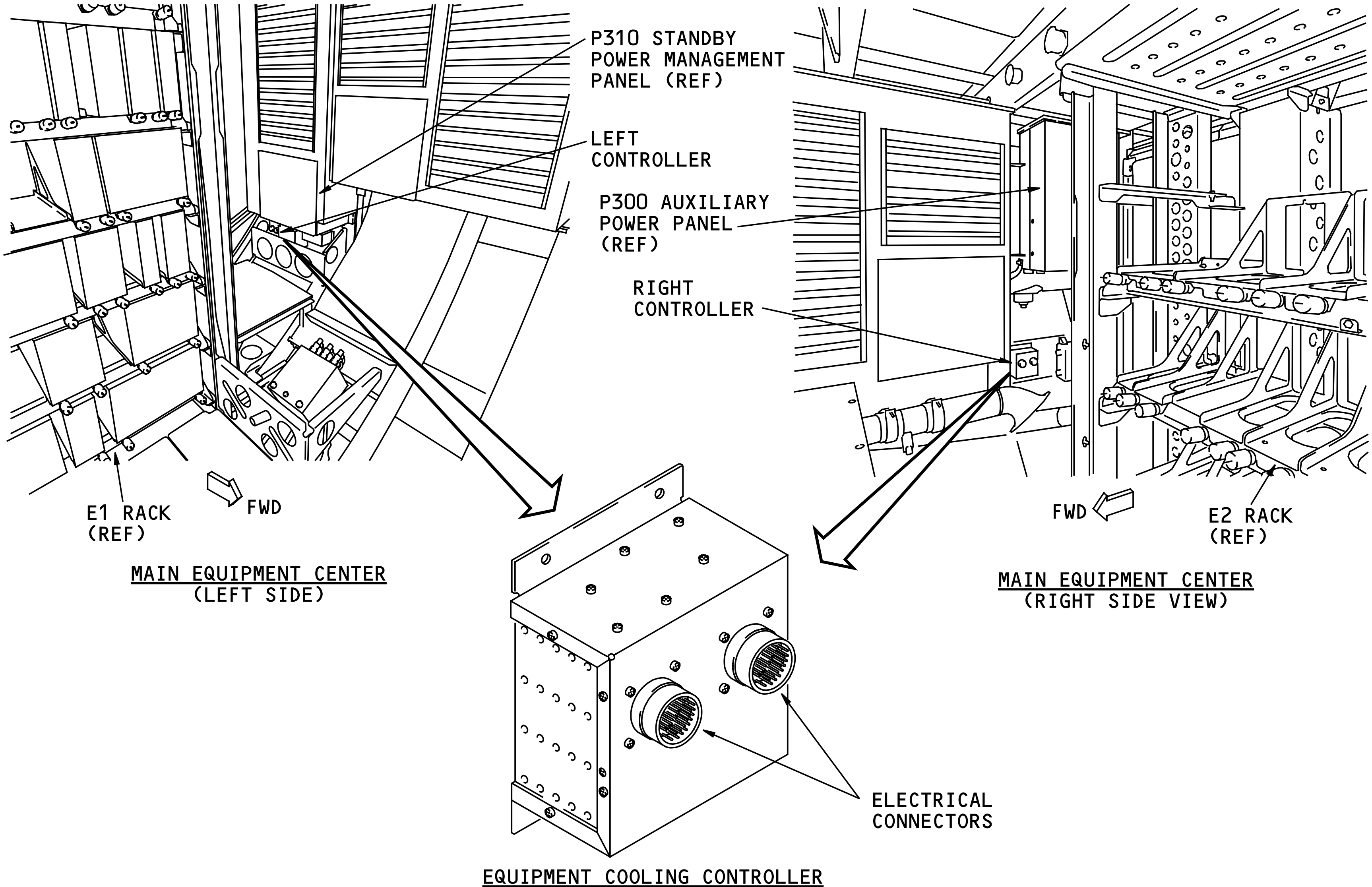
The equipment cooling controllers (ECC) supply control of the supply fans and the override valve.

Location

Both controllers are in the main equipment center (MEC). The left controller is below the P310 standby power management panel. The right controller is below the P300 auxiliary power panel.

Physical Description

The controllers are identical, solid state units. Each ECC has two independent channels, one for supply fan control and one for override valve control. The controllers have two electrical connectors.



21-27-00-008 Rev 2

A/C - EQUIPMENT COOLING - CONTROLLER

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A/C - EQUIPMENT COOLING - FUNCTIONAL DESCRIPTION - LOW FLOW SENSORS

General

The sensors calculate when the flow of air is below the amount necessary to cool the electrical and electronic equipment.

The flight deck (F/D) low flow sensor sends low flow information to the right ECC and to the right ECSMC. The sensor sends air temperature information to the right ECSMC.

The main equipment center (MEC) low flow sensor sends low flow information to the left ECC and to the left ECSMC. The sensor air temperature information to the left ECSMC.

Power

The sensors get power from the P210 right power management panel and the P310 standby power management panel.

ECC

The ECCs use low flow information in their takeover control logic. See the section on the controller for more information how the ECCs use low flow information.

The ECCs share low flow information through a cross talk connection.

ECSMC

The ECSMC in control uses the flow and temperature information to make low flow override mode signals and low flow indication signals.

The left and right ECSMCs share the signals for low flow and give it to the AIMS and the P310 standby power management panel through the ARINC 629 buses. The low flow logic is different when the airplane is on the ground than when it is in the air.

On the ground, only the low flow indication signal goes to the AIMS and P310. The cards do not give the low flow override mode signal on the ground. The override mode needs the airplane to be pressurized for it to cool the equipment. The low flow indication signal is sent if any of these conditions occur for more than five minutes:

- F/D or MEC duct air temperature more than 136F (58C)
- F/D or MEC duct air flow is low.

In the air, both the low flow indication signal (5 minute delay) and low flow override mode signal (60 second delay) are sent if all of these conditions occur:

- F/D air flow is low or the F/D sensor circuit has a malfunction
- MEC air flow is low or the MEC sensor circuit has a malfunction.

A/C - EQUIPMENT COOLING - FUNCTIONAL DESCRIPTION - LOW FLOW SENSORS

Flight Deck Indication

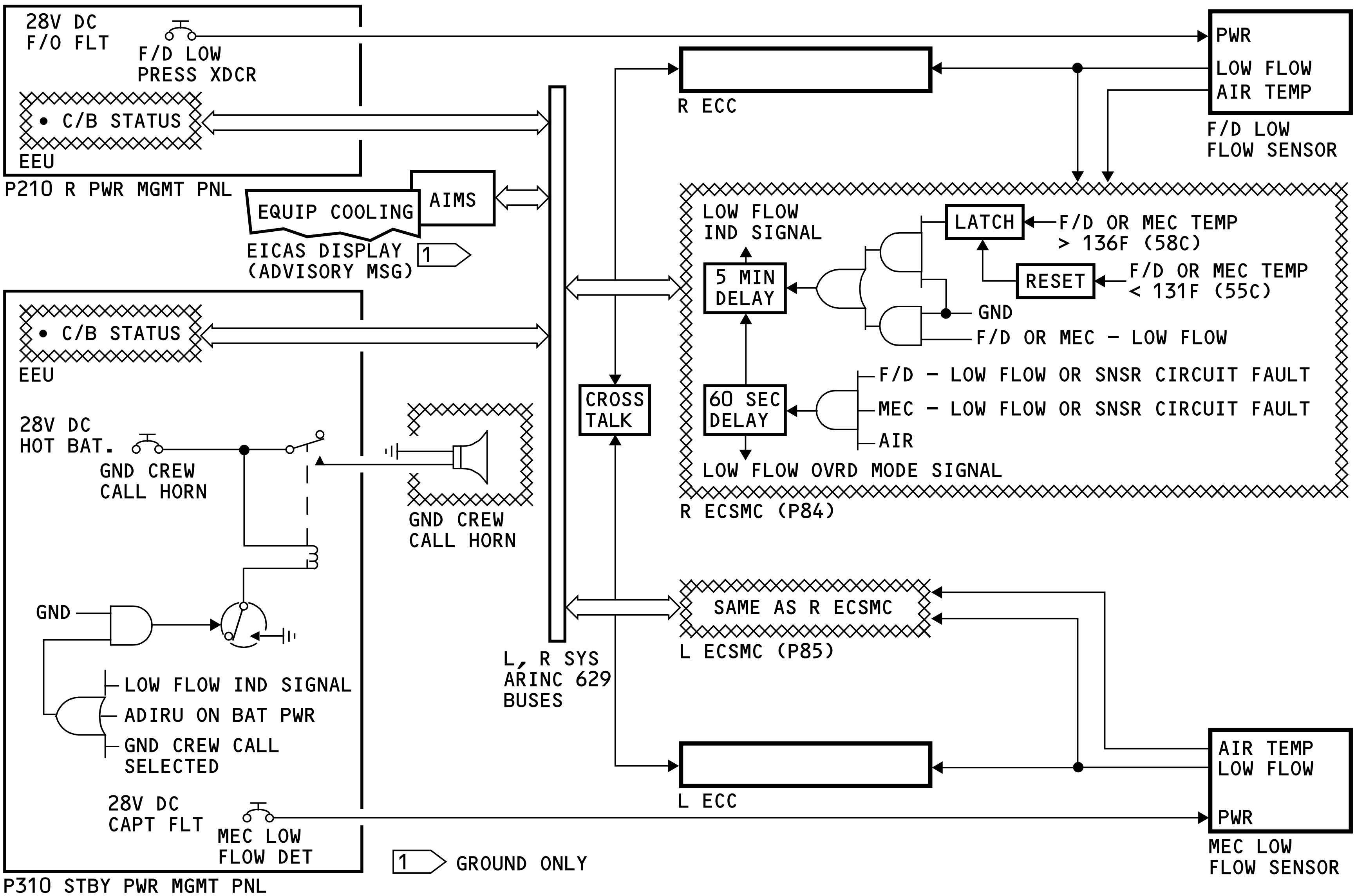
The low flow indication signal causes the EQUIP COOLING advisory message. The advisory message is inhibited in the air.

If a sensor fails, status messages show to tell you which sensor has a malfunction.

Ground Crew Call Horn

The ground crew call horn operates if the airplane is on the ground and any one of these conditions occur:

- Low flow - indication
- ADIRU on battery power
- Ground crew call selected (center CDU or flight deck hand set).



A/C - EQUIPMENT COOLING - FUNCTIONAL DESCRIPTION - LOW FLOW SENSORS

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A/C - EQUIPMENT COOLING - FUNCTIONAL DESCRIPTION - OVERRIDE MODE

General

The ECSMCs control the override (OVRD) mode. The card in control puts the forward equipment cooling system into the override mode. The override mode occurs if any of these conditions occur:

- LOW FLOW - OVRD MODE signal when the airspeed is more than 150 knots
- The left and right supply fans failed off and the airspeed is more than 150 knots
- Smoke alarm from the equipment cooling smoke detector
- Forward cargo fire switch in the ARMED position
- Equipment cooling switch in the OVRD position.

Low Air Flow

The ECSMCs use special logic to find a low air flow condition. See the section on the low flow sensors for more information. If a LOW FLOW - OVRD MODE signal occurs, the ECSMC in control latches the system to the override mode.

Supply Fans Malfunction

The ECSMC in control latches the system to the override mode if the two supply fans are off because of a malfunction.

For more information on the supply fans, see the functional description of the supply fans in this section.

Smoke Alarm

The ECSMC in control latches the system to the override mode if it gets a smoke alarm signal from form the equipment cooling smoke detector.

Reset

The latch caused by the LOW FLOW - OVRD MODE signal or a smoke alarm will reset if the condition that caused it goes away and any of these conditions occur:

- Airspeed is less than 70 knots
- Nose gear compressed (PSEU 2)
- Power cycled off then to on
- Forward cargo fire switch in the ARMED position
- Equipment cooling switch in the OVRD position.

Forward Cargo Fire Switch Set to ARMED

The ECSMC in control puts the system into the override mode when the forward cargo fire switch is in the ARMED position. The system stays in this mode as long as the switch is set to ARMED.

Equipment Cooling Switch to OVRD

The ECSMC in control puts the system into the override mode when the equipment cooling switch is set to OVRD. The system stays in this mode as long as the switch is in the OVRD position.

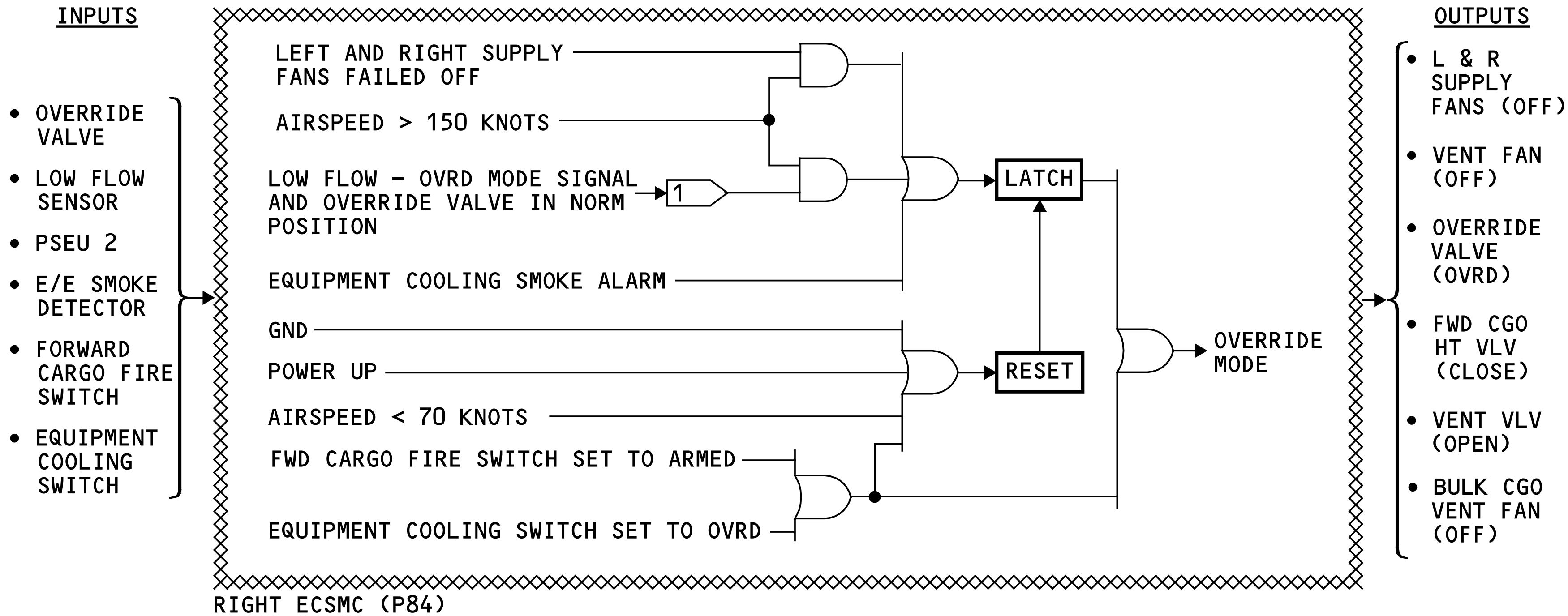
A/C - EQUIPMENT COOLING - FUNCTIONAL DESCRIPTION - OVERRIDE MODE

Override Mode

The override mode causes the forward part of the equipment cooling system to make these changes:

- Both supply fans and the vent fan go to off
- The override valve goes to the OVRD position
- Forward cargo heat valve closes (except for low flow)
- The bulk cargo ventilation fan goes off (only if the equipment cooling switch is in the OVRD position)
- Vent valve opens (except for low flow).

The LOW FLOW - OVRD MODE signal applies only to the supply fans, vent fan, and the override valve.



NOTE: RIGHT ECSMC SHOWN, LEFT SIMILAR.

1 THIS CONDITION APPLIES TO: L & R SUPPLY FANS, VENT FAN, AND OVERRIDE VALVE

21-27-00-027 Rev 4 09/04/96

A/C - EQUIPMENT COOLING - FUNCTIONAL DESCRIPTION - OVERRIDE MODE

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A/C - EQUIPMENT COOLING - FUNCTIONAL DESCRIPTION - CONTROLLER

General

Control logic for the right equipment cooling controller (ECC) is shown; the left is similar.

The right ECC gives control for the supply fans and the override valve. The ECC normally controls the fans and valve with inputs from the right or left ECSMC. The ECC does not use the inputs from the ECSMC if takeover control logic (see below) is true.

Inputs

The right ECC gets control power from the P210 right power management power. The controller gets inputs from these components for takeover control logic and to control the fans and the valve:

- Right ECSMC
- Left ECC, L ECSMC and MEC low flow sensor through the ECC cross talk
- PSEU 2
- Flight deck low flow sensor.

The controller uses the inputs to calculate if it should control the fans and override valve. It can use ECSMC inputs for normal control, or it can takeover control and use ECC fan/valve control logic.

Takeover Control Logic

The ECC takes control away from the ECSMCs when the airplane is in the air and any one of the following sets of conditions occur:

- Both ECSMCs try to control the fans and valve at the same time and both ECCs operate normally
- Left ECC is failed or there is low flow in the MEC supply duct and in the flight deck supply duct and the override valve is in the NORM position for more than 6.5 minutes
- Left ECC is failed or there is low flow in the MEC supply duct and in the flight deck supply duct and the override valve is in the OVRD position for more than 20 minutes.

Once the controller takes control it will not return control to the ECSMCs until the airplane is on the ground.

ECC Fan/Valve Control Logic

The controller uses the ECC fan/valve control logic to make the low flow condition go away. The controller uses a combination of supply fans on/off and override valve positions to do this. There are six combinations (modes). The controller tries each mode for 60 seconds. After 60 seconds the controller will try the next mode. If the low flow goes away the controller stays in that mode. If the low flow condition returns, the controller will select the next mode. After all modes have been tried, the controller starts over with mode 1. These are the six sets of modes:

- Left supply fan off, right supply fan off, and left override valve motor selected to the OVRD position
- Left supply fan off, right supply fan off, and right override valve motor selected to the OVRD position
- Left supply fan on, right supply fan off, and left override valve motor selected to the NORM position
- Left supply fan on, right supply fan off, and right override valve motor selected to the NORM position
- Left supply fan off, right supply fan on, and left override valve motor selected to the NORM position
- Left supply fan off, right supply fan on, and right override valve motor selected to the NORM position.

Outputs

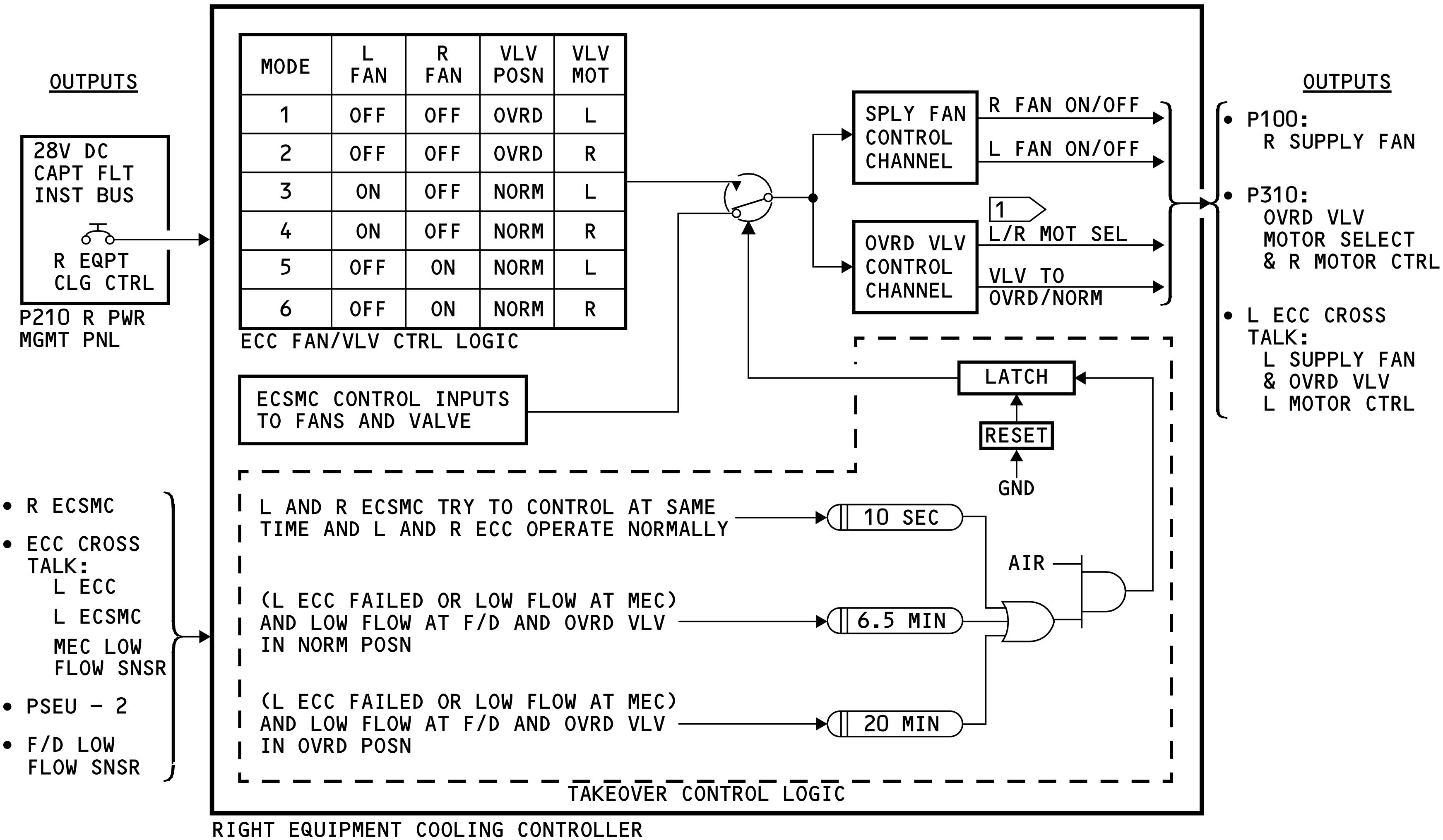
The ECC controls the supply fans and the override valve through separate control channels. The right ECC sends output control signals to these items:

- Right supply fan ON/OFF (through the P100 left power panel)
- Selection of which override valve motor to use (through the P310 standby power management panel)
- Control of the position (OVRD/NORM) of the right motor in the override valve (through the P310 standby power management panel).
- Left supply fan ON/OFF and left motor of the override valve OVRD/NORM position (through the left ECC cross talk)

The left ECC outputs are similar except it does not control which motor of the override valve to use.

Fault Indication

Status messages show if a controller has a malfunction.



NOTE: RIGHT ECC SHOWN, LEFT SIMILAR

1 R ECC ONLY

A/C - EQUIPMENT COOLING - FUNCTIONAL DESCRIPTION - CONTROLLER

21-27-00-019 Rev 3

A/C - EQUIPMENT COOLING - FUNCTIONAL DESCRIPTION - SUPPLY FANS

General

Only one of the two fans operate at a time. The right fan is primary and the left fan is the backup. Each time the airplane gets power, the right ECSMC does a test of the left fan. The right fan is set to off and the left fan is set to on. At the end of the test of the left fan, it is set to off and the right fan is set to on and tested.

The right ECSMC gives primary control of the supply fans when the airplane gets power and the left card gives backup control. When the airplane changes from air to ground, the card in control changes.

Supply Fan Control

The ECSMCs control through the right and left ECCs and the right and left power panels. Either card can control both fans. For example, these signals occur when the right card wants to turn on the left fan:

- Right ECSMC sends FAN ON signal to right ECC
- Right ECC sends FAN ON signal to left ECC (cross talk)
- Left ECC sends FAN ON signal to left power panel
- Left power panel turns on the left fan if no overcurrent condition is detected.

Both cards get information about the left and right fan overheat switches either directly from the fan or from the other card through the ARINC 629 buses.

During ground test the fans operate in the ground test sequence. See the section on equipment cooling - ground test for more information.

During normal conditions, the right fan operates if none of these conditions are true:

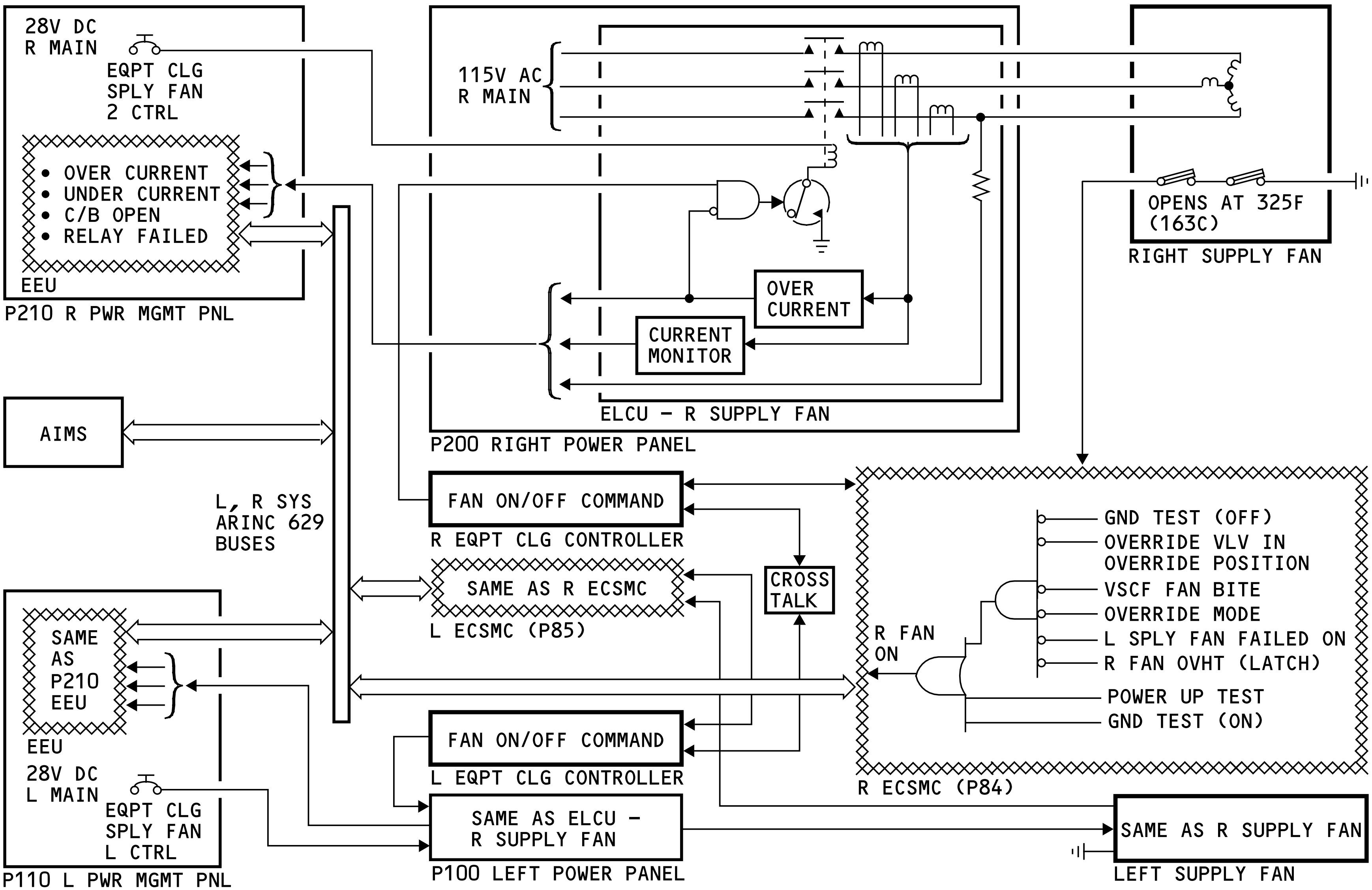
- System commanded to override
- Override valve in the override position
- ELMS detected fault conditions (no power, open circuit breaker, overcurrent, no current, or failed relay)
- Supply fan motor overheat
- Converter supplemental cooling fan (VSCF fan) in test (automatic)
- Ground test - fan off command.

If the right fan stops, the left fan starts automatically.

Fault Indication

Status messages show if a fan or the circuit that controls a fan has a malfunction.

The ECSMCs monitor information from ELMS. This information helps the cards isolate supply fan malfunctions.



A/C - EQUIPMENT COOLING - FUNCTIONAL DESCRIPTION - SUPPLY FANS

A/C - EQUIPMENT COOLING - FUNCTIONAL DESCRIPTION - OVERRIDE VALVE

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A/C - EQUIPMENT COOLING - FUNCTIONAL DESCRIPTION - OVERRIDE VALVE

General

The override valve has two positions: NORM and OVRD. The valve is usually in the NORM position. The override valve has two motors: left and right. Only one motor will operate the valve at a time.

The right ECSMC gives primary control of the override valve when the airplane gets power and the left card gives backup control. When the airplane changes from air to ground, the card in control changes.

Normal Control

The ECSMC controls the primary motor through the left and right equipment cooling controllers and the P310 standby power management panel. Either card can control both motors and can set which motor is primary. For example, these signals occur when the right card wants to set the left motor as primary and make it go to the NORM position:

- The right ECSMC sends L MOTOR PRIMARY and NORM signals to the right ECC
- The right ECC sets the left motor as the primary motor through a relay in the standby power management panel.
- The right ECC sends the NORM signal to left ECC (through cross talk)
- The left ECC sets the override valve to the NORM position through a relay in the standby power management panel
- The standby power management panel gives power so that the left motor moves the valve to NORM.

Limit switches (not shown) in each motor remove power from the motor when the valve gets to the commanded position. The same limit switches give valve position feedback directly to the ECSMCs.

The valve will stay in the NORM position if none of these conditions occur:

- System commanded to override
- Right and left equipment cooling supply fans off
- Ground test command to override.

The override valve relays in P310 standby power management panel are fail safe to make the valve go to the OVRD position. This makes sure the override valve will go the OVRD position if the ECCs or the ECSMCs have a malfunction.

Override Indication

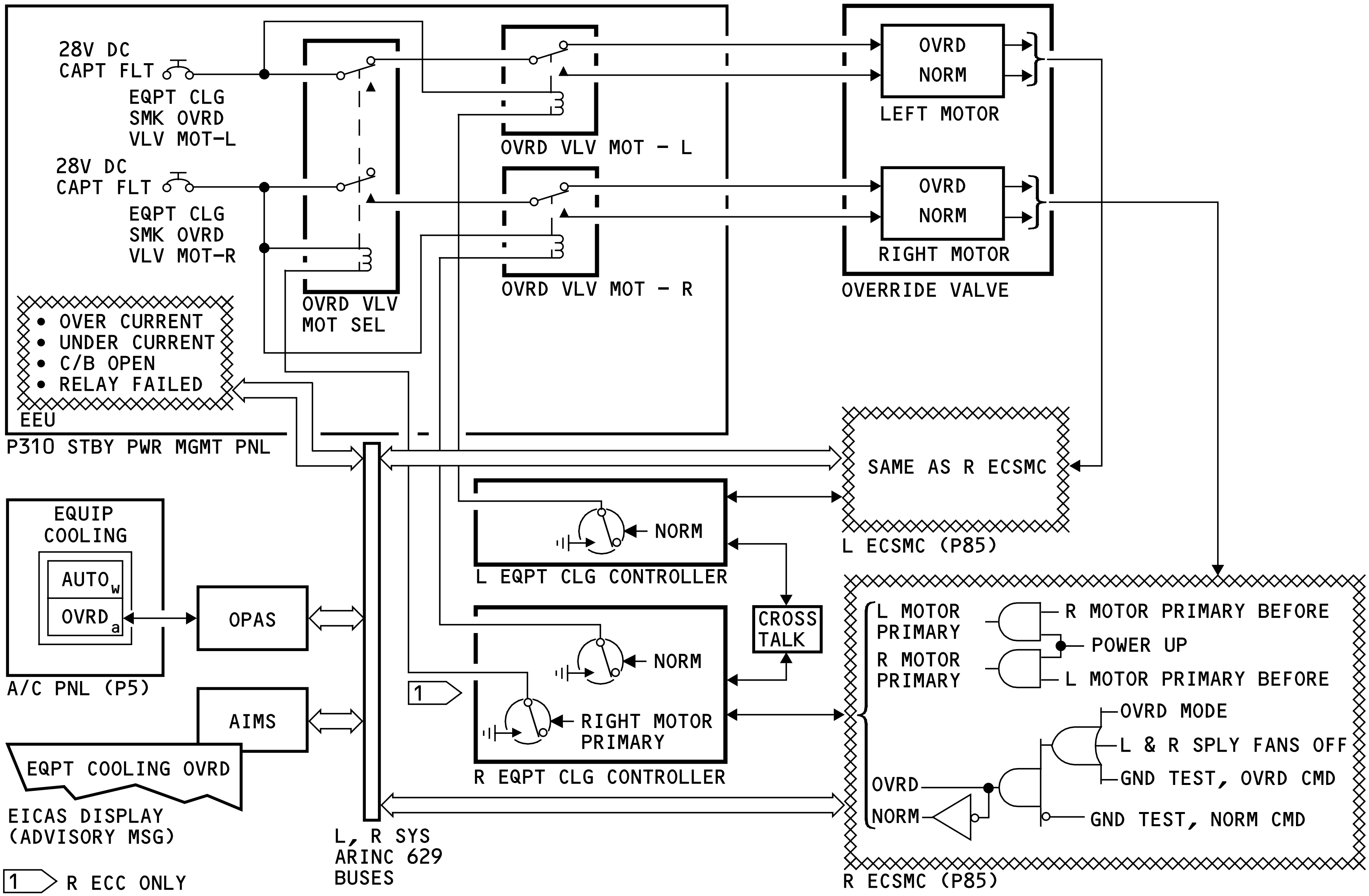
The EQUIP COOLING OVRD advisory message shows and the OVRD light comes on when the equipment cooling override valve is in the OVRD position.

Fault Indication

Status messages show when a motor or the circuit that controls the motor have a malfunction.

A/C - EQUIPMENT COOLING - FUNCTIONAL DESCRIPTION - OVERRIDE VALVE

The ECSMCs monitor information from ELMS. This information helps the ECSMCs isolate malfunctions with the override valve.



A/C - EQUIPMENT COOLING - FUNCTIONAL DESCRIPTION - OVERRIDE VALVE

A/C - EQUIPMENT COOLING - FUNCTIONAL DESCRIPTION - DUCT PRESSURE SENSORS

Functional Description

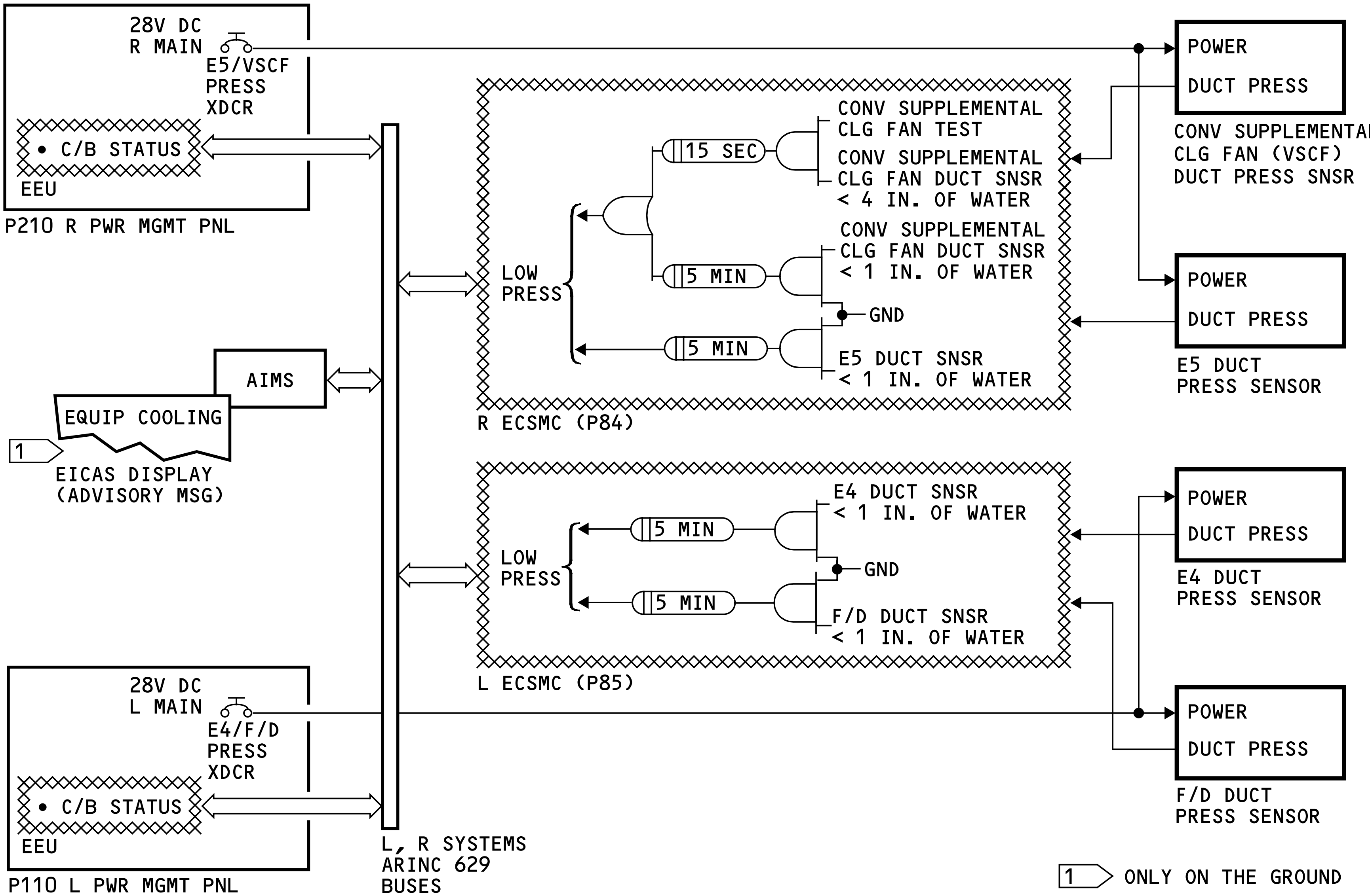
The duct pressure sensors measures the pressure in the equipment cooling ducts. The E5 and converter supplemental cooling fan duct pressure sensors send information to the right ECSMC. The E4 and flight deck duct sensors send information to the left ECSMC. The cards use the low pressure information for indication purposes only.

Low Pressure Indication

The EQUIP COOLING advisory message shows when there is a low pressure condition on the ground for more than five minutes. The advisory message also shows when there is a test of the converter (CONV) supplemental cooling fan and there is a low pressure condition for more than fifteen seconds. There are no flight deck indications for a low pressure condition when the airplane is in the air.

Fault Indication

Status messages show when a sensor has a malfunction.



A/C - EQUIPMENT COOLING - FUNCTIONAL DESCRIPTION - DUCT PRESSURE SENSORS

A/C - EQUIPMENT COOLING - OPERATION

General

An equipment cooling switch lets you set the desired mode of operation for the equipment cooling system.

Automatic Operation

The equipment cooling switch is an alternate-action switch. AUTO shows when you push the switch. This selects automatic operation (normal mode of operation) of the equipment cooling.

The OVRD light comes on when the override valve is in the OVRD position. The system puts the valve in the override position automatically or when the switch is out (non-normal mode of operation). The override mode gives cooling above a sufficient cabin differential pressure when the airplane is above 25,000 feet (7625 meters).

The override mode removes power to the supply and vent fans and sets the override valve to the OVRD position. This lets air vent from the supply part of the system overboard through the override valve. See the OVERRIDE MODE page in this section for more information on the override mode.

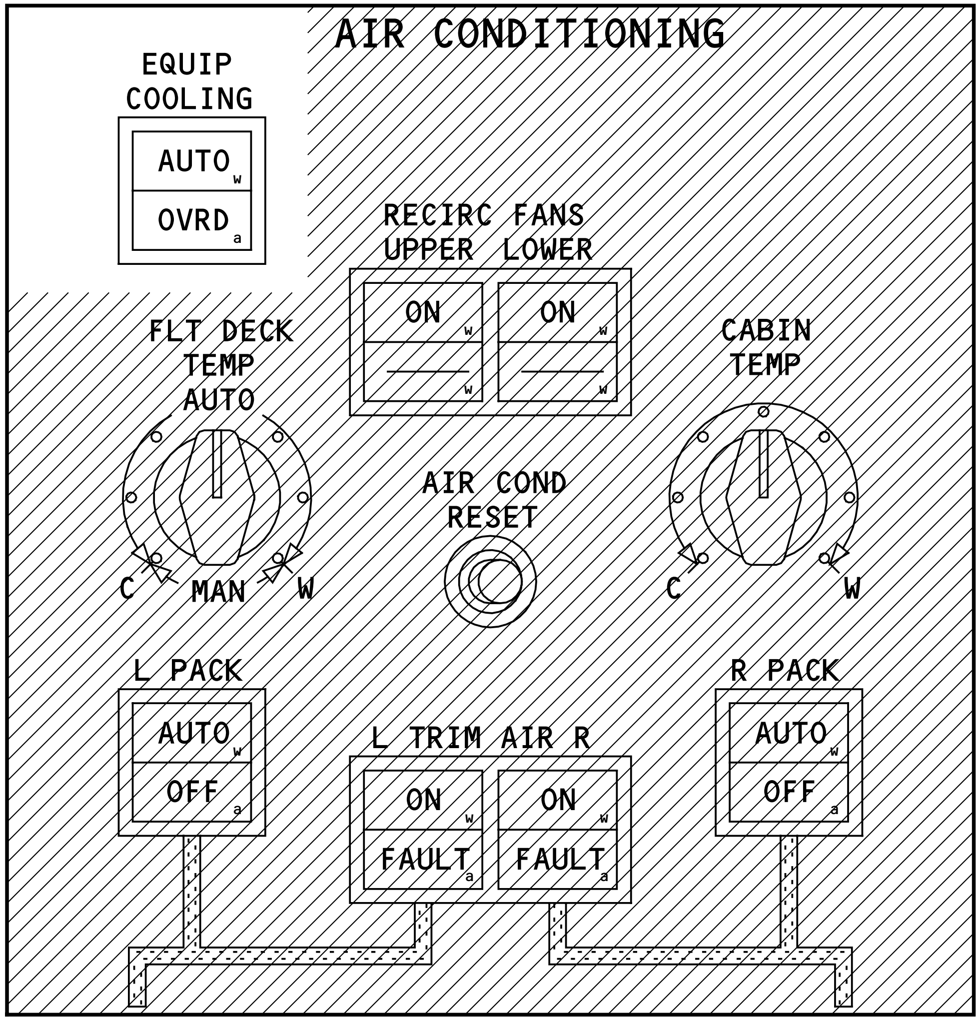
Ground Operation

Operation of the system on the ground normally does not require any inputs from you except to make sure that AUTO is selected.

If ambient temperature is equal to or greater than 110F (43C), you must supply conditioned air to the airplane.

Training Information Point

You can operate the system on the ground with a malfunction of the vent fan as long as ambient temperature is below 86F (30C). If the temperature goes above 86F (30C), then you must supply conditioned air to the airplane.



AIR CONDITIONING PANEL (P5)

21-27-00-028 Rev 1

A/C - EQUIPMENT COOLING - OPERATION

A/C - EQUIPMENT COOLING - IFE - INTRODUCTION

Purpose

The IFE cooling fan and related ducts pull cooling air through the in-flight entertainment (IFE) components in the passenger cabin. An IFE cooling smoke detector monitors for smoke in the air from the IFE components.

Location

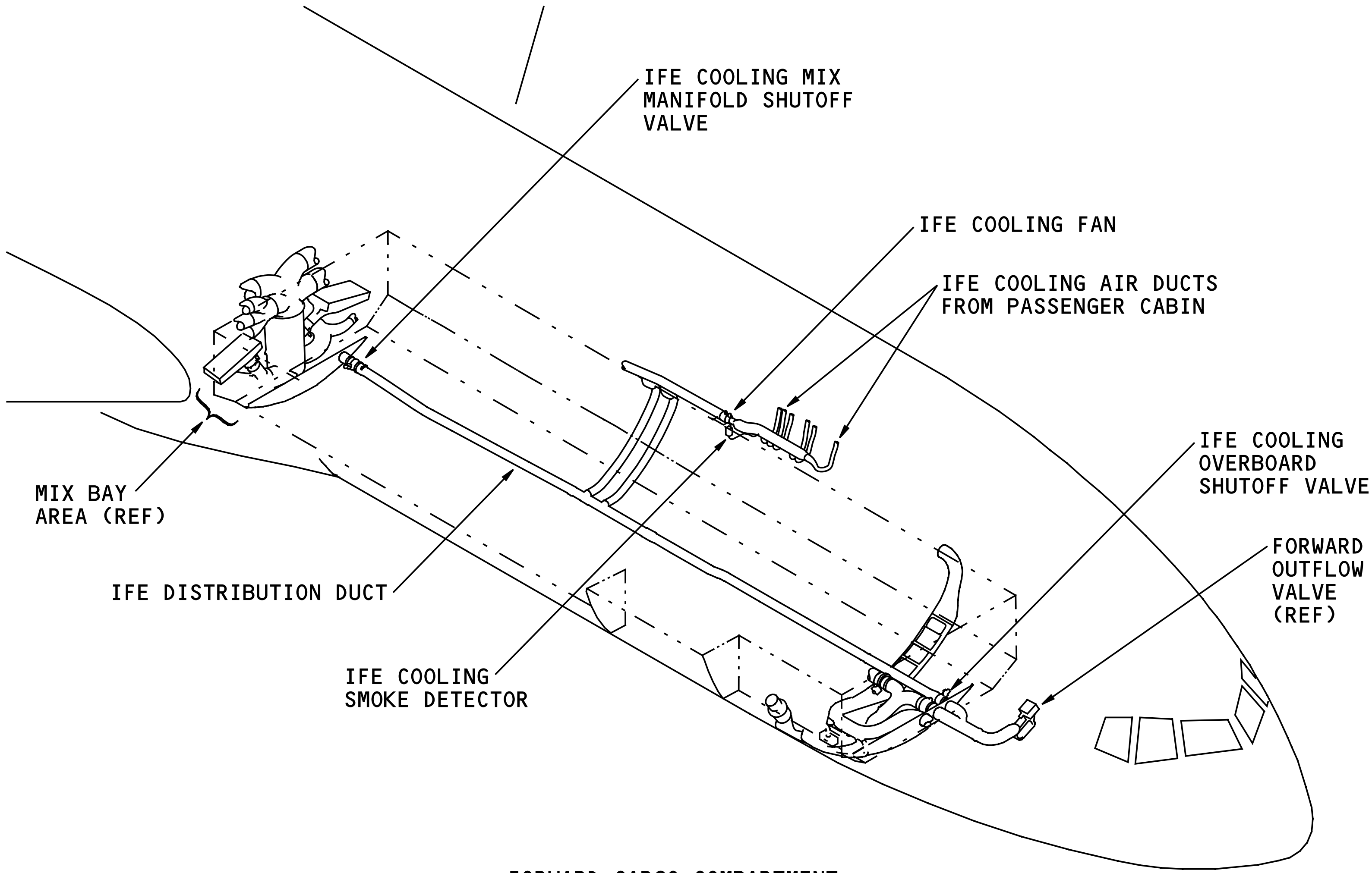
The IFE cooling fan is outboard of the forward cargo compartment sidewall on the left side. The IFE cooling smoke detector is adjacent to the fan at the same location.

Six small ducts connect the IFE components in the passenger cabin to the fan. These ducts are forward of the fan.

Two larger ducts aft of the fan connect it to a distribution duct under the cargo floor. This distribution duct goes forward and aft to shutoff valves at each end of the forward cargo compartment.

The IFE cooling overboard shutoff valve is at the front of the forward cargo compartment. It connects the distribution duct to the MEC.

The IFE cooling mix manifold shutoff valve is at the back of the forward cargo compartment. It connects the distribution duct to the mix bay area.



FORWARD CARGO COMPARTMENT
(TYPICAL)

21-27-00-033 Rev 0 04/23/1997

A/C - EQUIPMENT COOLING - IFE - INTRODUCTION

A/C - EQUIPMENT COOLING - IFE - GENERAL DESCRIPTION

General

The IFE cooling fan pulls cooling air through IFE components in the passenger cabin. ELMS opens the IFE cooling overboard shutoff valve to let air go forward to the MEC. ELMS opens the IFE cooling mix manifold shutoff valve to let air go aft to the mix bay area.

The ECS miscellaneous cards (ECSMC) give data to ELMS for operation of the fan and control of the valves. Fan overheat and valve position indications go directly to the ECSMCs. The ECSMCs gets these other inputs for control logic:

- OPAS, forward cargo arm
- AIMS, engine off or engine starting
- AGS, airplane on ground.

The mix manifold shutoff valve is open for these conditions:

- Overboard shutoff valve failed closed
- One or two engines on
- Engine start on ground
- Test.

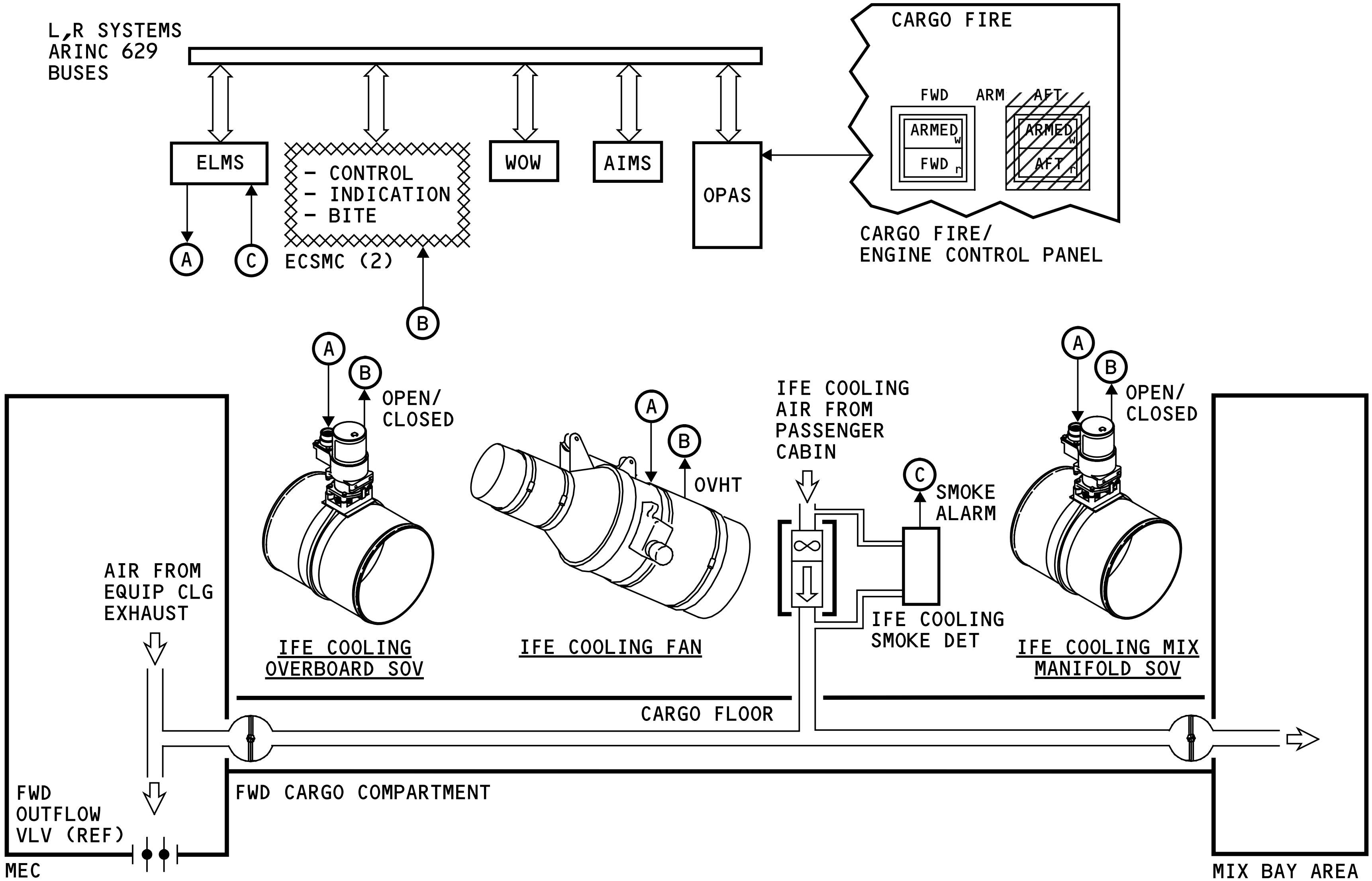
The overboard shutoff valve is open if all of these conditions are true:

- Engines off or mix manifold shutoff valve closed
- No engine start on ground
- Test.

An IFE cooling smoke detector monitors the cooling air at the fan. The smoke detector gives a smoke alarm indication to ELMS if it finds smoke in the air. For a smoke condition, ELMS does these things:

- Removes power from the IFE components
- Turns off the IFE cooling fan
- Closes the two shutoff valves.

No EICAS or CSCP/CACP indications show for IFE cooling air smoke.



A/C - EQUIPMENT COOLING - IFE - GENERAL DESCRIPTION

21-27-00-034 Rev 0 04/23/1997

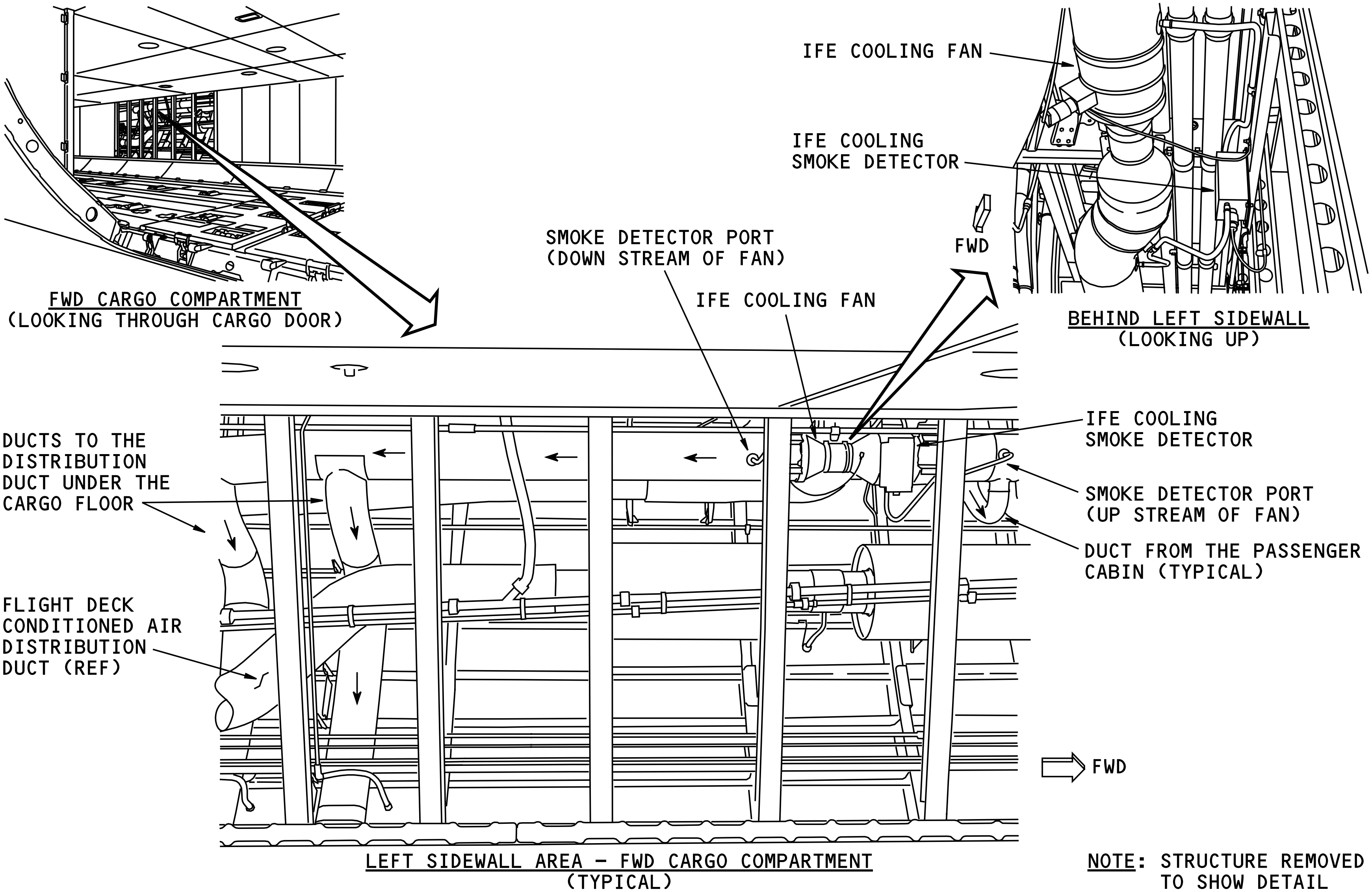
A/C - EQUIPMENT COOLING - IFE - COOLING FAN AND SMOKE DETECTOR

General

The IFE cooling fan and IFE cooling smoke detector are behind the left side wall in the forward cargo compartment. The smoke detector attaches to structure that holds the side wall panel on.

Cooling air from the IFE components in the passenger cabin comes through six small ducts forward of the fan. The smoke detector has ports that connect forward and aft of the fan.

Air that comes from the fan goes through two ducts that connect to a distribution duct under the cargo floor.



A/C - EQUIPMENT COOLING - IFE - COOLING FAN AND SMOKE DETECTOR

A/C - EQUIPMENT COOLING - IFE - SHUTOFF VALVES

Purpose

These are the two IFE cooling shutoff valves:

- IFE cooling overboard shutoff valve
- IFE cooling mix manifold shutoff valve.

The IFE cooling overboard shutoff valve lets IFE cooling air go forward from the distribution duct to the forward outflow valve.

The IFE cooling mix manifold shutoff valve lets IFE cooling air go aft from the distribution duct to the mix bay area.

The valves operate electrically.

Physical Description

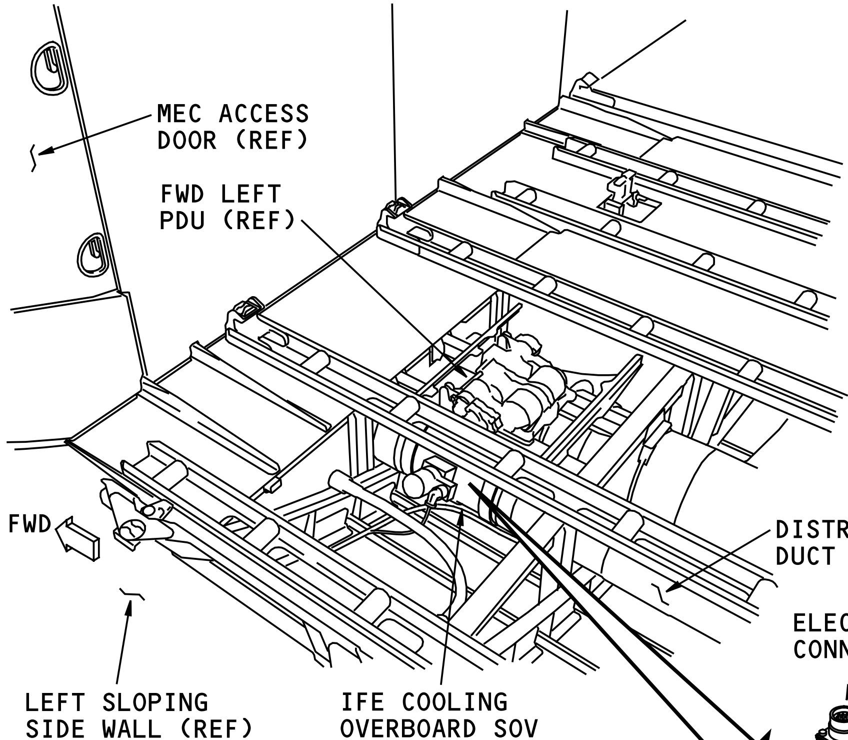
The two valves are interchangeable. They have these components:

- Valve body
- Electrical connector
- Motor
- Position indicator/manual override lever
- Valve disc.

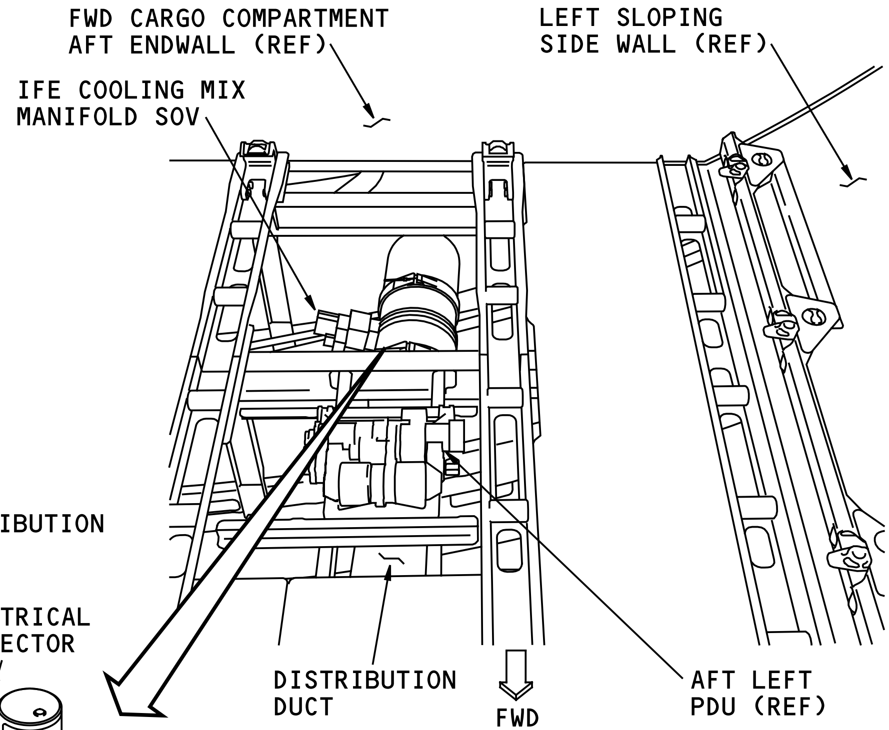
The diameter of the valve body is seven inches (17.8 cm).

Location

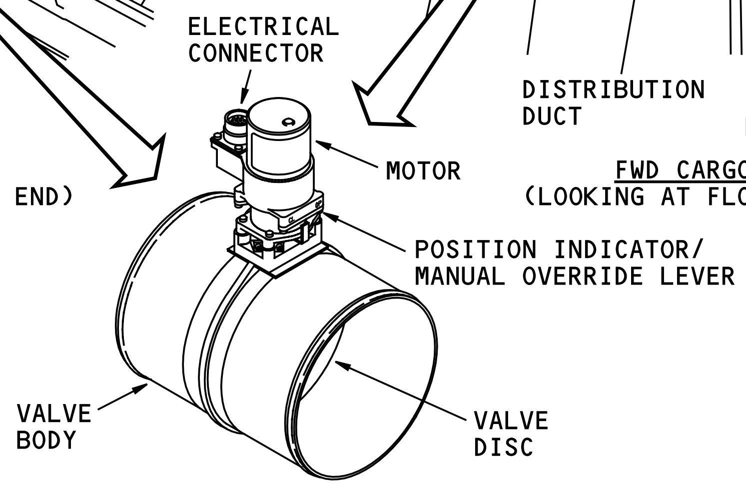
These valves are under the floor at each end of the forward cargo compartment.



FWD CARGO COMPARTMENT
(LOOKING AT FLOOR AREA - FWD END)



FWD CARGO COMPARTMENT
(LOOKING AT FLOOR AREA - AFT END)



IFE COOLING SHUTOFF VALVE
(TYPICAL)

A/C - EQUIPMENT COOLING - IFE - SHUTOFF VALVES

21-27-00-036 Rev 0 04/23/1997

A/C - EQUIPMENT COOLING - IFE - FUNCTIONAL DESCRIPTION

General

The 28v dc left main bus supplies power to the IFE cooling overboard shutoff valve. The 28v dc right main bus supplies power to the IFE cooling mix manifold shutoff valve. These valves function in the same way.

The ECS miscellaneous card (ECSMC) in control sends data to ELMS to open the valves. ELMS closes the valves if the ECSMC sends no open signal. Each ECSMC has logic for valve control.

In the fully closed or fully open position, switches in the valves send valve position to the related ECSMC. The IFE cooling overboard shutoff valve sends position indications to the left ECSMC. The IFE cooling mix manifold shutoff valve sends position indications to the right ECSMC.

The 115v ac left main section 2 bus supplies power to the IFE cooling fan. The ECSMC in control sends data to ELMS to turn on the fan. Each ECSMC has logic to control the fan. The fan sends an overheat indication to the left ECSMC. The EICAS status message IFE COOLING FAN shows for an overheat condition of the fan.

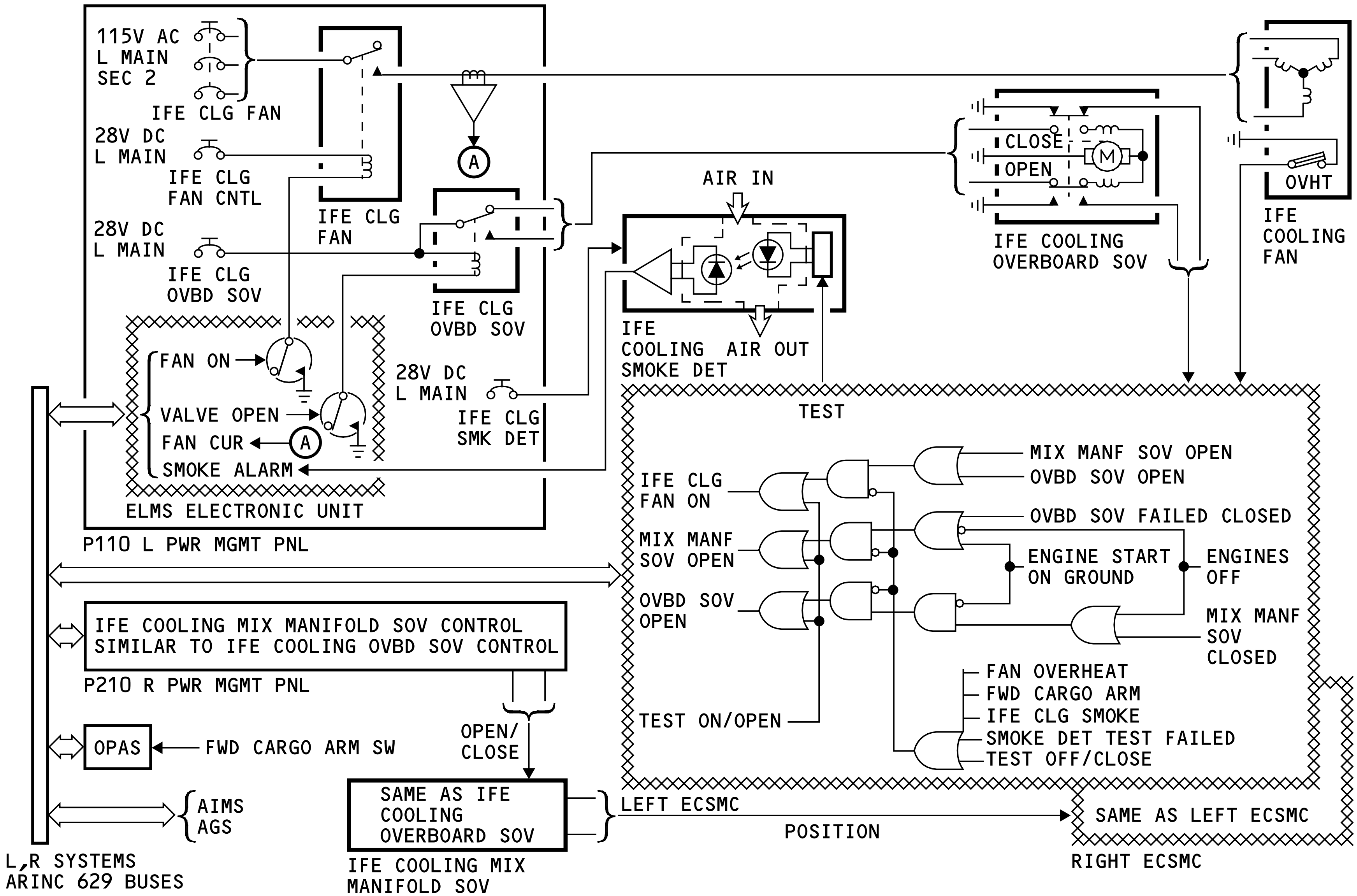
The 28v dc left main bus supplies power to the IFE smoke detector. The smoke detector monitors the opacity of the IFE cooling air that goes through it. It gives an alarm to ELMS if smoke is in the air. ELMS latches off the power to the IFE components if this occurs. No EICAS or CSCP/CACP indications show for IFE cooling air smoke.

The ECSMC in control turns off the fan and closes the two shutoff valves for these conditions:

- Cooling fan overheat
- Forward cargo arm
- IFE cooling smoke found
- IFE cooling smoke detector test failed
- IFE cooling system test.

Test

The ECSMC in control does a power-up test of the IFE cooling system. This test does a check to find if the control logic can operate the fan and two shutoff valves. This test also does a check of the operation of the smoke detector. You can do a ground test of the IFE cooling system from the maintenance access terminal, 21 ENVIRONMENTAL CONTROL SYSTEM, SYSTEM TEST, IFE COOLING SYSTEM. The EICAS status message IFE SMOKE DETECTOR shows if the power-up or ground test finds a smoke detector malfunction. No EICAS messages show if the power-up or ground test finds a fan or valve malfunction.



A/C - EQUIPMENT COOLING - IFE - FUNCTIONAL DESCRIPTION

21-27-00-037 Rev 0 04/23/1997

A/C - EQUIPMENT COOLING - GROUND TESTS

General

You select the equipment cooling ground tests from ATA 21 Environmental Control System.

Equipment Cooling

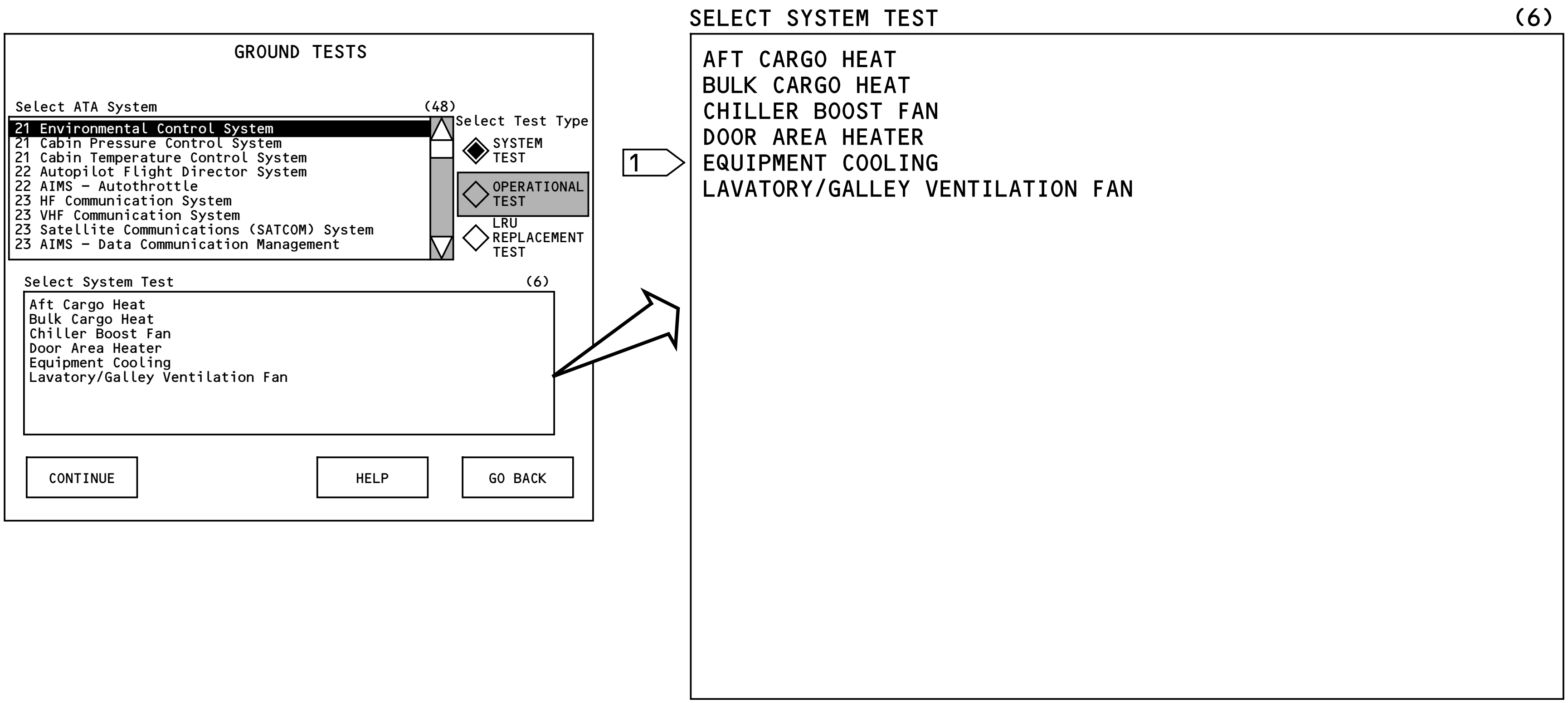
This test makes sure that these equipment cooling LRU installations are correct:

- Sensors
- Valves
- Fans.

The test takes approximately 2-5 minutes.

This test shows for these ground test types:

- System test
- LRU replacement test.



NOTE: SYSTEM TESTS SHOW.
LRU REPLACEMENT TESTS ARE THE SAME.

1 THIS IS THE AIR CONDITIONING - EQUIPMENT COOLING TEST.

21-27-00-032 Rev 2 08/17/96

A/C - EQUIPMENT COOLING - GROUND TESTS

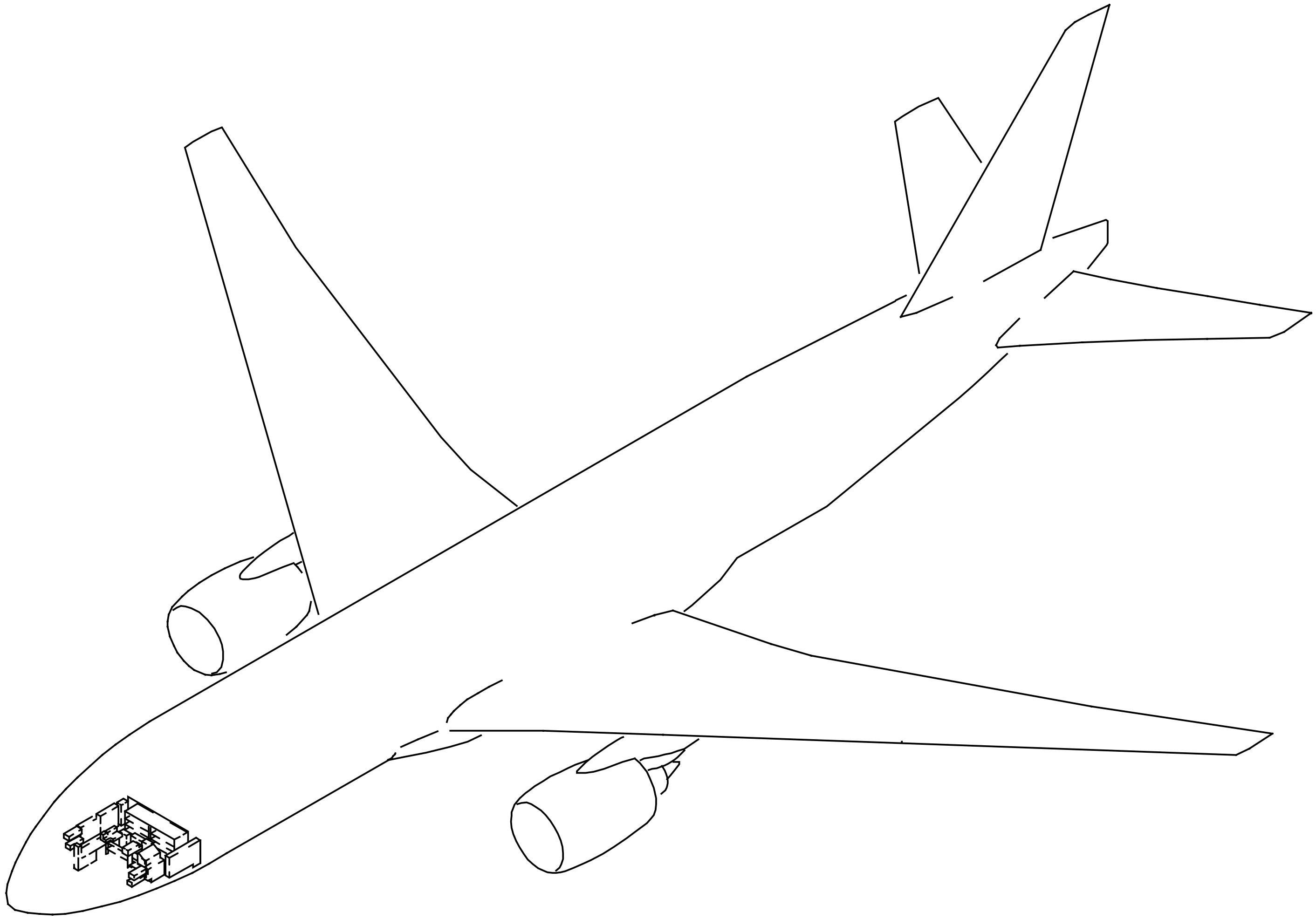
ELECTRICAL/ELECTRONIC (E/E) COOLING SMOKE DETECTION - INTRODUCTION

Purpose

The electrical/electronic cooling smoke detection system monitors the forward equipment cooling system airflow for smoke.

General

The the smoke detection system has an interface with the equipment cooling system. If there is smoke in the equipment cooling system supply or exhaust, the system operates in the override mode. This removes the smoke from the airplane.



ELECTRICAL/ELECTRONIC (E/E) COOLING SMOKE DETECTION - INTRODUCTION

E/E COOLING SMOKE DETECTION - GENERAL DESCRIPTION

General

The electrical/electronic (E/E) cooling smoke detector monitors air from the supply and exhaust parts of the forward equipment cooling system. If the detector finds smoke in the air, the equipment cooling system goes into the override mode. When the airplane is pressurized, cabin differential pressure causes the smoke to go overboard.

Interfaces

The E/E cooling smoke detector has interfaces with the AIMS and the ECS miscellaneous cards (ECSMCs) through the forward cargo smoke detector and the ASG cards.

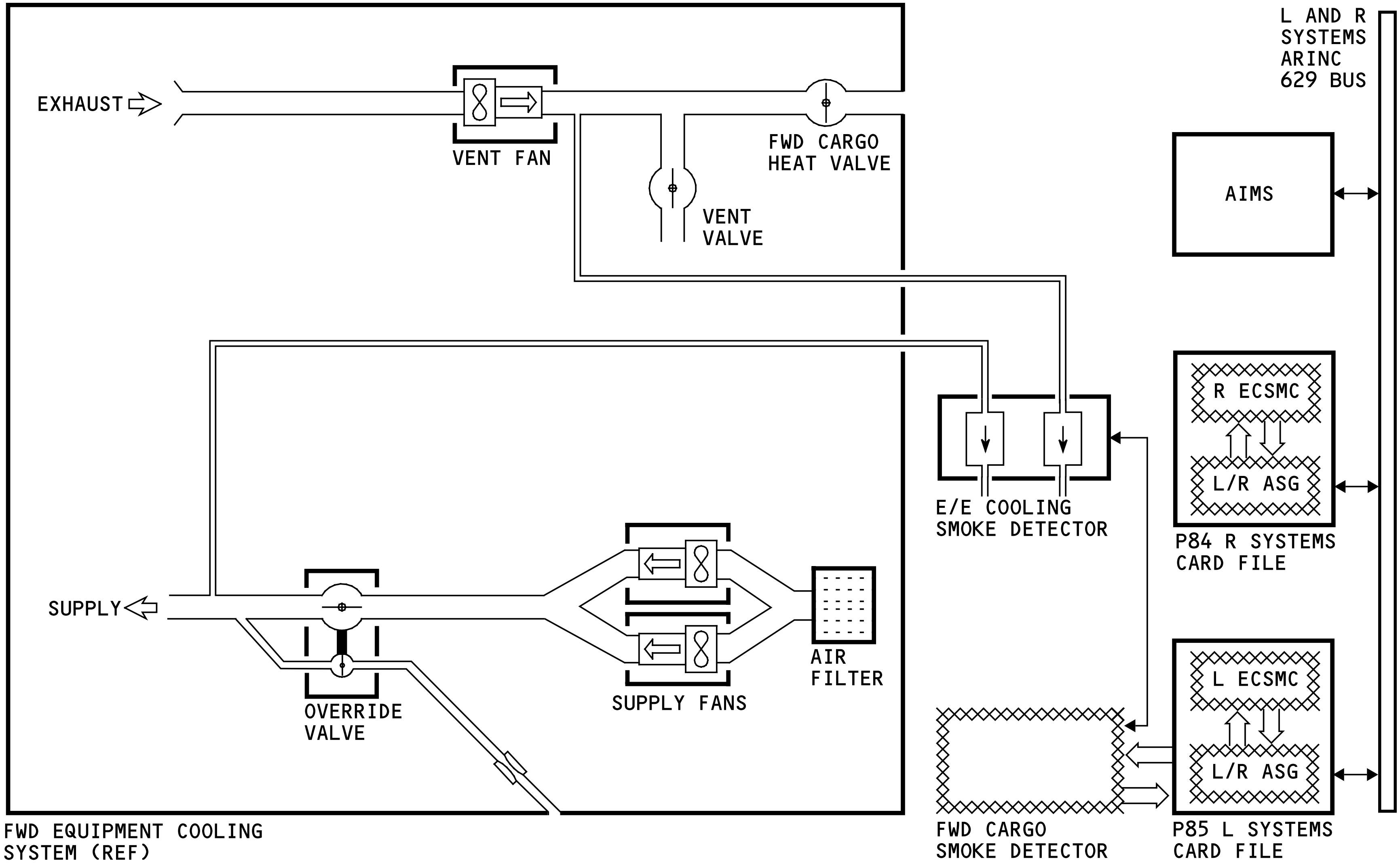
The forward cargo smoke detector controls the E/E cooling smoke detector, supplies electrical power to it, and gets smoke alarms from it.

General Operation

If there is smoke in the equipment cooling airflow, the E/E cooling smoke detector sends an alarm signal to the forward cargo smoke detector. The forward cargo smoke detector sends alarm data to the systems card files. In the card files, the alarm data goes to the ECSMCs. The ECSMC that is in control of the equipment cooling system puts the system into the override mode.

System Tests

The E/E cooling smoke detector has BITE. Fault data goes to the forward cargo smoke detector, to the left systems card file, then to the AIMS. Faults cause EICAS status messages.



E/E COOLING SMOKE DETECTION - GENERAL DESCRIPTION

E/E COOLING SMOKE DETECTION - E/E COOLING SMOKE DETECTOR - INTRODUCTION

Purpose

The E/E cooling smoke detector monitors air in the forward equipment cooling system for smoke.

Physical Description

The E/E cooling smoke detector has these components:

- Two air inlet ports
- Four mounting brackets
- Two smoke detection chambers (internal)
- Two electronic control channels (internal)
- Two air outlet ports
- Two electrical connectors.

Location

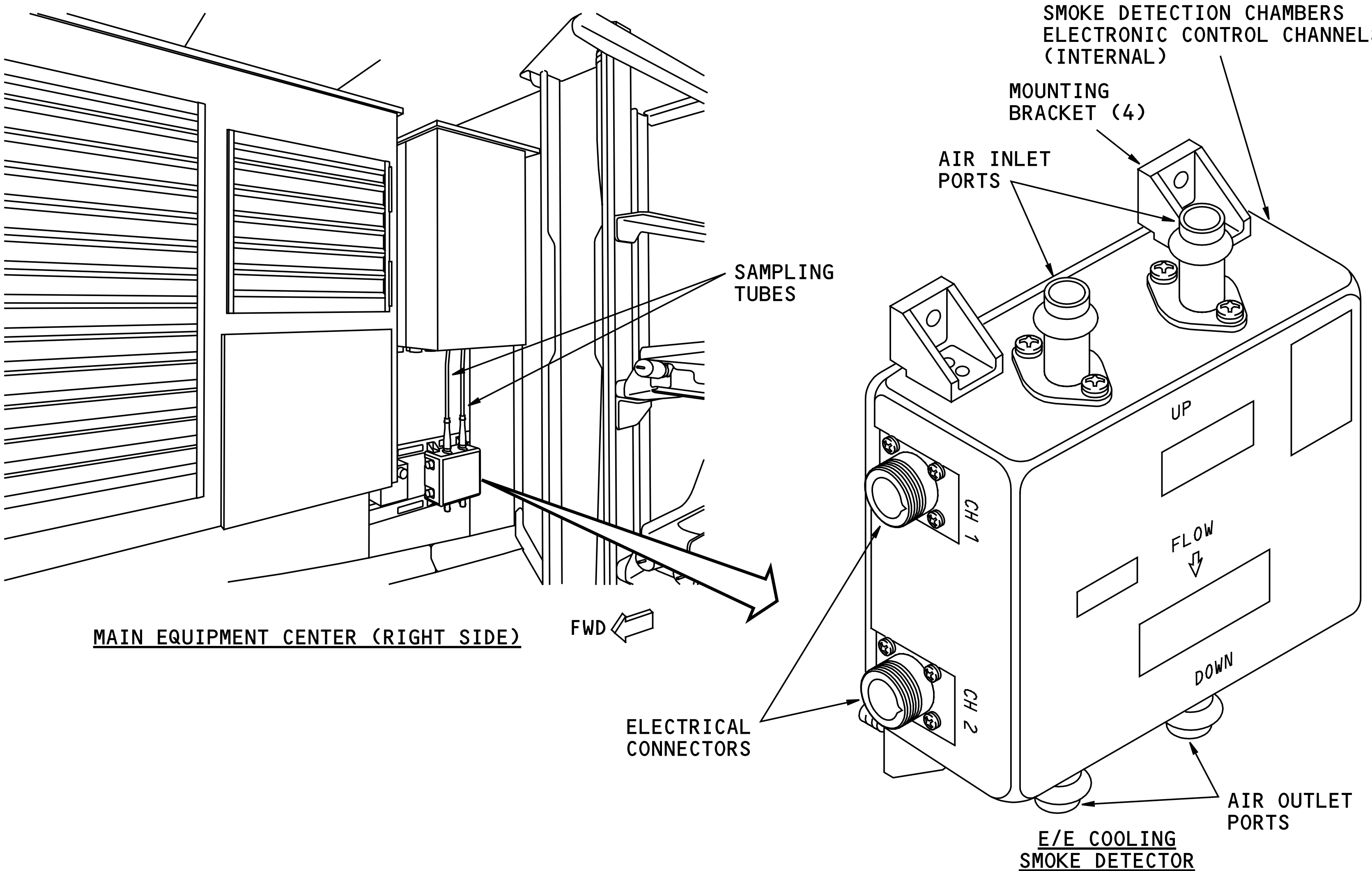
The E/E cooling smoke detector is on the right side of the main equipment center, outboard of the E2 rack.

Training Information Point

There is no scheduled maintenance of the E/E cooling smoke detector. Status and maintenance messages show if there is a fault condition.

The smoke detector is an LRU. Four bolts attach the smoke detector to the structure. Two sampling tubes connect to the air inlet ports. The sampling tubes are made of aluminum and attached to the structure with clamps. This makes it difficult to connect them to the wrong inlet ports on the detector. Each smoke detector channel has its own electrical connector. The two connectors are different so you cannot cross-connect the wires.

The smoke detector has no internal LRUs.



26-19-00-004 Rev 0

E/E COOLING SMOKE DETECTION - E/E COOLING SMOKE DETECTOR - INTRODUCTION

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E/E COOLING SMOKE DETECTION - E/E COOLING SMOKE DETECTOR - FUNCTIONAL DESCRIPTION

General

The two channels contain identical circuits. The forward cargo smoke detector makes a decision about which channel operates. The operating channel monitors the optical smoke detectors.

Optical Smoke Detectors

The optical smoke detector has these parts:

- Two source light emitting diodes (LEDs)
- Two intensity monitor photodiodes
- Two scatter detector photodiodes.

One set of diodes connects to channel 1. The other set of diodes connects to channel 2.

Inside the smoke detection chamber, air flows between a source LED and a scatter detector photodiode. Normally, only a small amount of light from the lED reaches the scatter detector. If the air has smoke in it, the smoke particles reflect more light onto the scatter detector. This causes a smoke alarm signal.

The intensity monitor photodiode makes sure the source LED is on and keeps the output of the source LED constant. This configuration also finds contamination of the LED and photodiodes.

BITE

The detector does power-up and periodic BITE tests. The power-up BITE includes these tests:

- Supply voltage
- Source LED intensity
- Optical contamination
- Scatter detector operation.

The periodic BITE test monitors the source LED intensity and the scatter detector operation.

If the operating channel fails, BITE sends a signal to the forward cargo smoke detector. That smoke detector causes the other E/E cooling smoke detector channel to operate.

Inputs And Outputs

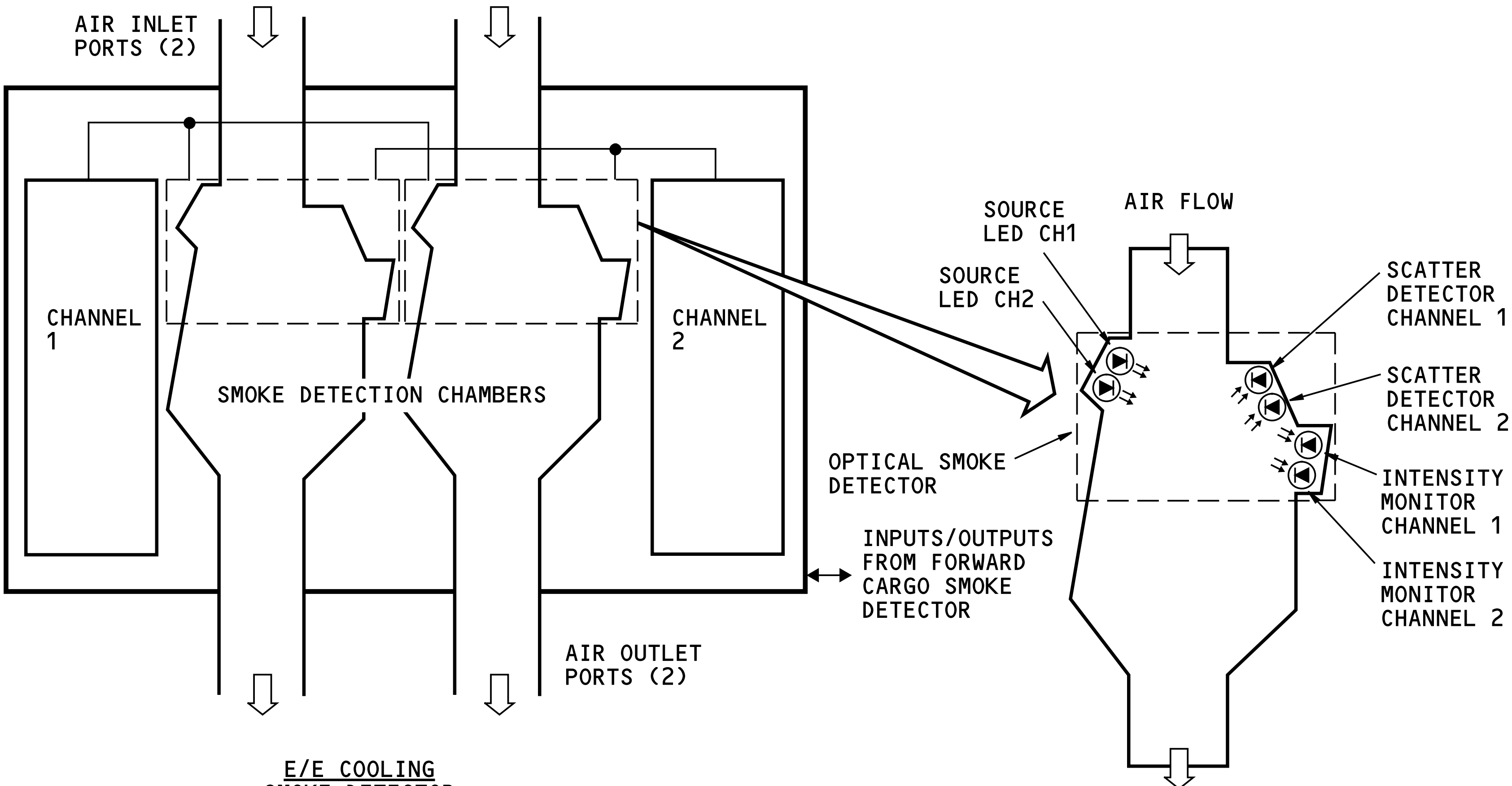
The smoke detector gets these inputs from the forward cargo smoke detector:

- 10.5v dc power
- LED 1 and 2 on/off

The smoke detector sends these outputs to the forward cargo smoke detector:

- Smoke alarm, chamber 1, channel 1
- Smoke alarm, chamber 2, channel 1
- Smoke alarm, chamber 1, channel 2
- Smoke alarm, chamber 2, channel 2

- Channel 1 BITE test pass/fail
- Channel 2 BITE test pass/fail.



E/E COOLING
SMOKE DETECTOR

SMOKE DETECTION
CHAMBER DETAIL

26-19-00-005 Rev 0

E/E COOLING SMOKE DETECTION - E/E COOLING SMOKE DETECTOR - FUNCTIONAL DESCRIPTION

E/E COOLING SMOKE DETECTION - FUNCTIONAL DESCRIPTION

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E/E COOLING SMOKE DETECTION - FUNCTIONAL DESCRIPTION

General

The E/E cooling smoke detector connects to the forward lower cargo smoke detector. The cargo smoke detector has two identical electronic channels. Channel 1 controls during one electrical power cycle, channel 2 controls during the next power cycle.

Each channel of the E/E cooling smoke detector connects to the related channel in the forward lower cargo smoke detector. The E/E cooling smoke detector gets these inputs from the cargo smoke detector control channel:

- DC power
- LED 1 and 2 on/off signals.

The E/E cooling smoke detector sends these outputs to the Lower cargo smoke detector control channel:

- Alarm 1 (smoke in detection chamber 1
- Alarm 2 (smoke in detection chamber 2)
- BITE pass/fail.

Smoke Detection

If there is smoke in one or two detection chambers, the E/E cooling smoke detector sends an alarm signal to the forward cargo smoke detector. The forward cargo smoke detector sends the alarm signal through the ARINC 429 bus to the ASG cards and left ECS miscellaneous card. The ASG cards transmit the alarm signal over the ARINC 629 buses to these systems and components:

- Overhead panel ARINC 629 system (OPAS)
- AIMS
- Right systems cardfile.

The OPAS makes a ground to turn on the E/E cooling override light. The AIMS causes a status message to show. The central maintenance computing function records the event as a flight deck effect for the in-bound flight. In the right systems cardfile, the ASG cards send the alarm signal to the right ECS miscellaneous card. The ECS miscellaneous cards put the equipment cooling system into the override mode. This sends the smoke overboard.

BITE

The forward cargo smoke detector controls the BITE circuits in the E/E cooling smoke detector. BITE tests occur when the system first gets power and regularly during operation. If the E/E cooling smoke detector fails a BITE test, it sends a BITE fail signal to the cargo smoke detector. The signal causes these things to occur:

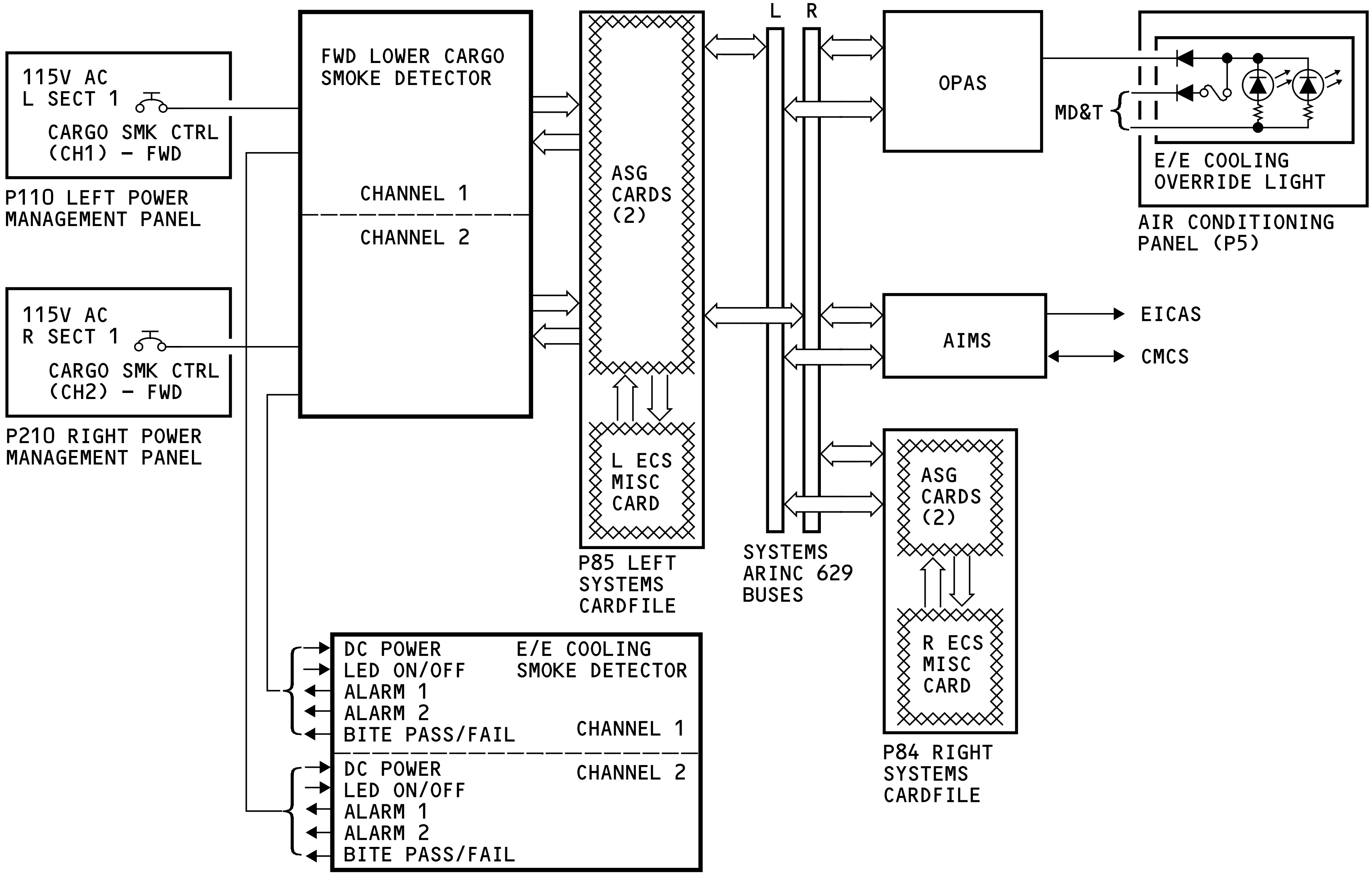
- The cargo smoke detector operates the other channel in the E/E cooling smoke detector
- The cargo smoke detector puts the fault data in memory
- The cargo smoke detector sends the fault information to the AIMS. The CMCS shows status and maintenance messages.

E/E COOLING SMOKE DETECTION - FUNCTIONAL DESCRIPTION

You can do a test of the system from the MAT. AIMS tells the cargo smoke detector to do a power-up BIT sequence.

Training Information Point

Use the MAT to get E/E cooling smoke detector fault data from the cargo smoke detector memory.



26-19-00-006 Rev 0

E/E COOLING SMOKE DETECTION - FUNCTIONAL DESCRIPTION

Continental Airlines, Inc

Pressurization

WB371

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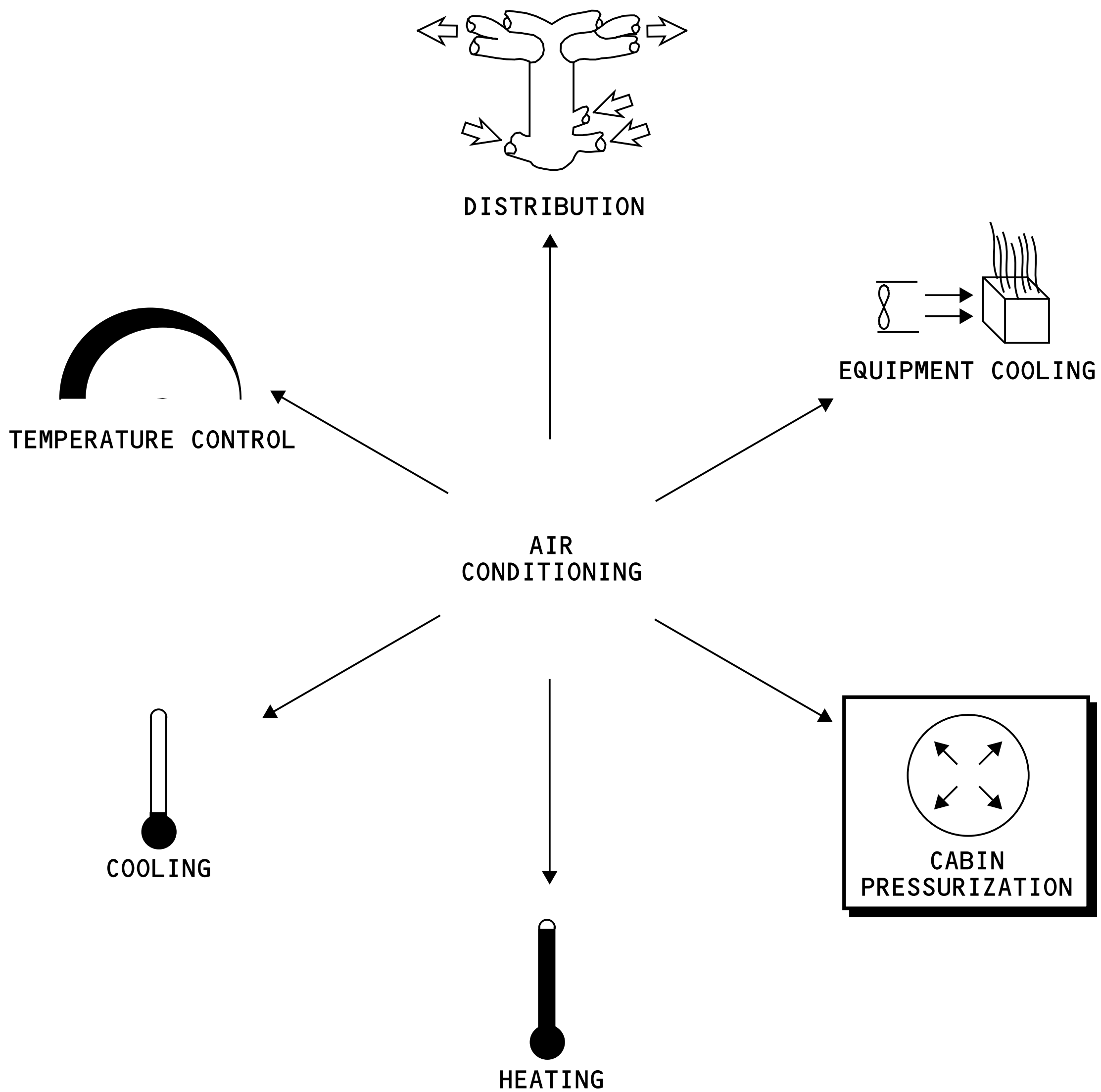
Purpose

The cabin pressurization system controls cabin altitude and protects the fuselage structure against internal and external overpressurization.

Abbreviations and Acronyms

actr	- actuator
ADIRS	- air data inertial reference system
ADIRU	- air data inertial reference unit
AFDS	- autopilot flight director system
AGS	- air/ground system
AIMS	- airplane information management system
alt	- altitude
ARINC	- Aeronautical Radio, Inc.
ASCPC	- air supply cabin pressure controller
auto	- automatic
brk	- brake
capt	- captain
CMCF	- central maintenance computing function
decr	- decrease
ECS	- environmental control system
EEC	- electronic engine control
EFIS	- electronic flight instrument system
elex	- electronics
ELMS	- electrical load management system
F/O	- first officer
flt	- flight
FMCF	- flight management computing function
fwd	- forward
incr	- increase
ldg	- landing
man	- manual
max	- maximum
mgmt	- management
MFD	- multi-function display
ofv	- outflow
OPAS	- overhead panel ARINC 629 system
PDF	- primary display function
pnl	- panel
pos	- position
press	- pressure
PSI	- pounds per square inch
pwr	- power
RVDT	- rotary variable differential transformer
sol	- solenoid
snsr	- sensor
stby	- standby
VCU	- valve control unit
vlv	- valve
WOW	- weight-on-wheels



AIR CONDITIONING - PRESSURIZATION - INTRODUCTION

AIR CONDITIONING - PRESSURIZATION - GENERAL DESCRIPTION

General

There are two parts that have a relation to the pressurization system: cabin pressure control and cabin pressure relief.

The cabin pressure control system controls the amount of air that flows out of the airplane. This keeps the cabin air pressure in limits at altitude.

The cabin pressure relief system keeps the internal pressure of the airplane to a limit.

The pneumatic system usually supplies more than a sufficient quantity of air through the air conditioning packs to pressurize the airplane. Outflow valves in the forward and aft areas of the airplane control the amount of air that goes out of the airplane. This keeps the cabin air pressure within limits.

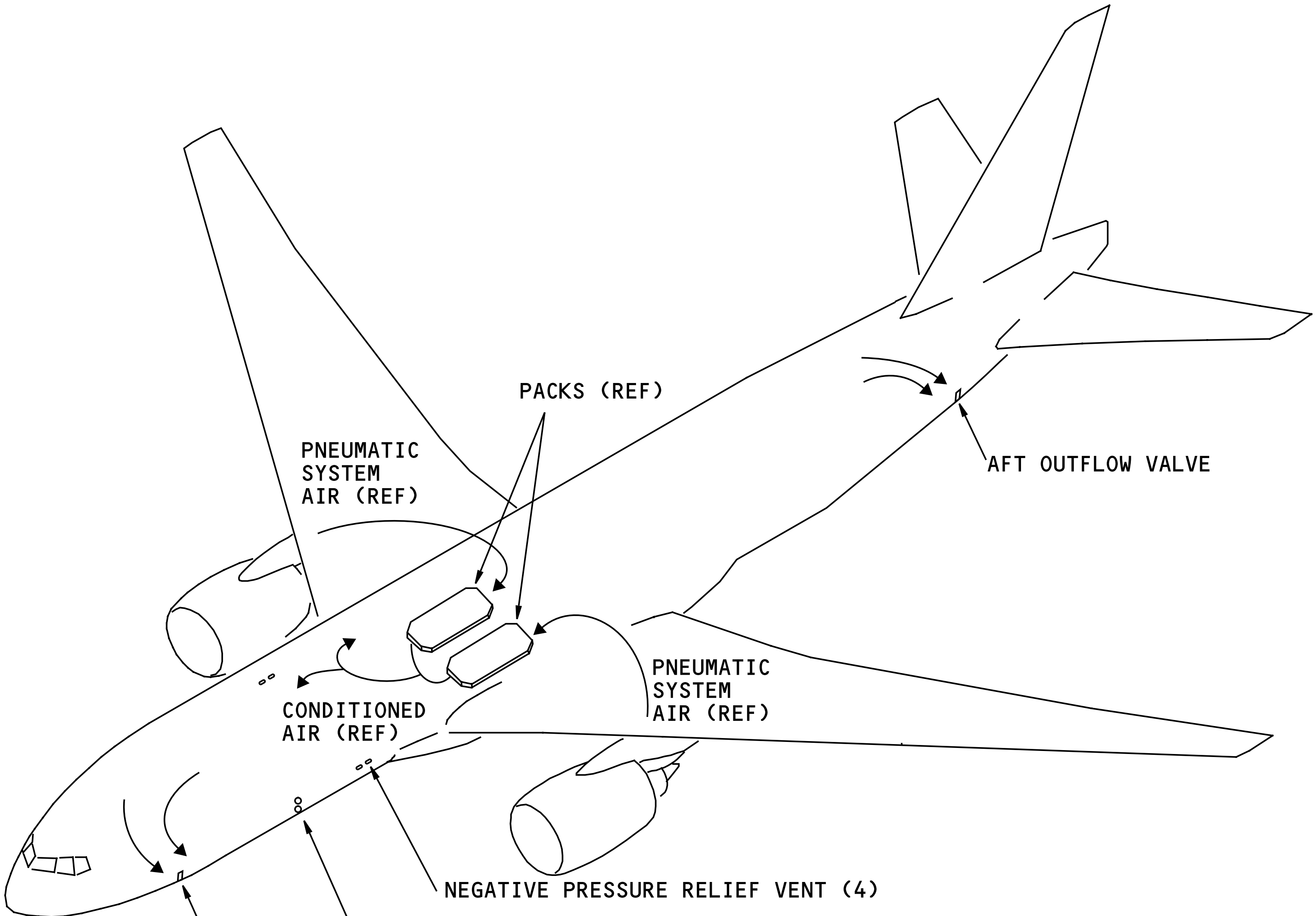
Outflow Valves

The flight crew sets automatic or manual control for one or both of the outflow valves from the flight deck. In the automatic mode, the usual position of the valves is controlled so that they are not the same. Valve position is set so that 20 percent of the total air outflow goes through the forward valve and 80 percent goes through the aft valve.

In the manual mode, the flight crew controls the position of one or both of the valves.

Pressure Relief

Positive pressure relief valves and negative pressure relief vents, in the forward part of the airplane keep the difference between cabin pressure and ambient pressure in limits.



AIR CONDITIONING - PRESSURIZATION - GENERAL DESCRIPTION

21-30-00-002 Rev 3 11/02/95

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Purpose

The cabin pressure control system controls the amount of air that flows out of the airplane. This keeps the cabin air pressure in limits at all airplane operating altitudes (-2,000 through 43,100 feet, -610 through 13,146 meters).

Physical Description

The cabin pressure control system has these components:

- One remote cabin pressure sensor
- Flight deck controls
- Two outflow valves.

Interfaces

The air supply cabin pressure controllers (ASCPCs) provide control, indications, and bit for this system. The controllers also have an internal sensor that they use to monitor cabin pressure. The sensor is used for control and to give an output on the ARINC 629 buses. The ASCPCs are part of the engine air supply system. See the engine air supply section for more information about the ASCPC interfaces related to cabin pressure control (AMM PART I 36-11).

The remote cabin pressure sensor sends data to the AIMS, the ASCPCs, and ELMS. AIMS uses the remote sensor data as an alternative to the ASCPC cabin pressure data.

The ASCPCs use the remote cabin pressure sensor to cross check data from there internal cabin pressure sensor.

ELMS sends the remote cabin pressure sensor data on the ARINC system buses. ELMS also uses the remote cabin pressure sensor data as an alternative to the ASCPC cabin pressure data.

See these section for more information about the ELMS interfaces related to cabin pressure:

- Passenger compartment illumination (AMM PART I 33-21)
- Information signs (AMM PART I 33-22)
- Passenger oxygen (AMM PART I 35-21).

The ASCPCs usually get landing altitude from the flight management computing function (FMCF) of the AIMS. As an alternative to the FMCF, the flight crew can manually set landing altitude from the bleed air/pressurization panel.

The cabin pressure control system also interfaces with these systems/LRUs:

- ADIRS
- CMCF
- EFIS
- FMCF
- PDF
- OPAS
- AFDS

- EEC
- Left (right) WOW card.

See the engine air supply section for more information about the interfaces related to the ASCPCs and cabin pressure control (AMM PART I 36-11).

General Description

The flight crew sets automatic or manual control of the outflow valves from the flight deck.

Each valve is controlled independently. You can set auto for one and manual for the other.

Auto Control

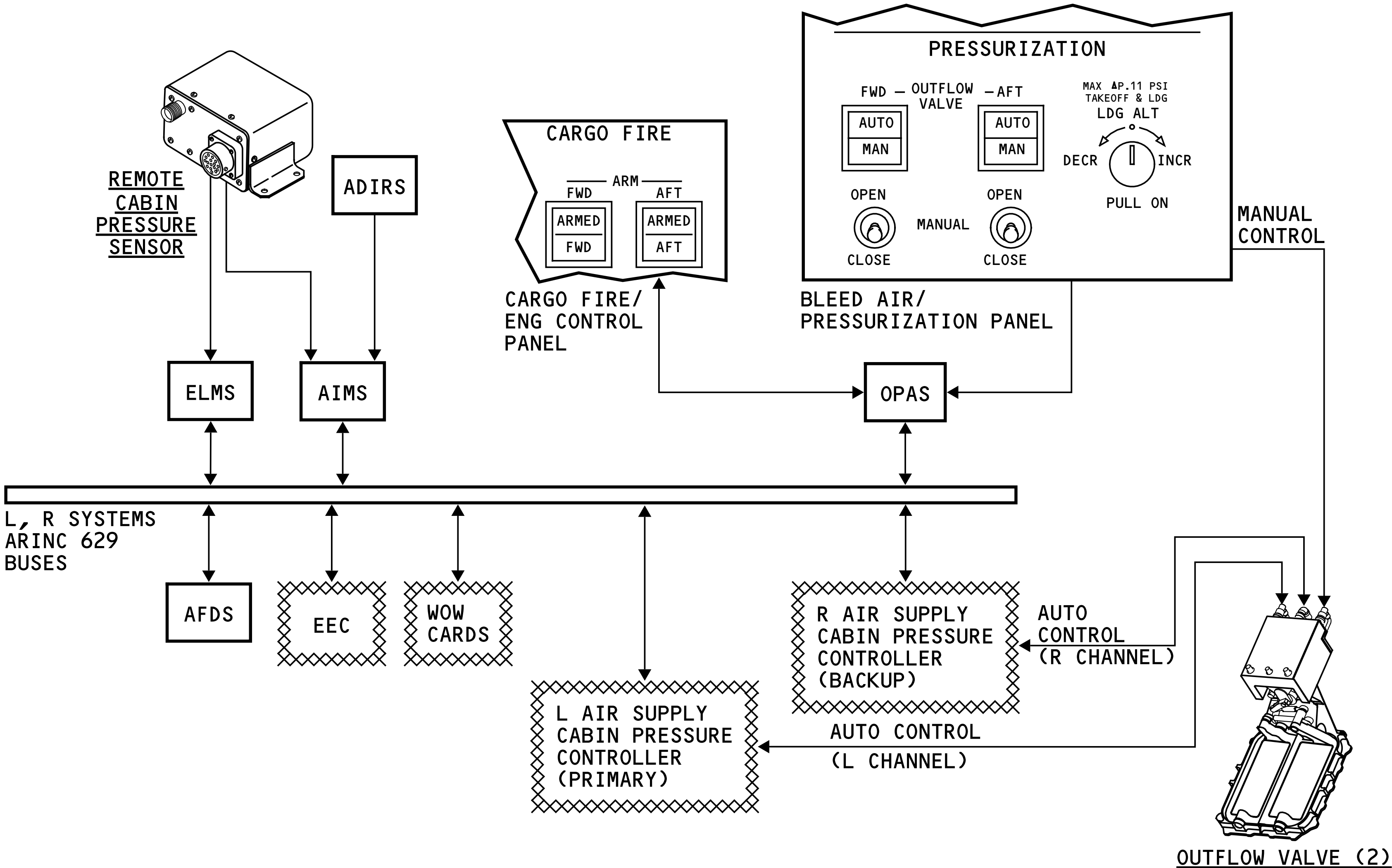
In the automatic mode, the left ASCPC usually controls the position of the valves. The right ASCPC gives backup control. Automatic control supplies these functions, most important first:

- Controls the cabin-to-ambient differential pressure to a maximum of 8.6 ±.05 psid
- Limits the cabin pressure rate-of-change
- Controls the cabin altitude to no more than 8000 feet (2440 meters)
- Limits takeoff and landing pressure bump
- Controls the ratio of air outflow between the forward and aft outflow valves.

Manual Control

For manual control the flight crew controls cabin rate-of-change and cabin altitude by manually controlling the position of the outflow valves. They use the outflow valve switches to turn on/off manual control.

Once manual control is selected, the flight crew uses the outflow valve manual switches to control the position of the outflow valves.



21-31-00-001 Rev 2 04/10/1997

AIR CONDITIONING - CABIN PRESSURE CONTROL SYSTEM - INTRODUCTION

AIR CONDITIONING - CABIN PRESSURE CONTROL SYSTEM - AIR SUPPLY CABIN PRESSURE CONTROLLER

General

The air supply cabin pressure controllers (ASCPCs) control the pneumatic system and cabin pressure. These functions operate independently.

Location

The left and right ASCPCs are in the MEC on the E1 and E2 racks.

Physical Description

The ASCPCs have test and cabin pressure sense ports on the front. The test port is for in-shop service. The cabin pressure sense port lets the controllers monitor cabin pressure.

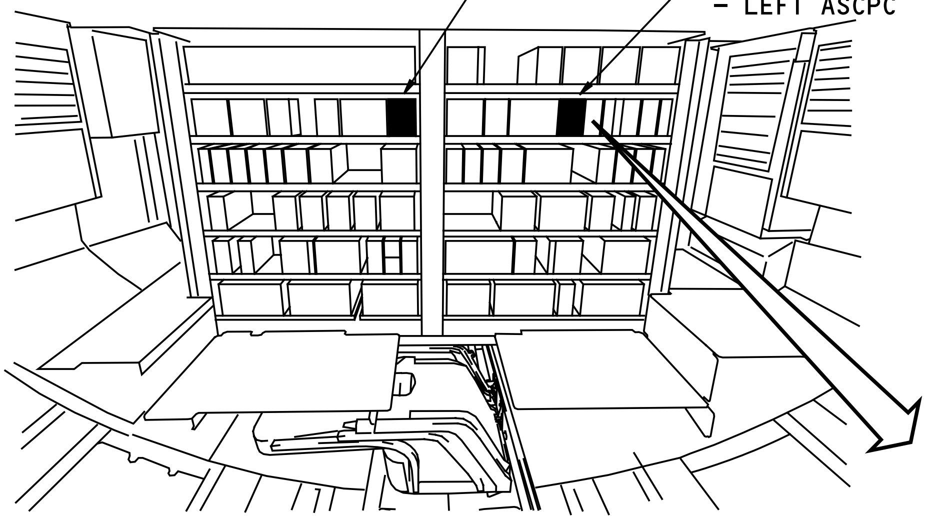
The ASCPCs use operational program software (OPS) that you can load.

Training Information Point

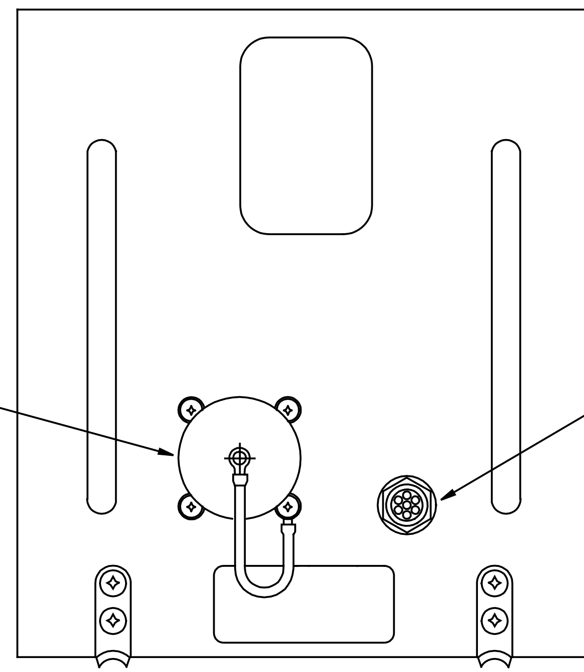
The ASCPCs are LRUs. The circuit cards inside the ASCPC are not lRUs.

The left and right ASCPCs are interchangeable.

See the engine air supply section for more information about the ASCPCs (AMM PART I 36-11).



MAIN EQUIPMENT CENTER
(LOOKING AFT)



AIR SUPPLY CABIN PRESSURE CONTROLLER
(TYPICAL)

21-31-00-008 Rev 1

AIR CONDITIONING - CABIN PRESSURE CONTROL SYSTEM - AIR SUPPLY CABIN PRESSURE CONTROLLER

AIR CONDITIONING - CABIN PRESSURE CONTROL SYSTEM - OUTFLOW VALVE - INTRODUCTION

Purpose

Forward and aft outflow valves control the flow rate of pressurized cabin air out of the airplane.

Location

The aft outflow valve is adjacent to the aft waste tank. Access is through the aft waste tank enclosure panel at the rear of the bulk cargo compartment.

The forward outflow valve is below the P110 left power management panel in the main equipment center.

Physical Description

Both forward and aft outflow valves are the same. The valve weighs approximately 30.25 lbs (13.72 kg). Each valve has these assemblies:

- Actuator assembly
- Frame assembly
- Gearbox assembly.

The actuator assembly has these line replaceable components:

- Outflow valve control unit
- Left outflow valve motor
- Right outflow valve motor
- Outflow valve gearbox assembly.

The frame assembly has these parts:

- Door (2)
- Nut plate (18)
- Push rod (2).

The valve control unit is a two channel controller. The unit has these parts:

- Airplane electrical connectors (3)
- RVDT electrical connector (1)
- Motor electrical connector (2).

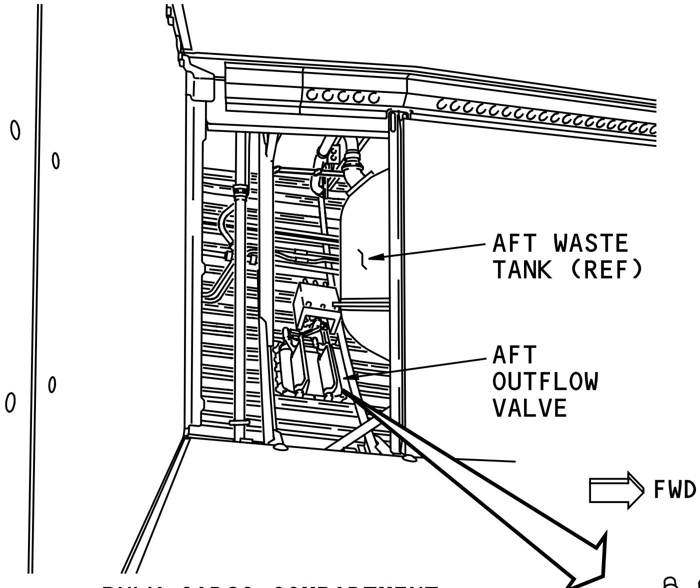
The gearbox assembly has reduction gears, two internal RVDTs and an actuator crank.

Training Information Point

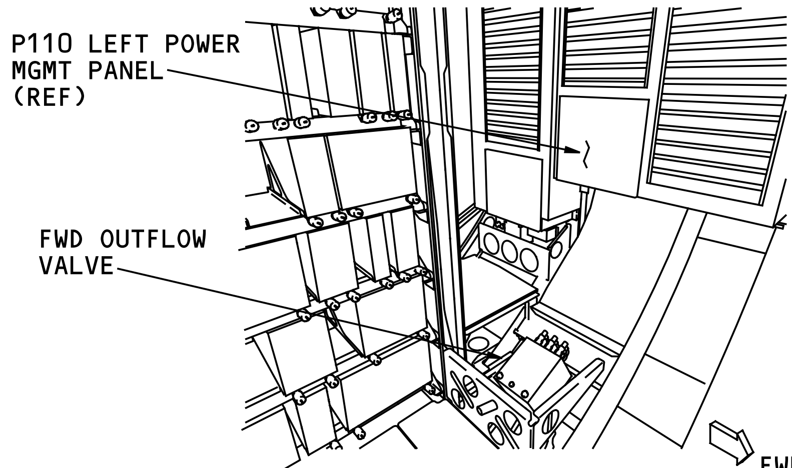
You can remove the forward outflow only from inside the airplane. You can remove the aft outflow valve from outside the airplane or from inside the airplane.

To prepare for pressurized flight with an outflow valve that does not operate, set the position of the valve to a specified position, then open the applicable circuit breakers.

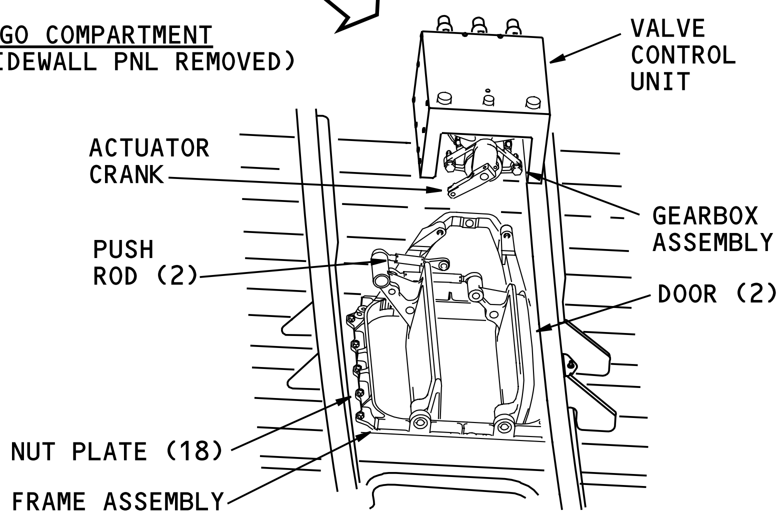
To prepare the airplane for unpressurized flight with outflow valves that do not operate, lock the valves open.



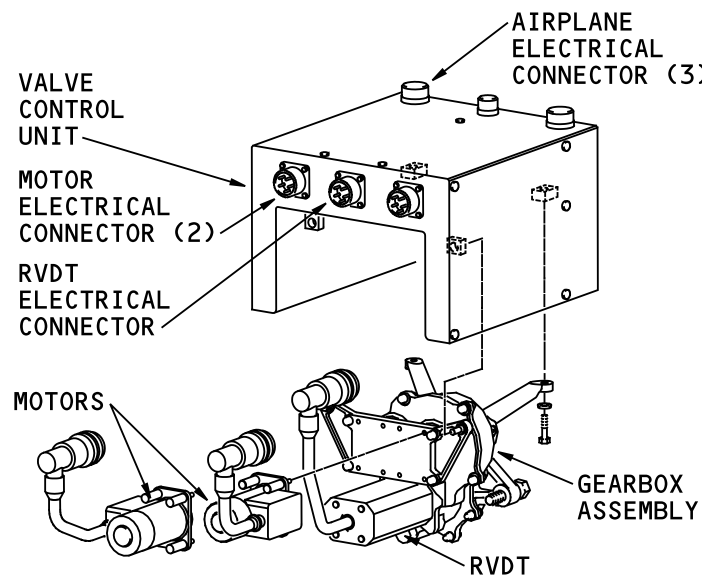
BULK CARGO COMPARTMENT
(LEFT SIDE, SIDEWALL PNL REMOVED)



MAIN EQUIPMENT CENTER
(LEFT SIDE, FLOOR PNL REMOVED)



OUTFLOW VALVE
(ACTUATOR ASSEMBLY REMOVED, TYP)



ACTUATOR ASSEMBLY

AIR CONDITIONING - CABIN PRESSURE CONTROL SYSTEM - OUTFLOW VALVE - INTRODUCTION

General

The outflow valve control unit (VCU) has two channels. The left channel controls the left outflow valve motor, and the right channel controls the right outflow valve motor. Each channel has a separate power supply.

The left channel has an interface with the left ASCPC and the right channel has an interface with the right ASCPC. The channels have interfaces with the ASCPC on an ARINC 429 bus. For manual mode operation, both channels have an interface with the bleed air/ pressurization panel.

Outflow Valve Control Unit

The valve control unit has these functions:

- Controls motor speed and position
- Monitors valve position (RVDTs)
- Supplies BITE.

In the automatic mode, the motor control logic uses information from the related ASCPC to set motor speed and the position of the outflow valve. The valve can open or close completely in less than 10 seconds for the automatic mode. ASCPC information usually causes the VCU to change motor speed for smooth changes in cabin pressure.

In the manual mode, the motor control logic uses the signal from the outflow valve manual switches on the bleed air/pressurization panel to open or close the outflow valve. The valve can open or close completely in approximately 27 seconds for the manual mode.

Two RVDTs that are part of the gearbox send valve position information back to the VCU and ASCPCs in automatic and manual modes.

Outflow Valve Motors

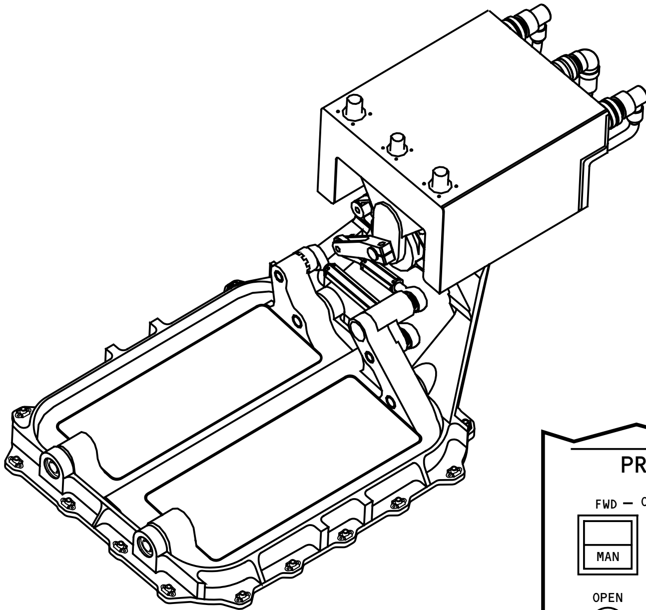
A brake solenoid in the motor stops movement when the motor does not have a command to turn. Sensors in the motor give rotor position information to the VCU. The VCU uses rotor position to monitor motor speed. Both motors mechanically connect to the gearbox.

Gearbox

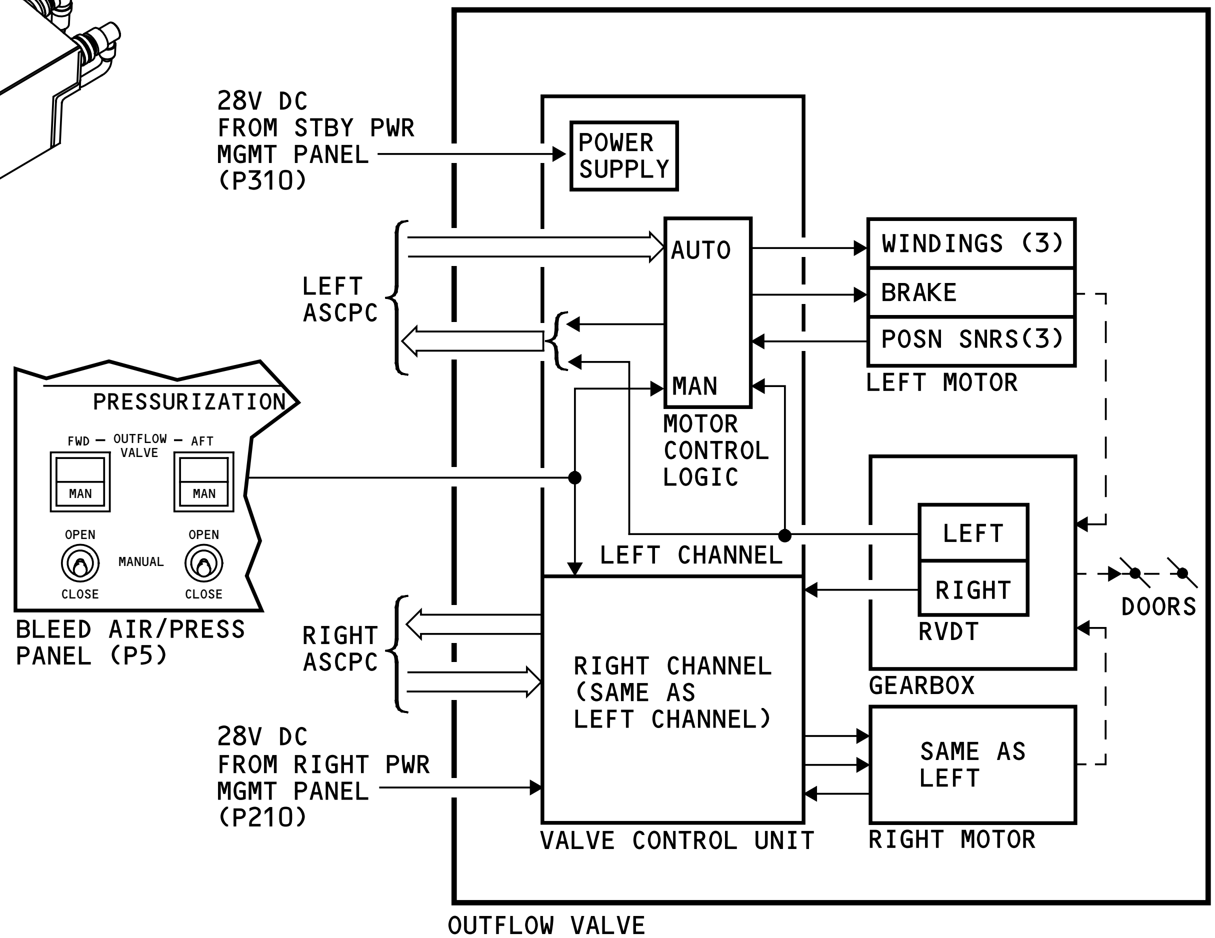
The gearbox changes the motor inputs to door and RVDT positions.

BITE

The VCU continuously monitors for outflow valve faults. If the VCU finds a fault, the VCU supplies the fault data to the ASCPCs for indication and to keep in memory.



OUTFLOW VALVE



21-31-00-003 Rev 2 09/16/96

AIR CONDITIONING - CABIN PRESSURE CONTROL SYSTEM - OUTFLOW VALVE - FUNCTIONAL DESCRIPTION

AIR CONDITIONING - CABIN PRESSURE CONTROL SYSTEM - REMOTE CABIN PRESSURE SENSOR

Purpose

The remote cabin pressure sensor measures cabin air pressure independently of the ASCPCs.

Physical Description

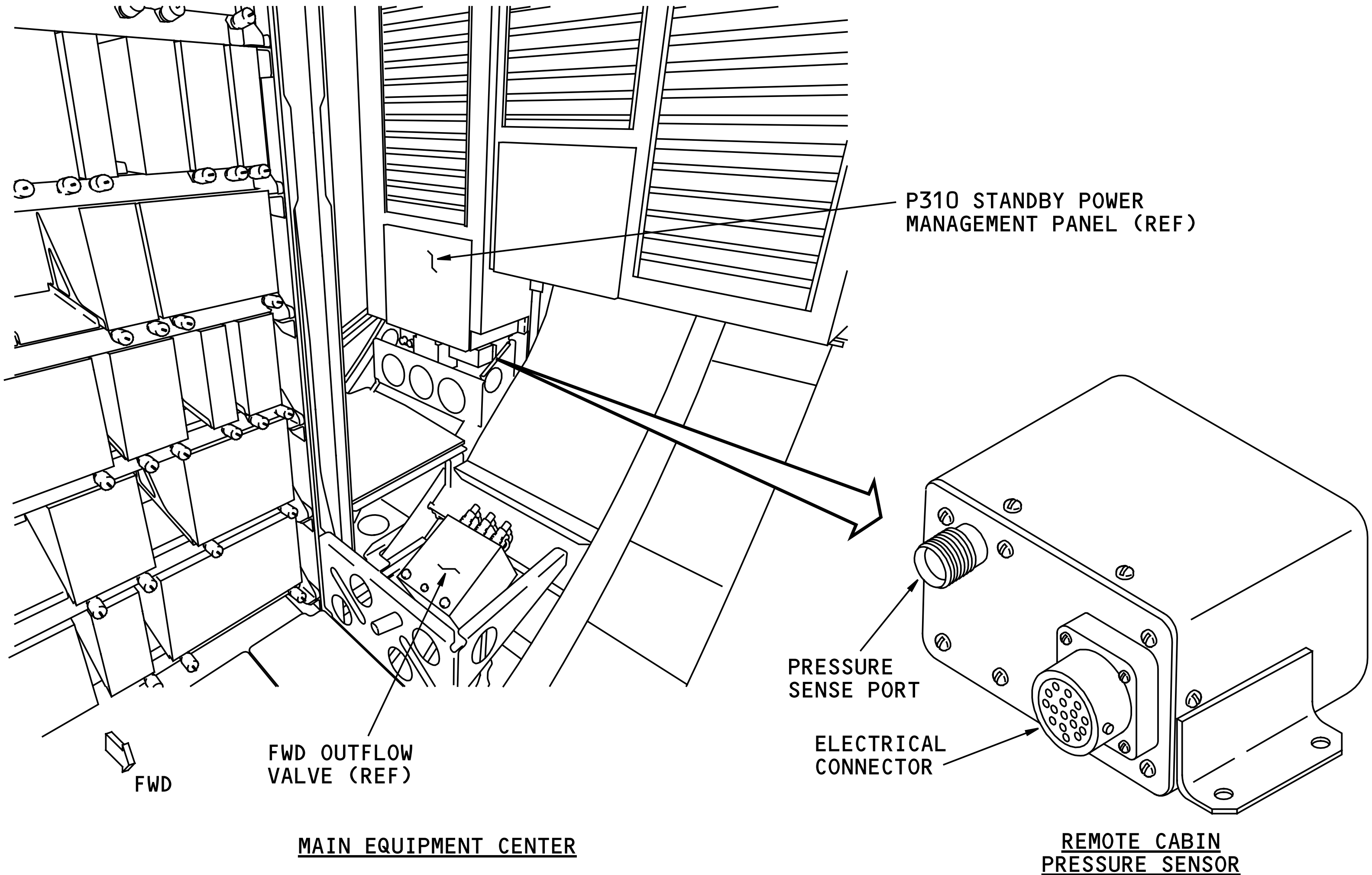
The sensor is an electronic device. It has an internal pressure sensor

Location

The remote cabin pressure sensor is in the main equipment center below the P310 standby power management panel.

The remote cabin pressure sensor mounts with the pressure sense port down. This keeps air velocity effects to a minimum.

The central maintenance computing system (CMCS) does not test the remote cabin pressure sensor.



21-31-00-004 Rev 0

AIR CONDITIONING - CABIN PRESSURE CONTROL SYSTEM - REMOTE CABIN PRESSURE SENSOR

Bleed Air/Pressurization Panel

These controls are on the bleed air/pressurization panel:

- Forward and aft outflow valve switches
- Forward and aft outflow valve manual switches
- Landing altitude selector.

Outflow Valve Switches

The forward and aft outflow valve switches set the outflow valves to automatic or manual operation. The switches are alternate-action switches. The AUTO indication on the switch shows the valves in automatic operation. When the MAN indication shows, the valves are in manual operation. In the MAN position, the ECS (environmental control system) data block shows on the EICAS display. The selection of the MAN position causes these indications:

- The related advisory message, OUTFLOW VALVE FWD (AFT) shows on the EICAS display
- The caution message, CABIN ALTITUDE AUTO shows on the EICAS display if both valves are set to MAN
- An M shows on the related valve position indicator in the ECS data block
- MAN shows below the valve position data on the air supply maintenance page (not shown).

Outflow Valve Manual Switches

The forward and aft outflow valve manual switches set the position of the outflow valves. The switches are toggle type switches with a spring-loaded center off position. These switches only function when the outflow valve switches are in the MAN position. Valve position shows in the ECS data block.

Landing Altitude Control

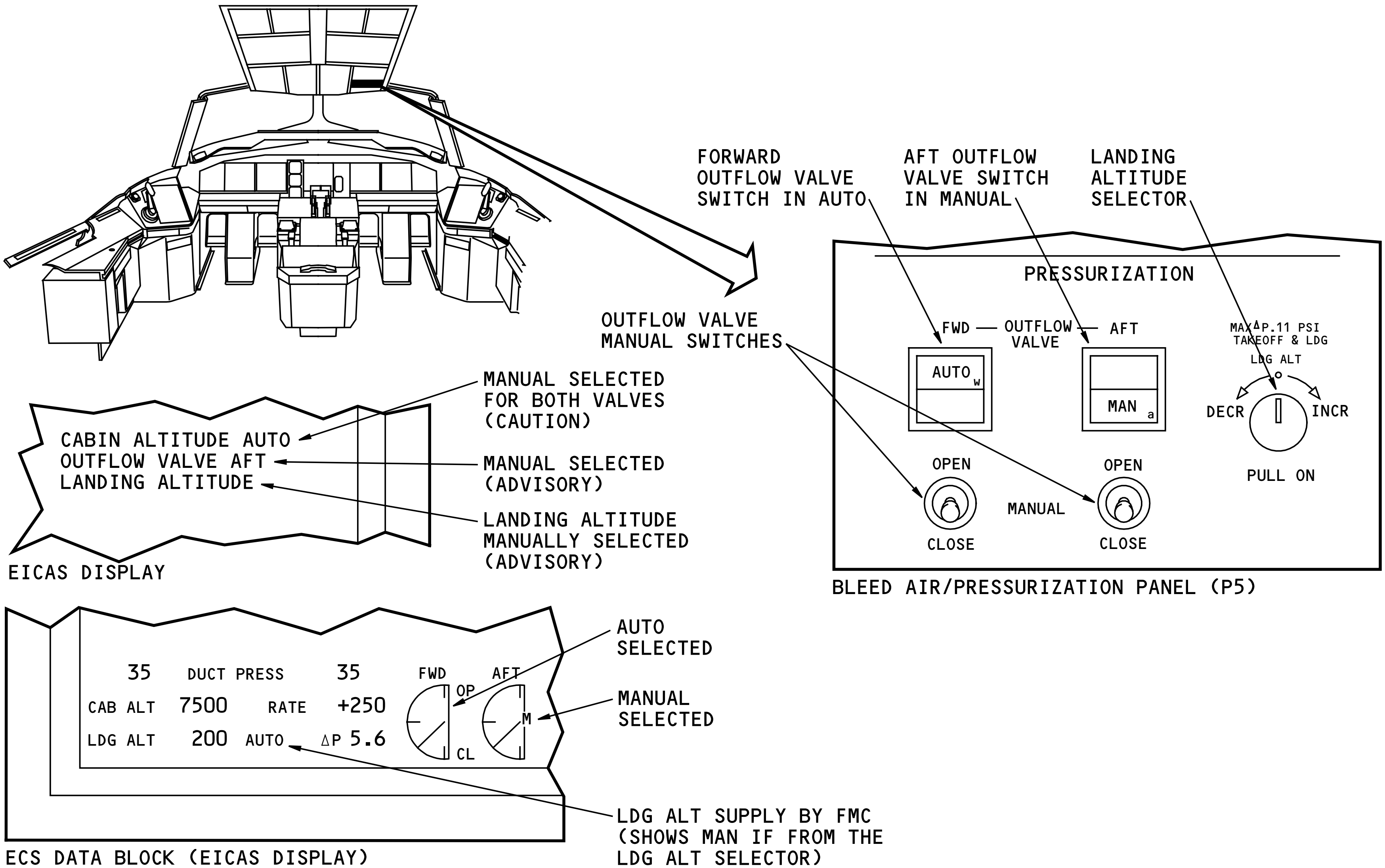
When the knob on the landing altitude selector is in, the ASCPC uses landing altitude data from the flight management computing function (FMCF) of AIMS.

When the landing altitude selector is out, the ECS data block shows and MAN shows next to the landing altitude data. MAN also shows on the air supply maintenance page (not shown) next to the landing altitude data. The landing altitude selector sets the landing altitude value. The ASCPC uses this value for landing altitude.

The flight crew moves the landing altitude control to the right to increase or to the left to decrease the landing altitude. The control is spring-loaded to the center position. The landing altitude limits are 2,000 feet below sea level to 15,000 feet above sea level.

Training Information Point

One outflow valve can operate in automatic mode and the other can operate in manual mode at the same time.



21-31-00-005 Rev 1 09/12/96

AIR CONDITIONING - CABIN PRESSURE CONTROL SYSTEM - BLEED AIR/PRESSURIZATION PANEL

AIR CONDITIONING - CABIN PRESSURE CONTROL SYSTEM - FUNCTIONAL DESCRIPTION

General

The air supply cabin pressure controllers (ASCPCs) supply control, indications, and BIT for the cabin pressure control system. ARINC 429 buses connect the ASCPCs to their related valve control unit (VCU) channels. The left and right VCU channels get power from a different bus. The outflow valve switches on the bleed air/pressurization panel set automatic or manual mode.

The ASCPCs have these modes of operation:

- Initialization (power up)
- Preflight BIT
- Automatic.

Initialization

The initialization mode is when power is first supplied to the ASCPCs or when new software is installed.

When the initialization mode is on, the ASCPCs do a check of these components and functions:

- Memory functions
- Checks if ground test is selected
- Software compatibility (left ASCPC to right ASCPC).

The initialization mode takes approximately 2 seconds to complete.

Preflight BIT

Both ASCPCs do a preflight BIT when the airplane is on the ground and one or both of the outflow valves are set to AUTO.

Preflight BIT is complete in 90 seconds or less. When the preflight BIT mode is on, the ASCPCs do internal checks and an operational check of the outflow valves. During these checks, the outflow valves move. If there are faults, flight deck indications will occur.

Automatic Mode

When the outflow valve switches are in AUTO, the OPAS sends a signal to the ASCPCs. This sets the outflow valves for automatic operation.

Usually, the left ASCPC controls the left motor in each outflow valve through the left VCU channels. If, because of system failures, the left ASCPC cannot control both valves, the control configuration changes. This is the control sequence:

- L ASCPC is in control if it can control both valves
- R ASCPC is in control if it can control both valves
- L ASCPC is in control if it can control the aft valve
- R ASCPC is in control if it can control the aft valve
- L ASCPC is in control if it can control the forward valve

- R ASCPC is in control if it can control the forward valve.

Usually the ASCPC uses the VCUs to set the positions of the valves so that 20 percent of the outflow is through the forward valve and 80 percent is through the aft valve. This changes if one of the ASCPCs cannot control both valves. In that condition, each valve permits 50 percent of the outflow. This helps prevent loss of cabin pressure control if one valve fails so that it can not be controlled by the left or right ASCPC.

The same change occurs if you arm the forward or aft cargo fire switches. This keeps smoke from the cargo compartment out of the cabin area and keeps a sufficient concentration of extinguishing agent in the cargo compartment.

The ASCPCs use the VCUs to control cabin pressure and cabin pressure rate of the change. The VCUs get speed commands from the ASCPC. The speed commands can make the VCU move the outflow valve slowly or fast. The valve can move fully open or close in less than 10 seconds.

The ASCPCs use this data to control cabin pressure:

SIGNAL	PRI SOURCE	BU SOURCE
Cabin Pressure	Active ASCPC	Other ASCPC
Ambient pressure	ADIRU	EEC
Ground speed	ADIRU	
Landing altitude	AIMS (FMCF)	Ldg Alt Selector
Differential press	AIMS (FMCF)	
Cruise altitude	AIMS (FMCF)	
Time for climb	AIMS (FMCF)	
Time for descent	AIMS (FMCF)	
ETA top of descent	AIMS (FMCF)	
Barometric correction	AIMS (PDF)	
Vertical nav on/off	AFDC	
Air or ground mode	WOW	

Cabin pressure

The controllers monitor cabin pressure from an internal sensor. The sensors also give an output on the ARINC 629 buses.

The remote cabin pressure sensor sends an analog pressure signal to the electrical load management system (ELMS). The ELMS puts this signal on the ARINC 629 buses. The ASCPCs use this data to do a BITE check of the internal cabin pressure sensors.

The remote sensor also gives an analog pressure output to the AIMS. The AIMS uses this signal if the cabin pressure data is not available from the ASCPCs or from ELMS.

Ambient Pressure

The ASCPCs usually get ambient pressure data from the ADIRU. If that data is not available or is not valid, the ASCPCs use ambient pressure data from the electronic engine control (EEC).

Landing Altitude

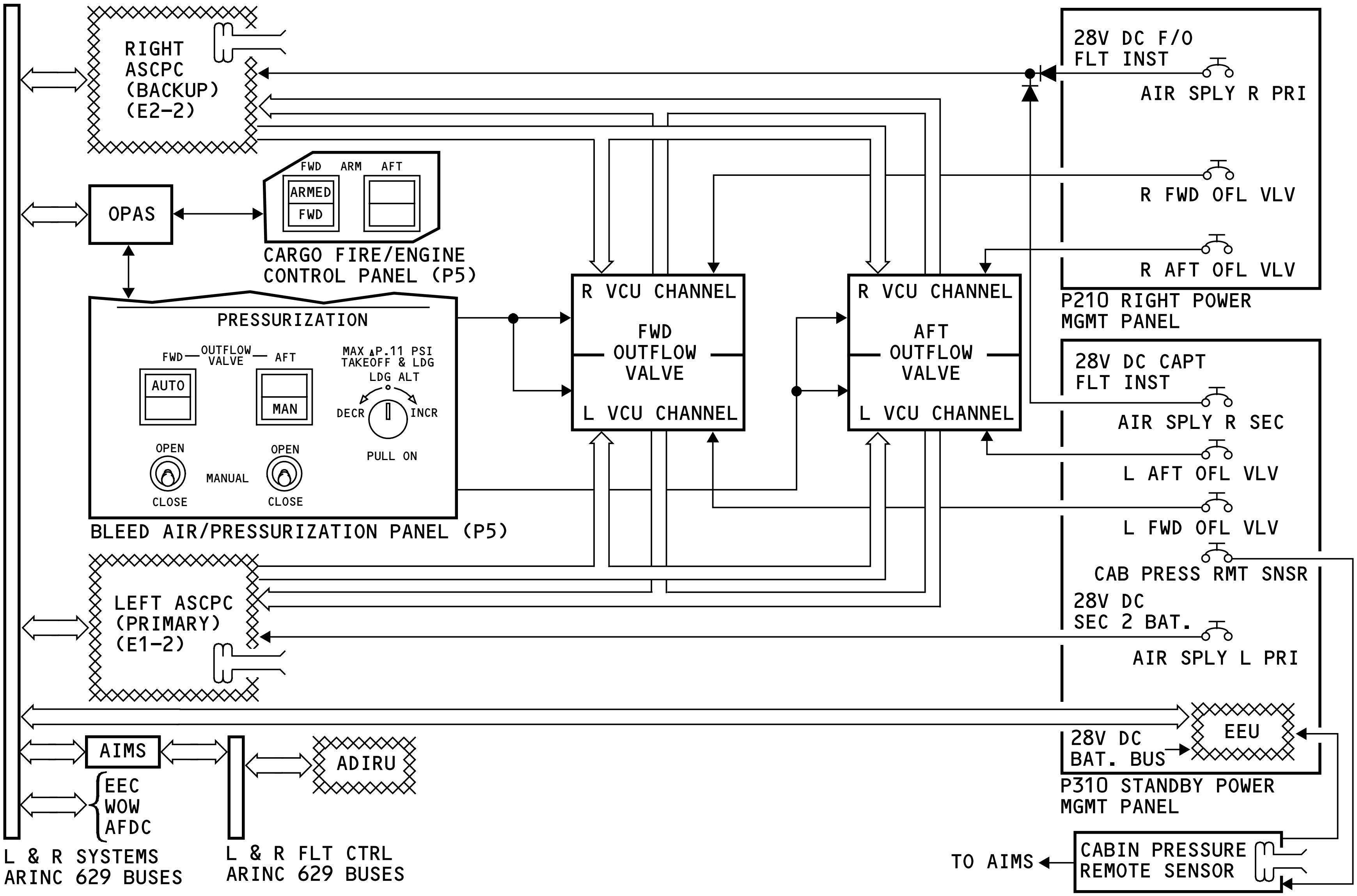
In usual operation, the flight management computing function (FMCF) of the AIMS sends landing altitude data to the ASCPCs. Alternatively, the flight crew manually sets the data with the landing altitude selector on the bleed air/pressurization panel.

Manual Mode

When an outflow valve switch is in the MAN position, the ASCPC releases control of that outflow valve. The outflow valve manual switch sends open or close signals to the left and right channels of the VCU. The VCU opens or closes the outflow valve at a fixed speed. In the manual mode the valve can open or close fully in approximately 27 seconds.

Training Information Point

You can use the MAT to do a ground test of the cabin pressure control system. The ground test is the same as the preflight BIT.



AIR CONDITIONING - CABIN PRESSURE CONTROL SYSTEM - FUNCTIONAL DESCRIPTION

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AIR CONDITIONING - CABIN PRESSURE CONTROL SYSTEM - FLIGHT PROFILE

General

The air supply and cabin pressure controllers (ASCPCs) use data from the flight management computing function (FMCF) of AIMS to control cabin pressure. These are the FMCF modes that the ASCPCs use:

- Ground mode/takeoff
- Climb
- Cruise
- Descent
- Landing/ground mode.

Ground Mode/Takeoff

When the ground mode is on, the ASCPC sets the outflow valves to fully open. This makes sure the airplane does not pressurize on the ground.

When the ground mode is on more than one minute, both ASCPCs do a preflight BIT. This test does a test of the operation of the ASCPCs and the outflow valve. The test takes approximately 90 seconds.

When the engine N1 speed is more than 60%, and the airplane speed is above 25 knots and increasing, the ASCPC moves the outflow valves to a more closed position. This pre-pressurizes the airplane to 0.1 psi above takeoff field pressure, approximately 189 feet (58 meters) below the takeoff field. The valves continue to close as the airplane speed increases. This keeps cabin pressure surges due to the force of ram air at a minimum as the airplane rotates.

Climb

The ASCPC enables the climb mode when any of these conditions occur:

- The takeoff mode is enabled and the airplane goes from the ground to the air
- The airplane climbs more than 1000 feet (305 meters)
- The FMCF shows a climb mode.

During climb, the ASCPC has these functions:

- Calculates and sets the target value for cabin altitude at cruise
- Calculates and sets the cabin rate of climb to a value less than or equal to 500 feet/minute (153 meters/minute)
- Limits the cabin to ambient pressure differential to 8.6 psi
- Limits cabin altitude to 8000 feet (2440 meters) or less
- Adjusts the outflow valves to give a smooth change in cabin pressure.

The climb mode has two ways that it can operate:

- FMC climb mode
- Internal climb mode.

The FMC climb mode is enabled if all of these conditions occur:

- FMC data is correct
- Autopilot is on
- Vertical navigation is on.

When the FMC climb mode is enabled, the ASCPC calculates and sets the target value for cabin altitude based on these inputs:

- The FMCF airplane cruise altitude data
- The FMCF landing field elevation data
- The cabin limits.

The target value is set to 0.1593 psi more that the set landing field pressure if these conditions occur:

- The cabin differential pressure does not go above its limit
- The cabin altitude does not go above its limit.

The 0.1593 psi value makes the cabin altitude approximately 300 feet (92 meters) below the landing field elevation. This helps to prevent cabin pressure surges when the airplane lands.

If the landing field is more than 8000 feet (2440 meters), the target value for cabin altitude is set to 7950 feet (2425 meters). This only occurs if the calculated cabin altitude target value is less than 8.6 psid.

The cabin altitude target value is set to a value that gives a differential pressure of 8.6 psi if the calculated target is more than 8.6 psid.

The internal climb mode is enabled when the FMC climb mode is not enabled. The internal climb mode causes these conditions to occur:

- The cruise altitude is set to 43,100 feet (13,146 meters)
- The target cabin altitude is set to 7950 feet (2425 meters).

If the FMC climb mode is enabled, the ASCPC uses cruise altitude data and the time to the cruise altitude from the FMCF to calculate the necessary climb schedule. The schedule makes sure the cabin reaches the target cabin altitude at the same time the airplane gets to the cruise altitude. The usual climb schedule sets the cabin rate of change to less than 0.266 psi/minute, approximately 500 ft./min (53 m/min).

Cruise

The ASCPC enables the cruise mode if the airplane altitude does not change more than 100 feet (31 meters) for more than three minutes. The ASCPC also enables the cruise mode if the FMCF mode is cruise.

At cruise altitude the ASCPC adjusts the outflow valves to keep the cabin pressure constant at the value calculated for the cabin altitude target.

Descent

The ASCPC enables the descent mode if the airplane descends more than 1000 feet (305 meters) or if the FMCF mode is descent.

During descent, the ASCPC adjusts the outflow valves to give a smooth change in cabin pressure. The descent mode sets the target cabin altitude to a cabin pressure value of 0.1593 psi more than landing field pressure.

For descent, the landing altitude can be equal to the airport that the airplane departed from. It can also be equal to the destination airport. The ASCPC uses the destination airport if any of these conditions occur:

- More than 400 nautical miles from departure airport
- More than halfway to the destination airport
- Two minutes or less before start of FMC planned descent.

The descent mode has two ways that it can operate:

- FMC descent mode
- Internal descent mode.

When the FMC descent mode is enabled, the ASCPC uses landing altitude data from the FMCF to calculate the necessary descent schedule. The descent schedule makes sure the cabin pressure gets to the target for the cabin altitude when the airplane gets to the landing altitude. The usual schedule for the FMC descent mode sets the cabin rate of change to 0.159 psi/minute, approximately 300 ft./min (92 m/min) or less.

If the internal descent mode is enabled, the cabin pressure changes at a maximum rate until one of these conditions occurs:

- The target cabin altitude is reached
- The 8.6 psi cabin differential pressure limit controls cabin pressure.

If the landing field elevation is above the cabin altitude, the cabin rate of changes is 0.266 psi/minute, approximately 500 ft./min (153 m/min). If the landing field elevation is below the cabin altitude, the cabin rate of change is 0.239 psi/minute, approximately 451 ft./min (138 m/min).

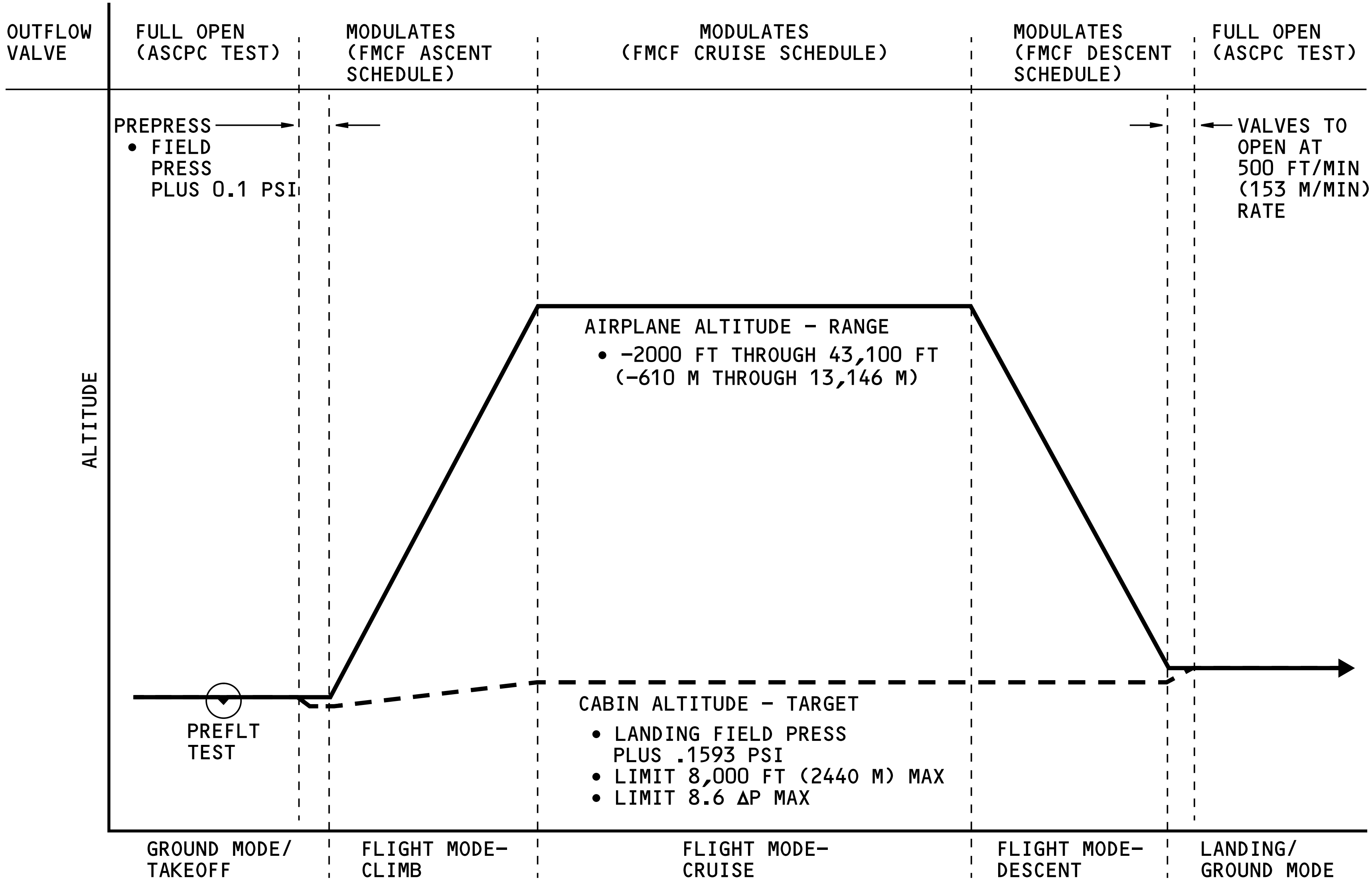
If the landing altitude is more than 8000 feet (2440 meters), the descent schedule lets the cabin altitude go above the usual limit of 8000 feet (2440 meters).

If landing altitude data from the FMCF is incorrect, the flight crew manually sets the landing altitude. If there is no landing altitude data given, 1000 feet (305 meters) is the default value.

Landing/Ground Mode

When the airplane lands, the ASCPC in control puts the outflow valves in the full open position. The valves move at a rate that makes the cabin pressure change 0.2655 psi/minute, approximately 500 ft./min (153 m/

min). If the valves are not full open after 45 seconds, the rate changes to 2000 feet/minute (610 m/min.). One minute after landing, the ASCPCs do a preflight BIT.



21-31-00-007 Rev 2 12/18/1996

AIR CONDITIONING - CABIN PRESSURE CONTROL SYSTEM - FLIGHT PROFILE

AIR CONDITIONING - CABIN PRESSURE RELIEF SYSTEM - INTRODUCTION

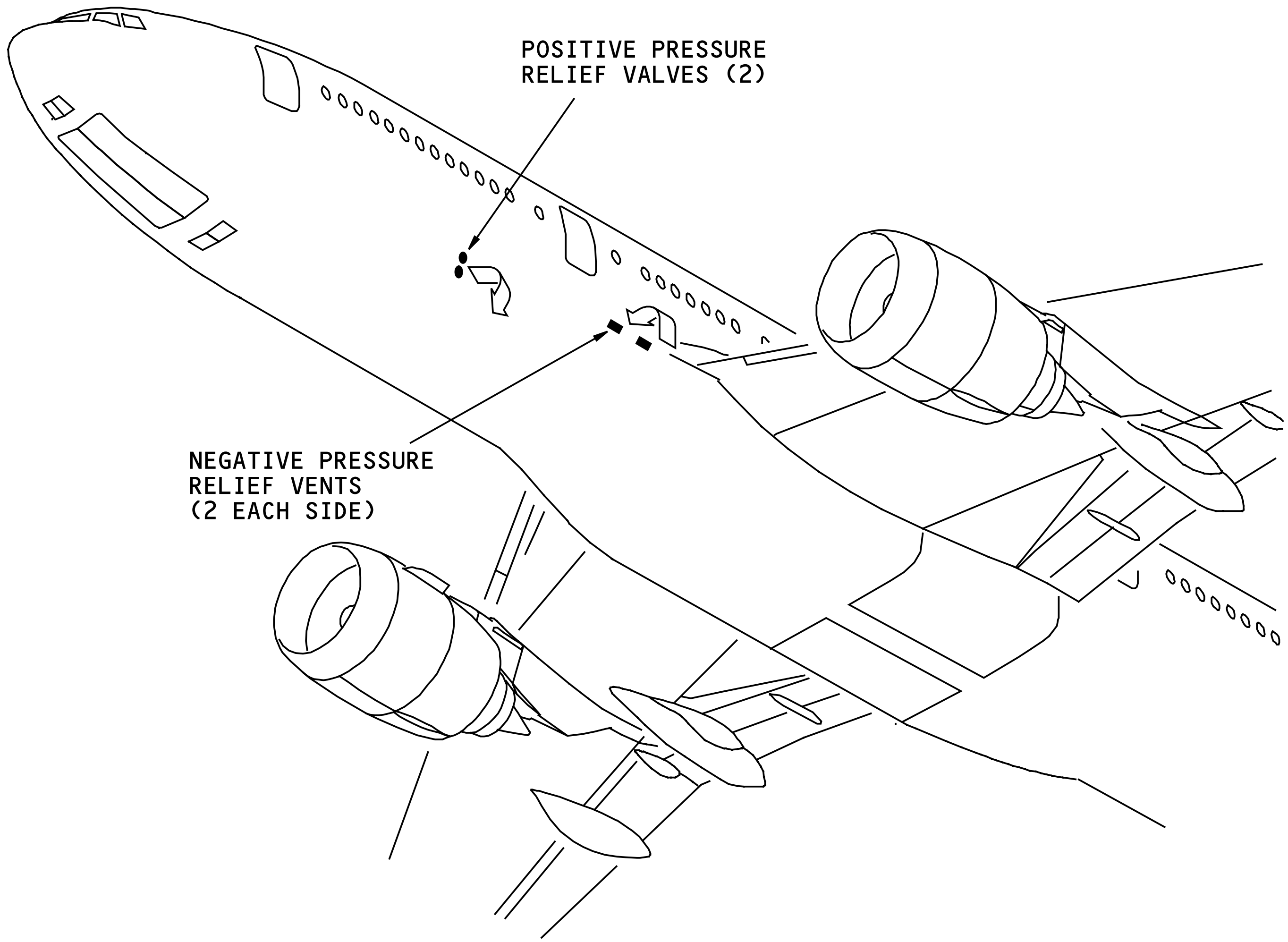
Purpose

The cabin pressure relief system limits the internal pressure of the airplane.

General Description

Two positive pressure relief valves bleed air overboard if the internal pressure increases above a safe limit. This limit is above the normal pressure in the airplane.

Four negative pressure relief vents bleed air into the airplane if ambient pressure is higher than the pressure in the airplane. This can occur during rapid airplane descent.



21-32-00-001 Rev 1

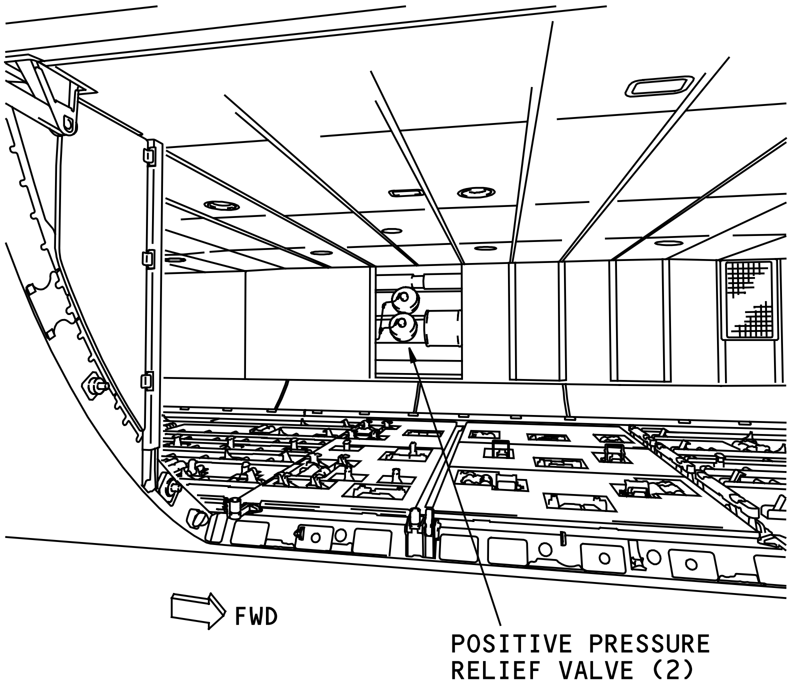
AIR CONDITIONING - CABIN PRESSURE RELIEF SYSTEM - INTRODUCTION

AIR CONDITIONING - CABIN PRESSURE RELIEF SYSTEM - COMPONENT LOCATIONS

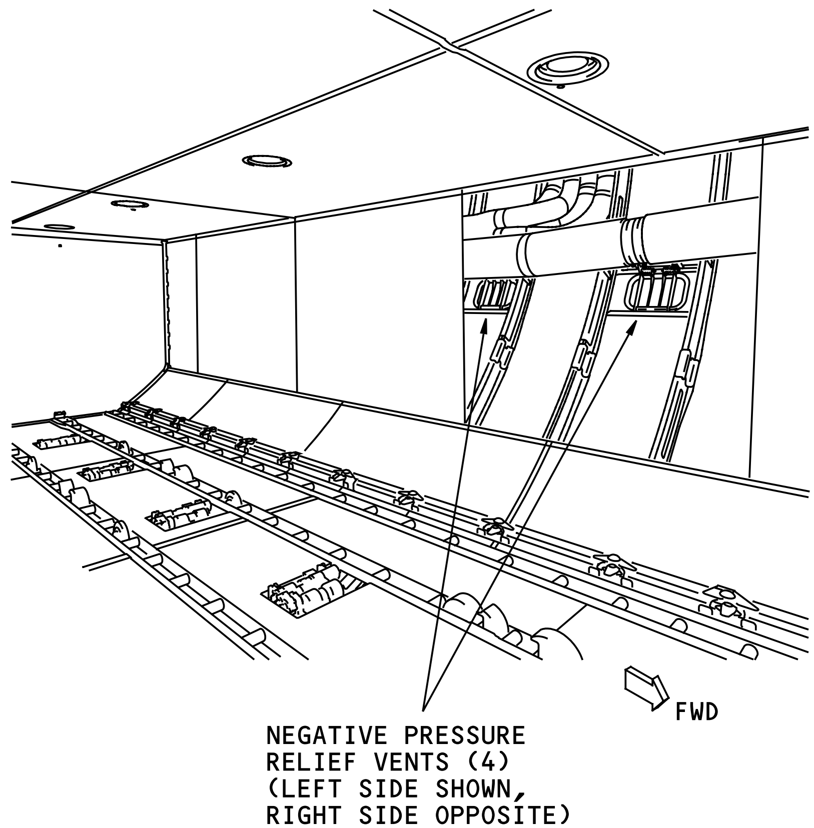
Component Locations

The positive pressure relief valves are adjacent to each other and behind the left sidewall lining of the forward cargo compartment. The valves are opposite the forward cargo door at station 603.

Two negative pressure relief vents are on each side of the airplane. These vents are at stations 815 and 857, behind the sidewall lining of the forward cargo compartment.



FORWARD CARGO COMPARTMENT
(LOOKING THROUGH FWD CARGO DOOR)



FORWARD CARGO COMPARTMENT
(LEFT SIDE LOOKING AFT)

21-32-00-002 Rev 1

AIR CONDITIONING - CABIN PRESSURE RELIEF SYSTEM - COMPONENT LOCATIONS

AIR CONDITIONING - CABIN PRESSURE RELIEF SYSTEM - POSITIVE PRESS RELIEF VALVE AND FILTER

Purpose

The positive pressure relief valve opens when cabin air pressure is higher than ambient pressure by a set value. This permits air to go out of the airplane to keep differential pressure below a safe limit.

Physical Description

The positive pressure relief valve is a mechanical device. It has an air filter and two ambient pressure sense connections. The air filter supplies cabin pressure to the valve. The ambient pressure connections supply ambient pressure to the valve.

An integral ambient sense port (not shown) is in the base of the valve. A remote ambient sense port is in the side of fuselage aft of the pressure relief valves. Tubing connects the sense ports to the valve.

Functional Description

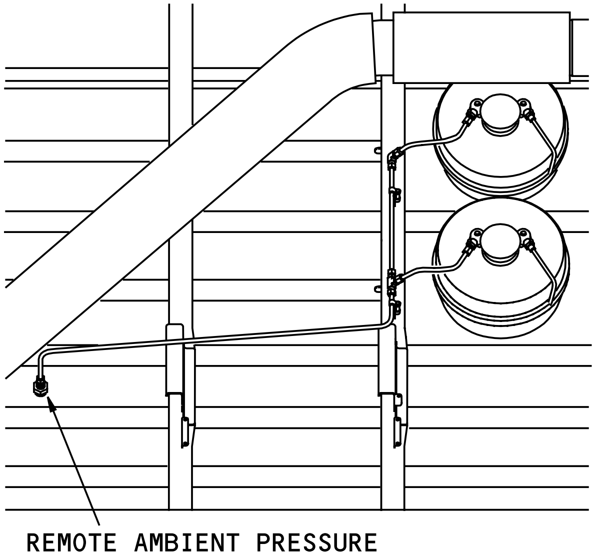
When cabin pressure differential at the remote ambient pressure sense port increases to 8.95 psi, the relief valve opens. This permits air to go out of the airplane. If the remote pressure sense port does not function, the relief valve opens when cabin pressure differential at the integral ambient sense port increases to 9.42 psi.

When cabin pressure differential goes below the limit, the positive pressure relief valve closes.

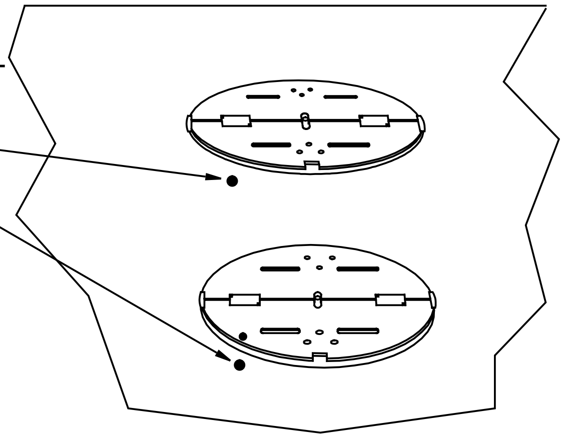
If the positive pressure relief valve opens, small doors open on the outer surface of the valve. This shows a brightly colored edge on the valve doors. These doors stay open when the valve closes. The maintenance technician must close these doors manually.

Training Information Point

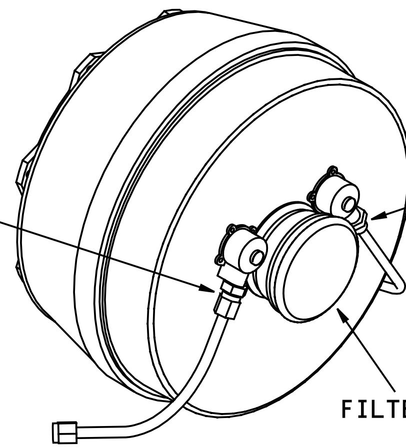
You can replace the air filter.



POSITIVE PRESSURE RELIEF VALVES
(INTERNAL VIEW)



POSITIVE PRESSURE RELIEF VALVES
TRIPPED OPEN
(EXTERNAL VIEW LOOKING UP)



POSITIVE PRESSURE RELIEF VALVE

21-32-00-003 Rev 1

AIR CONDITIONING - CABIN PRESSURE RELIEF SYSTEM - POSITIVE PRESS RELIEF VALVE AND FILTER

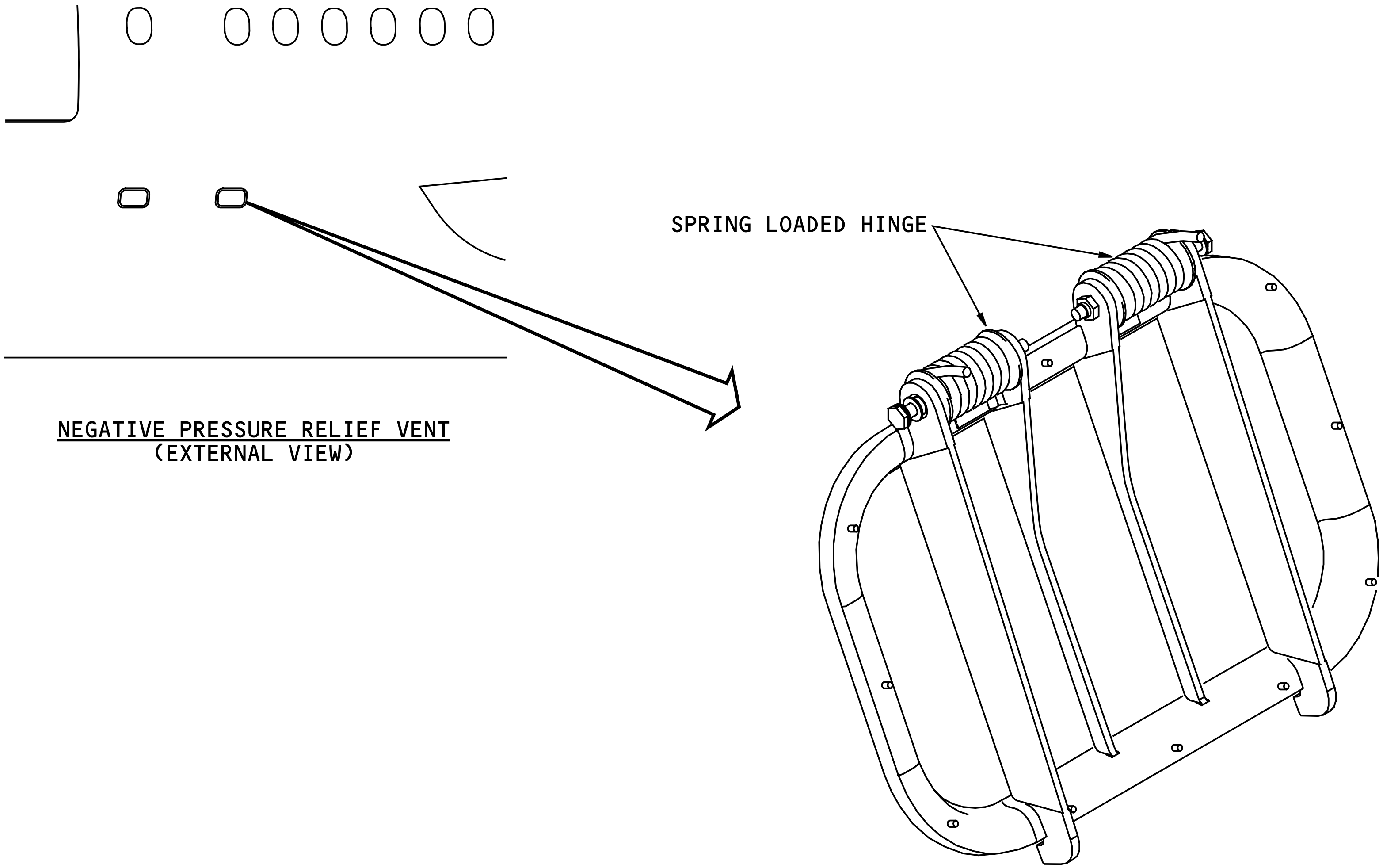
AIR CONDITIONING - CABIN PRESSURE RELIEF SYSTEM - NEGATIVE PRESS RELIEF VENT

Purpose

The negative pressure relief vent opens when cabin pressure is less than ambient pressure. This prevents negative cabin pressure. Too much negative cabin pressure could damage the fuselage structure.

Physical Description

The negative pressure relief vent is a spring-loaded door. The door starts to open at a differential pressure of 0.2 psi. It is full open at a differential pressure of 0.5 psi.



NEGATIVE PRESSURE RELIEF VENT
(EXTERNAL VIEW)

NEGATIVE PRESSURE RELIEF VENT
(INTERNAL VIEW)

21-32-00-004 Rev 1

AIR CONDITIONING - CABIN PRESSURE RELIEF SYSTEM - NEGATIVE PRESS RELIEF VENT

ECS Data Block

This pressurization information shows in the ECS (environmental control system) data block on the EICAS display:

- Duct pressure
- Cabin altitude (CAB ALT)
- Rate in feet per minute
- Forward and aft outflow valve position
- Landing altitude (LDG ALT)
- Indication of landing altitude from AIMS (AUTO) or from bleed air/pressurization panel (MAN).
- Cabin differential pressure (ΔP)

The ECS data block shows for these conditions:

- Duct pressure less than 11 psi with the related engine running
- Cabin altitude exceedance
- Selection of manual outflow valve operation
- Manual input of landing altitude
- Differential pressure exceedance
- Display of a related alert message
- Selection of the air synoptic display.

The ECS data block goes away after the condition which caused it goes away.

Duct pressure shows these colors for these conditions:

- White when duct pressure is 11 psi or more
- Amber if duct pressure is less than 11 psi.

Cabin altitude shows these colors for these conditions:

- White for a cabin altitude of 8500 feet or lower
- Amber if cabin altitude is higher than 8500 feet
- Red if the cabin altitude warning message shows.

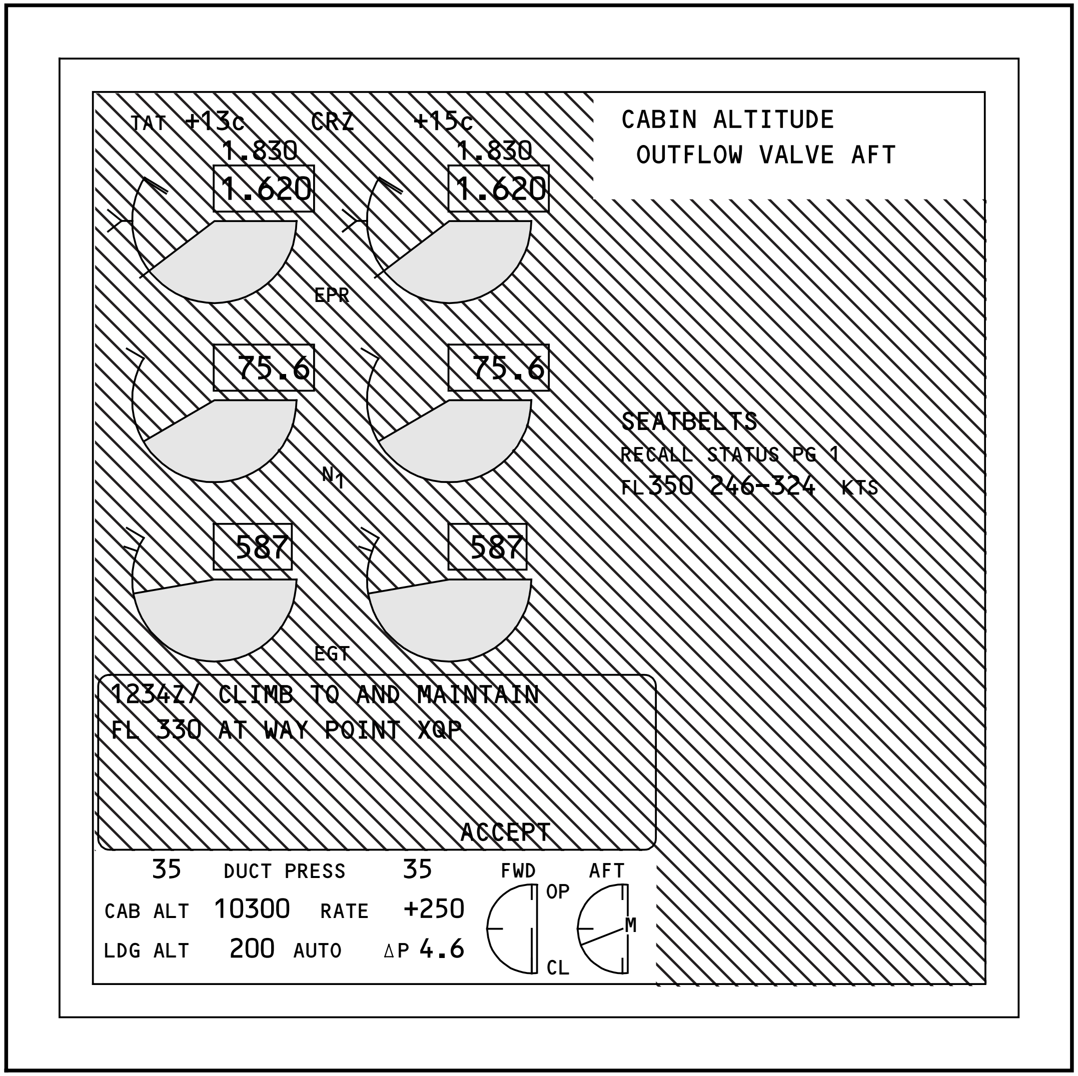
Differential pressure shows these colors for these conditions:

- White when ΔP is 8.95 psi or less
- Amber if ΔP is more than 8.95 PSI
- Red if ΔP is more than 9.42 PSI.

Cabin Altitude Warning Message

A warning message shows if cabin altitude is higher than a safe limit. The cabin altitude at which the warning message shows is related to the selected landing altitude:

- If the landing altitude is 9,650 feet or lower, then the warning message shows at 10,000 feet
- If the landing altitude is higher than 9,650 feet, then the warning message shows at 14,200 feet
- If the landing altitude data is not valid, then the warning message shows at 15,000 feet.



EICAS DISPLAY

21-30-00-004 Rev 1

AIR CONDITIONING - PRESSURIZATION - INDICATIONS - EICAS DISPLAY

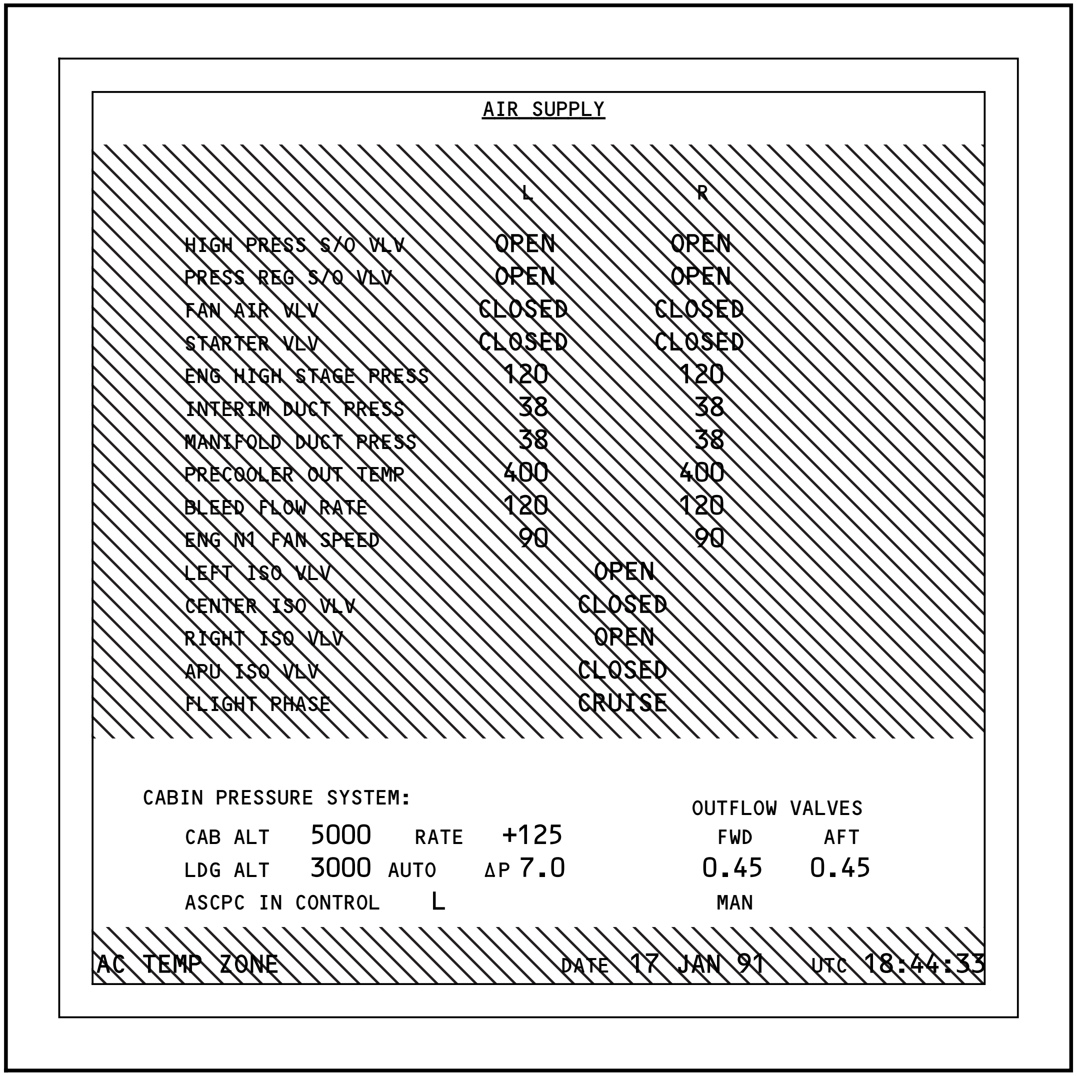
Air Supply Maintenance Page

The air supply maintenance page shows this cabin pressure system information:

- Cabin altitude (CAB ALT)
- Rate in feet per minute
- Landing altitude (LDG ALT)
- Indication of landing altitude from AIMS (AUTO) or from bleed air/pressurization panel (MAN)
- Differential pressure (ΔP)
- Indication of left (L) or right (R) air supply/ cabin pressure controller (ASCPC) in control (message goes away if none are in control).

The air supply maintenance page shows this outflow valve information:

- Forward and aft outflow valve position (0.00 closed, 1.00 fully open)
- Indication of manual (MAN) control of each outflow valve (no indication shows for automatic control).



AIR SUPPLY MAINTENANCE PAGE

21-30-00-005 Rev 1

AIR CONDITIONING - PRESSURIZATION - INDICATIONS - AIR SUPPLY MAINTENANCE PAGE

AIR CONDITIONING - PRESSURIZATION - SYSTEM TESTS

General

These are the pressurization system tests that show when you select ATA 21 Cabin Pressure Control System:

- Left cabin pressure control system
- Right cabin pressure control system.

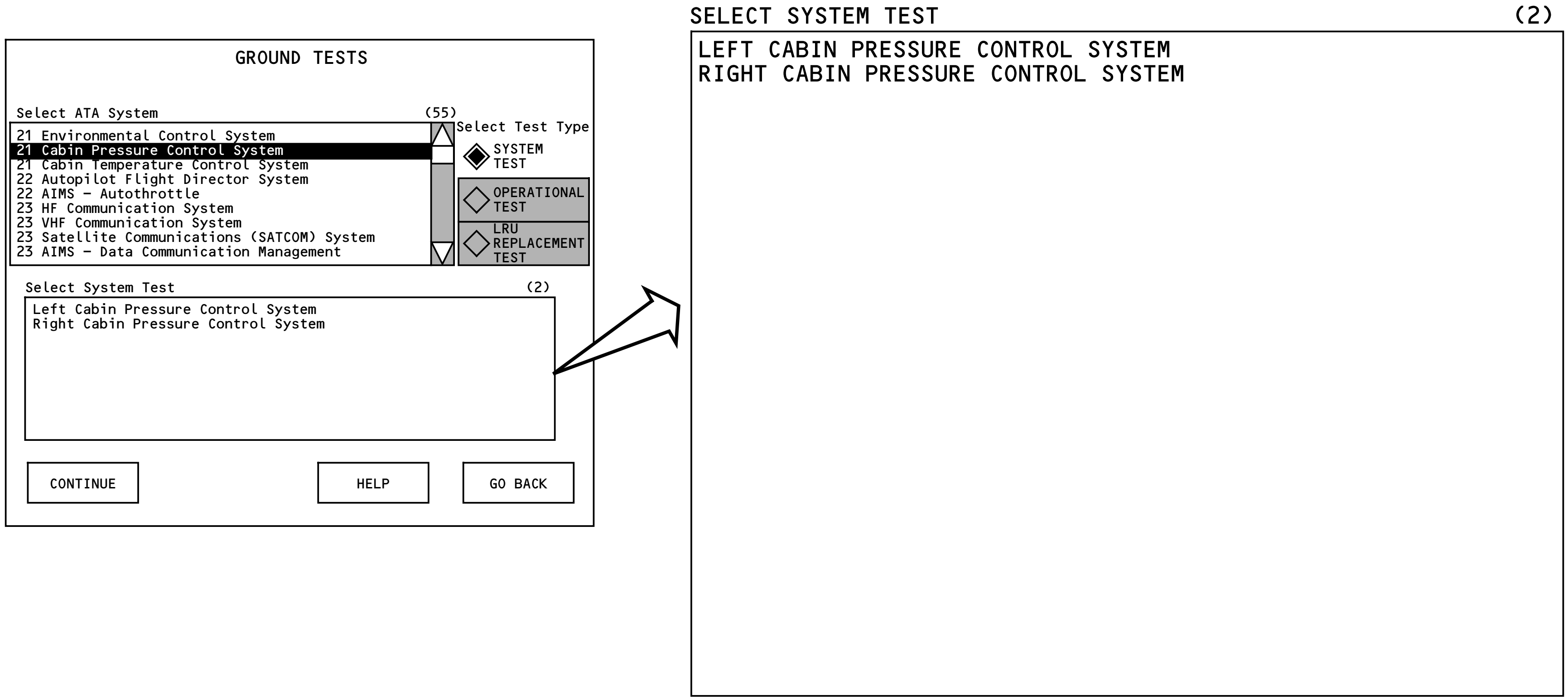
Left and Right Cabin Pressure Control System

These tests make sure that these LRUs operate correctly:

- Cabin pressure control function of the related ASCPC
- Forward outflow valve
- Aft outflow valve.

During the test, the outflow valves move. The tests take approximately 1-2 minutes each.

WARNING: MAKE SURE THAT PERSONS ARE CLEAR OF THE FORWARD AND THE AFT OUTFLOW VALVE ASSEMBLIES BEFORE YOU DO THIS TEST. INJURY TO PERSONS CAN OCCUR.



21-30-00-006 Rev 0 08/15/96

AIR CONDITIONING - PRESSURIZATION - SYSTEM TESTS

Continental Airlines, Inc

Equipment and Furnishings

WB371

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Continental Airlines, Inc

Equipment and Furnishings

WB371

TABLE OF CONTENTS

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EQUIPMENT AND FURNISHINGS - INTRODUCTION

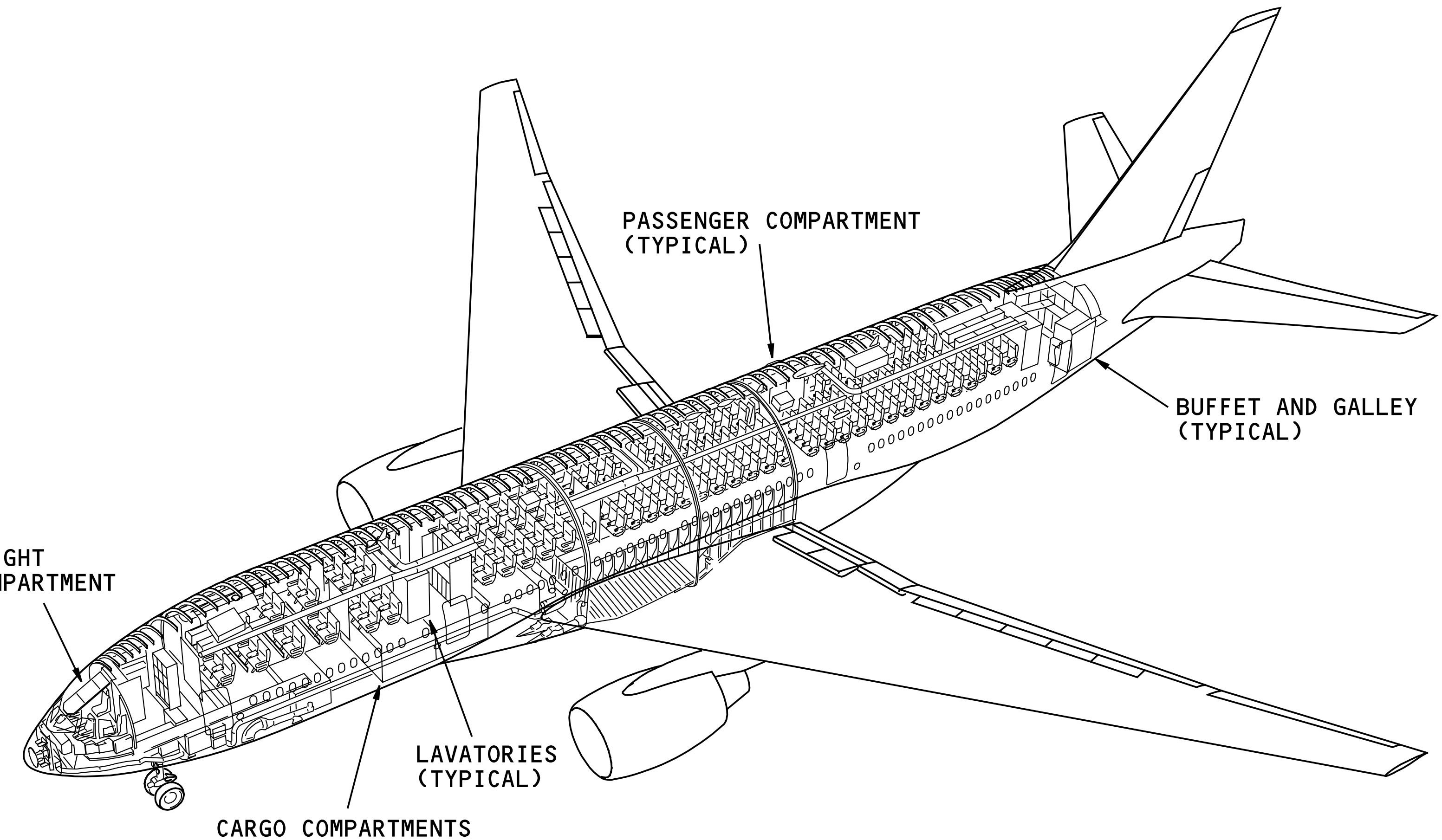
General

ATA chapter 25, equipment and furnishings, includes these sections:

- Flight compartment
- Lavatories
- Passenger compartment
- Buffet and galley
- Emergency Equipment
- Cargo compartments.

Abbreviations and Acronyms

C	- celsius
dn	- down
dr	- door
emer	- emergency
evac	- evacuation
F	- fahrenheit
F/D	- flight deck
fwd	- forward
gnd	- ground
inbd	- inboard
L	- left
lav	- lavatory
LLAR	- lower lobe attendants rest
mgmt	- management
OEU	- overhead electronics unit
pnl	- panel
PSIG	- pounds per square inch, gage
PSU	- passenger service unit
pwr	- power
R	- right
ref	- reference
SEU	- seat electronic unit
sig	- signal
svce	- service
SVU	- seat video unit
sw	- switch



EMERGENCY EQUIPMENT
(PASSENGER COMPARTMENT, FLIGHT
DECK AND LLAR IF INSTALLED)

25-00-00-001 Rev 2 04/10/1997

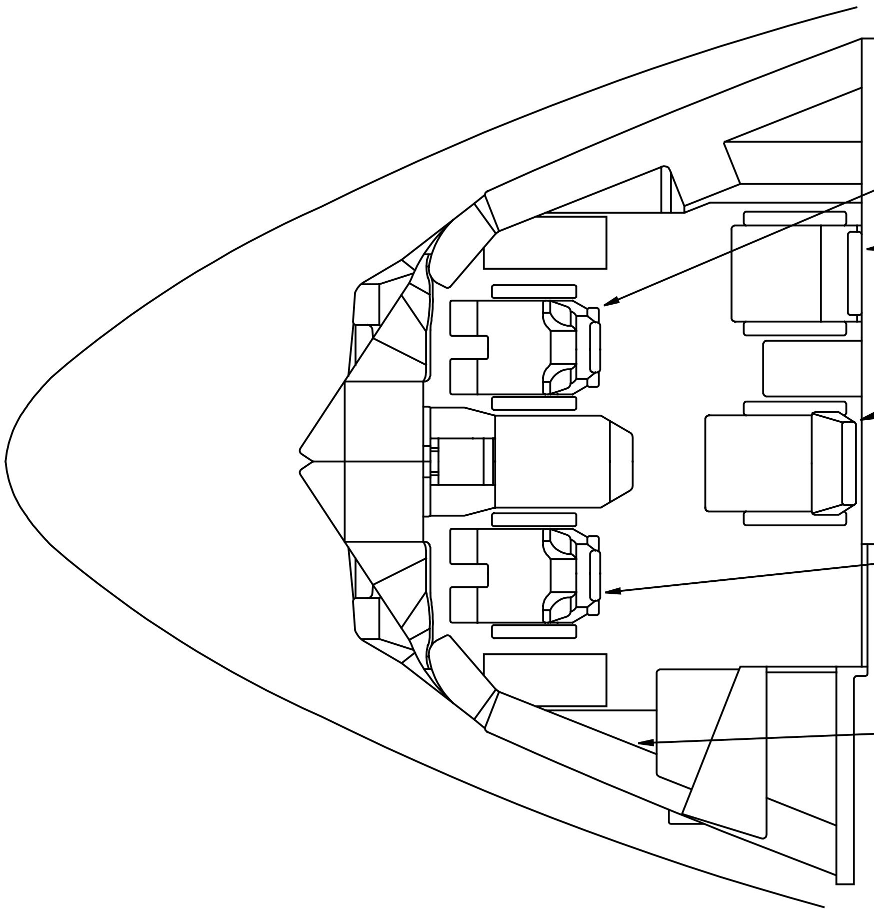
EQUIPMENT AND FURNISHINGS - INTRODUCTION

FLIGHT COMPARTMENT - INTRODUCTION

General

The flight compartment equipment and furnishings include these items:

- Captain and first officer seats
- Observer seats
- Flight compartment linings.



FLIGHT COMPARTMENT
(TOP VIEW)

25-10-00-001 Rev 0

FLIGHT COMPARTMENT - INTRODUCTION

FLIGHT COMPARTMENT - CAPTAIN/FIRST OFFICER SEAT - INTRODUCTION

Physical Description

The captain and first officer seats are opposite units. The main controls are on the right side of the pilot seat and the left side of the first officer seat. The seats have these parts:

- Headrest
- Back Cushion
- Seat cushion
- Armrests
- Restraint system
- Support base
- Electric actuator (2).

The height and angle of the headrest is manually adjustable.

The back cushion has a lumbar support with manual adjustment up/down and forward/aft. The angle of the seat back (recline) is also adjustable.

The seat cushion has adjustable thigh pads. The angle of the thigh pads is manually adjustable. The pads fold downward under pressure from rudder or brake application. When you remove the pressure, the pads return to their initial position.

The angle of each armrest is manually adjustable. The armrests lifts to a vertical position for entry and exit.

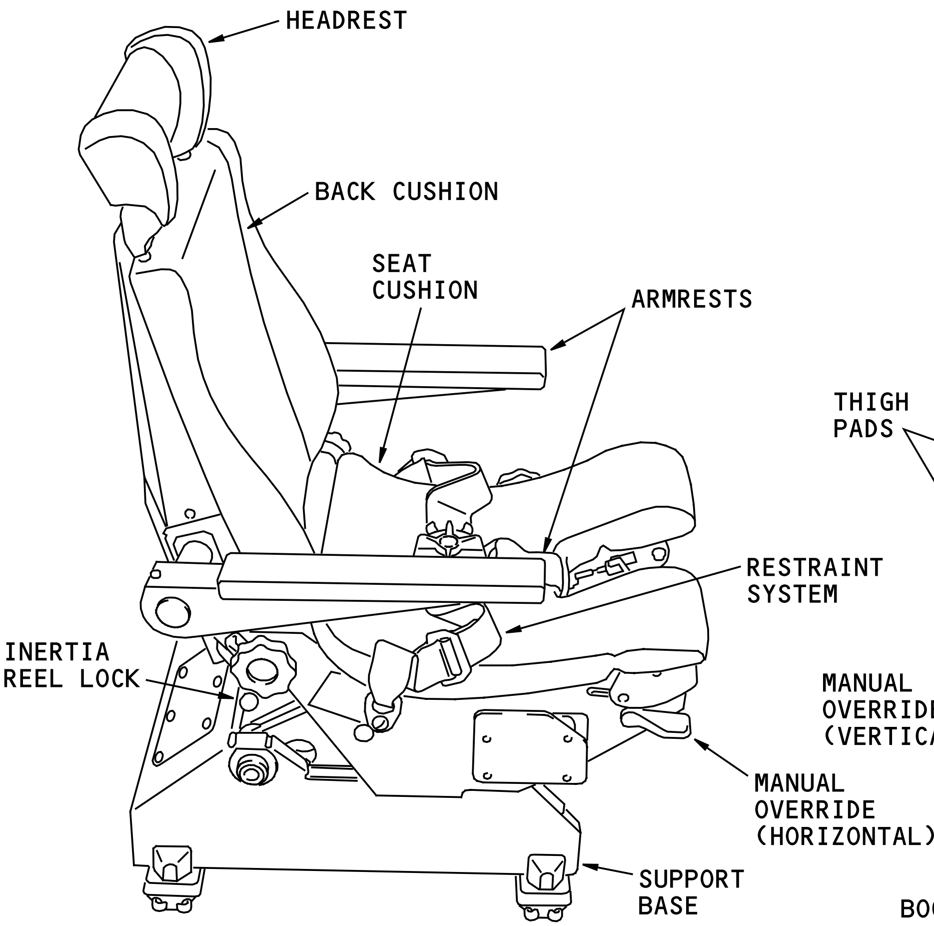
The restraint system has a shoulder harness (not shown), lap belt, and crotch strap. The inertia reel for the shoulder harness has a manual lock.

The support base has bogies which attach the seat to the floor tracks. The shape of the floor tracks give forward/aft adjustment as well as inboard/outboard movement for entry and exit.

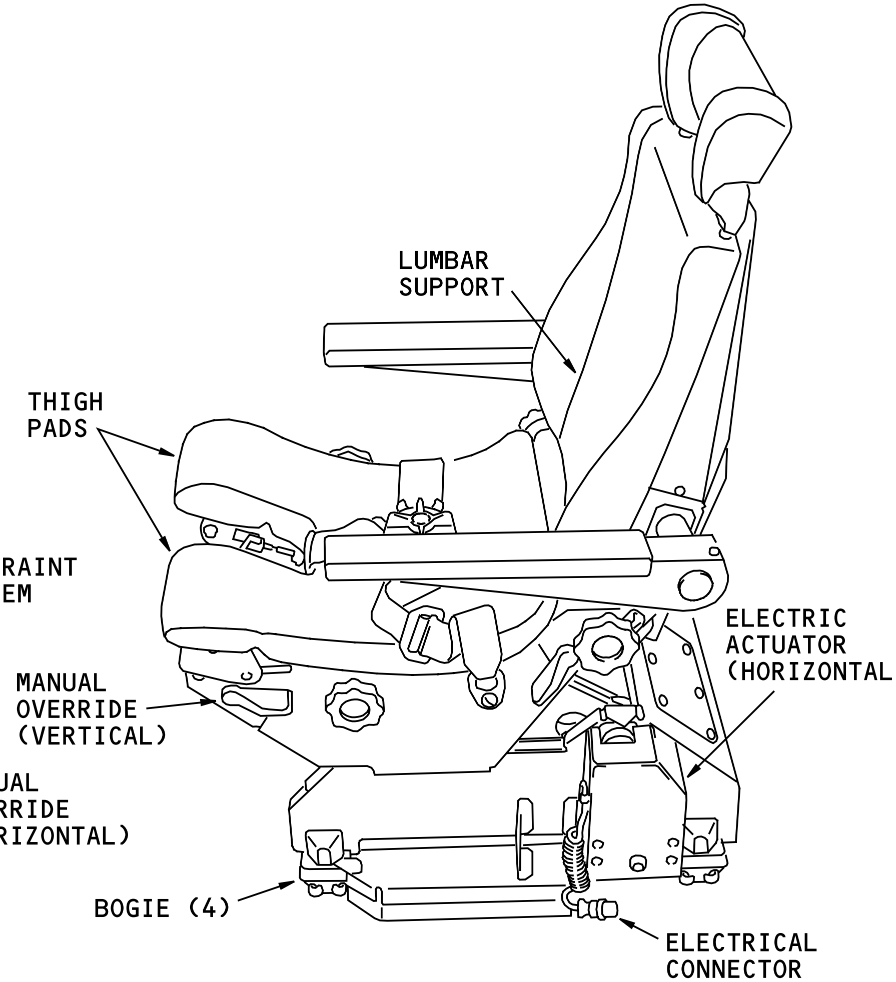
An electric actuator moves the seat horizontally on the seat tracks. The horizontal actuator drives a gear (not shown) which engages a toothed rack on the floor track. The horizontal adjustment has a manual override.

An electric actuator (internal) moves the seat vertically. The vertical adjustment has a manual override.

A coiled cord with an electrical connector connects the seat electrical system to the airplane wiring.



CAPTAIN SEAT - RIGHT SIDE



CAPTAIN SEAT - LEFT SIDE

25-10-00-002 Rev 0

FLIGHT COMPARTMENT - CAPTAIN/FIRST OFFICER SEAT - INTRODUCTION

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Headrest

Pull up or push down on the headrest to adjust the vertical position. Move the headrest cushion to the right and turn it to adjust the headrest angle. The angle adjustment has eight positions.

Recline

To increase the recline angle, pull up and hold the recline control then push aft on the seat back. Release the control to lock the seat back in the new position.

To decrease the recline angle, pull up and hold the recline control. Let the seat back move toward the upright position. Release the control to lock the seat back in the new position.

Lumbar Support

The back cushion has a built in lumbar support. Turn the left lumbar support control to move the back cushion up or down. Turn the right lumbar support control to move the back cushion forward or aft.

Armrests

Adjustment knobs are under the forward end of the armrests. Turn the knob to move the armrest up or down.

The armrests fold to a vertical position for entry and exit. Lift up on the front of the armrest to fold it up. When the armrest is folded up as far as it will go, you can push it in toward the center of the seat.

Thigh Pads

Turn the thigh pad control to lift or lower the thigh pad.

Horizontal Adjustment

Hold the horizontal control switch in the forward position to move the seat inboard and forward. The seat stops automatically when it is all the way forward. Hold the switch in the aft position to move the seat aft and outboard. The seat stops automatically when it is all the way outboard.

If the power adjustment fails, adjust the horizontal position of the seat manually. Pull up and hold the horizontal movement manual override. This disengages the electric actuator from the track. Move the seat to the desired position. Release the manual override to lock the seat in the new position. Stops on the seat tracks keep the horizontal movement to a limit.

Vertical Adjustment

Hold the vertical control switch in the up position to move the seat up. The seat stops automatically when it is all the way up. Hold the switch in the down position to move the seat down. The seat stops automatically when it is all the way down.

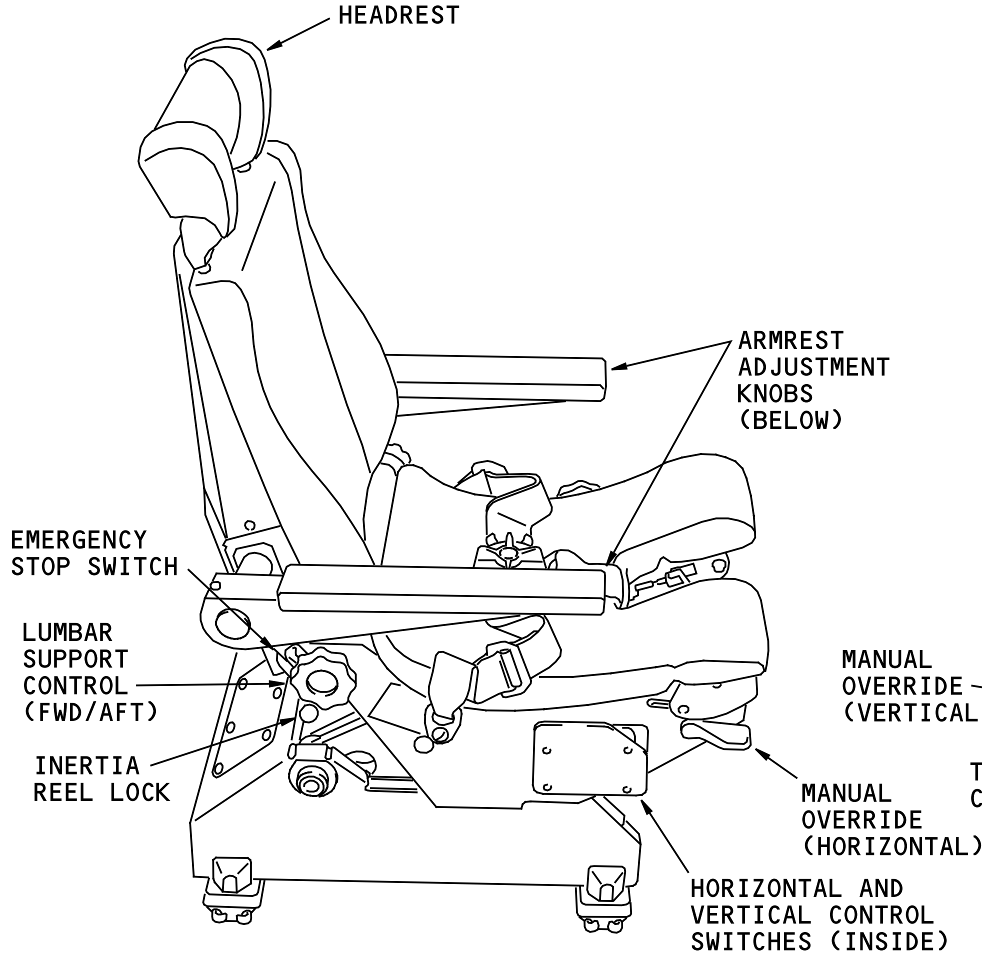
If the power adjustment fails, adjust the vertical position of the seat manually. Move some of your weight off the seat then pull up and hold the vertical movement manual override. This disengages the electric actuator. Move the seat to the desired position. Release the manual override to lock the seat in the new position. Internal stops keep the vertical movement to a limit.

Emergency Stop

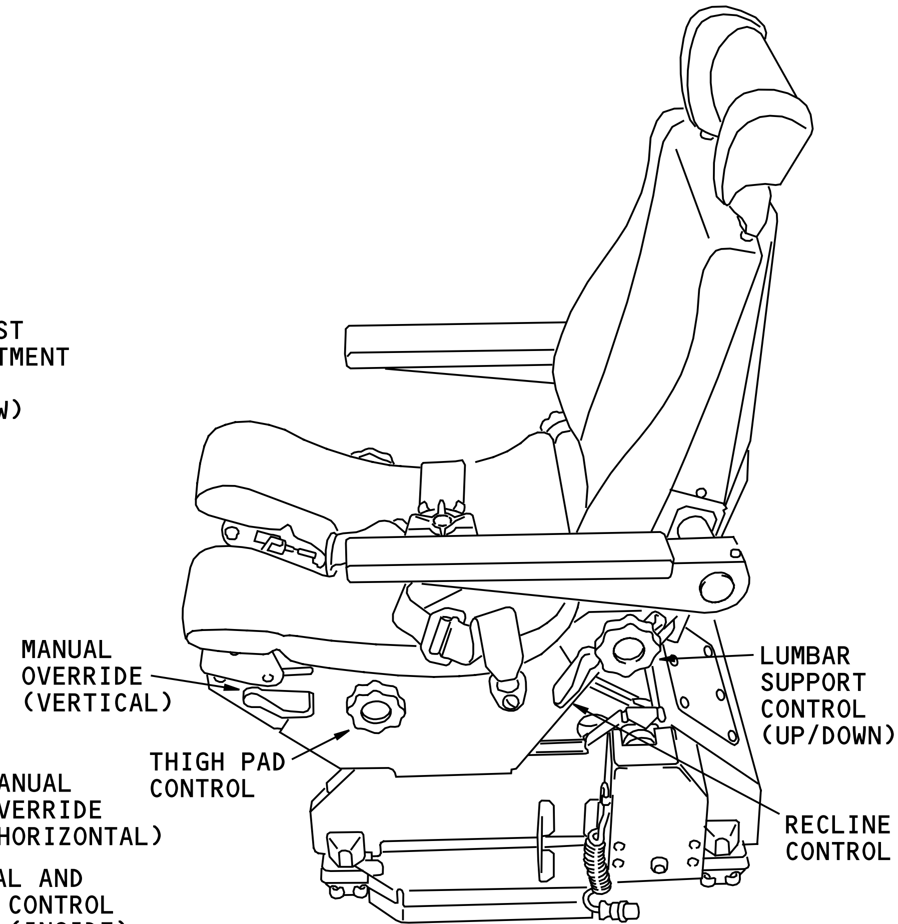
If the seat continues to move when you release an adjustment switch, use the emergency stop switch.

Inertia Reel Lock

The inertia reel lock has positions for lock and unlock.



CAPTAIN SEAT - RIGHT SIDE



CAPTAIN SEAT - LEFT SIDE

25-10-00-003 Rev 0

FLIGHT COMPARTMENT - CAPTAIN/FIRST OFFICER SEAT - OPERATION

FLIGHT COMPARTMENT - CAPTAIN/FIRST OFFICER SEAT - FUNCTIONAL DESCRIPTION

General

The left utility bus supplies 115v ac three phase power to the circuits. The vertical and horizontal control circuits are similar. Phase-switching relays control the direction of the motors. An emergency switch lets you stop the motors if the normal control circuits fail.

The circuits for the captain and first officer seats are similar except for the power source; power for the first officer seat comes from the right utility bus.

Up Operation

Phase C supplies power to the UP/DOWN switch. When you hold the switch in the UP position, power goes through the motor thermal protectors and the emergency switch to the power relay. The relay energizes and supplies three phase power to the up and down relays.

Another set of contacts in the UP/DOWN switch permits power to go through the up limit switch and the down relay to energize the up relay. Three phase power operates the vertical motor to move the seat up. When the seat is up as far as it will go, the up limit switch opens and removes power from the up relay coil. The relay de-energizes and removes power from the motor.

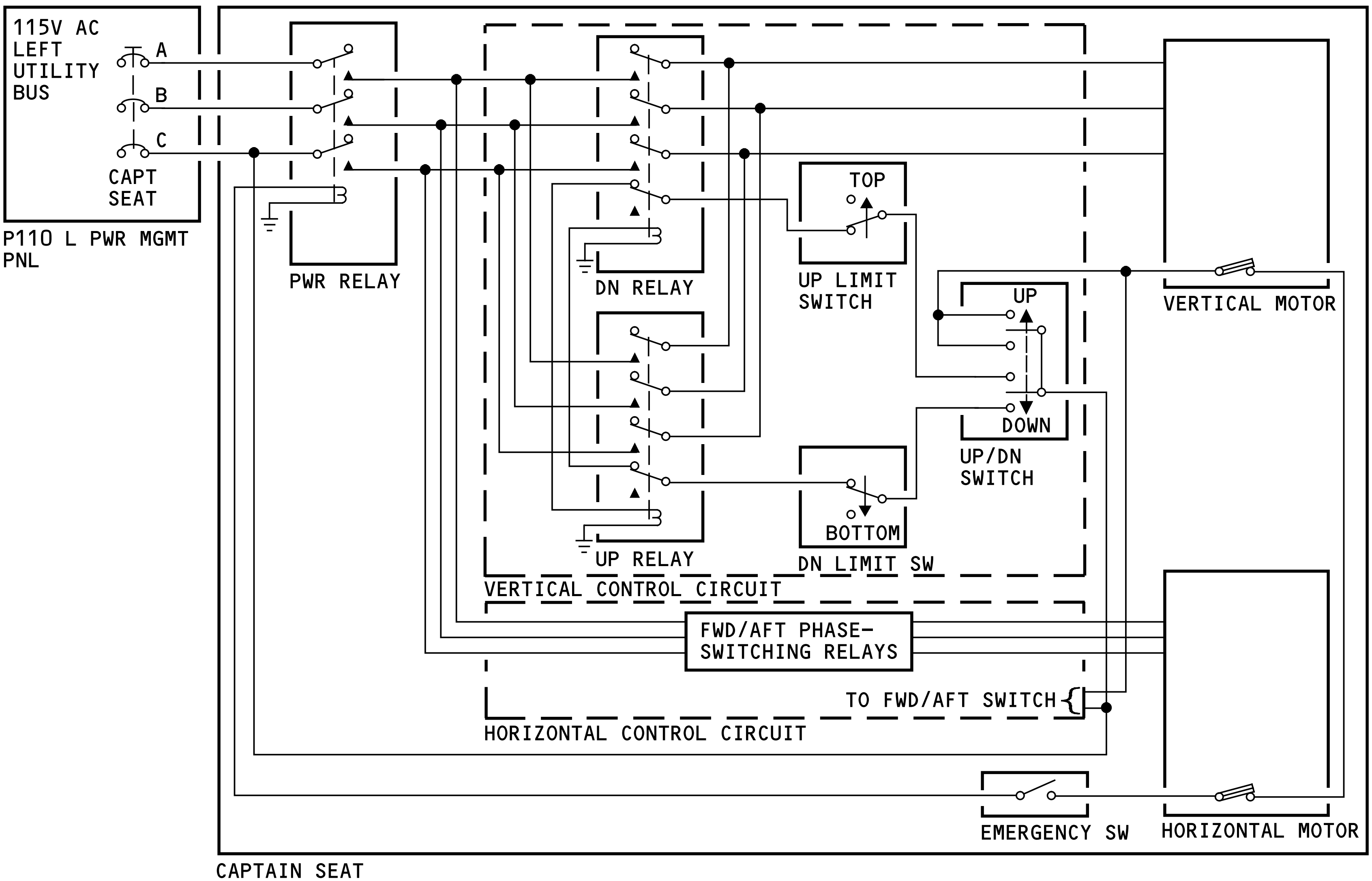
Down Operation

When you hold the switch in the DOWN position, power goes through the motor thermal protectors and the emergency switch to the power relay. The relay energizes and supplies three phase power to the up and down relays.

Another set of contacts in the UP/DOWN switch permits power to go through the down limit switch and the up relay to energize the down relay. Three phase power operates the vertical motor to move the seat down. When the seat is down as far as it will go, the down limit switch opens and removes power from the down relay coil. The relay de-energizes and removes power from the motor.

Horizontal Operation

The horizontal control circuit is similar to the vertical control circuit. A FWD/AFT switch controls the horizontal motor through phase-switching relays and limit switches.



25-10-00-004 Rev 0

FLIGHT COMPARTMENT - CAPTAIN/FIRST OFFICER SEAT - FUNCTIONAL DESCRIPTION

FLIGHT COMPARTMENT - CAPTAIN/FIRST OFFICER SEAT - TRAINING INFORMATION POINTS

Seat Removal

To remove the seat, do these steps:

- Disconnect the electrical connector
- Remove the forward stops from the seat tracks
- Use the horizontal control manual override to disengage the actuator gear from the seat track
- Slide the seat forward off the tracks.

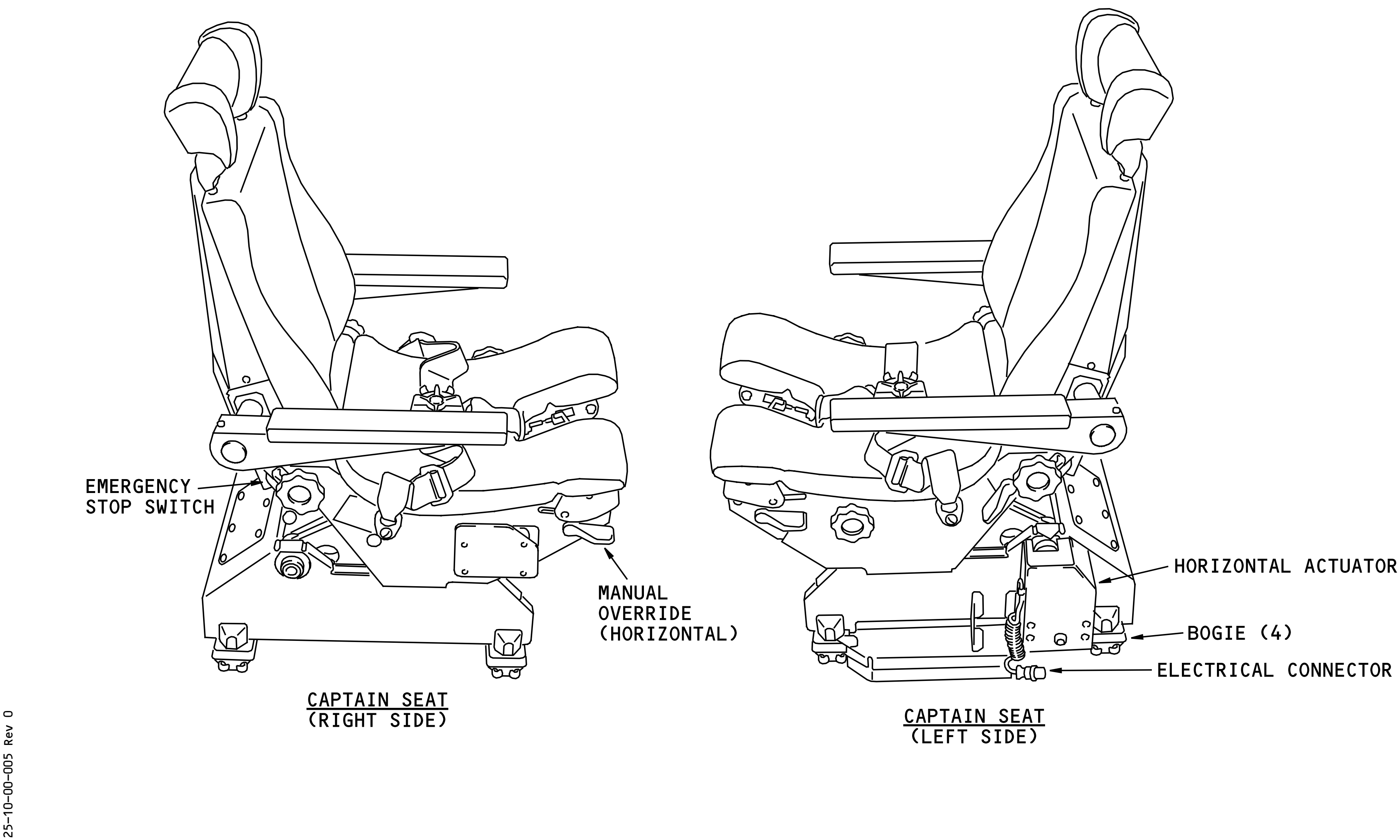
Seat Installation

To install the seat do these steps:

- Put the seat just forward of the seat tracks
- Turn the bogies so the roller with the angled face is inboard
- Align and engage the bogies with the seat tracks as you slide the seat aft
- Roll the seat aft until the actuator gear reaches the rack on the seat track
- Use the horizontal control manual override to raise the gear out of the way
- Turn the gear so it meshes with the rack, then release the manual override control
- Install the seat stops
- Connect the electrical connector.

Power Removal

The emergency stop switch removes power from the horizontal and vertical control circuits, but does not remove power from the seat. Disconnect the electrical connector if you need to remove power from the seat for maintenance.



FLIGHT COMPARTMENT - CAPTAIN/FIRST OFFICER SEAT - TRAINING INFORMATION POINTS

FLIGHT COMPARTMENT - OBSERVER SEATS - OPERATION

General

The second observer seat has no adjustments. To stow the seat, fold the armrests and seat bottom up. Fasten two retaining straps (not shown) to hold the seat bottom up.

The following adjustments are for the first observer seat.

Headrest

Pull up or push down on the headrest to adjust the vertical position. Move the top of the headrest forward or aft to adjust the headrest angle.

Recline

Pull back and hold the recline control to unlock the seat. Push aft on the seat back to increase the recline angle. Release the control to lock the seat back in the new position. To decrease the recline angle, pull back and hold the recline control. Let the seat back move toward the upright position. Release the control to lock the seat back in the new position.

Lumbar Support

Turn the upper lumbar support control to move the support up or down. Turn the lower lumbar support control to move the support forward or aft.

Armrests

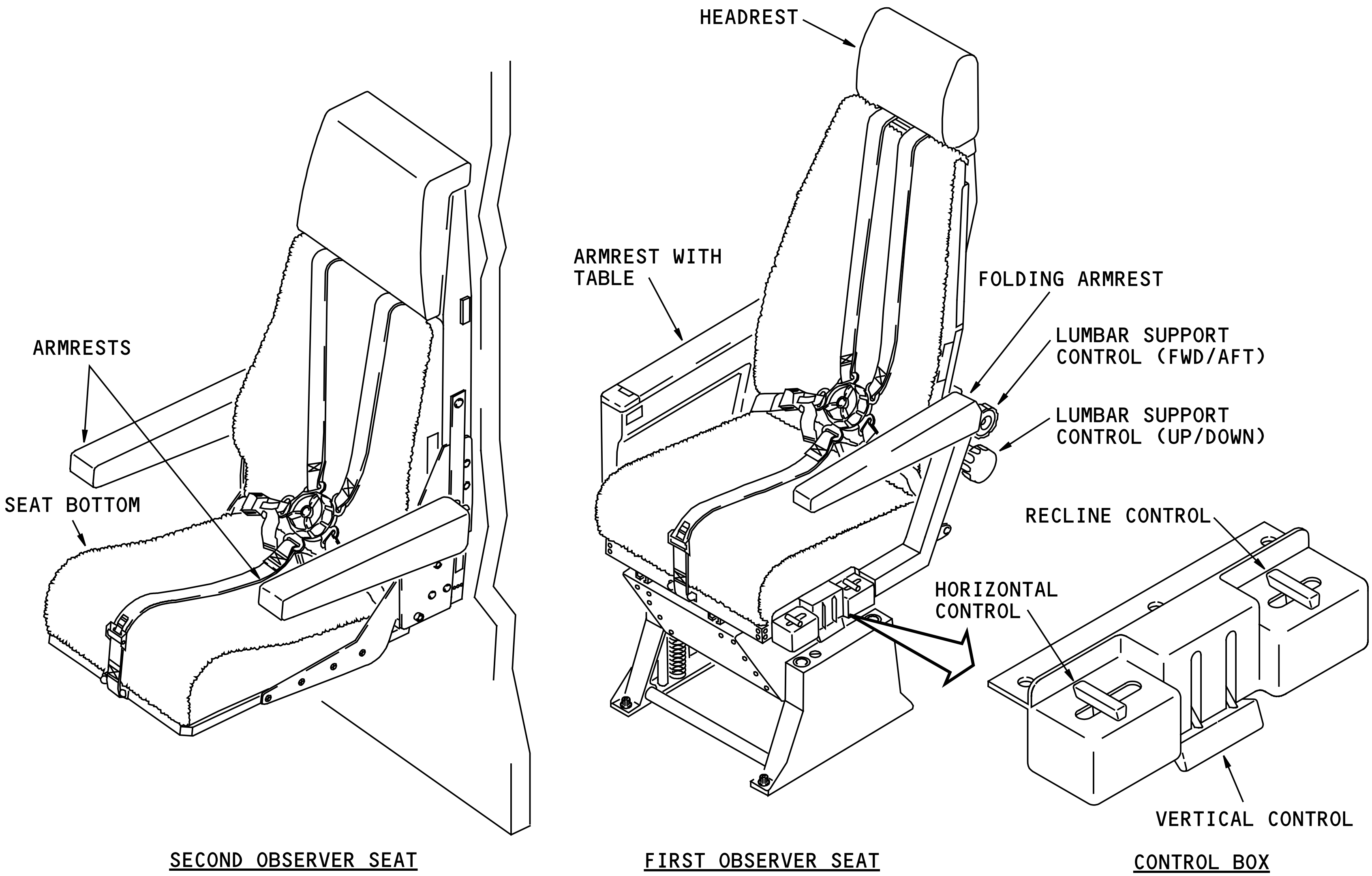
The left armrest folds to a vertical position for entry and exit. Lift up on the front of the armrest to fold it up. The right armrest contains a folding table. Open the top of the armrest, lift and unfold the table.

Horizontal

Pull back and hold the horizontal control to unlock the seat. Move the seat forward or aft. Release the control to lock the seat in the new position.

Vertical

Move some of your weight off the seat then pull up and hold the vertical control. Spring pressure pushes up on the seat. Move the seat up or down to the desired position. Release the control to lock the seat in the new position.



25-10-00-007 Rev 0

FLIGHT COMPARTMENT - OBSERVER SEATS - OPERATION

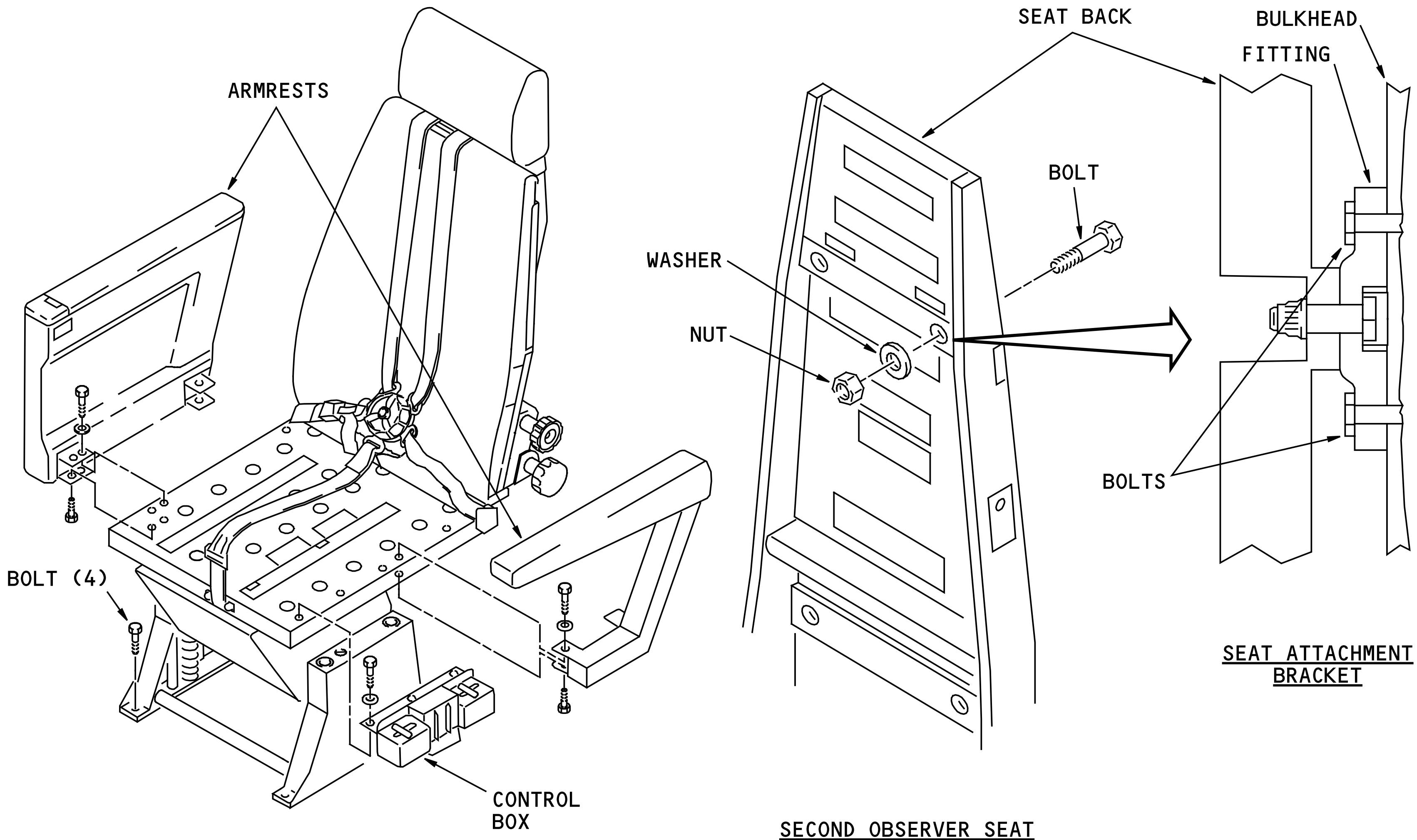
FLIGHT COMPARTMENT - OBSERVER SEATS - TRAINING INFORMATION POINTS

First Observer Seat

Four bolts attach the first observer seat to the floor. To move the seat through the flight deck door, remove both armrests and the control box from the seat. Do not disconnect the control cables from the box or the seat.

Second Observer Seat

Four bolts and fittings attach the second observer seat to the aft flight deck bulkhead. To remove the seat, remove the four nuts and washers. If you remove the fittings from the bulkhead, label the fittings so you can install them again in their original positions.



FIRST OBSERVER SEAT

SECOND OBSERVER SEAT

SEAT ATTACHMENT BRACKET

25-10-00-008 Rev 1

FLIGHT COMPARTMENT - OBSERVER SEATS - TRAINING INFORMATION POINTS

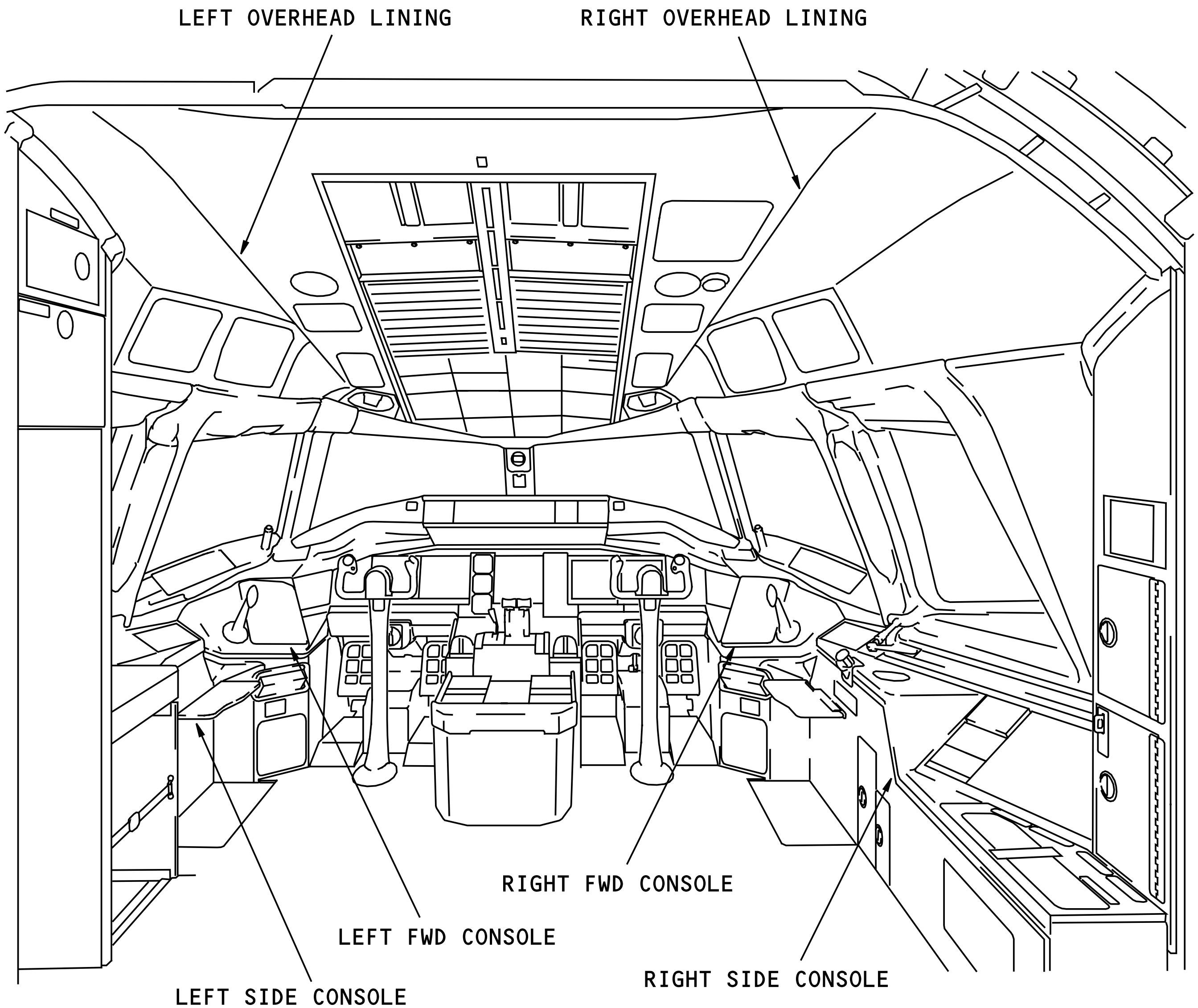
FLIGHT COMPARTMENT - FLIGHT COMPARTMENT LINING

Physical Description

Flight compartment linings are made of fiberglass-faced honeycomb material. The inboard surfaces are a washable and scratch-resistant decorative laminate. Screws attach the linings to the structure.

The flight deck has these linings:

- Left and right overhead lining
- Left and right forward console
- Left and right side consoles.



FLIGHT COMPARTMENT - FLIGHT COMPARTMENT LINING

PASSENGER COMPARTMENT - SIDEWALL PANELS

Location

The sidewall panels are on the outer sides of the passenger compartment on the walls.

Physical Description

The sidewall panels are made of a graphite composite that have a Tedlar lamination.

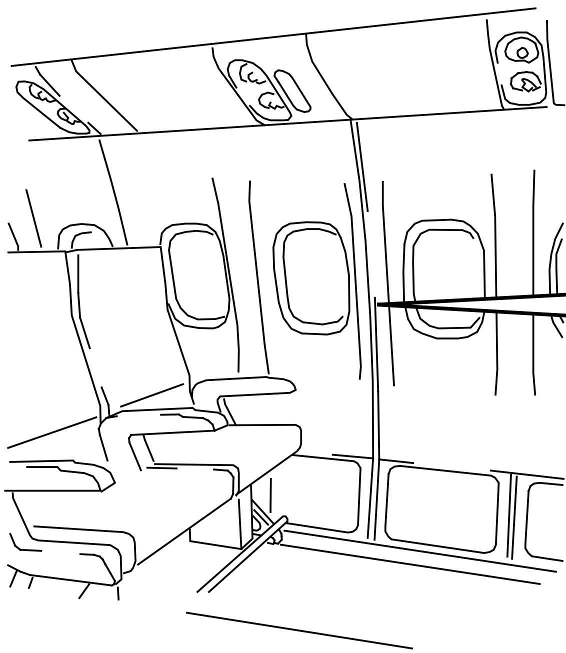
The panels have either zero, one, or two openings for the windows. They attach to the airplane structure with screws. Decorative covers go above the screws. The passenger service unit support holds the top of the panel.

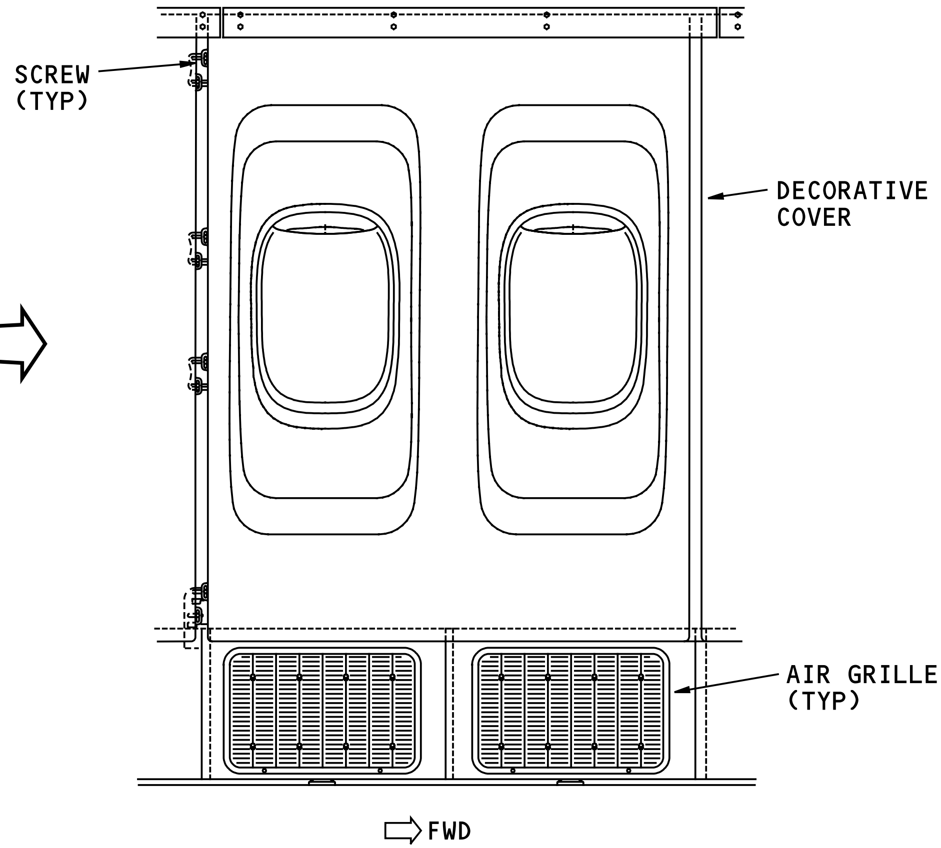
The panels have air grilles. The air grilles attach to the panel with quarter turn fasteners.

Training Information Point

To remove a sidewall panel, you must do these steps:

- Remove the passenger seats
- Remove the air grilles
- Remove the decorative covers between the panels
- Pull the lower edge of the panel inboard to release the top of the panel
- Remove the panel.





25-20-00-002 Rev 0

PASSENGER COMPARTMENT - SIDEWALL PANELS

PASSENGER COMPARTMENT - WINDOW REVEALS

Location

The window reveals are in openings in the sidewall panels.

Physical Description

The reveal assembly has:

- A shade
- Engagement points for upper reveal support
- A seal
- An inner reveal
- A dust cover
- Latch access hole
- A latch.

The inner window reveal holds the dust cover. The dust cover is clear plastic.

The seal closes the space between the passenger window assembly and the dust cover.

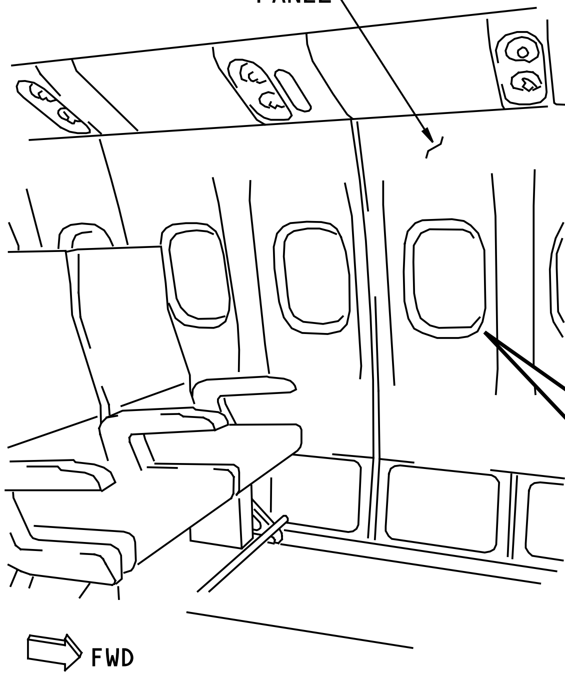
The outboard side of the sidewall panel has these components (not shown) that engage the window reveal:

- Shade track
- Upper reveal support
- Lower reveal support.

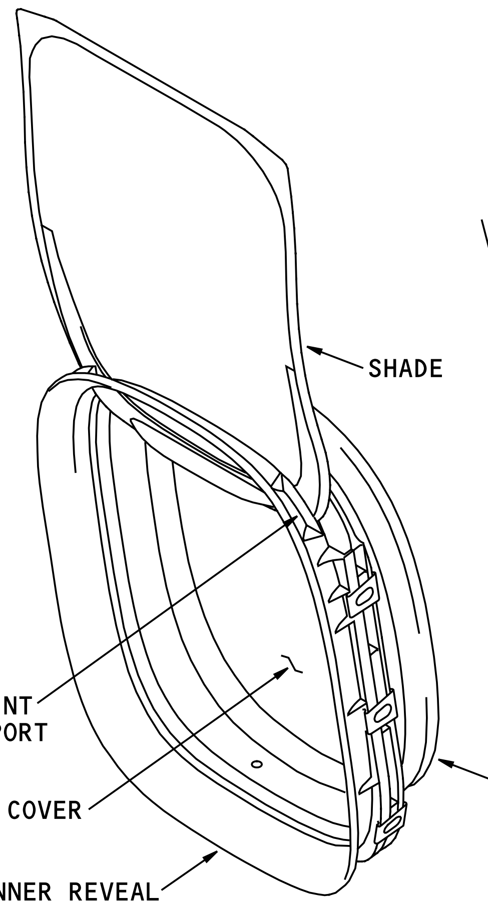
The upper reveal support engages the top of the window reveal assembly. The lower reveal support engages the latch. The shade track guides the movement of the shade.

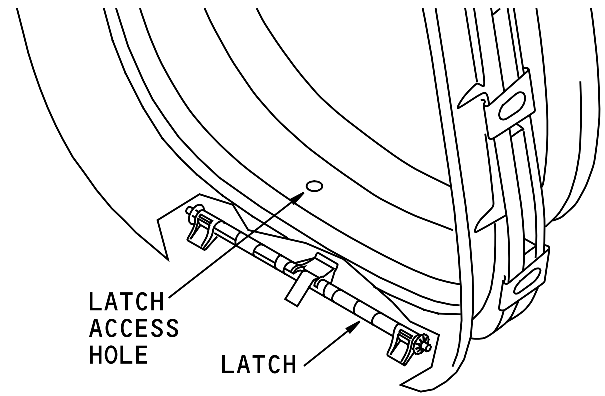
Training Information Point

You put a pin type tool through the latch access hole to release the latch. Put the shade in the down position when you move the shade out of and into the sidewall.



PASSENGER COMPARTMENT





WINDOW REVEAL

PASSENGER COMPARTMENT - WINDOW REVEALS

25-20-00-027 Rev 1 04/26/96

PASSENGER COMPARTMENT - MAIN CEILING PANEL

Location

The main ceiling panels are above the aisles in the passenger compartment. They are on both sides of the conditioned air outlet grilles.

Physical Description

The panels are made of graphite that have a Tedlar lamination.

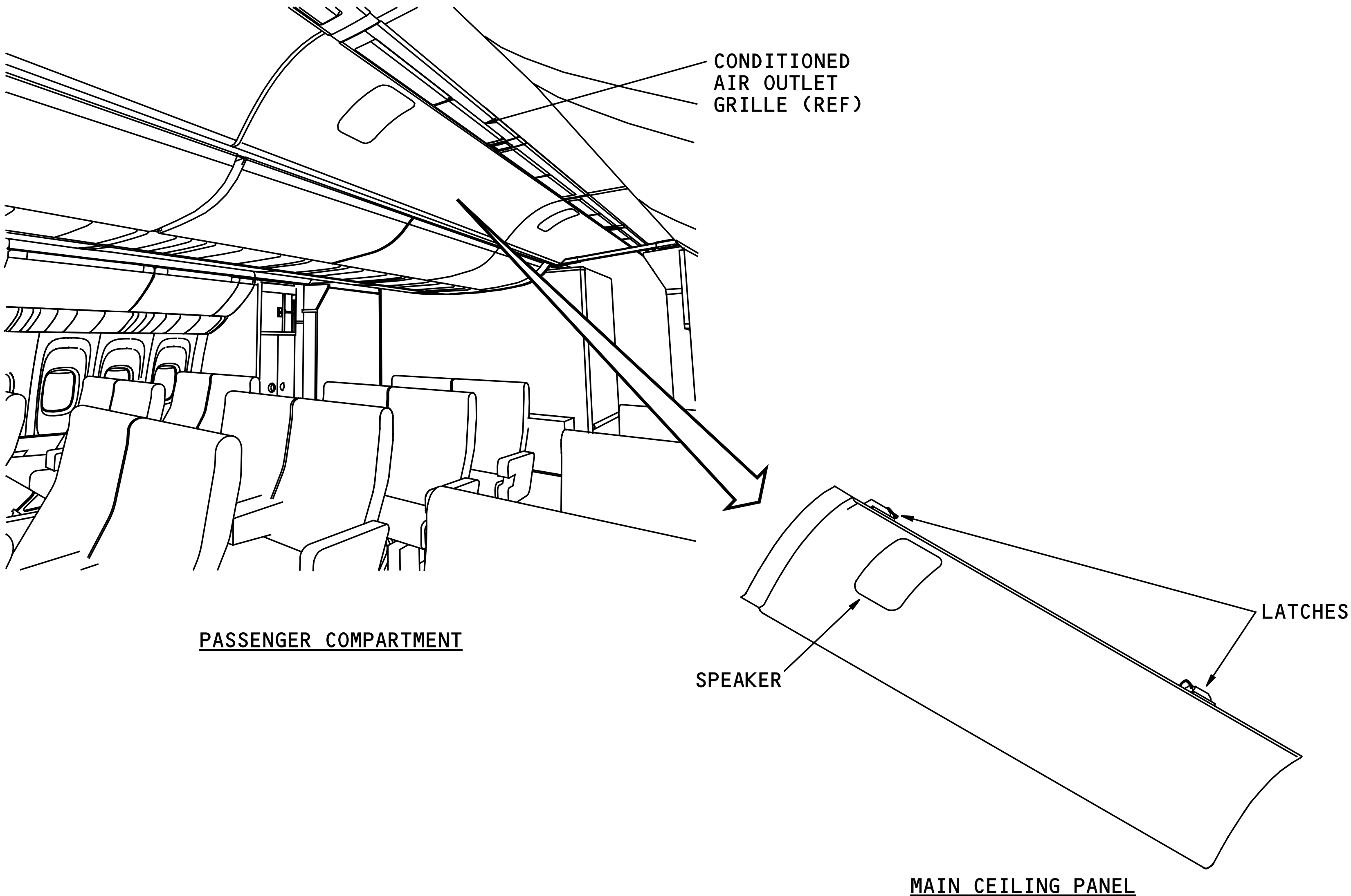
The main ceiling panels attach with lanyards (not shown), latches, and hinges (not shown). Some panels have speakers.

Training Information Point

For some panels you must disconnect the speaker wires to remove the panel.

To lower a main ceiling panel you do these things:

- Remove the air grilles between the inboard and outboard main ceiling panels
- Turn the latches above the panel, there is one latch at each end of the panel
- Let the panel hang by the lanyards
- Disconnect the lanyards
- Lift the panel out of the hinges.



25-20-00-004 Rev 0

PASSENGER COMPARTMENT - MAIN CEILING PANEL

PASSENGER COMPARTMENT - OVERDOOR PANEL

Location

The overdoor panels are on the ceiling, inboard from each passenger entry door.

Physical Description

The panels are made of a graphite composite material and have a Tedlar lamination.

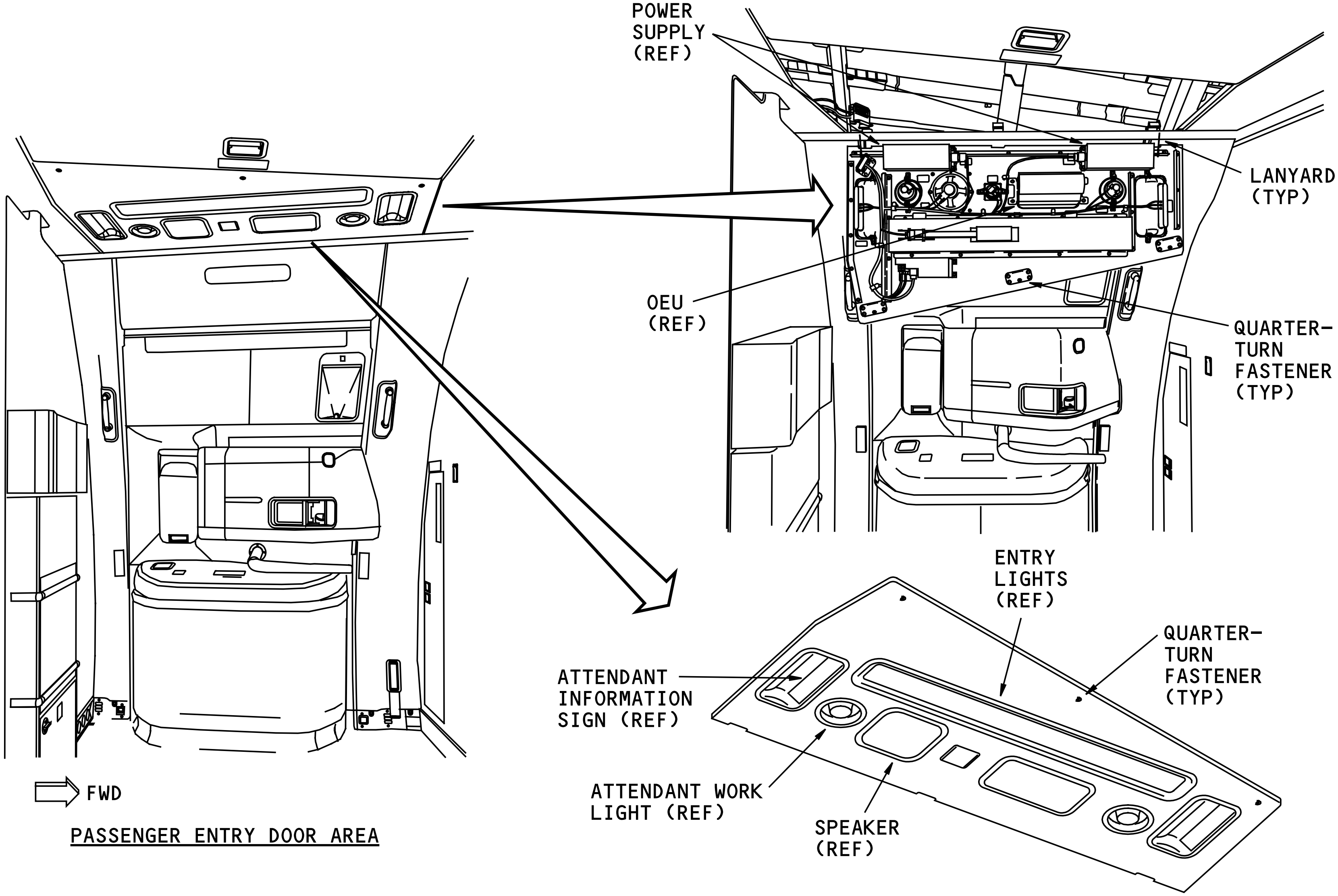
These components attach to the overdoor panels:

- Power supply for the emergency lights
- Lights
- Speaker
- Attendant information sign
- Overhead electronics unit (OEU).

The panels attach with two lanyards and quarter turn fasteners.

Training Information Point

To open an overdoor panel you turn the quarter turn fasteners and lower the panel. If you need to remove the overhead panel you disconnect the lanyards from the outboard side of the panel.



25-20-00-006 Rev 0

PASSENGER COMPARTMENT - OVERDOOR PANEL

PASSENGER COMPARTMENT - CONDITIONED AIR OUTLET GRILLE

Location

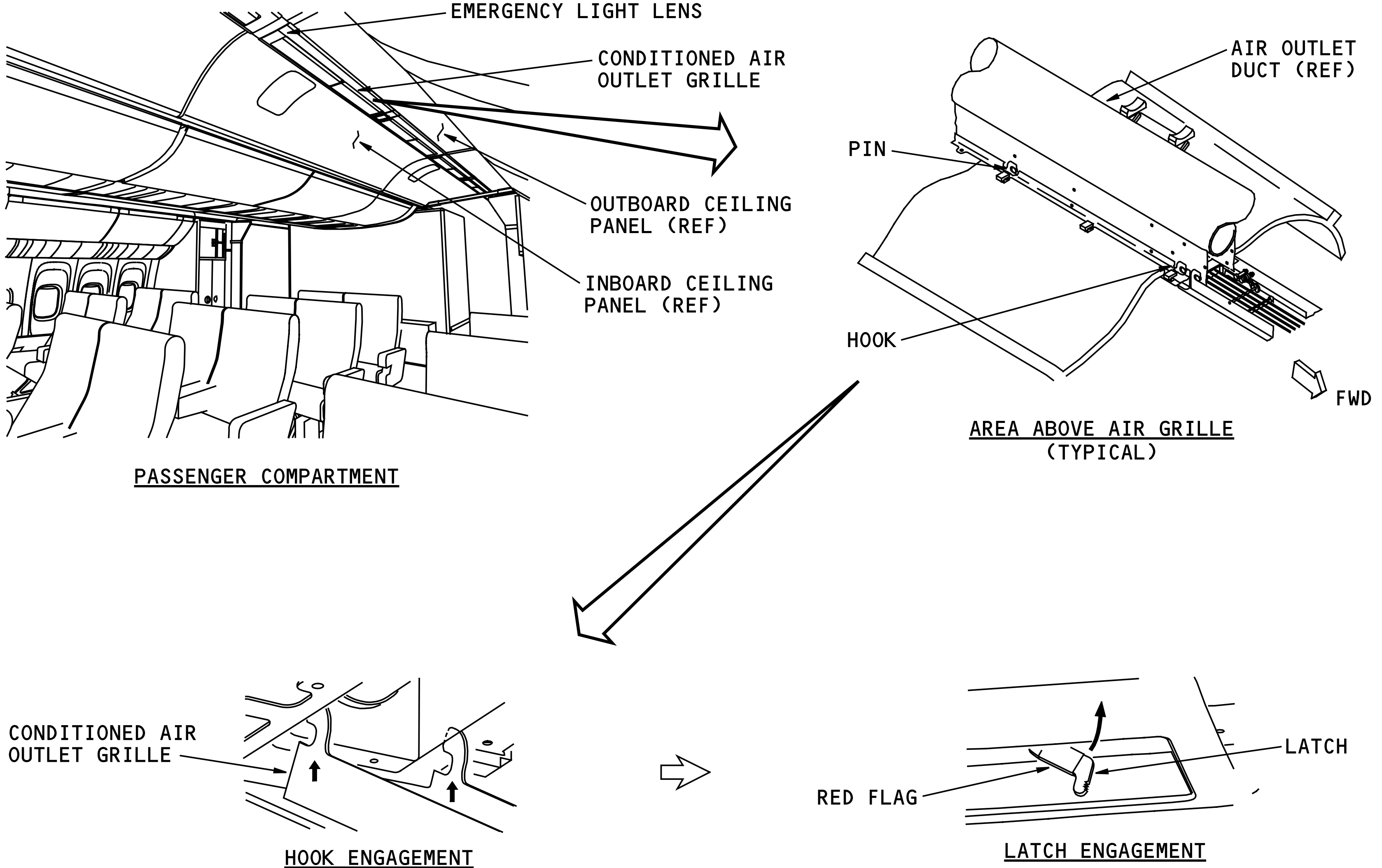
The conditioned air outlet grilles are above the aisles in the passenger compartment. They are between the inboard and outboard ceiling panels.

Physical Description

The grilles are made of plastic. Each grille has hooks and a latch to attach the grille to structure.

Training Information Point

To remove the air outlet grilles, remove the grille with the emergency light lens first. When you install the grilles, install the grille with the emergency light lens last. Also, make sure each hook on the grille is correctly engaged with the pin in the ceiling structure. The red flag on the latch will not show when you latch the grille correctly.



25-20-00-025 Rev 1 04/26/96

PASSENGER COMPARTMENT - CONDITIONED AIR OUTLET GRILLE

PASSENGER COMPARTMENT - PASSENGER SERVICE UNITS

General

These are the different types of passenger service units (PSUs):

- Gasper air
- Oxygen
- Spacer
- Reading Light
- Passenger information sign (not shown)
- Temperature sensor (not shown)
- Ambient noise sensor (not shown).

The PSUs may be installed in any order. This makes it easy for you to put the PSUs in sequence for different passenger compartment layouts.

Physical Description

The PSUs attach to the PSU rails with two or four latches. The latches are also the hinges for the PSUs.

Location

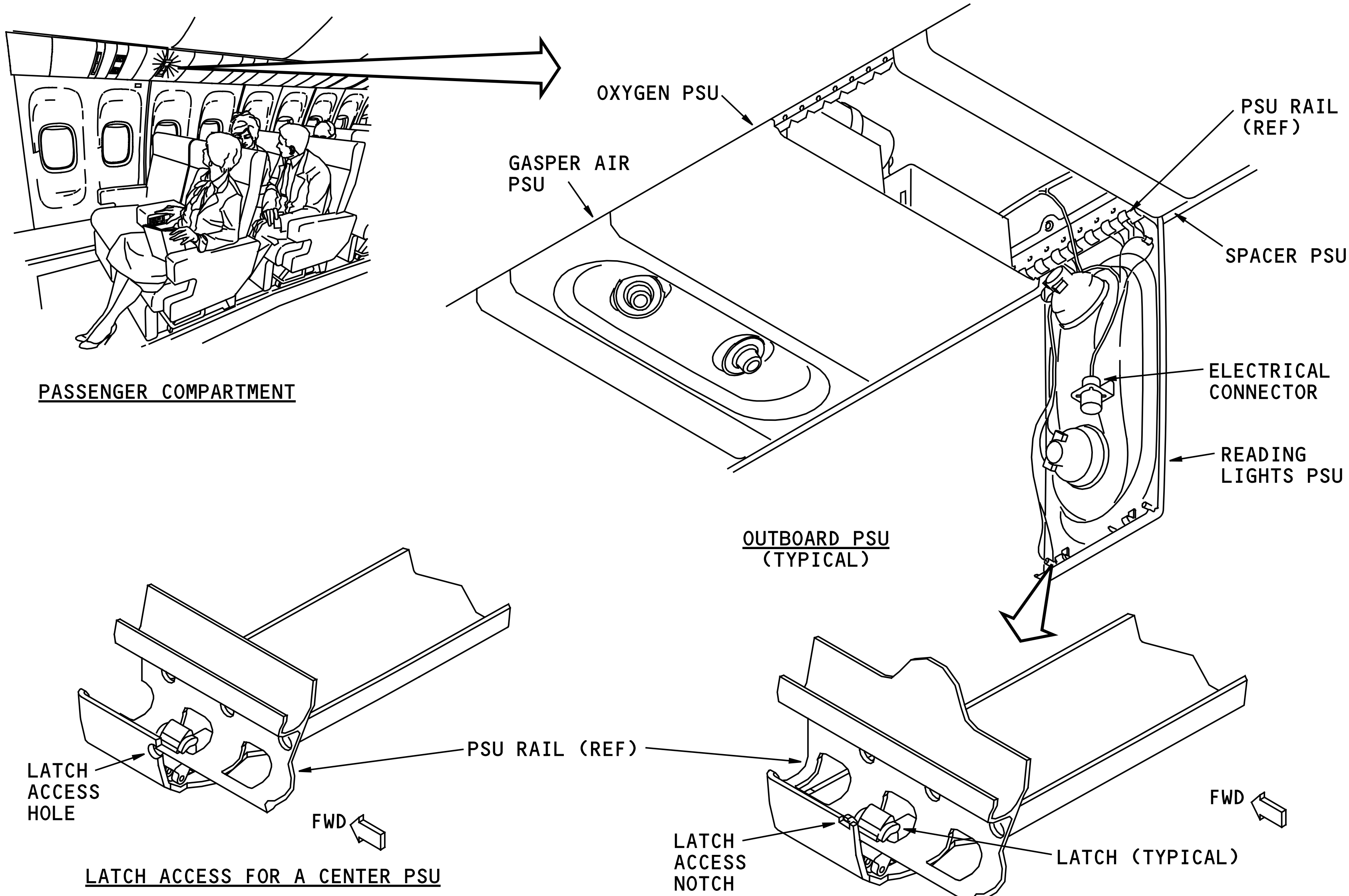
There are PSUs under the outboard and center stowage bins, above the passenger seats. There are also PSUs at attendant stations (not shown) and in lavatories (not shown).

Training Information Point

You use an allen wrench or a cylindrical rod to open a PSU. You put the tool through the access notch (outboard PSUs) or hole (center PSUs) and push on the latch. You can open the PSU from either side. To remove a PSU you open it from one side and then release the other latches from inside the PSU.

The outboard PSUs are interchangeable.

When you replace a PSU, make sure you install it so that the correct end points forward.



25-20-00-007 Rev 0

PASSENGER COMPARTMENT - PASSENGER SERVICE UNITS

PASSENGER COMPARTMENT - PASSENGER SEATS

General

First class and business class seats have electric controls for recline, lumbar support, and leg rest adjustments. Economy class seats have manual adjustments for recline.

Physical Description

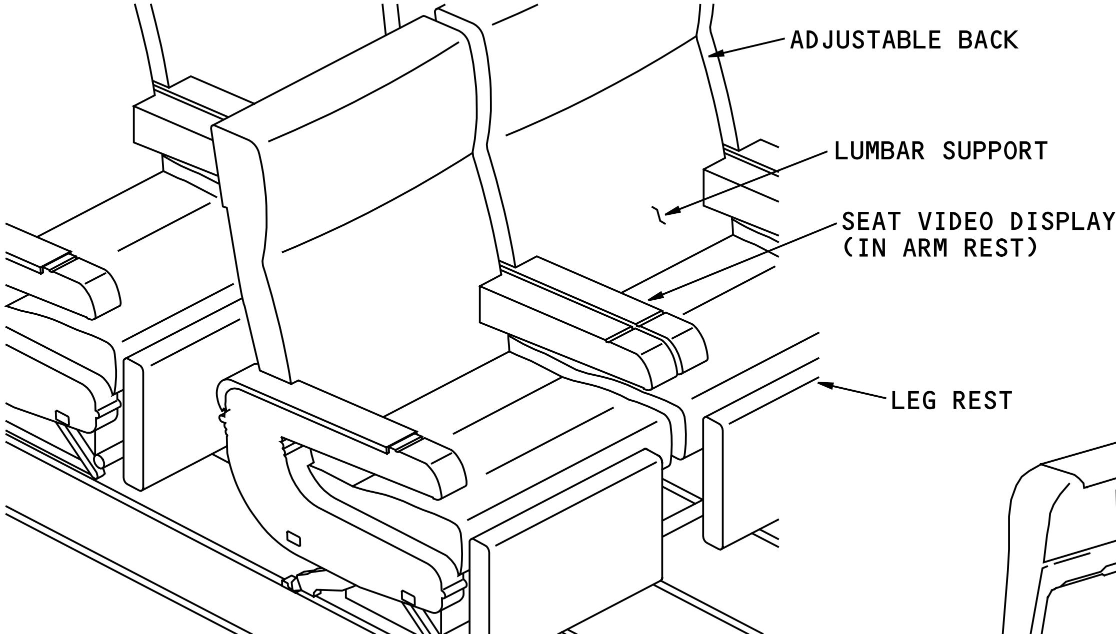
The seats have several components of the passenger entertainment system. The seats can have these components:

- Integrated telephone handset
- Seat video unit (SVU)
- Seat electronics unit (SEU)
- Seat video display.

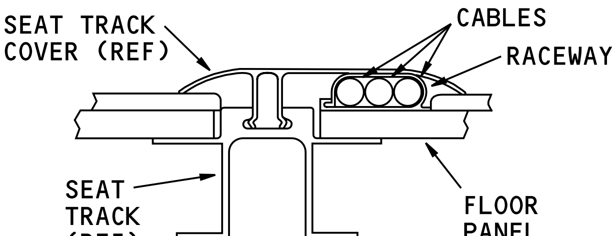
In some seats, the seat video folds and stows in the armrest. In other seats, the seat video display is in the seat back. (For seats immediately behind a bulkhead, the seat video display usually attaches to the bulkhead instead of the seat).

Training Information Point

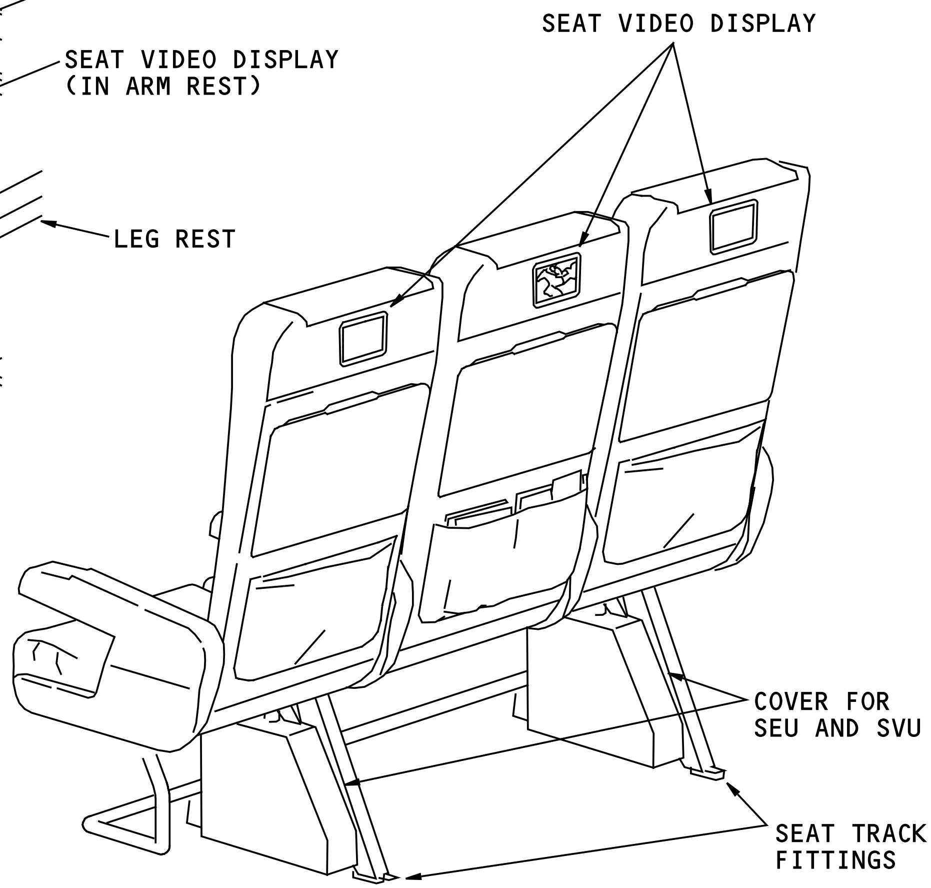
Passenger entertainment system cables connect to the seat electronic units and the seat video units. The cables are inside a plastic raceway adjacent to the seat tracks. A cover hides the seat tracks and cable raceways. Disconnect the seat cables before you remove a seat group.



FIRST CLASS SEATS (TYPICAL)



SEAT CABLES
(CROSS SECTION)



ECONOMY CLASS SEATS (TYPICAL)

25-20-00-015 Rev 1

PASSENGER COMPARTMENT - PASSENGER SEATS

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PASSENGER COMPARTMENT - ATTENDANT SEATS

General

The seat track mounted attendant seats attach to the seat tracks. The wall mounted attendant seats attach to the walls of the lavatories, galleys, or partitions. The seats have no adjustments.

There are two stowage compartments in the seat track mounted seat.

Physical Description

The seat track mounted attendant seats have these parts:

- Headrest cushion
- Backrest cushion
- Seat pan
- Seat cushion
- Seat belt and shoulder harness (not shown)
- Seat structure
- Stowage compartment doors.

The wall mounted attendant seats have these parts:

- Headrest cushion
- Backrest cushion
- Seat cushion
- Seat belt and shoulder harness (not shown)
- Seat structure.

The cushions attach to the seat structure with hook and loop tape. Remove the covers from the cushions to dry clean the covers.

Clips (not shown) attach the seat belts and shoulder harness to the seat structure. You can remove the seat belts and shoulder harness to clean them.

Functional Description

The seat structure has a seat pan which folds down. A spring folds the seat pan up when there is no weight on it. A damper (not shown) causes the seat pan to fold up slowly.

The seat track mounted attendant seats have springs (not shown) which cause the stowage compartment doors to close. Latches hold the doors closed. The latch striker plates are adjustable.

The stowage compartment below the seat of the wall mounted attendant seat has a door which folds down. To unlatch the door, move the door latch left or right.

Training Information Point

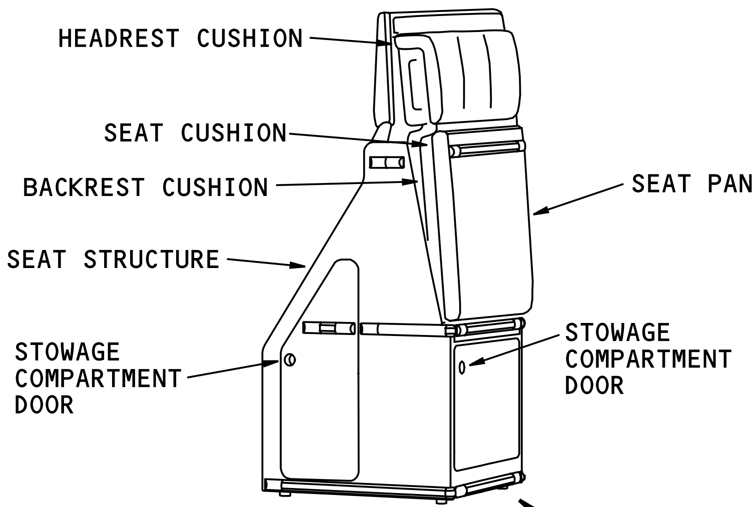
In seats with handsets or switch panels, electrical connectors (not shown) connect the seat wiring to the airplane wiring.

Four seat track fittings attach the seat track mounted attendant seat to the seat tracks.

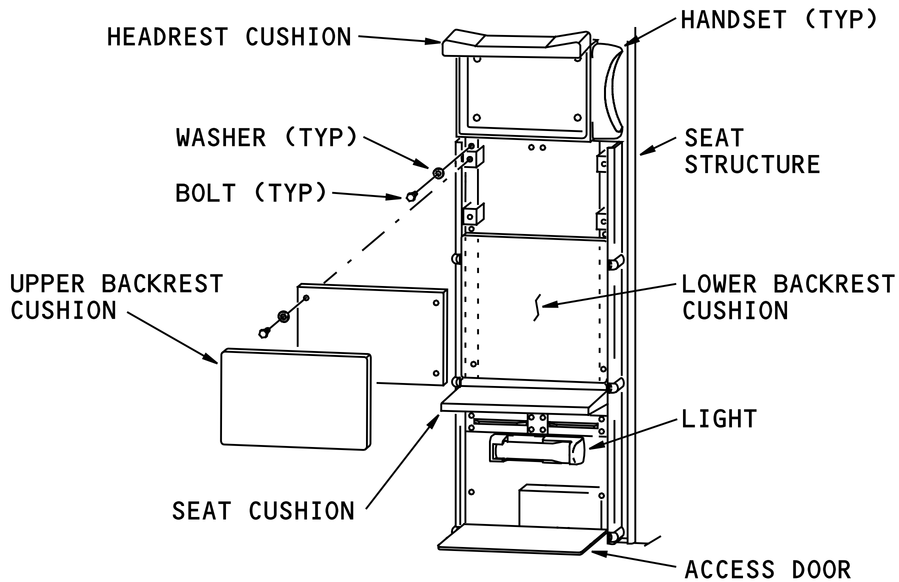
PASSENGER COMPARTMENT - ATTENDANT SEATS

The wall mounted attendant seats attach with bolts to vertical structure. To remove the seat, you must get access to the bolts as follows:

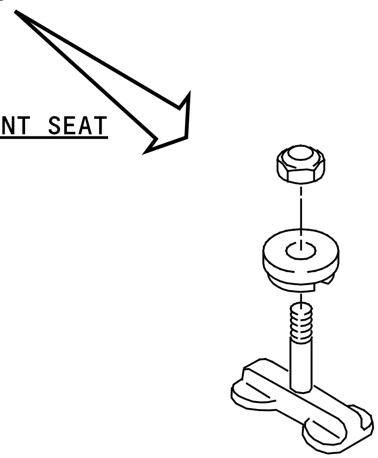
- Move the head rest up
- Remove the back rest
- Open the lower stowage compartment door.



FLOOR MOUNTED ATTENDANT SEAT



WALL MOUNTED ATTENDANT SEAT



SEAT TRACK FITTING

25-20-00-016 Rev 2 04/30/96

PASSENGER COMPARTMENT - ATTENDANT SEATS

PASSENGER COMPARTMENT - OUTBOARD STOWAGE BIN

Purpose

The outboard stowage bin supplies a location above the passenger for carry-on baggage.

Physical Description

The outboard stowage bin module has these components:

- Snubber (2)
- Latch
- Bin
- Strongback assembly.

The outboard stowage bin modules have four lengths:

- 21 inches
- 35 inches
- 42 inches
- 84 inches.

The 84 inch module has two stowage bins that attach to one strongback assembly. The other sizes have only one bin that attaches to the strongback assembly.

Location

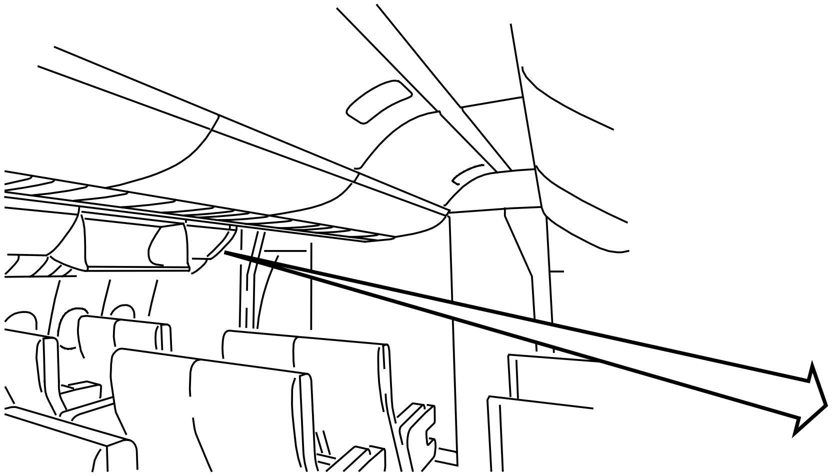
The outboard stowage bins are above the seats outboard of the aisle.

Functional Description

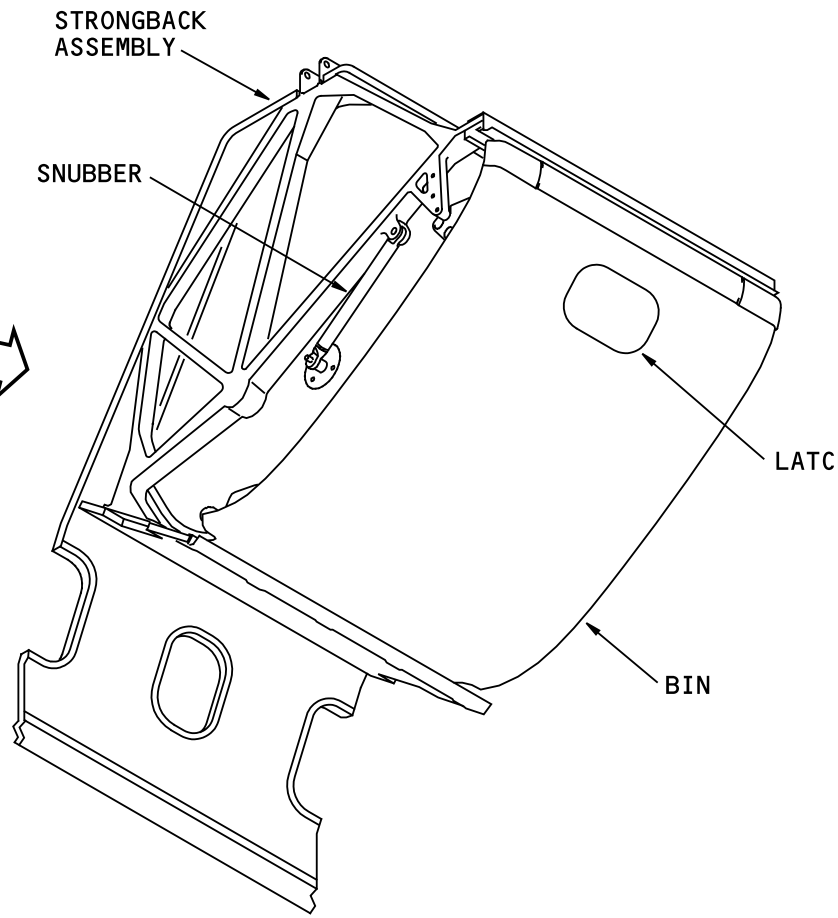
A latch on the face of the stowage bin lets you open the stowage bin. The stowage bin has two snubbers. The snubbers control the speed at which you can open the stowage bin. The bin latches when you close it.

Training Information Point

You can remove the stowage bin from the module and leave the strongback assembly in the airplane. Or you can remove the module with the strongback from the airplane.



PASSENGER COMPARTMENT



OUTBOARD STOWAGE BIN MODULE

25-20-00-017 Rev 1 08/21/95

PASSENGER COMPARTMENT - OUTBOARD STOWAGE BIN

PASSENGER COMPARTMENT - CENTER STOWAGE BIN

Purpose

The center stowage bin supplies a location above the passenger for carry-on baggage. The stowage bins in first class open vertically. The stowage bins in economy class open horizontally or vertically, depending on the seating configuration.

Physical Description

The center stowage bin has these components:

- Snubber (4)
- Spring (2)
- Latch
- Bin.

The center stowage bins have three lengths:

- 21 inches
- 35 inches
- 41 inches.

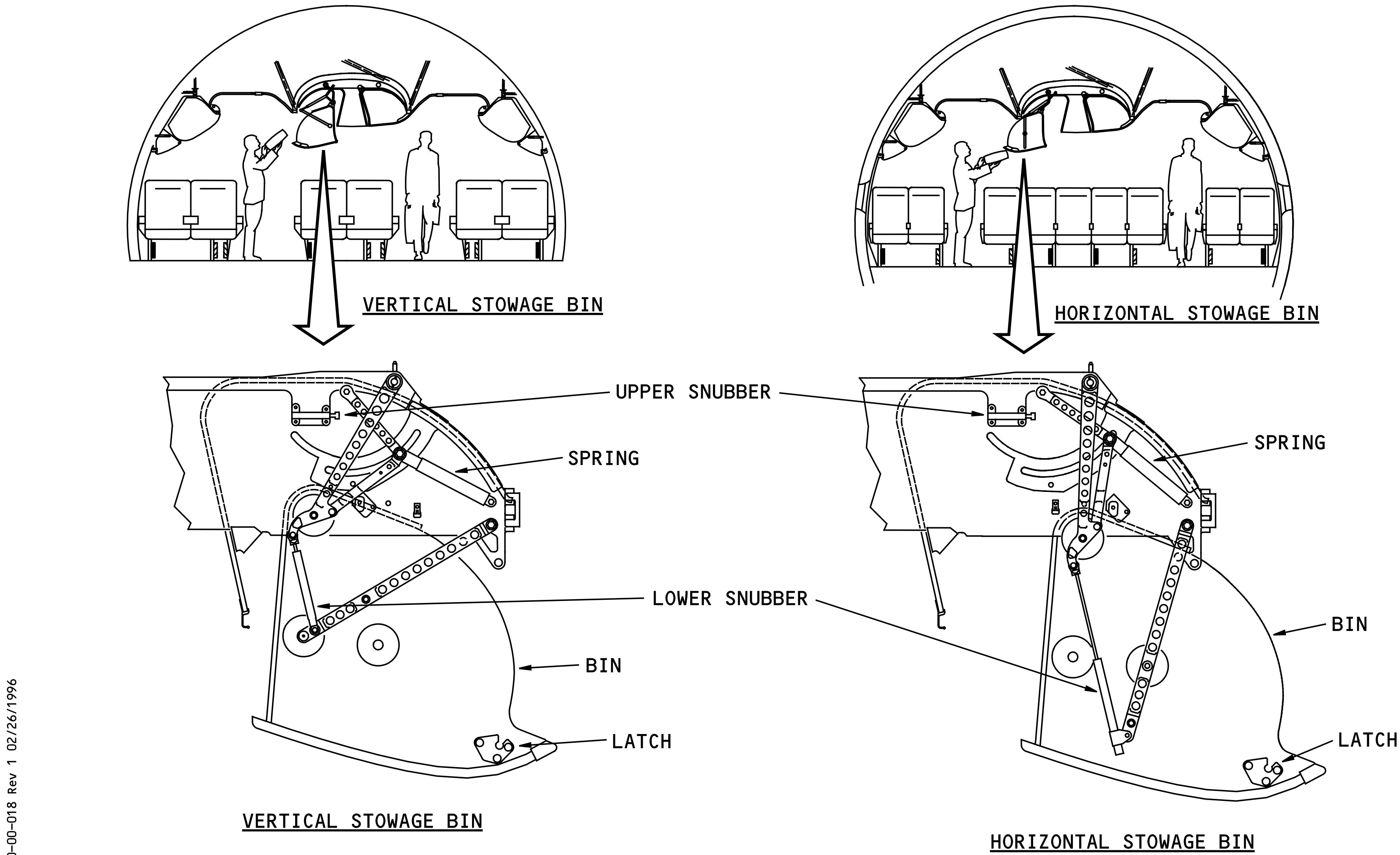
Location

The center stowage bins are above the center seats.

Functional Description

A latch on the face of the stowage bin lets you open the stowage bin. The stowage bin has four snubbers. The two lower snubbers control the speed at which you can open the stowage bin. The two upper snubbers control the speed at which you can close the stowage bin. The bin latches when it closes.

The center stowage bins in first class open vertically. The center stowage bins in economy class open horizontally or vertically, depending on the seating configuration. The bins that open horizontally extend further outboard than the vertical bins when open. This makes it easier to put baggage in the bins. The difference between the vertical and the horizontal stowage bin is the length and attachment point of the lower snubber.



PASSENGER COMPARTMENT - CENTER STOWAGE BIN

PASSENGER COMPARTMENT - STOWAGE BIN SNUBBER

Purpose

The stowage bin snubber controls the rate at which a stowage bin opens or closes.

Outboard Stowage Bin

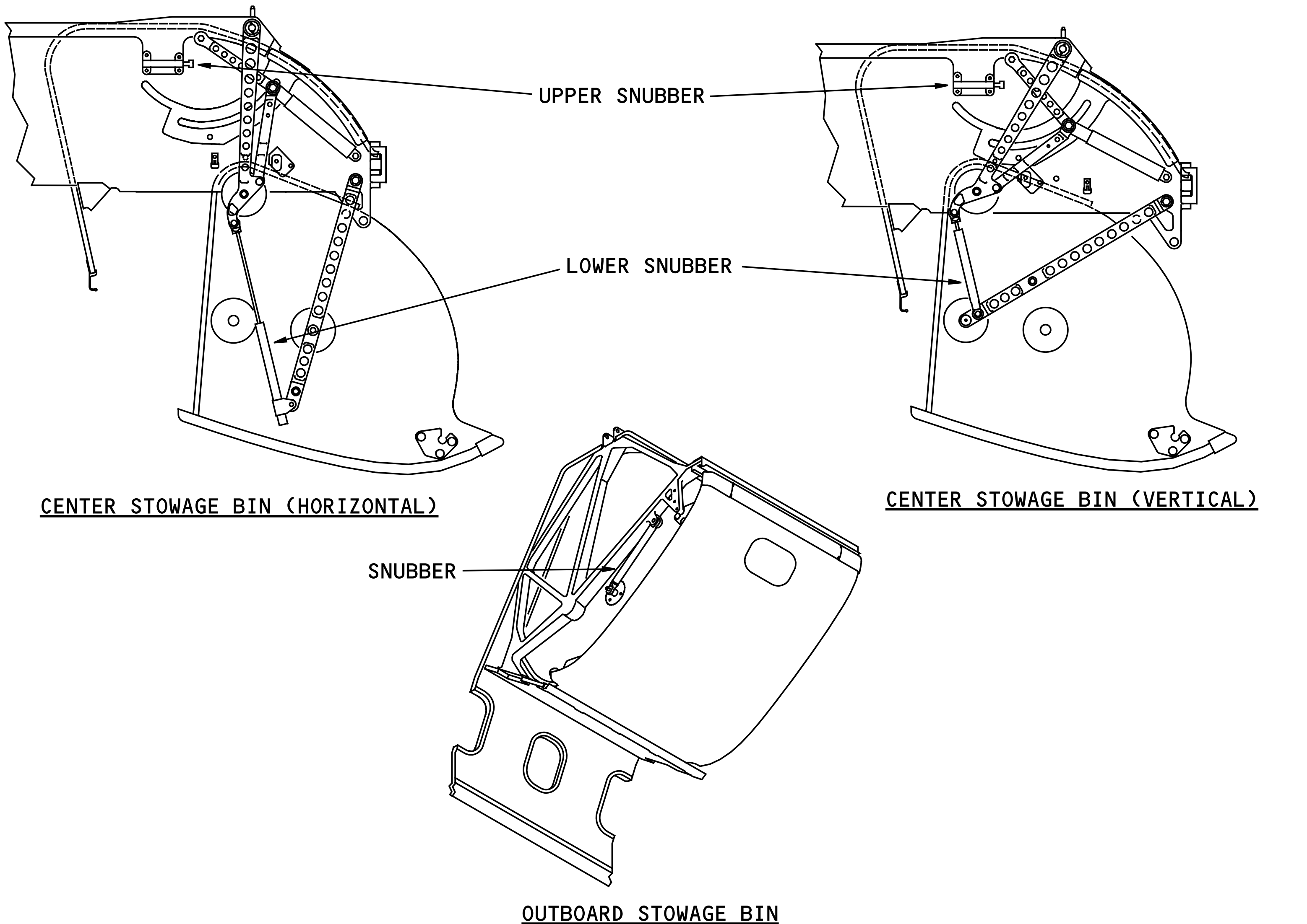
Two snubbers control the rate at which a outboard stowage bin opens.

Center Stowage Bin

Four snubbers control the rate at which a center stowage bin opens and closes. Two lower snubbers control the speed the stowage bin opens. Two upper snubbers control the speed a stowage bin can close.

Location

A snubber is at each end of the outboard stowage bin. Two snubbers are at each end of the center stowage bin.



25-20-00-019 Rev 0

PASSENGER COMPARTMENT - STOWAGE BIN SNUBBER

PASSENGER COMPARTMENT - STOWAGE BIN LATCH

Purpose

A stowage bin latch holds a stowage bin closed. You release the latch to open a stowage bin.

Physical Description

Stowage bin latch has these components:

- End assembly(2)
- Torque tube (2)
- Actuator
- Emergency release (2)
- Bezel.

Location

Stowage bin latch is on the face of these stowage compartments

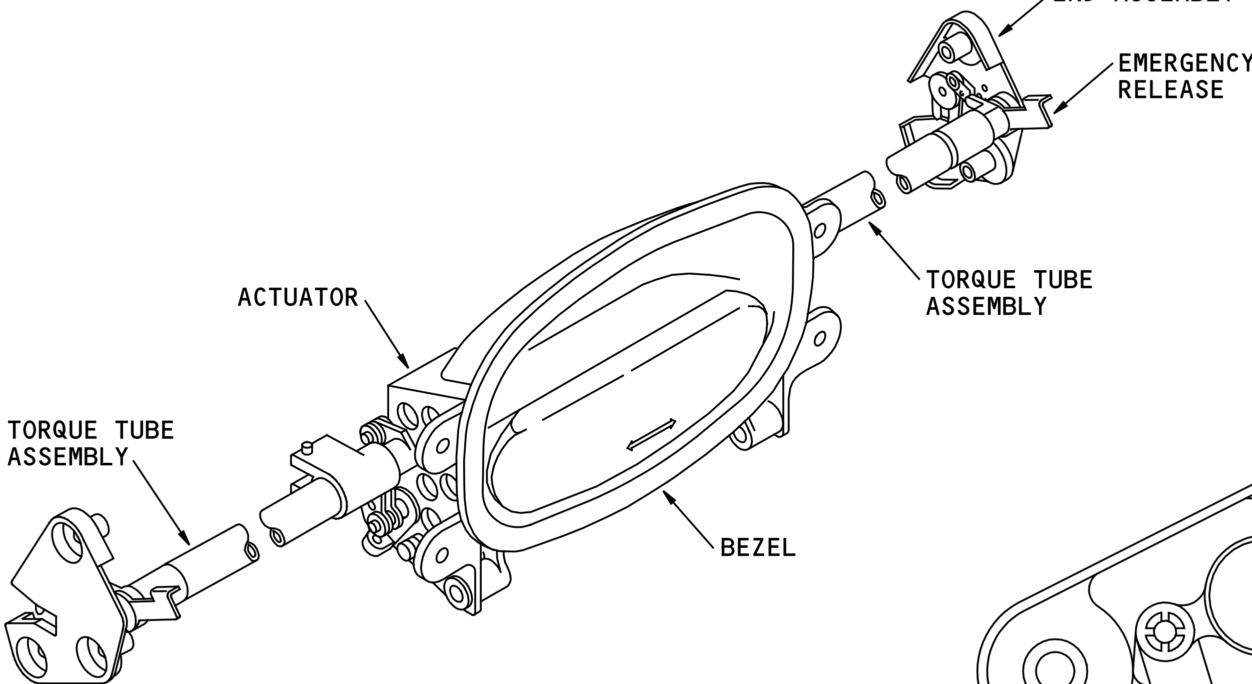
- Outboard stowage bins
- Center stowage bins
- Overhead stowage box.

Functional Description

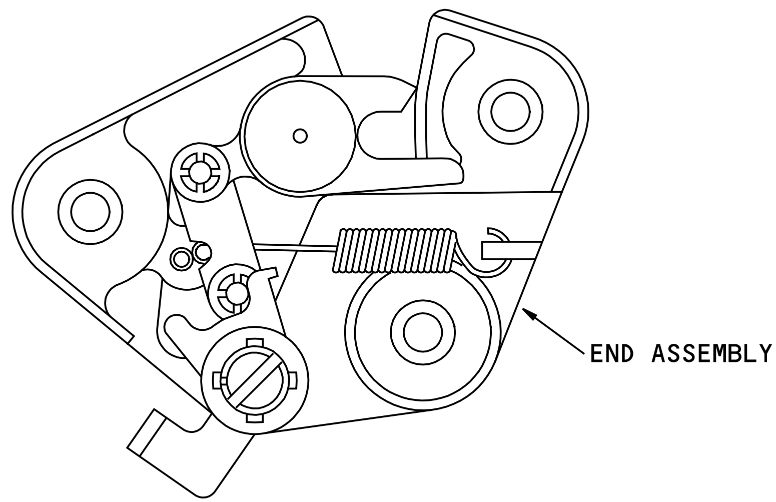
You pull on the bezel to unlatch the latch. The bezel turns the actuator which is attached to the torque tubes. The torque tubes then turns the end assembly and allow the latch to unlatch.

Training Information Point

The bezel extends past the stowage bin if it is not latched at both ends. You can see a red decal if the stowage bin is not latched. The emergency release lets you externally open the stowage bin if the actuator does not operate correctly.



STOWAGE BIN LATCH



LATCH
(END VIEW)

25-20-00-020 Rev 1 03/21/1996

PASSENGER COMPARTMENT - STOWAGE BIN LATCH

PASSENGER COMPARTMENT - OVERHEAD STOWAGE BOX

Purpose

The overhead stowage bin supplies a location above the passenger entry doors for carry-on baggage.

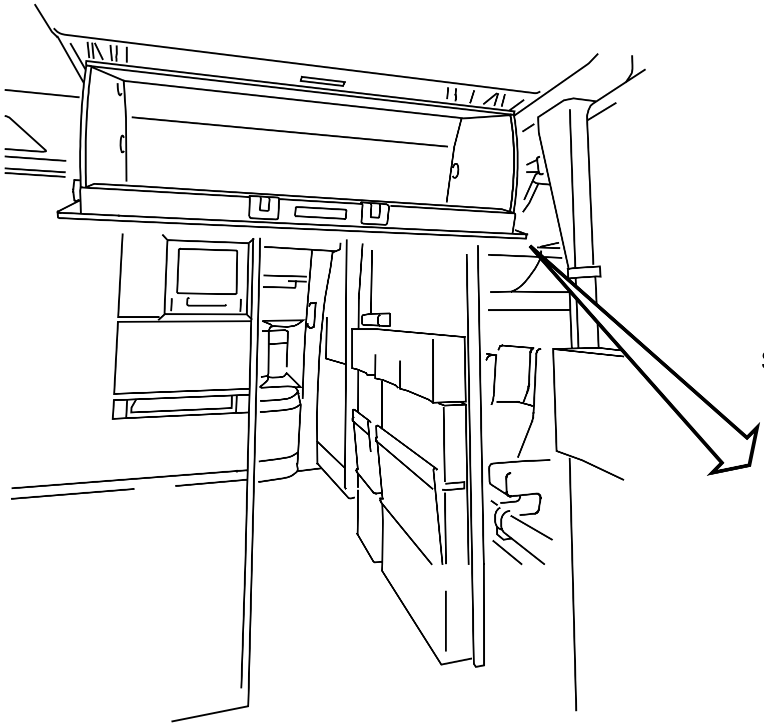
Physical Description

The overhead stowage bin has these components:

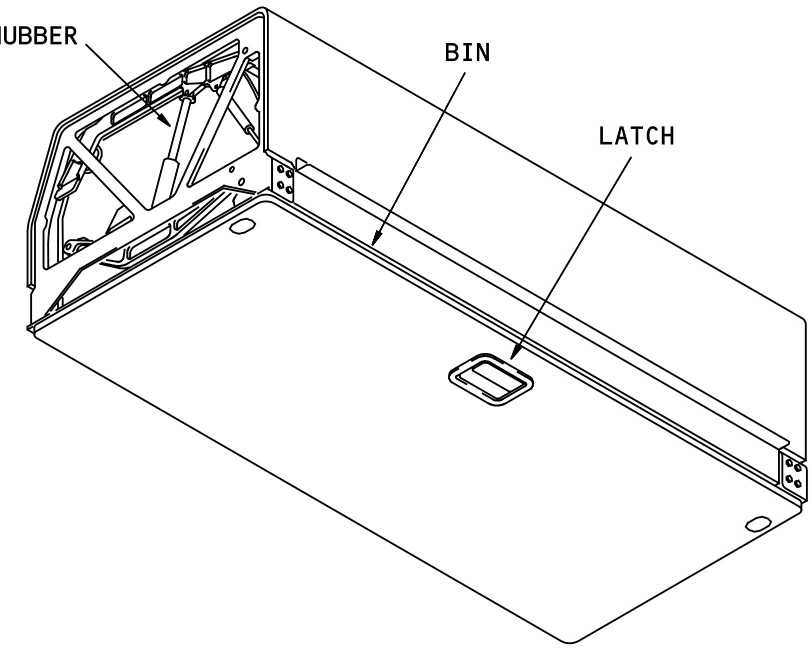
- Snubber (2)
- Latch
- Bin.

Location

The overhead stowage bins are above passenger entry doors 1 and 4 on the left and right side.



PASSENGER COMPARTMENT



OVERHEAD STOWAGE BOX

25-20-00-022 Rev 1

PASSENGER COMPARTMENT - OVERHEAD STOWAGE BOX

CREW REST AREAS AND CREW ACCOMMODATIONS - FLIGHT CREW REST AREA

Purpose

The flight crew rest (FCR) is an area for off-duty flight crew to rest during long flights. Crew members use the FCR only during cruise flight.

Location

The flight crew rest is in the passenger compartment, forward of door 1 left.

General Description

The FCR contains bunks for two crew members and storage compartments (not shown) for their belongings. The FCR has these systems and equipment (not shown):

- Lighting
- Attendant call switches
- Audio entertainment
- Cabin interphone handset
- Passenger address speakers
- Ventilation
- Temperature control
- Smoke detection
- Supplemental oxygen.

