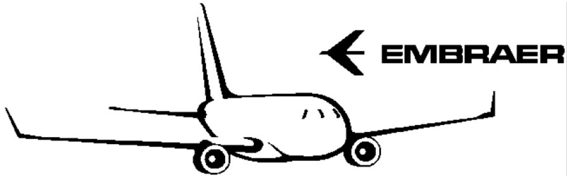

AOM VOLUME 2

EMBRAER 175 STD AND 190 STD

Statement

This manual is applicable to the EMBRAER 175 STD airplane models with CF34-8E5 engines and EMBRAER 190 STD airplane models equipped with CF34-10E5 engines, operating under EASA/JAA certification.

This revision includes EMBRAER TR 17.2 – 29 January, 2021.

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Revision Highlights

These are the highlights of Revision 3 of the Embraer 175/190 B2 Airplane Operation Manual.

The remaining items indicated on the applicable page with a revision bar contain editorial changes and/or do not have any operational impact.

Page	Comment
14.01-13	Note added regarding the cockpit seat restraint system.
14.01-33	Added a Note regarding the PEDESTAL CONTROLLER on the COCKPIT LIGHTS PANEL and changed several "KNOBS" into "CONTROLLER" due to cockpit pool changes.
14.01-34	Cockpit pool editorials.
14.01-39	Changed "SWITCH" into "BUTTON" due to introduction of cockpit pool.
14.01-40	Changed "SWITCH" into "BUTTON" due to introduction of cockpit pool.
14.01-42	Changed "SWITCH" into "BUTTON" due to introduction of cockpit pool.
14.01-63	For the emergency and abnormal checklists there are no closed loops available.
14.02-2	Changed APU bleed button to "BLEED APU BUTTON".
14.02-11	Changed the Fan Air Modulating Valve (FAMV) position applicable to the E190.
14.05-10	Changed white to cyan "IN USE" indication.
14.05-16	Updated DC POWER schematic overview with correct BATT 1 & 2 VDC.
14.05-30	Changed nomenclature of items powered by DC ESS BUS 3.
14.06-14	Added discrepancy between E175 and E190 engine fuel system operations.
14.06-14	The Variable geometry actuator is applicable to the E175.
14.06-15	Variable stator vanes are applicable to the E190.
14.06-31	Editorial change EICAS CAUTION message "ENG REF A-I DISAG" according to cockpit pool.
14.06-32	Editorial change EICAS STATUS message "ENG TDS REF A-I ENG" according to cockpit pool.
14.07-1	Changed "FIRE PROTECTION CONTROL PANEL" to "FIRE EXTINGUISHER PANEL" according to cockpit pool.
14.07-2	Editorial changes according to cockpit pool.
14.08-4	PITCH TRM SWITCH will be automatically deactivated if only half of the switch is actuated for more than 7s (E190) or 5s (E175).

(continued)

Page	Comment
14.08-4	Added NOTE: Operation of the switch while the autopilot is engaged causes the autopilot to disengage.
14.08-4	Added explanation related to the AP/TRIM DISC Button.
14.08-4	Updated according to the cockpit pool.
14.08-4	Added description of the PITCH TRIM DISC function in the AP/TRIM DISC Button when PITCH TRIM SYS CUTOUT BUTTON is pushed in.
14.08-7	Editorial cockpit pool changes and added additional information regarding the PITCH TRIM SYS 1 and 2 CUTOUT BUTTON (GUARDED).
14.08-18	Changed information related to HS-ACE to clarify how the channels operate.
14.08-31	Changed description of the Horizontal Stabilizer Control System to clarify the architecture of the system.
14.08-31	Changed Manual and Autopilot Trim description to detail the behavior of the system.
14.08-33	Changed Manual and Autopilot Trim description to detail the behavior of the system.
14.08-34	The autopilot sends commands to the HS-ACE that controls an electrical servo motor coupled to the HSA when the autopilot is engaged.
14.08-34	In case of an electrical failure, followed by RAT deployment, the trim function will operate at low rate, for either manual trim or autopilot trim.
14.08-47	Editorial.
14.08-48	Editorial.
14.08-49	Editorial.
14.09-9	ADI INDICATIONS image layout corrected.
14.09-44	Cockpit pool editorials.
14.09-60	Changed the description from ADS 5 to ADS FCS, which is a dedicated ADS to provide information to the flight control system.
14.09-76	Added additional information on the DVDR unit FDR storage capability.
14.09-77	Added additional information on the DVDR unit FDR storage capability.
14.09-86	Added printer scenarios.

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Page	Comment
14.09-90	Changed drawing to correct the schematic of the GPS and the reference to the GPS altitude.
14.09-112	Editorial change: page moved to new section.
14.09-185	Added EICAS ADVISORY message "LPV NOT AVAIL".
14.09-185	Added EICAS ADVISORY message "RNP AR NOT AVAIL".
14.10-2	Cockpit Pool editorials.
14.11-2	Cockpit Pool editorials.
14.11-3	Cockpit Pool editorials.
14.12-15	Added additional heating mode conditions for the two TAT probes to be heated.
14.15-2	Cockpit pool editorials.
14.15-25	Deleted "ADS-B FAIL" EICAS Message (Pre-mod Load27.1).
14.15-25	"DATALINK 1 FAIL" and FDR AFT (FWD) FAIL are inhibited through K3 and K5.
14.15-25	"FLT CTRL ADS FAIL" inhibited through K2b, K3, K4, and K5.
14.15-25	Added "LPV NOT AVAIL" EICAS message, inhibited through K3, K5.
14.15-25	Added "RNP AR NOT AVAIL" and "RNP AR <0.3 NOT AVAIL", inhibited through K3, K5.

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REVISIONS RECORD

Revision Number	Revision Date
0	07-Nov-2019
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2	05-Nov-2020
3	18-Feb-2021

14.01.01 GENERAL INFORMATION

This section provides a general overview of the airplane. More details of the airplanes and its systems are given within each section of this manual.

14.01.05 AIRPLANE BASIC DATA

The airplane is a low wing, conventional tail, pressurized airplane powered by two high by-pass ratio wing-mounted turbofan engines. The tricycle landing gear is fully retractable with dual wheels/tires for each strut.

A glass panel cockpit is installed with a highly integrated on-board avionic system enabling the pilots to better monitor the airplane's operation.

For detailed information on each system, refer to the appropriate section of this manual.

The passenger configuration has four seats abreast (two to each side of the aisle) with a front and aft galley, a front and rear toilet and 88 (E175) or 100 (E190) passenger seats.

The cockpit instruments and avionics are all certified and placed such that they are readily visible to flight deck crew and have sufficient redundancy to allow operations in IMC, instrument approach and landings down to CAT IIIA limits, RNP and RVSM operations. Communication equipment is installed allowing normal and emergency communication.

Quick donning oxygen masks are installed for both pilots and one observer allowing radio and interphone communication when donned. Cabin pressurization is indicated on EICAS and an EICAS warning "CABIN ALTITUDE HI" is presented in case of loss of pressurization. The flight crew oxygen system allows for an emergency descent from 41000 ft to 10000 ft in 22 minutes and continued cruise at 10000 ft for 98 minutes. An automatic drop down oxygen mask system is installed for all passengers supplying oxygen for 12 minutes during descent from 41000 ft to 10000 ft, including an intermediate level off segment at 18000 ft to clear possible terrain. Portable PBEs, protecting eyes, nose and mouth, are installed in the headrest of each cabin crew seat and one in the cockpit, supplying oxygen for at least 15 minutes and allowing communication via a phonic membrane. Refer to section 11 and 14.

Four portable halon fire extinguishers are installed in the cabin and one in the cockpit. A crash axe is installed in the cockpit. Refer to FSIM 2.4.

The lavatories are equipped with smoke detectors and fire extinguishers for the waste bins. Refer to Section 14.07.25.

Flashlights are installed at each cabin crew station and two in the cockpit. Refer to FSIM 8.11.

Two ELTs capable of transmitting simultaneously on 121.5 MHz and 406 MHz are installed: one fixed automatic and one portable survival ELT. Refer to FSIM 8.11.

All aircraft are equipped with TCAS and software version 7.1.

To detect and analyze adverse weather conditions and ground mapping a weather radar system is installed. Refer to section 14.09.20.

An Enhanced Ground Proximity Warning System (EGPWS) with forward looking terrain avoidance function is installed that warns the flight crew when the aircraft is in close proximity of the ground, or in case of excessive descent rates, excessive terrain closure rates, excessive altitude loss after takeoff or go-around, incorrect landing configuration and excessive deviations below ILS glide slope among other functions. Section 14.15.30 refers.

All aircraft are equipped with two digital solid state Honeywell or Universal combined flight Data and Cockpit Voice Recorders (DVDR) with 25 hours of flight data and 120 minutes of audio information capability. The Universal type also records datalink information. All recorders can at least record time, altitude, airspeed, normal acceleration and heading. The DVDRs are equipped with an automatically activated Underwater Locator Beacon (ULB), transmitting at 37.5 kHz for a minimum of 90 days. Section 14.09.15 refers.

Passenger seats are provided with seat belts. All flight crew and cabin crew seats are provided with a safety harness restraint system. Cabin crew seats are installed near all floor level exits. Refer to section 14.01.10 and FSIM 8.7.

The cargo holds are equipped with a smoke detection and warning system. Cargo fires can be extinguished and suppressed by means of a halon fire extinguishing system. Section 14.07.20 refers. Cargo is restrained by cargo separation nets or can be tied-down to the floor. Refer to Section 8-70.

The cockpit can be closed with a reinforced ballistic and intrusion resistant door, marked with a CREW ONLY sticker, which can be locked and unlocked with an electronic lock from each pilot station. The entrance area of the door can be monitored by the flight crew by means of cameras and a peephole in the door. Cabin crew may notify the flight crew to unlock the door by using the access panel in the cockpit entrance area. Section 14.01.60 and FSIM 4.1 refer.

Photoluminescent strips to mark the escape path and exits are installed along the passenger cabin floor. Refer to Section 14.01.40.

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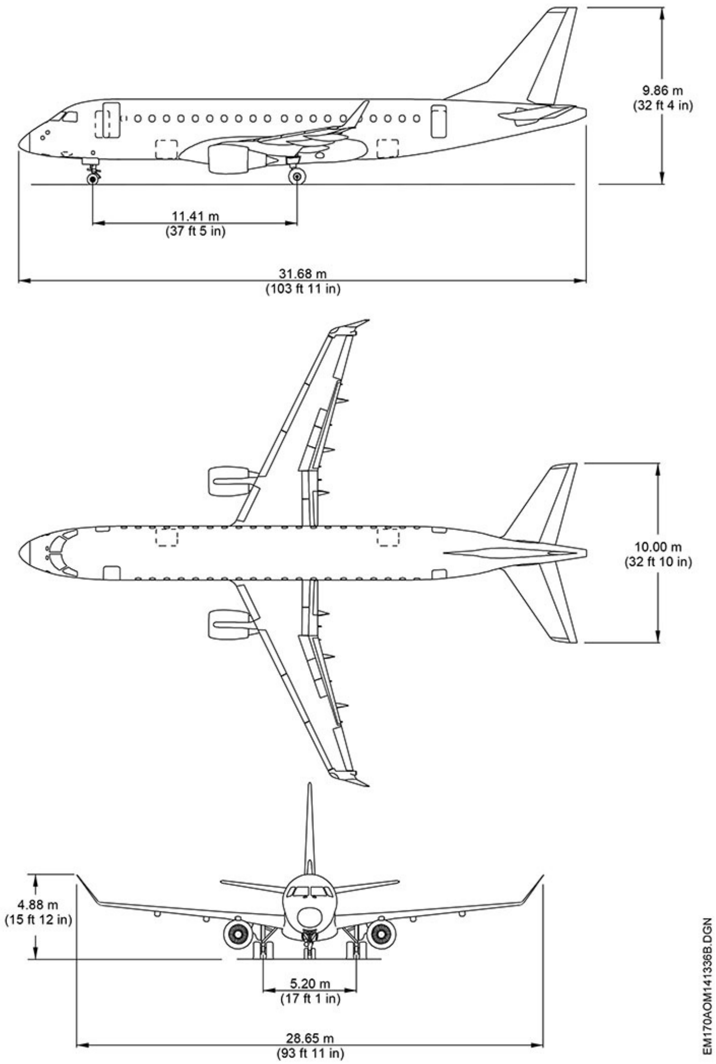
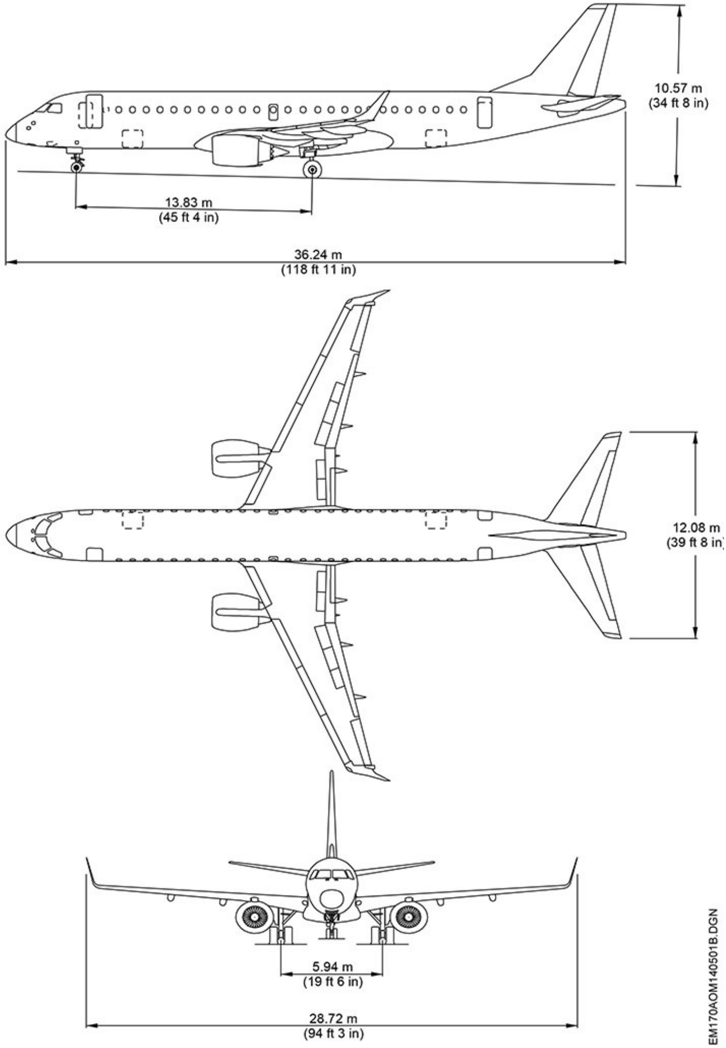


THREE VIEW DRAWING

EXTERNAL DIMENSIONS E190



THREE VIEW DRAWING

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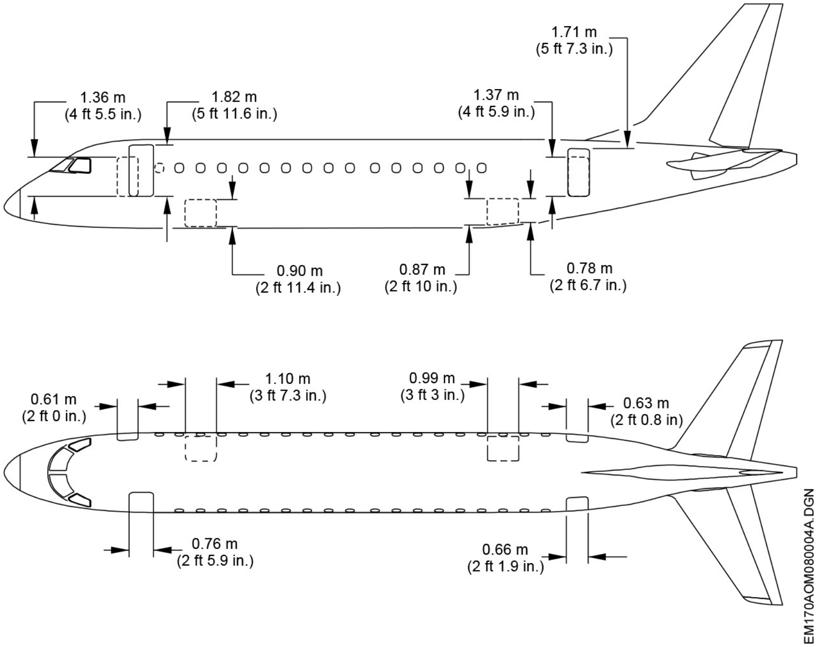

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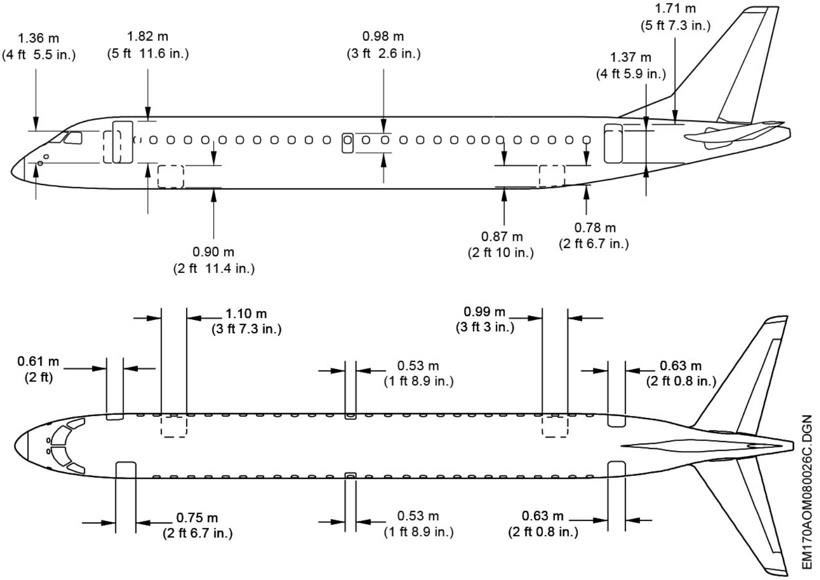

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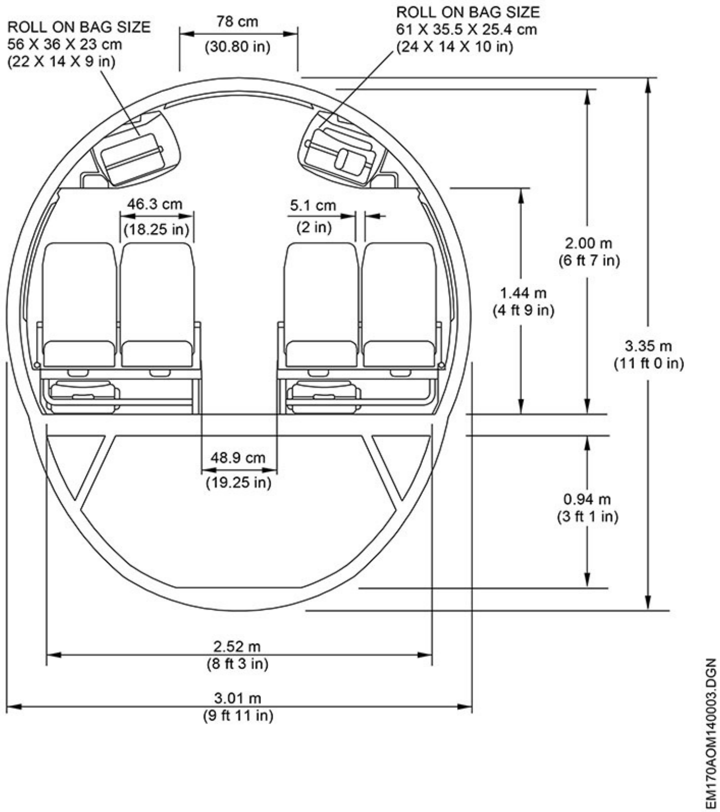
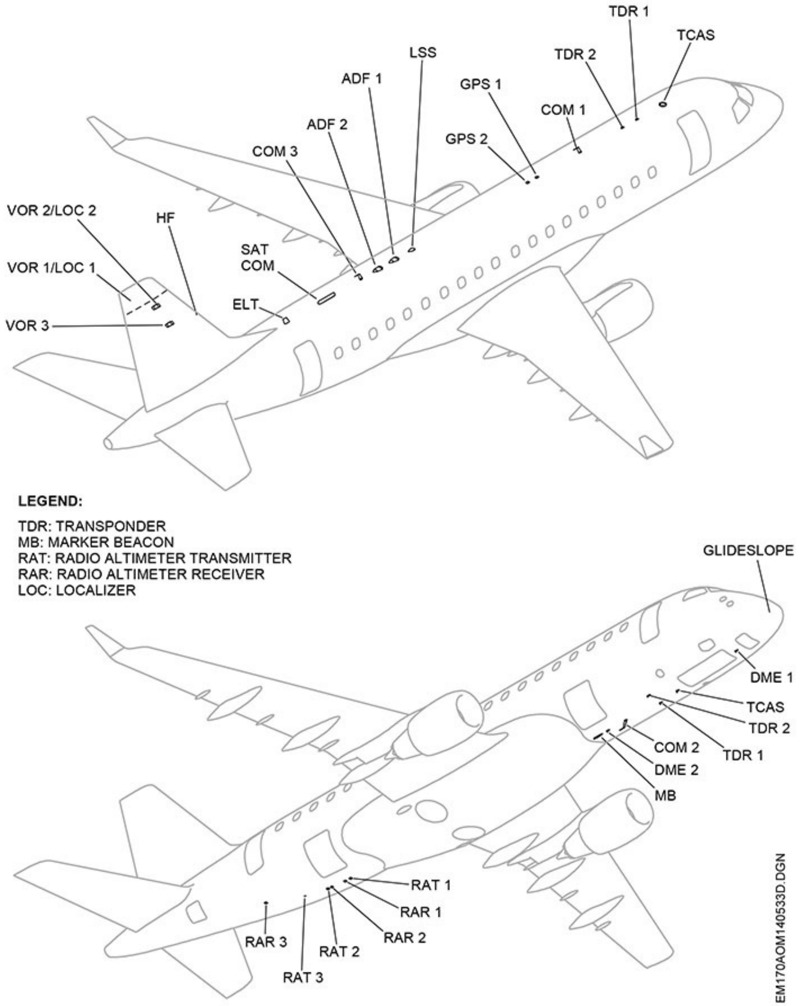


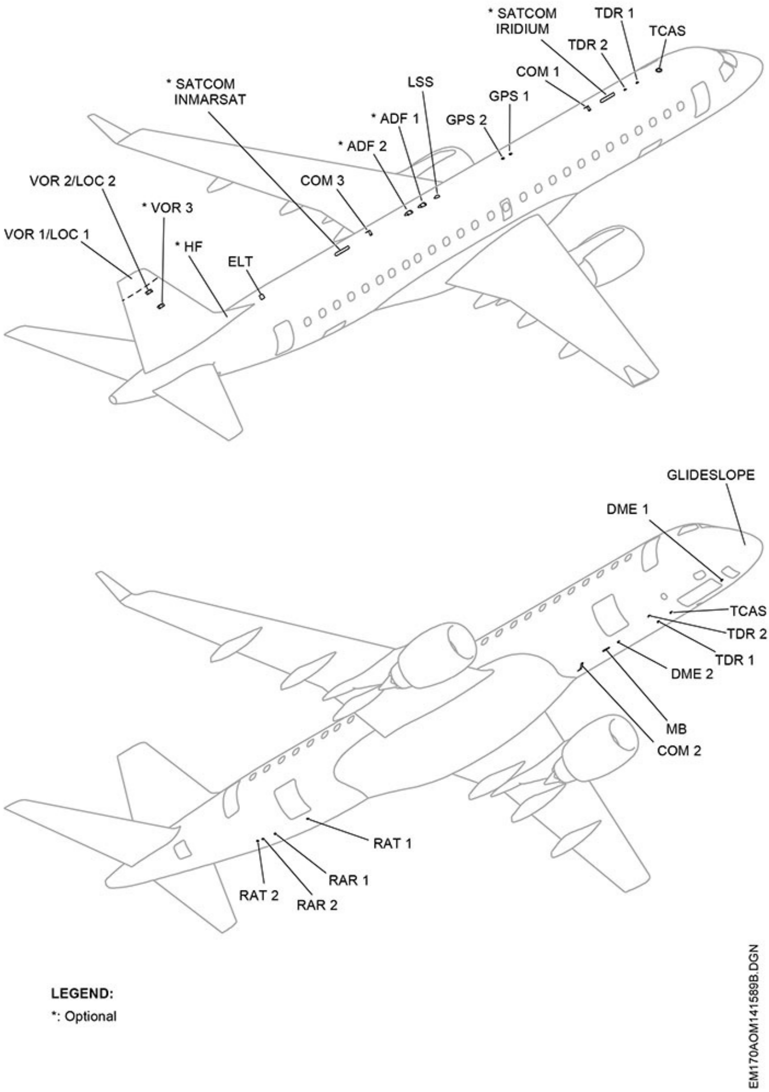
STANDARD CABIN

AIRPLANE ANTENNAS E175



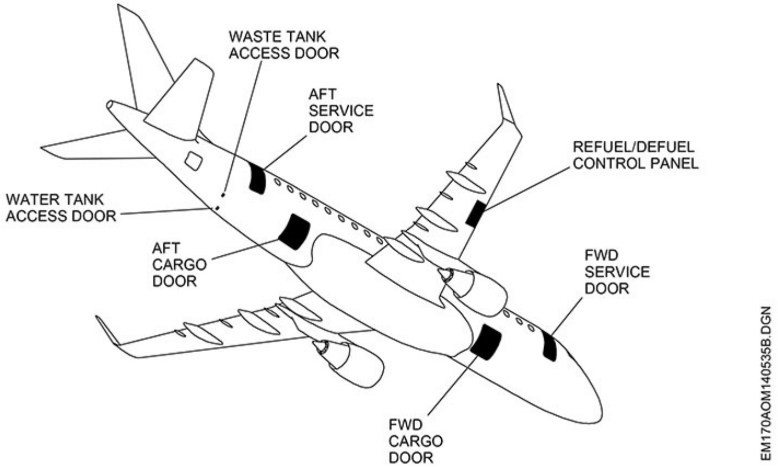
AIRPLANE ANTENNAS

AIRPLANE ANTENNAS E190



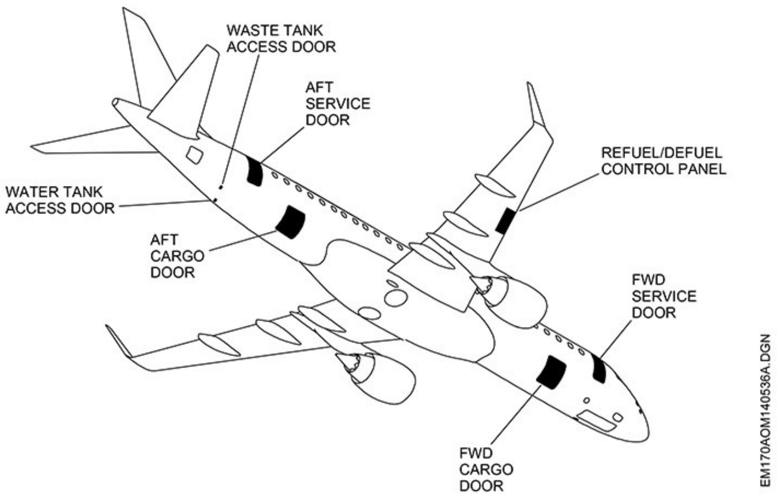
AIRPLANE ANTENNAS

MAIN SERVICE POINTS E175



MAIN SERVICE POINTS

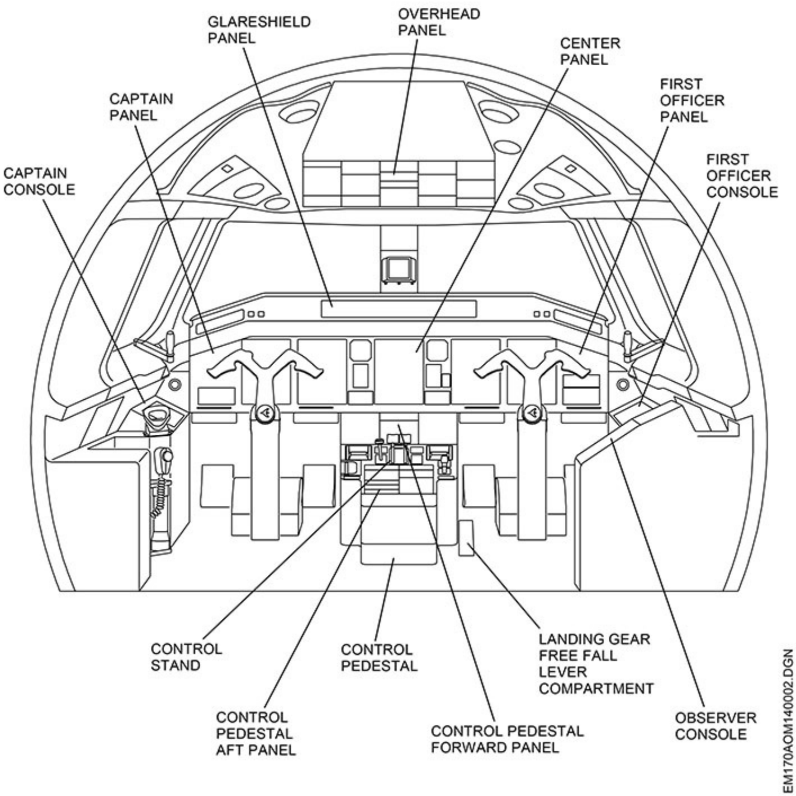
MAIN SERVICE POINTS E190



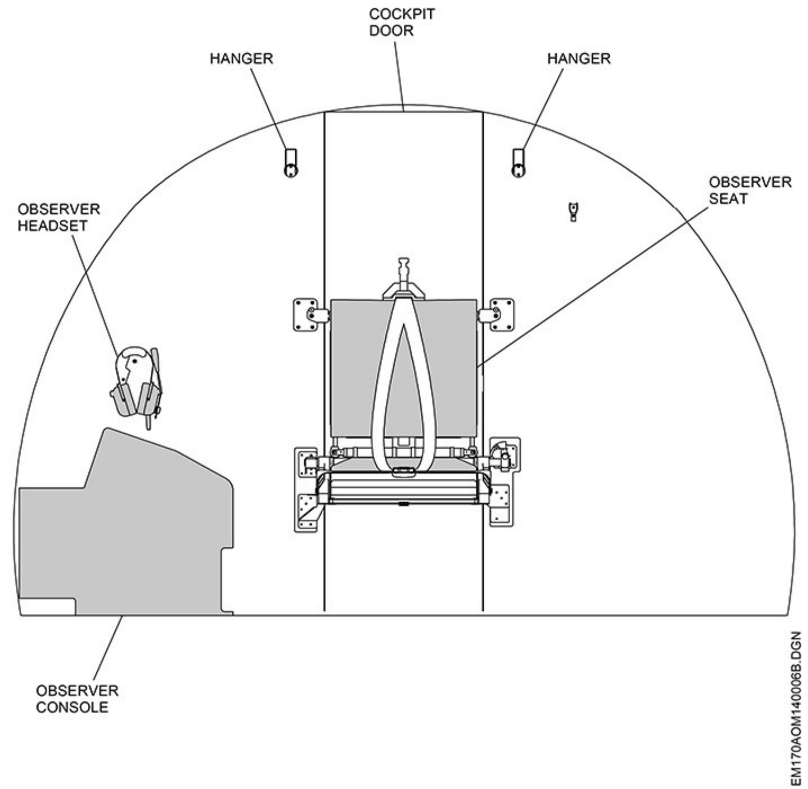
MAIN SERVICE POINTS

14.01.10 COCKPIT GENERAL

COCKPIT ARRANGEMENT



COCKPIT PARTITION



COCKPIT PARTITION

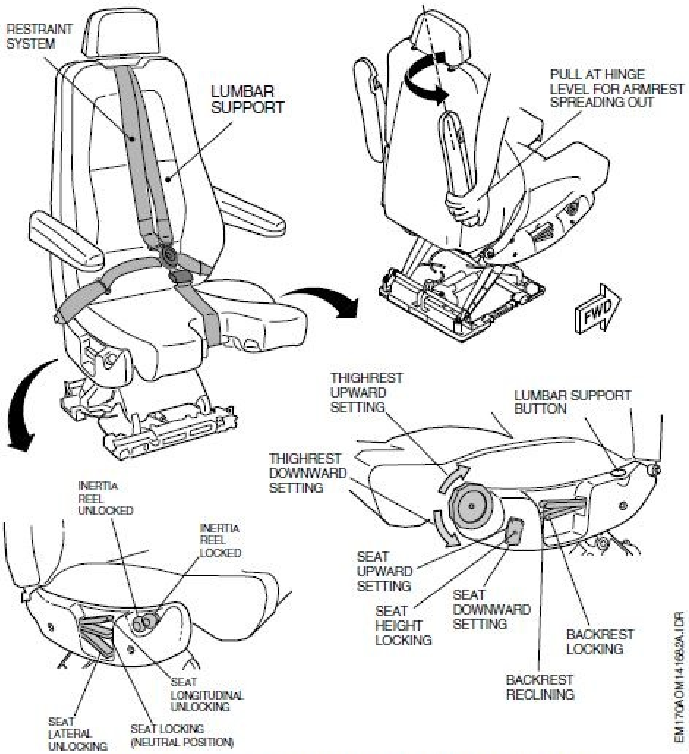
COCKPIT SEATS

Pilot seats are fixed to slide rails that permit fore and aft adjustments. When the seats are in their aft most position, a lateral movement is also available in order to ease crew access to the seat.

Manual adjustments of pilot seats are possible for vertical, lateral, aft and forward movements. A crank handle is located under the seat and allows vertical adjustments by attaching it to the plug at the aft lower part of the seat. The manual control handle allows aft and forward adjustments. Lateral movement is provided actuating both lateral locking pins.

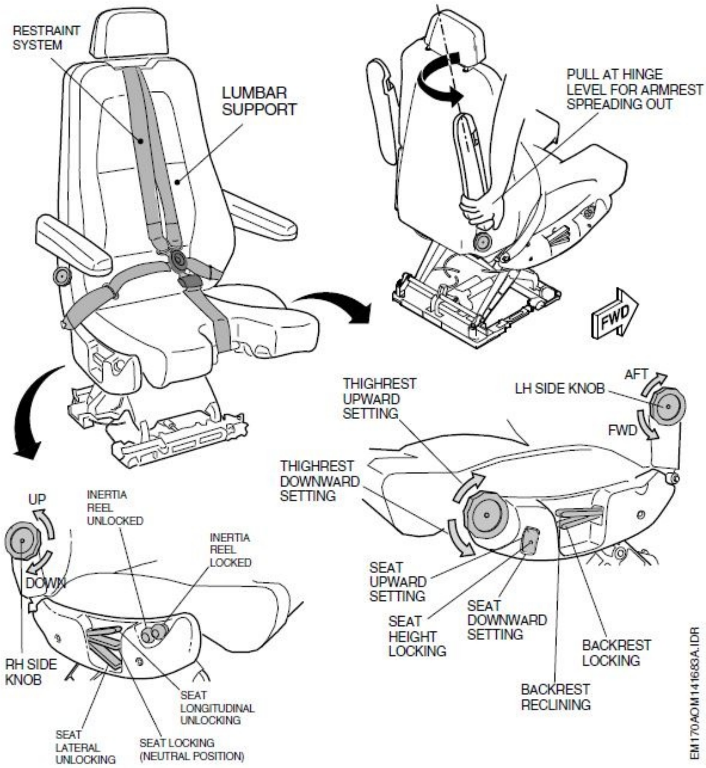
The five-points restraint system is equipped with a rotary buckle and an inertial reel to improve pilots comfort. The locking control is manual and simple to use.

NOTE: When the shoulder straps are released unrestrained, the mechanism can lock.



COCKPIT SEATS WITH PNEUMATIC LUMBAR SUPPORT

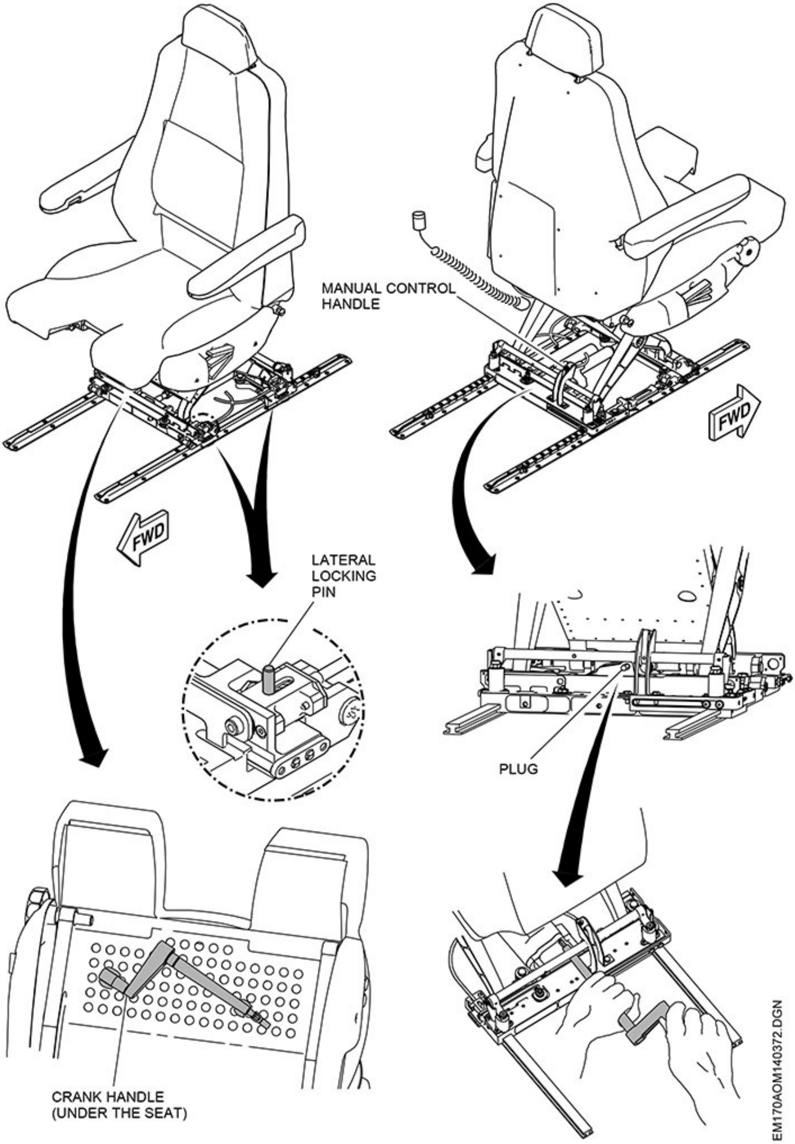
The pneumatic lumbar support has a foam bag with air inside. Using the dedicated button on the lateral of the seat, it is possible to adjust in different positions.



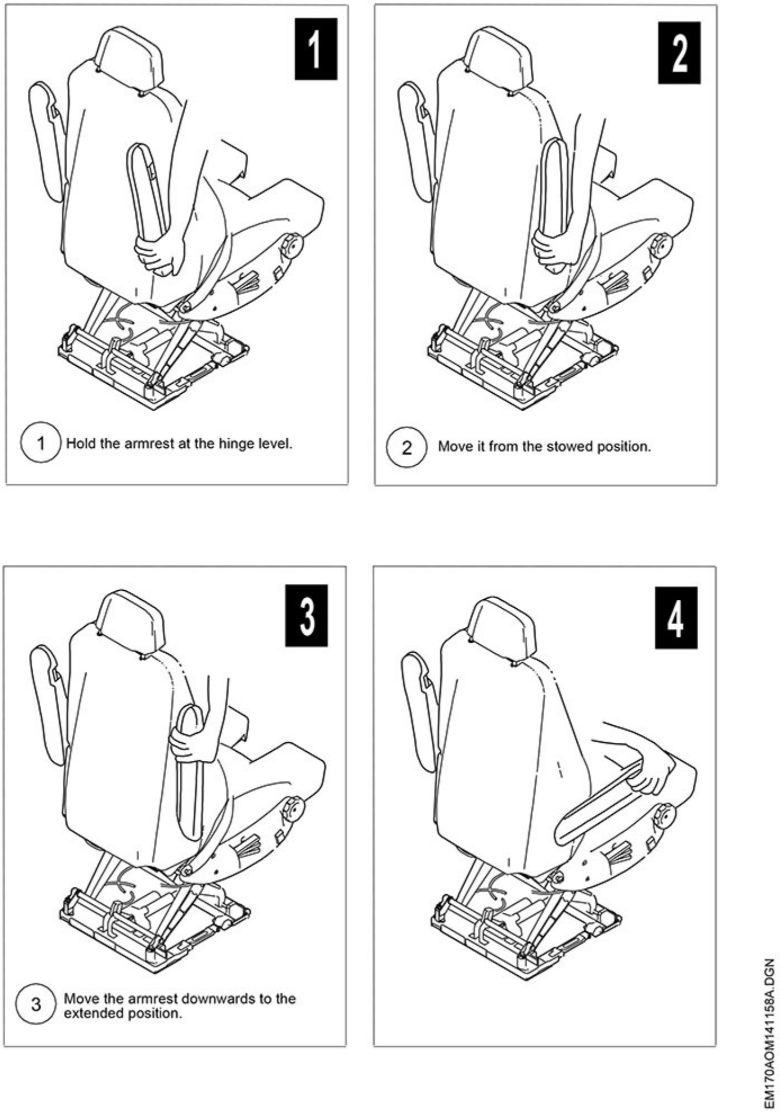
COCKPIT SEATS WITH MECHANICAL LUMBAR SUPPORT

The mechanical lumbar support has adjustments in two directions: vertical and longitudinal. A dedicated knob performs each adjustment. The RH side knob is used for vertical adjustment and the LH side knob is used for longitudinal adjustment.

