1. INTRODUCTION

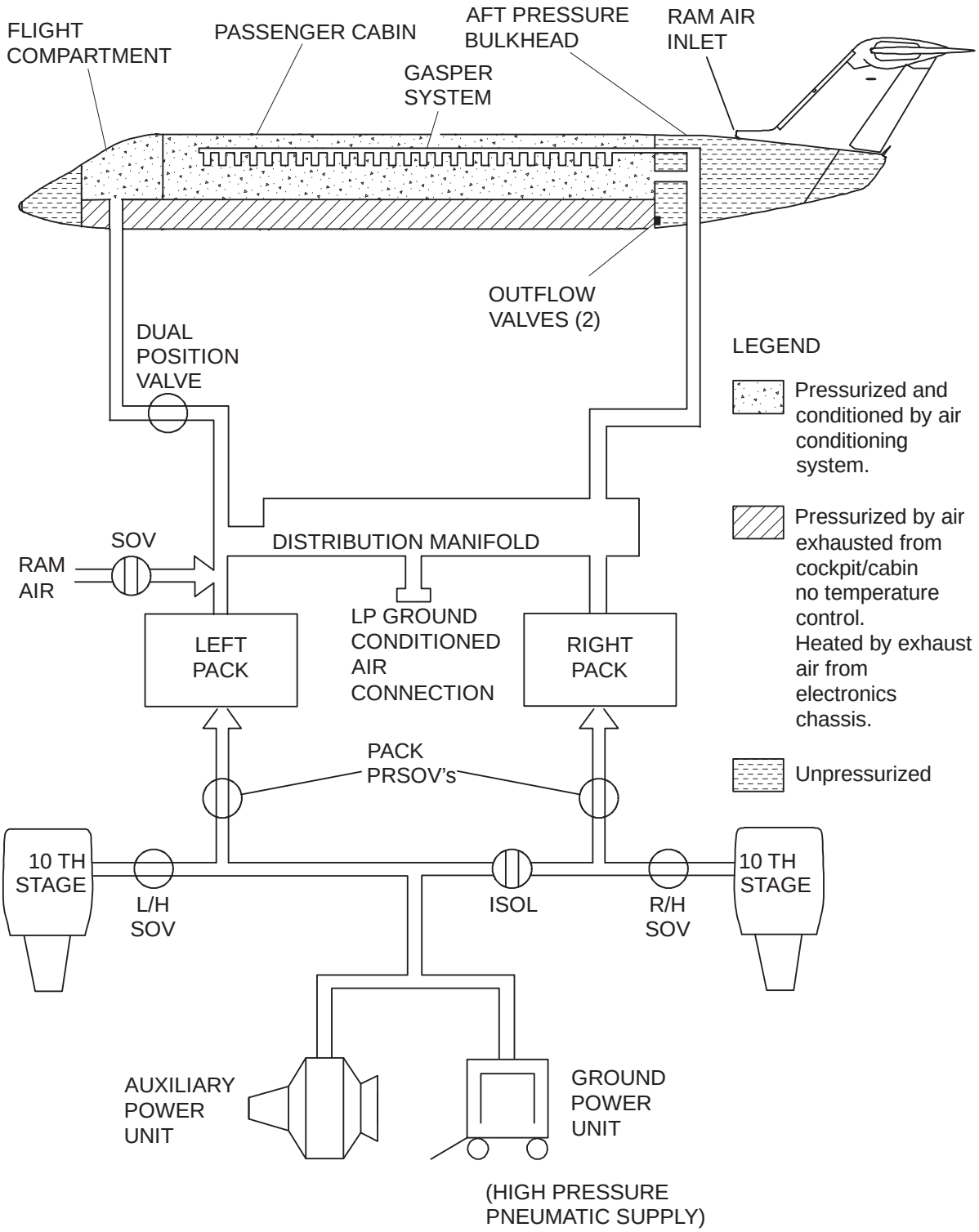
The environmental control system (ECS) provides temperature and pressure regulated air for heating, ventilating and pressurizing the flight and passenger compartments. Exhaust air, from the compartments, is used to ventilate the avionics and cargo compartments, before being dumped overboard through two outflow valves.

For ground operations, pneumatic air to operate the ECS can be obtained from:

- A ground air supply cart connected to the aircraft
- The auxiliary power unit (APU)
- Either or both engines.

During flight, the engines normally supply bleed air for operating the air-conditioning, pressurization, and avionics cooling systems.

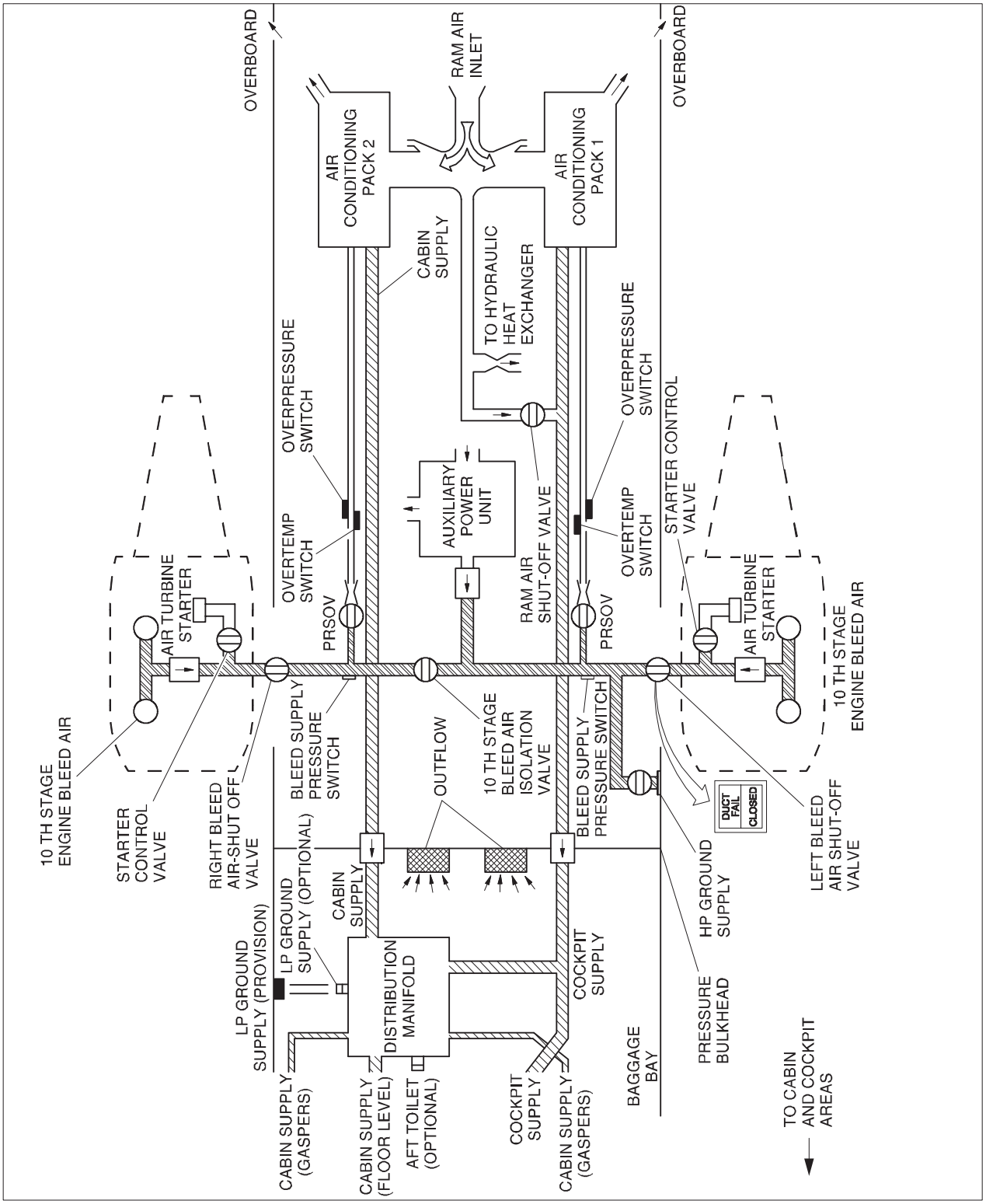
ECS warnings and cautions are displayed on the engine indication and crew alerting system (EICAS) primary page. ECS advisory and status messages are displayed on the EICAS status page. Views of the aircraft ECS temperature, pressure, valve positions and system status indications are displayed on the EICAS ECS synoptic page.



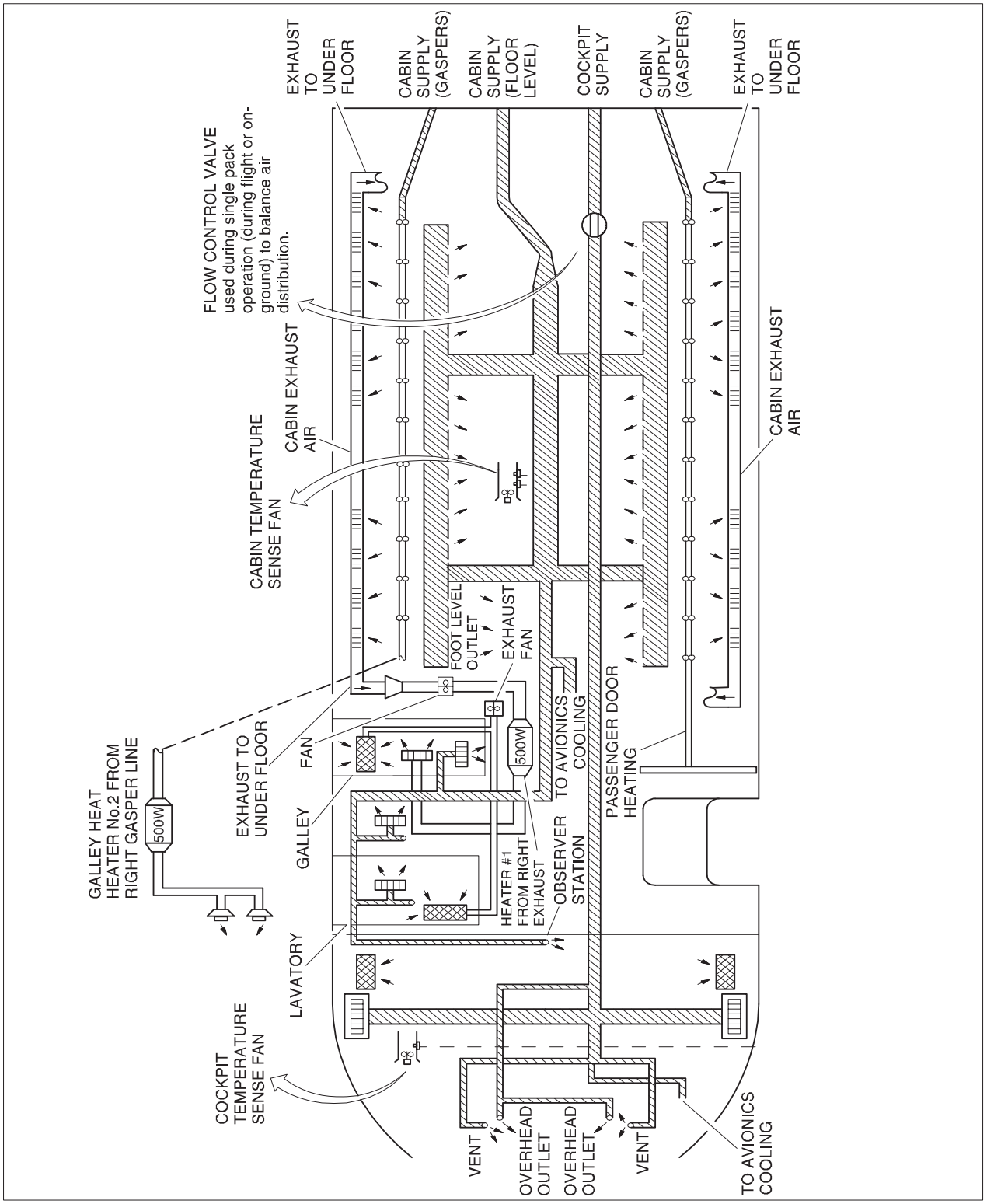
Simplified Block Diagram
Figure 08–10–1

1. AIR-CONDITIONING SYSTEM

There are two air-conditioning systems, which can be operated separately or in parallel, to supply conditioned air to the flight and passenger compartments. Each system consists of an air-conditioning unit or package (PACK), a temperature controller and ducting. Ram air is provided for pack cooling and ventilation. The temperature controllers also control the engine 10th stage bleed air supply to the system (see Chapter 19).