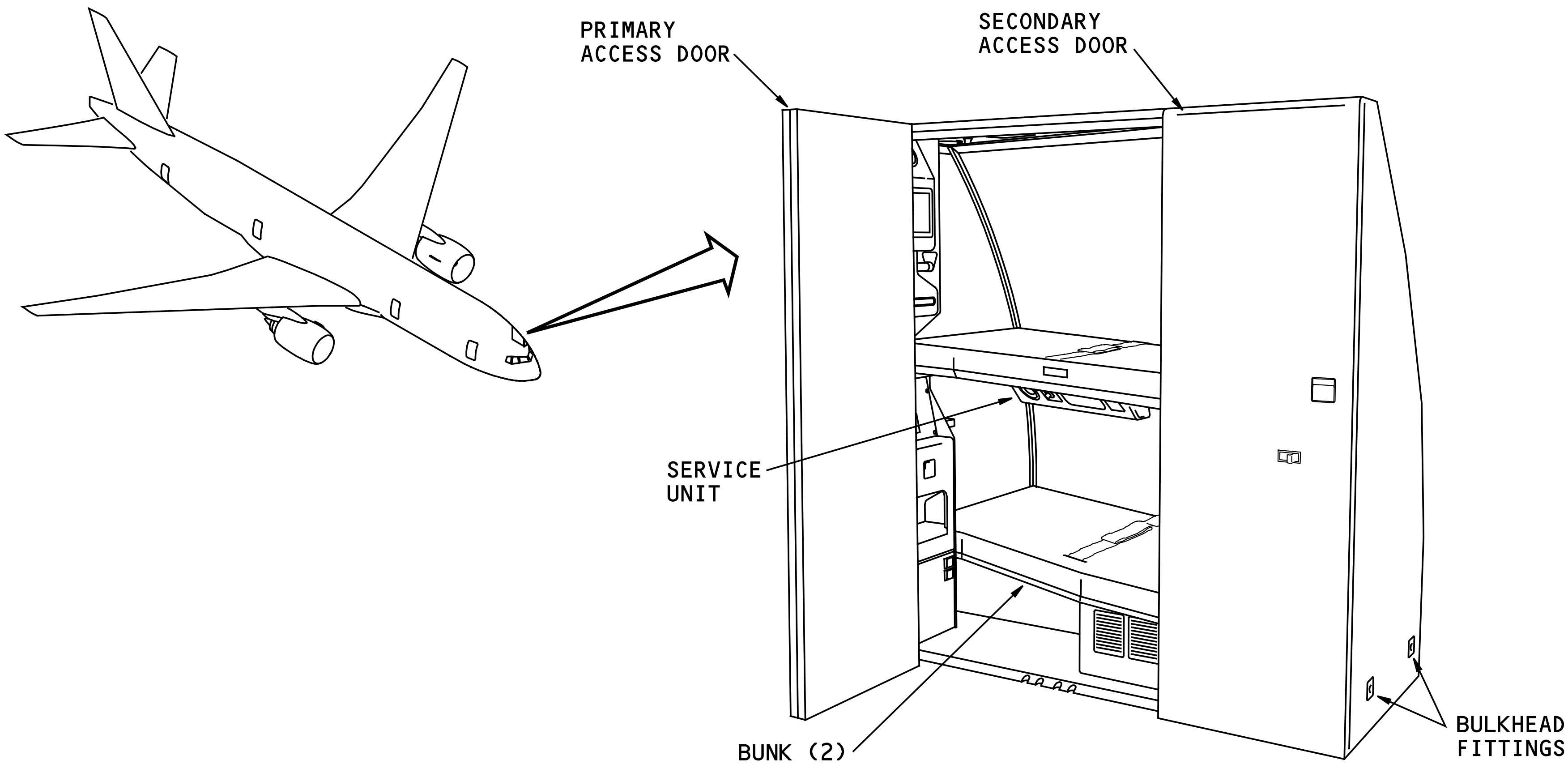
Physical Description

Two doors give access to the flight crew rest area. The primary access door latches open to block the adjacent aisle. This isolates the flight crew rest from the passenger compartment and makes an area where the crew members can change clothes. The secondary access door gives access to the bunks when it is open. You can close and latch the two doors from the top or the bottom bunk. A step and handle (not shown) help access to the upper bunk.

Three seat track fittings and one hard point (not shown) attach the FCR to the floor. Two tie rods attach the top of the FCR to the airplane structure. The FCR also attaches to the flight deck bulkhead. You can disassemble the FCR and remove the parts through a passenger entry door.

Training Information Point

Electrical connections (not shown) for the FCR equipment are on top of the FCR ceiling. Access to these connections is through a ceiling panel in the adjacent aisle.



FLIGHT CREW REST

25-29-00-003 Rev 1 04/10/1997

CREW REST AREAS AND CREW ACCOMMODATIONS - FLIGHT CREW REST AREA

BUFFET AND GALLEY - FORWARD FIXED GALLEY - INTRODUCTION

Physical Description

The forward fixed galleys can include one or more of these units:

- F1 galley
- F2 galley
- F3 galley.

The F1 galley is at the right side of the passenger compartment, forward of door 1. The galley faces aft.

The F2 galley is in the center of the passenger compartment, forward of door 1. The galley faces to the right.

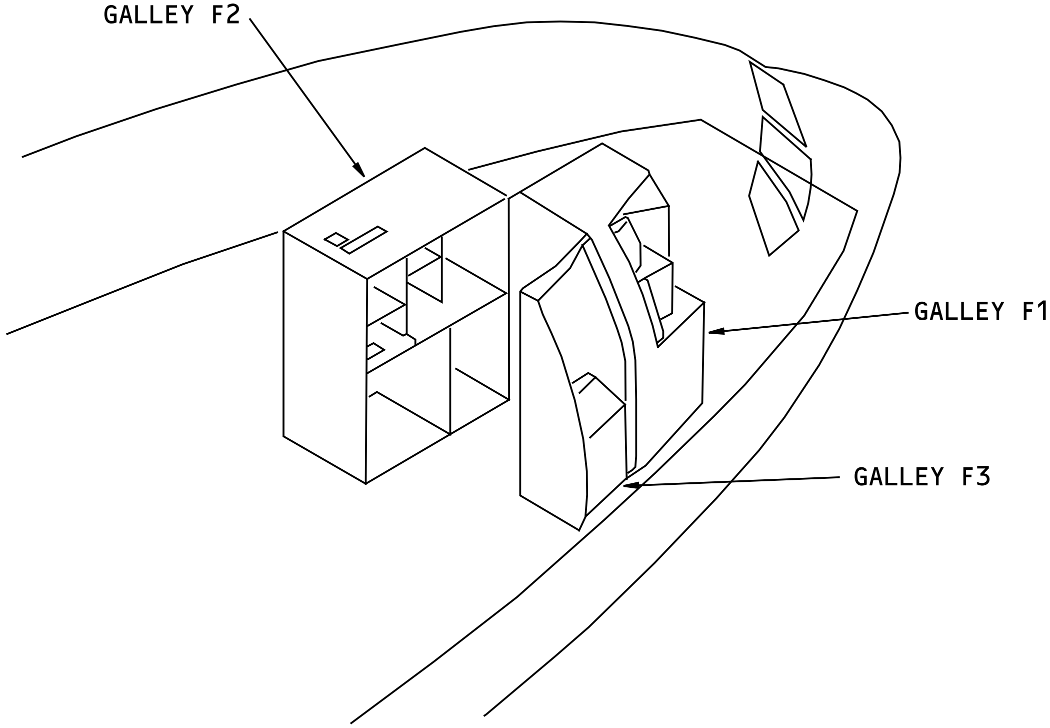
The F3 galley is at the right side of the passenger compartment, forward of door 1. The galley faces inboard.

Air Chillers

Air chillers can be attached to the top of the forward fixed galleys. The chiller supplies cold air to the refrigeration compartments.

The F1 galley has an air chiller.

The F2 galley has an air chiller.



FORWARD FIXED GALLEYS
(TYPICAL)

25-30-00-004 Rev 2 03/19/96

BUFFET AND GALLEY - FORWARD FIXED GALLEY - INTRODUCTION

BUFFET AND GALLEY - AFT FIXED GALLEY - INTRODUCTION

Physical Description

The aft fixed galleys can include one or more of these units:

- A1 galley
- A2 galley
- A3 galley.

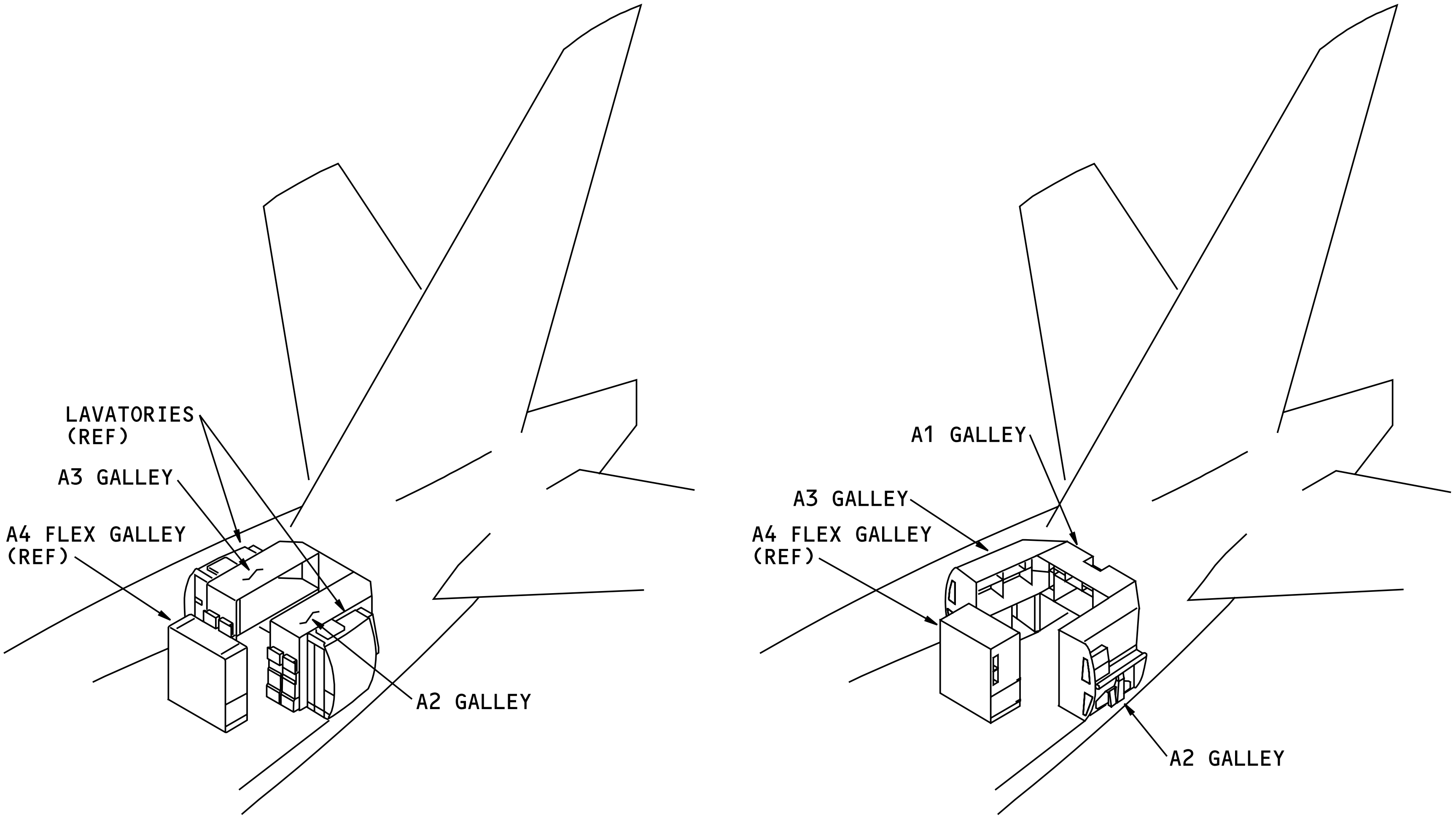
The A1 galley is at the center of the passenger compartment, aft of aft door. The galley faces forward.

The A2 galley is on the left side of the passenger compartment, aft of aft door. The galley faces inboard.

The A3 galley is at the right side of the passenger compartment, aft of aft door. The galley faces inboard.

Air Chillers

One or two air chillers (not shown) can be installed in the lower lobe area aft of the bulk cargo compartment. A chiller supplies cold air for refrigeration compartments in the aft fixed galleys.



AFT FIXED GALLEY
(POSSIBLE LOCATIONS)

BUFFET AND GALLEY - AFT FIXED GALLEY - INTRODUCTION

BUFFET AND GALLEY - LOWER LOBE AIR CHILLER

Purpose

The air chillers supply cold air to the carts or compartments of the aft fixed galleys that need refrigeration.

Location

One or two air chillers can be installed in the lower lobe area, aft of the bulk cargo compartment. Remove the left aft end wall panel to get access.

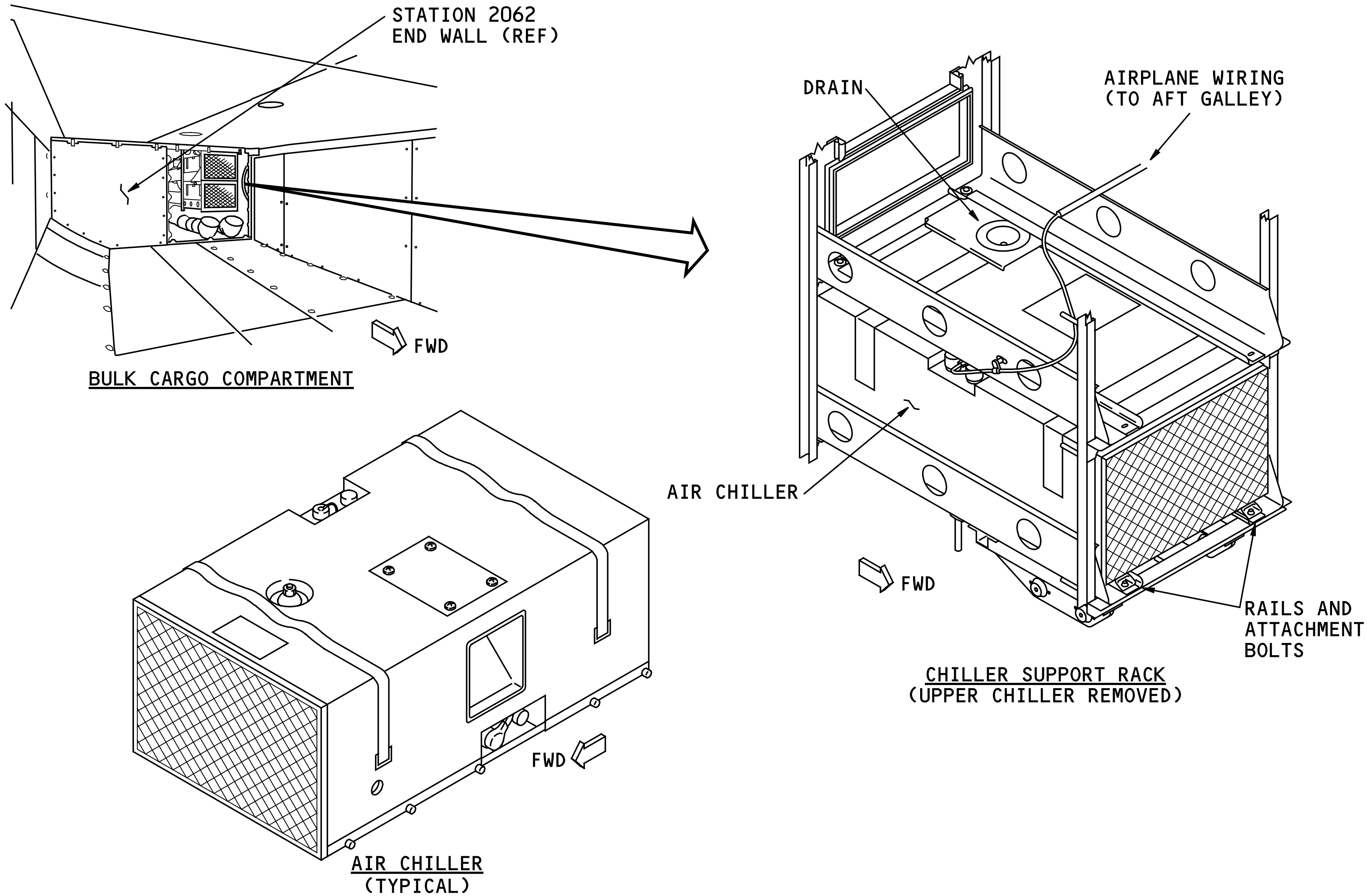
Supply and return air ducts (not shown) connect the air chillers to the appropriate galley. One or more of the galleys can have a supply and return duct connected to it. The ducts go aft and outboard of the chillers, near the aft pressure bulkhead (not shown).

Features

The air chiller is a vapor-cycle cooling unit.

The chiller attaches to rails with bolts. The rails attach with bolts to a support rack which hangs from the passenger compartment floor. When you remove a chiller, remove the bolts that attach the rails to the support rack. Remove the chiller with the rails attached to it.

Electrical power and control for the chiller comes from the aft galley. A wire bundle (not shown) connects the air chiller to the aft galley.



25-30-00-008 Rev 1 03/05/1998

BUFFET AND GALLEY - LOWER LOBE AIR CHILLER

BUFFET AND GALLEY - AIR CHILLER - PHYSICAL DESCRIPTION

Physical Description

The air chiller is a vapor-cycle cooling unit. It has these parts:

- Lifting strap (2)
- Condenser air exhaust (top)
- Chilled air outlet (evaporator outlet)
- Chilled air return (evaporator inlet)
- Condenser air exhaust (side)
- Electrical connector (2)
- Refrigerant sight glass
- Air filter (condenser air inlet).

The chiller weighs approximately 85 pounds (39 kg). A drain in the bottom of the chiller (not shown) carries the water away. Shop technicians use the refrigerant sight glass during servicing.

Exhaust Ports

The chiller has two condenser air exhaust ports to permit alternate installations. When you install a chiller, make sure that one port is open and the other port has a cover plate.

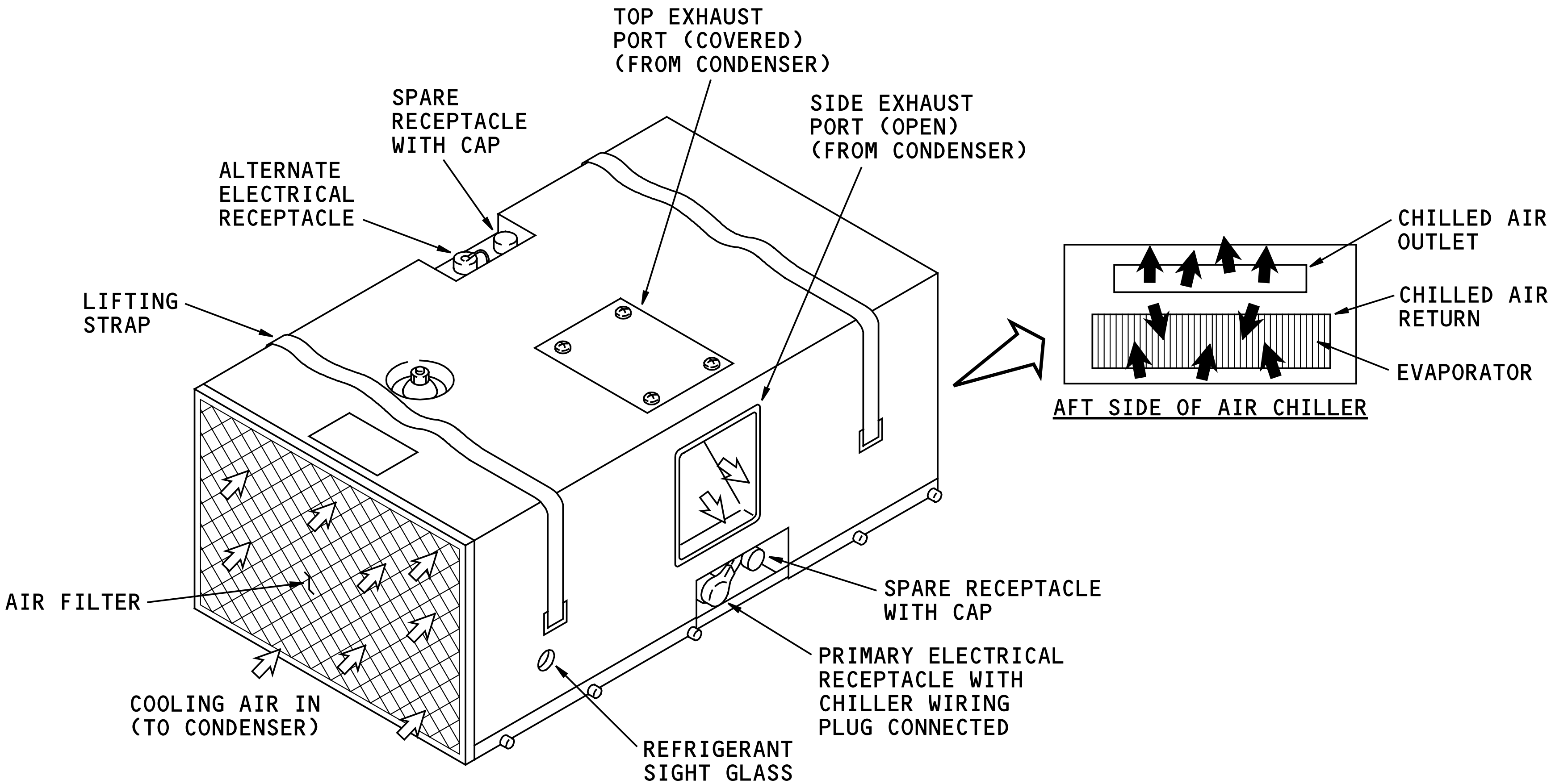
Electrical Receptacles

The chiller has two electrical receptacles. The primary receptacle (W4J1) is on the side of the chiller. The alternate receptacle (W3J1) is on top of the chiller. If you connect the airplane wiring to the alternate (top) receptacle. Connect the chiller wiring plug W3P1 to the primary (side) connector. Stow the two connector caps on the adjacent spare receptacles.

If you connect the airplane wiring to the primary receptacle (W4J1), stow the chiller wiring plug (W3P1) on the adjacent spare receptacle. Put one of the space caps on the alternate receptacle (W3J1).

Air Inlet Filter

You can clean the condenser air inlet filter. Remove the filter from the chiller. Wash the filter with soap and water then rinse the filter with clean water. Dry the filter with compressed air.



GALLEY AIR CHILLER
(TYPICAL)

25-30-00-010 Rev 1 02/27/1998

BUFFET AND GALLEY - AIR CHILLER - PHYSICAL DESCRIPTION

BUFFET AND GALLEY - OVERHEAD AIR CHILLER

Purpose

Overhead air chillers supply cold air for refrigeration.

Location

One or two air chiller can be above a galley to which it supplies chilled air. Usual refrigeration for a galley requires only one chiller. The forward galley area is shown as an example for a typical installation of an overhead chiller. These galleys have an overhead chiller(s):

- F-1.
- F-2.
- M-1.
- M-2.

Features

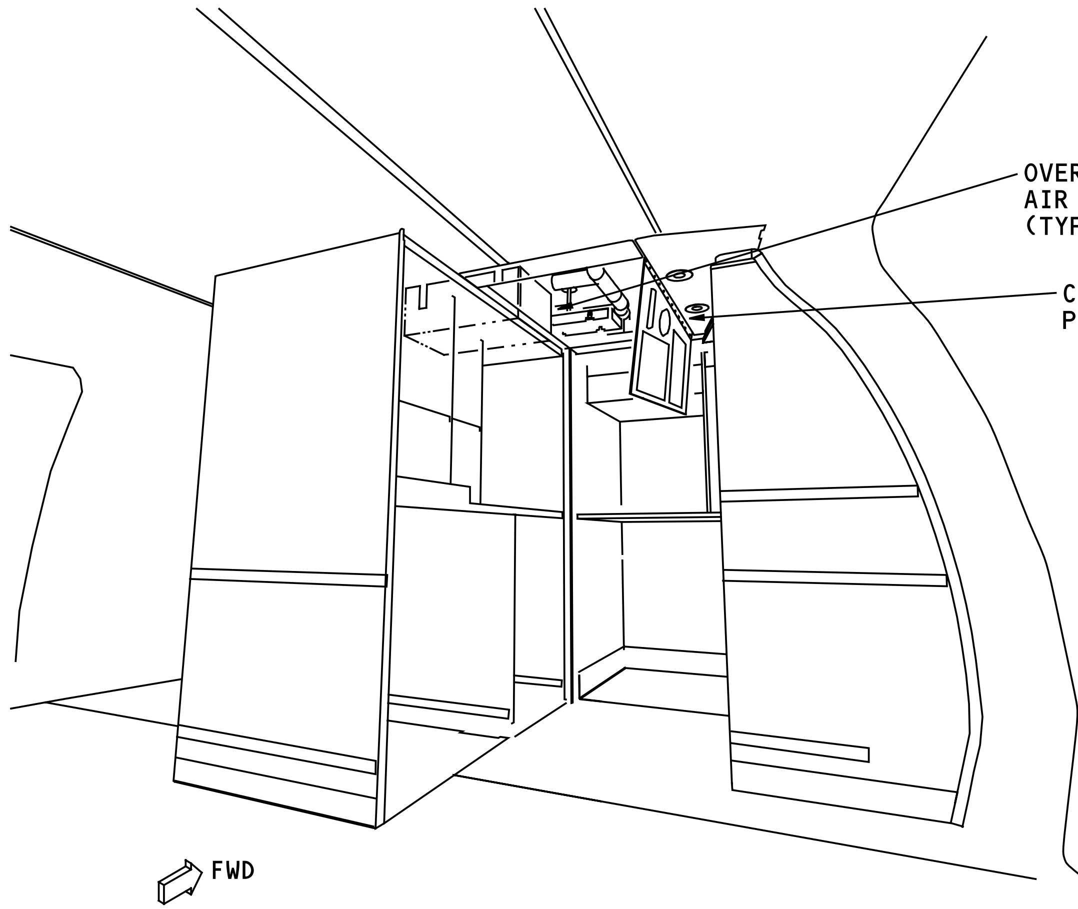
The air chiller is a vapor-cycle cooling unit.

The chiller attaches to a carriage with bolts. The carriage has wheels that fit into a rail assembly. The carriage and the rail assembly lets you move the chiller horizontally. The carriage and rail assembly also let you rotate the chillier to a vertical position. When you remove a chiller, remove the bolts that attach the carriage to the rails. Pull the chiller until the wheels on the carriage move into a detent in the rails. Pull down on the chillers to make it rotate to the vertical position. Lift the chiller and carriage up and off of the rails. Lower the chiller and carriage to the floor.

Electrical power and control for the chiller come from its related galley. A wire bundle connects the air chiller to the galley.

Training Information Point

Lower the ceiling panel adjacent to the galley to get access to the air chiller.



FORWARD GALLEY AREA
(TYPICAL)

BUFFET AND GALLEY - OVERHEAD AIR CHILLER

LOWER LOBE CARGO COMPARTMENT - INTRODUCTION

General Description

The lower lobe cargo compartments include forward, aft, and bulk cargo compartments. Heating and ventilating systems control the temperature and air quality in the lower lobe cargo compartments. The airplane can carry live animals in the bulk cargo compartment.

The lower lobe cargo compartments are class C for fire protection and have these features:

- Smoke detection systems tell the crew of smoke in the cargo compartments
- Cargo compartments have fire extinguishing systems which operate from the flight deck
- Compartment linings and the environmental control systems keep dangerous quantities of smoke and extinguishing agent out of the passenger and crew cabins
- Compartment linings meet specified burn through requirements.

Cargo linings make a closed area for the cargo compartments but permit access to other systems. Closed compartments are necessary for fire protection and temperature control.

WARNING: SEAL THE COMPARTMENT WITH THE LINERS. OBEY THE INSTRUCTIONS IN THE SPECIFIED PROCEDURE WHEN YOU INSTALL THE LINERS. IF YOU INSTALL THE LINERS INCORRECTLY, THE FIRE WILL NOT BE CONTAINED AND THE EXTINGUISHING AGENT OR SMOKE CAN GET INTO THE PASSENGER COMPARTMENT DURING A FIRE.

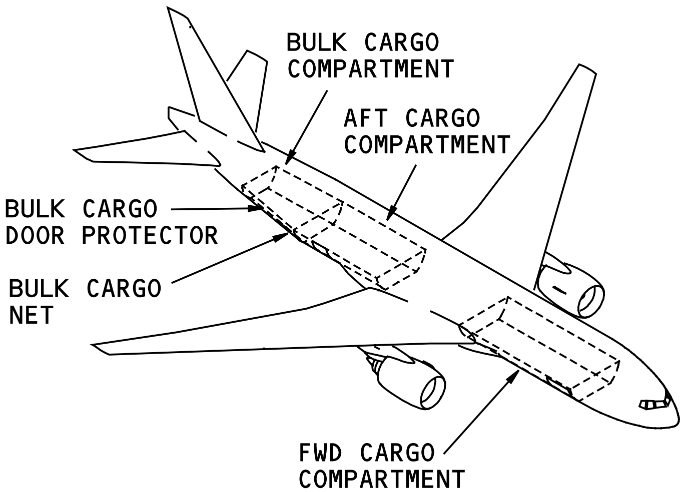
Lower lobe cargo compartments have these items:

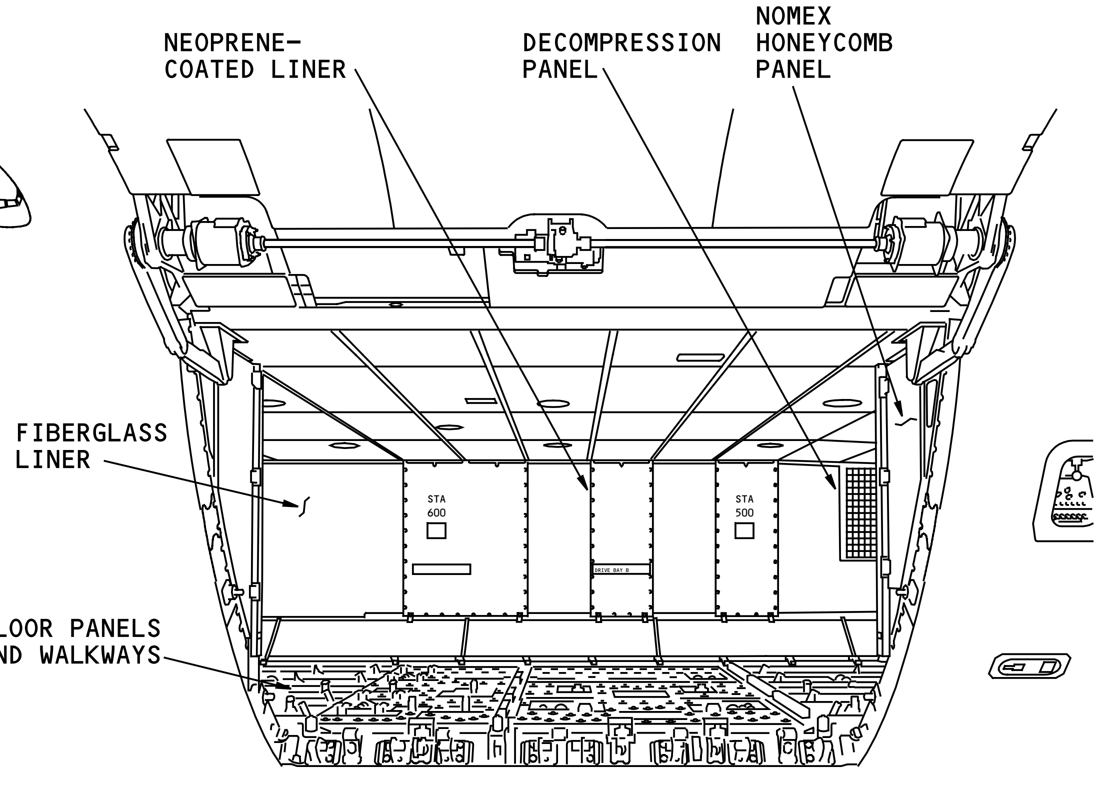
- Bulk cargo door protector
- Bulk cargo net
- Floor panels and walkways
- Fiberglass liners
- Neoprene-coated liner
- Decompression panels
- Nomex honeycomb panels.

Training Information Point

When you work in the cargo compartment, install a safety barrier in the doorway.

WARNING: INSTALL THE SAFETY BARRIER CORRECTLY WHEN THE CARGO DOOR IS OPEN. IF YOU DO NOT CORRECTLY INSTALL THE SAFETY BARRIER, PERSONS CAN FALL OUT OF THE CARGO COMPARTMENT AND INJURY CAN OCCUR.





FWD CARGO COMPARTMENT
(TYPICAL)

25-52-00-001 Rev 1 04/10/1997

LOWER LOBE CARGO COMPARTMENT - INTRODUCTION

LOWER LOBE CARGO COMPARTMENT - FIBERGLASS LINERS

Purpose

Fiberglass liners help isolate the cargo compartments from other parts of the airplane for fire protection and temperature control. The bulk cargo compartment liners also help transmit cargo loads to the airplane structure.

Physical Description

These cargo compartment liners are made from rigid fiberglass material:

- Sidewall liners
- Ceiling liners
- Station 1437 end wall.

These devices attach the fiberglass liners to the structure:

- Bolts
- Screws
- Scrivets
- Hook-and-loop tape.

Tape seals the edges and seams.

Location

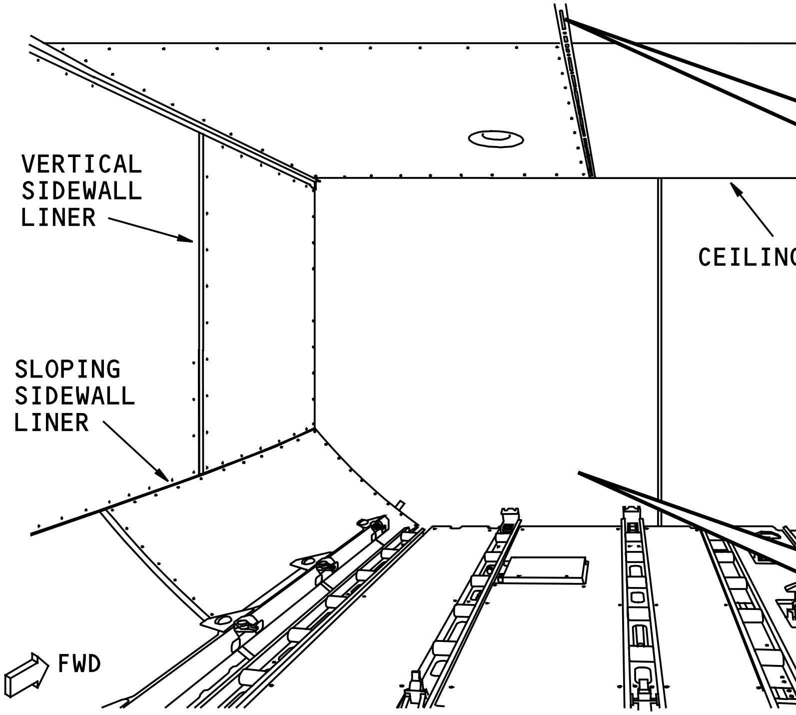
Sidewall liners extend from the floor to the ceiling along both sides of the forward, aft and bulk cargo compartments. The upper liner is a vertical sidewall liner. The lower liner is a sloping sidewall liner.

Ceiling liners make the ceilings of the cargo compartments.

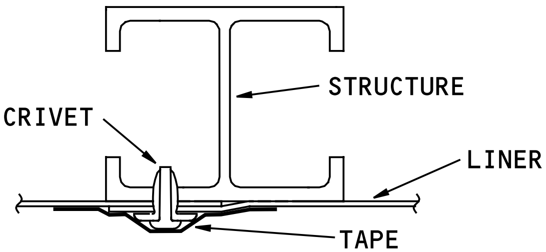
The station 1437 end wall is at the forward end of the aft cargo compartment.

Training Information Point

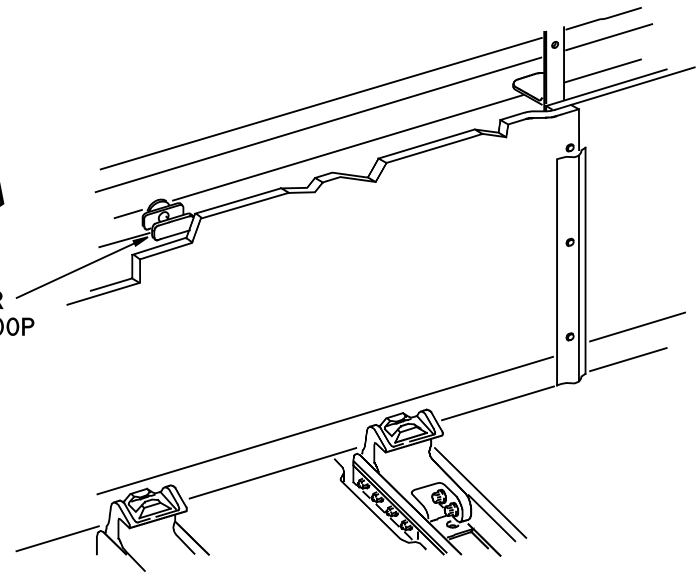
You must repair fiberglass liners which have cuts, tears or holes. If the damage is in specified limits, you can repair the liner with a patch. Otherwise you must replace the damaged liner. Special patch kits permit you to make bonded patch repairs without removing the liner from the airplane.



AFT CARGO COMPARTMENT
(TYPICAL)



FIBERGLASS LINER ATTACHMENT
(TYPICAL)



STATION 1437 END WALL
(AFT CARGO COMPARTMENT)

25-52-00-002 Rev 0

LOWER LOBE CARGO COMPARTMENT - FIBERGLASS LINERS

LOWER LOBE CARGO COMPARTMENT - NEOPRENE-COATED LINER

Purpose

Neoprene-coated liners help isolate the cargo compartments from other parts of the airplane for fire protection and temperature control. Neoprene-coated liners are also access panels to equipment behind them.

Physical Description

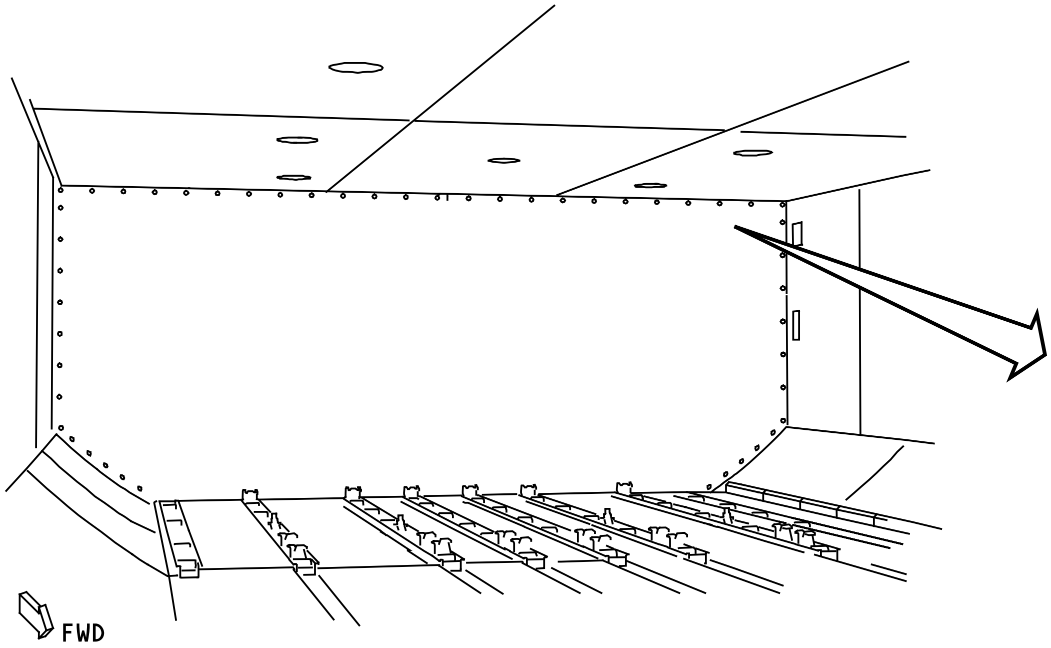
The liners are made from flexible neoprene-coated fiberglass. Snaps hold the liners in place.

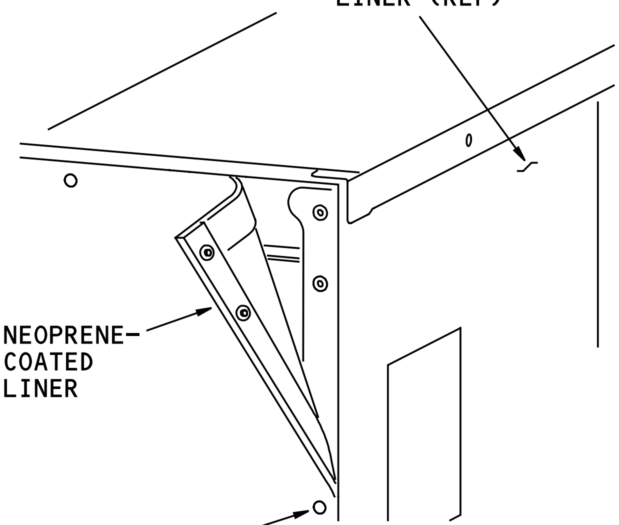
Location

The station 998 end wall is a neoprene-coated liner. It is at the aft end of the forward cargo compartment. Some of the vertical sidewall linings (not shown) in the forward and aft cargo compartments are also this type.

Training Information Point

You must repair cuts, tears or holes in the neoprene-coated liners. If the damage is in specified limits, you can repair the liner with a patch. Otherwise, you must replace the damaged liner.





25-52-00-003 Rev 0

LOWER LOBE CARGO COMPARTMENT - NEOPRENE-COATED LINER

LOWER LOBE CARGO COMPARTMENT - NOMEX HONEYCOMB PANELS

Purpose

The Nomex honeycomb panels help isolate the cargo compartments from other parts of the airplane for fire protection and temperature control. The panels also transmit cargo loads to the airplane structure.

Physical Description

These cargo compartment liners are made from Nomex honeycomb panels:

- Station 2062 end wall
- Waste tank enclosure panels
- Main equipment center bulkhead liner.

Latches and quarter-turn fasteners attach the station 2062 end wall to the structure.

Quarter-turn fasteners attach the waste tank enclosure panels to the structure.

The access door to the main equipment center has a hinge on the outboard side. A door restraint holds the door open. The door restraint folds to let the door close. Latches hold the door closed. Quarter-turn fasteners attach the stationary main equipment center bulkhead liners to the structure.

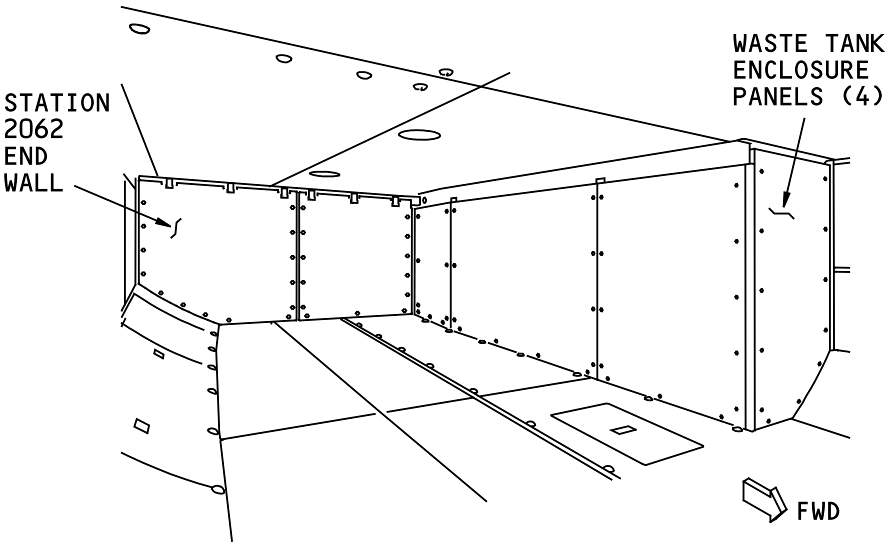
The main equipment center access door and all the panels have built-in seals.

Location

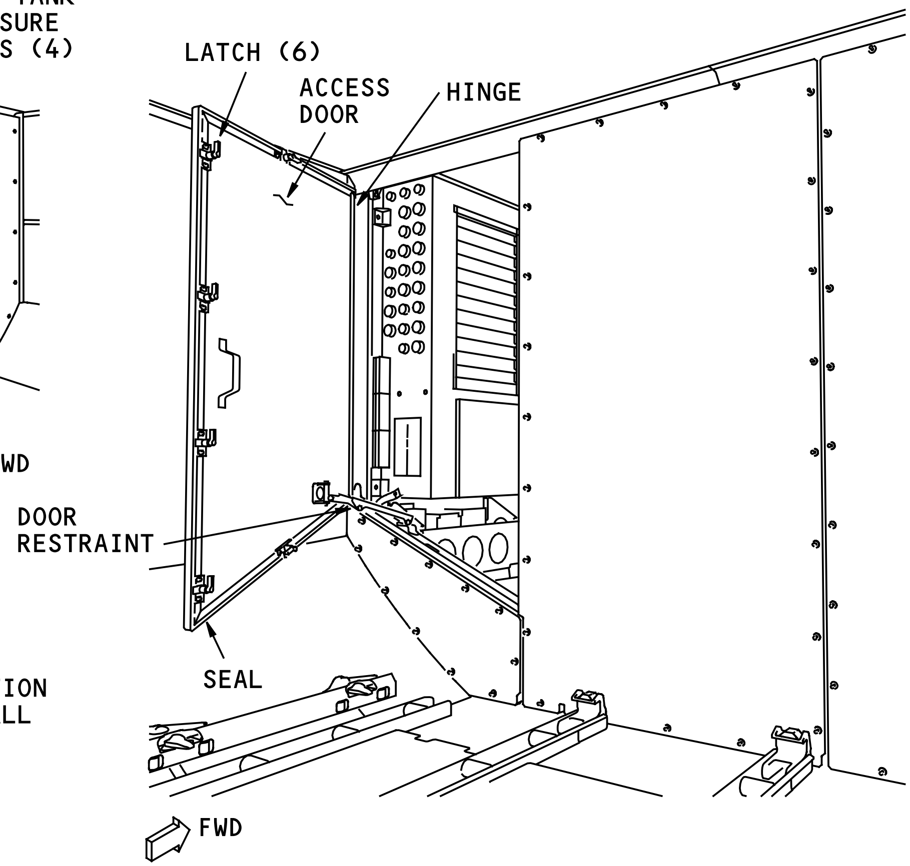
The station 2062 end wall is at the aft end of the bulk cargo compartment.

The waste tank enclosure panels are on the left side of the bulk cargo compartment.

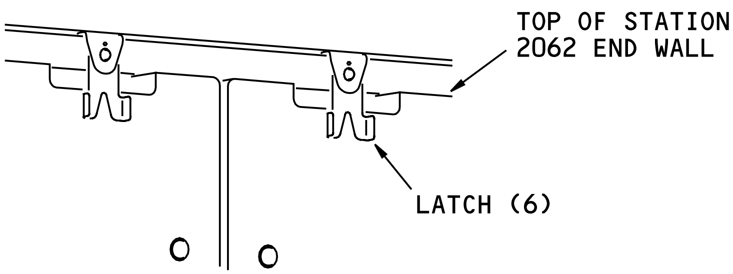
The main equipment center bulkhead liner is at the forward end of the forward cargo compartment.



BULK CARGO COMPARTMENT



MAIN EQUIPMENT CENTER BULKHEAD LINER
(FORWARD CARGO COMPARTMENT)



LATCHES
(STATION 2062 END WALL)

25-52-00-004 Rev 0

LOWER LOBE CARGO COMPARTMENT - NOMEX HONEYCOMB PANELS

LOWER LOBE CARGO COMPARTMENT - EQUIPMENT RACK ACCESS DOORS

Physical Description

These equipment rack access doors are made from Nomex honeycomb sandwich material:

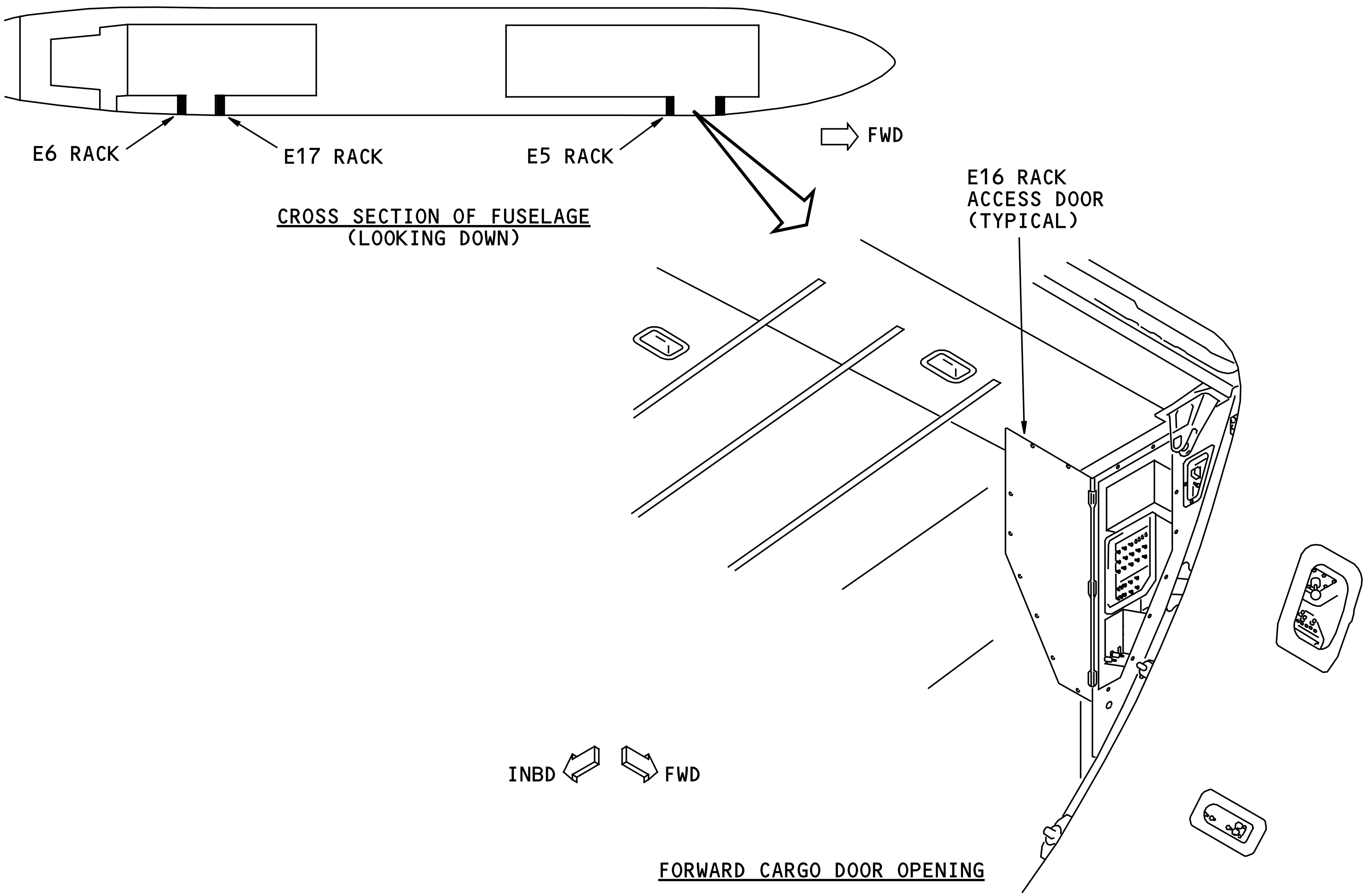
- E6 equipment rack
- E17 equipment rack
- E5 equipment rack
- E16 equipment rack.

The doors have a hinge on the inboard side. Quarter-turn fasteners hold the doors closed. The access doors have built-in seals.

Location

The E6 rack is at the aft edge of the aft cargo door opening. The E17 rack is at the forward edge of the aft cargo door opening.

The E5 rack is at the aft edge of the forward cargo door opening. The E16 rack is at the forward edge of the forward cargo door opening.



25-52-00-005 Rev 0

LOWER LOBE CARGO COMPARTMENT - EQUIPMENT RACK ACCESS DOORS

LOWER LOBE CARGO COMPARTMENT - DECOMPRESSION PANELS

Purpose

Decompression panels prevent fuselage structural damage if there is sudden decompression of the passenger compartment.

Physical Description

The decompression panel has these parts:

- Frame
- Vent
- Seal
- Blowout panel.

The blowout panel is a thin sheet of fiberglass held in the frame by seals. The vent is an aluminum grate which protects the blowout panel from impact. Bolts (not shown) hold the vent to the frame.

Screws go through the frame to hold the decompression panel in place. Tape seals the frame to the cargo compartment liner.

Location

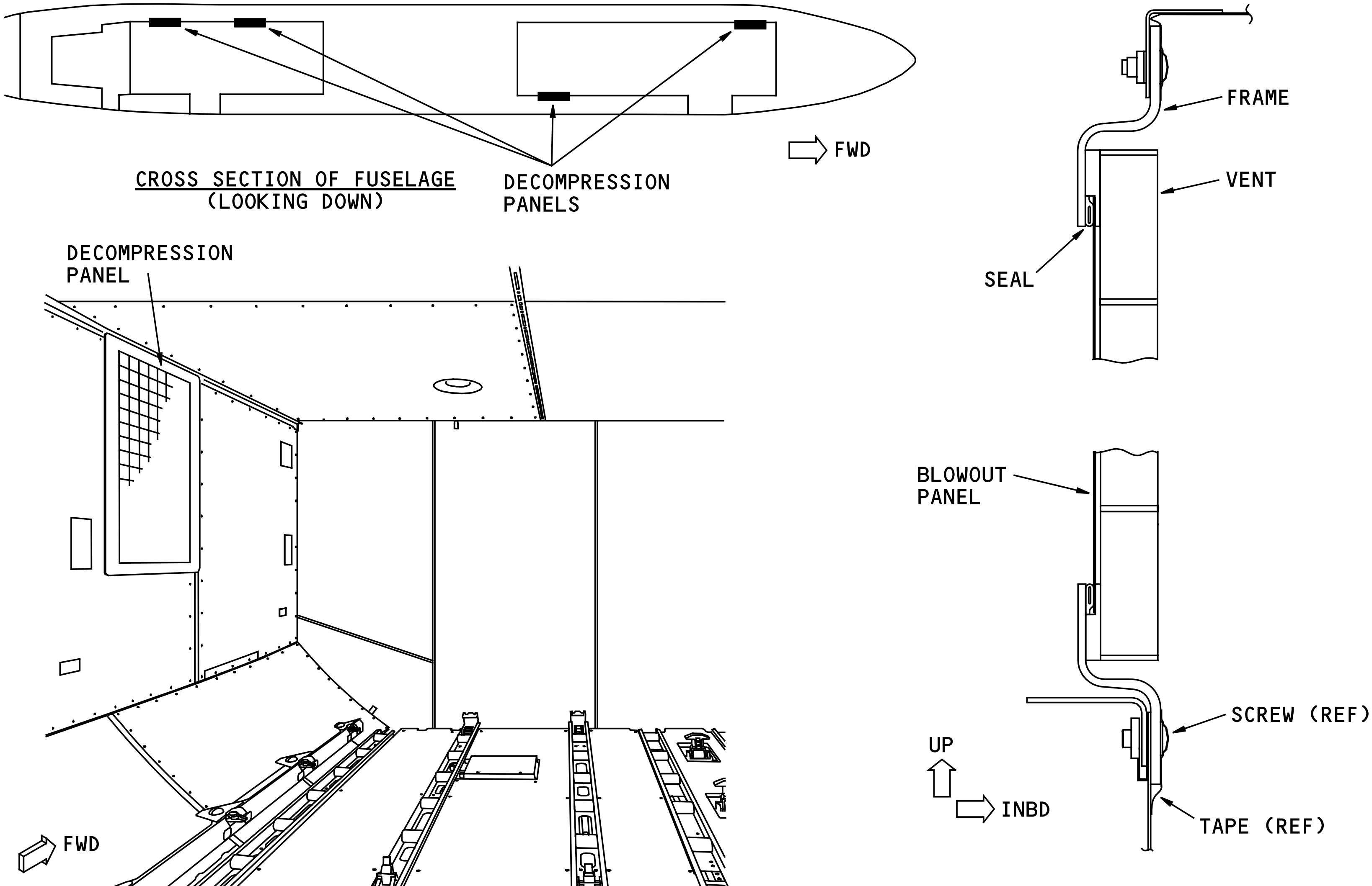
Two decompression panels are in the forward cargo compartment, one on the left side and one on the right side. Two panels are in the aft cargo compartment on the left side.

Functional Description

The blowout panel normally seals air inside the cargo compartment. If there is a rapid decompression of the passenger compartment, differential pressure pushes the blowout panel from the frame. Pressure in the cargo compartment quickly becomes equal to the reduced pressure in the passenger compartment. This prevents damage to the passenger compartment floor from too much pressure against the underside.

Training Information Point

The decompression panel must be air-tight for proper fire protection; the panel must be installed and sealed correctly. The blowout panel must be held to the frame on all four sides by the seals.



CROSS SECTION OF FUSELAGE
(LOOKING DOWN)

FWD CARGO COMPARTMENT

DECOMPRESSION PANEL
(SIDE VIEW)

25-52-00-006 Rev 1 04/10/1997

LOWER LOBE CARGO COMPARTMENT - DECOMPRESSION PANELS

LOWER LOBE CARGO COMPARTMENT - FLOOR PANELS AND WALKWAYS

Purpose

Floor panels and walkways make it easy for the ground crew to move around inside the cargo compartments.

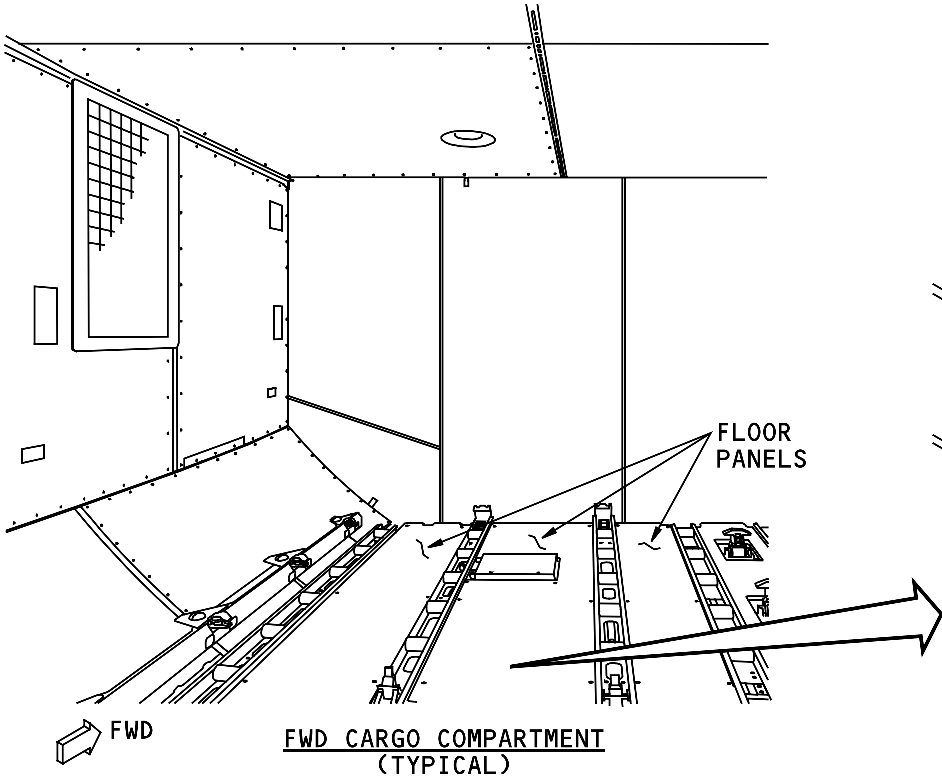
The aft end of the floor panels and walkways make a smoke barrier between the cargo compartments and other areas of the airplane.

Physical Description

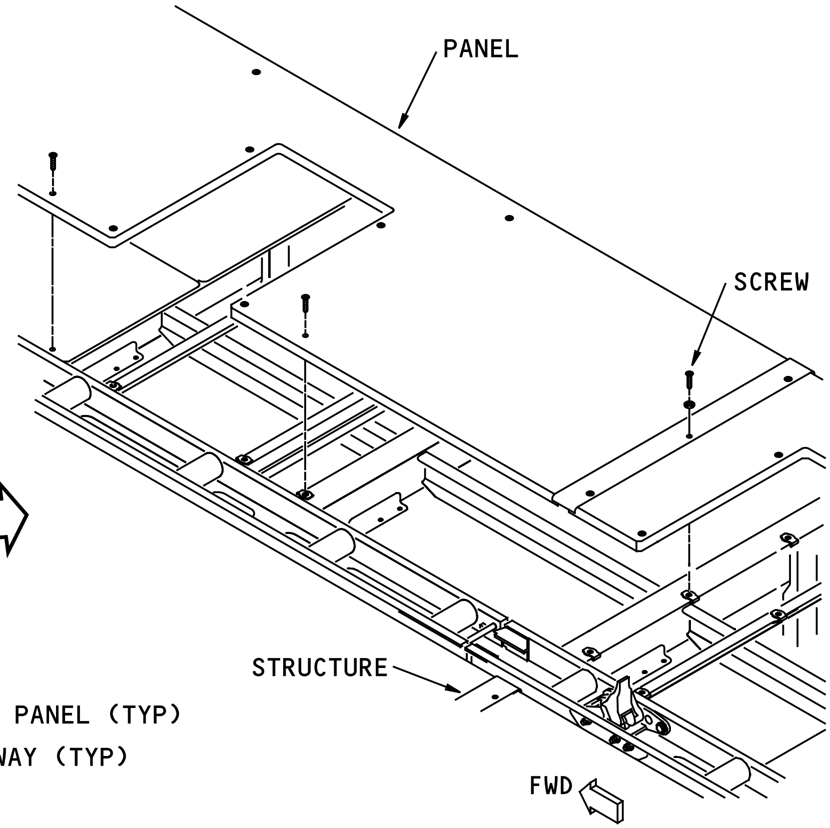
The floor panels and walkways are made of fiberglass-faced Nomex honeycomb core sandwich panel material. Countersunk screws attach the panels to the support structure.

Location

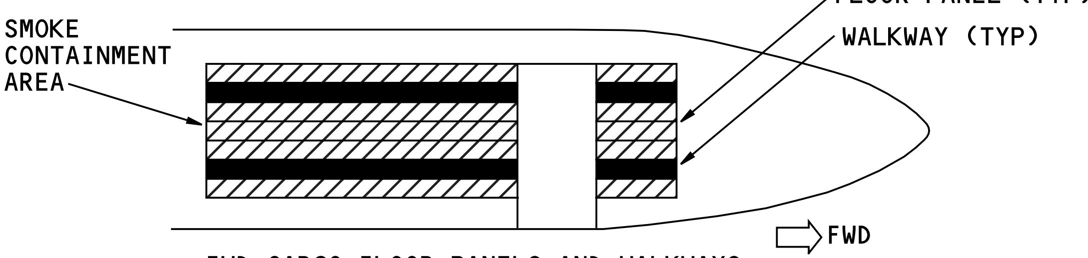
Floor panels and walkways are in the floor of the forward and aft cargo compartments.



FWD CARGO COMPARTMENT
(TYPICAL)



WALKWAY
(TYPICAL)



FWD CARGO FLOOR PANELS AND WALKWAYS
(AFT CONFIGURATION IS SIMILAR)

LOWER LOBE CARGO COMPARTMENT - FLOOR PANELS AND WALKWAYS

LOWER LOBE CARGO COMPARTMENT - BULK CARGO FLOOR

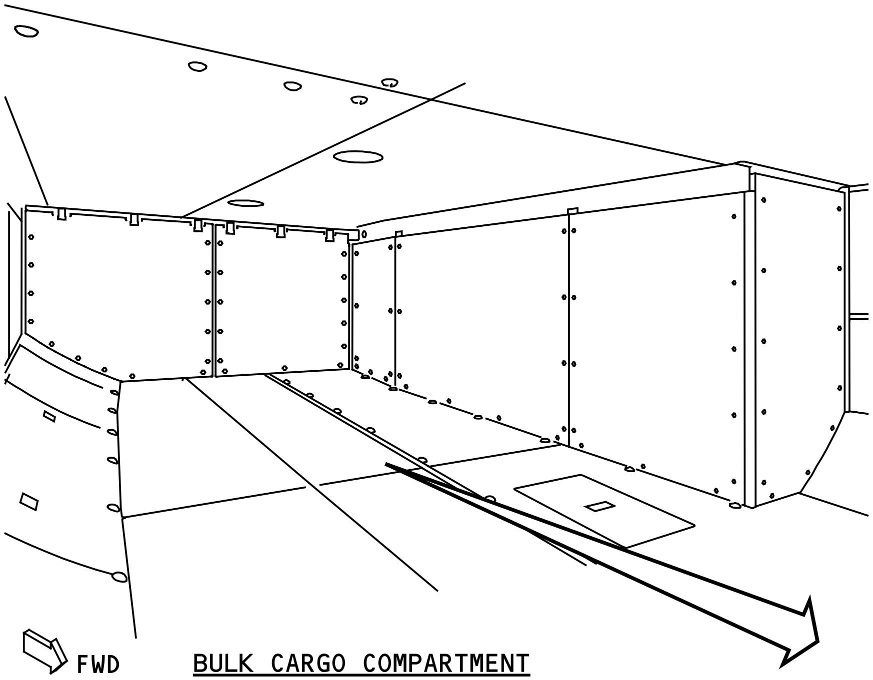
Purpose

The bulk cargo compartment floor supports the cargo.

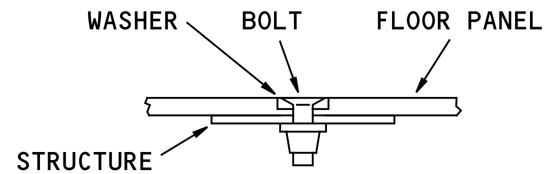
Physical Description

Bulk cargo floor panels are made of aluminum-fiberglass laminate material. Three layers of sheet aluminum are bonded to two layers of fiberglass sheet.

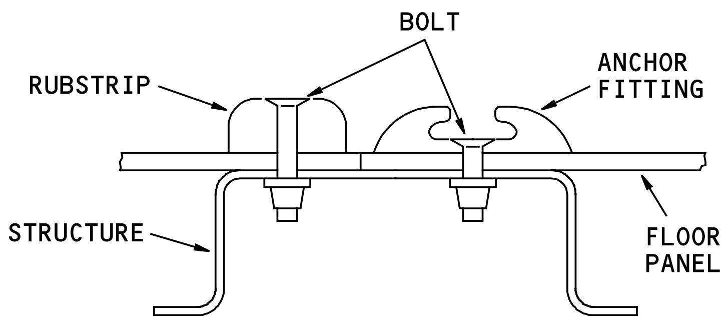
Bolts attach the floor panels to the structure. Anchor fittings attach tie downs and cargo nets to the floor. Rubstrips protect the floor.



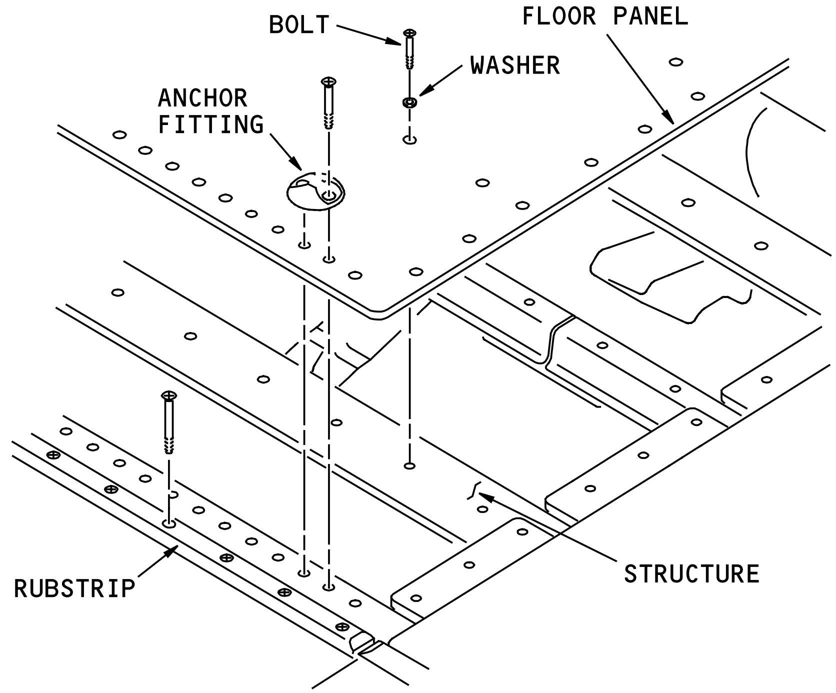
BULK CARGO COMPARTMENT



FLOOR PANEL ATTACHMENT



ANCHOR AND RUBSTRIP ATTACHMENT



BULK CARGO FLOOR

25-52-00-008 Rev 0

LOWER LOBE CARGO COMPARTMENT - BULK CARGO FLOOR

EMERGENCY - INTRODUCTION

General Description

The airplane has this emergency equipment:

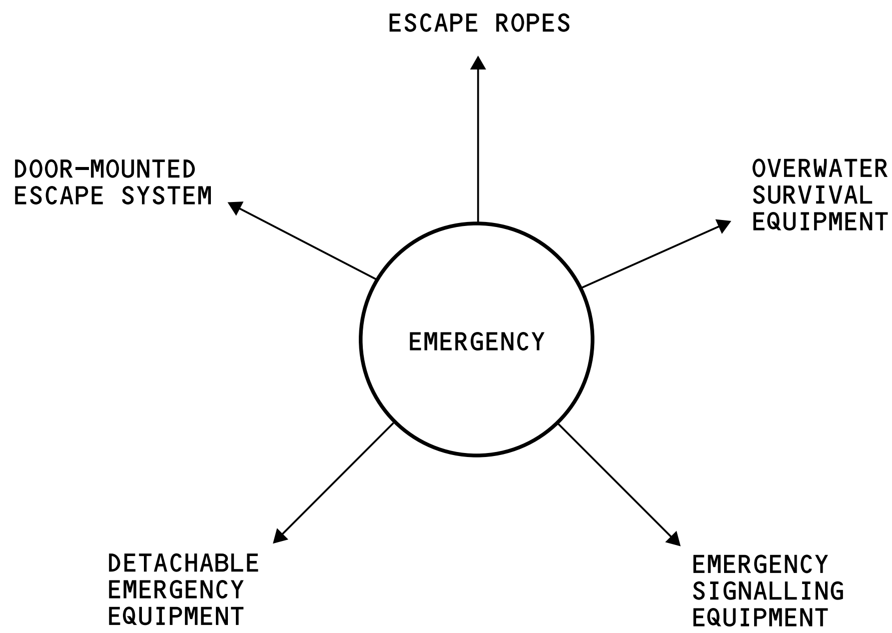
- Escape ropes
- Overwater survival equipment
- Emergency signaling equipment
- Detachable emergency equipment
- Door-mounted escape system.

The door-mounted escape system and escape ropes help passengers and crew get out of the airplane in an emergency. See the door-mounted escape system section for more information about the door-mounted escape system (AMM PART I 25-66).

Life vests are the overwater survival equipment.

Emergency signalling equipment includes emergency locator transmitters and the emergency evacuation signal system.

Detachable emergency equipment includes fire-fighting equipment, medical equipment, megaphones, and flashlights.



25-60-00-001 Rev 2 02/24/1997

EMERGENCY - INTRODUCTION

EMERGENCY - ESCAPE ROPES

Purpose

The escape ropes permit the flight crew to make their way safely to the ground through the number 2 windows.

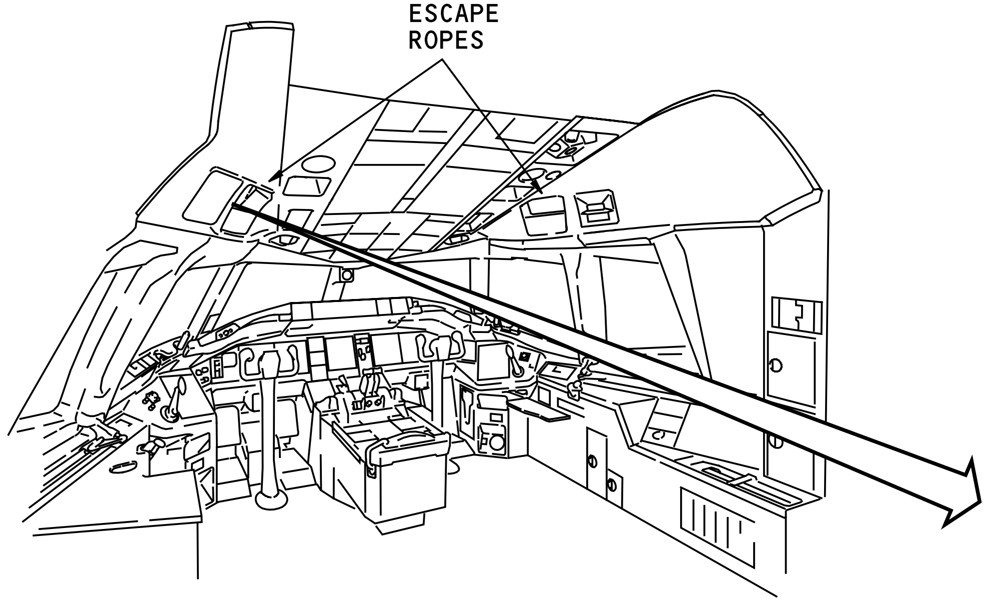
Physical Description

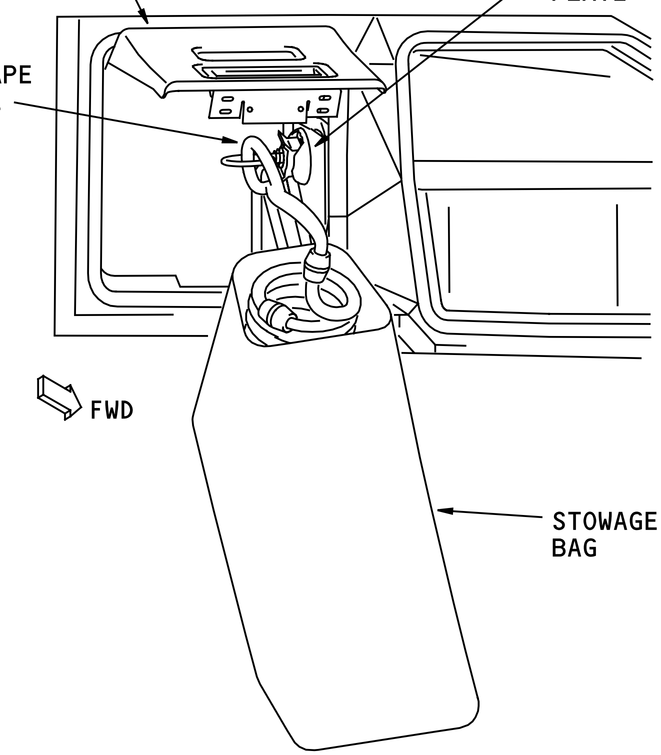
One end of the escape rope attaches to the airplane structure. The other end is coiled and stored in a stowage bag.

Location

The rope and stowage bag are behind doors in the flight deck lining above the number 2 windows.

WARNING: DO NOT CLOSE OR ATTACH THE BAG. IF THE BAG IS CLOSED OR ATTACHED, THE BAG AND THE ROPE WILL NOT FALL FROM THE POCKET IN AN EMERGENCY. INJURY TO PERSONS CAN RESULT.





ESCAPE ROPE STOWAGE BAG

25-60-00-002 Rev 1 07/02/1997

EMERGENCY - ESCAPE ROPES

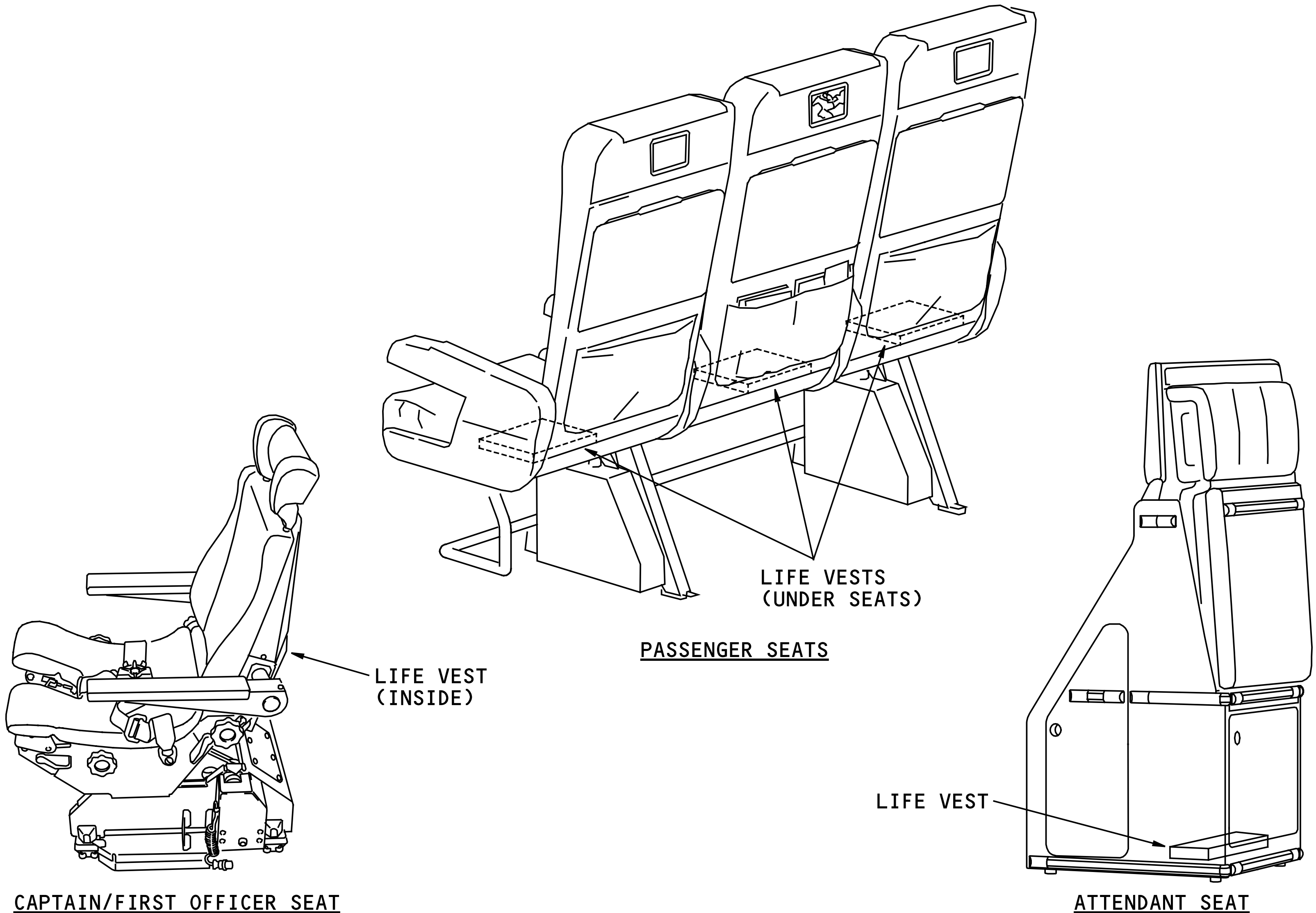
EMERGENCY - OVERWATER SURVIVAL EQUIPMENT - LIFE VESTS

General

The airplane has life vests for each passenger and crewmember. The vests are sealed in protective packages and stored in seat pouches.

Training Information Point

Make sure there is a life vest at every seat in the airplane. Make sure each vest is in a sealed protective package. If the package is damaged, make sure there is no damage to the life vest.



25-60-00-003 Rev 0

EMERGENCY - OVERWATER SURVIVAL EQUIPMENT - LIFE VESTS

EMERGENCY - EMERGENCY LOCATOR TRANSMITTER

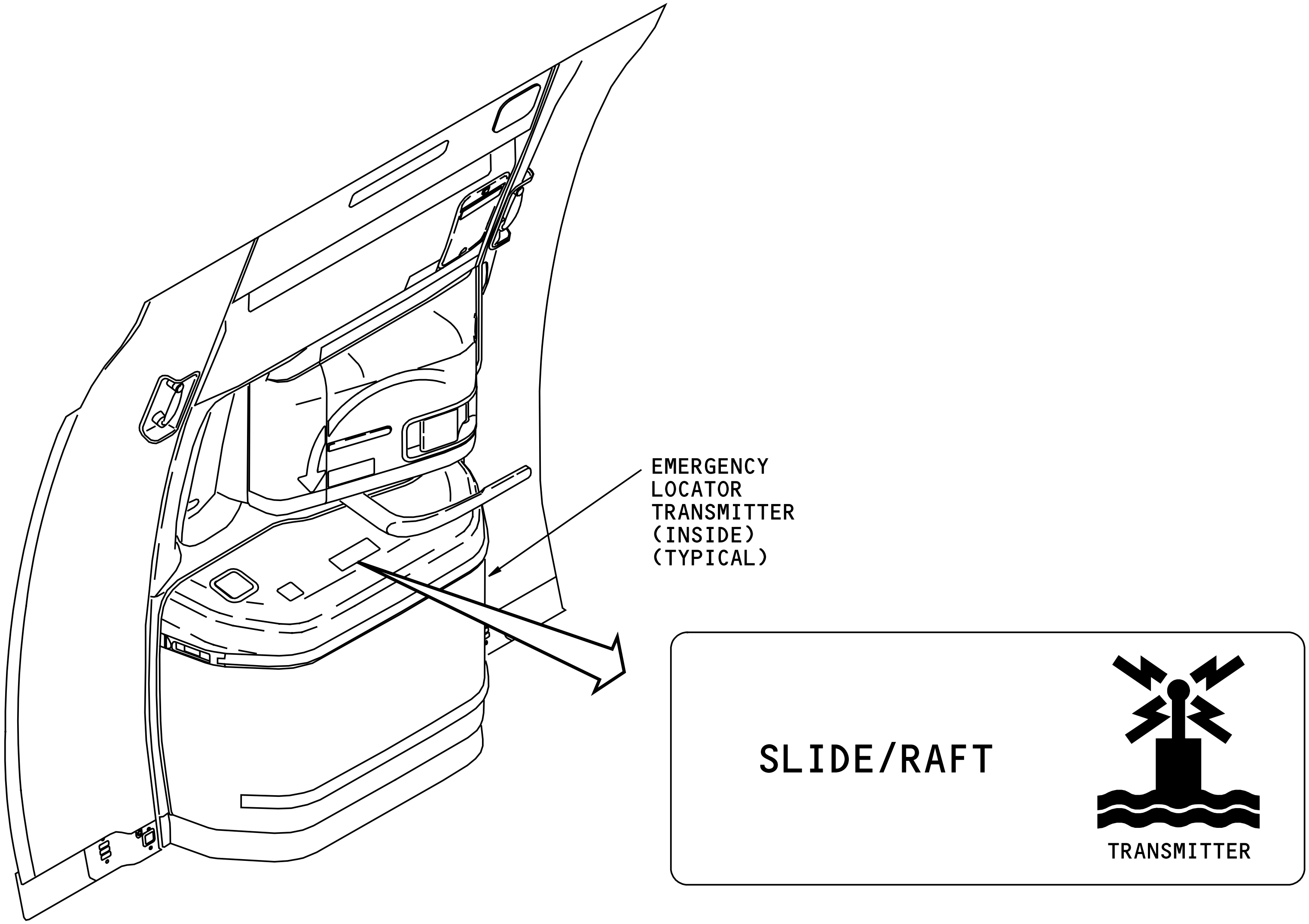
General

Emergency locator transmitters help rescue crews find airplanes which have landed away from an airport. The transmitters send a radio signal to satellites, other airplanes, or air traffic control facilities. Rescue crews use information from these sources to find the airplane.

Location

There are emergency locator transmitters at one or more of the these locations:

- Escape slide pack on the passenger entry door
- Emergency storage compartments (not shown).



25-60-00-004 Rev 0 12/18/1995

EMERGENCY - EMERGENCY LOCATOR TRANSMITTER

EMERGENCY - DETACHABLE EMERGENCY EQUIPMENT

General

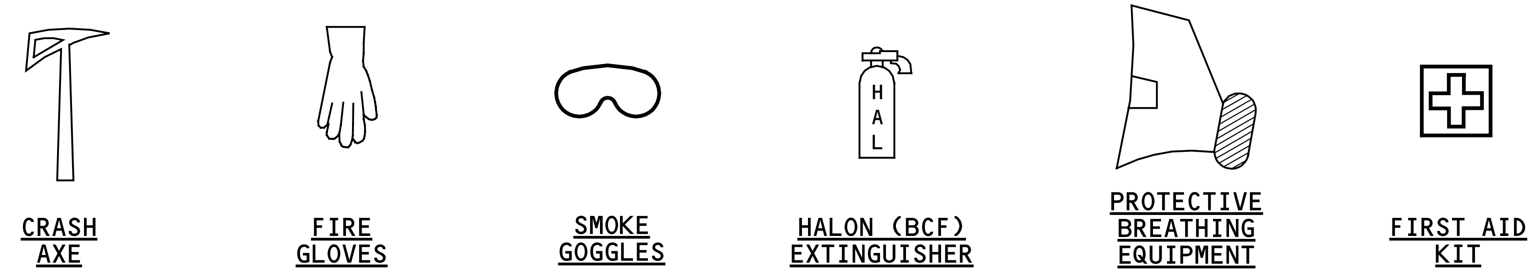
These items of detachable emergency equipment are in the flight deck:

- Crash axe
- Fire gloves
- Smoke goggles
- Portable fire extinguisher
- Protective breathing equipment
- First aid kit.

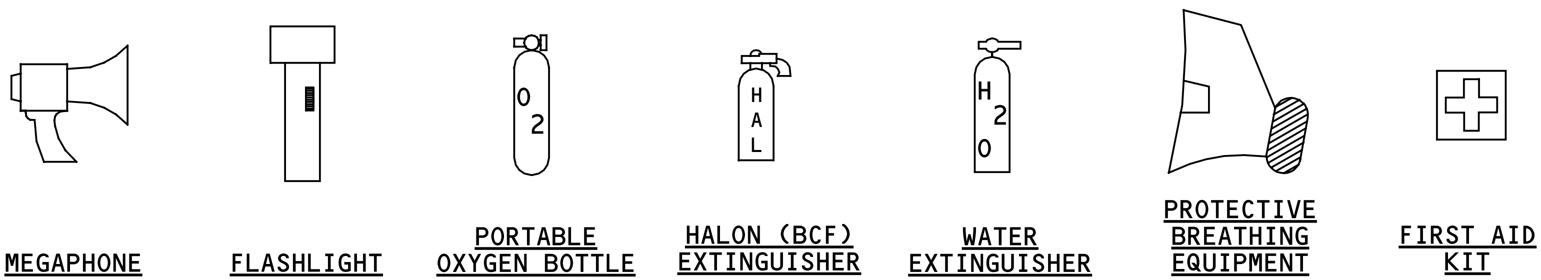
These items of detachable emergency equipment are in the passenger compartment:

- Megaphones
- Flashlights
- Portable oxygen bottles
- Portable fire extinguishers
- Protective breathing equipment
- First aid kits.

Placards in the airplane mark the locations of these items.



FLIGHT DECK DETACHABLE EMERGENCY EQUIPMENT



PASSENGER COMPARTMENT DETACHABLE EMERGENCY EQUIPMENT

25-60-00-007 Rev 0

EMERGENCY - DETACHABLE EMERGENCY EQUIPMENT

Continental Airlines, Inc

Water and Waste

WB371

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Water and Waste
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Continental Airlines, Inc

Water and Waste

WB371

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WATER AND WASTE - INTRODUCTION

General

The water system supplies potable water to the lavatories and galleys. The waste system keeps waste from the toilets and gives a way to remove it.

The potable water system has these subsystems:

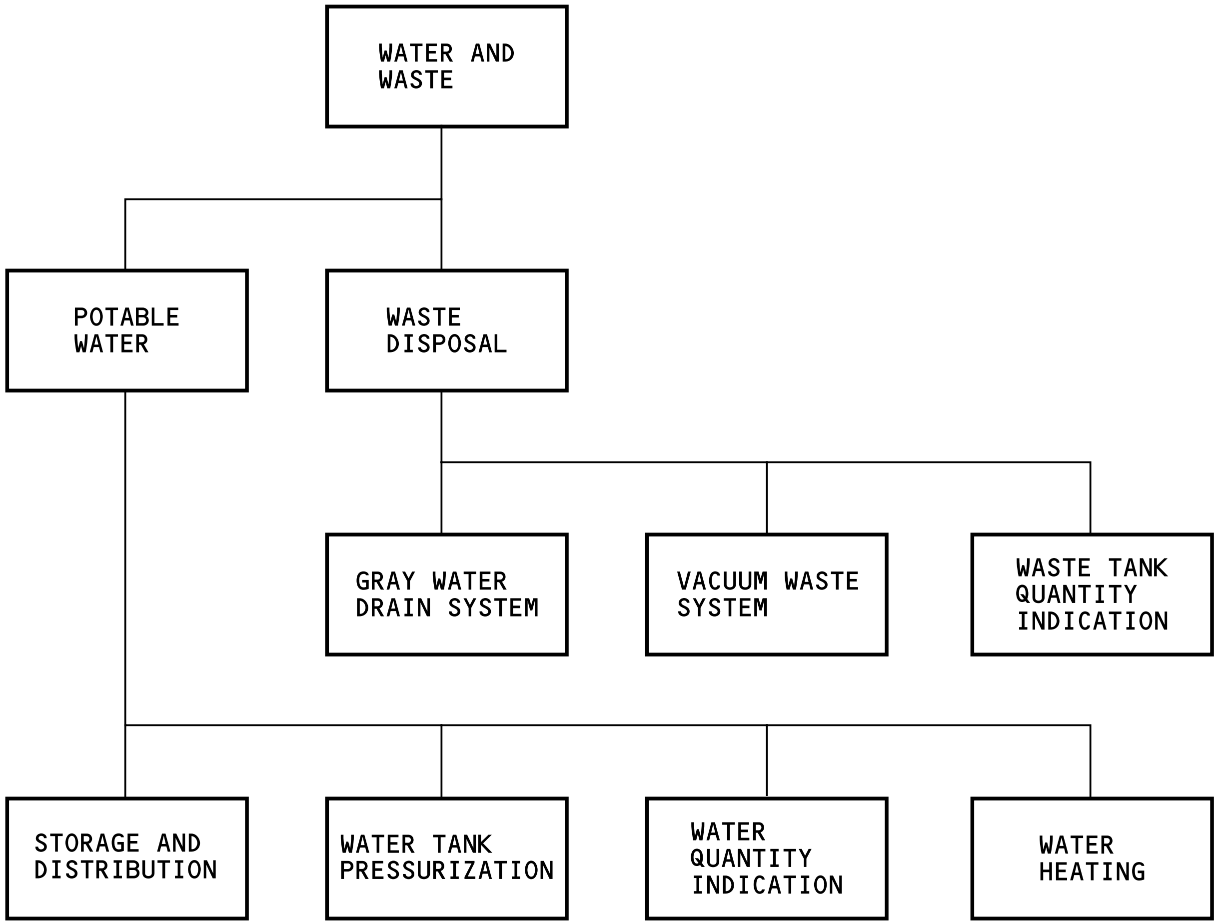
- Storage and distribution
- Water tank pressurization
- Water quantity indication
- Water heating.

These subsystems are in the waste disposal system:

- Gray water drain system
- Vacuum waste system
- Waste tank quantity indication.

Abbreviations and Acronyms

CACP	- cabin area control panel
CPRSR	- compressor
CSCP	- cabin system control panel
CSS	- cabin services system
FCU	- flush control unit
INTLK	- interlock
LCM	- logic control module
SW	- switch



38-00-00-001 Rev 1 03/12/1997

WATER AND WASTE - INTRODUCTION

WATER AND WASTE - GENERAL DESCRIPTION

Potable Water System

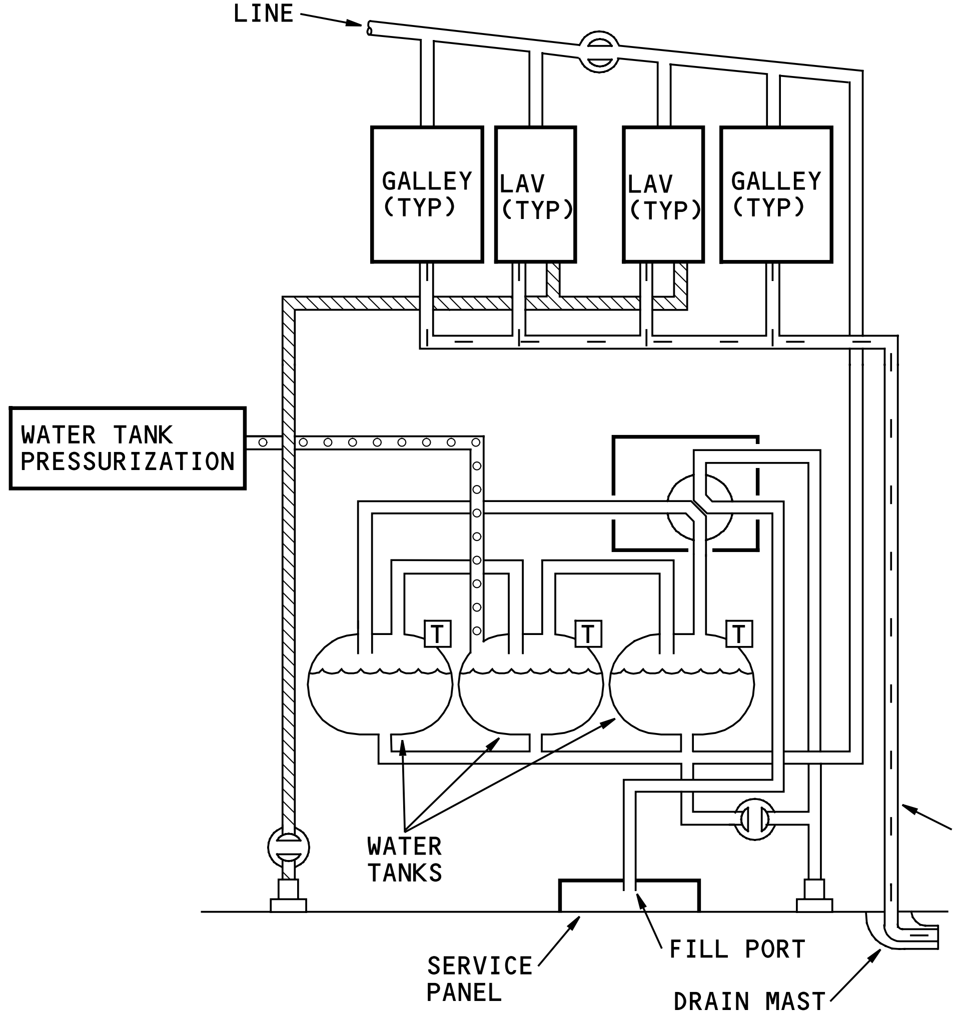
There are three potable water tanks. The pneumatic system or a compressor pressurizes the tanks. The pressure inside the tanks pushes the water through distribution lines to the lavatories and galleys. Potable water also goes to the toilets in the lavatories to flush the vacuum toilet bowls.

Waste Disposal System

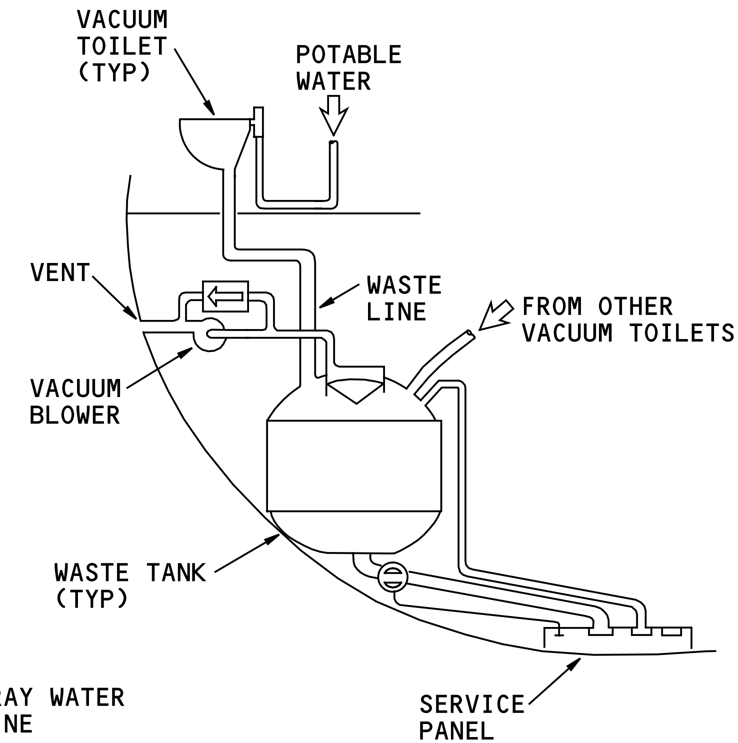
Gray water drains from the sinks in the lavatories and galleys. This gray water goes through drain lines to either of two drain masts on the bottom of the fuselage.

Each lavatory has a vacuum toilet. Waste lines connect the lavatories to one of three waste tanks. Each tank gets waste from a specified group of lavatories.

A vacuum in the tank pulls the waste from the toilet into the tank.



POTABLE WATER AND GRAY WATER SYSTEMS
(TYPICAL)



VACUUM WASTE SYSTEM
(TYPICAL)

38-00-00-002 Rev 3 07/18/1997

WATER AND WASTE - GENERAL DESCRIPTION

WATER STORAGE AND DISTRIBUTION - INTRODUCTION

Purpose

The water storage and distribution system supplies potable water to the lavatories and galleys.

General Description

There are three water tanks that contain potable water.

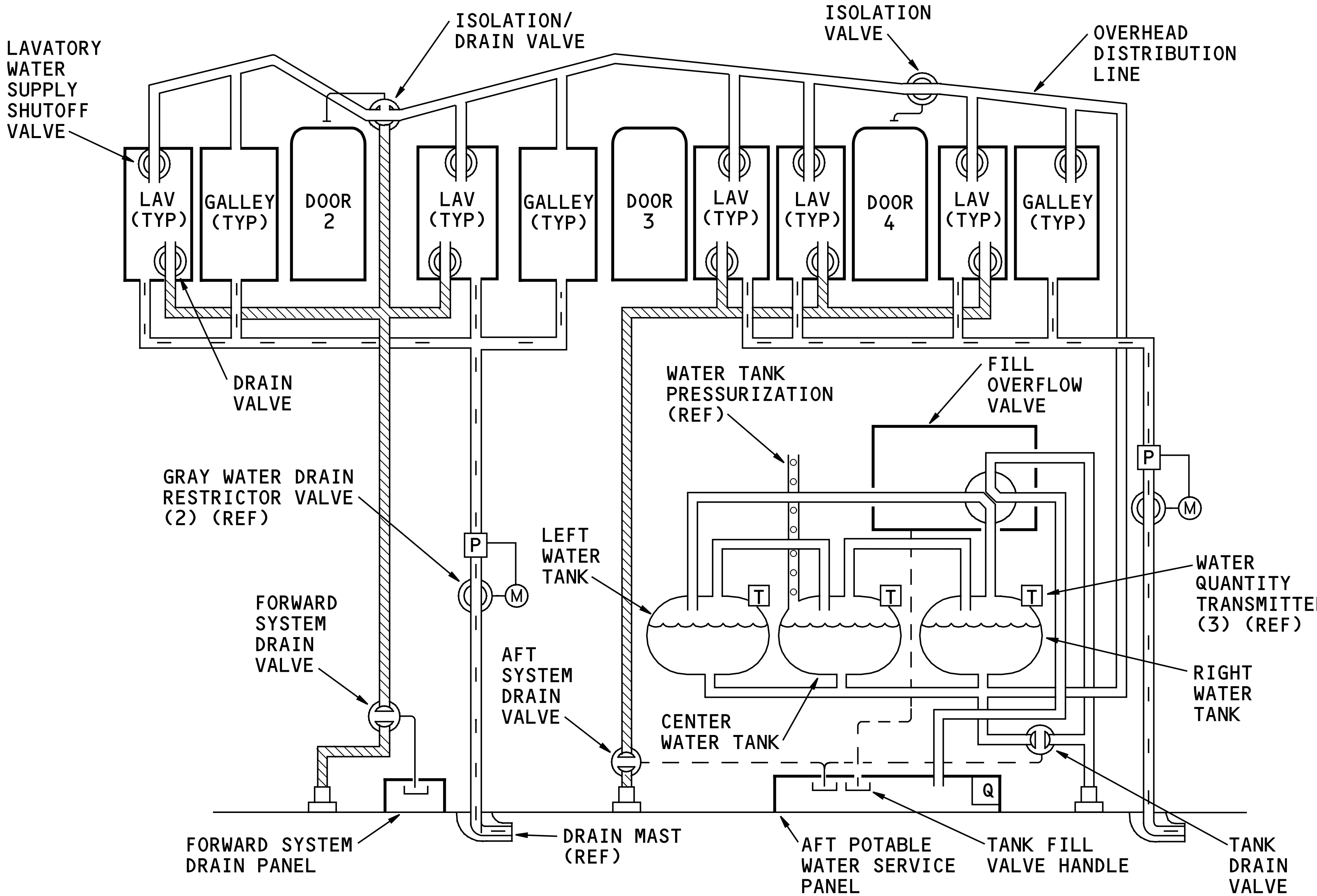
You fill the tanks from aft potable water service panel. You use the fill/overflow valve to fill the water tanks. The overhead distribution line supplies water to the lavatories and galleys. There is a water supply shutoff valve in each lavatory and galley.

There is an isolation/drain valve in the forward part of the system and an isolation valve in the aft part of the system. These two valves let you isolate parts of the system. The isolation/drain valve also lets you drain the forward part of the system to the forward drain valve.

There is a water supply shutoff valve in each lavatory and galley. There is a drain valve in each lavatory. It lets water drain from the distribution lines in the lavatory. You use the galley faucet to drain the galley distribution lines.

These are the three drain valves that let you drain water from the distribution system and the water tanks:

- Forward system drain valve
- Aft system drain valve
- Tank drain valve.



WATER STORAGE AND DISTRIBUTION - INTRODUCTION

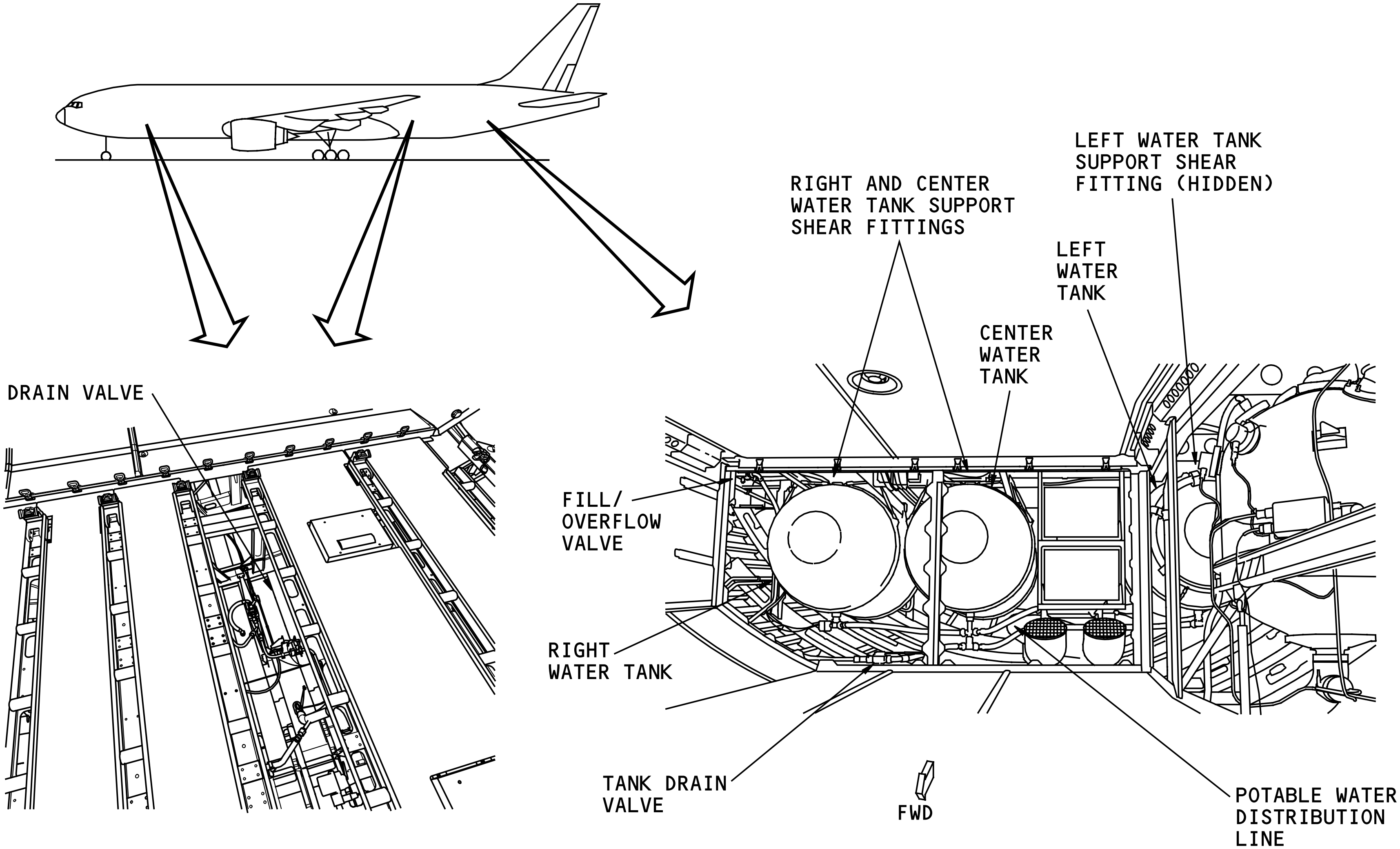
WATER STORAGE AND DISTRIBUTION - BULK CARGO COMPARTMENT COMPONENT LOCATIONS

Component Locations

These components are behind the bulk cargo compartment end wall:

- Three water tanks (left, center, and right)
- Fill overflow valve and control cable (cable not shown)
- Three water tank support shear fittings
- Potable water distribution line
- Tank drain valve.

The drain valve for the aft part of the overhead distribution system is in the aft cargo compartment, under the floor.



AFT CARGO COMPARTMENT FLOOR
(LOOKING AFT WITH PANEL REMOVED)
(FORWARD INSTALLATION SIMILAR)

BULK CARGO COMPARTMENT
(LOOKING AFT WITH END WALL REMOVED)

WATER STORAGE AND DISTRIBUTION - BULK CARGO COMPARTMENT COMPONENT LOCATIONS

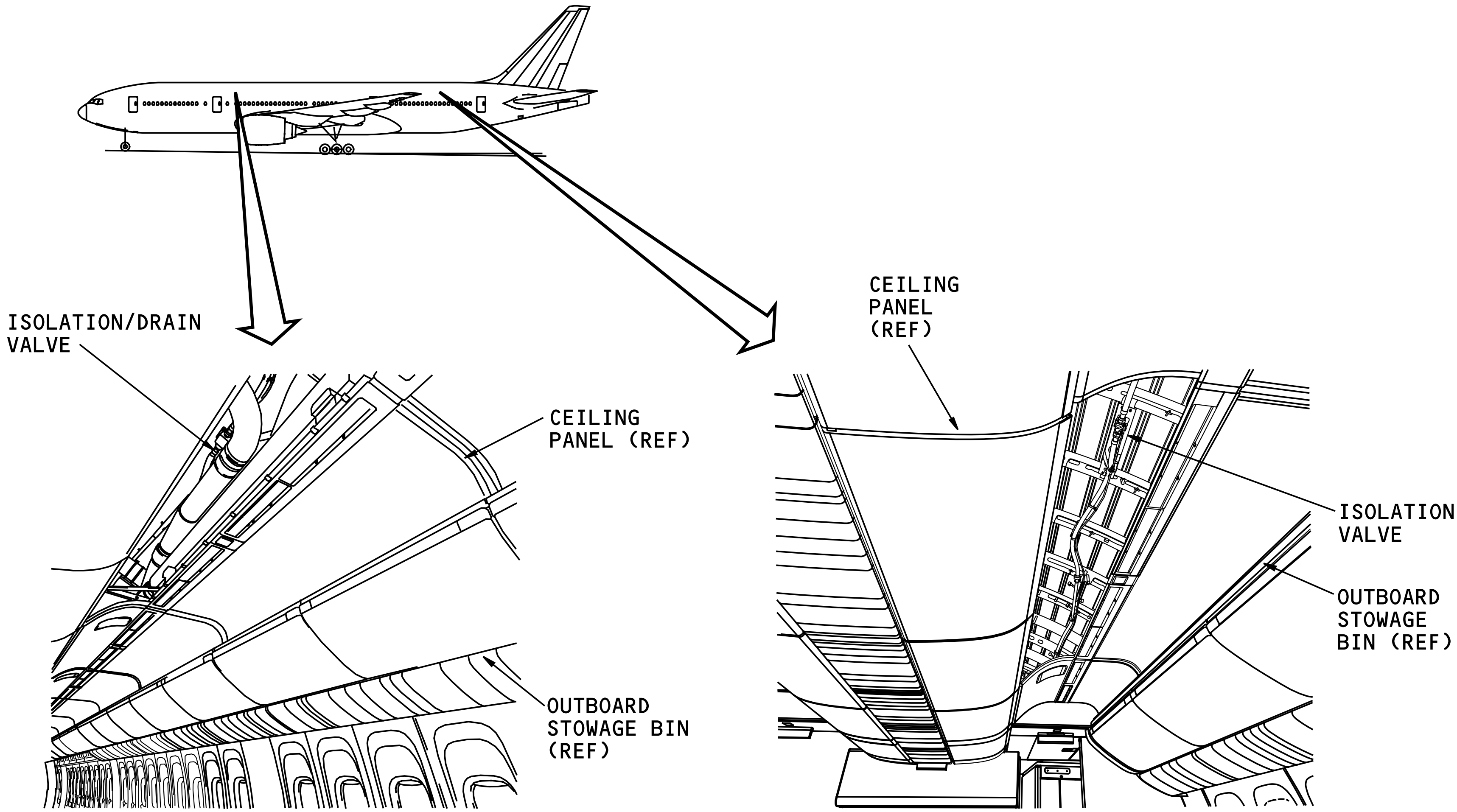
38-11-00-002 Rev 0 07/21/1997

WATER STORAGE AND DISTRIBUTION - PASSENGER COMPARTMENT COMPONENT LOCATIONS

Component Locations

The isolation/drain valve is above the ceiling on the left. It is near door 2.

The isolation valve is above the ceiling in the aft part of the passenger compartment. It is near door 4.



LEFT SIDE OF PASSENGER COMPARTMENT NEAR DOOR 2
(LOOKING AFT WITH CEILING PANEL REMOVED)

LEFT SIDE OF PASSENGER COMPARTMENT
(LOOKING AFT WITH CEILING PANEL REMOVED)

38-11-00-003 Rev 2 01/19/1998

WATER STORAGE AND DISTRIBUTION - PASSENGER COMPARTMENT COMPONENT LOCATIONS

WATER STORAGE AND DISTRIBUTION - LAVATORY COMPONENT LOCATIONS

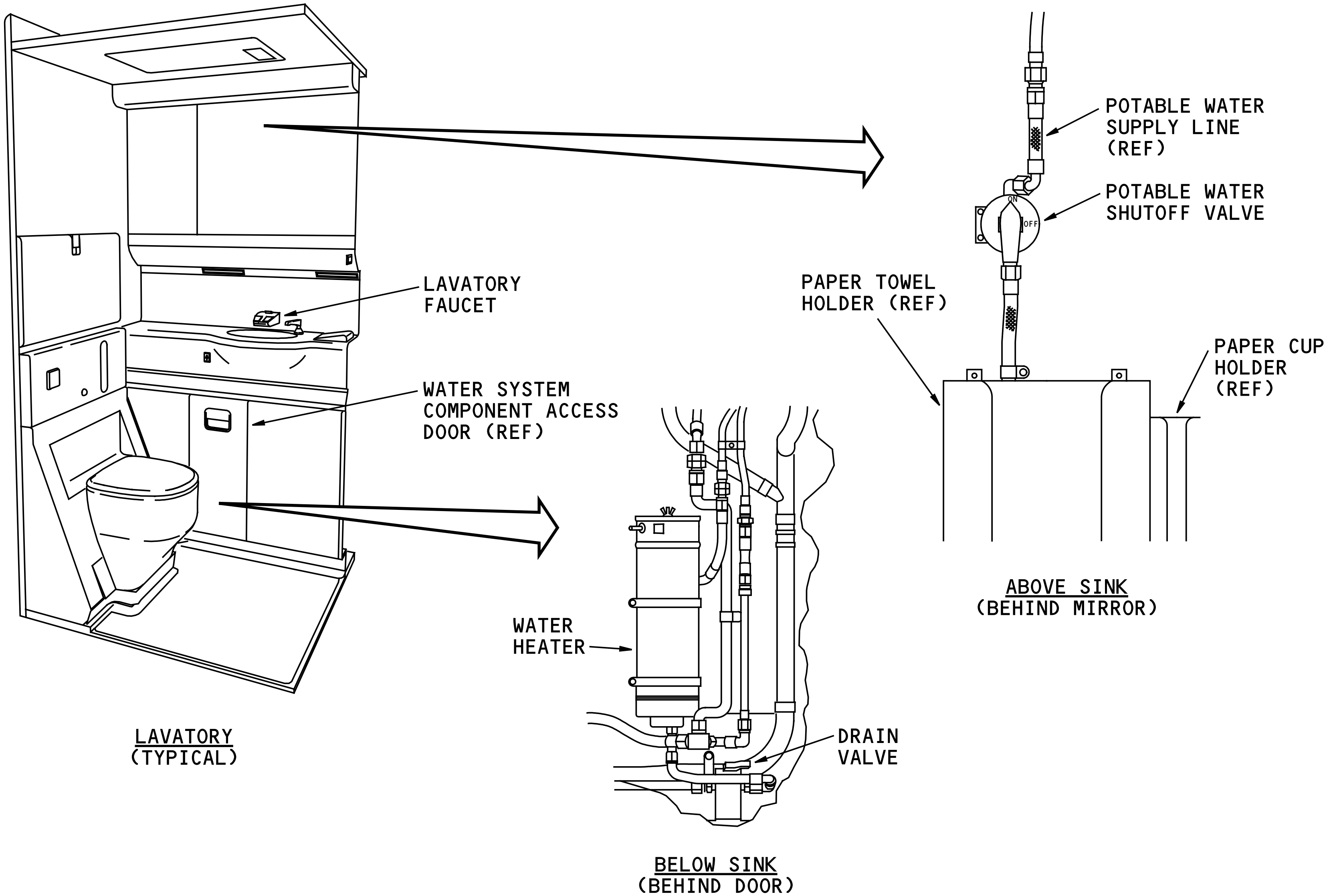
Component Locations

The potable water shutoff valve is behind the mirror.

The faucet is immediately above the sink.

These components are behind the door below the sink:

- Water heater
- Drain valve.



38-11-00-004 Rev 2 03/19/1997

WATER STORAGE AND DISTRIBUTION - LAVATORY COMPONENT LOCATIONS

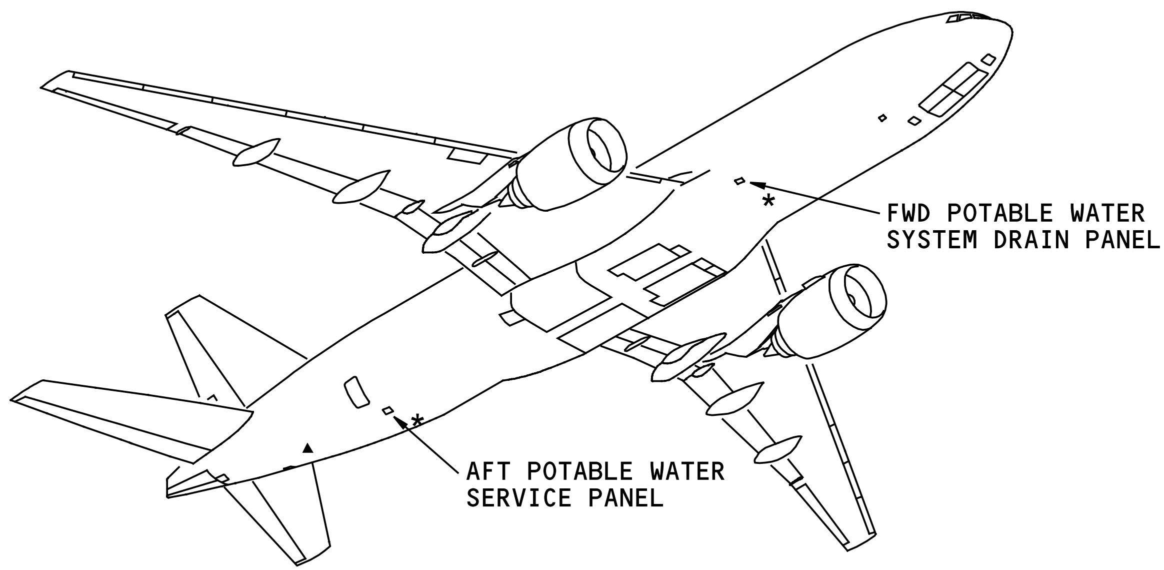
WATER STORAGE AND DISTRIBUTION - SERVICE PANEL COMPONENT LOCATIONS

Component Locations

The aft potable water service panel is on the right side of the airplane. It is between the aft cargo compartment door and the bulk cargo compartment door.

The forward potable system drain panel is on the right side of the airplane. It is aft of the forward cargo compartment door.

There are three water drains. One is near the forward potable water system drain panel. The second one is near the aft potable water service panel. The third is aft of the passenger entry door 4, on the right lower side of the fuselage.



▲ = TANK DRAIN/OVERFLOW
* = DISTRIBUTION DRAIN

38-11-00-005 Rev 3 07/21/1997

WATER STORAGE AND DISTRIBUTION - SERVICE PANEL COMPONENT LOCATIONS

WATER STORAGE AND DISTRIBUTION - WATER TANK

Purpose

There are three water tanks to hold potable water.

Physical Description

Each water tank has a capacity of 120 gallons (454 liters). There is a standpipe that limits the amount of water in each tank to 109 gallons (413 liters).

The water tanks have these components:

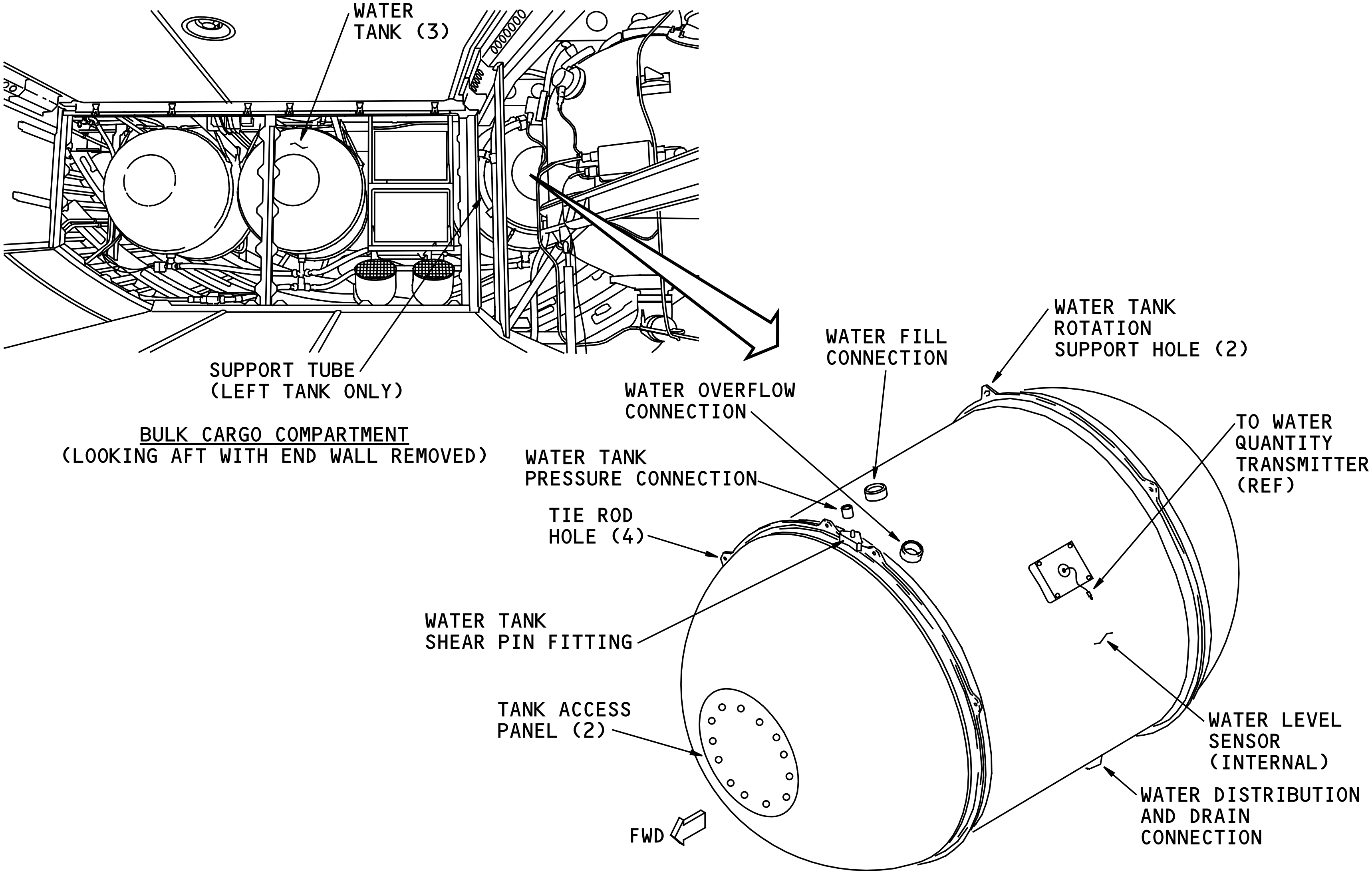
- Access panel (2)
- Water tank shear pin fitting
- Tie rod hole (4)
- Water tank pressure connection
- Water overflow connection
- Water fill connection
- Water tank rotation support hole (2)
- Water level sensor (internal)
- Water distribution and drain connection.

The left water tank has a support tube around the forward end of the tank.

Location

The water tanks are aft of the bulk cargo compartment end wall.

The left water tank is aft of the aft waste tank.



38-11-00-006 Rev 2 12/10/1996

WATER STORAGE AND DISTRIBUTION - WATER TANK

WATER STORAGE AND DISTRIBUTION - WATER TANK SUPPORT SHEAR FITTING

Purpose

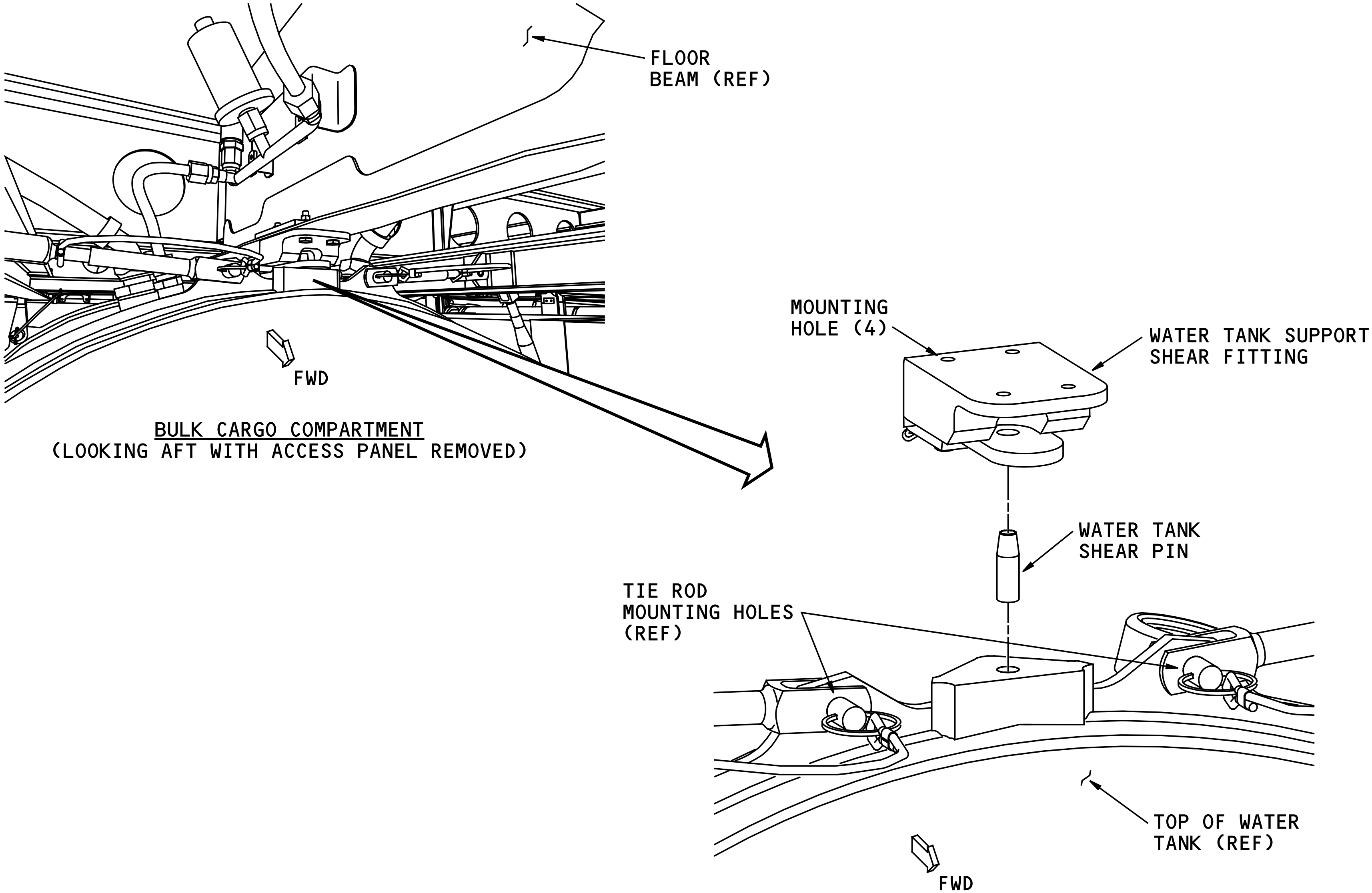
The water tank support shear fitting holds the water tank shear pin. The shear pin holds the water tank in place during forward loads.

Physical Description

The fitting has four mounting holes.

Location

The fitting is installed above the water tank. It attaches to the floor beams with four bolts.



38-11-00-007 Rev 0

WATER STORAGE AND DISTRIBUTION - WATER TANK SUPPORT SHEAR FITTING

WATER STORAGE AND DISTRIBUTION - FILL/OVERFLOW VALVE AND CONTROL CABLE

Purpose

The fill/overflow valve has these functions:

- Lets water flow into the potable water tanks from the aft potable water service panel
- Lets the air in the water tanks vent overboard as water flows into the tanks
- Lets water flow overboard when the tanks are full
- Does not let the air compressor operate when the valve is in the open position.

Physical Description

The valve has:

- A cable connection to the aft service panel
- Four water line connections
- An interlock switch for the tank pressurization compressor.

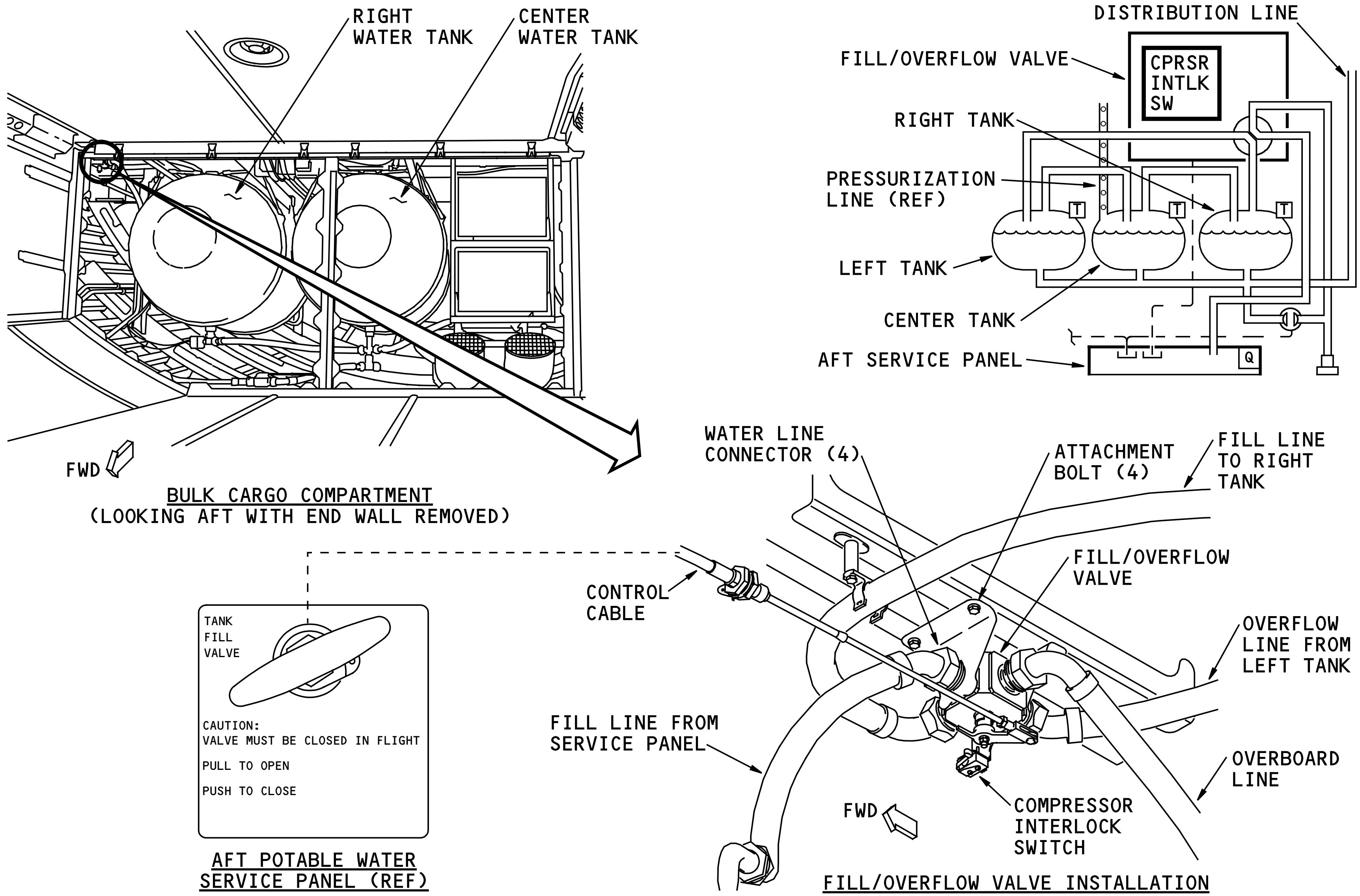
Location

The fill/overflow valve is behind the bulk cargo compartment end wall. It is above and outboard of the right water tank. The valve attaches to the passenger compartment floor structure with four bolts.

Functional Description

To open the valve you pull out on the handle. Water flows from the service panel to the right tank. Some of the water flows from the right tank to the center and left tanks through the water distribution line. This connection lets all three tanks fill at the same time. A vent line that does not go through the valve connects the standpipe of the right tank to the top of the center tank. When the right tank is full, water flows through this line to the center tank. Another vent line connects the standpipe of the center tank to the top of the left tank. When the center tank is full, water flows through this line to the left tank. When the left tank is full, the water flows through the valve, then overboard. Push the control handle in to close the valve.

When the valve is in the closed position, the fill line from the service panel connects to the overboard line.



38-11-00-022 Rev 4 07/21/1997

WATER STORAGE AND DISTRIBUTION - FILL/OVERFLOW VALVE AND CONTROL CABLE

WATER STORAGE AND DISTRIBUTION - DRAIN VALVE AND CONTROL CABLE

Purpose

The two drain valves let water drain overboard from the overhead water distribution line, the galleys, and the lavatories.

Physical Description

The two system drain valves are identical and interchangeable. The valve has two positions: open and closed.

The valves are a single-ball type of valve. The valves have these parts:

- Drain line connection (2)
- Actuator
- Ball (internal)
- Body.

The valve attaches with four bolts.

The aft system drain valve has two control cables. One attaches to the aft system drain valve control handle and to the valve actuator. The other attaches to the valve actuator and to the tank drain valve (not shown).

The forward system drain valve (not shown) has one cable that attaches to the valve actuator and to the forward system drain valve control handle (not shown).

The control cables are a push-pull type.

Location

The aft system drain valve is below the floor of the aft cargo compartment. It is near the bulk cargo compartment, inboard of the last powered drive unit on the left side (PDU 13L).

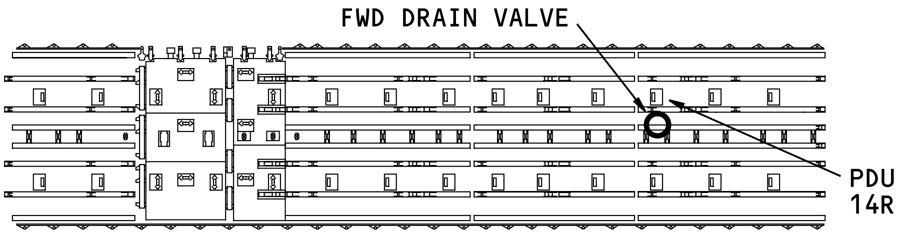
The forward system drain valve is below the floor of the forward cargo compartment. It is near the aft part of the compartment, inboard of powered drive unit number 14 right (PDU 14R).

The control handle for the forward potable water system drain valve is on the forward potable water system drain panel (not shown).

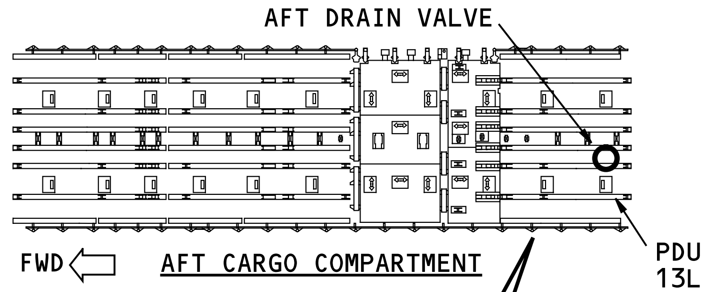
The control handle for the aft valve is on the aft potable water service panel (not shown).

Functional Description

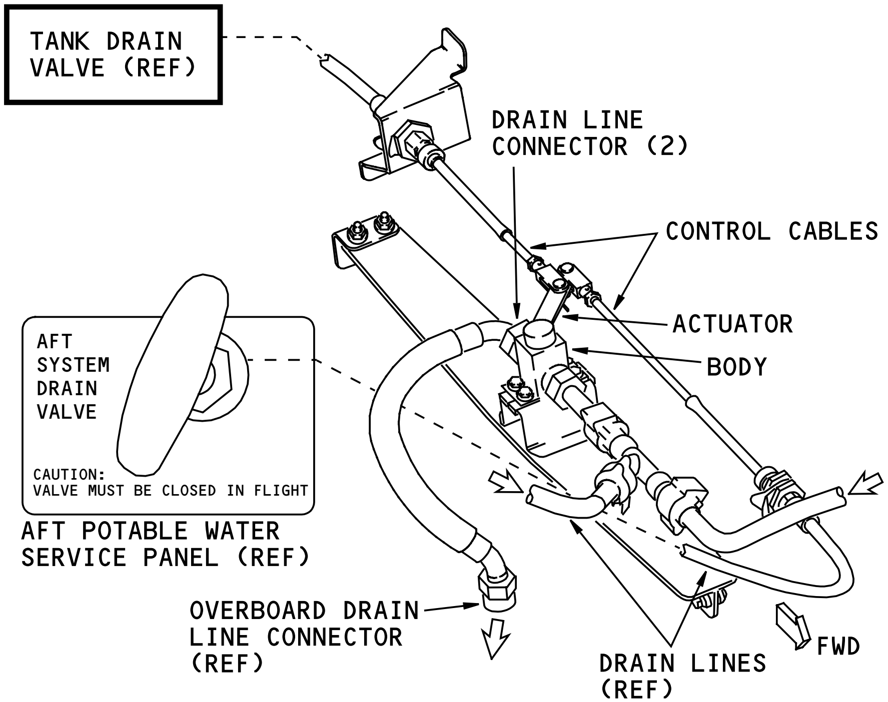
The control cables open the related valve(s) when you pull on the system drain valve control handle. The valve(s) closes when you push the handle.



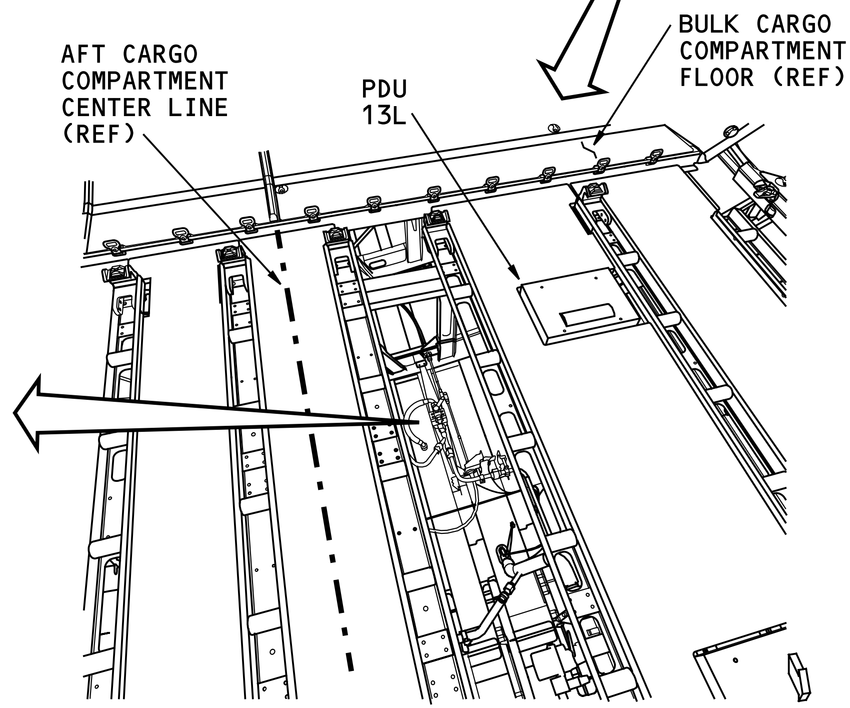
FWD CARGO COMPARTMENT



AFT CARGO COMPARTMENT



AFT SYSTEM DRAIN VALVE



AFT CARGO COMPARTMENT FLOOR
(LOOKING AFT WITH FLOOR PANEL REMOVED)

NOTE: AFT DRAIN VALVE AND INSTALLATION SHOWN. THE FORWARD DRAIN VALVE AND INSTALLATION ARE SIMILAR.

WATER STORAGE AND DISTRIBUTION - DRAIN VALVE AND CONTROL CABLE

WATER STORAGE AND DISTRIBUTION - TANK DRAIN VALVE AND CONTROL CABLE

Purpose

The tank drain valve lets water drain overboard from the water tanks and the aft section of the overhead water distribution lines. The control cable sets the position of the tank drain valve.

Physical Description

The tank drain valve is dual-ball type of valve. The valve has these parts:

- Handle
- Shaft (2)
- Cover assembly with two internal gears
- Ball (internal) (2)
- Drain line connection (2)
- Body.

The tank drain valve has an open and a closed position.

The valve has a control cable that attaches to the valve handle and to the aft system drain valve (not shown). The control cable is a push-pull type.

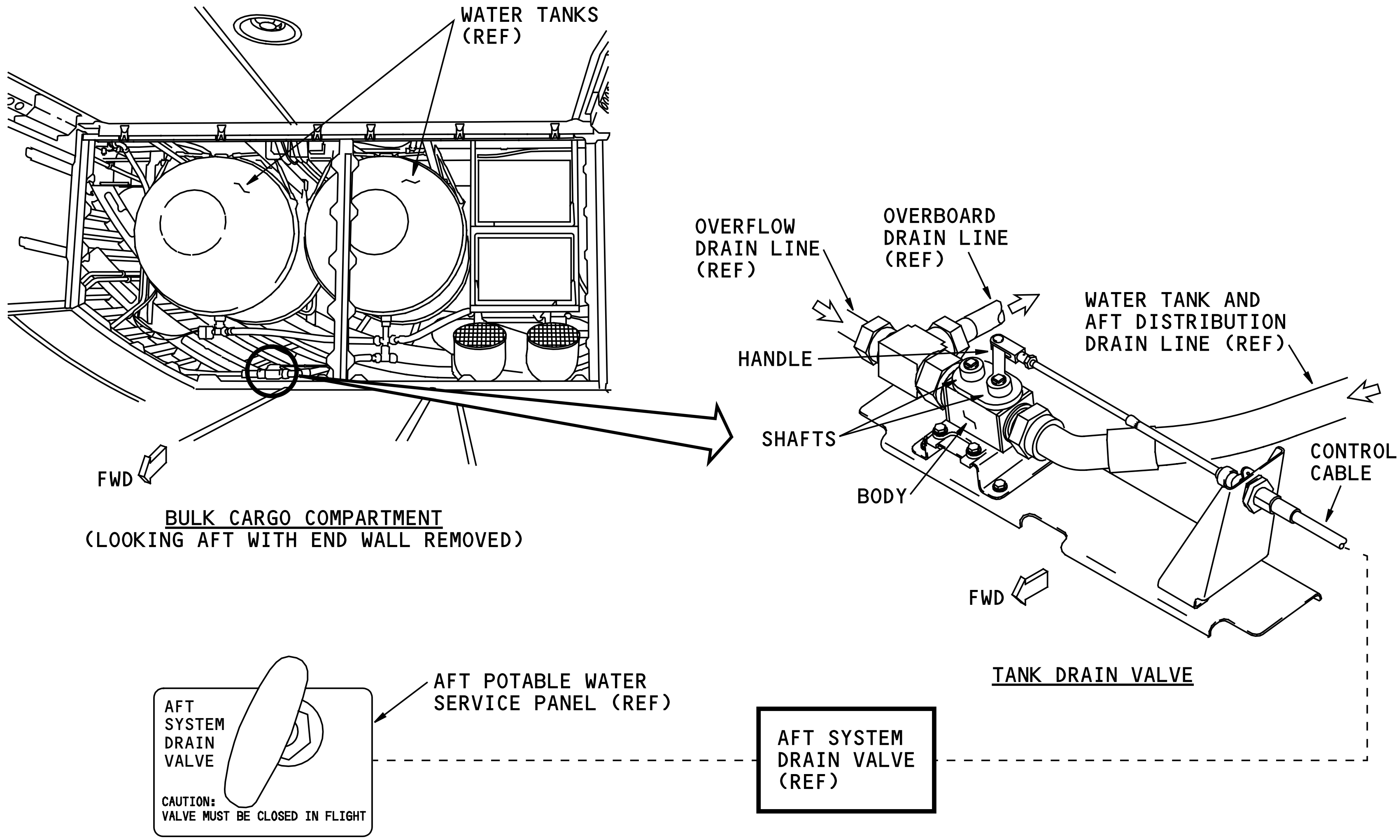
Location

The drain valve is behind the right end wall of the bulk cargo compartment. It is below the space between the right and center water tanks.

Functional Description

The control cable sets the position of the valve handle to the same position as the aft system drain valve. The handle is on a shaft connected by internal gears to a second shaft. Each shaft has a ball that attaches to it (internal to the body). The handle turns the gears and balls when the handle moves.

Control cables open the aft system drain valve and the tank drain valve when you pull on the aft system drain valve control handle (not shown). The valves closes when you push the handle. The aft system drain valve control handle is on the aft potable water service panel (not shown).



38-11-00-011 Rev 2 12/11/1996

WATER STORAGE AND DISTRIBUTION - TANK DRAIN VALVE AND CONTROL CABLE

WATER STORAGE AND DISTRIBUTION - ISOLATION VALVE AND CONTROL CABLE

Purpose

The isolation valve lets you isolate the overhead distribution lines that supply water to the forward and mid lavatories and galleys.

Physical Description

The valve has two positions: open and closed.

The valve has a manual actuator. A control cable attaches to the actuator. This allows you to manually open and close the valve.

The valve attaches with four bolts. It has two water line connectors.

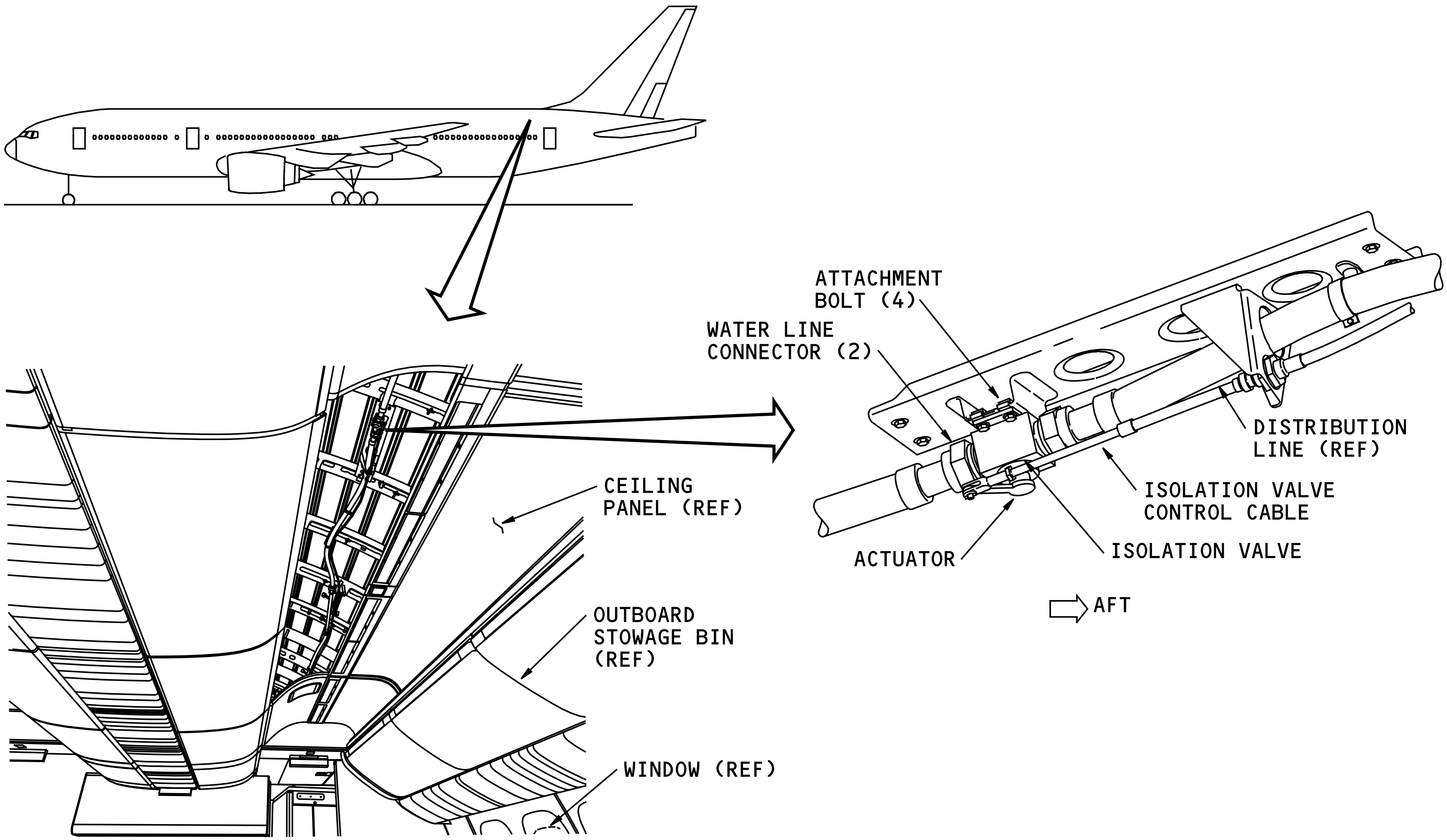
Location

The isolation valve is above the ceiling in the aft part of the passenger compartment. To get access, remove the ceiling panel that is above the left aisle next to a center overhead stowage bin.

The isolation handle is behind a panel above the passenger/entry door 4 left.

Functional Description

The control cable opens and closes the valve when you operate the isolation handle.



LEFT SIDE OF PASSENGER COMPARTMENT
(LOOKING AFT WITH CEILING PANEL REMOVED)

38-11-00-012 Rev 2 01/07/1998

WATER STORAGE AND DISTRIBUTION - ISOLATION VALVE AND CONTROL CABLE

WATER STORAGE AND DISTRIBUTION - ISOLATION/DRAIN VALVE AND CONTROL CABLE

Purpose

The isolation/drain valve lets you isolate the overhead distribution lines that supply water to the forward lavatories and galleys. It also permits you to drain the forward part of the overhead distribution line overboard.

Physical Description

The isolation/drain valve is a three-way, three-position valve. The positions are open, isolation, and drain.

The valve has a manual actuator. A control cable attaches to the actuator.

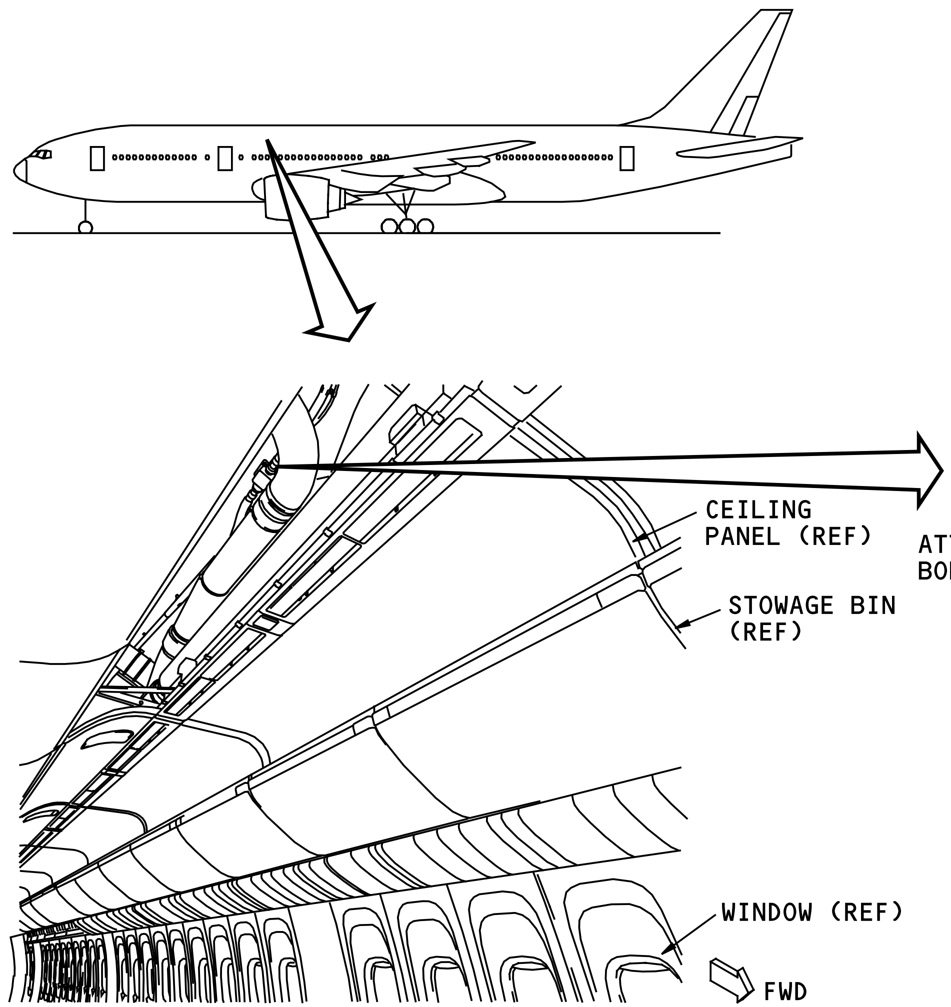
The valve attaches to the support with four bolts. It has three water line connectors, two for the overhead distribution lines, and one for the overboard drain line.

Location

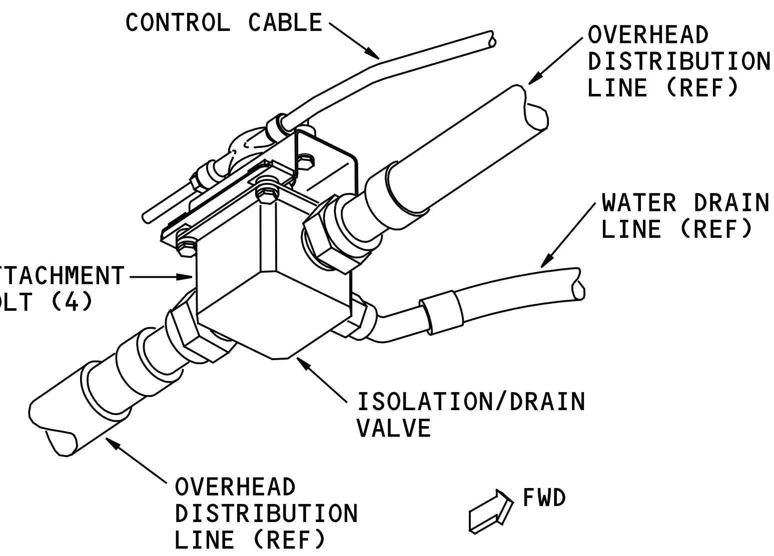
The isolation/drain valve is above the ceiling in the forward part of the passenger compartment. The ceiling panel that gives access is above the left aisle next to an inboard overhead stowage bin. It is near door 2.

Functional Description

The control cable operates the valve to any of the three positions when you operate the isolation/drain valve handle.



LEFT SIDE OF PASSENGER COMPARTMENT NEAR DOOR 2
(LOOKING AFT WITH CEILING PANEL REMOVED)



ISOLATION/DRAIN VALVE

38-11-00-013 Rev 1 01/21/1998

WATER STORAGE AND DISTRIBUTION - ISOLATION/DRAIN VALVE AND CONTROL CABLE

WATER STORAGE AND DISTRIBUTION - ISOLATION HANDLE AND ISOLATION/DRAIN VALVE HANDLE

Purpose

The isolation handle and isolation/drain valve handle let you operate the isolation valve and the isolation/drain valve.

Physical Description

The isolation/drain valve handle and the isolation handle are similar. Each handle connects the valve with a control cable.

The isolation/drain valve handle has three positions, open, closed, and drain. The isolation handle has two positions, open and closed.

Each handle attaches with two bolts.

Location

The isolation/drain handle is behind a panel above the passenger/entry door 2 left. The isolation handle is behind a panel above the passenger entry door 4 left.

Functional Description

When you turn the isolation handle clockwise, the isolation valve closes. This isolates the overhead distribution line. When you turn the handle counterclockwise, the valve opens.

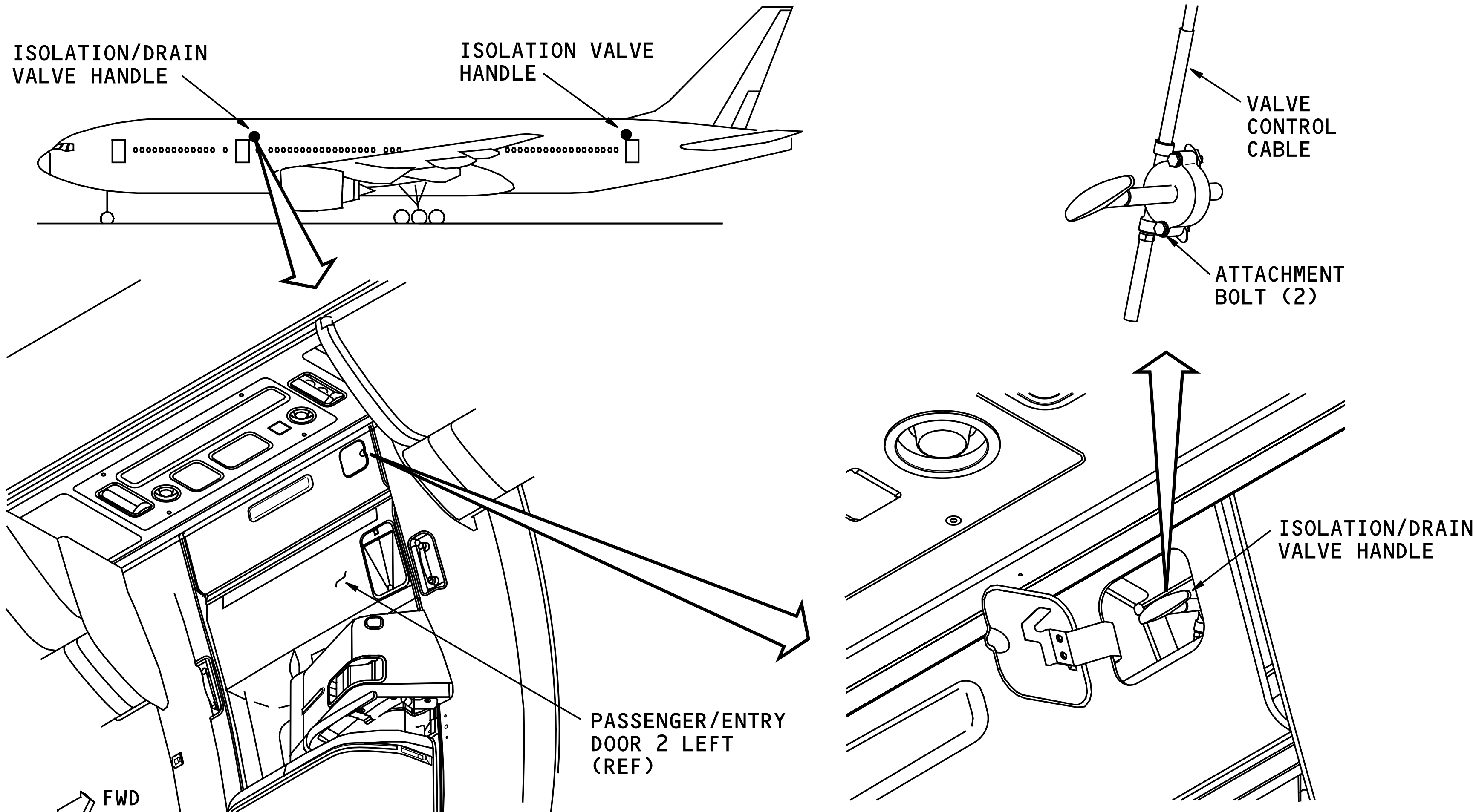
When you turn the isolation/drain valve handle clockwise to the closed position, the isolation/drain valve closes. This isolates the overhead distribution line.

Operation

You turn the isolation and isolation/drain valve handles clockwise to move them to the isolation position. You must pull the isolation/drain valve and turn it to move it to the drain position.

Training Information Point

If the panel for the isolation valve is closed, the valve is in the open position.



ACCESS PANEL

LEFT PASSENGER/ENTRY DOOR 2
(LOOKING UP AND AFT)

NOTE: ISOLATION/DRAIN VALVE HANDLE INSTALLATION SHOWN. ISOLATION VALVE HANDLE SAME, THE INSTALLATION IS SIMILAR.

38-11-00-014 Rev 1 01/07/1998

WATER STORAGE AND DISTRIBUTION - ISOLATION HANDLE AND ISOLATION/DRAIN VALVE HANDLE

WATER STORAGE AND DISTRIBUTION - INTRODUCTION - LAVATORY

Purpose

The part of the water storage and distribution system that is in the lavatory does these functions:

- Lets you control the flow of water into the lavatory
- Distributes water to components in the lavatory
- Lets you drain water from the lavatory.

Physical Description

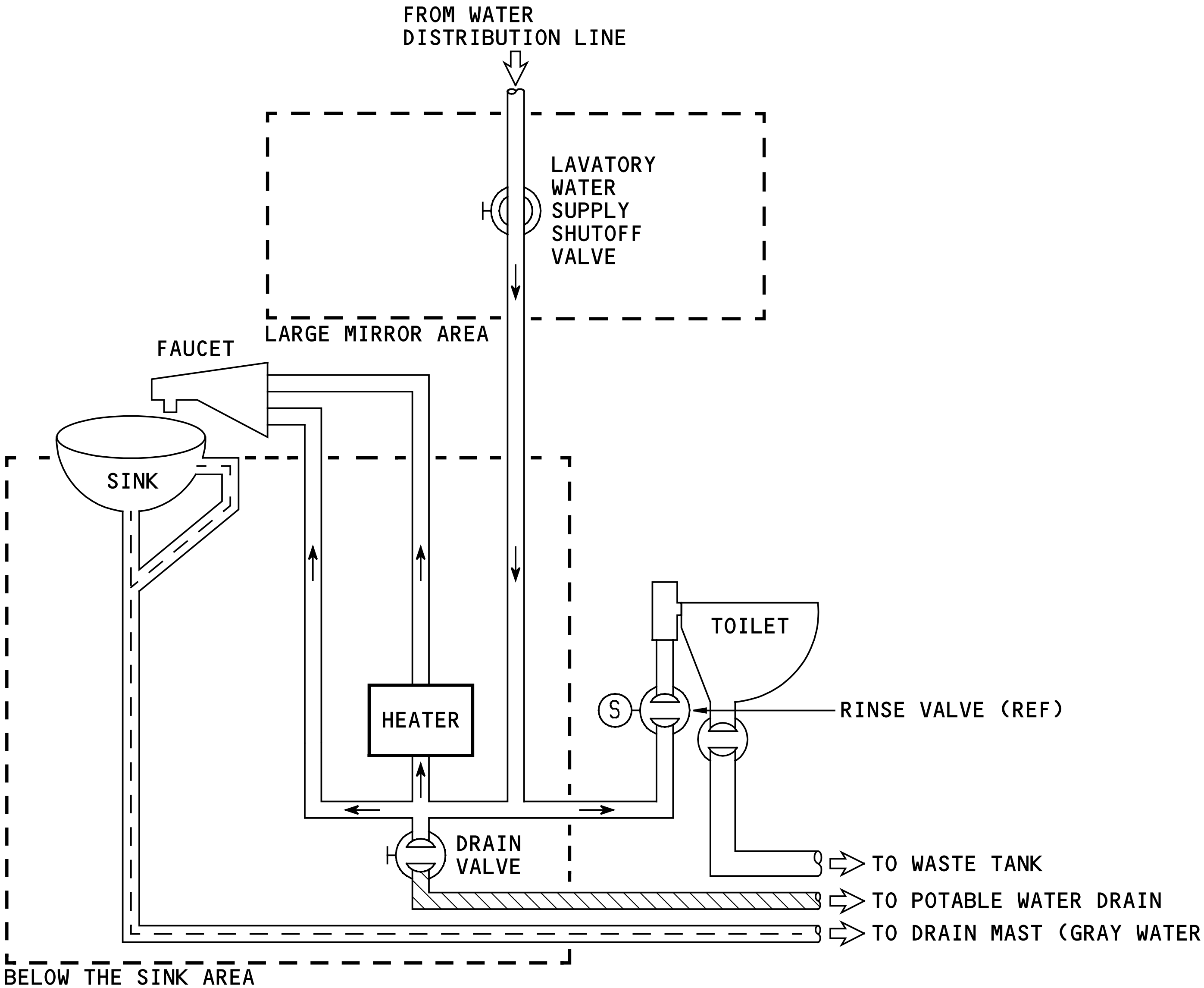
A typical lavatory has these water storage and distribution system components:

- Lavatory water supply shutoff valve
- Distribution lines and fittings (not shown)
- Drain valve
- Faucet.

The system has interfaces with the water heating system and the vacuum waste system.

See the water heating section or more information on water heating (AMM PART I 38-13).

See the vacuum waste system section for more information on the vacuum waste system (AMM PART I 38-32).



WATER STORAGE AND DISTRIBUTION - INTRODUCTION - LAVATORY

WATER STORAGE AND DISTRIBUTION - LAVATORY WATER SUPPLY SHUTOFF VALVE

Purpose

The lavatory water supply shutoff valve lets you control the flow of water into the lavatory.

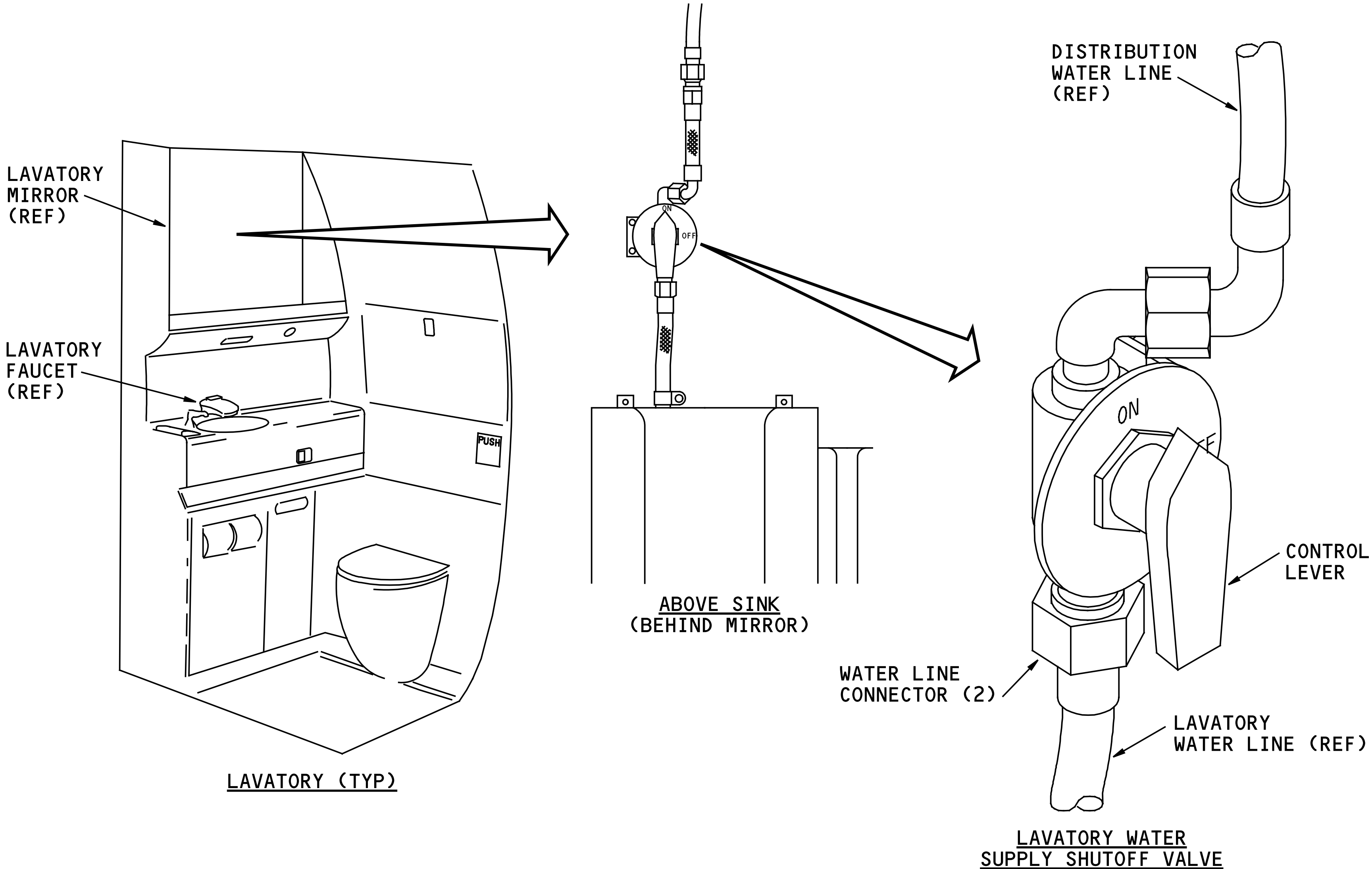
Physical Description

The valve has two positions, off and on.

It has two water connectors and a control lever.

Location

There is a valve in each lavatory. It is above the sink and behind the mirror.



38-11-00-015 Rev 0

WATER STORAGE AND DISTRIBUTION - LAVATORY WATER SUPPLY SHUTOFF VALVE

WATER STORAGE AND DISTRIBUTION - OPERATION - DRAIN

Forward System Drain Valve

This is a summary of the procedure to drain the water storage and distribution system:

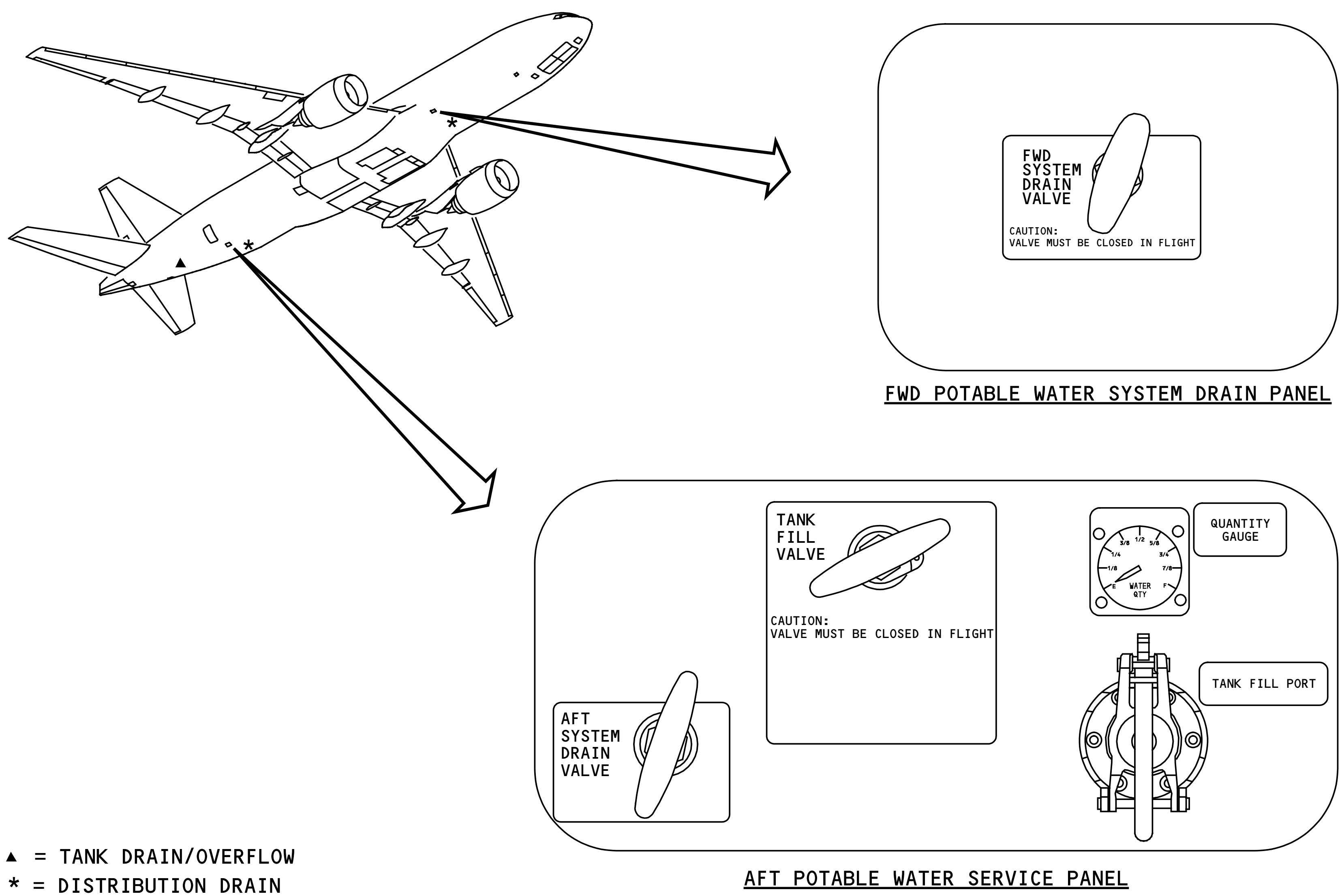
- Open the lavatory water heater circuit breakers
- Put the isolation/drain valve in the drain position
- Make sure the isolation valve is in the open position
- Open the distribution drain shutoff valves
- Pull the forward system drain valve handle
- Pull the aft system drain handle.

The water flows overboard through these three places:

- Forward system drain
- Aft system drain
- Overflow/tank drain.

The forward system drain is on the right side of the airplane and below the leading edge of the wing. The aft system drain is on the left side of the airplane, directly across from the aft service panel. The overflow/tank drain is almost straight aft of the aft service panel.

WARNING: DRAIN THE POTABLE WATER SYSTEM AT A MINIMUM OF 1 TIME EACH 3 DAYS IN ORDER TO PREVENT THE GROWTH OF BACTERIA. CONTAMINATION CAN OCCUR IF YOU DO NOT DRAIN THE SYSTEM REGULARLY. CONTAMINATION IN THE WATER CAN CAUSE ILLNESS TO PERSONS THAT DRINK THE WATER.



38-11-00-021 Rev 4 07/21/1997

WATER STORAGE AND DISTRIBUTION - OPERATION - DRAIN

WATER AND WASTE - WATER COOLING - INTRODUCTION

Purpose

The lavatory water cooler cools water for drinking. The cooler cools the water between 50F (10C) maximum and 35F (1.7C) minimum.

Physical Description

The water cooler has these components:

- Motor-driven fan
- Electrical connector
- Overheat warning light
- Water line connection (2)
- Air filter (2)
- Air fins
- Manual reset button
- Overheat thermal switch (Internal).

The water cooler and the air filter are LRUs.

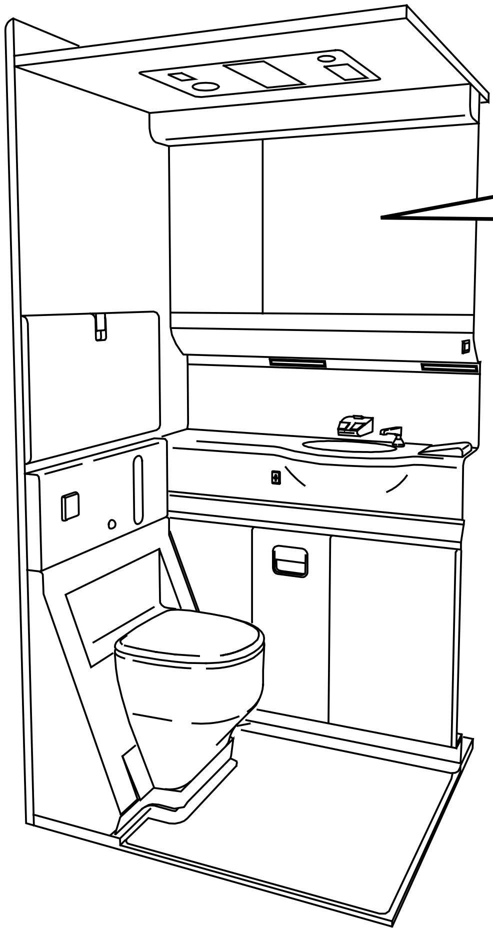
Location

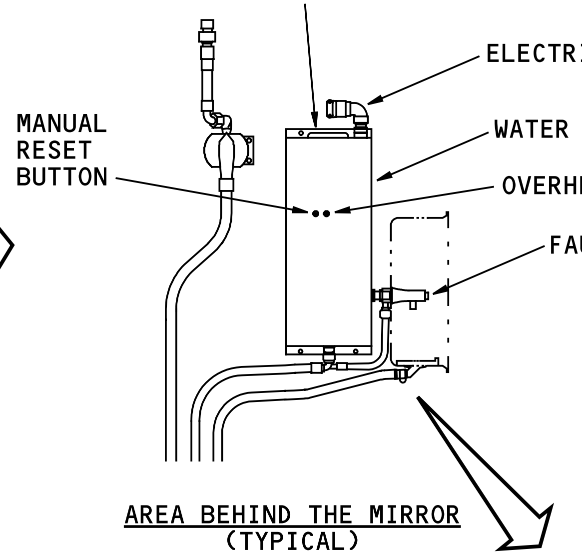
The water cooler is in the sidewall of the lavatory behind the large mirror. You open the mirror to get access to the cooler.

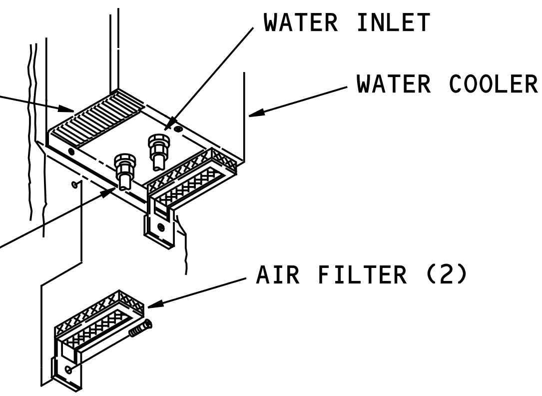
Operation

The water coolers will operate when the water temperature is more than 50F (10C).

If an overheat condition occurs, the overheat switch opens and the overheat warning light comes on. You push the manual reset button on the cover of the cooler to reset the overheat switch.







38-12-00-001 Rev 0 03/05/96

WATER AND WASTE - WATER COOLING - INTRODUCTION

WATER AND WASTE - WATER COOLING - FUNCTIONAL DESCRIPTION

Functional Description

The control thermal switch closes when the water temperature is more than 50 F (10 C). This energizes the relay and sends power to the thermoelectric modules and the cooling fan through the rectifier.

The control thermal switch opens when the water temperature is between 40F (4.4C) and 50F (10C). This removes power from the thermoelectric modules and the fan.

The overheat switch opens when the water temperature in the cooler is approximately 140F (60C).

The water cooler can get power from one of these two buses:

- Left utility bus in the P110 Power Management Panel
- Right utility bus in the P210 Power Management Panel (not shown).

Indication

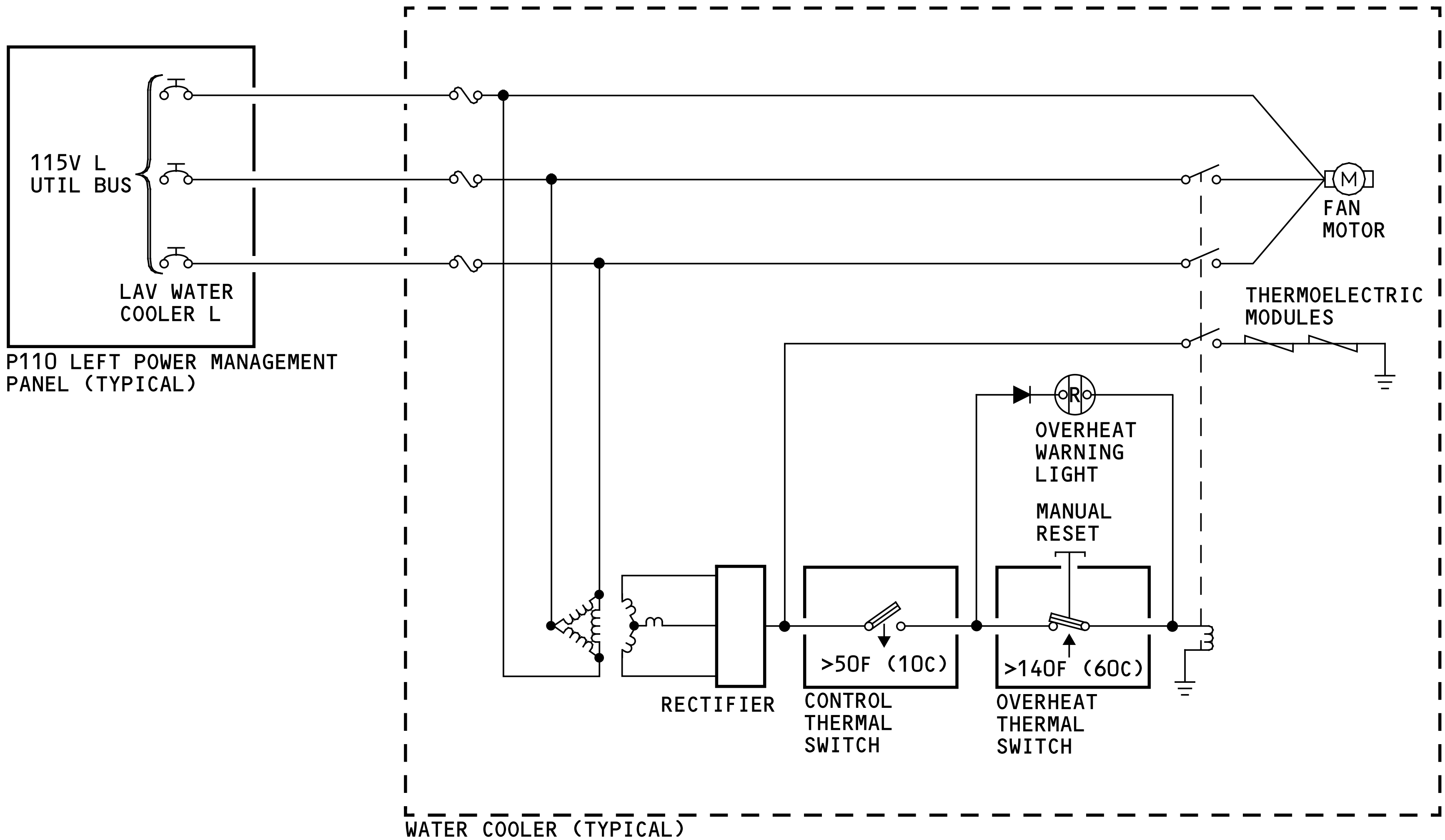
There is a red light on the outside of the water cooler. The light comes on when the overheat thermal switch opens.

Training Information Point

Open the circuit breakers for the water coolers when you drain the potable water system.

Before you can reset the cooler after an overheat condition, do these steps:

- Let the water to cool until it will not burn your skin when you touch it.
- Clean the cooler fins
- Replace or clean the air filter.



38-12-00-002 Rev 1 04/26/96

WATER AND WASTE - WATER COOLING - FUNCTIONAL DESCRIPTION

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WATER HEATING - INTRODUCTION

Purpose

The lavatory water heaters heats water for use in the lavatory sink.

Physical Description

The water heater is a cylindrical tank assembly of 2.0 quarts (1.89 L) capacity. The water heater has these components:

- Lid
- Indicator light
- Power switch
- Pressure relief valve
- Water outlet
- Tank
- Heater element (3) (internal)
- Temperature sensor (internal)
- Printed Circuit (PC) card (internal)
- Cold/hot water mixing/bypass device (internal)
- Water inlet
- Temperature selection switch
- Overheat switch and reset button
- Electrical connector.

The power switch has two positions, ON and OFF. The temperature selector has these positions and approximate water temperature:

- Low (105F, 40.6C)
- Medium (115F, 46C)
- High (125F, 51.7C).

The overheat switch is normally closed. It latches open when the tank temperature is approximately 170F (76.7C). The overheat switch can be manually reset (closed) when the tank temperature is less than 120F (48.9C).

The pressure relief valve opens when tank pressure is approximately 140 psig. This valve resets automatically when tank pressure goes below the opening value.

Location

There is a water heater in each lavatory, under the sink.

The overheat switch is under the heater lid.

Indication

The indicator light comes on when both of these conditions occur:

- The power switch is ON
- The overheat switch is closed.

It goes out for any of these conditions:

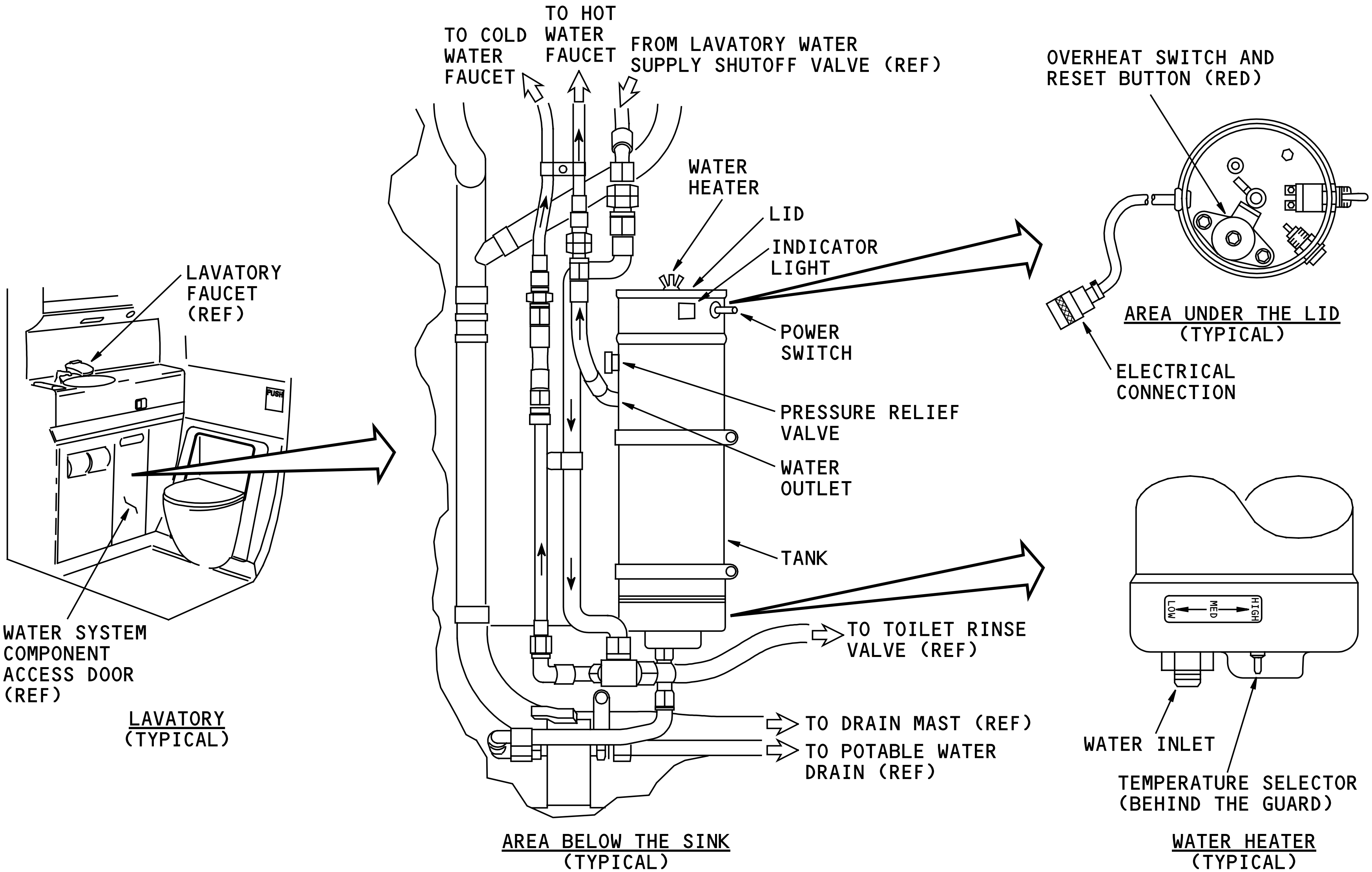
- The power switch is OFF
- The overheat switch is open.

WATER HEATING - INTRODUCTION

Training Information Point

If you use all of the hot water from the tank, the water heater takes approximately 15 minutes to heat the water to the set temperature.

When you drain the potable water system, remove power from the water heaters to prevent an overheat condition.



38-13-00-001 Rev 5 04/26/96

WATER HEATING - INTRODUCTION

WATER QUANTITY INDICATION - INTRODUCTION

Purpose

The water quantity indication system shows the water quantity in the tanks.

Physical Description

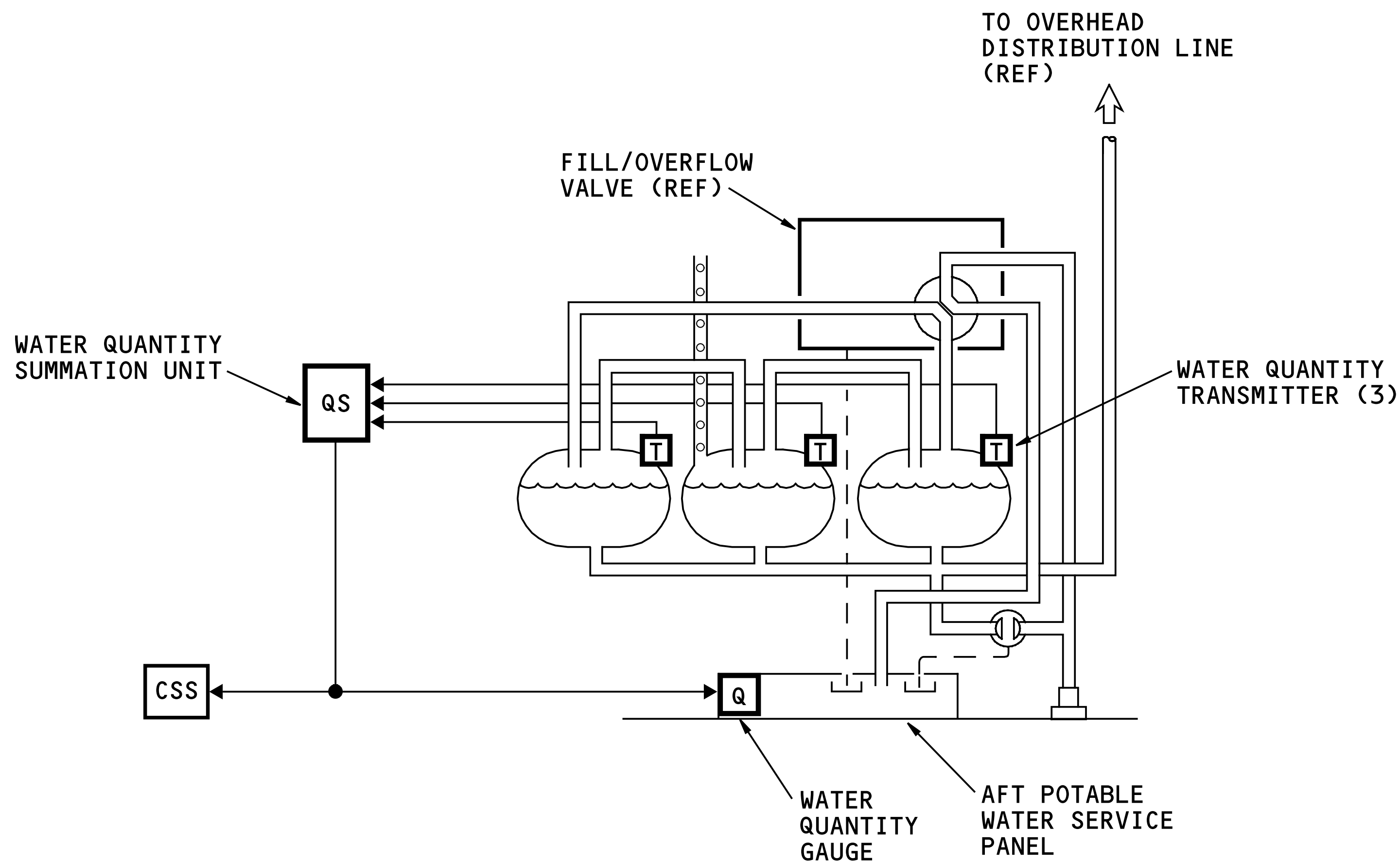
These are the water quantity indication components:

- Water quantity gauge
- Water quantity transmitter (3)
- Water quantity summation unit
- Water level sensors (part of tanks, not shown).

General Description

The water quantity transmitters send water quantity information to the summation unit. The summation unit sends quantity information to the:

- Cabin services system (CSS) panels
- Aft potable water service panel gauge.



WATER QUANTITY INDICATION - INTRODUCTION

WATER QUANTITY INDICATION - COMPONENT LOCATIONS

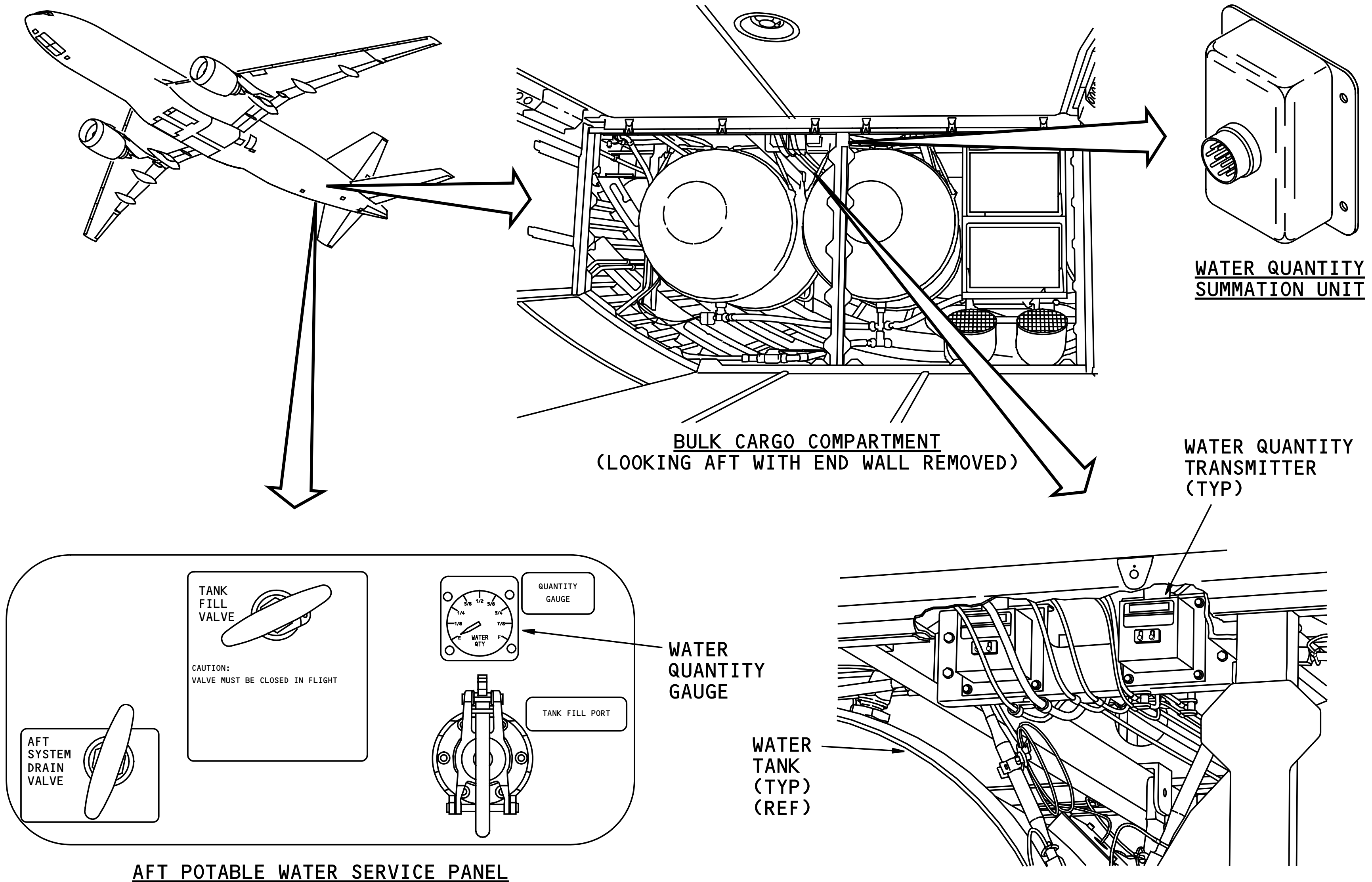
Component Locations

There is a water quantity gauge on the aft potable water service panel.

The water quantity summation unit is aft of the bulk cargo compartment end wall. It is on a passenger compartment floor beam.

There is a water level sensor that is part of each water tank.

There is a water quantity transmitter installed on a bracket near the forward side of each tank.



WATER QUANTITY INDICATION - COMPONENT LOCATIONS

WATER QUANTITY INDICATION - WATER QUANTITY TRANSMITTER

Purpose

The water quantity transmitter sends a signal to the water quantity summation unit.

Physical Description

The transmitter attaches to the transmitter mounting pad. The pad is part of the tank. The transmitter connects to the tank sensor through a terminal connector and a terminal screw.

The empty and full tank quantity adjustment screws are beneath an access plate on the transmitter.

Location

There is a transmitter installed on a bracket near the forward side of each tank.

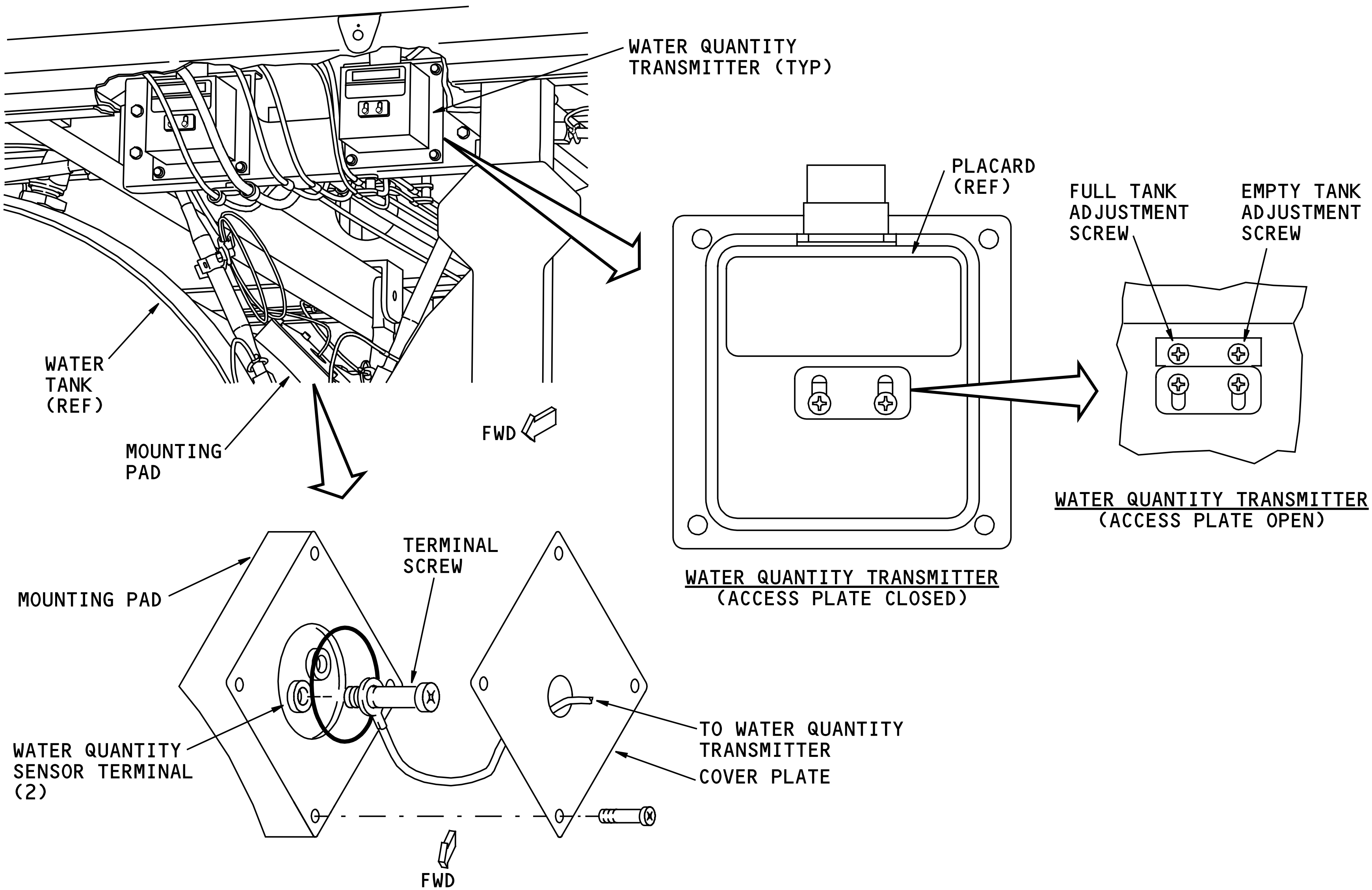
Functional Description

The transmitter uses a capacitance-type water level senor to find the water level in the tank. The sensor is part of the tank. The transmitter gives a signal to the water quantity summation unit.

There are two water quantity sensor terminals on each mounting pad. The transmitter can connect to either terminal. The two terminals are in parallel. If one does not operate, the other one will not operate either.

Training Information Point

To adjust the transmitter, you must fill the tanks to full, then drain them, before you make adjustments. The inner surface of the tank must be wet to make an accurate calibration of the transmitter.



38-14-00-005 Rev 2 12/18/1996

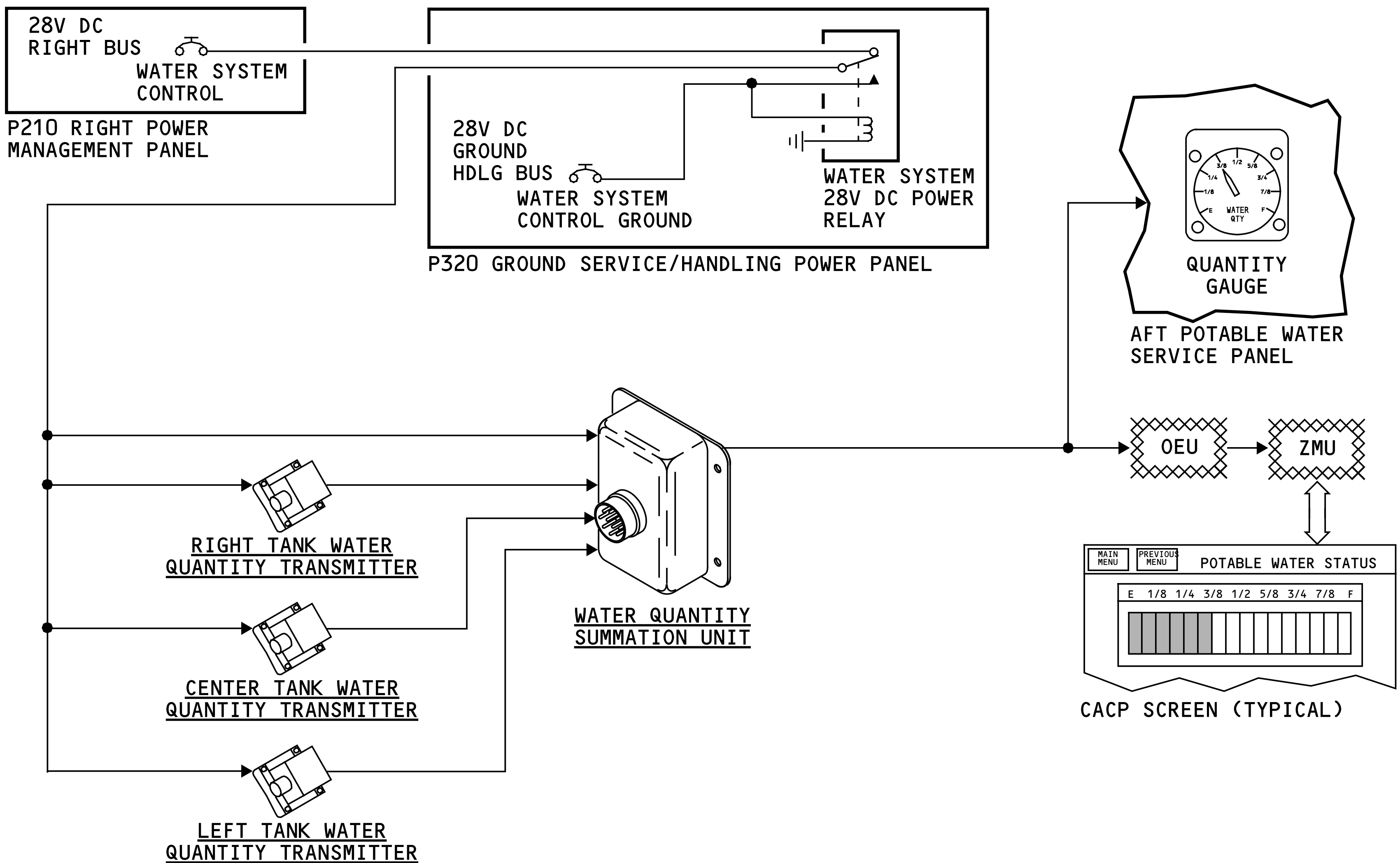
WATER QUANTITY INDICATION - WATER QUANTITY TRANSMITTER

WATER QUANTITY INDICATION - FUNCTIONAL DESCRIPTION - INDICATION

Functional Description

The water quantity transmitters give water quantity data to the water quantity summation unit.

The summation unit calculates the total amount of water in the water tanks. This data goes to the water quantity gauge on the aft potable water service panel and to the cabin services system.



NOTE: CACP SHOWN, CSCP SIMILAR

WATER QUANTITY INDICATION - FUNCTIONAL DESCRIPTION - INDICATION

38-14-00-007 Rev 5 07/24/1997

WATER QUANTITY INDICATION - OPERATION - CSCP/CACP INDICATIONS

Operation

The CMS gives data on the potable water.

This data is on the cabin system control panel (CSCP) and the cabin area control panels (CACPs).

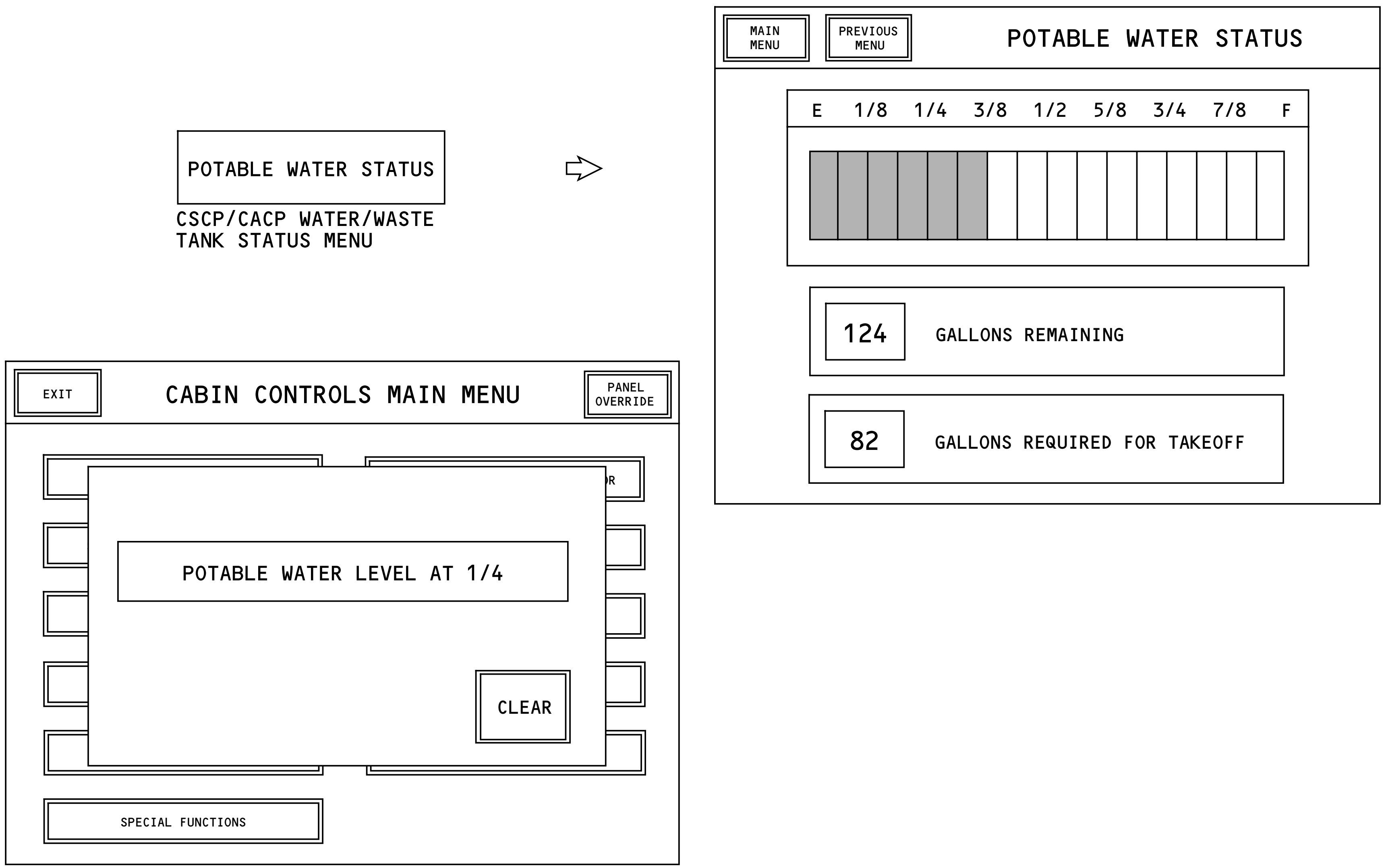
On the cabin controls main menu, select the water/waste status area. This causes the water/waste tank status menu to show. Then select the potable water status area. This causes the potable water status screen to show.

The potable water status screen shows the total amount of water in the tanks.

The quantity required for takeoff is a value set in the CSS configuration database. You can also use the CSS configuration database to make this area of the potable water status screen not show.

A screen automatically shows on the CSCP/CACP when the amount of water in the tanks is low. You touch the CLEAR button to remove the screen.

See the cabin services system section for more information (AMM PART I 23-39).



CSCP/CACP

WATER QUANTITY INDICATION - OPERATION - CSCP/CACP INDICATIONS

WATER TANK PRESSURIZATION - INTRODUCTION

Purpose

The water tank pressurization system pressurizes the potable water tanks for distribution.

General Description

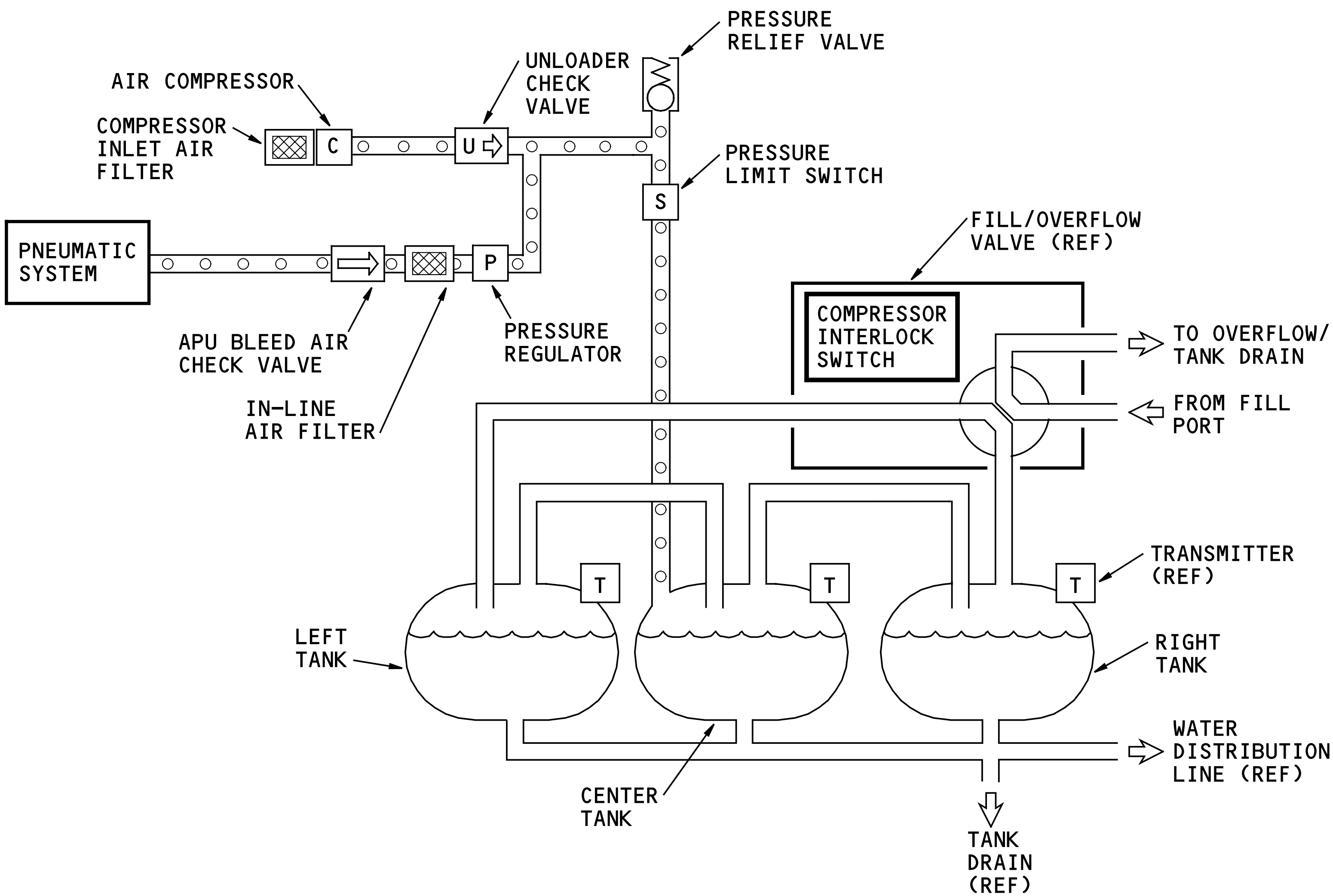
Pressure for the water tanks comes from the pneumatic system or from a compressor. The air compressor supplies pressure to the tanks when pressure from the pneumatic system is not sufficient.

These components control the amount of pressure that goes to the tanks:

- Pressure relief valve
- Pressure limit switch
- Pressure regulator
- Compressor interlock switch.

The APU bleed air check valve and the unloader check valve do not let pressure from one source go to the other source.

The compressor inlet air filter and the in-line air filter remove particles from the air.



WATER TANK PRESSURIZATION - INTRODUCTION

WATER TANK PRESSURIZATION - COMPONENT LOCATIONS - 1

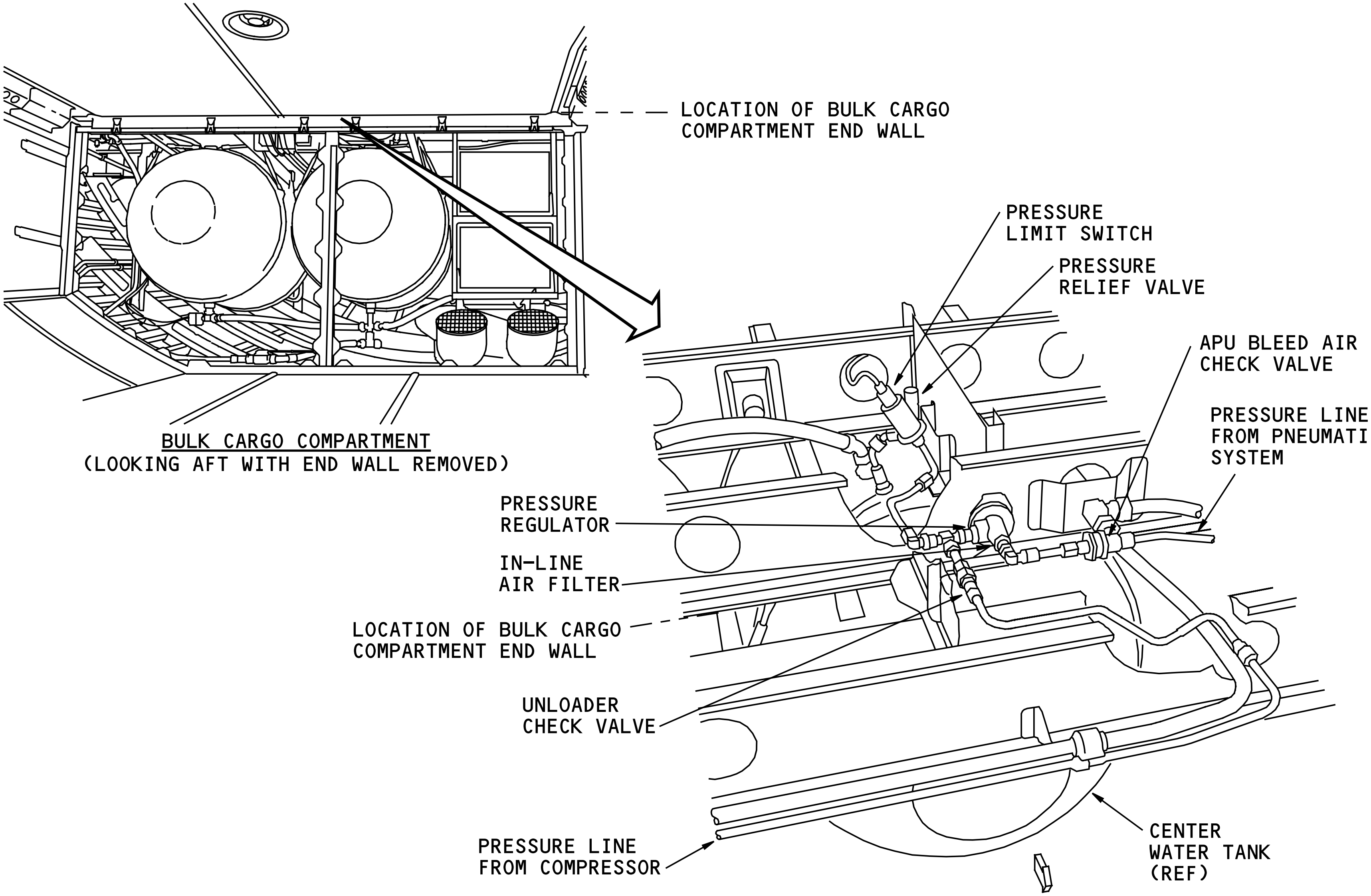
Component Locations

These components are behind the end wall of the bulk cargo compartment:

- Pressure relief valve
- Pressure limit switch.

These components are above the ceiling panels in the aft section of the bulk cargo compartment.

- Pressure regulator
- APU bleed air check valve
- In-line air filter
- Unloader check valve.



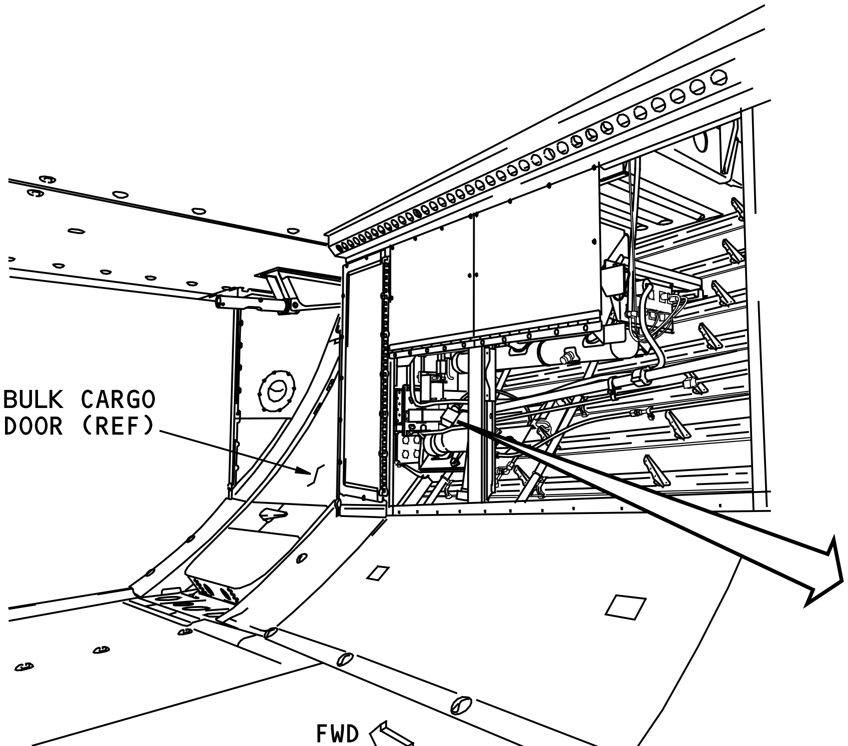
WATER TANK PRESSURIZATION - COMPONENT LOCATIONS - 1

38-42-00-002 Rev 2 12/18/1996

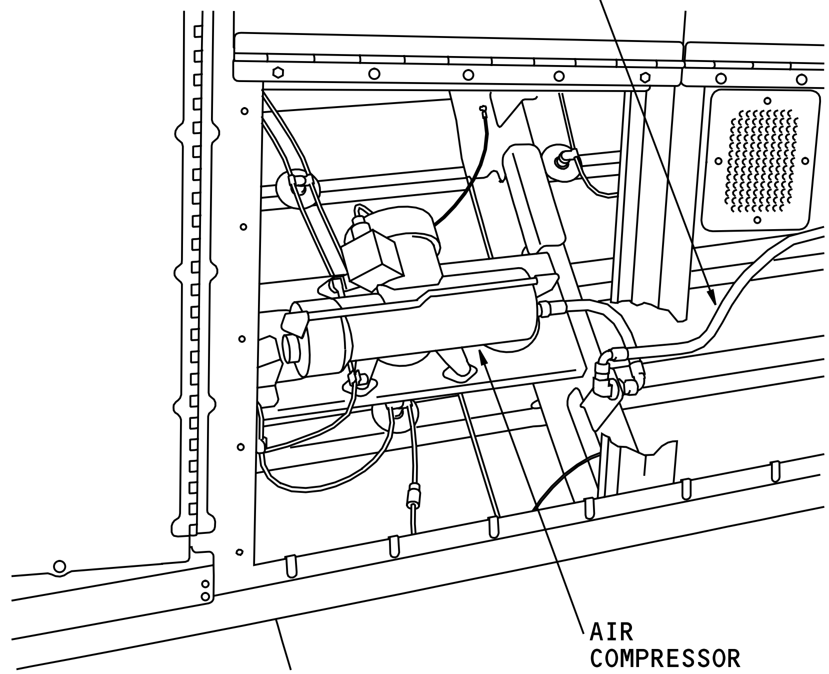
WATER TANK PRESSURIZATION - COMPONENT LOCATIONS - 2

Compressor and Pneumatic Drain Valve Location

The air compressor is behind the panels on the right side of the bulk cargo compartment.



RIGHT SIDE OF BULK CARGO COMPARTMENT
(LOOKING FORWARD WITH PANELS REMOVED)



WATER TANK PRESSURIZATION - COMPONENT LOCATIONS - 2

WATER TANK PRESSURIZATION - FUNCTIONAL DESCRIPTION - CONTROL

General

The compressor or the pneumatic system pressurize the potable water tanks. The compressor operates if pressure from the pneumatic system is not sufficient.

Power

The water system 28v dc power relay supplies power for control from the ground handling bus. If the ground handling bus has no power, the relay supplies power from the right bus.

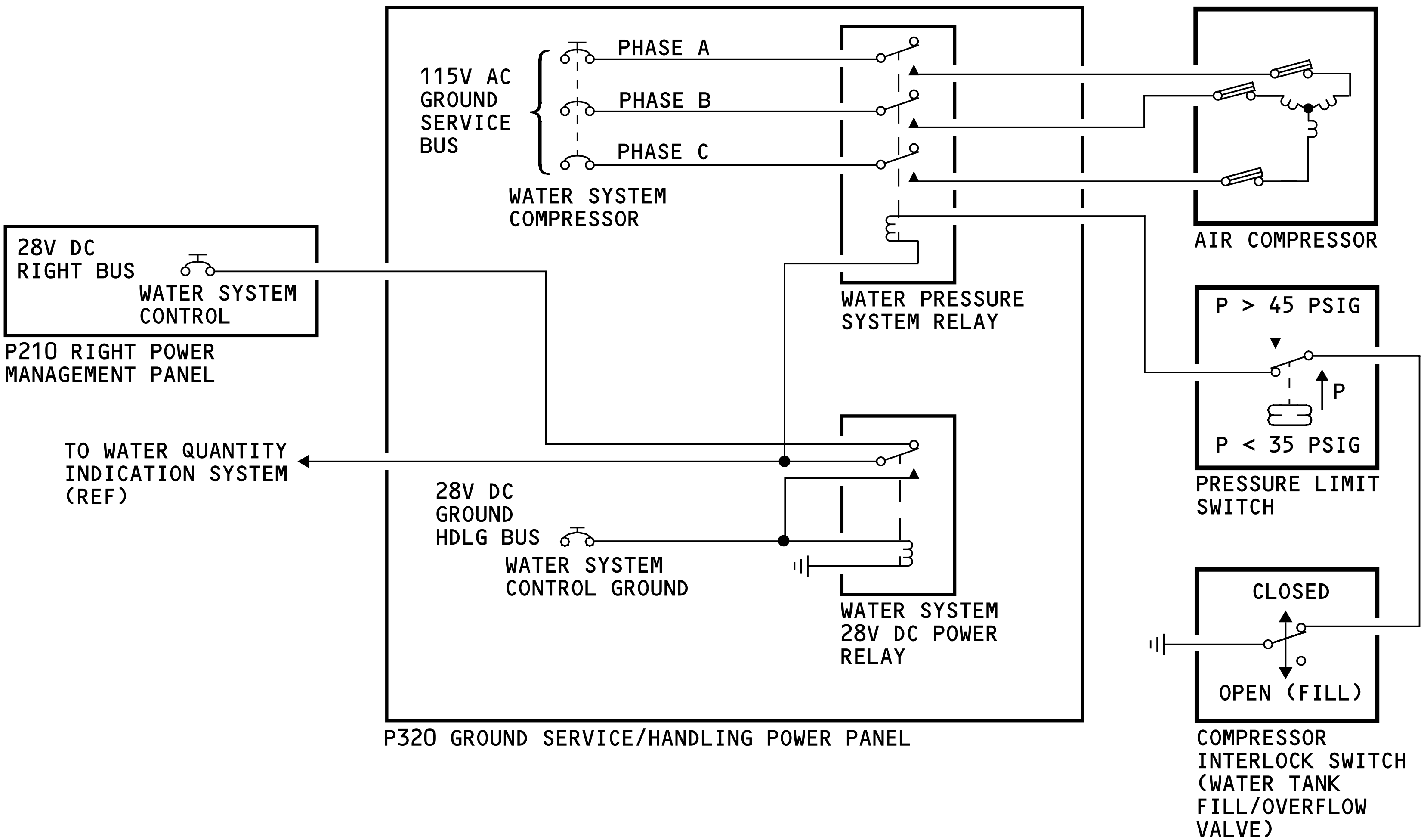
Power for compressor operation comes through the water pressure system relay. The compressor operates when the relay is energized. The relay energizes when the pressure limit switch and the compressor interlock switch are closed.

The pressure limit switch closes when tank pressure is 35 psig or less. It opens when tank pressure is 45 psig.

The compressor interlock switch is on the fill/overflow valve. The switch is closed when the valve is closed. The switch is open when you open the valve to fill the tanks.

Overcurrent and Overtemperature Protection

Three overheat switches give protection to the compressor motor. They stop the motor when the temperature of a phase is too high or there is too much current. The switches automatically go back to the normal position when the motor is cool.



38-42-00-014 Rev 3 05/27/95

WATER TANK PRESSURIZATION - FUNCTIONAL DESCRIPTION - CONTROL

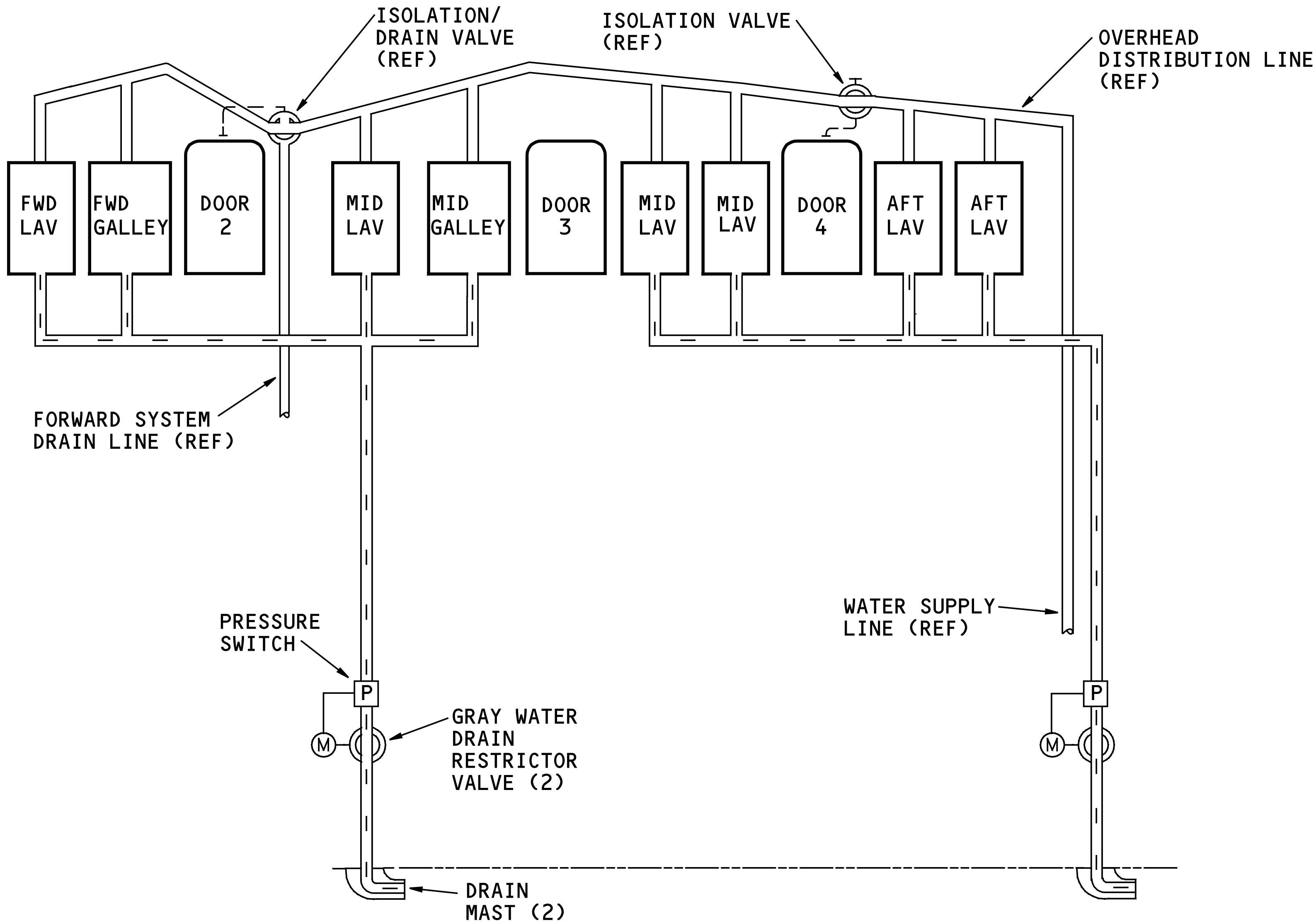
GRAY WATER DRAIN SYSTEM - INTRODUCTION

Purpose

The gray water drain system permits waste water from lavatory and galley sinks to drain overboard.

General Description

Waste water from the sinks goes through lines and flows overboard through the forward or aft drain mast. A gray water drain restrictor valve keeps the amount of air flow out of the plane to a limit when the airplane is in the air. This helps to decrease noise in the lavatories and galleys.



GRAY WATER DRAIN SYSTEM - INTRODUCTION

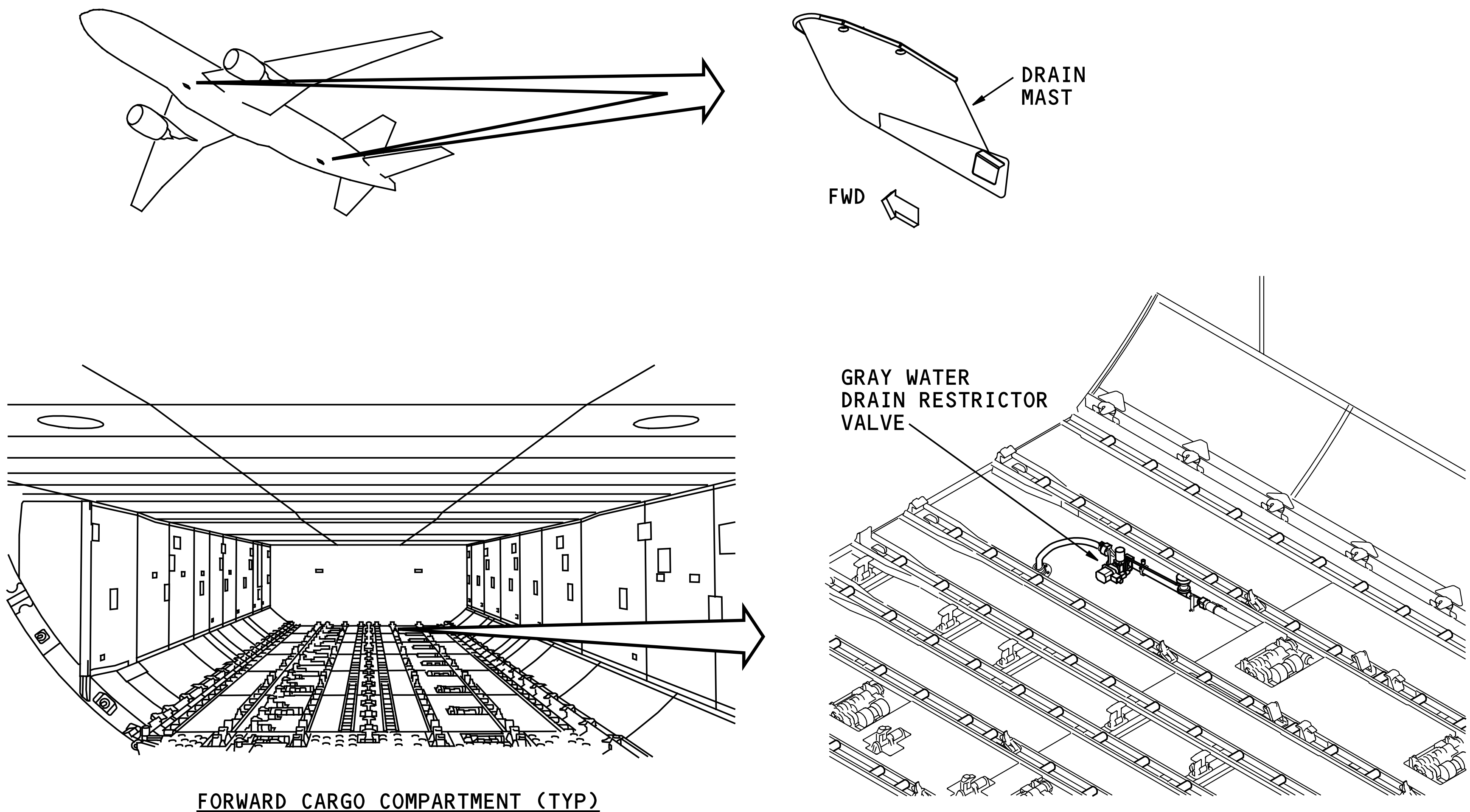
38-31-00-001 Rev 3 01/07/1998

GRAY WATER DRAIN SYSTEM - COMPONENT LOCATIONS

Component Locations

The forward and aft drain masts are on the bottom of the airplane.

The forward gray water drain restrictor valve is under the floor of the forward cargo compartment. The aft valve is under the floor of the aft cargo compartment.



38-31-00-002 Rev 1

GRAY WATER DRAIN SYSTEM - COMPONENT LOCATIONS

GRAY WATER DRAIN SYSTEM - DRAIN MAST

Purpose

The drain masts drain waste water from the lavatory and galley sinks overboard.

Heaters in the drain masts do not permit the gray water to freeze and cause a blockage of the line.

Physical Description

There are heaters that are a part of the forward and aft drain masts.

Each drain mast has these components:

- Power wire
- Ground wire
- Ground connector.

Location

The forward mast is on the left wing-to body fairing. It is forward and outboard of the left ECS bay.

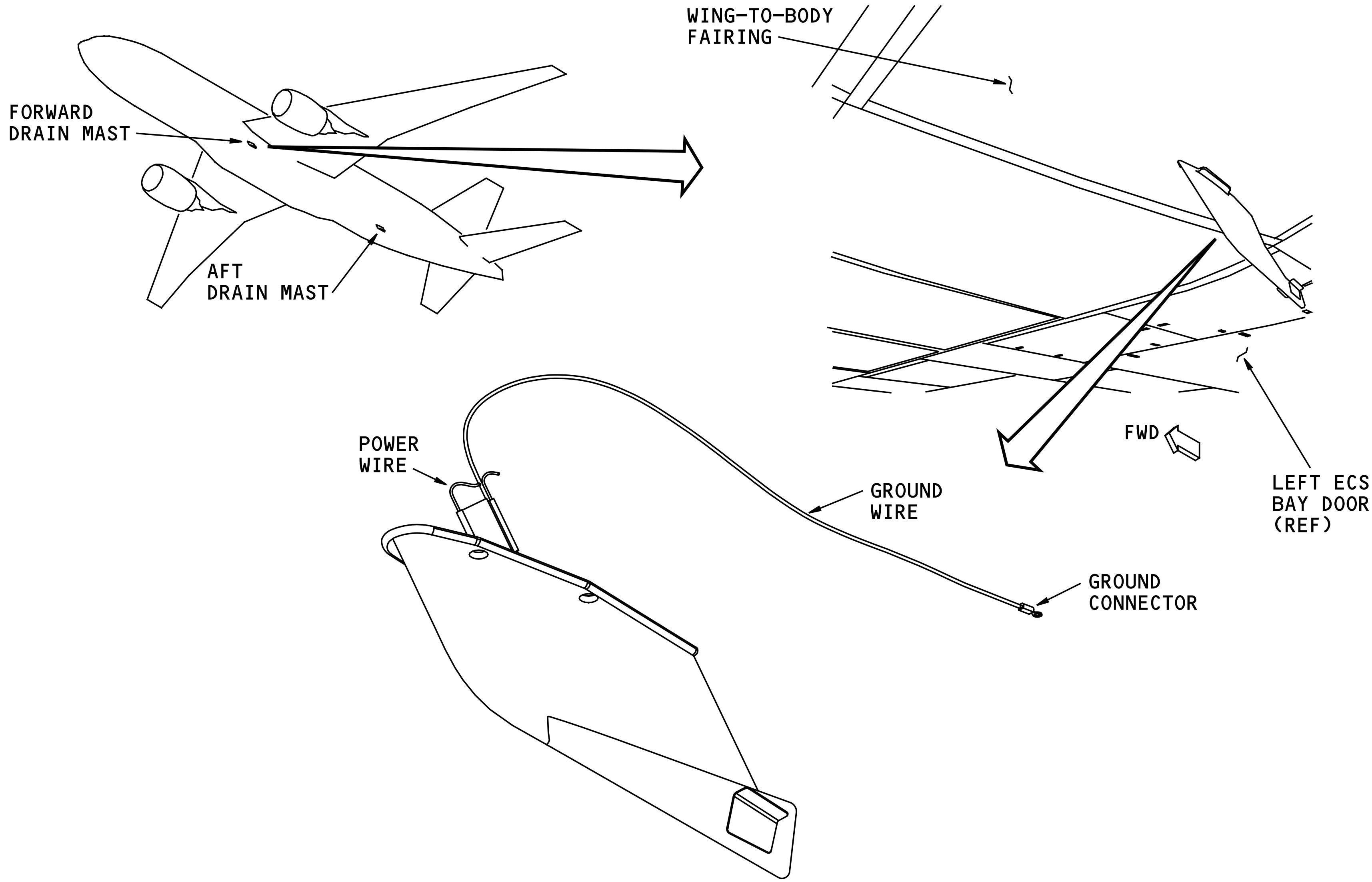
The aft mast is behind the aft cargo compartment door, on the bottom of the airplane.

Drain Mast Heater

See the drain and water supply line heating section for more information about the drain mast heaters (AMM PART I 30-71).

Training Information Point

You must make a splice in the wires when you replace a drain mast.



FORWARD DRAIN MAST

GRAY WATER DRAIN SYSTEM - DRAIN MAST

GRAY WATER DRAIN SYSTEM - GRAY WATER DRAIN RESTRICTOR VALVE

Purpose

The gray water drain restrictor valves keep the air flow out of the drain masts to a limit. They prevent noise in the drain lines.

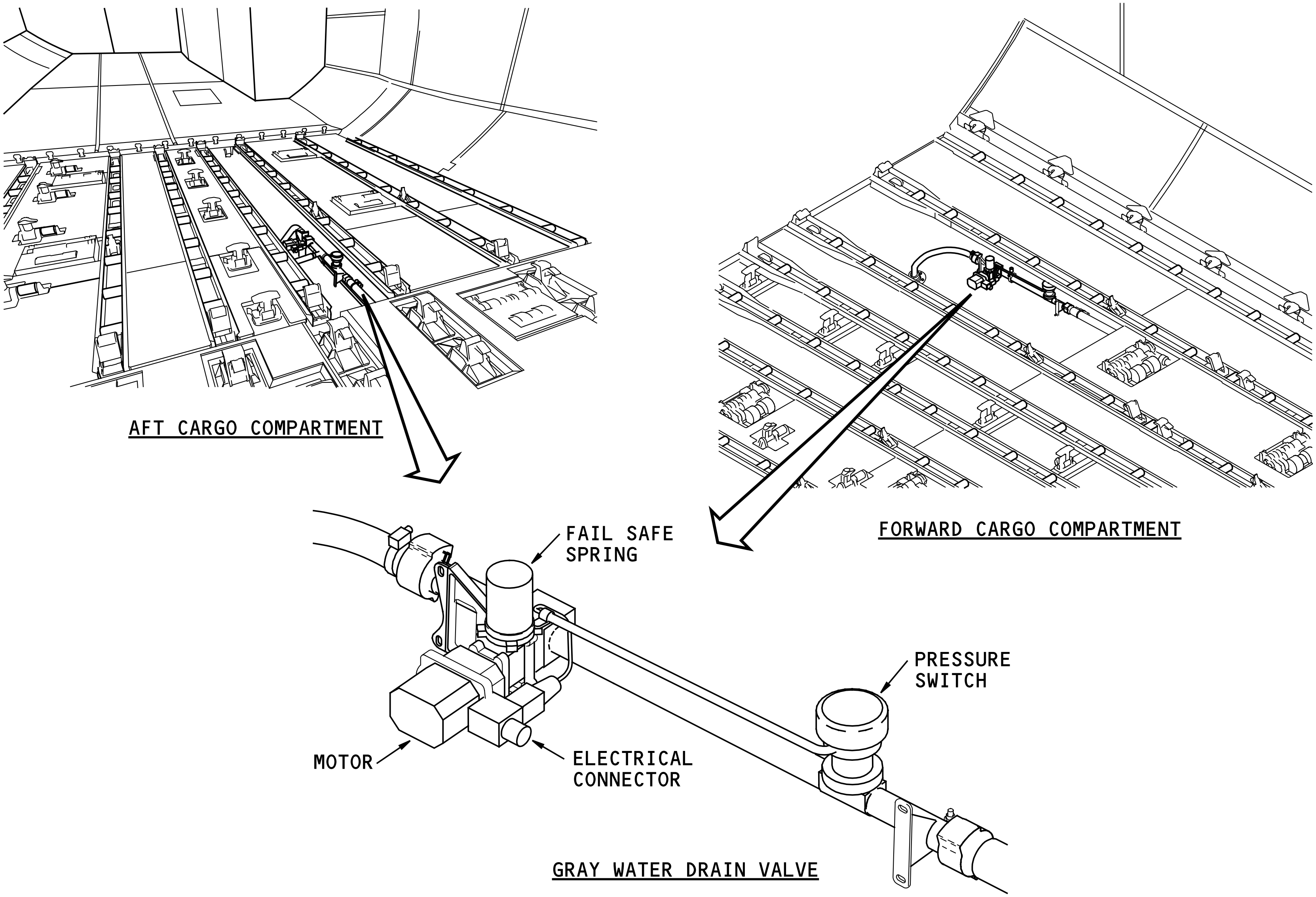
Physical Description

The valve has these components:

- Motor
- Fail safe spring
- Pressure switch
- Electrical connector.

Location

The forward valve is under the floor in the forward cargo compartment. The aft valve is under the floor of the aft cargo compartment.



38-31-00-004 Rev 1

GRAY WATER DRAIN SYSTEM - GRAY WATER DRAIN RESTRICTOR VALVE

GRAY WATER DRAIN SYSTEM - FUNCTIONAL DECSRIPTION

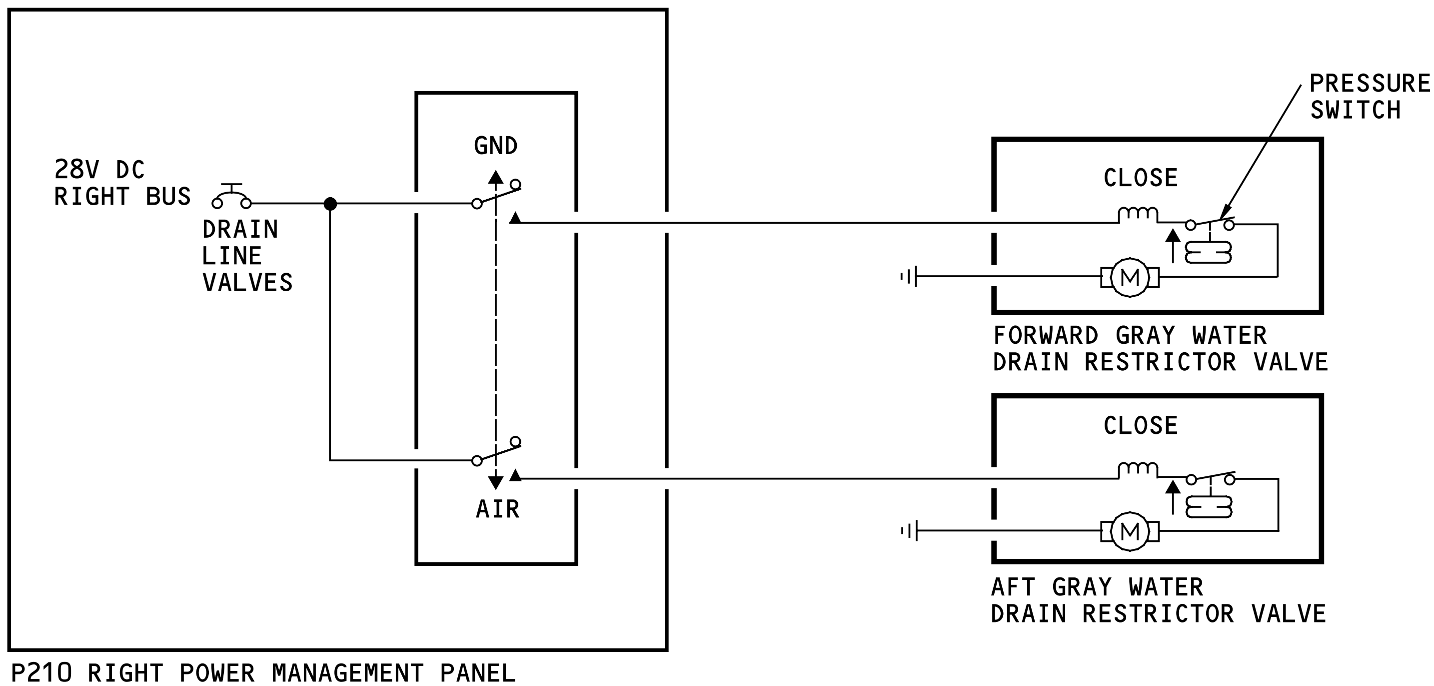
Gray Water Drain Restrictor Valve

The forward and aft gray water drain restrictor valves get power from the right main bus.

The motors move the valves so they are almost closed when the airplane is in the air.

Functional Description

When the pressure in the drain line increases beyond a limit, the pressure switch opens. This de-energizes the motor and the valve opens. This removes any blockage in the line. The pressure switch closes when the pressure decreases.



38-31-00-005 Rev 1

GRAY WATER DRAIN SYSTEM - FUNCTIONAL DECSRIPTION

VACUUM WASTE SYSTEM - INTRODUCTION

Purpose

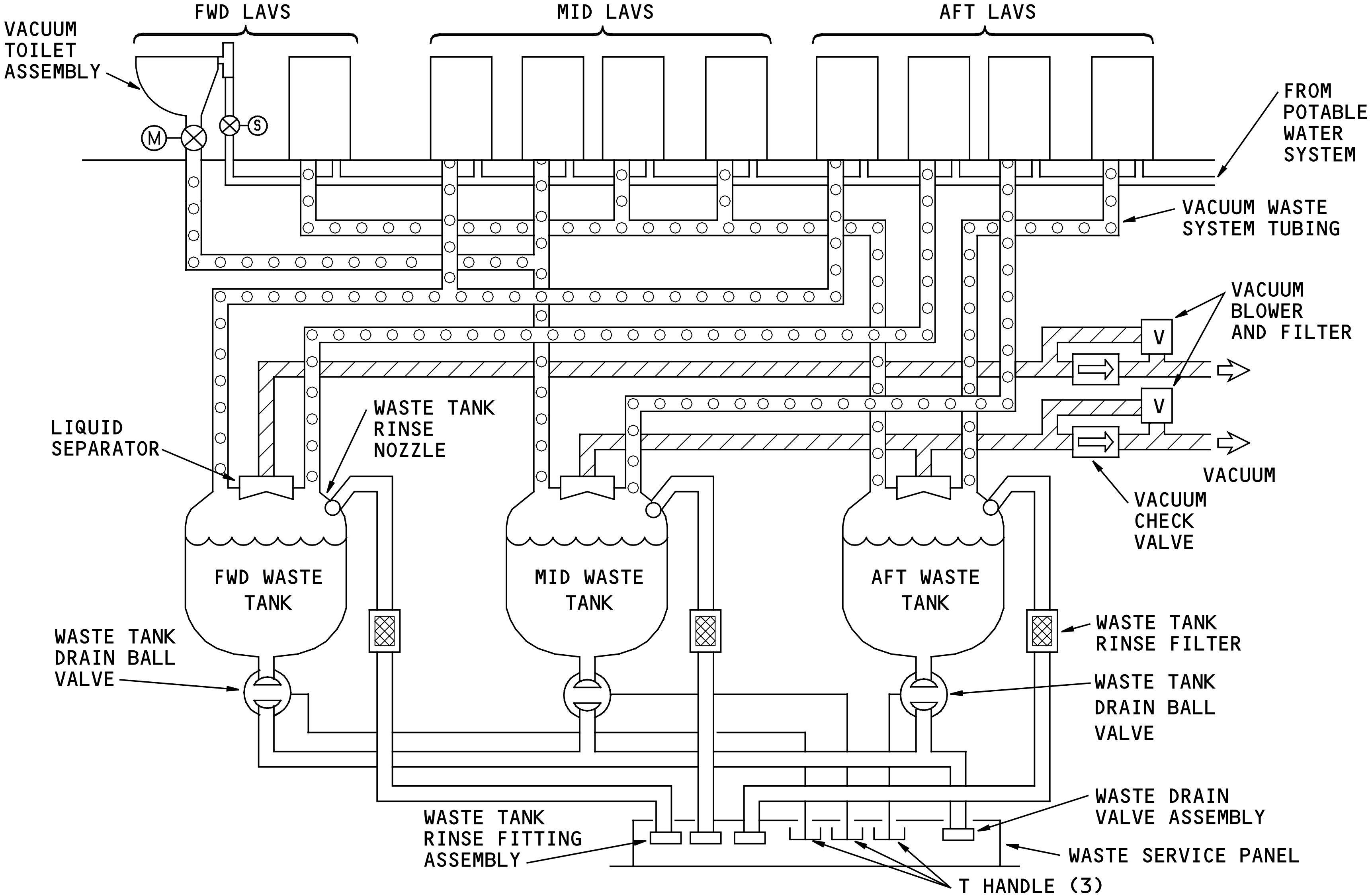
The vacuum waste system removes waste from the toilets and stores it in the waste tanks. The waste stays in the waste tanks until they are serviced.

General Description

Waste collects in the toilet. Suction then moves the waste to the waste tanks. The suction is made by the vacuum blower. The difference between the cabin pressure and the outside pressure also moves the waste to the waste tanks. You remove the waste in the waste tanks through the waste service panel. The T handle in the service panel opens the waste tank drain ball valve. When you open the waste drain valve assembly, you permit the waste tanks to drain.

These components make up the vacuum waste system:

- Vacuum toilet assembly
- Waste tank
- Vacuum blower and filter
- Vacuum blower barometric switch (not shown)
- Vacuum check valve
- Vacuum waste system tubing
- Liquid separator
- Waste tank drain ball-valve
- Waste drain valve assembly
- Waste tank rinse fitting assembly
- Waste tank rinse filter
- Waste tank rinse nozzle.



VACUUM WASTE SYSTEM - INTRODUCTION

38-32-00-001 Rev 0

VACUUM WASTE SYSTEM - BULK CARGO COMPARTMENT COMPONENT LOCATIONS - 1

Bulk Cargo Compartment Component Locations

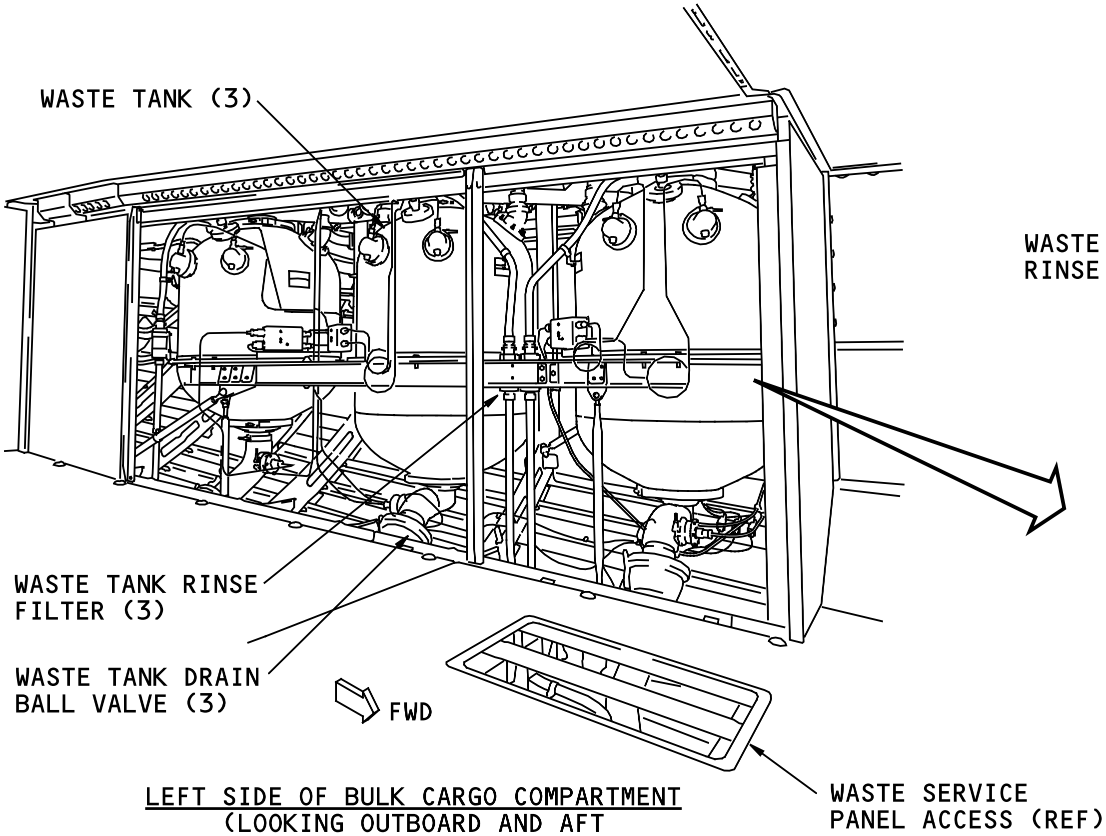
The waste tanks are in the left side of the bulk cargo compartment, behind the side wall.

The waste tank ball valves are below and inboard of each waste tank. They connect to the waste tank near the bulk cargo compartment floor.

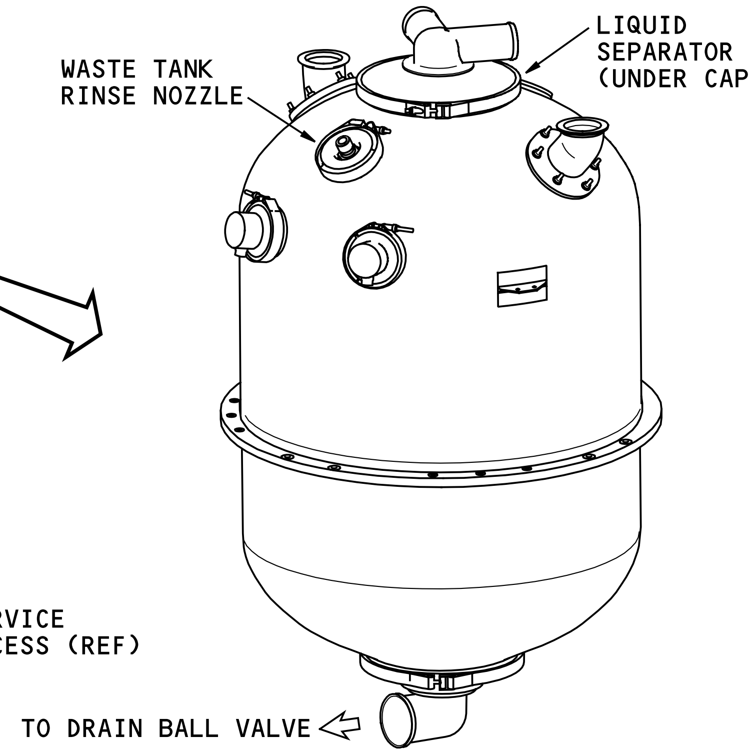
There is a waste tank rinse nozzle on each waste tank near the top of the tank.

There is a liquid separator on top of each waste tank. It is inside of the lid of the waste tank.

The filters are in the bulk cargo compartment on the left side, behind the side wall. The filter is up-stream of the rinse nozzle inboard of the waste tank.



LEFT SIDE OF BULK CARGO COMPARTMENT
(LOOKING OUTBOARD AND AFT
WITH SIDE WALL REMOVED)



WASTE TANK
(TYP)

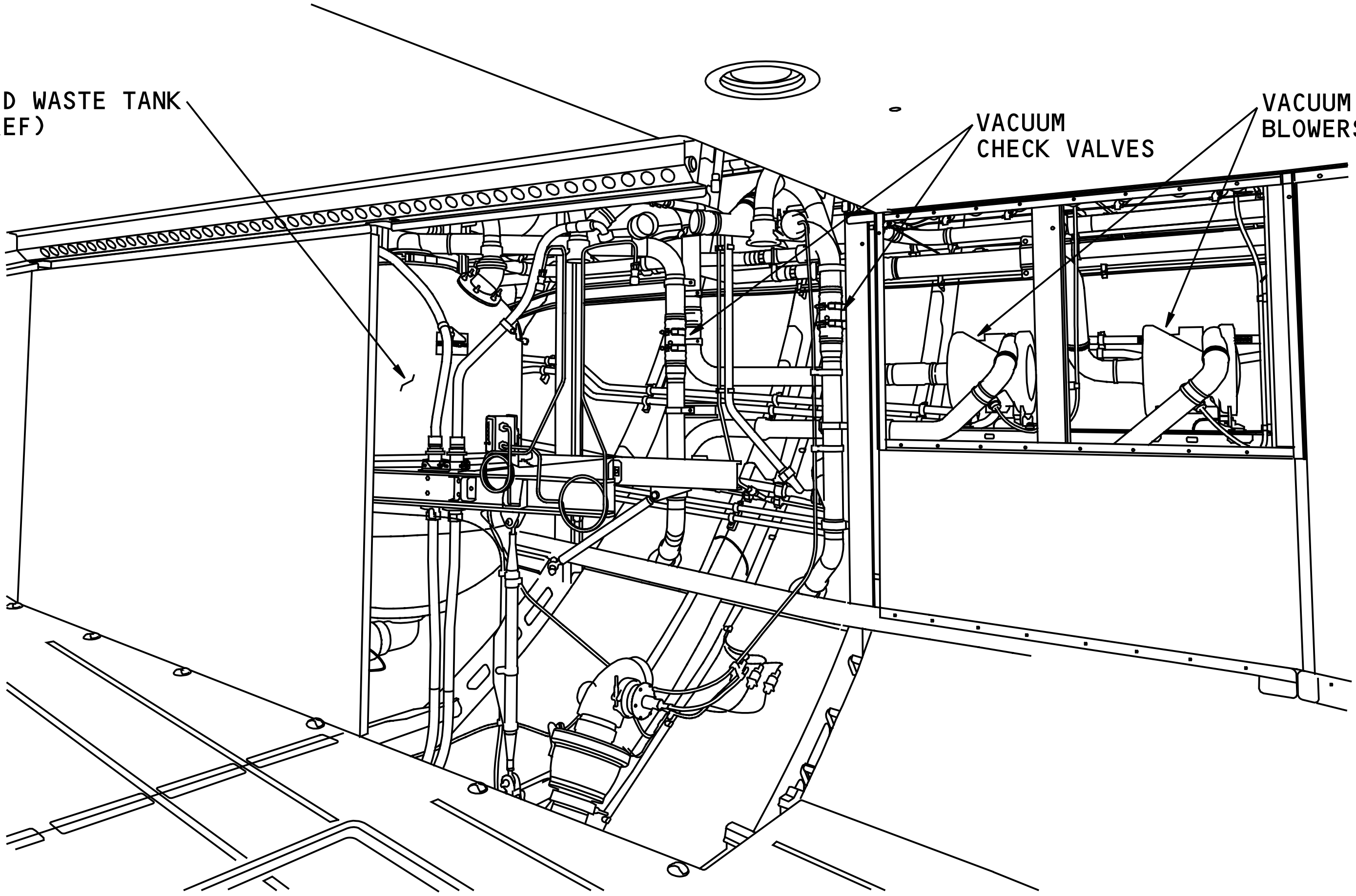
VACUUM WASTE SYSTEM - BULK CARGO COMPARTMENT COMPONENT LOCATIONS - 1

VACUUM WASTE SYSTEM - BULK CARGO COMPARTMENT COMPONENT LOCATIONS - 2

Bulk Cargo Compartment Component Locations

Two vacuum check valves are outboard of the forward and mid waste tanks.

Two vacuum blowers are forward of the forward waste tank.



LEFT SIDE OF BULK CARGO COMPARTMENT
(LOOKING OUTBOARD AND AFT WITH PANELS AND FORWARD TANK REMOVED)

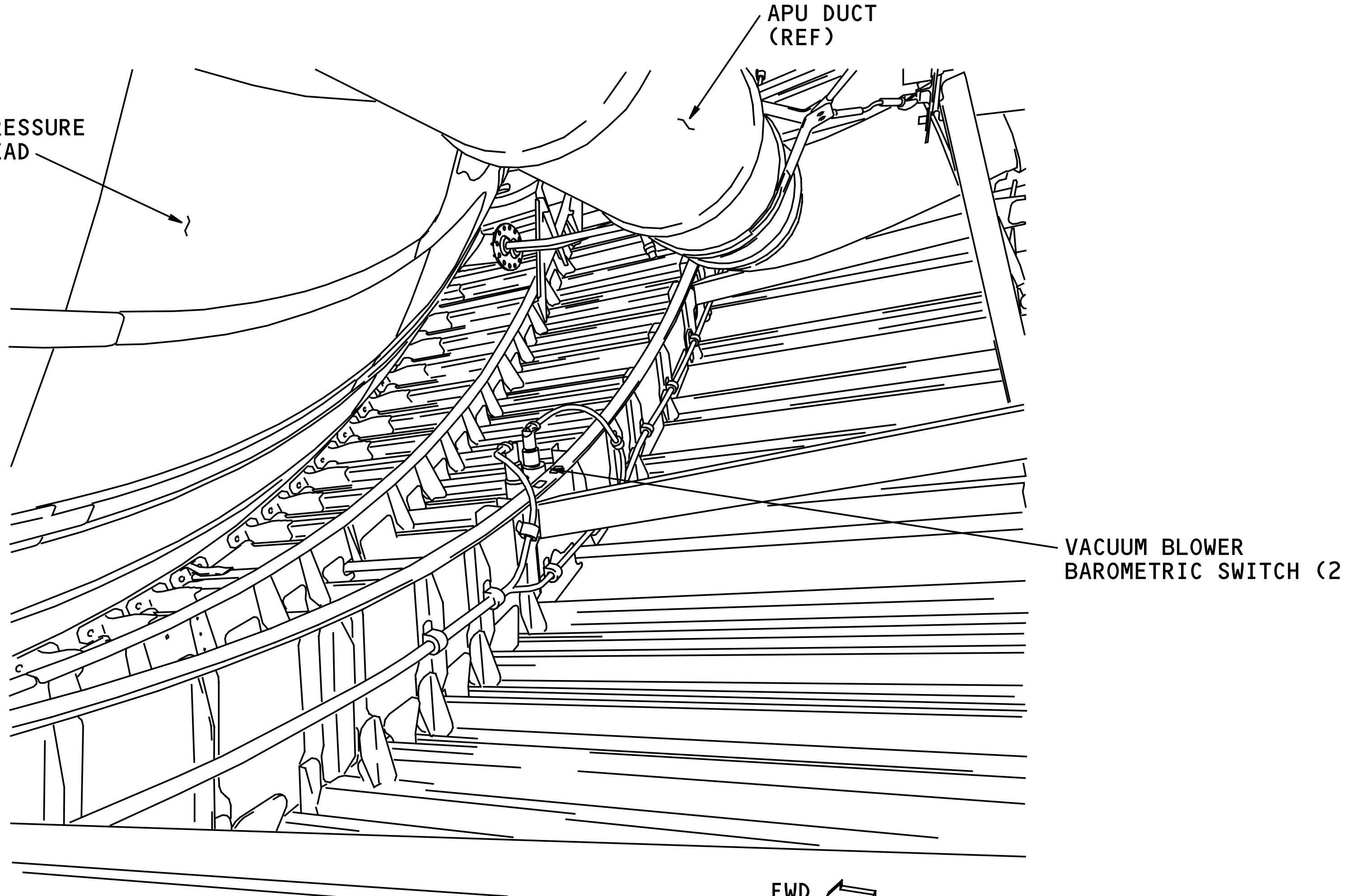
38-32-00-003 Rev 2 07/15/96

VACUUM WASTE SYSTEM - BULK CARGO COMPARTMENT COMPONENT LOCATIONS - 2

VACUUM WASTE SYSTEM - TAIL COMPONENT LOCATIONS

Component Location

Two vacuum blower barometric switches are immediately aft of the aft pressure bulkhead.



AREA AFT OF THE AFT PRESSURE BULKHEAD
(LOOKING FORWARD AND RIGHT)

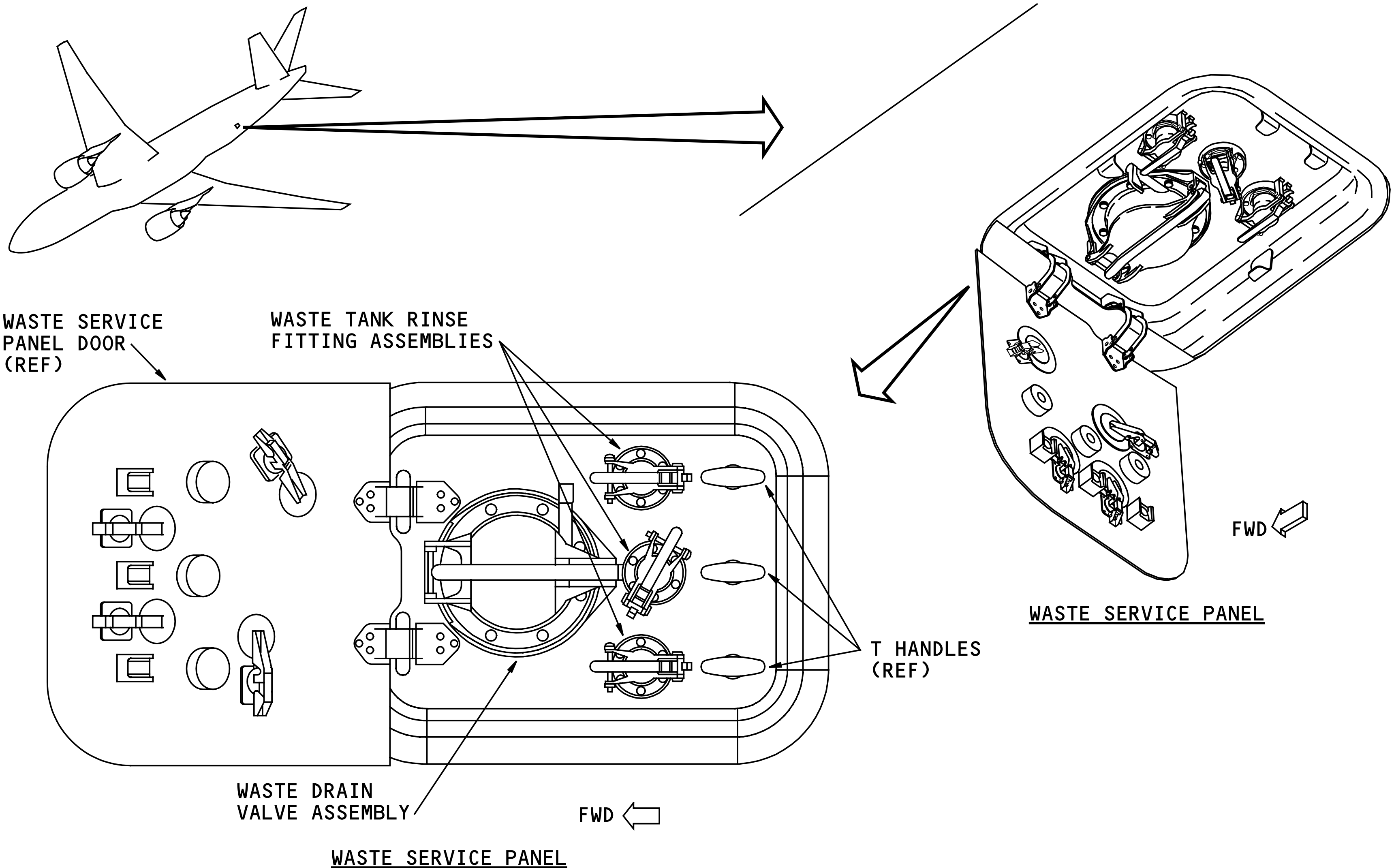
38-32-00-004 Rev 0

VACUUM WASTE SYSTEM - TAIL COMPONENT LOCATIONS

VACUUM WASTE SYSTEM - WASTE SERVICE PANEL COMPONENT LOCATIONS

Component Locations

Three waste tank rinse fitting assemblies and the waste drain valve assembly are in the waste service panel. You open the waste service panel door to get access to the fitting assemblies and the valve.



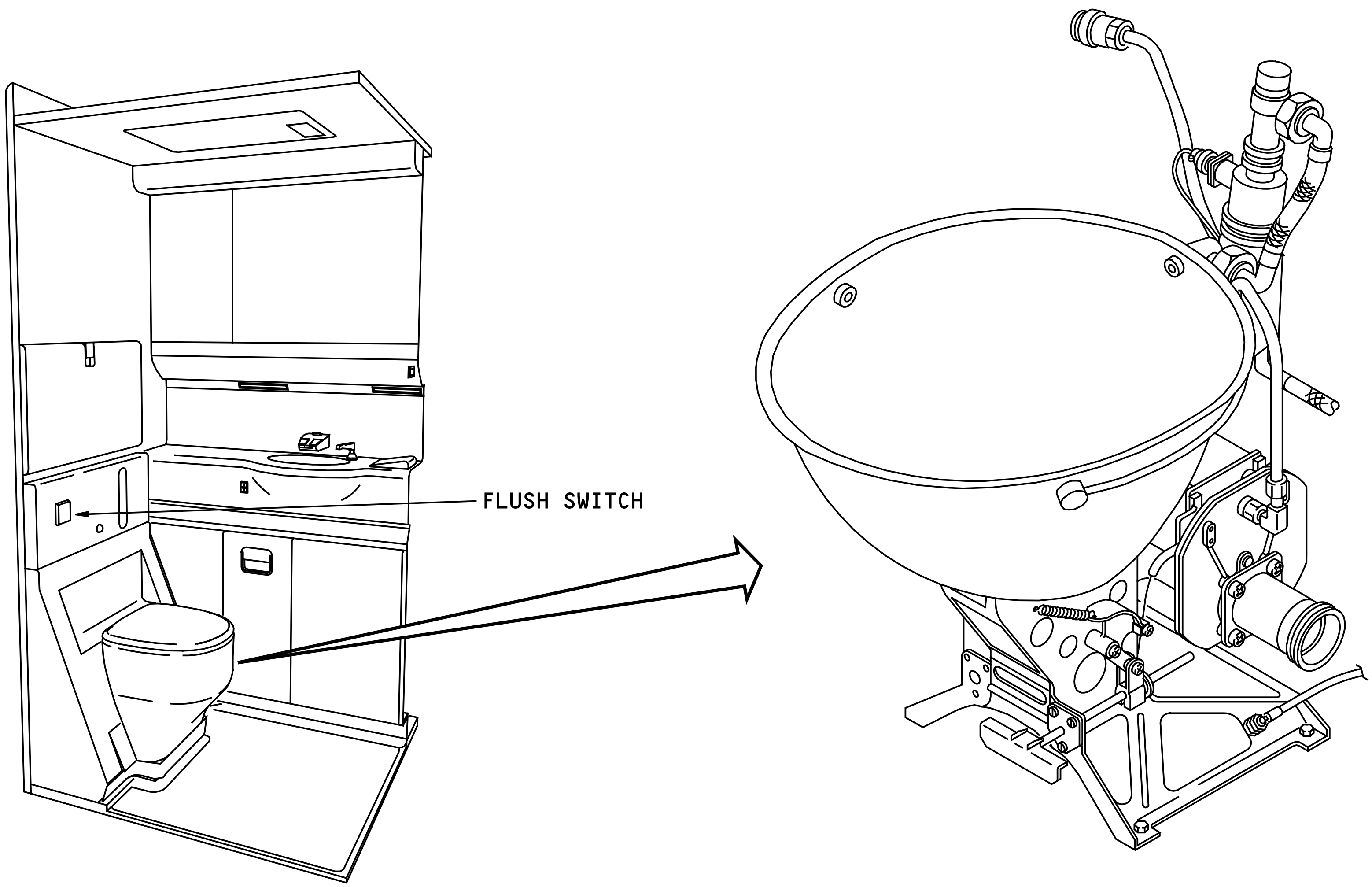
38-32-00-005 Rev 0

VACUUM WASTE SYSTEM - WASTE SERVICE PANEL COMPONENT LOCATIONS

VACUUM WASTE SYSTEM - LAVATORY COMPONENT LOCATIONS

Component location

A vacuum toilet assembly and flush switch are in each lavatory.



LAVATORY
(TYPICAL)

VACUUM TOILET ASSEMBLY
(ROTATED)

VACUUM WASTE SYSTEM - LAVATORY COMPONENT LOCATIONS

38-32-00-006 Rev 2 08/21/1997

VACUUM WASTE SYSTEM - VACUUM TOILET ASSEMBLY

Purpose

The vacuum toilet assembly collects waste.

Physical Description

The vacuum toilet assembly has these parts:

- Rinse ring
- Toilet bowl
- Anti-siphon valve
- Rinse valve
- Flush valve
- Manual shutoff handle
- Assembly mounting stand
- Manual shutoff valve handle
- Flush control module (FCM).

Location

A vacuum toilet assembly is in each lavatory. It is under the toilet shroud (not shown).

Functional Description

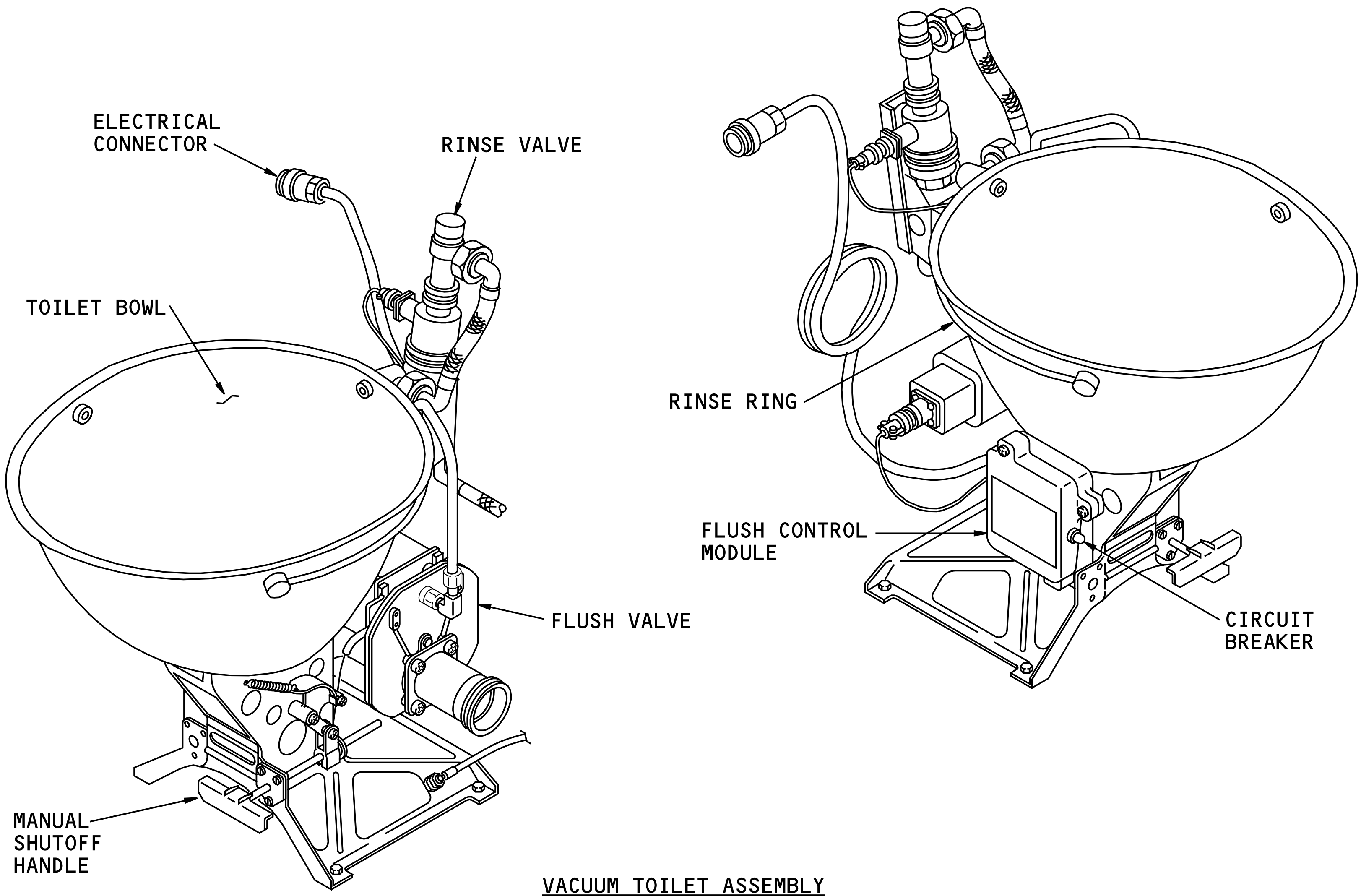
The rinse valve supplies potable water to the rinse ring. When the toilet flushes, the FCM opens the valve for 0.7 seconds and releases water. The rinse ring uses the water to rinse the toilet bowl.

The anti-siphon valve keeps water that is in the rinse ring and the toilet bowl out of the potable water system. This valve makes an air gap between the bowl and the potable water supply.

The flush valve keeps the flow path between the toilet bowl and the waste line closed. The valve opens to let waste move from the toilet bowl to the waste tank. The FCM controls the flush valve.

Training Information Point

If the flush valve fails in the open position, cabin pressure goes out through the vacuum waste system. To prevent this until you make repairs, manually close the flush valve. Pull the handle that is below the toilet shroud to close the flush valve.



VACUUM TOILET ASSEMBLY
(TYPICAL)

38-32-00-007 Rev 3 08/21/1997

VACUUM WASTE SYSTEM - VACUUM TOILET ASSEMBLY

VACUUM WASTE SYSTEM - WASTE TANK

Purpose

Waste tanks collect waste from the toilets.

Physical Description

There are three waste tanks on the airplane. The forward and mid tanks are 100-gallon (379 liters) tanks and they hold 83 gallons (314 liters) of waste. The aft tank is an 80-gallon (303 liters) tank and it holds 63 gallons (239 liters) of waste.

The waste tank is made out of composite materials and has a stainless steel inner liner. The tank has an opening and a cover at each end. The upper cover connects to two vent lines. The lower cover connects to tank drain line.

Two waste inlet fittings attach to the upper part of the tank. Two point level sensors and one rinse nozzle are attached to the inboard side of the tank. The rinse nozzle is above the point level sensors.

See the waste tank quantity indication section for more information on the point level sensors (AMM PART I 38-33).

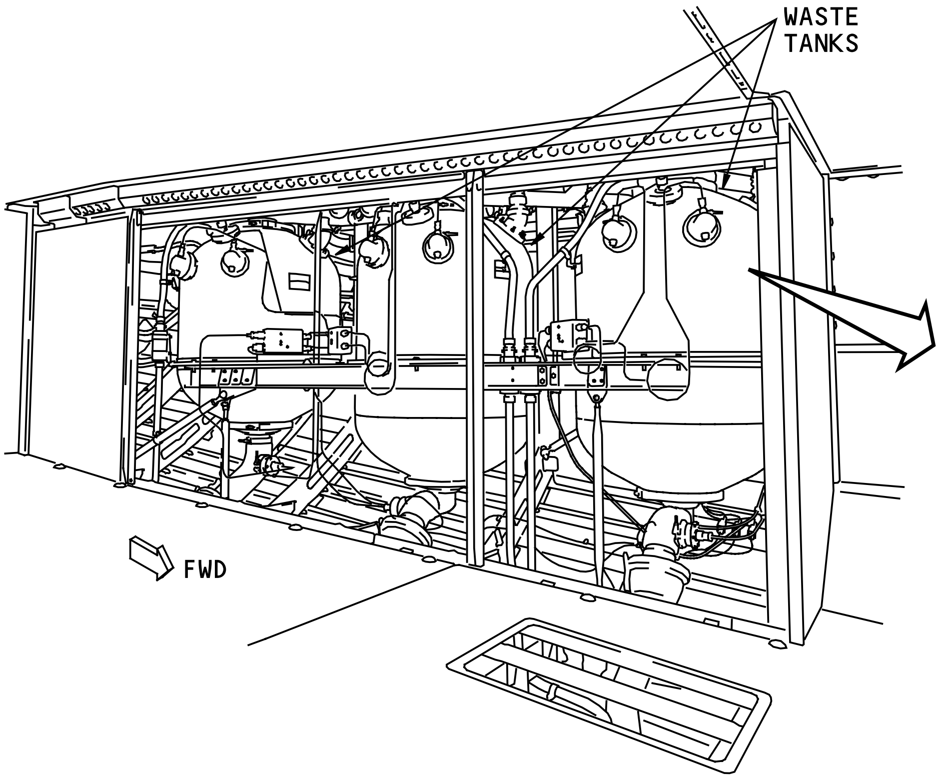
The waste tank has a lower mounting ring. Bolts attach the mounting ring to the tank cradle.

Location

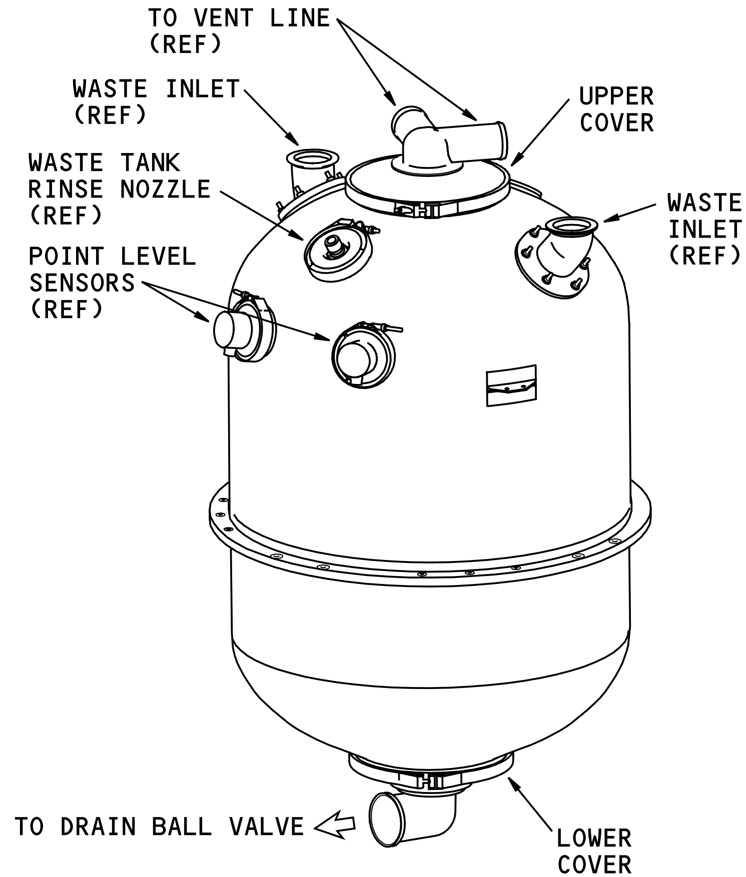
The waste tanks are in the bulk cargo compartment on the left side of the airplane.

Training Information Point

You use the service panel to drain and flush the waste tank before you remove it.



LEFT SIDE OF BULK CARGO COMPARTMENT
(LOOKING OUTBOARD AND AFT
WITH SIDE WALL REMOVED)



WASTE TANK
(TYP)

38-32-00-008 Rev 3 08/07/96

VACUUM WASTE SYSTEM - WASTE TANK

VACUUM WASTE SYSTEM - VACUUM BLOWER AND FILTER

Purpose

The vacuum blower supplies suction for the waste system. The suction moves the toilet rinse water and its contents to the waste tank. The filter removes particles from the air that cools the blower motor.

Physical Description

The vacuum blower has these parts:

- Intake port
- Cooling air filter
- Exhaust port.

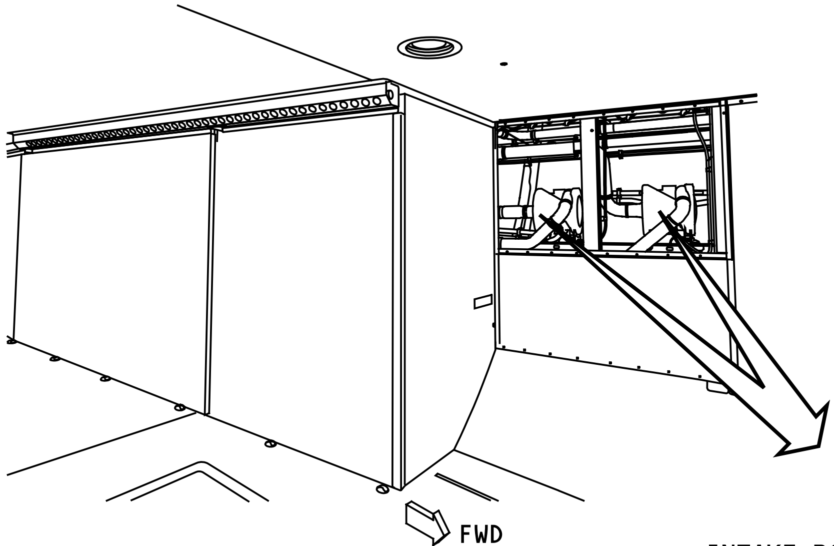
Location

Two vacuum blowers are in the aft cargo compartment on the left side. The vacuum blowers are forward of the waste tanks on a shelf.

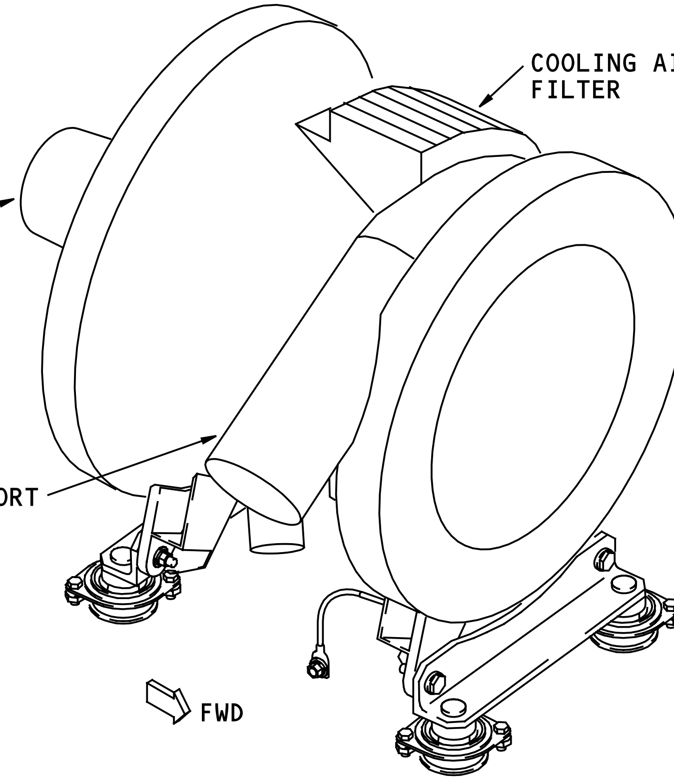
Functional Description

The vacuum blowers cause a pressure difference large enough to move the waste from the lavatories to the waste tanks. The vacuum blowers operate if the airplane is below 16,000 feet. When the airplane is above 16,000 feet, the vacuum blowers do not operate. Lower pressure outside the airplane creates a vacuum.

When the airplane is below 16,000 feet, the vacuum blower operates when you select the flush switch.



LEFT SIDE OF BULK CARGO COMPARTMENT
(LOOKING OUTBOARD AND AFT
WITH PANELS AND FWD TANK REMOVED)



38-32-00-009 Rev 2 01/06/1997

VACUUM WASTE SYSTEM - VACUUM BLOWER AND FILTER

VACUUM WASTE SYSTEM - VACUUM CHECK VALVE

Purpose

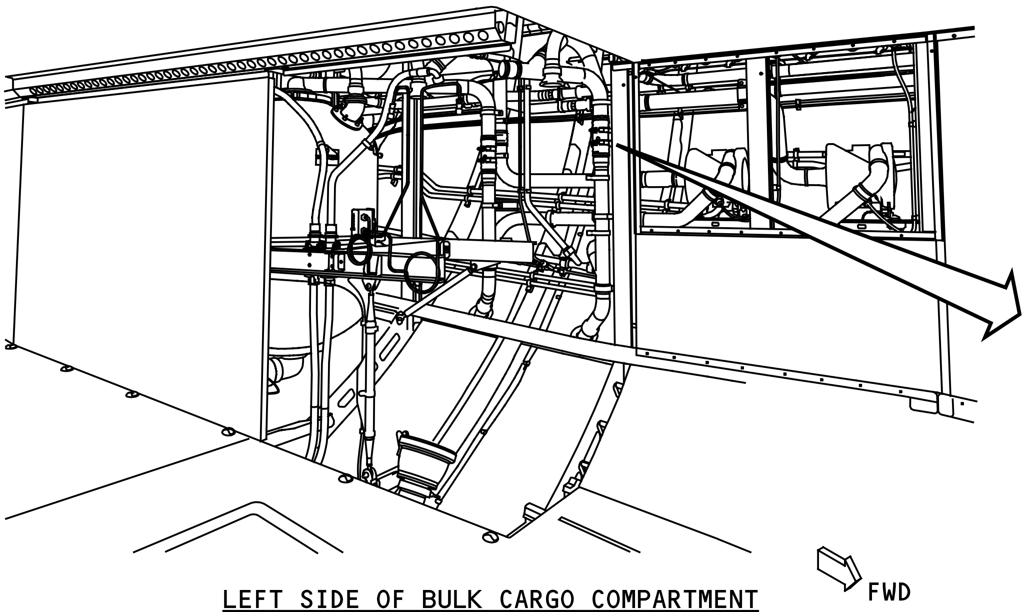
The vacuum check valve prevents reverse air flow through the bypass line when the blower is on.

Physical Description

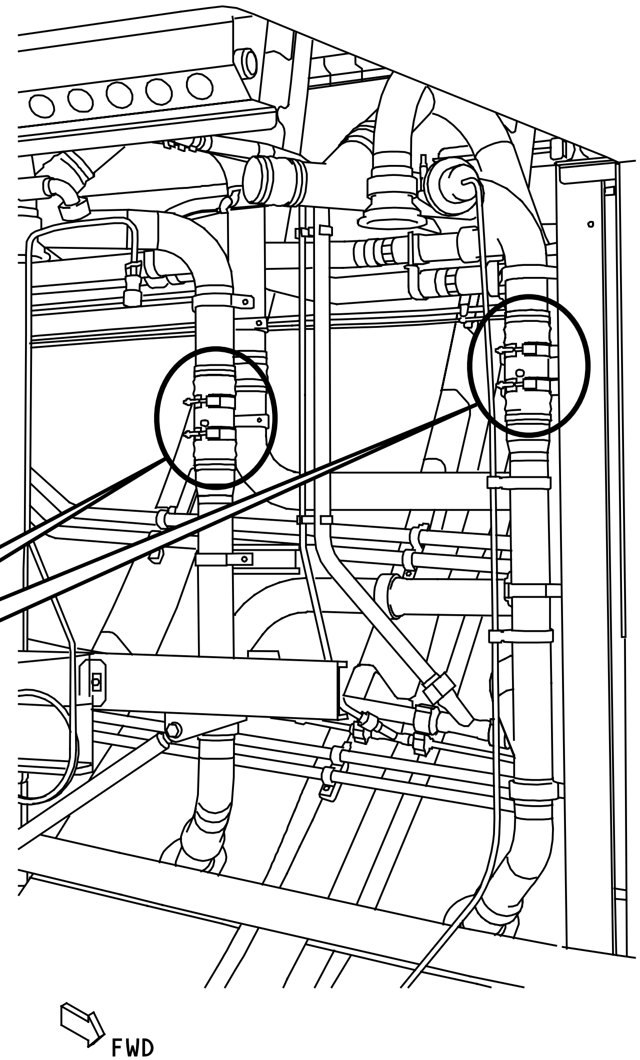
The check valve is a flapper-type valve.

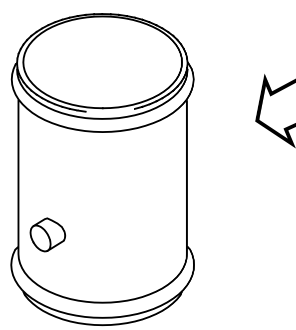
Location

The check valve is in the aft cargo compartment on the left side. The valve is in the blower bypass line that vents overboard. The valve is aft of the blowers and outboard of the forward waste tank.



LEFT SIDE OF BULK CARGO COMPARTMENT
(LOOKING OUTBOARD AND AFT
WITH PANELS AND FWD TANK REMOVED)





VACUUM CHECK VALVE
(TWO PLACES)

VACUUM WASTE SYSTEM - VACUUM CHECK VALVE

VACUUM WASTE SYSTEM - LIQUID SEPARATOR

Purpose

The liquid separator removes moisture and waste particles from the waste tank air before venting the air overboard.

Physical Description

The liquid separator has these parts:

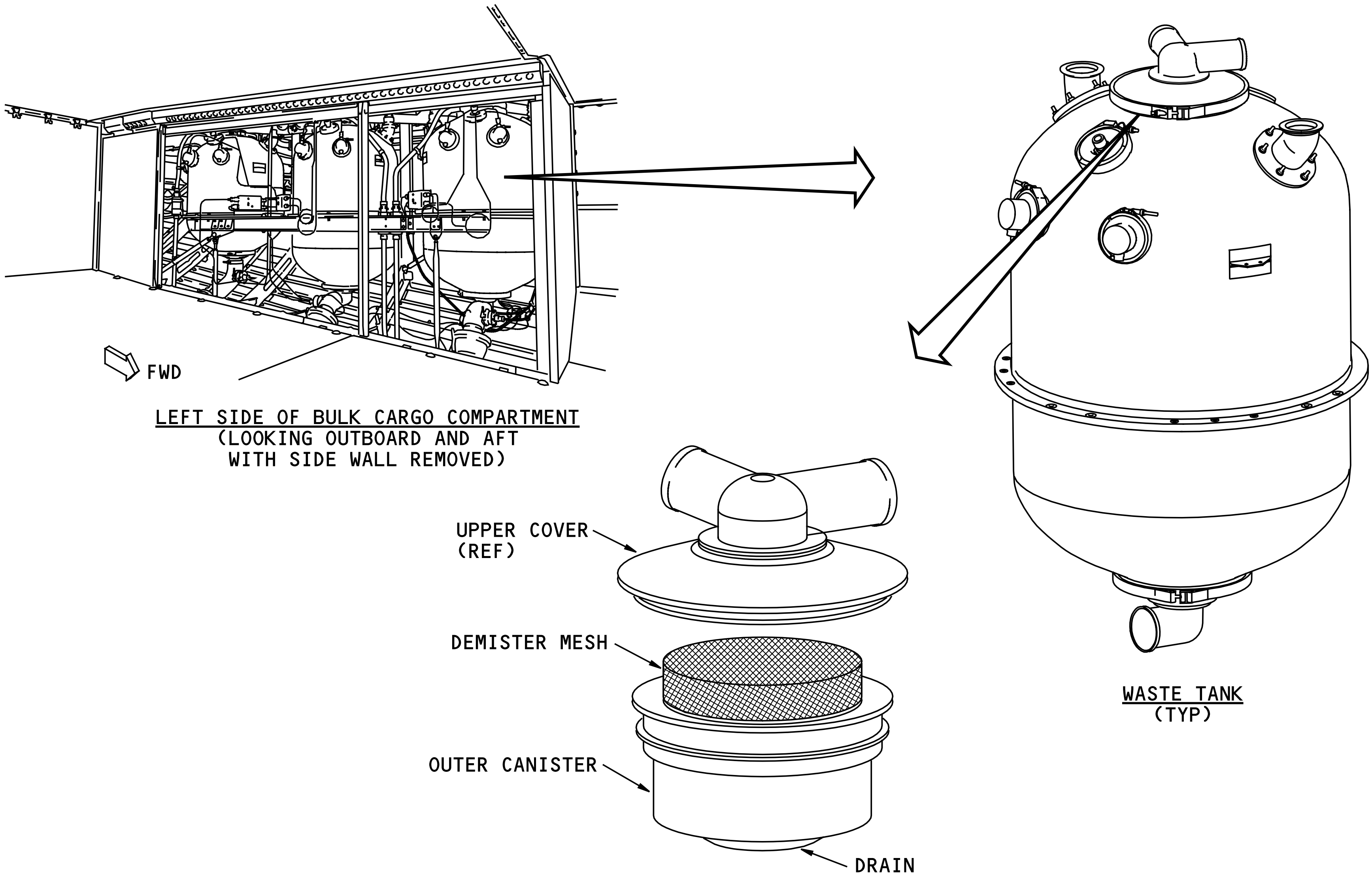
- Demister mesh
- Outer canister
- Inner bowl canister (not shown)

Location

The liquid separator is at the top of each waste tank.

Functional Description

Vents on the outer canister makes sure the air goes in a circular path when air goes into the canister. Centrifugal force removes moisture from the air. The moisture drains out the bottom of the liquid separator. The air then goes into the inner canister and through a demister mesh. The demister mesh removes any material still in the air. The air then goes to the overboard vent line.



38-32-00-012 Rev 1 08/07/96

VACUUM WASTE SYSTEM - LIQUID SEPARATOR

VACUUM WASTE SYSTEM - WASTE TANK DRAIN BALL-VALVE AND CONTROL CABLE

Purpose

The waste tank drain ball-valve and control cable permit the waste tank to drain.

Physical Description

The waste tank drain ball-valve has these parts:

- Housing
- Actuation lever
- Limit switch.

A T-handle attaches to one end of the control cable. The other end attaches to the actuation lever.

Location

The waste tank drain ball-valve and control cable are in the bulk cargo compartment on the left side. There is a valve and cable for each waste tank. The valve is under the waste tank and the cable goes between the valve and the waste service panel.

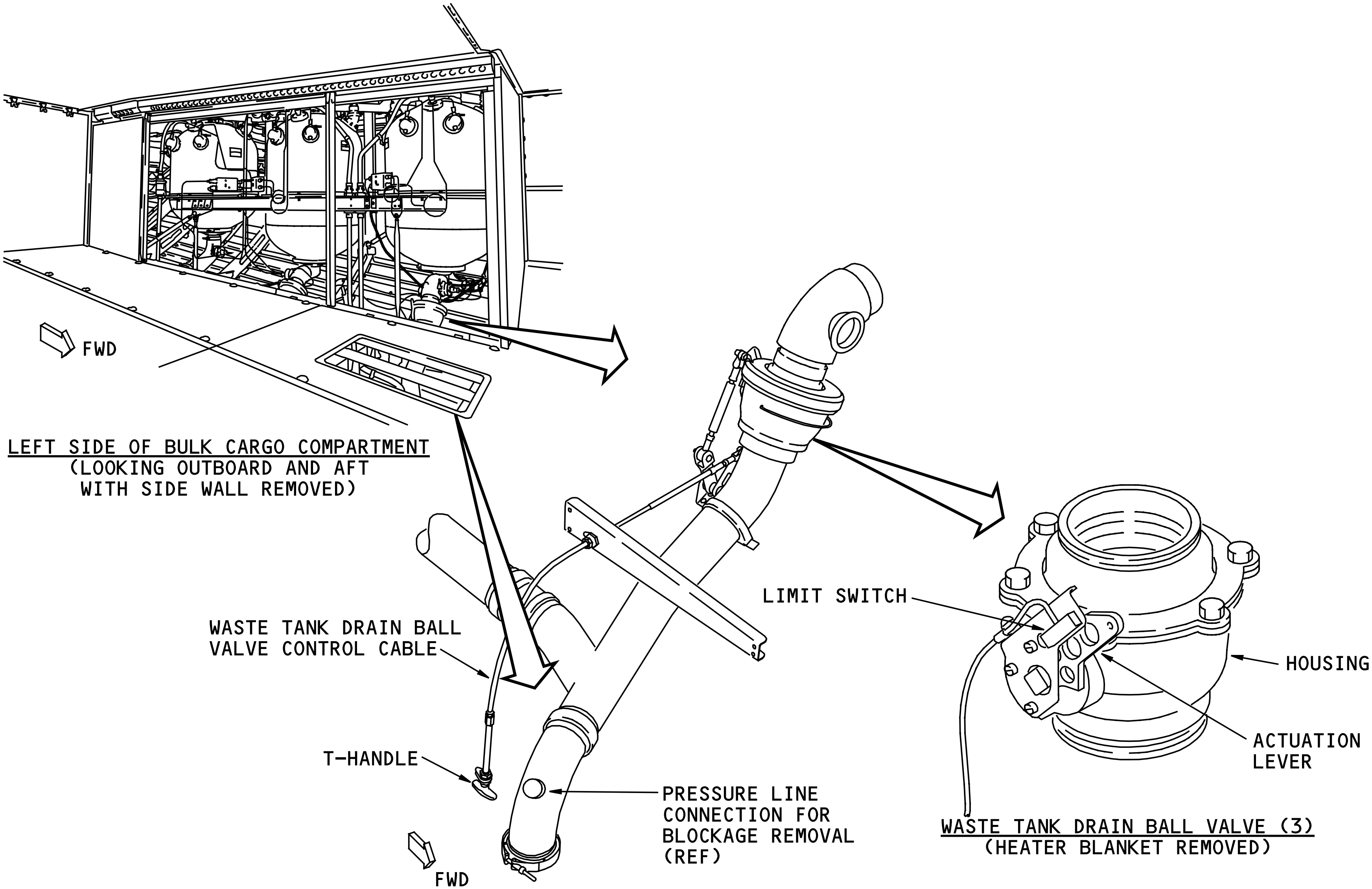
Functional Description

The actuation lever opens and closes the valve. The limit switch stops the operation of the vacuum blower when the valve is not closed. You operate the valve from the service panel. Pull the T handle to open the valve.

Training Information Point

There is a heater blanket around the ball-valve. This prevents any liquid in the valve from freezing.

See the drain and water supply system section for more information on the heater blanket (AMM PART I 30-71).