Vertical adjustment requires less force when the lumbar support is flattened first.



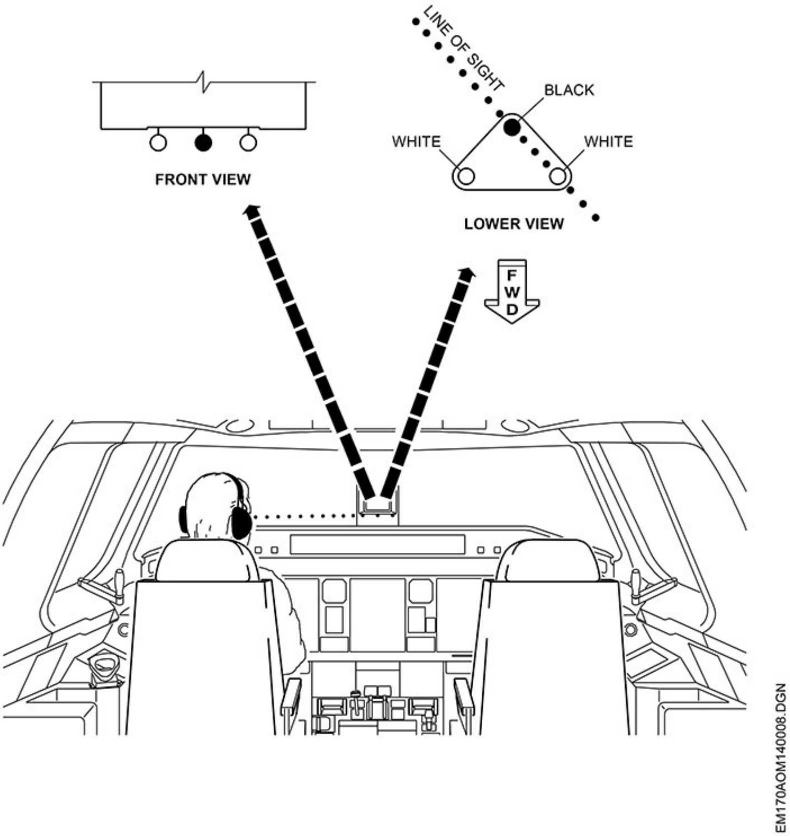
COCKPIT SEATS MANUAL ADJUSTMENTS



COCKPIT SEAT ARMREST OPERATION

PILOT SEAT ADJUSTMENT

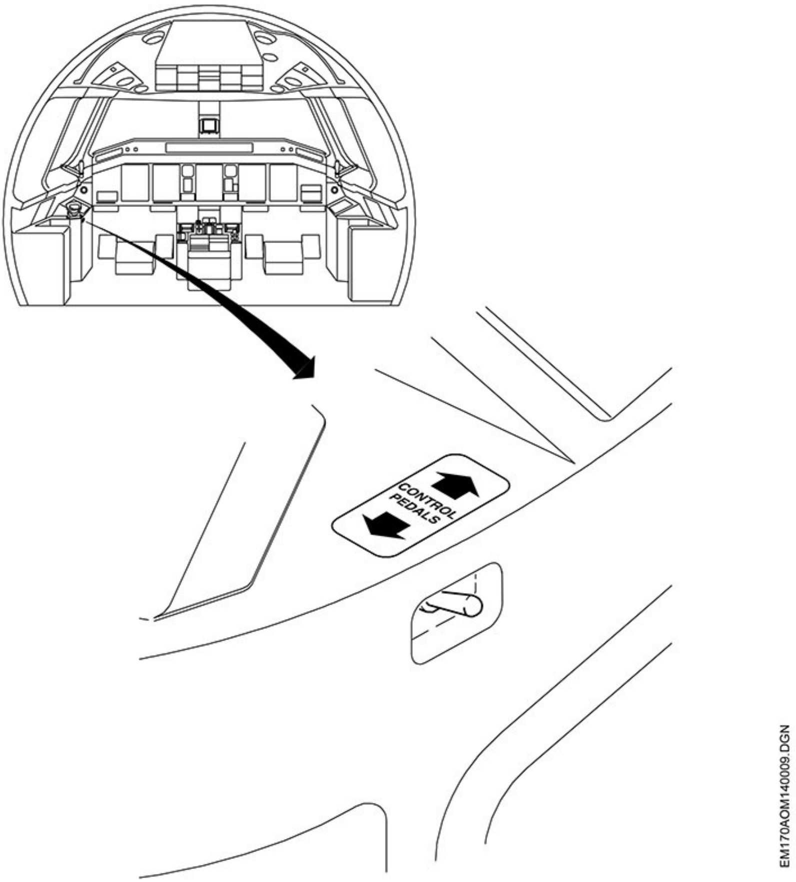
The seat should be adjusted up or down until the pilot's line of sight reaches the same horizontal plane of a sight device made up of two white spheres and a black sphere. Then, move the seat forward or aft until the opposite white sphere is aligned with the black one.



PILOT SEAT ADJUSTMENT

PEDAL ADJUSTMENT

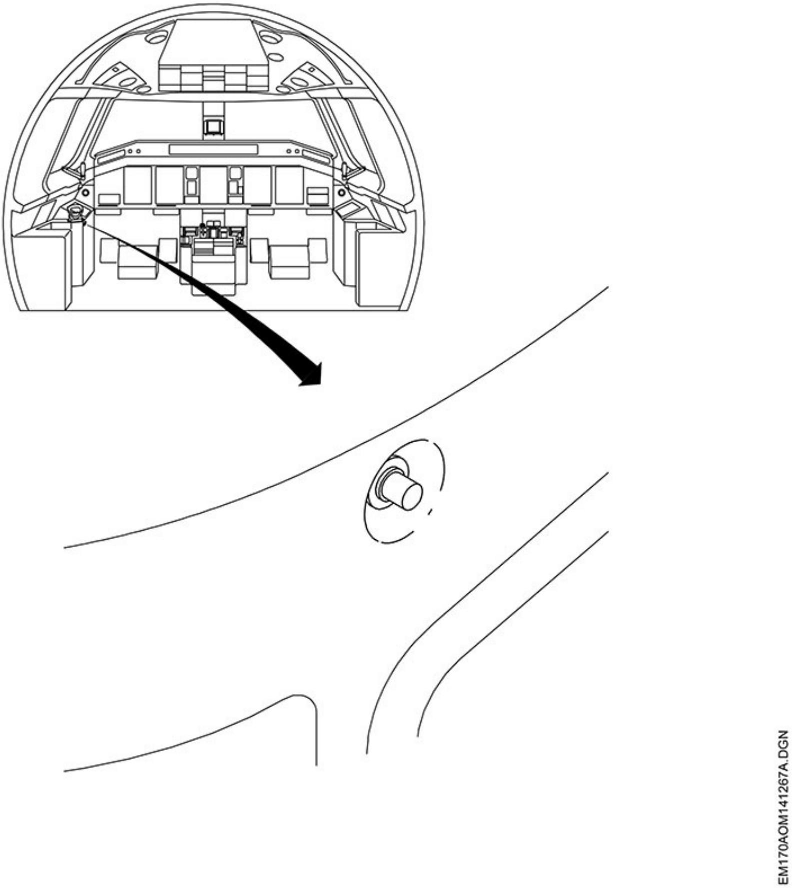
Spring-loaded switches installed on the captain and first officer’s panels allow rudder pedal adjustments performed by electric actuators. When operating the switch, the actuator moves the pedals forward or aft, to assure pilot comfort and a full rudder throw from the adjusted seat position. For rudder pedal manual adjustment call maintenance.



PEDAL ADJUSTMENT

RAMP HORN

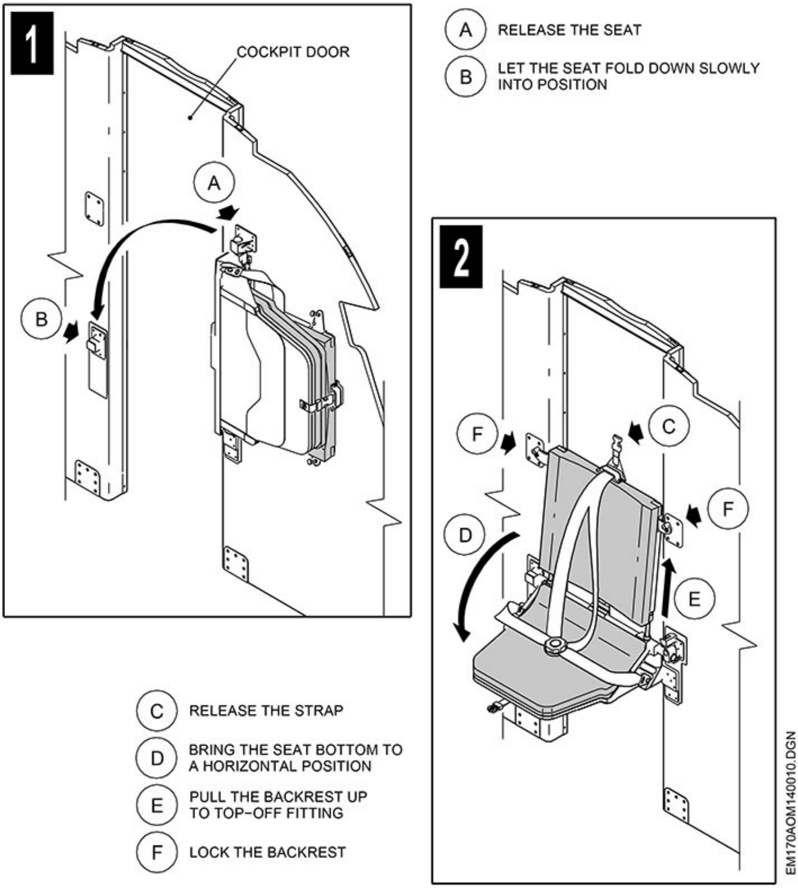
The ramp horn buttons installed on the captain's and first officer's consoles allow the cockpit crew to call the ground personnel attention. While the button is pressed, a continuous horn sounds.



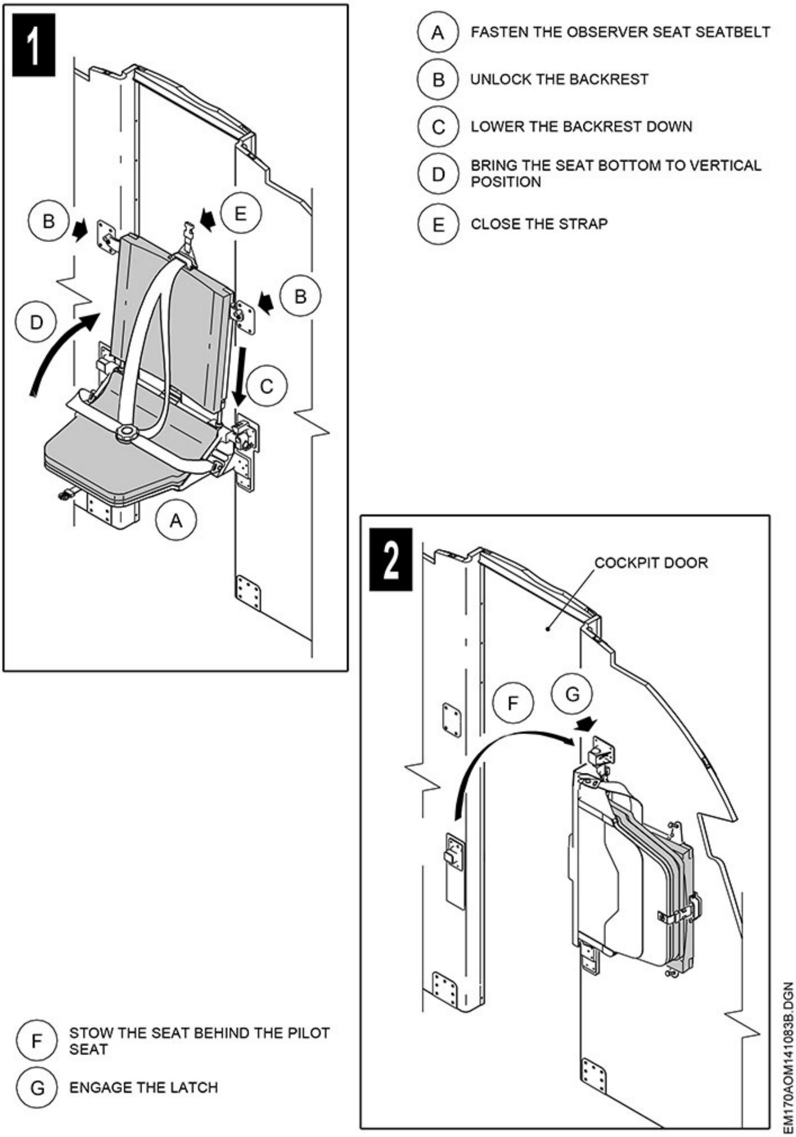
RAMP HORN

OBSERVER SEAT

The observer seat is located aft of and between the captain’s and first officer’s seats. When in use, it’s positioned in front of the cockpit door. The seat can be stowed by folding and rotating it away from the door area against the left side of the cockpit partition behind the captain’s seat. The cockpit door can be opened or closed when the observer seat is either stowed or in use.



OBSERVER SEAT – UNFOLD PROCEDURE



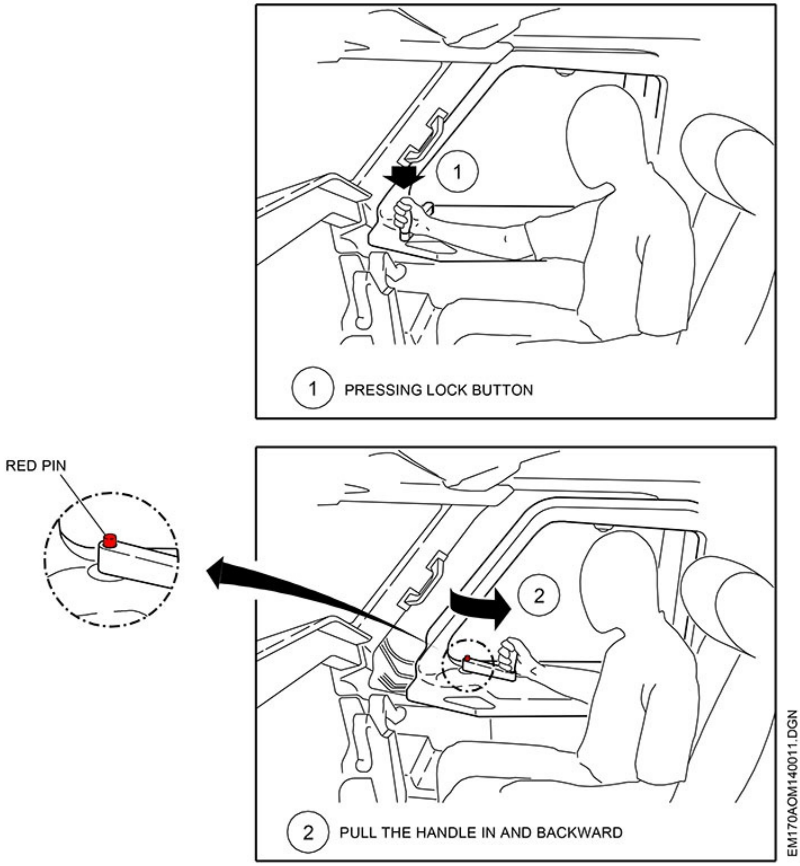
OBSERVER SEAT - FOLD PROCEDURE

COCKPIT WINDOW

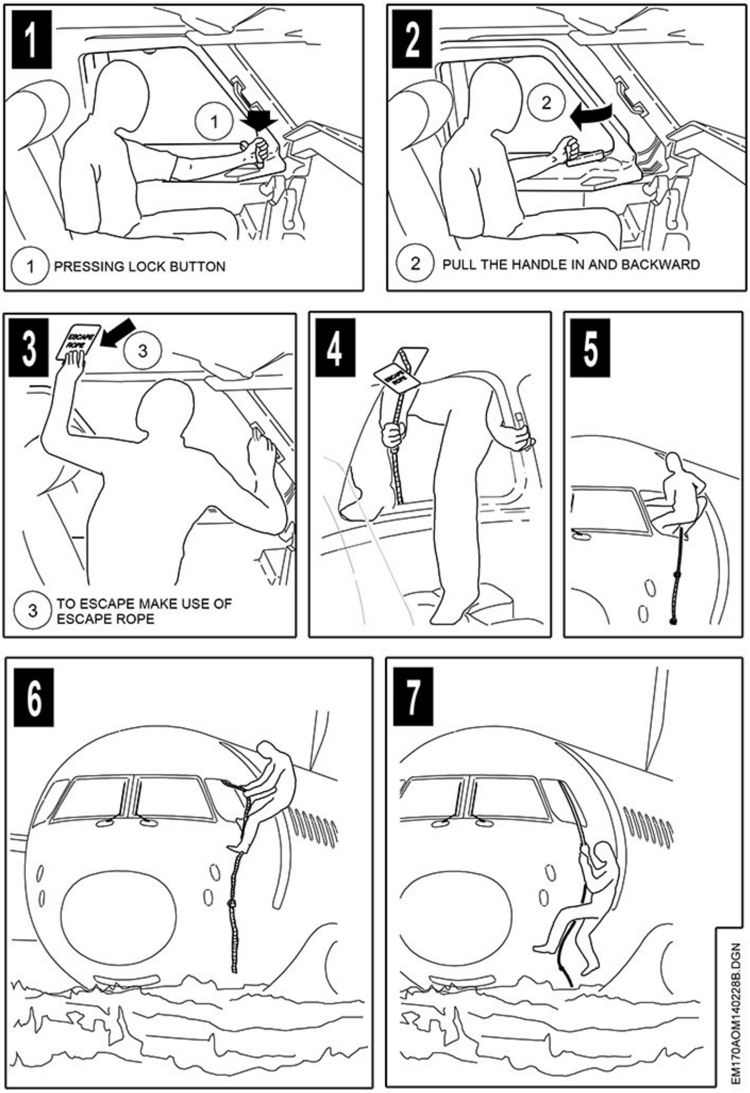
Cockpit windows may be opened in case of loss of visibility through the windshield or for cockpit emergency evacuation on the ground.

A pin protrudes near the opening handle when the window is not properly locked in the closed position.

NORMAL OPENING



EMERGENCY OPENING



COCKPIT WINDOW EMERGENCY EXIT

14.01.15 COCKPIT PHILOSOPHY

The EMBRAER 190 flight deck is designed to:

- Provides the necessary means to accomplish the required tasks.
- Provide acceptable and reasonable workloads.
- Minimize pilot errors and its consequences.
- Facilitate training with the commonality among the E-jets Family.
- Provide optimized ergonomics aimed at safety, ease of operation, control and comfort requirements.

Both pilots can access all essential information and necessary controls for safe flying and landing. Control of the airplane systems is done via the overhead panel.

Some knobs on the overhead panel have detent protection and must be pulled out to allow the knob rotation. This protection prevents inadvertent knob rotation and is indicated with a detent mark between knob positions. Knob stationary positions are marked with a white rectangle, and knob momentary positions are marked with a white triangle. To assure proper signal transmission when using the selector knobs that have momentary positions, hold the knob for at least two seconds at the positions before releasing it.

System failures are primarily monitored via EICAS message. The CCD and synoptics are included as an aid to the pilot monitoring systems status.

Critical systems give total authority to the pilot by employing intuitive procedures for maximum airplane performance with minimum workload. Cockpit design facilitates simple tasks as much as possible, thus leading to increased control of situation and systems. Automation is used only to improve the task accomplishment, complementing but not substituting for the crew.

DARK AND QUIET COCKPIT

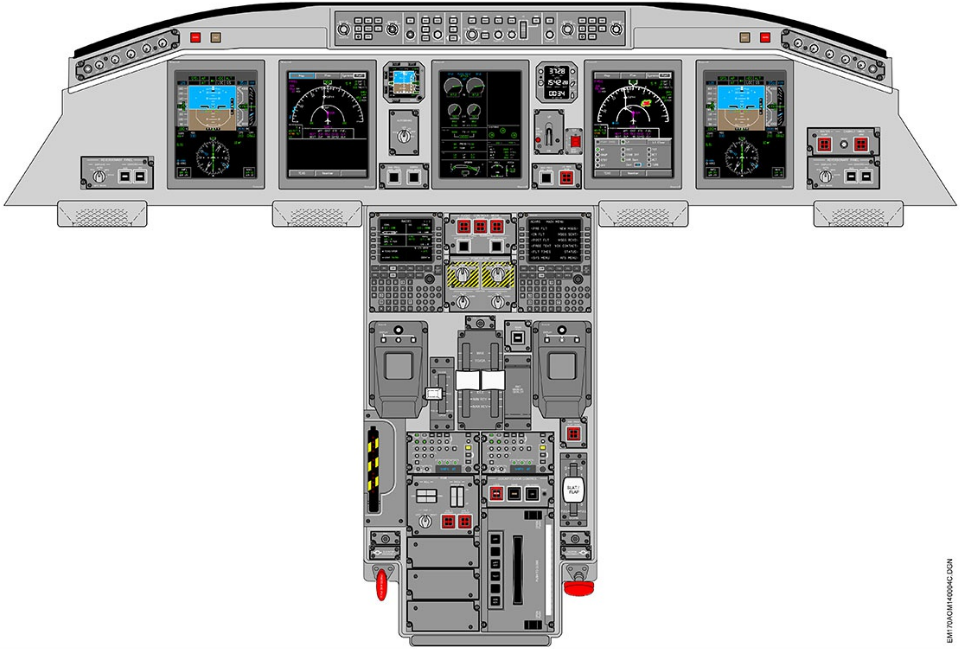
The concept used to design and operate the airplane was based on the assumption that while in flight, all systems are normal when:

- Overhead, main, glareshield and control pedestal panels have no lights on.
- No aural warnings are being issued.
- The selector knobs are positioned at twelve o’clock.

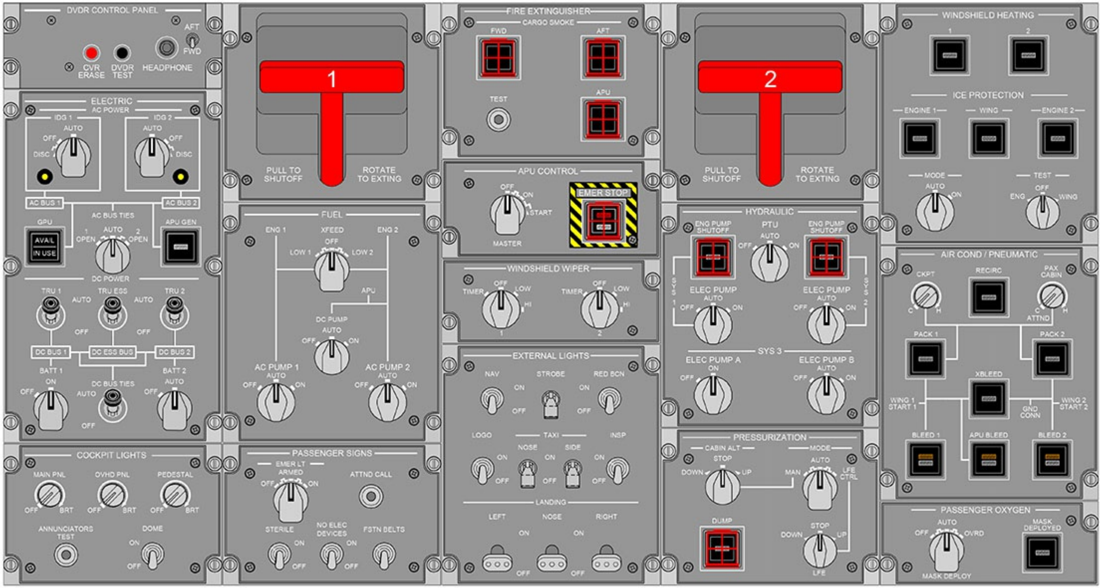
A white striped bar illuminates on any button to indicate that it is not in its normal position.

14.01.20 INSTRUMENT PANELS

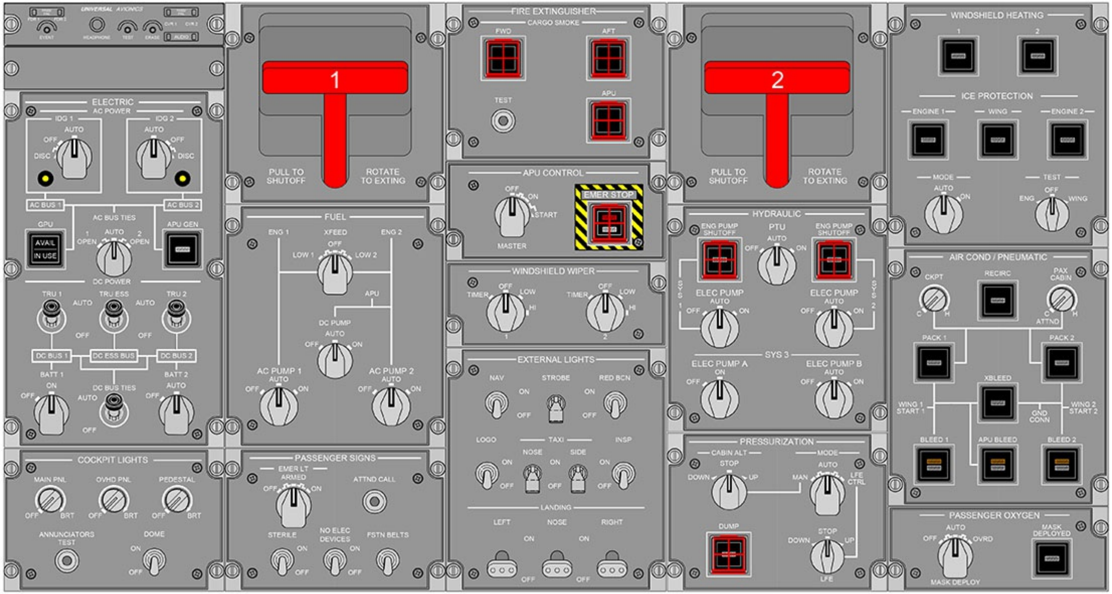
MAIN/GLARESHIELD/CONTROL PEDESTAL PANELS



OVERHEAD PANEL (HONEYWELL DVDR)



OVERHEAD PANEL (UNIVERSAL DVDR)

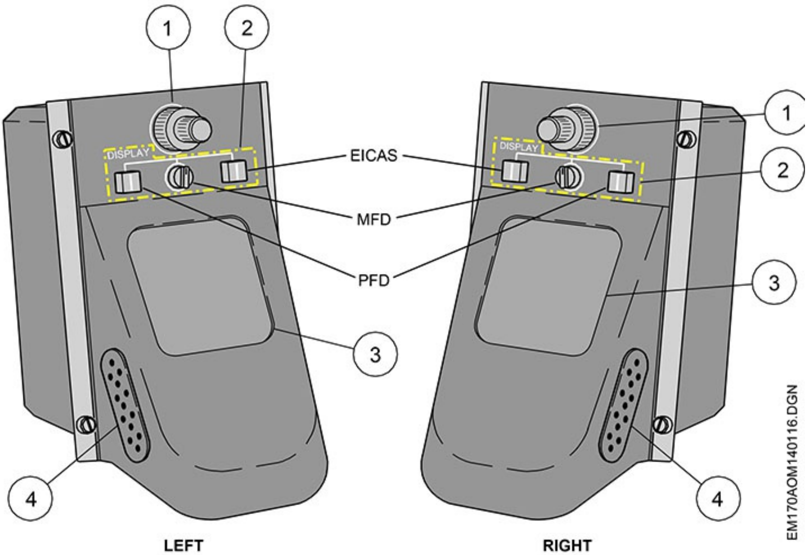


EM170AOM141186A DGN

14.01.22 CONTROLS AND INDICATIONS

AIRPLANE CONTROLS AND INDICATIONS

CURSOR CONTROL DEVICE (CCD)



CURSOR CONTROL DEVICE

1 – TUNING CONTROLLER

- Outer and inner controller select value or mode in the data field enclosed by the cursor.

2 – FORMAT LOCATION BUTTONS

- Places cursor on associated display (PFD, MFD or EICAS).

3 – TOUCH PAD

- Used to move cursor.

4 – ENTER KEYS

- Used to select soft keys

MULTI FUNCTION DISPLAY (MFD)

MULTI FUNCTION DISPLAY

1 – SOFT KEYS

- Selected through the CCD cursor and enter key.

2 – MENU CONTROLS

- Consist of checkboxes that can be selected and deselected for each function by using the CCD cursor and enter key. Square checkboxes are mutually selectable, while circle checkboxes are exclusively selectable.

3 – EXIT KEY

- Allows quick exit of each MFD soft key’s respective menu.

FLIGHT STATUS INFORMATION

Flight number, flight time, total air temperature (TAT), static air temperature (SAT) and gross weight are displayed on the synoptic status page. It can be selected by flight crew on either MFDs.

1 – FLIGHT

- Displays airplane flight abbreviation, number and time.

2 – STATIC AIR TEMPERATURE (SAT)

- Displays static air temperature – information obtained from ADS/ADA.

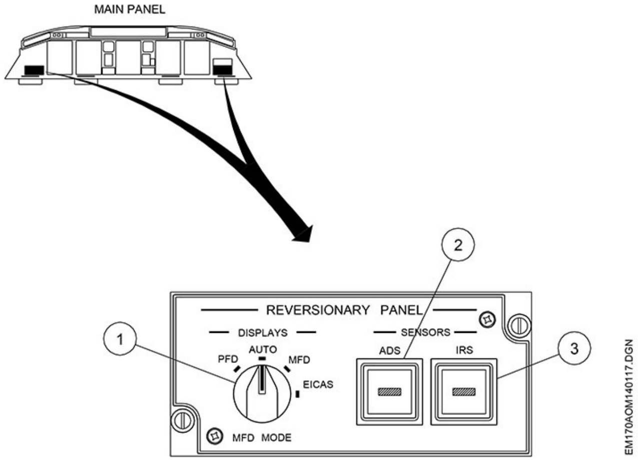
3 – GROSS WEIGHT

- Displays airplane gross weight – information obtained from FMS.

4 – TOTAL AIR TEMPERATURE (TAT)

- Displays total air temperature – information obtained from ADS/ADA.

REVERSIONARY PANEL



1 – DISPLAYS MFD MODE KNOB

PFD: display PFD information in the associated display unit.

AUTO: automatically reverts the MFD in case of display failure.

MFD: display MFD information in the associated display unit.

EICAS: display EICAS information in the associated display unit.

2 – ADS BUTTON

Momentary action button:

- Reverts the ADS source.
- When ADS source reversion is selected, a white stripped bar illuminates on the button.

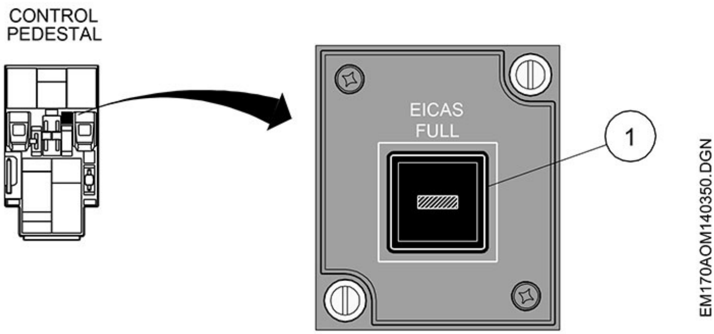
3 – IRS BUTTON

Momentary action button:

- Reverts the IRS source.
- When IRS source reversion is selected, a white stripped bar illuminates on the button.

NOTE: Associated ADS or IRS source flag is displayed on the PFD after a reversion is performed.

EICAS FULL PANEL



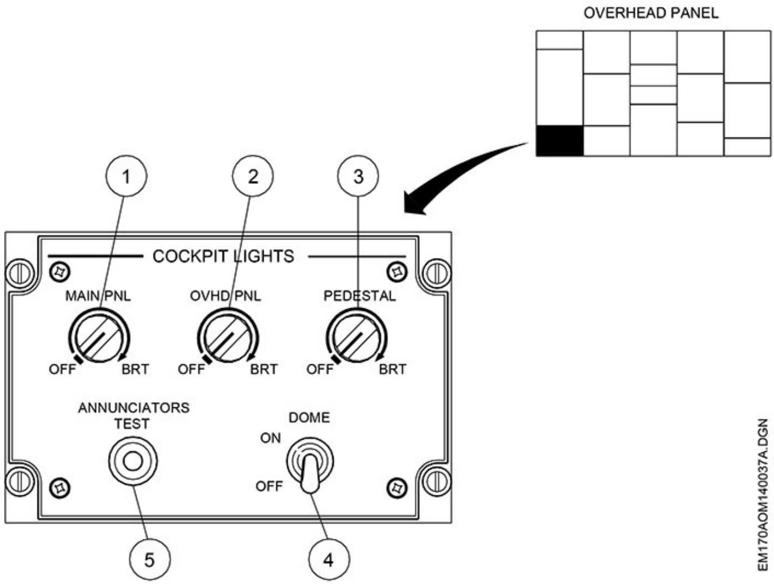
1 – EICAS FULL BUTTON

PUSH IN: EICAS full information presented.

PUSH OUT: enables the automatic EICAS de-clutter logic.

COCKPIT LIGHTING

COCKPIT LIGHTS PANEL



COCKPIT LIGHTS PANEL

1 – MAIN PNL CONTROLLER

- Turns on/off and regulates the lighting brightness of the main panel.

2 – OVHD PNL CONTROLLER

- Turns on/off and regulates the brightness of the overhead panel's integral lighting.

3 – PEDESTAL CONTROLLER

- Turns on/off and regulates pedestal lighting brightness.

NOTE: When the DIM POT is at OFF position, the button/window indications remain illuminated full bright as a default operations configuration.

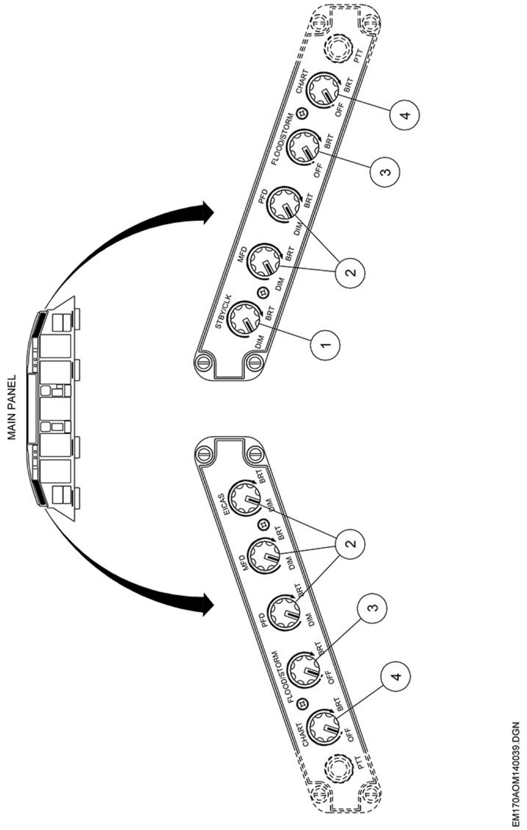
4 – DOME SWITCH

- Turns on/off the two cockpit dome lights.

5 – ANNUNCIATORS TEST BUTTON

- When actuated to the TEST position (momentary position) allows checking of the striped bars and caption indications in all buttons located on the main panel, overhead panel, control pedestal, allowing verification of lamp integrity.

GLARESHIELD LIGHTS PANEL



1 – STD/CLK CONTROLLER

- Regulates the brightness of the standby/clock lighting.

2 – EICAS, MFD AND PFD CONTROLLER

- Regulates the brightness of the associated electronic display.

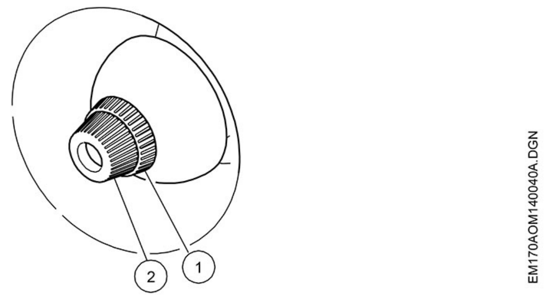
3 – FLOOD/STORM CONTROLLER

- Turns on/off and regulates the brightness of the flood/storm panel lighting.
- Provides maximum brightness for storm conditions at BRT position.

4 – CHART CONTROLLER

- Turns on/off and regulates the brightness of associated chart holder lighting.

FLIGHT CREW READING LIGHTS



1 – OUTER RING

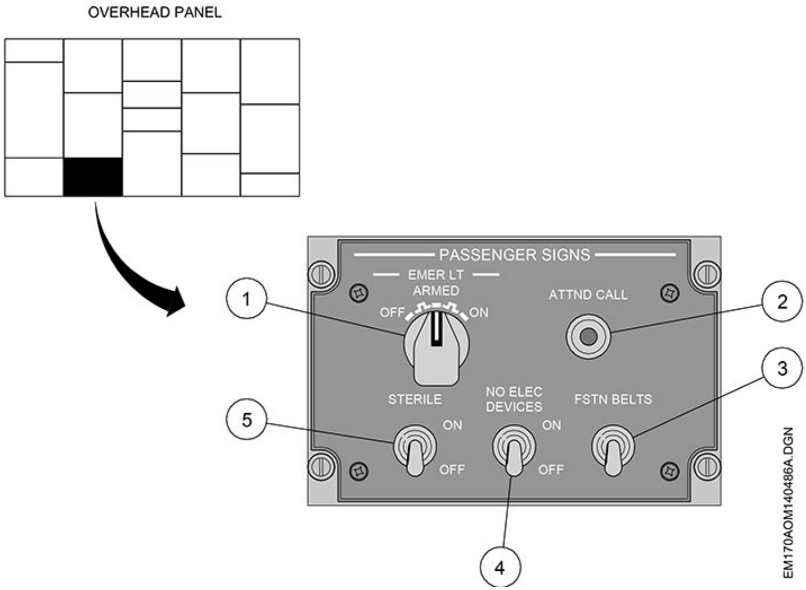
- Turn on/off and provides dimming control.

2 – INNER RING

- Adjusts aperture size of light pattern.

PASSENGER CABIN

PASSENGER SIGNS PANEL



1 – EMER LT SELECTOR

OFF: prevents all emergency lights from illuminating if airplane electrical power is turned off or fails.

ARMED: automatically illuminates all emergency lights if DC buses lose electrical power or if airplane electrical power is turned off.

ON: turns on all emergency lights.

2 – ATTND CALL BUTTON

- Pressing this button sounds a single hi/lo tone chime in passenger cabin.

3 – FSTN BELTS SWITCH

ON: illuminates the FASTEN SEATBELTS signs.

OFF: turns off the FASTEN SEATBELTS signs.

FASTEN SEATBELTS signs will automatically turn ON whenever the passenger mask doors are commanded open regardless of the switch position.

4 – NO SMKG / NO ELEC DEVICES SWITCH

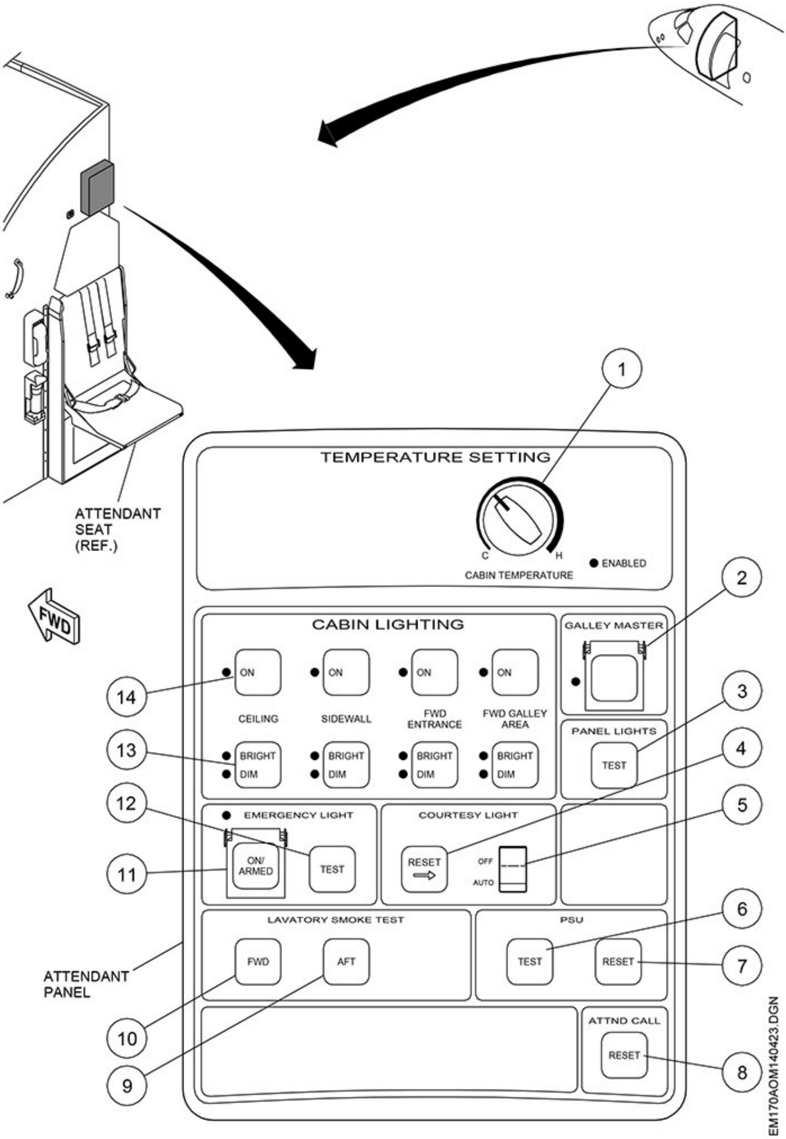
ON: illuminates the NO ELECTRONIC DEVICES signs.
OFF: turns off the NO ELECTRONIC DEVICES signs.

