

A350
TECHNICAL TRAINING MANUAL
MAINTENANCE COURSE - T1+T2 - RR Trent XWB
Air Conditioning

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AIR CONDITIONING

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FLOW CONTROL SYSTEM DESCRIPTION (2/3)

System Presentation

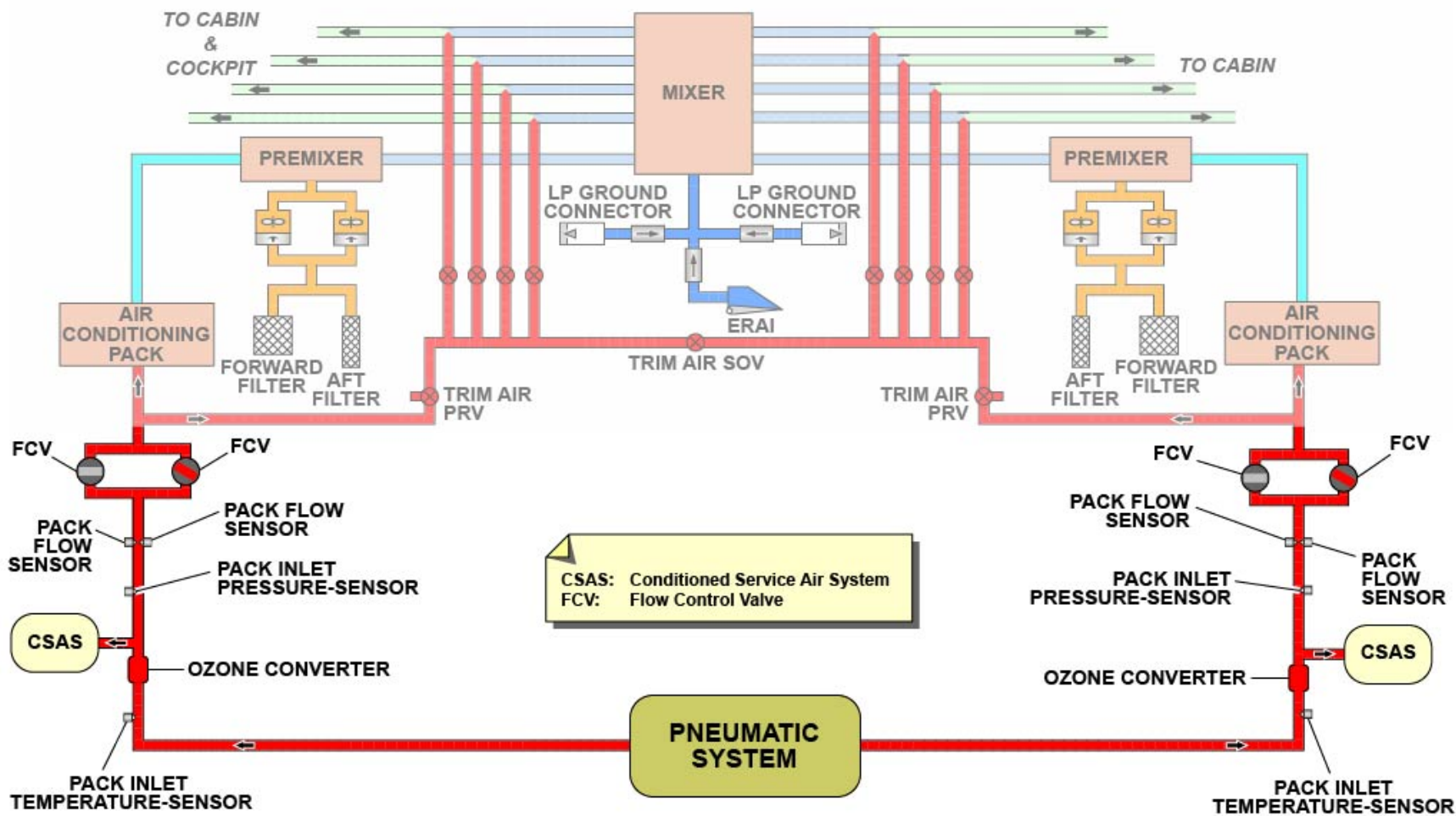
The flow control and monitoring system controls the quantity of the hot bleed air that flows to the air conditioning packs and the trim air manifolds.

The flow control and monitoring system is divided in two identical subsystems which are installed on the LH side and on the RH side of the A/C. Each subsystem has one ozone converter, two pack flow sensors, one pack inlet pressure-sensor, one pack inlet temperature-sensor and two Flow Control Valves (FCVs).

An ozone converter changes ozone in the hot bleed air that comes from the pneumatic system into the oxygen. After that, air goes to the FCVs and Conditioned Service Air System (CSAS).

The pack flow sensors, the pack inlet pressure-sensor and the pack inlet temperature-sensor send the airflow data to calculate and to monitor the flow.

Each FCV adjusts the quantity of the airflow that goes to the packs and to the trim air manifolds, only one FCV operates at a time.



SYSTEM PRESENTATION

FLOW CONTROL SYSTEM DESCRIPTION (2/3)

System Description and Interfaces

The Air Conditioning System (ACS) applications, which are installed on the CPIOMs control and monitor the system through the Air Systems Control Units (ASCUs). The ACS applications receive data from other A/C systems through AFDX. The ACS applications convert these data and send them through CAN bus connection to the ASCUs to calculate the flow demand.

Each ASCU has two channels to control and monitor two FCVs (one channel for each FCV). The ASCU1 calculates the flow demand and the actual flow for the air conditioning pack 1 and the ASCU2 calculates for the air conditioning pack 2. The ASCUs use the data received from the pack flow sensor, pack inlet pressure-sensor and pack inlet temperature-sensor to calculate and monitor the actual flow. For the flow control function, the ASCUs compare the actual flow and the flow demand to adjust the position of the FCVs with the Torque Motor (TM). The ASCUs use the FCV solenoids to control the positions of the FCV.

The PACK 1(2) P/BSW sends a discrete and a digital signal to the ASCUs to controls the FCVs in closed or open position with a solenoid.

The flight crew controls the quantity of air that flow to the air conditioning packs with the AIR FLOW selector SW.

The system controllers (ASCUs and ACS applications) are reset through PACK1 and PACK2 RESET SWs.

The DITCHING P/BSW sends a discrete and a digital signal to the ASCUs to close the FCVs and to prepare the A/C for ditching (emergency landing on water).

The ENG FIRE 1(2) P/BSWs sends a discrete signal to ASCU and a digital signal to the ACS application to close the related FCVs.

To adjust the fresh air flow, the Ventilation Control System (VCS) applications send to ACS application a pack flow increase/decrease command.

Cabin Pressure Control System (CPCS) application send to the ACS applications a pack flow increase/decrease command to supply the correct pressurization during flight.

The OverHeat Detection System (OHDS) sends a signal to ACS applications to close FCVs in case of overheat detection.

The interface between ACS applications and CDS shows the status of the system on the BLEED page.

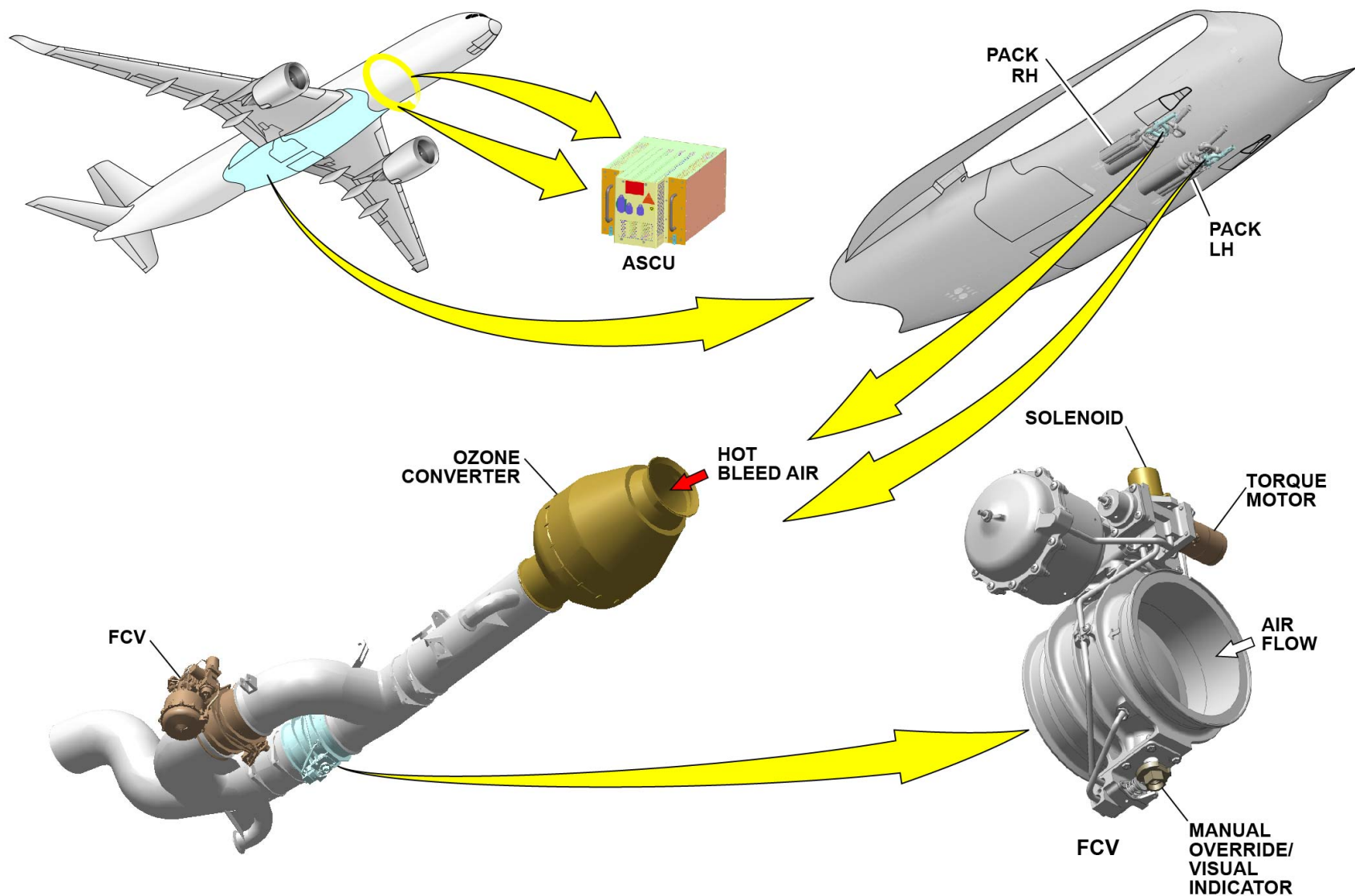


FLOW CONTROL SYSTEM DESCRIPTION (2/3)

Components Function and Description

Each FCV is a pressure regulating and shutoff butterfly valve which is electrically commanded and pneumatically actuated. It uses a TM to control the airflow and a solenoid to control the FCV position. The FCV has a visual indicator and manual override to lock it in the fully closed position if a malfunction occurs. The FCVs are installed on each side of the FWD belly fairing, downstream of the ozone converter.

The ASCU is a dual-lane and an air system controller with software loadable which controls and monitors the airflow for its related air conditioning pack. The ASCUs are installed in the rear triangle area of the FWD cargo. The ASCU1 is on the LH side and the ASCU2 is on the RH side.



COMPONENTS FUNCTION AND DESCRIPTION

V2414251 - V00T0MM0 - VM21DIFLOWC3001

PACKS DESCRIPTION (2/3)

Packs Presentation

The two symmetrical air conditioning packs decrease the temperature and remove water from the hot bleed air that comes from the pneumatic system.

Each air conditioning pack has these components:

- One Ram Air Inlet (RAI) which gives ram air for the pack heat exchangers and for the Conditioned Service Air Supply (CSAS) system
- One ram heat exchanger with a primary heat exchanger and a main heat exchanger
- One Air Cycle Machine (ACM) with a fan, a compressor and one turbine
- One water extraction loop which has a reheater, a condenser, a water extractor and water injectors
- One Ram Air Outlet (RAO) with a pack plenum and a RAO channel.

The bleed air from the Flow Control Valve (FCV) decreases its temperature through the primary heat exchanger by ram air. Then the air flows into the compressor of the ACM to increase its pressure. From here the air flows through the main heat exchanger, where the temperature decreases again.

Then the air goes through the water extraction loop, which removes the moisture. In the loop the air flows through the reheater and condenser.

The condenser uses the cold air from the turbine to decrease the bleed air temperature and to change the bleed air moisture into water.

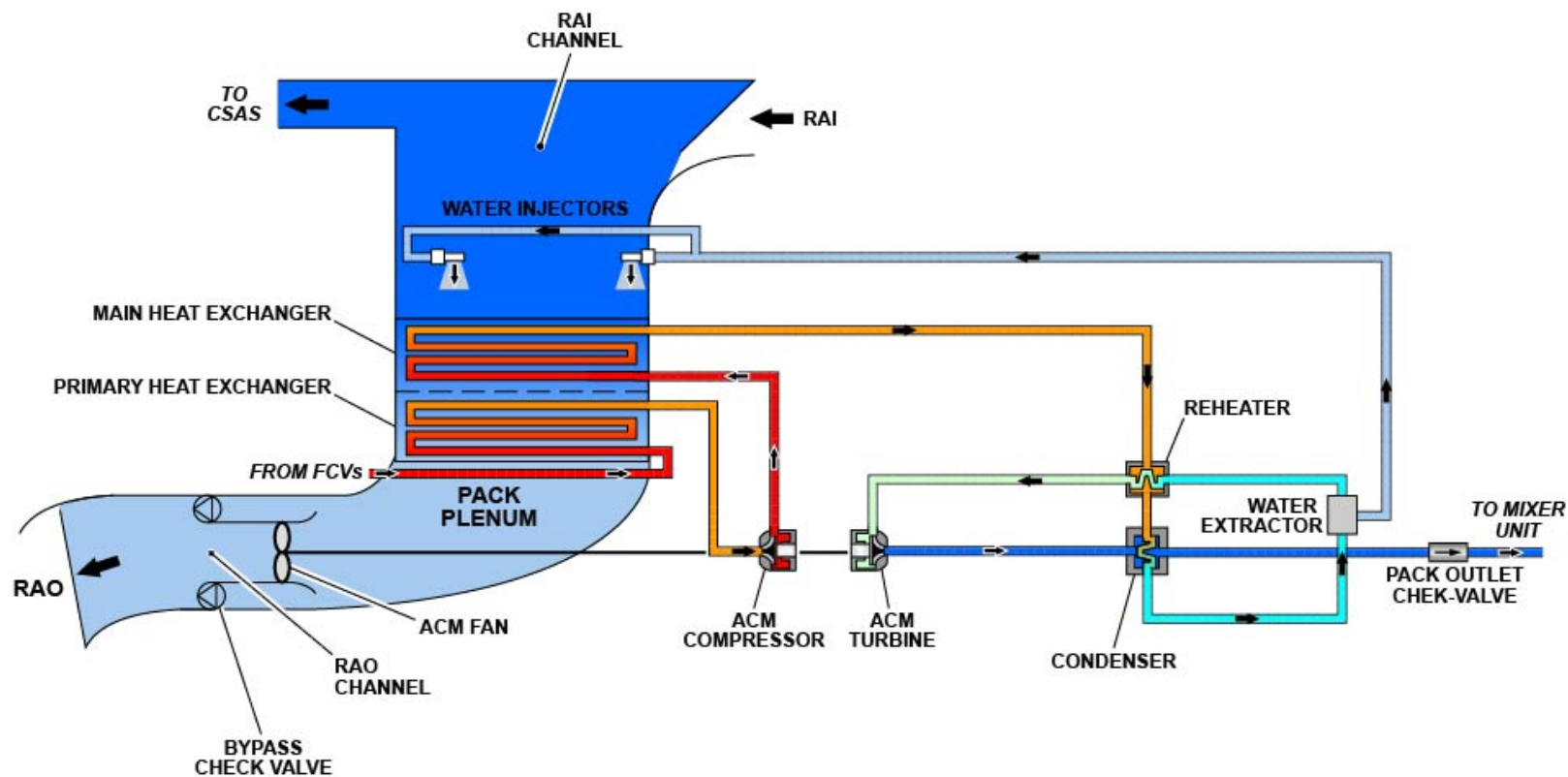
The water extractor helps to divide the water from the air and then the water goes to the water injectors. The water injectors spray the water on the main heat exchanger to increase its efficiency. The air flow goes through the reheater to increase the temperature. Then the air flows through the turbine of the ACM to decrease again the temperature of the air.

In the turbine, the air increases in volume and thus supplies the power necessary for the compressor and the fan to turn. From the turbine, the air flows through the condenser to the mixer unit and then through the pack outlet check-valve.

To decrease the bleed air temperature through the main heat exchanger and the primary heat exchanger the external air goes through:

- The RAI channel
- The pack plenum
- The RAO channel.

The ACM fan causes a movement of the external air through the heat exchanger. If the fan has not sufficient capacity to cause the movement of the air, the air bypasses the fan through the bypass check valves.



ACM: Air Cycle Machine
CSAS: Conditioned Service Air System
FCV: Flow Control Valve
RAI: Ram Air Inlet
RAO: Ram Air Outlet
TCS: Temperature Control System

PACKS PRESENTATION

PACKS DESCRIPTION (2/3)

Packs Components Description

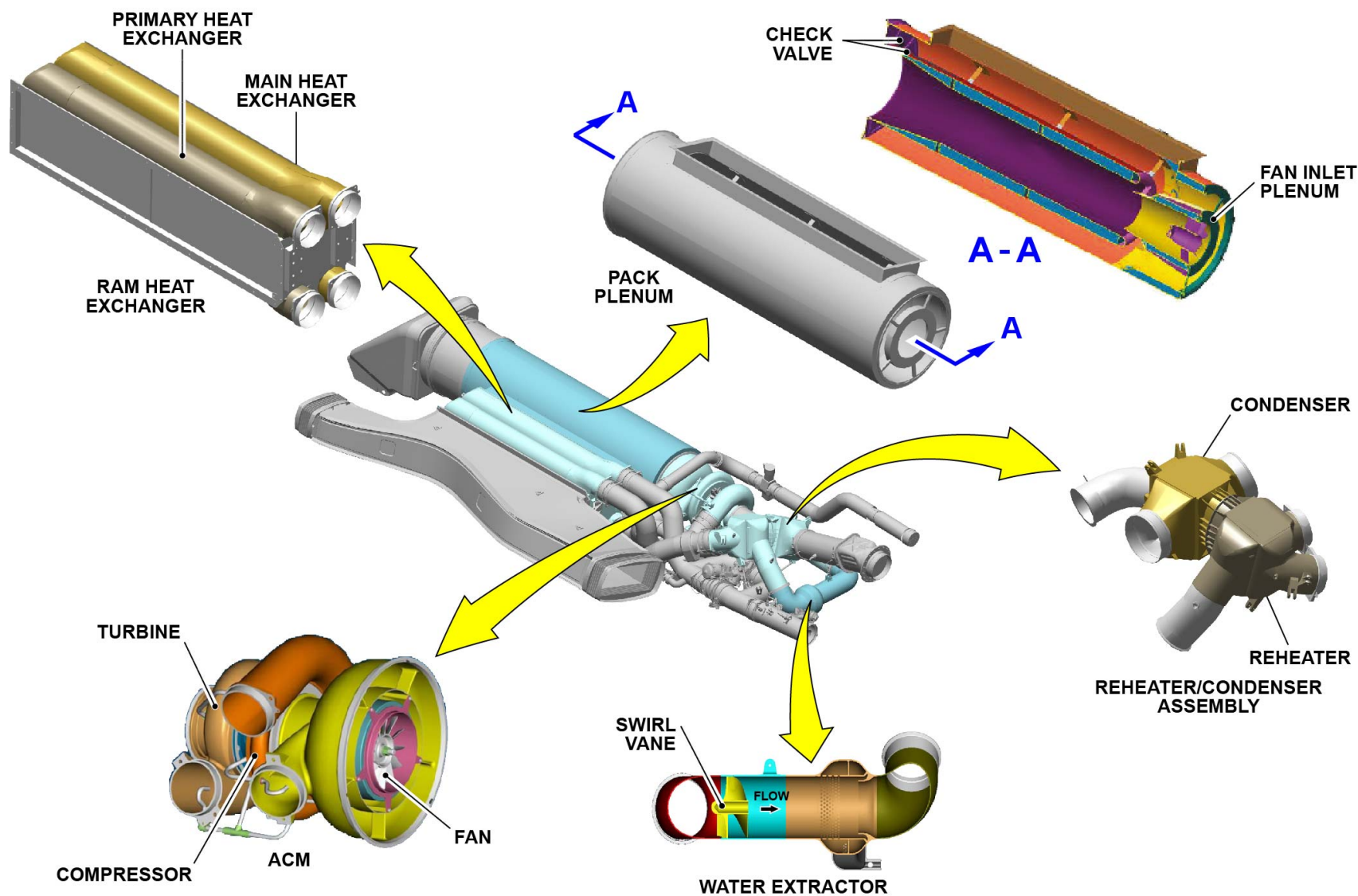
The reheater/condenser assembly is a LRU which has a reheater and a condenser.

The water extractor removes the condensed water from the condenser through a static internal swirl vane.

The ram heat exchanger is an assembly which has a primary heat exchanger and a main heat exchanger.

The fan and the bypass check valves are part of the pack plenum assembly.

The ACM has a compressor, a turbine and a fan which are installed on the same shaft.



PACKS COMPONENTS DESCRIPTION

V2414251 - V00T0MM0 - VM21D2PACKS3001

PACKS DESCRIPTION (2/3)

Packs Control and Monitoring Presentation

The pack control and monitoring system has these functions:

- Pack discharge temperature control
- Pack monitoring, which contains ice build-up and overheat protection.

The pack control components are:

- One temperature control valve
- One pack-discharge heating check-valve
- One pack discharge heating valve
- One RAI actuator that operates the RAI door (CSAS uses also the air that comes through inlet door)
- One RAO actuator that opens or closes the RAO door.

The temperature control valve adjusts the quantity of hot air mixed with cold air from the turbine. The hot air is used to adjust the temperature of the air that comes from the ACM turbine.

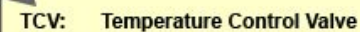
The temperature control valve receives hot air that comes from the primary heat exchanger through the pack discharge heating check valve. The temperature control valve can also receive bleed air through the pack discharge heating valve (depends on the altitude of the A/C).

To control the temperature of the hot air, each air conditioning pack has one RAI door and one RAO door. To adjust the quantity of external air that goes through exchangers, each actuator operates the related door. The CSAS uses the same air that comes through the RAI door.

To monitor the status of the air conditioning pack, to adjust discharge temperature and to prevent ice build-up, the air conditioning pack uses data from these sensors:

- The primary heat-exchanger-outlet temperature-sensor
- The compressor discharge temperature-sensor
- The main heat-exchanger-outlet temperature-sensor
- The water extractor temperature-sensor
- The pack discharge temperature-sensor
- Mixer temperature sensors

- The pack discharge delta pressure-sensor, which measures the differential pressure between condenser inlet pressure and the fuselage pressure
- The ACM speed sensor.



PACKS CONTROL AND MONITORING PRESENTATION

PACKS DESCRIPTION (2/3)

Packs Control and Monitoring Description Interfaces

Two Air Systems Control Units (ASCUs), one for each air conditioning pack.

Air Conditioning System (ACS) applications installed in two CPIOMs, control and monitor the air conditioning packs.

The ACS application is an interface between ASCUs and A/C system. Each ASCU has two channels, one is in active mode and the other is in the standby mode.

To control the air which comes through the temperature control valves and ram air doors, the ASCUs use the lowest temperature demand and data from mixer temperature sensors.

Each ASCU control and monitor the related temperature control valve. The primary function of the temperature control valve is to control and monitor the temperature of the related pack outlet, to get the lowest temperature demand in the mixer.

For this, the ASCUs use data from the water extractor temperature-sensor and pack discharge temperature-sensor.

Additionally, the temperature control valve uses data from the water extractor temperature-sensor to prevent ice build-up. Also the ASCUs use data from the pack discharge delta pressure-sensor to prevent ice build-up in the condenser and the air ducts between air conditioning pack and cabin.

Each ASCU controls and monitors the related RAI actuator and RAO actuator. The actuators open or close the related RAI door and RAO door. The RAI and the RAO actuators adjust the quantity of ram airflow that controls the pack discharge temperature and the ACM compressor discharge-temperature. The compressor discharge temperature-sensor monitors the ACM compressor discharge temperature. When the flight crew push the DITCHING P/BSW, all ram air doors move in the fully closed position.

The ASCUs control and monitor the pack discharge heating-valve. When the A/C is at low altitude (22 000ft), the pack discharge heating-valve is

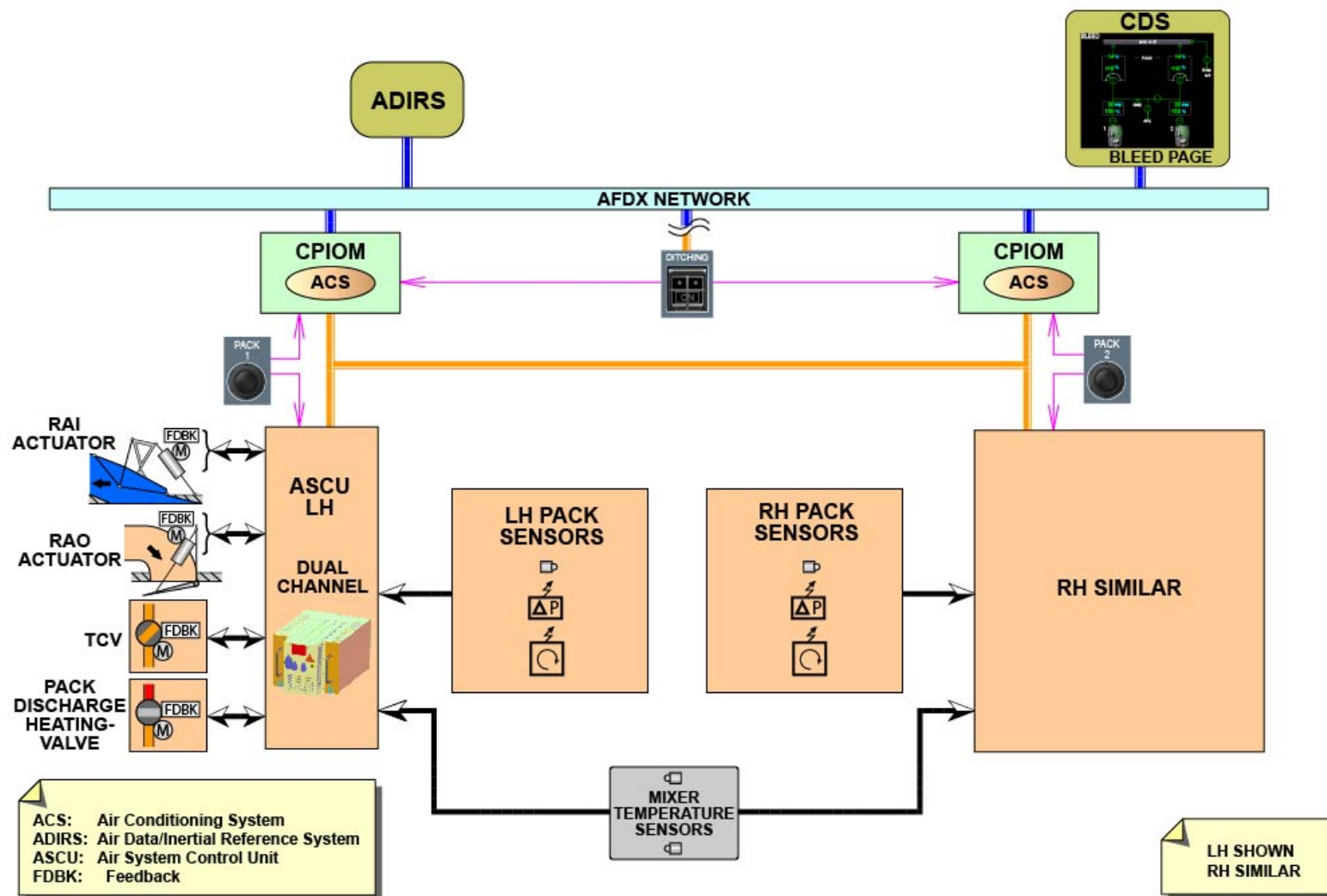
in the open position and the pack-discharge heating check-valve is in the closed position. Thus, the bleed air is a source of hot air for the temperature control valve. This makes sure that the quantity of humid air, which is mixed with dry turbine outlet air, is at a minimum and also decreases the risk of ice build-up. At high altitude (above 22 000ft), the pack discharge heating-valve is in the closed position and the primary heat exchanger-outlet becomes the source for the temperature control valve.

The ACM speed sensor, the compressor discharge temperature-sensor, the primary heat-exchanger-outlet temperature-sensor and the main heat-exchanger-outlet temperature-sensor monitor the air conditioning packs. If an overheat occurs when the A/C is on the ground, the FCVs move to the closed position and the air conditioning packs automatically shutdown.

The Air Data/Inertial Reference System (ADIRS) send data about A/C altitude to the ASCUs.

The ACS application sends air conditioning packs data to the CDS to display on the BLEED page.

The ASCUs and ACS application can be reset through the PACK 1(2) RESET SWs.



PACKS CONTROL AND MONITORING DESCRIPTION INTERFACES

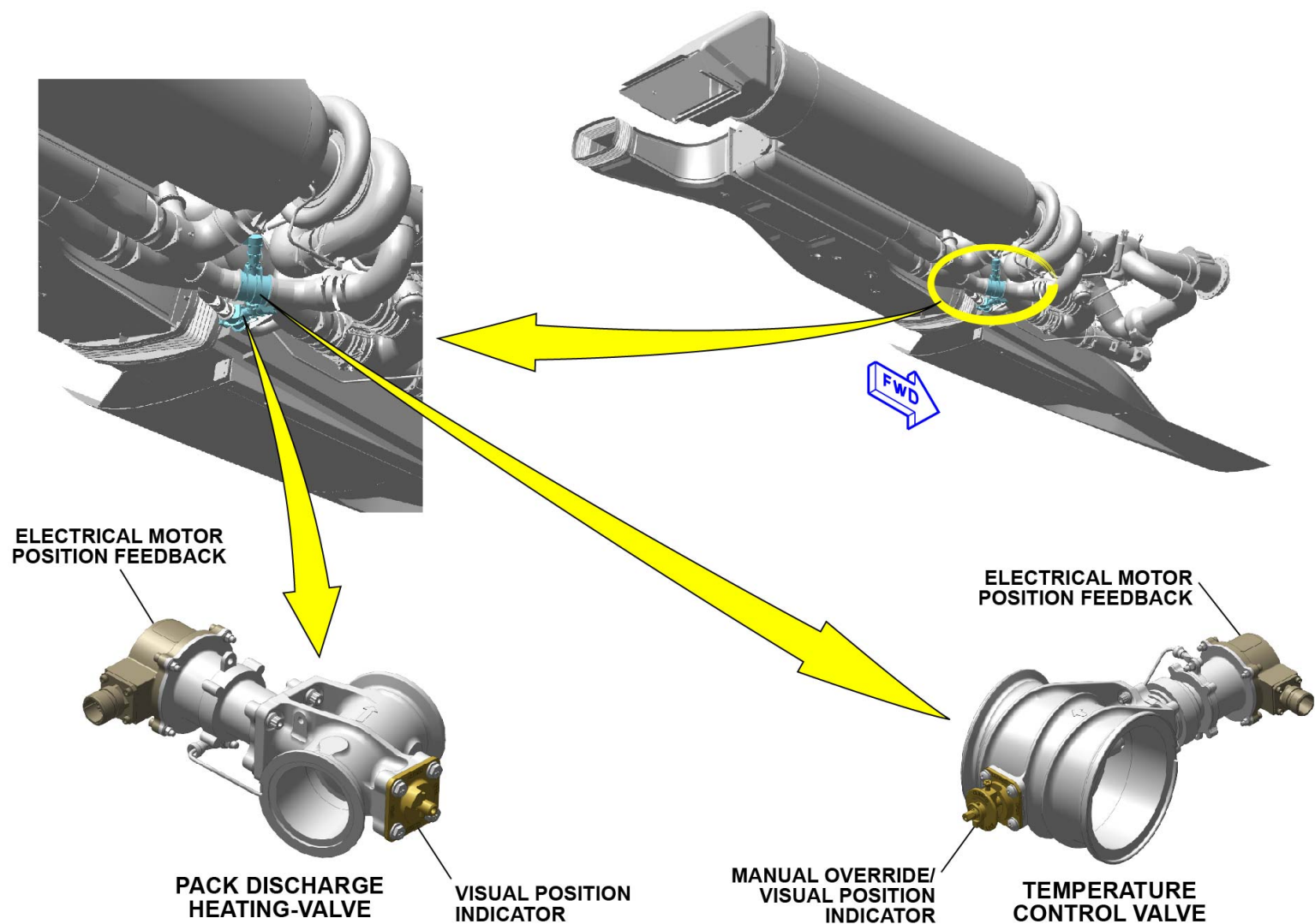
PACKS DESCRIPTION (2/3)

Packs Control And Monitoring Components Description

The Valves

The pack discharge heating-valve has an electrical motor which operates the rotary actuator that moves the flap and supplies feedback position. The valve has also a visual position indicator.

The temperature control valve is a modulating valve and has an electrical motor which operates the rotary actuator that moves the flap and supplies feedback position. The valve has also a manual override with a visual position indicator to set the valve to the fully open or fully closed position.



PACKS CONTROL AND MONITORING COMPONENTS DESCRIPTION - THE VALVES

V2414251 - V00T0MM0 - VM21D2PACKS3001

PACKS DESCRIPTION (2/3)

Packs Control And Monitoring Components Description (continued)

The Sensors

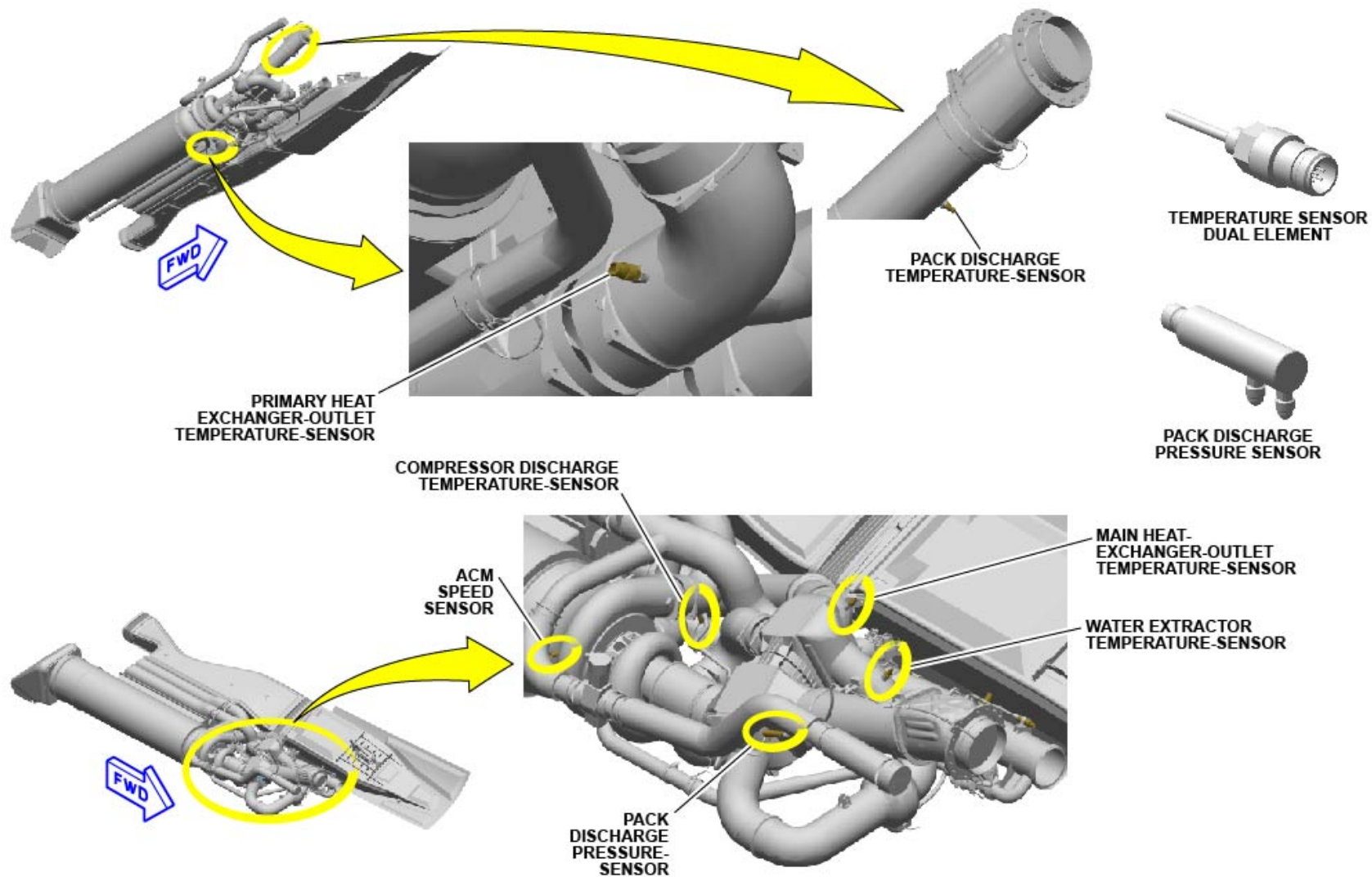
To measure the temperature, each pack uses these temperature sensors:

- One primary heat-exchanger-outlet temperature-sensor
- One compressor discharge temperature-sensor
- One main heat-exchanger-outlet temperature-sensor
- One water extractor temperature-sensor
- One pack discharge temperature-sensor.

All these temperature sensors have dual elements to send data to each ASCU channel.

The pack discharge delta pressure-sensor measures the differential pressure between condenser inlet and pressurized fuselage. The ASCUs use pack discharge delta pressure-sensors for icing condition detection.

The ACM speed sensor has two coils to send data to each ASCU channel.



PACKS CONTROL AND MONITORING COMPONENTS DESCRIPTION - THE SENSORS

PACKS DESCRIPTION (2/3)

Packs Control And Monitoring Components Description (continued)

Actuators and ASCUs

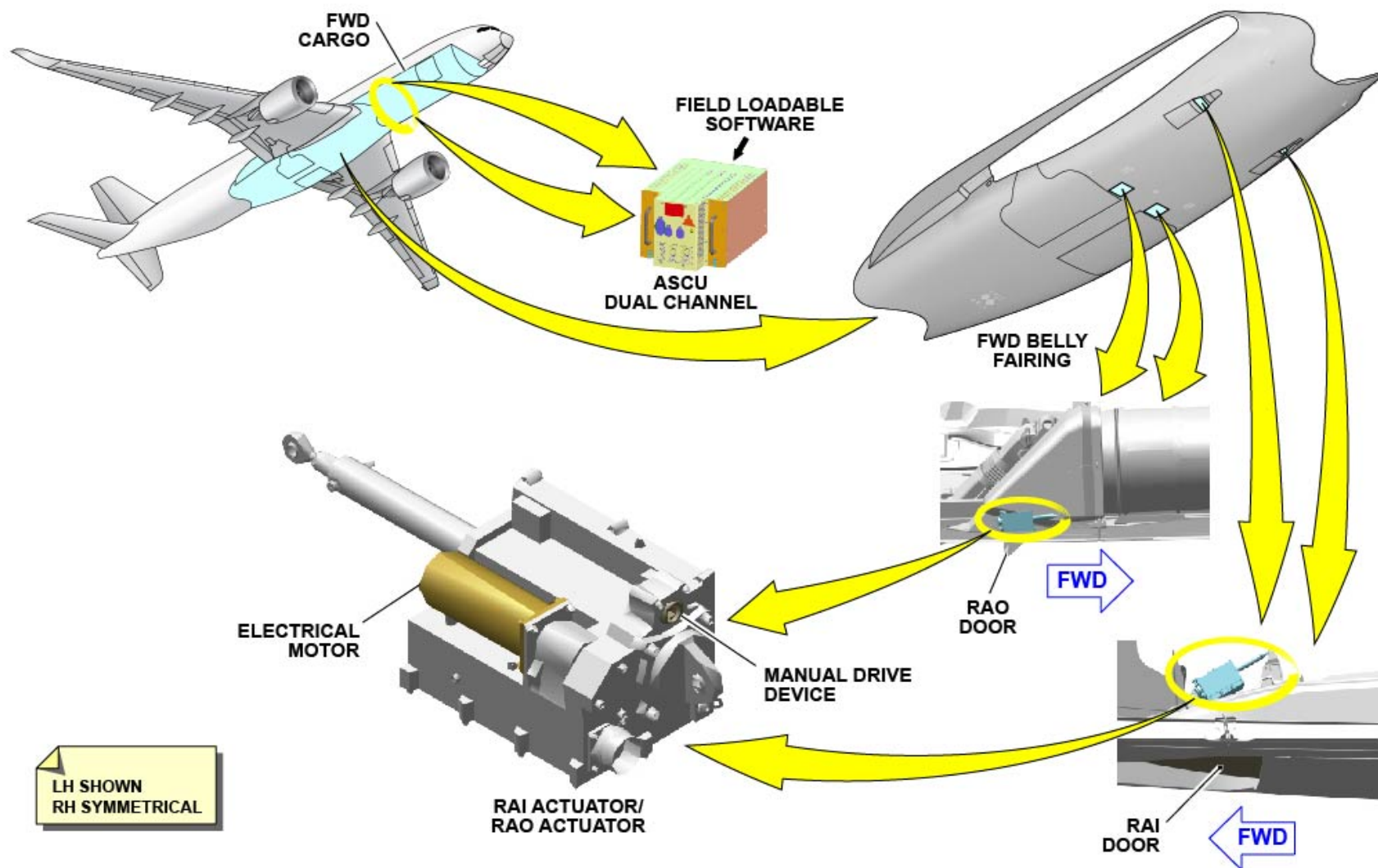
The RAI door and RAO door are installed on each side of the FWD belly fairing.

The RAI actuator and the RAO actuator are the same. The actuators have an electrical motor to operate the RAI door and RAO door. They send a position feedback signal to the related ASCU. Each actuator has a manual drive device, for deactivation propose.

Each ASCU is a dual channel controller with field loadable software.

One lane is in active mode and the other in standby mode.

The ASCUs are installed in the FWD cargo.



PACKS CONTROL AND MONITORING COMPONENTS DESCRIPTION - ACTUATORS AND ASCUS

PACKS CONTROL AND INDICATING (2/3)

Air Conditioning Packs - General (2)

On the AIR panel, the PACK 1 (2) P/B SWs are used to start their related Packs.

For each Pack, there are two Flow Control Valves (FCVs). Only one is active. It regulates the quantity of bleed air that flows into each pack and the Trim Air Manifold.

When the PACK P/B SW is ON, the pack Flow Control Valve is automatically controlled in accordance with bleed source, AIR FLOW selector position and the Pack flow demand computed from Air Conditioning system.

Air Conditioning Packs - Normal operation (3)

The packs provide cold air by cooling hot bleed air provided from Engine Bleed Air System (EBAS), the APU or the HP ground cart via the Pneumatic Air Distribution System (PADS).

In normal operation, when the PACK P/Bs are ON, the Air Supply Control Units (ASCUs) control Packs operation and the flow control valves.

For each PACK:

- The Flow Control Valve (FCV) modulates to adjust the bleed airflow. The air is sent through the primary Heat Exchanger (HX), then through the Air Cycle Machine (ACM) compressor.
- The turbine drives the compressor and the ACM fan, which draws air from the Ram Air Inlet (RAI) through the Heat Exchangers to the Ram Air Outlet (RAO), A/C on ground. In the Heat Exchangers this ambient air is used to cool the bleed.
- After passing through the ACM compressor, the hot air goes through the main HX, then through the reheater condenser and the water extractor.
- After this detent, the air temperature is regulated by adding hot air from the Temperature Control Valve (TCV) and sent to the Mixer Unit. Below 22,000 ft Air supply through the TCV is coming from the hot Bleed Air supplying the pack, Pack Discharge Heating Valve (PDHV) is open and

Pack Discharge Heating Check Valve (PDHCKV) is closed. Above 22,000ft PDHV is close and PDHCKV is open, air supply through the TCV is then coming from primary heat exchanger outlet.

On ground and in normal operation, with the both PACK P/Bs pressed in and bleed air available:

- The RAI Doors (RAIDs) and the RAO Doors (RAODs) are open.
- The FCV modulates to adjust the bleed air flow,
- The PDHV is open,
- The TCV modulates to adjust the pack discharge temperature.
- The ACM fans draw external air through the Heat Exchangers and discharge it overboard

In flight and in normal operation:

- The RAI Door (RAID) and the RAO Door (RAOD) are open but they are controlled to minimize the drag (ram air dynamically flows into the system and bypasses the fans through fan bypass check valves),
- The FCV modulates to adjust the bleed air flow,
- The PDHV opens to use hot air at low altitude (below 22,000ft).to supply the TCV for temperature regulation purpose.
- The PDHV closes at altitude above 22,000ft
- The TCV modulates to adjust air temperature at the Pack outlet, and also to avoid icing condition at the Water Extractor and the Reheater/Condenser.

If a FCV fails, the adjacent FCV take over.

If the Pack fails, the related FCVs close. The FCV of the other Pack delivers more flow as compensation.

If the Pack is shut down due to a failure and/or action on the PACK P/B (released out), all the valves and doors are closed.

If the DITCHING P/B is pressed ON:

- The RAIDs and RAODs close,
- The FCVs close,
- The Packs are stopped.

If an ENG FIRE P/B is released out, the associated FCVs close to prevent smoke from entering the system. The FCV of the other Pack compensates by adjusting the bleed air flow.

The AIR FLOW selector has four positions:

- MANual: the PACK flow demand is set to a default value.
- LOW: the PACK flow demand is set at 80% of NORMAl setting flow.
- NORM: the PACK flow demand is automatically calculated according the aircraft flight condition, cargo options, cabin recirculation fresh air setting, cabin layout and the actual number of passengers.
- HIGH: the AGU flow demand is set at 120% of NORMAl setting flow.

The flow demands calculation basically depends on:

- The AIR FLOW selection,
- The PAX number (FMS),
- The cabin Layout (CIDS),
- The cargo cooling selection (VCS).

The flow demand calculation is offset in case of:

- Recirculation fan failure
- Single Pack operation.
- APU operation (ECB)
- Engine set to take-off power (FADEC)
- Engine Bleed supply failure (EBAS).

Pack Overheat (3)

In case of compressor outlet temperature Overheat or Pack discharge temperature Overheat:

- FCV is automatically controlled to closed position on ground
- The MASTER CAUTION lights illuminate, accompanied with a single chime.
- The FAULT-light in the PACK1 (2) P/B comes on.
- The EWD shows the AIR PACK1 (2) OVHT warning message, in amber.
- OVHT legend indication is displayed (in amber) while compressor outlet temperature is above amber limit, the associated PACK P/B SW has to be set to OFF.

- After PACK 1 (2) P/B SW has been switched off, FAULT light of the PACK 1(2) P/B SW remains illuminated while overheat condition is valid.

- On the STATUS SD page, INOP SYS shows the PACK1 (2) message when the Pack is unserviceable.

Pack 1 Regulation Fault (3)

Each Pack is controlled by an ASCU which contains two fully redundant digital channels. The ASCU uses feedback from sensors to control the TCV to regulate the temperature of the pack discharge air delivered to the mixer unit. If this control is no longer possible due to a failure, the REGUL FAULT alarm is displayed. Pack has to be switched OFF on ground.

Pack is still available in flight with degraded performance.

Pack Fault (3)

In the case Pack fails to operate:

- The MASTER CAUTION lights illuminate, accompanied with a single chime.
- The FAULT-light in the PACK1 (2) P/B comes on.
- The EWD shows AIR PACK1 (2) FAULT, and its associated PACK P/B has to be switched OFF.
- On the STATUS SD page INOP SYS shows the PACK1 (2) message when the Pack is unserviceable.

- On BLEED SD page, associated Pack Valve is indicated amber closed, meaning both FCVs are inoperative.

Following associated warning messages can be triggered

In the case Flow Control Valve does not operate:

- The EWD shows a PACK1 (2) VLV1 (2) FAULT message.

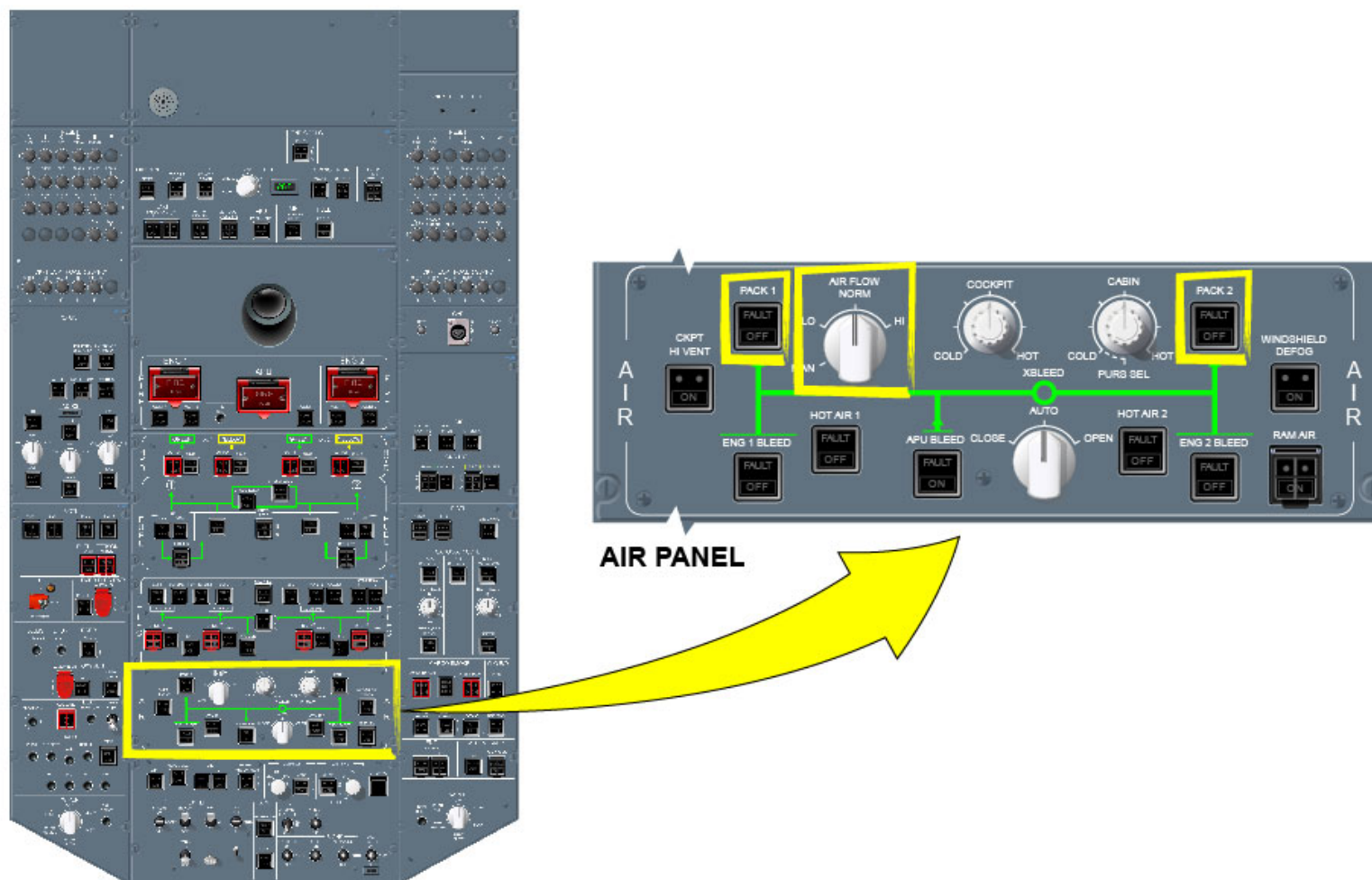
In the case Temperature sensor or valve fails to operate:

- The EWD shows PACK1 (2) REGUL FAULT message.

In the case ACS-application on the CPIOM or the ASCU fails to operate:

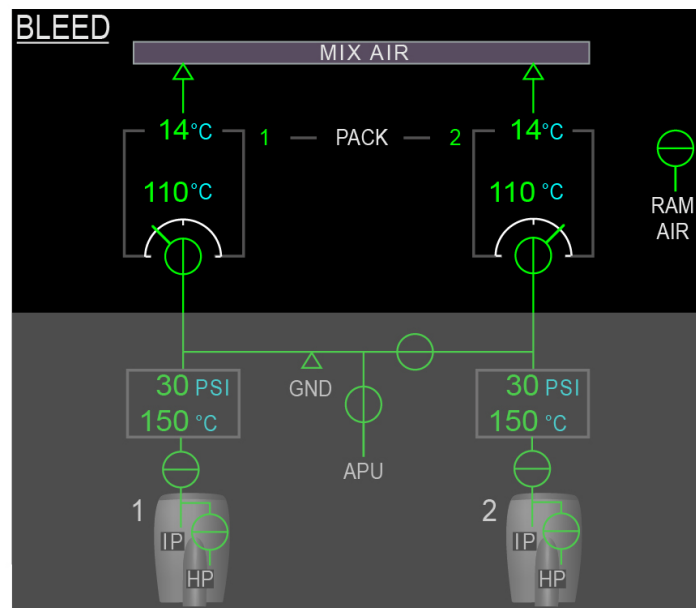
- The EWD shows the PACK1 (2) CTL1 (2) FAULT.

In case of one Pack is unserviceable, the related PACK1 (2) P/B SW is set to the OFF position. The other Pack, that operates correctly, supplies the air distribution system with conditioned air.



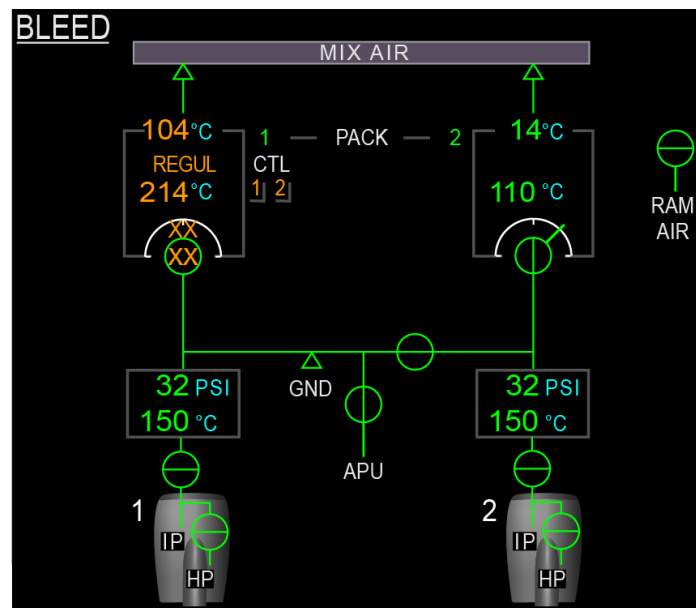
AIR CONDITIONING PACKS - GENERAL (2) ... PACK FAULT (3)

V2414251 - V00T0MM0 - VM2111PACKS3001



BLEED SD PAGE

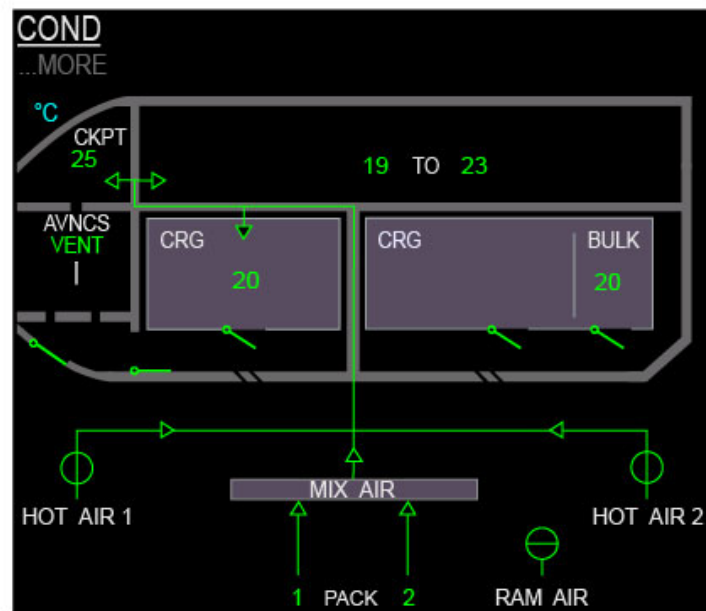
AIR CONDITIONING PACKS - GENERAL (2) ... PACK FAULT (3)



ABNORMAL BLEED SD PAGE

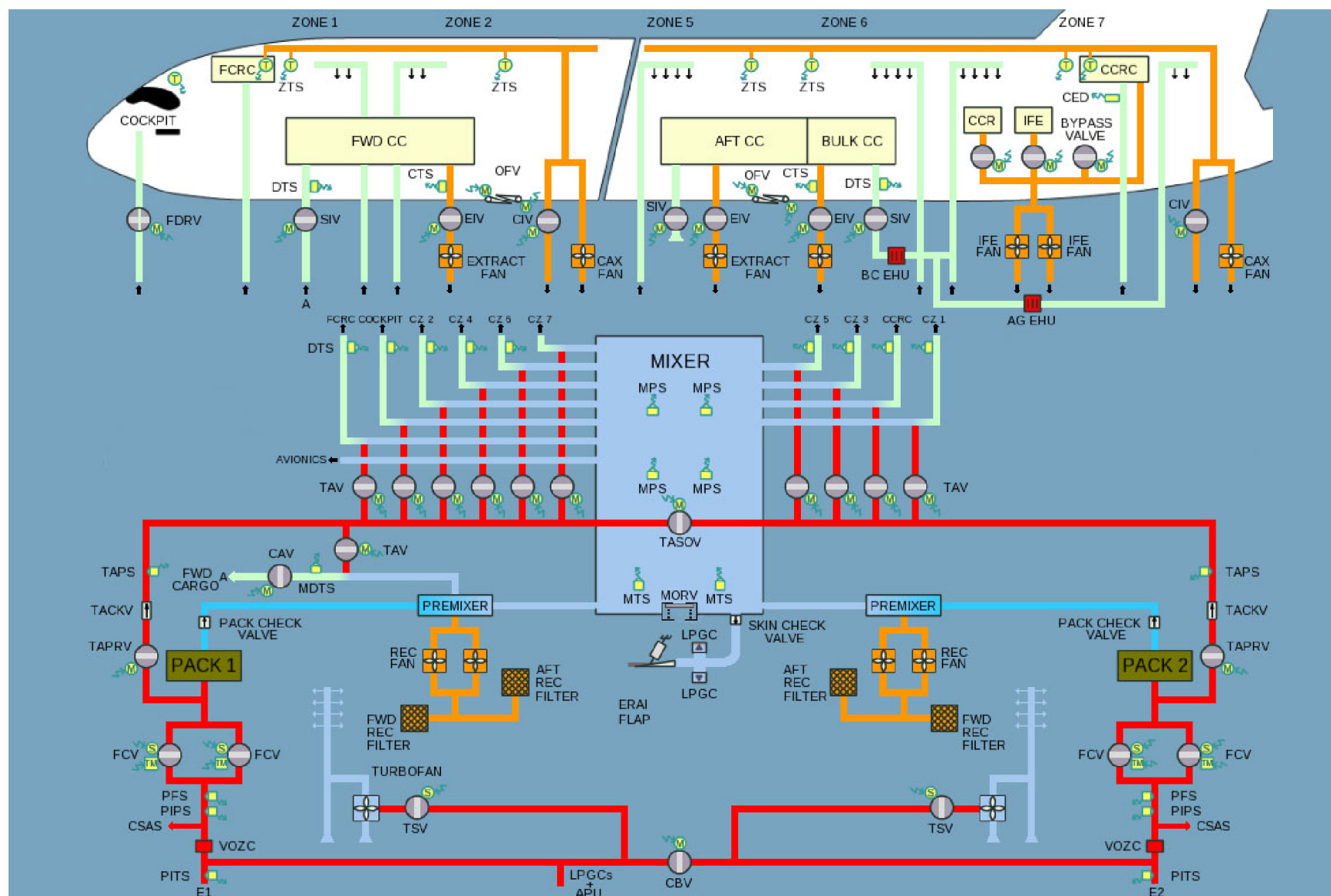
**THIS SD PAGE SHOWS SEVERAL
AVAILABLE INDICATIONS BUT
NOT A SYSTEM CONFIGURATION**

AIR CONDITIONING PACKS - GENERAL (2) ... PACK FAULT (3)

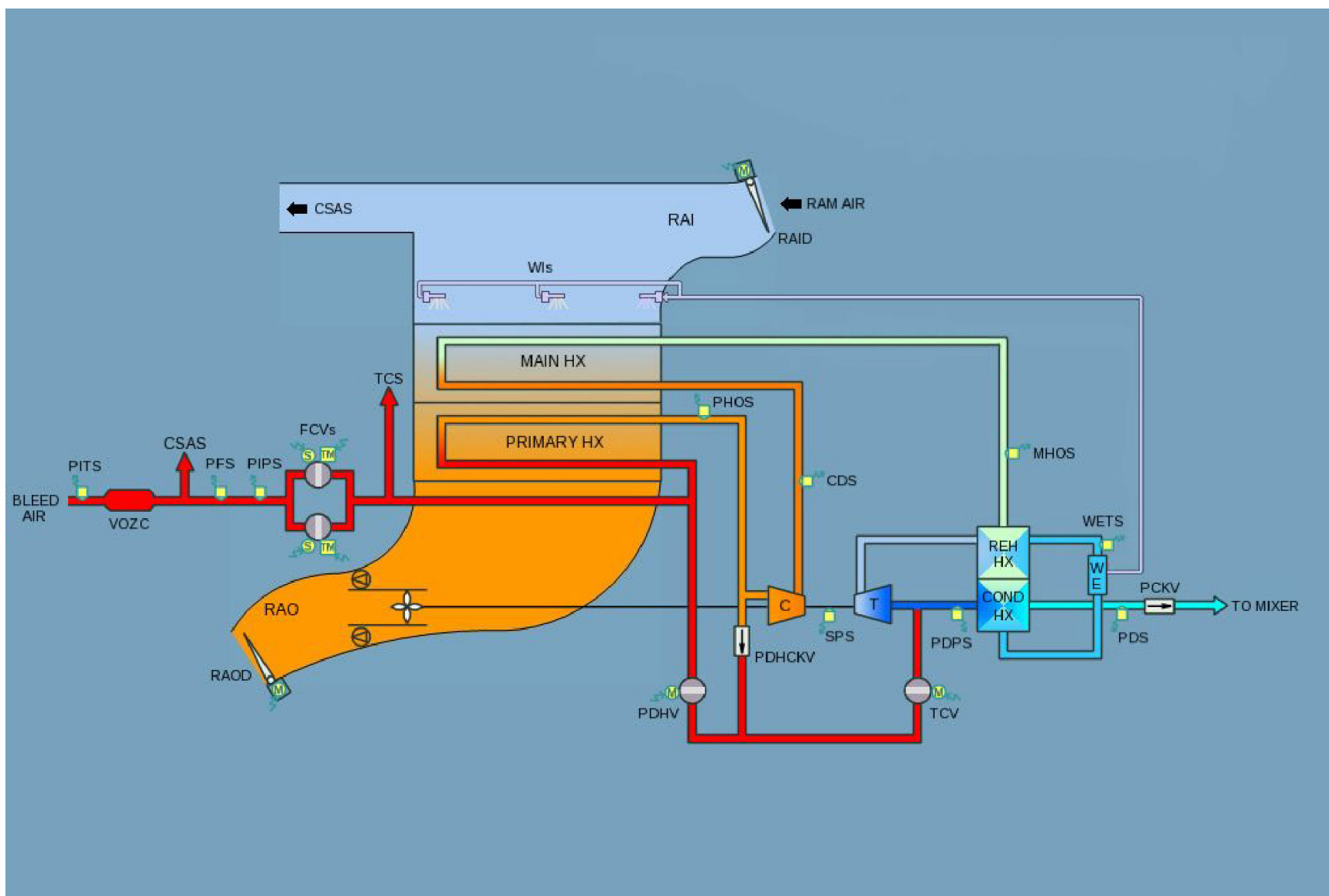


COND SD PAGE

AIR CONDITIONING PACKS - GENERAL (2) ... PACK FAULT (3)



AIR CONDITIONING PACKS - GENERAL (2) ... PACK FAULT (3)



AIR CONDITIONING PACKS - GENERAL (2) ... PACK FAULT (3)

V2414251 - V00T0MM0 - VM2111PACKS3001

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GROUND AND EMERGENCY AIR SUPPLY DESCRIPTION (2/3)

System Presentation

The emergency air supply system supplies ram air to the mixer if the two air conditioning packs are unserviceable during flight, to keep the cabin ventilation at a satisfactory level. The ram air from the emergency air supply system goes to the mixer through a skin check valve.

On the ground, the ground air supply system supplies conditioned air from ground carts to the mixer.