38-32-00-013 Rev 3 08/21/96

VACUUM WASTE SYSTEM - WASTE TANK DRAIN BALL-VALVE AND CONTROL CABLE

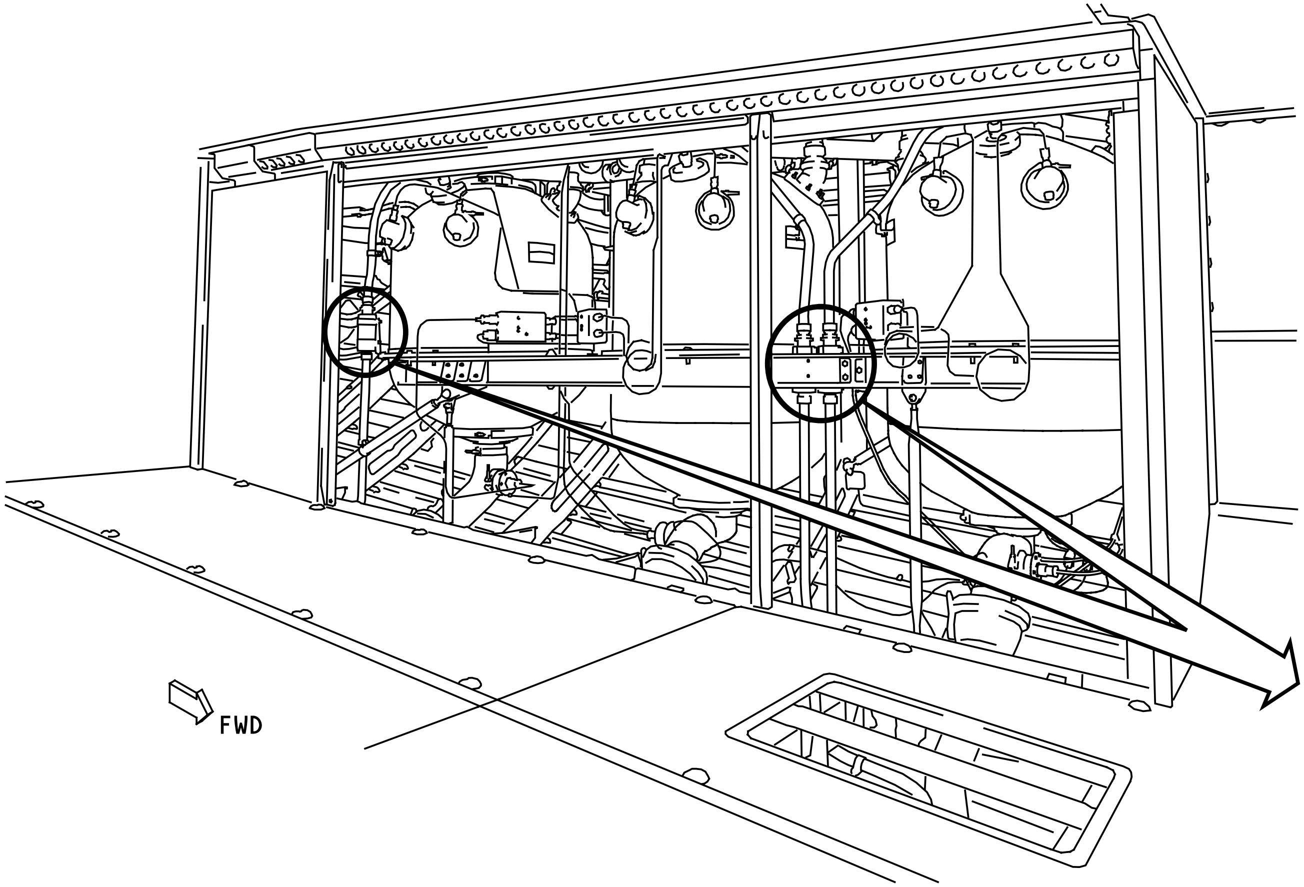
VACUUM WASTE SYSTEM - WASTE TANK RINSE FILTER

Purpose

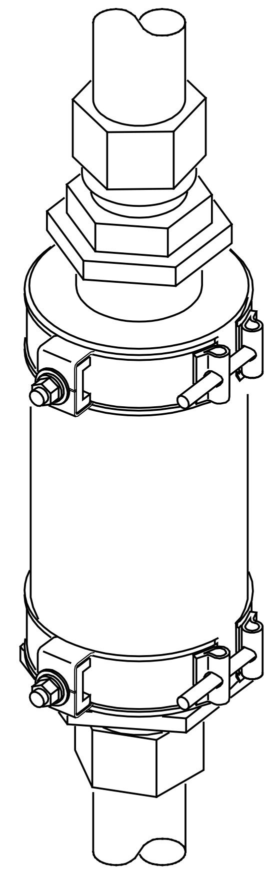
The waste tank rinse filter removes small particles as the rinse water goes through it.

Location

The filter is in the bulk cargo compartment on the left side. The filter is between the waste tank rinse fitting assembly and the rinse nozzle. There are three filters. One is inboard of each waste tank.



LEFT SIDE OF BULK CARGO COMPARTMENT
(LOOKING OUTBOARD AND AFT
WITH SIDE WALL REMOVED)



38-32-00-016 Rev 2 08/07/96

VACUUM WASTE SYSTEM - WASTE TANK RINSE FILTER

VACUUM WASTE SYSTEM - WASTE TANK RINSE NOZZLE

Purpose

The waste tank rinse nozzle points rinse water at the point level sensors and the waste tank interior surface. The rinse nozzle removes waste material from the point level sensors. The rinse nozzle also supplies precharge into the waste tanks.

Physical Description

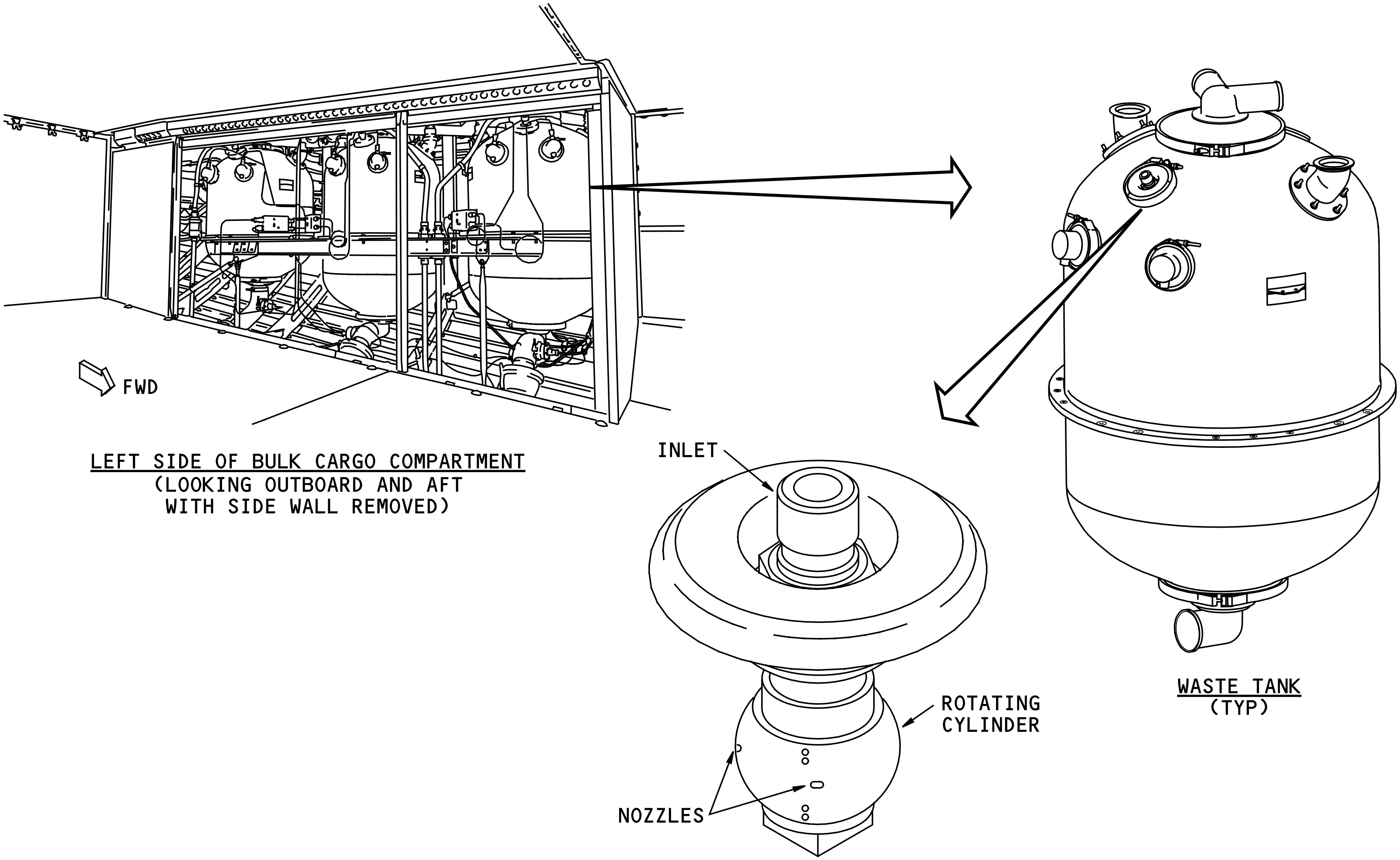
The nozzle has an inlet and rotating cylinder with a shaft. The nozzle inlet is stainless steel. The rotating cylinder and shaft are teflon-filled nylon.

Location

The rinse nozzle attaches to the waste tank. The rinse nozzle is near the top of the waste tank on the inboard side.

Functional Description

The rinse water goes in the inlet and out the rotating rinse nozzle. The nozzle has ports that point the rinse water at the point level sensors.



38-32-00-017 Rev 1 08/07/96

VACUUM WASTE SYSTEM - WASTE TANK RINSE NOZZLE

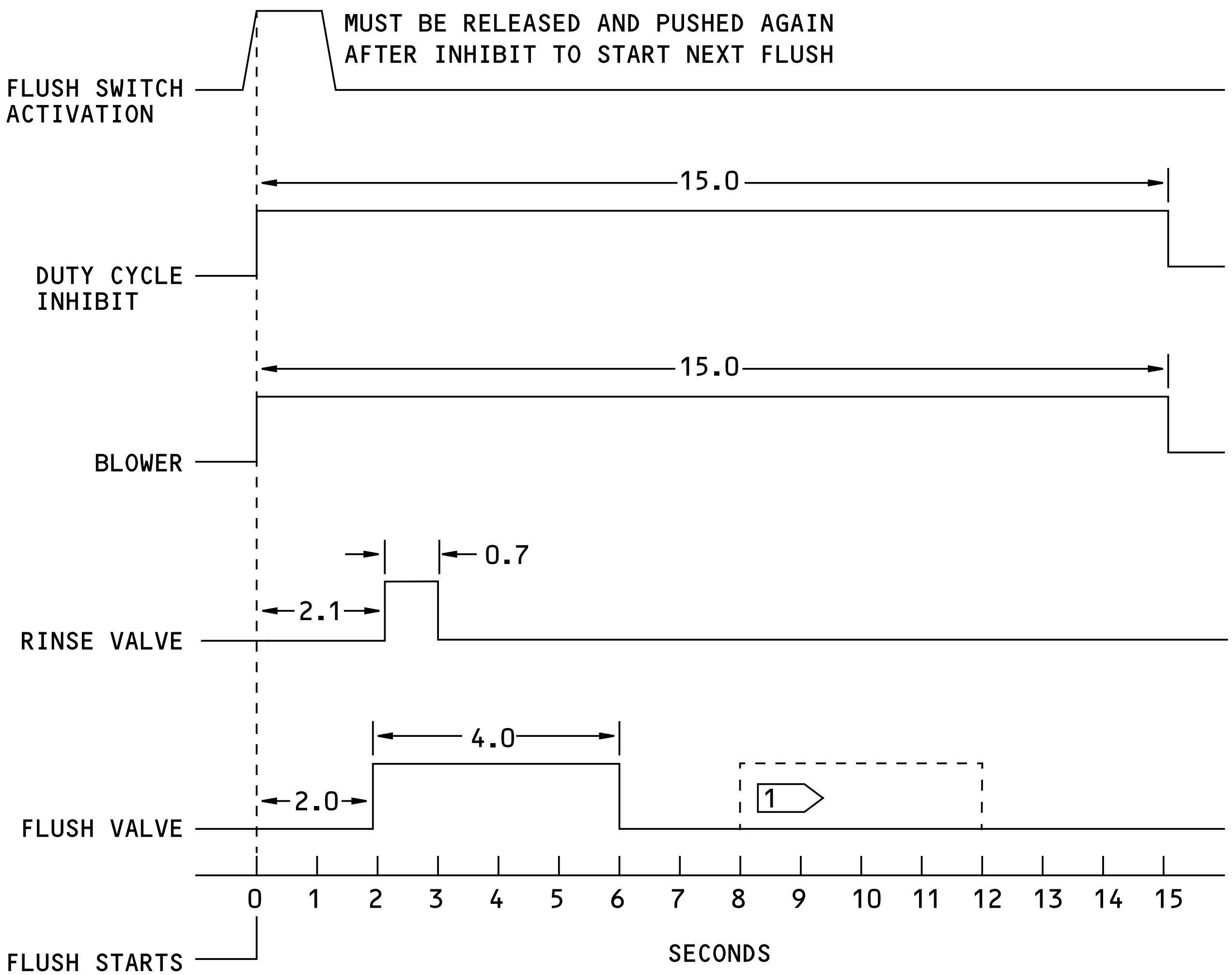
VACUUM WASTE SYSTEM - FLUSH CYCLE - FUNCTIONAL DESCRIPTION

Lavatory Flush Cycle Operation

One second after you push the flush switch, the rinse valve opens. The rinse valve stays open for 0.7 seconds. Eight ounces of potable water goes into the toilet bowl during this time. Two seconds after the flush cycle starts, the flush valve opens. The flush valve opens for four seconds then closes.

If the flush valve does not close eight seconds after the flush cycle starts, the valve has a jammed condition. During each jammed condition, one automatic dry flush occurs. During a dry flush, the rinse valve does not open. Then a dry flush follows each normal cycle. The flush valve automatically resets when the flush valve does not have a jammed condition.

There is no flush cycle if the tank ball valve is open or if the related waste tank if full.



1 DRY FLUSH

38-32-00-018 Rev 1 08/21/1997

VACUUM WASTE SYSTEM - FLUSH CYCLE - FUNCTIONAL DESCRIPTION

VACUUM WASTE SYSTEM - FUNCTIONAL DESCRIPTION - LAVATORY FLUSH CONTROL

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VACUUM WASTE SYSTEM - FUNCTIONAL DESCRIPTION - LAVATORY FLUSH CONTROL

General

There are three lavatory waste systems:

- Waste system one (forward waste tank)
- Waste system two (middle waste tank)
- Waste system three (aft waste tank).

The waste systems have these control circuits:

- Toilet flush
- Vacuum blower control.

There is one toilet flush circuit for each lavatory. A typical circuit is shown.

There are two vacuum blower control circuits. Waste system one uses one of the circuits (shown). Waste systems two and three use the other circuit (not shown). The two vacuum blower control circuits are independent.

For the control circuits, these are the most important components and their functions:

- Flush control module (FCM): supplies the control logic for blower and toilet operation
- Tank ball-valve limit switch: prevents blower operation when the valve is open
- Barometric switch: prevents blower operation when airplane altitude is above 16,000 feet (4877 meters)
- Vacuum blower overheat switches: stops the blower if it gets too hot
- The tank logic control module: controls when power goes to the flush control modules (enables/ disables toilet flushing).

Toilet Flush/Vacuum Blower Control

When you push the flush switch, the flush control module starts a flush cycle that continues for 15 seconds. The flush control logic sets the sequence of operation for the blower, rinse valve, and the flush valve.

All of these conditions must occur before a flush cycle can start:

- Waste tank: not full
- Point level sensors: one or both serviceable
- Flush switch: push
- Operation power: available, left (right) bus
- Control power: available, left (right) bus or ground handling bus.

All of these conditions must occur before the vacuum blower operates as part of the flush cycle:

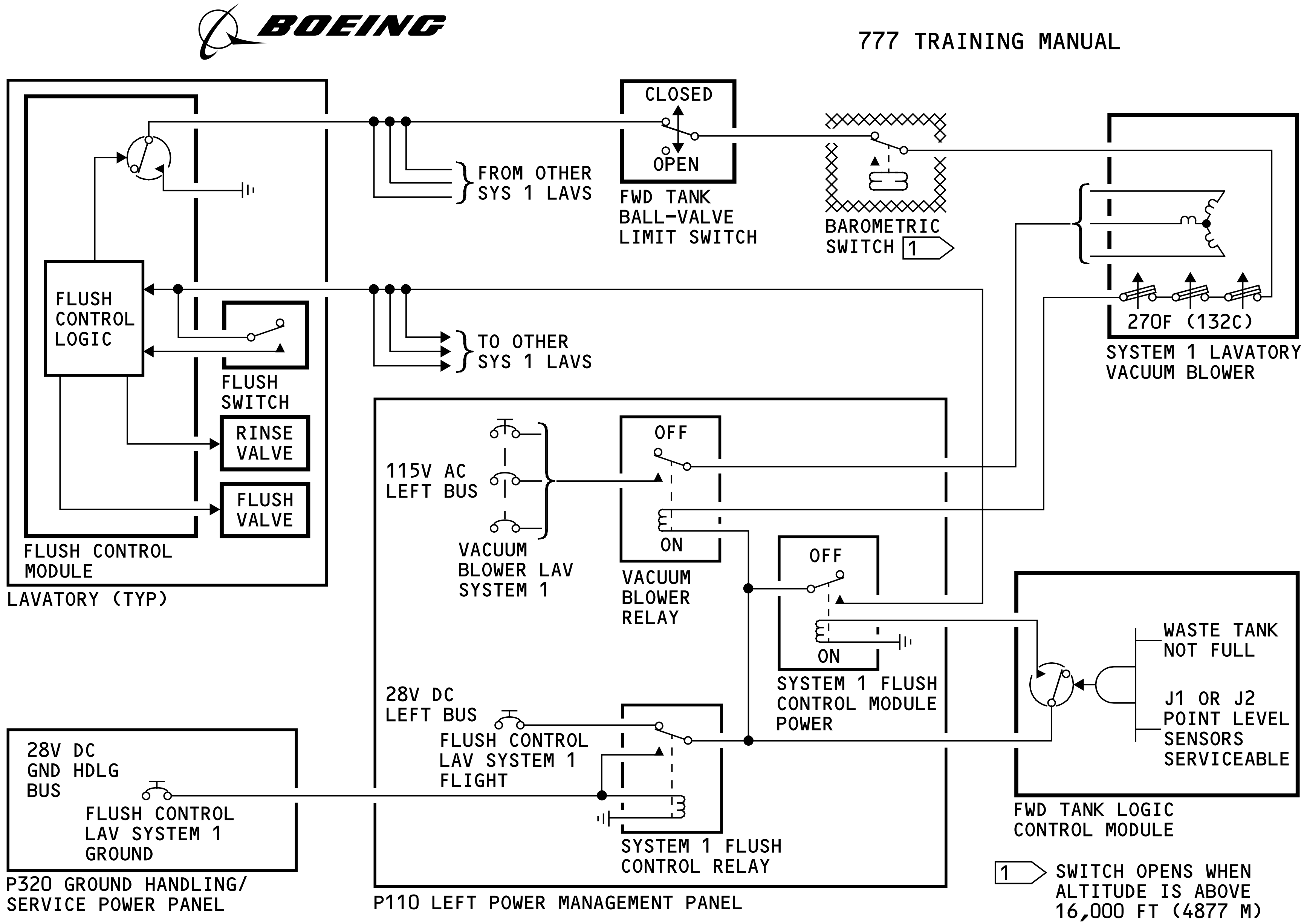
- Tank ball valve: closed
- Airplane altitude: below 16,000 feet (4877 meters)
- Vacuum blower motor: no overheat.

VACUUM WASTE SYSTEM - FUNCTIONAL DESCRIPTION - LAVATORY FLUSH CONTROL

If you push the flush switch when a cycle is active, a new cycle will not start. You can only start a new cycle when a flush cycle is complete.

Training Information Point

If a vacuum blower motor overheats, make sure the cooling air filter on the blower is clean. A dirty filter can cause the motor to overheat.



38-32-00-019 Rev 2 08/21/1997

VACUUM WASTE SYSTEM - FUNCTIONAL DESCRIPTION - LAVATORY FLUSH CONTROL

VACUUM WASTE SYSTEM - TRAINING INFORMATION POINTS - SERVICING

General

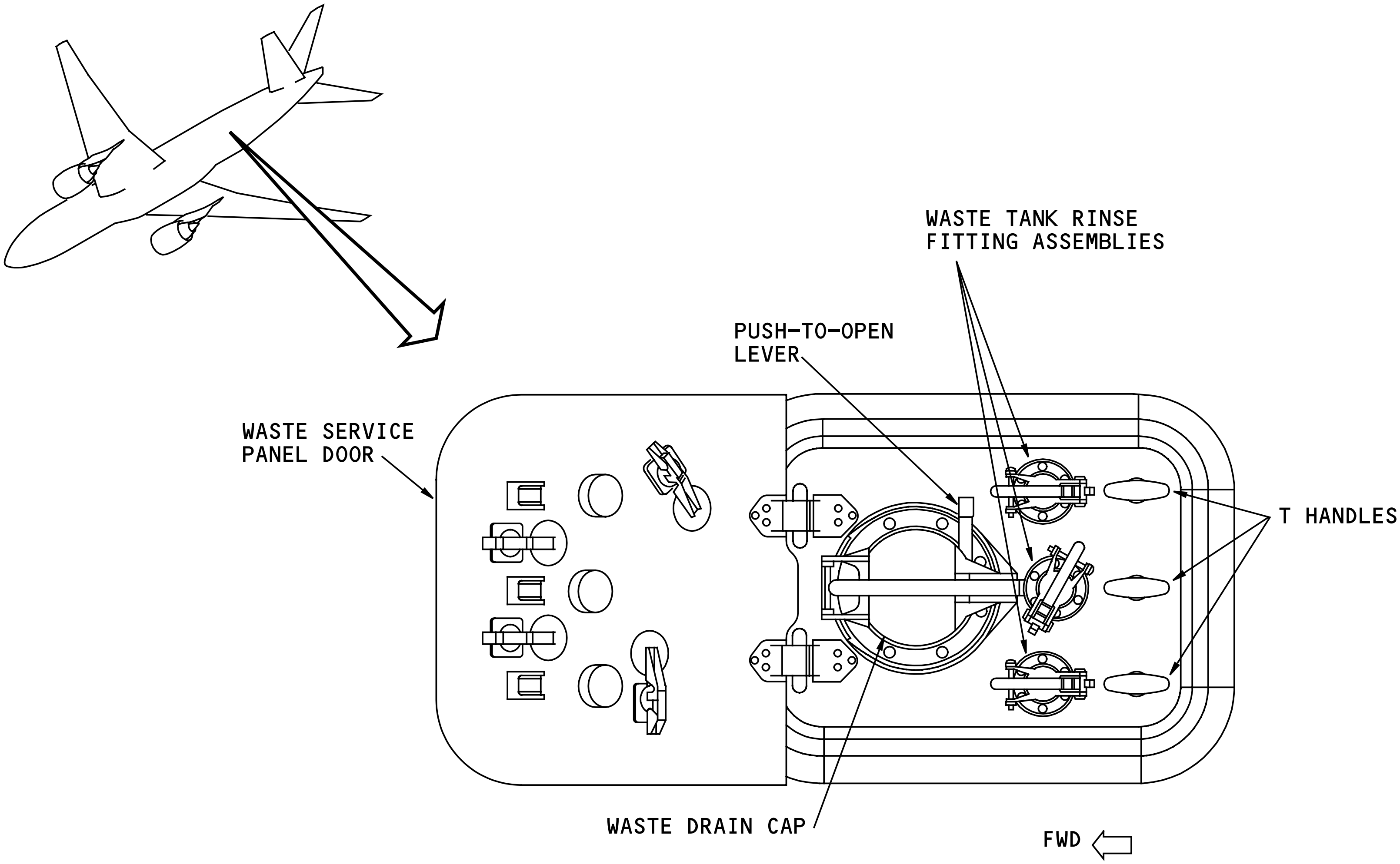
Service the waste tanks through the service panel. The service panel has these components:

- Waste drain cap
- Rinse fitting (3)
- T handle (3).

Toilet Waste System Servicing

To drain and flush the waste system you must do these tasks:

- Open the waste drain cap
- Connect support equipment to the waste drain fitting
- Push the push-to-open lever on the waste drain valve assembly
- Pull each T handle to open the waste tank drain ball-valves (this empties the waste tanks)
- Connect ground flush lines to the rinse fittings
- Flush the waste tanks with at least ten gallons of flushing liquid
- Drain each tank of the flushing liquid
- Push up each T handle to close the waste tank drain ball-valve after each waste tank has drained
- Remove the support equipment
- Close the waste drain cap
- Add a wet or dry precharge to the each waste tank
- Disconnect ground flush lines
- Close the rinse fittings
- Close the service panel.



WASTE SERVICE PANEL

38-32-00-020 Rev 0

VACUUM WASTE SYSTEM - TRAINING INFORMATION POINTS - SERVICING

WASTE TANK QUANTITY INDICATION - INTRODUCTION

General

The waste tank quantity indication system gives data about the amount of waste in the tanks. It also stops power to the toilets if the waste tank is full.

These components are in the waste tank quantity indication system:

- Waste tank point level sensors (6)
- Waste tank continuous level sensors (3)
- Logic control modules (LCM) (3).

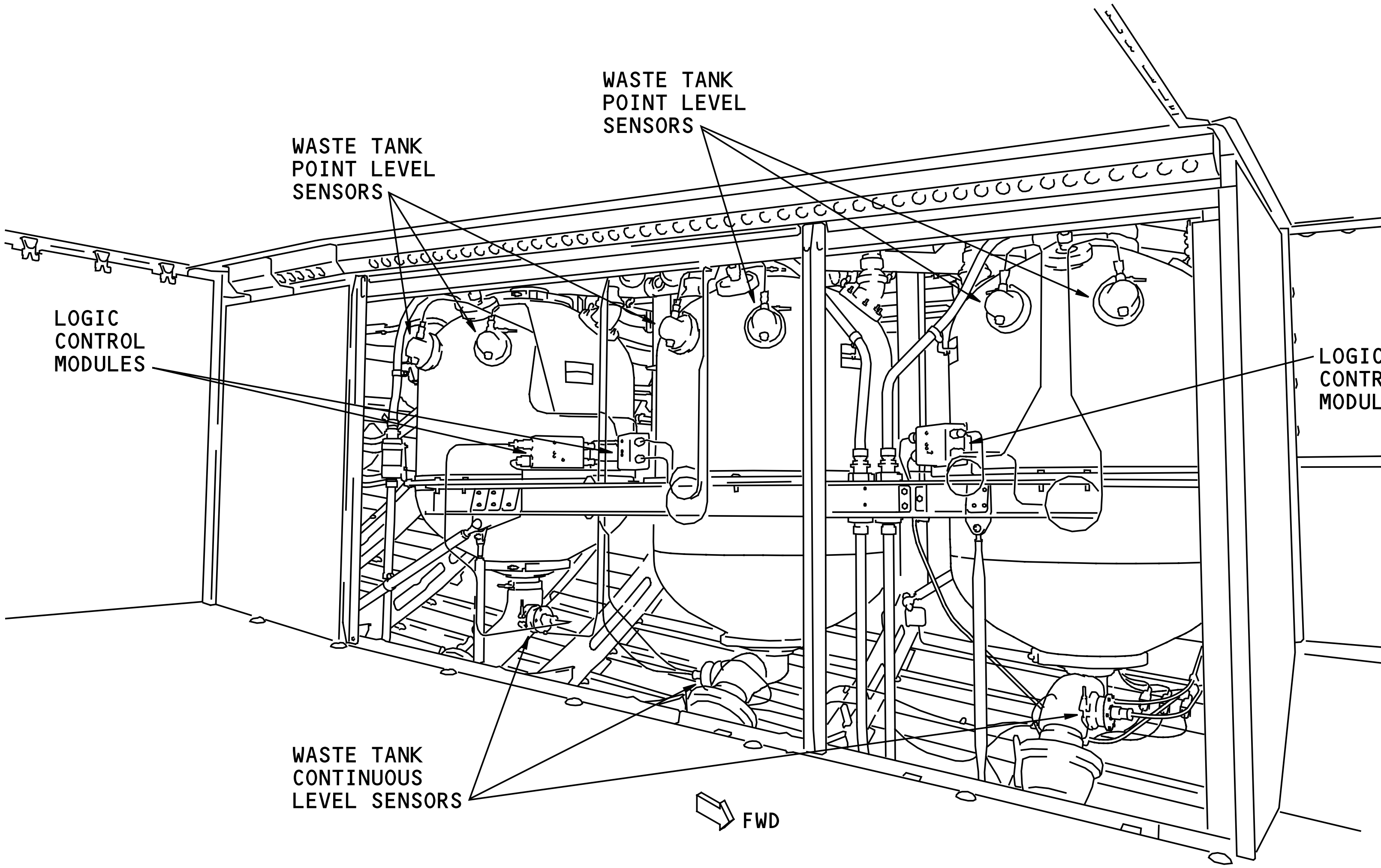
Location

The point level sensors, the continuous level sensors, and the LCMs are in the bulk cargo compartment, behind the panels on the left side. The LCMs attach to the support fitting inboard of each waste tank.

The point level sensors attach to the upper part of the tanks. The continuous level sensors are in the tank drain lines. Each continuous level sensor has a remote diaphragm (not shown) in the vent line above the tank.

Interface

The waste tank quantity indication system gives data about the amount of waste in the tanks to the cabin services system (CSS). They also give tank full data to the lavatory flush circuit in the vacuum waste system.



LEFT SIDE OF BULK CARGO COMPARTMENT
(LOOKING OUTBOARD AND AFT
WITH SIDE WALL REMOVED)

38-33-00-001 Rev 3 08/07/96

WASTE TANK QUANTITY INDICATION - INTRODUCTION

WASTE TANK QUANTITY INDICATION - WASTE TANK POINT LEVEL SENSOR

Purpose

The waste tank point level sensor sends a signal to the LCM when the waste tank is full. There are six waste tank point level sensors, two on each waste tank.

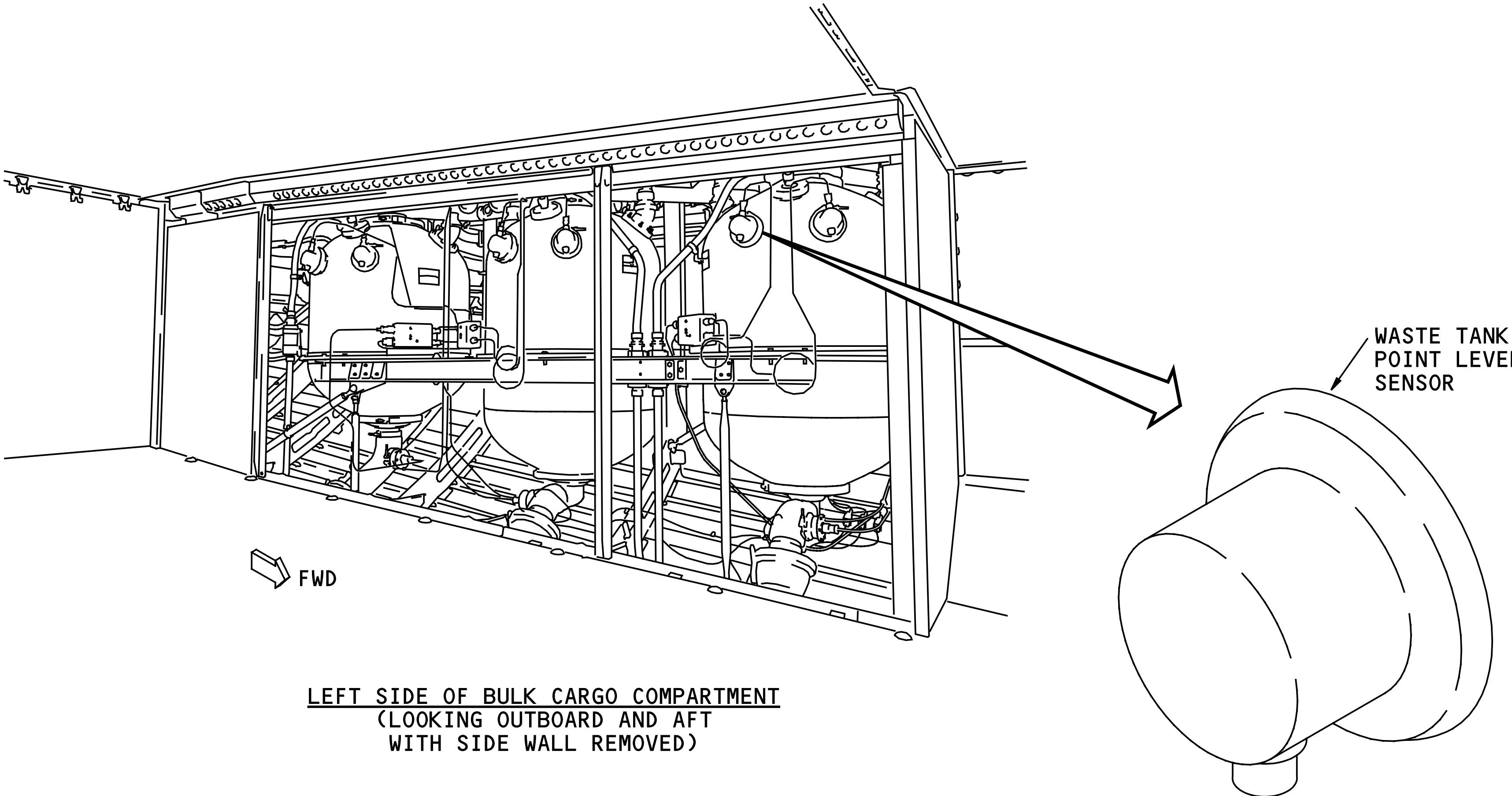
Physical Description

The sensor is a capacitance type sensor.

It has an electrical connector.

Location

The sensors are behind the left side panels of the bulk cargo compartment. They are on the upper part of the waste tanks.



LEFT SIDE OF BULK CARGO COMPARTMENT
(LOOKING OUTBOARD AND AFT
WITH SIDE WALL REMOVED)

38-33-00-002 Rev 1 08/07/96

WASTE TANK QUANTITY INDICATION - WASTE TANK POINT LEVEL SENSOR

WASTE TANK QUANTITY INDICATION - WASTE TANK CONTINUOUS LEVEL SENSOR

Purpose

The waste tank continuous level sensor calculates the amount of waste in the tanks. This data is only for indications that show on the cabin area control panels (CACP) and cabin system control panels (CSCP).

Physical Description

The waste tank continuous level sensor is a capacitance-type pressure sensor. The sensor has these components:

- Remote diaphragm
- Capillary tube
- Electrical connector J3
- Sensor module.

Wires connect the electrical connector to the logic control module (LCM).

Location

The continuous level sensors are in the bulk cargo compartment, behind the left side wall. There is a sensor for each waste tank. The sensor module is in the drain line below the tank. The remote diaphragm is in the vent line above the tank. The capillary tube goes from the remote diaphragm to the remote sensor.

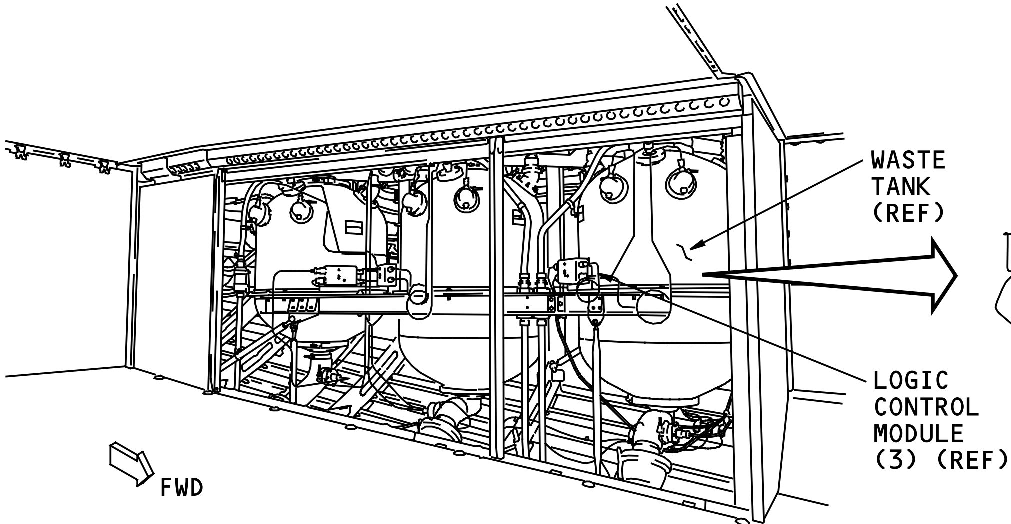
Functional Description

The remote diaphragm and the capillary tube find the pressure of the air in the tank. The sensor finds the difference between the air pressure in the tank and the liquid in the drain line. It uses the difference to calculate the amount of waste in the tanks.

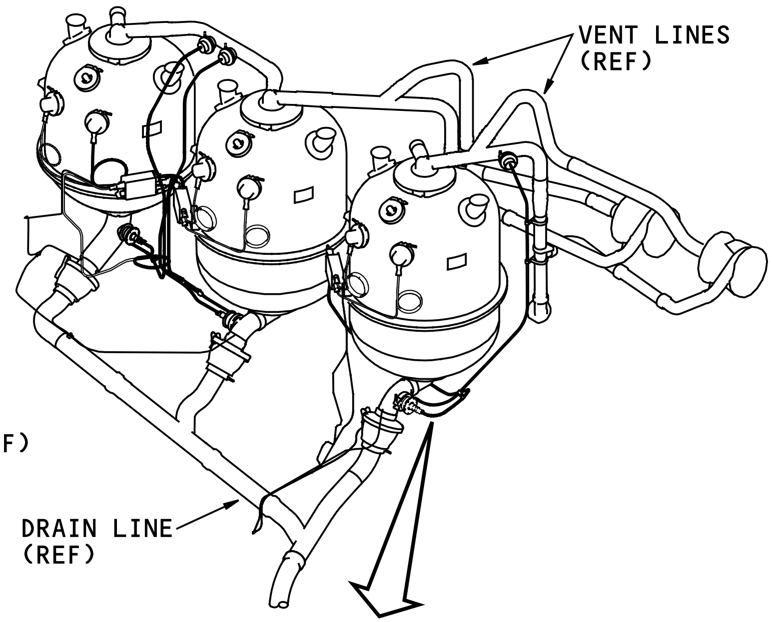
Training Information Point

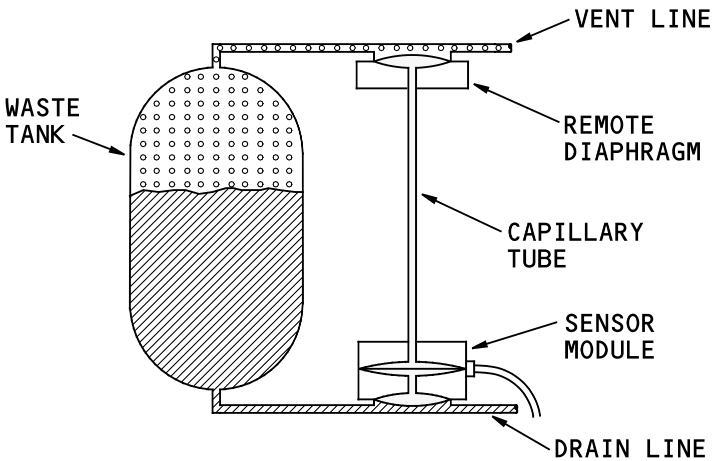
You use the (LCM) to do a zero adjustment when you install a continuous level sensor.

You can test the operation of the sensor with the LCM or with an all test through the cabin services system (CSS).

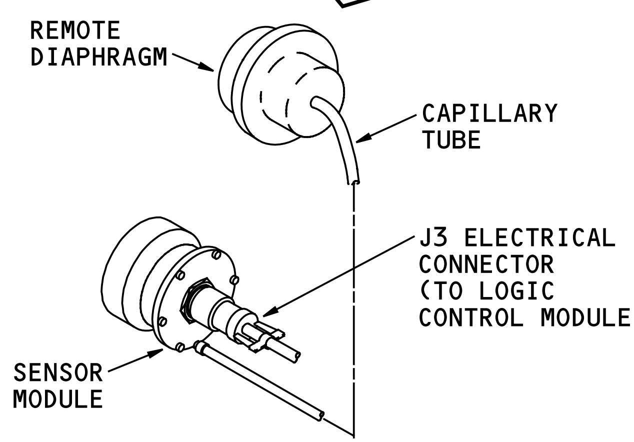


LEFT SIDE OF BULK CARGO COMPARTMENT
(LOOKING OUTBOARD AND AFT
WITH SIDE WALL REMOVED)





CONTINUOUS LEVEL SENSOR SCHEMATIC



CONTINUOUS LEVEL SENSOR
(TYPICAL)

WASTE TANK QUANTITY INDICATION - WASTE TANK CONTINUOUS LEVEL SENSOR

38-33-00-003 Rev 1 08/21/96

WASTE TANK QUANTITY INDICATION - LOGIC CONTROL MODULE

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WASTE TANK QUANTITY INDICATION - LOGIC CONTROL MODULE

General

The logic control module (LCM) gives information about the amount of waste in the waste tanks to the cabin services system. The LCM does not let the vacuum waste system operate for the lavatories connected to a waste tank that is full.

There are three LCMs, one for each tank. It also has BITE for itself, the point level sensors, and the continuous level sensor.

Physical Description

The LCM has four electrical connections. Three are for the sensors and one connects the LCM to the airplane wiring. The LCM also has a three-position switch.

It has five lights:

- Sensor J1, red
- Sensor J2, red
- Sensor J3, red
- Tank full, red
- Power on, green.

The first two lights are for the point level sensors. The third is for the continuous level sensor.

Location

The LCMs attach to the support fitting inboard of each waste tank.

Operation

To do a test of the LCM, first push the switch down. All five lights come on. When you release the switch the lights go off.

Next, push up on the switch. All five lights come on. If any light stays on when you release the switch, that sensor fails the test.

When you do an ALL TEST from the CSCP, the LCM does a test of the sensors and the LCM circuit.

See the cabin services system section for more information about the ALL TEST (AMM PART I 23-39).

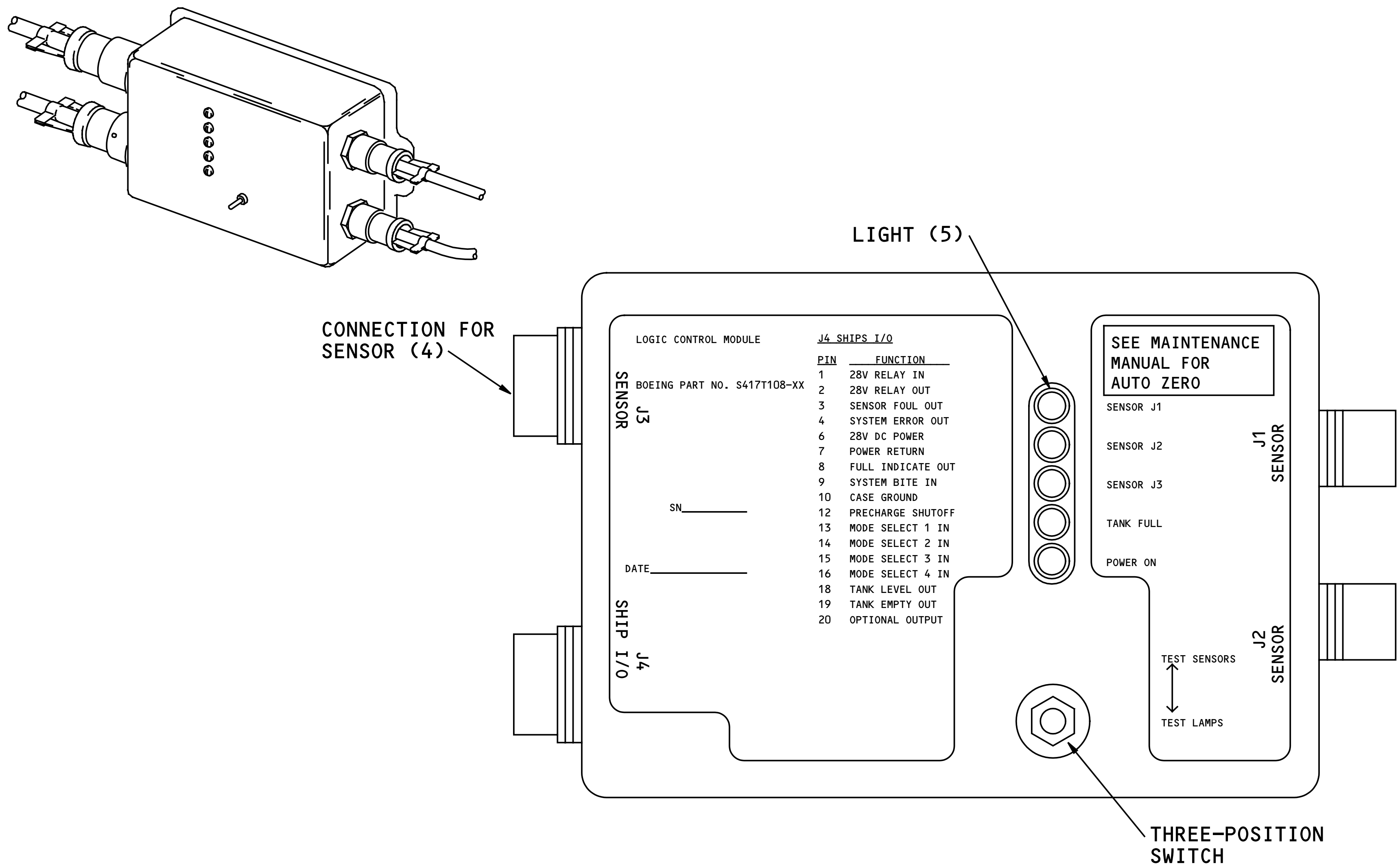
After you replace a continuous level sensor, you must do an auto zero adjustment of the LCM. You use the three-position switch to do an auto zero adjustment.

When a sensor detects that the tank is full, the associated sensor light on the LCM will come on. The tank full light turns on if any of these conditions occur:

- The two point level sensor detect the tank is full
- The two point level sensors fail
- One point level sensor fails or is fouled and the other point level sensor detects the tank is full
- The continuous level sensor detects the tank is almost full.

WASTE TANK QUANTITY INDICATION - LOGIC CONTROL MODULE

If any of the sensors are failed or the point level sensors are fouled, the light for that sensor will flash on the LCM. If the LCM fails, the tank full light flashes.



38-33-00-004 Rev 1

WASTE TANK QUANTITY INDICATION - LOGIC CONTROL MODULE

WASTE TANK QUANTITY INDICATION - FUNCTIONAL DESCRIPTION

General

The continuous level sensor sends data about the quantity of waste in the tanks to the LCM. The LCM sends the data to the cabin services system (CSS). The cabin area control panels (CACPs) (not shown) and the cabin system control panel (CSCP) (not shown) in the CSS show the waste tank level information.

When the tank is almost full, the CACPs and CSCP show a pop-up screen to tell the flight attendants. The waste tank status screen on the CACPs and CSCP show full. A chime sounds when a waste tank is full.

Control

The LCM gets data from the two point level sensors.

Normally, the flush module power relay is energized. It lets power to go to the lavatories.

When both point level sensors give a signal that the waste tank is full, the flush module power relay de-energizes. This removes power from all toilets that connect to the full tank. A pop-up screen shows on the CSCP/CACP.

If a sensor has an error, it gives the same signal that it does when the tank is full. When the other sensor finds that the tank is full the flush module power relay de-energizes.

If both sensors have errors, the LCM removes power to the related lavatories is removed.

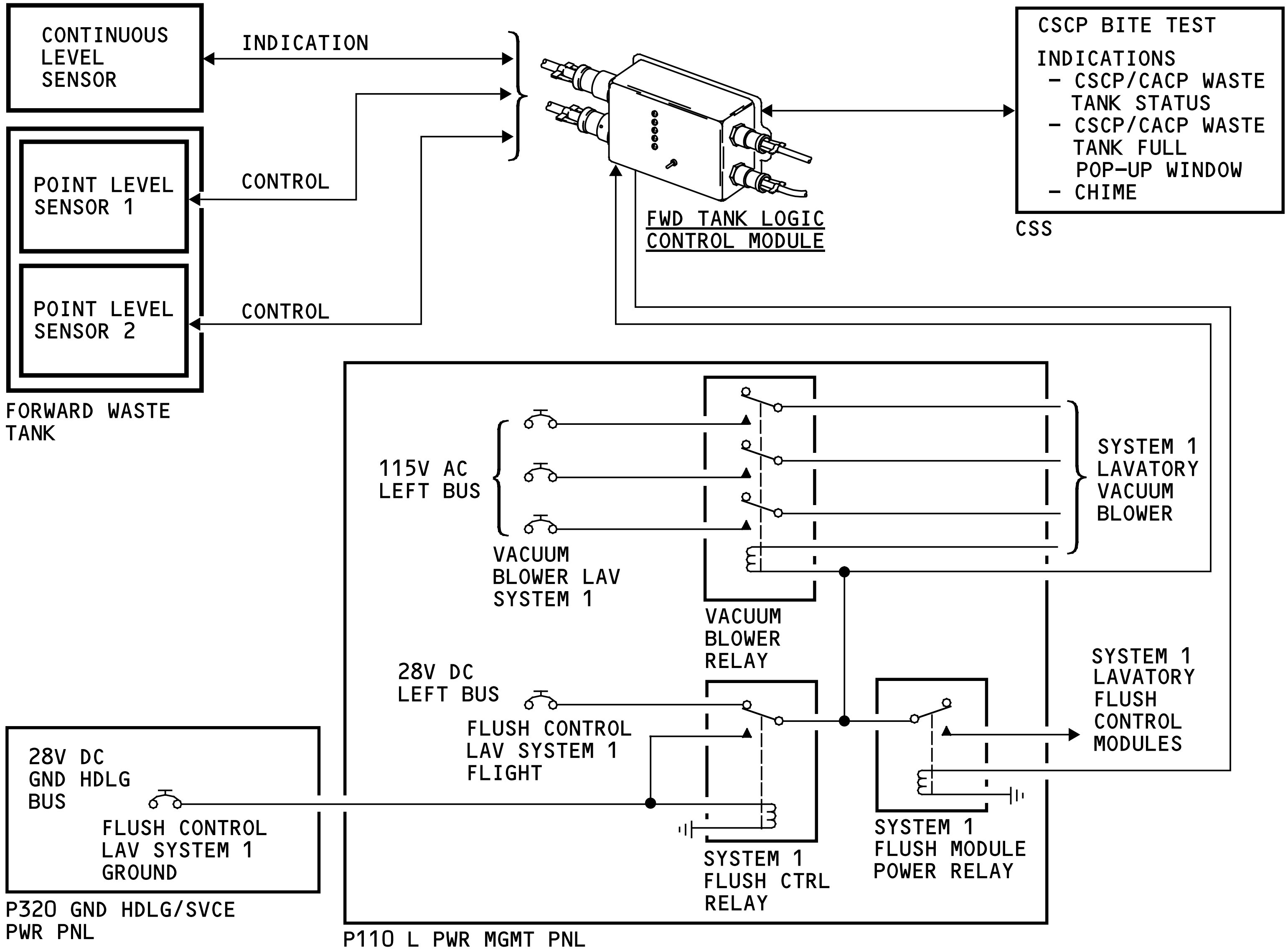
Interface

The LCM sends signals to an overhead electronics unit (OEU) (not shown). The OEU sends the signal to a zone management unit (ZMU) (not shown) on the OEU bus. The ZMU sends a signal to the CACPs on the CACP bus and to the CSCP on the intersystem (I/S) bus.

See the cabin services system section for more information on the OEU, CACP and the intersystem buses (AMM PART I 23-39).

Power

The ground service bus or the left main bus must have power for the LCM to operate.



WASTE TANK QUANTITY INDICATION - FUNCTIONAL DESCRIPTION

WASTE TANK QUANTITY INDICATION - OPERATION - CSCP/CACP INDICATIONS - 1

General

You use the cabin system control panel (CSCP) or cabin area control panels (CACP) to control and monitor lavatory functions and waste tank levels.

Lavatory/Waste Tank Status Screen

You use the lavatory waste tank status screen to monitor the conditions of the lavatories and waste tanks.

The lavatories area of the screen shows lavatory locations and status. The area to the right of the lavatories shows the related waste tank and the amount of waste in it.

When the waste level is less than 1/4, the vertical bars are green. When the waste level is 1/4 to 3/4 full, the vertical bars are yellow. When the waste level is more than 3/4, the vertical bars are red.

When the waste tank level shows full (F), all related lavatories show INOP.

Lavatory Inoperable Control Screen

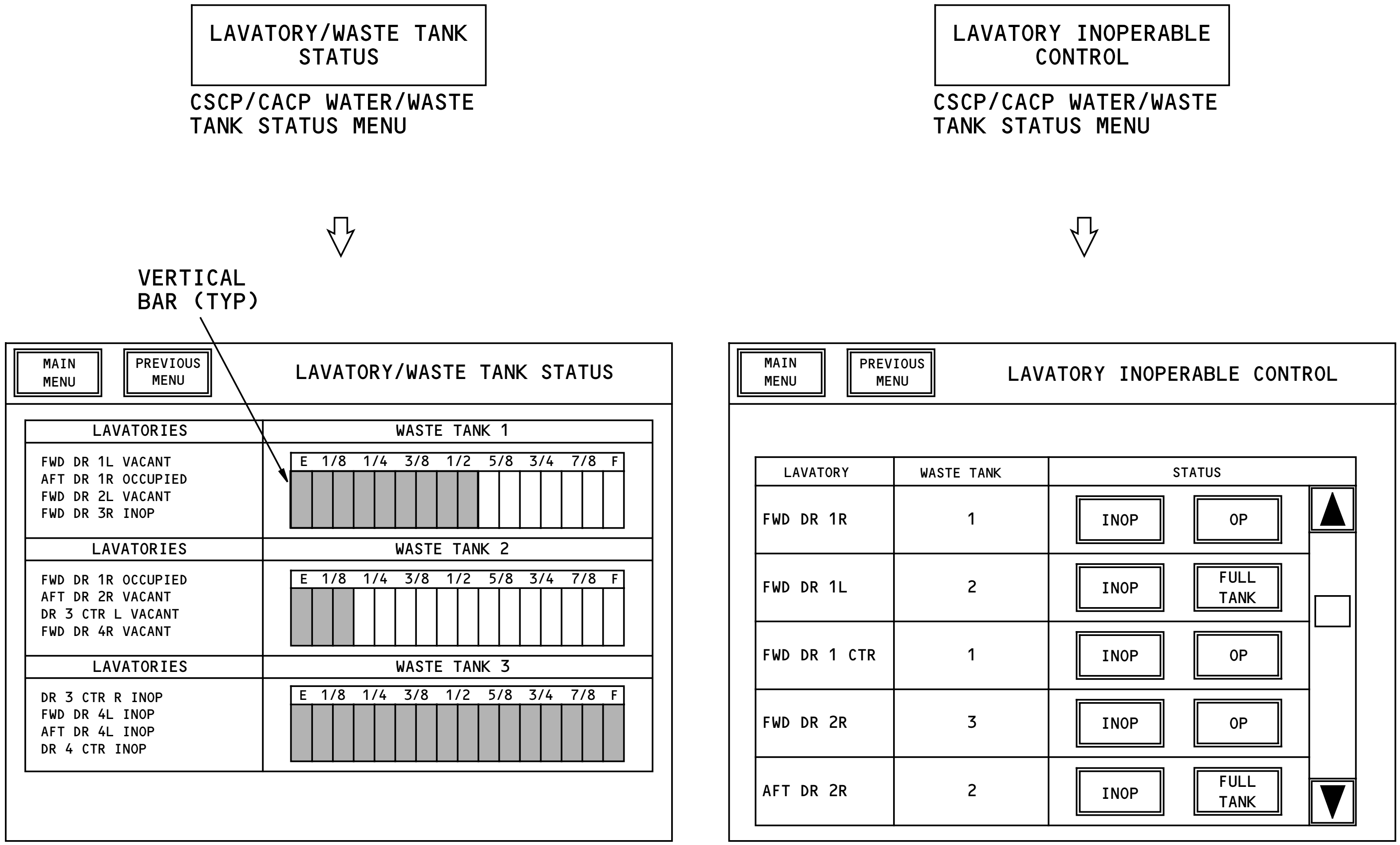
You use the lavatory inoperable control screen to show the conditions of the lavatories.

The screen shows the lavatories and assigned waste tanks. The status area of the screen shows the condition of each lavatory.

You touch OP or INOP to show that lavatory operational or inoperative. The OP and INOP selections show green.

INOP shows automatically for all lavatories with the same waste tank if the waste tank is full. FULL TANK shows in the area where OP would normally be. You cannot change this condition.

Use the up and down arrows at the right of the display to scroll the lavatory information up and down.



38-33-00-006 Rev 1 04/15/1997

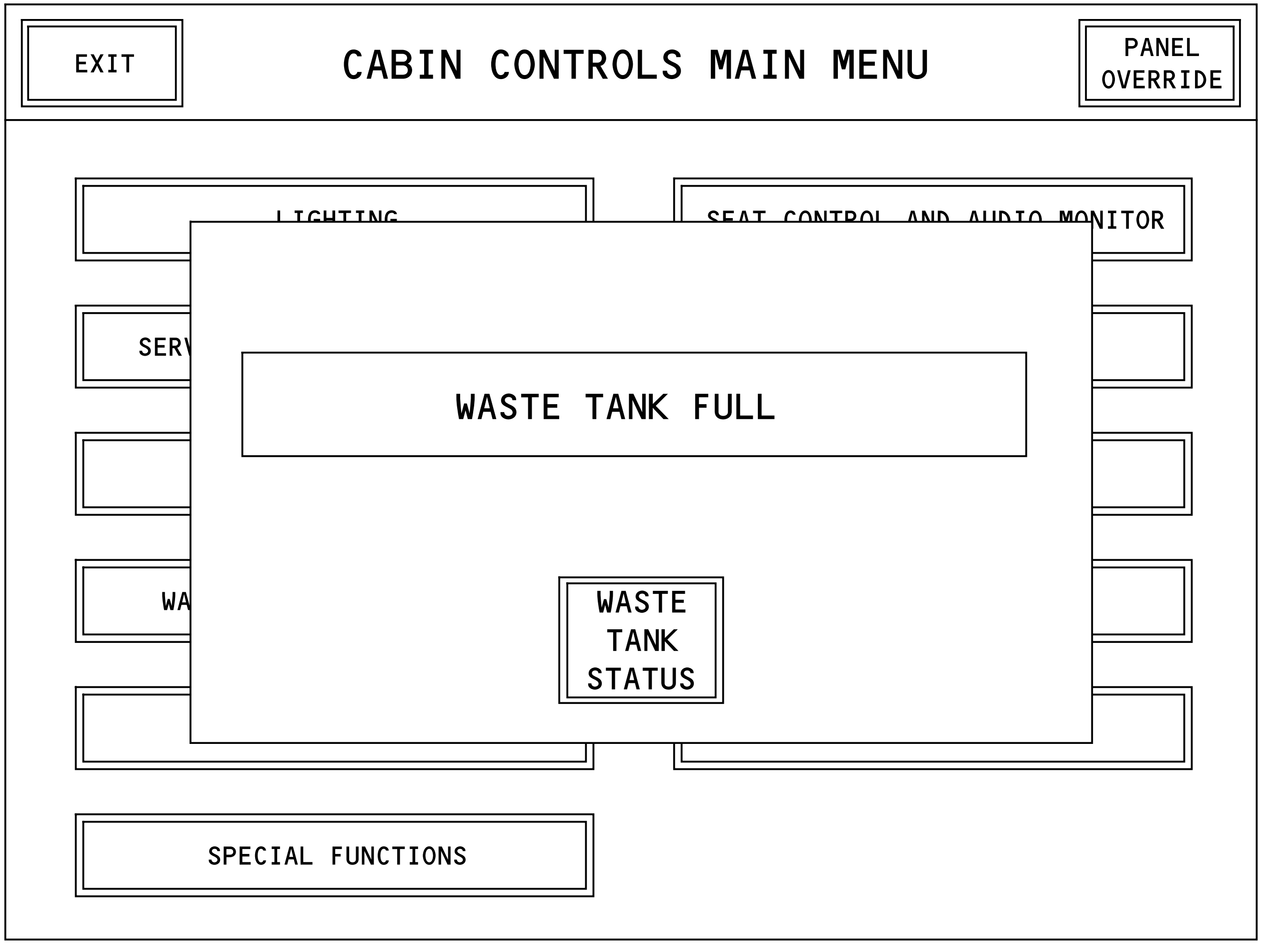
WASTE TANK QUANTITY INDICATION - OPERATION - CSCP/CACP INDICATIONS - 1

WASTE TANK QUANTITY INDICATION - OPERATION - CSCP/CACP INDICATIONS - 2

General

The waste tank full pop-up screen automatically comes on when a waste tank is full.

Touch the WASTE TANK STATUS to exit this screen and go to the waste tank status screen.



38-33-00-007 Rev 1

WASTE TANK QUANTITY INDICATION - OPERATION - CSCP/CACP INDICATIONS - 2

Continental Airlines, Inc

Lights

WB371

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LIGHTS - INTRODUCTION

General

These are the lights systems on the airplane:

- Flight compartment lights
- Passenger compartment lights
- Emergency lights
- Cargo and service compartment lights
- Exterior lights.

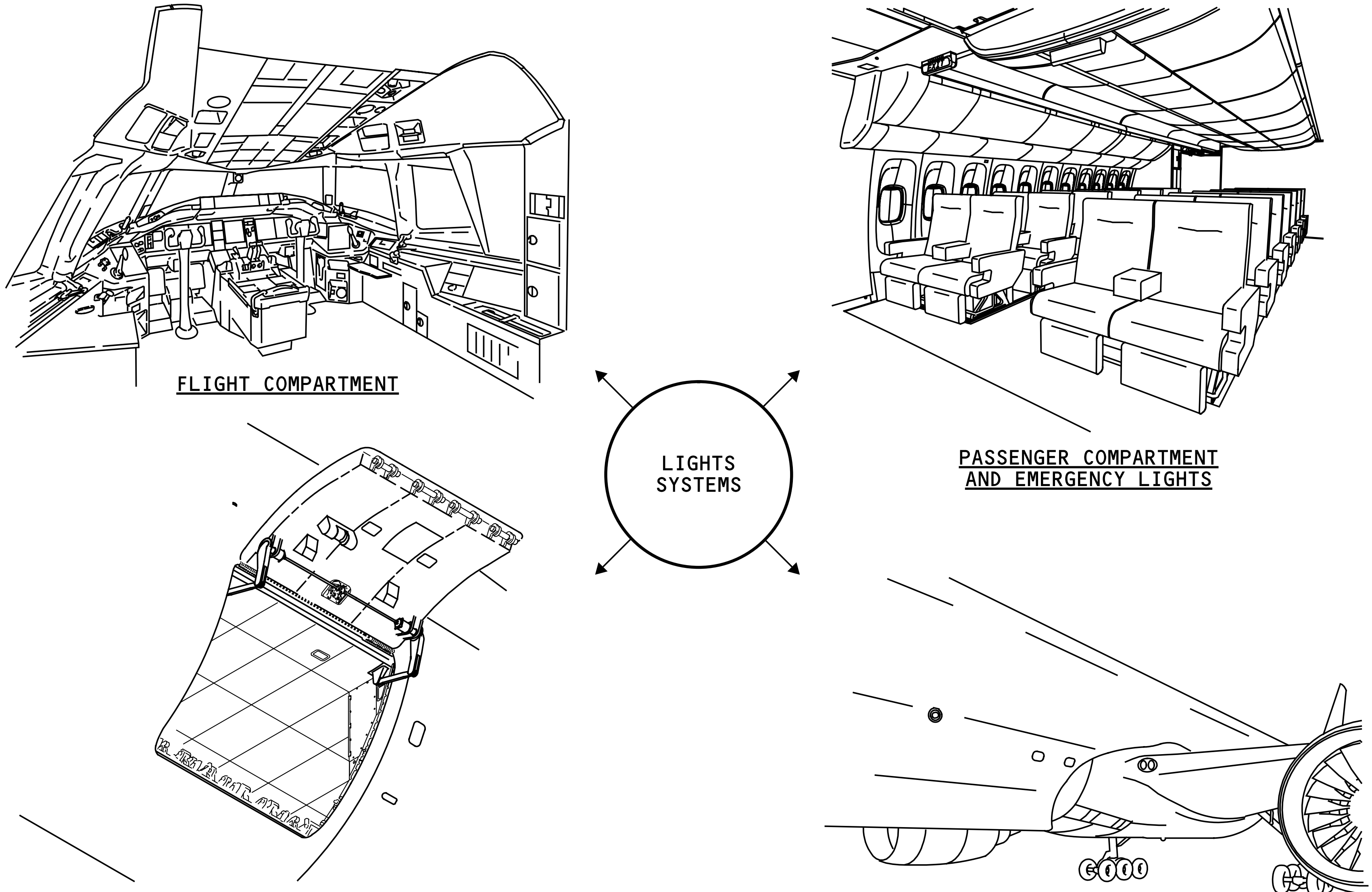
Emergency lights are part of passenger compartment lights.

Abbreviations and Acronyms

ADC	- air data computer
AIMS	- airplane information management system
ARINC	- Aeronautical Radio, Inc.
ASCPC	- air supply and cabin pressure controller
ASP	- attendant switch panel
APU	- auxiliary power unit
brt	- bright
CACP	- cabin area control panel
CB	- circuit breaker
ckt	- circuit
cm	- centimeter
CSS	- cabin services system
CSCP	- cabin system control panel
ctrl	- control
dist	- distribution
dmr	- dimmer
dr	- door
ECS	- environmental control system
ELMS	- electrical load management system
EEU	- ELMS electronics unit
emer	- emergency
ext	- exterior
FCR	- flight crew rest
FSEU	- flap/slat electronic unit
ft	- feet
fwd	- forward
gen	- generator
gnd	- ground
hdlg	- handling
illum	- illumination
inbd	- inboard
inst	- instrument
int	- interior
I/S	- intersystem
kg	- kilograms
L	- left
ldg	- landing
LED	- light emitting diode
LRU	- line replaceable unit
lt	- light
m	- meters
MBC	- master brightness control
MD&T	- master dim and test
MEC	- main equipment center
mgmt	- management

LIGHTS - INTRODUCTION

nav	- navigation
NLG	- nose landing gear
norm	- normal
OEU	- overhead electronics unit
OPAS	- overhead panel ARINC 629 system
ovhd	- overhead
PA/CI	- passenger address/cabin interphone
pax	- passenger
PC	- printed circuit
PCU	- passenger control unit
pnl	- panel
PSEU	- proximity sensor electronic unit
PSU	- passenger service unit
pwr	- power
R	- right
ref	- reference
rly	- relay
SDM	- speaker drive module
sect	- section
stby	- standby
svce	- service
SVU	- seat video unit
sw	- switch
typ	- typical
V	- volts
wht	- white
wng	- wing
xfmr	- transformer
ZMU	- zone management unit



LIGHTS - INTRODUCTION

FLIGHT COMPARTMENT LIGHTS - INTRODUCTION

General

Lights in the flight deck do these tasks:

- Give general light
- Give light to panels
- Supply light for system indications
- Supply specified light for tasks.

The flight compartment lights has these sections:

- Flight compartment illumination
- Integral panel lights
- Flight compartment miscellaneous lights
- Master dim and test.

The flight compartment illumination lights give general light in the flight compartment. These are the lights:

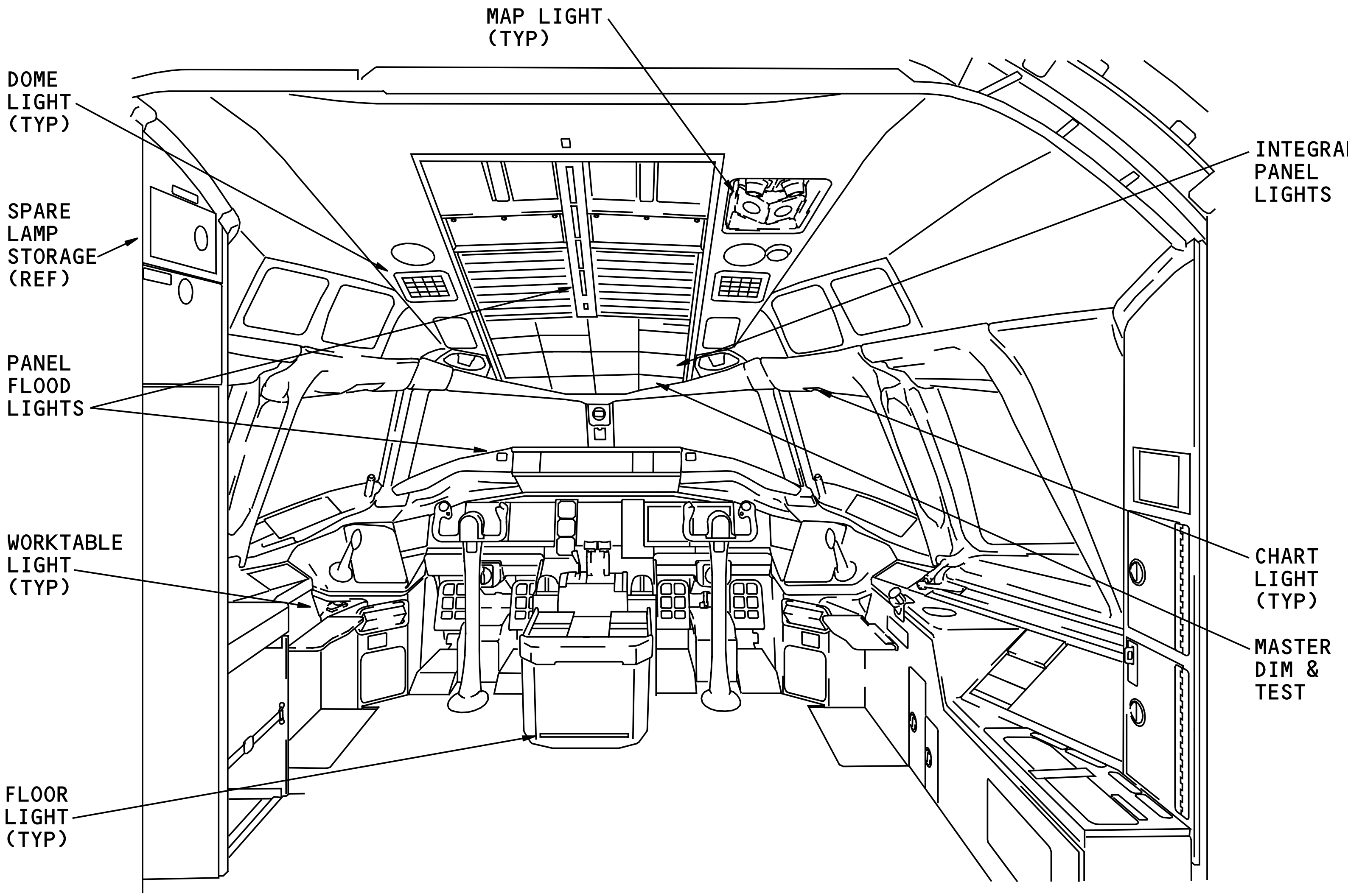
- Map lights
- Dome lights.

The integral panel lights give light to the controls and indications on panels in the flight compartment.

The flight compartment miscellaneous lights give light to work areas, the floor, and panels. These are the lights:

- Chart lights
- Floor lights
- Worktable lights
- Floodlights
- Utility light (not shown).

The master dim and test system controls the amount of light that comes from the system annunciators.

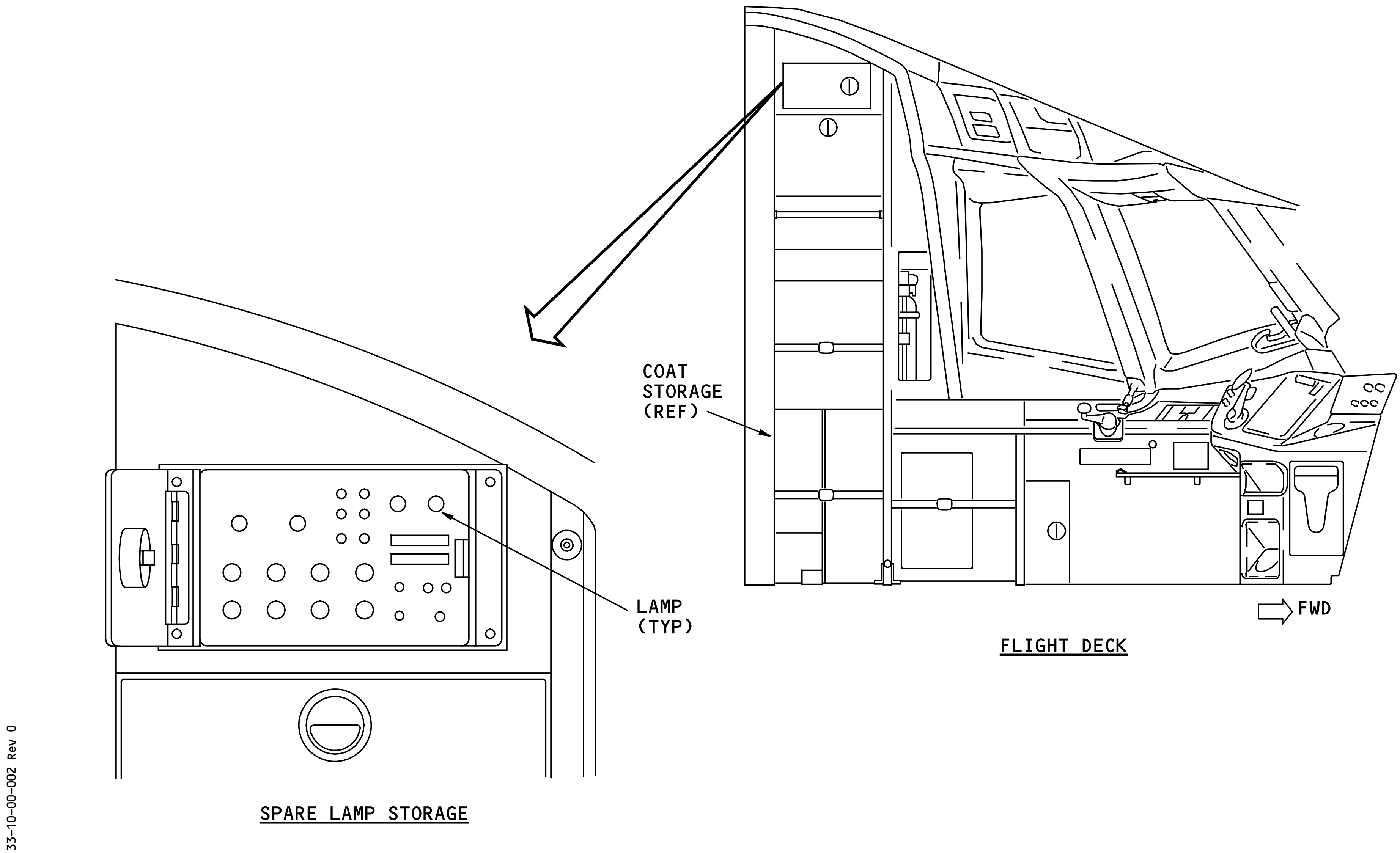


FLIGHT COMPARTMENT LIGHTS - INTRODUCTION

FLIGHT COMPARTMENT LIGHTS - SPARE LAMPS

General

The replacement lamps for the lights in the flight deck are above the coat storage area.



FLIGHT COMPARTMENT LIGHTS - SPARE LAMPS

FLIGHT COMPARTMENT LIGHTS - TRAINING INFORMATION POINTS - P96 OVERHEAD DIMMER PANEL

Purpose

The P96 overhead dimmer panel gives a place to attach dimmer control units, relays and resistors related to the flight compartment lights.

Location

The P96 is in the ceiling, aft of the flight compartment door.

Physical Description

The P96 has relays in the upper left corner, resistors in the upper right corner and dimmer control units (DCU) on the rest of the panel. The relays and resistors are part of the lighting circuits that give floodlighting and dome lighting to the flight deck. Some of the floodlighting circuits (6v ac lights) use the dimmer control units. The overhead panel/instrument lighting circuits for the P5 and P11 panels also use these units.

Relays for these circuits are on the P96 overhead dimmer panel:

- Dome lights dimmer
- Standby (power) - dome and floodlight (4)
- Storm - dome and floodlight (2).

Resistors for these circuits are on the P96 overhead dimmer panel:

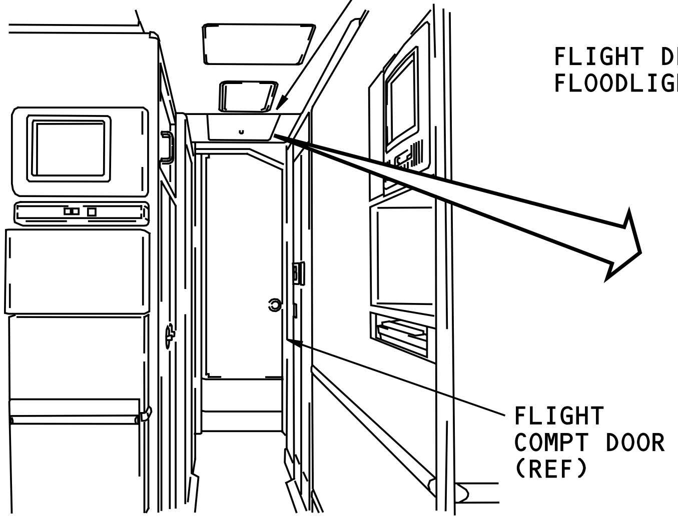
- Standby dome lights
- Captain's panel floodlight (2)
- Glareshield floodlight (2)
- First officer's floodlight (2)
- Aisle stand floodlight.

Dimmer control units for these circuits are on the P96 overhead dimmer panel:

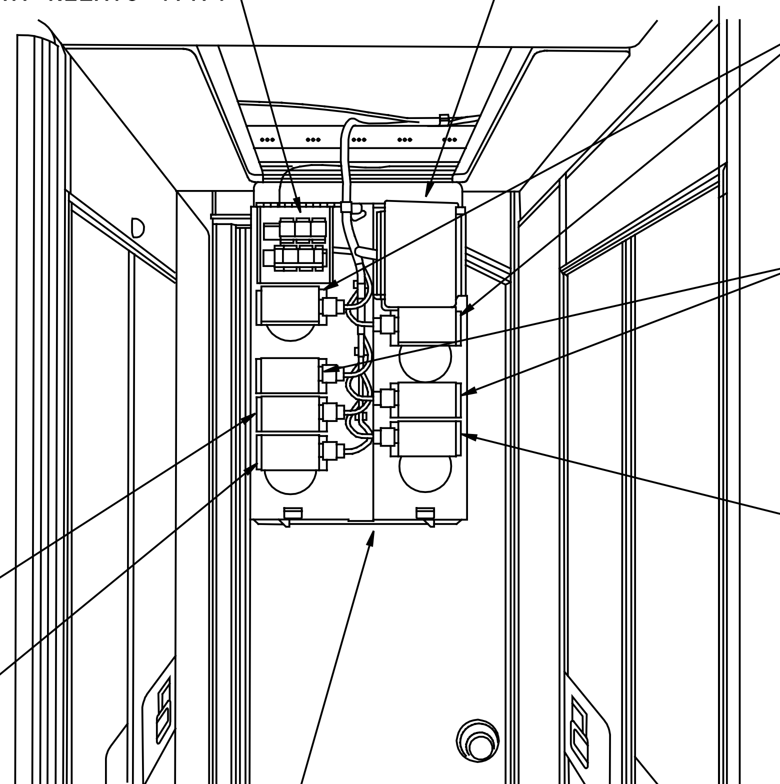
- P11 overhead circuit breaker panel light (2)
- P5 overhead instrument and panel light (2)
- Captain's floodlights
- Glareshield floodlights
- First officer's floodlights.

Dimmer control units step-down 115v ac to 5-6v ac for the lights connected to them.

See the integral panel lights section for more information on dimmer control units (AMM PART I 33-13).



AISLE TO FLIGHT COMPARTMENT
(TYPICAL)



CEILING AREA
AISLE TO FLIGHT COMPARTMENT
(TYPICAL)

33-10-00-003 Rev 2 06/27/95

FLIGHT COMPARTMENT LIGHTS - TRAINING INFORMATION POINTS - P96 OVERHEAD DIMMER PANEL

FLIGHT COMPARTMENT LIGHTS - TRAINING INFORMATION POINTS - FLIGHT COMPARTMENT DIMMERS AND RELAYS

Location

Dimmer control units (DCU) and relays related to these lights attach to the center aisle stand and the main instrument panels:

- Captain's instruments and panel lights
- Glareshield instruments and panel lights
- First officer's instruments and panel lights
- Aisle stand instruments and panel light.

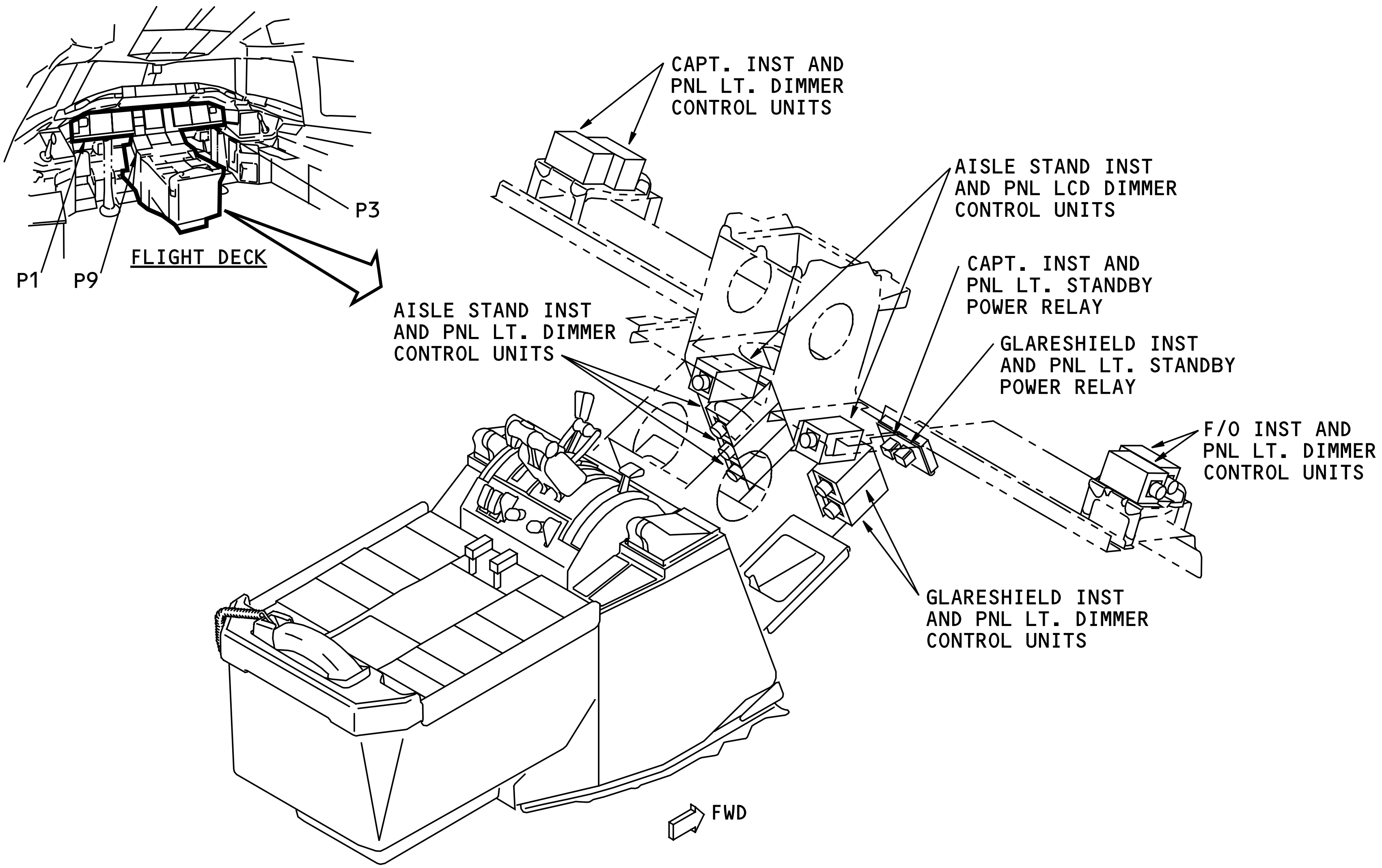
The captain's instrument and panel light DCUs are forward and outboard of the left outboard display unit on the P1. The first officer's instruments and panel light DCUs are forward and outboard of the right outboard display unit on the P3. The other DCUs and relays are forward of the P9 forward aisle stand panel.

Dimmer control units filter and change the 115v ac to 5-6v ac for the lights that connect to them.

Training Information Point

All dimmer control units are the same. All units in the flight compartment connect to the master brightness control (MBC) card (not shown) in the P29 master dim and test card file.

See the integral panel lights section for more information about the dimmer control units (AMM PART I 33-13).



CENTER AISLE STAND AND MAIN INSTRUMENT PANEL AREA

33-10-00-004 Rev 2 06/23/95

FLIGHT COMPARTMENT LIGHTS - TRAINING INFORMATION POINTS - FLIGHT COMPARTMENT DIMMERS AND RELAYS

FLIGHT COMPARTMENT ILLUMINATION - DOME LIGHTS - INTRODUCTION

Location

There are two dome lights, one is above the captain's seat and the other is above the first officer's seat.

Physical Description

Each light has these components:

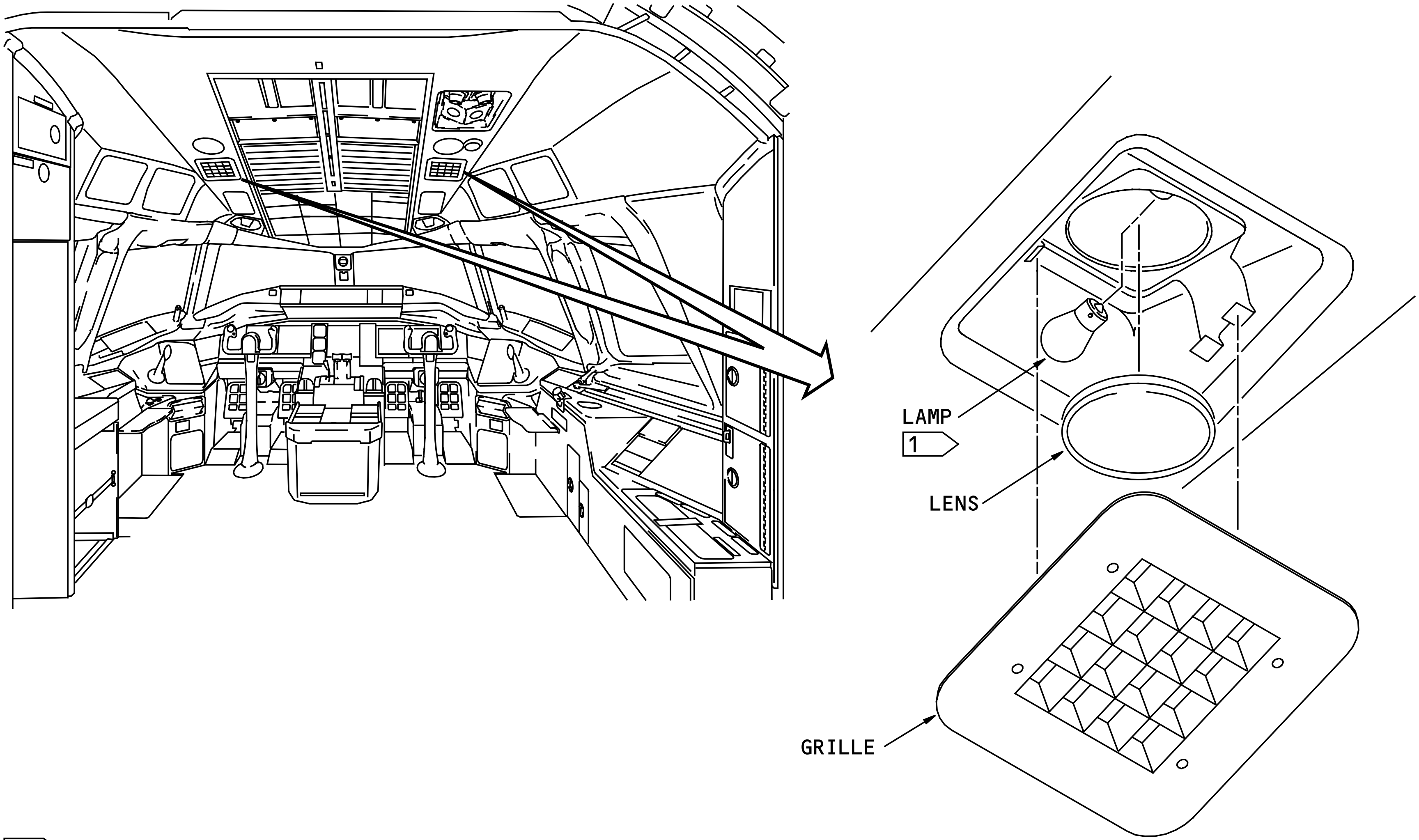
- Lamp
- Lens
- Grille.

The captain's dome light has two lamps. One is the normal lamp and the other is the lamp for the emergency light system.

See the emergency lights section for more information about the emergency lights (AMM PART I 33-50).

Training Information Point

To get access to the lamp you pull down on the grate and remove the lens. The lens has a bayonet-style mount. The lamp is a bayonet-style lamp.



DOME LIGHT

1 THE CAPTAIN'S DOME LIGHT HAS TWO LAMPS. ONE IS THE NORMAL LIGHT AND THE OTHER IS THE LAMP FOR THE EMERGENCY LIGHTS SYSTEM.

33-11-00-002 Rev 3 07/14/1997

FLIGHT COMPARTMENT ILLUMINATION - DOME LIGHTS - INTRODUCTION

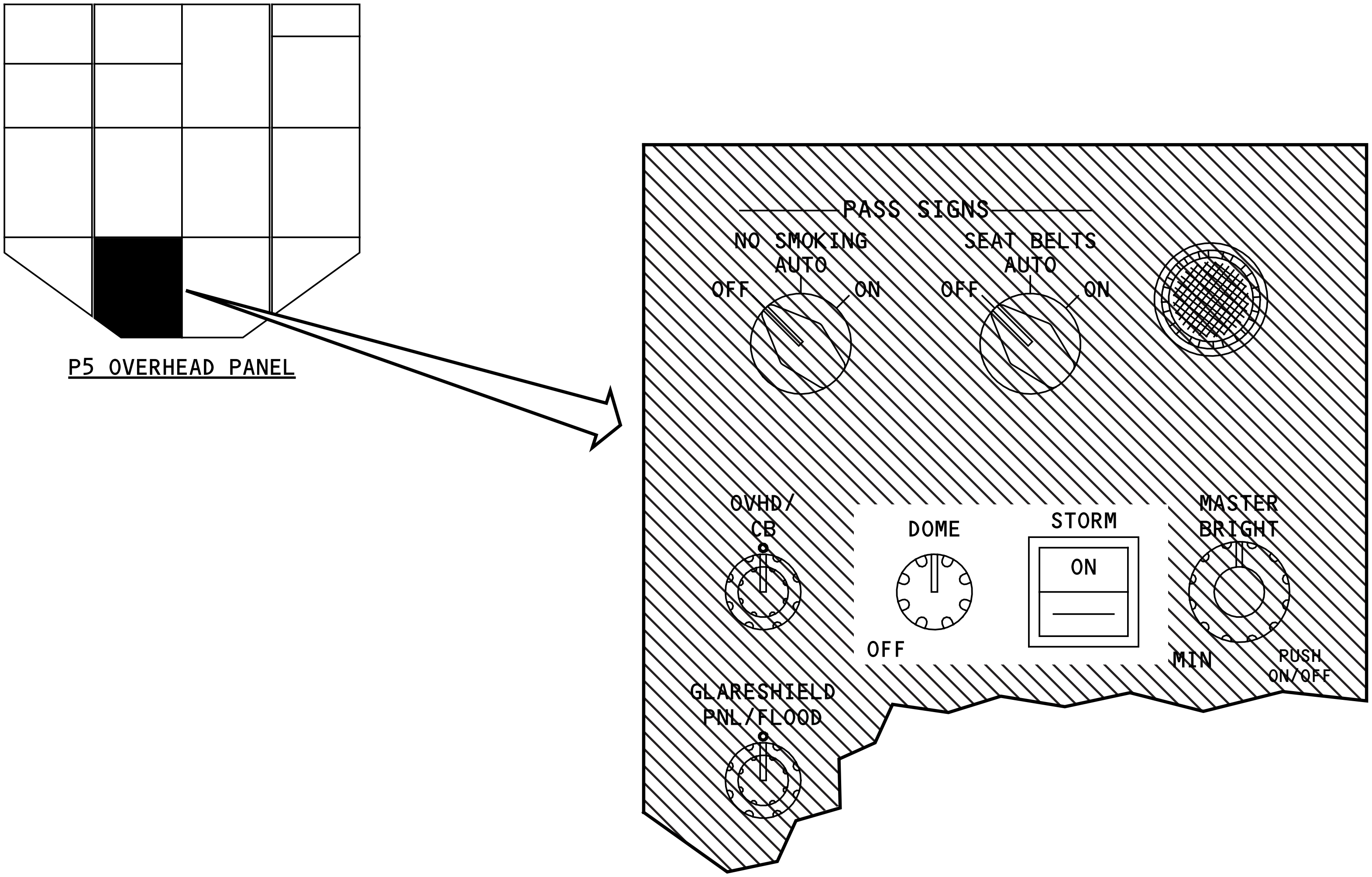
FLIGHT COMPARTMENT ILLUMINATION - DOME LIGHTS - OPERATION

Operation

You use the dome light control (DOME) to operate the dome lights. The control is on the passenger signs/ lighting panel on the P5 overhead panel. The control is a rotary-type control that controls the intensity of the lights.

You use the storm light switch (STORM) to make the dome and floodlights come on fully bright. It will also make the lights in the master dim and test system operate at the fully bright level.

See the master dim and test section for more information about the master dim and test system (AMM PART I 33-16).



PASSENGER SIGNS/LIGHTING PANEL

33-11-00-003 Rev 3 08/08/96

FLIGHT COMPARTMENT ILLUMINATION - DOME LIGHTS - OPERATION

FLIGHT COMPARTMENT ILLUMINATION - DOME LIGHTS - FUNCTIONAL DESCRIPTION

General

The dome lights have four modes of operation:

- Normal
- Backup
- Standby
- Storm.

In the normal and backup modes the amount of light that comes from the light is adjustable. In the standby mode the amount of light is not adjustable. In the storm mode the lights come on fully bright.

Normal Mode

When the ground service bus has power, the dome lights dimmer relay energizes. This supplies power to the dimmer on the passenger signs/lighting panel on the P5. It also energizes the standby lights relay.

When the standby lights relay is energized and the control is not in the OFF position, power from the ground service bus goes to the lights and makes them come on. When you adjust the control it adjusts the variable transformer in the dimmer. This adjusts the amount of light that comes from the dome lights.

Backup Mode

If the ground service bus does not have power and the right transfer bus has power, the dome lights operate in the backup mode. In the backup mode the dome lights operate the same as in the normal mode. The only difference is that the right transfer bus supplies power to the dome lights dimmer and the standby lights relay. The dome lights dimmer relay is de-energized to the backup position.

Standby Mode

If the ground service bus and the right transfer bus do not have power, the standby lights relay is de-energized to the standby position. Power from the standby power system goes to the captains flight instrument bus. It then goes through the standby dome lights resistor to decrease the voltage. The dome lights come on, but they are not at the fully bright level.

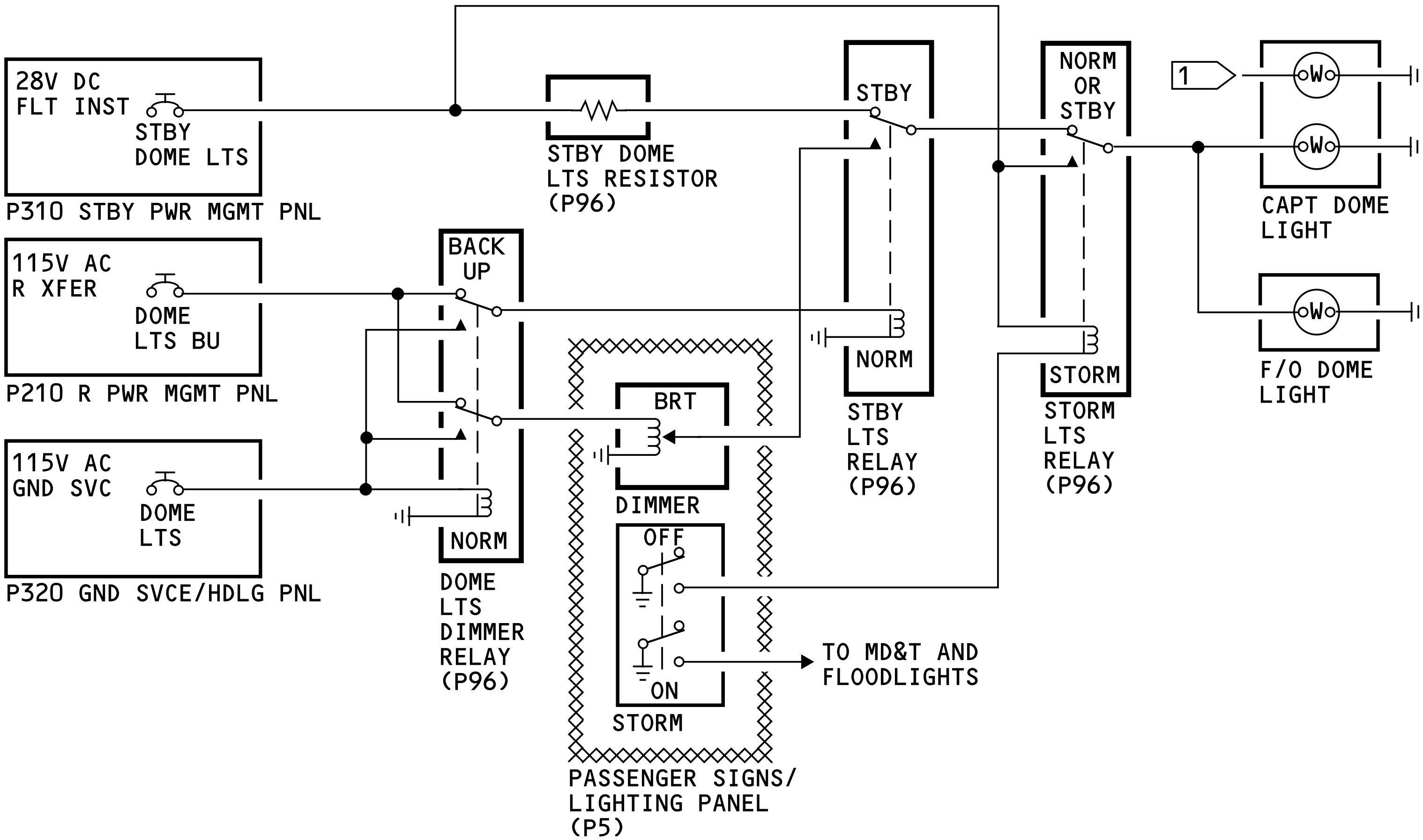
Storm Mode

When you push the storm light switch (STORM), the storm lights relay energizes. It energizes in every mode of operation because its power comes from the standby power system. When the relay energizes, 28v dc goes to the lights and they come on fully bright.

Training Information Point

The emergency lighting system turns on the second captain's dome light.

See the emergency lighting section for more information (AMM PART I 33-50).



1 POWER COMES FROM EMERGENCY LIGHTING SYSTEM.

33-11-00-004 Rev 3 04/10/1997

FLIGHT COMPARTMENT ILLUMINATION - DOME LIGHTS - FUNCTIONAL DESCRIPTION

FLIGHT COMPARTMENT ILLUMINATION - FLOODLIGHTS - INTRODUCTION

Purpose

The floodlights give light to these panels:

- P1 left forward panel
- P2 center forward panel
- P3 right forward panel
- P8 aft aisle stand panel
- P9 forward aisle stand panel
- P55 glareshield center panel.

Location

The floodlights for the P1, P2, and P3 panels are above the panels. The floodlight for the P8 and P9 panels is above the aisle stand in the P5 panel. The floodlights for the P55 are above the P55 panel.

Physical Description

There are two different kinds of floodlights, strip and spot. The strip flood lights have several incandescent lights attached to a lens. Each spot floodlights is an incandescent bulb.

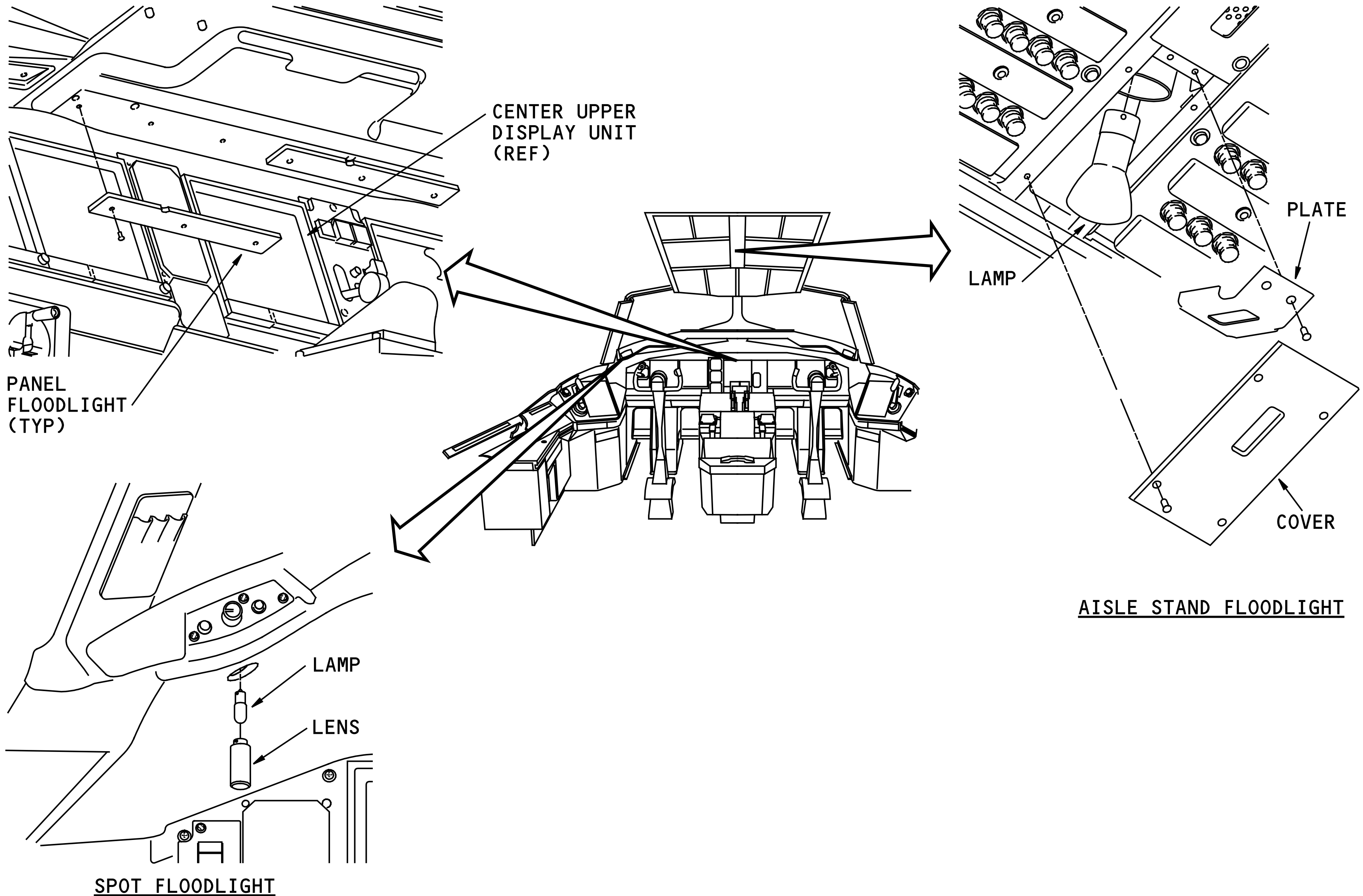
Training Information Point

The strip floodlights are above the P1, P2, P3, and P55 panels. The spot floodlights are above the P1, P3, and P8 and P9 panels.

When there is not sufficient light that comes from the strip floodlights, you replace the assembly. You remove two screws to release the assembly.

You remove the lens on the spot floodlights above the P1 and P3 panel to get access to the lamp. The lens and the lamp are bayonet-type.

You remove two plates to get access to the lamp that gives light to the aisle stand. The lamp is a bayonet-type.



33-11-00-005 Rev 1 07/14/1997

FLIGHT COMPARTMENT ILLUMINATION - FLOODLIGHTS - INTRODUCTION

FLIGHT COMPARTMENT ILLUMINATION - FLOODLIGHTS - OPERATION

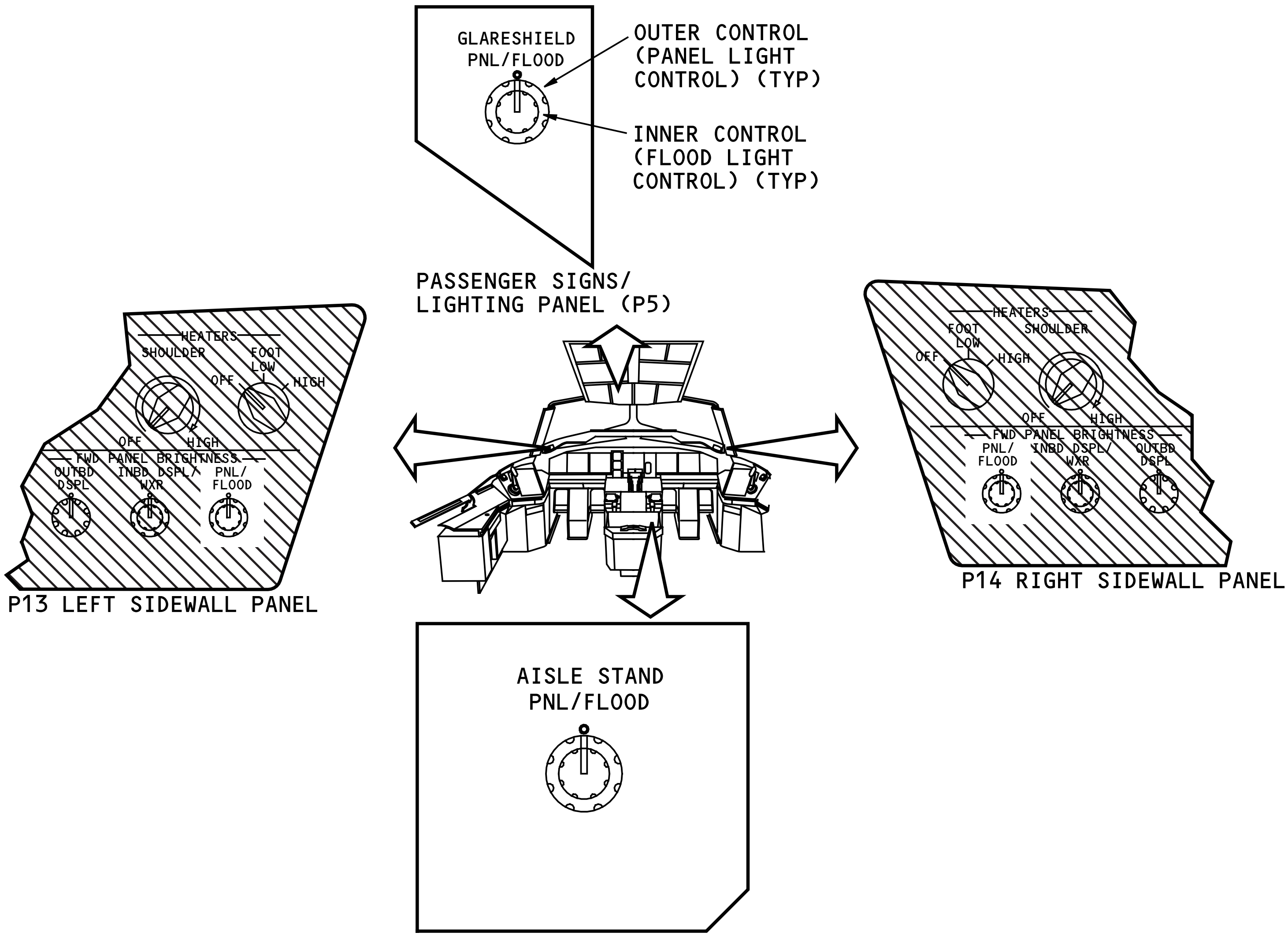
Operation

You use the inner control of the GLARESHIELD PNL/FLOOD light control to adjust the amount of light that comes from the two strip floodlights above the P55 panel. The control is on the passenger signs/lighting panel on the P5 overhead panel.

You use the inner control of the FWD PANEL BRIGHTNESS PNL/FLOOD light control to adjust the amount of light that comes from the captain's spot floodlight and the two strip flood lights above the P1 and P2 panels. The control is on the P13 left sidewall panel.

You use the inner control of the FWD PANEL BRIGHTNESS PNL/FLOOD light control to adjust the amount of light that comes from the first officer's spot floodlight and the two strip flood lights above the P2 and P3 panels. The control is on the P14 right sidewall panel.

You use the inner control of the AISLE STAND PNL/FLOOD light control to adjust the amount of light that comes from the aisle stand spot floodlight. The control is on the aisle stand brightness control panel on the P8 aft aisle stand panel.



FLIGHT COMPARTMENT ILLUMINATION - FLOODLIGHTS - OPERATION

FLIGHT COMPARTMENT ILLUMINATION - FLOODLIGHTS - FUNCTIONAL DESCRIPTION

General

The floodlights have these three modes of operation:

- Normal
- Standby
- Storm.

In the normal mode, the amount of light that comes from the floodlights is adjustable. In the standby mode, the amount of light is not adjustable. In the storm mode, the lights come on fully bright.

Normal Mode

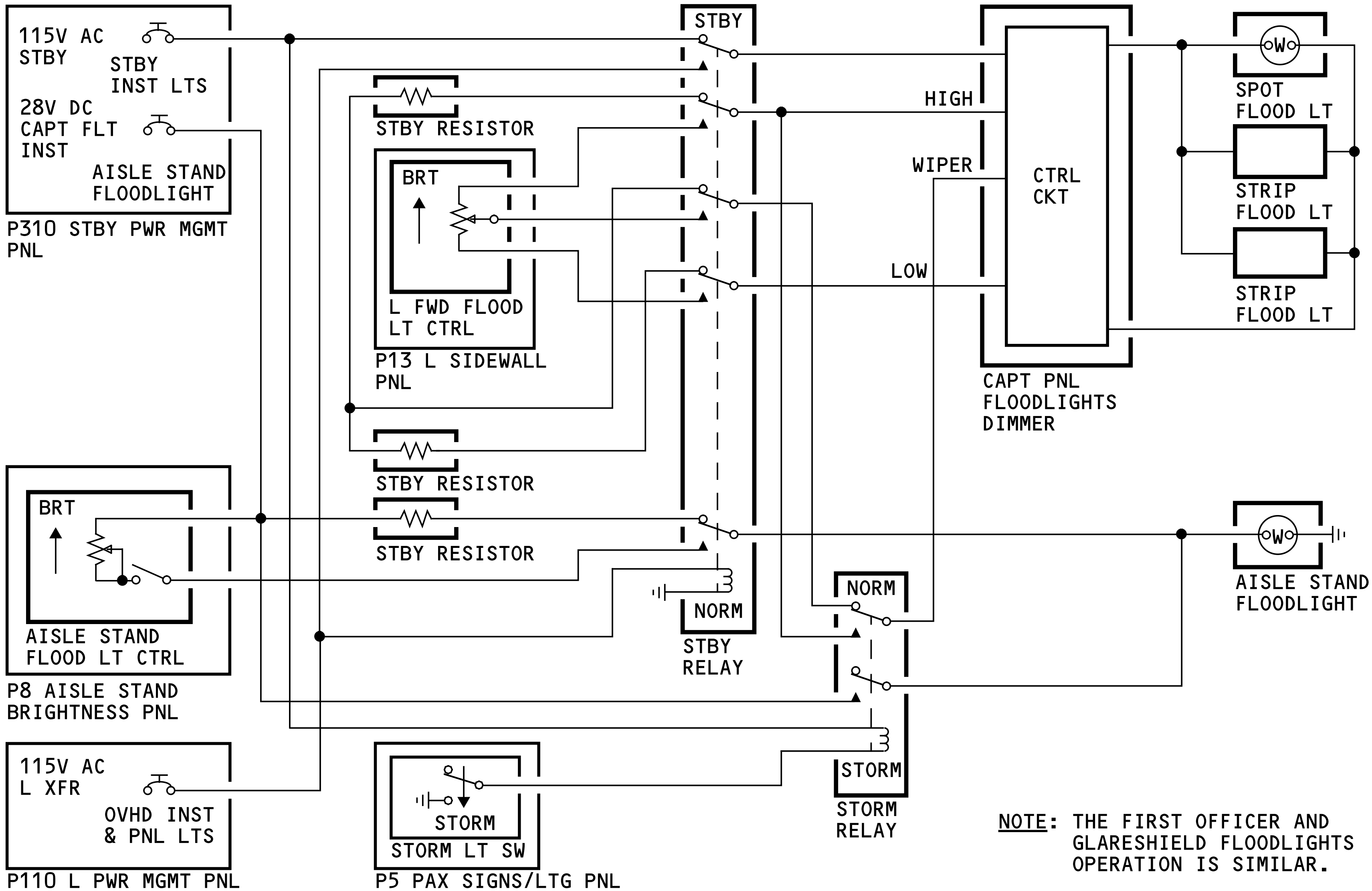
When the left transfer bus has power, the standby relay energizes to the normal position. This connects the floodlight dimmer with the floodlight control. When you rotate the control on the P13 left sidewall panel, it adjusts the position of the wiper. This adjusts the amount of light that comes from the captains floodlights. When you turn the control on the P8 aisle stand brightness panel, it adjusts the position of a wiper. This adjusts the amount of light that comes from the aisle stand floodlight.

Standby Mode

When the left transfer bus does not have power, the standby relay goes to the standby position. When the captain's flight instruments have power from the standby power system, the lights operate. In this mode, input to the control circuit comes from resistors. For the aisle stand floodlight, the voltage for the light must go through a resistor. The amount of light that comes from the floodlights is not as bright as it is in the fully bright position.

Storm

When you push the storm light switch on the P5 passenger signs/lighting panel, the storm relay energizes. The signal goes to the control circuit in the dimmer to make the lights come on full bright.



NOTE: THE FIRST OFFICER AND GLARESHIELD FLOODLIGHTS OPERATION IS SIMILAR.

FLIGHT COMPARTMENT ILLUMINATION - FLOODLIGHTS - FUNCTIONAL DESCRIPTION

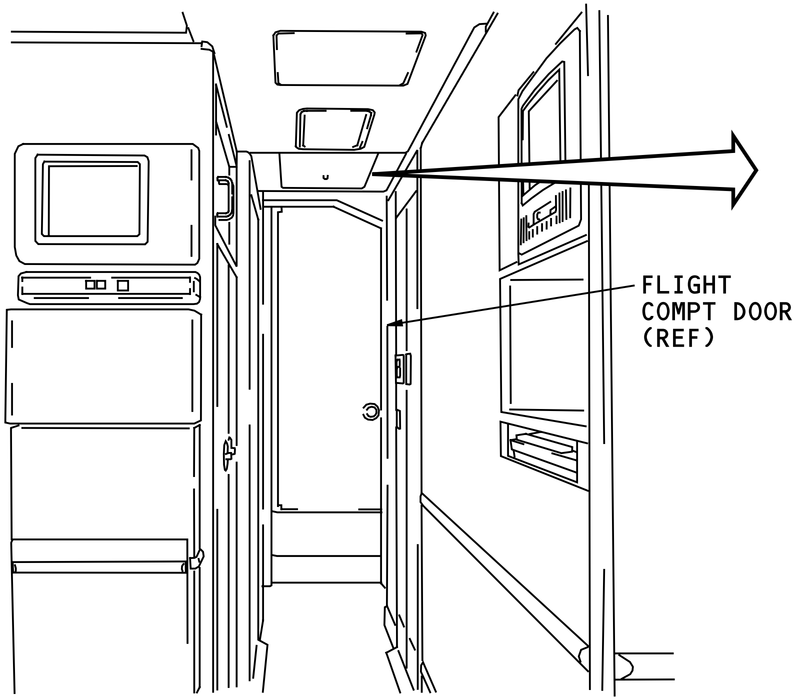
FLIGHT COMPARTMENT ILLUMINATION - TRAINING INFORMATION POINTS - RELAY LOCATIONS

Location

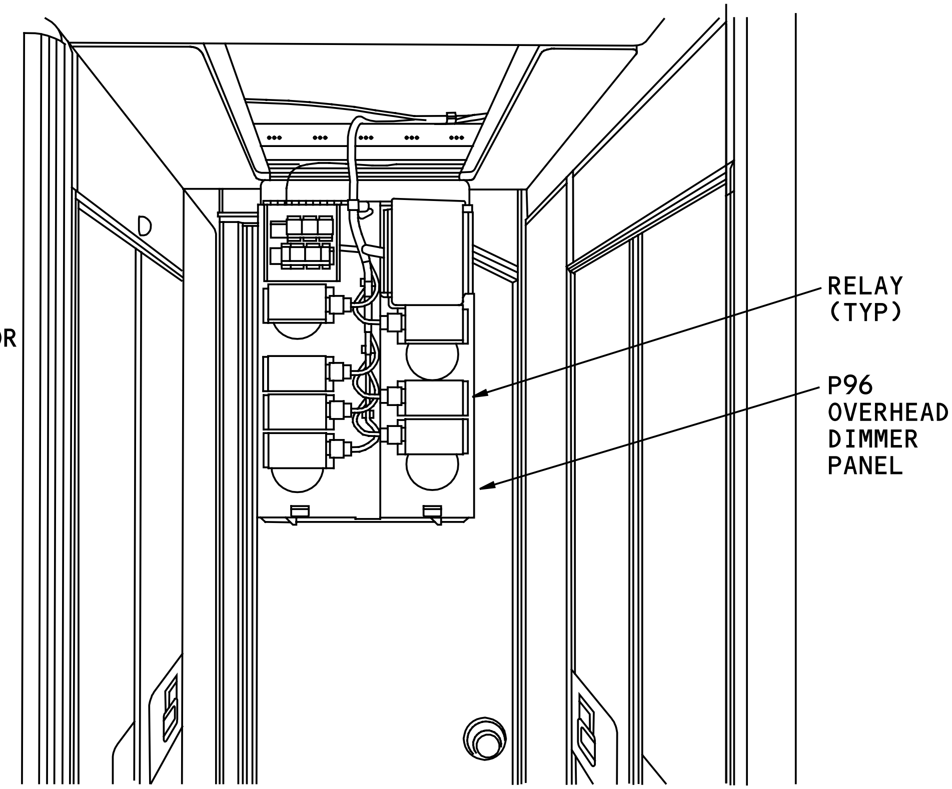
These relays are on the P96 overhead dimmer panel:

- Dome lights dimmer
- Standby lights
- Storm lights
- Captain's panel floodlights
- First officer's panel floodlights
- Glareshield floodlights.

The P96 panel is in the ceiling, aft of the flight compartment door.



AISLE TO FLIGHT COMPARTMENT



P96 PANEL (LOWERED)

33-11-00-008 Rev 0

FLIGHT COMPARTMENT ILLUMINATION - TRAINING INFORMATION POINTS - RELAY LOCATIONS

INTEGRAL PANEL LIGHTS - ANNUNCIATOR LIGHTS

Purpose

The annunciator lights give the flight or maintenance crew status, caution, or warning information about an airplane system.

Location

The annunciator lights are on the P5 overhead panel and the P8 aft aisle stand panel.

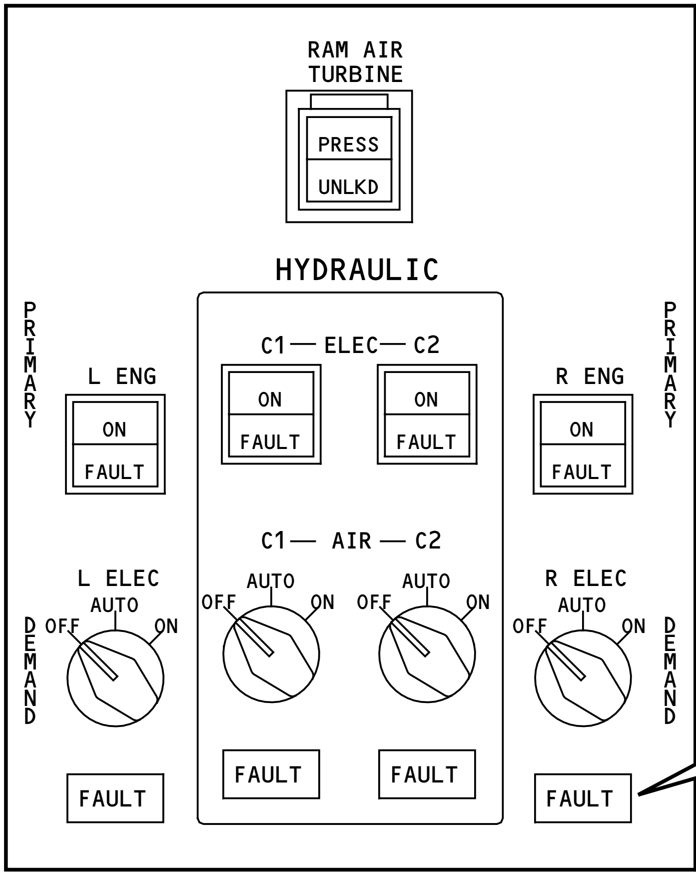
Physical Description

The annunciator lights use light emitting diodes (LEDs). Each light has these components:

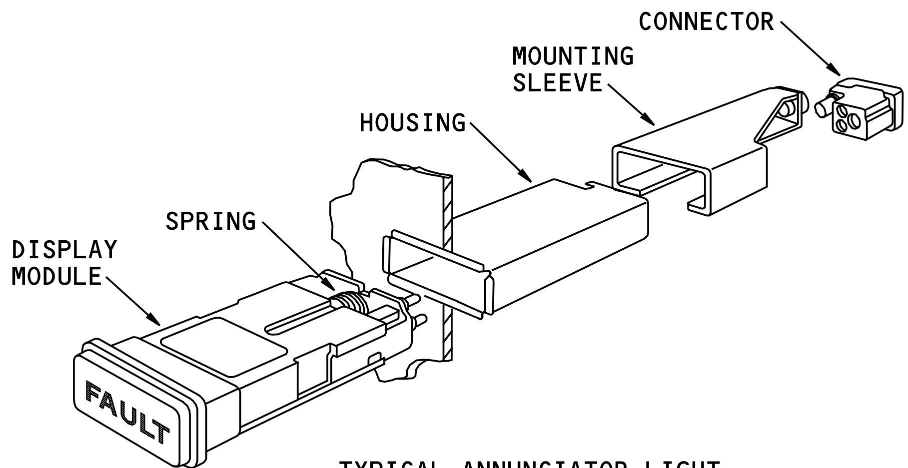
- Display module
- Mounting sleeve
- Connector
- Housing
- Spring.

Training Information Point

To remove a display module you push on the surface of the display module to compress the spring. This will release the module. Pull the module straight out to remove it. Make sure you apply equal pressure on the surface of the display module when you push it.



TYPICAL PANEL



TYPICAL ANNUNCIATOR LIGHT

33-13-00-003 Rev 0

INTEGRAL PANEL LIGHTS - ANNUNCIATOR LIGHTS

INTEGRAL PANEL LIGHTS - LIGHTED PUSH-BUTTON SWITCHES

Purpose

Lighted push-button switches give control inputs to their associated systems. They can also give information on system status.

Location

There lighted push-button switches on the P5 overhead and P9 forward aisle stand panel.

Physical Description

There are two kinds of push-button switches: momentary action and alternate action.

The lighted push-button switches have these components:

- Switch guard (not all switches) (not shown)
- Cap module
- Switch module
- Housing.

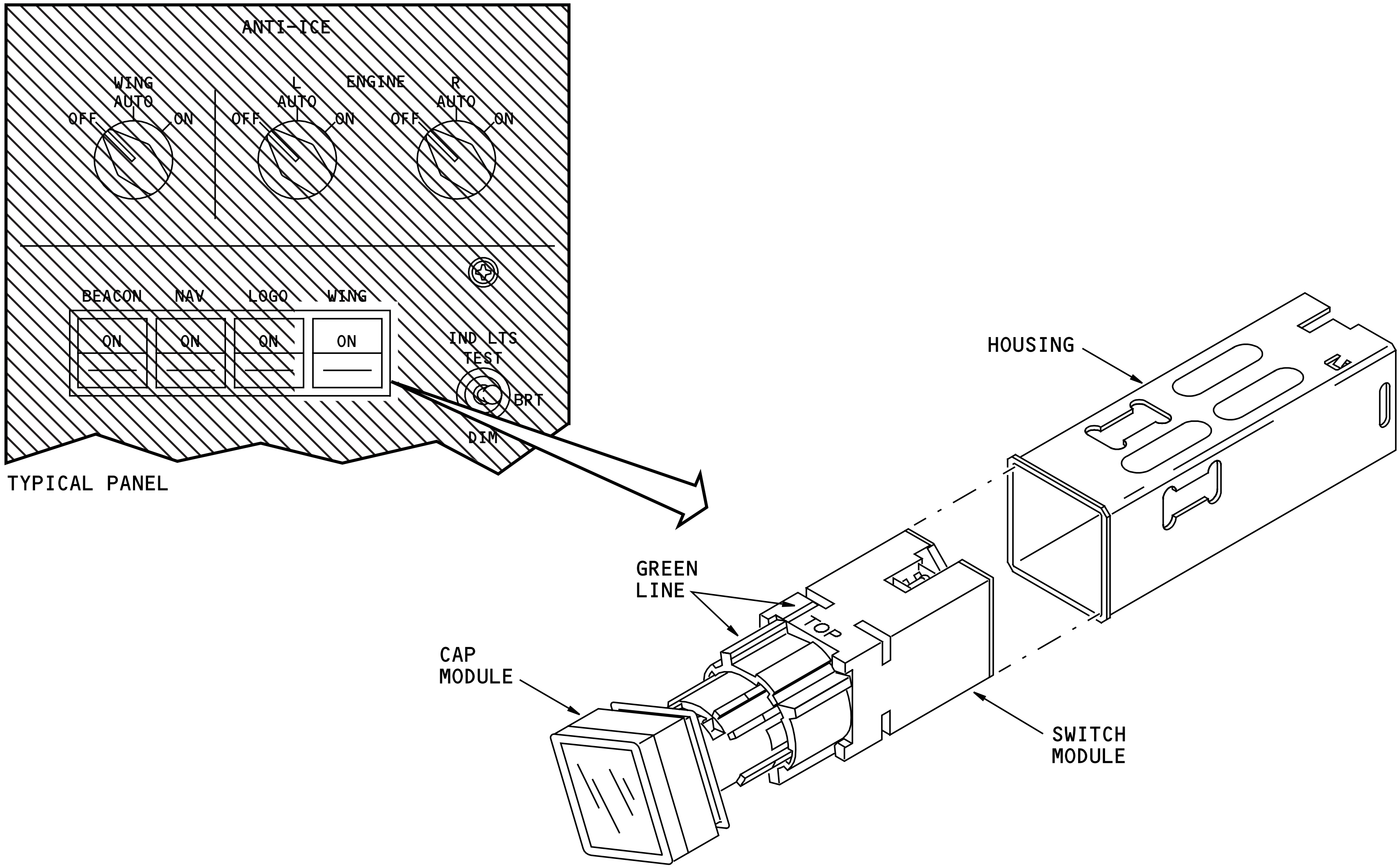
Training Information Point

To remove the lighted push-button switch, pull the cap module and turn the cap module counterclockwise and pull again. This will release the switch module from the panel.

To install the switch make sure the green lines on the top of the switch align before you install the switch.

Once this is done, insert the switch into the panel and turn the cap module clockwise.

See integral panel lights in AMM Part II for more information about switch removal and installation.



TYPICAL LIGHTED PUSH-BUTTON SWITCH

INTEGRAL PANEL LIGHTS - LIGHTED PUSH-BUTTON SWITCHES

INTEGRAL PANEL LIGHTS - OPERATION

General

These are the controls for the integral panel lights:

- Outer control of the OVHD/CB light control on the passenger signs/lighting panel for the P5 overhead panel
- Inner control of the OVHD/CB light control on the passenger signs/lighting panel for the P11 circuit breaker panel
- Outer control of the GLARESHIELD PNL/FLOOD light control on the passenger signs/lighting panel for the P7 glareshield panel
- MASTER BRIGHT control on the passenger signs/ lighting panel
- MASTER BRIGHT switch on the passenger signs/ lighting panel
- Outer control of the FWD PANEL BRIGHTNESS PNL/ FLOOD light control on the P14 right sidewall panel for the P3 right forward panel
- Outer control of the FWD PANEL BRIGHTNESS PNL/ FLOOD light control on the P13 left sidewall panel for the P1 left forward and P2 center forward panels
- Outer control of the AISLE STAND PNL/FLOOD light control on the aisle stand brightness panel for the P8 aft aisle stand panel.

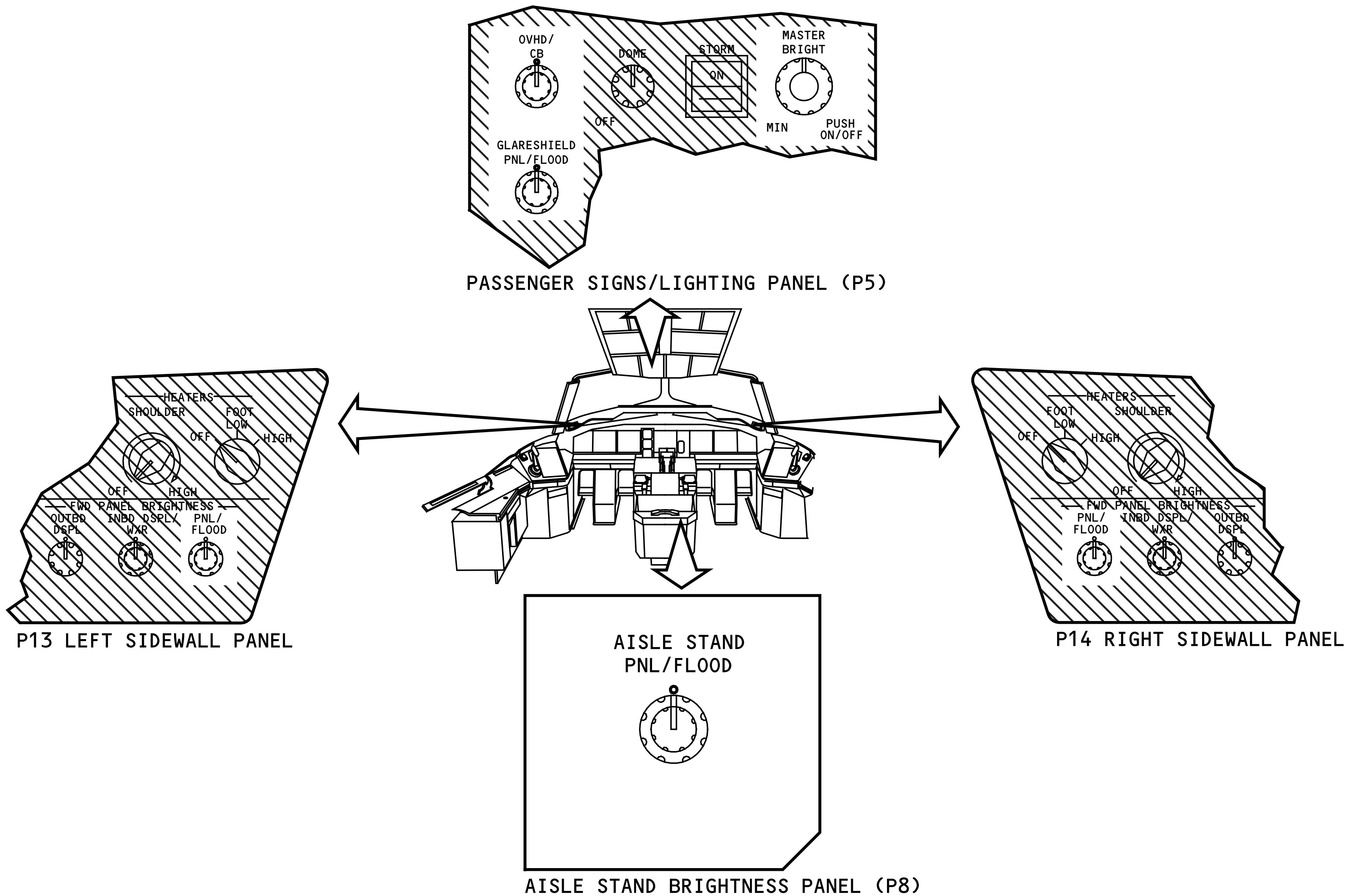
Operation

You use the controls to adjust the amount of light that comes from the integral panel lights. When the MASTER BRIGHT switch is in the OFF position, you can adjust the lights from fully dim to fully bright.

Master Brightness

With the MASTER BRIGHT switch in the ON position, you set the lighting level for all of the integral panel lights at the same time. You turn the MASTER BRIGHT control to adjust the amount of light that comes from the integral panel lights.

When the MASTER BRIGHT switch is in the ON position, you can use any panel control to adjust the amount of light for the related panel. The range of adjustment is ±20 percent.



INTEGRAL PANEL LIGHTS - OPERATION

33-13-00-005 Rev 3 08/08/96

INTEGRAL PANEL LIGHTS - DIMMER CONTROL UNITS

Purpose

The dimmer control units (DCUs) filter and control the voltage that goes to integral panel lights (lighted instruments and lightplate panels) and some floodlights in the flight deck. The units control the voltage based on inputs from controls in the flight deck.

Location

The DCUs are on the P96 overhead dimmer panel and in the flight deck. There are seven units on the P96. There are eleven units in the flight deck at these locations:

- P1 area: two units forward and outboard of the left outboard display unit (not shown)
- P3 area: two units forward and outboard of the right outboard display unit (not shown)
- P9 area: seven units, four on the left and three on the right, are forward and below left and right control display units (not shown).

See the flight compartment section for more information about the dimmer control units and their related light circuits (AMM PART I 33-10).

Physical Description

The DCUs are LRUs. Each DCU has these parts:

- Electrical connector
- Control card (internal)
- EMI filter (internal)
- Power transformer (internal).

The DCUs are static sensitive.

Functional Description and Interfaces

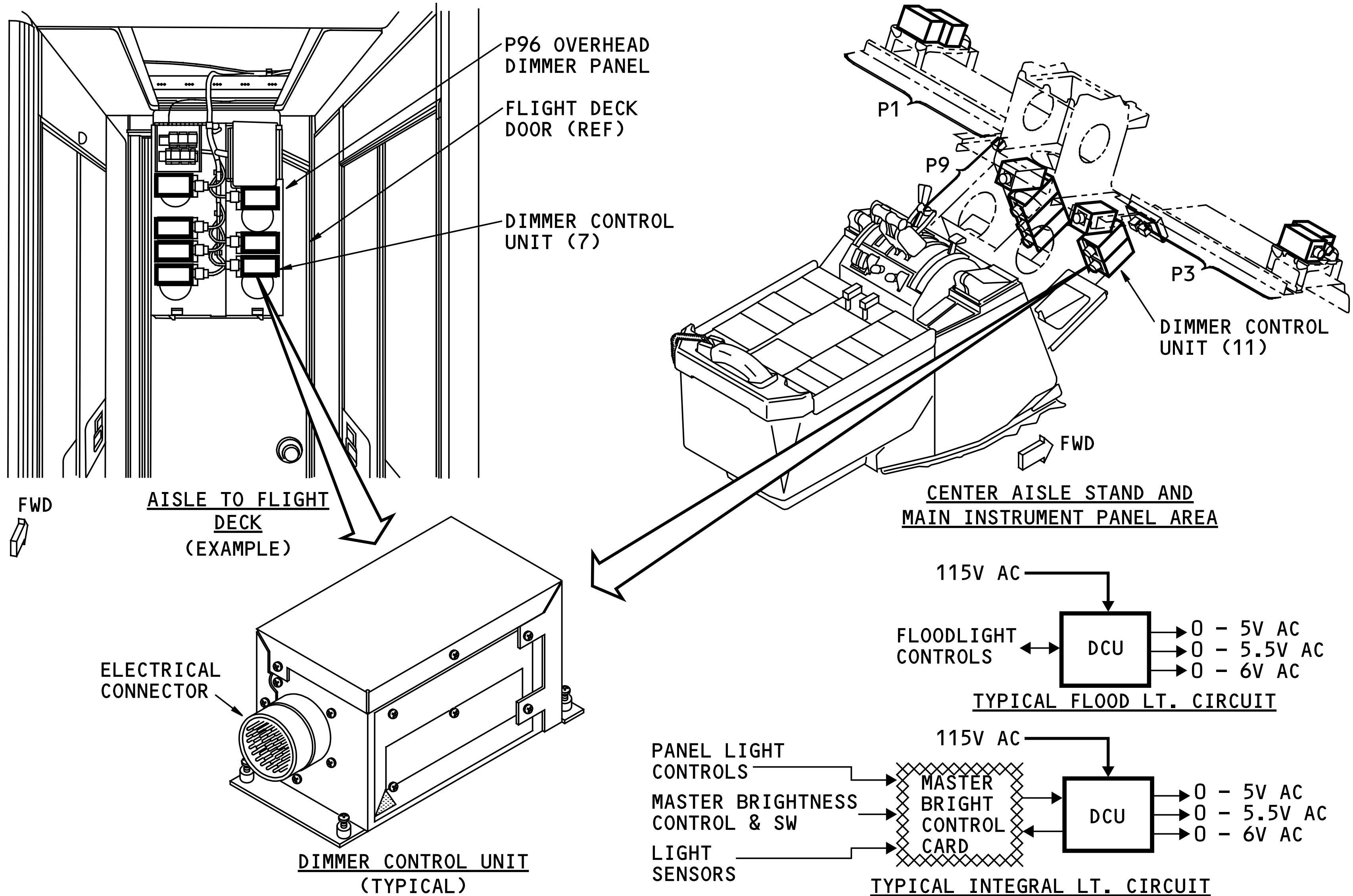
The DCUs use 115v ac for control and operation. The control card, EMI filter, and power transformer operate together to give any one of these outputs:

- 0 to 5v ac
- 0 to 5.5v ac
- 0 to 6v ac.

The DCUs in the flood light circuits monitor floodlight controls for operator input. Based on the operator input, the DCU adjusts output voltage to the floodlights.

The DCUs in the integral panel light circuits connect to the master brightness control (MBC) card. The card tells the DCUs the intensity for the lights based on operator inputs (panel light and master brightness controls). The card also monitors light sensors and can cause the DCUs related to the aisle stand LCDs to adjust for increased brightness inside or outside of the flight deck.

See the flight compartment illumination section for more information about the operation of the dimmer control units in the floodlight circuits (AMM PART I 33-11).



INTEGRAL PANEL LIGHTS - DIMMER CONTROL UNITS

33-13-00-009 Rev 1 06/23/95

INTEGRAL PANEL LIGHTS - FUNCTIONAL DESCRIPTION - MANUAL ADJUSTMENTS

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INTEGRAL PANEL LIGHTS - FUNCTIONAL DESCRIPTION - MANUAL ADJUSTMENTS

General

The light intensity for the integral panel lights is adjustable manually from the master bright control (MBC) and the individual panel light controls. You can adjust the light intensity from both controls if the master bright switch (MBS) is in the ON position.

When the master bright switch is ON, the master bright control has full control of the intensity of all the integral panel lights. The individual panel light controls let you bias the light intensity up or down by 20 percent.

When the MBS is off, the individual panel light controls have full control of the panel lights.

You can manually adjust these integral panel lights:

- P1
- P2
- P3
- P5
- P7
- P8
- P9
- P10
- P11
- P13
- P14
- P15
- P16
- P55.

Power Supply

The master brightness control (MBC) card gets 28v dc from the left main bus.

The dimmer control units for the captain's integral panel lights get power from these sources:

- 115v ac left transfer bus: usual power source
- 115v ac standby bus: backup power source.

The dimmer control units for other integral panel lights (not shown) get power from these sources:

- 115v ac left transfer bus: overhead panel
- 115v ac right transfer bus: glareshield, F/O and observer panels
- 115v ac left main bus, section 1: overhead circuit breaker panel.

The dimmer control units decrease the 115v ac to these values:

- 0 to 5v ac
- 0 to 5.5v ac
- 0 to 6v ac.

The dimmer control units supply power to the integral panel lights. The amount of power the dimmer control units supplies to the integral panel lights usually comes from operator input through the master bright control card. Some integral panel light circuits also

INTEGRAL PANEL LIGHTS - FUNCTIONAL DESCRIPTION - MANUAL ADJUSTMENTS

get inputs from light sensors through the master bright control card.

See the automatic adjustments training information points section for more information about the light sensors.

Manual Brightness Inputs

When the MBS is ON, the MBC adjusts the integral panel lights from full bright to full dim. The individual panel light controls can adjust the light brightness up or down 20 percent from the level set by the MBC.

The master bright control card has a master bright control blend function. The master bright control blend function mixes the inputs from the MBC and the individual panel light control. This is the function that lets you bias the panel lights by 20 percent. The master bright control blend function then sends a single output to the respective dimmer control unit. The dimmer control units then adjust the light intensity of the respective integral panel light.

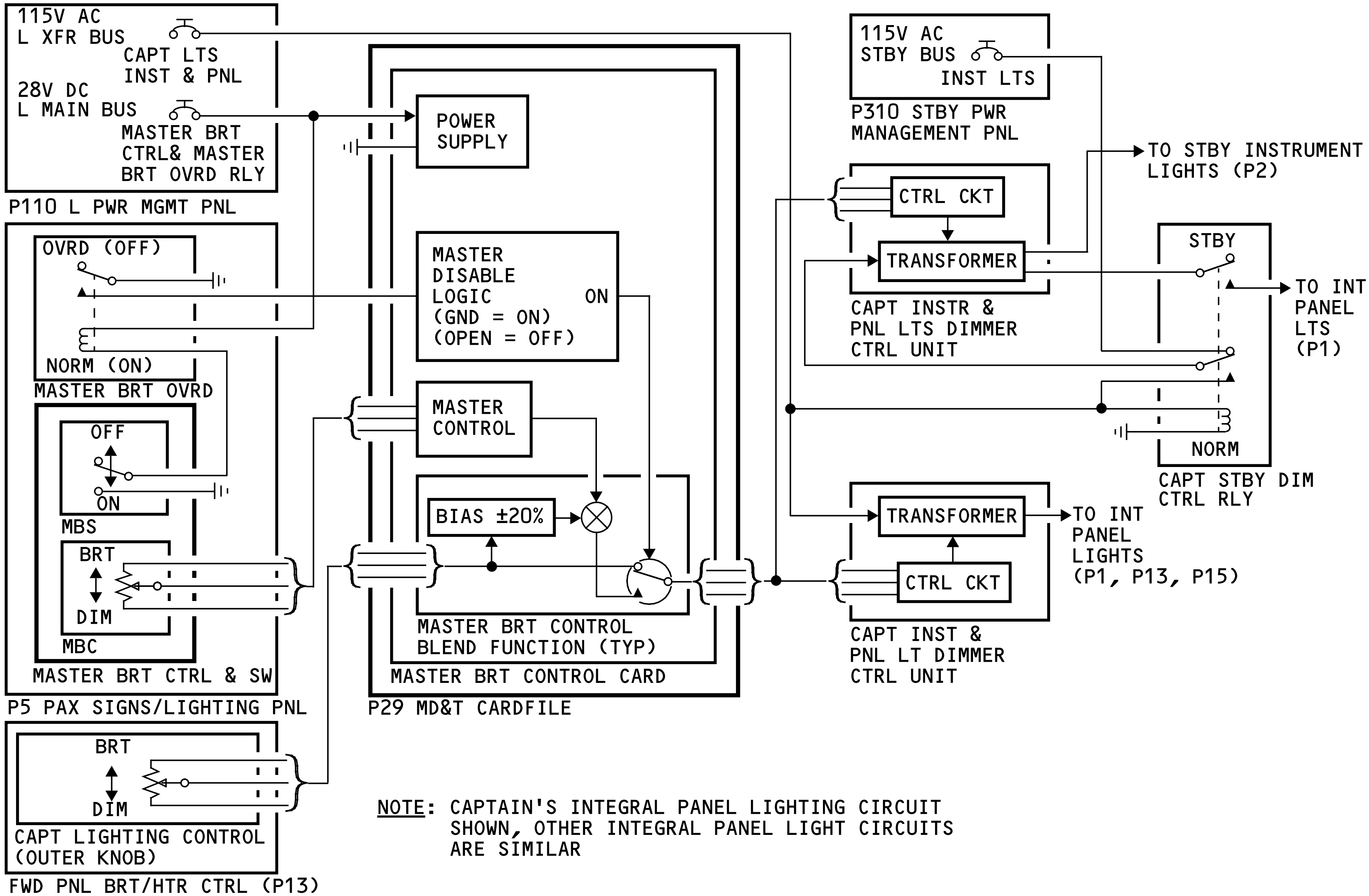
When the MBS is OFF, the master bright control card disables the master bright control blend function. The individual panel light controls adjust the integral panel lights from full bright to full dim. The master bright control card then sends the output to the respective dimmer control unit. The dimmer control unit then adjusts the light intensity of the related integral panel light.

Standby Power Mode

Critical dimmer control units get power from the 115v ac standby bus when power is not available from the left 115v ac transfer bus. 115v ac standby bus power then goes to the critical dimmer control units. The critical dimmer control units then supply power to the respective panel lights.

When standby power is the power source, you can not adjust the light intensity from the MBC. You can only adjust the light intensity from the related individual panel light control. These integral panel lights and instruments have power when the lights are in the standby mode:

- Standby attitude indicator
- Standby airspeed indicator
- Standby altimeter
- Standby compass
- Captains radio tuning frequency window
- TCAS/ATC control panel.



NOTE: CAPTAIN'S INTEGRAL PANEL LIGHTING CIRCUIT SHOWN, OTHER INTEGRAL PANEL LIGHT CIRCUITS ARE SIMILAR

33-13-00-006 Rev 3 01/06/1997

INTEGRAL PANEL LIGHTS - FUNCTIONAL DESCRIPTION - MANUAL ADJUSTMENTS

INTEGRAL PANEL LIGHTS - FUNCTIONAL DESCRIPTION - AUTOMATIC ADJUSTMENTS

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INTEGRAL PANEL LIGHTS - FUNCTIONAL DESCRIPTION - AUTOMATIC ADJUSTMENTS

General

The integral lights in some components have automatic brightness control and manual brightness control. These components have automatic brightness control:

- TCAS/ATC control integral panel
- Captain radio tuning frequency windows
- Center radio tuning frequency windows
- First officer tuning frequency windows
- Rudder trim indicator
- Left stab position indicator
- Right stab position indicator
- Standby instruments
- Primary display system.

See section 34-11 for more information on the automatic brightness control for the standby instruments.

See section 31-61 for more information on the automatic brightness control for the primary display system.

Functional Description

There are two sets of light sensors. Two remote light sensors (RLS) are on the glare shield and three bezel-light sensors (BLS) are on the aisle stand. There are bezel-light sensors in these components:

- Rudder trim indicator
- Right stab position indicator
- Left stab position indicator.

The bezel-light sensors send ambient light information to the MBC card. The MBC card uses the manually selected brightness level and adjusts the output signal based on inputs from the bezel-light sensors. The MBC card then uses the remote light sensor inputs and adjusts the output signal more. The MBC card then sends an output to the dimmer control units. The dimmer control units adjust the brightness for these components:

- TCAS/ATC control integral panel lights
- Captain radio tuning frequency windows
- Center radio tuning frequency windows
- First officer tuning frequency windows.

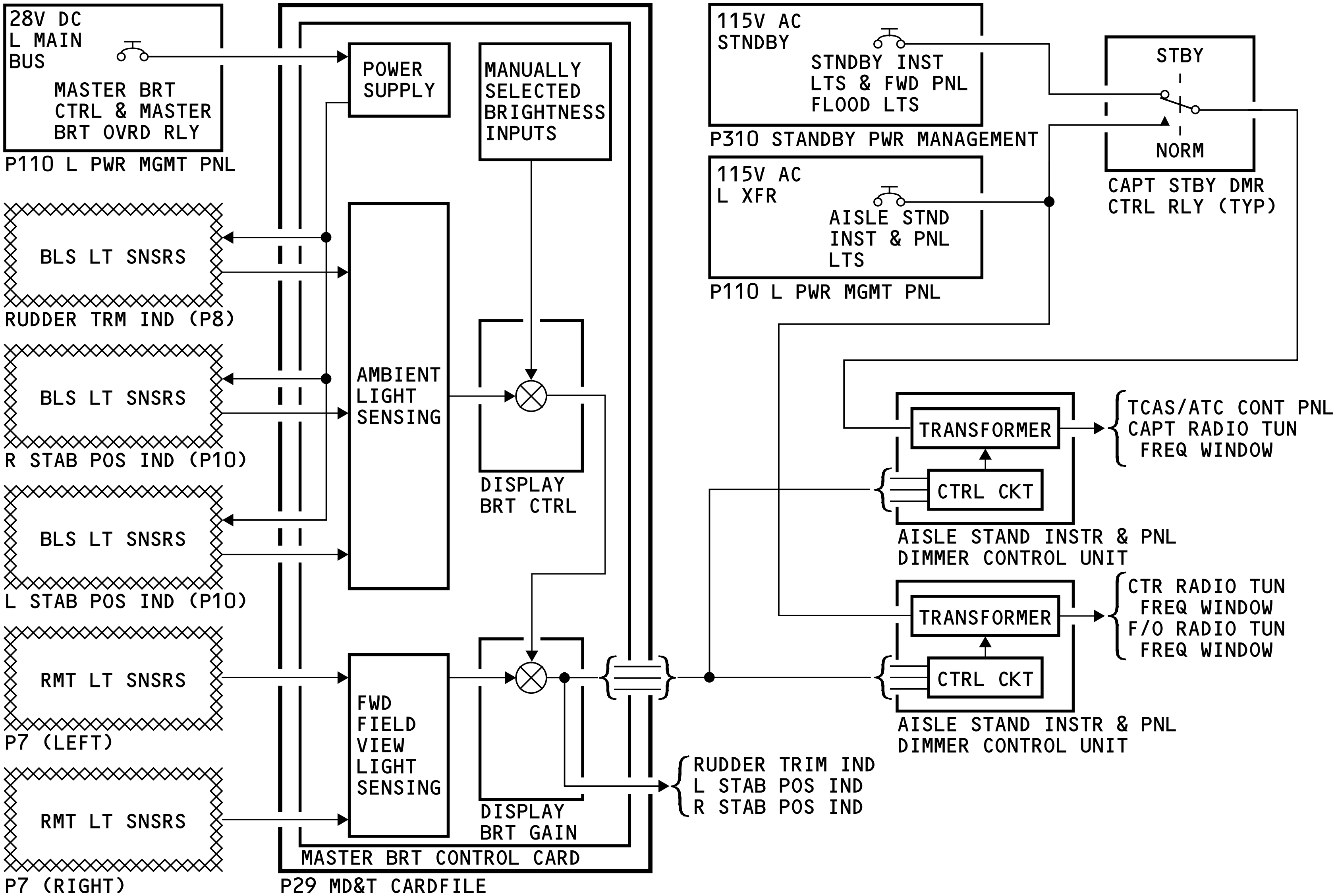
The MBC card also adjusts the brightness for these components without the use of a dimmer control unit:

- Rudder trim indicator
- Right stab position indicator
- Left stab position indicator.

Standby Mode

Critical dimmer control units get power from the 115v ac standby bus when power is not available from the left 115v ac transfer bus. The 115v ac standby bus energizes the standby dimmer control relay. 115v ac standby bus power then goes to the critical dimmer control units. The critical dimmer control units then supply power to the respective panel lights. You can not adjust the light intensity of these panel lights from the MBC. You can only adjust the light intensity from the related individual panel light control. These integral panel lights and instruments have power when the lights are in the standby mode:

- Captains radio tuning frequency window
- TCAS/ATC control panel.



33-13-00-007 Rev 0 09/03/1996

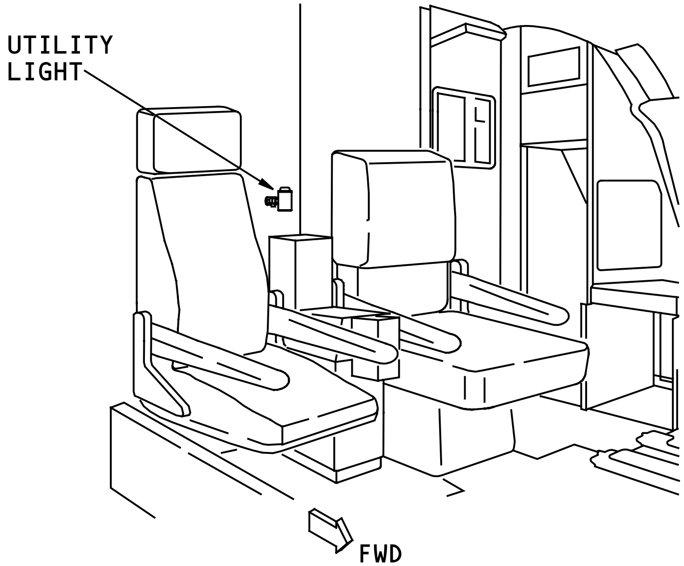
INTEGRAL PANEL LIGHTS - FUNCTIONAL DESCRIPTION - AUTOMATIC ADJUSTMENTS

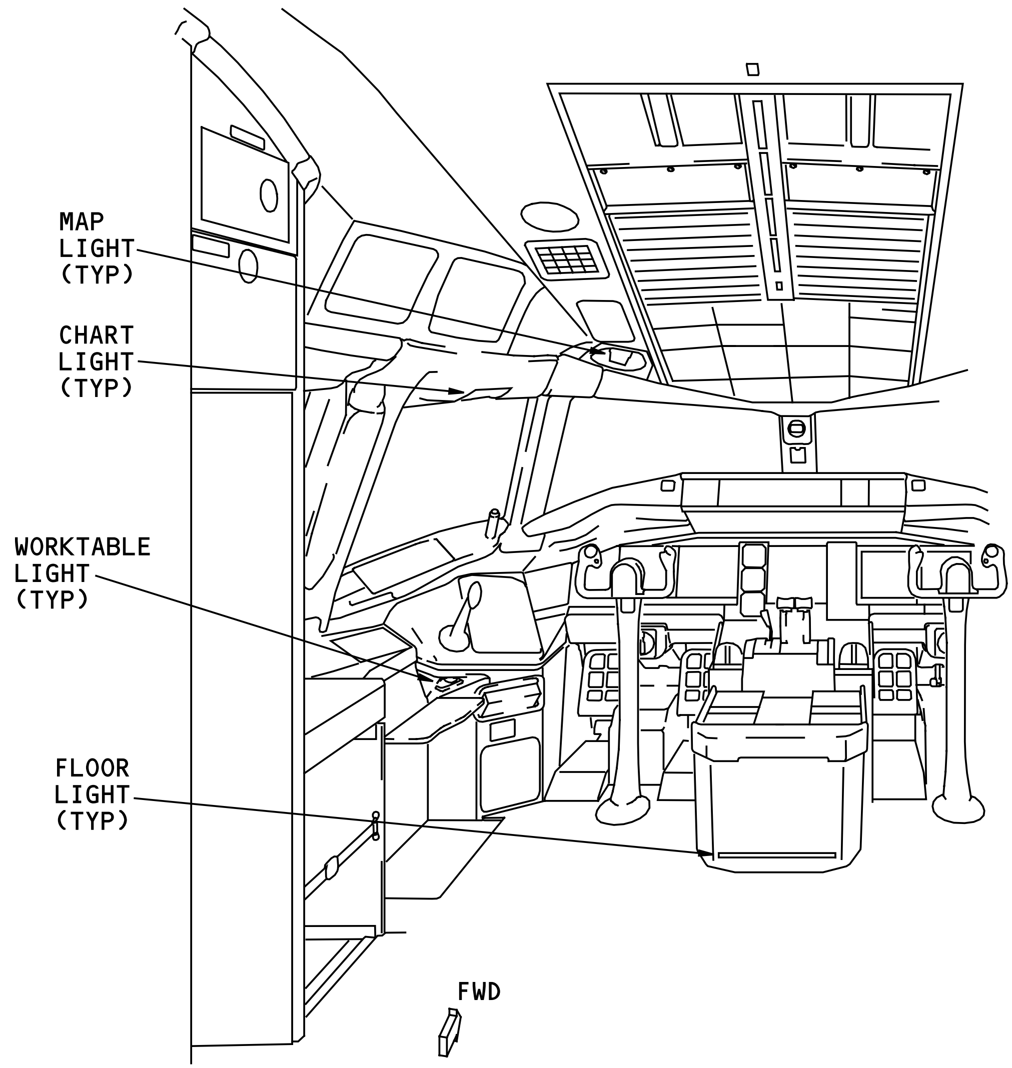
FLIGHT COMPARTMENT MISCELLANEOUS LIGHTS - INTRODUCTION

General

The flight compartment miscellaneous lights give light to specific areas in the flight compartment. These lights are the flight compartment miscellaneous lights:

- Utility light
- Map light (4)
- Chart light (2)
- Worktable light (2)
- Floor light (3).





33-14-00-001 Rev 0

FLIGHT COMPARTMENT MISCELLANEOUS LIGHTS - INTRODUCTION

FLIGHT COMPARTMENT MISCELLANEOUS LIGHTS - MAP LIGHTS

Purpose

The map lights give adjustable light for the captain, first officer, and observers.

Location

There are four map lights in the flight deck. There is one above each of the captain's and first officer's seats. They are forward of the flight deck handles. There are two on the ceiling above the first observers seat.

Physical Description

Each map light has these components:

- Lamp
- Bezel
- Lens.

Operation

There are rotary-type controls for the map lights on these panels:

- P7 glareshield panel
- P17 first observers panel
- P18 MAT/second observers panel.

The diameter and amount of light is adjustable. You can also point the light.

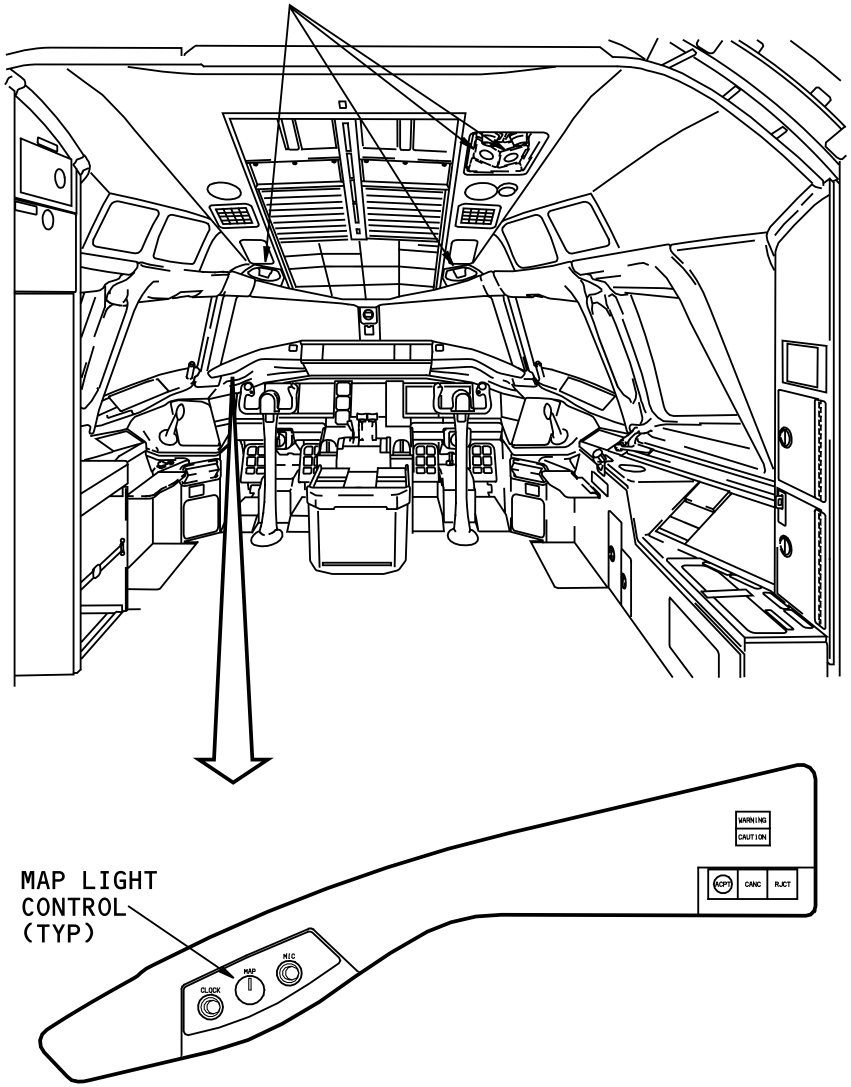
You pull the control to make the light come on. You turn the control to adjust the amount of light that comes from the map light. You turn the bezel to adjust the diameter of the light.

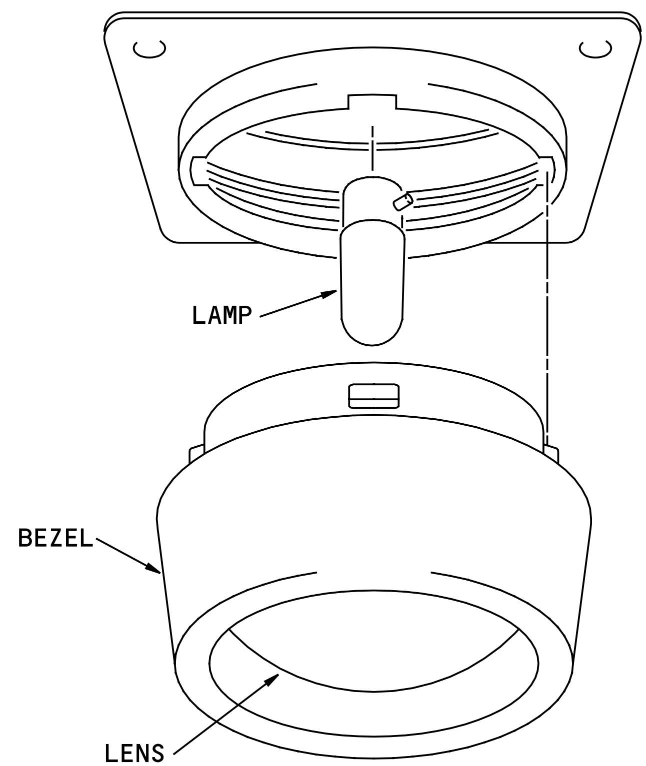
Training Information Point

To replace the map light you do these things:

- Compress the bezel/lens assembly
- Turn it counterclockwise to disconnect it
- Replace the lamp.

The lamp is a bayonet-type lamp.





MAP LIGHT

33-14-00-002 Rev 1 07/14/1997

FLIGHT COMPARTMENT MISCELLANEOUS LIGHTS - MAP LIGHTS

MASTER DIM AND TEST - INTRODUCTION

Purpose

The master dim and test (MD&T) system lets you do these tasks:

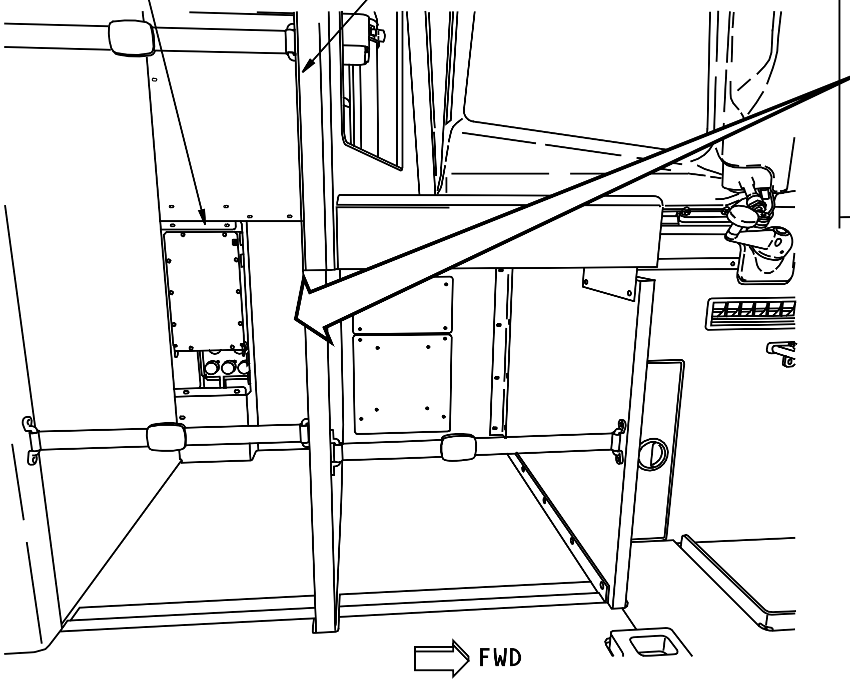
- Do a test of the flight deck annunciators and lighted push button switches
- Set annunciators and lighted push-button switches to the bright or dim mode.

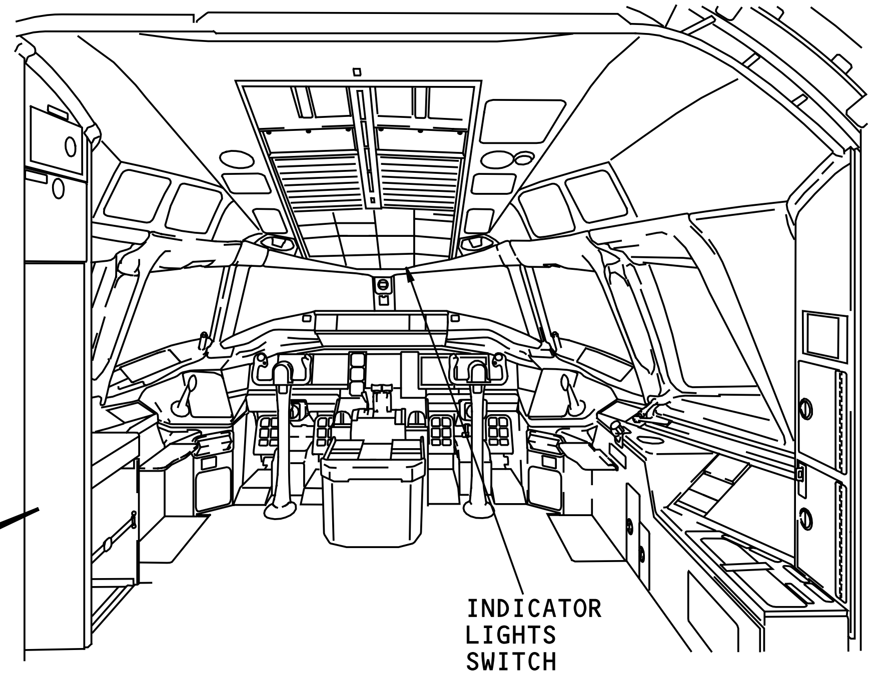
Location

The indicator lights switch is on the P5 overhead panel. The P29 MD&T card file is behind a panel in the coat storage closet in the flight deck.

Interface

The MD&T system has interfaces with the overhead panel ARINC 629 system (OPAS) and the AIMS.





33-16-00-001 Rev 1 07/14/1997

MASTER DIM AND TEST - INTRODUCTION

MASTER DIM AND TEST - MASTER DIM AND TEST CARD FILE

Purpose

The P29 master dim and test (MD&T) card file controls the amount of power that goes to the annunciator and lighted push-button switch lights.

Location

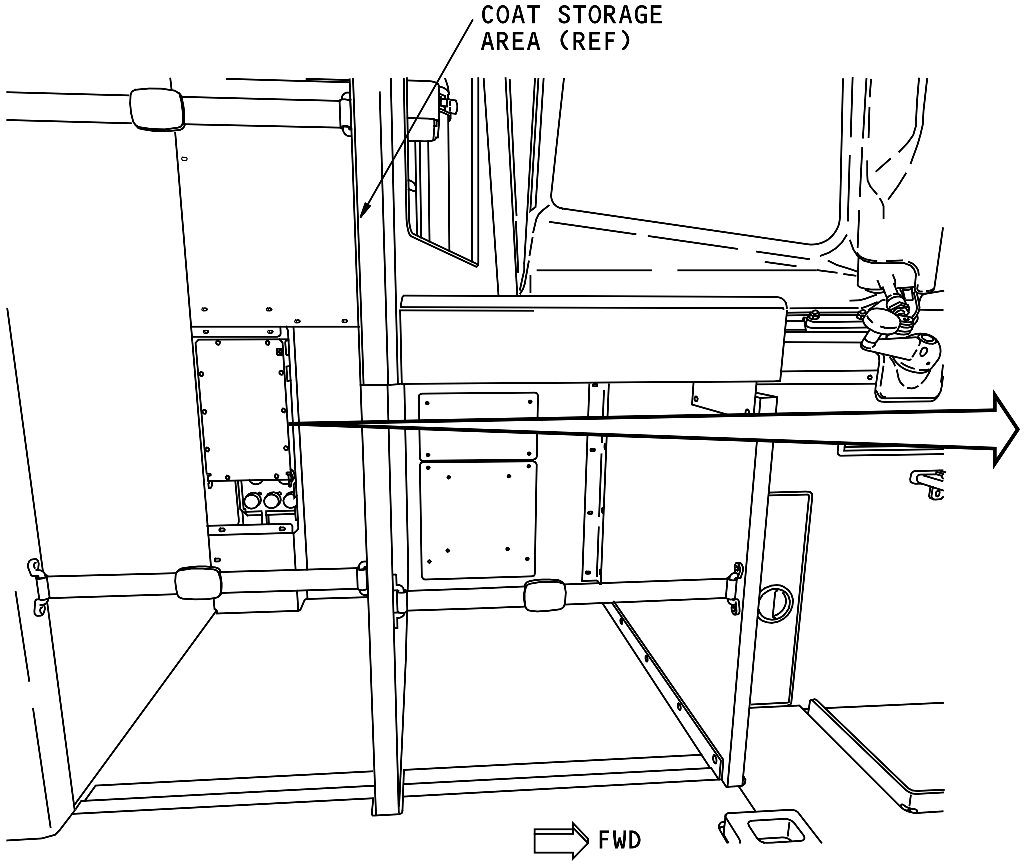
The card file is behind a panel in the coat storage area in the flight deck.

Physical Description

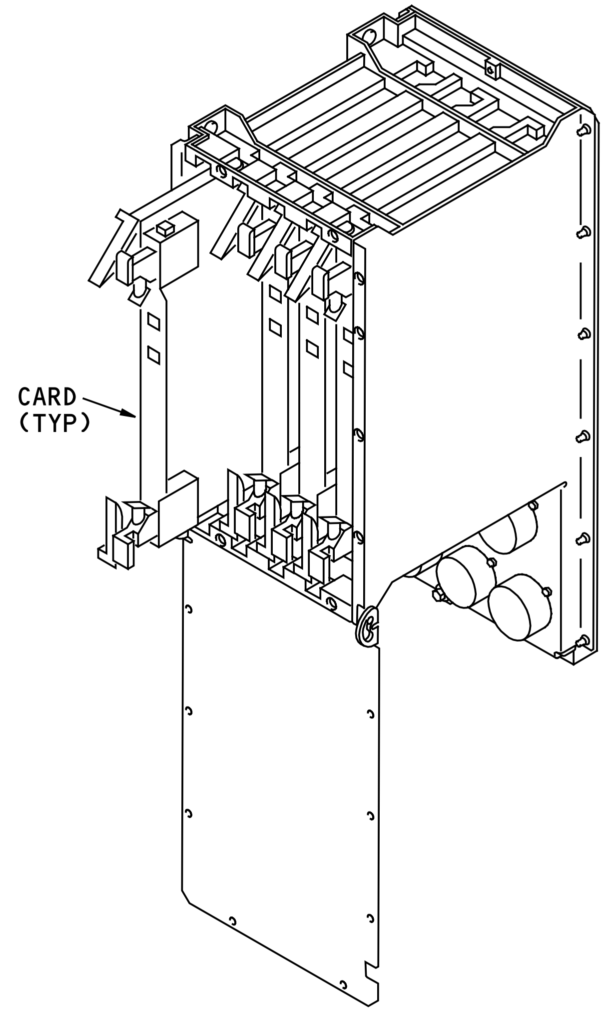
The card file contains three MD&T printed circuit (PC) dimmer cards and one master brightness control card.

Training Information Point

You release eight fasteners to open the MD&T card file.



FLIGHT DECK



P29 MASTER DIM AND TEST CARD FILE
(ACCESS DOOR OPEN)

33-16-00-002 Rev 0

MASTER DIM AND TEST - MASTER DIM AND TEST CARD FILE

MASTER DIM AND TEST - OPERATION

Operation

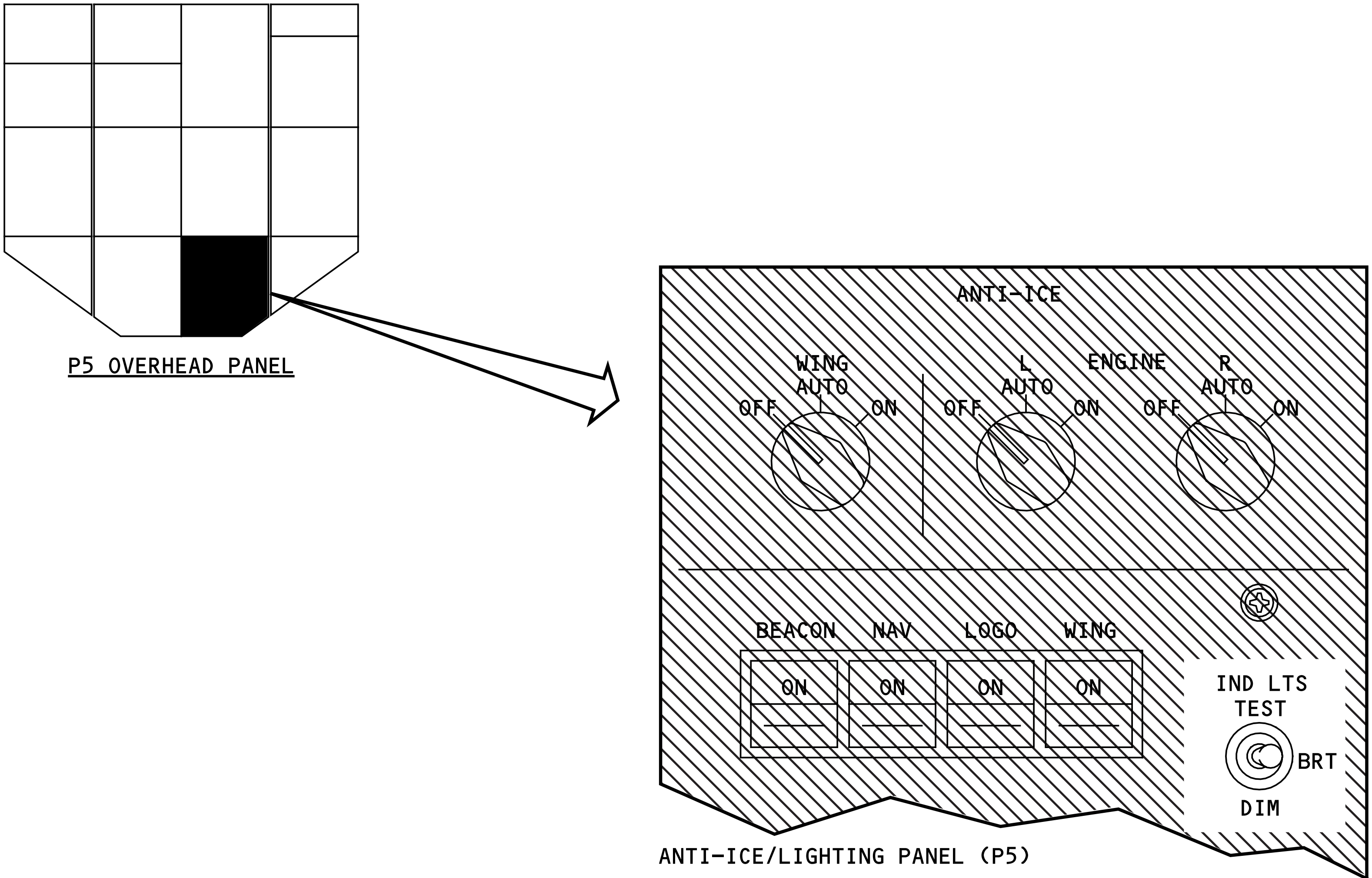
You use the indicator lights switch (IND LTS) to operate the master dim and test. When you hold the switch in the TEST position most of the flight deck annunciators and push-button switch indicator lights come on full bright. The lights stay full bright for 10 seconds and then come on in the dim mode. This permits the flight crew to see if the lights operate normally. When you release the switch it goes to the bright position. The fire warning lights will not come on during this test.

When you put the switch in the bright (BRT) position, if an annunciator or indicator light comes on, it will come on fully bright. When you put the switch in the dim (DIM) position, the lights are not as bright as in the bright mode. The fire warning lights will always come on in the bright mode.

Training Information Point

The storm light switch on the P5 passenger sign/ lighting panel makes the lights come on fully bright when it is on.

See the flight compartment illumination section for more information about the storm light switch (AMM PART I 33-11).



ANTI-ICE/LIGHTING PANEL (P5)

33-16-00-003 Rev 3 08/08/96

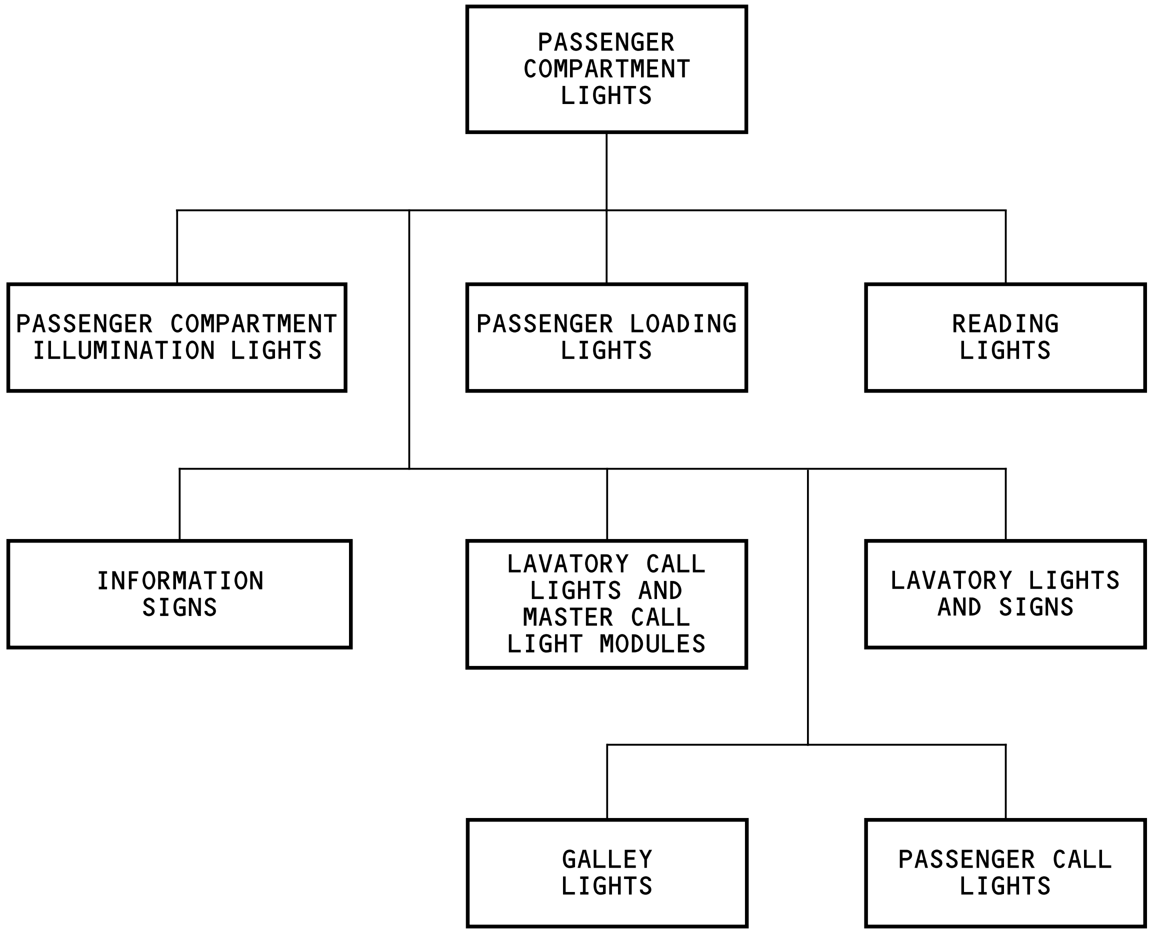
MASTER DIM AND TEST - OPERATION

PASSENGER COMPARTMENT LIGHTS - INTRODUCTION

General

The passenger compartment lights has these subsystems:

- Passenger compartment illumination lights
- Passenger loading lights
- Reading lights
- Information signs
- Lavatory call lights and master call light modules
- Lavatory lights and signs
- Galley lights
- Passenger call lights.



33-20-00-001 Rev 2 03/26/96

PASSENGER COMPARTMENT LIGHTS - INTRODUCTION

PASSENGER COMPARTMENT ILLUMINATION - INTRODUCTION

General

Passenger compartment illumination has these types of lights:

- Indirect ceiling lights
- Night lights
- Sidewall lights.

Location

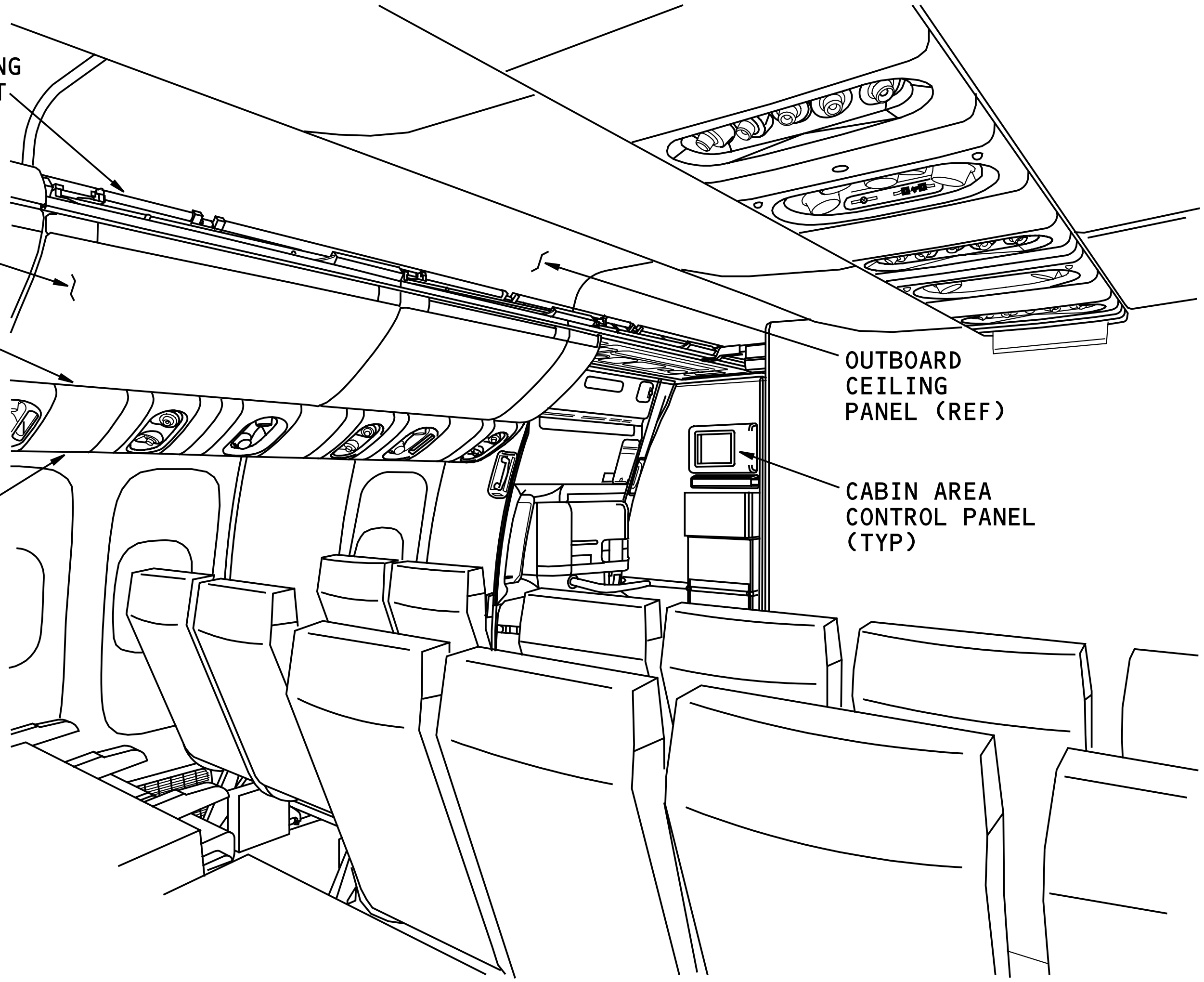
The indirect ceiling lights and night lights are above the outboard stowage bins.

The sidewall lights are between the outboard PSUs and the sidewall panels.

Controls for passenger compartment illumination are on the cabin lighting screen. This screen is on the cabin system control panel (CSCP) and the cabin area control panel (CACP).

You use the same screen for the passenger loading direct ceiling lights.

See the passenger loading lights section for more information (AMM PART I 33-22).



PASSENGER COMPARTMENT
(TYPICAL)

PASSENGER COMPARTMENT ILLUMINATION - INTRODUCTION

PASSENGER COMPARTMENT ILLUMINATION - INDIRECT CEILING AND NIGHT LIGHTS

Purpose

The indirect ceiling and night lights put light on the ceiling to illuminate the passenger compartment.

Physical Description

The indirect ceiling lights have a fluorescent lamp and a ballast. There are releases at both ends of the lamps. The length of the light is in proportion to the length of the stowage bin.

Night lights attach to some of the indirect ceiling lights. The lamp is an incandescent, bayonet-style lamp.

Location

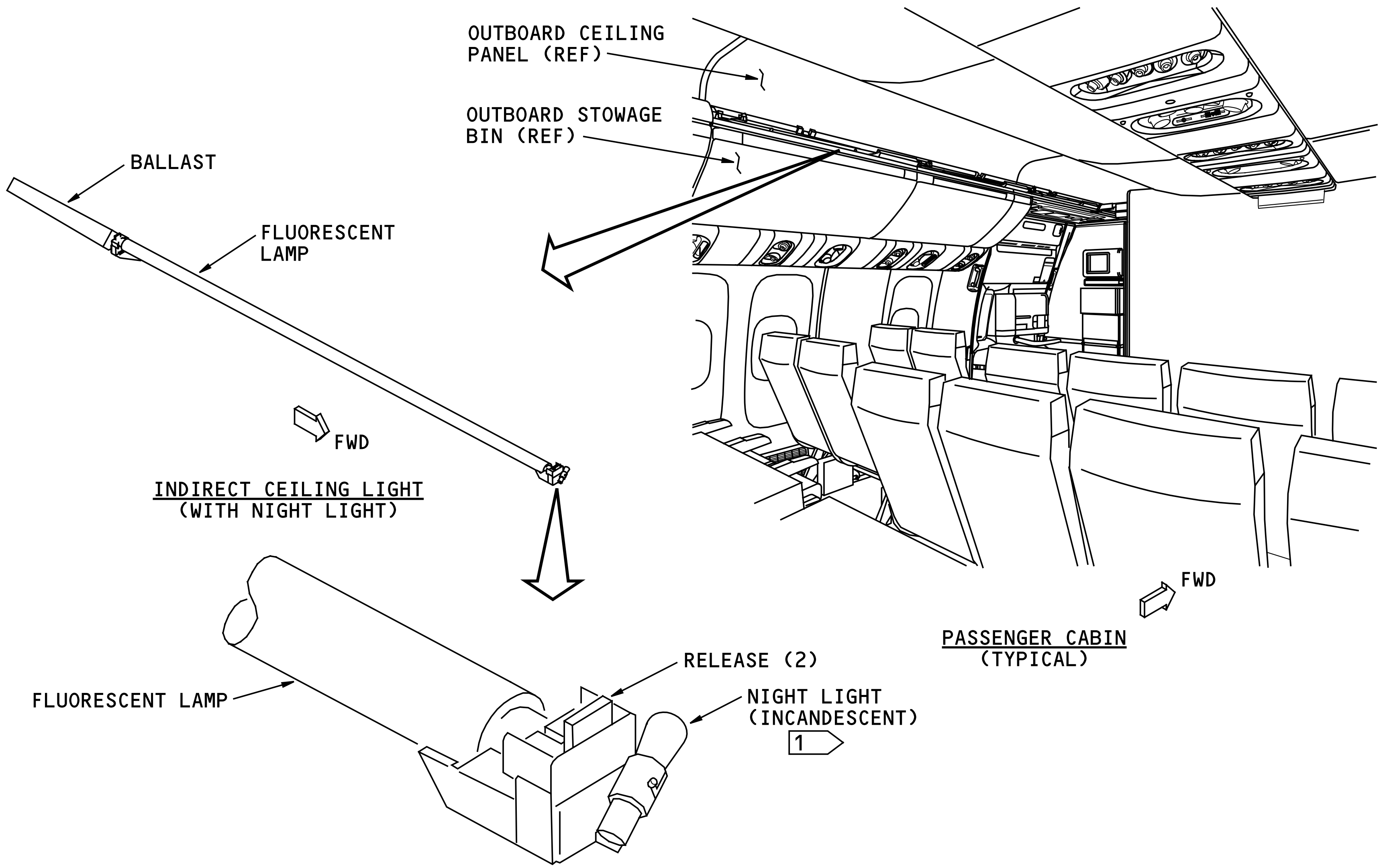
The indirect ceiling lights are on the inboard, top edge of the outboard stowage bins. The assemblies are set at an angle so they overlap each other. This prevents dark areas on the ceiling between light fixtures.

There are usually 14 night lights. The night lights are with the indirect ceiling lights near the passenger entry doors (PEDs) and between PEDs number two and three.

Training Information Point

You push the releases to remove the fluorescent light.

NOTE: The ballast for the indirect ceiling light or sidewall light is part of the light assembly. If the ballast does not operate, replace the light assembly. The light assembly can be repaired in a shop.



1 LOCATED NEAR THE PASSENGER ENTRY DOORS

PASSENGER COMPARTMENT ILLUMINATION - INDIRECT CEILING AND NIGHT LIGHTS

33-21-00-002 Rev 3 04/22/1997

PASSENGER COMPARTMENT ILLUMINATION - SIDEWALL LIGHTS

Purpose

The sidewall lights give fluorescent lighting below the stowage bins in the passenger compartment.

Location

The lights are under the outboard stowage bins, between the outboard PSUs and the sidewall panels.

Physical Description

Each sidewall light has these components:

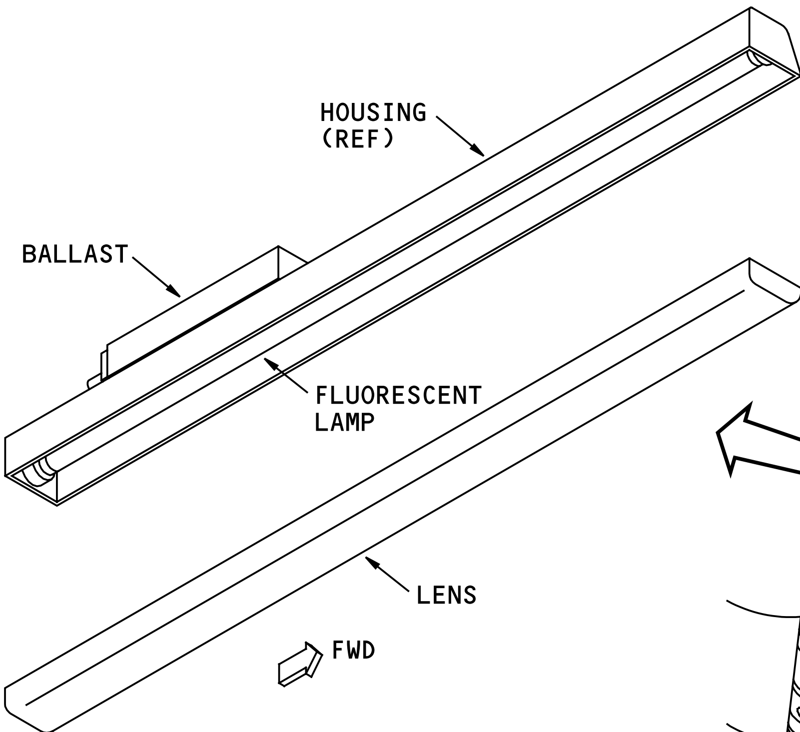
- Ballast
- Fluorescent lamp
- Lens.

The length of the light is in proportion to the length of the stowage bin it is under.

Training Information Point

You squeeze the lens to remove it.

NOTE: The ballast for the indirect ceiling light or sidewall light is part of the light assembly. If the ballast does not operate, replace the light assembly. The light assembly can be repaired in a shop.



SIDEWALL LIGHT
(TYPICAL)

PASSENGER CABIN
(TYPICAL)

33-21-00-003 Rev 1 03/26/96

PASSENGER COMPARTMENT ILLUMINATION - SIDEWALL LIGHTS

PASSENGER LOADING LIGHTS - INTRODUCTION

General

These are the passenger loading lights subsystems:

- Direct ceiling lights
- Standby lights
- Entry lights
- Attendant work lights
- Closet lights
- Attendant switch panel.

The passenger loading lights supply light in the:

- Passenger entry areas
- Attendant work areas
- Cross-aisles
- Closets.

There are two types of direct ceiling lights:

- Fluorescent
- Incandescent.

Location

The possible locations for fluorescent direct ceiling lights are in these lowered ceilings:

- Door 1 cross-aisles
- Door 4 cross-aisles
- Aisle to the flight deck.

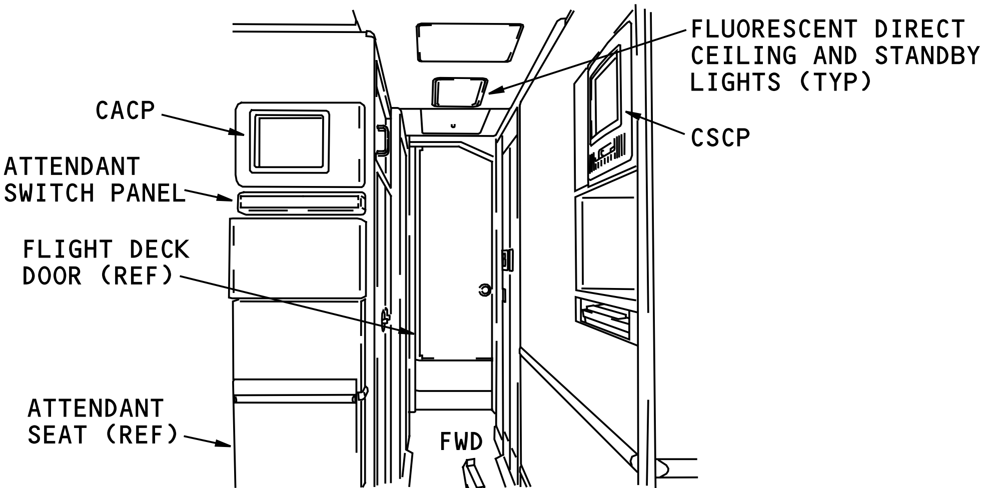
The possible locations for incandescent direct ceiling lights are in the door 2 and 3 cross-aisle lowered ceilings.

Controls for fluorescent and incandescent direct ceiling lights are on the cabin lighting screen. This screen is on the cabin system control panel (CSCP) and the cabin area control panel (CACP).

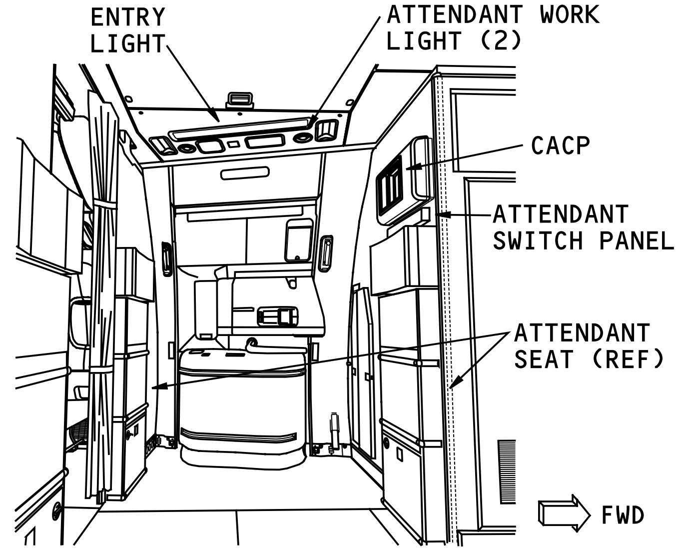
The entry lights are in the overdoor panels above the passenger entry doors. Controls for entry lights are on the entry way lighting screen. This screen is on the cabin system control panel (CSCP) and the cabin area control panels (CACPs).

The attendant work lights are in the overdoor panels and lowered ceilings in areas where there are attendant seats. Control is on the attendant switch panel. These panels are also in areas where there are attendant seats.

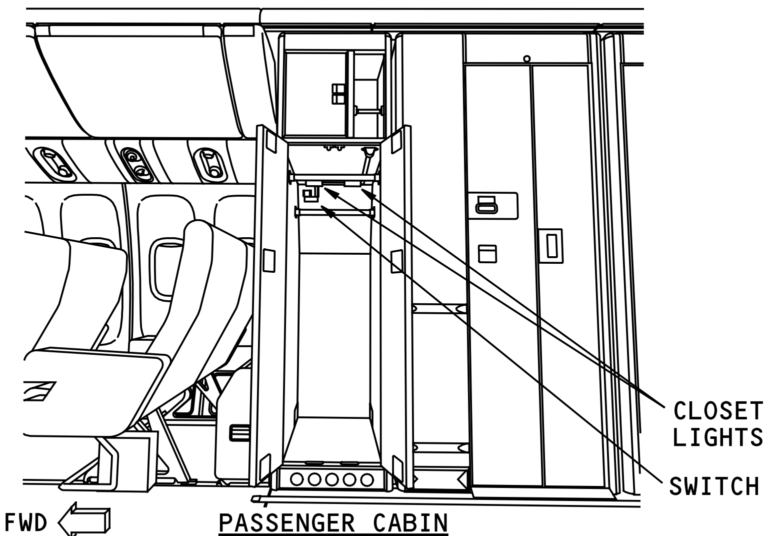
The closet lights are in the closets. A control switch is in the closet.



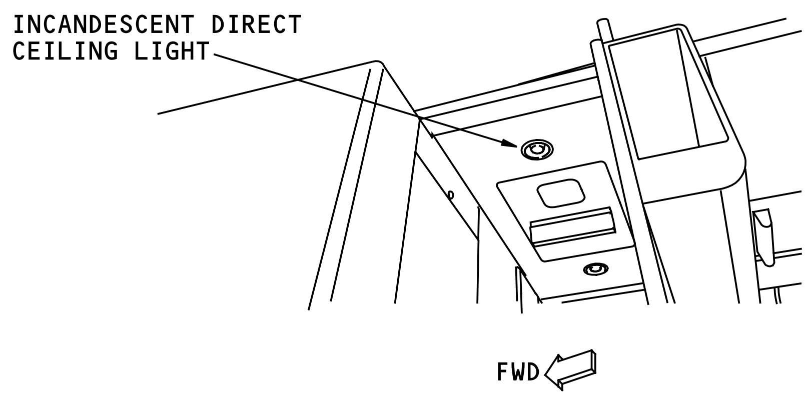
AISLE TO FLIGHT DECK
(TYPICAL)



PASSENGER ENTRY DOOR NO. 1 LEFT
(TYPICAL)



PASSENGER CABIN
(TYPICAL)



DOOR THREE CROSS AISLE
(TYPICAL)

PASSENGER LOADING LIGHTS - INTRODUCTION

PASSENGER LOADING LIGHTS - DIRECT CEILING LIGHTS - FLUORESCENT

Purpose

The fluorescent direct ceiling lights give light to aisles.

Location

These are the possible locations in lowered ceiling panels for fluorescent direct ceiling lights:

- Passenger entry door 1 cross-aisle
- Passenger entry door 4 cross-aisle
- Aisle to the flight deck.

Controls for fluorescent direct ceiling lights are on the cabin lighting screen. This screen is on the cabin system control panel (CSCP) and the cabin area control panel (CACP).

You use the same screen for the incandescent direct ceiling lights, and the passenger compartment illumination indirect ceiling, sidewall, and night lights.

See the passenger compartment illumination section for more information (AMM PART I 33-21).

See the cabin services system section for more information about the CSCP/CACP (AMM PART I 23-39).

Physical Description

Each light assembly has two fluorescent lamps, a ballast, and a lens in a bezel.

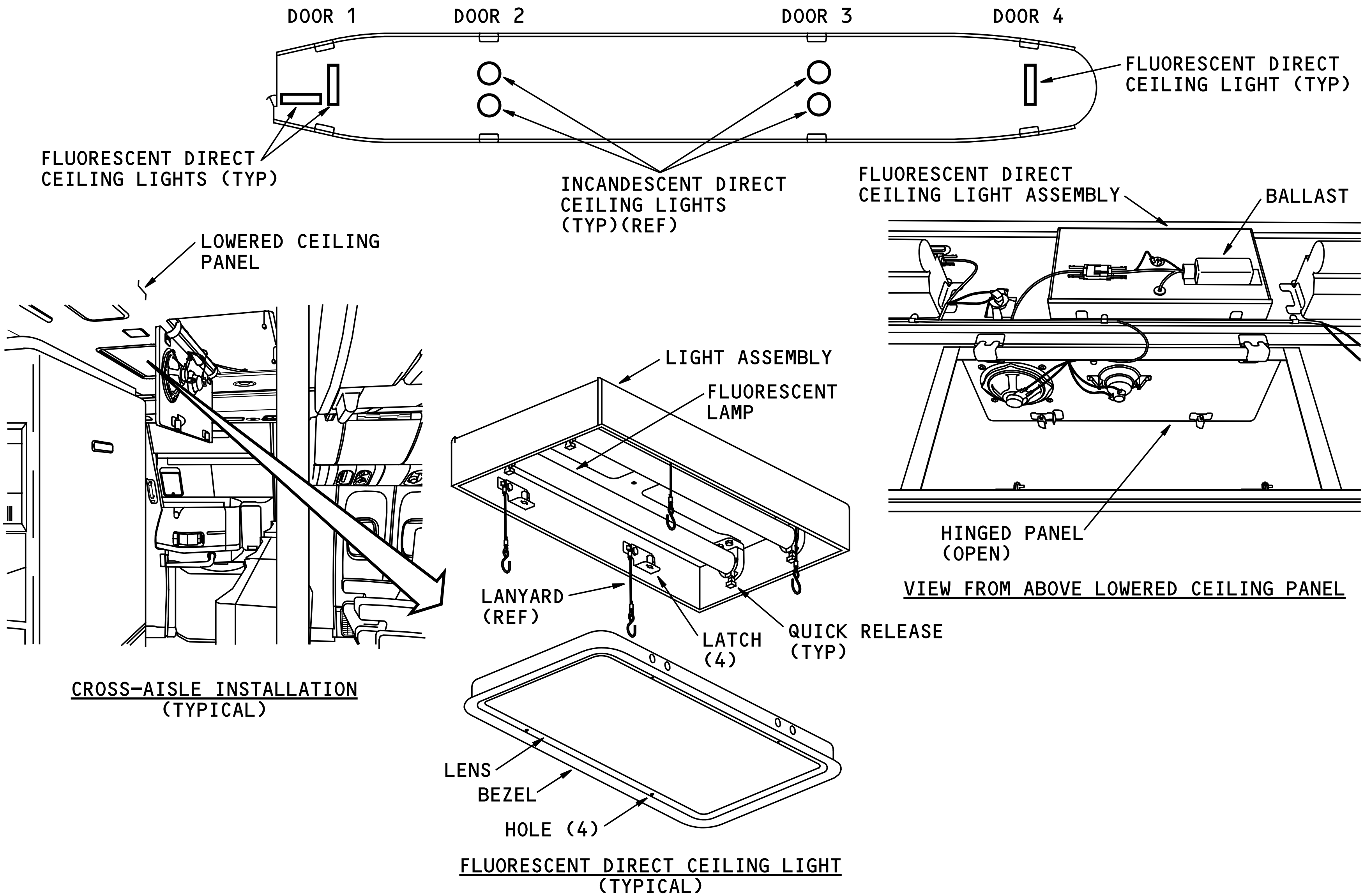
Training Information Point

Four holes in the bezel let you use a pin type tool to release the bezel. Four lanyards hold the bezel when it releases from the assembly.

Each light assembly has quick release fasteners for the lamps.

The ballast is an LRU.

A hinged panel in the lowered ceiling panel gives you access to the ballast.



PASSENGER LOADING LIGHTS - DIRECT CEILING LIGHTS - FLUORESCENT

PASSENGER LOADING LIGHTS - FLIGHT DECK DOOR SWITCH

Purpose

The flight deck door switch controls the direct ceiling light immediately aft of the flight deck door.

General

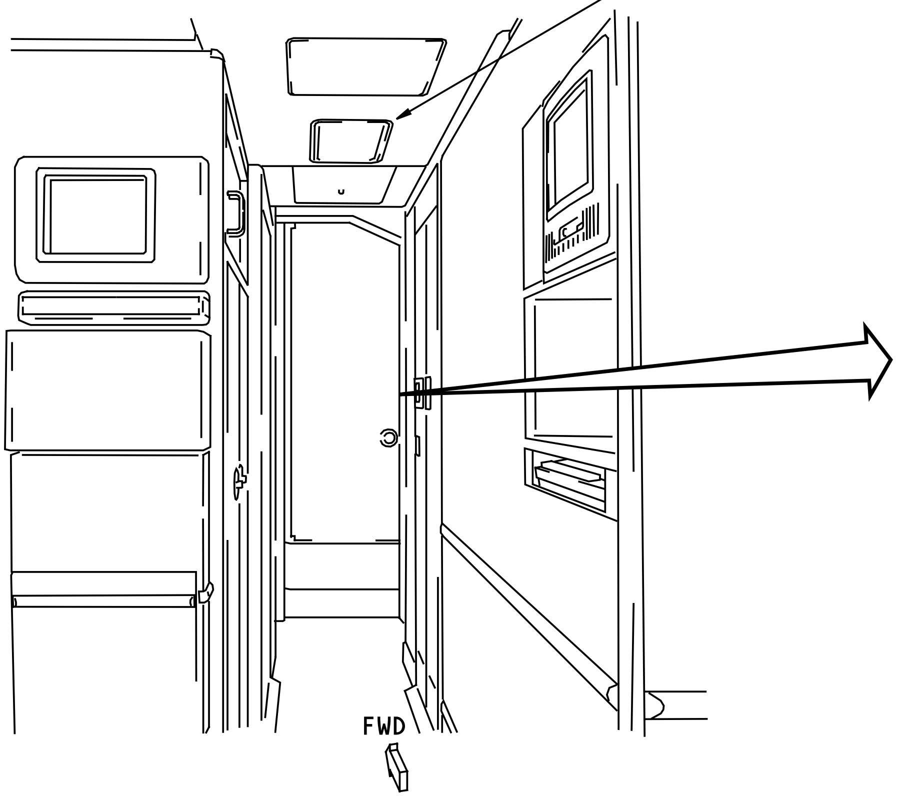
If you open the flight deck door when the engines are running, the direct ceiling light immediately aft of the flight deck door goes off. The reflection on the flight displays would make them difficult to see.

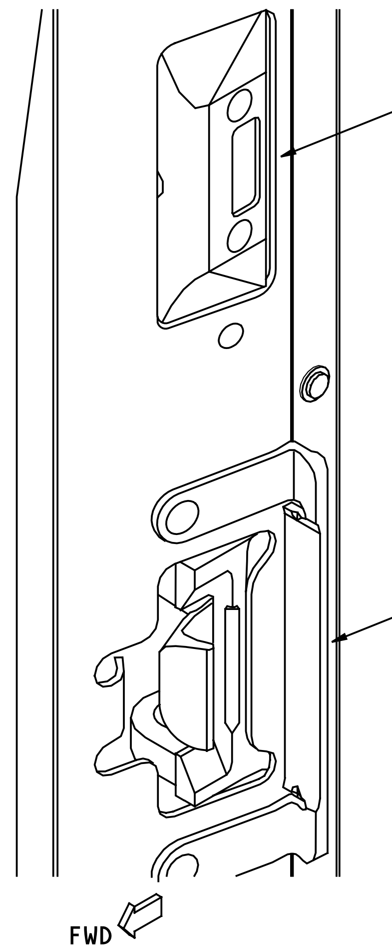
Location

The switch is on the door post, above the door stop.

Physical Description

The switch is a magnetic-reed type switch.





33-22-00-005 Rev 3 03/27/96

PASSENGER LOADING LIGHTS - FLIGHT DECK DOOR SWITCH

PASSENGER LOADING LIGHTS - ATTENDANT SWITCH PANELS - PASSENGER COMPARTMENT

Purpose

The attendant switch panels (ASPs) in the passenger compartment give control and indications for:

- Attendant work lights
- Passenger address system
- Cabin interphone system
- Emergency lights.

Panel Locations

Passenger compartment ASPs are in areas where there are attendant seats.

Lights

The lights in the switches and indicators are LEDs.

Switches and Indicators

Work light switches are on all ASPs in the passenger compartment. The number of work light switches on a panel depends on the panel location.

These switches are on the panel at passenger entry door (PED) number two left:

- PA NORM/ALT
- CI NORM/ALT.

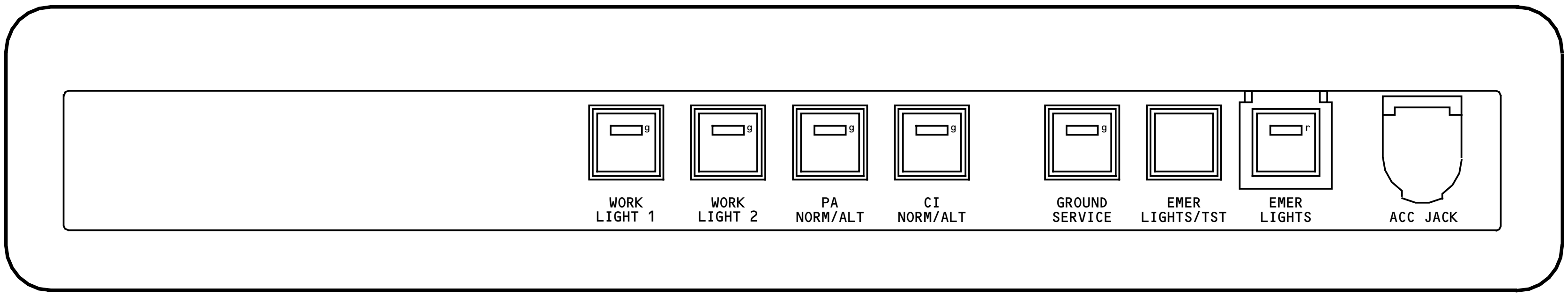
These switches are on the ASP at PED number two left:

- GROUND SERVICE
- EMER LIGHTS
- EMER LIGHTS/TEST.

See the passenger address system section for more information about the passenger address system (AMM PART I 23-31).

See the cabin interphone system section for more information about the cabin interphone system (AMM PART I 23-42).

See the emergency lighting section for more information about the emergency lights (AMM PART I 33-50).



ATTENDANT SWITCH PANEL (TYPICAL)

33-22-00-014 Rev 6 07/24/1997

PASSENGER LOADING LIGHTS - ATTENDANT SWITCH PANELS - PASSENGER COMPARTMENT

READING LIGHTS - INTRODUCTION

Purpose

The reading lights supply light from above the passenger seats.

Location

The reading lights are in the passenger service units (PSU).

Physical Description

A reading light has these parts:

- Slot (4)
- Bezel/lens retainer
- Lens
- Tab (4)
- Lamp
- Lever.

You use the lever to lock the light in position.

Operation

You operate the reading lights with the switch on the passenger control unit or through the reading light control (not shown) on the CSCP/CACP.

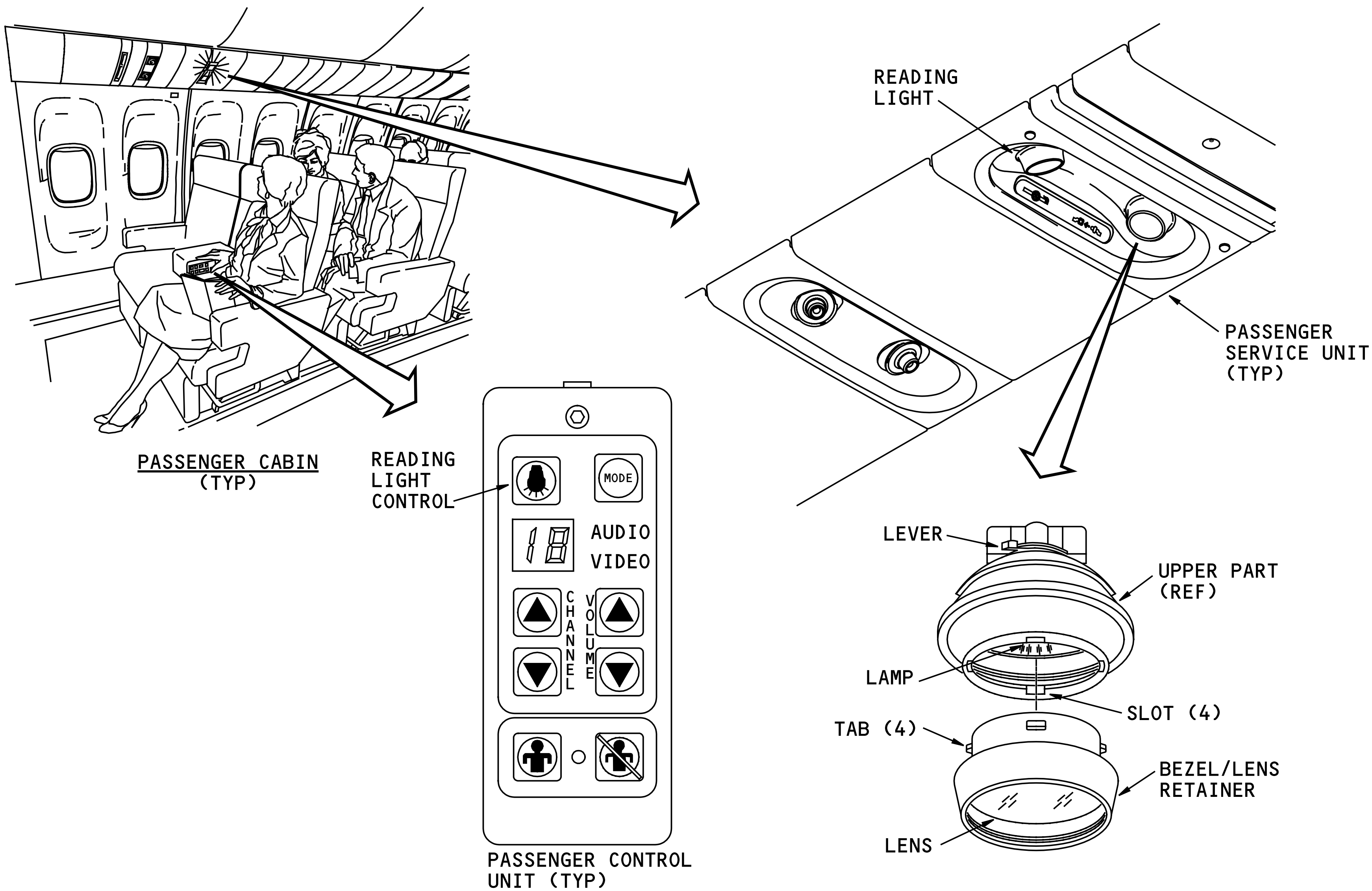
Training Information Point

You can replace the lamps from the front of the PSU. You do not have to lower the PSU to replace the lamps.

To replace a lamp:

- Compress the bezel/lens retainer
- Turn it counterclockwise to disconnect it from the slots on the upper part
- Replace the lamp.

You do the opposite procedure to install the bezel/lens retainer.



READING LIGHTS - INTRODUCTION

INFORMATION SIGNS - INTRODUCTION

Purpose

These information signs give information to the passengers and attendants:

- No smoking sign
- Fasten seat belt sign
- Return to seat sign.

Location

There are information signs in these locations:

- Passenger service units (PSUs)
- Overdoor panels
- Purser station (not shown)
- Lavatories.

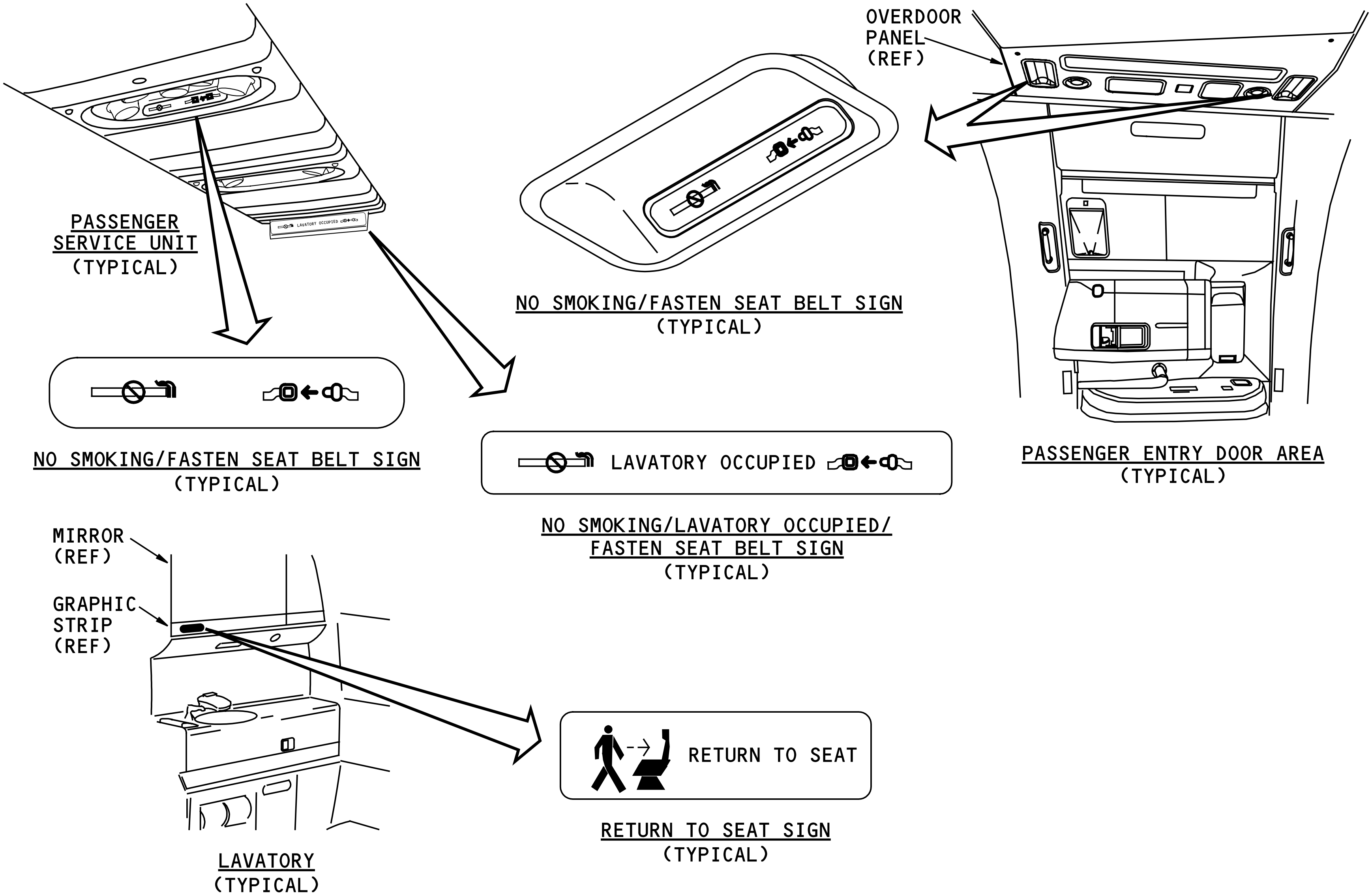
There are no smoking and fasten seat belts signs on the passenger service units (PSUs) and in the overdoor panels near the attendant seats.

There are return to seat signs in the lavatories.

Training Information Point

The no smoking and fasten seat belt signs have lamps that you can replace. You remove the lens to get access to the lamps.

The return to seat signs use LEDs. You replace the sign if the LEDs fail.



33-24-00-001 Rev 3 03/19/1997

INFORMATION SIGNS - INTRODUCTION

INFORMATION SIGNS - GENERAL DESCRIPTION

General

The passenger service system (PSS) supplies control signals for the information signs. The PSS gets inputs from the left and right systems ARINC 629 buses, the flight attendants, and the cabin services system configuration database.

Components

These are the main components of the information signs system:

- No smoking selector
- Seat belt selector
- No smoking sign
- Fasten seat belt sign
- Return to seat sign.

The PSS also supplies control for the lavatory-occupied signs and the lavatory door-lock signs (not shown). These signs are not part of the information signs system.

See the lavatory lights and signs section for more information about lavatory lights (AMM PART I 33-26).

These other systems and components have an interface with the information signs system:

- Overhead panel ARINC 629 system (OPAS)
- Airplane information management system (AIMS)
- Electrical load management system (ELMS)
- Flap/slat electronics unit (FSEU)
- Proximity sensor electronics unit (PSEU)
- Cabin services system (CSS)
- Passenger service system (PSS).

PSS Control

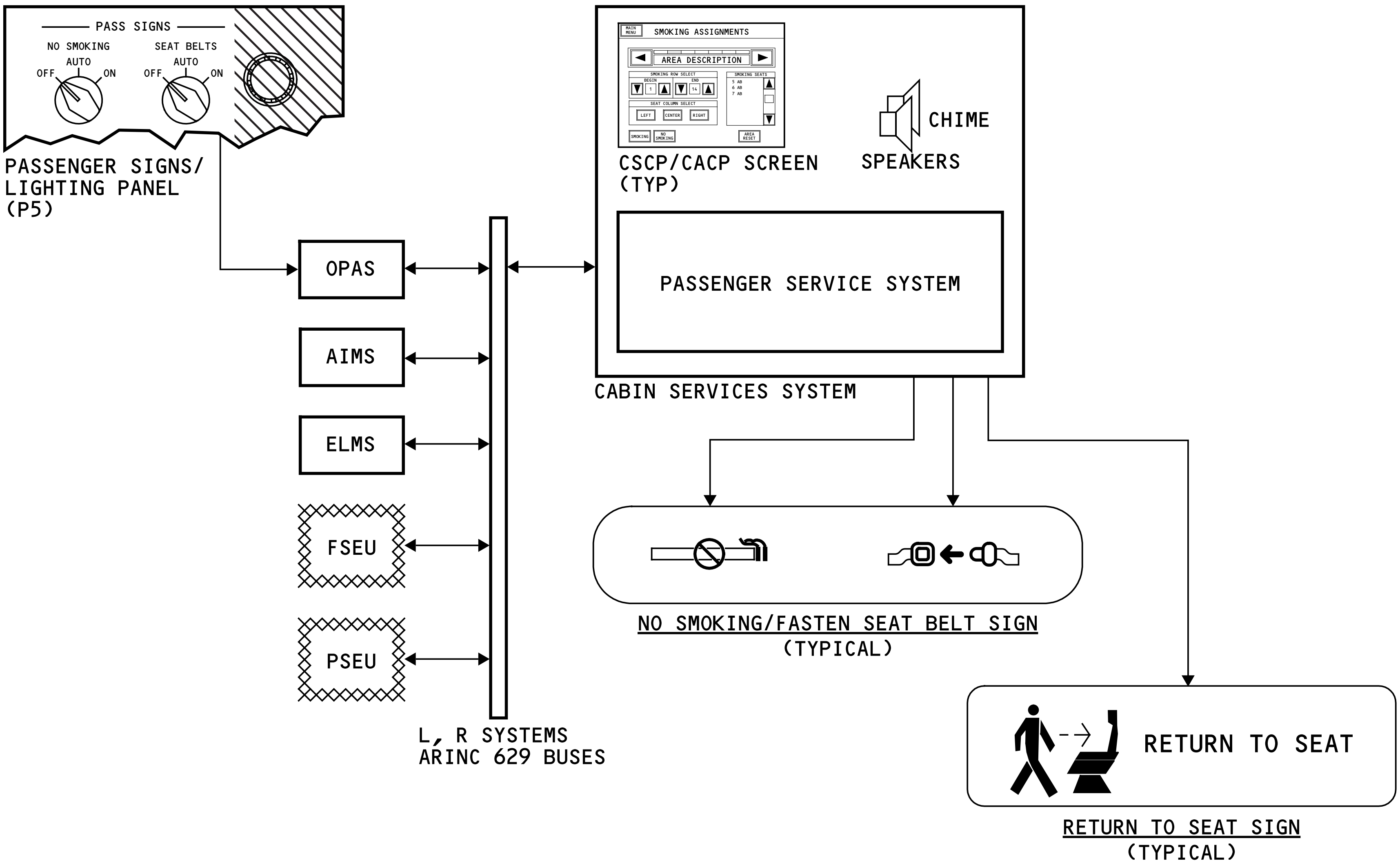
The PSS controls these information signs:

- No smoking sign
- Fasten seat belts sign
- Return to seat sign.

The PSS makes the signs come on or go off and sounds a chime based on selector position and airplane conditions.

The PSS causes an all airplane chime when the signs come on or go off. The configuration data base specifies the chime type (HI, LO, HI/LO, LO/HI).

For more information about the conditions that cause the signs to turn on or go off, see the information about information sign control logic in this section.



33-24-00-004 Rev 2 02/27/1997

INFORMATION SIGNS - GENERAL DESCRIPTION

LAVATORY CALL LIGHTS AND MASTER CALL LIGHT MODULES - INTRODUCTION

Purpose

The light in the lavatory call switch tell the flight attendants when a person in the lavatory needs aid.

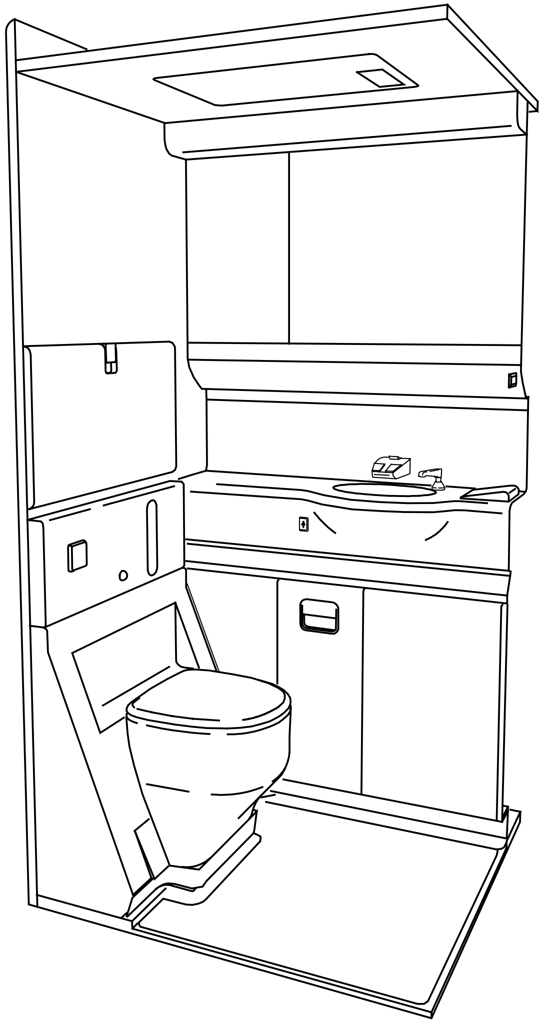
The master call light module tells the flight attendants when someone:

- Pushes a lavatory call switch
- Pushes an attendant call switch (not shown)
- Calls an attendant station (not shown).

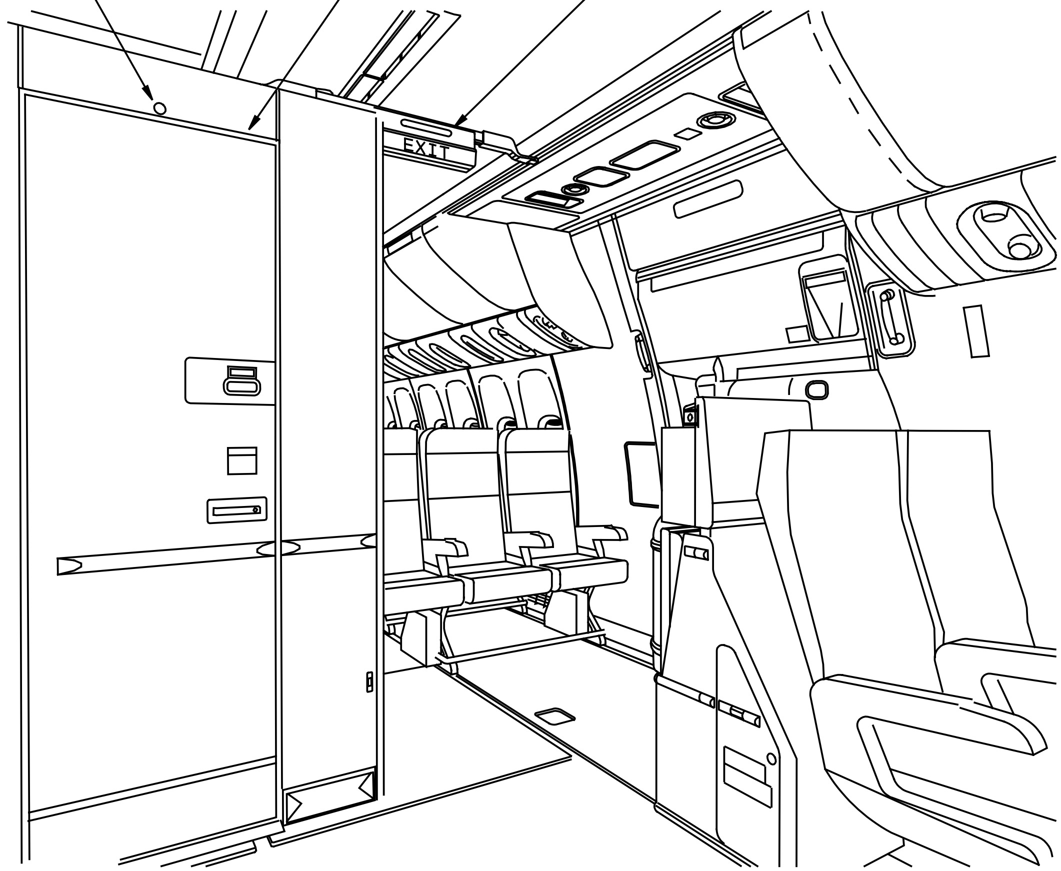
Location

There is a lavatory call switch in each lavatory and a lavatory call reset switch above the door on the external wall of the lavatory.

The master call light modules are on some exit signs.



LAVATORY (TYP)



PASSENGER COMPARTMENT (TYP)

33-25-00-001 Rev 0

LAVATORY CALL LIGHTS AND MASTER CALL LIGHT MODULES - INTRODUCTION

LAVATORY LIGHTS AND SIGNS - LIGHTS - INTRODUCTION

Purpose

The lavatory lights supply light in the lavatories.

Location

The lavatory lights are in the ceiling and on the sidewall of the lavatories.

The mirror light is above the mirror.

The dome light is in the passenger service unit (PSU).

Physical Description

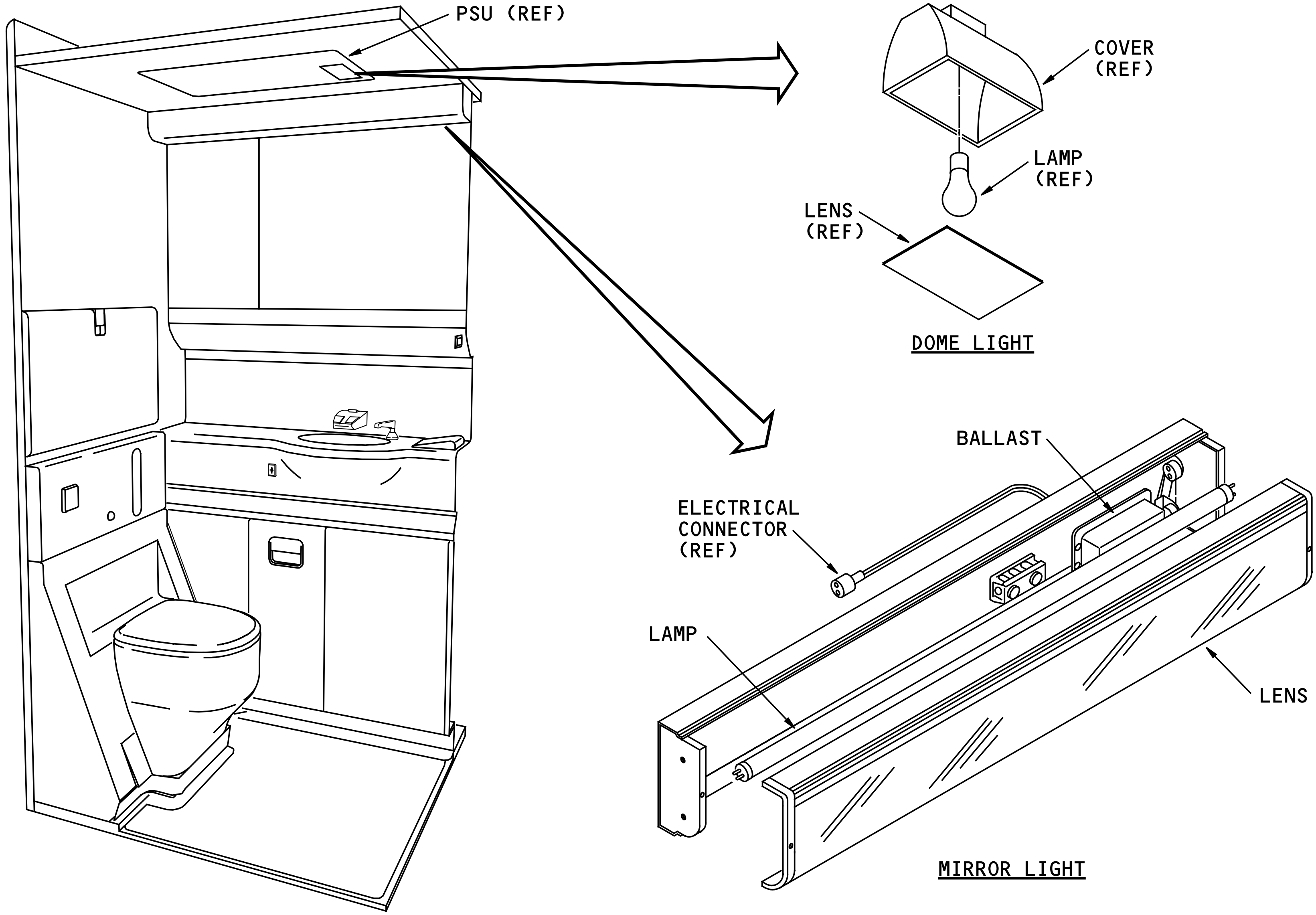
The light above the mirror is fluorescent. It has a ballast and an electrical connector.

The light in the lavatory PSU is incandescent.

Training Information Point

You compress the mirror light lens to remove it. You can get access to the lamp and the ballast when you remove the lens.

You lower the PSU and lift up on the cover to get access to the lamp.



33-26-00-001 Rev 0

LAVATORY LIGHTS AND SIGNS - LIGHTS - INTRODUCTION

LAVATORY LIGHTS AND SIGNS - SIGNS - INTRODUCTION

Purpose

Signs tell when all the lavatories in an area are in use and when to lock the lavatory door.

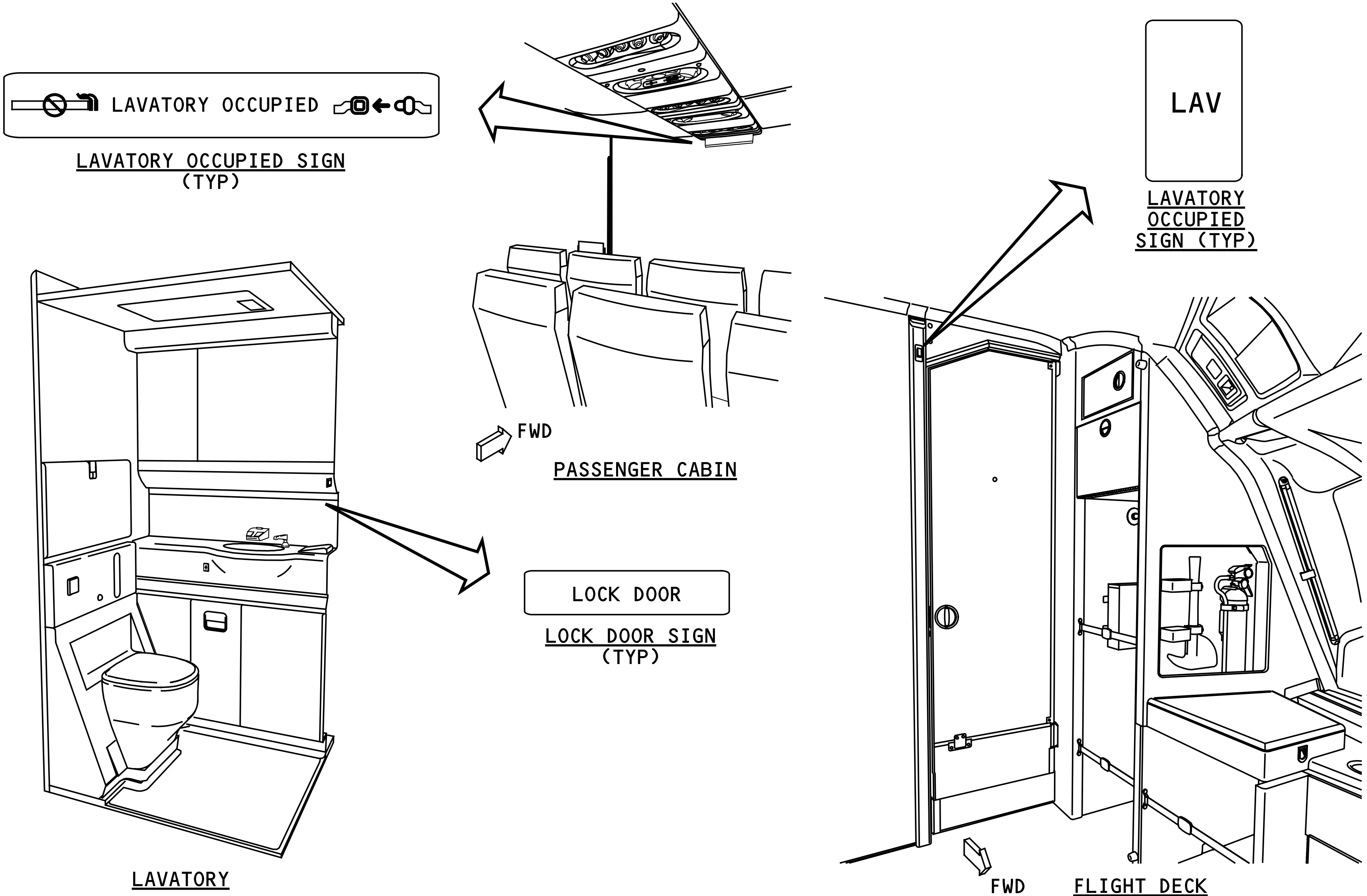
Location

The lavatory occupied signs are below the PSUs at the front or rear of a zone. They are above the passenger seats and below the PSUs. Also there is a lavatory occupied sign in the flight deck.

Training Information Point

There is a lock door sign in the lavatory.

You can use the configuration database in the cabin services system to program which lavatories make up an area.



33-26-00-002 Rev 1 03/04/1997

LAVATORY LIGHTS AND SIGNS - SIGNS - INTRODUCTION

GALLEY LIGHTS - INTRODUCTION

Purpose

The galley lights give light in the galleys.

Physical Description

These are the galley lights:

- Main galley lights
- Supplemental galley lights
- Standby lights.

The main galley lights are fluorescent lights. They have a lens.

The standby light has an incandescent lamp. The lamp is a bayonet-style lamp. The standby light is in the main galley light.

A supplemental galley light has these parts:

- Slot (4)
- Bezel/lens retainer
- Lens
- Tab (4)
- Lamp
- Lever.

You use the lever to lock the light in position.

Location

The the main and supplemental lights are in the ceiling in the galleys. The main galley lights have standby lights with them.

Training Information Point

To replace the main galley lights you use the fasteners in the corners of the lens to remove the lens and bezel. They are one part. This gives you access to the fluorescent lights.

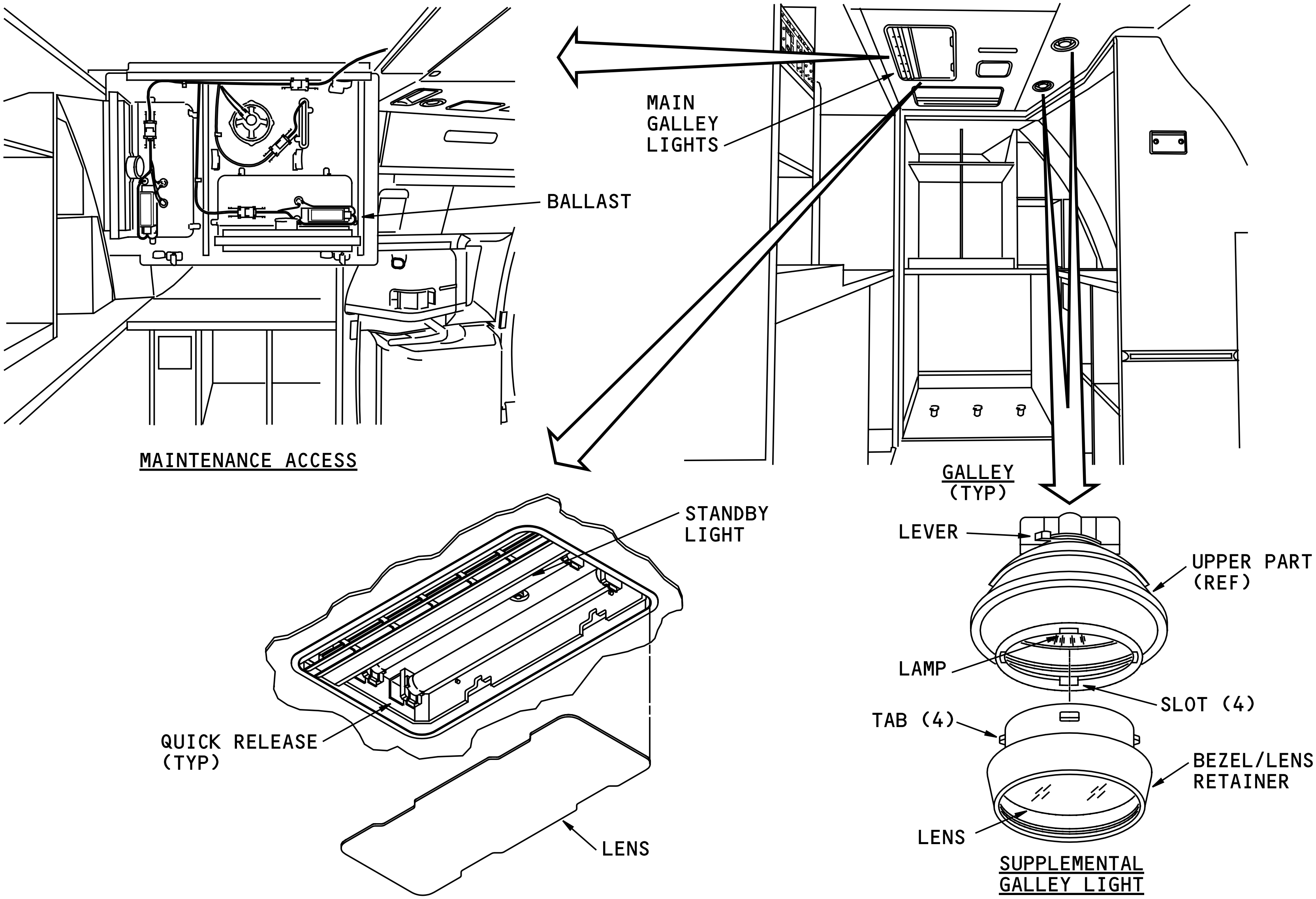
You use the quick releases to remove the fluorescent lights.

You lower the ceiling panel to get access to the ballast.

To replace a supplemental light you:

- Compress the lens/bezel retainer
- Turn it counterclockwise to disconnect it from the slots
- Replace the lamp.

You do the opposite procedure to install the bezel/lens retainer.



33-27-00-001 Rev 0

GALLEY LIGHTS - INTRODUCTION

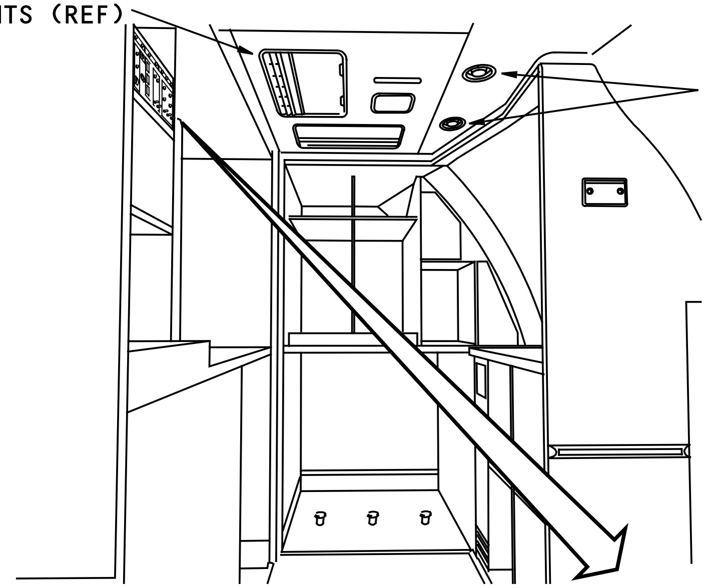
GALLEY LIGHTS - OPERATION

Operation

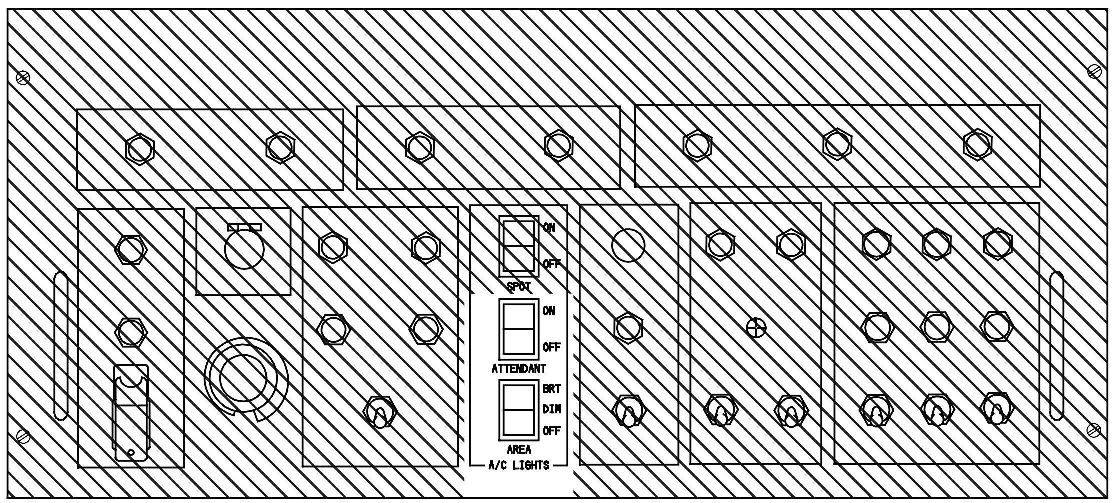
You use the area light switch to make the main galley lights come on in the dim or bright mode.

You use the attendant light switch to operate the supplemental lights.

The standby lights come on when the transfer buses have power and the ground service bus does not have power.



GALLEY (TYP)



GALLEY LIGHTS - OPERATION

PASSENGER CALL LIGHTS - INTRODUCTION

Purpose

The passenger call lights tell the flight attendants when aid is necessary.

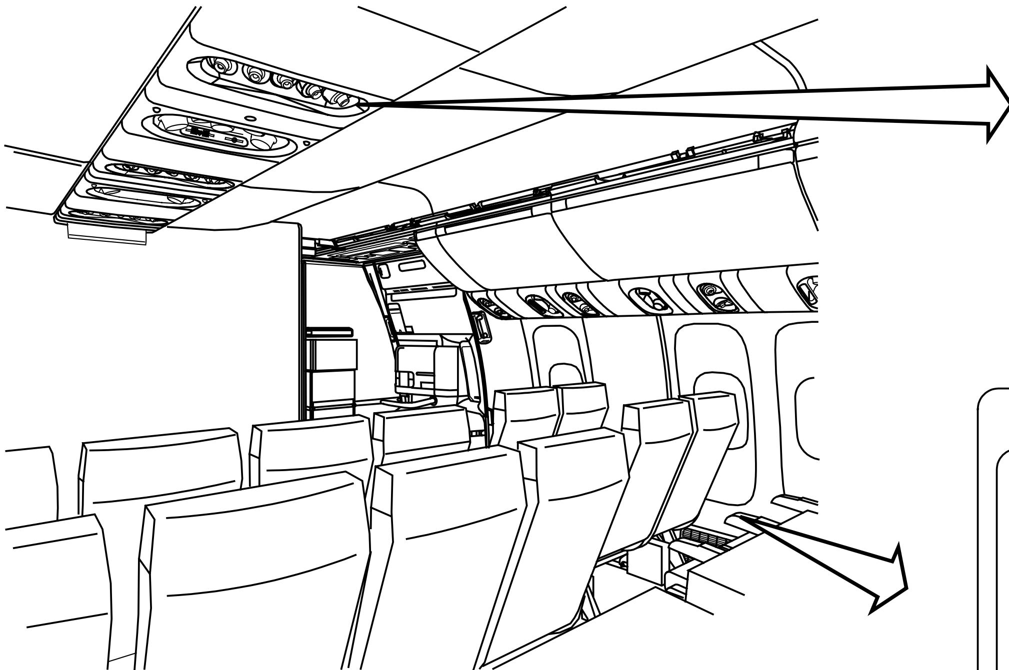
Location

There is an attendant call switch and attendant call reset switch on the passenger control unit (PCU) at each seat.

There are two passenger call lights on each center passenger service unit (PSU). There is one on each outboard PSU.

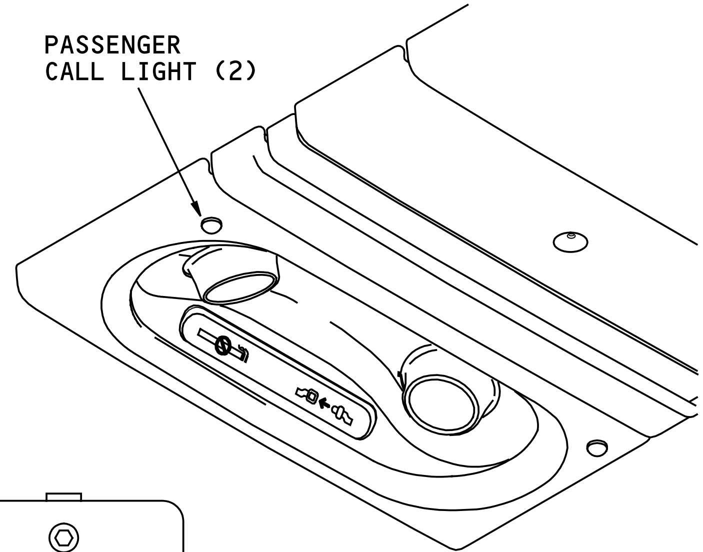
Interface

The passenger call lights give signals to the master call module, the passenger address/cabin interphone (PA/CI) system and the CACP and CSCP screens.



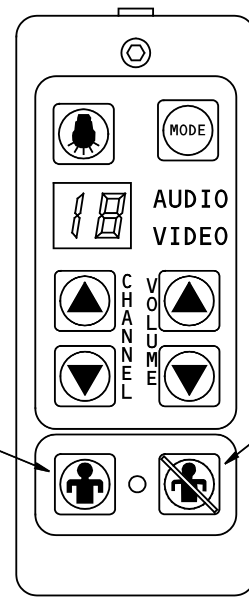
PASSENGER CABIN (TYP)

PASSENGER
CALL LIGHT (2)



PSU

ATTENDANT
CALL
SWITCH



ATTENDANT
CALL RESET
SWITCH

PASSENGER CONTROL
UNIT (TYP)

33-28-00-001 Rev 1 03/17/1997

PASSENGER CALL LIGHTS - INTRODUCTION

PASSENGER CALL LIGHTS - STERILE COCKPIT LIGHT

Purpose

The sterile cockpit light shows the cabin crew when the airplane is in a critical phase of flight.

General Description

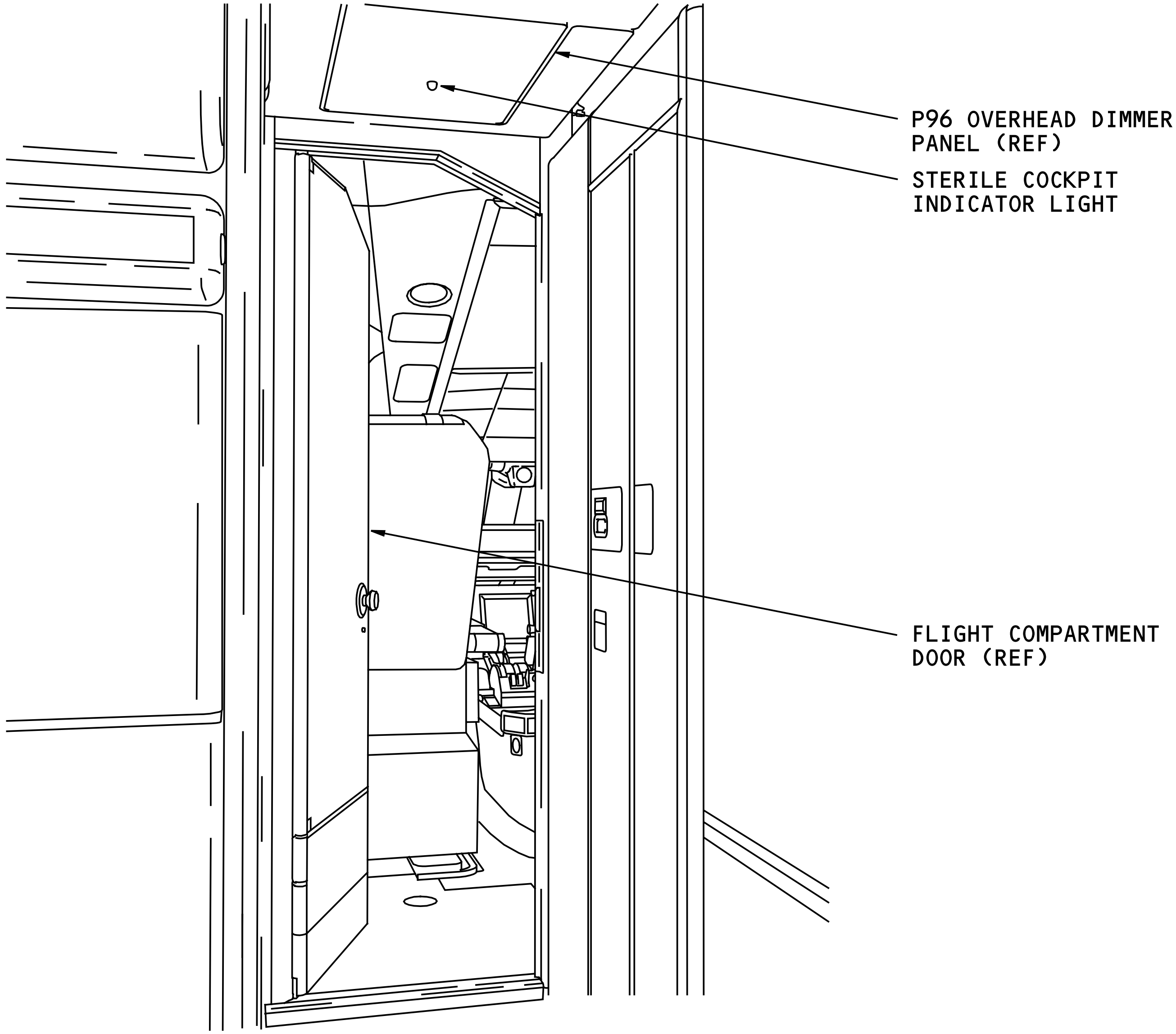
Federal aviation regulations make it necessary for the flight crew to keep a sterile cockpit during critical phases of flight. During these conditions, the crew is permitted to do only those tasks necessary for the safe operation of the airplane.

Critical phases of flight include taxi, takeoff, landing, and flight operations below 10,000 feet.

The sterile cockpit light comes on automatically when the airplane is below 10,000 feet and the parking brake is not set.

Location

The light is in the P96 overhead dimmer panel. This panel is part of the lowered ceiling aft of the flight compartment door.



PASSENGER CALL LIGHTS - STERILE COCKPIT LIGHT

PASSENGER CALL LIGHTS - STERILE COCKPIT LIGHT - FUNCTIONAL DESCRIPTION

Functional Description

The ADIRU gives airplane altitude data to AIMS through the ARINC 629 flight control buses. AIMS sends altitude and parking brake information to the cabin services system (CSS) through the ARINC 629 systems buses.

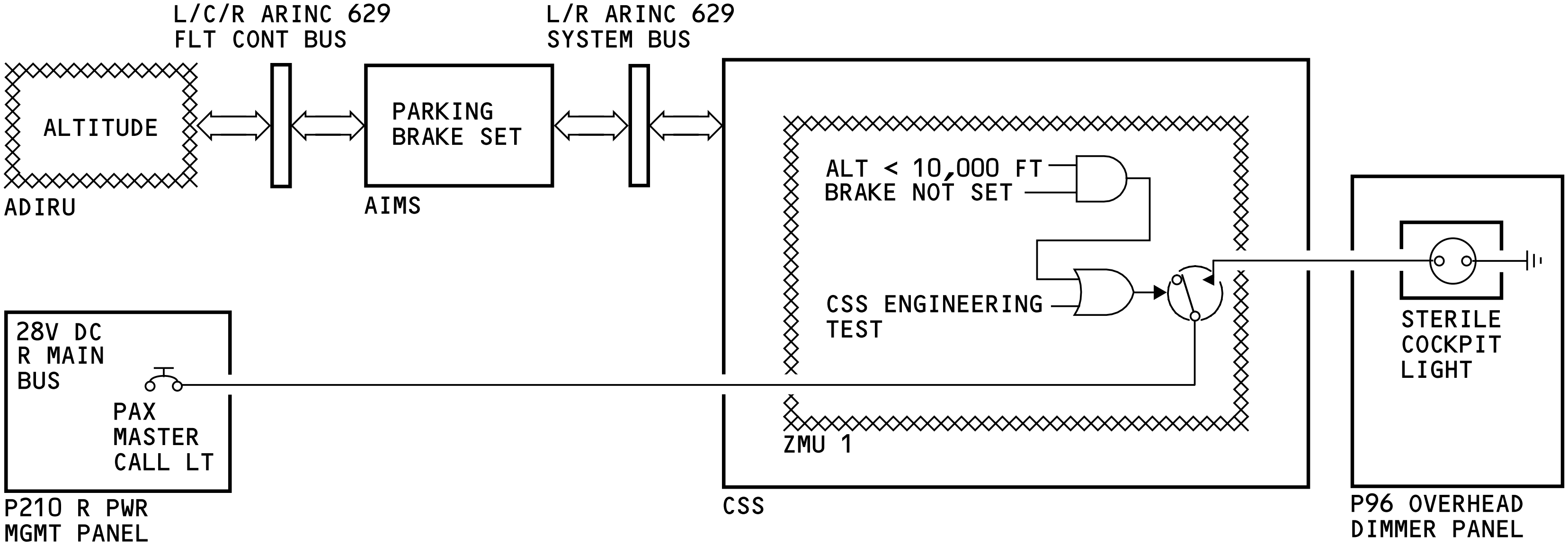
When the airplane altitude is less than 10,000 feet and the parking brake is not set, the zone management unit (ZMU) turns on the sterile cockpit light.

Power

The right main bus gives 28 volt dc power for the sterile cockpit light.

Training Information Point

You do a test of this light on the ground with the CSS engineering tests feature. See the cabin services system section for more information (AMM PART I 23-39).



33-28-00-005 Rev 1 03/12/1997

PASSENGER CALL LIGHTS - STERILE COCKPIT LIGHT - FUNCTIONAL DESCRIPTION

EMERGENCY LIGHTING - INTRODUCTION

Purpose

The emergency lights give light when normal power sources are not available.

They give light:

- In the aisles
- To identify exits
- To identify routes to the exits.
- Outside the airplane at the slides.

Physical Description

The emergency lighting system has these components:

- Area lights
- Exit signs
- Slide lights
- Floor proximity lights
- Power supplies
- Emergency dome light.

Location

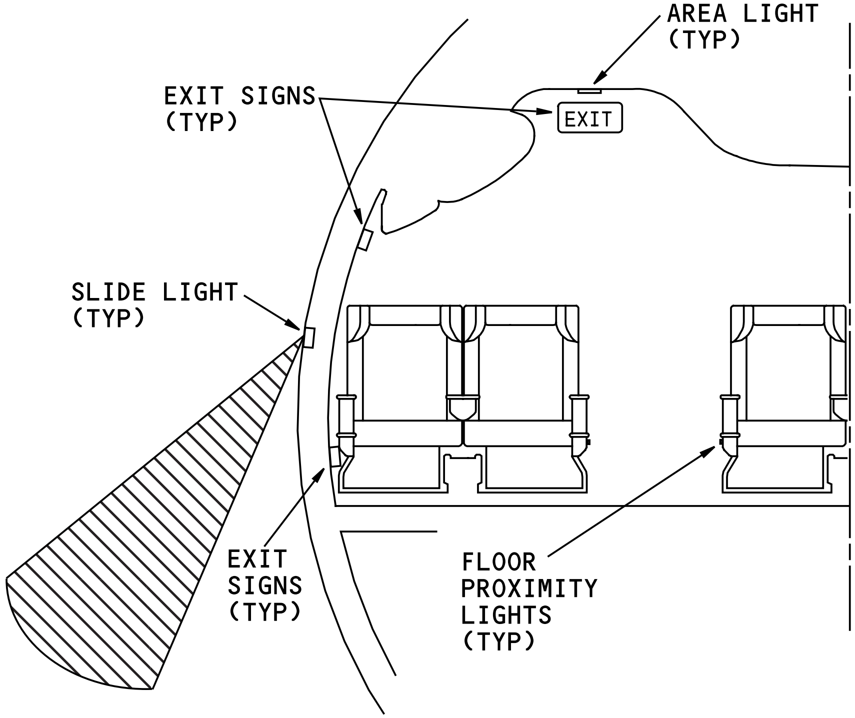
There are emergency lights:

- In the aisle ceilings
- Near the door
- On the center aisle seats
- On the lavatories
- On the closets
- On the galleys
- In the flight compartment.

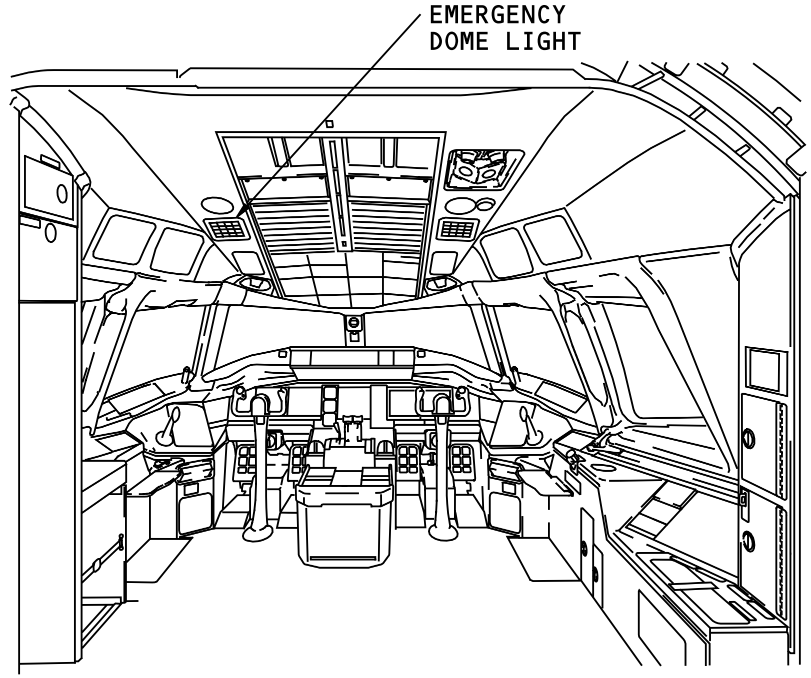
The power supplies (not shown) are above the ceiling, near each passenger entry door.

There are controls (not shown):

- In the flight compartment
- On some attendants panels
- On the nose gear.



PASSENGER COMPARTMENT
(RIGHT SIDE)



EMERGENCY LIGHTING - INTRODUCTION

EMERGENCY LIGHTING - EXIT SIGNS - GENERAL DESCRIPTION

Purpose

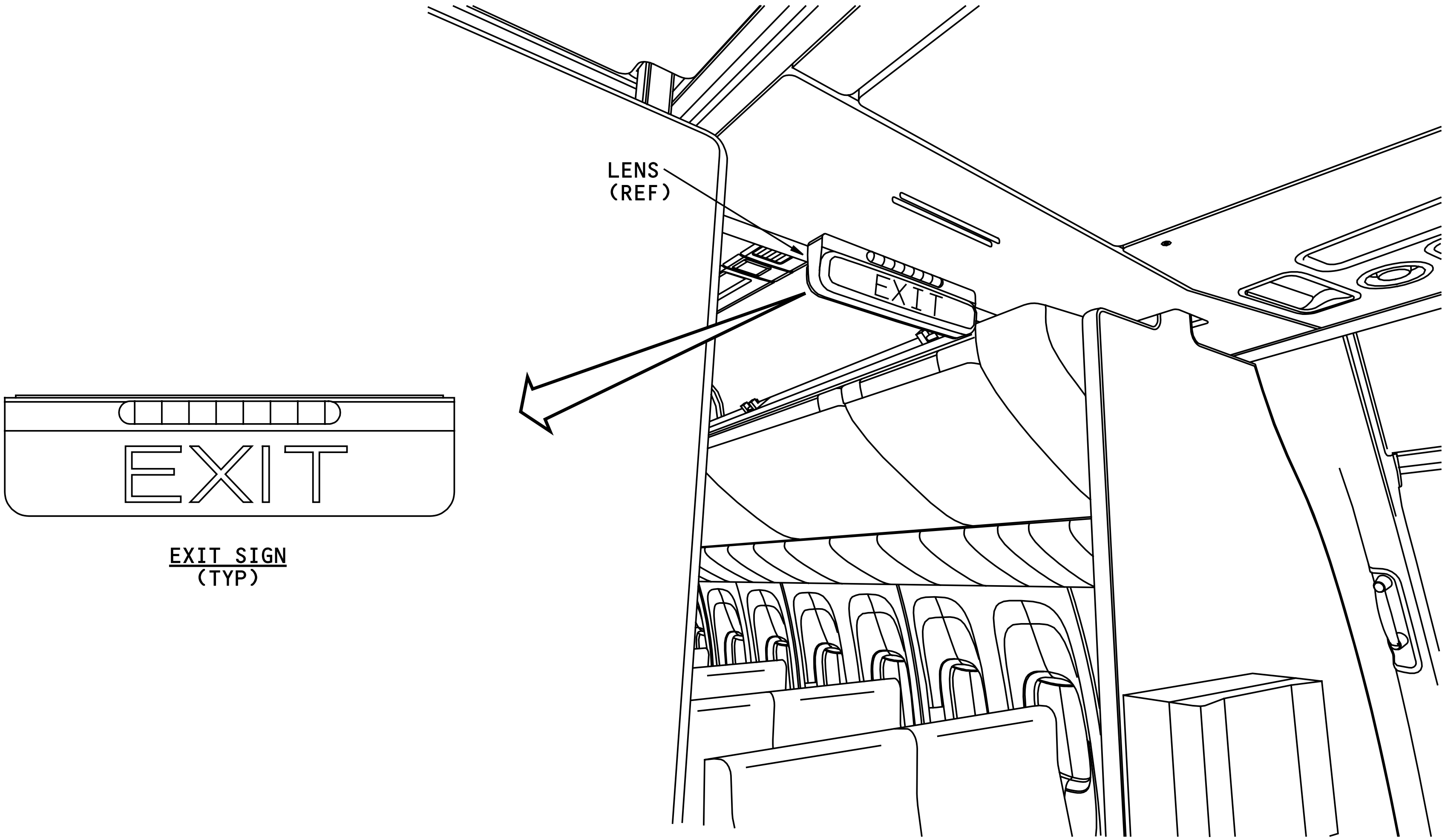
The exit sign lights come on to show where the exits are.

Location

The exit signs are on lowered ceiling panels near all the doors and in the cross aisles.

Training Information Point

You compress the lens of the exit sign to remove it and get access to the bulbs. There are twelve bulbs in each sign.



33-50-00-002 Rev 0

EMERGENCY LIGHTING - EXIT SIGNS - GENERAL DESCRIPTION

EMERGENCY LIGHTING - AREA LIGHTS - GENERAL DESCRIPTION

Purpose

The area lights give light to the aisles when the main buses do not have power. They help passengers and crew to see in an emergency.

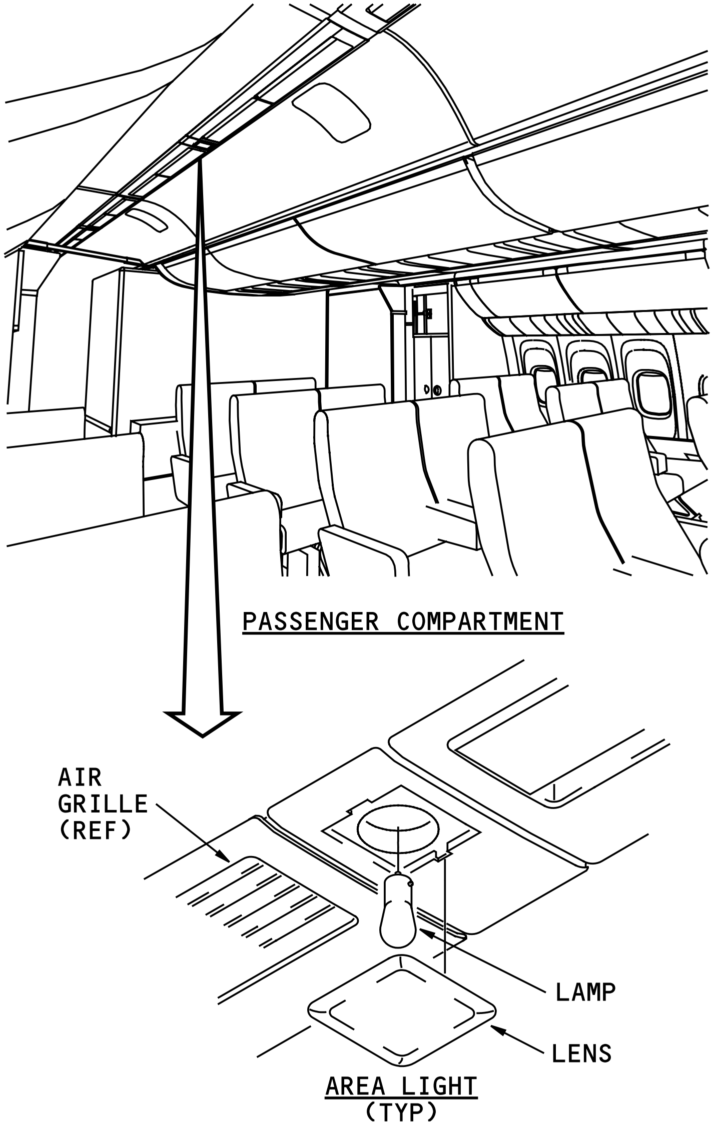
Location

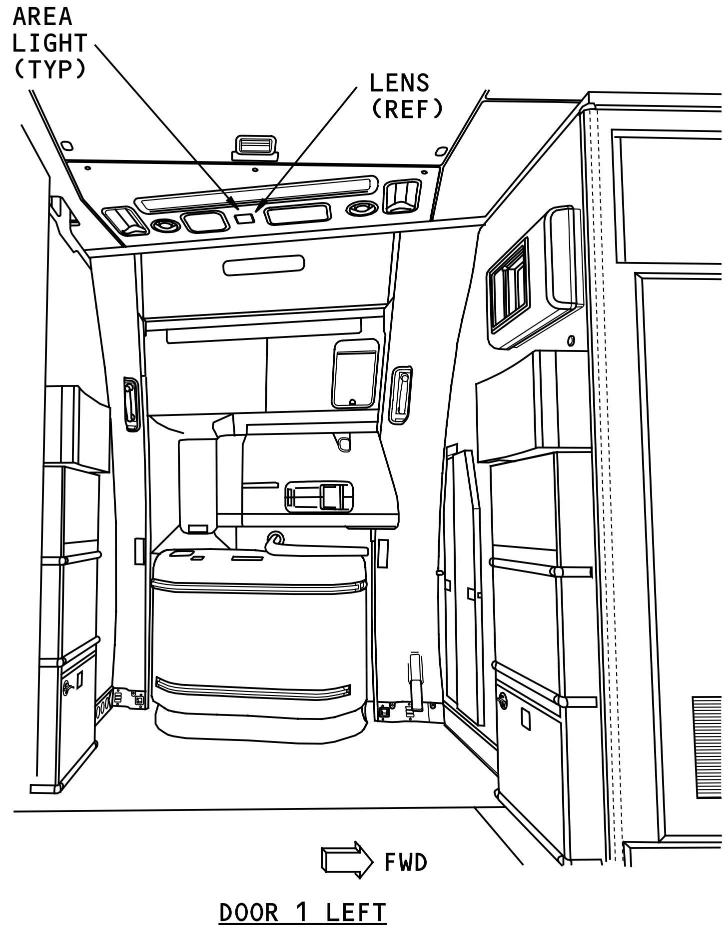
The area lights are in the ceiling:

- In the aisles of the passenger compartment
- In the galleys
- Near the doors.

Training Information Point

You compress the lens to get access to the lamp. The lamp is a bayonet-style lamp. All area lights use the same type lamp.





33-50-00-003 Rev 0

EMERGENCY LIGHTING - AREA LIGHTS - GENERAL DESCRIPTION

EMERGENCY LIGHTING - FLOOR PROXIMITY LIGHTS - GENERAL DESCRIPTION

Purpose

The floor proximity lights give light to the floor to help passengers and crew find the exits.

Location

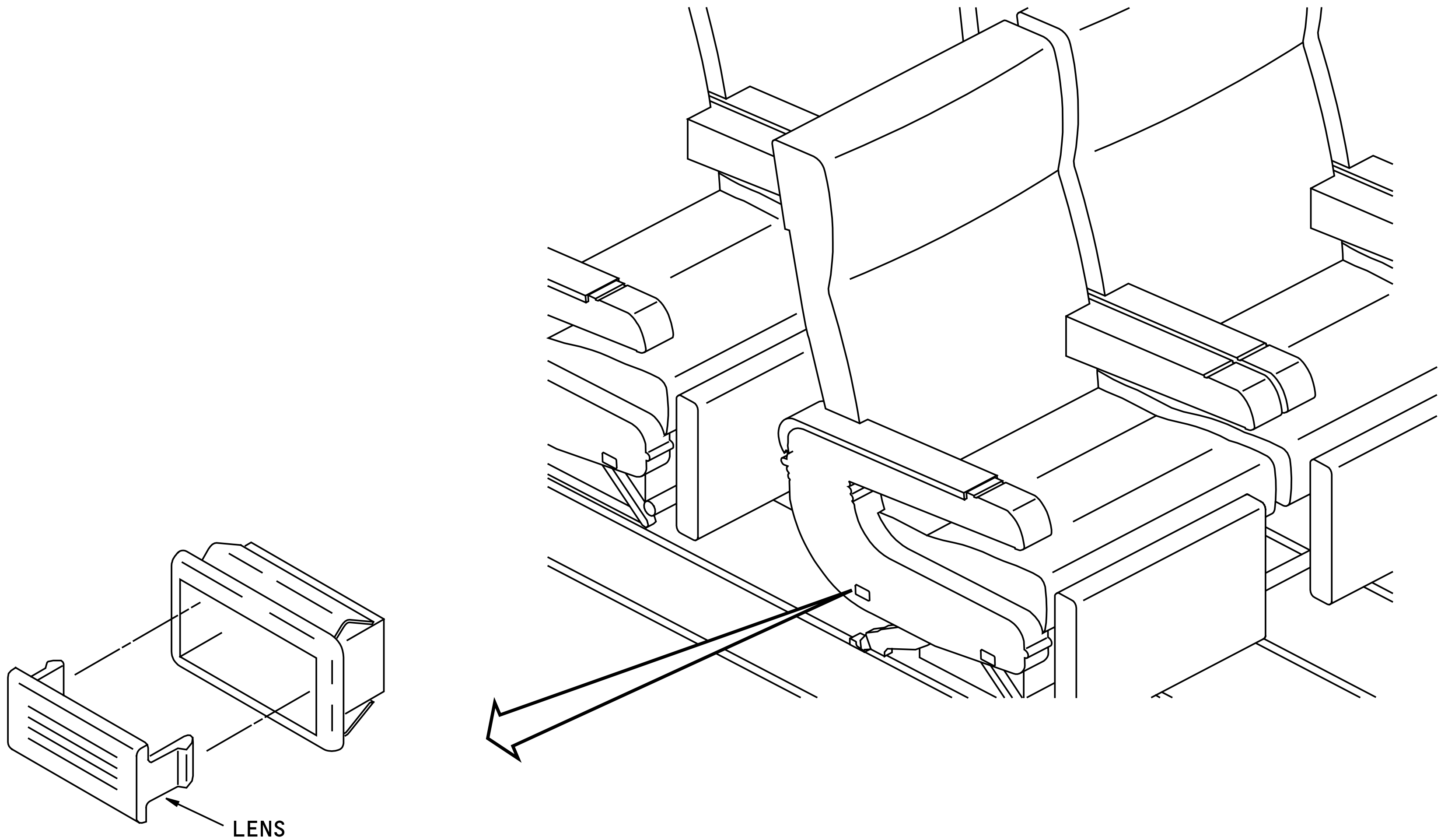
The lights are on the:

- Center aisle seats that are next to an aisle
- Center lavatories (not shown)
- Center closets (not shown)
- Center class dividers (not shown)
- Center galleys (not shown).

Physical Description

The lights on the seats have spring clips that hold the light assembly in place. The lights on other surfaces have screws that hold the light assembly in place. The lens has tabs to hold it in the assembly.

The light is bayonet-style. There is one light in each assembly in economy class and two lights in each assembly in first and business class.



33-50-00-004 Rev 2 08/07/96

EMERGENCY LIGHTING - FLOOR PROXIMITY LIGHTS - GENERAL DESCRIPTION

EMERGENCY LIGHTING - EMERGENCY DOME LIGHT - GENERAL DESCRIPTION

Purpose

The emergency dome light gives light in the flight deck when the main buses do not have power. It helps the crew to see in an emergency.

Location

The emergency dome light is part of the captain's dome light. It is above the captain's seat.

Physical Description

The light has these components:

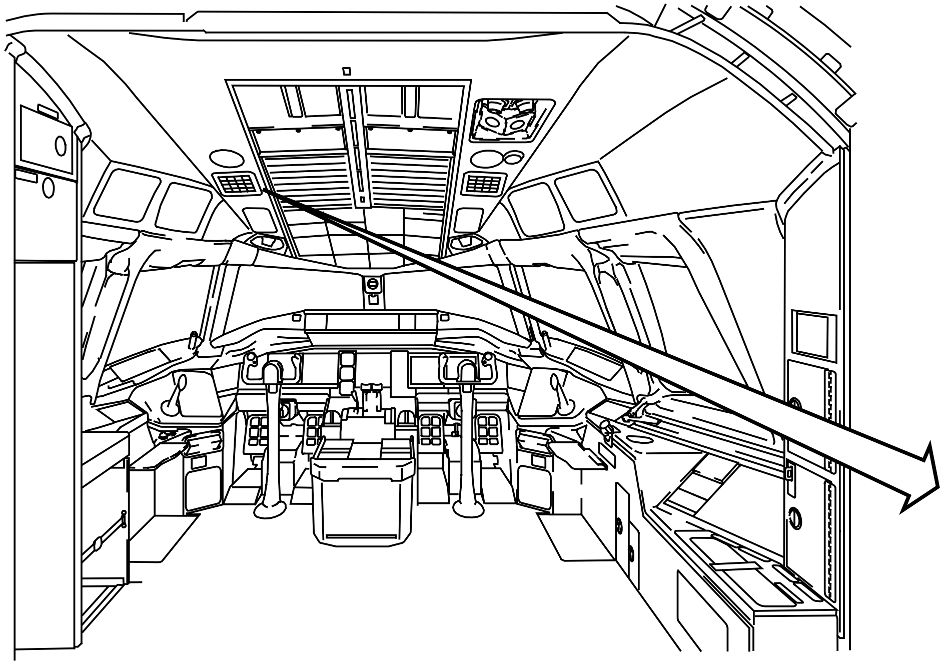
- Lamp
- Lens
- Grill.

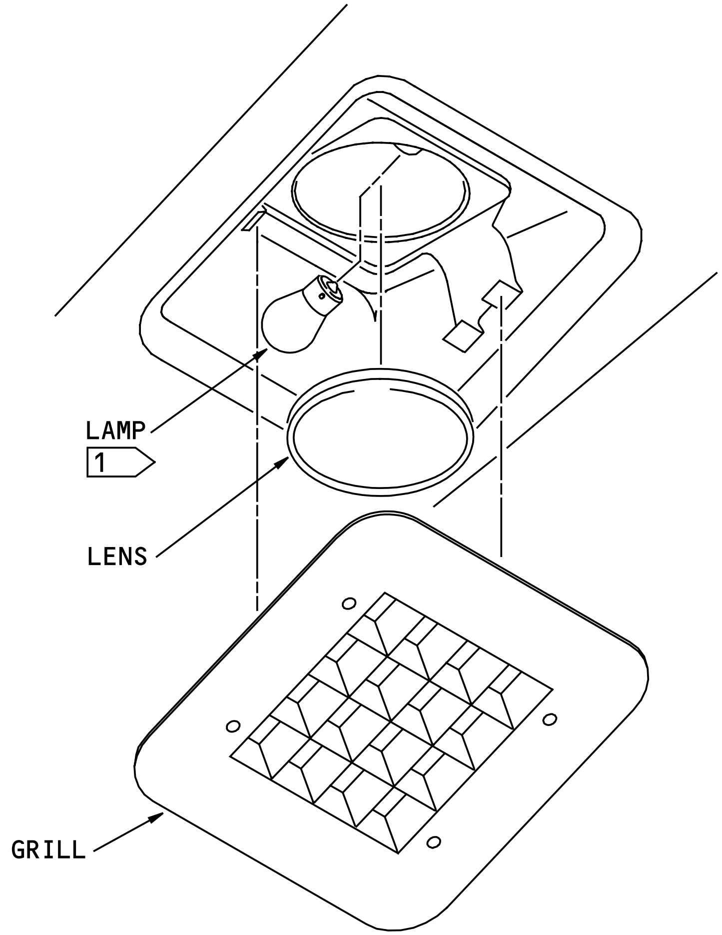
The captain's dome light has two lamps. One is the emergency light system and the other is the normal lamp.

See the flight compartment illumination section for more information about the captain's dome light (AMM PART I 33-11).

Training Information Point

To get access to the lamp you pull down on the grill and remove the lens. The lens has a bayonet-style mount. The lamp is a bayonet-style lamp.





DOME LIGHT

1 THE CAPTAIN'S DOME LIGHT HAS TWO LAMPS. ONE IS FOR THE EMERGENCY LIGHTS AND THE OTHER IS THE NORMAL LAMP.

33-50-00-005 Rev 3 07/17/1997

EMERGENCY LIGHTING - EMERGENCY DOME LIGHT - GENERAL DESCRIPTION

EMERGENCY LIGHTING - SLIDE LIGHTS - GENERAL DESCRIPTION

Purpose

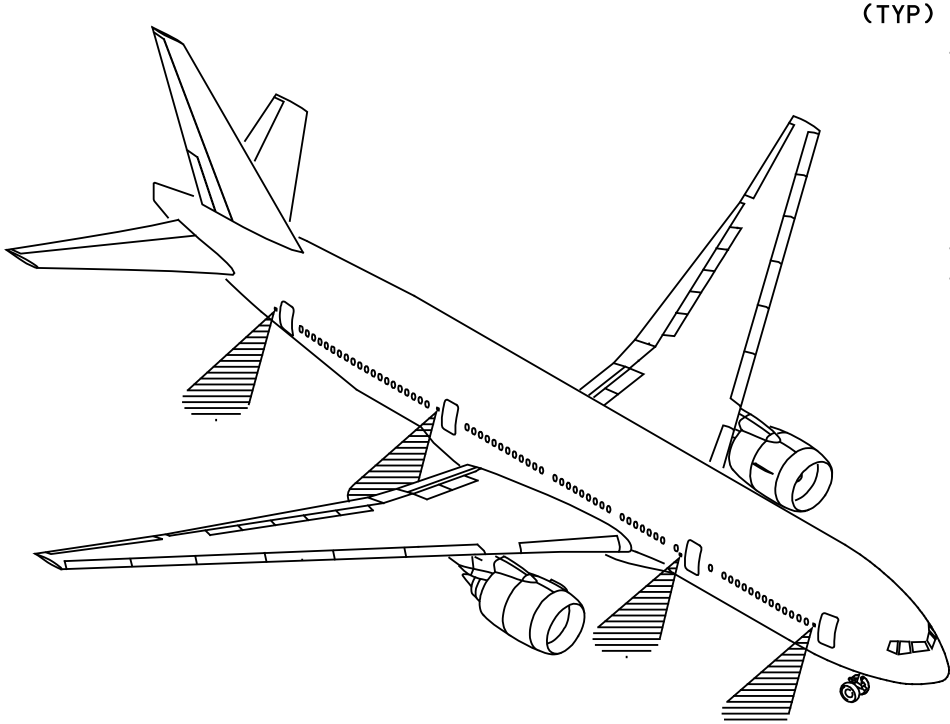
The slide lights give light to the slide on the outside of the airplane.

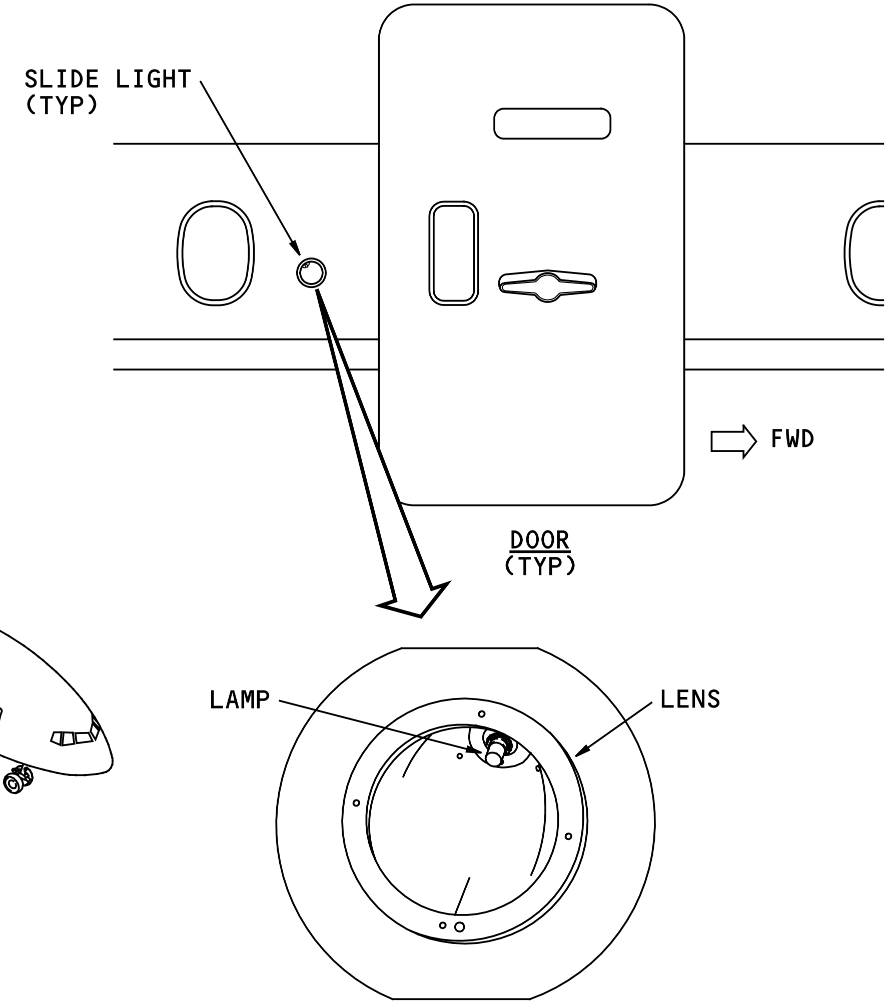
Location

The lights are on the outer surface of the airplane aft of each door.

Training Information Point

You remove the four retaining screws on the lens retainer to get access to the light bulb. There is a lanyard that does not let the lens fall. The light bulb is a bayonet-style bulb.





33-50-00-006 Rev 2 05/16/1997

EMERGENCY LIGHTING - SLIDE LIGHTS - GENERAL DESCRIPTION

EMERGENCY LIGHTING - POWER SUPPLIES - INTRODUCTION

Purpose

The power supplies for the emergency lighting system have these functions:

- Controls the rate of charge for its batteries
- Controls when the emergency lights turn on and off
- Controls the selection of airplane power or its batteries to operate the emergency lights.

Location

The power supplies are in the ceiling, above the passenger entry doors. There can be 2, 3, or 4 power supplies at each door.

Power supplies at doors 1 and 4 attach to the upper side of the overdoor panel.

Power supplies attach to the strong back assembly above the overdoor panel at these doors:

- 2
- 3.

The strong back assembly is related to the outboard stowage bin.See the passenger compartment section for more information about the outboard stowage bins (AMM PART I 25-20).

Physical Description

The power supplies weigh 2.8 pounds (1.3 kg). They supply 6v dc to the emergency lights.

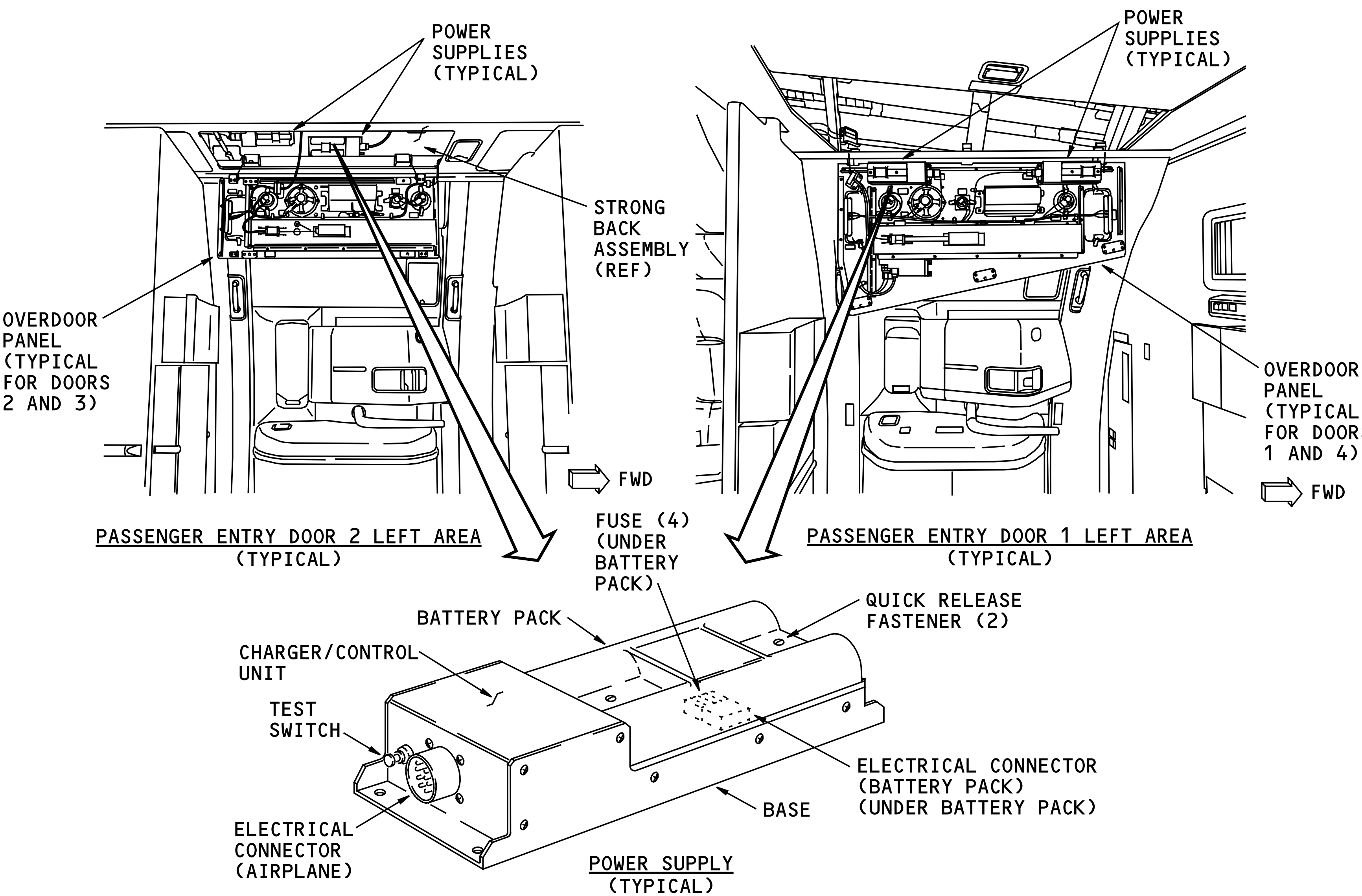
Each power supply has these parts:

- Test switch
- Charger/control unit
- Battery pack
- Fuse (4)
- Quick release fastener (2)
- Electrical connector (battery pack)
- Base
- Electrical connector (airplane).

The fuses and the battery pack are replaceable. The fuses attach to the base under the battery pack. The battery pack attaches to the base with two quick release fasteners. When fully charged, the battery pack provides power for a minimum of 15 minutes.

Training Information Point

The power supplies give power to the lights that are in the same airplane section as the power supplies. They are all the same and interchangeable. They continuously self-charge (L or R main dc buses). If the batteries discharge, they do a fast charge. It takes approximately 90 minutes for a fast charge.



33-50-00-007 Rev 4 02/10/1998

EMERGENCY LIGHTING - POWER SUPPLIES - INTRODUCTION

EMERGENCY LIGHTING - OPERATION

Operation

You use the emergency lights switch in the flight deck or on the P87 attendant switch panel (ASP) to operate (control) the emergency lights.

Either switch turns on the lights. The switch used to turn on the lights must be used to turn off the lights. The OFF position of the flight deck switch does not affect the function of the switch on the ASP.

In normal operation, the switch in the flight deck is in the ARMED position. The ARMED position lets all lights come on if there is no electrical power on the left and right main dc buses.

The ARMED position also lets a limited number of lights come on when a passenger entry door is opened in the armed mode.

To do a test of the lights, you use the test switches on these components:

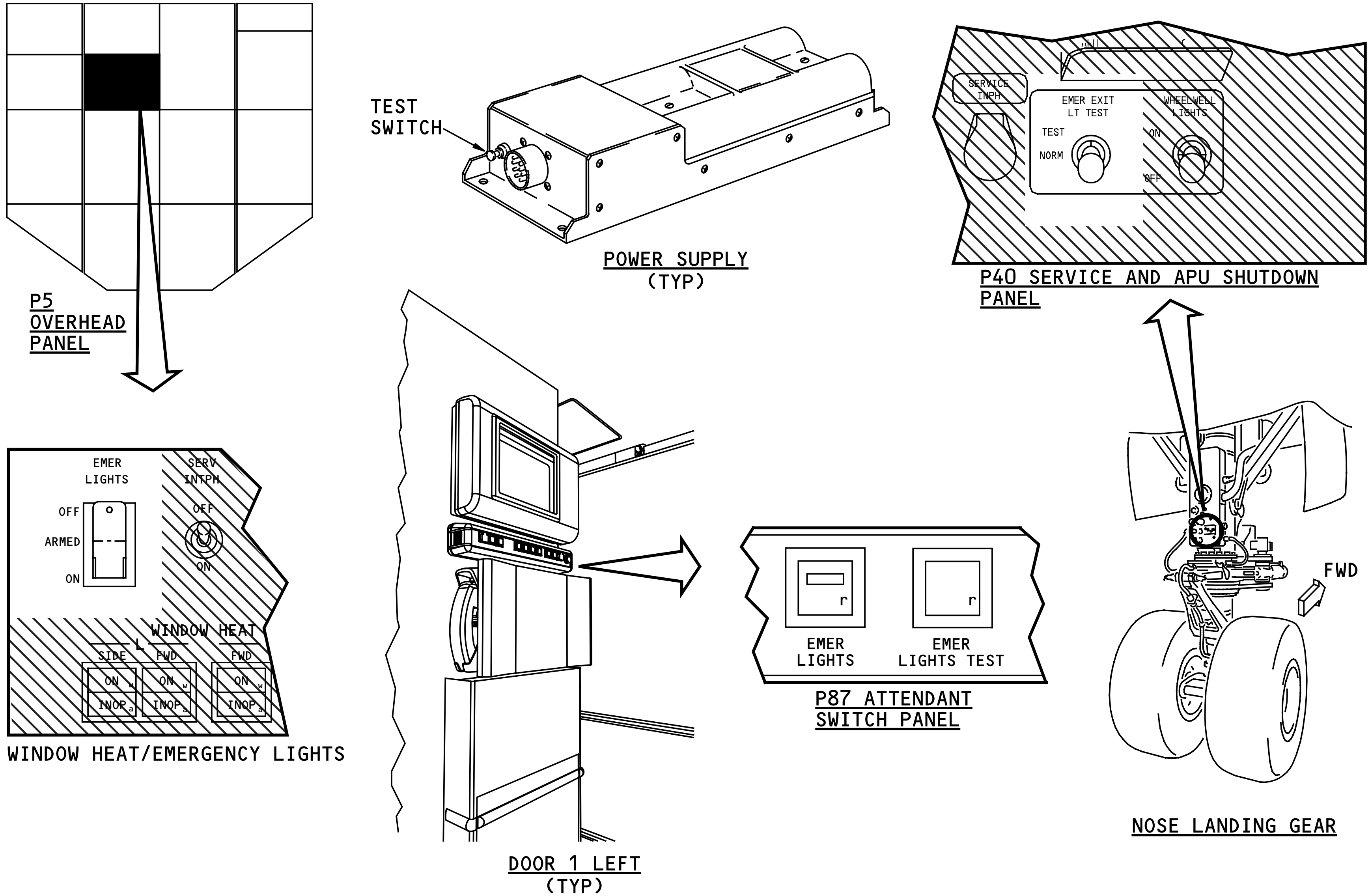
- P87 attendant switch panel at door 1 left
- P94 attendant switch panel at door 4 right (not shown)
- P40 service and APU shutdown panel
- Power supply.

The emergency lights come on for one minute.

Training Information Point

When you push the test switch on the power supply, only the emergency lights that connect to that power supply come on. When you use the test switch on one of the attendant switch panel or on the P40, all emergency lights come on.

Make sure that the test switches return to their usual position when you release them. The usual position for the test switches on the ASPs is out. If a switch is in the test (in) position, red LEDs inside the switch come on. The test switch on the P40 has labels that show the TEST and NORM (usual) positions. If any test switch does not return to its usual position, the battery packs can discharge fully.



EMERGENCY LIGHTING - OPERATION

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EMERGENCY LIGHTING - FUNCTIONAL DESCRIPTION - CONTROL

General

There are six separate emergency light circuits. All circuits are similar. A typical circuit is shown.

Functional Description

The emergency lights use power from the main dc bus if available or from battery packs. The battery packs usually last for 15 minutes or more. All emergency lights (slide and interior) come on when any of these conditions occur:

- The emergency lights switch in the flight deck (P5) is in the ARMED position and the related main dc bus does not have power (left main dc bus for power supplies above doors 1 and 2, right main dc bus for power supplies above doors 3 and 4)
- The emergency lights switch in the flight deck (P5) is in the ON position
- The emergency lights switch on the P87 attendant switch panel (door 1L) is in the ON position.

When a passenger entry door is set to the armed mode (mode select switch set to AUTO) and is open (door open switch) these lights come on:

- The related slide light
- The interior emergency lights, near and on the same side as the related passenger entry door.

The lights stay on until none of the above conditions is true or until the battery packs do not have sufficient charge.

Test

You can find test switches for the emergency lights at these locations:

- P87 attendant switch panel (door 1L)
- P94 attendant switch panel (door 4R)
- P40 nose gear electrical service panel.

When you push and release an emergency light test switch, all power supplies do a check of the condition of their battery pack. All emergency lights (slide and interior) related to power supplies with a good battery pack, come on for one minute.

When you push and release the test switch on a power supply, only the lights that connect to the power supply come on for one minute.

Indications

The advisory message EMER LIGHTS shows when any of these conditions occur:

- Emergency lights switch (P5) is in the ON or OFF position
- Emergency lights switch (P87) is in the ON position.

EMERGENCY LIGHTING - FUNCTIONAL DESCRIPTION - CONTROL

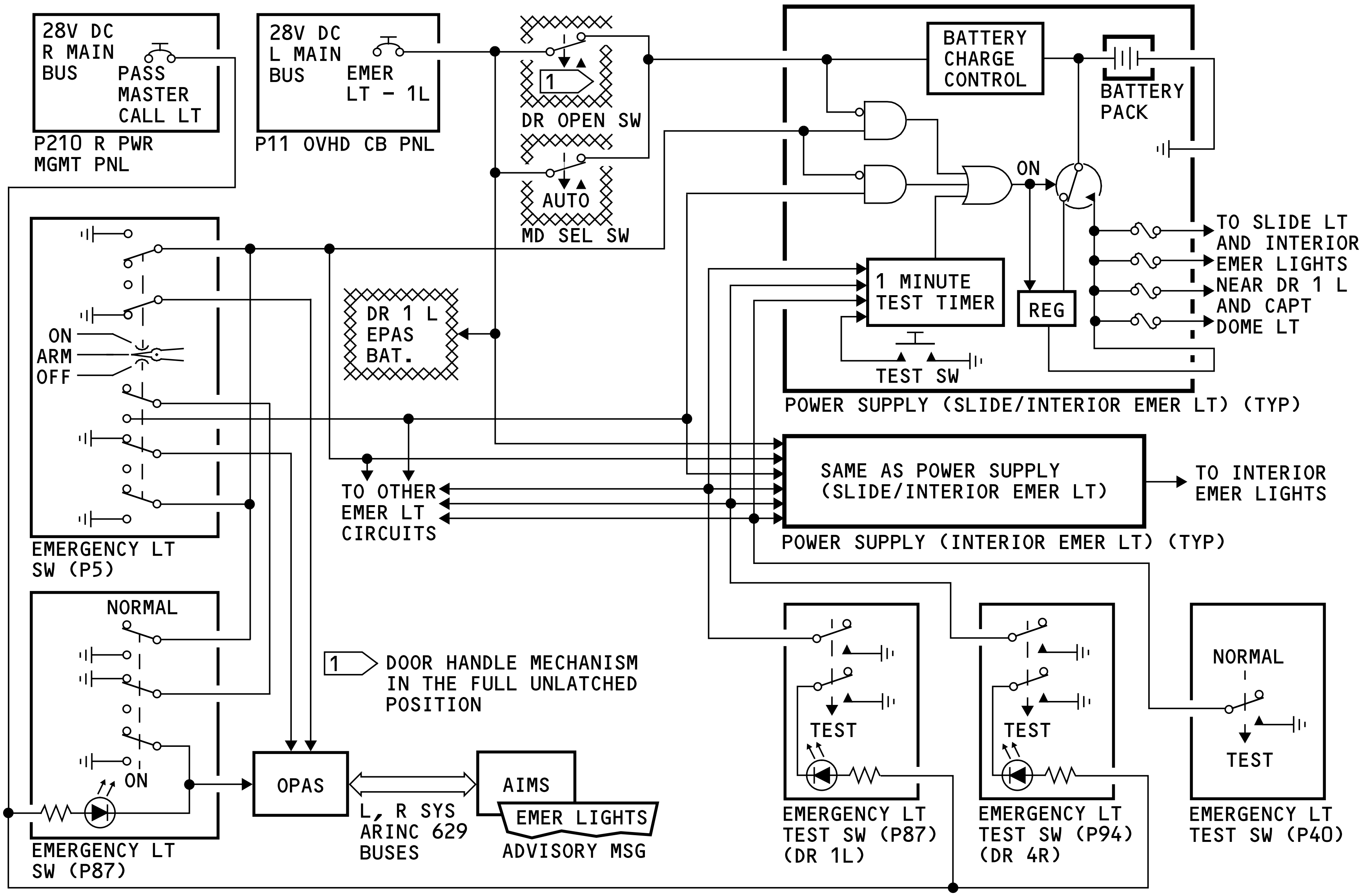
When the emergency lights switch on the attendants switch panel is in the ON position, a red light in the switch comes on.