NO ELECTRONIC DEVICES signs will automatically turn ON whenever the passenger mask doors are commanded open regardless of the switch position.

5 – STERILE SWITCH

ON: illuminates the sterile lights located in the rainbow lights.
OFF: turns off the sterile lights located in the rainbow lights.

FORWARD ATTENDANT PANEL



1 – CABIN TEMPERATURE CONTROLLER

- Controls cabin temperature.
- The “ENABLED” led turns on to indicate the knob controls the cabin temperature. The led turns on only if the Passenger Cabin Temperature Rotating Knob in the cockpit is set to ATTND position (Refer to Section 14-02 – AMS).

2 – GALLEY MASTER BUTTON (GUARDED)

- Turns off all galleys (AC power off).

3 – PANEL LIGHTS TEST BUTTON

- Provides a test in the attendant panel lights.

4 – COURTESY LIGHT RESET BUTTON

- Turns on all courtesy lights for 5 min every time it is pressed.

5 – COURTESY LIGHT SWITCH

AUTO: turns on or off the courtesy lights according to passenger door position (OPEN or CLOSED).

OFF: turns off the courtesy lights regardless of passenger door position.

6 – PSU TEST BUTTON

Allows the testing of the following lights:

- flight attendant reading lights.
- passenger reading lights.
- lavatory dome light.
- lavatory fluorescent light (from DIM to BRT mode).
- attendant call indicator lights.
- lavatory occupied signs.

7 – PSU RESET BUTTON

- Turns off the lights previously turned on by the PSU test.

8 – ATTND CALL RESET BUTTON

- Turns off the attendant call indicator lights, zonal lights and PSU lights, previously turned on due to an attendant call.

9 – AFT LAVATORY SMOKE TEST BUTTON

- The BUTTON needs to be pressed for 9 s to test the AFT lavatory smoke detector and both the cabin crew and flight crew indications.

10 – FWD LAVATORY SMOKE TEST BUTTON

- The BUTTON needs to be pressed for 9 s to test the FWD lavatory smoke detector and both the cabin crew and flight crew indications.

11 – EMERGENCY LIGHT ON/ARMED BUTTON (GUARDED)

ON: turns on all emergency lights.
Emergency light indication illuminates on the flight attendant panel.

ARMED: automatically illuminates all emergency lights in case of DC bus electrical power loss or if airplane electrical power is turned off.

12 – EMERGENCY LIGHT TEST BUTTON

- Provides a one-minute test of all passenger cabin emergency lights.

13 – CABIN LIGHTING BRIGHT/DIM BUTTON

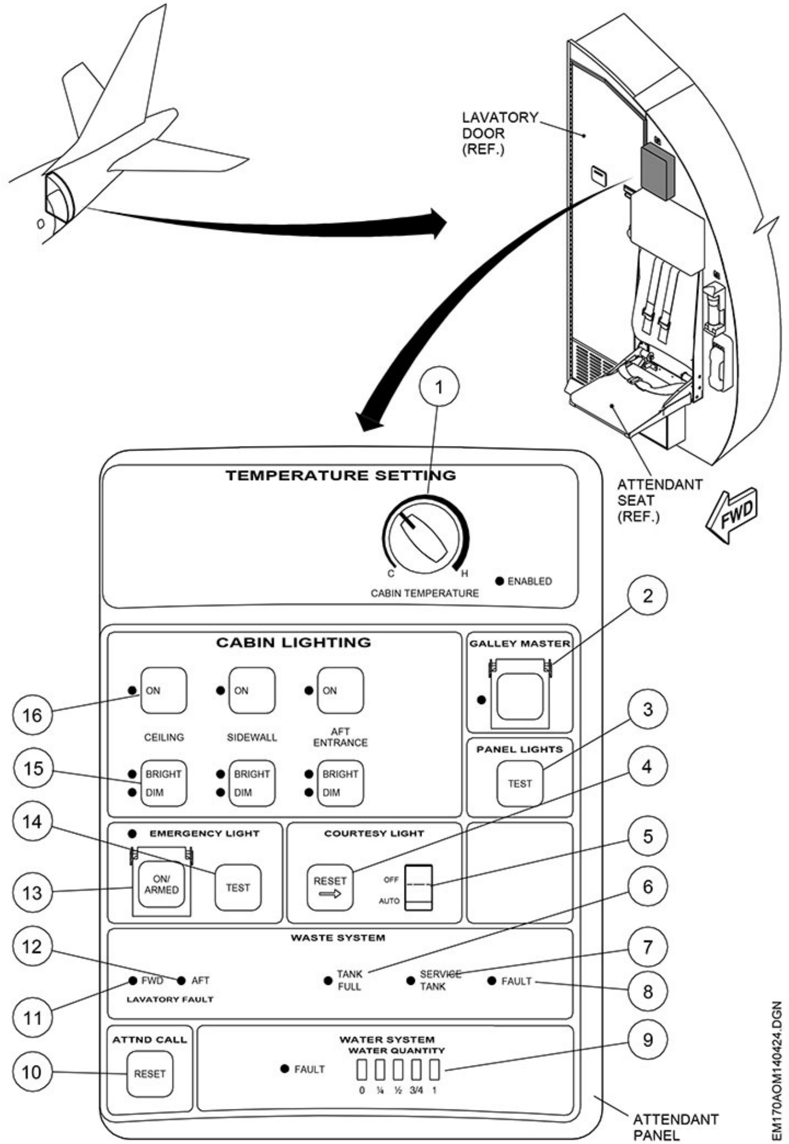
- Momentary press.

BRIGHT: sets the lights of the respective area to full brightness.
DIM: reduces lights of the respective area brightness.

14 – CABIN LIGHTING ON BUTTON

- Turns the respective cabin light on and off.

AFT ATTENDANT PANEL



1 – CABIN TEMPERATURE CONTROLLER

- Controls cabin temperature.
- The “ENABLED” led turns on to indicate the knob controls the cabin temperature. The led turns on when the Passenger Cabin Temperature Rotating Knob in the cockpit is set to ATTND position (Refer to Section 14-02 – AMS).
- Available only for airplanes with dual cabin temperature control.

2 – GALLEY MASTER BUTTON (GUARDED)

- Turns off all galleys (AC power off).

3 – PANEL LIGHTS TEST BUTTON

- Provides a test of the attendant panel lights.

4 – COURTESY LIGHT RESET BUTTON

- Turns on all courtesy lights for a 5-minutes period.

5 – COURTESY LIGHT SWITCH

AUTO: turns on or off the courtesy lights according to passenger door position (OPEN or CLOSED).

OFF: turns off the courtesy lights despite of passenger door position.

6 – TANK FULL INDICATION

- Illuminates to indicate that the waste tank has reached 100% of its capacity.

7 – SERVICE TANK INDICATION

- Illuminates to indicate that the waste tank has reached 75% of its capacity.

8 – FAULT INDICATION

- Illuminates to indicate that a fault in the waste system has been detected.

NOTE: Some FWD/AFT LAVATORY FAULT indications may be cleared by means of repeated toilet flush cycles. If the FAULT indication extinguishes after repeated flush cycles, the toilet may be normally operated. If the FAULT indication does not extinguish, report to maintenance personnel.

9 – WATER TANK CAPACITY AND FAULT INDICATION

- Indicates the water tank capacity. The fault light indicates one of the following conditions:
- A fault in the respective (FWD or AFT) drain valve is detected.
- Water level indication is not available.
- In-flight drainage is not available due to a fault in the drain valve or in the drain mast heater.

10 – ATTND CALL RESET BUTTON

- Turns off the attendant call indicator lights, zonal lights and PSU lights, previously turned on due to an attendant call.

11 – FORWARD LAVATORY FAULT INDICATION

- Illuminates to indicate that the forward lavatory is out of order.

12 – AFT LAVATORY FAULT INDICATION

- Illuminates to indicate that the aft lavatory is out of order.

13 – EMERGENCY LIGHT ON/ARMED BUTTON (GUARDED)

ON: turns on all emergency lights.

ARMED: automatically illuminates all emergency lights in case of DC bus electrical power loss or if airplane electrical power is turned off.

14 – EMERGENCY LIGHT TEST BUTTON

- Provides a one-minute test of all passenger cabin emergency lights.

15 – CABIN LIGHTING BRIGHT/DIM BUTTON

- Momentary press.

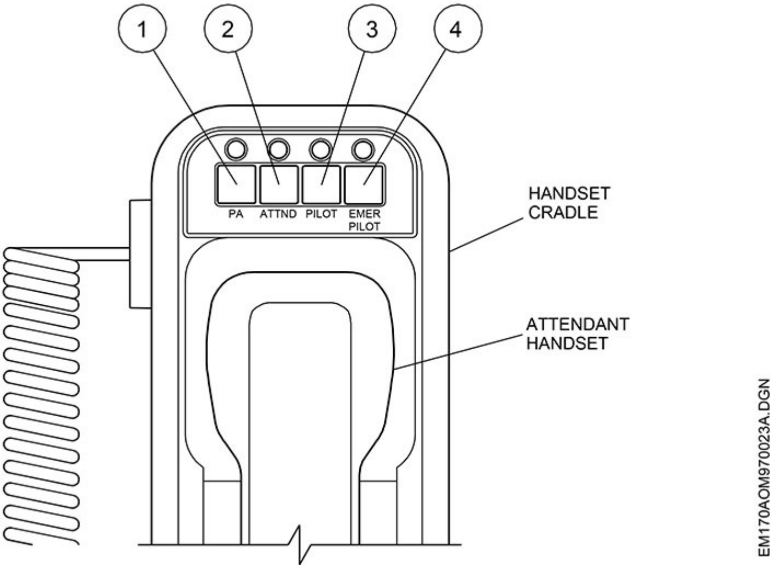
BRIGHT: sets the lights of the respective area to full brightness.

DIM: reduces light brightness of the respective area.

16 – CABIN LIGHTING BUTTON

- Turns on and off the respective cabin light.

INTERPHONE HANDSET/CRADLE ASSEMBLY



1 – PA BUTTON

- Provides passenger announcements.

2 – ATTND BUTTON

- Provides communication among flight attendants.

3 – PILOT BUTTON

- Provides communication among flight attendant and cockpit crew in normal condition (normal mode).

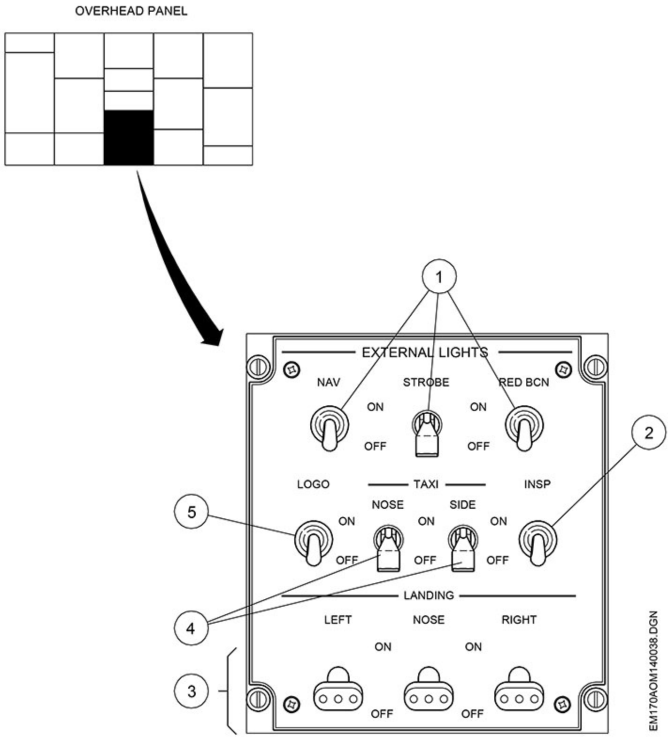
NOTE: If the “PILOT” button is pressed in the electrical emergency configuration (RAT deployed), the green light will illuminate and the call chime will be annunciated, but the communication channel will be unavailable. The “EMER PILOT” button can be used normally.

4 – EMER PILOT BUTTON

- Provides communication among flight attendant and cockpit crew in emergency condition (emergency mode).

EXTERNAL LIGHTING

EXTERNAL LIGHTS PANEL



1 – NAV, STROBE AND RED BCN SWITCHES

- Turns on/off the associated light.

2 – INSP SWITCH

- Turns the inspection lights on/off.

3 – LANDING LEFT, NOSE AND RIGHT SWITCHES

- Turns the associated landing light on/off.

4 – TAXI NOSE AND SIDE SWITCHES

- Turns the taxi lights on/off.

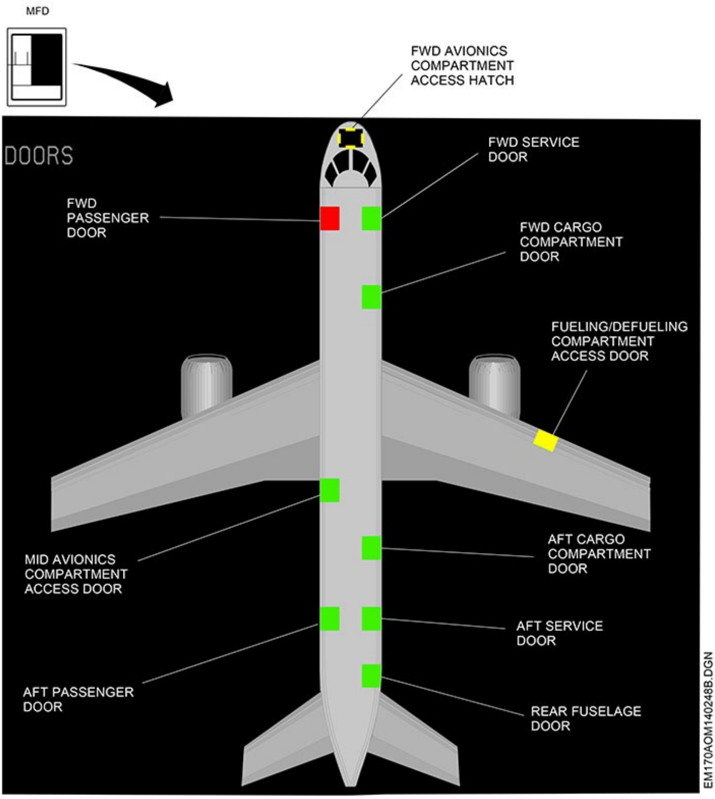
5 – LOGO SWITCH

- Turns the logotype lights on/off.

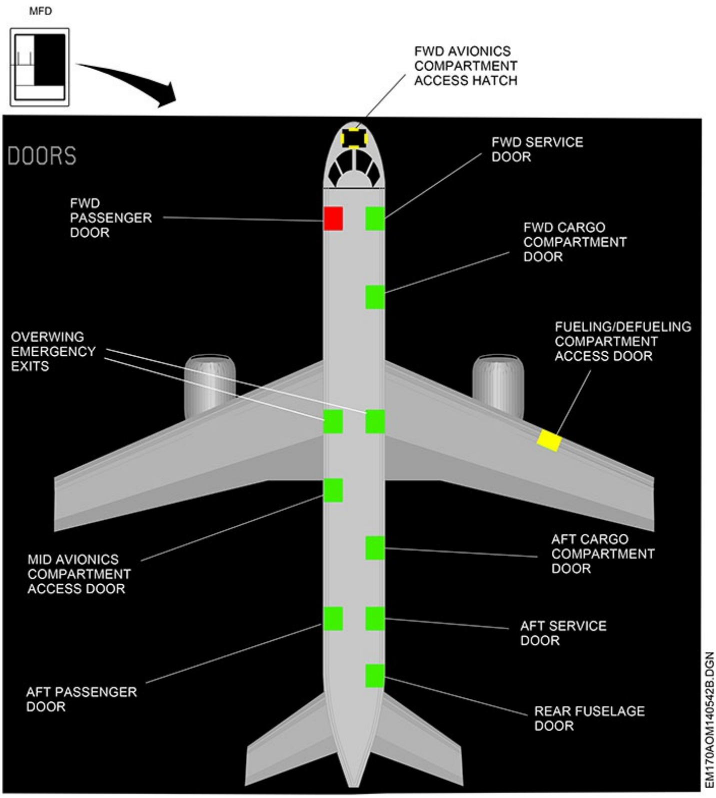
SYNOPTIC PAGE ON MFD

Door information is displayed on the synoptic status page. It can be selected by flight crew on either MFDs.

E175



E190



DOOR

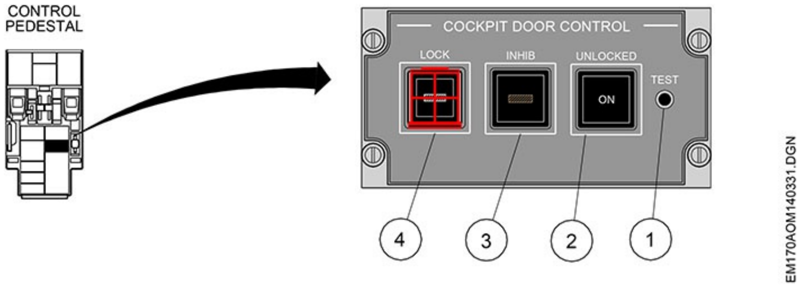
- On synoptic page, the door is shown as a colored solid square.

GREEN:	the associated door is closed.
RED:	the associated passenger, service or cargo door is open.
AMBER:	the associated access door is open.
AMBER DASHED:	the associated door status is undetermined.

NOTE: An annunciation is displayed at the right top of the doors status windows whenever the respective door is not properly closed.

REINFORCED COCKPIT DOOR

CONTROL PANEL IN THE COCKPIT



1 – TEST BUTTON

- Continually tests the DING-DONG alarm while the test button is pressed, regardless of audio selection.

2 – UNLOCKED INDICATION

- Turns on when door is unlocked.
- Starts flashing when the EMERG ENTRY button on the passenger cabin panel is pressed.
- Turns off when the INHIB button is pressed.

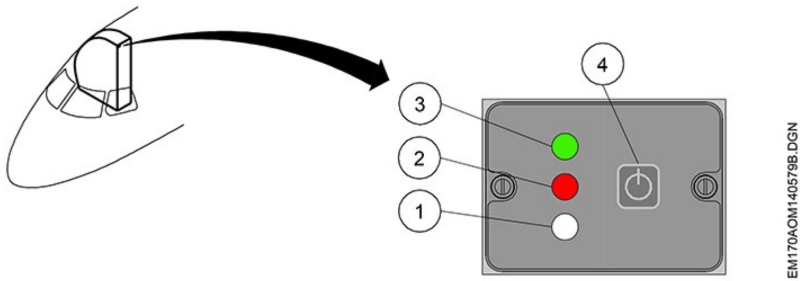
3 – INHIB BUTTON

- Inhibits the EMERG ENTRY command from cockpit door control panel in the passenger cabin for 500 seconds.
- Lights up the red LED in the passenger cabin panel.
- The cockpit door opens if the INHIB button is not pressed up to 30 s after the EMERG ENTRY button on the passenger cabin control panel is pressed.

4 – LOCK BUTTON (GUARDED)

- Controls the cockpit door's power supply.
- Activates and deactivates the electromechanical door latch.
- Deactivates the inhibition control.
- Resets the DING-DONG alarm and EMERG ENTRY command.
- Resets the green led on the door's control panel in the passenger cabin.

DOOR CONTROL PANEL



1 – WHITE LED

- Indicates that the unlock sequence has been started.

2 – RED LED

- Indicates that the INHIB button in the cockpit was pressed and EMERG ENTRY is temporarily inhibited.

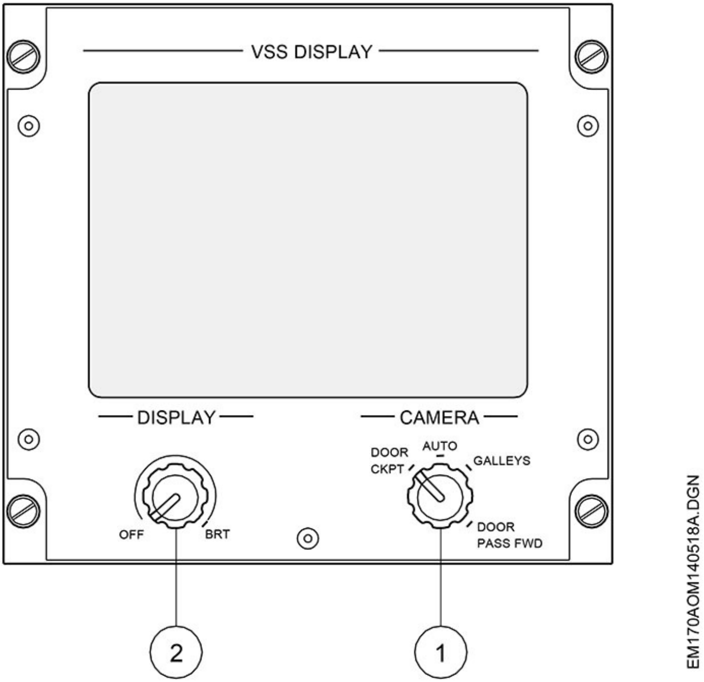
3 – GREEN LED

- Indicates the cockpit door is unlocked.

4 – EMERG ENTRY BUTTON

- The button needs to be pressed for 3 s to activate the DING-DONG alarm sequence in the cockpit.

CABIN SURVEILLANCE SYSTEM (CSS)



1 – VIDEO CAMERA CONTROLLER

DOOR CKPT: furnishes images of cockpit door area.

AUTO: automatically switches the image from one video camera to another with an interval of 3 seconds.

GALLEYS: furnishes images of the galleys area.

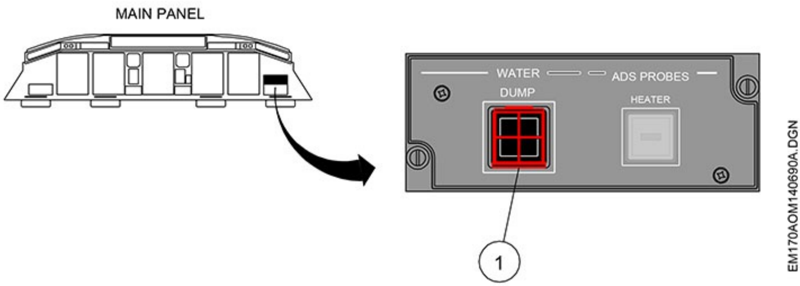
DOOR PAX FWD: furnishes images of the forward pax doors area.

2 – DISPLAY OFF/BRT CONTROLLER

OFF: turns off the CSS.

BRT: turns on the CSS and adjusts the brightness intensity.

WATER DUMP PANEL



1 – WATER DUMP BUTTON (GUARDED)

- Commands the potable water drainage during flight.
- When the button is pressed, the striped bar comes on.
- The striped bar will turn off if one of the following conditions occurs:
  - The Water Dump button is pressed again;
  - The landing gear is down;
  - Faulty drain mast heater indication in the aft flight attendant control panel.

14.01.25 ELECTRONIC DISPLAY SYSTEM (EDS)

ELECTRONIC DISPLAY SYSTEM (EDS)

The EDS is an advanced system that displays primary flight, navigation and system information to the flight crew and consists of:

- Five Display Units (DU).
- One Guidance Panel.
- Two Cursor Control Devices (CCD).
- Two Multi-function Control Display Units (MCDU).
- One EICAS FULL panel.
- Two Reversionary Panels.
- MAU hardware.
- Control I/O modules.
- EDS application software on processor module.

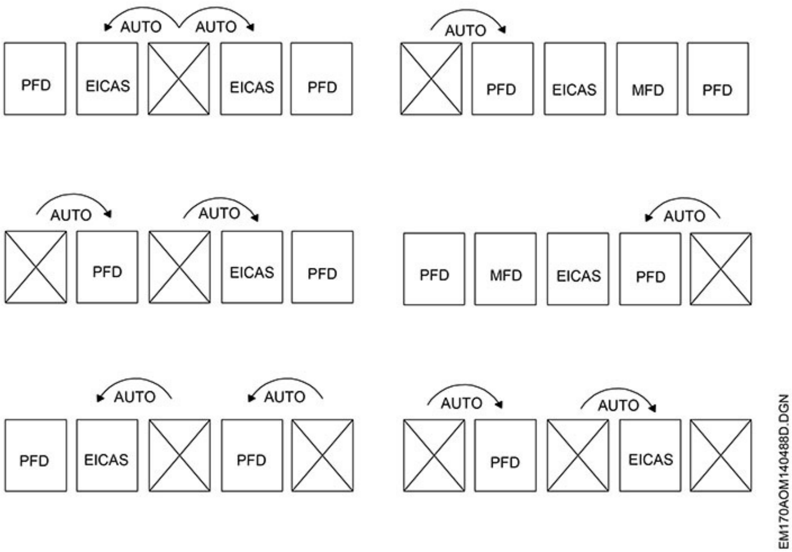
Five display units (DUs) are located on the main instrument panel. There are two Primary Flight Displays (PFD), two Multifunction Displays (MFD) and one Engine Indication and Crew Alerting System (EICAS). They are identical and interchangeable.

The guidance panel is located in the center of the glareshield above the DUs. The two CCDs, one EICAS FULL panel and the MCDUs are located on the pedestal, whereas the reversionary panels are located on the main instrument panel.

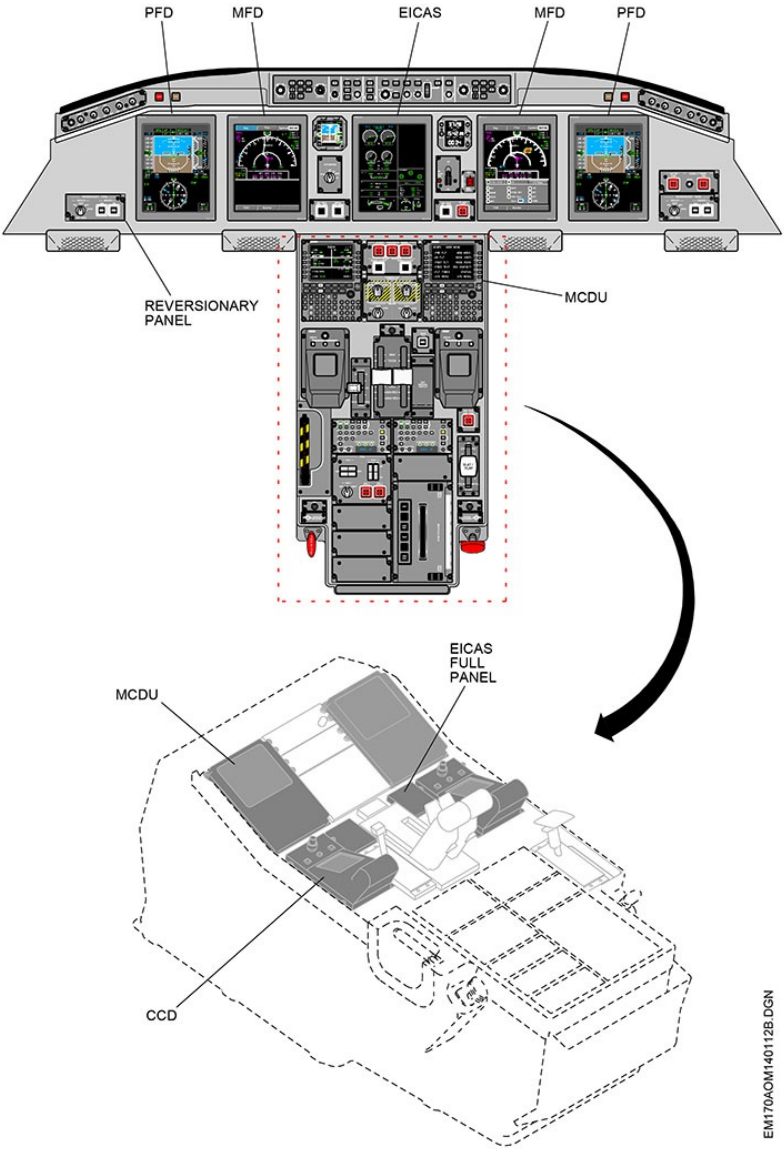
There are four different modes for the DU reversion control for each pilot: PFD, MFD, EICAS and AUTO. Only DU 2 and DU 4 can be reverted. DU 1 and DU 5 always operate as PFDs, and DU 3 is always an EICAS. In case of failure of one display, an automatic logic transfer will allow its information to be presented in the remaining units provided that the display selector knob is set to auto position. If the failed display is recovered, it is necessary to manually revert the display selector knob to have the MFD information on associated DU (DU 2 or DU 4) and then return to the AUTO position in order to restore the DU failure mode condition and normal reversion operation. Both sides need to be in AUTO position in order to restore the DU failure mode condition and normal reversion operation.

Rotating the display selector knob to a position other than AUTO forces that selection onto the MFD. When a pilot selected reversion occurs, the “failed/reverted from” DU is shutdown and the display will be blank.

The auto DU reversion function will have the following display format reversion priority (highest to lowest): PFD, EICAS and MFD.



EDS AUTO REVERSION LOGIC



AIRPLANE DISPLAYS

PRIMARY FLIGHT DISPLAY (PFD)

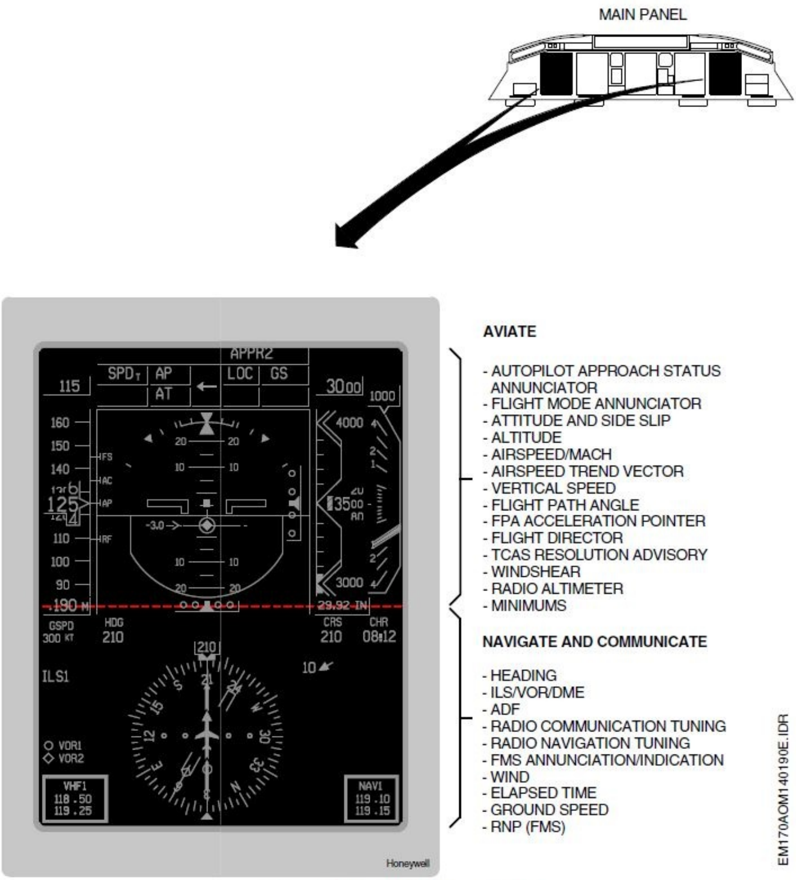
The PFD displays information such as airspeed indicator, altitude indicator, ADI, HSI, vertical speed indicator, radio aids, autopilot, flight director and radio altitude data. They are displayed in two sections, each one presenting a group of information.

In the event of a display failure, information may be presented in the MFD by appropriately setting the reversionary panel. Certain PFD internal failures will result in a large red X covering the PFD screen.

In case of mismatched information between two PFDs, a monitor warning annunciation is displayed when an unacceptable cross compare of any of the parameters that follow are detected.

- Pitch
- Roll
- Attitude
- Heading
- BARO altitude
- Airspeed
- Localizer
- Glideslope
- Radar altitude
- Flight path angle
- EICAS
- Crew Alerting System (CAS)

The display controller portion of the guidance panel allows the selection of PFD HSI formats, navigation sources, weather display, and bearing pointer selection.



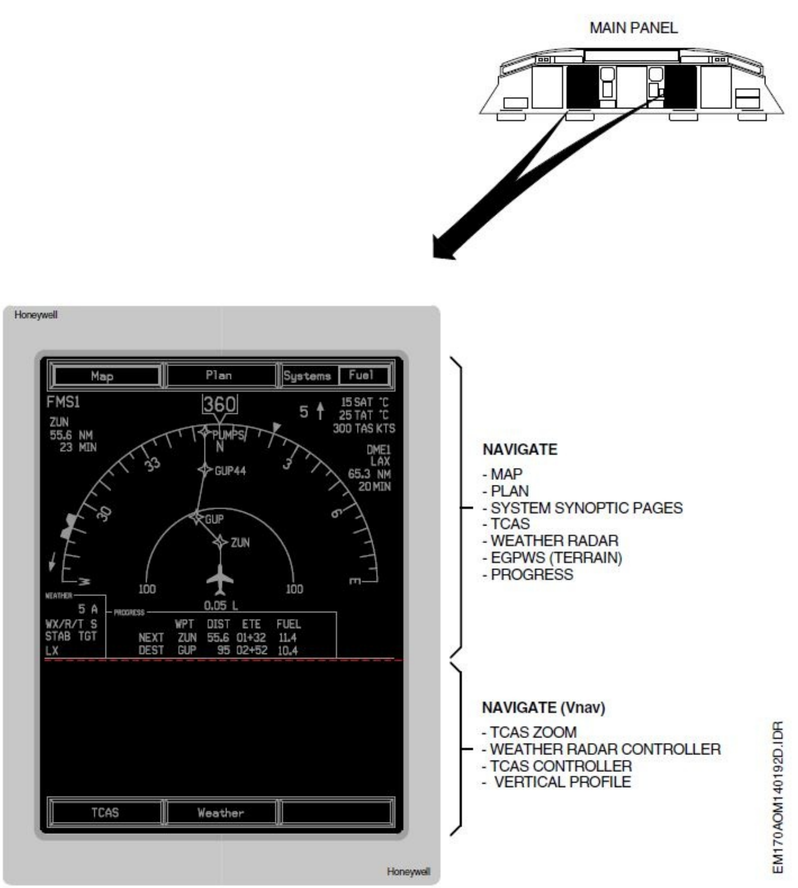
PFD DISPLAY PHILOSOPHY


MAIN PANEL
RNP 0.20
SPDT
AP
LNAV
GP
AT
125
03100
160
150
140
125
120
110
100
90
AP
RF
8000
7500
BARO
2000
1013 HPA
GSPD
235 KT
HDG
210
DTK
302
FMS2
YOCUL
2.0 NM
0 MIN
DME2
29.7 NM
---MIN
RNP 1.00
TERM
VHF1
118.50
119.25
NAV2
116.20
114.80
EM170AOM141390B.DGN

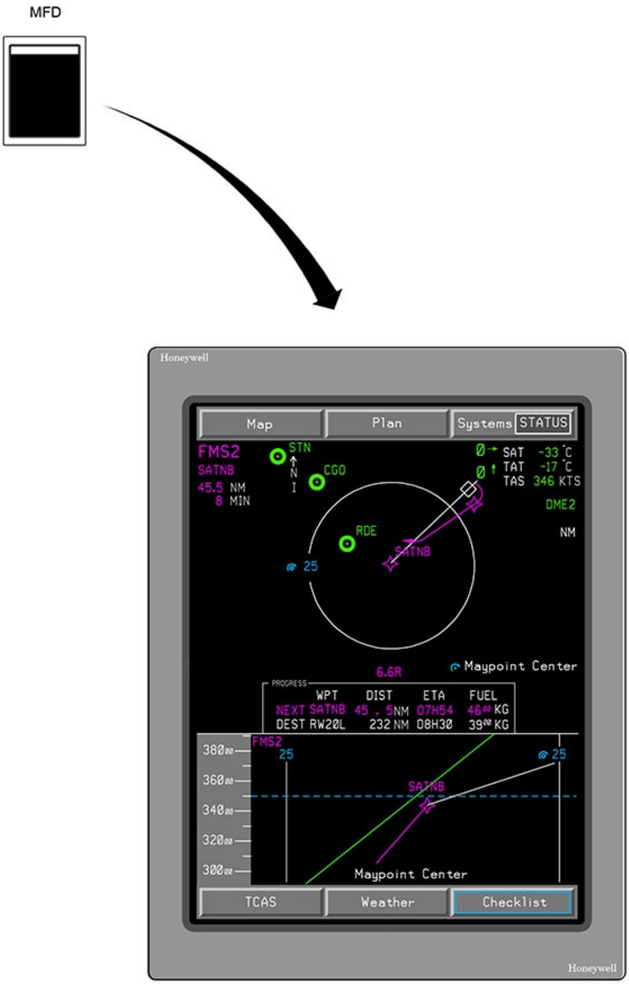
PFD DISPLAY

MULTI FUNCTION DISPLAY (MFD)

The MFD displays map and plan navigation formats, various systems synoptic formats selectable by the flight crew, and also the status page. The MFD provides redundancy to display both the PFD and EICAS formats based upon reversion. It also has the ability to display maintenance information. The MFD consists of menu softkeys, on the top and bottom of the screen, which are used to select formats and control various systems.



MFD DISPLAY PHILOSOPHY



EM170AOM940068B.DGN

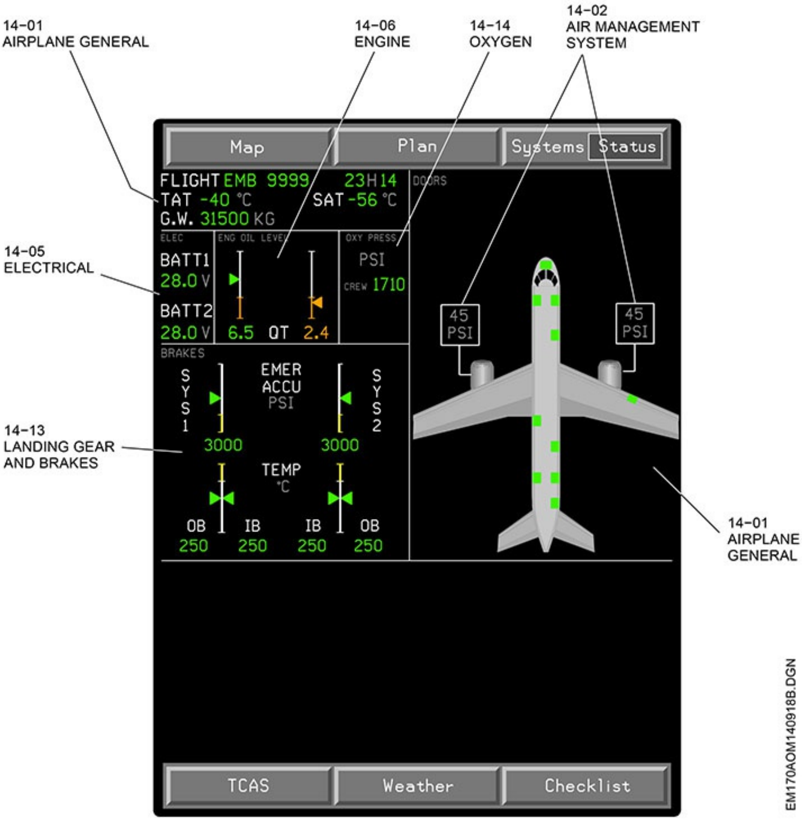
MFD DISPLAY

STATUS PAGE

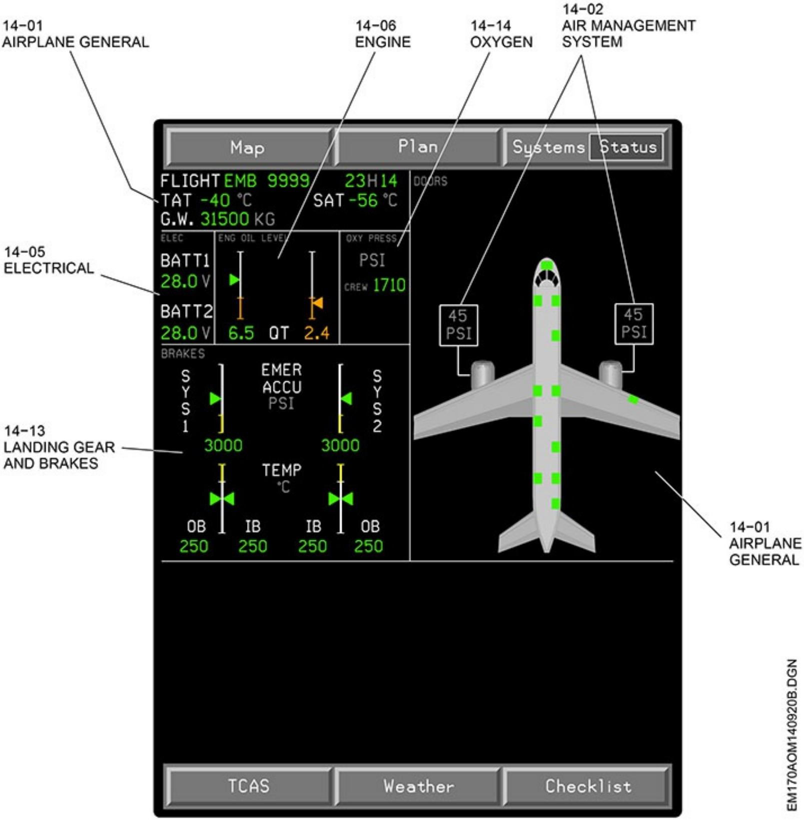
A dedicated page on MFD is available for pilots to achieve status information about:

- Flight;
- Battery;
- Engine Oil level;
- Brake;
- Crew oxygen;
- Door and Access Panel.