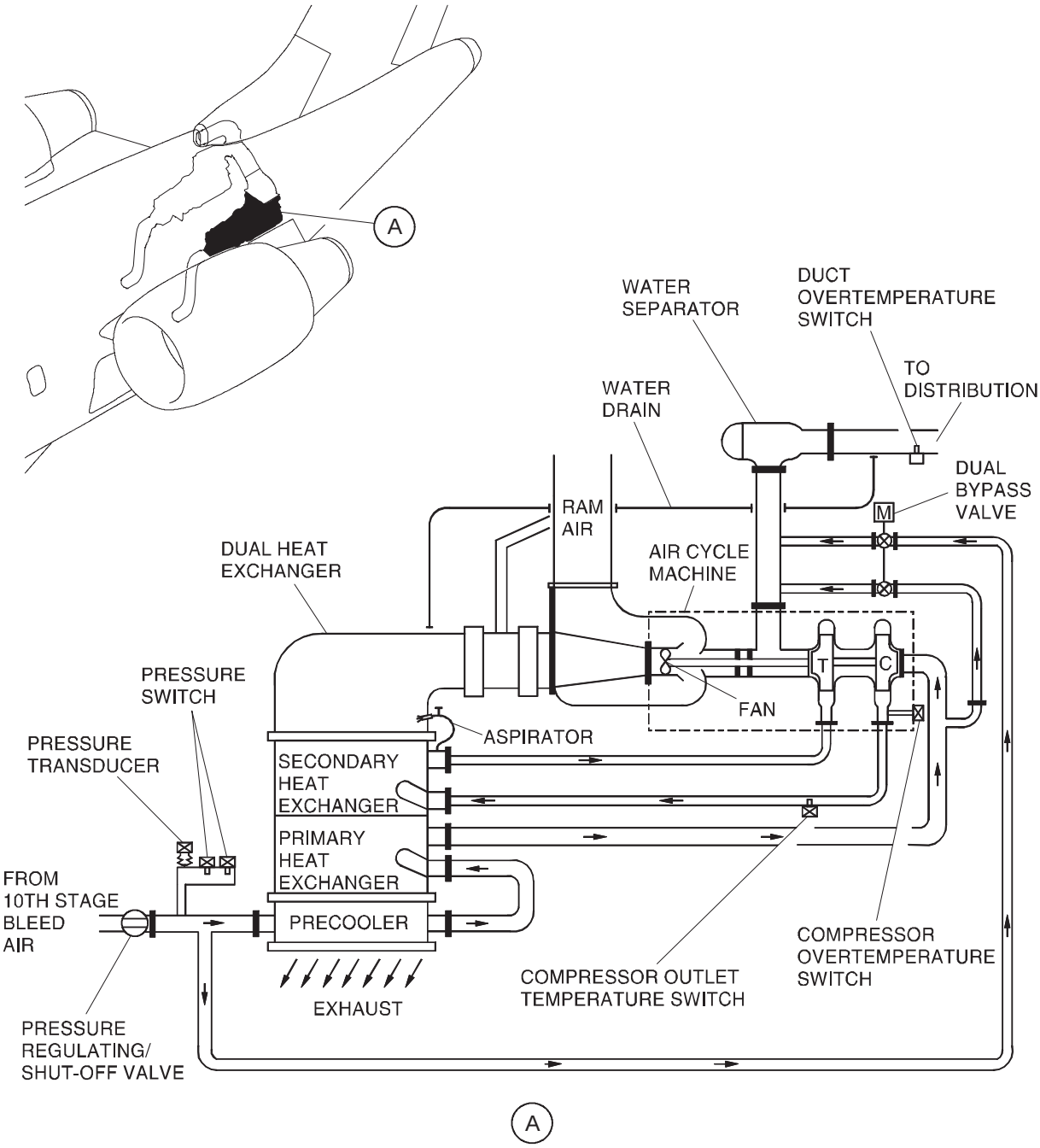
Air Conditioning System
Figure 08–20–1 Sheet 1



Air Conditioning System
Figure 08–20–1 Sheet 2

A. Packs

The packs are located in the aft equipment compartment. They provide cooling of the engine or APU bleed air supplies for distribution to the flight and passenger compartments. 10th stage bleed air to each pack is regulated to a constant 30 psi by respective pressure regulator and shutoff valves (PRSOV). For single pack operation, the PRSOV will regulate the pressure to 41 psi. Each pack consists of an air cycle machine and heat exchanger which are used to decrease the temperature and water content of the bleed air used in the conditioning process. Normally, the right pack supplies the passenger compartment and the left pack supplies the flight compartment. If a pack fails, the remaining pack can supply conditioned air to both compartments.



Air Conditioning Pack
Figure 08–20–2

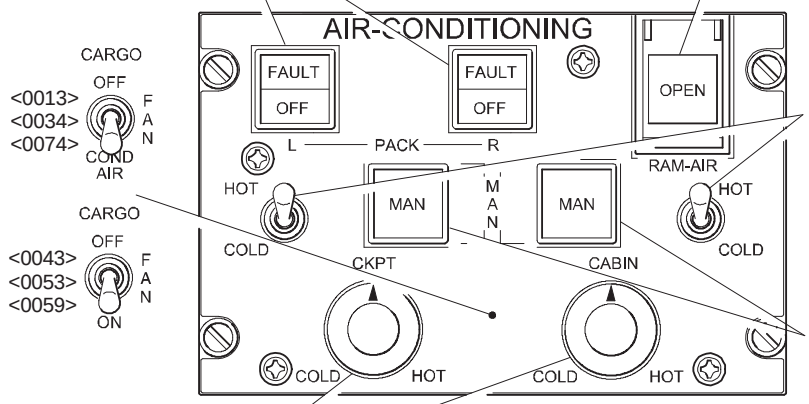
Left and Right PACK Switch/Lights
Used to control operation of air conditioning packs.

- When pressed in, associated pack pressure regulating/shut-off valve opens, permitting airflow into pack. OFF (white) light goes out.
- When pressed out, associated pack pressure regulating/shut-off valve closes, shutting down airflow into pack. OFF (white) light comes on and EICAS displays L/R PACK OFF status message.
- Amber FAULT light comes on: When overpressure occurs between primary heat exchanger and compressor section of pack.

RAM AIR Ventilation Switch/Light (Guarded)
Used when both packs fail. Provides ambient air to left conditioned air (cockpit) supply duct.

- When pressed in, ram air vent valve opens and supplies air into cockpit supply duct. OPEN (white) light comes on. EICAS displays RAM AIR OPEN status message and ECS page indicates valve position.
- When pressed out, ram air valve closes and OPEN light goes out. EICAS ECS page indicates valve at closed position.

Manual Mode Temperature Control Switch/Light
Used to operate air conditioning temperature control valves in manual mode. Range is 1.7 °C to 71 °C (35 °F to 160 °F). Do not activate and hold switch for extended periods of time, as excessive temperatures will occur.



Air-Conditioning Panel
Overhead Panel

Automatic Mode - Temperature Controls
Used to provide automatic control of temperature in selected compartment. Total automatic range is approximately 14.5 °C (58 °F) to 28 °C (82 °F).

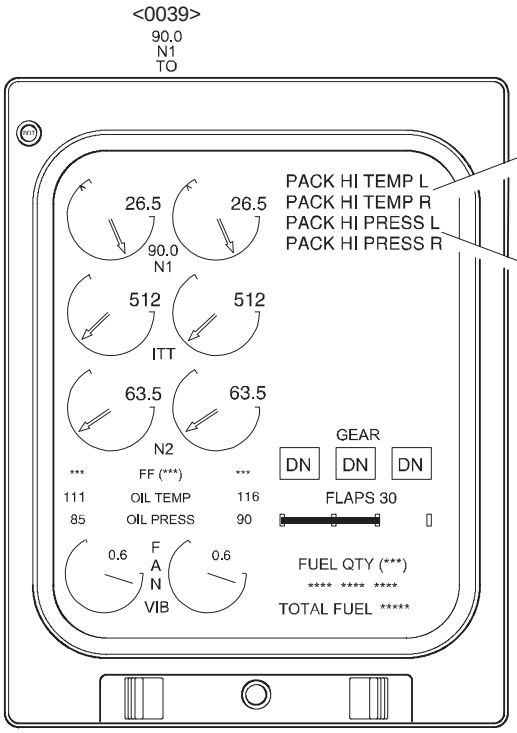
Manual Mode - Temperature Control Switch/Light
Used to select manual mode temperature control.

- When pressed in, selects manual control and light comes on green and EICAS indicates CKPT/ CABIN TEMP MAN.
- When pressed out, selects automatic control and light goes out.

Air Conditioning System – Controls <MST>
Figure 08–20–3

PACK HI TEMP L/R caution (amber)
Comes on when a high temperature 85 °C (185 °F) is sensed in respective air conditioning packs outlet duct. Corresponds to PACK L/R switch/lights indicating FAULT (amber). Pack may be restarted when duct temperature is below 85 °C (185 °F).

PACK HI PRESS L/R caution (amber)
Comes on when a high pressure (51 psi) is sensed in respective air conditioning pack's outlet duct. Corresponds to PACK L/R switch/lights indicating FAULT (amber).

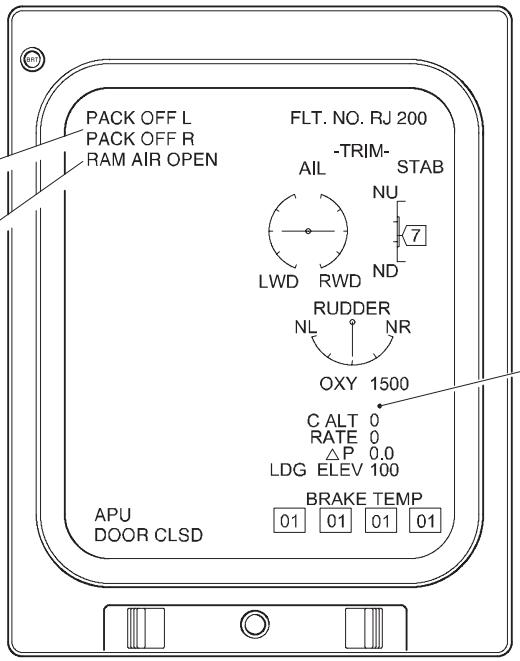


<0006>
FLAPS 20

Primary Page

PACK OFF L/R status (white)
Comes on to indicate that respective air conditioning pack has been shut down. Corresponds to PACK L/R switch/lights indicating OFF (white).

RAM AIR OPEN status (white)
Comes on to indicate that ram air valve has been selected open. Corresponds to RAM AIR switch/light indicating OPEN (white).



<0039>
7.2

<0039>
C TEMP 23°C

Status Page

Air Conditioning – EICAS Messages <MST>
Figure 08–20–4

MANUAL message (white)
Comes on to indicate that the respective CKPT/CABIN MAN switch/light is selected.

Ram Air Valve Position Indicator

- open (white)
- closed (white)
- failed (half-intensity magenta)

Overpressure Caution message (amber)
Indicates high pressure sensed in respective packs outlet, corresponds to PACK HI PRESS L, R caution on primary page and PACK switch/light indicating FAULT.

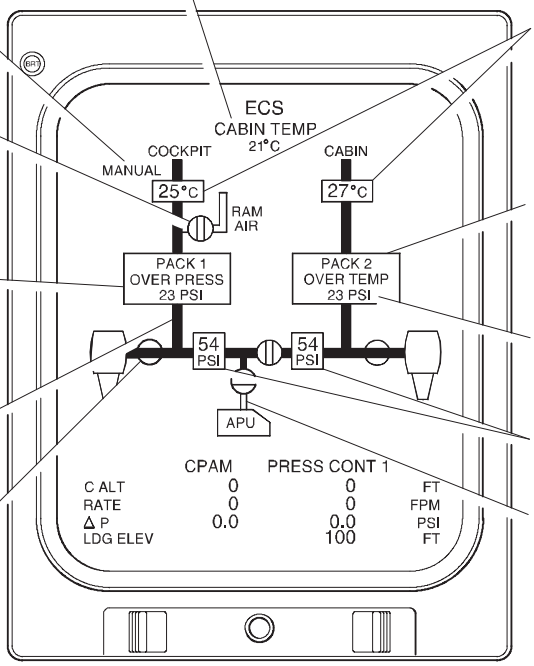
10th Stage Duct

- Green - Pressure greater than or equal to 5 psi.
- Red - Duct failure.

Pylon Duct

- Green - Pressure greater than or equal to 5 psi.
- Red - Duct failure.

Cabin Temperature Indicator (white)
Indicates temperature sensed at cabin temperature sensing fan. Temperature indicated in increments of 1 °C.