There are no lights in the test switches.

Training Information Point

When you do a test of the emergency lights, make sure you use a test switch and not one of the emergency lights switches. If you use an emergency lights switch, the condition of the battery packs will not be checked if the main buses have power.

When you do a test of the emergency lights in the passenger cabin, you should also do a check of the condition of the emergency light found in the captain's dome light assembly.



EMERGENCY LIGHTING - FUNCTIONAL DESCRIPTION - CONTROL

SERVICE AND CARGO LOADING LIGHTS - INTRODUCTION

Purpose

The service and cargo loading lights give light to aid maintenance personnel and the ground crew.

Location

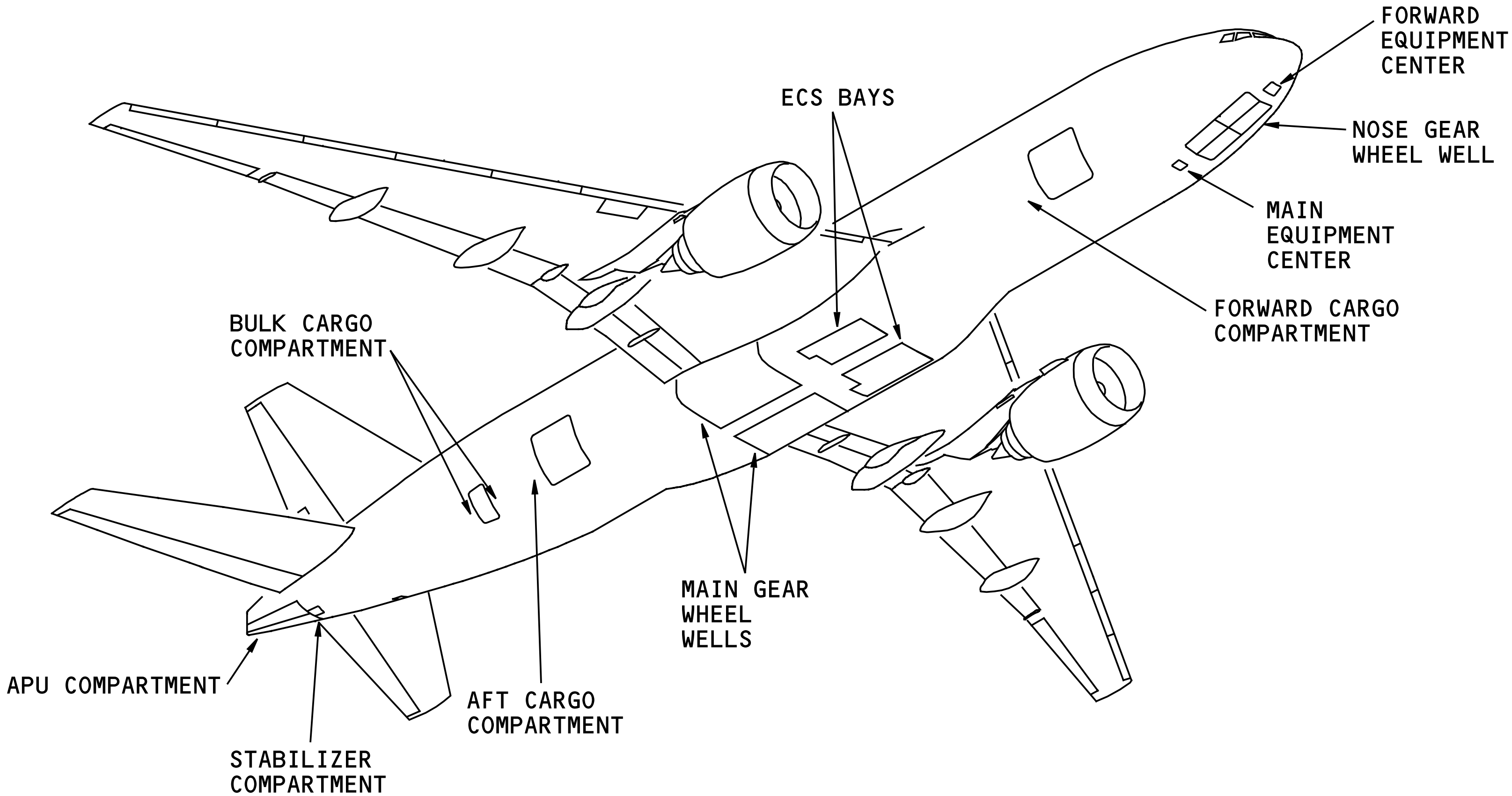
There are service lights in these areas:

- Forward equipment center
- Nose gear wheel well
- Main equipment center
- Environmental control system (ECS) bay
- Main gear wheel wells
- Stabilizer compartments
- APU compartment.

There are cargo loading lights on the external side of the airplane in these areas:

- Forward cargo compartment
- Aft cargo compartment
- Bulk cargo compartment.

There are also lights on the inside of the cargo doors that give light to the door area when the door is open (not shown).



33-31-00-001 Rev 1 04/10/1997

SERVICE AND CARGO LOADING LIGHTS - INTRODUCTION

SERVICE AND CARGO LOADING LIGHTS - EQUIPMENT CENTER LOCATIONS

Forward Equipment Center

There are six lights in the forward equipment center.

There are two FWD E/E BAY LTS switches that control the lights in the forward equipment center. One is in the forward equipment center, forward of the access door. It is adjacent to the cabin interphone jack. The other switch is in the main equipment center (MEC). It is above the MEC door.

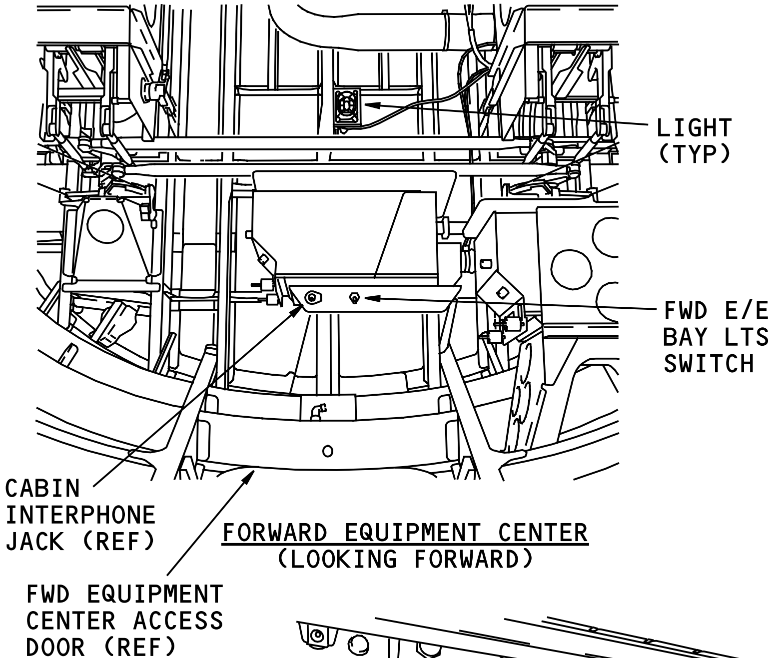
Main Equipment Center

There are ten lights on the ceiling of the MEC.

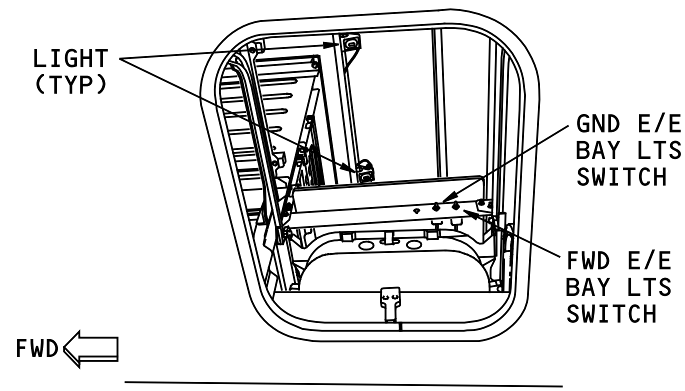
There are three light switches that control the lights in the MEC:

- GND E/E BAY LTS
- FLT E/E BAY LTS
- CARGO DR E/E LTS.

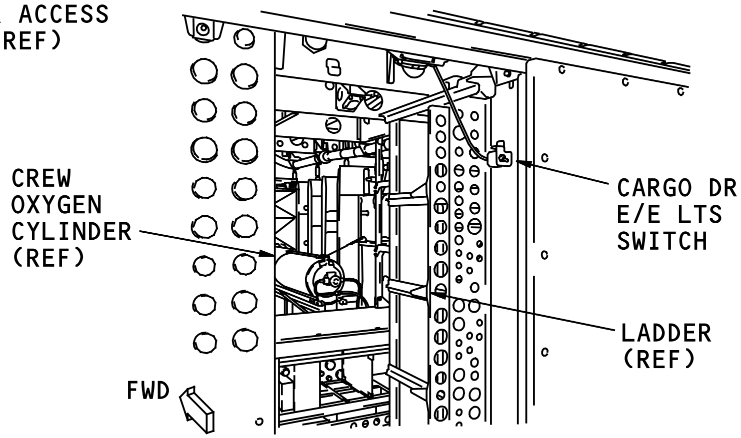
The GND E/E BAY LTS switch is above the MEC door, next to the FWD E/E BAY LTS switch. The FLT E/E BAY LTS switch is below the MEC access hatch and inboard from the P320. It is above and aft of the ladder. The CARGO DR E/E LTS switch is forward of the access panel between the forward cargo compartment and MEC. It is aft of the ladder.



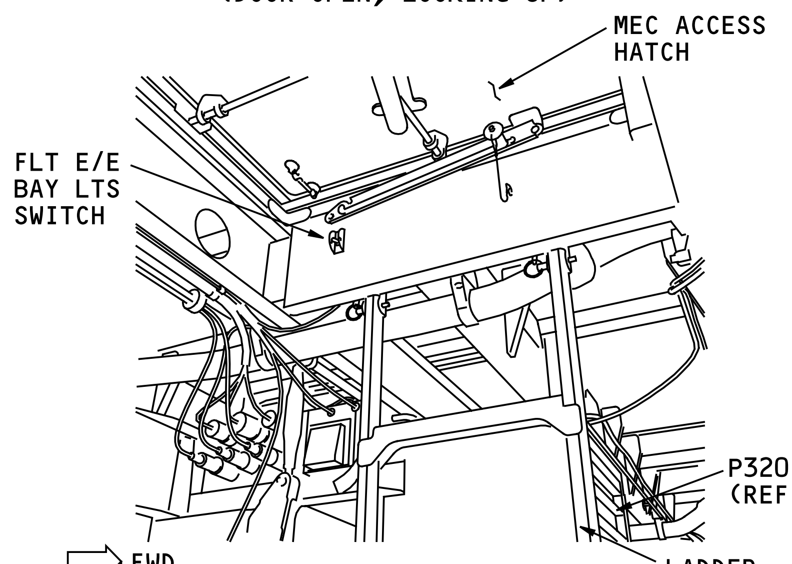
FORWARD EQUIPMENT CENTER
(LOOKING FORWARD)



MAIN EQUIPMENT CENTER
(DOOR OPEN, LOOKING UP)



FORWARD CARGO COMPARTMENT
(ACCESS DOOR REMOVED
LOOKING FORWARD INTO MEC)



MAIN EQUIPMENT CENTER

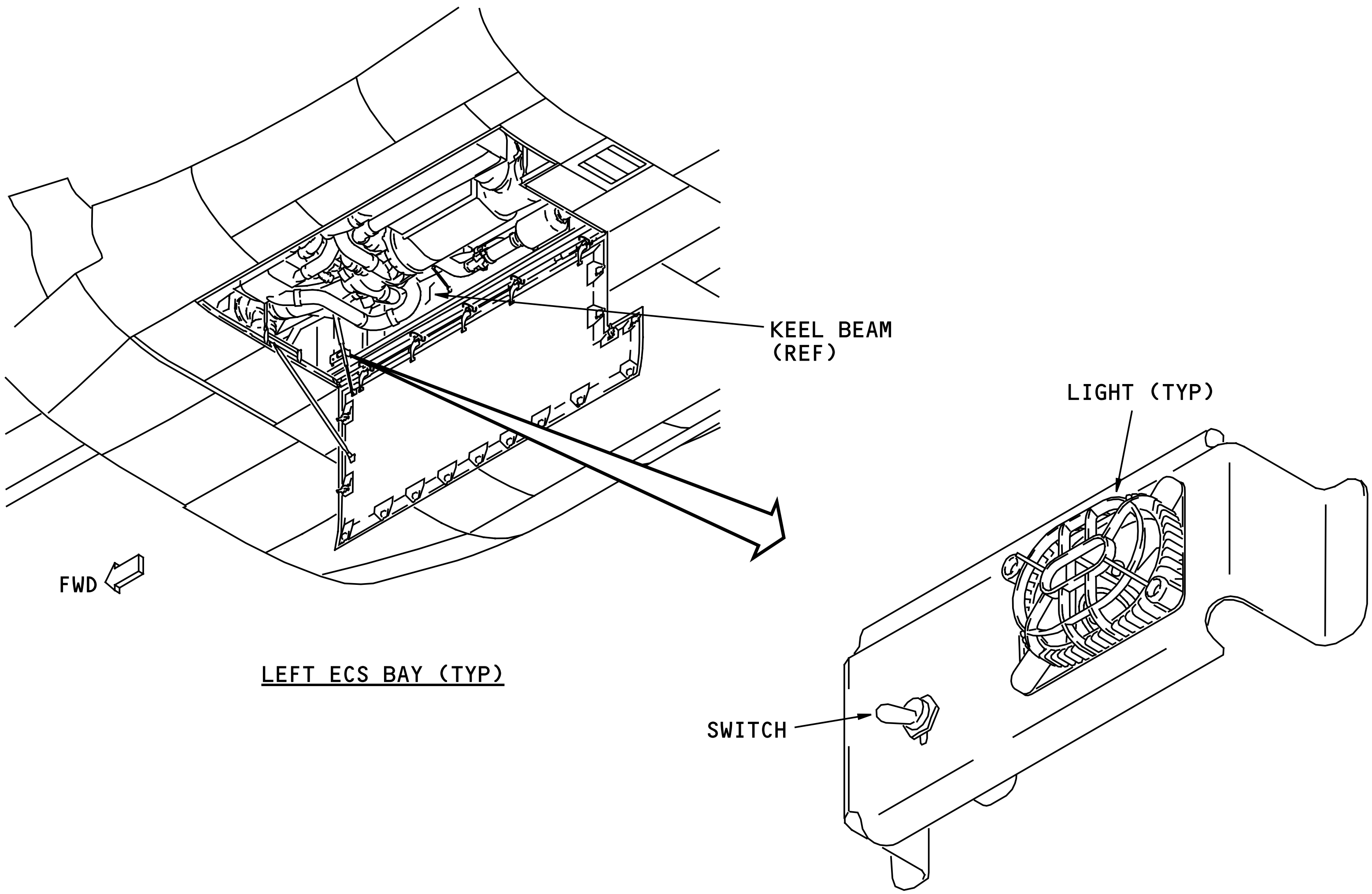
SERVICE AND CARGO LOADING LIGHTS - EQUIPMENT CENTER LOCATIONS

SERVICE AND CARGO LOADING LIGHTS - ECS BAY LOCATIONS

Location

There are two lights in each ECS bay. The forward light is on the keel beam near the front of the compartment. The aft light (not shown) is near the left and right isolation valves.

The switches are next to the forward light.



33-31-00-004 Rev 0

SERVICE AND CARGO LOADING LIGHTS - ECS BAY LOCATIONS

SERVICE AND CARGO LOADING LIGHTS - MAIN WHEEL WELL LOCATIONS

Main Wheel Well Lights

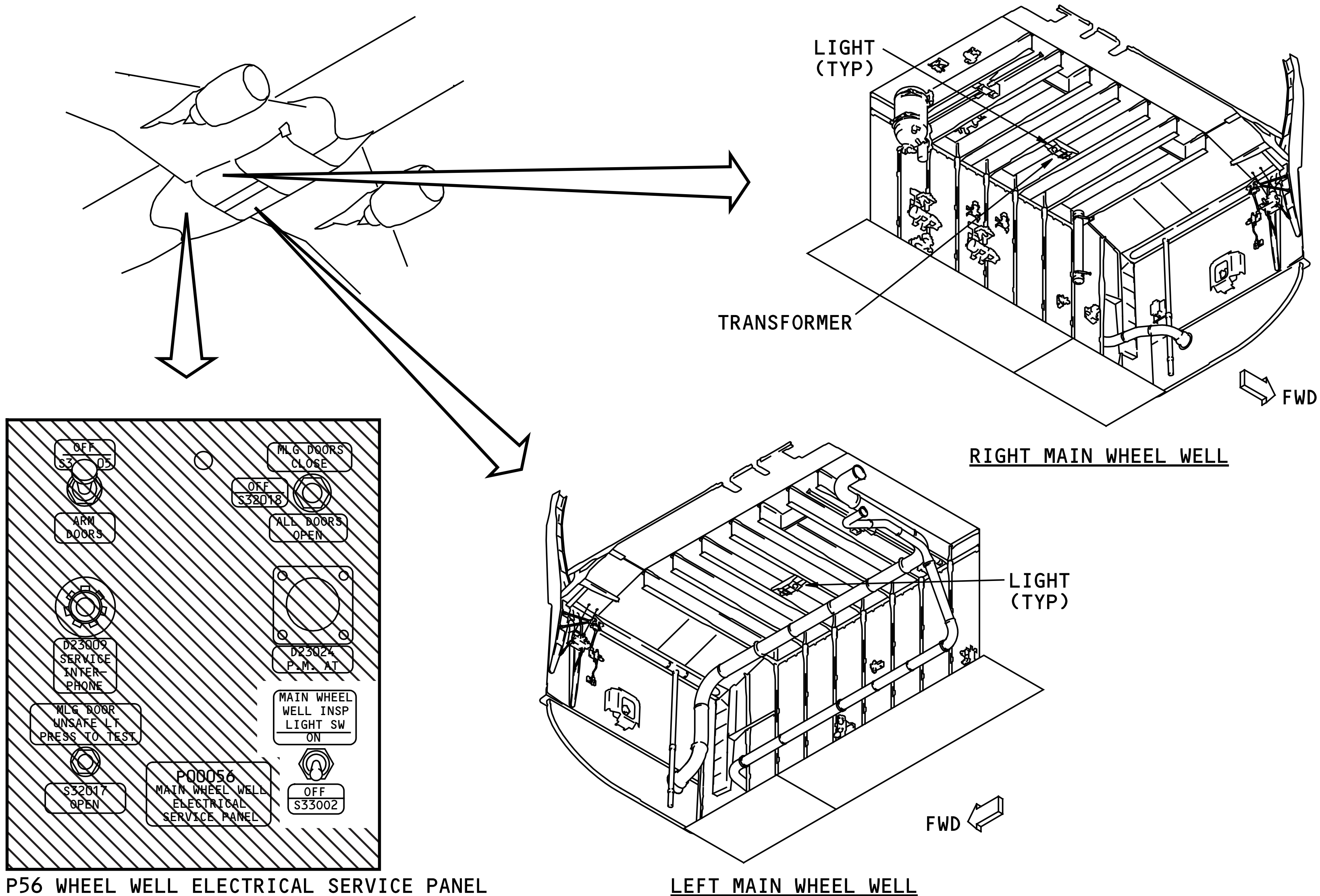
There are two lights in the left and right main wheel wells. They are on the ceiling in the center of the wheel well.

Main Wheel Well Lights Switch

The switch for the main wheel well lights is on the P56 wheel well electrical service panel. The panel is aft of the right main wheel well.

Main Wheel Well Lights Transformer

The transformer for the left and right wheel well lights is on the ceiling of the right wheel well. It is between the two lights on the ceiling.



33-31-00-005 Rev 0

SERVICE AND CARGO LOADING LIGHTS - MAIN WHEEL WELL LOCATIONS

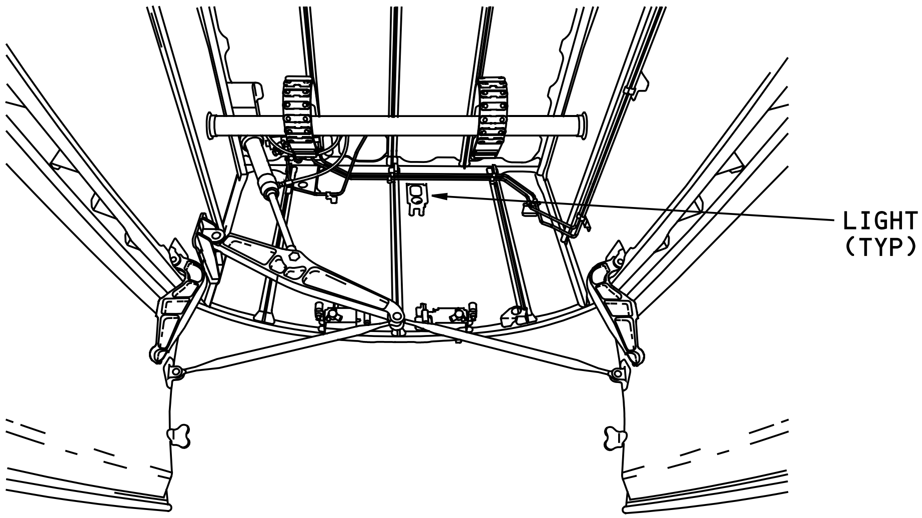
SERVICE AND CARGO LOADING LIGHTS - NOSE WHEEL WELL LOCATIONS

Nose Gear Wheel Well Lights

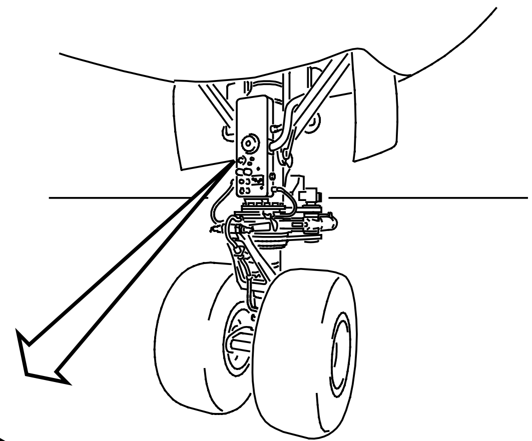
There are two lights in the nose gear wheel well. There is one on the front bulkhead and one on the aft bulkhead.

Nose Gear Wheel Well Switch

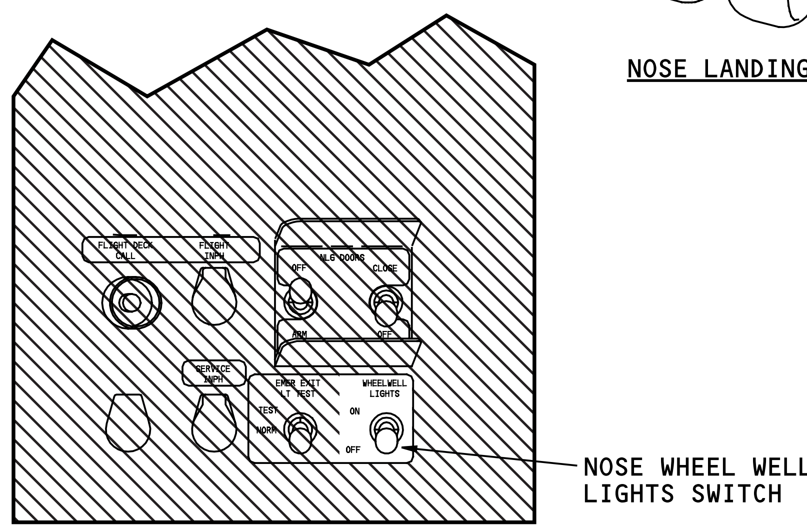
The switch for the nose wheel well lights is on the P40 service and APU shutdown panel.



NOSE WHEEL WELL
(LOOKING FORWARD)



NOSE LANDING GEAR



P40 SERVICE AND APU SHUTDOWN PANEL

33-31-00-006 Rev 0

SERVICE AND CARGO LOADING LIGHTS - NOSE WHEEL WELL LOCATIONS

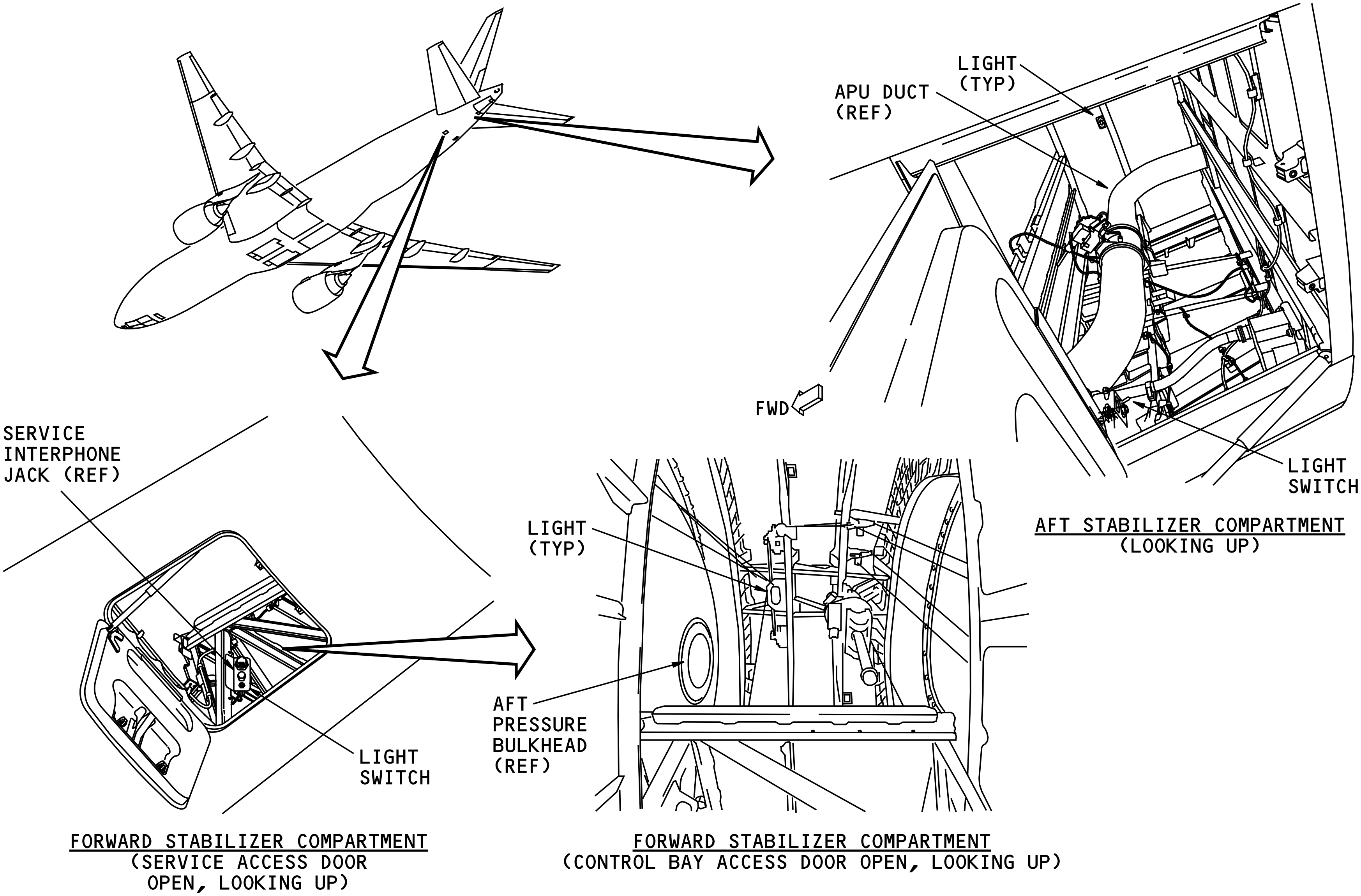
SERVICE AND CARGO LOADING LIGHTS - STABILIZER COMPARTMENT LOCATIONS

Forward Stabilizer Compartment

There are two lights on the ceiling of the forward stabilizer compartment. The switch is above the service access door.

Aft Stabilizer Compartment

There is one light on the ceiling of the aft stabilizer compartment. The switch is above the control bay access door. It is on the right side of the door opening.



SERVICE AND CARGO LOADING LIGHTS - STABILIZER COMPARTMENT LOCATIONS

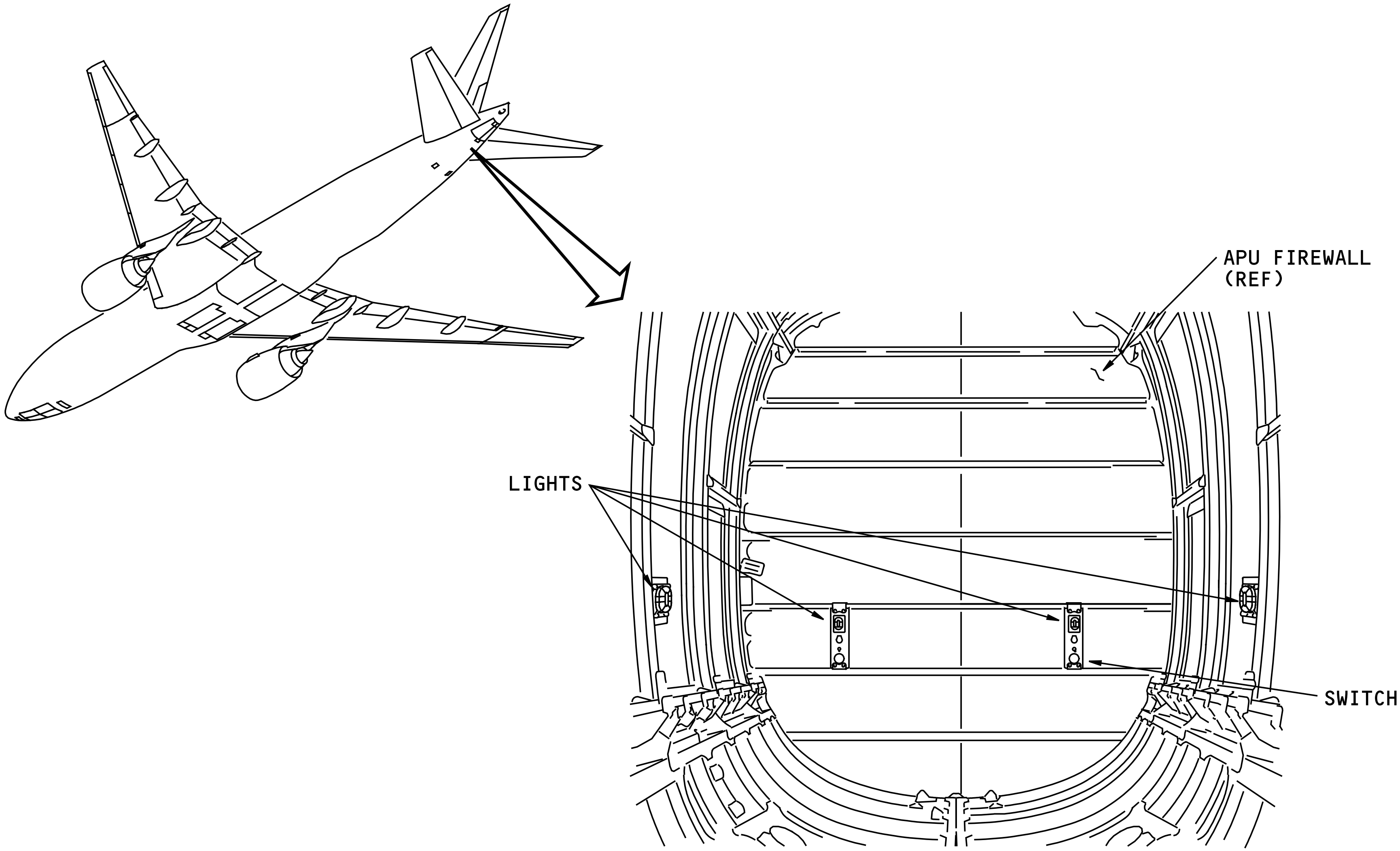
SERVICE AND CARGO LOADING LIGHTS - APU COMPARTMENT LOCATIONS

APU Compartment Lights

There are four lights in the APU compartment. There are two lights on the forward APU fire wall and two lights on the side walls.

APU Compartment Lights Switch

The switch for the APU compartments lights is under the right light on the fire wall.



APU COMPARTMENT
(APU REMOVED, LOOKING FORWARD)

SERVICE AND CARGO LOADING LIGHTS - APU COMPARTMENT LOCATIONS

33-31-00-008 Rev 1 04/10/1997

SERVICE AND CARGO LOADING LIGHTS - CARGO LOADING LIGHTS - INTRODUCTION

Purpose

The cargo loading lights give light near the cargo compartment loading areas to help the ground crew.

Location

There are 12 cargo loading lights. Four lights are body-mounted and eight are cargo door-mounted. The forward and aft cargo doors each have four door-mounted lights.

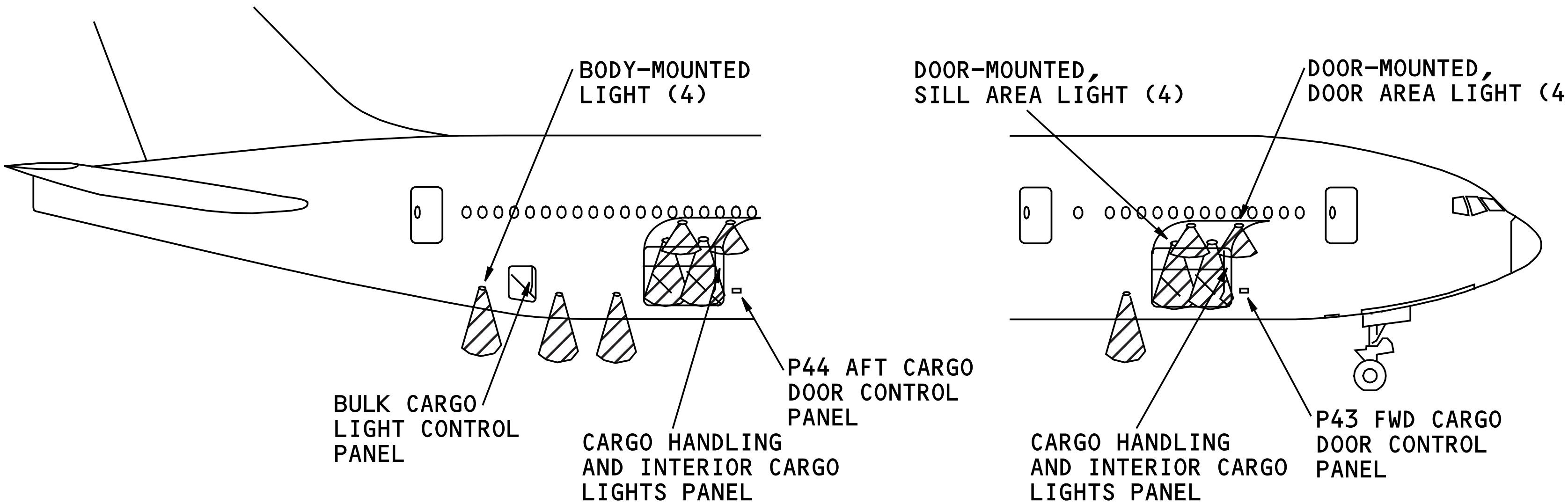
General Description

The cargo loading lights get power from the ground handling bus.

You use control switches near the cargo doors to operate the cargo Loading lights.

Some door-mounted lights automatically come on when you open the access door between the forward cargo compartment and the MEC.

Door-mounted lights operate only if the cargo door is full open.



33-31-00-018 Rev 0 02/12/96

SERVICE AND CARGO LOADING LIGHTS - CARGO LOADING LIGHTS - INTRODUCTION

SERVICE AND CARGO LOADING LIGHTS - CARGO LIGHTS TRANSFORMER - LOCATION

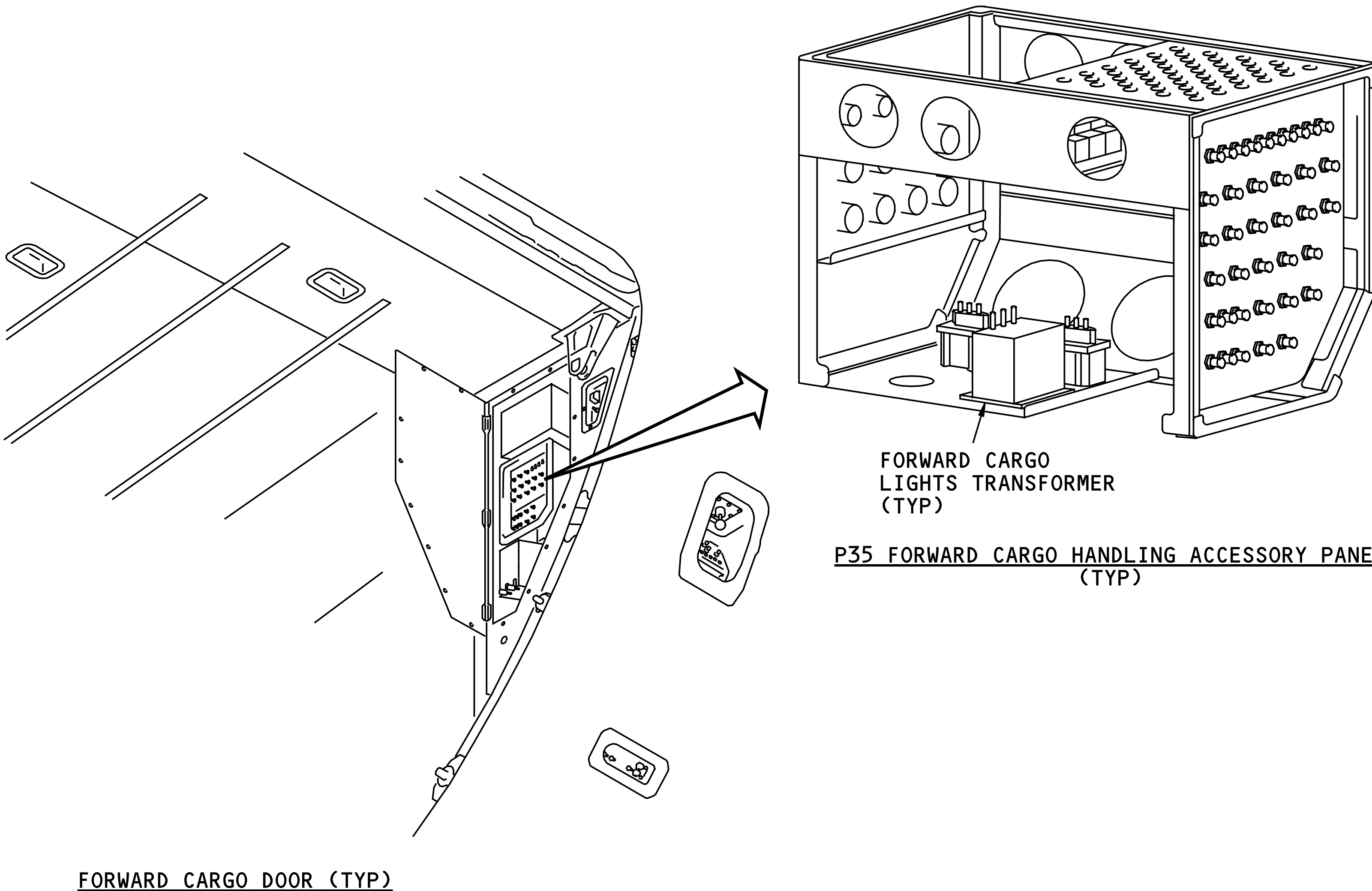
Purpose

The forward and aft cargo compartment light transformers decrease the amount of power that go to these lights:

- Interior cargo lights
- Exterior cargo lights
- ECS bay lights
- Door lights
- Sill lights.

Location

The forward transformer is in the P35 forward cargo handling accessory panel. The aft transformer is in the P39 aft cargo handling accessory panel.



33-31-00-015 Rev 0

SERVICE AND CARGO LOADING LIGHTS - CARGO LIGHTS TRANSFORMER - LOCATION

SERVICE AND CARGO LOADING LIGHTS - CARGO LOADING LIGHTS - OPERATION

General

The cargo loading lights get power from the ground handling bus. Door-mounted cargo loading lights (door and sill area) operate only when the related door is full open and a related control switch is on.

External - Cargo Loading Area Lighting

You use EXTERNAL (EXTERIOR) cargo light control switches to operate the body-mounted and the door-mounted door area lights. There is one switch for each of the cargo compartment loading areas. The switches operate only the lights in the related area. The switches are in these areas:

- Forward cargo area uses the switch on the P43
- Aft cargo area uses the switch on the P44
- Bulk cargo area uses the switch on the bulk cargo light control panel (forward of the door, in the compartment).

Internal - Cargo Door Sill Area Lighting

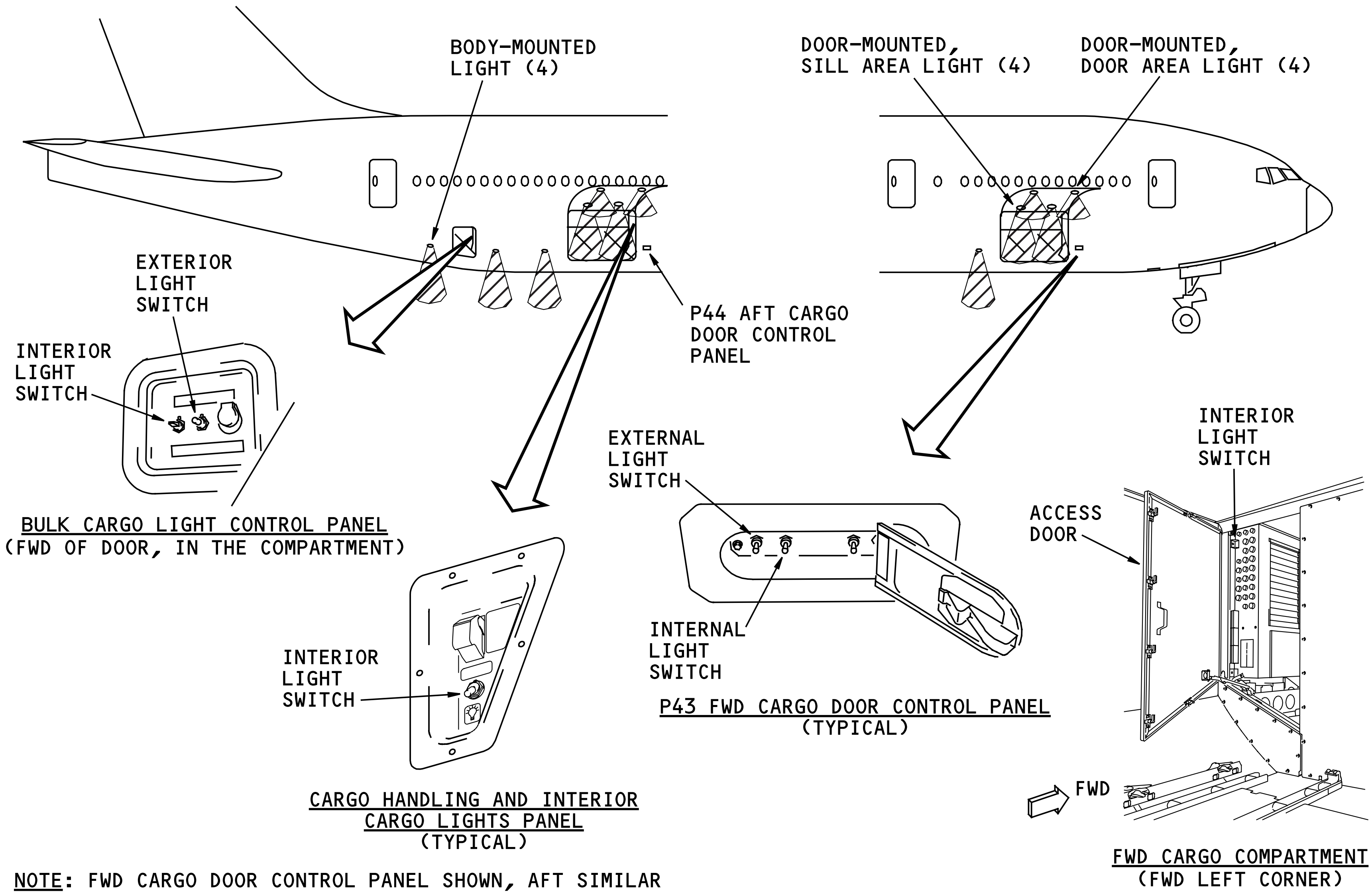
You use INTERNAL (INTERIOR) cargo light control switches to operate the door-mounted, door sill area lights. For internal lighting, the aft and bulk cargo compartment areas are one area. The forward and aft cargo areas have three switches. The switches for the forward cargo area are in these areas:

- P43
- Cargo handling and interior cargo lights panel (forward of the door, inside the compartment)
- A switch that is near the main equipment center/ cargo compartment access door

The switches for the aft cargo area are in these areas:

- P44
- Cargo handling and interior cargo lights panel (forward of the aft cargo door, in the compartment)
- Bulk cargo light control panel (forward of bulk cargo door, in the compartment).

See the lower lobe cargo compartment lights section for more information about the cargo lights (AMM PART I 33-37).



NOTE: FWD CARGO DOOR CONTROL PANEL SHOWN, AFT SIMILAR

SERVICE AND CARGO LOADING LIGHTS - CARGO LOADING LIGHTS - OPERATION

LOWER LOBE CARGO COMPARTMENT LIGHTS - INTRODUCTION

Purpose

The lower lobe cargo compartment lights give light in the forward, aft, and bulk cargo compartments.

Location

The lights are in the ceiling of the cargo compartments and in the sidewall near the bulk cargo door (not shown). There are light switches in these locations:

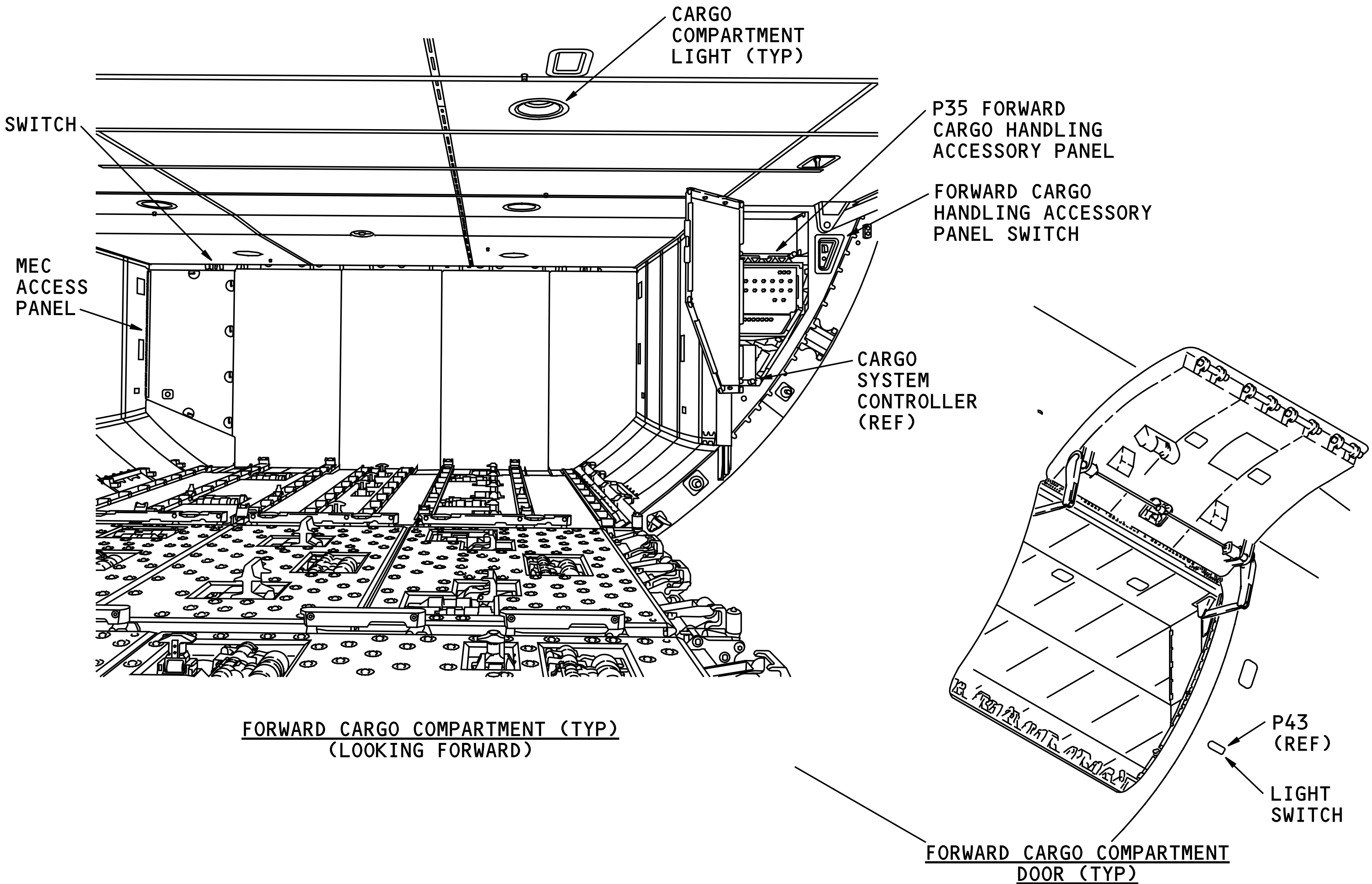
- On the exterior door control panels
- Near the door in the interior of the compartments
- Near the access panel to the main equipment center (MEC).

There are relays and transformers in the P35 and P39 forward and aft cargo handling accessory panels.

See the service and cargo loading lights section for more information about the relays and transformers (AMM PART I 33-31).

Interface

The cargo lights use information from a proximity sensor electronics unit (PSEU). Power for the lights comes from the cargo system controllers.



33-37-00-001 Rev 2

LOWER LOBE CARGO COMPARTMENT LIGHTS - INTRODUCTION

LOWER LOBE CARGO COMPARTMENT LIGHTS - COMPARTMENT LIGHTS

Location

The lights are in the ceiling of the forward, aft, and bulk cargo compartments. There is also a light near the forward edge of the bulk cargo compartment door.

Physical Description

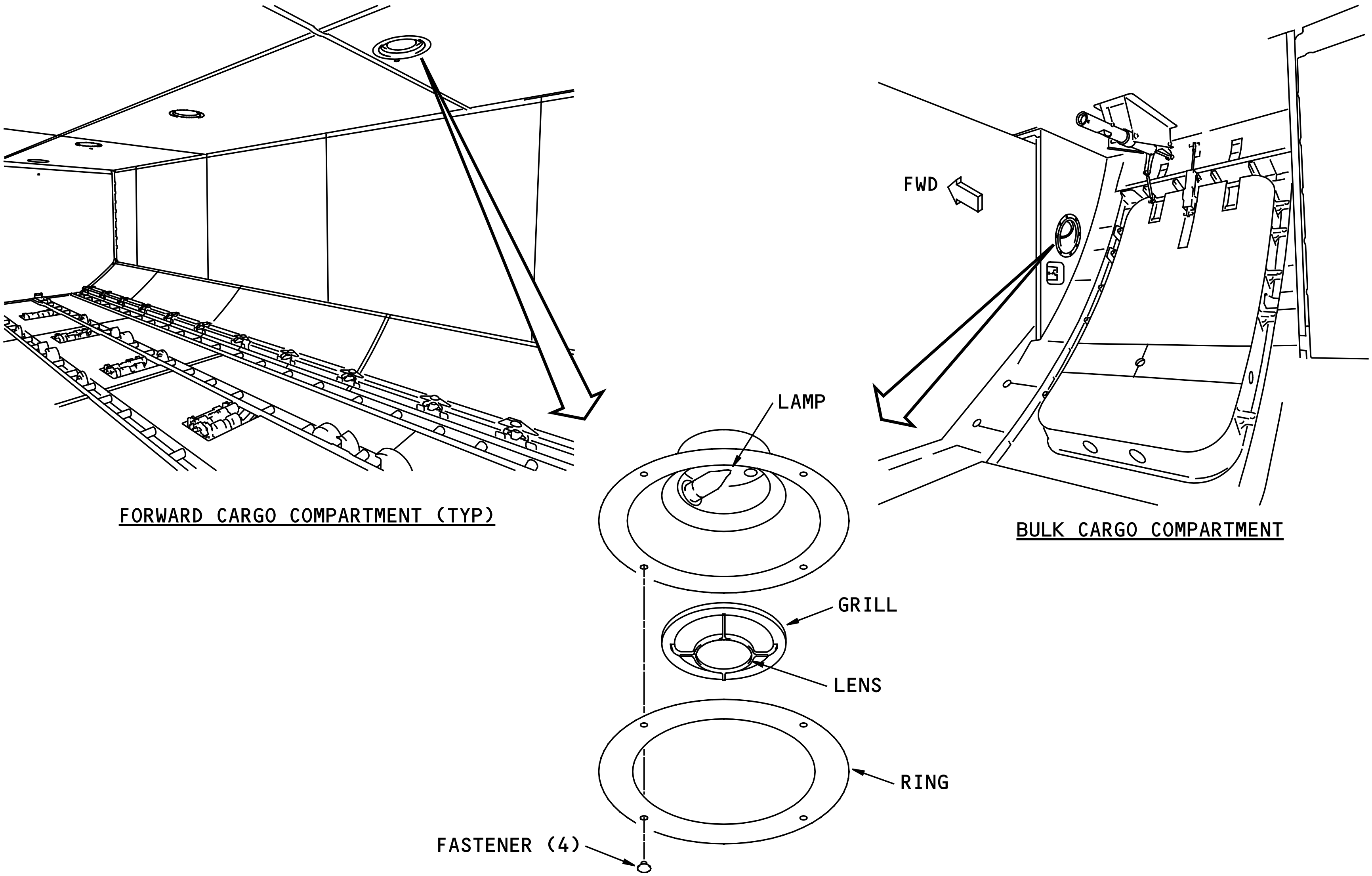
Each light has a:

- Lamp
- Grill
- Lens
- Ring
- Fastener (4)
- Micro switch (not shown).

Training Information Point

All of the lights in the ceiling of the cargo compartments are the same. To get access to the lamp you pull out the grill. There is a lanyard that holds the grill.

The light will not operate if the grill is not in position.



33-37-00-002 Rev 0

LOWER LOBE CARGO COMPARTMENT LIGHTS - COMPARTMENT LIGHTS

EXTERIOR LIGHTS - INTRODUCTION

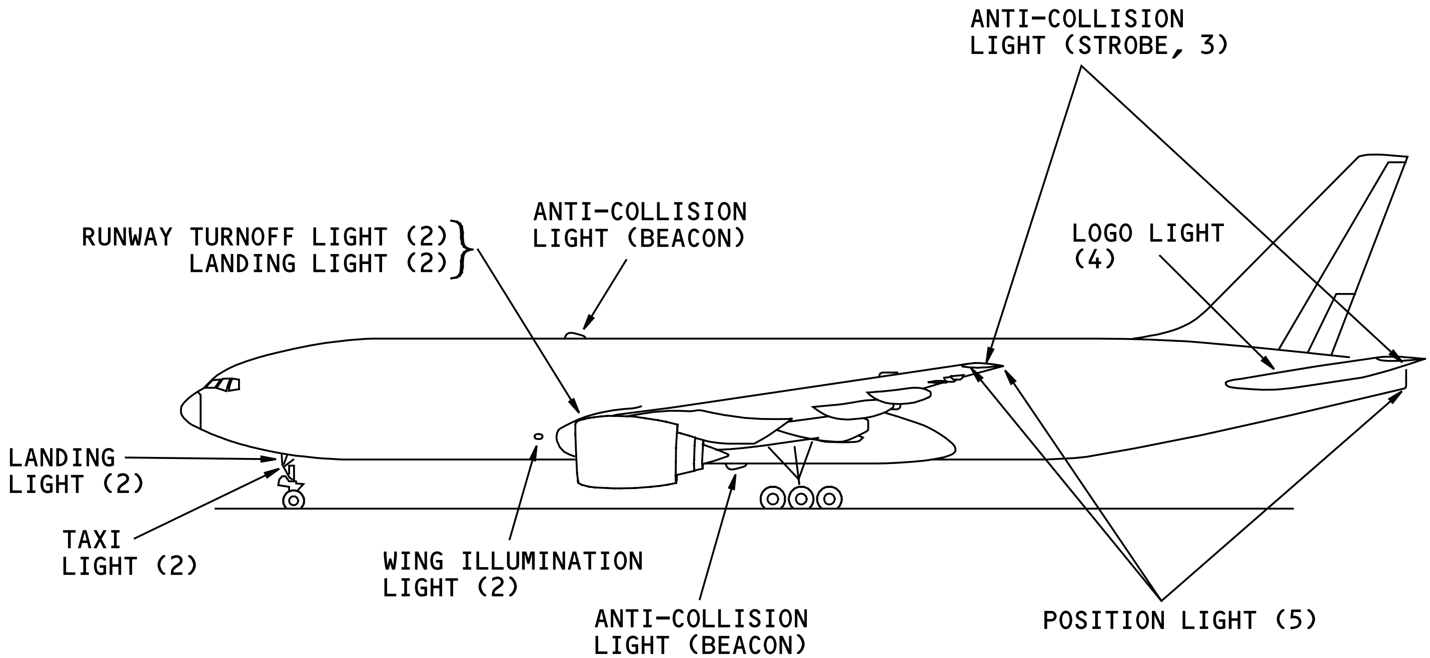
Purpose

The exterior lights give light to make the airplane more visible and to aid in safe operation of the airplane.

Location

These lights make up the exterior lights:

- Runway turnoff (2)
- Landing (4)
- Anti-collision (beacon) (2)
- Position (5)
- Logo (4)
- Anti-collision (strobe) (3)
- Wing illumination (2)
- Taxi (2).



33-40-00-001 Rev 2 04/30/1997

EXTERIOR LIGHTS - INTRODUCTION

WING ILLUMINATION LIGHTS - INTRODUCTION

Purpose

The wing illumination lights give light on the leading edge of the wings and the front of the nacelles. This lets the crew to see if there is ice on the leading edge.

The transformers decrease the amount of voltage that goes to the lights.

Location

The lights are on the right and left sides of the airplane, forward of where the wing connects to the fuselage.

The transformers are behind the sidewall panels in the forward cargo compartment. There is one transformer on each side.

Physical Description

The light has these components:

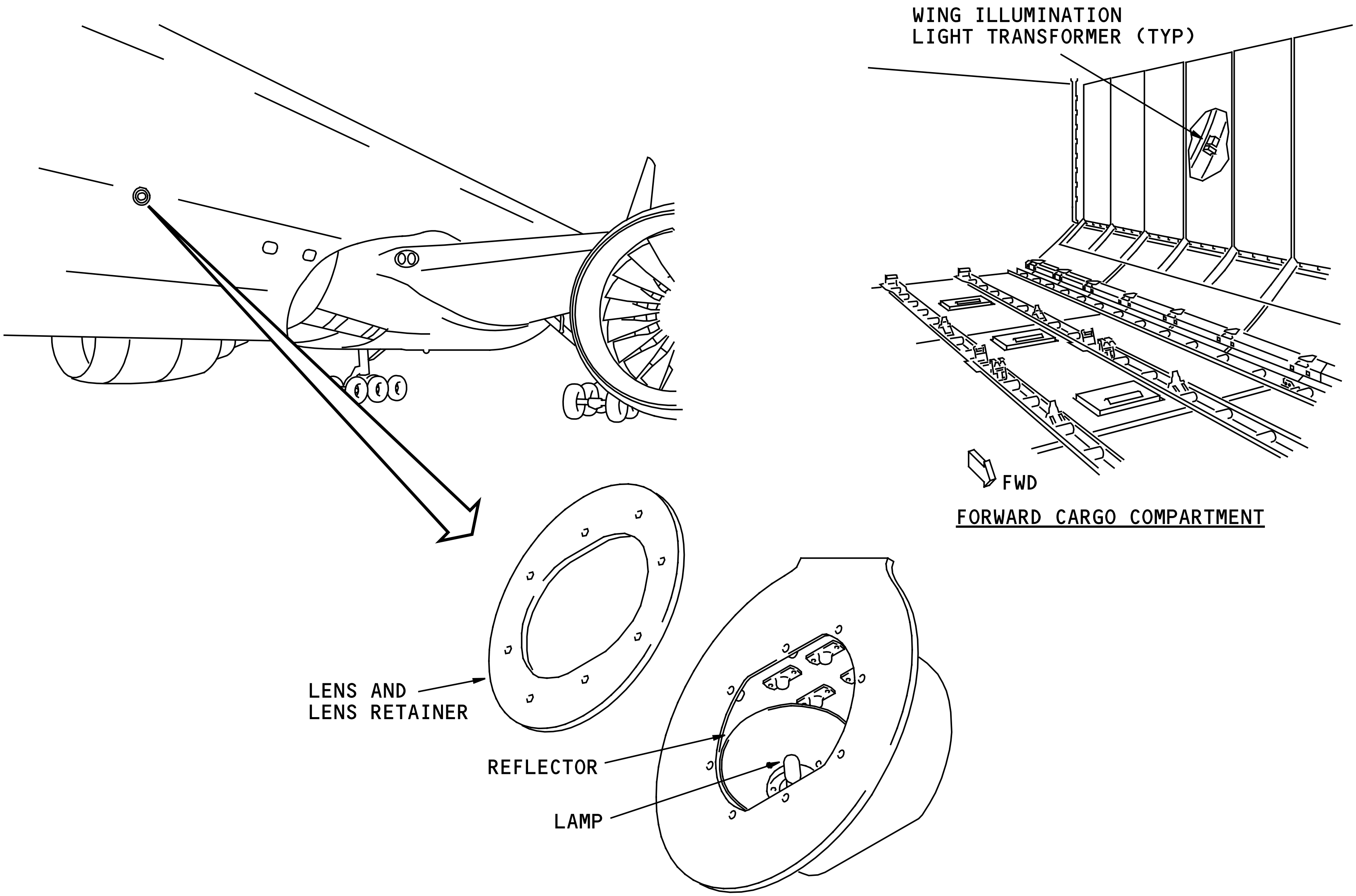
- Lens
- Lens retainer
- Lamp
- Reflector.

There are six captive screws that hold the lens retainer. There are two captive screws that hold the reflector.

Training Information Point

You replace the wing illumination light from outside the airplane.

You remove panels on the sidewalls of the forward cargo compartment to get access to the transformers.

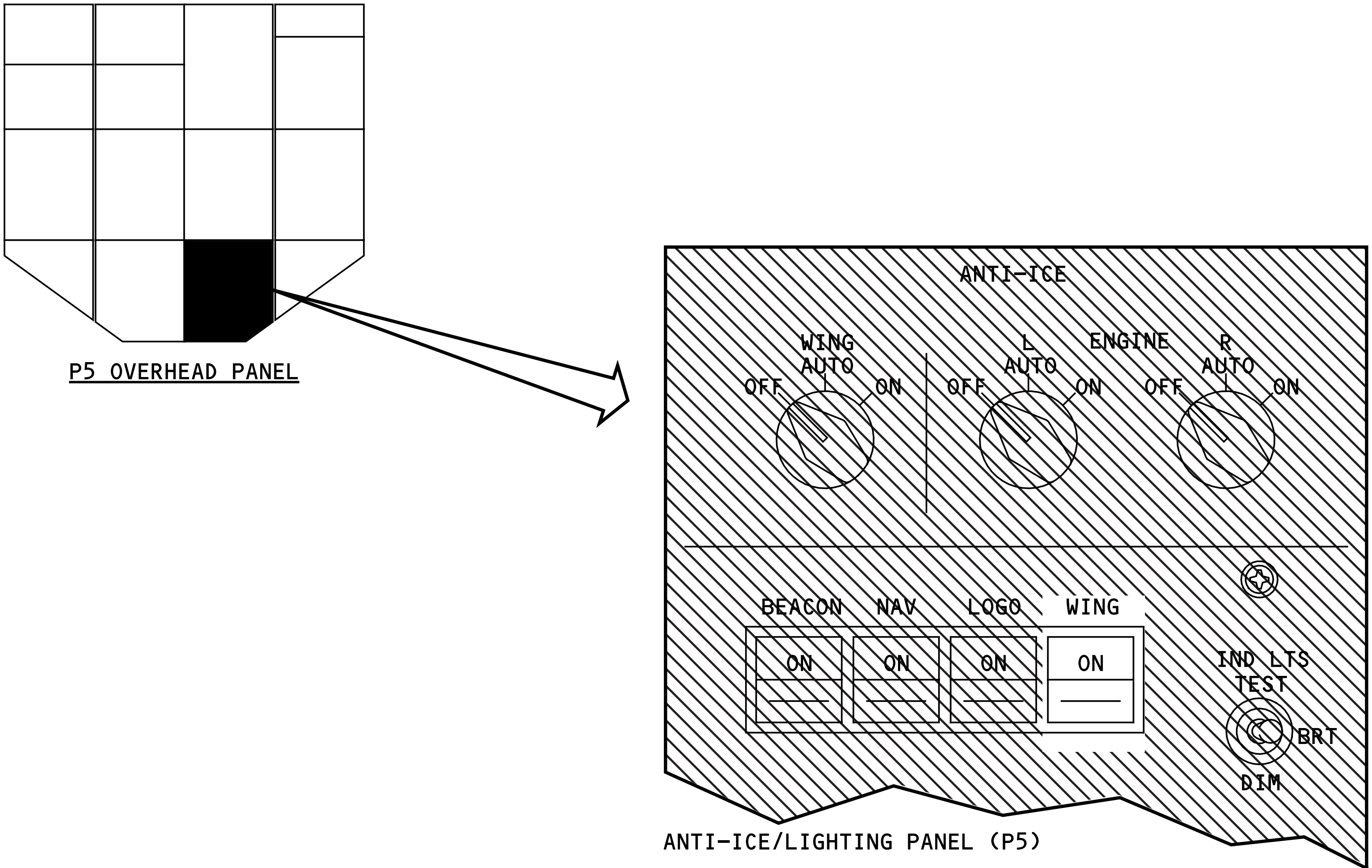


WING ILLUMINATION LIGHTS - INTRODUCTION

WING ILLUMINATION LIGHTS - OPERATION

Operation

You use the wing light switch (WING) to operate the wing illumination lights. It is on the anti-ice/ lighting panel on the P5 overhead panel. It is an alternate action switch.



ANTI-ICE/LIGHTING PANEL (P5)

33-41-00-002 Rev 1 08/09/96

WING ILLUMINATION LIGHTS - OPERATION

LANDING, RUNWAY TURNOFF, AND TAXI LIGHTS - INTRODUCTION

Purpose

The nose gear landing lights and the wing landing lights give light to the runway for takeoff and landing.

The runway turnoff lights give light to the side of the airplane so the crew can see the runway and taxiway turnoffs.

The taxi lights give light in front of the airplane for taxiing.

Transformers (not shown) decrease the voltage that goes to the lights.

Location

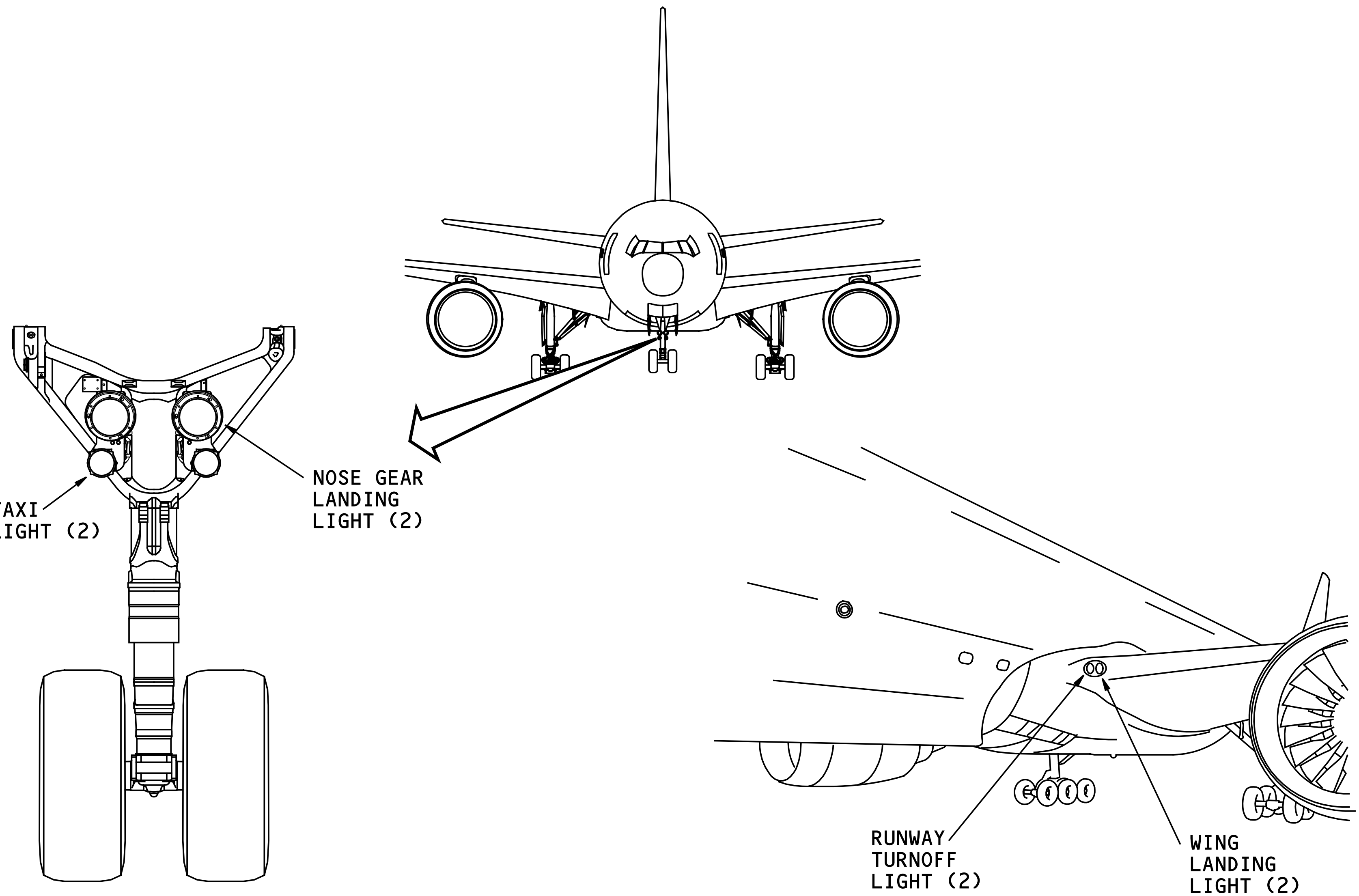
The nose gear landing lights and the taxi lights are on the front of the nose gear.

The wing landing lights and runway turnoff lights are on the left and right side of the fuselage. They are on the wing-to-body fairing.

There are transformers on the nose landing gear and in the forward cargo compartment.

Interface

The proximity sensor electronic (PSEU) unit gives information to control the level of light that comes from the landing lights.



LANDING, RUNWAY TURNOFF, AND TAXI LIGHTS - INTRODUCTION

LANDING, RUNWAY TURNOFF, AND TAXI LIGHTS - NOSE GEAR LANDING LIGHTS

Purpose

The nose gear landing lights give light to runways and taxiways when the airplane is on the ground.

Location

The nose gear landing lights are on the front of the nose gear. They are above the taxi lights. There is one light on each side of the nose gear strut.

Physical Description

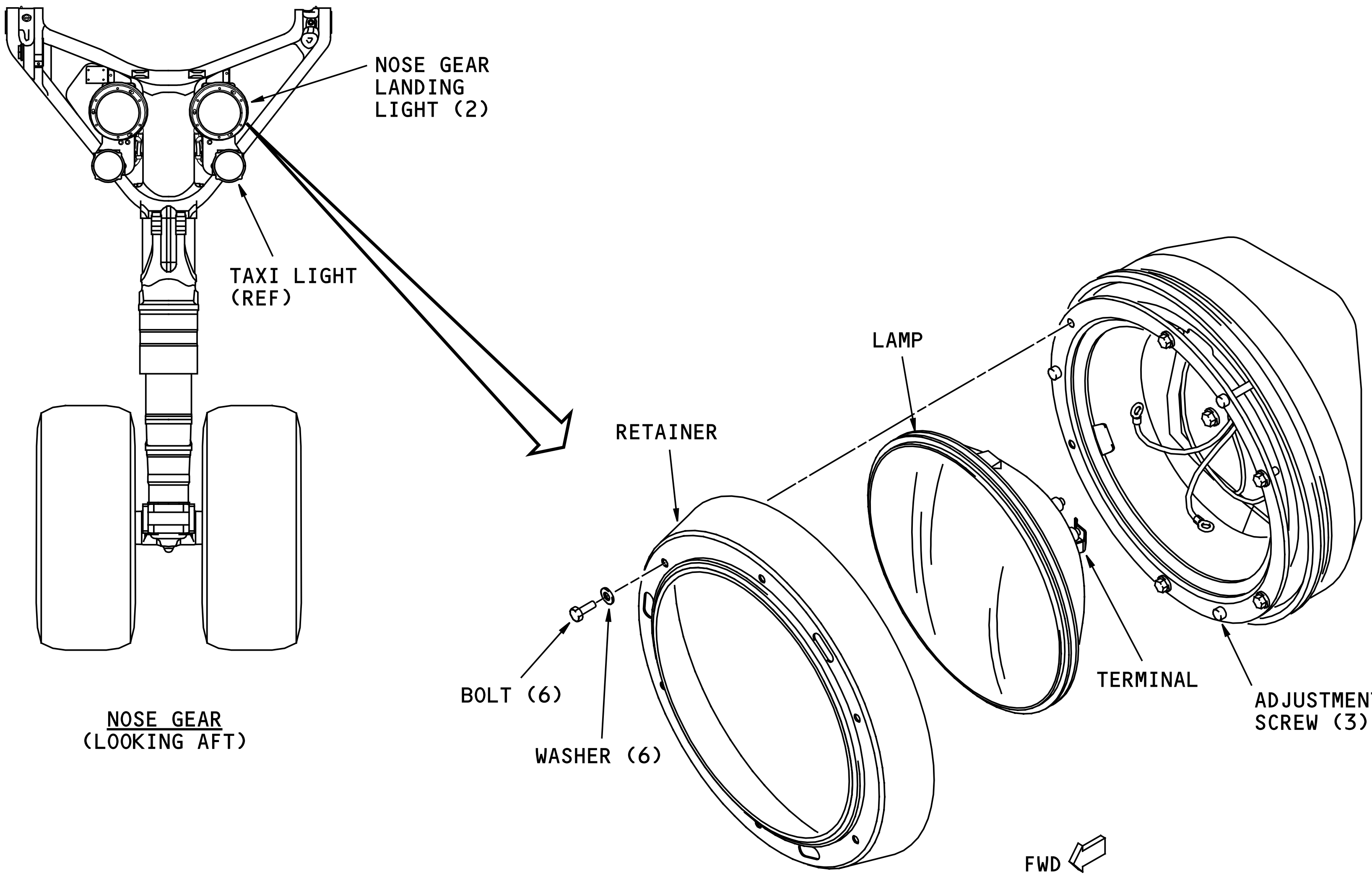
The nose gear landing lights have these components:

- Retainer
- Lamp
- Adjustment screw (3)
- Terminal.

Training Information Point

There are six bolts that hold the lamp. You remove these bolts to get access to the lamp. There are three adjustment screws that you use to point the lamp.

There is a gasket that is part of the retainer.



33-42-00-002 Rev 1

LANDING, RUNWAY TURNOFF, AND TAXI LIGHTS - NOSE GEAR LANDING LIGHTS

LANDING, RUNWAY TURNOFF, AND TAXI LIGHTS - WING LANDING LIGHTS

Purpose

The wing landing lights give light in front of the airplane. They give light to the runway when the airplane is landing. They also give light in front of the airplane when it is taking off.

Location

The lights are on the front edge of each wing-to-body fairing.

Physical Description

The wing landing lights have these components:

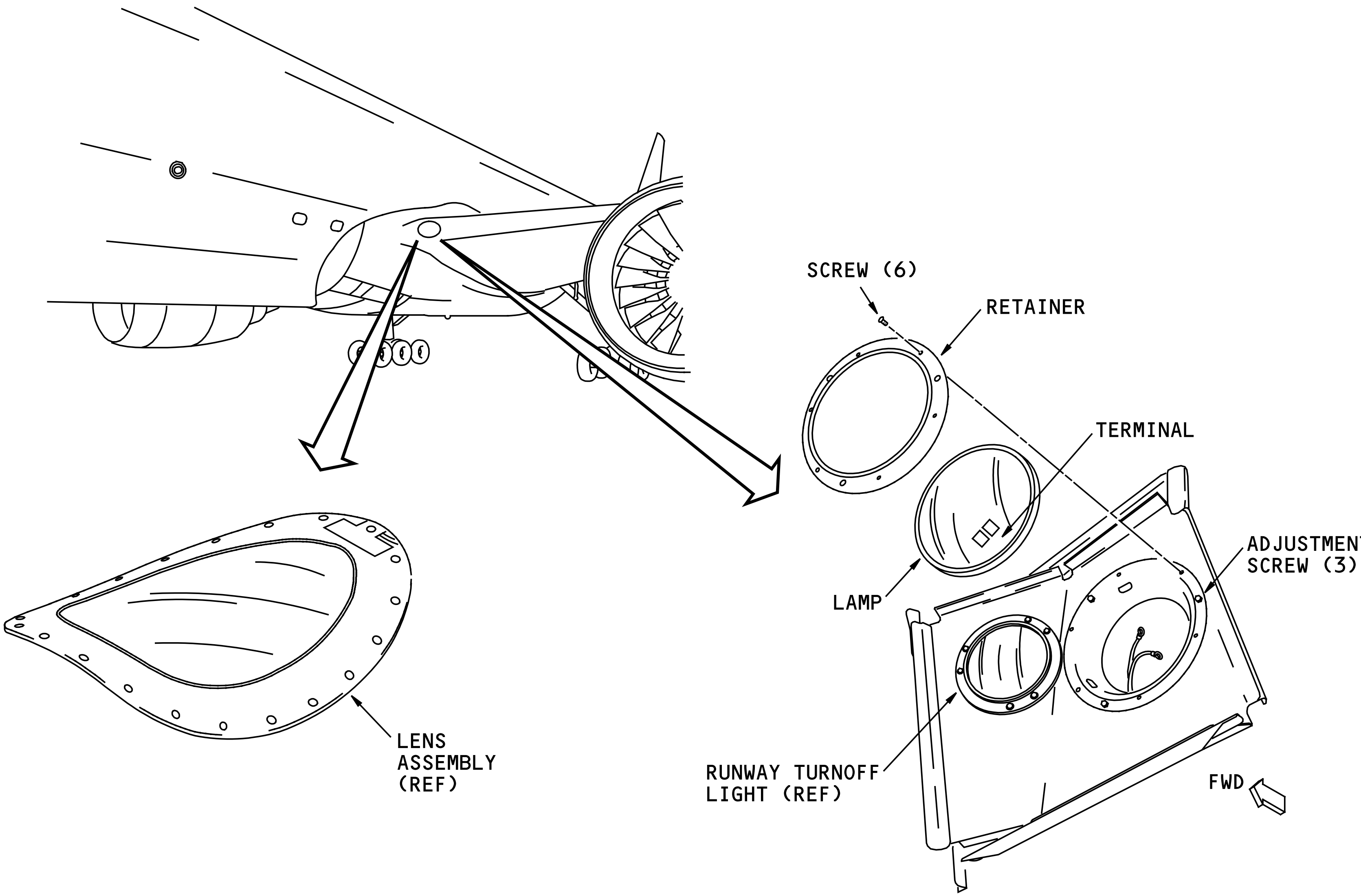
- Retainer
- Lamp
- Terminal.

Training Information Point

You remove the lens assembly to get access to the wing landing light. There are six screws that hold the lamp.

You use the three adjustment screws to point the light.

There is a gasket that is part of the retainer.



33-42-00-003 Rev 1 04/15/1997

LANDING, RUNWAY TURNOFF, AND TAXI LIGHTS - WING LANDING LIGHTS

LANDING, RUNWAY TURNOFF, AND TAXI LIGHTS - TAXI LIGHTS

Purpose

The taxi lights give light in front of the airplane for taxiing.

Location

The taxi lights are on the front of the nose gear. They are below the nose gear landing lights. There is one light on each side of the nose gear strut.

Physical Description

The taxi lights have these components:

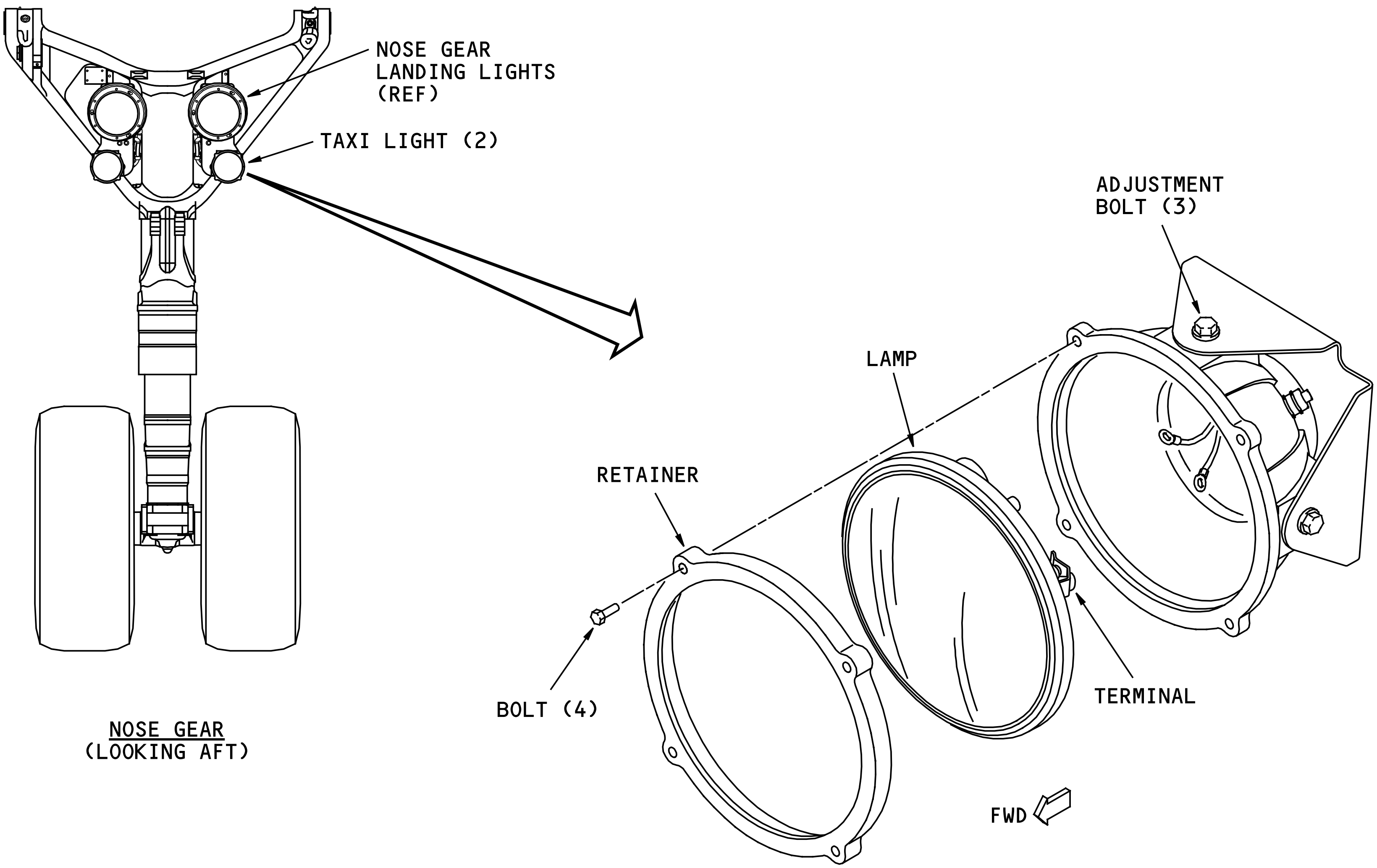
- Retainer
- Gasket
- Lamp
- Terminal.

Training Information Point

There are four bolts that hold the retainer and lamp. You remove these bolts to get access to the lamp.

You use the three adjustment bolts to point the light.

There is a gasket that is part of the retainer.



NOSE GEAR
(LOOKING AFT)

33-42-00-004 Rev 1

LANDING, RUNWAY TURNOFF, AND TAXI LIGHTS - TAXI LIGHTS

LANDING, RUNWAY TURNOFF, AND TAXI LIGHTS - TRANSFORMERS

Purpose

The transformers decrease the voltage that goes to the lights.

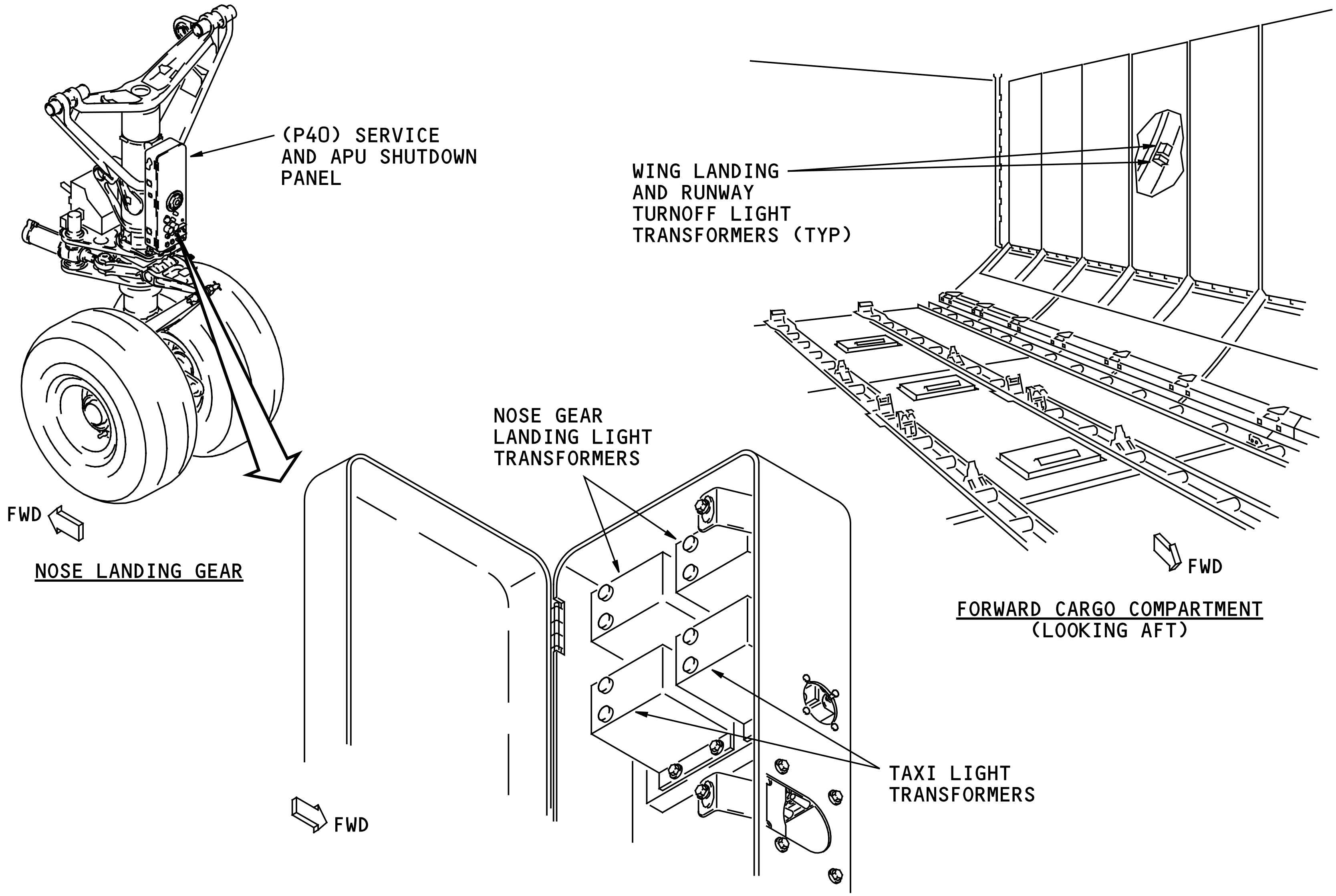
Location

The transformers for the nose gear landing lights and the taxi lights are in the P40 service and APU shutdown panel. The panel is on the nose landing gear.

The transformers for the wing landing lights and the runway turnoff lights are outboard of the left and right sidewall liners in the forward cargo compartment.

Physical Description

Each transformer attaches with four bolts and has two electrical connectors.



33-42-00-006 Rev 0

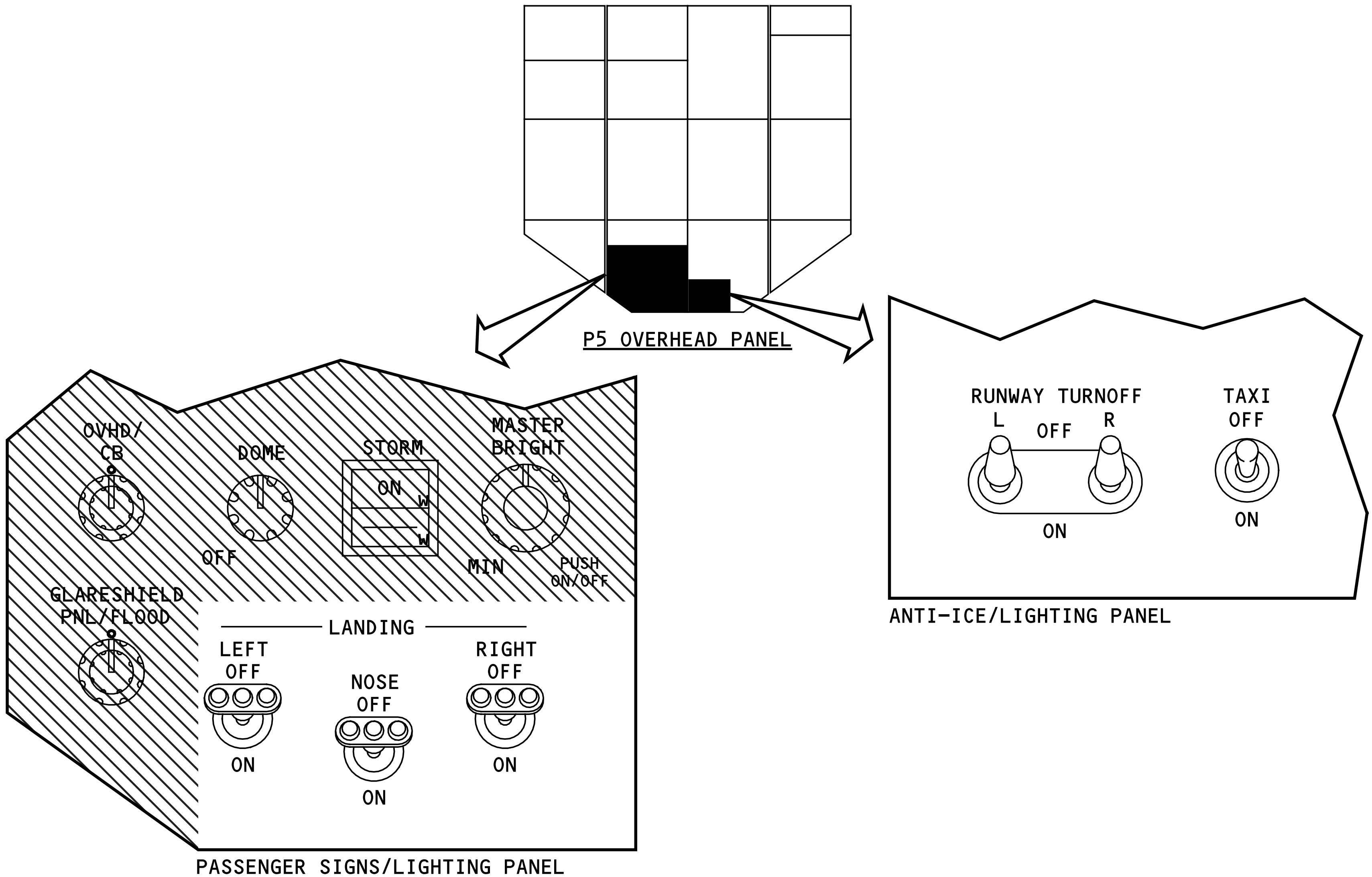
LANDING, RUNWAY TURNOFF, AND TAXI LIGHTS - TRANSFORMERS

LANDING, RUNWAY TURNOFF, AND TAXI LIGHTS - OPERATION

Operation

You use the left, nose, and right landing light switches (LEFT, NOSE, RIGHT LANDING) to operate the landing gear lights. These switches are on the passenger signs/lighting panel on the P5 overhead. The switches are the toggle-type.

You use the left and right runway turnoff light switches (L, R RUNWAY TURNOFF) to operate the runway turnoff lights. You use the taxi light switch (TAXI) to operate the taxi lights. These switches are on the anti-ice/lighting panel on the P5 overhead panel. The switches are the toggle-type.



33-42-00-007 Rev 1 08/21/96

LANDING, RUNWAY TURNOFF, AND TAXI LIGHTS - OPERATION

LANDING, RUNWAY TURNOFF, AND TAXI LIGHTS - LANDING LIGHTS - FUNCTIONAL DESCRIPTION

General

The LEFT, NOSE, and RIGHT landing lights switches give signals to the overhead panel ARINC systems (OPAS). These signals go to the electronic load management system (ELMS) electronics unit. There is an ELMS electronics unit in each power management panel.

The panel gets gear position data from the proximity sensor electronics unit (PSEU).

Wing Landing Lights

When the LEFT or RIGHT landing light switch is in the ON position, a control relay energizes. This makes the wing landing (WG LDG) light come on.

The lights have two modes, bright and dim. A bright/dim control relay energizes when the landing gear is down and locked. This makes the lights operate in the bright mode. When the relay is not energized the lights operate in the dim mode.

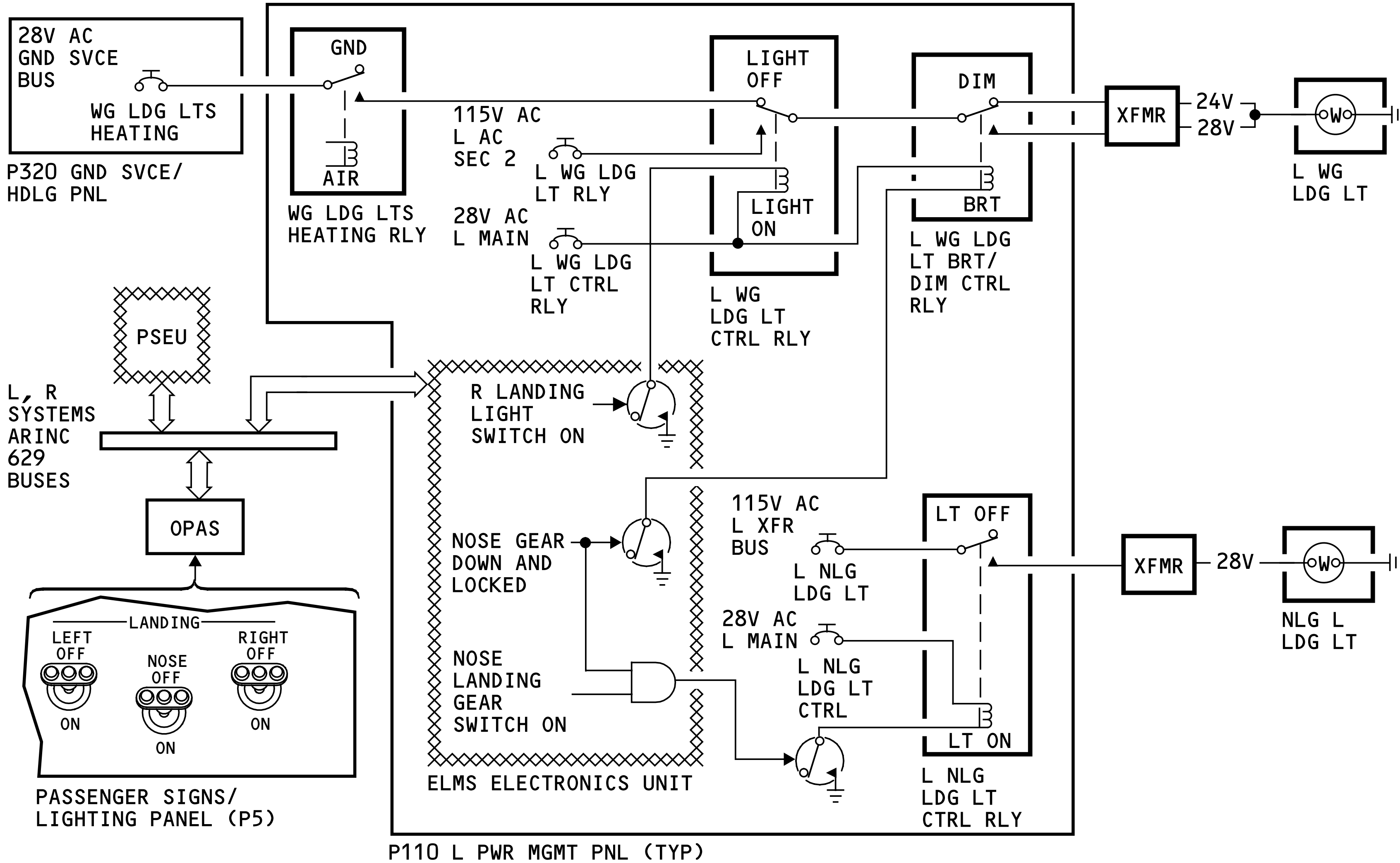
In the bright mode the transformer decreases the voltage to 28 V AC. In the dim mode it decreases the voltage to 24 V AC.

A small amount of power goes to the wing landing lights to prevent thermal shock when the lights comes on and to increase the life of the lights. The small amount of power goes to the lights when the:

- Airplane is in the air
- LEFT and RIGHT landing light switches are OFF
- Nose gear is not down and locked.

Nose Gear Landing Lights

When the NOSE landing light switch is in the ON position, a control relay energizes. This makes the nose landing gear (NLG) lights come on. A transformer decreases the voltage to 28 V AC.



NOTE: LEFT SYSTEM IS SHOWN. THE RIGHT SYSTEM IS SIMILAR.

33-42-00-008 Rev 1 08/21/96

LANDING, RUNWAY TURNOFF, AND TAXI LIGHTS - LANDING LIGHTS - FUNCTIONAL DESCRIPTION

POSITION LIGHTS - INTRODUCTION

Purpose

The position lights aid in collision avoidance.

The position light transformers (not shown) decrease the voltage that goes to the lights.

Physical Description

The position lights are red, green, or white.

Location

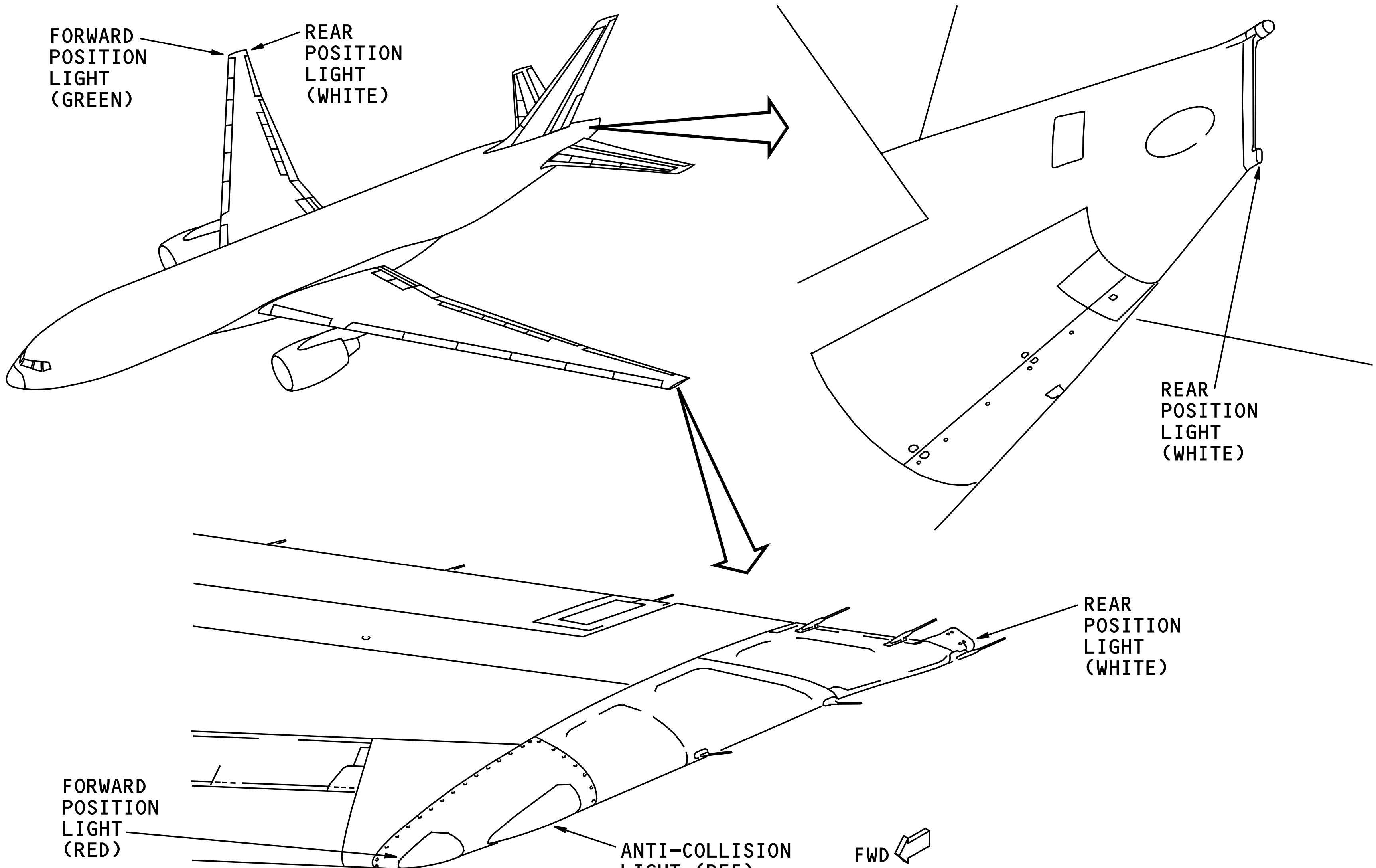
There are position lights on the forward and aft tips of each wing. There is a position light on the airplane tailcone.

The transformers are in the tip of each wing and in the airplane tailcone.

Training Information Point

CAUTION: DO NOT TOUCH THE LAMP WITH YOUR HANDS. FINGERPRINTS DECREASE LIGHT OUTPUT AND CAN CAUSE FAILURE OF THE LAMPS BEFORE THE USUAL TIME.

WARNING: REMOVE POWER AND ALLOW LAMPS TO COOL BEFORE YOU REPLACE THEM. IF YOU TOUCH THE LAMPS WHEN THEY ARE HOT, THEY CAN BREAK AND CAUSE INJURY TO PERSONS AND DAMAGE TO EQUIPMENT.



POSITION LIGHTS - INTRODUCTION

POSITION LIGHTS - WING POSITION LIGHTS

General

The wing position lights show the position, attitude, and direction of flight of the airplane. There are forward position lights and rear position lights.

Location

The forward position lights are on the wing tips, forward of the wing anti-collision light. There are two lamps in each light assembly.

The rear position lights are on the rear of the wing at the tip, aft of the wing anti-collision light. There are two lamps in each light assembly.

Physical Description

The left forward position light has a red lens. The right light has a green lens. The aft position lights have a clear lens, thus the light is white.

The forward and rear position lamps are two-prong-flange-type lamps.

Each forward position light assembly has these parts:

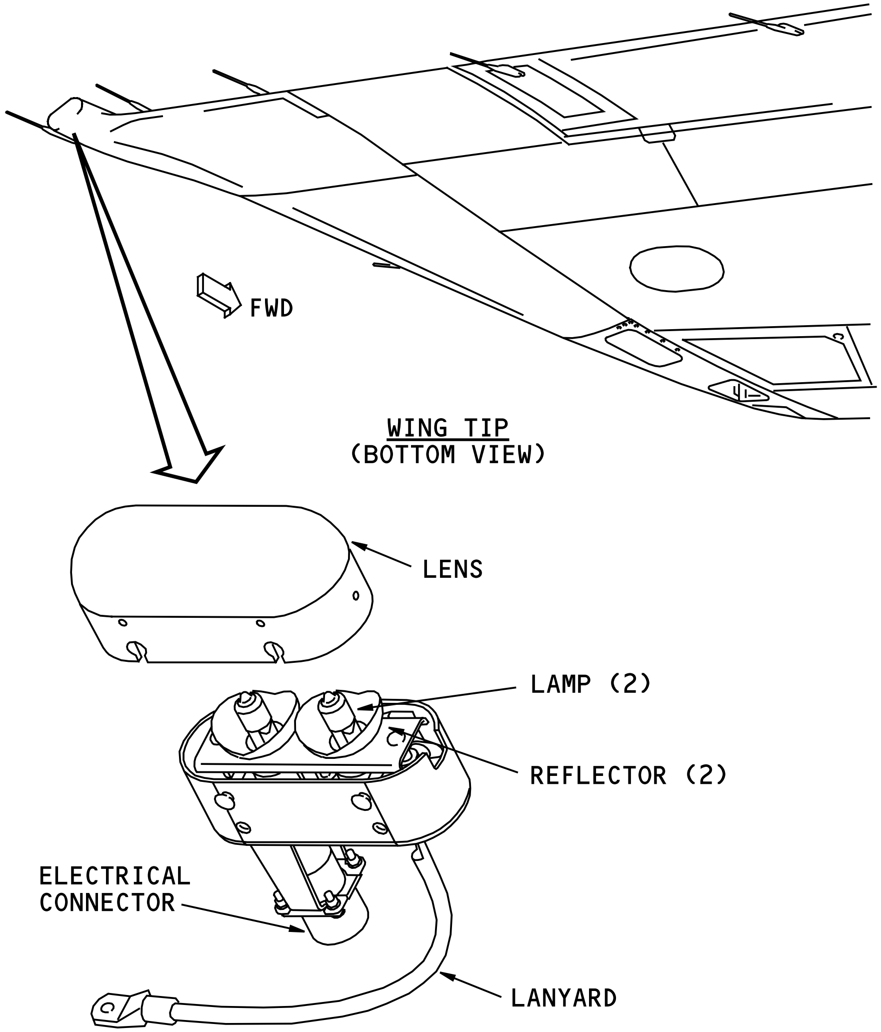
- Hinge bracket
- Reflector (2)
- Lamp (2)
- Lanyard (not shown)
- Electrical connector (not shown).

Each rear position light has these parts:

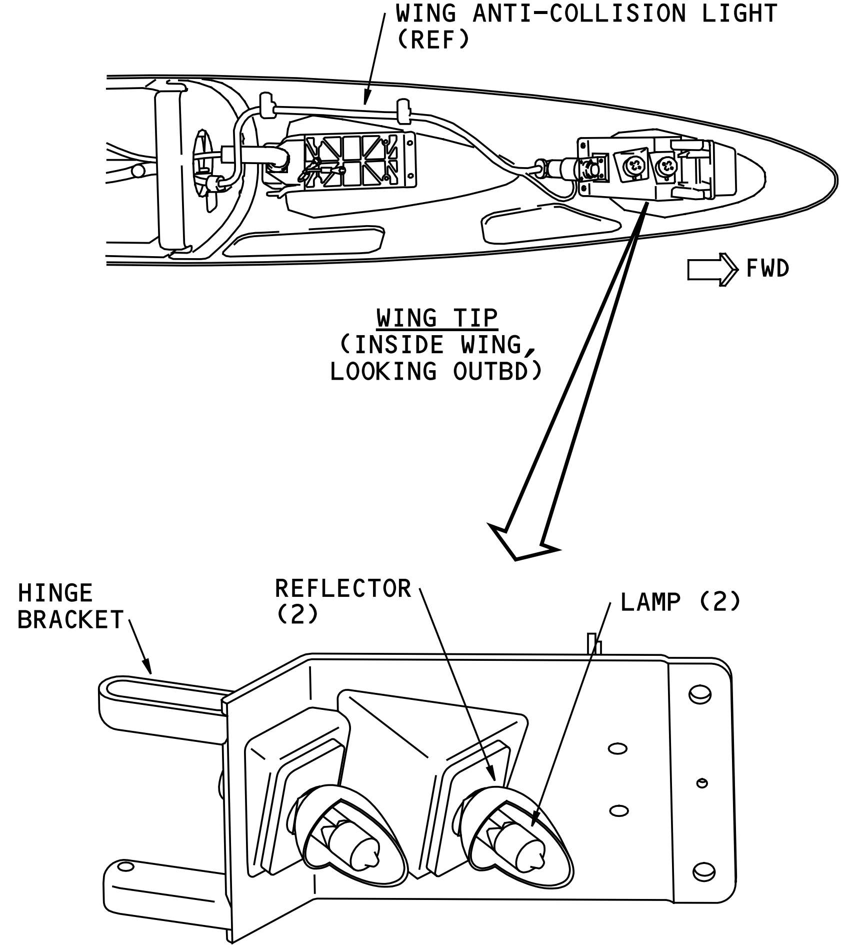
- Lens
- Lamp (2)
- Reflector (2)
- Lanyard
- Electrical connector.

Training Information Point

To get acces to the forward position lamps, loosen the captive screws to release the panel on the bottom side of the wing at the tip. Loosen two captive screws; rotate, and unhook the light assembly to get it out of the wing. The light assembly hangs by a lanyard. This gives you access to the lamps.



REAR POSITION LIGHT ASSEMBLY



FORWARD POSITION LIGHT ASSEMBLY

POSITION LIGHTS - WING POSITION LIGHTS

33-43-00-002 Rev 1 12/06/1996

POSITION LIGHTS - WING POSITION LIGHT TRANSFORMERS

Purpose

The position light transformers decrease the amount of voltage that goes to the position lights.

Location

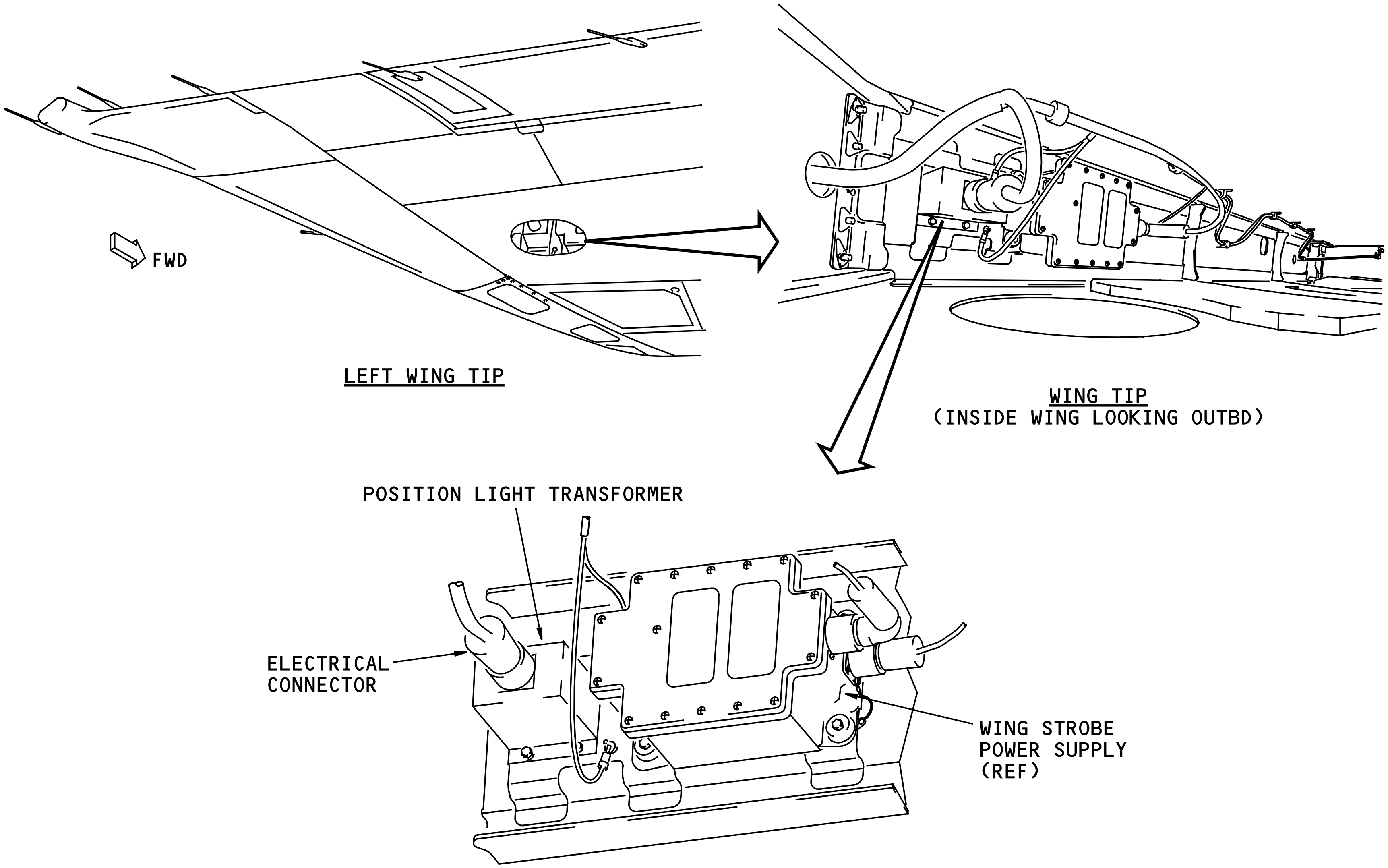
There is one transformer in each wing tip, inboard from the position lights. They are near the wing anti-collision light power supplies.

Physical Description

Each transformer has an electrical connector and four fasteners.

Training Information Point

You loosen captive screws to release the panel on the bottom of the wing at the tip to get access to the transformer.



33-43-00-003 Rev 0 10/17/96

POSITION LIGHTS - WING POSITION LIGHT TRANSFORMERS

POSITION LIGHTS - TAILCONE POSITION LIGHT

Purpose

The tailcone position light lets people outside the airplane see the location of the aft end of the airplane.

Location

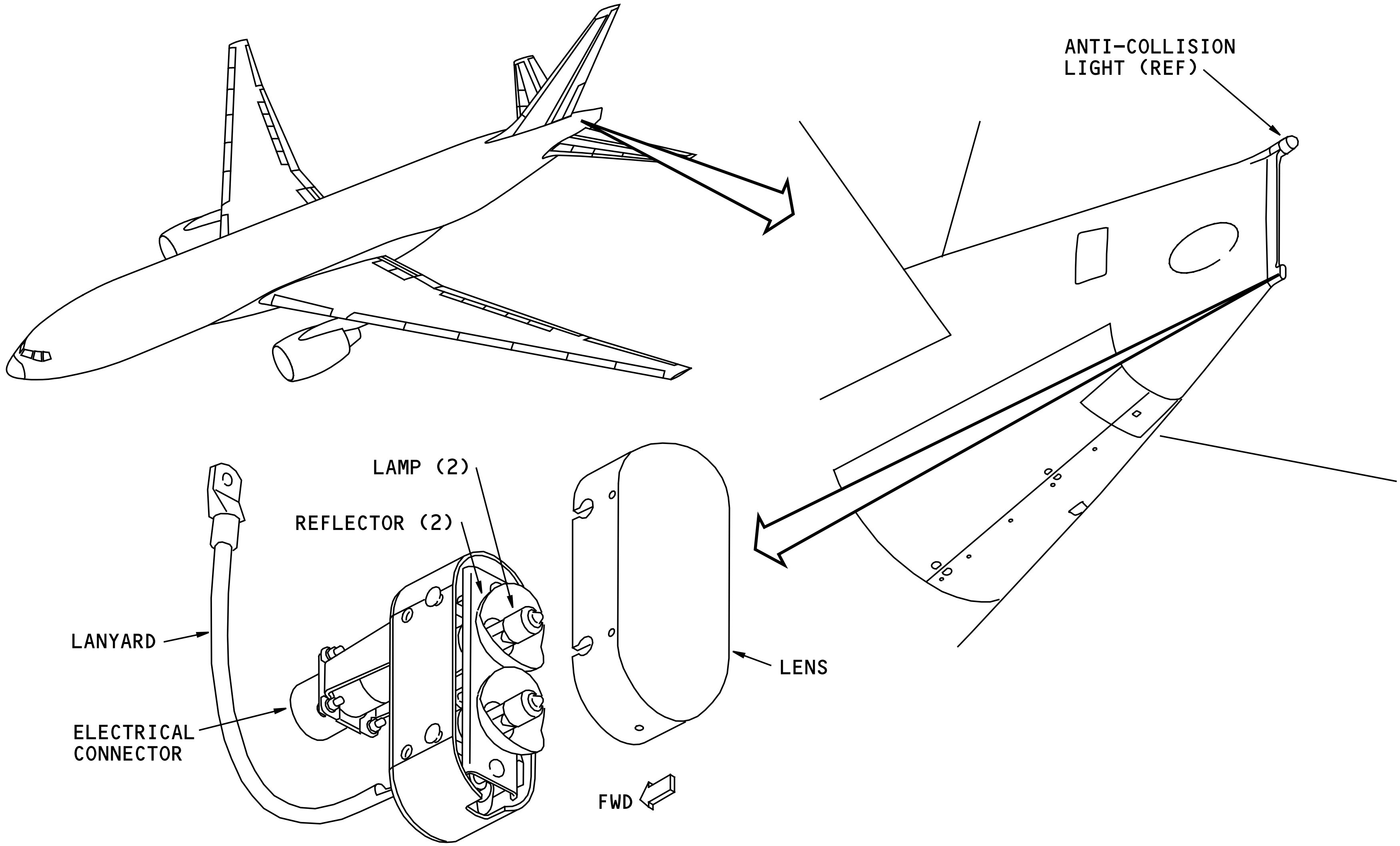
The light is on the lower corner of the airplane tailcone.

Physical Description

The tailcone position light has a clear lens, thus the light is white.

There are two lamps in the position light. The lamps are two-prong-flange-type lamps. There is a reflector for each lamp.

The position light has an electrical connector and lanyard.



TAILCONE POSITION LIGHT ASSEMBLY

33-43-00-006 Rev 0 01/06/1997

POSITION LIGHTS - TAILCONE POSITION LIGHT

POSITION LIGHTS - TAILCONE POSITION LIGHT TRANSFORMER

Purpose

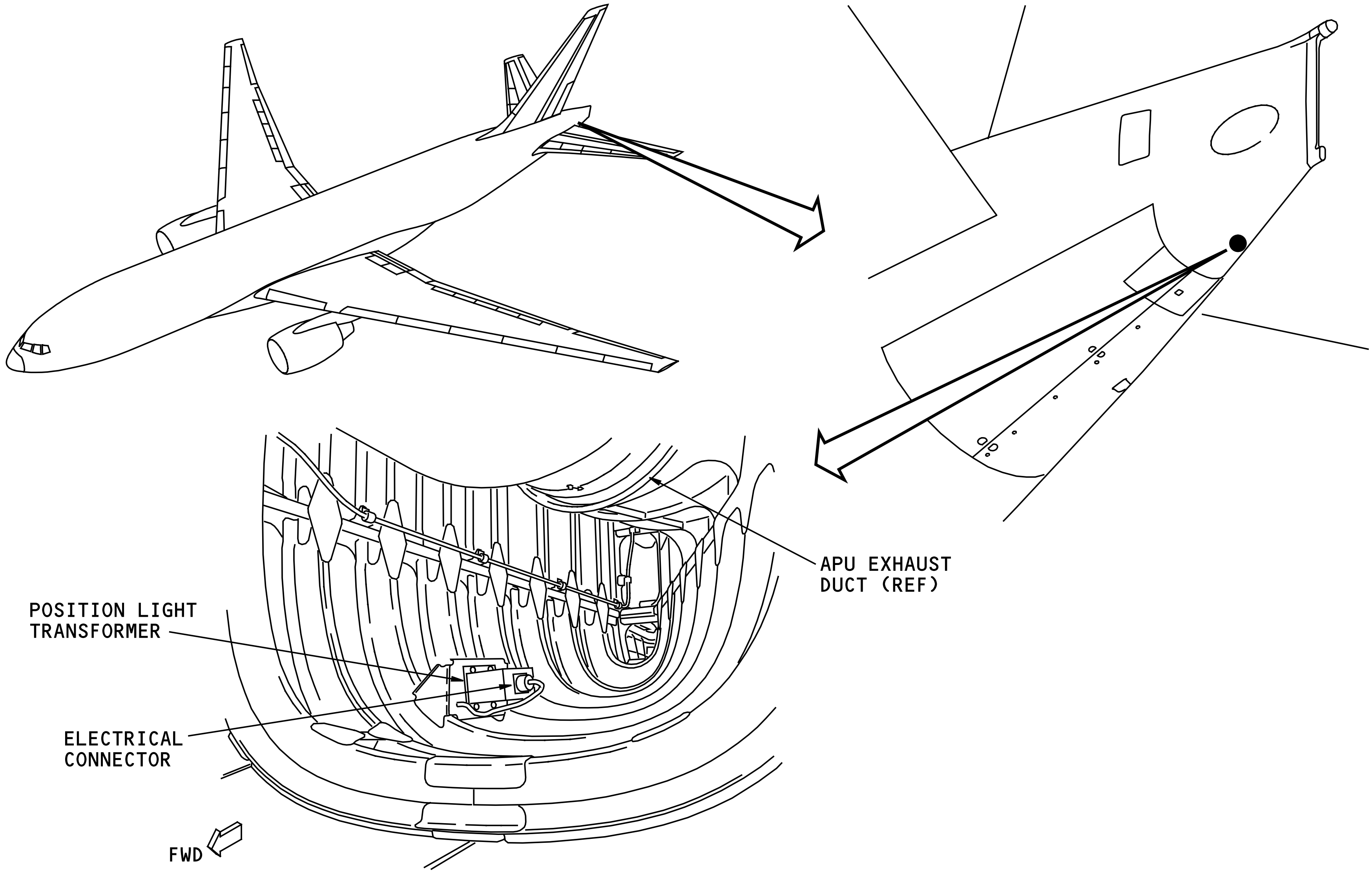
The position light transformer decreases the amount of voltage that goes to the position lights.

Location

The transformer is in the tailcone area in the aft end of the APU compartment. It is on the right side.

Physical Description

The transformer has an electrical connector and four fasteners.

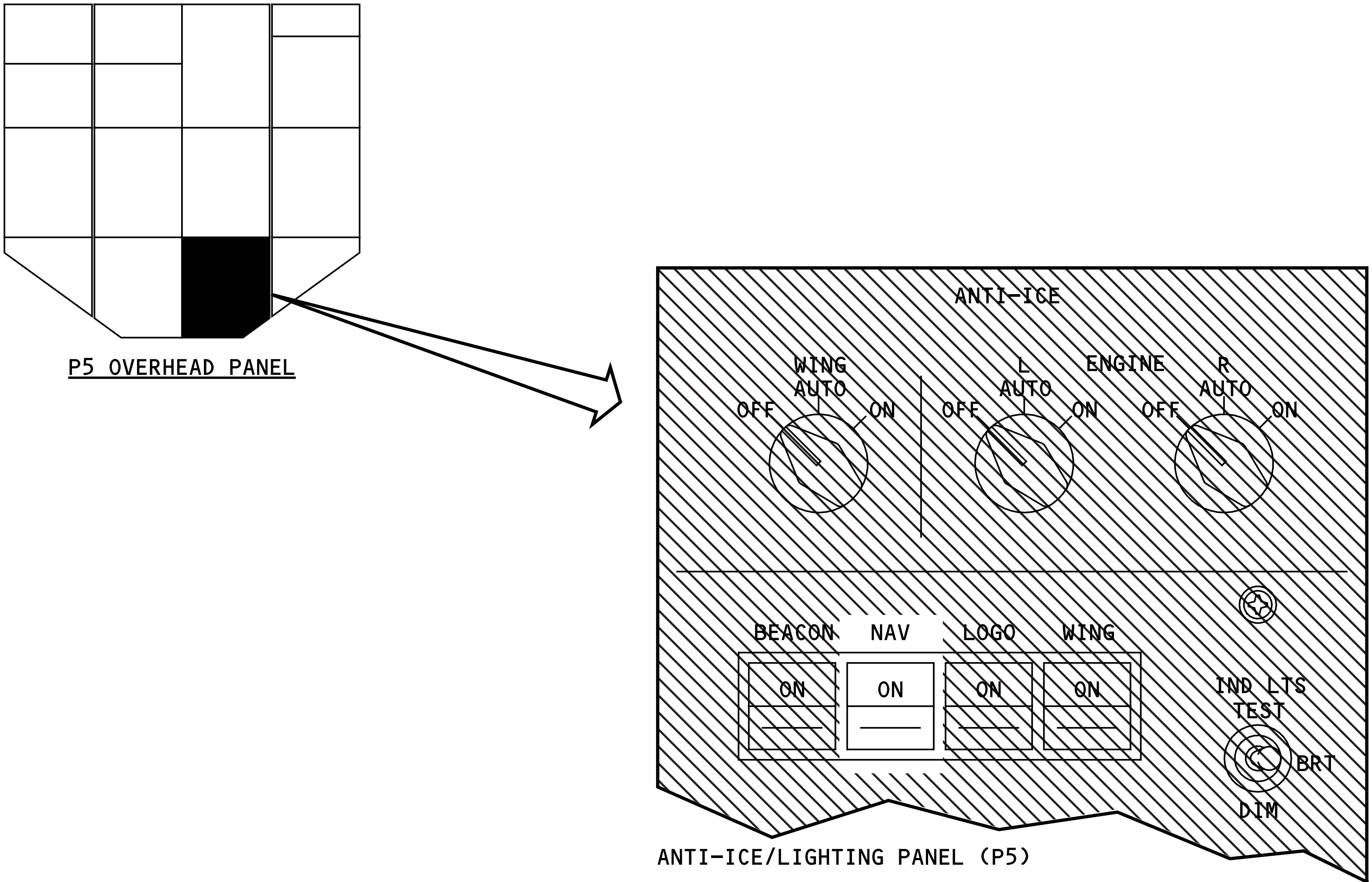


POSITION LIGHTS - TAILCONE POSITION LIGHT TRANSFORMER

POSITION LIGHTS - OPERATION

Operation

You use the navigation light switch (NAV) to operate the position lights. It is on the anti-ice/lighting panel on the P5 overhead panel. It is an alternate-action switch.



ANTI-ICE/LIGHTING PANEL (P5)

33-43-00-004 Rev 1 09/04/96

POSITION LIGHTS - OPERATION

ANTI-COLLISION LIGHTS - INTRODUCTION

Purpose

The anti-collision lights aide in collision avoidance and make the airplane easier to see.

Power supplies give power to the lights and make them flash.

Location

The upper body anti-collision light is on the top of the fuselage. The lower body anti-collision light (not shown) is on the bottom of the fuselage. These lights are referred to as beacons.

The wing anti-collision lights are on the tips of the wings. The tailcone anti-collision light is on the tailcone. These lights are referred to as strobes.

The power supplies (not shown) are near the beacons and strobes. There is one power supply for each light.

General Description

The beacons and strobes are redundant systems.

The two beacon lights flash at the same time. The three strobe lights also flash at the same time, but not at the same time as the beacon lights.

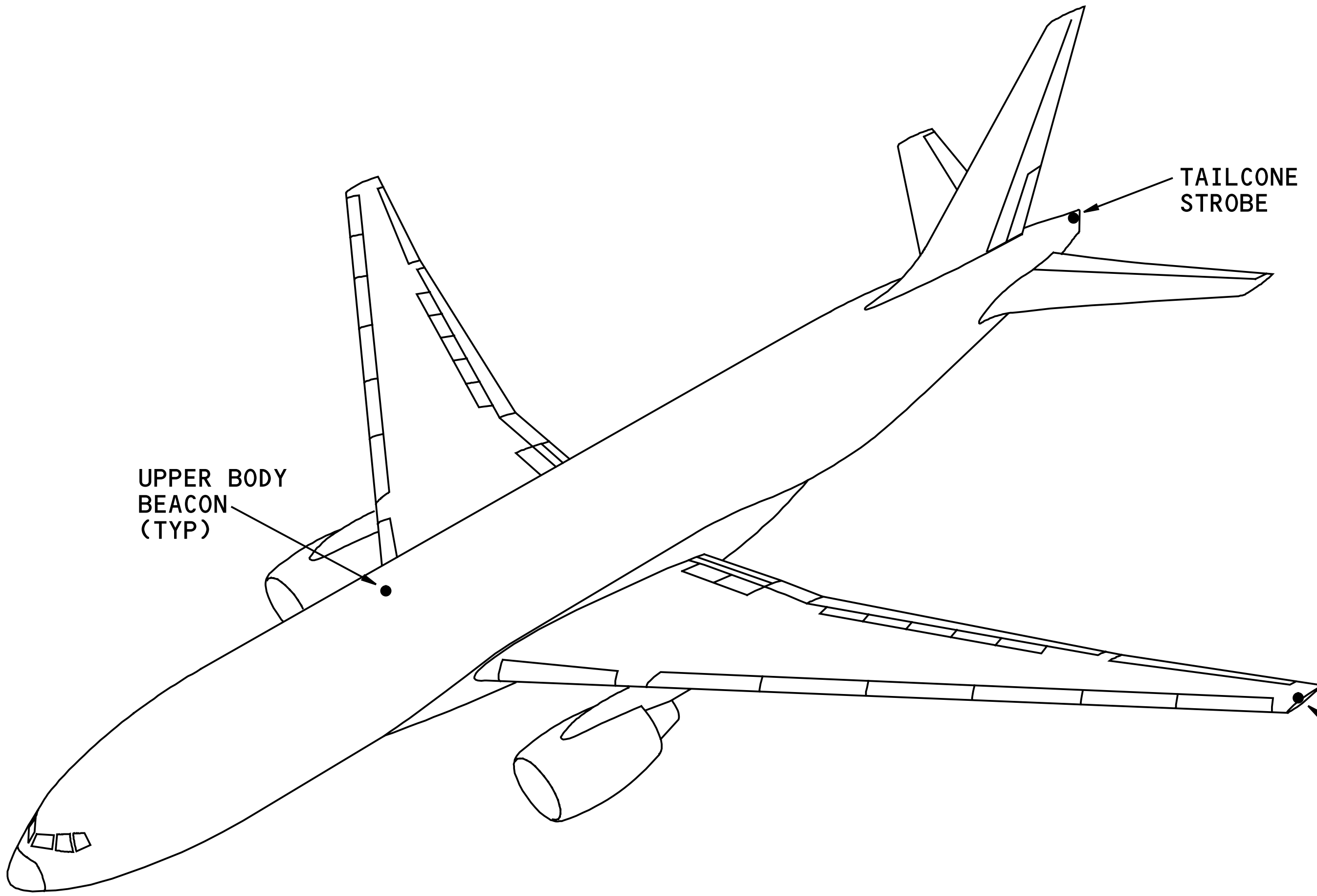
Training Information Point

WARNING: DO NOT LET THE LIGHTS FLASH DIRECTLY IN YOUR EYES. THE INTENSITY OF THE LIGHT CAN CAUSE INJURY TO YOUR EYES TEMPORARILY.

WARNING: WAIT TEN MINUTES BEFORE YOU REMOVE A LIGHT. IF YOU TOUCH THE LIGHT WHEN IT IS HOT, INJURY TO PERSONS CAN OCCUR.

WARNING: DO NOT TOUCH THE POWER SUPPLY FOR THREE MINUTES AFTER YOU REMOVE THE POWER. IF YOU TOUCH A POWER SUPPLY BEFORE YOU BLEED IT, INJURY TO PERSONS OR DAMAGE TO EQUIPMENT CAN OCCUR.

CAUTION: DO NOT TOUCH THE LAMP WITH YOUR BARE HANDS. FINGERPRINTS DECREASE LIGHT OUTPUT AND CAN CAUSE FAILURE OF THE LAMP BEFORE THE USUAL TIME.



33-44-00-001 Rev 1 04/15/1997

ANTI-COLLISION LIGHTS - INTRODUCTION

ANTI-COLLISION LIGHTS - UPPER AND LOWER BODY BEACONS

Component Locations

The upper body beacon is on the top of the fuselage, above the forward wing to body fairing.

The lower body beacon is on the bottom of the fuselage, forward of the main gear wheel wells.

Physical Description

The lamps in the beacons are the xenon strobe type. They flash approximately 48 times per minute.

The beacon light has these components:

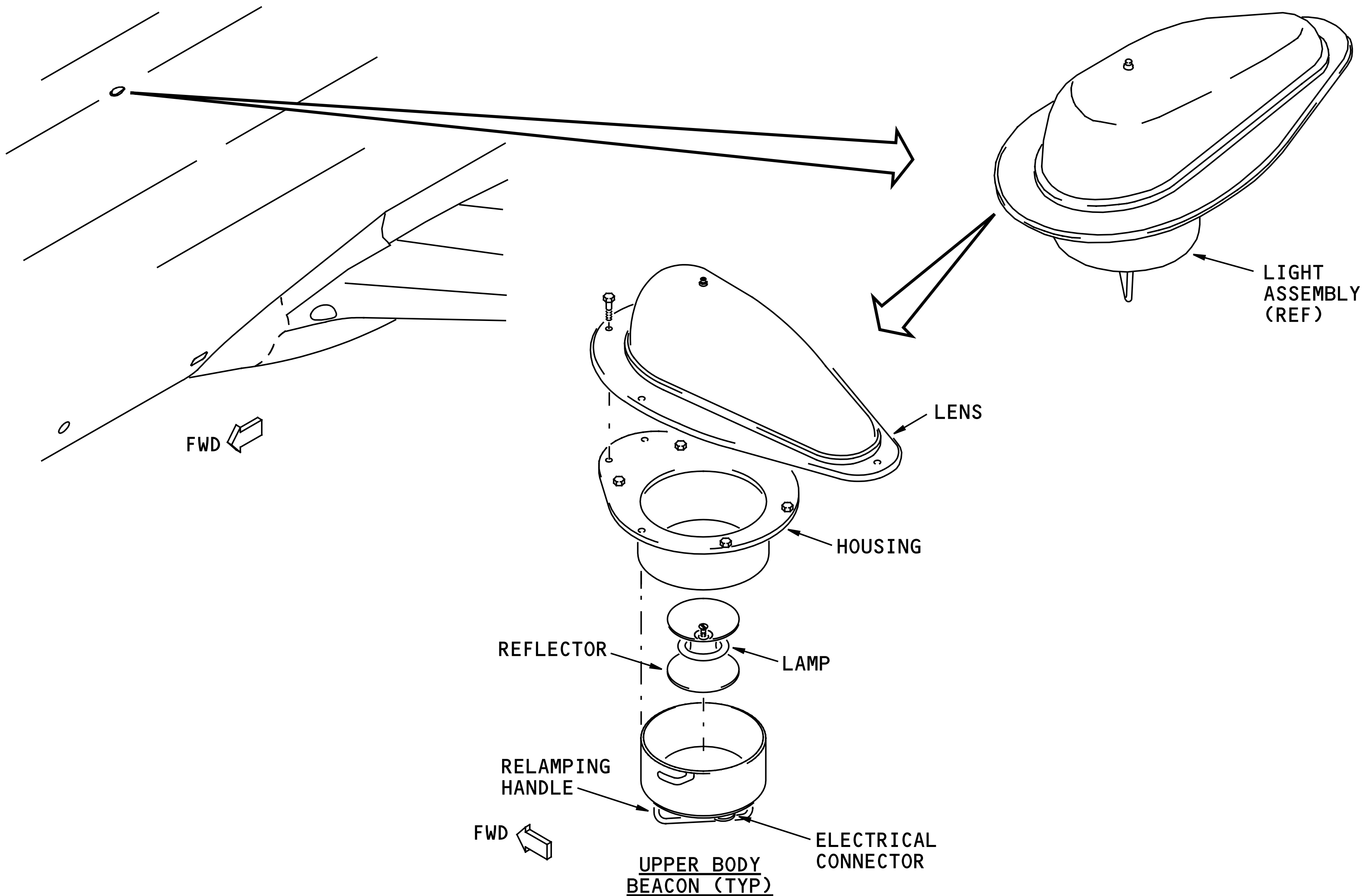
- Lens
- Lamp
- Housing
- Electrical connector
- Relamping Handle
- Reflector.

The lens is red.

Training Information Point

You lower the ceiling panel at station 876 to get access to the upper body beacon. There are station markers above each center ceiling panel. They are on the center bin stowage bin rail.

You get access to the lower body beacon from the outside of the airplane.



ANTI-COLLISION LIGHTS - UPPER AND LOWER BODY BEACONS

ANTI-COLLISION LIGHTS - WING STROBE

Location

The wing strobes are on the tips of the wings. They are aft of the red or green position light.

Physical Description

The lamps in the wing strobes are the xenon strobe type.

Each light has a:

- Lanyard
- Lamp assembly.

Each lamp assembly has a:

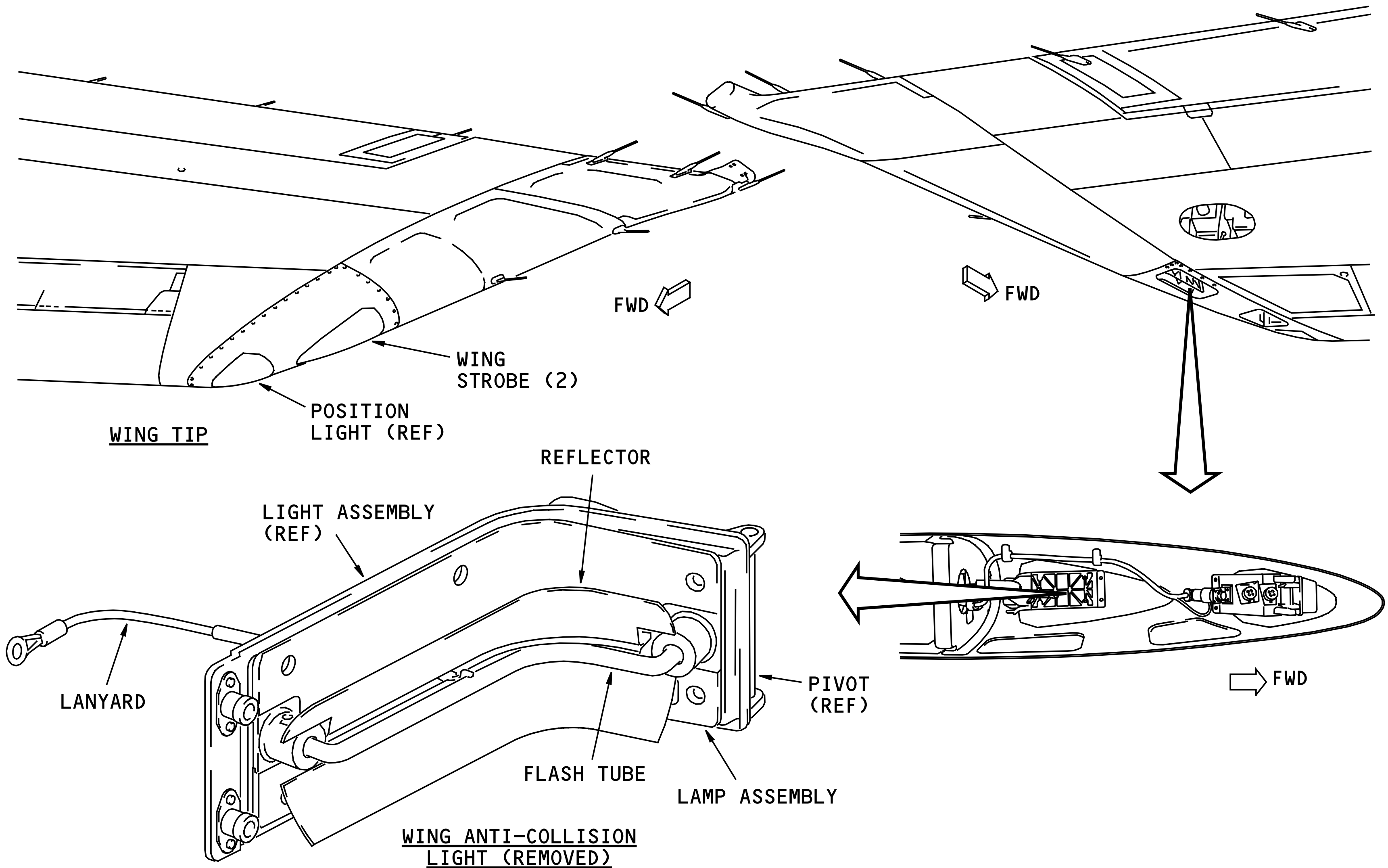
- Reflector
- Flash tube.

The lamp assembly attaches to the light assembly. There is a lanyard that does not allow the light assembly to fall when you remove the fasteners. There is an electrical connector on the back of the light assembly.

You loosen the captive screws to release the panel on the bottom side of the wing tip to access the position light lamps. You loosen two quick release fasteners and rotate the assembly around the pivot to get it out of the wing. This gives you access to the lamp assembly.

Training Information Point

You replace the lamp assembly. The flash tube is not an LRU.



33-44-00-003 Rev 1

ANTI-COLLISION LIGHTS - WING STROBE

ANTI-COLLISION LIGHTS - TAILCONE STROBE

Location

The tailcone strobe is on the end of the fuselage.

Physical Description

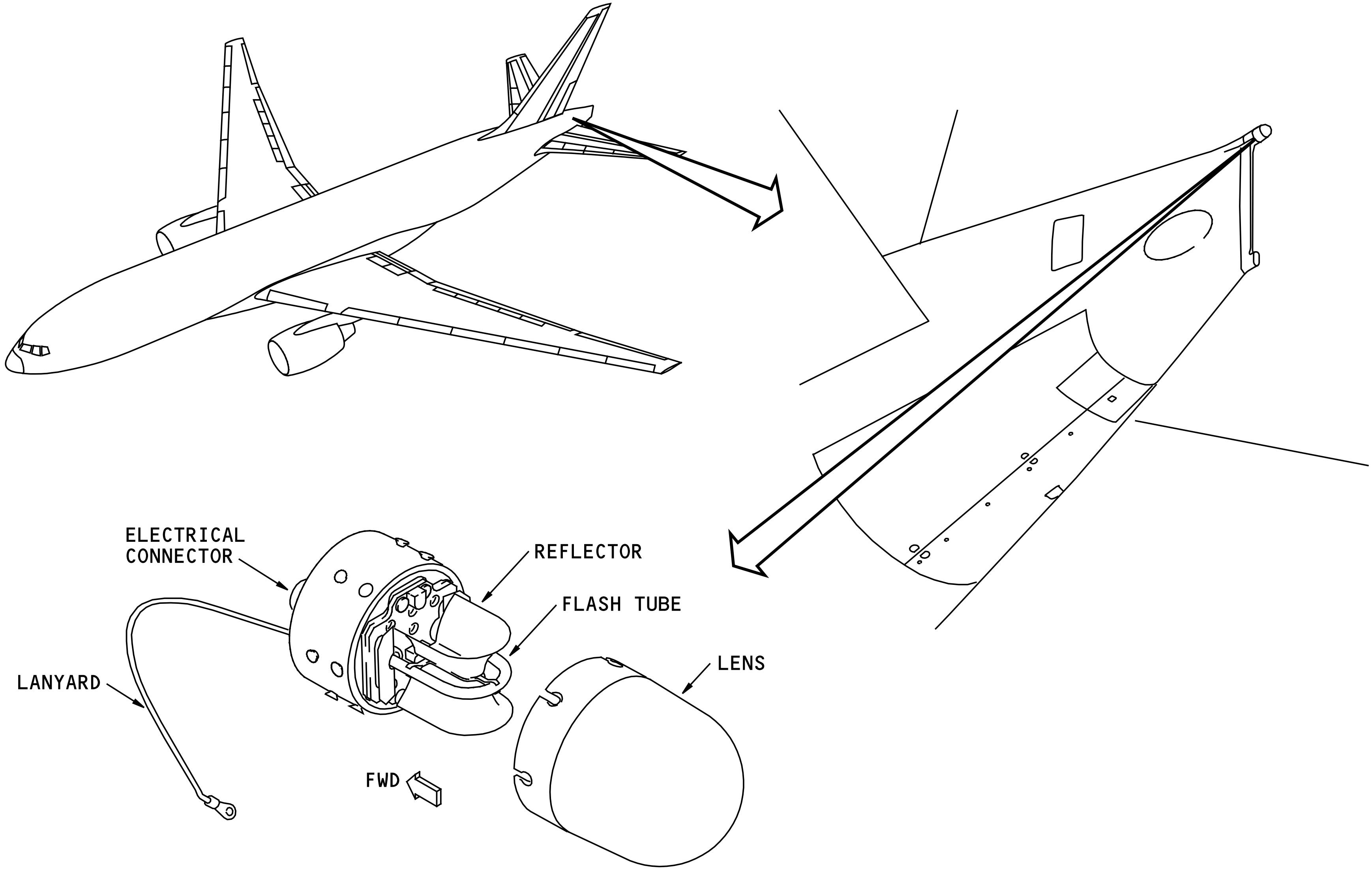
The lamp in the tailcone strobe is the xenon-strobe type.

The strobe has a:

- Lanyard
- Electrical connector
- Reflector
- Flash tube
- Lens.

Training Information Point

You get access to the tailcone strobe from the outside of the airplane.



TAILCONE STROBE LIGHT ASSEMBLY

ANTI-COLLISION LIGHTS - TAILCONE STROBE

ANTI-COLLISION LIGHTS - POWER SUPPLY - INTRODUCTION

Purpose

The power supplies give power to the beacons and the strobes. They make the beacons and the strobes flash.

Location

The power supplies for the wing strobes are behind a panel on the bottom side of the wing at the tip.

The power supply for the tailcone beacon is in the stabilizer compartment. It is on the forward side of the APU compartment bulkhead.

Physical Description

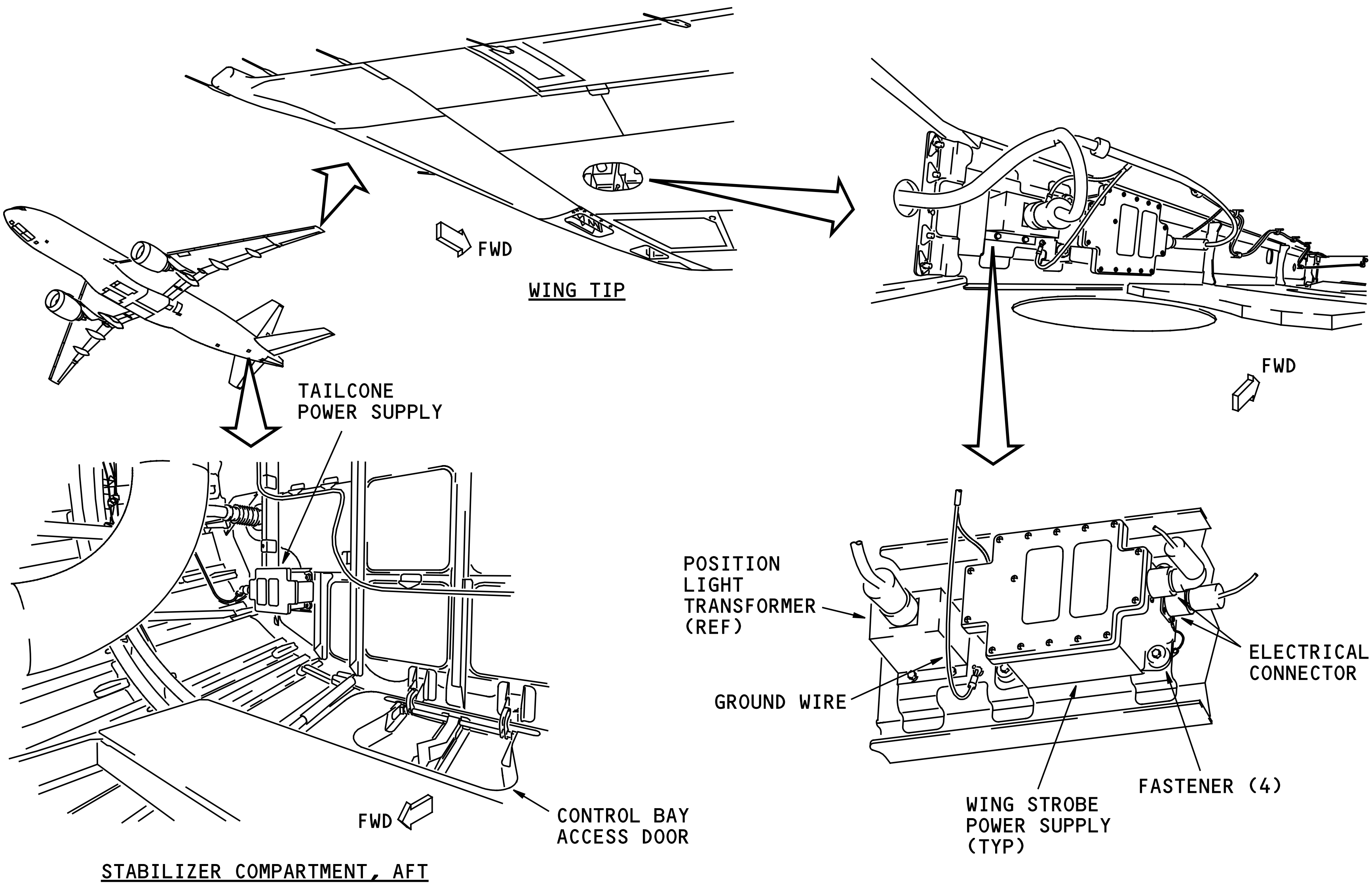
Each power supply has an:

- Electrical connector
- Fastener (4)
- Ground wire.

The power supplies make the beacons and strobes flash.

Training Information Point

The power supplies are the same and interchangeable.



33-44-00-005 Rev 1 04/15/1997

ANTI-COLLISION LIGHTS - POWER SUPPLY - INTRODUCTION

ANTI-COLLISION LIGHTS - POWER SUPPLY - BODY BEACON LOCATION

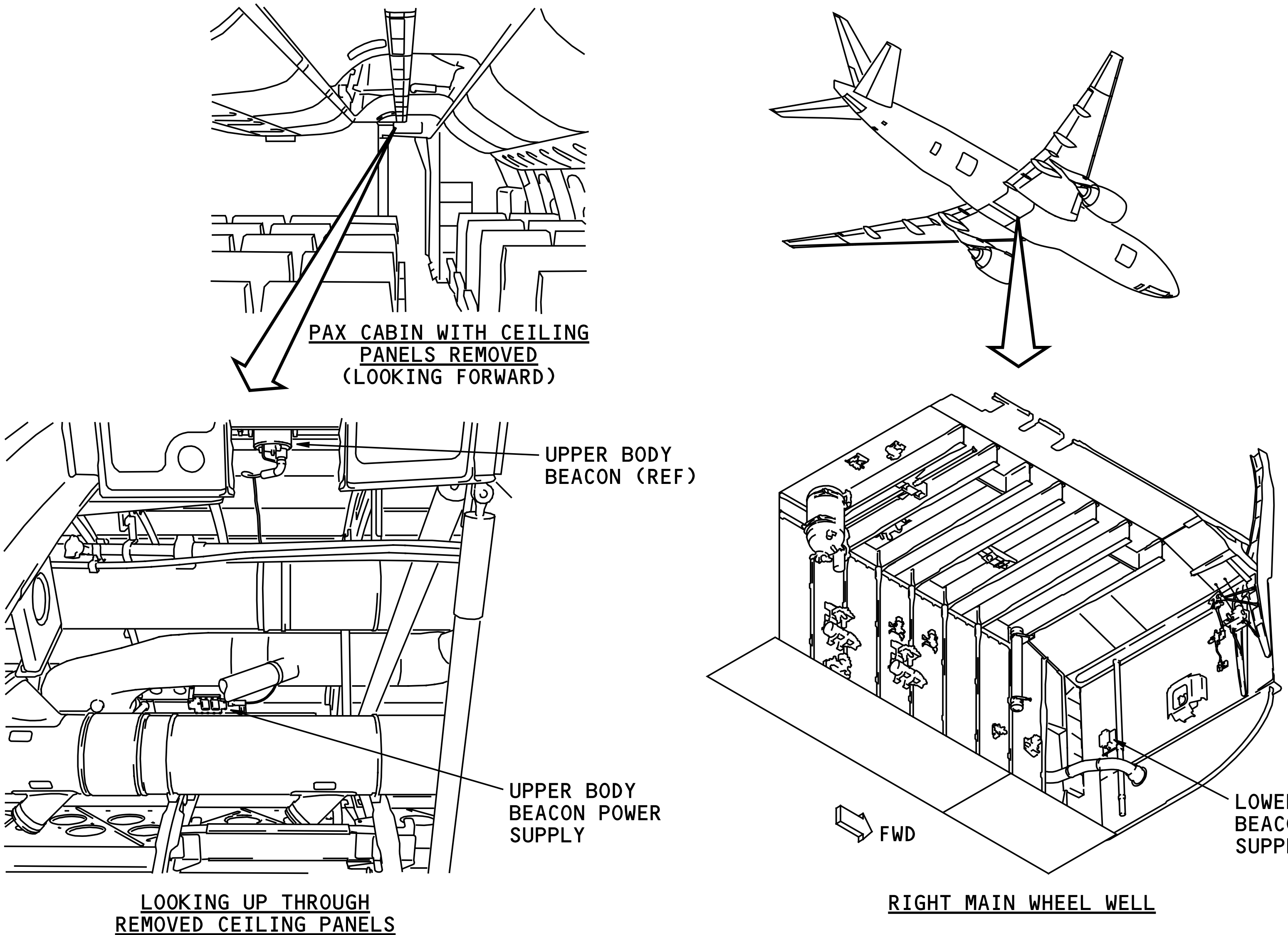
Location

The power supply for the upper body beacon is above the ceiling at approximately the same station line as the forward wing to body fairing. It is forward of the upper beacon.

The power supply for the lower body beacon is in the right main wheel well, on the forward wall.

Training Information Point

The power supplies are the same and interchangeable.



33-44-00-006 Rev 1 04/15/1997

ANTI-COLLISION LIGHTS - POWER SUPPLY - BODY BEACON LOCATION

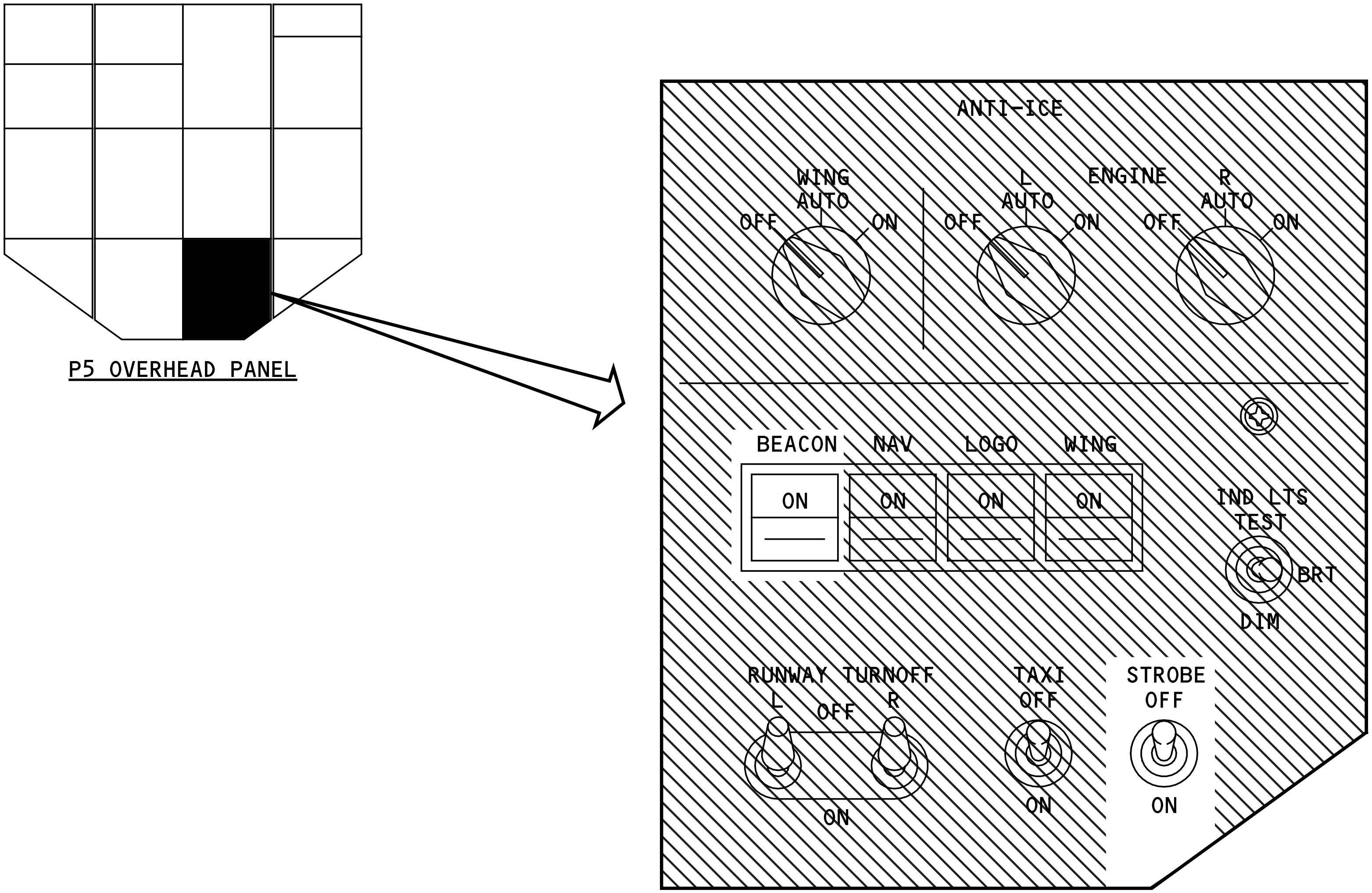
ANTI-COLLISION LIGHTS - OPERATION

Operation

You use the beacon light switch (BEACON) to operate the upper and lower body beacons.

You use the strobe light switch (STROBE) to operate the wing and tailcone strobes.

The switches are on the anti-ice/lighting panel on the P5 overhead panel. The beacon switch is an alternate action switch. The strobe switch is a toggle switch.



ANTI-ICE/LIGHTING PANEL (P5)

33-44-00-007 Rev 1 08/21/96

ANTI-COLLISION LIGHTS - OPERATION

LOGO LIGHTS - INTRODUCTION

Purpose

The logo lights give light to both sides of the vertical stabilizer.

Location

The lights are on the upper side of the horizontal stabilizer. They are near the leading edge. There are two on each side of the vertical stabilizer.

Physical Description

The logo light is a two-pin, flange-mounted light. It has these components:

- Reflector
- Lens
- Lens retainer
- Transformer (not shown).

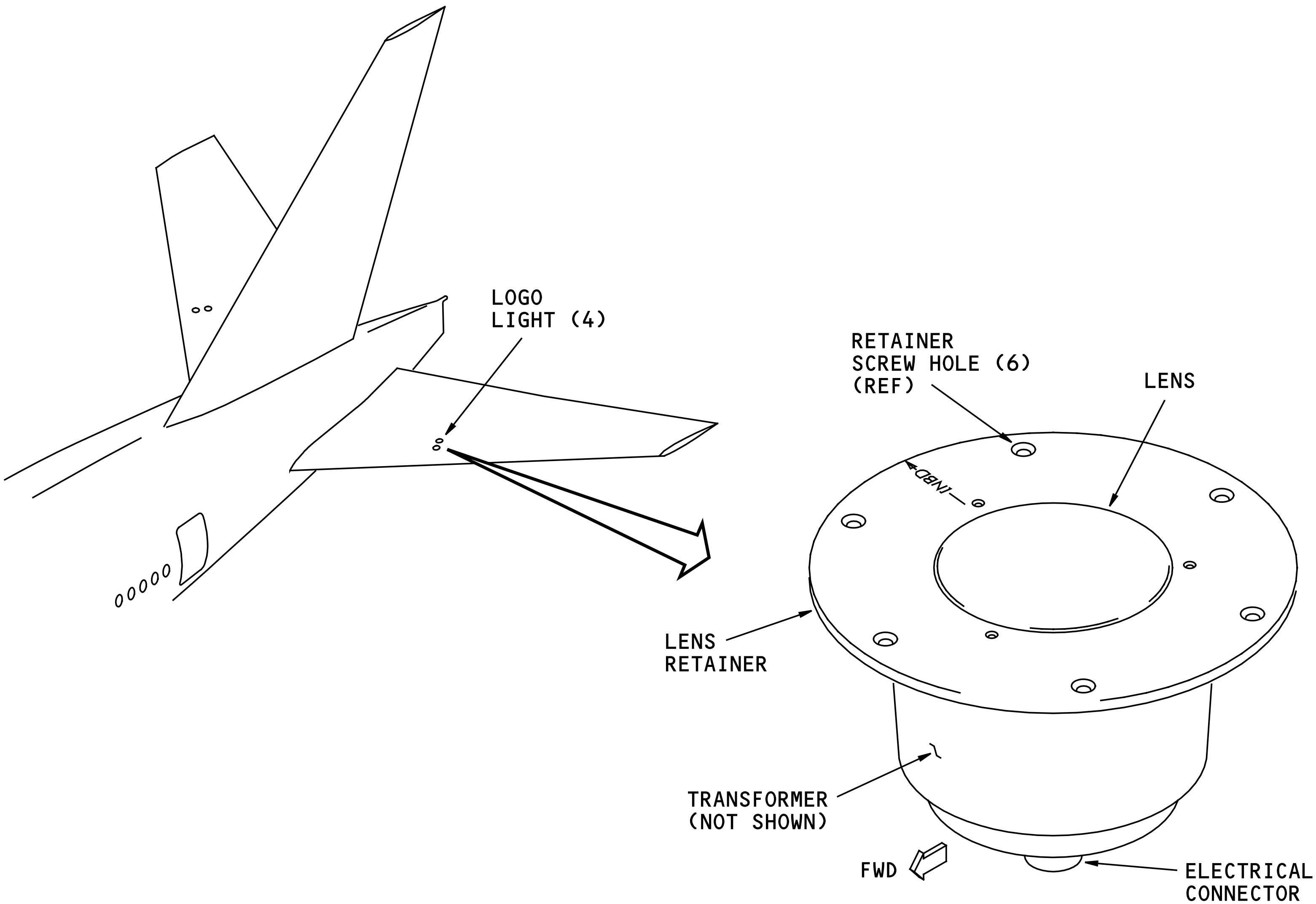
The transformer is part of the light. Two captive screws hold the reflector in position.

You remove the lens retainer and lens as one part. This gives you access to the light. There are six screws that hold the lens retainer.

Training Information Point

When you replace the lens retainer make sure the INBD arrow points inboard.

Since there are two lights on each side of the stabilizer, one indication of a failed light is a decrease in the amount of light on that side.



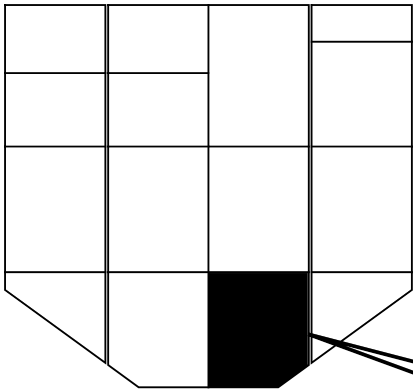
33-45-00-001 Rev 0

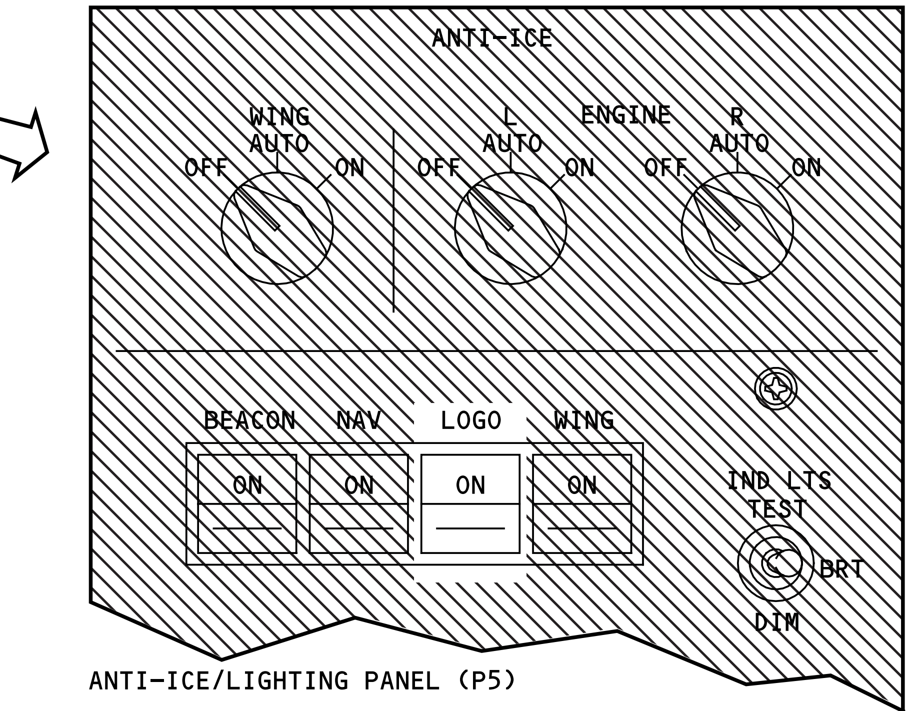
LOGO LIGHTS - INTRODUCTION

LOGO LIGHTS - OPERATION

Operation

You use the logo lights switch (LOGO) to operate the logo lights. It is on the anti-ice/lighting panel on the P5 overhead panel. It is an alternate-action switch.





ANTI-ICE/LIGHTING PANEL (P5)

33-45-00-002 Rev 1 09/03/96

LOGO LIGHTS - OPERATION

Continental Airlines, Inc

Oxygen

WB371

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OXYGEN - INTRODUCTION

Purpose

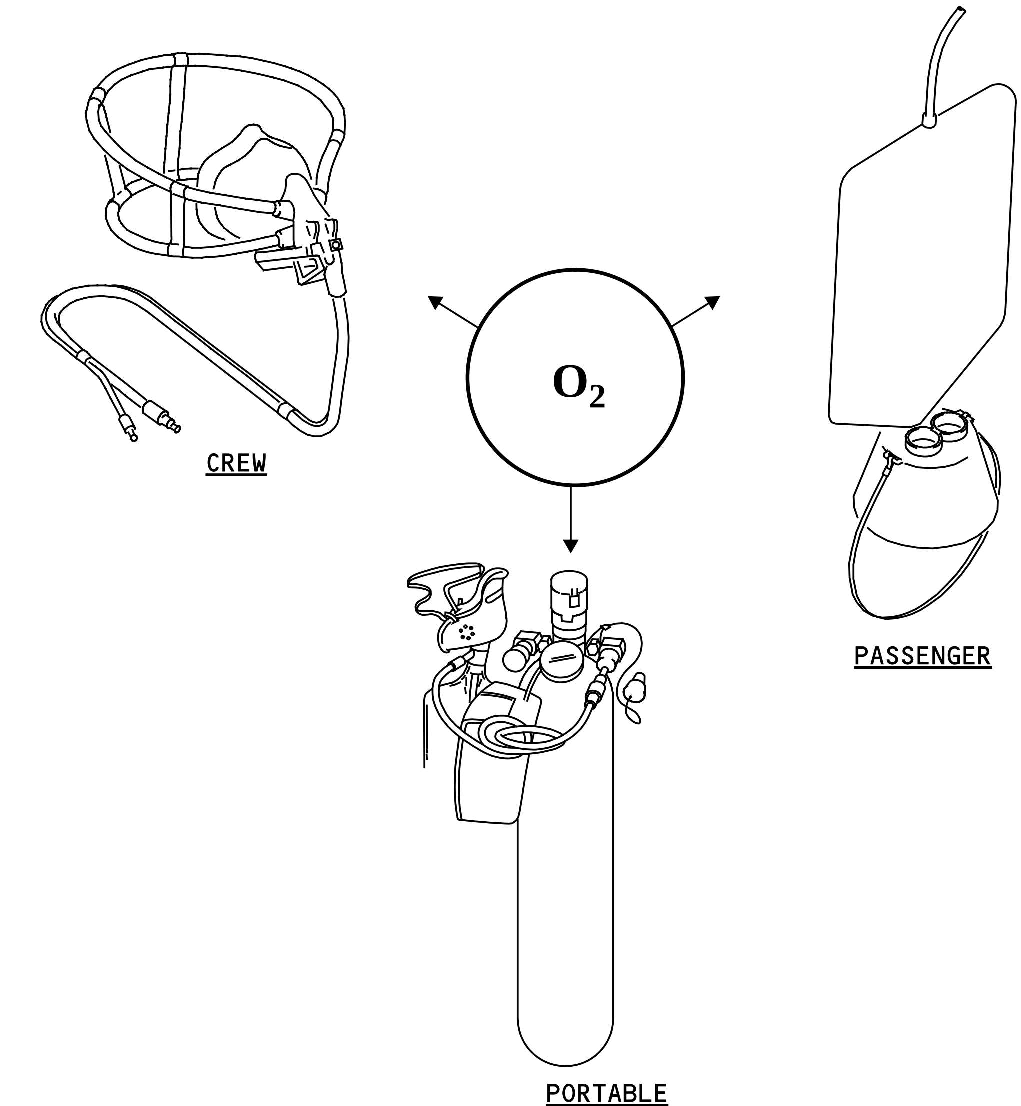
The oxygen systems supply oxygen to the flight crew, cabin attendants, and passengers.

Location

There are separate systems in the flight deck and passenger compartment. There are also portable oxygen units.

Abbreviations and Acronyms

AIMS	- airplane information management system
CSS	- cabin services system
EEU	- ELMS electronics unit
EICAS	- engine indicating and crew alerting system
ELMS	- electrical load management system
MEC	- main equipment center
MFD	- multi-functional display
PSU	- passenger service unit



OXYGEN - INTRODUCTION

CREW OXYGEN - INTRODUCTION

Purpose

The crew oxygen system gives oxygen to the flight crew for emergencies and procedures that make its use necessary.

Component Locations

The crew oxygen masks and storage boxes are in the flight compartment.

The oxygen cylinders and the bleed valve are in the main equipment center (MEC).

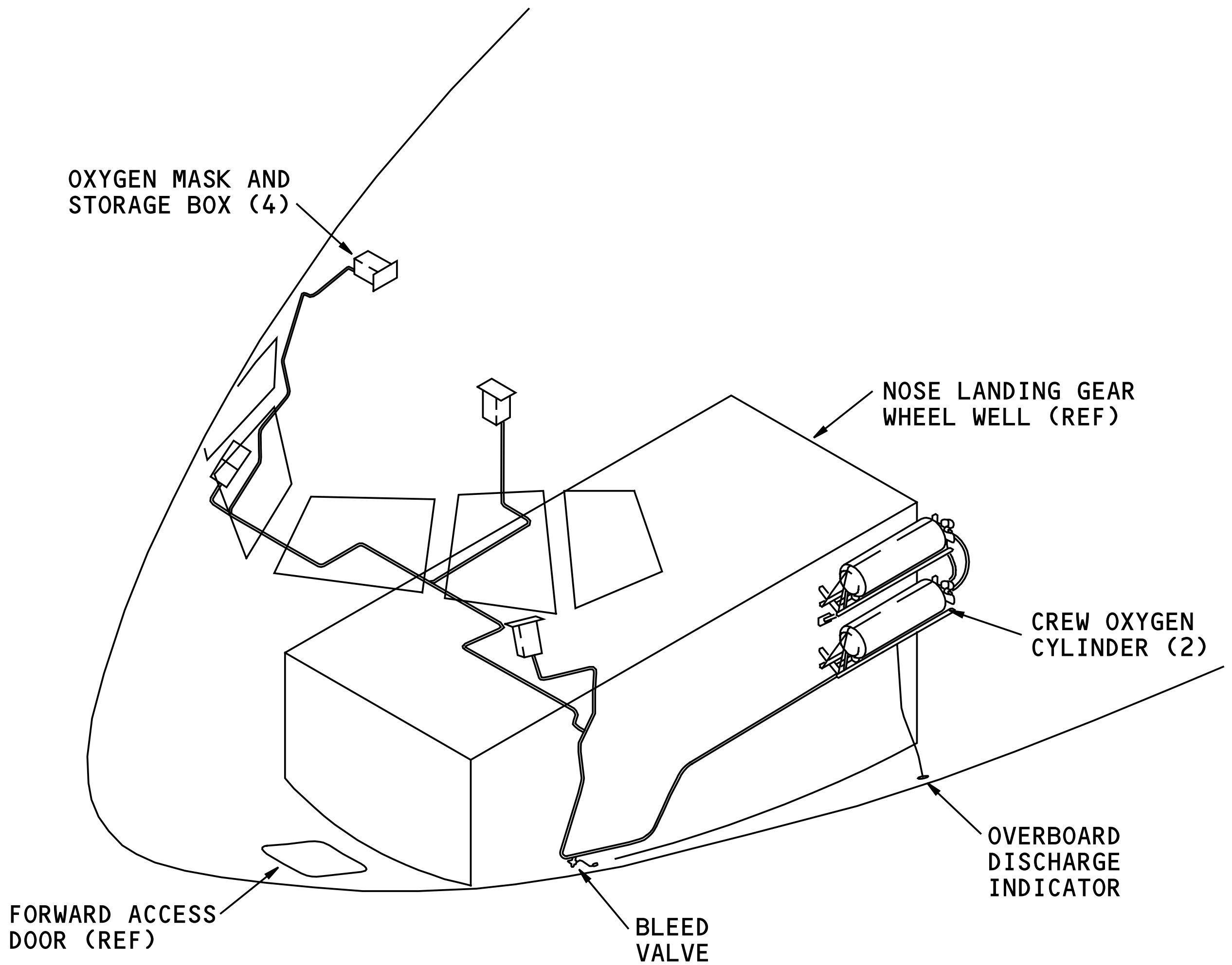
The overboard discharge indicator is external, on the airplane skin.

General Description

The cylinders in the MEC hold pressurized oxygen. A line connects the cylinders to oxygen masks in the flight deck. A regulator at the cylinders and diluter/ demand valves at the masks decrease oxygen pressure to the correct pressure for crew use.

The diluter/demand valve also mixes an applicable amount of flight deck air with the oxygen. The valve uses flight deck air pressure to make the decision on the quantity of oxygen to mix. The crew can also set the valve for 100 percent oxygen.

You can get oxygen cylinder pressure information from the gages at the cylinders and from the primary display system (PDS).



35-11-00-001 Rev 4 08/13/96

CREW OXYGEN - INTRODUCTION

CREW OXYGEN - CYLINDER

Purpose

The crew oxygen cylinders contain oxygen for the flight crew.

Location

The cylinders are on the left side of the main equipment center (MEC), forward of the E3 rack and the ladder to the MEC access hatch.

General Description

The cylinder is made of composite materials. It holds 115 cubic feet (3150 liters) of oxygen at 1850 psi. It has a fitting at one end. These items are on the fitting:

- Direct reading pressure gage
- Shutoff valve
- Threaded connection (not shown) for B-nut on the thermal compensator and overboard discharge line
- Thermal relief frangible disc (not shown).

A cylinder support structure holds the cylinder to the airplane. There are retainer rings at both ends of the structure. The forward ring is set and cannot move. The aft ring is movable. Fittings on the bottom of the aft ring let you connect it to the structure and turn it up over the end of the cylinder.

One end of the retainer strap connects to the set ring. The other end of the strap has a tee bolt. It goes through the top of the movable ring. A nut holds the ring and bolt together.

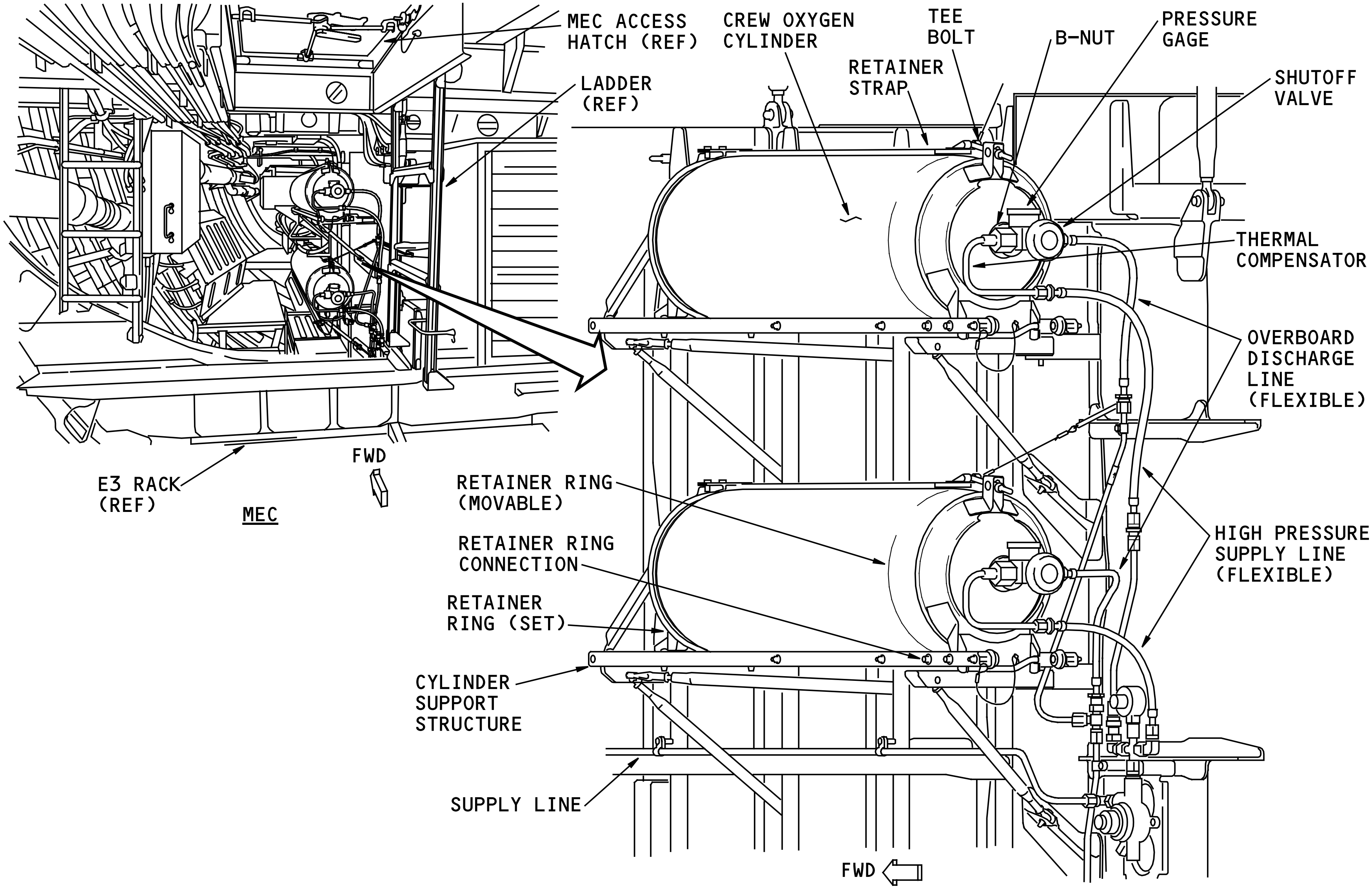
The B-nuts on the thermal compensator and overboard discharge line connect them to the cylinder fitting.

The high pressure supply line lets oxygen flow into the thermal compensator and cylinder. It also lets oxygen flow out of the cylinder to the mask supply line.

The thermal relief frangible disc in the fitting breaks to release oxygen to the overboard discharge line when cylinder pressure gets above safe cylinder limits.

Training Information Point

There are two positions for the movable retainer ring on the cylinder support structure. One position lets the structure hold a composite cylinder. The other lets it hold a steel oxygen cylinder.



CREW OXYGEN - CYLINDER

35-11-00-003 Rev 3 08/16/96

CREW OXYGEN - OVERBOARD DISCHARGE INDICATOR

Purpose

The overboard discharge indicator shows when overpressure causes an oxygen release from the flight crew oxygen cylinders.

Location

The indicator is to the left of the nose landing gear wheel well.

Physical Description

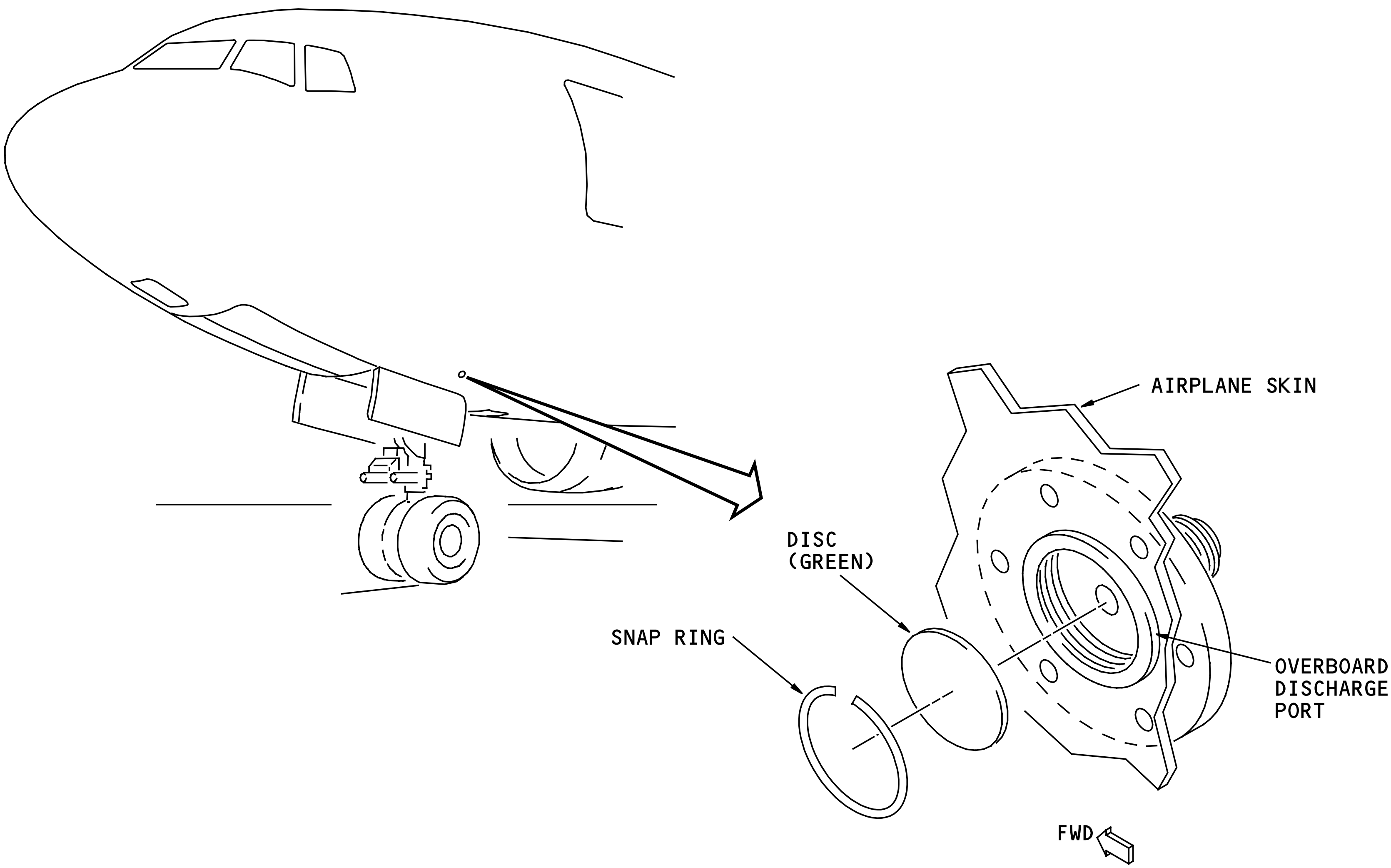
The indicator is a green disc. A snap ring holds it in position.

Functional Description

An overpressure condition causes the frangible disc in the oxygen cylinder to break. The oxygen flows through the overboard discharge line to the overboard discharge port. The pressure pushes the indicator disc out of the snap ring. The disc falls away.

Training Information Point

If the disc is gone, do a check to see if the oxygen cylinders are empty.



35-11-00-004 Rev 2

CREW OXYGEN - OVERBOARD DISCHARGE INDICATOR

CREW OXYGEN - BLEED VALVE

Purpose

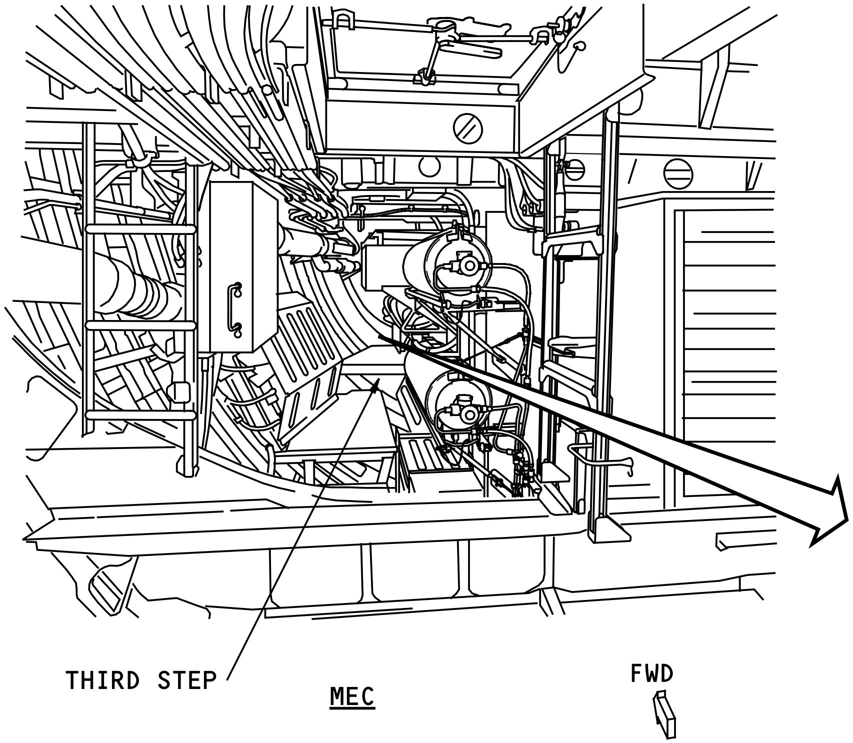
The bleed valve helps to make sure that the AIMS gets correct oxygen cylinder pressure information.

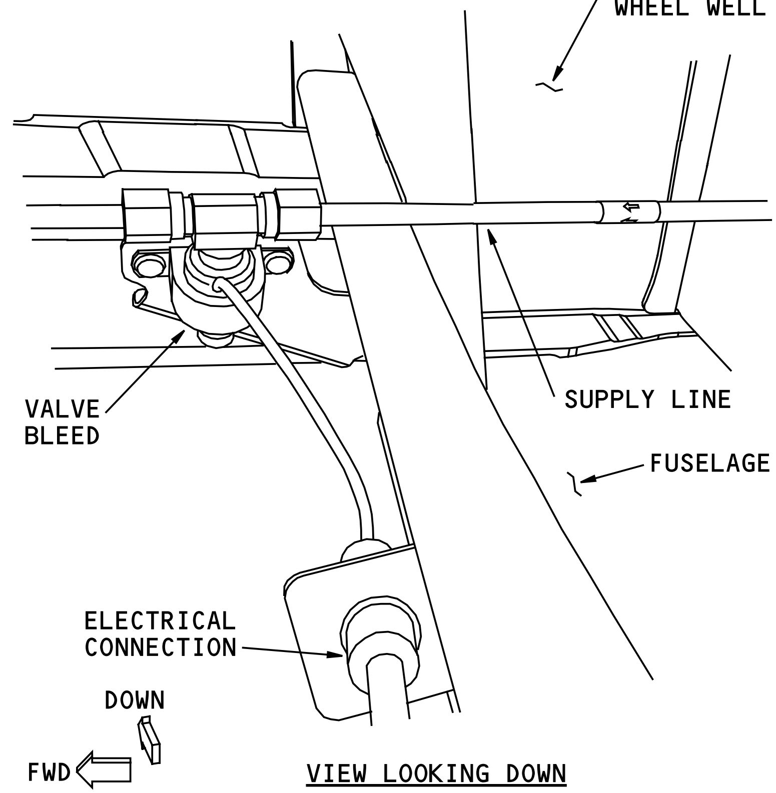
Location

The valve is on the lower, left side of the MEC. It is below and forward of the third step of the walkway.

Physical Description

The valve has a solenoid which supplies the force to open the valve.





35-11-00-006 Rev 3 08/07/96

CREW OXYGEN - BLEED VALVE

CREW OXYGEN - OPERATION

Operation

Pull on the release levers of the diluter/demand regulator to remove the mask from the box. The shutoff valve opens when the left door opens. You hold the left release lever (inflation control) in as you hold the mask by the diluter/demand regulator. This makes oxygen inflate the pneumatic harness.

You put the harness around your head with the mask over your nose and mouth. When you release the release levers, the oxygen that inflates the harness shuts off and bleeds from the harness. Elastic in the harness pulls the mask tight to the face.

Normally you breathe a mixture of oxygen and compartment air when you set the oxygen dilution control to N (normal). The percent of oxygen has a relation to the pressure altitude in the flight deck. At or above a preset pressure altitude the regulator gives you 100 percent oxygen. You breathe only oxygen at any pressure altitude when you set the dilution control to 100 percent.

Normally, oxygen flows only when you breathe (on demand). The flow indicator shows flow each time you breathe. If you set the emergency demand control to emergency, oxygen will flow continuously (pressure breathing). The flow indicator shows continuous flow.

The vent valve (not shown) is part of the mask. The valve lets air and oxygen flow from the mask into the goggles (not shown).

You manually open and close the vent valve with the push-pull control (not shown).

If you close the left door on the box, the oxygen on indicator shows.

You can turn oxygen off at the oxygen box with the shutoff valve. Close the left door and push the reset/ test lever sets the valve to the close position.

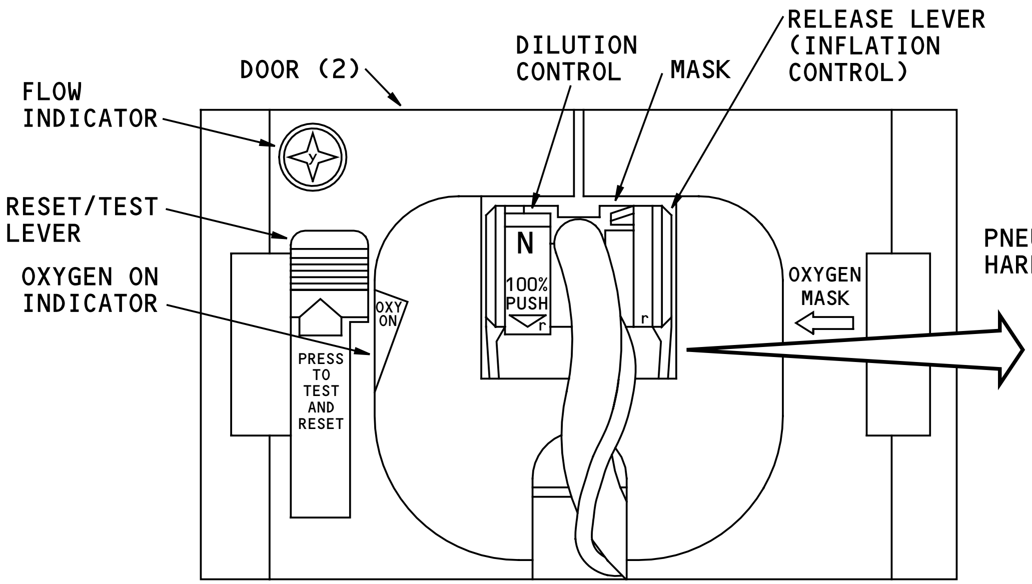
Mask Storage

To return the mask to the box, set the test and emergency demand control to the normal position. Put the wire, hose, and harness into the box. Place the mask into the box so the tabs are against the upper stop and the mask is against the lower stop in the box. Close the left door. Push down on the reset/test lever to close the shutoff valve and retract the oxygen on indicator. Move the mask to the left. Close the right door.

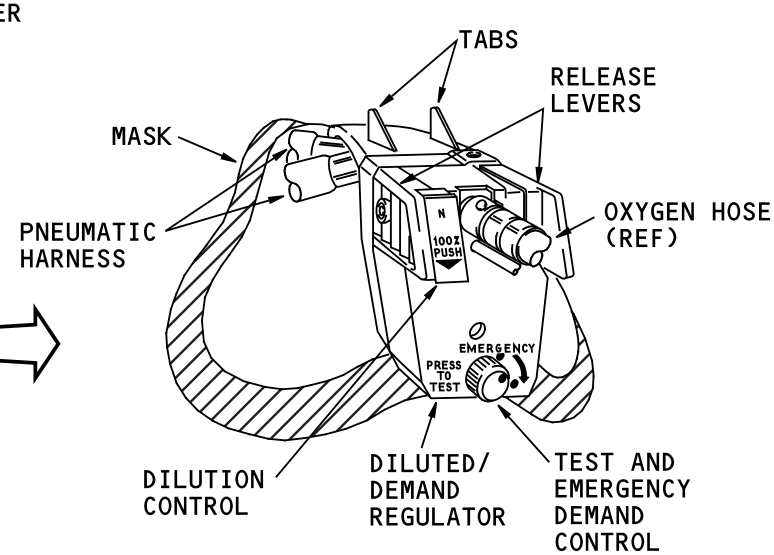
Test

Push down and hold the reset/test lever. The flow indicator should show a momentary flow.

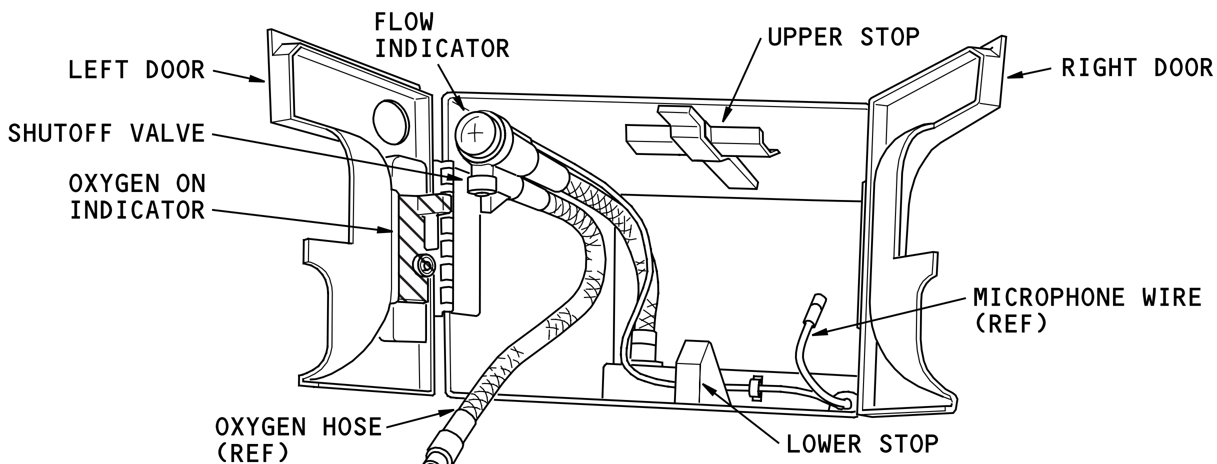
Push down and hold the reset/test lever. Push in on the test and emergency demand control. The flow indicator should show a continuous flow.



CREW OXYGEN BOX AND MASK



DILUTER/DEMAND REGULATOR
(TYPICAL)



CREW OXYGEN BOX

CREW OXYGEN - OPERATION

35-11-00-008 Rev 7 03/19/1998

CREW OXYGEN - FUNCTIONAL DESCRIPTION

Supply and Regulation

The cylinders supply oxygen through the shutoff valves, pressure regulator, and supply line to the masks in the flight deck. The supply line pressure regulator decreases the bottle pressure to 70 psi. The diluter/ demand regulator/mask supplies the flow and pressure that the crew needs.

Indications

The gauge on the cylinder shows cylinder pressure. A pressure transducer also measures the pressure. The information goes to the AIMS. The pressure shows on the status display. An advisory message shows if the bottle pressure goes below 500 psi.

Bleed Valve

The bleed valve operates one time after the airplane lands (air to ground change) and when all of these conditions occur:

- Airplane is on the ground
- Both engines off
- You start an engine.

The ELMS electronics unit (EEU) causes electrical power to go to a solenoid for 25 seconds. The solenoid opens the bleed valve to let oxygen pressure out of the line. If the cylinder shutoff valve is closed, the line will not repressurize when the bleed valve closes. The pressure transducer sends the line pressure information to the AIMS.

Overboard Discharge

The frangible disc breaks if cylinder pressure gets above safe limits (2500 - 2750 psi). The oxygen flows overboard through the overboard discharge indicator.

Oxygen Shutoff Valve/Indicator

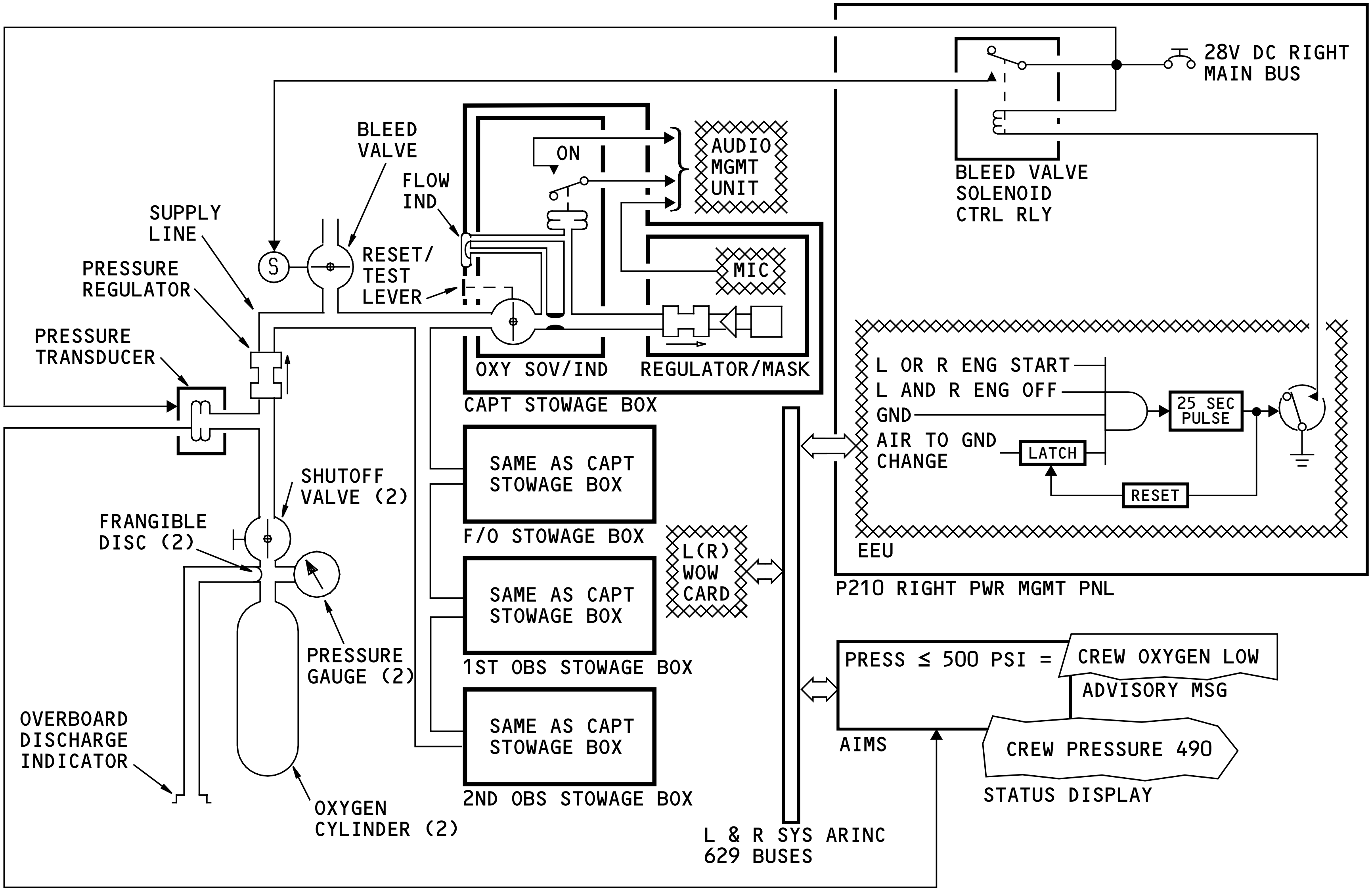
The oxygen shutoff valve/indicator supplies these functions:

- On/off control
- Flow indication
- Starts the oxygen regulator/mask-mounted microphone.

The valve automatically opens when the left door (not shown) on the stowage box is open. The valve stays open until you close the door and push the RESET/TEST LEVER.

The valve supplies flow indication when oxygen flows through the valve.

A switch in the valve supplies an oxygen ON signal to the audio management unit when there is oxygen pressure between the valve the regulator/mask. The audio management unit uses this signal to start the operation of the microphone. See the flight interphone system section for more information about the audio management unit (AMM PART I 23-51).



CREW OXYGEN - FUNCTIONAL DESCRIPTION

PASSENGER OXYGEN - INTRODUCTION

Purpose

The passenger oxygen system supplies oxygen to the passengers and cabin attendants if the airplane loses cabin pressurization.

General Description

The passenger oxygen system uses chemical generators to make the oxygen. The passenger oxygen masks can drop automatically or manually.The masks drop automatically when all these conditions are true:

- The airplane is in the air with an airspeed of more than 80 knots
- The cabin altitude goes above 13,500 feet (4115 meters).

Push the passenger oxygen switch to drop the masks manually. The chemical reaction that generates oxygen starts when you pull down on the mask.

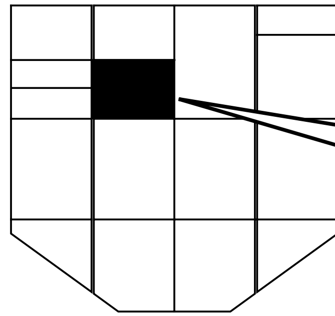
Location

The oxygen generators and masks are in these locations:

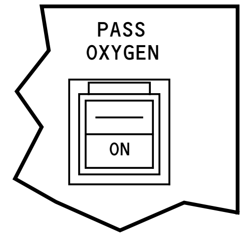
- In passenger service units (PSU)
- In the lavatory PSUs
- In the flight crew rest (FCR) service units
- In the overdoor panels.

Oxygen generators and masks can also be in lowered ceiling panels in cross aisles and in other areas of the airplane.

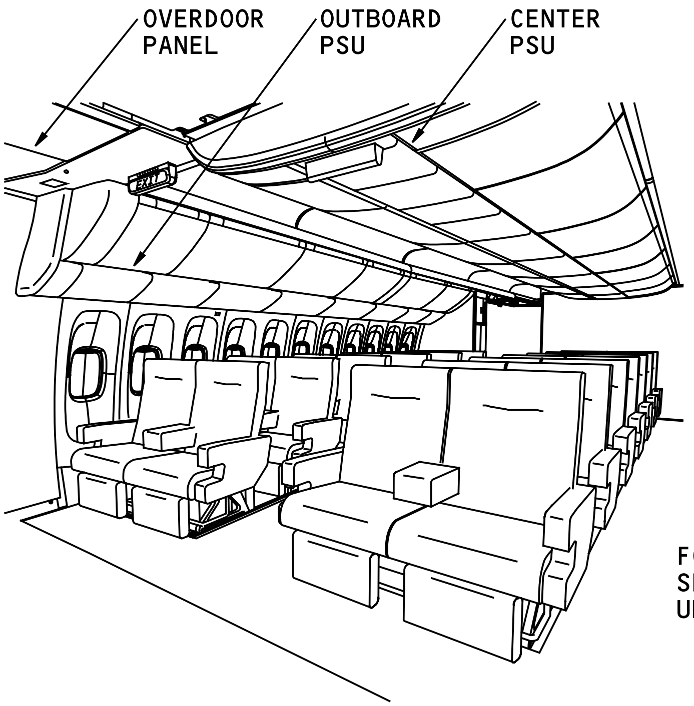
The control switch is on the P5 overhead panel in the flight compartment.



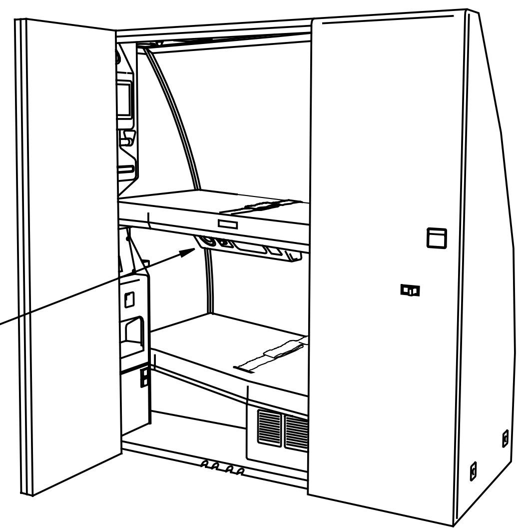
P5 OVERHEAD PANEL



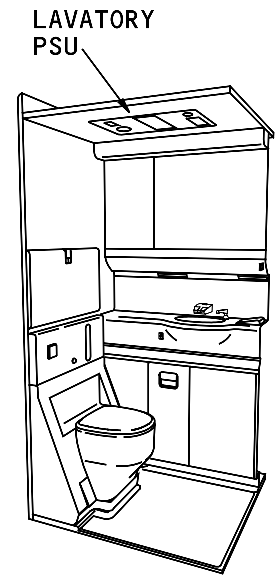
WINDOW HEAT/EMERGENCY LIGHTS PANEL (P5)



PASSENGER COMPARTMENT (EXAMPLE)



FLIGHT CREW REST AREA



LAVATORY (EXAMPLE)

PASSENGER OXYGEN - INTRODUCTION

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PASSENGER OXYGEN - PASSENGER OXYGEN BOX AND PASSENGER OXYGEN MASK

Purpose

The passenger oxygen boxes contain the oxygen masks for the passengers and flight attendants. The oxygen masks supply oxygen to the passengers and attendants if the airplane loses cabin pressure.

Location

Oxygen mask boxes are in these locations:

- Center passenger service units (PSUs)
- Outboard PSUs
- Lavatory PSUs
- Above the flight crew rest bunks
- On overdoor panels
- On some lowered ceiling panels.

Passenger Oxygen Box

A chemical oxygen generator attaches to each box. The center PSUs have two generators if they supply oxygen to more than three seats. A manifold (not shown) in the box distributes oxygen from the generator to the masks. A door with an electrically operated latch keeps the masks in the box until the oxygen deployment circuit operates.

The total quantity of oxygen masks is greater than the quantity of passenger and attendant seats. These are the quantities of masks in each type of oxygen box:

- Outboard PSUs - one more mask than the quantity of related seats
- Center PSUs - one more mask than the quantity of related seats
- Overdoor and lowered ceiling boxes - two masks
- Flight crew rest oxygen boxes - two masks
- Lavatory boxes - two masks.

Latches attach the outboard and center PSUs to the airplane structure. Release the latches and lower the PSU for access to the oxygen generators.

Lower the overdoor panel for access to the oxygen generators above those panels. To get access to the generators in the lavatories or lowered ceiling panels, remove the adjacent lowered ceiling panel.

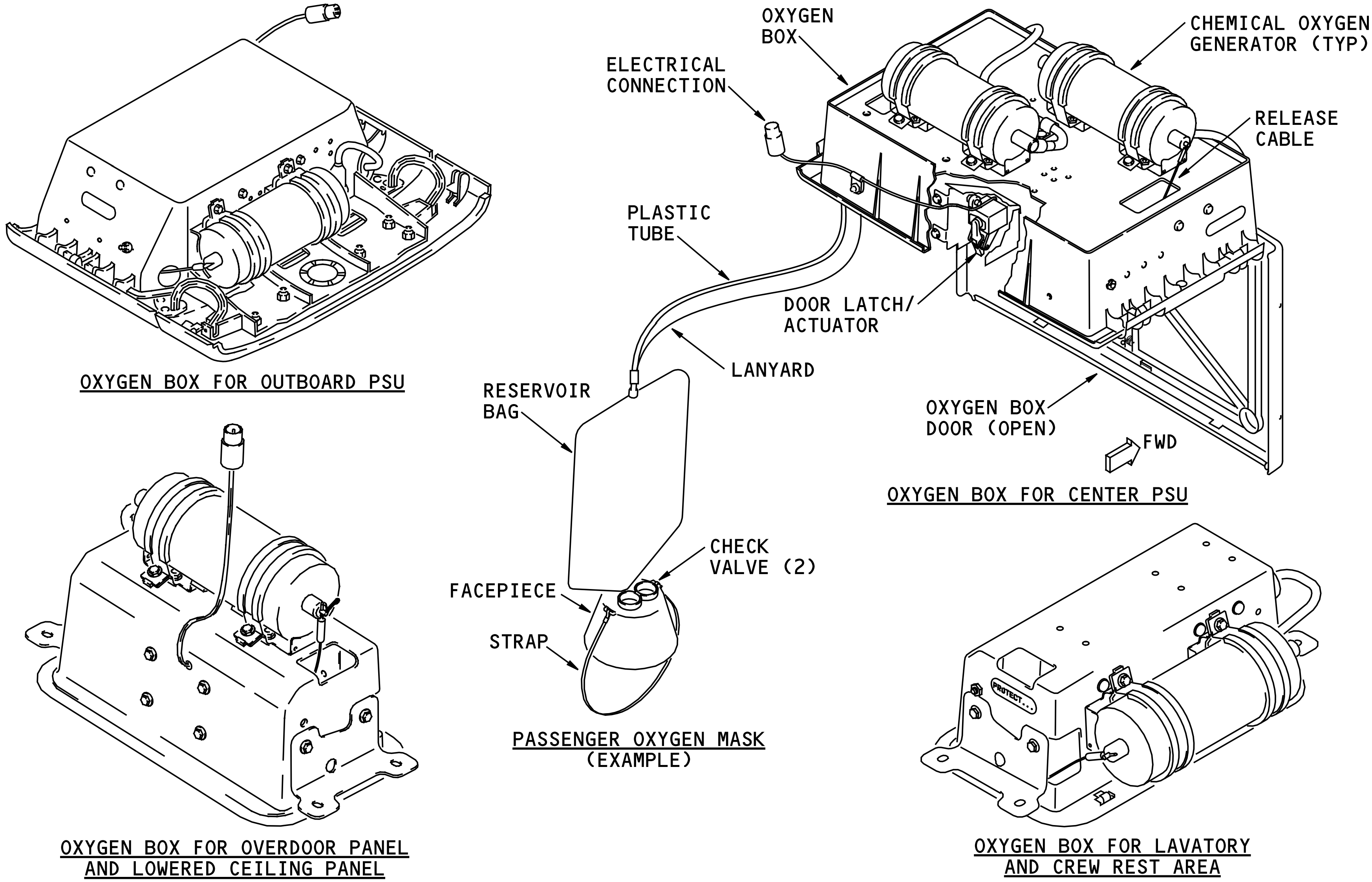
In the flight crew rest area, access to the oxygen generators is different for the two bunks. Open the PSU for access to the oxygen generator for the lower bunk. Remove the lowered ceiling panel above the aisle for access to the oxygen generator for the upper bunk.

See the equipment and furnishings chapter for more information about the PSUs, overdoor panels, lowered ceiling panels and crew rest areas (AMM PART I 25).

Passenger Oxygen Mask

The masks are continuous-flow units. A plastic tube connects the oxygen box manifold to a mask reservoir bag. A flexible facepiece with two check valves attaches to the reservoir bag. An elastic strap holds

the facepiece in place over the user's nose and mouth.
A lanyard connects the mask to the release cable in the oxygen box.



PASSENGER OXYGEN - PASSENGER OXYGEN BOX AND PASSENGER OXYGEN MASK

35-21-00-002 Rev 6 08/16/96

PASSENGER OXYGEN - DOOR LATCH/ACTUATOR - INTRODUCTION

Purpose

The latch part of the door latch/actuator holds the oxygen door closed. The actuator causes the latch to release the door.

Physical Description

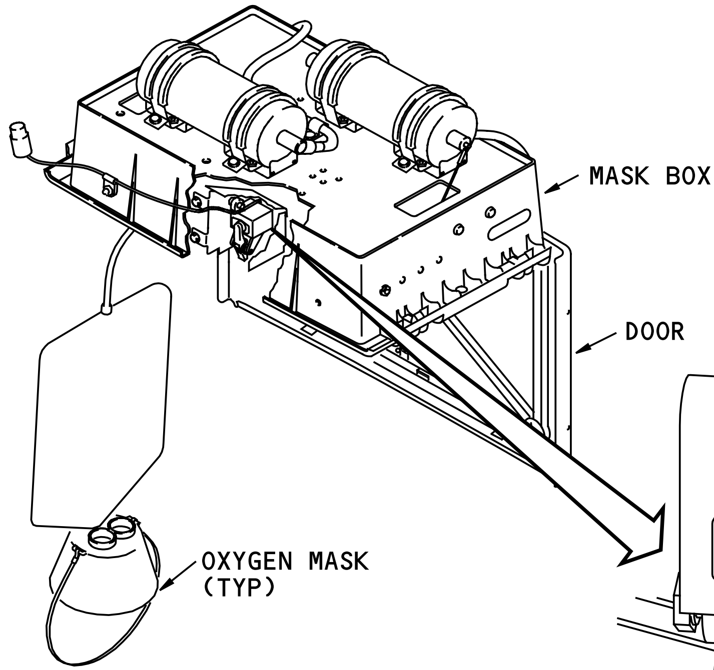
The latch/actuator has these parts:

- Electrical connector
- Housing
- Spring
- Lever arm with metal plate.

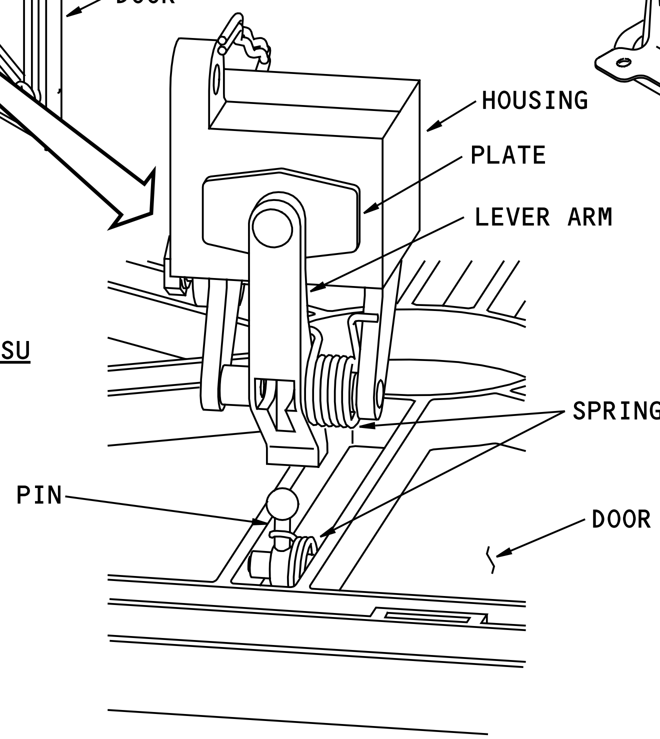
The housing contains a permanent magnet with an electric coil around it.

There is a spring-loaded latch pin on the oxygen door. It fits into a notch on the bottom of the lever arm to hold the door closed.

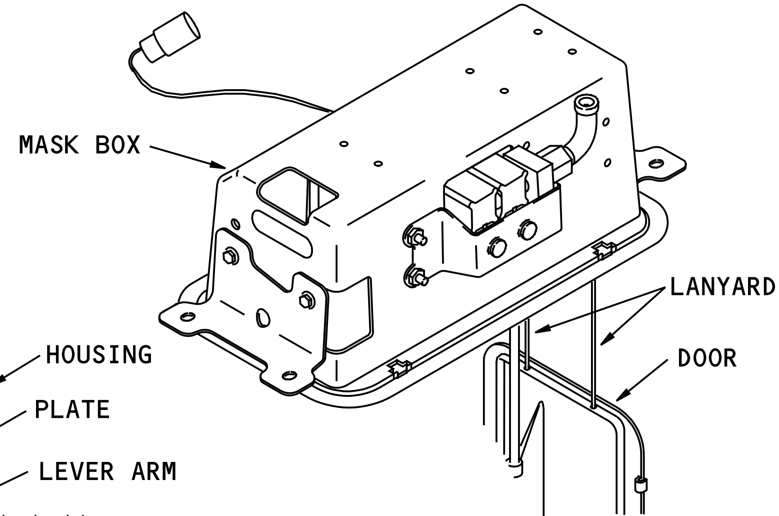
The hinge on the mask box in the lavatory at door one left has a design that is different from the other boxes. When the door is released and moves to open, the hinge separates and lets the door fall. It hangs on lanyards. In this position, the box door will not interfere with the operation of the lavatory bifold door.



MASK BOX FOR CENTER PSU
(EXAMPLE)



DOOR LATCH/ACTUATOR



MASK BOX AT DOOR
ONE LEFT LAVATORY

35-21-00-003 Rev 1 03/29/96

PASSENGER OXYGEN - DOOR LATCH/ACTUATOR - INTRODUCTION

PASSENGER OXYGEN - DOOR LATCH/ACTUATOR - FUNCTIONAL DESCRIPTION

General

Either of these two conditions releases the oxygen masks:

- The passenger oxygen switch on the P5 is set to the ON position
- Two of the three cabin pressure sensors give a signal that the cabin pressure altitude is above 13,500 feet (4115 meters) and the airplane is in the air with an airspeed more than 80 knots.

Functional Description

When you operate the passenger oxygen switch, a signal goes from OPAS to the ELMS. The ELMS latches a ground for the channel A and B oxygen deployment relays for fifteen seconds. (The channel B relay is not shown. It is redundant with the channel A relay.) The relays let 115v ac energize the oxygen module door latch/ actuators.

When the deployment relays energize, the ELMS sends a signal to these systems:

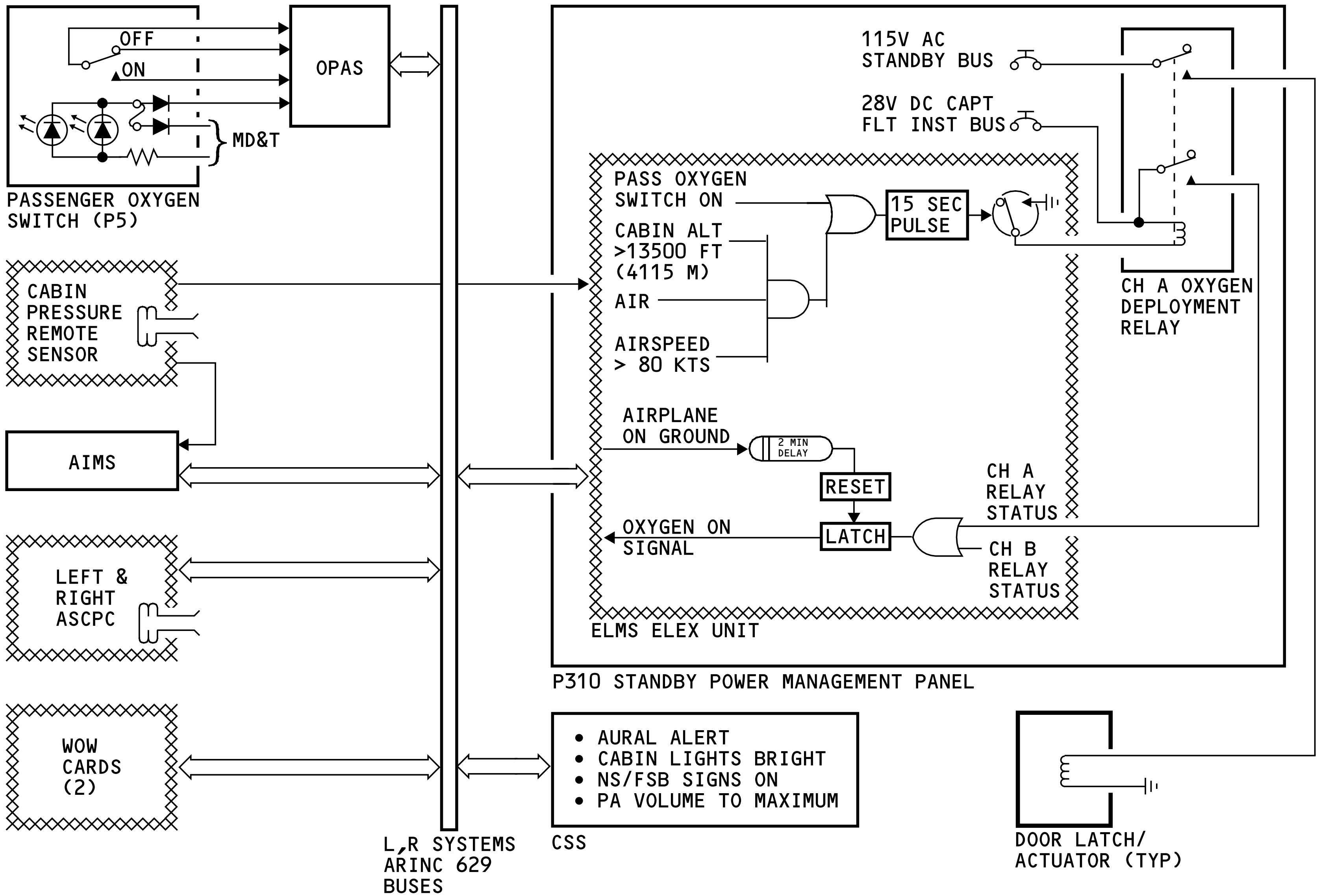
- AIMS
- Cabin services system (CSS)
- OPAS.

The OPAS turns on the light in the passenger oxygen switch. The AIMS shows an advisory message.

The CSS causes these events in the passenger compartment:

- Aural alert
- The passenger compartment lights come on bright
- The no smoking and fasten seat belt signs come on
- Passenger address volume increases to maximum.

The ELMS cancels the oxygen on signal two minutes after the airplane lands.



PASSENGER OXYGEN - DOOR LATCH/ACTUATOR - FUNCTIONAL DESCRIPTION

PASSENGER OXYGEN - CHEMICAL OXYGEN GENERATOR

Purpose

The chemical oxygen generators supply oxygen for the passengers and flight attendants.

Physical Description

The size of the generator has a relation to the number of oxygen masks that connect to it. The masks connect to a manifold at one end of the generator.

A firing pin is at the other end. A release pin holds the firing pin against the spring force. A release cable connects to a lanyard that goes to the mask. A safety pin holds the firing pin when the release pin is not installed.

The generator contains iron and sodium chlorate.

An expended indicator is around the middle of the generator. It goes to a dark color to show that the generator has been used.

Functional Description

When a passenger or attendant pulls on an oxygen mask, the lanyard and release cable pull the release pin out of the firing pin. The spring moves the firing pin into the primer. This causes the iron and sodium chlorate to react to release oxygen.

You cannot stop the reaction after it starts. There is full oxygen flow 10 seconds after the reaction starts. The oxygen flows at least 22 minutes.

Training Information Point

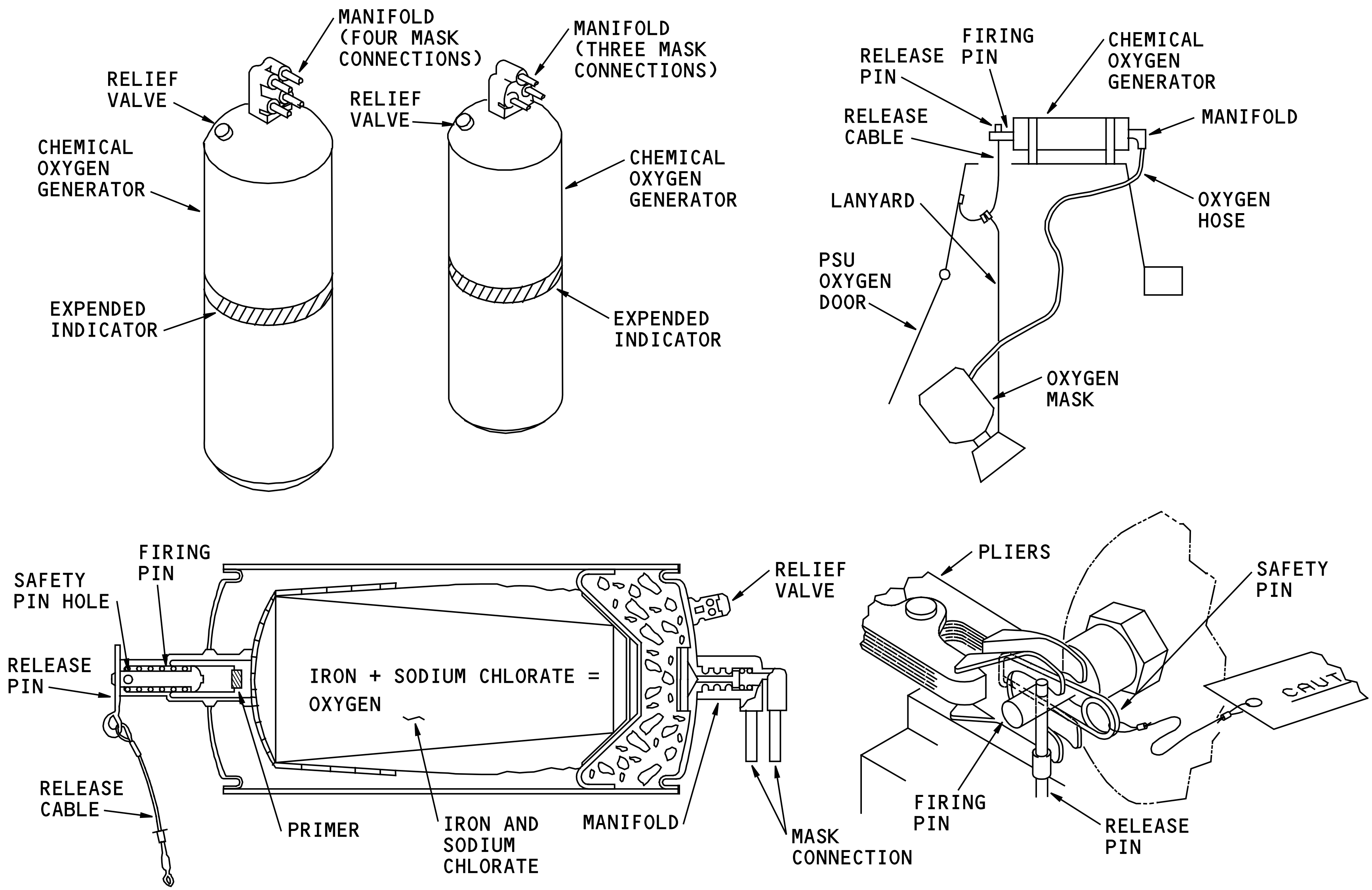
The expended indicator turns a dark color because of the heat of the reaction. This shows you that you must replace the generator.

There are pliers you use to pull out on the firing pin so you can put in a safety pin.

WARNING: MAKE SURE THE SAFETY PIN IS INSTALLED. THE GENERATOR IS A PYROTECHNIC ARMED DEVICE. IF THE GENERATOR FIRES, IT WILL GET VERY HOT (450 F OR MORE), WHICH CAN CAUSE INJURY TO PERSONS OR CAN CAUSE DAMAGE TO EQUIPMENT.

WARNING: MAKE SURE TO REMOVE THE SAFETY PIN FROM THE GENERATOR. THE GENERATOR WILL NOT FIRE IN AN EMERGENCY IF THE SAFETY PIN IS IN THE GENERATOR.

NOTE: If the firing pin is in the fired position (you cannot install the release pin), the generator has fired.



PASSENGER OXYGEN - CHEMICAL OXYGEN GENERATOR

PASSENGER OXYGEN - DOOR LATCH/ACTUATOR - TRAINING INFORMATION POINT

Door Latch/Actuator Test

There is a restraint tool you use when you test the door latch/actuator. The tool goes through a slot in the PSU oxygen door. Push up on the tool until it locks in position.

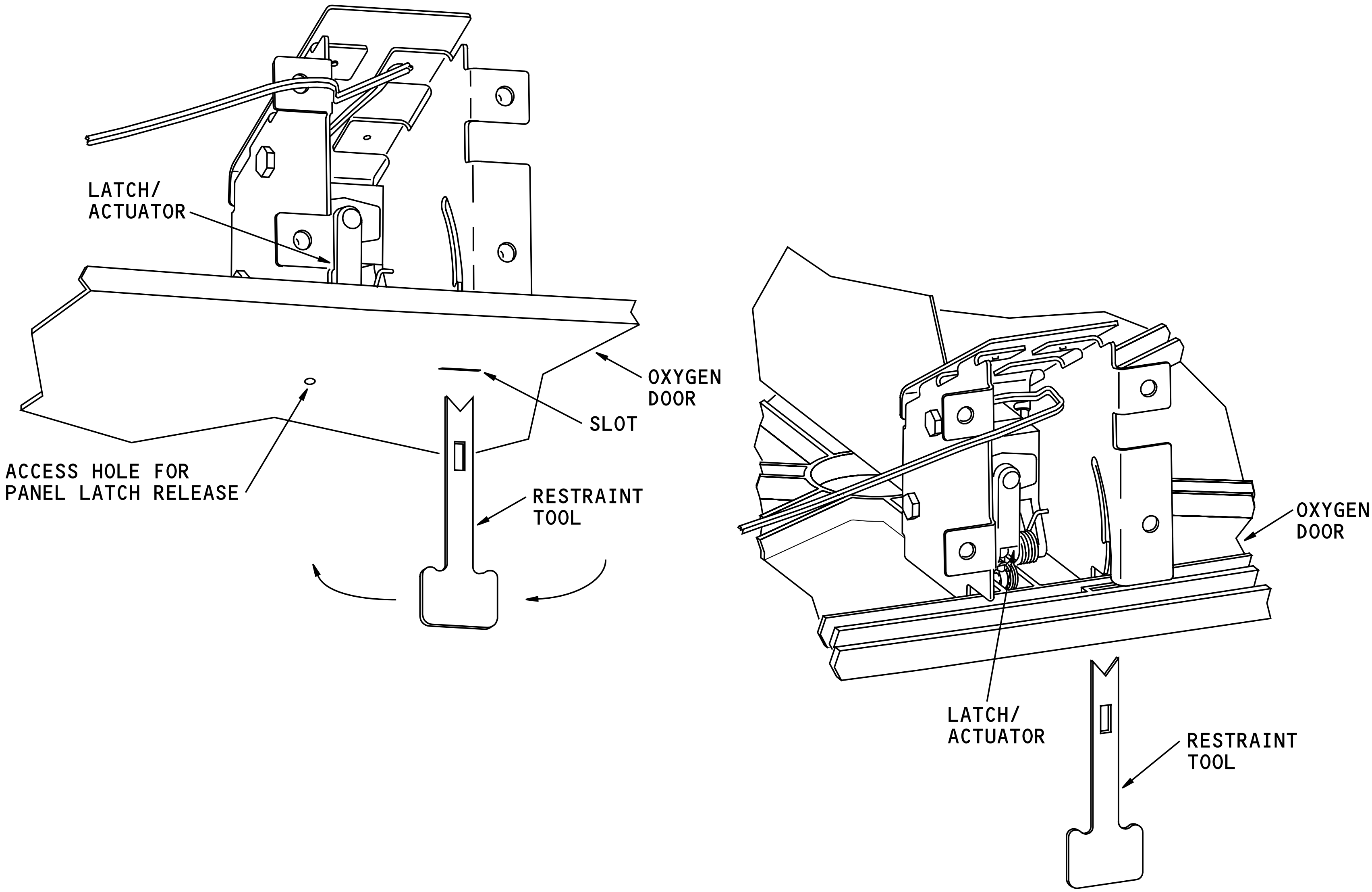
When you push the passenger oxygen switch on the P5 overhead panel, you release the oxygen doors on the PSUs so they can open. The restraint tool will let the door open sufficiently so you can see that the latch/ actuator operates correctly. The door cannot open sufficiently to let the masks drop.

Door Latch/Actuator Reset

The electric circuit that causes the latch/actuator to open will reset automatically after two minutes.

After the test you must reset the latch/actuators and close the doors. The open space between the door and the PSU is sufficient to let you touch the latch/ actuator. Push the lever arm of the latch/actuator against the force of its spring so the lever goes against the housing. The magnet in the housing will hold the lever arm in this position.

Close the door. To remove the restraint tool, push up on the tool, pull it to the side, and then pull it down.



35-21-00-006 Rev 1

PASSENGER OXYGEN - DOOR LATCH/ACTUATOR - TRAINING INFORMATION POINT

PORTABLE OXYGEN - GENERAL DESCRIPTION

Purpose

Portable oxygen equipment lets the flight attendants move in the airplane when oxygen is in use. It is also a gaseous oxygen supply for medical emergencies.

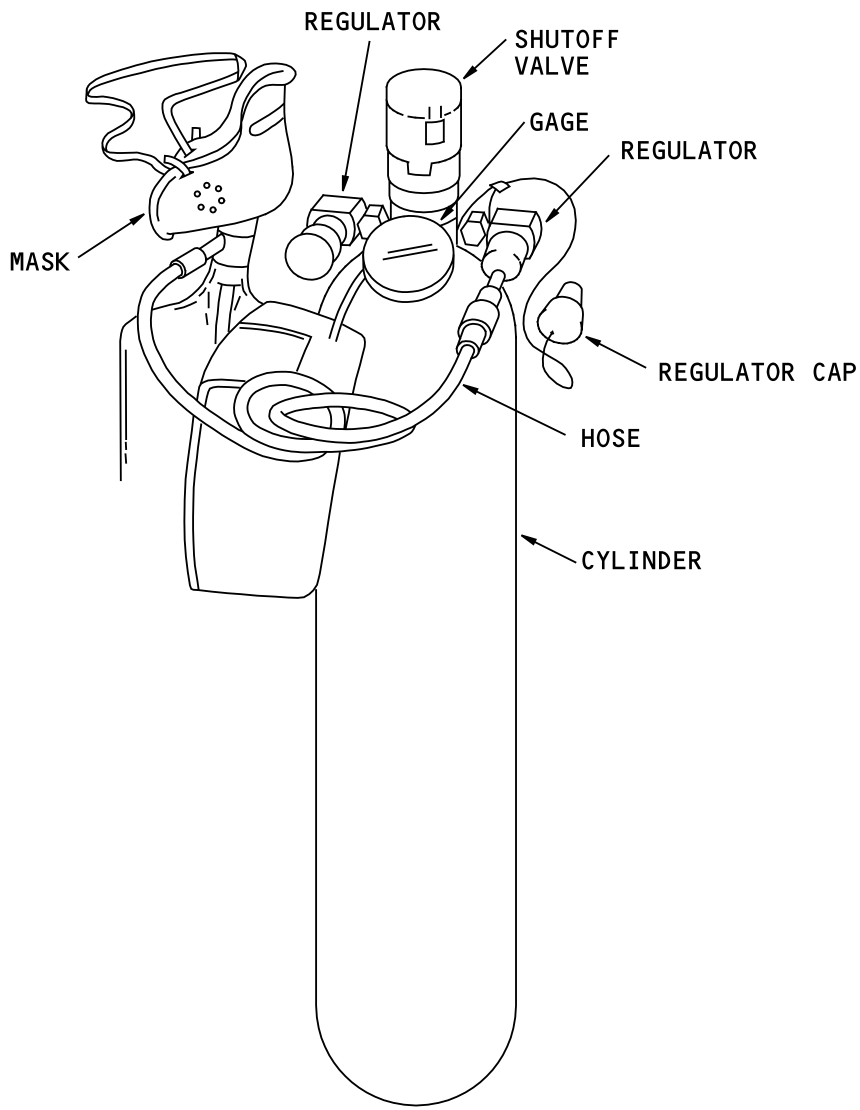
Physical Description

The portable oxygen equipment has these components:

- Regulator (2)
- Shutoff valve
- Gage
- Hose
- Cylinder
- Mask.

Operation

You connect the mask hose to the regulator that gives the oxygen flow that you want. One regulator supplies four liters per minute. The other supplies two liters per minute. Oxygen will flow through the regulator when you connect the mask and open the shutoff valve.



PORTABLE OXYGEN - GENERAL DESCRIPTION

Continental Airlines, Inc

Ice and Rain Protection

WB371

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Continental Airlines, Inc
Ice and Rain Protection
WB371

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ICE AND RAIN PROTECTION - INTRODUCTION

Purpose

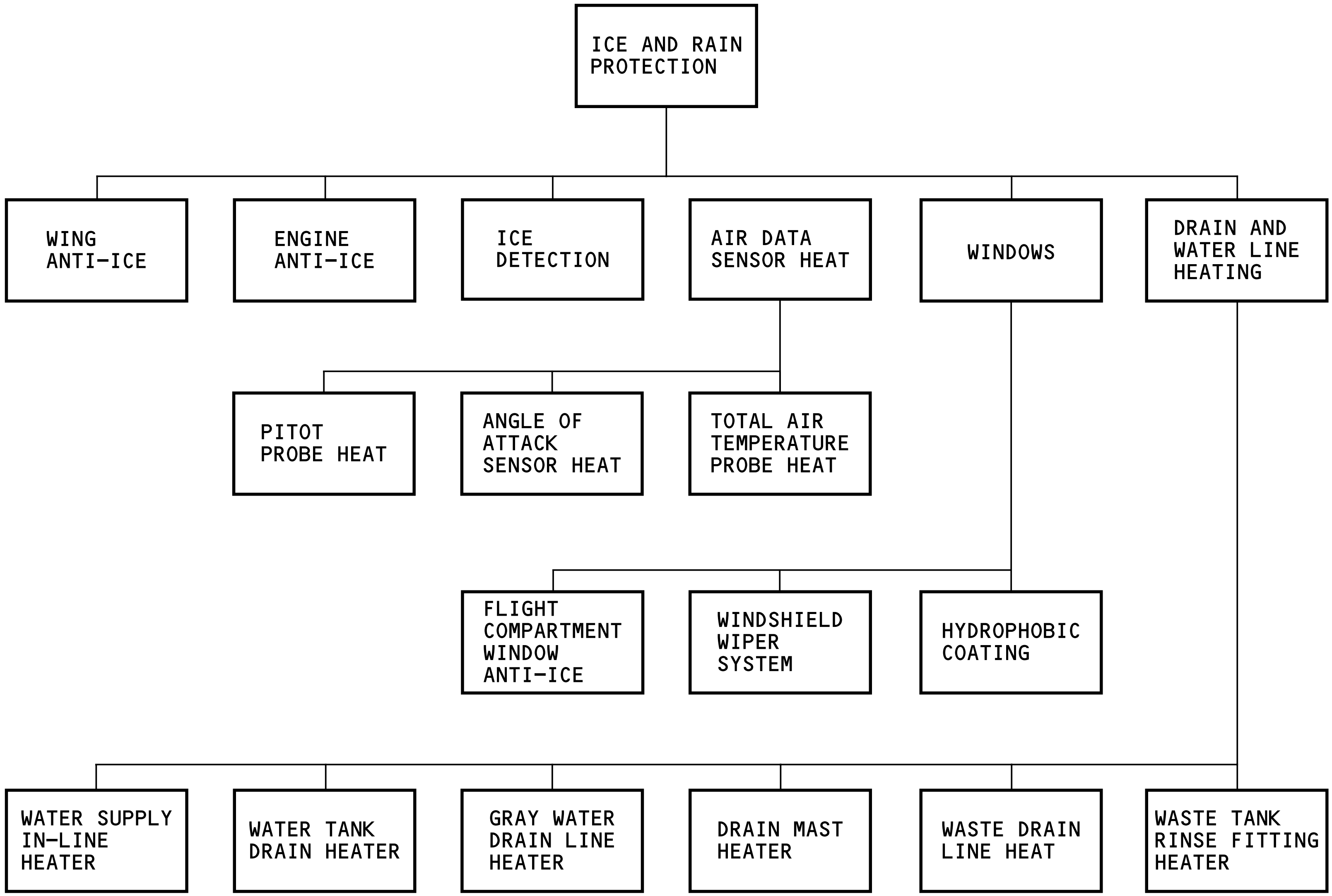
The ice and rain protection system keeps ice from forming on these airplane components:

- Wing leading edges
- Engine cowl leading edges
- Air data probes
- Flight deck windows
- Water and waste system lines and drains.

Windshield wipers and a permanent chemical coating give rain protection to the flight deck windows.

Abbreviations and Acronyms

ACIPS	- airfoil and cowl ice protection system
ADIRU	- air data inertial reference unit
ADM	- air data module
AOA	- angle of attack
CMCS	- central maintenance computing system
EAI	- engine anti-ice
EEC	- electronic engine control
EICAS	- engine indication and crew alerting system
ELMS	- electrical load management system
HPFAC	- high pressure fan air controller
IDS	- ice detection system
int	- intermittent
LRU	- line replaceable unit
MFD	- multi-function display
PRSOV	- pressure regulating and shutoff valve
PRSOVC	- pressure regulating and shutoff valve controller
TAT	- total air temperature
WAI	- wing anti-ice
WHCU	- window heat control unit



30-00-00-001 Rev 2 03/26/96

ICE AND RAIN PROTECTION - INTRODUCTION

ICE AND RAIN PROTECTION - GENERAL DESCRIPTION

Wing and Engine Anti-Ice Systems

The wing anti-ice (WAI) and engine anti-ice (EAI) systems use hot air to prevent ice.

Ice Detection System

The ice detection system detects ice and automatically controls the WAI and EAI systems.

Air Data Sensor Heat

Air data sensors have electric heaters to prevent ice.

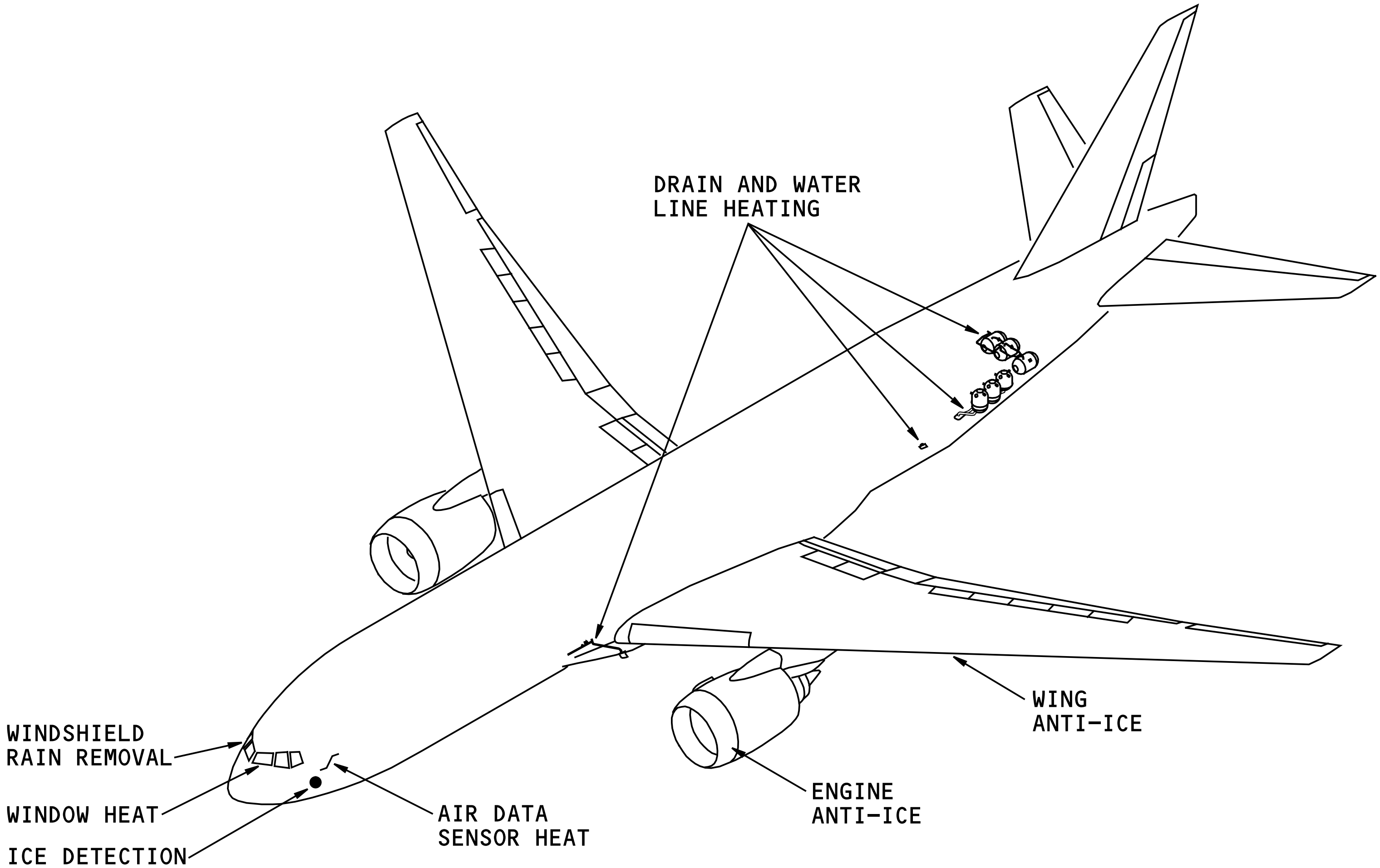
Flight Deck Windows

Flight deck windows have electrical heaters to prevent fog and ice.

The windshields have wipers to remove rain. They also have a hydrophobic coating to keep rain off (repel rain). The coating helps flight crew vision in rain but is not necessary for operation in rain.

Drain and Water Line Heating

Electric heaters prevent freezing in water and waste system lines and fittings.



ICE AND RAIN PROTECTION - GENERAL DESCRIPTION

WING ANTI-ICE - INTRODUCTION

Purpose

The wing anti-ice system heats some of the leading edge slats so that ice does not collect on them in flight.

General Description

The pneumatic system supplies bleed air to heat the leading edge slats. Slats 3, 4, and 5 on the left wing and slats 10, 11, and 12 on the right wing are heated. Two wing anti-ice (WAI) valves control the air flow from the pneumatic system to WAI ducts. The WAI ducts carry the air to the slats. Holes in the bottom of each slat let the air out.

The airfoil and cowl ice protection system (ACIPS) control card - WAI controls the wing anti-ice valves. WAI pressure sensors send WAI duct air pressure data to the control card.

The wing anti-ice selector in the flight deck lets the crew set automatic or manual control. With AUTO selected, the WAI system comes on when the ice detection system finds ice. The OFF and ON positions are for manual control.

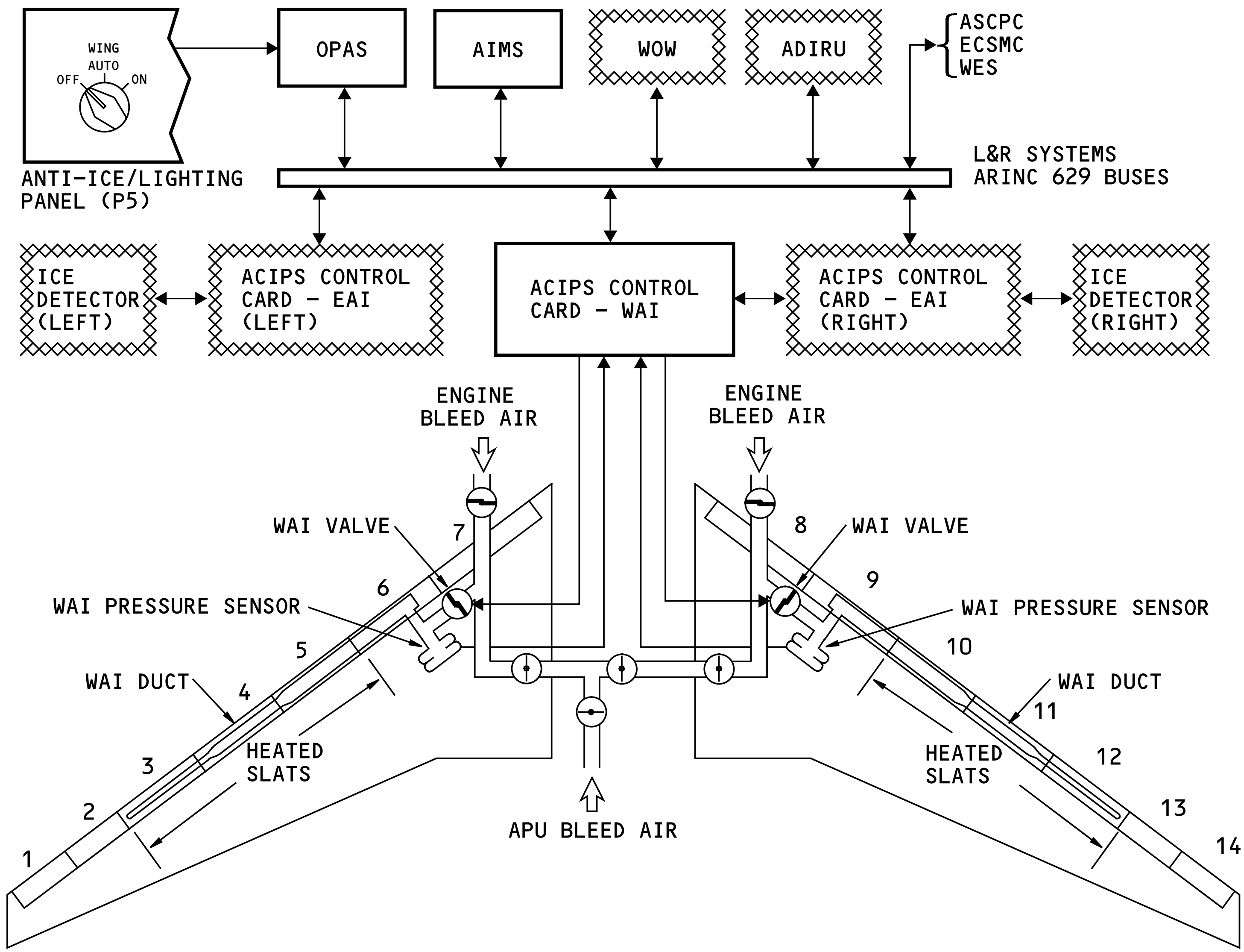
See the ice detection system section for more information (AMM PART I 30-81).

BITE circuits in the control card monitor the condition of the system. The AIMS gives information about the system through the EICAS display, status display, and maintenance pages. You use the MAT to do ground tests of the system.

Except for ground tests, the WAI system only operates in flight. Air/ground information from the weight on wheels (WOW) cards or airspeed data from the air data inertial reference unit (ADIRU) tells the control card when the airplane is in flight.

The wing anti-ice system has these other interfaces:

- ASCPC (air supply cabin pressure controller)
- ECSMC (ECS miscellaneous card)
- WES (warning electronic system).



WING ANTI-ICE - INTRODUCTION

WING ANTI-ICE - WING COMPONENT LOCATIONS

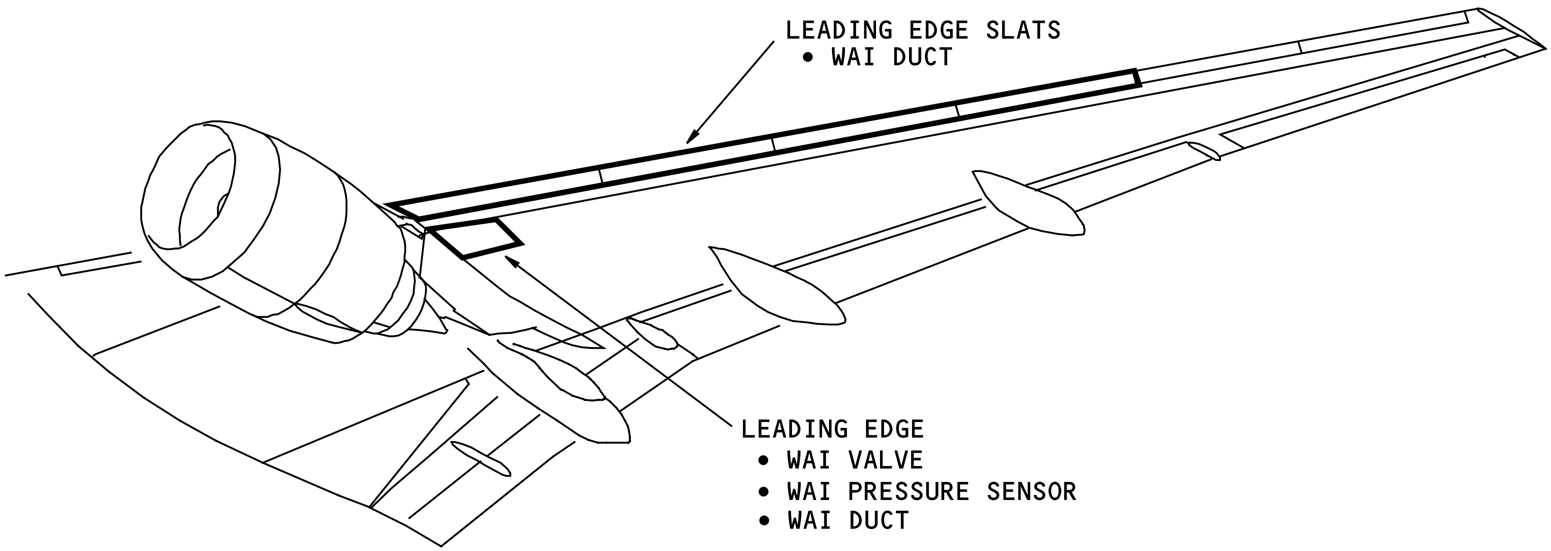
Component Locations

These components are in the wing leading edge next to the outboard side of the engine strut:

- WAI valve
- WAI pressure sensor
- WAI ducts.

There are also WAI ducts in the leading edge slats.

All of these components are LRUs.



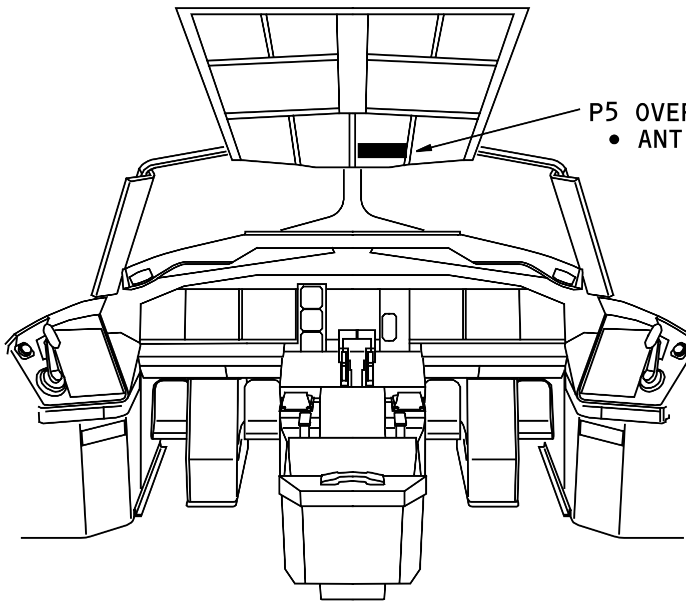
30-11-00-002 Rev 1

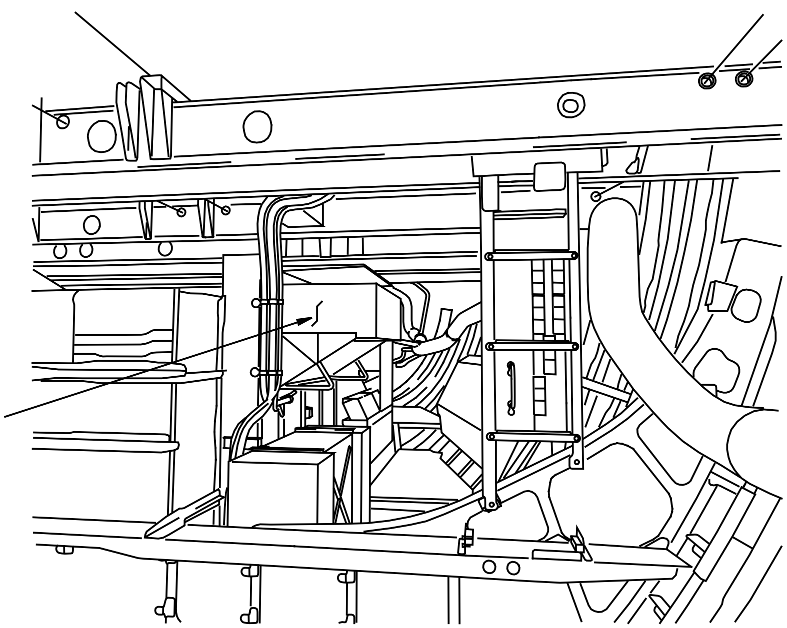
WING ANTI-ICE - WING COMPONENT LOCATIONS

WING ANTI-ICE - FLIGHT DECK AND MEC COMPONENT LOCATIONS

Component Locations

The anti-ice control panel is on the P5 overhead panel. The WAI airfoil and cowl ice protection system control card (WAI ACIPS control card) is in the P84 right systems card file.





MAIN EQUIPMENT CENTER
(RIGHT SIDE LOOKING FORWARD)

30-11-00-003 Rev 1

WING ANTI-ICE - FLIGHT DECK AND MEC COMPONENT LOCATIONS

WING ANTI-ICE - WAI VALVE

Purpose

The WAI valve controls the flow of bleed air from the pneumatic system to the wing anti-ice ducts.

Physical Description

The WAI valve has these parts:

- Body
- Pneumatic actuator
- Torque motor
- Electrical connector
- Locking crank and position indicator
- Locking screw.

The valve is electrically controlled and pneumatically actuated.

Location

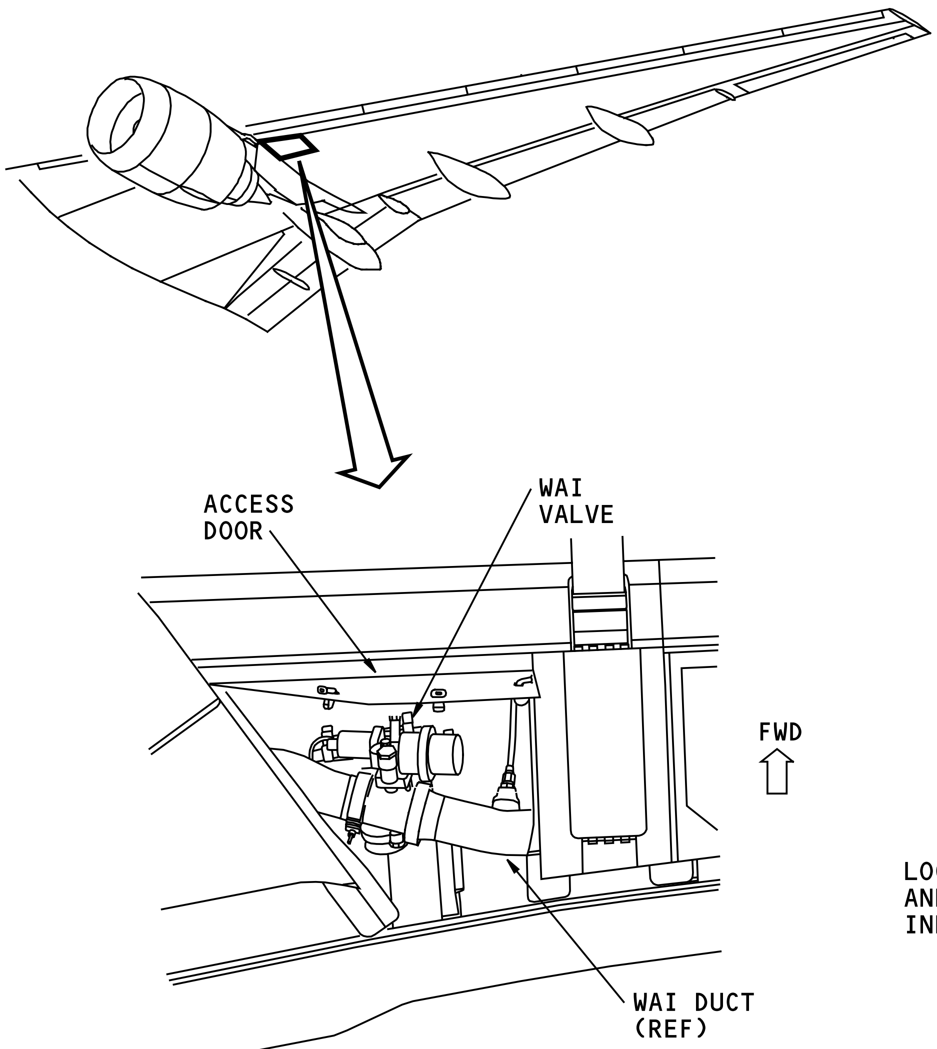
The WAI valve is in the WAI duct in the leading edge of the wing. The WAI valve access door is on the bottom of the wing leading edge, outboard of the engine strut.

Functional Description

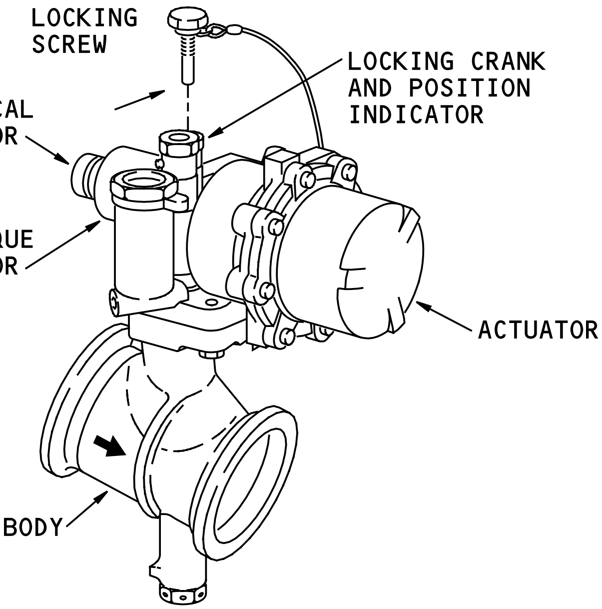
The WAI ACIPS control card controls the current through the torque motor. The torque motor controls operation of the valve. With no electrical power to the torque motor, air pressure on one side of the actuator holds the valve closed. Electrical current through the torque motor allows air pressure to open the valve. As the torque motor current increases, the valve opening increases.

Training Information Point

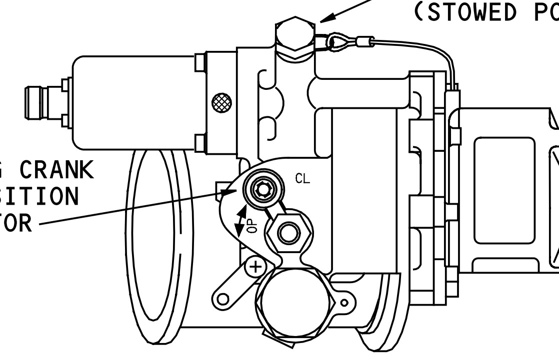
If a WAI valve does not operate, you can lock the valve closed. Remove the locking screw from the actuator. Set the locking crank to the closed position and install the locking screw into the hole in the locking crank.



WING LEADING EDGE
(LOOKING UP AND AFT)



WAI VALVE
(SIDE VIEW)



WAI VALVE
(TOP VIEW)

30-11-00-004 Rev 1 01/25/95

WING ANTI-ICE - WAI VALVE

WING ANTI-ICE - WAI PRESSURE SENSOR

Purpose

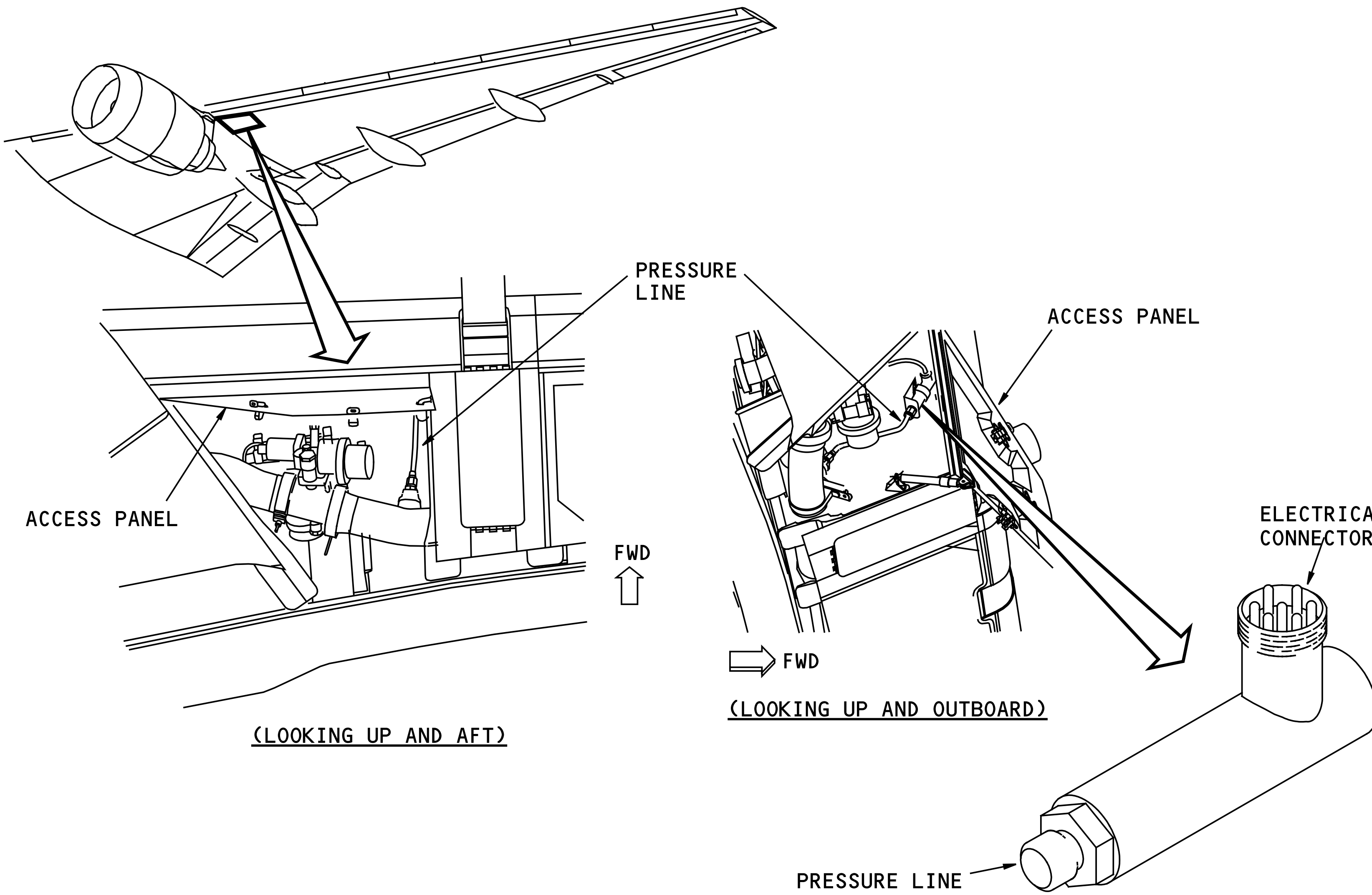
The WAI pressure sensor gets input from the air pressure in the WAI duct after the WAI valve. The center ACIPS card uses the pressure information to control the WAI system.

Physical Description

The WAI pressure sensor has a pressure line connector on one end and an electrical connector on the other end.

Location

The sensor is installed above the WAI duct in the leading edge of the wing. The access panel for the sensor is on the bottom surface of the wing leading edge next to the outboard side of the engine strut.



30-11-00-005 Rev 1

WING ANTI-ICE - WAI PRESSURE SENSOR

WING ANTI-ICE - WAI DUCTS

Purpose

The WAI ducts move air from the pneumatic system to leading edge slats which are outboard of the engines.

Physical Description

Some of the WAI ducts are perforated. The holes allow air to flow into the space in the leading edge slats. The air leaves the slats through holes in the bottom of each slat.

Some of the WAI ducts can telescope. Each telescoping duct has two sections. One section is to a duct in the wing. The other section attaches to a duct in the leading edge slat. The sections can move into each other. This permits the duct to extend or retract when the slat extends or retracts.

Locations

The perforated ducts are inside these slats:

- 3, 4, and 5 on the left wing
- 10, 11, and 12 on the right wing.

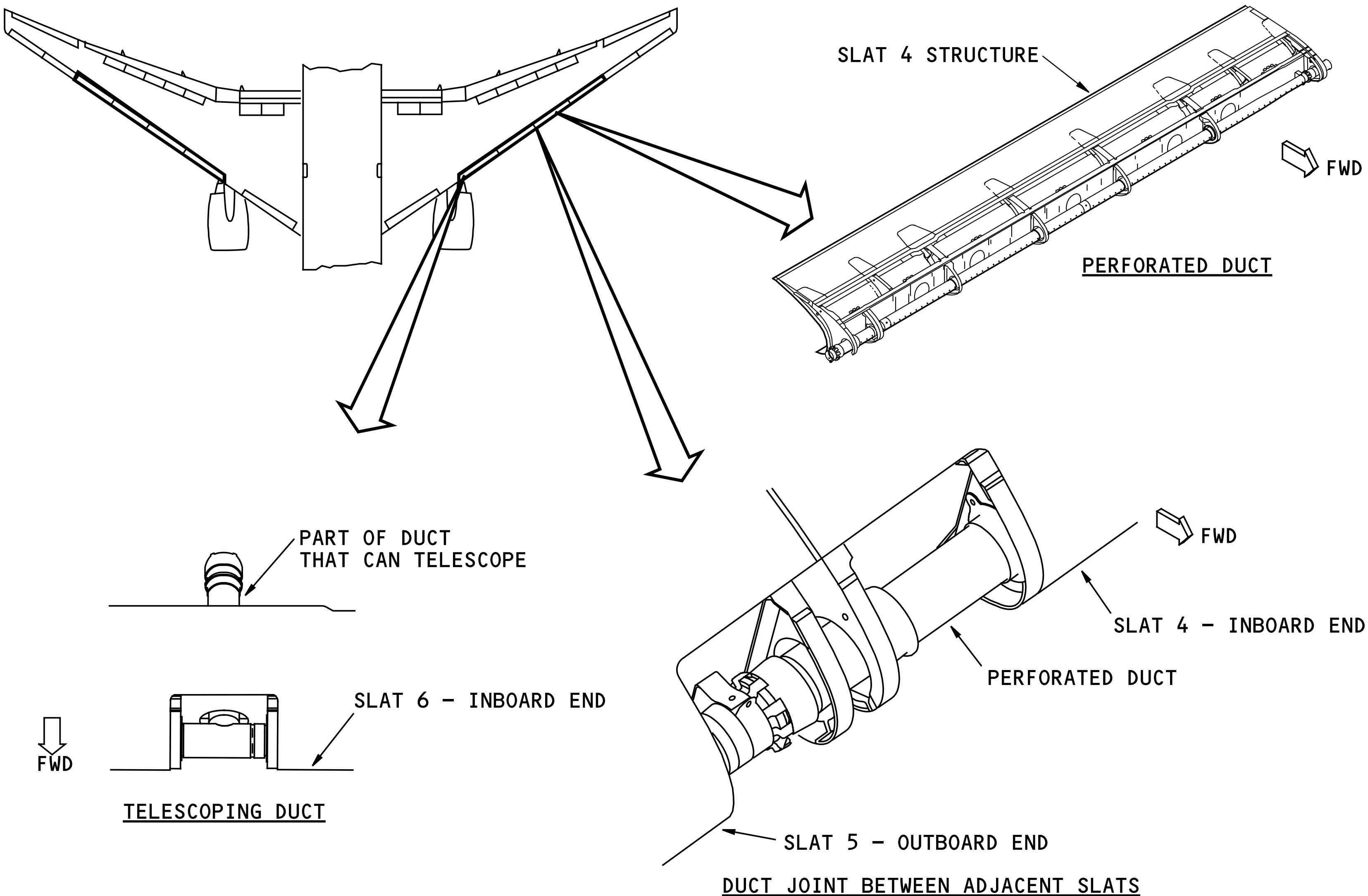
The ducts that can telescope are in the wings and in these slats:

- 6 on the left wing
- 9 on the right wing.

Access

There are duct joints between adjacent slats. The inboard and outboard end of each slat has an access panel for the duct joints between adjacent slats.

There is an access panel in the slat for the telescoping duct.



30-11-00-006 Rev 0

WING ANTI-ICE - WAI DUCTS

WING ANTI-ICE - FUNCTIONAL DESCRIPTION - ELECTRICAL

General

The WAI ACIPS control card controls both wing anti-ice valves. The required positions of the WAI valves change as bleed air temperature and altitude change. The left and right valves operate at the same time to heat both wings equally. This keeps the airplane aerodynamically stable in icing conditions.

The WAI pressure sensors supply feedback information to the WAI ACIPS card for WAI valve control and position indication. If either pressure sensor fails, the WAI ACIPS card sets the related WAI valve to either fully open or fully closed. If either valve fails closed, the WAI card keeps the other valve closed.

The WAI ACIPS control card receives ice detector data from the systems ARINC 629 buses. The data comes from the left and right ice detectors through the EAI ACIPS control cards.

There is one selector for the WAI system. The selector has three positions: AUTO, ON, and OFF.

Operational Modes

With the selector in AUTO and no operational mode inhibits, the WAI ACIPS card sends a signal to open the WAI valves when either ice detector finds ice. The valves close after a three minute delay when the ice detector no longer finds ice. The time delay prevents frequent on/off cycles during intermittent icing conditions.

With the selector ON and no operational mode inhibits, the wing anti-ice valves open. With the selector OFF, the wing anti-ice valves close.

Operational Mode Inhibits

With AUTO or ON selected, any of these operational mode inhibits keeps the WAI valves closed:

- Airplane on the ground (except during an initiated or periodic BITE test)
- TAT is more than 50F and the time since takeoff is less than 5 minutes
- Takeoff mode and airplane in the air less than 10 minutes
- Auto slat operation
- Air-driven hydraulic pump operation
- Engine start
- Bleed air temperature less than 200F (93C).

The valves stay closed as long as the operational mode inhibit is active. If the valves are already open, the operational mode inhibit causes the valves to close.

ARINC 629 Interfaces

The OPAS sends WAI selector position and engine start selector position to the WAI ACIPS control card.

The EAI ACIPS control cards send ice detector data to the WAI system. With AUTO selected, the ice detection system controls operation of the wing anti-ice system.

WING ANTI-ICE - FUNCTIONAL DESCRIPTION - ELECTRICAL

The weight on wheels cards (WOW) send air/ground status to the WAI system. Wing anti-ice does not operate on the ground.

The air data inertial reference unit (ADIRU) sends mach number, static pressure, and total air temperature data to the WAI system. Mach number is an alternative to air/ground status if air/ground data is missing or not valid. The WAI BITE compares static pressure with WAI duct air pressure to make sure the WAI duct pressure sensors work correctly.

The warning electronic system (WES) sends auto slat operation data to the WAI system. The WAI valves close for a short time during auto slat operation. This makes more bleed air available to the air-driven hydraulic pumps.

The air supply and cabin pressure controller (ASCPC) sends a WAI shutoff signal to the WAI ACIPS control card if the air-driven hydraulic pumps are on or intermittent. Wing anti-ice does not operate during ADP operation.

The ASCPC sends pneumatic manifold temperature and pressure data to the WAI ACIPS control card. The control card uses this data to calculate the WAI air flow rate and valve position. The flow rate and valve position show on the ice protection maintenance page. Also, bleed air temperature less than 200F (93C) prevents wing anti-ice operation.

The ASCPC receives anti-ice air flow data from the WAI ACIPS control card. The ASCPC needs this data to calculate the bleed flow rate in the pneumatic system. The engine bleed air system flow limit function uses this flow rate. The flow rate shows on the air supply maintenance page. The ASCPC also needs anti-ice air flow data to set the air conditioning pack flow schedule.

The ECS miscellaneous cards (ECSMC) receive WAI valve position data from the WAI ACIPS control card. The ECSMCs need this data to control the aft and bulk cargo heating systems.

The AIMS primary display function gives EICAS messages, status messages, air synoptic information and maintenance page information related to the WAI system. The central maintenance computing function helps you isolate faults and lets you do ground tests.

The flight management computing system (FMCS) gives takeoff mode information to the WAI ACIPS card. In takeoff mode, WAI does not operate for 10 minutes after the ground to air transition.

BITE

BIT circuits in the WAI ACIPS control card continuously monitor the wing anti-ice system. Faults that affect dispatch cause status messages. Other faults cause CMCS maintenance messages.

WING ANTI-ICE - FUNCTIONAL DESCRIPTION - ELECTRICAL

The BITE in the WAI ACIPS control card also does automatic power-up and periodic tests. Faults found during these tests that affect dispatch cause status messages. Other faults cause CMCS maintenance messages.

The power-up test occurs when the card gets power. BITE does a test of the card hardware and software functions and the valve and pressure sensor interfaces. The valves do not move during this test.

The periodic test occurs when all these conditions are true:

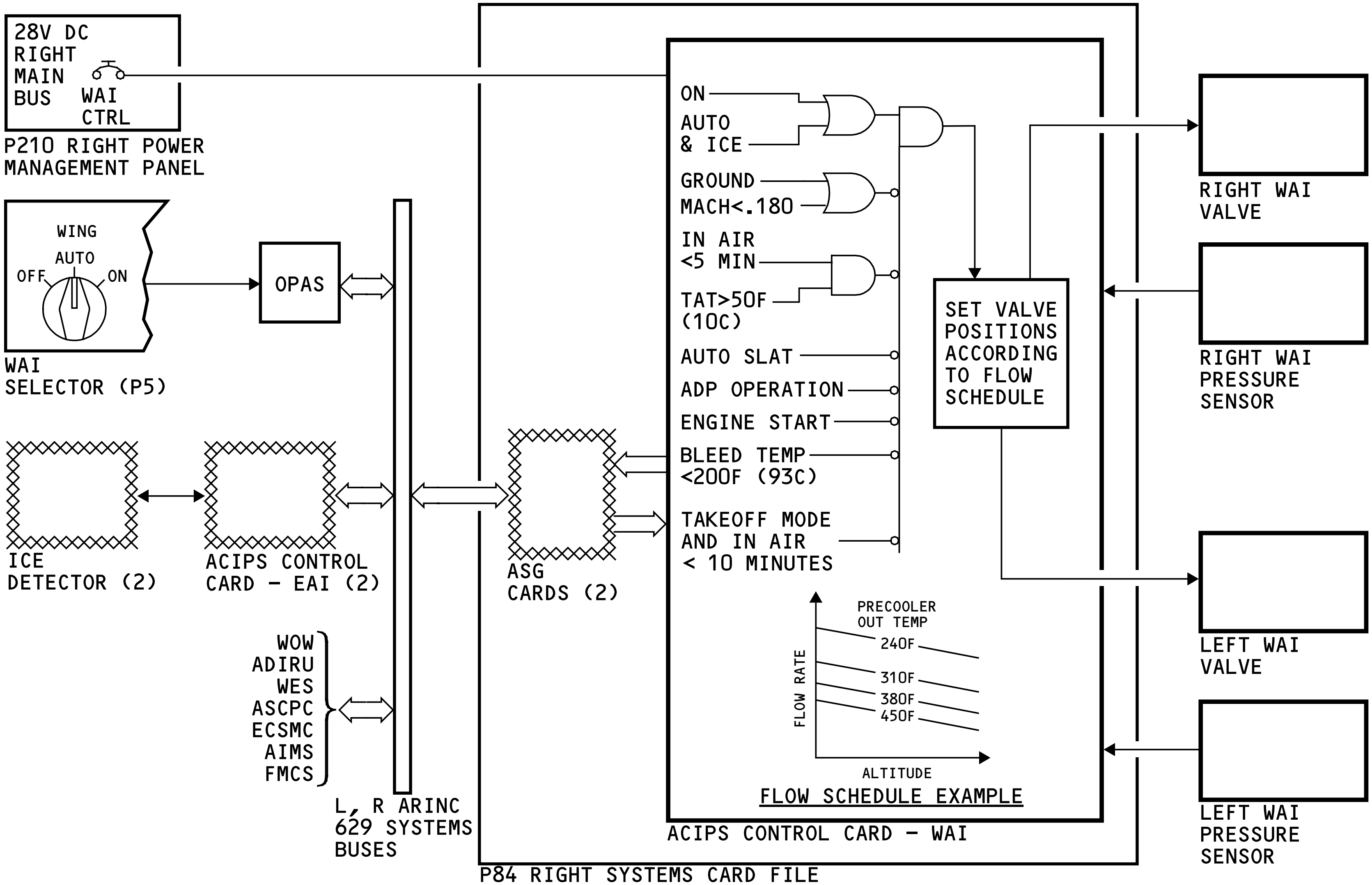
- The airplane has been on the ground between 1 and 5 minutes
- The WAI selector is set to AUTO or ON
- Air-driven hydraulic pumps are not in intermittent operation
- Bleed pressure is sufficient to open the WAI valves
- The time since the last periodic test is more than 24 hours.

During this test, the WAI valves cycle open and closed. This test makes sure that valve malfunctions are detected.

Training Information Point

You do wing anti-ice system ground tests with the MAT. Two tests are available: one with bleed air and one without bleed air.

You use the MAT data load function to replace the WAI ACIPS control card software.



30-11-00-007 Rev 2 07/18/1997

WING ANTI-ICE - FUNCTIONAL DESCRIPTION - ELECTRICAL

WING ANTI-ICE - OPERATION

General

The wing anti-ice selector lets the flight crew select the operational mode of the system. Indications on the EICAS display and on the air synoptic display show when the WAI valves are open.

Operation

The selector is on the anti-ice/lighting panel (P5). With the selector set to OFF, the WAI system does not operate. The WAI valves stay closed. The EICAS advisory message ICING WING shows if the ice detection system finds ice. The OFF selection prevents the WAI BITE periodic ground test.

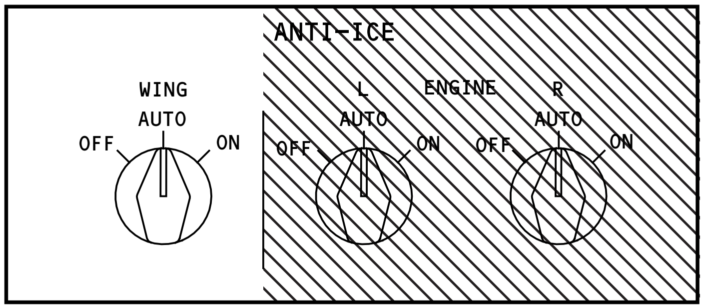
For normal operation, the crew keeps the selector in AUTO. The wing anti-ice system operates automatically. The ice detection system controls wing anti-ice system operation as long as operational mode inhibits are not active. The AUTO position enables the BITE periodic ground test.

For manual operation, the crew sets the selector to ON when wing anti-ice is needed. The WAI valves stay open as long as no operational mode inhibits are active. The EICAS advisory message ANTI-ICE ON shows if the WAI selector is on, no ice is detected, and the TAT is more than 50F (10C).

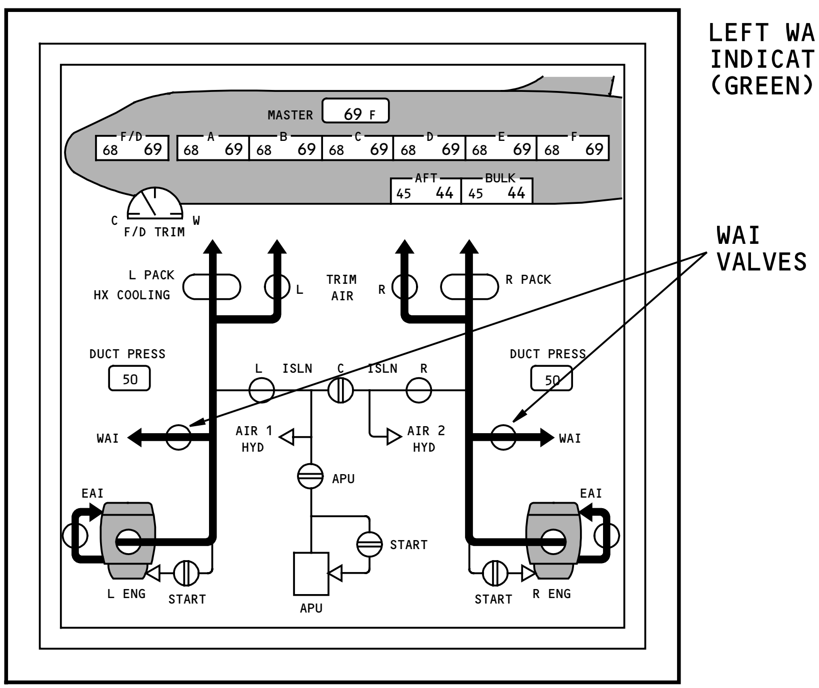
Air Synoptic Display

The valve symbols show these conditions:

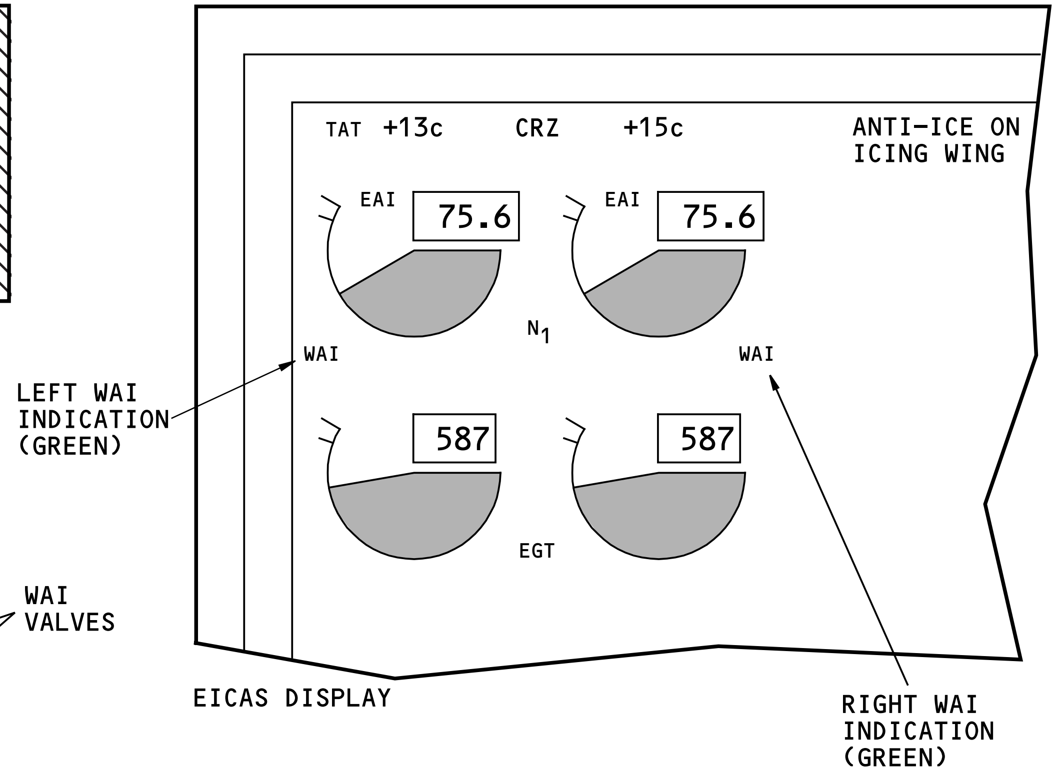
- Valve open - white circle with a horizontal green flow bar
- Valve closed - white circle with two vertical white bars
- Valve not in commanded position - amber circle with an amber cross through it
- Valve position data not available - white circle.



ANTI-ICE/LIGHTING (P5)



AIR SYNOPTIC DISPLAY



EICAS DISPLAY

30-11-00-008 Rev 1 01/25/95

WING ANTI-ICE - OPERATION

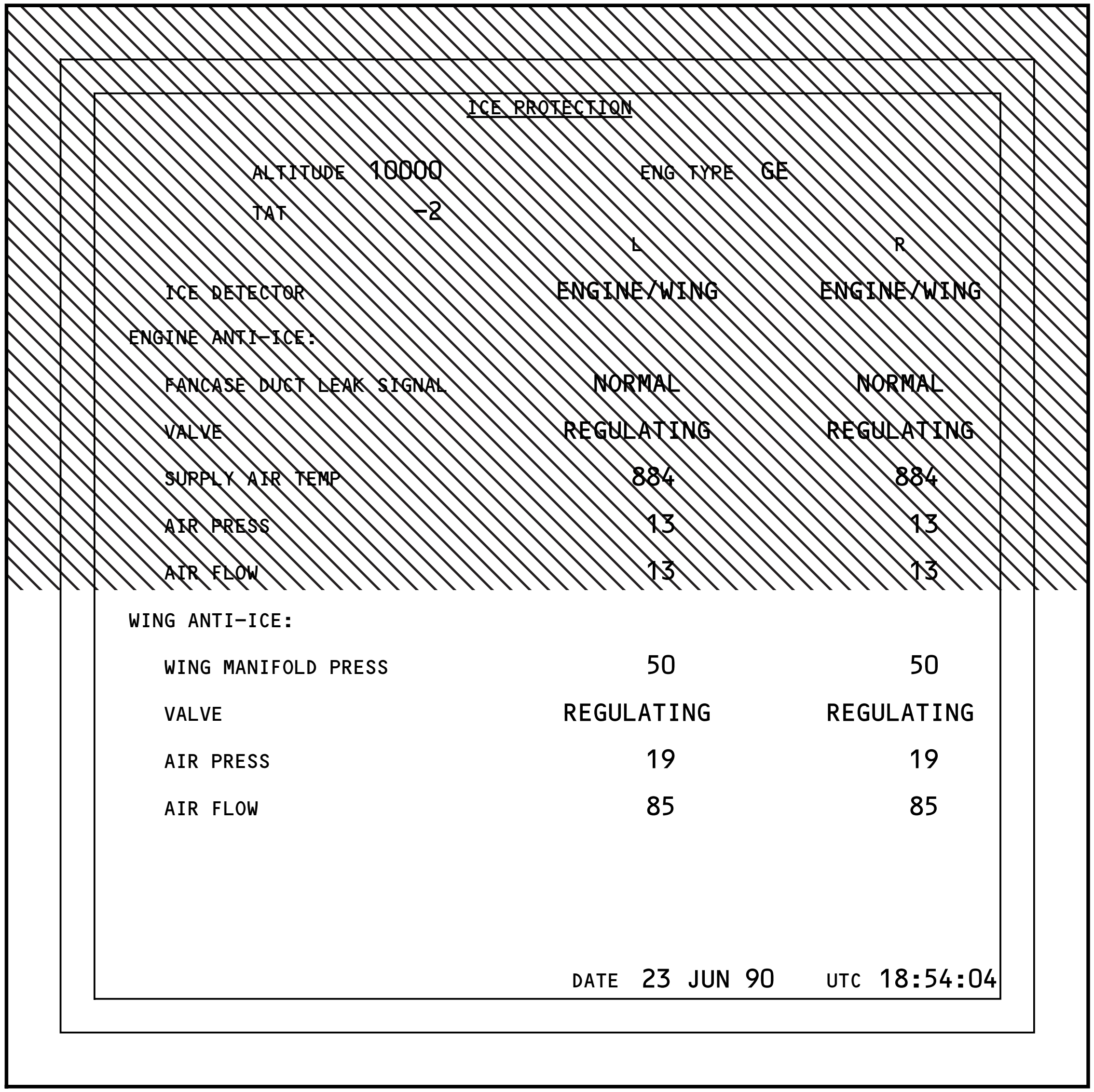
WING ANTI-ICE - INDICATIONS - ICE PROTECTION MAINTENANCE PAGE

Ice Protection Maintenance Page

The ice protection maintenance page shows this data for the wing anti-ice system:

- WING MANIFOLD PRESSURE - Pneumatic duct pressure in psig
- VALVE - WAI valve open, closed, or regulating
- AIR PRESSURE - Pressure downstream of the WAI valves in psig
- AIR FLOW - Air flow through the WAI valves in lb/min or kg/min.

Valve positions and air flow rates are calculated from air pressure measurements upstream and downstream of the WAI valves.



30-11-00-009 Rev 1 01/25/95

WING ANTI-ICE - INDICATIONS - ICE PROTECTION MAINTENANCE PAGE

WING ANTI-ICE - SYSTEM TESTS

General

These are the wing anti-ice system tests that show when you select ATA 30 Airfoil Cowl Ice Protection System:

- Wing anti-ice (pneumatics available)
- Wing anti-ice (pneumatics not available).

Wing Anti-Ice (Pneumatics Available)

This test makes sure that the wing anti-ice system can control the bleed airflow to each wing.

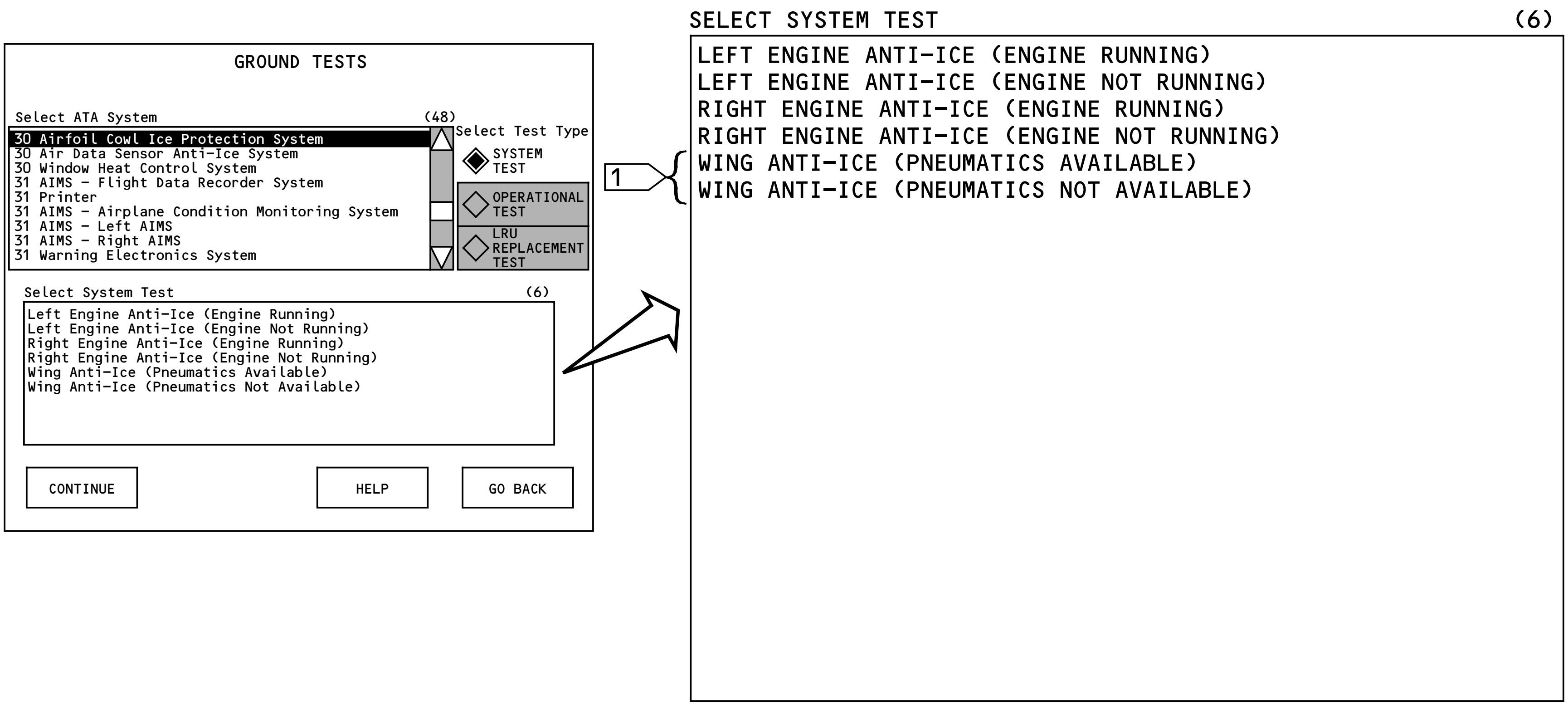
During the test, hot air flows out of the leading edge on each wing. The test takes approximately 1-2 minutes.

WARNING: DO NOT OPERATE THE WAI SYSTEM UNTIL ALL PERSONS ARE CLEAR OF THE WING LEADING EDGE. THE HOT AIR CAN BURN YOU.

Wing Anti-Ice (Pneumatics Not Available)

This test makes sure that the electrical interface connections of the wing anti-ice system are correct.

The test takes approximately 1-2 minutes.



1 THESE ARE THE WING ANTI-ICE TESTS.

WING ANTI-ICE - SYSTEM TESTS

30-11-00-010 Rev 0 08/17/96

ENGINE ANTI-ICE - INTRODUCTION

Purpose

The engine anti-ice (EAI) system heats the leading edge of the engine cowls so that ice does not collect on them.

General

The EAI systems for the left and right engines are identical. A high stage bleed port (HP7) on the engine supplies bleed air to heat the cowl leading edge. This is a different stage than the high stage port for the pneumatic system. An engine anti-ice valve controls the air flow from the bleed port to the EAI duct. The EAI duct moves the air to the cowl leading edge. Overboard vents in the cowl let the air out.

The EAI valve is pneumatically actuated. Control pressure for the valve comes from an EAI controller.

ACIPS Control Cards - EAI

Two airfoil and cowl ice protection system (ACIPS) control cards - EAI control the systems. The left card controls the left engine system and the right card controls the right engine system. The cards send electric signals to the EAI controllers to control the valves. EAI pressure sensors give control feedback.

Fan Case Overheat

A fan case overheat detector monitors the EAI duct for leaks. The detector is part of the duct leak and overheat detection system (DLODS). The DLODS sends a signal to the EAI ACIPS control card. The card sends a signal to close the EAI valve. See the duct leak and overheat detection system section for more information (AMM PART I 26-18).

Flight Deck Controls

The engine anti-ice selectors in the flight deck let the crew set automatic or manual control for each engine. With AUTO selected, the EAI system comes on when the ice detection system finds ice. The OFF and ON positions are for manual control.

See the ice detection system section for more information (AMM PART I 30-81).

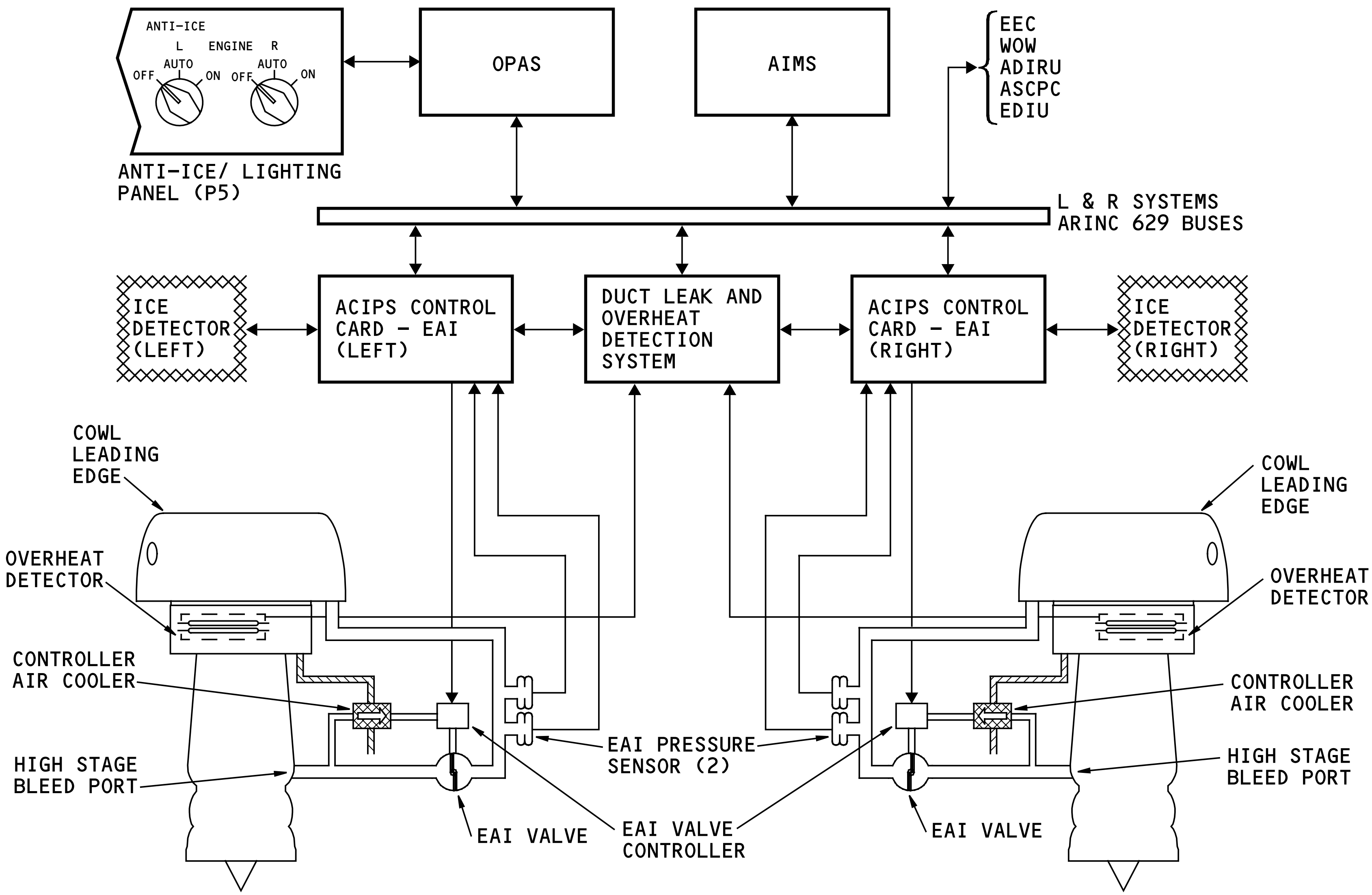
BITE

BITE circuits in the control cards monitor the condition of the systems. The AIMS gives information about the systems through the EICAS display, status display, and maintenance page.

Interfaces

The engine anti-ice system has these other interfaces:

- EEC (electronic engine control)
- WOW (weight on wheels cards)
- ADIRU (air data inertial reference unit)
- ASCPC (air supply cabin pressure controller)
- EDIU (engine data interface unit).



ENGINE ANTI-ICE - INTRODUCTION

ENGINE ANTI-ICE - ENGINE COMPONENT LOCATIONS

Component Locations

The engine anti-ice (EAI) components are in these locations:

- Engine fan case - upper left side
- Engine core - upper left side
- Engine fan hub - left side
- Engine inlet - left side.