Refer to the associated section of the AOM for more information.



E175 STATUS PAGE



E190 STATUS PAGE

ELECTRONIC CHECKLIST

The airplane's Electronic Checklist (ECL) presents the checklists on the lower part of the MFDs. The ECL permits automation of checklist items reducing crew workload.

The flight crew uses both the CCDs to respond manual checklist items and to navigate through the checklist pages.

ECL DATABASE LOADING PAGE

After an airplane Power Up, clicking the Checklist softkey opens the CHECKLIST DB LOADING page. On this page the airplane's available ECL Database names are displayed. Selecting the database and clicking enter with the CCD loads the database.

After loading the database, the ECL automatically opens the ECL NORMAL page.

ECL OPERATION

Clicking the Checklist softkey on the MFD allows access to ECL pages. When both MFDs are displaying the ECL pages, they are synchronized, however only one side at a time has control over the ECL.

The first side to access the ECL has the control over it through its respective CCD. In this condition the ECL can be opened on the cross-side MFD, however the cross-side CCD cannot make any input on the ECL.

If the side with control over the ECL allows one second without providing any input, the first side to do an input in ECL gains the control over it.

The ECL combines automatic and manual response functions. Automatic responses receive information from the airplane systems and sensors to verify an item's accomplishment (Closed Loops); manual responses are flight crew inputs from the CCD.

The following controls have closed loops in the normal checklists:

- Autobrake Knob position (RTO selected or not);
- Brake Temperature (acceptable or not for takeoff);
- Engine Start/Stop Selectors position;
- Fuel AC Pump Knobs position;
- Gear Lever position;
- Hydraulic Pump Knobs position;
- Pack Buttons status;
- Parking Brake Lever status;
- Slat/Flap Lever position (0 or FULL or neither 0 nor FULL);
- TLA Levers position (IDLE or TOGA or neither IDLE nor TOGA).

For the emergency and abnormal checklists there are no closed loops available.

The following softkeys are available on the ECL:

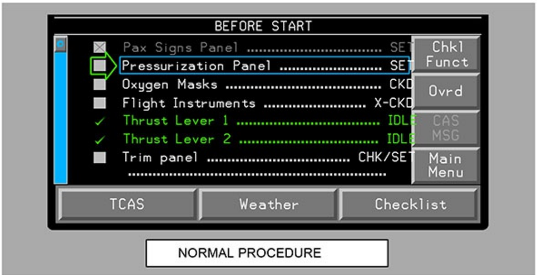
- Main Menu: Opens a new menu presenting the following checklist categories:
  - Normal;
  - Non Annunciated (optional);
  - Emergency (optional);
  - Abnormal (optional);
  - User Defined (optional).

Selecting one of the categories opens an index with all the associated procedures.

- **CAS MSG:** Opens the ECL ACTIVE ABNORMAL page (optional).
- **Ovrd:** Allows the pilot to override a checklist step or an entire checklist.
- **Chkl Funct:** Opens three more softkeys:
  - Undo: Undoes last pilot action on the checklist.
  - Chkl Reset: Resets current or a selected checklist.
  - Reset All: Resets all checklists.

Along the execution of each checklist, smart features are available to reduce crew workload. They are:

- **Timers:** Automatically started when a checklist item requires so.
- **Branches:** The "if" clauses that, upon the "Yes or No" response from the pilot, only the applicable actions to be followed from that point on are displayed.
- **Hyperlinks:** Links to synoptic pages are available (green button on the left side of the checklist item) when applicable during the procedures.
- **Closed Loops:** Items that are automatically checked by airplane systems upon action completion. (Closed loops are only available for NORMAL checklists).



ECL PROCEDURES

ENGINE INDICATION AND CREW ALERTING SYSTEM (EICAS) DISPLAY

The EICAS displays engine and system parameters such as flap, gear, spoilers and trim positions, total fuel quantity, APU and environmental information. The EICAS also displays crew awareness messages. For further information on engine parameters and CAS messages shown, refer to section 14-06 Engine and 14-15 Warnings respectively. In case of failure in the EICAS display, its information may be presented in the MFD by appropriately setting the reversionary panel.

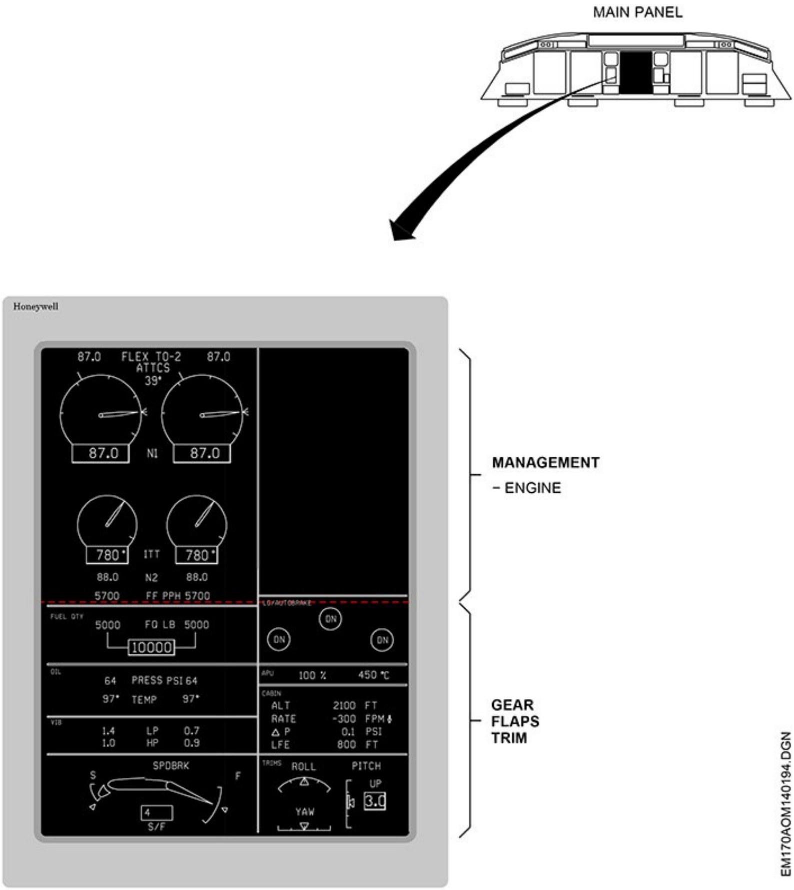
An automatic mode de-clutters the EICAS after takeoff. De-cluttering occurs 30 seconds after landing gear retraction and flap/slat retraction, if all parameters are displaying normal indications.

The following items are de-cluttered from EICAS:

- Oil pressure.
- Oil temperature.
- Engine vibration.
- Slat position.
- Flap position.
- Speed brake position.
- Landing gear position.
- Pitch trim green band.
- APU.

The EICAS FULL pushbutton on the control pedestal inhibits the automatic de-clutter of EICAS. The EICAS is fully displayed when a cautionary condition is detected on one of de-cluttered indications.

In normal conditions, de-clutter is disabled when the landing gear is extended and/or flap/slat is not at 0.



EICAS DISPLAY PHILOSOPHY

FULL EICAS DISPLAY

DECLUTTERED EICAS DISPLAY

MULTIFUNCTION CONTROL DISPLAY UNIT (MCDU)

The MCDU allows radio tuning, PFD radio tuning display setup, manual engine rating selection, engine takeoff data set, avionics display setup and test, performance initialization, flight planning, access to electronic CBs, amongst others.

The EDS allows either MCDU to perform any of the functions available.

EM170AOM140196A.DGN

MCDU

CURSOR CONTROL DEVICE (CCD)

Two CCDs are installed on the control pedestal and allow the flight crew to quickly position the cursor within the different selectable menus and displays.

Each CCD has three function keys corresponding to the respective flight crew's display. Pressing a function key activates the CCD on the corresponding display (PFD, MFD or EICAS). The middle button has a different shape to make the identification easier under low visibility condition or turbulence.

ENTER buttons are provided on both sides of CCD.

A dual concentric rotary knob on the CCD is used to control the:

- WX radar tilt angle and range selection;
- Selection of Radio frequency;
- Scrolling of EICAS messages (caution, advisory, and status).

Touching the touch pad moves a crosshair pointer on the MFD selectable areas. The cyan selector box selects the soft key under the crosshair pointer. There are no hot spots in the MFD.

The cursor automatically goes to a default position if CCD is not operated for more than 20 seconds, provided there are no virtual control panel and pull-down menus opened.

An opened pull-down menu closes automatically if a different display is selected. This logic is not applicable for WX radar control panel on MFD.

GUIDANCE PANEL

The guidance panel houses the display controllers, used for display control, autopilot and yaw damper engagement functions, flight director mode engagement and selection of display data source for the flight director.

MODULAR AVIONICS UNIT (MAU)

MAUs are cabinets that house modules assigned to different functions in an integrated architecture and also avionics and non-avionics functions. Among the avionics functions are the air data application, autopilot, autothrottle, data acquisition, display control functions, flight director, Flight Management System (FMS), flight control modules, global position system, monitor/warning system, stall protection/warning and windshear guidance.

MAU 1 and 2 are located in the forward electronics bay and MAU 3 is located in the center electronics bay.

MAU 1 is a 20-slot cabinet while MAU 2 and MAU 3 are 16 slot cabinets. The typical layout of the MAUs, showing the location of each module, is provided on the next page.

Where each MAU module is named as:

NIC: network interface controller.

AIOP: actuator input/output processor.

PROC 1: ADA 1 (air data application), MW 1 (monitor warning),
UTIL 1 (utility), CAL/MCDU 1 and CMS 1 (configuration management system).

PROC 2: CMF 2 (communication management function).

PROC 3: FMS 1.

PROC 4: ADA 2, MW 2, UTIL 2, CAL/MCDU 2, CMS 2.

PROC 5: FMS 2, ADA 3, FBW.

PROC 6: CMF 1, ECL.

MODULAR AVIONICS UNIT 1

SLOT	BUS	CH	POWER SUPPLY 3 DC 1	CH	BUS
20		B	SPARE		
19	2	B			
18	2	B	CMC		
17	2	B	GPS 1		
			POWER SUPPLY DC ESS 1		
16	2	B	FCM 1		
15				A	1
14	2	B	CUSTOM I/O 1		
13				A	1
	2	B	NIC 2		
	2	B	PROC 2		
12	2	B	GENERIC I/O		
11				A	1
10			AIOPB1	A	1
9					
			PROC 1	A	1
			NIC 1	A	1
8	2	B	FCM 2		
7				A	1
6			CONTROL I/O 1	A	1
5			BRAKES (OUTBD)	A	1
4			PSEM 1		
3				A	1
2			AIOPA1	A	1
1					
SLOT	**BUS**	**CH**	**POWER SUPPLY 1 DC ESS 1**	**CH**	**BUS**

MODULAR AVIONICS UNIT 2

SLOT	BUS	CH	POWER SUPPLY 2 DC ESS 2/DC 2	CH	BUS
16	2	B	BRAKES (INBD)		
15	2	B	CONTROL I/O 2		
14			AIOPA2		
13	2	B			
12			SPARE		
11			SPARE		
10	2	B	GENERIC I/O 2		
9				A	1
	2	B	NIC 4		
	2	B	PROC 4		
			PROC 3	A	1
			NIC 3	A	1
8			SPARE		
7	2	B	DATABASE		
6			AUTOBRAKE	A	1
5	2	B	EGPWM		
4			NOSEWHEEL STEERING	A	1
3					
2			SPARE	A	1
1				A	
SLOT	**BUS**	**CH**	**POWER SUPPLY 1 DC 2**	**CH**	**BUS**

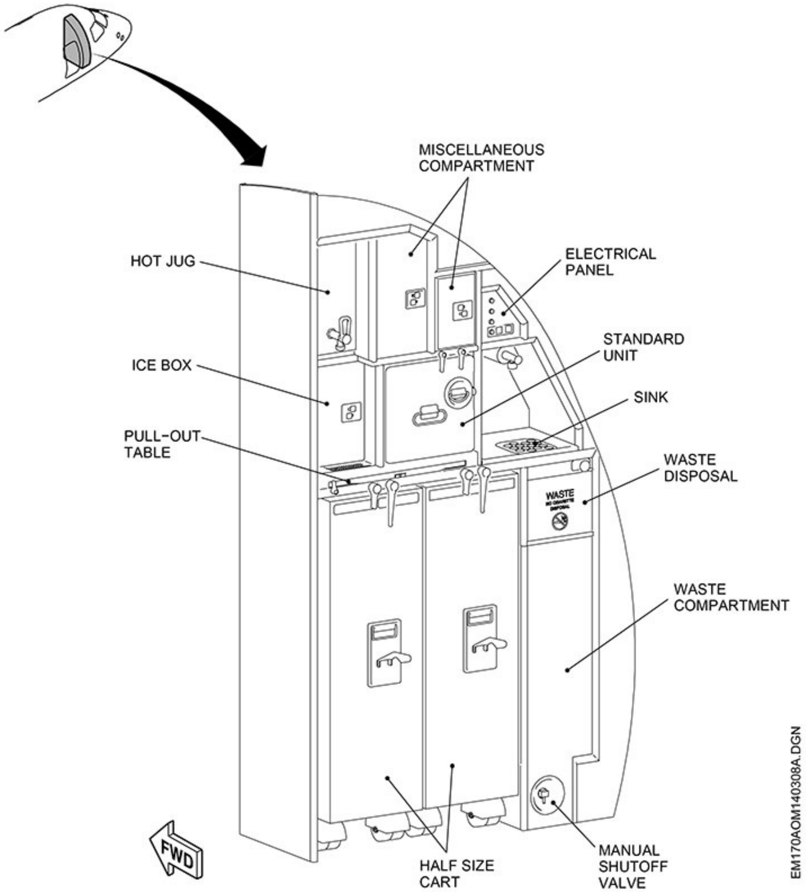
MODULAR AVIONICS UNIT 3

SLOT	BUS	CH	POWER SUPPLY 2 DC 2	CH	BUS
16	1	B	ENGINE VIBE		
15			GPS 2	A	2
14			PSEM 2		2
13				A	
12	1	B	FCM 3		
11				A	2
10	1	B	GENERIC I/O 3		
9				A	2
	1	B	NIC 6		
	1	B	PROC 6		
			PROC 5	A	2
			NIC 5	A	2
8	1	B	CUSTOM I/O 2		
7				A	2
6			AIOPB2	A	2
5					
4			SPARE		
3			SPARE		
2	1	B	FCM 4		
1				A	2
SLOT	**BUS**	**CH**	**POWER SUPPLY 1 DC ESS 2**	**CH**	**BUS**

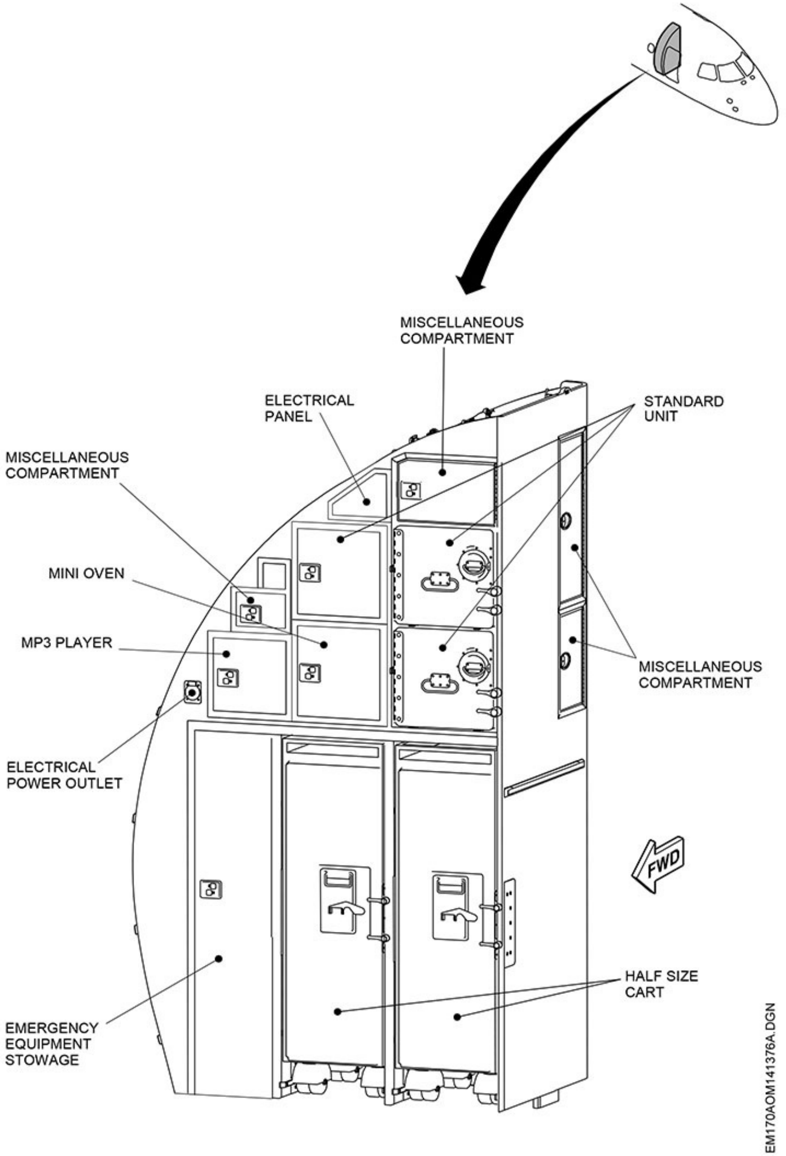
14.01.35 PASSENGER CABIN

GALLEY

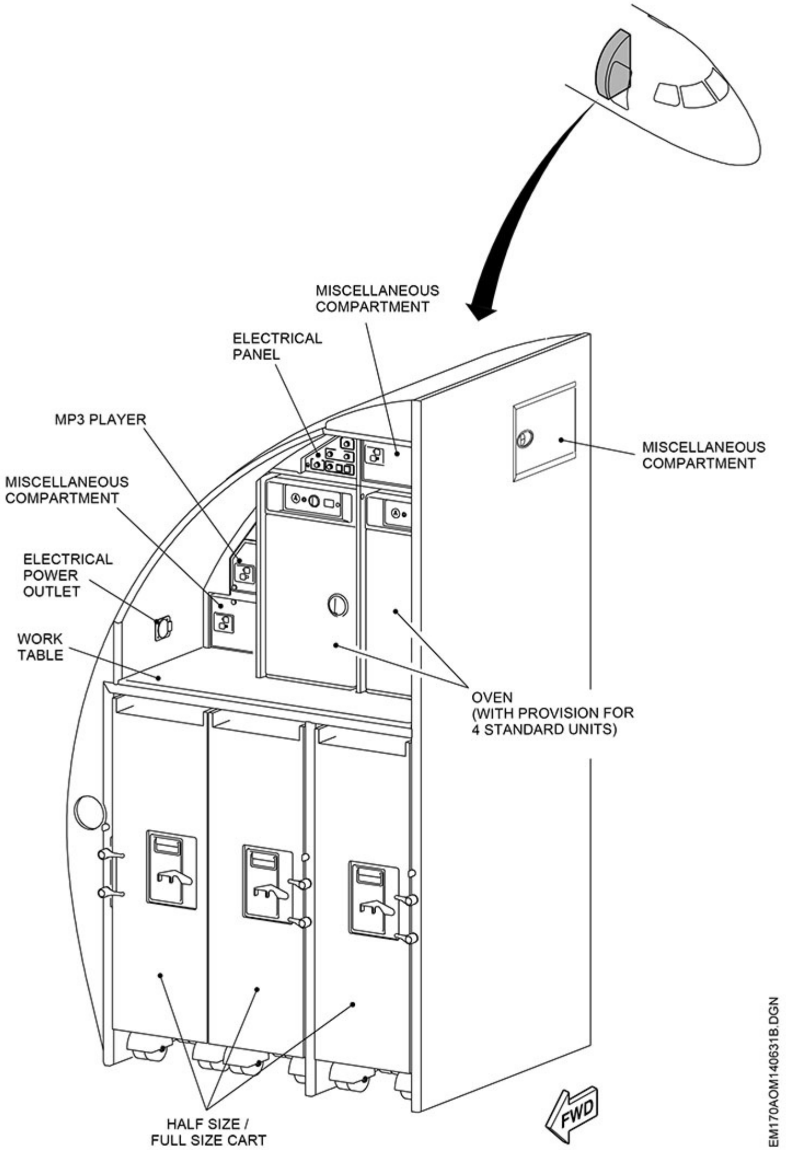
The galleys provide means for food preparation as well as stowage for food and miscellaneous items. A work deck is provided to assist flight attendants with their tasks.



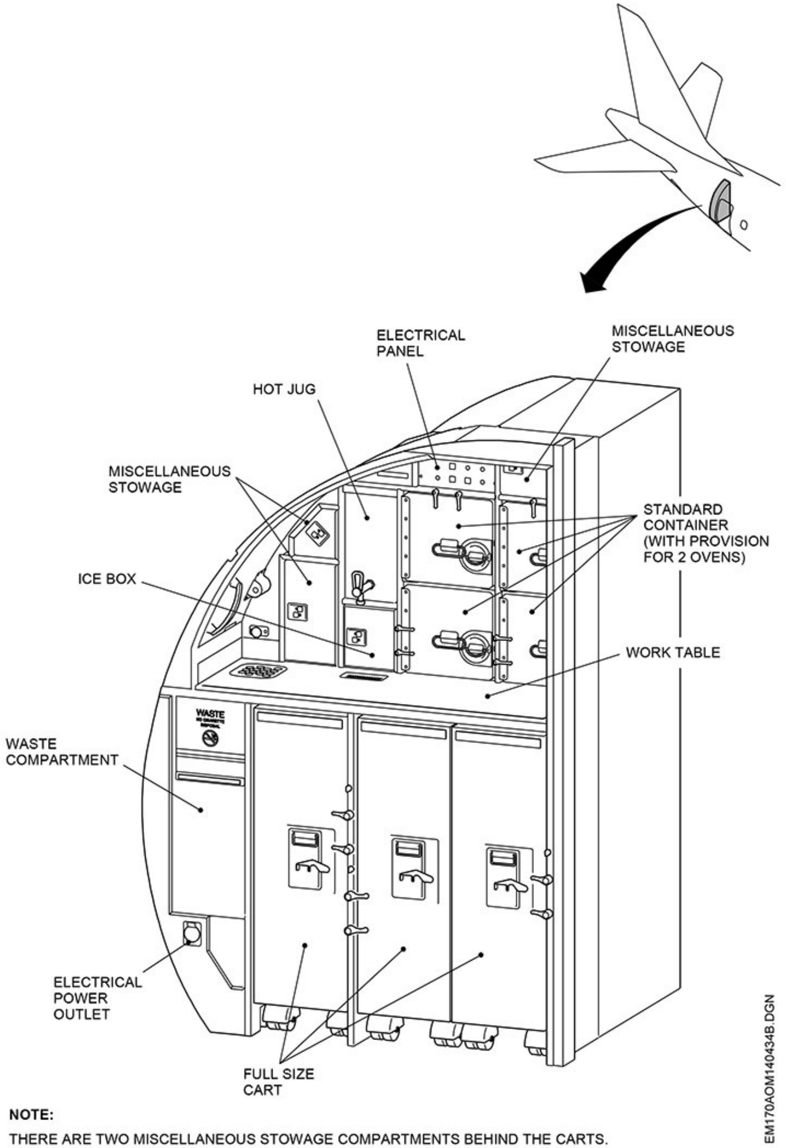
FORWARD GALLEY (G1)



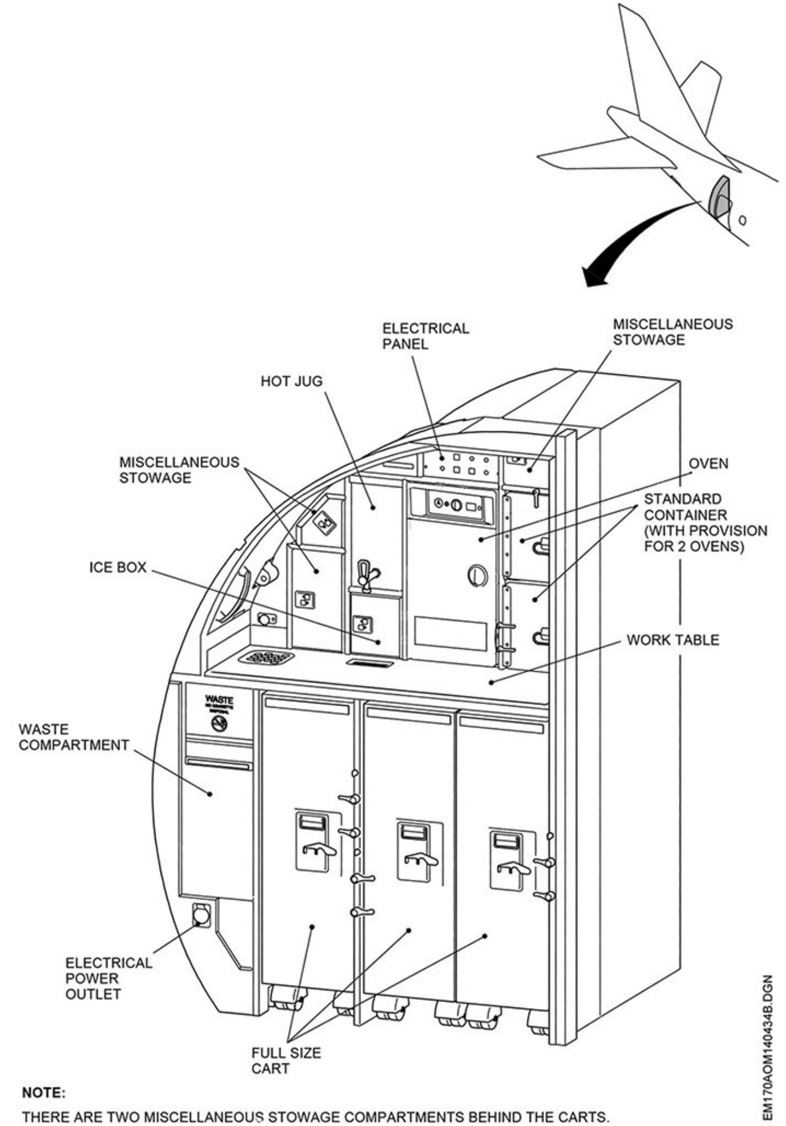
E175 - FWD GALLEY (G2)



E190 - FWD GALLEY (G2)

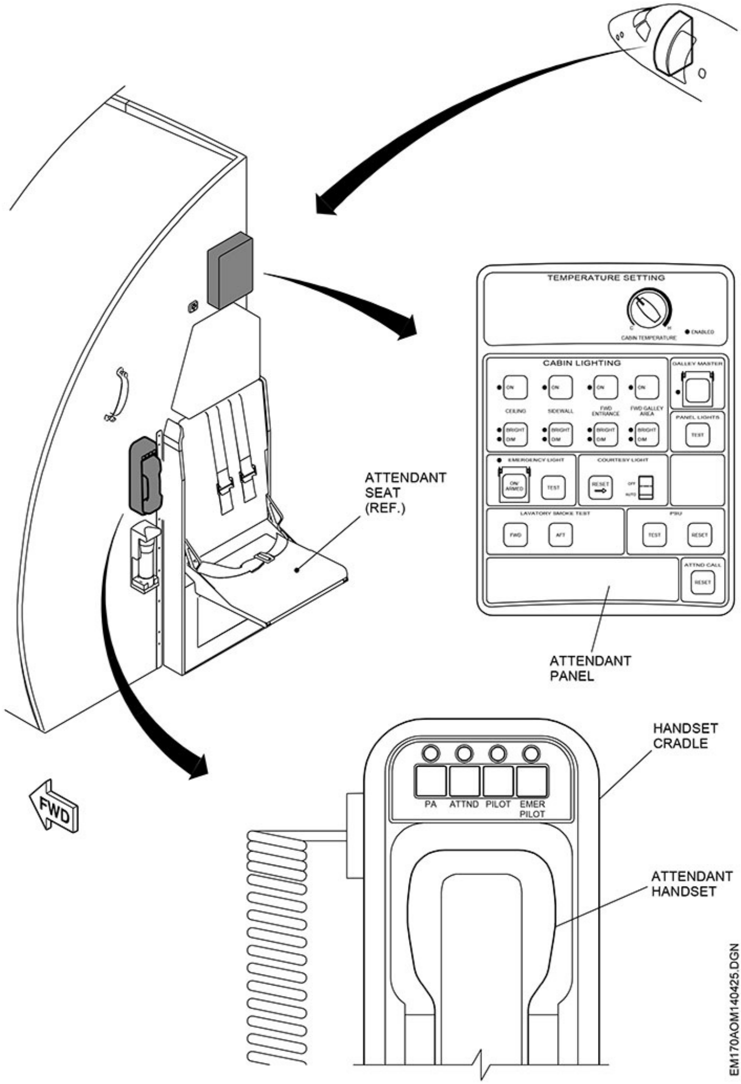


E190 - AFT GALLEY (G3)

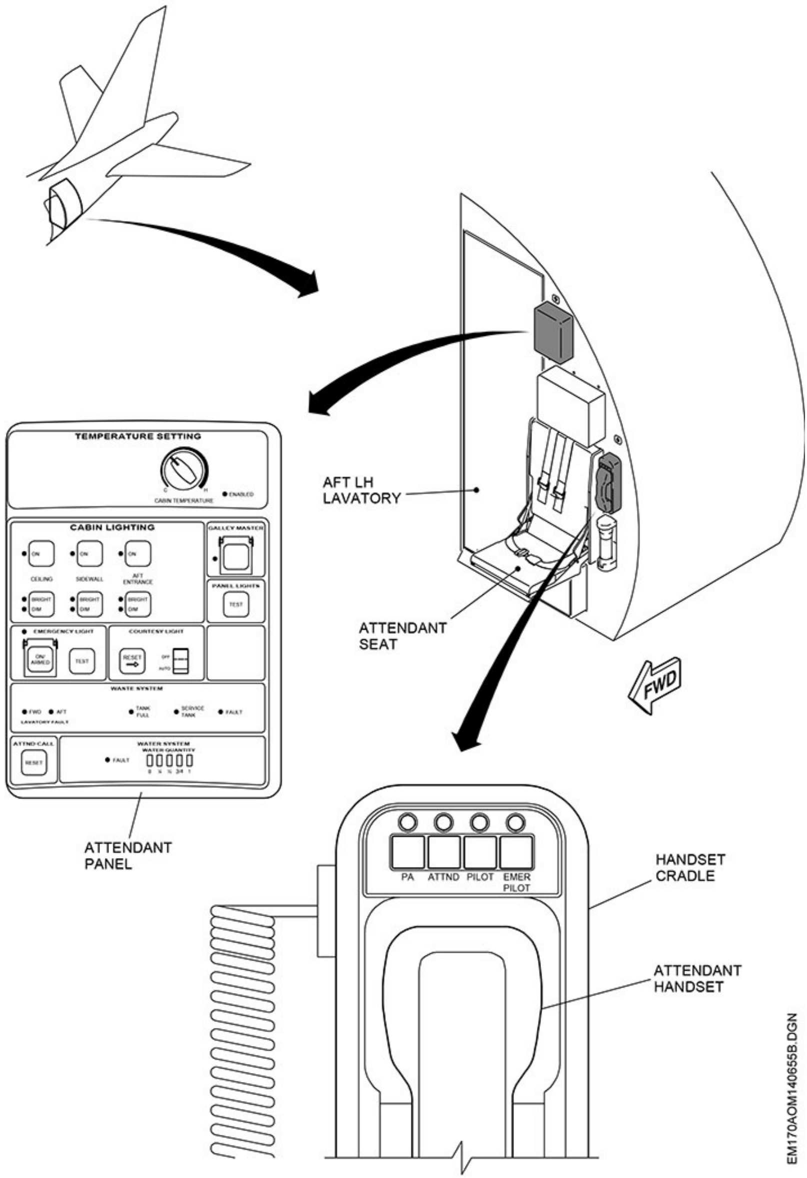


E175 - AFT GALLEY (G3)

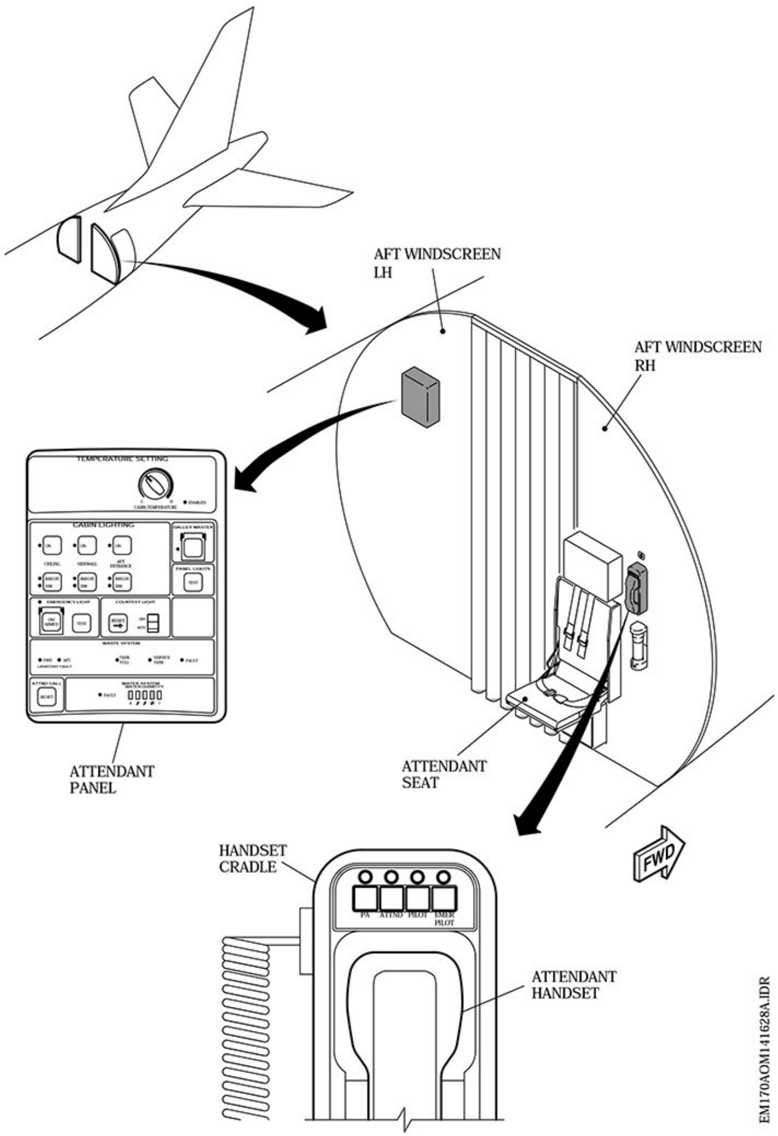
ATTENDANT STATIONS AND SEATS



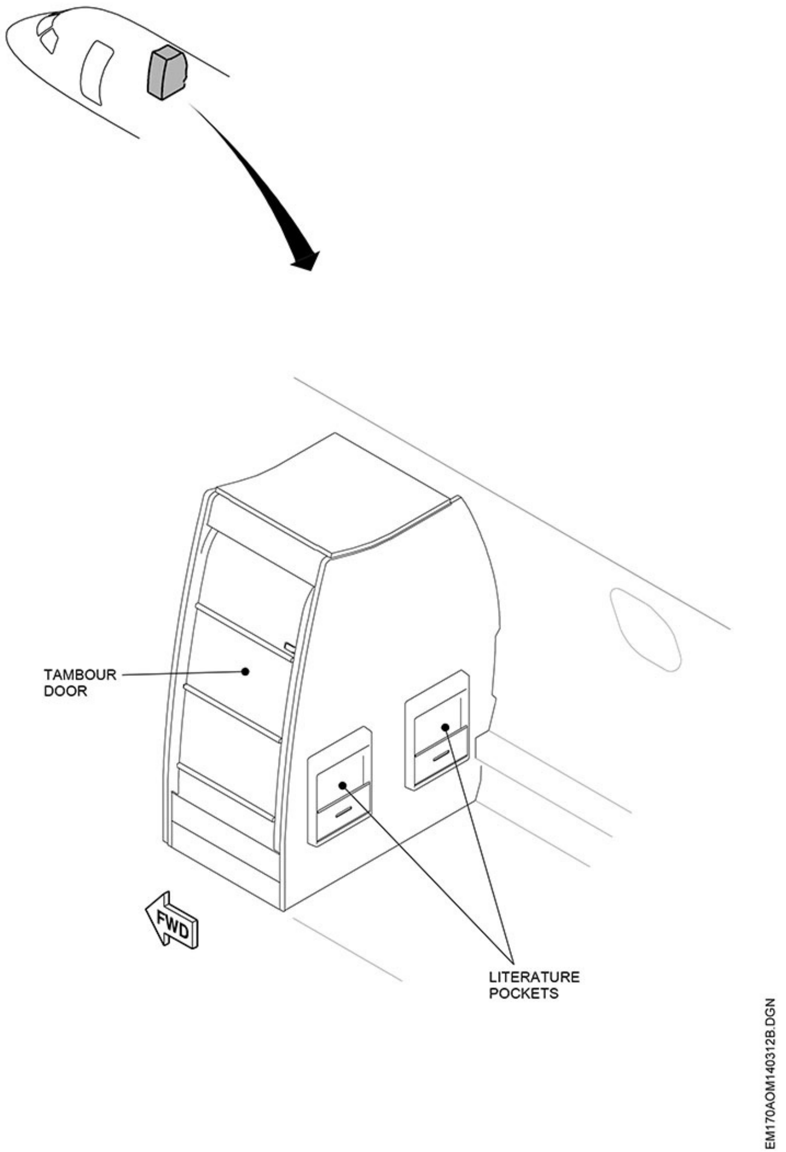
FWD FLIGHT ATTENDANT STATION AND SEAT (CC1)



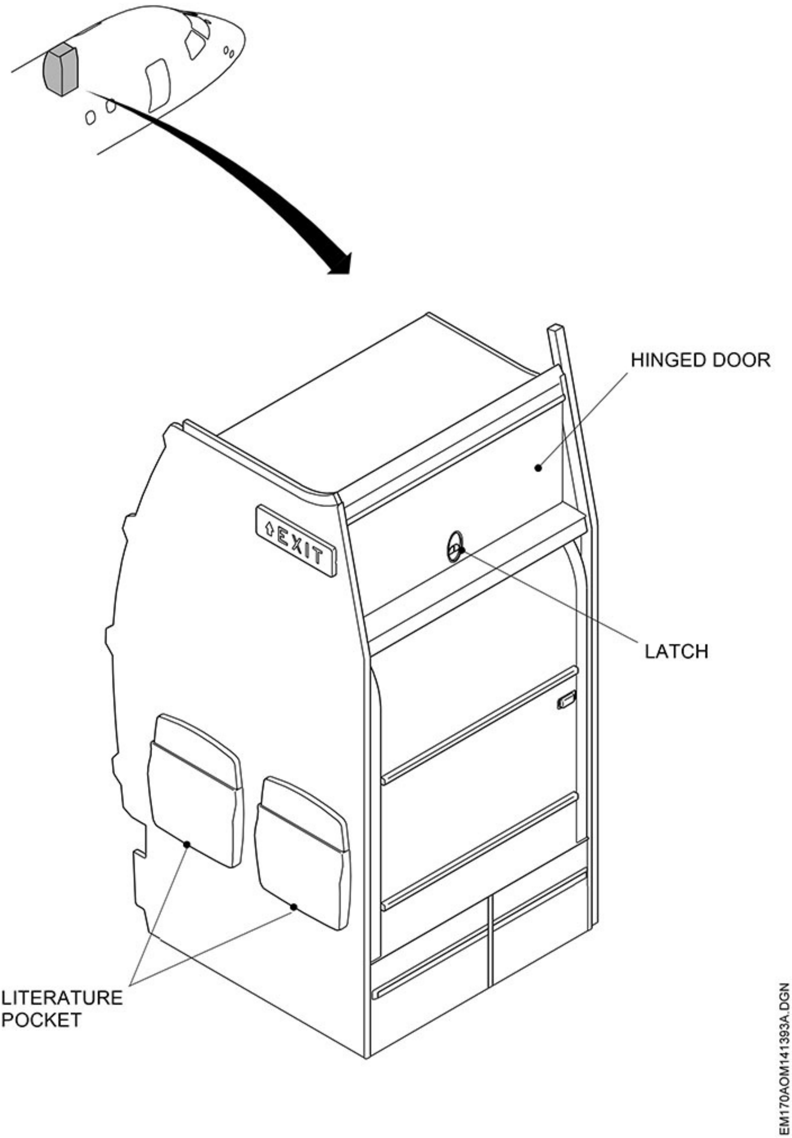
AFT FLIGHT ATTENDANT STATION AND SEAT (CC2)



E190 ONLY - AFT FLIGHT ATTENDANT STATION AND SEAT (CC3)



STOWAGE (E190 ONLY)

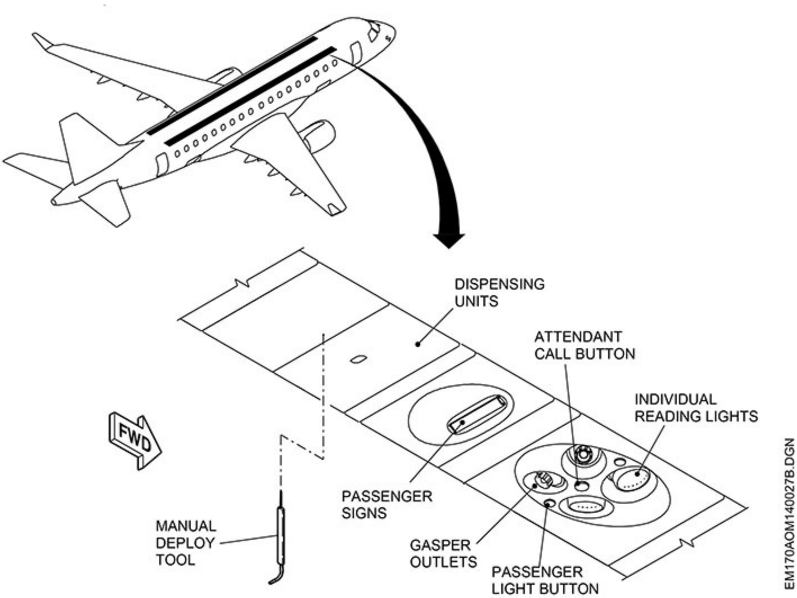


WARDROBE (E190 ONLY)