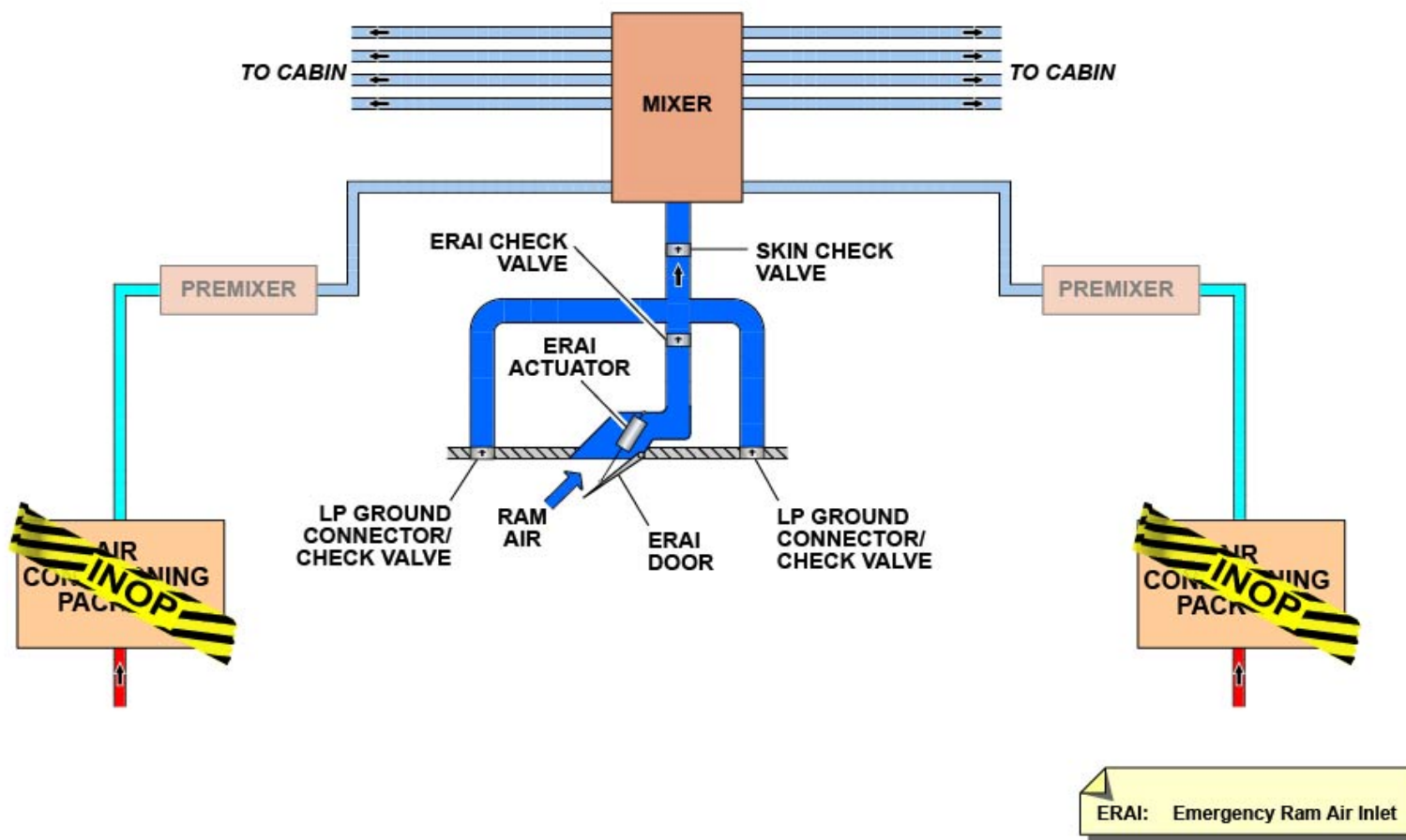
The components of the emergency air supply system are:

- One Emergency Ram Air Inlet (ERAI) door
- One ERAI actuator
- One ERAI check valve.

The ERAI actuator opens or closes the ERAI door.

The ERAI check valve lets the air flow to the mixer when the pressure at the ERAI is higher than the pressure in the mixer. Also, this valve prevents an airflow in the opposite direction when an external air source supplies air through the ground air supply system.

The ground air supply system has two LP ground connectors. Each connector has a check valve to prevent an airflow in the opposite direction.



SYSTEM PRESENTATION

GROUND AND EMERGENCY AIR SUPPLY DESCRIPTION (2/3)

System Description and Interfaces

The ERAI door is manually or automatically operated.

In the automatic control, the Cabin Pressure Control System (CPCS) applications open the ERAI door under the following conditions:

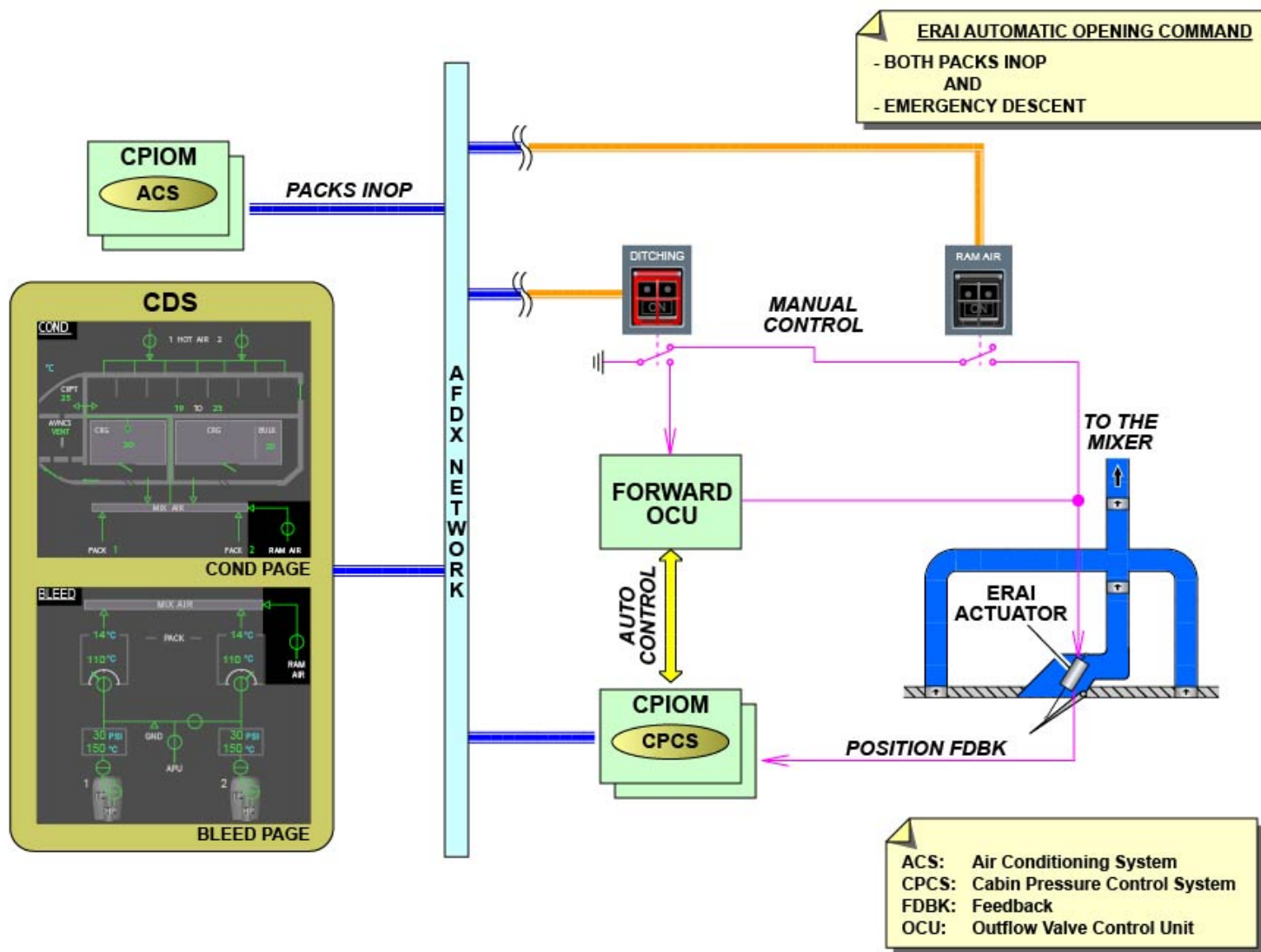
- The two air conditioning packs are not in operation (inputs from Air Conditioning System (ACS) applications)
- Emergency descent (more than 2000 fpm - cabin vertical speed).

The open signal goes to the FWD Outflow Valve Control Unit (OCU), which controls the ERAI actuator. The CPCS applications monitor the position of the ERAI actuator.

In manual control, the pilot decreases the A/C altitude to less than 10000 feet and pushes the RAM AIR P/BSW to open the ERAI door. The manual mode overrides the automatic mode.

When the pilot pushes the DITCHING P/BSW the ERAI door moves to the fully closed position. The ditching command overrides the ERAI door controls (Manual/Auto).

The ERAI door position comes into view on the BLEED and COND pages of the CDS.



SYSTEM DESCRIPTION AND INTERFACES

GROUND AND EMERGENCY AIR SUPPLY DESCRIPTION (2/3)

Components Description

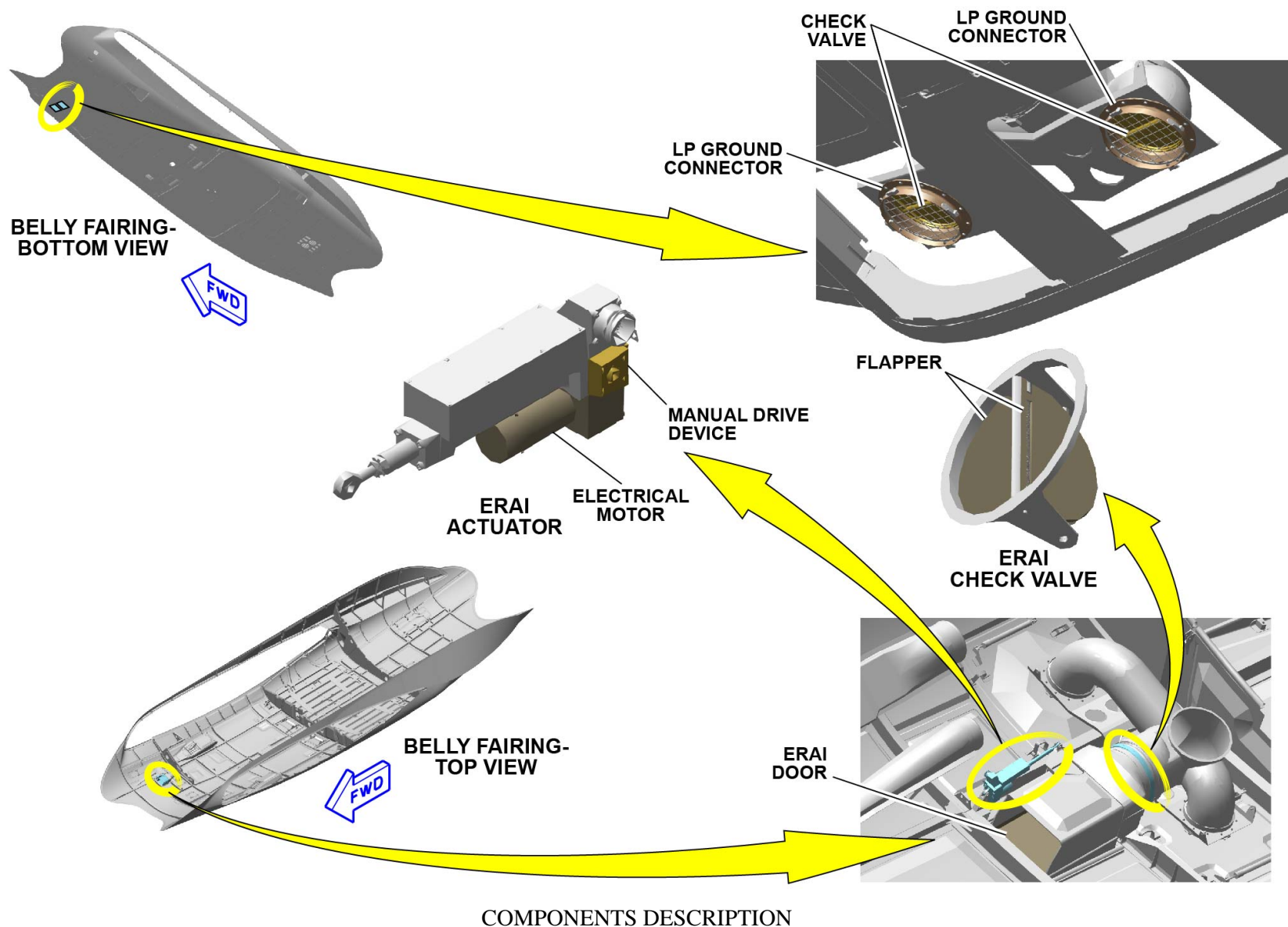
The ERAI actuator is installed in the FWD RH belly fairing and has:

- An electrical motor
- A manual drive device.

The ERAI Check valve is a dual flapper valve and is installed downstream of the ERAI, in the FWD belly fairing.

The dual flappers valve prevents an airflow in the opposite direction, when LP ground connectors supply fresh air.

Each of the two LP ground connectors has a check valve which is installed in the FWD belly fairing.



V2414251 - V00T0MM0 - VM21D3GNDEM3001

EMERGENCY AIR SUPPLY CONTROL AND INDICATING (2)

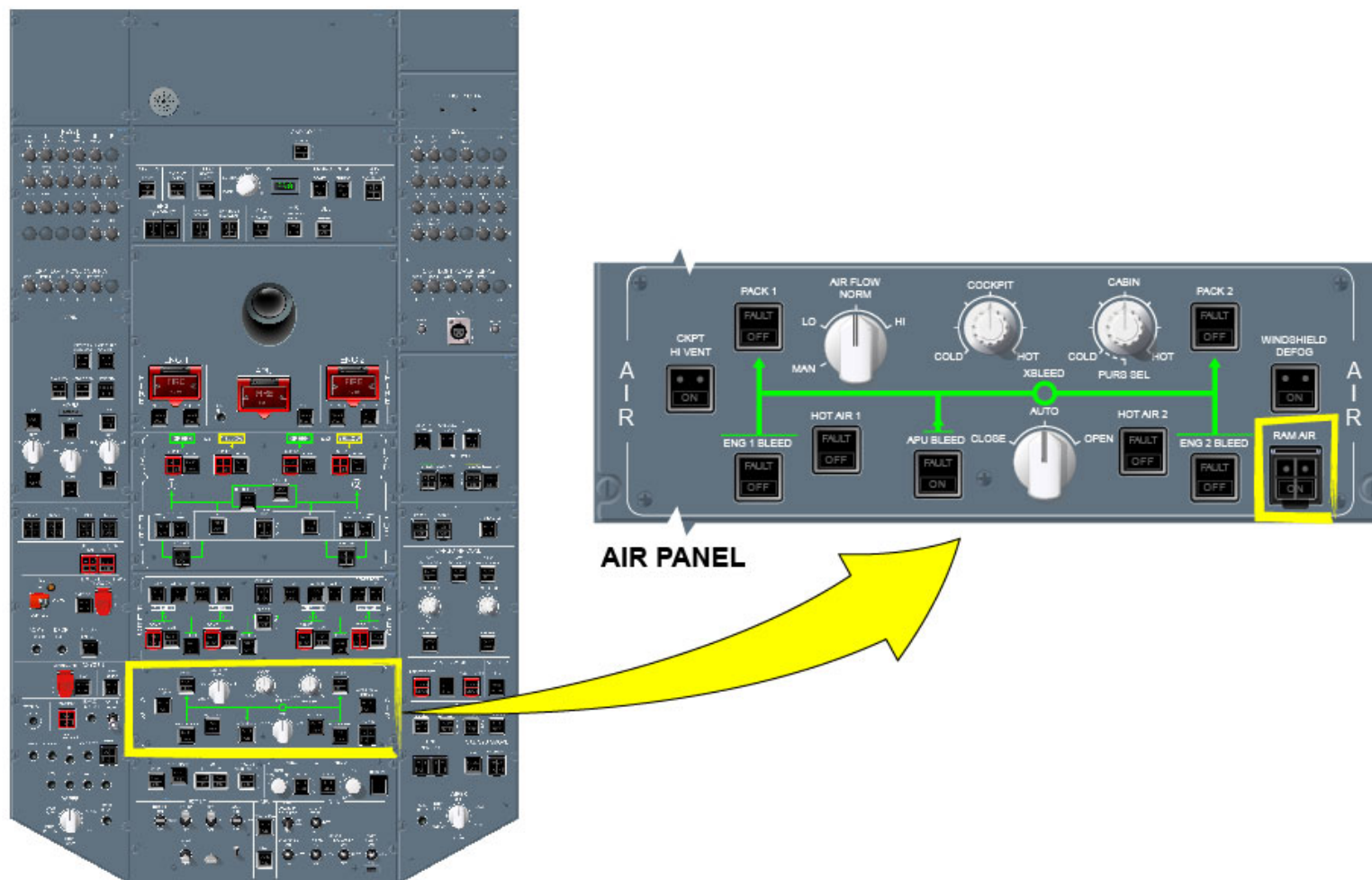
Emergency Ram Air Inlet Manual Control (2)

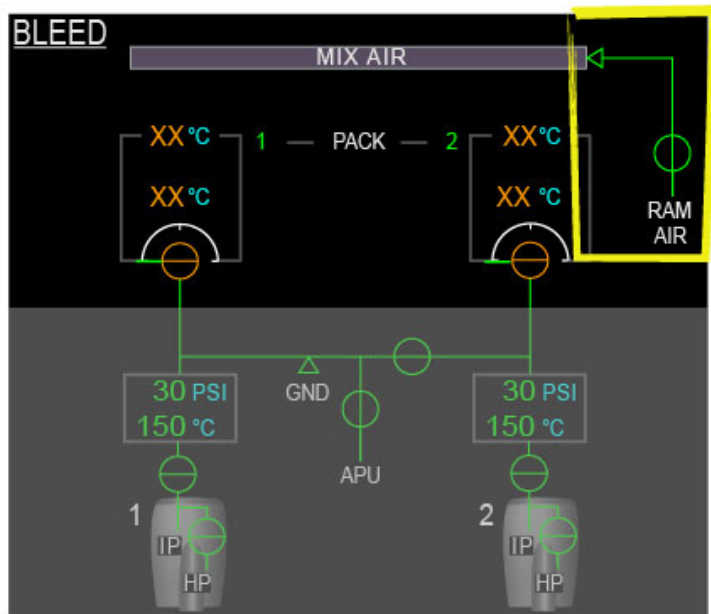
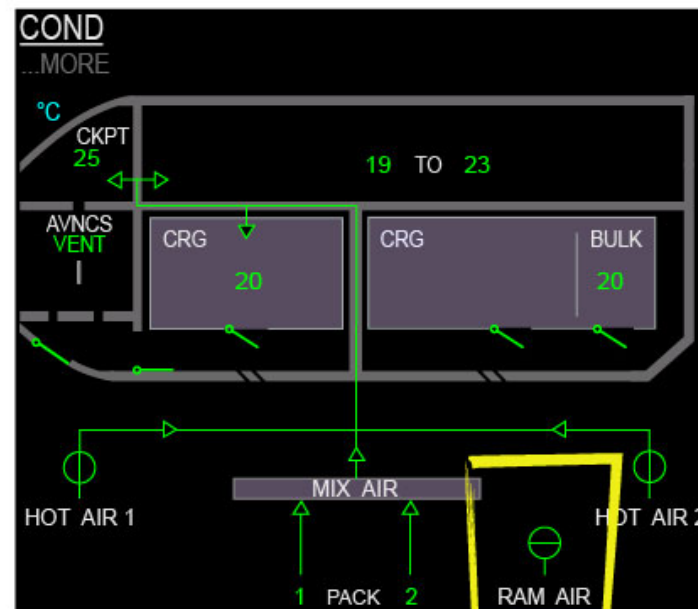
One Emergency Ram Air Inlet (ERAI) is installed near to the LP Ground Connectors on the Belly Fairing.

If both Packs are not available in flight, the ERAI will be opened automatically (by the CPCS) or manually using the RAM AIR P/Bsw in order to supply external air to the cabin and the cockpit.

Once ERAI flap is opened, the ram air is directly supplied to the Mixer Unit.

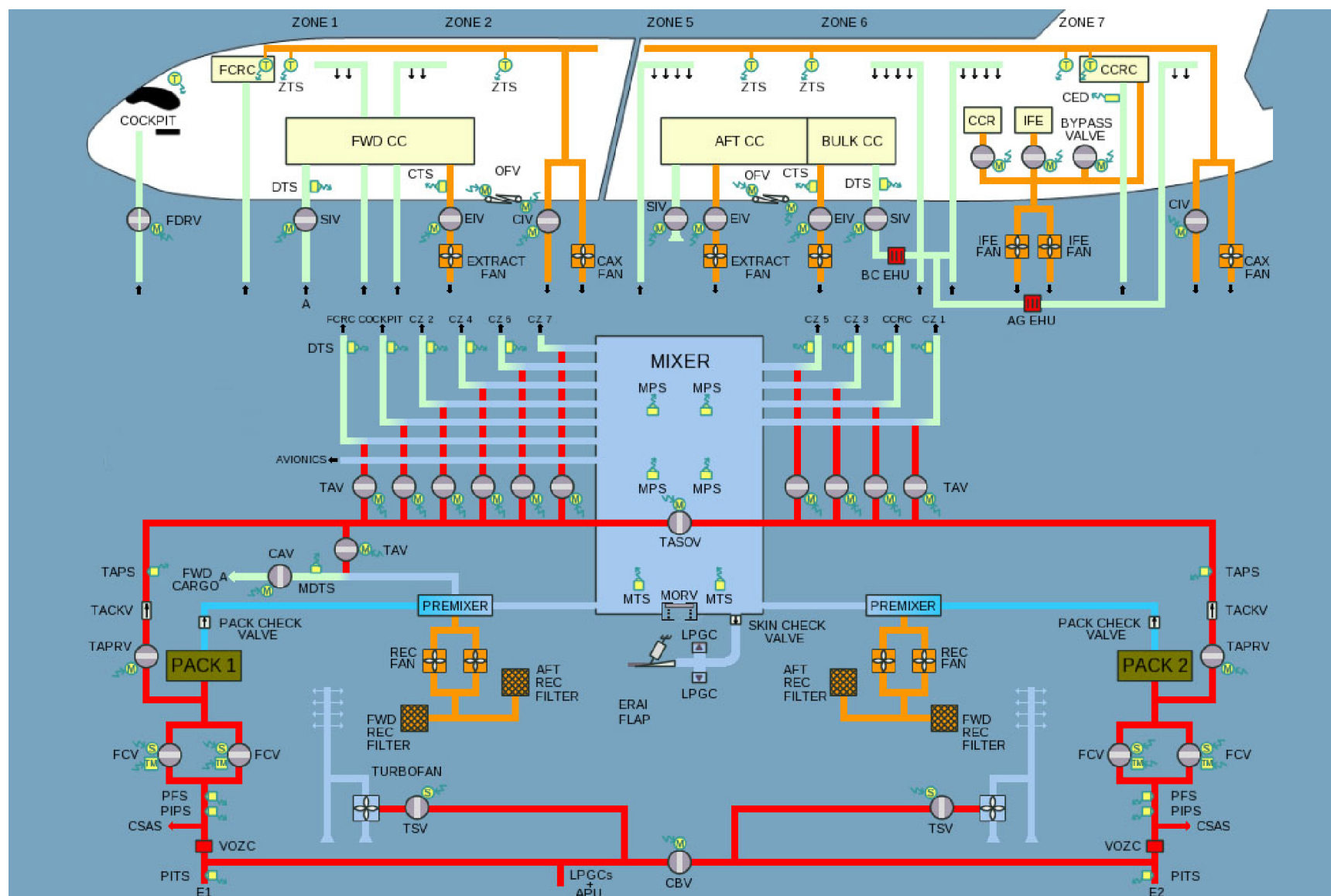
In Automatic or Manual control mode the ERAI flap opens provided the DITCHING P/B SW is not set to ON.


AIR PANEL
EMERGENCY RAM AIR INLET MANUAL CONTROL (2)


BLEED SD PAGE

COND SD PAGE

THIS SD PAGE SHOWS ALL AVAILABLE INDICATIONS BUT NOT A SYSTEM CONFIGURATION

EMERGENCY RAM AIR INLET MANUAL CONTROL (2)



EMERGENCY RAM AIR INLET MANUAL CONTROL (2)

RECIRCULATED AND DISTRIBUTION AIR SYSTEM DESCRIPTION (2/3)

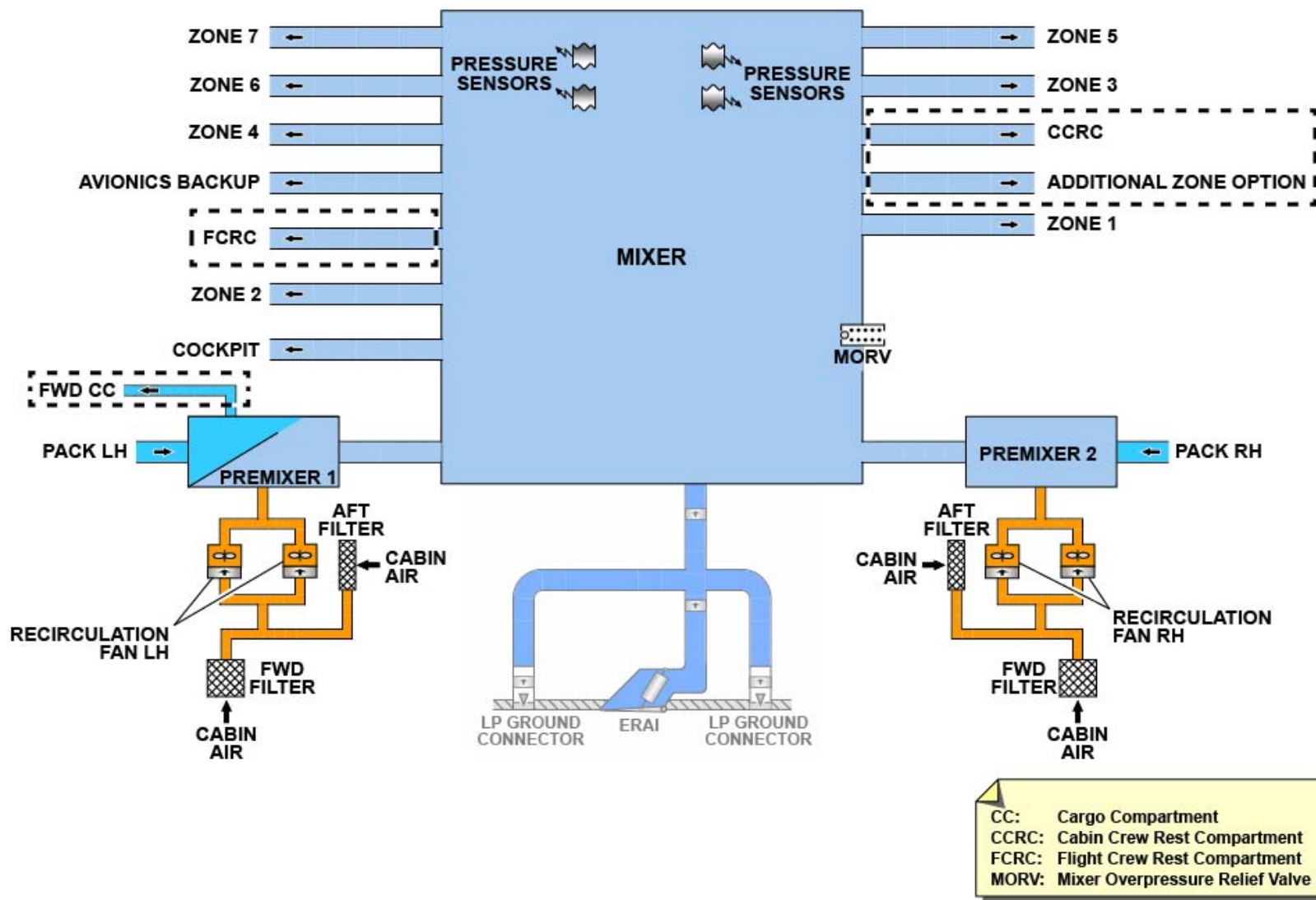
Recirculation and Distribution Air System Presentation

The air recirculation system removes the air from the cabin and mixes it with the fresh air from the air conditioning packs. Then it supplies a permanent airflow to the air distribution system.

The recirculation system removes the cabin air from the left and right side of the A/C. Two recirculation fans are installed on each extraction side to pull air through one FWD and one aft recirculation filter assembly. LH and RH premixers mix cold air from the air conditioning packs with recirculated air from the recirculation fans to prevent ice accretion. The mixed air flows to the mixer before to be distributed to the cabin zones, the cockpit and the avionics ventilation. Also, the LH premixer supplies air to the optional Temperature Control System (TCS) for the FWD cargo compartment. The mixer has four pressure sensors, which control and monitor the recirculation system. A Mixer Overpressure Relief Valve (MORV) prevents overpressure in the mixer.

The air distribution system supplies air from the mixer to:

- The cockpit
- Cabin zones (seven, with optional extra zones)
- The Avionics Ventilation System (AVS) in backup
- The optional Cabin Crew Rest Compartment (CCRC)
- The optional Flight Crew Rest Compartment (FCRC).



RECIRCULATION AND DISTRIBUTION AIR SYSTEM PRESENTATION

RECIRCULATED AND DISTRIBUTION AIR SYSTEM DESCRIPTION (2/3)

Air Recirculation Description/Interfaces

The two Ventilation Control System (VCS) applications, which are installed in the CPIOMs, control and monitor the air recirculation system. One application is in active mode and the other in standby mode. The VCS application control and monitor the recirculation fans with an enable signal through the CRDCs and adjust the fans speed through CAN buses. To adjust the recirculation fans speed, the VCS applications use:

- The position of the AIR FLOW selector SW
- The signal from the mixer pressure sensors
- The recirculation airflow demand from the Air Conditioning System (ACS) applications.

Also, the VCS applications monitor the mixer overpressure through the MORV position feedback.

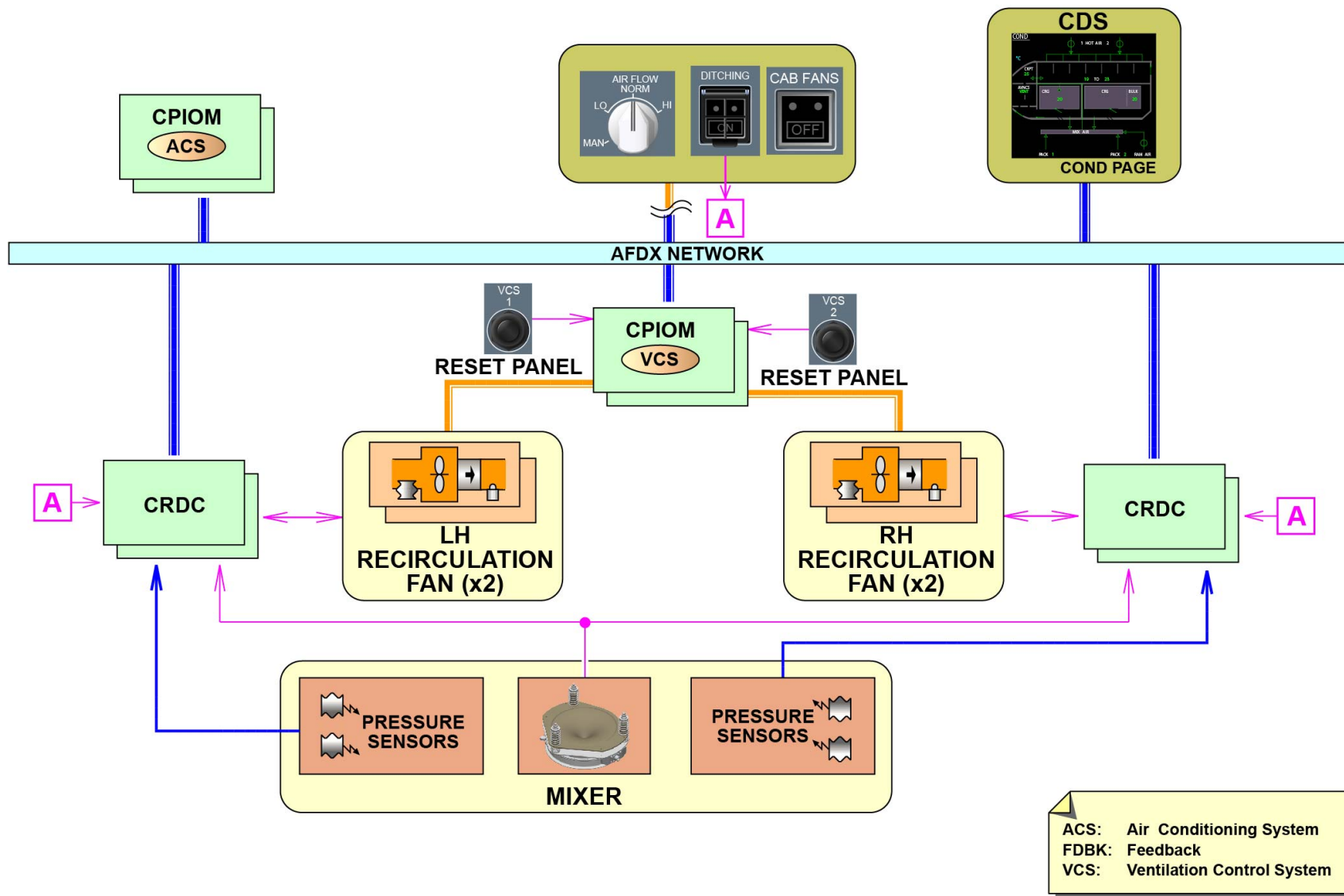
When the recirculation fan speed control through the CAN bus is not possible, the VCS application controls the fans through the CRDCs at default speed.

The recirculation fans stop when:

- The DITCHING P/BSW is pushed
- The CAB FANS P/BSW is set to OFF.

The VCS applications can be reset through the VCS 1 and VCS 2 RESET SWs.

The VCS applications send the system status to the CDS on the COND page.


AIR RECIRCULATION DESCRIPTION/INTERFACES

RECIRCULATED AND DISTRIBUTION AIR SYSTEM DESCRIPTION (2/3)

Air Recirculation Description/Interfaces (continued)

Air Recirculation Components Description

All the recirculation fans are the same and they are installed adjacent to the mixer, at the aft of the FWD cargo compartment. Each recirculation fan has an electrical motor and a control board with field loadable software. Each fan also has a pressure sensor and a flow sensor, which control the fan speed and detect when the filter is clogged.

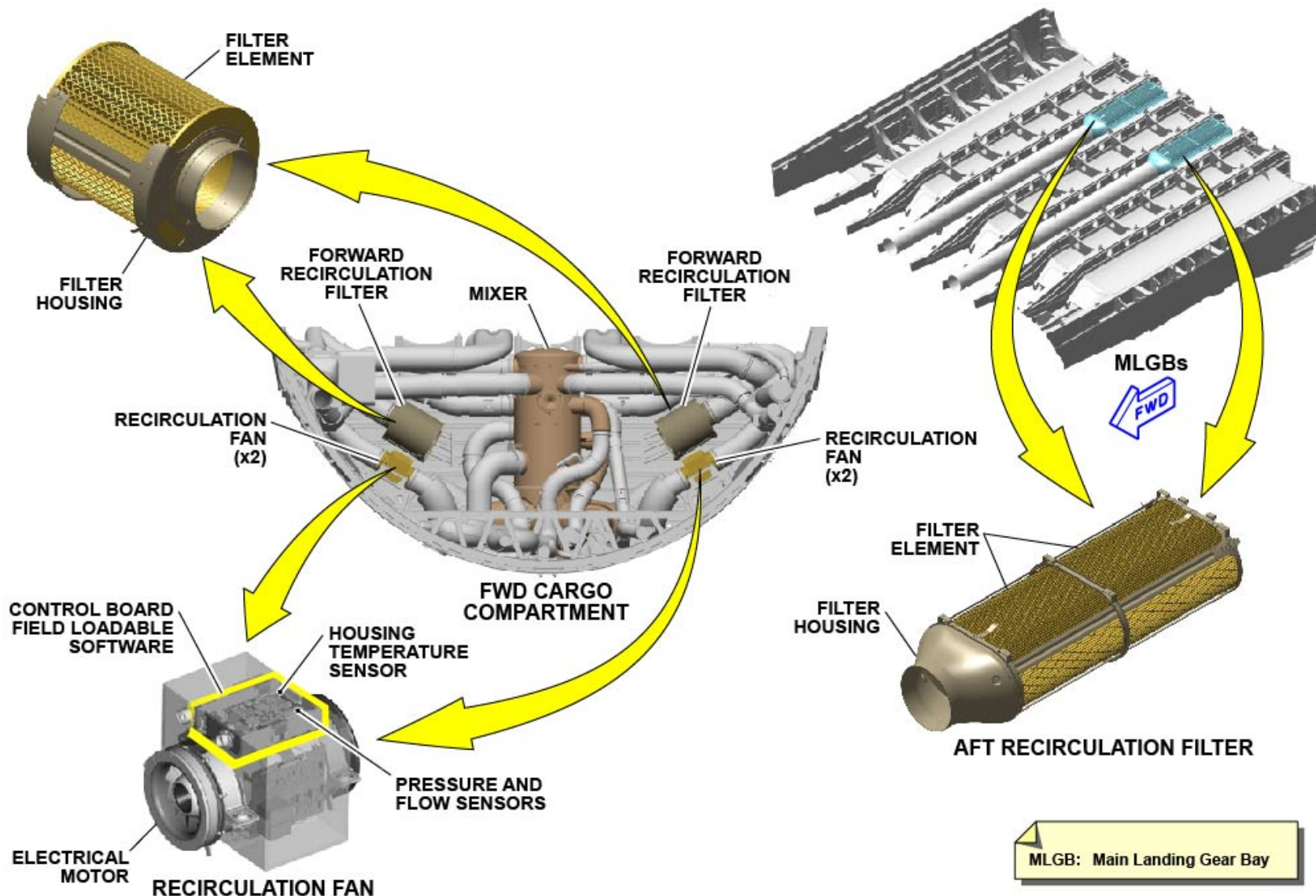
A fan housing temperature sensor prevents the fan overheat.

The recirculation filter assemblies have:

- One or two filter elements (one for the FWD filters and two for the aft filters)
- A filter housing.

The FWD filter assemblies are installed at the aft of the FWD cargo compartment.

The AFT filter assemblies are installed above the Main Landing Gear (MLG) bays. The access of the aft filters assemblies is through the aft cargo compartment.



AIR RECIRCULATION DESCRIPTION/INTERFACES - AIR RECIRCULATION COMPONENTS DESCRIPTION

RECIRCULATED AND DISTRIBUTION AIR SYSTEM DESCRIPTION (2/3)

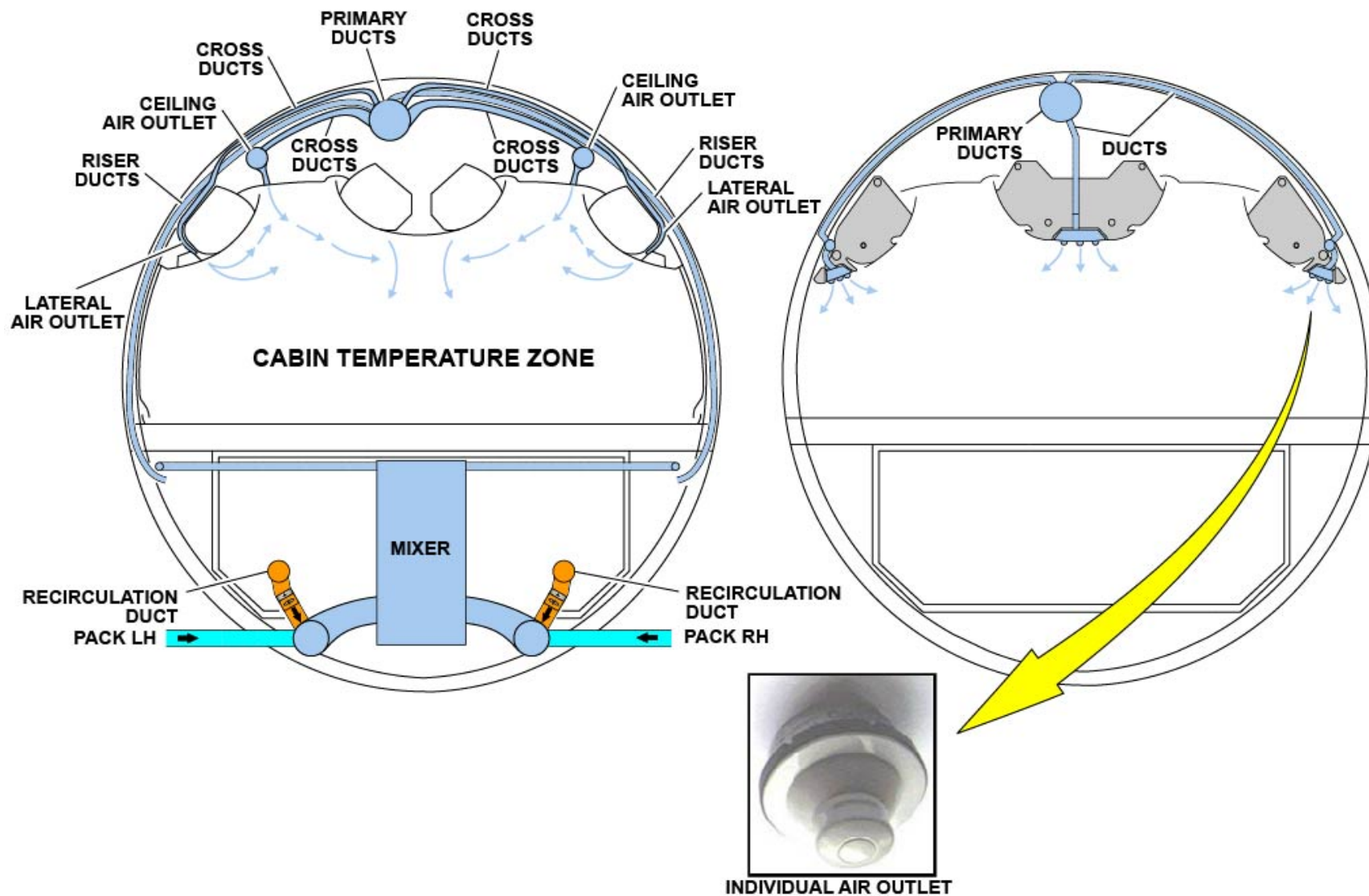
Cabin Air Distribution Presentation

The cabin air distribution system includes the basic cabin air distribution system and the optional cabin air distribution system.

The air from the mixer flows to the cabin zones through air ducts. These air ducts are riser ducts, supply ducts, primary ducts and cross ducts.

The individual cabin air distribution system is optional. The system uses specific ducts to supply air to individual air outlets.

The passengers can adjust air direction and flow with the individual air outlets.



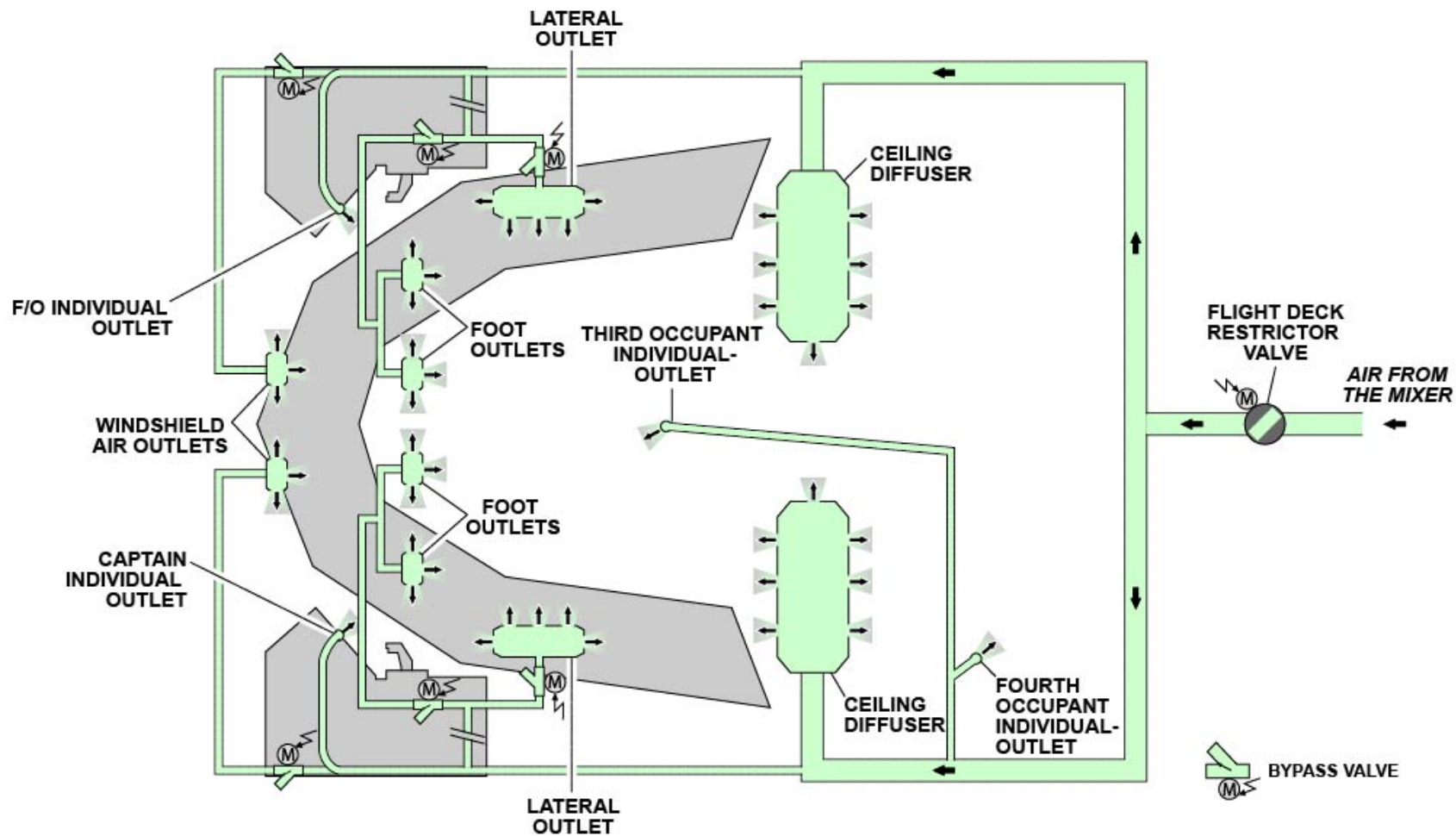
CABIN AIR DISTRIBUTION PRESENTATION

V2414251 - V00T0MM0 - VM21D4RECIR3001

RECIRCULATED AND DISTRIBUTION AIR SYSTEM DESCRIPTION (2/3)

Cockpit Air Distribution Presentation

A routing, which is directly connected to the mixer, supplies air to the cockpit. The air goes permanently to the flight deck through a flight deck restrictor valve and through air outlets and ceiling diffusers. Six electrical bypass valves adjust the airflow quantity that goes to the cockpit.



COCKPIT AIR DISTRIBUTION PRESENTATION

RECIRCULATED AND DISTRIBUTION AIR SYSTEM DESCRIPTION (2/3)

Cockpit Air Distribution Presentation (continued)

Cockpit Air Distribution Description/Interfaces

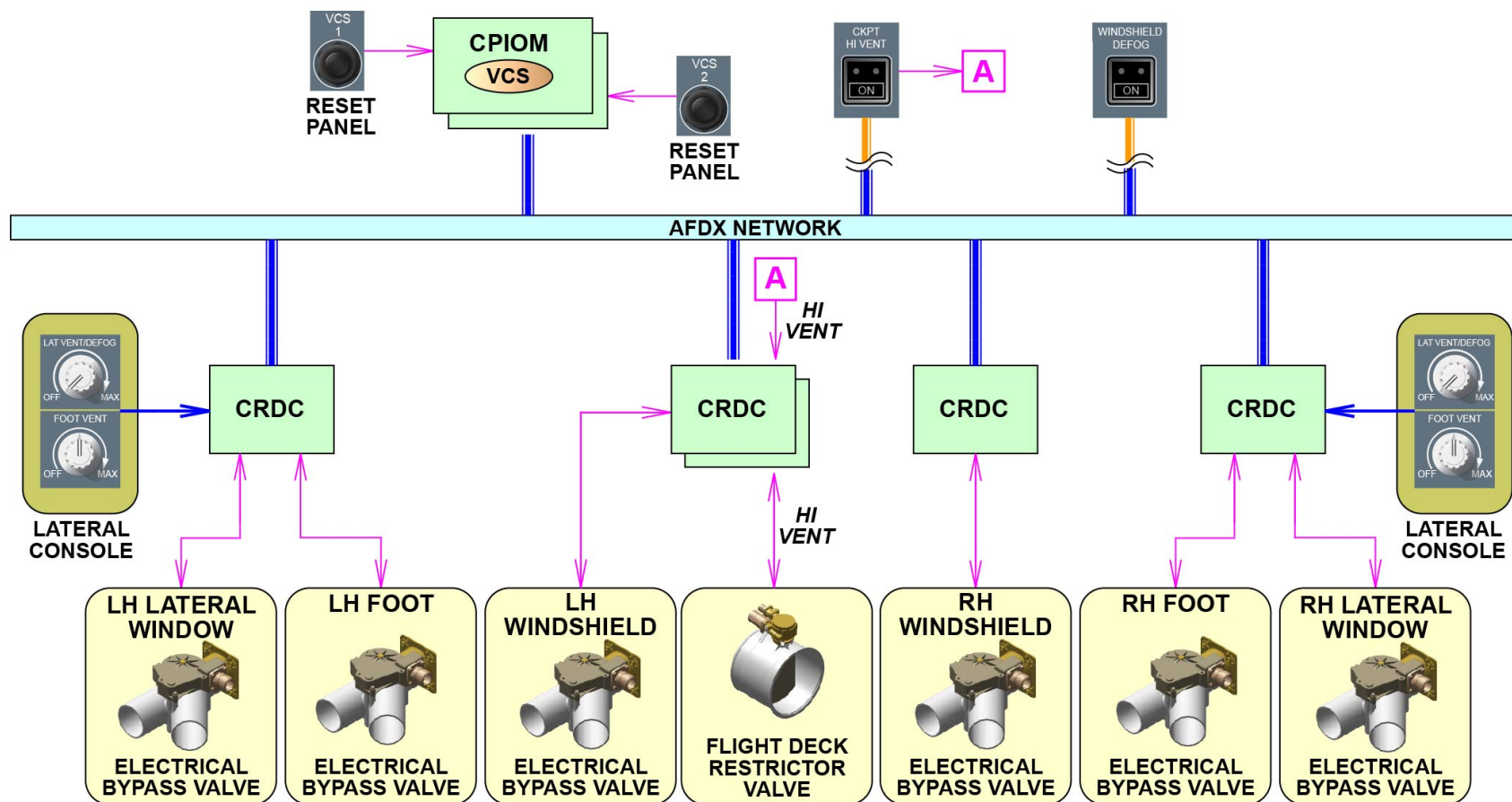
The VCS application, which is installed in two CPIOMs, is the functional software that controls and monitors the cockpit ventilation system. One application is in the active mode the other in the standby mode.

The VCS application:

- Controls and monitors the electrical bypass valves and the flight deck restrictor valve through CRDCs
- Receives the position of the FOOT and LAT VENT/DEFOG rotary selectors to adjust the related electrical bypass valves
- Receives the position of the WINDSHIELD DEFOG P/BSW to control the electrical bypass valves for related windshield
- Receives the position of the CKPT HI VENT P/BSW.

If the CKPT HI VENT P/BSW is pushed, the smoke removal procedure starts and the flight deck restrictor valve and all the electrical bypass valves move to the fully open position. The P/BSW position is sent through AFDX and discrete signal to the CRDCs, which controls the flight deck restrictor valve.

The flight crew can reset the VCS applications through the VCS 1 and VCS 2 RESET SWs.



COCKPIT AIR DISTRIBUTION PRESENTATION - COCKPIT AIR DISTRIBUTION DESCRIPTION/INTERFACES

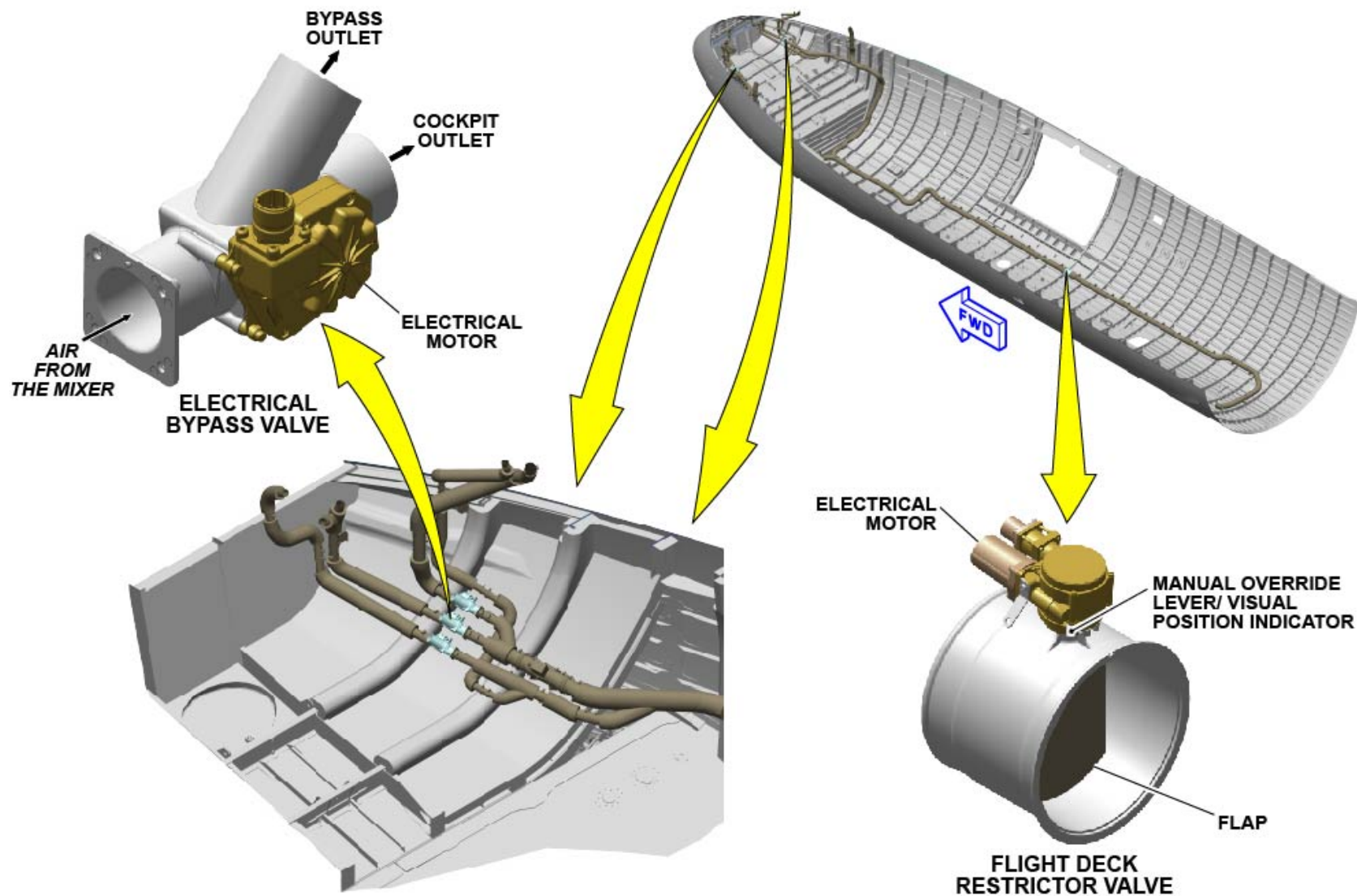
RECIRCULATED AND DISTRIBUTION AIR SYSTEM DESCRIPTION (2/3)

Cockpit Air Distribution Presentation (continued)

Cockpit Air Distribution Components Description

The flight deck restrictor valve is electrically operated and has a flap with a cutaway, to let airflow through the valve when it is in the fully closed position. The valve has a manual override lever to manually set to the open or closed position. The manual override lever has a visual position indicator.

Each electrical bypass valve is electrically operated and has different positions. When the valve is in the fully closed position no airflow is supplied to the cockpit outlet. When the crew adjust the airflow, the air goes through the bypass outlet and then into the avionics compartment.



COCKPIT AIR DISTRIBUTION PRESENTATION - COCKPIT AIR DISTRIBUTION COMPONENTS DESCRIPTION

V2414251 - V00T0MM0 - VM21D4RECIR3001

CABIN AND COCKPIT AIR TEMPERATURE CONTROL SYSTEM DESCRIPTION (2/3)

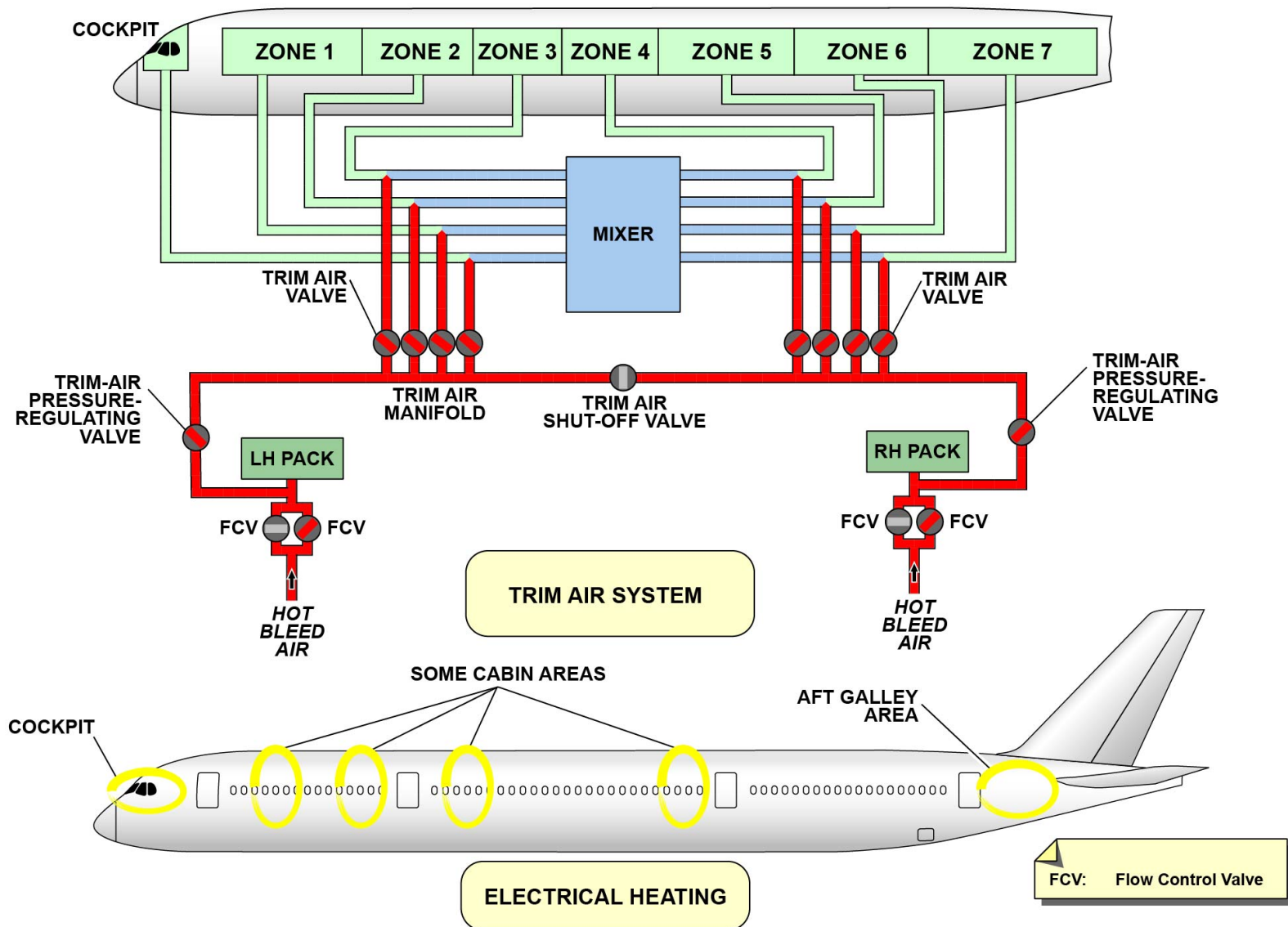
Cabin & Cockpit Temperature Control System (TCS)

Presentation

The cabin and cockpit Temperature Control System (TCS) gives an automatic temperature control of the cockpit and individual cabin zones, for the comfort of the crew and passengers. The TCS includes the trim air system and the electrical heating system.

The trim air system supplies hot bleed air to the cockpit and the cabin air distribution-ducts, to have air at the desired temperature. The trim air system uses hot bleed air taken downstream of the Flow Control Valves (FCVs) to supply the trim air manifold through the trim air pressure regulating valves and trim air valves.

The electrical heating system is an additional heating source in case the trim air system causes cost and installation constraints. The electrical heating system is used in the cockpit, the aft galley area, and in some cabin areas concerned by inhomogeneous heat load distribution.



CABIN & COCKPIT TEMPERATURE CONTROL SYSTEM (TCS) PRESENTATION

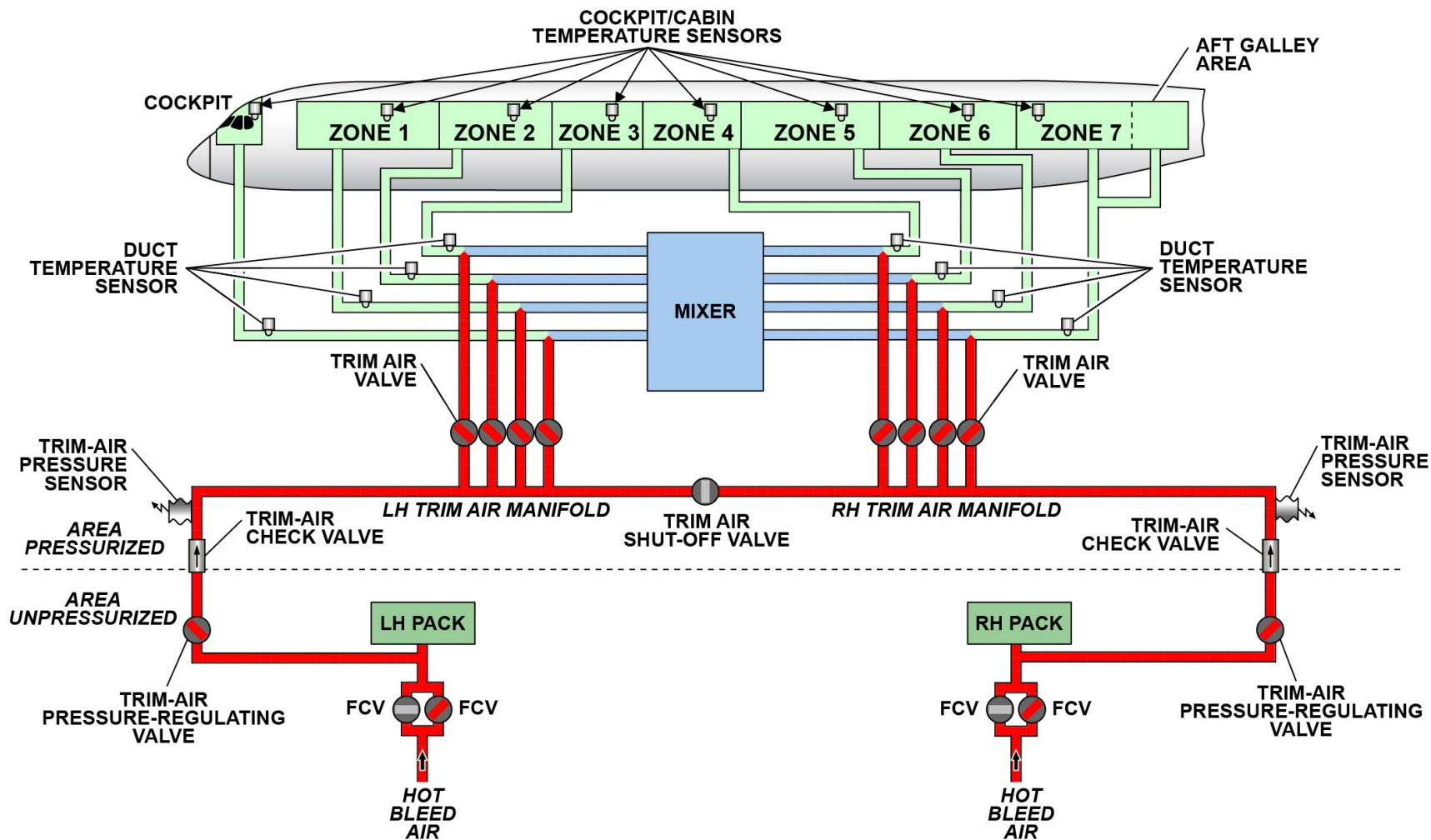
CABIN AND COCKPIT AIR TEMPERATURE CONTROL SYSTEM DESCRIPTION (2/3)

Trim Air System Presentation

The trim air system adds hot bleed air to the air coming from the mixer for the cockpit and cabin temperature zones. The rear cabin zone includes aft galley area.

The trim air system includes:

- Two trim-air pressure-regulating valves, to regulate the hot air pressure in the LH and RH trim air manifold sides
- Two trim-air check valves, one for each trim air manifold side. It prevents reverse airflow, from the pressurized area to the unpressurized area
- Two trim-air pressure sensors, measure the pressure downstream of the trim-air pressure-regulating valves
- A trim air shut-off valve, isolates the LH and the RH trim air manifold sides. When the trim air system does not supply hot air to one side, the valve opens to keep the system fully operational
- Trim air valves modulate hot bleed air flow to adjust the temperature
- Duct temperature sensors measure the air temperature downstream of the trim air valve
- A cabin/cockpit temperature sensor measures the temperature in the cabin zones and in the cockpit.