These are the components on the engine core:

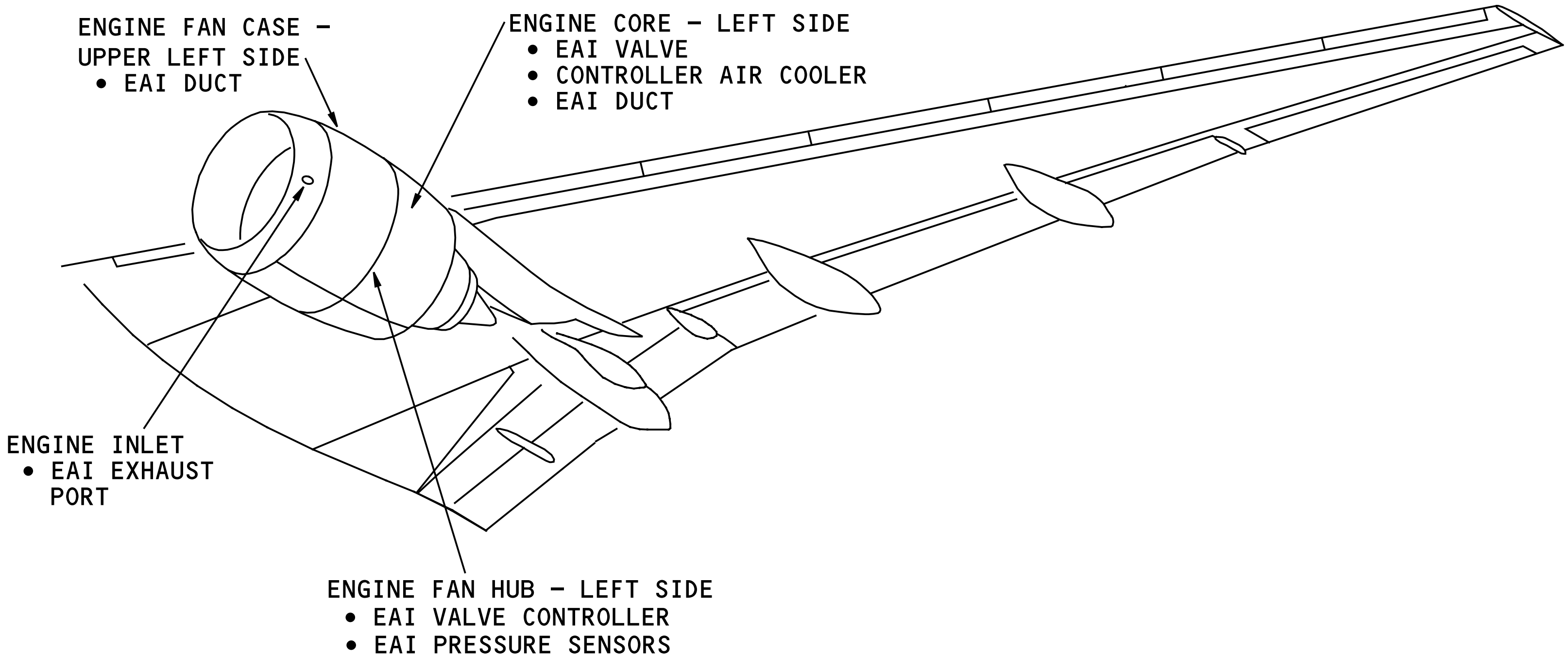
- EAI valve
- Controller air cooler
- EAI duct.

The EAI duct is in the area of the fan case on the left side the engine.

These are the components on the fan hub:

- EAI valve controller
- EAI pressure sensors.

The left side of the engine inlet has the EAI exhaust port.



30-21-00-002 Rev 2 01/23/95

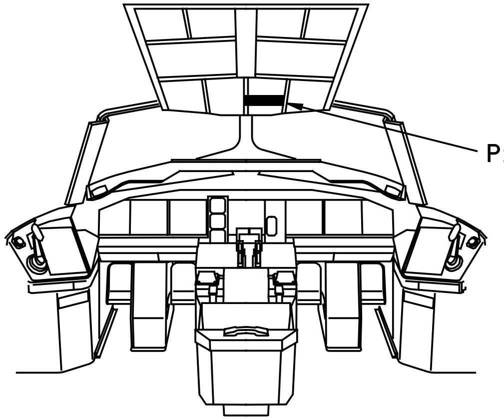
ENGINE ANTI-ICE - ENGINE COMPONENT LOCATIONS

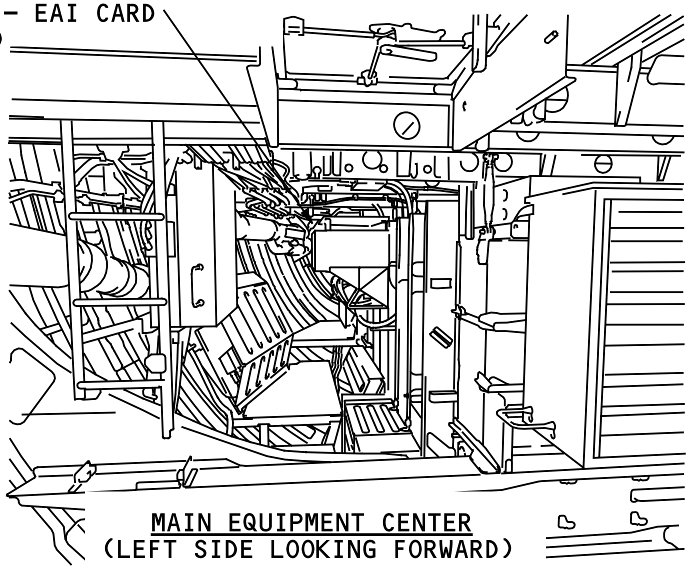
ENGINE ANTI-ICE - FLIGHT DECK AND MEC COMPONENT LOCATIONS

Component Locations

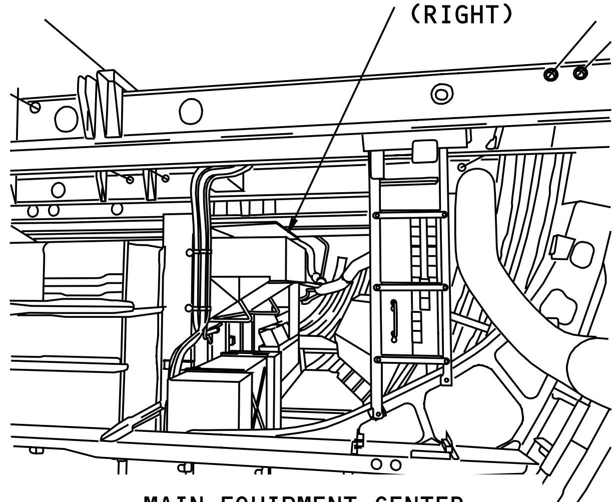
Controls for the EAI system are on the anti-ice/ lighting panel (P5).

The ACIPS - EAI cards (left and right) are in the left and right systems card files.





MAIN EQUIPMENT CENTER
(LEFT SIDE LOOKING FORWARD)



MAIN EQUIPMENT CENTER
(RIGHT SIDE LOOKING FORWARD)

30-21-00-003 Rev 1

ENGINE ANTI-ICE - FLIGHT DECK AND MEC COMPONENT LOCATIONS

ENGINE ANTI-ICE - EAI VALVE

Purpose

The EAI valve controls the flow of engine bleed air though the EAI duct to the engine cowl leading edge.

Physical Description

The EAI valve is a pneumatically-operated, piston-type valve. The valve has these parts:

- Body
- Locking screw
- Locking crank
- Control pressure line connector.

Location

The EAI valve is on the left side of the engine core at the 11:00 position. The valve is in the EAI duct aft of the fan hub.

Functional Description

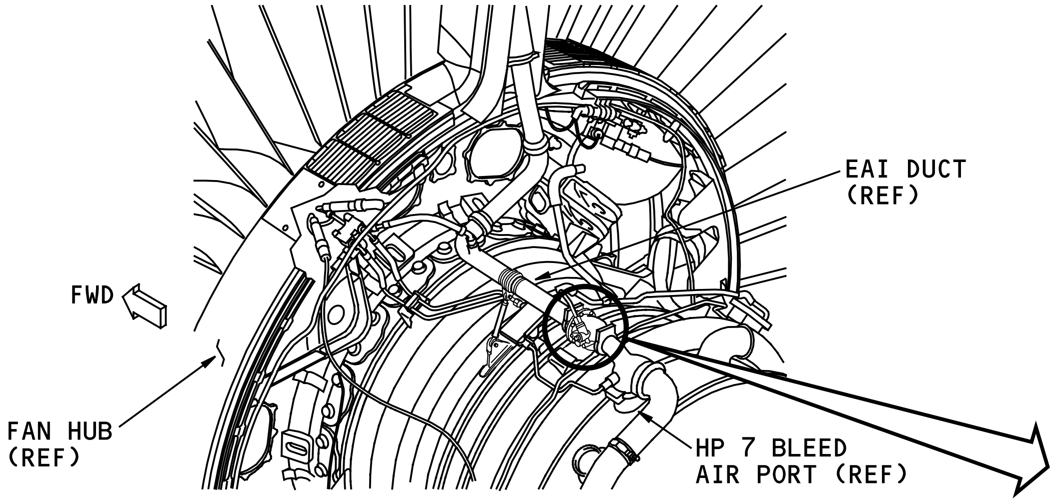
The piston freely slides on the guide tube. Control pressure pushes on the inner part of the piston to open the valve and control flow. Air from the high pressure bleed air source pushes on the outer part of the piston to move it to the closed position.

The locking screw and locking crank let you manually set the EAI valve for normal operation (unlocked position) or to the locked closed position. The locking screw keeps the locking crank in its unlocked position for normal valve operation or in the valve locked closed position. When you remove the screw from its stowed position, it lets control pressure vent and the locking crank move. When you move the locking crank to CLOSED and install the locking screw, the crank holds the piston in the closed position.

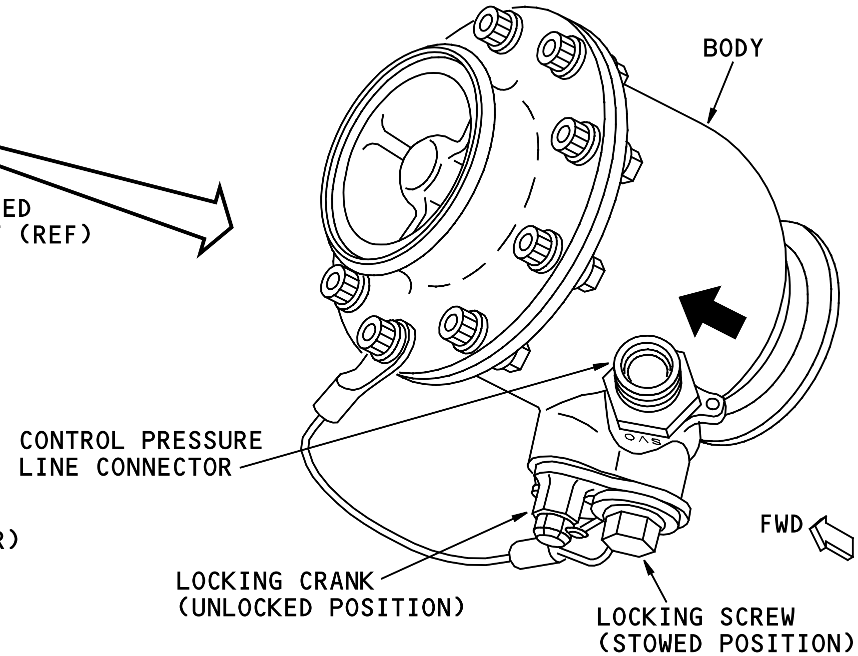
Training Information Point

You use the EAI valve controller (not shown) to manually set the EAI valve open.

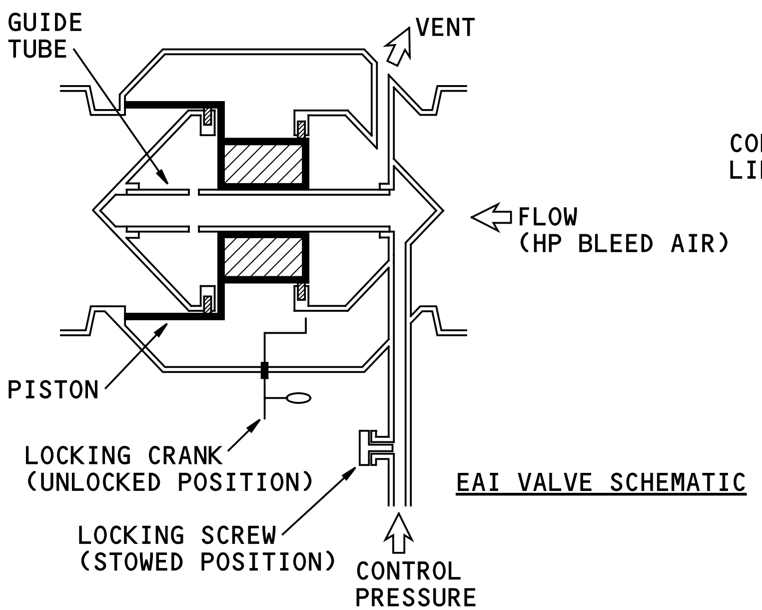
See the procedure in part II of the AMM, Preparation - Engine Anti-ice Systems Inoperative, for more information on deactivation of the engine anti-ice valve open.



ENGINE CORE - LEFT SIDE



EAI VALVE
(ROTATED)



EAI VALVE SCHEMATIC

ENGINE ANTI-ICE - EAI VALVE

30-21-00-004 Rev 2 02/22/95

ENGINE ANTI-ICE - EAI VALVE CONTROLLER

Purpose

The EAI valve controller supplies control pressure to the EAI valve.

Physical Description

The EAI valve controller is an electropneumatic controller. The controller has these parts:

- Two pressure line connectors
- Body
- Torque motor
- Electrical connector.

Location

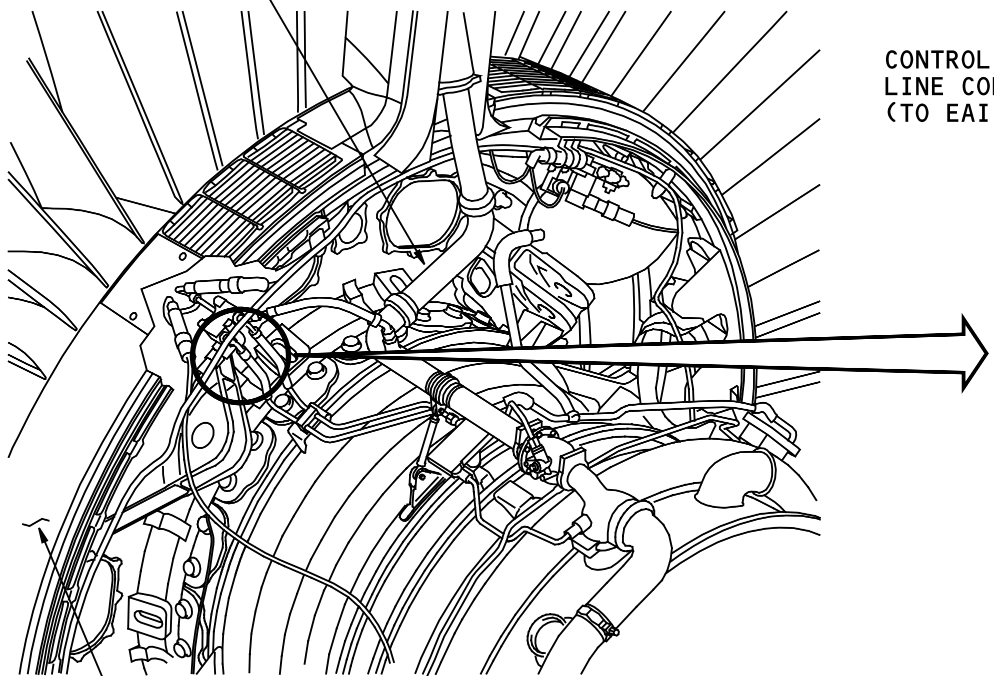
The controller is on the left side of the fan hub at the 11:00 position. The controller is inside the fan hub above the engine core.

Functional Description

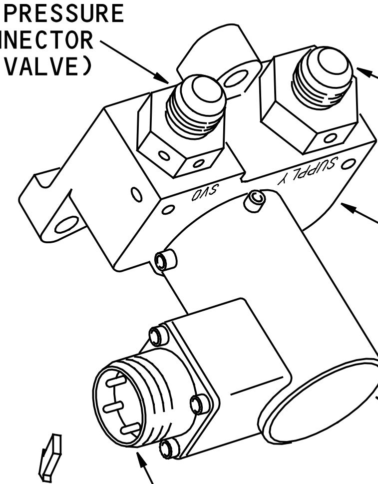
The EAI controller uses the torque motor to regulate control pressure to the EAI valve. The controller gives control pressure to the valve if the torque motor has no power (fail safe on).

Training Information Point

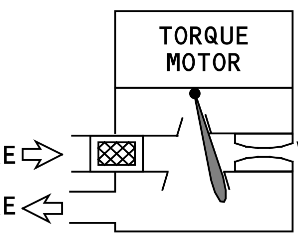
You remove, cap, and stow the torque motor electrical connector when you want to manually set the EAI valve open.



ENGINE CORE - LEFT SIDE



EAI VALVE CONTROLLER
(ROTATED)



EAI VALVE CONTROLLER SCHEMATIC
(SHOWN WITH NO POWER)

30-21-00-005 Rev 4 03/29/96

ENGINE ANTI-ICE - EAI VALVE CONTROLLER

ENGINE ANTI-ICE - EAI PRESSURE SENSOR

General

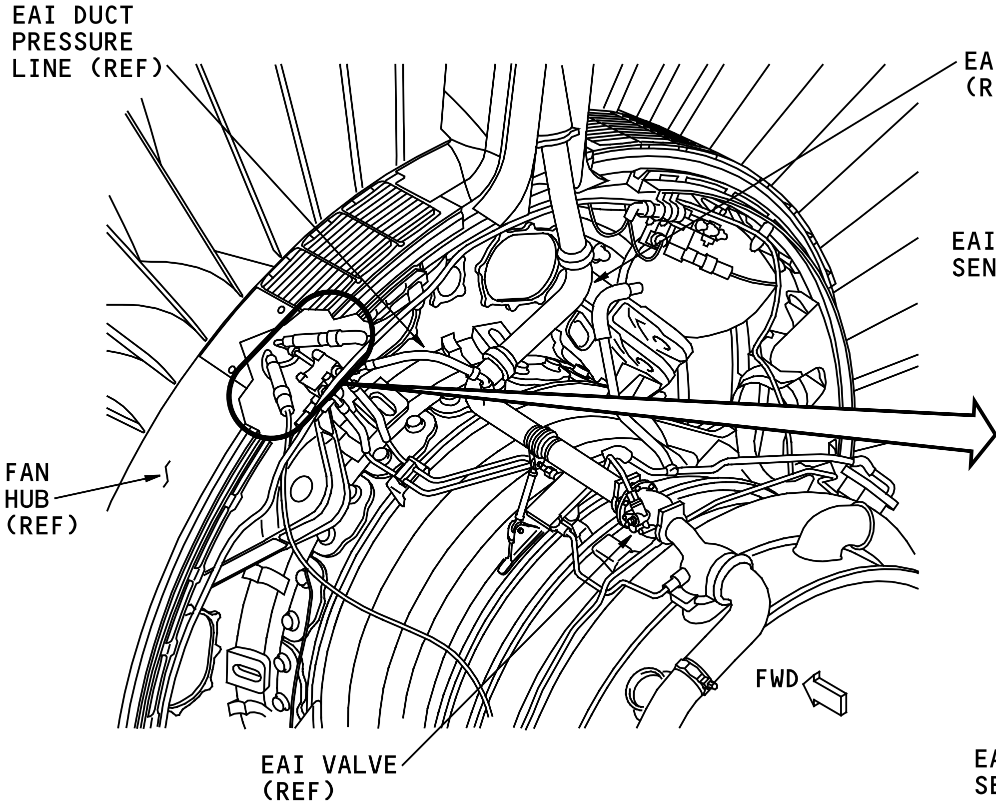
Each engine has two EAI pressure sensors. The sensors are the same. They both measure the pressure in the EAI duct downstream of the EAI valve. The left and right ACIPS - EAI control cards use the information from the pressure sensors to control the EAI system.

The pressure sensors are redundant. If one sensor fails, the system operates the same.

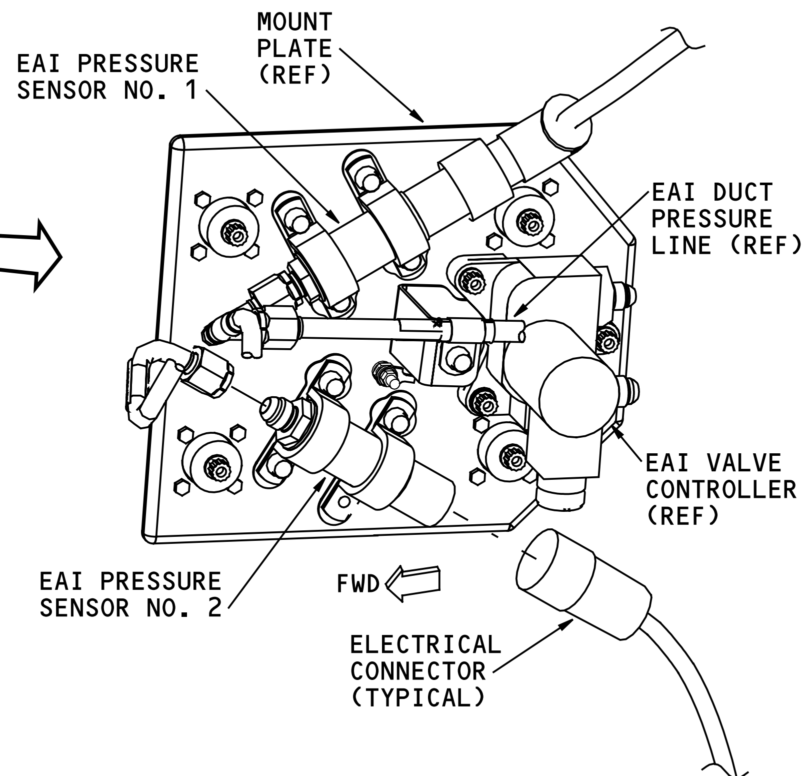
Each pressure sensor has a pressure line connector, a housing and an electrical connector.

Location

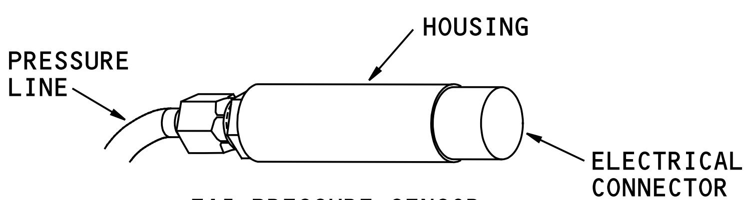
The sensors are on the left side of the fan hub at the 11:00 position. The sensors attach to the same mount plate as the EAI valve controller.



ENGINE CORE - LEFT SIDE



EAI PRESSURE SENSORS AND
EAI VALVE CONTROLLER INSTALLATION
(ROTATED, BOTTOM SIDE VIEW)



EAI PRESSURE SENSOR
(TYPICAL)

30-21-00-006 Rev 2 04/20/95

ENGINE ANTI-ICE - EAI PRESSURE SENSOR

ENGINE ANTI-ICE - EAI DUCT

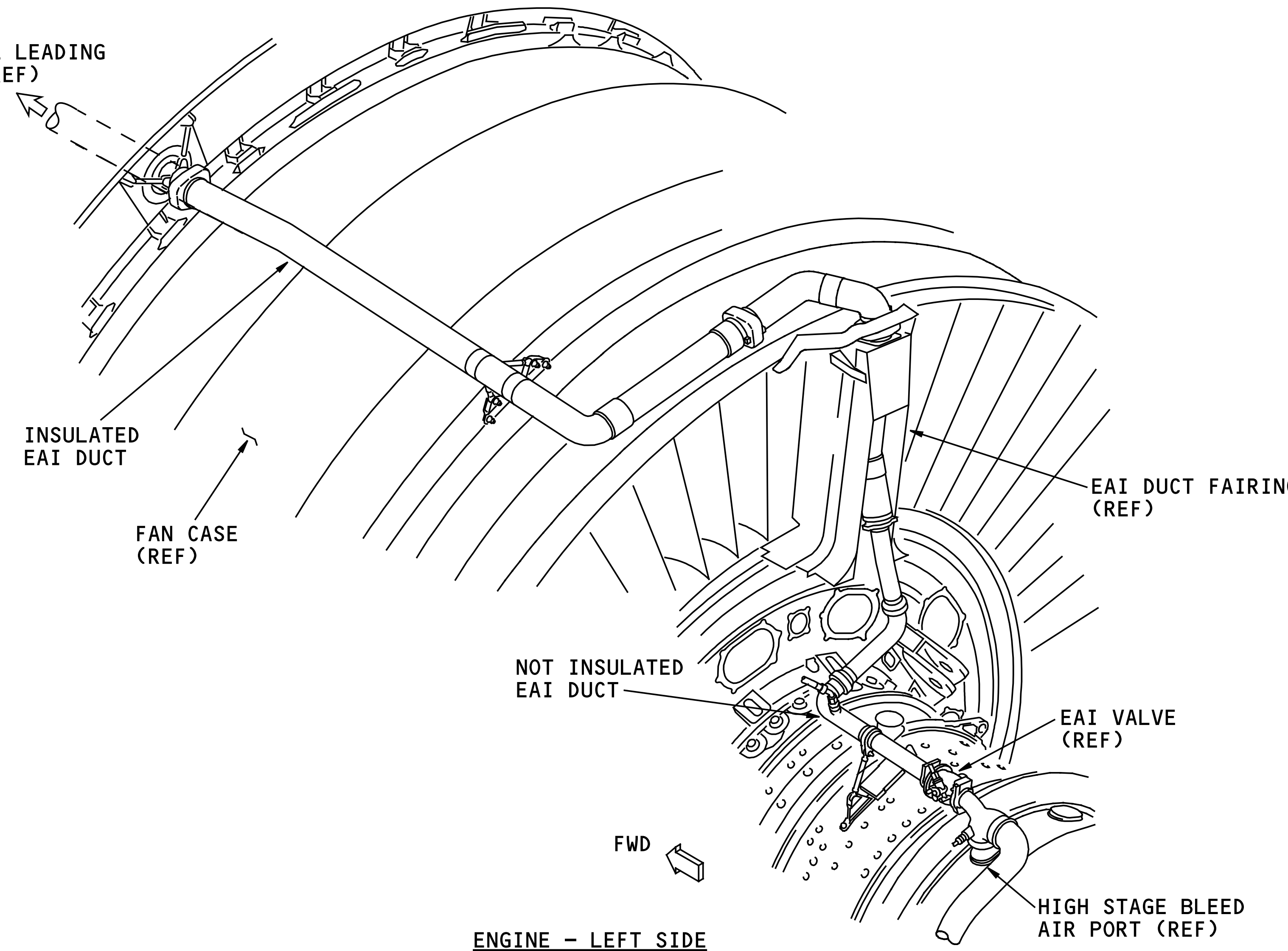
General

The EAI ducts move air from the engine high stage bleed port to the cowl leading edge.

There are two EAI ducts. One is not insulated and the other is insulated.

Locations

The not insulated EAI duct is on the left sides of the engine core forward of the EAI valve. The insulated EAI duct is in the EAI duct fairing and on the left side of the fan case.



ENGINE - LEFT SIDE

ENGINE ANTI-ICE - EAI DUCT

ENGINE ANTI-ICE - CONTROLLER AIR COOLER

General

There are two controller air coolers (CAC) on each engine. There is one for the engine air supply part of the pneumatic system (not shown) and there is one for the engine anti-ice system.

The EAI controller air cooler decreases the temperature of the engine bleed air (HP7) that goes to the EAI valve controller.

See the engine air supply section for more information about the engine air aupply system CAC (AMM PART I 36-11).

Physical Description

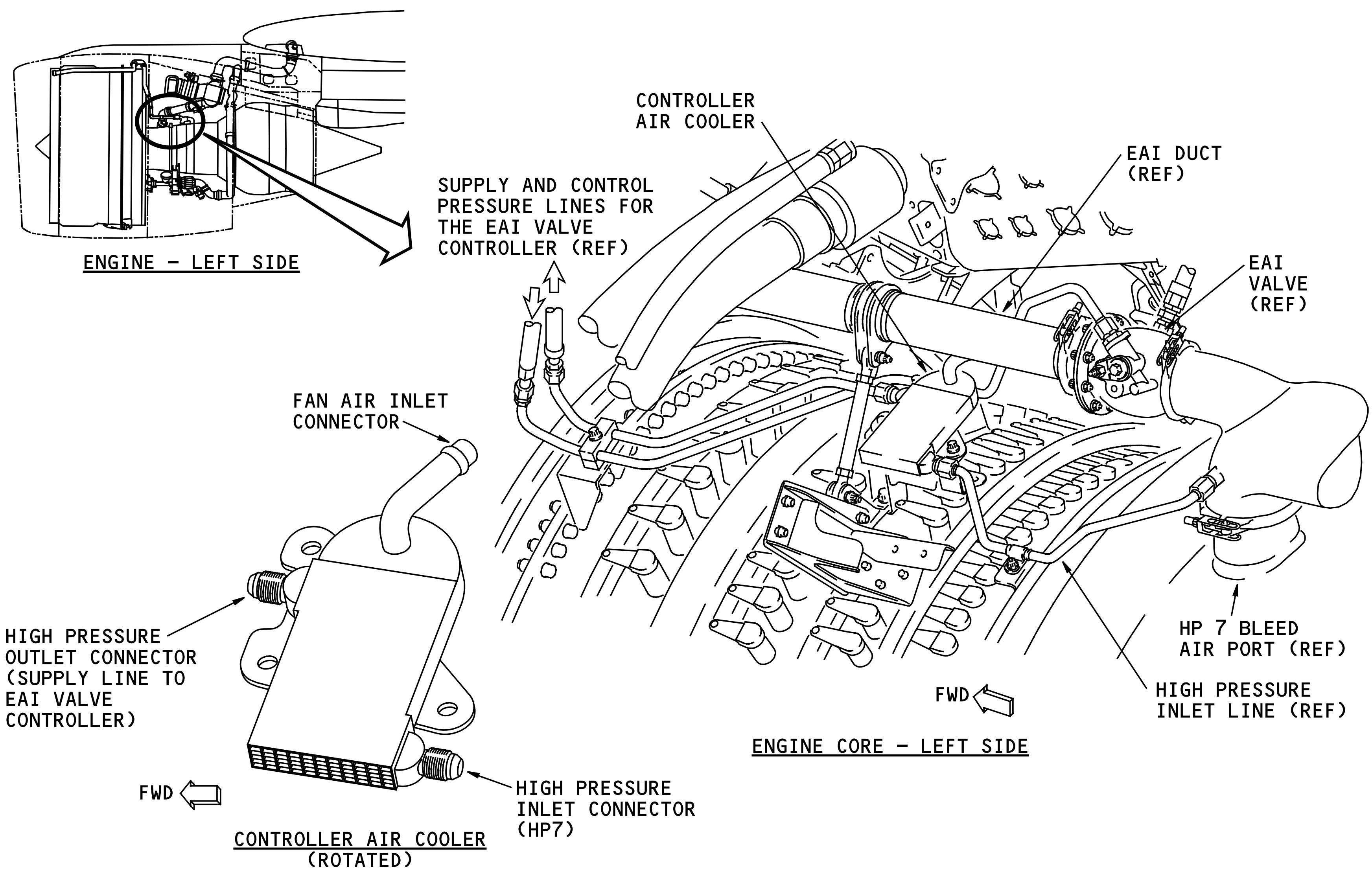
The controller air cooler is an air-to-air heat exchanger. It has three pneumatic line connectors, two high pressure and one low pressure (fan air).

Location

The controller air cooler is on the left side of the engine core at the 11:00 position. The cooler is below and forward of the engine anti-ice valve.

Functional Description

Hot air from the high stage compressor section and cool fan air flows through the controller air cooler. The cool air removes heat from the hot air. This decreases the temperature of the hot air.



30-21-00-008 Rev 6 05/16/95

ENGINE ANTI-ICE - CONTROLLER AIR COOLER

ENGINE ANTI-ICE - FUNCTIONAL DESCRIPTION

General

An EAI selector for each engine lets the flight crew operate the EAI system independently on each engine. Each selector has three positions: OFF, AUTO, and ON.

The left ACIPS control card controls the left EAI system. The right ACIPS control card controls the right EAI system. The ice detectors supply analog inputs to the EAI ACIPS control cards. The left detector connects to the left card. The right detector connects to the right card. Each card gives its ice detector data to the other card through the systems ARINC 629 buses.

See the ice detection system section for more information about the ice detectors (AMM PART I 30-81).

Operational Modes

The ACIPS control cards have two operational modes, AUTO and ON. The AUTO mode lets the ACIPS control card enable the related EAI valve if all of these conditions occur:

- EAI selector is set to AUTO
- Conditions do not inhibit operation.

If the EAI selector position shows invalid on the 629 data bus, the ACIPS control card operates in the AUTO mode.

The ON mode lets the ACIPS control card enable the related EAI valve if all of these conditions occur:

- EAI selector is set to ON
- Conditions do not inhibit operation.

The ACIPS control cards use torque motors in the related EAI valve controller to control the position of the EAI valve. The controller causes the valve to go full open if it has no power to its torque motor. The ACIPS control cards give power to the torque motor to cause the valve to regulate or to fully close.

When an ACIPS control card enables an EAI valve, the card sets the valve to one of these positions:

- Regulating
- Full open.

The regulating position is the usual position. In usual operation, the EAI ACIPS control card calculates a heat flow necessary for the engine cowl. The card adjusts the EAI valve to set a pressure in the EAI duct that causes this quantity of heat flow. The card keeps the mass flow to a limit if the airplane operates in these limits:

- Altitude; -2500 feet to 37,500 feet
- Temperature; -40F to 50F (-40C to 10C).

When the valve is set to regulate, the EAI ACIPS control card limits the minimum pressure in the EAI duct to 10 psig.

The EAI valve is set to full open when any of these conditions occur:

- Both EAI pressure sensors fail
- The torque motor circuit is open.

The EAI pressure sensors supply feedback information to the ACIPS control card for valve control and indications. There are two pressure sensors on each engine. These sensors do the same function.

Operational Mode Inhibits

The ACIPS control card closes the EAI valve if any of these conditions occur:

- Engine start
- Fan case overheat
- EAI selector set to OFF
- EAI selector set to AUTO with no ice detected.

The fan case overheat condition causes the ACIPS control card to close the EAI valve and set a latch. This keeps the system off after the overheat condition goes away. The flight crew must move the EAI selector to OFF, then to AUTO or ON to remove the latch.

See the duct leak and overheat detection system section for more information (AMM PART I 26-18).

BITE Operation

At power-up, the ACIPS control cards do built-in test (BIT) on internal hardware and software functions and interfaces.

The ACIPS control cards do a periodic BIT if all of these conditions are true:

- It is more than 20 seconds and less than five minutes after landing
- No fan case overheat is present
- Time since the last periodic test is more than 24 hours.

You can use the maintenance access terminal (MAT) or portable maintenance access terminal (PMAT) to do these EAI ground tests:

- Engine running
- Engine not running.

The BITE in the ACIPS control card can find short and open circuits in the system. The BITE does a check of these components:

- ACIPS control cards
- EAI valve controller
- EAI valve
- EAI pressure sensors
- Ice detector.

The BITE finds a failure if either EAI valve does not:

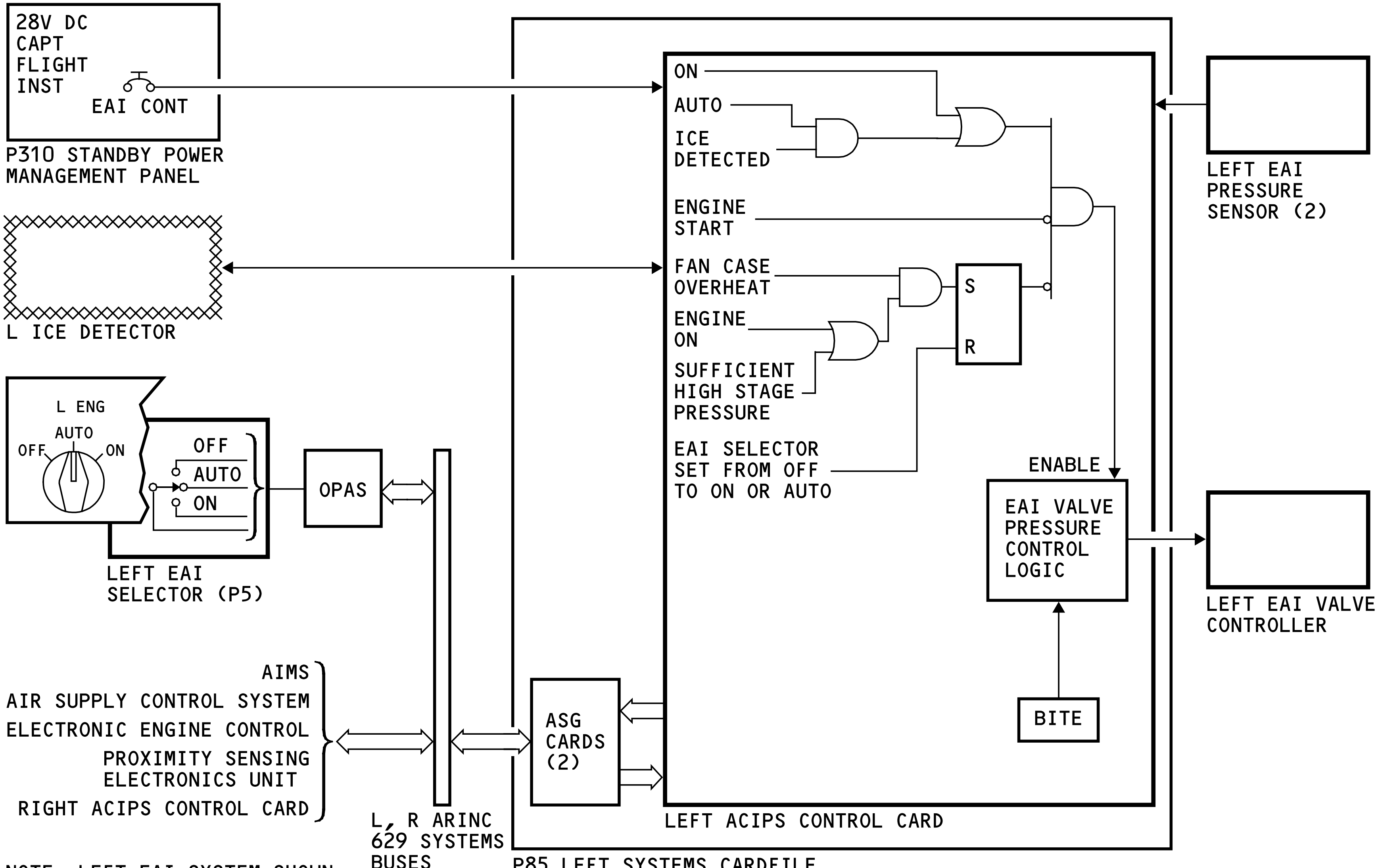
- Open
- Close
- Regulate.

ENGINE ANTI-ICE - FUNCTIONAL DESCRIPTION

Interfaces

The ACIPS control cards gets data from these systems:

- Opposite ACIPS control card; ice detected, failed ice detection
- OPAS; EAI switch position, engine start switch position
- DLODS; fancase overheat
- FMC; engine type, flight phase
- AIMS; engine on
- AGS; air/ground status
- ADIRU; mach number, static pressure, static air temperature, total air temperature
- EEC; P3 burner pressure, T3 selected temperature.



NOTE: LEFT EAI SYSTEM SHOWN.
RIGHT EAI SYSTEM SIMILAR.

ENGINE ANTI-ICE - FUNCTIONAL DESCRIPTION

ENGINE ANTI-ICE - OPERATION

General

The engine anti-ice selectors let the flight crew select the operational mode independently for each engine. Indications on the EICAS display and on the air synoptic display show when the EAI valves are open.

Operation

The selectors are on the anti-ice/lighting panel (P5). With the selector set to OFF, the EAI system does not operate. The EAI valve stays closed. The EICAS caution message ICING ENG shows if the ice detection system finds ice. The OFF selection prevents the EAI BITE periodic ground test.

In flight, when the EAI selector is in AUTO, engine anti-ice system operation is automatic. The ice detection system controls engine anti-ice system operation as long as operational mode inhibits are not active. The AUTO positions enable the BITE periodic ground test.

For manual operation, the crew sets the selectors to ON when engine anti-ice is needed. The EAI valves stay open as long as no operational mode inhibits are active. The EICAS advisory message ANTI-ICE ON shows if the EAI selector is on, no ice is detected, and the TAT is more than 50F (10C). The selectors must be ON for the EAI system to operate on the ground.

Air Synoptic Display

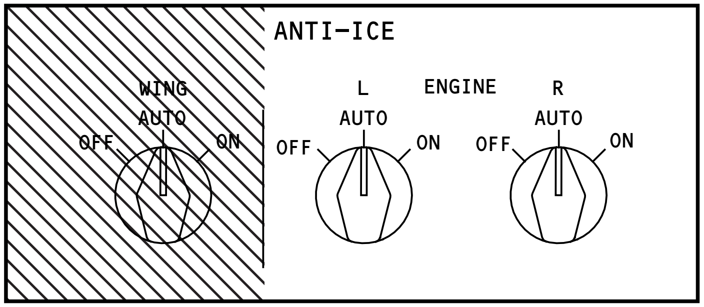
The EAI valve symbols show these conditions:

- Valve open - white circle with a vertical green flow bar
- Valve closed - white circle with two horizontal white bars
- Valve not in commanded position - amber circle with an amber cross through it
- Valve position data not available - white circle.

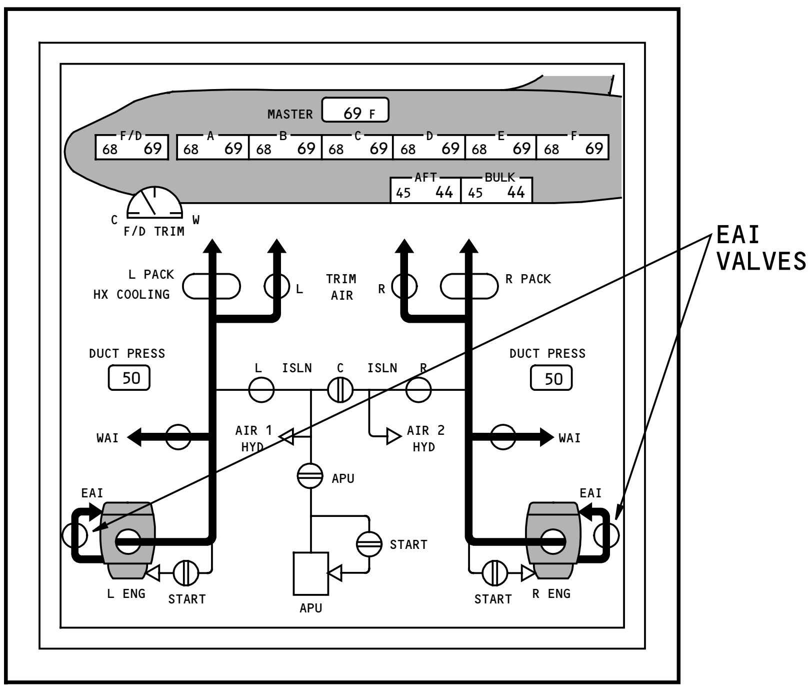
Non-Normal Indications

These EICAS messages (not shown) show non-normal conditions:

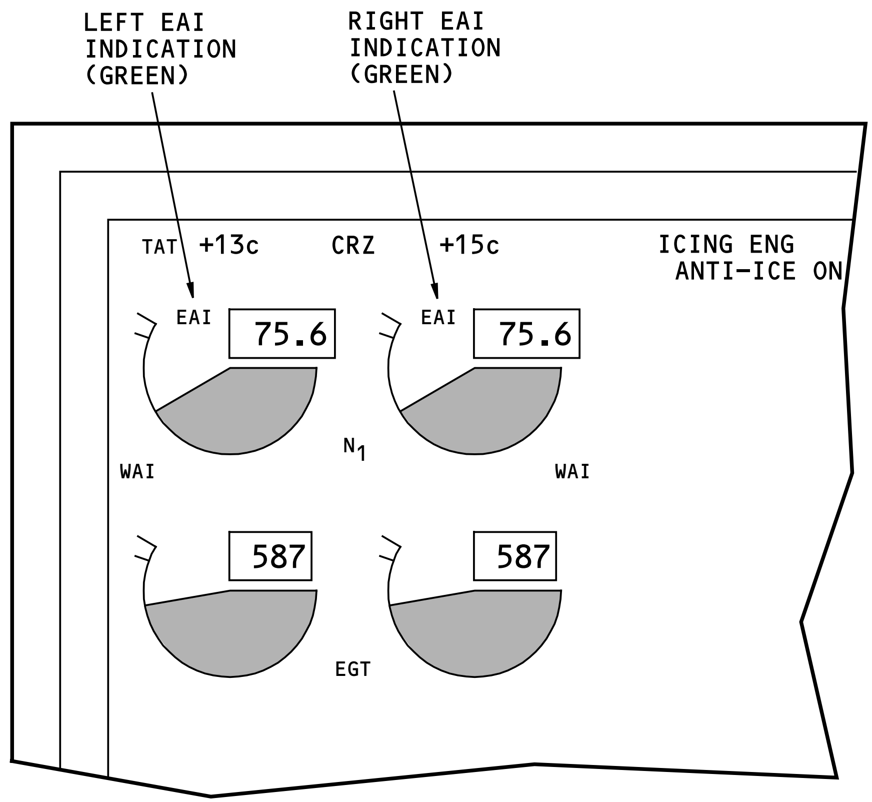
- ANTI-ICE LEAK ENG L,R (Caution) - The fan case overheat detector signals a duct leak condition
- ANTI-ICE LOSS ENG L,R (Advisory) - The EAI valve closes because of a duct leak
- ANTI-ICE ENG L,R (Advisory) - The EAI valve fails closed.



ANTI-ICE/LIGHTING (P5)



AIR SYNOPTIC DISPLAY



EICAS DISPLAY

30-21-00-010 Rev 2 02/17/95

ENGINE ANTI-ICE - OPERATION

ENGINE ANTI-ICE - SYSTEM TESTS

General

These are the engine anti-ice system tests that show when you select ATA 30 Airfoil Cowl Ice Protection System:

- Left engine anti-ice (engine running)
- Left engine anti-ice (engine not running)
- Right engine anti-ice (engine running)
- Right engine anti-ice (engine not running).

Left and Right Engine Anti-Ice (Engine Running)

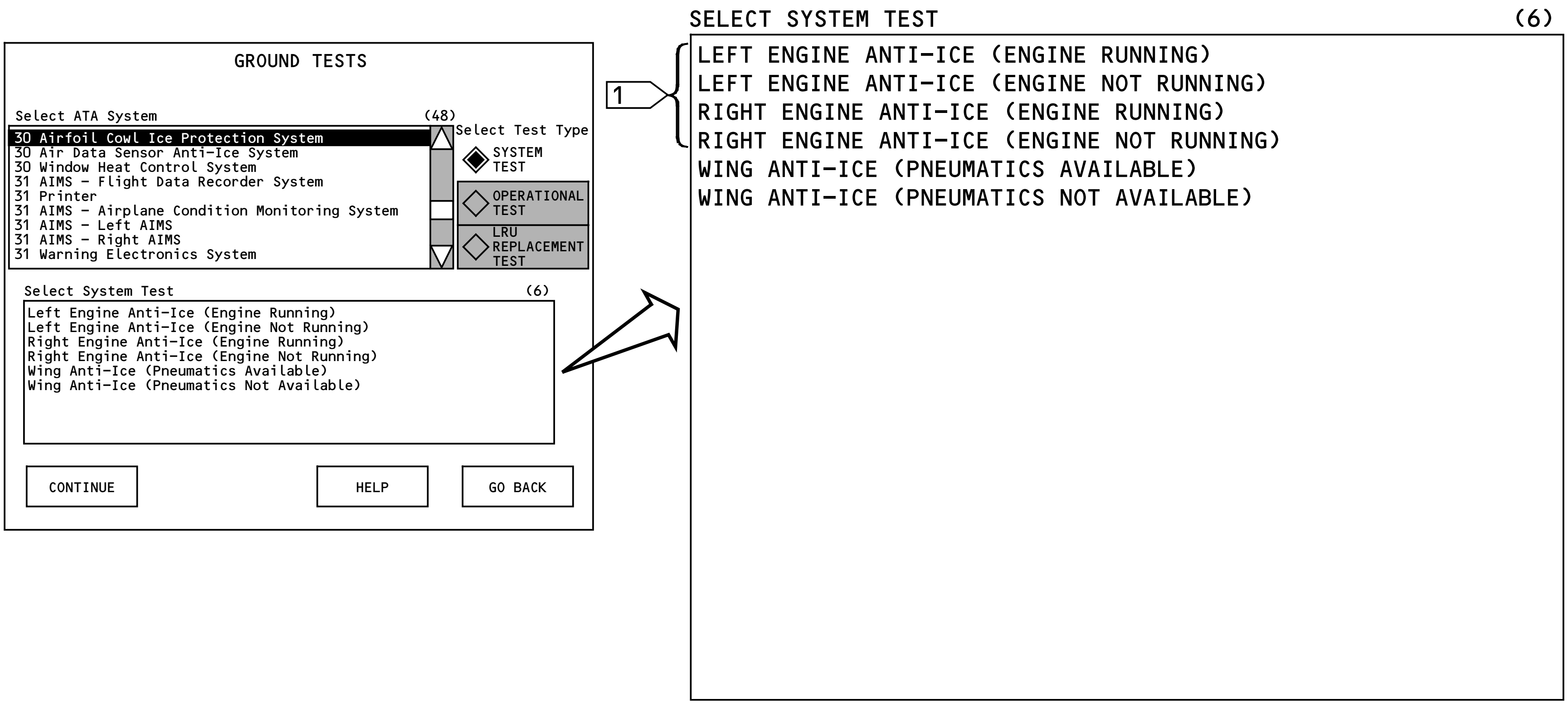
These tests make sure that the related engine anti-ice system can control the bleed airflow.

During the test, you must operate the related engine. The tests each take approximately 1-2 minutes.

Left and Right Engine Anti-Ice (Engine Not Running)

This test makes sure that the electrical interface connections of the related engine anti-ice system are correct, and that the related ice detector operates correctly.

The tests each take approximately 1-2 minutes.



30-21-00-012 Rev 0 08/17/96

1 THESE ARE THE ENGINE ANTI-ICE TESTS.

ENGINE ANTI-ICE - SYSTEM TESTS

ICE AND RAIN PROTECTION - ICE PROTECTION MAINTENANCE PAGE

General

The ice protection maintenance page shows this information:

- ALTITUDE - Airplane altitude in feet
- ENG TYPE - Engine manufacturer (GE, PW, or RR)
- TAT - Total air temperature in degrees C
- ICE DETECTOR - Status of the left and right ice detectors (OFF, ENGINE, ENGINE/WING, or FAIL)

Engine Anti-Ice

The engine anti-ice part of the maintenance page shows this information:

- FANCASE DUCT LEAK SIGNAL - Status of the fan case overheat detector (NORMAL, OVERHEAT, or FAIL)
- VALVE - EAI valve open, closed, or regulating
- SUPPLY AIR TEMP - EAI air supply temperature in degrees F
- AIR PRESS - Pressure downstream of the EAI valves in psig
- AIR FLOW - Air flow through the EAI valves in lb/min.

Wing Anti-Ice

The wing anti-ice part of the maintenance page shows this information:

- WING MANIFOLD PRESS - Pneumatic duct pressure in psig
- VALVE - WAI valve open, closed, or regulating
- AIR PRESS - Pressure downstream of the WAI valves in psig
- AIR FLOW - Air flow through the WAI valves in lb/min.

Valve positions and air flow rates are calculated from air pressure measurements upstream and downstream of the anti-ice valves.

ICE PROTECTION

ALTITUDE 10000 ENG TYPE --
TAT -2

	L	R
ICE DETECTOR	ENGINE/WING	ENGINE/WING
ENGINE ANTI-ICE:		
FANCASE DUCT LEAK SIGNAL	NORMAL	NORMAL
VALVE	REGULATING	REGULATING
SUPPLY AIR TEMP	884	884
AIR PRESS	13	13
AIR FLOW	13	13
WING ANTI-ICE:		
WING MANIFOLD PRESS	50	50
VALVE	REGULATING	REGULATING
AIR PRESS	19	19
AIR FLOW	85	85

DATE 23 JUN 90 UTC 18:54:04

ICE AND RAIN PROTECTION - ICE PROTECTION MAINTENANCE PAGE

ICE DETECTION SYSTEM - INTRODUCTION

Purpose

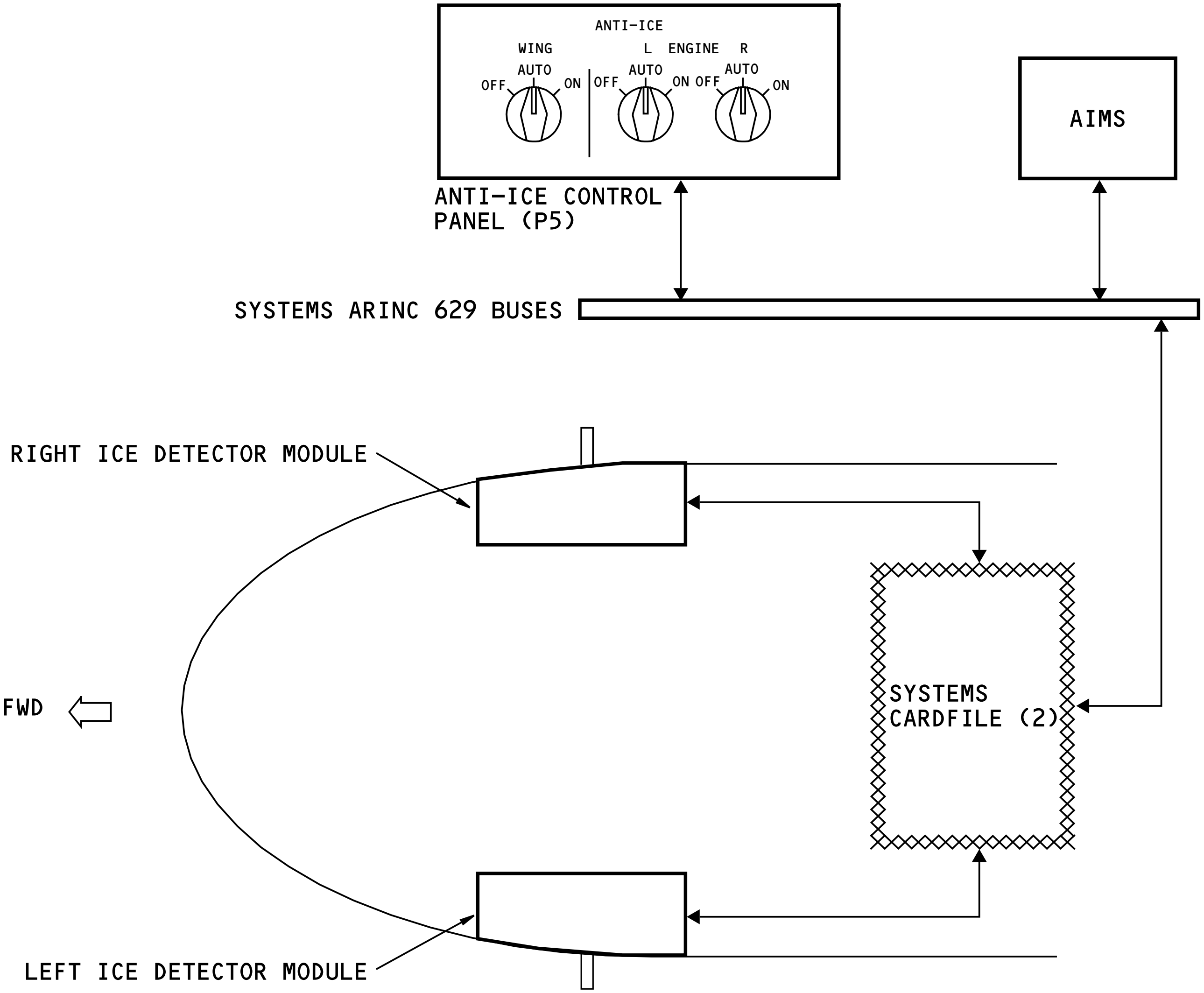
The ice detection system (IDS) operates the WAI and EAI systems when there is ice.

General Description

The IDS has two ice detection modules. If either detection module finds conditions that can cause ice, it sends an ice signal to the WAI and EAI systems. This automatically causes the anti-ice systems to operate.

Component Locations

There is an ice detection module on each side of the airplane nose.



30-81-00-001 Rev 0

ICE DETECTION SYSTEM - INTRODUCTION

ICE DETECTION SYSTEM - ICE DETECTORS

General

The ice detectors monitor for ice conditions. The ice detectors give an ice signal for use by the AIMS and the EAI and WAI ACIPS control cards.

Physical Description

There are two identical ice detectors. An ice detector has an ice detection probe and an electrical connector. There is a microprocessor in the detector.

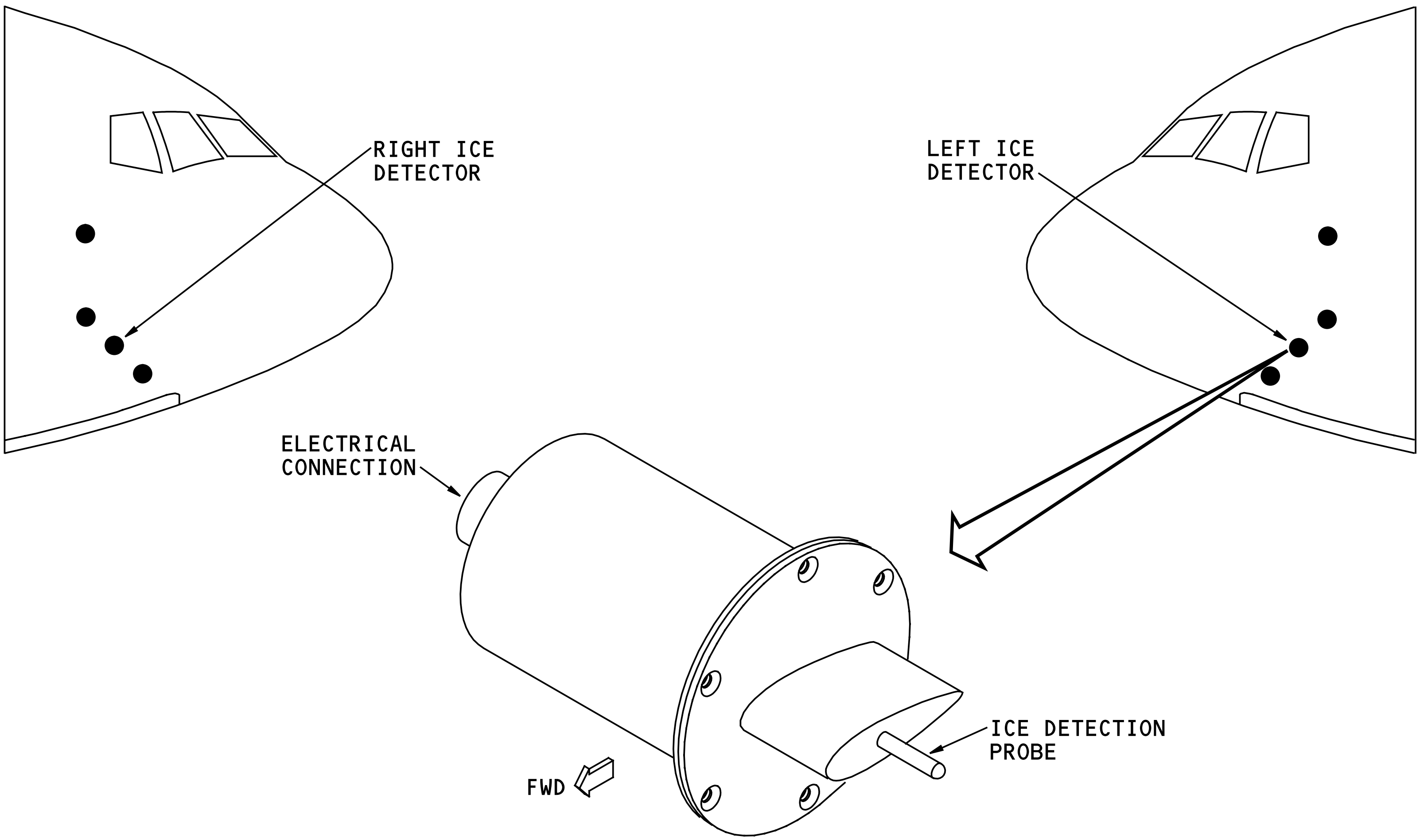
Location

The ice detectors are on the left and right sides of the fuselage on the nose of the airplane.

Functional Description

Each ice detector operates independently from the other. The ice detection probe vibrates. The probe vibrates differently when it collects ice. When ice is detected for a necessary period, the related ice detector sends an ice signal to the related (left or right) EAI ACIPS control card (not shown).

See the wing anti-ice section for more information about wing anti-ice (AMM PART I 30-11). See the engine anti-ice section for more information about engine anti-ice (AMM PART I 30-21).



ICE DETECTOR
(TYPICAL)

30-81-00-002 Rev 2 04/27/95

ICE DETECTION SYSTEM - ICE DETECTORS

PITOT AND STATIC (AIR DATA SENSORS) - INTRODUCTION

General

Some probes and sensors have heaters to keep ice off, so their data is reliable. The static system does not have any heaters. These are the probes and sensors that have heaters:

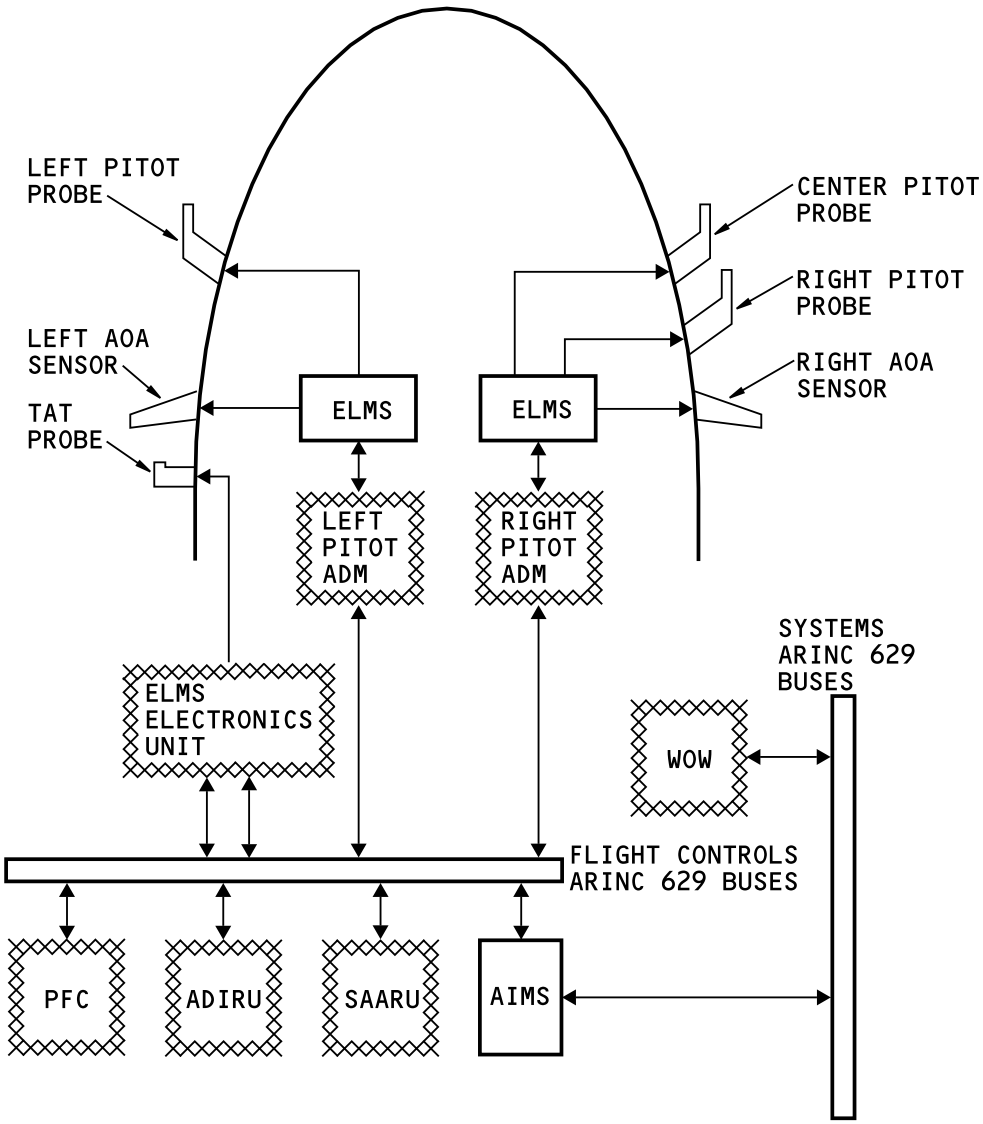
- Left, right, and center pitot probes
- Total air temperature (TAT) probe
- Left and right angle of attack (AOA) sensors

The pitot air data modules (ADMs) control the heat for the pitot probes and the AOA sensors. The pitot probes get low heat after an engine starts. They get high heat when the airplane reaches 50 knots airspeed or is in the air. The AOA probe heats when an engine starts.

See the attitude and direction section for more information about the ADMs (AMM PART I 34-20).

An electronics unit in the electrical load management system (ELMS) controls the heat for the TAT probe. The TAT probe heats when the airplane is in the air.

See the electrical load management (ELM) system section for more information about the ELMS (AMM PART I 24-09).



PITOT AND STATIC (AIR DATA SENSORS) - INTRODUCTION

30-30-00-001 Rev 5 01/19/95

PITOT AND STATIC (AIR DATA SENSORS) - GROUND TESTS

General

These are the pitot and static (air data sensors) operational tests that show when you select ATA 30 Air Data Sensor Ice System:

- Pitot/AOA heat (left) test
- Pitot/AOA heat (right) test
- Pitot heat (center) test
- TAT probe heat.

Left and Right Pitot/AOA Heat Tests

These tests make sure that the related pitot probe and the AOA sensor heaters operate correctly.

During the test, the related pitot probe and AOA sensor become very hot. The tests each take less than 1 minute.

WARNING: KEEP PERSONS AND EQUIPMENT AWAY FROM THE LEFT (RIGHT) PITOT PROBES AND THE LEFT (RIGHT) ANGLE OF ATTACK VANE. THESE COMPONENTS WILL BECOME VERY HOT AND CAUSE INJURY TO PERSONS AND DAMAGE TO EQUIPMENT.

Center Pitot Heat Test

This test makes sure that the center pitot probe heater operates correctly.

During the test, the center pitot probe becomes very hot. The test takes less than 1 minute.

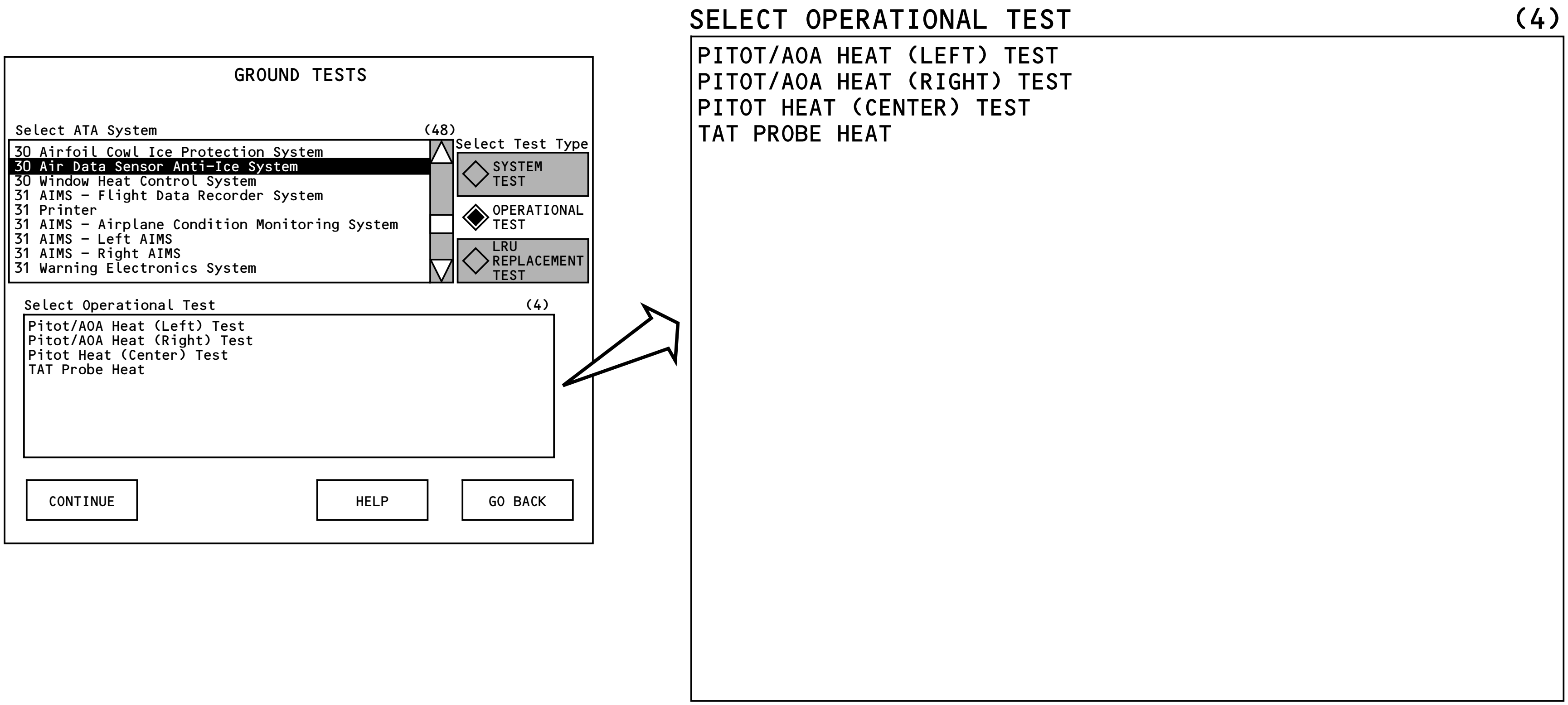
WARNING: KEEP PERSONS AND EQUIPMENT AWAY FROM THE CENTER PITOT PROBE. THESE COMPONENTS WILL BECOME VERY HOT AND CAUSE INJURY TO PERSONS AND DAMAGE TO EQUIPMENT.

TAT Probe Heat

This test makes sure that the TAT probe heater operates correctly.

During the test, the TAT probe becomes very hot. The test takes less than 1 minute.

WARNING: KEEP PERSONS AND EQUIPMENT AWAY FROM THE TAT PROBE. THESE COMPONENTS WILL BECOME VERY HOT AND CAUSE INJURY TO PERSONS AND DAMAGE TO EQUIPMENT.



30-30-00-003 Rev 0 08/17/96

PITOT AND STATIC (AIR DATA SENSORS) - GROUND TESTS

PITOT AND STATIC (AIR DATA SENSORS) - PITOT PROBE HEAT - FUNCTIONAL DESCRIPTION

General

The left, center, and right pitot probe heat systems operate the same. The left, right, and center pitot air data modules (ADMs) supply control and indications for the pitot probe heat systems.

Ground Mode

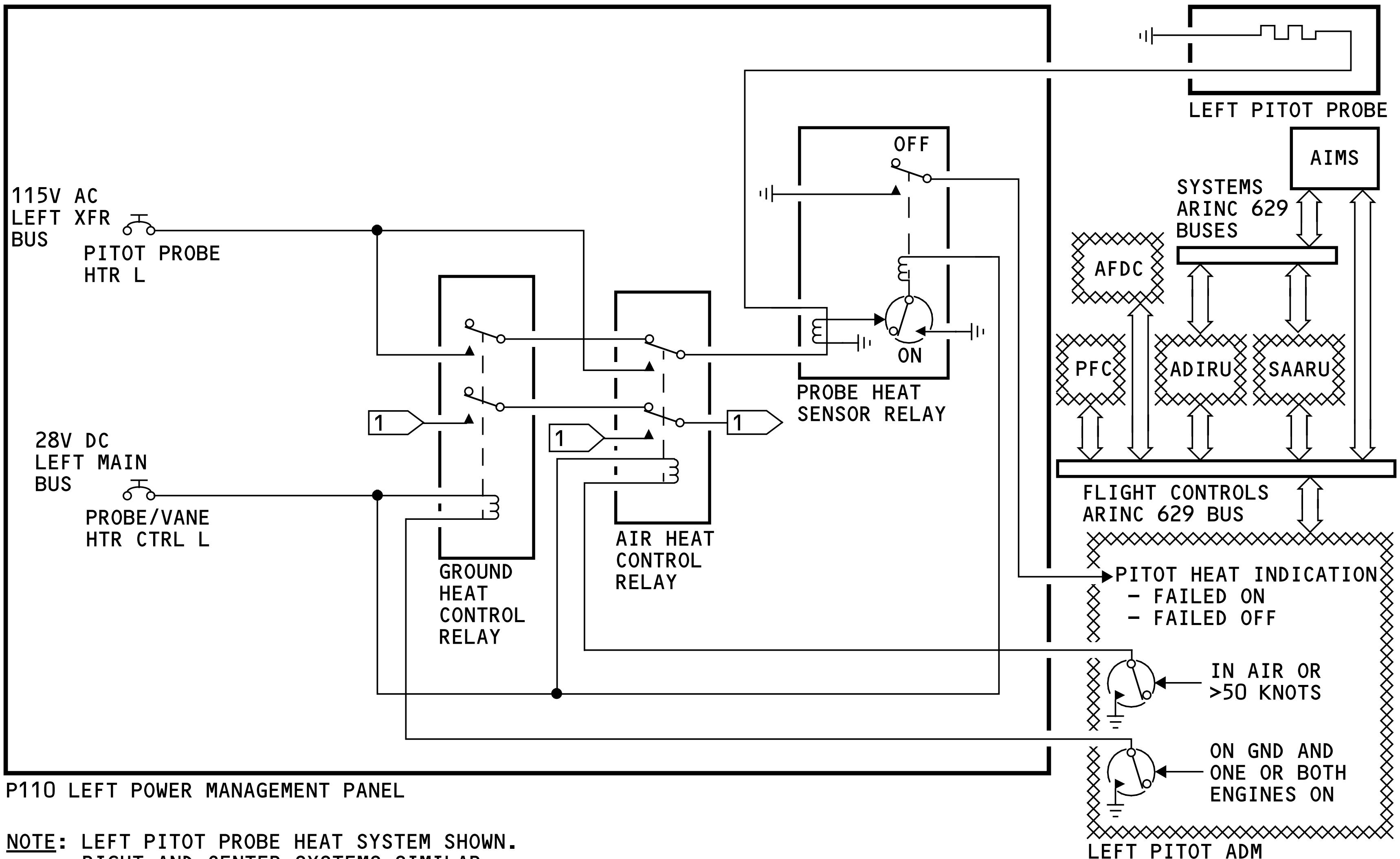
The primary flight computer (PFC) supplies air/ground signals for the ADM to energize the ground and air heat control relays. When the airplane is on the ground and either engine is on, the pitot probe gets 115v ac through the ground and the air heat control relays.

Air Mode

When the airplane gets to 50 knots or is in the air, the air heat control relay supplies 115v ac.

Indications

The probe heat sensor relay supplies a ground signal to the ADM when the pitot heat is on. The ADM supplies the pitot heat fault information directly through the data buses to the AIMS. It also supplies the information through the air data inertial reference unit (ADIRU) and the secondary attitude air data reference unit (SAARU) for advisory and status messages.



NOTE: LEFT PITOT PROBE HEAT SYSTEM SHOWN. RIGHT AND CENTER SYSTEMS SIMILAR.

1 SEE AOA PROBE HEAT

PITOT AND STATIC (AIR DATA SENSORS) - PITOT PROBE HEAT - FUNCTIONAL DESCRIPTION

FLIGHT DECK WINDOW ANTI-ICE SYSTEM - INTRODUCTION

Purpose

The window heat system prevents ice and fog on the flight deck windows.

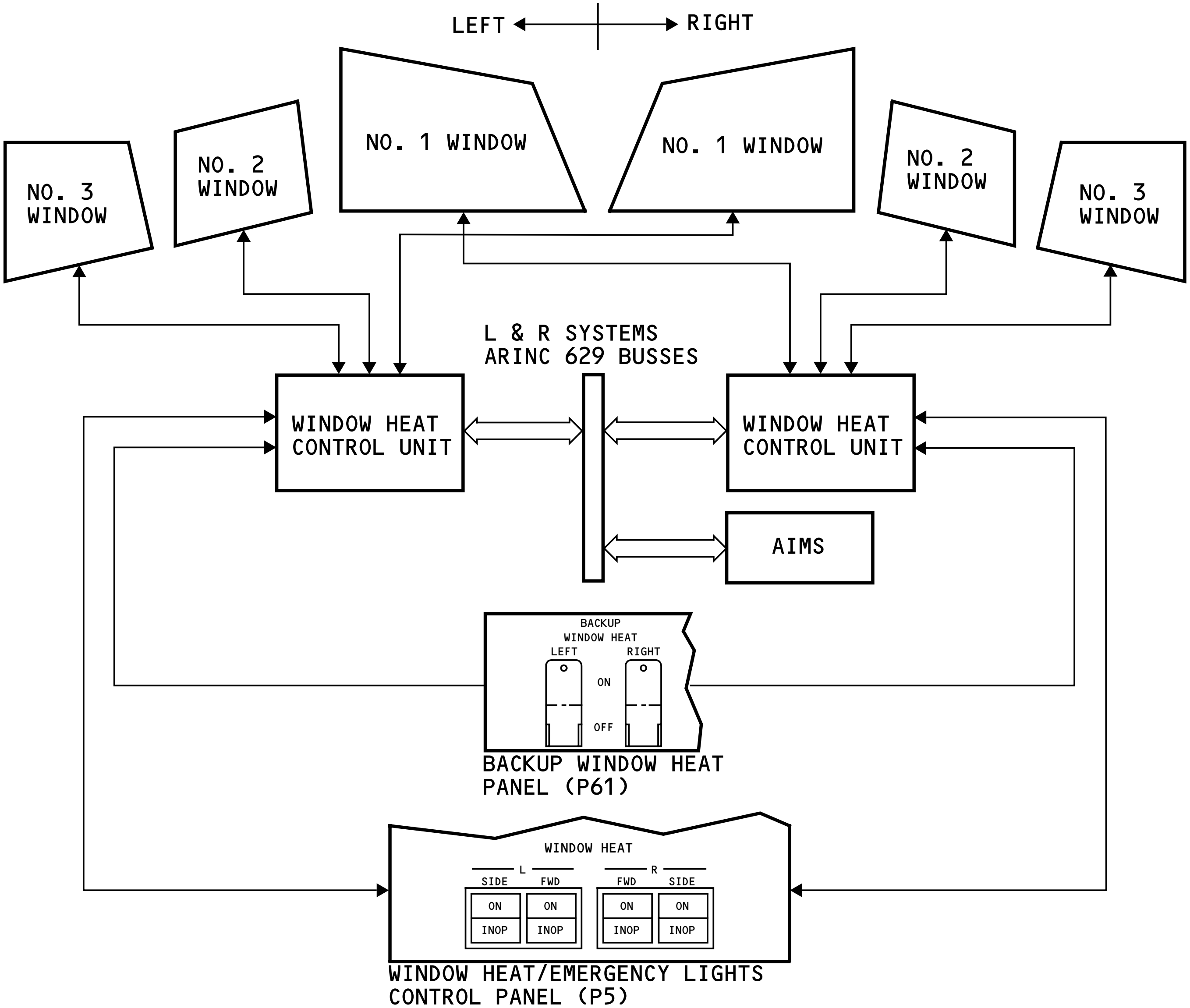
General Description

Electric heaters in the window laminations heat the flight deck windows.

The window heat switches enable the window heat system. With window heat ON, the window heat control units (WHCUs) control the power to the windows. With window heat OFF, the backup window heat system can operate.

The number 1 windows have a backup heat system. The backup window heat switches let you remove power from the backup window heat system for maintenance.

There are no test switches for the window heat system. The BITE automatically tests the system. You can use the MAT to do initiated BITE tests of the window heat system.



FLIGHT DECK WINDOW ANTI-ICE SYSTEM - INTRODUCTION

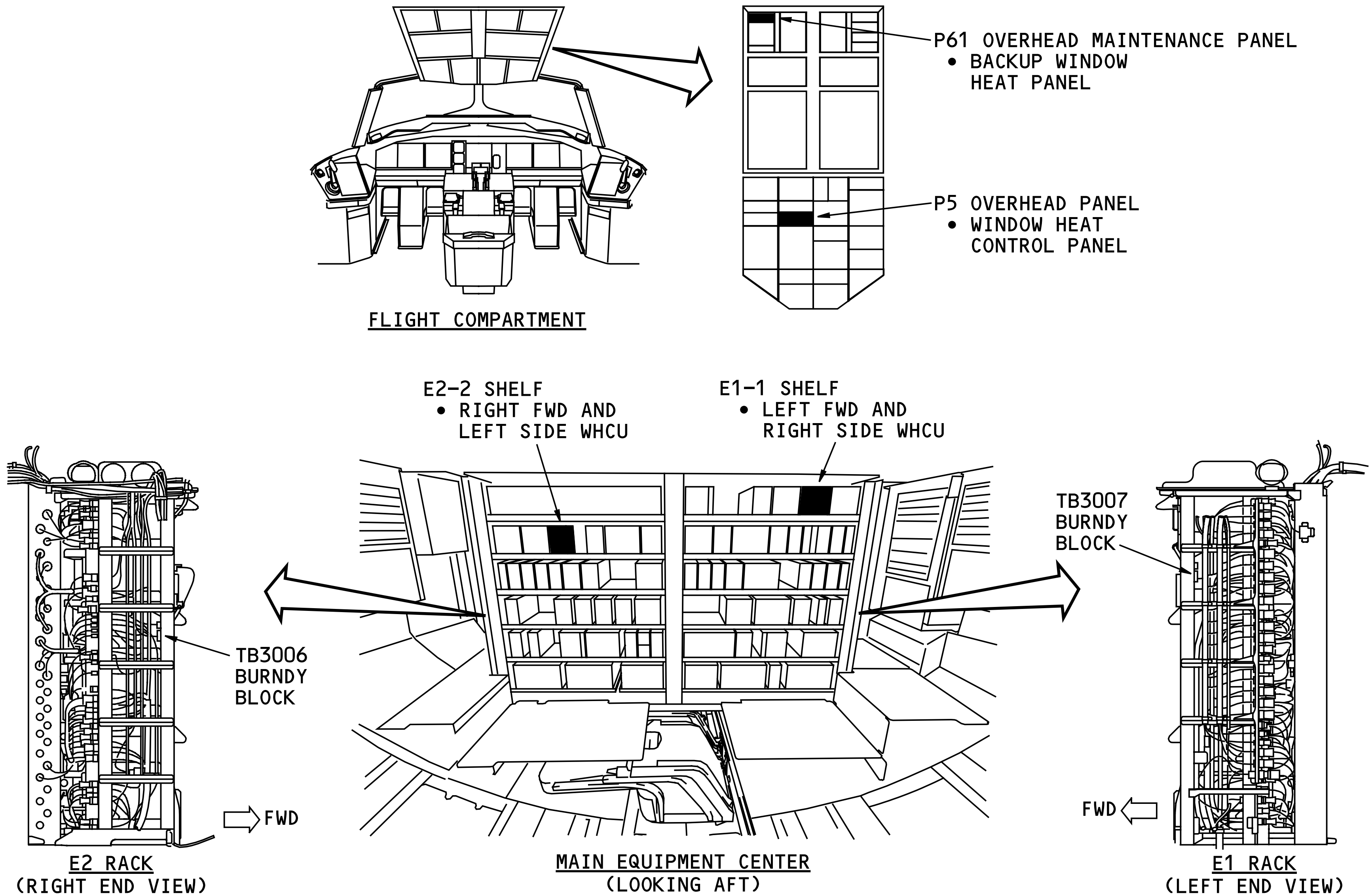
FLIGHT DECK WINDOW ANTI-ICE SYSTEM - COMPONENT LOCATIONS

Component Locations

The window heat control panel is on the P5 overhead panel. The backup window heat panel is on the P61 overhead maintenance panel.

The two window heat control units (WHCUs) are on the E1 and E2 main equipment racks. The left forward and right side WHCU is on the E1-1 shelf. The right forward and left side WHCU is on the E2-2 shelf.

Burndy blocks for the spare window heat sensors are on the outboard ends of the E1 and E2 rack.



FLIGHT DECK WINDOW ANTI-ICE SYSTEM - COMPONENT LOCATIONS

30-41-00-002 Rev 1 08/03/95

FLIGHT DECK WINDOW ANTI-ICE SYSTEM - FUNCTIONAL DESCRIPTION - 1

General

There are two WHCUs. One WHCU is for the left forward and right side windows. The other WHCU is for the right forward and left side windows. The WHCUs are the same.

Each WHCU has a separate power supply for each heater circuit in the flight deck windows. Each WHCU also has a separate power supply for BITE.

The power supplies for the heater circuits are 115v ac. The power supply for the BITE is 28v dc.

Each WHCU receives air/ground status from two air/ground relays. The inputs are analog. They are redundant.

Power Supply Circuits

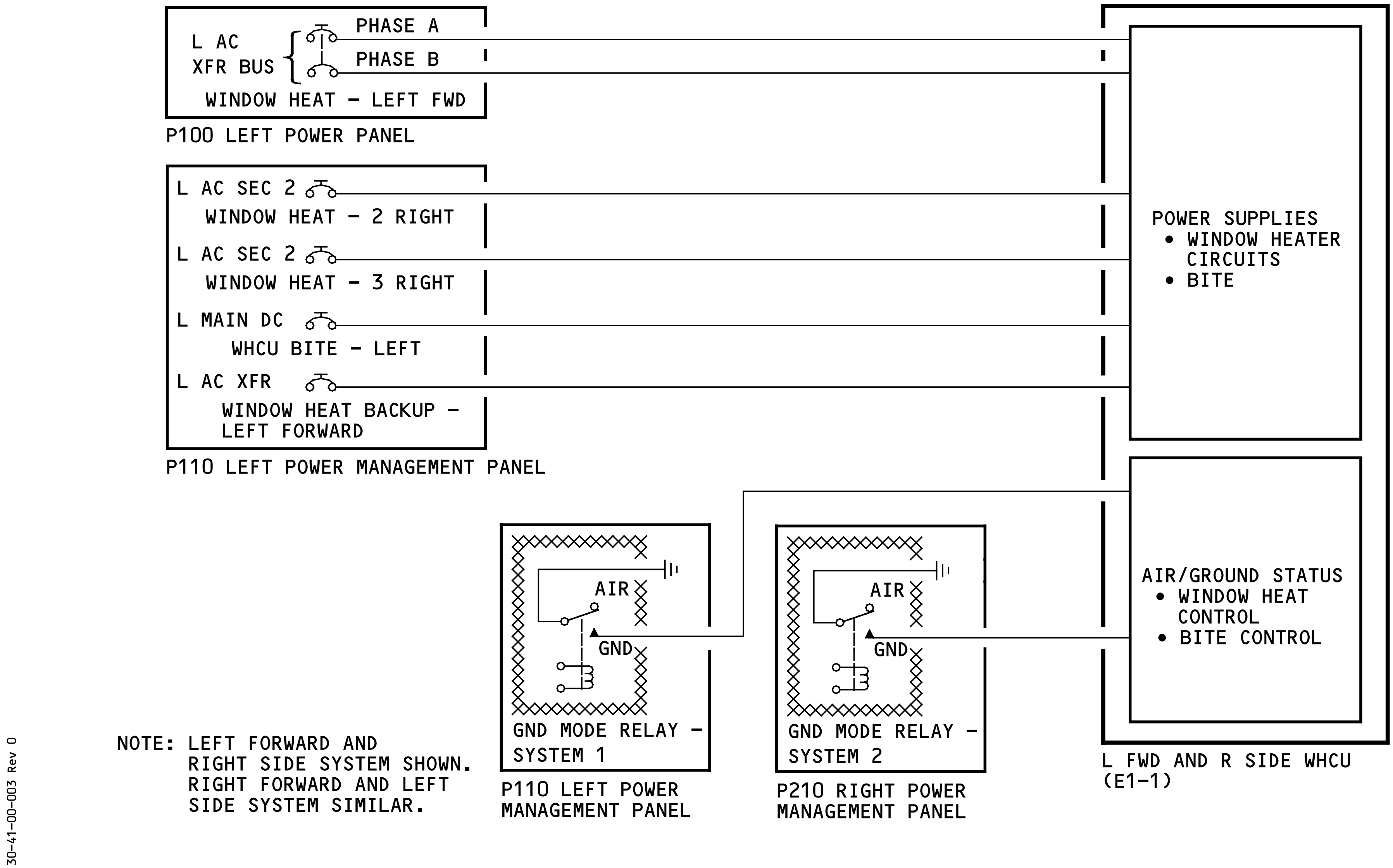
The number 1 window uses two phase ac. The number 2 and 3 windows use single phase ac.

Air/Ground Inputs

The WHCU uses the air/ground status for these functions:

- The WHCUs decrease the power to all of the window heaters during the first four minutes of operation on the ground
- The WHCU inhibits initiated BITE tests in flight.

The initiated BITE tests occur during power-up of the WHCU, and when you do the window heat ground test on the MAT.



FLIGHT DECK WINDOW ANTI-ICE SYSTEM - FUNCTIONAL DESCRIPTION - 1

FLIGHT DECK WINDOW ANTI-ICE SYSTEM - FUNCTIONAL DESCRIPTION - 2

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FLIGHT DECK WINDOW ANTI-ICE SYSTEM - FUNCTIONAL DESCRIPTION - 2

General

These control switches connect to one WHCU (left forward and right side WHCU):

- Left forward window heat switch
- Right side window heat switch
- Left backup window heat switch.

The other switches connect to the other WHCU (right forward and left side WHCU).

Each window heat switch has an ON light and an INOP light. The backup window heat switches do not have indications.

These heater circuits are for normal operation:

- Number 1 window anti-ice heater circuit
- Number 2 window anti-fog heater circuit
- Number 3 window anti-fog heater circuit.

The anti-fog heater circuit in the number 1 window is for backup operation.

The WHCU supplies control power to the window heaters. The WHCU also has BITE.

Window Heat Enable

The left forward window heat switch enables the anti-ice heater circuit in the left number 1 window. The right side window heat switch enables the anti-fog heaters in the right number 2 and 3 windows.

The INOP lights are on when the window heat switches are OFF. The INOP light shows that the heater circuit is not enabled.

When you push the switches, a mechanical ON label shows switch position. The ON light comes on if the instrument lights system has power. The INOP light goes out to show the heater circuit is enabled.

Window Heat Control

A temperature sensor in each window supplies control feedback to the WHCU. The WHCU controls the temperature of each window independently. The WHCU does not supply power to the heater circuit if the window temperature is too warm.

BITE Operation

The BITE in the WHCU tests for failures in these components:

- WHCU
- Heater
- Temperature sensor.

The WHCU can remove all power to a window heater if the BITE in the WHCU finds a failure. The INOP light comes on to show that the heater circuit is not enabled.

FLIGHT DECK WINDOW ANTI-ICE SYSTEM - FUNCTIONAL DESCRIPTION - 2

There are continuous BITE tests and initiated BITE tests. The continuous BITE tests occur during normal operation. The initiated BITE tests occur during power-up of the WHCU and when you do the window heat ground test on the MAT.

Window Heat Backup

The WHCU supplies electrical power to the anti-fog heater in the number 1 window if the backup window heat switch is ON and either of these conditions exists:

- Forward window heat switch OFF
- Forward window heat switch ON and no power to the anti-ice heater in the number 1 window.

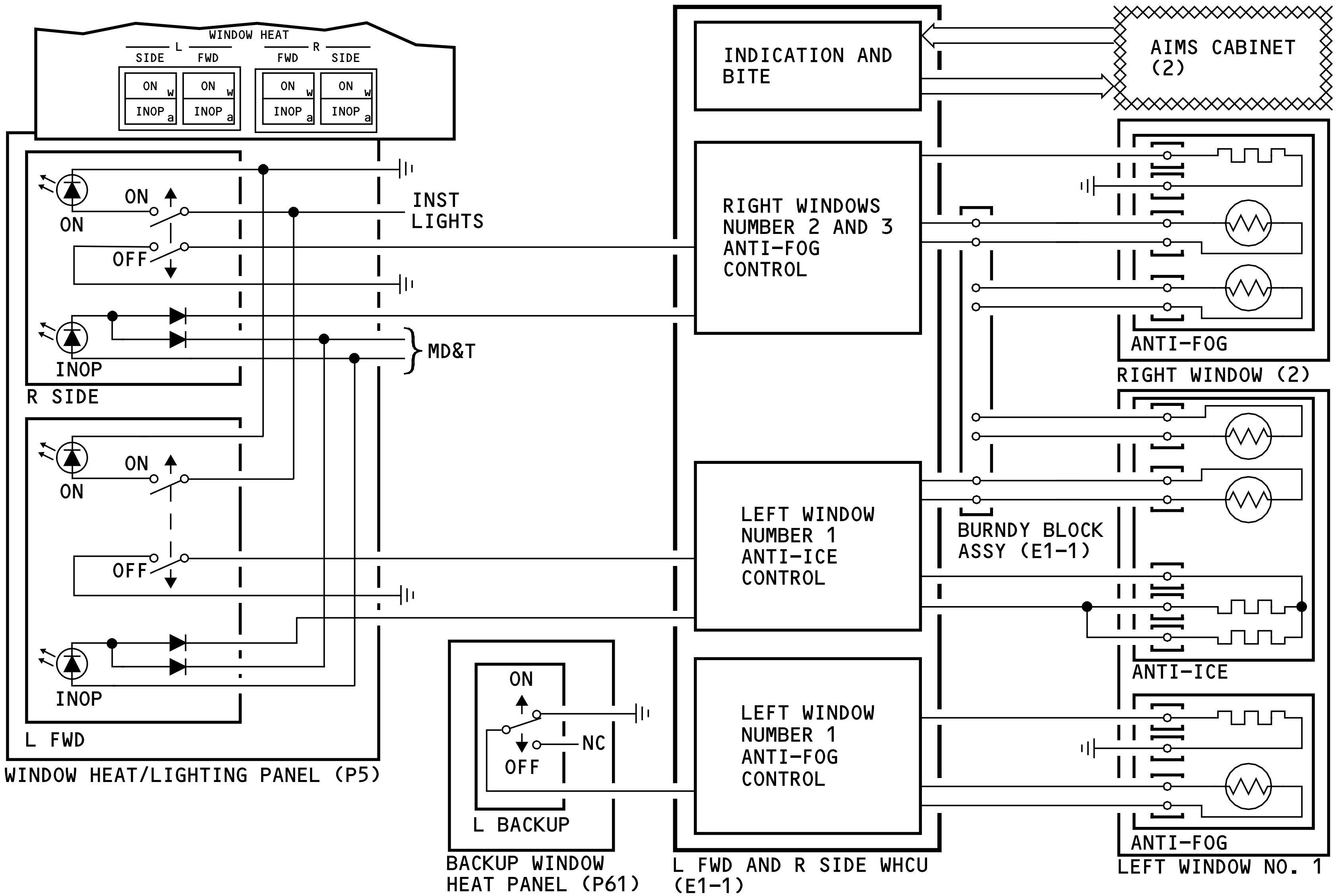
A backup temperature sensor supplies feedback.

To remove backup heat from the number 1 window, move the backup window heat switch to the OFF position.

Training Information Point

To remove power from the window heater circuits, select the window heat switches and the backup window heat switches OFF. You need to do this for safety before you clean the windows or do maintenance on the windows.

The window anti-ice system has burndy blocks on the left of the E1 rack and right of the E2 rack. This lets you switch to the spare sensor if the primary sensor fails.



FLIGHT DECK WINDOW ANTI-ICE SYSTEM - FUNCTIONAL DESCRIPTION - 2

FLIGHT DECK WINDOW ANTI-ICE SYSTEM - OPERATION

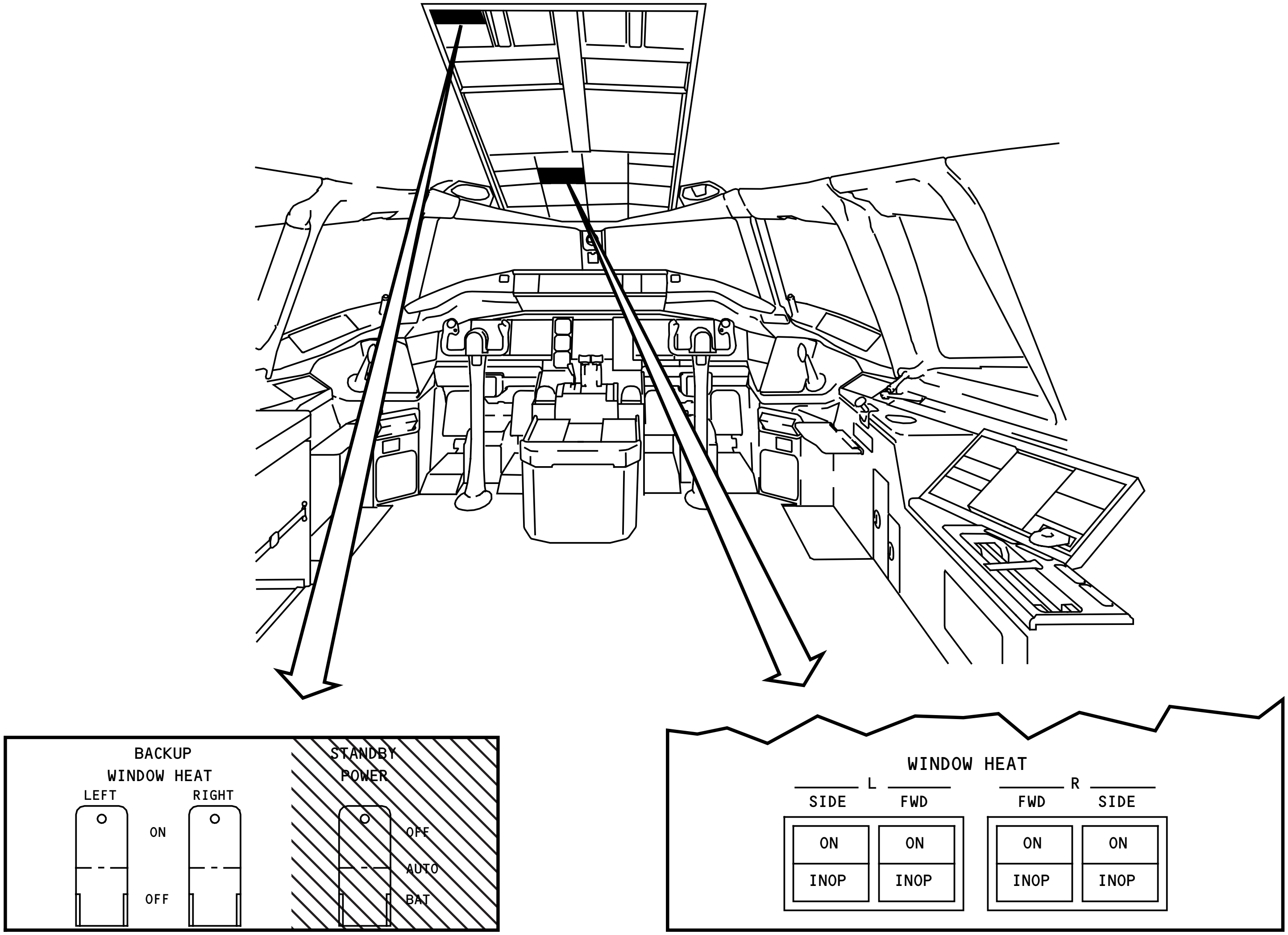
Window Heat Switches

There are four window heat switches, two for the windows on the left side of the flight compartment, and two for the windows on the right side of the flight compartment.

The left and right forward window heat switches enable the heater circuits in the left and right number 1 windows. The left and right side window heat switches enable the heater circuits for the left and right number 2 and 3 windows.

Backup Window Heat Switches

There are two backup window heat switches, one for each of the left and right number 1 windows. The switches are normally in the ON position. The switches have guards. You move the backup window heat switch to the OFF position to remove power from the backup window heat system.



BACKUP WINDOW HEAT/STANDBY POWER PANEL (P61)

WINDOW HEAT/EMERGENCY LIGHTS PANEL (P5)

FLIGHT DECK WINDOW ANTI-ICE SYSTEM - OPERATION

30-41-00-005 Rev 3 08/08/96

FLIGHT DECK WINDOW ANTI-ICE SYSTEM - SYSTEM TESTS

General

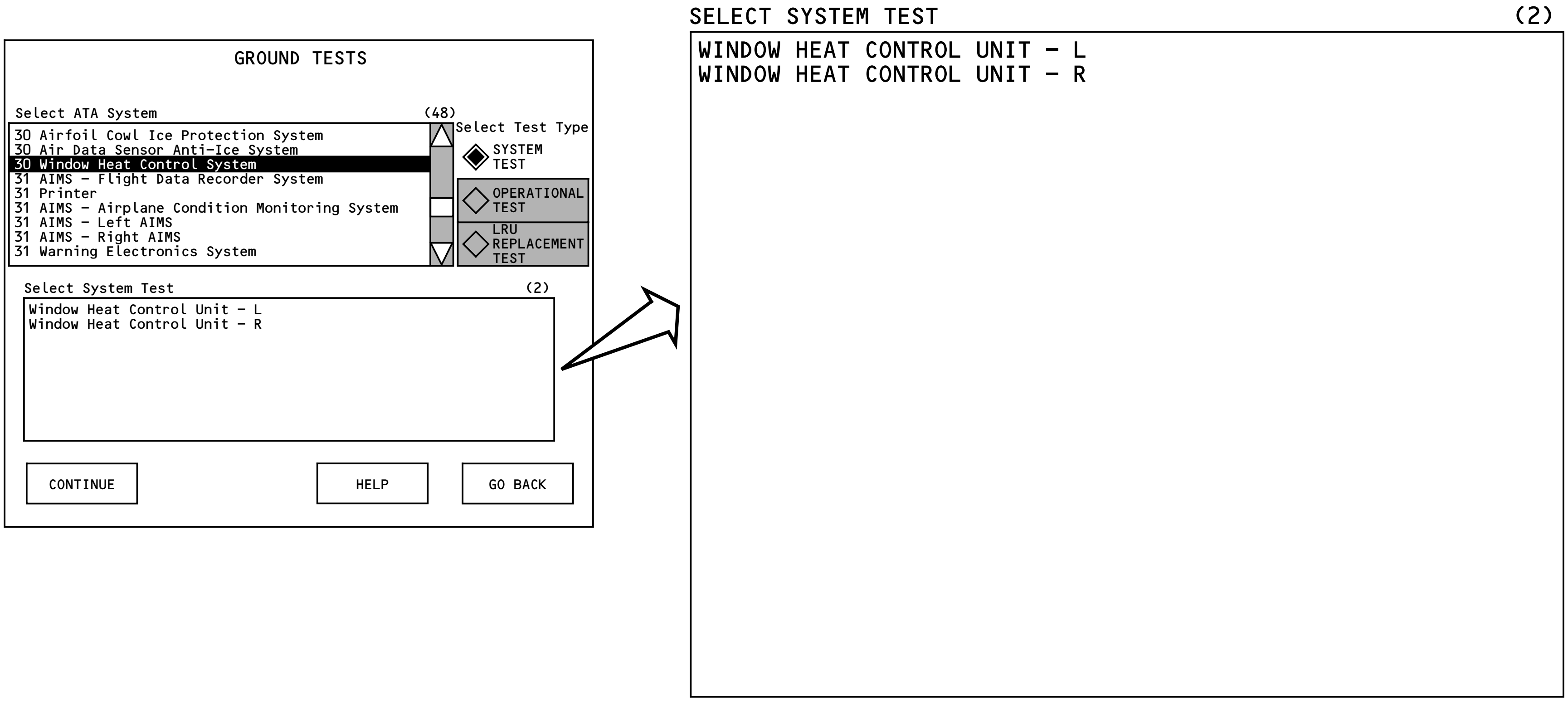
These are the flight deck window anti-ice system tests that show when you select ATA 30 Window Heat Control System:

- Window heat control unit - L
- Window heat control unit - R.

Left and Right Window Heat Control Unit

These tests make sure that the related window heat control unit operates correctly.

During the test, the window heat control unit applies power to the related flight deck window. The tests each take approximately 1-2 minutes.



30-41-00-006 Rev 0 08/17/96

FLIGHT DECK WINDOW ANTI-ICE SYSTEM - SYSTEM TESTS

WINDSHIELD WIPER SYSTEM - INTRODUCTION

Purpose

The windshield wiper system removes water from the left and right number one flight deck windows.

Windshield Wipers

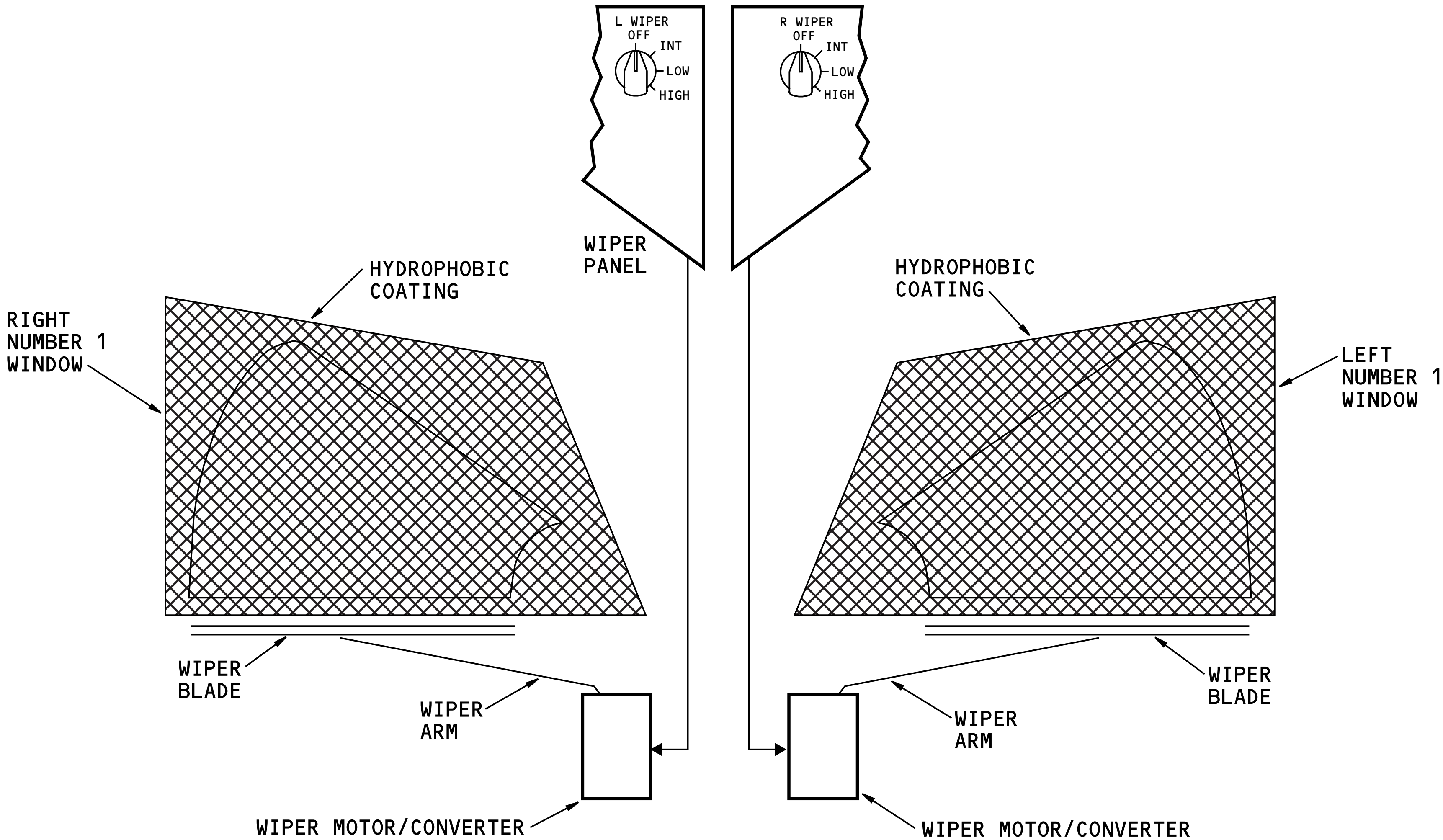
There are two windshield wipers, one for each of the number one windows. Each windshield wiper assembly has these components:

- Wiper
- Wiper arm
- Wiper motor/converter.

There is a switch on the P5 overhead panel for each wiper.

Hydrophobic Coating

A hydrophobic coating on each forward window repels rain. The windshield does not have a liquid rain repellent system because there is a hydrophobic coating.



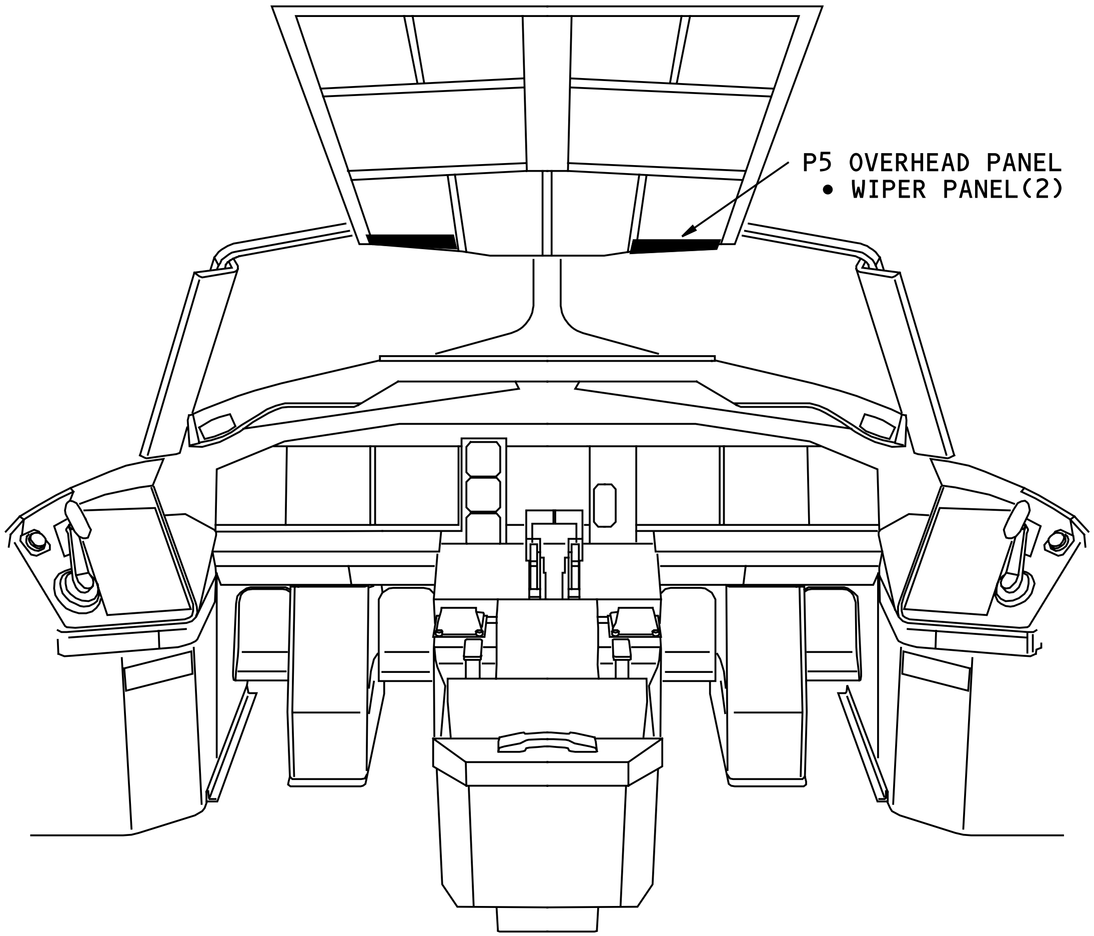
30-42-00-001 Rev 1 08/08/96

WINDSHIELD WIPER SYSTEM - INTRODUCTION

WINDSHIELD WIPER SYSTEM - COMPONENT LOCATIONS - 1

Wiper Panel

The left and right wiper panels are on the P5 overhead panel.



30-42-00-002 Rev 0

WINDSHIELD WIPER SYSTEM - COMPONENT LOCATIONS - 1

WINDSHIELD WIPER SYSTEM - COMPONENT LOCATIONS - 2

Wipers

The windshield wipers are on the forward nose of the fuselage below the number 1 left and right windows.

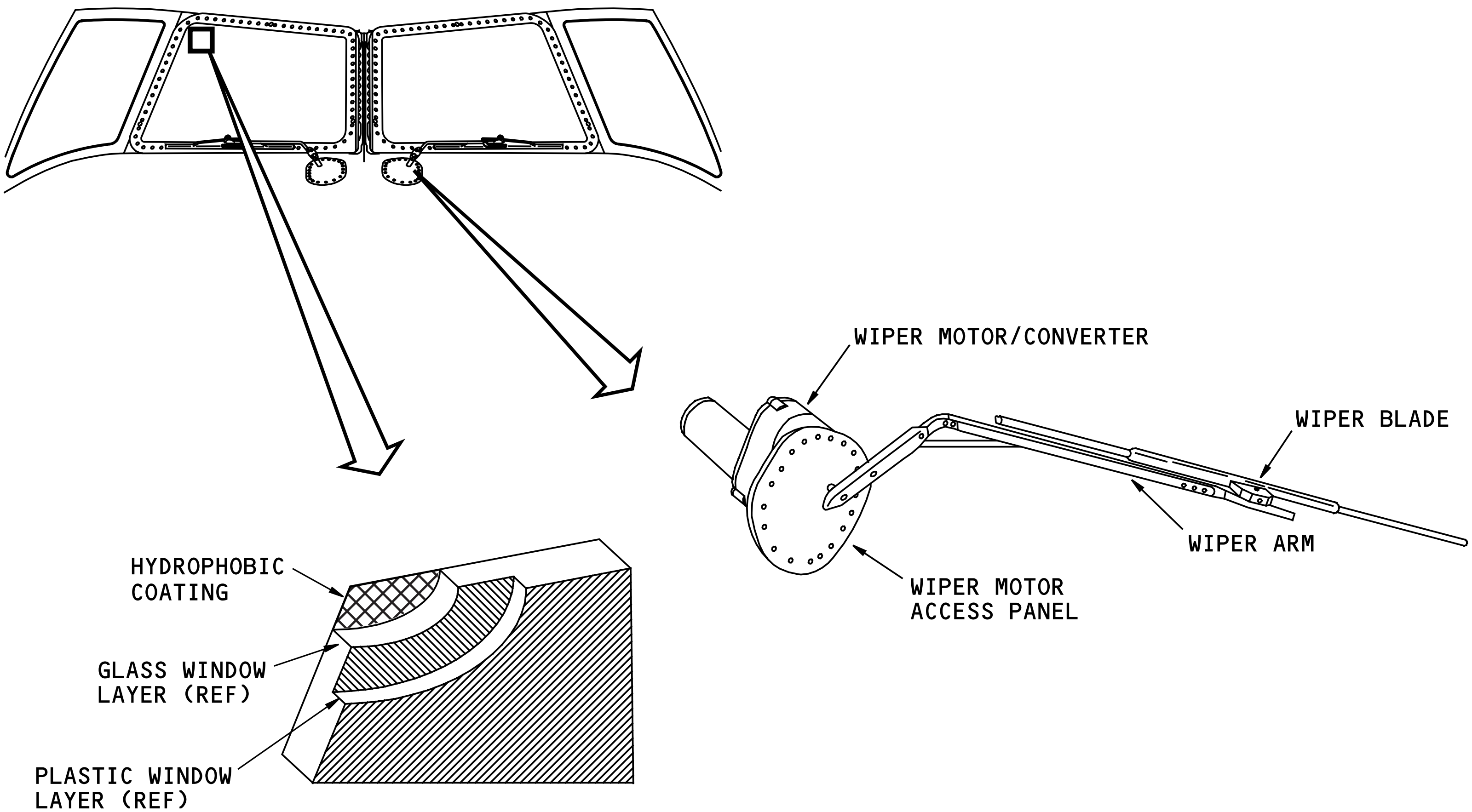
The windshield wipers have these components:

- Wipers
- Arm
- Motor.

Access to the motor is from outside the airplane.

Hydrophobic Coating

The windshield hydrophobic coating is on the external surface of the left and right number one flight deck windows.



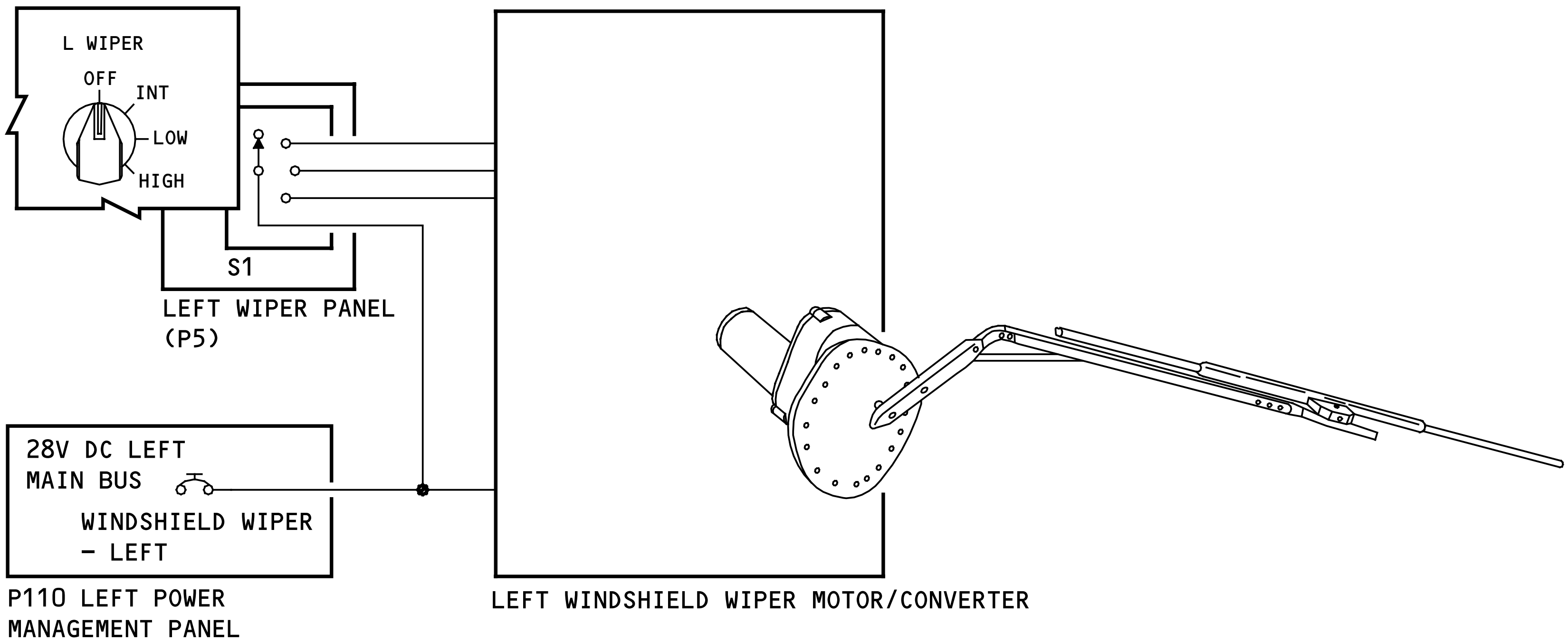
30-42-00-003 Rev 0

WINDSHIELD WIPER SYSTEM - COMPONENT LOCATIONS - 2

WINDSHIELD WIPER SYSTEM - FUNCTIONAL DESCRIPTION

Functional Description

The windshield wipers are similar. The wiper selector supplies continuity between the power supply and the terminal pins on the wiper motor/converter.



30-42-00-004 Rev 0

WINDSHIELD WIPER SYSTEM - FUNCTIONAL DESCRIPTION

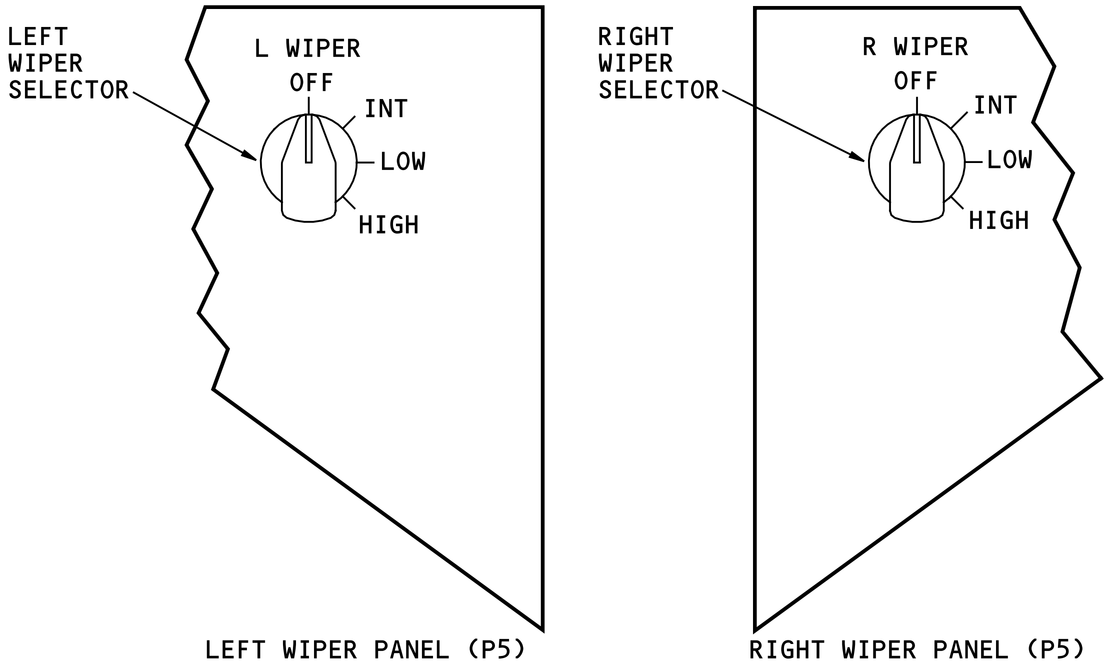
WINDSHIELD WIPER SYSTEM - OPERATION

Wiper Selectors

The wiper selectors are on the wiper panel (P5).

Each selector has these positions:

- OFF
- INT
- LOW
- HIGH.



30-42-00-005 Rev 1 08/08/96

WINDSHIELD WIPER SYSTEM - OPERATION

DRAIN AND WATER SUPPLY LINE HEATING - INTRODUCTION

Purpose

Electric heaters prevent ice in the water and waste systems.

General Description

These heaters are in the potable water system:

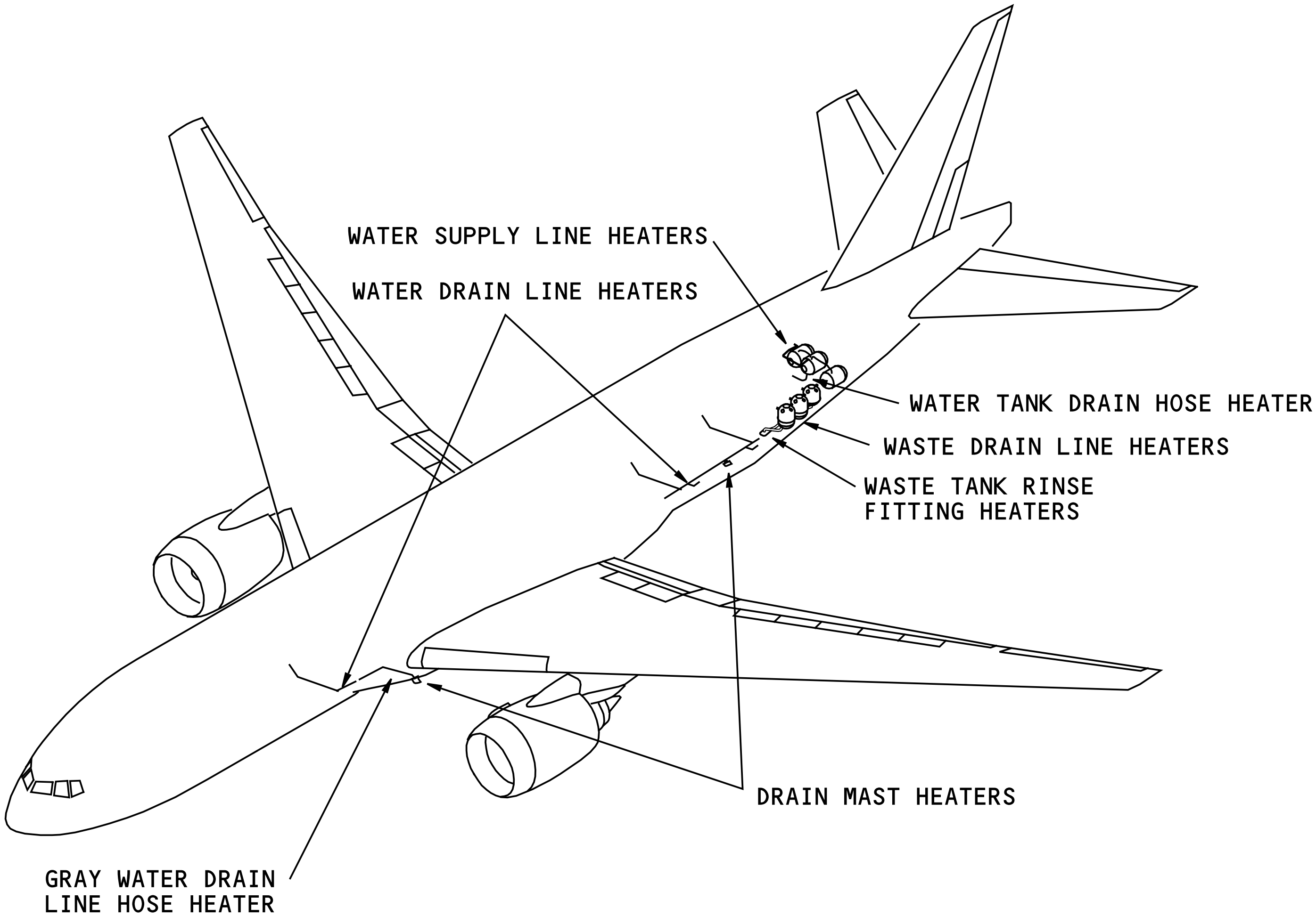
- Water supply line heaters
- Water tank drain hose heater.

These heaters are in the waste system:

- Waste drain line heaters
- Waste tank rinse fitting heaters.

These heaters are in the gray water drain system:

- Drain mast heaters
- Gray water drain line hose heater
- Water drain line heaters.



30-71-00-001 Rev 2 05/06/1997

DRAIN AND WATER SUPPLY LINE HEATING - INTRODUCTION

DRAIN AND WATER SUPPLY LINE HEATING - WATER SUPPLY IN-LINE HEATER - INTRODUCTION

General

Water lines carry water from the potable water tanks to the lavatories and galleys.

Each water line has a water supply in-line heater, controller and thermostat.

Some heaters have remote thermostats. The heaters and the remote thermostats are LRUs. Each LRU has an electrical connector.

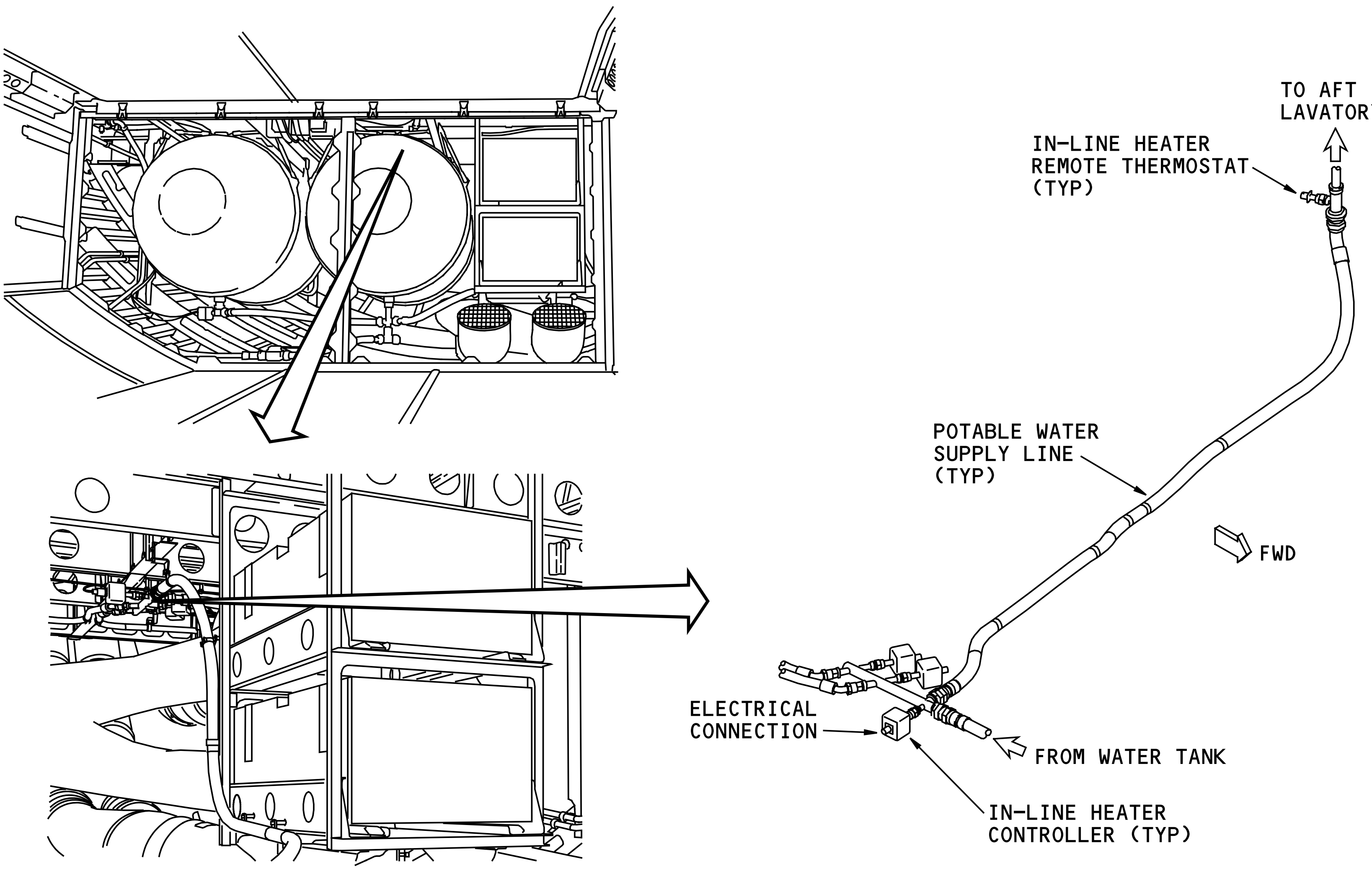
Two heaters have integral thermostats in the controllers. These thermostats are not separate LRUs.

Location

The water supply in-line heaters are near the potable water tanks. Access to the heaters is through the end wall of the bulk cargo compartment.

Training Information Point

It is not necessary to splice the wires when you replace an LRU.



BULK CARGO COMPARTMENT
(LOOKING AFT WITH END WALL REMOVED
AND POTABLE WATER TANK REMOVED)

30-71-00-002 Rev 2 12/11/1996

DRAIN AND WATER SUPPLY LINE HEATING - WATER SUPPLY IN-LINE HEATER - INTRODUCTION

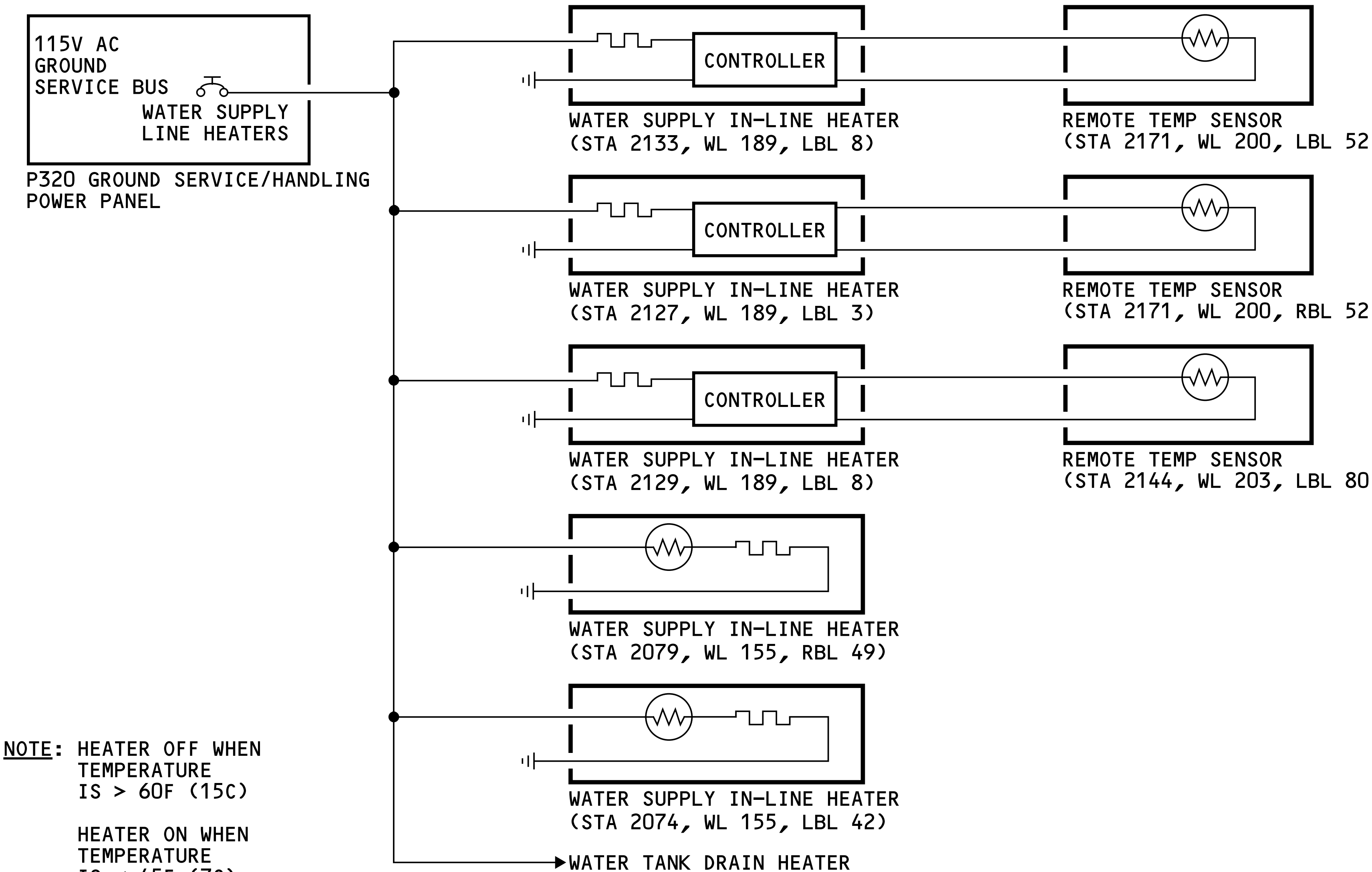
DRAIN AND WATER SUPPLY LINE HEATING - WATER SUPPLY IN-LINE HEATER - FUNC. DESC.

General

The heaters in the distribution lines have remote thermostats. The heaters below the left and right potable water tanks have integral thermostats in the controllers. The heaters operate the same.

Functional Description

The thermostat supplies electrical continuity as temperature decreases below freezing. As temperature increases, the thermostat stops continuity to prevent too much heat. The thermostat stops continuity when the temperature is greater than 60F (15C). Continuity comes back when the temperature is less than 45F (7C).



30-71-00-003 Rev 2 02/20/95

NOTE: HEATER OFF WHEN TEMPERATURE IS > 60F (15C)

HEATER ON WHEN TEMPERATURE IS < 45F (7C)

DRAIN AND WATER SUPPLY LINE HEATING - WATER SUPPLY IN-LINE HEATER - FUNC. DESC.

DRAIN AND WATER SUPPLY LINE HEATING - WATER TANK DRAIN HEATER

General

The drain line for the potable water tanks has an integral water tank drain heater. The heater prevents freezing in the line. This heated hose is an LRU.

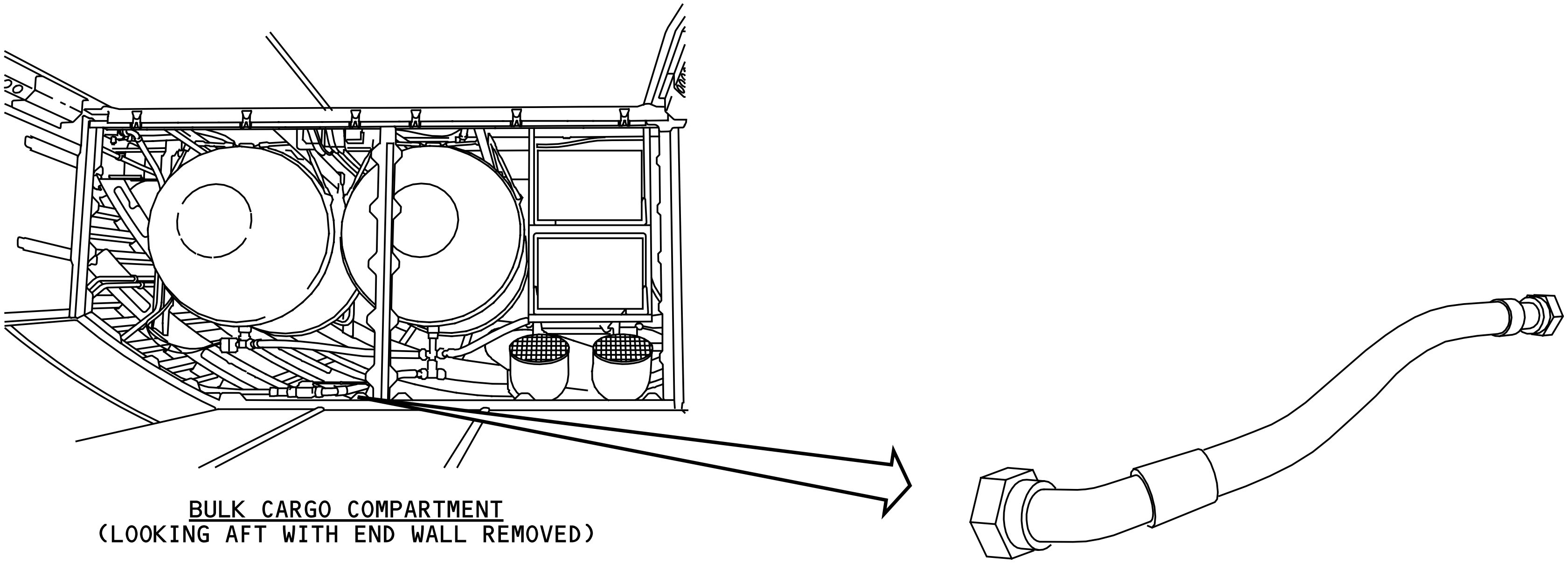
The heater wires on the heated hose do not have electrical connectors. You must splice the wires when you replace a drain hose.

Location

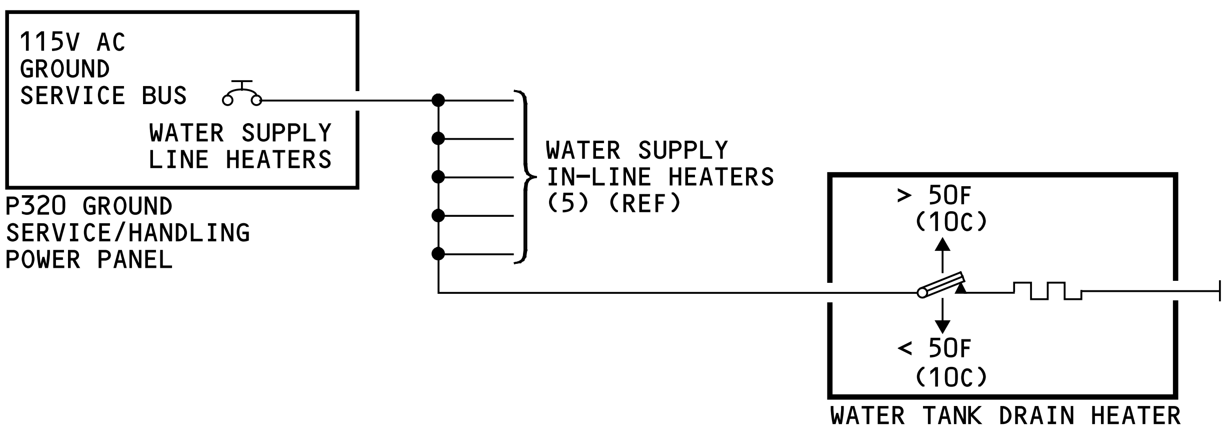
The heated hose is below the space between the right and center potable water tanks. Removable panels provide access to the hose through the aft cargo compartment.

Functional Description

The heated hose has an integral thermostat. The thermostat supplies electrical continuity as temperature decreases below the freeze point. As temperature increases, the thermostat opens the circuit to prevent too much heat. The thermostat opens the circuit when the temperature is greater than 50F (10C). The thermostat closes the circuit when the temperature is less than 50F (10C).



BULK CARGO COMPARTMENT
(LOOKING AFT WITH END WALL REMOVED)



DRAIN AND WATER SUPPLY LINE HEATING - WATER TANK DRAIN HEATER

DRAIN AND WATER SUPPLY LINE HEATING - GRAY WATER DRAIN LINE HEATER AND THERMOSTAT

General

The forward drain mast has a heated hose identified as the gray water drain line hose heater.

The heated hose has a remote thermostat identified as the gray water drain line hose heater thermostat.

Each component, the hose and the thermostat, is an LRU. The wires do not have electrical connectors. To replace a component you must splice the wires together.

The aft drain mast does not have a heated hose.

Location

The heated hose and its thermostat are in the forward left wing-to-body fairing.

An access panel aft of the drain mast supplies access to the thermostat.

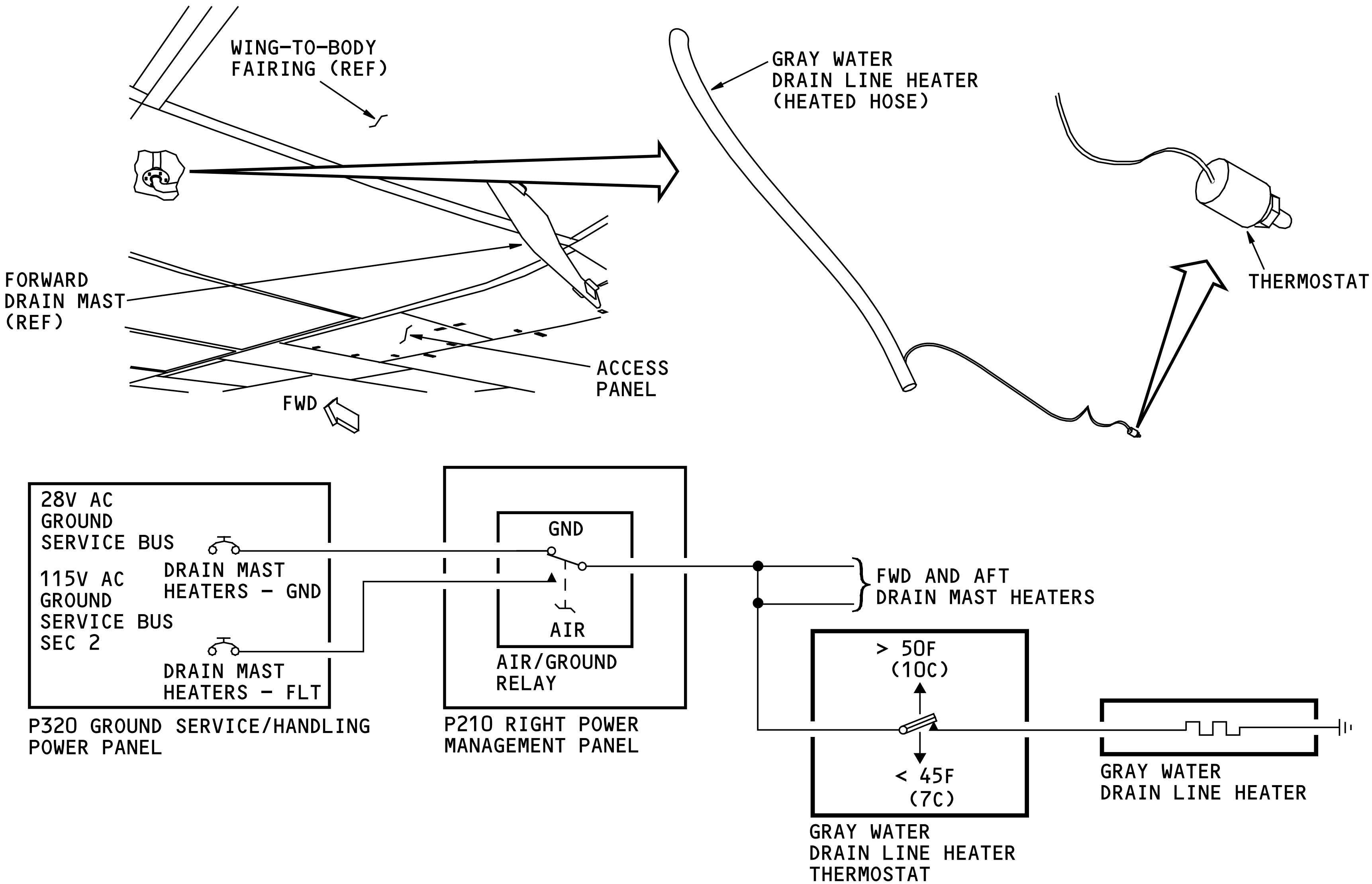
Functional Description

Power for the drain mast heaters comes through an air/ground relay. The heaters get 28v ac on the ground and 115V ac in the air.

The thermostat opens the circuit when the temperature is more than 50F (10C). The circuit closes when the temperature is less than 45F (7C).

Training Information Point

You can remove the drain mast to get better access to the heated hose.



30-71-00-005 Rev 3 04/29/96

DRAIN AND WATER SUPPLY LINE HEATING - GRAY WATER DRAIN LINE HEATER AND THERMOSTAT

DRAIN AND WATER SUPPLY LINE HEATING - DRAIN MAST HEATER

General

There are drain mast heaters in the forward and aft drain masts to prevent freezing. Each drain mast is an LRU and is interchangeable with the other.

The heater wires on the drain masts do not have electrical connectors. You must splice the wires when you replace a drain mast.

Location

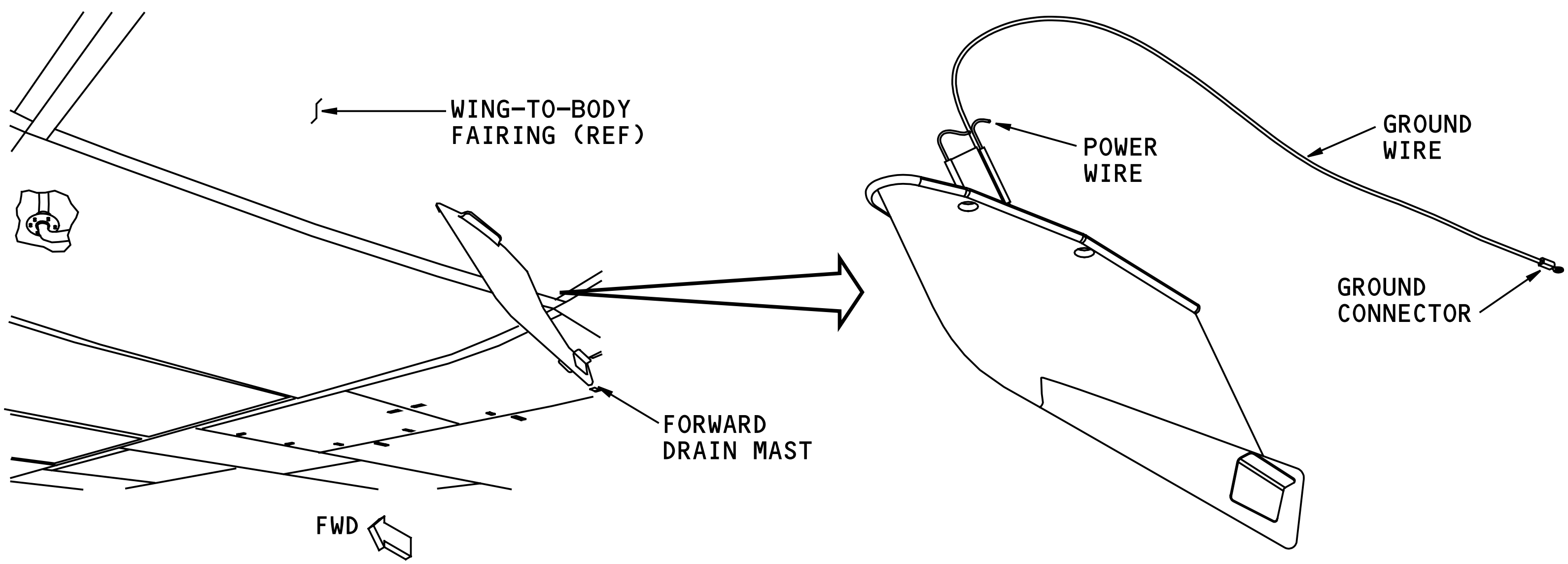
Both drain masts are on the left wing-to-body fairing.

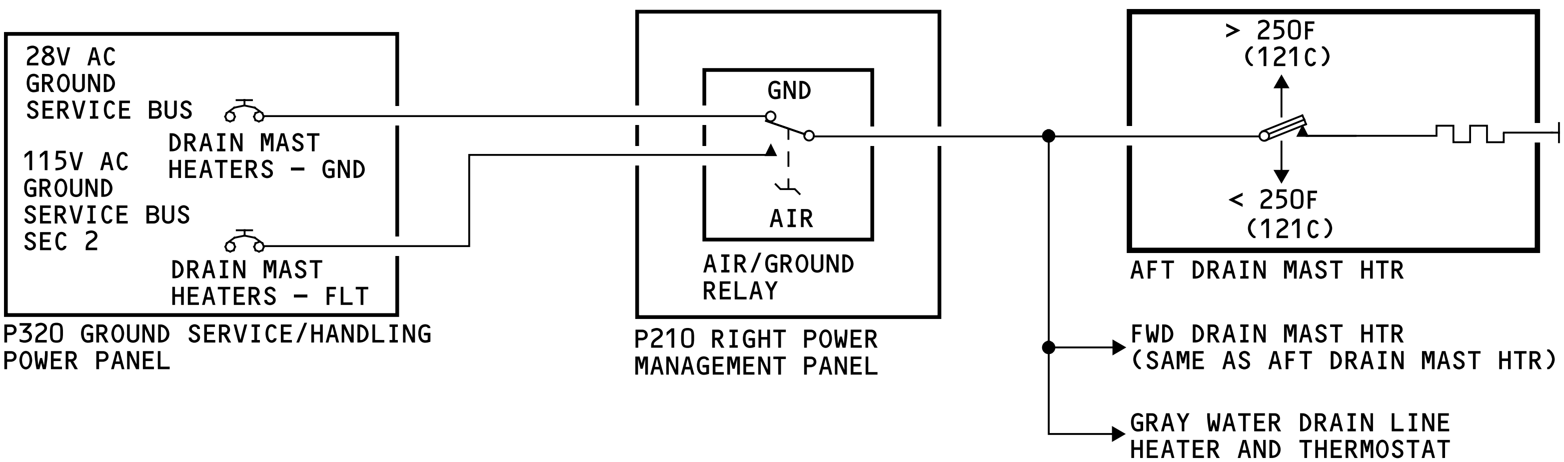
You can remove the drain mast from the fairing. It is not necessary to open a panel to get access to the drain mast.

Functional Description

Power for the drain mast heaters comes through an air/ground relay. The heaters get 28v ac on the ground and 115v ac in the air.

An overheat thermostat will opens the circuit when the temperature is greater than 250F (121C). The circuit closes when the temperature is less than 250F (121C).





DRAIN AND WATER SUPPLY LINE HEATING - DRAIN MAST HEATER

30-71-00-006 Rev 3 04/29/96

DRAIN AND WATER SUPPLY LINE HEATING - WATER DRAIN LINE HEATERS - INTRODUCTION

Purpose

Water drain line heaters keep the gray water drain lines in the lower part of the fuselage from freezing.

General Description

The heater is a flexible element installed around the drain line. The heater also includes an overheat switch (not shown). Electrical connectors attach to the heater and to ground studs. Metal clamps attach the ground studs to the drain line. (Some assemblies have only one connector and ground stud.)

Thermal insulation (held in place with tape) covers the drain line and heating element. Adhesive markers identify the flow direction and part number. On some drain lines, a clamp holds a thermostat.

Location

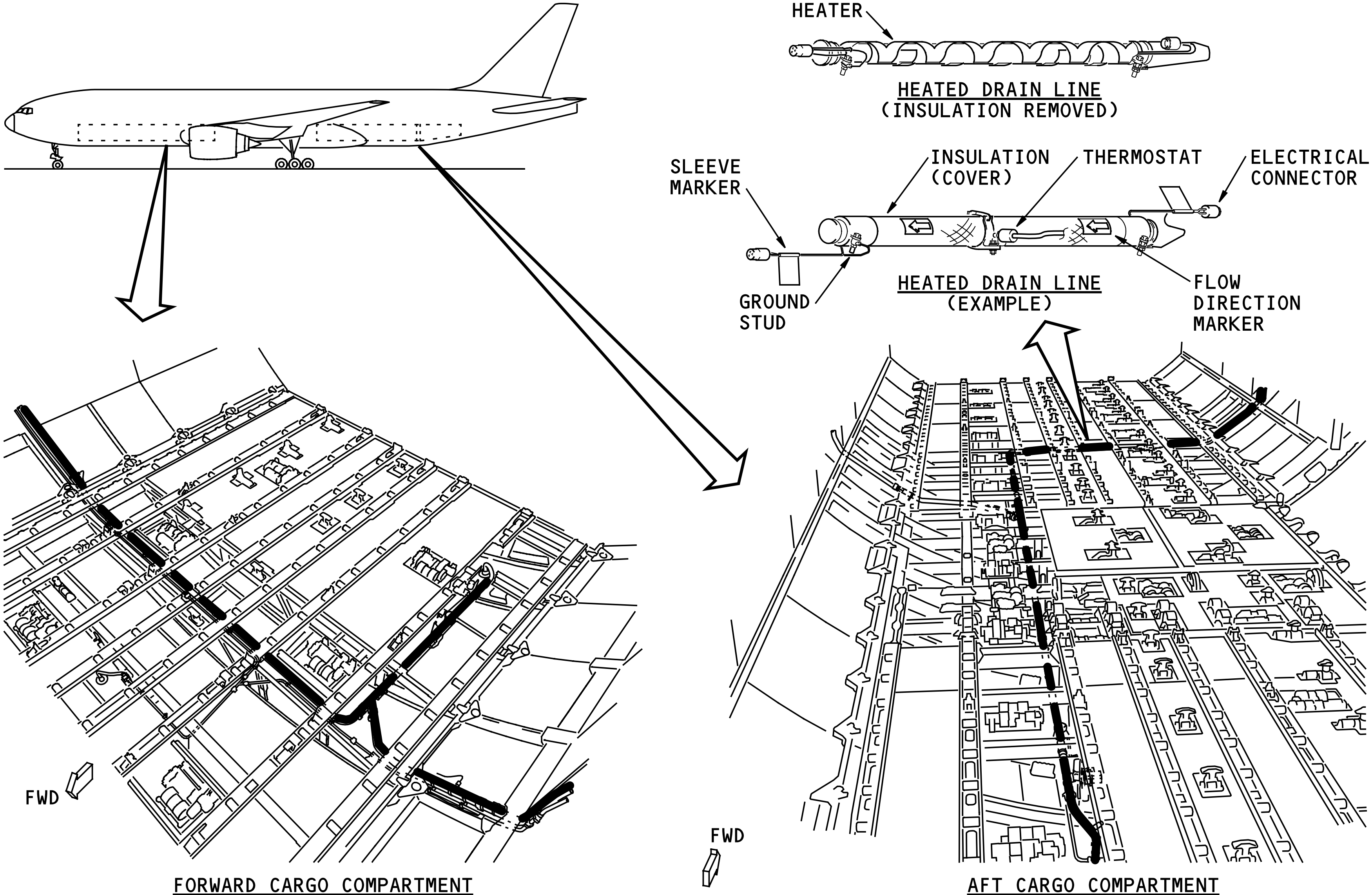
The heated gray water drain lines are below the floor panels and walkways of the forward, aft, and bulk cargo compartments.

Training Information Point

The heater is an LRU. In some places it is easier to replace the heater if you remove the drain line from the airplane. If you do this, you must do a leak check when you install the drain line.

When you replace a heater, you need to do an operational test. Cool the thermostat with crushed ice or freeze spray and use a clamp-on ammeter to measure current through the heater.

CAUTION: MAKE SURE YOU PUT THE CORRECT HEATER ASSEMBLY ON THE TUBE ASSEMBLY. IF THE HEATER ASSEMBLY IS INCORRECT, IT WILL CAUSE THE DRAIN LINES TO FREEZE OR BECOME TOO HOT.



DRAIN AND WATER SUPPLY LINE HEATING - WATER DRAIN LINE HEATERS - INTRODUCTION

DRAIN AND WATER SUPPLY LINE HEATING - WATER DRAIN LINE HEATERS - FUNCTIONAL DESCRIPTION

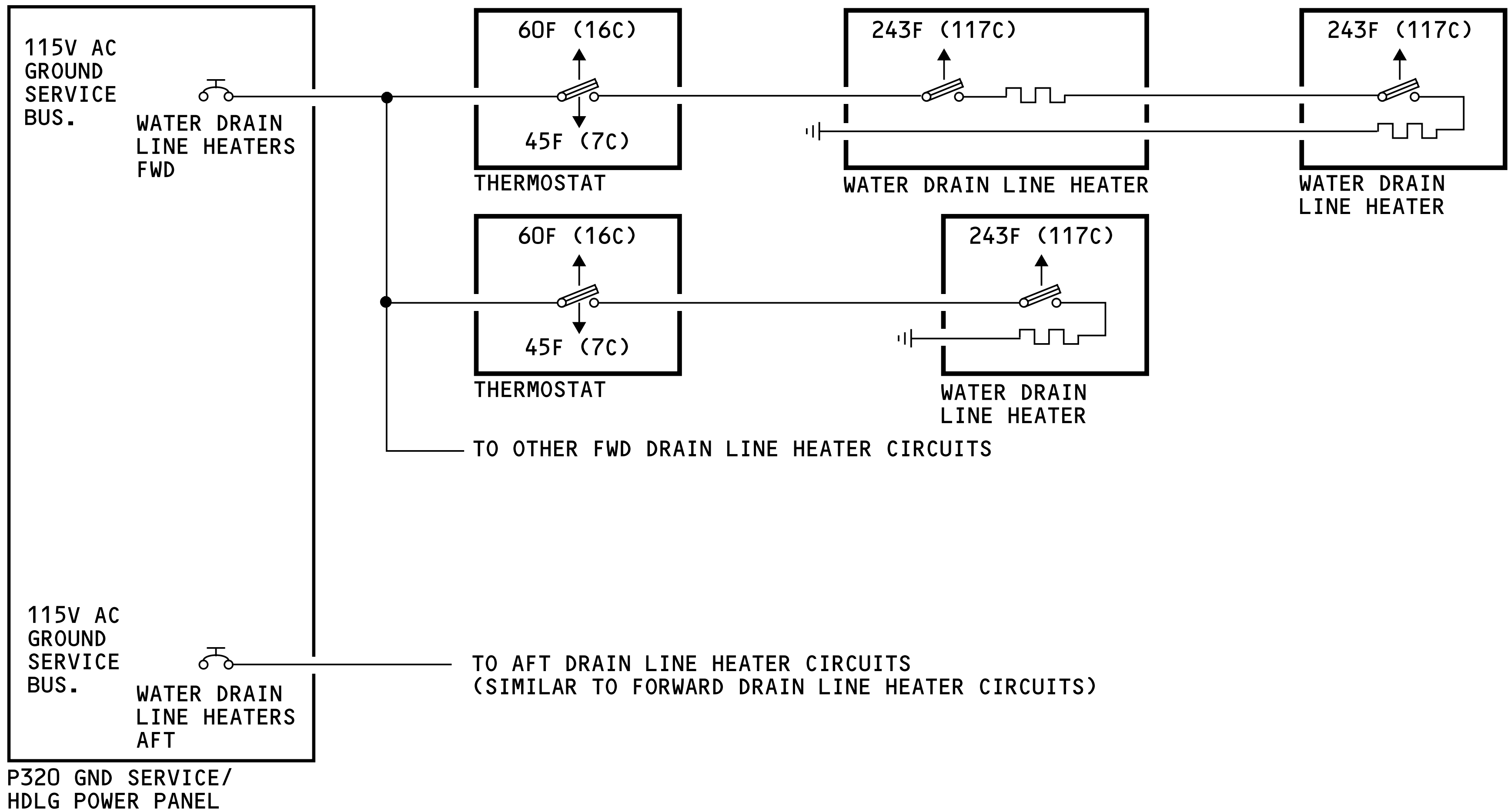
General

The ground service bus supplies 115v ac power to the water drain line heater circuits. There is one circuit breaker for the forward drain line heaters and one circuit breaker for the aft drain line heaters. The forward drain lines connect to the forward drain mast and the aft drain lines connect to the aft drain mast.

Functional Description

A thermostat (bi-metallic switch) opens the heater circuit when the temperature at the thermostat is 60F (16C) or more. When the temperature is 45F (7C) or less, the thermostat closes the heater circuit. In most circuits, the thermostat controls power to more than one heater.

An overheat switch in the heater opens if the temperature is 243F (117C) or more. The overheat switch does not reset. Most circuits have several heaters in series. If an overheat switch opens, it removes power from all the heaters in the series circuit.



30-71-00-011 Rev 0 05/06/1997

DRAIN AND WATER SUPPLY LINE HEATING - WATER DRAIN LINE HEATERS - FUNCTIONAL DESCRIPTION

DRAIN AND WATER SUPPLY LINE HEATING - WASTE TANK RINSE FITTING HEATERS

General

There are three waste tank rinse fittings. The rinse fittings connect the waste tank rinse lines to the waste drain service panel. Each rinse fitting has a heater boot identified as the waste tank rinse fitting heater. The rinse fitting heaters are interchangeable LRUs.

The waste tank rinse fitting heater has a power wire and a ground wire. The power wire does not have an electrical connector. You need to splice the power wire when you replace a rinse fitting heater.

The waste tank rinse fitting heater has an integral thermostat and an integral overheat thermostat.

Location

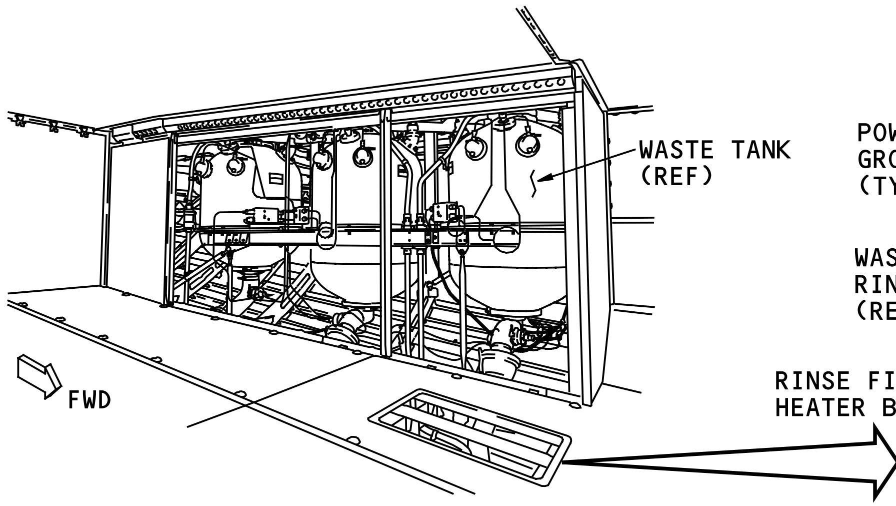
The waste tank rinse fitting heaters are below the bulk cargo compartment floor. You can access the heaters through an access panel on the floor of the bulk cargo compartment.

Functional Description

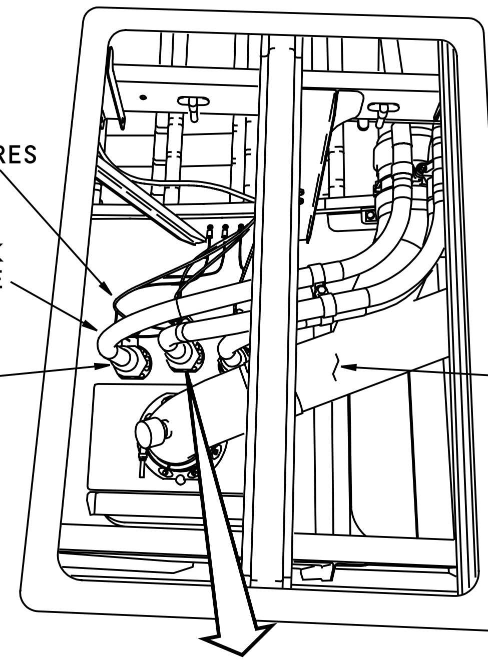
The integral thermostat controls the power for the waste tank rinse fitting heater. The thermostat closes the circuit as temperature decreases below the freeze temperature. The thermostat opens the circuit to prevent too much heat.

The integral overheat thermostat prevents damage to the heater if the integral thermostat fails.

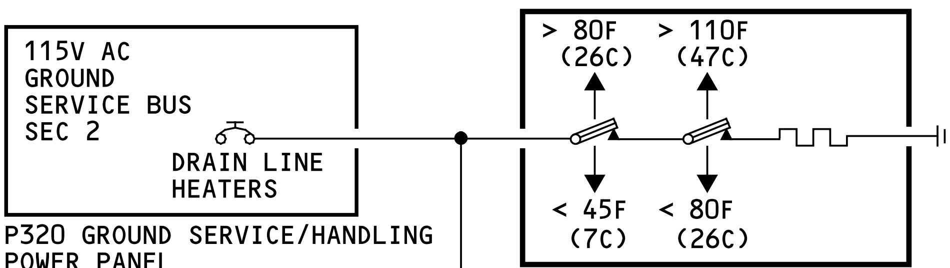
The integral thermostat opens the circuit when the temperature is greater than 80F (26C). The circuit closes when the temperature is less than 45F (7C). The integral overheat switch opens the circuit when the temperature is greater than 110F (47C). The circuit closes when the temperature is less than 80F (26C).

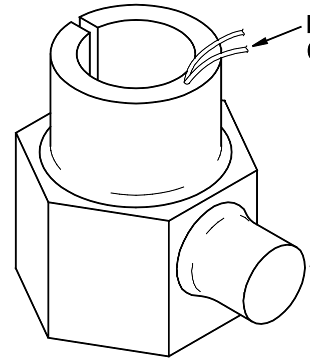


LEFT SIDE OF BULK CARGO COMPARTMENT
(LOOKING OUTBOARD AND AFT)



BULK CARGO COMPARTMENT FLOOR
(LOOKING DOWN)





DRAIN AND WATER SUPPLY LINE HEATING - WASTE TANK RINSE FITTING HEATERS

30-71-00-007 Rev 3 08/07/96

DRAIN AND WATER SUPPLY LINE HEATING - WASTE TANK DRAIN LINE HEATERS - INTRODUCTION

General

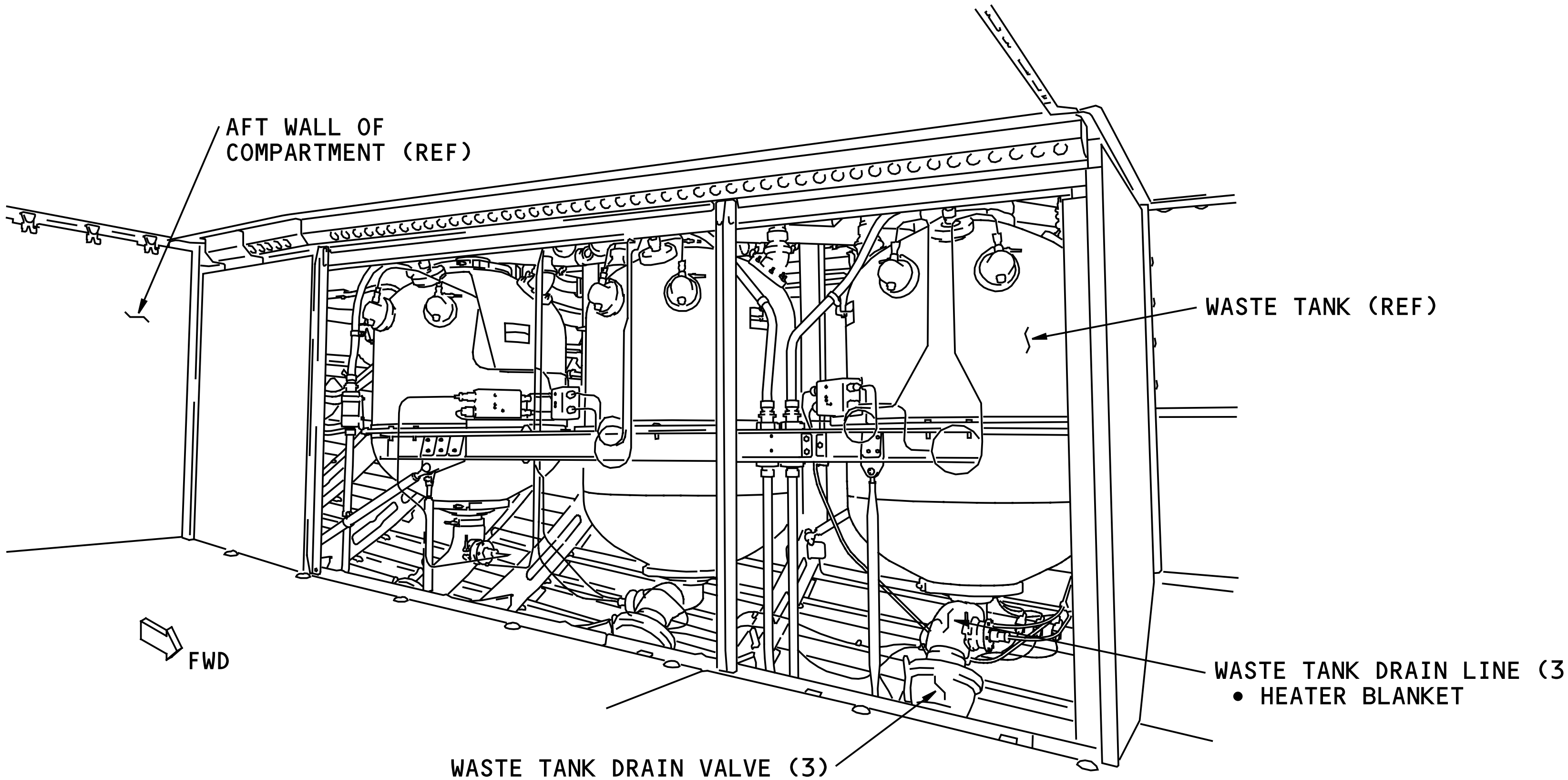
There are three waste tank drain lines. Each drain line has a valve. The lines and valves all have thermostatically-controlled heater blankets.

Each heater blanket has an integral thermostat and a overheat switch that can not be reset. Each heater is an LRU. Drain line blankets are not interchangeable. Valve blankets are interchangeable. Drain line blankets are not interchangeable with valve blankets.

The heater blankets have electrical connectors.

Location

The heater blankets are below the waste tanks. You can get access to them through the same panels that supply access to the waste tanks.



LEFT SIDE OF BULK CARGO COMPARTMENT
(LOOKING OUTBOARD AND AFT
WITH SIDE WALL REMOVED)

30-71-00-008 Rev 1 08/07/96

DRAIN AND WATER SUPPLY LINE HEATING - WASTE TANK DRAIN LINE HEATERS - INTRODUCTION

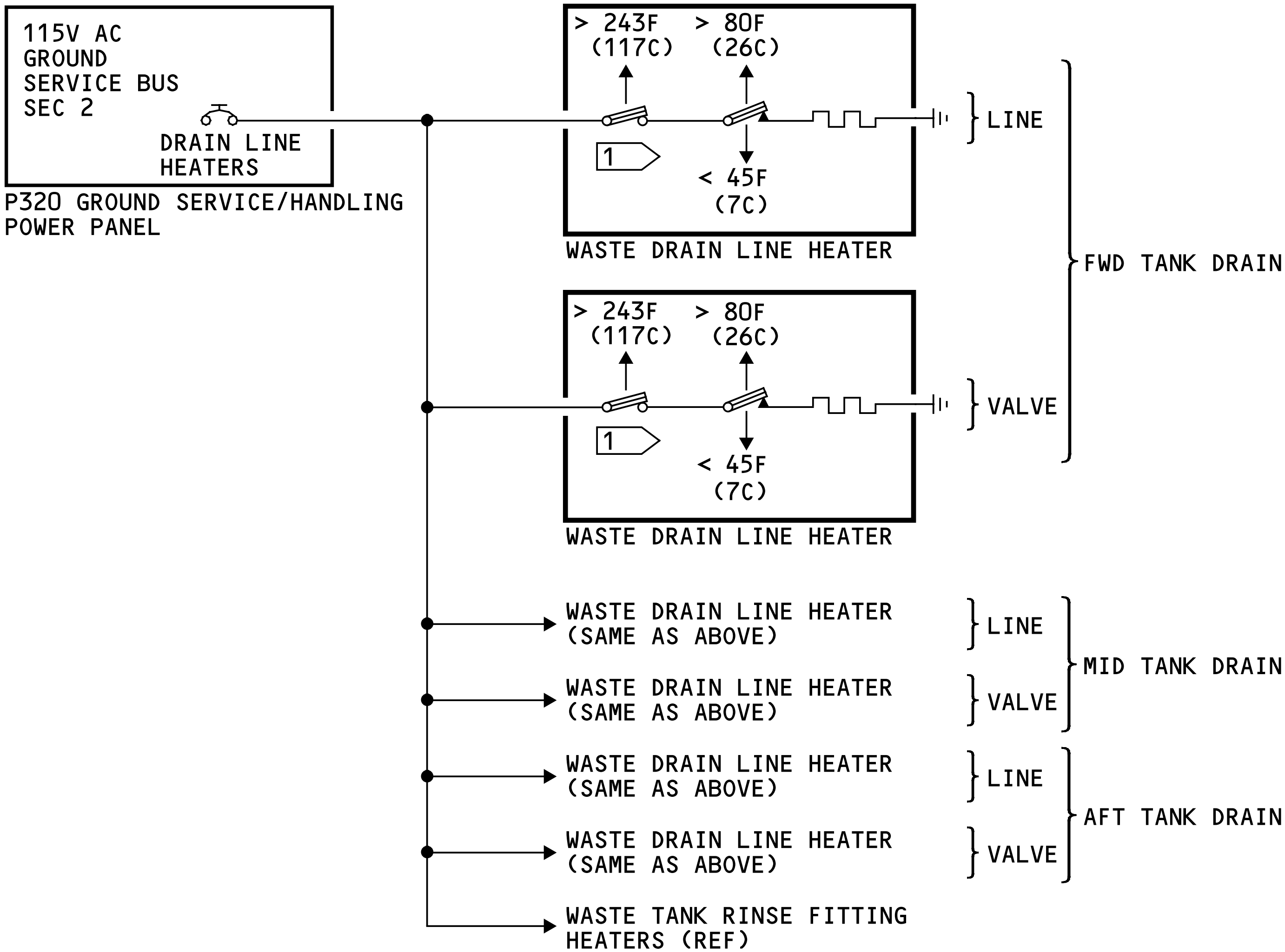
DRAIN AND WATER SUPPLY LINE HEATING - WASTE TANK DRAIN LINE HEATERS - FUNC. DESC.

General

The heater blankets on the waste tank drain lines operate the same as the heater blankets on the drain valves.

Functional Description

Each heater blanket has an integral thermostat and an overheat switch. The thermostat supplies electrical continuity as temperature decreases below freezing. As temperature increases, the thermostat opens the circuit to prevent too much heat. The thermostat opens the circuit when the temperature is greater than 80F (26C). The thermostat closes the circuit when the temperature is less than 45F (7C). The overheat switch opens the circuit when the temperature is greater than 243F (117C). If the overheat switch opens the circuit, the circuit will not automatically reset.



1 THE SWITCH DOES NOT RESET.

30-71-00-009 Rev 1 02/20/95

DRAIN AND WATER SUPPLY LINE HEATING - WASTE TANK DRAIN LINE HEATERS - FUNC. DESC.

Continental Airlines, Inc

Fire Protection

WB371

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Continental Airlines, Inc
Fire Protection
WB371

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FIRE PROTECTION - INTRODUCTION

Purpose

The fire protection systems monitor the airplane for these conditions:

- Fire
- Smoke
- Engine overheat
- Pneumatic duct leak.

The fire protection systems also include fire extinguishers.

Fire/Overheat Detection

The airplane has these fire/overheat detection systems:

- Engine fire detection
- Lavatory smoke detection
- Miscellaneous modules (flight crew rest) smoke detection
- APU fire detection
- Lower cargo compartment smoke detection
- Wheel well fire detection
- Duct leak and overheat detection
- Electrical and electronic (E/E) cooling smoke detection.

Extinguishing

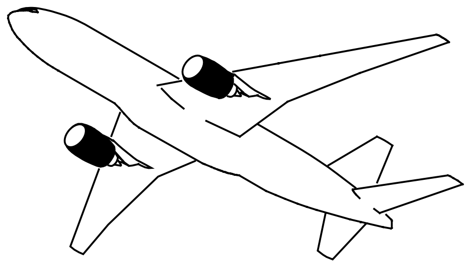
The airplane has these fire extinguishing systems:

- Engine fire extinguishing
- Lavatory waste compartment fire extinguishing
- APU fire extinguishing
- Lower cargo fire extinguishing
- Portable fire extinguishers.

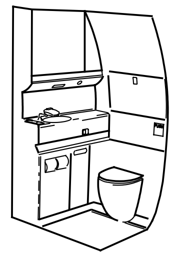
Abbreviations and Acronyms

ACIPS	- airfoil and cowl ice protection system
ACMF	- airplane conditioning monitoring function
ACMS	- airplane conditioning monitoring system
AGS	- air ground system
AIMS	- airplane information management system
APU	- auxiliary power unit
APUC	- auxiliary power unit controller
ARINC	- Aeronautical Radio, Inc.
ASCPC	- air supply and cabin pressure controller
ASG	- ARINC signal gateway
auto	- automatic
BIT	- built-in-test
BITE	- built-in-test-equipment
btl	- bottle
btls	- bottles
CACP	- cabin area control panel
cgo	- cargo
ch	- channel
CMCS	- central maintenance computing system
CSS	- cabin services system
CSCP	- cabin system control panel
disch	- discharge

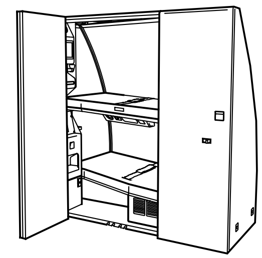
DLODS	- duct leak and overheat detection system
ECS	- environmental control system
EDP	- engine-driven pump
EEU	- ELMS electronic unit
EICAS	- engine indicating and crew alerting system
ELMS	- electrical load monitoring system
ENG	- engine
equip	- equipment
ext	- external
ext	- extinguishing
FCR	- flight crew rest
fwd	- forward
ind	- indicator
kg	- kilogram
LED	- light emitting diode
LRU	- line replaceable unit
MAT	- maintenance access terminal
MD&T	- master dim and test
MEC	- main equipment center
MFD	- multi-function display
MGMT	- management
OEU	- overhead electronics unit
OPAS	- overhead panel ARINC 629 system
ovht	- overheat
ovrd	- override
press	- pressure
PSEU	- proximity switch electronics unit
pwr	- power
rmt	- remote
stby	- standby
vlv	- valve
WEU	- warning electronic unit
WES	- warning electronic system
WOW	- weight-on-wheels



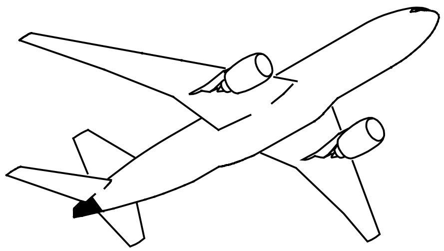
ENGINES
- FIRE DETECTION
- FIRE EXTINGUISHING



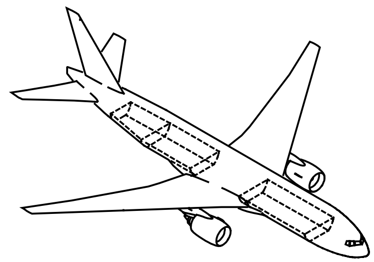
LAVATORIES
- SMOKE DETECTION
- FIRE EXTINGUISHING



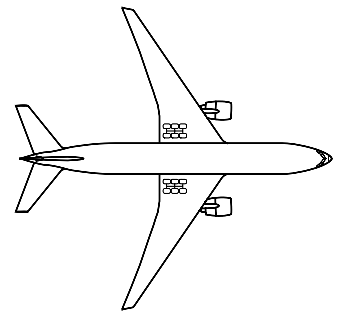
MISCELLANEOUS MODULES
- SMOKE DETECTION



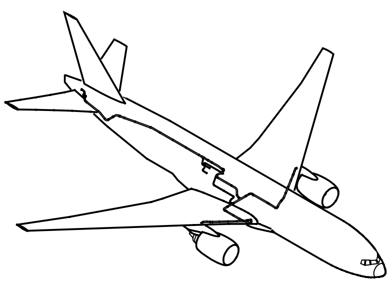
AUXILIARY POWER UNIT
- FIRE DETECTION
- FIRE EXTINGUISHING



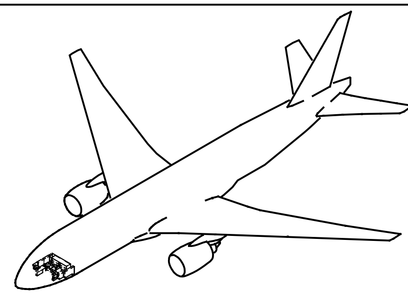
CARGO COMPARTMENTS
- SMOKE DETECTION
- FIRE EXTINGUISHING



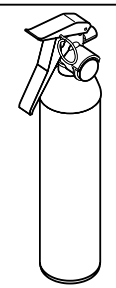
WHEEL WELL FIRE DETECTION



DUCT LEAK AND
OVERHEAT DETECTION



ELECTRICAL/ELECTRONIC (E/E)
COOLING SYSTEM SMOKE DETECTION



PORTABLE FIRE
EXTINGUISHERS

FIRE PROTECTION - INTRODUCTION

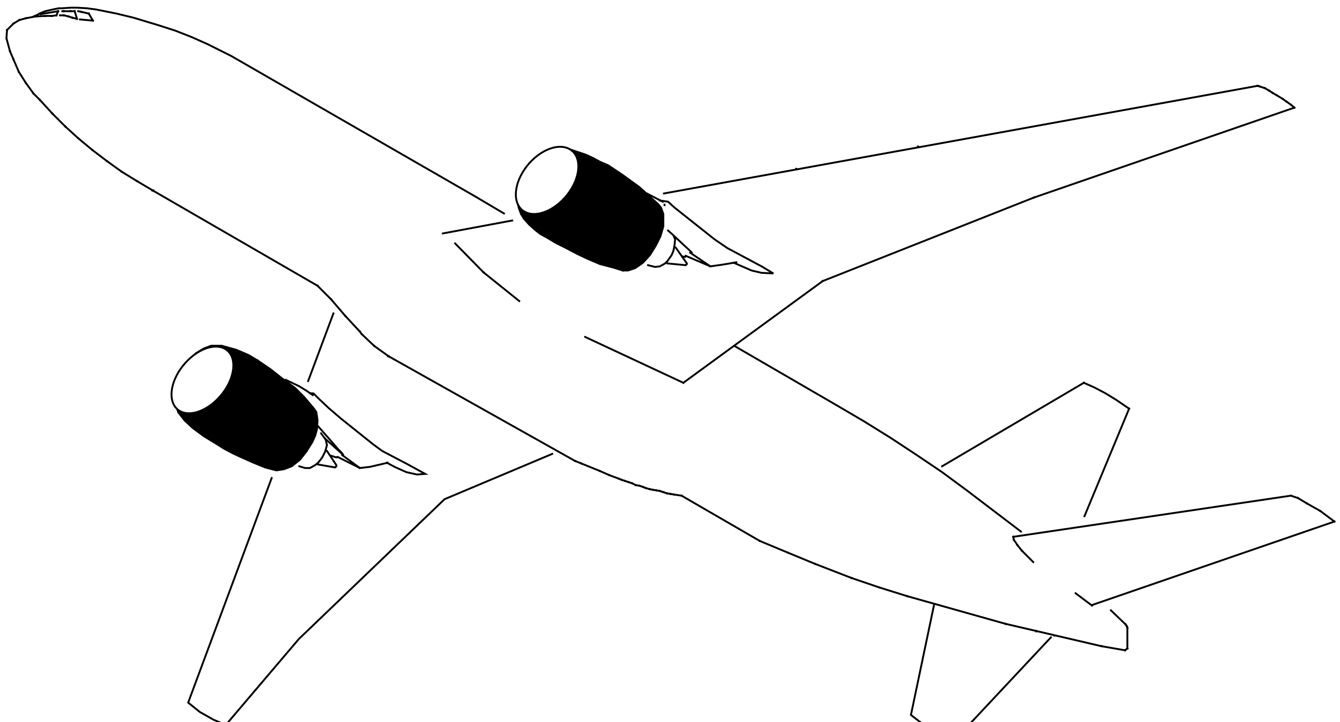
ENGINE FIRE DETECTION - INTRODUCTION

Purpose

The purpose of the engine fire detection system is to:

- Give warnings in the flight deck if there is a fire in an engine nacelle
- Give caution indications in the flight deck if an engine has an overheat condition
- Measure nacelle temperature for the airplane condition monitoring system (ACMS).

The system has built in test equipment. Failures cause EICAS messages, status messages, or maintenance messages.



ENGINE FIRE DETECTION - INTRODUCTION

ENGINE FIRE DETECTION - GENERAL DESCRIPTION

General

Each engine has two fire detection loops, loop 1 and loop 2. A fire detection card in the system card file monitors the loops for fires, overheat conditions, and faults. There is a fire detection card for each engine.

Overheat Detection

If the fire detection loops find an overheat condition, the fire detection card sends a signal to the AIMS and to the warning electronics unit. The AIMS shows a caution message and turns on the master caution light. The warning electronics unit turns on the caution aural.

When the overheat condition goes away, the indications go away.

Fire Detection

If an engine fire occurs, the fire detection card sends a signal to the AIMS and to the warning electronics unit. A warning message shows. The warning electronics unit turns on the master warning lights and the fire warning aural. Another fire alarm signal causes the fuel control switch fire warning light and the engine fire warning light to come on.

When the fire is extinguished, the indications go out of view.

Nacelle Temperature Recording

The fire detection card measures the average temperature of the loops. This data goes to the AIMS through the systems ARINC 629 buses. The airplane condition monitoring function records this data.

Continuous Fault Monitoring

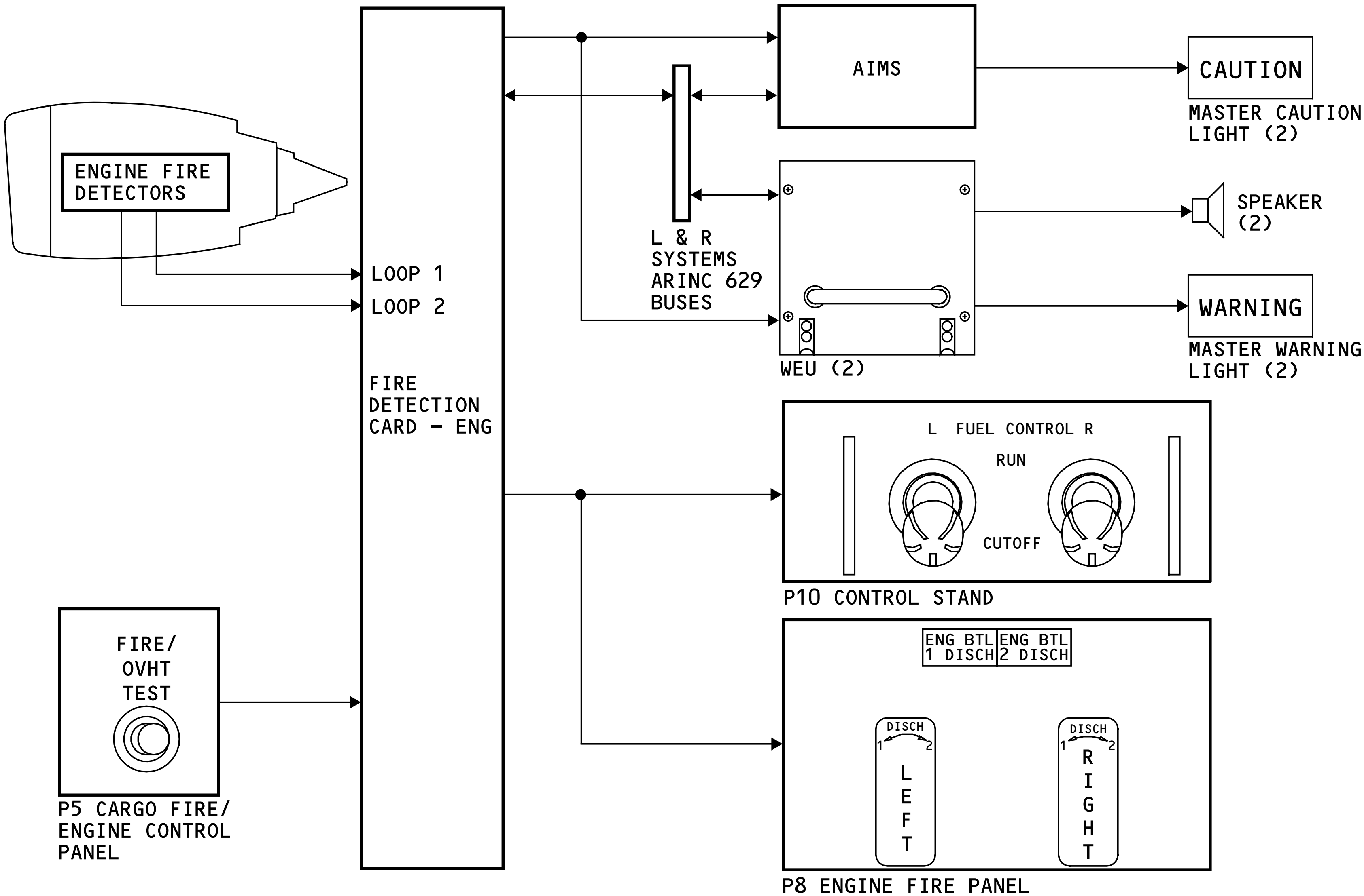
The fire detection card monitors the two loops and their wiring for defects. In normal (dual loop) operation, both loops must have a fire or overheat condition to cause the flight deck indications.

If a failure occurs in a loop, the fire detection card sends the data to the AIMS. A status message shows and the system changes to single loop operation. In this mode, fire/overheat indications occur when one loop is defective and the other has a fire or overheat condition.

System Tests

Use the FIRE/OVHT TEST switch on the P5 overhead panel to do a test of the system. Test results show on the primary display system.

The fire and overheat detection system has a built-in-test function which does tests of the loops, system logic, and interface electronics. System failures show on the primary display system and the MAT.



ENGINE FIRE DETECTION - GENERAL DESCRIPTION

26-11-00-002 Rev 3 11/30/1995

ENGINE FIRE DETECTION - FLIGHT DECK AND MEC COMPONENT LOCATIONS

Flight Deck Component Locations

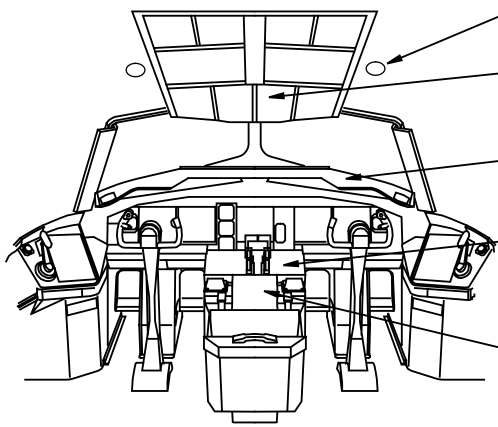
The components in the flight deck that have an interface with the engine fire detection system are:

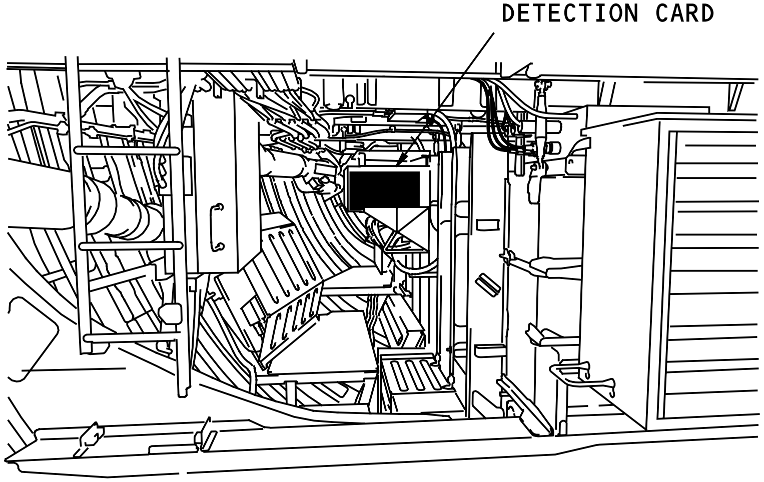
- Speakers
- Fire/overheat test switch
- Master warning/caution lights
- Fuel control switch fire warning lights
- Engine fire warning lights.

MEC Component Locations

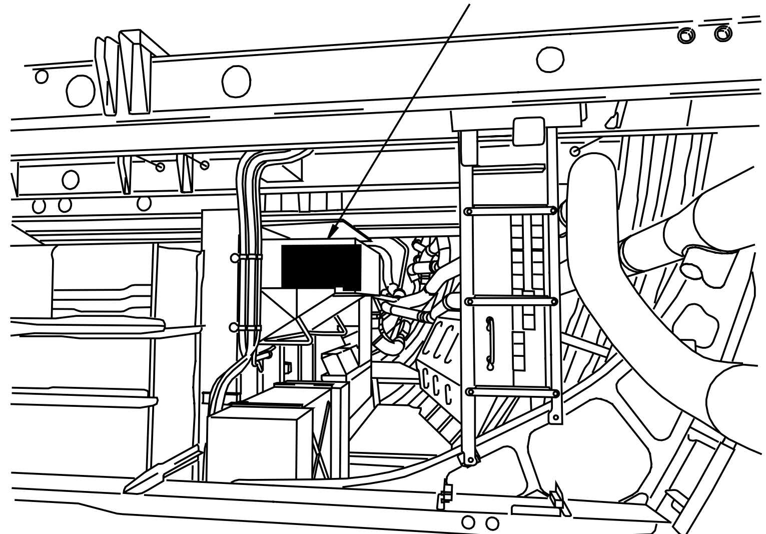
These are the engine fire detection system components in the main equipment center (MEC):

- Left engine fire detection card
- Right engine fire detection card.





MEC (LEFT SIDE, LOOKING FORWARD)



MEC (RIGHT SIDE, LOOKING FORWARD)

26-11-00-003 Rev 2

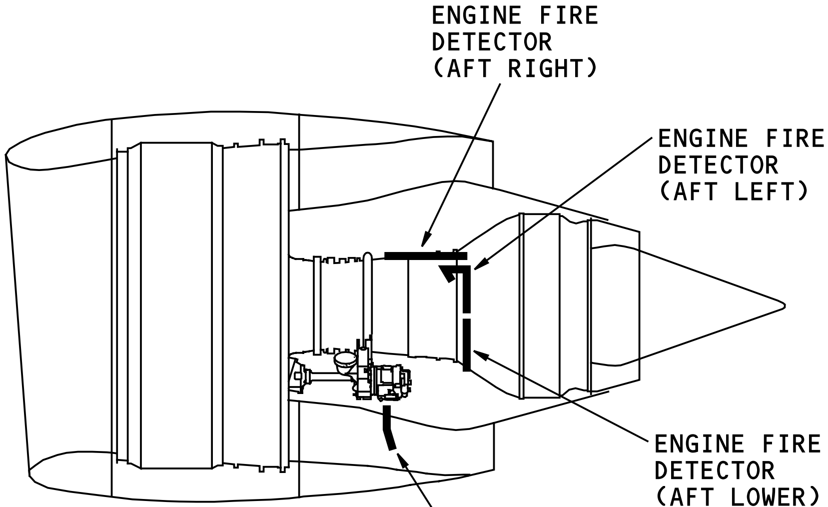
ENGINE FIRE DETECTION - FLIGHT DECK AND MEC COMPONENT LOCATIONS

ENGINE FIRE DETECTION - ENGINE COMPONENT LOCATIONS

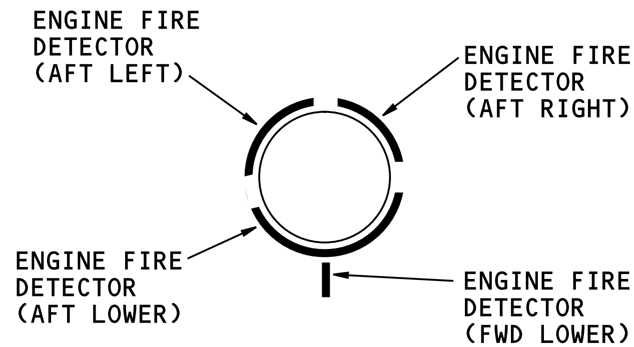
Component Locations

These are the engine fire detection system components on the engines:

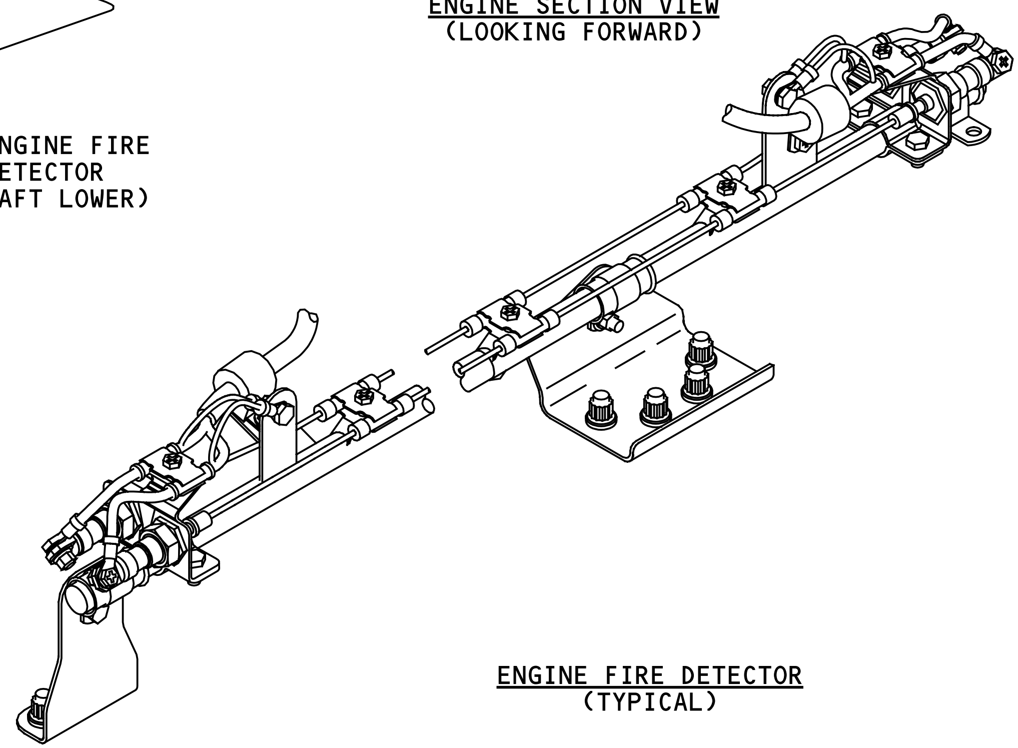
- Engine fire detector - aft right
- Engine fire detector - aft left
- Engine fire detector - aft lower
- Engine fire detector - forward lower.



ENGINE SIDE VIEW



ENGINE SECTION VIEW
(LOOKING FORWARD)



ENGINE FIRE DETECTOR
(TYPICAL)

26-11-00-004 Rev 3 03/09/95

ENGINE FIRE DETECTION - ENGINE COMPONENT LOCATIONS

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ENGINE FIRE DETECTION - ENGINE FIRE DETECTORS

Purpose

The engine fire detectors monitor the temperature in the engine nacelles.

Physical Description

Each detector has two elements that attach to a support tube. The elements connect to make loop 1 and loop 2.

The element is an inconel tube filled with a thermistor core material. Two electrical conductors go through the length of the core. One conductor has a ground connection to the tube. The other conductor connects to the fire detection card.

Functional Description

As the temperature of the core increases, electrical resistance to ground decreases. The fire detection card monitors this resistance. If the resistance decreases to the overheat set point, an overheat indication occurs in the flight deck. There is a 9.6 second time delay for the overheat indication. If the resistance decreases more to the fire set point, a fire warning occurs. When the fire or overheat condition is gone, the resistance increases to the reset point and the flight deck indications go away.

The tables show temperatures in degrees F (and degrees C) which cause overheat and fire indications. Reset temperatures are also shown.

DETECTOR	OVERHEAT TEMP	RESET TEMP
FWD LOWER	501 (261)	486 (252)
AFT LOWER	706 (374)	689 (365)
AFT LEFT	706 (374)	689 (365)
AFT RIGHT	706 (374)	689 (365)

DETECTOR	FIRE TEMP	RESET TEMP
FWD LOWER	610 (321)	595 (313)
AFT LOWER	826 (441)	810 (432)
AFT LEFT	826 (441)	810 (432)
AFT RIGHT	826 (441)	810 (432)

The rate of change of resistance identifies an electrical short or a fire. The resistance decreases more quickly with an electrical short than with a fire.

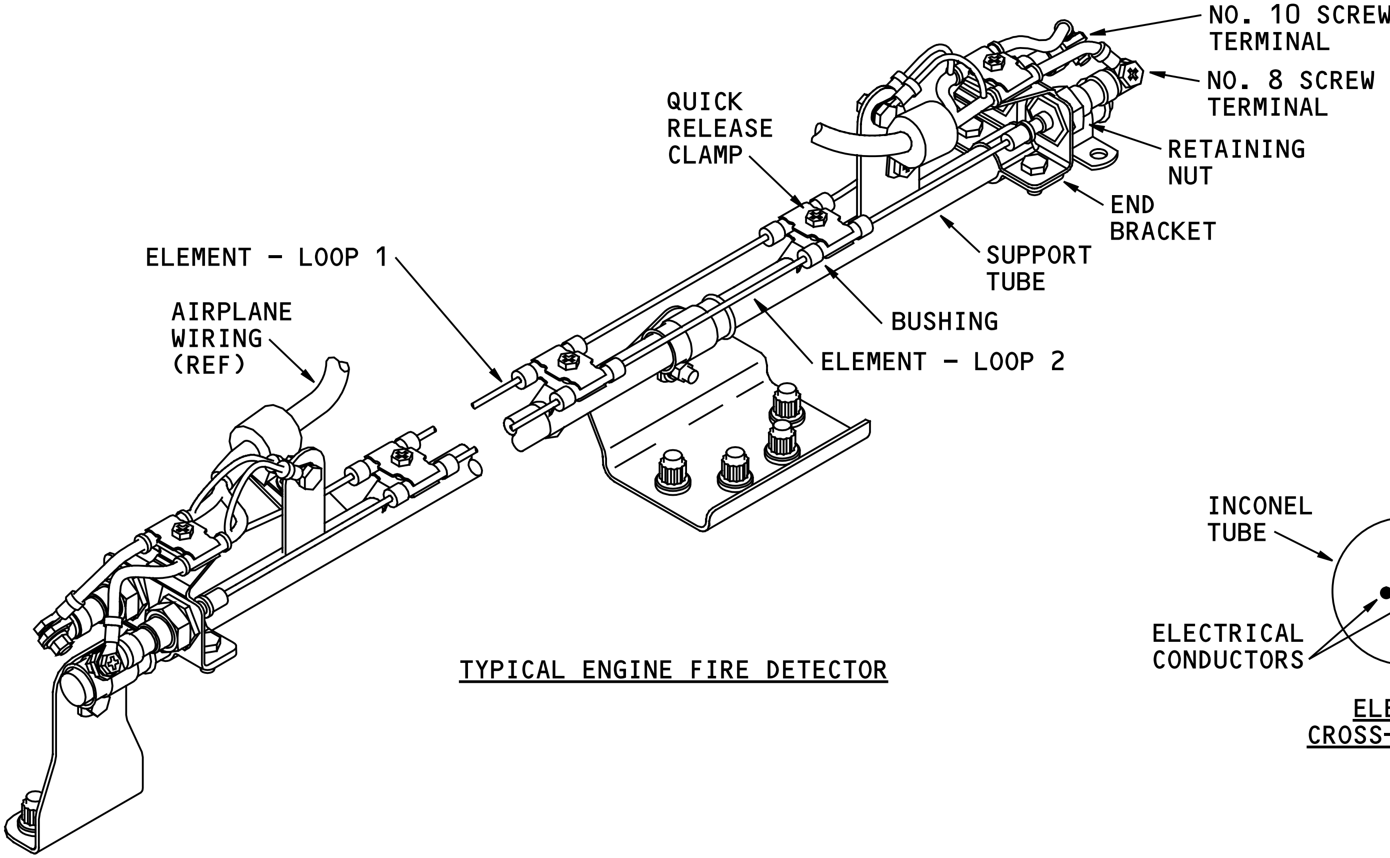
In addition to fire and overheat detection, the engine fire detectors continuously supply nacelle temperature data to the airplane condition monitoring function of the AIMS.

Training Information Point

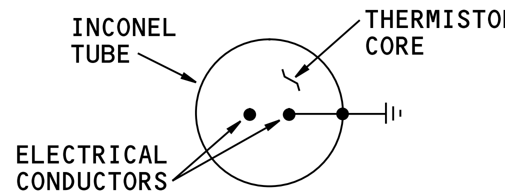
Each element uses a #10 screw wire-termination on one end and a #8 screw wire-termination on the other end. The elements are installed so each end of the detector has a #8 terminal and a #10 terminal. This prevents crossed wiring. The #10 terminal and the mating wire terminal have a black stripe around the insulation.

ENGINE FIRE DETECTION - ENGINE FIRE DETECTORS

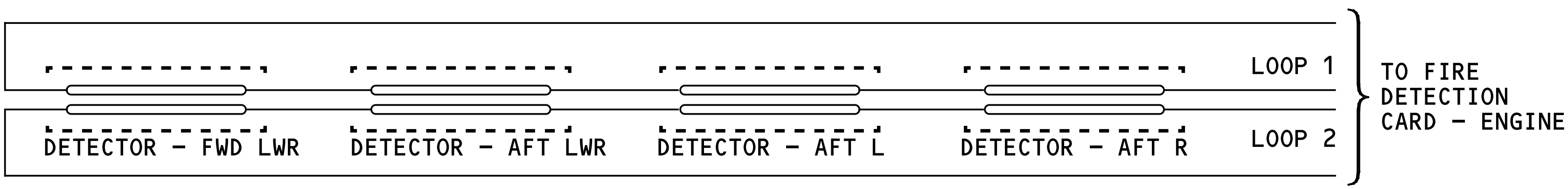
The ends of the element attach to the support tube bracket with retaining nuts. Quick-release clamps and bushings support the element along its length.



TYPICAL ENGINE FIRE DETECTOR



ELEMENT
CROSS-SECTION



ENGINE FIRE DETECTION LOOP CIRCUITS

26-11-00-005 Rev 3

ENGINE FIRE DETECTION - ENGINE FIRE DETECTORS

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ENGINE FIRE DETECTION - FIRE DETECTION CARDS

Purpose

The fire detection card has these purposes:

- Measures the nacelle temperature and sends it to the airplane condition monitoring system (ACMS)
- Monitors the fire detectors for a fire or overheat condition and supplies alarm signals
- Monitors the fire detectors for defects and sends fault data to AIMS
- Sets the logic (and/or logic) for the detector loops
- Does tests of the engine fire detection system.

Fire Detection Circuits

The fire detection circuits monitor the resistance of the fire detector element thermistor core. The resistance of the core is normally high. If the resistance goes low, the circuit supplies a FIRE output.

A short circuit in the loop also causes low resistance. The rate at which the resistance changes identifies an electrical short or a fire. A short circuit causes the resistance to decreases very quickly. A fire causes the resistance to decrease more slowly.

If the resistance decreases quickly, the circuit supplies a SHORT output for the life of the short circuit. If the short circuit stays for more than 0.2 seconds, the circuit supplies a DESELECT output. A deselect output also occurs if a power-up BIT finds an open circuit in the loop.

Program Logic Device

Output signals from the fire detection circuits go to the program logic device. The device normally causes dual-loop operation. Both Loop 1 and loop 2 must have a fire to cause fire alarms. If a detection circuit sends a FAULT signal, the logic device causes single-loop operation. A FAULT is a short, deselect, or power loss. The table shows alarm and fault conditions:

LOOP 1	LOOP 2	CARD OUTPUT
NORMAL	NORMAL	-
FIRE	NORMAL	FAULT (SEE TEXT)
FIRE	FIRE	ALARM
NORMAL	FIRE	FAULT (SEE TEXT)
FAULT	NORMAL	FAULT - LOOP 1
NORMAL	FAULT	FAULT - LOOP 2
FIRE	FAULT	ALARM
FAULT	FIRE	ALARM
FAULT	FAULT	FAULT - BOTH LOOPS

If one loop reports a fire and the other loop is normal, a 15 second timer starts. During this time, if the loop status changes from fire to normal, the timer stops. If the status of the normal loop changes to fire, the card sends a fire alarm.

ENGINE FIRE DETECTION - FIRE DETECTION CARDS

If neither loop changes status in 15 seconds, the card does a test of the normal loop. If the test fails, the card removes the selection of that loop and sends a fire alarm. If the test passes, the card removes the selection of the other loop and reports a fault.

Temperature Monitor Circuit

This circuit measures the average temperature of the fire detection loops. The ARINC 429 transmitter sends temperature data to AIMS.

The circuit also compares average temperature to an overheat set point kept in memory. If the temperature is more than the set point for 9.6 seconds, the temperature monitor circuit sends an overheat alarm through the ARINC 429 transmitter to AIMS.

Software in the temperature monitor circuit selects single or dual loop logic as applicable.

Built-In-Test Circuit

BIT continuously monitors the fire detection circuits. The ARINC 429 transmitter sends failure data to the AIMS as soon as BIT finds the condition.

BIT also does a test of the complete engine fire detection system at these times:

- At power-up
- After power interrupt
- Every five minutes of operation.

BIT signals a fire on both loops at the same time and does a check of the system. The ARINC 429 transmitter sends a fire alarm signal to AIMS. The CMCS uses this signal to make sure the fire detection system transmits ARINC data. Fire warnings do not occur during the tests.

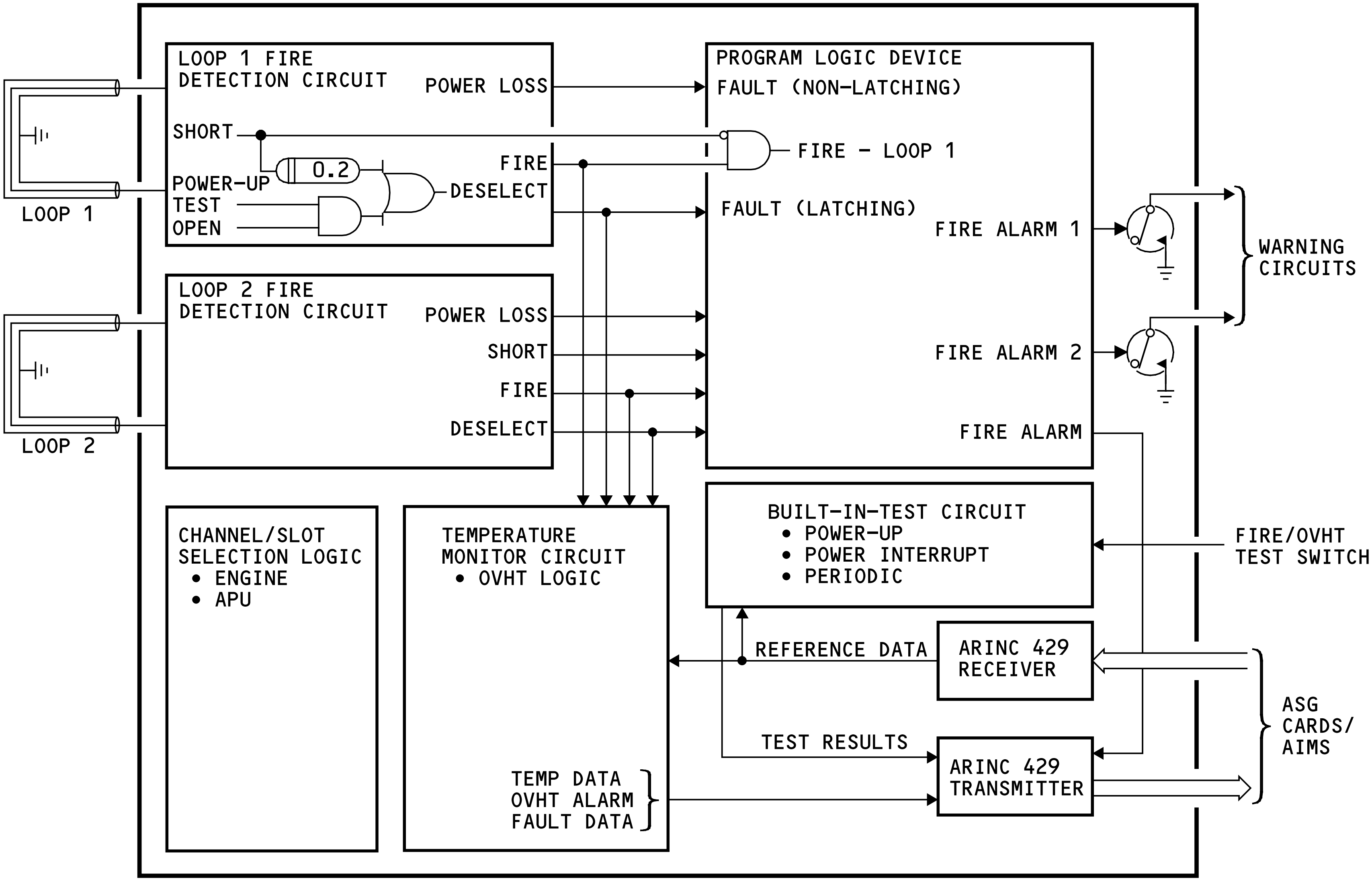
If there is a failure, the ARINC 429 transmitter sends fault data to the AIMS. The system changes to single loop operation if necessary.

The fire/ovht test switch in the flight deck starts a similar test. If there is a fault, the ARINC 429 transmitter sends fault data to the AIMS. Fire warnings occur during this test.

Training Information Point

The engine and APU fire detection cards function differently but are interchangeable. Program pins in the cardfile interface with the channel/slot selection logic circuit. That circuit tells the card whether to function as an APU fire detection card or as a left or right engine fire detection card.

The fire detection cards are electrostatic discharge sensitive (ESDS) devices. Be careful to obey the procedures in part II of the maintenance manual (Standard Practices - Airframe, Electrostatic Discharge Sensitive Devices - Maintenance Practices) before you touch the cards.



26-11-00-006 Rev 1

ENGINE FIRE DETECTION - FIRE DETECTION CARDS

ENGINE FIRE DETECTION - FUNCTIONAL DESCRIPTION

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ENGINE FIRE DETECTION - FUNCTIONAL DESCRIPTION

Fire Detection

If there is a fire in an engine nacelle, the fire detection card supplies three fire alarm outputs. Alarm 1 supplies a ground for these components:

- The fire switch unlocking solenoid
- The engine fire warning lights
- The fuel control switch fire warning light.

Alarm 2 supplies a signal to AIMS and to the warning electronics unit. An EICAS warning message shows. The master warning lights and fire warning aural come on.

A third fire alarm output goes to the AIMS through the ASG (ARINC signal gateway) cards. The CMCS uses this signal to make sure the engine fire detection system transmits ARINC data.

The indications go away when the fire is out.

Overheat Detection

If the fire detection loops find an overheat condition, the fire detection card sends a signal to AIMS through the ASG cards. An EICAS caution message shows. The master caution light and caution aural come on. When the overheat condition is gone, the indications go away.

Nacelle Temperature Recording

The fire detection card measures the average temperature of the engine fire detectors. This data is sent to AIMS through the ASG cards. The ACMF (airplane condition monitoring function) of the AIMS puts this data in memory.

Single/Dual Loop Operation

The fire detection card monitors the loops for faults. In normal (dual loop) operation, both loops must have a fire or overheat condition to cause the flight deck indications.

If one detection loop fails, the card sends data about the failure to the AIMS. A status message shows. The card changes to single loop operation if necessary.

If both detection loops fail, an advisory message and status messages show. The fire detection system does not operate.

BITE

BITE does a test of the engine fire detection system for these conditions:

- When the system first gets power
- After a power interrupt
- Every 5 minutes of operation.

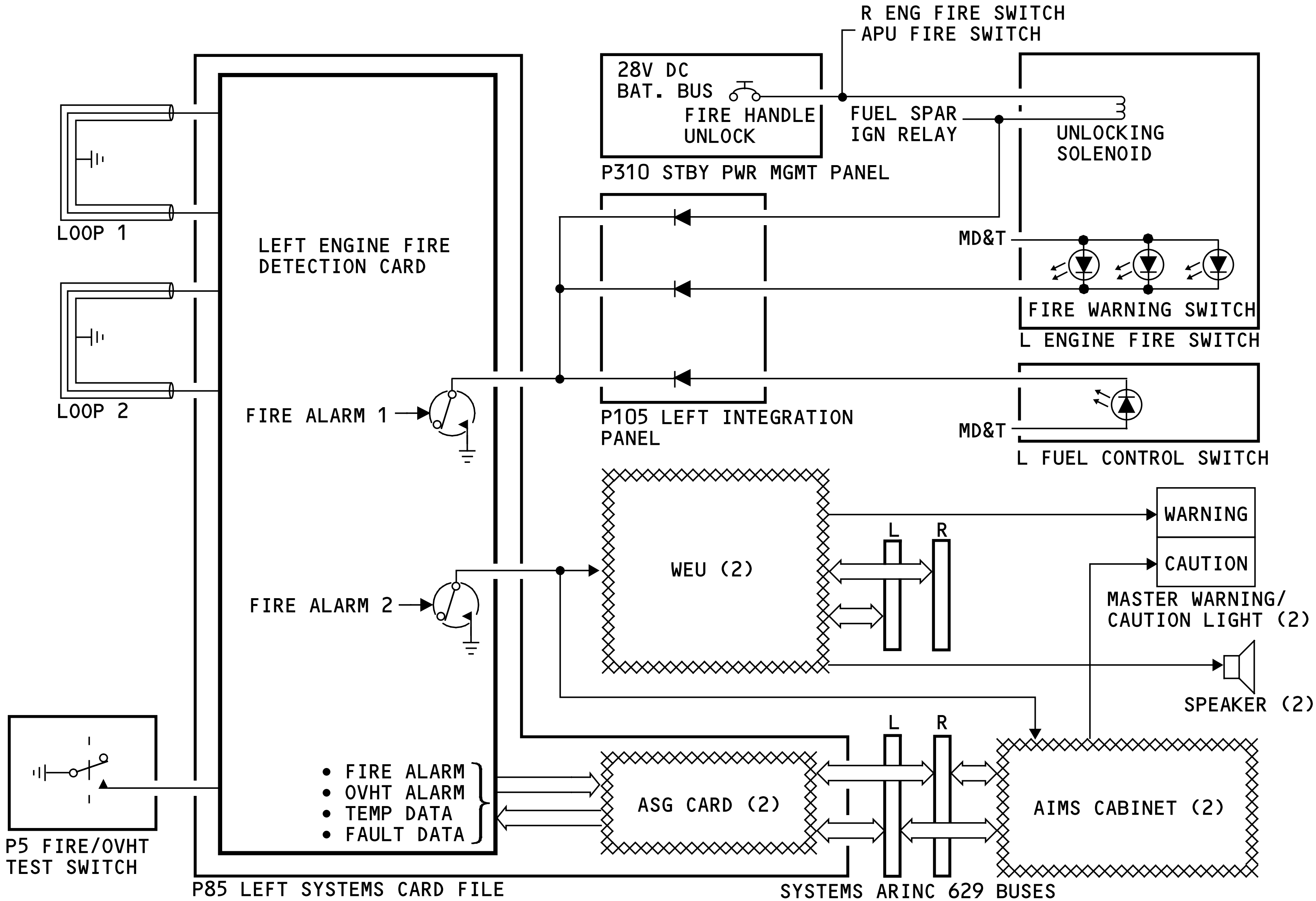
ENGINE FIRE DETECTION - FUNCTIONAL DESCRIPTION

BIT data goes to the AIMS. If the system has a malfunction, the primary display system shows advisory or status messages. The MAT shows maintenance messages.

If a loop opens after the power-up BIT, the system stays in the dual-loop mode until you apply electrical power again. A loop which is open in only one place still operates. If the power-up BIT finds an open loop, the system changes to single-loop operation. Both ends of the loop are possibly disconnected.

After you do maintenance, use the FIRE/OVHT TEST switch to make sure the system operates correctly.

You can use the MAT to see the nacelle temperature data kept in memory by the ACMF.



ENGINE FIRE DETECTION - FUNCTIONAL DESCRIPTION

ENGINE FIRE DETECTION - INDICATIONS

Overheat Indication

If an engine has an overheat condition, these indications occur in the flight deck:

- The master caution lights come on
- The caution aural operates
- An engine overheat caution message shows.

Fire Indication

If an engine has a fire, these indications occur in the flight deck:

- The master warning lights come on
- The fire warning aural operates
- An engine fire warning message shows
- The engine fire warning light comes on
- The fuel control switch fire warning light comes on.

Failure Indications

If continuous fault monitoring or built-in-test finds a fault, indications show in the flight deck.

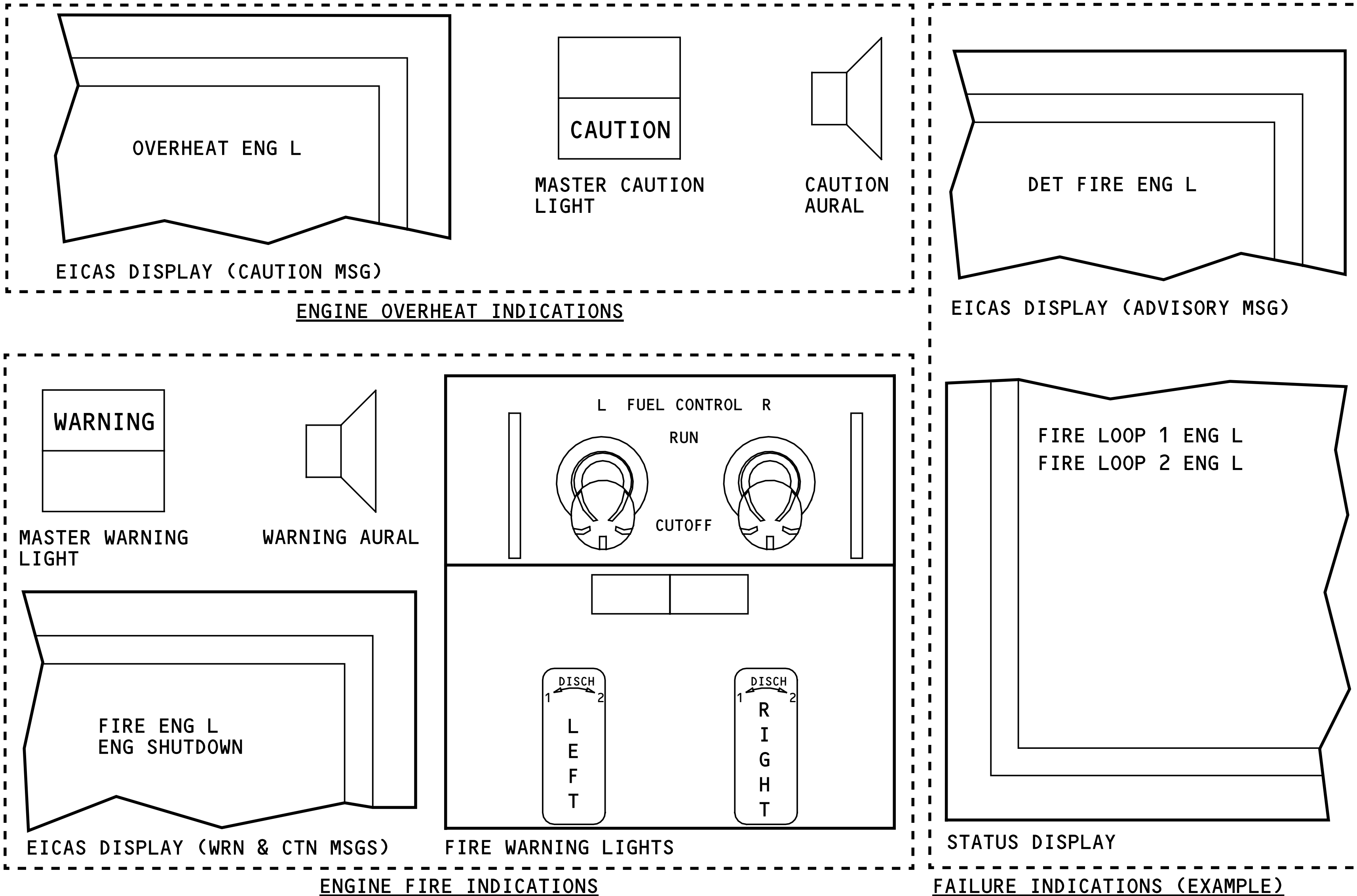
Dual loop failures in the engine fire detection system cause advisory messages and status messages. The engine fire detection system does not operate.

Single loop failures in the engine fire detection system cause status messages. The engine fire detection system still operates.

Failures in the temperature monitor function cause a status message.

Training Information Point

Maintenance messages, that you get from the maintenance access terminal, generally give more details about the failure condition. For example, if a loop fails, the maintenance message tells you that the loop is open or shorted or connected incorrectly. If the loop is shorted, the maintenance message tells which detector element or wiring segment has the short.



ENGINE FIRE DETECTION - INDICATIONS

ENGINE TURBINE OVERHEAT DETECTION - INTRODUCTION

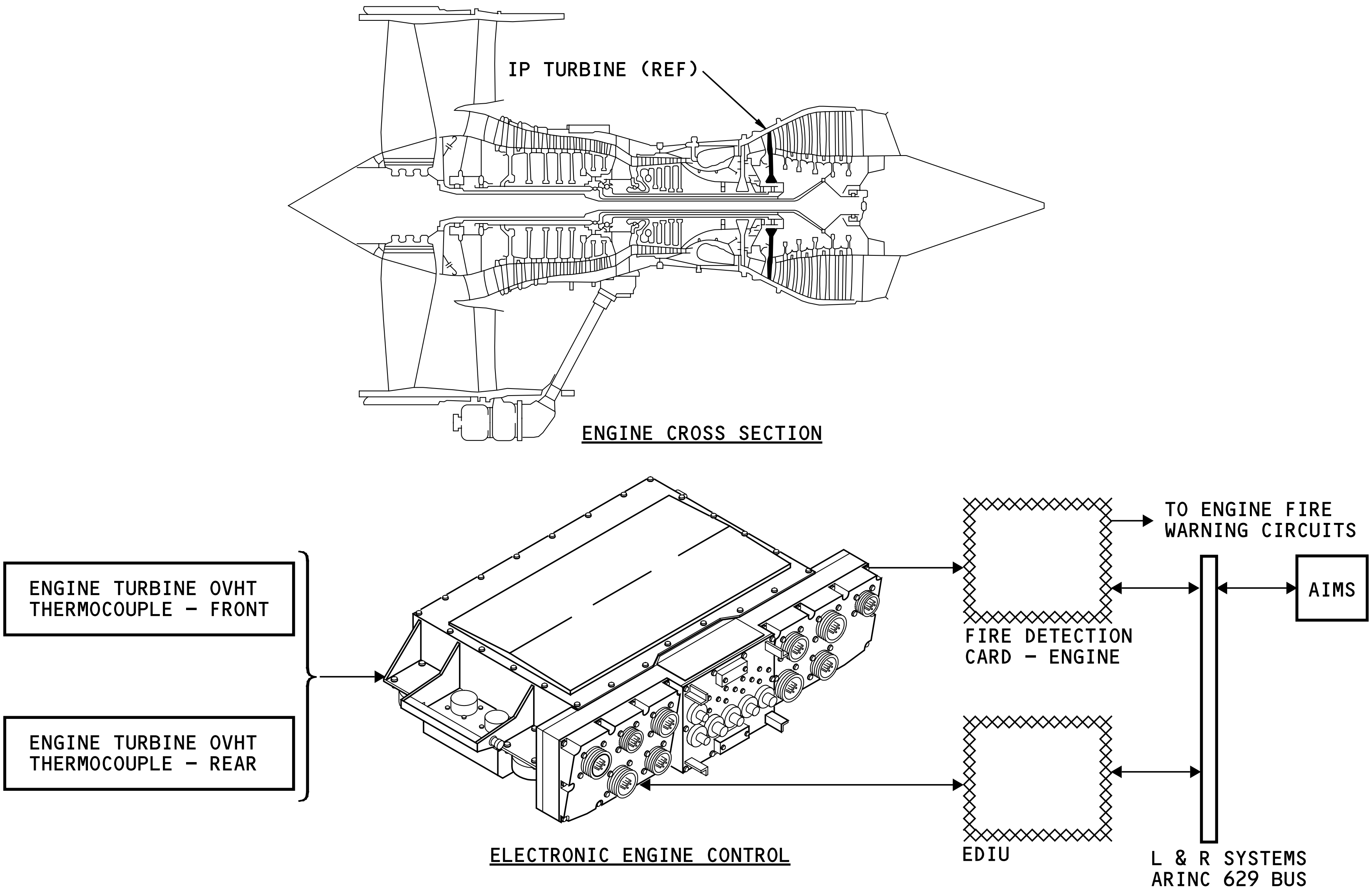
Purpose

The engine turbine overheat detection system monitors the temperature of the cooling air at the front and rear of the IP turbine. Engine fire warnings occur in the flight deck if the front or rear temperature is more than limits.

General Description

Two thermocouples give IP cooling air temperature information to the electronic engine control (EEC). The EEC makes an analysis of the temperature information. If the EEC finds an overheat condition, it sends a signal to the engine fire detection card. The fire detection card turns on the engine fire warning indications in the flight deck.

BITE does a check of the condition of the system. Status and maintenance messages give information about system failures. The fire detection card monitors its interface with the EEC for failures and sends information about the failure to the AIMS. The EEC monitors the thermocouple circuits for failures. The EEC sends information about the failure through the engine data interface unit (EDIU) to the AIMS. The FIRE/OVHT TEST switch in the flight deck does not do a test of this system.



ENGINE TURBINE OVERHEAT DETECTION - INTRODUCTION

ENGINE TURBINE OVERHEAT DETECTION - ENGINE TURBINE OVERHEAT THERMOCOUPLES

Purpose

The engine turbine overheat thermocouples monitor the temperature of engine cooling air at the front and rear of the IP turbine.

Physical Description

Each thermocouple has a probe that fits through an opening in the IP turbine case. Each probe contains two elements: loop 1 and loop 2. The thermocouples have four electrical connections. Two connections are for loop 1 and the other two connections are for loop 2.

Location

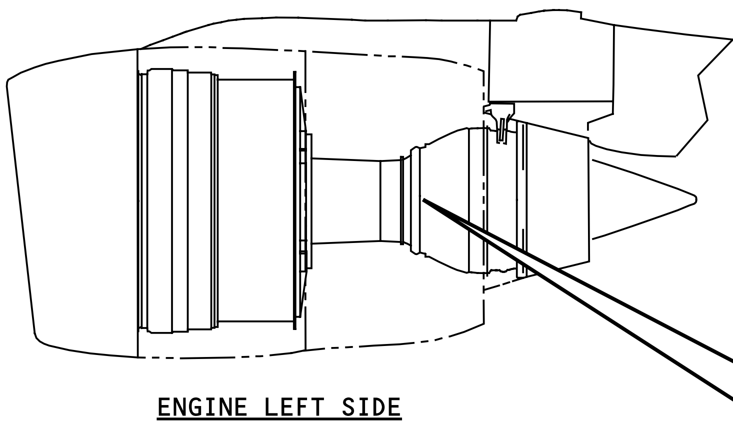
The front and rear thermocouples are on the left side of the engine IP turbine case. Open the thrust reverser to get access to the thermocouples.

Functional Description

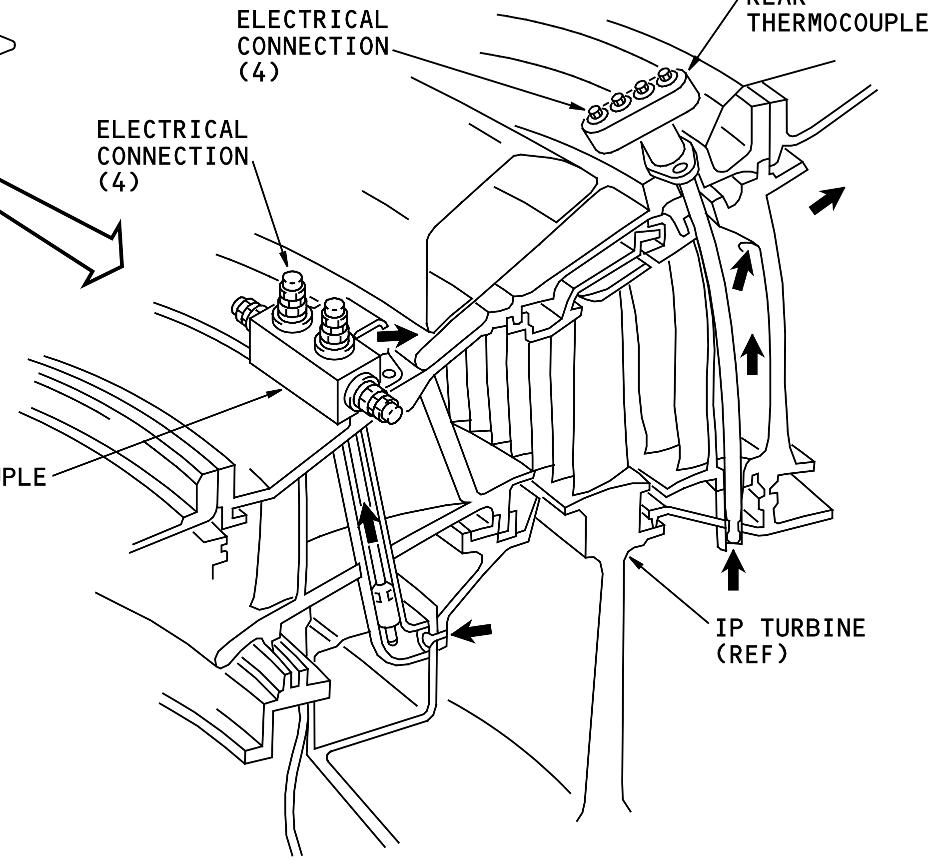
The front thermocouple monitors the engine cooling air in front of the IP turbine. The air that flows over the front thermocouple bleeds overboard.

The rear thermocouple monitors the engine cooling air temperature behind the IP turbine. The air that flows over the rear thermocouple goes back into the engine gas path through holes in the LP1 nozzle guide vane.

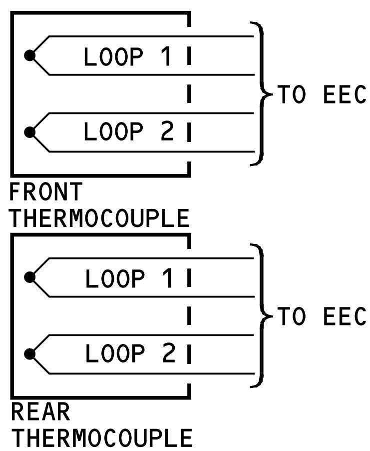
The electrical signal output from each thermocouple loop is in proportion to the cooling air temperature.



ENGINE LEFT SIDE



CROSS SECTION OF ENGINE IP TURBINE CASE



TURBINE OVERHEAT
THERMOCOUPLE CIRCUIT

26-12-00-003 Rev 0 03/16/95

ENGINE TURBINE OVERHEAT DETECTION - ENGINE TURBINE OVERHEAT THERMOCOUPLES

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ENGINE TURBINE OVERHEAT DETECTION - FUNCTIONAL DESCRIPTION

General

Each thermocouple loop gives an input signal to the EEC. The fire detection card monitors the EEC turbine overheat interface circuit.

An overheat condition causes fire alarm 1 and fire alarm 2 outputs from the fire detection card. These outputs cause fire warning indications in the flight deck. See section 26-11 for more information about the engine fire detection system and fire indications.

EEC Overheat Logic

The EEC gives an overheat signal if these conditions occur for the front or the rear thermocouple:

- BIT finds no loop failures
- Loop 1 and loop 2 have an overheat condition

With a single loop failure in a thermocouple, the EEC gives an overheat signal if the serviceable loop has an overheat condition.

Fire Detection Card Interface

The fire detection card continuously monitors the resistance of the circuit from the fire detection card through the EEC. If the EEC finds an overheat condition, the two switches in the EEC close and connect the two resistors in parallel. This amount of resistance in the circuit causes the fire detection card to send the fire alarm signals.

BITE

The status message DET TURB OVHT ENG L(R) shows a failure of the turbine overheat detection system. The status message TURB OVHT SNSR ENG L(R) shows a single loop fault in the system.

The EEC monitors the thermocouple loops. If the EEC finds a failure, it sends information about the failure to the AIMS through the EDIU. A failure in one thermocouple loop causes the single loop fault status message. A failure in both front or both rear thermocouple loops causes the system failure status message to show.

The fire detection card monitors the circuit from the fire detection card through the EEC. If the resistance is less than the value of the two EEC resistors in parallel, the circuit has a short. Information about the short goes to AIMS through the ASG cards.

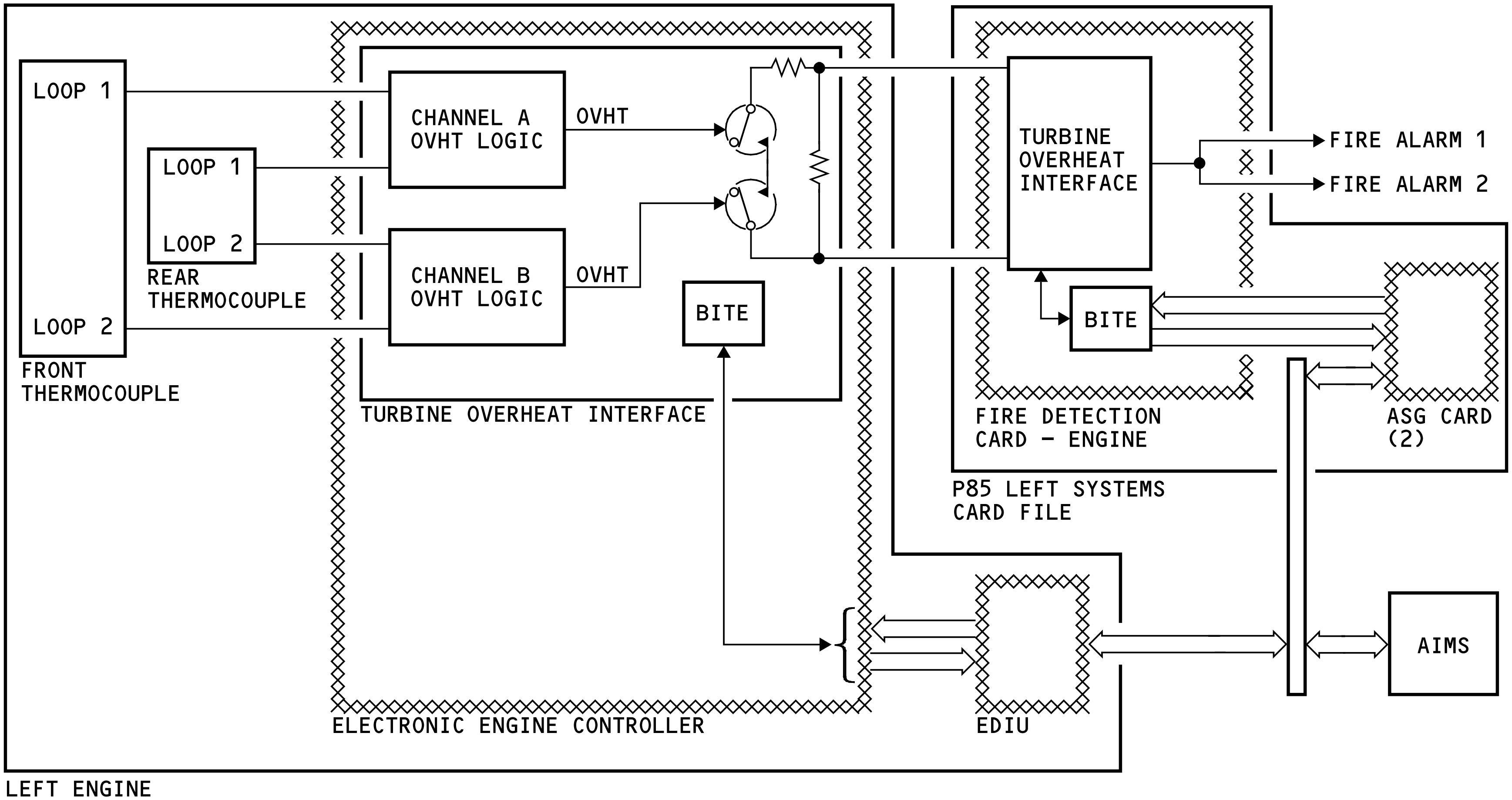
The fire detection card also does a check of the circuit through the EEC for an open condition. The open circuit check is not continuous, but is part of the power-up and periodic BIT.

A short or open in the circuit from the fire detection card through the EEC causes the system failure status message to show.

ENGINE TURBINE OVERHEAT DETECTION - FUNCTIONAL DESCRIPTION

Training Information Point

The fire/overheat test switch in the flight deck does not do a test of the engine turbine overheat detection system.



NOTE: LEFT ENGINE SYSTEM IS SHOWN.
RIGHT ENGINE SYSTEM IS SIMILAR.

ENGINE TURBINE OVERHEAT DETECTION - FUNCTIONAL DESCRIPTION

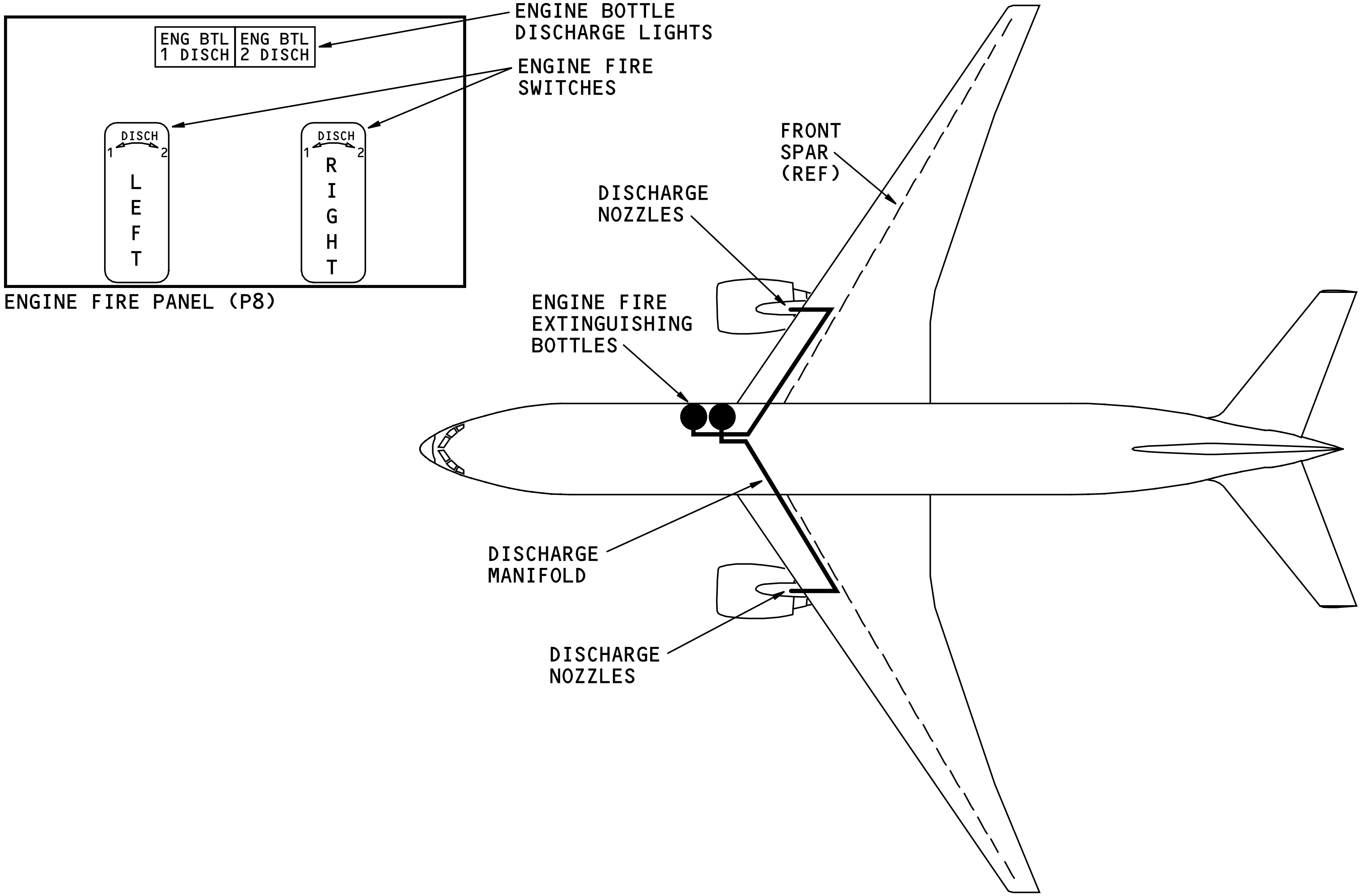
ENGINE FIRE EXTINGUISHING - INTRODUCTION

Purpose

The engine fire extinguishing system extinguishes fires in the engine nacelles.

General Description

The two fire extinguishing bottles contain halon fire extinguishing agent pressurized with nitrogen. You use the engine fire switches in the flight deck to release the halon. Halon from each bottle can go to the right or left engine. EICAS messages, status messages, and indicator lights show when the bottle pressure is low.



26-21-00-001 Rev 2 07/09/1997

ENGINE FIRE EXTINGUISHING - INTRODUCTION

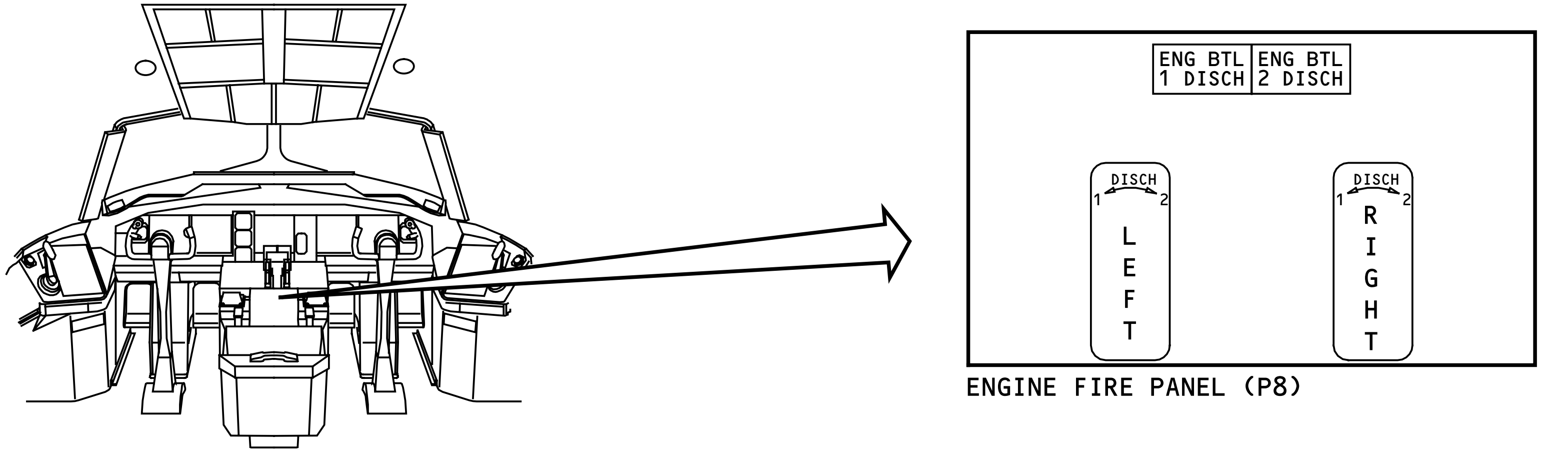
ENGINE FIRE EXTINGUISHING - COMPONENT LOCATIONS

Flight Deck Component Locations

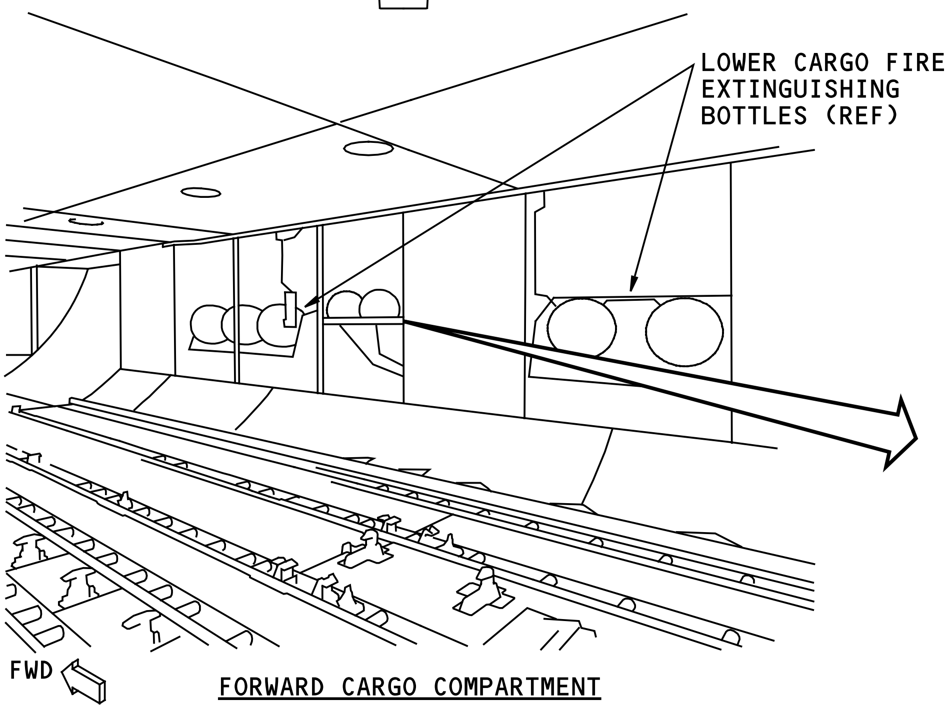
The engine fire panel is in the flight deck on the P8 aisle stand.

Forward Cargo Compartment Component locations

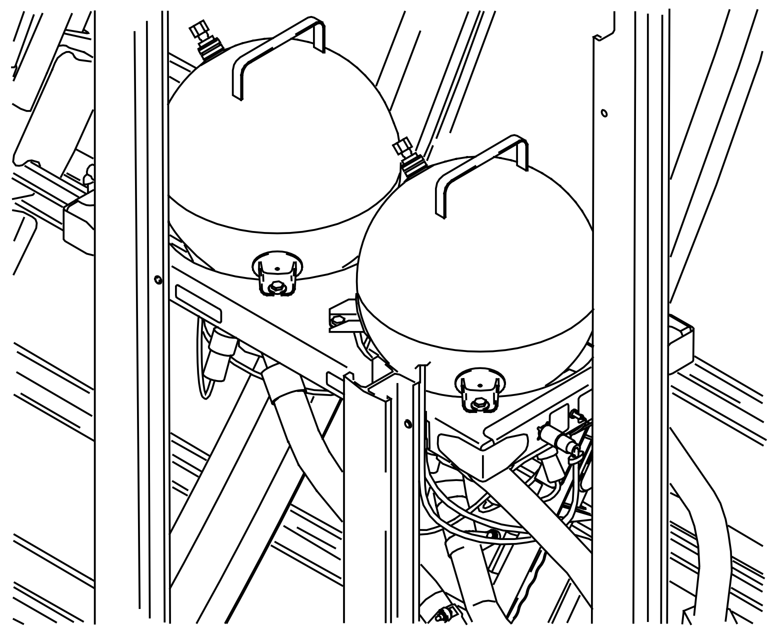
The two engine fire extinguishing bottles are behind the right sidewall lining of the forward cargo compartment, aft of the cargo door. Open the cargo compartment lining to get access to the bottles.



ENGINE FIRE PANEL (P8)



FORWARD CARGO COMPARTMENT



ENGINE FIRE EXTINGUISHING BOTTLES

ENGINE FIRE EXTINGUISHING - COMPONENT LOCATIONS

26-21-00-002 Rev 4 07/10/1997

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ENGINE FIRE EXTINGUISHING - ENGINE FIRE EXTINGUISHING BOTTLES

Purpose

The engine fire extinguishing bottles contain the fire extinguishing agent.

Location

The two fire extinguishing bottles are outboard of the right sidewall lining of the forward cargo compartment. The access panel is identified ENGINE FIRE EXTINGUISHER ACCESS PANEL.

Physical Description

The two engine fire extinguishing bottles are identical. Each bottle has these components:

- A safety relief and fill port
- A handle for removal and installation
- A pressure switch
- Two discharge assemblies
- An identification plate
- Four mounting lugs.

The engine fire extinguishing bottles are interchangeable with the APU fire extinguishing bottle.

Functional Description

The bottles contain halon fire extinguishing agent pressurized with nitrogen. If the pressure in the bottle becomes too high, the safety relief and fill port opens so the bottle does not explode. The discharge assembly has an explosive squib. An electric current from the fire extinguishing circuit fires the squib. This releases the halon through the discharge port.

The pressure switch gives flight deck indications when bottle pressure decreases. The switch monitors the pressure inside the bottle and is normally open. When the pressure decreases because of a leak or because of bottle discharge, the switch closes an indicating circuit.

Training Information Point

A special service platform is available which makes bottle replacement easier.

When you replace bottles, handle them carefully to prevent damage. Compare the weight of the new bottle with the weight on the identification plate. This prevents installation of a bottle which is not full.

The discharge ports for the left and right engines are different sizes. This prevents crossed connections. Install the bottle with the identification plate inboard.

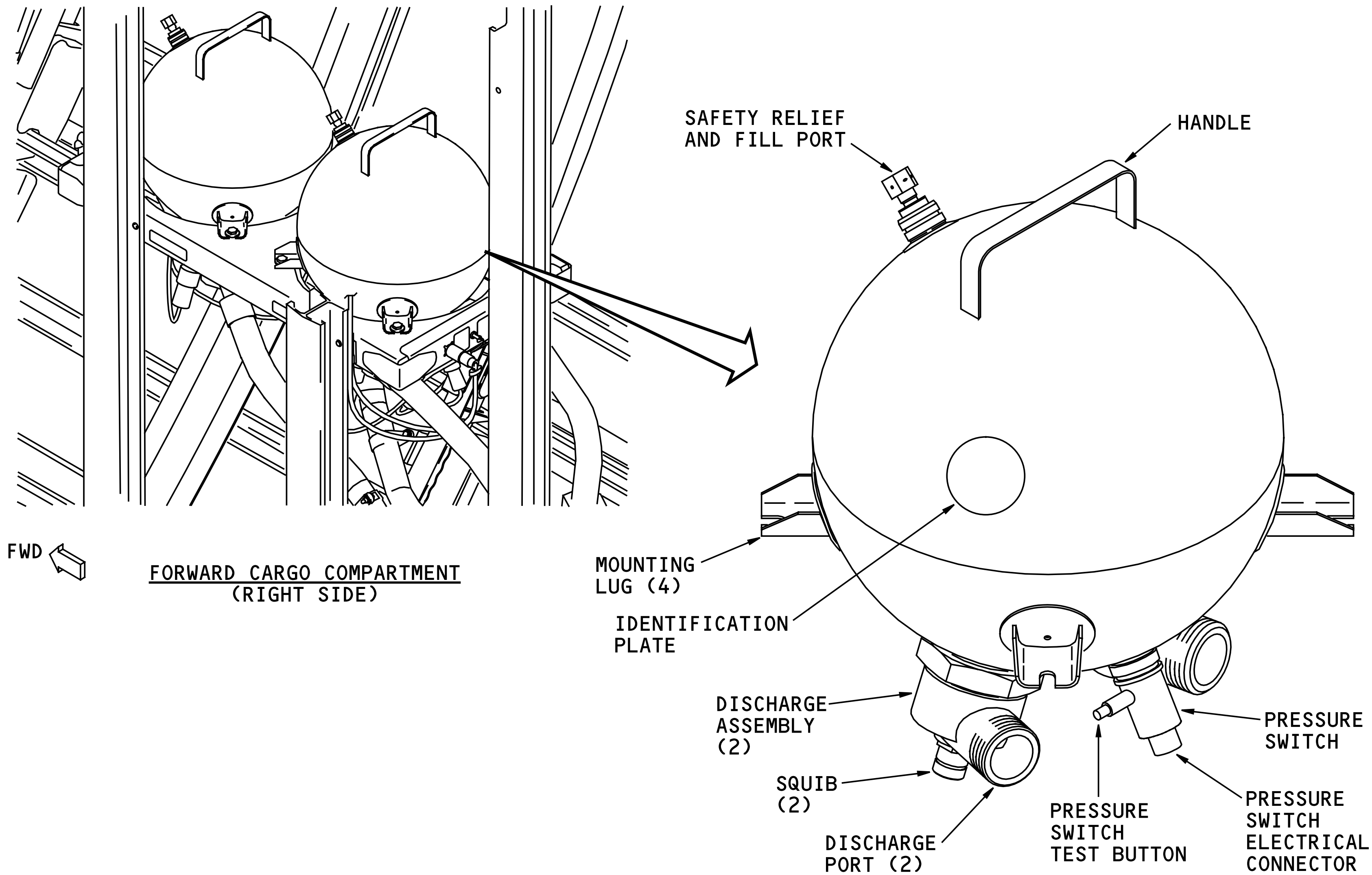
The fire extinguishing bottles must have a hydrostatic test every 5 years. The date of the last test is stamped on one of the mounting lugs and on an inspection tag. The tag is attached to one of the discharge assemblies.

ENGINE FIRE EXTINGUISHING - ENGINE FIRE EXTINGUISHING BOTTLES

WARNING: BE CAREFUL WHEN YOU MOVE THE FIRE EXTINGUISHING BOTTLE. THE FIRE EXTINGUISHING BOTTLE IS HIGHLY PRESSURIZED AND HAS AN EXPLOSIVE CARTRIDGE AS A COMPONENT. ACCIDENTAL DISCHARGE OF THE FIRE EXTINGUISHING BOTTLE CAN CAUSE INJURY TO PERSONS OR DAMAGE TO EQUIPMENT.

WARNING: DO NOT TOUCH THE SQUIB BEFORE YOU DO THE PROCEDURES FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE THE FIRE BOTTLE TO RELEASE ITS CONTENTS SUDDENLY AND CAUSE INJURY TO PERSONS AND DAMAGE TO EQUIPMENT.

WARNING: PUT A PROTECTIVE COVER ON THE SQUIB. IF YOU DO NOT PUT A PROTECTIVE COVER ON THE SQUIB, THE FIRE EXTINGUISHING BOTTLE CAN RELEASE ITS CONTENTS SUDDENLY AND CAUSE INJURY TO PERSONS.



26-21-00-003 Rev 6 07/10/1997

ENGINE FIRE EXTINGUISHING - ENGINE FIRE EXTINGUISHING BOTTLES

ENGINE FIRE EXTINGUISHING - ENGINE FIRE BOTTLE SQUIB

Purpose

The squib releases the halon from the engine fire extinguishing bottle.

Location

The squib is in the discharge assembly at the bottom of the fire bottle. A fire bottle has two squibs, one for each engine.

Physical Description

The squib is an electrically operated explosive device. It is adjacent to a bottle diaphragm that can break. The diaphragm normally seals the pressurized bottle.

Functional Description

The squib fires when you put the fire switch to the DISCH 1 or DISCH 2 position. The explosion opens the diaphragm. Nitrogen pressure inside the bottle pushes the halon through the discharge port.

Training Information Point

The ELMS does an automatic squib test for these conditions:

- When ELMS first gets power
- At engine shutdown with the airplane on the ground.

You can also use the maintenance access terminal (MAT) to do a squib test. See the fire protection section for more information about the squib tests (AMM PART I 26-00).

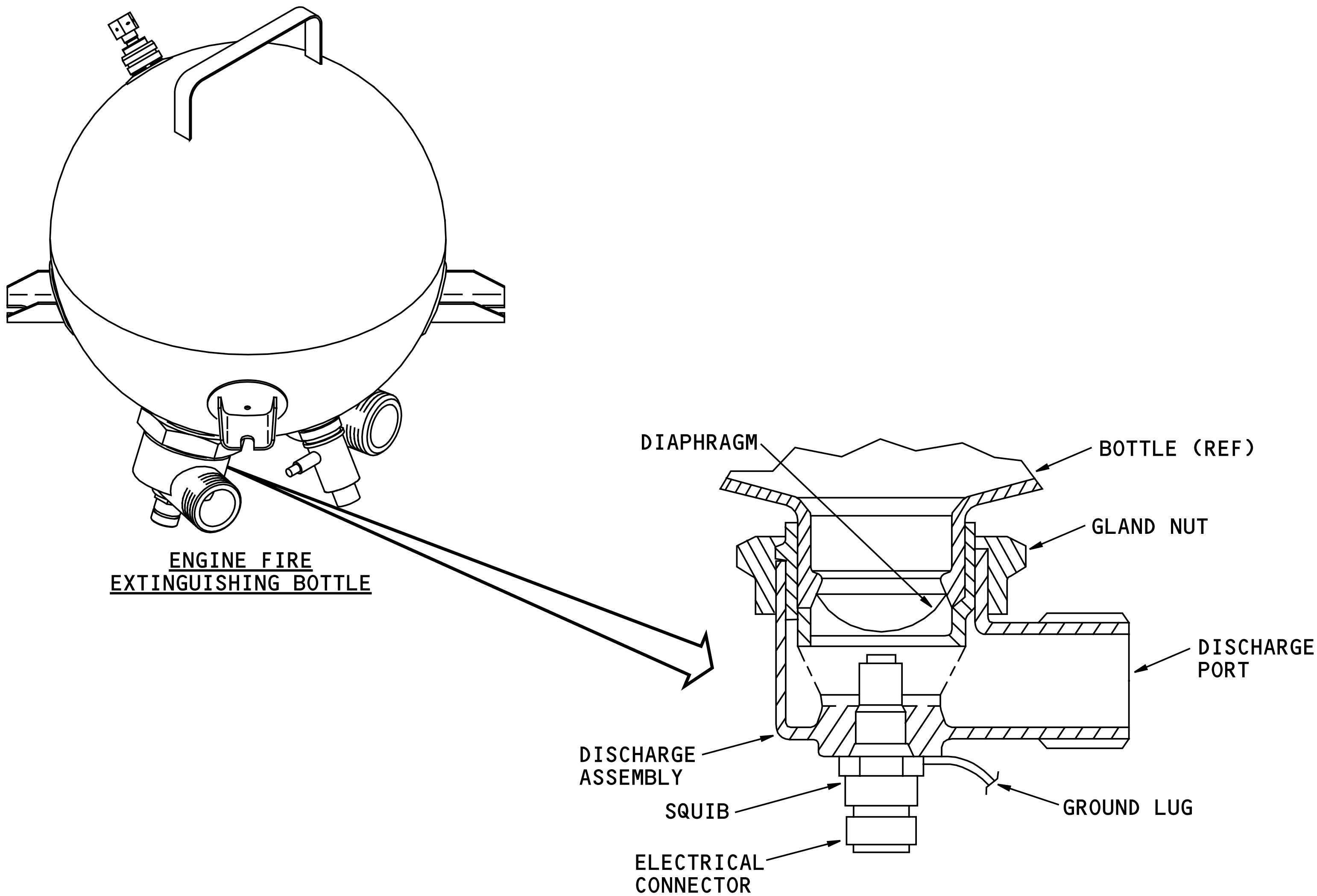
You must replace The squib every 10 years. The service date is on one of the squib wrench flats. You can replace the squib without removing the fire extinguishing bottle.

WARNING: MAKE SURE THERE IS NO VOLTAGE AT THE ELECTRICAL CONNECTOR. IF THERE IS A VOLTAGE AT THE ELECTRICAL CONNECTOR, THE SQUIB CAN ACCIDENTALLY FIRE AND CAUSE THE FIRE EXTINGUISHING BOTTLE TO RELEASE ITS CONTENTS. ACCIDENTAL DISCHARGE OF THE FIRE EXTINGUISHING BOTTLE CAN CAUSE INJURY TO PERSONS OR DAMAGE TO EQUIPMENT.

WARNING: PUT A PROTECTIVE COVER ON THE SQUIB. IF YOU DO NOT PUT A PROTECTIVE COVER ON THE SQUIB, THE FIRE EXTINGUISHING BOTTLE CAN RELEASE ITS CONTENTS SUDDENLY AND CAUSE INJURY TO PERSONS.

CAUTION: DO NOT PUT A SHUNT PLUG ON THE SQUIB. THE SHUNT PLUG CAN CAUSE DAMAGE TO THE SQUIB PINS.

The electrical connectors and the discharge assembly interface threads are different sizes for the left and right engine squibs. This prevents incorrect connection.



ENGINE FIRE EXTINGUISHING - ENGINE FIRE BOTTLE SQUIB

ENGINE FIRE EXTINGUISHING - ENGINE FIRE PANEL

Purpose

The engine fire panel keeps the engine fire switches and engine fire bottle discharge lights together and in easy reach of the flight crew.

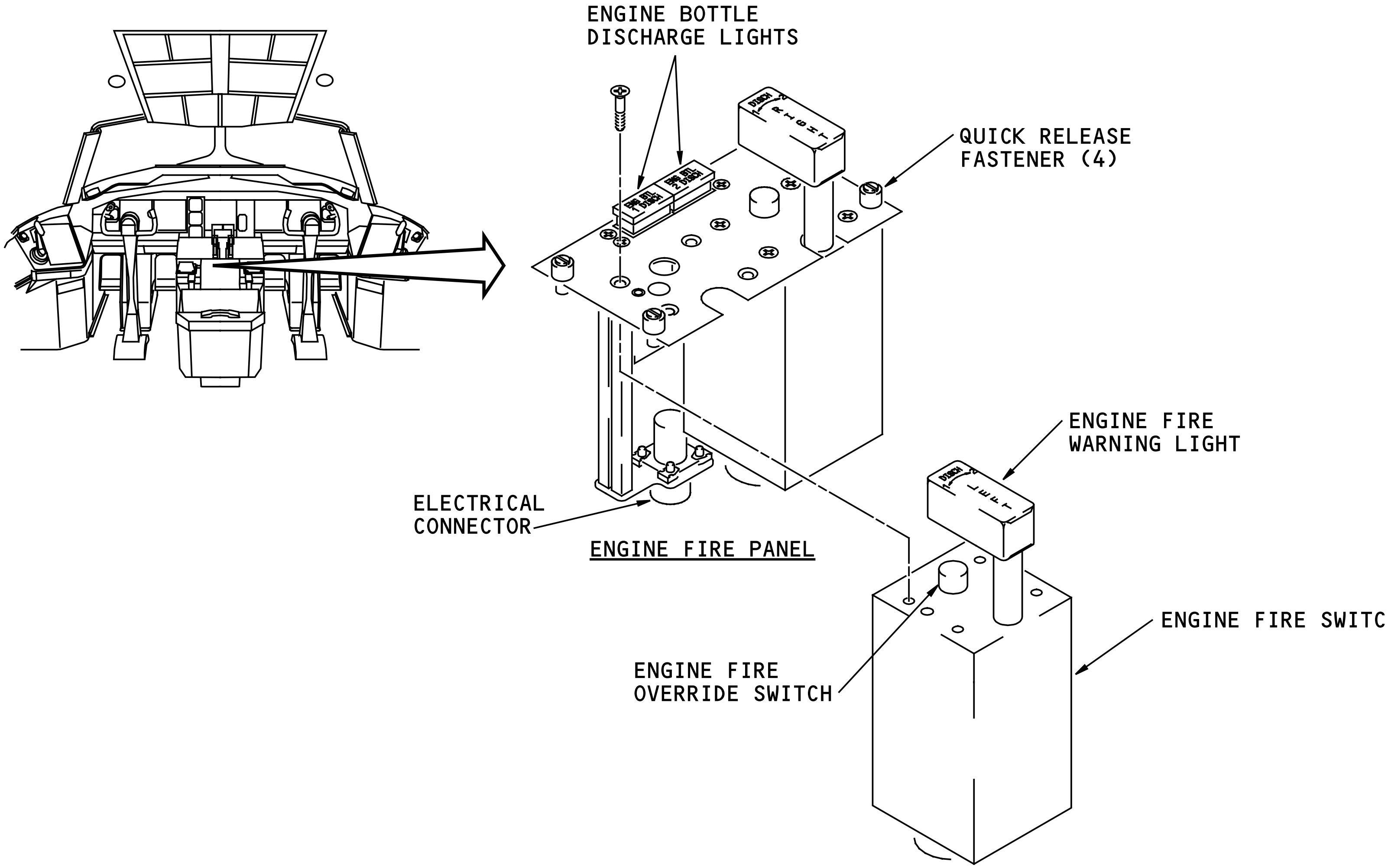
Location

The engine fire panel is in the flight deck on the P8 aisle stand.

Physical Description

The engine fire panel has a fire switch for each engine and a discharge light for each fire bottle.

Quick release fasteners attach the panel to the aisle stand structure. Electrical connectors connect the airplane wires to the panel.



ENGINE FIRE EXTINGUISHING - ENGINE FIRE PANEL

ENGINE FIRE EXTINGUISHING - ENGINE FIRE SWITCH

Purpose

The engine fire switch does four things:

- Gives an indication of an engine fire
- Stops the engine
- Isolates the engine from the airplane systems
- Controls the engine fire extinguishing system.

Physical Description

The engine fire switch includes these parts:

- Engine fire warning light
- Solenoid
- Engine fire override switch
- Push-pull switch contacts (internal)
- Rotary switch contacts (internal)
- Electrical connector.

Functional Description

The solenoid locks the fire switch so you cannot pull it accidently. If an engine has a fire, the fire warning light comes on and the solenoid energizes to release the switch.

The fire override switch lets you pull the fire switch when the solenoid is not energized.

When you pull the fire switch, the push-pull switch contacts operate electrical circuits which stop the engine and isolate it from the airplane systems.

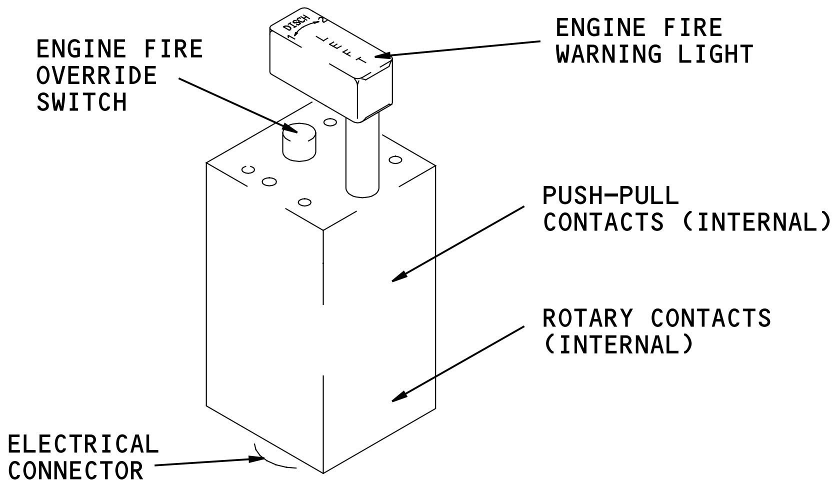
With the switch pulled, you can rotate it left or right to a mechanical stop at the discharge position. The rotary switch contacts close and operate the fire extinguishing system.

When you release the switch, a spring moves the switch a small distance from the discharge position to open the rotary switch contacts.

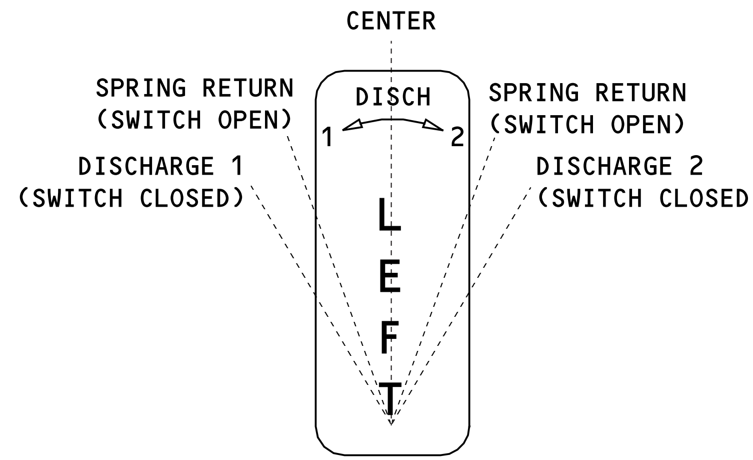
You must put the switch back to the center position before you can push the switch in.

Training Information Point

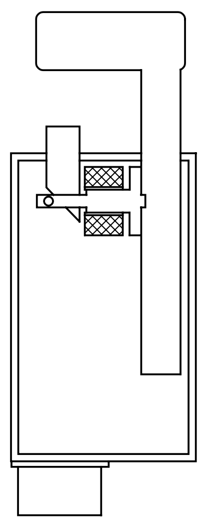
The left and right engine and APU fire switches are not interchangeable. The fire warning light labels and the electrical connectors are different. The engine fire switches have a hole that engages a peg in the control panel. The hole position is different in the left and right switches.



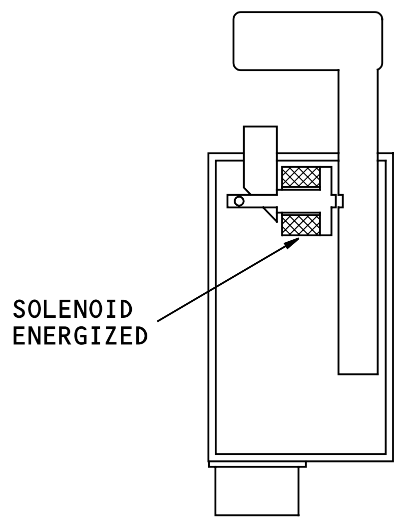
ENGINE FIRE SWITCH (P8)



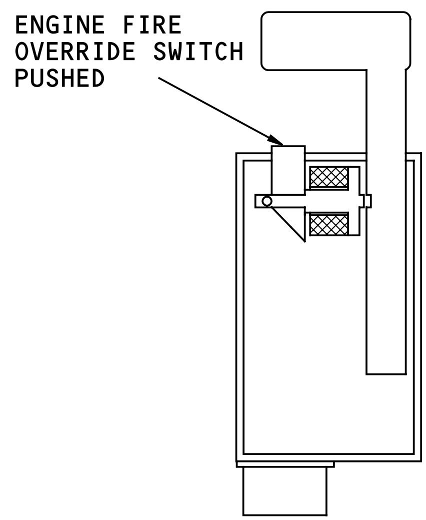
SWITCH POSITIONS



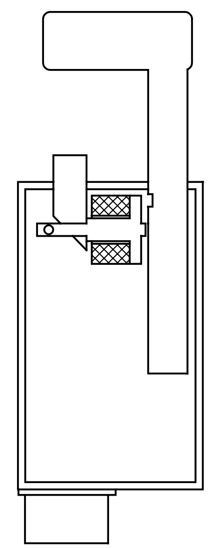
SWITCH LOCKED



SWITCH RELEASED ELECTRICALLY



SWITCH RELEASED MANUALLY



SWITCH PULLED

ENGINE FIRE EXTINGUISHING - ENGINE FIRE SWITCH

26-21-00-006 Rev 3

ENGINE FIRE EXTINGUISHING - FUNCTIONAL DESCRIPTION - BOTTLE DISCHARGE

General

Each bottle has two discharge assemblies. The discharge assemblies connect the bottles to the discharge manifolds. One manifold goes to discharge nozzles in the left engine nacelle. The other manifold goes to discharge nozzles in the right engine nacelle.

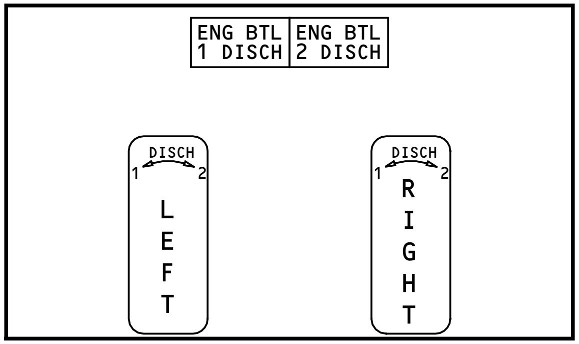
Functional Description

Explosive squibs inside the discharge assemblies connect to the fire switches in the flight deck. Squibs for the left engine connect to the left switch; squibs for the right engine connect to the right switch. A squib for bottle 1 fires when you put the related fire switch to DISCH 1. A squib for bottle 2 fires when you put the related switch to DISCH 2. When a squib fires, the bottle releases the halon into the engine nacelle.

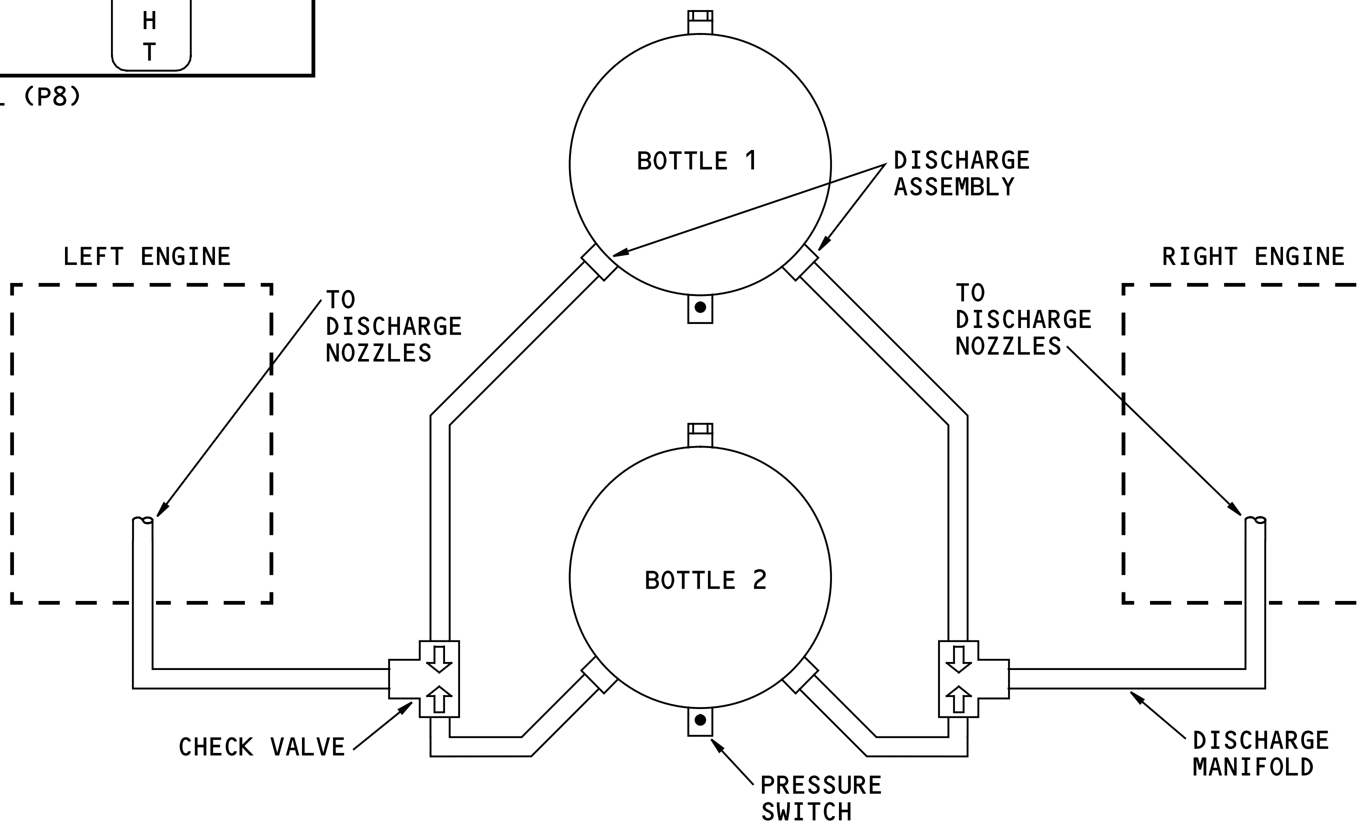
A pressure switch monitors the pressure in each bottle. The switch turns on the discharge indicator light when the bottle pressure decreases. The switch also causes advisory and status messages to show.

Training Information Point

Rigid tubing connects the bottles to the check valves. The diameter of the tubing is different for the left and right engines. This prevents incorrect connection.



ENGINE FIRE PANEL (P8)



ENGINE FIRE EXTINGUISHING - FUNCTIONAL DESCRIPTION - BOTTLE DISCHARGE

ENGINE FIRE EXTINGUISHING - ENGINE FIRE SWITCH CIRCUIT - FUNCTIONAL DESCRIPTION

General

The engine fire switch includes a solenoid, fire warning lights, and two sets of electrical contacts. One set of contacts controls engine functions. The other set of contacts controls the engine fire extinguishing system.

Solenoid and Warning Light Operation

The solenoid energizes if an engine has a fire. This releases the fire switch so you can pull it. The engine fire warning lights come on to help you identify the correct switch to use.

The same condition normally occurs in both engine fire switches while you do a fire/overheat test.

The solenoid also energizes when the battery switch is ON and the fuel control switch is in CUTOFF.

You can override the solenoid with the engine fire override switch.

Out Position

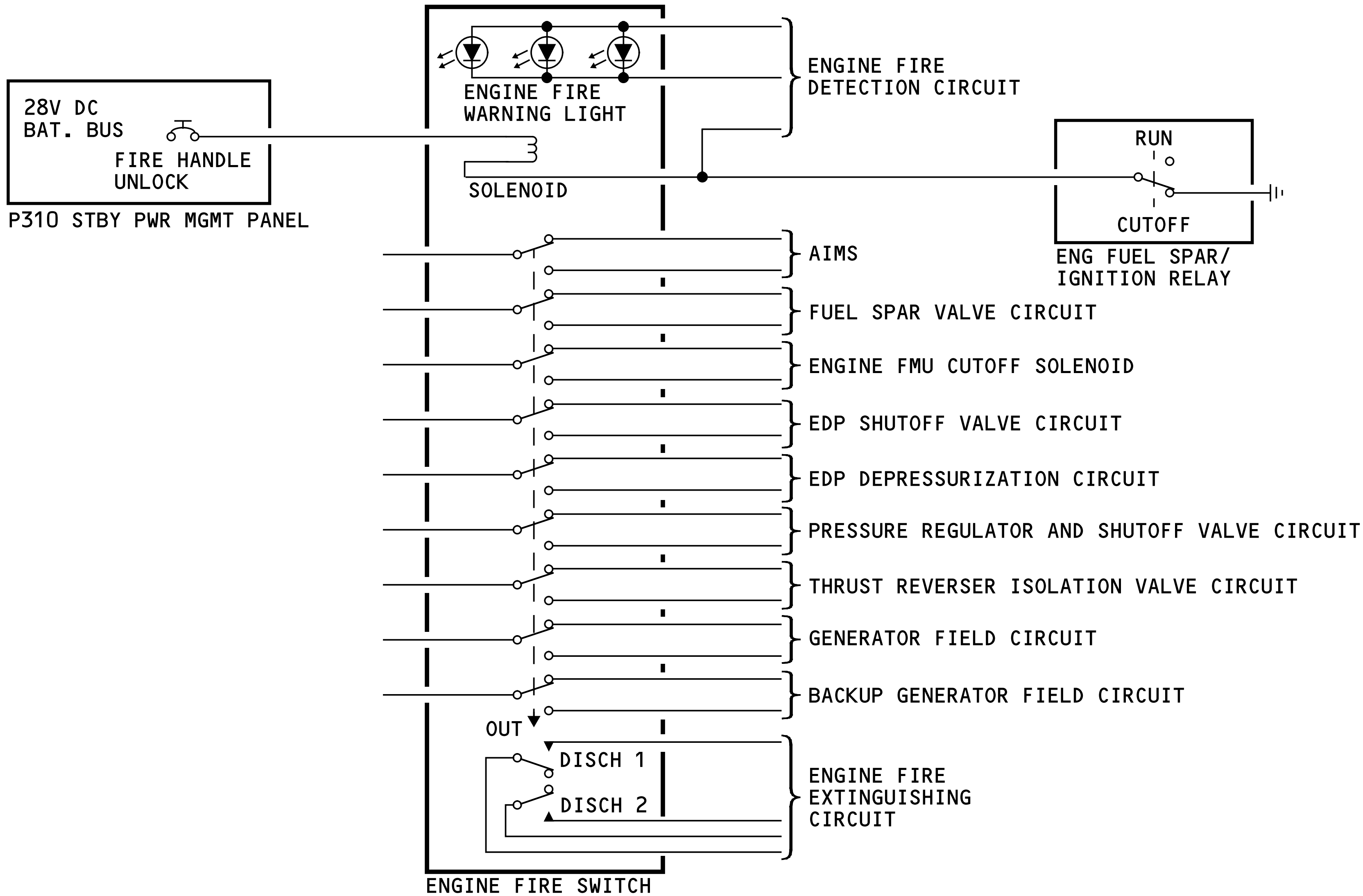
When you pull the fire switch, this is how the switch isolates the engine:

- Closes the fuel spar valve
- De-energizes the engine fuel metering unit (FMU) cutoff solenoid
- Closes the engine hydraulic pump shutoff valve
- Depressurizes the engine driven hydraulic pump valve
- Closes the pressure regulator and shutoff valve
- Removes power from thrust reverser isolation valve
- Trips the generator field
- Trips the backup generator field.

A signal to the AIMS cancels messages related to these isolation functions.

Discharge Positions

The DISCH 1 position fires the squib for bottle 1. The DISCH 2 position fires the squib for bottle 2.



26-21-00-008 Rev 2 09/08/1997

ENGINE FIRE EXTINGUISHING - ENGINE FIRE SWITCH CIRCUIT - FUNCTIONAL DESCRIPTION

Bottle Discharge

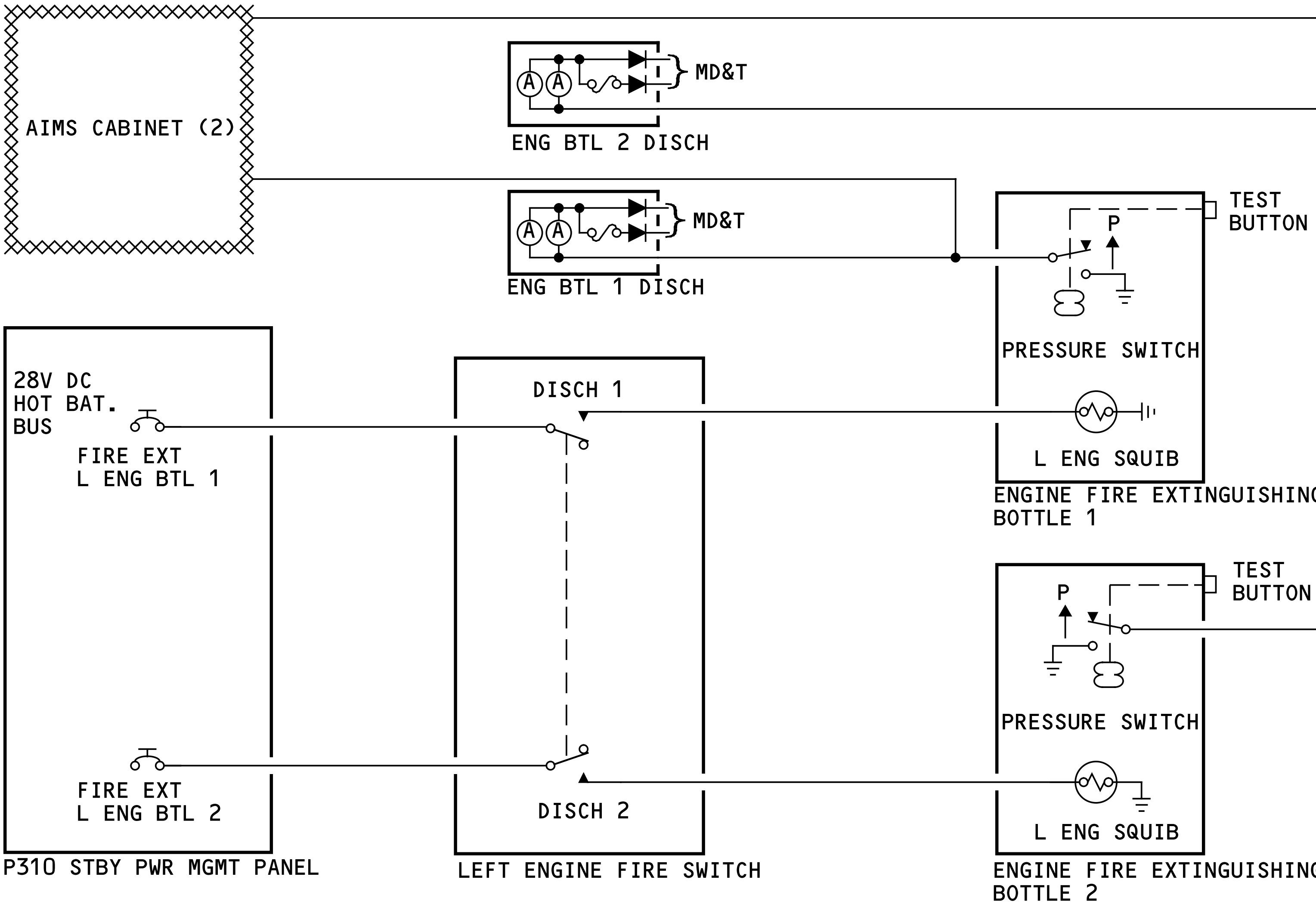
The engine fire switch supplies power from the hot battery bus to the engine fire extinguishing bottle squibs. The DISCH 1 position fires the squib for bottle 1. The DISCH 2 position fires the squib for bottle 2.

Discharge Indication

When pressure inside the bottle decreases, the pressure switch closes and makes a ground for the discharge indicator light. The ground also causes AIMS to show advisory and status messages.

Training Information Point

You can do a check of the pressure switch circuit on the ground. Push and hold the test button to close the switch. The bottle discharge light in the flight deck should come on. Bottle discharge advisory and status messages should show.



26-21-00-009 Rev 0

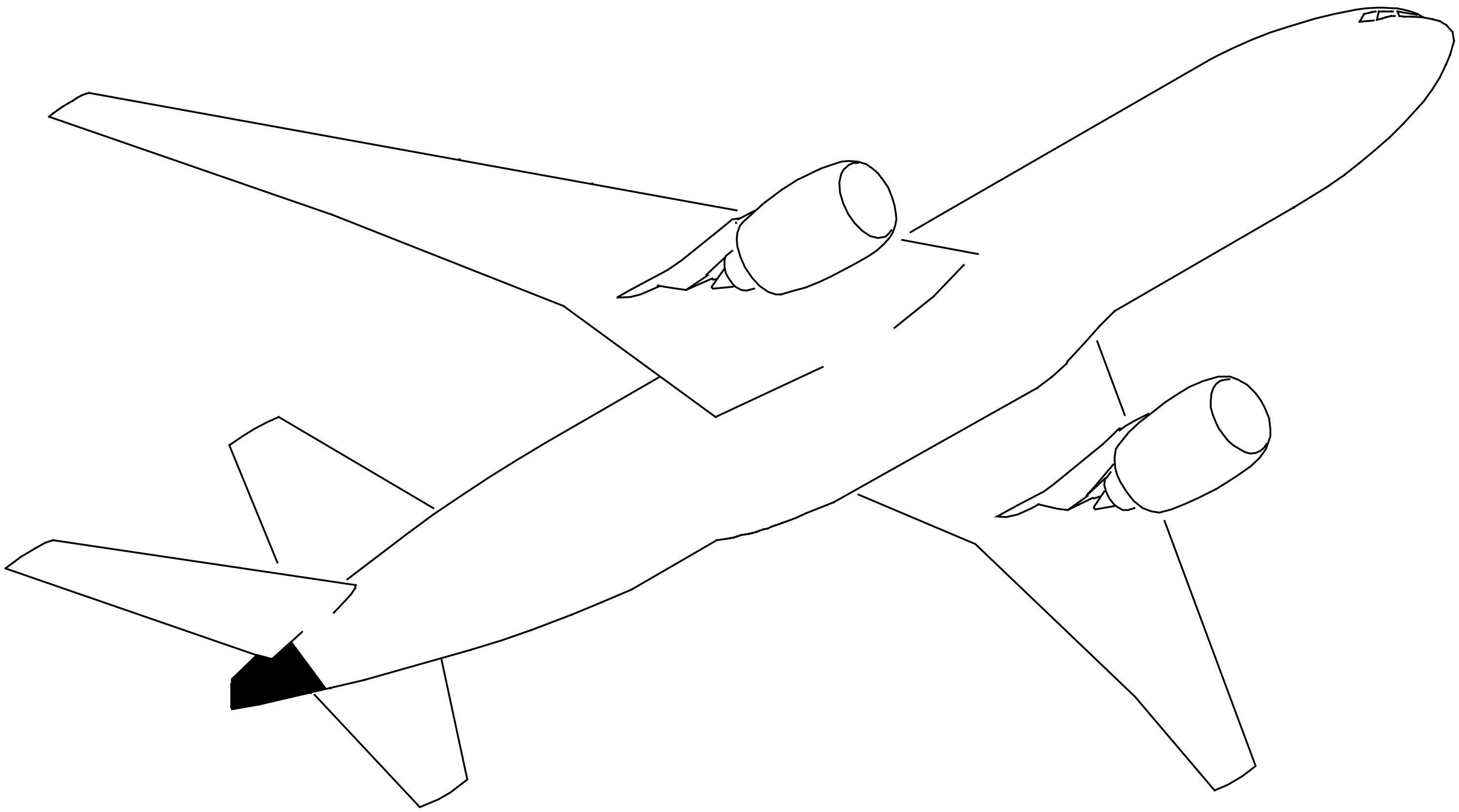
ENGINE FIRE EXTINGUISHING - FUNCTIONAL DESCRIPTION - ENGINE FIRE EXTINGUISHING CIRCUIT

APU FIRE DETECTION - INTRODUCTION

Purpose

The APU fire detection system warns the flight or ground crew of an APU fire. The APU stops automatically if there is a fire.

If a fire occurs on the ground and the engines are not running, the APU fire extinguisher discharges automatically. This permits unattended operation of the APU.



APU FIRE DETECTION - INTRODUCTION

APU FIRE DETECTION - GENERAL DESCRIPTION

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APU FIRE DETECTION - GENERAL DESCRIPTION

General

The APU fire detection system has these components:

- APU fire detectors
- Fire detection card - APU.

There are two modes of operation: unattended mode and attended mode. A signal from the electrical load management system (ELMS) puts the card in the unattended mode when the airplane is on the ground with the engines not running. When the airplane is in the air, or an engine is running, the system operates in the attended mode.

Built-in-test equipment does tests of the system. Faults cause alert messages, status messages, and maintenance messages. Use the fire/overheat test switch to do a manual test of the system. See the fire protection section for more information about the fire/ overheat test (AMM PART I 26-00).

Fire Detection Loops

The APU has two fire detection loops, loop 1 and loop 2. The APU fire detection card continually monitors the two loops for faults. If there are no faults, the card monitors both loops for fires. This is dual loop operation.

If a loop fails, the card sends the data to the AIMS. Status and maintenance messages show. The system changes to single loop operation and monitors only the loop that has not failed. Fire alarms occur if the loop that has not failed has a fire.

Operation

If there is an APU fire, the detection card sends an alarm signal to these components and systems:

- The electrical load management system (ELMS)
- The APU controller
- The AIMS
- The warning electronics system (WES).

The ELMS and the APU controller stop the APU. The AIMS causes a warning message. The WES turns on the master warning lights and the fire warning aural.

A second fire alarm signal turns on the APU fire warning light in the fire switch. If the airplane is on the ground, a warning horn and a light come on at the P40 service and APU shutdown panel.

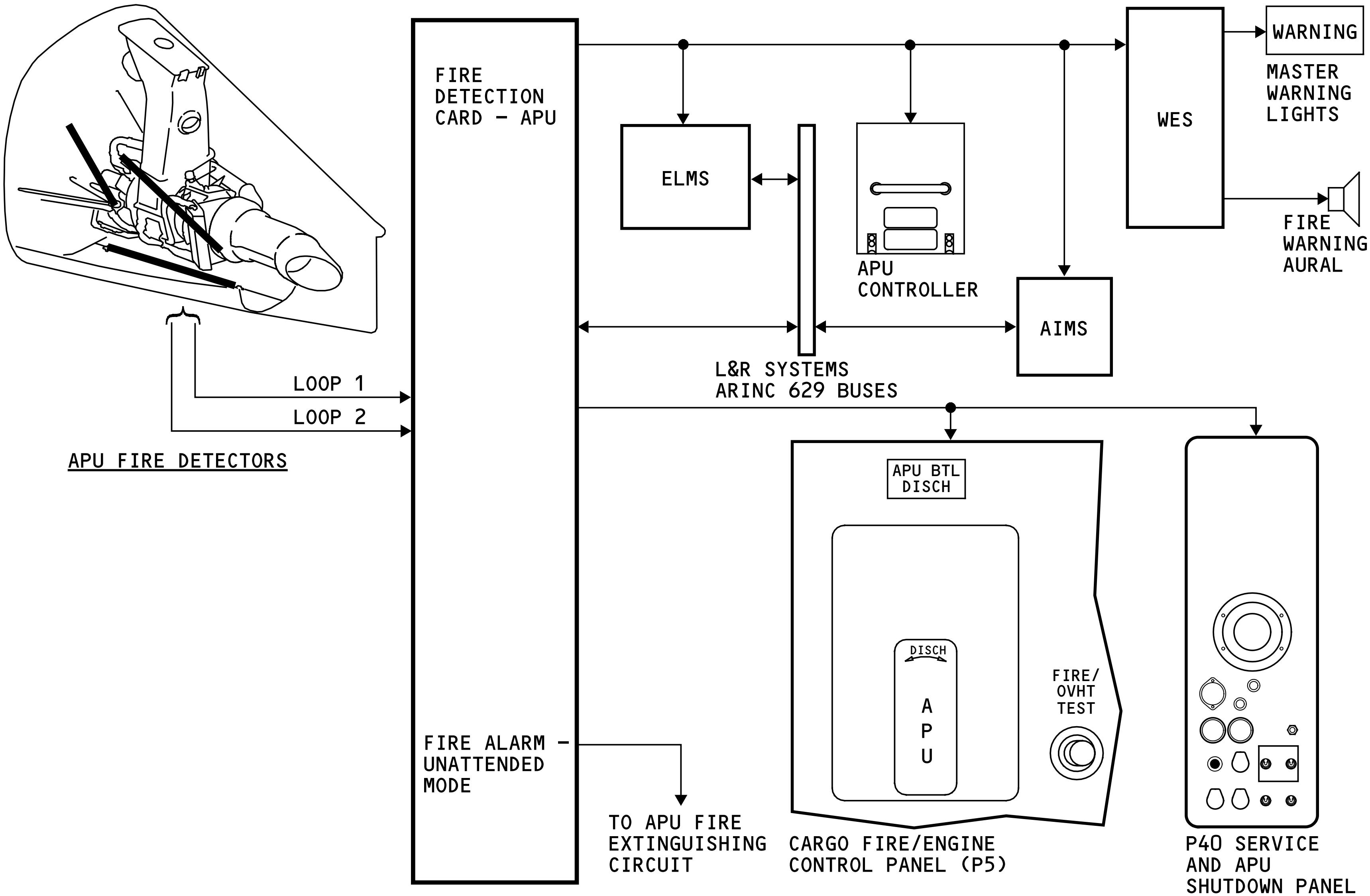
Attended Mode

Normal operation in the attended mode is dual loop with AND logic. Loop 1 AND loop 2 both must have a fire to cause fire alarms. AND logic helps prevent false alarms. A crew member decides whether or not to use the fire extinguishing system.

APU FIRE DETECTION - GENERAL DESCRIPTION

Unattended Mode

Normal operation in the unattended mode is dual loop with OR logic. Loop 1 OR loop 2 must have a fire to cause fire alarms. OR logic gives maximum safety for unattended operation. The fire extinguishing system operates automatically.



26-15-00-002 Rev 3

APU FIRE DETECTION - GENERAL DESCRIPTION

APU FIRE DETECTION - FLIGHT DECK AND MEC COMPONENT LOCATIONS

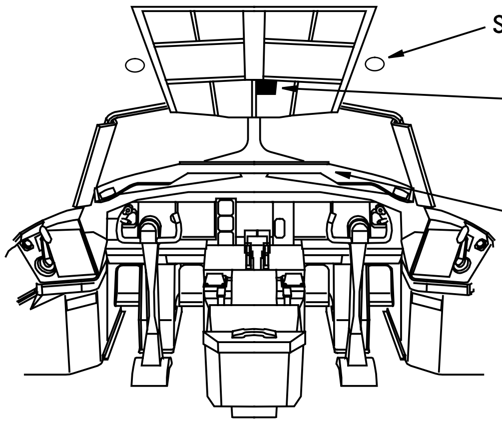
Flight Deck Component Locations

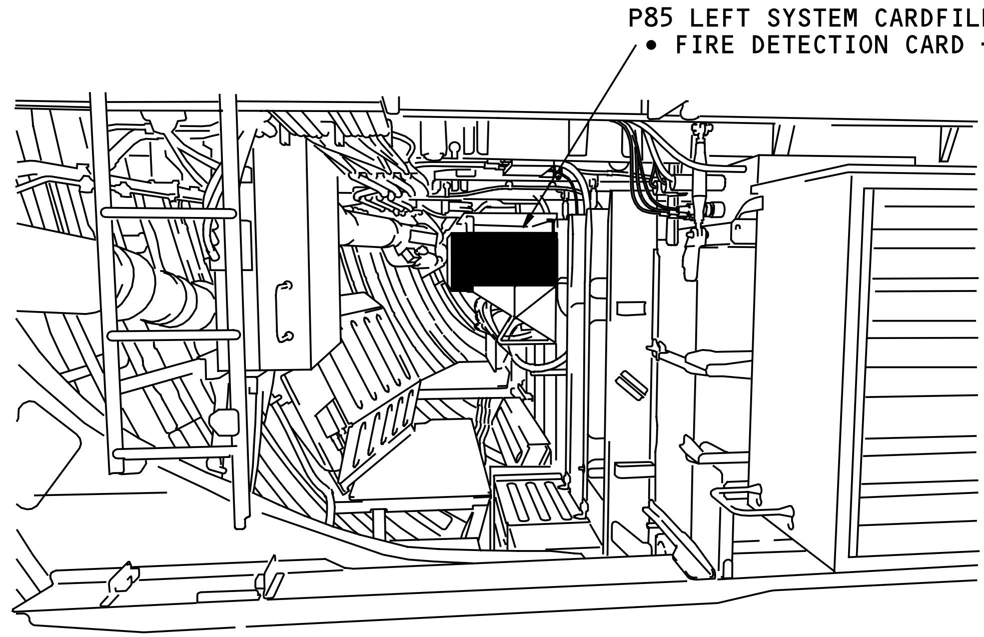
The components in the flight deck that have an interface with the APU fire detection system are:

- Speakers
- Fire/overheat test switch
- Master warning lights
- APU fire warning light.