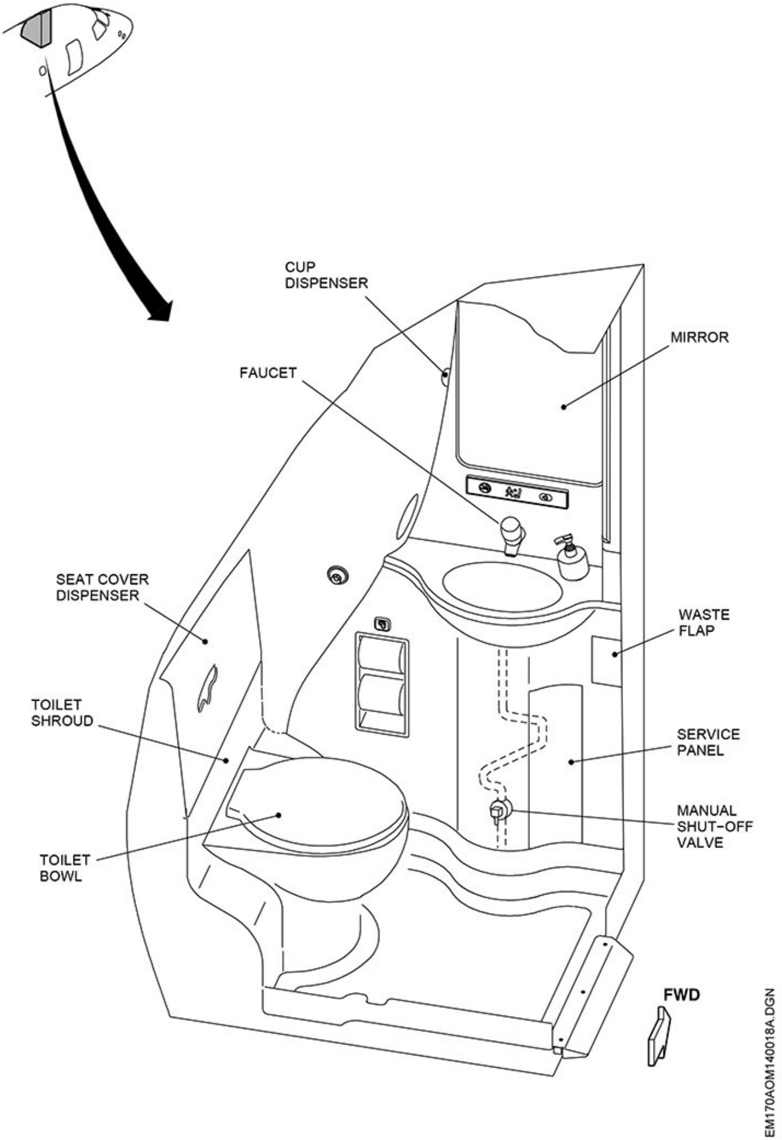
PASSENGER SERVICE UNIT (PSU)

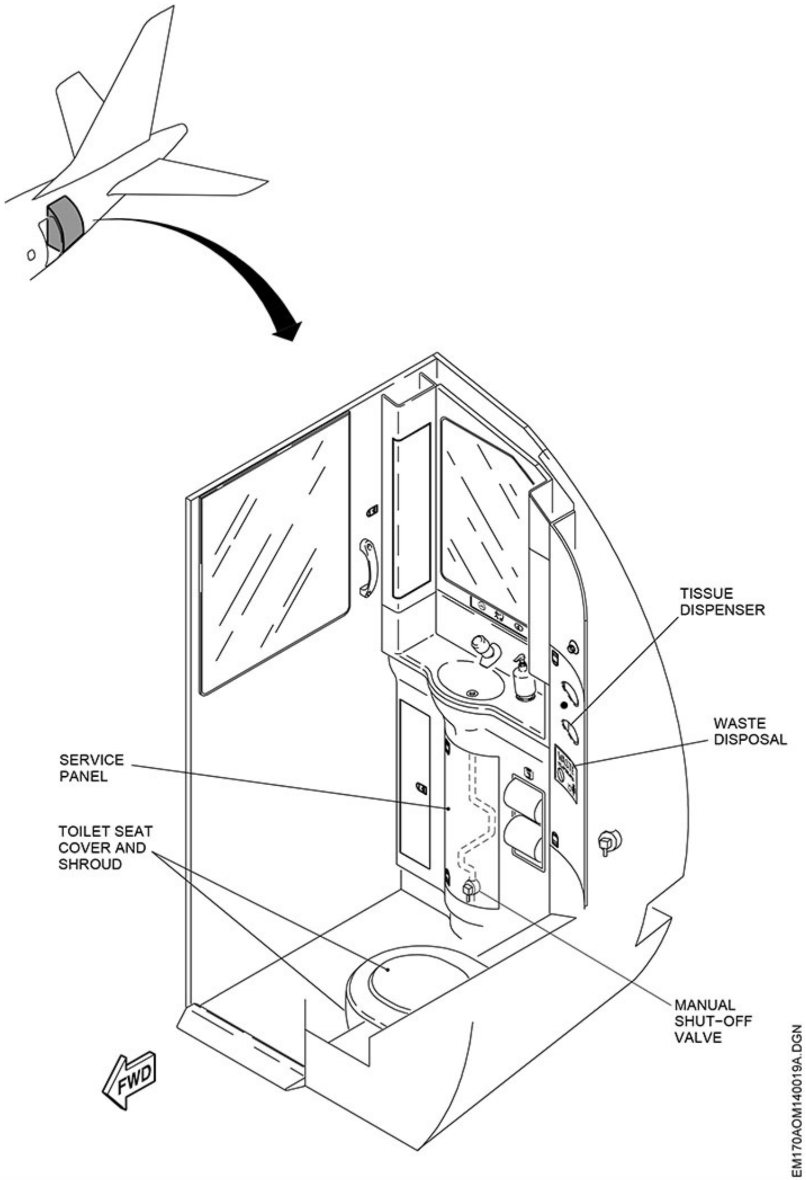
The PSU provides:

- Reading light at each passenger seat.
- FASTEN SEAT BELTS and TURN OFF ELECTRONIC DEVICES signs.
- Pushbutton and indicator for attendant call.
- Air gasper for each individual passenger seat.
- Oxygen mask dispensing unit.
- Loudspeaker for internal communication.



LAVATORY


CUP DISPENSER
MIRROR
FAUCET
SEAT COVER DISPENSER
WASTE FLAP
TOILET SHROUD
SERVICE PANEL
MANUAL SHUT-OFF VALVE
TOILET BOWL
FWD
EM170AOM140018A.DGN


TISSUE
DISPENSER
WASTE
DISPOSAL
SERVICE
PANEL
TOILET SEAT
COVER AND
SHROUD
MANUAL
SHUT-OFF
VALVE
FWD
EM170AOM140019A.DGN

14.01.37 PC POWER SYSTEM

COCKPIT PC POWER SYSTEM

The PC power system supplies 110 VAC / 60 Hz to two outlets installed into the cockpit, and two outlets installed into the forward and mid electronic compartments. The PC power outlets are used by the flight crew or maintenance personnel to connect laptops or other PED (Portable Electronic Devices).

Each PC power outlet unit is connected to an AC converter that is powered by AC BUS 2. The PC power control switch is installed above the RH side PC power outlet and a striped bar illuminates when the AC power is available (pushed in).

The electronic compartment PC power outlets are intended for use only on ground while the cockpit PC power outlets can be used on ground or in flight. The use of cockpit PC power outlets in flight is restricted to equipment and procedures approved by the local authority.

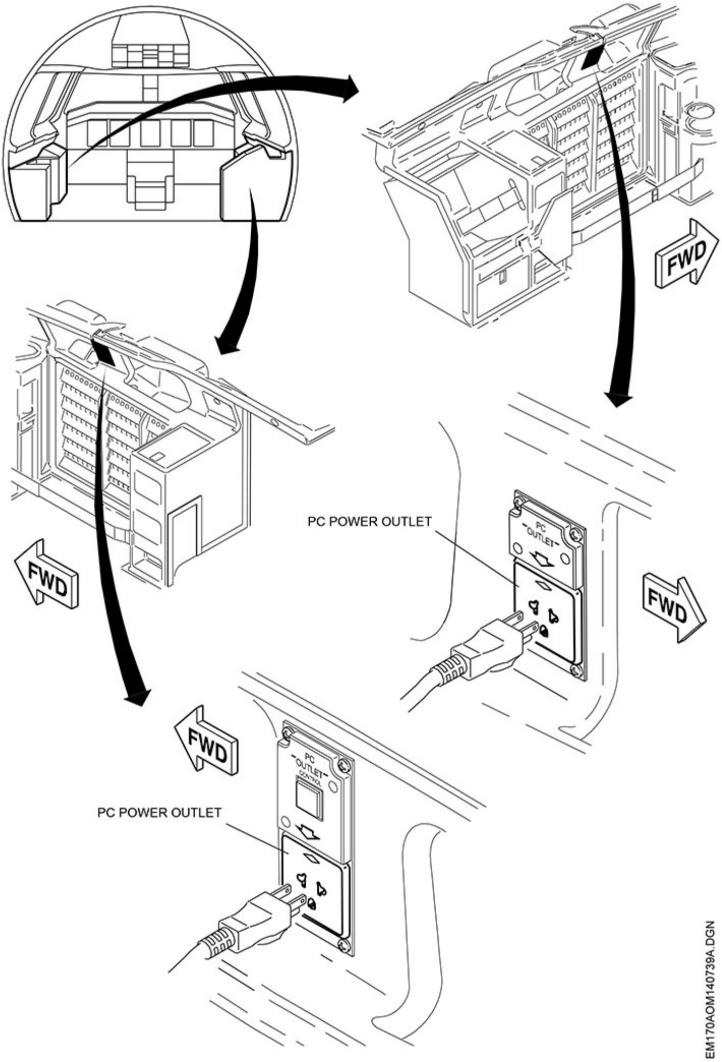
NOTE: Ensure PEDs batteries are charged (above 75%) before plugging them into the outlets. PEDs with low battery levels may exceed the outlets power limit, disabling them. In case an outlet is disabled, flight crew may perform a reset. Remove the PED plug from the outlet and press the PC power control switch. Do not plug the same PED into the outlet. In case the outlet power is not re-established, maintenance action is required. This limitation does not apply to phones and company provided PEDs

COCKPIT PC POWER OUTLET

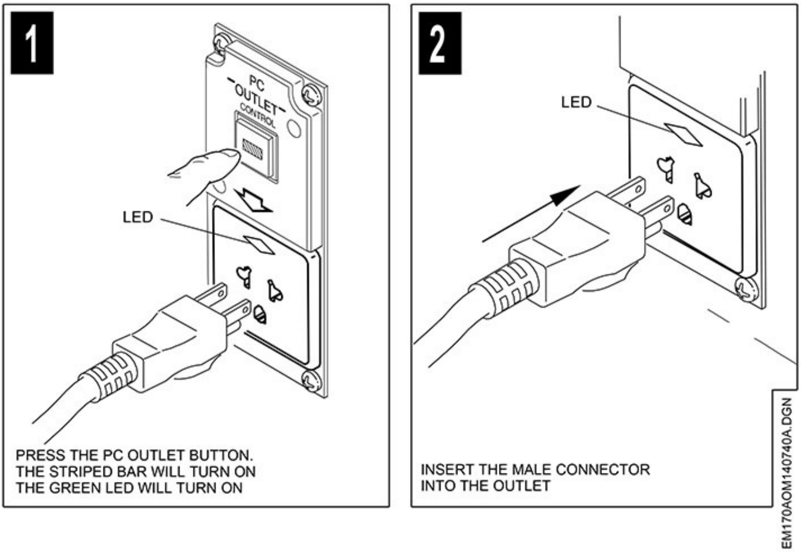
Pushing IN the PC Power Outlet Control button illuminates the striped bar on the button and the green LED at the outlet. Inserting the plug completely into the outlet makes the AC power available.

The LED is turned off when the system is not energized. The outlet provides power for use only when the plug is correctly connected into the socket and PED power is enabled. The LED is shown in red color when a fault condition is detected or the over-temperature limit is exceeded.

NOTE: Ensure the plug is not inserted into the outlet before the power up of airplane. If the plug is inside the outlet when the airplane is powered up, the power outlet unit will not be energized. Remove the plug from the outlet and insert it again according to the procedures above to energize the power outlet unit.



COCKPIT PC POWER OUTLETS



PROCEDURES TO ENERGIZE THE PC POWER OUTLETS

COCKPIT PC POWER PROTECTIONS

The system provides protection against under-voltage, over-voltage, over-current, short circuit and over temperature.

The PC power system controls the power available to the AC outlet units and monitors the total electrical current in use and, if necessary, disables or enables the power outlets.

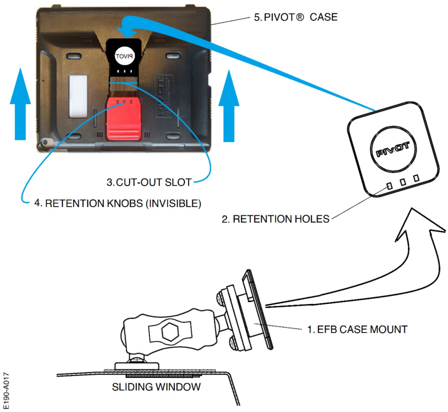
The system is turned off automatically in case of cabin decompression. Pressing the PC power control switch resets the system.

14.01.38 EFB MOUNT

Two EFB mounts are installed. It consists of two parts, one part is the aircraft mount and the second part is the iPad/Pivot case with a built-in mechanism to attach the iPad/Pivot case on the aircraft mount.

The aircraft mounts are installed on the windowsills of the left and right hand sliding windows. The aircraft mounts are placed on adjustable arms.

Slide the iPad/Pivot case on the aircraft mount from the side with the three Rentention holes until it clicks in, oneway fit.



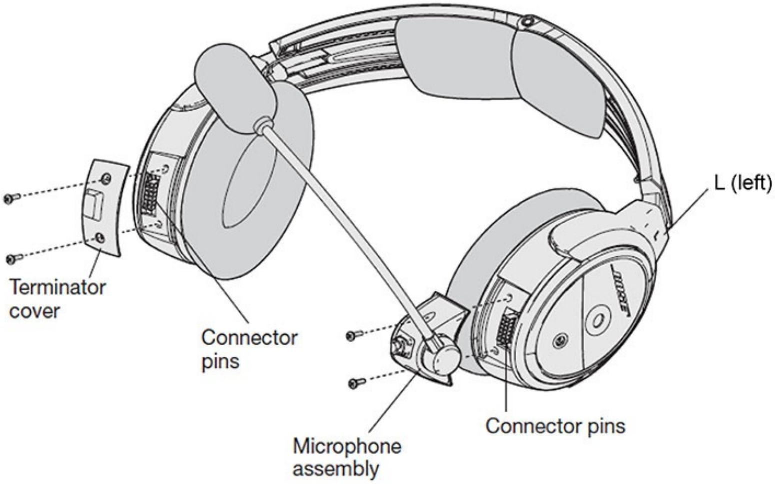
The EFB mounts are certified for the following iPad models:

- Apple iPad® 6th and 7th generation, and
- Apple 9.7-inch iPad® Pro.

14.01.39 HEADSET

Three BOSE A20 headsets are installed. The headset includes a control module, two clothing clips and a cable with a 5 pin XLR connector. The headsets operate with either aircraft power or battery power. No battery is needed when connected to aircraft power.

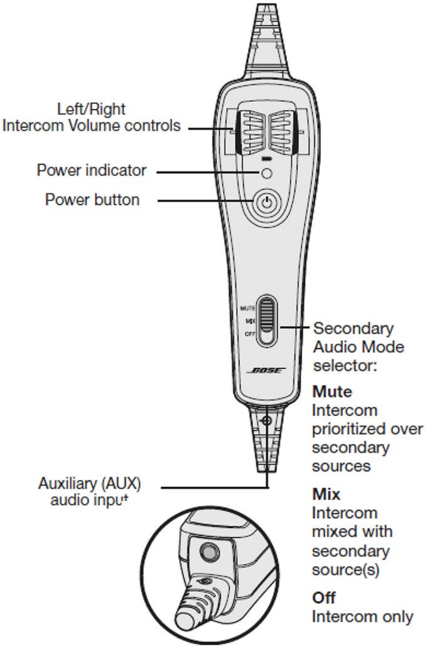
The microphone on the captain’s headset is configured on the LH side. The first officer and observer microphone are configured on the RH side (if wrongly installed the microphone can be swapped by maintenance).



Proper fit on your head is important both for comfort and optimal noise reduction performance. Use the left (L) and right (R) markings above the earcups to orient the headset properly. As you put the headset on, lightly grasp each earcup and adjust it so its cushion is completely over your ear. You should feel an even, gentle pressure all around each ear. Adjust the headband so it rests gently on top of your head. Spare ear and microphone cushions are present in the drawer of the observer compartment.

HEADSET CONTROL MODULE

The control module is attached to the headset cable.



INTERCOM VOLUME CONTROLS

The left and right volume control wheels on the control module adjust the intercom volume of the corresponding earcup. It is recommended to tune the volume wheels to the mid position and adjust the intercom volume to the desired level on the Audio Control Panel, this to prevent loud or low AURAL warnings.

NOTE: Even at its lowest setting, neither volume control wheel can completely turn off the volume.

POWER INDICATOR

The power indicator changes color to indicate the power status, as follows: Green light indicates the power is ON. No light indicates the headset is OFF. Amber or red colors are not applicable as they indicate the battery status. To dim the power indicators press power button twice quickly, repeat to brighten.

POWER BUTTON

The headset comes with an AUTO ON function, the headset will turn ON automatically when aircraft power is available. To turn OFF press and hold the power button for three seconds.

Secondary Audio Mode selector

The selector has three positions: MUTE, MIX and OFF.

- MUTE, intercom prioritized over any secondary audio sources. If an intercom signal is detected, all secondary audio sources are temporarily muted. Secondary audio will return after intercom audio ceases.
- MIX, intercom mixed with any secondary audio sources. All secondary audio sources are mixed with the intercom audio. (Audio from a connected device will keep playing during intercom communications)
- OFF, only intercom audio is active. All secondary audio sources are off.

NOTE: Default is the OFF position Secondary audio sources may not be used.

14.01.40 LIGHTING

INTRODUCTION

Lighting system provides lighting to all essential parts located inside and outside of the fuselage and ensures proper and safe operation of the airplane.

The lighting system includes:

- External Lights.
- Cockpit Lights.
- Passenger Cabin Lights.
- Emergency lighting.

The system also provides lighting for baggage and service compartments.

EXTERNAL LIGHTING

The external lights necessary for a proper and safe operation of the airplane are:

- Landing and taxi lights.
- Navigation and anti-collision lights.
- E175: Wing inspection and logotype lights.
- E190: Wing inspection, logotype and overwing emergency lights.

LANDING AND TAXI LIGHTS

Landing and taxi lights are fitted to each wing roots behind glazed covers. A third landing light and a third taxi light are mounted on the nose gear structure.

The landing light units provide adequate lighting during final approach, flare out and takeoff. The taxi light provides sufficient intensity and beam spread to aid pilots during all taxi operation phases, covering the runway and adjacent areas.

Different switches for nose and root landing and taxi lights are located at the overhead panel.

NAVIGATION AND ANTI COLLISION LIGHTS

E175

The enhanced wing tip is equipped with LED navigation and anti collision lights.

The navigation lights, red on the left, green on the right, and white on both wings, are fitted on each enhanced wing tip. A switch located at the overhead panel controls the navigation lights.

The anti collision lights, two white strobe lights per enhanced wing tip and two red beacon lights mounted on the upper and lower fuselage provide illumination for visual recognition and collision avoidance during all flight/taxi operations. Two different switches, one for strobe lights and another for the red beacon lights are located on the overhead panel.

The forward light assembly is composed of one navigation light and one strobe light. A combined LED navigation/anti collision light is installed on the trailing edge of the enhanced wing tip.

E190

The navigation lights, red on the left, green on the right and white on both wings, are fitted on each wing tip. A switch located at the overhead panel controls the navigation lights.

The anti collision lights, two white strobe lights per wing tip and two red beacon lights mounted on the upper and lower fuselage provide illumination for visual recognition and collision avoidance during all flight/taxi operations. Two different switches, one for strobe lights and another for the red beacon lights are located at the overhead panel.

Each navigation light assembly is composed of two lamps while the strobe light assembly is composed of only one lamp. Normally only one navigation lamp is on, while the second lamp is on standby. In case of failure, maintenance personnel can manually switch the navigation lights through a maintenance panel in the cockpit.

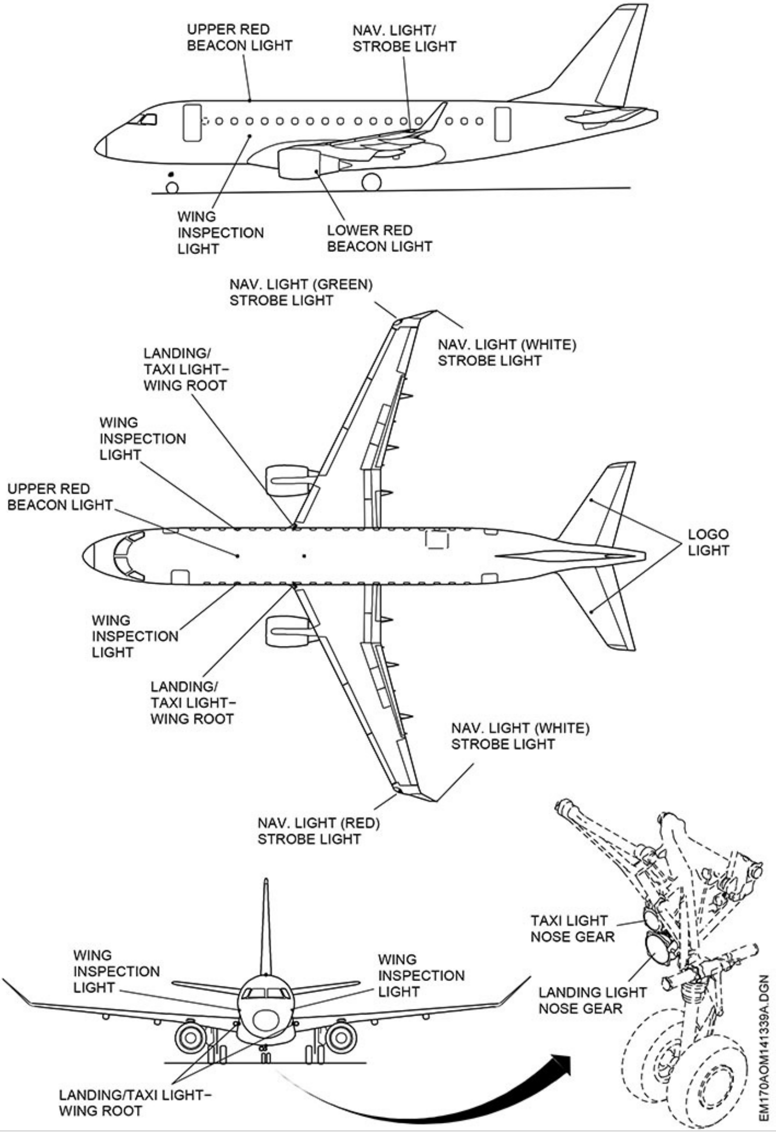
WING INSPECTION, LOGO AND OVERWING EMERGENCY LIGHTS

Provide proper illumination of the engine intake and of the wing leading edges of the wings for the flight crew to inspect for ice formation. A switch located at the overhead panel controls the engine and wing illumination light system.

The logo lights are installed in the upper surface of both horizontal stabilizers and are directed to the vertical fin perpendicular to the centerline of the airplane, in order to provide adequate illumination of the airplane’s logo during operation on the ground and in flight. A switch located at the overhead panel controls the logotype lights.

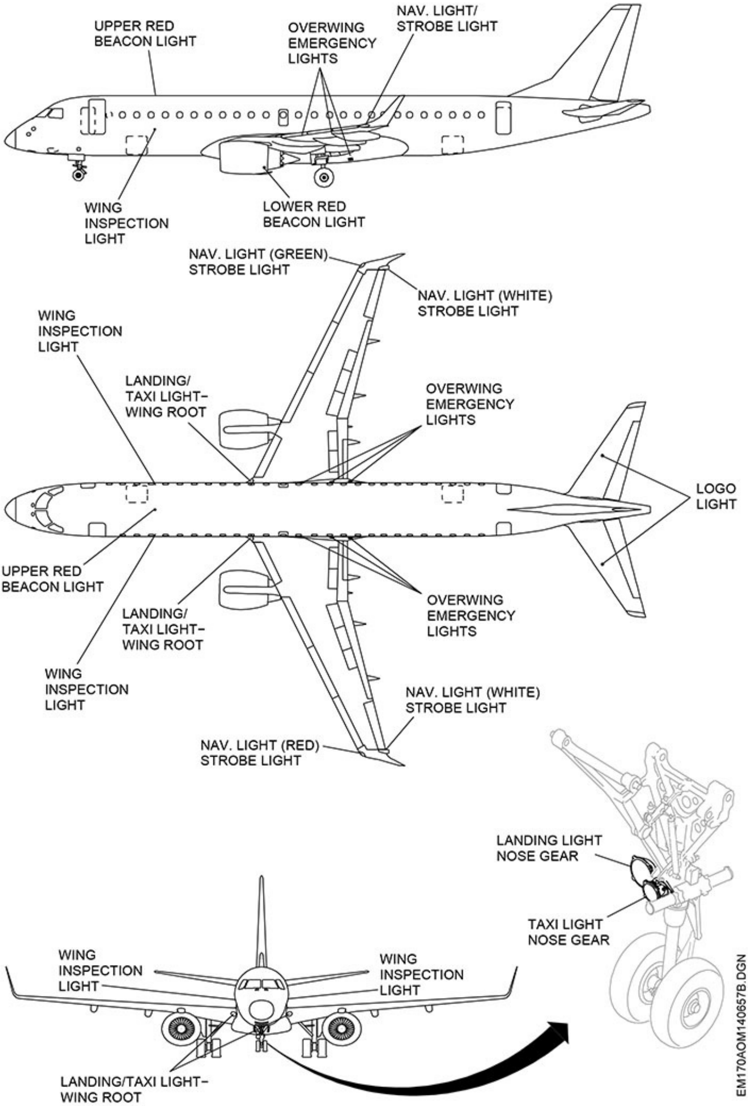
E190 only: The overwing emergency lights are composed of three route lights at each side, located near of overwing emergency exits. The EMER LT knob at the overhead panel controls the overwing emergency lights.

E175:



EXTERNAL LIGHTING

E190:



EXTERNAL LIGHTING

INTERNAL LIGHTING

COCKPIT LIGHTS

Cockpit lighting consists of:

- Chart lights.
- Dome lights.
- Fluorescent flood/storm light.
- Reading lights.

The system provides lighting for instruments, control panels and buttons.

CHART LIGHTS

Provide variable intensity lights to illuminate chart holders located at the cockpit side windows.

DOME LIGHTS

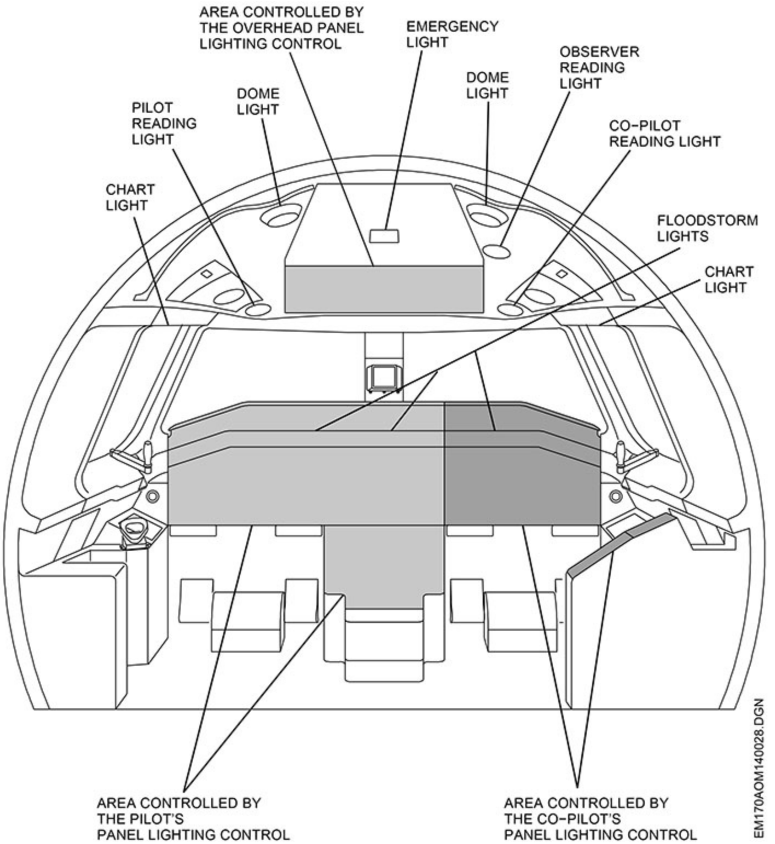
Provide fixed intensity cockpit illumination above Captain and First Officer’s seats.

FLUORESCENT FLOOD/STORM LIGHT

Provide high quality illumination to ensure panel readability under high intensity ambient lighting (lightning).

READING LIGHTS

Provide illumination to help the pilots read maps, check lists and manuals.



COCKPIT LIGHTS

COURTESY AND STAIRS LIGHTS

Provide lighting for safe boarding of crewmembers and passengers. Courtesy and stair lights consist of the main door light (entry area), service door light (galley area), stairway lights and cockpit step light.

PASSENGER CABIN LIGHTS

A general passenger cabin illumination, reading lights in the passenger service unit, lavatory lights, galley lights and cabin signs make up the passenger cabin lighting.

PASSENGER CABIN SIGNS

Passenger cabin signs provide passengers and flight attendants with signs like:

- NO ELECTRONIC DEVICES.
- FASTEN SEAT BELTS.
- RETURN TO SEAT.
- LAVATORY OCCUPIED.

The signs are available on every passenger service unit (PSU). An aural signal sounds whenever any passenger sign is turned on or off by the crew. NO ELECTRONIC DEVICES and FASTEN SEAT BELTS signs are also activated when the oxygen dispensing units are open.

STERILE LIGHTS

Amber sterile light located on the cockpit/passenger partition indicates when entry into the cockpit is not allowed. An aural signal sounds whenever the sterile light is illuminated.

SERVICE COMPARTMENT LIGHTS

Provide lighting in the service compartments for quick inspection and accomplishment of several tasks. Service lights are installed in the refueling panel, mid and forward electronic bays, APU, tail cone and rear hydraulic compartment.

The lights are controlled by door micro-switches or dedicated standard switches installed in each compartment, which turn on the associated light when the access door is open.

RAINBOW LIGHTS

The rainbow lights located on the forward and aft main ceiling panel areas provide a visual indication to attendants when there is a call from the flight crew or passengers.

The rainbow lights consist of the following colored indicator lights:

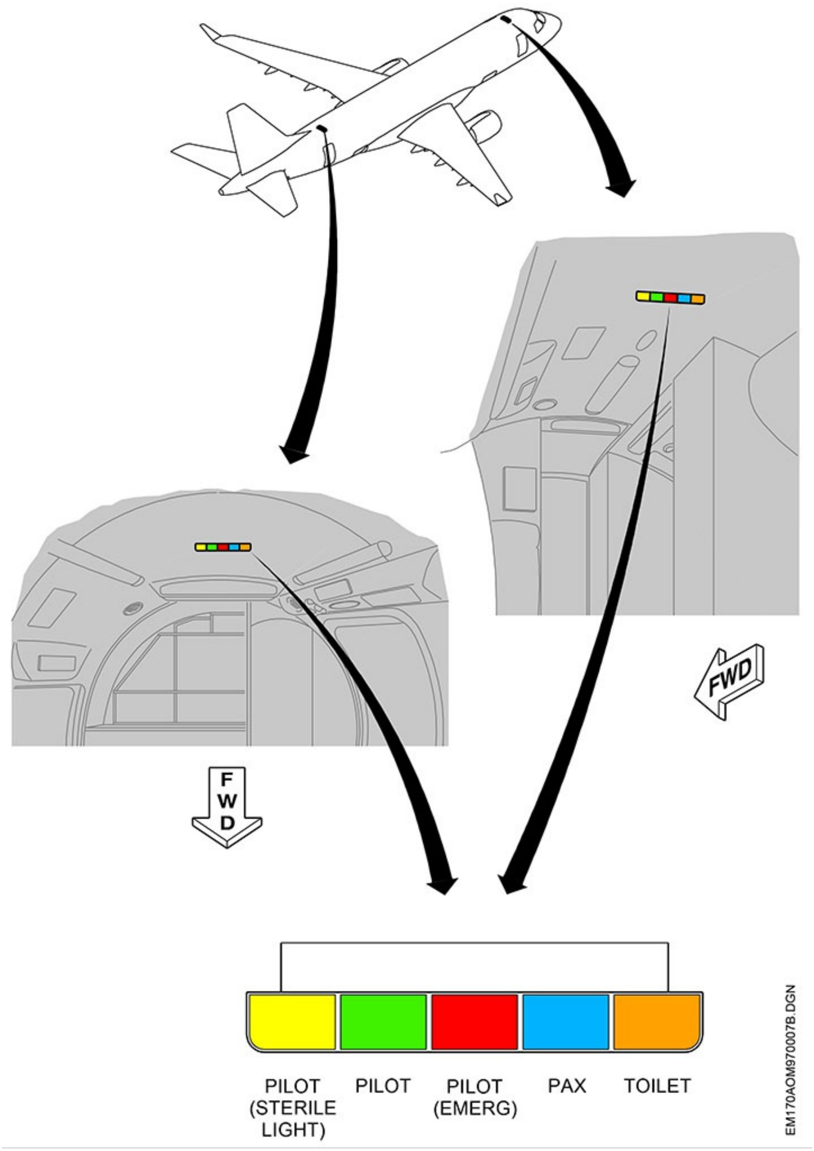
- ORANGE: a steady orange light illuminates when a passenger calls from the lavatory. Flashing orange light illuminates when smoke is detected in the lavatory.
- BLUE: a steady blue light illuminates when a passenger calls from the main cabin area.
- RED: a flashing red light illuminates when the flight crew makes an emergency call to the flight attendant from the cockpit. The light stops flashing after the call is taken.
- GREEN: a flashing green light illuminates when the pilot calls the flight attendant from the cockpit. The light stops flashing when the call is taken.
- AMBER: a steady amber light illuminates for a sterile light call.

An audible tone is sounded by the passenger address system whenever a passenger presses any attendant call switch located in a PSU or the attendant call switch in the lavatory or flight crew call switches. There is also a blue steady light on the cabin ceiling, indicating from which cabin area the respective passenger call was made.

NOTE: There is no indication on the rainbow lights when a flight attendant calls another flight attendant station. It only flashes green on both handset cradles.

CALL SYSTEM TABLE

Visual Indication	Aural Indication	From	To
Steady ORANGE light	Single hi tone chime	Respective lavatory call	Attendant station
Flashing ORANGE light	Lavatory fire protection alarm	Respective lavatory smoke detection	Attendant station
Steady BLUE light	Single hi tone chime	Passenger PSU	Attendant station
Flashing RED light	Triple hi/lo tone chime in PAX cabin	Cockpit	Attendant Station
	Single hi/lo tone chime in cockpit	Attendant station	Cockpit
Flashing GREEN light.	Single hi/lo tone chime in PAX cabin	Cockpit	Attendant Station
	Single hi/lo tone chime in cockpit	Attendant station	Cockpit
AMBER sterile cockpit light	Single hi tone chime	Cockpit	Attendant station
Electronic devices or fasten belt signs illuminate/ extinguish	Single lo tone chime	Cockpit	Passenger cabin, lavatories and galleys



ATTENDANT LIGHTS (RAINBOW LIGHTS)

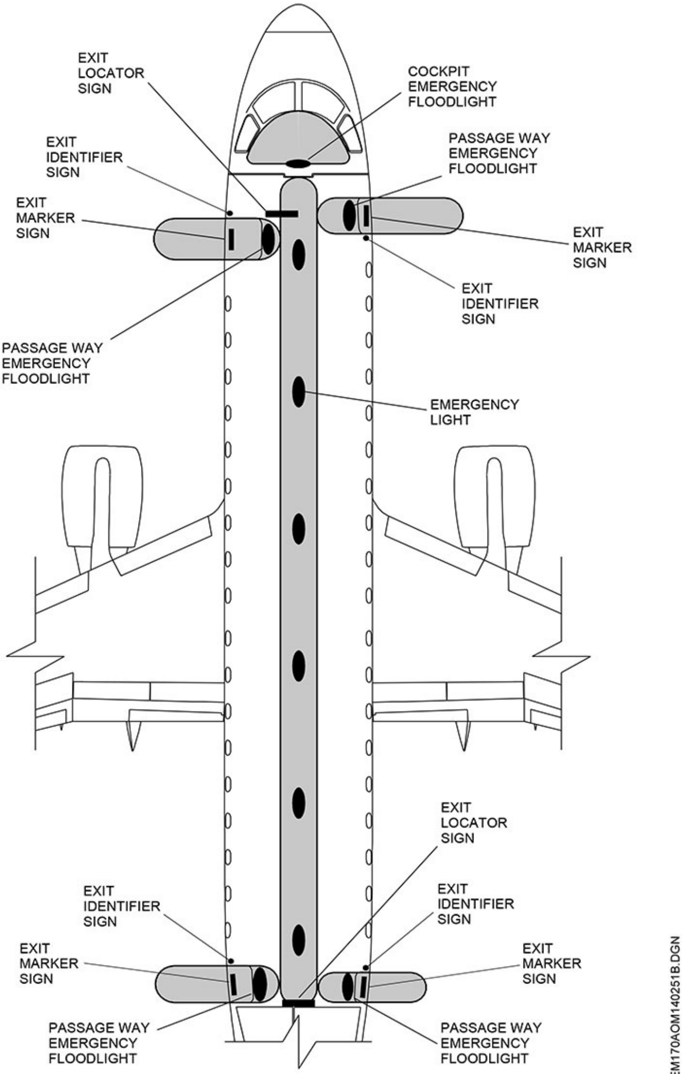
EMERGENCY LIGHTING

Emergency lighting consists of internal and external lights. The internal emergency lights are powered by four (E175) or six (E190) dedicated Emergency Lights Power Units (ELPU) with internal batteries connected to the DC BUS 1. The charge of the batteries is sufficient to supply all emergency lights for approximately 10 minutes. External emergency lighting is provided by led lights on each escape slide and, E190 only, by three route overwing lights at each side of airplane.

A switch located in the cockpit enables the pilots to turn ON, OFF or ARM the emergency lights. Additional switches on the FWD and AFT Flight Attendant Panels enable flight attendants to turn ON or OFF (ARM) the emergency lights. In ARM mode (cockpit switch), the emergency lights are activated automatically when the airplane loses its normal electrical power.

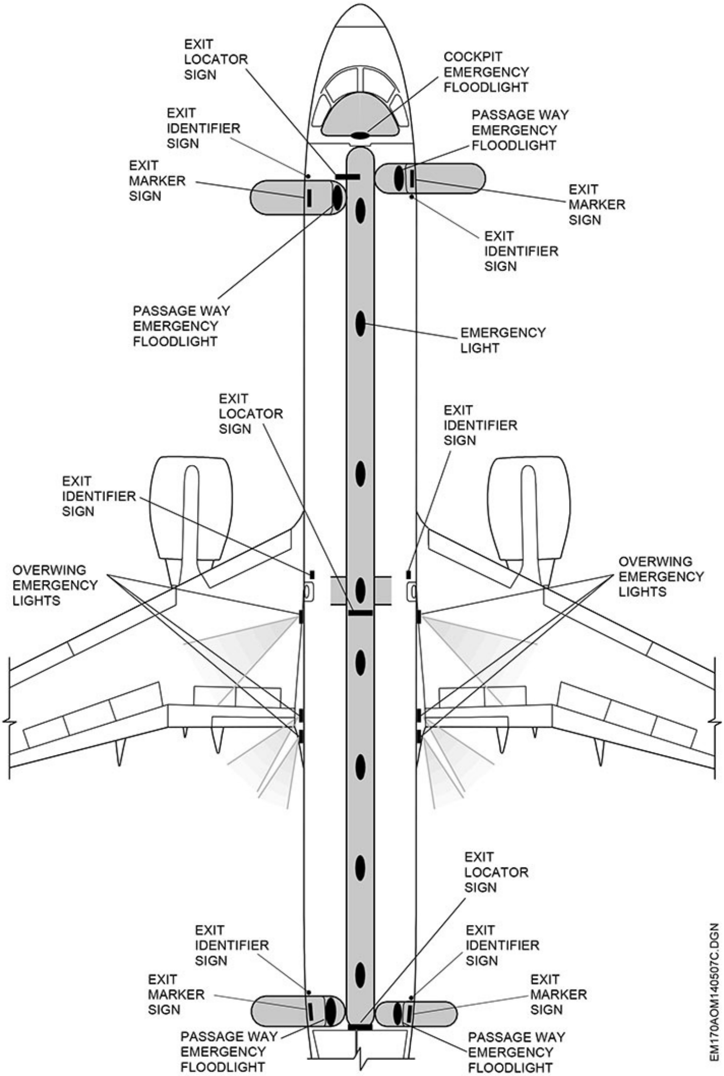
Internal emergency lights comprise the exit locator signs, exit marker signs, exit identifier signs, cabin/cockpit emergency floodlights and passageway emergency exit floodlights. A cockpit light is located at the cockpit ceiling and provides general emergency illumination of the cockpit area.

