Reference to Figure 5 Avionics Ventilation System Schematic

ATA 21 AIR CONDITIONING

21–26 AVIONICS EQUIPMENT VENTILATION

SYSTEM DESCRIPTION

Avionics Equipment Ventilation Operation

The avionics equipment is cooled with air supplied in different ways. These are:

- Open Circuit
- Closed Circuit
- Partially Open Circuit
- Cockpit Supply air (in failure cases)

AEVC System Schedule

System Schedule depending on certain configurations:

- Skin Temperatures
- Aircraft Air/Ground Position
- Engine Power Settings

1 Skin Heat Exchanger

The Skin Heat Exchanger is located in the upper fuselage between frames 12 and 14.

In normal flight operations it is used to cool the avionics ventilation air. A thermally insulated internal wall is bolted to these frames to form two rectangular ducts.

2 Skin Temperature Sensor

The Skin Temperature Sensor is installed on the inside of the fuselage skin. The set temperature values are as follows:

- On Ground
  - Increasing Values +11°C
  - Decreasing Values +4°C
- After Take-Off
  - Increasing values +34°C
  - Decreasing Values +27°C

3 Skin Air Outlet Valve

This valve is an electrically operated single flap valve with a smaller flap built into it. It can be manually closed. Before the valve is closed manually it must first be isolated electrically with a toggle switch inside the valve.

4 Demister Air Filter

The Demister Air Filter is a two-stage filter assembly which is installed upstream of the blower fan.

5 Skin Air Inlet Valve

The Skin Air Inlet Valve is an electrically operated single flap valve which can be manually overriden. Before the valve is closed manually it must first be isolated electrically with a toggle switch located inside the valve.

6 Avionic Equipment Ventilation Controller

The AEVC (**A**vionic **E**quipment **V**entilation **C**ontroller) controls the valves and fans in the avionics ventilation system. Control conditions depend on information sent by pressure switches, temperature sensors, thrust lever angle, smoke detectors and flight/ground information.

7 Air Conditioning Inlet Valve

The Air Conditioning Inlet Valve supplies cockpit air into the system to make sure of the cooling in failure cases.

8 Skin Heat Exchanger Inlet Bypass Valve

The Skin Heat Exchanger Inlet Bypass Valve discharges the ventilation air above the required quantity to the cargo underfloor area.

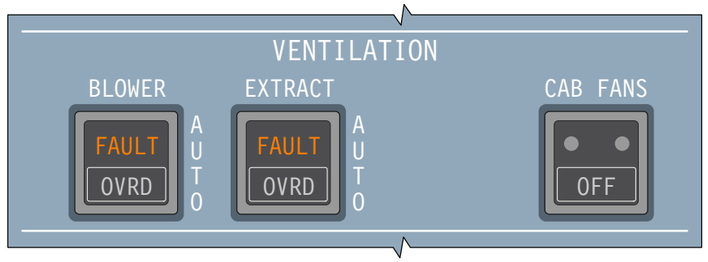
9 Skin Heat Exchanger Outlet Bypass Valve

The Skin Heat Exchanger Outlet Bypass Valve function is to allow avionics compartment air into the system.

10 Skin Heat Exchanger Isolation Valve

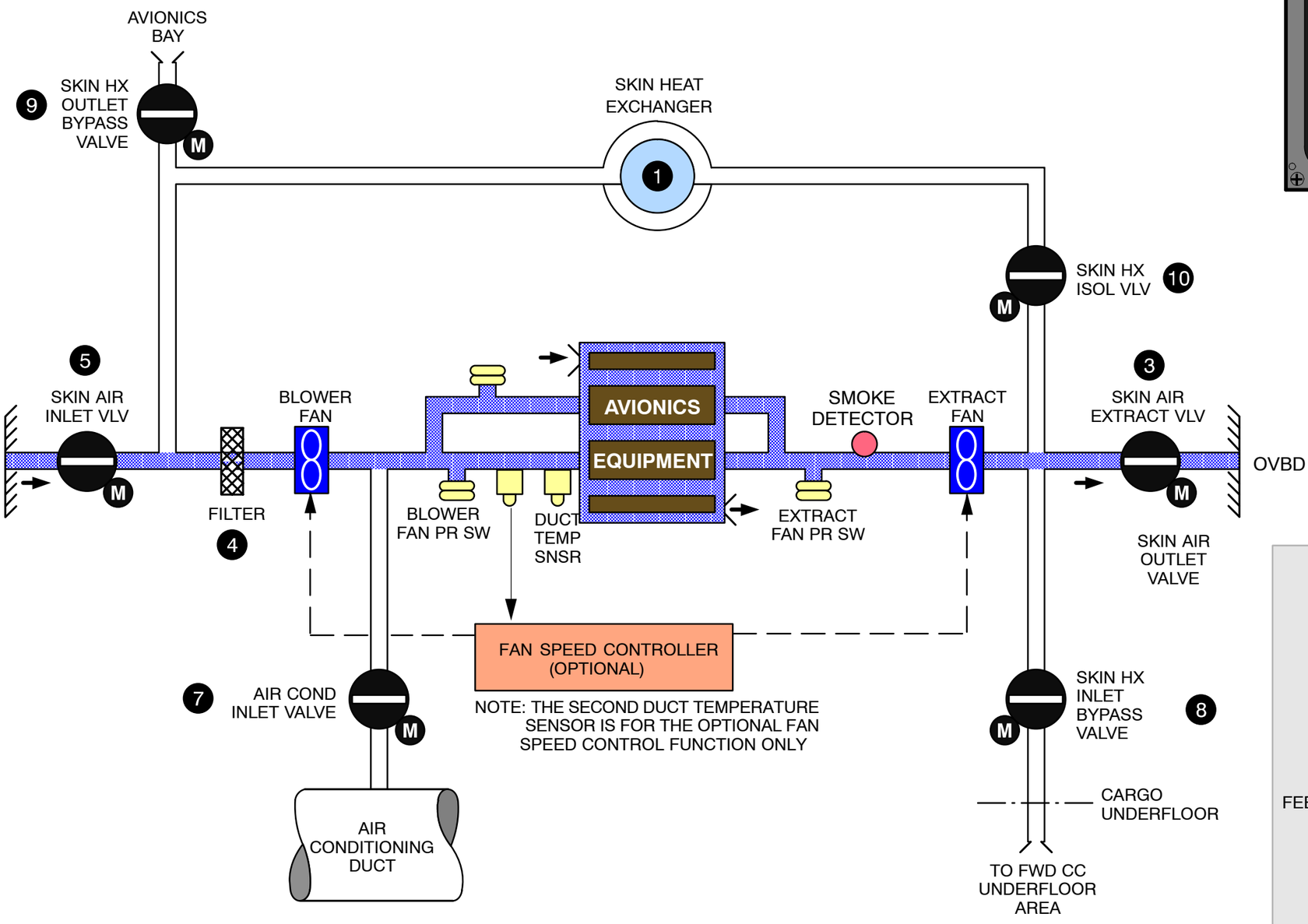
The Skin Heat Exchanger Isolation Valve allows air to enter the skin heat exchanger.