MEC Component Locations

The APU fire detection card is in the MEC.





MEC (LEFT SIDE, LOOKING FORWARD)

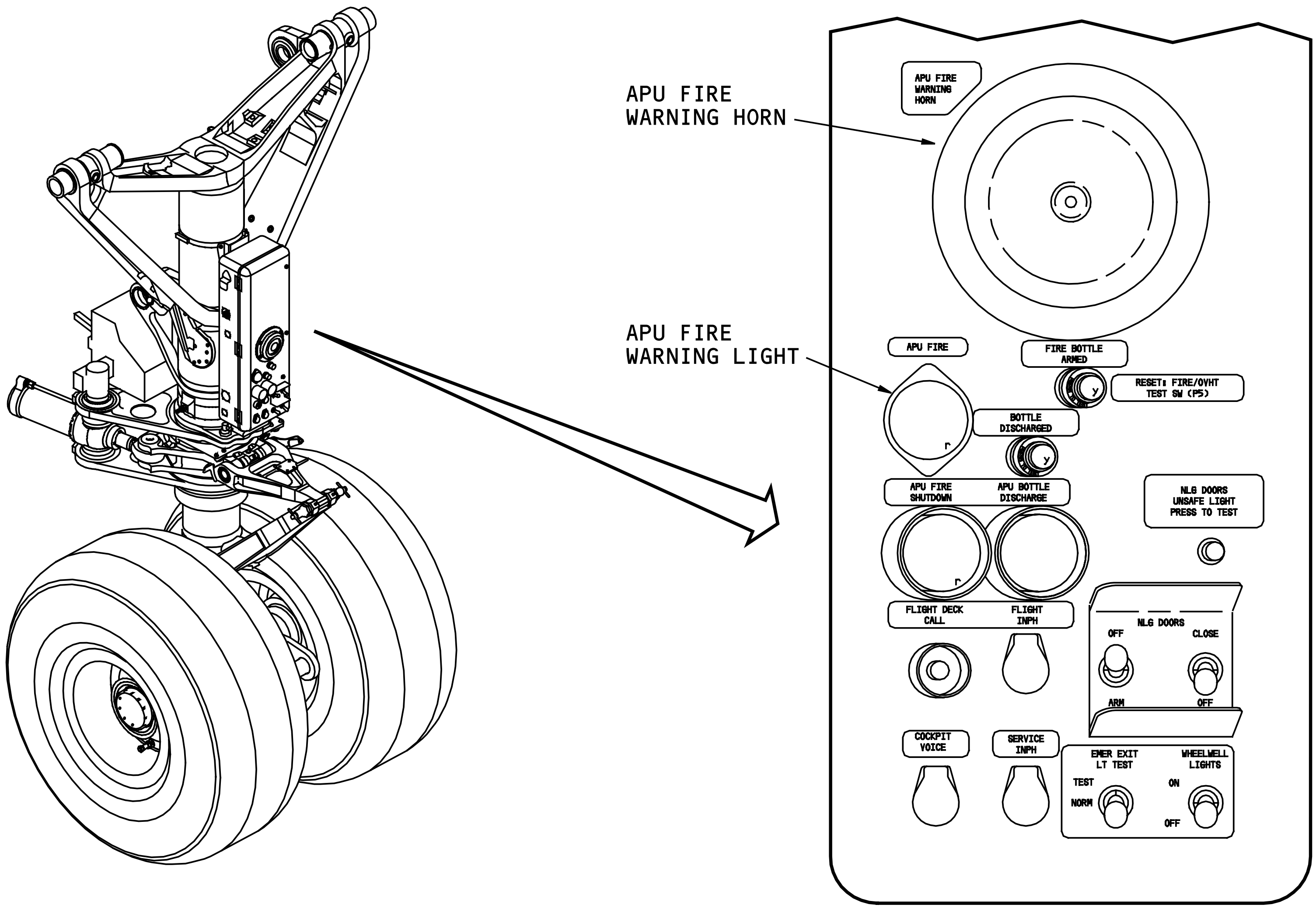
26-15-00-003 Rev 1

APU FIRE DETECTION - FLIGHT DECK AND MEC COMPONENT LOCATIONS

APU FIRE DETECTION - NOSE LANDING GEAR COMPONENT LOCATIONS

Nose Landing Gear Component Location

The P40 service and APU shutdown panel is on the nose landing gear. The panel has an APU fire warning horn and an APU fire warning light.



NOSE LANDING GEAR

P40 SERVICE AND APU SHUTDOWN PANEL

APU FIRE DETECTION - NOSE LANDING GEAR COMPONENT LOCATIONS

26-15-00-004 Rev 1

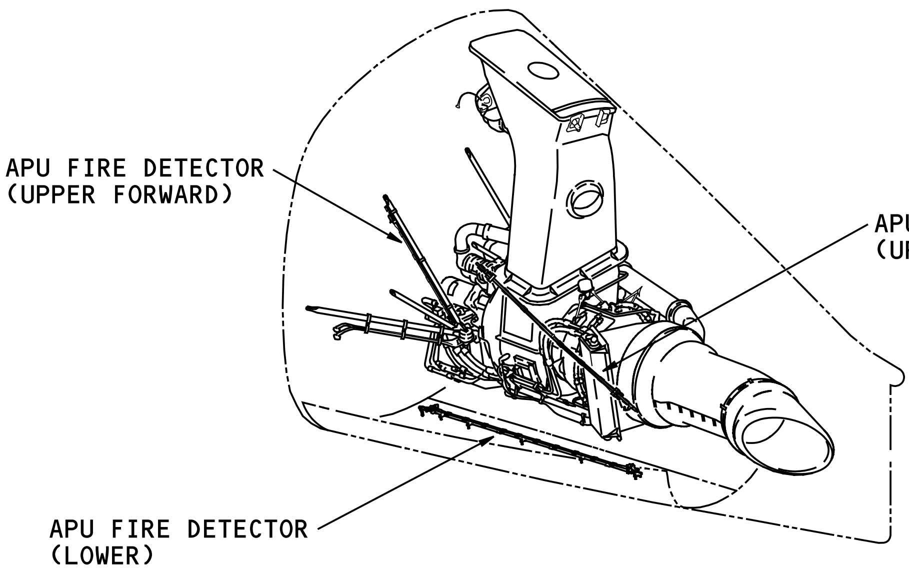
APU FIRE DETECTION - APU COMPONENT LOCATIONS

Component Locations

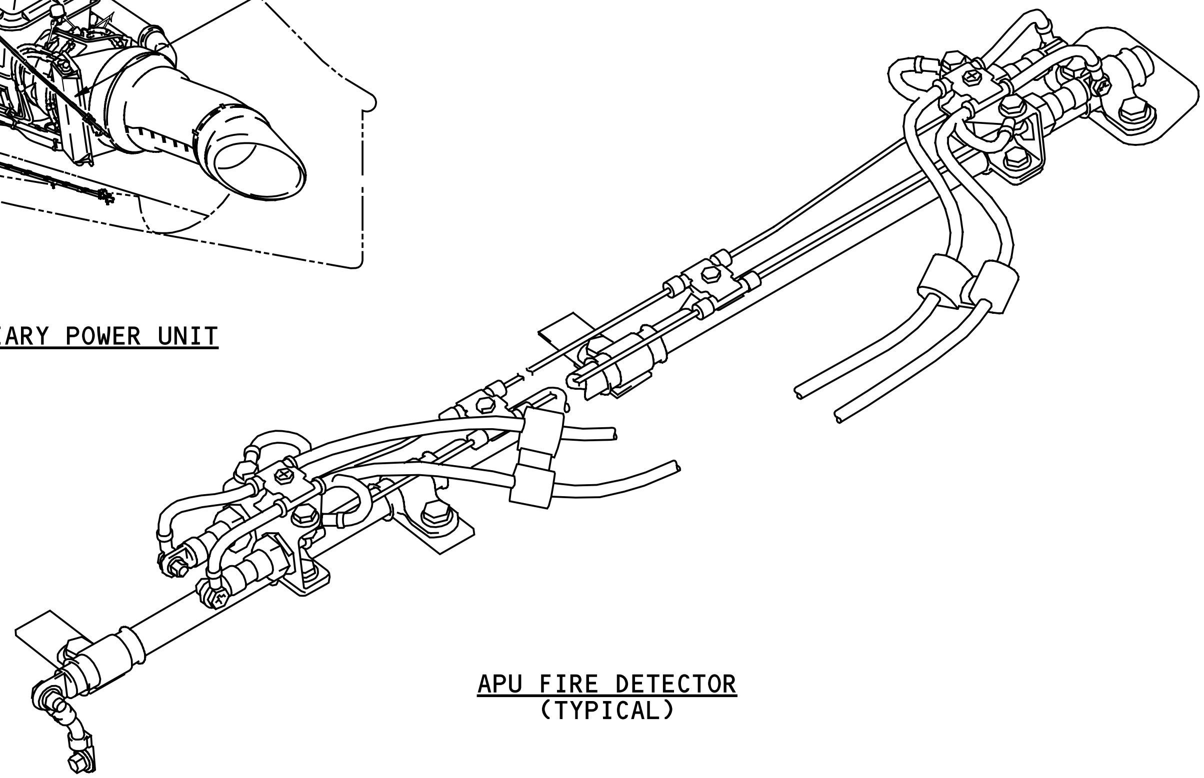
These are the APU fire detection system components in the APU compartment:

- APU fire detector - upper forward
- APU fire detector - upper aft
- APU fire detector - lower.

The upper forward detector is on the forward support and vibration isolation mount. The upper aft detector is on the left side of the APU compartment. The lower detector is on the left APU access door.



AUXILIARY POWER UNIT



APU FIRE DETECTOR
(TYPICAL)

APU FIRE DETECTION - APU COMPONENT LOCATIONS

APU FIRE DETECTION - APU FIRE DETECTORS

Purpose

The APU fire detectors monitor the temperature in the APU compartment.

Physical Description

Each detector has two elements attached to a support tube. The elements connect to make loop 1 and loop 2.

The element is an inconel tube filled with a thermistor core material. Two electrical conductors go through the length of the core. One conductor has a ground connection to the tube. The other conductor connects to the APU fire detection card.

Functional Description

As the temperature of the core increases, electrical resistance to ground decreases. If the resistance decreases to the set point, a fire alarm occurs. When the fire is gone, the resistance increases to the reset point and the alarm signal goes away.

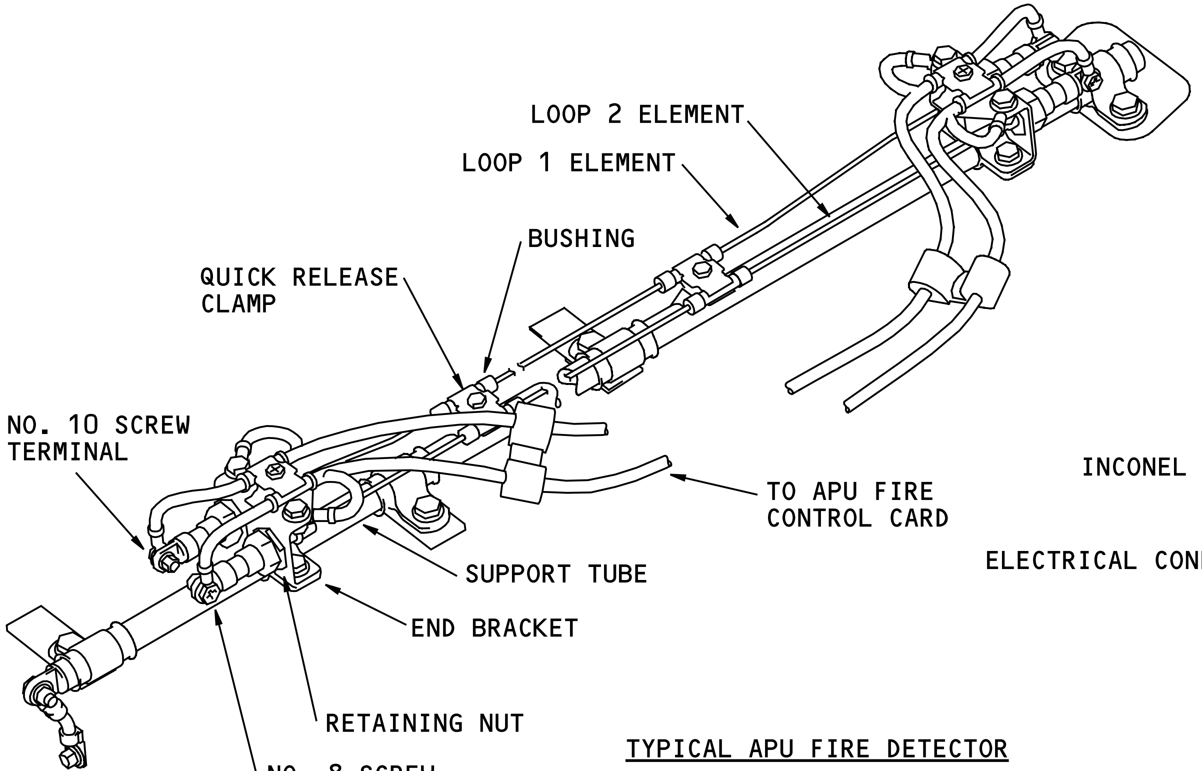
The tables show approximate temperatures in degrees F (and degrees C) which cause a fire alarm. Reset temperatures are also shown.

DETECTOR	FIRE TEMP	RESET TEMP
UPPER FWD	479 (248)	468 (242)
UPPER AFT	511 (266)	499 (259)
LOWER	488 (253)	478 (248)

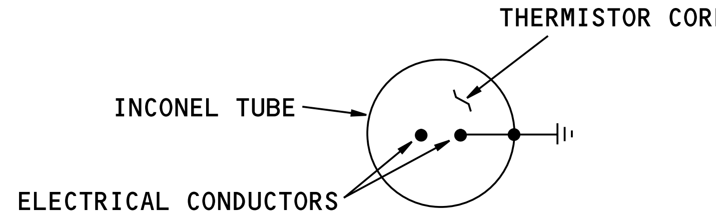
Training Information Point

Each element uses a #10 screw wire-termination on one end and a # 8 screw wire-termination on the other end to prevent crossed wiring. The #10 terminal and the mating wire terminal have a black stripe around the insulation.

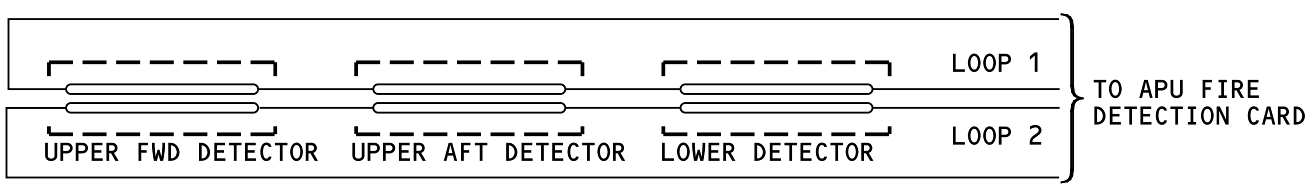
The ends of the element attach to the support tube bracket with retaining nuts. Quick-release clamps and bushings support the element along its length.



TYPICAL APU FIRE DETECTOR



ELEMENT CROSS-SECTION



APU FIRE DETECTION LOOP CIRCUITS

APU FIRE DETECTION - APU FIRE DETECTORS

APU FIRE DETECTION - FIRE DETECTION CARD - APU

Purpose

The APU fire detection card has these purposes:

- Operate in attended or unattended mode
- Monitor the detectors for a fire condition
- Monitor the detectors for failures and send the data to AIMS
- Set the correct logic for the loops (and/or logic)
- Do tests of the APU fire detection system.

Location

The APU fire detection card is in the P85 system card file in the A9 slot. The cardfile slots have labels.

Fire Detection Circuits

The fire detection circuit monitors the resistance of the detector element thermistor core. The resistance of the core is normally high. If the resistance goes low, the card supplies a FIRE output.

A short circuit in the loop also cause low resistance. The rate at which the resistance changes identifies an electrical short or a fire. A short circuit causes the resistance to decreases quickly. A fire causes the resistance to decrease more slowly.

If the resistance decreases quickly, the circuit supplies a SHORT output for the life of the short circuit. If the short circuit stays for more than 0.2 seconds, the circuit supplies a DESELECT output. A deselect output also occurs if a power-up BIT finds an open circuit in the loop.

Program Logic Device

The program logic device gives attended or unattended mode of operation. A signal from the ARINC 429 receiver puts the device in the correct mode.

The device sets the correct logic for the fire detection circuits. Dual-loop operation is normal. If a detection circuit sends a short, deselect, or power loss signal, the logic device changes to single-loop operation.

The program logic device supplies the fire alarm signals to the other circuits which have interfaces with the card.

Attended Mode Operation

The program logic device operates with AND logic. Loop 1 and loop 2 both must have a fire to cause the alarms. The table shows alarm and fault conditions:

APU FIRE DETECTION - FIRE DETECTION CARD - APU

ATTENDED MODE - AND LOGIC		
LOOP 1	LOOP 2	CARD OUTPUT
NORMAL	NORMAL	-
FIRE	NORMAL	FAULT (SEE TEXT)
FIRE	FIRE	ALARM
NORMAL	FIRE	FAULT (SEE TEXT)
FAULT	NORMAL	FAULT - LOOP 1
NORMAL	FAULT	FAULT - LOOP 2
FIRE	FAULT	ALARM
FAULT	FIRE	ALARM
FAULT	FAULT	FAULT - BOTH LOOPS

If one loop reports a fire and the other loop is normal, a 15 second timer starts. During this time, if the loop status changes from fire to normal, the timer stops. If the status of the normal loop changes to fire, the card sends a fire alarm.

If neither loop changes status in 15 seconds, the card does a test of the normal loop. If the test fails, the card removes the selection of that loop and sends a fire alarm. If the test passes, the card removes the selection of the other loop and reports a fault.

Unattended Mode Operation

The program logic device operates with OR logic. A fire at loop 1 OR loop 2 causes fire alarms. The table shows alarm and fault conditions:

UNATTENDED MODE - OR LOGIC		
LOOP 1	LOOP 2	CARD OUTPUT
NORMAL	NORMAL	-
FIRE	NORMAL	ALARM
FIRE	FIRE	ALARM
NORMAL	FIRE	ALARM
FAULT	NORMAL	FAULT - LOOP 1
NORMAL	FAULT	FAULT - LOOP 2
FIRE	FAULT	ALARM
FAULT	FIRE	ALARM
FAULT	FAULT	FAULT - BOTH LOOPS

The unattended fire alarm signal causes the fire extinguishing system to operate automatically.

Built-In-Test Circuit

BIT continuously monitors the fire detection circuits. The ARINC 429 transmitter sends failure data to the AIMS as soon as BIT finds the condition.

BIT also does a test of the full fire detection system:

- At power-up
- After power interrupt
- Every five minutes of operation.

BIT signals a fire on both loops at the same time and does a check of the system. The ARINC 429 transmitter sends a fire alarm signal to AIMS. The central maintenance computing system (CMCS) uses this signal to

APU FIRE DETECTION - FIRE DETECTION CARD - APU

make sure the fire detection system transmits ARINC data. Fire warnings and APU shutdown do not occur during the tests.

If there is a failure, the ARINC 429 transmitter sends the data to the AIMS.

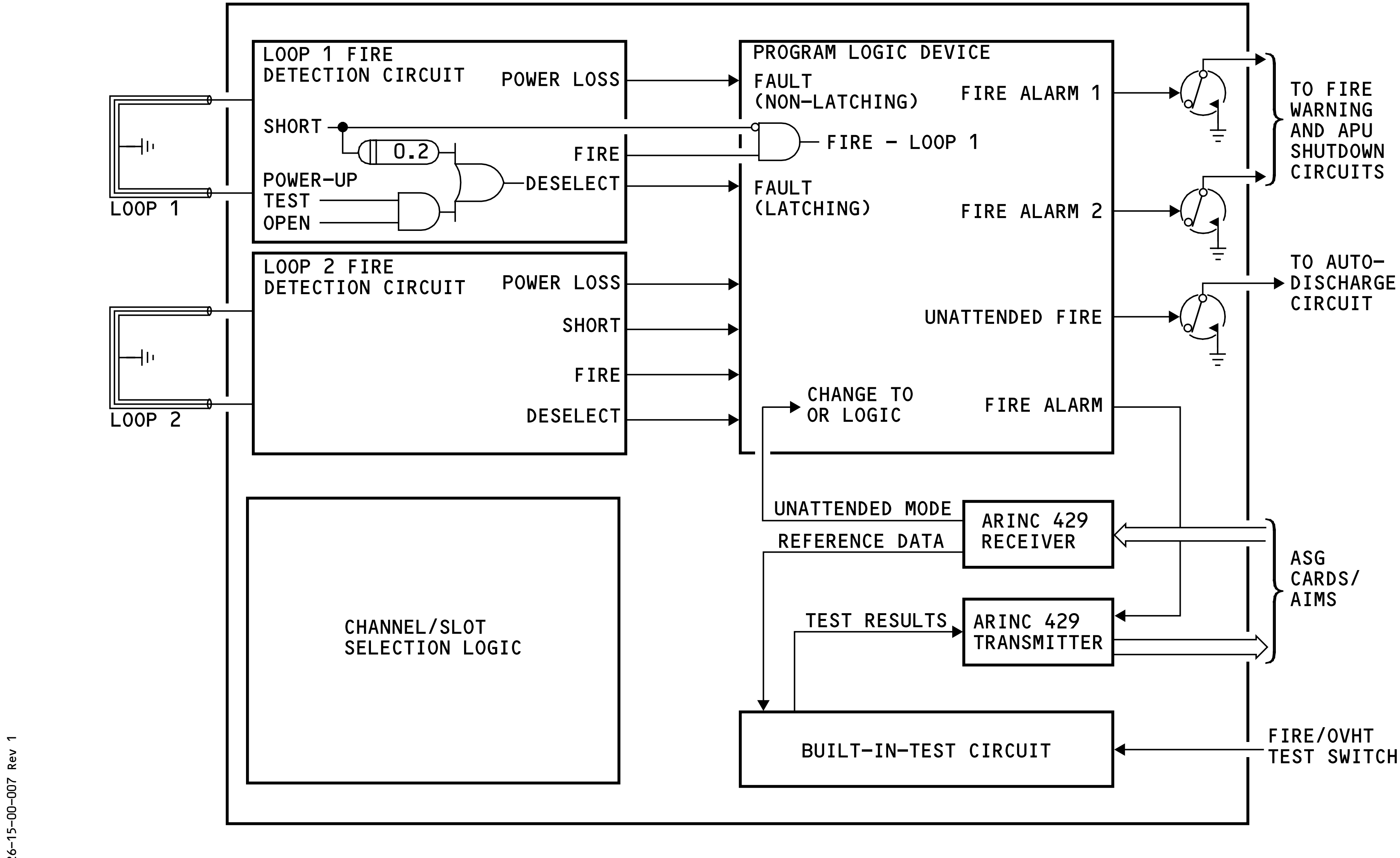
The system changes to single loop operation if necessary.

The fire/overheat test switch starts a similar test. If there is a failure, the ARINC 429 transmitter sends the data to the AIMS. Fire warnings occur during this test.

Training Information Point

The engine and APU fire detection cards function differently but are interchangeable. Program pins in the cardfile have an interface with the channel/slot selection logic circuit. This circuit tells the card whether to function as an APU or engine fire detection card.

The fire detection cards are electrostatic discharge sensitive (ESDS) devices. Be careful to obey the procedures in part II of the maintenance manual (Standard Practices - Airframe, Electrostatic Discharge Sensitive Devices - Maintenance Practices) before you touch the cards.



APU FIRE DETECTION - FIRE DETECTION CARD - APU

APU FIRE DETECTION - FUNCTIONAL DESCRIPTION - P40 PANEL INDICATION CIRCUIT

General

Fire indications at the P40 service and APU shutdown panel are different on the ground and in the air. For both conditions, the battery bus supplies power to the circuit through the APU fire switch in the flight deck.

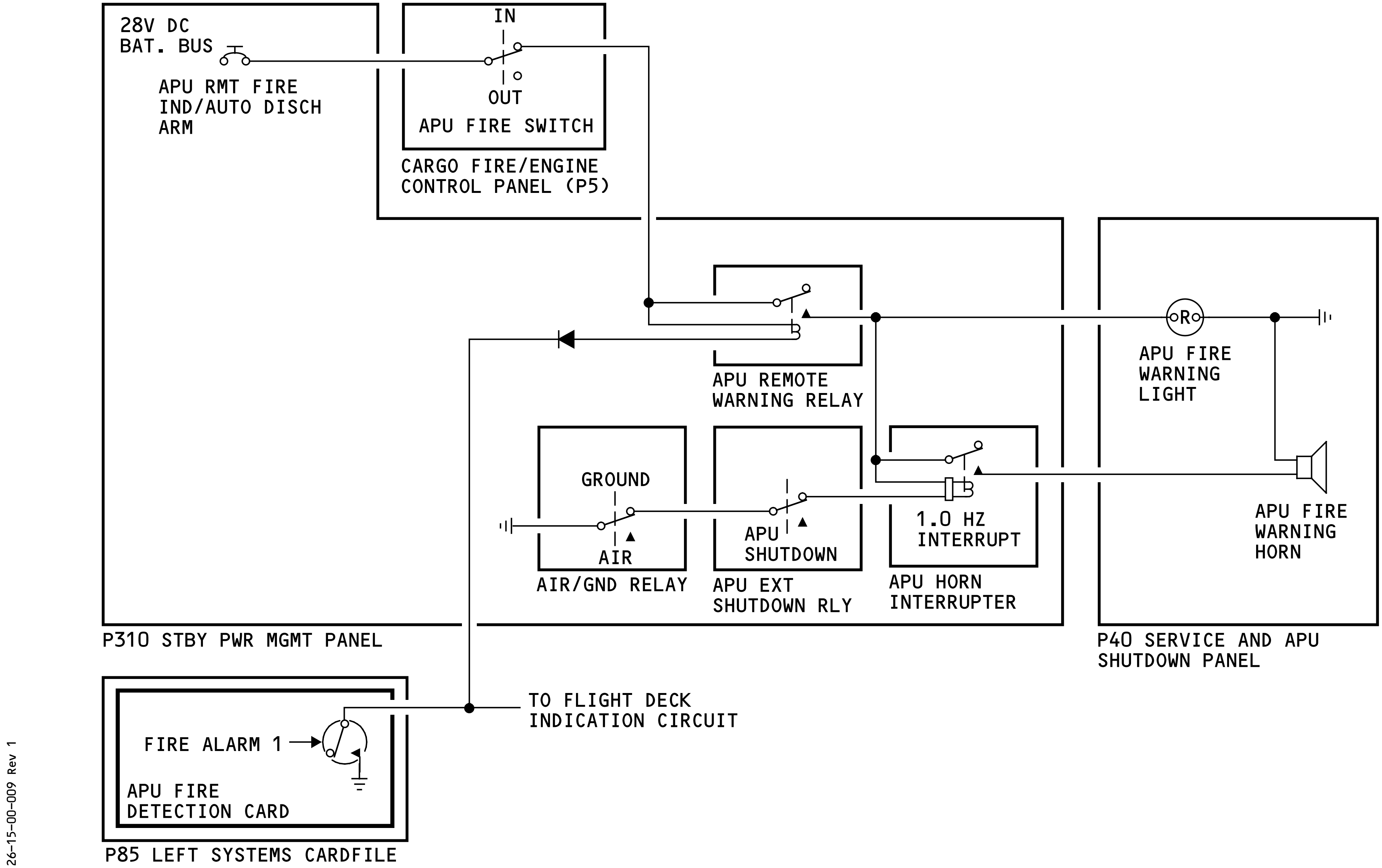
Ground Operation

If there is an APU fire, the APU fire detection card makes a ground for the APU remote warning relay. The relay energizes and supplies power to the APU fire warning light and the horn interrupter. If the airplane is on the ground and the APU external shutdown relay is not energized, the APU horn interrupter energizes. This supplies power to the APU fire warning horn. The horn interrupter causes the warning horn to sound intermittently.

If you pull the APU fire switch in the flight deck, the warnings at the P40 service and APU shutdown panel go away. If you push the APU fire shutdown switch on the P40 panel, the APU external shutdown relay energizes and stops the horn.

Air Operation

In flight, the air/ground relay is in the AIR position. The warning horn does not operate.



APU FIRE DETECTION - FUNCTIONAL DESCRIPTION - P40 PANEL INDICATION CIRCUIT

APU FIRE DETECTION - INDICATIONS

Flight Deck Indications

If there is an APU fire, these indications occur in the flight deck:

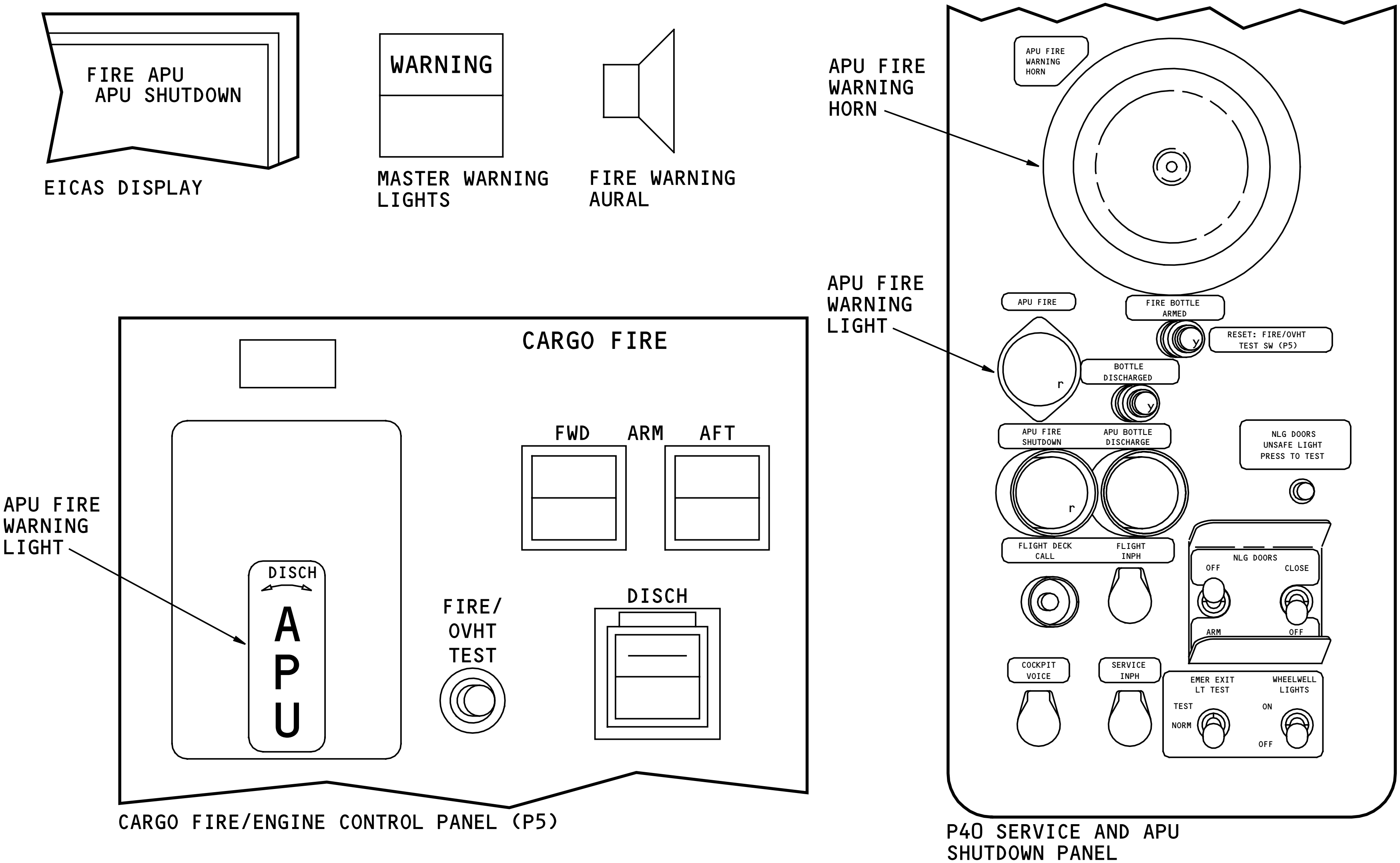
- The master warning lights come on
- The fire warning aural operates
- An APU fire EICAS warning message shows
- The APU fire warning light comes on.

Also, because the APU stops automatically, the APU fault light comes on and an EICAS advisory message shows APU shutdown.

Service and APU Shutdown Panel Indications

If the airplane is on the ground, these indications occur at the P40 service and APU shutdown panel:

- The APU fire warning horn operates intermittently
- The APU fire warning light comes on.



26-15-00-010 Rev 1

APU FIRE DETECTION - INDICATIONS

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APU FIRE EXTINGUISHING - APU FIRE EXTINGUISHING BOTTLE

Purpose

The APU fire extinguishing bottle contains the halon fire extinguishing agent.

Location

The fire extinguishing bottle is on the forward side of the APU firewall, inside the control bay access door.

Physical Description

The fire extinguishing bottle has these components:

- A safety relief and fill port
- An identification plate
- A pressure switch
- A handle
- Two squibs
- Two discharge assemblies
- Four mounting brackets.

The APU fire extinguishing bottle is interchangeable with the engine fire extinguishing bottles. Caps cover one squib and discharge port.

Functional Description

The bottle contains halon fire extinguishing agent pressurized with nitrogen. If the pressure in the bottle becomes too high, the safety relief and fill port opens so the bottle does not explode.

The discharge assembly has an explosive squib. An electric current from the fire extinguishing circuit fires the squib. This releases the halon through the discharge port.

The pressure switch gives control panel indications when bottle pressure decreases. The switch monitors the pressure inside the bottle and is normally open. When the bottle pressure decreases because of a leak or because of bottle discharge, the switch closes an indicating circuit.

Training Information Point

A special service platform is available to use during bottle replacement.

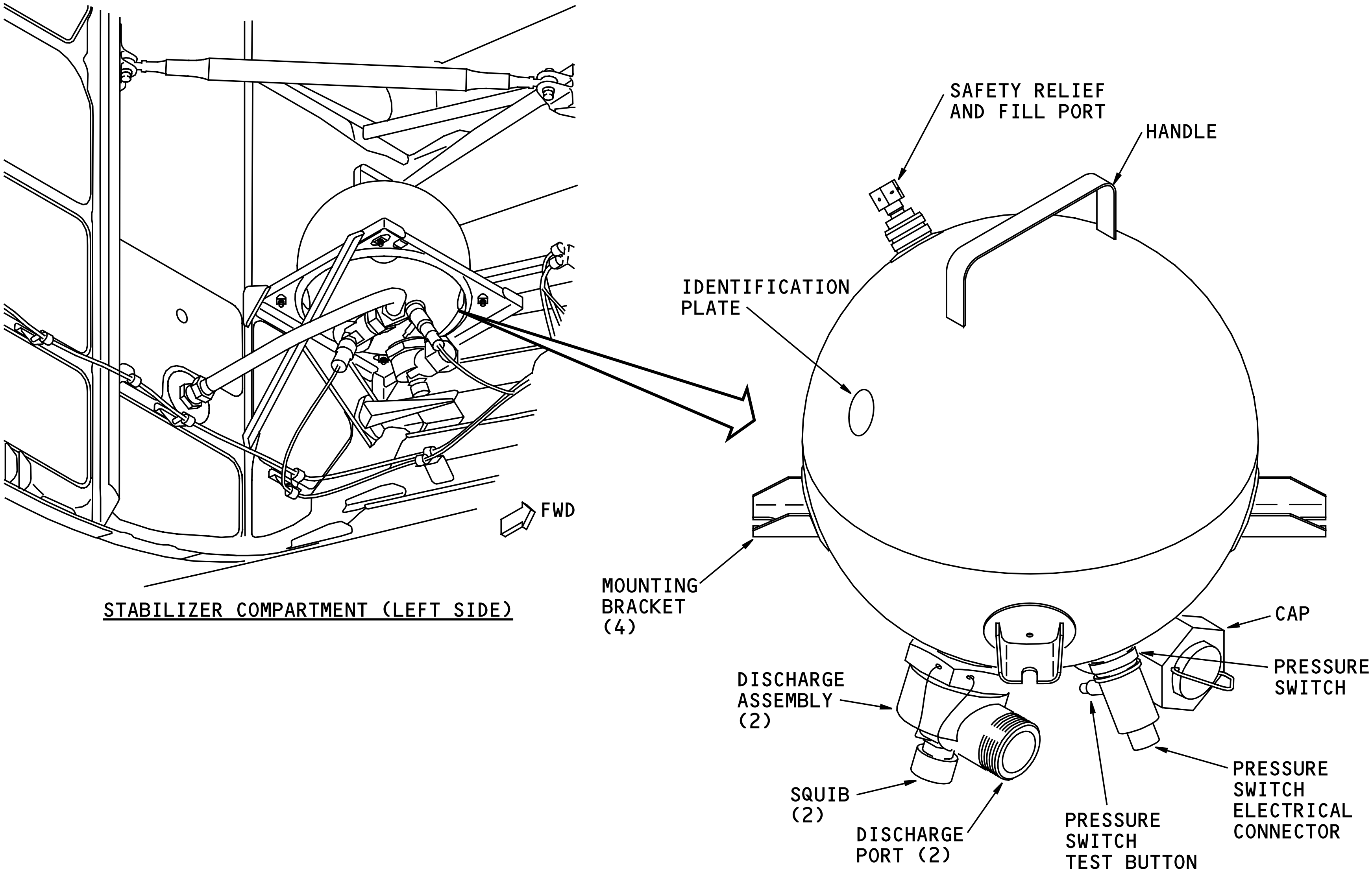
When you replace the bottle, compare the weight of the new bottle with the weight on the bottle identification plate. This prevents installation of a bottle which is not full.

The fire extinguishing bottle must have a hydrostatic test every 5 years. The date of the last test is on one of the mounting brackets and on an inspection tag. The tag is attached to one of the discharge assemblies.

APU FIRE EXTINGUISHING - APU FIRE EXTINGUISHING BOTTLE

WARNING: BE CAREFUL WHEN YOU MOVE THE FIRE EXTINGUISHING BOTTLE. THE FIRE EXTINGUISHING BOTTLE IS HIGHLY PRESSURIZED AND HAS AN EXPLOSIVE CARTRIDGE AS A COMPONENT. ACCIDENTAL DISCHARGE OF THE FIRE EXTINGUISHING BOTTLE CAN CAUSE INJURY TO PERSONS OR DAMAGE TO EQUIPMENT.

WARNING: STAY OFF THE CONTROLS BAY ACCESS DOOR, 313AL. YOUR WEIGHT CAN RELEASE THE SPRING-LOADED LATCHES. IF YOU FALL THROUGH THE DOOR, INJURIES WILL OCCUR.



26-22-00-005 Rev 3 05/08/96

APU FIRE EXTINGUISHING - APU FIRE EXTINGUISHING BOTTLE

APU FIRE EXTINGUISHING - FUNCTIONAL DESCRIPTION - APU FIRE EXTINGUISHING CIRCUIT

General

The APU fire extinguishing bottle squib fires for three conditions:

- If there is an unattended fire alarm
- If you operate the controls on the P40 service and APU shutdown panel
- If you operate the flight deck fire switch.

For each condition, power comes from the 28v dc hot battery bus.

Unattended Fire Alarm

Fire alarm 1 from the APU control card makes a ground for the APU remote warning relay. The relay energizes if the APU fire switch on P5 is not out. The unattended fire alarm makes a ground for the APU auto fire bottle discharge relay. The relay energizes after a 10 second delay. Power from the hot battery bus goes through the relay contacts to the squib.

Service and APU Shutdown Panel

The APU external shutdown relay energizes when you push the APU fire shutdown switch. The relay latches through its own contact and the fire/overheat test switch. With the relay energized, the fire bottle armed light comes on and power goes to the APU bottle discharge switch. When you push the APU bottle discharge switch, the squib fires.

Flight Deck Fire Switch

With the APU fire switch in the left or right discharge position, power from the hot battery bus fires the squib.

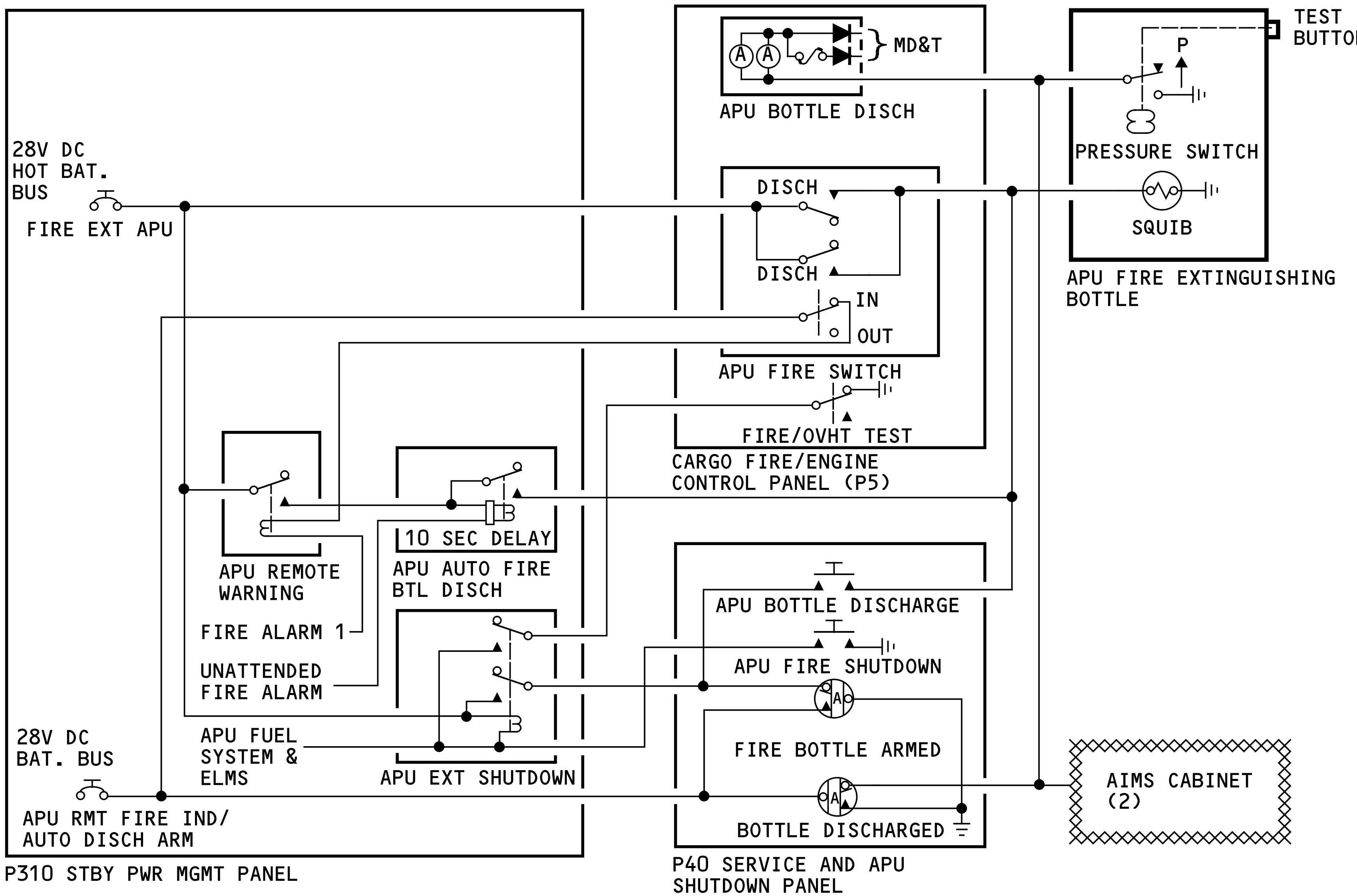
Indications

When pressure inside the bottle decreases, the pressure switch closes and makes a ground for the discharge indicator lights. The ground also causes advisory and status messages to show.

When you push the APU fire shutdown switch, the APU external shutdown relay latches through its own contact and the fire/overheat test switch. A ground for the APU fuel system closes the APU fuel shutoff valve. The ground signal to ELMS causes an EICAS status message. The message shows a remote APU shutdown and stays until you do a fire/overheat test to release the relay. You cannot start the APU with the relay latched.

Training Information Point

You can do a check of the pressure switch circuit on the ground. Push and hold the bottle pressure switch test button to close the switch. The bottle discharge lights on the P5 and P40 panels must come on. Bottle discharge advisory and status messages must show.



26-22-00-011 Rev 0

APU FIRE EXTINGUISHING - FUNCTIONAL DESCRIPTION - APU FIRE EXTINGUISHING CIRCUIT

APU FIRE EXTINGUISHING - OPERATION - P40 SERVICE AND APU SHUTDOWN PANEL

General

If the APU has a fire during ground operation, the APU fire detection system gives a fire warning at the P40 service and APU shutdown panel. The APU fire warning light comes on and the APU fire warning horn operates intermittently.

APU Fire Extinguishing

When you push the APU fire shutdown switch, these things happen:

- The fire extinguishing system arms
- The fire warning horn stops
- If the APU is still running it stops
- The APU fuel shutoff valve closes.

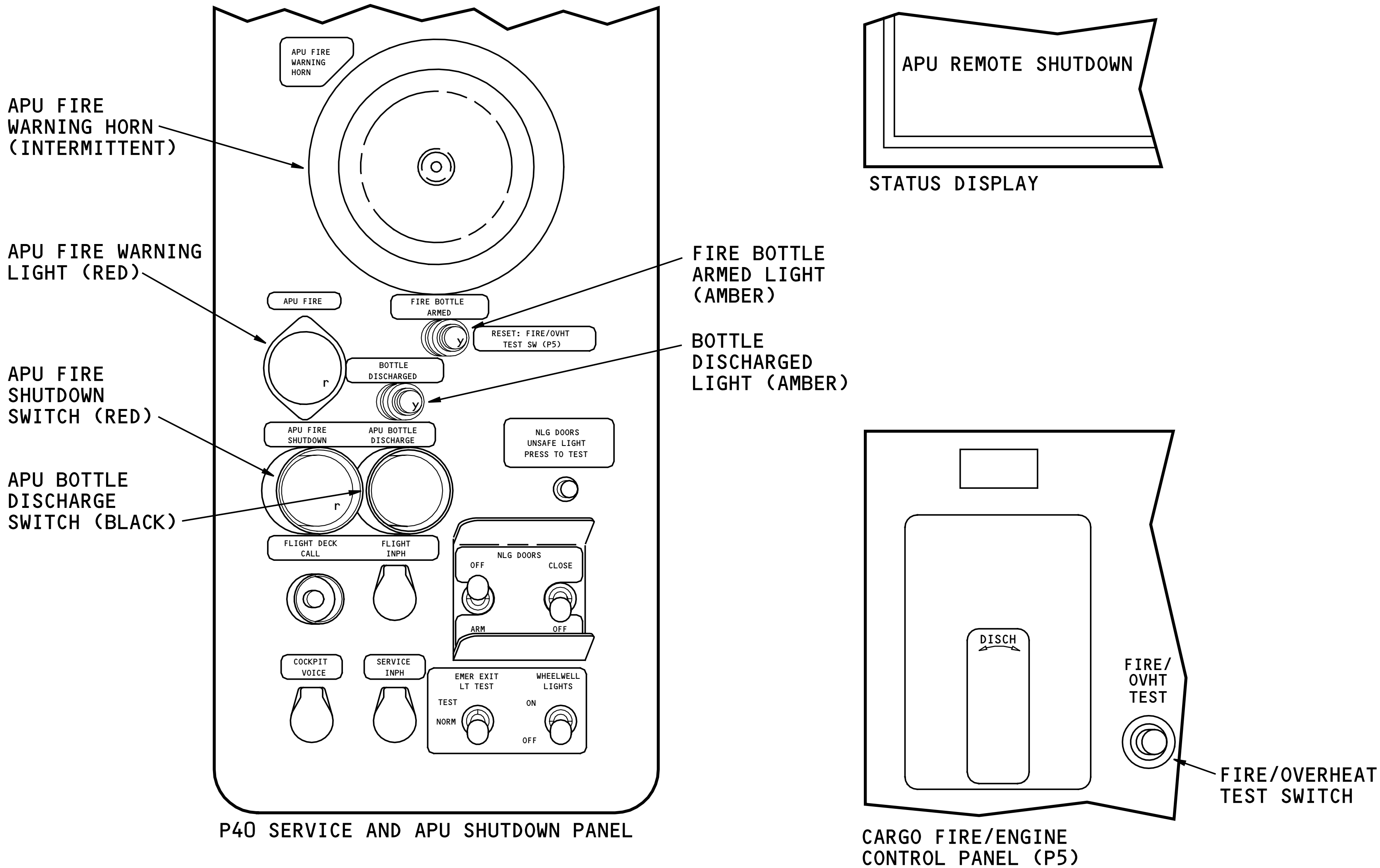
Make sure the fire bottle armed light comes on.

If the fire warning light stays on after you push the fire shutdown switch, push the bottle discharge switch to discharge the fire extinguisher bottle. Make sure the bottle discharged light comes on.

Training Information Point

When you push the APU fire shutdown switch, the circuit latches through the fire/overheat test switch in the flight deck. A status message shows a remote APU shutdown. You cannot start the APU with the circuit latched. Do a fire/overheat test to release the circuit and remove the status message. Also make sure the circuit is released before you replace the fire extinguishing bottle.

NOTE: The APU fire switches connect to the hot battery bus. If you push the APU fire shutdown switch and the bottle discharge switch, the APU fire bottle discharges. This happens with the battery switch ON or OFF, and with or without ground power on the airplane.



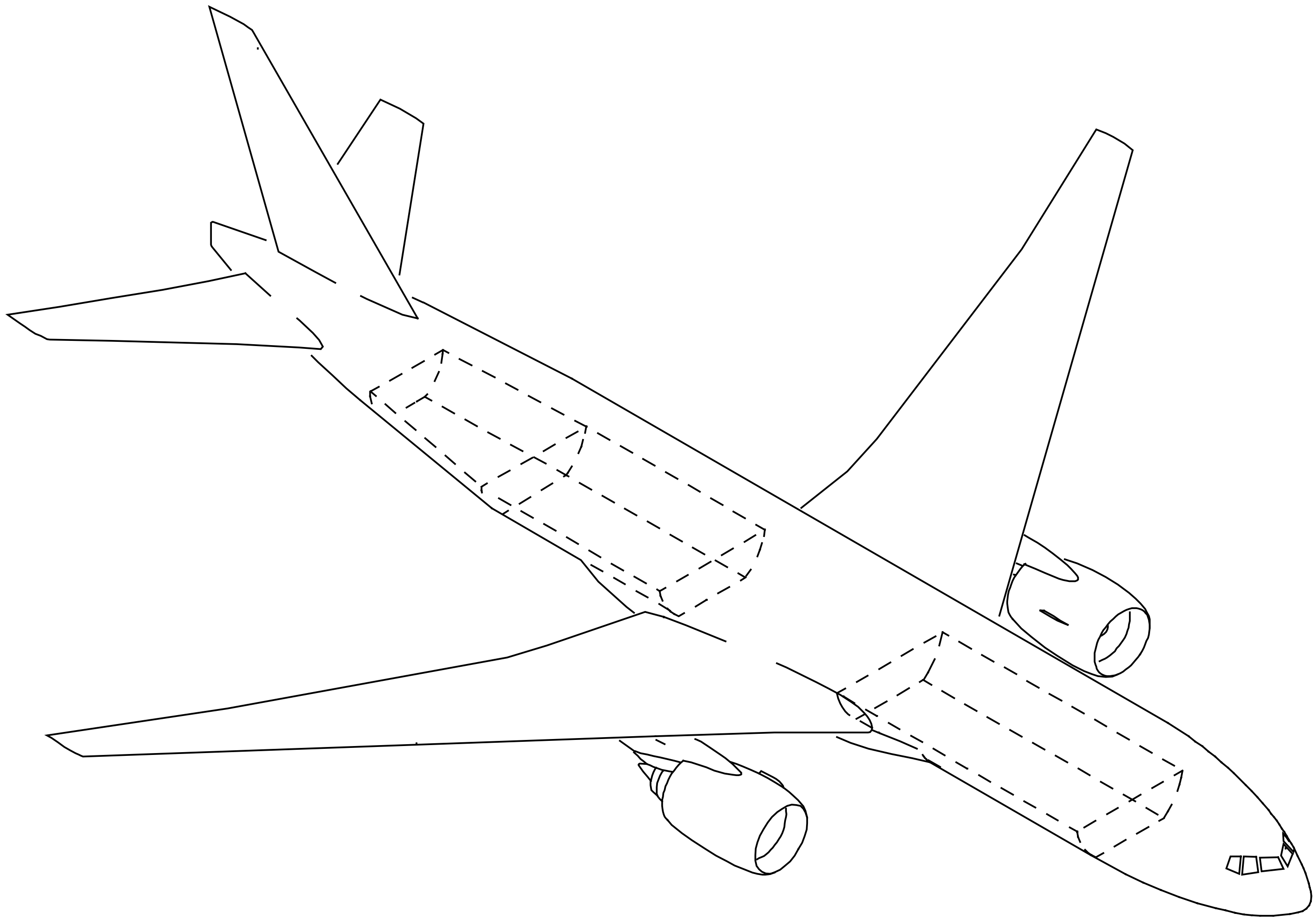
APU FIRE EXTINGUISHING - OPERATION - P40 SERVICE AND APU SHUTDOWN PANEL

LOWER CARGO COMPARTMENT SMOKE DETECTION - INTRODUCTION

Purpose

The lower cargo compartment smoke detection system gives warnings in the flight deck if there is smoke in a lower cargo compartment.

The system also monitors and controls a remote smoke detector for the electronic equipment cooling system.



26-16-00-001 Rev 2 07/08/1997

LOWER CARGO COMPARTMENT SMOKE DETECTION - INTRODUCTION

LOWER CARGO COMPARTMENT SMOKE DETECTION - GENERAL DESCRIPTION

General

The forward and aft lower cargo compartments each have one smoke detector. The smoke detector monitors the cargo compartment air for smoke. Before the air goes in the smoke detector, in-line water separators remove condensation and heaters increase the air temperature.

The forward cargo smoke detector also controls an electrical/electronic cooling smoke detector and supplies electrical power to it.

See the electrical and electronic cooling smoke detection section for more information about the electrical/electronic cooling smoke detector (AMM PART I 26-19).

Interfaces

The lower cargo compartment smoke detection system has these interfaces:

- E/E cooling smoke detector
- Left and right systems card files
- AIMS
- Warning electronics system (WES)
- Overhead panel ARINC 629 system (OPAS)
- Proximity sensor electronics unit (PSEU)
- Equipment cooling system
- Cargo fire/engine control panel.

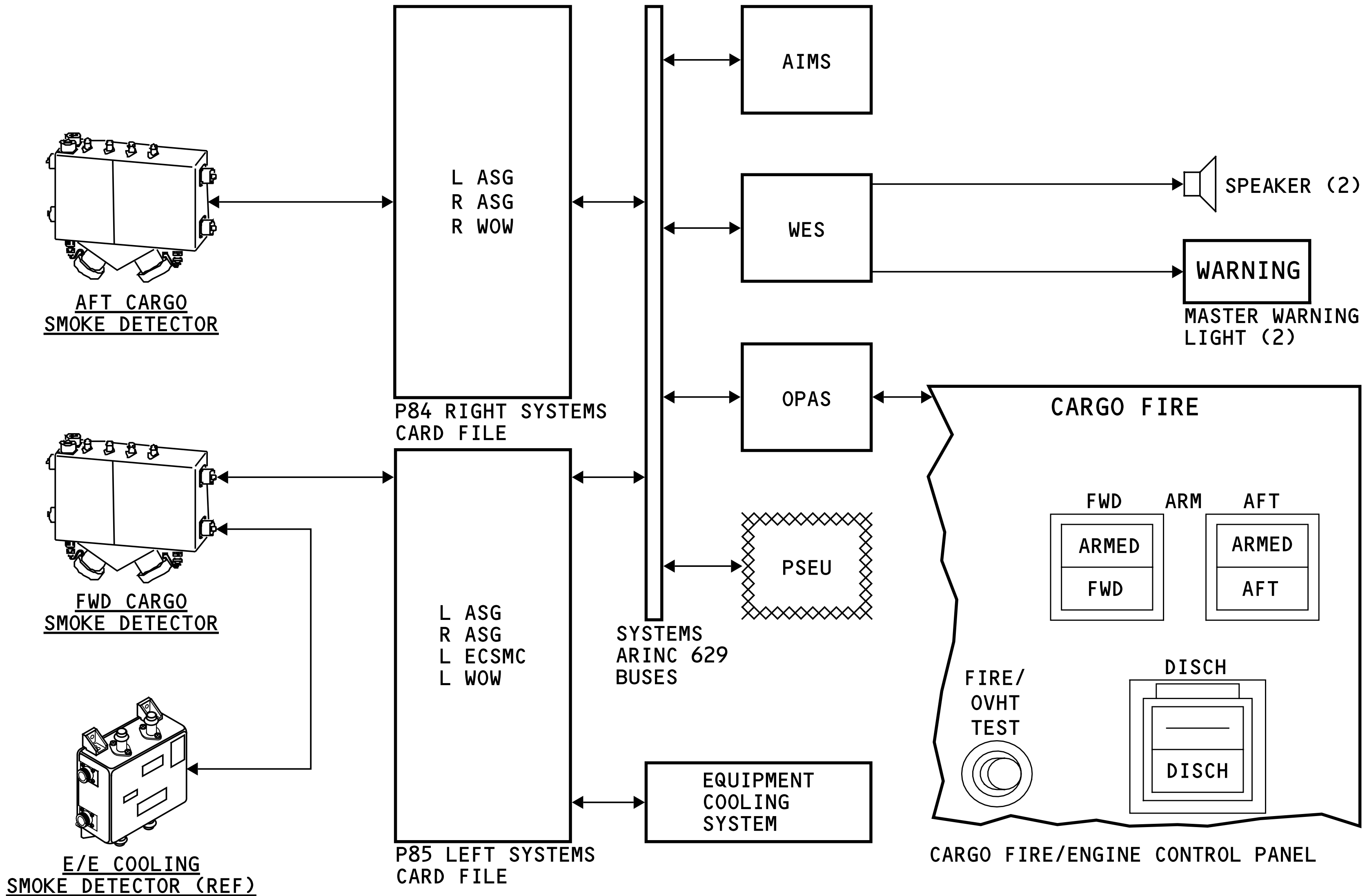
General Operation

If there is smoke in a cargo compartment, AIMS causes a cargo fire warning message. The WES turns on the fire warning aural and the master warning lights. The OPAS turns on the FWD or AFT cargo fire warning light on the cargo fire/engine control panel.

System Tests

The smoke detectors have built-in-test-equipment (BITE). The BITE does power-up and periodic tests of the system. Faults cause alert messages, status messages, or maintenance messages.

You can also use the fire/overheat test switch to do a test of the system. See the fire protection section for more information about the fire/overheat test (AMM PART I 26-00).



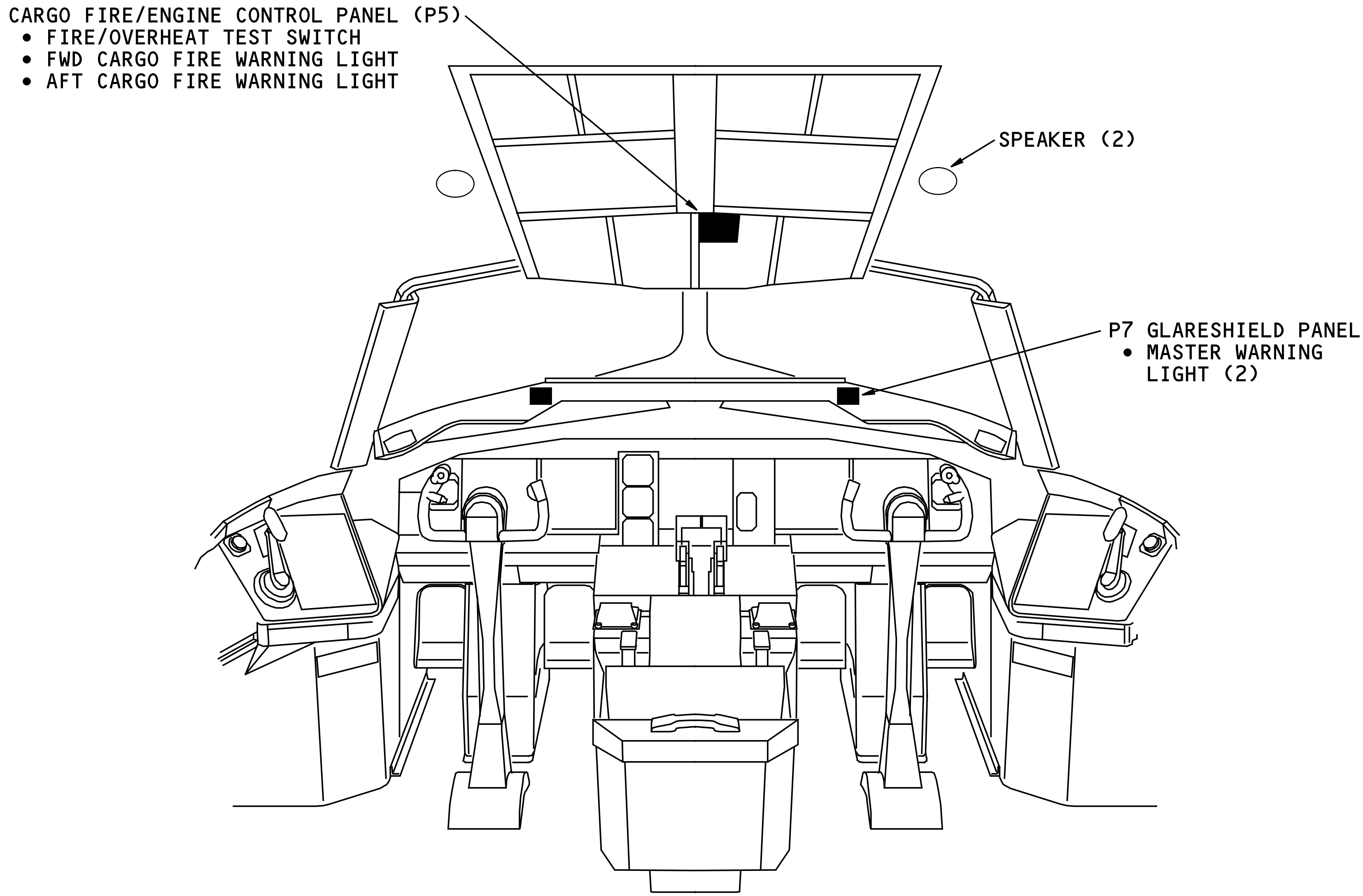
LOWER CARGO COMPARTMENT SMOKE DETECTION - GENERAL DESCRIPTION

LOWER CARGO COMPARTMENT SMOKE DETECTION - FLIGHT DECK COMPONENT LOCATIONS

Component Locations

These are the components in the flight deck that have an interface with the lower cargo compartment smoke detection system:

- Speakers
- Cargo fire/engine control panel
- Master warning lights.



26-16-00-003 Rev 0

LOWER CARGO COMPARTMENT SMOKE DETECTION - FLIGHT DECK COMPONENT LOCATIONS

Lower Cargo Compartments

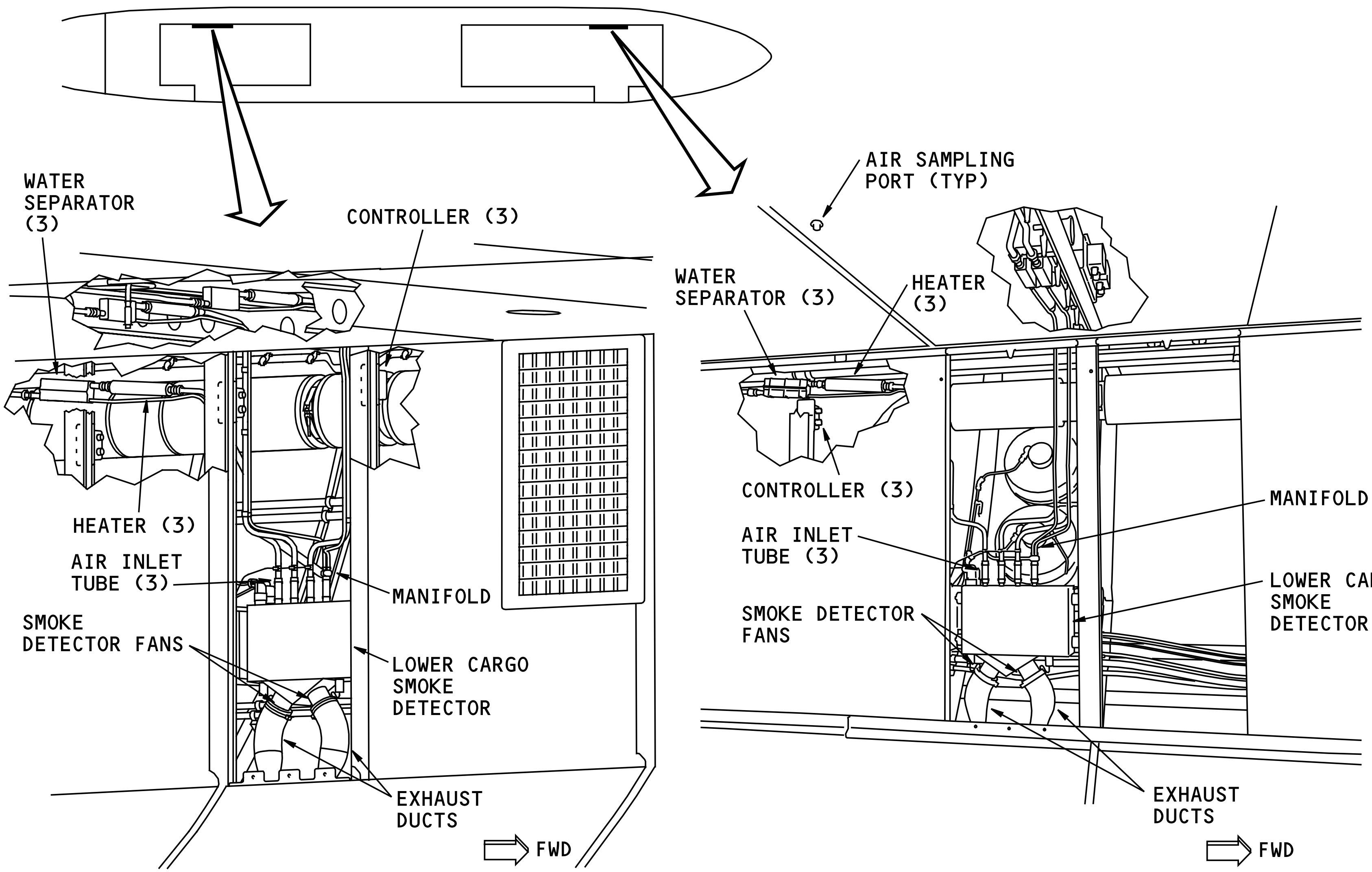
The forward and aft lower cargo compartments each have one smoke detector. Each smoke detector has two fans. Air sampling ports in the cargo compartment ceiling connect to air inlet tubes. The air inlet tubes are above the ceiling and behind the left side of the cargo compartments. The tubes connect to air inlet ports at the top of the smoke detectors. Exhaust ducts take air from the fans and release it behind the sidewall lining.

A water separator and heater are in line with each air inlet tube. Suction lines go from each water separator to a manifold at an inlet port of the smoke detector. Each heater connects to a controller.

Training Information Point

Open the cargo compartment sidewall lining that is opposite the cargo doors to get access to the smoke detectors.

To get access to the water separators, heaters and controllers, open the sidewall lining adjacent to the smoke detectors or the ceiling lining above the smoke detectors.



AFT CARGO COMPARTMENT

FORWARD CARGO COMPARTMENT

LOWER CARGO COMPARTMENT SMOKE DETECTION - LOWER CARGO COMPARTMENT COMPONENT LOCATIONS

LOWER CARGO COMPARTMENT SMOKE DETECTION - LOWER CARGO SMOKE DETECTOR AND FANS - INTRODUCTION

Purpose

The smoke detectors monitor air in the cargo compartments for smoke. The fans bring air from the cargo compartment into the smoke detector. Only one fan on each detector operates at a time.

Physical Description

The forward and aft lower cargo smoke detectors are identical. The smoke detectors have these components:

- Two electrical connectors
- Four air inlet ports
- Four shock mounts
- Two fans
- Four airflow sensors (internal)
- Four smoke detection chambers (internal)
- Two electronic control channels (internal).

The smoke detectors use light emitting diode (LED) optical smoke detectors and acoustic air flow sensors.

Location

There is a smoke detector in the forward and aft lower cargo compartments. The detectors are behind the cargo compartment sidewall lining opposite the cargo doors.

Training Information Point

The smoke detector is an LRU and the fans are LRUs. The smoke detector has no internal LRUs. There is no scheduled maintenance of the cargo smoke detectors or fans. Alert messages or status messages show if there is a fault condition.

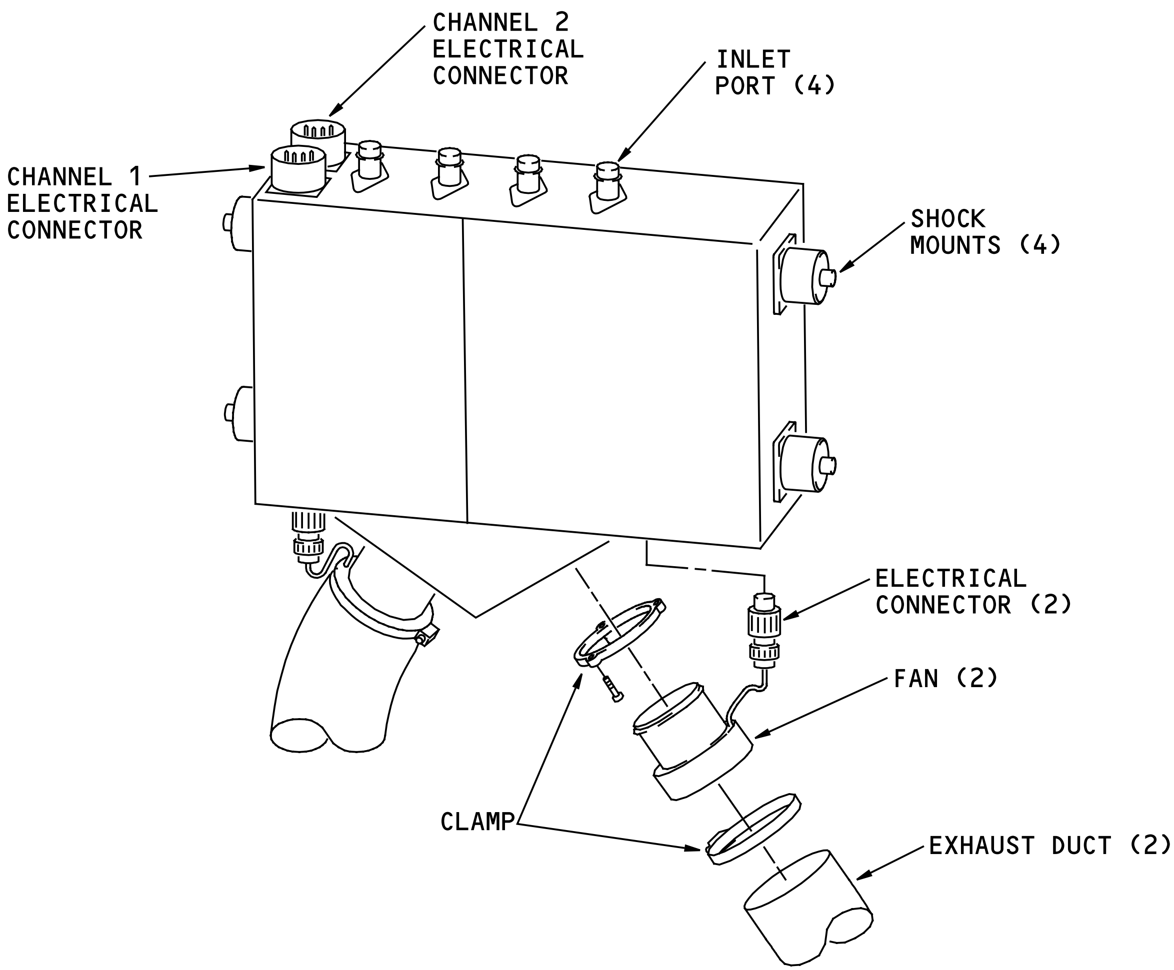
The forward lower cargo smoke detector and the aft lower cargo smoke detector are interchangeable. Four bolts attach the smoke detector to the structure.

Each smoke detector channel has its own electrical connector. The two connectors are different so you cannot cross-connect the wires. Program pins in the connectors give the detector this information:

- Location in the airplane, forward or aft
- If a remote smoke detector is connected
- The active air inlet ports.

Clamps attach the fans to the smoke detector. The length of the wire connected to the fan is such that you cannot connect the wire to the wrong connector on the smoke detector.

The lower cargo smoke detectors are onboard software loadable LRUs. You use the maintenance access terminal (MAT) to load software into the smoke detectors.



26-16-00-005 Rev 2 11/30/1995

LOWER CARGO COMPARTMENT SMOKE DETECTION - LOWER CARGO SMOKE DETECTOR AND FANS - INTRODUCTION

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LOWER CARGO COMPARTMENT SMOKE DETECTION - LOWER CARGO SMOKE DETECTOR - FUNCTIONAL DESCRIPTION

General

The smoke detector has two identical channels that control and monitor these components:

- Airflow sensor
- Optical smoke detector
- Fans.

Airflow Sensors

The airflow sensor has these parts:

- Transmitter
- Receiver.

The sensor monitors the amount of air going through each air inlet port. The smoke detector sends fault message on an ARINC 429 bus for these conditions:

- Too much airflow
- Not enough airflow
- Failed airflow sensor.

Optical Smoke Detectors

The optical smoke detector has these parts:

- Two source light emitting diodes (LEDs)
- Two intensity monitor photodiodes
- Two scatter detector photodiodes.

One set of diodes connects to channel 1. The other set of diodes connects to channel 2. Only one set of diodes operates at a time.

Inside the smoke detection chamber, air flows between a source LED and a scatter detector photodiode. Normally, only a small amount of light from the LED reaches the scatter detector. If the air has smoke in it, the smoke particles reflect more light on the scatter detector. This causes an alarm signal.

The intensity monitor photodiode makes sure the source LED is on and keeps the output of the source LED constant. This configuration also finds contamination of the LED and photodiodes. Diode failure or contamination causes the detector to switch to the other set of diodes. The detector sends a fault message.

Condensation from the in-line water separators flows through one of the chambers. The airflow sensor and optical smoke detectors in this chamber are not active.

Channel 1 And 2 Circuits

One channel does continuous BITE while the other channel controls the smoke detector. Channel 1 controls during one electrical power cycle, channel 2 controls during the next power cycle. If the control channel or its diodes fail, the other channel takes over. The detector sends a fault message.

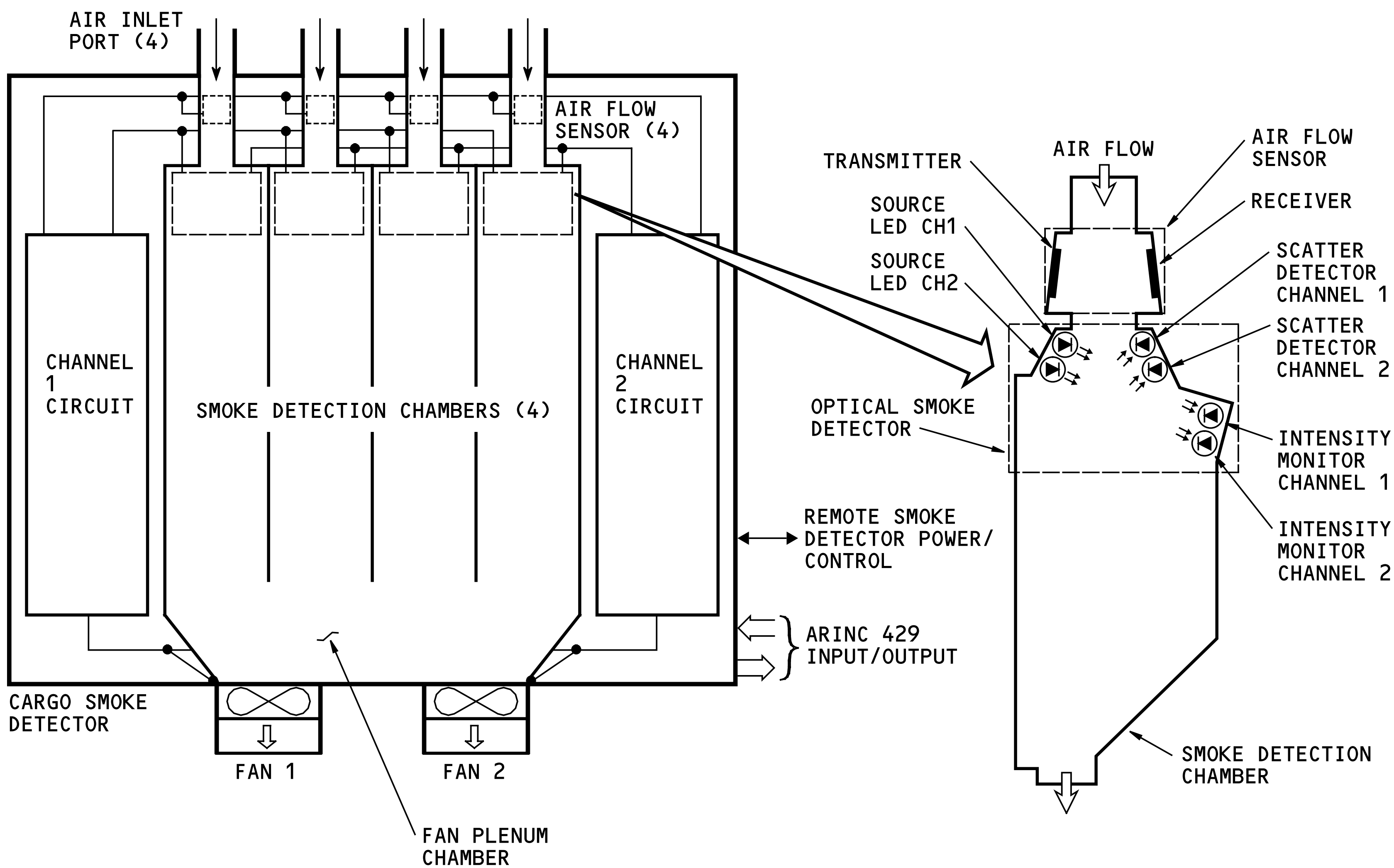
Fans

Channel 1 normally controls fan 1, and channel 2 normally controls fan 2. If a fan fails, the control channel turns on the other fan. The detector sends a fault message. The fans have a built in check valve which prevents reverse air flow through the fan that is off.

Condensation from the in-line water separators goes through the fan. An internal splash shield (not shown) keeps water spray out of the active chambers.

Remote Smoke Detector Control

The smoke detector can supply electrical power to a remote smoke detector and control its operation.



26-16-00-006 Rev 2 07/08/1997

LOWER CARGO COMPARTMENT SMOKE DETECTION - LOWER CARGO SMOKE DETECTOR - FUNCTIONAL DESCRIPTION

LOWER CARGO COMPARTMENT SMOKE DETECTION - FUNCTIONAL DESCRIPTION - AIR SAMPLING

General

The smoke detector installation for the forward lower cargo compartment is shown. The smoke detector installation in the aft cargo compartment operates the same.

The smoke detector has four air inlet ports. Three of the inlet ports connect to air sampling tubes. The fourth inlet port has a manifold that connects to the suction lines from the water separators. The sampling tubes are above the cargo compartment ceiling and in the left sidewall. Silicone rubber sampling ports attach to the ends of the tubes and go through the ceiling into the cargo compartment.

Air Sampling

The forward and aft cargo compartments each have three smoke sampling zones. Each smoke detector inlet port gets an air sample from one zone. Zone 1 is at the back of the compartments and zone 3 is at the front of the compartments.

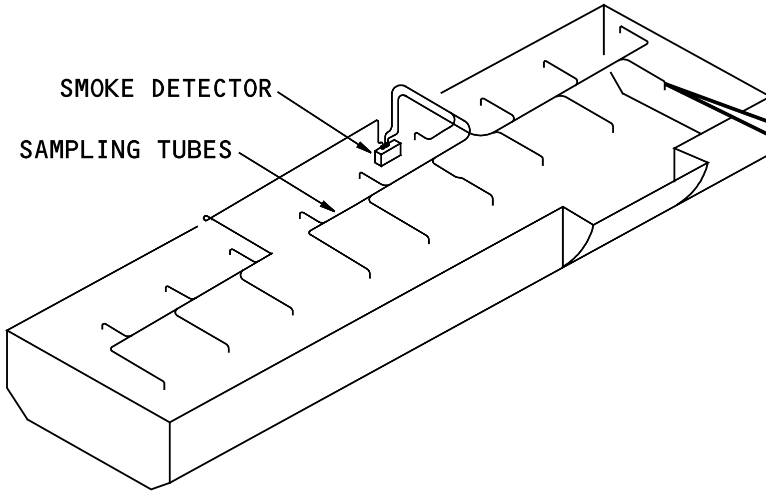
The smoke detector fan pulls air in through the sampling ports and tubes. It also pulls condensation from the water separators. Exhaust air and water spray from the fan goes into the space behind the cargo compartment sidewall.

Training Information Point

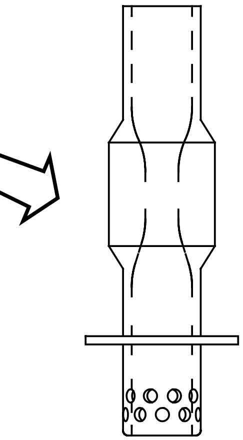
Squeeze a blocked sampling port with your fingers to clean it, or blow compressed air laterally through the holes.

If a sampling tube is blocked, remove the sampling ports and disconnect the other end of the tube. Use compressed air to clean the tube.

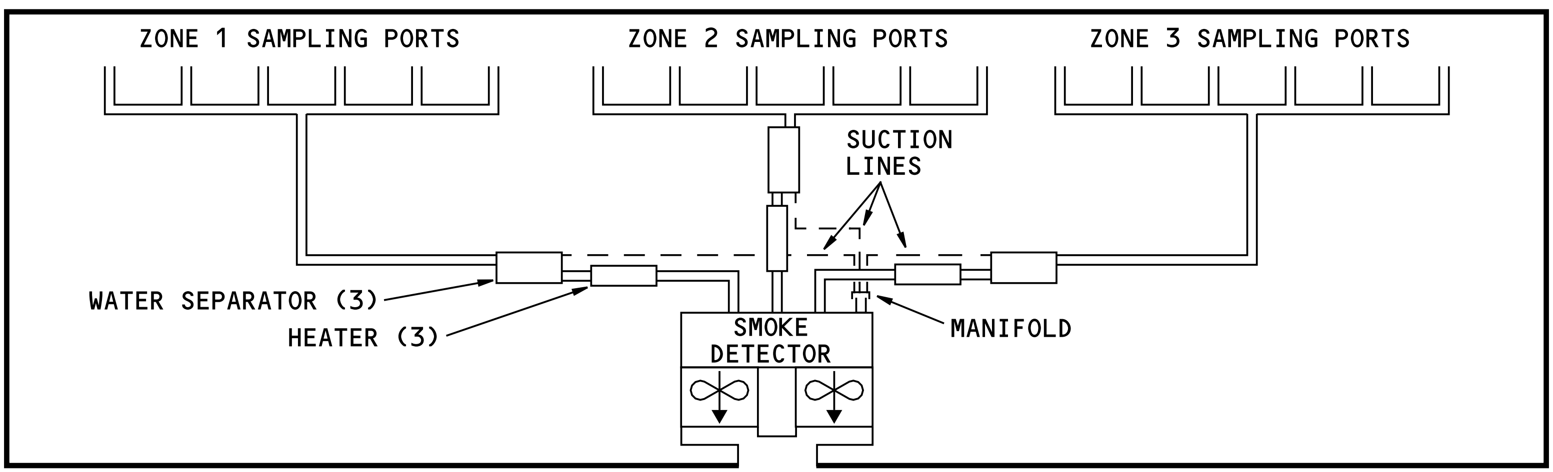
The sampling tubes are made of aluminum and attach to the structure with clamps. This makes it difficult to connect them to the wrong inlet ports on the detector.



FORWARD LOWER CARGO COMPARTMENT



AIR SAMPLING PORT



LOWER CARGO COMPARTMENT (TYPICAL)

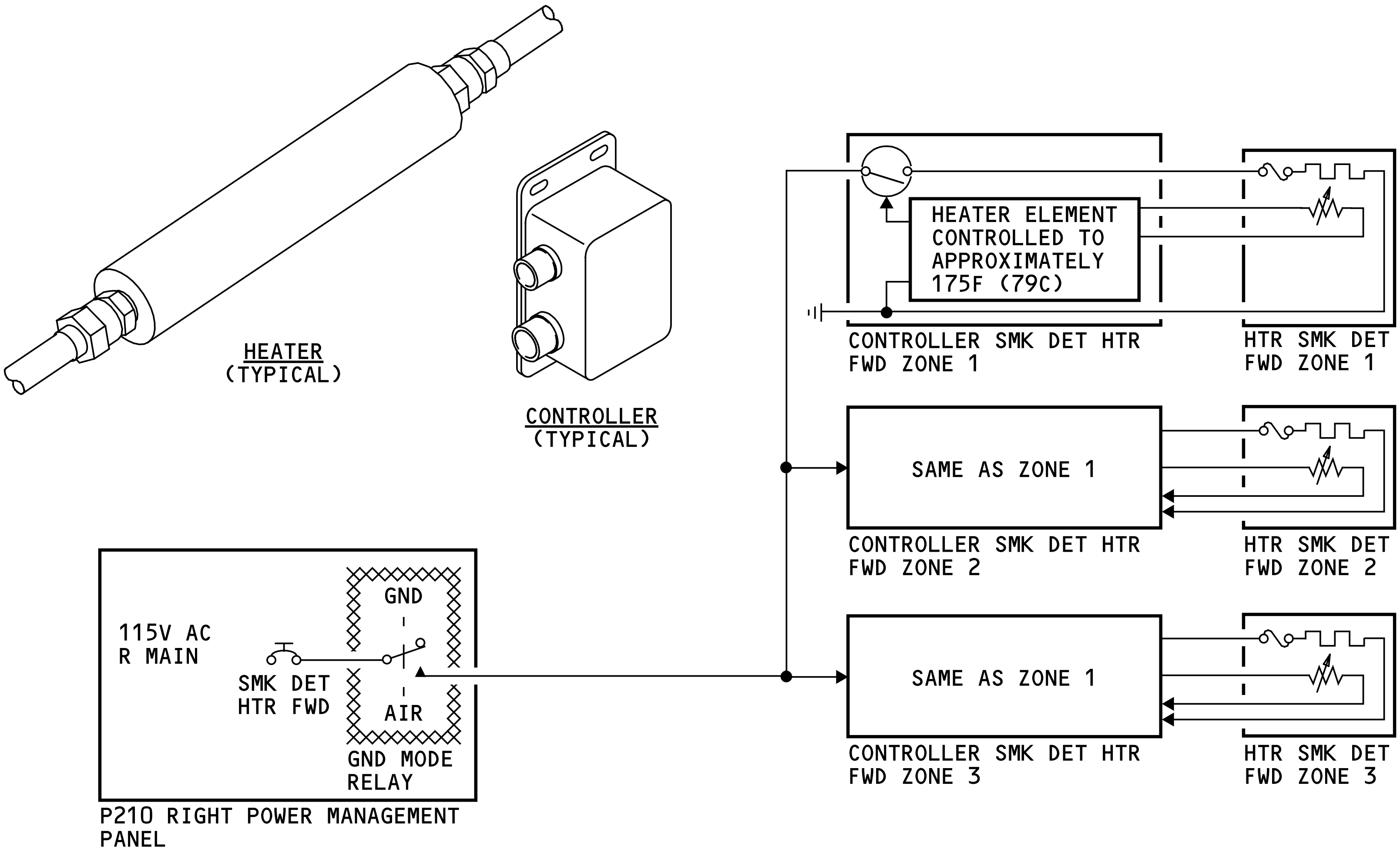
LOWER CARGO COMPARTMENT SMOKE DETECTION - FUNCTIONAL DESCRIPTION - AIR SAMPLING

LOWER CARGO COMPARTMENT SMOKE DETECTION - IN-LINE HEATER AND CONTROLLER

General

The in-line heater increases the temperature of the air that flows to the smoke detector. There is a controller for each in-line heater. The controller uses a sensor in the heater to control the temperature of the heater element to approximately 175F (79C). This increases the air temperature approximately 30F (17C).

The controllers only get power when the airplane is in the air.



NOTE: FORWARD CARGO COMPARTMENT IN-LINE HEATERS AND CONTROLLERS SHOWN.
AFT CARGO COMPARTMENT IN-LINE HEATERS AND CONTROLLERS SIMILAR.

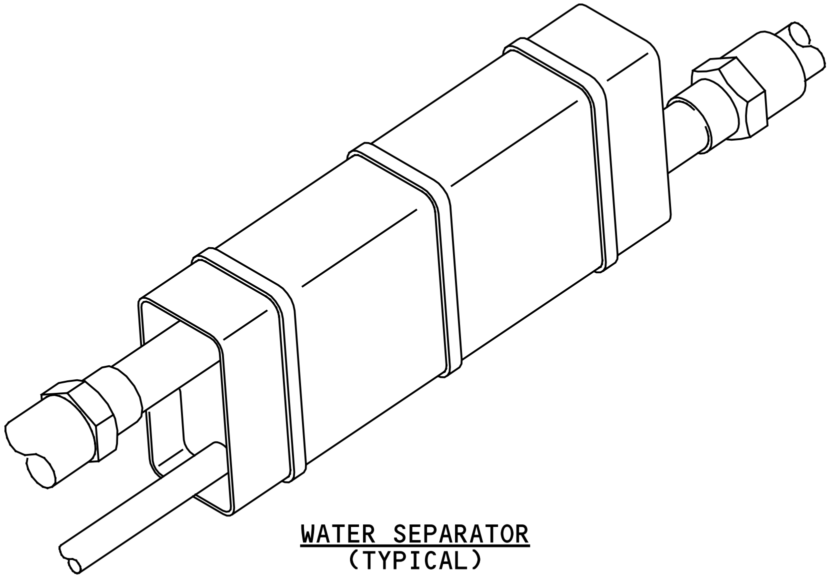
LOWER CARGO COMPARTMENT SMOKE DETECTION - IN-LINE HEATER AND CONTROLLER

LOWER CARGO COMPARTMENT SMOKE DETECTION - WATER SEPARATOR

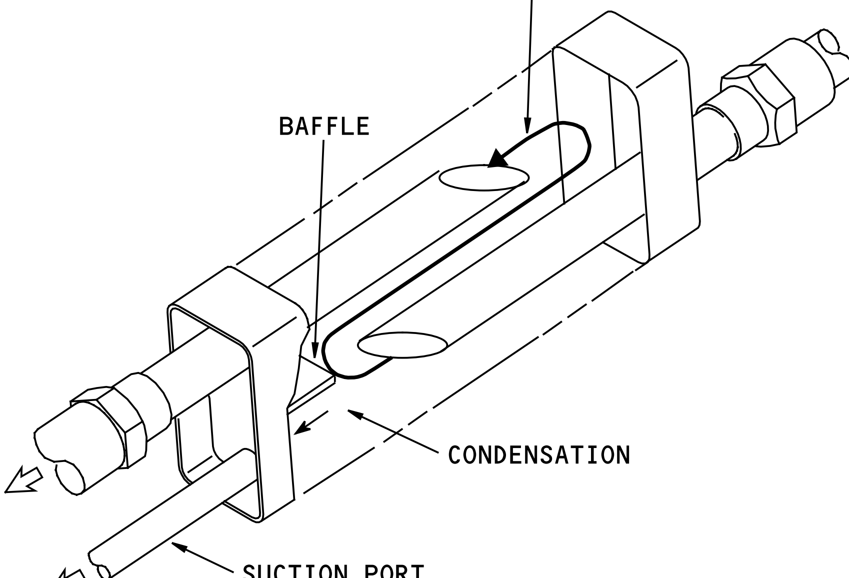
General

The water separator removes condensation from the air that flows to the smoke detector. The air that comes in changes direction quickly at the suction port. This lets condensation collect for removal.

The water separator is a sealed unit. It has no moving parts.



WATER SEPARATOR
(TYPICAL)



WATER SEPARATOR
(INNER VIEW)

26-16-00-013 Rev 0 01/06/1997

LOWER CARGO COMPARTMENT SMOKE DETECTION - WATER SEPARATOR

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LOWER CARGO COMPARTMENT SMOKE DETECTION - FUNCTIONAL DESCRIPTION - CIRCUIT

General

The circuit for the forward lower cargo compartment is shown. The circuit for the aft lower cargo compartment operates the same. The left and right main ac buses supply power to the smoke detectors. The smoke detector gets inputs from these:

- Left ECS miscellaneous card (ECSMC)
- Weight-on-wheels (WOW) card
- Overhead panel ARINC 629 system (OPAS)
- Proximity sensor electronics unit (PSEU) 2
- AIMS.

The smoke detector sends data to these:

- Overhead panel ARINC 629 system (OPAS)
- Warning electronics system (WES)
- AIMS.

Electrical Power

Each channel continuously monitors the electrical power input to the opposite channel. If power to one channel is not within limits, the smoke detector sends a fault message to AIMS. This condition shows on the fire protection maintenance page.

System Tests

The smoke detectors have built-in-test equipment (BITE). BITE does a power-on test automatically when it gets electrical power, and a periodic test regularly during operation.

You can do a test (initiated test) with the fire/overheat test switch or the maintenance access terminal. The test switch sends a signal through the overhead panel cardfile and ASG cards to the smoke detector. BITE does a test of the system. When you use the MAT, AIMS tells the smoke detector to do a power-up BIT sequence.

Smoke Detection

If there is smoke in the cargo compartment, the detector sends an alarm signal through the ARINC 429 bus to the ASG cards. The ASG cards send the alarm signal through the systems ARINC 629 buses to these systems and components:

- OPAS
- WES
- AIMS.

OPAS makes a ground to turn on the cargo fire warning light. The WES turns on the master warning lights and fire aural warning. The AIMS causes a warning message.

Ground Operation

The cargo smoke detector fans do not operate during cargo handling. This keeps contamination of the detectors to a minimum. The fans in the forward and aft compartments do not operate when all these conditions occur:

- The airplane is on the ground
- The forward cargo door is open
- The aft or bulk cargo door is open
- The right engine is not operating.

The WOW card supplies the air/ground signal. The proximity sensor electronics unit (PSEU 2) supplies the cargo door open signal. AIMS supplies the engine operating/not operating signal.

If the smoke detector does not receive the expected inputs, it continues to operate with these default values:

- Air
- Cargo doors closed
- Right engine operating.

Airflow Sensing

The smoke detector airflow sensors make allowance for changes in air density. The detector uses air temperature and pressure data to do this. Cargo compartment temperature data comes from the left ECSMC. Cabin altitude comes from the AIMS.

If the smoke detector does not receive the expected inputs, it continues to operate with these default values:

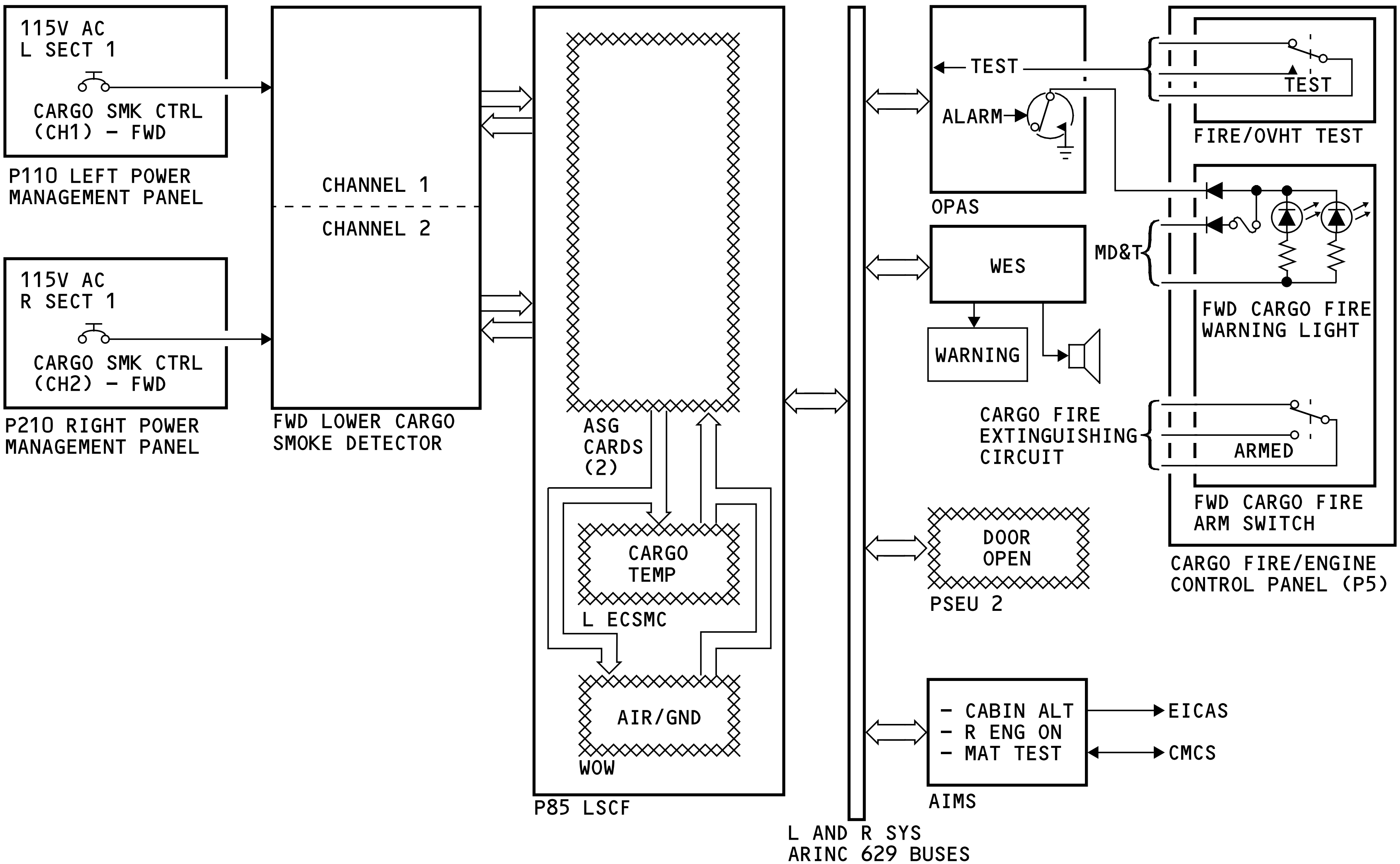
- Cabin altitude 8000 feet
- Cargo compartment temperature 40 degrees F.

Training Information Point

The CMCS shows status and maintenance messages for the smoke detectors. A fire protection maintenance page shows information about the system.

The cargo smoke detectors keep fault data in memory. You can use the MAT to access this fault data. You can also use the MAT to access smoke detector hardware and software part numbers.

Use the CMCS download function to load new software into the smoke detector.



26-16-00-008 Rev 3 07/08/1997

LOWER CARGO COMPARTMENT SMOKE DETECTION - FUNCTIONAL DESCRIPTION - CIRCUIT

LOWER CARGO COMPARTMENT SMOKE DETECTION - INDICATIONS

General

Operation of the lower cargo compartment smoke detection system is automatic and does not need crew action. The system operates when the main ac buses have power.

Cargo Smoke Indication

If there is smoke in a lower cargo compartment, these indications occur in the flight deck:

- A cargo fire EICAS warning message shows
- The master warning lights come on
- The fire warning aural operates
- The cargo fire warning light comes on.

The master warning lights and fire warning aural do not operate during part of the takeoff if there is a fire.

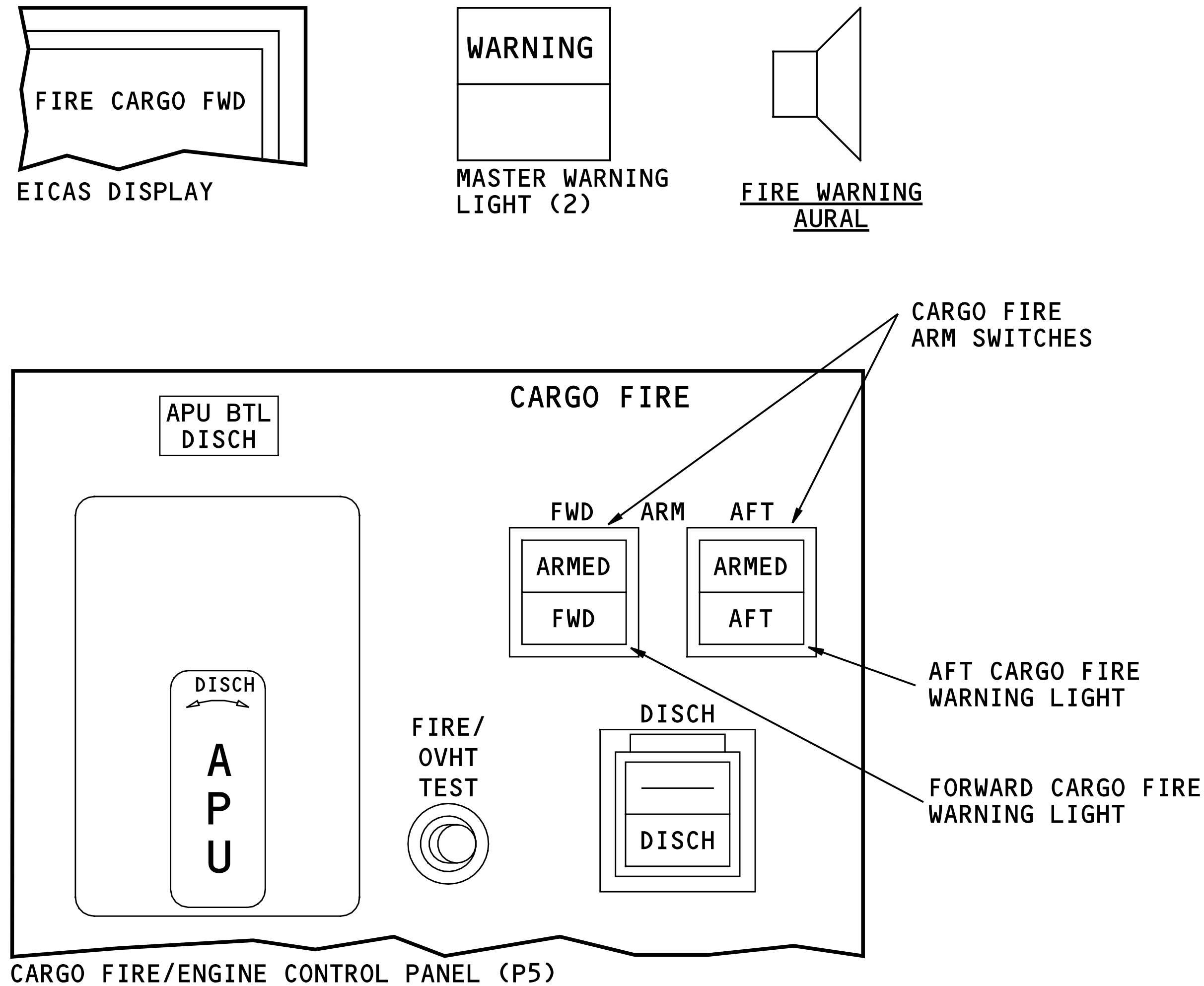
Training Information Point

If the smoke detector fails while it supplies a fire alarm signal, the alarm signal latches. This condition occurs if soot from a cargo fire causes contamination of the smoke detector optics.

All these conditions must be true to make the alarm signal stop:

- Airplane is on the ground
- Related cargo fire arm switch is off
- There is no cargo smoke
- There is no failure condition.

You can use the fire/overheat test switch or the MAT to do a test of the system at any time. Test results show on the primary display system.



26-16-00-009 Rev 1

LOWER CARGO COMPARTMENT SMOKE DETECTION - INDICATIONS

LOWER CARGO COMPARTMENT SMOKE DETECTION - TRAINING INFORMATION POINTS

Maintenance Page

Operational status of the cargo smoke detection system shows on the fire protection maintenance page.

Advisory, Status, And Maintenance Messages

Advisory, status, or maintenance messages show for these fault conditions:

- Low airflow at the zone 1, 2, or 3 air inlet port (blocked air sampling tube)
- Too much airflow at the zone 1, 2, 3, or 4 air inlet port (air sampling tubes not connected to ports 1, 2, 3 or port 4 not capped)
- Faulty air flow sensor
- Smoke detector optic contamination
- Smoke detector internal failure
- Fan failure
- Power source failure
- ARINC 429 bus failure
- Program pin parity error
- Software not compatible with hardware.

FIRE PROTECTION

CARGO SMOKE DETECTION SYSTEM:

	FWD DETECTOR 1	FWD DETECTOR 2	AFT DETECTOR 1	AFT DETECTOR 2
POWER	ON	ON	ON	ON
DATA BUS	NORM	NORM	FAULT	NORM
CHANNEL	NORM	NORM	FAULT	NORM
FAN	NORM	NORM	FAULT	FAULT
DETECTOR AIR	NORM		NO AIR	
DETECTOR	NORM		FAULT	

SMOKE DETECTOR ZONES

	1	2	3
FWD	NORM	NO AIR	FAULT
AFT	NO AIR	NO AIR	NO AIR

CARGO FIRE EXTINGUISHING SYSTEM:

BOTTLE	1A	1B	2A	2B	2C
PRESSURE	NORM	NORM	NORM	NORM	NORM
SQUIB	NORM	NORM	NORM	NORM	NORM

CARGO COMPARTMENT	FWD	AFT
FLOW VLV SQUIB 1	NORM	NORM
FLOW VLV SQUIB 2	NORM	NORM
DISCHARGE PRESS SW	NORM	NORM

DATE 23 JUN 90 UTC 18:54:04

FIRE PROTECTION MAINTENANCE PAGE

26-16-00-010 Rev 2 07/08/1997

LOWER CARGO COMPARTMENT SMOKE DETECTION - TRAINING INFORMATION POINTS

LOWER CARGO COMPARTMENT SMOKE DETECTION - SYSTEM TESTS

General

These are the system tests for the cargo smoke detection system:

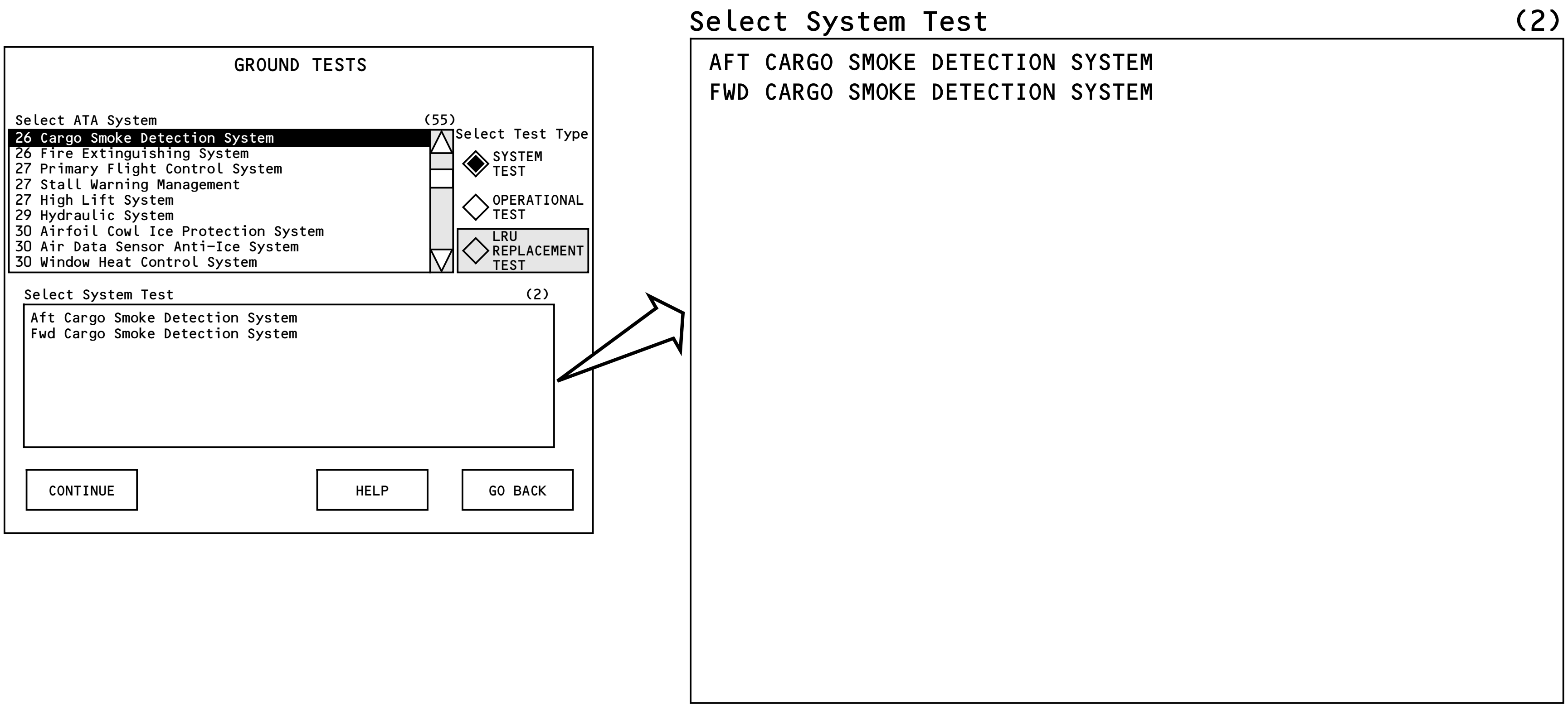
- Aft Cargo Smoke Detection System
- Fwd Cargo Smoke Detection System.

Aft Cargo Smoke Detection System

This test makes sure that the aft lower cargo compartment smoke detector operates correctly.

Fwd Cargo Smoke Detection System

This test makes sure that the forward lower cargo compartment smoke detector operates correctly.



26-16-00-011 Rev 0 07/31/95

LOWER CARGO COMPARTMENT SMOKE DETECTION - SYSTEM TESTS

LOWER CARGO FIRE EXTINGUISHING - INTRODUCTION

Purpose

The lower cargo fire extinguishing system extinguishes fires in the forward or aft lower cargo compartments.

General Description

The lower cargo fire extinguishing system has these components:

- Three fire extinguishing metered bottles
- A filter regulator
- Fwd and aft in-line pressure switches
- Two flow valves
- Two fire extinguishing dump bottles
- Eight discharge nozzles.

The five fire extinguishing bottles contain halon 1301 fire extinguishing agent pressurized with nitrogen. Tubing connects the bottles to discharge nozzles in the cargo compartment ceilings. Flow valves send the halon to the forward or aft compartment.

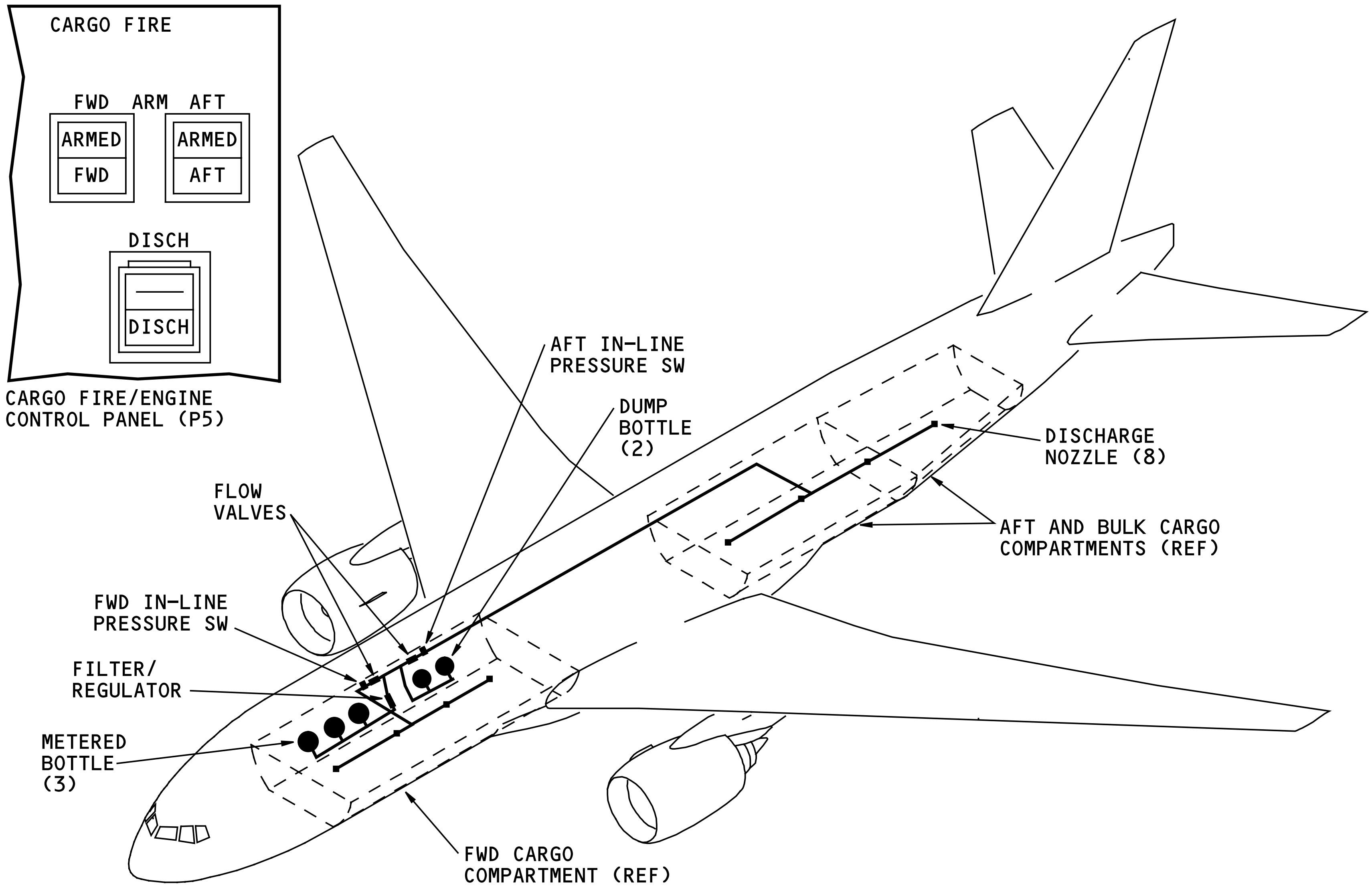
In the flight deck, cargo fire arming switches set the discharge to the forward or aft compartment. The discharge switch starts the fire bottle discharge sequence. A line pressure switch turns on the DISCH indication to show that the discharge sequence has started.

The two dump bottles discharge into the selected compartment as soon as you push the discharge switch. The bottles discharge quickly to extinguish the fire.

After a time delay, the metered bottles discharge slowly and at a controlled rate through the filter regulator. Halon from the metered bottles replaces the extinguishing agent leakage. This keeps the correct concentration of extinguishing agent in the cargo compartment to make sure the fire stays out.

The metered bottles operate differently in flight and on the ground. If the airplane is on the ground when you push the discharge switch, one metered bottle starts to discharge after a twenty minute time delay. The discharge continues for an hour, until the bottle is empty. The other metered bottles do not discharge.

If you push the discharge switch in flight, none of the metered bottles start to discharge immediately. If the airplane lands in less than twenty minutes, one metered bottle starts to discharge when the airplane lands. The other metered bottles do not discharge. If the airplane does not land in twenty minutes, all three metered bottles start to discharge twenty minutes after you push the discharge switch. The discharge continues for three hours, until the bottles are empty.



LOWER CARGO FIRE EXTINGUISHING - INTRODUCTION

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LOWER CARGO FIRE EXTINGUISHING - INTERFACES

General

The lower cargo fire extinguishing system has these interfaces:

- Cargo fire/engine control panel (P5)
- Overhead panel ARINC 629 system (OPAS)
- AIMS
- ELMS
- Cabin temperature controllers
- Left and right ASCPCs
- Left and right ECS miscellaneous cards.

Cargo Fire Extinguishing System Interfaces

These are the results when you push the FWD or AFT arm switches on the P5 panel:

- The circuit for the forward or aft flow valve arms
- The circuit for the two dump bottles arms
- The switch gives OPAS a FWD or AFT ARMED signal
- OPAS transmits the ARMED signal on the 629 buses

These are the results when you push the DISCH switch on the P5 panel:

- The selected flow valve opens
- The dump bottles discharge
- The DISCH switch gives the OPAS a DISCH signal
- OPAS transmits the DISCH signal on the 629 buses
- The in-line pressure switch turns on the DISCH light on the P5 overhead panel
- ELMS discharges the metered bottles after a delay

As the pressure in each bottle decreases, a pressure switch on the bottle sends a signal to the ELMS. The ELMS sends this data to the AIMS. The AIMS shows advisory and status messages to show that the bottle pressure is low.

Environmental Control System Interfaces

These are the results in the environmental control system when OPAS transmits the FWD ARMED signal:

- Lower recirculation fans - off
- Air conditioning packs - flow schedule 2
- Pressurization air outflow - 50 percent forward, 50 percent aft
- Equipment cooling system - override mode
- Galley chiller boost fan - off
- Equipment cooling vent valve - closed.

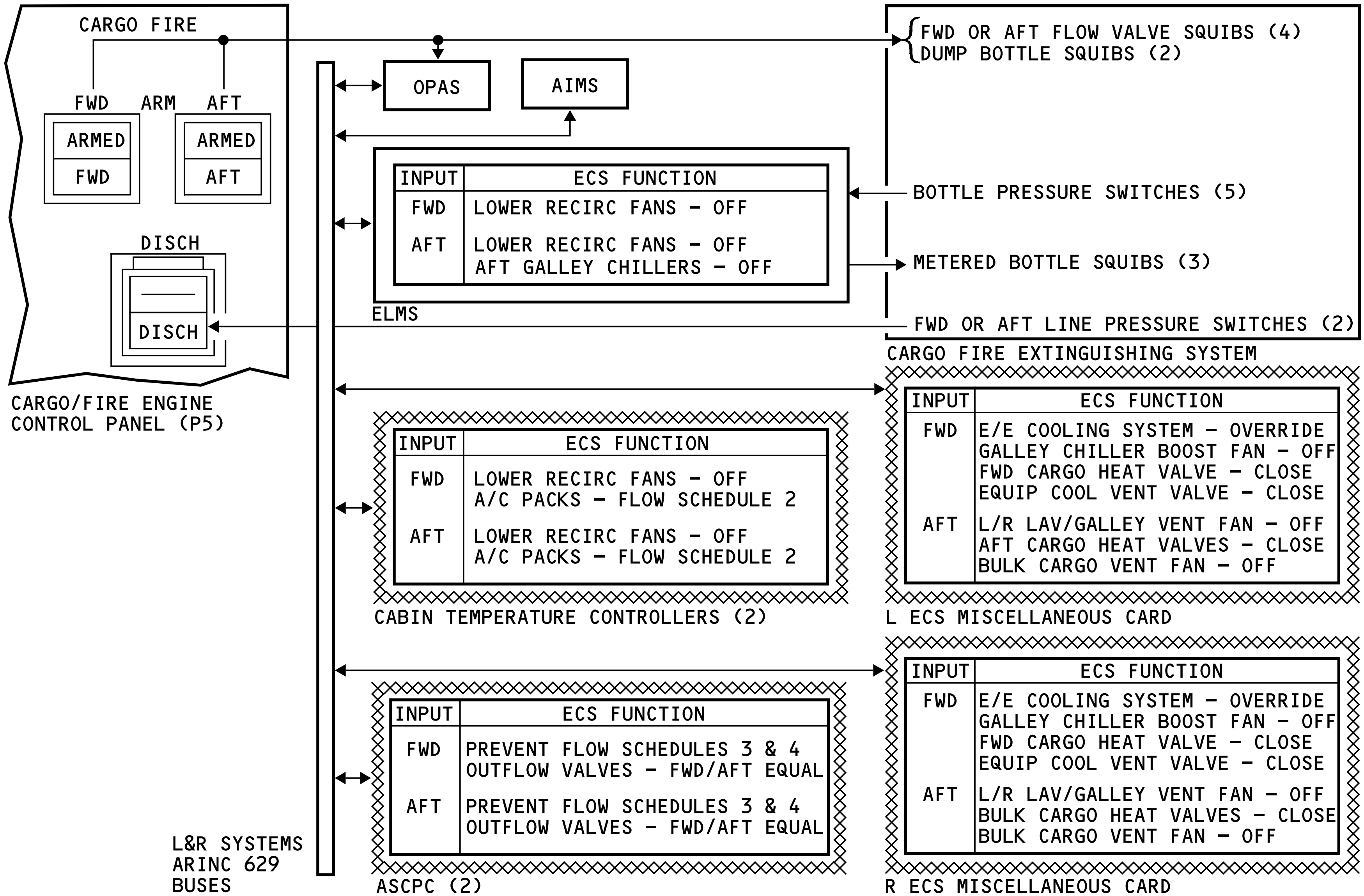
These are the results in the environmental system when OPAS transmits the AFT ARMED signal:

- Lower recirculation fans - off
- Air conditioning packs - flow schedule 2
- Pressurization air outflow - 50 percent forward, 50 percent aft
- Lav/galley vent fans - off
- Aft cargo heat valves - closed
- Bulk cargo vent fan - off
- Bulk cargo heat valves - closed.

These functions change the air flow around and through the cargo compartments. This keeps the fire

LOWER CARGO FIRE EXTINGUISHING - INTERFACES

extinguishing agent in the cargo compartment and keeps smoke out of the passenger compartment and flight deck.



LOWER CARGO FIRE EXTINGUISHING - INTERFACES

LOWER CARGO FIRE EXTINGUISHING - COMPONENT LOCATIONS

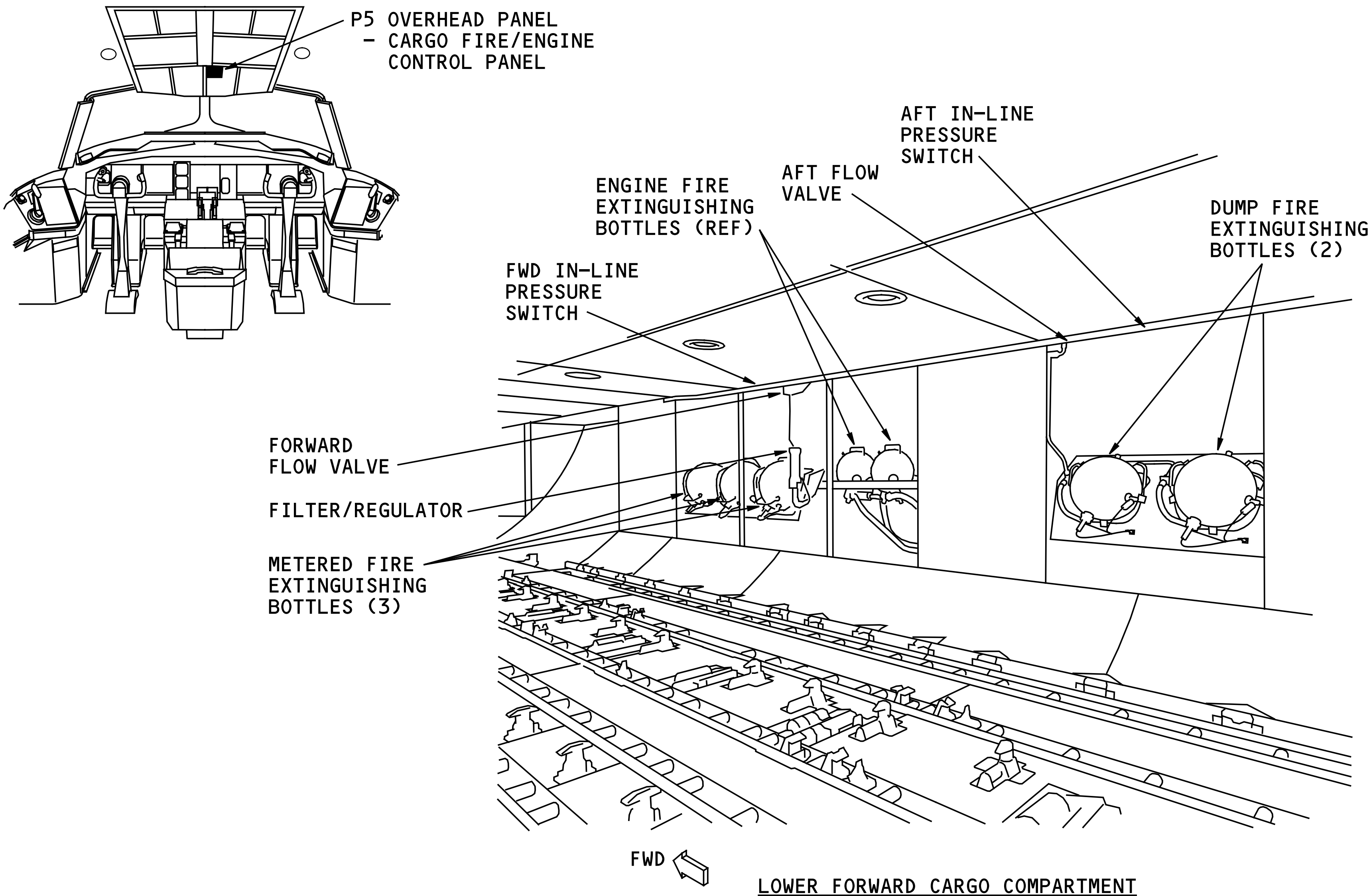
Flight Deck

The cargo fire/engine control panel is in the flight deck on the P5 overhead panel.

Lower Forward Cargo Compartment

These components of the lower cargo fire extinguishing system are in the lower forward cargo compartment:

- Filter/regulator
- Metered fire extinguishing bottles
- Forward flow valve
- Forward in-line pressure switch
- Aft flow valve
- Aft in-line pressure switch
- Dump fire extinguishing bottles.



LOWER CARGO FIRE EXTINGUISHING - COMPONENT LOCATIONS

LOWER CARGO FIRE EXTINGUISHING - LOWER CARGO FIRE EXTINGUISHING BOTTLES - INTRODUCTION

Purpose

The lower cargo fire extinguishing bottles contain the fire extinguishing agent.

Location

The bottles are on the right side of the forward lower cargo compartment, behind the cargo compartment lining. Release the snaps then roll up the lining for access.

Physical Description

The bottles contain halon 1301 fire extinguishing agent pressurized with nitrogen. The metered bottles and dump bottles are different sizes. The metered bottles weigh approximately 80 lb (36 kg). The dump bottles weigh approximately 65 lb (30 kg). The three metered bottles are identical. The two dump bottles are identical.

The fire extinguishing bottles have these components:

- Identification plate
- Safety relief and fill port
- Handles
- Pressure switch
- Mounting brackets
- Discharge assembly
- Warning Label.

Indications

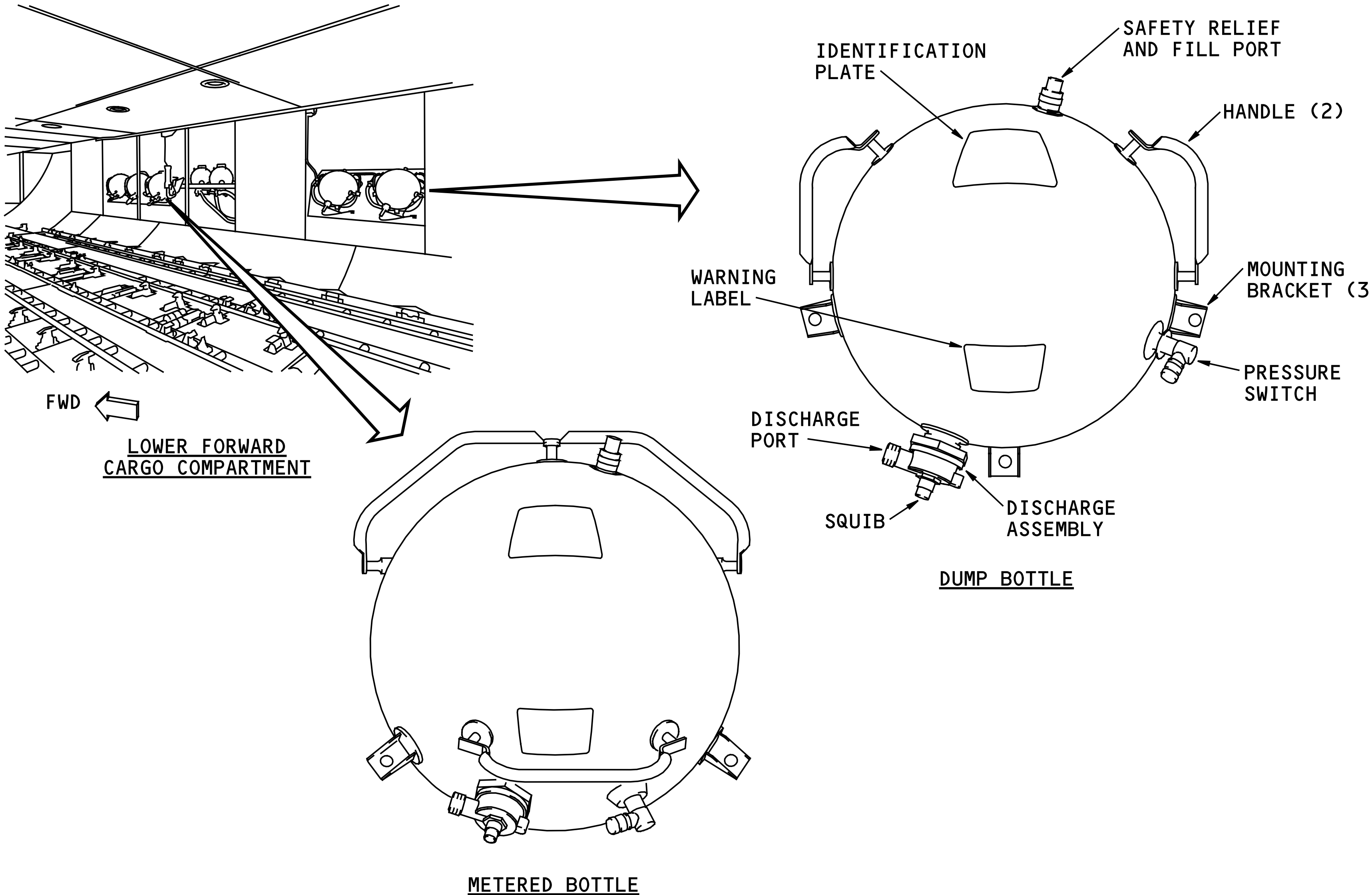
Status messages, maintenance messages, and a fire protection maintenance page show if the bottle pressure is low.

Functional Description

The discharge assembly has an explosive squib which releases the halon through the discharge port.

The pressure switch monitors the pressure inside the bottle and is normally open. When the bottle pressure decreases, the switch closes and sends a signal for indication.

The safety relief and fill port is a single fitting on the bottle. The safety relief opens to make sure the bottle does not break if internal pressure is too high.



26-23-00-004 Rev 1 07/10/1997

LOWER CARGO FIRE EXTINGUISHING - LOWER CARGO FIRE EXTINGUISHING BOTTLES - INTRODUCTION

LOWER CARGO FIRE EXTINGUISHING - FIRE EXTINGUISHING BOTTLES - TRAINING INFORMATION POINTS

Bottle Weight

You cannot fill an empty bottle on the airplane. You must replace the bottle. Compare the weight of the new bottle with the weight on the bottle identification plate. This prevents installation of a bottle which is not full.

Removal/Installation

WARNING: BE CAREFUL WHEN YOU DISCONNECT THE HOSE ASSEMBLY FROM THE FIRE EXTINGUISHER BOTTLE. IF THE FIRE EXTINGUISHING BOTTLE DISCHARGED, THE TUBING MAY BE PRESSURIZED. WHEN YOU RELEASE THE PRESSURE IN THE TUBING YOU CAN CAUSE INJURY TO PERSONS.

WARNING: DO NOT TOUCH THE SQUIB BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE THE FIRE BOTTLE TO RELEASE ITS CONTENTS SUDDENLY AND CAUSE INJURY TO PERSONS AND DAMAGE TO EQUIPMENT.

WARNING: PUT A PROTECTIVE COVER ON THE SQUIB. IF YOU DO NOT PUT A PROTECTIVE COVER ON THE SQUIB, THE FIRE EXTINGUISHING BOTTLE CAN RELEASE ITS CONTENTS SUDDENLY AND CAUSE INJURY TO PERSONS.

WARNING: BE CAREFUL WHEN YOU MOVE THE FIRE EXTINGUISHING BOTTLE. THE FIRE EXTINGUISHING BOTTLE IS HIGHLY PRESSURIZED AND HAS AN EXPLOSIVE CARTRIDGE AS A COMPONENT. ACCIDENTAL DISCHARGE OF THE FIRE EXTINGUISHING BOTTLE CAN CAUSE INJURY TO PERSONS OR DAMAGE TO EQUIPMENT.

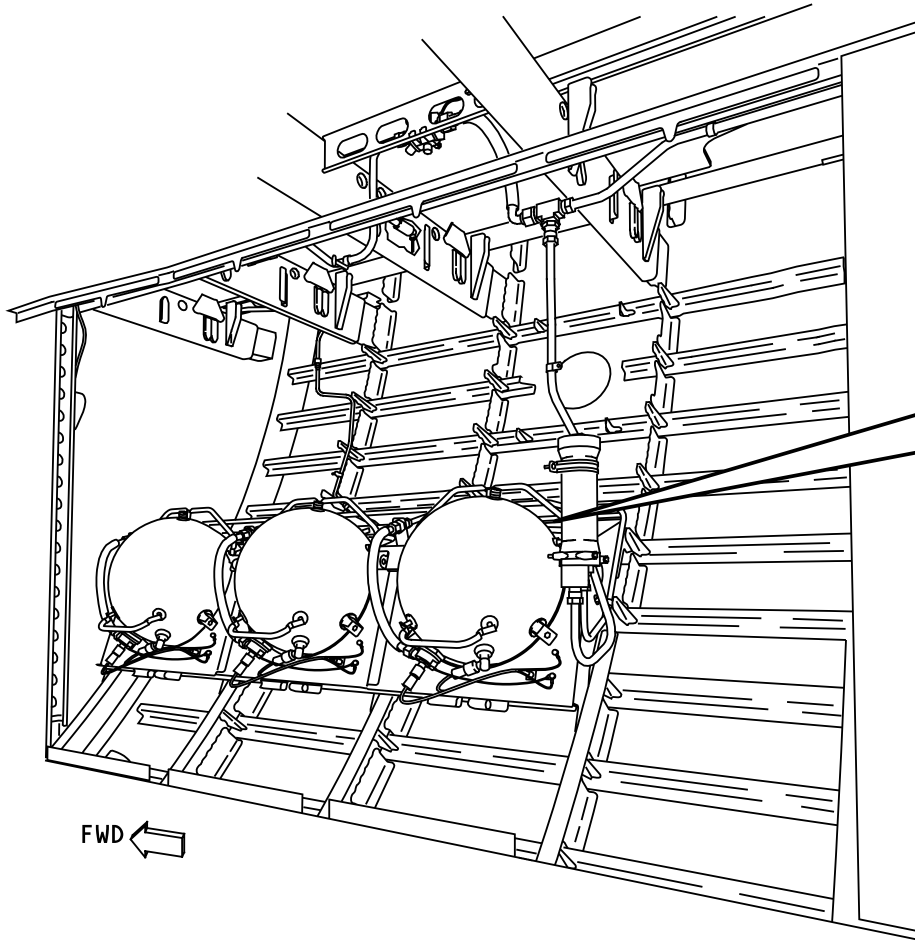
The discharge tubing and electrical wires are not long enough to connect to the wrong bottle. The electrical connectors for the squib and the pressure switch are different. You cannot connect the airplane wiring to the wrong device.

A platform is available to stand on while you remove and install the fire bottles.

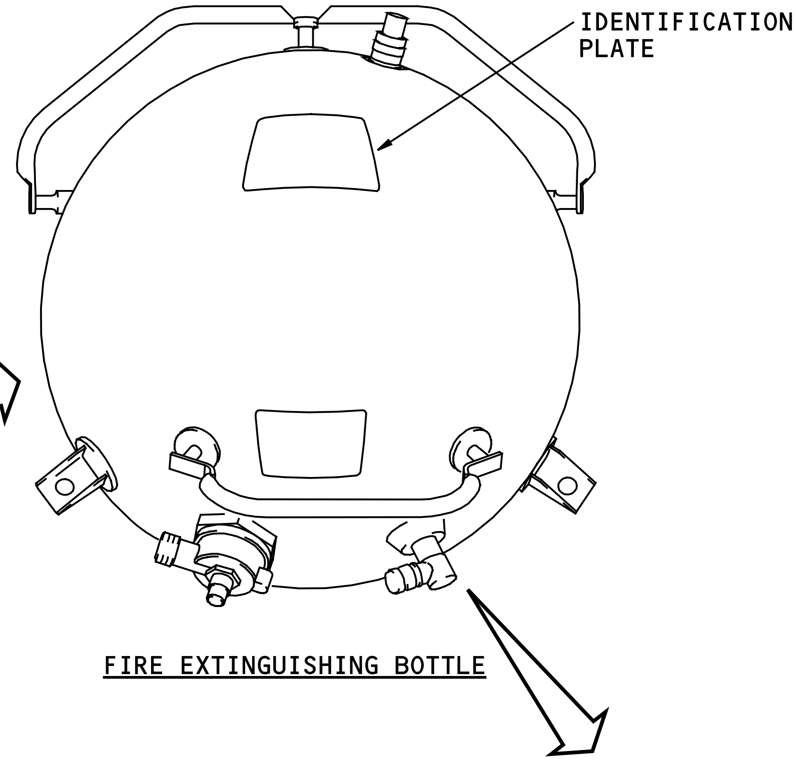
Tests

You must remove the fire extinguishing bottle every five years for a hydrostatic test. The date of the last test is on the identification plate.

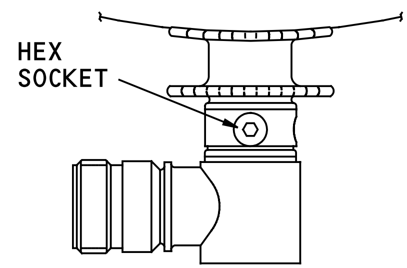
Operate the pressure switch with a hex wrench to do a test of the pressure switch and indicating circuit. If the circuit operates properly, bottle discharge indications show in the flight deck when you operate the pressure switch.



FORWARD CARGO COMPARTMENT, RIGHT SIDEWALL
(LINING REMOVED)



FIRE EXTINGUISHING BOTTLE



BOTTLE PRESSURE SWITCH

26-23-00-005 Rev 1 07/09/1997

LOWER CARGO FIRE EXTINGUISHING - FIRE EXTINGUISHING BOTTLES - TRAINING INFORMATION POINTS

LOWER CARGO FIRE EXTINGUISHING - IN-LINE PRESSURE SWITCH

Purpose

The in-line pressure switch gives a flight deck indication when there is pressure in the discharge line downstream of a flow valve. The cargo fire discharge light comes on to show that the fire extinguishing system operates. A maintenance message also shows.

Physical Description

The in-line pressure switch has these parts:

- Electrical connector
- Reset button
- Inlet fitting.

A bolt and clamp attaches the switch to the airplane structure.

Location

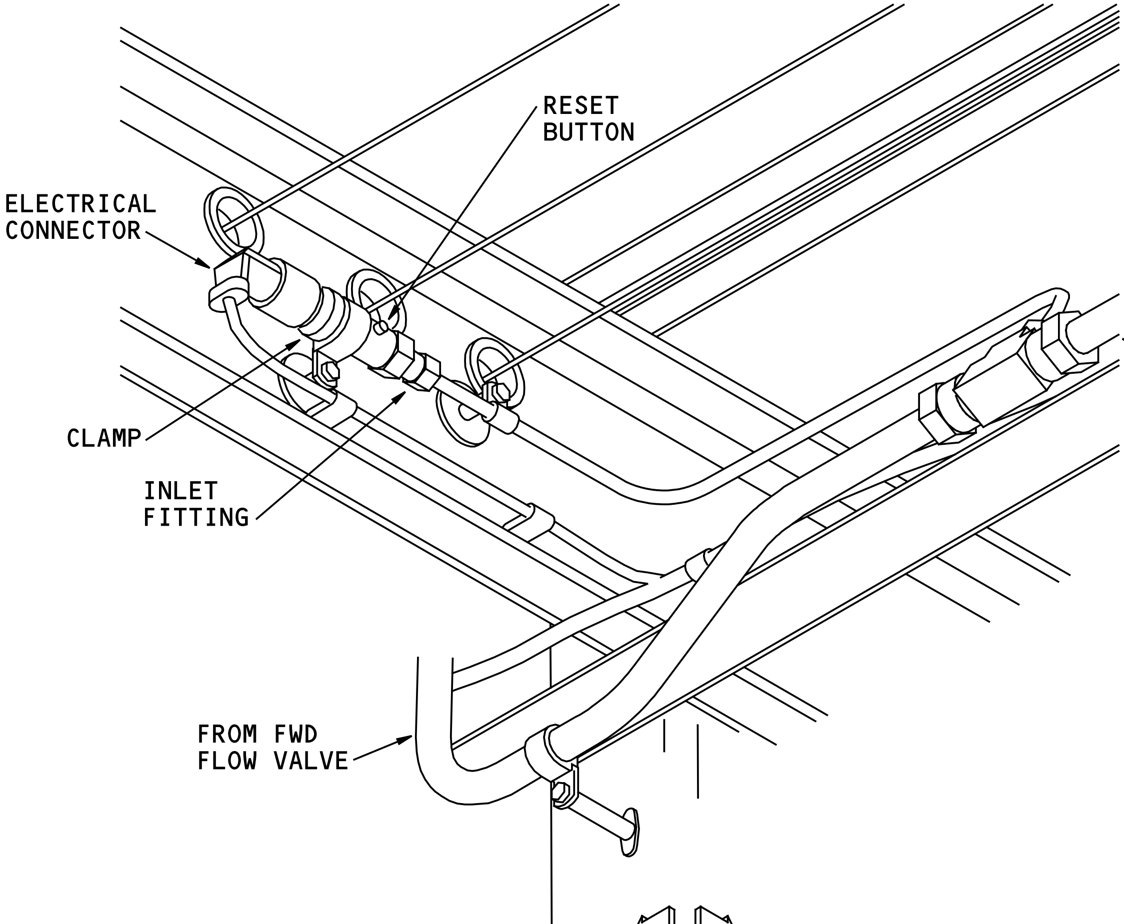
The forward in-line pressure switch is just forward of the forward flow valve. The aft in-line pressure switch is just aft of the aft flow valve. Access is through the lower cargo fire extinguishing bottle access panels.

Functional Description

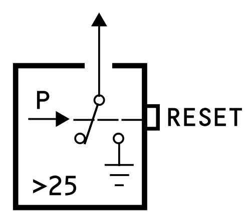
The switch is normally open. When halon pressurizes the discharge line, the switch closes. Indicating circuits give the flight deck indications. The switch latches in the closed position.

Training Information Point

The in-line pressure switch latches closed when the fire extinguishing system operates. A maintenance message and the fire protection maintenance page show this condition. Use the reset button to set the switch contacts open.



FWD IN-LINE PRESSURE SWITCH
(AFT INSTALLATION SIMILAR)



IN-LINE PRESSURE
SWITCH CIRCUIT

26-23-00-007 Rev 0

LOWER CARGO FIRE EXTINGUISHING - IN-LINE PRESSURE SWITCH

LOWER CARGO FIRE EXTINGUISHING - FILTER/REGULATOR

Purpose

The filter/regulator causes a slow and continuous flow of halon from the metered bottles into the cargo compartment to keep the fire out.

Physical Description

The filter regulator has these parts:

- Inlet port
- Outlet port
- Filter/drier element (internal)
- Regulator (internal).

Location

The filter regulator is near the metered bottles, behind the lining of the lower forward cargo compartment. Access is through the metered bottle access panel.

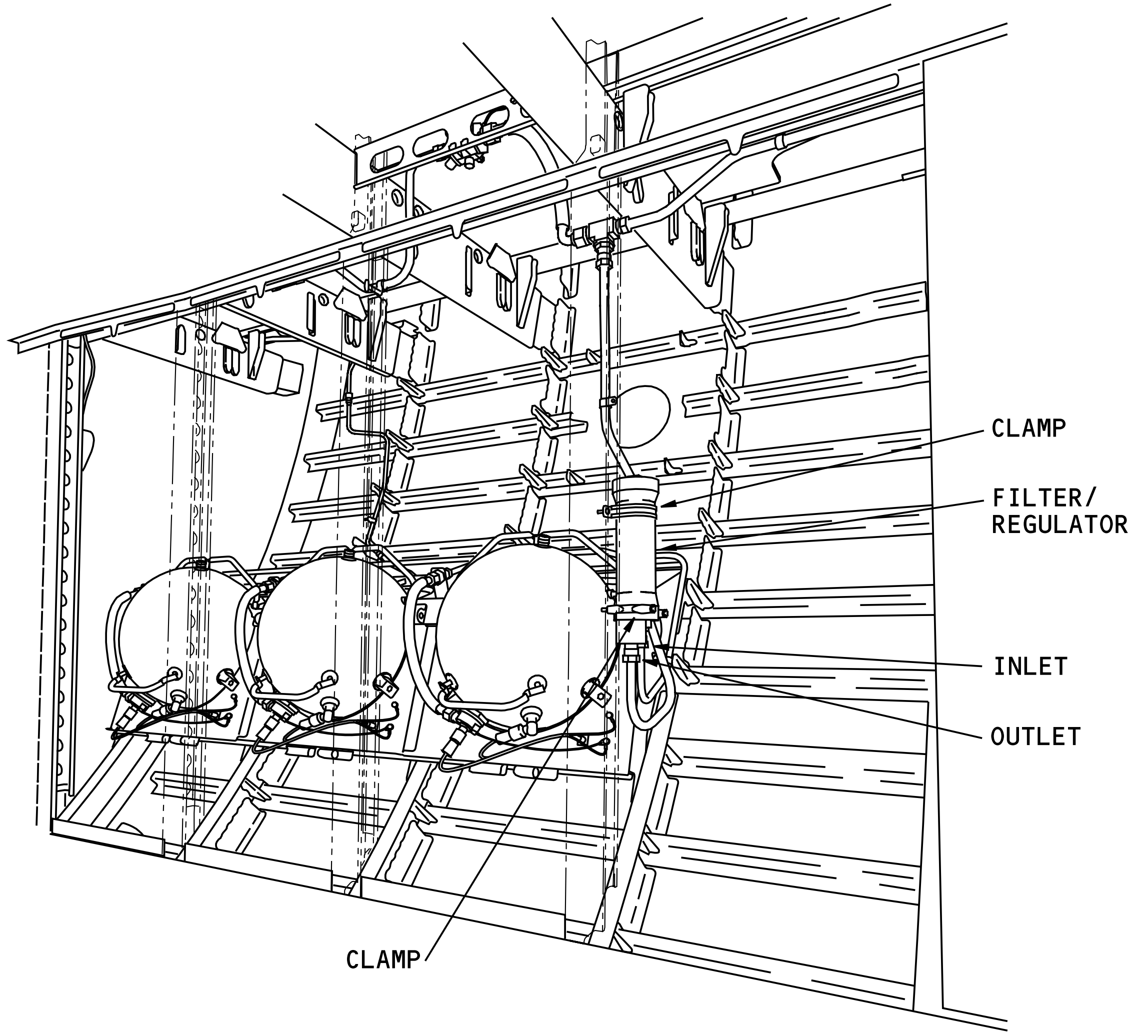
Functional Description

From the inlet port, halon goes through the filter/drier element, then through the regulator to the outlet port. The filter/drier makes sure no contamination goes to the regulator. The regulator controls the flow of halon to the discharge nozzles.

Training Information Point

The filter/regulator is internally sealed at the inlet and outlet. Pressurized halon opens the seals when the fire extinguishing system operates.

Replace the filter/regulator after the fire extinguishing system operates. The inlet and outlet are different sizes so you cannot install it incorrectly.



METERED BOTTLES

26-23-00-008 Rev 0

LOWER CARGO FIRE EXTINGUISHING - FILTER/REGULATOR

LOWER CARGO FIRE EXTINGUISHING - FLOW VALVE

Purpose

The forward flow valve lets fire extinguishing agent from the bottles go to the forward cargo compartment. The aft flow valve lets fire extinguishing agent from the bottles go to the aft cargo compartment.

Physical Description

The flow valve has these parts:

- Two protective caps
- Two cap rests
- Inlet port
- Diaphragm
- Two squibs
- Outlet port
- Debris screen.

Location

The two flow valves are behind the right sidewall lining of the forward cargo compartment, near the ceiling. The forward flow valve is above the metered bottles. The aft flow valve is above the dump bottles. Access is through the fire bottle access panels.

Functional Description

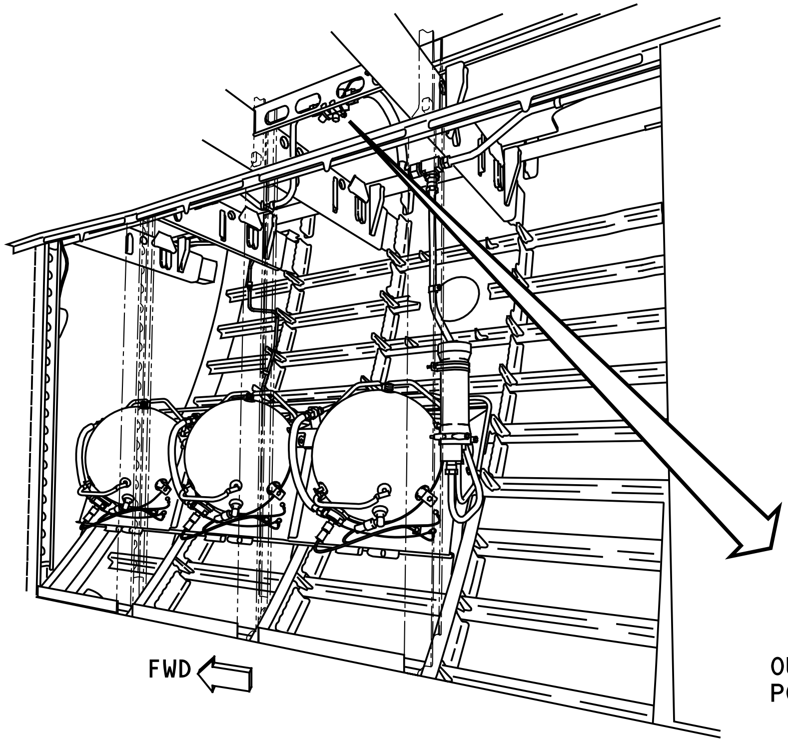
The inlet port connects to the fire extinguishing bottles. The outlet port connects to the discharge line. The valve is normally closed by the diaphragm between the inlet and outlet.

Two explosive squibs are adjacent to the diaphragm. The squibs fire when you operate the related fire extinguishing controls. The explosion tears the diaphragm and lets halon go through the valve. The debris screen catches pieces of the disc and squibs to prevent contamination of downstream components. Only one squib is necessary to tear the diaphragm. Two squibs are used to make sure the valve opens.

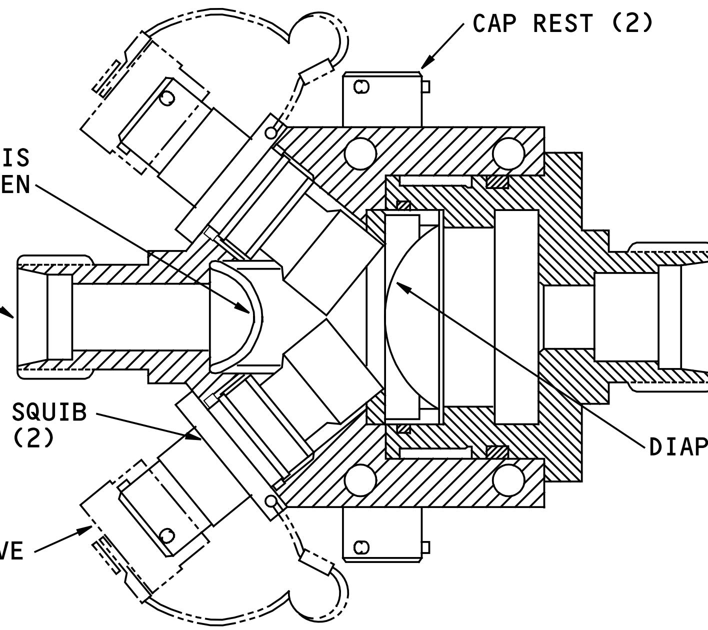
Training Information Point

Replace the correct flow valve after the fire extinguishing system operates. Different size inlet and outlet ports prevent incorrect installation. The two squibs have the same purpose. Connect the airplane wiring to the squibs in any sequence. The forward and aft flow valves are interchangeable.

WARNING: INSTALL THE PROTECTIVE CAPS ON THE ELECTRICAL CONNECTORS ANY TIME THE AIRPLANE WIRING IS NOT CONNECTED. ACCIDENTAL DISCHARGE OF THE SQUIBS CAN CAUSE INJURY.



FORWARD CARGO COMPARTMENT, RIGHT SIDEWALL
(LINING REMOVED)



FORWARD FLOW VALVE
(TYPICAL)

26-23-00-009 Rev 1 07/09/1997

LOWER CARGO FIRE EXTINGUISHING - FLOW VALVE

LOWER CARGO FIRE EXTINGUISHING - FUNCTIONAL DESCRIPTION - FLOW

General

An explosive squib inside the discharge assembly releases halon from the bottles. Flow valves, also operated by explosive squibs, let the halon go to the forward or aft cargo compartment. Flight and ground operation are different.

Operation - Flight

This is what happens when you operate the controls for a lower cargo fire:

- The squibs for bottles 1A and 1B fire
- The squibs in the selected flow valve fire
- A twenty-minute timer in the ELMS starts.

The squib explosion opens the diaphragms in the dump bottles and in the selected flow valve. Nitrogen pressure pushes the halon from the bottles, through the open flow valve, and into the selected cargo compartment. Pressure in the discharge line operates the in-line pressure switch. This switch gives a flight deck indication of bottle discharge.

Pressure switches monitor the pressure in the dump bottles. When the pressure decreases, the switches causes low pressure indications to show in the flight deck.

After twenty minutes, the ELMS fires the squibs for bottles 2A, 2B, and 2C. Halon from the bottles goes through the filter/regulator and into the selected cargo compartment. The filter/regulator causes a slow and continuous flow of halon into the cargo compartment to keep the fire out.

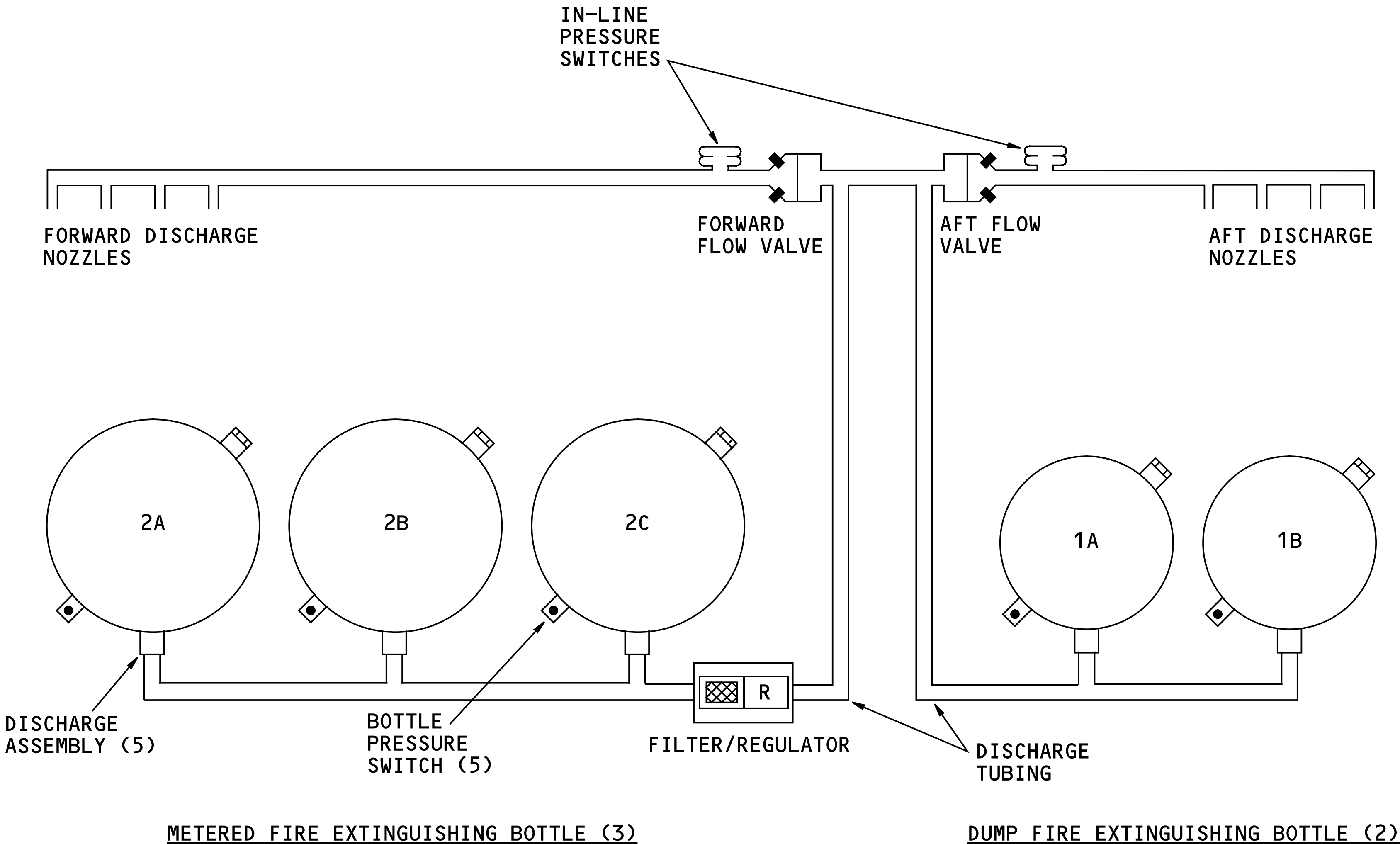
If the airplane lands before the twenty minute time delay ends, bottle 2A discharges at landing. Bottles 2B and 2C do not discharge.

When pressure in a metered bottle decreases, the bottle pressure switch causes advisory and status low pressure messages to show.

Operation for an aft cargo fire is almost the same. The aft flow valve opens instead of the forward flow valve. This causes the fire extinguishing agent to go to the aft lower cargo compartment.

Operation - Ground

If you operate the system when the airplane is on the ground, the metered bottle discharge is different. After the twenty minute time delay, the squib for bottle 2A fires. Bottles 2B and 2C do not discharge when the airplane is on the ground.



26-23-00-011 Rev 2 07/09/1997

LOWER CARGO FIRE EXTINGUISHING - FUNCTIONAL DESCRIPTION - FLOW

LOWER CARGO FIRE EXTINGUISHING - FUNCTIONAL DESCRIPTION - DUMP BOTTLES CIRCUIT

Bottle Discharge

Push the forward or aft cargo fire arm switch to arm the cargo fire extinguishing system. The switch makes a ground for the squib bottles 1A, 1B control relay. Push the cargo fire discharge switch to fire the squibs. That switch lets power from the hot battery bus go to energize the relay. With the relay energized, power from the hot battery bus goes to the bottle 1A and 1B squibs. At the same time, power goes through the discharge switch and the arm switch to the forward or aft flow valve squibs.

Discharge Indication

Pressure in the discharge line closes the forward or aft in-line pressure switch. The EEU makes a ground for the cargo fire discharge light and sends a signal to the AIMS. Advisory and maintenance messages show that the forward or aft in-line pressure switch is closed. The fire protection maintenance page also shows this condition.

When pressure inside a bottle decreases, the bottle pressure switch closes and makes a ground. The EEU sends a signal to the AIMS. Status and maintenance messages show low bottle pressure. The fire protection maintenance page also shows this condition.

Squib Test

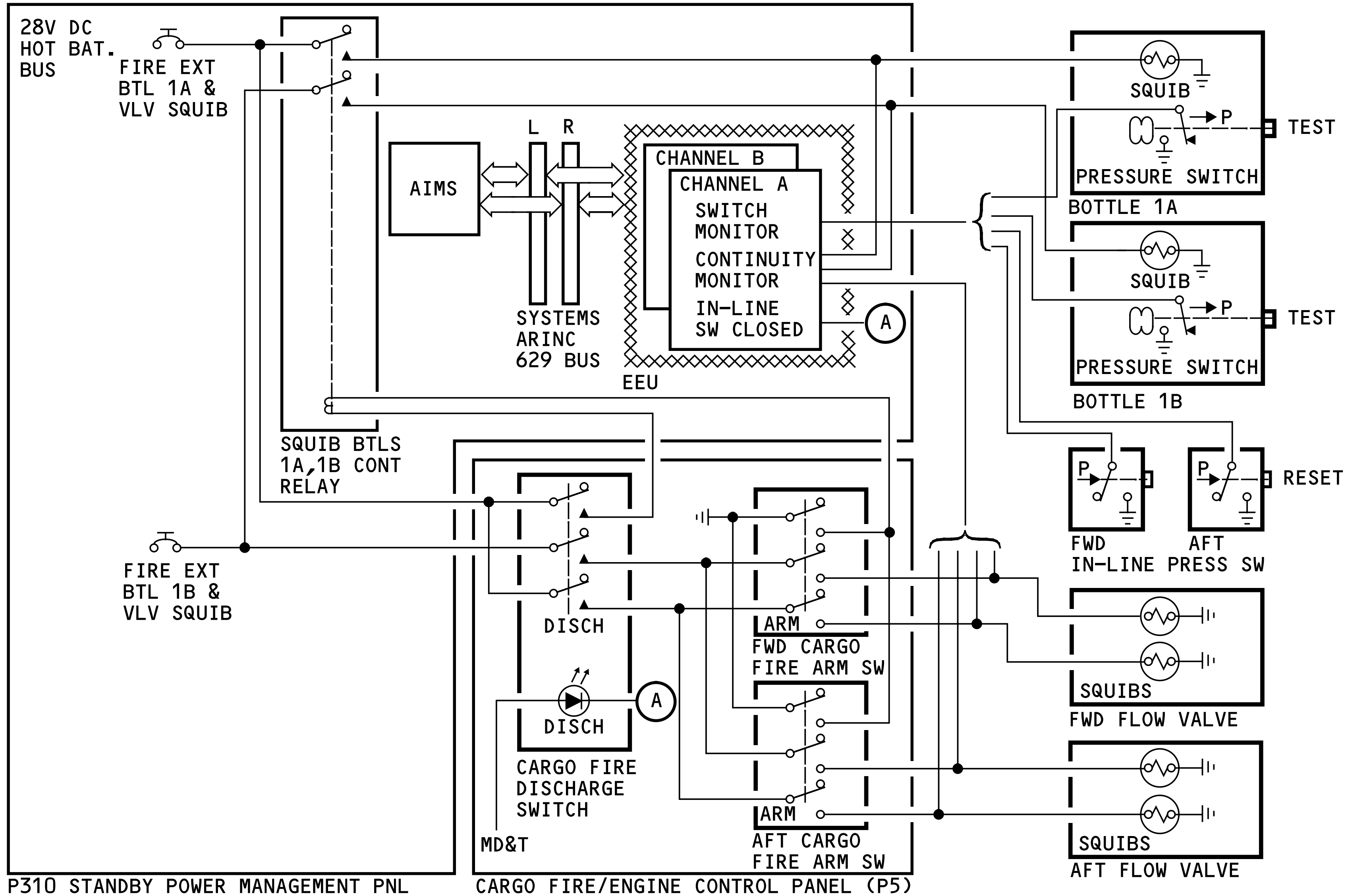
The ELMS monitors the electrical continuity of the squib circuits. The ELMS does this check one time during each flight leg. The ELMS transmits data about an open squib circuit to the AIMS. Status and maintenance messages show that a squib circuit is faulty. The fire protection maintenance page also shows this condition.

You can also do a test of the squib circuits with the MAT.

Training Information Point

You can do a check of the bottle pressure switch circuits on the ground. Use a hex key to rotate the bottle pressure switch test socket to close the switch. A bottle low pressure status messages must show

The in-line pressure switch latches closed when the fire extinguishing system operates. Use the reset button to set the switch contacts open.



26-23-00-012 Rev 0

LOWER CARGO FIRE EXTINGUISHING - FUNCTIONAL DESCRIPTION - DUMP BOTTLES CIRCUIT

LOWER CARGO FIRE EXTINGUISHING - FUNCTIONAL DESCRIPTION - METERED BOTTLES CIRCUIT

Bottle Discharge

When you push a cargo fire arm switch, a signal goes to the overhead panel ARINC 629 system (OPAS). The OPAS sends this data to the EEU. The discharge control circuit starts a twenty minute timer. After twenty minutes, the discharge control circuit makes a ground for the two squib control relays. The relays energize and send power from the hot battery bus to the three fire bottle squibs.

Discharge Indication

When pressure inside a bottle decreases, the bottle pressure switch closes and makes a ground. The ELMS electronics unit sends a signal to the AIMS. Status and maintenance messages show low bottle pressure. The fire protection maintenance page also shows this condition.

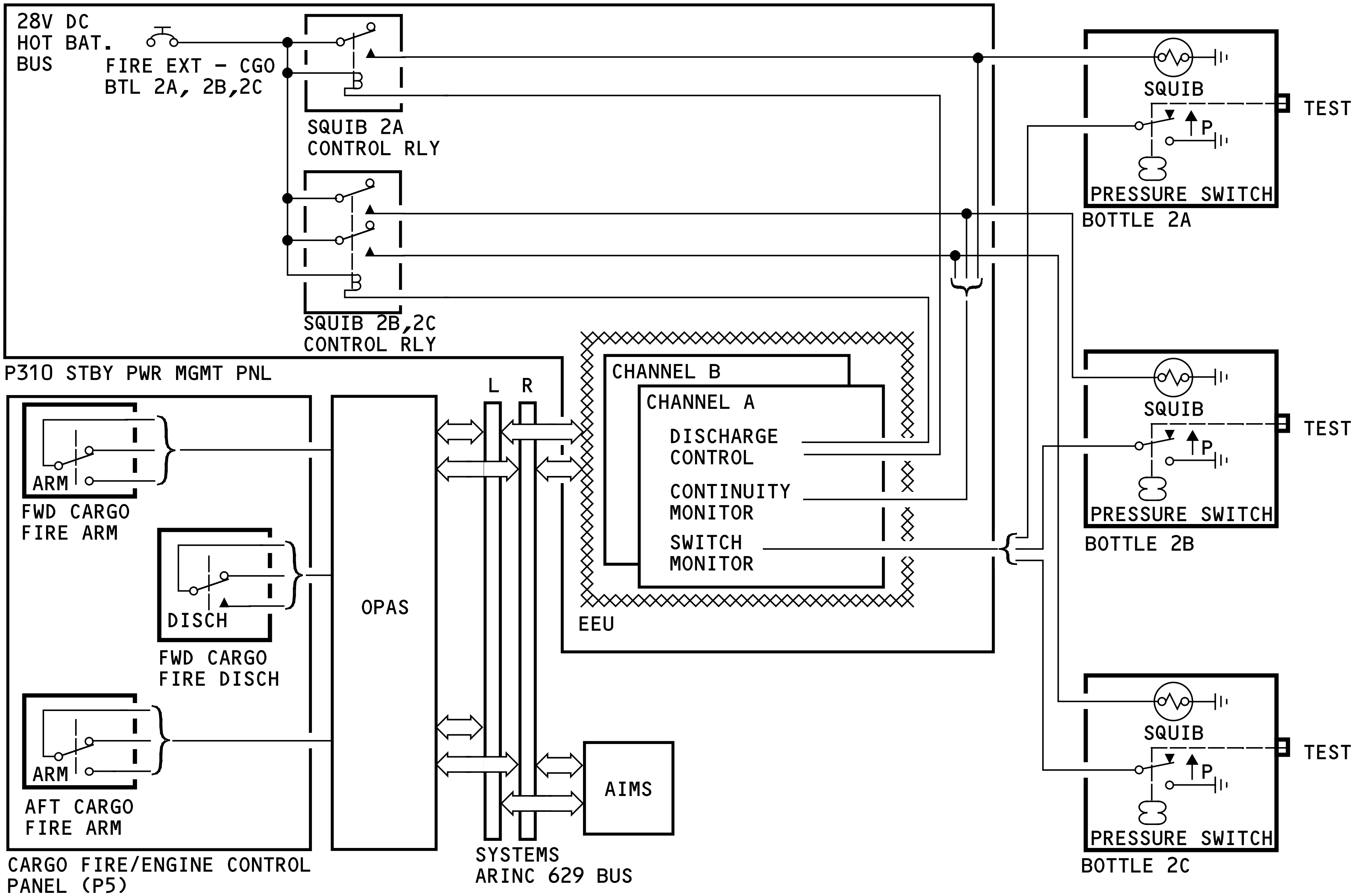
Squib Test

The ELMS monitors the electrical continuity of the squib circuits. The ELMS does this check one time during each flight leg. The ELMS transmits data about an open squib circuit to the AIMS. Status and maintenance messages show that a squib circuit is faulty. The fire protection maintenance page also shows this condition.

You can also do a test of the squib circuits with the MAT.

Training Information Point

You can do a check of the bottle pressure switch circuits on the ground. Use a hex key to rotate the bottle pressure switch test socket to close the switch. A bottle low pressure status messages must show.



26-23-00-013 Rev 0

LOWER CARGO FIRE EXTINGUISHING - FUNCTIONAL DESCRIPTION - METERED BOTTLES CIRCUIT

LOWER CARGO FIRE EXTINGUISHING - OPERATION - INDICATIONS

Fire Protection Maintenance Page

Operational status of the lower cargo fire extinguishing system is shown on the fire protection maintenance page format.

EICAS And Maintenance Messages

EICAS or maintenance messages show these conditions:

- A fire bottle has Low pressure
- A bottle squib circuit is open
- A flow valve squib circuit is open
- An in-line pressure switch is set
- The initiated squib test is complete.

FIRE PROTECTION

CARGO SMOKE DETECTION SYSTEM:

	FWD DETECTOR 1	FWD DETECTOR 2	AFT DETECTOR 1	AFT DETECTOR 2
POWER	ON	ON	ON	ON
DATA BUS	NORM	NORM	FAULT	NORM
CHANNEL	NORM	NORM	FAULT	NORM
FAN	NORM	NORM	FAULT	FAULT
DETECTOR AIR	NO AIR		NO AIR	
DETECTOR	FAULT		FAULT	

SMOKE DETECTOR ZONES

	1	2	3
FWD	NORM	NO AIR	NO AIR
AFT	NO AIR	NO AIR	NO AIR

CARGO FIRE EXTINGUISHING SYSTEM:

BOTTLE	1A	1B	2A	2B	2C
PRESSURE	LOW	LOW	LOW	NORM	NORM
SQUIB	FAULT	FAULT	FAULT	NORM	NORM

CARGO COMPARTMENT	FWD	AFT
FLOW VLV SQUIB 1	NORM	FAULT
FLOW VLV SQUIB 2	NORM	FAULT
DISCHARGE PRESS SW	NORM	SET

DATE 23 JUN 90 UTC 18:54:04

FIRE PROTECTION MAINTENANCE PAGE FORMAT

LOWER CARGO FIRE EXTINGUISHING - OPERATION - INDICATIONS

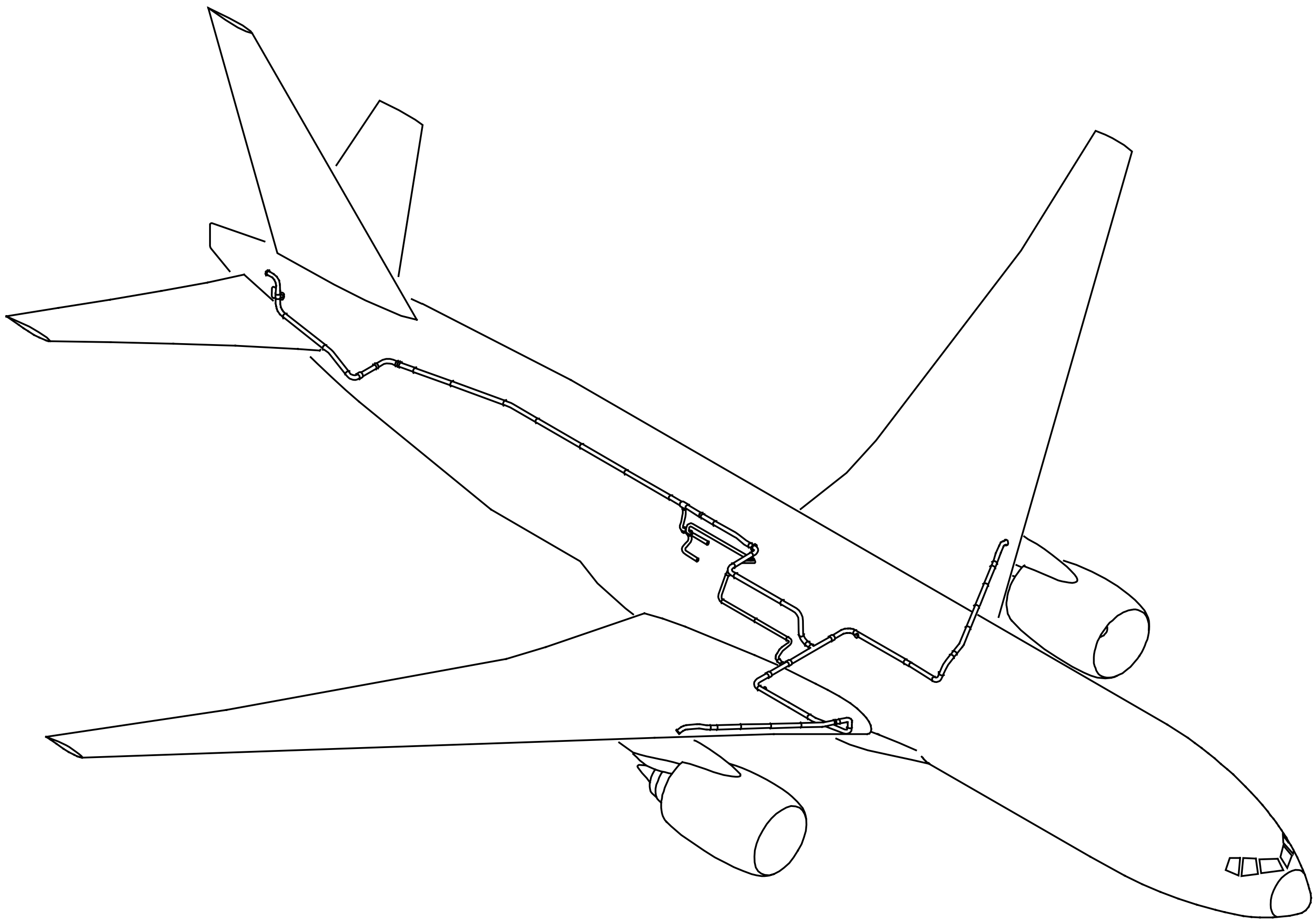
DUCT LEAK AND OVERHEAT DETECTION - INTRODUCTION

Purpose

The duct leak and overheat detection system (DLODS) monitors the pneumatic ducts and engine anti-ice ducts for leaks.

General

DLODS has an interface with the pneumatic and engine anti-ice systems. Valves in these systems close automatically to stop the leak. A duct leak that does not stop can cause structural damage to the airplane. EICAS messages tell the crew about the duct leak.



DUCT LEAK AND OVERHEAT DETECTION - INTRODUCTION

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DUCT LEAK AND OVERHEAT DETECTION - GENERAL DESCRIPTION

General

The duct leak and overheat detection system (DLODS) has these detectors:

- Wheel well fire detectors (ref)
- Fan case overheat detectors
- Strut overheat detectors
- Wing duct leak detectors
- Body duct leak detectors.

Three identical DLODS control cards monitor the detectors:

- Left DLODS control card
- Center DLODS control card
- Right DLODS control card.

Interfaces

The DLODS control cards have these interfaces:

- Pneumatic system (ASCPC)
- Engine anti-ice system (ACIPS cards - EAI)
- Overhead panel ARINC 629 system (OPAS)
- APU controller (APUC)
- Warning electronic system (WES)
- AIMS primary display system and central maintenance computing function.

Wheel Well Fire Detection

If a wheel well fire detector finds a fire, the DLODS control cards send a signal on the data bus. The warning electronic system turns on the fire bell and the master warning lights. The AIMS shows an EICAS warning message.

When you do a fire/overheat test, you test the wheel well fire detection part of DLODS, but not the duct leak and overheat detection part.

See the fire protection section for more information about the fire/overheat test (AMM PART I 26-00).

See the wheel well fire detection system section for more information about the wheel well fire detection system (AMM PART I 26-17).

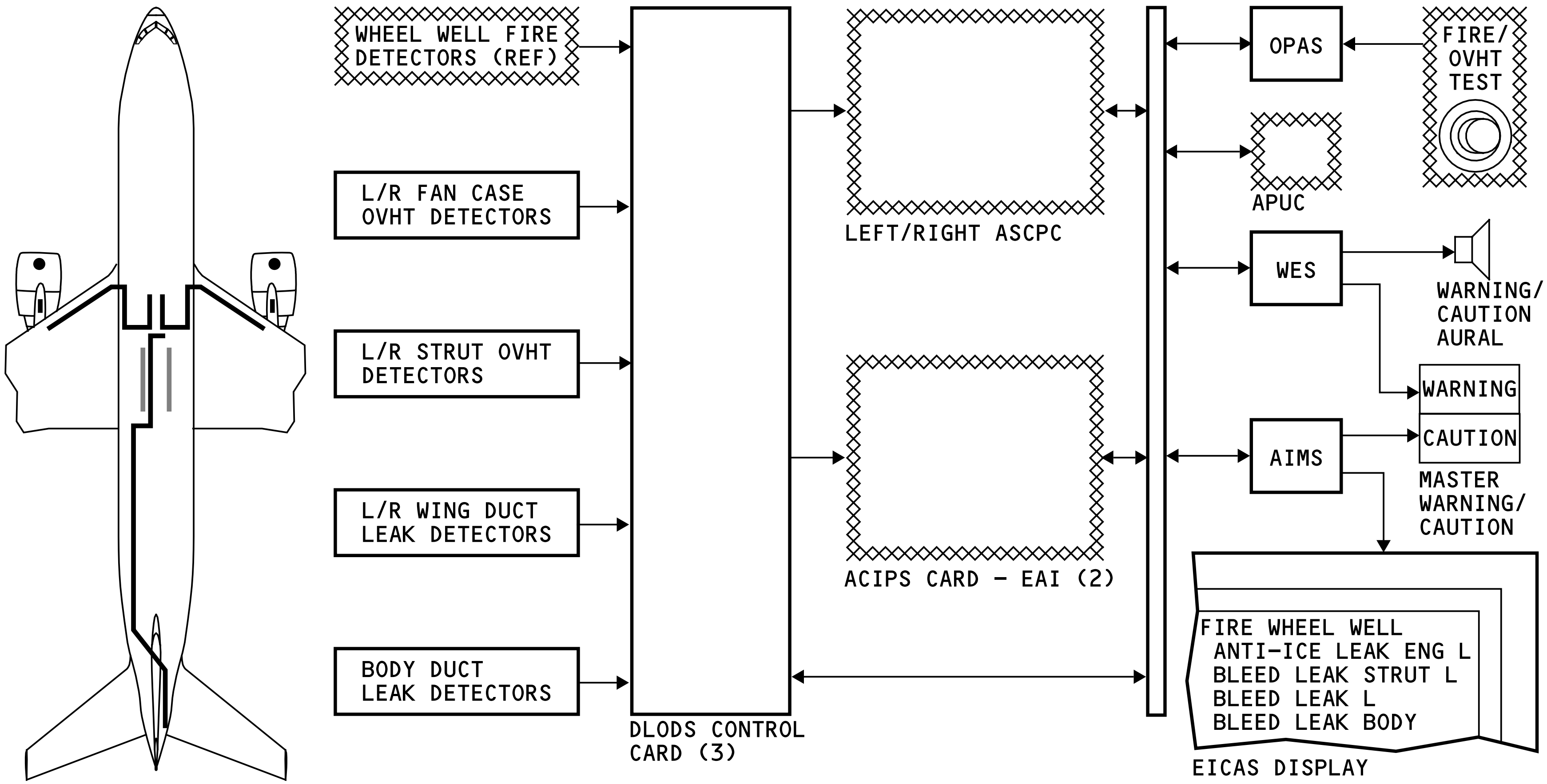
Duct Leak and Overheat Detection

If a detector finds an overheat condition, the DLODS control cards send a signal on the data bus. The warning electronic unit turns on the master caution aural. The AIMS turns on the master caution lights and shows an EICAS caution message. For a fan case overheat condition, the DLODS control cards also send a signal to the EAI ACIPS cards to close the engine anti-ice valve. For a strut overheat condition, a wing duct leak, or a body duct leak, the DLODS control cards send a signal to the ASCPC. Pneumatic system valves close automatically to isolate the leak. A signal to the APUC causes the APU surge valve to open if necessary.

DUCT LEAK AND OVERHEAT DETECTION - GENERAL DESCRIPTION

BITE

The DLODS cards continuously monitor the detectors for open and short circuits. For either condition, the DLODS control cards send a signal to the AIMS. A status message shows which detector has failed.



26-18-00-002 Rev 2 05/03/95

DUCT LEAK AND OVERHEAT DETECTION - GENERAL DESCRIPTION

DUCT LEAK AND OVERHEAT DETECTION - COMPONENT LOCATIONS

Engine Struts and Nacelles

These DLODS components are in the engine struts and nacelles:

- Right strut overheat detectors
- Right fan case overheat detector
- Left strut overheat detectors
- Left fan case overheat detector.

Wings and Fuselage

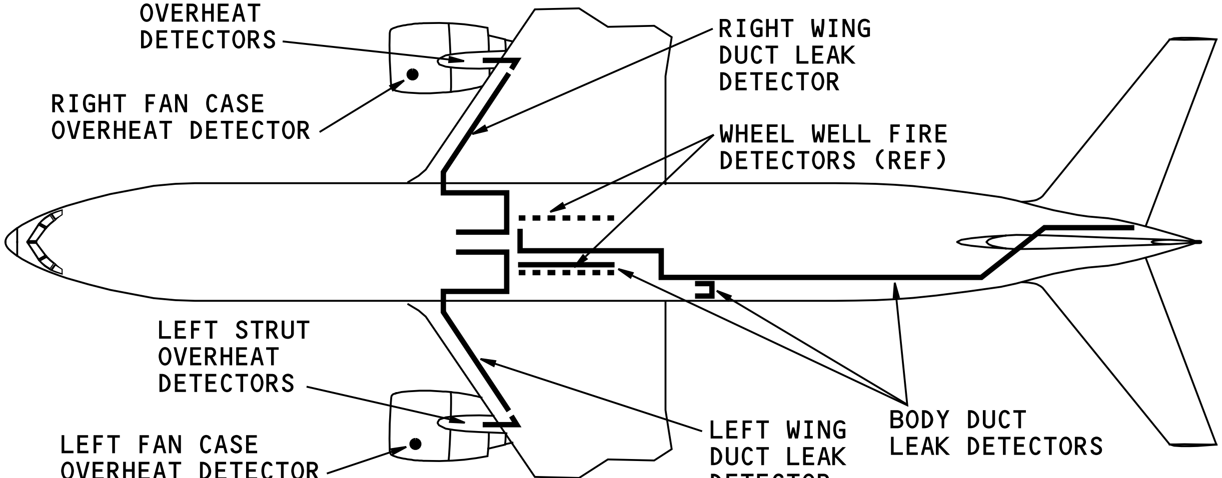
These DLODS components are in the wings and fuselage:

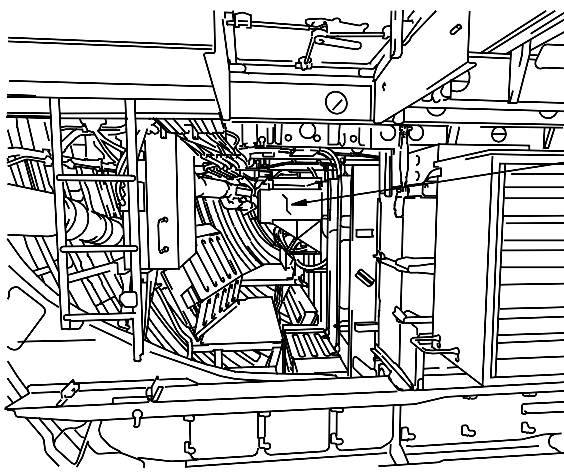
- Right wing duct leak detector
- Body duct leak detectors
- Left wing duct leak detector.

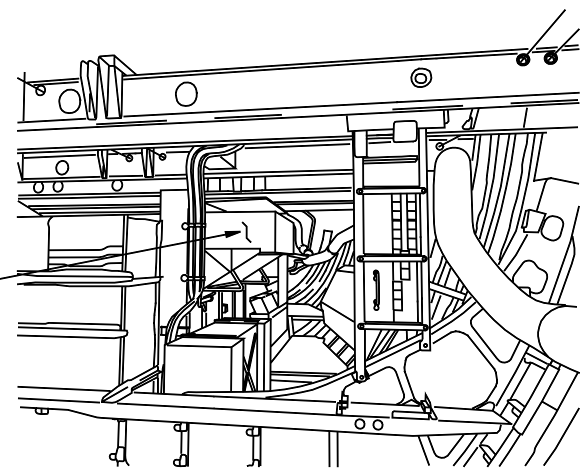
Main Equipment Center

These DLODS components are in the main equipment center:

- Left DLODS control card
- Right DLODS control card
- Center DLODS control card.







MAIN EQUIPMENT CENTER
(LEFT SIDE, LOOKING FORWARD)

MAIN EQUIPMENT CENTER
(RIGHT SIDE, LOOKING FORWARD)

26-18-00-003 Rev 1

DUCT LEAK AND OVERHEAT DETECTION - COMPONENT LOCATIONS

DUCT LEAK AND OVERHEAT DETECTION - FAN CASE OVERHEAT DETECTORS

Purpose

The fan case overheat detector monitors the temperature in the area around the engine fan case. A leak in the engine anti-ice duct causes an overheat condition.

Physical Description

The fan case overheat detector has two elements: loop 1 and loop 2, attached to a metal support. Bolts connect the elements to the airplane wiring.

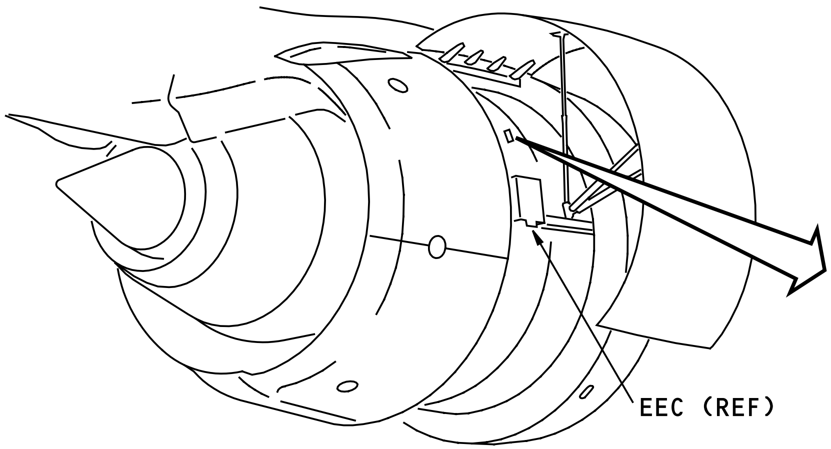
Each element has an outer conductor around an inner conductor. The separator between these conductors is an electrical insulator at temperatures less than the overheat set point (255F, 124C).

Functional Description

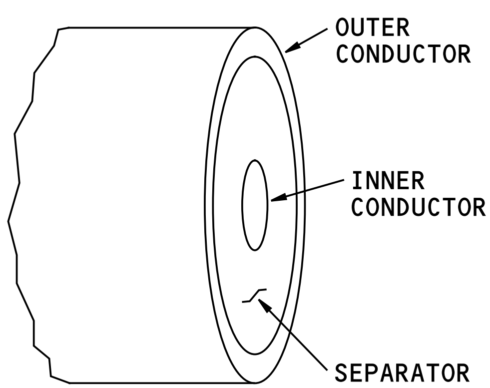
When the temperature is more than the set point, the separator conducts electricity. The electrical continuity between the inner and outer conductors gives an input to the DLODS control card.

Location

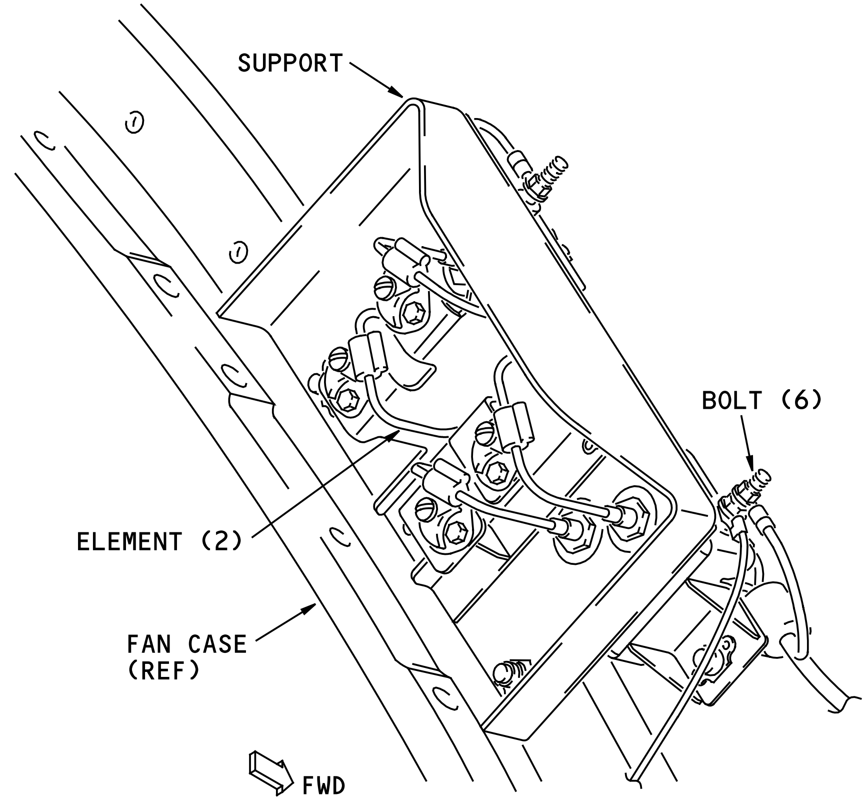
The fan case overheat detector attaches to the right side of the fan case above the electronic engine control.



ENGINE RIGHT SIDE



CROSS SECTION OF ELEMENT



FAN CASE OVERHEAT DETECTOR

26-18-00-004 Rev 1

DUCT LEAK AND OVERHEAT DETECTION - FAN CASE OVERHEAT DETECTORS

DUCT LEAK AND OVERHEAT DETECTION - STRUT OVERHEAT DETECTORS

Purpose

The strut overheat detectors monitor the temperature in the engine strut and the wing leading edge immediately inboard of the strut. A leak in the pneumatic duct causes an overheat condition.

Physical Description

Each side of the airplane has a dual loop strut overheat detector circuit. Each loop in the circuit has a set of elements that connect in series. Clips attach one long pair of elements to the front of the wing spar. A metal frame assembly contains another pair of elements. Electrical connectors and bolts connect the elements to the airplane wiring.

Each element has an outer conductor around an inner conductor. The separator between these conductors is an electrical insulator at temperatures less than the overheat set point (310F, 154C).

Functional Description

When the temperature is more than the set point, the separator conducts electricity. The electrical continuity between the inner and outer conductors gives an input to the DLODS control card.

Location

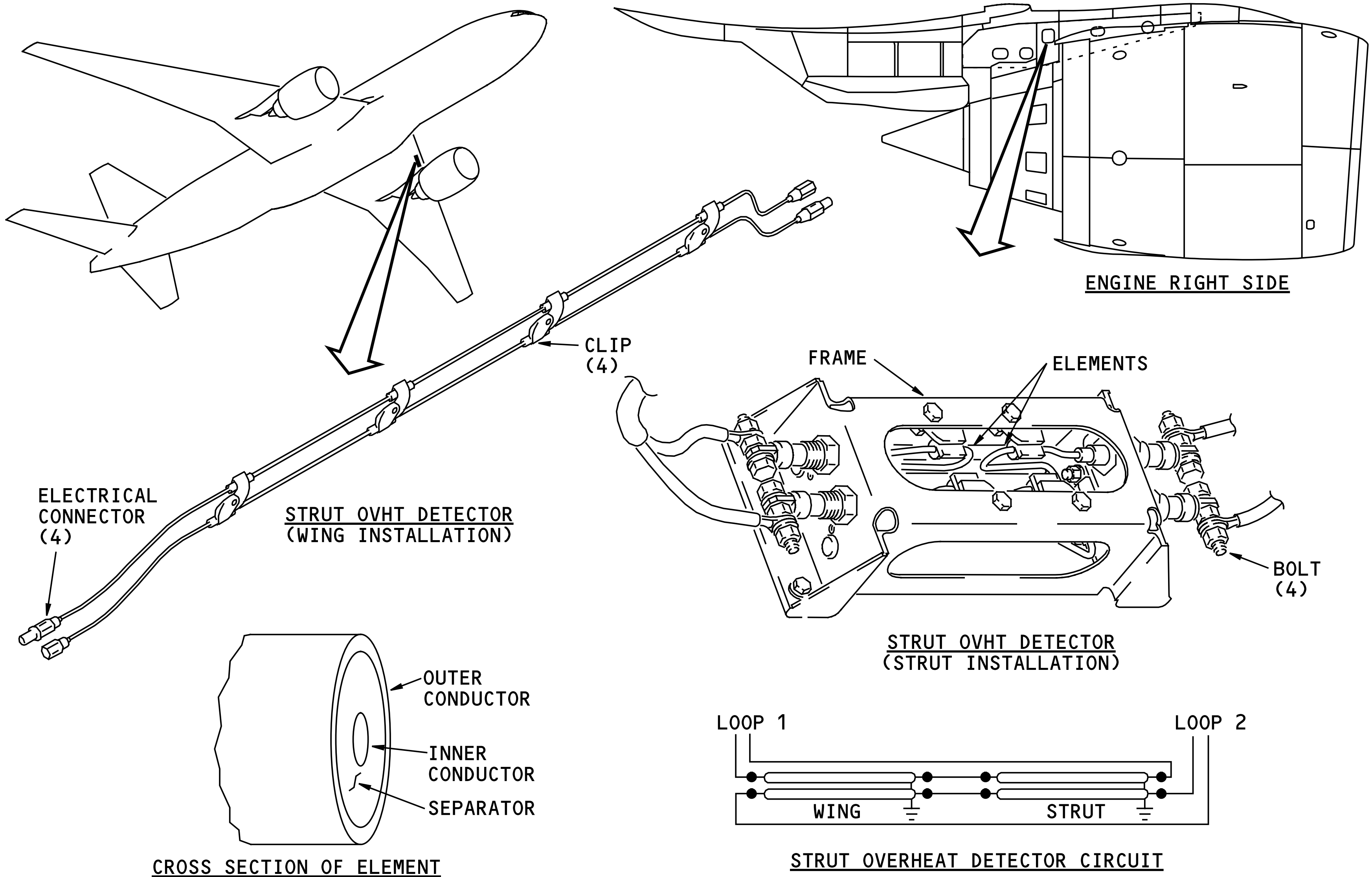
The strut overheat detectors are in two locations. One type is in the wing leading edge and another type is in the engine strut.

Access to the detector in the wing is through two panels on the bottom of the fixed leading edge. The panels are immediately inboard of the strut.

Access to the detector in the strut is through the pressure relief door in the right side of the strut.

Training Information Point

The strut overheat detection system has a fault locating feature for the detector loops. Maintenance messages include a zone number to help you find the location of a duct leak or a short circuit.



26-18-00-005 Rev 1 04/27/1995

DUCT LEAK AND OVERHEAT DETECTION - STRUT OVERHEAT DETECTORS

DUCT LEAK AND OVERHEAT DETECTION - WING DUCT LEAK DETECTORS

Purpose

Wing duct leak detectors monitor the pneumatic distribution ducts in the wing leading edges and in the environmental control system (ECS) bays for leaks.

Physical Description

Each side of the airplane has a dual loop wing duct leak detector circuit. Each loop in the circuit has five elements that connect in series. Clips along the length of the detectors attach the elements to the structure.

Each element has an outer conductor around an inner conductor. The separator between these conductors is an electrical insulator at temperatures less than the overheat set point (255F, 124C).

Functional Description

When the temperature is more than the set point, the separator conducts electricity. The electrical continuity between the inner and outer conductors gives an input to the DLODS control card.

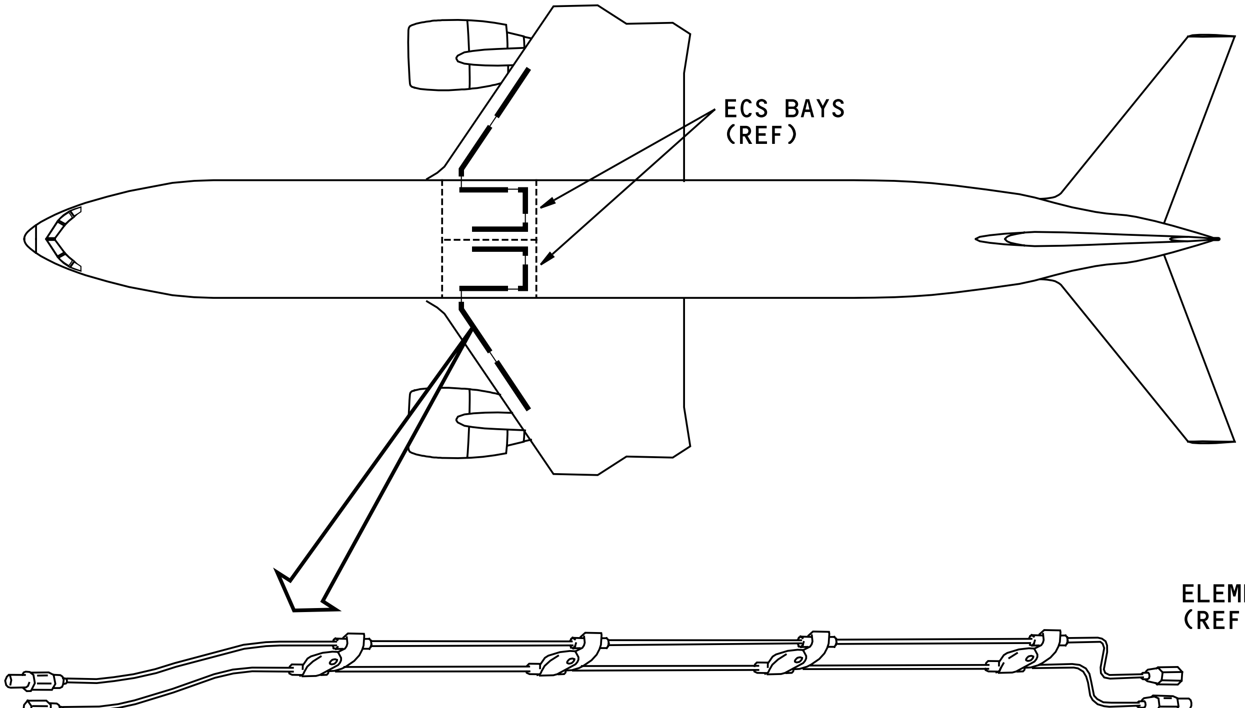
Location

The wing duct leak detectors are near the pneumatic distribution system ducts in the wing leading edges and in the ECS bays.

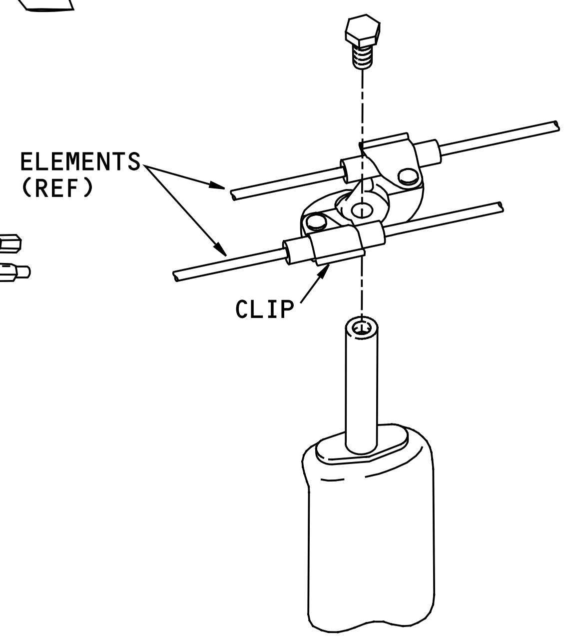
Training Information Point

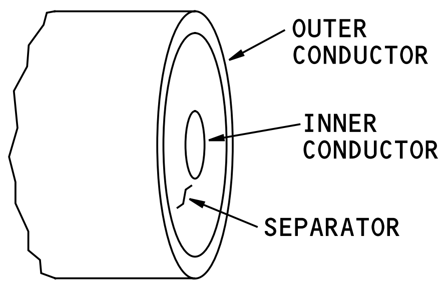
Where loop 1 uses a male connector, loop 2 uses a female connector to prevent cross connection of the loops.

The wing duct leak detection system has a fault locating feature for the detection loops. Maintenance messages include a zone number to help you find the location of a duct leak, short circuit, or open circuit.

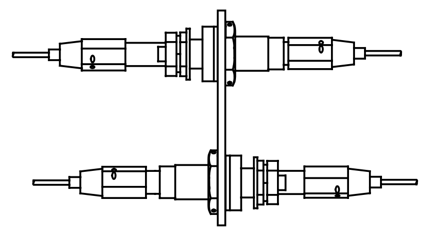


WING DUCT LEAK DETECTOR
(TYPICAL)





CROSS-SECTION OF ELEMENT



CONNECTION BETWEEN ELEMENTS
(TYPICAL)

ATTACH LOCATION
(TYPICAL)

26-18-00-006 Rev 1 03/16/95

DUCT LEAK AND OVERHEAT DETECTION - WING DUCT LEAK DETECTORS

DUCT LEAK AND OVERHEAT DETECTION - BODY DUCT LEAK DETECTORS

Purpose

Body duct leak detectors monitor the pneumatic distribution ducts for leaks in these areas:

- Main wheel wells
- Outboard of the aft and bulk cargo compartments, left side
- Fuselage from the aft pressure bulkhead to the APU firewall
- Air driven pump area.

Physical Description

The airplane has a dual loop body duct leak detector circuit. Each loop in the circuit has twelve elements that connect in series. Clips along the length of the assembly attach the elements to the structure.

Each element has an outer conductor around an inner conductor. The separator between these conductors is an electrical insulator at temperatures less than the overheat set point (255F, 124C).

Functional Description

When the temperature is more than the set point, the separator conducts electricity. The electrical continuity between the inner and outer conductors gives an input to the DLODS control card.

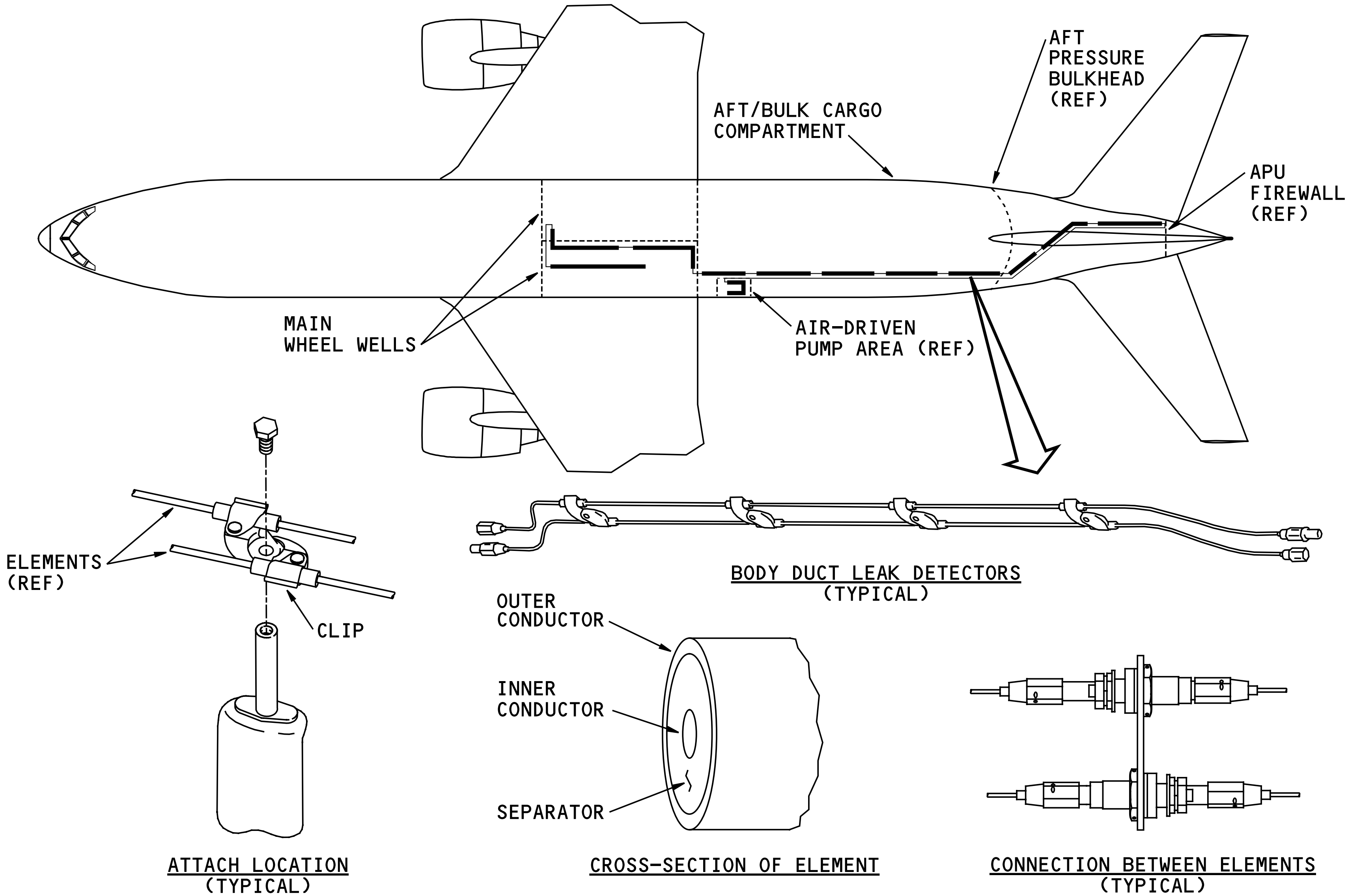
Location

The body duct leak detectors are near the pneumatic distribution ducts in the body areas. The detectors extend from the main wheel wells to the APU firewall.

Training Information Point

Where loop 1 uses a male connector, loop 2 uses a female connector to prevent cross connection of the loops.

The body duct leak detection system has a fault location feature for the detector loops. Maintenance messages include a zone number to help you find the location of a duct leak, short circuit, or open circuit.



26-18-00-007 Rev 2 07/10/1997

DUCT LEAK AND OVERHEAT DETECTION - BODY DUCT LEAK DETECTORS

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DUCT LEAK AND OVERHEAT DETECTION - FUNCTIONAL DESCRIPTION

General

The three DLODS control cards monitor the detector loops. Each DLODS control card uses ARINC 429 buses and two ARINC signal gateway (ASG) cards as an interface with the ARINC 629 systems buses. The DLODS control cards use this configuration to send data to each other and to other systems and LRUs.

Detector Status

Each detector loop has three possible conditions:

- Usual - low impedance in the inner conductor loop circuit and high impedance between the inner and outer conductors
- Open circuit - high impedance in the inner conductor loop circuit
- Short circuit - low impedance between the inner and outer conductors.

A loop in the usual condition has no electrical defects and no overheat condition. A loop with an open circuit is broken or disconnected from the card. A loop with a short circuit is damaged or has an overheat condition.

Control Card Logic

The cards compare the condition of both loops of a detector to find an overheat condition. The cards transmit an overheat signal if both loops have a short circuit. The cards also transmit an overheat signal if one loop has a short circuit while the other loop has an open circuit.

If a DLODS control card fails, the remaining cards do not get information about the loops connected to the failed card. The operating cards transmit an overheat signal if one loop has a short and the other loop connects to a failed card.

Interfaces

A wheel well fire causes an EICAS warning message and master warning indications. The fire/overheat test switch does a test of the wheel well fire detection part of DLODS.

Duct leak or overheat conditions cause EICAS caution messages and master caution indications. The duct leak or overheat input to the ASCPCs causes pneumatic system valves to close and isolate the leak. The input to the APUC causes the APU surge valve to open if it is necessary. A fan case overheat input to the ACIPS cards causes the engine anti-ice valve to close.

Training Information Point

The AIMS shows a loop failure status messages if a loop is not in the usual condition. The message specifies the detector circuit and the loop. The message shows for loops with open or short circuits. If there is an overheat condition, loop failure messages show for both detector loops. If a DLODS control card fails, loop

DUCT LEAK AND OVERHEAT DETECTION - FUNCTIONAL DESCRIPTION

failure messages show for all the loops that connect to that card.

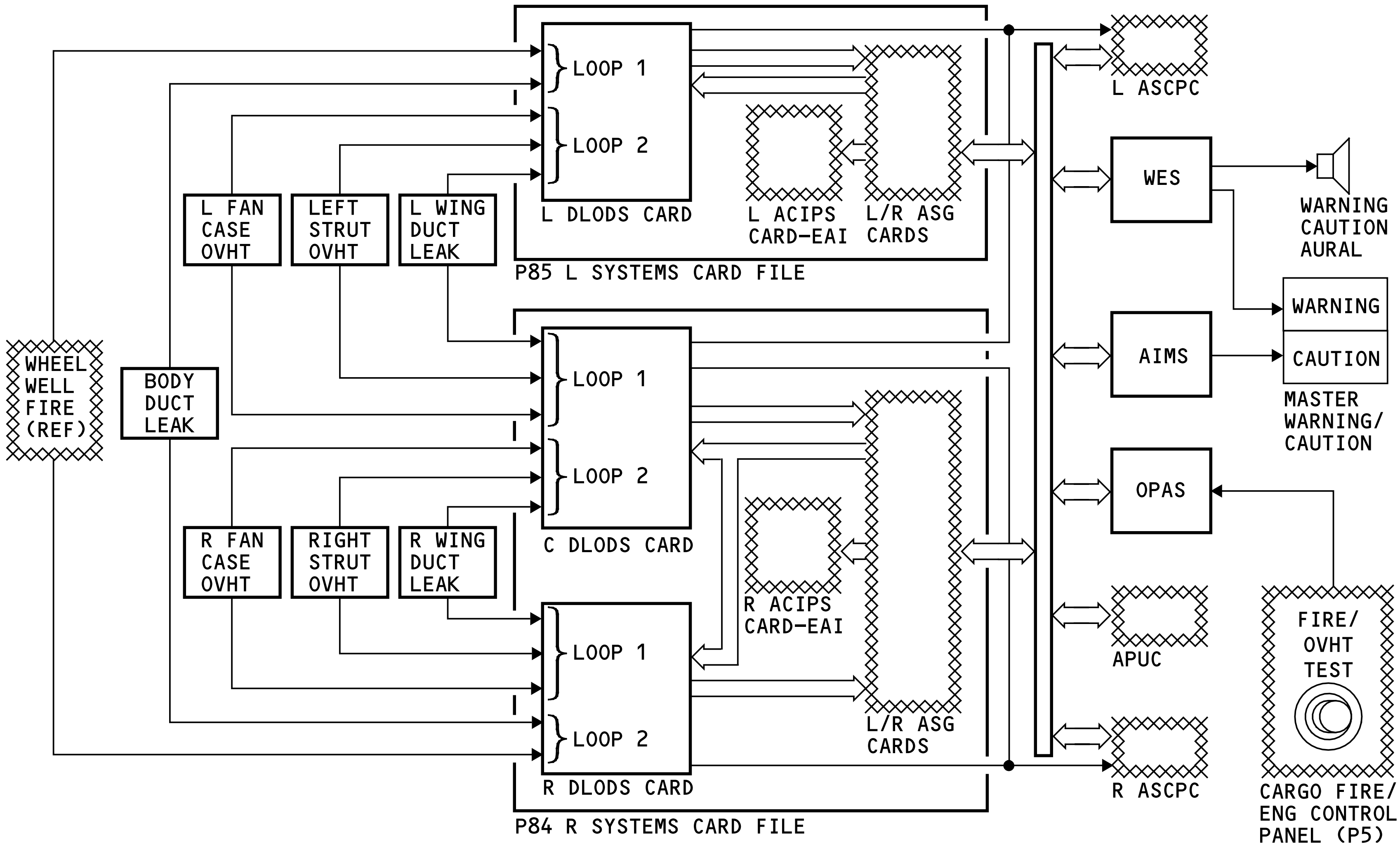
The central maintenance computing system also shows messages for loops not in the usual condition. The maintenance message specifies the detector circuit, loop, and if the problem is an open or short. The message also specifies the zone location for these failures:

- Strut overheat detectors - short circuit
- Wing duct leak detectors - short and open
- Body duct leak detectors - short and open.

The zone location for a short circuit helps you find electrical defects and duct leaks.

The CMCS also shows a maintenance message for a failed DLODS control card.

You use the MAT data load function to replace the software in the DLODS control cards.



26-18-00-008 Rev 1

DUCT LEAK AND OVERHEAT DETECTION - FUNCTIONAL DESCRIPTION

DUCT LEAK AND OVERHEAT DETECTION (DLODS) - FUNCTIONAL DESCRIPTION

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Overheat Detection

Each DLODS control card monitors its related detector loops. If the two loops of a detector have low resistance, the DLODS control cards send a signal to the AIMS to indicate an overheat condition at that detector. This causes an EICAS caution message.

If there is a fan case overheat, the DLODS control cards send a signal to the airfoil and cowl ice protection system (ACIPS) control cards. These cards close the engine anti-ice valve.

If there is a strut overheat or a wing duct leak, the DLODS control cards send a signal to the air supply and cabin pressure controllers (ASCPCs). The ASCPCs close the related isolation valve to isolate the problem duct.

Loop Failure

The DLODS control cards continuously monitor the detector loops for open and short circuits. If a card finds a short circuit in only one loop of a detector, the cards send a signal to AIMS to show a short circuit failure of the detector.

If the signal from a loop shows an open circuit, the DLODS control cards send a signal to AIMS to show an open failure of the detector.

Short and open failures of the detectors cause status and maintenance messages.

Isolation of a Short Circuit in an Overheat Detector

A DLODS control card isolates the zone location of a short circuit in these detectors:

- Strut overheat detectors
- Wing duct leak detectors
- Body duct leak detectors.

When there is a short circuit, the DLODS control card measures the electrical resistance to the short. The card calculates the proportion that this resistance is to the total loop resistance. This proportion of the loop length identifies the location of the short. The central maintenance computer system (CMCS) shows this location as an airplane zone.

Isolation of an Open Circuit in an Overheat Detector

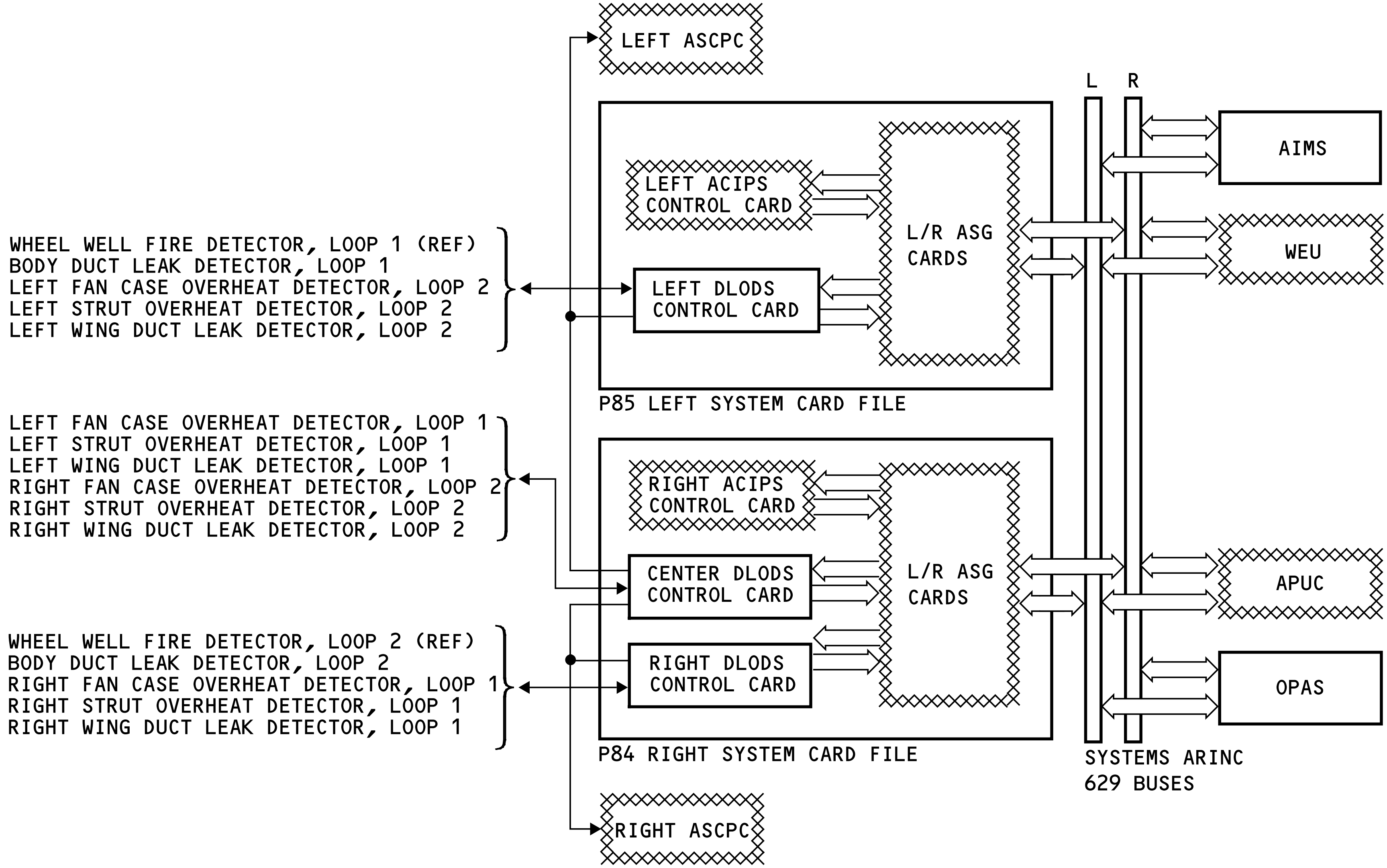
When loop resistance is greater than a specified level, A DLODS control card shows the loop as an open circuit. A DLODS control card isolates the zone location of an open circuit in these detectors:

- Wing duct leak detectors
- Body duct leak detectors.

When there is an open circuit, the DLODS control card measures the electrical capacitance to the open. The card calculates the proportion that this capacitance is to the total loop capacitance. This proportion of the loop length identifies the location of the open. The central maintenance computer system (CMCS) shows this location as an airplane zone.

DLODS Control Card Failure

If a DLODS control card has a failure, status messages show the loops for that card as failed. The serviceable cards use the related loop in a detector as the only source of fire/overheat detection.



26-18-00-009 Rev 0

DUCT LEAK AND OVERHEAT DETECTION (DLODS) - FUNCTIONAL DESCRIPTION

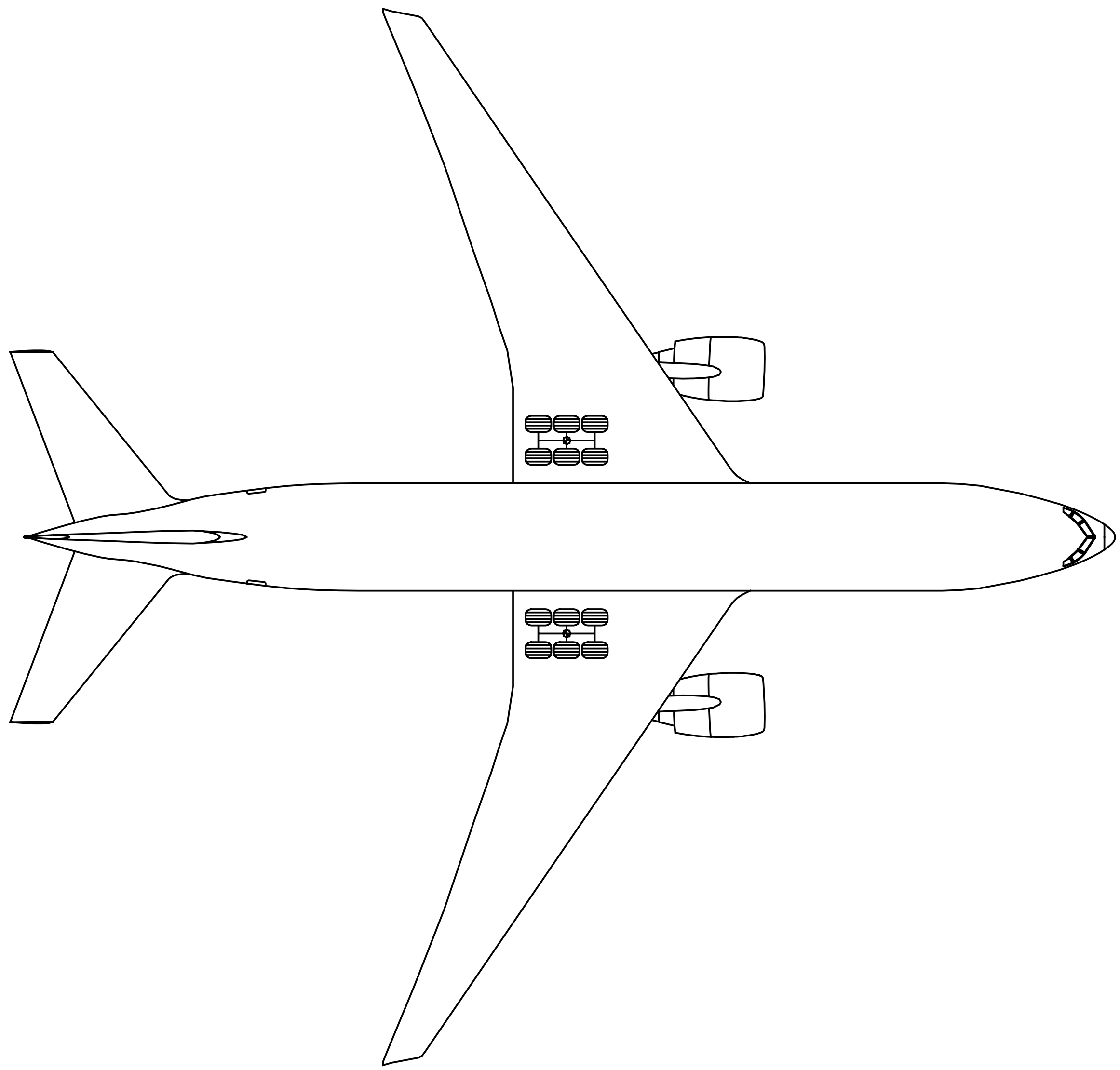
WHEEL WELL FIRE DETECTION - INTRODUCTION

Purpose

The wheel well fire detection system monitors the main wheel wells for a fire condition.

General

The wheel well fire detection system has an interface with the duct leak and overheat detection system. A fire in a wheel well causes an EICAS warning message in the flight deck.



WHEEL WELL FIRE DETECTION - INTRODUCTION

WHEEL WELL FIRE DETECTION - GENERAL DESCRIPTION

General

There are two adjacent fire detectors in each main wheel well. Each detector in the left wheel well connects to a detector in the right wheel. This makes two detector loops that operate independently.

Interfaces

The wheel well fire detection system has these interfaces:

- AIMS
- Warning electronics unit (WEU)
- Cargo fire/engine control panel
- Duct leak/overheat detection system (DLODS).

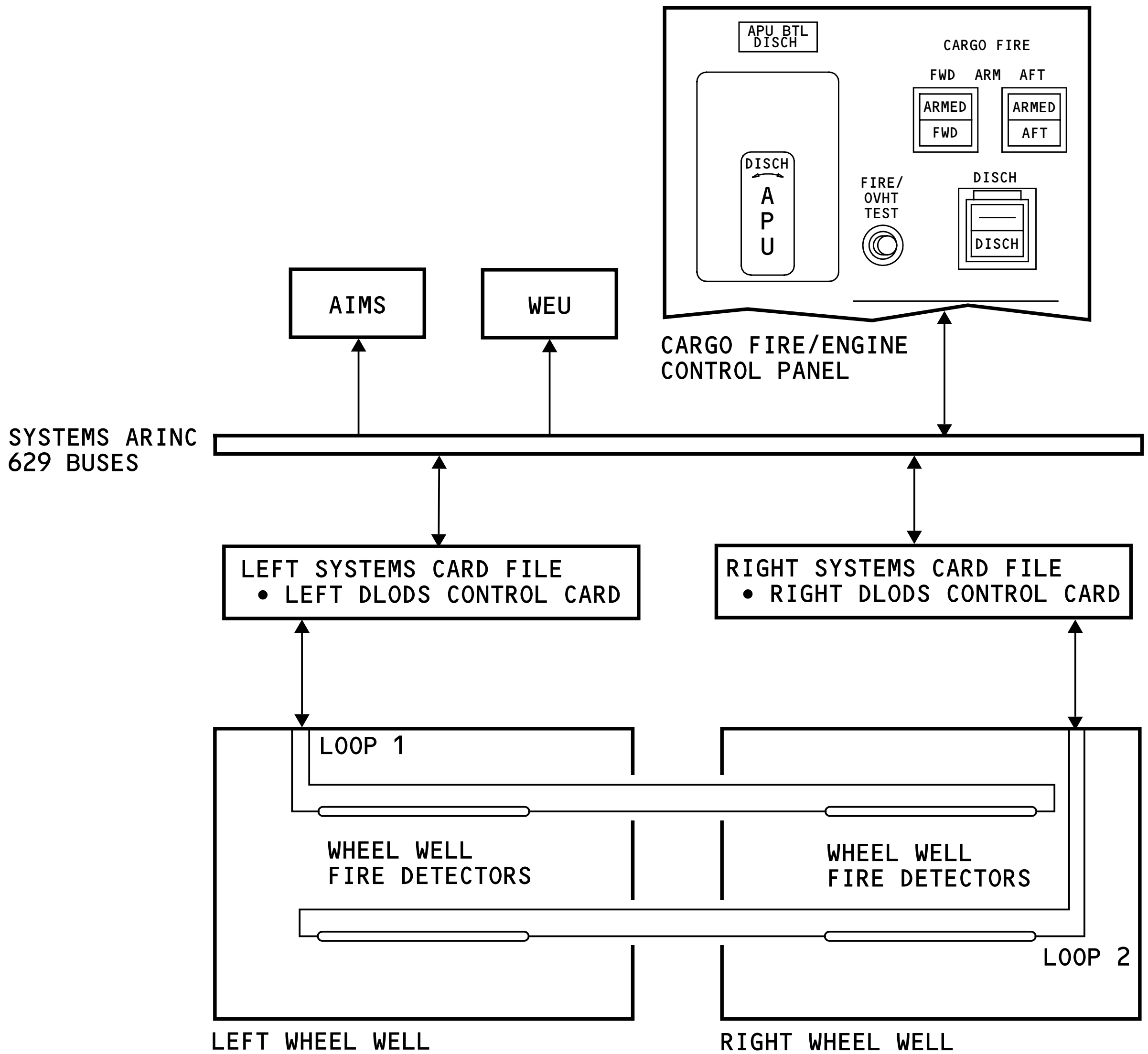
General Operation

Duct leak and overheat detection (DLODS) control cards in the left and right card files monitor the wheel well detectors. If both loops give an indication of a wheel well fire, the DLODS control cards send a signal to the AIMS. A fire warning message shows on EICAS.

Tests

The DLODS control cards continuously test the detector loops for open and short circuits. If the DLODS control cards find a failure, the cards send a signal to AIMS. A maintenance message shows if a single loop fails. A status message shows if both loops fail.

Use the fire/overheat test switch to manually test the wheel well fire detection system.



WHEEL WELL FIRE DETECTION – GENERAL DESCRIPTION

WHEEL WELL FIRE DETECTION - COMPONENT LOCATIONS

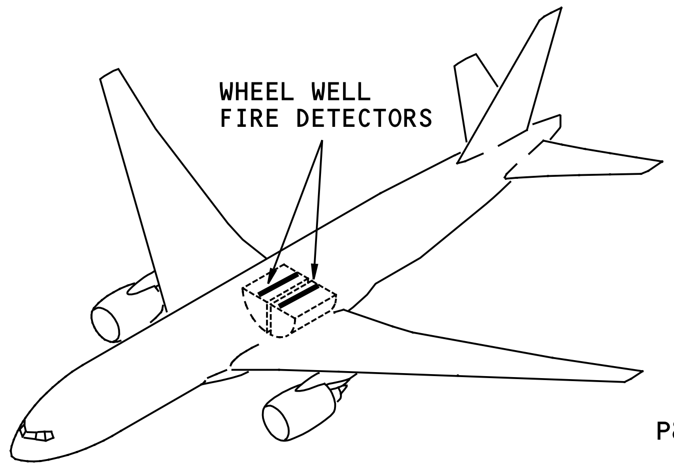
Wheel Wells

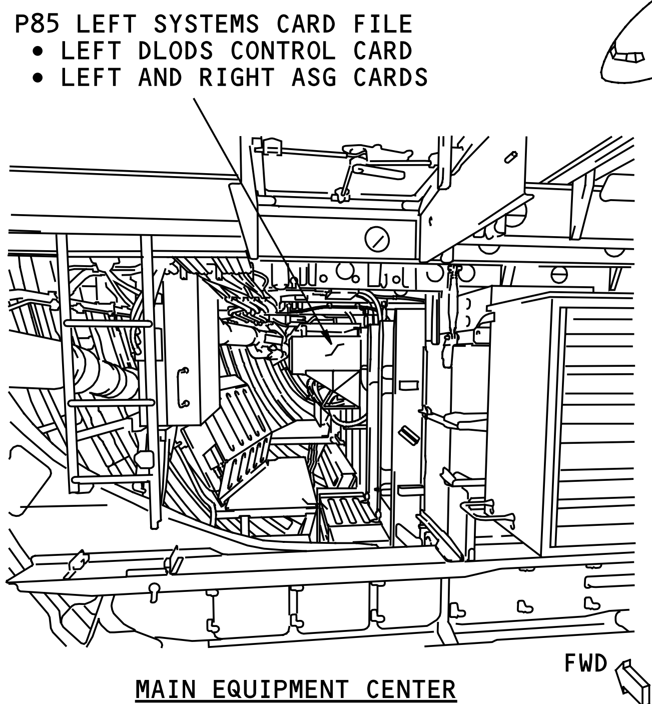
Each wheel well has two wheel well fire detectors.

Main Equipment Center

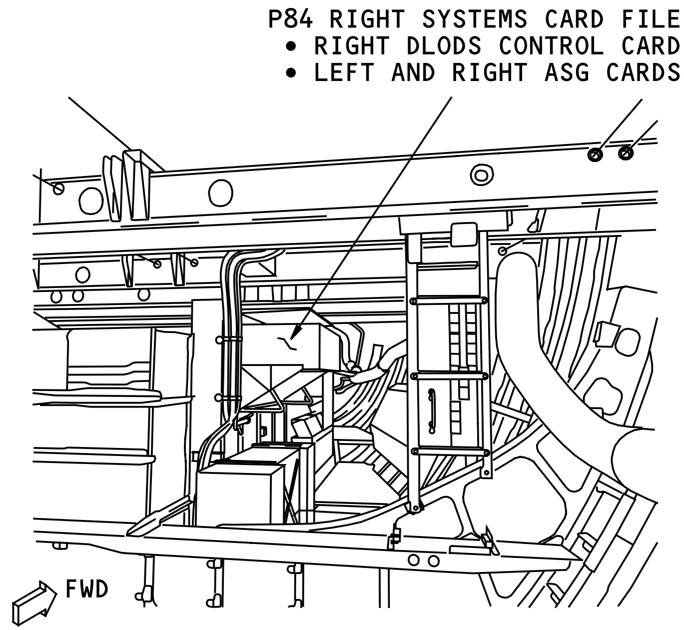
These are the components in the main equipment center that have an interface with the wheel well fire detection system:

- Left DLODS control card
- Left and Right ASG cards (two each)
- Right DLODS control card.





MAIN EQUIPMENT CENTER
(LEFT SIDE, LOOKING FORWARD)



MAIN EQUIPMENT CENTER
(RIGHT SIDE, LOOKING FORWARD)

26-17-00-003 Rev 0

WHEEL WELL FIRE DETECTION - COMPONENT LOCATIONS

WHEEL WELL FIRE DETECTION - WHEEL WELL FIRE DETECTORS - INTRODUCTION

Purpose

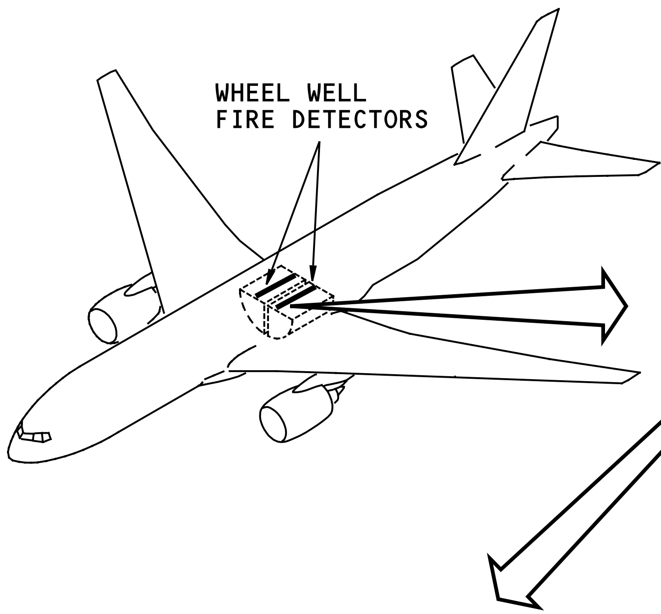
Wheel well fire detectors monitor the main gear wheel wells for tire fires.

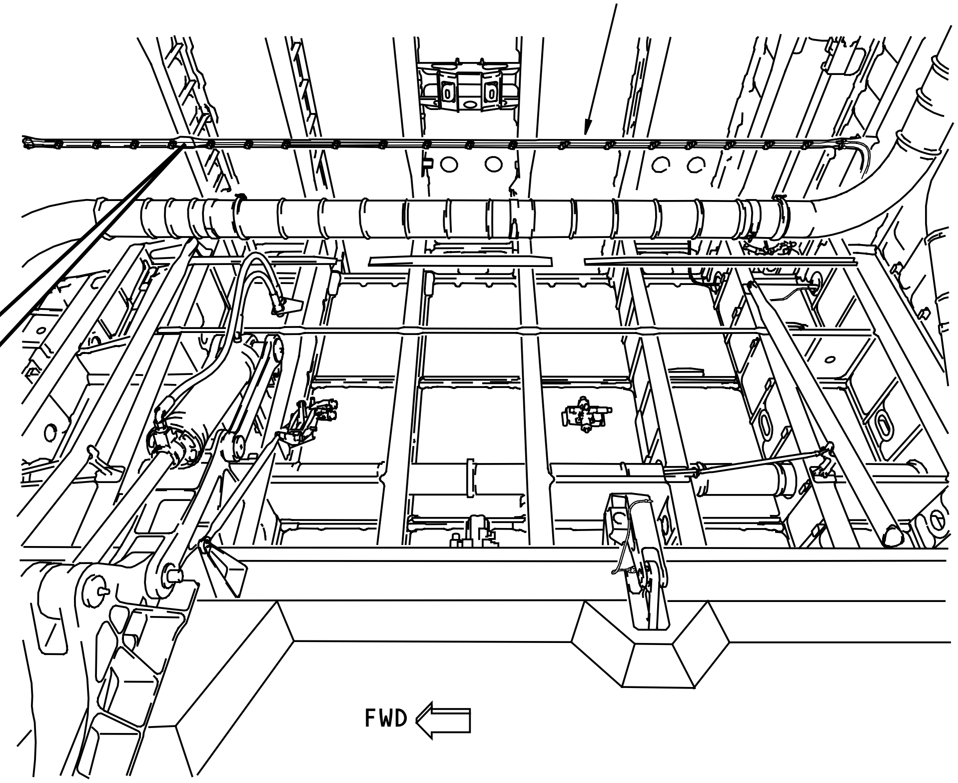
Physical Description

The wheel well fire detector has two electrical elements with connectors at each end. Each detector element has an outer conductor around an inner conductor. The material between these conductors is an electrical insulator at temperatures less than 575 F (302 C).

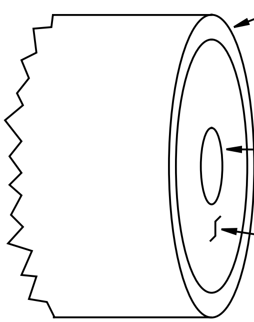
Location

A pair of detectors are at the top of each main gear wheel well. These detectors are above the wheels when the landing gear retracts.





LEFT WHEEL WELL LOOKING UP
(RIGHT WHEEL WELL SIMILAR)



CROSS SECTION OF
DETECTOR ELEMENT

26-17-00-004 Rev 0

WHEEL WELL FIRE DETECTION - WHEEL WELL FIRE DETECTORS - INTRODUCTION

WHEEL WELL FIRE DETECTION - FUNCTIONAL DESCRIPTION

Fire Detection

The wheel well fire detection system has two detector loops that operate independently.

The left duct leak and overheat detection system (DLODS) control card monitors loop 1. The right (DLODS) control card monitors loop 2. Each card electrically excites its related loop at a specified voltage. The signal from the loop shows a high electrical resistance at temperatures less than the fire set point (575 F, 302 C). At the fire set point or higher, the signal from the loop shows a low electrical resistance.

If the DLODS control cards find low resistance in both loops of a wheel well, the cards send a signal to the AIMS to indicate a fire. A warning message shows on EICAS. The warning electronic unit (WEU) turns on the master warning lights and fire aural warning.

Loop Failure

The DLODS control cards continuously monitor the detector loops for open and short circuits. If a card finds a short circuit in only one loop of a wheel well, the cards send a signal to AIMS to show a short circuit failure of the detector.

If the signal from the loop shows an open circuit, The DLODS control cards send a signal to AIMS to show an open circuit failure of the detector.

A short or open circuit failure of one detector loop causes maintenance messages. A failure of the two loops causes a status message to show.

DLODS Control Card Failure

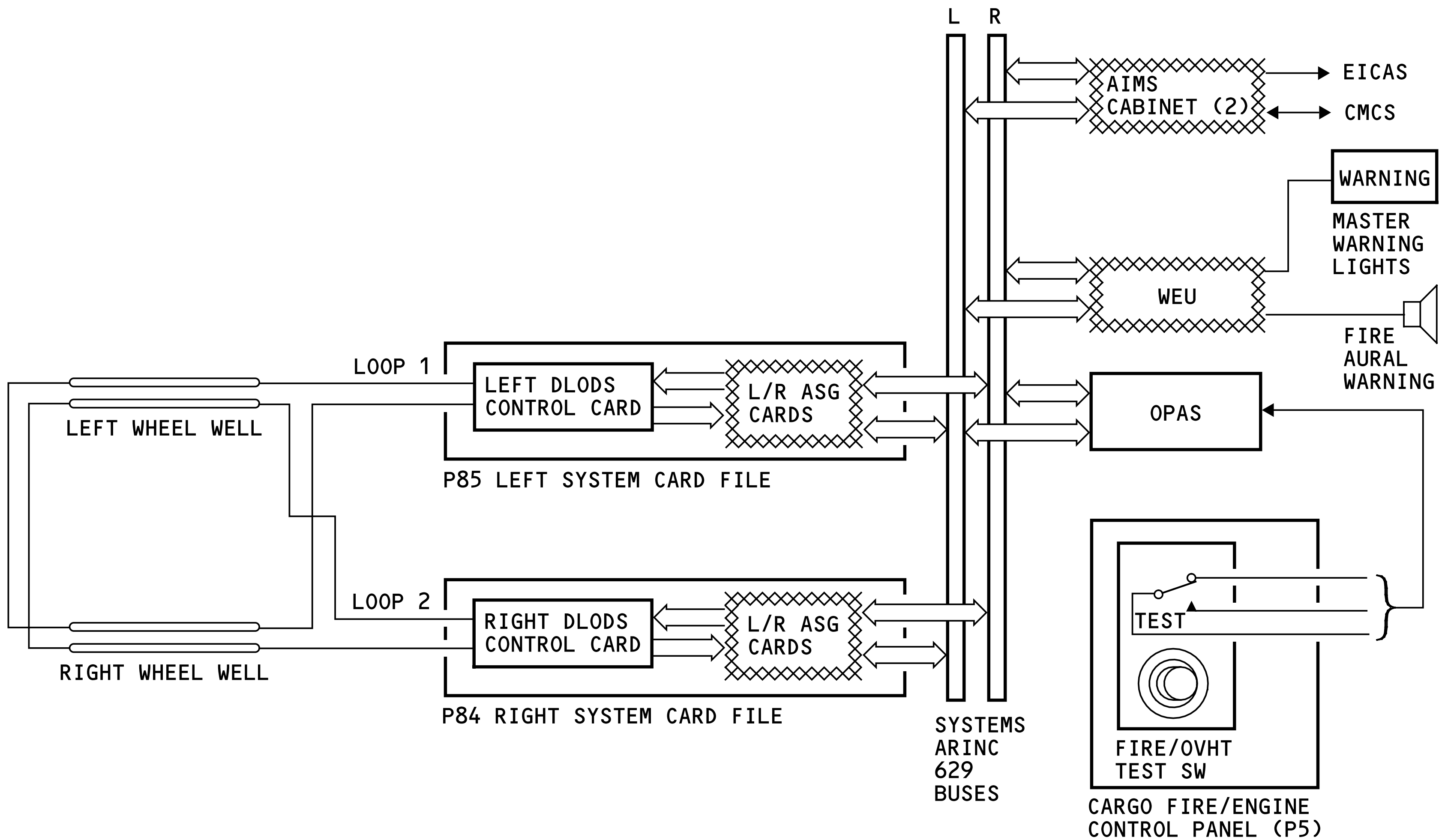
If a DLODS control card has a failure, a status message on EICAS show the loop monitored by that card as failed. The serviceable card then uses the other loop as the only source of fire detection.

Fire/Overheat Test

A fire/overheat test causes the DLODS control cards to do a test of the wheel well fire detectors. If the cards find an open or a short circuit in the loop, they send a signal to AIMS. EICAS messages report the results of the test. Failure of the two loops causes an advisory message to show.

Training Information Point

The advisory message that shows as a result of the fire/overheat test only shows for this manual test. If the DLODS control card finds a failure during continuous testing, there is no advisory message.



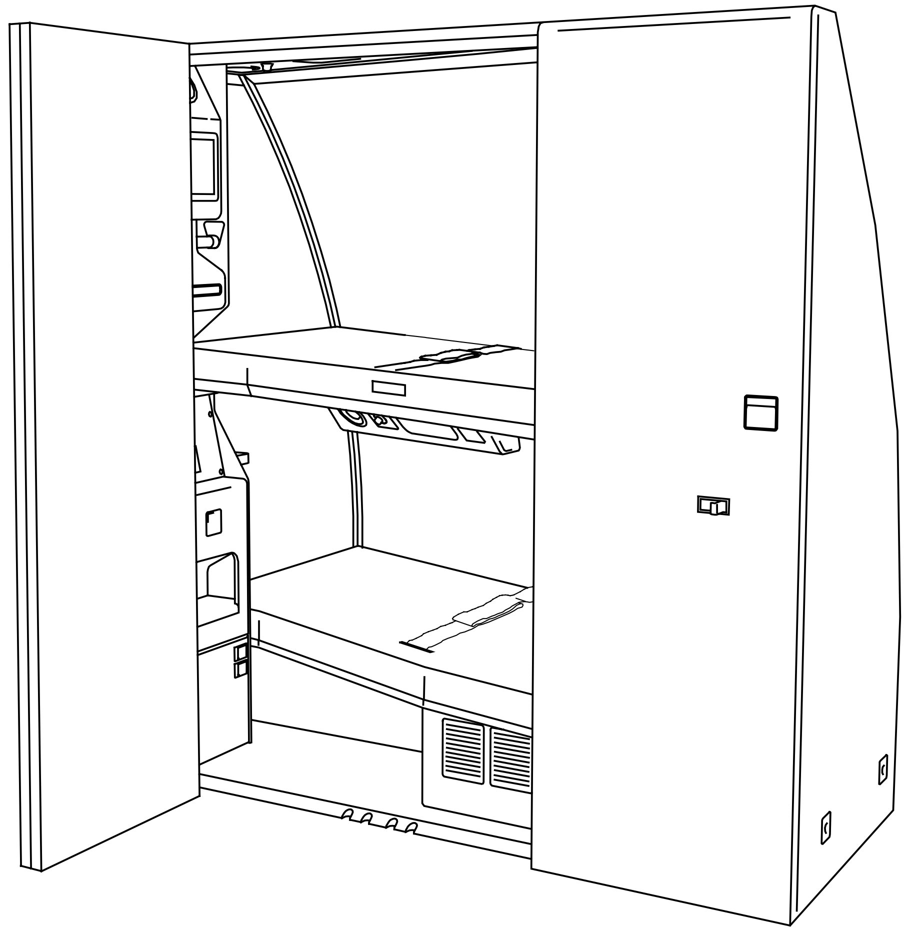
26-17-00-006 Rev 0

WHEEL WELL FIRE DETECTION - FUNCTIONAL DESCRIPTION

MISCELLANEOUS MODULE SMOKE DETECTION - INTRODUCTION

Purpose

The flight crew rest (FCR) smoke detection system monitors the flight crew rest area for smoke.



FLIGHT CREW REST AREA

MISCELLANEOUS MODULE SMOKE DETECTION - INTRODUCTION

MISCELLANEOUS MODULE SMOKE DETECTION - FLIGHT CREW REST - GENERAL DESCRIPTION

General

The smoke detection system gives indications to the flight crew and cabin attendants if there is smoke in the crew rest area. There is one smoke detector for each bunk and one for the common area.

Indications

CSS gives these smoke indications to the cabin attendants:

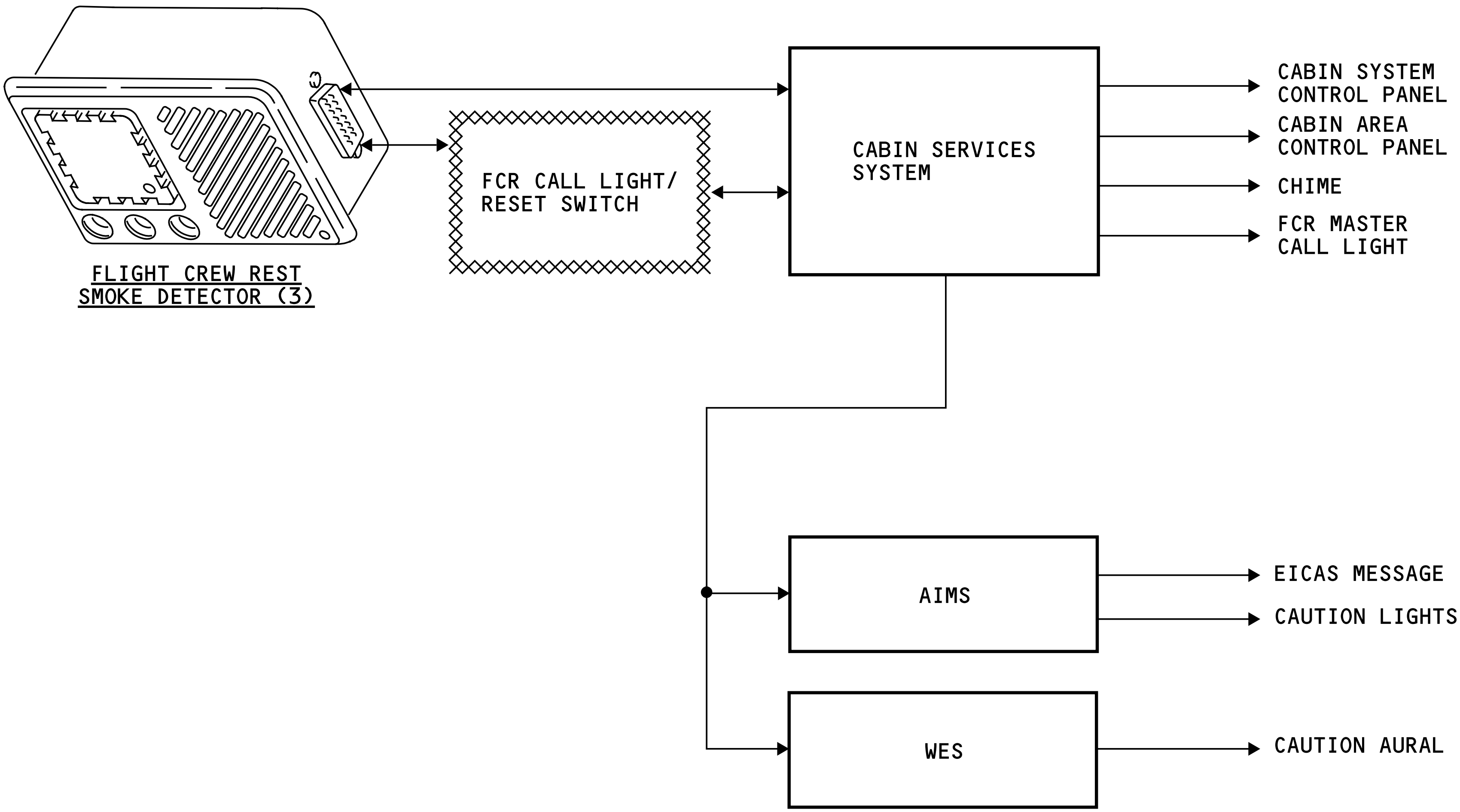
- CSCP/CACP crew rest smoke message shows
- Master call light
- Chime.

The AIMS causes an EICAS caution message and the caution lights to show in the flight deck. The warning electronic system (WES) causes the caution aural to sound.

The flight crew rest call light flashes and the warning horn in the smoke detector operates.

System Test

The cabin services system ALL TEST does a test of the flight crew rest smoke detection system. Each smoke detector also has a test switch you can use to do a test of the detector.



26-14-00-011 Rev 2 02/17/1997

MISCELLANEOUS MODULE SMOKE DETECTION - FLIGHT CREW REST - GENERAL DESCRIPTION

MISCELLANEOUS MODULE SMOKE DETECTION - CREW REST AREA SMOKE DETECTOR

Purpose

The smoke detector monitors the crew rest area for smoke and gives warnings if there is smoke.

Physical Description

The smoke detector has these parts:

- Electrical connector
- Mounting bracket
- Smoke sensor
- Filter
- Alarm LED (red)
- Power-on LED (green)
- Interrupt switch
- Test switch
- Alarm horn.

Operation

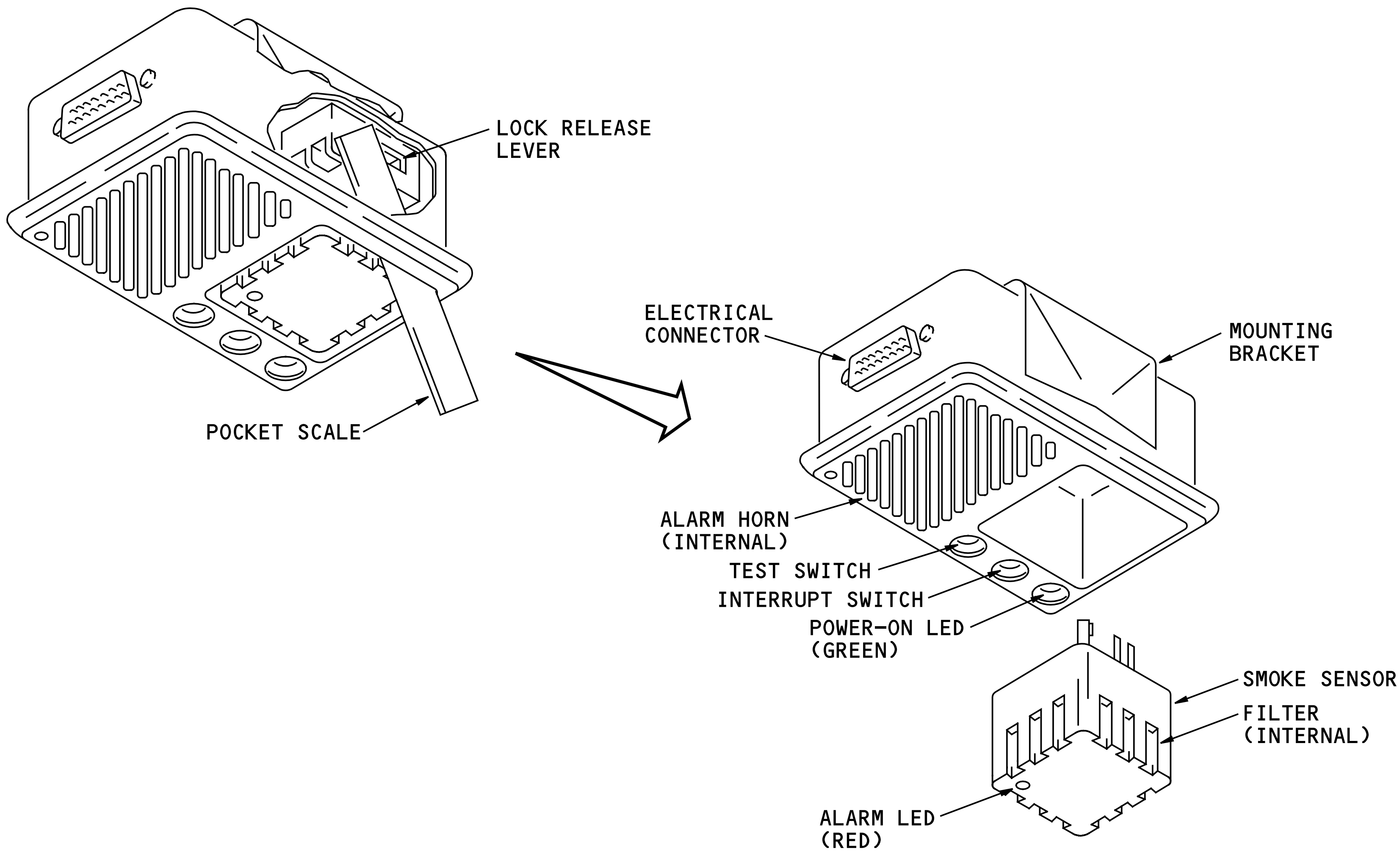
The power-on LED comes on when the smoke detector gets power. The alarm LED and horn come on when the detector senses smoke. Push the interrupt switch to make the horn stop. The alarm LED stays on until the smoke is gone.

Use the test switch to do a test of the smoke detector. The horn and alarm LED (red) come on during the test.

Training Information Point

The smoke sensor is an LRU. There is a filter inside the smoke sensor. It is necessary to clean the filter. It is not necessary to remove the smoke detector to remove the smoke sensor. To remove the smoke sensor, use a pocket scale to move the lock release lever. This lets the sensor come out of the smoke detector assembly.

CAUTION: DO NOT TOUCH THE ELECTRODE INSIDE OF THE SENSOR.



26-14-00-012 Rev 1 08/07/96

MISCELLANEOUS MODULE SMOKE DETECTION - CREW REST AREA SMOKE DETECTOR

MISCELLANEOUS MODULE SMOKE DETECTION - FLIGHT CREW REST - FUNCTIONAL DESCRIPTION

General

The left main dc bus supplies 28 volt electrical power to the flight crew rest smoke detectors. The power-on LED (green) shows that the smoke detector has power.

Smoke Detection

If there is smoke in the sensing chamber, the alarm LED (red) comes on. The timing circuit makes an intermittent ground and causes the warning horn to operate. The smoke detection circuit makes a ground for the relay. The energized relay makes a ground signal for these items:

- The ELMS electronic unit (EEU)
- The call light select relay
- The call light flasher relay
- The overhead electronics unit (OEU).

The EEU sends data about the alarm condition to the AIMS to cause the SMOKE CREW REST F/D advisory message to show.

The call light select relay and the call light flasher relay cause the flight crew rest call light to flash.

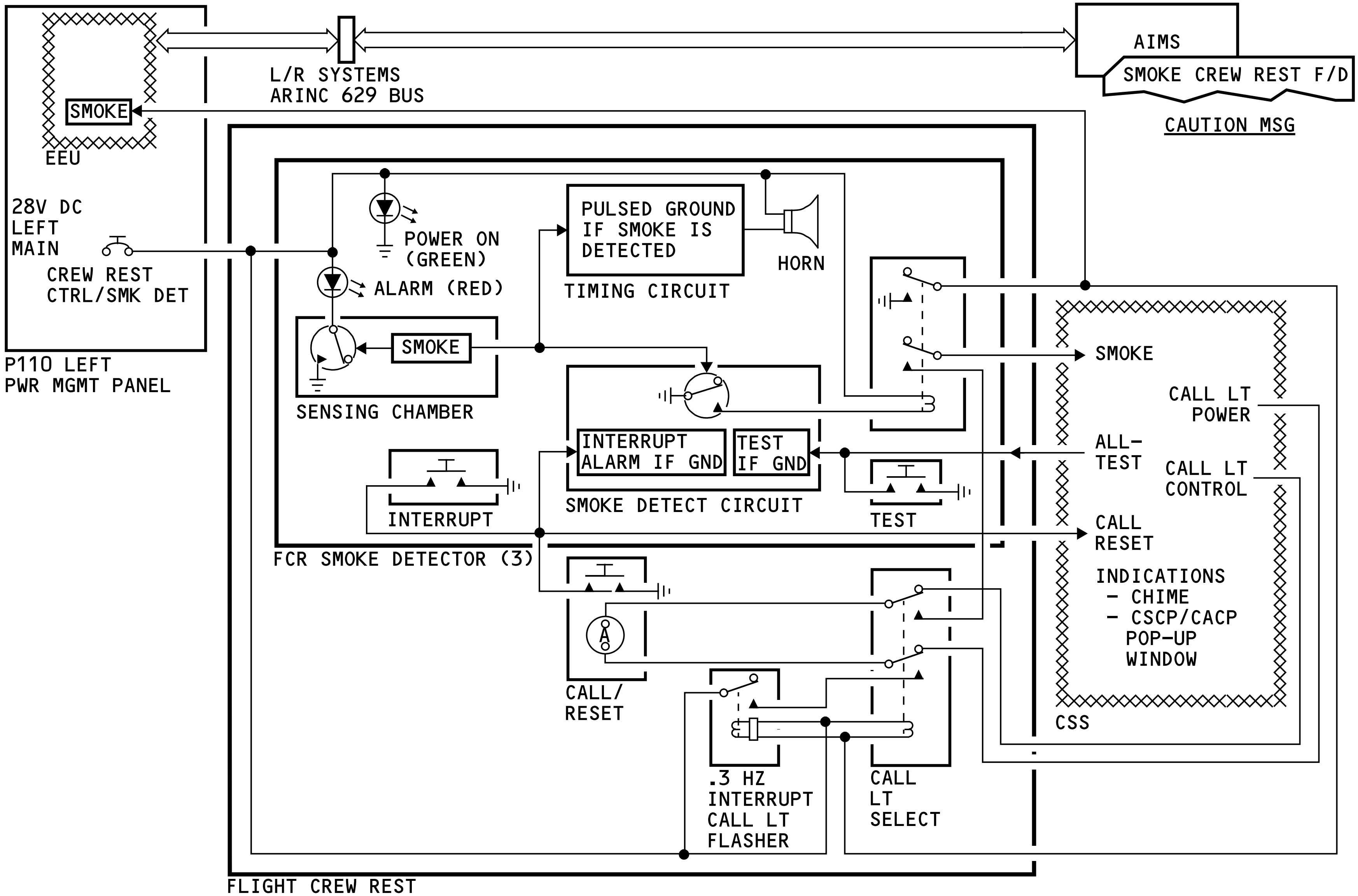
The OEU is the interface with the cabin services system. The CSS gives these indications:

- FCR master call light flashes
- CSCP/CACP pop-up windows show
- FCR call chime operates.

Push the call/reset switch or the smoke detector interrupt switch to cancel the smoke indications. If there is still smoke in the crew rest area, the alarm LED (red) stays on. All smoke indications go away automatically when the smoke is gone.

Training Information Point

You can do a test of the crew rest smoke detectors from the cabin system control panel. Use the cabin tests menu ALL TEST. During the ALL TEST, the OEUs make a ground for the test circuit in the smoke detectors. Test results show on the CSCP.



MISCELLANEOUS MODULE SMOKE DETECTION - FLIGHT CREW REST - FUNCTIONAL DESCRIPTION

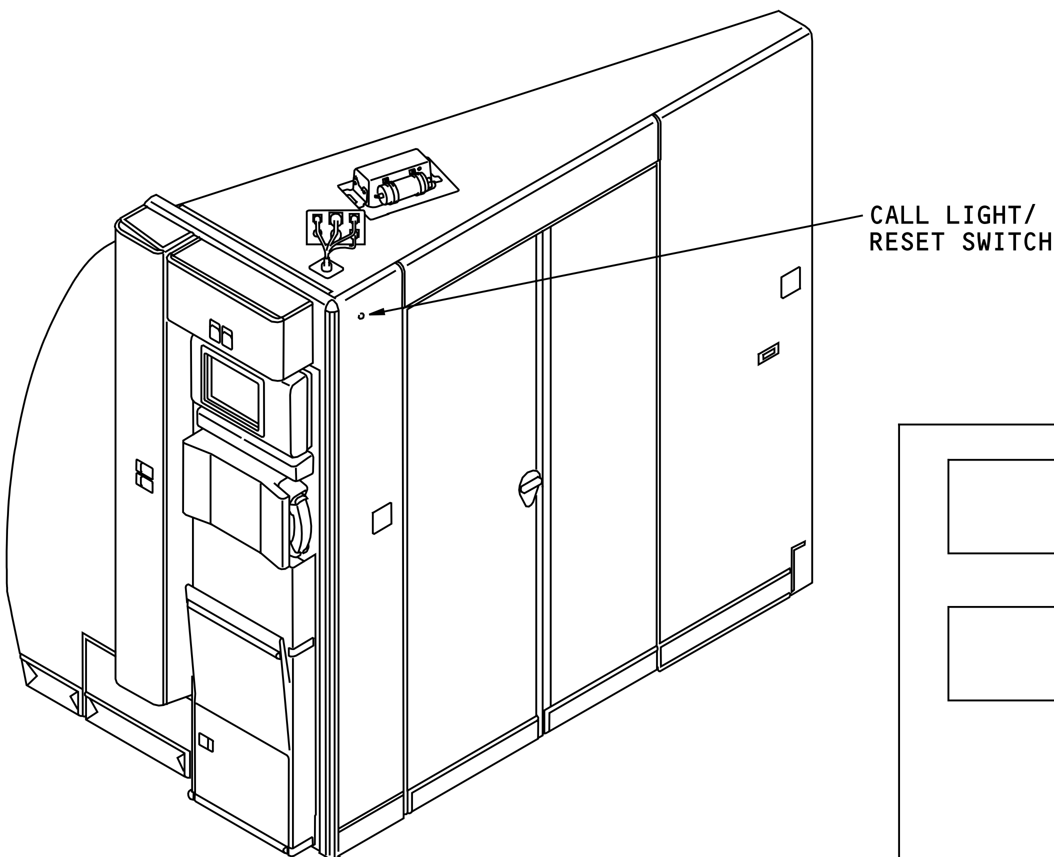
MISCELLANEOUS MODULE SMOKE DETECTION - FLIGHT CREW REST - INDICATIONS

Smoke Indications

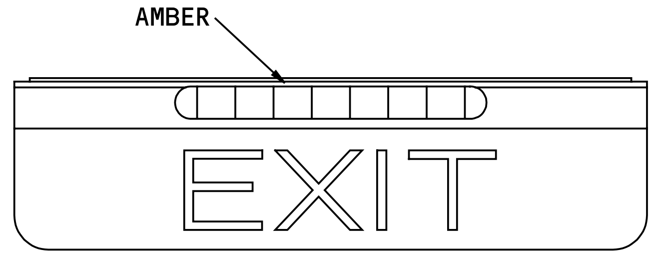
If there is smoke in the flight crew rest area, these are the indications:

- Flight crew rest call light flashes
- Master call light for the crew rest comes on
- Flight crew rest call chime sounds
- Crew rest smoke pop-up window shows at the CSCP and CACPs
- Smoke detector horn operates
- Smoke detector alarm LED comes on.

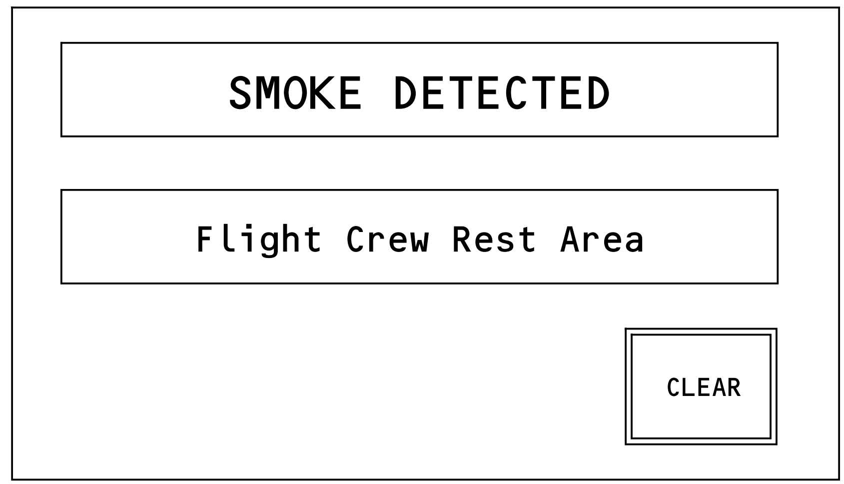
Push the flight crew rest call light/reset switch or the smoke detector interrupt switch to make the indications stop. All indications except the smoke detector alarm LED should go away. The alarm LED goes out when the smoke is gone.



FLIGHT CREW REST AREA



MASTER CALL
LIGHT MODULE (TYP)



CSCP/CACP POP-UP WINDOW

MISCELLANEOUS MODULE SMOKE DETECTION - FLIGHT CREW REST - INDICATIONS

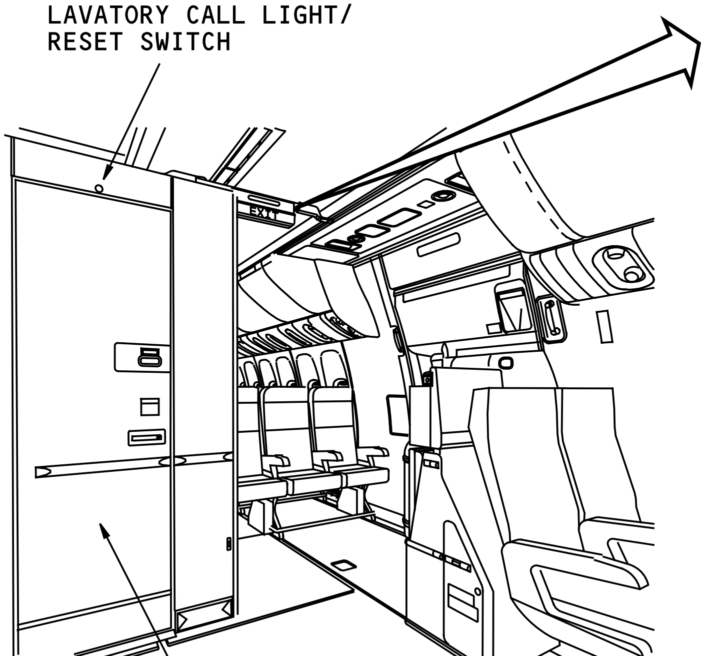
LAVATORY SMOKE DETECTION - OPERATION - INDICATIONS

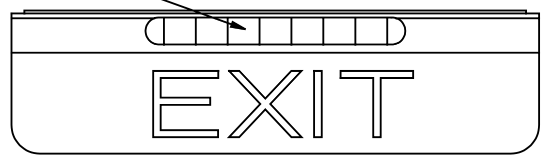
Smoke Indications

If there is smoke in a lavatory, these are the indications:

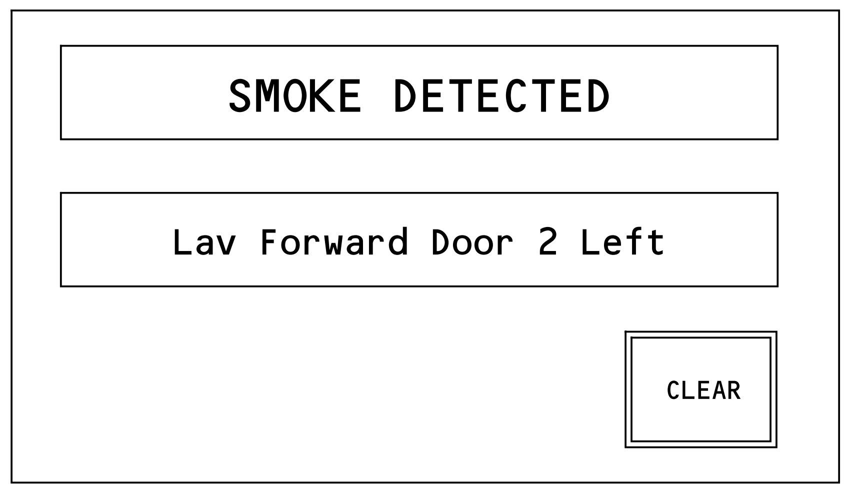
- Lavatory call light flashes
- Master call light for the lavatory comes on
- Lavatory call chime sounds
- Lavatory smoke pop-up window shows at the CSCP and CACPs
- Smoke detector horn operates
- Smoke detector alarm LED comes on.

Push the lavatory call light/reset switch or the smoke detector interrupt switch to make the indications stop. All indications except the smoke detector alarm LED should go away. The alarm LED goes out when the smoke is gone.





MASTER CALL
LIGHT MODULE (TYP)



CSCP/CACP POP-UP WINDOW

LAVATORY SMOKE DETECTION - OPERATION - INDICATIONS

LAVATORY WASTE COMPARTMENT FIRE EXTINGUISHING - FIRE EXTINGUISHER BOTTLE

Purpose

The lavatory waste compartment fire extinguisher extinguishes fires in the waste compartment.

Physical Description

The fire extinguisher is a bottle with two nozzles. The bottle contains pressurized halon 1301 fire extinguishing agent. The nozzles are sealed with a solder which melts at approximately 170 F (77 C).

Location

The fire extinguisher is above the waste container in the cabinet under the sink. The fire extinguisher nozzles point into the waste container. Open the cabinet for access.

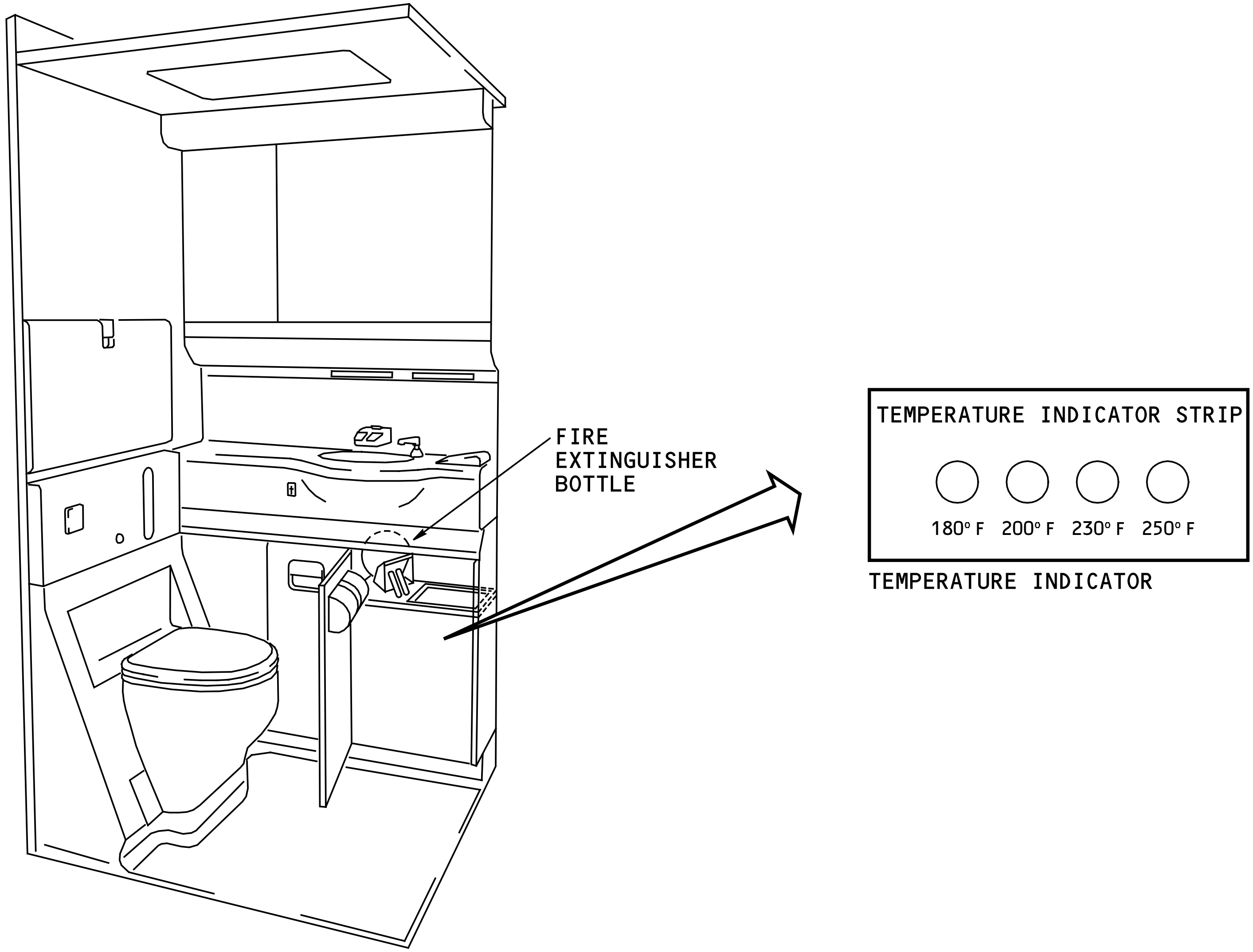
Functional Description

A fire in the waste container melts the solder on the nozzles. This releases halon from the bottle to put out the fire.

Training Information Point

A temperature indicator on the side of the waste container shows if there has been a fire. You can see the indicator without removing the container to look inside. The indicator circles are normally white. Black circles show a fire.

You can weigh the fire extinguisher to find out if it is empty. Replace an empty bottle; you cannot fill it again.



26-24-00-001 Rev 0

LAVATORY WASTE COMPARTMENT FIRE EXTINGUISHING - FIRE EXTINGUISHER BOTTLE

PORTABLE FIRE EXTINGUISHERS

General

The portable fire extinguishers extinguish fires. There are two types of extinguishers: water and Halon 1211. The Halon extinguishers are used on electrical and flammable liquid fires. The water extinguisher is used on non-electrical fires.

Location

There are extinguishers in these areas:

- Flight deck
- Galley stowage compartment
- Closet
- Underseat stowage
- Attendant seat bustle
- Seat track mounted storage.

Placards identify all the extinguisher locations.

Physical Description

The water extinguishers contain a water and anti-freeze mixture. Each water extinguisher has these parts:

- Trigger
- Cartridge (internal)
- Handle
- Quick-release mounting strap.

The fire extinguisher is held on a mounting bracket by a quick release strap.

Each Halon extinguisher has these parts:

- Pressure gage
- Handle lock pin
- Handle.

The fire extinguisher is held on a mounting pad by a quick release mounting strap.

Operation

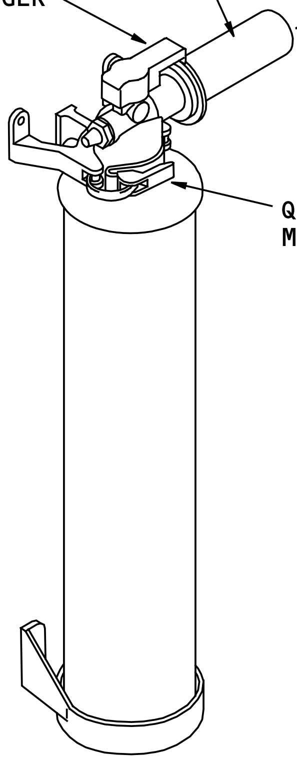
To operate the water extinguisher, turn the handle and push the trigger.

To operate the Halon extinguisher, remove the handle lock pin and push the handle.

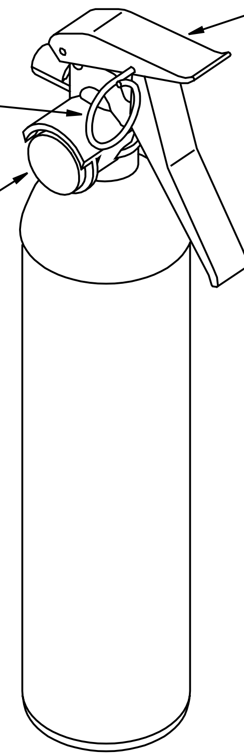
Training Information Point

After you use the water extinguisher, it must be refilled and you must replace the cartridge.

If the handle lock pin on the Halon extinguisher is not there, you must weigh the extinguisher to find out if it has been discharged. The pressure gage is not a satisfactory check of the extinguisher.



WATER FIRE EXTINGUISHER



HALON FIRE EXTINGUISHER

26-26-00-001 Rev 1 08/08/1996

PORTABLE FIRE EXTINGUISHERS

FIRE PROTECTION - SYSTEM TESTS

General

These are the system tests for the fire extinguishing system:

- Cargo squibs
- Engine and APU squibs.

Cargo Squibs

WARNING: KEEP PERSONS AWAY FROM THE CARGO COMPARTMENT DURING THIS TEST. IF A SQUIB FIRES ACCIDENTALLY, THE FIRE BOTTLE CAN RELEASE ITS CONTENTS AND CAUSE INJURIES.

This test supplies a small current to these squibs:

- Cargo compartment fire extinguishing bottles
- Cargo compartment fire extinguishing flow valves
- Engine fire extinguishing bottles
- APU fire extinguishing bottle.

The test makes sure that there are no open circuits in the cargo compartment fire extinguishing squibs and their related wiring.

Engine and APU Squibs

WARNING: KEEP PERSONS AWAY FROM THE ENGINE AND APU DURING THIS TEST. IF A SQUIB FIRES ACCIDENTALLY, THE FIRE BOTTLE CAN RELEASE ITS CONTENTS AND CAUSE INJURIES.

This test supplies a small current to these squibs:

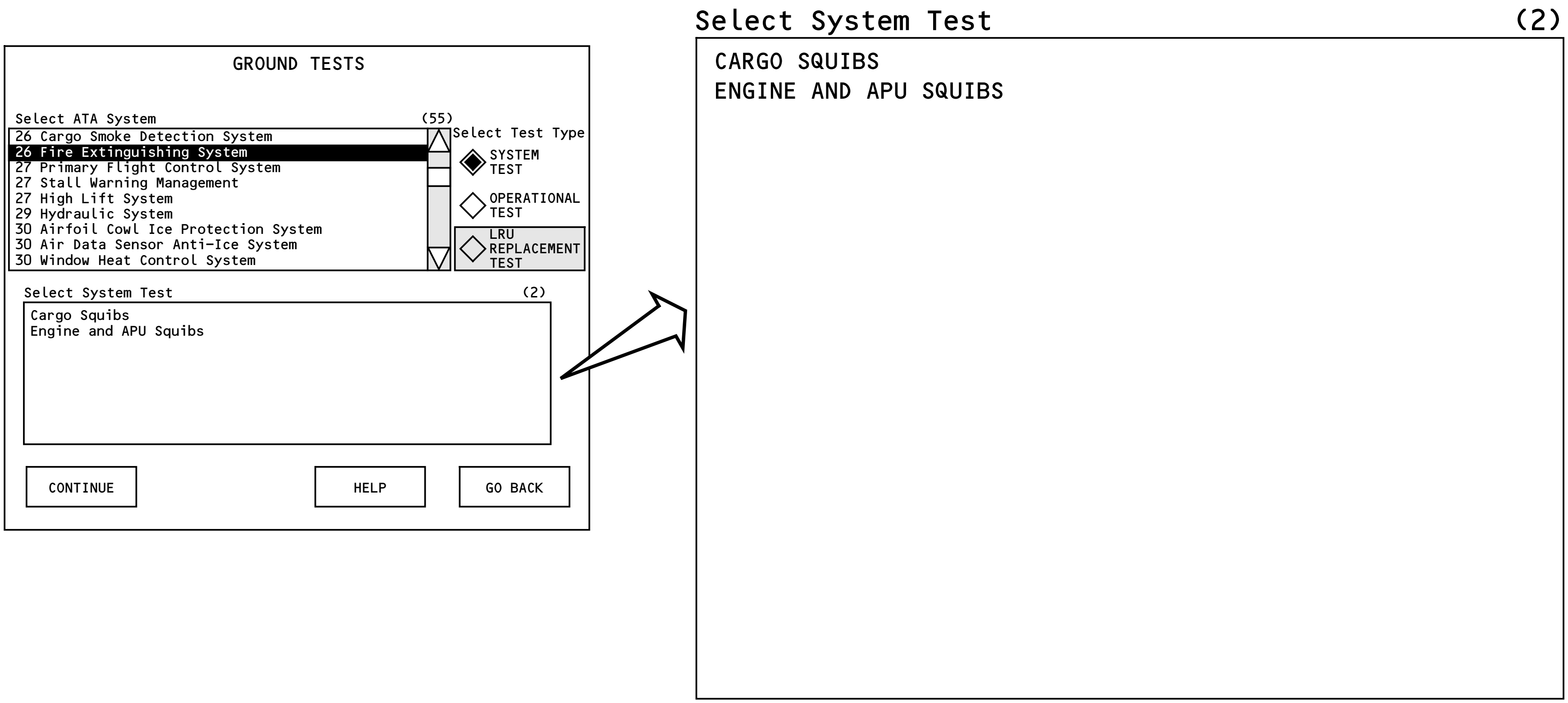
- Engine fire extinguishing bottles
- APU fire extinguishing bottle
- Cargo compartment fire extinguishing bottles
- Cargo compartment fire extinguishing flow valves.

The test makes sure that there are no open circuits in the engine and APU fire extinguishing squibs and their related wiring.

Training Information Point

NOTE: When you do either test, keep persons away from the cargo compartments, engines, and APU. Each test supplies power to all the squibs in the airplane.

When you do either test, the ELMS supplies a small current to all the squibs in the airplane. The MAT shows the test results only for the selected test. See Fire Protection - Squib Test - Functional Description in this section for more information.



26-00-00-002 Rev 3 07/31/95

FIRE PROTECTION - SYSTEM TESTS

FIRE PROTECTION - TRAINING INFORMATION POINT - FIRE/OVERHEAT TEST

General

The fire and overheat test switch (FIRE/OVHT TEST) does a test of these systems:

- Engine fire detection
- APU fire detection
- Lower cargo compartment smoke detection
- Wheel well fire detection.

Fire/Overheat Test

Push and hold the fire/overheat test switch. Make sure these indications come on:

- APU fire warning light
- Forward cargo fire warning light
- Aft cargo fire warning light
- Master warning lights
- Fire aural warning
- Engine fuel control switch fire warning lights
- Left and right engine fire warning lights
- FIRE TEST IN PROGRESS warning message.

Release the fire/overheat test switch when the test is complete. The test is complete when the warning message FIRE TEST PASS or FIRE TEST FAIL shows. All the test indications go away when you release the switch.

Fire Test Pass

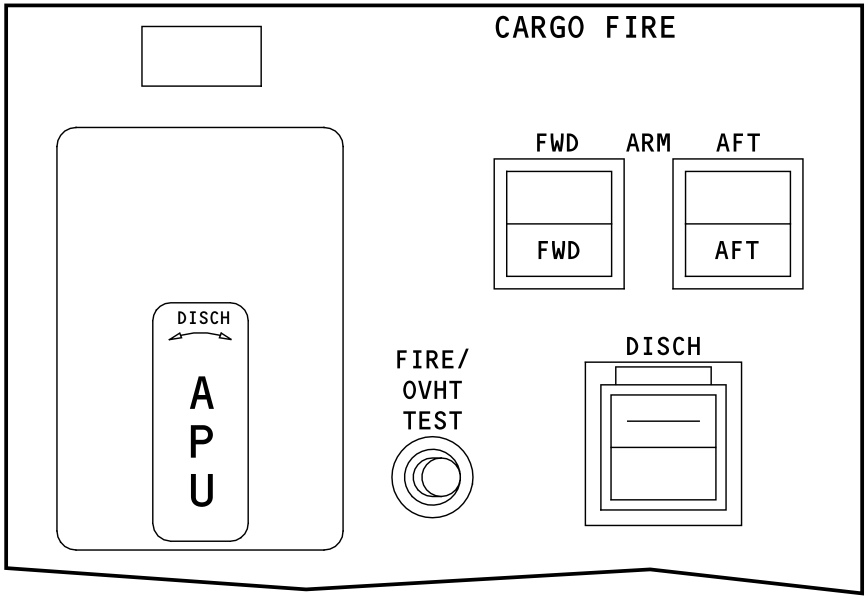
This message shows that the systems are serviceable. The systems may have faults which do not prevent flight. An example is a single loop fault in the engine fire detection system. Status messages show these faults. Look in the Dispatch Deviation Guide book to see if these faults limit flight operations.

Fire Test Fail

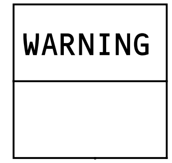
This message shows that one or more systems are not serviceable. These advisory messages show which system has a failure:

- DET FIRE ENG L
- DET FIRE ENG R
- DET FIRE APU
- DET FIRE CARGO FWD
- DET FIRE CARGO AFT
- DET FIRE WHEEL WELL.

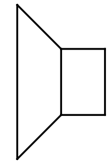
Status messages show the failed LRUs.



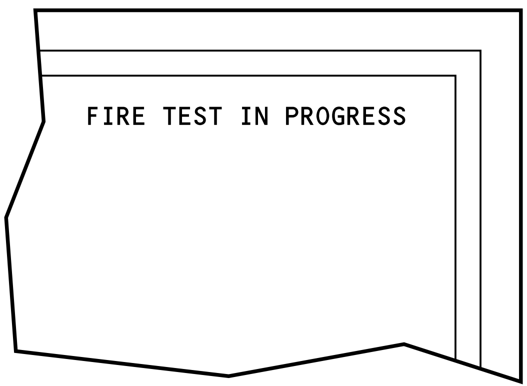
APU AND CARGO FIRE WARNING LIGHTS (P5)



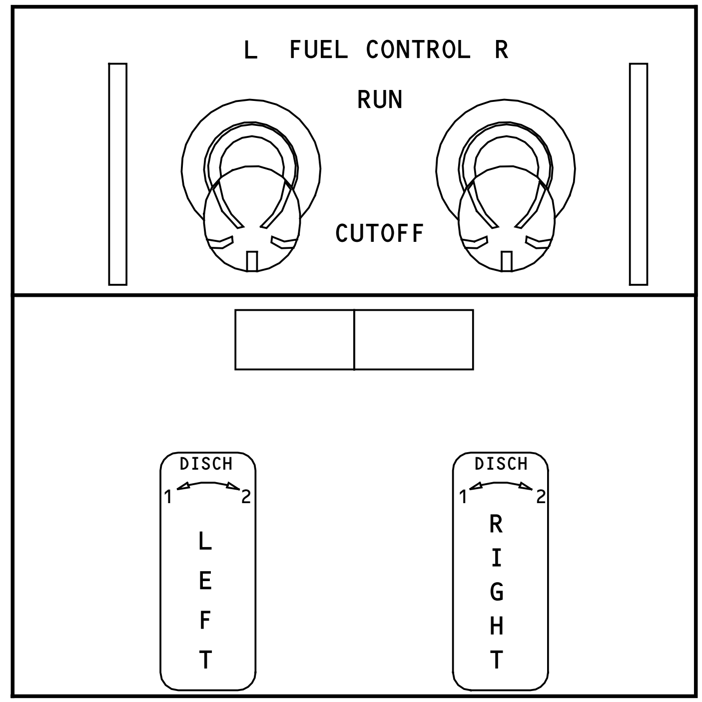
MASTER WARNING LIGHTS



FIRE AURAL WARNING



EICAS ENGINE PRIMARY FORMAT



ENGINE FIRE WARNING LIGHTS (P10/P8)

26-00-00-003 Rev 0

FIRE PROTECTION - TRAINING INFORMATION POINT - FIRE/OVERHEAT TEST

Continental Airlines, Inc

Doors

WB371

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Doors

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Continental Airlines, Inc

Doors

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DOORS - INTRODUCTION

Purpose

Doors give access to compartments and service areas.

General Description

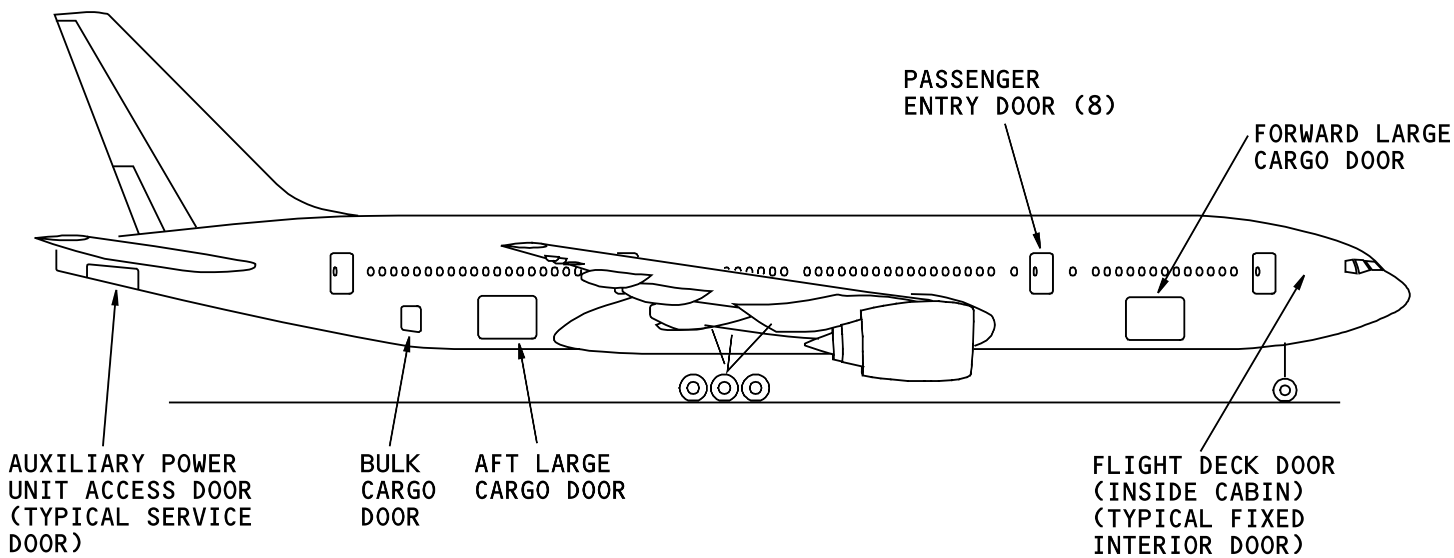
These are the types of doors:

- Passenger entry doors
- Cargo doors
- Service doors
- Fixed interior doors.

There is a door warning system that gives door status information to the flight crew.

Abbreviations and Acronyms

AC - alternating current
ADP - air-driven pump
AIMS - airplane information management system
APU - auxiliary power unit
ARINC - Aeronautical Radio, Inc.
aux - auxiliary
CACP - cabin area control panel
cm - centimeter
CSS - cabin services system
CSCP - cabin system control panel
DC - direct current
ECS - environmental control system
EICAS - engine indication and crew alerting system
E/E - electrical and electronic
EPAS - emergency power assist system
fwd - forward
gnd - ground
hdlg - handling
Hz - hertz
inbd - inboard
MAT - maintenance access terminal
MEC - main equipment center
outbd - outboard
PDU - power drive unit
pnl - panel
PSI - pounds per square inch
PSEU - proximity sensor electronics unit
pwr - power
ref - reference
RPM - revolutions per minute
V - volt



52-00-00-001 Rev 3 09/15/1997

DOORS - INTRODUCTION

PASSENGER ENTRY DOOR SYSTEM - INTRODUCTION

Purpose

Passenger entry doors give access to the passenger compartment.

General Description

There are four passenger entry doors on each side of the airplane.

Linings cover the hinge and upper part of the door. A bustle covers the escape/slide raft on the lower part of the door.

The doors are plug-type. They open and close on a single hinge arm. As a door opens, the first movement is upward out of its plug position. Then it translates forward. Translation means that the door does not turn in relation to the airplane. When open, the inside of the door is next to the outside of the fuselage.

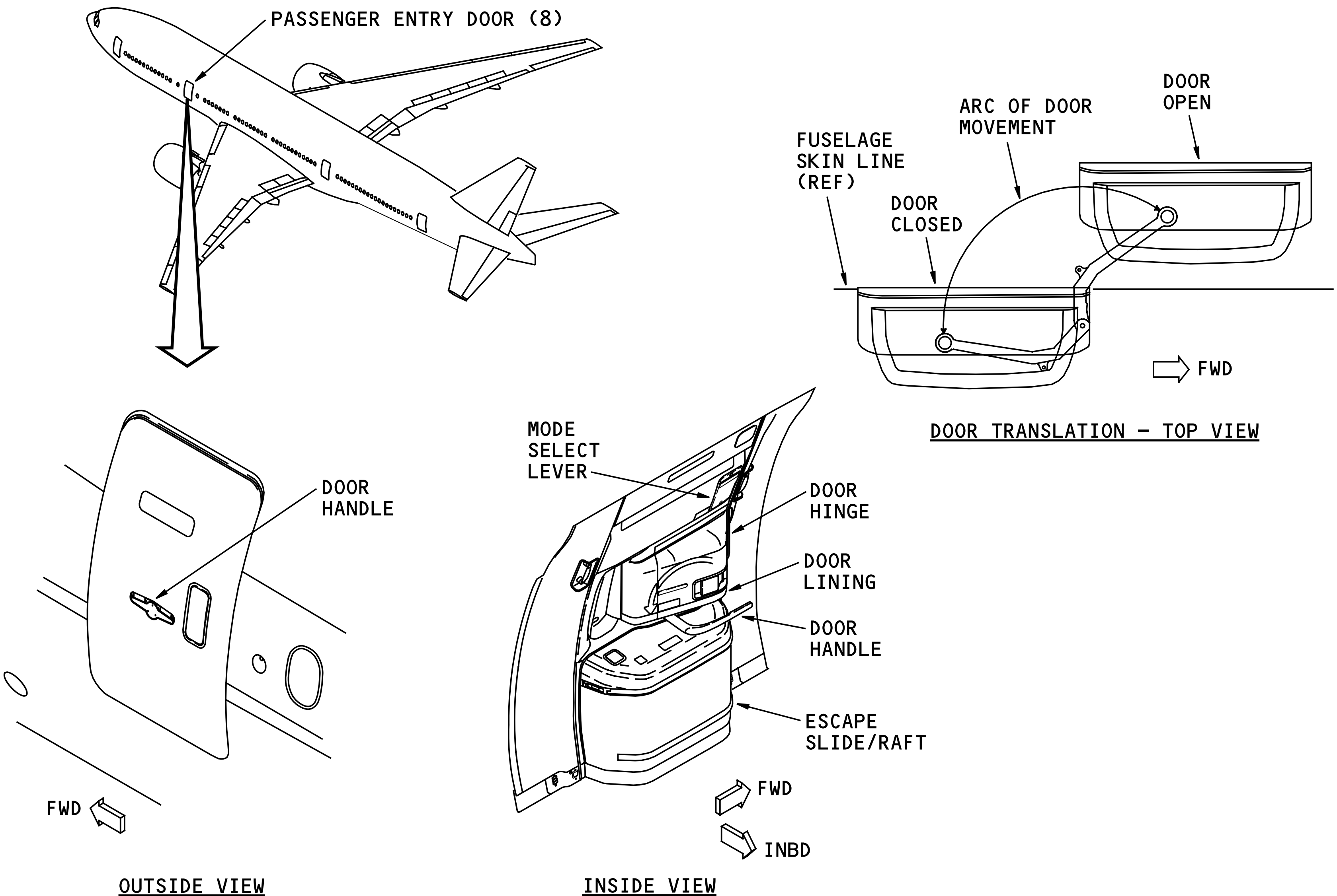
The door dimensions allow two people to move through the door at the same time.

Handles to open and close the door are on the inside and outside of the door.

The mode select lever for armed or disarmed operation is on the inside of the door.

In the armed mode operation, when you move the internal door handle to the open position:

- The emergency power assist system (EPAS) (not shown) moves the door to the open position
- The emergency escape slide/raft deploys.



52-11-00-001 Rev 3 07/30/1997

PASSENGER ENTRY DOOR SYSTEM - INTRODUCTION

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PASSENGER ENTRY DOOR SYSTEM - COMPONENT LOCATIONS

<u>Components on the Inside of the Door - Lining Removed</u>

The vent door mechanism is near the top of the door.

The mode select mechanism is on the forward, upper part of the door. The girt bar mechanism is on the bottom of door. The push/pull cable connects the mode select mechanism and the girt bar mechanism.

The door hinge connects the middle of the door to the forward side of the door cutout.

These components are on the door hinge:

- Programming chain mechanism
- Snubber
- Hold-open mechanism
- Emergency power assist system (EPAS) battery
- EPAS reservoir
- EPAS actuator.

The EPAS actuator does not show in this view. It is on the outboard side of the door hinge.

<u>Components Outboard of the Door Hinge</u>

The flight lock mechanism is near the forward edge of the door. It connects to the Latch mechanism.

The door handle mechanism is near the middle of the door. It connects to the latch mechanism and the vent door mechanism.

The latch mechanism goes across the middle of the door. It connects to the handle mechanism and the vent door mechanism.

<u>Proximity Sensors and Mechanical Switches</u>

The proximity sensors on the aft door latch and the vent door are components of the door warning system. See the door warning section for more information on the door warning system (AMM PART I 52-71). The proximity sensors (not shown) on the flight lock mechanism are components of the door system.

The EPAS uses these two mechanical switches:

- The mode select switch on the mode select mechanism
- The door open switch on the door handle mechanism.

<u>Door Open Sequence</u>

Movement of the lever on the mode select mechanism disarms the escape slide/raft and EPAS. The mode select switch on the mechanism is the component that disarms the EPAS. The push/pull cable transmits mode select lever movement to the girt bar mechanism.

The door handle mechanism lets you unlatch the passenger entry door. The mechanical switch on the mechanism starts the EPAS if the mode select mechanism is in the armed position.

PASSENGER ENTRY DOOR SYSTEM - COMPONENT LOCATIONS

The vent door mechanism releases pressurization before the passenger entry door can unlatch completely. It also locks the latch mechanism if pressurization is too high for safe passenger entry door operation.

The latch mechanism lifts and unlatches the door.

The door moves up past the stops on the cutout and translates open on the hinge.

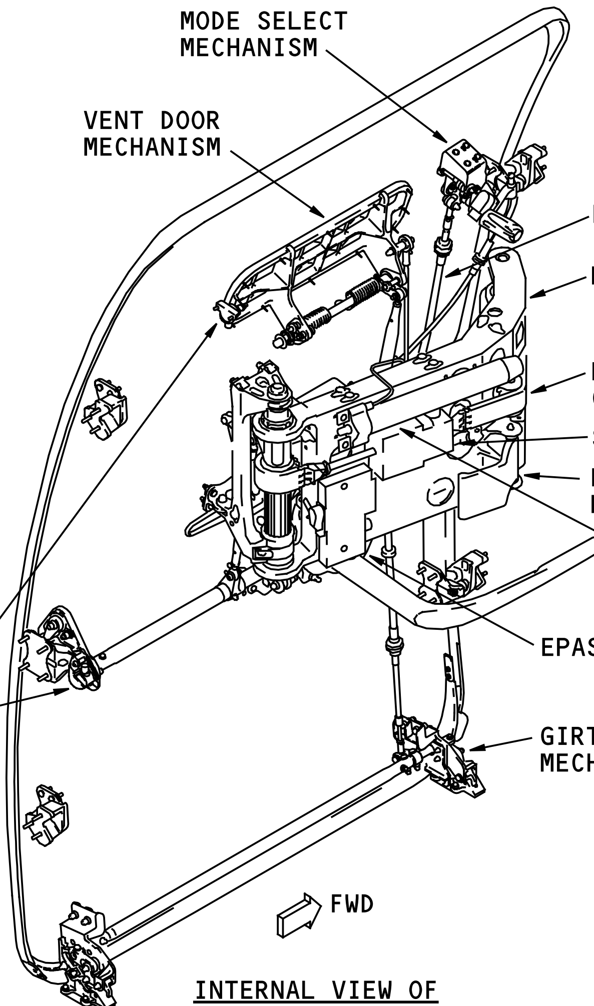
The programming chain mechanism keeps the inside of the door parallel to the airplanes longitudinal axis as the door opens.

The snubber controls the rate of movement of the door.