TRIM AIR SYSTEM PRESENTATION

CABIN AND COCKPIT AIR TEMPERATURE CONTROL SYSTEM DESCRIPTION (2/3)

Trim Air System Presentation (continued)

Trim Air System Description/Interfaces

The Air Conditioning System (ACS) application, which is hosted in two CPIOMs and two Air Supply Control Units (ASCUs), control and monitor the trim air system. Each ASCU has two channels, one in active mode and the other in standby mode, to control and monitor trim air manifold sides (LH or RH) with data from ACS applications. ASCUs open or close the trim-air pressure-regulating valves, in accordance with the status of the HOT AIR 1 and HOT AIR 2 P/BSWs. Each ASCU uses data from the trim-air pressure sensors to control and adjust the trim-air pressure-regulating valves in order to keep the trim air manifold pressure above the cabin pressure.

The ACS application and the CRDCs send the cabin/cockpit temperature demand and the actual cabin/cockpit temperature to the ASCUs. Then, the ASCUs calculate the duct temperature demand for each cabin zone and cockpit. The ASCUs compare the duct temperature demand with the actual duct temperature from the duct temperature sensor. The ASCUs control the supplied air temperature by adjusting the related trim air valves.

The flight crew selects the temperature demand for the cockpit and the cabin through the COCKPIT and CABIN rotary selectors.

When the CABIN rotary selector is in the PURS SEL position, the cabin crew can set the temperature for each cabin temperature zone with the FAP.

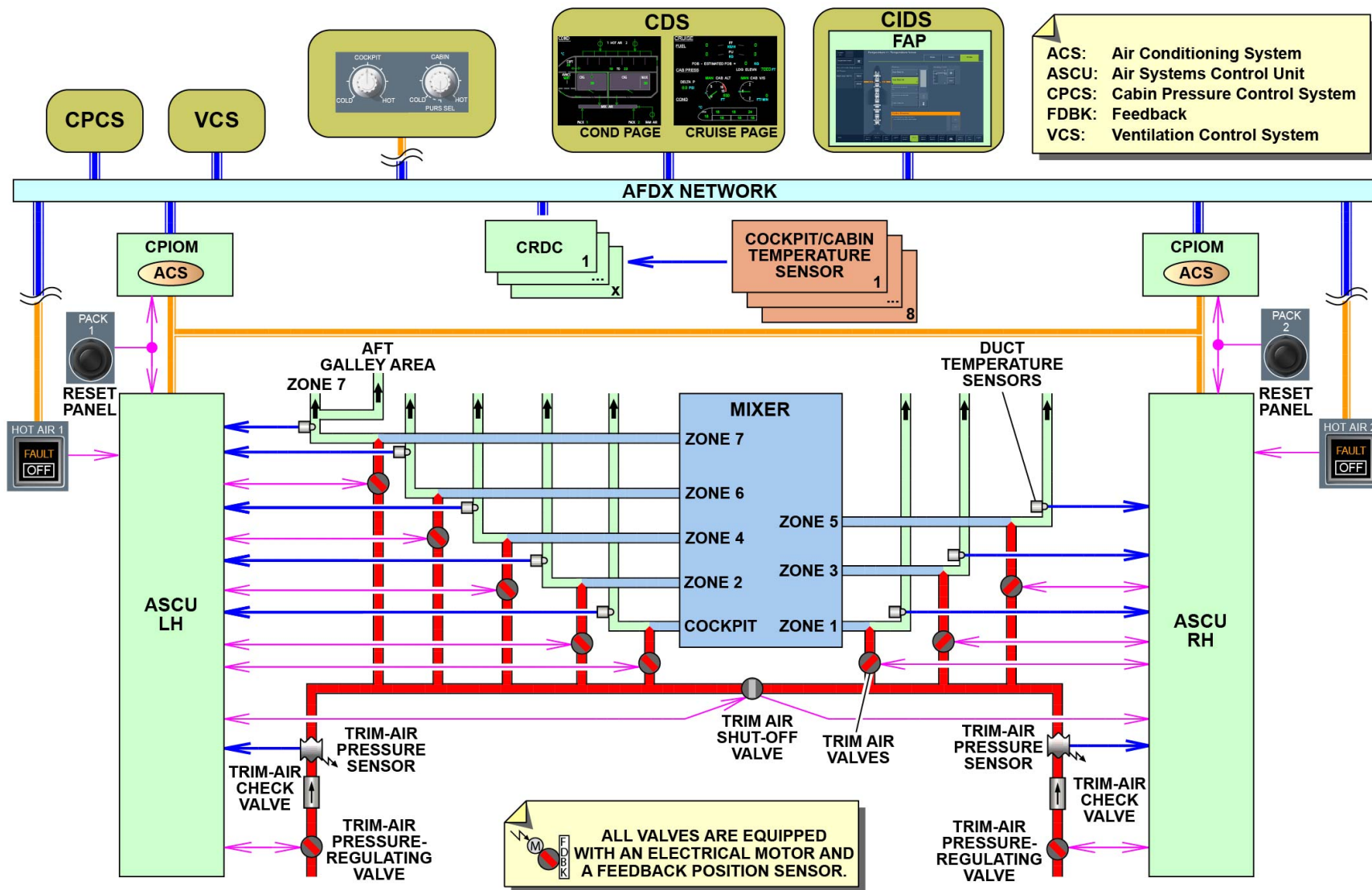
The trim air shut-off valve is usually closed. The two ASCUs monitor the valve and if a failure occurs in one of the trim air manifolds, the left ASCU opens the trim air shut-off valve.

The Cabin Pressure Control System (CPCS) application sends cabin pressure data to the ACS application. Then, the ACS application transmits this data to the ASCUs to adjust the air pressure in the trim air manifold above the cabin pressure.

The ACS application is in interface with Ventilation Control System (VCS) to make sure that the Compartment Air Extraction (CAX) system correctly ventilates the cabin temperature sensors. If not, the ACS uses a back-up temperature control-mode.

The trim air system status is shown on the COND and CRUISE ECAM pages of the CDS.

ASCUs and ACS applications can be reset by PACK 1 (2) RESET SWs.



TRIM AIR SYSTEM PRESENTATION - TRIM AIR SYSTEM DESCRIPTION/INTERFACES

V2414251 - V00T0MM0 - VM21D6TEMPC3001

CABIN AND COCKPIT AIR TEMPERATURE CONTROL SYSTEM DESCRIPTION (2/3)

Trim Air System Presentation (continued)

Trim Air System Components Description

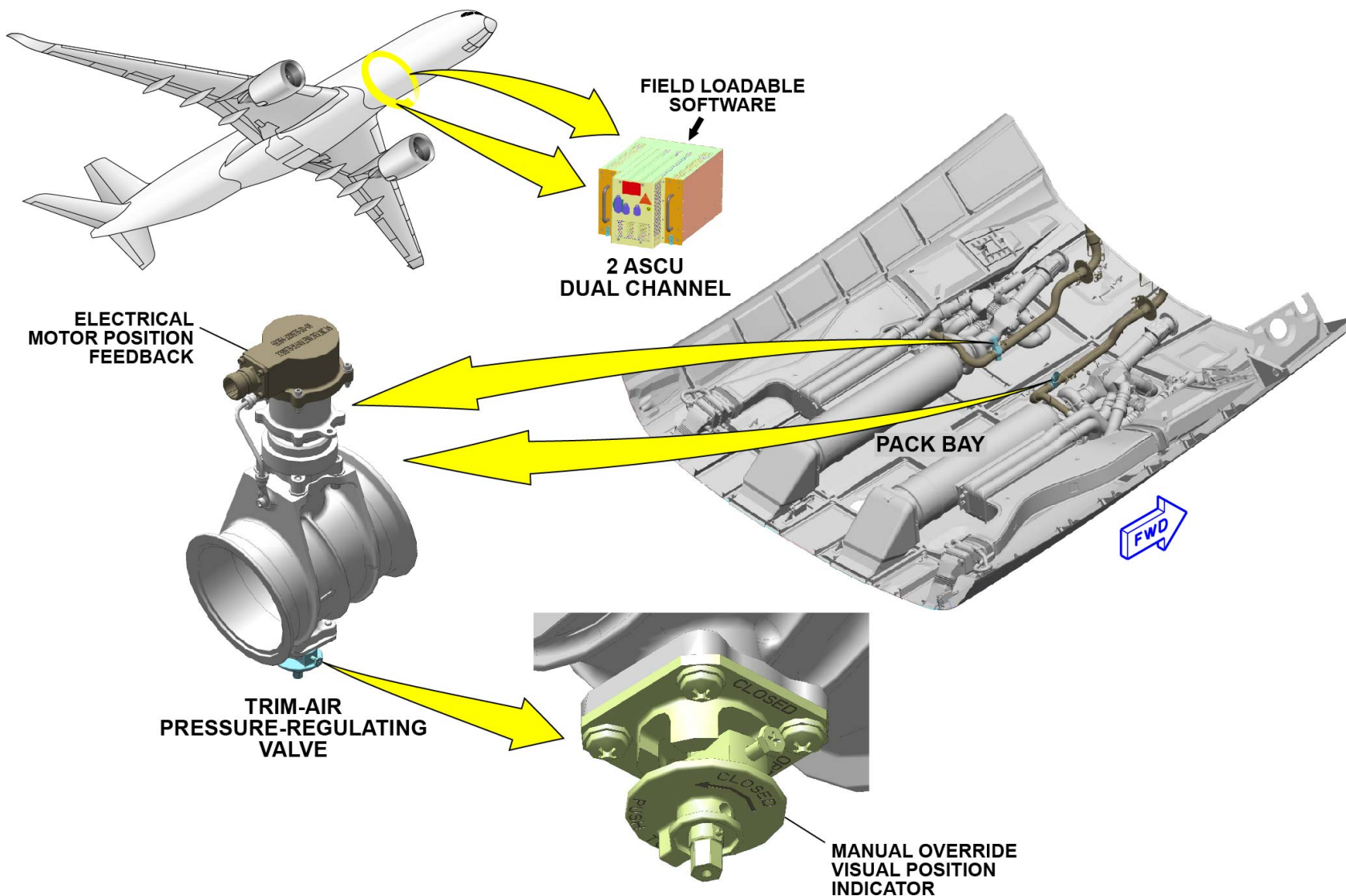
There are two ASCUs, which have dual channel and field loadable software.

The trim-air pressure-regulating valve has an electrical motor which supplies position feedback signal for monitoring. The valve also has a manual override and a visual position indicator for deactivation purposes.

The trim air valve has an electrical motor which supplies feedback signal for monitoring. The trim air valve has a manual override with a lock bolt and a visual position indicator for deactivation purposes.

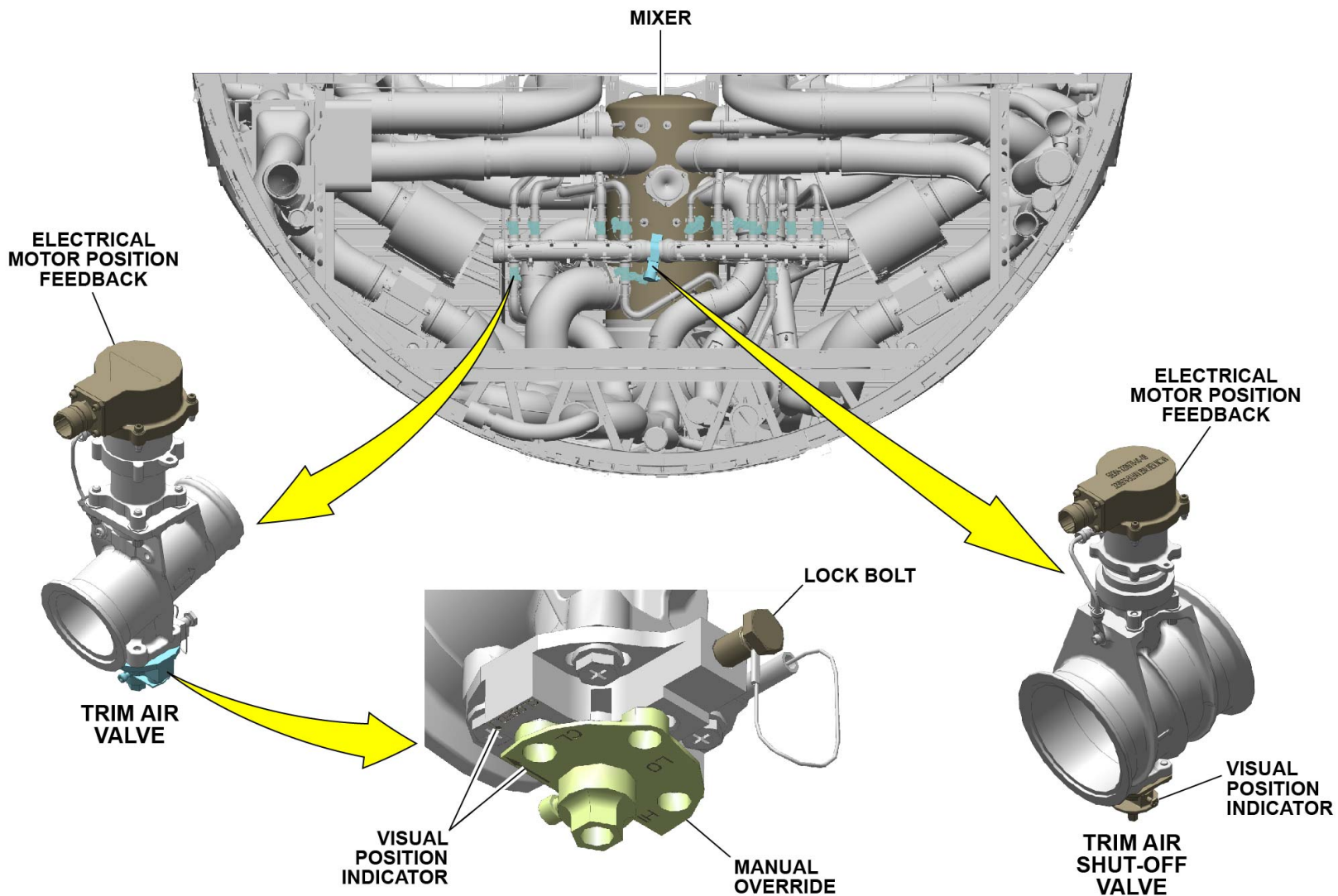
The trim air shut-off valve has an electrical motor which supplies position feedback for monitoring. The valve has a visual position indicator.

The cabin and cockpit temperature system has a cabin, cockpit and duct temperature sensors. All these temperature sensors have a dual element. The cabin temperature sensor housings have a filter which can be replaced.



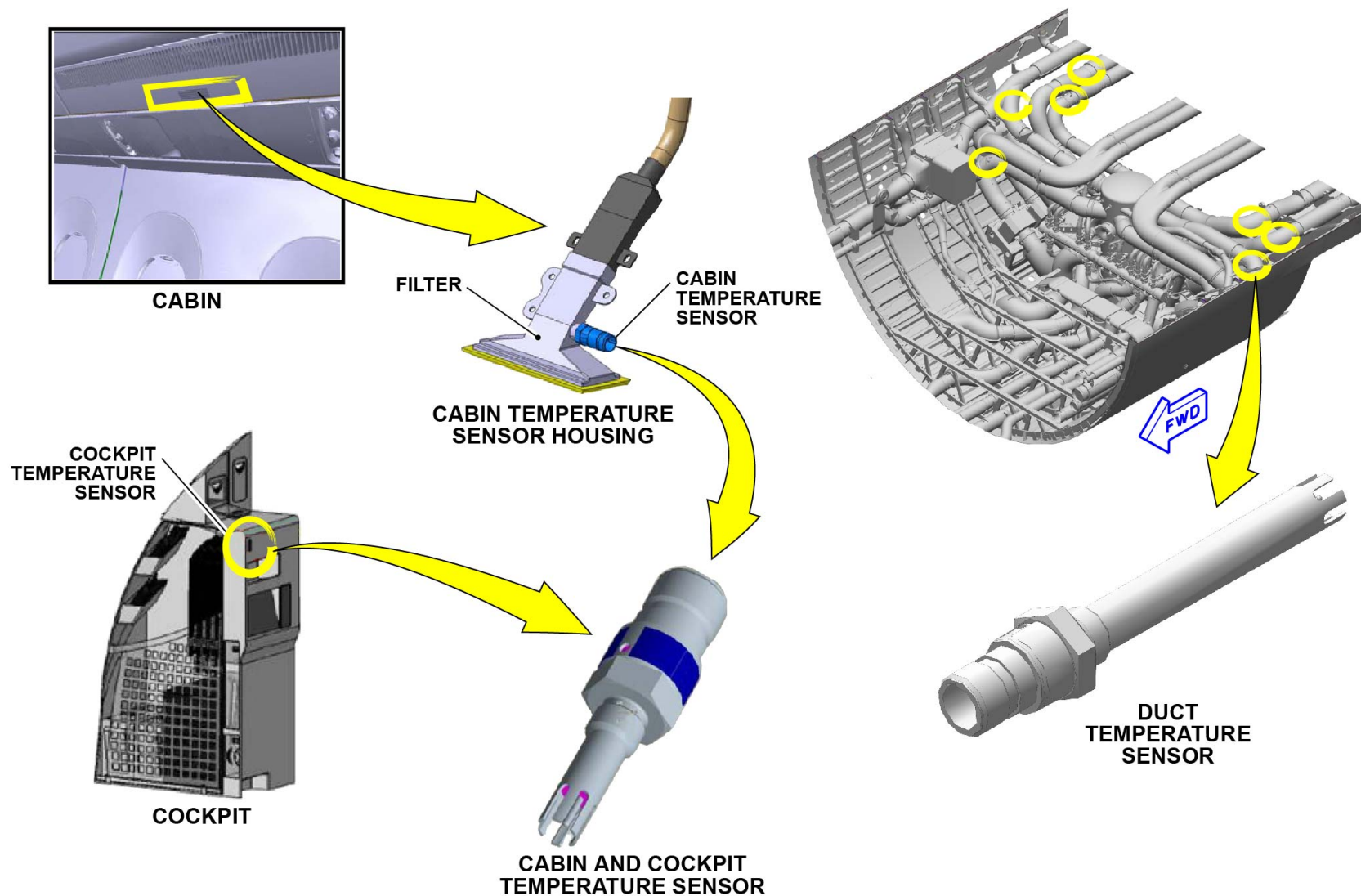
TRIM AIR SYSTEM PRESENTATION - TRIM AIR SYSTEM COMPONENTS DESCRIPTION

V2414251 - V00T0MM0 - VM21D6TEMPC3001



TRIM AIR SYSTEM PRESENTATION - TRIM AIR SYSTEM COMPONENTS DESCRIPTION

V2414251 - V00T0MM0 - VM21D6TEMPC3001



TRIM AIR SYSTEM PRESENTATION - TRIM AIR SYSTEM COMPONENTS DESCRIPTION

CABIN AND COCKPIT AIR TEMPERATURE CONTROL SYSTEM DESCRIPTION (2/3)

Electrical Heating System Presentation

The electrical heating system uses electrical heaters for aft galley area, cockpit and optionally in some cabins area.

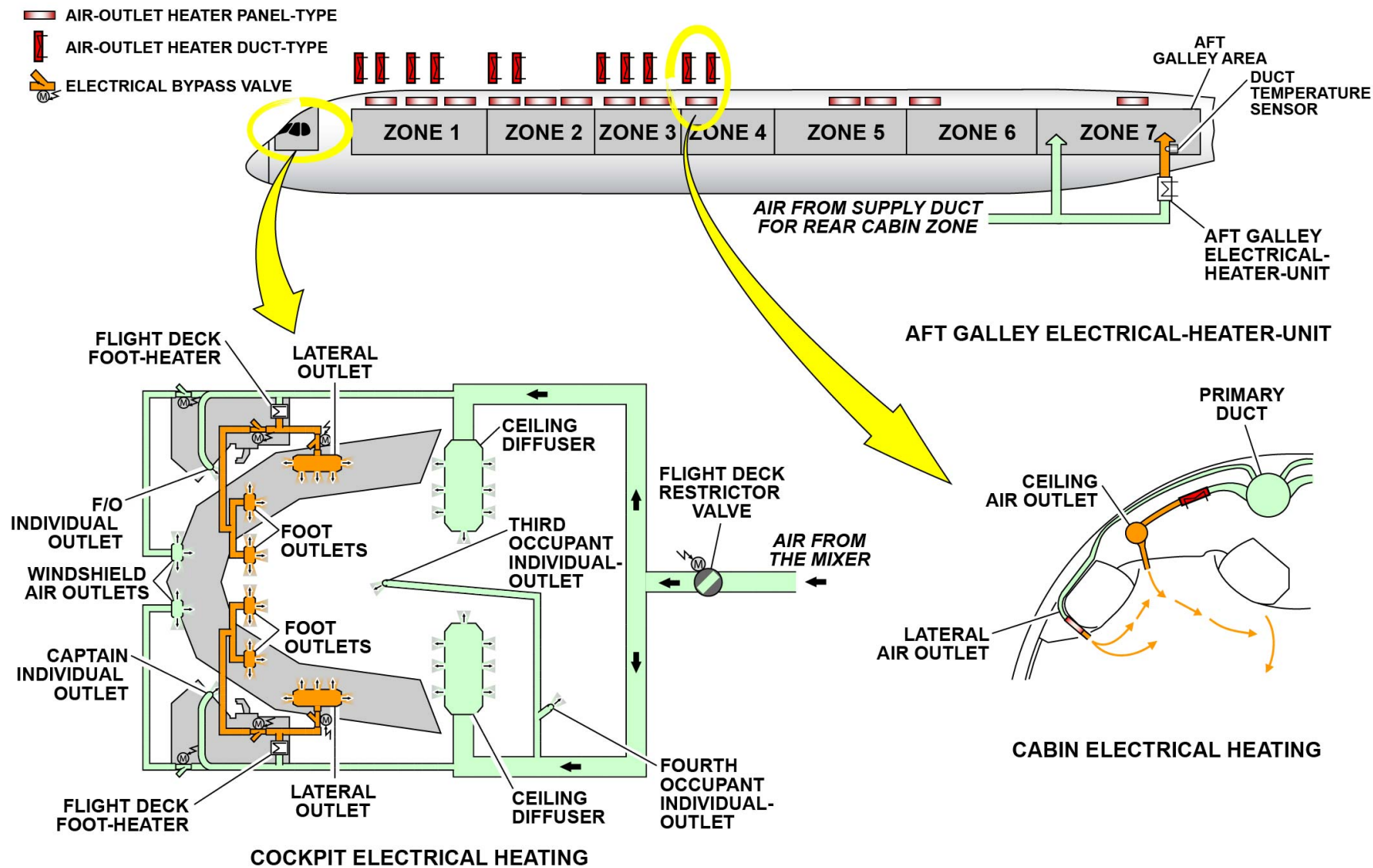
For a comfortable temperature in the galley, an aft galley electrical-heater-unit increases the temperature of the air that goes to aft galley area. The air for the aft galley area ventilation comes from the mixer, through the duct used for the rear cabin zone (zone seven). A duct temperature sensor gives the duct temperature data for the control and monitoring.

For the cockpit electrical heating two flight deck foot-heaters increase the temperature of the air that comes from the mixer through the flight deck restrictor valve. The flight deck foot-heaters, which are installed on each side of the cockpit, supply warm air through the electrical bypass valves to the feet and lateral windows outlets.

The optional cabin area electrical heating system can also increase the temperature of the air that comes from distribution ducts.

There are two types of electrical heaters:

- Air-outlet heater panel-type for some lateral air outlets
- Air-outlet heater duct-type for some ceiling air outlets.



ELECTRICAL HEATING SYSTEM PRESENTATION

CABIN AND COCKPIT AIR TEMPERATURE CONTROL SYSTEM DESCRIPTION (2/3)

Electrical Heating System Presentation (continued)

Electrical Heating System Description Interfaces

For the aft galley heating system, the ACS application uses the FAP aft galley temperature selection to calculate the duct temperature demand and transmits it to the single channel-electrical heater-controller. The ACS application and the single channel-electrical heater-controller monitor the system. The single channel-electrical heater-controller uses data from the duct temperature sensor to control the monitor the electrical heater unit.

ACS application transmits ON/OFF command to the single channel-electrical heater-controller through the CAN bus and also through CRDCs and discrete signal.

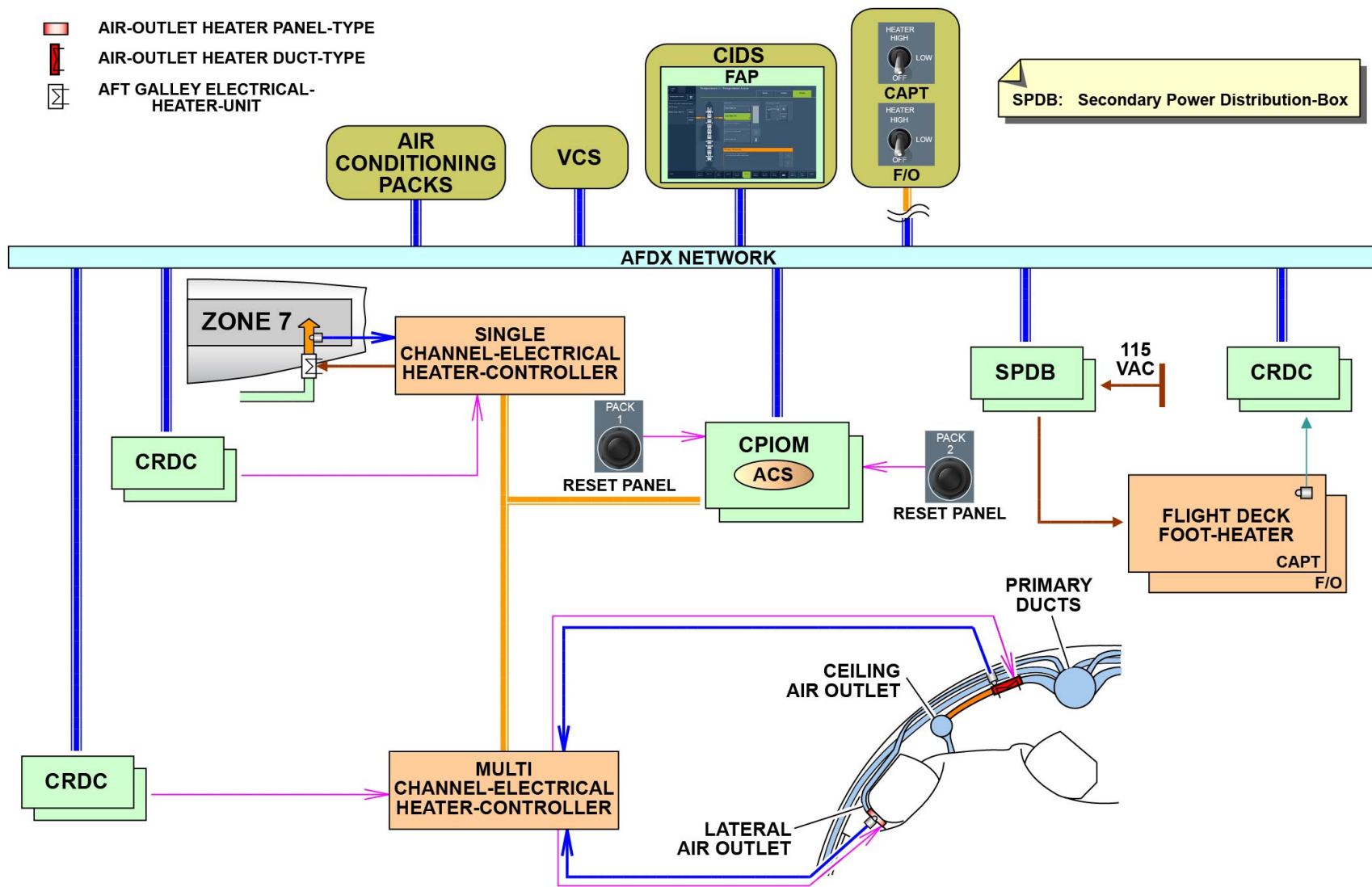
For cockpit heating system the ACS application controls and monitors the system. The application receives the heating demand from CAPT and F/O HEATER toggle SWs. The ACS application uses data from the temperature sensor which is installed in flight deck foot-heater through the CRDCs. These data are used to control the heating level of flight deck foot-heater through the Second Power Distribution Box (SPDBs).

For the cabin area heating system, the ACS application and the multi channel-electrical heater-controller monitor the system. The ACS application transmits to the multi channel-electrical heater-controller the temperature demand from the FAP. The multi channel-electrical heater-controller controls the temperature through a sensor installed in the air-outlet heater panel-type and in the air-outlet heater duct-type. The ACS application transmits an ON/OFF command to the multi channel-electrical heater-controller through the CAN bus and also through CRDCs and discrete signal.

The ACS application inhibits the electrical heating system for the cockpit if the ventilation airflow is not sufficient. The VCS and air conditioning packs provide data to the ACS application.

The ACS applications can be reset through PACK 1(2) RESET SWs.

V2414251 - V00T0MM0 - VM21D6TEMPC3001



ELECTRICAL HEATING SYSTEM PRESENTATION - ELECTRICAL HEATING SYSTEM DESCRIPTION INTERFACES

CABIN AND COCKPIT AIR TEMPERATURE CONTROL SYSTEM DESCRIPTION (2/3)

Electrical Heating System Presentation (continued)

Electrical Heating System Components Description

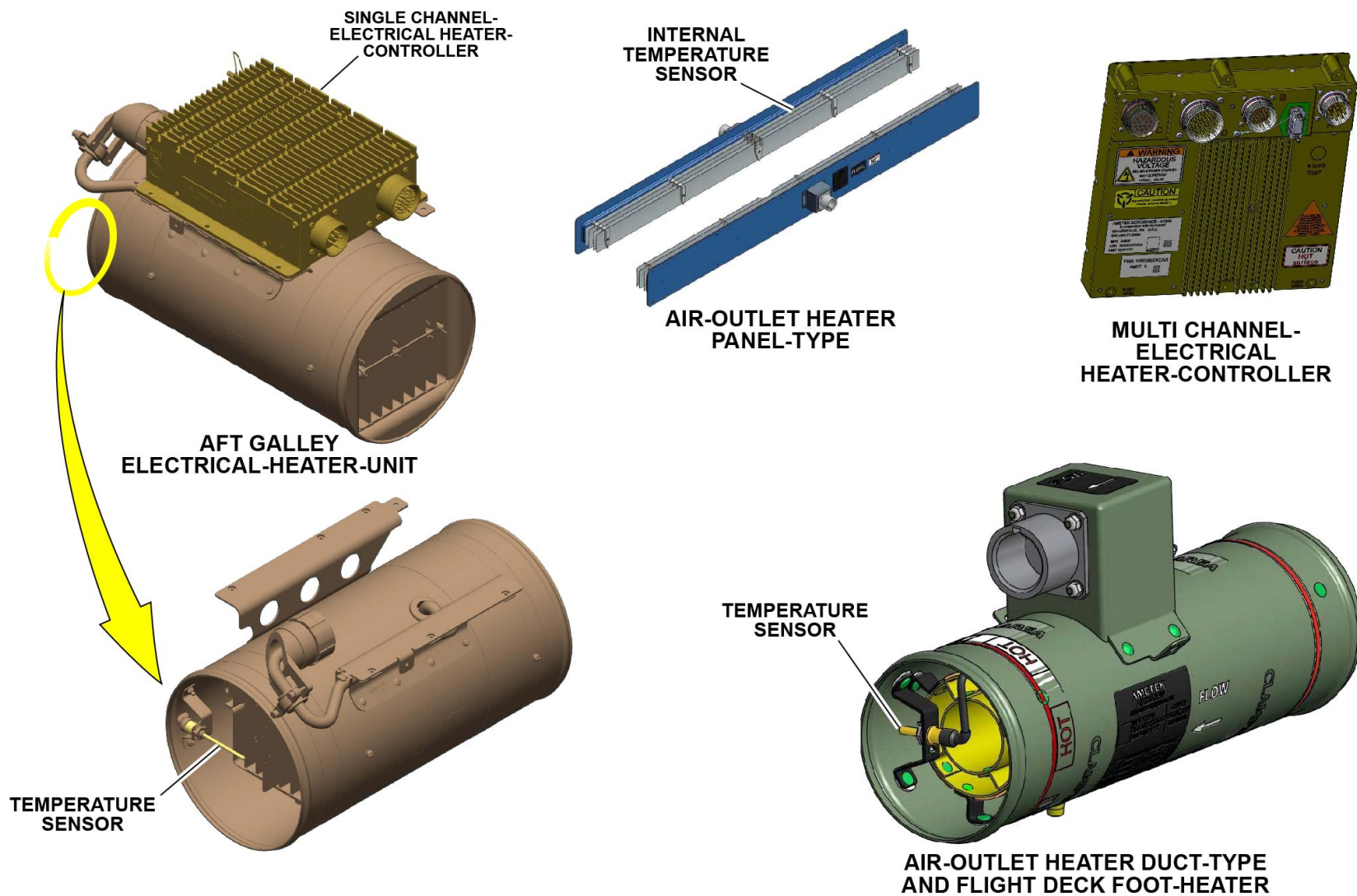
Each aft galley electrical-heater-unit has an internal temperature sensor.

The single channel-electrical heater-controller used for the aft galley electrical-heater-unit is a LRU.

The air-outlet heater duct-type and the flight deck foot-heater are the same. Each has an internal temperature sensor.

The air-outlet heater panel-type has an internal temperature sensor.

One or more multi channel-electrical heater-controller, control the air outlet heaters. One multi channel-electrical heater-controller can control air outlet heaters (maximum of 12 air outlet heaters). It is an LRU, which is installed separately from the heaters.



ELECTRICAL HEATING SYSTEM PRESENTATION - ELECTRICAL HEATING SYSTEM COMPONENTS DESCRIPTION

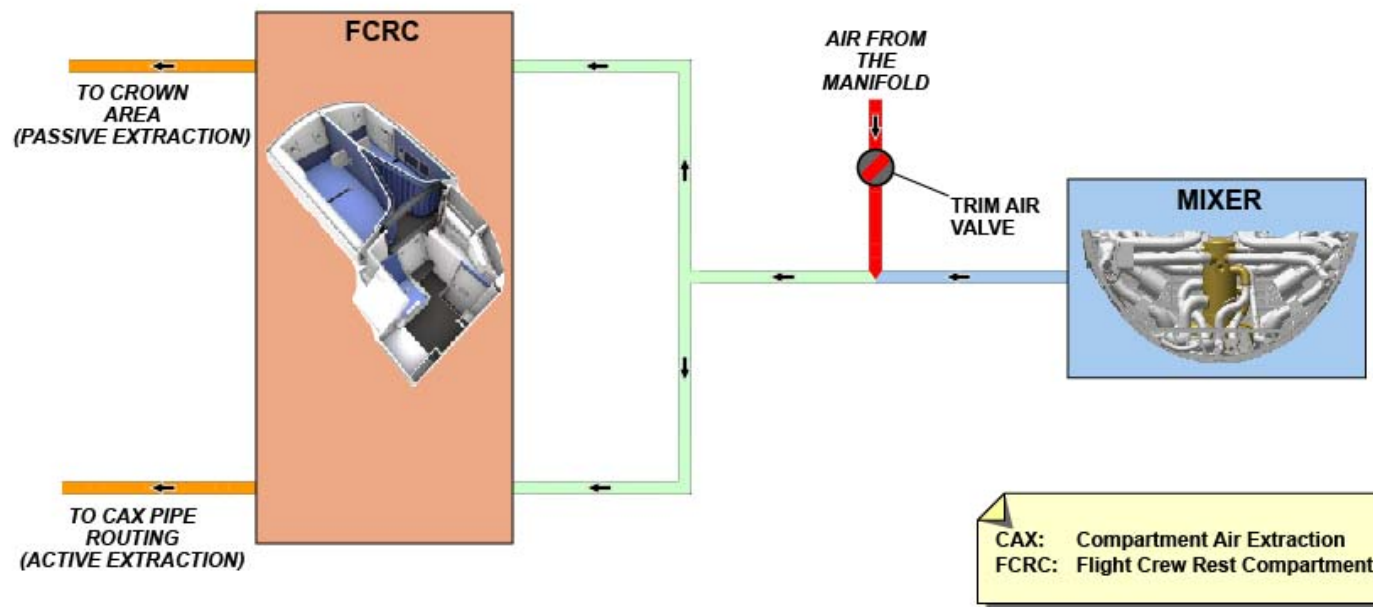
FLIGHT CREW REST COMPARTMENT AND CABIN CREW REST COMPARTMENT DESCRIPTION (OPTION) (2/3)

FCRC Ventilation and Temperature System Presentation

One Flight Crew Rest Compartment (FCRC) is optionally installed in the A/C.

FCRC ventilation is made through air supplied from the mixer unit. From the FCRC, the air is extracted to the cabin crown area (passive extraction via positive pressure) and to the Compartment Air Extraction (CAX) pipe routing (active extraction).

Compartment air temperature is controlled with hot air supplied by a specific trim air valve.



FCRC VENTILATION AND TEMPERATURE SYSTEM PRESENTATION

FLIGHT CREW REST COMPARTMENT AND CABIN CREW REST COMPARTMENT DESCRIPTION (OPTION) (2/3)

FCRC Ventilation and Temperature System

Description/Interface

FCRC temperature control is managed by the Air Conditioning System (ACS) application hosted in two CPIOMs and the LH Air Systems Control Unit (ASCU).

The FCRC has a duct temperature sensor and a compartment temperature sensor.

The duct temperature sensor sends temperature data to the LH ASCU and the compartment temperature sensor sends temperature data to the ACS application through a CRDC.

The ACS application sends temperature demand and actual compartment temperature to the LH ASCU.

LH ASCU calculates the quantity of hot trim air that is necessary and adjusts the temperature by the dedicated trim air valve.

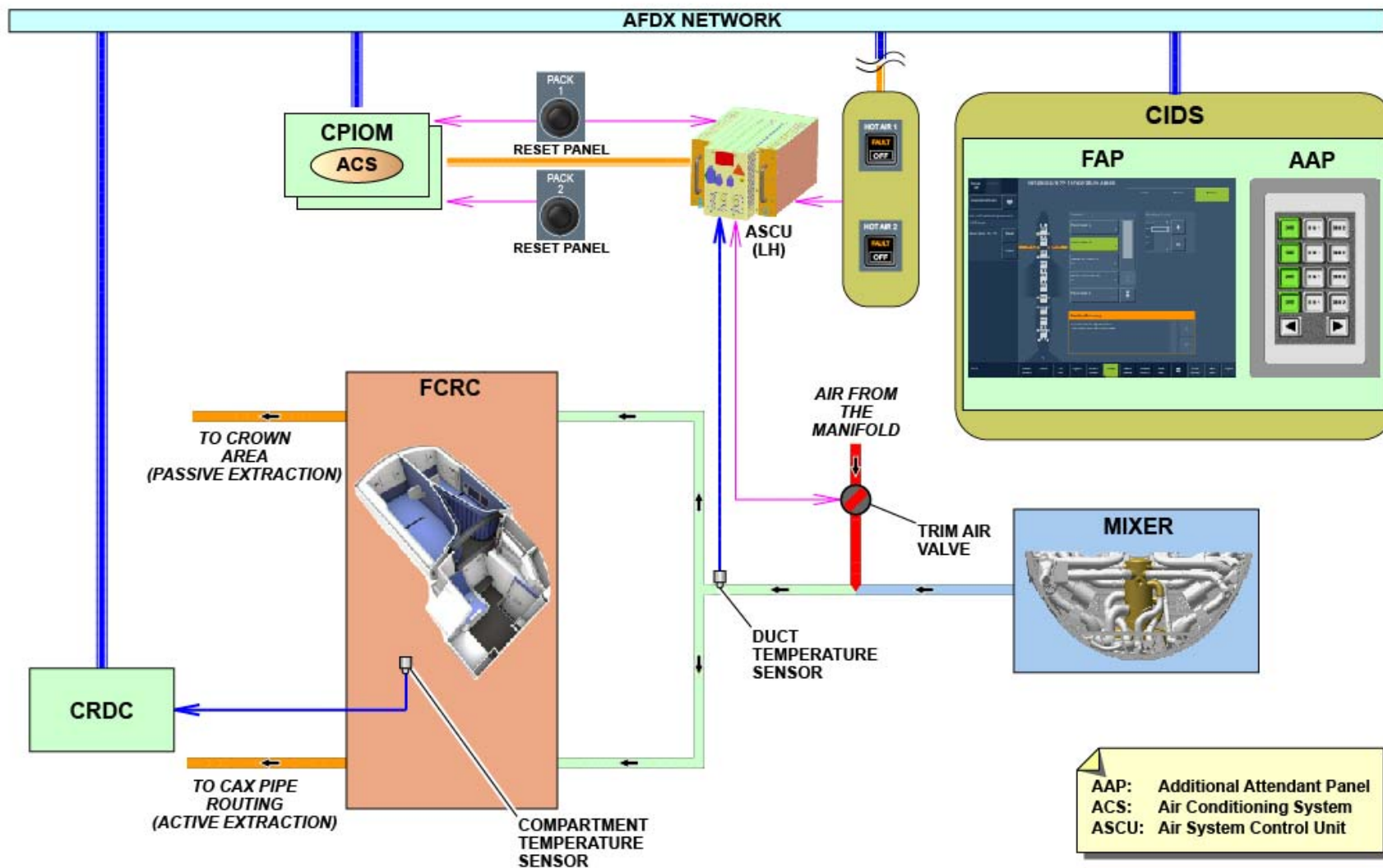
Quantity of hot trim air is monitored by duct temperature sensor.

The FCRC temperature control is provided by means of an Additional Attendant Panel (AAP) located inside the compartment and/or FAP connected with the CIDS.

The temperature control of FCRC is inhibited by HOT AIR 1&2 P/BSWs on OFF position.

The PACK1 RESET SW reset the LH ASCU controller as well as one ACS application, and PACK2 RESET SW reset the other ACS application.

V2414251 - V00T0MM0 - VM21D9CRCD03001



FCRC VENTILATION AND TEMPERATURE SYSTEM DESCRIPTION/INTERFACE

FLIGHT CREW REST COMPARTMENT AND CABIN CREW REST COMPARTMENT DESCRIPTION (OPTION) (2/3)

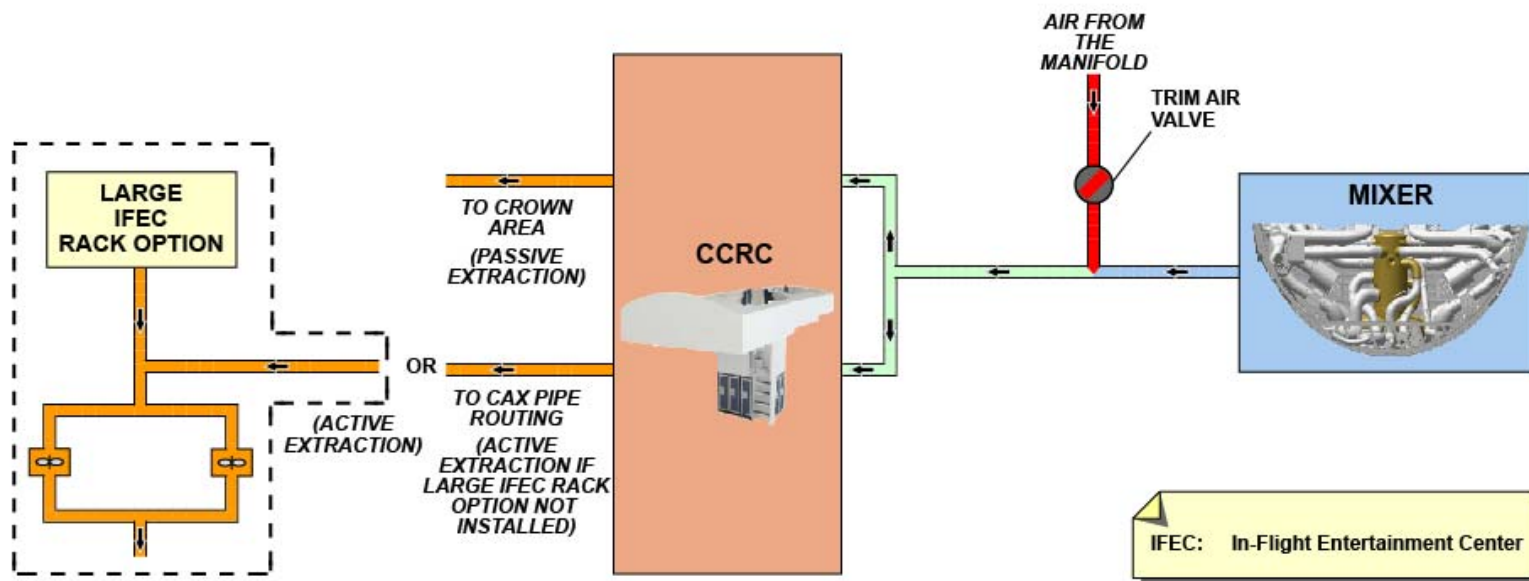
CCRC Ventilation and Temperature System Presentation

One Cabin Crew Rest Compartment (CCRC) is optionally installed in the A/C.

The CCRC ventilation is made through air supplied from the mixer unit. From the CCRC, the air is extracted to the cabin crown area through passive extraction via positive pressure.

Air extraction is also made through active extraction to the CAX pipe routing or to the In-Flight Entertainment Center (IFEC) extraction if large IFEC rack option is installed.

Compartment air temperature is controlled with hot air supplied by a dedicated trim air valve.



CCRC VENTILATION AND TEMPERATURE SYSTEM PRESENTATION

FLIGHT CREW REST COMPARTMENT AND CABIN CREW REST COMPARTMENT DESCRIPTION (OPTION) (2/3)

CCRC Ventilation and Temperature System

Description/Interface

The CCRC temperature control is managed by the ACS hosted in two CPIOMs and the RH ASCU.

CCRC ventilation monitoring is managed by the VCS hosted in two CPIOMs.

The CCRC has a duct temperature sensor and a compartment temperature sensor.

The duct temperature sensor sends temperature data to the RH ASCU and the compartment temperature sensor sends temperature data to the ACS application through CRDCs.

The ACS application sends temperature demand and actual compartment temperature to the RH ASCU.

RH ASCU calculates the quantity of hot trim air that is necessary and adjusts the temperature by the dedicated trim air valve.

Quantity of hot trim air is monitored by duct temperature sensor.

In addition, a Cooling Effect Detector (CED) sensor is installed on the CCRC supply duct.

In case of loss of ventilation, the CED sends to VCS application through a CRDC, a low flow signal to generate cockpit and CCRC warnings.

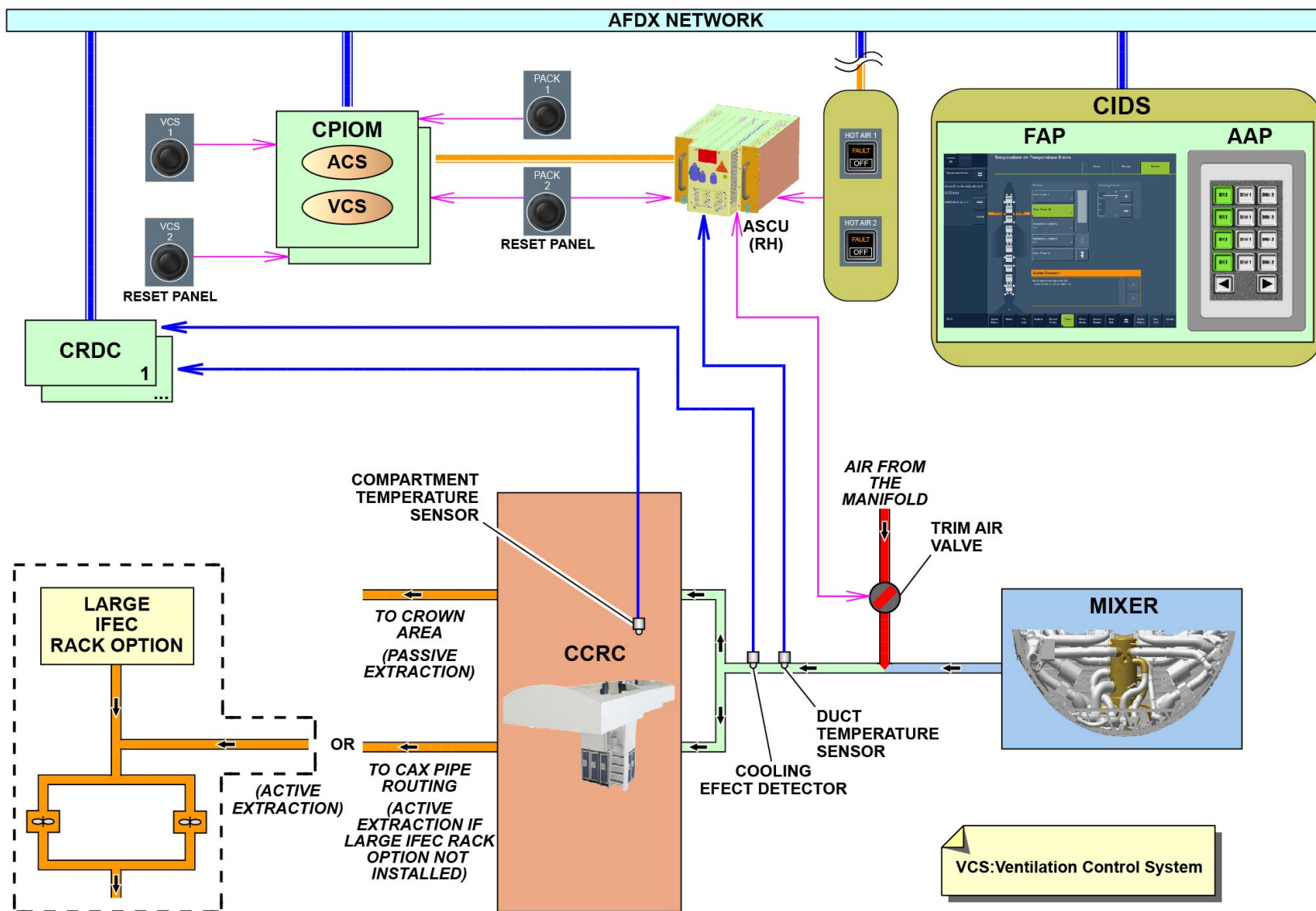
The CCRC temperature control is provided by means of an AAP located inside the compartment and/or FAP connected with the CIDS.

The temperature control of CCRC is inhibited by HOT AIR 1&2 P/BSWs on OFF position.

The PACK2 RESET SW reset the RH ASCU controller as well as one ACS application, and PACK1 RESET SW reset the other ACS application.

VCS1 RESET SW reset one VCS application system and VCS2 RESET SW reset the other VCS application.

V2414251 - V00T0MM0 - VM21D9CRCRD03001



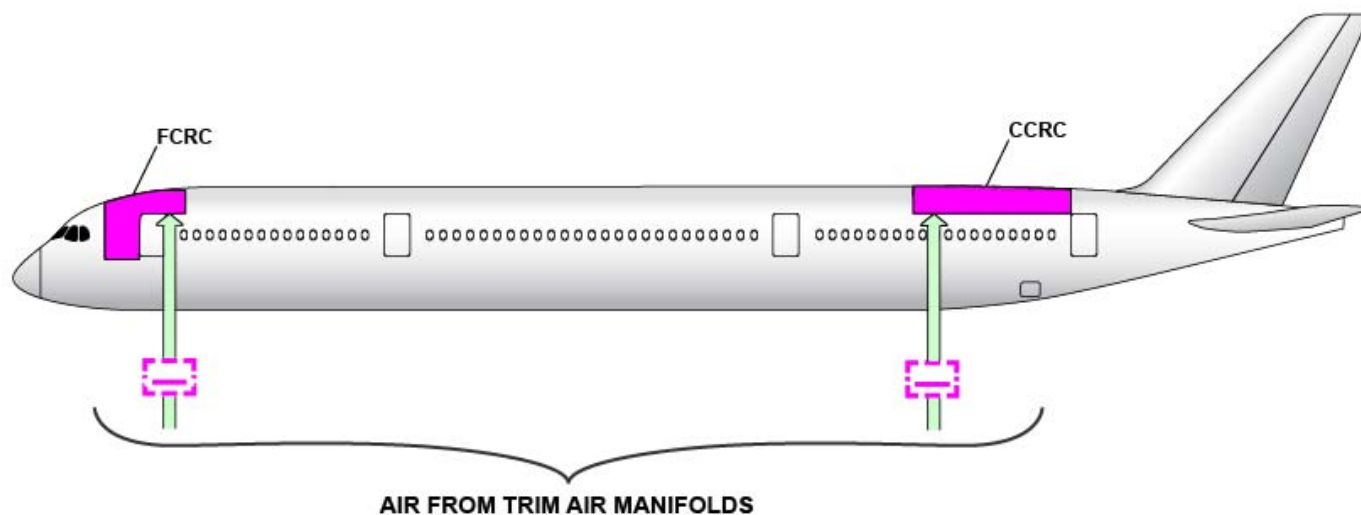
CCRC VENTILATION AND TEMPERATURE SYSTEM DESCRIPTION/INTERFACE

FLIGHT CREW REST COMPARTMENT AND CABIN CREW REST COMPARTMENT DESCRIPTION (OPTION) (2/3)

FCRC/CCRC Humidification System Presentation

The humidification system which is an optional system works on cold evaporation principle.

Humidification system increases the level of humidity of the air that flows to the optional FCRC/CCRC by adding water to the respective heated air supply flows in order to give the best comfort for the crew.


 **OPTIONAL HUMIDIFIER**

FCRC/CCRC HUMIDIFICATION SYSTEM PRESENTATION

FLIGHT CREW REST COMPARTMENT AND CABIN CREW REST COMPARTMENT DESCRIPTION (OPTION) (2/3)

FCRC/CCRC Humidification System Description/Interface

Each crew rest compartment humidification system is mainly composed of one humidifier module.

This humidifier module receives heated air from the mixer of the distribution system, and water from the ATA 38 with a supply line.

Water is added to the air to increase its relative humidity and this air flows to its designated crew rest compartment.

One air vent valve allows the drainage of the water supply line.

The humidification module includes an evaporation pad, a water pulse valve and a bypass water valve.

The evaporation pad ensures contact area between water and air.

The water pulse valve is controlled to regulate the water flow provided to the evaporation pad through a distribution tube.

The bypass water valve supplies water to the evaporation pad or drain / flush it to water drain mast.

The VCS applications hosted in two CPIOMs control and monitor the humidification system.

When the system is activated from the FAP, the VCS application opens the water bypass valve and water pulse valve to supply with water the evaporation pad.

The VCS application receives via CRDCs the humidity level measured by the relative humidity sensor.

Based on this input the VCS application determines the opening time of the water pulse valve.

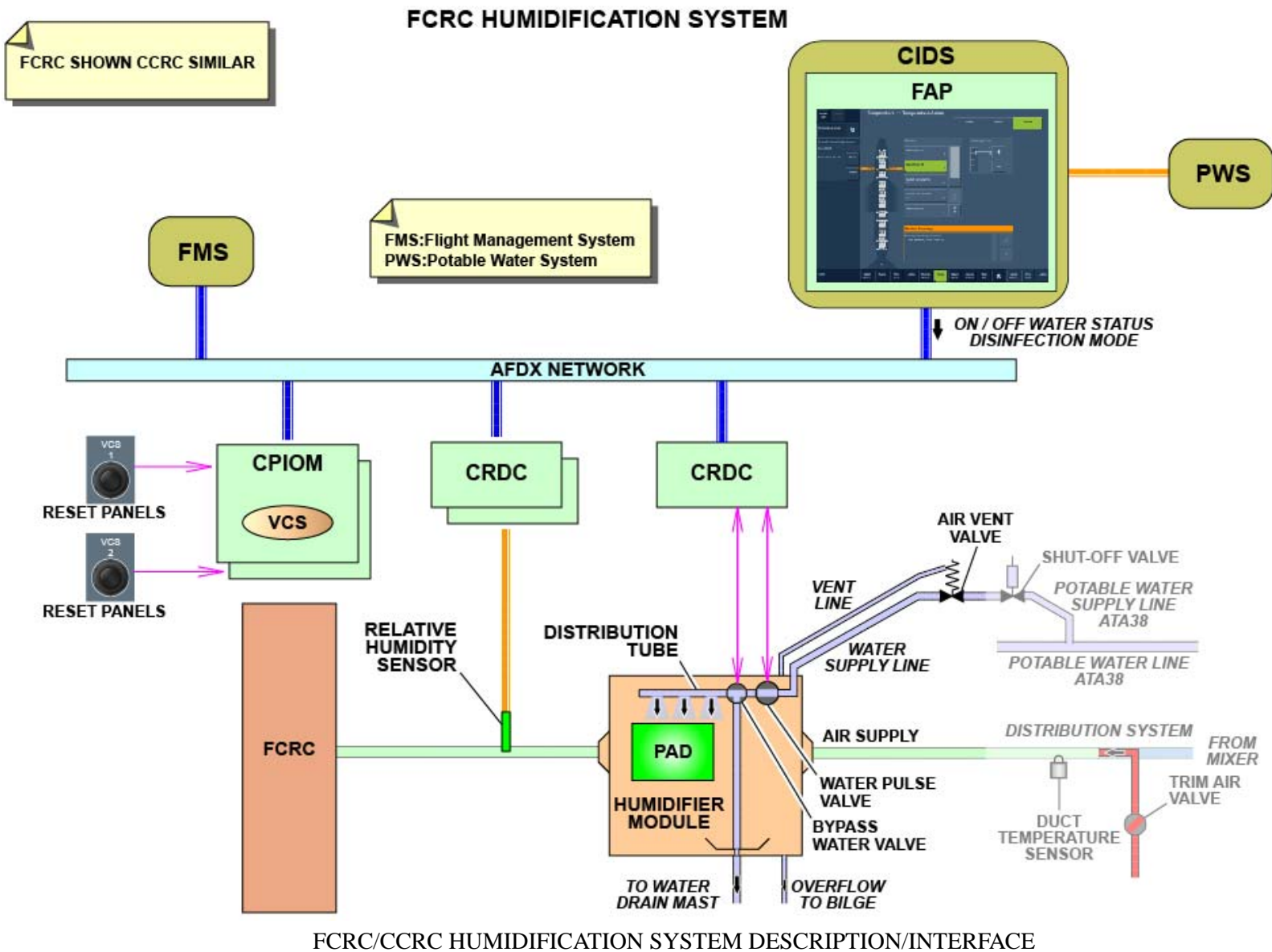
The humidification system has different operational modes:

- Humidification mode: this operational mode is active if A/C is above a dedicated high altitude (FL 260)
- Drain mode: activated when humidification mode is stopped. Bypass water valve and water pulse valve are operated to remove residual water
- Disinfection mode: valves are operated following request (ATA 38) to disinfect the water piping.

The humidification system operates above high altitude supplied by FMS. The FCRC/CCRC humidification system has interface with CIDS via FAP to control and display the system status.

The CIDS supplies ON/OFF signal to VCS. Potable Water System (PWS) supplies water supply status/disinfection mode to VCS.

The VCS 1(2) RESET SWs allowed to reset VCS applications hosted in the two CPIOMs.



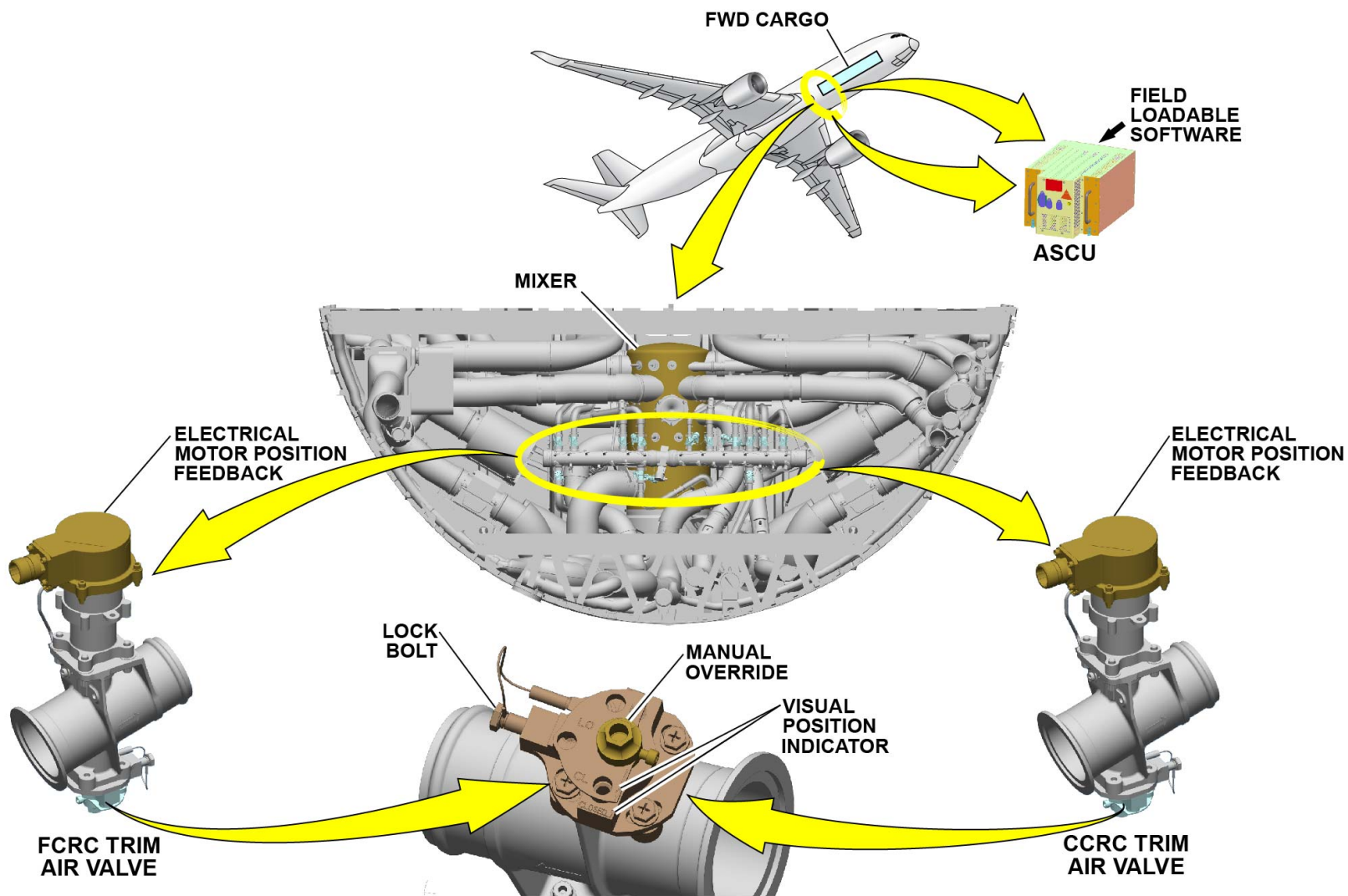
FLIGHT CREW REST COMPARTMENT AND CABIN CREW REST COMPARTMENT DESCRIPTION (OPTION) (2/3)

FCRC/CCRC Components Description

The trim air valve has an electrical motor and supplies feedback signal for monitoring. The trim air valve has a manual override equipped with hexagonal head with a lock bolt and a visual position indicator for deactivation purposes.

There are two ASCUs, which have a field loadable software.

The ASCUs are located on the LH and RH side of FWD cargo (triangle area).



FCRC/CCRC COMPONENTS DESCRIPTION

V2414251 - V00T0MM0 - VM21D9CRCRD03001

DRY AIR GENERATION SYSTEM (DAGS) DESCRIPTION (OPTION) (2/3)

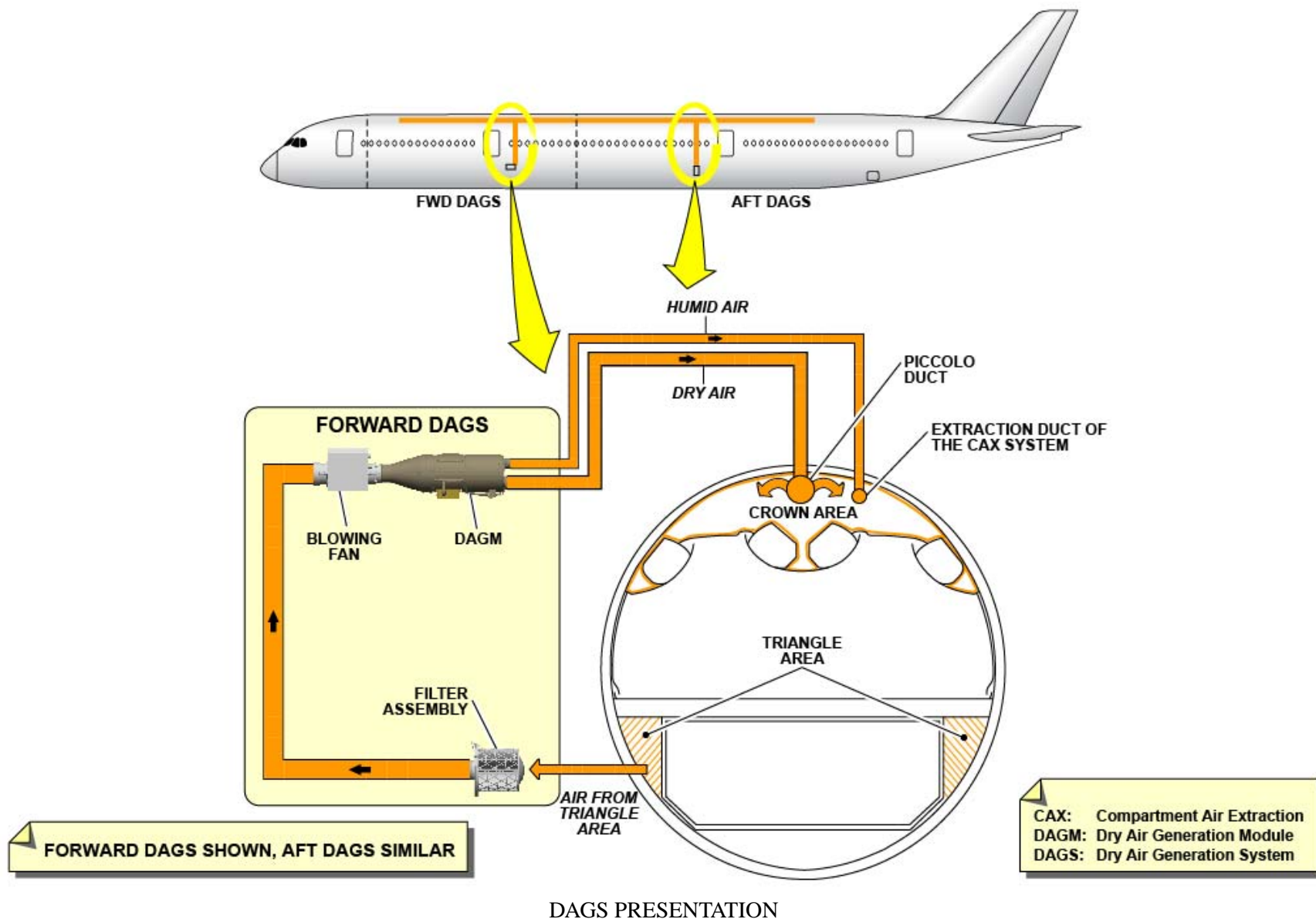
DAGS Presentation

DAGS is an optional system, which can be installed independently or together with the cabin humidification system. The system supplies dry air to prevent water condensation in the A/C. The DAGS includes two identical subsystems, one installed in the AFT part and the other in the FWD part of the A/C.