E175:



EMERGENCY LIGHTING

E190:



EMERGENCY LIGHTING

PHOTOLUMINESCENT STRIPS

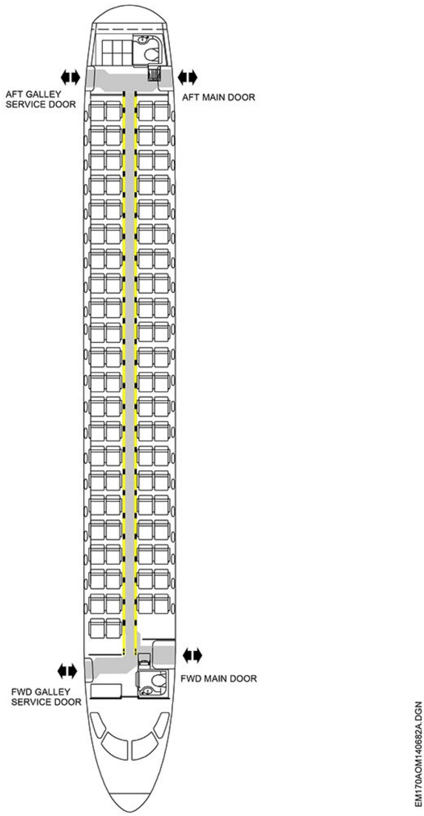
Photoluminescent strips are installed along the passenger cabin floor to provide means of identifying the emergency escape path even in dense smoke conditions. Double red dots on the strips indicate the end of each exit path.

Photo luminescent escape path strips must be charged prior to the first flight of the day by interior cabin lighting.

For 15 minutes of ceiling and entrance cabin lighting exposure in BRIGHT mode the strip luminescence will be available for 7 hours.

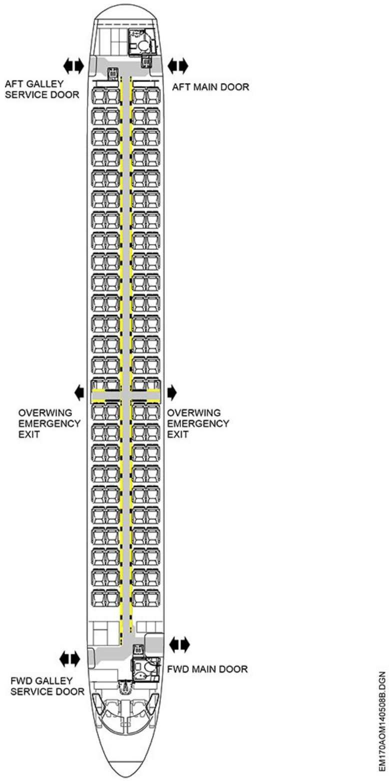
Luminescence time is not limited if during flight either daylight or cabin lighting exist in the cabin.

E175:



PHOTOLUMINESCENT STRIPS

E190:



PHOTOLUMINESCENT STRIPS

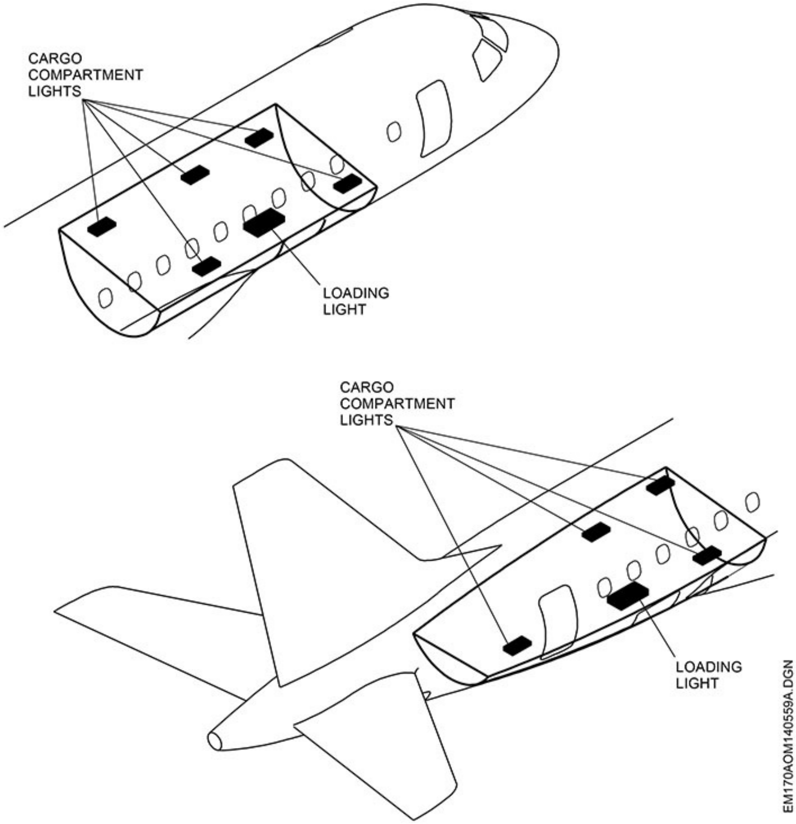
CARGO COMPARTMENT LIGHTS

The forward cargo bay has 5 (E175) or 6 (E190) cargo lights and 1 loading light and the aft cargo bay has 4 (E175) or 5 (E190) cargo lights and 1 loading light.

There is a manual switch located at each cargo door that gives “AUTO” and “OFF” selections. In “AUTO” mode, the cargo lights come on when the cargo door is opened and turn off when the door is closed. The “OFF” mode turns off the lights regardless of the door position.

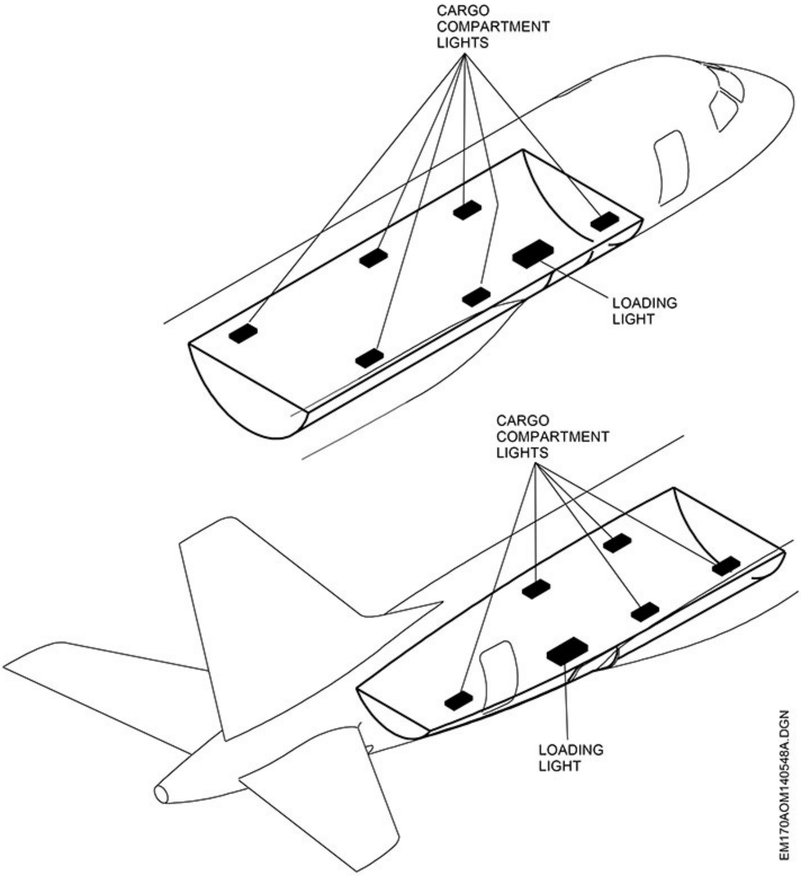
The cargo lights have protective grills installed to protect them against damage from the cargo.

E175:



CARGO COMPARTMENT LIGHTS

E190:



CARGO COMPARTMENT LIGHTS

14.01.45 DOORS

This airplane has two jetway passenger doors on the left side (forward and aft location), two jetway service doors on the right side (forward and aft location), and a number of access doors for different airplane systems along the fuselage.

E190: Two overwing emergency exit doors are located one on each side of the airplane, centered over the wing.

PASSENGER AND SERVICE DOORS

This airplane has one passenger door located at the left forward fuselage section and another located at the aft fuselage section. Passenger door operation is manual and it is identical for both passenger doors. Passenger doors are plug type and they are of type 1 design.

One service door is located at the right forward fuselage section and another located at the aft fuselage section. Service doors are used for galley servicing and cabin cleaning between flights. It may also be used as an emergency exit. The operation of service and passenger doors is identical.

One external, three internal handles and one vent flap are installed in each door for opening and closing operation.

Refer to FSIM for detailed description of passenger and service door operation.

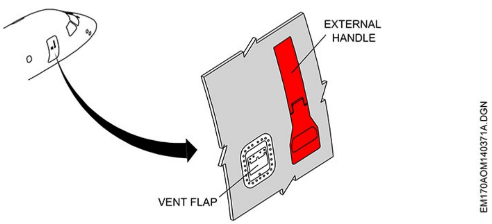
DOOR EXTERNAL HANDLE

The vent flap function ensures the correct latching and locking of the door so that the airplane can be pressurized.

The vent flap also ensures that there is no residual indoor pressure on the ground before the door opening.

The escape slide is automatically disarmed when door is opened from outside. The vent flap opens automatically when the lower part of the external handle is pulled.

For further information on the escape slide refer to escape slide description in this section.



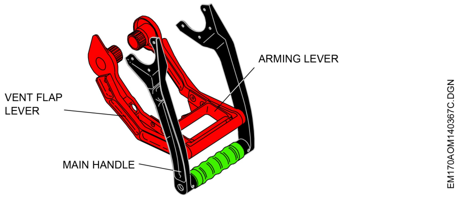
EXTERNAL HANDLE AND VENT FLAP

DOOR INTERNAL HANDLES

The main handle activates the door's latch mechanism.

The vent flap and door's lock mechanism are linked together. The airplane pressurization loads the vent flap against the door structure. The effort required to unlock the door (lift the vent flap lever) increases with the airplane pressurization level.

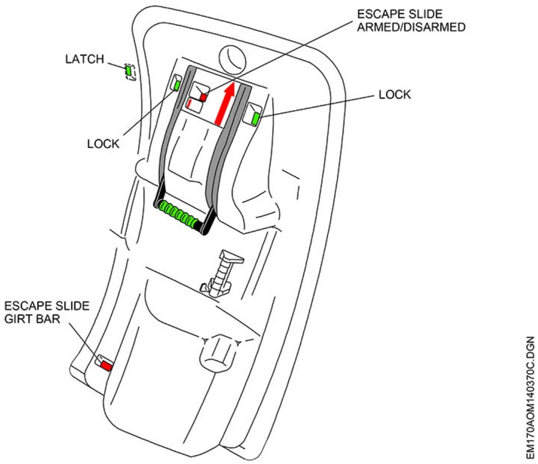
The arming lever arms/disarms the emergency system (escape slide and door's emergency assisting system) and engages/disengages the girt bar.



INTERNAL HANDLES

DOOR INDICATIONS

One green latch and two green lock indications are provided to ensure the door is secured in the locked position. An escape slide ARMED/DISARMED indication provides the escape slide armed/disarmed condition. A red indication in the bottom of the door provides means to verify if the girt bar is engaged.



DOOR INDICATIONS

Door indications change according to the handle's position.

MAIN HANDLE DOWN

- Door: Closed
- Latch indication: GREEN

MAIN HANDLE UP

- Door: Open
- Latch indication: NO green indication

VENT FLAP LEVER DOWN

- Vent flap: Closed
- Lock indications: GREEN

VENT FLAP LEVER UP

- Vent flap: Open
- Lock indications: NO green indications

ARMING LEVER DOWN

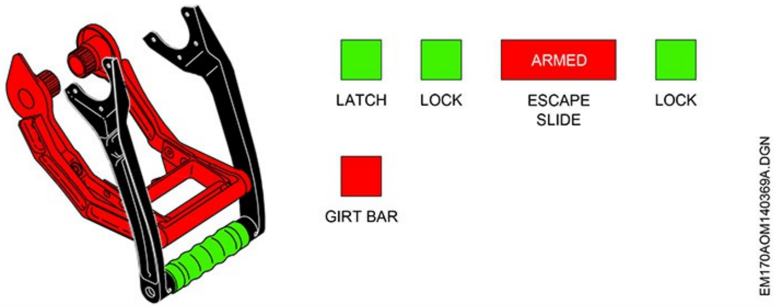
- Escape slide: Armed
- Escape slide indication: RED ARMED
- Girt bar indication: RED – girt bar connected to airplane.

ARMING LEVER UP

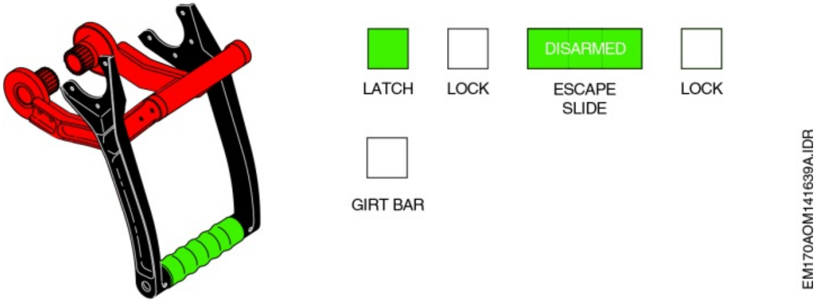
- Escape slide: Disarmed
- Escape slide indication: GREEN DISARMED
- Girt bar indication: NO red indication – girt bar disconnected from airplane.

The following door indications are displayed for different internal handles positions.

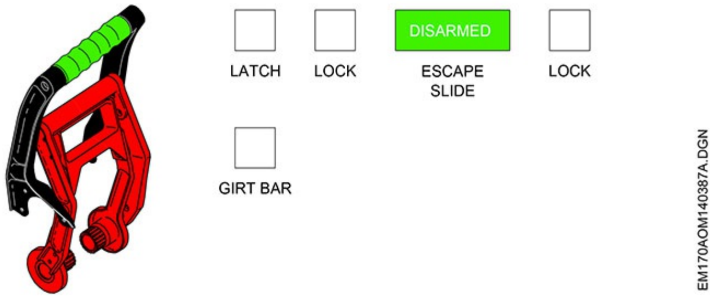
- Main handle DOWN (Door closed and latched)
- Vent Flap lever DOWN (Vent Flap closed and door locked)
- Arming lever DOWN (Escape Slide ARMED)



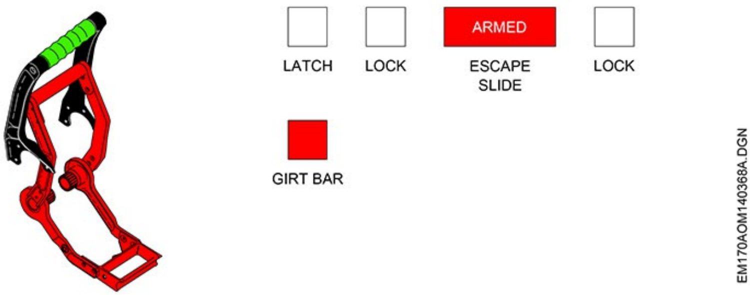
- Main handle DOWN (Door closed and latched)
- Vent Flap lever UP (Vent Flap opened and door unlocked)
- Arming lever UP (Escape Slide DISARMED)



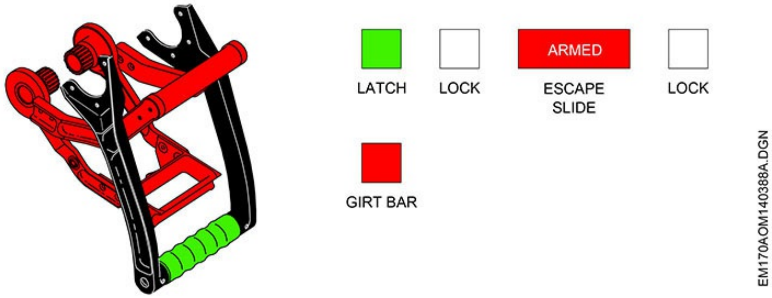
- Main handle UP (Door unlatched and opened)
- Vent Flap lever UP (Vent Flap opened and door unlocked)
- Arming lever UP (Escape Slide DISARMED)



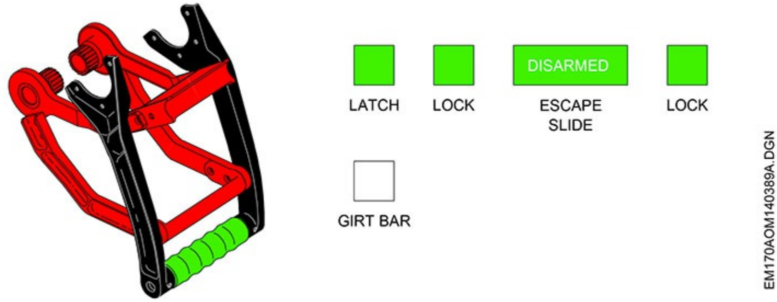
- Main handle UP (Door unlatched and opened)
- Vent Flap lever UP (Vent Flap opened and door unlocked)
- Arming lever DOWN (Escape Slide DEPLOYED)



- Main handle DOWN (Door closed and latched)
- Vent Flap lever UP (Vent Flap opened and door unlocked)
- Arming lever DOWN (Escape Slide ARMED)



- Main handle DOWN (Door closed and latched)
- Vent Flap lever DOWN (Vent Flap closed and door locked)
- Arming lever UP (Escape Slide DISARMED)



EMERGENCY EXITS

Both service and passenger doors are designed as type I emergency doors. Emergency slides are provided at both passenger and service doors. The direct vision windows in the cockpit are designed as emergency exits.

Opening the door from inside in emergency mode will activate the Emergency Assisting System that will fully open the door after lifting up the main internal handle. The Emergency Assisting System is installed in passenger and service doors.

In case of ditching, all emergency exits are supposed to be over the water line.

E190: OVERWING EMERGENCY EXITS (OWE)

Two Overwing Emergency Exit doors (OWE) exist for passenger evacuation in the event of an emergency. They are located on each side of airplane, centered over the wings. The OWE doors are designed as type III emergency doors.

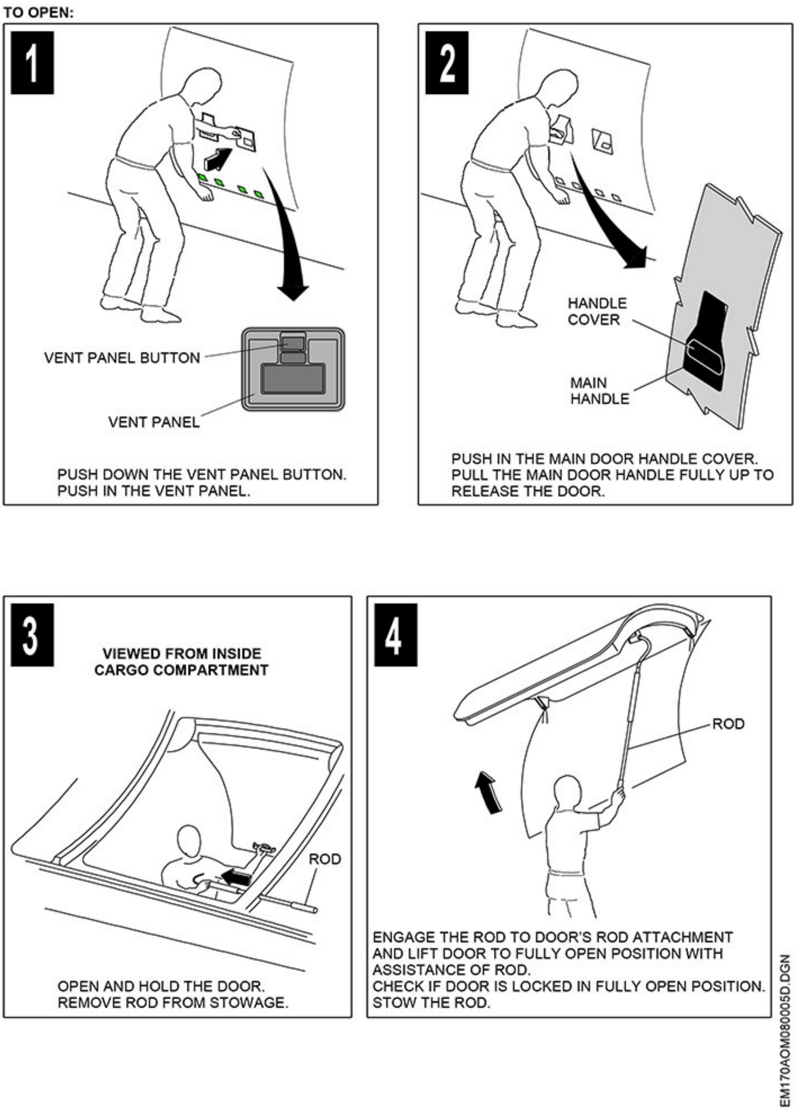
The OWE can be opened from inside or from outside. They can be closed only from inside. Green indication windows at the door ensure that the door is locked.

Refer to FSIM for detailed description of overwing exit operation.

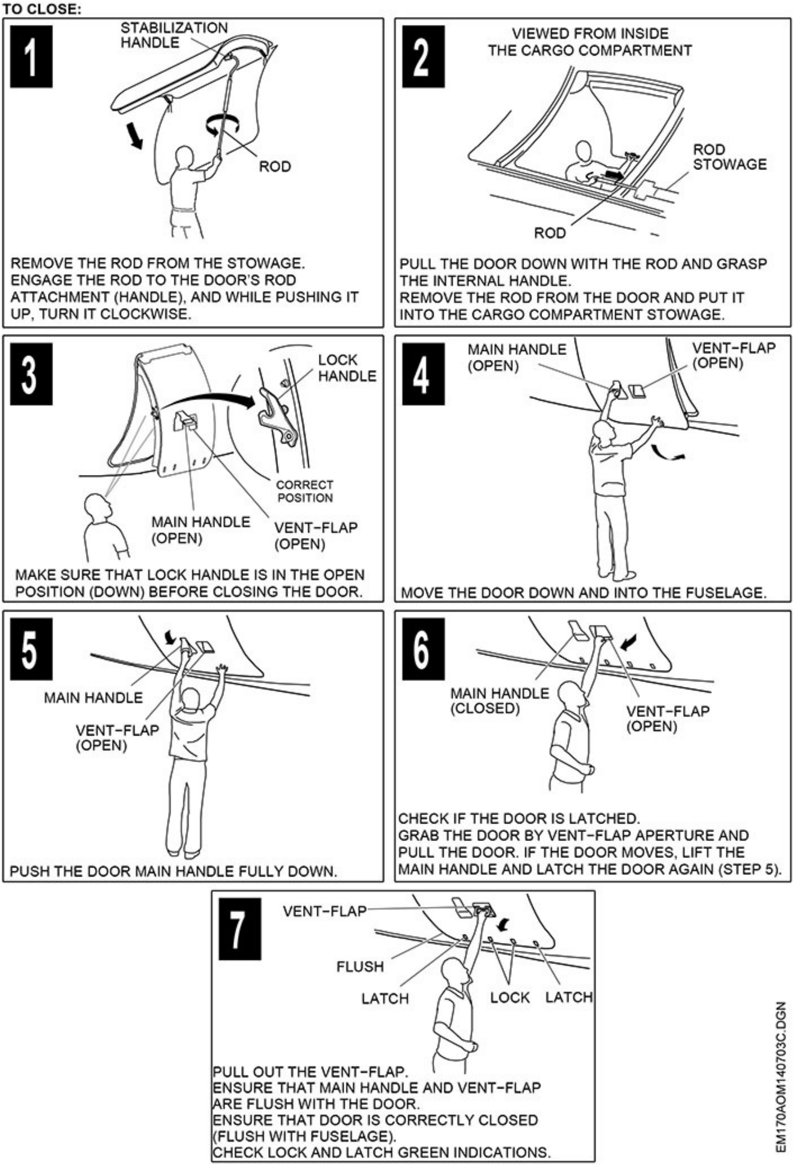
CARGO DOORS

The cargo doors located aft and forward of the wing on the right side of the fuselage are manually operated from the outside. They have a locking mechanism controlled by an external handle, stowed in the lower half of the door. The vent flap prevents pressurization of the airplane above 0.5 psi when the door is not fully closed, latched and locked. The cargo doors open outwards and are hinged along the upper edge and are latched at the lower edge with four hooks.

CARGO DOORS OPENING



CARGO DOORS CLOSING

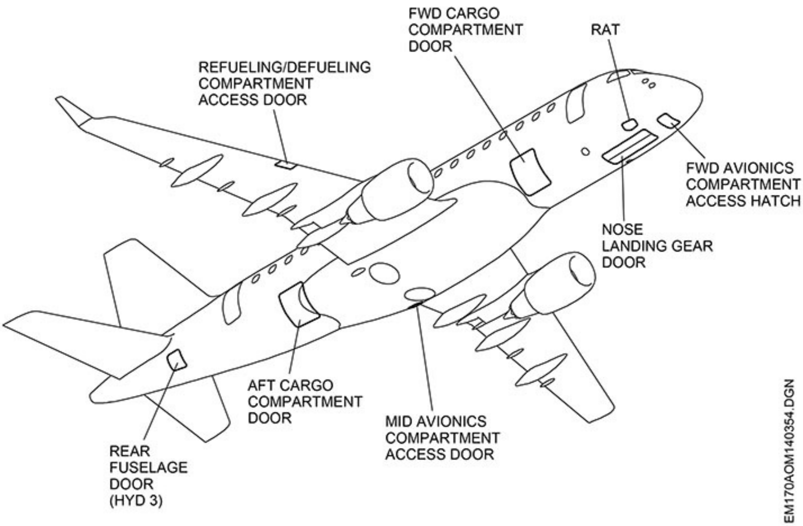


ACCESS DOORS

A number of access doors, which provides access for servicing the airplane systems and equipment, can be found along the fuselage.

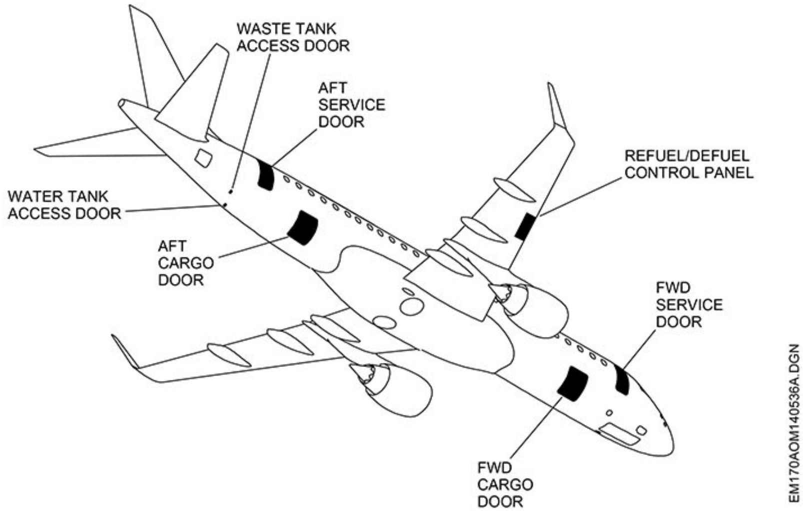
- Forward avionics compartment access door.
- Mid avionics compartment access door.
- Fueling/defueling compartment access door.
- Rear fuselage door.

E175:



ACCESS DOORS

E190:



ACCESS DOORS

DOORS WARNING SYSTEM

Door warning is provided for all external and access doors and hatches in the pressurized vessel. Proximity sensors processed by the proximity sensor evaluation modules (PSEM), monitor the doors.

An EICAS message displays whenever an unlocked condition of any external door has occurred. Additionally the MFD indicates the open door condition in a graphical representation.

14.01.50 ESCAPE SLIDE

The escape slides are designed to provide passengers and crew a means to safely descend from the airplane to the ground during an emergency evacuation. In the event of emergency evacuation, the slides deploy automatically when the exit door is opened.

Upon completion of the inflation sequence, the slide is fully inflated and ready to assist passengers and crew in descending to the ground.

The emergency evacuation slides are equipped with a lighting system independent from the airplane. The unfolding process activates the lighting system illuminating the sliding surface and the area where evacuees make first contact with the ground. A battery contained within the slide provides electrical power to the lights.

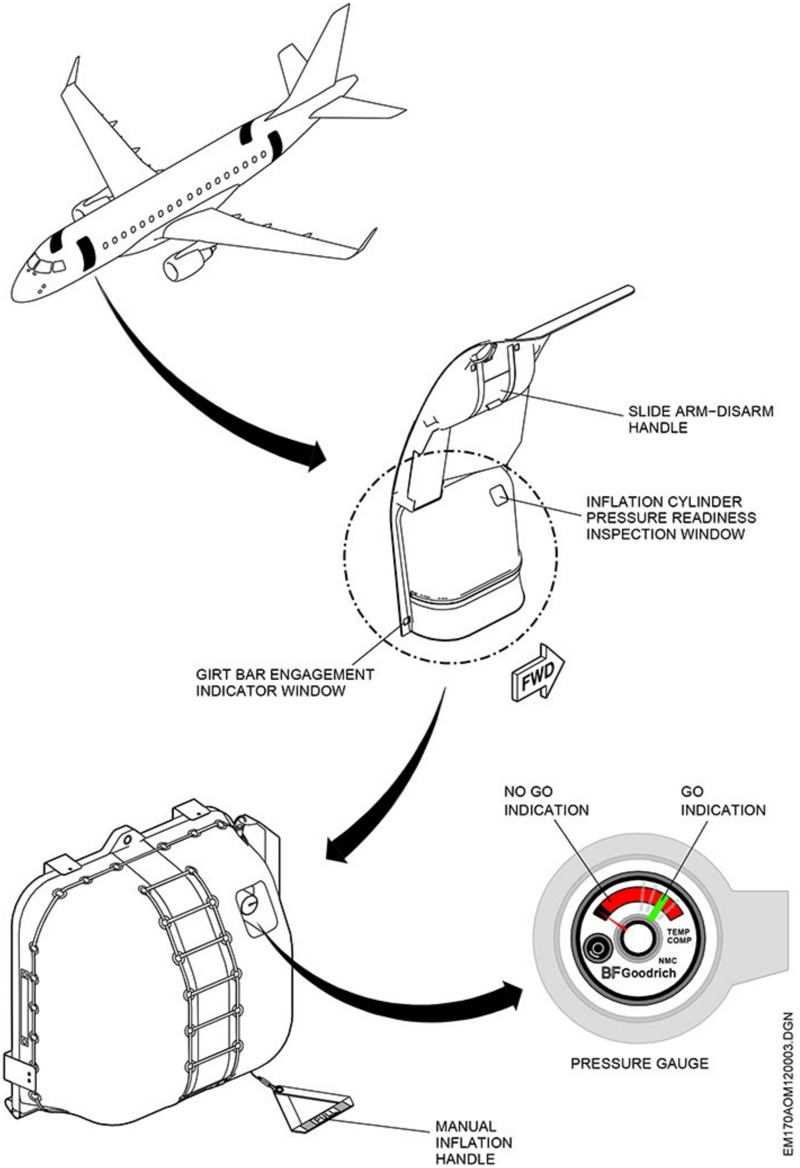
The escape slides are armed by raising the slide arming lever cover located on the door and moving the slide arming lever to the “armed” position (down). The lever movement attaches the girt bar to the cabin floor brackets. The escape slide is attached to the girt bar by means of a fabric girt.

Opening the door from the outside automatically disengages the girt bar from the floor fittings, disarming the slide.

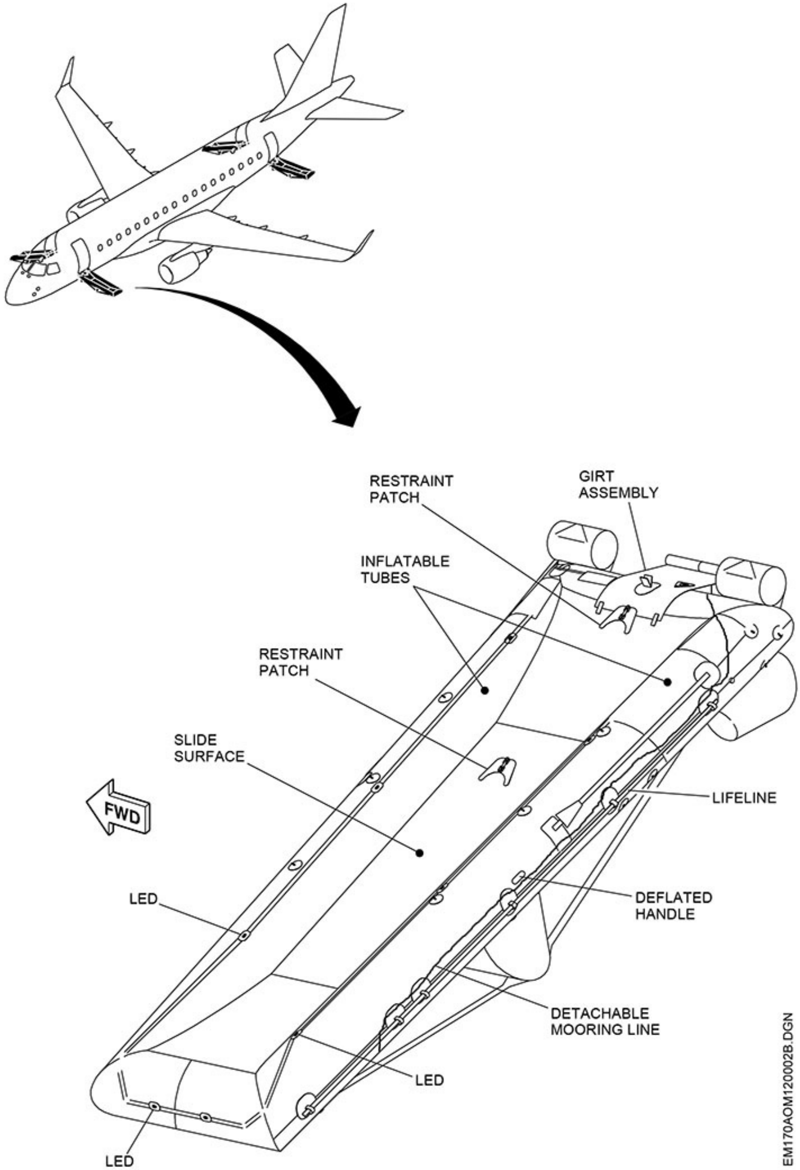
A dedicated battery powers the escape slide lights, which will be on for a minimum of 10 minutes even after the escape slide is disconnected.

The escape slide may be used as a flotation device after disconnection from airplane.

If the mooring line is not manually detached from the airplane in an emergency situation, the system is fail-safe in that the mooring line will break free from the slide if enough load is applied.

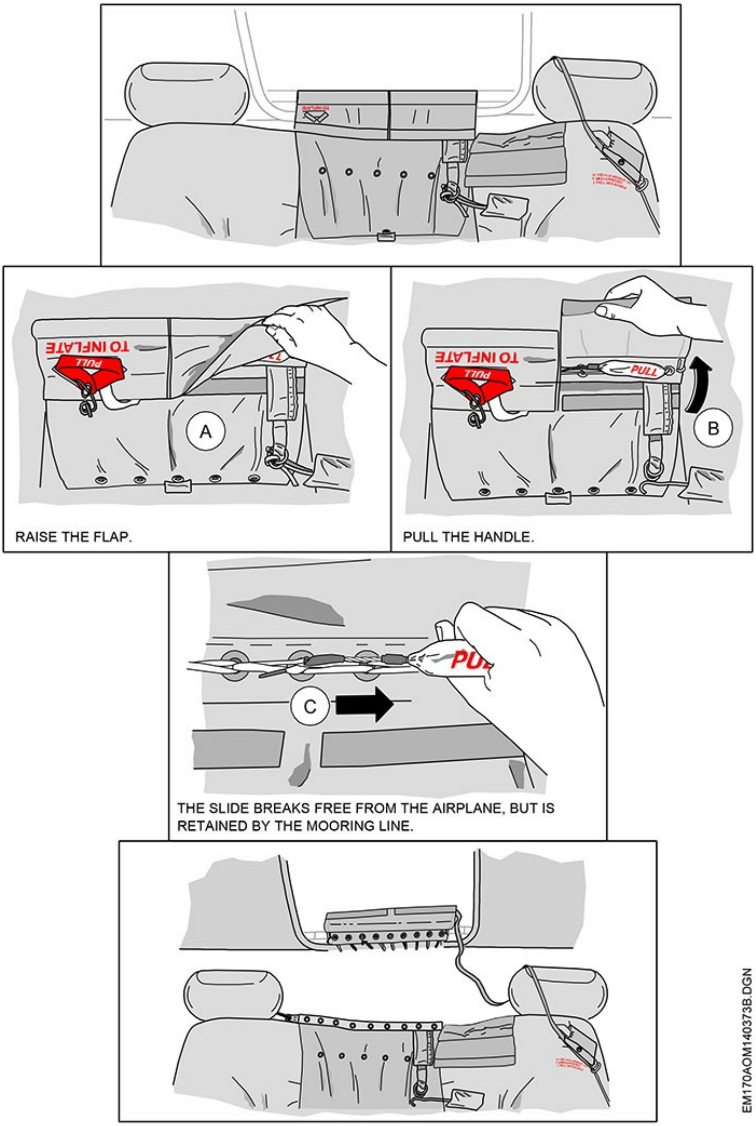


ESCAPE SLIDE – PACKED

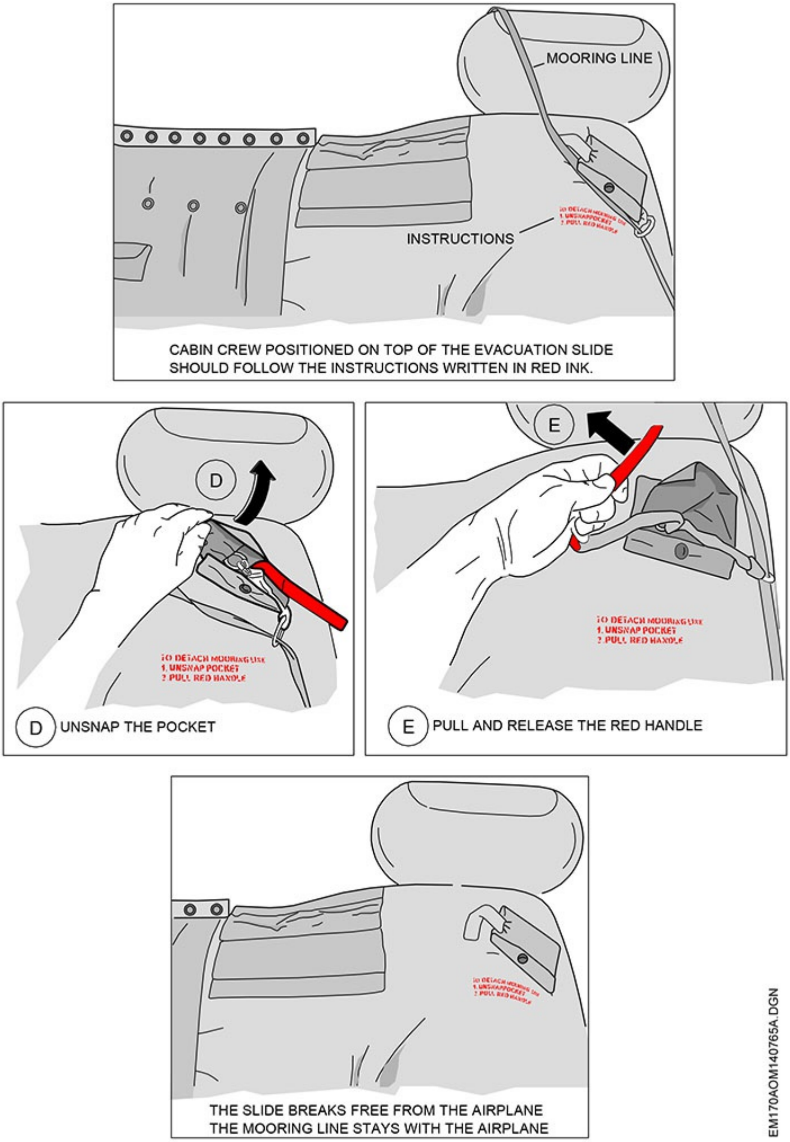


Escape Slide – Deployed

ESCAPE SLIDE DISCONNECTION



EM170AOM140373B.DGN



MOORING LINE DISCONNECTION

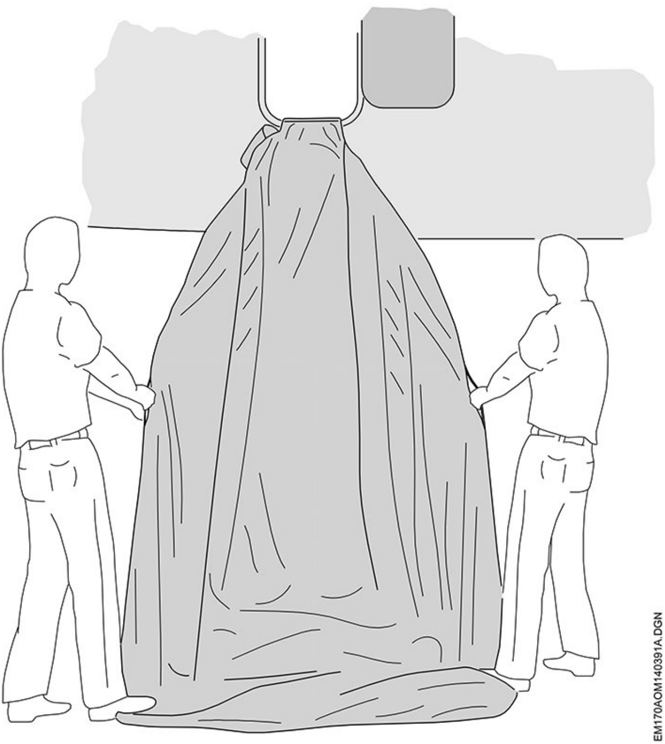
ABNORMAL OPERATION

The airplane escape slide is equipped with a manual inflation actuation control. In the event that the inflation system does not actuate automatically, the cabin attendant should pull on the manual inflation handle, which activates the inflation system and fully inflates the slide.