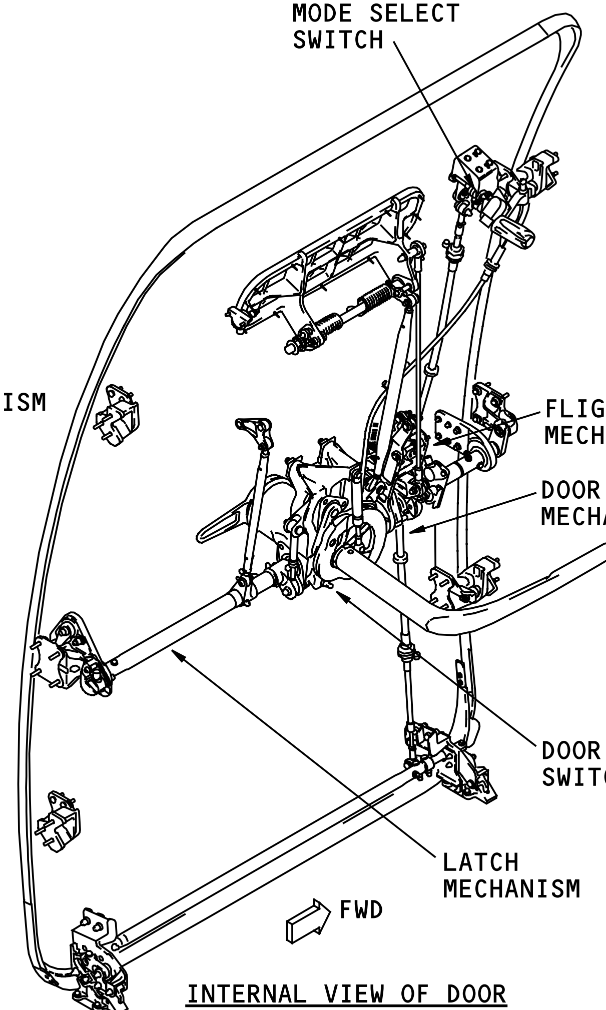
The hold-open mechanism holds the door in the completely open position.

The EPAS moves the door open in emergencies.

The girt bar mechanism locks the emergency escape slide/raft to the bottom of the door cutout when you open the door in emergencies.



INTERNAL VIEW OF DOOR MECHANISMS



INTERNAL VIEW OF DOOR MECHANISMS WITHOUT HINGE

PASSENGER ENTRY DOOR SYSTEM - COMPONENT LOCATIONS

PASSENGER ENTRY DOOR SYSTEM - DOORS AND SEALS

Purpose

The passenger entry doors and seals close and seal the external access to the passenger compartment.

Physical Description

The door has these components:

- Outer skin
- Acoustic seal
- Inner skin
- Frames
- Intercostals
- Beams
- Stops
- Pressure seal.

Part of the blade-type pressure seal attaches to the bottom edge and corners of the door. The other part of the seal attaches to the sides and top of the door cutout.

The tube-type acoustic door seal attaches to the top door beam.

Functional Description

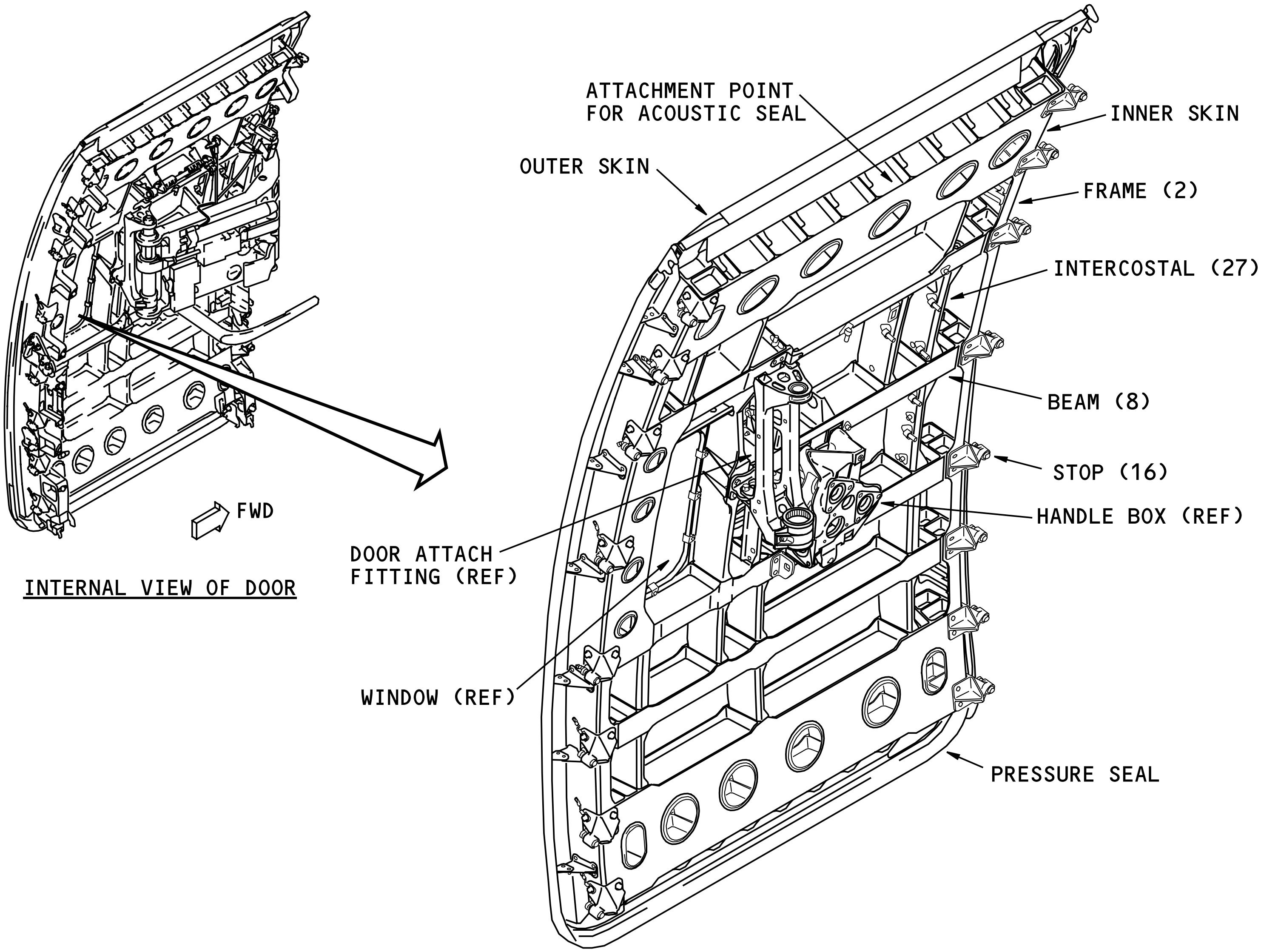
The door is a plug-type. The door stops fit against cutout stops. The stops prevent the outward movement of the door when the airplane is pressurized.

The pressure door seal prevents flow of cabin air to the outside.

The acoustic door seal reduces the outside noise that enters the cabin.

Training Information Point

The pressure seal depressor (not shown) on the forward side of doors one left and one right may have one or two holes in the area 40 to 50 inches above the cabin floor. These holes help control air noise. Do not block these holes. If a new depressor is installed, drill the same size holes in the same location on the new depressor.



52-11-00-003 Rev 1

PASSENGER ENTRY DOOR SYSTEM - DOORS AND SEALS

PASSENGER ENTRY DOOR SYSTEM - DOOR HINGE

Purpose

The hinge connects the door to the airplane and lets the door open and close.

Physical Description

The door hinge has these components:

- Hinge support fitting
- Hinge arm
- Lift sleeve
- Linear lift
- Door attach fitting

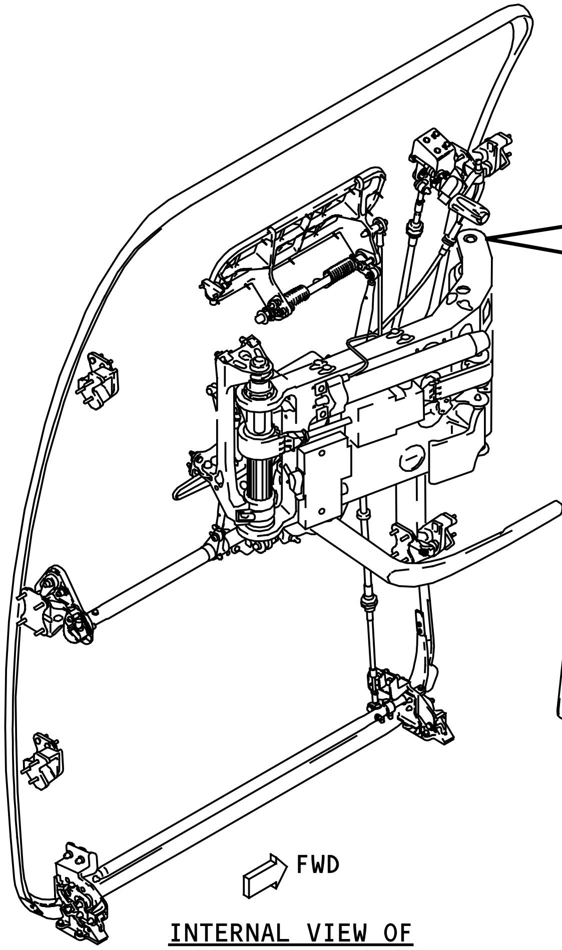
The hinge support fittings connect the hinge arm to the door cutout. The upper fitting has a sprocket for the programming chain.

The door attach fitting connects the door to the linear lift. The linear lift connects to the hinge arm. It has a sprocket for the programming chain. The programming chain is described later in this section.

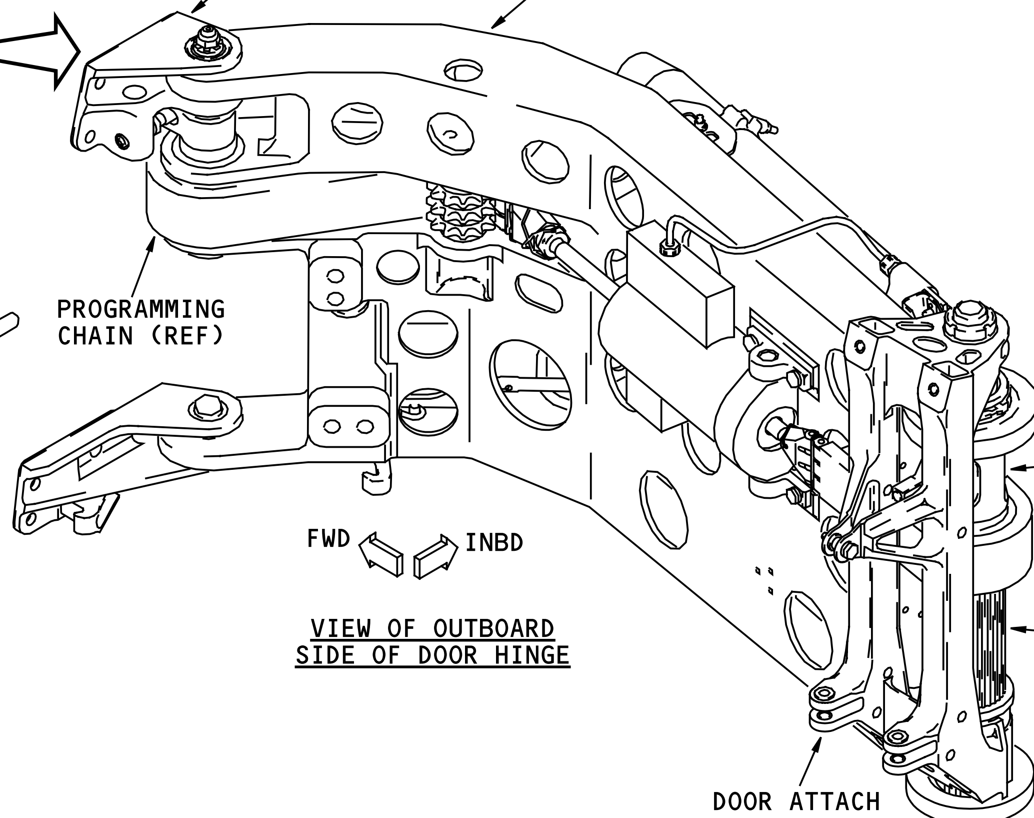
Functional Description

As the door opens or closes:

- The hinge arm turns on the hinge support fittings
- The door turns and moves up and down on the linear lift.



INTERNAL VIEW OF DOOR MECHANISMS



VIEW OF OUTBOARD SIDE OF DOOR HINGE

52-11-00-004 Rev 0

PASSENGER ENTRY DOOR SYSTEM - DOOR HINGE

PASSENGER ENTRY DOOR SYSTEM - DOOR HINGE - LINEAR LIFT FUNCTION

Linear Lift Functional Description

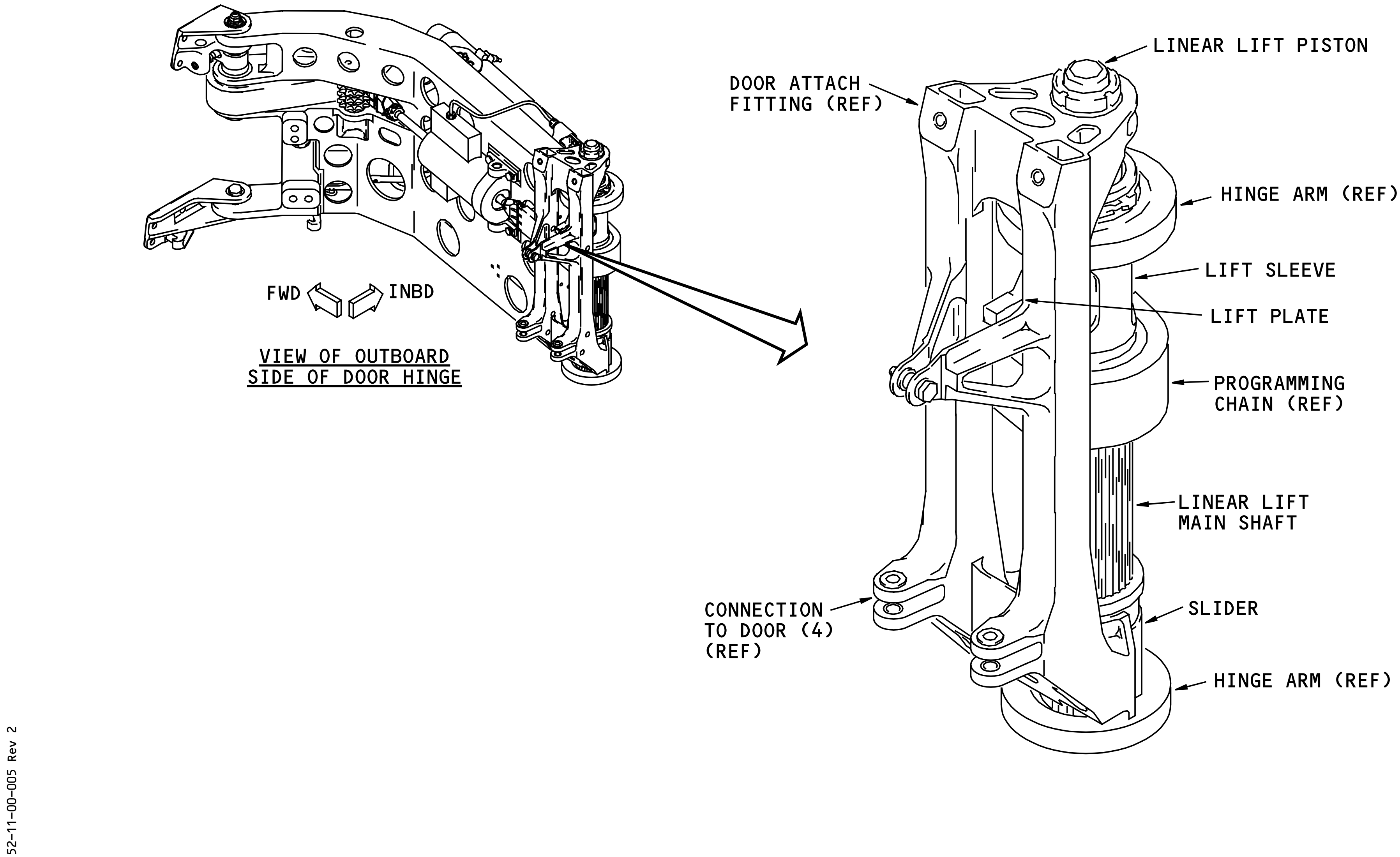
The linear lift piston moves up and down inside the main shaft. The door counterbalance spring is inside the main shaft. It pushes the piston up.

The top of the piston connects to the door attach fitting. A slider that moves up and down on the main shaft connects to the bottom of the door attach fitting.

The force of the counterbalance spring helps the latch mechanism lift the door. The movement of the piston inside the main shaft makes sure the door lift is vertical.

Training Information Point

Do not lubricate the linear lift. Its surface includes a dry lubricant. Liquid lubricants can collect dirt.



PASSENGER ENTRY DOOR SYSTEM - DOOR HINGE - LINEAR LIFT FUNCTION

PASSENGER ENTRY DOOR SYSTEM - PROGRAMMING MECHANISM CHAIN

Purpose

The programming mechanism chain has these functions:

- Correctly aligns the door to the airplane as the door opens and closes
- Lets he door emergency power assist system (EPAS) open the door in emergencies.

Physical Description

The chain goes completely around the hinge arm.

The chain has two parts. One part of the chain connects to the snubber piston. It goes around the sprocket on the linear lift and connects to the EPAS actuator piston. The second part of the chain connects to the other end of the actuator piston. It goes around a sprocket on the hinge pin and connects to the other end of the snubber piston.

Idler sprockets let the chain follow the shape of the hinge arm.

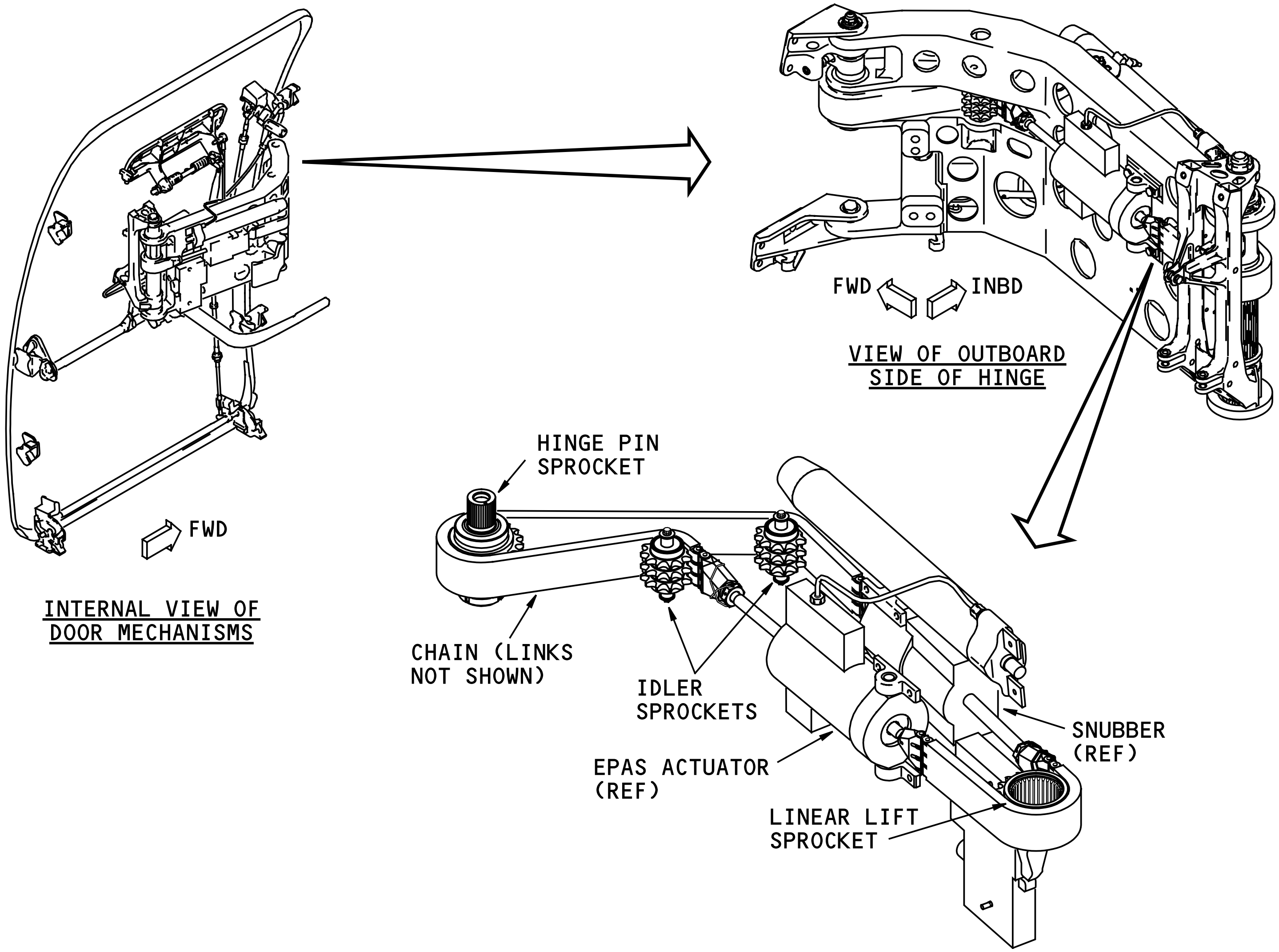
Functional Description

The hinge arm turns on the hinge pin as the door opens and closes. The sprocket on the hinge pin does not turn. This causes the chain to move in relation to the hinge arm. The pistons of the EPAS actuator and the snubber pass the movement through to the other part of the chain.

The sprocket on the linear lift does not turn in relation to the door. The movement of the chain around the sprocket causes the door to move in relation to the hinge arm. This lets the door move forward and aft but not turn in relation to the airplane.

Training Information Point

Do not lubricate the chain. Its surface includes a dry lubricant. Liquid lubricants can collect dirt.



52-11-00-006 Rev 1

PASSENGER ENTRY DOOR SYSTEM - PROGRAMMING MECHANISM CHAIN

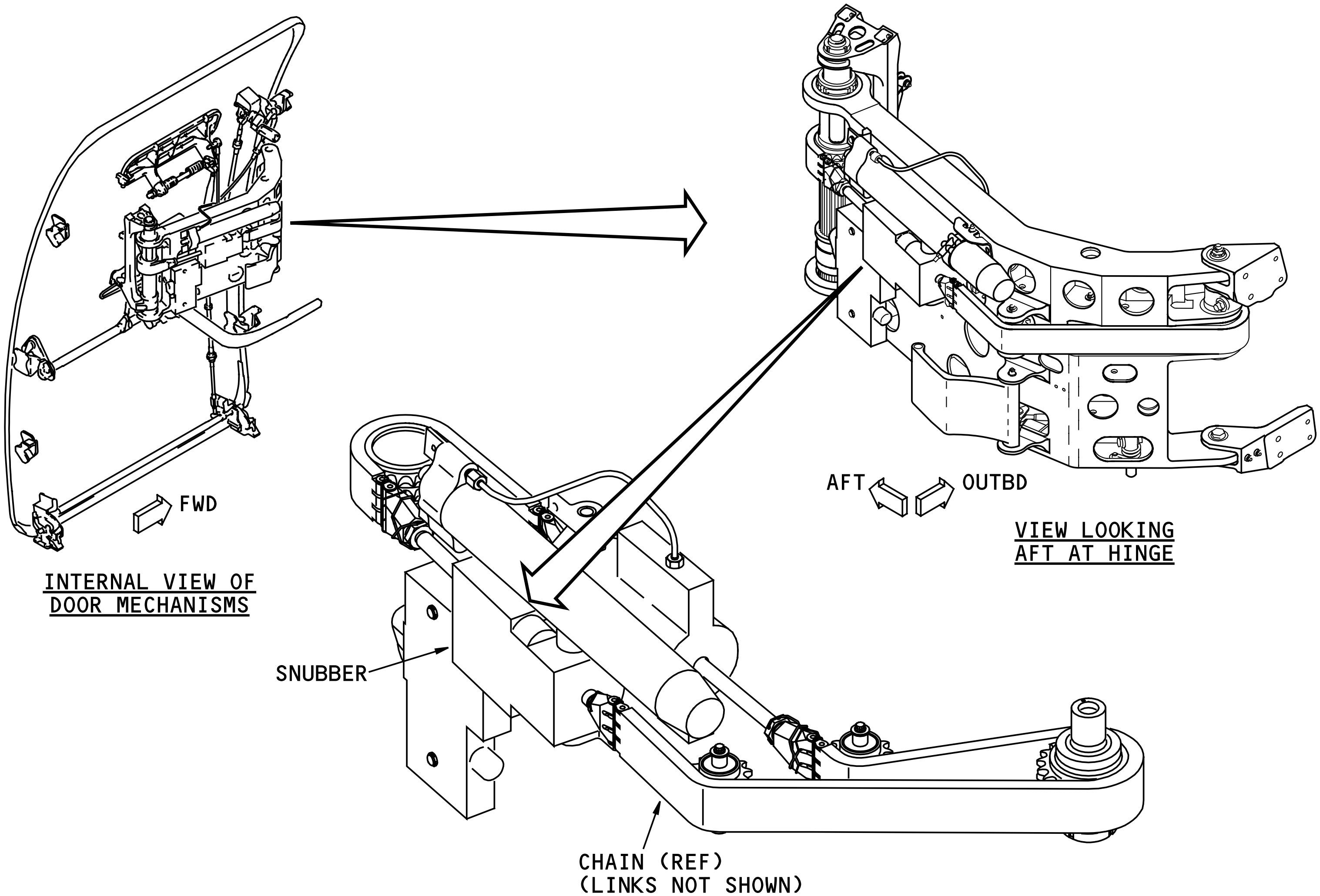
PASSENGER ENTRY DOOR SYSTEM - SNUBBER

Purpose

The snubber controls the rate at which the door opens or closes.

Physical Description

The snubber attaches to the inboard side of the hinge arm. It has a piston and hydraulic fluid. The ends of the piston attach to the programming chain.



52-11-00-007 Rev 0

PASSENGER ENTRY DOOR SYSTEM - SNUBBER

PASSENGER ENTRY DOOR SYSTEM - HOLD-OPEN MECHANISM

Purpose

The hold open mechanism holds the door in the full open position. You use the mechanism handle to pull the door closed.

Physical Description

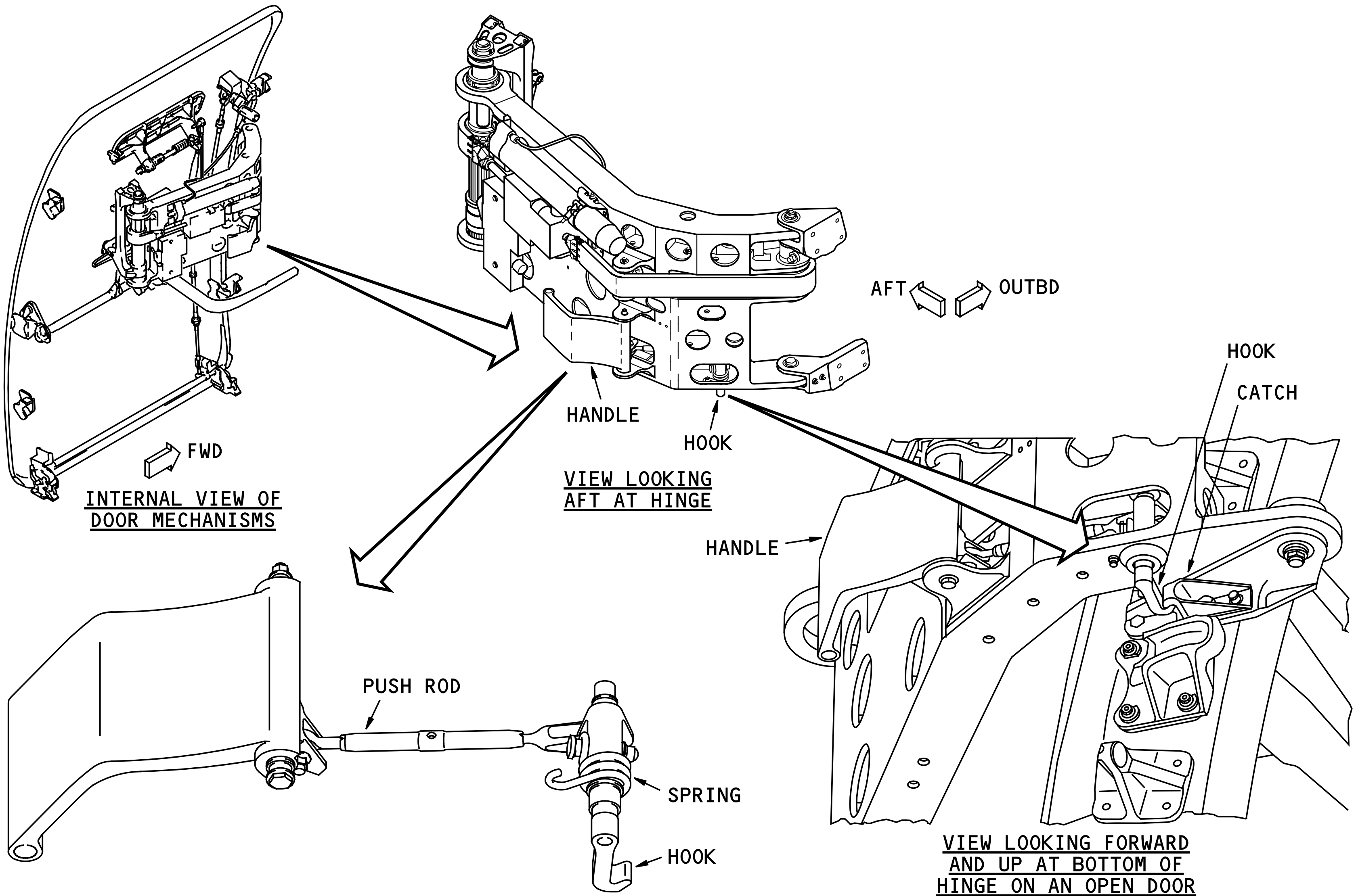
The mechanism is on the hinge arm and has these components:

- Handle
- Hook
- Catch
- Spring
- Push rod.

Functional Description

When the door is full open, the spring pushes the hook into the catch on the door cutout.

You pull on the handle to release the hook. The door closes if you continue to pull on the handle.



PASSENGER ENTRY DOOR SYSTEM - HOLD-OPEN MECHANISM

52-11-00-008 Rev 0

PASSENGER ENTRY DOOR SYSTEM - HANDLE MECHANISM AND MECHANICAL SWITCHES

Purpose

The door handle mechanism lets you open and close the door.

Physical Description

The door handle mechanism has these components:

- Internal handle
- Inner shaft
- Outer shaft
- External handle
- External handle return spring
- Disarm crank
- Handle box
- Gas spring
- Vent door crank
- Door open switch
- Handle cam
- Lift crank.

The door open switch is on the door handle mechanism.

Functional Description

The external handle connects to the outer shaft. The internal handle connects to the inner shaft. The outer shaft fits over the inner shaft.

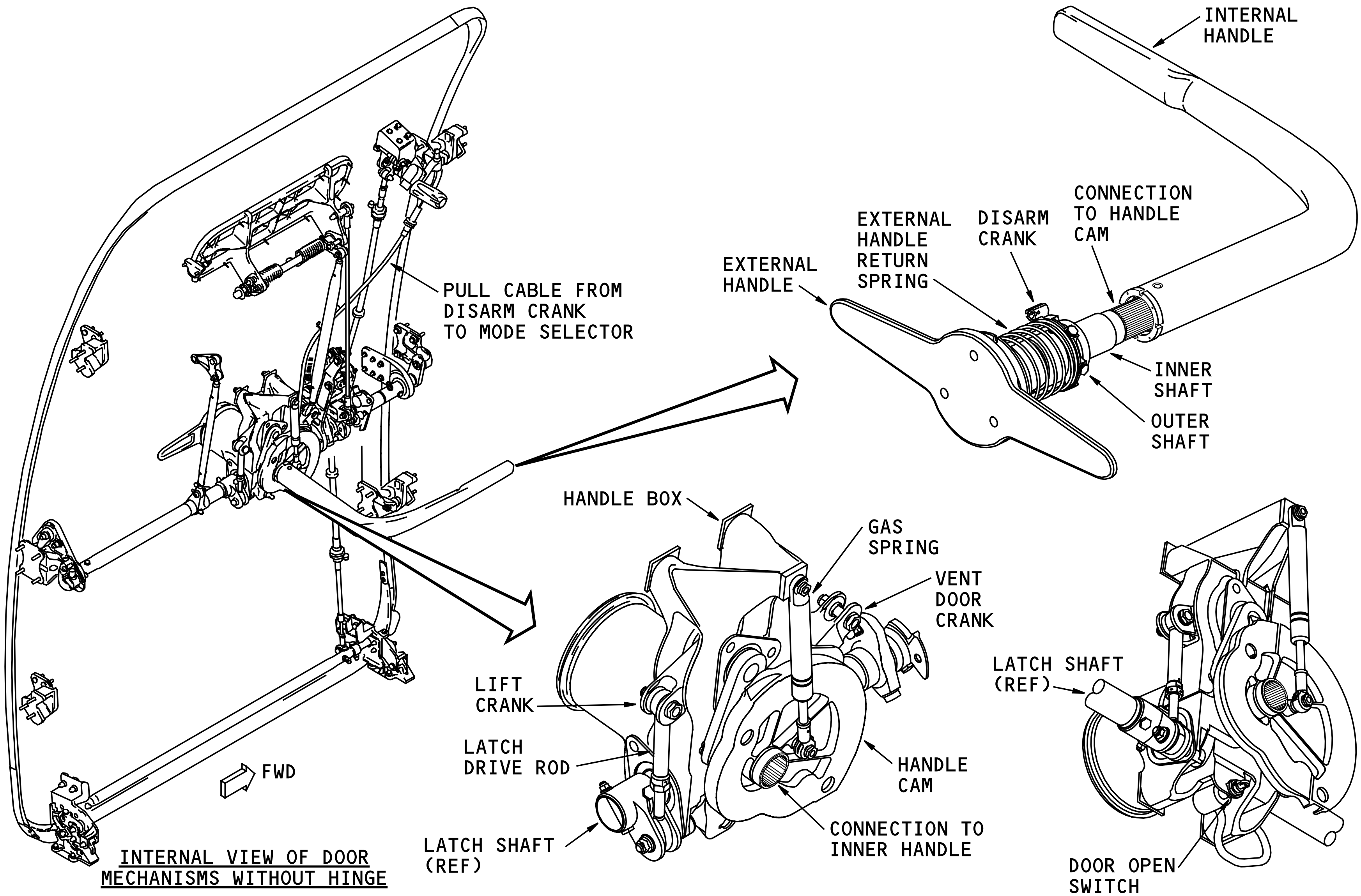
The external handle return spring holds the outer shaft over the inner shaft. When you pull outboard on the external handle, the outer and inner shafts lock together.

The inner shaft goes through the handle box which provides a bearing surface for the handle. The inner shaft connects to the handle cam. A lift drive crank and a latch drive rod connect the handle cam to the latch shaft. When you turn either handle, you move the latch shaft.

Pressure in the gas spring pushes down on the handle cam so the door handles are held in the full close position. Movement of either handle toward open compresses the gas in the spring. When the handle is past the center of movement, the compressed gas helps move the handle to full open.

A cable connects the disarm crank on the external handle to the mode select mechanism. When you pull the external handle out, you move the disarm crank. It pulls on the cable which moves the mode select mechanism to the disarm mode.

When the door is open, the handle cam will not transmit back drive forces from the latch shaft to the handles.



52-11-00-009 Rev 4

PASSENGER ENTRY DOOR SYSTEM - HANDLE MECHANISM AND MECHANICAL SWITCHES

PASSENGER ENTRY DOOR SYSTEM - LATCH MECHANISM - INTRODUCTION

Purpose

The latch mechanism does these functions:

- Unlatches and latches the door
- Lifts and lowers the door as it opens and closes so the door stops can move past the cutout stops.

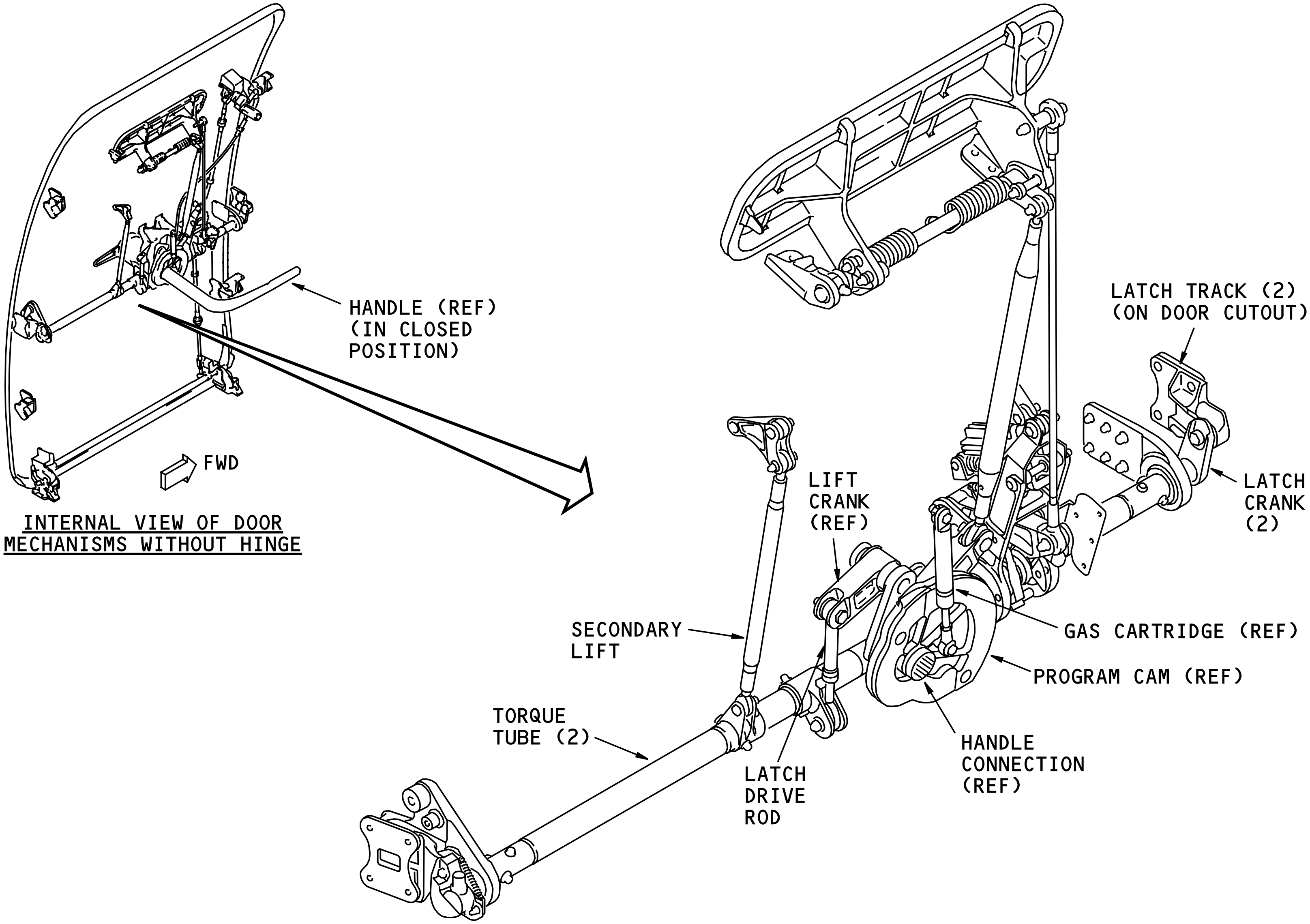
Physical Description

The mechanism has these components:

- Door locked proximity sensor
- Latch track (2)
- Latch crank (2)
- A latch drive rod
- Torque tube (2)
- A secondary lift.

Functional Description - Cam, Crank, and Torque Tube

The program cam moves the lift crank which pulls the latch drive rod up. This turns the torque tubes.



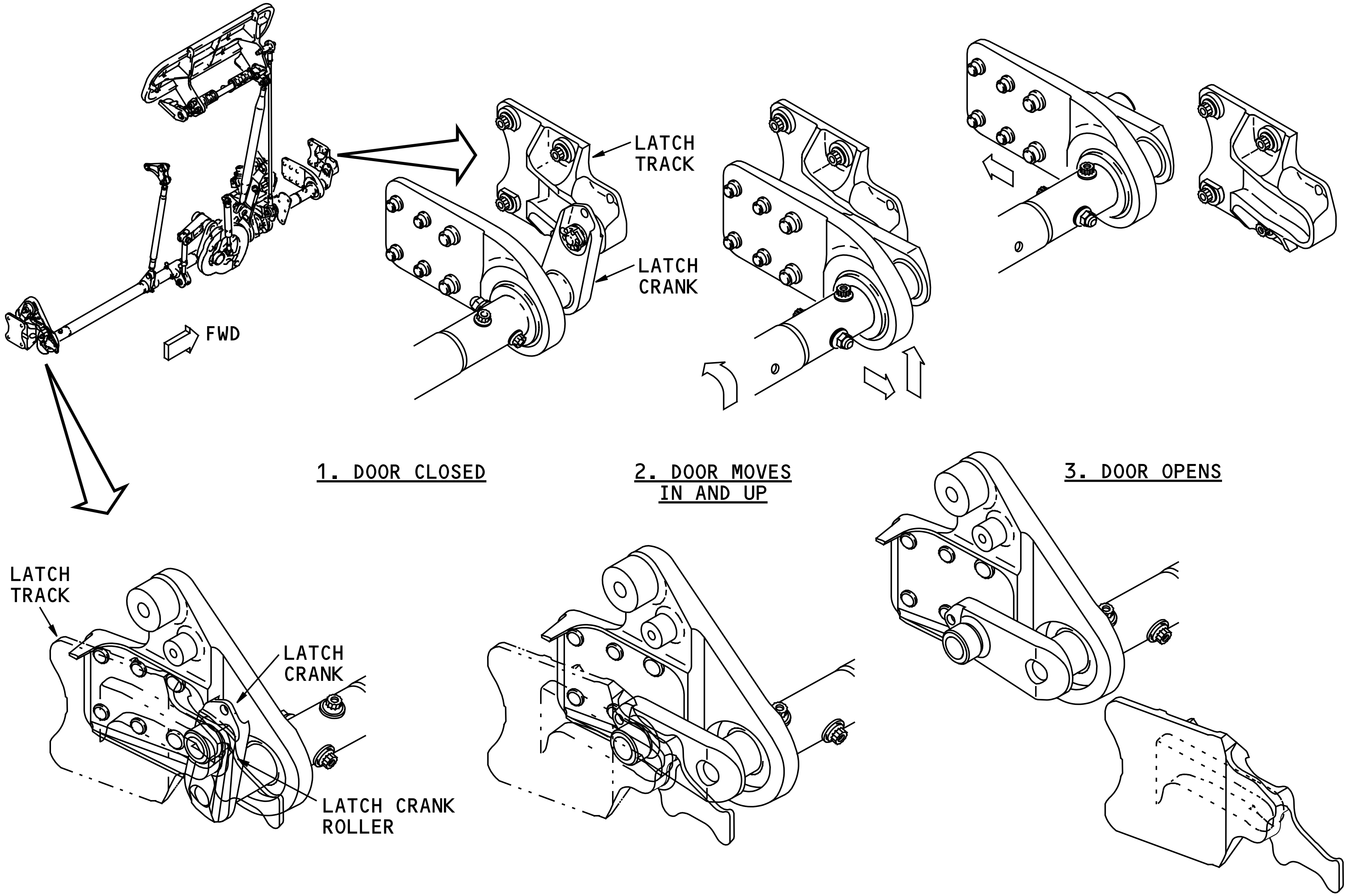
52-11-00-010 Rev 4 11/06/1997

PASSENGER ENTRY DOOR SYSTEM - LATCH MECHANISM - INTRODUCTION

PASSENGER ENTRY DOOR SYSTEM - LATCH MECHANISM - LATCH CRANK FUNCTION

Functional Description

The torque tubes turn the latch cranks. The latch crank rollers push down on the latch tracks when opening. This moves the door inboard and lifts the door. During closing they perform the opposite motions.



52-11-00-011 Rev 1 11/06/1997

PASSENGER ENTRY DOOR SYSTEM - LATCH MECHANISM - LATCH CRANK FUNCTION

PASSENGER ENTRY DOOR SYSTEM - LATCH MECHANISM - SECONDARY LIFT FUNCTION

Functional Description

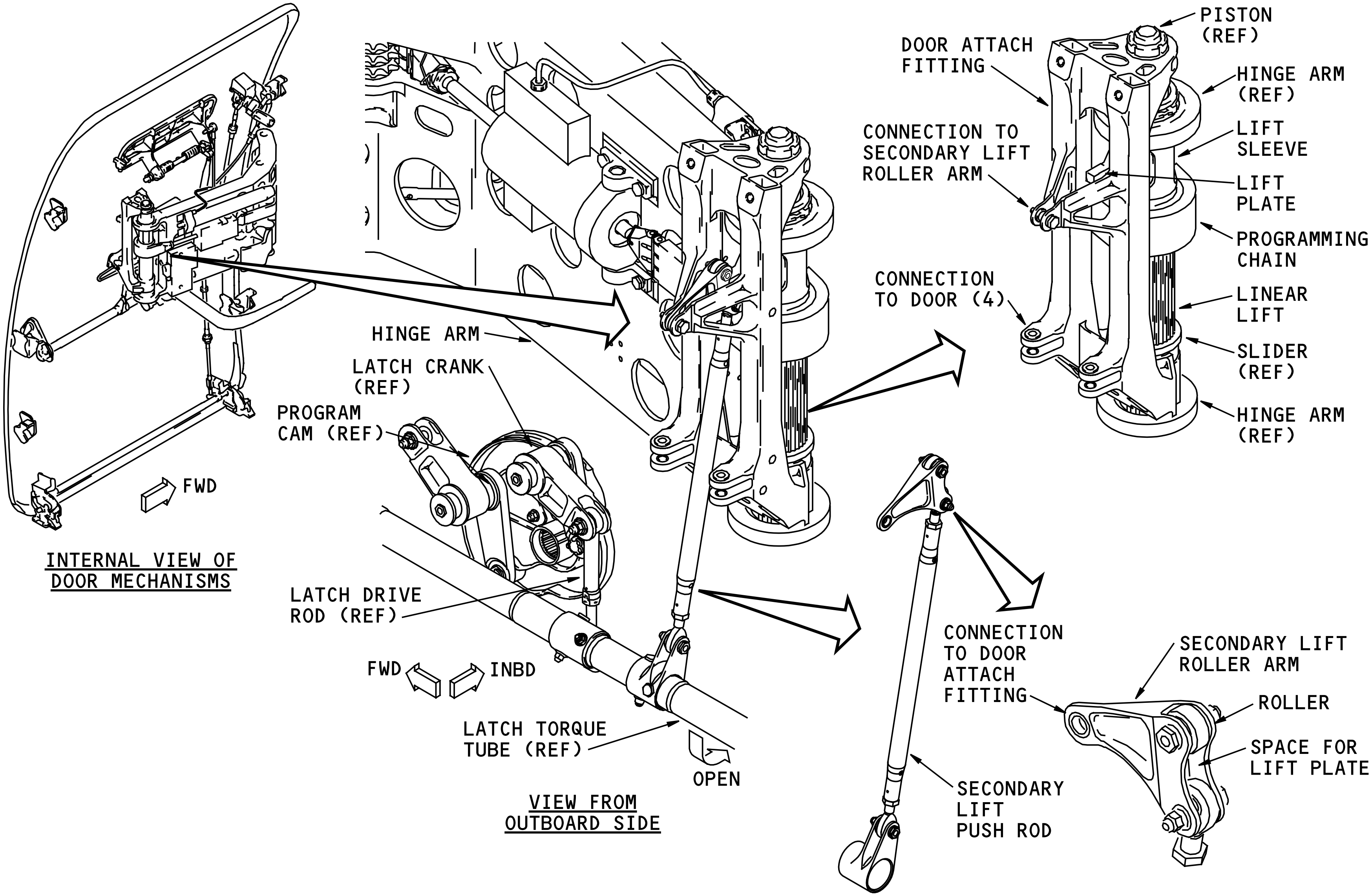
The secondary lift works with the door attach fitting and the lift sleeve.

The lift plate is part of the lift sleeve. The lift sleeve is held by the hinge arm. It can turn but cannot move up and down.

The secondary lift roller arm connects to the door attach fitting. The roller fits above the lift sleeve lift plate.

Rotation of the latch torque tube to open the door, pulls down on the secondary lift. The roller arm roller pushes down on the lift plate. This causes the outboard end of the roller arm to moves up. This lifts the door attach fitting which lifts the door.

When the door is closed, the secondary lift works against aerodynamic forces or airplane movement that try to lift the door. When the door lifts on the end of the roller arm, the roller arm pushes down on the push rod. The rod push on the torque tube rotates the tube in the door close direction.



52-11-00-012 Rev 1

PASSENGER ENTRY DOOR SYSTEM - LATCH MECHANISM - SECONDARY LIFT FUNCTION

PASSENGER ENTRY DOOR SYSTEM - VENT DOOR MECHANISM - INTRODUCTION

Purpose

The vent door mechanism:

- Releases pressurization to prevent damage when the passenger entry door opens
- Will not let the passenger entry door unlatch if differential pressurization is above 0.21 psi.

Physical Description

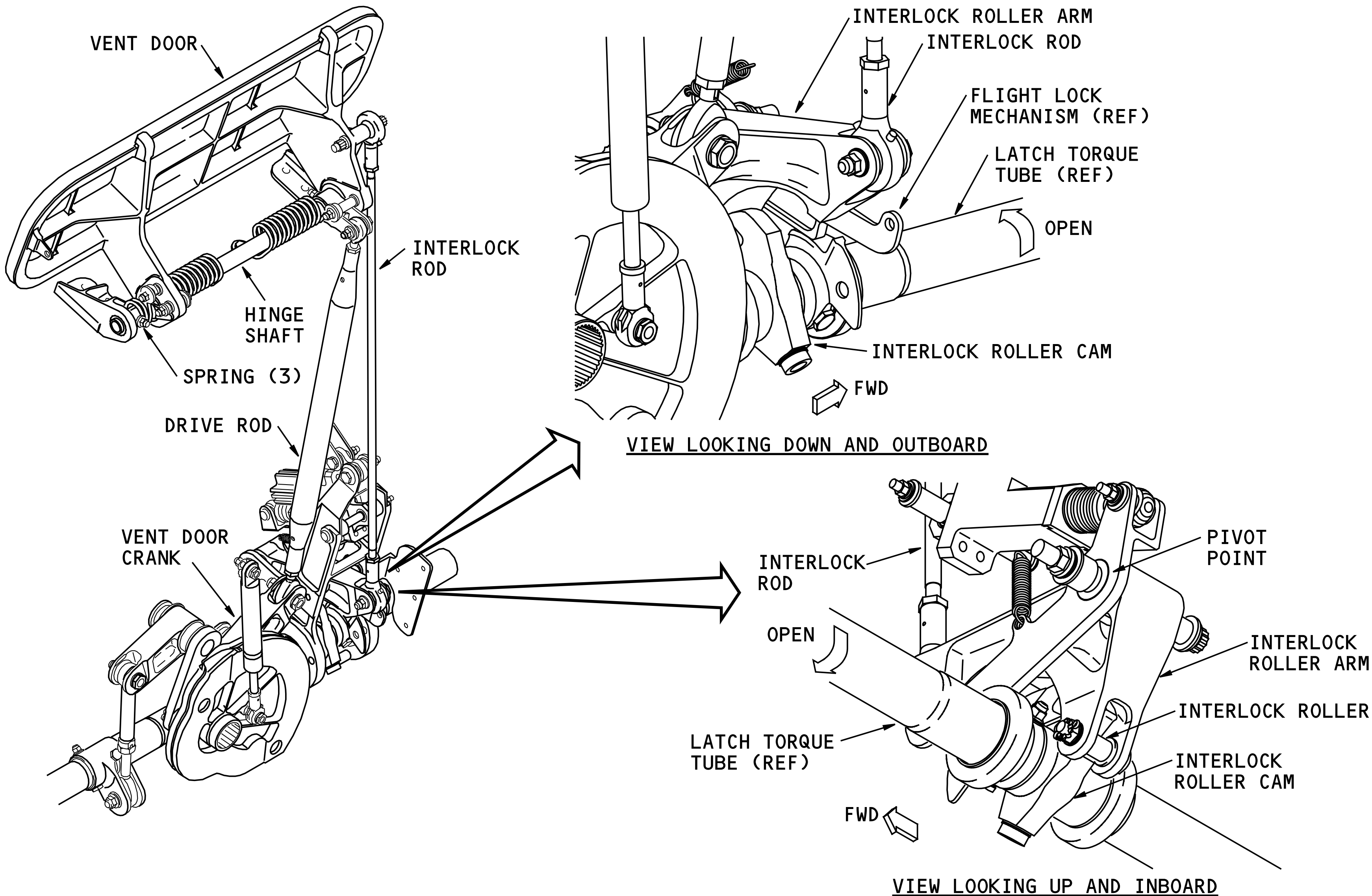
The vent door mechanism has these components:

- Vent door
- Interlock rod
- Interlock roller arm
- Interlock cam
- Drive rod
- Spring (3)
- Hinge shaft.

Functional Description - Vent Door

In the passenger entry door closed position, the drive rod holds the vent door closed. The initial movement of the door handle pulls down on the drive rod which releases the vent door. The springs open the vent door if differential pressurization is below 0.125 psi.

When the vent door opens the interlock rod pushes down on the roller arm. The roller arm moves the roller away from the interlock cam so the cam will let the latch torque tube turn.



52-11-00-013 Rev 2 10/13/96

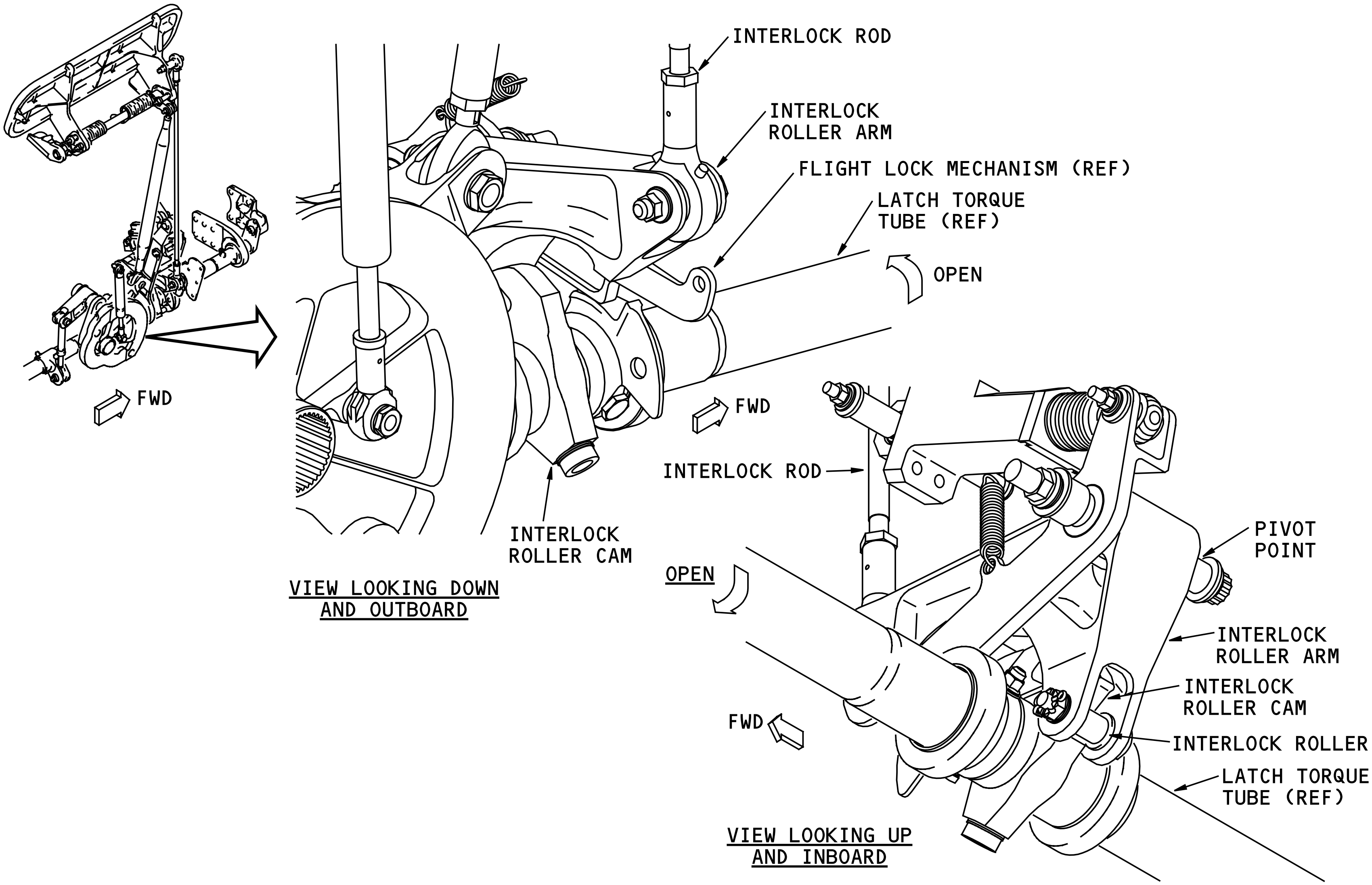
PASSENGER ENTRY DOOR SYSTEM - VENT DOOR MECHANISM - INTRODUCTION

Pressurization Lockout Function

The vent door mechanism will not let you open the passenger entry door when pressurization is too high for safe operation.

When the vent door opens, the interlock rod pushes down on the interlock roller arm. This moves the interlock roller out of the interlock cam. The latch torque tube can complete its rotation to open the door.

If too much pressurization remains, the vent door springs cannot open the vent door. The interlock rod continues to hold the interlock roller arm up. The interlock roller will not let the interlock cam turn. The latch torque tube cannot turn to unlatch the passenger entry door.



52-11-00-014 Rev 1

PASSENGER ENTRY DOOR SYSTEM - VENT DOOR MECHANISM - PRESSURIZATION LOCKOUT FUNCTION

PASSENGER ENTRY DOOR SYSTEM - VENT DOOR MECHANISM - INTERLOCK FUNCTION

Pressurization Lockout Function

When differential pressurization is above 0.125 psi, the vent door springs cannot open the vent door. The interlock rod continues to hold the interlock roller arm up. The interlock roller will not let the interlock cam turn. The latch torque tube cannot turn to unlatch the passenger entry door.

If differential pressurization is between 0.125 and 0.21 psi, and you continue to pull up on the door handle with sufficient force:

- The cam will force the roller to move outboard along the flat cam surface
- The roller arm to will pull down on the interlock rod
- The vent door will open
- The roller will move past the hook.

If differential pressurization is above 0.21 psi, and you continue to pull up on the door handle with sufficient force:

- The cam will force the roller to move outboard along the flat cam surface
- The roller arm to will pull down on the interlock rod sufficient to open the vent door 30 degrees
- The roller cannot move past the hook.

When the differential pressurization goes below 0.21 psi, upward force on the handle will move the vent door full open.

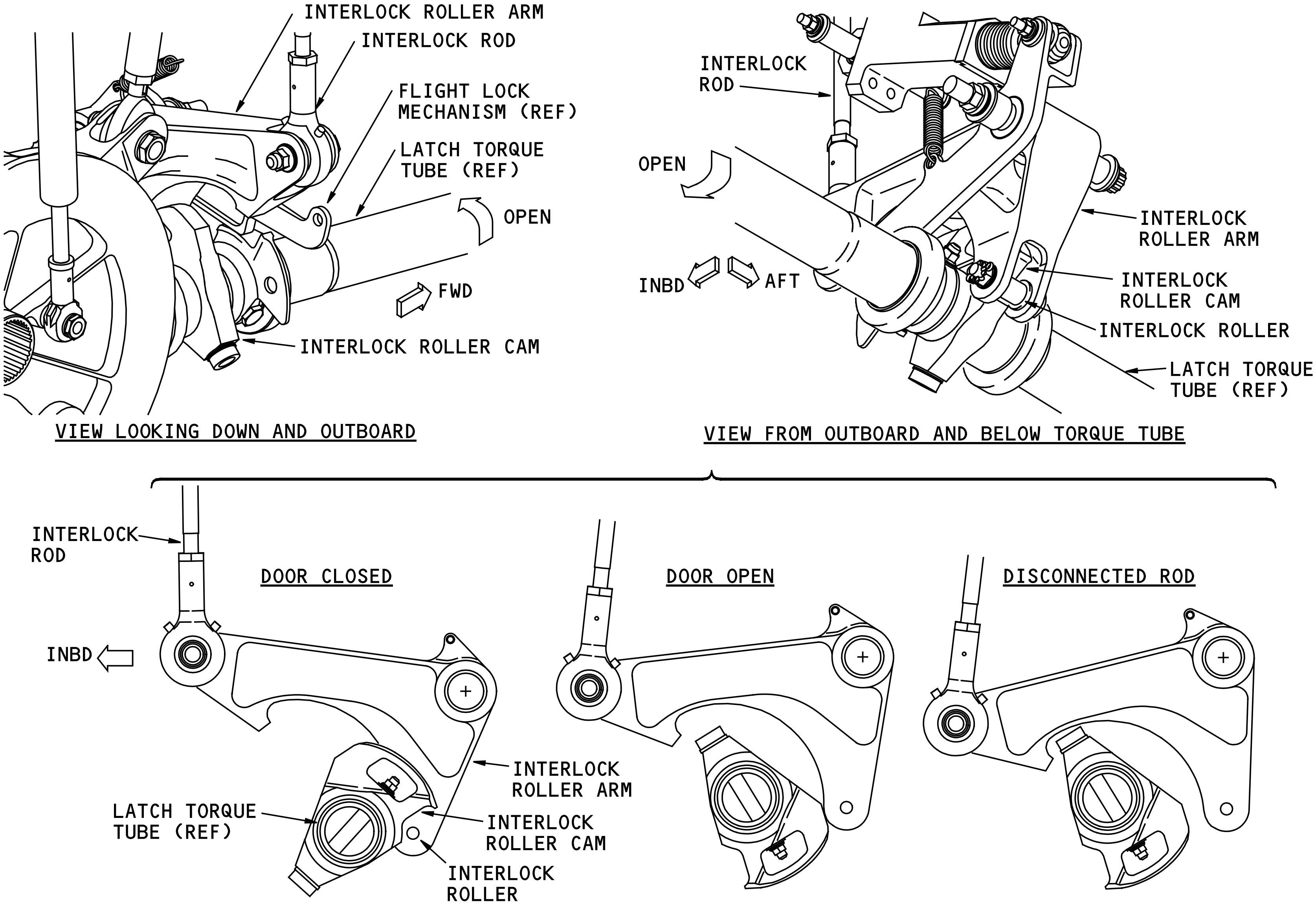
An example of sufficient force to open the vent door 30 degrees is approximately 200 pounds when differential pressurization is 1.0 psi.

Vent Door Mechanism Failure

If either rod fails or disconnects, the inboard end of the roller arm moves down. The rotation of the roller arm moves the roller away from the interlock cam so the interlock cam can turn. The cam can push the roller arm up to let you open the door. If you try to latch the door, the arm catches the cam. The cam cannot push the arm up to go back to the door close position.

Training Information Point

Do a check of the vent door mechanism if you cannot move either door handle to the close position when you try to close the door.



PASSENGER ENTRY DOOR SYSTEM - VENT DOOR MECHANISM - INTERLOCK FUNCTION

52-11-00-015 Rev 1 10/12/96

PASSENGER ENTRY DOOR SYSTEM - FLIGHT LOCK MECHANISM AND FLIGHT LOCK SENSORS

Purpose

The flight lock mechanism locks the latch mechanism closed when the airplane airspeed is 80 knots or more.

Physical Description

The flight lock mechanism has these components:

- Motor
- Flight lock disengaged sensor
- Flight lock engaged sensor
- Target
- Lock pawl lever
- Cam
- Spring (2)

Functional Description - Flight Lock Mechanism

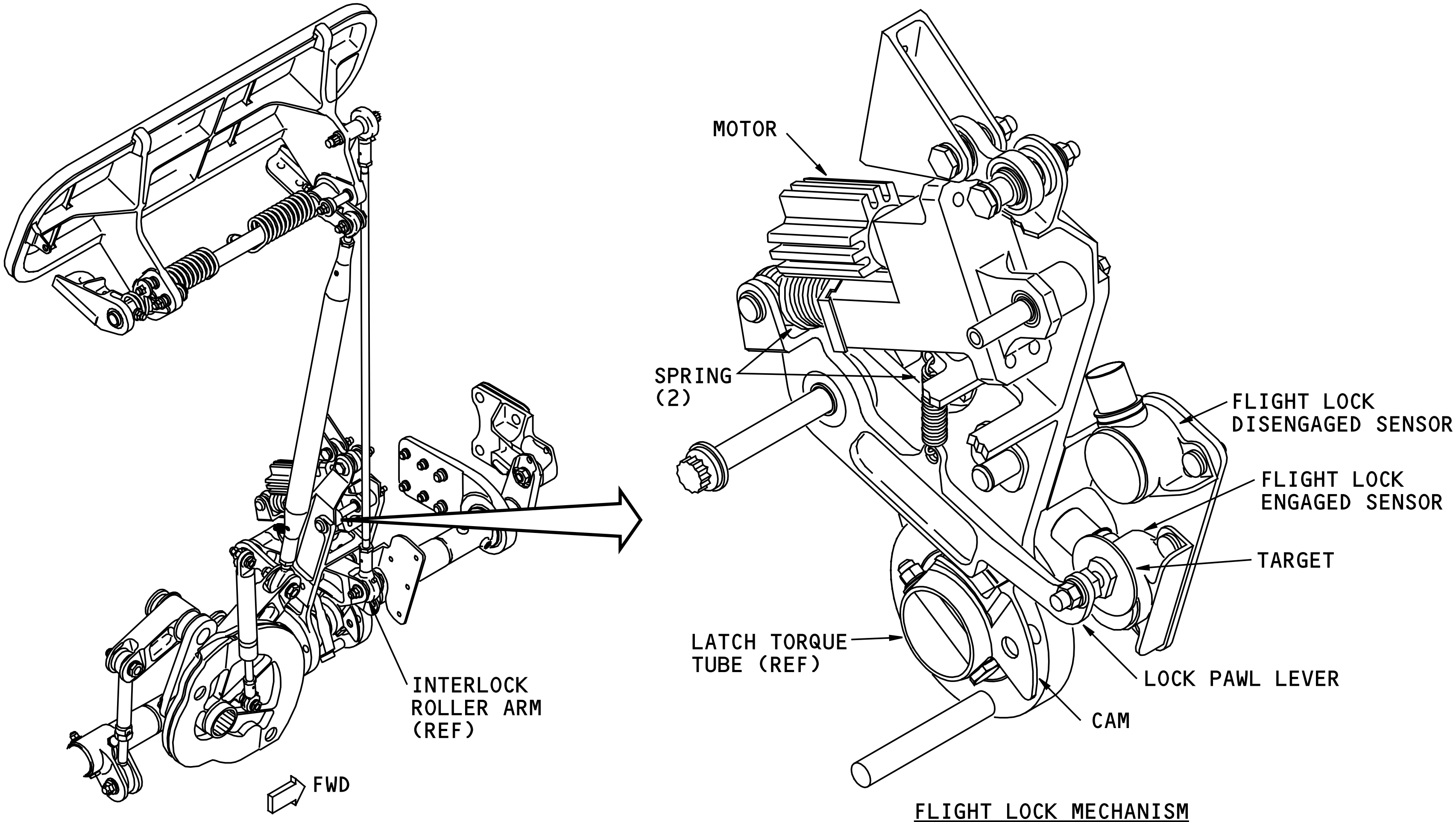
The air data inertial reference unit (ADIRU) and the secondary attitude and air data reference unit (SAARU) supply an airspeed signal when the airplane reaches 80 knots.

The PSEU and an ELMS electronics unit energize relays that send power to the flight lock motor. The motor moves the lock pawl lever to the locked position. The motor stalls and holds the lever in the locked position. The lever engages the cam on the latch torque tube. The latch torque tube cannot turn to unlatch the door.

When the airplane goes below 80 knots, the relays open to remove power from the motor. The springs move the lever to the unlocked position. The latch torque tube can turn to unlatch the door.

Functional Description - Flight Lock Sensors

Flight lock engaged and the flight lock disengaged sensor information goes from the proximity sensor electronics units (PSEU) to the airplane information management system (AIMS). Status and maintenance messages show when the lock pawl lever is not in its commanded position.



52-11-00-016 Rev 3 10/18/96

PASSENGER ENTRY DOOR SYSTEM - FLIGHT LOCK MECHANISM AND FLIGHT LOCK SENSORS

PASSENGER ENTRY DOOR SYSTEM - MODE SELECT MECHANISM AND MECHANICAL SWITCHES

Purpose

The mode select mechanism lets you set the operation mode for the emergency power assist system (EPAS), and the girt bar mechanism.

Physical Description

The mode select mechanism has these components:

- Mode select handle
- Cable crank
- Push/pull cable assembly
- Cam lever
- Spring.

The mode select switch is on the mode select mechanism.

Functional Description

When you move the mode select handle aft, you select the armed mode. Selection of the armed mode does these two things:

- Closes the mode select switch which arms the emergency power assist system (EPAS)
- Pushes down on the push/pull cable which arms the girt bar mechanism.

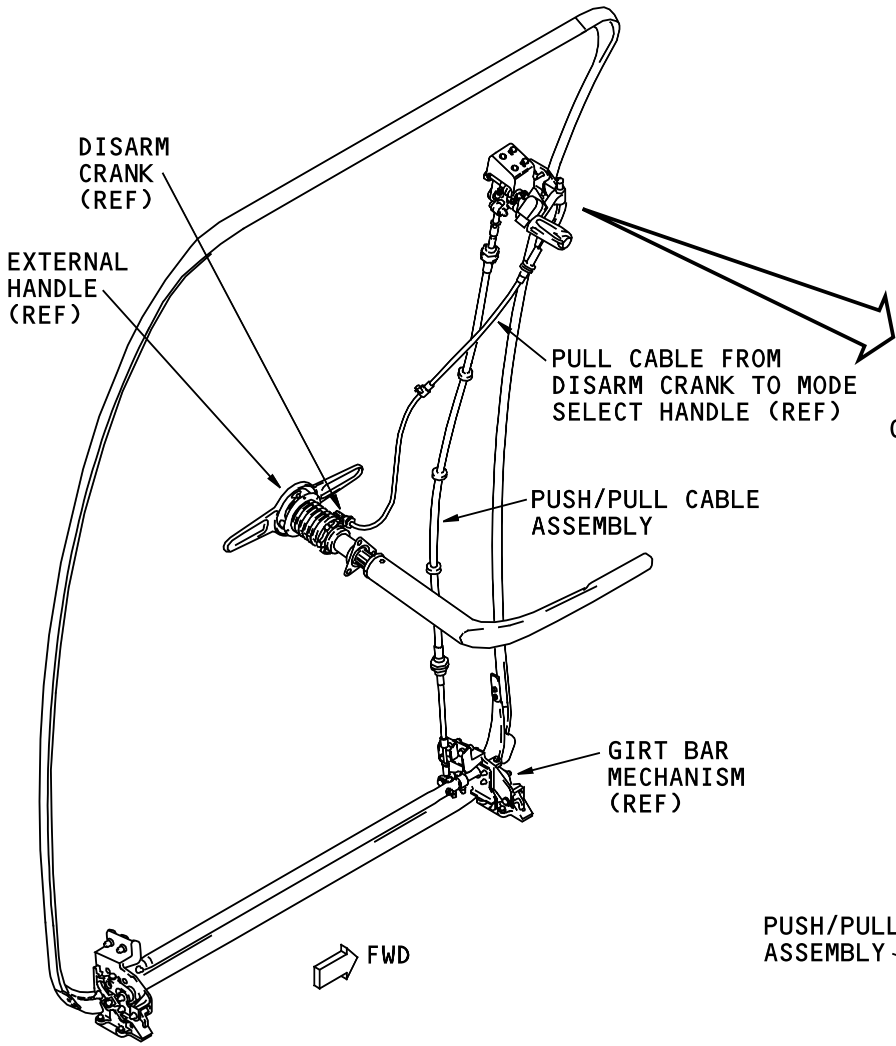
When you pull the external door handle outboard, the disarm crank pulls the cable that goes to the mode select handle. It moves the handle forward to the disarm position.

When you move the external door handle inboard, the disarm crank pushes the cable. The cable slides through the mode select handle. It does not move the handle. The lever stays in the disarm position.

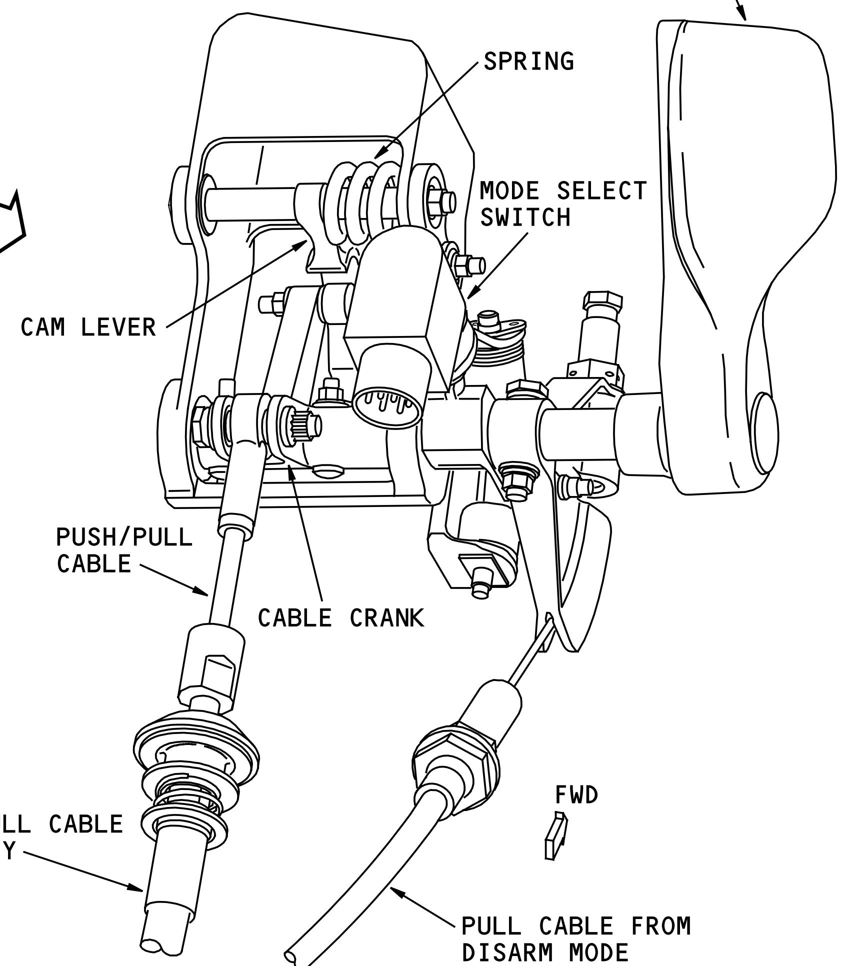
When you move the mode select handle forward, it does not push on the cable. The cable slides through the handle. It does not move the external door handle.

The spring and cam lever are an overcenter device for the mode select handle. When you move the handle the spring and cam push the handle completely to the position you select.

The mode select switch is one of two mechanical switches used in the emergency power assist system (EPAS) operation.



INTERNAL VIEW OF DOOR WITHOUT LATCH MECHANISM,
VENT DOOR MECHANISM AND HINGE



52-11-00-017 Rev 4 11/06/1997

PASSENGER ENTRY DOOR SYSTEM - MODE SELECT MECHANISM AND MECHANICAL SWITCHES

PASSENGER ENTRY DOOR SYSTEM - GIRT BAR MECHANISM AND GIRT BAR FLOOR FITTING - INTRODUCTION

Purpose

The girt bar mechanisms hold the emergency slide girt bar on the bottom of the door in the disarmed mode and releases it into the girt bar floor fittings in the armed mode.

The floor fittings hold the girt bar on the floor when you open the door in the armed mode.

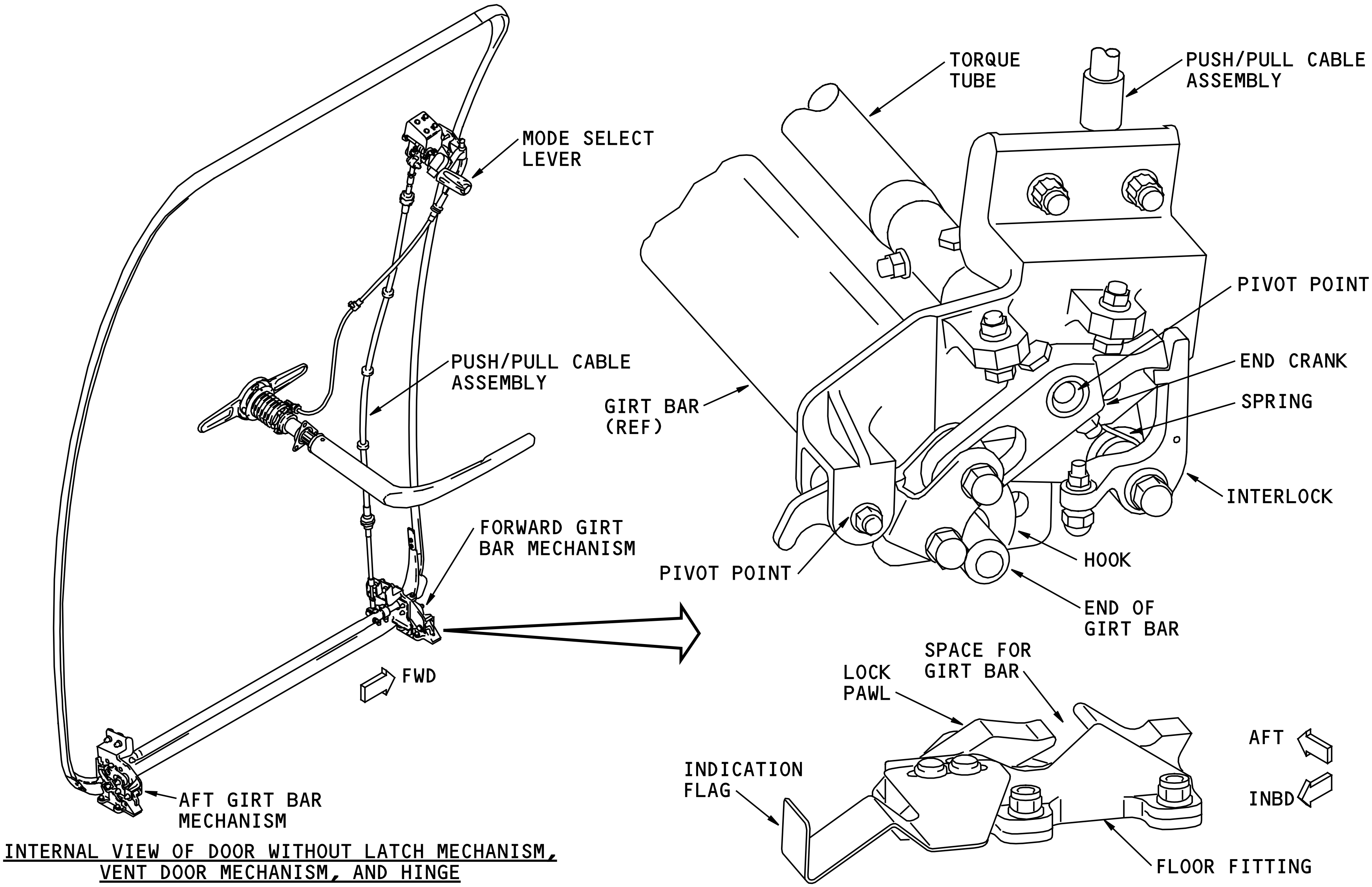
Physical Description

There are girt bar mechanisms on the lower forward and aft corners of the door. A torque tube connects the end crank of the two mechanisms to the push/pull cable assembly.

Each girt bar mechanism has these components:

- End crank
- Spring
- Interlock
- Hook
- Carrier fitting.

Each floor fitting assembly has a spring-loaded lock pawl. A yellow indication flag attaches to the lock pawl. The flag shows through a witness port on the sidewall. You see the witness port later in this section, in the door operation.



INTERNAL VIEW OF DOOR WITHOUT LATCH MECHANISM,
VENT DOOR MECHANISM, AND HINGE

52-11-00-018 Rev 4 11/06/1997

PASSENGER ENTRY DOOR SYSTEM - GIRT BAR MECHANISM AND GIRT BAR FLOOR FITTING - INTRODUCTION

PASSENGER ENTRY DOOR SYSTEM - GIRT BAR MECHANISM - FUNCTIONAL DESCRIPTION

Door Lifted, Escape Slide Not Armed

The girt bar mechanism holds the girt bar when the door is not latched and in the armed mode. The girt bar is held between the hook and the carrier fitting (not shown).

You cannot move the mode select lever when the door is open. The spring holds the interlock so the end crank cannot turn. The hook that holds the girt bar will not move to release the girt bar.

The indication flag is not lifted. You see the flag through the witness port in the sidewall.

Door Latched, Escape Slide Not Armed

When the door moves down to latch, these two things occur with the girt bar mechanism:

- The roller pushes down on the lock pawl and lifts the indication flag up out of the witness port
- The interlock pushes down on the floor fitting and turns to release the end crank.

Door Latched, Escape Slide Armed

When you move the mode select lever to the armed position, the push/pull cable turns the torque tube. The torque tube turns the end crank. The crank turns the hook.

When the hook turns, the outboard end moves up to releases the girt bar and releases the lock pawl. The spring in the lock pawl lifts the pawl and lowers the flag.

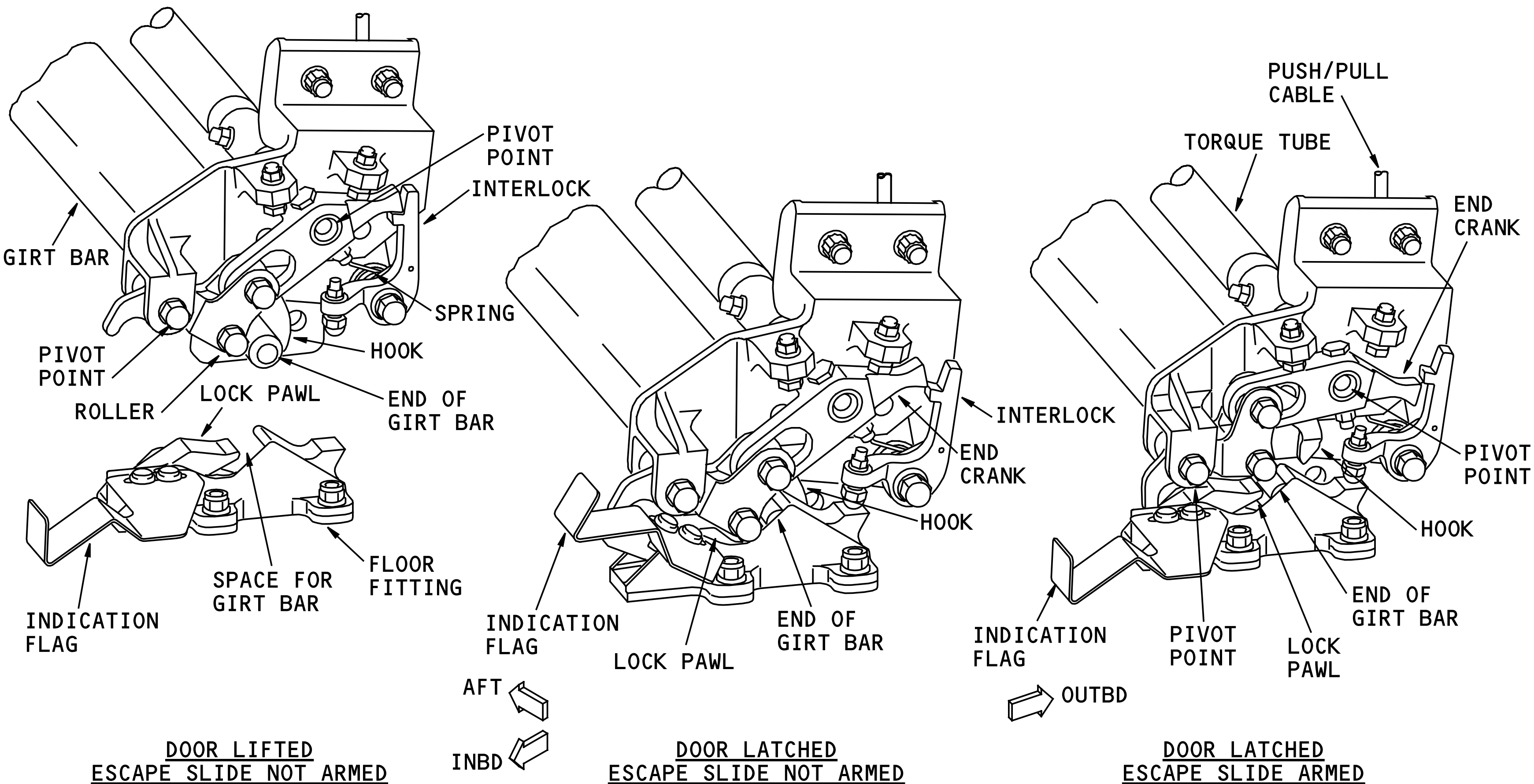
The lock pawl locks the girt bar to the floor. The door is in the armed mode. The flag in the witness port indicates the door is in the armed mode.

If you unlatch and open the door, the girt bar stays locked to the floor. The bar pulls the escape slide/ raft out of the door.

Training Information Point

The interlock must release the end crank before you can move the mode select lever to the arm position. If you cannot move the lever to the arm position, it may show a blockage problem.

Make sure there is no unwanted material around the door bottom that keeps the door from moving completely outboard as it closes. When the door is not completely outboard, the floor fitting will not push the interlock sufficiently to release the end crank.



52-11-00-019 Rev 4 11/06/1997

PASSENGER ENTRY DOOR SYSTEM - GIRT BAR MECHANISM - FUNCTIONAL DESCRIPTION

PASSENGER ENTRY DOOR SYSTEM - EMERGENCY POWER ASSIST SYSTEM (EPAS) - INTRODUCTION

Purpose

The emergency power assist system (EPAS) supplies mechanical power to open the passenger entry door in emergencies.

Physical Description

The EPAS has these components:

- Reservoir
- Actuator
- Battery pack.

Functional Description

Power from the EPAS battery ignites the squib on the reservoir when you move the internal door handle to open with the mode select handle in the armed mode. The squib breaks the rupture disc on the reservoir.

Compressed nitrogen gas from the reservoir goes through a tube to the actuator. Gas expansion in the actuator pushes on piston attached to the rod. This moves the chain. The chain pulls on the fixed sprockets to open the door open.

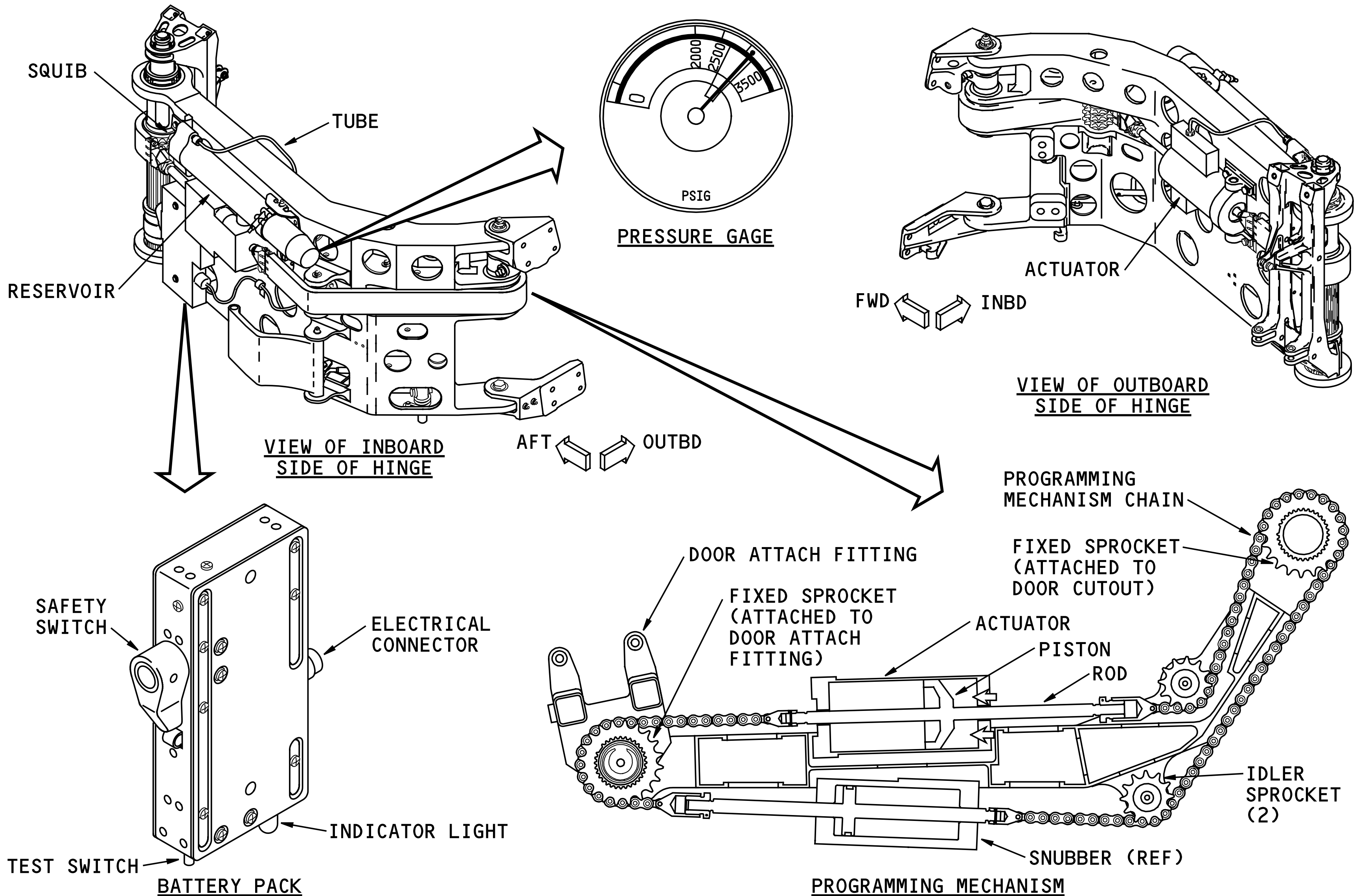
Training Information Point

A safety switch on the battery pack lets you stop the EPAS operation when you do door maintenance. You cannot close the hinge cover when the switch is in the safe position.

A test switch and a red test indicator light on the bottom of the battery let you do a test of the battery for a sufficient charge. You put your hand below the hinge cover to push the switch. You do not have to open the cover. If the battery has a sufficient charge, the red indicator light comes on. The light is red so you can see it reflect off of your hand. You do not have to look directly at the light.

A gage on the forward end of the reservoir lets you know if the pressure in the reservoir is sufficient. You can see the gage through a hole in the hinge cover.

You cannot close the door when there is pressure in the actuator. It takes five minutes for actuator pressure to bleed down after the EPAS has fired.



PASSENGER ENTRY DOOR SYSTEM - EMERGENCY POWER ASSIST SYSTEM (EPAS) - INTRODUCTION

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PASSENGER ENTRY DOOR SYSTEM - OPERATION

General

There are markers on the door that tell you the direction to move the handles for door operation.

External Open Operation

Pull the external handle outboard. This will move the mode select handle to the disarm position if it has not already been set to that position.

Turn the handle 180 degrees in the open direction. The vent door should open as you start to turn the handle. The door will move inboard and upward as you continue to turn the handle. The external handle will stay in the extended position while the door is open.

Pull the door outboard and push it forward until it stops. Do a check to see that the hold-open hook has engaged the hold-open catch.

External Close Operation

Do a check to see that the door area and girt bar floor fitting are not blocked.

If the external handle is not extended, pull it outboard and rotate it 180 degrees. It will remain extended outboard.

Pull the hold-open release handle on the inside of the door. This releases the door and start its close movement. Use the extended, external handle to push the door inboard into the cabin.

Turn the external handle 180 degrees in the close direction. The door will move downward and slightly outboard as it goes to the closed position. The vent door should close as you complete the door handle movement. The door is now closed, latched, and locked.

The handle is spring loaded and moves inboard to the faired position at the end of the rotation.

When you turn the external handle to close the door, it does not move the mode select handle to the armed position.

If the handle will not turn to the closed position, do a check of the door system.

Internal Open Operation

Move the mode select lever to the disarm position. Do a check of the two witness ports in the sidewall near the bottom of the door. The yellow door armed indication flags should not be visible.

If either flag is visible, do not use the door. Do a system check.

Move the handle to the open position. Push outboard and forward on the door. When the door stops, do a check to see that the hold-open hook has engaged the hold-open catch.

PASSENGER ENTRY DOOR SYSTEM - OPERATION

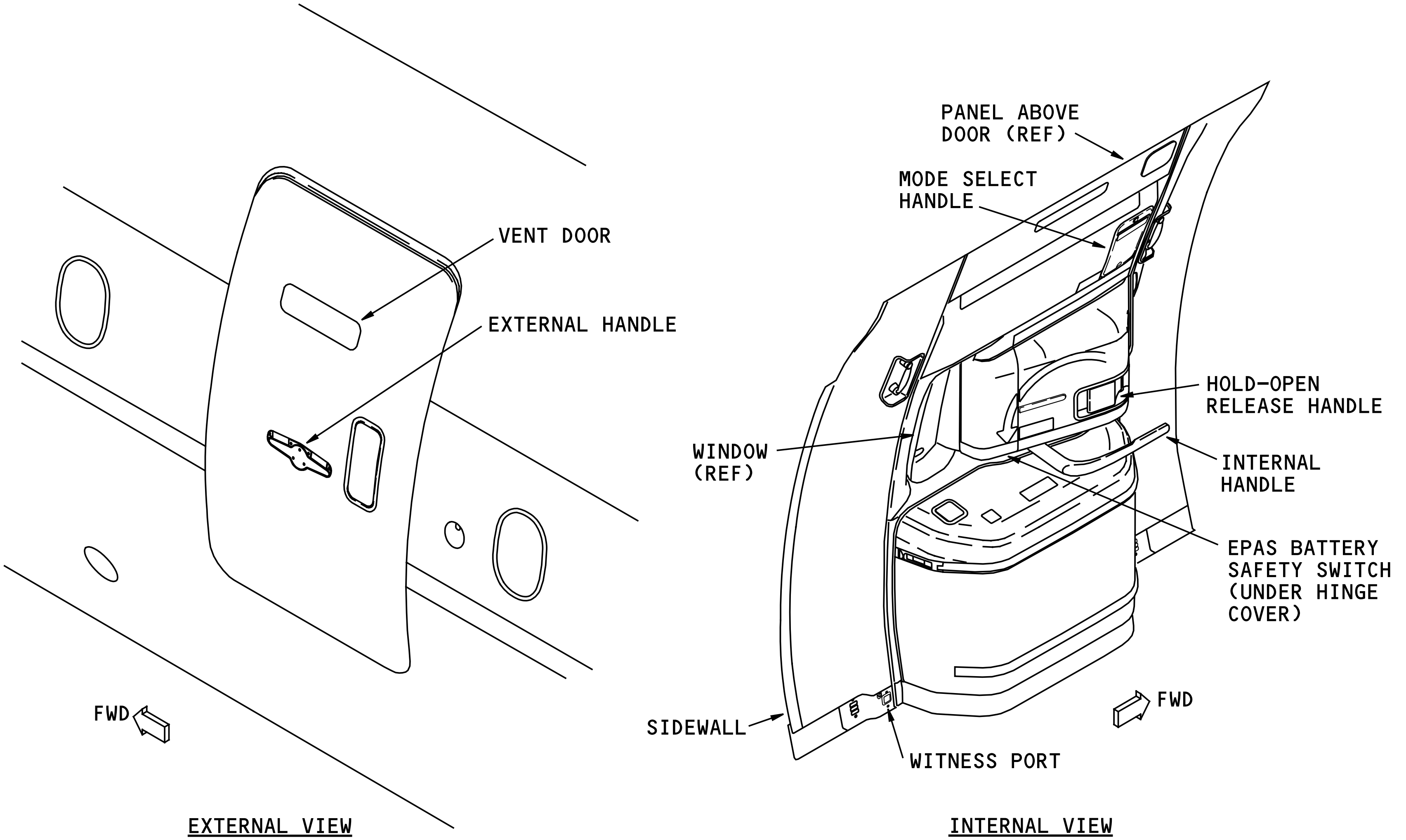
Internal Close Operation

Do a check to see that the door area and girt bar floor fitting are not blocked. Pull on the hold-open release handle to release the door and move the door into the cabin.

Turn the door handle in the close direction. If the handle will not turn to the closed position, do a check of the door system.

Training Information Point

A safety switch on the battery pack lets you stop the EPAS operation when you do door maintenance. You cannot close the hinge cover when the switch is in the safe position.



52-11-00-021 Rev 5 06/19/95

PASSENGER ENTRY DOOR SYSTEM - OPERATION

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PASSENGER ENTRY DOOR SYSTEM - FUNCTIONAL DESCRIPTION

Flight Lock Disengage

Airplane airspeed below 80 knots removes electric power from the flight lock. The flight lock releases the latch mechanism.

Disarm

Forward movement of the mode select lever opens the mode select switch so the emergency power assist system (EPAS) will not operate. It also pulls the push/pull cable. This unlocks the girt bar from the floor fitting and locks it to the girt bar mechanism on the door.

Unlatch

When you pull on the external handle, it connects to the internal handle. The external handle open movement pulls a cable that moves the mode select lever to the disarm position.

Initial movement of either door handle releases the vent door. The vent door opens if the airplane is sufficiently depressurized. The interlock rod pushes down on the interlock roller arm. The interlock roller releases the interlock cam on the latch torque tube.

The latch torque tube turns the latch cranks. The cranks push down on the latch tracks. The secondary lift pushes up on the door attach fitting and lifts the door. The girt bar mechanism interlock turns to stop mode select mechanism movement.

Open

The latch crank rollers move out of the latch tracks. The latch crank interlock locks the cranks.

The door translates open on the hinge. The programming chain keeps the door parallel to the fuselage. The snubber controls the rate of door movement.

When the door is completely open the hold open hook engages the hold open catch.

Close

When you pull on the hold open handle (not shown), the hold open hook releases and the door moves aft.

Either the external or internal handle closes the door. The secondary lift and latch cranks lower the door into the plug position inboard of the cutout stops. The drive rod pushes the vent door closed.

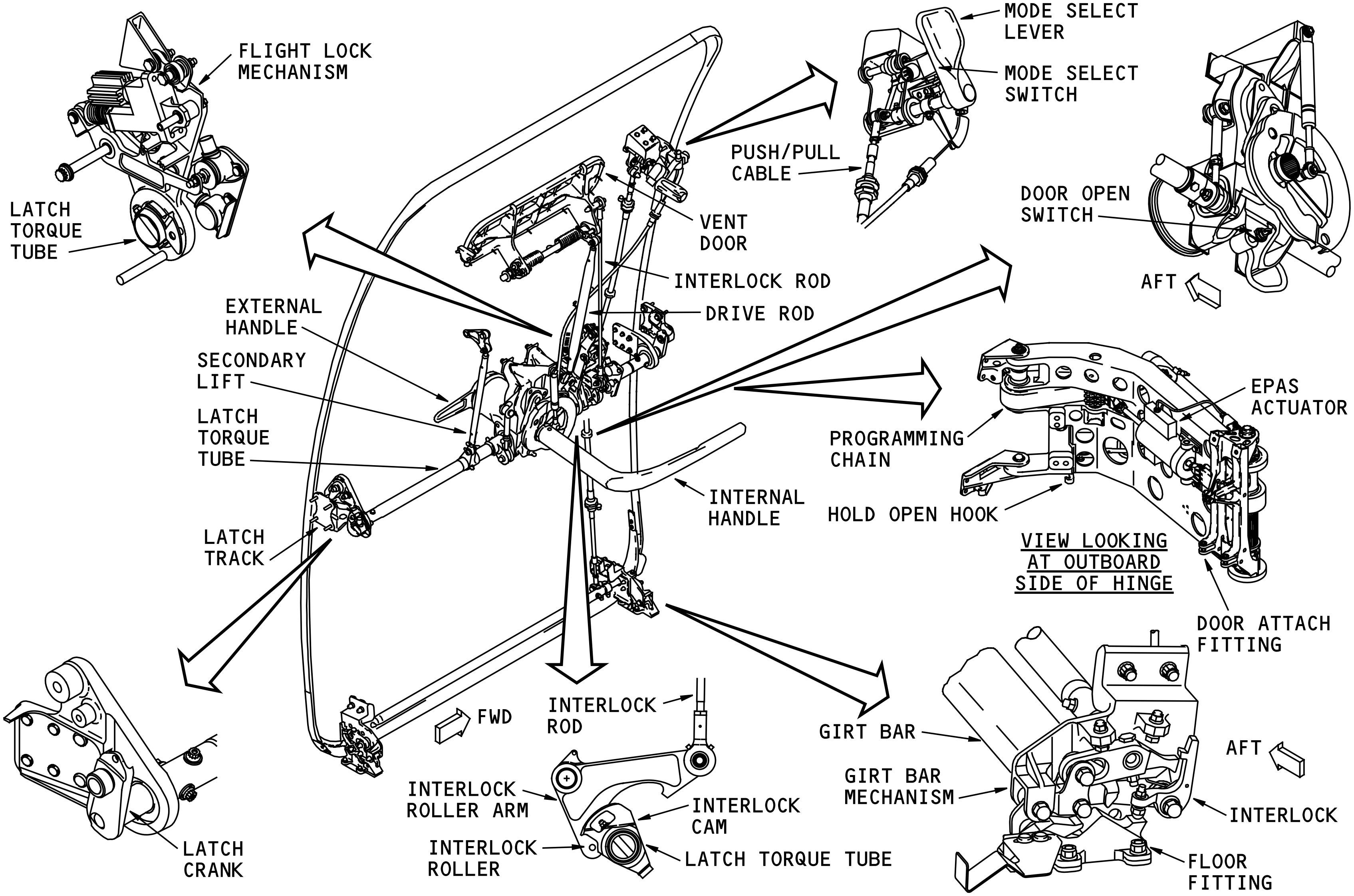
The girt bar mechanism interlock releases the end crank.

Either the external or internal handle closes the door. The secondary lift and latch cranks lower the door into the plug position inboard of the cutout stops. The drive rod pushes the vent door closed.

PASSENGER ENTRY DOOR SYSTEM - FUNCTIONAL DESCRIPTION

Arm

Aft movement of the mode select mechanism lever closes the mode select switch. This arms the EPAS electric power circuit. The movement also releases the girt bar from the girt bar mechanism. The floor fitting assembly locks the bar to the floor.



PASSENGER ENTRY DOOR SYSTEM - FUNCTIONAL DESCRIPTION

Functional Description

The emergency power assist system (EPAS) gets electrical power for its batteries from the same source as the emergency lights power supplies. See the emergency lights section for more information (AMM PART I 33-50).

The battery test circuit does a check of the battery and the position of the safety switch. When you hold the test switch in, the red test indicator light will come on if there is sufficient voltage to ignite the squib and the safety switch is set to ARM.

The safety switch is for maintenance. It disconnects the battery from the circuit to the squib.

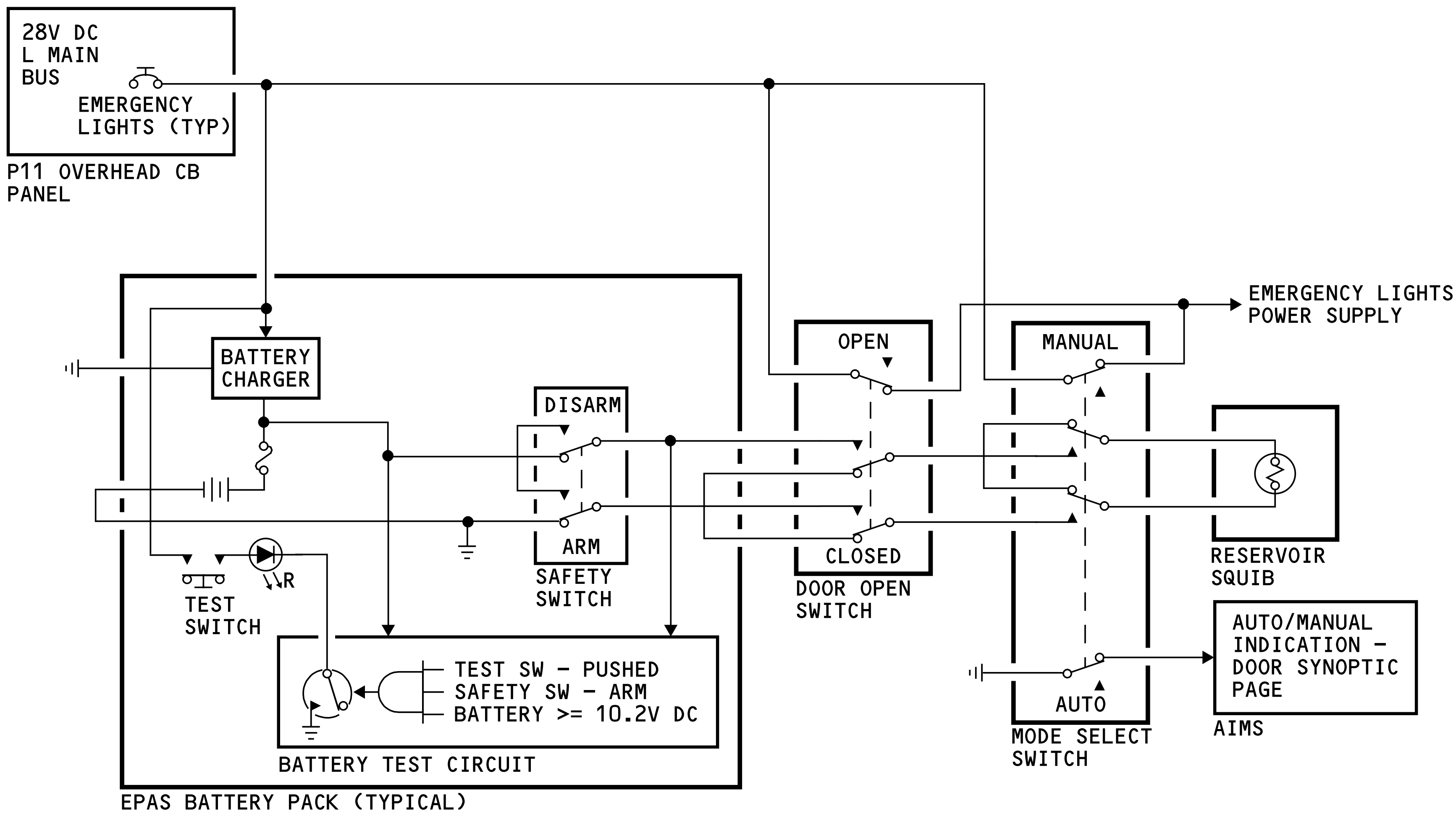
The mode select switch is on the mode select handle on the door. When the handle is in the armed position, the switch is in the auto position. This arms the system.

The door open switch goes to the open position when the internal door handle moves to the door open position. Electrical power goes from the battery to the squib. The squib discharges when it gets power.

Use of the external door handle automatically moves the mode select handle to the disarm position.

The shunts in the door open switch and the mode select switch and the safety switch protect the squib from accidental ignition.

The position of the mode select switch goes to the AIMS to show on the door synoptic display. See the door warning system section for more information about indications (AMM PART I 52-71).



52-11-00-023 Rev 5 11/06/1997

PASSENGER ENTRY DOOR - EMERGENCY POWER ASSIST SYSTEM (EPAS) - FUNCTIONAL DESCRIPTION

PASSENGER ENTRY DOOR SYSTEM - SYSTEM TESTS

General

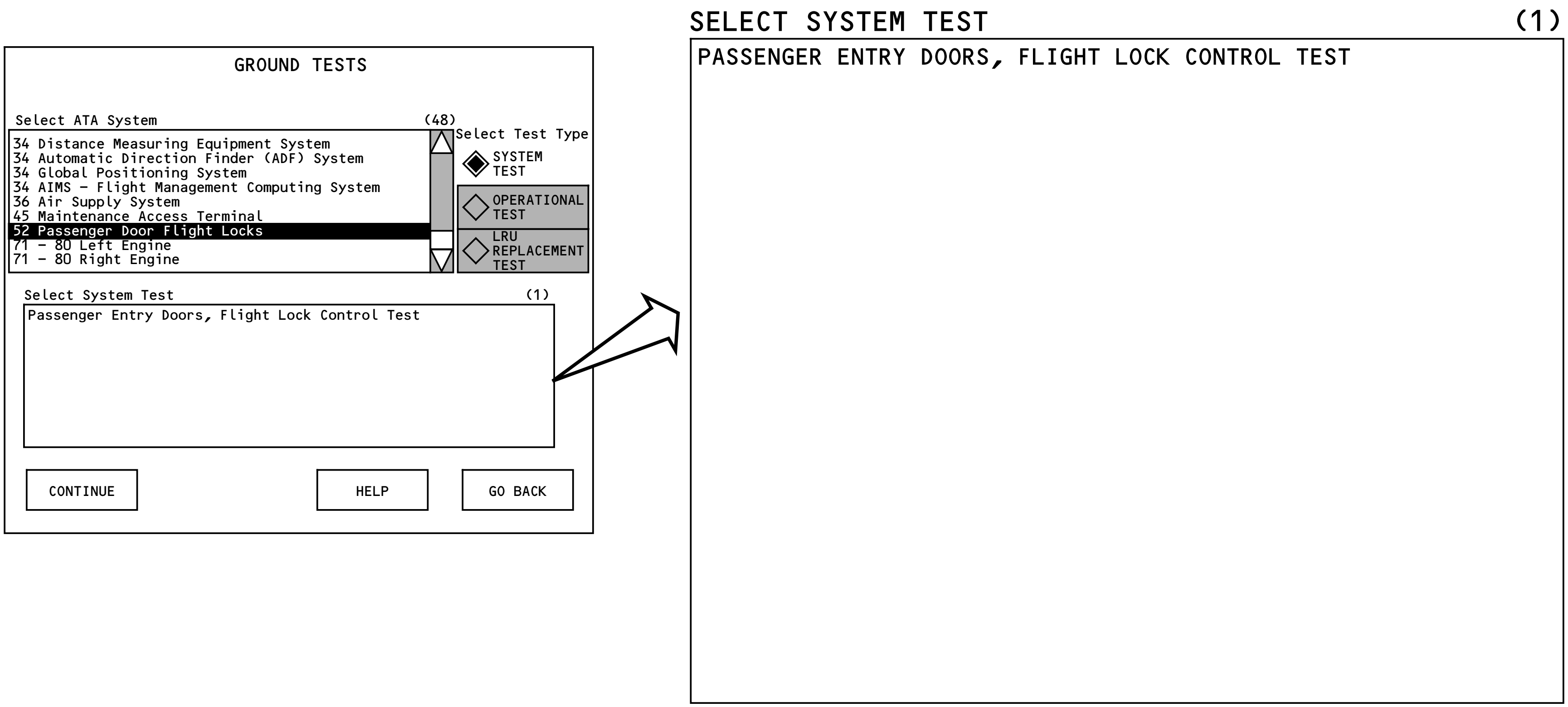
ATA 52 Passenger Door Flight Locks has this systems test:

- Passenger entry doors, flight lock control test.

Passenger Entry Doors, Flight Lock Control Test

In this test, the proximity sensor electronics unit 1 (PSEU 1) sets the flight lock on all the passenger entry doors. See the proximity sensor system section for more information about proximity sensors (AMM PART I 32-08).

You must operate each passenger entry door to make sure that the flight lock is set. When you finish, you must select stop on the MAT or PMAT. No pass/fail shows for this test.



52-11-00-024 Rev 1 09/03/96

PASSENGER ENTRY DOOR SYSTEM - SYSTEM TESTS

DOOR-MOUNTED ESCAPE SYSTEM - GENERAL DESCRIPTION

Purpose

The door-mounted escape system helps passengers and crew get out of the airplane in an emergency. If the airplane lands in water, the slide/rafts disconnect from the airplane and used as life rafts.

General Description

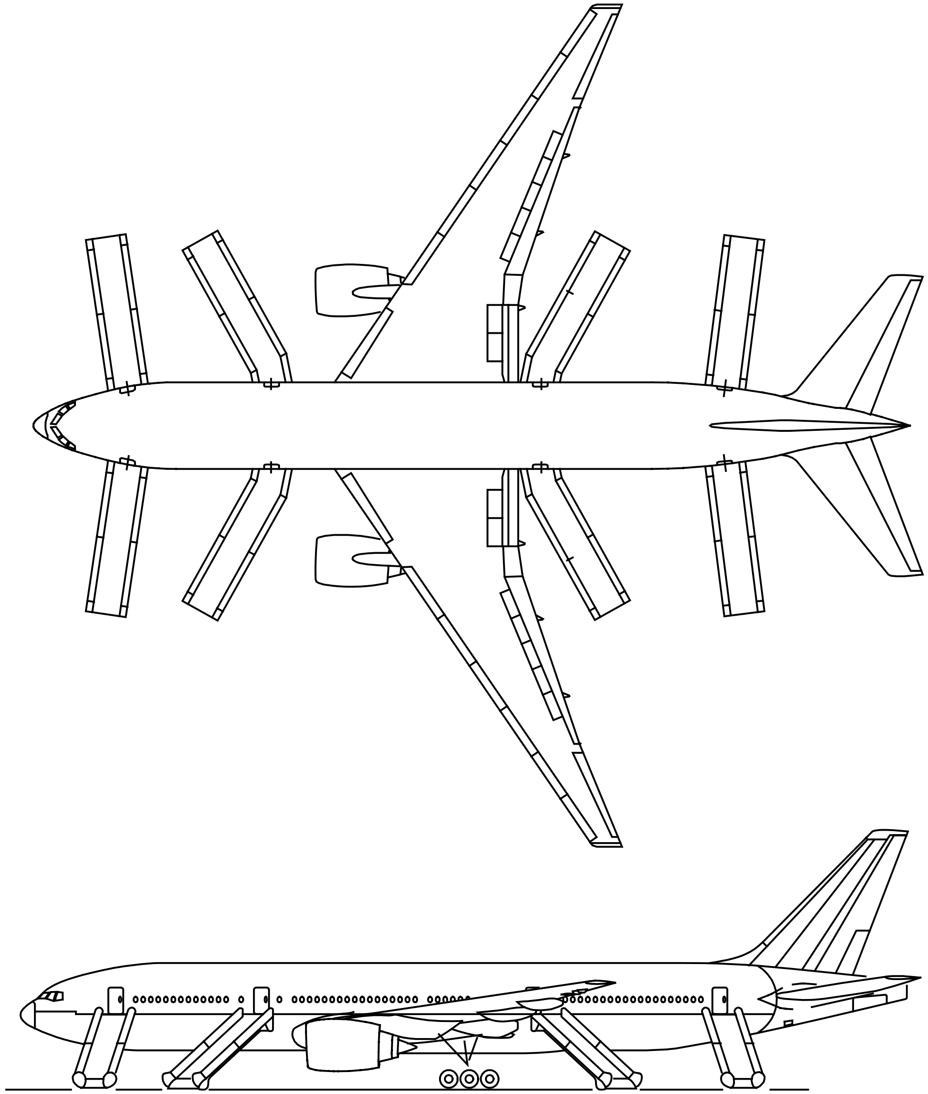
When you arm a door, the girt bar latches in the floor fittings (not shown). The girt bar and floor fittings attach one end of the slide/raft to the airplane floor. When you open the door, the bottom of the escape slide pack opens. The folded slide/raft falls through the door opening. The slide/raft unfolds and inflates automatically in six seconds or less.

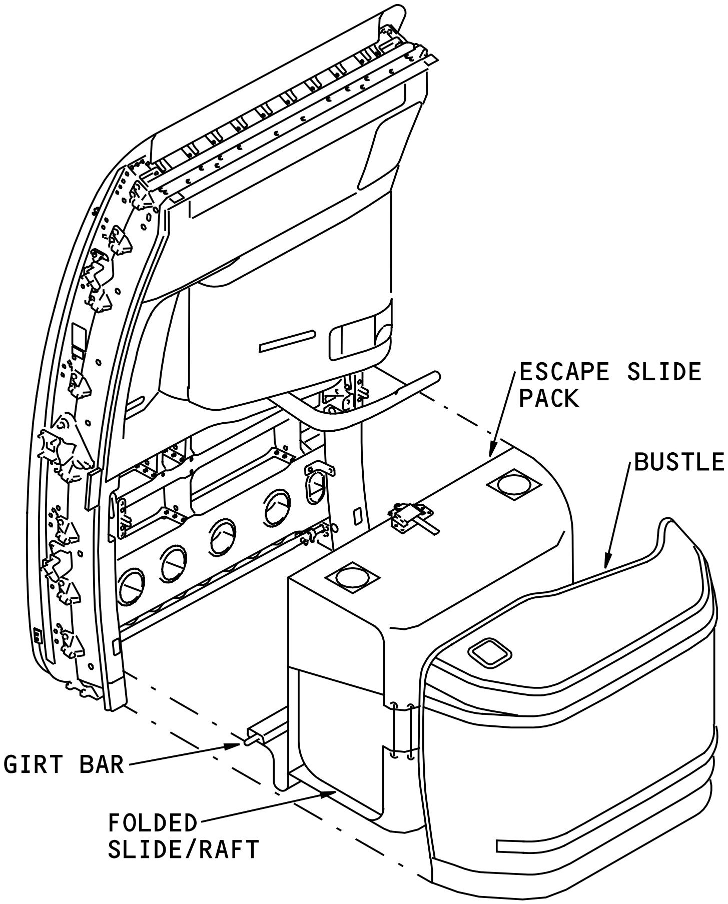
The slide/rafts operate correctly in wind as much as 25 knots. The slide/rafts are safe to use with different door heights caused by the failure of one or more landing gear. The slide/raft has two lanes; two people can use the slide at the same time.

The capacity of the life rafts is sufficient to hold all the passengers and crew, even if one raft is lost.

This equipment (not shown) can be included with each raft:

- Sea anchor
- Mooring line
- Hook knife
- Lighting systems
- Manual inflation pump
- Heaving ring and line
- Survival kit
- Raft canopy
- Emergency locator transmitter (if installed).





DOOR-MOUNTED ESCAPE SYSTEM

DOOR-MOUNTED ESCAPE SYSTEM - GENERAL DESCRIPTION

DOOR-MOUNTED ESCAPE SYSTEM - ESCAPE SLIDE PACK - INTRODUCTION

General

The escape slide pack has two primary parts: the packboard and the slide/raft.

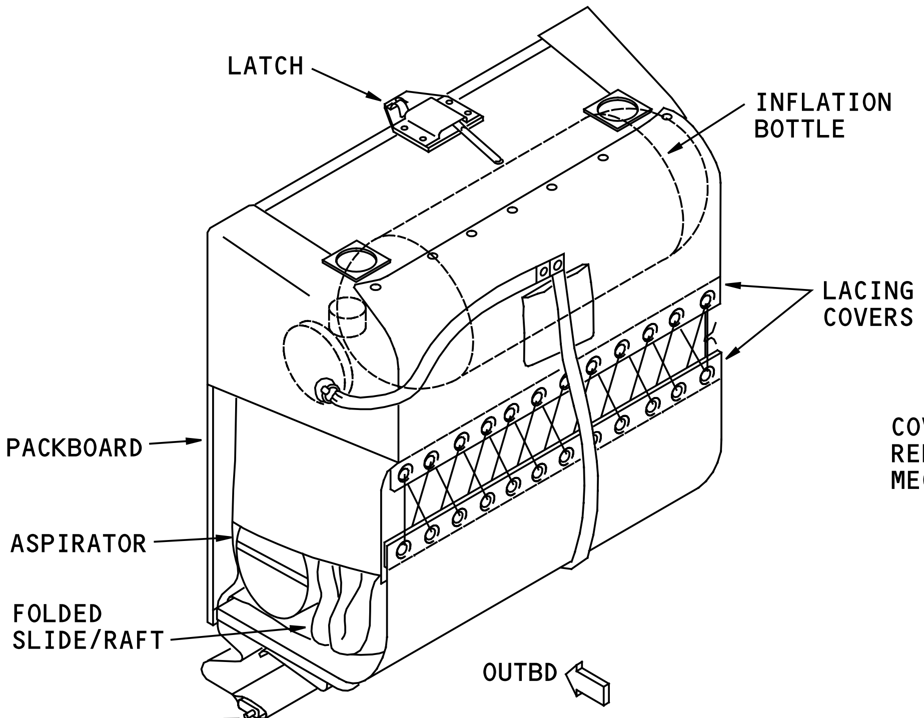
Packboard

The packboard is a composite tray (Kevlar honeycomb) which attaches to the door with two fittings and a latch. Fabric lacing covers hold the folded slide/raft in the packboard until released by the cover release mechanism. When the release mechanism opens, the folded slide/raft falls out of the packboard.

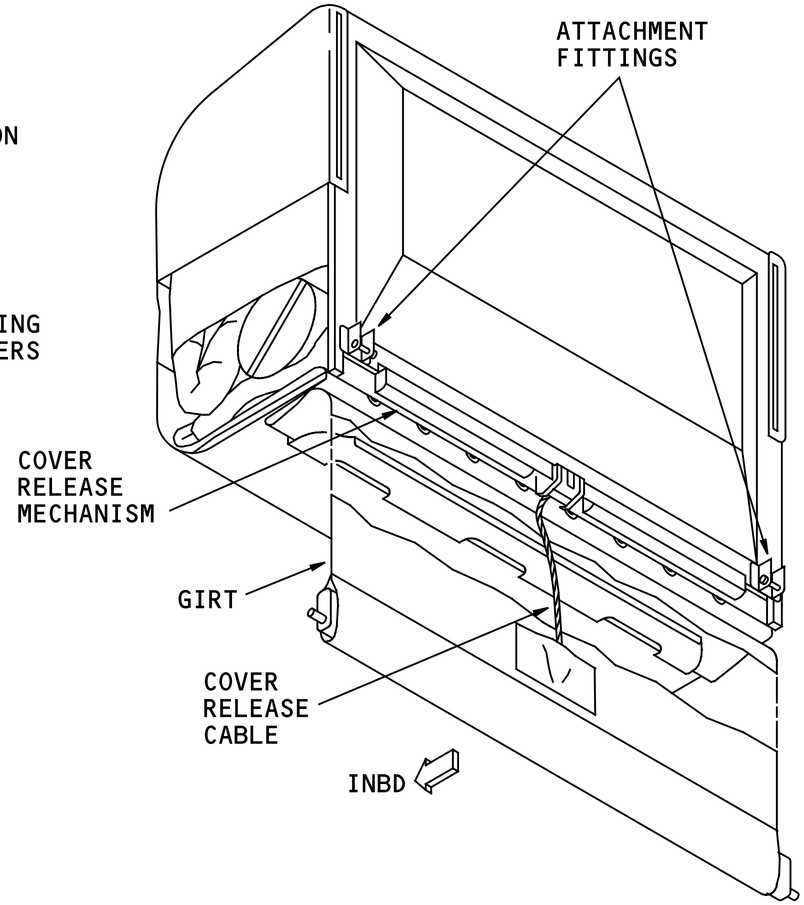
Slide/Raft

The slide/raft is an inflatable structure made of coated Nylon fabric. Upper and lower air chambers support the slide/raft floor. An inflation cylinder and two aspirators inflate the air chambers. A manual handle (not shown) operates the inflation mechanism if the slide/raft fails to inflate automatically. Relief valves (not shown) keep internal pressure to a limit.

The girt and girt bar attach the slide/raft to the airplane doorway. The girt is part of the escape slide. Speed-lacing attaches the girt to the girt bar. After ditching, remove the speed-lacing to release the inflated slide/raft from the airplane.



ESCAPE SLIDE PACK
(INBOARD SIDE)



ESCAPE SLIDE PACK
(OUTBOARD SIDE)

25-66-00-002 Rev 0

DOOR-MOUNTED ESCAPE SYSTEM - ESCAPE SLIDE PACK - INTRODUCTION

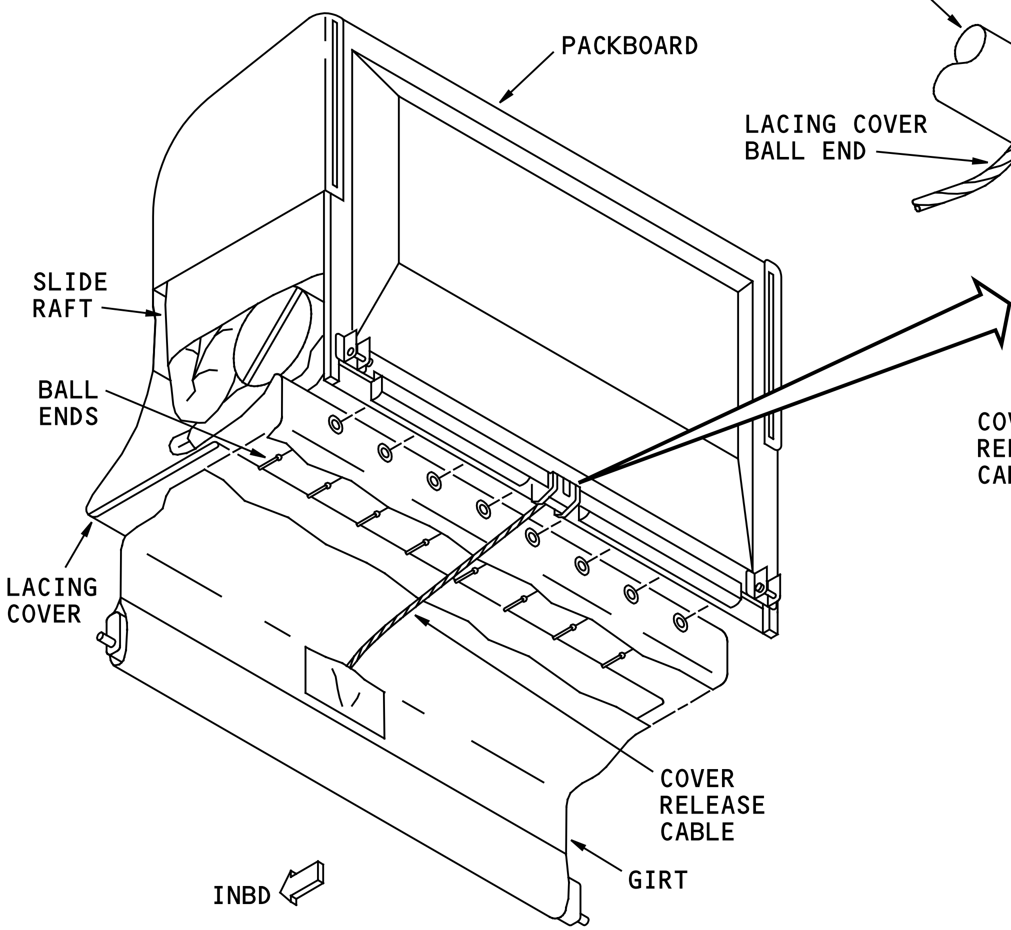
DOOR-MOUNTED ESCAPE SYSTEM - ESCAPE SLIDE PACK - PACKBOARD FUNCTIONAL DESCRIPTION

Cover Release

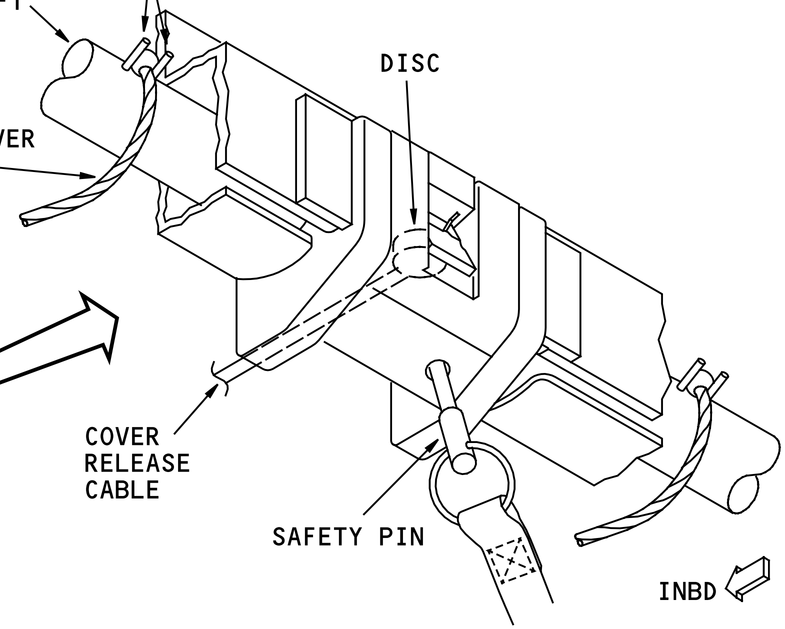
Tension on the girt pulls on the cover release cable. The cable disengages the disc from the release mechanism. The shaft rotates and causes the pins to release the lacing cover ball ends. With the bottom of the lacing cover released from the packboard, the folded slide/raft falls away from the packboard.

Training Information Point

A lanyard attaches a safety pin to the lacing cover. Install the pin to lock the release mechanism during removal or installation of the escape slide pack. When you return the airplane to its usual condition, be sure to remove the pin from the release mechanism. The inboard side of the lacing cover has a stowage pouch for the pin.



ESCAPE SLIDE PACK



LACING COVER RELEASE MECHANISM

25-66-00-003 Rev 0

DOOR-MOUNTED ESCAPE SYSTEM - ESCAPE SLIDE PACK - PACKBOARD FUNCTIONAL DESCRIPTION

DOOR-MOUNTED ESCAPE SYSTEM - ESCAPE SLIDE PACK - SLIDE/RAFT FUNCTIONAL DESCRIPTION

Slide/Raft Inflation

The inflation cylinder holds a mixture of carbon dioxide and nitrogen at 3000 psig. A gage shows how much pressure is in the cylinder. A pressure relief valve protects the cylinder from excessive pressure. The relief valve opens at 4500 psig. A fusible plug protects the inflation cylinder from high temperatures. The plug opens at 174F (79C).

Tension on the inflation cable rotates the inflation valve to the open position. The pressure regulator (internal) reduces the pressure to 550 psig. Gas flows through the hoses, check valves, aspirator nozzles, then into the slide raft air chambers.

The gas flow through the aspirator nozzle creates a venturi effect in the aspirator. The flapper valve opens and ambient air flows through the aspirator to help inflate the slide/raft.

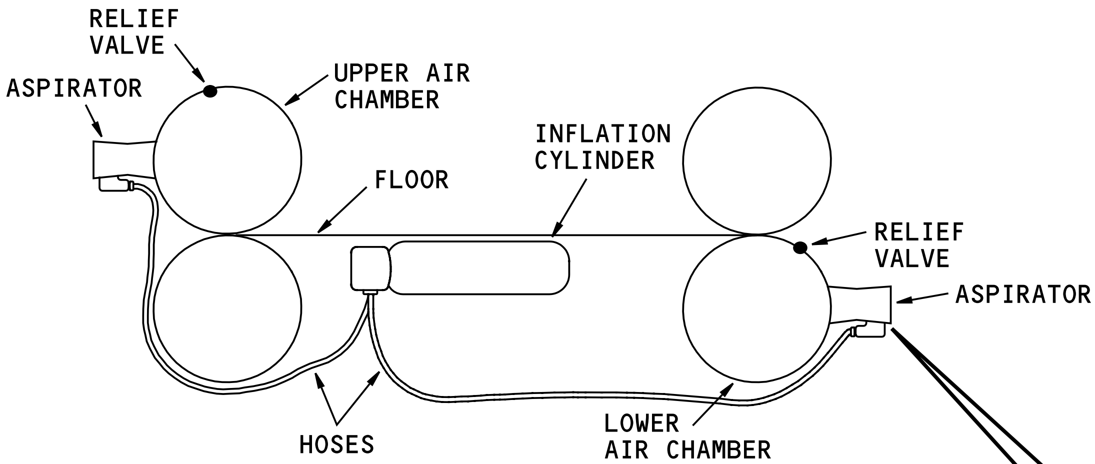
When pressure inside the slide/raft reaches a specified value, the flapper valves close. Gas continues to flow from the cylinder into the slide raft. When the slide/raft is at the correct operating pressure (2.6 psig), relief valves open to prevent overpressurization.

Training Information Point

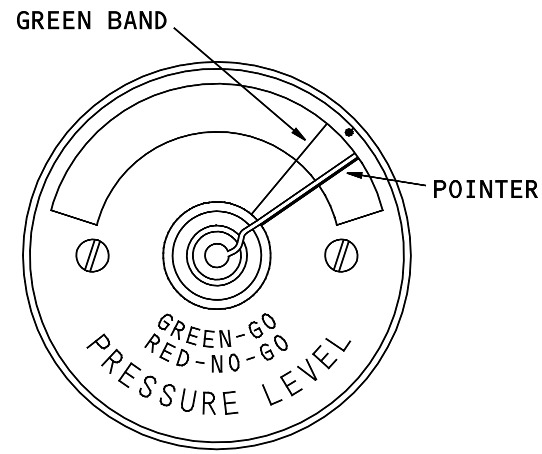
Hold the aspirator flapper valves open to deflate the slide/raft after an inflation test.

You must install the safety pin to lock the inflation valve during removal or installation of the escape slide pack. When you return the airplane to its usual condition, be sure to remove the pin from the valve. The slide pack lacing cover has a stowage pouch for the pin.

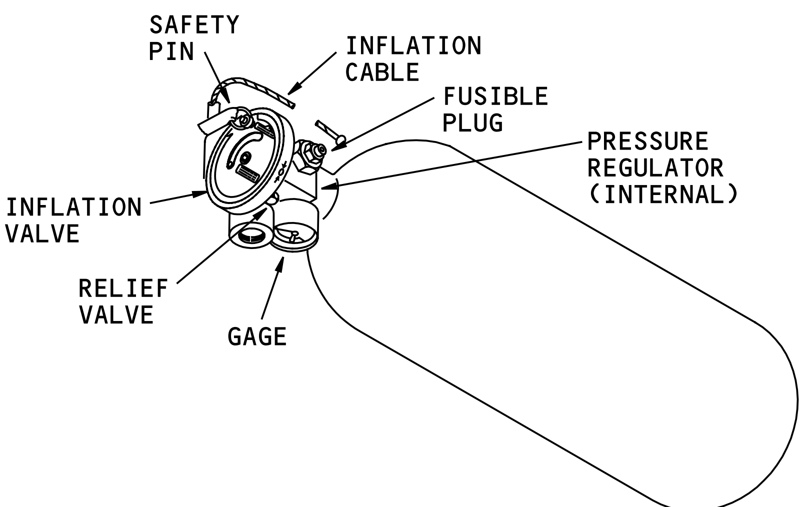
The pressure gage makes allowance for temperature changes. The pointer moves with pressure changes. The green band moves with temperature changes. If the pointer is within the green band, the cylinder pressure is correct for the cylinder temperature.



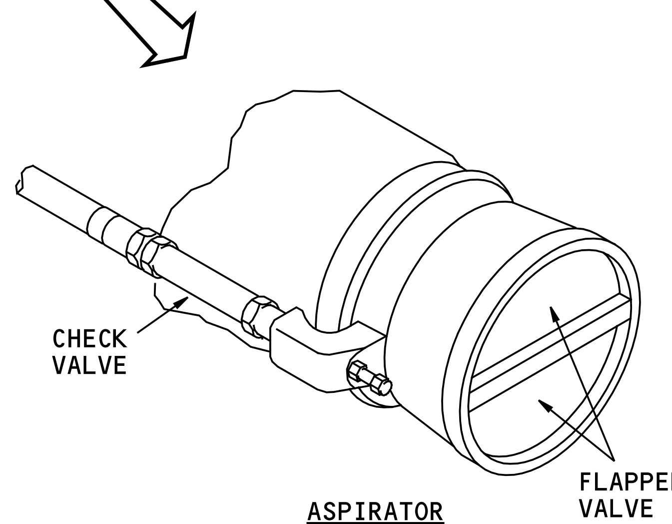
INFLATED SLIDE/RAFT CROSS SECTION
(SCHEMATIC)



PRESSURE GAGE



INFLATION CYLINDER



ASPIRATOR

25-66-00-004 Rev 0

DOOR-MOUNTED ESCAPE SYSTEM - ESCAPE SLIDE PACK - SLIDE/RAFT FUNCTIONAL DESCRIPTION

DOOR-MOUNTED ESCAPE SYSTEM - BUSTLE

Purpose

The bustle is the door lower liner. It is a cover for the slide/raft and makes the installation look good.

Physical Description

The bustle is a crushed core shell covered on both sides with graphite composite. Tedlar laminate covers the inboard side. A window in the bustle lets you see the slid pack pressure gauge. Rubstrips protect the bustle from galley service carts.

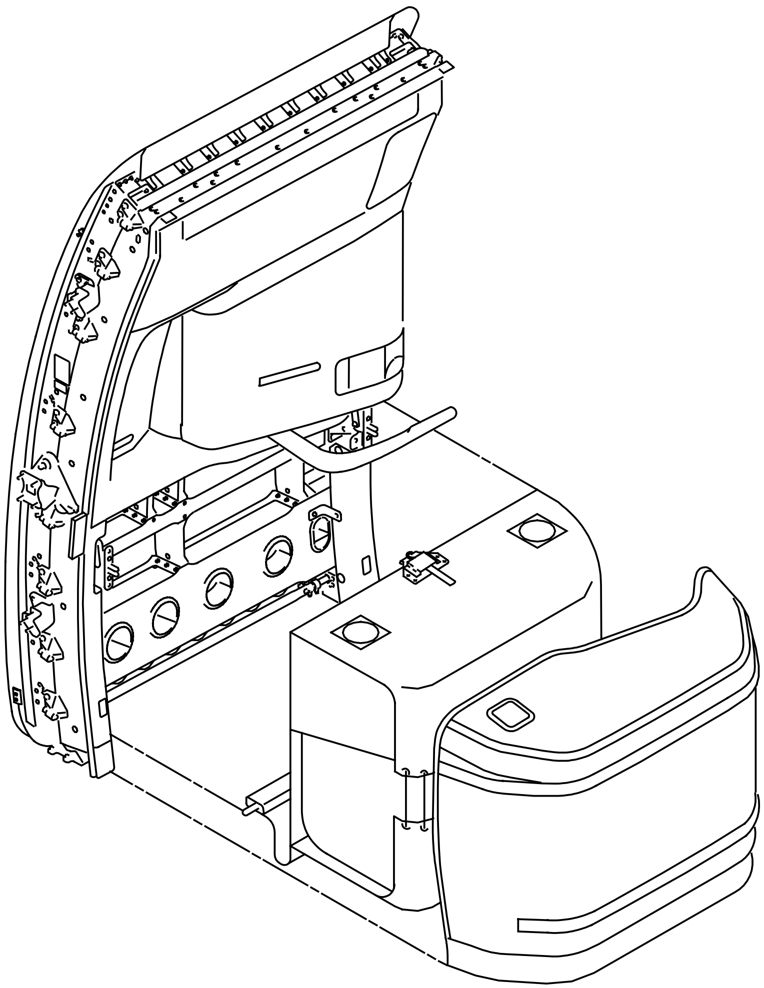
Two latches hold the top of the bustle to the door. The latches have a hinge which allows the bottom of the bustle to move inboard. Alignment fittings hold the bottom of the bustle in position against the door.

Functional Description

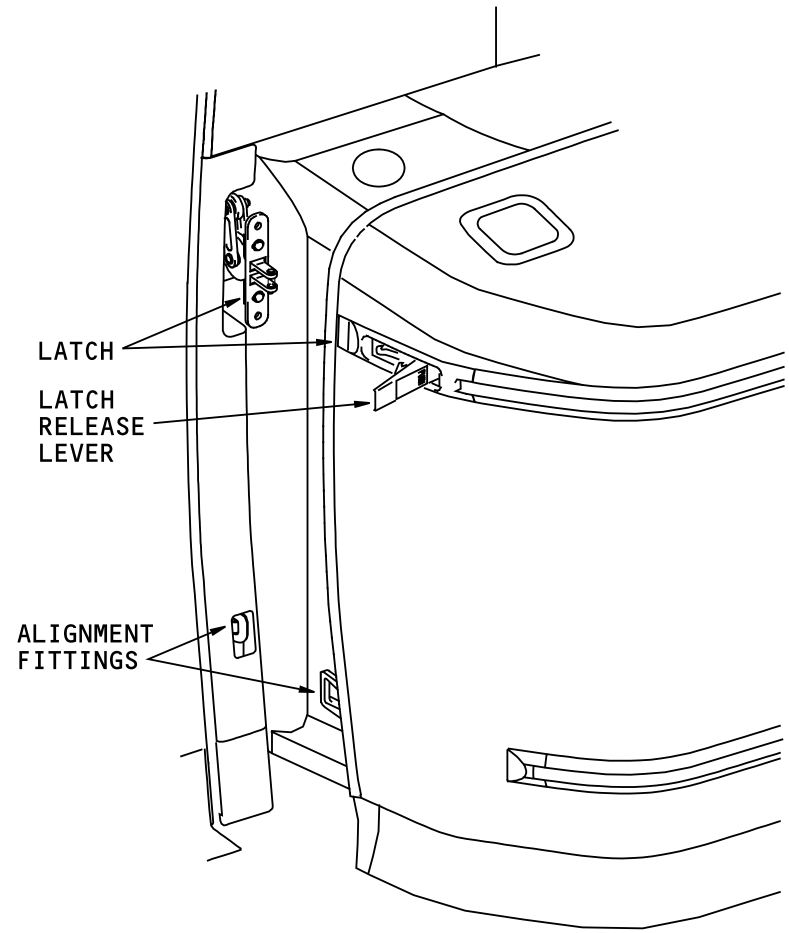
When the door opens in the armed mode, the escape slide girt puts pressure on the bottom edge of the bustle. The alignment fittings at the bottom of the bustle click open. This permits the door to continue opening while the escape slide drops.

Training Information Point

Release the alignment fittings and latches to remove the bustle from the door. Pull the bottom of the bustle inboard to release the alignment fittings. Open the levers to release the latches at the top of the bustle.



DOOR-MOUNTED ESCAPE SYSTEM



BUSTLE

25-66-00-005 Rev 0

DOOR-MOUNTED ESCAPE SYSTEM - BUSTLE

DOOR-MOUNTED ESCAPE SYSTEM - FUNCTIONAL DESCRIPTION - DEPLOYMENT

Door Handle Moved to the Open Position

When you put the door mode selector in the armed position, the girt bar locks in the floor fittings. When you move the door handle to the open position, the door unlatches. The emergency power assist system (EPAS) starts to open the door. See the passenger entry doors section for more information on the EPAS (AMM PART I 52-11).

Tension on the Cover Release Cable

When the door opens far enough to put tension on the cover release cable, this sequence occurs:

- Tension at the girt clicks the bustle open
- The door continues to move open
- The cover release cable pulls free of the release mechanism, so it can open
- The lower lacing cover releases from the packboard
- The escape slide pack falls from the packboard.

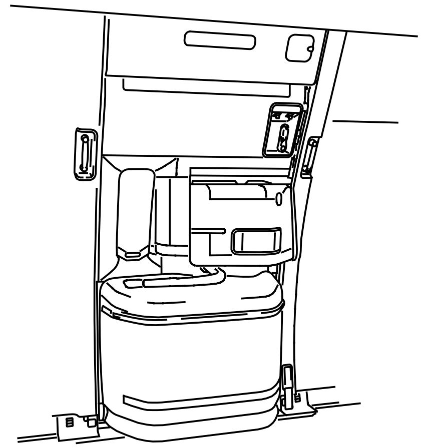
Tension on the Slide Inflation Cable

When the escape slide pack falls from the packboard, the weight of the pack applies tension to the slide inflation cable. This sequence occurs:

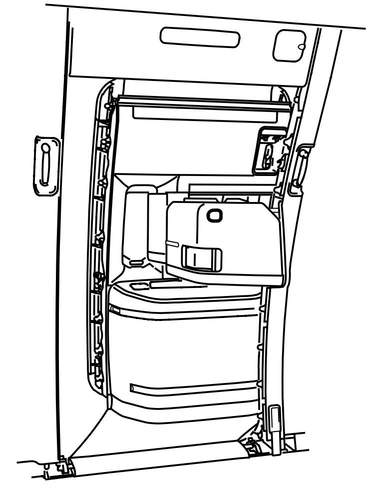
- Tension on the inflation cable opens the inflation cylinder valve
- The inflation cylinder uses air from the aspirators to inflate the slide.

Manual Inflation

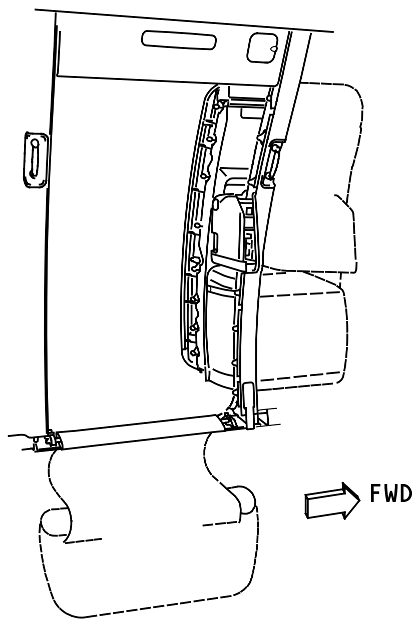
Sometimes the slide pack hits the ground or water before it falls far enough to apply tension to the inflation cable. If that happens the slide does not inflate automatically. A handle on the girt end of the inflation cable lets you open the inflation valve manually. Pull the handle to inflate the slide.



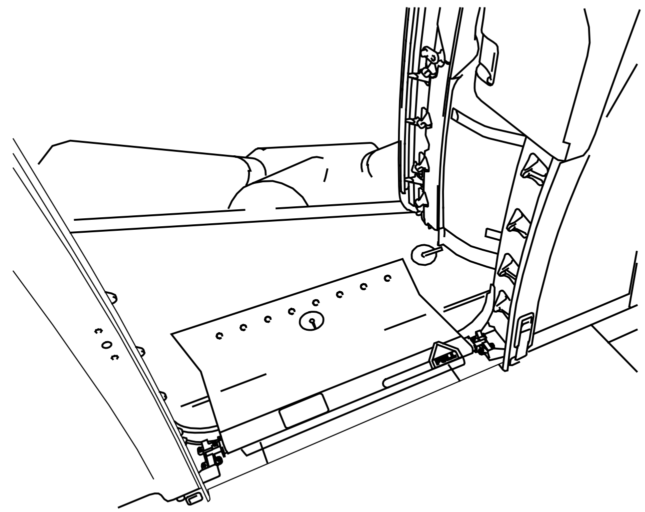
DOOR HANDLE MOVED TO OPEN



TENSION ON COVER RELEASE CABLE



TENSION ON SLIDE INFLATION CABLE



INFLATED SLIDE/RAFT

25-66-00-006 Rev 2

DOOR-MOUNTED ESCAPE SYSTEM - FUNCTIONAL DESCRIPTION - DEPLOYMENT

DOOR-MOUNTED ESCAPE SYSTEM - FUNCTIONAL DESCRIPTION - SEPARATION

General

During ditching, when passengers and crew are aboard the rafts, the rafts must move away from the airplane.

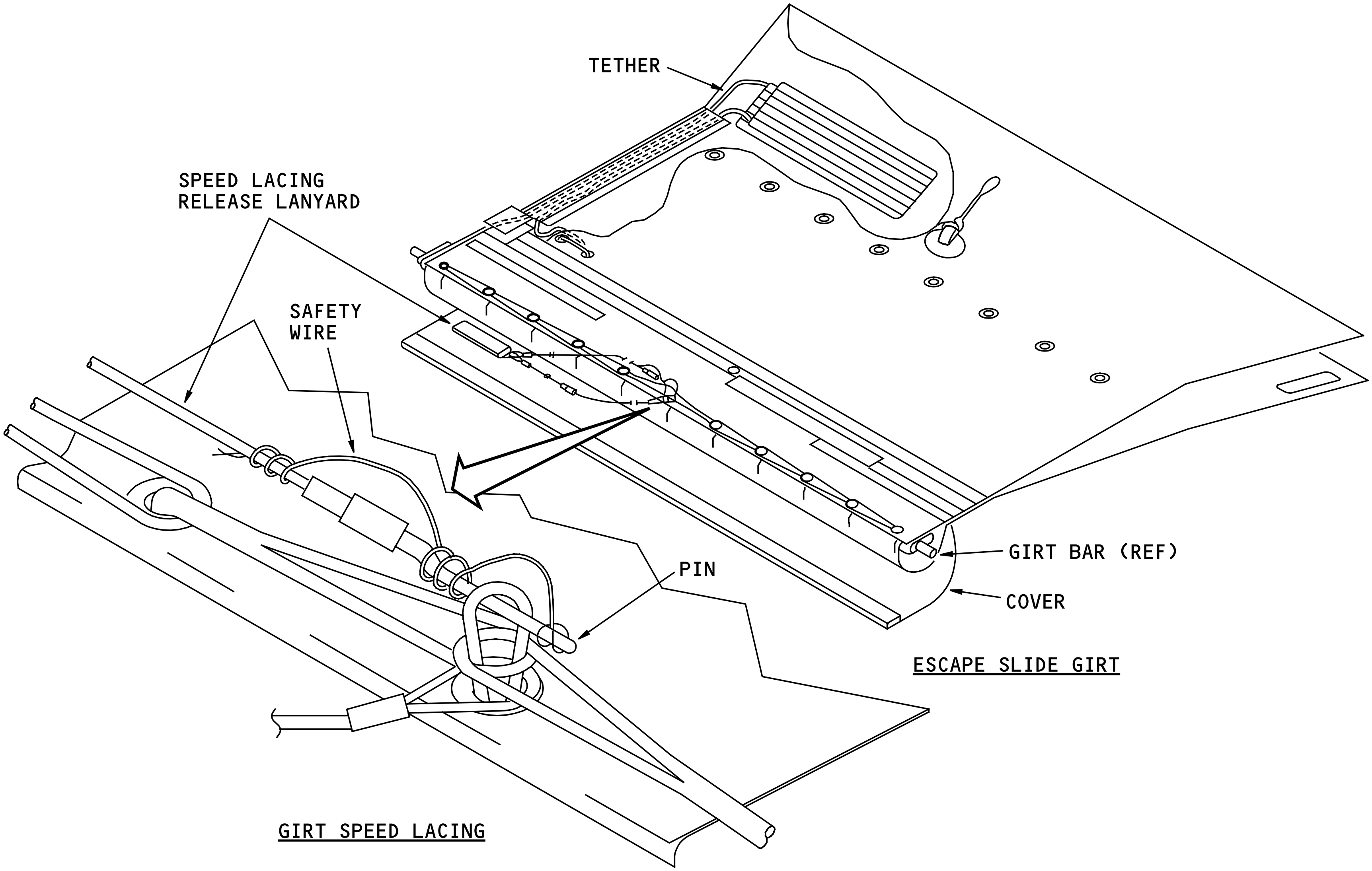
The slide raft girt attaches to the girt bar with speed lacing. Open the cover at the girt and pull the lanyard. This removes the pin and releases the speed lacing so the slide/raft can move away from the airplane. The girt bar stays attached to the airplane.

A tether stowed in the girt keeps the raft attached loosely to the airplane. A hook knife is in the raft to cut the tether when necessary.

Training Information Point

After an inflation test, remove the slide/raft from the airplane this way:

- Support the girt end of the slide/raft
- Remove the girt bar from the floor fittings
- Lower the girt end of the slide/raft to the floor.



25-66-00-007 Rev 0

DOOR-MOUNTED ESCAPE SYSTEM - FUNCTIONAL DESCRIPTION - SEPARATION

CARGO DOORS - INTRODUCTION

Purpose

Cargo doors give access to the forward, aft, and bulk cargo compartments.

Location

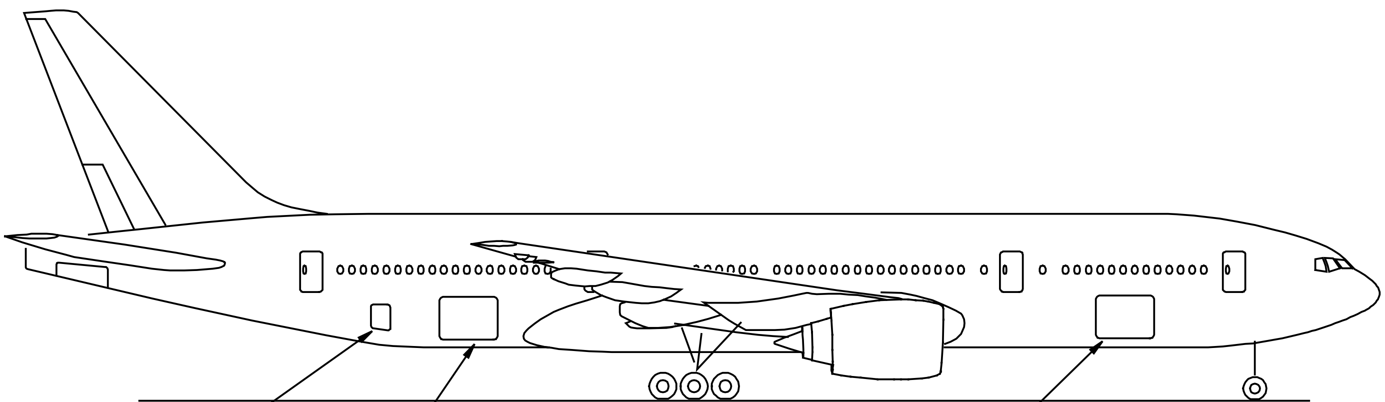
The cargo doors are on the right side of the airplane.

General Description

The forward and aft large cargo doors are the same.

The forward and aft cargo doors lets the crew load cargo on pallets and in containers.

The bulk cargo door lets the crew load smaller cargo that is not on pallets or in containers.



52-30-00-001 Rev 2 11/06/1997

CARGO DOORS - INTRODUCTION

FORWARD LARGE CARGO DOOR SYSTEM - INTRODUCTION

Purpose

The forward large cargo door system gives access to the forward cargo compartment.

Location

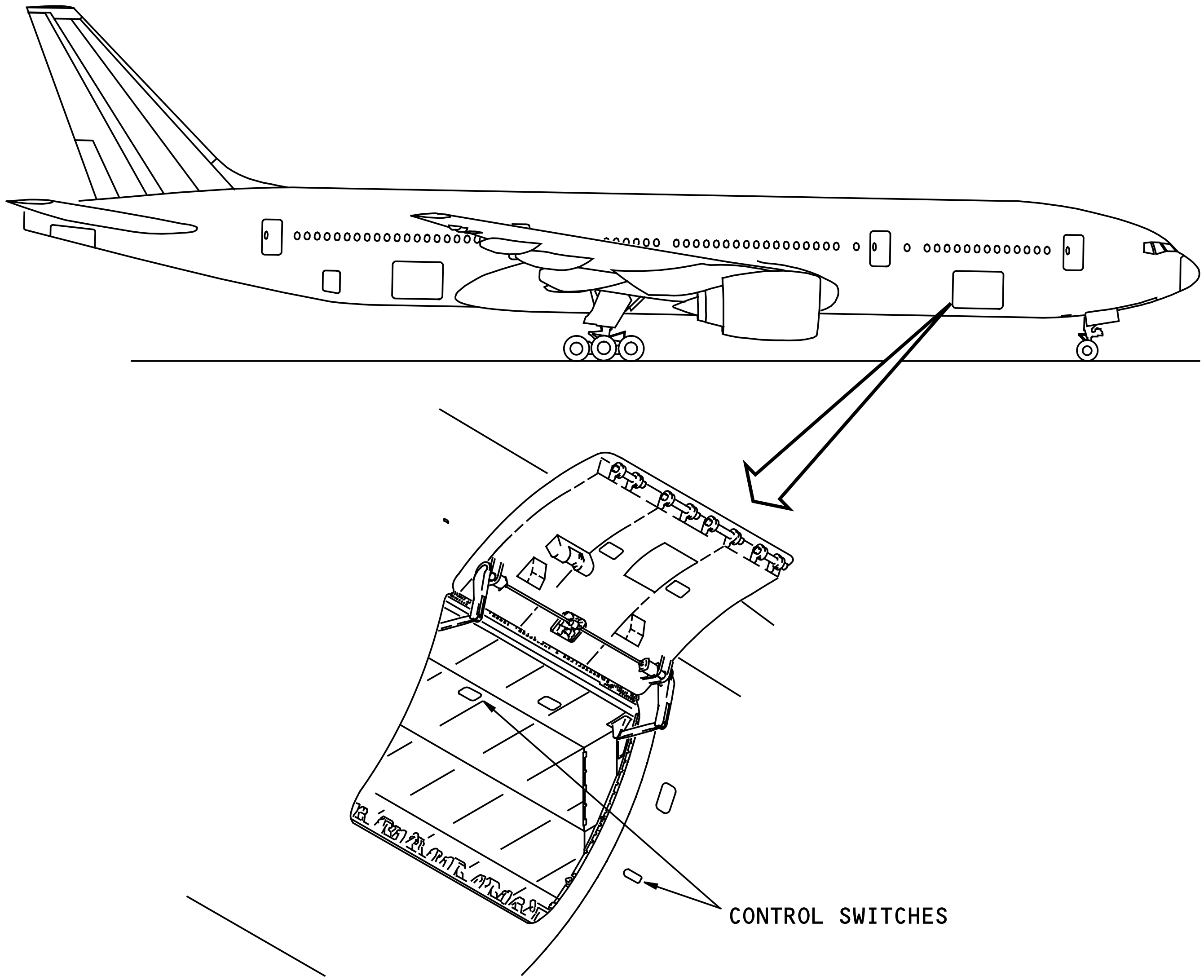
The door is forward of the wing on the right side of the airplane.

General Description

The large cargo door supplies a clear opening of 106 inches (269.2 cm) wide and 67 inches (170.2 cm) high. The dimensions of the door lets cargo handlers load and unload pallets and containers. The aft cargo door is the same.

The door is a non-plug type of door. Door latches hold the door closed against cabin pressure loads.

The door opens outward and upward. You can operate it electrically from inside or outside the cargo compartment. You can operate it manually from outside the cargo compartment.



FORWARD LARGE CARGO DOOR SYSTEM - INTRODUCTION

FORWARD LARGE CARGO DOOR SYSTEM - COMPONENT LOCATIONS - 1

Components on the Outside of the Door

The lift manual drive sockets are on the upper, forward corner of the door.

The lock handle is on the lower half of the door, near the center. You can see the latch manual drive socket when you release the handle to the open position.

There are eight witness ports along the bottom edge of the door.

There are three sling attach points.

There are seven component access panels.

Training Information Point

Use the lock handle to lock and unlock the door. It connects to the lock mechanism on the inside of the door. Also, you enable electrical operation of the door when you release the lock handle.

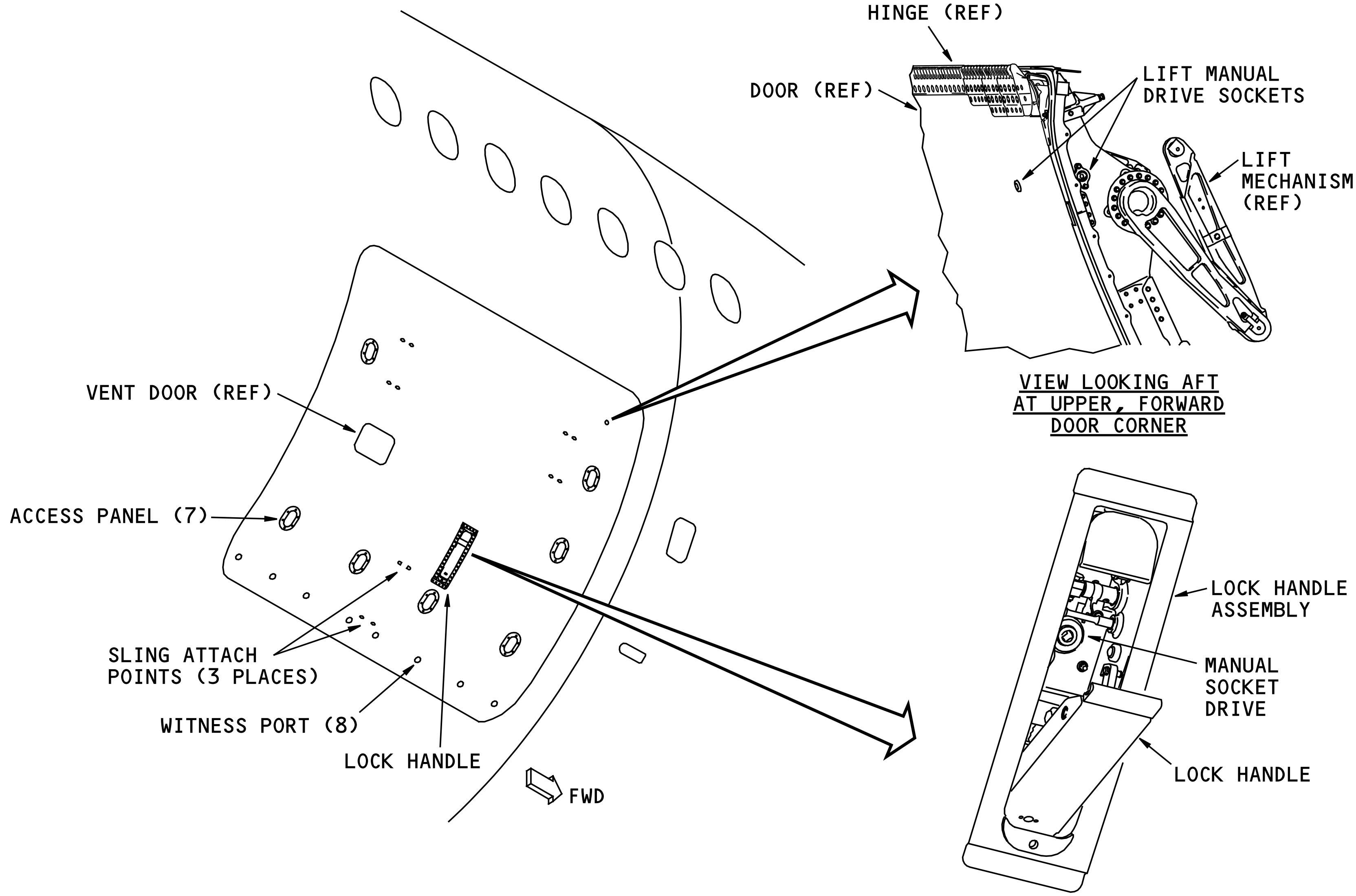
The latch manual drive socket is for manual operation of the latch cams and pull-in hooks. It connects to the latch manual drive on the inside of the door.

The lift manual drive sockets are for manual operation of the lift mechanism. They connect to the lift manual drive on the inside of the door.

The witness ports let you make sure the door is latched and locked.

The sling attach points let you sue a sling to lift the door for removal and replacement. It also lets you lift the door open if the lift mechanism fails.

The access panels give access to failed components if the cargo door is not open.



52-34-00-002 Rev 0

FORWARD LARGE CARGO DOOR SYSTEM - COMPONENT LOCATIONS - 1

FORWARD LARGE CARGO DOOR SYSTEM - COMPONENT LOCATIONS - 2

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52-34-00-003 Rev 1 11/06/1997

FORWARD LARGE CARGO DOOR SYSTEM - COMPONENT LOCATIONS - 2

Components on the Inside of the Door

The two lift mechanisms are near the upper forward and the upper aft corners of the cargo door.

The two rotary actuators are near the upper, forward and the upper, aft corners.

The lift manual drive is near the upper, forward corner.

The lift power unit is located near the top, center of the door.

The vent door is near the horizontal mid line of the cargo door, near the aft edge.

The two pull-in hooks are at the forward and aft edges.

The vent door mechanism goes from the vent door to the lock mechanism lock pawl on the aft latch cam.

The latch mechanism goes from the latch/hook power unit to the pull-in hooks and latch cams.

The latch power unit is on the lower part of the door, near the center.

Eight main latch cams are near the bottom of the door.

The lock mechanism goes from the lock handle to lock pawls on the eight main latch cams at the bottom of the door. The mechanism also goes to the vent door interlock.

The lock handle assembly is near the center of the cargo door.

The latch manual drive is goes from the lock handle assembly to the latch/hook power unit.

The graphic does not show the location of the proximity sensors that do control functions. Their locations are shown at the component level.

General Description

This section describes the function of the components on the inside of the door as the door goes from the fully open position to the closed, latched, and locked position.

The motor in the lift power unit supplies the torque to lower the door. Torque can also come from the lift manual drive. The torque goes to the rotary actuators. The torque goes from the rotary actuators to the lift mechanism. The lift mechanism lowers the door.

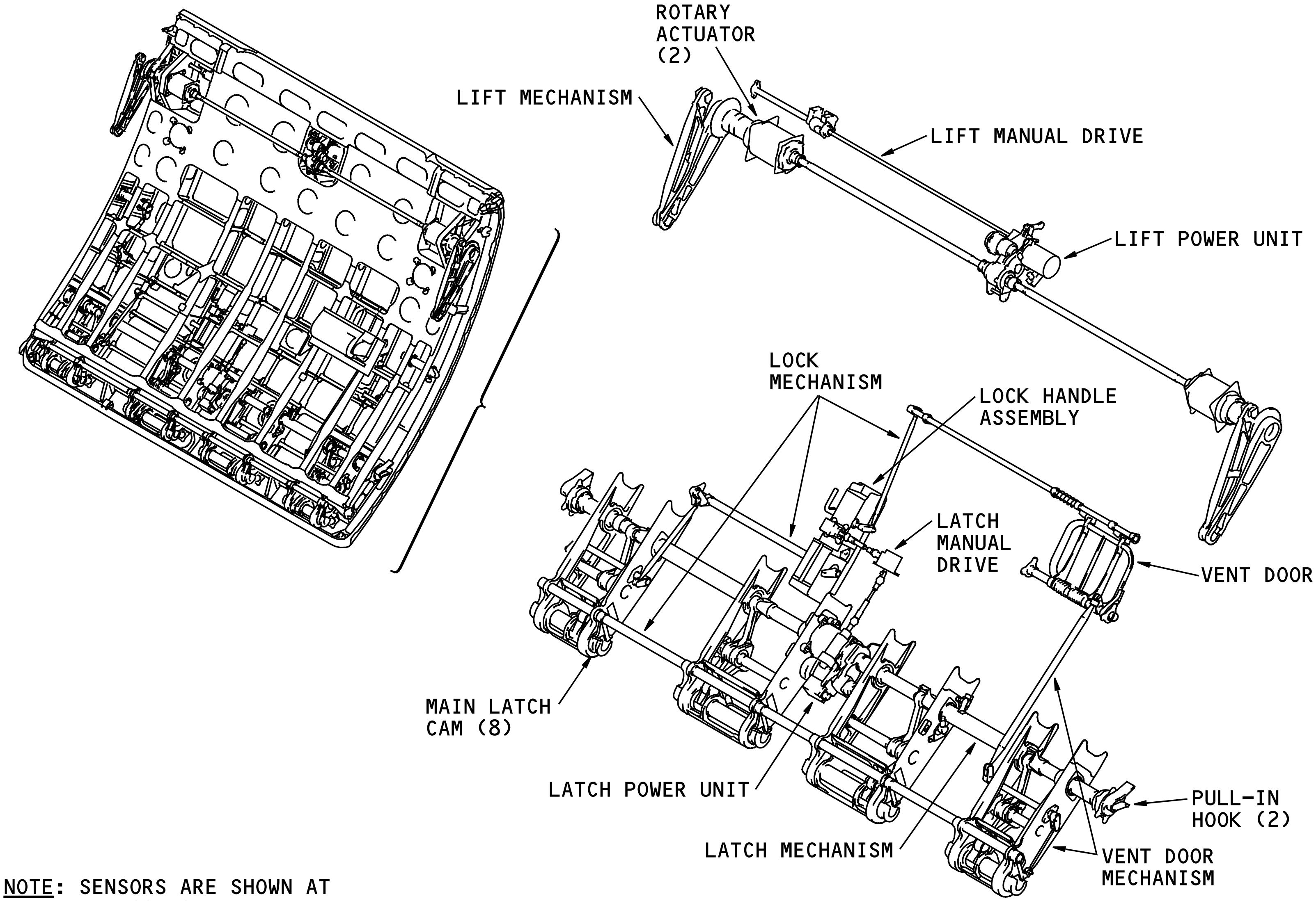
Electric power shifts from the lift power unit to the latch power unit when a proximity sensor senses the door is completely lowered. Torque goes from the latch power unit to the pull-in hooks. Movement of the pull-in hooks around the pull-in pins on the door cutout, pulls the door into the latch position.

FORWARD LARGE CARGO DOOR SYSTEM - COMPONENT LOCATIONS - 2

After the door is pulled in, torque goes from the latch power unit to all of the latch cams. The cams turn around the latch pins. This latches the door. When a proximity sensor senses the door is latched, electric power is removed from the power unit.

Movement of the lock handle on the outside of the door to the lock position, locks the door. The lock action causes these actions to occurs on the inside of the door:

- Proximity sensors cause electric door operation to be disabled
- The lock mechanism locks the main latch cams at the bottom of the door
- The lock mechanism holds the vent door closed.



NOTE: SENSORS ARE SHOWN AT THE COMPONENT LEVEL.

52-34-00-003 Rev 1 11/06/1997

FORWARD LARGE CARGO DOOR SYSTEM - COMPONENT LOCATIONS - 2

FORWARD LARGE CARGO DOOR SYSTEM - COMPONENT LOCATIONS - 3

Components on the Door Cutout

The hinge is along the top of the door cutout.

The two pull-in pins are on the forward and aft side of the door cutout.

Eight main latch pins are along the bottom of the door cutout.

Components near the Door Cutout

The internal door control switch is in the cargo compartment ceiling, near the forward end of the door cutout.

The P43, external cargo door control panel is forward of the door cutout.

General Description

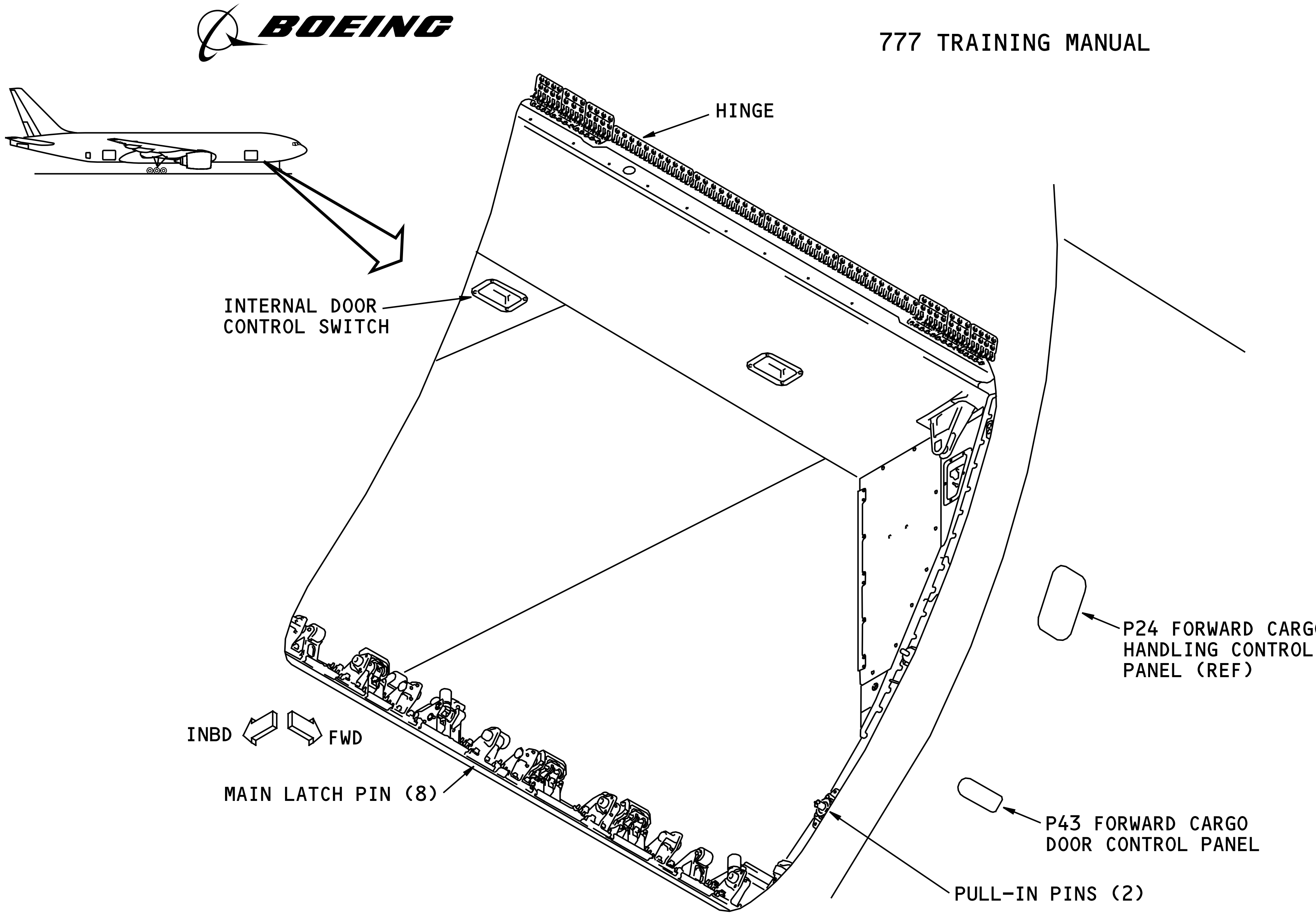
The door rotates on the hinge as it opens and closes.

The pull-in hooks on the door engage the pull-in pins to pull the door into position where it can be latched.

The latch cams on the side and bottom of the door turn around the latch pins to latch the door.

Training Information Point

The internal cargo door control switch and the door control switch on the P43, external cargo door control panel, let you operate the door electrically.



VIEW LOOKING INTO CARGO COMPARTMENT
(DOOR REMOVED)

FORWARD LARGE CARGO DOOR SYSTEM - COMPONENT LOCATIONS - 3

FORWARD LARGE CARGO DOOR SYSTEM - LIFT POWER UNIT

Purpose

The lift power unit supplies the power to open and close the door.

Physical Description

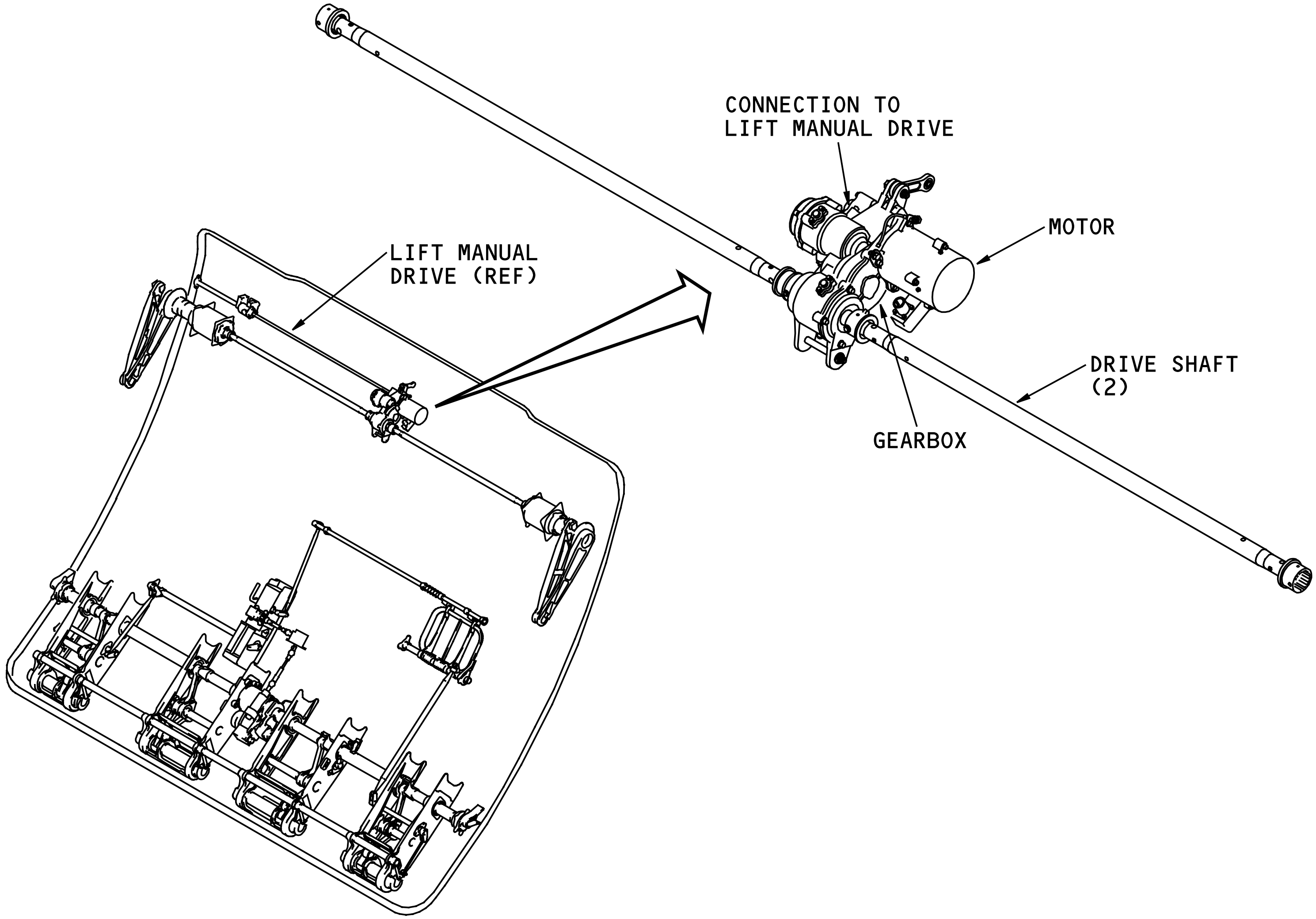
The unit has these components:

- Connection to the lift manual drive
- A three phase, 115/200v ac, 400 Hz motor with a brake
- A gear box
- Two drive shafts.

Functional Description

The motor supplies torque through the gearbox and torque tubes to rotary actuators.

The gearbox gets torque from the lift manual drive when you lift and lower the door manually.



52-34-00-006 Rev 1 11/06/1997

FORWARD LARGE CARGO DOOR SYSTEM - LIFT POWER UNIT

FORWARD LARGE CARGO DOOR SYSTEM - LIFT MANUAL DRIVE

Purpose

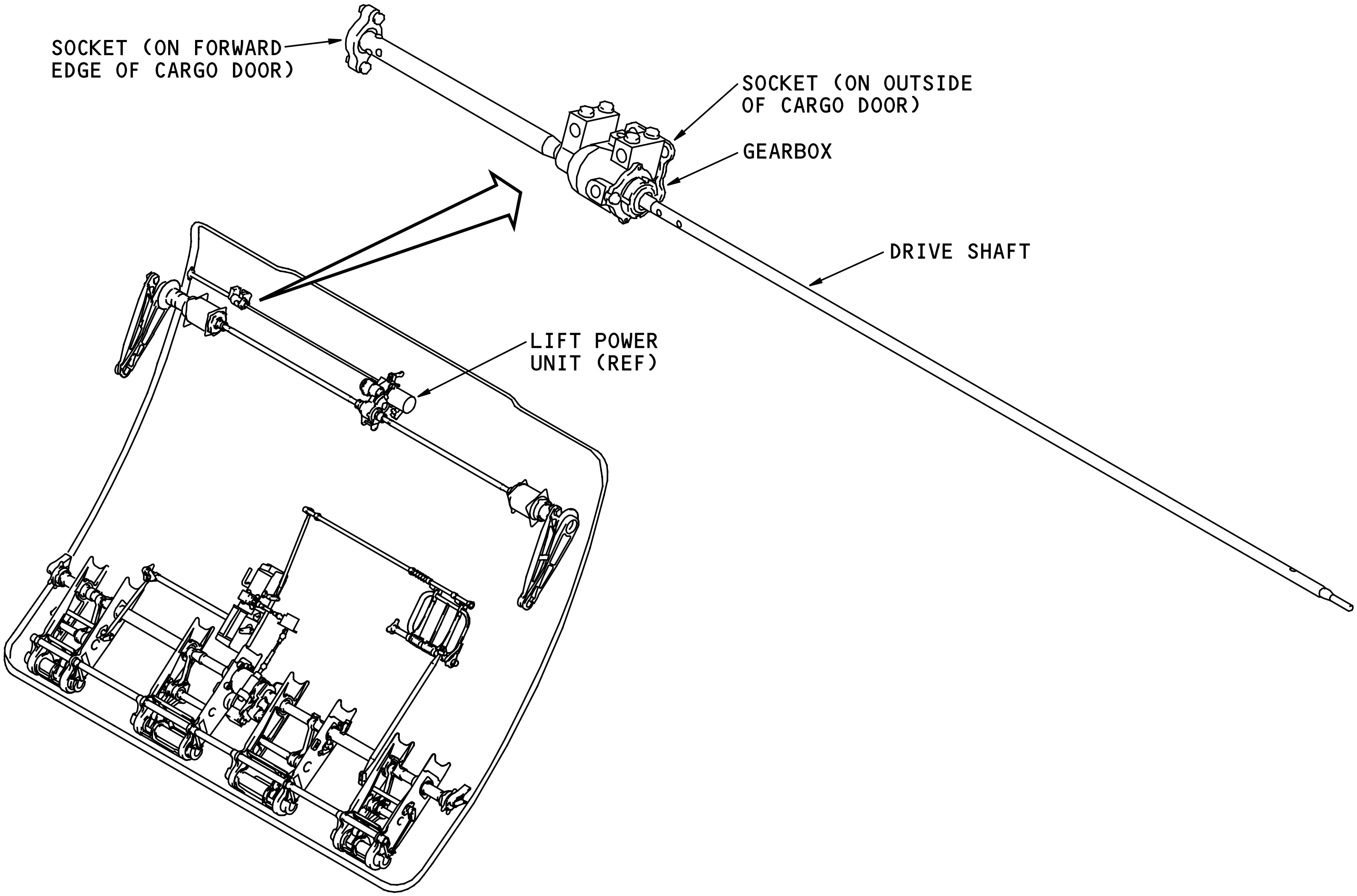
The lift manual drive lets you manually lift and lower the door.

Physical Description

The lift manual drive has two 3/8-inch square drive sockets. A drive shaft goes from the socket on the forward edge of the door, through a gear box, to the lift power unit. A short shaft connects the socket on the outside of the door to the gear box.

Functional Description

The lift manual drive receives torque through the sockets. The torque goes from the sockets, through the gear box and torque tubes, to the lift power unit.



52-34-00-007 Rev 1 11/06/1997

FORWARD LARGE CARGO DOOR SYSTEM - LIFT MANUAL DRIVE

FORWARD LARGE CARGO DOOR SYSTEM - ROTARY ACTUATOR

Purpose

The two rotary actuators transmit torque from the lift power unit torque tubes to the door lift mechanisms.

Physical Description

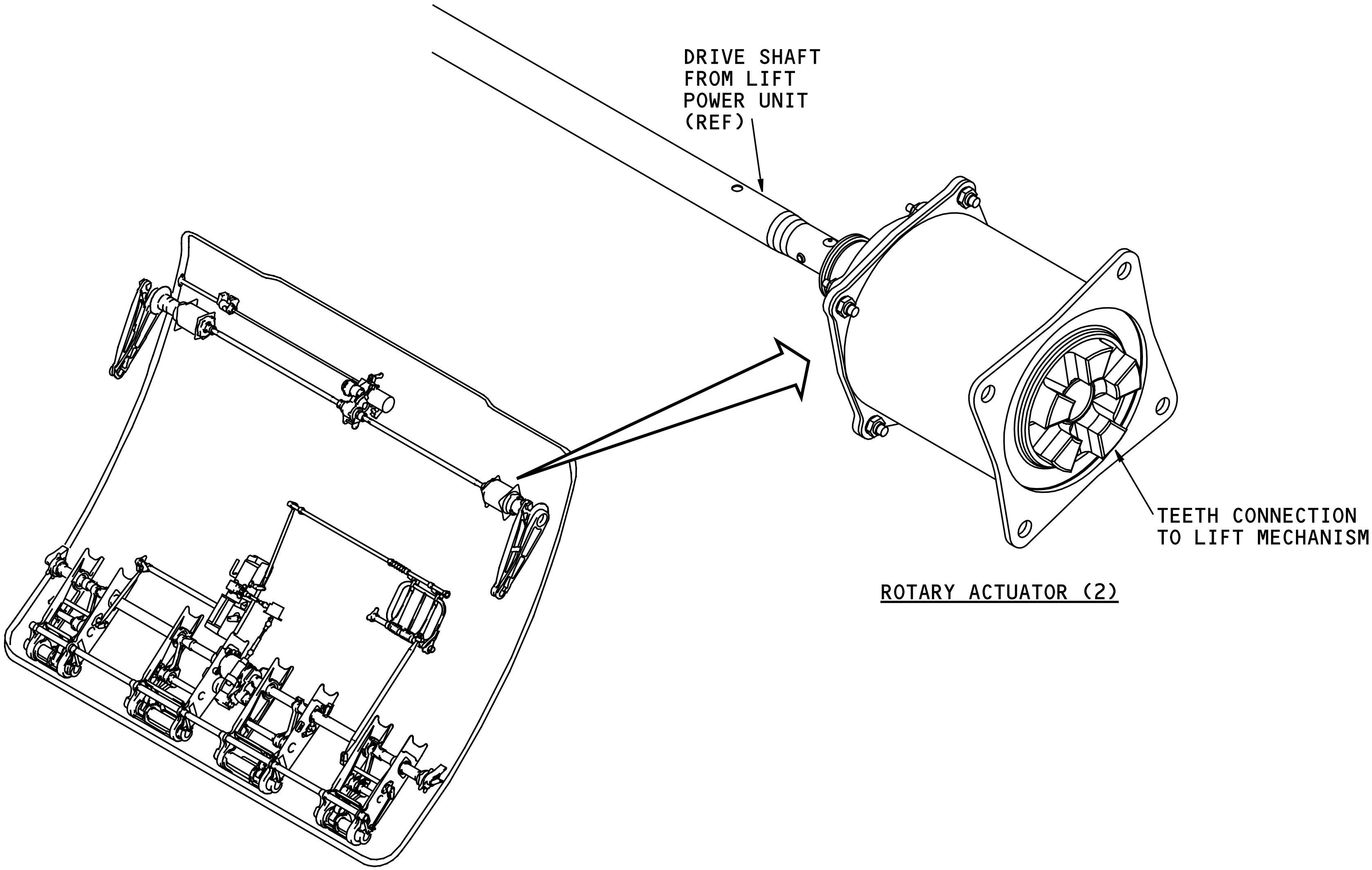
The actuator has these parts:

- A dog coupling to the lift drive mechanism
- Three planetary gear stages (internal)
- A no-back (internal).

Functional Description

The gears of the actuator reduce the rotation rate from the lift power unit. The teeth transmits torque into the lift mechanism. The free play in the teeth connection lets the door move a small amount without torque from the lift power unit. This lets the latch mechanism operate.

The no-back inside each actuator stops door movement toward closed when you remove power from the lift power unit.



FORWARD LARGE CARGO DOOR SYSTEM - ROTARY ACTUATOR

FORWARD LARGE CARGO DOOR SYSTEM - LIFT MECHANISM

Purpose

The lift mechanisms supply the motion that lifts and lowers the door.

Physical Description

Each lift mechanism has a drive arm and a drive link. One end of the drive arm has a short shaft with a teeth connection to the rotary actuator. The other end is a pivot connection to the drive link. The drive link connects to the door cutout structure.

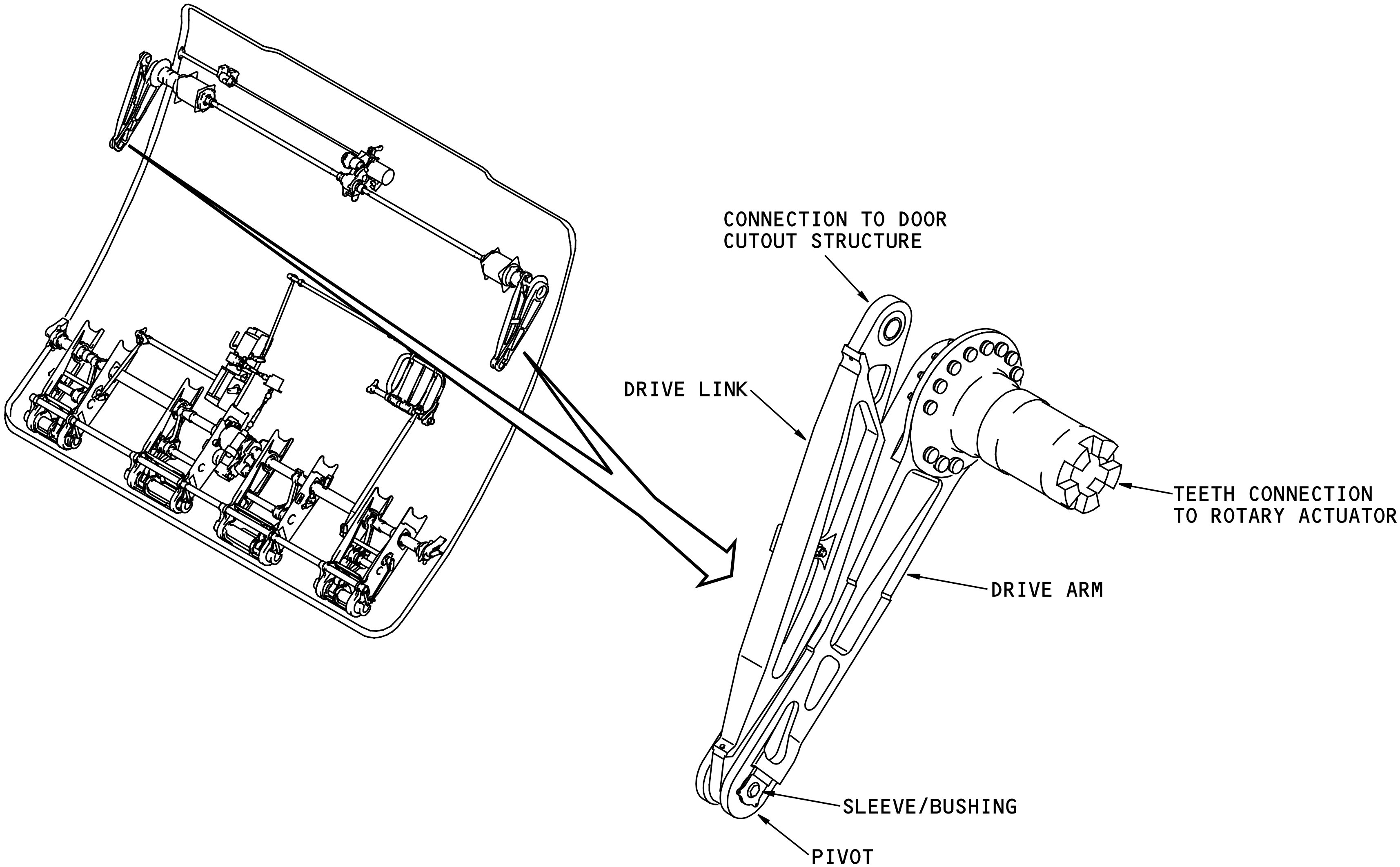
Functional Description

The lift mechanism takes the rotary motion of the rotary actuator and changes it into motion that lifts and lowers the door.

Training Information Point

If the door fails to open because of a problem with the lift mechanism, lift power drive unit, or rotory actuator, it may be necessary to remove the fasteners at the joint between the drive arm and the drive link at the forward and aft sides of the door. There are two panals (not shown) on the outside of the door that provide access to the fasteners.

WARNING: BLOCK THE DOOR AT THE LOWER EDGE. THE DOOR CAN OPEN SUDDENLY WITH GREAT FORCE AND INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT CAN OCCUR.



LIFT MECHANISM

FORWARD LARGE CARGO DOOR SYSTEM - LIFT MECHANISM

FORWARD LARGE CARGO DOOR SYSTEM - LATCH POWER UNIT

Purpose

The latch power unit supplies torque to the latch cams and the pull-in hooks.

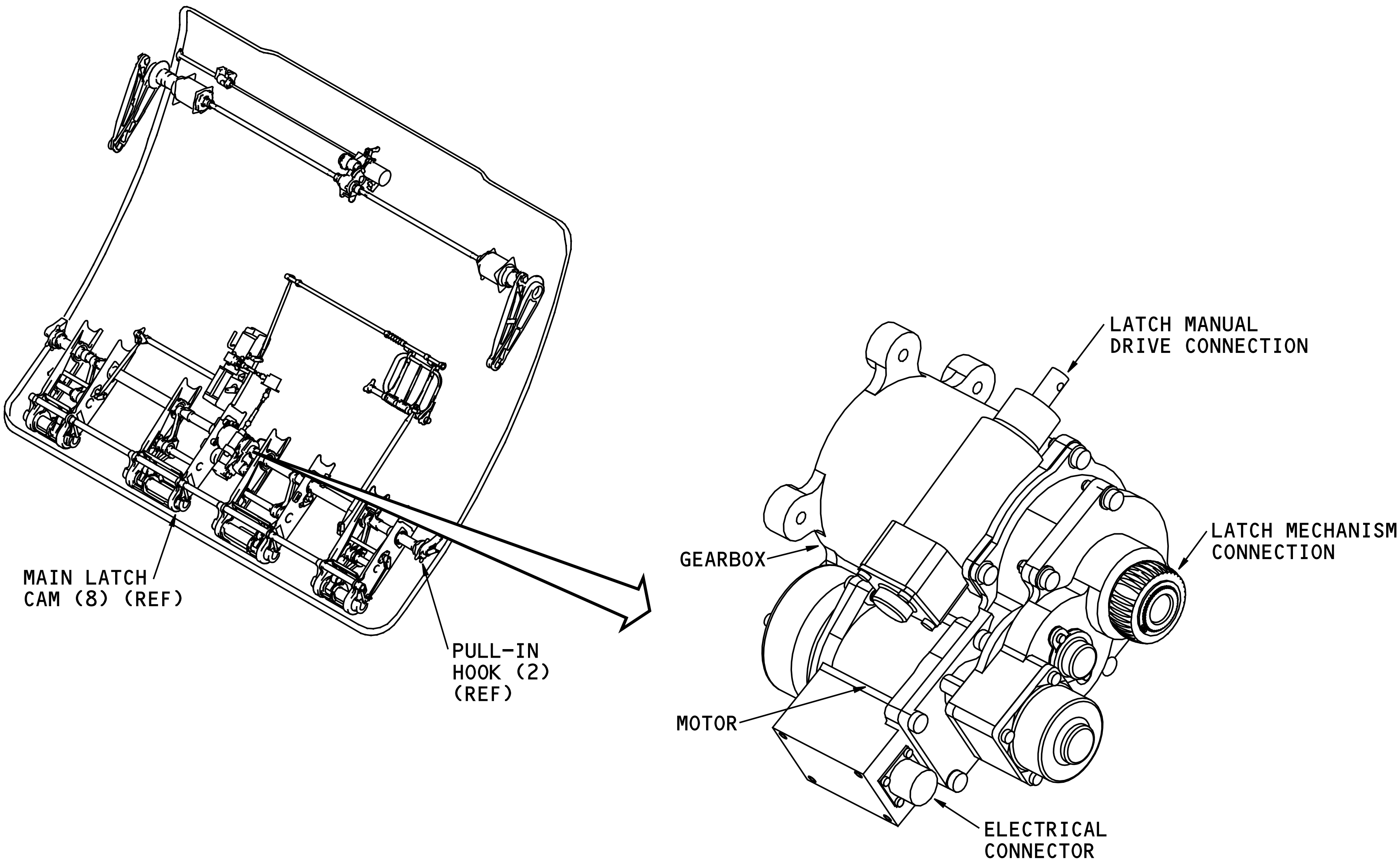
Physical Description

The latch power unit has these components:

- Latch manual drive connection
- Latch mechanism connection
- Electric power connection
- Three phase, 115/200v ac, 400 Hz motor
- Gear box
- Clutch (internal).

Functional Description

The motor supplies torque to the gearbox. The latch manual drive can also supply the torque. The clutch limits the torque supplied to the pull-in hooks and latch cams. This prevents damage when the latch cams or pull-in hooks are not able to move.



FORWARD LARGE CARGO DOOR SYSTEM - LATCH POWER UNIT

FORWARD LARGE CARGO DOOR SYSTEM - LATCH MANUAL DRIVE

Purpose

The latch manual drive lets you manually unlatch and latch the cargo door.

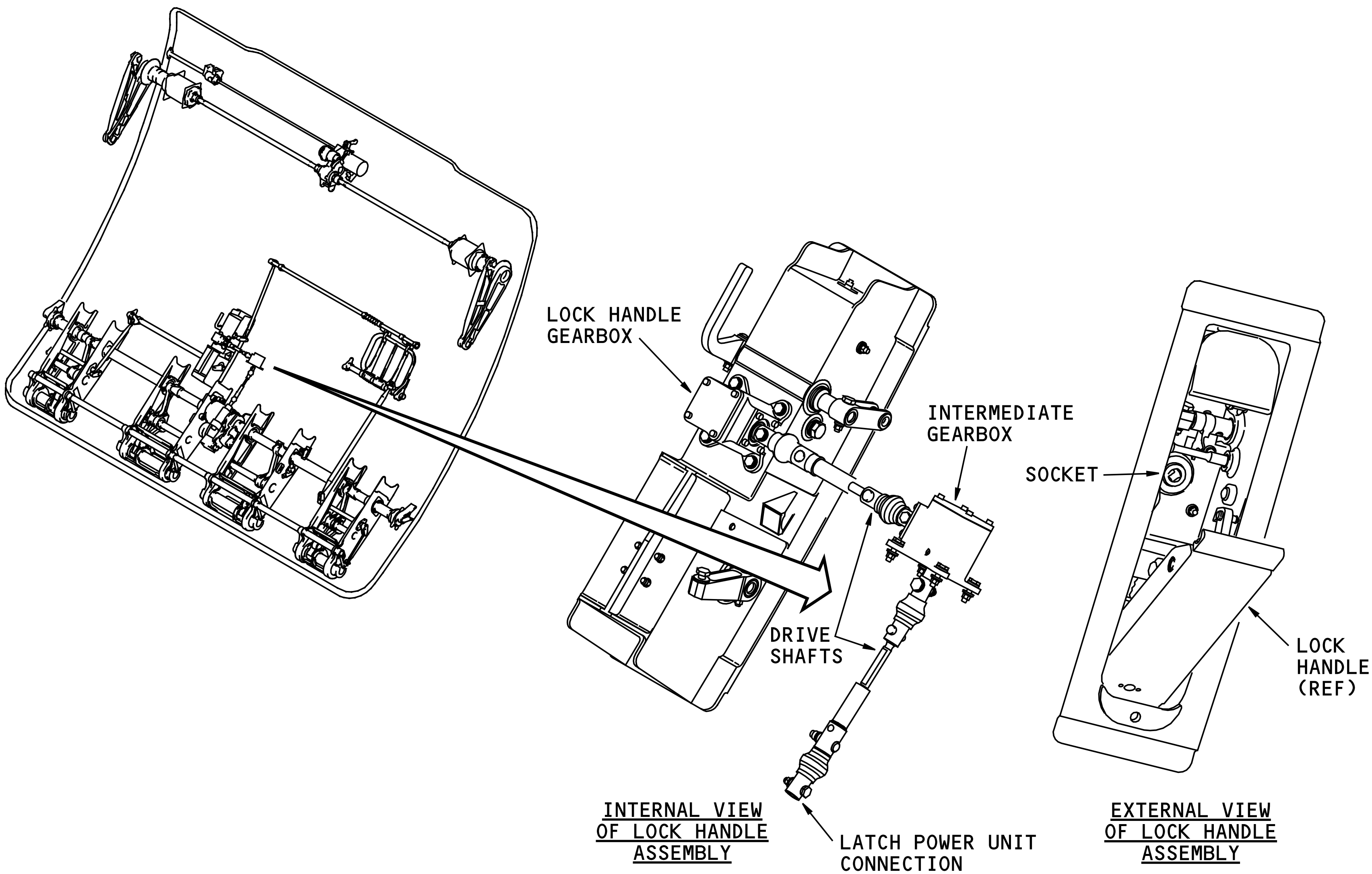
Physical Description

The manual drive has these components:

- Two gear boxes
- Two drive shafts
- A 3/8 inch drive socket
- A latch power unit connection.

Functional Description

The latch manual drive receives torque through the drive socket located in the lock handle housing. Torque goes from the sockets, through the gear boxes and shafts, to the latch power unit.



52-34-00-011 Rev 1 11/07/1997

FORWARD LARGE CARGO DOOR SYSTEM - LATCH MANUAL DRIVE

FORWARD LARGE CARGO DOOR SYSTEM - LATCH MECHANISM

Purpose

The latch mechanism transmits torque from the latch power unit to the latch cams and pull-in hooks.

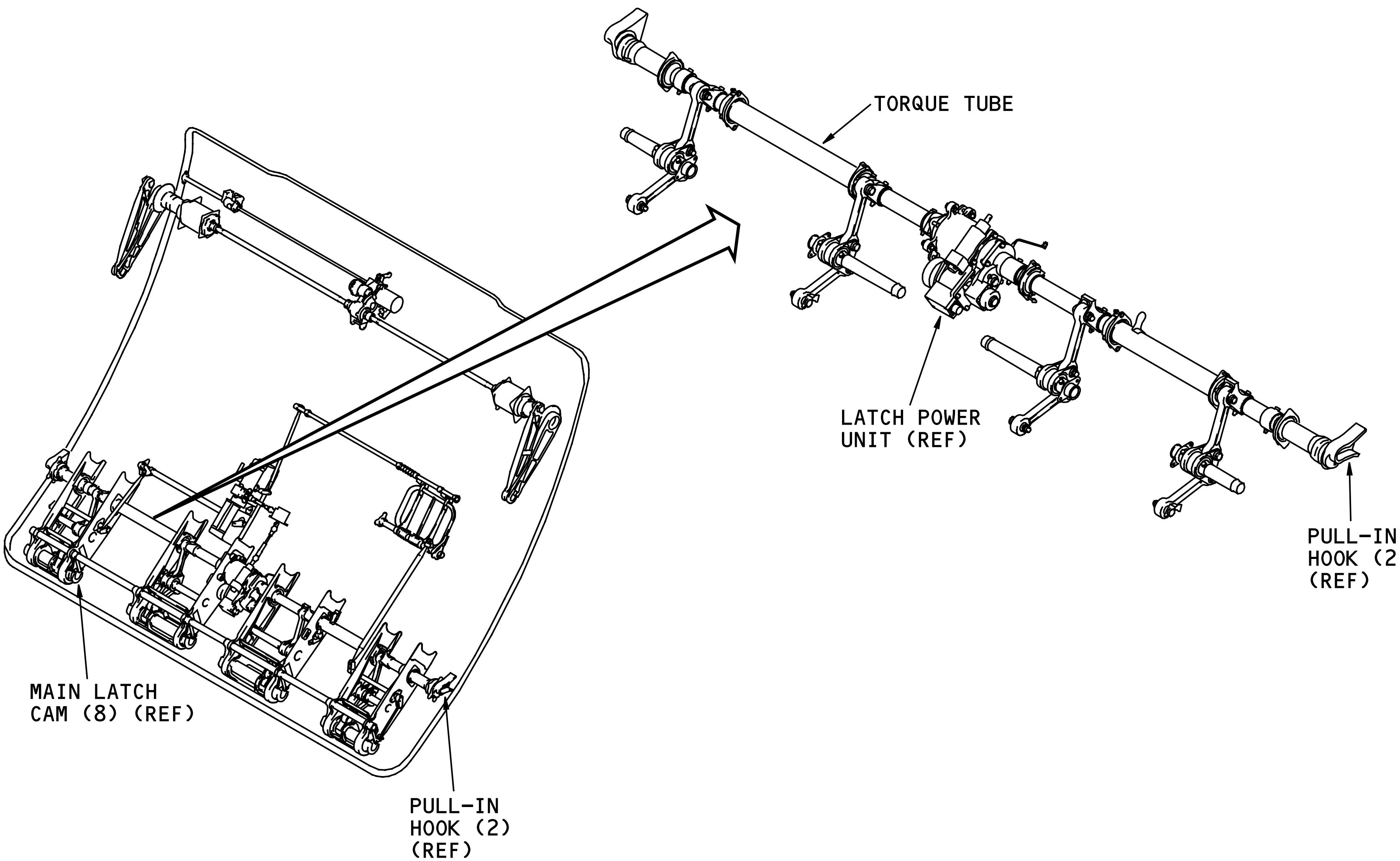
Physical Description

The mechanism has these components:

- Torque tubes
- Push rods
- Bellcranks
- Drive links
- Pull-in hooks
- Main latch cams.

Functional Description

The torque tubes transmit torque directly to the pull-in hooks. The push rods, bellcranks, and drive links transmits torque from the torque tube to the latch cams.



52-34-00-012 Rev 1 11/07/1997

FORWARD LARGE CARGO DOOR SYSTEM - LATCH MECHANISM

FORWARD LARGE CARGO DOOR SYSTEM - PULL-IN HOOKS AND PINS

Purpose

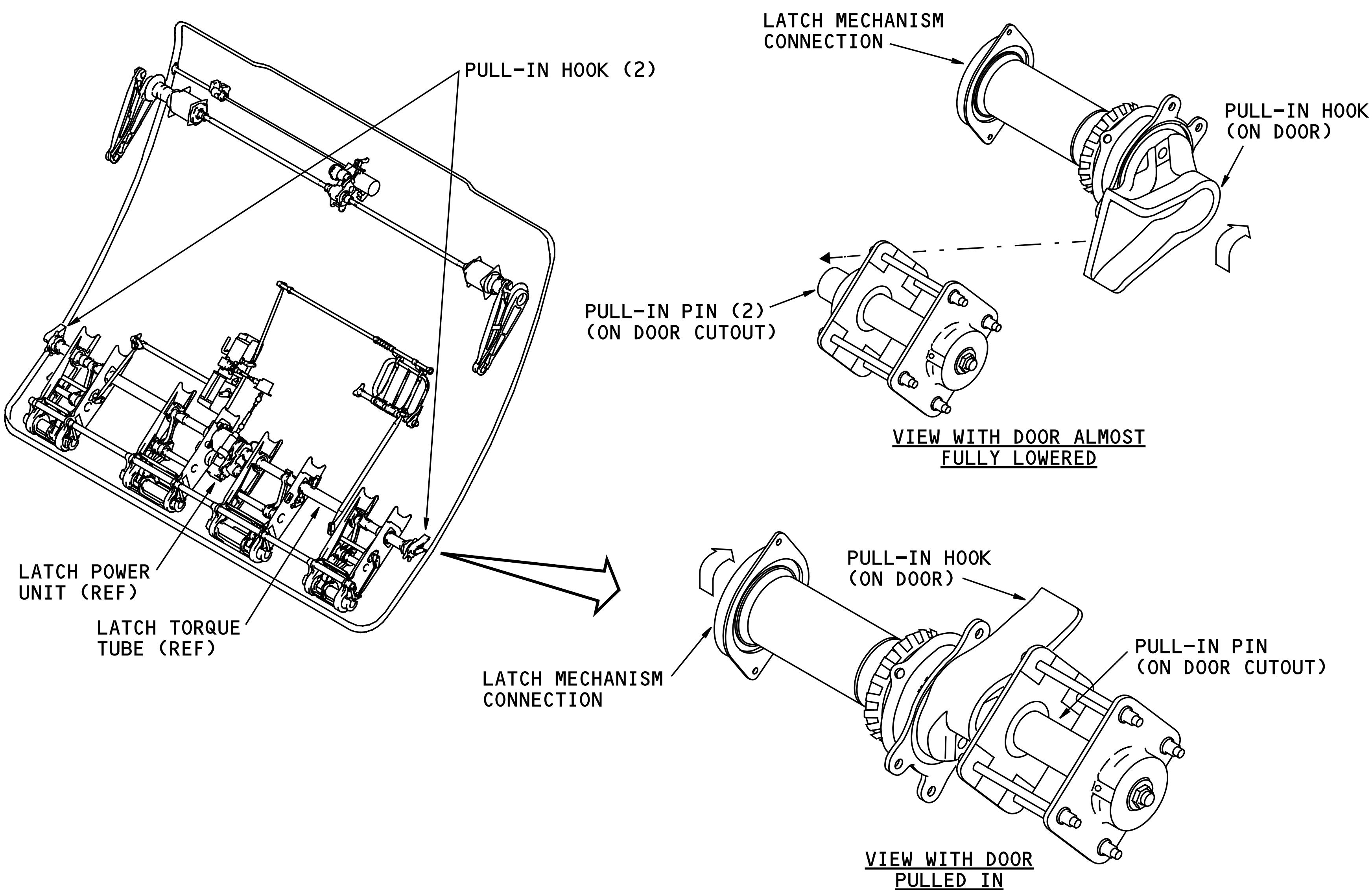
The pull-in hooks and pins pull the door into the position where the cargo door can latch.

Location

The pull-in hooks are on the ends of the latch torque tubes. The pins are on the forward and aft sides of the door cutout.

Functional Description

The pull-in function begins when the door is lowered fully. In this position, the open end of the hook is around the pin. The latch power unit turns the pull-in hooks. As the hook turns around the pin, it pulls the door into the position where the latch cams can turn around the latch pins.



52-34-00-013 Rev 1 11/07/1997

FORWARD LARGE CARGO DOOR SYSTEM - PULL-IN HOOKS AND PINS

FORWARD LARGE CARGO DOOR SYSTEM - LATCH CAMS AND LATCH PINS

Purpose

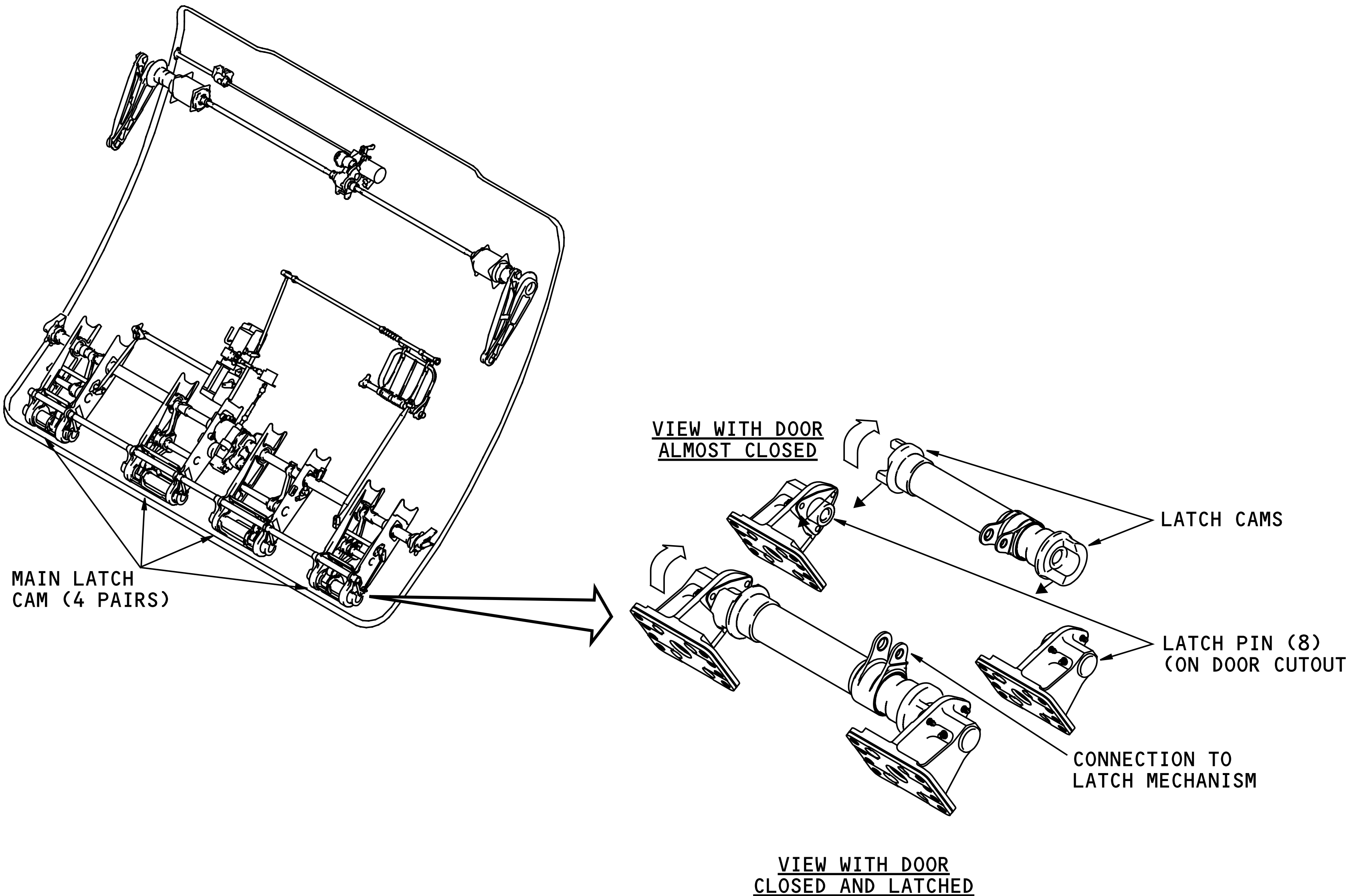
The latch cams and latch pins hold the cargo door closed.

Location

The eight main latch cams are in pairs along the bottom of the door. The eight main latch pins are along the bottom of the door cutout.

Functional Description

Linkage connects the latch cams to latch mechanism torque tubes. Torque from the power unit turns the latch cams around the latch pins. In the rotated position the cams cannot move away from the pins. This latches the door.



FORWARD LARGE CARGO DOOR SYSTEM - LATCH CAMS AND LATCH PINS

52-34-00-014 Rev 1 11/07/1997

FORWARD LARGE CARGO DOOR SYSTEM - LOCK MECHANISM

Purpose

The lock mechanism holds the large cargo door main latch cams in the latched position and the vent door closed.

Physical Description

The lock mechanism has these components:

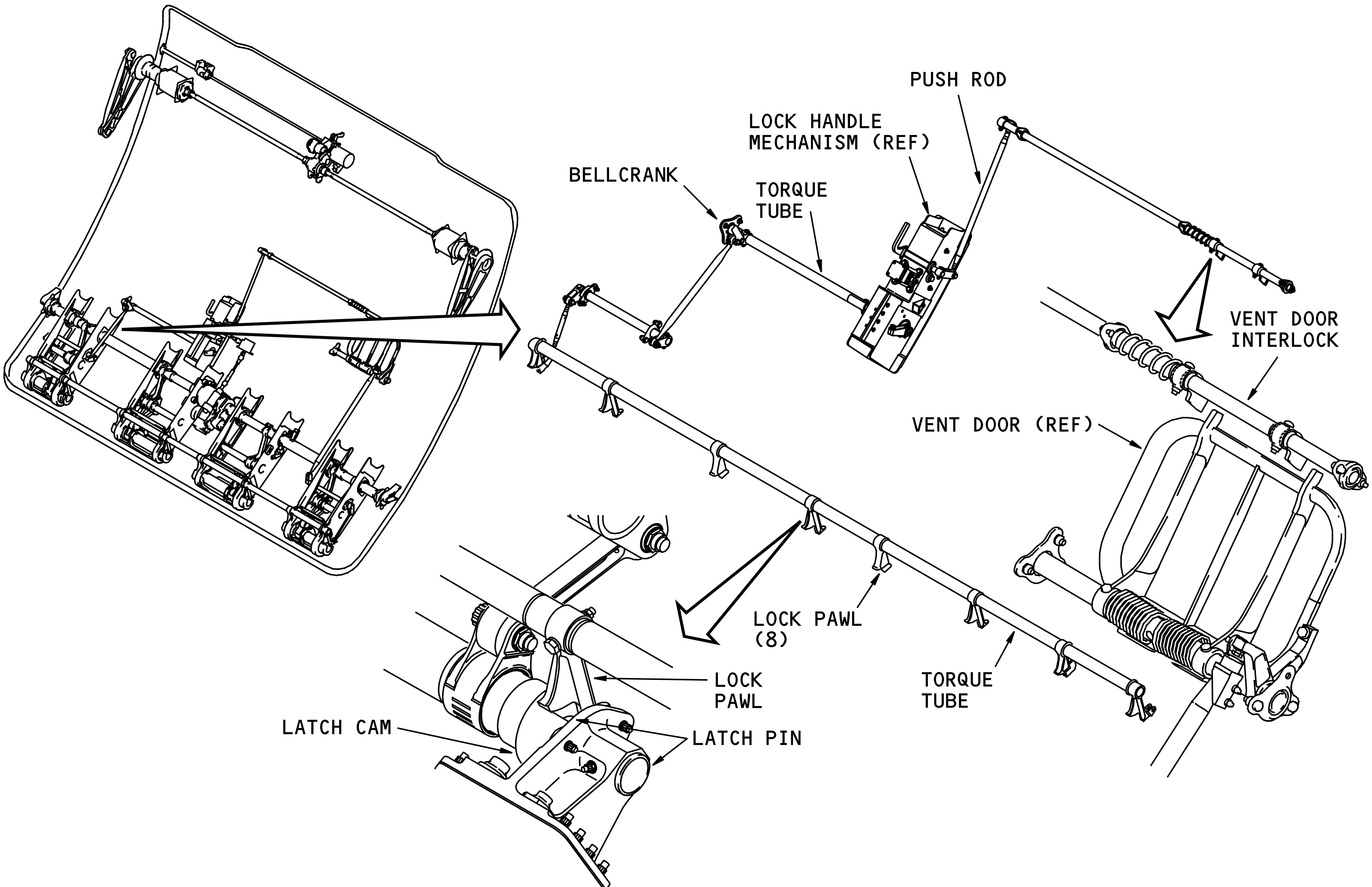
- Bellcranks
- Torque tubes
- Push rods
- Vent door interlock
- Torque tubes
- Lock pawls.

Functional Description

The lock mechanism does two things when you move the lock handle to the lock position.

The mechanism transmits the movement of the lock handle to the lock pawls. The lock pawls move to a position that will not let the main latch cams turn.

The mechanism also transmits the movement of the lock handle to the vent door interlock. The vent door interlock keeps the vent door closed if the airplane is ditched in water.



FORWARD LARGE CARGO DOOR SYSTEM - LOCK MECHANISM

FORWARD LARGE CARGO DOOR SYSTEM - VENT DOOR AND VENT DOOR MECHANISM

Purpose

The vent door and vent door mechanism prevent damage from pressurization when you open the cargo door.

Physical Description

The door has stops and connections to the torque shaft. The mechanism has these components:

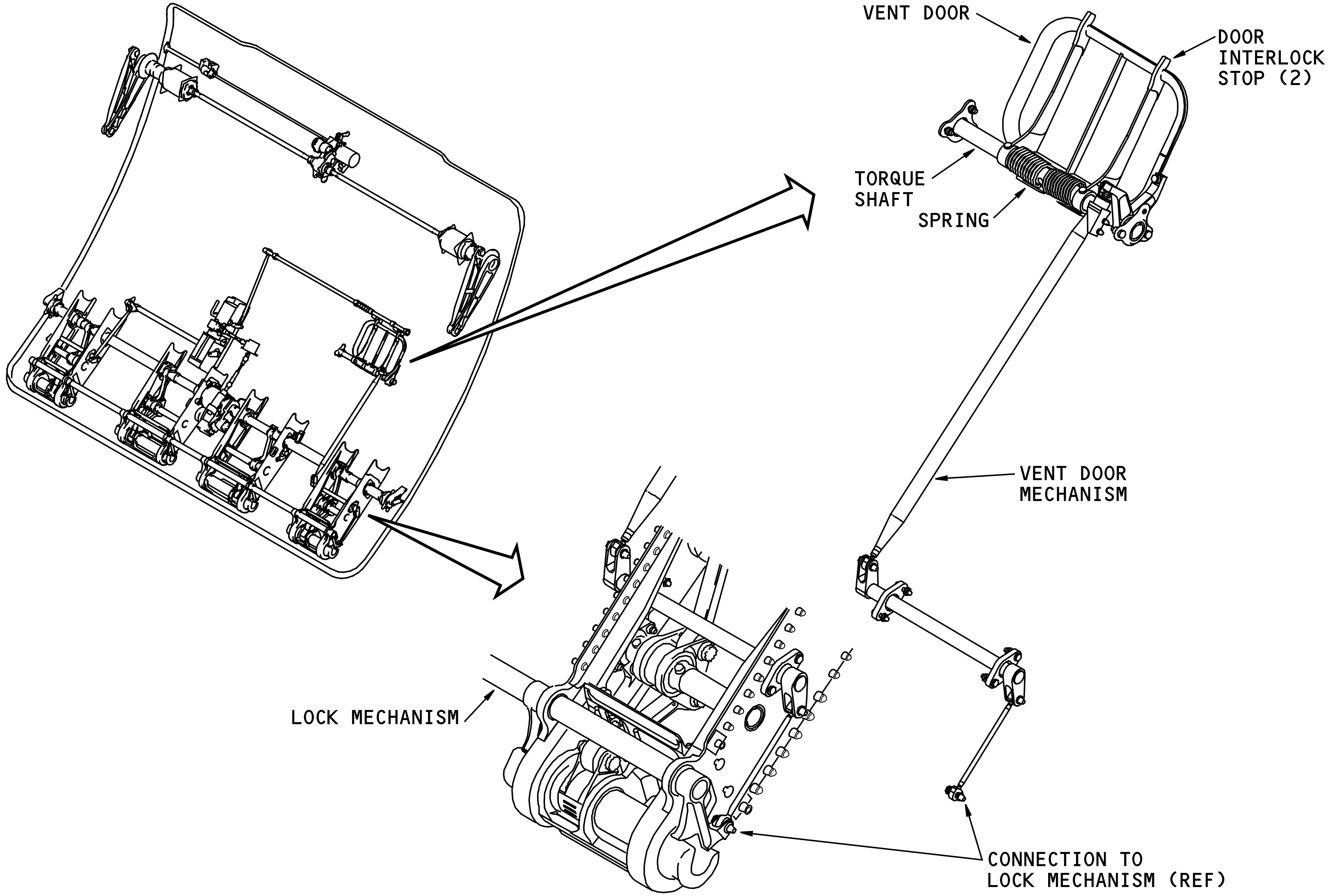
- A spring that pulls the vent door open
- A torque shaft
- Linkage that connects the vent door to the lock mechanism.

Functional Description

The door and vent door mechanism have two functions.

One function is to release air pressure from inside the airplane before you open the cargo door. When the lock mechanism moves to the unlock position, it causes the vent door mechanism to pull the vent door open. This releases any air pressure that remains.

The second function is to keep the cargo door locked if there is too much pressure to let you open the cargo door safely. Pressure on the vent door prevents movement of the vent door mechanism. This stops movement of the lock mechanism. You cannot unlock and open the cargo door.



FORWARD LARGE CARGO DOOR SYSTEM - VENT DOOR AND VENT DOOR MECHANISM

FORWARD LARGE CARGO DOOR SYSTEM - CONTROL SWITCHES

Purpose

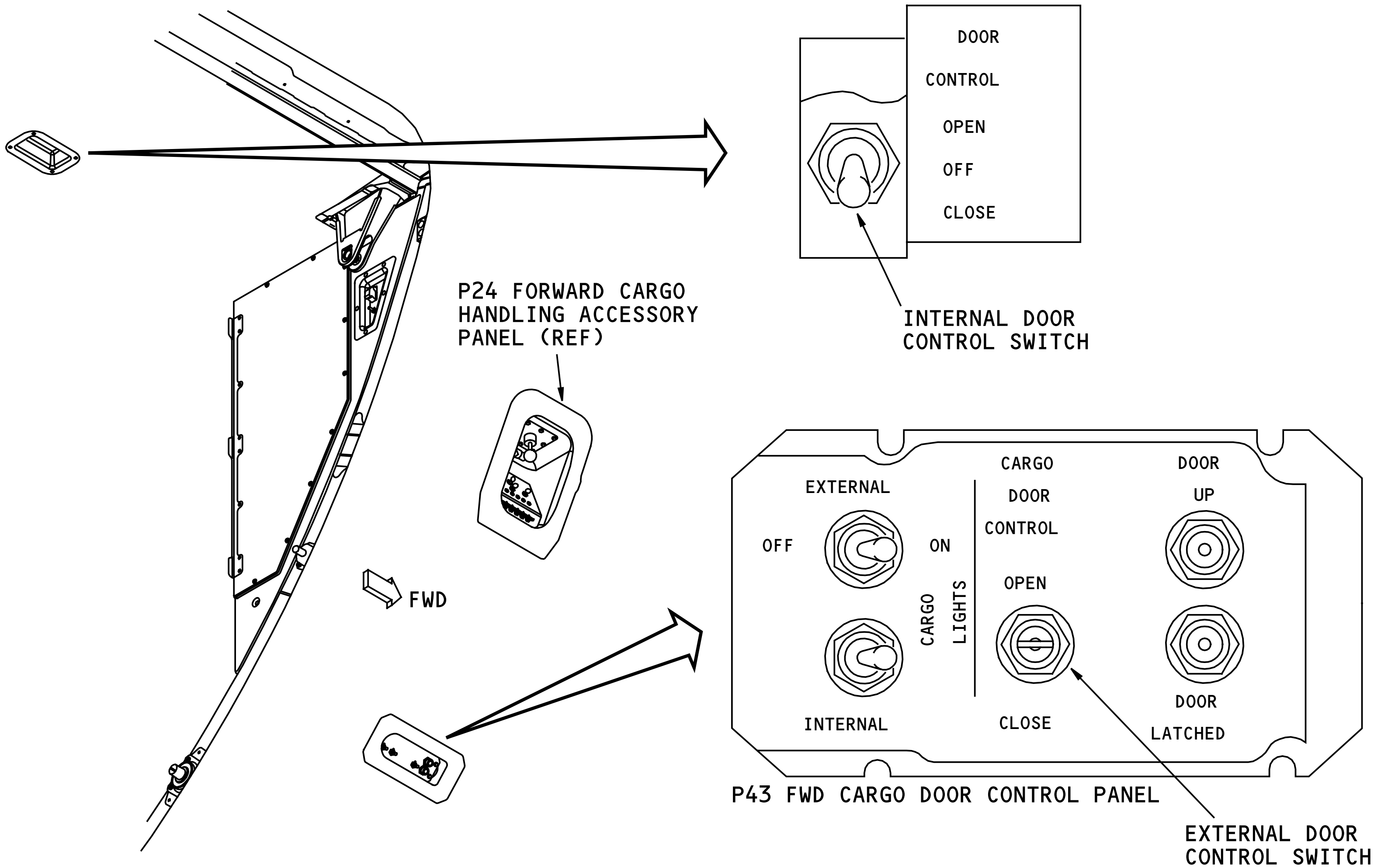
Control switches let you operate the door electrically.

Physical Description

The internal and external toggle type door control switches are spring-loaded.

Functional Description

The switches let you operate the door electrically, after the door is unlocked. You can use either switch. The internal switch has priority over the external switch.



52-34-00-018 Rev 0

FORWARD LARGE CARGO DOOR SYSTEM - CONTROL SWITCHES

FORWARD LARGE CARGO DOOR SYSTEM - PROXIMITY SENSORS

Purpose

Proximity sensors supply door and door mechanism position information to the proximity sensor electronics unit (PSEU) for door operational control and door status indications.

Physical Description

The sensors are electrical devices that work with metal targets.

Functional Description

These sensors are for door operation control:

- Door up
- Door latched
- Door unlatched
- Latch range
- Handle unlocked.

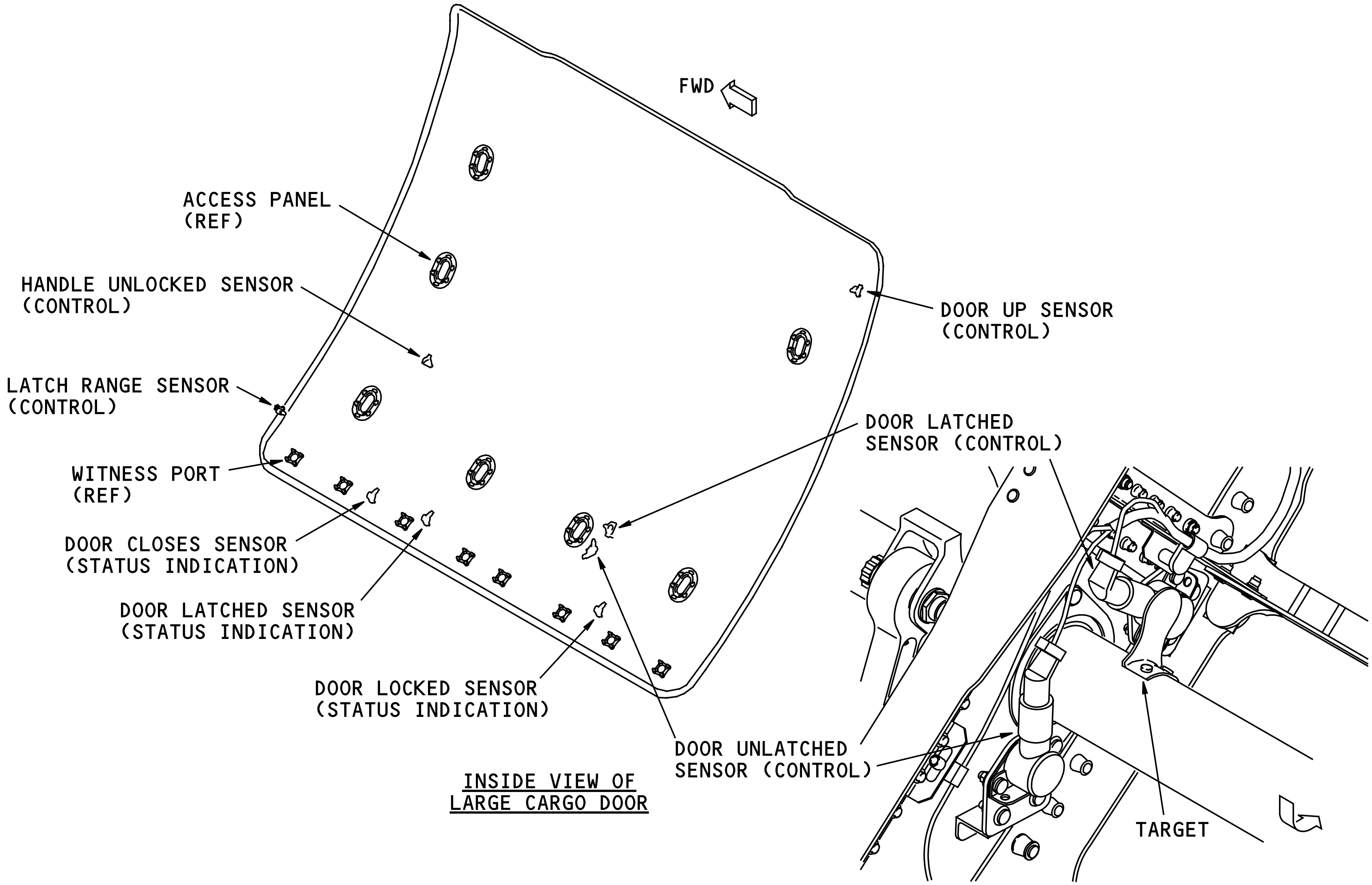
The door status indication sensors are:

- Door closed
- Door latched
- Door locked.

See the door warning system section for more information on the door status sensors (AMM PART I 52-71).

Each sensor has a related target. The sensor senses if the target is near or far. The position information goes to the PSEU.

The door operation control sensors tell the PSEU the position of the door and door mechanisms. The PSEU uses the information to control the cargo door operation and the door control panel indication lights.



INSIDE VIEW OF LARGE CARGO DOOR

TYPICAL SENSORS

52-34-00-019 Rev 3

FORWARD LARGE CARGO DOOR SYSTEM - PROXIMITY SENSORS

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FORWARD LARGE CARGO DOOR SYSTEM - ELECTRICAL OPERATION

General

The large cargo door uses power from the ground handling bus for electrical operation.

WARNING: DO NOT OPERATE THE DOOR IN WINDS MORE THAN 40 KNOTS. DO NOT LET THE DOOR STAY OPEN IN WINDS MORE THAN 65 KNOTS. INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT CAN OCCUR.

WARNING: DO NOT OPEN THE DOOR WHEN THE AIRPLANE IS PRESSURIZED. INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT CAN OCCUR.

Controls

The cargo door lock handle is on the outside of the door. There is an internal and an external release.

The external door control switch is on P43. The internal door control switch is in the cargo compartment ceiling.

Displays and Indications

Indication lights on the external control panel supply door operation information.

Witness ports on the door let you see the position of the door latches and locks.

Unlock Operation

WARNING: STAY AWAY FROM THE PATH OF THE LOCK HANDLE. THE LOCK HANDLE IS SPRING-LOADED TO OPEN WHEN YOU PULL THE CATCH RELEASE LEVER AND INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT CAN OCCUR.

Release the lock handle to unlock the cargo door. If the vent door opens, the cargo door has unlocked. This enables cargo door electric operation.

Unlatch and Open Operation

WARNING: MAKE SURE ALL PERSONS AND EQUIPMENT ARE CLEAR OF THE PATH OF THE DOOR ON THE EXTERNAL SIDE. THE DOOR OPENS OUTBOARD AND UP. INITIALLY, THE DOOR MOVES DOWN BELOW THE DOOR CUTOUT. THE MOVEMENT OF THE DOOR CAN CAUSE INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT.

CAUTION: DO NOT OPERATE THE DOOR ELECTRICALLY MORE THAN 2 FULL OPEN/CLOSE CYCLES WITHIN 5 MINUTES. DAMAGE TO THE LIFT MECHANISM CAN OCCUR.

Move either the external or the internal switch to the open position. The door unlatches.

Continue to hold the switch in the open position. The door moves to the full up position. When it stops. The amber door up light on the P43 comes on.

FORWARD LARGE CARGO DOOR SYSTEM - ELECTRICAL OPERATION

Close and Latch Operation

CAUTION: MAKE SURE THE E/E EQUIPMENT DOORS ARE CLOSED ON THE SIDES OF THE DOOR CUTOUT BEFORE YOU CLOSE THE DOOR. THE CARGO DOOR CAN CAUSE DAMAGE TO OPEN E/E EQUIPMENT DOORS WHEN IT CLOSES.

Move either the external or the internal switch to the close position. The amber door up light goes off when the door leaves the full up position.

Continue to hold the switch in the close position. The door goes to the full down position. Then it latches. The green door closed and latched light comes on.

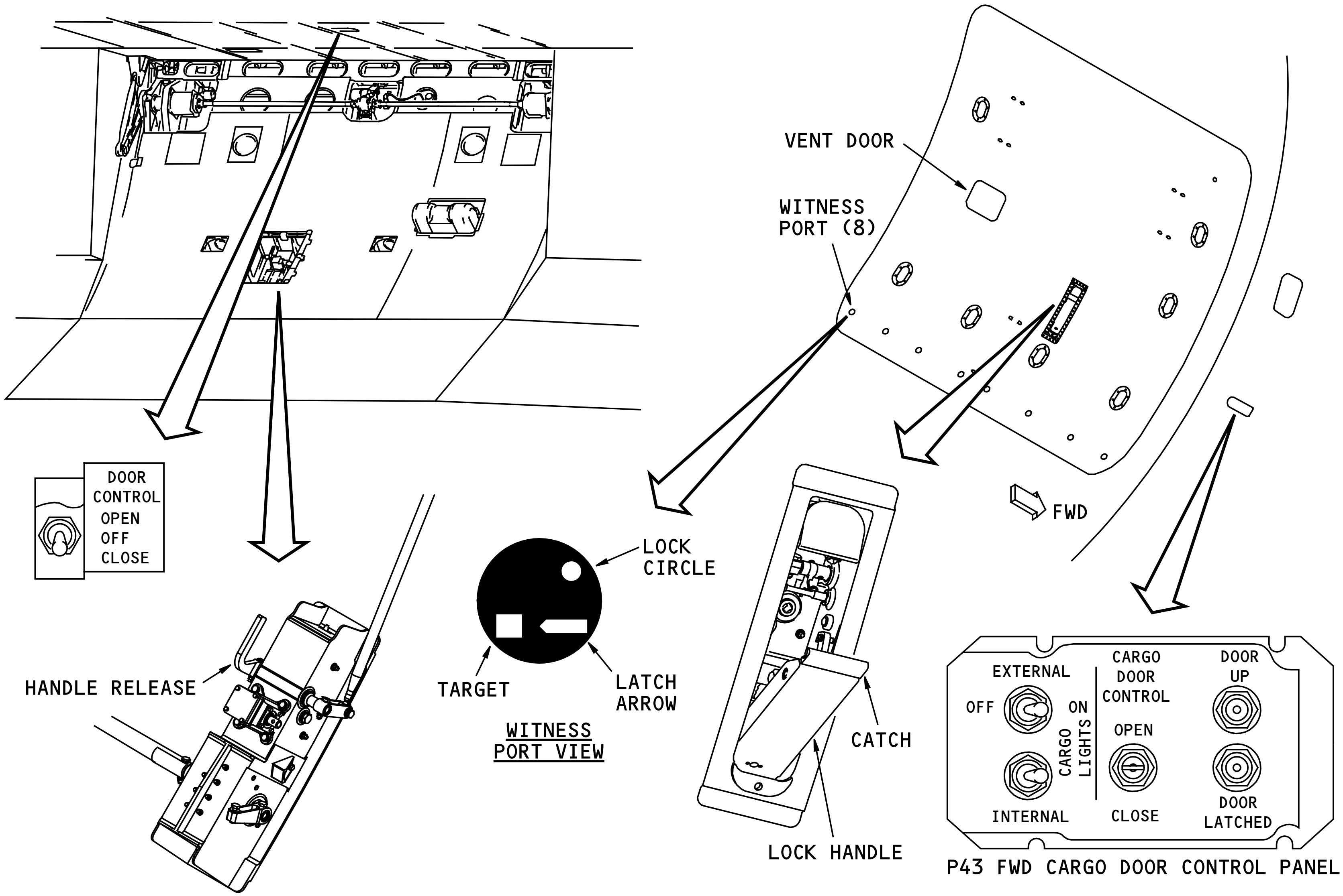
Lock Operation

Close the lock handle. Make sure that the vent door closes. The door is locked if the vent door is closed.

Training Information Point

Look through each witness port along the bottom edge of the door for latch and lock indications. The latch and lock components are black. The indications and target are yellow.

The door is latched if the indication arrow on each latch cam points to the target on each latch fitting. The door is locked if you see all of the door locked circle on each lock pawls.



FORWARD LARGE CARGO DOOR SYSTEM - ELECTRICAL OPERATION

52-34-00-020 Rev 1

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FORWARD LARGE CARGO DOOR SYSTEM - MANUAL OPERATION

General

Use a 3/8 inch drive tool for manual door operations.

WARNING: DO NOT OPERATE THE DOOR IN WINDS MORE THAN 40 KNOTS. DO NOT LET THE DOOR STAY OPEN IN WINDS MORE THAN 65 KNOTS. INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT CAN OCCUR.

WARNING: DO NOT OPEN THE DOOR WHEN THE AIRPLANE IS PRESSURIZED. INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT CAN OCCUR.

Controls

The cargo door lock handle covers the latch manual drive socket. Release lock handle to access the socket.

There are two lift manual drive sockets on the upper, forward corner of the cargo door.

Indications

Witness ports along the bottom edge of the door let you see if the door is latched and locked.

Unlock and Unlatch Operations

WARNING: STAY AWAY FROM THE PATH OF THE LOCK HANDLE. THE LOCK HANDLE IS SPRING-LOADED TO OPEN WHEN YOU PULL THE CATCH RELEASE LEVER AND INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT CAN OCCUR.

Release the lock handle. If the vent door opens, the door is unlocked.

Insert the drive tool into the latch manual drive socket. Turn it in the unlatch direction. The door is unlatched when it moves outboard to where you can move it freely a small distance inboard and outboard, approximately 120 full turns.

NOTE: The lower edge of door will move 2-3 inches (5-8 cm) outboard.

Lift and Lower Operations

CAUTION: DO NOT LET THE POWER DRIVE UNIT OPERATE WITH TORQUE LIMITER SLIPPAGE FOR MORE THAN 5 SECONDS. DAMAGE TO THE POWER DRIVE UNIT CAN OCCUR.

DO NOT OPERATE THE MANUAL DRIVE AT A SPEED FASTER THAN 500 RPM OR A TORQUE OF MORE THAN 110 POUNDS-INCHES. DAMAGE TO THE MANUAL DRIVE CAN OCCUR.

Insert the drive tool in the lift manual drive socket on the outside of the door. Turn it in the open direction, approximately 320 full turns. When the door is open sufficiently, move the tool to the lift manual drive socket on the forward edge of the door. Turn it in the open direction until the door is in the full up position, approximately 1150 full turns.

FORWARD LARGE CARGO DOOR SYSTEM - MANUAL OPERATION

NOTE: It is usual for the door to stop at the low point of its travel.

CAUTION: MAKE SURE THE E/E EQUIPMENT DOORS ARE CLOSED ON THE SIDES OF THE DOOR CUTOUT BEFORE YOU CLOSE THE DOOR. THE CARGO DOOR CAN CAUSE DAMAGE TO OPEN E/E EQUIPMENT DOORS WHEN IT CLOSES.

Reverse the operations to lower the door.

latch and Lock Operations

Insert the drive tool in the latch manual drive socket. Turn it in the latch direction. The door latches.

Close the handle. Check that the vent door closes. The door is locked if the vent door is closed.

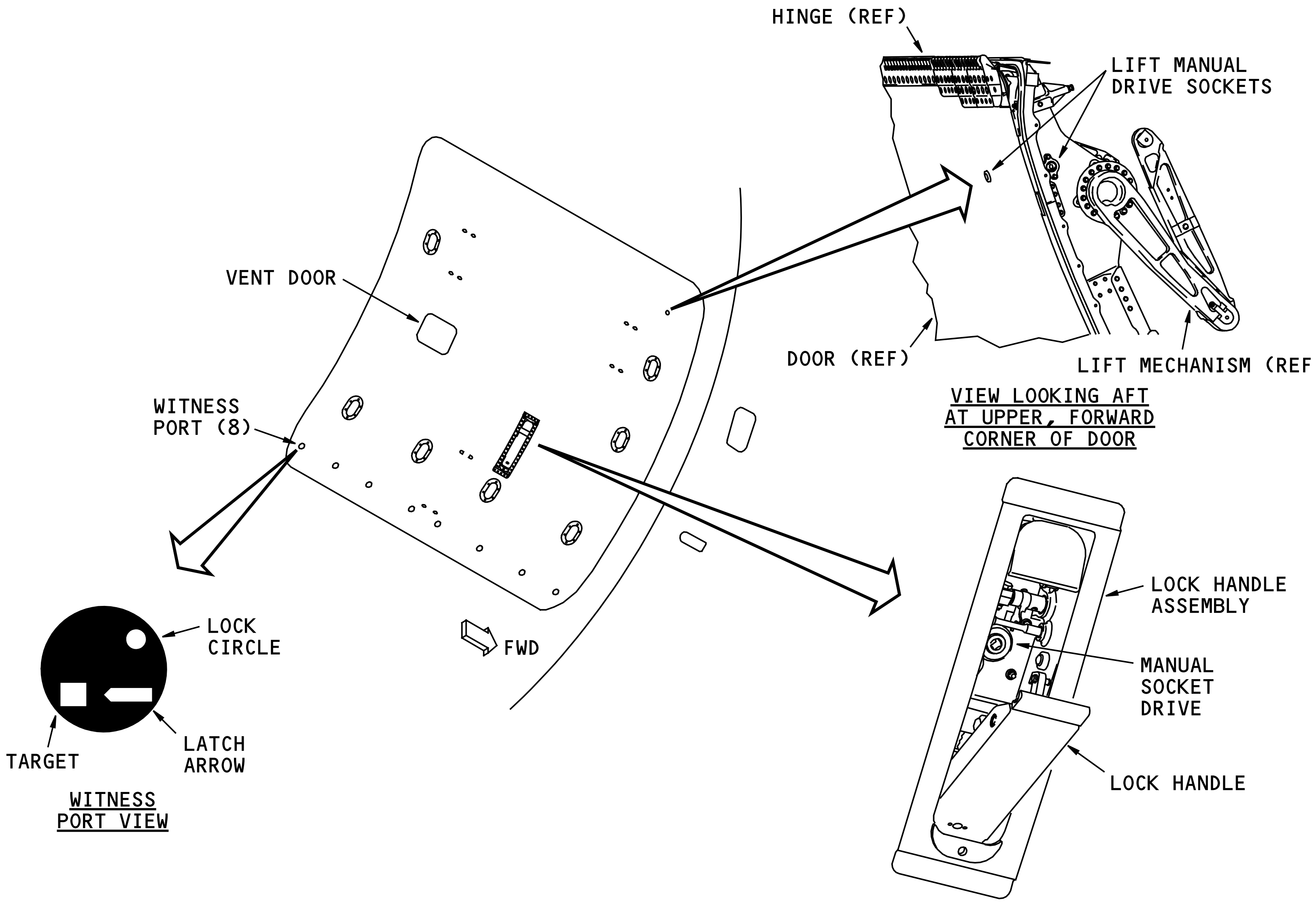
Training Information Point

The door must be unlatched before you lift the door with the lift manual drive.

The door must be full down before you can latch the door with the latch manual drive.

Look through each witness ports along the bottom edge of the door for latch and lock indications. The latch and lock components are black. The indications and target are yellow.

The door is latched if the indication arrow on each latch cam points to the target on each latch fitting. The door is locked if you see all of the door locked circle on each lock pawls.



52-34-00-021 Rev 1

FORWARD LARGE CARGO DOOR SYSTEM - MANUAL OPERATION

FORWARD LARGE CARGO DOOR SYSTEM - MECHANICAL FUNCTIONAL DESCRIPTION

Unlock

Release of the cargo door lock handle starts the unlock operation.

The lock handle connects to the lock mechanism. The lock mechanism has a vent door interlock. Open movement of the lock handle releases the vent door from the vent door interlock. The vent door spring moves the vent door open if the airplane is not pressurized.

The vent door connects to the vent door mechanism. The vent door mechanism connects to the lock mechanism. Movement of the vent door and the lock handle cause the lock mechanism to turn. It moves the lock pawls away from the latch cams. This unlocks the door.

Unlatch

With the door unlocked, the latch power unit or the latch manual drive can unlatch the door. The dog drive connection between the rotary actuator and the lift mechanism leaves free play sufficient to let the pull-in hooks move the door.

Torque goes through linkage to the latch cams and pull-in hooks. The latch cams turn from around the latch pins. The pull-in hooks turn from around the pull-in pins. The door is unlatched and can open.

Lift and Lower Movement

With the door unlatched, the hinge power unit or the lift manual drive supplies torque. Power goes through the rotary actuators and lift mechanism to move the door up and down.

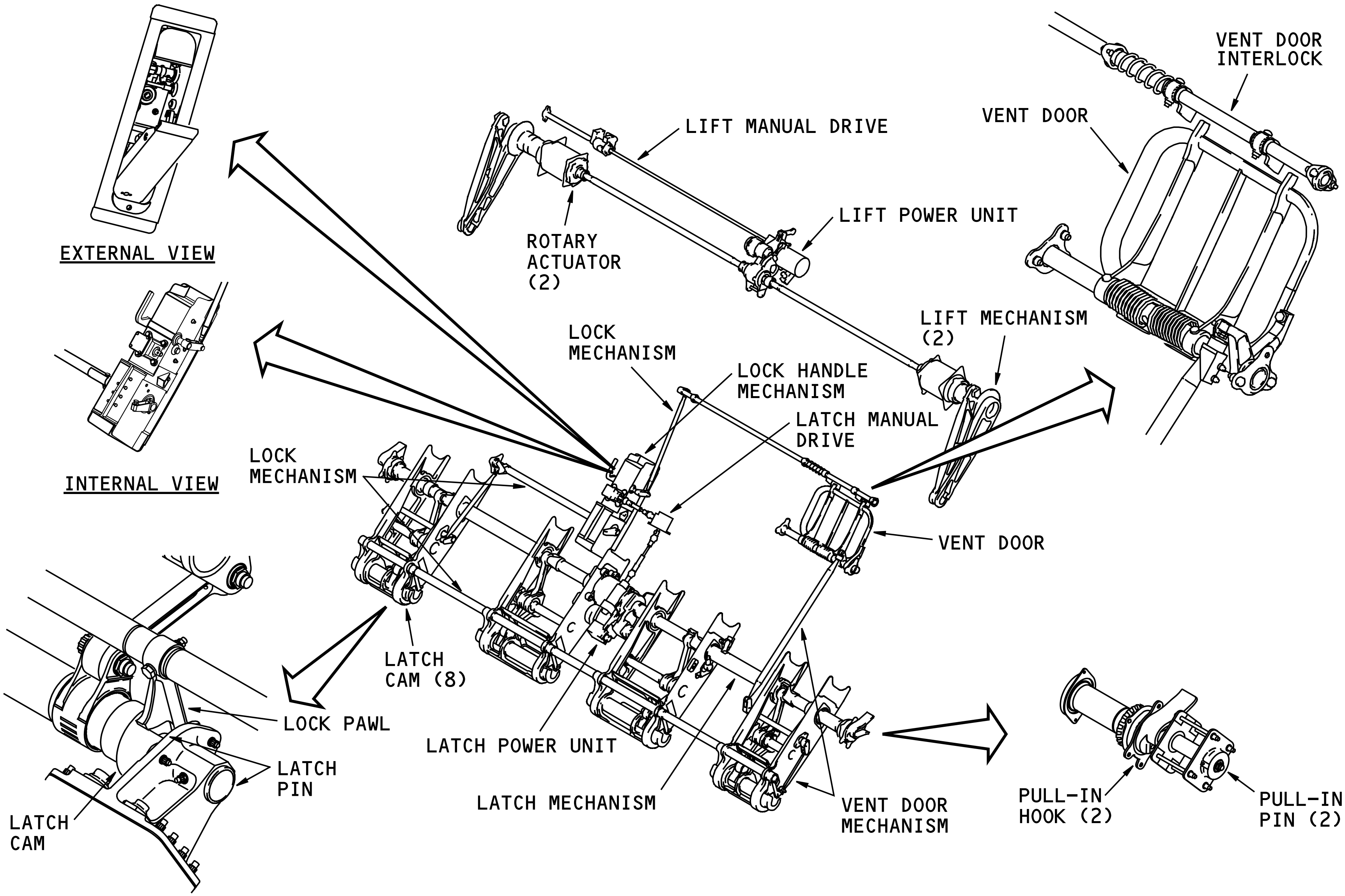
Latch

The latch power unit or the latch manual drive can latch the door when the door is fully down. The dog drive connection between the rotary actuator and the lift mechanism leaves free play sufficient to let the pull-in hooks move the door.

Torque goes through linkage to the pull-in hooks, and the latch cams. The pull-in hooks turn around the pull-in pins. This pulls the door in to where the latch cams can turn around the latch pins. The door latches.

Lock

Return of the lock handle to the close position locks the door. The movement of the handle moves the lock mechanism. The lock pawls move into a position that will not let the latch cams turn. Linkage from the lock mechanism to the vent door closes the vent door. Linkage from the lock handle moves the vent door interlock to a position that will not let the vent door open. The door is locked.



FORWARD LARGE CARGO DOOR SYSTEM - MECHANICAL FUNCTIONAL DESCRIPTION

FORWARD LARGE CARGO DOOR SYSTEM - ELECTRICAL FUNCTIONAL DESCRIPTION

General

Sensors on the door give inputs to the proximity sensor electronics unit (PSEU). The PSEU uses the inputs to turn on door position indication lights, and enable door control relays.

The relays supply three phase power in specified configurations to power units on the door. The phase configuration controls whether a power unit opens or closes the door.

There are internal and external control switches. The internal switch has priority over the external switch.

Unlock and Unlatch

A full open door lock handle enables door operation. The PSEU uses inputs from the handle unlocked sensor and door unlatched sensor to enable the door control relay. Either control switch in the OPEN position energizes the relay. The relay configures the power phases so the latch power unit unlatches the door.

Lift Movement

The PSEU uses input from the door unlatched sensor and door up sensor to enable the hinge up relay. Either control switch in the OPEN position energizes the relay. The relay configures the power phases so the lift power unit moves the door up. The PSEU uses input from the door up sensor to open the hinge up relay, and turn on the door up light.

Lower Movement

The PSEU uses input from the door unlatched sensor and latch range sensor to enable the hinge down relay. Either the external or internal control switch in the CLOSE position energizes the relay. The relay configures the power phases so the lift power unit lowers the door.

The PSEU uses input from the door up sensor to turn off the door up light.

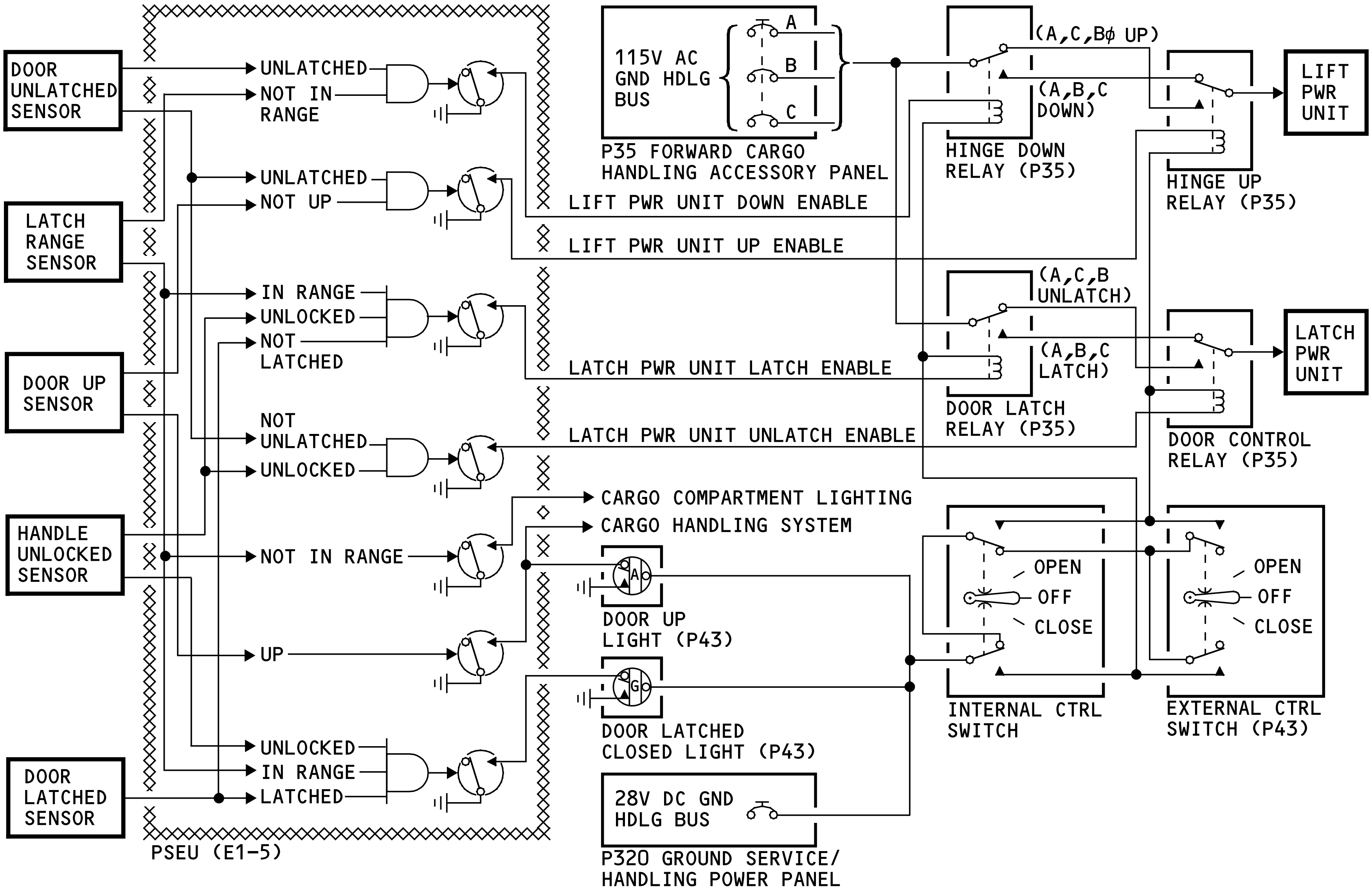
The PSEU uses input from the latch range sensor to open the hinge down relay.

Latch and lock

The PSEU uses input from the latch range sensor and handle unlocked sensor to enable the door latch relay. Either control switch in the CLOSE position energizes the relay. The relay configures the power phases so the latch power unit pulls in and latches the door. The PSEU uses input from the door latched sensor to open the door latch relay.

The PSEU uses input from the latch range sensor, door latched sensor, and handle unlocked sensor to turn on the door latched closed light.

When the lock handle is closed, the PSEU uses inputs from the handle unlocked sensor to turn off the door latched closed light.



52-34-00-023 Rev 1

FORWARD LARGE CARGO DOOR SYSTEM - ELECTRICAL FUNCTIONAL DESCRIPTION

AFT LARGE CARGO DOOR SYSTEM - INTRODUCTION

Purpose

The aft large cargo door system gives access to the aft cargo compartment.

Location

The door is on the right side of the air plane, aft of the wing.

General Description

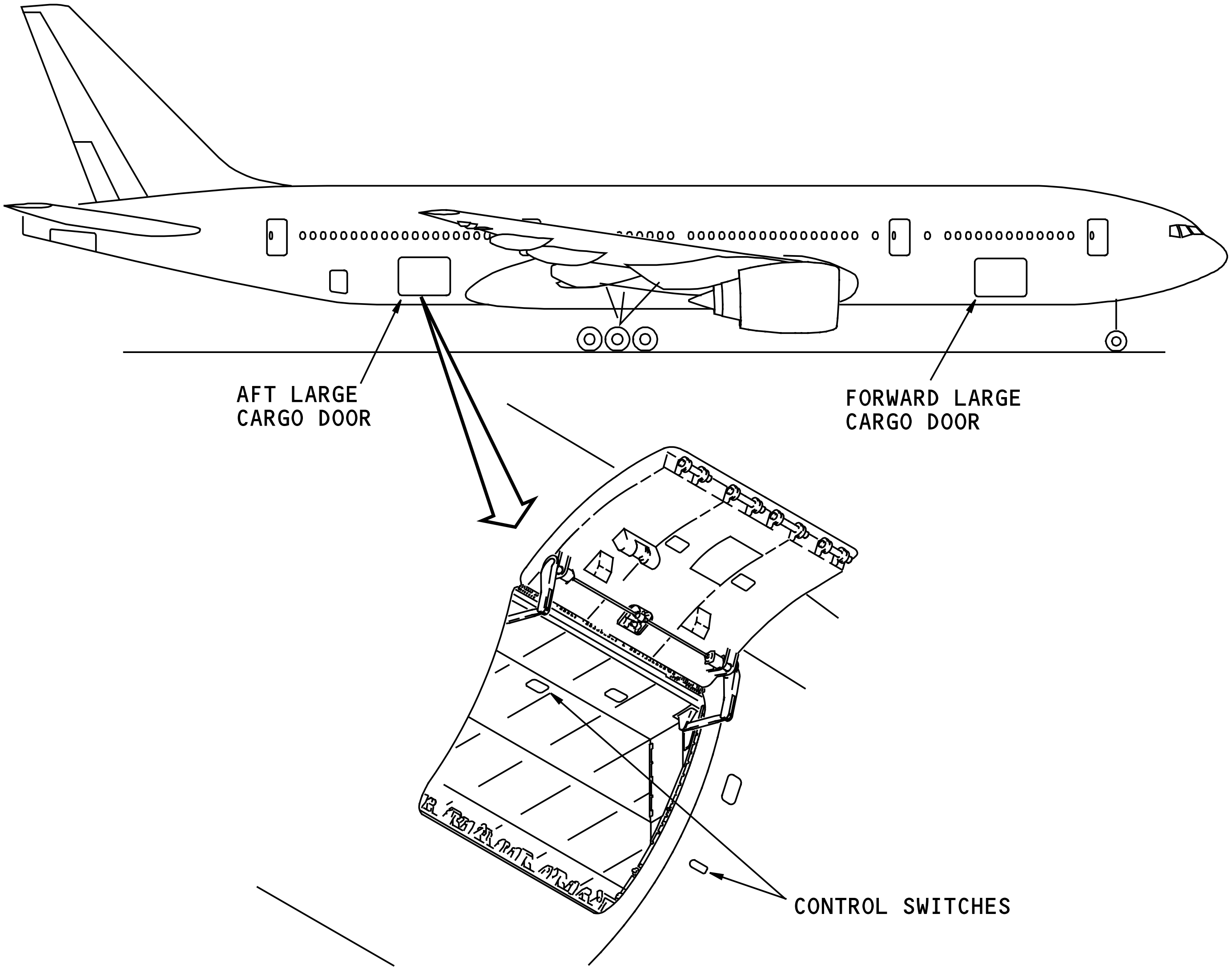
The large cargo door supplies a clear opening of 106 inches (269.2 cm) wide and 67 inches (170.2 cm) high. The dimensions of the door lets cargo handlers load and unload pallets and containers.

The door is a non-plug type of door. Door latches hold the door closed against cabin pressure loads.

The door opens outward and upward. You can operate it electrically from inside or outside the cargo compartment. You can operate it manually from outside the cargo compartment.

The forward and aft large cargo doors are the same in structure and operation.

See the forward large cargo door section for more information (AMM PART I 52-34).



AFT LARGE CARGO DOOR SYSTEM - INTRODUCTION

BULK CARGO DOOR SYSTEM - INTRODUCTION

Purpose

The bulk cargo door system gives access to the bulk cargo compartment.

Location

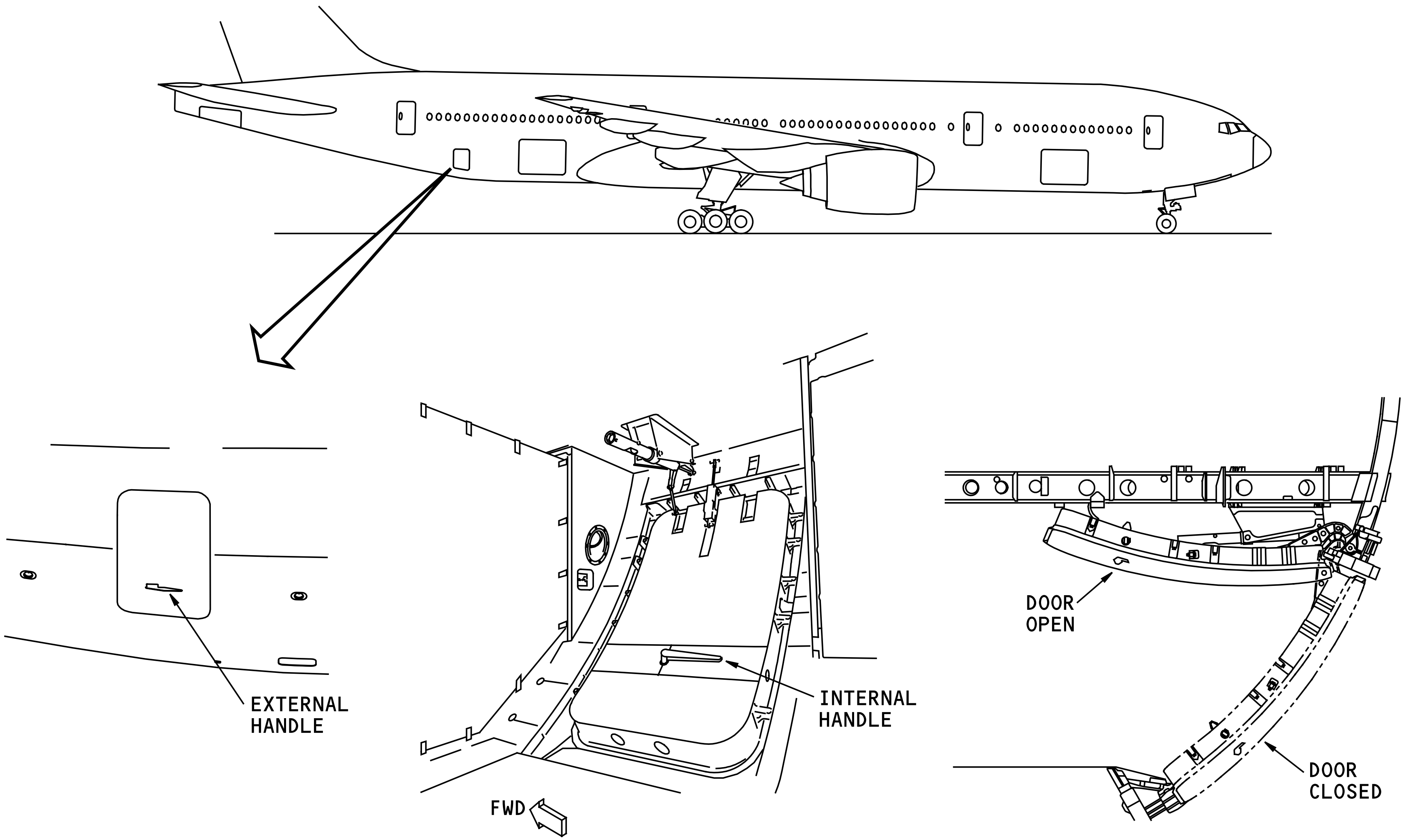
The bulk cargo door is on the right side of the airplane, aft of the aft cargo door.

General Description

The bulk cargo door supplies a clear opening of 36 inches (91.4 cm) wide and 45 inches (114.3 cm) high. Door dimensions let cargo handlers load and unload cargo that is not on pallets or in containers.

The door is a plug type. To open, it hinges along the top and moves into the bulk cargo compartment area.

You operate it manually from outside or inside the bulk cargo compartment.



INSIDE VIEW OF DOOR

VIEW LOOKING FORWARD

BULK CARGO DOOR SYSTEM - INTRODUCTION

52-36-00-001 Rev 3 03/02/1998

BULK CARGO DOOR SYSTEM - COMPONENT LOCATIONS

Component Locations

The counterbalance mechanism is on the cargo compartment ceiling structure, inboard of the bulk cargo door.

The snubber is at the top, center of the cargo door.

The two hinge arms are at the top of the cargo door.

The latch mechanism is across the door, near the bottom.

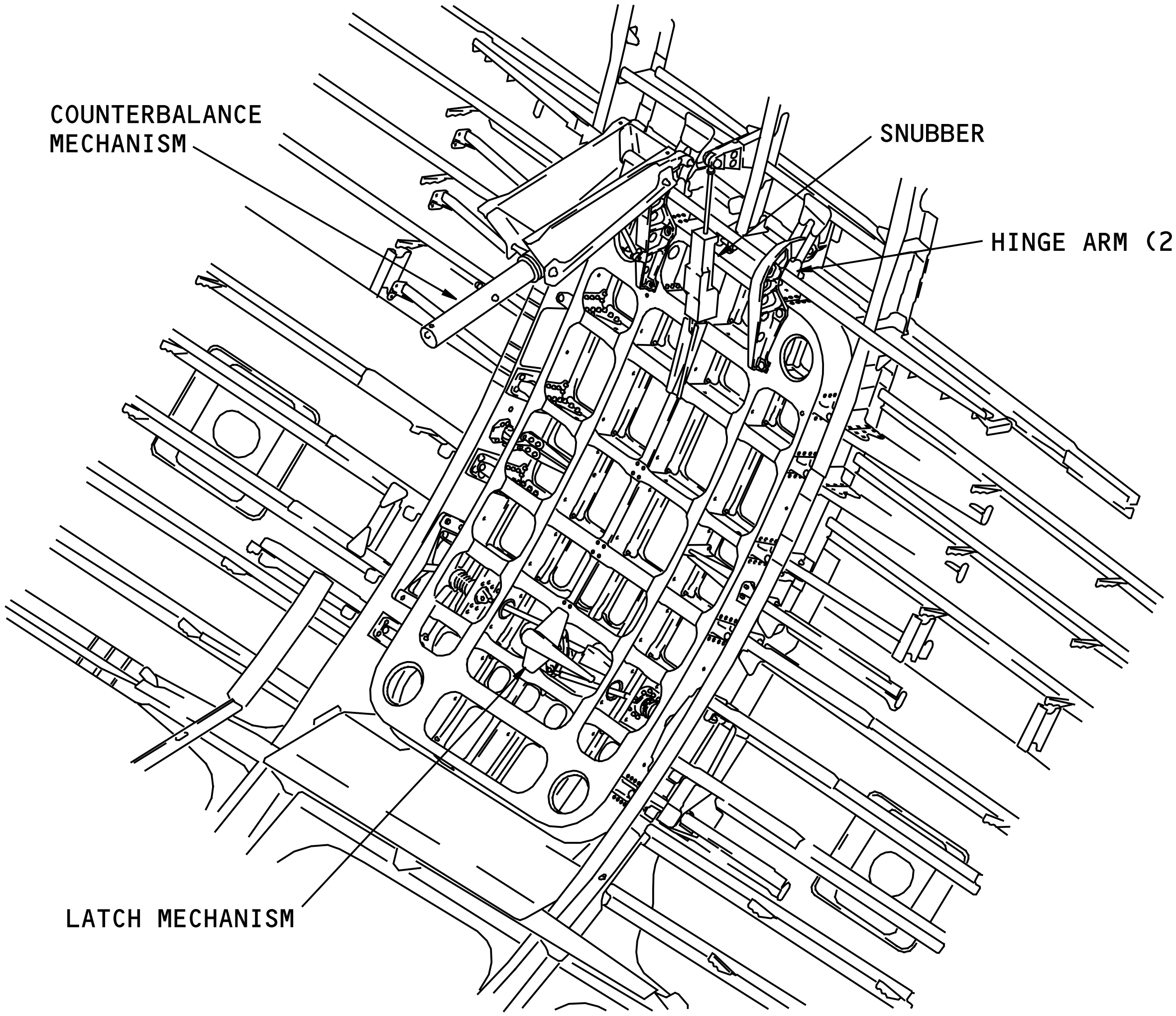
General Description

The latch mechanism lets you open and close the door. It also holds the door closed.

The hinge arms let the door rotate open and closed.

The counterbalance lifts the door open.

The snubber controls the movement rate of the door.



52-36-00-002 Rev 0

BULK CARGO DOOR SYSTEM - COMPONENT LOCATIONS

BULK CARGO DOOR SYSTEM - DOOR AND SEAL

Purpose

The door and seal close and seal the external access to the bulk cargo compartment.

Physical Description

The door is a plug-type. It has a skin, frames, beams, guide rollers, and stops.

The seal is a blade-type that goes completely around the edge of the door.

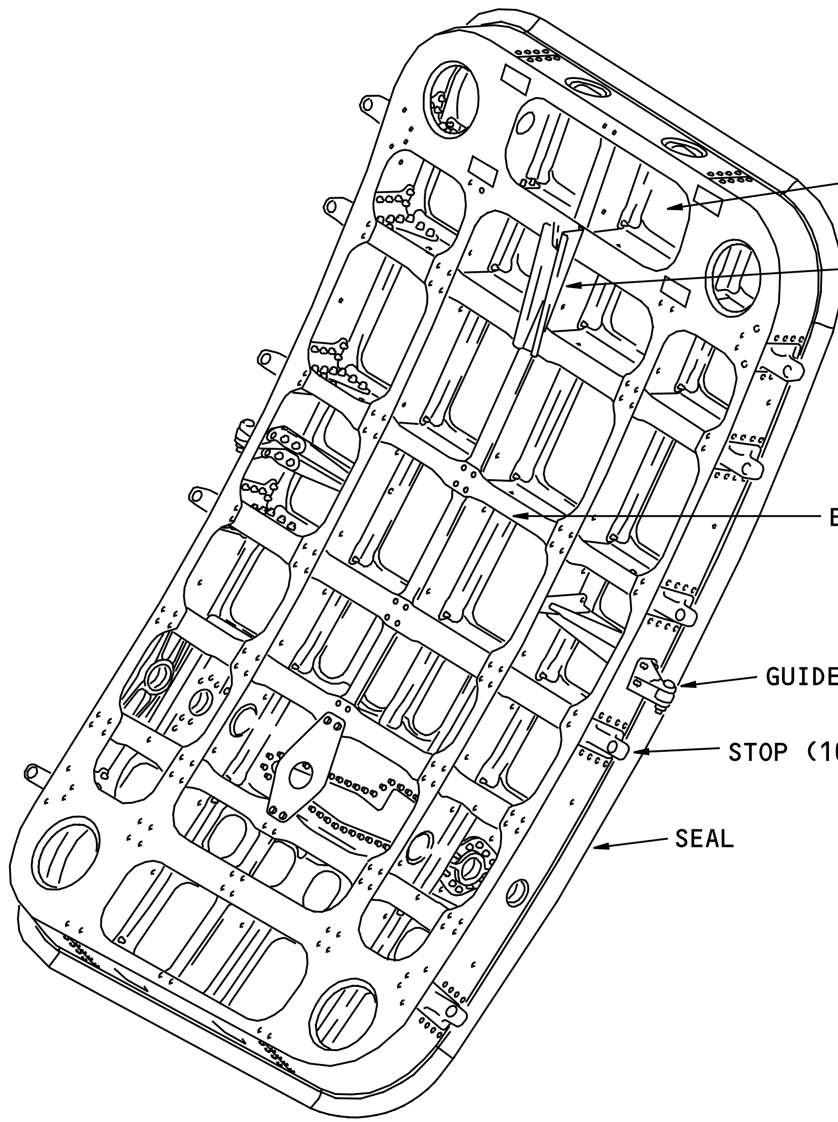
Functional Description

The five stops on each side of the door pass the pressurization load on the door to stops on the door cutout.

The guide rollers put the door in the correct position as it goes into the cutout.

Training Information Point

The door seal prevents air flow from the cargo compartment to the outside.



52-36-00-003 Rev 0

BULK CARGO DOOR SYSTEM - DOOR AND SEAL

BULK CARGO DOOR SYSTEM - COUNTERBALANCE MECHANISM

Purpose

The counterbalance mechanism lifts the bulk cargo door to the open position.

Physical Description

The counterbalance mechanism has these components:

- Tube that contains four springs
- Saddle fitting
- Piston rod
- Bellcrank
- Control rod.

Location

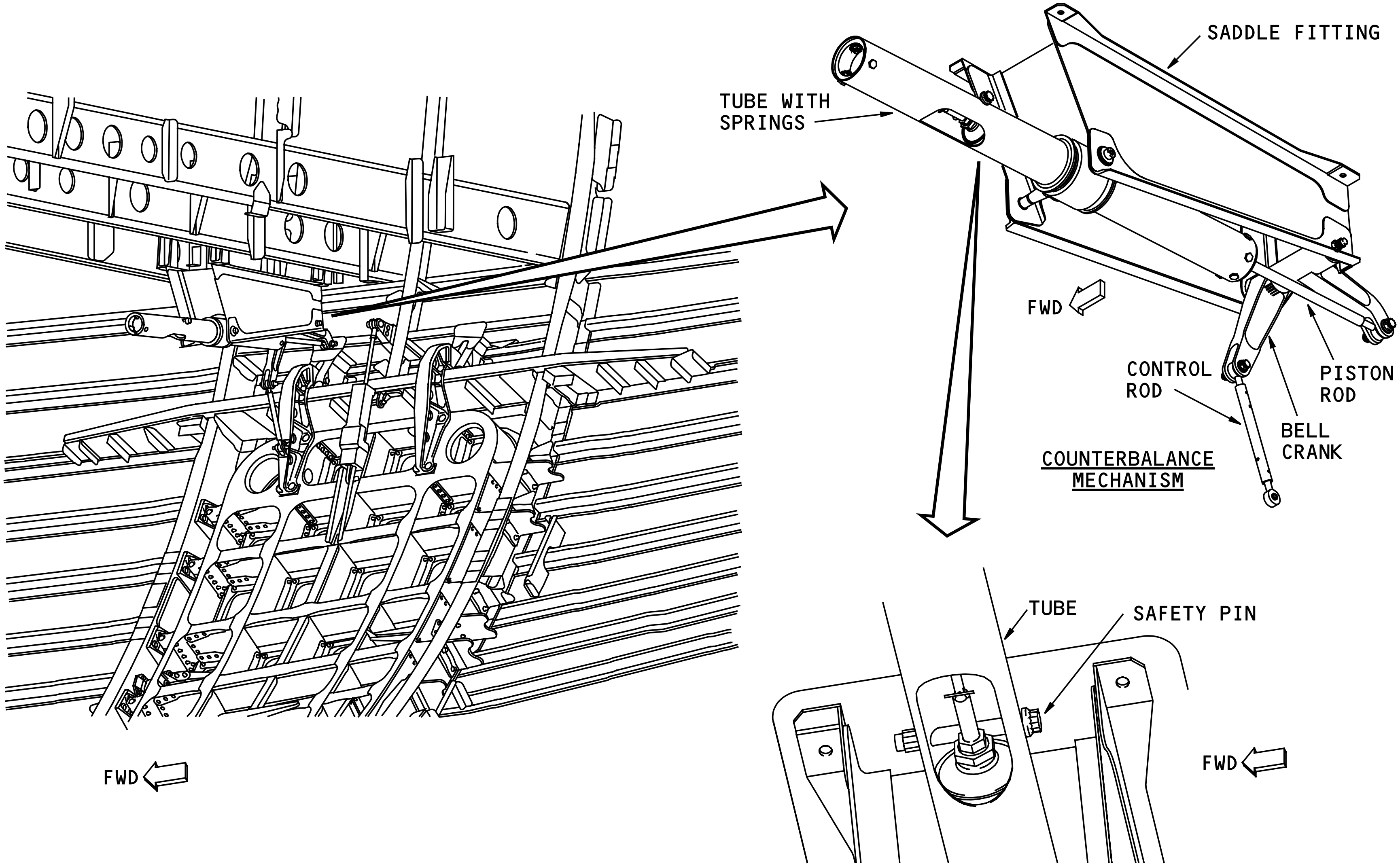
The tube has a pin in the middle that attaches to the saddle fitting. The saddle fitting attaches to airplane structure at the top of the bulk cargo compartment. The control rod attaches to the door.

Functional Description

The springs in the tube supply the force that opens the door. The piston rod, bellcrank, and control rod transmit the force that lifts the door.

Training Information Point

You can put a safety pin through the tube to keep the springs compressed when you disconnect linkage or remove the tube from the saddle fitting.



52-36-00-004 Rev 1 10/09/96

BULK CARGO DOOR SYSTEM - COUNTERBALANCE MECHANISM

BULK CARGO DOOR SYSTEM - SNUBBER

Purpose

The snubber controls the rate at which:

- The counterbalance opens the door
- You can close the door
- The door closes if the counterbalance fails.

Physical Description

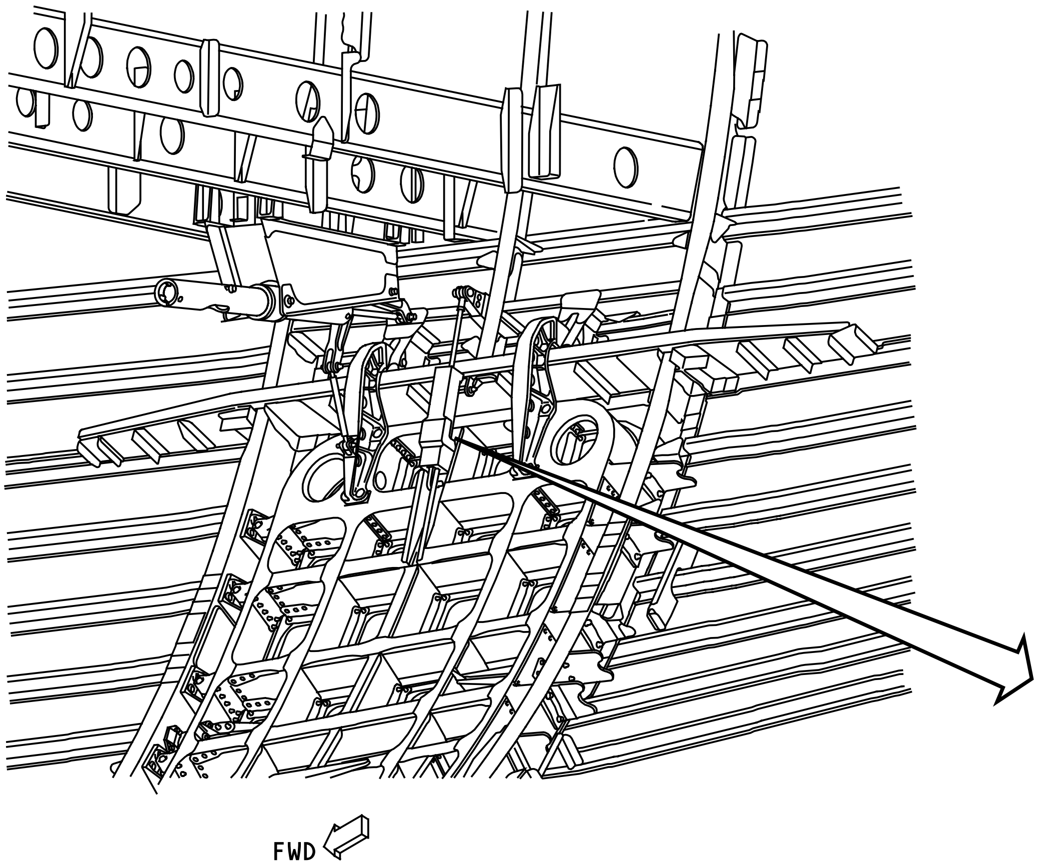
The snubber is a piston rod in a fluid-filled tube.

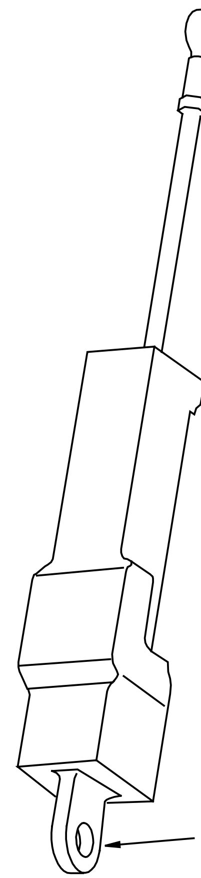
Location

The tube end of the snubber attaches to the airplane structure above the door cutout. The rod end attaches to the door.

Functional Description

Movement of the piston rod makes fluid flow through an orifice in the piston. This controls the rate at which the door moves.





SNUBBER

52-36-00-005 Rev 0

BULK CARGO DOOR SYSTEM - SNUBBER

BULK CARGO DOOR SYSTEM - LATCH MECHANISM

Purpose

The latch mechanism lets you latch and unlatch the door.

Physical Description

The mechanism is made up of these components:

- External handle
- Latch probes
- Springs
- Push/pull rods
- Internal handle.

Location

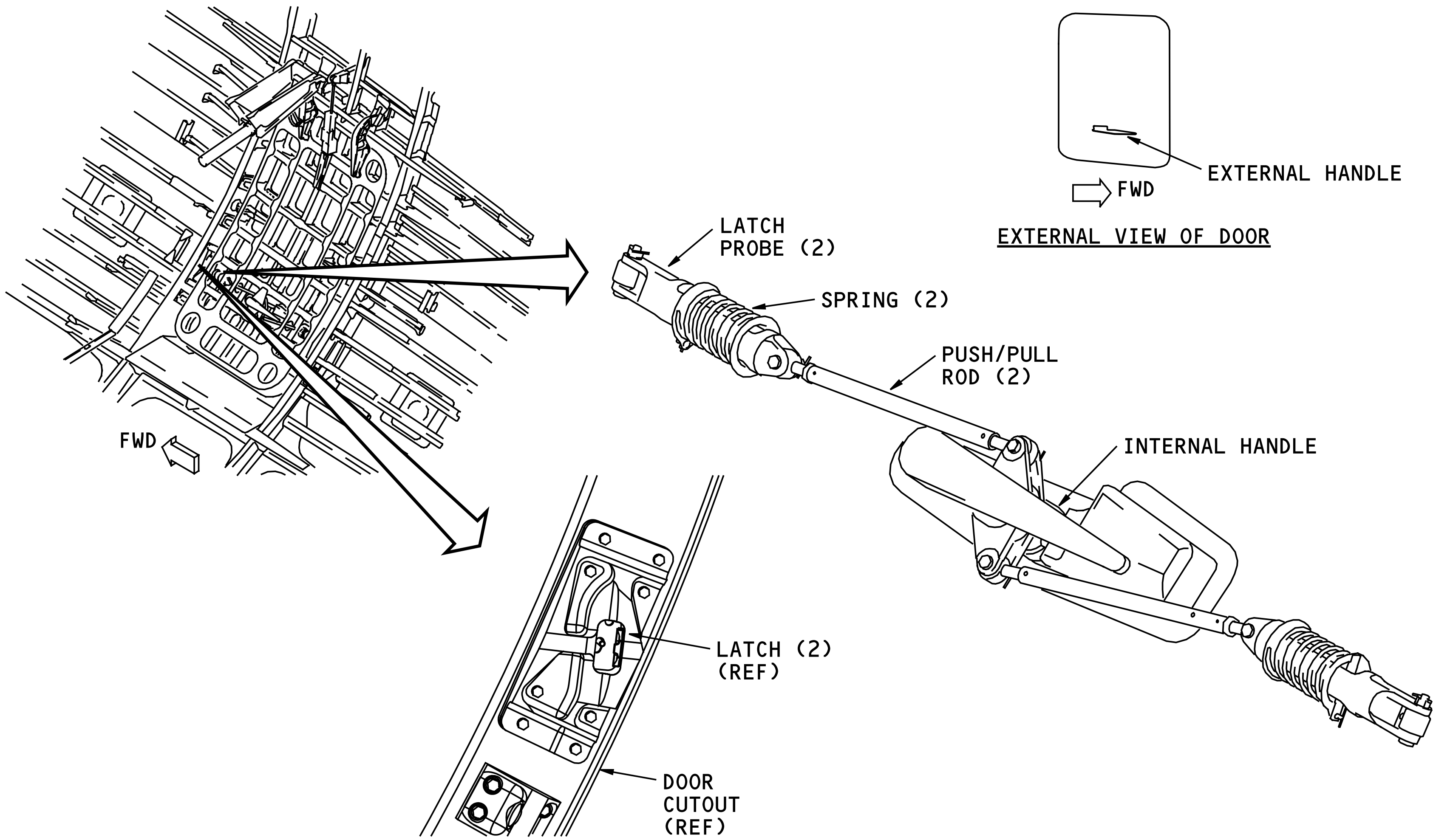
The latch mechanism goes across the door, near the bottom. The latches are on the door cutout.

Functional Description

When you pull outboard on the external handle, it connects to the internal handle. The internal handle connects to the push/pull rods.

When you turn either handle, the push/pull rods compress the springs and pull the probes out of the latches. When you release the handle, the springs push the latch probes outward.

A spring on the external handle pulls it inboard to the fair position when the door is latched.



EXTERNAL VIEW OF DOOR

VIEW LOOKING FORWARD AT THE
FORWARD SIDE OF THE DOOR CUTOUT

52-36-00-007 Rev 0

BULK CARGO DOOR SYSTEM - LATCH MECHANISM

BULK CARGO DOOR SYSTEM - OPERATION

Operation - Door Open

You can use either the internal or the external handle to unlatch door. To use the external handle, pull the handle outboard until you can turn it. To use the internal handle, you only need to turn it.

When the door is unlatched, the counterbalance supplies the force to open the door. The snubber controls the rate at which the door opens. The door rotates inward and upward on the hinge arms.

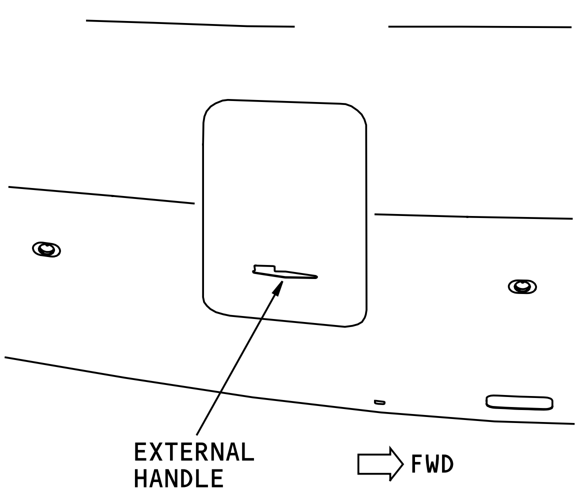
When the door is fully open, put the hold-open strap around the lower, aft door stop.

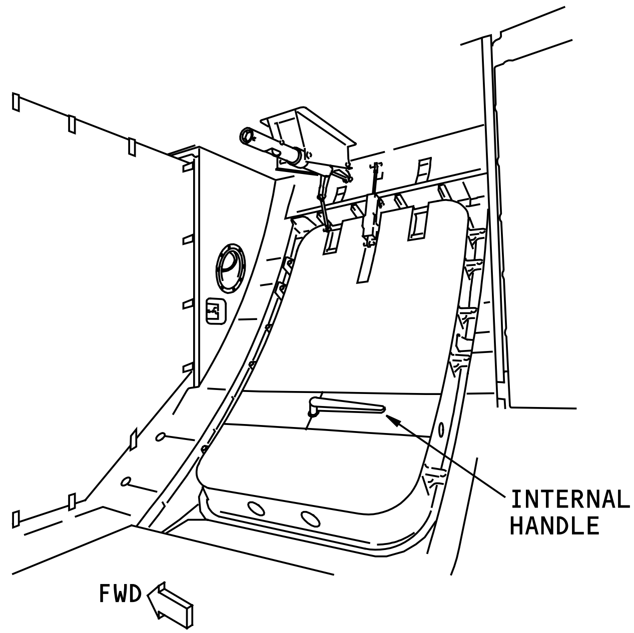
Operation - Door Close

To close the door, release the hold open strap. Pull or push the door down. Rotate the handle to the unlatch position. Close the door. Turn the handle to the latch position. The door is latched and locked.

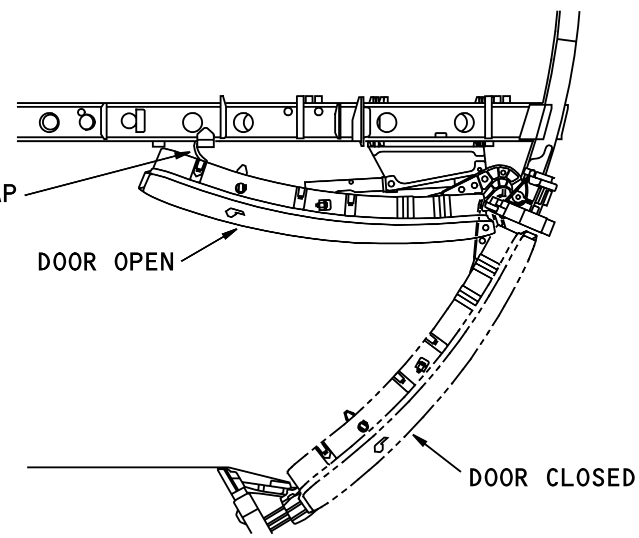
When the door is full open, use the hold open strap. It gives protection in case the counterbalance and snubber fail.

If you use the external handle, make sure the handle goes inboard to the fair position when you close the door.





INSIDE VIEW OF DOOR



VIEW LOOKING FORWARD

BULK CARGO DOOR SYSTEM - OPERATION

EQUIPMENT COMPARTMENT AND EQUIPMENT SERVICE DOORS - LEFT SIDE OF AIRPLANE

Purpose

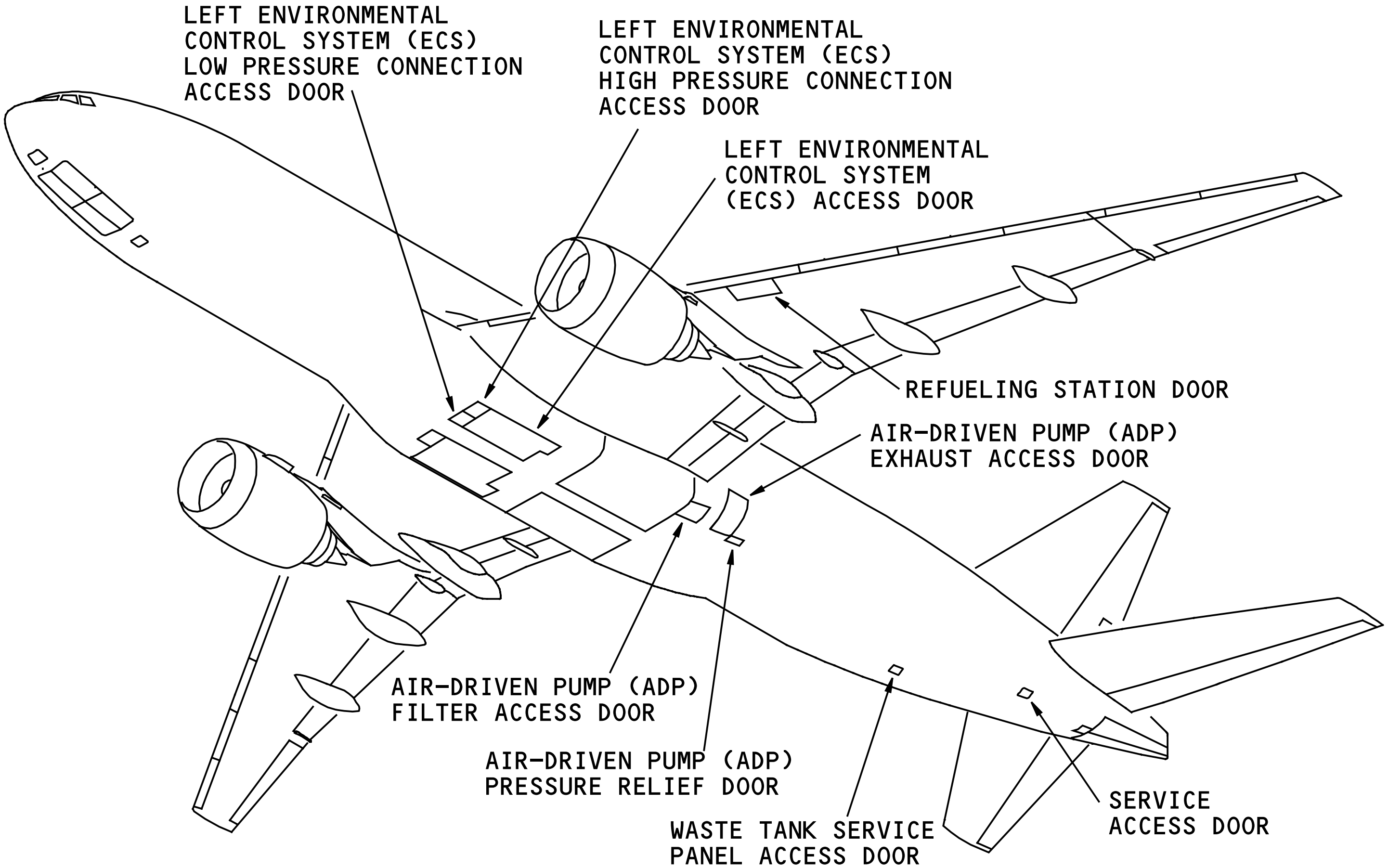
Equipment compartment doors give access to equipment on the airplane.

Equipment service doors give access to service airplane systems.

Location

These equipment compartment and equipment service doors are on the left side of the airplane:

- Left environmental control system (ECS) low pressure connection access door
- Left environmental control system (ECS) high pressure connection access door
- Left environmental control system (ECS) access door
- Refueling station door
- Air driven pump (ADP) exhaust door
- Service access door
- Waste tank service access door
- Air-driven pump (ADP) pressure relief door
- Air-driven pump (ADP) filter access door.



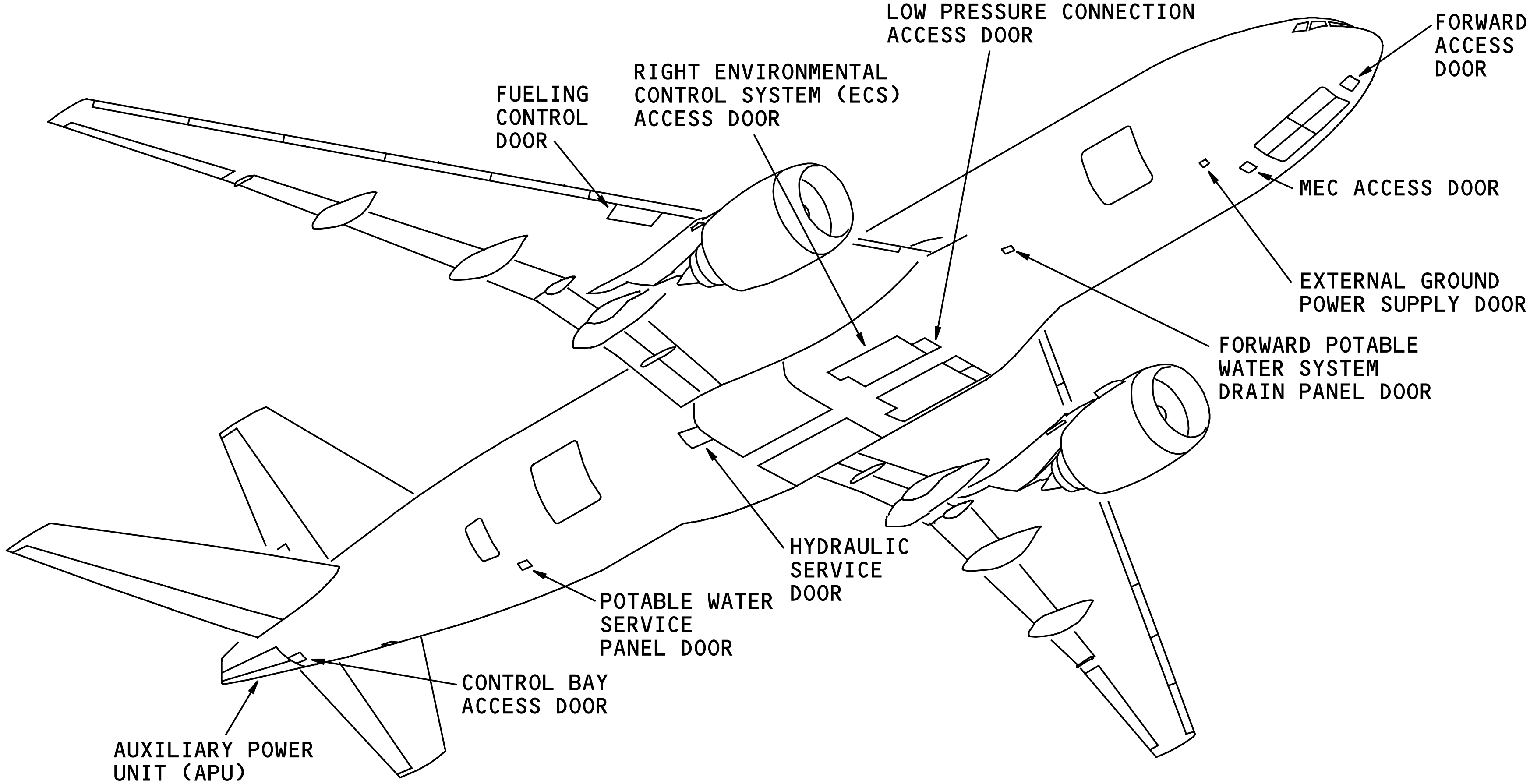
EQUIPMENT COMPARTMENT AND EQUIPMENT SERVICE DOORS - LEFT SIDE OF AIRPLANE

EQUIPMENT COMPARTMENT AND EQUIPMENT SERVICE DOORS - RIGHT SIDE AND BOTTOM OF AIRPLANE

Location

These equipment compartment doors and equipment service doors are on the right side and bottom of the airplane:

- Fueling control door
- Right environmental control system (ECS) access door
- Right environmental control system (ECS) low pressure connection access door
- MEC access door
- Forward access door
- External ground power supply access door
- Forward potable water system drain panel door
- Hydraulic service door
- Potable water service panel door
- Control bay access door
- Auxiliary power unit (APU) access door.



52-40-00-002 Rev 2 03/02/1998

EQUIPMENT COMPARTMENT AND EQUIPMENT SERVICE DOORS - RIGHT SIDE AND BOTTOM OF AIRPLANE

FIXED INTERIOR DOORS - INTRODUCTION

Purpose

Fixed interior doors give access from one compartment to another inside the airplane.

Location

These are the fixed interior doors:

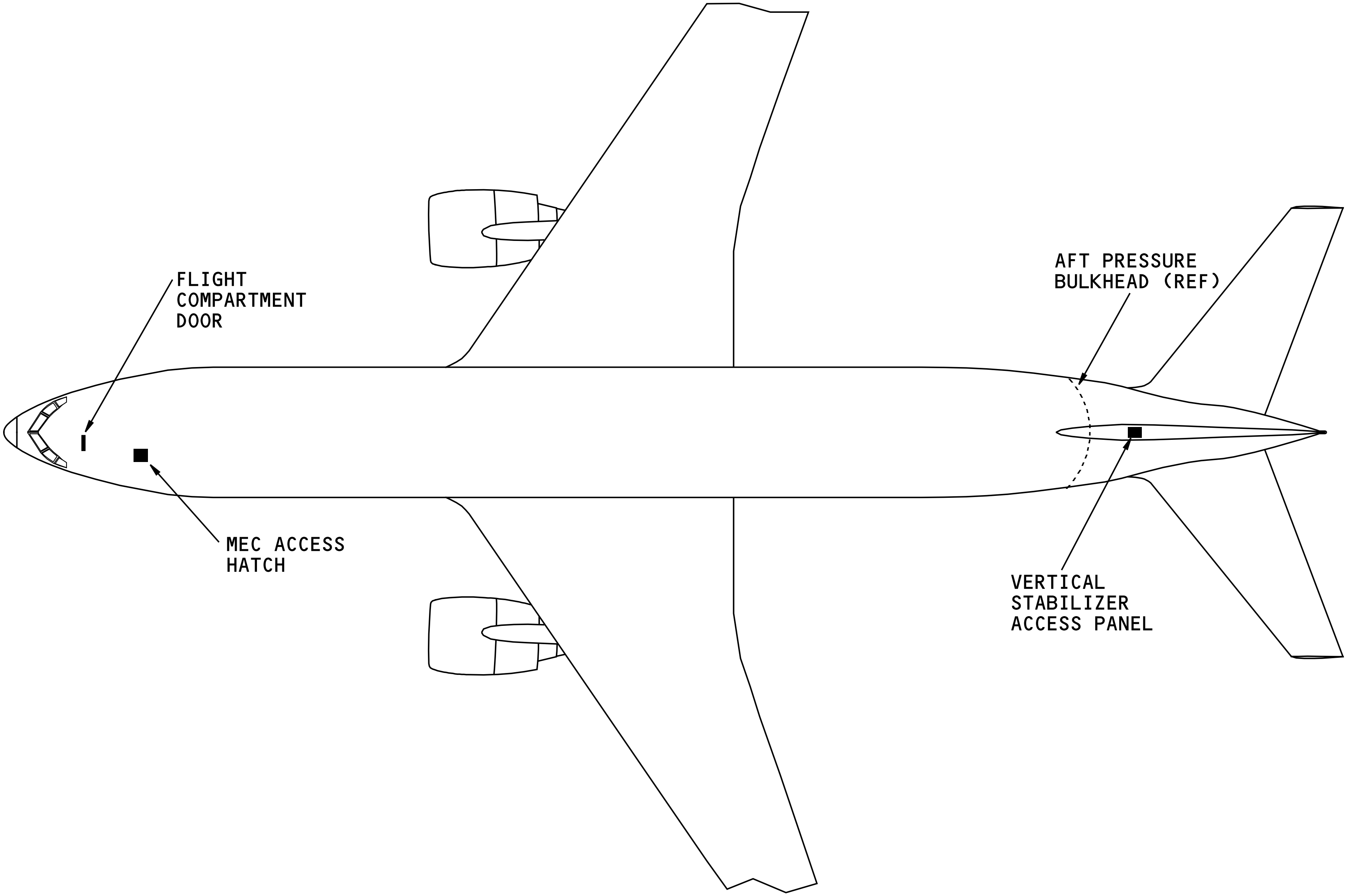
- Flight compartment door
- Main equipment center (MEC) access hatch
- Vertical stabilizer access panel.

The flight compartment door is on the left side of flight compartment aft bulkhead.

The main equipment center access hatch is in the forward end of the passenger compartment left aisle near the passenger entry door.

The vertical stabilizer access panel is in the top of the fuselage tail section. Access to the tail section is through the service access door.

See the equipment compartment and equipment service doors section for more information (AMM PART I 52-40).