Each DAGS subsystem has:

- A Dry Air Generation Module (DAGM)
- A DAGS blowing fan
- A DAGS filter assembly.

The DAGS blowing fan takes ambient air from the triangle area through a filter and then blows it to the DAGM. Then, the DAGM supplies two airstreams, one dry airstream and humid airstream. The dry airstream goes through piccolo ducts into the cabin crown area. The humid airstream goes into the extraction duct of the Compartment Air Extraction (CAX) system, which releases it overboard.



V2414251 - V00T0MM0 - VM21D7DAGSP3001

DRY AIR GENERATION SYSTEM (DAGS) DESCRIPTION (OPTION) (2/3)

DAGS Description and Interfaces

The Ventilation Control System (VCS) application hosted by two CPIOMs. One application is in active mode and other is in standby mode. The VCS application controls the blowing fans with an enable discrete signal through CRDCs and uses CAN bus with CRDC to adjust the speed of the fan.

The VCS application controls and monitors the DAGS through the DAGS control unit. The DAGS control unit exchanges data with the VCS application through CAN bus/discrete signal. If the external temperature is high (above 35 degrees C) the DAGS starts the ventilation mode. In this mode, the DAGS control unit stops the electrical heater of the drying unit.

Further to cabin crew selection done on FAPs, DAGS can be set to ON/OFF through CIDS.

The DAGS status is shown on the related FAP page (Humidification/Dehumidification).

The Air Data/Inertial Reference System (ADIRS) supplies external temperature data to the VCS applications.



DRY AIR GENERATION SYSTEM (DAGS) DESCRIPTION (OPTION) (2/3)

DAGS Components Description

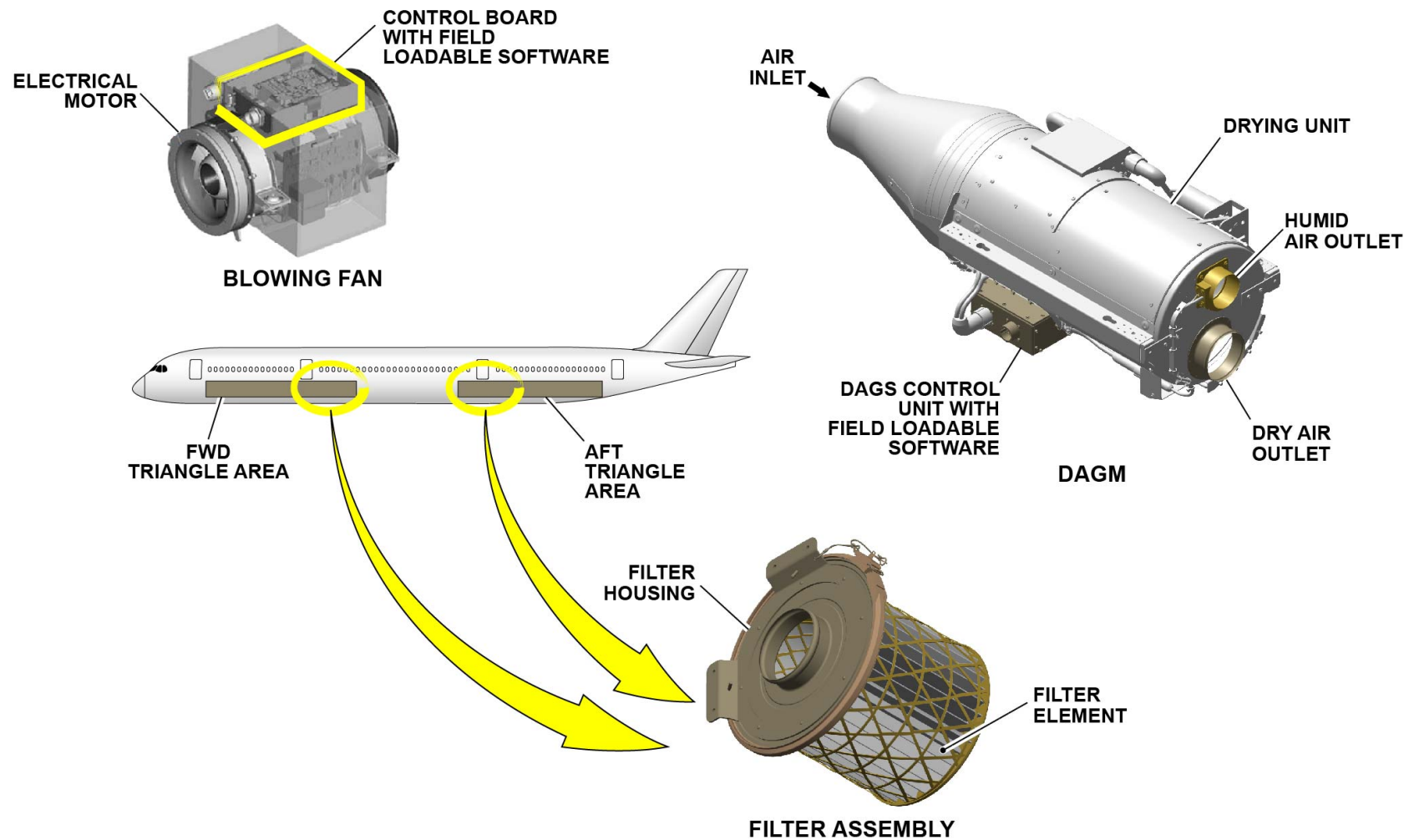
The DAGM has a drying unit and a drying control unit, which are LRUs.

The drying unit has one air inlet and two air outlets, humid air outlet and dry air outlet. The drying control unit has a field loadable software.

The DAGS fan has a control board with field loadable software.

The DAGS filters are installed in the cargo triangle area. One filter is installed in the FWD triangle area and the other in the AFT triangle area.

The DAGS filters assemblies have a filter housing and a filter element.



DAGS COMPONENTS DESCRIPTION

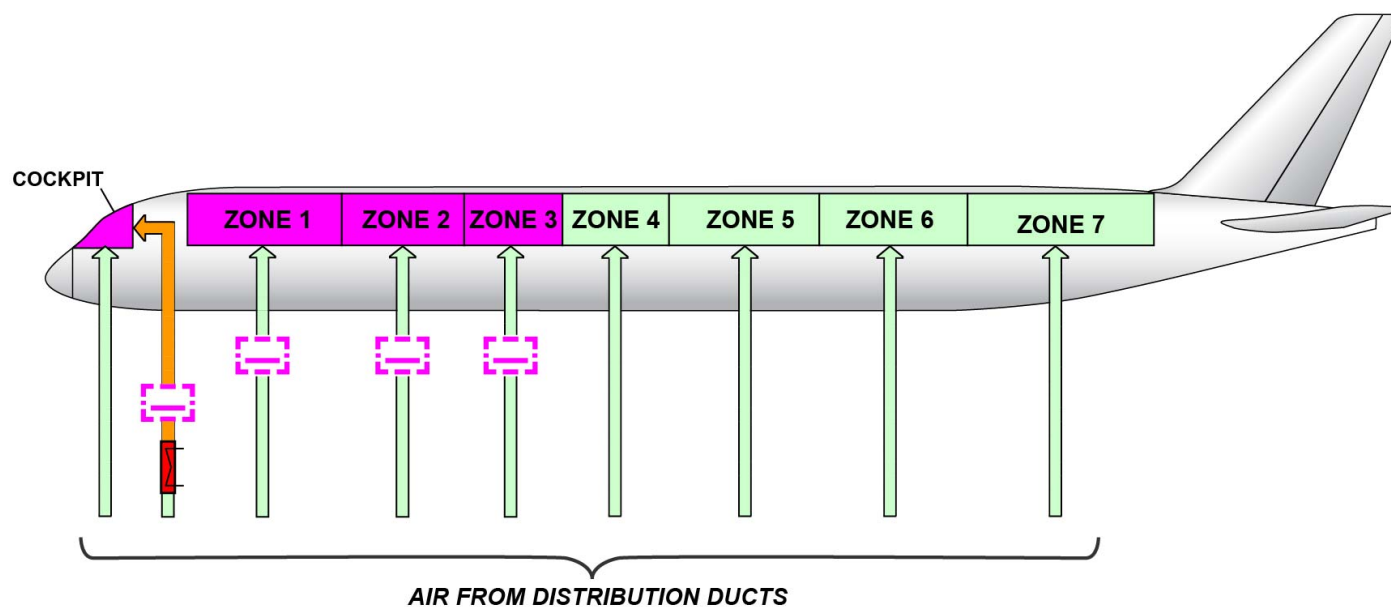
V2414251 - V00T0MM0 - VM21D7DAGSP3001

HUMIDIFICATION SYSTEM DESCRIPTION (OPTION) (2/3)

Cabin / Cockpit Humidification System Presentation

The humidification system which is an optional system increases the level of humidity of the air that flows to the cabin to give the best comfort for the passengers and the crew. The humidification system can be installed to supply the cockpit, some cabin zones (1, 2, 3) one humidifier per zone.

Only for the cockpit, an electrical heater has been added to the humidification system.



CABIN / COCKPIT HUMIDIFICATION SYSTEM PRESENTATION

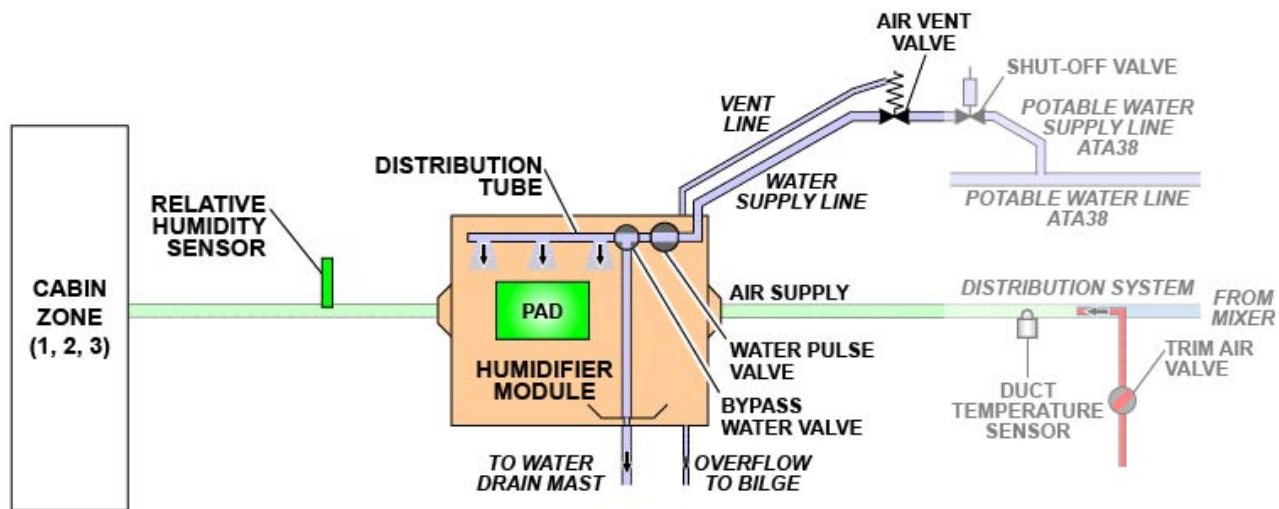
HUMIDIFICATION SYSTEM DESCRIPTION (OPTION) (2/3)

Cabin Humidification System Presentation

Each humidification zone system is mainly composed of one humidifier module. This humidifier module receives heated air from the mixer of the distribution system, and water from the ATA 38. Water is added to the air to increase its relative humidity and this air flows to its designated zone of the A/C.

The humidification module includes an evaporation pad, a water pulse valve and a bypass water valve. The evaporation pad ensures contact area between water and air. The water pulse valve is controlled to regulate the water flow provided to the evaporation pad through a distribution tube. The bypass water valve supplies water to the evaporation pad or drain / flush it to water drain mast. One air vent valve allows the drainage of the water supply line.

CABIN HUMIDIFICATION SYSTEM



CABIN HUMIDIFICATION SYSTEM PRESENTATION

HUMIDIFICATION SYSTEM DESCRIPTION (OPTION) (2/3)

Cabin Humidification System Description/Interfaces

The Ventilation Control System (VCS) applications hosted in two CPIOMs control and monitor the humidification system. One is active, the other is in standby. When the system is activated from the FAP, the VCS application opens the water bypass valve and receives via CRDCs the humidity level measured by the relative humidity sensor. Based on this input the VCS application determines the opening time of the water pulse valve.

The humidification system has different operational modes:

- Humidification mode: this operational mode is active if A/C is above a dedicated high altitude (FL 260)
- Drain mode: activated when humidification mode is finished, bypass water valve and water pulse valve are operated to remove residual water
- Disinfection mode: valves are operated following request (ATA 38) to disinfect the water piping.

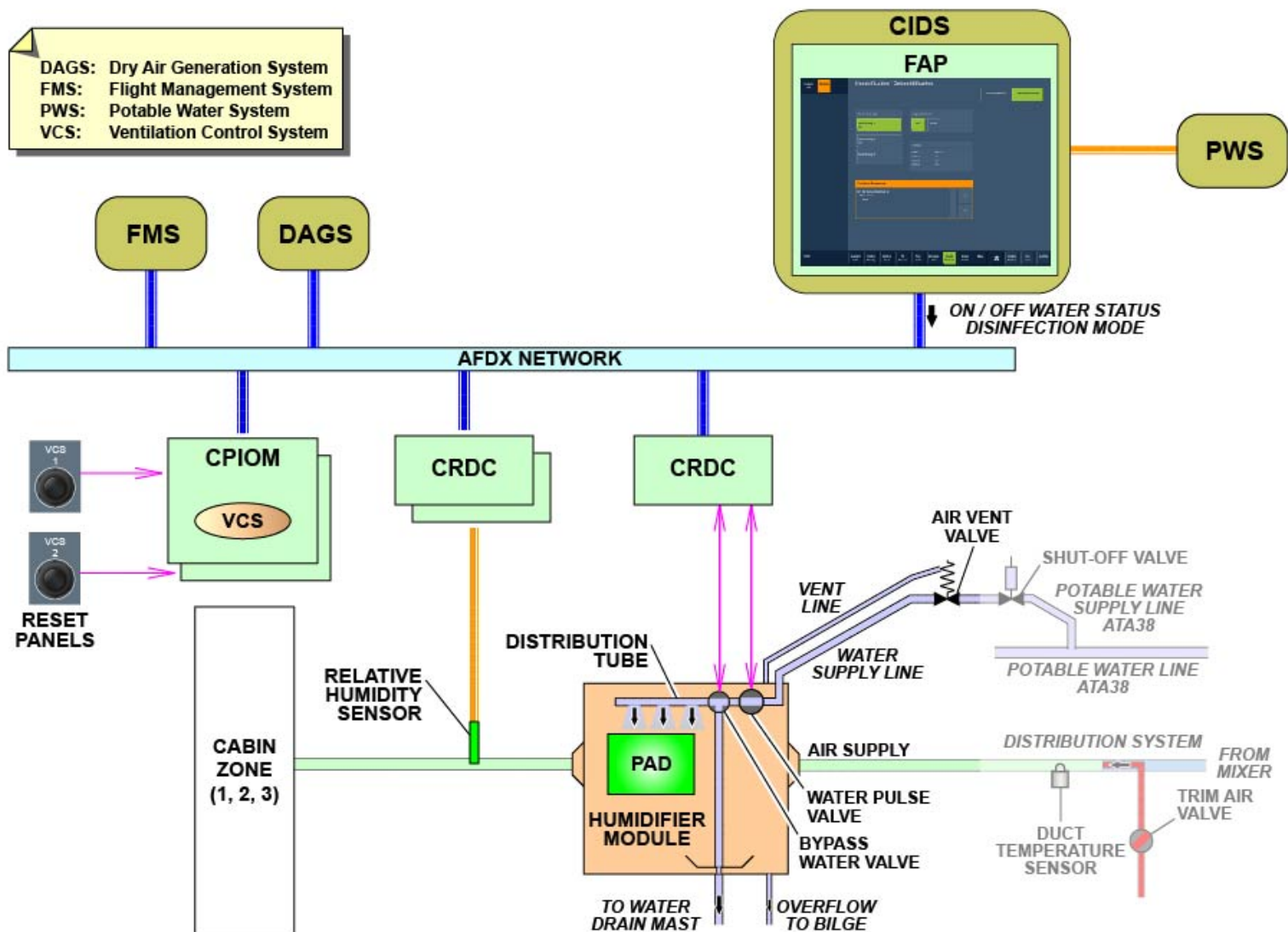
The humidification system operates above high altitude supplies by Flight Management System (FMS). The cabin humidification system has interface with CIDS via FAP to control and display the system status.

The CIDS supplied ON/OFF signal to VCS and water supply status/disinfection mode from potable water system to VCS.

The Dry Air Generation System (DAGS) supplies its status to VCS. If DAGS is inoperative humidification system is inhibited.

The VCS 1(2) RESET SWs allowed to reset VCS application.

CABIN HUMIDIFICATION SYSTEM



CABIN HUMIDIFICATION SYSTEM DESCRIPTION/INTERFACES

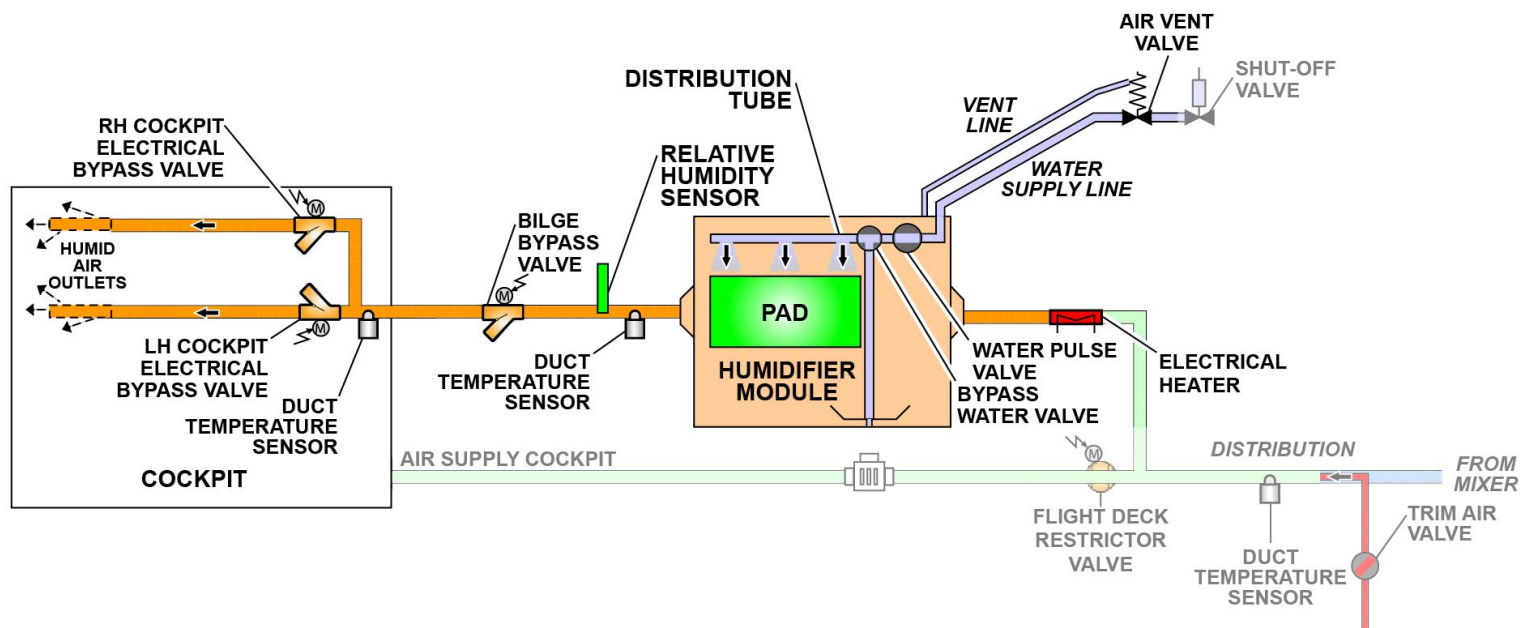
V2414251 - V00T0MM0 - VM21D8HUMID3001

HUMIDIFICATION SYSTEM DESCRIPTION (OPTION) (2/3)

Cockpit Humidification System Presentation

The cockpit humidification system is different from the other zones humidification system. Air supplying the cockpit humidification system is tapped upstream of the flight deck restrictor valve, in order to have only humidification to the head level of the pilots and to minimize condensation effects to the flight deck instruments. Due to this design an electrical heater is installed upstream of the humidifier module to compensate temperature drop through the humidifier module. Three valves called bypass valves have been installed to control the humidified airflow. The bilge bypass valve which bypasses the flow to bilge area when the system is OFF. The LH and RH cockpit bypass valves are ON/OFF valves without bypass function even if they are called bypass valves.

COCKPIT HUMIDIFICATION SYSTEM



COCKPIT HUMIDIFICATION SYSTEM PRESENTATION

HUMIDIFICATION SYSTEM DESCRIPTION (OPTION) (2/3)

Cockpit Humidification System Description/Interfaces

The VCS applications hosted in two CPIOMs control and monitor the humidification system. One is active, the other is in standby. When the system is activated from cockpit HUMIDIFIER toggle SWs, VCS opens the corresponding electrical bypass valves and water bypass valve. The VCS application uses the relative humidity sensor to determine the opening time of the water pulse valve.

ACS application hosted in two CPIOMs, provides duct temperature demand to single channel Electrical Heater Controller (EHC). The single channel EHC uses data from the duct temperature sensors to adjust heating level.

The humidification system has different operational modes:

- Humidification mode: this operational mode is active if A/C is above a dedicated high altitude (FL 260) data supplies by the FMS
- Drain mode: activated when humidification mode is finished, bypass water valve and water pulse valve are operated to remove residual water
- Disinfection mode: valves are operated following request (ATA 38) to disinfect the water piping.

The VCS received from PWS through CIDS the water supply status and disinfection mode selection.

VCS 1(2) RESET SWs allowed to reset VCS application.

PACK 1(2) RESET SWs allowed to reset ACS application.

The HUMID power supply breaker can be used to stop the cockpit humidifier.



HUMIDIFICATION SYSTEM DESCRIPTION (OPTION) (2/3)

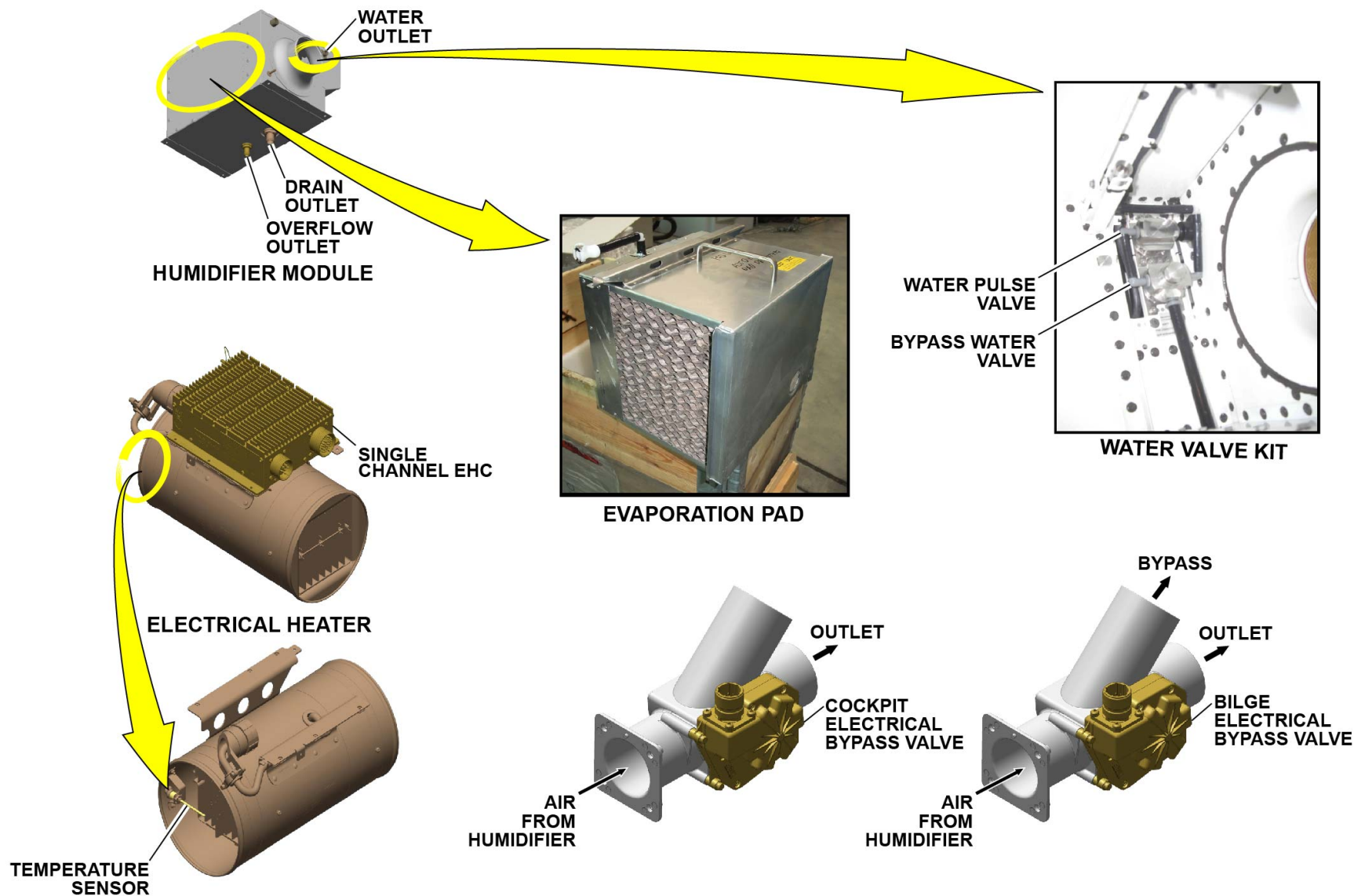
Humidification System Components Description

The humidifier module has two LRUs (Line Replaceable Units), an evaporation pad and a water valve kit including the bypass water valve and the water pulse valve. The size of the humidifier module varies depending upon the volume of the zone to humidify.

The electrical heater is equipped with internal temperature sensor for overheat protection.

The single channel EHC is a LRU installed on the electrical heater.

The cockpit electrical bypass valves supplying the flow above the crew head are ON/OFF valves, the bilge electrical bypass valve supplies the flow either to the distribution system or to the bilge area.



HUMIDIFICATION SYSTEM COMPONENTS DESCRIPTION

CABIN, COCKPIT AND CREW REST COMPARTMENTS TEMPERATURE CONTROL AND INDICATING (2/3)

Temperature Control - General (2)

Cockpit and Cabin Temperature control (2)

The Air conditioning system is fully automatic. It provides continuous air renewal, and maintains desired temperature in the cockpit and cabin zones.

The Air cooled from the Packs then goes to the Mixer Air Unit, where is combined with recycled air from cockpit and cabin zones by means of recirculation fans. Air from the Air conditioning is also used for cargo ventilation.

A Trim Air system adjusts the temperature of the air in each cockpit and cabin zone. Temperature is adjusted by adding Hot Air tapped from Trim air manifolds to air from the Mixer unit.

HOT AIR 1 & HOT AIR 2 P/B SWs are used to isolate their related hot air manifolds.

On the AIR panel, there are two temperature selectors, one for Cockpit and another for Cabin.

The flight-crew can set a basic temperature for all cabin zones with the CABIN temperature selector-switch.

- When the CABIN selector is set to PURS SEL position, the cabin crew can directly select the temperature for each cabin zones on the Flight Attendant Panel - FAP TEMPERATURE page.

Crew Rest Compartments Temperature Control (2)

A Trim Air system adjusts the temperature of the air in each Crew Rest Compartment. Temperature is adjusted by adding Hot Air tapped from Trim air manifolds to air from the Mixer unit.

HOT AIR 1 & HOT AIR 2 P/B SWs are used to isolate their related hot air manifolds. These P/B SWs are selected to OFF position in case of a duct overheat.

Whatever the CABIN selector position is, the crew directly select the temperature for each Crew Rest Compartment on the Flight Attendant Panels - FAP TEMPERATURE page.

Cockpit, Cabin Temperature and Crew Rest Compartments Temperature Control (3)

Trim Air System:

The trim air system uses hot air tapped downstream from FCVs. The trim air system has two Trim Air Pressure Regulating Valves (TAPRVs) used for the:

- Trim air pressure regulation,
- Trim air supply shut-off.

This Trim Air system consists of two manifolds L/H and R/H sides. Once regulated by the TAPRVs, this hot air is ducted to a Trim Air system which will provide the desired temperature to each Cockpit and Cabin zone.

Both TAPRVs are connected to a manifold. This architecture minimizes the impact of a single component failure.

TAPRV1 supplies the LH manifold; whereas TAPRV2 supplies the RH manifold.

In normal operation the LH and RH manifolds are isolated by means of the Trim Air Shut-Off Valve (TASOV).

The TASOV remains in the closed position during normal operation and consequently maintains isolated both manifolds.

The HOT AIR indication shows two HOT AIR 1&2 valves, called Trim Air Pressure Regulating Valves (TAPRVs), which regulate the trim air pressure inside the HOT AIR manifolds:

Cabin zones temperature control:

The cabin zones temperature can be set via two different ways:

- With the CABIN temperature selector in the "PURSer SElection" position, the cabin crew can select the temperature value for each zone

on the FAP. The Trim Air Valves (TAVs) will adjust the hot air flow accordingly,

- The flight crew can select the cabin temperature for the entire cabin by selecting a temperature level between "COLD" and "HOT" {temperature range between 18 deg.C (46 deg.F) and 30 deg.C (86 deg.F)}, on the CABIN temperature selector.

On the FAP, the temperature values are displayed for each zone, whereas on the COND ECAM page, only the lowest and highest temperature values of all the cabin zones are displayed.

The SD COND page will indicate the Temperature Controller status, as follows:

On the AIR panel, the PACK 1 (2) P/B SWs are used to start the Packs. When the PACK 1 (2) P/B SW is selected to OFF, the related Air Pack is isolated and the second Pack supplies the opposite side manifold with hot air.

On the same panel, the HOT AIR 1 (2) P/BSWs are used to isolate their related hot air duct. These P/B SWs are used in case of a duct overheat. Normally the Trim Air Shut-Off Valves (TASOVs) are closed.

The TASOV remains in the closed position during normal operation and consequently isolates L/H and R/H trim air manifolds.

In case of one TAPRV fails in closed position, the Trim Air System opens the TASOV in order to reestablish HOT AIR on both manifolds.

Note: If one PACK is switched OFF, The TASOV is controlled to open and allow remaining Pack to supply the entire trim air manifold.

In normal operation:

- The FCV regulates the flow entering the Pack,
- The Trim Air Pressure Regulating Valves (TAPRVs) modulate to regulate the trim air pressure.
- The Trim Air Shut-Off Valve (TASOV) is closed,
- The TAVs modulate for temperature control per zone.

If the PACK P/B (1or2) is released out:

- The related FCVs close,
- The TAPRV closes.
- The TASOV opens to supply the manifold with trim air from the other Pack,

If the HOT AIR P/B (1or2) is released out:

- The related Trim Air Pressure Regulating Valve (TAPRV) closes,
- The TASOV remain closed,

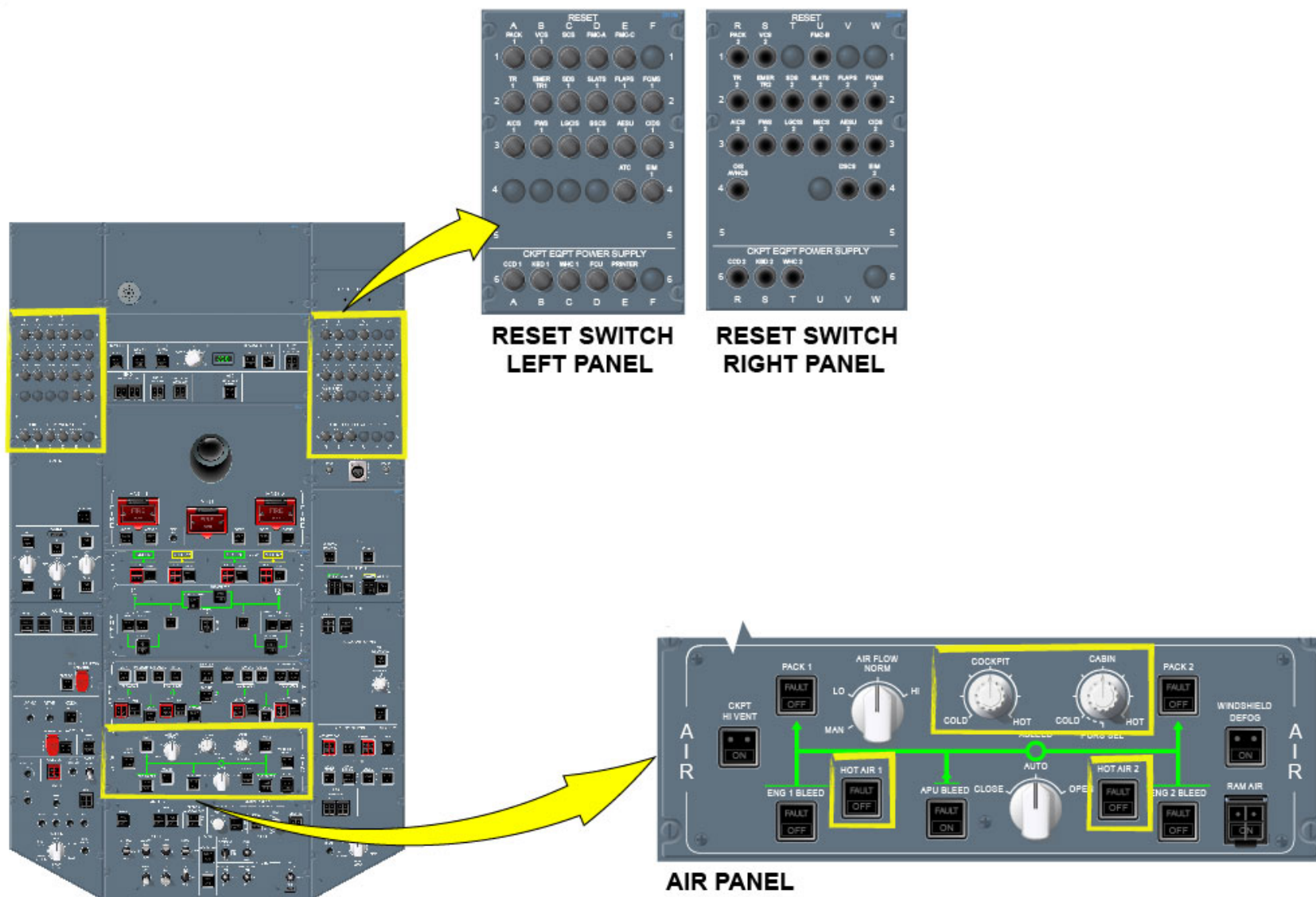
Cabin Duct Overheat (3)

A duct overheat warning comes on when one of the duct temperature sensors detects more than 80 deg.C (176.00 deg.F):

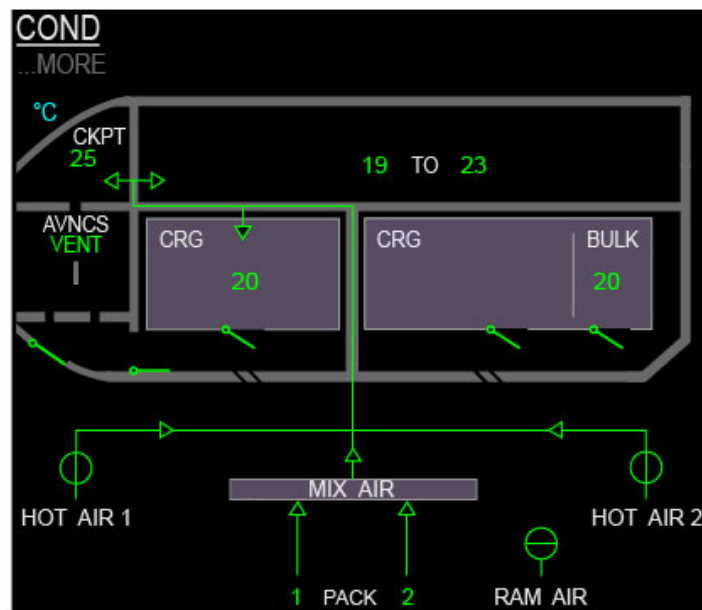
- The MASTER CAUTION-lights illuminate, accompanied with a single chime,
- The ASCU closes automatically the related Trim Air Pressure Regulating Valve (TAPRV),
- The COND page shows a closed TAPRV on the system display,
- The COND page shows OVHT legend in amber in the related cabin temperature zone,
- The EWD shows COND DUCT OVHT amber warning message, with associated subtitle CABIN DUCT OVHT,
- The INOP SYS on STATUS page shows CAB PART TEMP REGUL message in amber, and the INFO message CABIN TEMP REGUL DEGRADED is displayed in green.
- The FAULT light in the HOT AIR 1(2) P/BSW comes on.

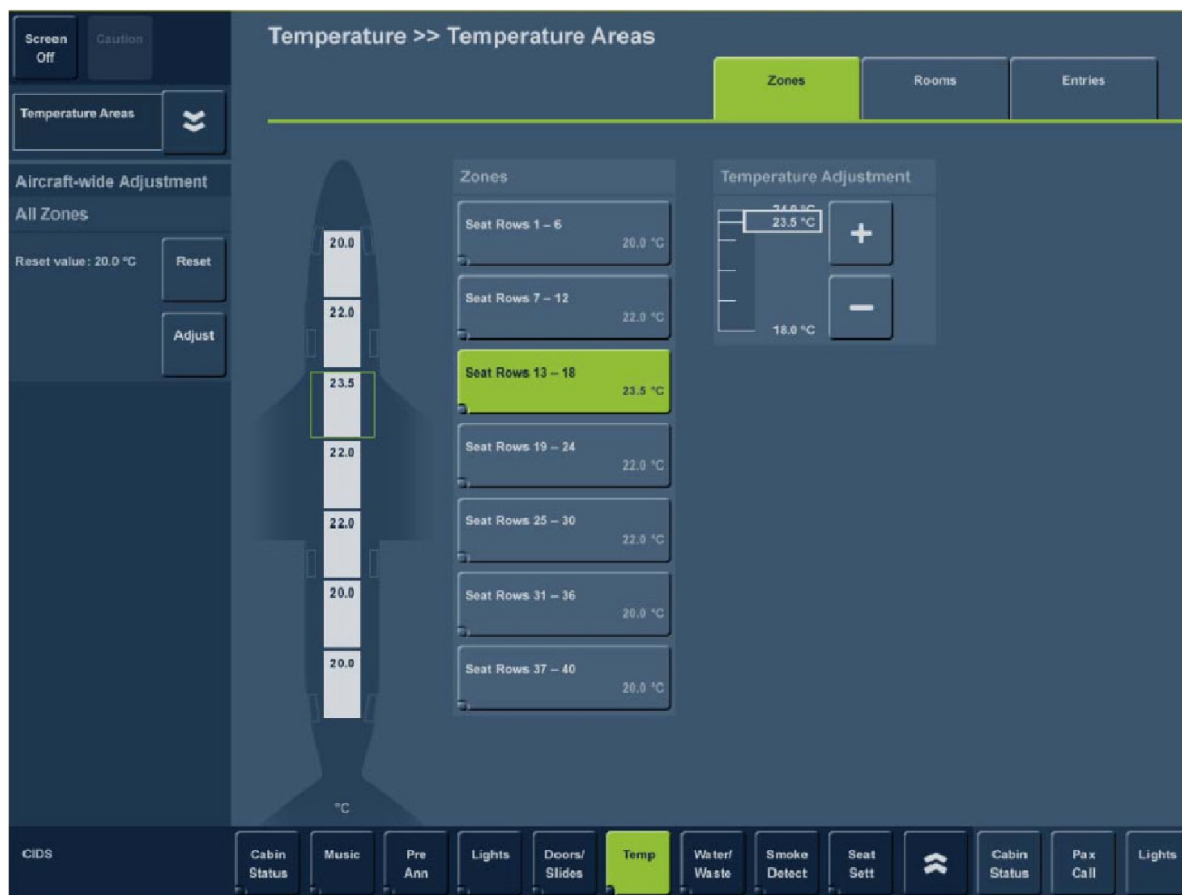
On the AIR panel, set the HOT AIR 1(2) P/BSW to OFF.

Reset of the overheat-warning by action on the HOT AIR 1 (2) P/B is allowed when the duct temperature goes below 70 deg.C(158.00 deg.F).



TEMPERATURE CONTROL - GENERAL (2) ... CABIN DUCT OVERHEAT (3)

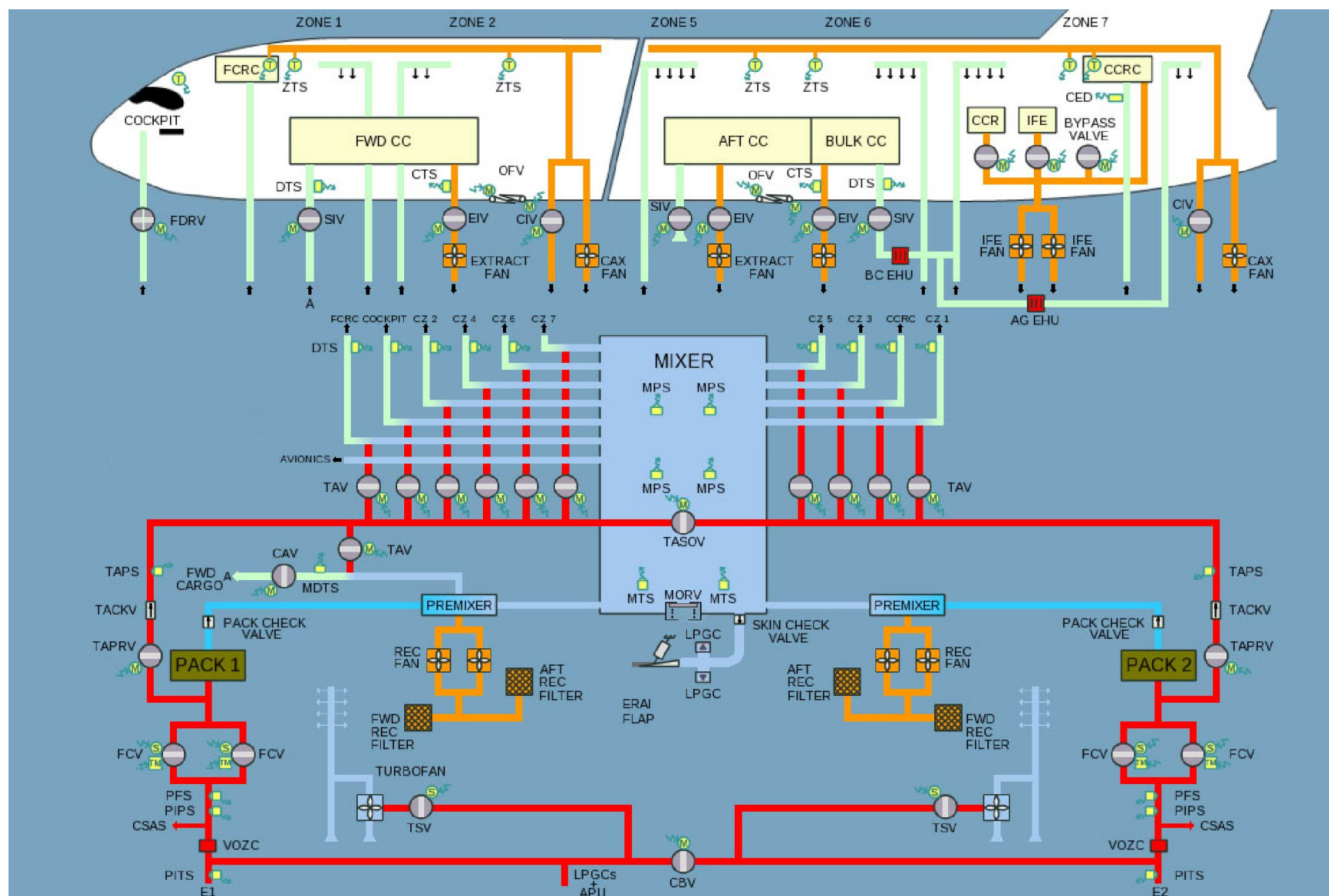

BLEED SD PAGE
TEMPERATURE CONTROL - GENERAL (2) ... CABIN DUCT OVERHEAT (3)



TEMPERATURE FAP PAGE

THIS FAP SHOWS SEVERAL AVAILABLE INDICATIONS BUT NOT A SYSTEM CONFIGURATION

TEMPERATURE CONTROL - GENERAL (2) ... CABIN DUCT OVERHEAT (3)



RECIRCULATION AND HUMIDIFICATION SYSTEM CONTROL AND INDICATING (2/3)

Cabin Air Recirculation (2)

Four HP recirculation Fans remove air from the cabin to supply the Mixer Unit.

On VENT panel, when CAB FANS P/B SW is selected OFF, all cabin recirculation fans stop.

The CAB FANS P/Bsw is normally set to ON and the cabin air recirculation fans run.

The COND page gives the status of the four recirculation Fans.

The COND page indicates the Four Recirculation Fans status, as follows:

- Green arrow: All recirculation fans operate. Fan symbols are not displayed when all fans operate normally.
- Green fan: This fan is not faulty but at least one of the 3 other recirculation fan is faulty,
- Amber arrow: A pair of recirculation fans is faulty,
- Amber fan: One recirculation fan of a pair is faulty.
- Amber XX: Fan data not valid.

The COND page will indicate the Ventilation Controllers status, as follows:

- The "VENT CTL" indication appears with its associated faulty channel number (1 or 2) in amber. No display when both 1 and 2 channels operate normally.

Humidification System (3)

The humidification system works according to the cold evaporation principle.

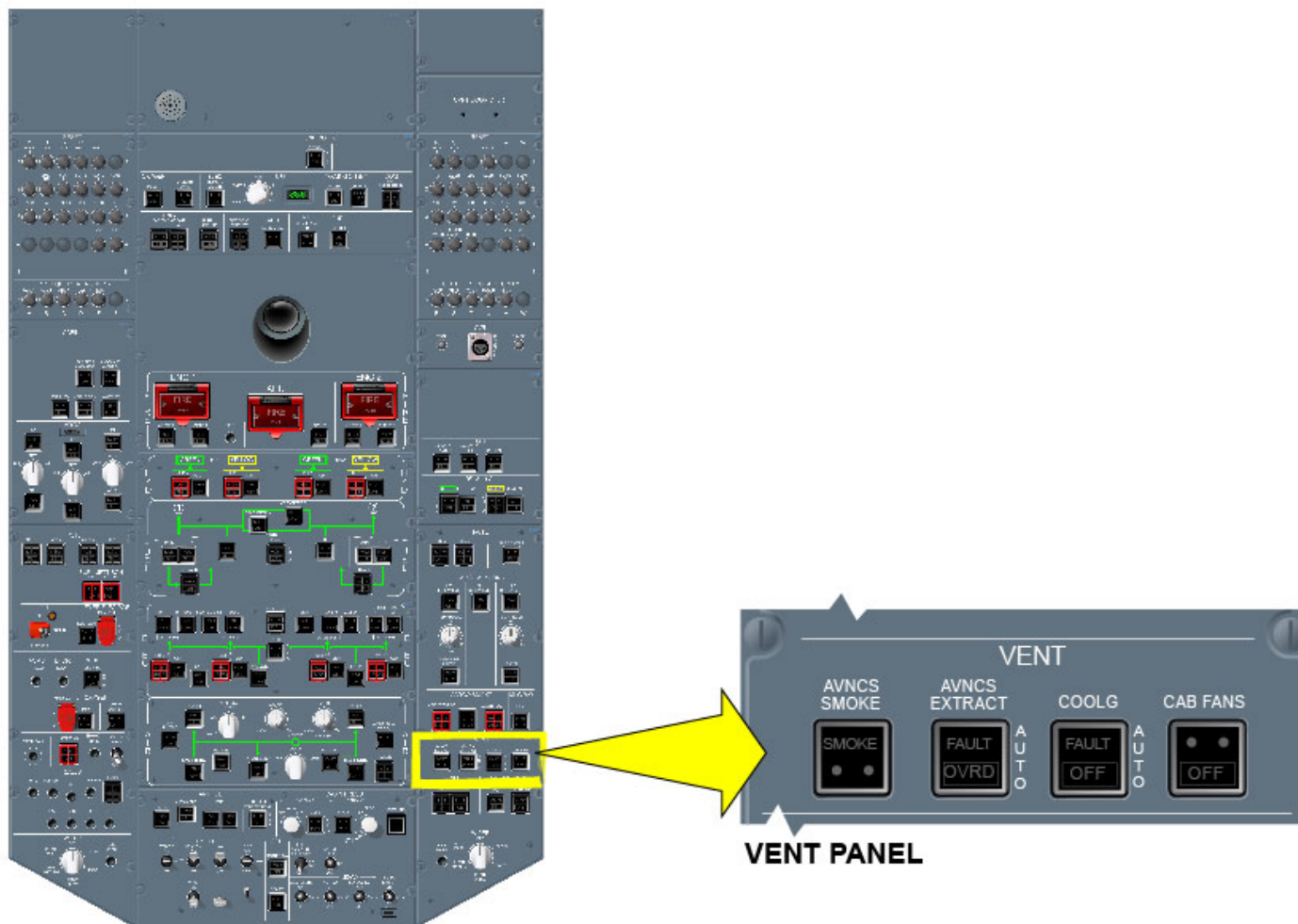
The PAD ensures a large, intensive contact area between water and air. The dry and preheated air flows through the PAD and thereby charges itself with humidity.

The humidity level of the air is controlled by the VCS application, and measured downstream of the Humidifier (HDF) by the Relative Humidity Sensor(RHS) to determine the opening of the Water Pulse Valve (WPV)

to supply the Bypass Water Valve (BWV). Water is supplied from the potable water system.

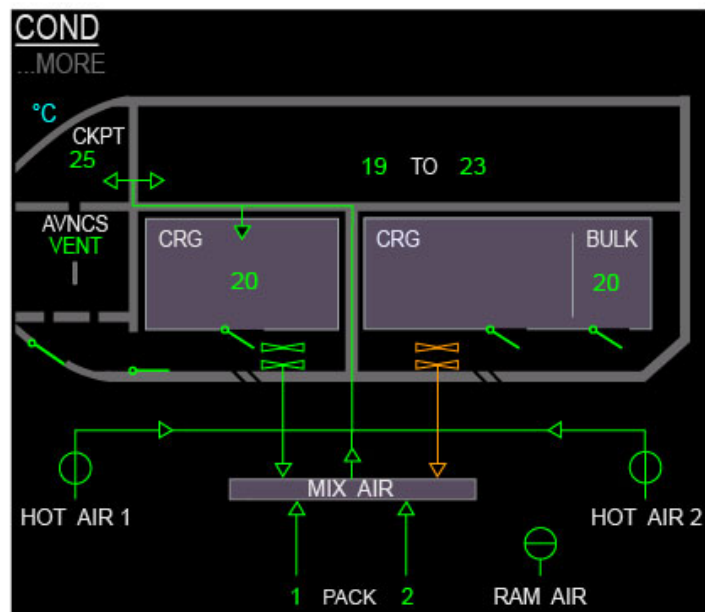
Humidification mode starts at a flight level above 26000ft and stopped two hours prior to top of descent.

The system is controlled and monitored via the Flight Attendant Panel (FAP), control panel for the cockpit.



CABIN AIR RECIRCULATION (2) & HUMIDIFICATION SYSTEM (3)

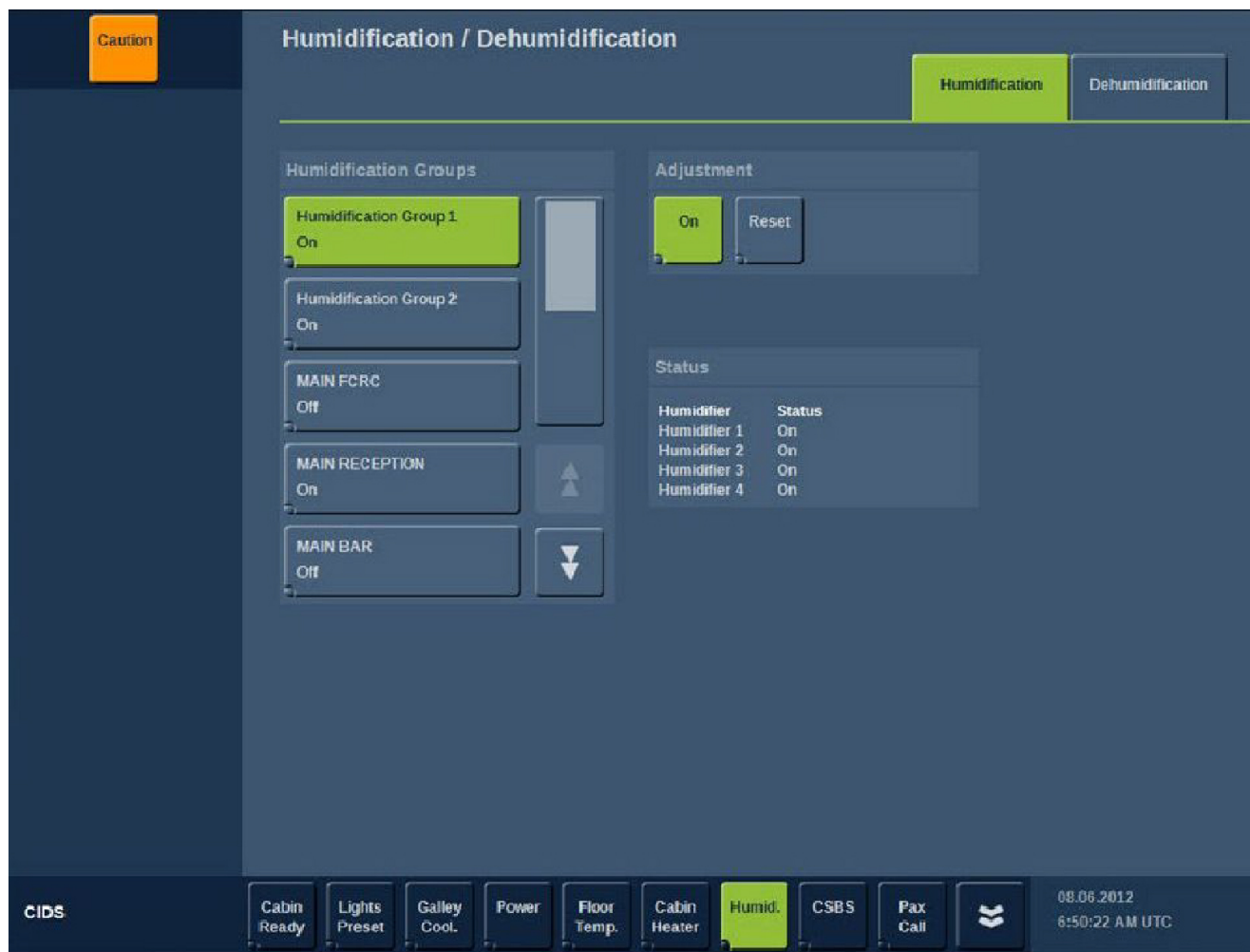
V2414251 - V00T0MM0 - VM2114RECIR3001

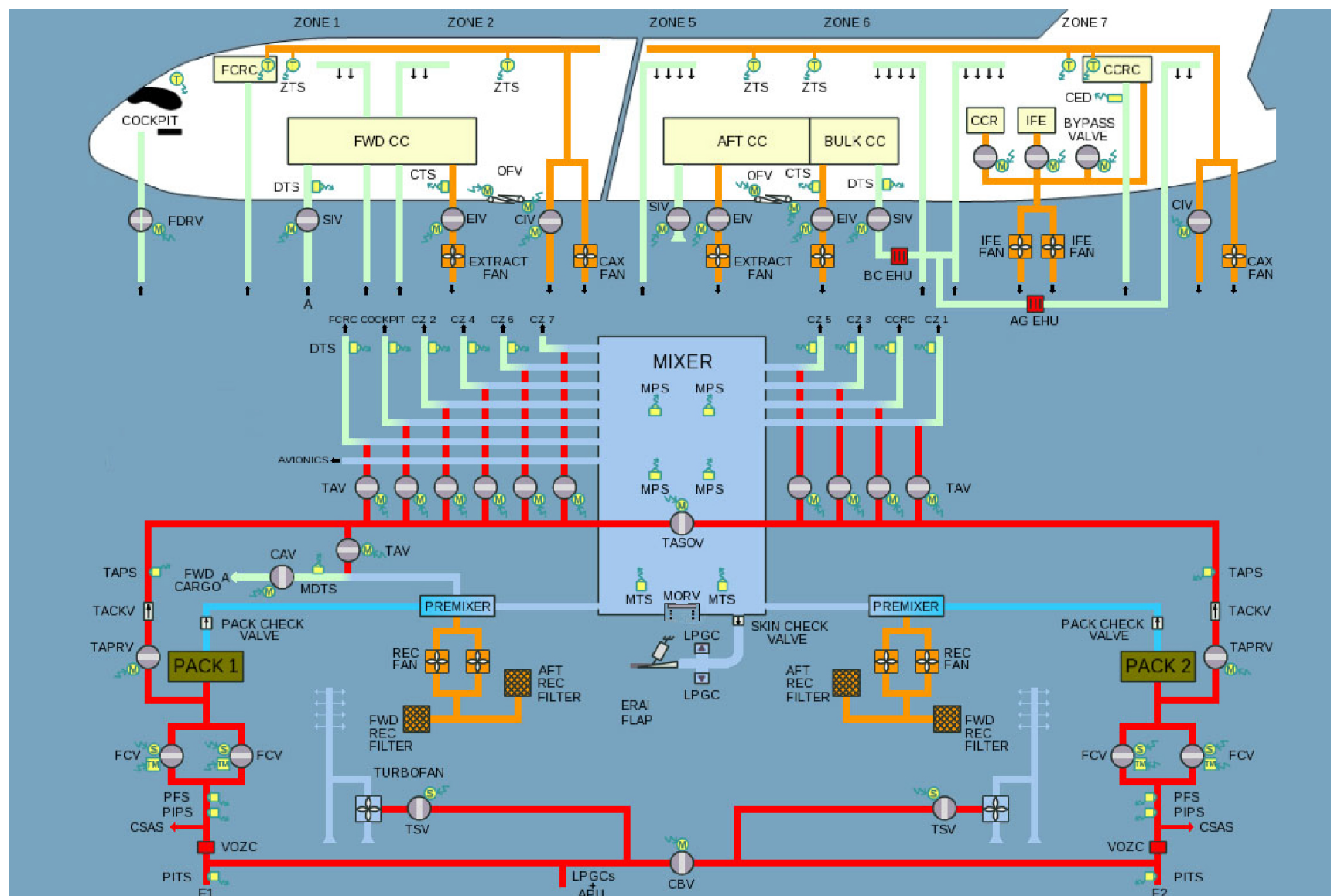


COND SD PAGE

**THIS SD PAGE SHOWS SEVERAL
AVAILABLE INDICATIONS BUT
NOT A SYSTEM CONFIGURATION**

CABIN AIR RECIRCULATION (2) & HUMIDIFICATION SYSTEM (3)


HUMIDIFICATION FAP PAGE
CABIN AIR RECIRCULATION (2) & HUMIDIFICATION SYSTEM (3)



CABIN AIR RECIRCULATION (2) & HUMIDIFICATION SYSTEM (3)

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SUPPLEMENTAL COOLING SYSTEM (SCS) DESCRIPTION (2/3)

Supplemental Cooling System (SCS) presentation

The Supplemental Cooling System (SCS) maintains at low temperature the air in the trolleys of the galleys. Cold air keeps foods and beverages at a satisfactory temperature.

In addition, as an option, the SCS can be used to decrease the temperature of the air used for the Avionics Ventilation System (AVS).

The SCS has three functions:

- The cold generation
- The cold distribution
- The cold consumption.

For the cold generation function, the SCS maintains a liquid coolant at low temperature with Vapor Cycle Refrigeration Units (VCRUs) associated to ram air channels.

Depending on options, a variable number of VCRUs (2, 3 or 4) and ram air channels (1 or 2) can be installed.

A flap operated by a ram air channel actuator supplies air flow to the VCRUs to decrease the temperature of the liquid coolant.

The cold distribution function is the distribution of a liquid coolant (propylene glycol - water mixture) between cold air consumers and VCRUs. The subsystem includes one or two liquid coolant loops (depending on options) and each loop has an associated Coolant Distribution Module (CDM). The CDM enables the liquid coolant distribution.

The liquid coolant in the loops is used to cool the air which circulates in the trolleys and, as option, in the AVS. The liquid coolant cools also the CDM.

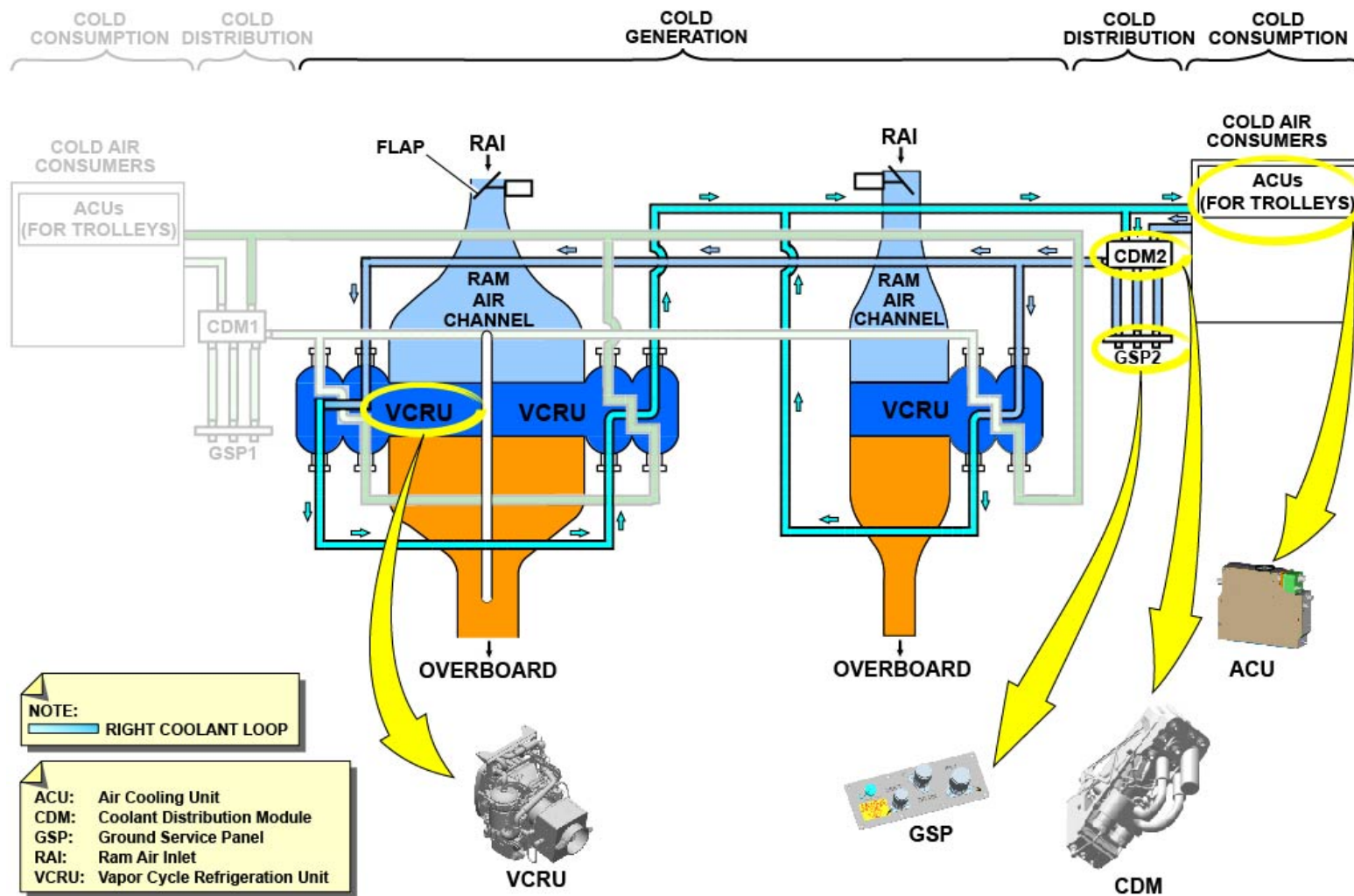
One or two Ground Service Panels (GSP), depending on the number of coolant loops installed, are used for the servicing of the coolant loops and CDMs.