(25VU)



(22VU)

PRESSURIZATION SYSTEM DISPLAY



OPEN CIRCUIT CONFIGURATION
On Ground and Skin Temperature above 11°C the Heat Exchanger is bypassed.

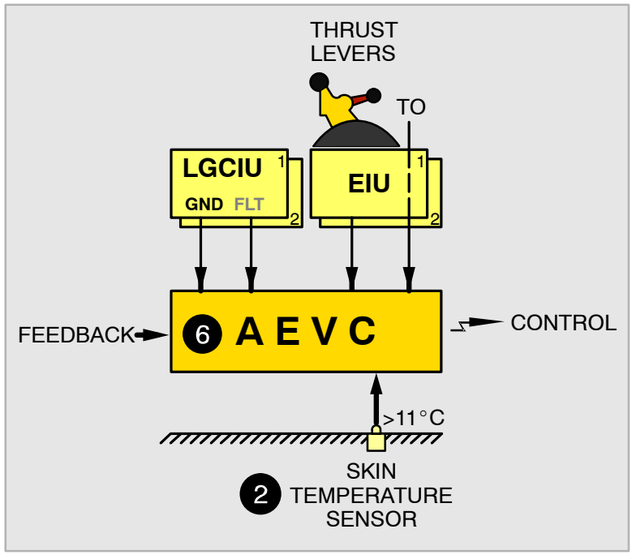


Figure 5 Avionics Ventilation System Schematic

Reference to Figure 6 Avionics Ventilation Configuration

AEV CONFIGURATIONS DESCRIPTION

CLOSED CIRCUIT CONFIGURATION

In Flight and Skin Temperature <27°C or
on GND and Skin Temperature <4°C
the Skin Heat Exchanger is in full use.

The Skin Exchanger Outlet Bypass Valve is open to add avionic bay air into the circuit.

The Skin Exchanger Inlet Bypass Valve opens only if pressure is above the maximum value.

PARTIALLY OPEN CONFIGURATION

In Flight and Skin Temperature >34°C only the Small Flap on the Skin Air Outlet Valve opens to the Partially Open Position (also De-Activation Position)

BLOWER OR EXTRACT FAULT

Blower or Extract fan is switched to OVRD:
The Skin Heat Exchanger is in use and air from the air conditioning duct is added.

NOTE: If Blower Fan is switched to OVRD, the Blower Fan stops and the Extract Fan remains energized.

NOTE: If the Extract Fan is switched to OVRD, both Fans remain energized.