Environmental Control System Page

Cabin/Cockpit Supply Duct Temperature Indicator (white)
Indicates temperature sensed in cabin and cockpit air conditioning supply ducts. Temperature indicated in increments of 1 °C.

Temperature indicated in increments of 1 °C with a range from -40 °C to 120 °C. <0039>

Overtemperature Caution message (amber)
Indicates high temperature sensed in respective air conditioning pack's outlet corresponds to PACK HI TEMP L, R caution on primary page, and PACK switch/light indicating FAULT.

Pack Pressure Readout

- normal - 5 to 46 psi
- caution - 47 to 51 psi

10th Stage Bleed Pressure (white)

APU Duct

- Green - APU ready to load, barometric altitude <15000 feet.
- Amber - APU ready to load barometric altitude >15000 feet.

Air Conditioning System – Synoptic Page Indications <MST>
Figure 08–20–5

B. Temperature Control

The flight compartment and the passenger compartments have identical but independently-operated temperature control systems. Each controller subsystem is dedicated to an air-conditioning pack. Temperature control, in automatic mode, is provided by CKPT and CABIN selector knobs on the air conditioning panel. Control in manual mode is provided by left and right pack MAN switchlights and HOT/COLD switches on the same panel. The individual packs can be manually turned OFF by selecting the respective L or R PACK switchlight on the air conditioning panel.

AUTOMATIC MODE – Operating Range	MANUAL MODE – Operating Range
14.5°C to 28°C (58°F to 82°F)	1.7°C to 71°C (35°F to 160°F)

NOTE

Manual mode temperature below 3°C (37°F) may result in icing of the pack water separator and subsequent cycling of the pack output.

C. Ram Air Ventilation

The cooling air for the left and right heat exchangers is supplied from a ram air intake, located on the upper aft fuselage. During normal operation, the ram air is exhausted through an exhaust duct in the lower aft fuselage, after passing over the heat exchangers. The ram air intake duct also provides cooling air to the hydraulic systems heat exchanger to cool the hydraulic fluid. (Refer to Chapter 14).

Ram air ventilation is used only when the air conditioning packs fail (unpressurized). Operating the (guarded) RAM AIR, switchlight on the air–conditioning panel, opens the normally closed ram air valve. Ram air then enters the left (flight compartment) supply system. Ram air also flows through the distribution manifold to the passenger compartment.

D. Conditioned Air Distribution

Conditioned air, from the left and right air-conditioning packs, is routed through separate ducting systems through a distribution manifold to the flight compartment and the passenger compartments.

Conditioned air, to the passenger compartment, is distributed from ducts along each side of the aircraft. Passenger compartment exhaust air is routed underfloor to the outflow valves on the aft pressure bulkhead.

Conditioned air, to the flight compartment, is distributed to the side console panels, gaspers and vents, and avionics units within the instrument panel. Dedicated fans and ducts direct conditioned air over the flight compartment display units. Flight compartment exhaust air is routed underfloor through the avionics compartment to the outflow valve at the aft pressure bulkhead.

E. Low Pressure Ground Air Connection <0007>

An external ground air connector, located on the right aft fuselage, is provided for ground air-conditioning. Low pressure compressed air from a ground air conditioning cart can be supplied directly into flight and passenger compartment distribution systems.

F. System Circuit Breakers

SYSTEM	SUB-SYSTEM	CB NAME	BUS BAR	CB PANEL	CB LOCATION	NOTES
Air Conditioning – Flight Compartment	Left Pack	L AIR COND UNIT	DC BUS 1	1	J1	
	Cockpit Temperature Control	CKPT TEMP/CONT			J2	
		CKPT TEMP/CONT MAN			J3	
		CKPT FAN	AC BUS 1		C8	
	Ram Air	RAM AIR SOV	DC BAT	2	P5	
Air Conditioning – Cabin	Right Pack	R AIR COND UNIT	DC BUS 2		J1	
	Cabin Temperature Control	CABIN TEMP/CONT			J2	
		CABIN TEMP/CONT MAN			J3	
		GALLEY FAN	AC BUS 2		C5	
		CABIN FAN			C8	

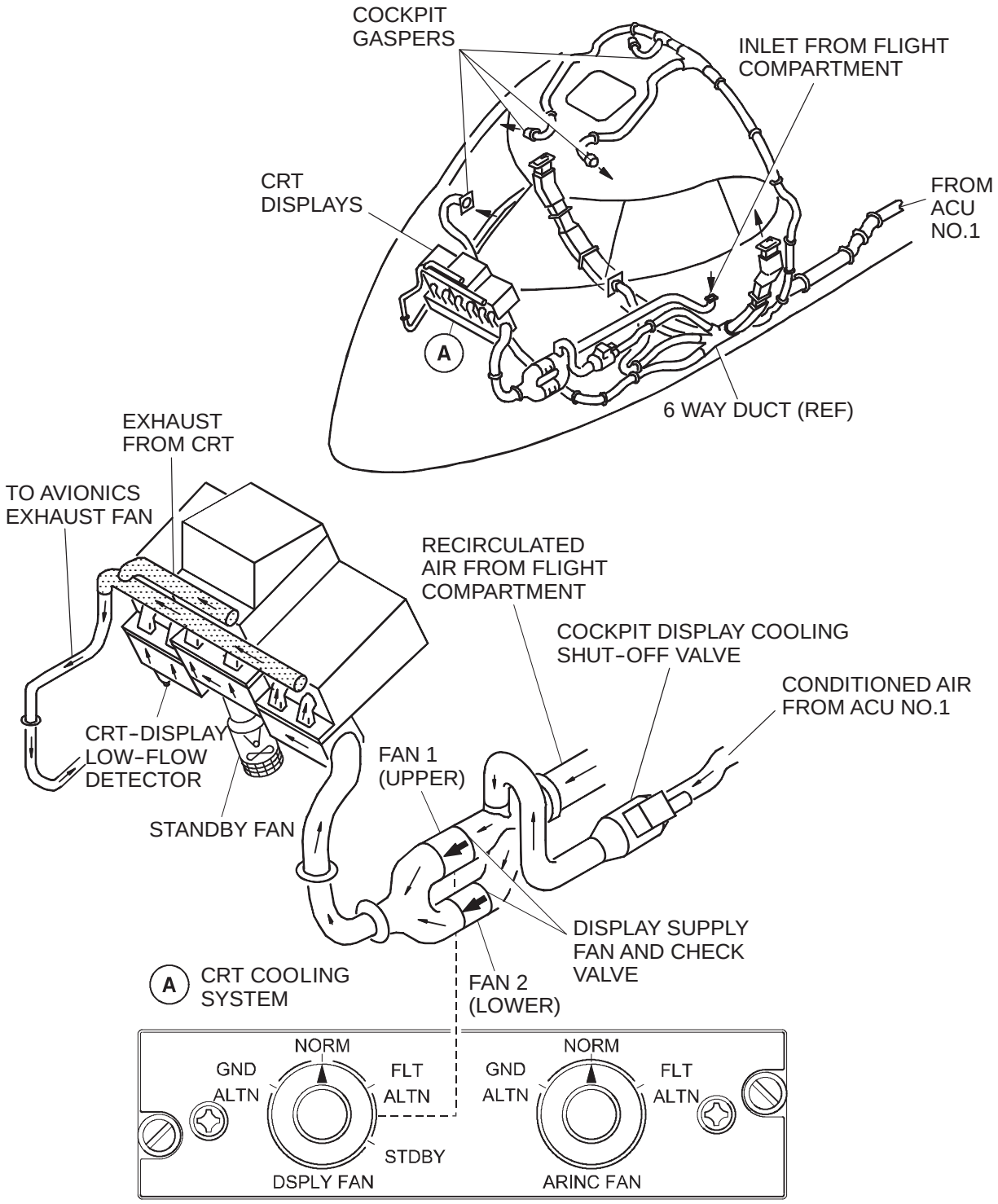
1. AVIONICS COOLING SYSTEM

The electronic flight instruments in the flight compartment instrument panel, control panels and display units in the center pedestal, and electronic units in the left and right portions of the underfloor avionics bay are cooled during on-ground and flight operations.

The cockpit displays are cooled with air from two display fans located under the flight compartment floor. Fan control is provided by a DSPLY FAN selector knob on the avionics cooling panel. Normally, only one fan operates at a time (controlled by WOW). In flight, only fan 1 is powered and on the ground, only fan 2 is powered. When powered, the respective fan draws in recirculated air from the flight compartment and mixes it with conditioned air then supplies the air to the backs of each display. In the event of a fan failure, the alternate fan can be powered by selecting the FLT ALTN or GND ALTN position. If both fans fail, selecting STDBY permits conditioned air to ventilate the displays. A low flow sensor monitors the air flow to ensure adequate cooling. Check valves prevent loss of cooling air or reverse flow.

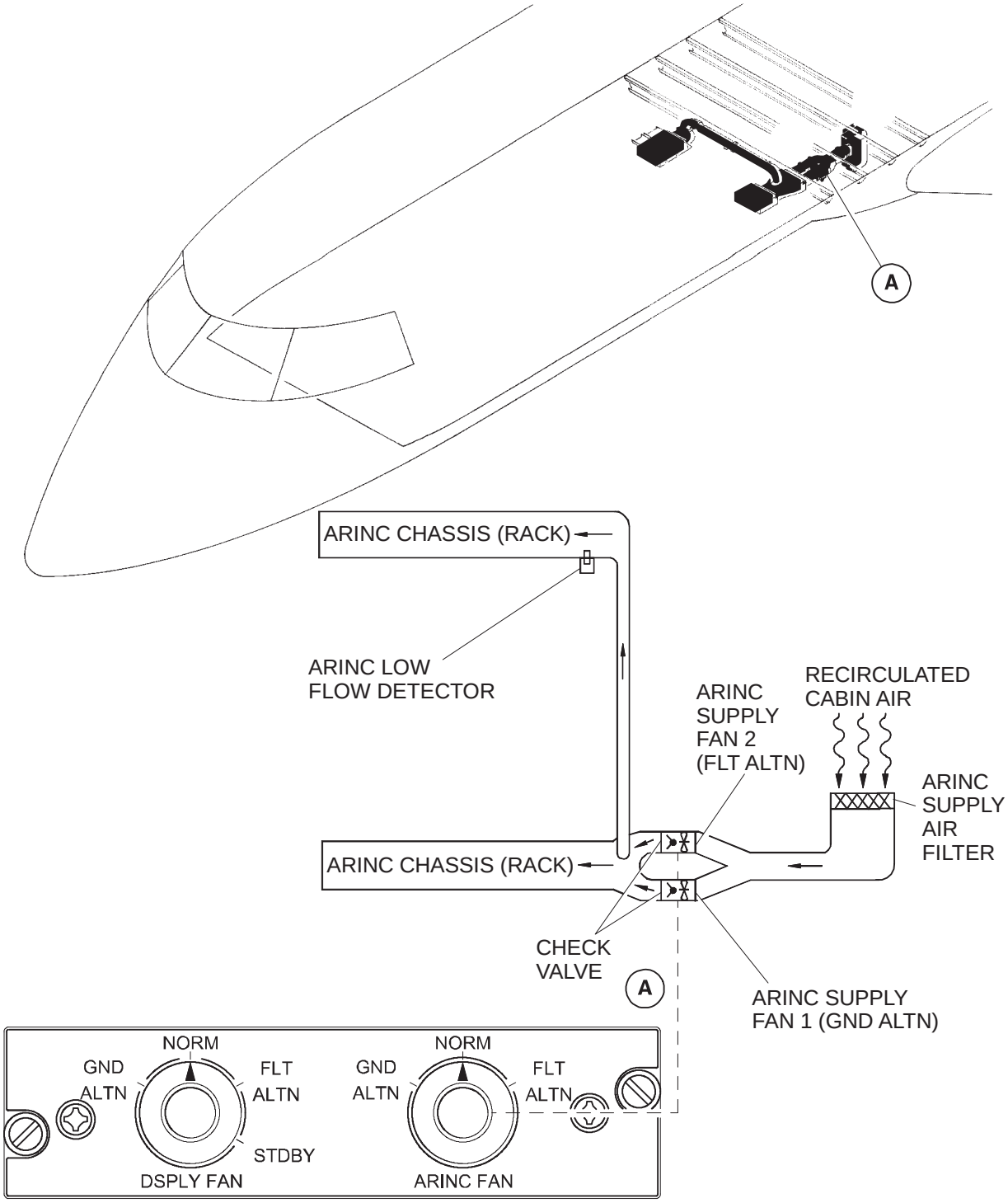
Two ARINC cooling fans are installed under the flight compartment floor. The fans are used to provide recirculated cabin air to the left and right avionics equipment racks. Fan control is provided by an ARINC FAN selector knob on the avionics cooling panel. In the NORM position, only one fan operates at a time (controlled by WOW). In flight, only fan 1 is powered and on the ground, only fan 2 is powered. In the event of a fan failure, the alternate fan can be powered by selecting the FLT ALTN or GND ALTN position.