For the cold consumption function, components decrease the temperature of the air used by cold air consumers. The components for the cold air

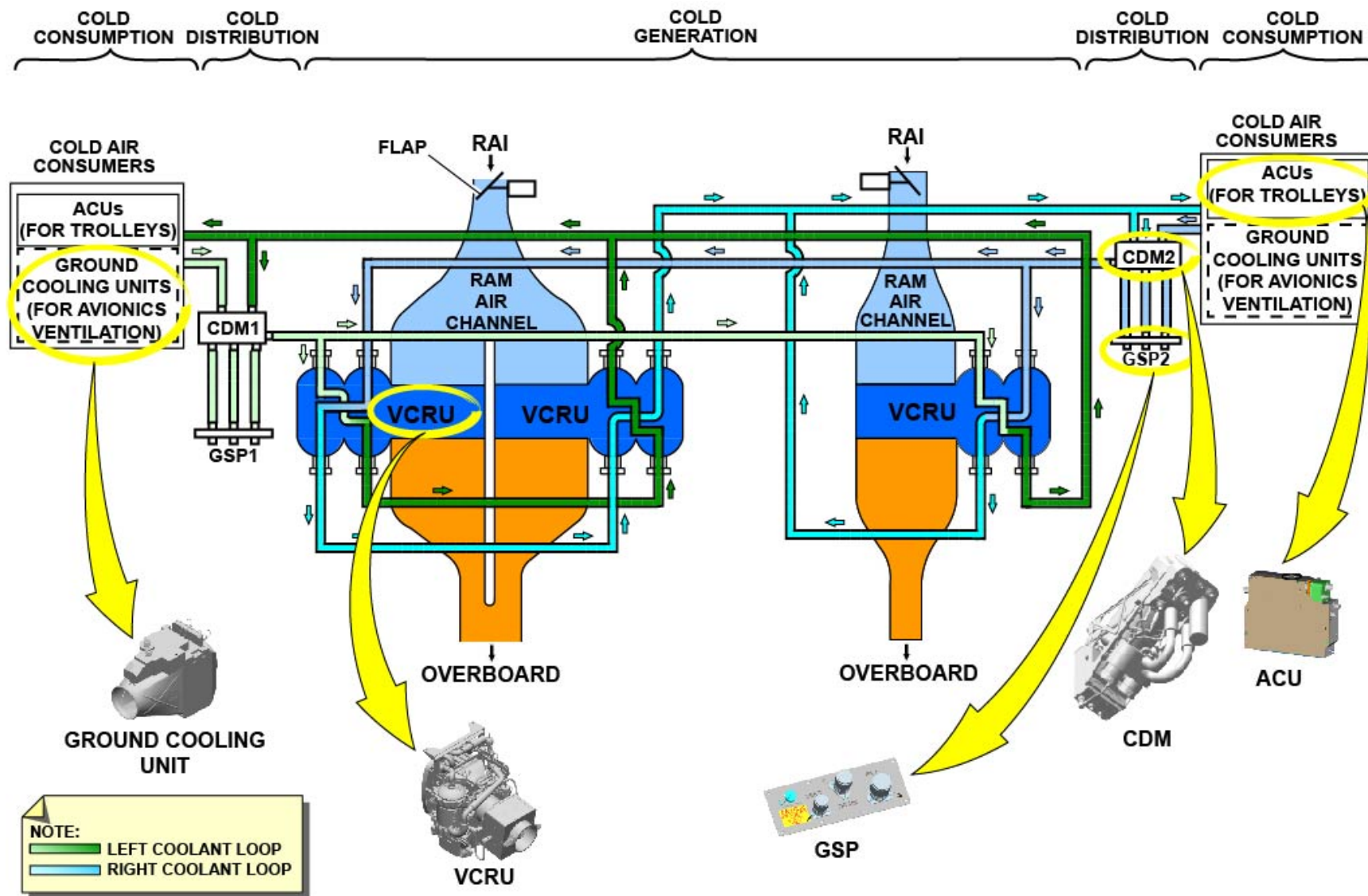
generation are Air Cooling Units (ACUs) and, as option, ground cooling units.

ACUs are used to transfer the cooling capacity from the liquid coolant to the air which circulates in the trolleys.

The ground cooling units option is used to transfer the cooling capacity from the liquid coolant to the air used for the AVS.



SUPPLEMENTAL COOLING SYSTEM (SCS) PRESENTATION



SUPPLEMENTAL COOLING SYSTEM (SCS) PRESENTATION

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SUPPLEMENTAL COOLING SYSTEM (SCS) DESCRIPTION (2/3)

SCS Components Description

Vapor Cycle Refrigeration Unit

VCRU COMPONENTS

Each VCRU includes:

- An internal refrigerant loop
- An evaporator
- A compressor
- A condenser
- An expansion valve
- A fan assembly (including the VCRU controller)
- Pressure and temperature sensors.

VCRU COMPONENTS FUNCTIONS

The refrigerant loop, in association with the evaporator, absorbs the heat of the coolant coming from the coolant loops.

Thanks to the VCRU compressor, the refrigerant circulates from the evaporator to the condenser and the expansion valve before to go back to the evaporator.

On the refrigerant loop there is a burst disc to protect the pipe in case of overpressure.

The condenser cools the refrigerant with the airflow coming from the ram air channel.

On ground only, an electrical fan operates to suck outside air in the ram air channel.

Downstream of the condenser, an expansion valve reduces also the temperature of the refrigerant before it goes back to the evaporator.

VCRU CONTROLLER

A VCRU controller controls and monitors the VCRU components with temperature and pressure sensors.

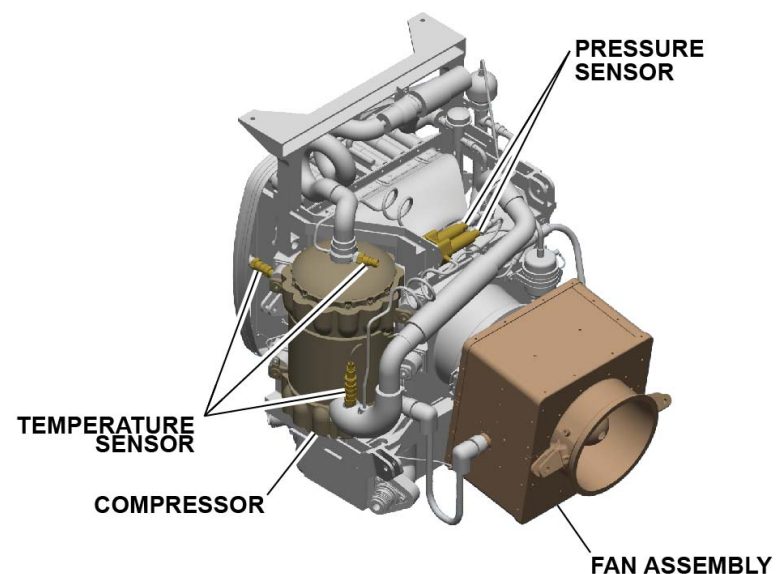
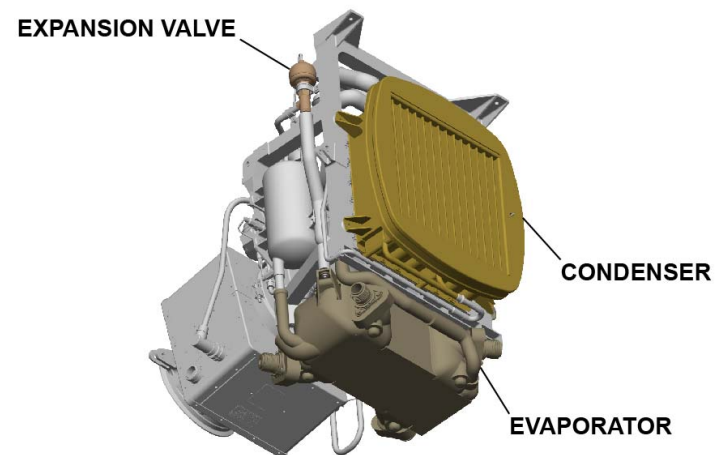
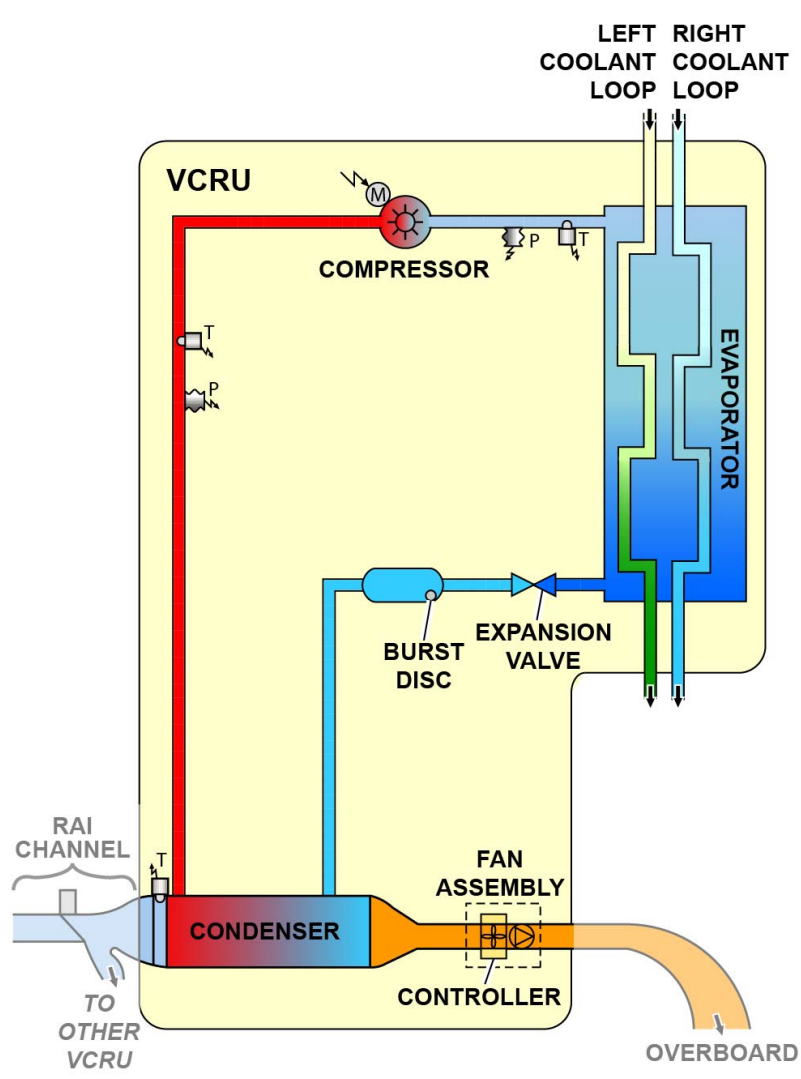
The VCRU controller is part of the fan assembly and the airflow in the ram air channel is also used to cool the VCRU controller.

The VCRU controller has a field loadable software.

VCRU INSTALLATION

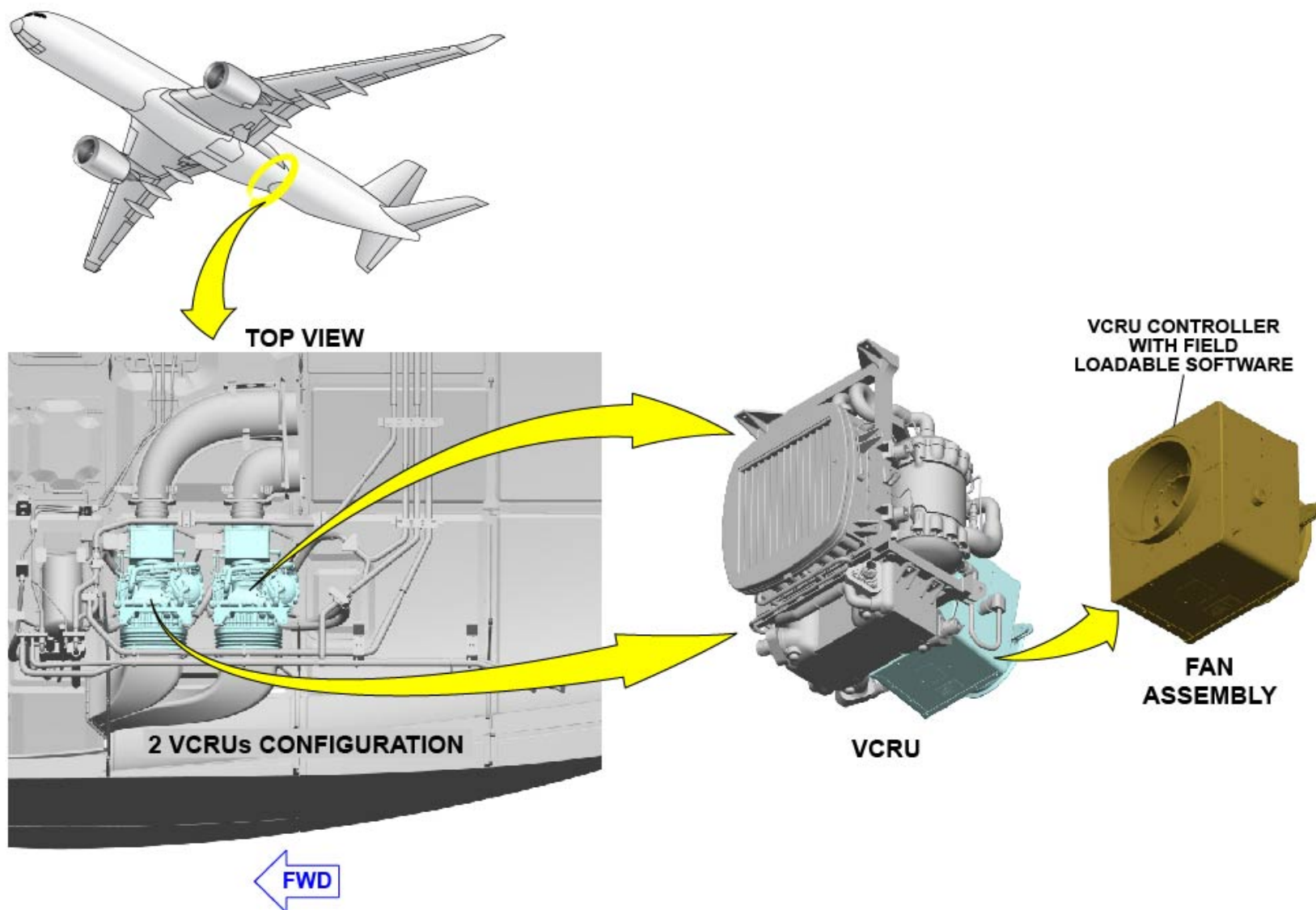
The VCRUs are installed in the rear of the belly fairing.

The VCRUs are Line Replaceable Units (LRU) and on a VCRU only the fan assembly is also a LRU, not the other components.



SCS COMPONENTS DESCRIPTION - VAPOR CYCLE REFRIGERATION UNIT

V2414251 - V00T0MM0 - VM21DESUPCO3001



SCS COMPONENTS DESCRIPTION - VAPOR CYCLE REFRIGERATION UNIT

V2414251 - V00T0MM0 - VM21DESUPCO3001

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SUPPLEMENTAL COOLING SYSTEM (SCS) DESCRIPTION (2/3)

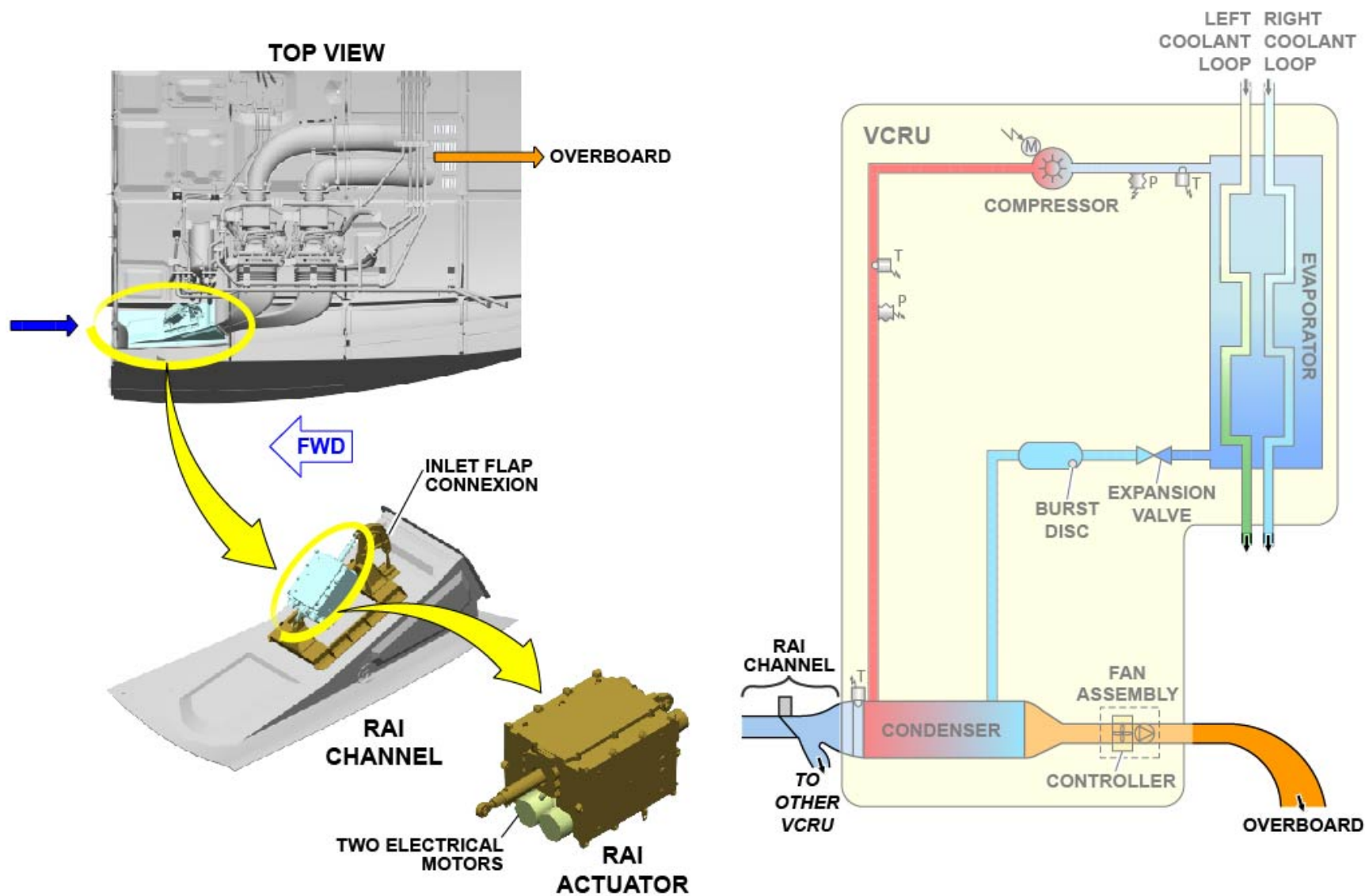
SCS Components Description (continued)

Ram Air Channel

The ram air channel supplies airflow to the VCRU condenser with an inlet flap.

The inlet flap is operated by an actuator, called ram-air channel actuator.

The actuator is equipped with two electrical motors for redundancy and opens fully the inlet flap on ground. During flight, it adjusts the flap position based on the cooling requirement.



SCS COMPONENTS DESCRIPTION - RAM AIR CHANNEL

V2414251 - V00T0MM0 - VM21DESUPCO3001

SUPPLEMENTAL COOLING SYSTEM (SCS) DESCRIPTION (2/3)

SCS Components Description (continued)

Coolant Distribution Module and Ground Service Panel

CDM COMPONENTS

Each CDM includes:

- A dual pump assembly
- A CDM motor controller with a field loadable software
- A coolant filter
- An accumulator
- Pressure, differential pressure, temperature and level sensors
- A sensor service valve.

CDM COMPONENTS FUNCTION

The CDM pump assembly distributes the liquid coolant through the supply and return lines of the SCS. The dual pump assembly has two electrical pumps and is controlled by the CDM motor controllers.

The CDM motor controller is cooled by a heat exchanger (cold plate) connected to the coolant supply line.

Downstream of the pump assembly, the coolant is filtered before to go back to the VCRUs. The coolant filter has a removable cartridge and the filter contamination is monitored by a differential pressure sensor.

The CDM accumulator adjusts the quantity of the liquid coolant in case of thermal expansion/contraction or small leaks.

The accumulator is equipped with a level sensor.

A CDM load bypass valve opens and lets coolant goes back to the return line in case of overpressure in the coolant supply line.

The CDM motor controller monitors the CDM with data from sensors (pressure, differential pressure, temperature and level sensors).

To replace pressure and differential pressure sensors a sensor service valve has to be manually operated.

GROUND SERVICE PANEL

The Ground Service Panel (GSP) has three hydraulic ports for the CDM and coolant loop servicing. With these ports connected to the

CDM, it is possible with a Ground Support Equipment (GSE) to drain, fill and vent (bleed) the coolant loop and refill the accumulator. An electrical socket (signal port) on the GSP allows communication between the GSE and the SCS through the CDM motor controller.

CDMs INSTALLATION

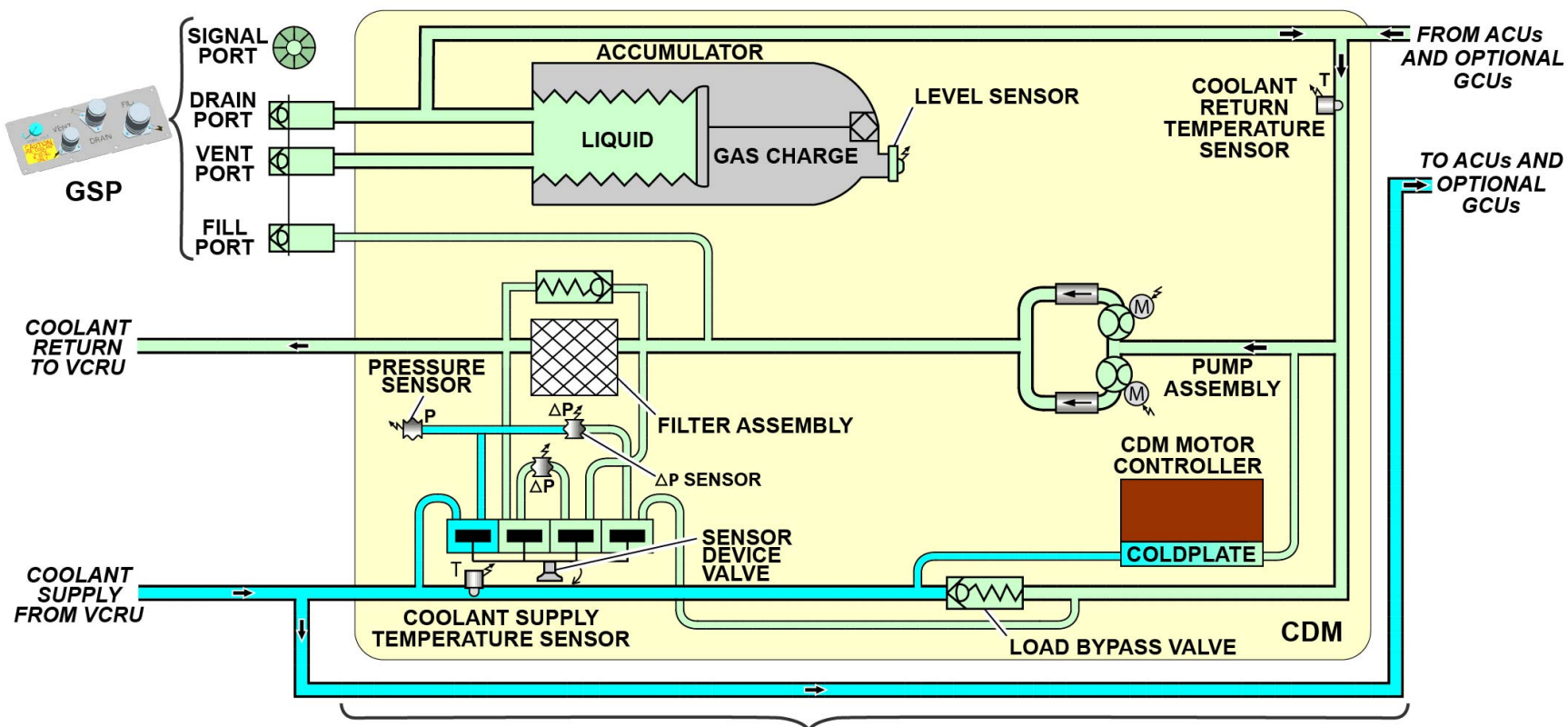
There is one CDM per coolant loop. CDMs are installed in the aft belly fairing, next to the VCRUs.

The CDM is an LRU and some CDM components are also LRUs (motor controller, dual pump assembly, filter, sensors).

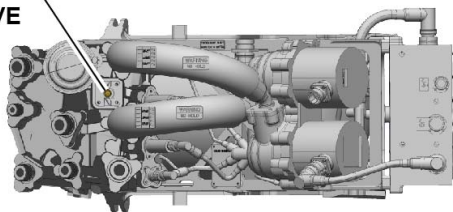
Each CDM is connected to a GSP.

GSPs INSTALLATION

There is one GSP per coolant loop. The GSPs are installed in the aft belly fairing and are accessible with a service panel.

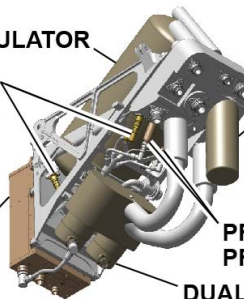


SENSOR
DEVICE
VALVE



ACCUMULATOR
TEMPERATURE
SENSOR

MOTOR CONTROLLER
(FIELD LOADABLE
SOFTWARE)

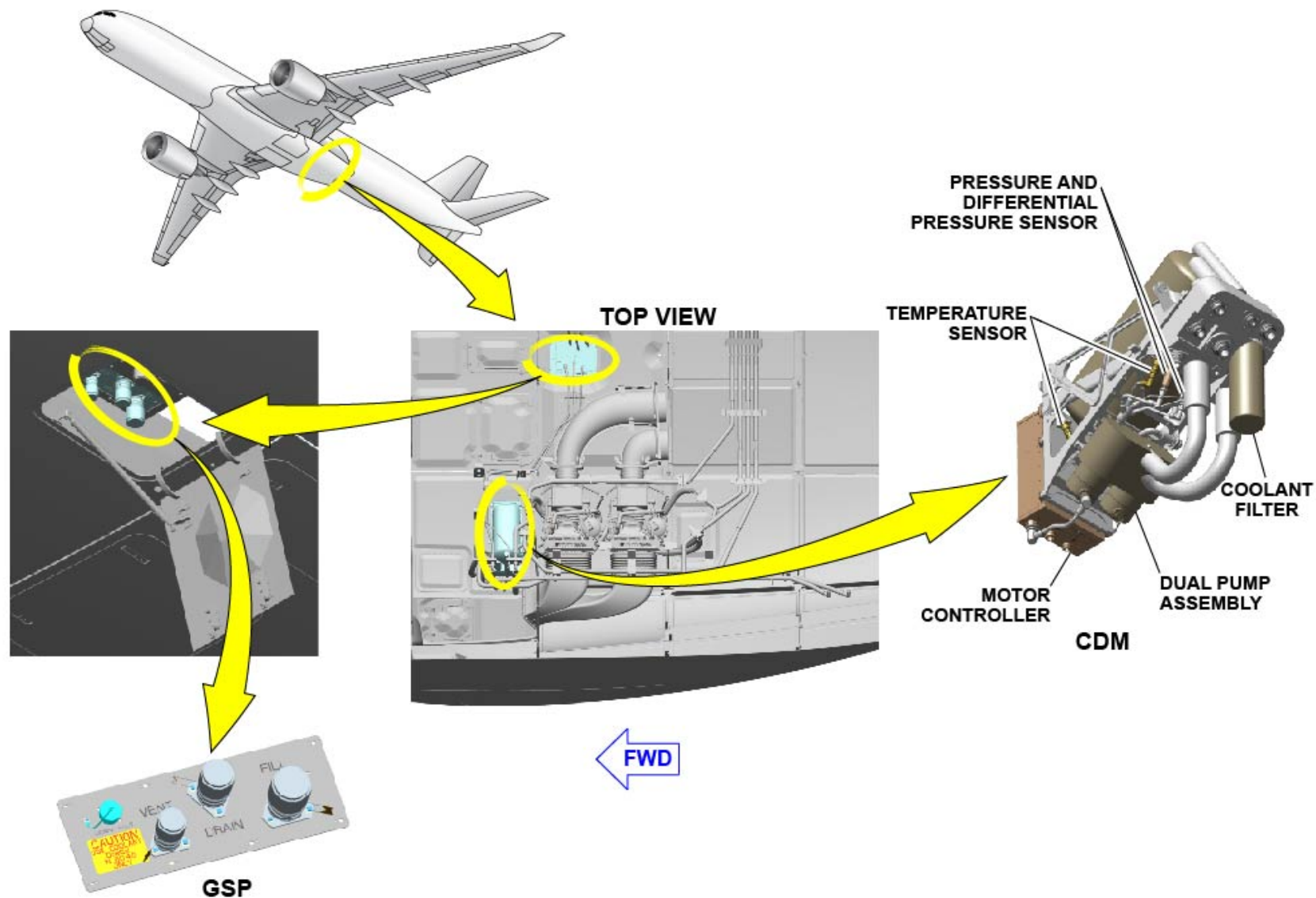


COOLANT
FILTER

PRESSURE AND DIFFERENTIAL
PRESSURE SENSOR

DUAL PUMP
ASSEMBLY

SCS COMPONENTS DESCRIPTION - COOLANT DISTRIBUTION MODULE AND GROUND SERVICE PANEL



SCS COMPONENTS DESCRIPTION - COOLANT DISTRIBUTION MODULE AND GROUND SERVICE PANEL

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SUPPLEMENTAL COOLING SYSTEM (SCS) DESCRIPTION (2/3)

SCS Components Description (continued)

Air Cooling Unit and Ground Cooling Unit

ACUs

The number of ACUs depends on the number of trolleys and the galleys configuration.

The ACUs maintain at low temperature the air circulation around or through the trolleys.

Each ACU includes:

- A heat exchanger. The heat exchanger is connected to a drain pipe to evacuate condensation water to the A/C bilge.
- A fan assembly
- A coolant control valve
- A local controller with a field loadable software
- Temperature sensors.

ACU COMPONENTS FUNCTION

To maintain air at a low temperature, a fan draws out the air from the trolleys and forces it to go through a heat exchanger before to return to the trolleys.

The heat exchanger decreases the air temperature with the coolant loop interface. The coolant flow in the heat exchanger is adjusted with a modulating coolant control valve.

To control and monitor the ACU, a local controller uses air and coolant temperature data from the temperature sensors. The data from temperature sensors are used for the adjustment of the coolant control valve position and the fan speed.

Ground Cooling Unit

The ground cooling units are optional. They decrease the temperature of the air blown to avionics bays (refer to AVS). They are used on ground when the air temperature blown to avionics bays is above a certain value.

Each ground cooling unit includes:

- A heat exchanger.

The heat exchanger is connected to a drain pipe to evacuate condensation water to the A/C bilge.

- A coolant control valve
- A local controller
- Temperature sensors.

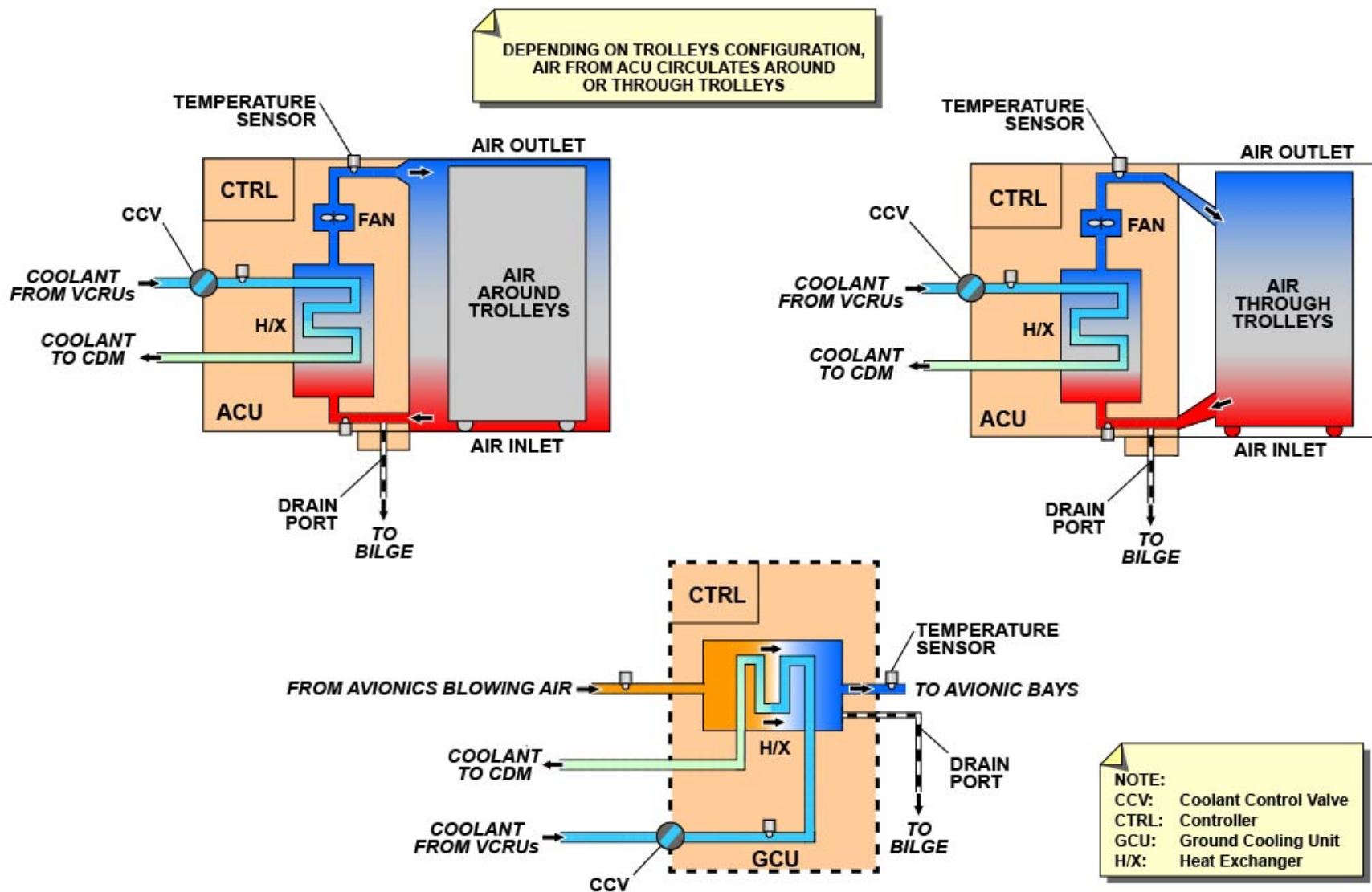
GROUND COOLING UNIT COMPONENTS FUNCTION

The ground cooling unit heat exchanger is connected to the coolant loop of the SCS. With the coolant, the heat exchanger decreases the temperature of the air coming from the avionics blowing air system (refer to AVS). Downstream of the heat exchanger, the cold air flows to the avionics bays.

Air temperature is adjusted with a modulation of the coolant control valve.

To control and monitor the ground cooling unit, the local controller uses air and coolant temperature data from temperature sensors.

Temperature sensors data are used for the adjustment of the coolant control valve position.



SCS COMPONENTS DESCRIPTION - AIR COOLING UNIT AND GROUND COOLING UNIT

SUPPLEMENTAL COOLING SYSTEM (SCS) DESCRIPTION (2/3)

SCS Control/Interfaces

The SCS application, which is installed in two CPIOMs, controls and monitors the SCS components. In one CPIOM the SCS application is active and in the other CPIOM the application is in standby. Without failure, active/standby switching occurs at A/C power-up.

VCRUs CONTROL AND MONITORING

The SCS application controls and monitors the VCRUs components through CRDCs and the VCRUs controllers.

Depending on the cooling demands, the SCS application controls with the VCRUs controllers the speed of the compressors and the fans. The SCS application receives, through the VCRUs controllers and CRDCs, the pressure and temperature sensors data for VCRUs monitoring.

CDMs CONTROL AND MONITORING

The SCS application controls and monitors the CDMs through CRDCs and the CDMs controllers.

Depending on the cooling demands, the SCS application controls with the CDMs controllers the speed of the pumps.

During a normal operation, for an A/C with two coolant loops and up to three VCRUs installed, only one pump of each pump assembly is operated.

If a CDM controller fails, the remaining controller of the other CDM operates two pumps, one pump of its associated CDM and also the second pump previously in standby in the other CDM.

Pressure, differential pressure, level and temp sensors data are sent to the SCS application through CDMs controllers and CRDCs for monitoring.

RAM AIR CHANNEL ACTUATORS CONTROL AND MONITORING

The ram air channel actuators are controlled and monitored by the SCS application via CRDCs.

LGERS interface is used for flight / ground condition, when A/C is on ground the flap is fully open.

The Air Data/Inertial Reference System (ADIRS) interface is used to adjust ram air inlet flap position in flight depending on air data.

ACUs CONTROL AND MONITORING

Each ACU is controlled and monitored by the SCS application and its ACU controller.

The ACU controller receives the ACU operation demand from the SCS application and directly from the galley control panel.

The ACU fan speed and the coolant control valve position adjustment are controlled by the ACU controller based on the cooling demand.

Temperature sensors data are used by the ACU controller for the control and the monitoring.

The ACU is monitored by the SCS application through the ACU controller.

GCU's CONTROL AND MONITORING

The ground cooling units are controlled and monitored by the SCS application with the ground cooling unit controllers interface.

The ground cooling units are operated only on ground, SCS application receives the flight / ground configuration from the LGERS interface.

The ground cooling-unit coolant-control-valve position is adjusted based on temperature sensors data used for the control and monitoring.

GROUND SERVICE PANELS

During servicing, each ground service panel allows communication between the GSE and the SCS application through the associated CDM controller.

SCS OPERATION

The SCS operation depends on:

- Cockpit controls selections (COOLG P/BSW, COMMERCIAL P/BSW, GALLEY P/BSW)
- Galley control panels selections
- Preconditioning selection on FAP Galley Cooling page.

The ground cooling units operation is automatic if the SCS COOLG P/BSW and the AVNCS GND COOLG P/BSW are not selected OFF.

The Galley Cooling page on the FAP of the CIDS shows the SCS status.

RESET

The SCS 1 and 2 RESET SWs are used to reset the SCS applications, VCRU controllers, CDM controllers and ground cooling units controllers.



SCS CONTROL/INTERFACES

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SUPPLEMENTAL COOLING SYSTEM (SCS) CONTROL AND INDICATING (2/3)

SCS - General (2)

SCS Normal Operation (2)

Supplemental Cooling System (SCS) introduction:

The Supplemental Cooling System (SCS) supplies cooling capacity to the galleys locations.

Supplemental Cooling System has in basic configuration:

- Two Vapor Cycle Refrigeration Units (VCRUs) that cool the Coolant fluid of the system,
- One Coolant Distribution Module (CDM) that circulates the Coolant fluid to the Air Cooling Units (ACUs) installed in the galleys
- One Coolant distribution loop (left loop) to distribute the coolant to the different consumers.

When Aircraft is electrically powered and provided that the COOLG P/B SW is set to AUTO position, Supplemental Cooling System operates if there is a demand.

Cockpit Controls

On the integrated control panel there are four control pushbuttons that monitor the SCS. These are:

- On the VENT panel, the COOLG P/B SW is used to control the Supplemental Cooling System. During normal operation, the COOLG P/B is pressed in (AUTO mode).
- On the ELEC panel, the GALLEY P/B SW is used to manually shed all the galley loads, or to restore the galleys after an overload or an automatic shedding procedure. The Air Cooling Units (ACUs) are powered through the galleys. If the galleys are shed, the ACUs are not supplied. The normal position of the GALLEY P/B SW is pressed in (AUTO mode).
- On the ELEC panel, the COMMERCIAL 1 P/B and 2 P/B SWs control the electrical power supply to the secondary power distribution-system. With the "COMMERCIAL" pushbuttons all the commercial electrical loads can be shed in case of an electrical emergency situation.

As a consequence parts of the supplemental cooling are not supplied with electrical power and therefore not operational.

Cabin indications

The general condition and status information applicable to the Supplemental Cooling System (SCS) is shown on the Flight Attendant Panel (FAP) of the CIDS. All the ACUs data (location, temperature, status) are displayed on the FAP GALLEY COOLING - page. In case of malfunction of an Air Cooling Unit (ACU), warning and status messages are displayed on the FAP.

Each Air Cooling Unit (ACU) can be controlled, independently by the cabin crew via the galley panel.

The galley Air Cooling Unit control panel consists of:

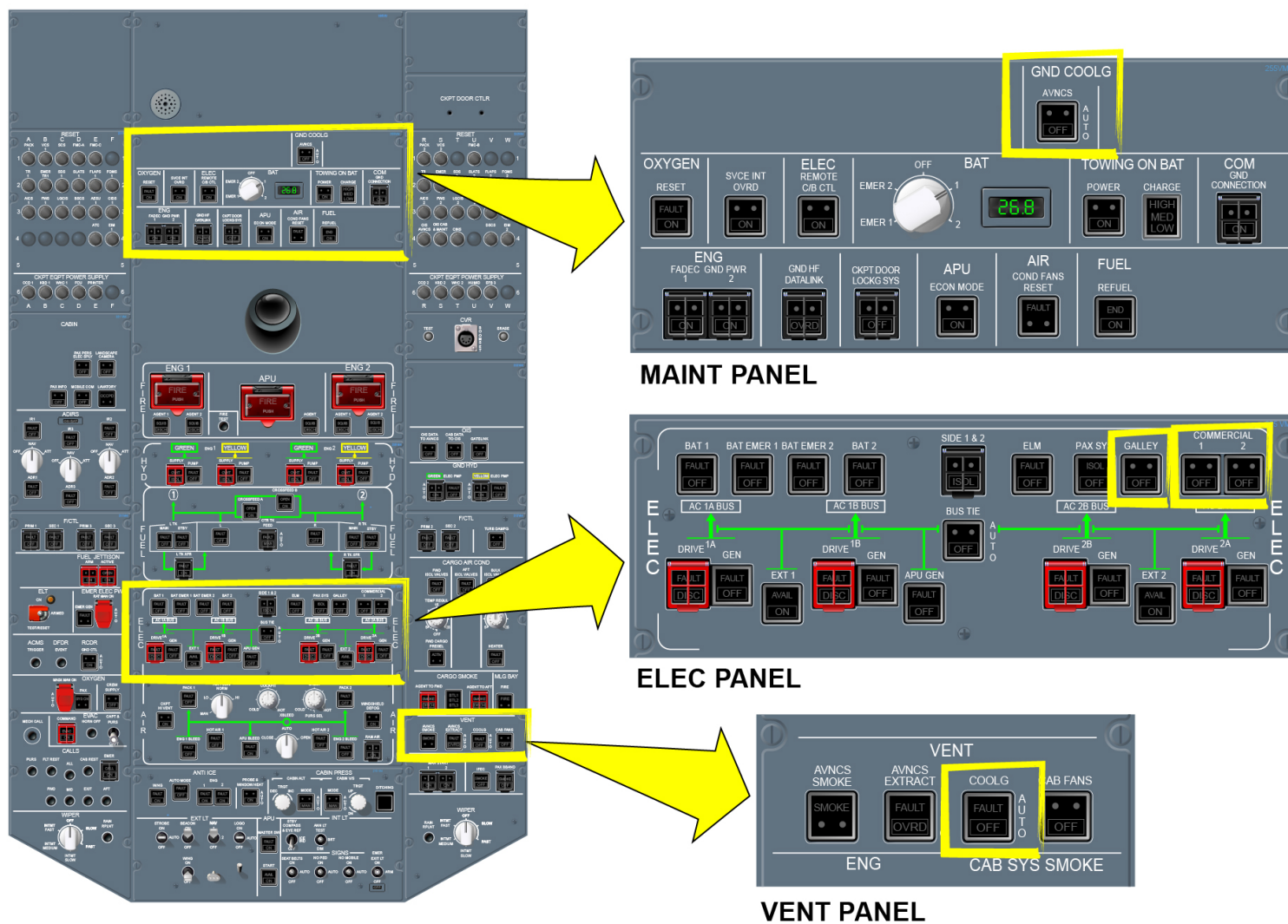
Normal Operation Mode

The system works into the normal operation when:

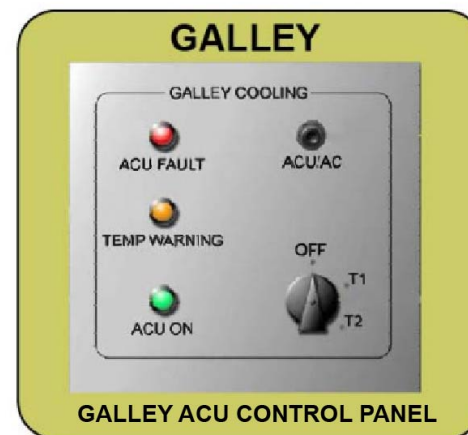
- The COOLG pushbutton is in the AUTO position.
- Demand from the Galley control panel or the Flight Attendant Panel.

SCS Abnormal operation (3)

In case the overheat protection of both coolant loops is degraded, the level of degradation and affected galleys are indicated on the FAP.

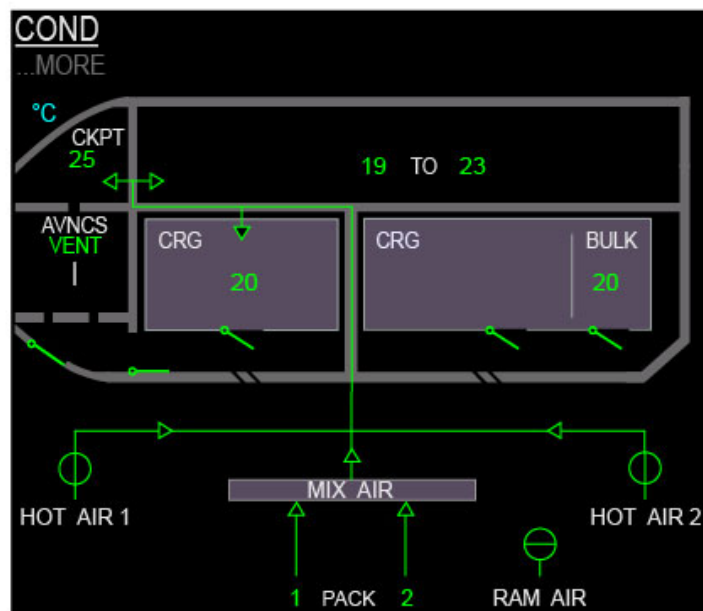


SCS - GENERAL (2) ... SCS ABNORMAL OPERATION (3)


FAP


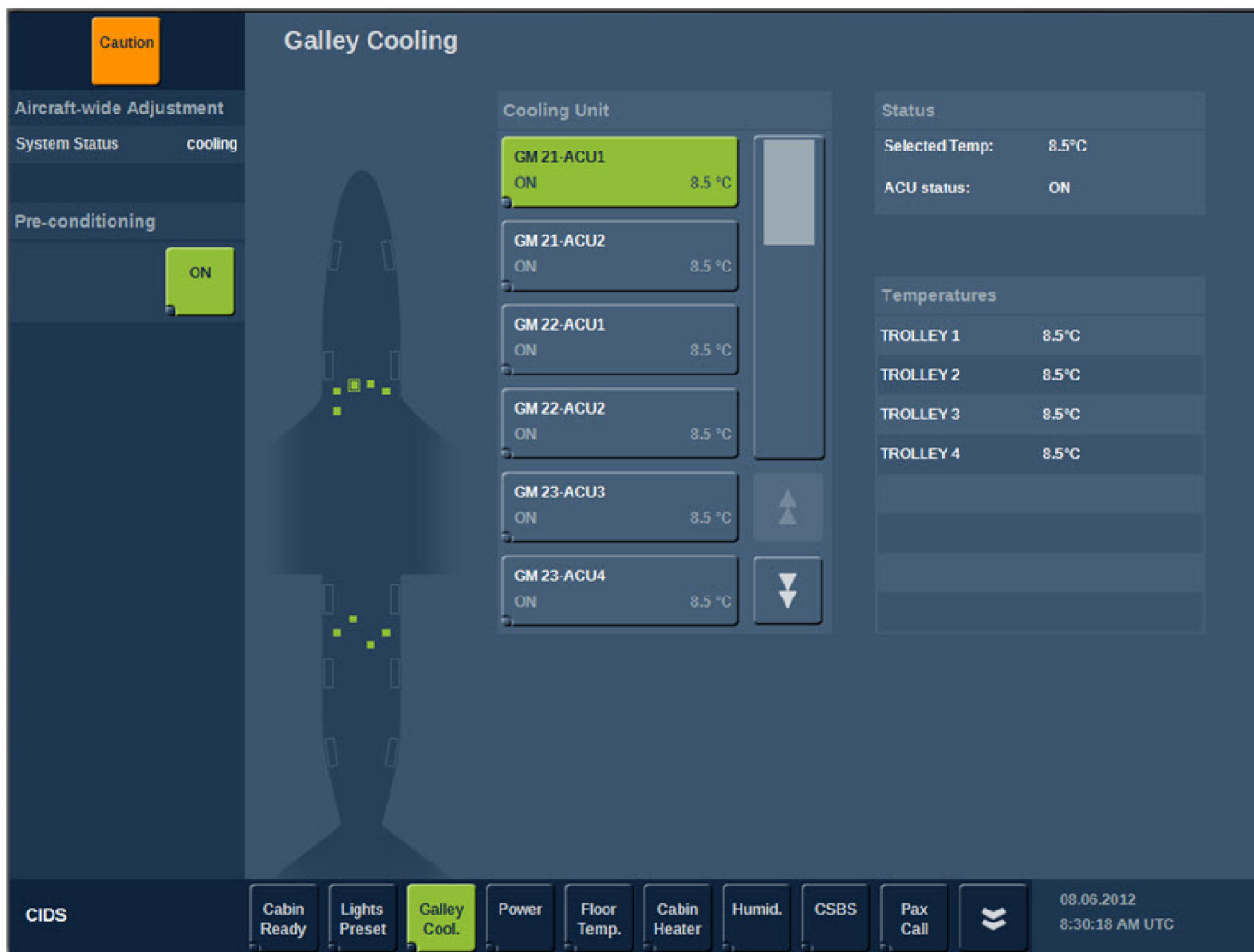
FAP: Flight Attendant Panel
ACU : Air Cooling Unit

SCS - GENERAL (2) ... SCS ABNORMAL OPERATION (3)



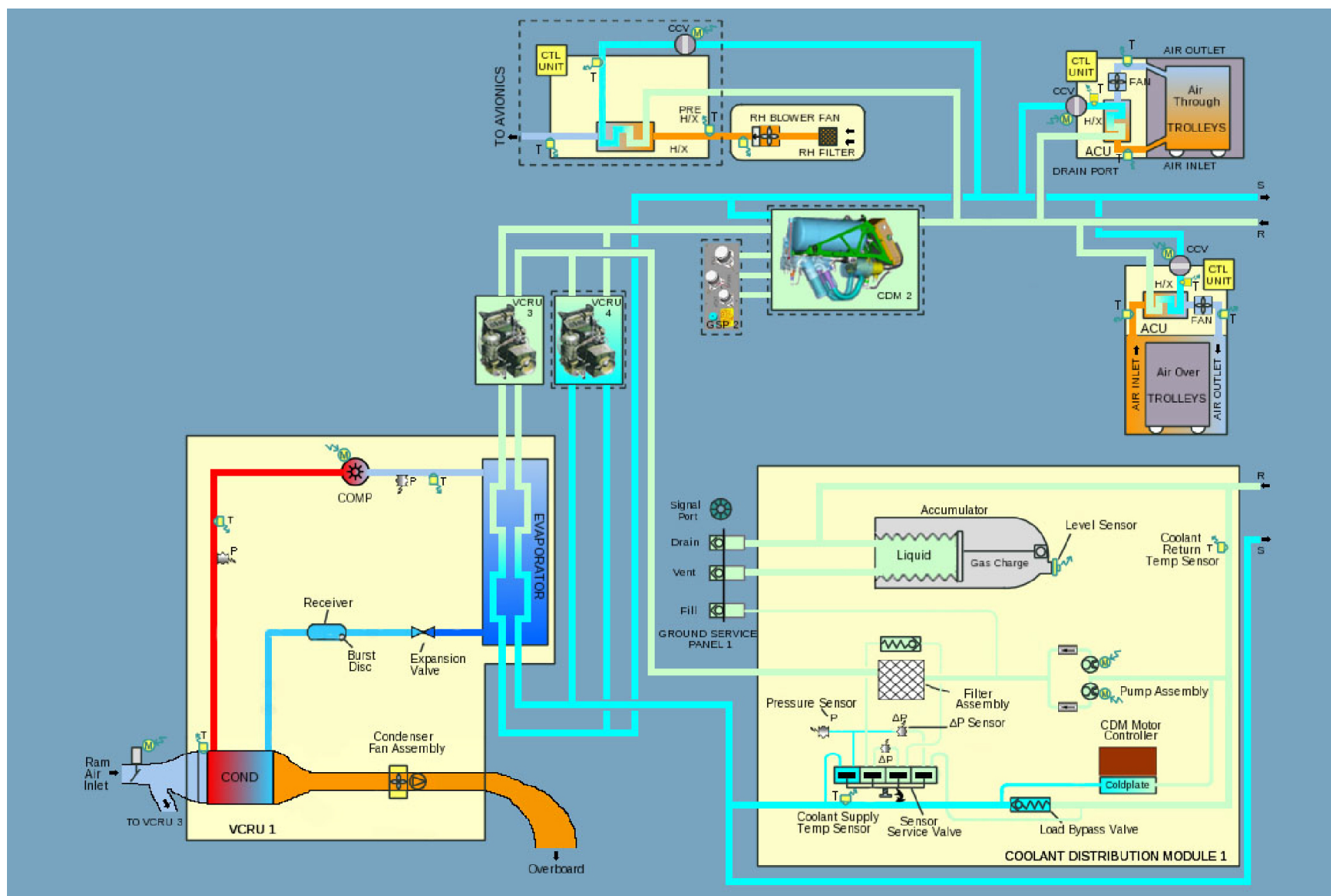
COND SD PAGE

SCS - GENERAL (2) ... SCS ABNORMAL OPERATION (3)



GALLEY COOLING FAP PAGE

SCS - GENERAL (2) ... SCS ABNORMAL OPERATION (3)



SCS - GENERAL (2) ... SCS ABNORMAL OPERATION (3)

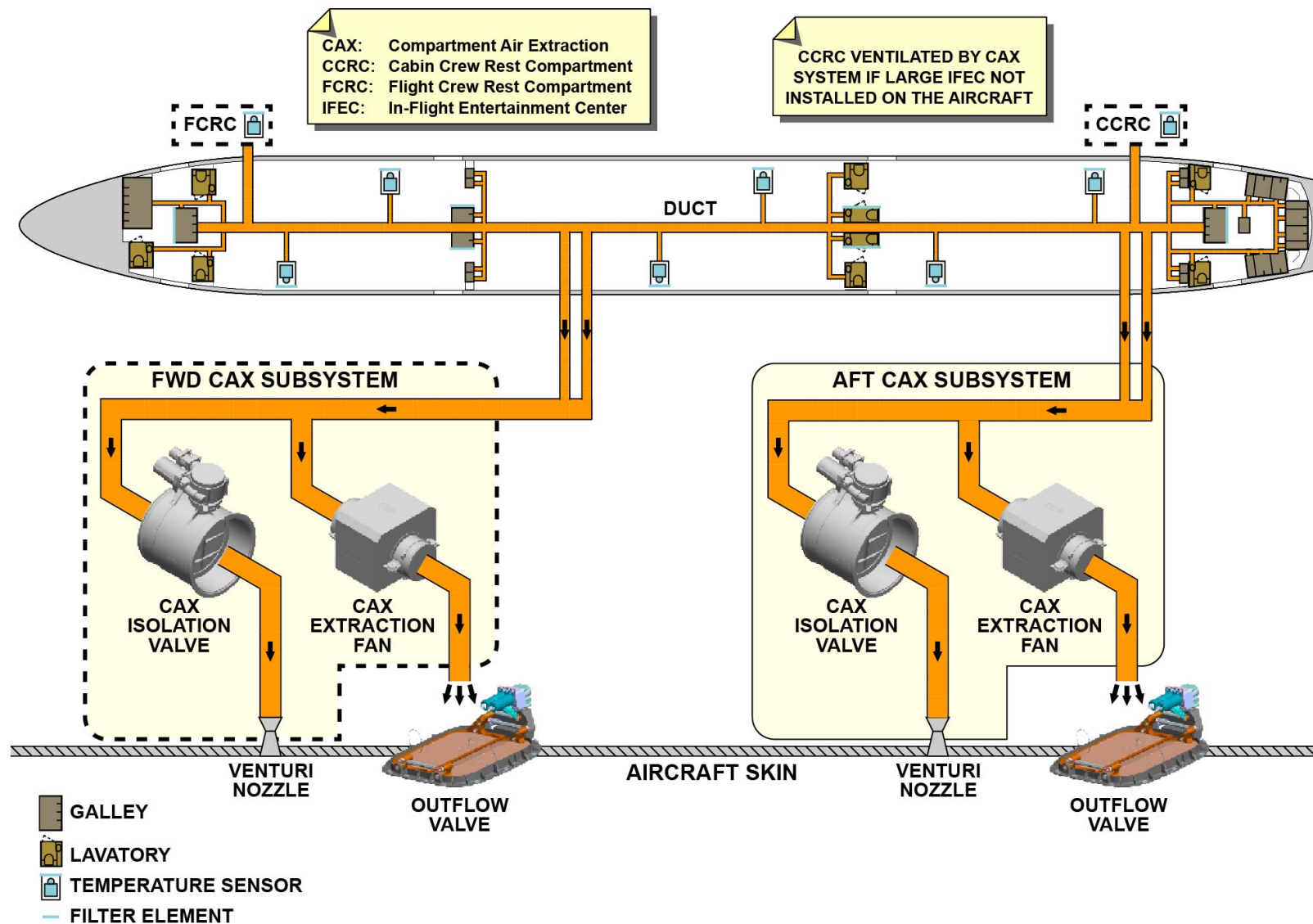
COMPARTMENT AIR EXTRACTION (CAX) SYSTEM DESCRIPTION (2/3)

CAX System Presentation

The Compartment Air Extraction (CAX) system:

- Removes the odors from the galleys and the lavatories and gives the airflow to these areas
- Supplies airflow around the cabin temperature sensors, to have an accurate measurement
- Extracts air from the optional compartments, Flight Crew Rest Compartment (FCRC) and Cabin Crew Rest Compartment (CCRC) to have constant quantity fresh air. For the CCRC, the CAX operates if the In-Flight Entertainment Center (IFEC) ventilation system is not installed. The CAX system has one or two identical subsystems that are installed in the FWD cargo bilge-area (optional subsystem) and aft cargo bilge-area (basic subsystem). Each subsystem removes air through the CAX extraction fan and the outflow valve when the A/C is on the ground. In flight, each subsystem removes air through the CAX isolation valve and through the venturi nozzle.

The air from the galleys, lavatories, cabin temperature sensors and other optional compartments goes through the extraction filters elements (to prevent contamination of the air) and then through the ducts.



CAX SYSTEM PRESENTATION

COMPARTMENT AIR EXTRACTION (CAX) SYSTEM DESCRIPTION (2/3)

CAX Description and Interfaces

The Ventilation Control System (VCS) application, which is installed in two CPIOMs controls and monitors the CAX system.

The CAX system operates automatically when the A/C is energized.

The VCS application controls the CAX isolation valve and the extraction fan through the CRDCs (depending GND/Flight configuration).

When the A/C is on the ground, the CAX isolation valve closes and the CAX extraction fan runs. In flight, the CAX isolation valve opens and the CAX extraction fan stops.

The VCS applications also monitor the CAX isolation valves and the CAX extraction fans through the CRDCs.

The VCS application controls the CAX extraction fans through the CAN bus to adjust the fan speed and to receive the feedback signal.

The VCS application also keeps the fan in operation during flight, if the CAX isolation valve has a failure in closed condition.

The VCS applications receive:

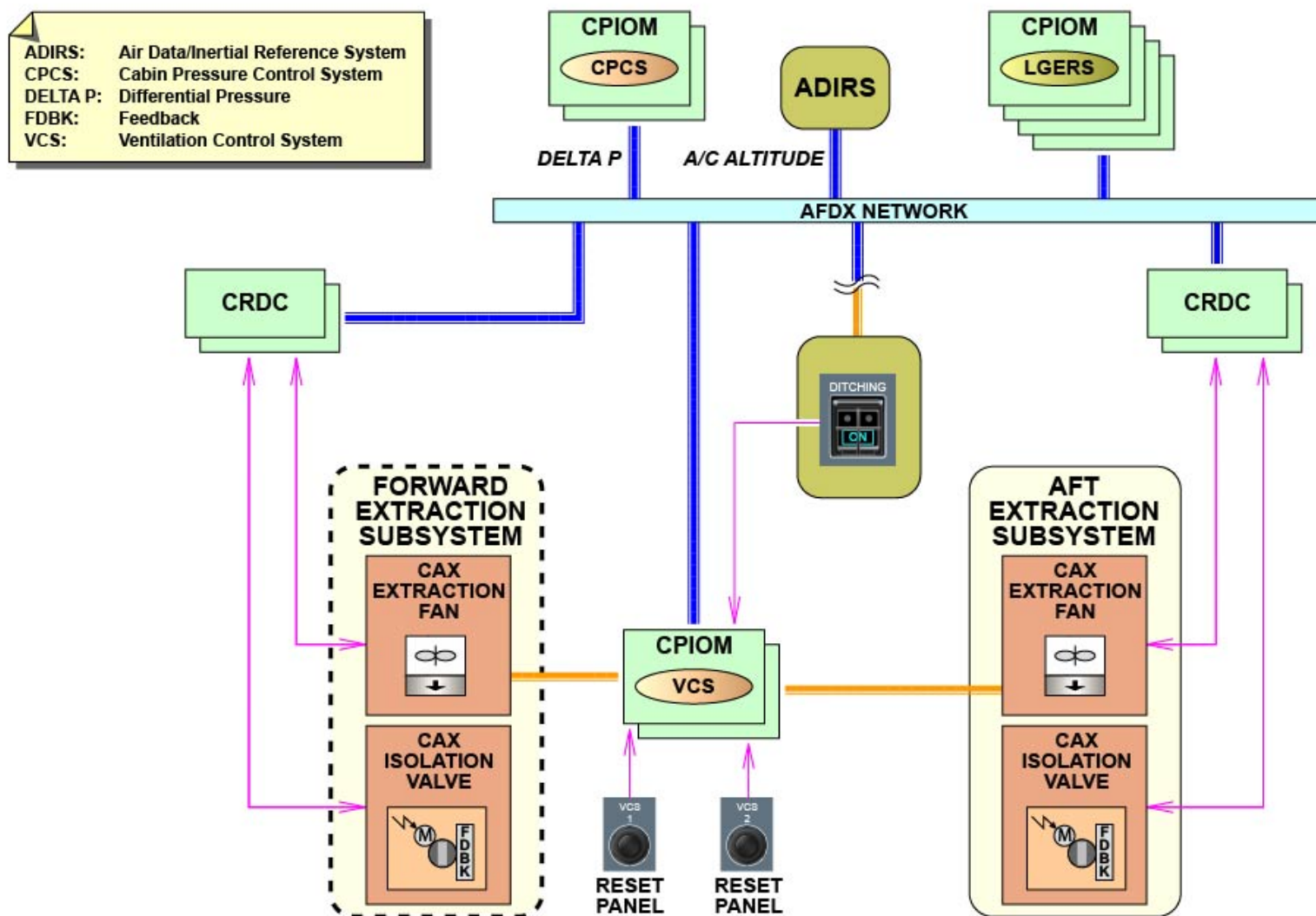
- The ground or flight signal from LGERS
- The A/C altitude from the Air Data/Inertial Reference System (ADIRS).

The two systems are used to determine the ground or flight configuration, when A/C is in flight at a defined altitude.

During a decompression event (the two air conditioning packs are inoperative) the Cabin Pressure Control System (CPCS) sends signals to close the CAX isolation valve and to start the CAX extraction fan.

If used, the DITCHING P/BSW sends a discrete and AFDX signal to the VCS applications. The VCS applications send a signal to stop the CAX extraction fans and to close the CAX isolation valves in the fully closed position.

The flight crew can reset the VCS application in CPIOM through the VCS1 and VCS2.



CAX DESCRIPTION AND INTERFACES

COMPARTMENT AIR EXTRACTION (CAX) SYSTEM DESCRIPTION (2/3)

CAX Components Description

Each CAX extraction fan has an electrical motor and an integrated control board with field loadable software to control and monitor the fan.