FIXED INTERIOR DOORS - INTRODUCTION

FIXED INTERIOR DOORS - FLIGHT COMPARTMENT DOOR - FUNCTIONAL DESCRIPTION

Door Hinge

The door hinge is on the outboard side of the door cutout in the flight compartment aft bulkhead. The door turns forward on the hinge into the flight compartment. Three pins let you disconnect the door from the hinge.

Lock Unit and Handle

The door lock unit is on the inboard side of the door cutout in the door post. A door bolt (not shown) engages a spring-loaded catcher in the lock unit to hold the door closed.

The door handle on the flight compartment side of the door connects to the door bolt. When you turn the handle the door bolt pulls out of the catcher and you can open the door into the flight compartment.

The door handle on the passenger compartment side of the door does not connect to the door bolt. You push on the door to open it. The door bolt pushes on the catcher. The catcher turns against its spring until the bolt moves past. When you close the door, the bolt pushes on the catcher. The bolt moves into the door against its spring until it moves past the strike.

The catcher and the lock are on the same bolt in the lock unit. Two balls are in detents, between the catcher and the lock. A spring washer (not shown) on the bolt, pushes the catcher, balls, and lock together. The roller attaches to the lock. When you open the door normally, the catcher, balls, lock, and roller turn together.

A flight compartment door lock switch (not shown) on the P5 lets you lock the door. The solenoid moves a pin up. When you try to push the door open from the passenger side, the roller pushes against the pin. The lock and catcher cannot turn.

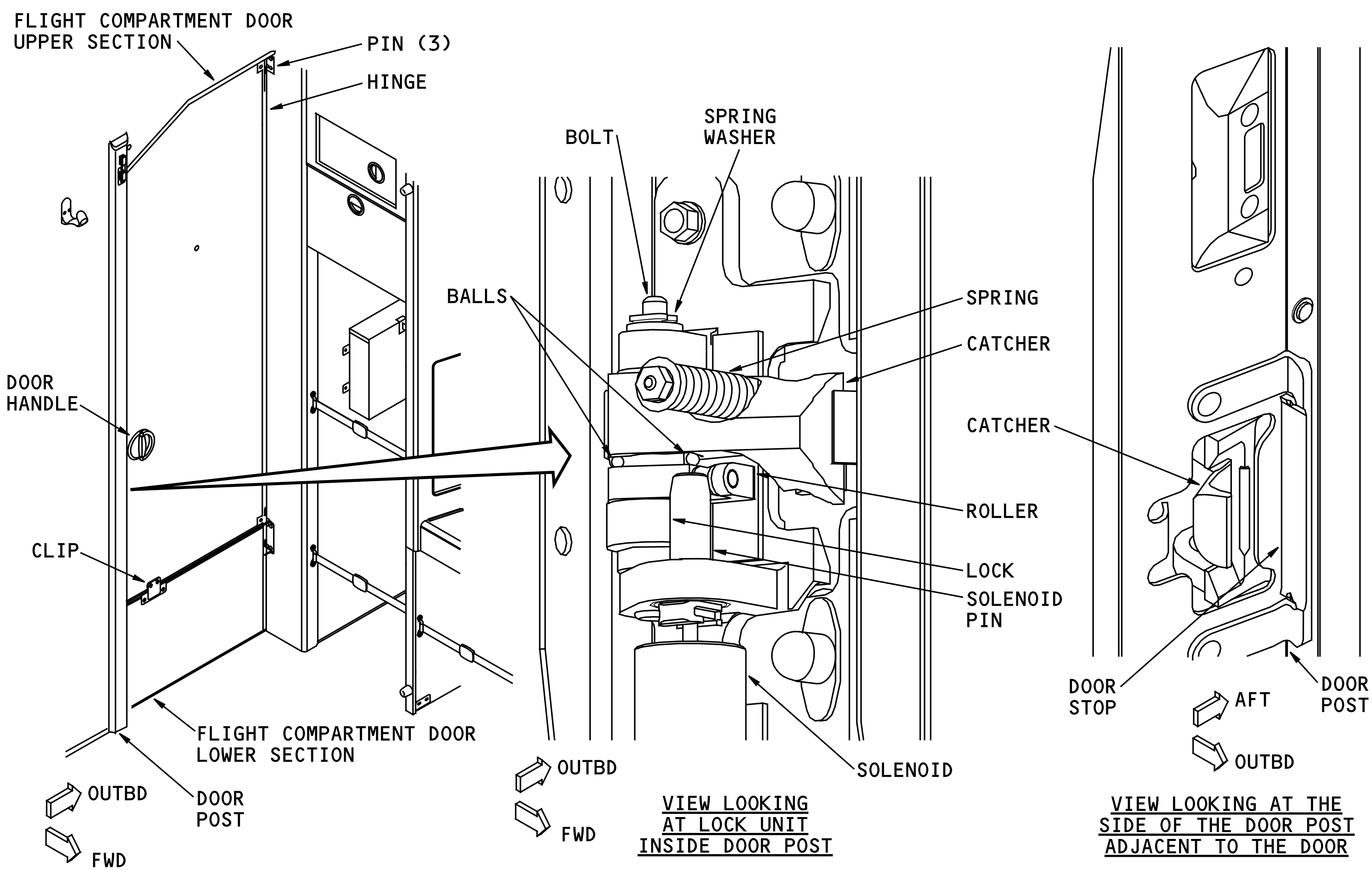
Decompression

If there is fast decompression in the flight deck, passenger compartment air pressure pushes against the door. A 120 pound force compresses the spring washer sufficiently to let the balls in the detents disconnect the catcher from the lock. The catcher can turn. This releases the door to move on its hinge into the flight compartment.

If there is fast decompression in the passenger compartment, air pressure pushes the door toward the passenger compartment. A 120 pounds force breaks the door stop. This releases the door to move on its hinge into the passenger compartment.

Door Sections

The door has upper and lower sections. They are held together by a clip and normally turn together. If a blockage on the floor will not let the door turn, the clip lets the sections disconnect. This releases the upper section to turn.



52-50-00-002 Rev 1 11/03/1997

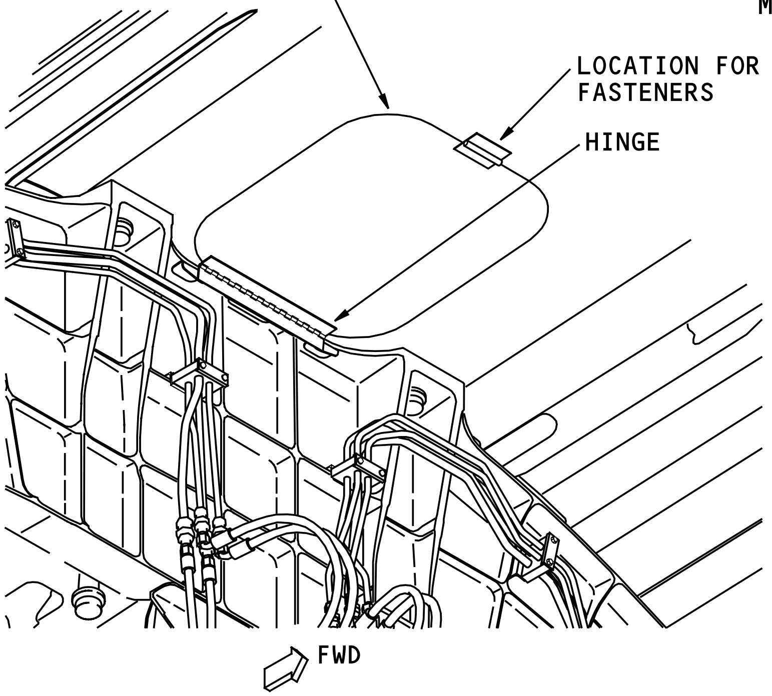
FIXED INTERIOR DOORS - FLIGHT COMPARTMENT DOOR - FUNCTIONAL DESCRIPTION

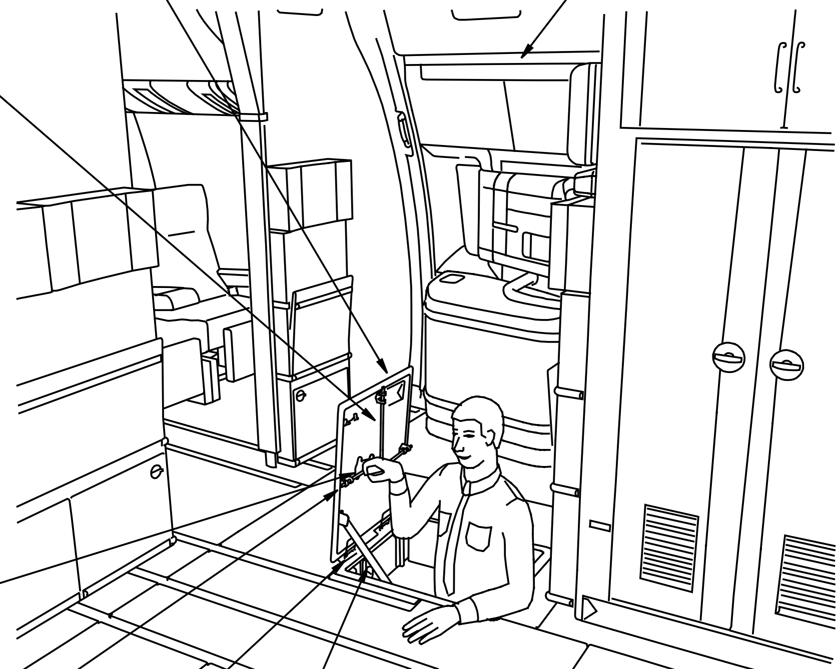
Vertical Stabilizer Access Panel Functional Description

The vertical stabilizer access panel is held closed by quarter turn fasteners (not shown) on the forward side of the panel. The panel opens downward on a hinge on the aft side of the panel.

Electrical/Electronic Access Hatch Functional Description

The electrical/electronics access hatch has handles on both sides that move the three pins of the latch mechanism. Hinges on the aft side of the hatch let it open upward. The restraint arm holds it in the open position.





52-50-00-003 Rev 1 08/13/96

FIXED INTERIOR DOORS - ELECTRICAL/ELECTRONICS ACCESS HATCH & VERTICAL STABILIZER ACCESS PANEL

DOOR WARNING SYSTEM - PASSENGER ENTRY DOOR SENSORS

Location

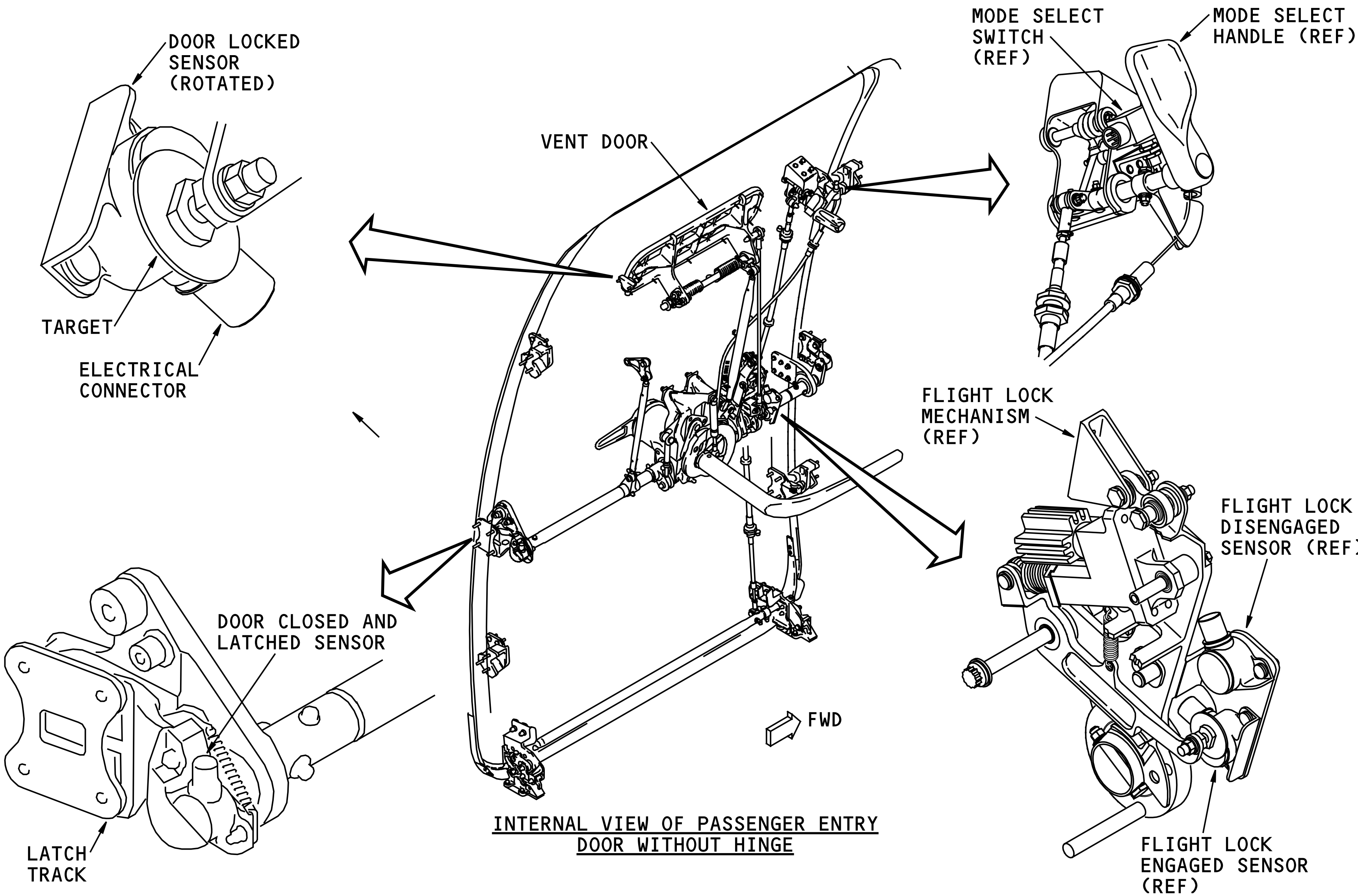
Each passenger entry door has two proximity sensors that are components of the door warning system. The door closed and latched sensor is on the aft latch track. The door locked sensor is on the vent door.

The mode select switch on the mode select handle is a door component. It is part of the emergency power assist system (EPAS). It also gives door warning information.

See passenger entry door section for more information on the mode select switch (AMM PART I 52-11).

The flight lock engaged and disengaged sensors are flight lock components. They give information for status and maintenance messages.

See passenger entry door section for more information on the flight lock sensors (AMM PART I 52-11).



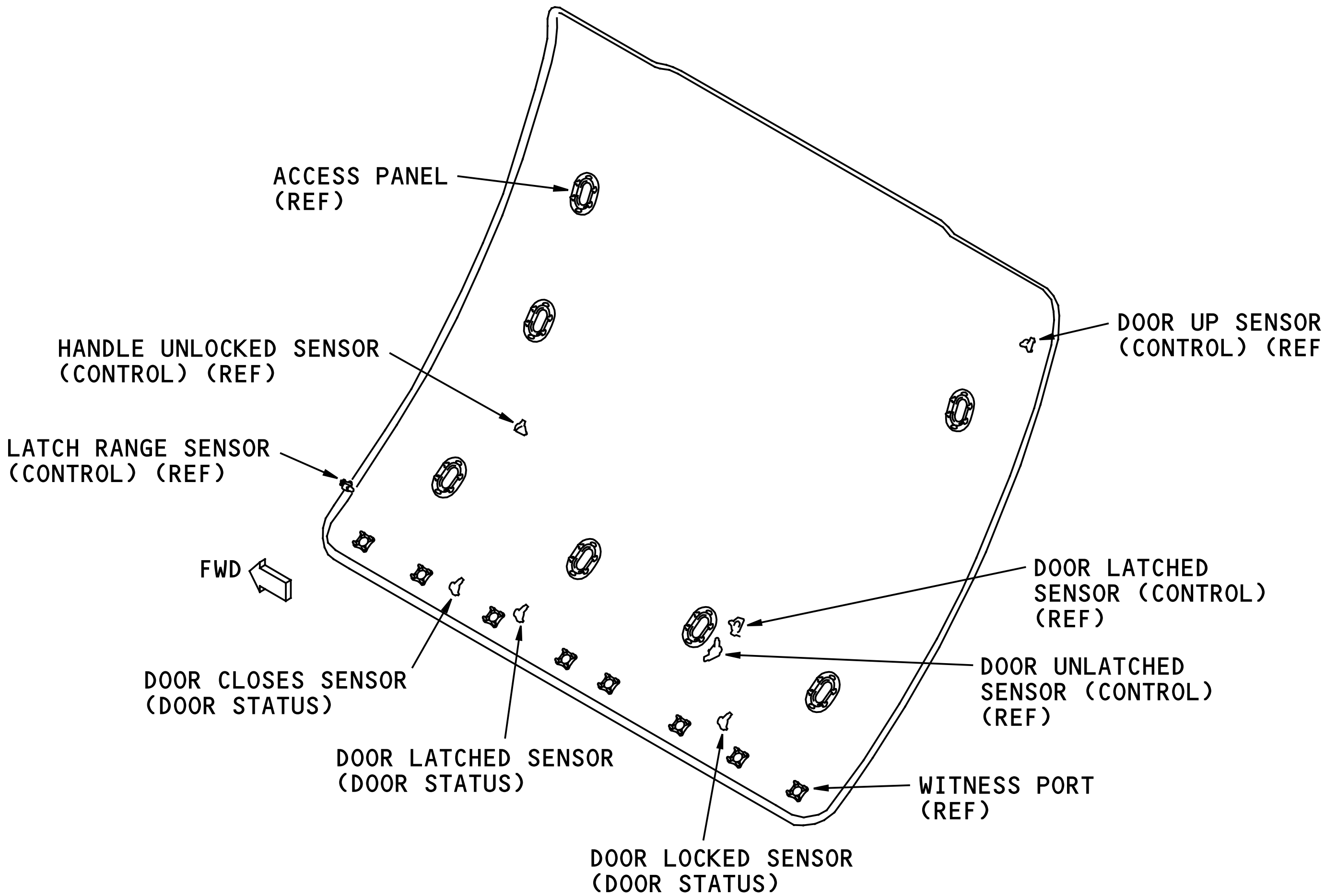
DOOR WARNING SYSTEM - PASSENGER ENTRY DOOR SENSORS

DOOR WARNING SYSTEM - LARGE CARGO DOOR SENSORS

Location of Large Cargo Door Sensors

There are three proximity sensors on the large cargo door that supply information for door status indications along the bottom of the door. These are the large cargo door status sensors:

- Closed sensor
- Latched sensor
- Locked sensor.



INSIDE VIEW OF
LARGE CARGO DOOR

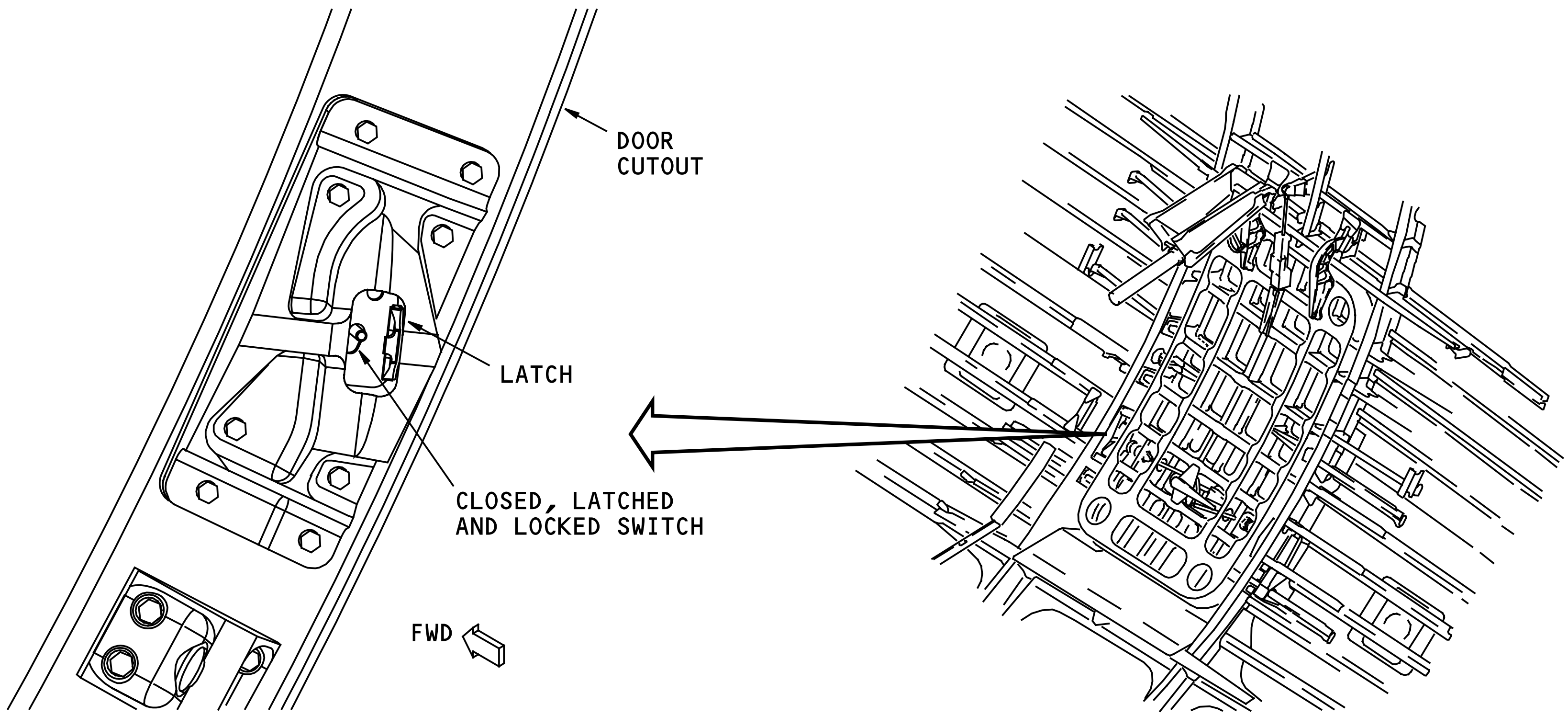
52-71-00-003 Rev 1

DOOR WARNING SYSTEM - LARGE CARGO DOOR SENSORS

DOOR WARNING SYSTEM - BULK CARGO DOOR SWITCH

Location

The bulk cargo door closed, latched and locked switch is in the latch on the forward side of the door cutout.



VIEW LOOKING FORWARD AT THE
FORWARD SIDE OF THE DOOR CUTOUT

INSIDE VIEW OF
BULK CARGO DOOR

52-71-00-004 Rev 0

DOOR WARNING SYSTEM - BULK CARGO DOOR SWITCH

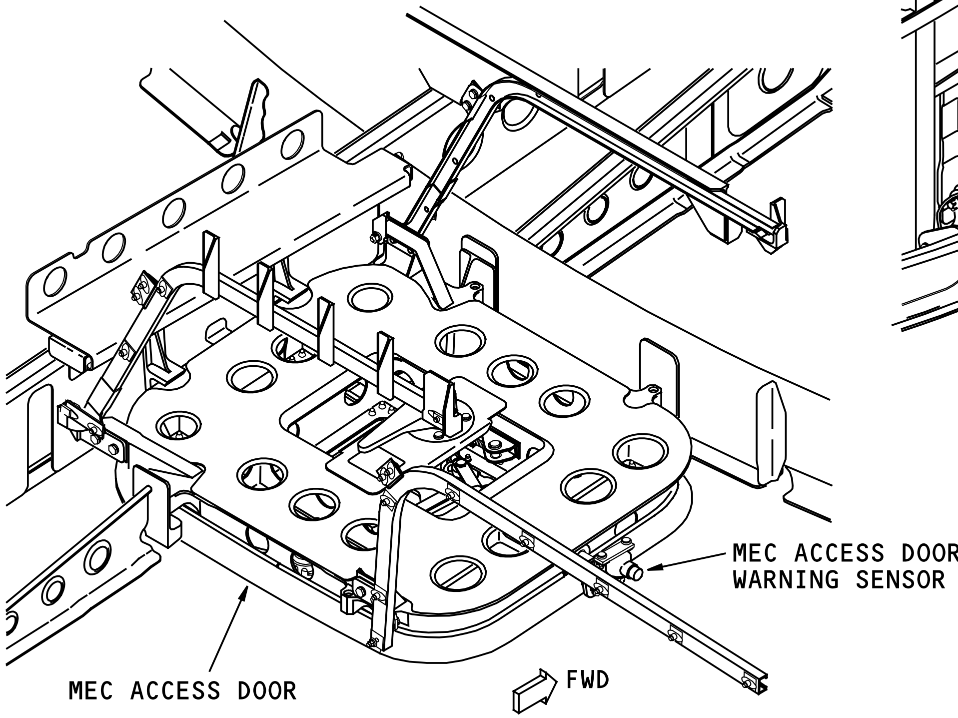
DOOR WARNING SYSTEM - ACCESS DOOR SENSORS

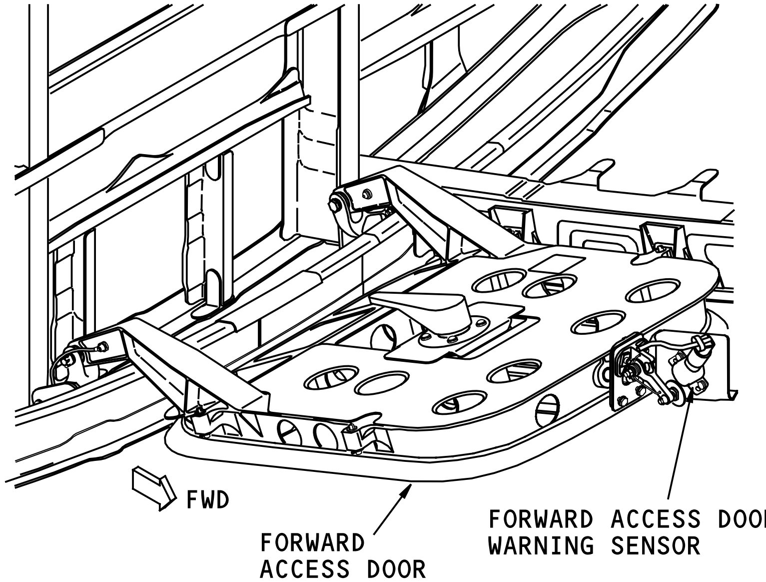
Location of Forward Access Door Warning Sensors

The forward access door proximity sensor that supplies door status information is adjacent to the door latch in the cutout.

Location of Main Equipment Center (MEC) Access Door Warning Sensors

The electrical/electronics access door proximity sensor that supplies door status information is adjacent to the door latch in the cutout.





52-71-00-005 Rev 1

DOOR WARNING SYSTEM - ACCESS DOOR SENSORS

DOOR WARNING SYSTEM - FUNCTIONAL DESCRIPTION

Functional Description

These components give door status information to the PSEU:

- A switch on the bulk cargo door
- Proximity sensors on all of the other doors that go through the pressurized structure of the airplane.

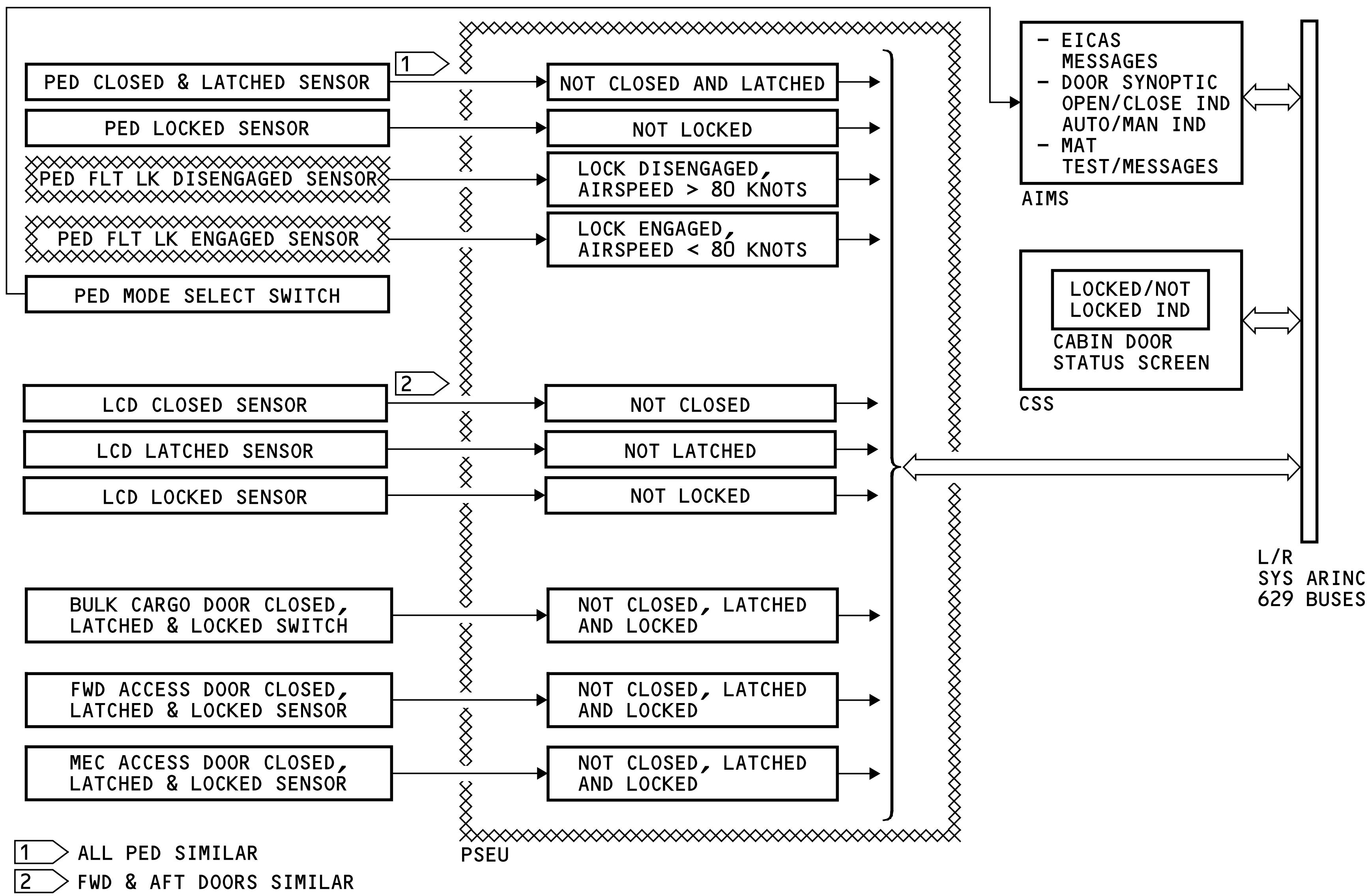
The PSEU monitors information about door positions and about the sensors/switches used to monitor door positions. The PSEU sends the information to the AIMS through the left and right ARINC 629 buses.

AIMS shows the information on these displays:

- EICAS
- STATUS
- DOOR SYNOPTIC
- MAT.

The AIMS supplies passenger entry door information from the PSEU to the cabin services system (CSS). The CSS shows door LOCKED/NOT LOCKED information on the cabin door status screen.

The passenger entry door mode select switch sends auto/manual position information directly to the AIMS. AIMS shows the position information on the door synoptic display.



DOOR WARNING SYSTEM - FUNCTIONAL DESCRIPTION

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DOOR WARNING SYSTEM - INDICATIONS

General

The following displays show door indications:

- EICAS
- Door synoptic
- Status
- MAT.

EICAS Display

The following door information shows on the EICAS display:

- Configuration warning
- Caution
- Advisory
- Memo.

A configuration warning shows if an engine is put at takeoff power with one or more of these doors not in the closed, latched, and locked position.:

- Passenger entry
- Forward cargo
- Aft cargo.

Caution or advisory messages show for each door that is not in the closed, latched, and locked position. The large cargo door has a caution message. The other doors have advisory messages. For the doors that have advisory messages, a single message will show when these conditions are true:

- The airplane is on the ground
- Both engines are off
- More than one of the doors are not closed, latched and locked.

Memo messages show this passenger entry door mode information:

- AUTO when all of the doors are in the auto mode
- MANUAL when all of the doors are in the manual mode
- AUTO/MANUAL when some of the doors are in the auto mode and some are in the manual mode.

These memo messages do not show from the time takeoff power is applied to one minute after landing.

Door Synoptic Display

The door synoptic display shows the status of these doors:

- Equipment center access doors
- Passenger entry doors
- Cargo compartment doors.

The names of the doors always show. An amber door symbol shows when a door is not closed, latched, and locked. The symbol does not show when a door is closed, latched, and locked. Invalid sensor information shows as a white door symbol outline.

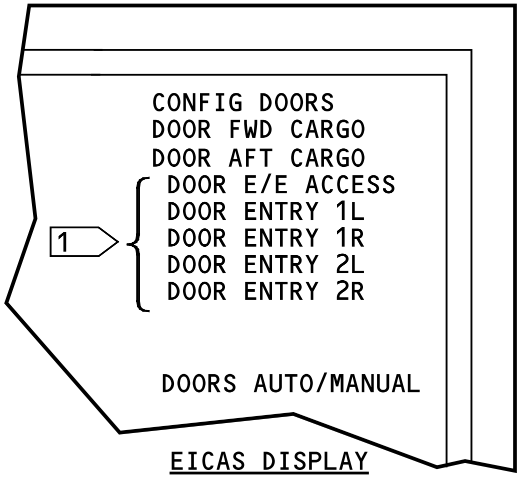
DOOR WARNING SYSTEM - INDICATIONS

When a passenger entry door is closed, latched, and locked, these letters (in color) show the position of the mode select handle:

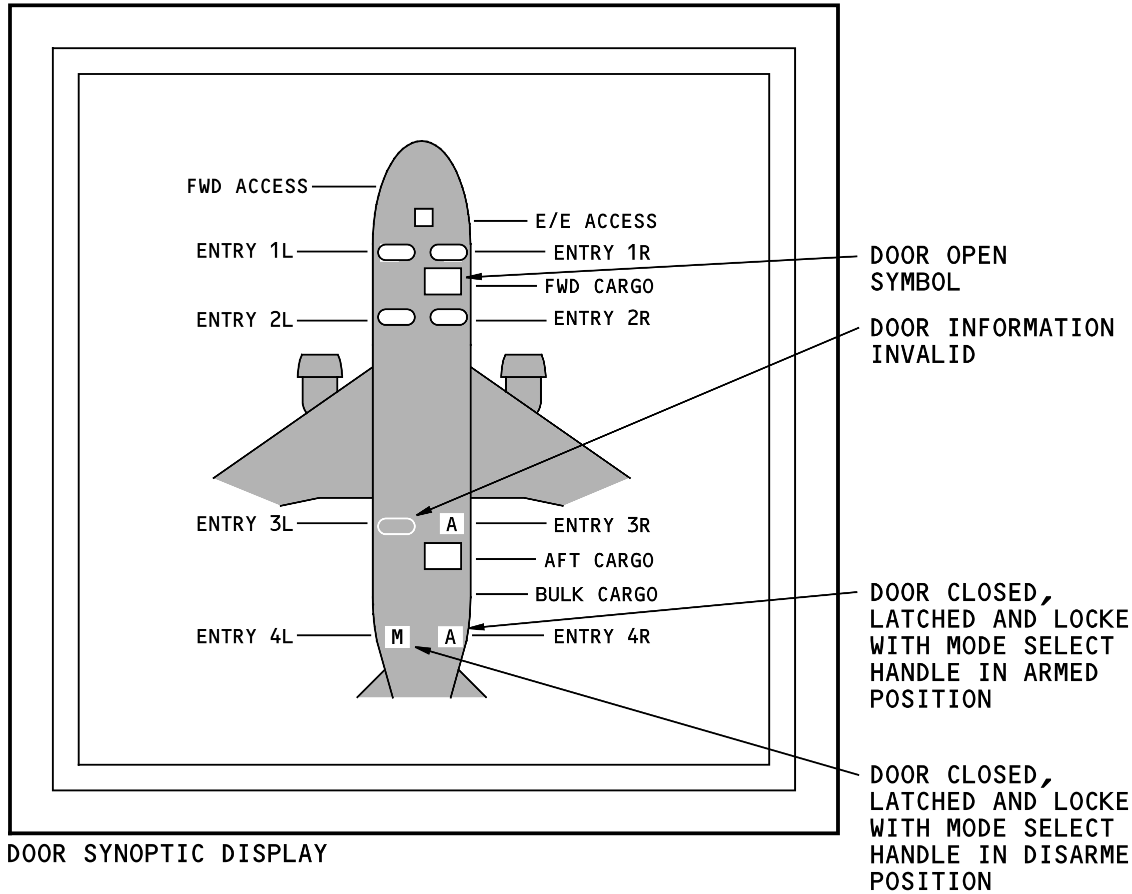
- A - auto (green)
- M - manual (white).

Status and MAT Displays

Door fault information shows on the status display and the MAT.



EICAS DISPLAY



DOOR SYNOPTIC DISPLAY

1 THESE MESSAGES WILL CHANGE TO A SINGLE MESSAGE, DOORS, WHEN THE AIRPLANE IS ON THE GROUND WITH BOTH ENGINES OFF.

52-71-00-007 Rev 5 08/29/1997

DOOR WARNING SYSTEM - INDICATIONS

DOOR WARNING SYSTEM - INDICATIONS - CSCP/CACP - CABIN DOOR STATUS SCREEN

General

Attendants use the cabin door status screen to see if the doors are locked or not locked.

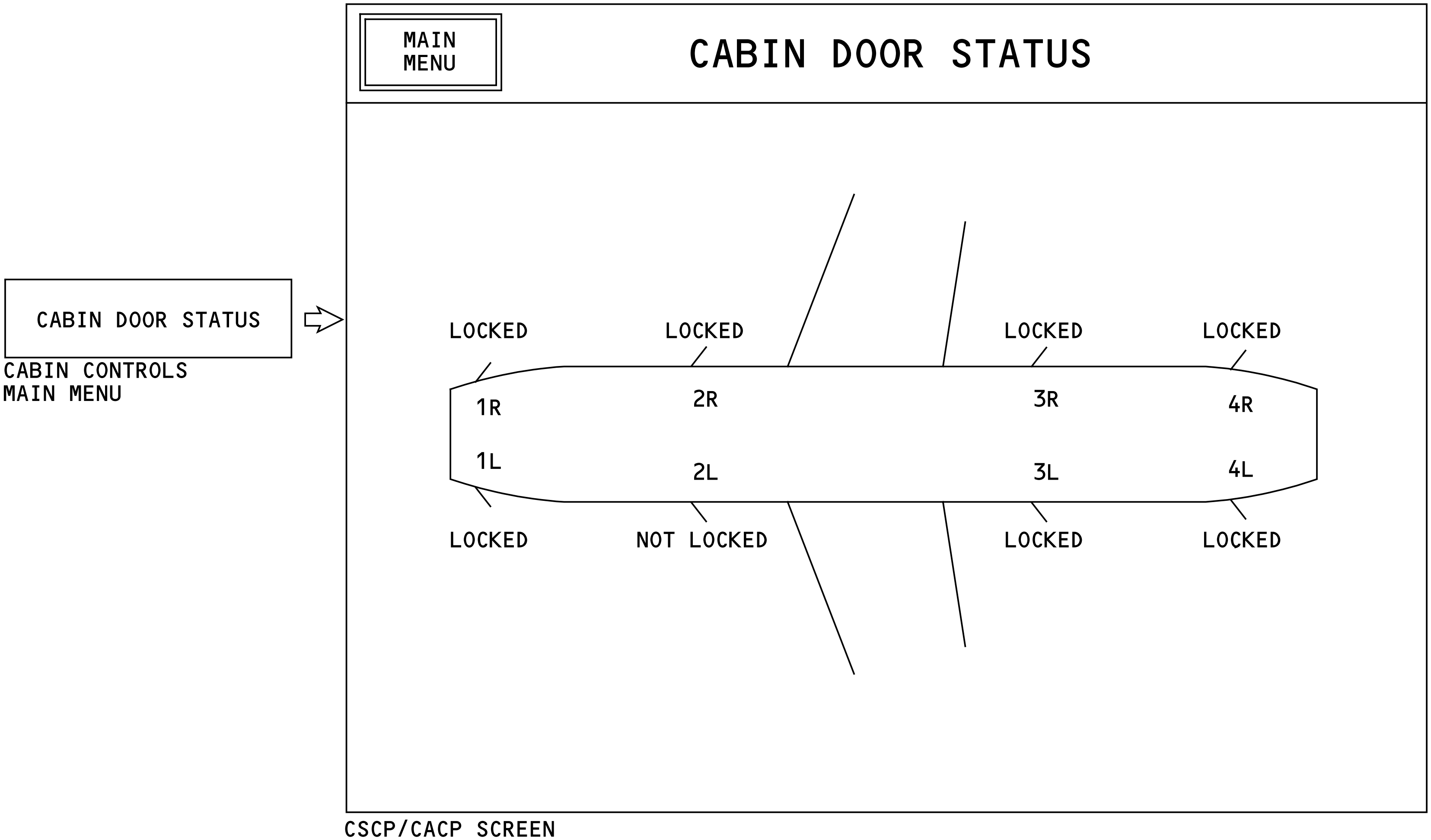
Access

You use the cabin system control panel (CSCP) or cabin area control panels (CACP) to get the status of the cabin doors. Touch CABIN DOOR STATUS on the cabin controls main menu to show this screen.

Indications

The cabin door status screen shows (in color) the status of the cabin doors:

- LOCKED (green)
- NOT LOCKED (red).



52-71-00-008 Rev 2 07/31/1997

DOOR WARNING SYSTEM - INDICATIONS - CSCP/CACP - CABIN DOOR STATUS SCREEN

Continental Airlines, Inc

Windows

WB371

TABLE OF CONTENTS

WINDOWS - INTRODUCTION

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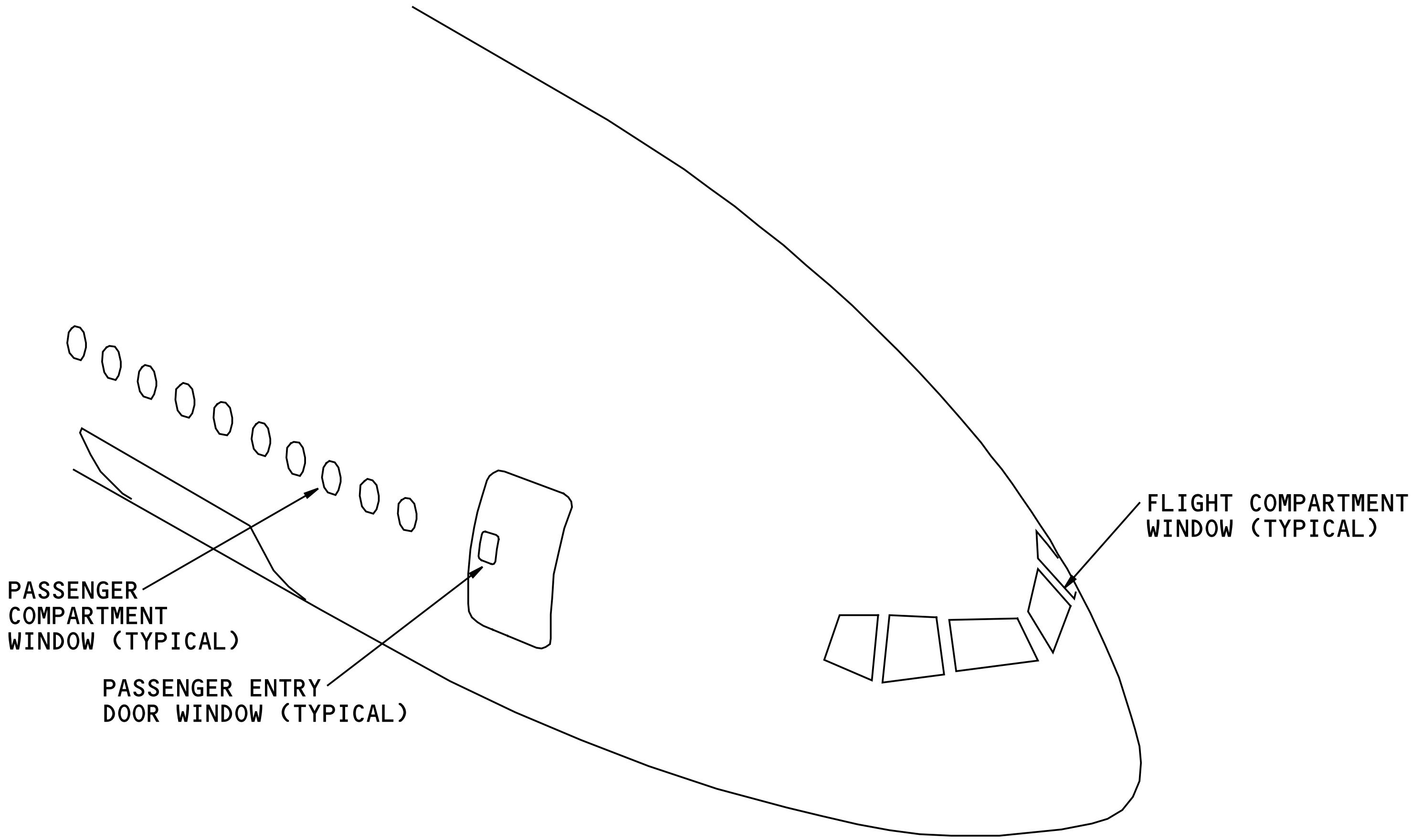
WINDOWS - INTRODUCTION

Location

Windows are in these locations:

- Passenger compartment (126)
- Passenger entry doors (8)
- Flight compartment (6).



56-00-00-001 Rev 1 03/26/96

WINDOWS - INTRODUCTION

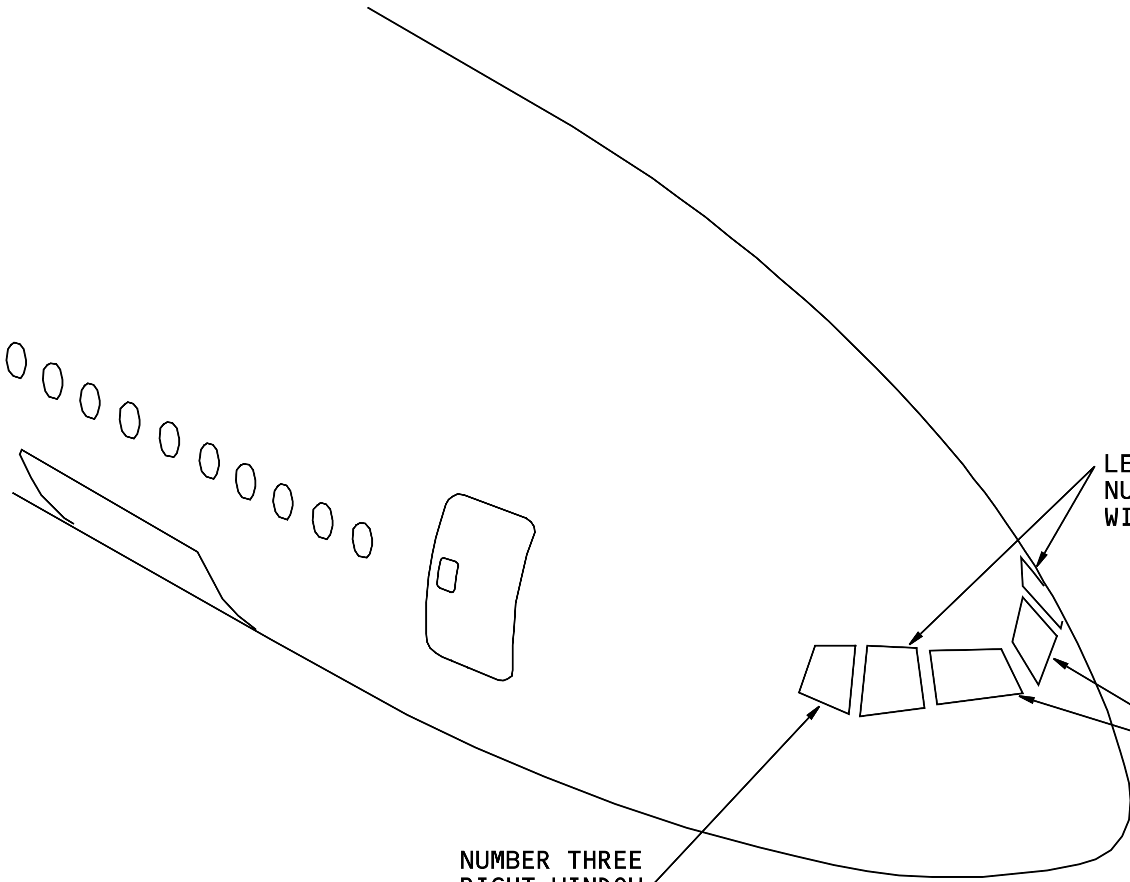
WINDOWS - FLIGHT COMPARTMENT WINDOWS - INTRODUCTION

Location

The left and right number one windows are in front of the captain and the first officer. The number two and three windows are aft of the number one windows.

Interface With Other Systems

The flight compartment windows get electric power from the window anti-ice system. See the flight deck window anti-ice section for more information (AMM PART I 30-41).



56-11-00-001 Rev 2

WINDOWS - FLIGHT COMPARTMENT WINDOWS - INTRODUCTION

Physical Description

Each number three window is a lamination of glass, plastic, and an anti-fog heating film. The external and internal window surfaces are glass.

Each number one window is a lamination of glass, plastic, anti-ice heating film, and anti-fog heating film. The external and internal window surfaces are glass. The external surface has a rain protection hydrophobic coating.

The windows have retainer rings, moisture seals, and pressure seals. Sealant holds the rings, seals, and window together as an assembly.

Screws go through the rings to attach the assembly to the airplane structure.

There are temperature sensors for the heating films. The heating film and sensors have electrical terminals. The bus bar connects the electric terminals for heat to the heating film.

The number three window has these terminals:

- Two sensor
- Two anti-fog electric.

The number one window has these terminals:

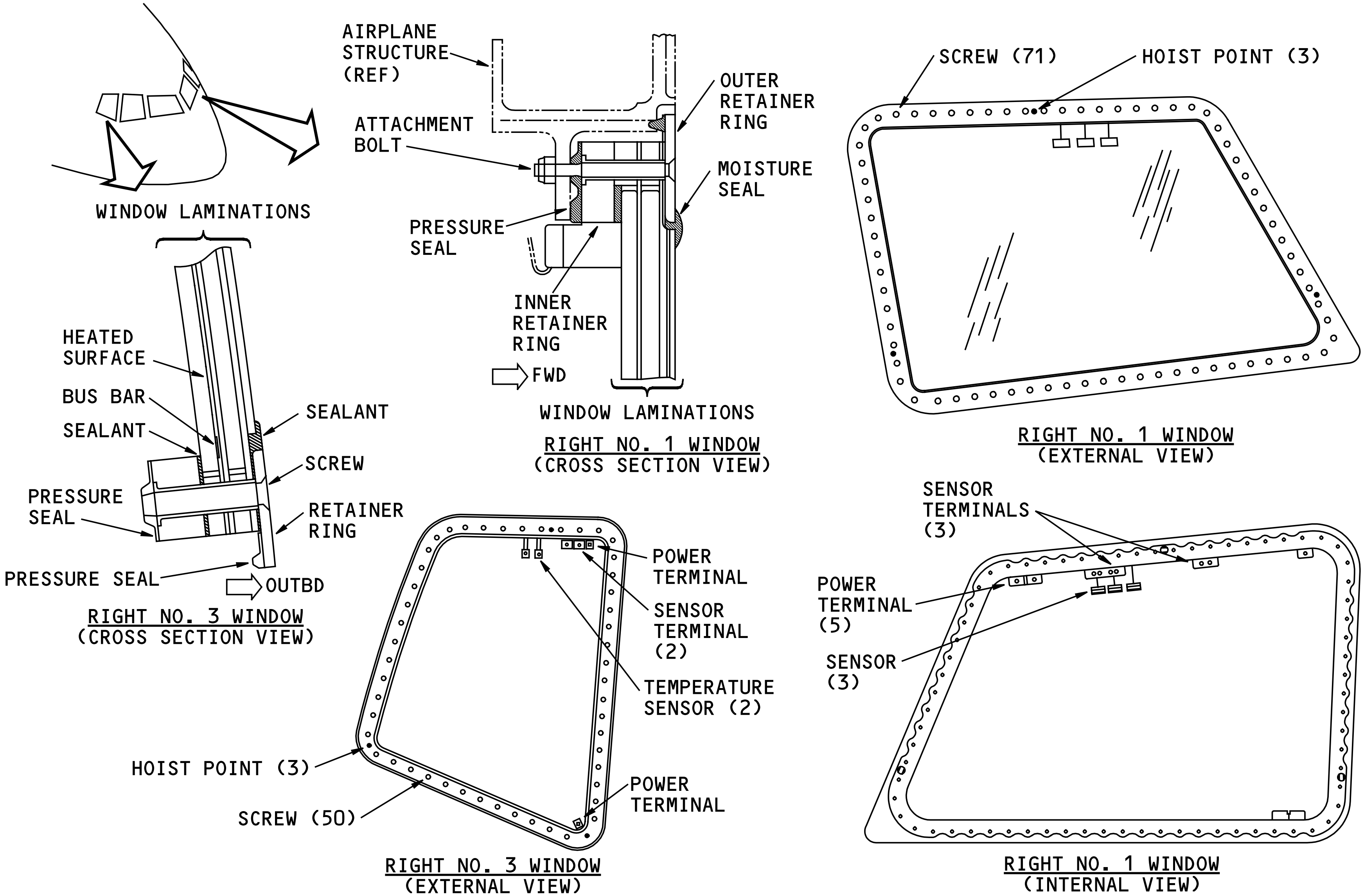
- Three sensor
- Three anti-ice electric power
- Two anti-fog electric.

Training Information Point

There are three hoist points to lift each number three and number one window for removal and installation.

Use proper methods when you clean the windows to prevent damage. On the external surface use an isopropanol and water mixture. On the internal surface use a mild soap and water mixture or an isopropanol and water mixture.

You can put a new hydrophobic coating on the number one windows on the airplane.



WINDOWS - FLIGHT COMPARTMENT WINDOWS - NUMBER ONE AND NUMBER THREE WINDOWS

WINDOWS - FLIGHT COMPARTMENT WINDOWS - NUMBER TWO OPENABLE WINDOW - INTRODUCTION

Purpose

The number two openable windows give emergency escape routing.

Physical Description

Each number two openable window has operating and latching mechanisms.

The operating mechanism has:

- Upper and lower tracks
- Drive cable
- Operating handle
- Drive screw (not shown) in lower aft track
- Rollers
- Carriage
- Link arm
- Torque tube.

The latching mechanism has:

- Latch handle
- Teleflex cable
- Latches.

There is an alert switch at the top of the window. It operates with a cam that attaches to the top latch.

The window is a lamination of glass, plastic, and an anti-fog heating film. The external and internal window surfaces are glass. The window has electrical terminals for the heating film and for heat control sensors. The bus bar connects the electric terminals for heat to the heating film. Coiled electrical wire connects the window terminals to terminals on the airplane.

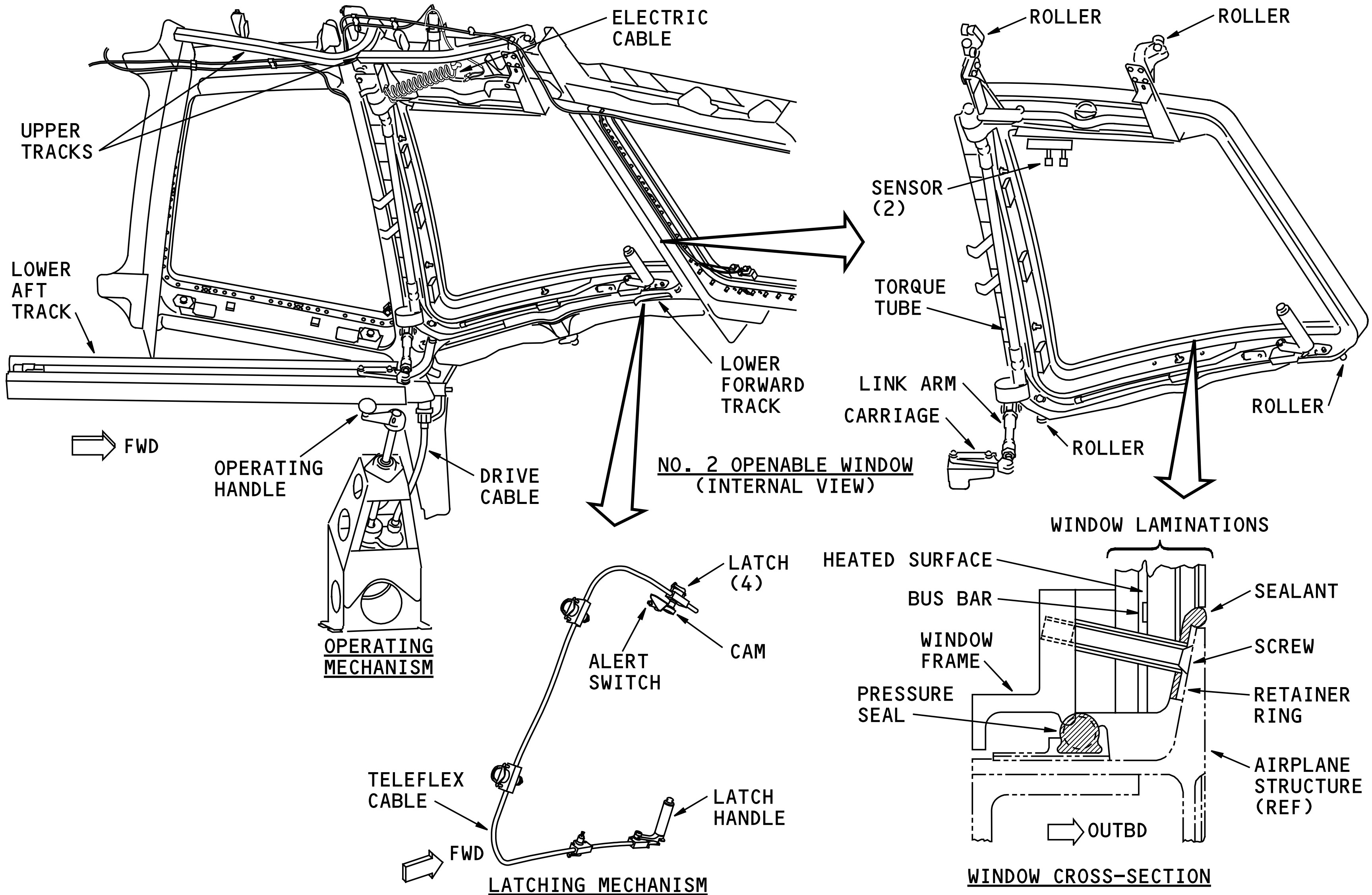
There is a retainer ring, sealant, and frame. Screws go through the ring and lamination, and into the frame to hold them together as an assembly.

The silicone bulb pressure seal between the window frame and fuselage attaches to the fuselage.

Training Information Point

Use proper methods when you clean the windows to prevent damage. Use a mild soap and water mixture or an isopropanol and water mixture.

Do not touch the silicone bulb pressure seal when you have the window open for maintenance activities. This can damage the seal and cause air leaks.



56-11-00-003 Rev 4 03/26/96

WINDOWS - FLIGHT COMPARTMENT WINDOWS - NUMBER TWO OPENABLE WINDOW - INTRODUCTION

WINDOWS - FLIGHT COMPARTMENT WINDOWS - NUMBER TWO OPENABLE WINDOW - ALERT SWITCH

Purpose

The alert switch supplies window status to the flight crew.

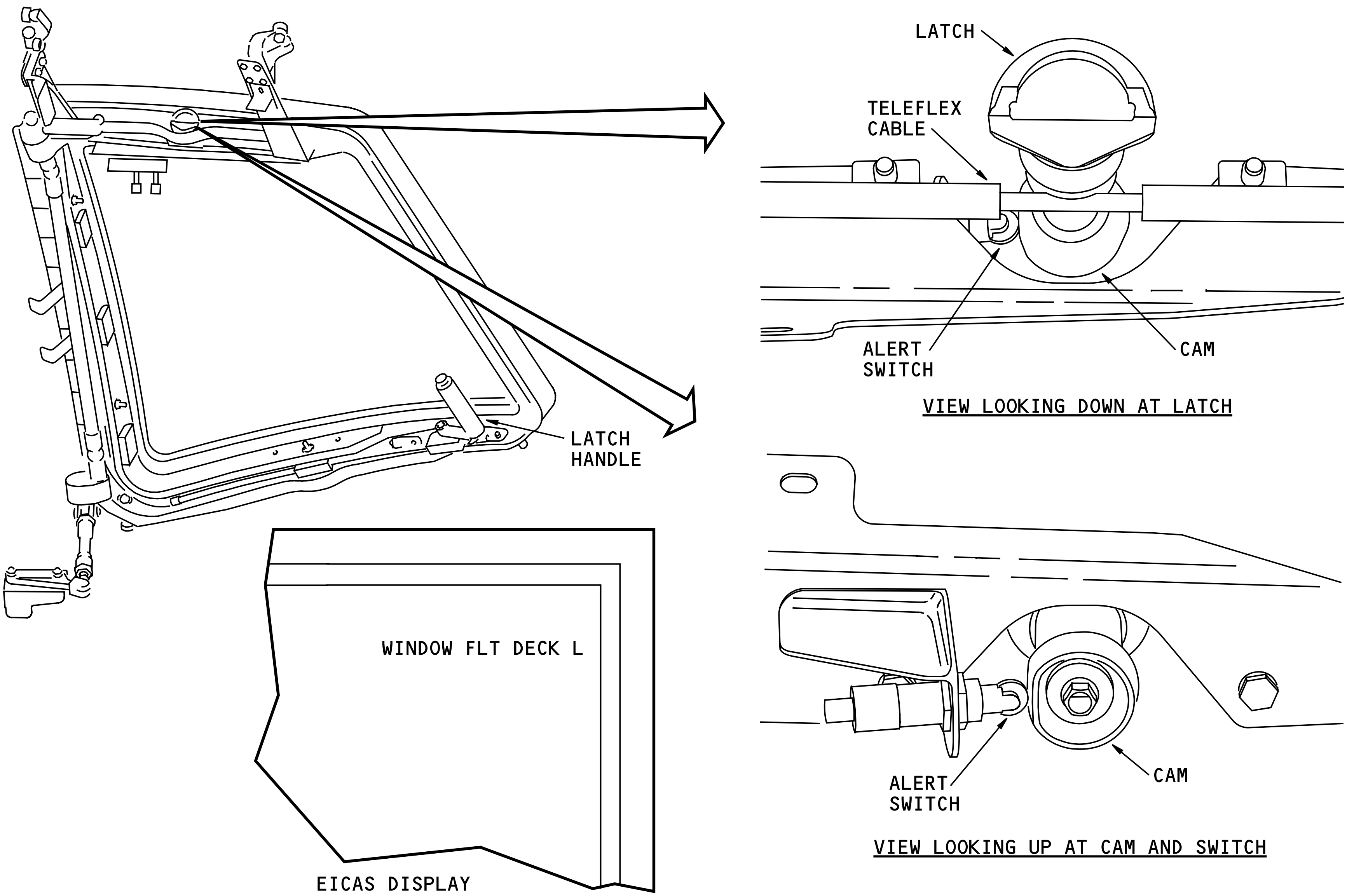
Physical Description

The switch is a plunger type that attaches to the window frame below the top window latch. The switch is adjacent to a cam that attaches to the upper latch.

Functional Description

Movement of the latch handle out of the latched position causes the teleflex cable to turn the latch and cam. The cam pushes the switch plunger in to close the switch.

When the switch closes, the WINDOW FLT DECK L(R) advisory message shows.



56-11-00-007 Rev 1 03/27/96

WINDOWS - FLIGHT COMPARTMENT WINDOWS - NUMBER TWO OPENABLE WINDOW - ALERT SWITCH

WINDOWS - FLIGHT COMPARTMENT WINDOWS - NUMBER TWO OPENABLE WINDOW - OPERATION

Unlatch/Latch Operation

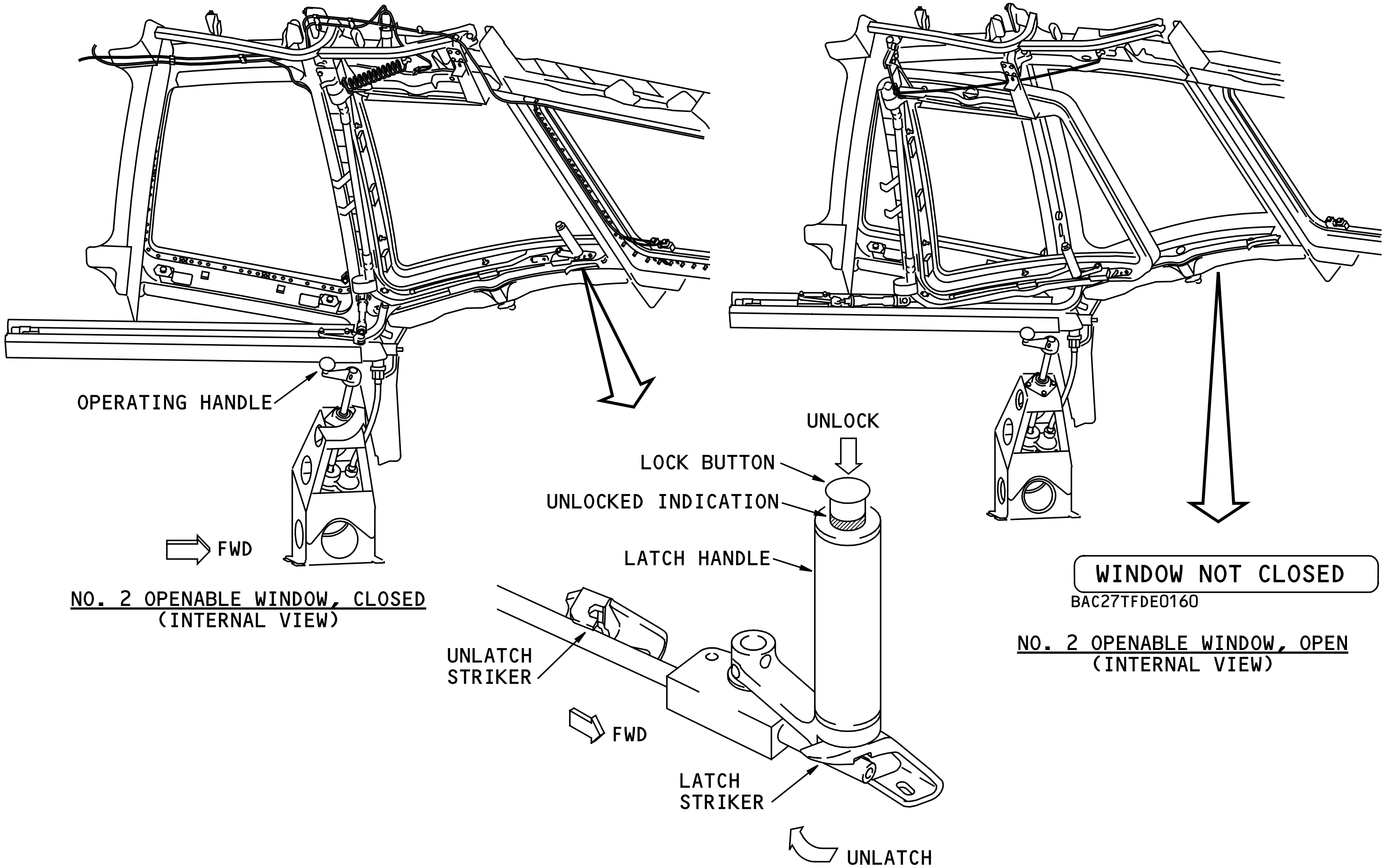
Push down on the latching handle lock button until the handle releases from the latch striker. Move the handle inboard and aft until it locks in the unlatch striker.

Reverse these operations to latch the window. The window is latched and the latching handle is locked when you cannot see the yellow indication stripe on the latch handle release.

Open/Close Operation

Turn the window operating handle to open the window. The left window handle turns counterclockwise. The right window handle turns clockwise.

Reverse these operations to close the window. The window is not closed if you see the WINDOW NOT CLOSED decal.



56-11-00-004 Rev 1

WINDOWS - FLIGHT COMPARTMENT WINDOWS - NUMBER TWO OPENABLE WINDOW - OPERATION

WINDOWS - NUMBER TWO OPENABLE WINDOW - FUNCTIONAL DESCRIPTION - CLOSE/OPEN

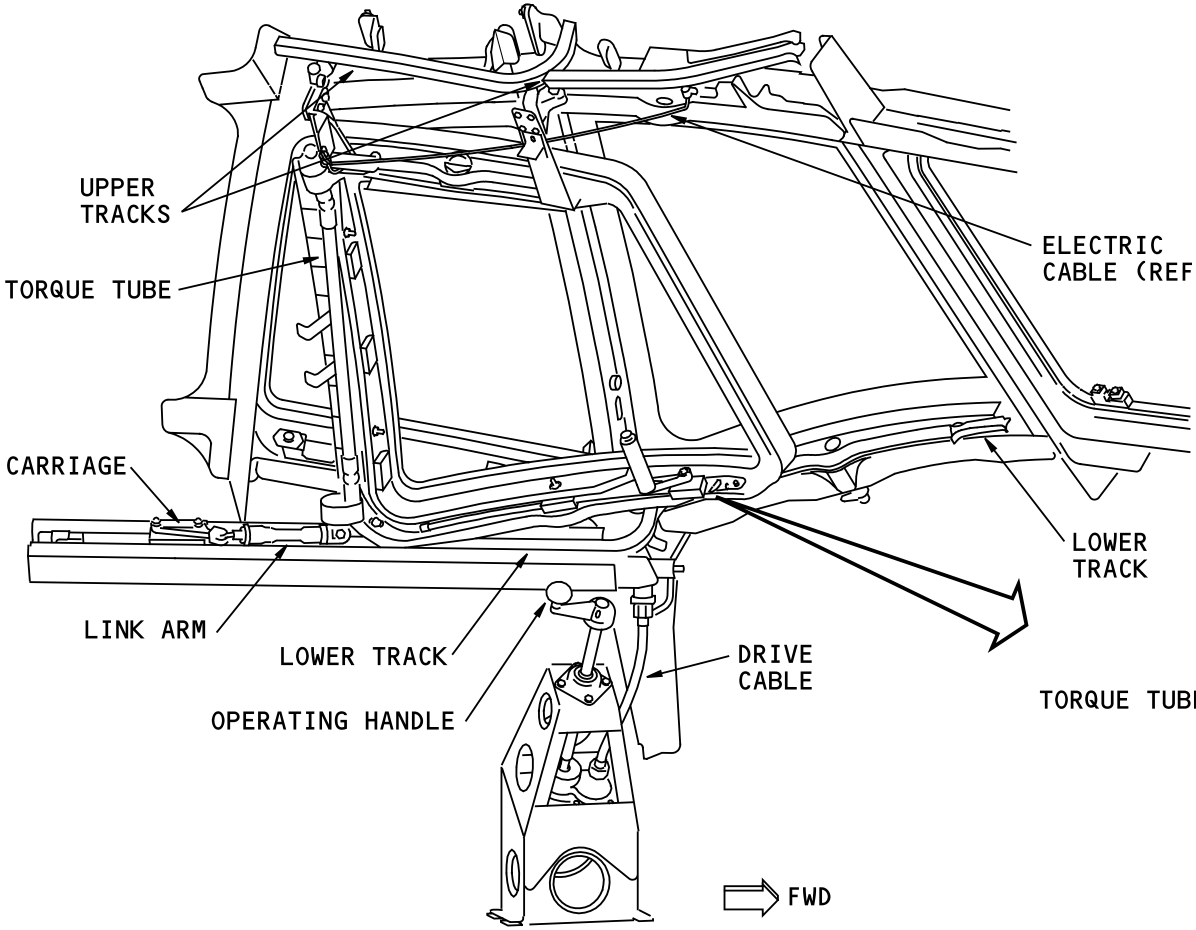
Close Functional Description

Clockwise rotation of the operating handle goes through the drive cable to the ball screw (not shown) in the lower latch track. The ball screw rotates. The carriage moves forward on the screw. The carriage pushes on the link arm. The link arm pushes on the torque tube on the window. The window moves forward on its rollers in the tracks.

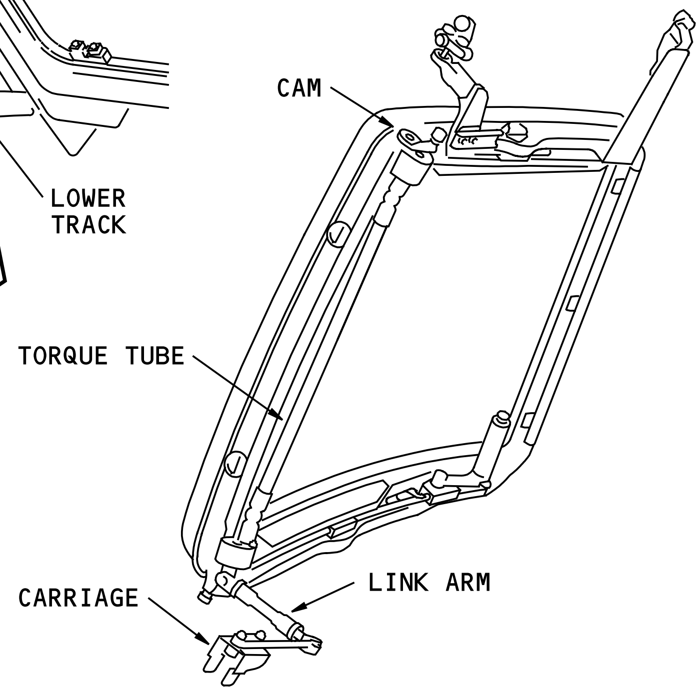
When the rollers gets to the curves in the tracks, the window moves outboard. The carriage and link arm push the bottom of the window to the completely closed position and turn the torque tube. A cam on the top of the torque tube push the top of the window outboard to the completely closed position.

Open Functional Description

Component movement to open the window is the reverse of the movement to close the window.



NO. 2 OPENABLE WINDOW
(INTERNAL VIEW)



VIEW OF WINDOW WITH MECHANISMS
IN CLOSED POSITION

56-11-00-005 Rev 0

WINDOWS - NUMBER TWO OPENABLE WINDOW - FUNCTIONAL DESCRIPTION - CLOSE/OPEN

WINDOWS - NUMBER TWO OPENABLE WINDOW - FUNCTIONAL DESCRIPTION - LATCH/UNLATCH

Latch Functional Description

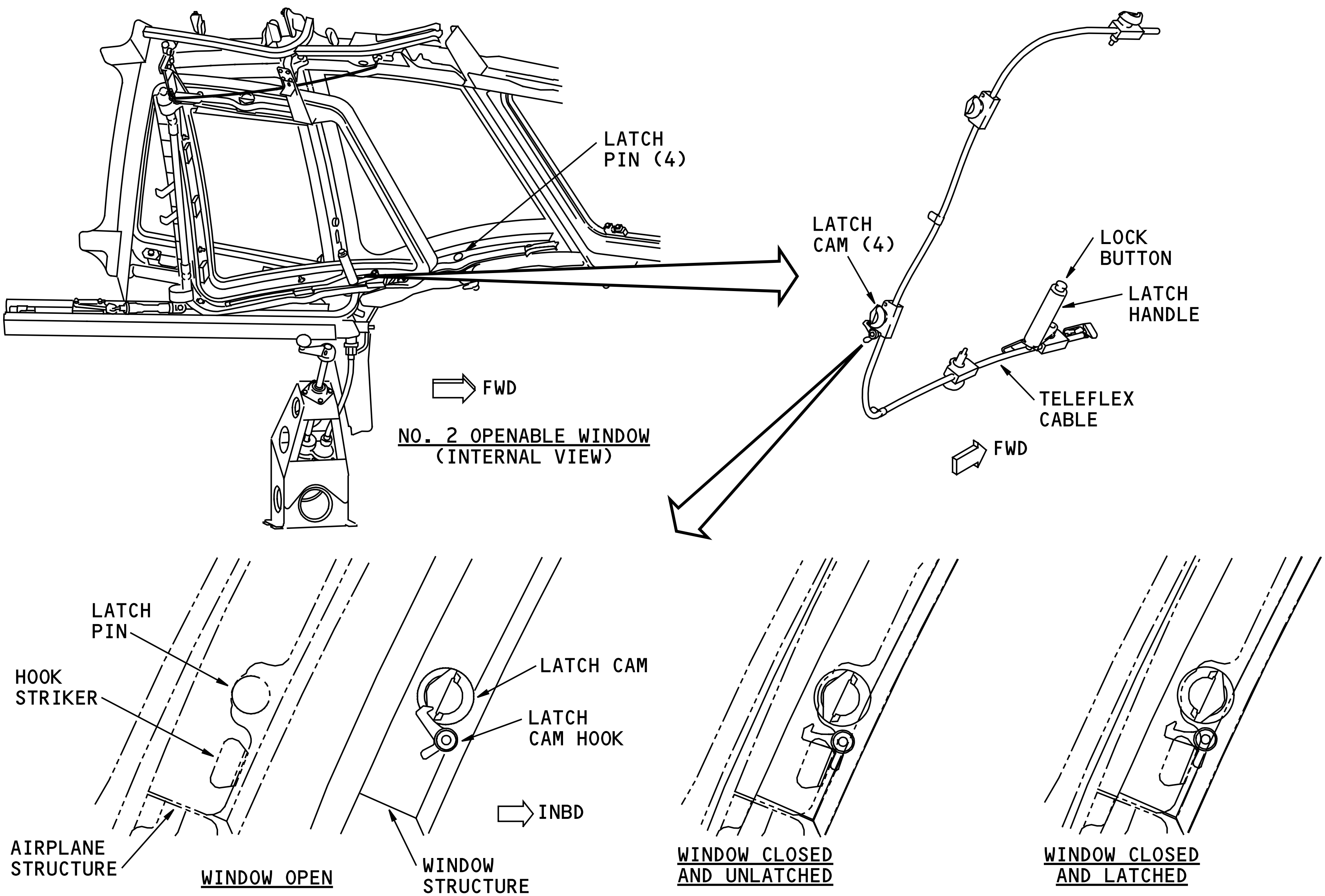
Four latch pins are on the airplane structure around the window opening. One is on the top, two are on the aft side, and one is on the bottom. The latch cams on the window use these latch pins to latch the window.

When the window is not completely closed, the spring-loaded latch cam hook will not let the latch cam turn. When the window moves to the closed position, the hook striker on the airplane structure moves the latch cam hook. The latch cam is free to turn.

Downward movement of the lock button on the latching handle releases the handle from the handle unlatched striker. Forward movement of the handle causes the teleflex cable to turn the latch cams to a position outboard of the latch pins. The window cannot move inboard. It is latched. The latch striker holds the latch handle.

Unlatch Functional Description

Component movement to unlatch the window is the reverse of the movement to latch the window.



56-11-00-006 Rev 0

WINDOWS - NUMBER TWO OPENABLE WINDOW - FUNCTIONAL DESCRIPTION - LATCH/UNLATCH

WINDOWS - PASSENGER COMPARTMENT WINDOWS

Location

There are passenger compartment windows along both sides of the passenger compartment.

Physical Description

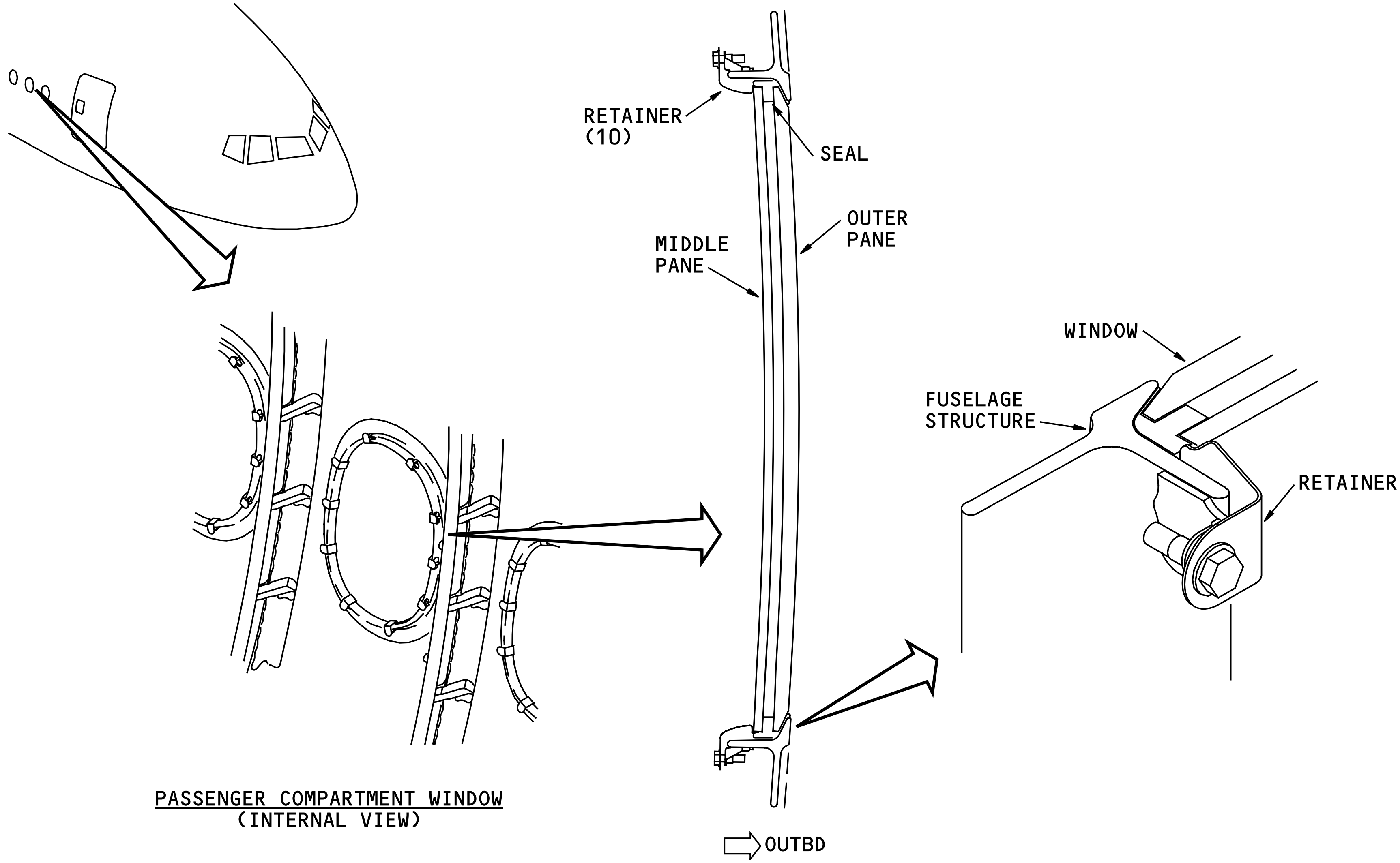
Each window has a plastic middle and outer pane. A seal holds the panes together in an assembly. Retainers hold the assembly to the fuselage.

The inner pane (not shown) is part of the passenger compartment sidewall lining. See the passenger compartment section for more information (AMM PART I 25-20).

Training Information Point

There are retainers with different grip lengths. The grip length depends on the location of the window in the fuselage. The retainers are a different color for each grip length.

Use proper methods when you clean the windows to prevent damage. Use a mild soap and water mixture or an isopropanol and water mixture.



PASSENGER COMPARTMENT WINDOW
(INTERNAL VIEW)

56-21-00-001 Rev 3 10/08/1996

WINDOWS - PASSENGER COMPARTMENT WINDOWS

WINDOWS - DOOR-MOUNTED WINDOWS

Purpose

The door-mounted windows let the cabin attendants see if the space outside the door is clear to open the door.

Location

There is a window in each of the passenger entry doors.

Physical Description

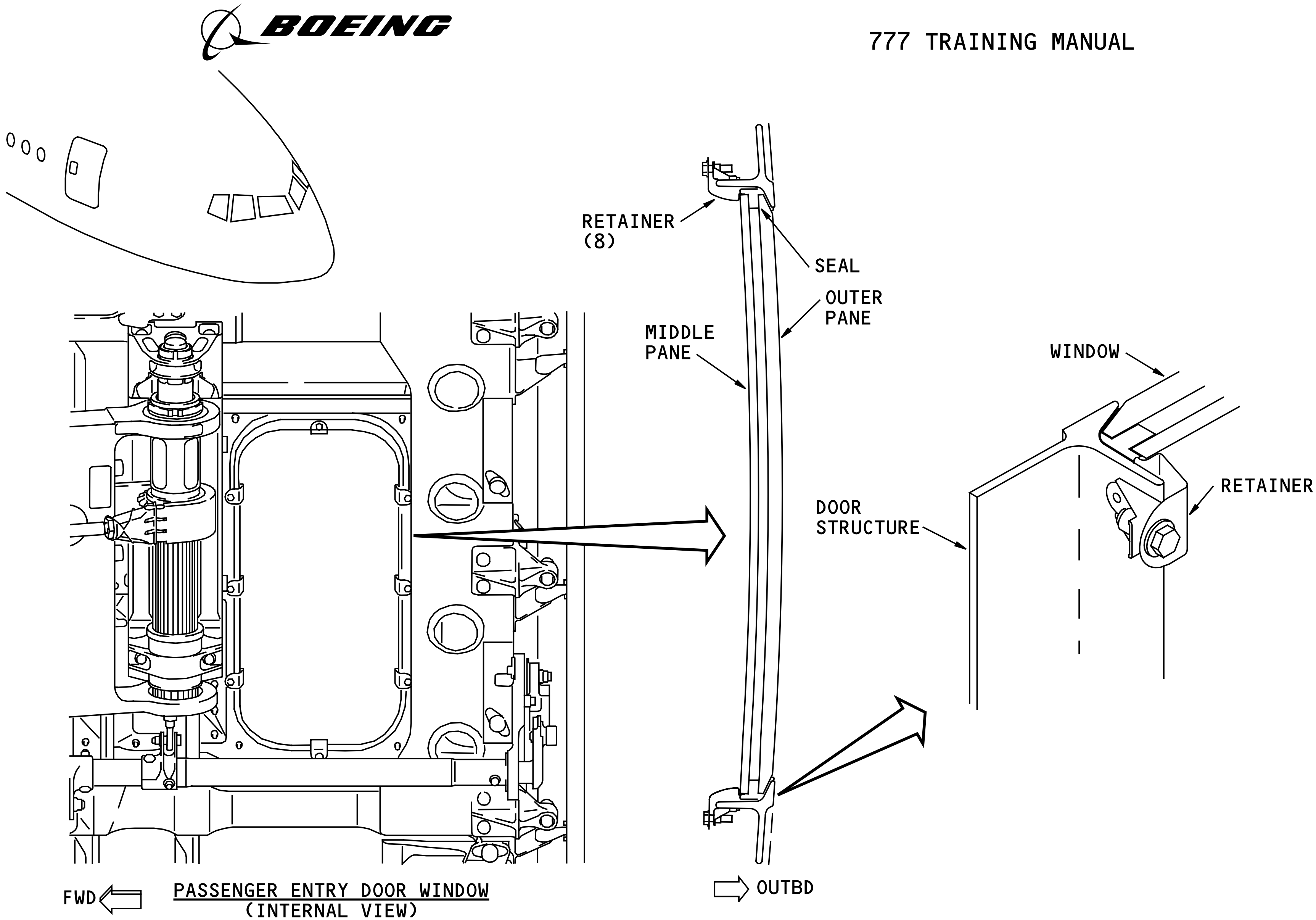
Each window has a plastic outer and a middle pane. A seal holds the panes together in an assembly. Retainers hold the assembly to the door.

The inner pane (not shown) is part of the door lining.

The retainers for the passenger entry door windows are all the same grip length and color.

Training Information Point

Use proper methods when you clean the windows to prevent damage. Use a mild soap and water mixture or an isopropanol and water mixture.



PASSENGER ENTRY DOOR WINDOW
(INTERNAL VIEW)

56-31-00-001 Rev 1 10/08/1996

WINDOWS - DOOR-MOUNTED WINDOWS

Continental Airlines, Inc

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CARGO HANDLING SYSTEM - INTRODUCTION

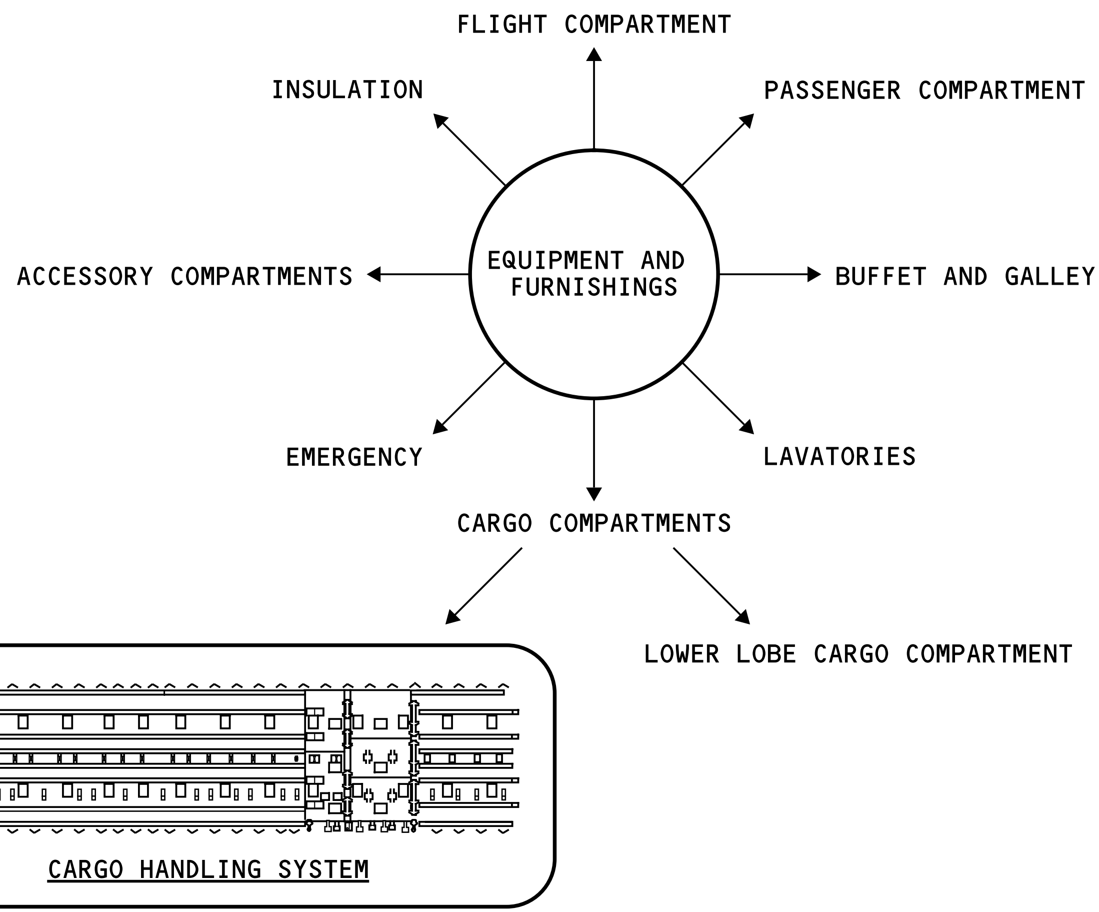
General

The cargo handling system lets a single operator safely load, unload, and lock cargo.

Cargo handling is a subsystem of equipment and furnishings.

Abbreviations and Acronyms

aux	- auxiliary
cmd	- command
CSC	- cargo system controller
ctr	- center
fwd	- forward
LBL	- left buttock line
LCD	- large cargo door
LD	- load device
LED	- light emitting diode
LRU	- line replaceable unit
MEC	- main equipment center
PSEU	- proximity sensor electronics unit
PDU	- powered drive unit
ref	- reference
ret	- retractable
RBL	- right buttock line
sta	- station line
typ	- typical
ULD	- unit load device



CARGO HANDLING SYSTEM - INTRODUCTION

CARGO HANDLING SYSTEM - GENERAL DESCRIPTION - INTRODUCTION

General

The forward and aft cargo compartments each have cargo handling systems. Operation of the two systems is similar. Both systems use electrically and manually operated components. The bulk cargo compartment does not have a cargo handling system.

Controls

The controls for the forward and aft cargo handling systems are similar. The controls are near the forward part of the cargo door openings. You operate and set the forward or aft cargo handling systems using these interior and exterior controls:

- Secondary joystick
- Cargo control joystick
- Cargo handling control panel.

The cargo system controller (CSC) uses inputs from the interior and exterior controls to position the electrically operated system components. The controller does not affect manually operated components.

The cargo handling accessory panels have system power relays and circuit breakers.

You can manually operate the components that are normally electrically operated if electrical power is not available.

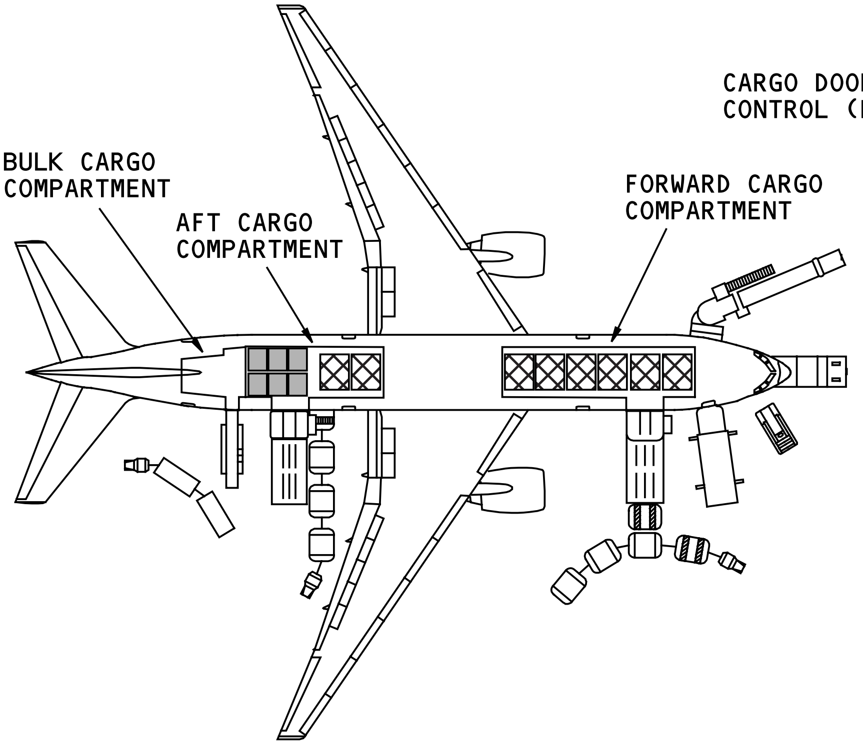
Unit Load Devices

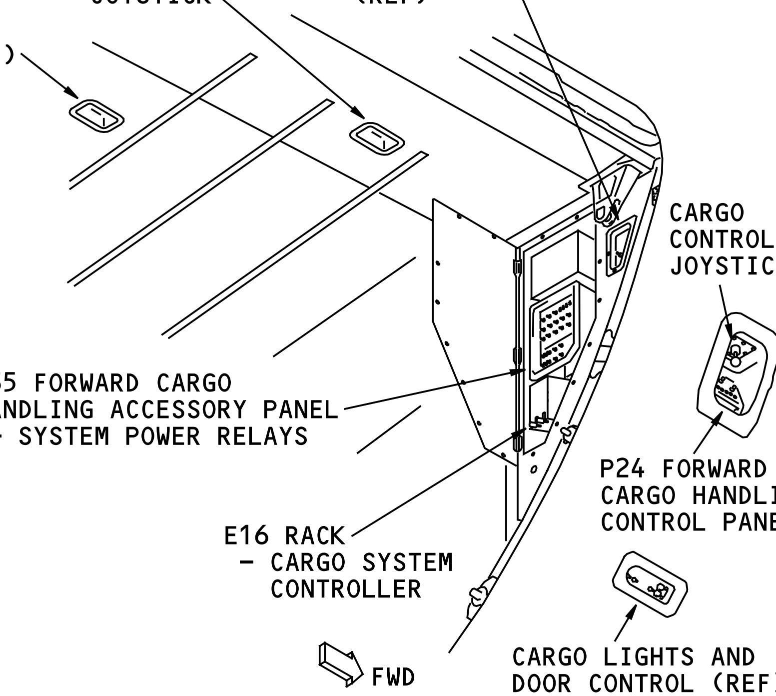
The cargo handling system lets the airplane carry different sizes of unit load devices (ULDs). The airplane can carry containers with profiles matching these sizes:

- LD-1
- LD-2
- LD-3
- LD-4
- LD-5
- LD-6
- LD-7
- LD-8
- LD-10
- LD-11.

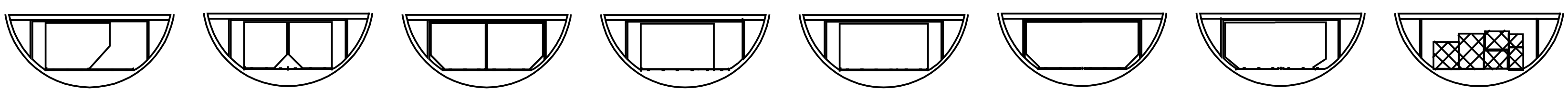
Pallets matching these sizes can also be carried:

- A
- K
- L
- M
- N.





<u>FORWARD CARGO DOOR</u>
(LOOKING UP AND INBOARD, TYP)



<u>NOTE</u>: FORWARD SYSTEM SHOWN,
AFT SIMILAR

25-53-00-002 Rev 3 07/21/1997

CARGO HANDLING SYSTEM - GENERAL DESCRIPTION - INTRODUCTION

CARGO HANDLING SYSTEM - FWD CARGO ELECTRICAL/MECHANICAL COMPONENT LOCATIONS

General

The forward cargo handling system has electrical/mechanical components that let you load and unload ULDs.

These are the electrical/mechanical components:

- Powered drive units (PDUs)
- Lateral guides.

You may operate the lateral guides manually.

Location

PDUs are in all areas of the cargo compartment.

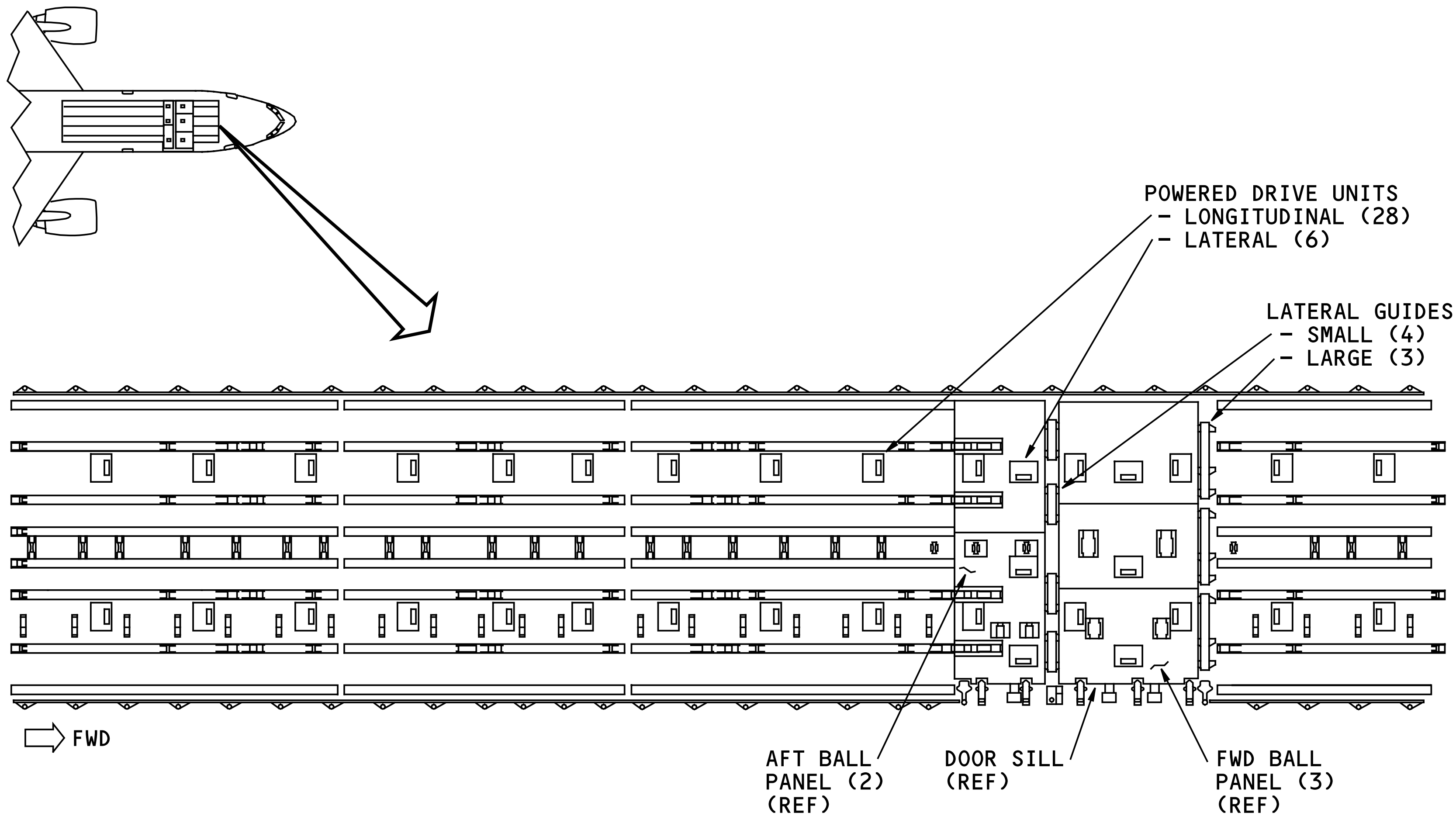
Lateral PDUs are in the same area as the ball panels. There are two rows of lateral PDUs. Each row has three PDUs.

Longitudinal PDUs are on the left and right sides of the compartment in rows. There are fourteen rows of longitudinal PDUs. Each row has two PDUs.

Lateral guides are in the ball panel area of the cargo compartment.

Small lateral guides are between the forward and aft ball panels.

Large lateral guides are forward of the forward ball panels.



FORWARD CARGO HANDLING SYSTEM
(LOOKING DOWN)
(TYPICAL)

25-53-00-003 Rev 4 08/21/1997

CARGO HANDLING SYSTEM - FWD CARGO ELECTRICAL/MECHANICAL COMPONENT LOCATIONS

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CARGO HANDLING SYSTEM - FWD CARGO MECHANICAL COMPONENT LOCATIONS

General

The forward cargo handling system has mechanical components that let you load, unload, and lock ULDs. These are the mechanical components:

- End stops
- Side guide rails
- Stop/locks
- Roller trays
- Pallet locks
- Ball panels
- Center stop/locks
- Guide rollers
- Auxiliary stop/locks
- Rollout stop/locks
- Retractable guide roller/lock
- Sill rollers
- Auxiliary guides
- Center guides
- Partial load stops.

Location

End stops are in the forward and aft ends of the cargo compartment. There are six in the aft end and four in the forward end. All end stops are the same except for the middle two in the aft end of the compartment. These do not give vertical restraint.

Side guide rails are along the sides of the cargo compartment. There are five on the left side and four on the right side of the compartment.

Stop/locks are in the aft part of the compartment. All four stop/locks are in one row. The stop/locks attach to the roller trays.

Roller trays are forward and aft of the ball panels. There are eight columns of roller trays across the compartment. Each column has four trays each.

Pallet locks are throughout the cargo compartment. The locks attach in nine rows with four locks in each row. Twenty-eight of the pallet locks mount to the roller trays. Eight of the pallet locks attach to floor structure in the area of the aft ball panels.

Ball panels are to the left of the door sill. The panels are in two sets, forward and aft. The forward set is in the area used to load/unload containers and pallets. The aft set of panels are in the area used to load/unload pallets.

Center stop/locks are in the middle panel of the forward ball panels.

Guide rollers are in the door sill area, one roller forward and one aft.

Auxiliary stop/locks are in the right panel of the forward ball panels.

Rollout stop/locks are in the door sill area.

Retractable guide roller/lock is in the door sill area.

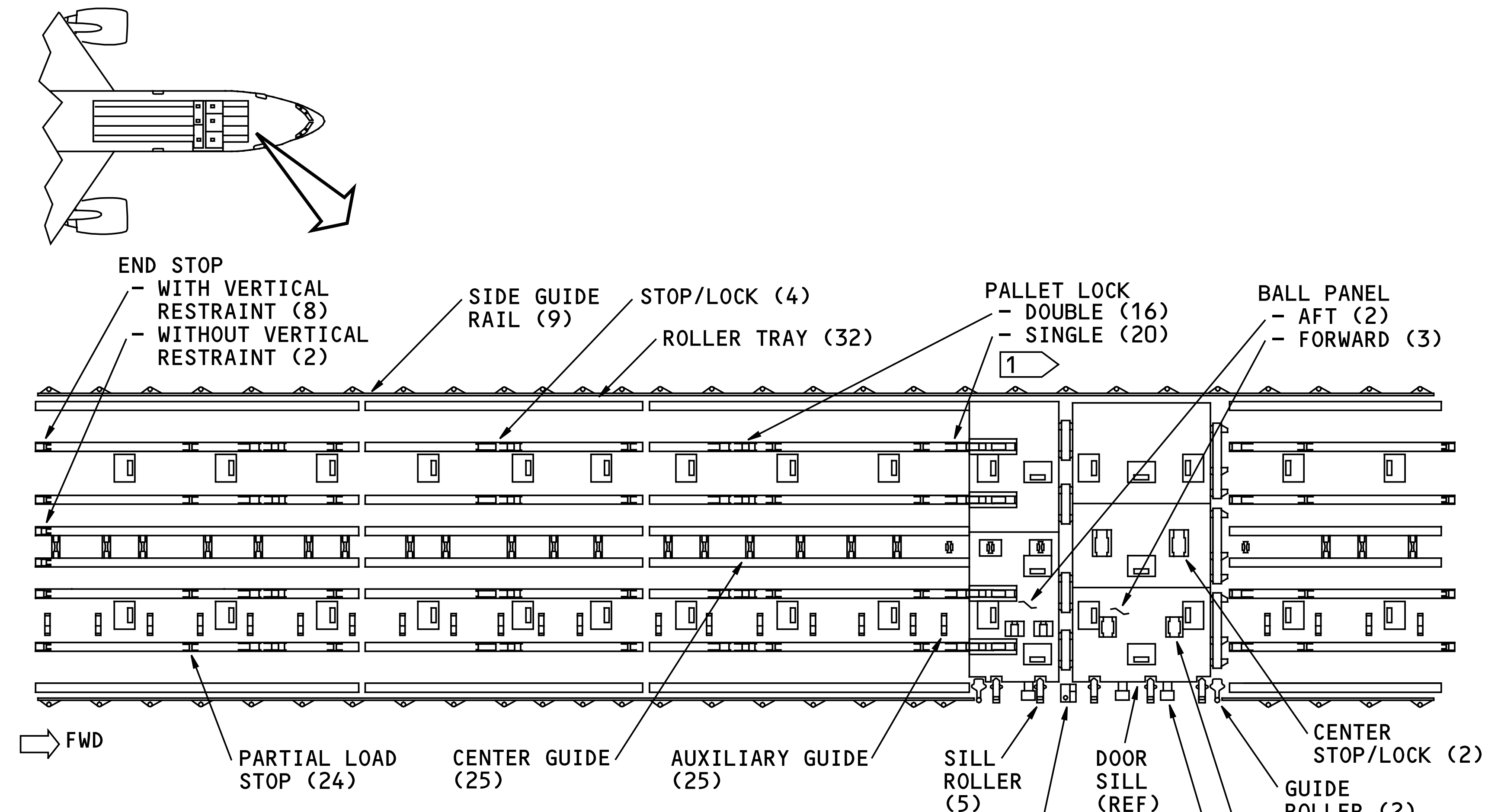
CARGO HANDLING SYSTEM - FWD CARGO MECHANICAL COMPONENT LOCATIONS

Sill rollers are in the cargo door sill area.

Auxiliary guides are along the right part of the cargo compartment.

Center guides are along the center of the cargo compartment.

Partial load stops are in all areas of the cargo compartment. There are six rows of stops with four in each row. All partial load stops attach to the roller trays.



1 ROLLER TRAY MOUNTED PALLET LOCKS SHOWN, BALL PANEL AREA PALLET LOCKS SIMILAR

FORWARD CARGO HANDLING SYSTEM
(LOOKING DOWN)
(TYPICAL)

CARGO HANDLING SYSTEM - FWD CARGO MECHANICAL COMPONENT LOCATIONS

CARGO HANDLING SYSTEM - AFT CARGO ELECTRICAL/MECHANICAL COMPONENT LOCATIONS

General

The aft cargo handling system has electrical/mechanical components that let you load and unload ULDs.

These are the electrical/mechanical components:

- Powered drive units (PDUs)
- Lateral guides.

You may operate the lateral guides manually.

Location

Powered drive units are in all areas of the cargo compartment.

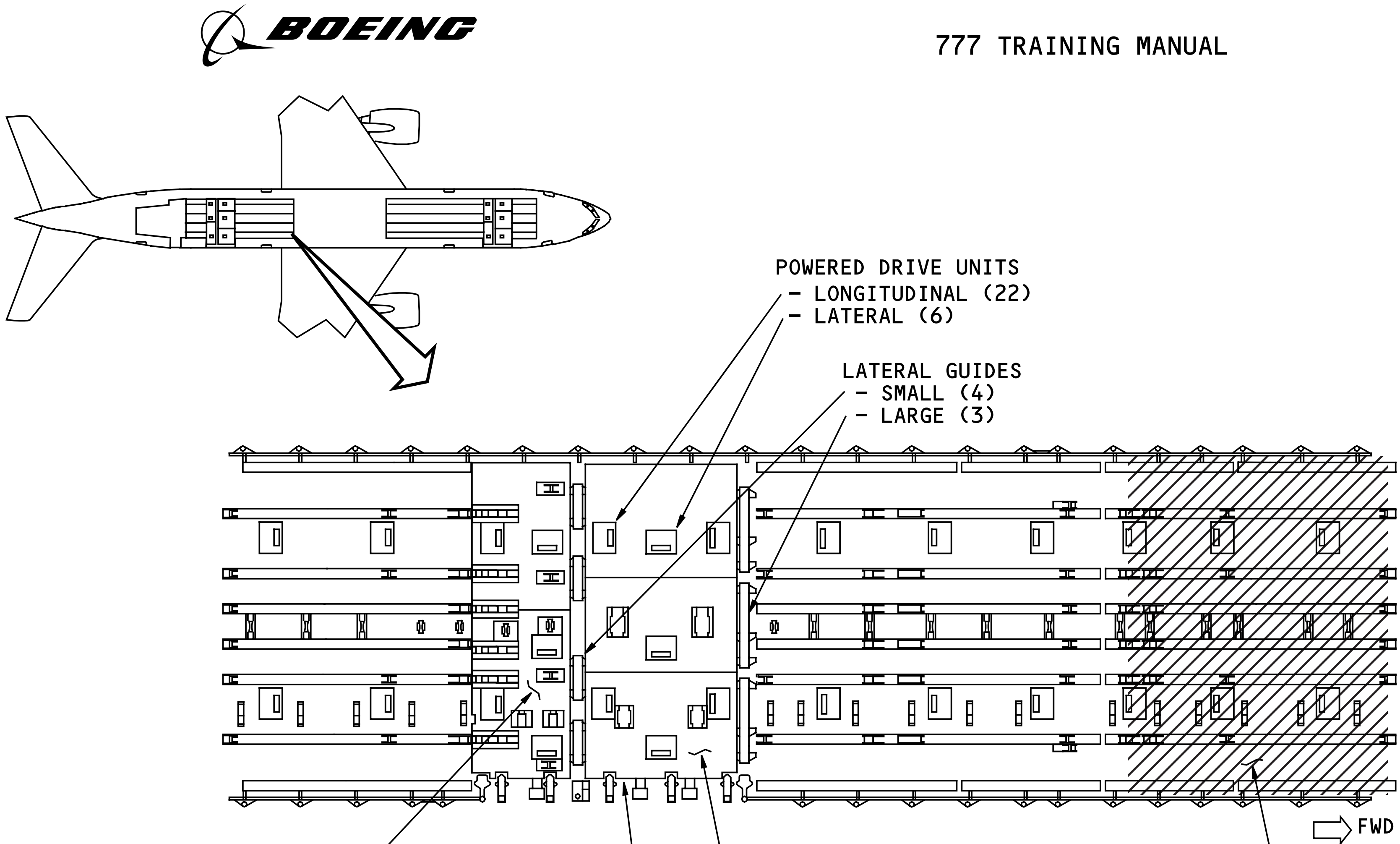
The longitudinal PDUs are on the left and right sides of the compartment in rows. There are eleven rows of PDUs with two PDUs in each row.

Lateral PDUs are in the same area as the ball panels. There are two rows of lateral PDUs, each row has three PDUs.

Lateral guides, small and large are next to the ball panels.

Small lateral guides are between the forward and aft ball panels. These guides are structurally different than the ones in the forward cargo handling system.

Large lateral guides are forward of the forward ball panels. These guides are different from the ones in the forward system because give vertical restraint for only one pallet while the ones in the forward system give vertical restraint for two pallets.



AFT CARGO HANDLING SYSTEM
(LOOKING DOWN)
(TYPICAL)

CARGO HANDLING SYSTEM - AFT CARGO ELECTRICAL/MECHANICAL COMPONENT LOCATIONS

CARGO HANDLING SYSTEM - AFT CARGO MECHANICAL COMPONENT LOCATIONS

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CARGO HANDLING SYSTEM - AFT CARGO MECHANICAL COMPONENT LOCATIONS

General

The aft cargo handling system has mechanical components that let you load, unload, and lock ULDs. You operate the mechanical components manually.

These are the mechanical components:

- Ball panels
- Center stop/locks
- Auxiliary stop/locks
- Rollout stop/locks
- Retractable guide roller/lock
- Side guide rails
- Roller trays
- Pallet locks
- End stops
- Stop/locks
- Guide rollers
- Sill Rollers
- Auxiliary guides
- Center guides
- Partial load stops.

Location

Ball panels are to the left of the door sill. The panels are in two sets: forward and aft. The forward set is in the area used for loading/unloading containers and pallets. The aft set of panels are in the area used for loading/unloading pallets. The aft ball panels have a different shape than the ones used in the forward cargo handling system.

Center stop/locks mount to structure in the area of the middle forward ball panel.

Auxiliary stop/locks mount to structure in the area of the forward right ball panel.

Rollout stop/locks mount to structure in the door sill area.

Retractable guide roller/lock mounts to structure in the area of the door sill.

Side guide rails are along the sides of the cargo compartment. There are six on the left side and five on the right side of the compartment. These guide rails are shorter than the ones used in the forward cargo handling system.

Roller trays are forward and aft of the ball panels. There are eight columns of roller trays across the compartment. The columns along the sides of the compartment have five trays each. The columns along the middle of the compartment have three trays each. These roller trays are a different length than the ones in the forward cargo handling system.

Pallet locks are all along the cargo compartment. The locks are installed in six rows with six locks in each row. Twelve of the pallet locks mount to the roller trays. Twelve of the pallet locks mount to structure in the area of the aft ball panels.

CARGO HANDLING SYSTEM - AFT CARGO MECHANICAL COMPONENT LOCATIONS

End stops are at the forward and aft ends of the cargo compartment in the roller trays. There are six in the aft end and six in the forward end. The aft cargo handling system uses one type of end stop, with vertical restraint. The forward system uses two types one without vertical restraint and one with vertical restraint.

Stop/locks are forward of the ball panels. All six stop/locks attach to roller trays. The aft cargo handling system uses stop/locks that are structurally different than the ones in the forward compartment.

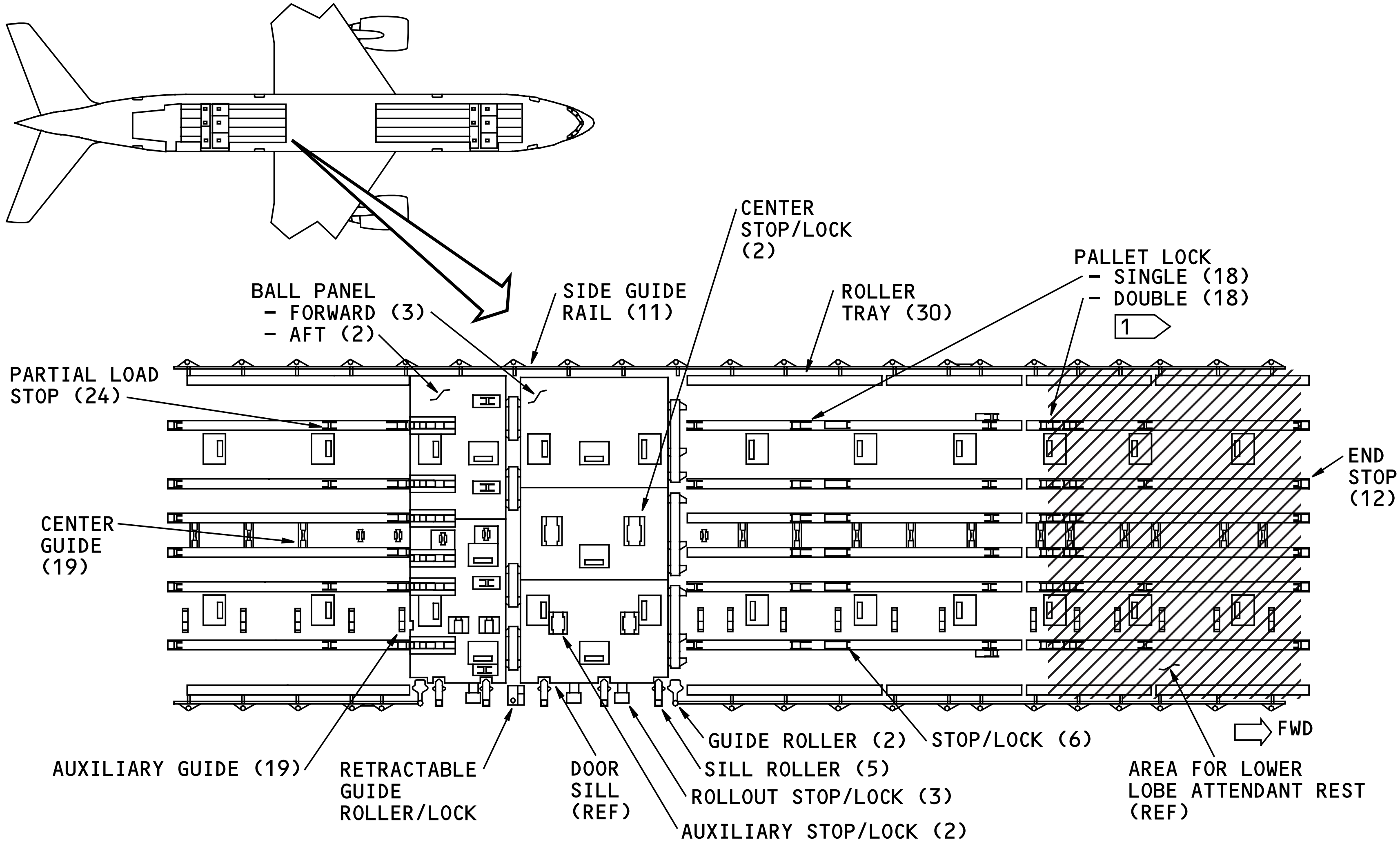
Guide rollers are in the door sill area, one roller forward and one aft.

Sill rollers are in the door sill area. The aft cargo handling system uses cantilevered rollers for all of its sill rollers. The forward system uses both cantilevered and non-cantilevered.

Auxiliary guides are along the right part of the cargo compartment.

Center guides are along the center of the cargo compartment.

Partial load stops are all along the cargo compartment. Twenty stops attach to the roller trays in four rows. Another row of four stops attach to floor structure in the area of the aft ball panels. All rows except row two have four stops. Row two has eight stops, four that face aft and four that face forward.



1 ROLLER TRAY MOUNTED PALLET LOCKS SHOWN, BALL PANEL AREA PALLET LOCKS SIMILAR

AFT CARGO HANDLING SYSTEM
(LOOKING DOWN)
(TYPICAL)

CARGO HANDLING SYSTEM - AFT CARGO MECHANICAL COMPONENT LOCATIONS

25-53-00-006 Rev 4 08/21/1997

CARGO HANDLING SYSTEM - ELECTRICAL GENERAL DESCRIPTION

General

The cargo handling system gets power for control from the P320 ground service/handling power panel. The system gets operating power from the P300 auxiliary power panel.

PSEU number one supplies cargo door position information. The cargo system controller (CSC) lets the system operate only if the cargo door is full open.

CSC Inputs

The cargo system controller (CSC) gets inputs from these components:

- Cargo handling accessory panel (system power relays and circuit breakers)(P35 fwd, P39 aft)
- Secondary joystick
- Cargo control joystick
- Cargo handling control panel (Switches, P24, P27)
- Hard wired program pins give controller installation location and information about system options. (Fwd cargo compartment, LD-4/LD-8 option, aft large cargo door option, crew rest in place 1 option, crew rest in place 2 option, no gearmotor devices installed).

The CSC does not get inputs from the PDUs or the lateral guides. The CSC has no interface with the AIMS.

Operation

The CSC controls the position of these electrical/ mechanical components:

- Powered drive units
- Lateral guides.

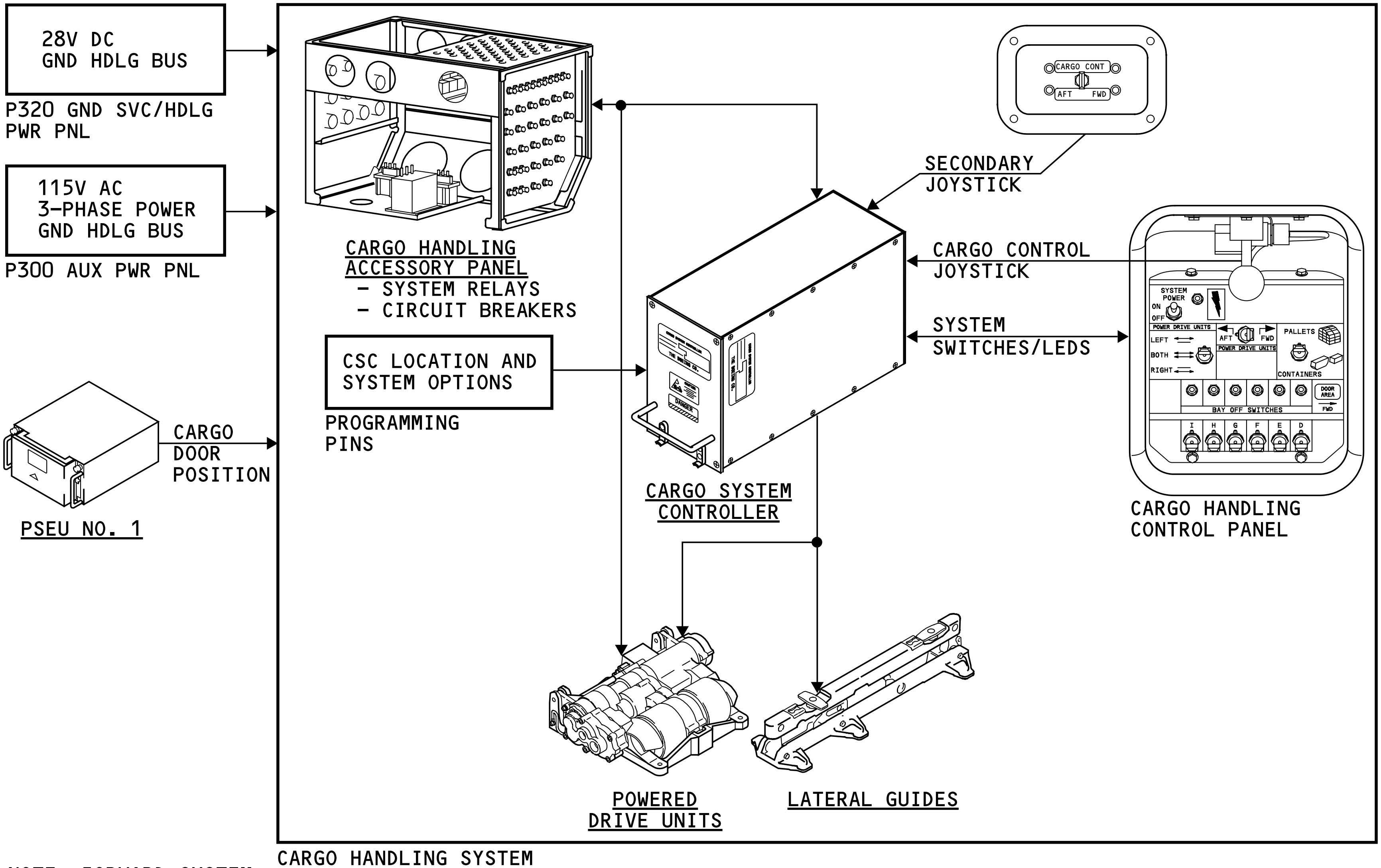
To supply power to the system these conditions must be true:

- the ground handling bus has power
- the cargo door is full open
- the SYSTEM POWER switch on the cargo handling control panel is in the ON position.

You can tell that power is on when the system power LED comes on.

Use the switches on the cargo handling control panel to configure the system. The switches let you set the system for the type of cargo you need to load or unload (CONTAINERS OR PALLETS). The switches also let you enable sets of power drive units (PDU FWD or AFT and PDU LEFT, CENTER OR RIGHT).

You use the cargo control joystick to move ULDs in all directions, FORWARD, AFT, IN or OUT. The secondary joystick lets you move ULDs in two directions, FORWARD or AFT. The secondary joystick does not let you move ULDs onto or off of the ball panels. The cargo system controller uses your inputs for system configuration and joystick position to operate the components.



NOTE: FORWARD SYSTEM
SHOWN, AFT SIMILAR

CARGO HANDLING SYSTEM - ELECTRICAL GENERAL DESCRIPTION

25-53-00-007 Rev 4 08/21/1997

CARGO HANDLING SYSTEM - MECHANICAL GENERAL DESCRIPTION

General

These are the mechanical components that you manually operate:

- Pallet locks
- Stop/locks
- Center stop/locks
- Center guides
- Auxiliary stop/locks
- Auxiliary guides
- Rollout stop/locks
- Retractable guide roller/lock
- Partial load stops.

Operation

A typical unloading/loading operation usually requires the use of both electrically and manually operated components. The type of ULDs (containers or pallets) and the amount of cargo (partial or full load) tell you which components to use.

Pallet locks and stop/locks let you lock pallets in place. The lock position gives vertical and longitudinal restraint for the pallets.

Center and auxiliary guides in the area of the ball panels can be locked down. You do this so pallets can be loaded and unload.

You use the center stop/locks for these functions:

- To give laterial seperation between containers
- To give laterial restraint for containers
- To give vertical restraint for containers.

You use the auxiliary stop/locks for these functions:

- To give laterial restraint for containers (LD-4 or LD-8)
- To give vertical restraint for containers (LD-4 or LD-8).

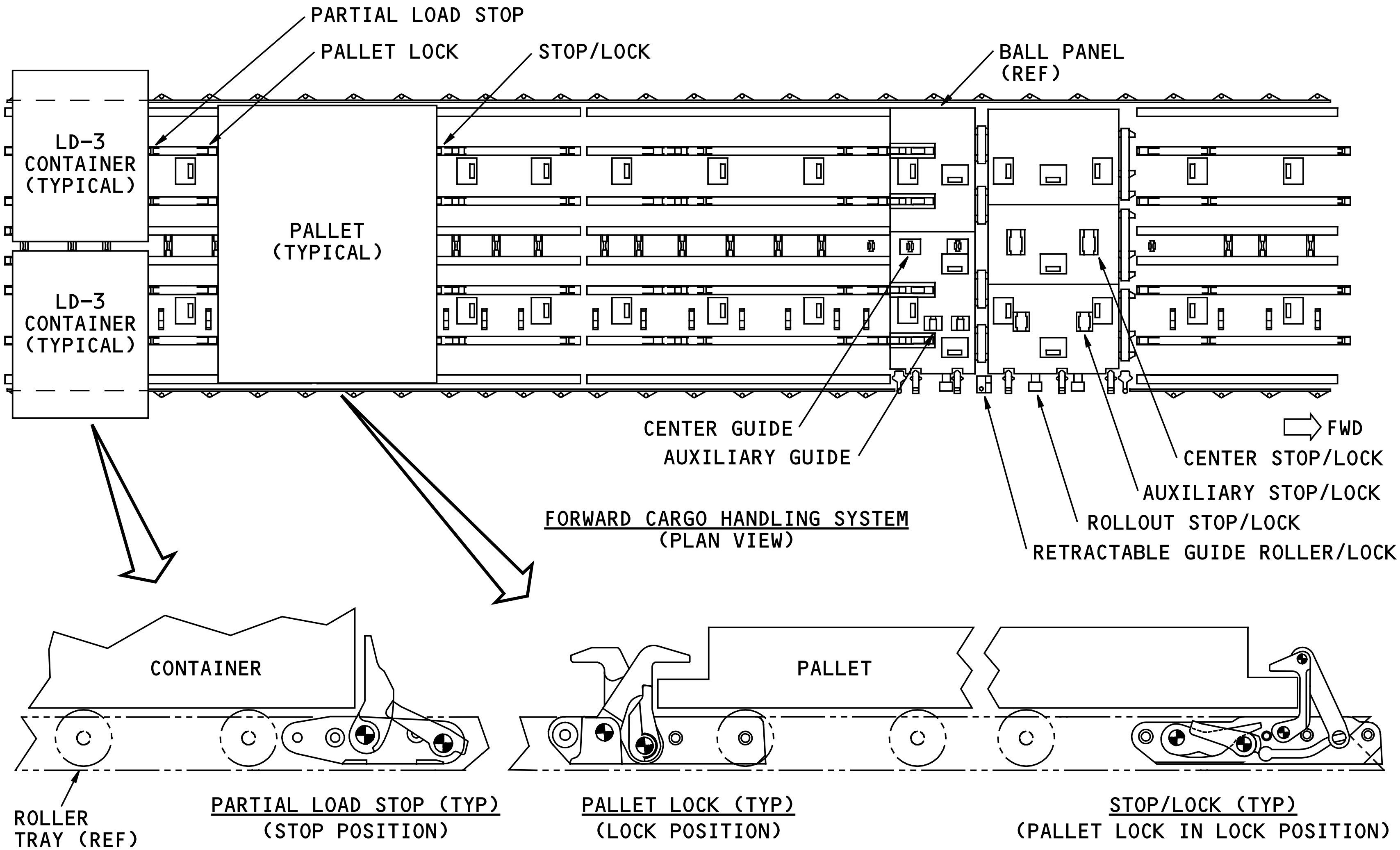
You use the rollout stop/locks for these functions:

- To give laterial restraint for containers and pallets
- To give vertical restraint for containers and pallets.

You use the retractable guide roller/lock for these functions:

- To guide contrainers into the compartment
- To give vertical restraint for containers and pallets.

You use the partial load stop to give longitudinal restraint for containers when another container is not adjacent to it.



NOTE: TYPICAL SYSTEM SHOWN

25-53-00-008 Rev 3 08/21/1997

CARGO HANDLING SYSTEM - MECHANICAL GENERAL DESCRIPTION

CARGO HANDLING SYSTEM - ROLLOUT STOP/LOCK - INTRODUCTION

Purpose

The rollout stop/lock gives lateral and vertical restraint for containers and pallets.

Physical Description

These units are spring-loaded mechanical units. They have these parts:

- Lateral restraint
- Vertical restraint
- Pedal
- Base.

Location

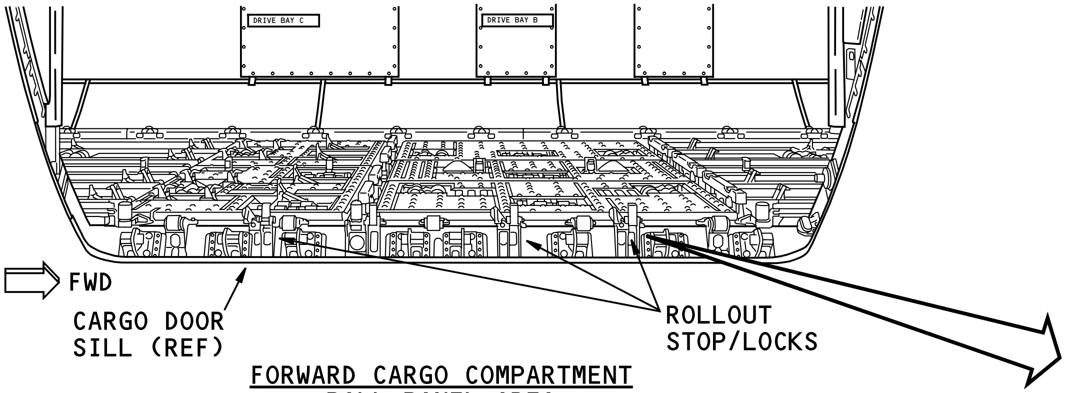
Each cargo compartment has three rollout stop/locks in the cargo door sill area.

Functional Description

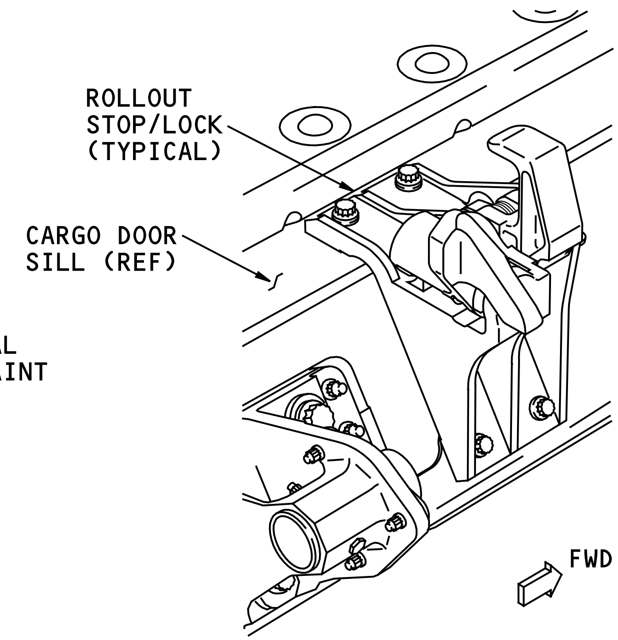
Manual movement of the lateral restraint lets you set the restraint in the up or down position. Manual movement of the of the vertical restraint lets you set the restraint to the up position. Manual movement of the pedal lets you lower the vertical restraint.

Training Information Point

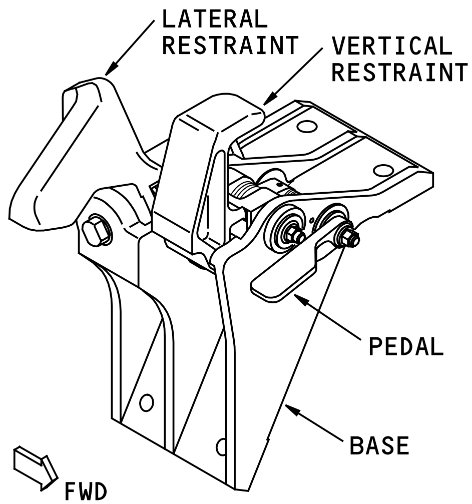
You remove the rollout stop/lock as a single unit.



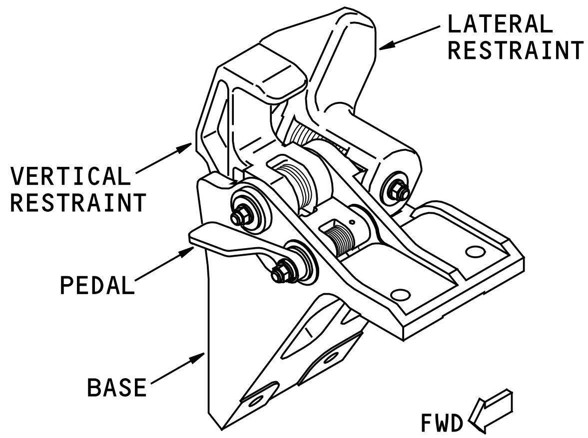
FORWARD CARGO COMPARTMENT BALL PANEL AREA
(TYPICAL)



FORWARD CARGO DOOR SILL AREA
(TYPICAL)



ROLLOUT STOP/LOCK



ROLLOUT STOP/LOCK

NOTE: FORWARD SYSTEM SHOWN, AFT SIMILAR

25-53-00-009 Rev 4 08/21/1997

CARGO HANDLING SYSTEM - ROLLOUT STOP/LOCK - INTRODUCTION

CARGO HANDLING SYSTEM - AUXILIARY STOP/LOCK - INTRODUCTION

Purpose

Auxiliary stop/locks supply lateral and vertical restraint for LD-4/LD-8 containers and longitudinal guidance for LD-4/LD-8 containers.

Physical Description

The auxiliary stop/locks are spring-loaded mechanical units. The units have these parts:

- Base
- Vertical restraint
- Lateral restraint
- Pedal.

The forward and aft auxiliary stop/locks are opposite of each other.

Location

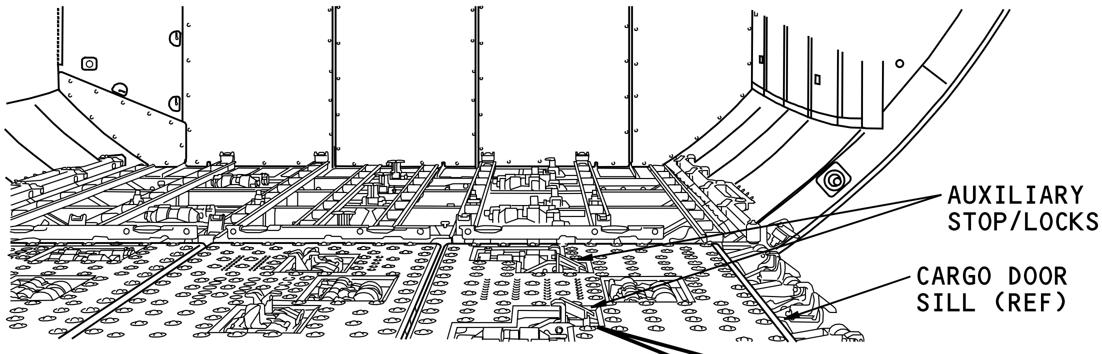
There are two auxiliary stop/locks in the ball panel area of the forward and aft cargo compartments. They are on the right side of the compartments.

Functional Description

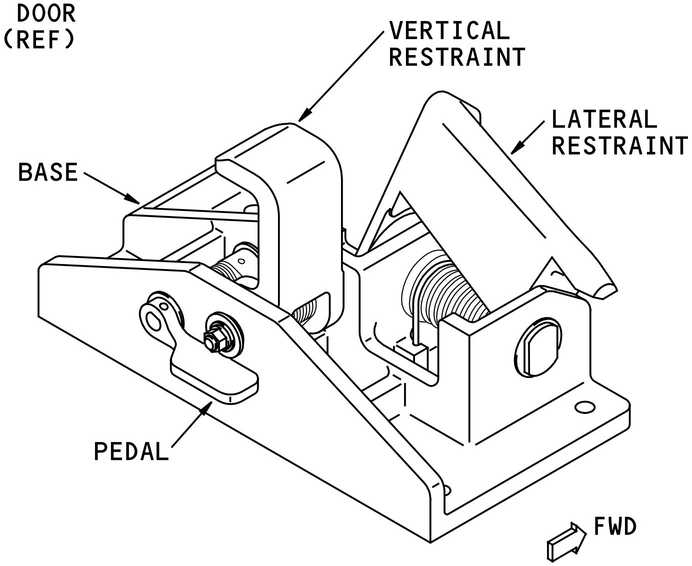
Manual movement of the lateral restraint lets you set the restraint in the up or down position. Manual movement of the of the vertical restraint lets you set the restraint to the up position. Manual movement of the pedal lets you lower the vertical restraint.

Training Information Point

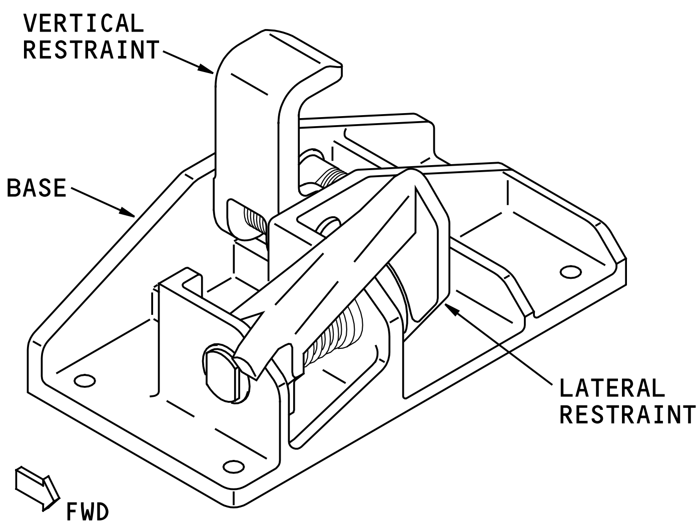
You remove the auxiliary stop/locks as single units.



FORWARD CARGO COMPARTMENT
BALL PANEL AREA
(TYPICAL)



AUXILIARY STOP/LOCK
(AFT SHOWN, FWD OPPOSITE)
(TYPICAL)



AUXILIARY STOP/LOCK
(AFT SHOWN, FWD OPPOSITE)
(TYPICAL)

25-53-00-010 Rev 4 08/21/1997

CARGO HANDLING SYSTEM - AUXILIARY STOP/LOCK - INTRODUCTION

CARGO HANDLING SYSTEM - CENTER STOP/LOCK - INTRODUCTION

Purpose

Center stop/locks have these functions:

- Supplies lateral and vertical restraint for LD-3/LD-1 containers, K and N size pallets
- Supplies lateral separation between LD-3 containers, K and N size pallets
- Supplies longitudinal guidance for LD-3/LD-1 containers, K and N size pallets.

Physical Description

Center stop/locks are spring-loaded mechanical units. The units have these parts:

- Vertical restraints
- Pawl
- Base
- Lateral restraint
- Lockdown pawl
- Retract lever
- Latch.

The center stop/locks are opposite of each other.

Location

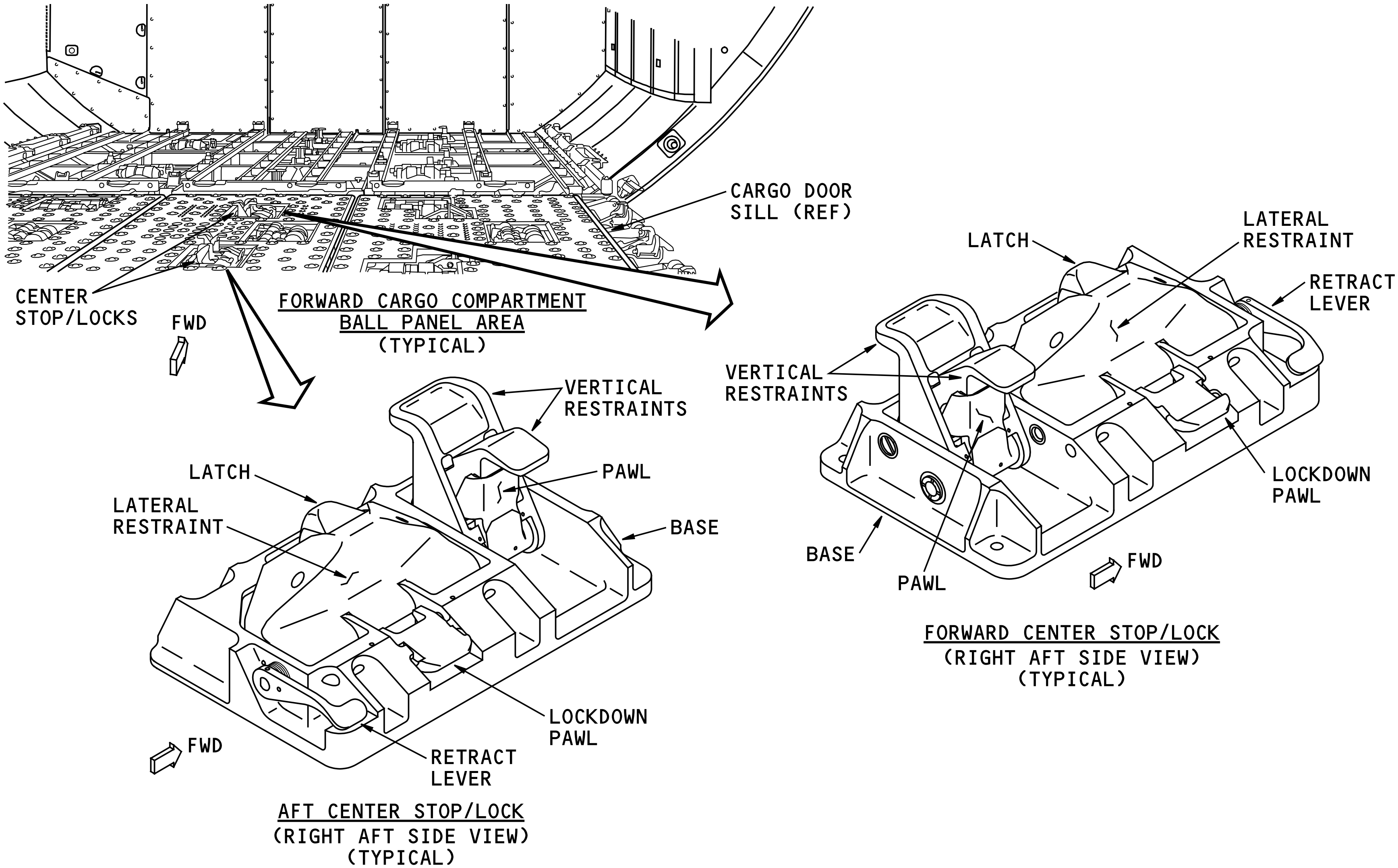
There are two center stop/locks in the ball panel area of the forward and aft cargo compartments. The center stop/locks are along the centerline of the compartments.

Functional Description

Manual movement of the lateral restraint lets you set the restraint in the up or down position. Manual movement of the of the vertical restraint lets you set the restraint to the up position. Manual movement of the pedal lets you lower the vertical restraint.

Training Information Point

You remove the center stop/locks as single units.



25-53-00-043 Rev 3 08/21/1997

NOTE: FORWARD CARGO HANDLING SYSTEM SHOWN, AFT SIMILAR

CARGO HANDLING SYSTEM - CENTER STOP/LOCK - INTRODUCTION

CARGO HANDLING SYSTEM - ROLLOUT, CENTER, AND AUXILIARY STOP/LOCKS - OPERATION

General

The rollout, center and auxiliary stop/locks operate almost the same. The shape and size of their restraints are different. You manually operate the stop/locks to set them to one of these positions:

- Lock, vertical and lateral restraints are up
- Load, vertical restraints are down, lateral restrains are up
- Unload, all restraints are down.

Manual Operation - Down

You use the pedals on the rollout and on the auxiliary stop/locks and the pawl on the center stop/lock to release a lock that holds the vertical restraint up. To move a vertical restraint down on a rollout or on an auxiliary stop/lock, push the pedal down. To move the vertical restraints down on a center stop/lock, pull the pawl down. This lets restraints move down over the pawl.

The lateral restraints are spring-loaded to the load (up) position. To lock a lateral restraint in the unload (down) position you push the restraint to the left (away from the cargo door) and at the same time push the restraint down. Hold the restraint down and let it move to the right (towards the door). This lets a lock hold the lateral restraint down.

Manual Operation - Up

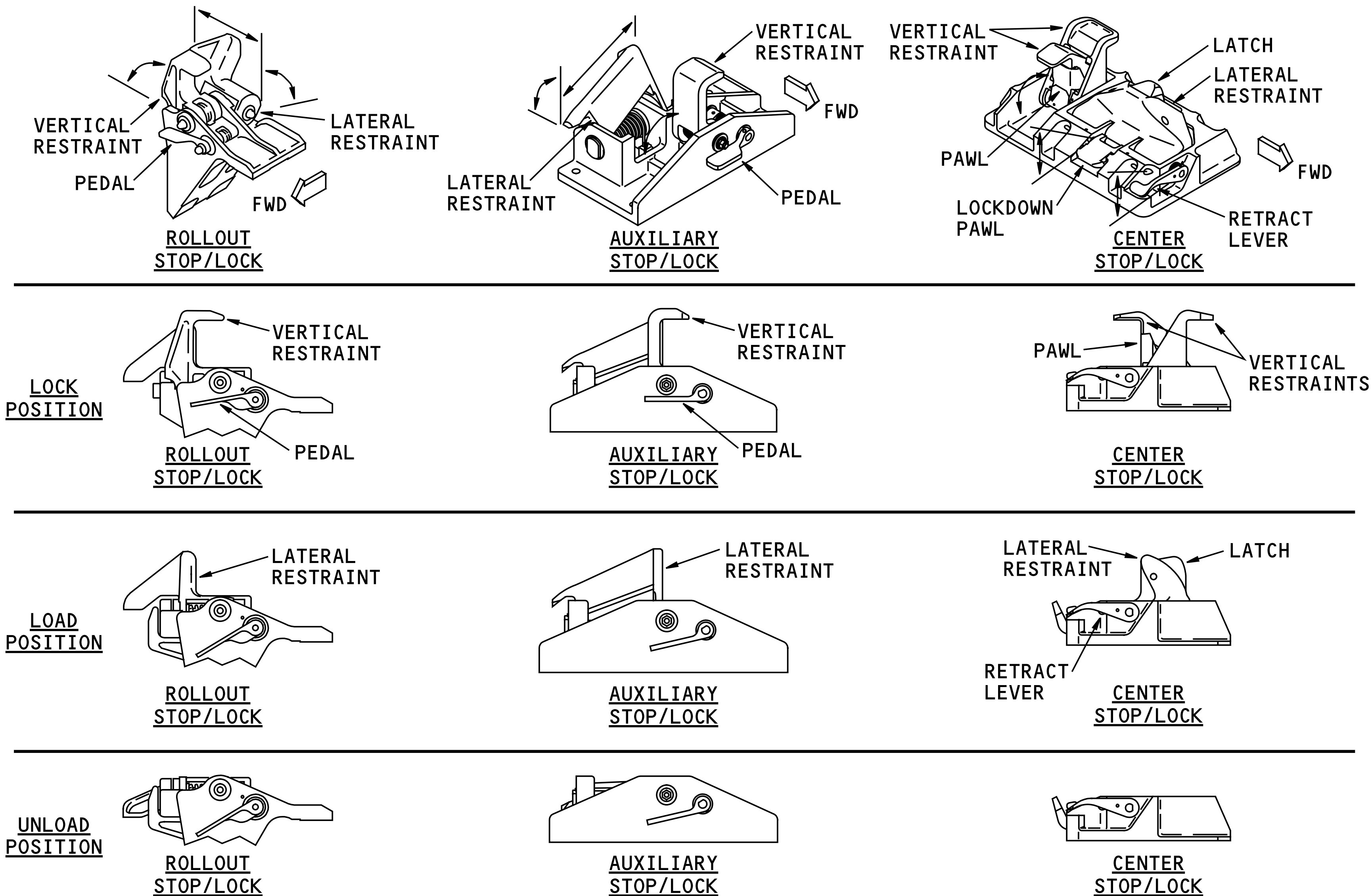
If the lateral restraint for a rollout or an auxiliary stop/lock is down, push the restraint to the left and let it move up. The lateral restraint is spring-loaded up. It will move up by itself to the load position.

If the lateral restraint for a center stop/lock is down, push down on the lockdown pawl. The pawl releases a lock that holds the restraint down. The lateral restraint is spring-loaded up. It will move up by itself to the load position.

If a vertical restraint is down, lift up the restraint to move it up to the lock position.

Lateral Restraint Operation

The lateral restraint is spring-loaded to the load position. During the load operation the restraint pivots down when a ULD pushes on it from the outboard side. When the ULD moves completely into the ball panel area, the lateral restraint pivots back up to the load position. ULDs cannot move outboard past the lateral restraint.



25-53-00-011 Rev 2 08/21/1997

CARGO HANDLING SYSTEM - ROLLOUT, CENTER, AND AUXILIARY STOP/LOCKS - OPERATION

CARGO HANDLING SYSTEM - RETRACTABLE GUIDE ROLLER/LOCK - INTRODUCTION

Purpose

The retractable guide roller/lock guides and aligns containers as they move through the cargo door opening. It also gives lateral and vertical restraint for containers and pallets.

Physical Description

The retractable guide roller/lock is a spring-loaded mechanical unit.

The unit has these parts:

- Fork
- Roller
- Restraint
- Pedal
- Bracket.

Location

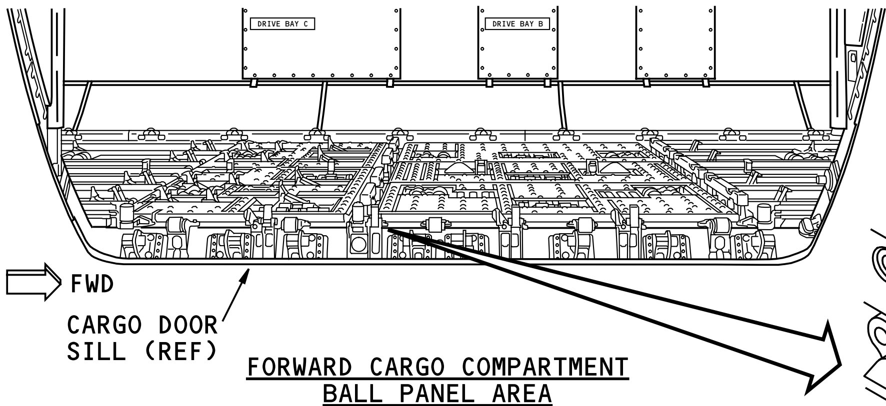
There is one retractable guide roller/lock in each cargo compartment. It mounts to the middle part of the door sill.

Functional Description

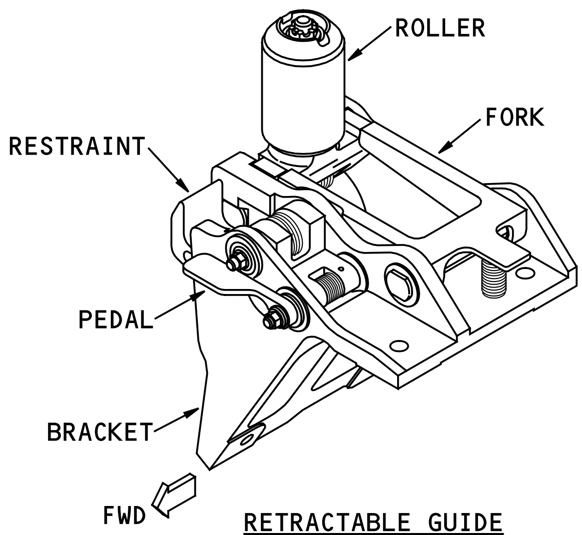
You control the position of the restraint and the roller manually. Manual movement of the roller or of the vertical restraint lets you set them to the up position. The pedal and fork let you manually lower the restraint and the roller.

Training Information Point

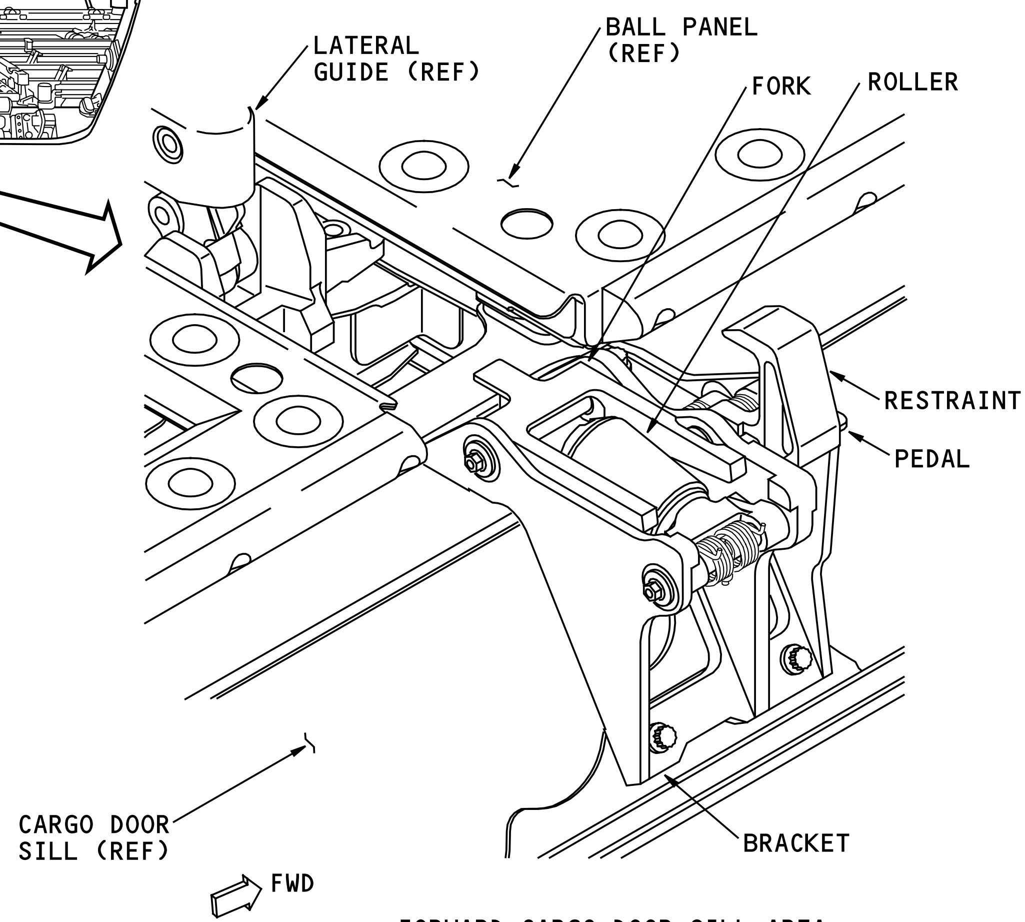
The roller on the retractable guide roller/lock is a LRU.



FORWARD CARGO COMPARTMENT
BALL PANEL AREA
(TYPICAL)



RETRACTABLE GUIDE
ROLLER/LOCK
(CONTAINER LOAD POSITION)



FORWARD CARGO DOOR SILL AREA
(TYPICAL RETRACTABLE GUIDE ROLLER/LOCK)
(LOCK POSITION)

CARGO HANDLING SYSTEM - RETRACTABLE GUIDE ROLLER/LOCK - INTRODUCTION

CARGO HANDLING SYSTEM - RETRACTABLE GUIDE ROLLER/LOCK - OPERATION

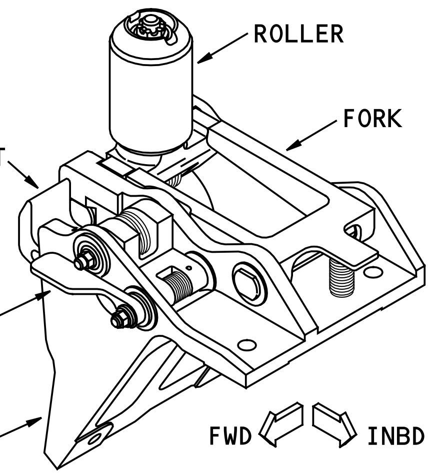
Operation

The retractable guide roller/lock has these positions:

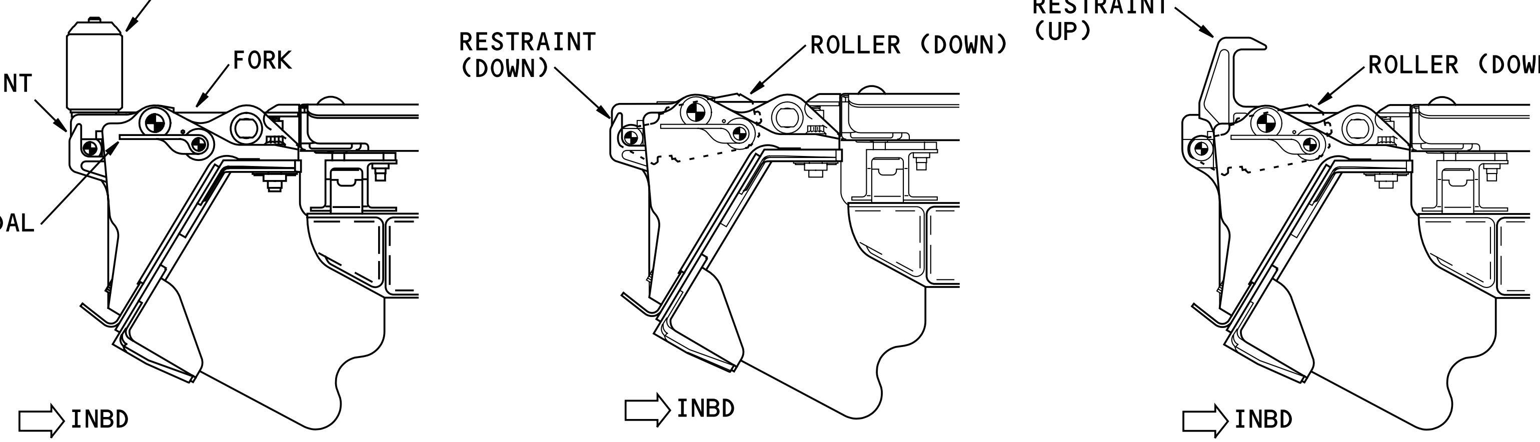
- Container load: The roller is up and the restraint is down to move containers into the cargo compartment.
- Pallet load and Contain/Pallet Unload: The roller and the restraint are down. Use this position to load pallets or unload containers and pallets.
- Lock: The roller is down and the restraint is up when cargo movement into or out of the cargo compartment is complete.

You use the pedal to lower the restraint. You use the fork to lower the roller. Push the pedal all the way down to move the restraint down. Push down on the inboard end of the fork to move the roller down.

You lift the roller or the restraint to put them up.



RETRACTABLE GUIDE ROLLER/LOCK
(CONTAINER LOAD POSITION)



CONTAINER LOAD POSITION

PALLET LOAD POSITION
CONTAINER/PALLET UNLOAD POSITION

LOCK POSITION

25-53-00-013 Rev 1 08/21/1997

CARGO HANDLING SYSTEM - RETRACTABLE GUIDE ROLLER/LOCK - OPERATION

CARGO HANDLING SYSTEM - LATERAL GUIDE - INTRODUCTION

General

Lateral guides make sure containers stay straight on the forward ball panels for the load or unload operation. Some guides also give vertical restraint and more anchor fittings for pallets.

Seven lateral guides are in each cargo compartment. There are four different types of lateral guides:

- Large with forward and aft vertical restraints (forward cargo compartment)
- Large with aft vertical restraints only (aft cargo compartment)
- Small with heavy weight rail and base (forward cargo compartment)
- Small with light weight rail and base (aft cargo compartment).

Large Guides

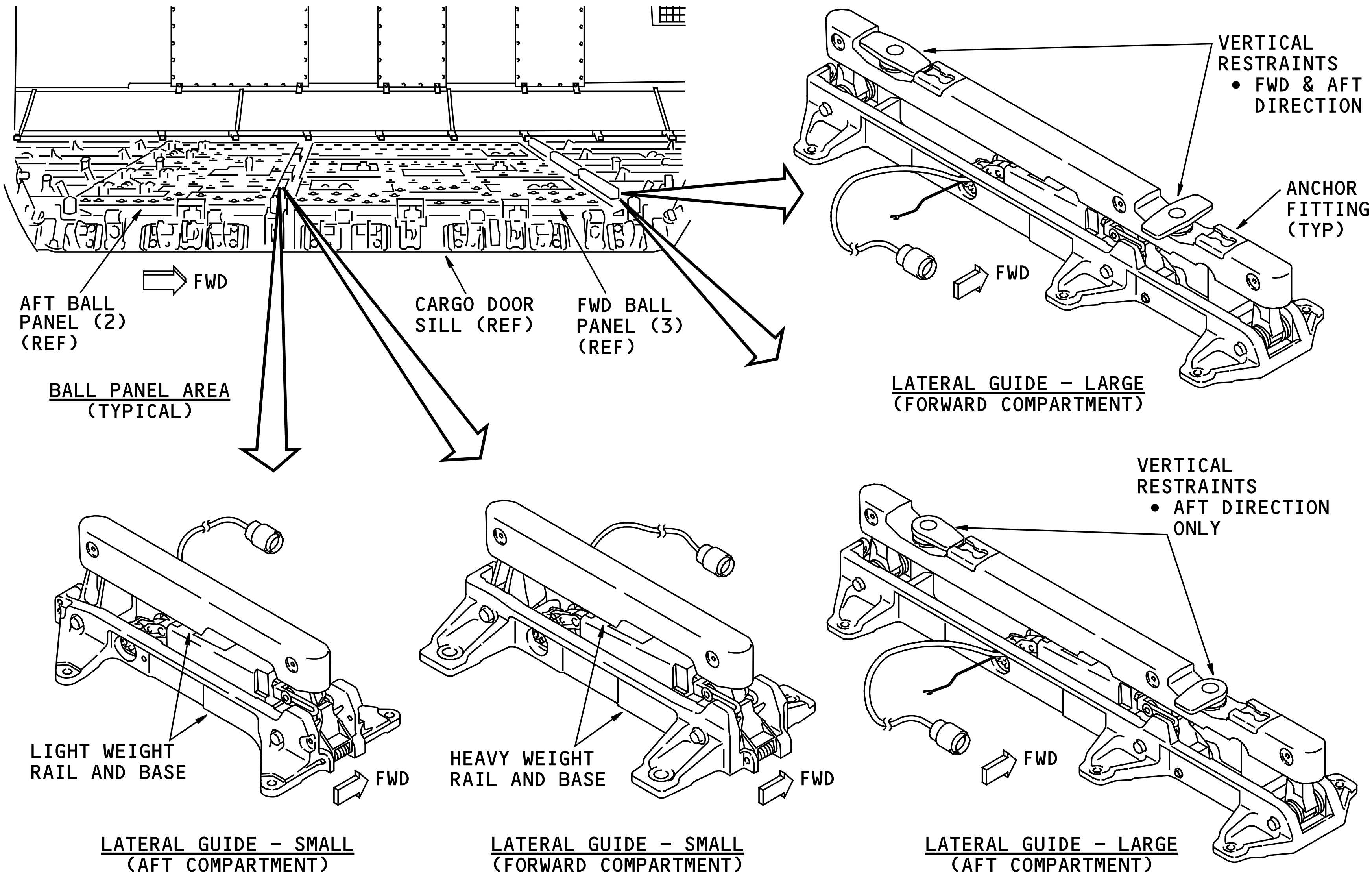
The large lateral guides in the forward cargo compartment give vertical restraint for pallets forward and aft of the guide. The large lateral guides in the aft compartment give vertical restraint for pallets aft of the guide only.

Small Guides

The small lateral guides in the forward cargo compartment are heavier in construction than the ones in the aft compartment. This makes them more resistant to the higher longitudinal loads in the forward compartment.

Location

Three large lateral guides are forward of the forward ball panels. Four small lateral guides are between the forward and aft ball panels.



25-53-00-015 Rev 3 12/11/1996

CARGO HANDLING SYSTEM - LATERAL GUIDE - INTRODUCTION

CARGO HANDLING SYSTEM - LATERAL GUIDE - PHYSICAL DESCRIPTION

Physical Description

Lateral guides are spring loaded electrical/mechanical units. The guides have these parts:

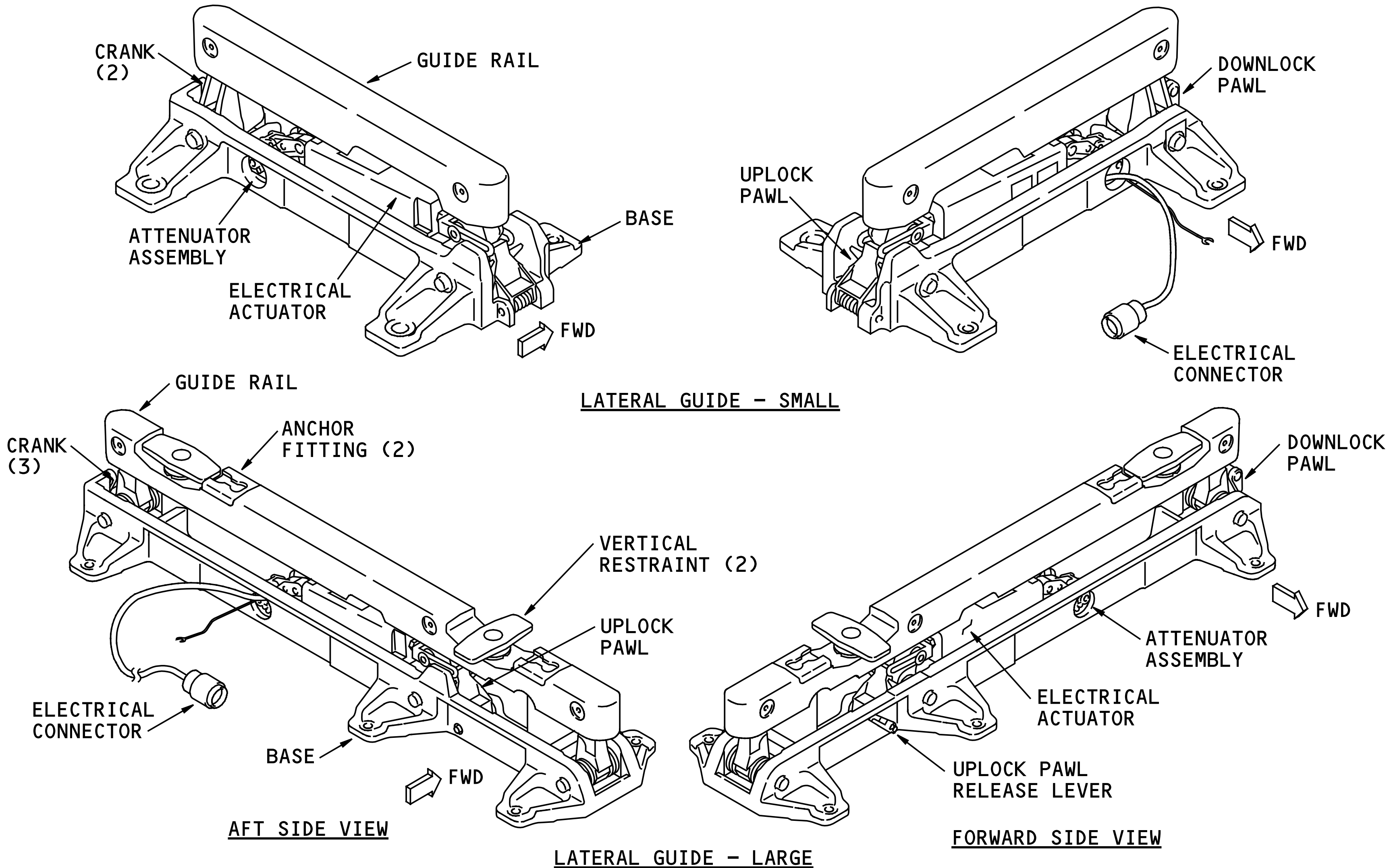
- Crank (2 for small guides, 3 for large guides)
- Guide rail
- Base
- Electrical actuator
- Attenuator assembly
- Downlock pawl
- Electrical connector
- Uplock pawl
- Anchor fitting (2) (large lateral guides only)
- Vertical restraint (2) (large lateral guides only)
- Uplock pawl release lever (large lateral guides only).

Functional Description

The electrical actuator controls the position of the guide rail. The pawls and pawl release lever manually operate the guide rail.

Training Information Point

You remove the lateral guides as a single unit.



NOTE: FORWARD CARGO LATERAL GUIDES SHOWN, AFT SIMILAR

25-53-00-016 Rev 0

CARGO HANDLING SYSTEM - LATERAL GUIDE - PHYSICAL DESCRIPTION

CARGO HANDLING SYSTEM - LATERAL GUIDE - OPERATION - LOCK DOWN

General

Normally the guide rail on the lateral guides moves electrically to down when you move cargo forward or aft. If the rail does not move electrically you can manually move and lock it down with these components:

- Uplock pawl (small guides only)
- Uplock pawl release lever (large guides only)
- Guide rail
- Down lock pawl.

Lock down

For small guides move the uplock pawl away from the crank. For large guides use the uplock pawl release lever to move the uplock pawl away from the crank. The uplock pawl is spring loaded. Hold the pawl or lever to keep the pawl away from the crank.

While you hold the pawl or the release lever push the guide rail down. The guide rail is spring loaded up.

As you hold the guide rail, move the downlock pawl to lock the guide rail down.

Release

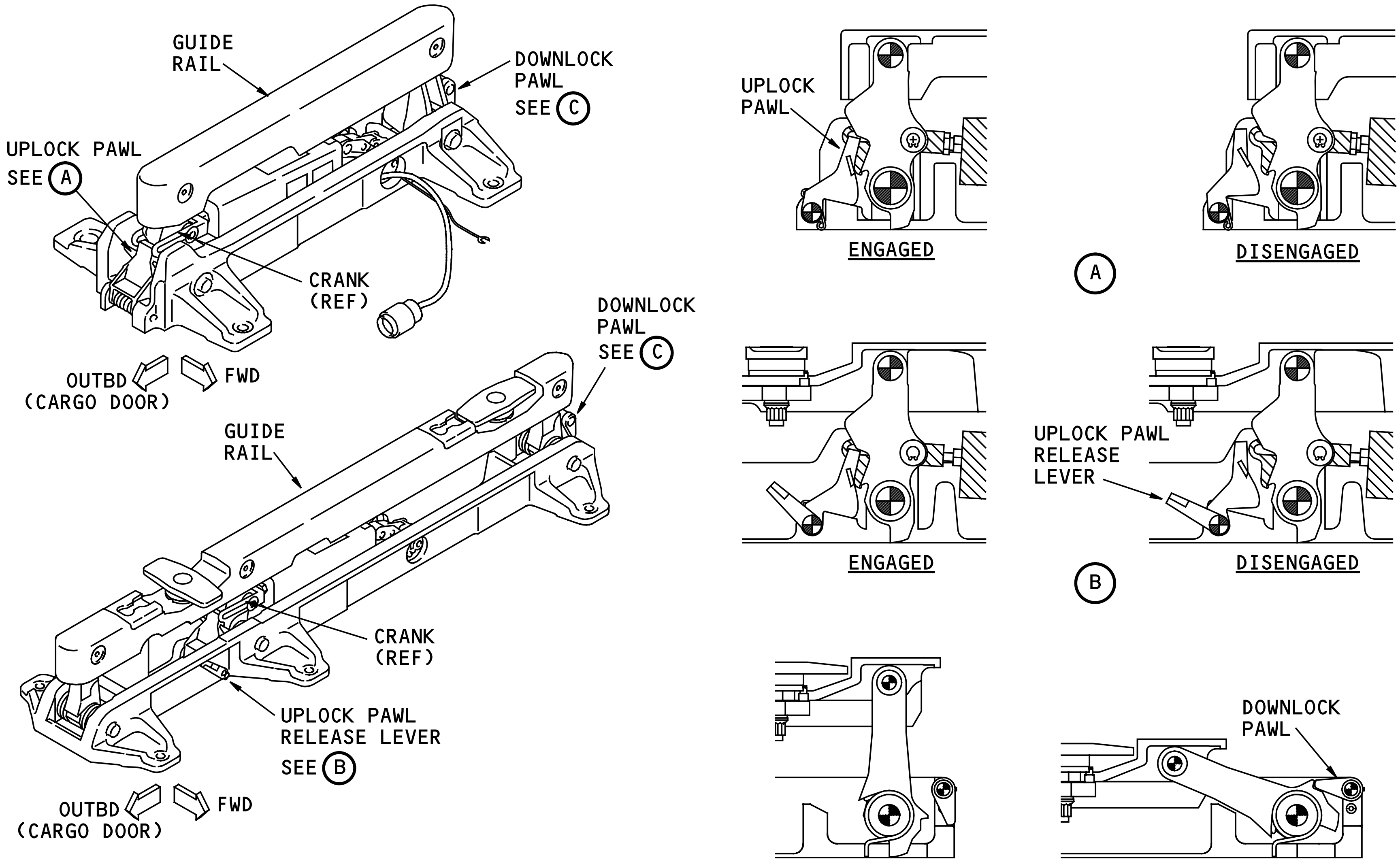
Push and hold down the guide rail. This removes pressure on the downlock pawl.

Move the downlock pawl to unlock the guide rail.

Release the guide rail. Springs automatically move it up.

Training Information Point

If you manually lower a lateral guide, you must manually release it before it will operate electrically.



NOTE: FORWARD CARGO LATERAL GUIDES SHOWN, AFT SIMILAR

25-53-00-017 Rev 0

CARGO HANDLING SYSTEM - LATERAL GUIDE - OPERATION - LOCK DOWN

CARGO HANDLING SYSTEM - LATERAL GUIDE - OPERATION - LIFT UP

General

To lift up a lateral guide when it does not move up electrically, you must manually operate the toggle link in the attenuator assembly.

Lift up

Use a common screwdriver or similar long, thin object to trip the toggle link on the attenuator assembly. Springs lift the guide rail automatically if the toggle link is tripped correctly.

The attenuator resets automatically when the guide rail is lowered manually.

Access

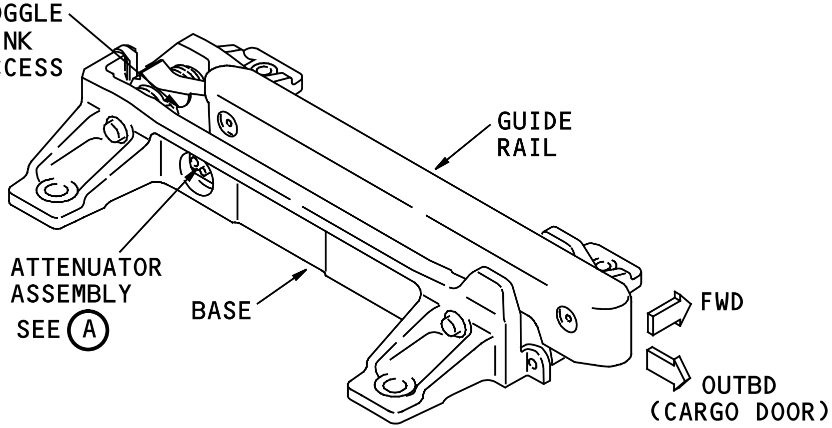
Access to the toggle link is different for large and small guides.

Large guides - you access the toggle link thought a side access hole in the base of the lateral guide. This hole is on the forward side of the guide.

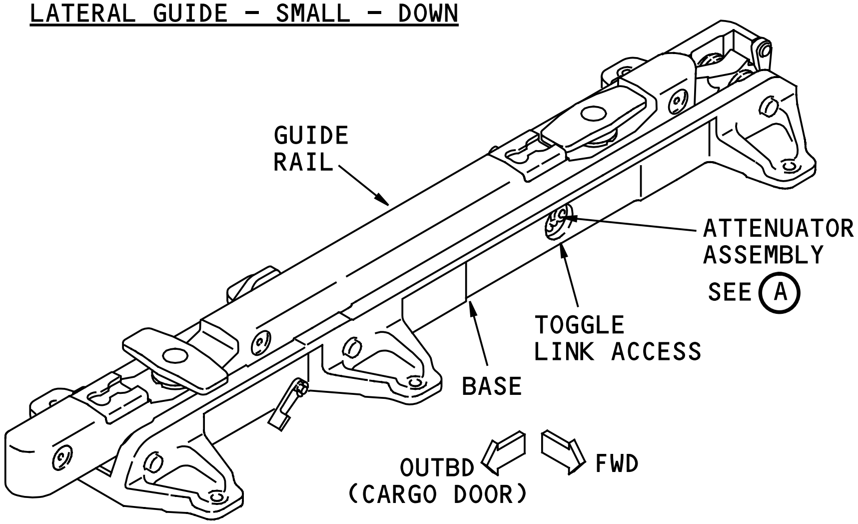
Small guides - you access the toggle link from the top of the lateral guide. The tool you use to the trip the toggle link fits between the rail and the base of the guide.

Training Information Point

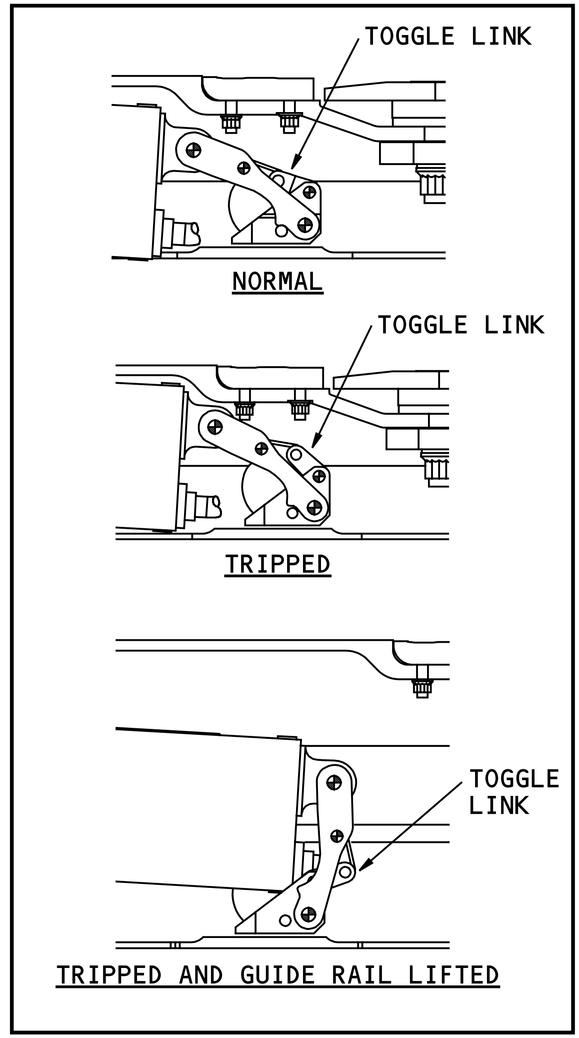
If you manually lift a lateral guide, you do not have to move it down before electrical operation. The lateral guide will reset itself when power is put on the system.



LATERAL GUIDE - SMALL - DOWN



LATERAL GUIDE - LARGE - DOWN



ATTENUATOR ASSEMBLY
A

NOTE: FORWARD CARGO LATERAL GUIDES SHOWN, AFT SIMILAR

25-53-00-018 Rev 1

CARGO HANDLING SYSTEM - LATERAL GUIDE - OPERATION - LIFT UP

CARGO HANDLING SYSTEM - POWERED DRIVE UNIT - INTRODUCTION

General

Powered drive units (PDUs) move containers and pallets.

There are two types of PDUs:

- Lateral
- Longitudinal.

Lateral PDU

There are six lateral PDUs in each compartment. The lateral PDUs move containers and pallets into or out of the cargo compartment.

longitudinal PDU

There are 28 longitudinal PDUs in the forward cargo compartment and 22 in the aft cargo compartment. They move containers and pallets forward or aft in the compartment.

Location

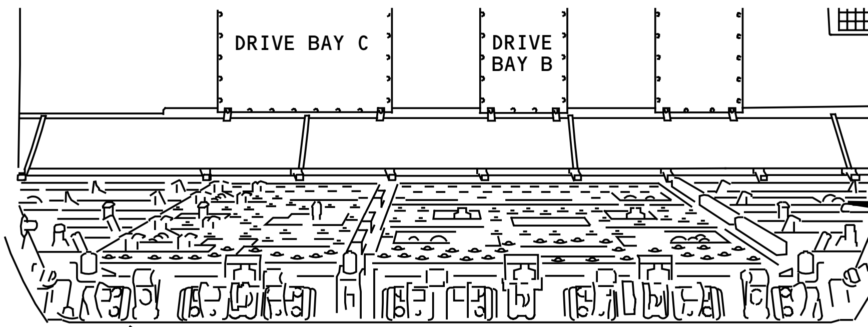
Lateral PDUs are in the ball panel area, bays B and C forward compartment, bays E and F aft compartment (not shown).

Longitudinal PDUs are throughout the compartments.

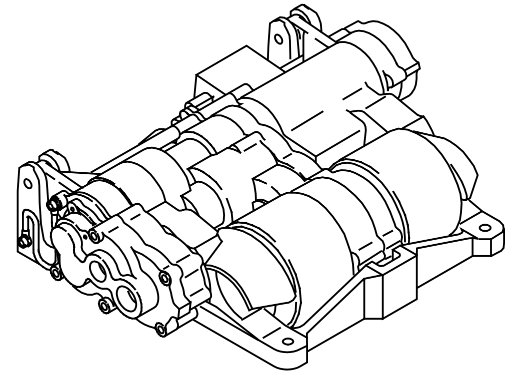
Training Information Point

The lateral PDUs are interchangeable with the longitudinal PDUs.

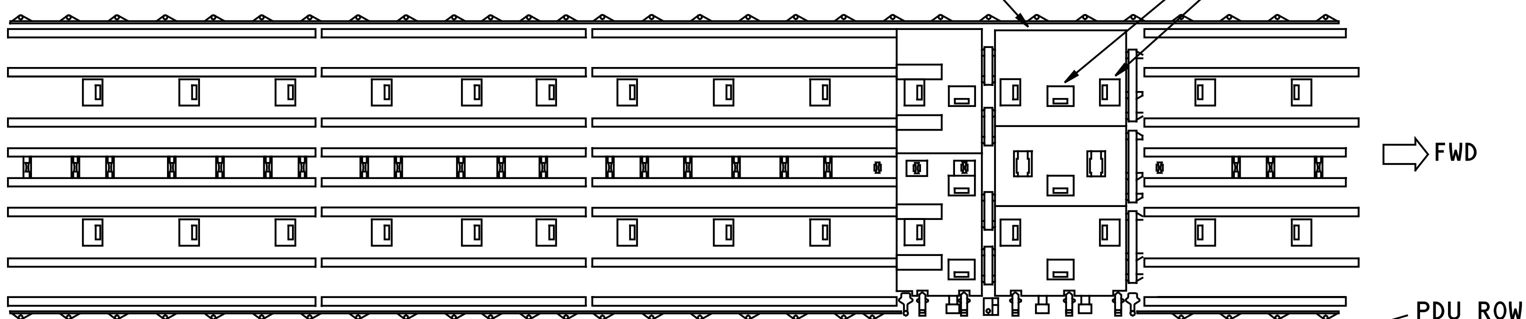
You identify individual PDUs by PDU row location number and its location in the row, right, center or left. For one example, 5R is the PDU in the fifth row of PDUs from the front of the compartment on the right side. For another example, 4C in the forward compartment is the center PDU in the fourth row from the front of the compartment.



BALL PANEL AREA
FORWARD CARGO COMPARTMENT
(TYPICAL)



POWERED DRIVE UNIT
(TYPICAL)



FORWARD CARGO HANDLING SYSTEM
(TYPICAL)

NOTE: FORWARD SYSTEM SHOWN, AFT SIMILAR

25-53-00-019 Rev 3 10/31/1997

CARGO HANDLING SYSTEM - POWERED DRIVE UNIT - INTRODUCTION

CARGO HANDLING SYSTEM - POWERED DRIVE UNIT - FUNCTIONAL DESCRIPTION

General

The power drive unit (PDU) has these parts:

- Hinge
- Actuator
- Roller guards
- Rollers
- Mounting base
- Electrical connector
- Lift cams.

The actuator attaches to the mounting base at the hinge. The rollers are a hard rubber-like material. The lift cams are on the bottom side of the actuator.

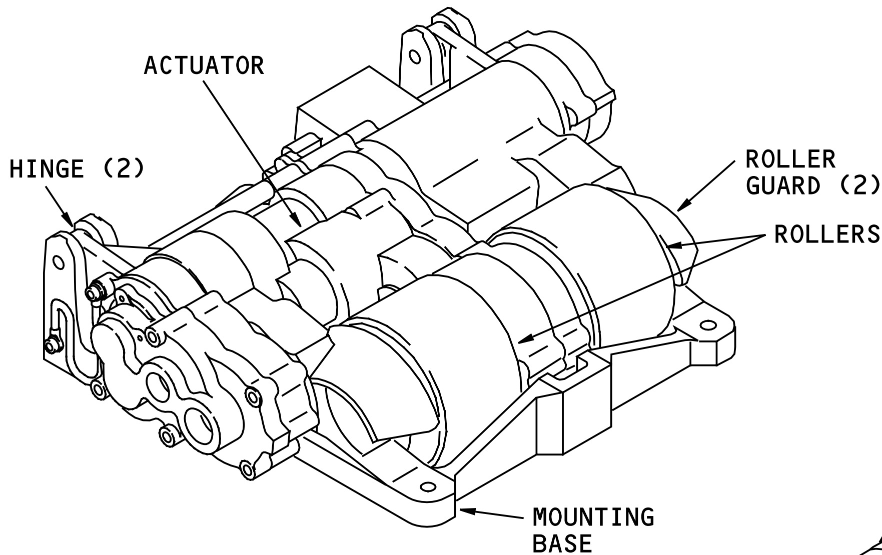
Functional Description

The PDUs actuator has a reversible AC motor (not shown) that drives the rollers and lift cams through reduction gears (not shown). The actuator also has an internal erection coil (not shown) that locks the lift cams when the PDU is in the raised position. The motor has an electrically activated brake (not shown). It stops and holds the motor when the PDU is not in the drive condition. The lift cams move the PDU up the first time the motor is in the drive condition. The cams keep the PDU up until power is removed from the PDU. Power to the PDU is removed by any of these:

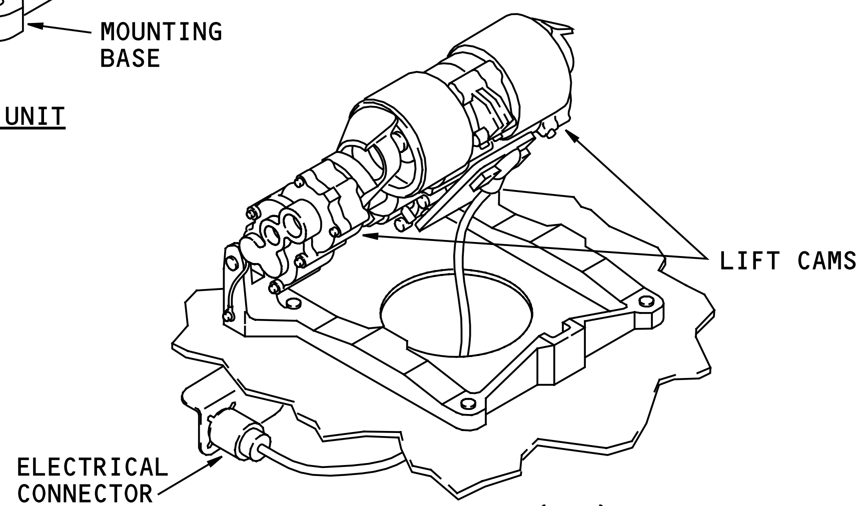
- System power switch
- Bay OFF switch
- Cargo system controller (CSC) control logic.

Training Information Point

When you replace a PDU you must clean and seal the PDU mounting base to the airframe. Then make sure electrical resistance between the PDU and airframe is acceptable. Make sure the wire bundle is clamped (not shown) to prevent fraying.



POWER DRIVER UNIT
(TYP)



POWER DRIVE UNIT (TYP)
(VIEW IN THE UP POSITION TO SHOW
ACCESS TO THE ELECTRICAL CONNECTOR)

25-53-00-020 Rev 2 10/16/96

CARGO HANDLING SYSTEM - POWERED DRIVE UNIT - FUNCTIONAL DESCRIPTION

CARGO HANDLING SYSTEM - SILL ROLLER

Purpose

The sill rollers support cargo as it moves through the cargo door opening. The rollers make sure that the cargo is at same height of the balls in the ball panels. They also give a place to tie down cargo.

Physical Description

There are two types of sill rollers:

- Non-Cantilevered
- Cantilevered.

The forward cargo handling system uses both types. The aft system uses only the cantilevered type.

The sill rollers have these parts:

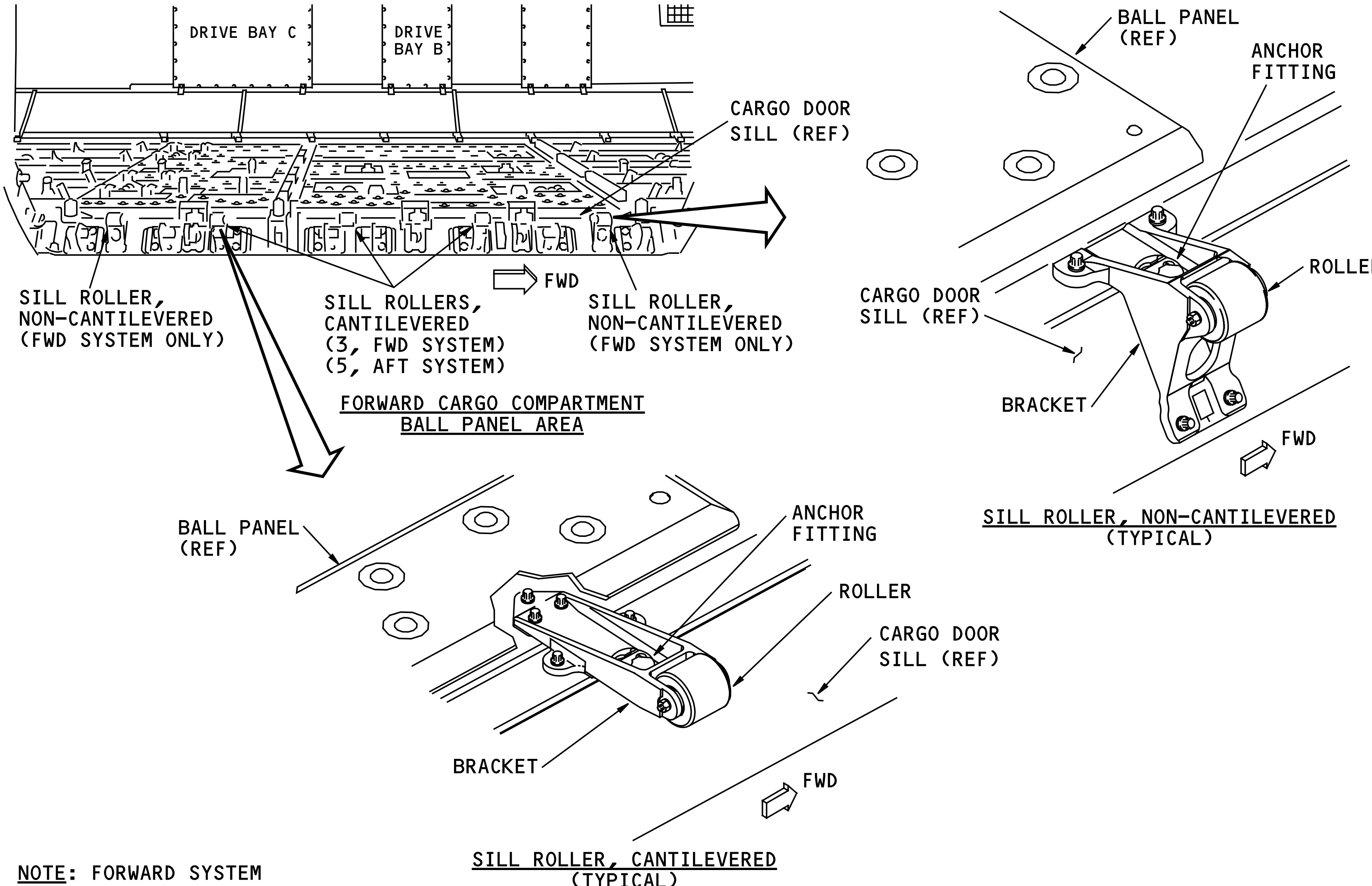
- Anchor fitting
- Roller
- Bracket.

Location

There are five sill rollers in each cargo compartment on the cargo door sill. The first and last sill rollers on the forward cargo door sill are the non-cantilevered type.

Training Information Point

The roller is a LRU.



NOTE: FORWARD SYSTEM SHOWN, AFT SIMILAR

25-53-00-021 Rev 1 06/02/1995

CARGO HANDLING SYSTEM - SILL ROLLER

CARGO HANDLING SYSTEM - GUIDE ROLLERS

Purpose

The guide rollers guide and align cargo as it moves through the cargo door opening.

Physical Description

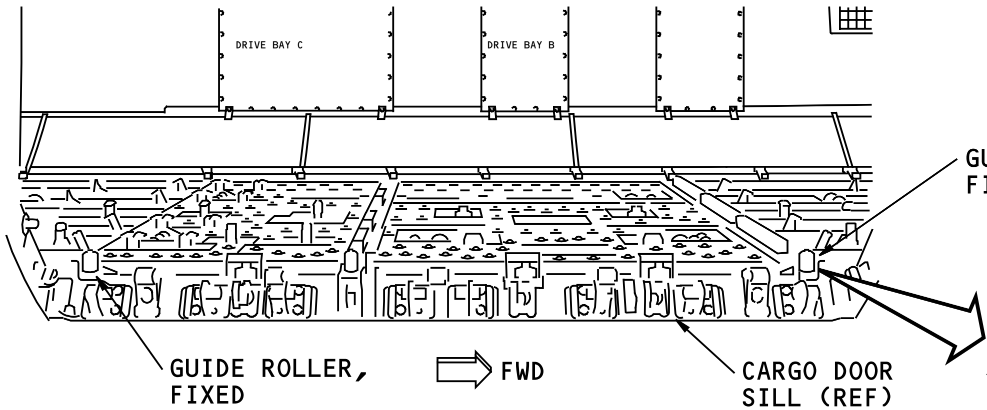
The guide roller has a bracket and a roller. The guide rollers in the forward cargo compartment have a different bracket than the ones used in the aft cargo compartment. The side guide rail attaches to the bracket of the guide rollers.

Location

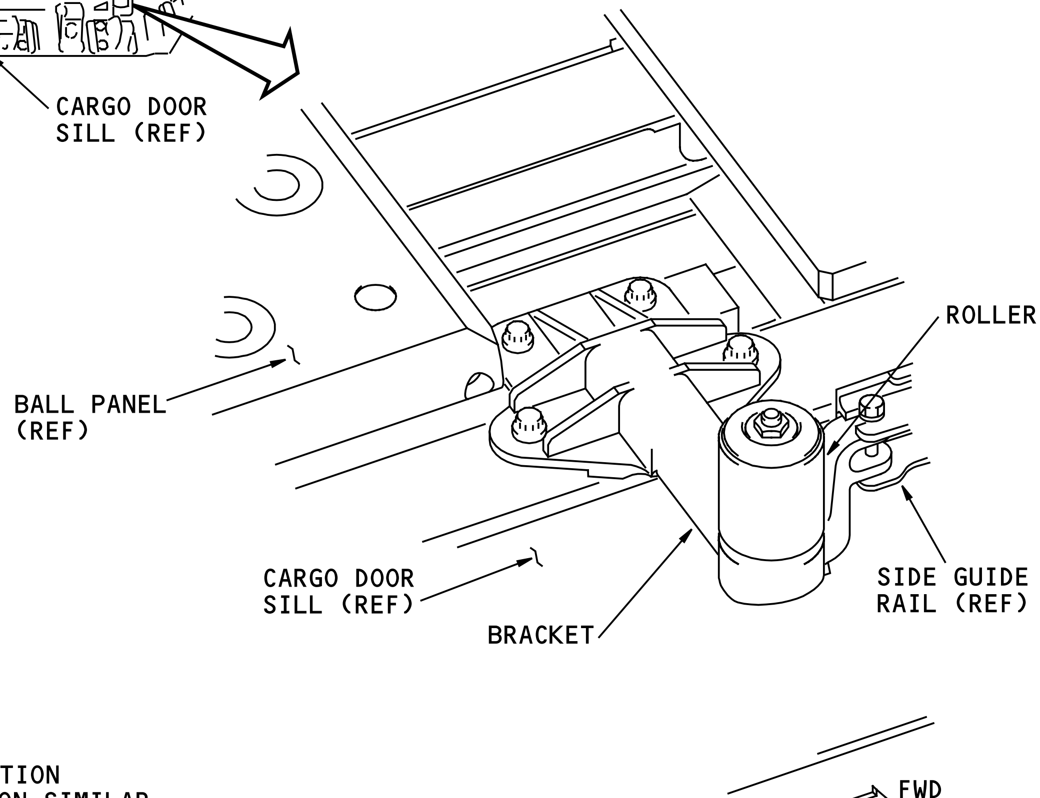
There are two guide rollers in each cargo compartment. The guide rollers mount to the door sill, one forward and one aft of the ball panel area.

Training Information Point

The roller is an lRU.



FORWARD CARGO COMPARTMENT
BALL PANEL AREA



GUIDE ROLLER - FIXED
(TYPICAL)

NOTE: FORWARD CARGO COMPARTMENT INSTALLATION SHOWN, AFT COMPARTMENT INSTALLATION SIMILAR EXCEPT GUIDE ROLLERS HAVE A DIFFERENT BRACKET.

25-53-00-022 Rev 0 06/01/1995

CARGO HANDLING SYSTEM - GUIDE ROLLERS

CARGO HANDLING SYSTEM - BALL PANEL

Purpose

The ball panels do these functions:

- Make a low friction surface to help in the movement of cargo
- Supply a primary bearing surface to transmit cargo loads to the airframe
- Make a surface to walk on.

Physical Description

Airplanes with large forward and aft cargo doors have five ball panels in each cargo compartment, three forward panels and two aft panels.

The panels are two sheets of aluminum that are bonded and riveted to a corrugated inner core. The inner core is made of channels and doublers. Each ball panel has insert cups that let the ball transfer units (BTU) lock to the panel.

Each BTU locks into an insert cup with two latches.

Location

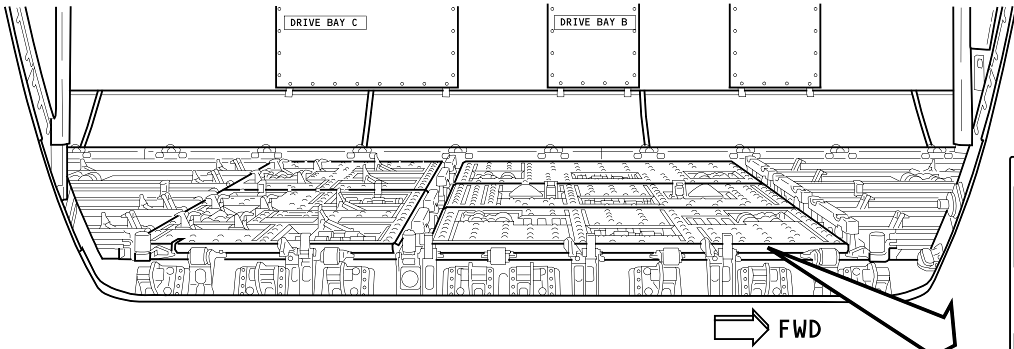
The panels are adjacent to the forward and aft cargo doors (not shown). The panels are in container bays B and C for the forward compartment.

The panels are in container bays E and F for the aft cargo compartment (not shown).

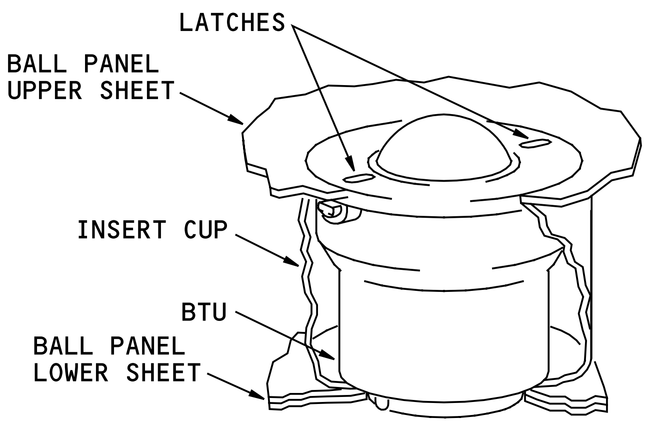
Training Information Point

BTUs are LRUs.

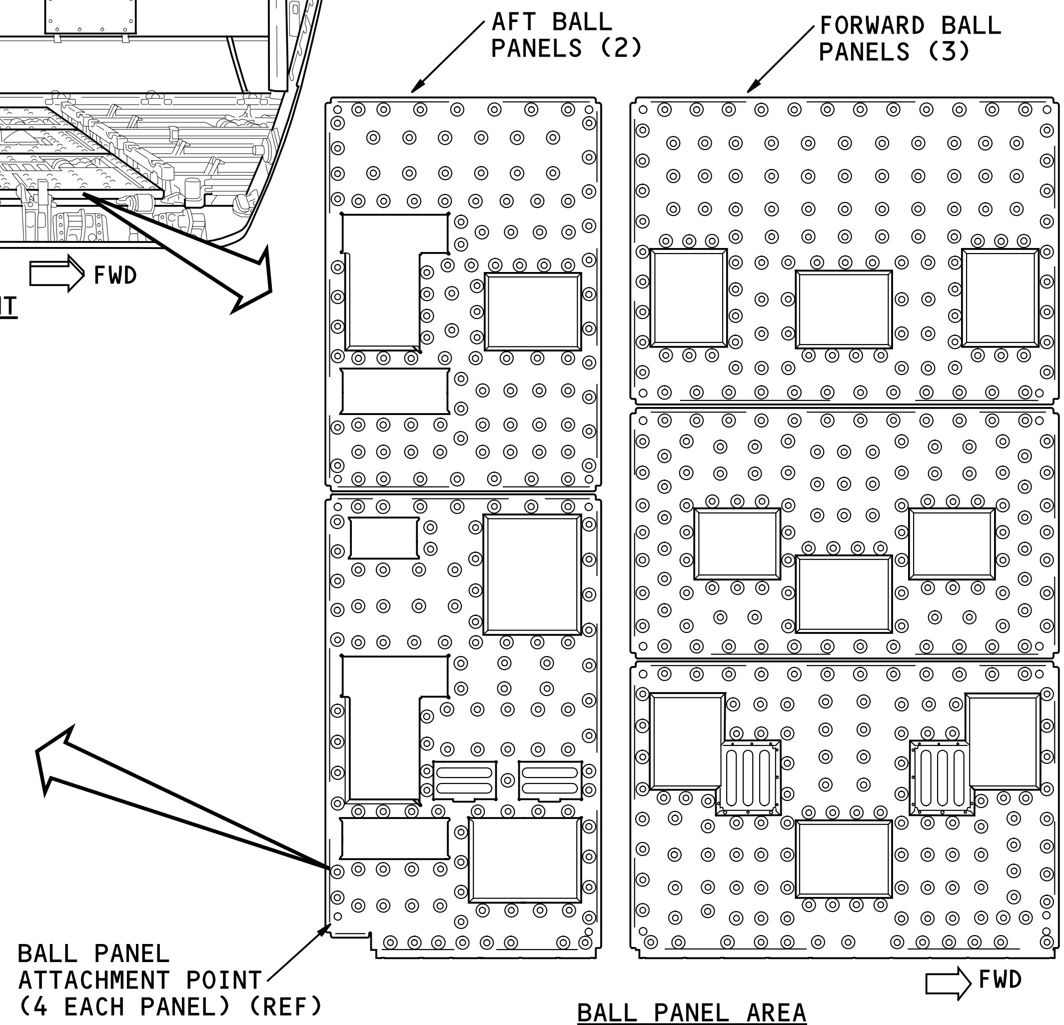
WARNING: BE CAREFUL WHEN YOU WALK ON THE BALL PANELS OR ALONG THE FLOOR PANELS IN THE CARGO COMPARTMENT. THE COMPONENTS IN THE CARGO COMPARTMENT CAN MOVE AND CAUSE YOU TO FALL.



FORWARD CARGO COMPARTMENT
BALL PANEL AREA
(TYPICAL)



BALL TRANSFER UNIT
(TYPICAL)



BALL PANEL AREA
(PLAN VIEW)
(TYPICAL)

NOTE: FORWARD SYSTEM
SHOWN, AFT SIMILAR

25-53-00-023 Rev 3 10/31/1997

CARGO HANDLING SYSTEM - BALL PANEL

CARGO HANDLING SYSTEM - ROLLER TRAY

Purpose

The roller trays do these functions:

- Make a low friction surface to help in the forward and aft movement of cargo
- Supply a primary cargo load bearing surface
- Supply a place to mount cargo handling system components.

Physical Description

The roller trays have rollers and a tray.

These cargo handling components mount to the trays:

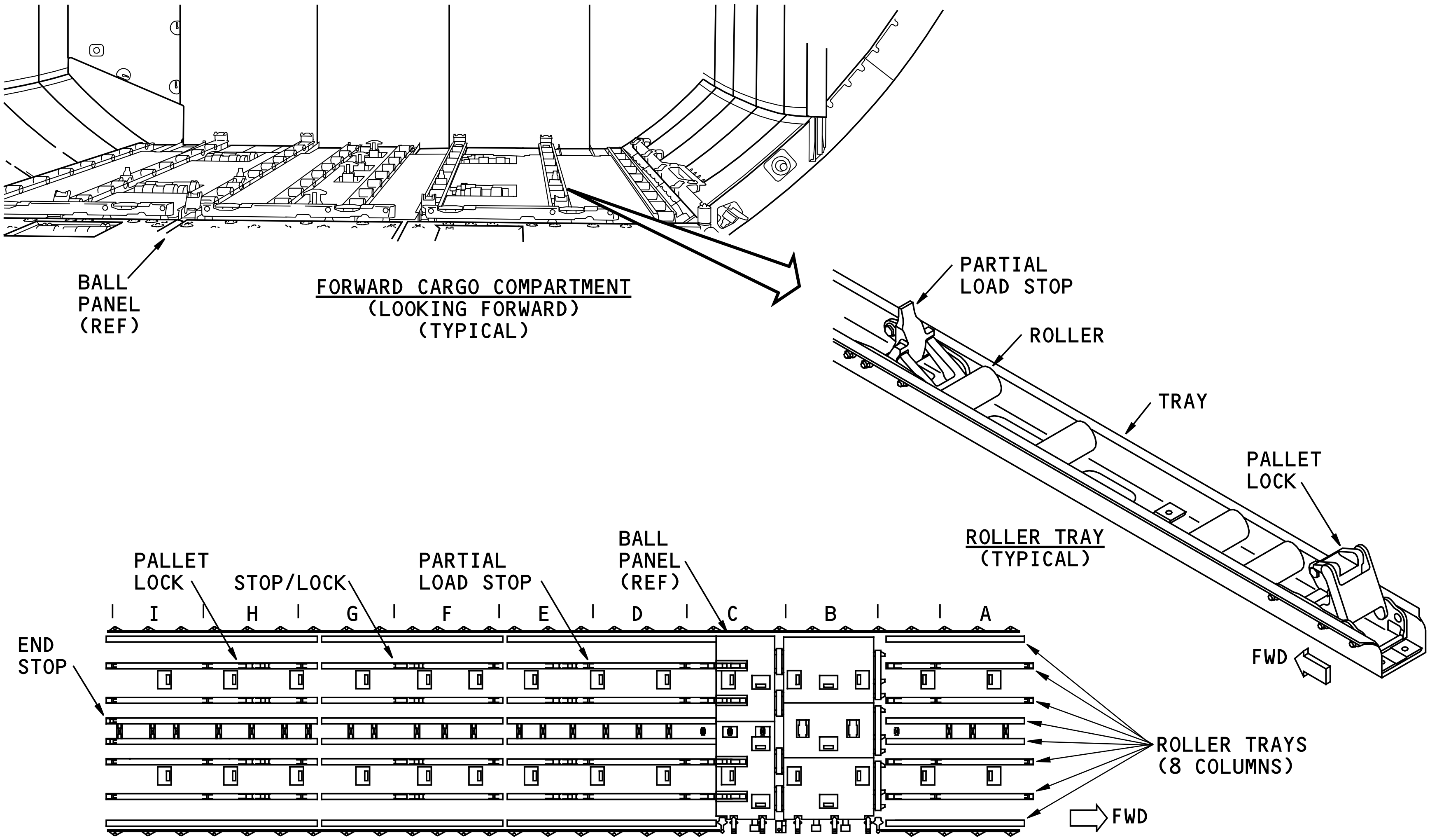
- End stops
- Pallet locks
- Stop/locks
- Partial load stops.

Location

Roller trays are forward and aft of the ball panels in the forward and aft cargo compartments. There are eight columns of roller trays across each compartment. There are different tray lengths.

The aft cargo compartment has auxiliary roller trays (not shown) in the area forward of the ball panels. The trays give more places to mount equipment for the lower lobe attendant rest module.

In the forward cargo compartment each column has four trays. In the aft cargo compartment the columns along the sides of the compartment have five trays (not shown). The columns along the middle of the compartment have three trays (not shown).



FORWARD CARGO COMPARTMENT
(LOOKING FORWARD)
(TYPICAL)

ROLLER TRAY
(TYPICAL)

FORWARD CARGO HANDLING SYSTEM
(TYPICAL)

NOTE: FORWARD SYSTEM SHOWN,
AFT SYSTEM SIMILAR

25-53-00-024 Rev 4 10/31/1997

CARGO HANDLING SYSTEM - ROLLER TRAY

CARGO HANDLING SYSTEM - SIDE GUIDE RAIL

Purpose

The side guide rail has these functions:

- Gives lateral alignment and longitudinal guidance to the cargo
- Gives the cargo lateral and vertical restraint
- Gives a place to tie down cargo.

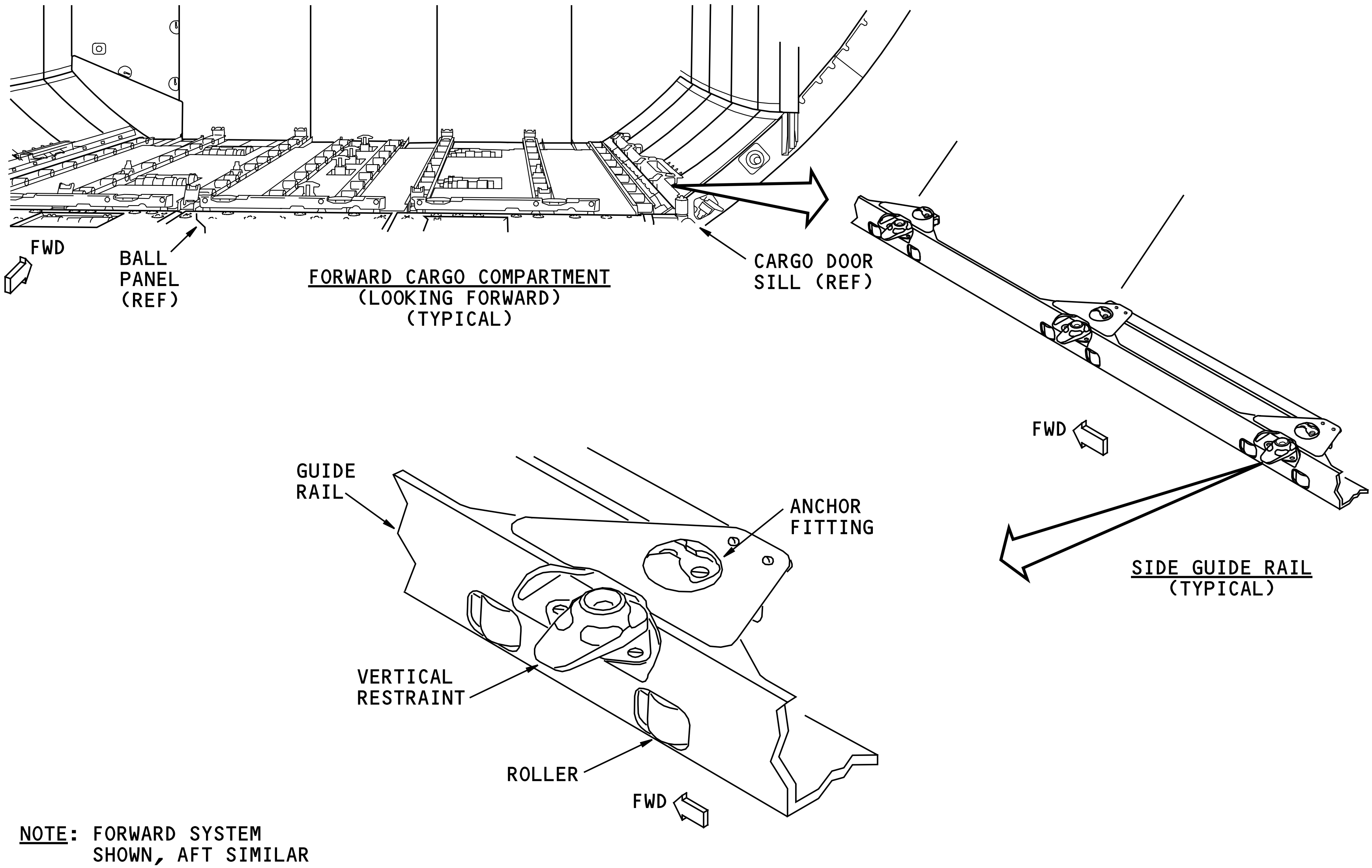
Physical Description

The side guide rail has these parts:

- Anchor fitting
- Roller
- Vertical restraint
- Guide rail.

Location

Side guide rails are along the sides of the cargo compartment, except in the cargo door sill area. In the forward cargo compartment there are five on the left side and four on the right side of the compartment. In the aft cargo compartment there are six on the left side and five on the right side of the compartment (not shown).



25-53-00-025 Rev 2 10/31/1997

CARGO HANDLING SYSTEM - SIDE GUIDE RAIL

CARGO HANDLING SYSTEM - AUXILIARY GUIDE - INTRODUCTION

General

There are two types of auxiliary guides: with-roller and without-roller.

With-roller guides are light-weight units forward and aft of the ball panels, away from the pallet loading area. Without-roller guides are heavier units near the ball panels, in the pallet loading area. Without-roller guides let you lock them down so pallets can be loaded.

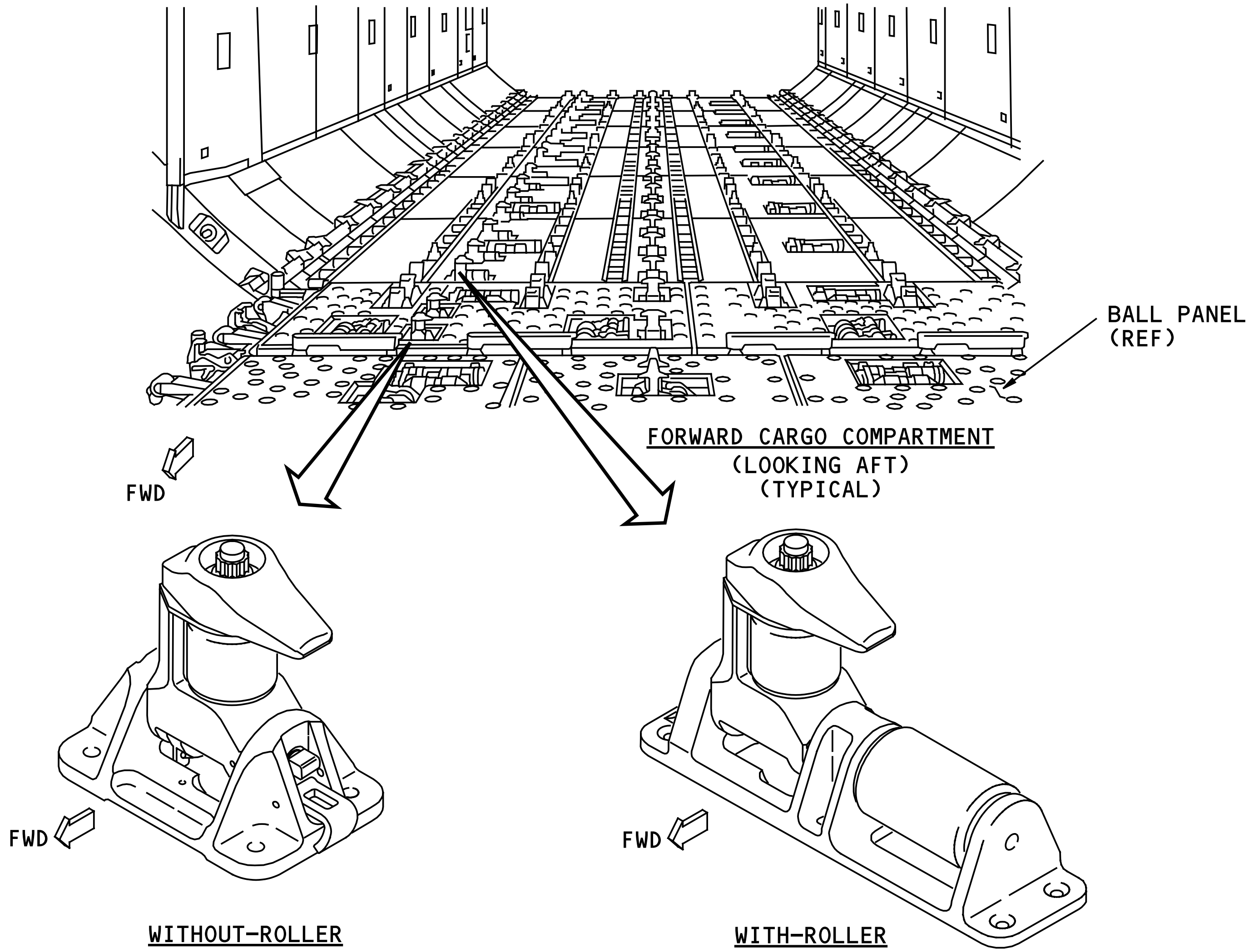
Purpose

The auxiliary guides have these functions:

- Lateral and vertical restraint for LD-4/LD-8 containers
- Longitudinally guidance for LD-4/LD-8 containers
- A low friction surface to help in the movement of LD-4/LD-8 containers longitudinally.

Location

Auxiliary guides are on the right side of each cargo compartment. The without-roller auxiliary guides are in the area of the ball panels. The with-roller auxiliary guides are forward and aft of the ball panels.



FORWARD CARGO COMPARTMENT
(LOOKING AFT)
(TYPICAL)

WITHOUT-ROLLER

WITH-ROLLER

AUXILIARY GUIDES
(TYPICAL)

CARGO HANDLING SYSTEM - AUXILIARY GUIDE - INTRODUCTION

CARGO HANDLING SYSTEM - CENTER GUIDE - INTRODUCTION

General

There is only one type of center guide. This type of guide is foot operated and can be locked down if necessary.

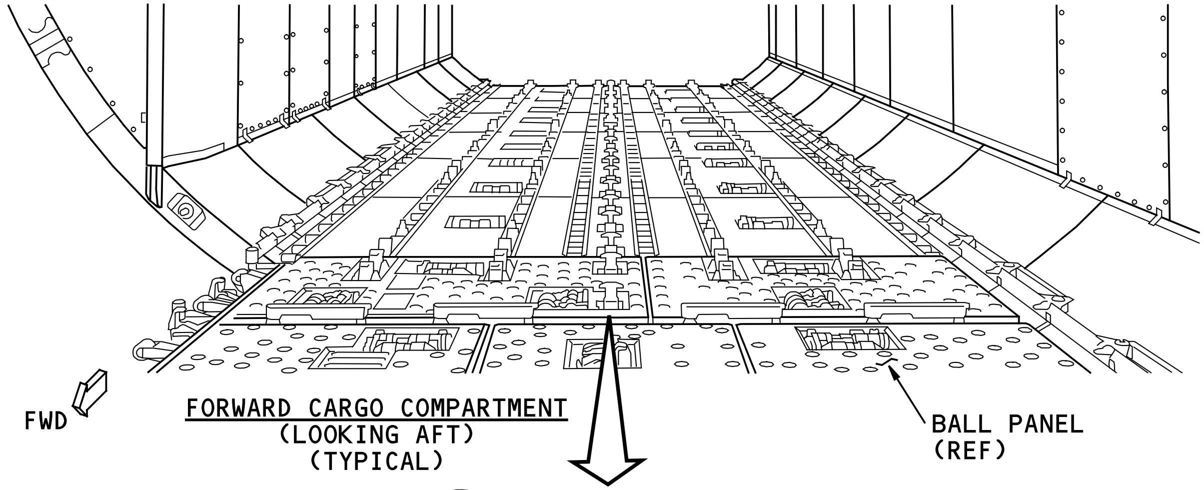
Purpose

The center guides have these functions:

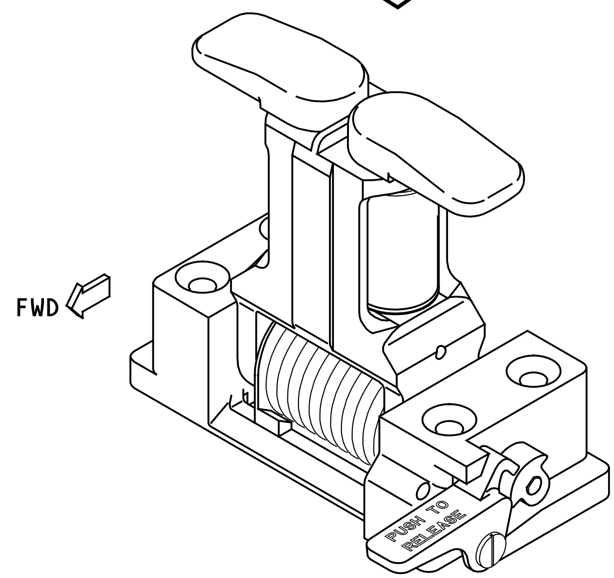
- Supplies lateral and vertical restraint for LD-3/LD-1 containers, K and N size pallets
- Supplies lateral separation between LD-3 containers, K and N size pallets
- Supplies longitudinal guidance for LD-3/LD-1 containers, K and N size pallets.

Location

Center guides are along the center of each cargo compartment. The guides are in the area of the ball panels and in the areas forward and aft of the ball panels.



FORWARD CARGO COMPARTMENT
(LOOKING AFT)
(TYPICAL)



CENTER GUIDE
(TYPICAL)

NOTE: FORWARD SYSTEM
SHOWN, AFT SIMILAR

25-53-00-045 Rev 1 08/21/1997

CARGO HANDLING SYSTEM - CENTER GUIDE - INTRODUCTION

CARGO HANDLING SYSTEM - CENTER GUIDE - OPERATION

Physical Description

Center guides are spring-loaded mechanical devices. They have these parts:

- Vertical restraints (movable)
- Housing
- Base
- Spring
- Lock lever
- Lock cam
- Roller (2).

Functional Description

The spring in the base makes sure that the housing stays in the up position. The housing and the lock cam pivot together in the forward or aft direction. A lock lever spring (not shown) makes sure that the lock lever continues to touch the lock cam as it rotates.

The vertical restraints are spring-loaded devices. They are shown in there usual position.

Operation

You push the center guide all the way down (forward or aft) to lock it down. When the guide is all the way down, the lock lever engages one of two flats on the lock cam. This holds the center guide in the down position.

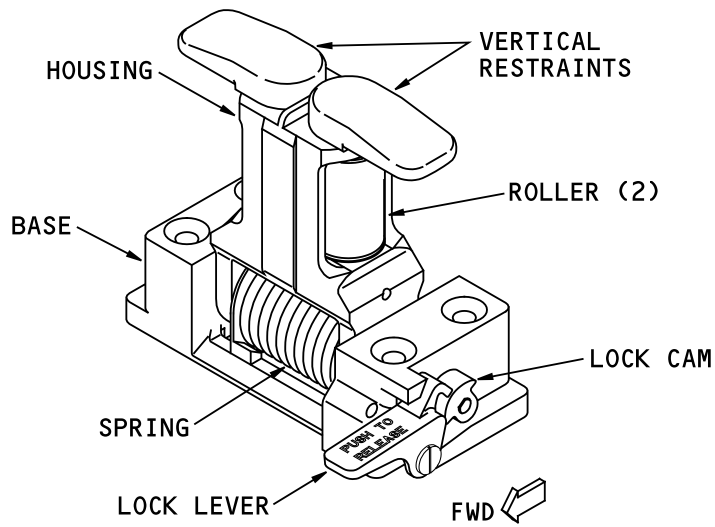
You push the lock lever to let the center guide move up.

Training Information Point

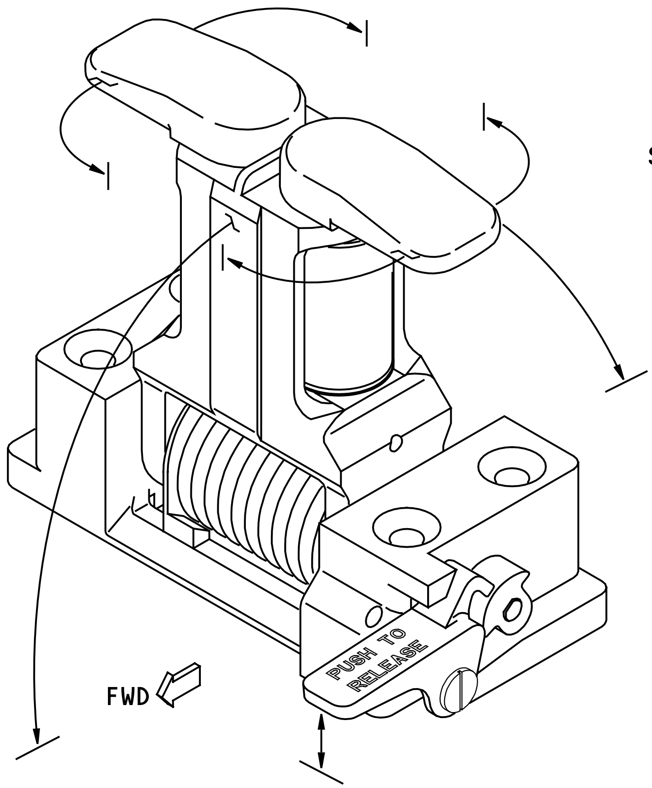
The center guides are for LD-3 and LD-1 containers. Other ULDs move over or to the sides of the center guides.

When you load pallets, they will hit the right side of the center guides in the ball panel area. You must lock the center guides down in the ball panel area when you load pallets.

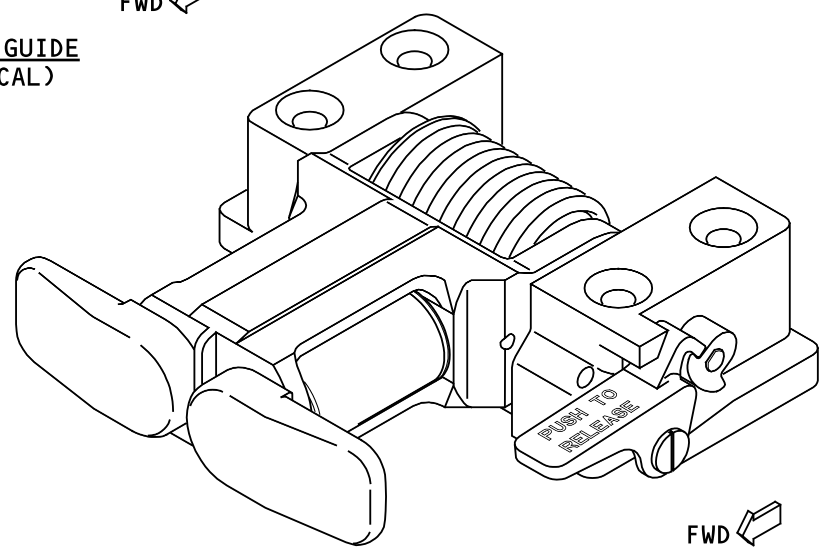
The guide is spring-loaded to up. Thus, when you lock or unlock a center guide, it will come up quickly when the lock is disengaged.



CENTER GUIDE
(TYPICAL)



CENTER GUIDE - UP POSITION
(TYPICAL)



CENTER GUIDE - DOWN POSITION
(TYPICAL)

25-53-00-027 Rev 1 08/21/1997

CARGO HANDLING SYSTEM - CENTER GUIDE - OPERATION

CARGO HANDLING SYSTEM - AUXILIARY GUIDE - OPERATION

Physical Description

Auxiliary guides are spring loaded mechanical devices. They have these parts:

- Bolt
- Vertical restraint
- Vertical roller
- Shaft
- Horizontal roller (nonlocking guide only)
- Ball plunger (locking guide only)
- Lock (locking guide only)
- Spring
- Base
- Housing.

Functional Description

The vertical restraint pivots around a bolt in the housing. A spring (not shown) under the restraint keeps the restraint in the position shown. The spring in the base makes sure that the housing stays in the up position. The housing and the shaft pivot together. The housing and shaft pivot in the forward or aft direction. On locking guides only, the end of shaft next to the lock has two flats. These flats line up with a slot in the lock when the housing is all the way down. The lock pivots around a pin (not shown) in the base to engage or disengage with the flats. The ball plunger keeps pressure on the lock so it does not move by itself.

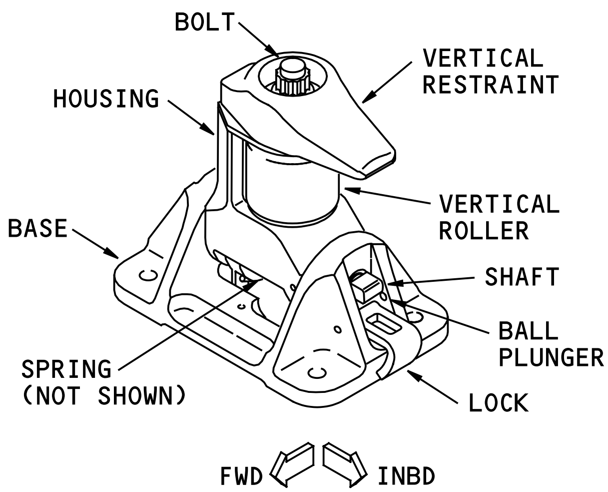
Operation

You use the lock to hold the auxiliary guide down. Push and hold the housing of the guide all of the way down in the aft direction. The auxiliary guide can not be locked down in the forward direction. Move the lock up so the slot in the lock fits over the flats on the shaft. The ball plunger holds the lock up.

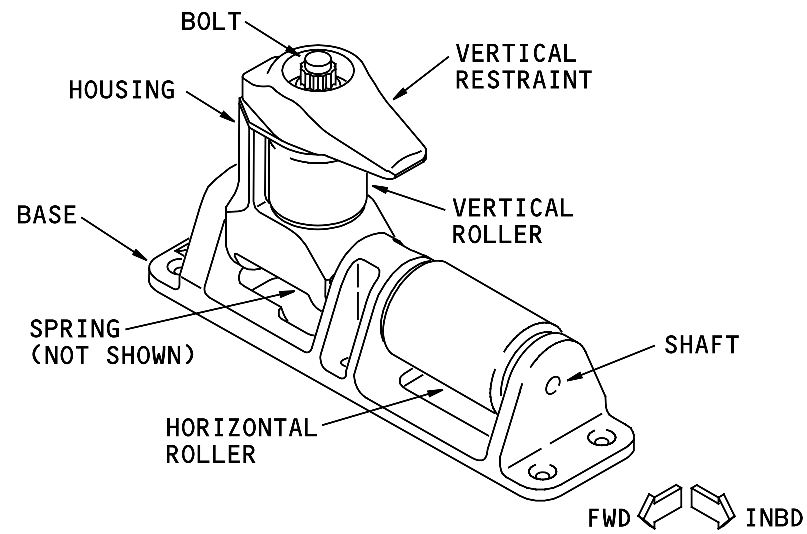
Training Information Point

The auxiliary guides are designed for LD-4 and LD-8 containers. Other ULDs pass over or to the left of the auxiliary guides. Pallets hit the right side of the auxiliary guides in the ball panel area during loading. You must lock the auxiliary guides down in the ball panel area when you load pallets.

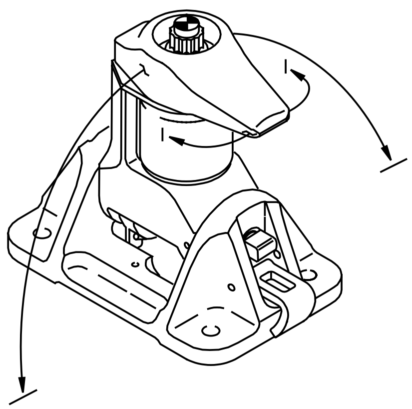
The guide is spring-loaded to up. Thus, when you lock or unlock a center guide, it will come up quickly when the lock is disengaged.



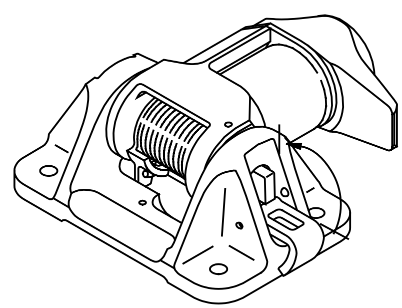
AUXILIARY GUIDE - WITHOUT ROLLER



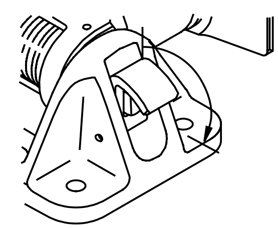
AUXILIARY GUIDE - WITH ROLLER



AUXILIARY GUIDE -
WITHOUT ROLLER (UP)



AUXILIARY GUIDE -
WITHOUT ROLLER (DOWN)



AUXILIARY GUIDE -
WITHOUT ROLLER
(DOWN AND LOCKED)

CARGO HANDLING SYSTEM - AUXILIARY GUIDE - OPERATION

25-53-00-028 Rev 1 08/21/1997

CARGO HANDLING SYSTEM - PARTIAL LOAD STOPS - INTRODUCTION

Purpose

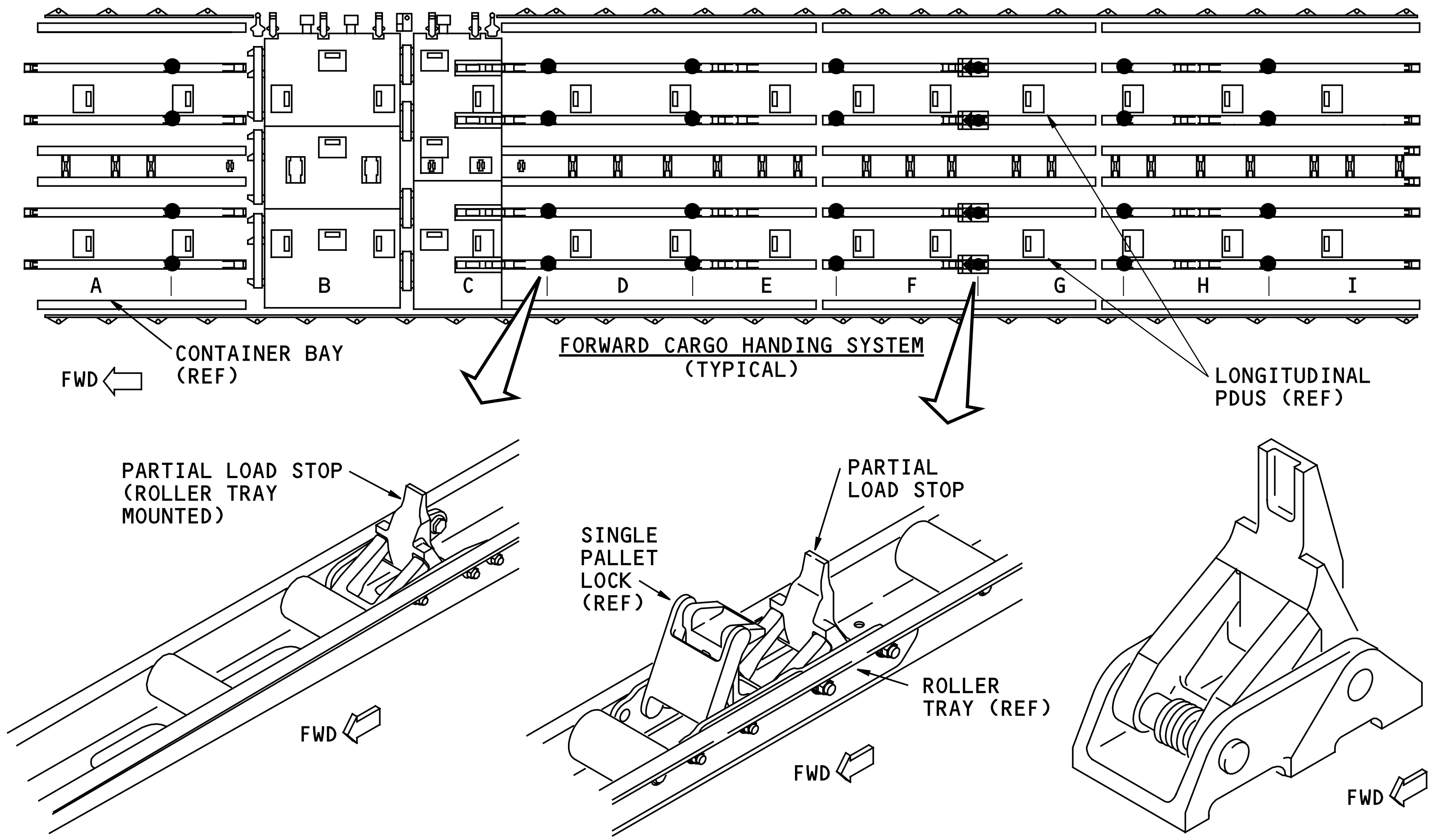
Partial load stops give longitudinal restraint for containers when container loading is not continuous in the cargo compartment.

Location

Partial load stops are in many places in the forward and aft cargo compartments. In both cargo compartments, the stops attach to the four roller trays adjacent to the longitudinal PDUs.

The partial load stops are in rows. Each row has four stops.

The aft cargo compartment also has one row of four partial load stops that attach to structure. They are in the area of the aft ball panels (not shown).



ROLLER TRAY
(REF)

STOP/LOCK
(TYPICAL)

PARTIAL LOAD STOP
(STRUCTURE MOUNTED,
AFT CARGO, AFT BALL PANEL AREA)

NOTE: FORWARD SYSTEM SHOWN, AFT SIMILAR

● = PARTIAL LOAD STOP
= STOP/LOCK

CARGO HANDLING SYSTEM - PARTIAL LOAD STOPS - INTRODUCTION

25-53-00-029 Rev 4 03/09/1998

CARGO HANDLING SYSTEM - PARTIAL LOAD STOPS - OPERATION

Physical Description

Partial load stops are spring-loaded mechanical units. There are six types of partial load stops that are almost the same (not all shown). Most partial load stops are single units, but some may be part of a stop/lock unit (not shown).

Each partial load stop has these parts:

- Lockhead
- Base
- Fork
- Springs (not shown).

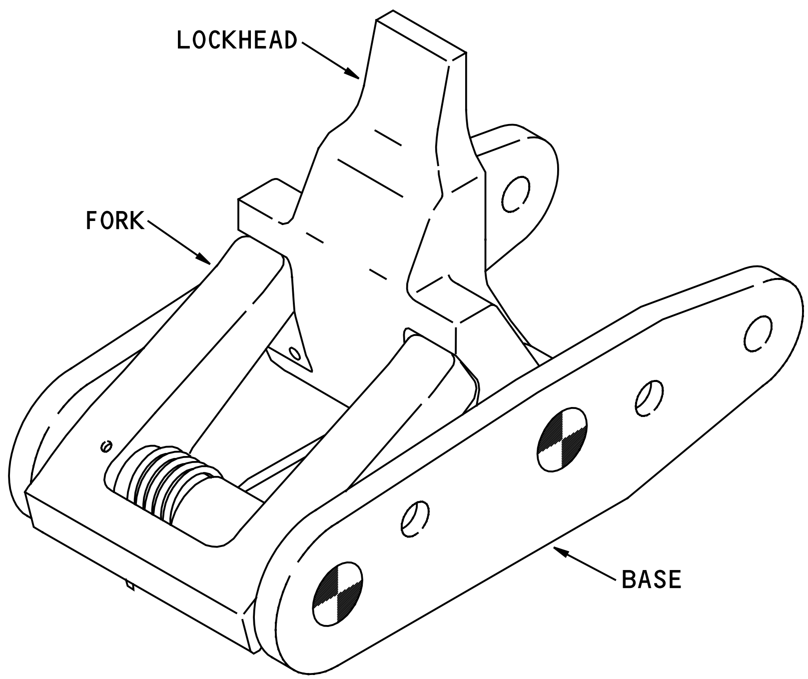
Operation

You manually put the lockhead up to the STOP position to restrain a partial load of containers. The lockhead is spring loaded to down so you must lift the lockhead until the fork locks the lockhead in the STOP position.

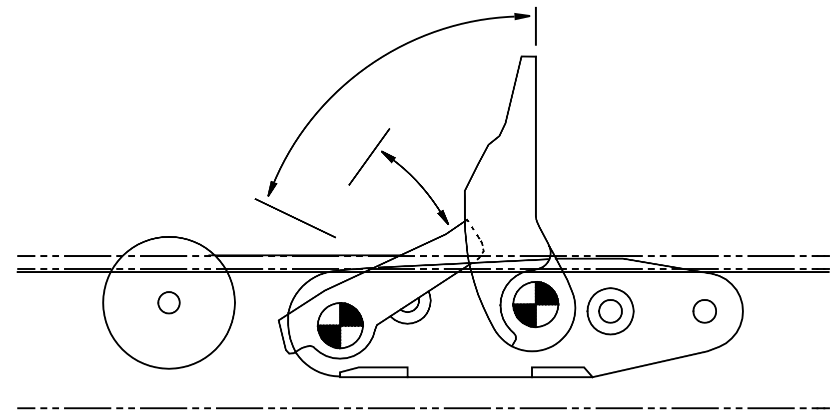
You manually put down the lockhead to load more containers or to unload a partial load of containers. The lockhead will go down by itself when you lift the fork.

Training Information Point

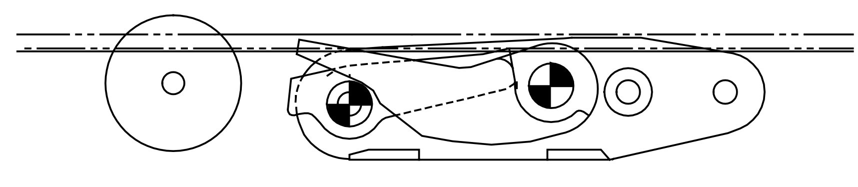
When you put the lockhead down, it is easier if you hold the lockhead as you lift the fork. This lets you get the fork up all the way and your fingers out of the way of the lockhead before the lockhead goes down.



PARTIAL LOAD STOP
(TYPICAL)



STOP



DOWN

25-53-00-030 Rev 1 10/31/1997

CARGO HANDLING SYSTEM - PARTIAL LOAD STOPS - OPERATION

CARGO HANDLING SYSTEM - PALLET LOCK - INTRODUCTION

Purpose

Pallet locks give longitudinal and vertical restraint for pallets and pallet sized containers, LD-7 and LD-11.

Location

Pallet locks are in many places in the forward and aft cargo compartments.

Most pallet locks mount to the roller trays and some mount to floor structure. Some pallet locks may be part of a stop/lock unit.

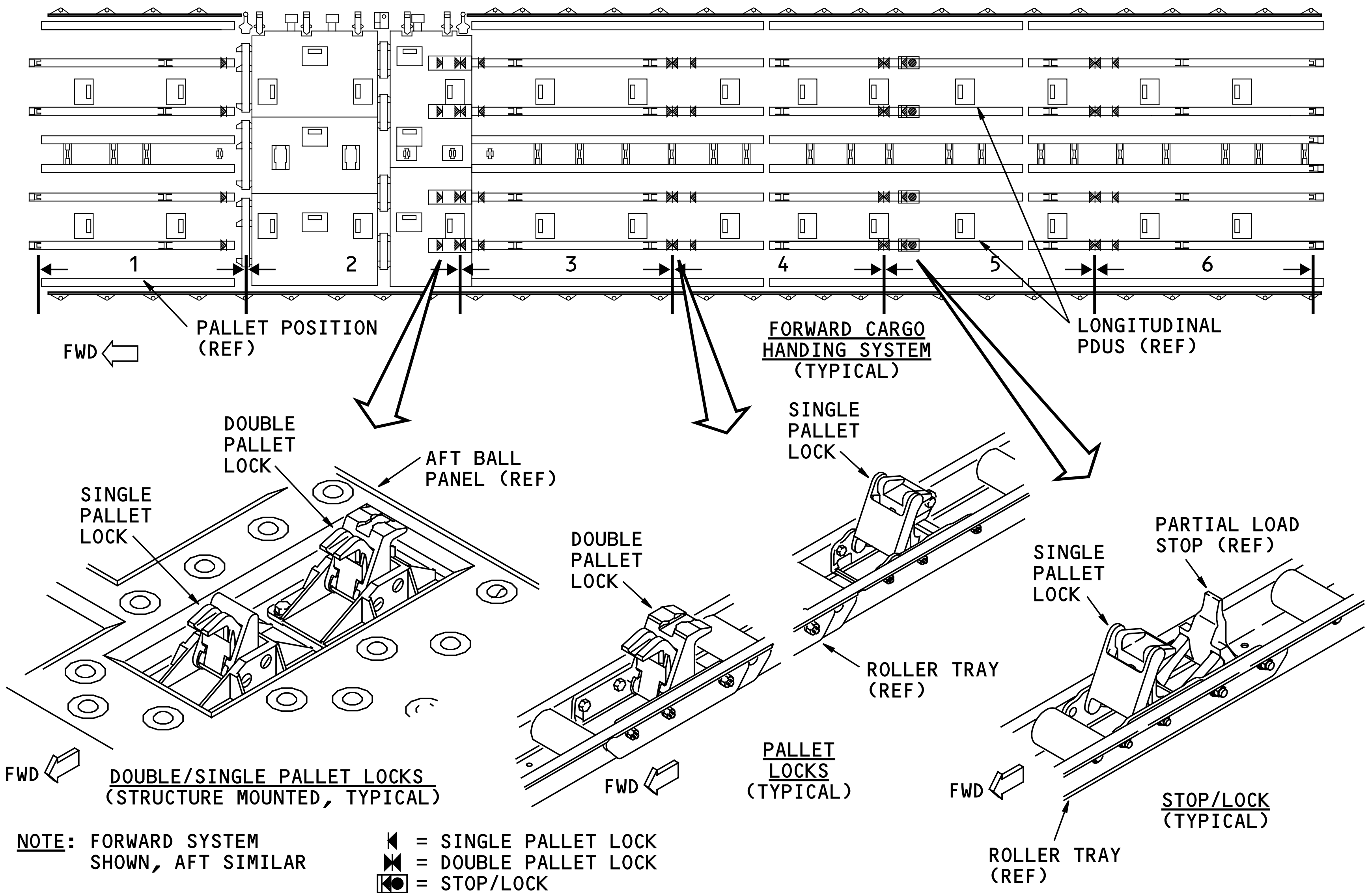
The locks mount to the four roller trays that parallel the longitudinal PDUs.

The aft cargo compartment also has pallet locks mounted in the two center most roller trays (not shown).

The floor structure mounted locks are in the area of the aft ball panels.

The locks are in rows, each row in the forward cargo compartment has four locks.

In the aft cargo compartment, each row has six locks. The additional locks are necessary to divide the weight of the cargo evenly to the airplane structure.



CARGO HANDLING SYSTEM - PALLET LOCK - INTRODUCTION

CARGO HANDLING SYSTEM - PALLET LOCK - OPERATION

Physical Description

All pallet locks are spring-loaded mechanical units. There are seven similar types of pallet locks (not all shown). More than one type is necessary because of mounting and space limits. Some pallet locks have parts that let them restrain only one pallet. Others have parts that let them restrain two pallets.

Pallet locks have these parts:

- Lockhead(s)
- Anchor fitting (not all locks)
- Base
- Pawl (double pallet locks)
- Link (single pallet locks)
- Springs (not shown).

Double Pallet Lock Operation

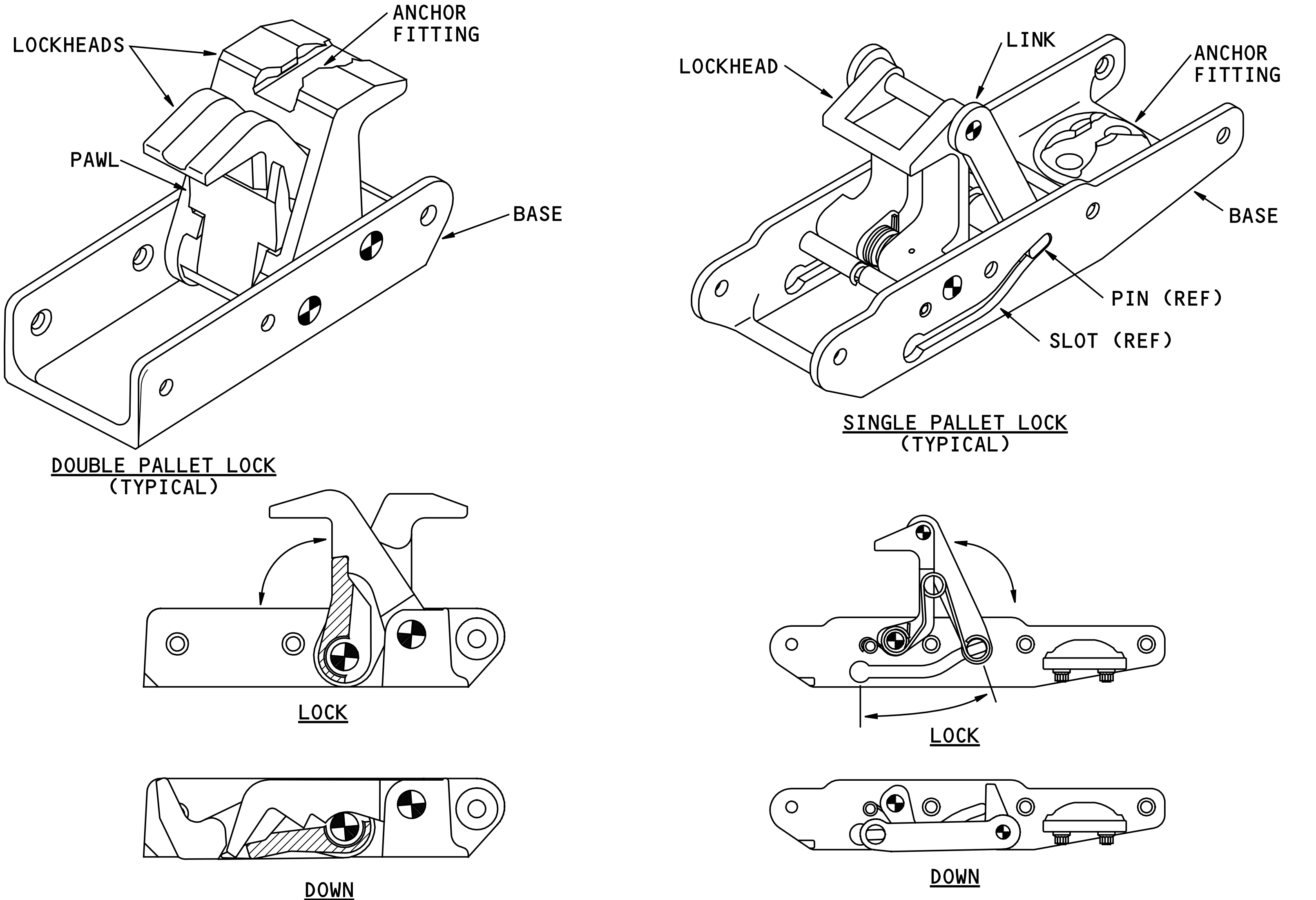
You manually put the lockhead up to restrain pallets. The lockhead is spring loaded to down so you must lift the lockheads until the pawl locks the lockheads in the LOCK position.

You manually put down the lockheads to unload cargo. The lockheads will go down on there own when you pull the upper part of the pawl away from them. It is easier to move the pawl if you hold the heads up then let them go down.

Single Pallet Lock Operation

You manually put the lockhead up to the LOCK position to restrain one pallet. The lockhead is spring-loaded down so you must lift the lockhead until the link locks the lockhead in the LOCK position.

You manually put down the lockhead to unload cargo. The lockhead will go down by itself when you push the lower part of the link towards it. The lower part of the link attaches to a pin. The pin follows slots in the base when you push on the lower part of the link.



CARGO HANDLING SYSTEM - PALLET LOCK - OPERATION

CARGO HANDLING SYSTEM - STOP/LOCK - INTRODUCTION

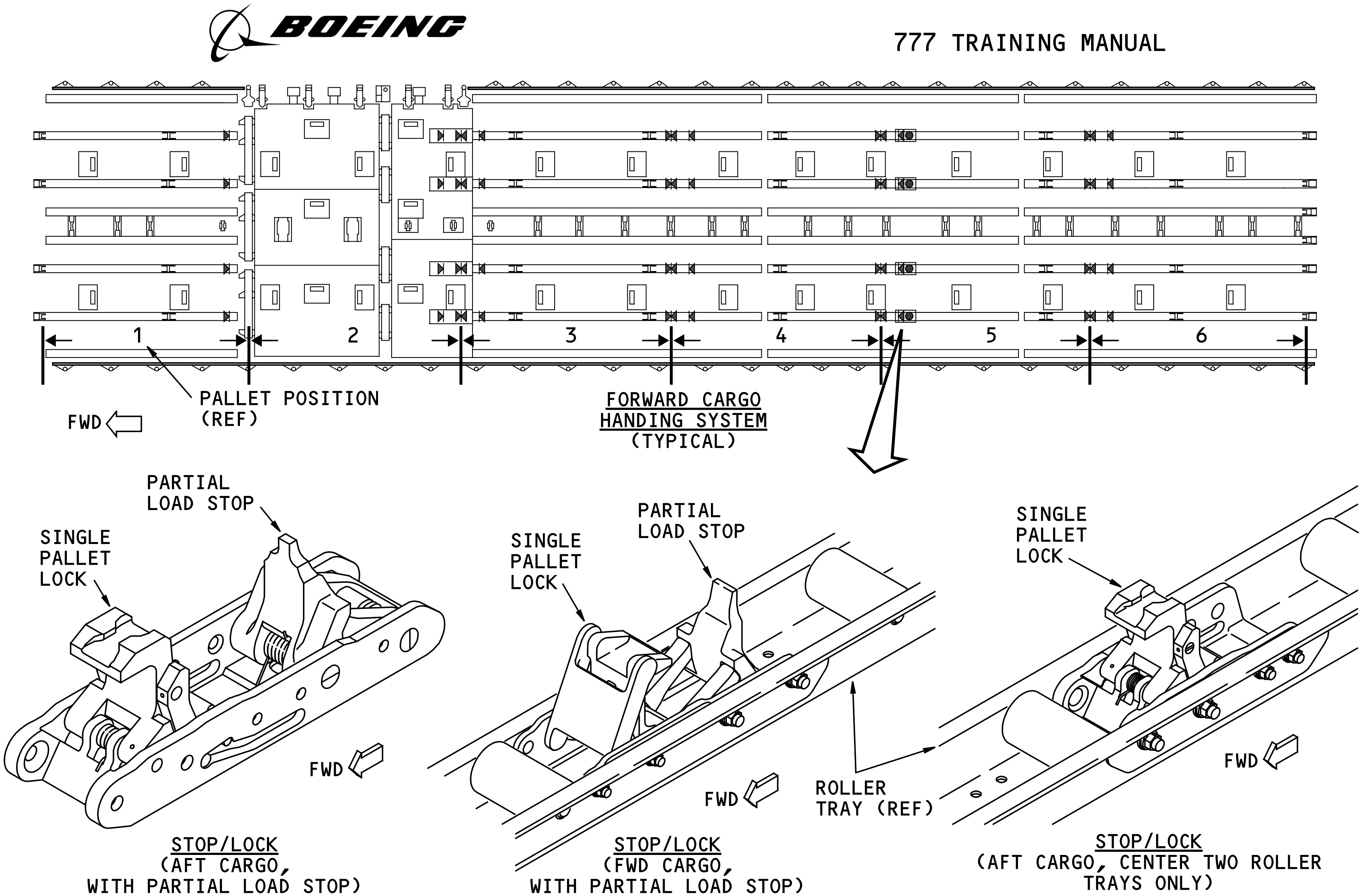
Purpose

Stop/locks give longitudinal and vertical restraint for pallets. Some locks also give longitudinal restraint for containers.

Location

Both cargo compartments have one row of stop/locks. In the forward cargo compartment the row is aft of the ball panels and in the aft compartment (not shown) the row is forward of ball panels.

Stop/locks with partial load stops mount to the roller trays that parallel the longitudinal PDUs in both compartments. Locks without partial load stops are in the two center most roller trays in the aft cargo compartment only (not shown).



NOTE: FORWARD SYSTEM SHOWN, AFT SIMILAR

= STOP/LOCK

25-53-00-033 Rev 4 10/31/1997

CARGO HANDLING SYSTEM - STOP/LOCK - INTRODUCTION

CARGO HANDLING SYSTEM - STOP/LOCK - OPERATION

Physical Description

The three types of stop/locks are almost the same:

- Stop/lock, with partial load stop and no anchor fitting (4, fwd cargo)
- Stop/lock, with partial load stop and with anchor fitting (4, aft cargo)
- Stop/lock, without partial load stop and with anchor fitting (2, aft cargo).

The stop locks are spring-loaded mechanical units with these parts:

- Anchor fitting (aft cargo stop/locks only)
- Lockhead(s)
- Base
- fork (not all locks)
- Pin
- Link
- Pawl (aft cargo stop/locks only)
- Springs (not shown).

Operation

If a stop/lock has two lockheads, you use only one at a time. The one you use depends on if the cargo is a container or a pallet.

You manually set the stop/locks to one of these positions:

- LOCK (for pallets)
- STOP (for containers)
- UNLOAD.

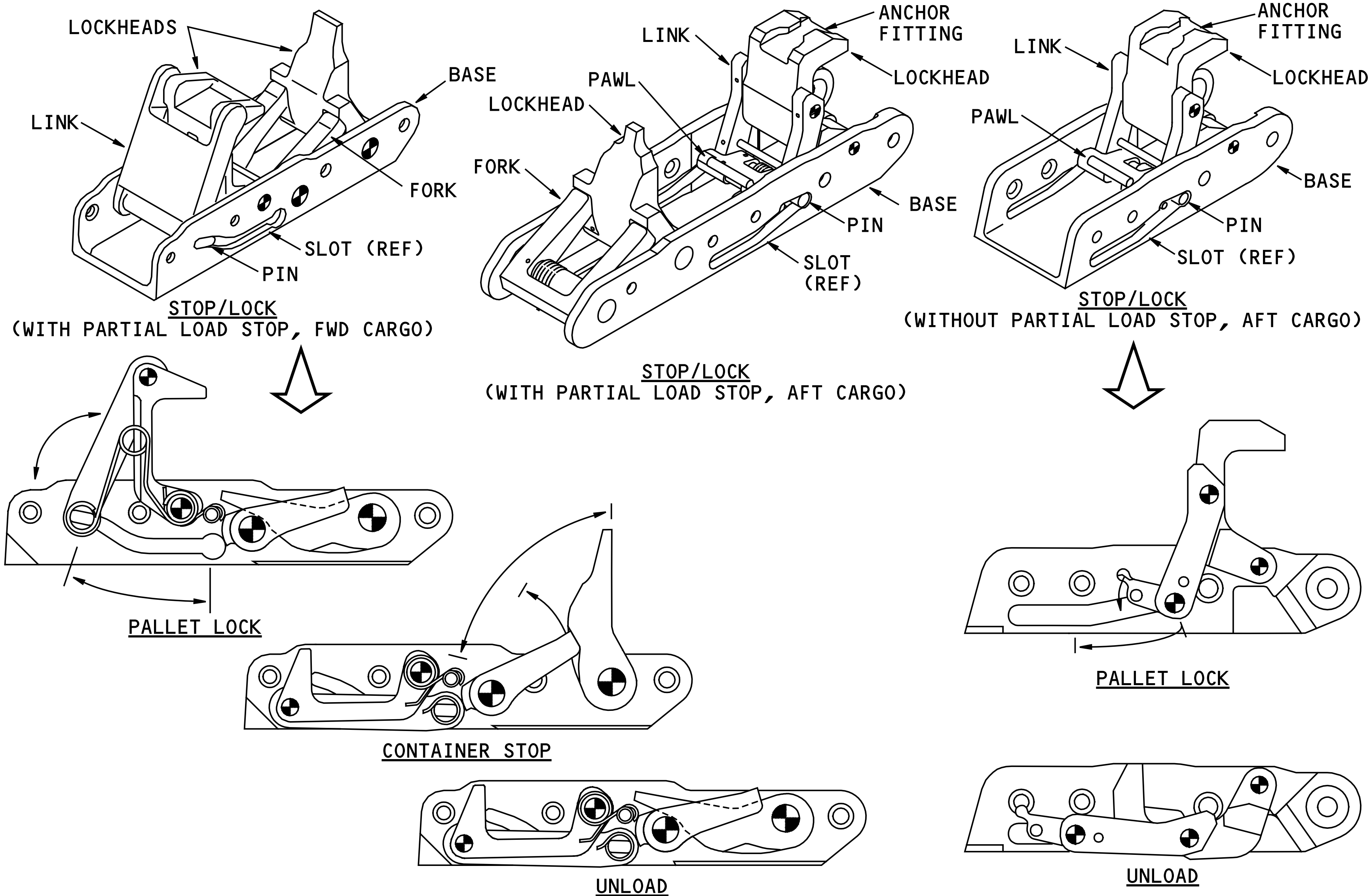
You manually put the lockheads up, LOCK or STOP position to restrain cargo. The lockheads are spring loaded to down so you must lift the lockheads until the fork or the link locks the heads up.

You manually put down the lockheads to unload cargo.

The container stop lockhead (fwd cargo) will go down by itself when you lift the fork. It is easier to lower the head if you hold the head up as you lift the fork.

The pallet lock lockhead (fwd cargo) will go down by itself when you push the lower part of the link towards it. The lower part of the link attaches to the pin. The pin follows the slots in the base when you push on the lower part of the link.

The pallet lock lockhead (aft cargo) will go down on its own when you push down on the pawl and pull it away from the head. The pawl attaches to the lower part of the link. The link attaches to the pin. The pin follows the slot in the base when you pull on the pawl.



CARGO HANDLING SYSTEM - STOP/LOCK - OPERATION

25-53-00-034 Rev 1 05/31/95

CARGO HANDLING SYSTEM - END STOP

General

There are two types of end stops:

- End stop with vertical restraint
- End stop without vertical restraint.

All end stops give longitudinal restraint for containers and pallets. End stops with vertical restraint give vertical restraint for pallets and pallet sized containers, LD-7 and LD-11.

Physical Description

The forward cargo compartment uses both types of end stops.

The aft cargo compartment uses end stops with vertical restraint only.

The stops are one piece, fixed (non-retractable) units. Stops with vertical restraint have an anchor fitting.

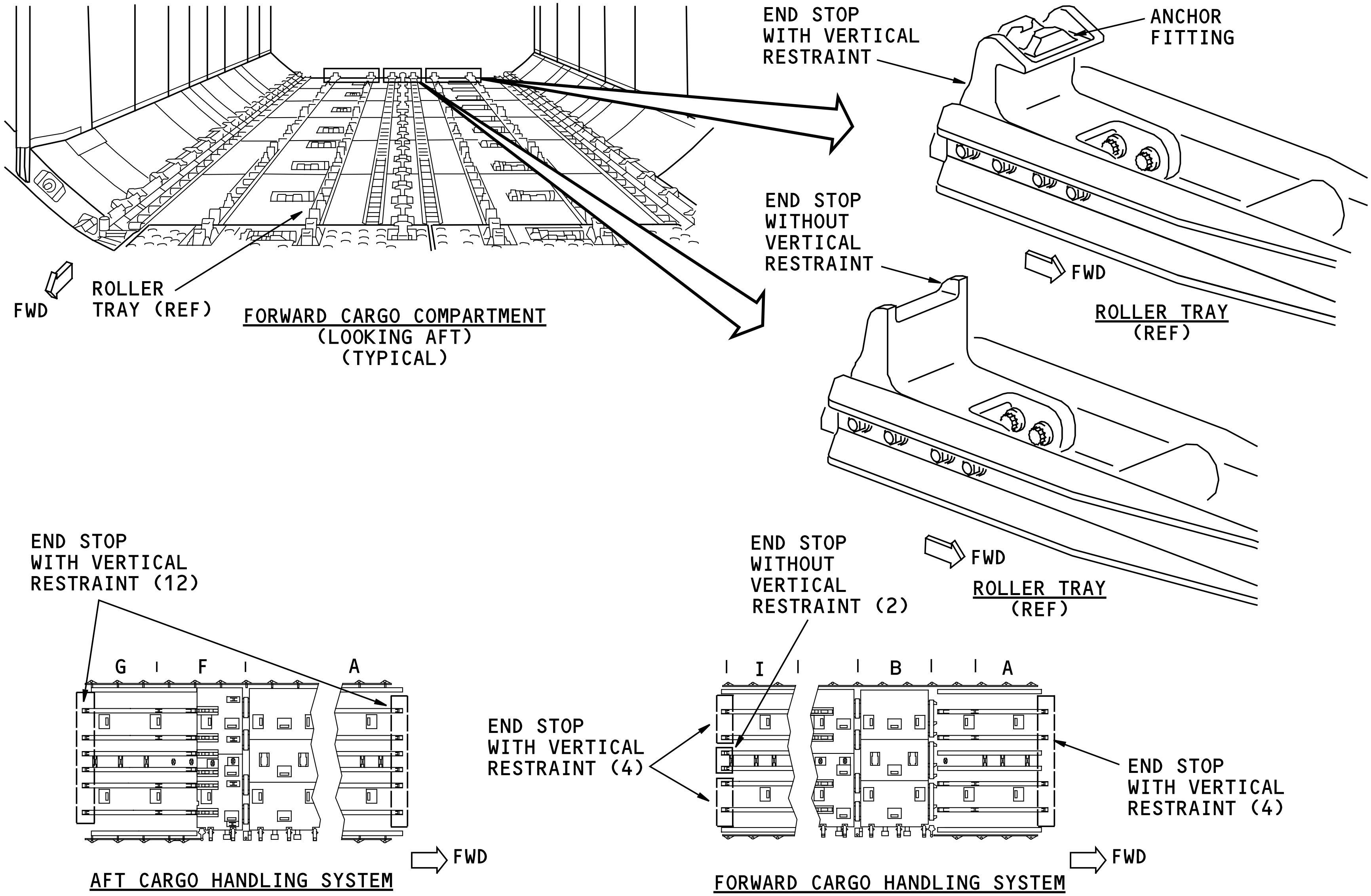
Location

The end stops mount to the roller trays at each end of the compartments.

The forward cargo compartment has four with vertical restraint at each end.

The forward cargo compartment also has two end stops without vertical restraint in the aft end of the compartment.

The aft cargo compartment has six with vertical restraint at each end.



CARGO HANDLING SYSTEM - END STOP

CARGO HANDLING SYSTEM - CARGO SYSTEM CONTROLLER

Purpose

The cargo system controllers (CSCs) give an interface between the cargo handling controls and the cargo handling electrical/mechanical units. The controllers control the operation and the sequence of operation for the units and give protection to prevent actuator/gear motor overheat and burnout.

Physical Description

The forward and aft CSCs are the same. The CSCs are passively cooled units.

Location

The forward cargo system controller is on the E16-2 shelf.

The aft cargo system controller is on the E17-1 shelf (not shown).

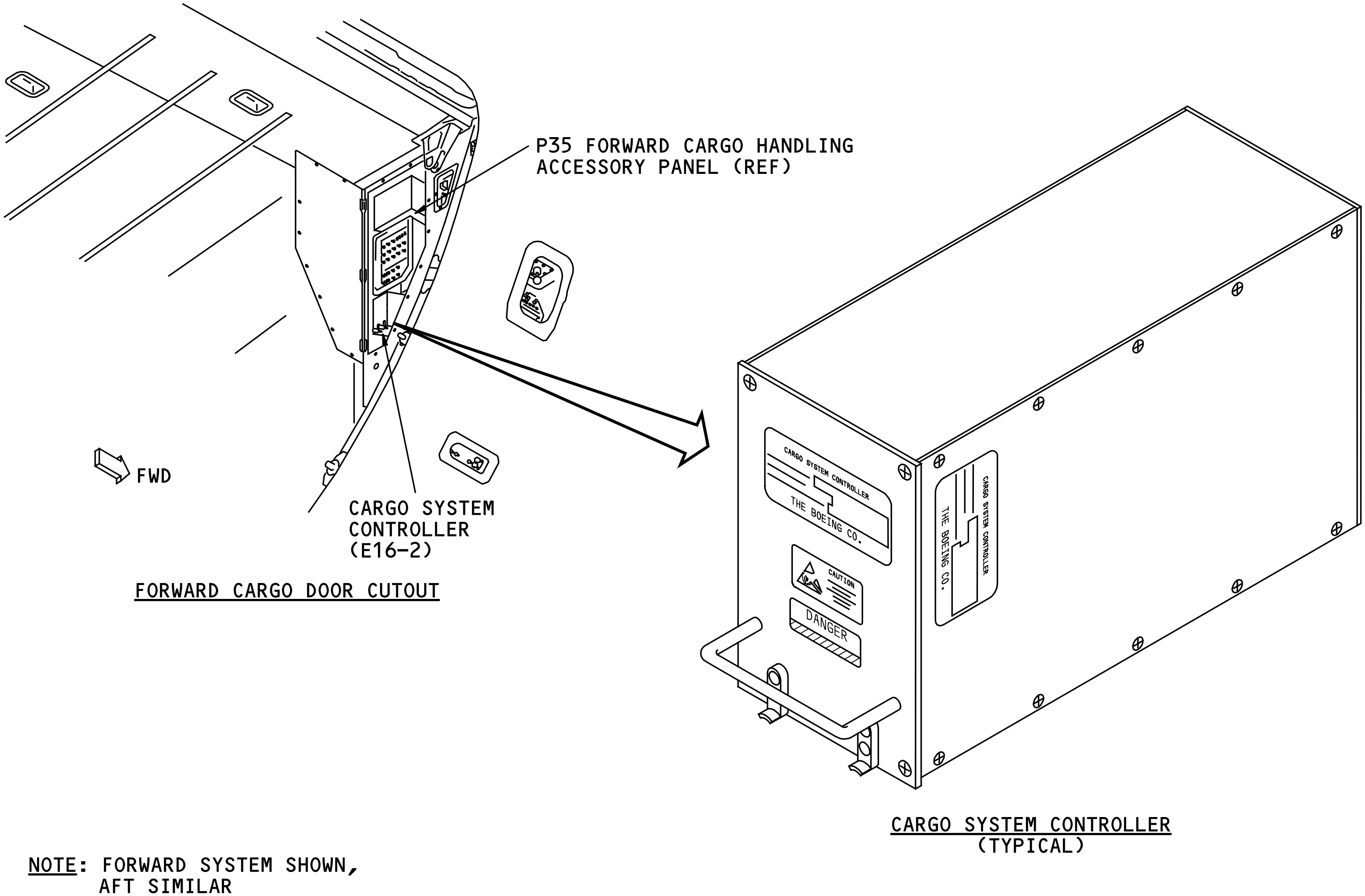
Operation

Controller logic changes with hard-wired programming pins. Pins in the electrical connector of the equipment rack (not shown), tell the controllers which cargo compartment they are in and which system options are active. This lets the controllers adjust for the difference between the forward and aft cargo compartments and for system options. For example, programming pins give this type of information:

- Forward or aft cargo compartment
- LD-4/LD-8 containers
- Aft large cargo door
- Crew rest in place 1
- Crew rest in place 2
- No gearmotor devices installed.

Training Information Point

The controllers do not have BITE. To do a test, you operate the system to see if it operates correctly. The controllers do not have an interface with the AIMS.



25-53-00-036 Rev 3

CARGO HANDLING SYSTEM - CARGO SYSTEM CONTROLLER

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CARGO HANDLING SYSTEM - OPERATION - CONTROLS

General

Controls for the cargo handling system let you operate the system. The controls for the forward and aft cargo handling systems are almost the same.

These are the controls that you use to operate the systems:

- Cargo control joystick
- P24 forward cargo handling control panel or P27 aft cargo handling control panel (not shown)
- Secondary joystick panel.

Location

Controls for the forward and aft cargo handling systems are near the forward part of the cargo cut out.

The cargo control joystick and the cargo handling control panel, P24 forward system and P27 aft system (not shown) are forward of the door cut out on the exterior.

The secondary joystick panel is in the ceiling of the cargo compartment between the interior cargo door control and cargo handling accessory panel (P35 forward or P39 aft, not shown).

P24 Cargo Handling Control Panels (P27 not shown)

The forward cargo handling control panel has these parts:

- SYSTEM POWER switch
- System power LED
- PDU AFT/FWD switch
- PDU LEFT/BOTH/RIGHT switch
- PALLETS/CONTAINERS switch
- Bay on LEDs
- BAY OFF switches.

The aft cargo handling control panel (not shown) has the same parts.

SYSTEM POWER switch: a two-position, ON/OFF switch. This switch lets you set system power to on/off.

System power ON LED: a yellow LED. This comes on when power is on the system. The CSC controls the LED.

PDU AFT/FWD switch: a two-position switch. This switch lets you set the area of the cargo compartment in which PDUs will be active.

PDU LEFT/BOTH/RIGHT switch: a three-position switch. This switch lets you set the side of the compartment in which PDUs will be active.

PALLETS/CONTAINERS switch: a two-position switch. This switch lets you set the system for the type of ULDs being loaded or unloaded.

Bay on LEDs: Yellow LEDs come on to let you know which bays have active PDUs.

CARGO HANDLING SYSTEM - OPERATION - CONTROLS

BAY OFF switches: These are three-position toggle switches spring-loaded to the center position. The up or down position lets you set the PDUs on or off. (Up or down for on, up or down again for off.) The P27 aft cargo handling control panel (not shown) only has four bay off switches: A, B, C, and G.

Lighting for the cargo handling control panel comes from an area light above the panel. The light shines down on the panel so you can see it when it is dark outside. The light also shows that power is available to the cargo handling system, because it is on anytime the ground handling bus has power.

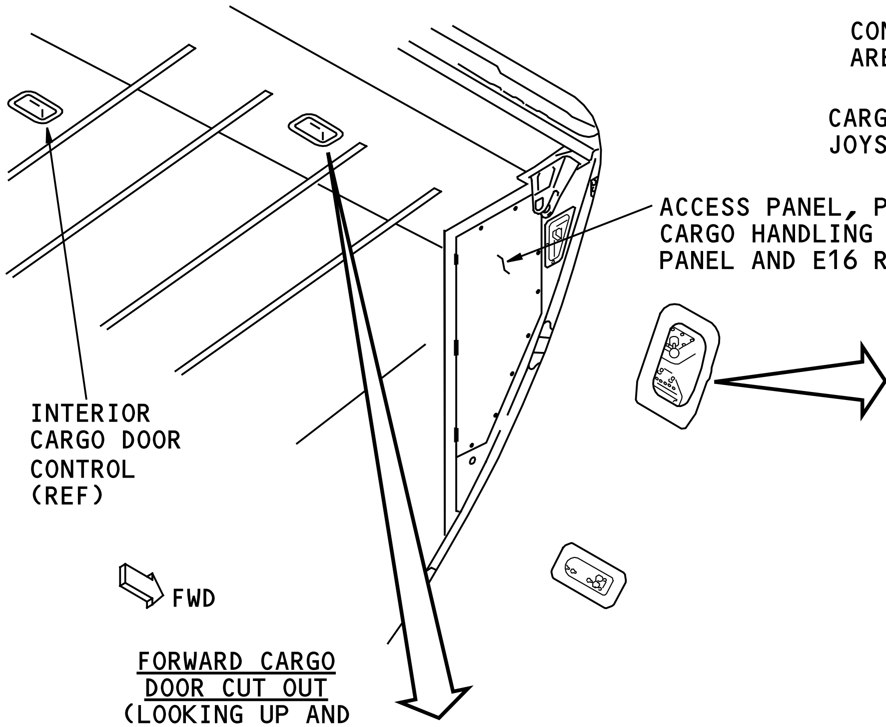
The cargo control joystick is not part of the cargo handling control panel.

Cargo Control Joystick

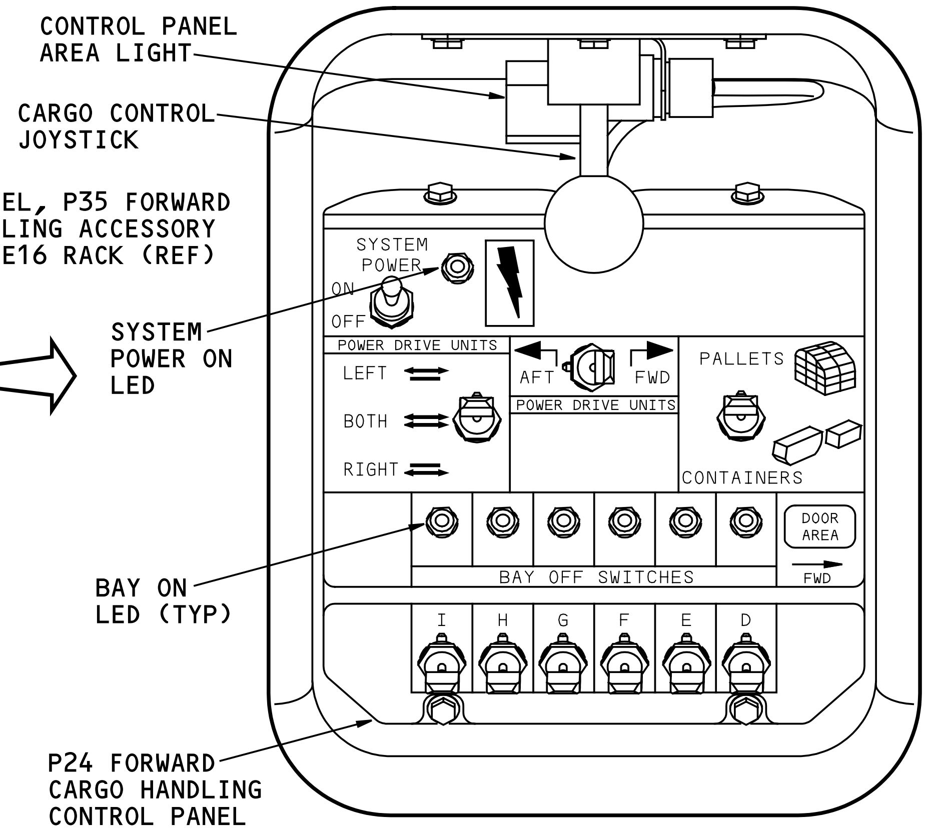
The forward and aft (not shown) cargo control joysticks let you control the longitudinal and lateral movement of ULDs. The joystick has five positions: IN, OUT, FWD, AFT and neutral. It is spring loaded to the neutral position.

Secondary Joystick Panel

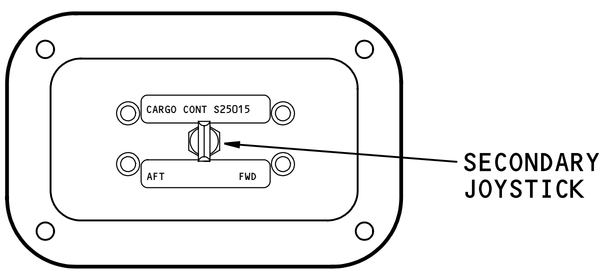
This panel has only the secondary joystick. This joystick is a three-position toggle switch that is spring-loaded to the middle position. The switch functions as a joystick because it lets you move cargo forward or aft but not on to the ball panel.



FORWARD CARGO
DOOR CUT OUT
(LOOKING UP AND
INBOARD)



FORWARD CARGO HANDLING
EXTERIOR CONTROLS



SECONDARY JOYSTICK PANEL

25-53-00-037 Rev 3 08/21/1997

CARGO HANDLING SYSTEM - OPERATION - CONTROLS

CARGO HANDLING SYSTEM - FUNCTIONAL DESCRIPTION - POWER

General

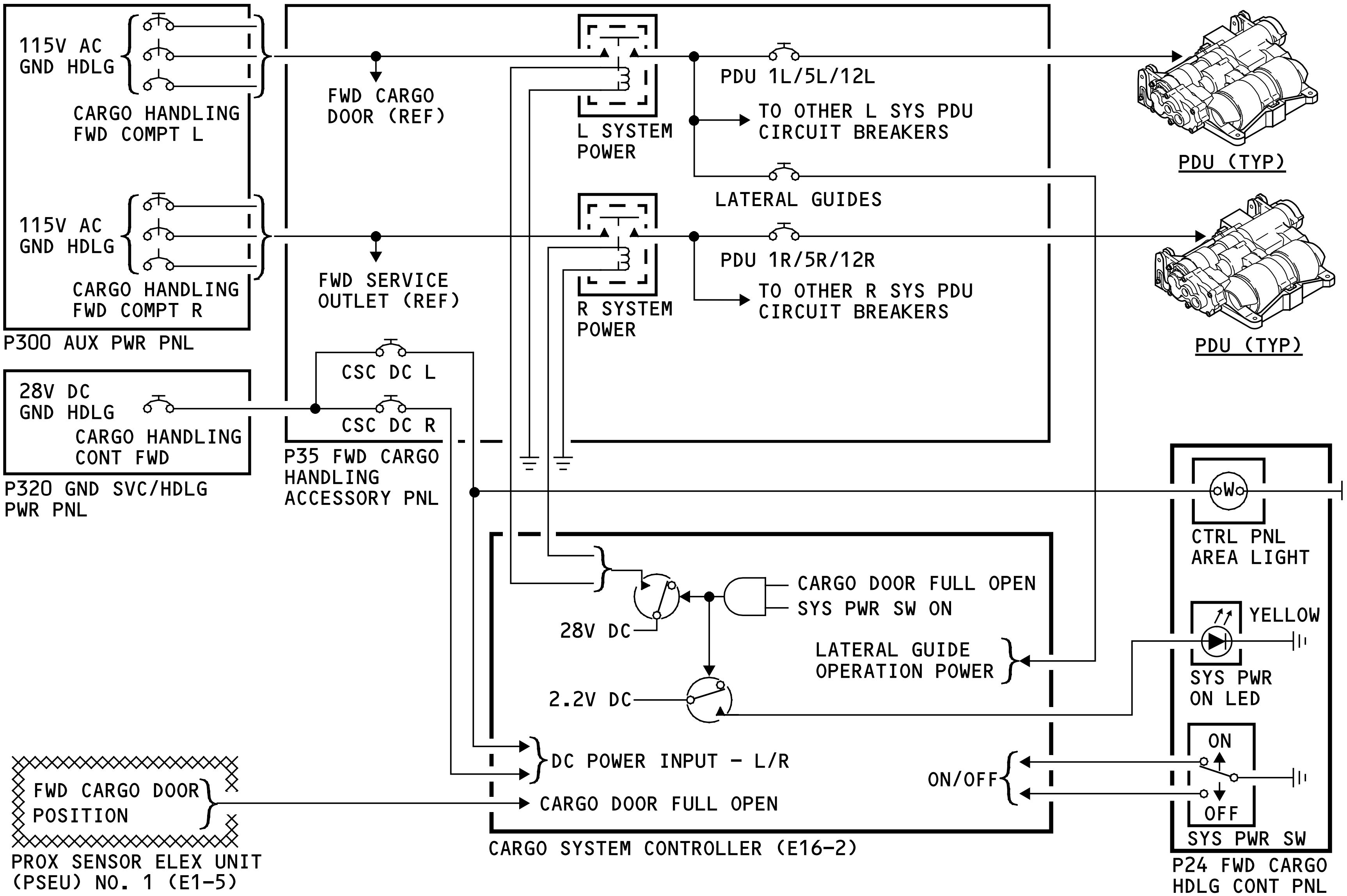
The cargo handling system gets its power from the ground handling bus. It uses three phase 115v ac for operation and 28v dc for control.

Operation power loads go to two circuits: left system power and right system power. The CSC uses the left and right system relays to control system power.

System Power

The ground handling bus gives power directly to the cargo control panel area light. The light is on when the bus has power.

The CSC turns on system power if you open the cargo door to full open and set the cargo handling system power switch to the ON position. When power is on the system, the CSC turns on the system power ON LED.



25-53-00-038 Rev 4 08/21/1997

CARGO HANDLING SYSTEM - FUNCTIONAL DESCRIPTION - POWER

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CARGO HANDLING SYSTEM - FUNCTIONAL DESCRIPTION - LATERAL GUIDE

General

For control, the lateral guides have two major groups, forward and aft. Each major group has two minor groups, left and right. Guides in each major group have a number. The numbers increase from right to left.

These are the minor groups and the guides in them:

- Forward right: FWD 1 and FWD 2
- Forward left: FWD 2 and FWD 3
- Aft right: AFT 1 and AFT 2
- Aft left: AFT 3 and AFT 4.

Only the guides in a single major group operate at a time. Within a major group, the left and right minor groups of guides may operate independently or at the same time. The lateral guides have two positions, up and down.

The CSC uses inputs from these switches to set the position of the lateral guides:

- Cargo control joystick
- PDU forward/aft switch
- PDU left/both/right switch
- Pallet/container switch.

CSC Control

Power switching circuits in the CSC, get 115v ac single phase voltage from the ground handling bus. The switching circuits control the voltage and monitor for current flow to the lateral guides. The default value for CSC logic is to command (CMD) the guides to up. The down CMD is based on switch inputs.

The power switching circuits give voltage to move the guides up or down. Limit switches in the guides stop the current flow and apply a brake when the guide moves to the desired position. If a guide does not stop the current within three seconds after a up or down CMD is given, the power switching circuit removes the voltage. If no current draw is sensed within seventy-five milliseconds after a CMD is given, the voltage is removed.

Guides UP Position

All guides go to up when not commanded to down.

Forward Right Guides 1 and 2 Down Position

Forward guides 1 and 2 go to the down position when all of these events occur:

- Joystick to FWD or AFT
- System set to PDU RIGHT or to PDU BOTH
- System set to PDU FWD.

Forward Left Guides 2 and 3 Down Position

Forward guides 2 and 3 go to the down position when all of these events occur:

- Joystick to FWD or AFT

- System set to PDU LEFT or to PDU BOTH
- System set to PDU FWD.

Aft Right Guides 1 and 2 Down Position

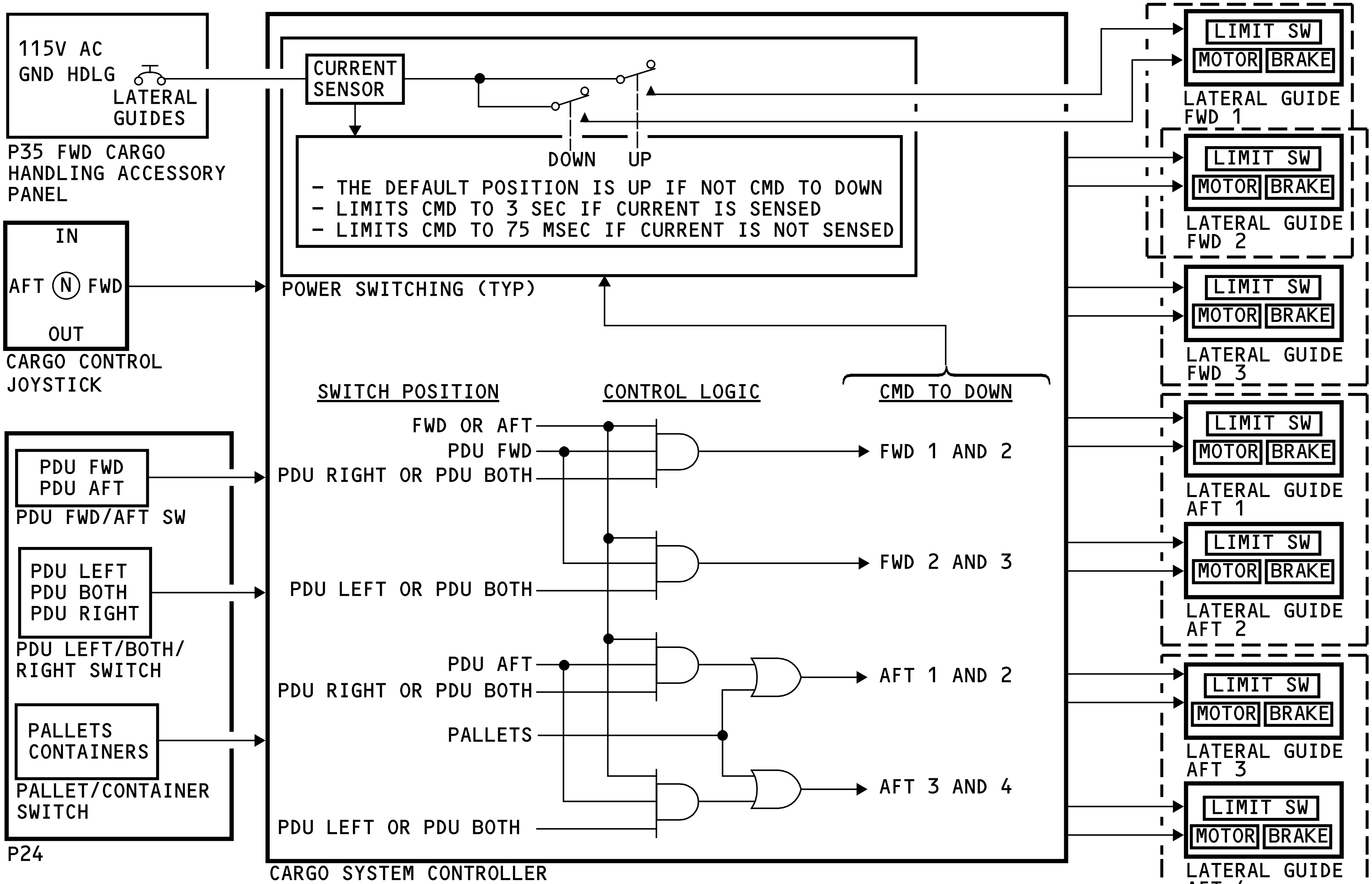
Aft guides 1 and 2 go to the down position when the system is set to PALLETS or when all of these events occur:

- Joystick to FWD or AFT
- System set to PDU RIGHT or to PDU BOTH
- System set to PDU AFT.

Aft Left Guides 3 and 4 Down Position

Aft guides 3 and 4 go to the down position when the system is set to PALLETS or when all of these events occur:

- Joystick to FWD or AFT
- System set to PDU LEFT or to PDU BOTH
- System set to PDU AFT.



25-53-00-041 Rev 3

CARGO HANDLING SYSTEM - FUNCTIONAL DESCRIPTION - LATERAL GUIDE

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CARGO HANDLING SYSTEM - FUNCTIONAL DESCRIPTION - PDU

General

For control purposes, the powered drive units (PDUs) are in two major groups, longitudinal and lateral. The longitudinal group has two minor groups, left and right. All PDUs are also grouped by location in the compartment (bays). These are PDUs by group and location for the forward cargo handling system. The aft system is almost the same.

PDU Groups and Location		
Area	Major Group	PDUs by Row
Forward Bays	Longitudinal	1L/R, 2L/R
Ball Panel	Longitudinal	3L/R, 5L/R, 7L/R
	Lateral	4L/C/R, 6L/C/R
Aft Bays	Longitudinal	8L/R through 16L/R

Only the PDUs in a single major group operate at a given time. Within the longitudinal group, the left and right minor groups may operate independently or at the same time. You can operate all PDUs row by row. The PDUs have three conditions:

- Erect/drive
- Erect/brake
- Down.

All PDUs get 115v ac, three-phase voltage from the ground handling bus. They use this ac voltage for the erection coil, motor, brake and phase reversing relays.

The CSC uses inputs from these switches to set the position of the PDUs:

- Secondary joystick
- Cargo control joystick
- PDU forward/aft switch
- PDU left/both/right switch
- Pallet/container switch
- Bay off switches.

CSC Control

Control circuits within the CSC, use phase reversing relays in the PDUs to control when and how voltage is given to the PDU motor. The circuits also control the erection coils and brake for the PDUs in the ball panel area. PDUs forward and aft of the ball panels have their erection coils and brake active when system power is on and the PDU is not in the drive condition. CSC control circuits command PDUs to erect/drive one row at a time with a small delay between rows. This reduces inrush current demands.

The bay off switches stop the drive command for rows of PDUs. This prevents PDUs from scrubbing under ULDs that are in position. The PDU rows affected by the bay off switches are different for containers and pallets. These charts show the functions of the bay off switches for the forward cargo handling system. The aft system is almost the same.

Bay Off Switches (CONTAINER Mode)			
Action	Sw	Bay(s) Effected	PDU Rows Active
Toggle On	D	D	8, 9
Toggle On	E	D, E	8, 9, 10
Toggle On	F	D, E, F	8, 9, 10, 11, 12
Toggle On	G	D, E, F, G	8, 9, 10, 11, 12, 13
Toggle On	H	D, E, F, G, H	8, 9, 10, 11, 12, 13, 14, 15
Toggle On	I	D, E, F, G, H, I	8, 9, 10, 11, 12, 13, 14, 15, 16
Action	Sw	Bay(s) Effected	PDU Rows Not Active
Toggle Off	D	D, E, F, G, H, I	8, 9, 10, 11, 12, 13, 14, 15, 16
Toggle Off	E	E, F, G, H, I	10, 11, 12, 13, 14, 15, 16
Toggle Off	F	F, G, H, I	11, 12, 13, 14, 15, 16
Toggle Off	G	G, H, I	13, 14, 15, 16
Toggle Off	H	H, I	14, 15, 16
Toggle Off	I	I	16

Bay Off Switches (PALLET Mode)			
Action	Sw	Bay(s) Effected	PDU Rows Active
Toggle On	D	D	8, 9
Toggle On	E	D, E, F	8, 9, 10, 11, 12
Toggle On	F	D, E, F	8, 9, 10, 11, 12
Toggle On	G	D, E, F, G	8, 9, 10, 11, 12, 13, 14
Toggle On	H	D, E, F, G, H, I	8, 9, 10, 11, 12, 13, 14, 15, 16
Toggle On	I	D, E, F, G, H, I	8, 9, 10, 11, 12, 13, 14, 15, 16
Action	Sw	Bay(s) Effected	PDU Rows Not Active
Toggle Off	D	D, E, F, G, H, I	8, 9, 10, 11, 12, 13, 14, 15, 16
Toggle Off	E	E, F, G, H, I	10, 11, 12, 13, 14, 15, 16
Toggle Off	F	E, F, G, H, I	10, 11, 12, 13, 14, 15, 16
Toggle Off	G	G, H, I	13, 14, 15, 16
Toggle Off	H	H, I	15, 16
Toggle Off	I	H, I	15, 16

The PDU erect command does not operate (ball panel area only) the longitudinal PDUs when the cargo control joystick is moved to IN or to OUT. Lateral PDUs erect command stops when the cargo control joystick is moved to FWD or AFT. The erect command for all PDUs stops when there is no system ac power.

Longitudinal PDUs - Ball Panel

The CSC uses almost the same logic to control longitudinal PDUs in the ball panel area as it uses for the PDUs in the forward and aft bays. The PDU forward/aft switch and the secondary joystick do not control the longitudinal PDUs in the ball panel area. The CSC also controls the erect/brake and down conditions for these PDUs. The PDUs go to the down condition when the cargo control joystick is set to IN or OUT.

Longitudinal PDUs - Ball Panel/Forward Bays

Longitudinal PDUs in the forward cargo bays stay in the erect/brake condition when system ac power is on and the PDUs are not commanded to the erect/drive condition.

PDUs in the ball panel and forward bays go to the erect/drive condition when all of these events occur:

- System set to PDU FWD

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- Cargo control joystick to FWD or AFT or secondary joystick to FWD or AFT (secondary joystick affects only PDUs fwd or aft of ball panels)
- Forward lateral guides in the down position.

The position of the PDU left/both/right switch and the container/pallet switch controls which minor group of longitudinal PDUs go to the erect/drive condition when the cargo control joystick is set to FWD or AFT. If BOTH or PALLETS is set, then all PDUs in the area go to erect/drive condition. If CONTAINERS and LEFT or RIGHT is set, then only the PDUs in the area on the related side go to the erect/drive condition.

Longitudinal PDUs - Ball Panel/AFT Bays

Control for the longitudinal PDUs in the ball panel and aft bays is the same as the ones in the forward bays except for the following.

PDUs in the ball panel and aft bays go to the erect/drive condition when all of these events occur:

- System set to Bay ON for at least one bay
- System set to PDU AFT
- Cargo control joystick to FWD or AFT or secondary joystick to FWD or AFT (secondary joystick affects only PDUs fwd or aft of ball panels)
- Aft lateral guides in the down position
- Aft lateral guides in the down position.

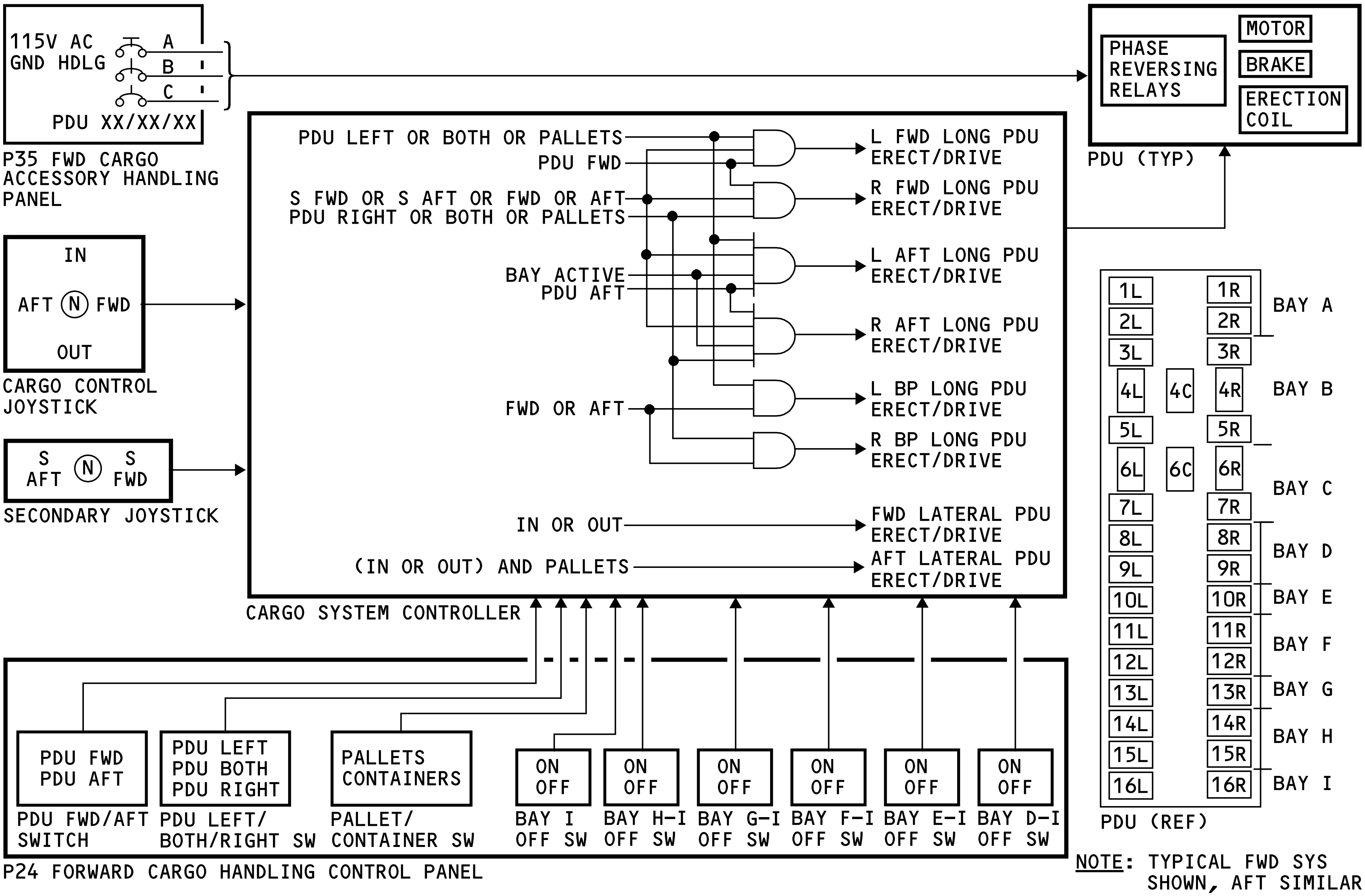
Lateral PDUs

All lateral PDUs go to the erect/drive condition when all of these events occur:

- System set to PALLETS
- Cargo control joystick to IN or OUT.

The forward set of lateral PDUs go to the erect/drive condition when all of these events occur:

- System set to CONTAINERS
- Cargo control joystick to IN or OUT.



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