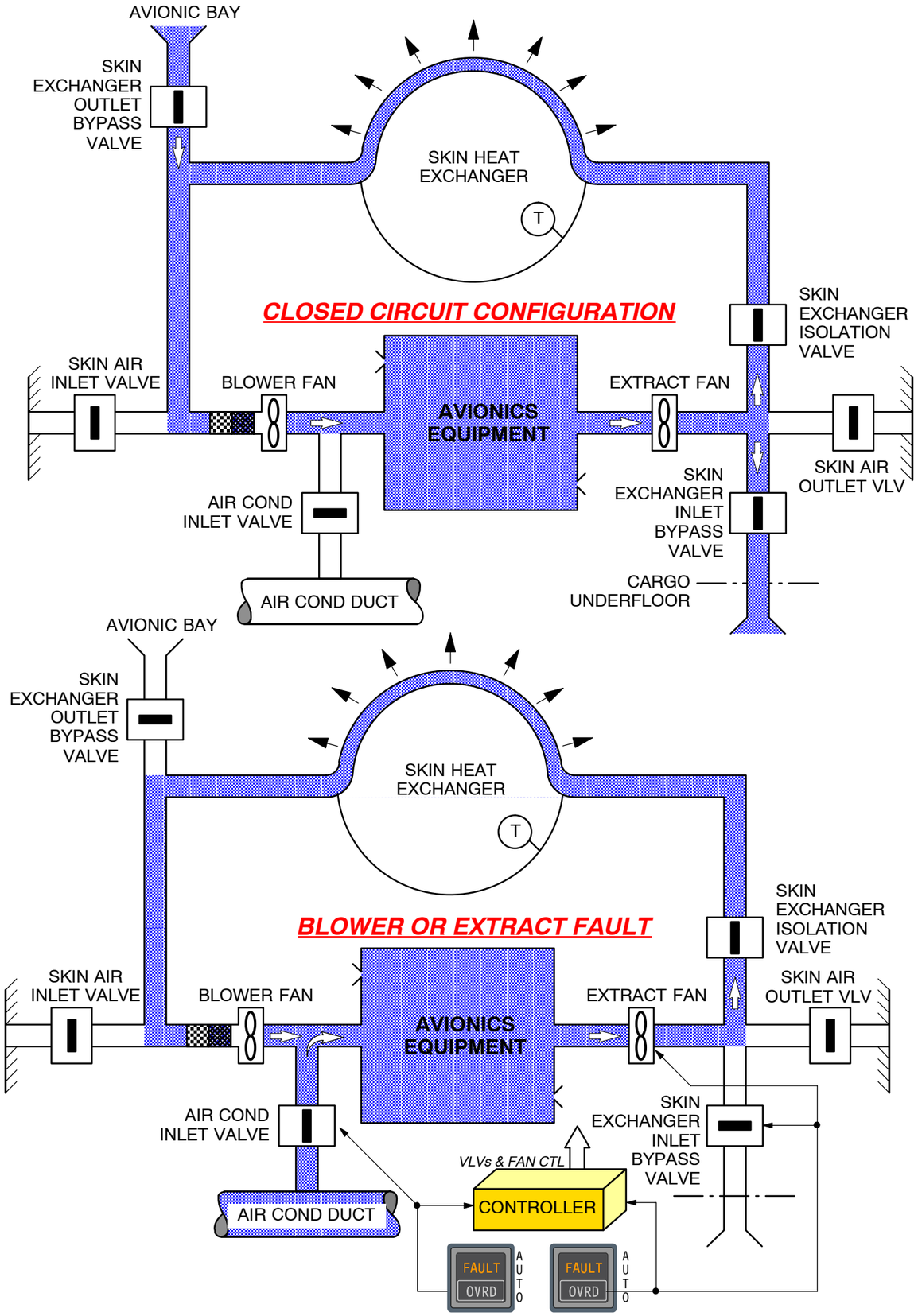
SMOKE DRILL CONFIGURATION

In case of smoke or both, Blower Fan and Extract Fan are in OVRD (in this configuration the Blower Fan stops and the Extract Fan remains energized), the Skin Heat Exchanger is not in use, air from the air conditioning duct is added and Skin Air Outlet Valve is partially open.

CONTROLLER FAILED

In case of total Controller fail the
Air Conditioning Inlet Valve opens and the
Skin Air Outlet Valve partially opens.

All others remain in their last position.