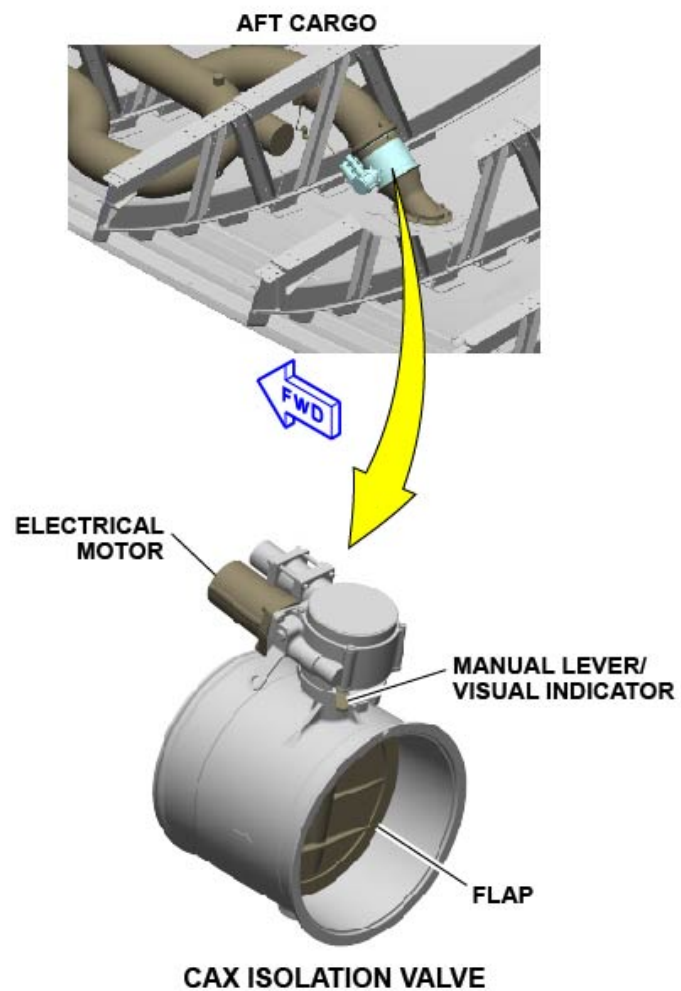
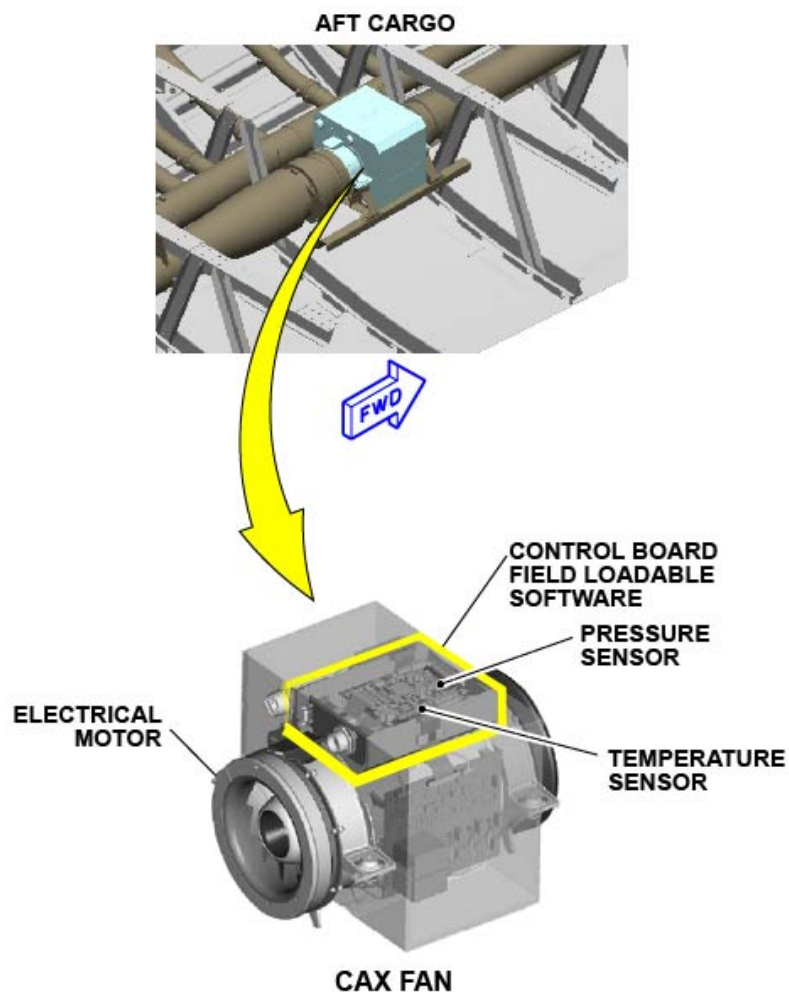
It has differential pressure sensor to monitor the filter contamination on ground.

The fan uses a fan housing temperature sensor to have an internal shutoff function for the overheat detection and protection.

Each CAX isolation valve has an electrical motor, which operates the rotary actuator to move the flap.

The CAX isolation valve has two positions, fully open or fully closed.

If there is a failure, it is possible to deactivate the valve in the fully opened or fully closed position with a manual lever, which also has a visual indicator.



CAX COMPONENTS DESCRIPTION

AVIONICS EQUIPMENT VENTILATION DESCRIPTION (2/3)

System Presentation

The functions of the Avionics Ventilation System (AVS) are to ensure the ventilation of the avionics equipment and to remove the heat dissipated, to guarantee a high reliability level.

The AVS includes two blowing subsystems and one extraction subsystem. The two independent blowing subsystems, one on the LH and one on the RH side of the A/C, supply the ventilation airflow from the FWD cargo LH or RH triangle area to the racks and equipments.

The RH blowing subsystem supplies air to:

- The RH and center avionics racks
- The RH flight deck equipments.

The LH blowing subsystem supplies air to:

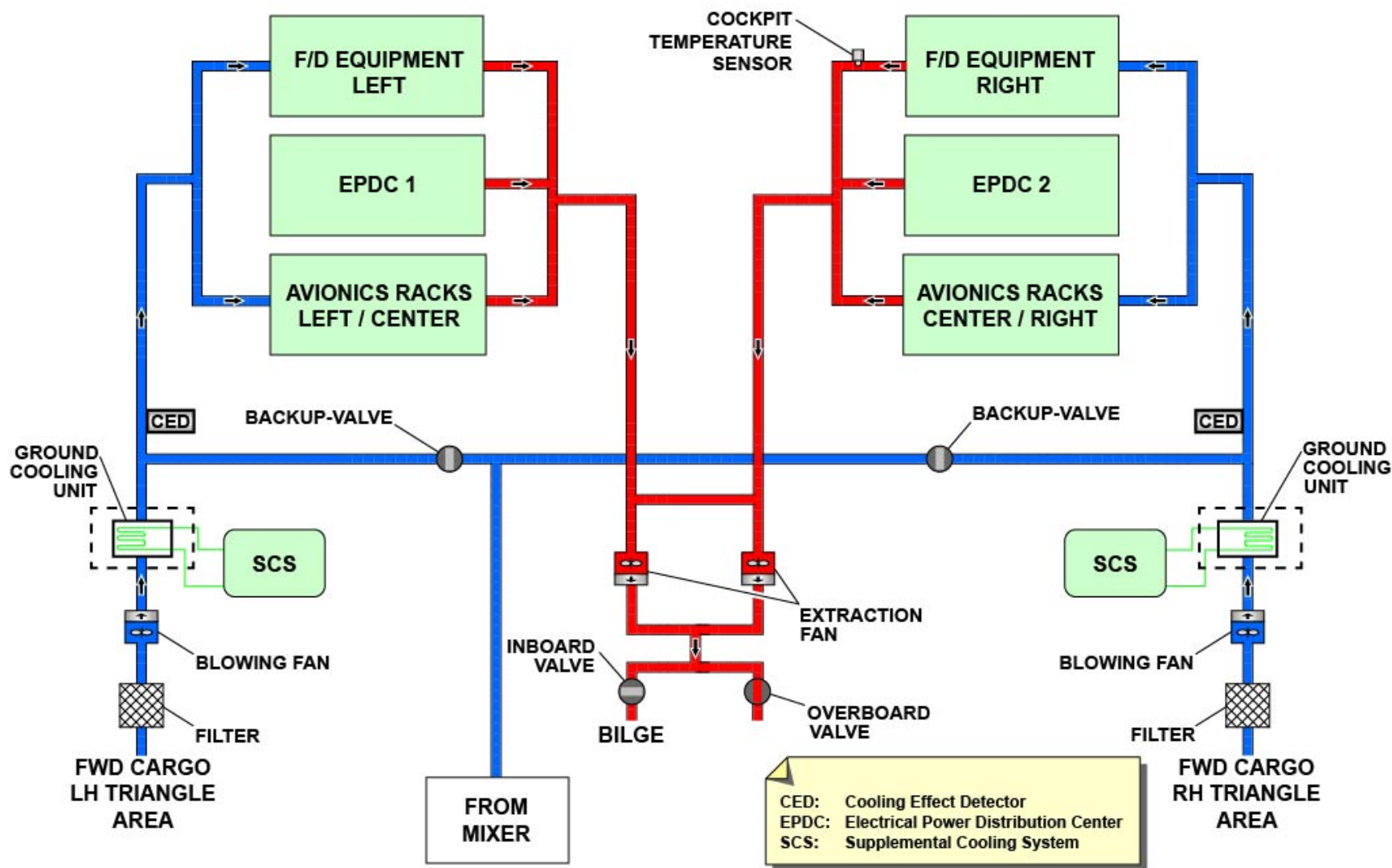
- The LH and center avionics racks
- The LH flight deck equipments.

The AVS extraction subsystem extracts heat from the racks and equipments supplied by both blowing subsystems. It also extracts heat from the LH and RH Electrical Power Distribution Centers (EPDCs) and ensures airflow around the cockpit temperature sensor to have accurate measurement.

Each blowing subsystem includes a filter to remove the contamination from the air draws by a blowing fan. Air from the blowing fan goes through the Cooling Effect Detector (CED) used to measure the cooling capacity. A backup valve can supply fresh air from the mixer in case of blowing subsystem failure.

Depending on Supplemental Cooling System (SCS) configuration, an optional ground cooling unit can be installed to decrease the temperature of the blowing air flow.

The extraction subsystem has two extraction fans installed in parallel in order to remove heat dissipation. Depending on the A/C configuration this air is discharged outside the A/C through the inboard valve or through the overboard valve.



SYSTEM PRESENTATION

AVIONICS EQUIPMENT VENTILATION DESCRIPTION (2/3)

System Description and Interfaces

The AVS system operates automatically as soon as A/C is energized. Two CPIOMs host a Ventilation Control System (VCS) application to control and monitor AVS. Through the CRDCs, the VCS application controls and monitors the backup valves, overboard valve and inboard valve position, and monitors CEDs, blowing and extraction fans. The VCS application adjusts the speed of the blowing and extraction fans via CAN bus. In case of VCS application or AFDX failure, some CRDCs are able to maintain the control of the backup valves, overboard valve and inboard valve using discrete signal.

In normal operation the blowing fan speed is controlled according to the monitored blowing fan outlet's temperature. In case of CAN bus failure, blowing fan runs at default speed.

If one blowing fan fails or one CED detects insufficient cooling, the VCS application or CRDCs, control the backup valve of the dedicated side in open position. The air is now supplied from the mixer. If insufficient cooling remains, the VCS activates a horn and AVNCS light on the Nose Landing Gear (NLG) when A/C is on ground.

In normal operation the extraction subsystem draws heated air through both extraction fans. On ground configuration, the air extracted is sent outside via the overboard valve which is in fully open position (inboard valve is in the closed position). In flight configuration, the air extracted is sent in the bilge area through the inboard valve which is in opened position (the overboard is in the closed position). The extraction fan speed is controlled by the VCS applications and linked to the speed of the blowing fans.

If one extraction fan fails, the remaining extraction fan increases its speed to compensate the extraction flow. If both extraction fans fail, in flight air is extracted via cabin pressure difference through the partially open position of the overboard valve and the inboard valve is closed. On ground, no air is extracted and the VCS application activates the horn and the AVNCS VENT light on the Maintainability Panel via CRDCs.

The VCS applications receive data from the LGERS and Propulsion Control System (PCS) systems in order to determine the ground/flight configuration.

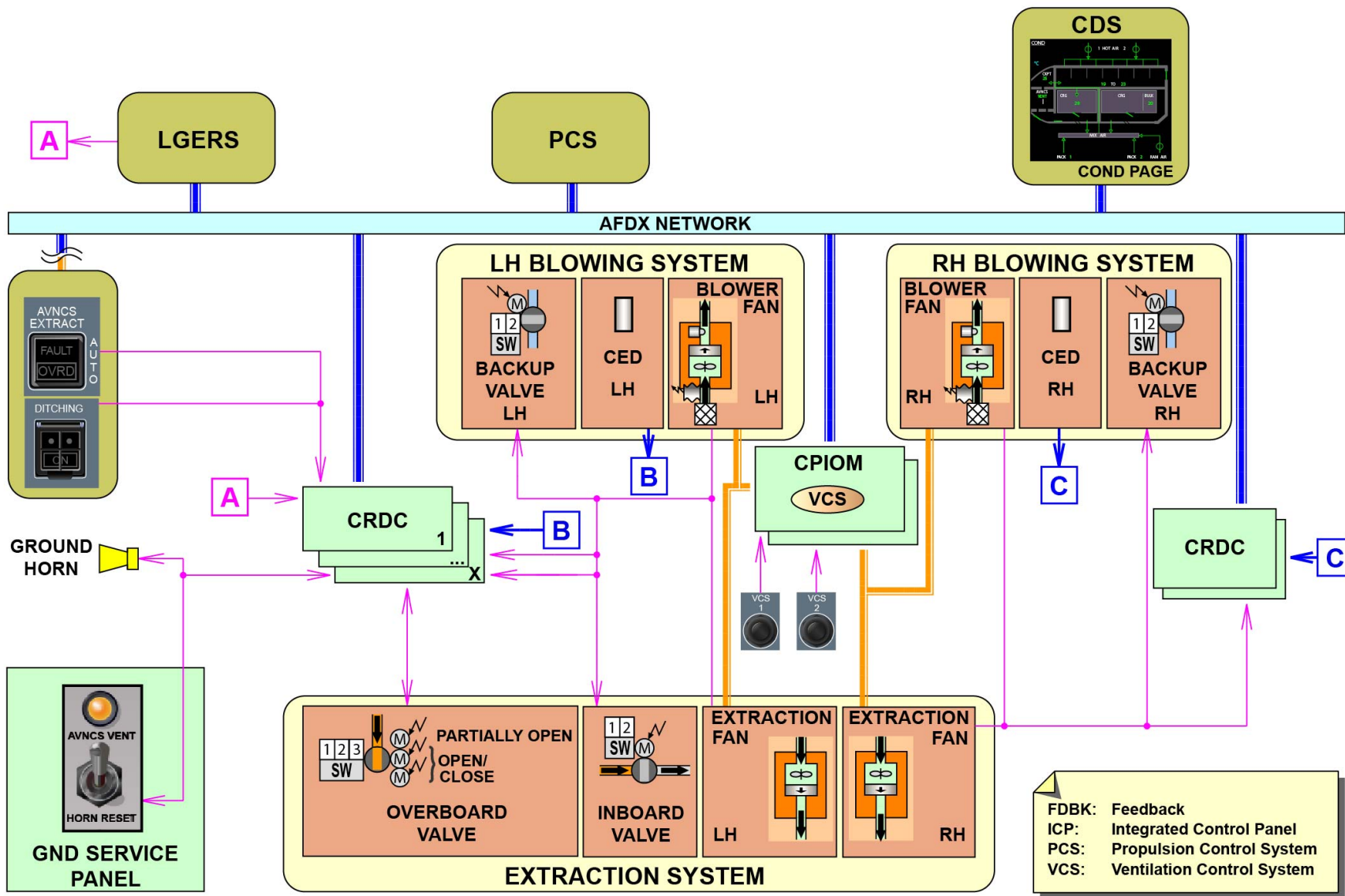
Ground configuration corresponds to A/C on wheels and both engines OFF.

The LGERS discrete signal is used by CRDCs for ground/flight configuration in case of AFDX failure.

The status of the AVS is displayed on the CDS by the VCS application. In case of air extraction subsystem failure or in case of smoke in the AVS, the pilot can press AVCNS EXTRACT P/BSW. Then overboard valve is set to partially open position and inboard valve is maintained open if at least one extraction fan is running. The inboard valve is set to close position if both extraction fans are inoperative.

DITCHING P/BSW has priority over other AVS controls, to close the overboard valve and to open the inboard valve.

The VCS1 and VCS2 RESET SWs send a discrete signal to reset the VCS application in the CPIOM.



V2414251 - V00T0MM0 - VM21DEAVSVE3001

AVIONICS EQUIPMENT VENTILATION DESCRIPTION (2/3)

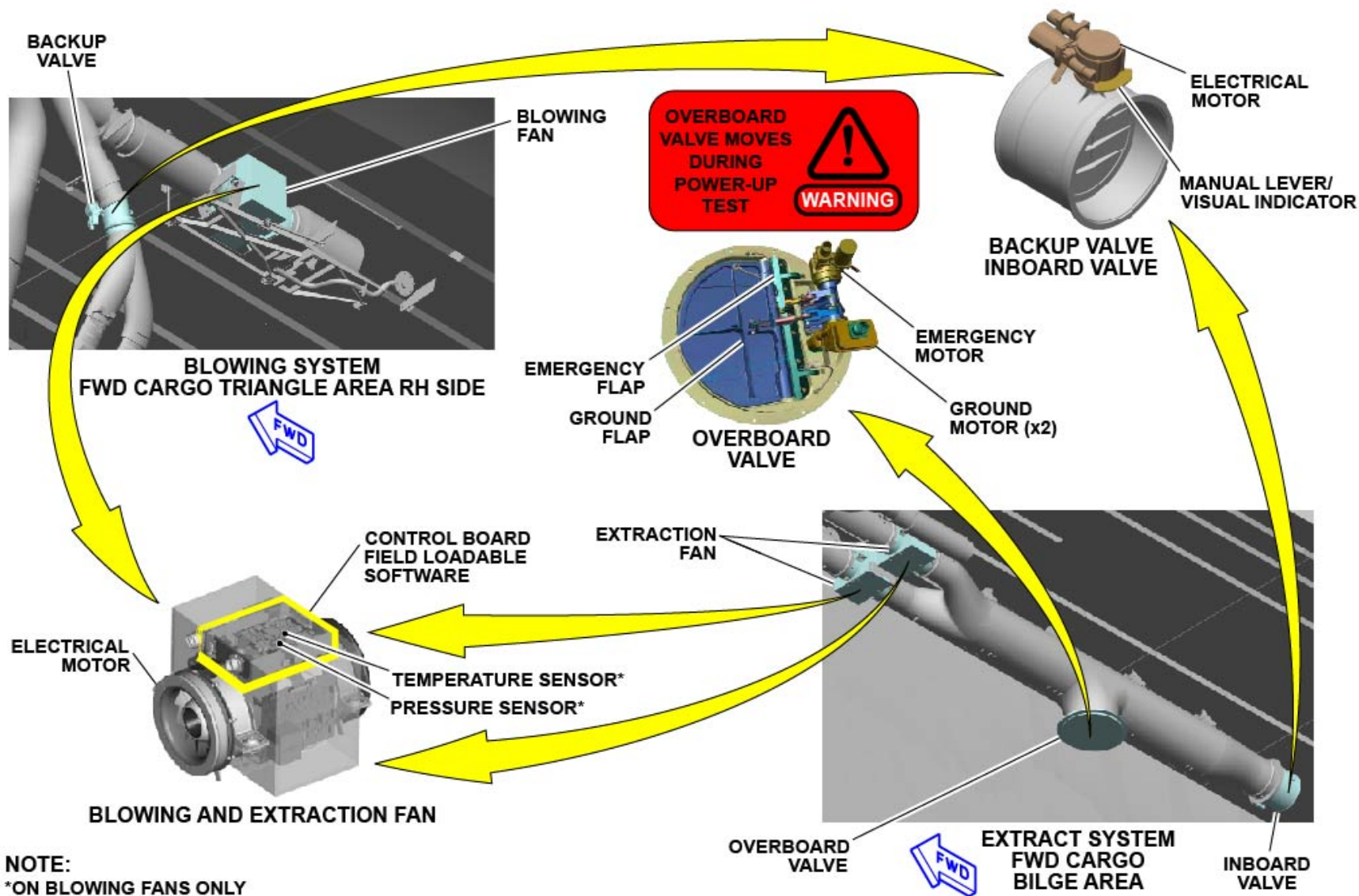
Component Description

Each blowing and extraction fan has an electrical motor and an internal control board with field loadable software.

The blowing fans have also an outlet temperature sensor for fan speed adjustment and an inlet pressure sensor to provide blowing filter degree of contamination.

There are two backup valves, and one inboard valve. Backup valves are located in LH and RH FWD cargo triangle area and the inboard valve is located in FWD cargo bilge area. Each valve has an electrical motor and a manual lever/visual indicator used for manual valve operation.

The overboard valve has three electrical motors. Two motors drive the ground flap (large flap) to get fully open/close position, and one drive the emergency flap (small flap) to get the partially open position. The overboard valve moves during power-up test.



COMPONENT DESCRIPTION

AVIONICS EQUIPMENT VENTILATION CONTROL AND INDICATING (2/3)

Avionics Equipment Ventilation - General (2)

AVNCS EXTRACT and DITCHING Control (2)

On the VENT panel:

- AVNCS EXTRACT P/B permits to bypass the automatic mode of air extraction from the avionics compartments.
- CAB FANS P/B is normally set to ON.
- The COOLG P/B SW is used to control the Supplemental Cooling System in AUTO mode.

There are two avionics blowing circuits LH and RH. Both L and R circuits ventilate cockpit panels, the main avionics bay. The air used for ventilation through various cockpit panels and equipment racks, is then extracted and discharged overboard.

In normal mode the inboard and overboard valves operate automatically. On ground, the extracted air is directly discharged overboard through the overboard valve. During flight, the extracted air is blown under the floor area of the FWD Cargo compartment through the inboard valve and then discharged overboard through the Cabin Pressure FWD Outflow Valve. When the EXTRACT P/B SW is set to OVRD (override configuration), it will partially open the overboard valve and close the inboard valve, provided that DITCHING P/B is not set to ON.

AVNCS VENT indication is provided on both ECAM SD COND and CAB PRESS pages.

In the case of an Avionics ventilation malfunction during ground operation, the AVNCS VENT Amber caution light installed on nose gear maintenance service panel and the external horn are activated.

On the Maintenance panel, the VENT AVNCS GND COOLG P/B is used for the ON/OFF control of the avionics equipment ground cooling system (optional equipment).

The avionics equipment ground cooling system supplies additional automatic cooling on ground, during external hot conditions.

The system is composed of two Ground Cooling Units (GCUs).

The air from the blowing sub-system exchanges heat with a coolant liquid in each GCU.

The coolant liquid is supplied by the Supplemental Cooling System (SCS).
Avionics Ventilation System Normal operation

Avionics Ventilation System Normal operation (3)

The blowing sub-system has two independent circuits installed in the left and right sides of the forward part of the aircraft:

- The RH circuit supplies: the RH avionics racks, and RH cockpit equipments.
 - The LH circuit supplies: the LH avionics racks, LH cockpit equipments.
- For each blowing circuit:
- A Cooling Effect Detector (CED) checks the cooling and blowing capacity from the blowing fan, if it is sufficient.
 - A back-up valve will be controlled automatically to open, in the case of its dedicated blowing fan fails.
 - A blowing fan operates as long as Aircraft electrical system is energized, a filter installed upstream of the fan avoid contamination.

The extraction sub-system extracts air through or around the avionics equipment, in order to dissipate the heat.

The extraction fans operate continuously as long as Aircraft electrical system is energized.

If a blowing side of the avionics compartments is not sufficient, the related system is shown in amber on the ECAM COND page. The system with sufficient ventilation is shown in green.

When one engine is started :

- The air is extracted under the floor area of the FWD Cargo Compartment through the inboard valve,
- And then air is released outside through the FWD cabin pressure outflow valve, by cabin Differential Pressure.

On ground, there is no cabin differential pressure for ensuring appropriate airflow through outflow valves. Therefore, the air is extracted through the Overboard valve.

In the case of Extract fans failure, the EXTRACT P/B SW has to be selected to the OVRD position and the air can be extracted through the overboard valve.

The VENT/AVNCS EXTRACT P/B SW overrides the control of the inboard and overboard valves :

- Closes the inboard valve,
- Partially opens the overboard valve.

If DITCHING P/B is selected ON:

- The Overboard valve closes,
- The Inboard valve opens.

The status of the overboard valve is displayed on the COND page.

The same indication is also shown on CAB PRESS Page.

- On ground and in normal operation:
- The 2 blowing fans blow recirculated air from the triangle areas to the avionics compartments,
- The 2 back-up valves are closed,
- The air is extracted via the extract fans through the fully open overboard valve,
- The inboard valve is closed.
- After first engine start :
- The 2 blowing fans blow recirculated air from the triangle areas to the avionics compartments,
- The 2 back-up valves are closed,
- The air is extracted via the extract fans through the fully open inboard valve,
- The overboard valve is closed.

VENT AVNCS L BLOWING FAULT (3)

If a blowing fan fails, the related back-up valve will open automatically, so that cool airflow from the mixer unit is supplied to the affected avionics compartment side.

VENT AVNCS EXTRACT FAULT (3)

If one extract fan fails, no alarm, speed of the second extract fan increase to compensate.

If both extract fan fail, air has to be sent overboard via differential pressure effect. The ECAM warning message VENT AVNCS EXTRACT FAULT is triggered, and:

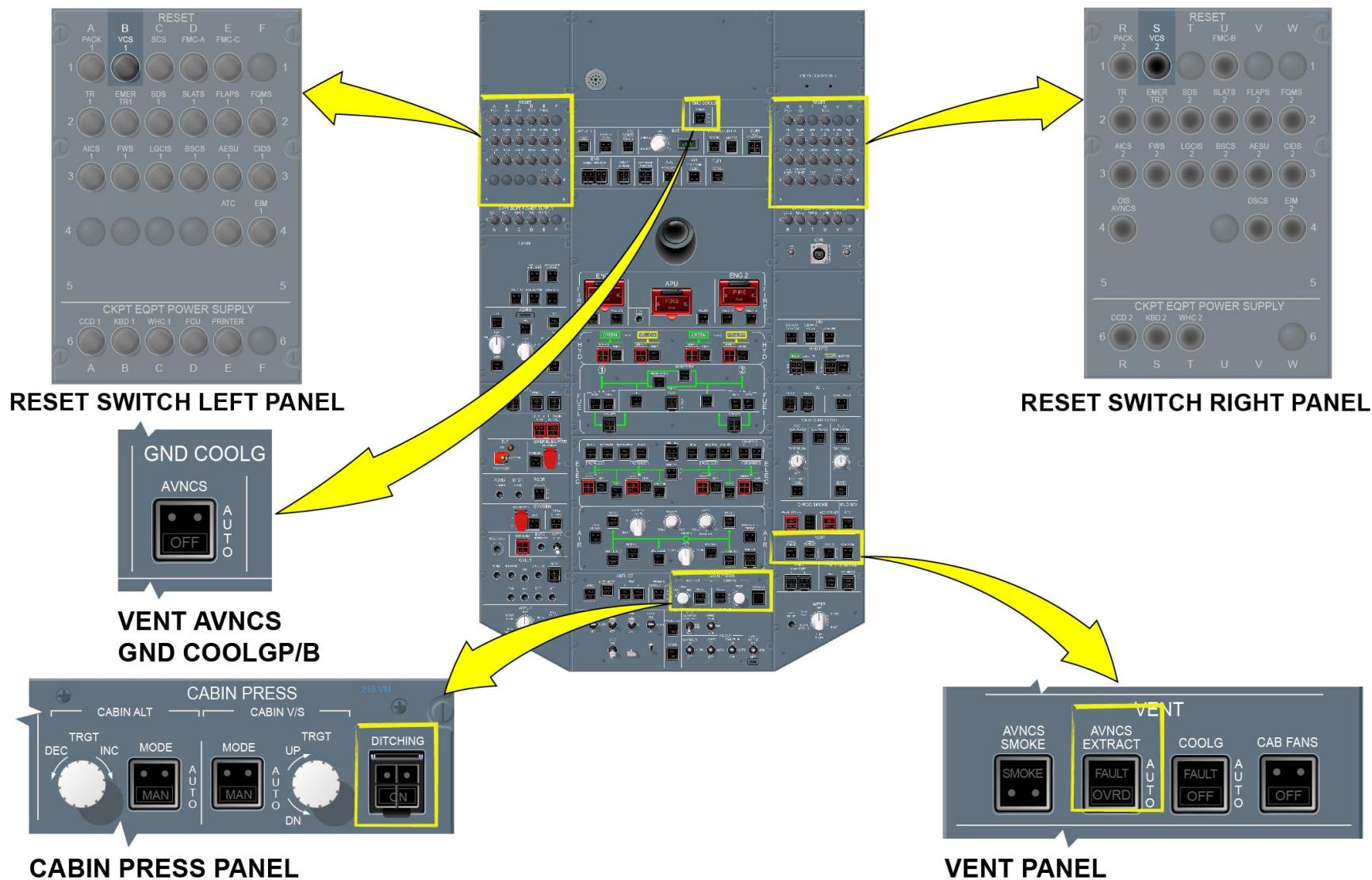
- The fault light on the AVNCS EXTRACT P/B comes on,
- The extract fan symbol on the ECAM COND page appears in amber.

Action on the AVNCS EXTRACT P/B to Override causes:

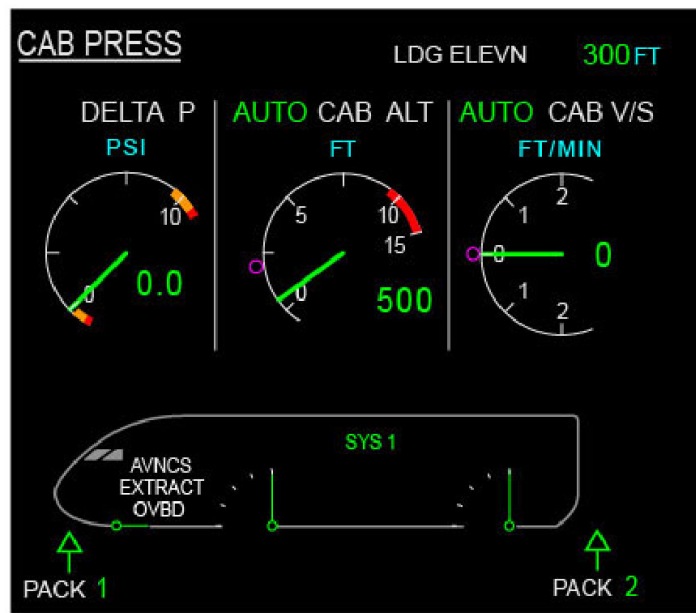
- The inboard valve to close,
- The overboard valve to partially open.

VENT AVNCS OVBD VLV FAULT (3)

After engine start, if the Avionics overboard valve is not correctly closed the AVNCS EXTRACT P/B SW has to be select to OVRD.

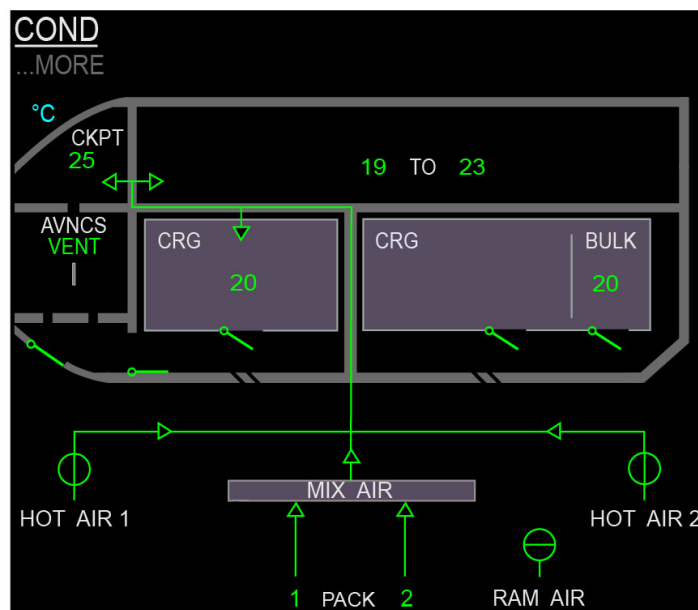


AVIONICS EQUIPMENT VENTILATION - GENERAL (2) ... VENT AVNCS OVBD VLV FAULT (3)



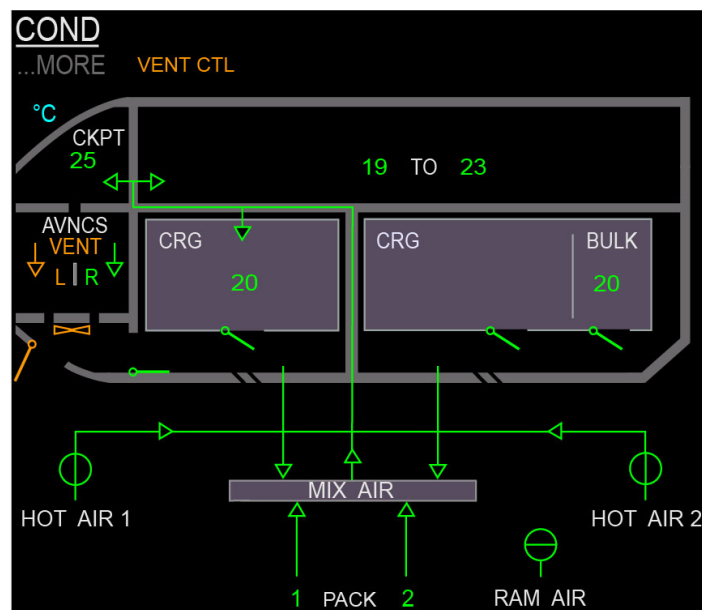
CAB PRESS SD PAGE

AVIONICS EQUIPMENT VENTILATION - GENERAL (2) ... VENT AVNCS OVBD VLV FAULT (3)



COND SD PAGE

AVIONICS EQUIPMENT VENTILATION - GENERAL (2) ... VENT AVNCS OVBD VLV FAULT (3)



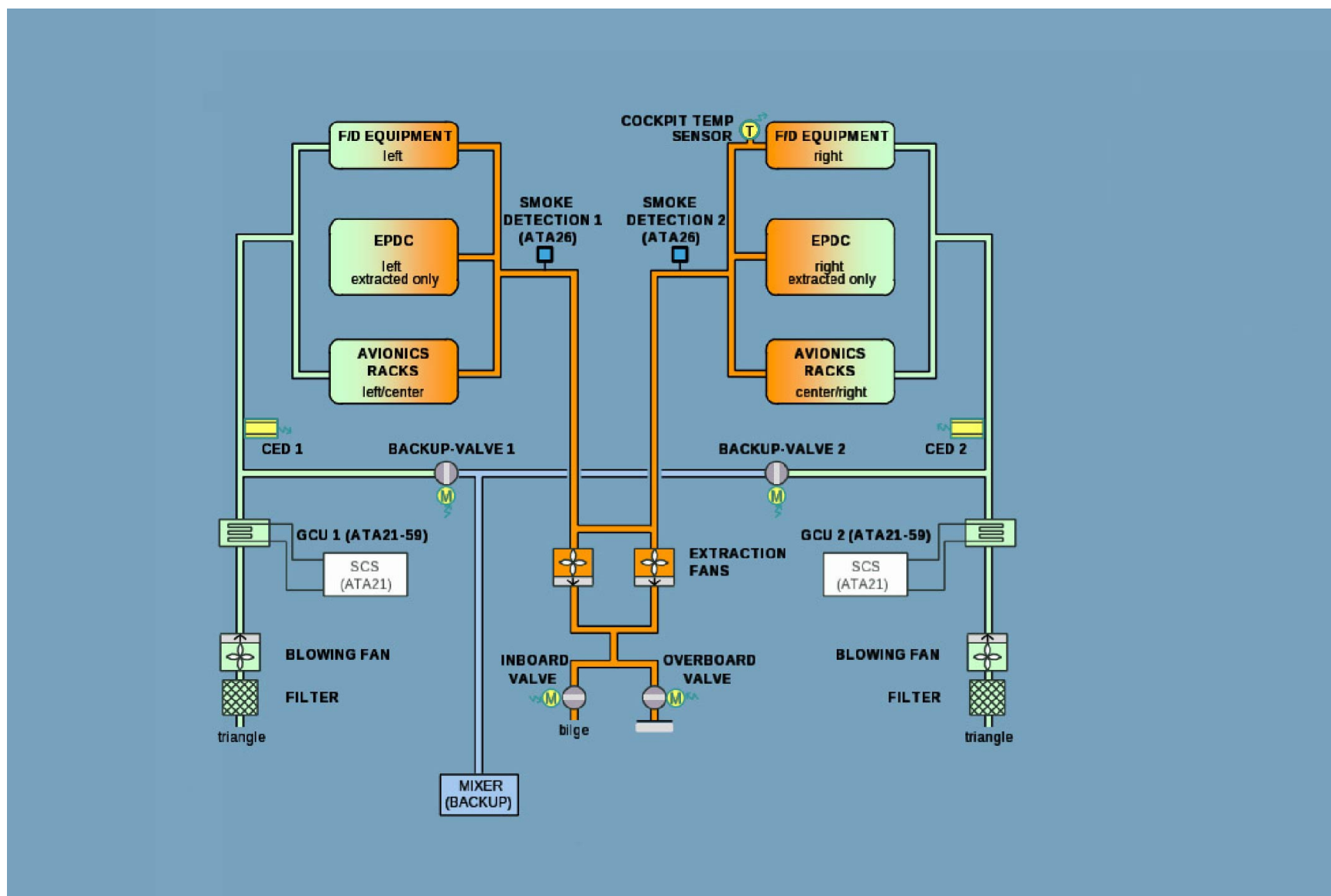
COND SD PAGE

THIS SD SHOWS SEVERAL AVAILABLE INDICATIONS BUT NOT A SYSTEM CONFIGURATION

AVIONICS EQUIPMENT VENTILATION - GENERAL (2) ... VENT AVNCS OVBD VLV FAULT (3)



V24I4251 - V00T0MM0 - VM2I6AVSVE300I



AVIONICS EQUIPMENT VENTILATION - GENERAL (2) ... VENT AVNCS OVBD VLV FAULT (3)

IFE CENTER AND CONNECTIVITY RACK VENTILATION DESCRIPTION (OPTION) (2/3)

IFEC Presentation

The In-Flight Entertainment Center (IFEC) ventilation system is an optional system which ventilates with ambient air the IFEC rack and connectivity rack. It also removes the air from the Cabin Crew Rest Compartment (CCRC), if installed, for ventilation purpose.

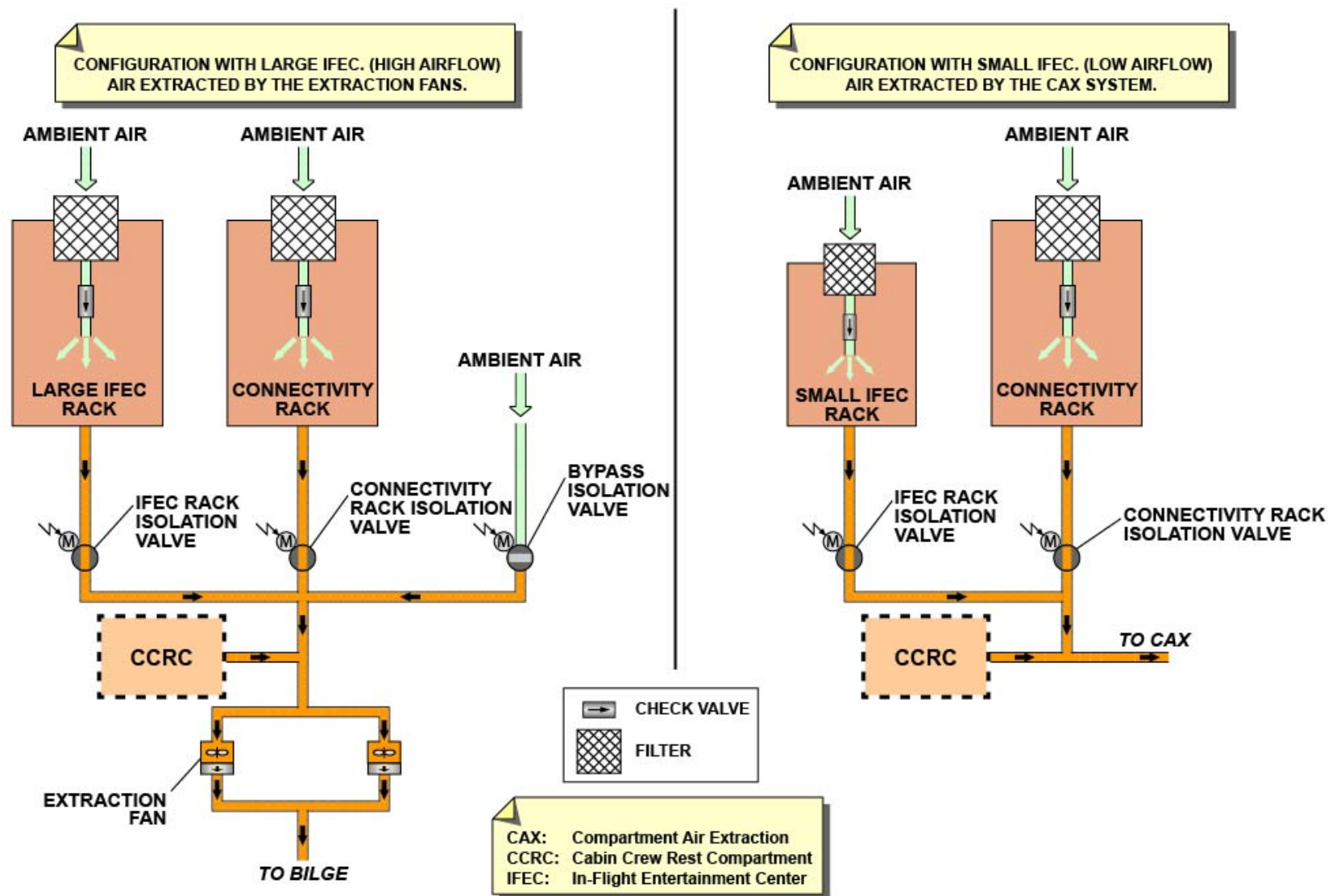
These racks are installed behind the bulk cargo compartment, on the right side.

Ambient air flows to the racks through inlet filters and check valves.

Downstream of each rack, one isolation valve is installed on the extraction ducts. At the end of these ducts, two extraction fans are installed in parallel. They remove the air through an internal check valve and send it to the bilge area.

If there is smoke in one of the racks (IFEC or Connectivity), the related isolation valve moves to the fully closed position to isolate the related rack. To have a stable system and to prevent a stall of the extraction fan, the bypass isolation valve opens and supplies the necessary airflow.

If only the connectivity rack and a small type of IFEC rack are installed, the necessary airflow level is very low. For this configuration the extraction fans are not installed and the air goes out of the racks and the CCRC through a connection to the Compartment Air Extraction (CAX) system.



IFE CENTER PRESENTATION

IFE CENTER AND CONNECTIVITY RACK VENTILATION DESCRIPTION (OPTION) (2/3)

IFEC Ventilation Description and Interfaces

The IFEC ventilation system operates automatically when the IFEC rack, connectivity rack or CCRC is energized. The Ventilation Control System (VCS) applications, which are installed in the CPIOMs control and monitor the system (one is in active mode the other in standby mode). The application controls and monitors the isolation valves and the extraction fans through CRDCs. It also adjusts the speed of the extraction fans through CAN bus.

During normal operation, only one extraction fan is active at a time and the other being in standby mode. A changeover occurs at each flight.

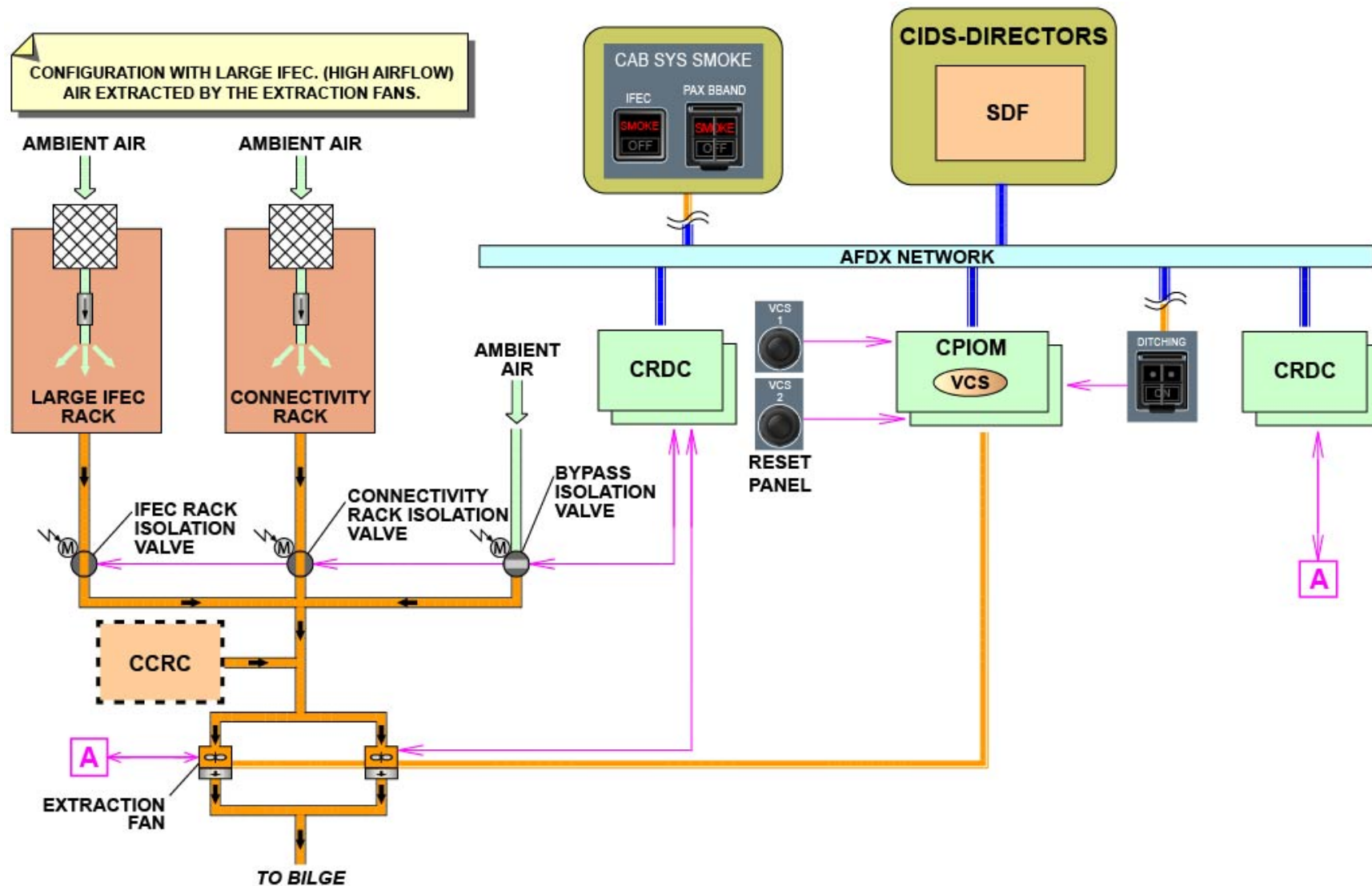
If smoke occurs in the IFEC rack the Smoke Detection Function (SDF) partitions, which are installed in the CIDS directors, send a signal to the VCS applications. The electrical power to the related rack is cut-off and the related isolation valve moves to the fully closed position. Then the VCS application opens the bypass isolation valve.

A smoke indicator illuminates on the IFEC P/BSW that is used by the flight crew to confirm the related isolation valve closure.

If smoke occurs in the connectivity rack, it is possible to confirm the closure of the isolation valve and the electrical power cut-off with the PAX BBAND P/BSW.

The VCS1 and VCS2 RESET SWs send a discrete signal to the VCS applications in CPIOM to reset them.

When the flight crew presses DITCHING P/BSW, the isolation valves move to the closed position and the extraction fans stop.



IFEC VENTILATION DESCRIPTION AND INTERFACES

IFE CENTER AND CONNECTIVITY RACK VENTILATION DESCRIPTION (OPTION) (2/3)

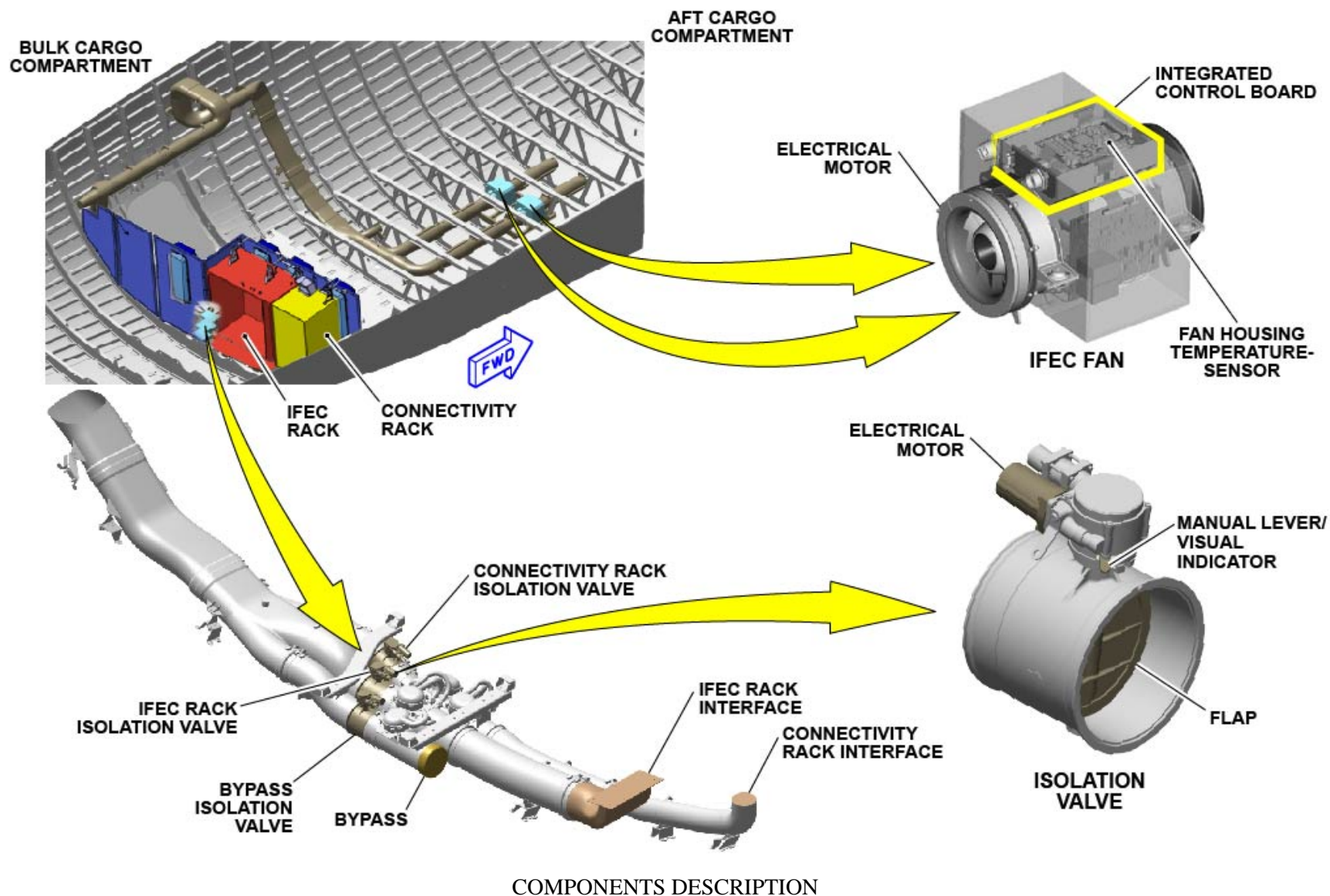
Components Description

The extraction fans are installed in the bilge area of the AFT cargo compartment. Each extraction fan has an electrical motor and an integrated control board to control and monitor the fan.

They also have a fan housing temperature sensor which gives an internal shutoff function. This sensor prevents and detects the fan overheat.

The isolation valves are operated by electrical motors.

If there is a failure, it is possible to deactivate the valve to the fully open or fully closed position using a manual lever fitted with a visual indicator.



IFE CENTER AND CONNECTIVITY RACK VENTILATION CONTROL AND INDICATING (OPTION) (2/3)

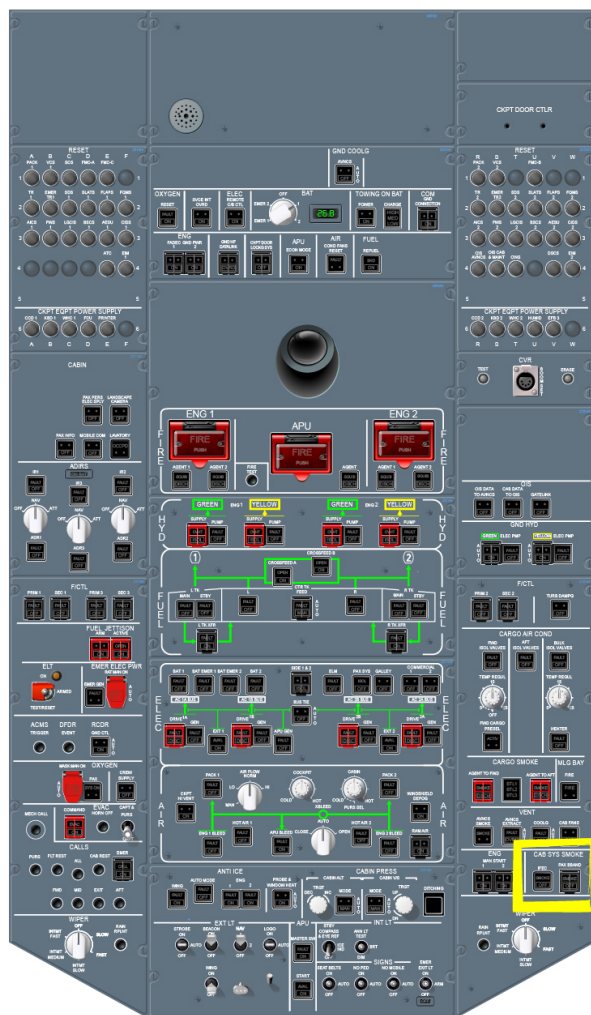
IFEC and Connectivity Rack Ventilation (2/3)

The CEV system provides cooling to commercial equipment such as IFE Center rack and the Core Connectivity Rack. It also maintains the extraction for the CCRC.

The system is composed of two fans and Isolation valves.

A by-pass valve will open in case of one isolation valve closure to avoid extraction fan stall condition.

Ambient air from the vicinity of the racks is extracted and drawn through the different racks. Only one Fan is running the other is in standby, operation of the fans is alternating with changing flight leg.


CABIN SYS SMOKE PANEL

IFEC AND CONNECTIVITY RACK VENTILATION (2/3)



V24I4251 - V00T0MM0 - VM21I7IFECV3001

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FWD CARGO VENTILATION AND TEMPERATURE CONTROL DESCRIPTION (OPTION) (2/3)

System Presentation

The ventilation and temperature control system for the FWD cargo compartment are optional. The optional ventilation system becomes mandatory with the optional Temperature Control System (TCS).

The optional FWD cargo compartment ventilation system enables the necessary airflow to ventilate the FWD cargo compartment. The FWD cargo compartment ventilation system has one extraction subsystem and one supply subsystem.

The extraction subsystem includes extraction ducts, one extraction isolation valve and one extraction fan.

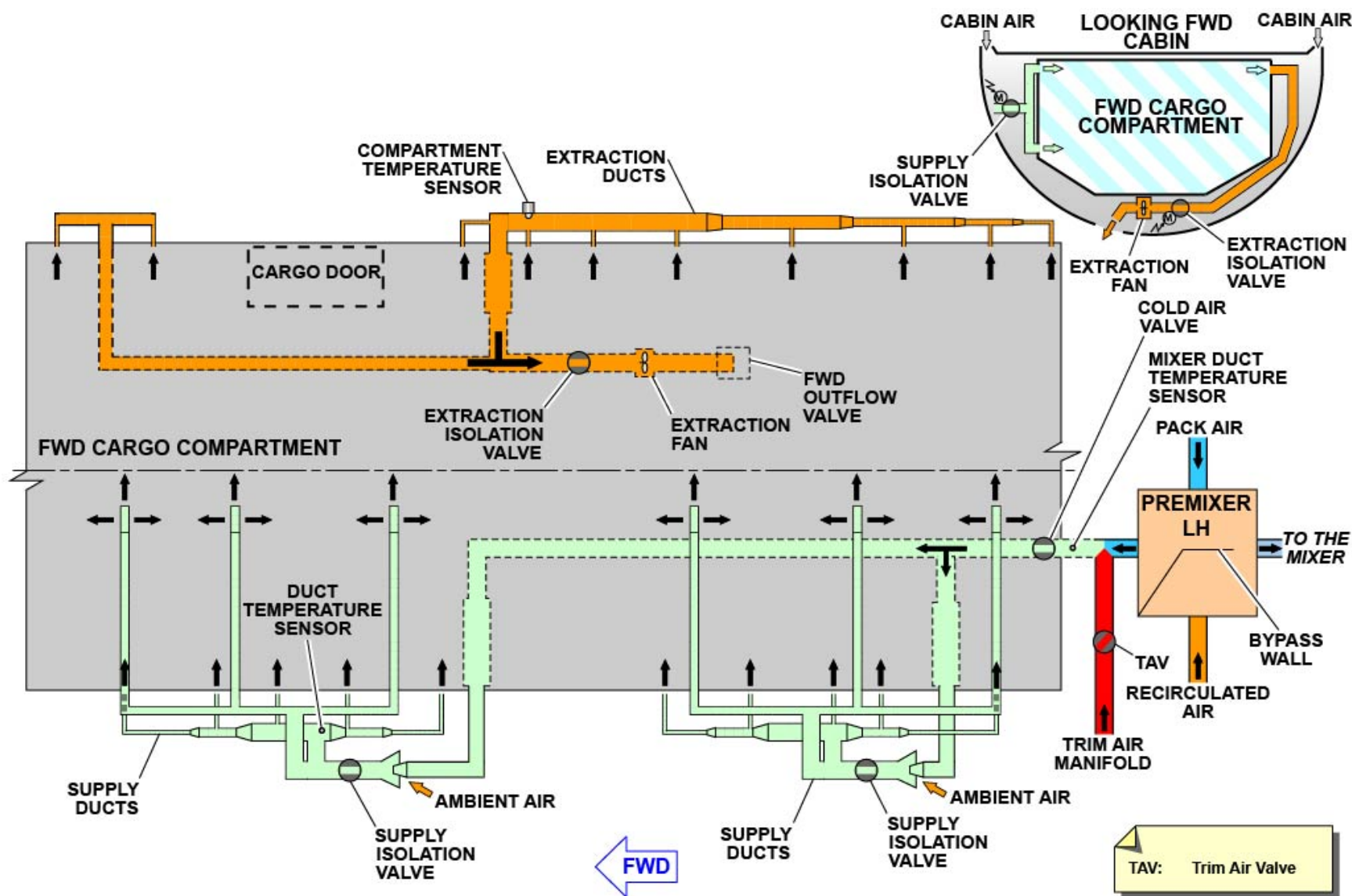
The supply subsystem includes supply ducts and supply isolation valves. The extraction fan removes air from the FWD cargo compartment through extraction ducts and one extraction isolation valve. The air goes into the bilge area to the FWD outflow valve. The operation of the extraction fan causes a negative pressure in the FWD cargo compartment. Thus, the ambient air goes into the FWD cargo compartment through the supply ducts and two supply isolation valves.

The TCS adjusts the temperature of the air that goes in the FWD cargo compartment. A trim air valve supplies hot air from the trim air manifold, and a cold air valve can increase the cold air flow coming from the LH premixer. An internal wall in the LH premixer ensures the air is sent to cold air valve comes mainly from pack (recirculated air goes mainly to mixer).

Three sensors supply data to control and monitor the FWD cargo compartment temperature system. The sensors are:

- One compartment temperature sensor
- One duct temperature sensor
- One mixer duct temperature-sensor.

V2414251 - V00T0MM0 - VM21DDFWDC3001



SYSTEM PRESENTATION

FWD CARGO VENTILATION AND TEMPERATURE CONTROL DESCRIPTION (OPTION) (2/3)

System Description and Interfaces

Two CPIOMs host the Ventilation Control System (VCS) and Air Conditioning System (ACS) applications. The applications exchange data together to control the ventilation and temperature systems.

The VCS application controls and monitors the FWD cargo compartment ventilation system through the CRDCs. The VCS application also adjusts the extraction fan speed and monitors it.

The ACS application sends the FWD cargo compartment temperature demand, the FWD cargo compartment current temperature to the ASCU (LH) and monitors the temperature system.

The ACS application has an interface with the VCS application for temperature control in the FWD cargo compartment. The cold air valve is controlled by the ACS application through the VCS application. The ACS application has the packs status, if one pack is inoperative there is not sufficient flow to operate the TCS and the cold air valve stays in closed position.

The VCS application in conjunction with the CRDCs control and monitor:

- The position of the isolation valves
- The position of the cold air valve
- The extraction fan.

The VCS application in conjunction with CRDCs control the extraction fan with a discrete enable signal. In case of a CAN bus failure, the fan is controlled at default speed.

The extraction fan operates only when the isolation valves are in the fully open position.

The ASCU (LH) controls and monitors the trim air valve.

The ASCU (LH) receives data from:

- The compartment temperature sensor via CRDCs and ACS application
- The duct temperature sensor
- The mixer duct temperature-sensor
- The temperature demand from the TEMP REGUL rotary selector via ACS application.

With these data, the ASCU (LH) calculates the duct temperature demand, compare the demand to the actual duct temperature supplied by the mixer duct temperature-sensor and duct temperature sensor. Also, the ASCU (LH) controls the supply air temperature of the compartment, by adding hot air with trim air valve to premixer supply air, or more cold air by increasing cold air valve opening. If the temperature selector is not selected OFF, the cold air valve is open. The mixer duct temperature-sensor is used also for overheat detection.

The FWD ISOL VALVES P/BSW sends an AFDX signal and a discrete signal to the CRDCs, to control (open or close) the associated isolation valves. When its selected to OFF, the extraction fan and temperature control is inhibited.

The flight crew can adjust the temperature in the FWD cargo compartment through the TEMP REGUL rotary selector. The selector sends the desired temperature to the ACS application.

The VCS1 and the VCS2 RESET SWs allow to reset the VCS application hosted in the CPIOMs.

The PACK1 and PACK2 RESET SWs allow to reset the ACS application hosted in the CPIOMs. The ASCU (LH) is also reset with the PACK1 RESET SW.

The DITCHING P/BSW sends its status to the ACS/VCS applications via AFDX and discrete signal. The DITCHING P/BSW status is also sent to the ASCU (LH). If selected, all the valves move to the closed position, the extraction fan and the temperature system stop.

The ACS application has interfaces with:

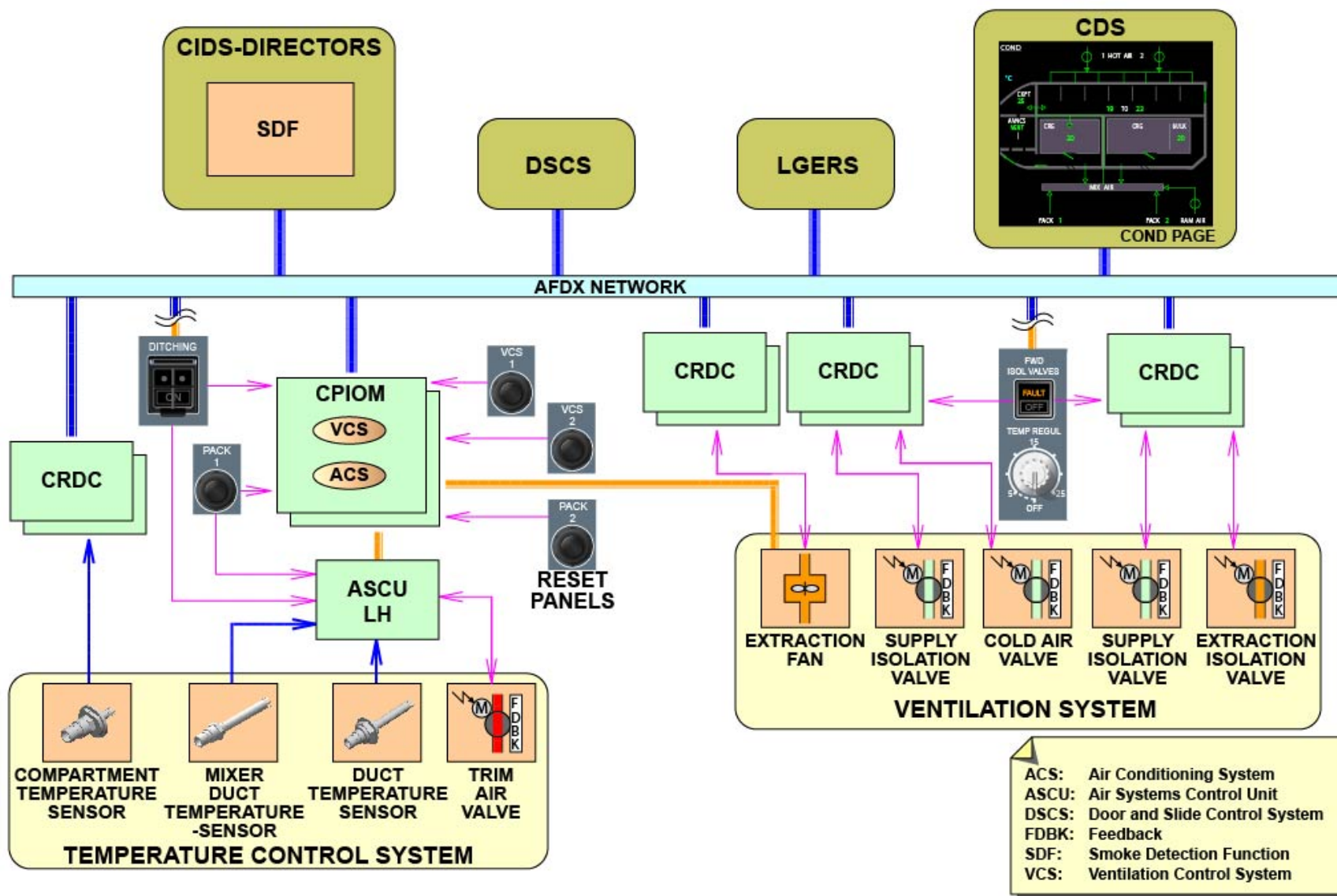
- LGERS
- Doors and Slide Control System (DSCS).