The avionics exhaust system consists of an exhaust fan, an inboard exhaust valve and an outboard exhaust valve. The exhaust fan is installed in the avionics compartment and operates whenever AC BUS 1 is powered. The fan is used to remove warm air from the CRT displays, pedestal panels and the left and right avionics equipment racks, then direct it to the exhaust valves. When either the passenger door or service door is open, the inboard valve is closed and the outboard valve is open to exhaust the air to the wing root area. When the passenger and service doors are closed, the outboard valve is closed and the inboard valve is open to exhaust the air to the rear lower fuselage where it is dumped overboard through the outflow valves.



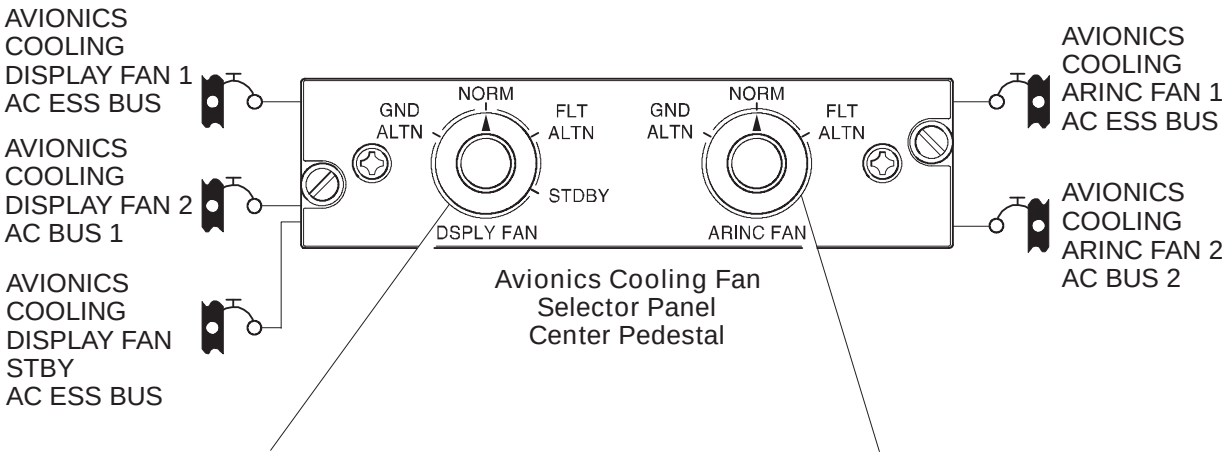
Avionics Cooling Fan Selector Panel
Center Pedestal

Avionics Cooling – CRT Display Supply
Figure 08–30–1



Avionics Cooling Panel
Center Pedestal

Avionics Cooling – ARINC Supply
Figure 08–30–2



Avionics Cooling Fan
Selector Panel
Center Pedestal

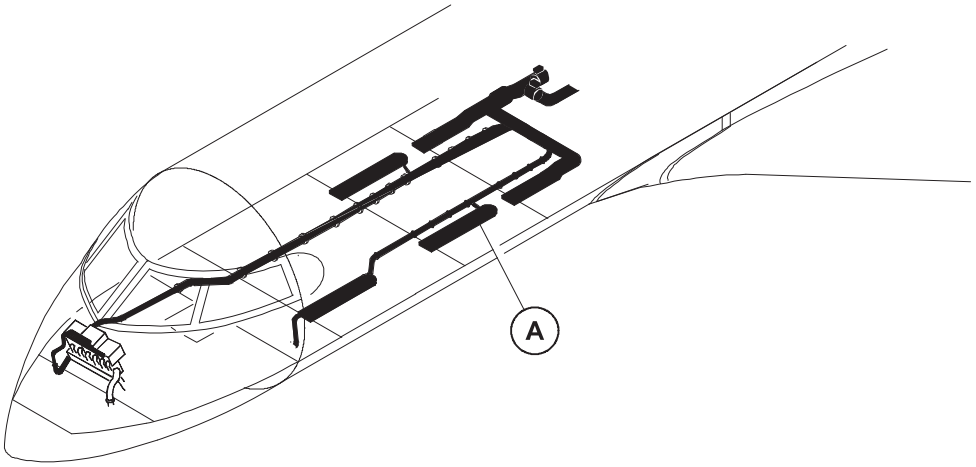
DISPLAY FAN SELECTOR
- NORM – Fans in EFIS/EICAS display duct operate in automatic mode providing airflow through flight compartment displays:
  Fan 1 during flight, and
  Fan 2 during ground operations.
- FLT ALTN – Selects flight alternate (fan 2) as the reversionary fan.
- GND ALTN – Selects ground alternate (fan 1) as the reversionary fan.
- STBY – Select standby fan as the reversionary fan.

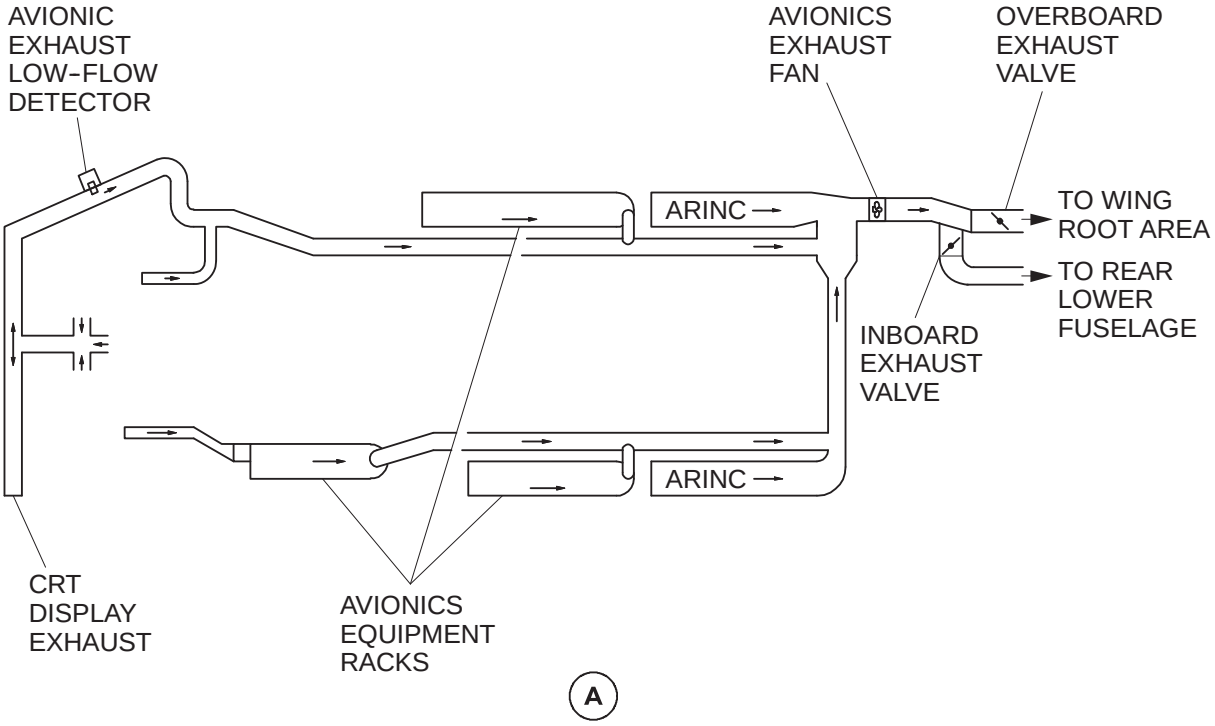
Reversionary mode selected when DISPLAY COOL caution (amber) indicated on EICAS.

ARINC FAN SELECTOR
- NORM – Fans in ARINC chassis supply duct operate in automatic mode providing airflow through ARINC chassis:
  Fan 1 during flight,
  Fan 2 during ground operations.
- FLT ALTN – Selects flight alternate (fan 2) as the reversionary fan.
- GND ALTN – Selects ground alternate (fan 1) as the reversionary fan.

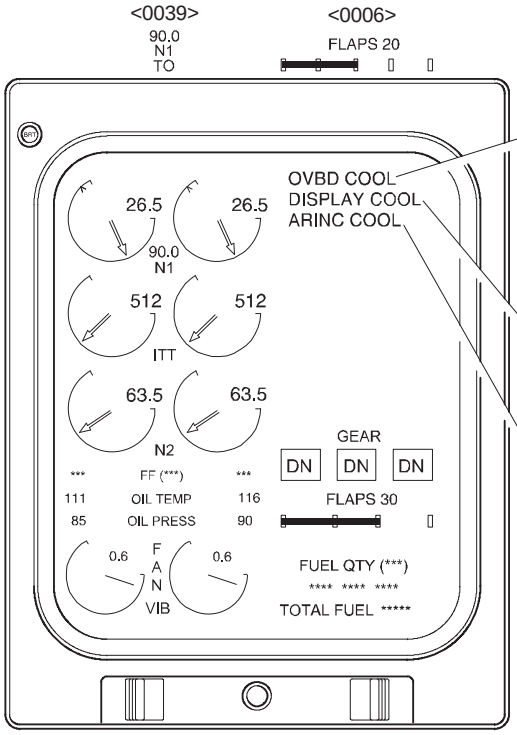
Reversionary mode selected when ARINC COOL caution (amber) indicated on EICAS.

Avionics Cooling – Controls
Figure 08–30–3





Avionics Cooling – Exhaust System
Figure 08–30–4



Primary Page

OVBD COOL caution (amber)
Overboard avionics cooling SOV not closed with the passenger door and service door closed (10 secs. time delay).

NOTE

The avionics cooling overboard shut-off valve (OVBD COOL SOV) is used during ground operations to flush cool the avionics system and dump hot air overboard. The valve is normally open on the ground and closed during flight. The airplane will not pressurize to normal levels if the overboard cooling shut-off valve is failed open.

DISPLAY COOL caution (amber)
Low airflow is detected in cockpit display cooling duct (due to duct disconnection, duct blockage) or display fan 1 or 2, or standby fan has failed (10 secs. time delay).

ARINC COOL caution (amber)
Low airflow is detected in ARINC unit cooling duct (due to duct disconnection, duct blockage) or avionics cooling fan 1 or 2 has failed (10 secs. time delay).

OVBD COOL FAIL status (white)
Comes on during ground operations, if the overboard avionics cooling SOV has failed closed with passenger door unlatched (10 secs. time delay).

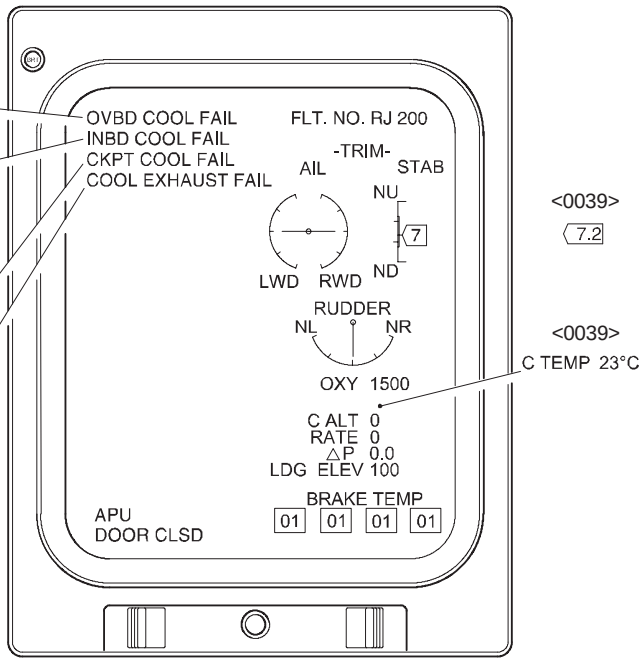
INBD COOL FAIL status (white)
Inboard avionics cooling SOV not open with the passenger door closed (10 secs. time delay).

NOTE

The inboard cooling shut-off valve (INBD COOL SOV) is used during flight to flush cool the avionics system equipment. The valve is normally closed on the ground and open during flight.

CKPT COOL FAIL status (white)
Avionics cooling SOV not in correct position (closed on ground or open during flight).