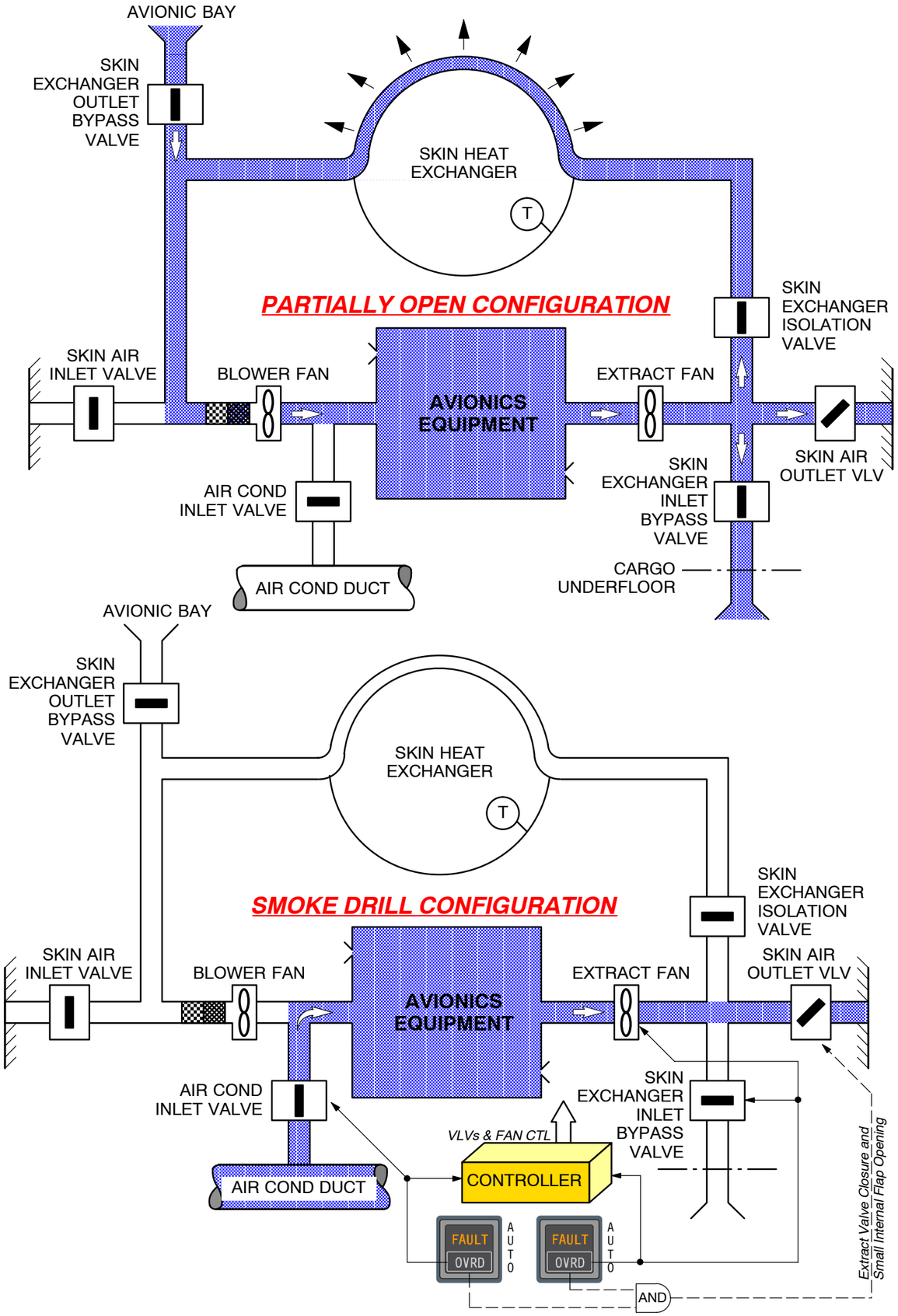


Figure 6 Avionics Ventilation Configuration

Reference to Figure 7 Avionics Ventilation Basic Schematic

SYSTEM OPERATION

1 – 10 see Level 2 Description

11 **Pressure Switch [17HQ, 19HQ, 30HQ]**

A low flow indication is given at a differential pressure of 1.7 mbar +1.3 or –0.5 mbar.

The low flow signal is used to monitor the blower function.

Increasing pressure signals are used to open the skin exchanger inlet bypass valve.

12 **Duct Temperature Sensor**

If an overheat condition is detected the same indications and actions as a blowing low flow will occur.

13 **Smoke Detector**

A duct ionization type smoke detector is installed upstream of the extraction fan.

14 **Battery Ventilation**

The Battery Ventilation is an independent circuit. The batteries are cooled with avionics compartment air drawn through an inlet around the batteries and overboard through a venturi. The ventilation airflow only takes place during flight because of the cabin differential pressure.