When the A/C is on the ground and the FWD cargo door is not closed the ACS application closes the trim air valve.

The VCS application has interface with the Smoke Detection Function (SDF) partition hosted in the CIDS directors.

If a smoke event occurs, the VCS application closes the isolation valves, stops extraction fan and the temperature control system is inhibited.

The COND page on the CDS shows the status of the FWD cargo compartment ventilation and temperature control system.



SYSTEM DESCRIPTION AND INTERFACES

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FWD CARGO VENTILATION AND TEMPERATURE CONTROL DESCRIPTION (OPTION) (2/3)

Components Description

The trim air valve, which supplies modulated hot air to the air coming from the LH premixer, operates with an electrical motor. The trim air valve supplies feedback signal for monitoring. A manual override is used for deactivation purposes of the valve and as visual position indicator. The isolation valves isolate the FWD cargo compartment during specific operation (eg: smoke, ditching). The FWD cargo compartment has two supply isolation valves and one extract isolation valve which are identical. Each isolation valve has an electrical motor, and supplies feedback signal for monitoring.

A manual override lever and a visual position indicator are used for deactivation purposes.

The extraction fan extracts air from the FWD cargo compartment.

The fan has an electrical motor, an integrated control board with field loadable software for control and monitoring. A fan housing temperature sensor is installed for overheat detection and protection.

The ASCU (LH) is a dual channels controller with field loadable software which controls and monitors the TCS. The ASCU (LH) is installed in the LH rear triangle area of the FWD cargo compartment.

The cold air valve has an electrical motor and controls the quantity of cool air that comes from the LH premixer.

The valve has four:

- Fully closed
- Partially open 1
- Partially open 2
- Fully open.

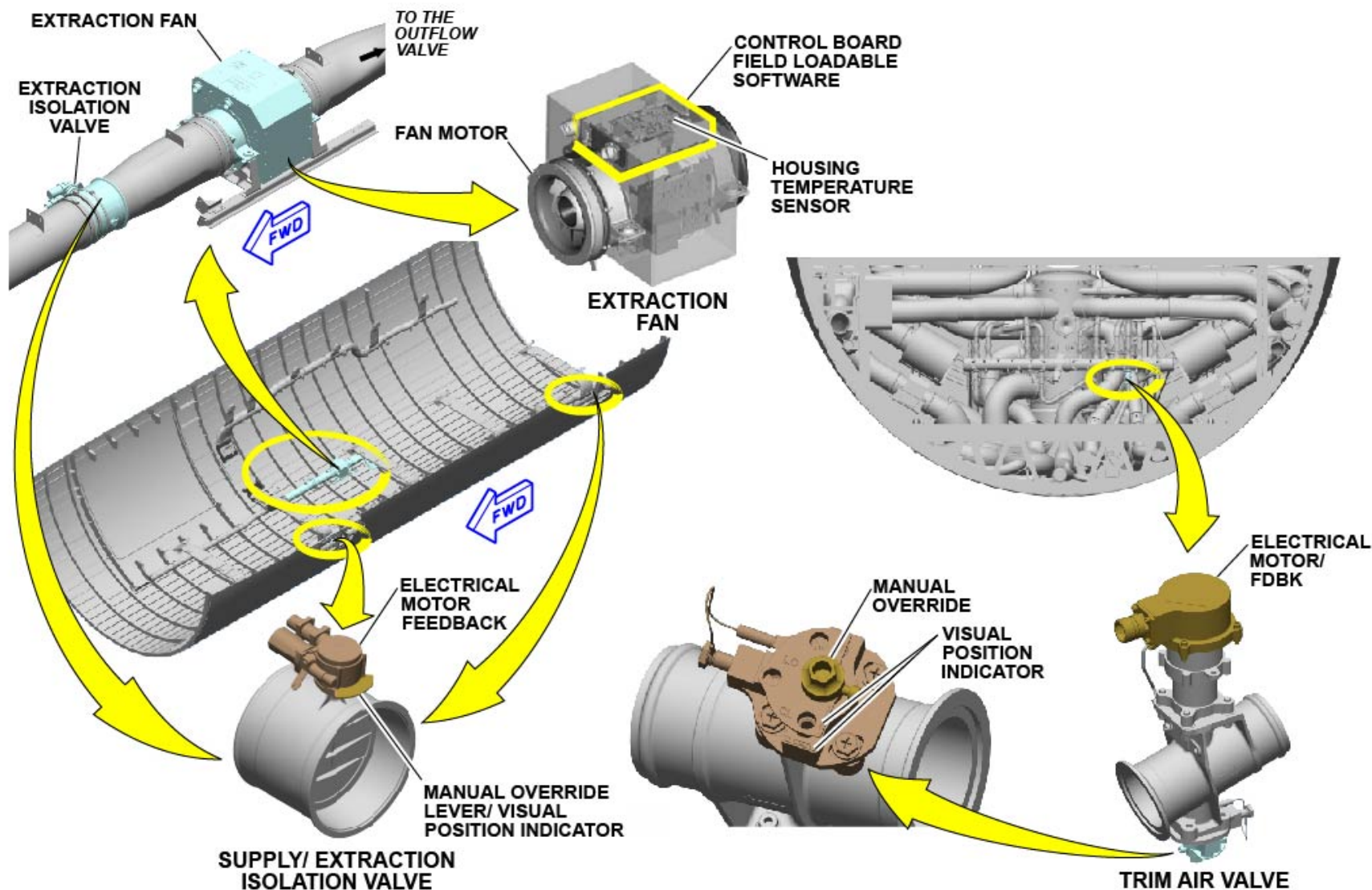
The valve supplies feedback signal for monitoring.

A manual override lever and a visual position indicator are used for manual valve operation.

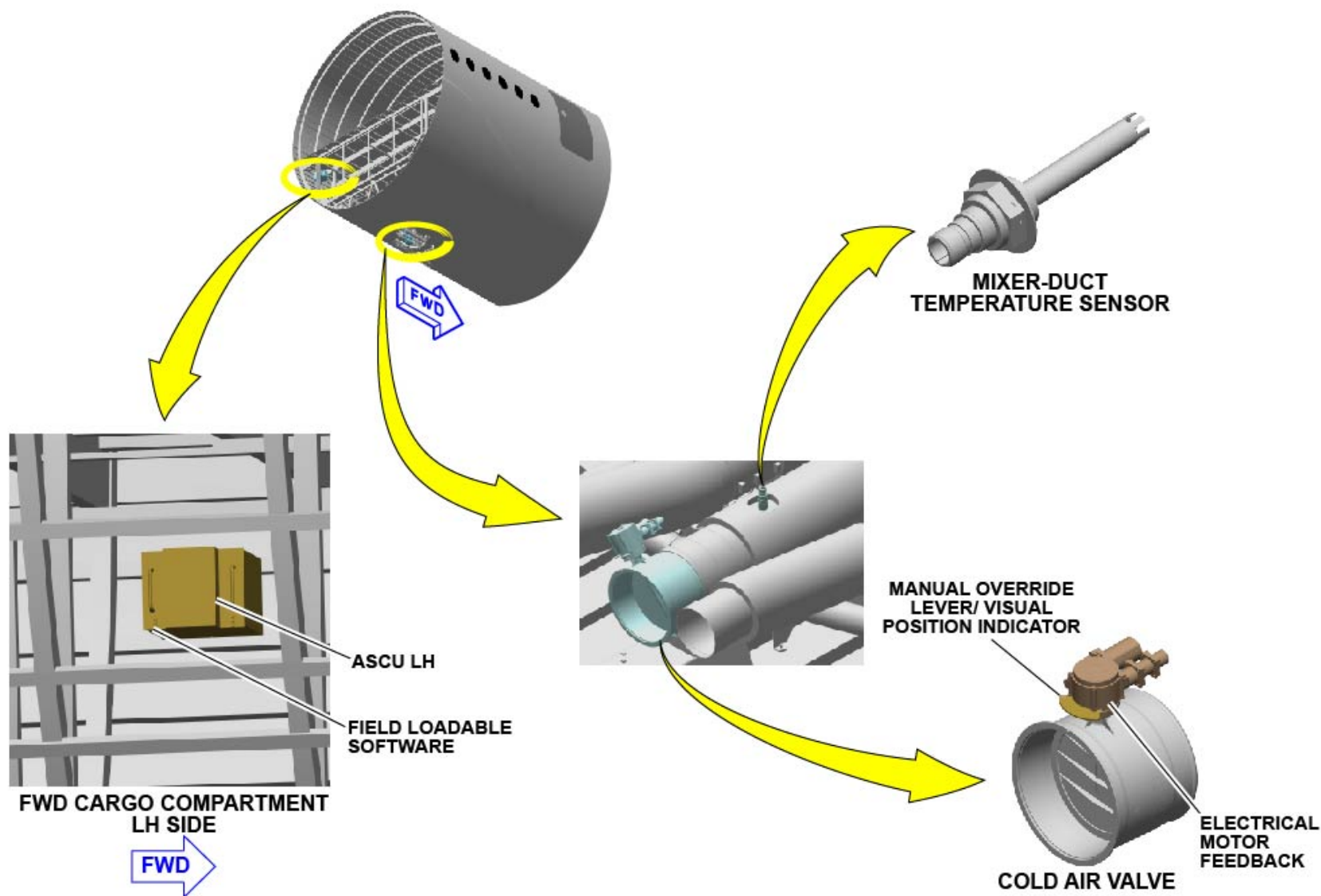
The FWD cargo compartment temperature system has three temperature sensors installed in the system ducts.

The sensors are:

- Compartment temperature sensor
 - Duct temperature sensor
 - Mixer duct temperature-sensor.
- All the sensors have a dual element.



COMPONENTS DESCRIPTION



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AFT CARGO VENTILATION DESCRIPTION (OPTION) (2/3)

System Presentation

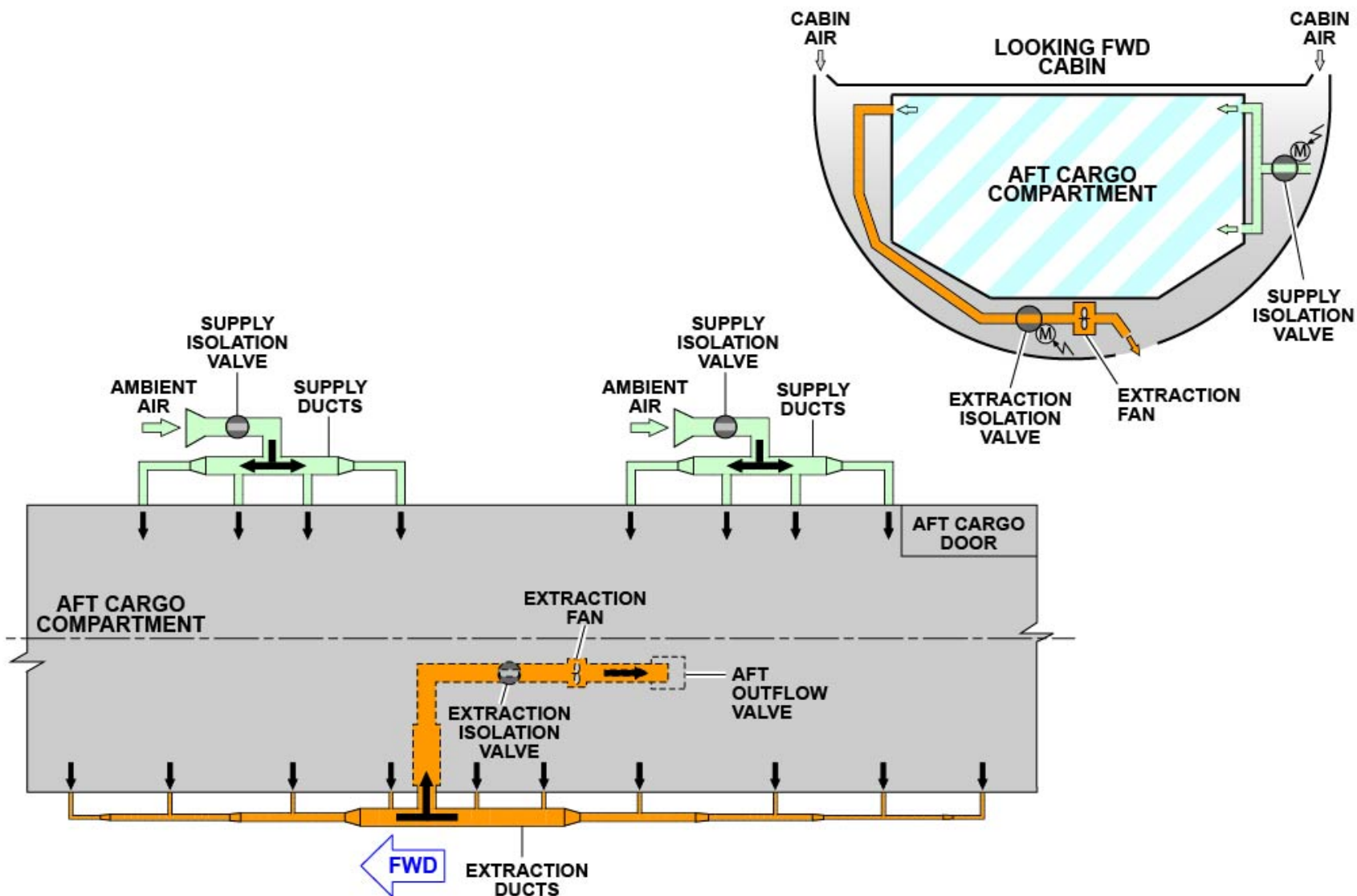
The aft-cargo ventilation-system is an optional system and lets the necessary airflow to the aft cargo.

The aft cargo-compartment ventilation-system has one extraction subsystem and one supply subsystem.

The extraction subsystem has extraction ducts, one extraction isolation valve and one extraction fan.

The supply subsystem has supply ducts and supply isolation valves.

The extraction fan removes air from the aft cargo compartment through the extraction ducts and the extraction isolation valve. The air goes into the bilge area and sends overboard through the aft outflow valve. The operation of the extraction fan causes a negative pressure in the aft cargo compartment. Thus, ambient air goes into the cargo compartment through the supply ducts and the supply isolation valves.



SYSTEM PRESENTATION

V2414251 - V00T0MM0 - VM21DBAFTCC3001

AFT CARGO VENTILATION DESCRIPTION (OPTION) (2/3)

System Description Interfaces

The Ventilation Control System (VCS) application is installed in two CPIOMs. The VCS application controls and monitors the aft cargo-compartment ventilation-system through the CRDCs. The VCS application adjusts the extraction fan speed and monitors it through a CAN bus connection.

The VCS applications together with the CRDCs control and monitor:

- The position of the isolation valves
- The extraction fan.

If there is a CAN bus failure, the VCS application together with the CRDCs send a discrete start signal to the extraction fan, so that it can control it at default speed.

The AFT ISOL VALVE P/BSW controls the isolation valves through the VCS application and the CRDCs. If there is a VCS application or an AFDX failure, the AFT ISOL VALVE P/BSW sends a discrete signal to CRDCs, which closes the isolation valves. If isolation valves move to the closed position, the extraction fan stops.

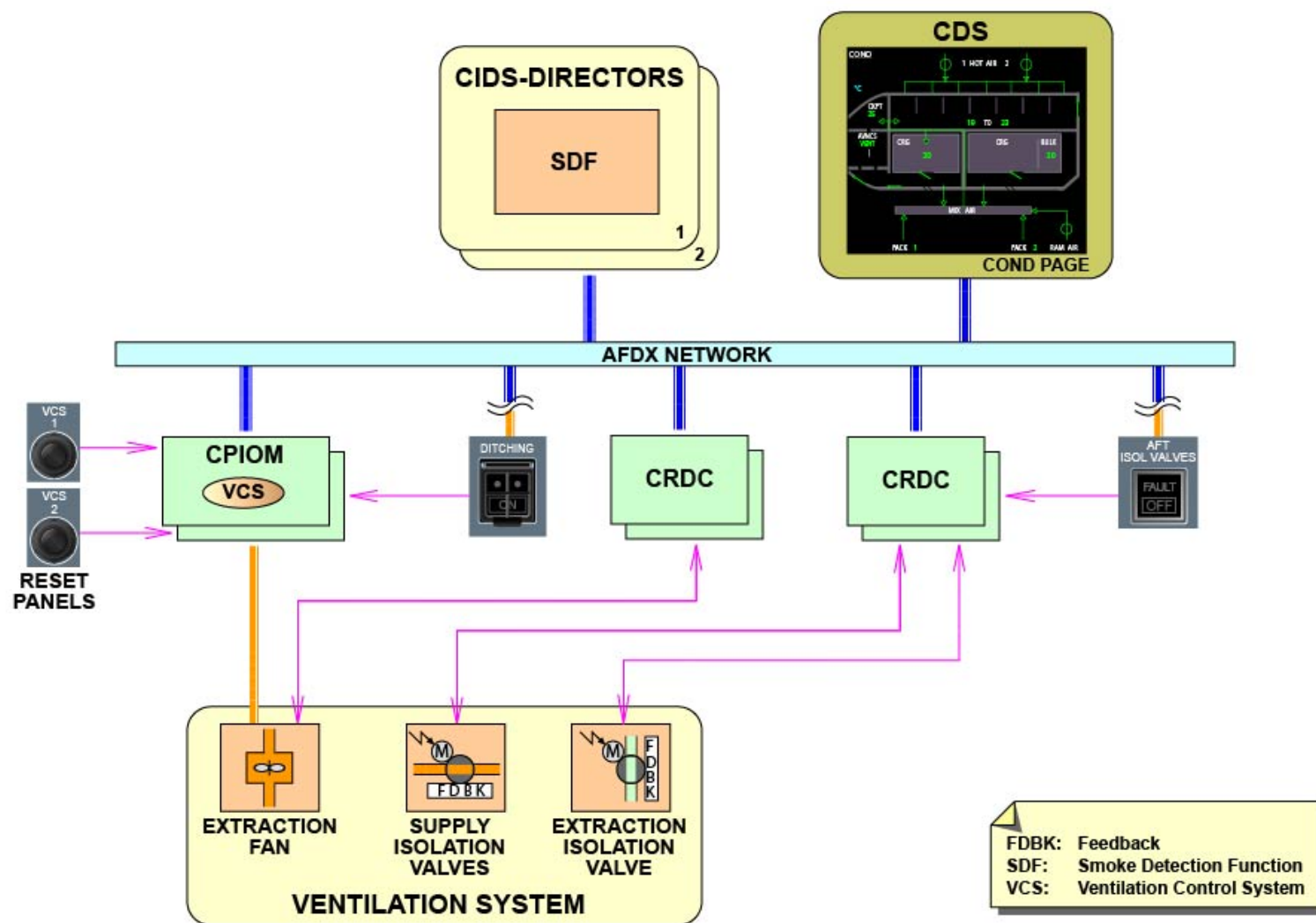
With the VCS1 and VCS2 RESET SWs you can reset the VCS application which is installed in the CPIOMs.

The DITCHING P/BSW sends its status to the VCS application through a discrete signal and AFDX network. If it is selected, all the isolation valves close and the extraction fan stops.

The VCS application has an interface with the Smoke Detection Function (SDF) partition in the CIDS directors.

If smoke occurs in the aft cargo compartment, the CIDS-SDF partitions send a signal to the VCS application through the AFDX network to close the isolation valves and stop the extraction fan.

The VCS application transmits the status of the AFT ventilation system to the CDS. Then, the CDS shows the status of the system on the COND page.



SYSTEM DESCRIPTION INTERFACES

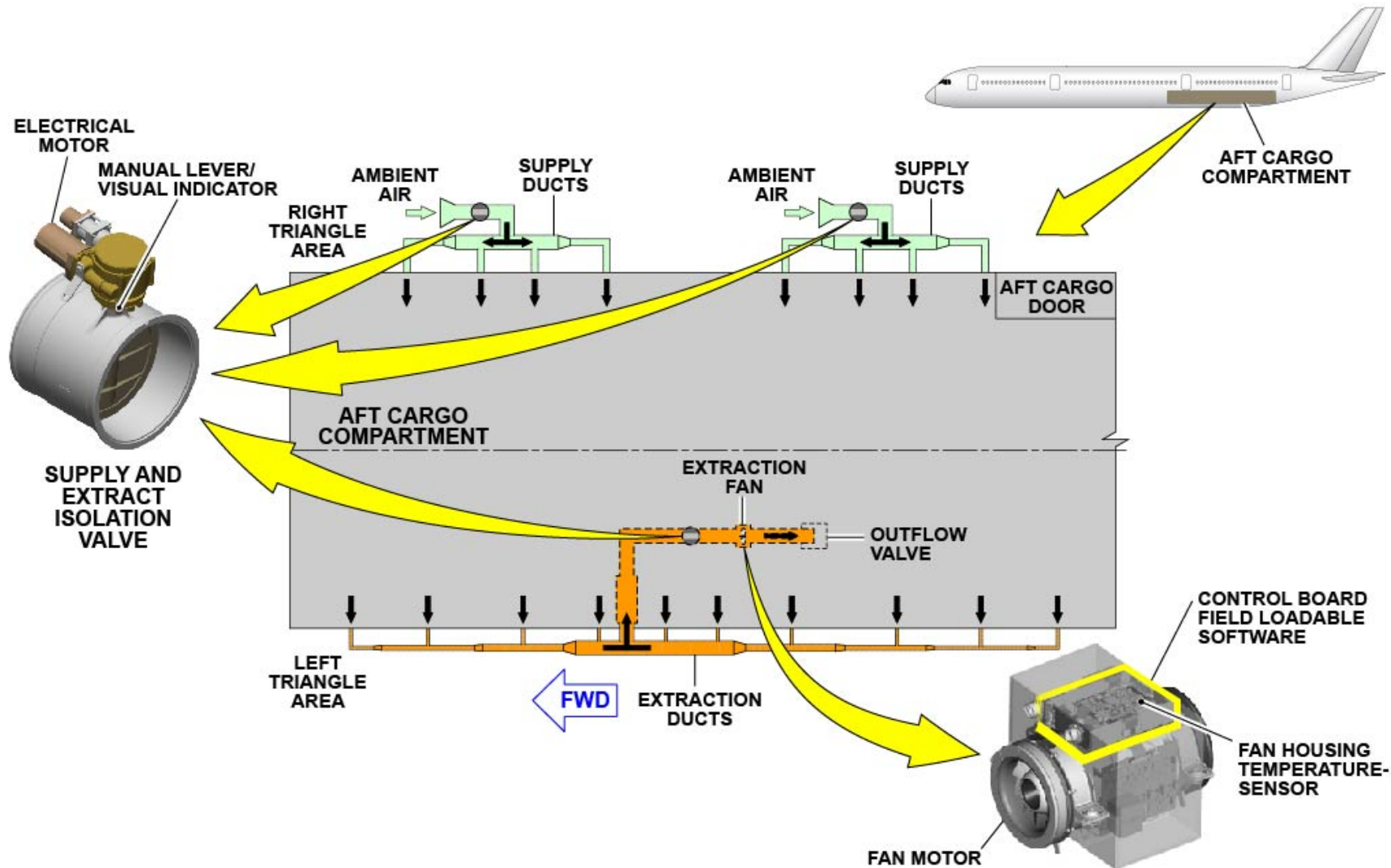
AFT CARGO VENTILATION DESCRIPTION (OPTION) (2/3)

Components Description

The extraction fan has an electrical motor, an integrated control board with field loadable software for the control and monitoring. It also has a fan housing temperature-sensor for the overheat protection.

The supply isolation valves and the extraction isolation valve are identical. Each isolation valve has an electrical motor. The valves have two stable positions, fully open or fully closed.

For deactivation propose, it is possible to adjust the valve with a manual lever/visual indicator.



COMPONENTS DESCRIPTION

BULK CARGO VENTILATION AND TEMPERATURE CONTROL DESCRIPTION (2/3)

System Presentation

The A/C basic configuration has a bulk-cargo-compartment ventilation system and a heating system.

The bulk-cargo-compartment ventilation system enables the necessary airflow to ventilate the bulk cargo compartment. The basic bulk-cargo-compartment ventilation system has one extraction subsystem and one supply subsystem.

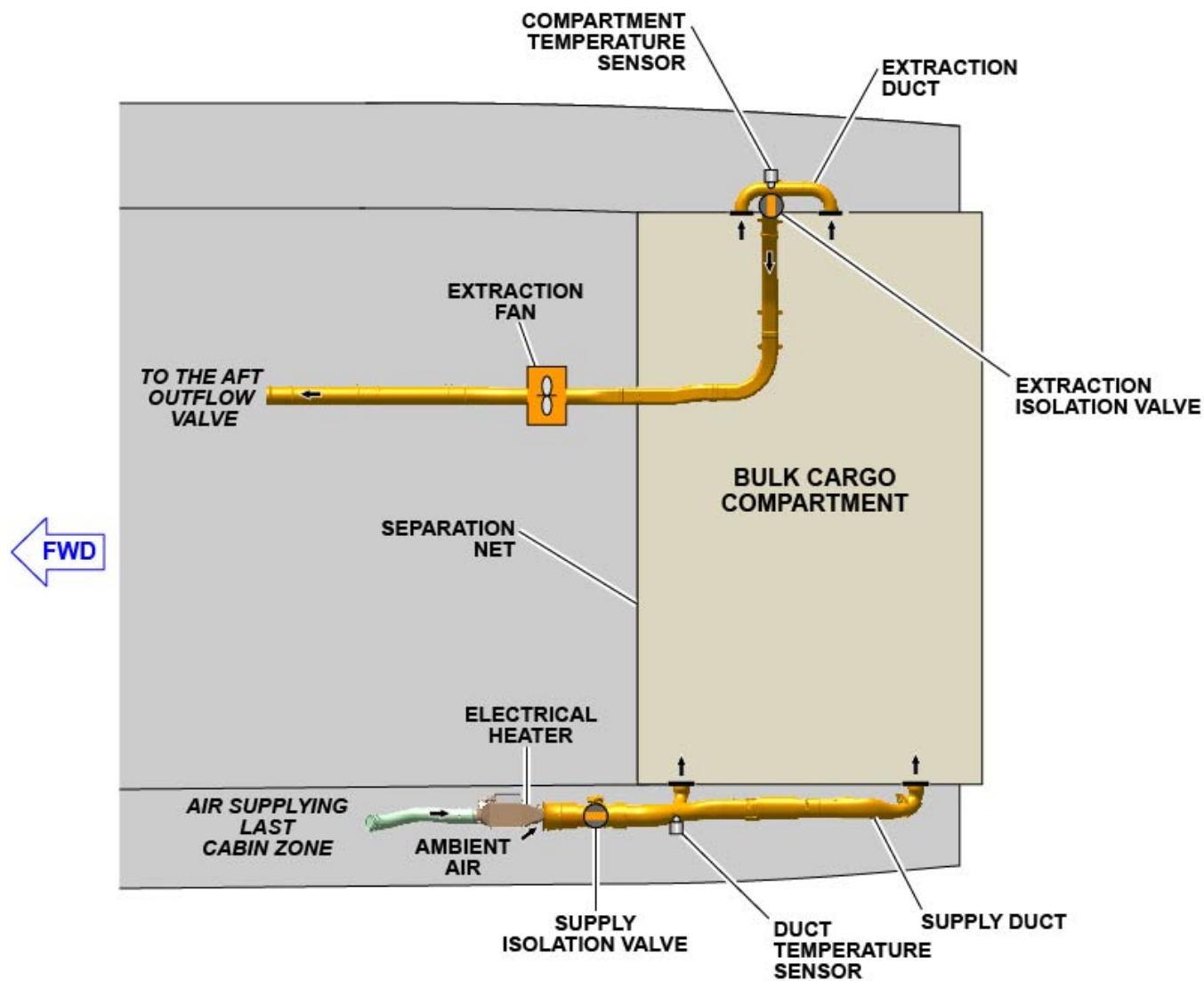
The extraction subsystem includes the extraction ducts, one extraction isolation valve and one extraction fan.

The supply subsystem includes supply ducts and supply isolation valve. The extraction fan removes air from the bulk cargo compartment through the extraction ducts and the extraction isolation valve. The air goes into the bilge area below the aft cargo compartment floor and discharge through the outflow valve. The operation of the extraction fan causes a negative pressure in the bulk cargo compartment. Thus, the ambient air goes into the cargo compartment through the supply ducts and the supply isolation valve.

The basic heating system adjusts the temperature of the air entering in the bulk cargo compartment.

The bulk-cargo-compartment heating subsystem has an electrical heater, a duct temperature sensor and a compartment temperature sensor. The electrical heater increases the temperature of the air supplying the last cabin zone. The warmed air then is mixed with ambient air and goes into the bulk cargo compartment. The duct temperature sensor and the compartment temperature sensor are used to control and monitor the temperature in the bulk cargo compartment. The duct temperature sensor is also used for overheat detection.

V2414251 - V00T0MM0 - VM21DCBULK3001



SYSTEM PRESENTATION

V2414251 - V00T0MM0 - VM21DCBULK3001

BULK CARGO VENTILATION AND TEMPERATURE CONTROL DESCRIPTION (2/3)

System Description/Interfaces

The Ventilation Control System (VCS) and Air Conditioning System (ACS) applications, which are installed in two CPIOMs control the bulk cargo compartment ventilation and heating system.

The VCS application controls and monitors the bulk cargo ventilation system through CRDCs.

The VCS application adjusts the extraction fan speed via CAN bus and monitors it.

The ACS application sends the bulk temperature demand to the Electrical Heater Controller (EHC) and monitors the heating system.

For the ventilation system the VCS applications in conjunction with CRDCs control and monitor:

- The position of the isolation valves
- The extraction fan.

The VCS in conjunction with CRDCs controls the extraction fan with a discrete enable signal. In case of CAN bus failure, the fan is controlled at default speed.

For the heating system, the VCS applications via CRDCs controls the electrical heater with an ON/OFF signal.

The EHC controls and monitors the electrical heater. The EHC receives data from the compartment temperature sensor and the temperature selected by the crew. With these data EHC calculates the duct temperature demand, compare it with actual duct temperature and controls consequently the heated air. The electrical heater does not operate if there is no ventilation.

The BULK ISOL VALVES P/B sends an AFDX and a discrete signal to the CRDCs to control in open/close position associated isolation valves. When selected OFF, extraction fan and heating system stop.

The HEATER P/B sends a digital signal via AFDX to the ACS application which control ON/OFF the electrical heater via CRDCs

The flight crew can adjust the temperature in the bulk cargo compartment through the TEMP REGUL rotary selector. This rotary selector sends the desired temperature to the ACS application.

The VCS1 and VCS2 RESET SWs let to reset the VCS application hosted in the CPIOMs.

The PACK1 and the PACK2 RESET SWs allow to reset the ACS application which hosted also in the CPIOMs.

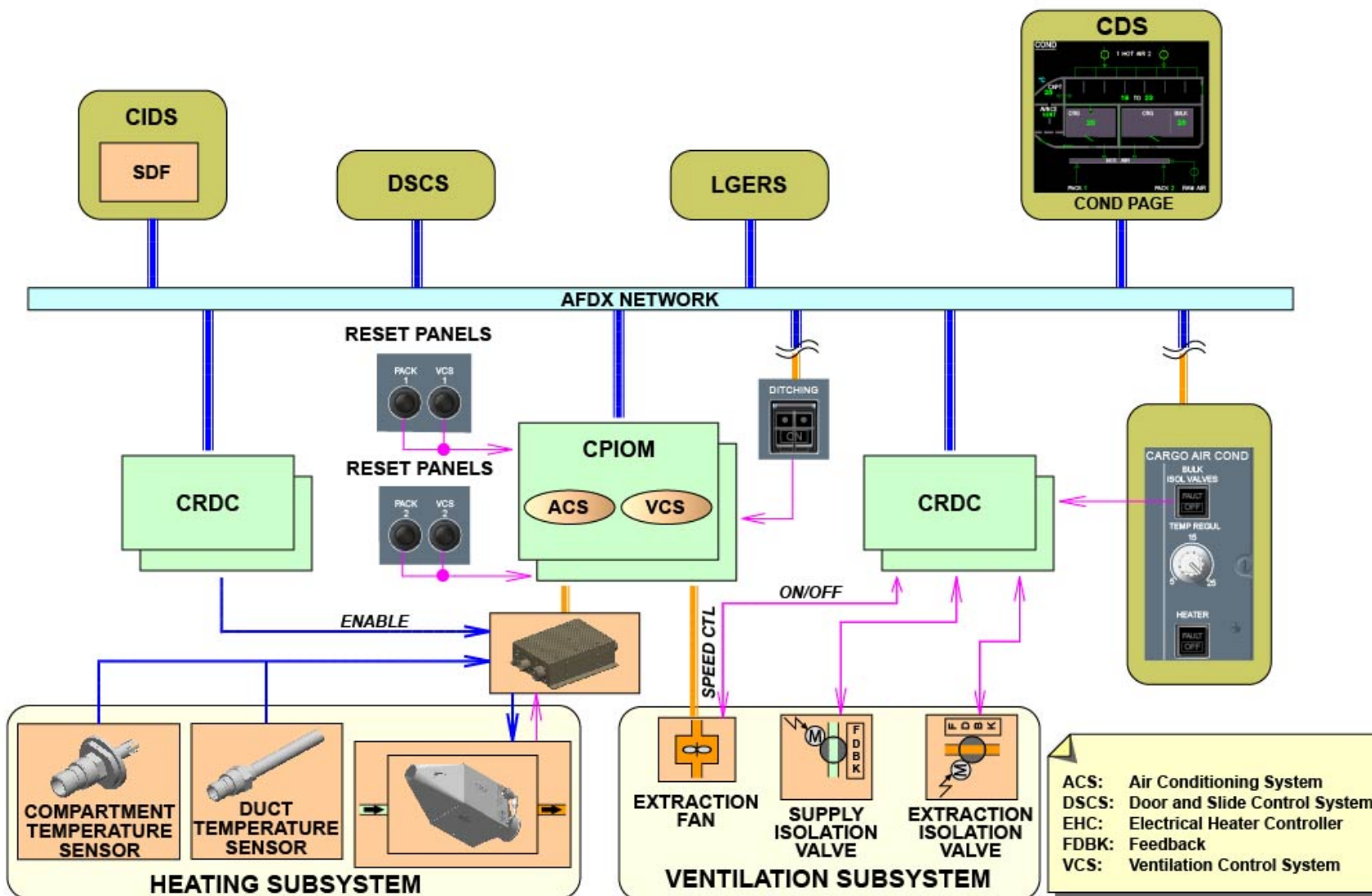
The DITCHING P/BSW sends its status to the VCS and ACS applications via AFDX and discrete for redundancy. If the DITCHING is selected, all the isolation valves close, consequently extraction fan and heating system stop.

The VCS application has an interface with the Smoke Detection Function (SDF) partitions which are hosted in the CIDS directors. If a smoke occurs, the SDF partition transmits a bulk cargo compartment smoke status to the VCS application, which closes all the isolation valves, stops the extraction fan and consequently the electrical heater stops.

The ACS application has interface with the LGERS and Door and Slide Control System (DSCS).

When the A/C is on ground and at least either one door of the bulk or aft cargo compartment is opened, the ACS application automatically stops the heating system.

The COND page on the CDS shows the status of the bulk cargo compartment ventilation and heating system.



SYSTEM DESCRIPTION/INTERFACES

BULK CARGO VENTILATION AND TEMPERATURE CONTROL DESCRIPTION (2/3)

Components Description

The electrical heater is located in the left rear triangle area of the aft cargo compartment.

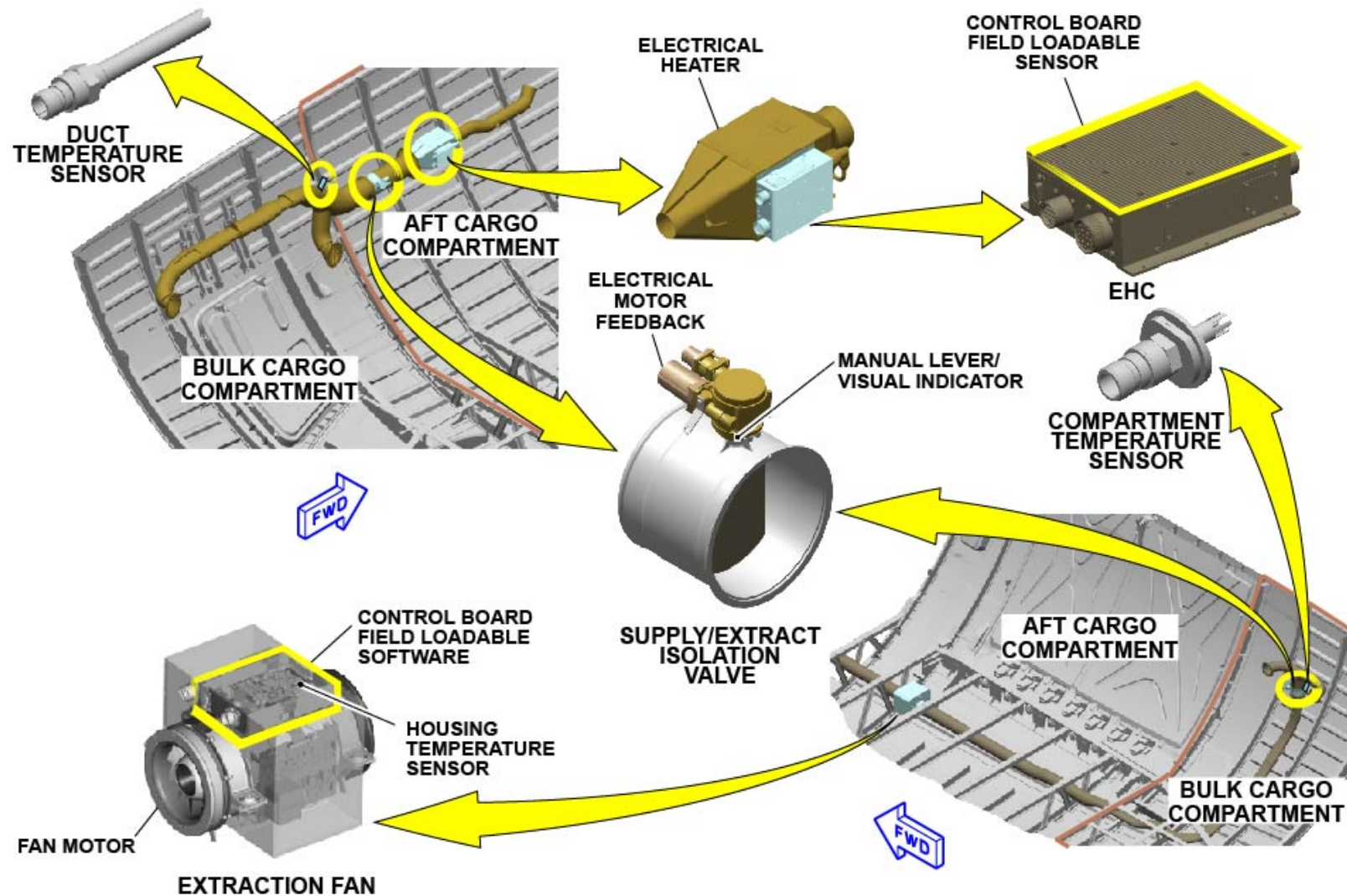
The EHC is installed on the electrical heater. It has a control board with the field loadable software to control and monitor the power supply to the electrical heater.

The ventilation system has one supply isolation valve and one extraction isolation valve to ensure the isolation of the bulk cargo compartment.

Both isolation valves have an electrical motor. The isolation valves have two possible positions, open or closed and supply feedback position. A manual lever/visual indicator are used for the manual valve operation.

The extraction fan has an electrical motor, an integrated control board with field loadable software. It has also a fan housing temperature sensor for overheat detection and protection.

The duct temperature sensor and the compartment temperature sensor have a dual element.



COMPONENTS DESCRIPTION

LDCC VENTILATION CONTROL AND INDICATING (2/3)

LDCC Ventilation - General (2)

LDCC Ventilation Normal Operation (2)

Normal Operation (A/C on the Ground):

- The FWD and BULK Cargo Compartments are ventilated with air from the LH triangle area, the AFT Cargo Compartment with air from the RH triangle area.

With the PACKs operating and the cargo doors closed:

- The FWD cargo compartment temperature can be controlled using the TEMP REGUL rotary selector. Air from the LH triangle area is mixed either with fresh air from the mixer unit via the Cold Air Valve (CAV), or with hot air from the trim air manifold via dedicated Trim Air Valve (TAV).

- The Bulk Cargo Compartment temperature can be controlled using the TEMP REGUL rotary selector. If the selected temperature value is greater than the actual Bulk Cargo temperature value, the duct heater warms the air coming from cabin air distribution system (zone 7).

- Air extraction is performed via the FWD, AFT and BULK extract fans.

Notes:

- The Cargo Compartment temperature control is only available when the related Cargo Compartment door is closed.
- When the Cargo Compartment ventilation is isolated, the temperature control or heating is inhibited.
- If the DITCHING P/B is activated, all the isolation valves are closed and the fans are stopped.
- If Smoke is detected in the cargo compartments, the ventilation and temperature control systems are automatically stopped, and SMOKE legend appears in the dedicated zone.

FWD Cargo Ventilation and Temperature Control Normal Operation (3)

The Forward cargo compartment can be optionally equipped with ventilation and temperature control systems.

Ventilation is supplied from the L/H side and extracted via the R/H side thanks to the extraction fan.

When the Aircraft is on Ground:

- When the FWD cargo door is open the heating system is inhibited, but cooling is available. The extraction fan operates continuously.

On the CARGO AIR COND panel, for FWD CARGO:

- The FWD ISOL VALVES P/B SW operates the isolation valves for the forward cargo zone. When the isolation valves open, the related cargo compartments are supplied with a nominal airflow.

If, the FWD ISOL VALVES P/B SW is set to OFF, the isolation valves close, and the related white OFF light indication comes on, the Extraction Fan stops, ventilation and temperature control are not longer available.

- The FWD TEMP REGUL rotary selector is used to adjust the temperature for the FWD cargo compartment from 5 deg.C (41 deg.F) to 25 deg.C (77 deg.F), selected in OFF position the temperature control system stops, trim air valve and cold air valve are closed.

On the ECAM COND page:

- A duct with an arrow in green is showing the distribution from the Mixing unit to the FWD cargo if system is operative, not displayed if Isolation valves closed.
- FWD CARGO EXTRACTION FAN: no display, when FWD cargo extraction fan operates normally. Amber when the FWD cargo extraction fan fails, if extraction fan fails the temperature control stops.
- FWD CARGO ISOLATION VALVE: green when the FWD cargo isolation valves are normally open. Amber when the FWD cargo isolation valves are abnormally open or closed.
- FWD CARGO TEMPERATURE indication: displayed in green, amber XX if not valid data.

FWD Cargo Compartment Extraction Fan is controlled and monitored by the ACS application and CRDC.

FWD Cargo Temperature Control Fault (3)

Control of the temperature in the forward cargo is faulty, can be due to a failure of:

- Trim Air Valve,
- Cold Air Valve,
- Temperature sensor,
- Cargo ventilation system.

AFT Cargo Ventilation Normal Operation (3)

Ventilation is supplied from the R/H side and extracted via the L/H side thanks to the extraction fan.

The optional AFT cargo compartment ventilation system is controlled and monitored by the ACS application and CRDC .

The AFT ISOL VALVES P/B SW operates the isolation valves for the aft cargo zone. When the isolation valves open, the related cargo compartments are supplied with a nominal airflow.

If, the AFT ISOL VALVES P/B SW is set to OFF, the isolation valves close, and the related white OFF light indication comes on, the Extraction Fan stops.

Bulk Cargo Ventilation and Temperature Control Normal Operation (3)

In basic configuration the bulk cargo compartment is equipped with ventilation and heating.

Ventilation is supplied from the L/H side and extracted via the R/H side thanks to the extraction fan.

When the Aircraft is on Ground:

- An open AFT cargo or Bulk cargo door stops the Bulk cargo heating system. The extraction fan operates continuously.

On the CARGO AIR COND panel, for BULK CARGO:

- The BULK ISOL VALVES P/B SW operates the isolation valves for the bulk zone. When the isolation valves open, the related cargo compartments are supplied with a nominal airflow.

If, the BULK ISOL VALVES P/B SW is set to OFF, the isolation valves close, and the related white OFF light indication comes on, the Extraction Fan stops and heating is not longer available.

- The BULK TEMP REGUL rotary selector is used to adjust the temperature for the Bulk cargo compartment from 5 deg.C (41 deg.F) to 25 deg.C (77 deg.F).

- The BULK HEATER P/B SW is in normal position (not set to OFF), the Bulk Cargo Heater automatically operates the electrical heating system. If the system is faulty, the FAULT light appears on the HEATER P/B SW and the heating system has to be switched off manually.

On the ECAM COND page:

- BULK CARGO EXTRACTION FAN: no indication, when Bulk cargo extraction fan operates normally. Amber when the Bulk cargo extraction fan is failed, if extraction fan fails the heater power stops.

- BULK CARGO ISOLATION VALVE: green when the Bulk cargo isolation valves are normally open . Amber when the Bulk cargo isolation valves are abnormally open or closed.

- BULK CARGO HEATER indication: no indication, when bulk cargo heater operates normally. The HEATER legend will appear in amber if the Bulk cargo Heater is failed, or the temperature cannot be regulated.

- BULK CARGO TEMPERATURE indication: displayed in green, amber XX if not valid data.

Bulk Heater Fault (3)

Bulk Cargo Duct Overheat (3)

The ACS application hosted in the CPIOM monitors and controls the heater power.

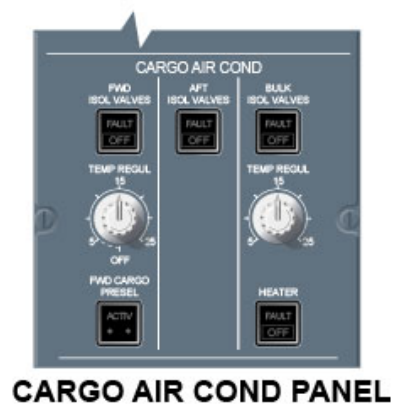
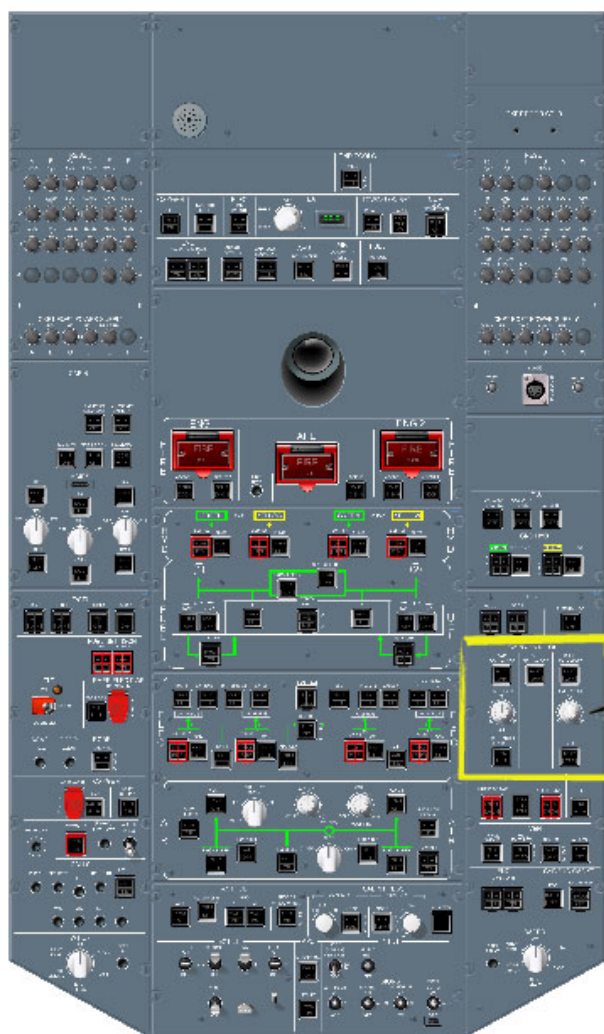
If there is a BULK Cargo Compartment HEATER FAULT, the FAULT-light in the HEATER P/B SW comes on and the HEATER legend appears in Amber below BULK title on the ECAM COND page. In this

case The Bulk Heater has to be isolated by pressing the HEATER P/B to OFF.

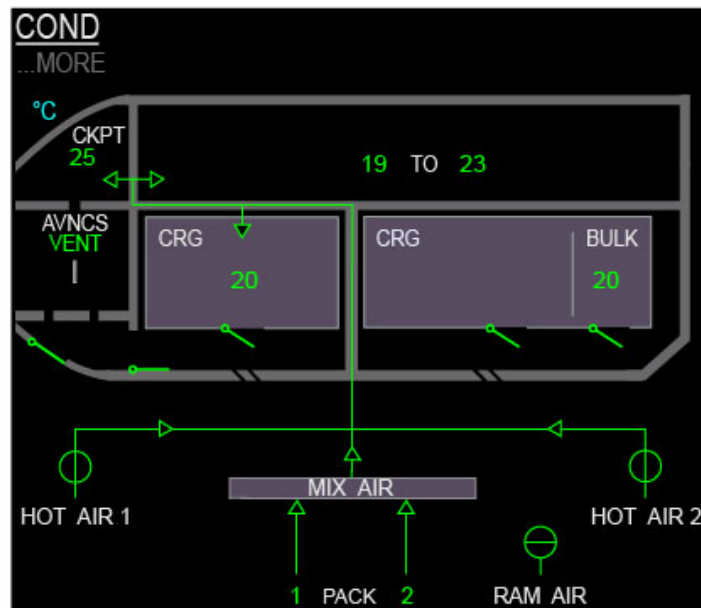
When the duct temperature sensor detects more than 80 deg.C (176 deg.F):

- A MASTER CAUT-light comes on and the single chime sounds.
- The COND-page shows HEATER in amber at the cargo compartment.
- The EWD shows BULK CARGO DUCT OVHT warning message.
- The COND page shows the bulk heater unserviceable.
- The FAULT-light in the HEATER pushbutton-switch comes on.

The overheat warning can be reset when the temperature goes below 80 deg.C (176 deg.F) and to switch the HEATER P/B SW to OFF and then ON.

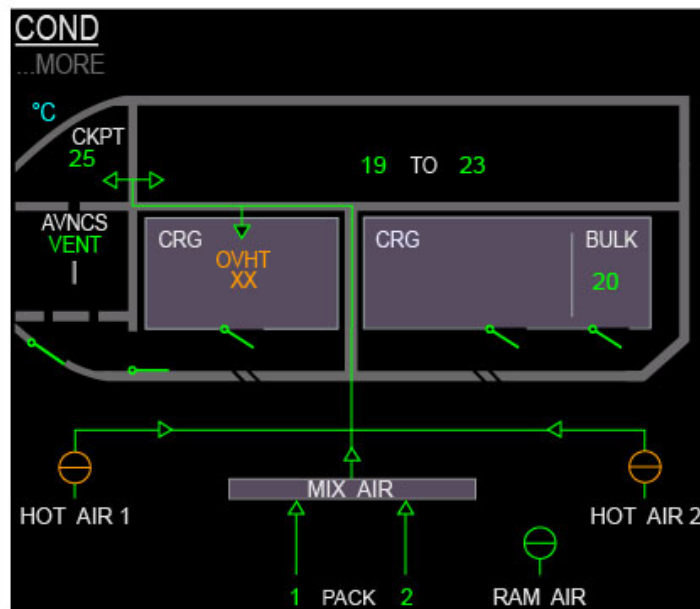


LDCC VENTILATION - GENERAL (2) ... BULK CARGO DUCT OVERHEAT (3)



COND SD PAGE

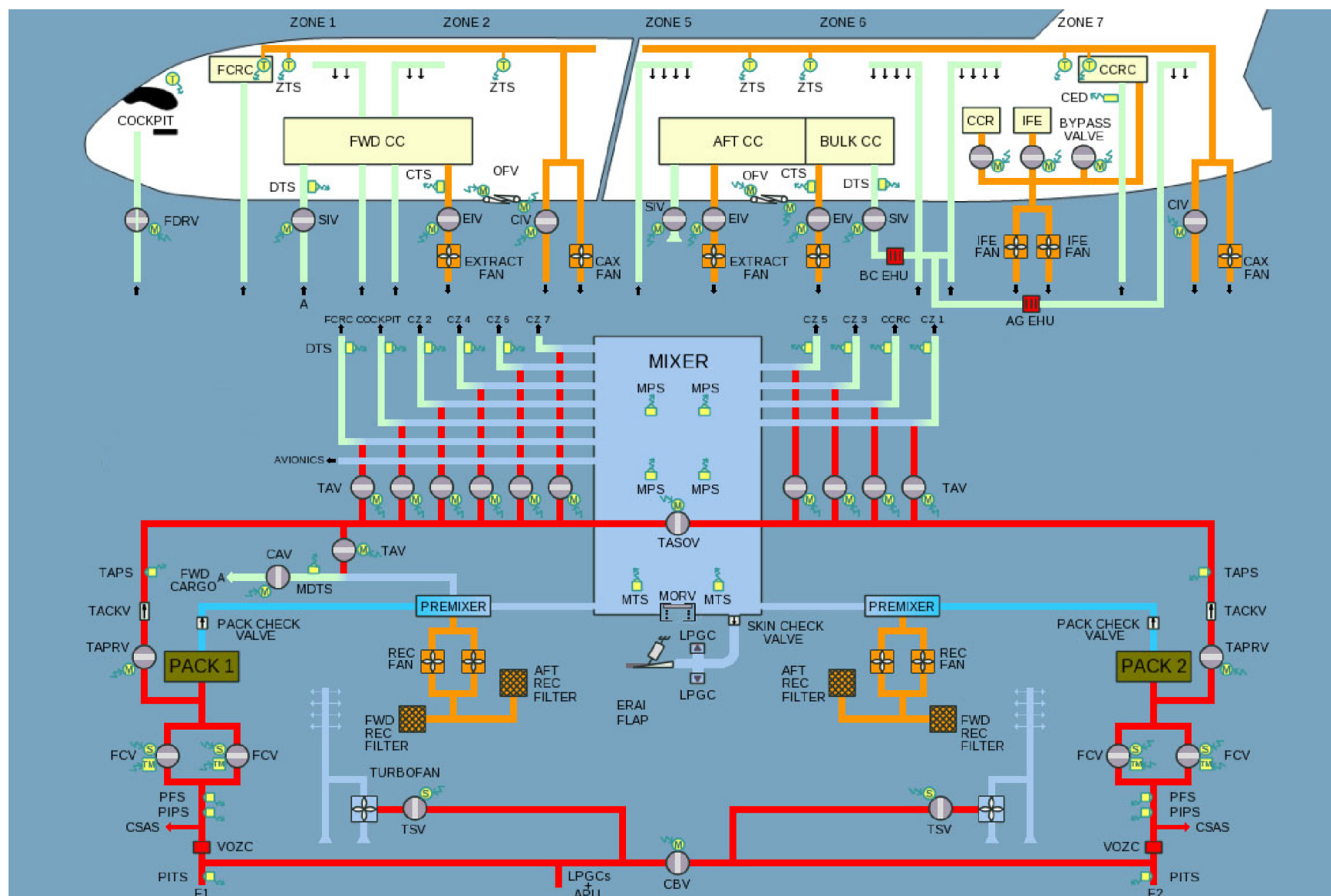
LDCC VENTILATION - GENERAL (2) ... BULK CARGO DUCT OVERHEAT (3)



ABNORMAL COND SD PAGE

**THIS SD SHOWS SEVERAL
AVAILABLE INDICATIONS BUT
NOT A SYSTEM CONFIGURATION**

LDCC VENTILATION - GENERAL (2) ... BULK CARGO DUCT OVERHEAT (3)



LDCC VENTILATION - GENERAL (2) ... BULK CARGO DUCT OVERHEAT (3)

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CABIN PRESSURE CONTROL SYSTEM (CPCS) DESCRIPTION (2/3)

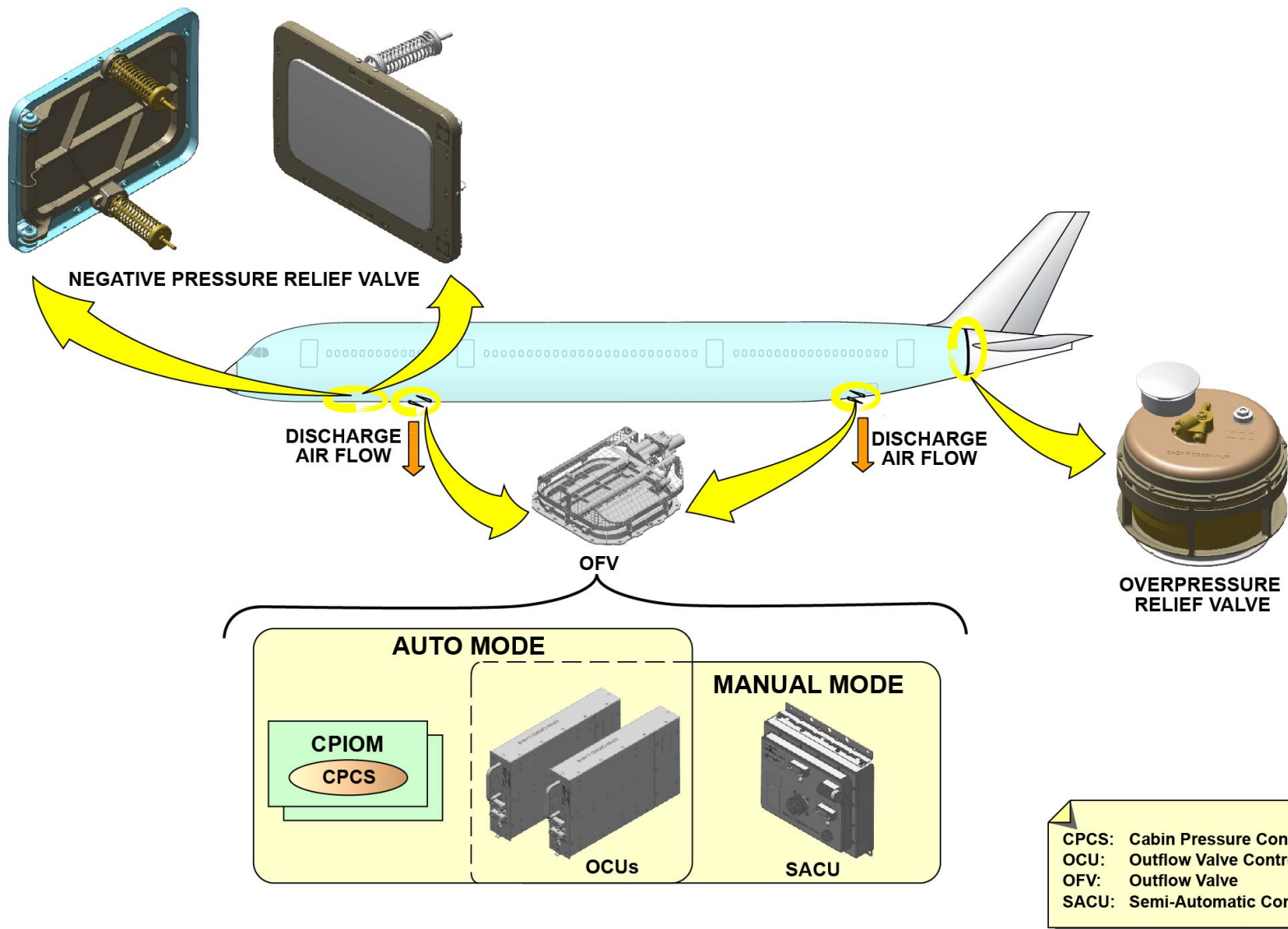
CPCS Presentation

The CPCS regulates the cabin air pressure by modulation of a discharge airflow overboard through two Outflow Valves (OFVs) to assure the best possible passenger comfort and safety.

The CPCS includes the AUTO mode and the MAN/semi-automatic mode to control the pressure in the fuselage during flight or ground operation. In AUTO mode the CPCS uses two CPCS application in CPIOMs and two Outflow valve Control Units (OCUs).

In MAN/semi-automatic mode, the CPCS uses a Semi-Automatic Control Unit (SACU) and both OCUs.

In case of excessive over/underpressure, two negatives relief valves and one overpressure relief valve protect the A/C.



CPCS PRESENTATION

V2414251 - V00T0MM0 - VM21DAPRESS3001

CABIN PRESSURE CONTROL SYSTEM (CPCS) DESCRIPTION (2/3)

CPCS Description/Interfaces

AUTO mode Description

In AUTO mode each CPCS application hosted in the CPIOMs exchanges data between A/C systems and the OCUs. The OCUs drive the OFVs to modulate discharge airflow based on A/C systems data and cabin pressure.

Each OCU includes two partitions:

- An OCU COM/MON partition is used for normal AUTO mode
- An OCU backup motor drive partition for backup AUTO mode.

The OCU COM/MON partition includes two cabin pressure sensors, one located in OCU COM section, and one located In OCU MON section.

Each OFV has two electrical motors:

- One controlled by OCU COM section for normal AUTO mode
- One controlled by OCU backup motor drive for backup AUTO mode.

During normal AUTO mode, CPCS applications transmit flight and air data to OCUs COM. The OCUs COM section calculate a cabin pressure target and a pressure change rate using its internal cabin pressure sensor and data from CPCS applications. Among the two OCUs COM one is master the other is slave, the master adjusts consequently the OFVs position. The master OCU COM controls directly its OFV electrical motor and the other OFV electrical motor via the slave OCU COM. OFVs position are monitored by OCUs.

The OCUs MON section use its internal cabin pressure sensor and air data from ADIRS to monitor the cabin pressure and the cabin DELTA P for A/C overpressure/underpressure protection and indicating.

One OCU operates in backup AUTO mode in case of:

- CAB ALT and/or CAB DELTA P out of range detected by OCU MON section
- OCU COM and/or OCU MON sections internal failure.

For the concern OCU the OCU COM section is disabled. The backup motor drive partition is used to control corresponding OFV with a

dedicated electrical motor, following orders from the other OCU COM section.

The AUTO mode interfaces:

- The OCU COM and the OCU MON sections receive air data from the ADIRS
- The FMS sends to the CPCS applications the flight data
- To avoid pressurization on ground CPCS applications are in interface with LGERS
- In AUTO mode, a pre-pressurization occurs when CPCS applications receive from Propulsion Control System (PCS) the engines at T/O power signal and from Door Slide Control System (DSCS) the all doors closed signal
- The air conditioning packs supplies the pack status to CPCS applications to control OFVs in close position if packs are inoperative
- The OCUs transmit via CPCS applications and CRDCs the status of the AUTO mode to the CDS on the CAB PRESS page
- OCUs are in interface via CRDCs and CAN bus with the DLCS
- If the DITCHING P/BSW is activated, a discrete and an AFDX signal are supplied to the OCUs to control OFVs in closed position.



V2414251 - V00T0MM0 - VM21DAPRESS3001

CABIN PRESSURE CONTROL SYSTEM (CPCS) DESCRIPTION (2/3)

CPCS Description/Interfaces (continued)

Manual/Semi-Automatic Mode Description

Following AUTO mode failure, and/or selection by the pilot, the MAN/semi-automatic mode is selected from the MAN P/B.

The MAN/semi-automatic mode is controlled and monitored by the SACU. The SACU receives MAN P/B activation and cabin ALT and/or V/S selection from the CABIN PRESS panel. Also, the SACU sends signal to OCUs backup motor drive, to drive OFVs to modulate the discharge airflow.

The SACU has one internal cabin pressure-sensor and one internal-cabin differential pressure-sensor.

The MAN/semi-automatic mode selection is sent to OCUs for AUTO mode inhibition and to SACU to operate the MAN/semi-automatic mode. The SACU receives cabin altitude and/or cabin vertical speed selected by the crew. The air data and SACU internal sensors are used by SACU to:

- Control the OFVs via OCU backup motor drive ensuring that all safety and comfort criteria are not exceeded
- Provide cockpit indicating and warning.

The SACU receives air data from the Integrated Standby Instrument System (ISIS).

The SACU transmit via CRDC the status of the MAN/semi-automatic mode to the CDS on the CABIN PRESS page.

The field loadable software is loaded by the DLCS to the SACU through CRDC and CAN bus.

The LGERS and DSCS send a discrete signal to the SACU for residual pressure protection on ground and prevention of pressurization if all doors are not closed.

The SACU is in interface with CPIOMs and CPCS applications via CRDCs for BITE system.



V24I4251 - V00T0MM0 - VM21DAPRESS300I

CABIN PRESSURE CONTROL SYSTEM (CPCS) DESCRIPTION (2/3)

CPCS Components Description

The two negative relief valves are necessary to provide the negative-pressure relief function as last protection. Each valve has two springs which open mechanically when the external pressure is higher than the combined force of valves springs and the cabin pressure.