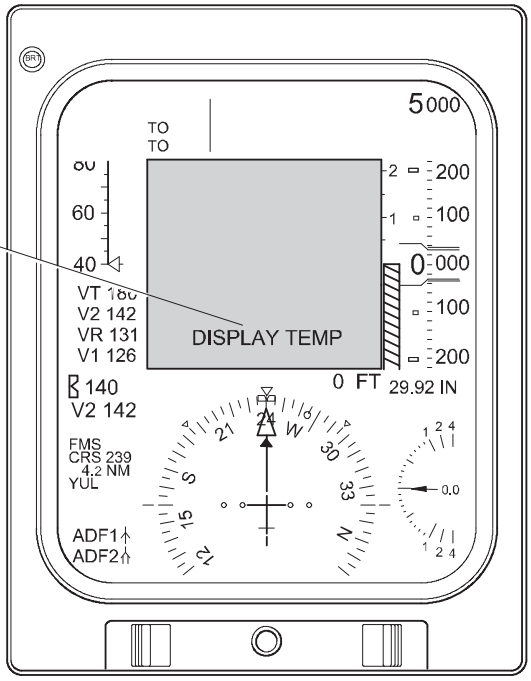
COOL EXHAUST FAIL status (white)
Exhaust fan failed or low flow from cooling exhaust (10 secs. time delay).



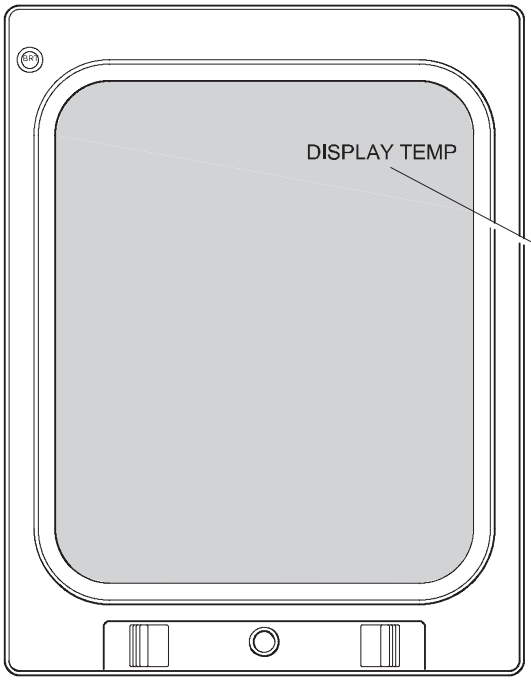
Status Page

Avionics Cooling – EICAS Indications <MST>
Figure 08–30–5

Display Overtemperature warning (red)
Indicates an approaching thermal shutdown of PFD.
- Sky and ground raster is removed (to delay thermal shutdown).



Primary Flight Display
Pilot's and Copilot's Instrument Panels



Display Overtemperature warning (red)
Indicates an approaching thermal shutdown of MFD.

Multifunction Display
Pilot's and Copilot's Instrument Panels

Display Overtemperature Indications
Figure 08–30–6

A. System Circuit Breakers

SYSTEM	SUB-SYSTEM	CB NAME	BUS BAR	CB PANEL	CB LOCATION	NOTES
Avionics Cooling System	Display Fans	DISPLAY FAN 1	AC ESS	3	C9	
		DISPLAY FAN 2	AC BUS 1	1	D2	
		DISPLAY FAN STBY	AC ESS	3	C6	
		EXHAUST FAN	AC BUS 1	1	C5	
	ARINC Chassis Fans	ARINC FAN 1	AC ESS	3	C12	
		ARINC FAN 2	AC BUS 2	2	D2	
	Controller and Shutoff Valves	CONT2	DC BUS 2		L2	
		CKPT SOV			L3	
		I/B SOV			L4	
		O/B SOV	DC BUS 1	1	L4	
		AVIONICS CONT 1	DC ESS	4	C4	

1. CARGO COMPARTMENT AIR SYSTEM

The cargo compartment air system allows the flight crew to control the ventilation air within the cargo compartment. The system consists of a recirculation air shut–off valve, recirculation fan and an exhaust air shut–off valve. <0043><0059>

The cargo compartment conditioned air system allows the flight crew to control the ventilation air and temperature within the cargo compartment. The system consists of a recirculation air shut–off valve, recirculation fan, heater and an exhaust air shut–off valve. <0013><0034>

The system is controlled by a 2–position CARGO, OFF/FAN switch on the air-conditioning panel. In the OFF position, both shut–off valves are closed and the system is disabled. In the FAN position, both shut–off valves open and the fan is powered to blow recirculated cabin air into the cargo compartment to maintain the compartment temperature above freezing. <0043><0059>

The system is controlled by a CARGO, 3–position, OFF/FAN/AIR COND switch on the air-conditioning panel. In the OFF position, both shut–off valves are closed and the system is disabled. In the FAN position, both shut–off valves open and the recirculation fan is powered to blow recirculated cabin air into the cargo compartment to maintain the compartment temperature above freezing. In the COND AIR position, both shut–off valves are open, the heater is enabled and the recirculation fan is powered to blow heated air into the cargo compartment. The heater is controlled by a temperature control switch in the exhaust duct which will cycle the heater ON and OFF as necessary to maintain the cargo compartment temperature between 21°C and 27°C (70°F and 80°F). <0013><0034>

An overheat switch in the exhaust duct provides overtemperature protection by removing power to the heater when the exhaust duct temperature exceeds 49°C (120°F). A signal is also sent to the EICAS to display a CARGO OVHT caution message. The switch will reset when the temperature decreases below 29°C (85°F). <0013><0034>

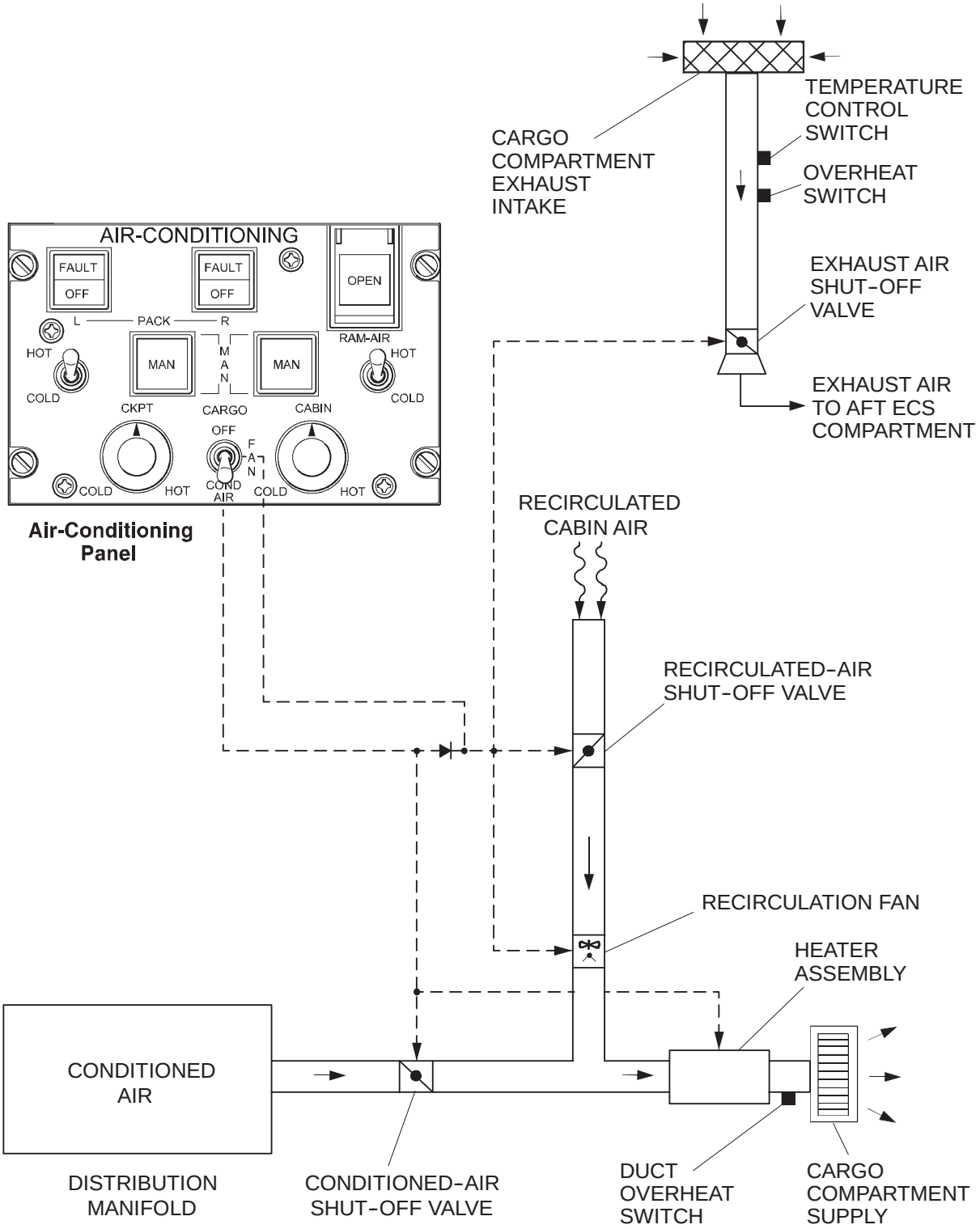
A duct overheat switch is installed in the heater outlet. If the heater discharge temperature exceeds 49°C (120°F) power is removed from the heater. The switch will reset when the temperature decreases below 38°C (104°F). <0013><0034>

The system interacts with the cargo bay smoke detectors and fire extinguishing system (See Chapter 10, Fire Protection). When smoke is detected, the shut-off valves automatically close to isolate the cargo compartment. <0043><0059>

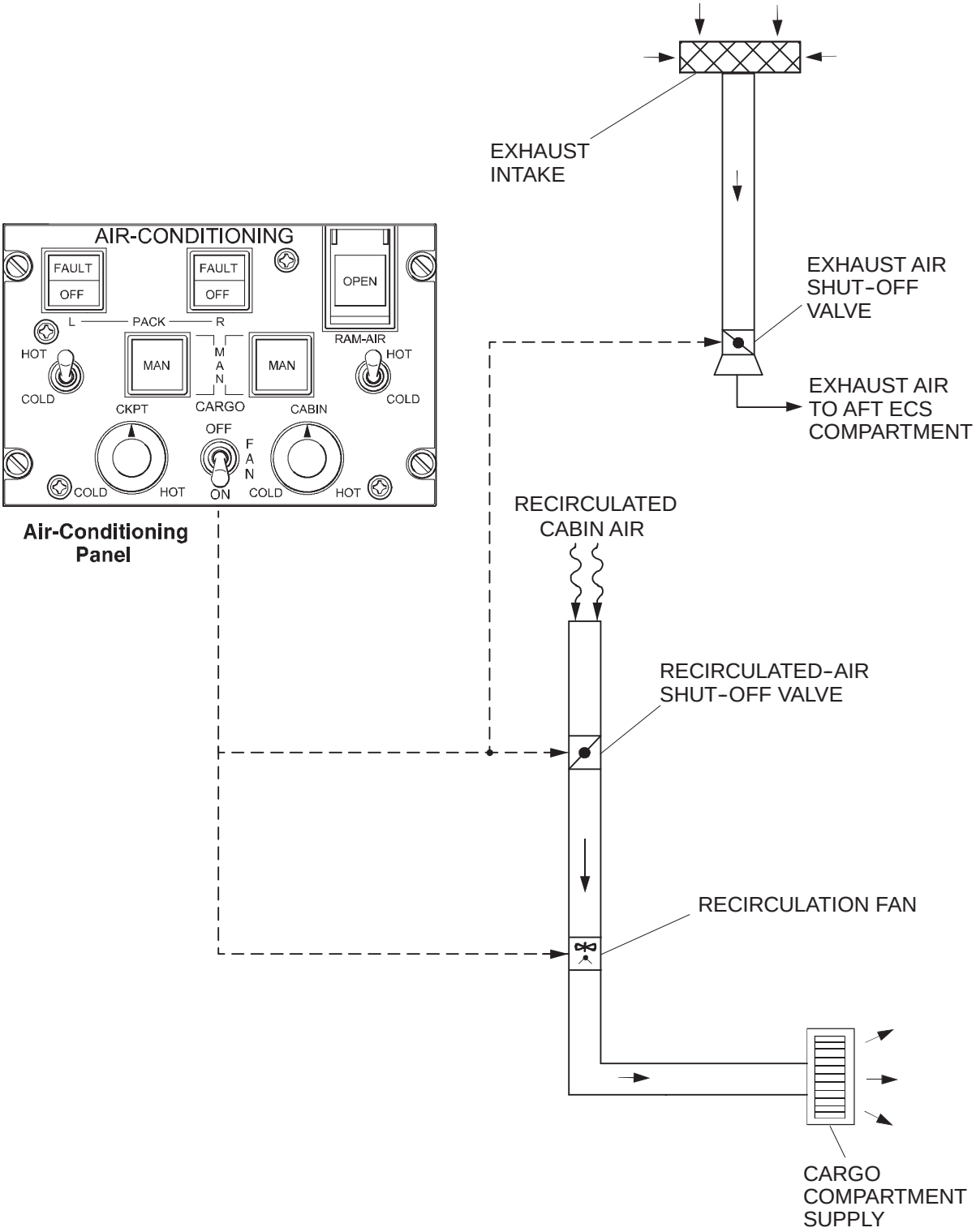
The system interacts with the cargo bay smoke detectors and fire extinguishing system (See Chapter 10, Fire Protection). When smoke is detected, the heater power is removed and the shut-off valves automatically close to isolate the cargo compartment. <0013><0034>