SKIN AIR INLET VALVE

SKIN HEAT EXCHANGER

SKIN TEMPERATURE SENSOR

DEMISTER AIR FILTER

SKIN AIR OUTLET VALVE

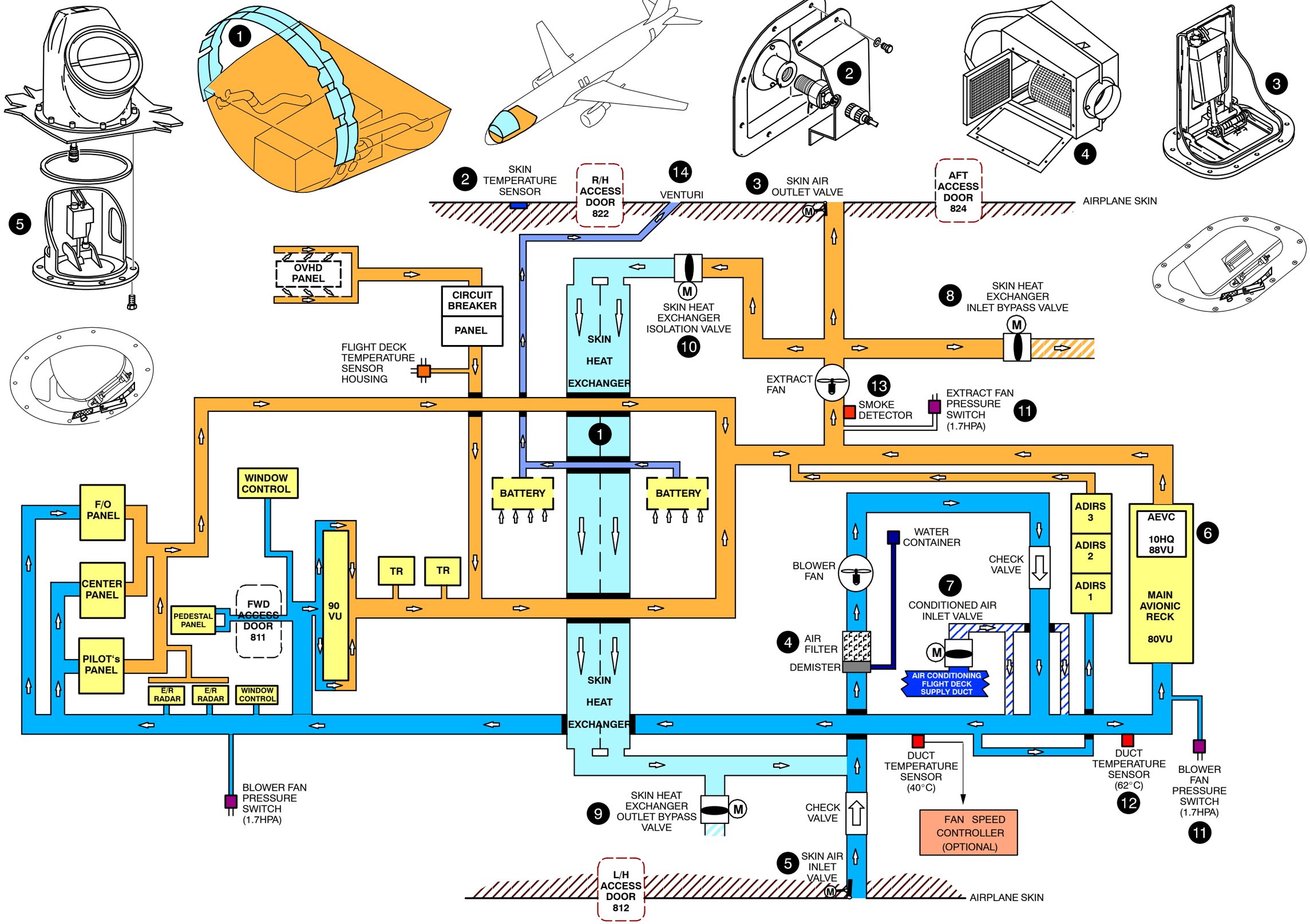


Figure 7 Avionics Ventilation Basic Schematic

Reference to Figure 8 Air Conditioning Distribution Schematic

21–20 AIR CONDITIONING DISTRIBUTION

SYSTEM DESCRIPTION

1 Flow Control Valve

The FCV is controlled to open or close by a Pack P/B SW on Panel 30VU in the cockpit and can be closed by the pack controller in case of malfunctions. The airflow can be selected by the Pack Flow Selectors. The CPOS (**C**ompressor **P**neumatic **O**verheat **S**ensor) at the compressor outlet of the ACM (**A**ir **C**ycle **M**achine) is connected to the flow control valve muscle pressure. If the temperature is too high, the open pressure is vented and the FCV starts to close. The valve will open again as soon as the temperature decreases to the reset value.
On Enhanced A/Cs the FCV is controlled by the ACSC (**A**ir **C**onditioning **S**ystem **C**ontroller) and the overheat thermostat function has been deleted.

2 Primary and Main Heat Exchanger

These heat exchangers cool down pneumatic air to and from the ACM compressor.

3 Air Cycle Machine

In the ACM air is compressed and then routed to heat exchangers. The expansion of the air in the turbine turns the turbine wheel, the compressor wheel and the fan wheel. The fan wheel gives a flow of ram air through the ram air system if there is no ram air effect (on the ground).

4 Reheater

The hot air from the main heat exchanger increases the temperature of the cold air from the water extractor.

5 Condensor

The cold air from the turbine of the air cycle machine decreases the temperature of the hot air from the Reheater. The temperature of the hot air decreases to less than its dew point and the water in the air condenses.

6 Water Extractor

Swirl vanes centrifuge the water droplets in the air to the inner surface of the water extractor body. The water collects at the lowest point of the body. It is then drained to water injectors.

7 Mixer Unit

In the mixer unit air from packs and recirculated cabin air is mixed. It contains two chambers to separate the airflow between cockpit and cabin. Internal perforations allow always a small amount of transfer. An internal flap is opened to give free flow to the cockpit in case pack 1 is switched off.

8 Hot Manifold and Trim Air System

Via the trim air pressure regulator valve hot bleed air is taken from the packs and via trim air valves routed to the cockpit, forward and aft cabin.

9 Pack Controller (Non Enhanced A/Cs)

The two PCs control their related pack outlet temperature (through the water extractor outlet temperature) and the ram-air cooling flow, which is kept to a minimum for fuel economy. The pack outlet temperature is normally controlled by the PC based on demands of the ZC.

Each PC contains two computers. The primary is capable of full control and modulation. The secondary is a back–up with reduced optimization.

10 Zone Controller (Non Enhanced A/Cs)

Based on crew selection, altitude bias and zone references the ZC controls the zone trimming system and gives pack discharge demands to the pack controllers to produce a lowest zone demand in the mixer unit.

There is only one ZC which contains two computers. The primary is capable of full control and modulation. The secondary is a back–up with reduced optimization.

11 Air Conditioning System Controller (Enhanced A/Cs)

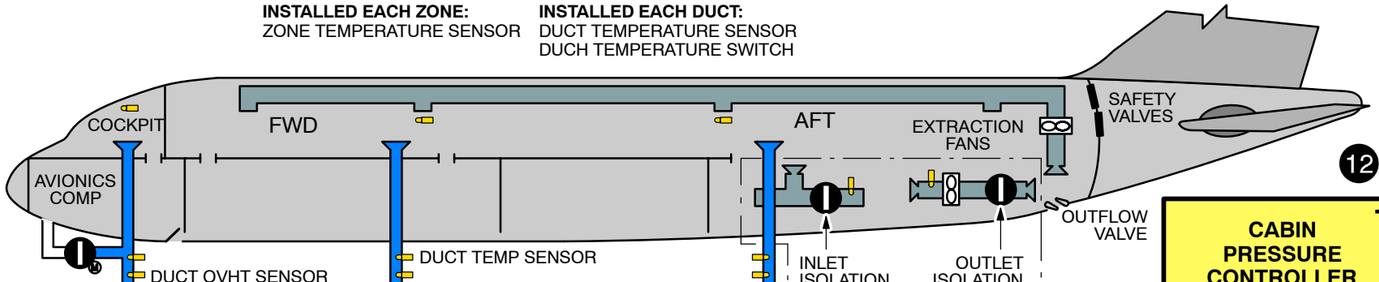
On enhanced aircrafts the ACSC combines the functions of the Pack and Zone Controllers. The two lanes in each ACSC are fully redundant. Some functions are shared between the lanes.