The overpressure relief valve which is installed in the rear of the A/C is required to perform the overpressure relief function as last protection.

The valve has pressure ports for cabin DELTA P measurement and air filter to avoid contamination.

There are two OCUs. One is installed in the FWD cargo and one is in the AFT cargo. Each OCU has pressure sensors ports for cabin pressure measurement and field loadable software.

The SACU is installed in the nose fuselage of the A/C.

The SACU has:

- A control board with a field loadable software
- A momentary AIRCRAFT PRESSURE TEST ENABLE P/BSW to inhibit the residual pressure protection-function to allow A/C fuselage leakage test

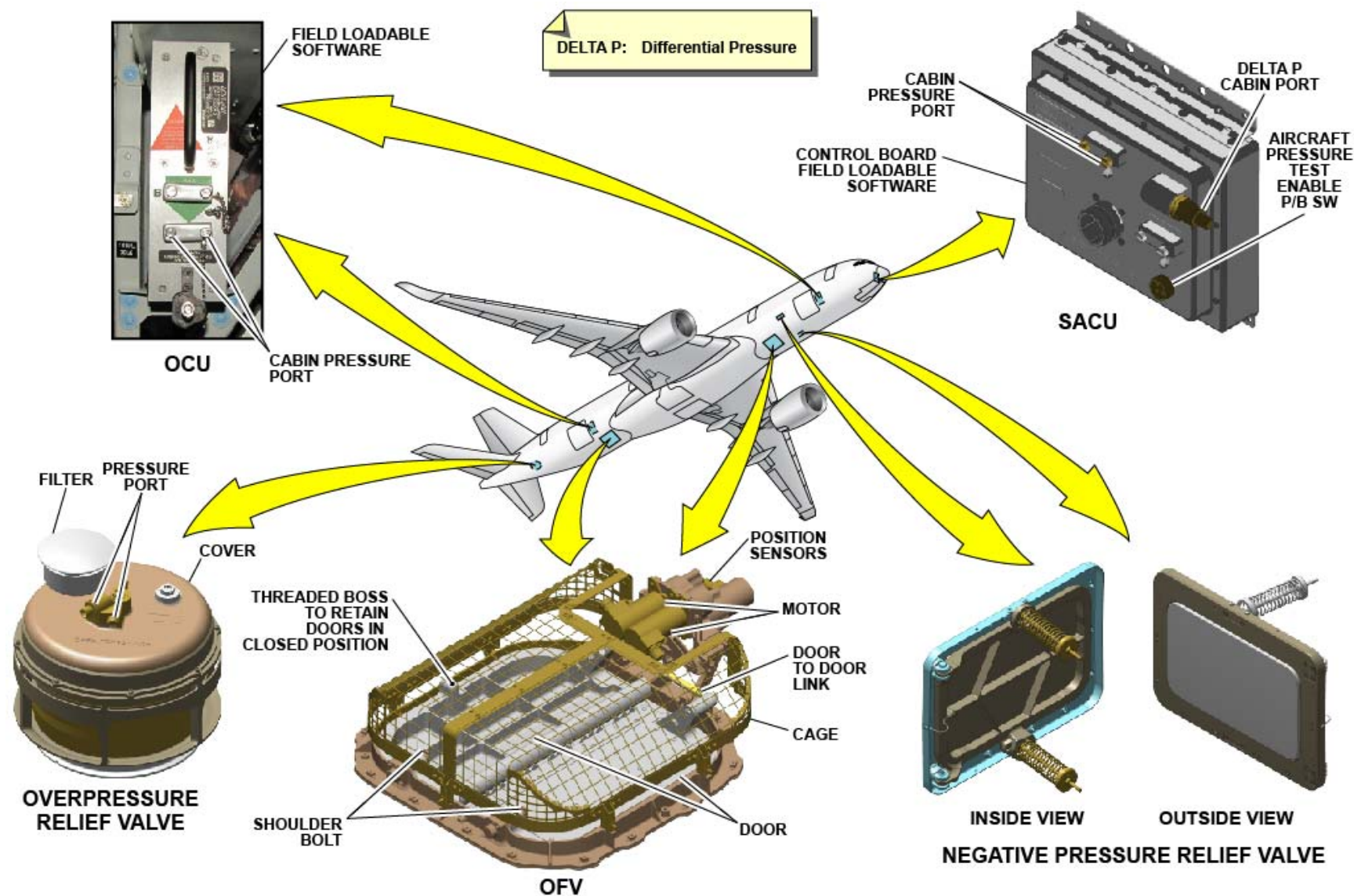
- Three pressure ports which measure the cabin pressure and DELTA P.

There are two OFVs. One OFV is installed in the lower part of the FWD fuselage, and one OFV is installed in the lower part of the AFT fuselage.

Each OFV has:

- A cage to avoid foreign objects ingestion
- Two doors mechanically linked
- Two electrical motors
- Position feedback sensors.

The doors of the OFVs can be deactivated in the closed position with a shoulder bolt and a related threaded boss.


CPCS COMPONENTS DESCRIPTION

CABIN PRESSURE CONTROL SYSTEM (CPCS) CONTROL AND INDICATING (2/3)

CPCS - General (2)

CPCS Controls (2)

The Cabin Pressurization system is supplied by air from the Air conditioning Packs.

For this reason the PACK 1 and PACK 2 indications are displayed on the CAB PRESS SD page.

-The Cabin Pressure Control System is normally in automatic mode. There is a Manual back-up mode for Cabin Altitude and Cabin Vertical Speed selection (flight crew action).

- When the CABIN ALT MODE and CABIN V/S MODE P/B SWs are in AUTO mode, the Cabin Pressure Control System (CPCS) regulates automatically the cabin air pressure by means of the modulation of two Outflow Valves installed in the aircraft lower skin.

- On the CAB PRESS page, the Cabin Pressurization Control System is indicated normally into Auto Control mode.

- Cabin Differential Pressure, Cabin Altitude, Cabin Vertical Speed and Landing Field Elevation are displayed on CAB PRESS page.

- When the DITCHING P/B SW is set to ON, all the valves and flaps, located below the floatation line, are forced to close.

CPCS Normal Operation on Ground (3)

Cabin Pressure Control System Architecture:

The cabin pressure system consists of two electrically actuated Outflow Valves (OFV) driven by two identical Outflow Control Units (OCUs). Both OCUs measure the actual cabin pressure, calculate the target cabin Pressure, then the master OCU controls the OFVs position to vary the airflow discharged through the valves in order to adjust the internal air pressure according to the demand. Two Core Processor Input/Output Modules (CPIOM) are used with the cabin pressure system as a gateway. A separate Semi Automatic Control Unit (SACU), provides with the

Integrated Control Panel (ICP) a fully independent mean for semi automatic pressure control (manual control).

The cabin pressure system also utilizes an independent pneumatically controlled ORV and two NRV for additional protection. One OFV is installed at the forward lower skin and one OFV is installed at the aft lower skin.

It is essential for the Outflow valves (OFVs) control logic that ADIRUS are all selected in -NAV position.

In normal operation Cabin Pressure Control System modulate automatically the OFVs positions, in order to maintain the required Cabin Altitude.

Automatic Control Mode

The Cabin Pressurization system is automatically controlled when CAB ALT MODE P/B SW and CABIN V/S MODE P/B SW are both set to AUTO. The outflow valve control units (OCUs) use a master and slave relationship.

During normal operation both OFVs are simultaneously controlled in order to achieve the correct cabin pressurization.

The automatic pressurization is performed by :

- Cabin Pressure Control System (CPCS) application, hosted in the CPIOM.

- Outflow valve Control Units (OCUs).

On Ground, all outflow valves are controlled to fully open position to ensure there is no residual cabin pressure.

During Take-Off, the Outflow valve Control Units (OCUs) control the position of the outflow valves to pre-pressurize the cabin and to avoid cabin vertical speed bump at liftoff.

Cabin Pressurization Inhibited by Doors (3)

On ground, after first engine start, if at least one door is not closed and locked the cabin pressurization is inhibited. The outflow valves are maintained open, and the Packs are automatically set to off.

The Door and Slide Control System (DSCS) sends the unlocked door signal.

The DSCS is the interface with Cabin Pressure Control System (CPCS) for A/C pressurization.

When the DSCS sends the unlocked door signal, the Cabin Pressure Control System (CPCS) is inhibited. The Pack-Flow Control Valves are automatically controlled to closed position.

Ditching Selection (3)

The RAM AIR P/B is used to control manually the Emergency Ram Air Inlet (ERAI). In normal configuration Air Conditioning Packs provide air flow for Cabin ventilation and pressurization system. In case of Packs unavailability, the ERAI will provide back-up air for Cabin ventilation. On the CABIN PRESS panel, when the DITCHING P/B SW is pressed to ON:

- the outflow valves,
- the emergency ram air inlet,
- the avionics overboard valve,
- the Cabin Air Extraction (CAX) isolation valves,
- the Pack ram air doors,
- the Pack flow control valves,
- and the cargo compartment isolation valves are closed.

Also on the following systems (except Avionics ventilation), the fans are automatically stopped:

- Cabin air recirculation,
- Cabin Air Extraction (CAX),
- Cargo air ventilation extract,
- Commercial Equipment Ventilation.

CAB PRESS AUTO CTL REDUNDANCY FAULT (3)

One Outflow valve Control Unit (OCU) is failed, redundancy is lost for automatic mode.

No effect on system performance.

No effect on the PRESS page.

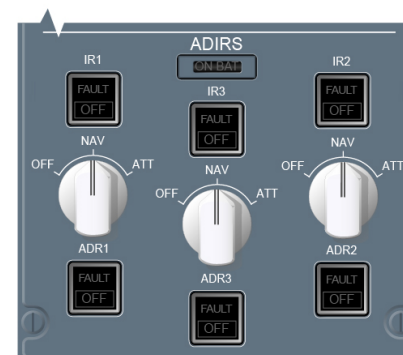
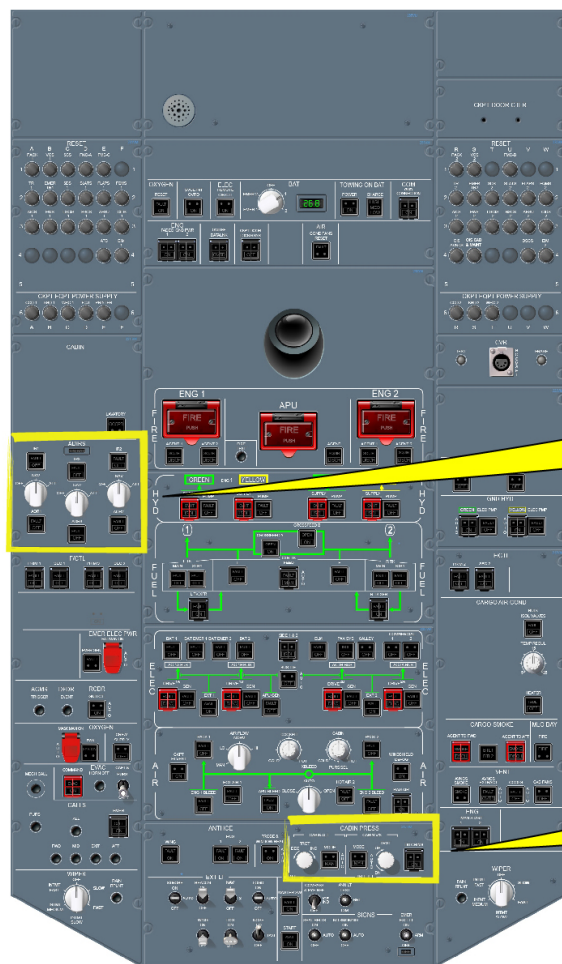
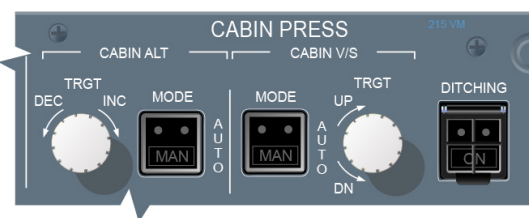
CAB PRESS AUTO CTL FAULT (3)

This alert is triggered when automatic mode is lost:

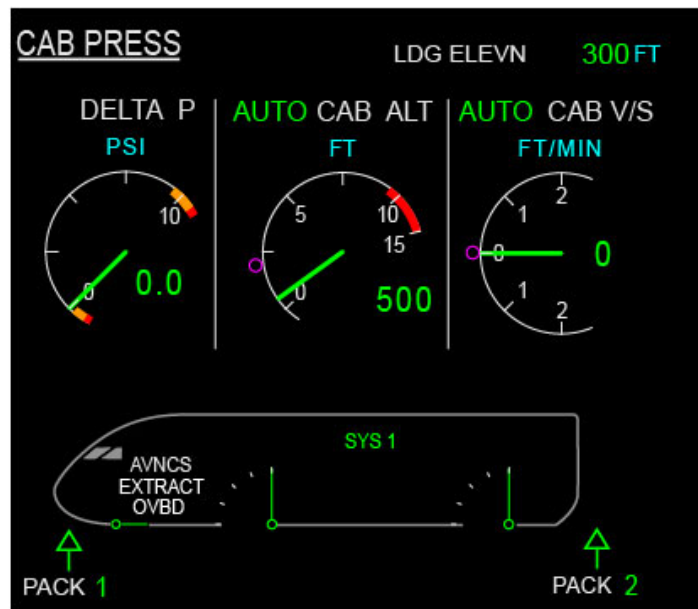
- CPIOMs failure or OCUs failure.

In this case crew has to select MAN mode and CABIN ALT TARGET according to reference table.

Check indications on PRESS page.

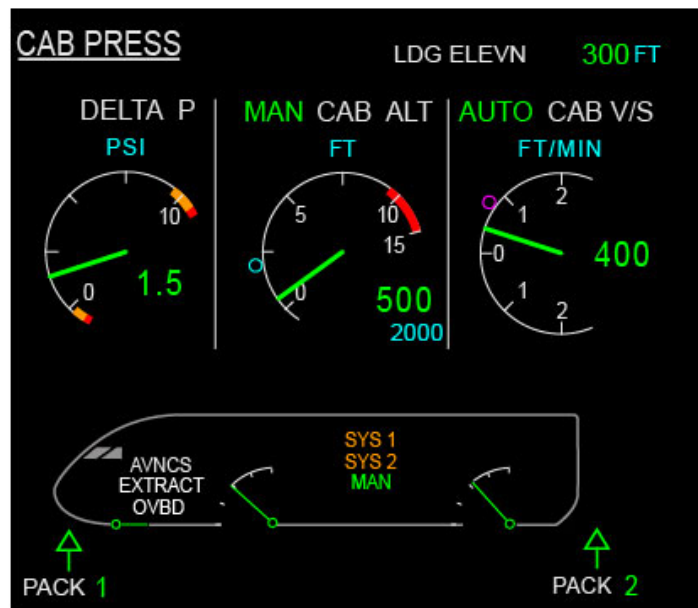

ADIRS PANEL

CABIN PRESS PANEL

CPCS - GENERAL (2) ... CAB PRESS AUTO CTL FAULT (3)



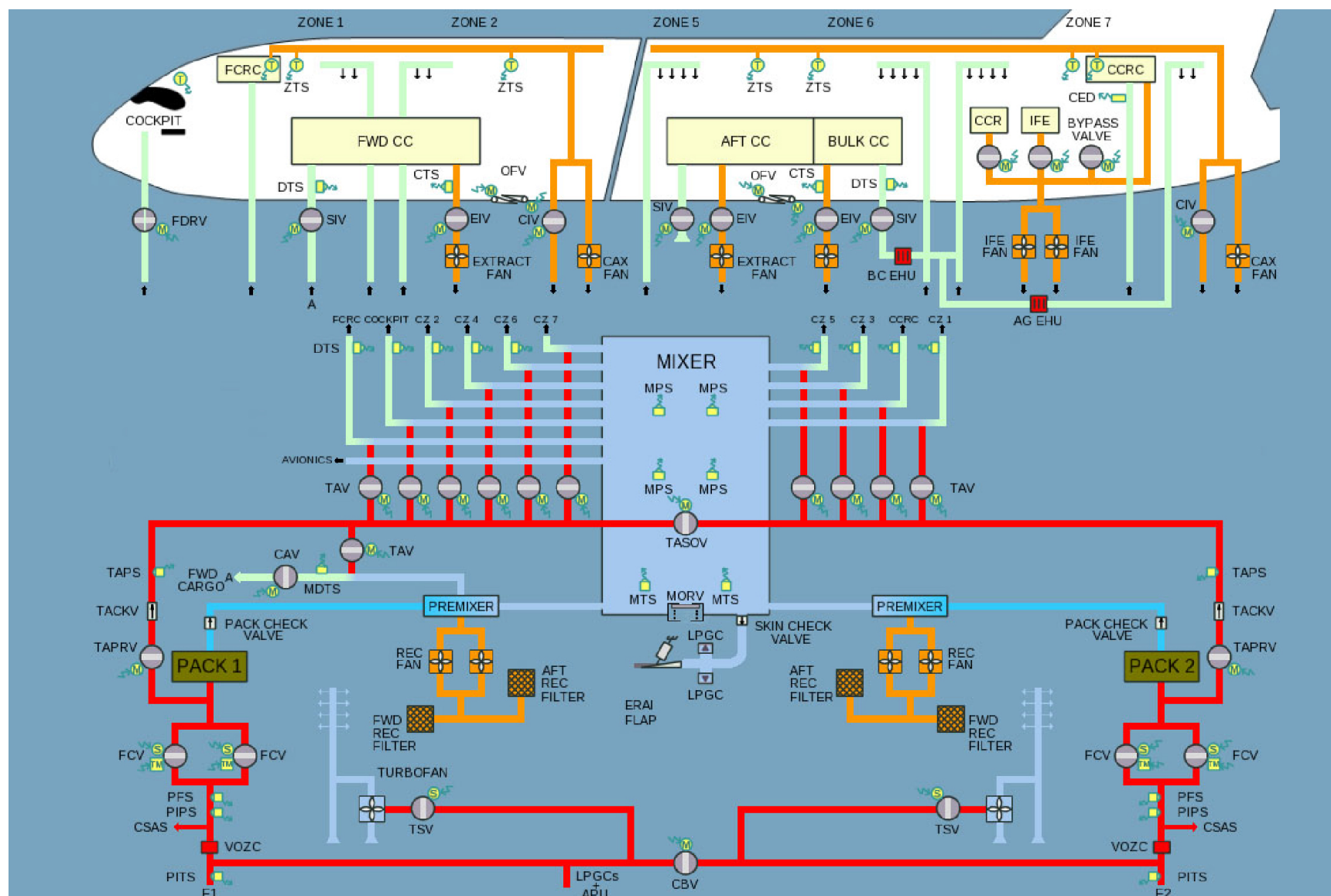
PRESS SD PAGE

CPCS - GENERAL (2) ... CAB PRESS AUTO CTL FAULT (3)



ABNORMAL PRESS SD PAGE

CPCS - GENERAL (2) ... CAB PRESS AUTO CTL FAULT (3)



CPCS - GENERAL (2) ... CAB PRESS AUTO CTL FAULT (3)

UNPRESSURIZED COMPARTMENTS VENTILATION DESCRIPTION (2/3)

System Presentation

The unpressurized compartment ventilation system:

- Removes the heated air that comes from the air conditioning packs and the Conditioned Service Air System (CSAS). Also keeps the temperature in normal limits to prevent damage of the structure.
- Ventilates areas to avoid the fuel and hydraulic vapor accumulation.

The unpressurized compartments ventilation system has two subsystems:

- The pack-bay ventilation system
- The Main Landing Gear Bay (MLGB) ventilation system.

The pack-bay ventilation system is installed in each pack bay area.

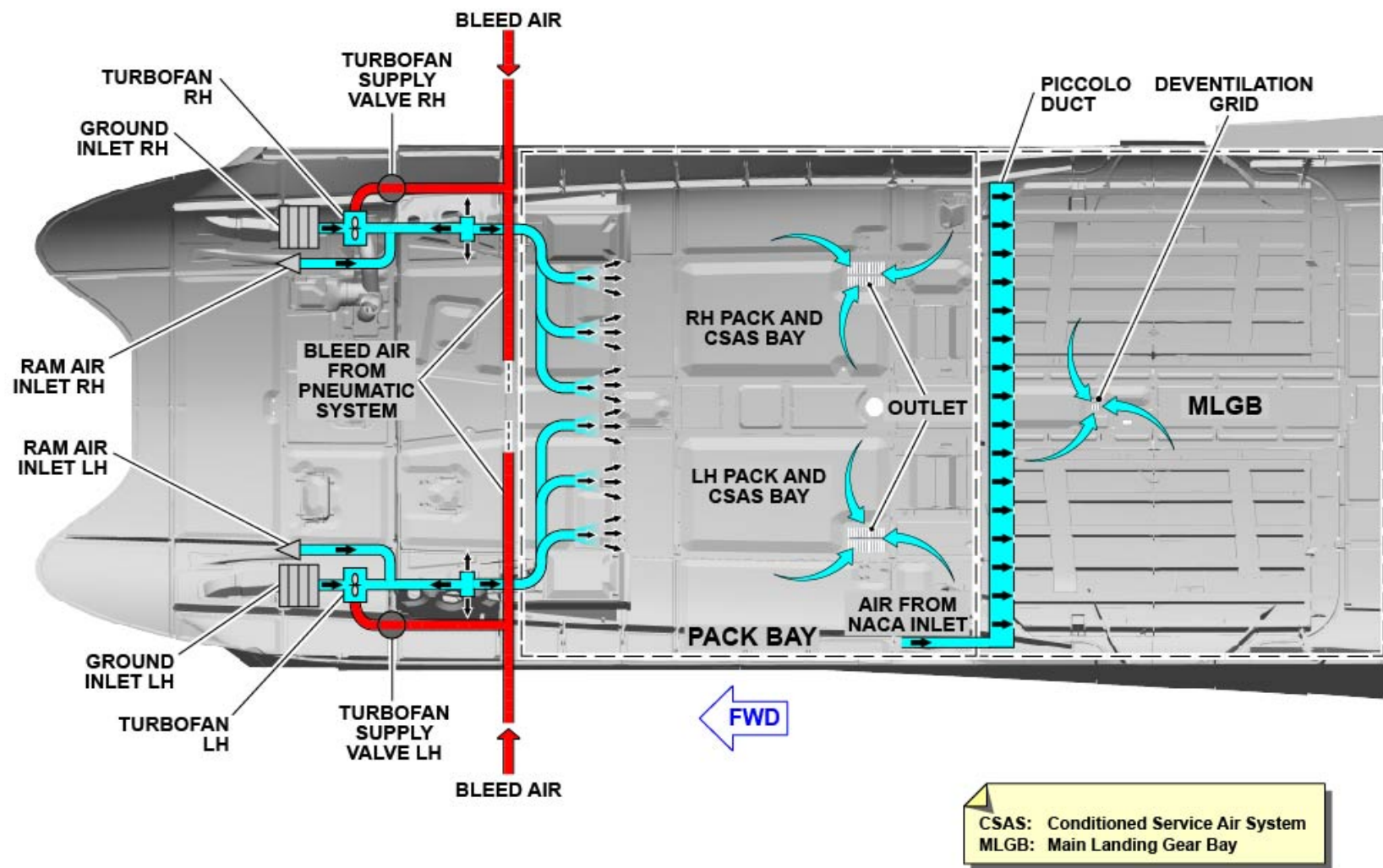
The system supplies air to ventilate:

- The air conditioning packs and the CSASs
- The adjacent bleed ducts.

Each pack bay ventilation has:

- A turbofan supply valve
- A turbofan
- A ground inlet
- A Ram Air Inlet (RAI)
- Outlets.

The MLGBs ventilation operates only in flight. The air comes through the NACA inlet which is installed on the LH belly fairing and flows through piccolo ducts to the MLGB. The air is discharged through a grid at the mid in the bottom of the bay.



SYSTEM PRESENTATION

UNPRESSURIZED COMPARTMENTS VENTILATION DESCRIPTION (2/3)

System Description and Interfaces

The two Air Systems Control Units (ASCUs) control and monitor the unpressurized compartments ventilation system. The ASCU1 for LH pack bay area and ASCU2 for the RH pack bay area. The ASCUs control the solenoid valves of the turbofan supply valves and monitor their position. ASCUs also receive the turbofan speed value. If there is a failure of the system, the ASCU stops the related air conditioning pack.

On the ground, the turbofan supply valve opens and supplies bleed air from the pneumatic to its related turbofan. The turbofan supplies the external air through the ground inlet and throat section to the bays.

In flight, the turbofan supply valve closes and stops to supply bleed air to the turbofan. The external air comes in through the RAI and the throat section to decrease the temperature in the bays.

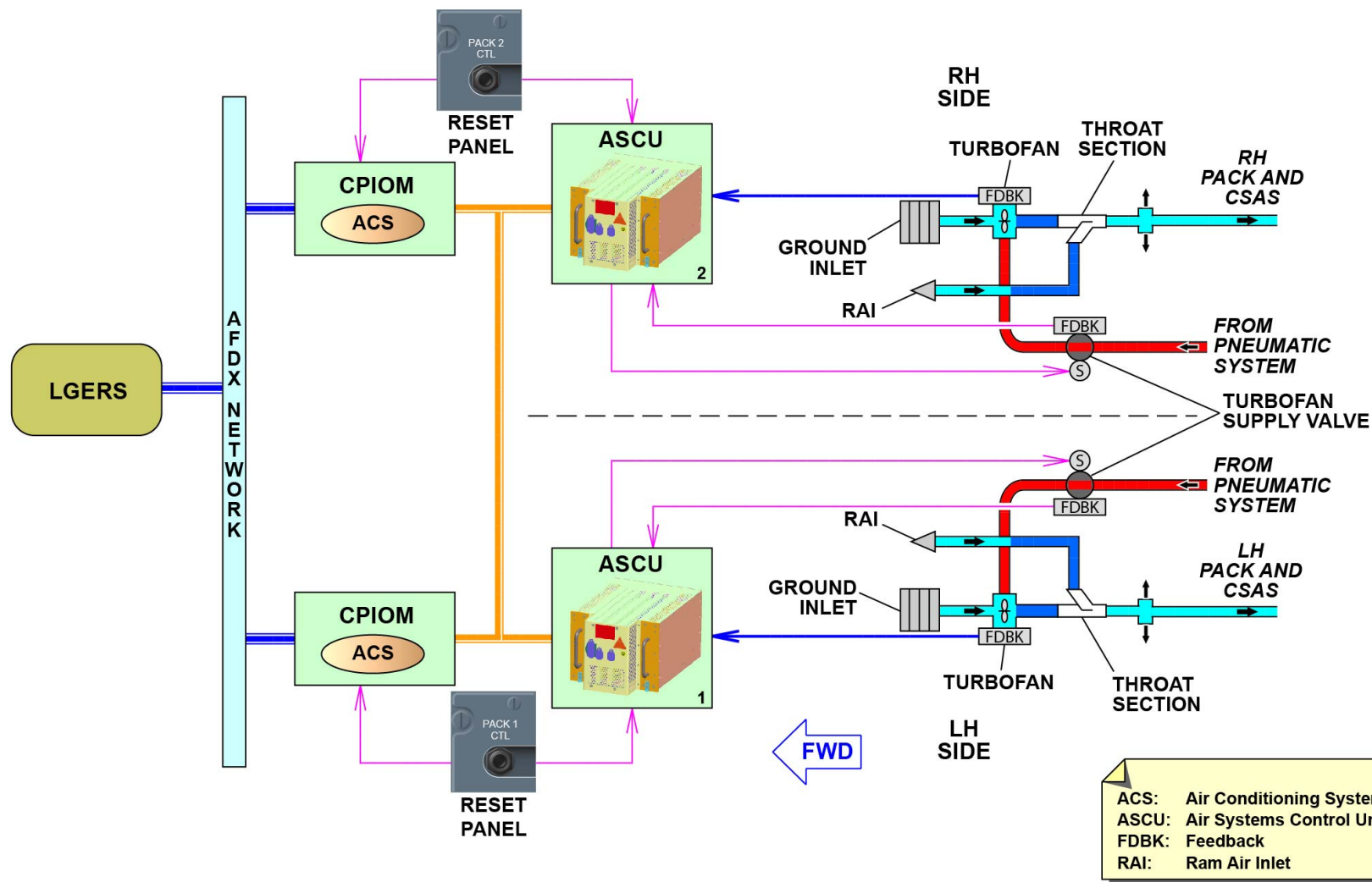
On the ground and in flight the air is sent overboard through outlets.

The throat section prevents the airflow in the opposite direction between the ground inlet and RAI.

The Air Conditioning System (ACS) applications are installed in the two CPIOMs. The ACS applications supply the ASCUs with A/C data and also monitor the system.

The LGERS applications send a signal to each ASCU through the ACS applications to determine the GROUND/FLIGHT configuration.

The PACK RESET P/BSWs, reset the ACS applications and ASCUs.



SYSTEM DESCRIPTION AND INTERFACES

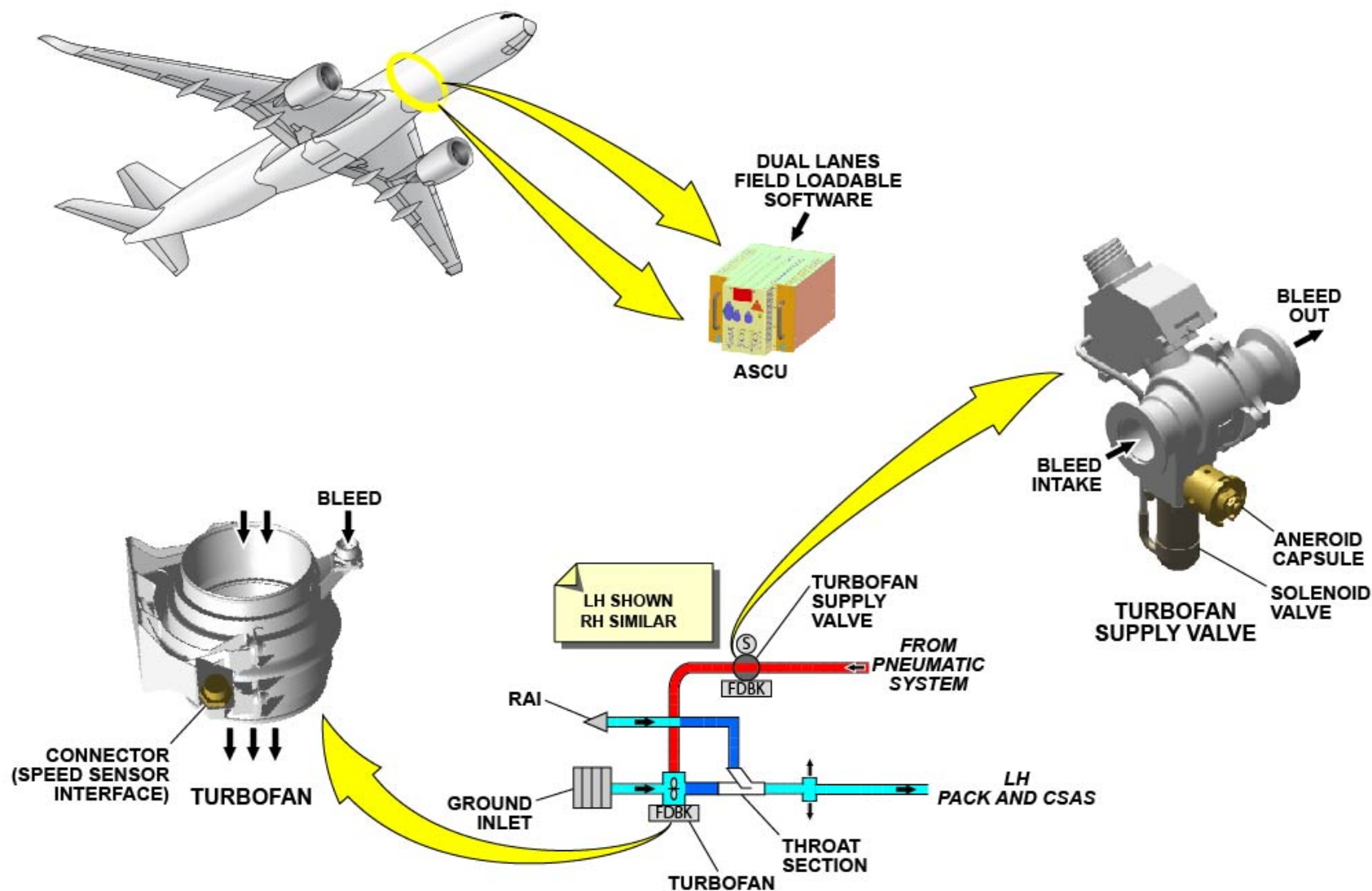
UNPRESSURIZED COMPARTMENTS VENTILATION DESCRIPTION (2/3)

Components Description

The ASCUs are installed in the FWD cargo compartment. Each ASCU is a dual-lane digital controller with field loadable software which controls and monitors the unpressurized compartments ventilation system.

The two turbofan supply valves are pneumatically actuated and spring loaded closed. Each turbofan supply valve is controlled with a solenoid. An aneroid capsule closes the valve at specified altitude if it is not in the closed position.

There are two turbofans, one for each subsystem. The function of the turbofan is to supply the cool air in the unpressurized compartment when the A/C is on the ground. Each turbofan operates with hot bleed air from the pneumatic system (ATA36). It operates without electrical power and has internal speed sensors.



COMPONENTS DESCRIPTION

UNPRESSURIZED COMPARTMENTS VENTILATION CONTROL AND INDICATING (2/3)

Pack Bay Ventilation (2)

The Unpressurized Compartments Ventilation System is divided into two sub systems located in each side of the forward belly fairing. Ambient air is taken from outside to ventilate the pack bays, Conditioned Service Air System (CSAS), bleed ducts.

The forward belly fairing area ventilation system is composed of two identical sub-systems, LH and RH sides.

Each sub-system has:

- A Turbofan Supply Valve (TSV),
- A turbofan,
- Two check-valves,
- A ground inlet,
- A ram air inlet.

On ground, turbofans draw outside air through the ground inlets to ensure Ventilation.

In flight dynamic air is provided through the ram air inlets to ventilate the bays.

When open (on ground), the Turbofan Supply Valve (TSV) enables air from the HP Pneumatic bleed air system to supply a dedicated turbofan.

In flight, the TSV closes the turbofan bleed air supply.

Each Pack Bay Ventilation Turbofan is monitored by its dedicated Air Supply Control Unit (ASCU).

On ground and in normal operation:

- Bleed air of the pneumatic system is supplied to the turbofans via the open Turbofan Supply Valves (TSVs).

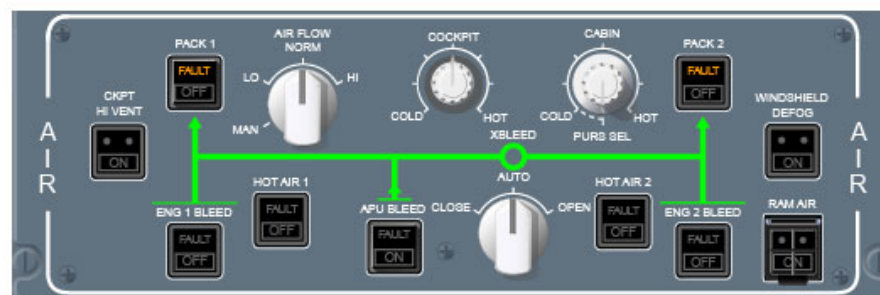
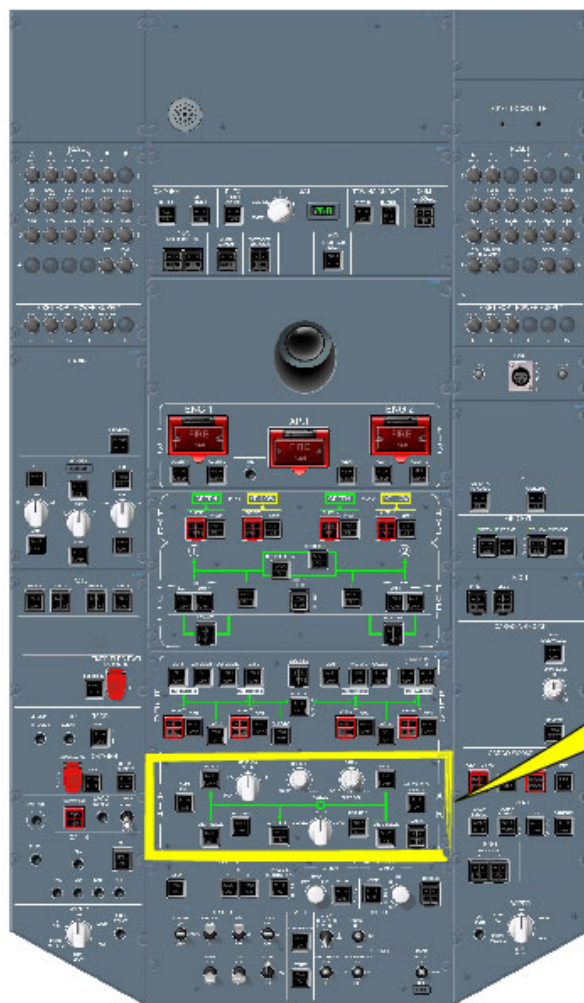
PACK BAY VENT FAULT (3)

On ground the Turbofan Supply Valve (TSV) enables air to the dedicated turbofan.

In flight, the TSV closes air supply to the turbofan.

In the case of a Turbofan supply valve fails in closed position on ground, the related PACK is automatically shut down and the dedicated PACK P/B has to be switched to the OFF position.

After takeoff, the pack p/b is set to ON, the system use the flight Ram Air Inlets to ventilate the areas.

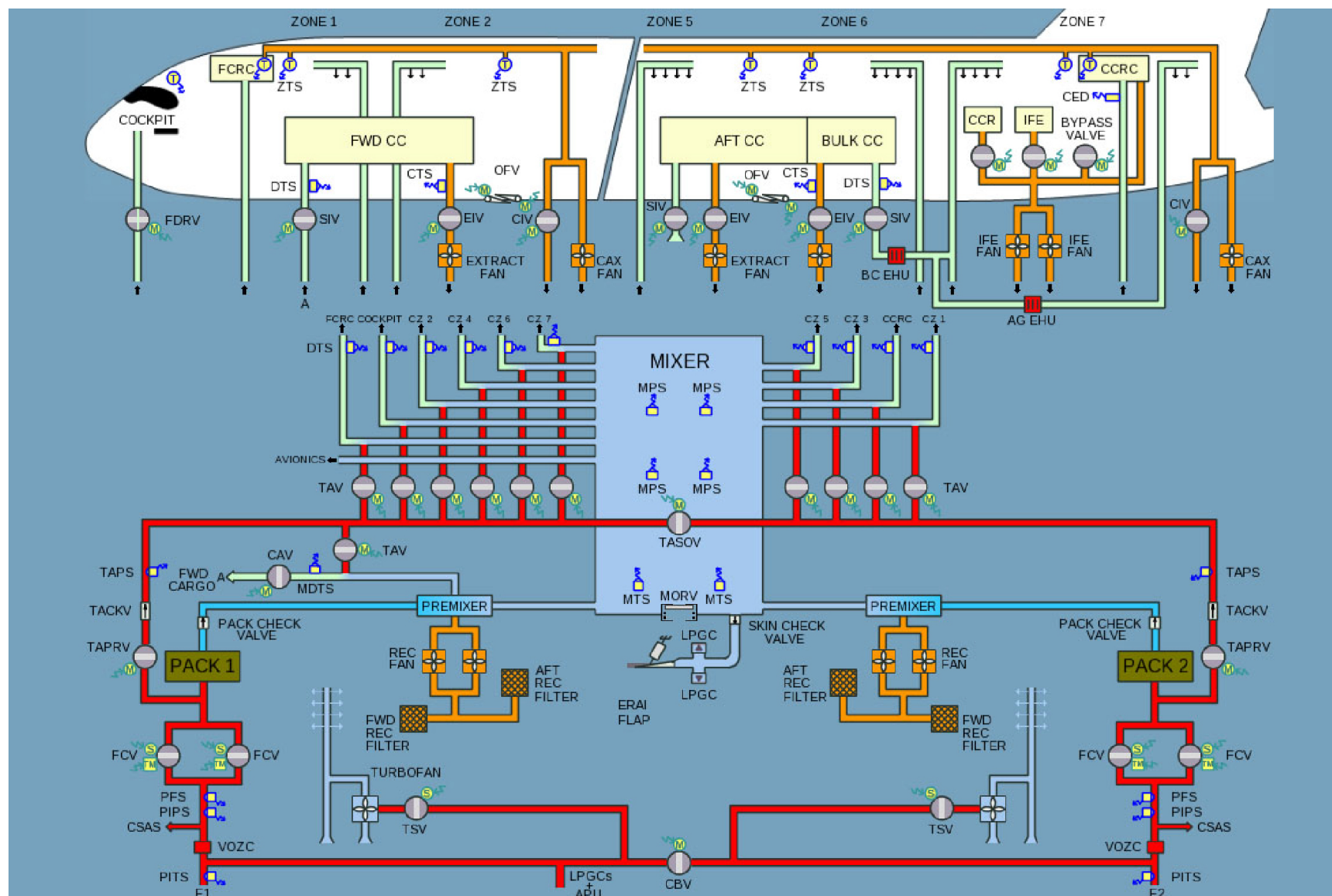

AIR PANEL

PACK BAY VENTILATION SYSTEM HAS NO MANUAL CONTROL AND NO INDICATION ON SD PAGE.

AUTOMATIC CONTROL IS BASED ON BLEED AIR PRESSURE FROM PNEUMATIC SYSTEM.

PACK AUTOMATIC SHUTDOWN ON GROUND IN CASE OF SYSTEM FAILURE.

PACK BAY VENTILATION (2) & PACK BAY VENT FAULT (3)



PACK BAY VENTILATION (2) & PACK BAY VENT FAULT (3)

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CONDITIONED SERVICE AIR SYSTEM (CSAS) DESCRIPTION (2/3)

CSAS Presentation

The Conditioned Service Air System (CSAS) is supplied by ATA36 Bleed Air System (BAS). The system decreases ozone concentration and adjusts bleed air temperature and pressure for the Inert Gas Generation System (IGGS) ATA 47.

The CSAS includes two subsystems LH and RH installed on the A/C.

The main components of the CSAS (LH or RH) are:

- A CSAS inlet valve
- An ozone converter decreases the ozone content in the bleed air by catalytic conversion of ozone to oxygen
- A compressor check valve
- A main heat exchanger and a precooler heat exchanger
- A Ram Air Outlet (RAO) and PACK/CSAS Ram Air Inlet (RAI) (common inlet for PACK and CSAS)
- A temperature control valve
- A turbine valve
- A turbo compressor.

The CSAS is operated in the following modes:

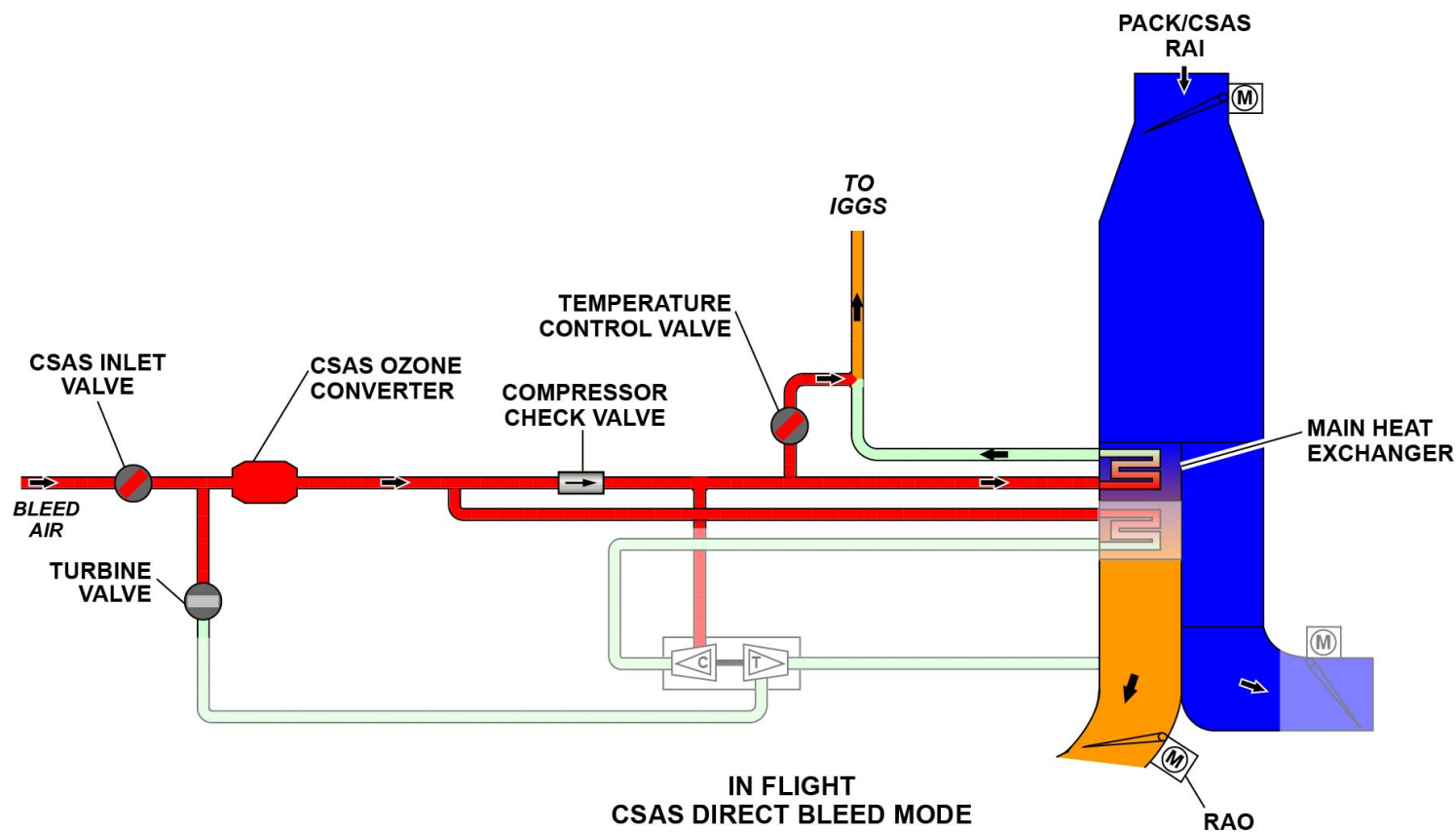
- Standby mode on ground
- Direct bleed mode in flight
- Boosted mode in flight.

In standby mode the CSAS is electrically energized but is not supplied with bleed air, CSAS inlet valve is closed.

In direct bleed mode the CSAS is supplied with bleed air, the CSAS inlet valve is in the open position and the turbine valve is in the closed position.

The bleed air passes through the ozone converter and the compressor check valve, the turbo compressor and the precooler heat exchanger are bypassed. Air goes through the main heat exchanger, its temperature decreases and goes to the IGGS. The temperature control valve adds some hot bleed air to the air that comes from the main heat exchanger to get the required temperature at the outlet of the CSAS.

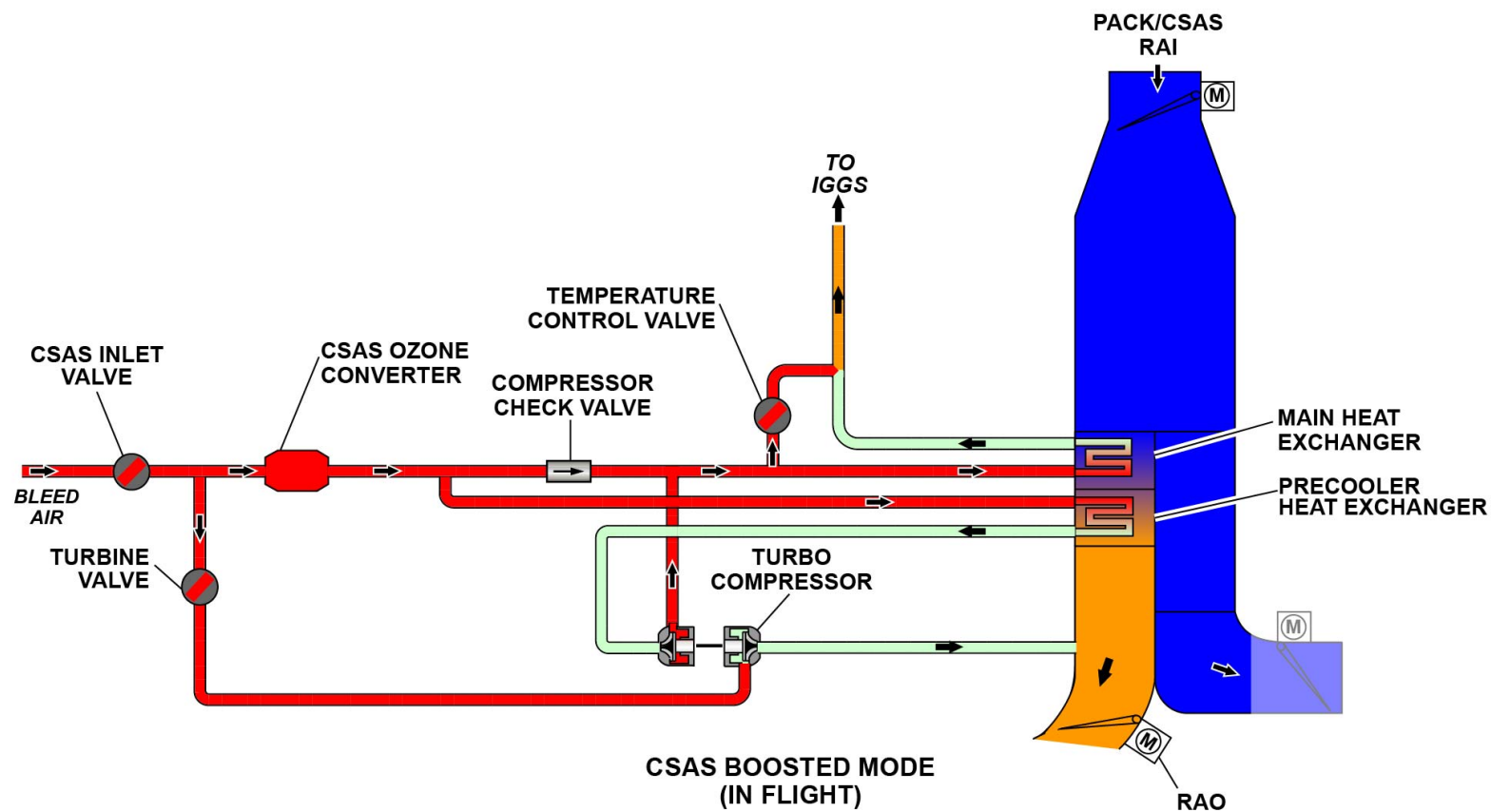
In boosted mode the CSAS inlet valve and the turbine valve are opened. Some bleed air goes to the turbine of the turbo compressor, to drive the turbine and the compressor. Bleed air is sucked by the compressor, where the pressure and temperature of the air increases. Bleed air from the ozone converter flows through the precooler heat exchanger to decrease the bleed air temperature before to be sucked by the compressor. Downstream of the compressor, bleed air goes to the main heat exchanger and the temperature control valve. The higher pressure of the bleed air causes, the compressor check valve to move in the closed position. As the direct bleed mode, the air flows in the main heat exchanger where the air temperature decreases, and goes to IGGS. The temperature control valve is used to adjust the temperature at required value.



ON GROUND, CSAS IN STANDBY MODE:

- CSAS ELECTRICALLY ENERGIZED
- CSAS INLET VALVE CLOSED

CSAS PRESENTATION



CSAS PRESENTATION

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CONDITIONED SERVICE AIR SYSTEM (CSAS) DESCRIPTION (2/3)

CSAS Description/Interfaces

The Air Conditioning System (ACS) application is hosted in two CPIOMs and provides the communication between A/C systems and the Air Supply Control Units (ASCUs) which are the CSAS controller. The application ensures the monitoring function of the CSAS.

There is one ASCU which ensures the control and monitoring of the CSAS LH and the other ASCU ensures the control and monitoring of the CSAS RH. Each ASCU includes two channels one is active and one is in standby. The ASCU receives the operational mode requested (standby, direct bleed mode, boosted mode). The ASCU uses data supplied by the pressure and temperature sensors to control valves and the RAO actuator to supply the IGGS with air at correct pressure and temperature.

The compressor discharge temperature sensor is used to monitor compressor overheat condition, and the outlet temperature sensor to monitor the temperature of the air sent to the IGGS. The compressor discharge temperature sensor is used by ASCU to modulate turbine valve, and outlet temperature sensor is used by ASCU to modulate the temperature control valve.

The outlet pressure sensor and the compressor inlet pressure sensor are used to adjust the pressure delivered to the IGGS. Both sensors are used by ASCU to modulate CSAS inlet valve.

The IGGS applications transmit the operational mode requested and its status to ASCUs.

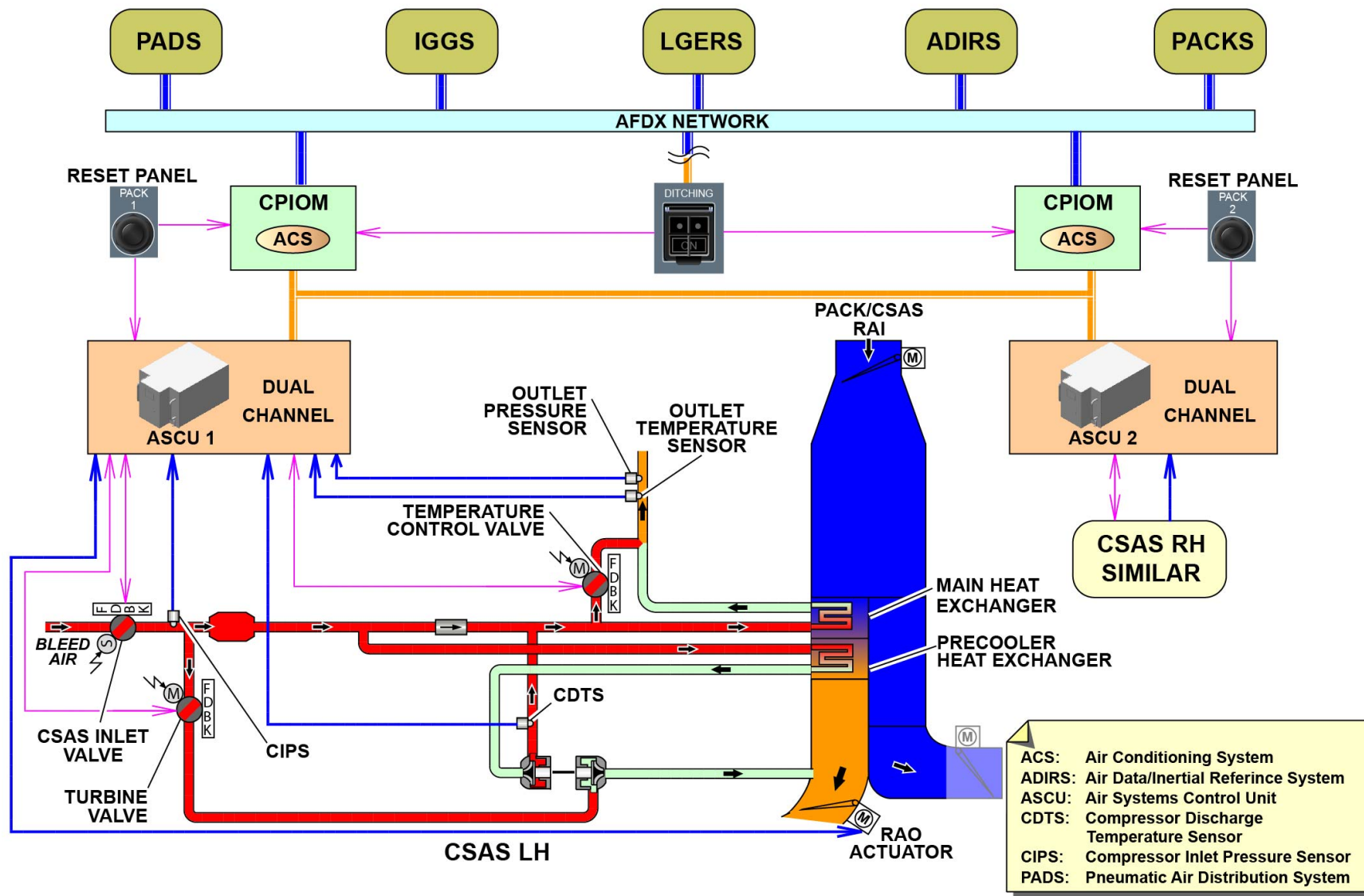
If the CSAS can not provide sufficient cooling, it requests to PACK control system to open more the PACK/CSAS RAI door.

In addition, as soon as one PACK is inoperative the CSAS also is inoperative.

As soon as Pneumatic Air Distribution System (PADS) sends the signal to open the cross bleed valve, both CSAS are inhibited. The Air Data/Inertial Reference System (ADIRS) supply to CSAS air data for heat exchange control.

The LGERS supply to CSAS the A/C ground flight status. The CSAS is in standby on ground, only a test can be performed.

If DITCHING P/BSW is selected ram air doors close and CSAS stops. PACK 1(2) RESET SWs are used to reset the ACS applications and ASCUs.



CSAS DESCRIPTION/INTERFACES

CONDITIONED SERVICE AIR SYSTEM (CSAS) DESCRIPTION (2/3)

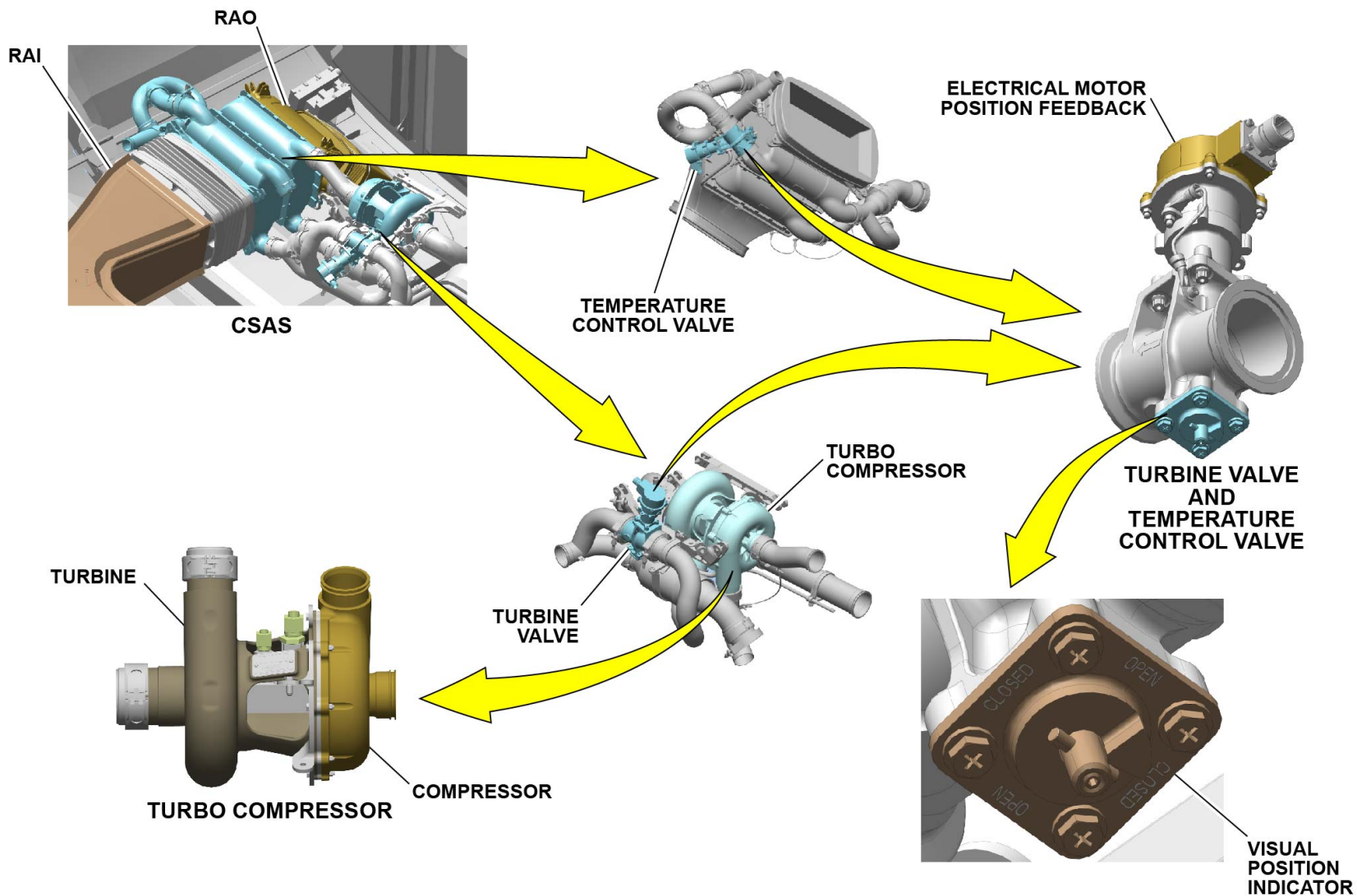
Components Description

The temperature control valve, and turbine valve, which are identical, have an electrical motor, a visual position indicator and supplies position feedback signal.

The ASCUs are dual channel with field loadable software. The ASCUs are located in the FWD cargo compartment.

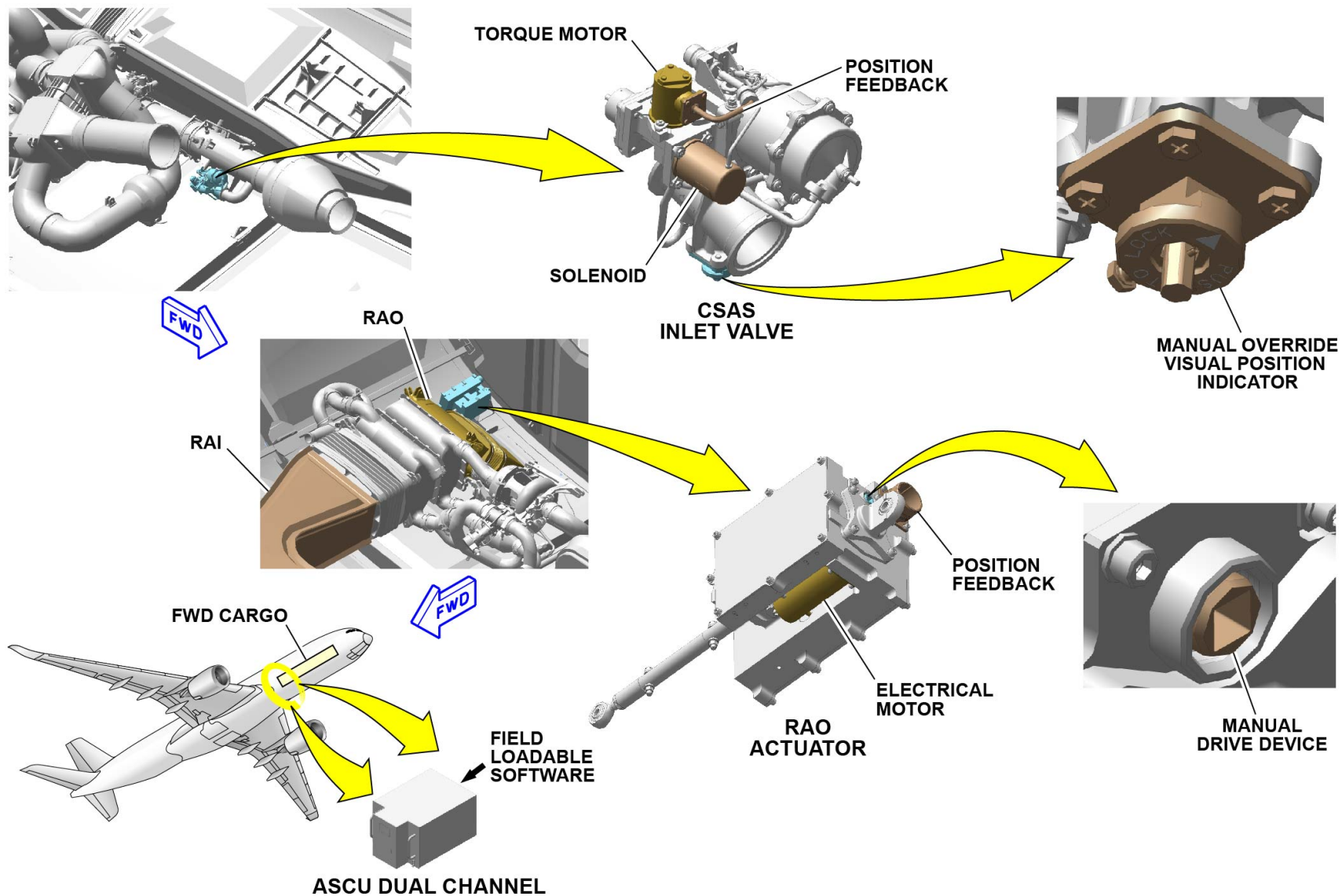
The RAO actuator used to adjust the RAO door and to supply position feedback signal, has an electrical motor. For deactivation purposes the RAO actuator has a manual drive device.

The CSAS inlet valve is electrically commanded, and pneumatically actuated. A torque motor is used to modulate valve position and a solenoid to control the shutoff function. The valve is spring loaded closed and supplies position feedback. A manual locking device/visual position indicator allows to operate manually the valve for deactivation purposes.



COMPONENTS DESCRIPTION

V2414251 - V00T0MM0 - VM21DICASS3001



COMPONENTS DESCRIPTION

V2414251 - V00T0MM0 - VM21DICSASS3001

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