The airplane escape slide is designed to permit use with ground personnel assistance as a non-inflatable device in the event of puncture or tear. The resulting damage may render the device incapable of holding air and sustaining an inflated condition.

If the slide is not fully inflated during evacuation, people already positioned on the ground may pull the slide tightly by its handles while other passengers continue to evacuate the airplane.

DEFLATED ESCAPE SLIDE OPERATION

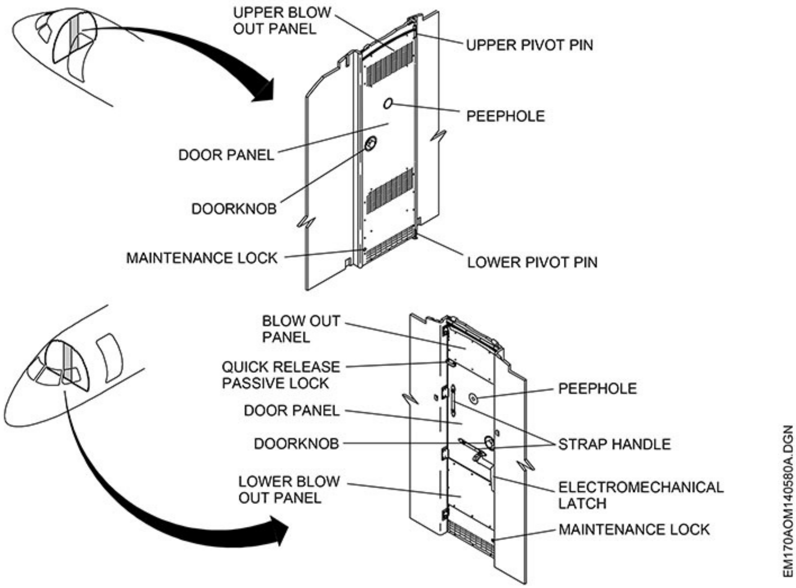


14.01.60 COCKPIT DOOR

REINFORCED COCKPIT DOOR

The Reinforced Cockpit Door is a ballistic and intrusion resistant door designed in accordance with requirements issued by international airworthiness authorities. The door weight is approximately 25,4 kg (56lb).

A Cockpit Door Control Panel and a passenger cabin control panel command the door latch. The door's electromechanical latch, installed on the cockpit side, can be remotely or manually operated.



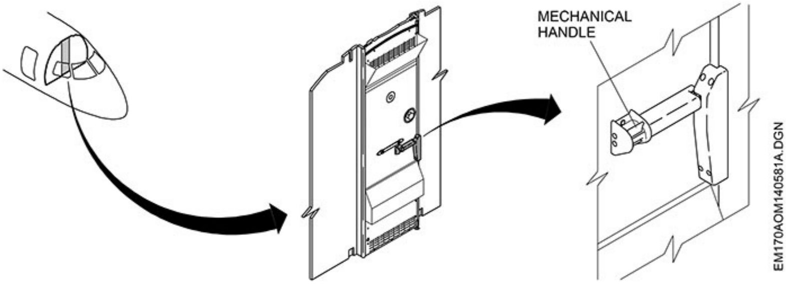
ELECTROMECHANICAL LATCH

AIRCRAFT WITH LATCH INSTALLED AT BULKHEAD

An electrically-actuated solenoid closes the electromechanical latch. The control panel in the cockpit sends an electrical pulse to the electromechanical latch, which actuates a bolt and locks the door. The door is unlocked when a new electrical pulse is sent to the electromechanical latch.

The DC BUS 2 powers the door's electromechanical latch. In case of electrical failure the door latch will stay in its previous setting. In this case the manual override inside the cockpit can be used to lock or unlock the door.

The door will not close if the electromechanical latch is locked while the door is opened. It is necessary to unlock the electromechanical latch to place the door to the closed position.



NOTE: The electromechanical latch will not open if the flight crew commands the reinforced cockpit door to UNLOCK while the door is pulled towards the cabin side. It is recommended to wait until latch is unlocked before pulling open the door. The sound of mechanism is heard when the latch unlocks.

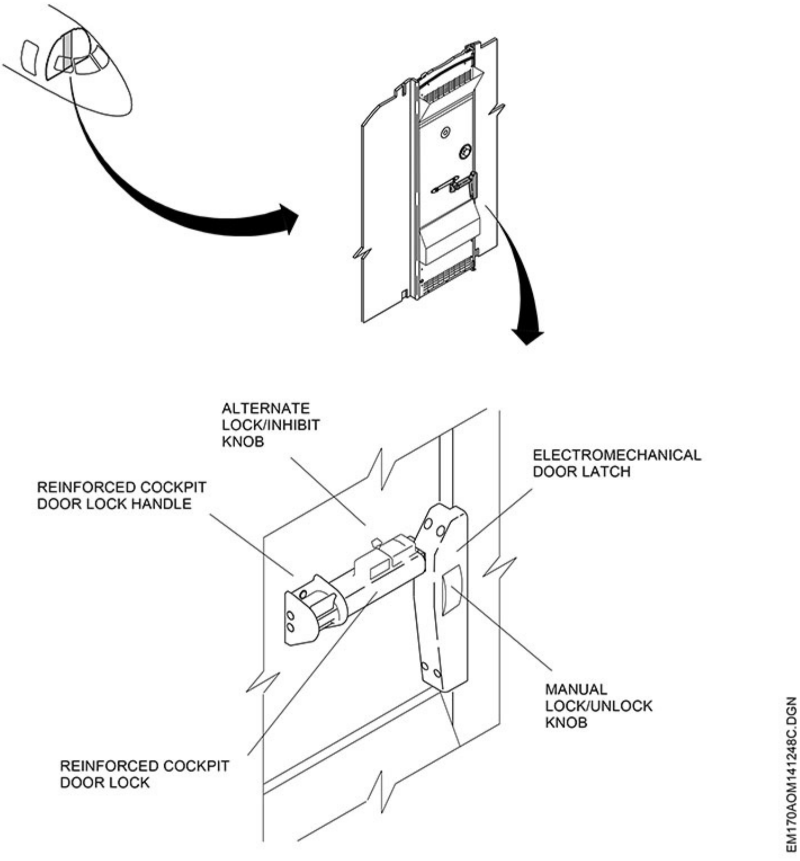
AIRCRAFT WITH ADAMS RITE DOORLOCK SYSTEM

The electrical operation is made through the cockpit control panel. An electrically-actuated solenoid closes the electromechanical latch. The control panel in the cockpit sends an electrical pulse to the electromechanical latch, which actuates a bolt and locks the door. The door is unlocked when a new electrical pulse is sent to the electromechanical latch. The DC BUS 2 powers the door's electromechanical latch. In case of electrical failure the door latch will stay in its previous setting.

The manual operation is made through the manual override lock/unlock knob located on the electromechanical latch. To lock, the manual override knob is moved upward until a stop is reached, then it is released. Once the manual override knob has come to rest, a green flag will be exposed. To manually unlock the electromechanical latch, the manual override knob is moved upward until a stop is reached, then the manual override knob is released. Once the manual override knob has come to rest, a red flag will be exposed. The lock/unlock indication (green/red flag) occurs independent of how the electromechanical latch is operated (electrically or manually).

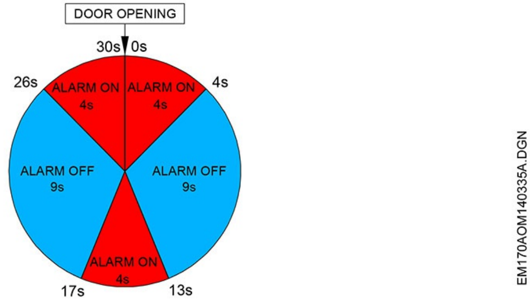
The door will not close if the electromechanical latch is locked while the door is opened. It is necessary to unlock the electromechanical latch to place the door to the closed position.

NOTE: The electromechanical latch will not open if the flight crew commands the reinforced cockpit door to UNLOCK while the door is pulled towards the cabin side. It is recommended to wait until latch is unlocked before pulling open the door. The sound of mechanism is heard when the latch unlocks.


ALTERNATE LOCK/INHIBIT KNOB
ELECTROMECHANICAL DOOR LATCH
REINFORCED COCKPIT DOOR LOCK HANDLE
MANUAL LOCK/UNLOCK KNOB
REINFORCED COCKPIT DOOR LOCK
EM170AOM141248C.DGN

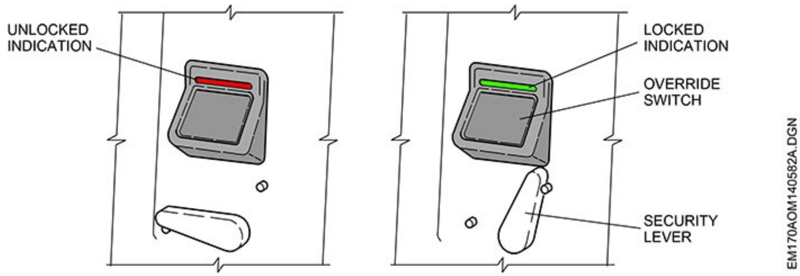
SYSTEM LOGIC

Actuating the EMERG ENTRY pushbutton starts the chime alarm sequence. The DING-DONG sound chime remains on for 4 s and is repeated three times at 9-s intervals during which the sound chime remains paused. After the third chime cycle ends, the door will unlock if the INHIB pushbutton is not pressed within 30 s after EMERG ENTRY pushbutton actuation.



Aircraft with Security Lever

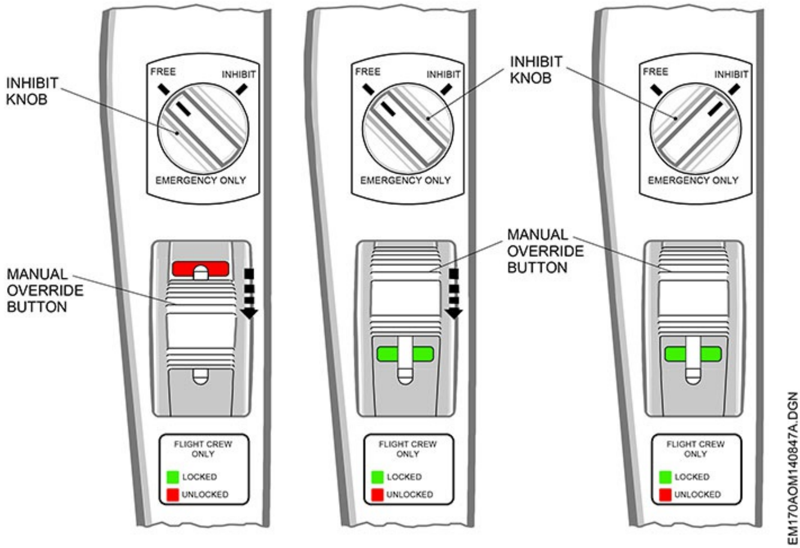
In case of failure in the inhibit function, the inhibit knob locks the override switch and prevents the door from opening 30 s after the beginning of the system's logic.



SECURITY LEVER

Aircraft with Inhibit knob

In case of failure in the inhibit function, the inhibit knob locks the manual override button and prevents the door from opening 30 s after the beginning of the system's logic.



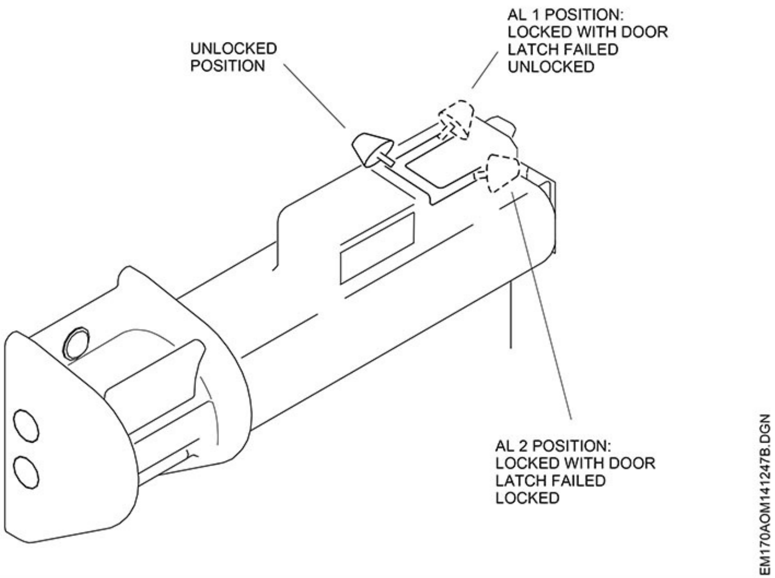
Alternate Lock/Inhibit Knob (Adams Rite system)

The alternate lock/inhibit knob must remain in the unlock position if the system is properly working.

In case the electromechanical latch is failed in the unlocked position, being not possible to lock it through the Cockpit Door Control Panel or using the manual lock/unlock knob, the door can be closed and locked positioning the Alternate Lock/Inhibit knob on AL 1. This position is also to be used as inhibit backup, if the electrical inhibit system is failed.

In case of the electromechanical latch is failed on the locked position being not possible to unlock it through the cockpit door control panel activation or using the manual lock/unlock knob, the door can be closed and locked positioning the Alternate Lock/Inhibit knob on AL 2.

To close and lock the door, in the case the electromechanical latch stuck failed, use Alternate Lock/Inhibit knob on AL 2 position. This condition overrides the door pin actuator, and avoids the occurrence of the door locked with no one in the cockpit.



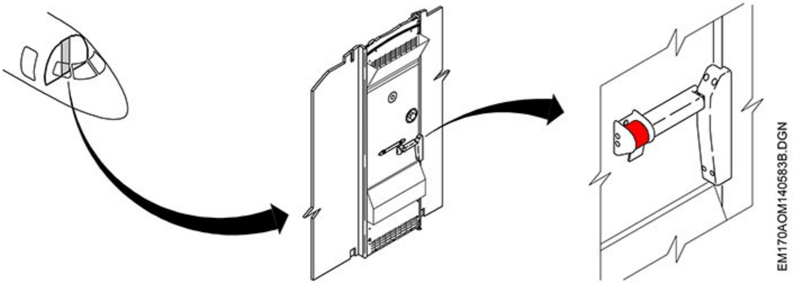
MANUAL OVERRIDE

AIRCRAFT WITH LATCH INSTALLED AT BULKHEAD

The latch locking system can be overridden by actuating either a mechanical handle installed on the door or a manual override button installed on the electromechanical latch.

The door lock bolt retracts by turning down the mechanical handle. It opens the door and allows an emergency egress. A red mark on the handle indicates that the door is unlocked. Turning the handle upwards will set the bolt to the LOCKED position.

NOTE: Latch manual operation through the mechanical handle must be used to override the locking system only in case of system electrical failure.



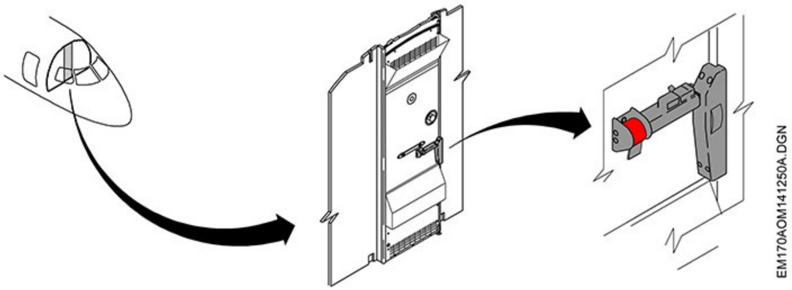
The manual override button installed in the electromechanical latch manually unlocks the door. Actuating downwards the manual override button alternates between locked and unlocked status. If the door is unlocked, a red indication is shown on the button. The door is locked when a green indication is shown.

AIRCRAFT WITH ADAMS RITE DOORLOCK SYSTEM

The latch locking system can be overridden by actuating either a mechanical handle installed on the door or a manual override button installed on the electromechanical latch.

The door lock bolt retracts by turning down the mechanical handle. It opens the door and allows an emergency egress. A red mark on the handle indicates that the door is unlocked. Turning the handle upwards will set the bolt to the LOCKED position.

NOTE:
- Latch manual operation through the mechanical handle must be used to override the locking system only in case of system electrical and/or mechanical failure.
- The alternate lock/inhibit knob must be set in the unlock position for manual override.

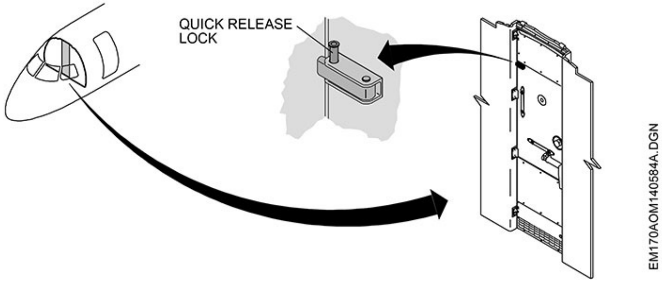


AUXILIARY LOCKS

PASSIVE LOCK

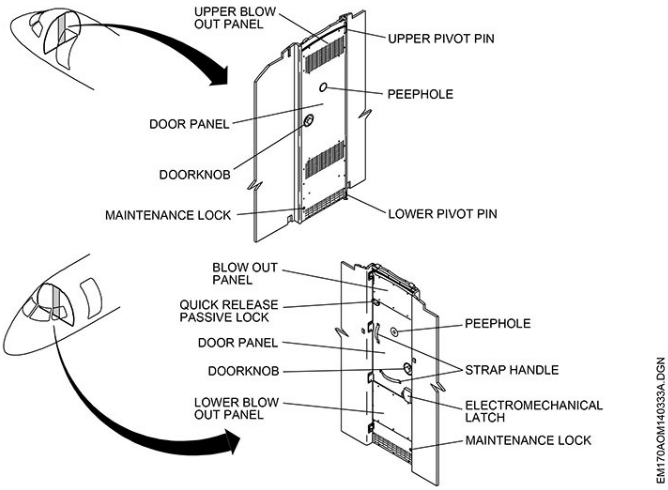
A passive lock installed on the cockpit door does not permit the door to be pushed towards the passenger cabin whenever the door is closed. The normal position of the quick release pin is locked. The passive lock is unlocked when the pin is removed.

NOTE: The passive lock must be unlocked only under emergency conditions, for an emergency cockpit egress procedure.



MAINTENANCE LOCK

A maintenance lock blocks the door during the airplane's overnight parking. A key is necessary to lock and unlock it. The keyhole is located on the passenger cabin side of the door.



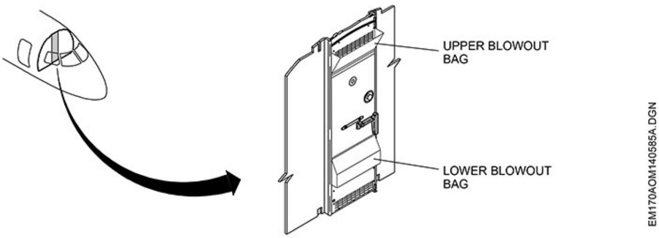
BLOWOUT PANELS

The reinforced cockpit door assembly possesses two blowout panels to equalize sudden decompression. When a sudden decompression occurs, the blowout bags automatically unfold and deploy forward.

The blowout bags are installed within grill-protected openings that maintain the door's full ballistic and impact-resistant characteristics even when deployed.

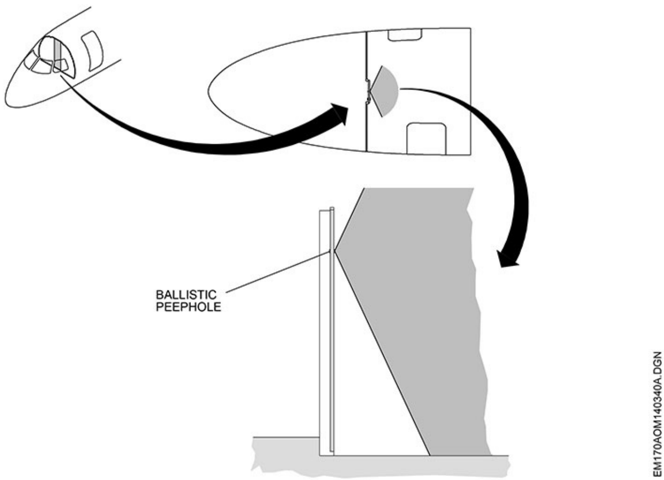
Both blowout bags can be deployed with the observer seat in use and without any type of interference or hazard to the observer.

A door grill opening equalizes the pressure in the event of decompression in the passenger cabin area.



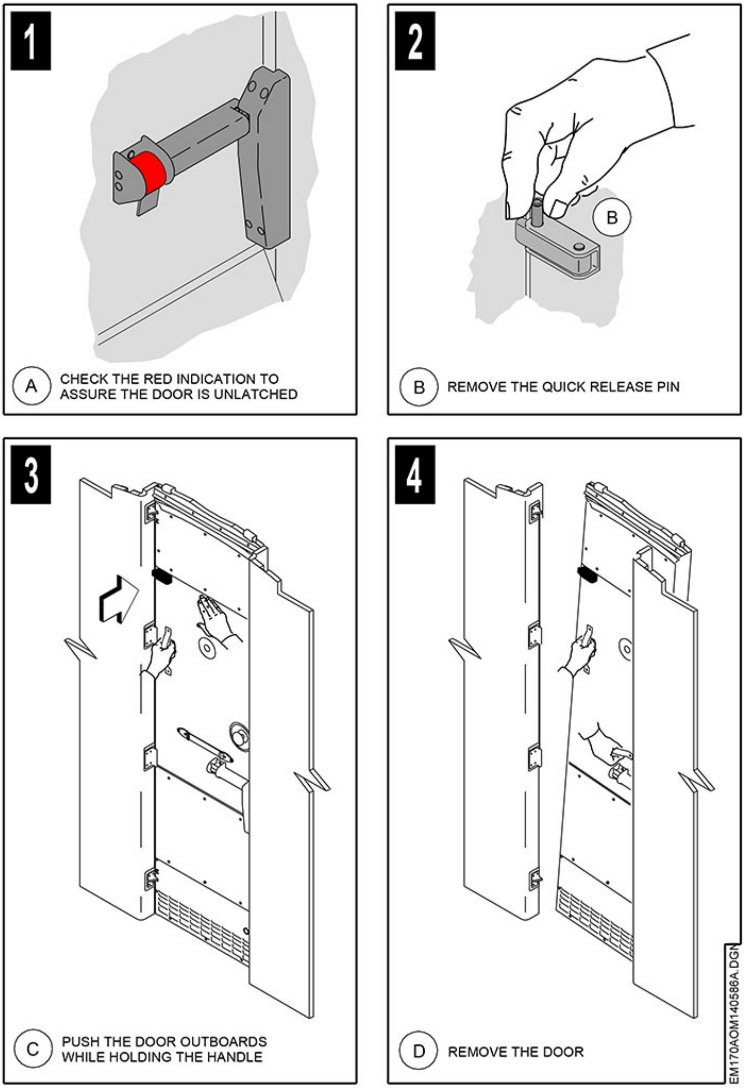
PEEPHOLE

The reinforced cockpit door is equipped with a ballistic-resistant peephole. The peephole field of view inhibits any hidden threats.

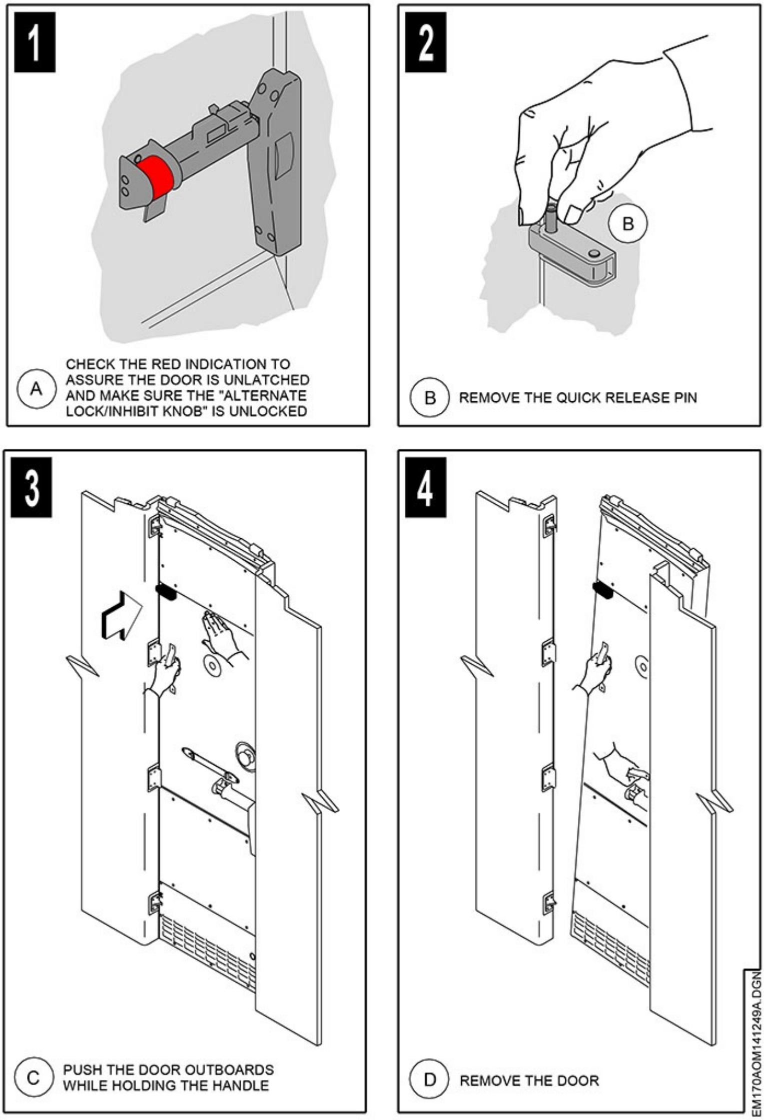


JAMMED DOOR EMERGENCY EGRESS

AIRCRAFT WITH LATCH INSTALLED AT BULKHEAD



AIRCRAFT WITH ADAMS RITE DOORLOCK SYSTEM



14.01.63 CABIN SURVEILLANCE SYSTEM (CSS)

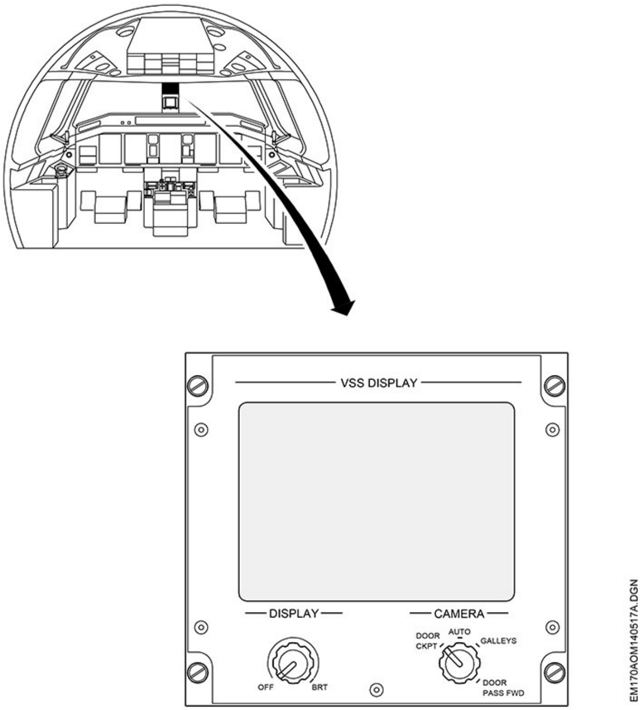
The Cabin Surveillance System (CSS) provides the means to monitor the entire door area outside the cockpit from either pilot's seat. It aids the flight crew with the identification of persons requesting entry to the cockpit and the detection of suspicious behavior or a potential threat.

The CSS is composed of three infrared video cameras and one video unit, above the compass and between the pilot seats. The DC BUS 1 powers the CSS.

VIDEO UNIT

Video display is achievable under all operational lighting conditions and provides sufficient resolution to clearly identify persons requesting entry into the cockpit.

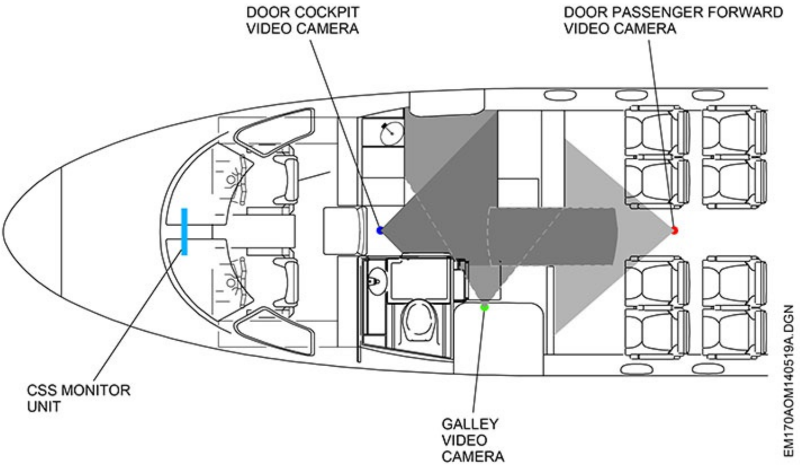
The information is viewable from each pilot's normal seated position preventing distractions to the flight crew which may hinder pilot performance of required tasks. The images transmitted to the video display are not recorded.



CSS VIDEO UNIT

VIDEO CAMERAS

One video camera provides images of the cockpit door area. A second video camera furnishes images of the forward pax doors area, and a third video camera covers the galleys area. The CSS field of view is limited to the forward area of the first row of passenger seats. The passenger seating area and aft galleys/doors area are not monitored.



CSS VIDEO CAMERAS LOCATION

14.01.65 WATER AND WASTE

WATER

A central storage tank holds potable water. Pressurized water is supplied to the heaters and faucets in the lavatories and water spigots, and coffee makers in the galleys. Water is also supplied for flushing of the vacuum toilets in the lavatories.

Engine and APU bleed air pressurizes the potable water system. If the engines or APU are not running on the ground, or bleed air pressure is below the optimal range during the flight, an optional air compressor pressurizes the water system.

The potable water storage tank's maximum capacity is configured to 110 liters. The AFT flight attendant panel indicates the percentage of total water quantity remaining in the tank.

The lavatory faucet has a single cap. Water flow is started by pressing the cap, while rotating it allows water temperature control.

Water from lavatory washbasins and galleys is automatically drained through forward and aft masts.

In case of water system leakage at either the galley or lavatory, the respective shutoff valve may be actuated to isolate the system.

If the auto-drain valve clogs, the flight attendant may manually actuate the remote actuation cable located on the front of the galley. Pulling on the self drain valve handle clears the galley drain valve. Access to the lavatory valve is through the under sink cabinet door. Pulling up on the ring handle clears the lavatory drain valve.

In-flight drainage is commanded by pressing the water dump pushbutton in the cockpit. Water is drained through aft and forward masts and the drainage may take from 10 to 15 minutes. After a total drainage of water, toilets and other systems that use water will not be available until the next refilling. Pressing the water dump pushbutton again discontinues the drainage. Water drainage is automatically interrupted if the landing gear is lowered or under any faulty drain mast heater condition.

The flight attendant panel indicates a FAULT condition whenever:

- A fault in the respective (FWD or AFT) drain valve is detected;
- Water level indication is not available;
- In-flight drainage is not available due to a fault in the drain valve or in the drain mast heater.

WASTE

The vacuum waste system collects waste from the lavatory toilets to an aft mounted vertical waste tank.

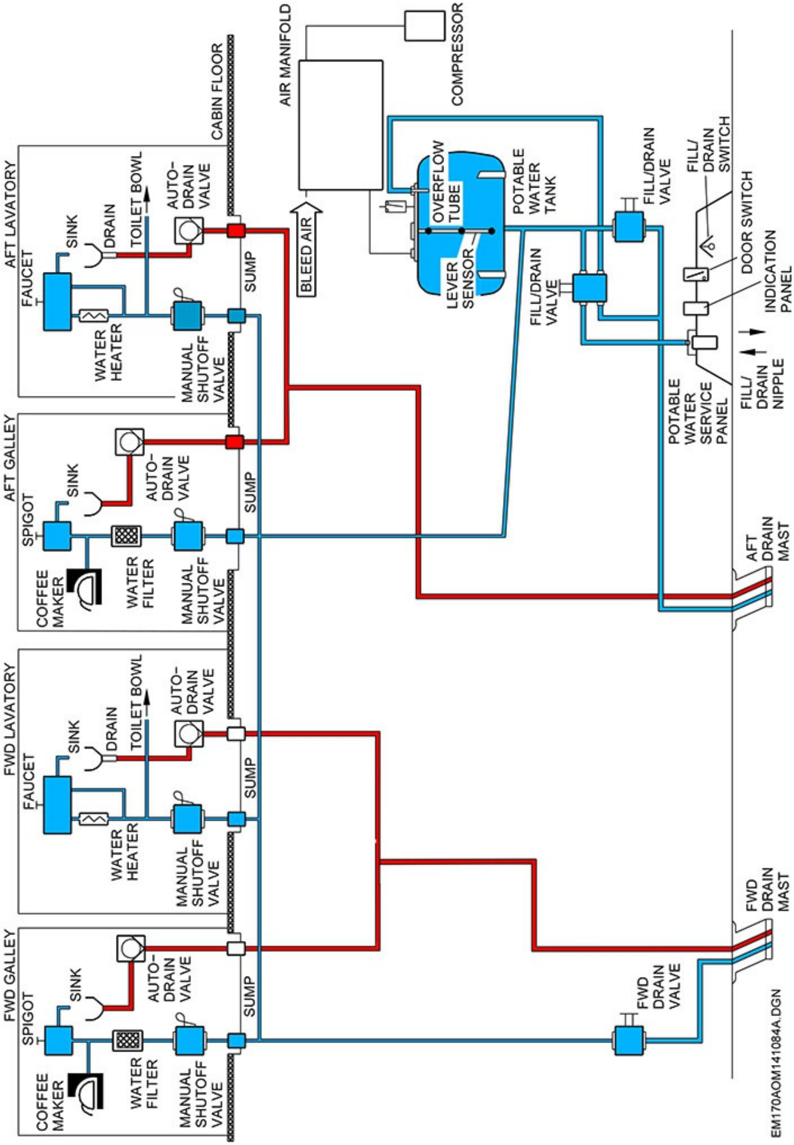
A vacuum generator is used to create differential pressure on the ground or at altitudes below 18000 ft. At higher altitudes, the differential between the airplane's cabin pressure and ambient pressure is sufficient to transport the waste.

Pushing the flushing switch located inside the lavatory initiates toilet-flushing sequence. Water is introduced to rinse the bowl before opening of the toilet-flushing valve.

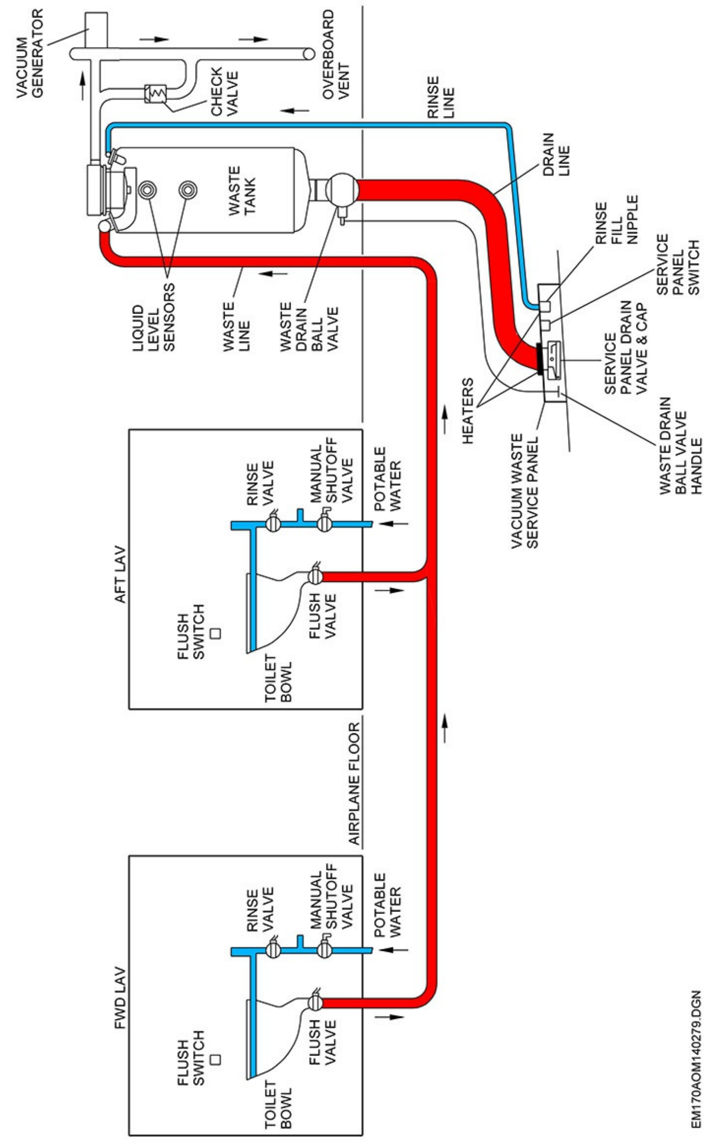
The usable capacity of the waste tank is 95 liters. The Service Tank indication illuminates on the flight attendant's panel when waste tank capacity reaches 75%. When the waste tank's full capacity is reached, the Tank Full indication illuminates and the vacuum toilets are disabled.

Waste tank draining is performed through the service panel in the aft right-hand side of the fuselage.

POTABLE AND GRAY WATER SCHEMATIC

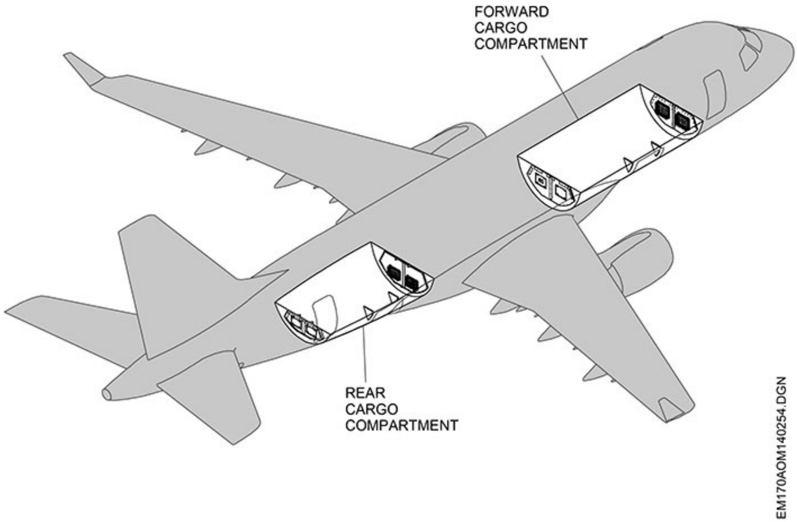


WASTE SCHEMATIC

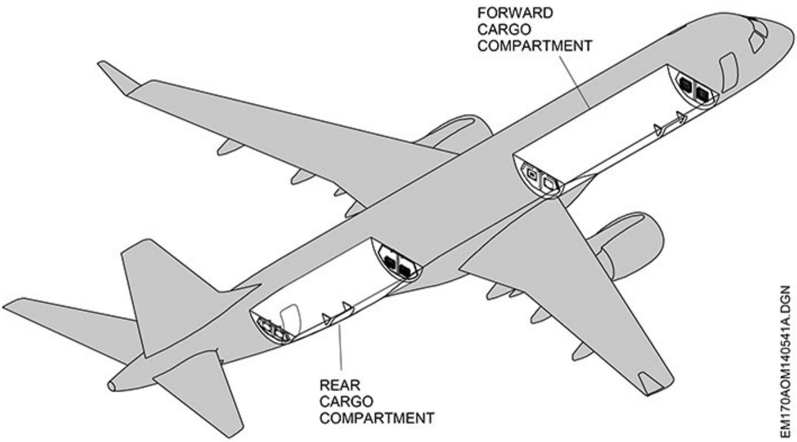


14.01.70 CARGO COMPARTMENT

The airplane has two class C cargo compartments. Both compartments are equipped with fire detection and extinguishing systems providing protection against fire damage.