12 Cabin Pressure Controller

Two identical CPCs control independent motors on the dual–gate outflow valve. In automatic mode only one CPC is active and the second one is standby. The system transfers 70sec after touchdown.

INSTALLED EACH ZONE:
ZONE TEMPERATURE SENSOR

INSTALLED EACH DUCT:
DUCT TEMPERATURE SENSOR
DUCH TEMPERATURE SWITCH



AVIONICS EQUIPMENT VENTILATION COMPUTER (AEVC)

CARGO VENTILATION CONTROLLER

CABIN PRESSURE CONTROLLER (CPC) 1 2 — 12

ZONE CONTROLLER (ZC) *(NON ENHANCED)* — 10

AIR CONDITIONING SYSTEM CONTROLLER (ACSC) 2 — 11

PACK CONTROLLER (PC) 2 *(NON ENHANCED)* — 9

AIR CONDITIONING SYSTEM CONTROLLER (ACSC) 1 — 11

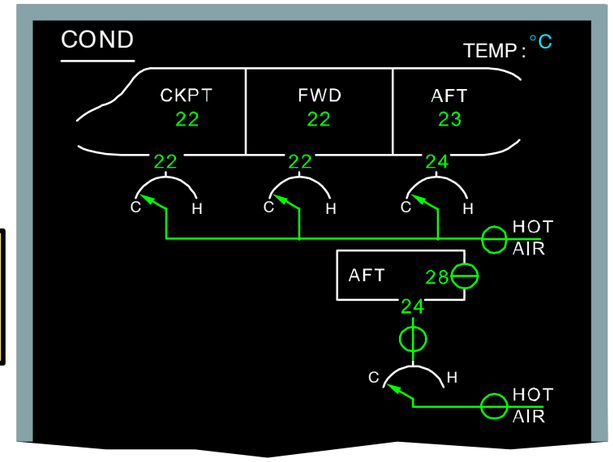
PACK CONTROLLER (PC) 1 *(NON ENHANCED)* — 9

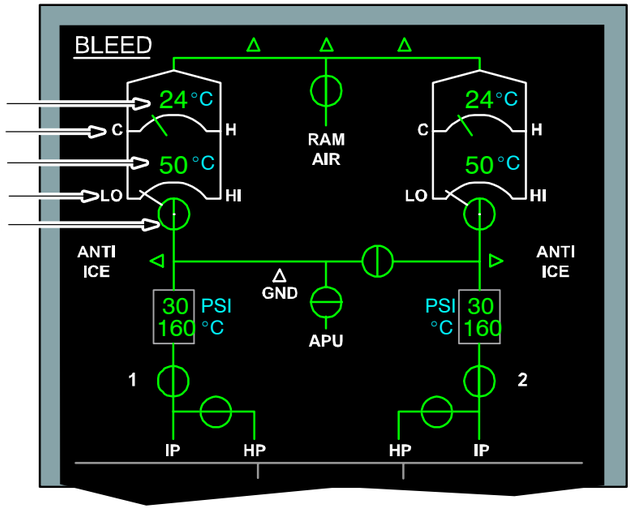
AFT CARGO HEAT CONTROLLER

LEGEND:

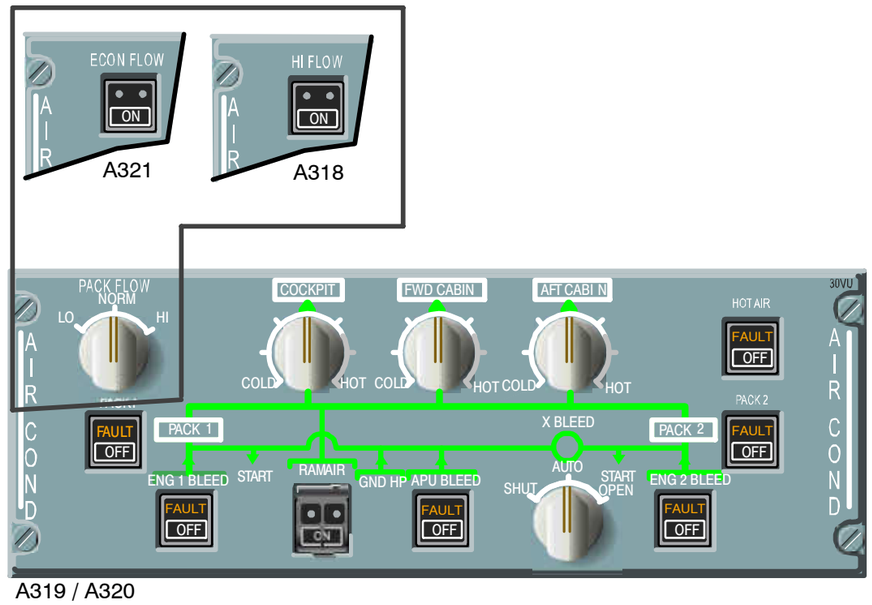
FCV	Flow Control Valve
BPV	By-Pass Valve
CPOS	Compr. Pneumatic OVHT Sensor
CDTS	Compr. Disch Temperature Sensor
COTS	Compr. Outlet Temperature Sensor
WETS	Water Extractor Temperature Sensor
PDTS	Pack Discharge Temperature Sensor

OPTIONAL





ECAM BLEED PAGE (ENHANCED)



A319 / A320

Figure 8 Air Conditioning Distribution Schematic

Reference to Figure 9 Air Conditioning Basic Schematic

FUNCTIONAL OPERATION

1 Bleed Temperature Sensor

The BTS is used for CFDS in case of OVHT (>280°C) at the pack inlet.