NOTE

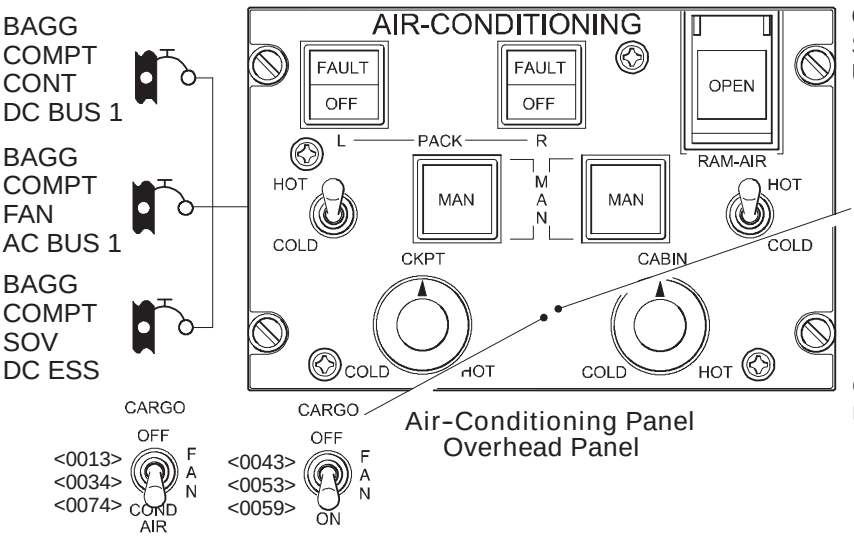
For ground operations with the cargo compartment door open, the CARGO switch may be set to COND AIR. For ambient temperatures above 30°C (86°F), this may result in a cargo overheat caution message. The cargo switch must be reset to the FAN position after the cargo door has been closed. <0013><0034>



Cargo Compartment Air System with Air Conditioning – Schematic <0013><0034>
Figure 08–40–1



Cargo Compartment VentilationSystem – Schematic <0043><0059>
Figure 08–40–2



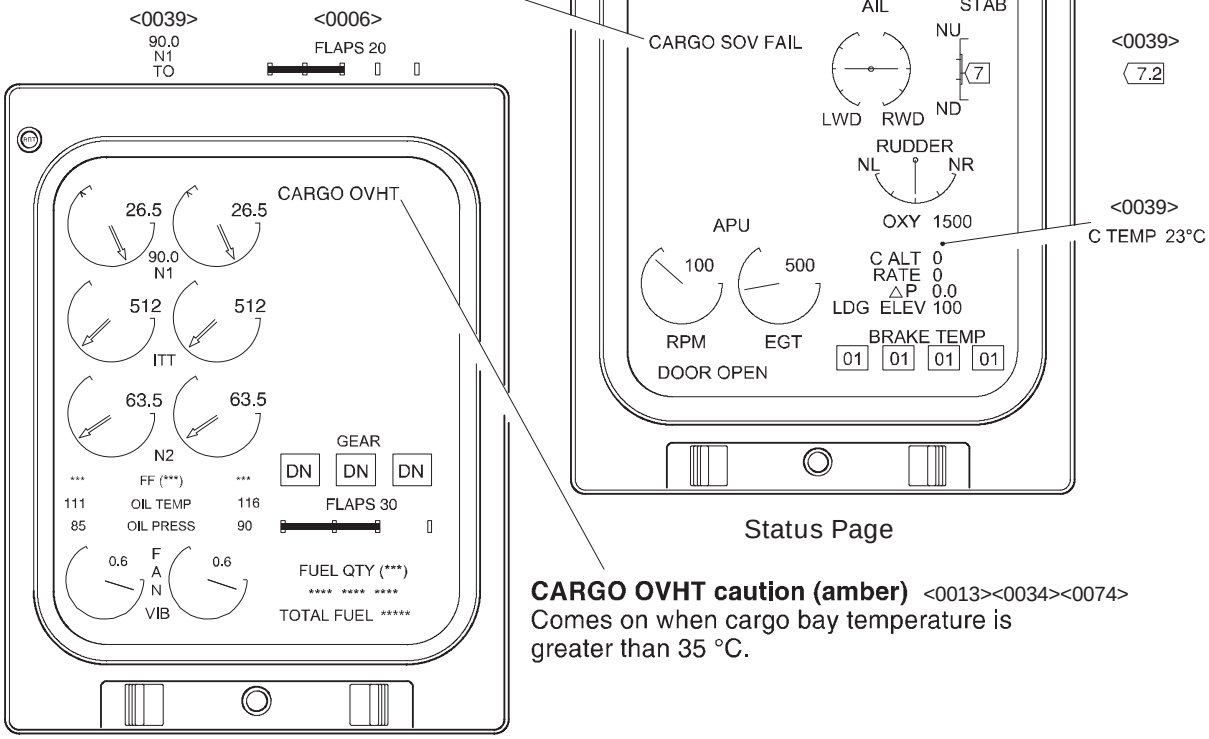
Air-Conditioning Panel
Overhead Panel

Cargo Bay Air Conditioning Switch <0013><0034><0074>
Used to select to system mode.
- COND AIR – Temperature controlled airflow provided to cargo bay area.
- FAN – Recirculated cabin exhaust air provided to cargo bay area.
- OFF – Shuts off airflow to the cargo bay area.

<0043>
<0053>
Cargo Bay Mode Switch <0059>
Used to select to system mode.
- FAN – Recirculated cabin exhaust air provided to cargo bay area.
- OFF – Shuts off airflow to the cargo bay area.

CARGO FAN FAIL status (white)
Comes on to indicate low air flow at cargo bay recirculation fan.

CARGO SOV FAIL status (white)
Comes on to indicate that air supply shut-off valve has failed (either open or closed).



Status Page

Primary Page

CARGO OVHT caution (amber) <0013><0034><0074>
Comes on when cargo bay temperature is greater than 35 °C.

Cargo Compartment Air/ventilation System <MST>
Figure 08–40–3

A. System Circuit Breakers

SYSTEM	SUB-SYSTEM	CB NAME	BUS BAR	CB PANEL	CB LOCATION	NOTES
Cargo Bay Conditioned Air System	Controller	BAGG COMPT CONT	DC BUS 1	1	L3	
	Heater	BAGG COMPT HEATER	AC BUS 1	1	B8	<0013> <0034> <0074>
	Fan	BAGG COMPT FAN	AC BUS 1	1	D5	
	Shutoff Valve	BAGG COMPT SOV	DC ESS	4	A12	

Effectivity:

- Aircraft 7002, 7050 and subsequent.
- Aircraft 7003 to 7010, 7015,7016, 7019 to 7021, 7023 to 7025, 7032, 7033, 7036, 7039, 7040 incorporating SB 601R–25–012.

1. GALLEY HEATING SYSTEM

The galley is heated with two 500 watt heaters to provide supplementary heat to the galley and service door area. One heater uses the air from the right exhaust riser duct and the second heater warms conditioned air from the right gasper supply duct. The heaters are controlled by switchlights on the Flight Attendants panel. There is no EICAS display for the galley heating system.

Each heater incorporates an internal overtemperature switch that removes power to the heater when the heater outlet temperature becomes excessive. The heater also incorporates an internal, overheat protection switch which disables the heater when the internal temperature exceeds a preset limit. Heater #1 has a fan which can be used in conjunction with or separate from the heaters.

System test is accomplished using the SYSTEM 1 & 2 TEST switchlight on the Flight Attendants panel as follows:

Latch the FAN and HTR 1 and 2 switchlights and check that:

- The FAN and HRT 1 and 2 lights illuminate green.

Press the TEST switchlight and hold; check that:

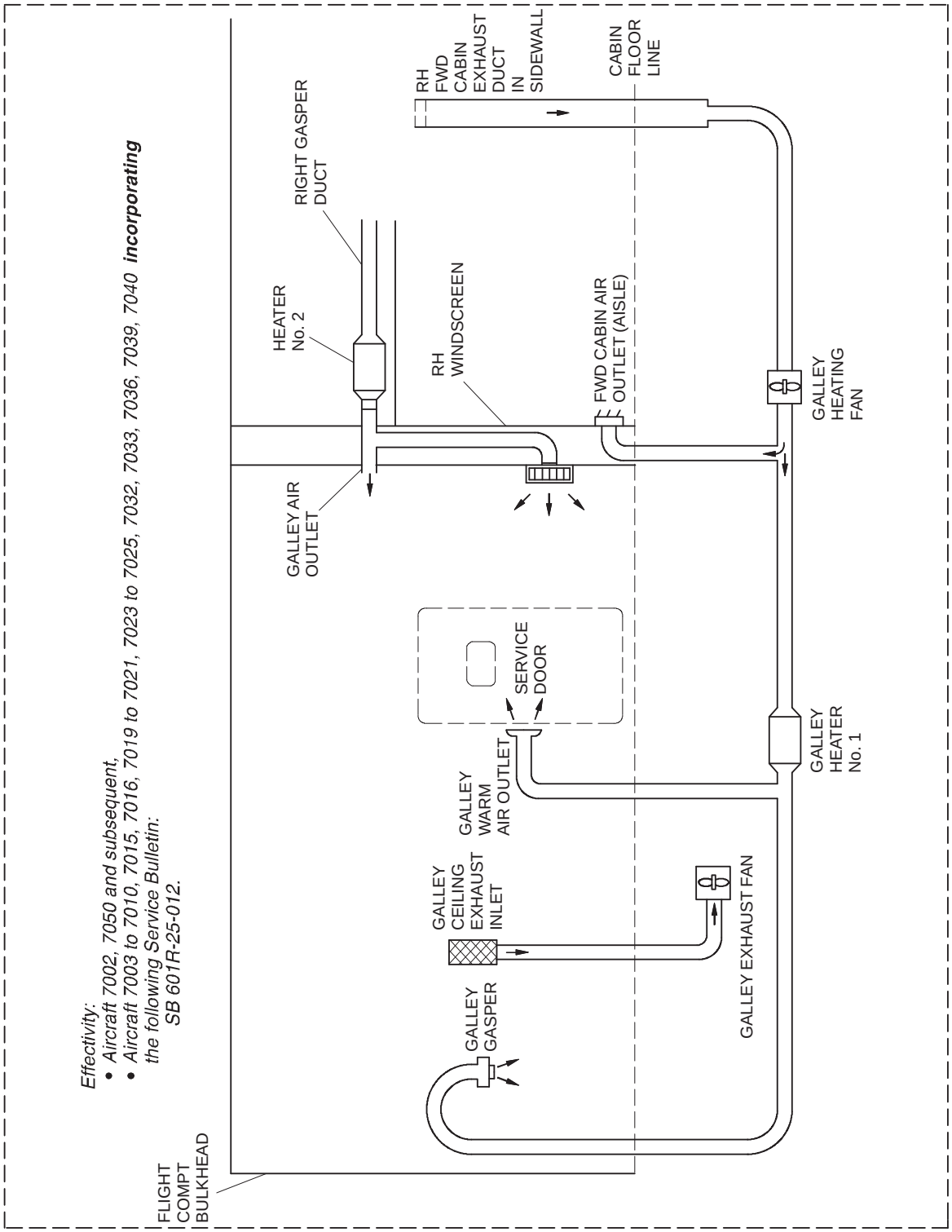
- The FAN FAIL and HTR 1 and 2 INOP lights illuminate (amber), and
- The FAN and HRT 1 and 2 green lights go out.

Release the TEST switchlight and check that:

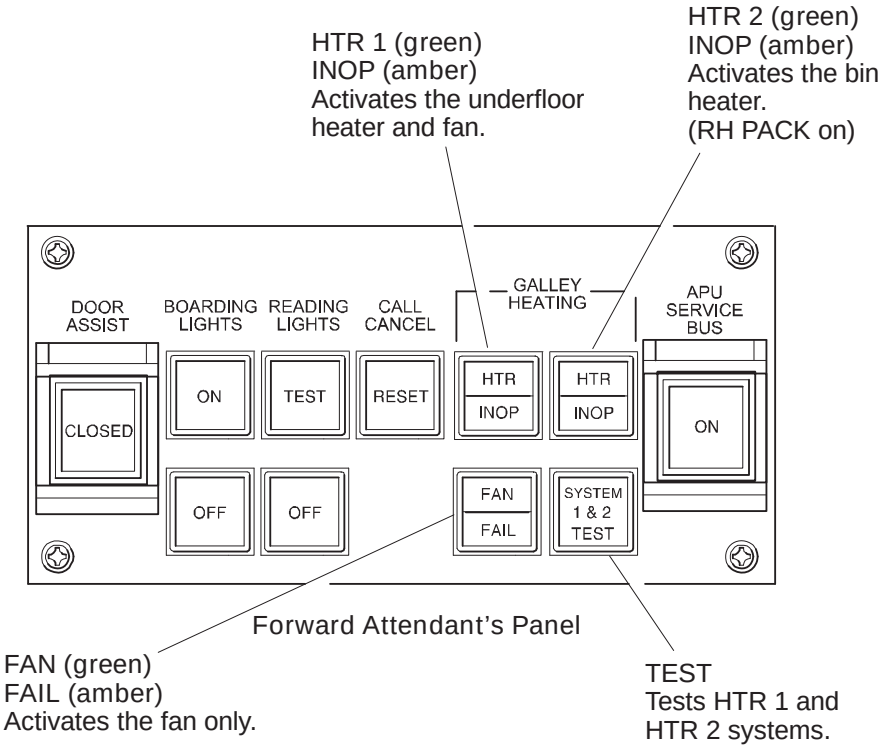
- The HTR 2 INOP light goes out, and
- The FAN FAIL and HTR 1 INOP lights remain ON.

Unlatch the FAN and HTR 1 and 2 switchlights and check that:

- All galley heating panel lights are off.



Galley Heating System
Figure 08–50–1



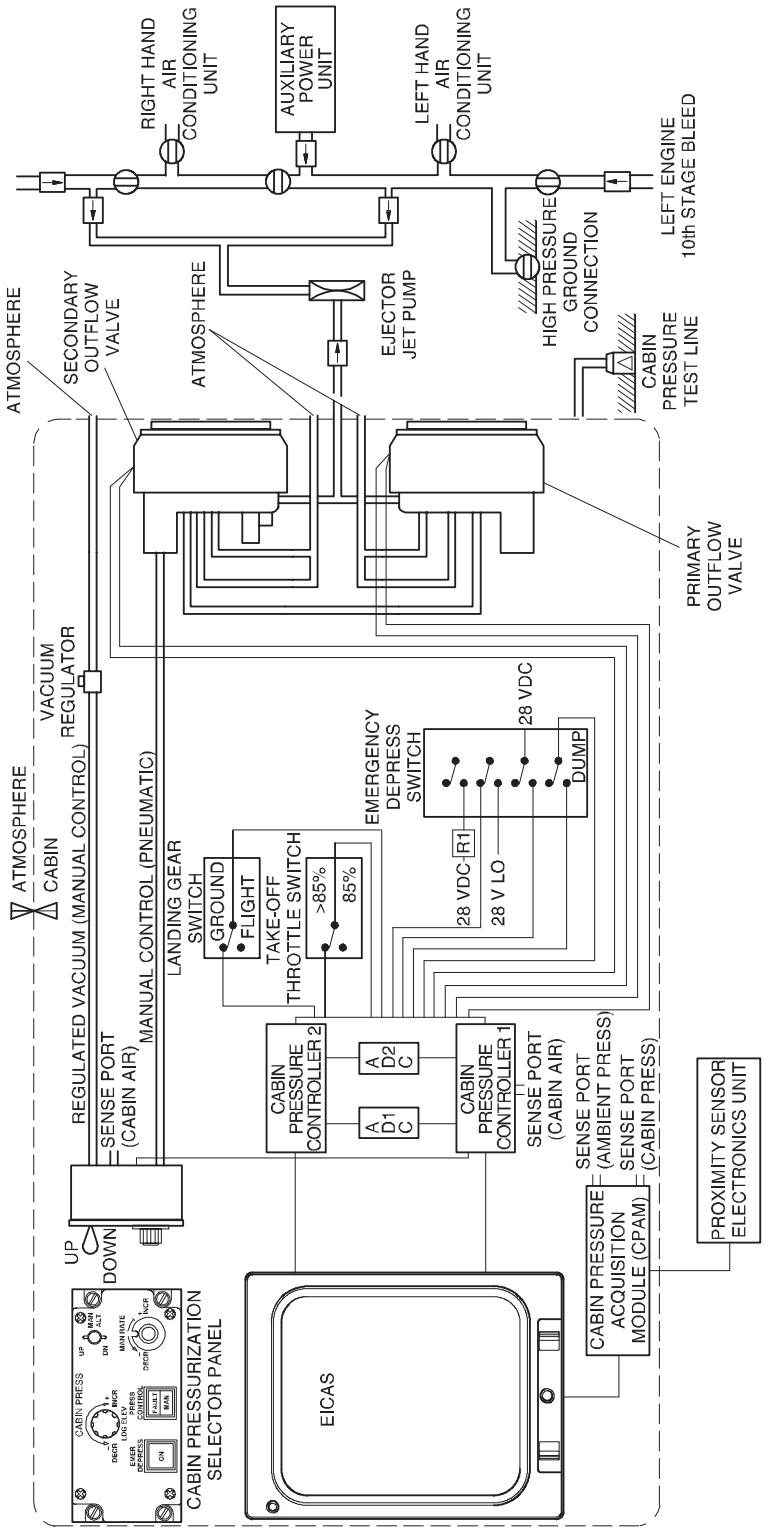
Galley Heating System – Control Switches
Figure 08–50–2

A. System Circuit Breakers

SYSTEM	SUB-SYSTEM	CB NAME	BUS BAR	CB PANEL	CB LOCATION	NOTES
Galley Heating	Heater #1, Heater #2 and Fan	GALLEY HTRS	AC BUS 2	2	B11	

1. PRESSURIZATION SYSTEM

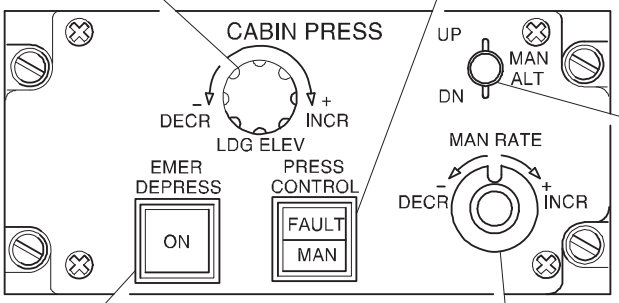
The aircraft is pressurized by bleed air supplied by the air-conditioning system. Cabin pressure is normally controlled by regulating cabin air overboard through two outflow valves located on the rear pressure bulkhead. The outflow valves are automatically controlled by either of two independent cabin pressure controllers. The pressurization is almost totally automatic, the crew only has to set the landing field elevation, on the CABIN PRESS control panel, to program the system for flight. If the normal automatic mode fails, the outflow valves can be controlled manually by controls on the CABIN PRESS control panel. Both valves also operate as safety valves to provide overpressure and negative pressure relief. If cabin altitude exceeds 14,000 feet, a signal is sent to the passenger oxygen system to deploy the oxygen masks. A cabin pressure acquisition module (CPAM) is used in the system to supply signals to the EICAS.



Pressurization Control System – Schematic
Figure 08–60–1

Landing Field Elevation Selector
Used to set destination airport altitude.
Setting Shown at the LDG ELEV indication on the EICAS status page and ECS synoptic page.
- Scale - 20-foot increments.
- Range -1,000 feet to +14,000 feet.

Pressurization Control Switch/Light
Selects either manual or automatic control of pressurization system.
- When pressed in, manual mode selected. Removes electrical supply from both outflow valves, locks them in their existing position and permits their manual (pneumatic) operation. MAN (white) light comes on and EICAS displays pressurization system data on EICAS primary display.
- When pressed out, automatic mode is selected and MAN light goes out. Automatic mode pressurization data is displayed on EICAS secondary display.
- When pressed twice, the redundant controller gains control.
- FAULT (amber) light comes on when system detects failure of both cabin pressure controllers. EICAS displays AUTO PRESS caution message.



Cabin Pressurization Selector Panel Overhead Panel

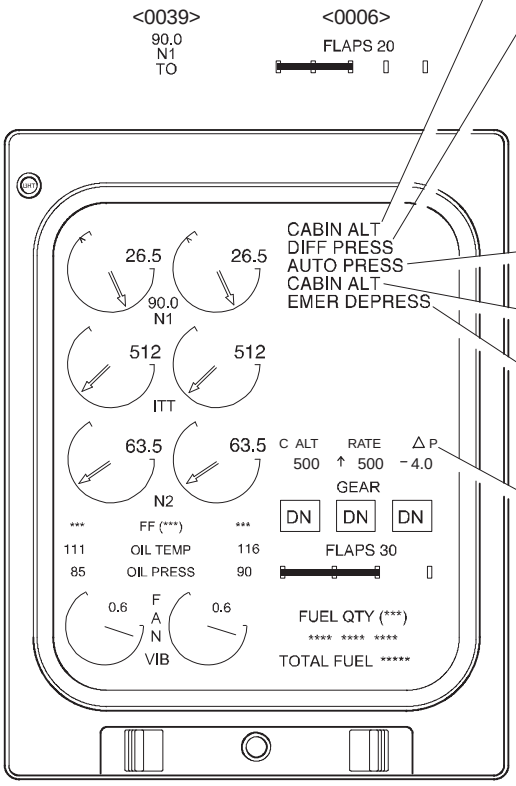
Manual Cabin Altitude Regulators
Used to control pressurization system in manual (pneumatic) mode.
MAN ALT selector is used to change cabin altitude manually:
- UP – causes outflow valves to open and increases cabin altitude. When selected cabin altitude is acquired, select middle/centre position.
- DOWN – causes outflow valves to close and decreases cabin altitude. When selected cabin altitude is acquired, select middle/centre position.
- Middle/Centre position–Disables all previous manual selections.

Emergency Depressurization Switch/Light
Used to depressurize airplane during an emergency.
- When pressed in, both outflow valves open fully to dump cabin pressure. At cruise, valves dump to cabin pressure of 14250 ±750 feet. Amber ON light comes on when pressed in and EICAS displays EMER DEPRESS caution.
- When pressed out, both outflow valves revert to automatic control and amber ON light goes out.

RATE Control (Needle Valve) (Manual Mode)
Pneumatically adjusts outflow valve rate during manual mode.
- Ascent from 50 fpm to 3000 ±1000 fpm.
- Descent from 50 fpm to 3000 ±1000 fpm.

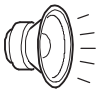
Ascent and descent rates indicated on ECS page of EICAS.

Pressurization Control Panel
Figure 08–60–2



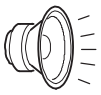
Primary Page

CABIN ALT warning (red)
Comes on when cabin altitude is greater than 10,000 feet.
Accompanied by aural warning:



CABIN PRESSURE

DIFF PRESS warning (red)
Comes on when differential pressure is greater than 8.6 psi.
Accompanied by aural warning:



CABIN PRESSURE

NOTE

There may be an EICAS time delay/ instrument lag between the display of a red △P readout and a subsequent DIFF PRESS warning message and CABIN PRESSURE aural coming on.

AUTO PRESS caution (amber)
Comes on at a failure of both automatic pressurization controllers.

CABIN ALT caution (amber)
Comes on when cabin altitude is greater than 8,500 feet but not greater than 10,000 feet.

EMER DEPRESS caution (amber)
Comes on when EMER DEPR switch/light has been selected on.

Pressurization Readouts (manual mode)
Comes on when PRESS CONTROL switch/light operated to MAN:

- C ALT – Indicates current cabin altitude.
- RATE – Indicates rate of change in feet per minute (increments of 100 fpm) and direction via arrow symbol.
- △P – Indicates cabin and cockpit to ambient differential pressure.

Landing Elevation readout is not displayed.