2 Pack Inlet Pressure Sensor

The PIPS is used for FADEC, Ram Air Actuator CTL and BPV CTL.

3 Flow Control Valve

The FCV is an FSO (**F**ail **S**afe **O**pen) Electro-Pneumatic Venturi Type Valve.
It opens if inlet pressure is >10 psi and CPOS senses no OVHT.

4 Pressure Sensor

The DPS signal is send to the Pack Controller for pack flow calculation and pack flow Indication on ECAM. On enhanced FCV a Differential Pressure Sensor is used.

5 Compressor Pneumatic Overheat Sensor

The CPOS is a pneumatic sensor which starts bleeding the FCV muscle pressure if the compressor outlet temperature is >230°C.

6 Compressor Discharge Temperature Sensor

The CDTS monitors the compressor discharge temperature. The warning thresholds are:

- 4x >230°C PACK FAULT
- 1x >260°C PACK OVHT

7 Compressor Overheat Temperature Sensor

The COTS monitors the compressor outlet temperature for ECAM indication and serves as a backup of CDTS.

8 Water Extractor Temperature Sensor

The WETS monitors the Water Extractor outlet temperature for BPV control. (Range=2–70°C).

9 Pack Discharge Temperature Sensor

The PDTS monitors the pack discharge temperature for ECAM indication. A pack overheat warning will be triggered at >95°C.

10 Pack Outlet Pneumatic Sensor

The POPS is a pneumatic sensor which controls the AIV in case of Pack Controller failure. In this case the AIV regulates the pack discharge temperature to 15°C.

11 Pack By-Pass Valve

The BPV modulates the pack discharge temperature (short term regulation) to the required level. Additionally it maintains an ACM minimum flow. The basic(prefered) position is 21deg. open. It is also used for a preventive anti/ ice function.

12 Anti-Ice Valve

The AIV prevents ice formation downstream of the turbine and in the condenser based on differential pressure regulation. By de-energizing a solenoid and therefore influencing control servo pressure the valve is used for a pneumatic 15˚C regulation function in case the PC fails totally.

13 Mixer Unit Temperature Sensor [24HK/25HK]

The sensors are used for pack outlet temperature demand control.

14 Mixer Unit Flap Actuator

Opens if Pack#1 is selected OFF.

15 Duct Temperature Sensors

Used for temperature control and indication on ECAM COND SD.
DUCT OVHT Warning Thresholds:

- 4x 80°C
- 1x >88 °C

16 Duct Overheat Sensors

Used for duct overheat detection.

- 4x 80°C
- 1x >88 °C

17 Zone Temperature Sensors

Used for zone temprerature control and ECAM COND SD indication.

18 Trim Air Pressure Regulating Valve

The TA PRV is an electro-pneumatic operated valve.

- REG 4 psi S1 ON if <80°C
- REG 2 psi S2 ON if <88°C
- CLOSE S1/S2 OFF if >88°C

19 Hot Air Pressure Switch

Sends a signal to ZC if trim air supply pressure >6.5 psi above regulating pressure (used as monitoring signal for CFDS).

PACK CONTROLLER 1 2

ZONE CONTROLLER

SYSTEM DISPLAY

BLEED

24°C
C H
50°C
LO HI
30PSI
160°C

COMP OUTLET TEMP

POS FDBK

PACK FLOW

PIPS 2

PS 4

3 FCV S M

BTS 1

CABIN PRESS

PRIM HX

200

113

5 CPOS

7 COTS

CDTS 6

179

19

MAIN HX

WATER EJECTOR

–35

RAI FLAP

REHEATER

9

5

CONDENSOR

ACM C T

3O

9 PDTS

10 POPS

WETS 8

2

10

11 BPV M

POS FDBK

9HH

RAO FLAP
(IF INSTALLED)