NOTE

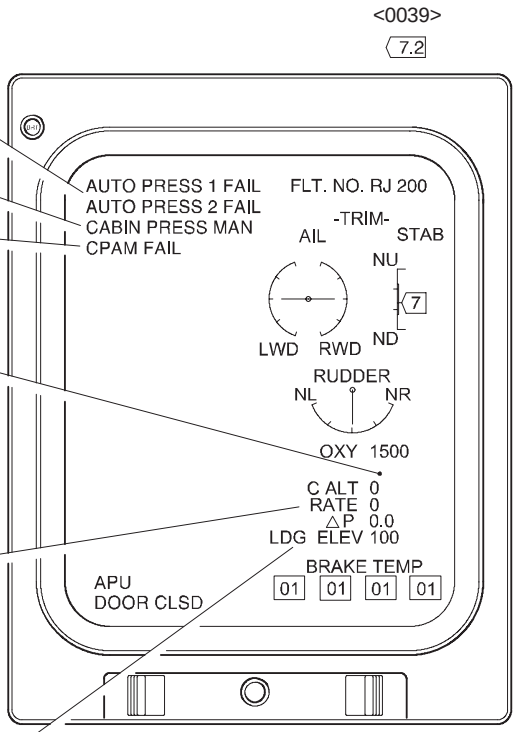
Readouts removed from primary page when automatic mode selected.

Pressurization – EICAS Messages <MST>
Figure 08–60–3 Sheet 1

AUTO PRESS 1, 2 FAIL status (white)
Comes on to indicate failure of respective automatic pressurization controller module.

CABIN PRESS MAN status (white)
Comes on to indicate that PRESS CONTROL switch/light is operated to MAN.

CPAM FAIL status (white)
Comes on to indicate failure of cabin pressure acquisition module (CPAM).
- Oxygen system will not auto-deploy at 14,000 feet.
- Seatbelt / No smoking signs will not automatically come on when cabin altitude exceeds 10,000 feet.



Status Page

<0039>
C TEMP 23°C

Pressurization Readouts (automatic mode)
Comes on when pressurization system is operated in automatic mode; PRESS CONTROL switch/light pressed out.
- C ALT - Indicates current cabin altitude. Readout will turn to amber, if cabin altitude is greater than 8,500 feet but less than 10,000 feet. Readout will turn to red when cabin altitude is 10,000 feet or above.
- RATE - Indicates rate of change in feet per minute (increments of 100 fpm) and direction via arrow symbol.
- △P - Indicates cabin to ambient differential pressure. Readout will turn red when differential pressure exceeds 8.65 psid.

LANDING FIELD ELEVATION readout
Displays elevation (20 foot increments) as set at LDG ELEV selector.
- Amber dashes are displayed if input value is invalid or greater than 14,000 ft or less than -1,000 ft.
- Elevation readout not displayed on status page when manual mode selected.

Pressurization – EICAS Messages <MST>
Figure 08–60–3 Sheet 2

Environmental Control System Page

EMER DEPRESS caution (amber)
Comes on when EMER DEPRESS switch/light operated.

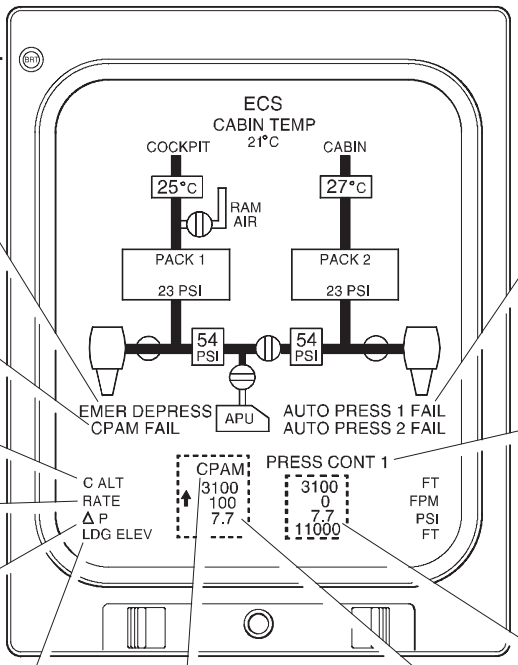
CPAM FAIL status (white)
Comes on to indicate failure of cabin pressure acquisition module (CPAM). Corresponds to CPAM FAIL message on status page.

Cabin/Cockpit Altitude Readout
Displays current cabin/ cockpit altitude (in automatic or manual mode).

Cabin/Cockpit Rate of Change Readout
Displays rate of change in feet per minute and direction via arrow symbol.

Delta Pressure Readout
Displays cabin and cockpit to ambient differential pressure. Excursions above 8.65 psi indicated on EICAS as DIFF PRESS warning and CABIN PRESSURE warning is heard.

Landing Field Elevation Readout
Displays elevation (in feet) as set at LDG ELEV selector. Scale set in 20–foot increments.



AUTO PRESS 1, 2 FAIL status (white)
Comes on to indicate failure of respective controller. Corresponds to AUTO PRESS 1, 2 message on status page.

SOURCE INDICATOR – ACTIVE CONTROLLER
Comes on (white) to indicate pressurization controller:
- PRESS CONT 1, or
- PRESS CONT 2, or
- PRESS MAN

Active Controller's Data
Displayed on ECS page only.

SOURCE INDICATOR – Monitoring / Reference
Comes on (white) to indicate monitoring source:
- CPAM, or
- PRESS CONT 1, or
- PRESS CONT 2

If all sources failed, comes on as dashes (amber).

Monitored Data
Displayed on EICAS
- Primary page (MAN)
- Status page (AUTO)

ITEM	MONITORED DATA (LH)				ACTIVE DATA (RH)	
	GREEN	AMBER	RED	AMBER (---)	WHITE	AMBER (---)
C ALT	Less than 8,500 feet	More than 8,500 but less than 10,000 feet	More than 10,000 feet	Invalid Data	Increments of 100 feet	Invalid Data
RATE	Positive/ negative rates at 100 fpm	*	*	Invalid Data	Positive/ negative rates at 100 fpm	Invalid Data
△P	Less than 8.65 psi	*	More than 8.65 psi	Invalid Data	Increments of 0.1 psi	Invalid Data
LDG ELEV	*	*	*	*	Increments of 20 feet (cyan)	Invalid Data
	Data measured by the monitoring source (CPAM, PRESS CONT 1, PRESS CONT 2)				Data measured by the active controller (PRESS CONT 1, PRESS CONT 2)	

Pressurization Synoptic Page Indications
Figure 08–60–4

2. **OUTFLOW VALVES**

The dual, redundant, electro-pneumatic outflow valves are installed on the rear pressure bulkhead, below floor level, and are designated as the primary and secondary valves. Both valves are slaved together through a pneumatic line and are electrically controlled. The valves will respond to either electrical signals in automatic mode, or to pneumatic input signals from the manual regulators on the CABIN PRESS control panel.

3. CABIN PRESSURE CONTROLLERS

The aircraft is equipped with dual, redundant pressure controllers, which operate only in automatic mode. All controller outputs are sent to the outflow valves. While one controller is in use, the other updates automatically. The active cabin pressure controller commands the outflow valve to a nominal differential pressure of 8.33 psid. Inputs to the pressure controllers are received from air data computer (ADC 1) normally. ADC 2 is the backup to ADC 1. If a controller fails, the system will automatically switch over to the other controller. If automatic switch-over fails, select the PRESS CONTROL switch twice. This will enable the redundant controller. If both pressure controllers fail, both outflow valves will go to an isobaric hold mode.When the airplane is on the ground for 3 minutes, automatic pressure controller switch-over will occur.

The pressurization system automatically maintains cabin pressure through all phases of flight. Typical values used in the cabin/flight altitude schedule during manual mode are as follows:

CABIN PRESSURE ALTITUDE (feet)		AC FLIGHT ALTITUDE (feet)
DECENT	CLIMB	
-600	-600	0
-600	0	5,000
-350	575	10,000
740	1,240	15,000
1,260	1,630	17,500
1,770	2,020	20,000
4,270	4,330	30,000
5,990	5,990	35,000
6,880	6,880	37,500
7,990	7,990	41,000

A. Automatic Pressurization Modes

- Ground mode,
  Both outflow valves are driven full open.

- Pre-Pressure mode,
  When thrust levers are advanced to take-off, the cabin is pressurized to -150 feet at approximately 300 ft/min.

- Take-Off abort mode,
  When the thrust levers are retarded to idle, the cabin ascends at approximately 500 ft/min for 20 seconds, then the outflow valves are driven full open.

- Climb mode,
  Cabin climb is in accordance with a fixed schedule, cabin altitude vs aircraft altitude at a rate of approximately 500 ft/min. The controller compares selected landing elevation to the climb schedule, then selects the highest pressure schedule.

- Flight abort mode,
  When the aircraft has maintained 6,000 feet altitude or lower altitude for 10 minutes, and then has initiated a descent of 1,000 ft/min, the system will then assume the elevation for the departing airport, regardless of the pre-selected landing elevation.

- The cabin descent schedule occurs when the aircraft altitude is maintained at 0 ± 200 feet for 10 minutes. The system pre–sets a decent rate of approximately 300 ft/min.

- The cabin full descent schedule occurs when the aircraft is in descent. Cabin altitude decreases at approximately 300 ft/min, to either landing elevation, or maximum differential, whichever is highest. When the landing elevation exceeds 8,000 feet, cabin altitude will be maintained at maximum differential, until the aircraft descends, then the cabin altitude will rate up to the pre-selected landing elevation.

- Landing mode,
  The cabin altitude is driven below field elevation or the aircraft is unpressurized. When the cabin is below field elevation, then the cabin is rated up at approximately 500 ft/min for 60 seconds, then the outflow valve is driven full open.

- Touch and Go mode,
  On aircraft touchdown, the system will assume landing mode; as the thrust levers are advanced, the system will schedule pre-pressure mode.

B. Manual Pressurization Modes

- UP selection,
  Cabin ascends at selected rate of 50 fpm to 3,000 ± 1000 fpm. When the desired cabin altitude is reached, select MAN ALT to mid position.

- DN selection,
  Cabin descends at selected rate of 50 fpm to 3,000 ± 1000 fpm. When the desired cabin altitude is reached, select MAN ALT to mid position.

- Mid selection,
  Disables all previous MAN ALT selections.

Automatic mode schedules the pressurization controllers to automatically regulate the rate of change of cabin altitude:

- Ascent from 500 ± 75 fpm.

- Decent from 300 ±75 fpm.

Manual mode rate controls are provided to manually regulate the rate of change to cabin altitude:

- Ascent from 150 ±150 fpm to 3,000 ±500 fpm and
- Decent from 100 ±100 fpm to 2,500 ±500 fpm..

C. Differential Pressure Control

Each outflow valve has positive and negative pressure relief. The pressure controllers normally control the cabin-to-outside pressure to 8.33 psid. The valves are preset to open at a maximum positive differential pressure of 8.6 ±0.1 psid and at a negative differential pressure of −0.5 psid.

D. Cabin Altitude Limitation

Altitude limit controllers within each outflow valve, operate to prevent the cabin altitude from increasing above 14,250 ±750 feet.

E. Emergency Depressurization

Electrical signals from the EMER DEPRESS switch commands both outflow valves to open. If the aircraft is at a cruise altitude (above 15,000 feet), the altitude limiters operate to prevent cabin altitude from exceeding 14,250 ±750 feet.

F. Cabin Pressure Monitoring

The system uses measurements from the two cabin pressure controllers and the cabin pressure acquisition module (CPAM) to control and monitor the system. The CPAM supplies signals to the EICAS to display the following information:

- Cabin altitude (z)
- Cabin altitude rate of change (dz/dt)
- Cabin to ambient differential pressure (delta P)
- CPAM failure - If a CPAM fails, the redundant controller will assume the function of the failed CPAM (indications only)
- If the PASS SIGNS switches are selected to AUTO, the CPAM will cause the NO SMKG and SEAT BLTS signs to come on when the cabin altitude reaches 10,000 feet
- The CPAM will automatically trigger the passenger oxygen auto deploy system when the cabin altitude reaches 14,000 feet.

A “CABIN PRESSURE” voice alert is also provided during the following EICAS warnings:

- DIFF PRESS warning message
- CABIN ALT warning message (cabin altitude above 10,000 feet).

G. System Circuit Breakers

SYSTEM	SUB-SYSTEM	CB NAME	BUS BAR	CB PANEL	CB LOCATION	NOTES
Cabin Pressurization Control	Flight Compartment Control Panel	CONT PNL	DC ESS	4	A10	
	Controller	CONT 1			A8	
		CONT 2			A9	
	Cabin Pressure Acquisition Module (CPAM)	CABIN PRESS MOD	DC BAT	2	P6	