CABIN PRESS

AIV 12 S

WE

LAV/GALLEY EXTRACT FAN

17

ZONE TEMP SENSORS

SATCOM EQUIP VENT

AVIONICS EQUIPM VENT

DUCT OVHT SENSORS 16

DUCT TEMP SENSORS 15

14 MIXER UNIT FLAP ACT

CABIN PRESS

24HK

LH CAB FAN

MIXER UNIT

13 25HK

RH CAB FAN

37–51%

TAVs

CAB FANS

OFF

FROM PACK #2

HOT AIR PR SW 19

DIVERTER FLAP

PNEUM (MUSCLE) PRESS

S1 S2

TRIM AIR PRV 18

EMERG RAI ACTUATOR

RAI OPEN
dP<1psi
AND
OFV 50%

8“ AIR COND GND CONN

CABIN PRESS

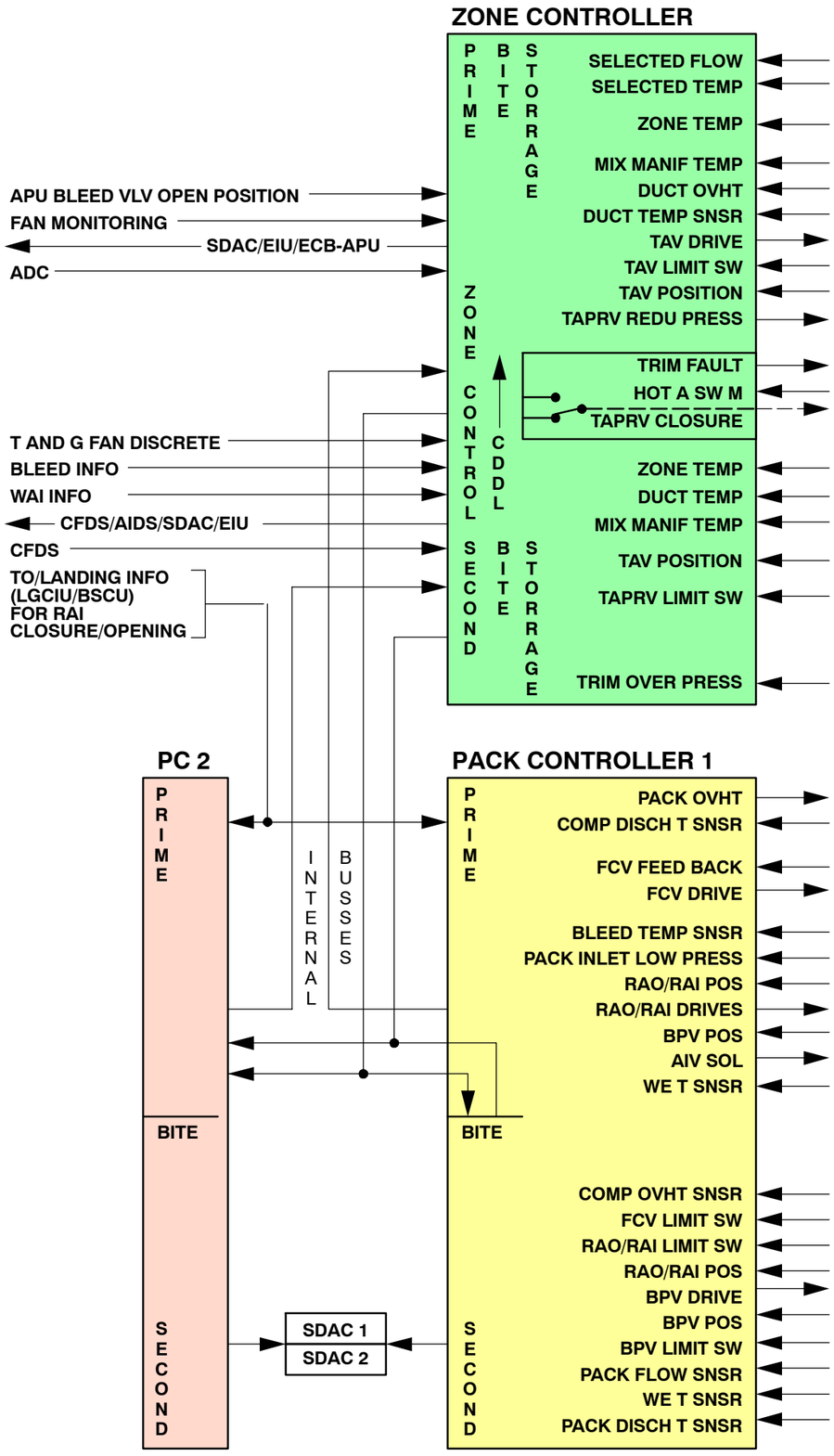
NOTE: Shown Pack Temperatures are a Snapshot during following conditions:
Cruise Flight FL25
Ambient Temperature –61°C
FCV 100% / BPV 37° OPEN / RAD 13% OPEN / ACM 26700 rpm

Reference to Figure 10 Interfaces Schematic

INTERFACES

Zone Controller

Pack Controller



ZONE CONTROLLER (ZC) AND PACK CONTROLLER (PC) BACK-UP RESTRICTIONS AND COMMUNICATION

⇒ COMPUTER PART FUNCTIONAL

⇒ COMPUTER PART FAIL

ZONE CONTROLLER (1EA)
PRIM/SEC (BACK-UP)

PRIM ⇒
- Full flow control and demand elaboration to PC (Temp sensor in Mix Unit → WETS)
- Coldest demand for both packs similar

PRIM ⇒
- Fixed cockpit and cabin temperature select to 24°C
- No more trim air valve control (but sensors still active)
- Zone control by pack outlet temperature (WETS → Mix Unit temp sensor)
- Pack#1 for cockpit / Pack#2 for cabin
- No more demand elaboration for APU (APU at full flow)

PRIM + SEC ⇒
- PC takes control
- WETS#1 fixed to 20°C
- WETS#2 fixed to 10°C

PRIM + SEC BUT COMMUNICATION TO PC LOST ⇒
- PC takes control
- WETS#1 fixed to 5°C
- WETS#2 fixed to 10°C

IN THIS CASE THE TRIM SYSTEM IS STILL ACTIVE AND MAY ADJUST ZONE TEMPERATURE

PACK CONTROLLER (2EA)
PRIM/SEC (BACK-UP)

PRIM ⇒
- Full pack control (Ram Air ↔ BPV)

PRIM ⇒
- Ram Air Doors full open, BPV regulation only
- Flow frozen at last setting

PRIM + SEC ⇒
- Anti Ice Valve regulates pneumatically to 15°C at POPS

EXTRACT FAN (GALLEY & LAVATORY VENT) INOP:
- No more demand by cabin sensors (indication xx)
- Cabin temperature trimmed to 15˚C in ducts

Figure 10 Interfaces Schematic