EMBRAER 175 CARGO HOLDS



EMBRAER 190 CARGO HOLDS

14.01.80 EICAS MESSAGES

TYPE	MESSAGE	MEANING
WARNING	DOOR CRG AFT (FWD) OPEN	Associated baggage door open or not properly locked.
	DOOR EMER LH (RH) OPEN (E190 only)	Associated overwing emergency door open or not properly locked.
	DOOR PAX AFT (FWD) OPEN	Main door is open or not properly locked either on the ground with any engine running or in flight.
	DOOR SERV AFT (FWD) OPEN	Service door is open or not properly locked either on the ground with any engine running or in flight.
CAUTION	APM FAIL	At least three APMs have failed.
	APM MISCOMP	One or more APMs do not match.
	AVNX MAU 1 (2) (3) A (B) FAIL	All functions in the associated MAU channel have failed.
	AVNX MAU 1 (2) (3) A (B) OVHT	None of the functions in the associated MAU channel is unavailable.
	AVNX MAU 1 (2) (3) FAN FAIL	Associated fan cannot be turned on.
	CMS FAIL	Both CMSs have failed. No dispatch relief.
	DOOR CENTER (FWD) EBAY OPEN	Associated electronic bay is open or not properly locked.
	DOOR HYD OPEN	Hydraulic system 3 access door is open or not properly locked.
	EICAS FAULT	DU has suffered failure condition(s) that affect the functionality.
	EICAS OVHT	DU has suffered an over temperature condition. Continued operation may result in the loss of DU.

TYPE	MESSAGE	MEANING
CAUTION	EMER LT NOT ARMED	Emergency lighting system is not armed.
	EMER LT ON	Emergency lighting system is on.
	MFD 1 (2) FAULT	DU has suffered failure condition(s) that affect the functionality.
	MFD 1 (2) OVHT	DU has suffered an over temperature condition. Continued operation may result in the loss of DU.
	PFD 1 (2) FAULT	DU has suffered failure condition(s) that affect the functionality.
	PFD 1 (2) OVHT	DU has suffered an over temperature condition. Continued operation may result in the loss of DU.
	SYS CONFIG FAIL	Automatic configuration monitoring system has found non-dispatchable configuration miscompare.
ADVISORY	APM FAULT	One or two APMs have failed.
	AVNX DB MODULE FAIL	On board Database module has failed.
	AVNX MAU 1 (2) (3) A (B) FAULT	The associated MAU channel suffered failure condition(s) that does not affect its functionality, but may cause loss of redundancy.
	CCD 1 (2) FAULT	Cursor control of one or more DUs has been lost.
	CMS FAULT	1 CMS has failed, dispatch relief possible.
	DOOR FUELING OPEN	Fueling door open or not properly locked.
	EMER LT BATT FAULT	One of the six emergency batteries is not working properly.

TYPE	MESSAGE	MEANING
ADVISORY	APM FAULT	One or two APMs have failed.
	AVNX DB MODULE FAIL	On board Database module has failed.
	AVNX MAU 1 (2) (3) A (B) FAULT	The associated MAU channel suffered failure condition(s) that does not affect its functionality, but may cause loss of redundancy.
	CCD 1 (2) FAULT	Cursor control of one or more DUs has been lost.
	CMS FAULT	1 CMS has failed, dispatch relief possible.
	DOOR FUELING OPEN	Fueling door open or not properly locked.
	EMER LT BATT FAULT	One of the six emergency batteries is not working properly.

14.02.01 GENERAL DESCRIPTION

The Air Management System (AMS) consists of:

- The Pneumatic System.
- The Environmental Control System (ECS).

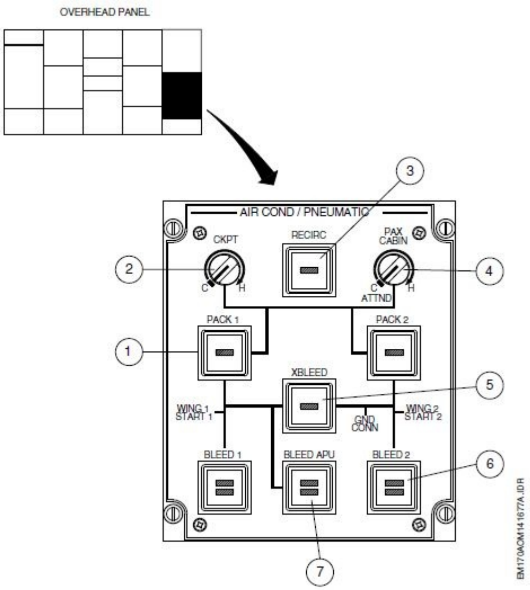
The Cabin Pressure Control System (CPCS) is part of the AMS, but it has a separate controller.

The AMS controller provides primary control for various airplane subsystems such as bleed control, air conditioning control, hot air leak detection, crew oxygen monitoring and wing and engine ice protection. The AMS controller also interfaces with the smoke detectors providing fault detection, isolation and reporting.

During the AMS operation, if the active channel fails, the control of the system will be automatically transferred to the other channel, with no interruption of AMS system functions.

14.02.05 CONTROLS AND INDICATIONS

AIR CONDITIONING AND PNEUMATIC PANEL



1 – PACK 1 AND PACK 2 BUTTONS

PUSH IN: allows automatic operation by the AMS. This position opens the respective pack flow control valve.

PUSH OUT: manually closes the respective pack flow control valve.

2 – CKPT CONTROLLER

- Controls cockpit temperature relative to the controller position.

3 – RECIRC BUTTON

PUSH IN: allows automatic operation by the AMS. This position turns on both recirculation fans, according to system operational logic.

PUSH OUT: turns off both recirculation fans.

4 – PAX CABIN CONTROLLER

- Controls passenger cabin temperature relative to the knob position.
- Rotating the controller to the ATTND position allows the cabin temperature to be controlled by the flight attendant panel.

5 – XBLEED BUTTON

PUSH IN: allows automatic operation by the AMS. This position opens the crossbleed valve, according to system logic.

PUSH OUT: manually closes the crossbleed valve.

6 – BLEED 1 AND BLEED 2 BUTTONS

PUSH IN: allows automatic operation by the AMS. This position commands the respective engine bleed valves, according to system logic.

PUSH OUT: manually closes engine bleed valves.

NOTE: When a leak is detected, the button amber striped bar is illuminated.

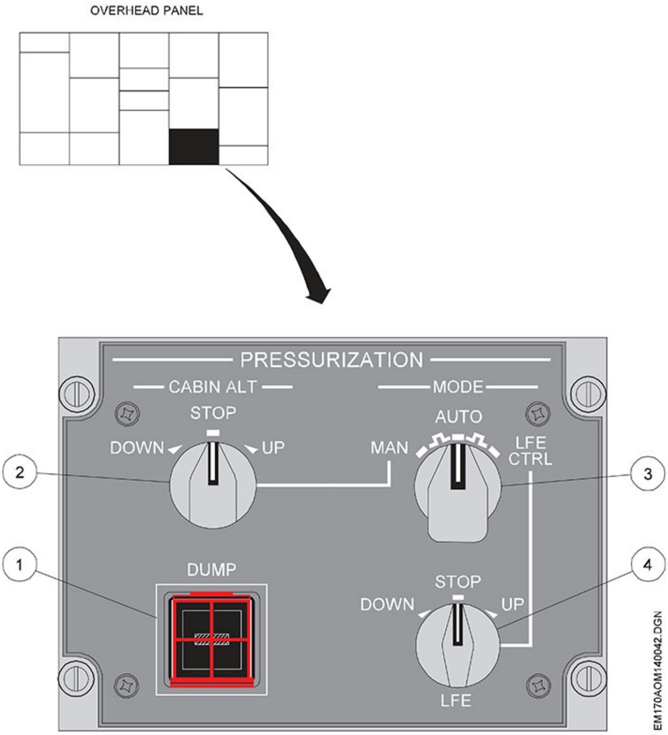
7 – BLEED APU BUTTON

PUSH IN: allows automatic operation by the AMS. This position commands the APU bleed valve, according to system logic.

PUSH OUT: closes the APU bleed valve.

NOTE: When leak is detected, the button amber striped bar is illuminated.

PRESSURIZATION PANEL



1 – DUMP BUTTON (GUARDED)

Momentary button:

- Provides rapid cabin depressurization, by opening the outflow valve and commanding the packs and the recirculation fans to off.
- When pressed the dump function is activated and a white striped bar illuminates on the button. When pressed a second time the system returns to normal.

NOTE: When operating in manual mode, the outflow valve will not be commanded open.

2 – CABIN ALT CONTROLLER

DOWN: (momentary action) manually closes the outflow valve.

STOP: normal operation position.

UP: (momentary action) manually opens the outflow valve.

NOTE: Manual actuation of the outflow valve is possible only with the PRESSURIZATION MODE SELECTOR set to MAN position.

3 – PRESSURIZATION MODE SELECTOR

MAN: allows manual control of the outflow valve.

AUTO: allows automatic operation of the pressurization system.

LFE CTRL: allows manual input of landing field elevation, although the pressurization system will remain in automatic mode.

4 – LFE CONTROLLER

DOWN: (momentary action) decreases the LFE in 100 ft increments.

STOP: normal operation position.

UP: (momentary action) increases the LFE in 100 ft increments.

NOTE: Manual input of the LFE is possible only with the PRESSURIZATION MODE SELECTOR set to LFE CTRL position.

EICAS INDICATION

PRESSURE INDICATION ON EICAS

1 – CABIN ALTITUDE INDICATION

- Displays cabin altitude in feet, regardless of the operating mode.

GREEN: normal operating range.

AMBER: cautionary operating range.

RED: warning operating range.

AMBER DASHED: invalid information.

2 – CABIN RATE OF CHANGE INDICATION

- Displays the cabin rate of change in feet per minute, regardless of the operating mode.

GREEN: normal operating range.

AMBER: cautionary operating range.

AMBER DASHED: invalid information or value out of displayable range.

3 – DIFFERENTIAL PRESSURE INDICATION

- Displays the differential pressure between the cabin interior and the outside in pounds per square inch, regardless of the operating mode.

GREEN: normal operating range.

AMBER: caution operating range.

RED: warning operating range.

AMBER DASHED: invalid information.

4 – LANDING FIELD ELEVATION INDICATION

- Displays the landing field elevation in feet, regardless of the operating mode.

GREEN:	inputs from FMS.
CYAN:	manual input. A cyan “M” in front of altitude readout indicates manual input.
AMBER DASHED:	invalid information or value out of displayable range. Manual operation is active.

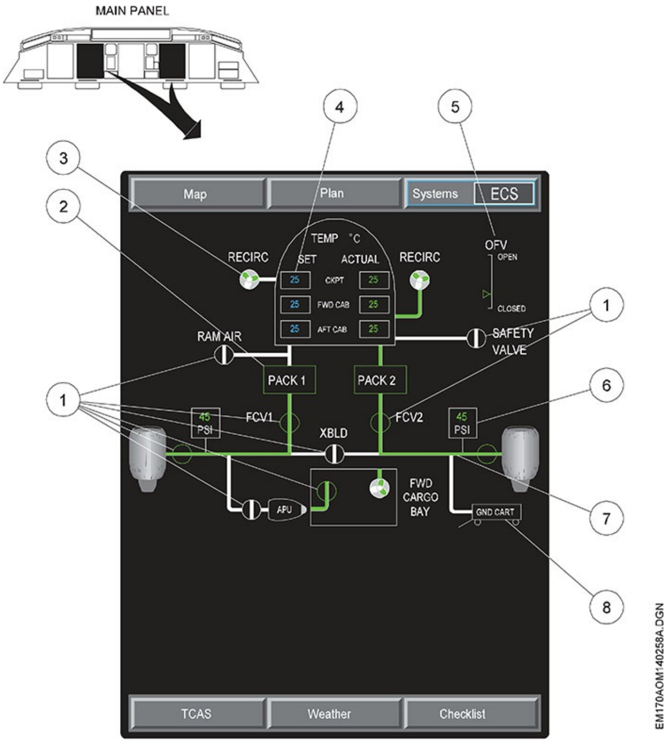
NOTE: Flight plan on MCDU must be closed to display landing field elevation (LFE) on EICAS.

5 – HI FIELD INDICATION

- Displays HI FIELD label whenever the Cabin Altitude Warning set point is shifted from its original value of 9700 ft indicating the airplane is in High Altitude operation mode.

SYNOPTIC PAGE ON MFD

The environmental control system synoptic page provides a visual representation of the system operation and parameters. It can be selected by flight crew on both MFDs.



1 – AIR SHUTOFF VALVES STATUS

- Air shutoff valves are shown as a circle and an internal line representing the valve position.
  - OPEN: a green circle and a green line aligned with the flow line.
  - CLOSED: a white circle and a white line perpendicular to the flow line.
  - UNDETERMINED: an amber dashed circle with no line.
  - IN TRANSIT: a white circle and a white line in diagonal to the flow line.
  - FAILED CLOSED: a white circle and a white line perpendicular to the flow line covered by an amber cross.
  - FAILED OPEN: a green circle and a green line aligned with the flow line covered by an amber cross.

2 – PACK STATUS

- ON: a green rectangle.
- OFF: a white rectangle.
- UNDETERMINED: an amber dashed rectangle.
- FAILED: an amber dashed rectangle covered by an amber cross.

3 – RECIRCULATION FAN STATUS

- The recirculation fan is shown as a circle and an internal windmill, representing the fan status.
  - ON: a gray circle and a green windmill.
  - OFF: a gray circle and a gray windmill.
  - UNDETERMINED: an amber dashed circle and an amber windmill.
  - FAILED: a gray circle and a white windmill beneath an amber cross.

4 – COCKPIT/CABIN TEMPERATURE INDICATION

- Digital Temperature.
  - The digital information displays selectable and actual temperature for the cockpit, forward cabin and aft cabin.

GREEN:	used for all actual temperature indication.
CYAN:	used for all set temperature indication.
AMBER DASHED:	invalid information or value out of displayable range.

  - Temperatures are set using the Cockpit/Passenger Cabin Temperature rotating knob on the Air Conditioning and Pneumatic control panel. Cabin temperatures can also be set on the Flight Attendant Panel.

5 – OUTFLOW VALVE (OFV) POSITION INDICATION

- Outflow Valve Scale/Pointer.
- The pointer on the scale indicates the actual OFV position. When the OFV is fully open at 90º, the pointer will be parked at the OPEN position, at the top of the scale. When the OFV is fully closed at 0º, the pointer will be parked at the CLOSED position, at the bottom of the scale. If the OFV signal is invalid the pointer will be removed from view.
  - Scale:

    WHITE: always, despite of OFV position.

  - Pointer:

    GREEN (hollow): always, despite of OFV position.

6 – MANIFOLD PRESSURE INDICATION

- Digital Pressure.
  - Colors:

GREEN:	normal operating range.
AMBER:	caution operating range.
GRAY:	label (PSI).
AMBER DASHED:	invalid information or value out of displayable range.

7 – FLOW LINE

- The flow line is shown as a colorful line.

GREEN:	indicates an air flow condition.
WHITE:	indicates a no air flow condition.
WHITE/AMBER DASHED:	the associated line flow information is invalid.
AMBER:	overheat condition.

8 – GROUND CART

- A ground cart connection is displayed only when it is connected to the airplane.

14.02.10 BLEED AIR SYSTEM

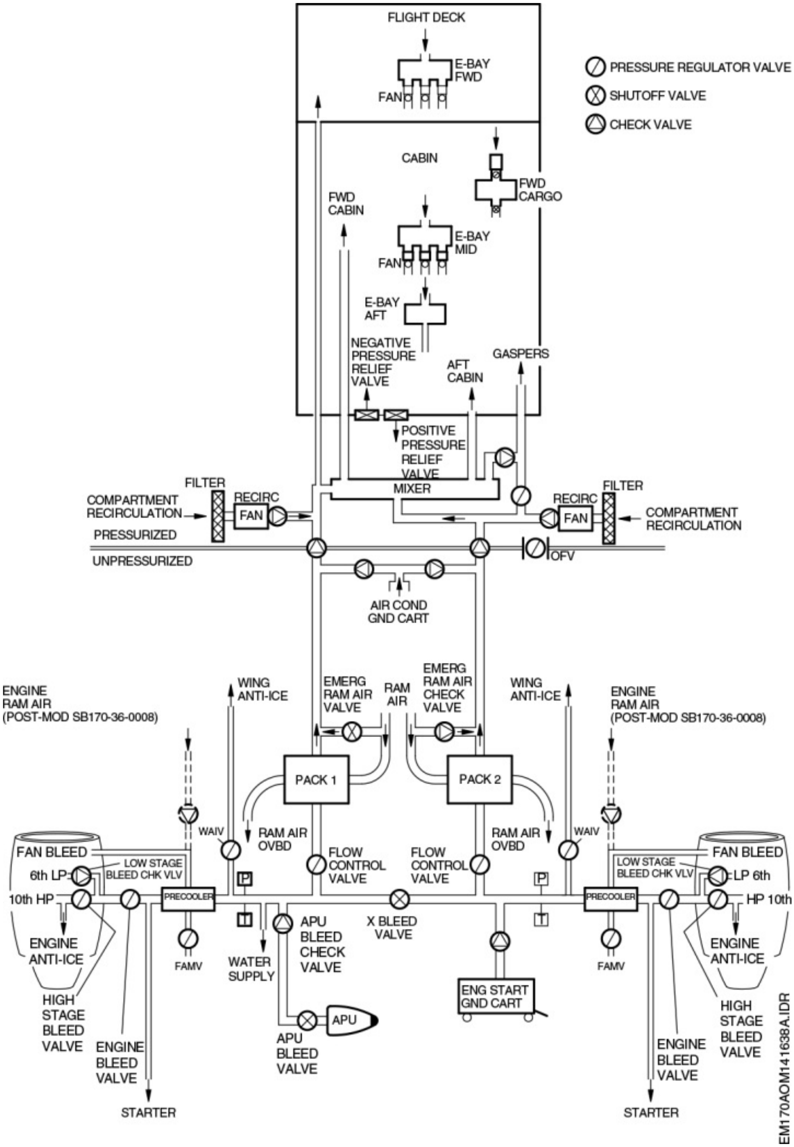
PNEUMATIC SYSTEM

Bleed air is provided to the Air Management System by the engines, or the APU. The bleed air is used for:

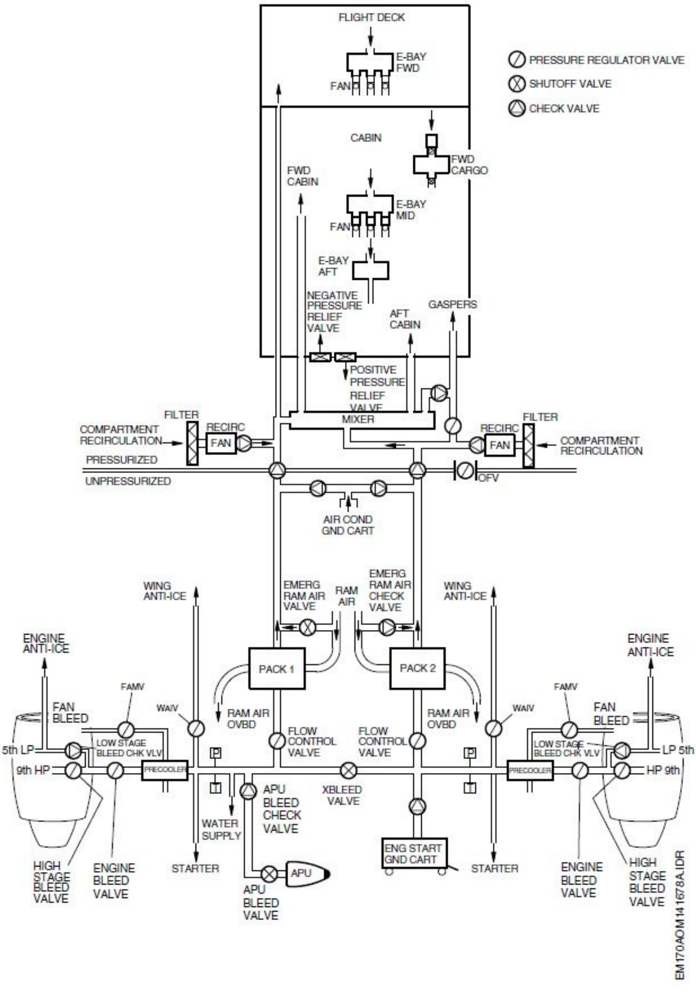
- Environmental Control System (ECS).
- Engine start.
- Engine and wing anti-ice.
- Water pressurization.

The external ground connections can also be used to supply pressurized air for the engine start and air conditioning.

SYSTEM SCHEMATIC E175



SYSTEM SCHEMATIC E190



ENGINE BLEED SYSTEM

The engine bleed system alternates between low-pressure and high-pressure engine bleed sources in order to maintain adequate and safe bleed supply pressure at any engine operating condition.

This control is established via opening/closing of the Low Pressure Check Valve and of the High Stage Bleed Valve located in the nacelle.

The Engine Bleed Valve (EBV), located in the nacelle, regulates the bleed pressure provided by the engine bleed system.

Embraer 175:

Engine bleed air temperature is regulated by a precooler, which uses the engine fan air modulated by the Fan Air Valve (FAMV) to cool the hot bleed air.

Embraer 190:

Engine bleed air temperature is regulated by the precooler and the Fan Air Valve (FAMV) which modulates fan air to cool the hot bleed air.

The bleed system control functions are integrated with anti-ice and air conditioning functions through the AMS controller.

NORMAL OPERATION

The Engine Bleed Valve is commanded open when the following conditions occur simultaneously:

- Respective bleed switch is set to AUTO.
- Respective engine bleed is available.
- No fire is detected in the respective engine.
- No bleed duct leak is detected.

During single AMS pack operation with both bleed valves available, the engine bleed valve associated to the inoperative pack is commanded to close and the crossbleed valve is commanded to open. The EICAS message BLEED 1 (2) OFF is not displayed in this condition.

ABNORMAL OPERATION

The system will automatically shut down the affected bleed system by closing the engine bleed valves when a leak, overpressure or fail condition is identified.

APU BLEED

The APU supplies bleed air on the ground or in flight. However, it is used primarily as a ground pneumatic source for the air conditioning packs (ECS) and engine starting. The APU Bleed Check Valve prevents engine bleed air from flowing to the APU when the engine bleed is the pneumatic source.

The APU Bleed Valve (ABV) controls the APU bleed airflow to the pneumatic system.

The APU Bleed Valve is commanded open when the following conditions occur simultaneously:

- APU switch is set to AUTO.
- APU Bleed is available.
- No APU and left bleed duct leak.
- Left engine bleed is unavailable.
- Wing anti-ice system not requested (or wing anti-ice system requested ON and anti-ice system is failed).

CROSS BLEED (XBLEED)

NORMAL OPERATION

The cross bleed is commanded open when the XBLEED Button is pushed in (AUTO) and any of the following conditions is met:

- One side provides manifold pressure and there is not a bleed air source on the opposite side,
- BLEED APU Button pushed out for main engine start,
- Engine #2 start in the air,
- APU bleed OFF and engine #1 start in the air,

The cross bleed is commanded closed when any of the following conditions is met:

- Bleed leak, unless starting an engine,
- Engine fire extinghuishing handle pulled,
- Manifold side with pressure above 90 psi.

ABNORMAL OPERATION

The Engine Bleed #1 will be commanded closed if the cross bleed fails OPEN and the other bleed source is the #2 engine.

GROUND CONNECTION

A dedicated high-pressure Engine Start Ground Connection is available for engine starting and a low-pressure Air Conditioned Ground Connection is available for air conditioning.

Both pneumatic ground connection ports are located on the lower section of the fairing area of the airplane.

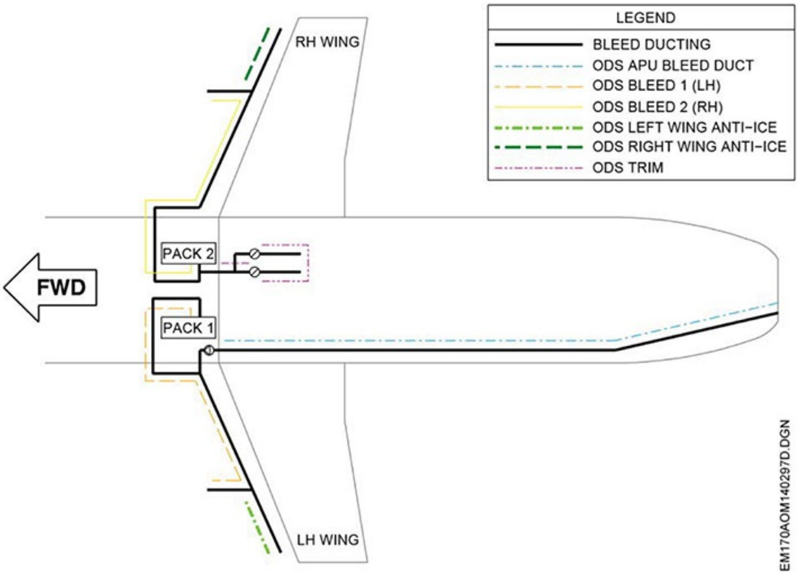
OVERHEAT DETECTION SYSTEM (ODS)

The Overheat Detection System (ODS) consists of overheat sensors and electronic control which provide rapid and reliable overheat and leak detection for the engine bleed, air conditioning ducts, APU bleed air distribution and anti-ice supply ducting.

Normally the overheat sensors use dual loop sensing. In this configuration an overheat is indicated when both loops detect an overheat condition.

If a single loop fails, the remaining will monitor for an overheat conditions (single loop operation).

BLEED AIR DISTRIBUTION



BLEED AIR DISTRIBUTION AND OVERHEAT DETECTION ZONES

OVERHEAT DETECTION ZONES

ZONE	Monitored Area
APU	APU Bleed Duct
LEFT ANTI-ICE	Left slat anti-ice supply ducts
LEFT AIR SUPPLY	Left bleed system ducts and left air conditioning ducts
RIGHT ANTI-ICE	Right slat anti-ice supply ducts
RIGHT AIR SUPPLY	Right bleed system ducts and right air conditioning ducts
OPTIONAL TRIM SYSTEM	Optional trim pressure ducts

BLEED SOURCE PRIORITIZATION

The AMS controller automatically selects the bleed source on ground and during flight between the engines, the APU and the external connections. The selection is based on input from the flight deck control panel, takeoff data setting, engine status, APU status, flow demands, fault status, manifold pressures, and valve position switches.

The AMS controller will choose one bleed source between the APU bleed and the engine bleeds when both are available. It is not possible to have the APU and the engines as bleed sources simultaneously.

APU AS BLEED SOURCE

While the aircraft is on the ground and the APU is on, the AMS gives priority to APU bleed supply when all of the following conditions are met:

- The APU bleed and the cross bleed push buttons are set to AUTO.
- The APU bleed valve and the cross bleed valve are operating normally.
- Ground speed is below 50 kt and 30 s have passed after touchdown.
- Either REF ECS is OFF and REF A/I is not ALL on the MCDU T/O DATA SET MENU page or the airplane is single engine taxiing.

When all the conditions above are satisfied, the engine bleed valves are commanded closed (engine bleed unavailable) and the APU will supply bleed to both packs.

If the ground speed exceeds 50 kt when taxiing only with the left engine, this engine will supply bleed to both packs. And if the ground speed exceeds 50 kt when taxiing only with the right engine, the APU and this engine will supply bleed for packs 1 and 2 respectively.

The APU bleed cannot be used for the anti-ice system operation.

During airborne engine start without Anti-Ice the left engine will be started with the opposite engine if the right bleed pressure is greater than the minimum required for engine start. The right engine will be started with the bleed source that is available at engine start (APU or left engine).

ENGINE AS BLEED SOURCE

The AMS gives priority to the Engine supply bleeds when the following conditions are simultaneously met, with the engine and APU bleeds available simultaneously:

- Engine bleed is available.
- The XBLEED valve is operating normally.
- ENG REF ECS is selected ON.

During engine start with Anti-ice, the AMS controller will prioritize cross bleed start.

BLEED SOURCE PRIORITIZATION LOGIC

The following tables describe the bleed priorization logic until liftoff. The logic considers: bleed source availability, takeoff data setting on the MCDU, anti-ice requirement and the flight phase.

The tables show the bleed valve position to identify the bleed source and the air conditioning availability according to the ECS and Anti-ice pre takeoff selection, APU bleed availability and the flight phase.

NOTE:
- No selection changes are evaluated.
- Ice conditions are known and pre-selected.
- APU bleed selection is retained until liftoff.

	MCDU T/O DATASET page Setting and APU bleed availability			
Flight Phase	ENG REF ECS ON ENG REF AI OFF APU bleed AUTO	ENG REF ECS ON ENG REF AI OFF APU bleed OFF	ENG REF ECS ON ENG REF AI ALL APU bleed AUTO	ENG REF ECS ON ENG REF AI ALL APU bleed OFF
1st engine start	- EBV: closed - ABV: open - Bleed Source: APU - PACKS OFF during eng start	- EBV: closed - ABV: closed - Bleed Source: GND Cart - PACKS OFF with GND Cart	- EBV: closed - ABV: open - Bleed Source: APU - PACKS OFF during eng start	- EBV: closed - ABV: closed - Bleed Source: GND Cart - PACKS OFF with GND Cart
Taxi single engine	- EBV: closed - ABV: open - Bleed Source: APU - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON	- EBV: closed - ABV: open - Bleed Source: APU - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON
2nd engine start	- EBV: closed - ABV: open - Bleed Source: APU - PACKS OFF during eng start	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS OFF during eng start	- EBV: closed - ABV: open - Bleed Source: APU - PACKS OFF during eng start	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS OFF during eng start
Taxi with 2 engines	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON
Takeoff	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON - SAI ON after WSPEED 40kt	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON - SAI ON after WSPEED 40kt
500 ft after takeoff	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON -SAI ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON -SAI ON

	MCDU T/O DATASET page Setting and APU bleed availability			
Flight Phase	ENG REF ECS OFF ENG REF AI OFF APU bleed AUTO	ENG REF ECS OFF ENG REF AI OFF APU bleed OFF	ENG REF ECS OFF ENG REF AI ALL APU bleed AUTO	ENG REF ECS OFF ENG REF AI ALL APU bleed OFF
1st engine start	- EBV: closed - ABV: open - Bleed Source: APU - PACKS OFF during eng start	- EBV: closed - ABV: closed - Bleed Source: GND Cart - PACKS OFF with GND Cart	- EBV: closed - ABV: open - Bleed Source: APU - PACKS OFF during eng start	- EBV: closed - ABV: closed - Bleed Source: GND Cart - PACKS OFF with GND Cart
Taxi single engine	- EBV: closed - ABV: open - Bleed Source: APU - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON	- EBV: closed - ABV: open - Bleed Source: APU - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON
2nd engine start	- EBV: closed - ABV: open - Bleed Source: APU - PACKS OFF during eng start	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS OFF during eng start	- EBV: closed - ABV: open - Bleed Source: APU - PACKS OFF during eng start	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS OFF during eng start
Taxi with 2 engines	- EBV: closed - ABV: open - Bleed Source: APU - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON
Takeoff	- EBV: closed - ABV: open - Bleed Source: APU - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS OFF during takeoff	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS OFF during takeoff - SAI ON after WSPEED 40kt	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS OFF during takeoff - SAI ON after WSPEED 40kt
500 ft after takeoff	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON -SAI ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON -SAI ON

14.02.15 AIR CONDITIONING SYSTEM

ENVIRONMENTAL CONTROL SYSTEM

The Environmental Control System (ECS) provides pressurized and conditioned air for the flight deck and passenger cabin, filtered cabin air recirculation, conditioned air supply for gaspers, fan air cooling for avionics and emergency ram air ventilation for flight deck smoke clearance.

The ECS can also provide cargo bay ventilation. The cargo bay ventilation system is optional.

AIR CONDITIONING PACKS

Two ECS cooling packs are installed in the wing-to-fuselage fairings. The AMS controller sets the bleed airflow to each pack independently, through the respective pack flow control valve (FCV). Each engine normally supplies bleed air to the respective pack. A single pack is capable of keeping adequate cabin/cargo hold pressurization and temperature. Single engine bleed can supply both ECS packs using the cross bleed.

CABIN AIR DISTRIBUTION

During normal operation, pack 1 adjusts the airflow and flight deck temperature according to the CKPT temperature selector knob position. Pack 2 adjusts the airflow to control passenger cabin temperature according to PAX CABIN selector knob position.

SINGLE PACK OPERATING INFORMATION

When operating with a single air conditioning pack, the zone related to the disabled pack will receive air from the operational pack through the mixer. The temperature selector knob associated with the disabled pack will have no effect on the temperature of the disabled pack zone.

In order to improve cabin temperature control, keep the operative temperature selector knob at 12 o'clock position when on ground. During climb, keep the operative temperature selector know between 12 and 14 o'clock position. During cruise, make slight temperature changes as required, observing 10 min interval between selections. During descent, increase the temperature of the operative selection knob between 14 and 16 o'clock position to compensate the reduced airflow to the cabin.

Monitor cabin temperature and, if necessary, make slight adjustments, respecting the 10 min interval among them for system stabilization.

GASPER VENTILATION

The gasper air distribution system provides air to each pilot and passenger position. Air flowing from the mixing manifold through the gasper check valve supplies the gasper ventilation system. When the gasper valve is opened, air from the right recirculation fan supplies the gasper system.

During normal system operation the gasper shutoff valve remains closed. It automatically opens whenever the gasper air supply exceeds 35ºC (95ºF). This prevents hot air from blowing on the passengers during cabin heating.

TWO-ZONE AIR CONDITIONING CONTROL (TRIM AIR)

The trim air system controls the amount of hot bleed air provided from pack 2 into the mixer for independent control of forward and aft cabin zone temperatures.

NOTE: If the temperature in one zone goes out of the range from 18°C to 30°C, the pack automatically takes over control in both zones to maintain the temperature in the entire passenger cabin within limits. In this case, the temperature in the healthy zone (18°C to 30°C) may undergo some variations until the unhealthy zone temperature is put back between limits.

RECIRCULATION FANS

Recirculated air from the passenger cabin and cockpit is ducted to the mixing manifold via two recirculation fans located in the pressurized section of the airplane. The recirculation fans draw air from the recirculation bays and impel the air back into the flight deck and cabin distribution system.

The total flow entering the cockpit and the passenger cabin is made up of approximately 52% of fresh air and 48% of recirculation air.

NORMAL OPERATION

Recirculation fans are automatically ON during ground and in flight.

On hot and humid days, with doors opened, the recirculation fans may be switched OFF to avoid fog in the cockpit.

ABNORMAL OPERATION

The recirculation fans are commanded OFF when:

- Both packs are commanded OFF;
- During on ground, cabin warm-up mode with the APU as bleed source according to a function of ambient temperature and altitude;
- The cargo bay fire signal activates;
- The DUMP button is pressed;
- Smoke is detected in the recirculation bay.

RECIRC FAN 1 is commanded OFF when:

- On ground, pack 1 is OFF and pack 2 is ON;
- In flight, IAS is greater than 50 kt and pack 1 is OFF.

RECIRC FAN 2 is never commanded OFF on a single pack condition.

ELECTRONIC COMPARTMENTS VENTILATION

FORWARD ELECTRONIC BAY (E –BAY)

The forward e-bay ventilation consists of three fans, which provide forced cooling air for # 1 Secondary Power Distribution Assembly (SPDA 1), Emergency Integrated Control Center (EICC) and all other avionics located in this e-bay. The fans draw air from the cockpit and expel air toward the underfloor recirculation bay. A flow sensor is used for fan/flow health monitoring.

CENTER ELECTRONIC BAY (E –BAY)

The center e-bay ventilation consists of three fans, which provide forced cooling air for the center e-bay electronics, Left Integrated Control Center (LICC), Right Integrated Control Center (RICC) and SPDA 2. The fans draw air from the rear cabin return and expel it towards the underfloor recirculation bay.

Flow sensors are used for fans/flow health monitoring.

AFT ELECTRONIC BAY (E –BAY)

Forced cooling is not necessary in the aft e-bay and, therefore, no fan is installed in this compartment. Air flowing from passenger cabin provides cooling of the aft e-bay and is expelled towards the underfloor recirculation bay.

FORWARD CARGO BAY VENTILATION

The ECS provides ventilation for live animals in the forward cargo bay. This optional system contains a fan on the side of the bay which provides underfloor recirculation air into the bay. The system also contains a shutoff valve at the outlet of the bay that closes in the event of fire and thus preventing halon from leaving the bay. In addition, in the event of fire, the forward cargo compartment fan is commanded OFF, thus closing the check valve preventing halon from entering the cabin.

EMERGENCY RAM AIR VENTILATION

Emergency ram air ventilation is provided in case of pack shutdown or for smoke removal.

The flight deck pack emergency ram air ventilation valve is commanded OPEN only if both ECS cooling packs are commanded OFF or failed OFF and the plane's altitude is less than 25000 ft.

An emergency ram air ventilation check valve is provided and does not require electronic control. The emergency ram air check valve will be open whenever the pressure in the ram air circuit is greater than cabin pressure.

During smoke removal, both ECS cooling packs will be commanded OFF and therefore, the flight deck emergency ram air ventialtion valve will be commanded OPEN.

RAM AIR INLET DOOR

The Ram Air Inlet Door (RAID) modulates and optimizes the quantity of ram air sent to the packs through changes in the door deflection. This modulation decreases drag and fuel consumption.

The AMS controller controls the RAID mechanism, which is installed in the wing-to-fuselage fairing. There is one mechanism for each RAID.

The ram air inlet area with the RAIDs fully open is equivalent to the inlet area without the RAIDs.

The AMS controller commands the two RAIDs to OPEN when one of the following conditions occurs:

- Airplane is on ground and until 17500 ft during the climb phase.
- Airplane is below 17000 ft during descent.
- Pressurization dump button is activated.
- RAT is deployed.
- Anti-ice system is activated.

The AMS controller commands one of the RAIDs to OPEN when one of the following conditions occurs:

- Related ECS pack failure.
- Related ECS pack is commanded off by automation or manual pilot command.

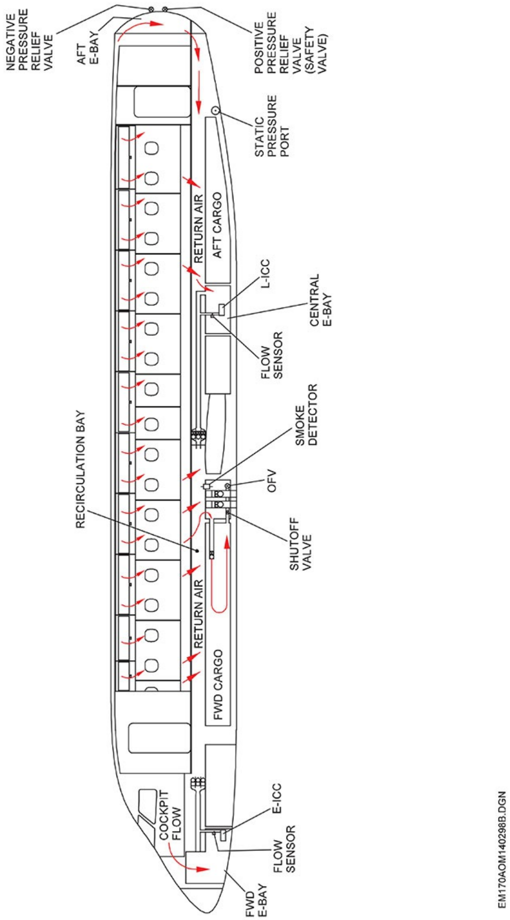
The AMS controller commands the two RAIDs to CLOSE when all of the following conditions occur:

- Airplane is on ground.
- Ground speed is less than 50 KIAS.
- ECS packs 1 and 2 are detected OFF by the AMS controller.
- Pack 1 and 2 buttons are selected OFF on the overhead panel.
- The Pressurization Dump Button is not activated.

In flight, a RAID failure when it is more than 90% CLOSED causes the EICAS message PACK 1 (2) FAIL. A RAID failure when it is more than 10% OPEN causes the EICAS message RAM AIR FAULT only after landing.

On ground, a RAID failure when it is more than 90% CLOSED causes the two EICAS messages PACK 1 (2) FAIL and RAM AIR FAULT. A RAID failure when it is more than 10% OPEN causes the EICAS message RAM AIR FAULT.

ECS DISTRIBUTION



AMS AUTOMATION

AMS Controller functional logic provides automatic control of engine bleed, APU bleed, ECS packs, Anti-Ice systems, Pressurization and recirculation bay smoke detection according to the airplane's operation and condition.

ECS PACKS LOGIC

An ECS pack is OFF when its associated pack flow control valve (FCV) is closed. The ECS packs 1 or 2 are OFF if any of the following conditions occur:

- Bleed air source is NOT available for the pack.
- The associated Pack push button is OFF on the overhead panel.
- Any engine is starting and there is weight-on-wheels (both packs OFF).
- The associated engine is starting, there is no weight-on-wheels and the opposite engine is not starting.
- Any engine is starting AND APU is the bleed source (both packs OFF).
- Associated bleed system duct leak.
- Associated packs BIT shutdown failures are present (PACK 1(2) FAIL EICAS message displayed).
- Ram air valve BIT is running (Pack 1 OFF).

Aircraft with RAID installed:

- Above 17500 ft, with a RAID failure when it is more than 90% CLOSED and the other ECS pack ON, regardless of the Mach number;
- Below 17500 ft, with a RAID failure when it is more than 90% CLOSED. In this case, the two ECS packs are commanded OFF. As a result, the two RAIDs and the emergency ram air ventilation valve are commanded OPEN.

Above 17500 ft and Mach number higher than 0.65, after a RAID failure when it is more than 35% OPEN, the related ECS pack is not shut down.

After a RAID failure when it is more than 10% OPEN, the related ECS pack is not shut down, regardless of the altitude value.

FADEC ECS OFF SIGNAL

The FADEC may send an ECS OFF signal to the AMS controller, requesting that no bleed is extracted from the engine for the air-conditioning system. The FADEC sets this signal depending on the T/O DATASET input (REF ECS OFF), pressure altitude, flight phase, and engine inoperative detection. The AMS controller disregards the ECS OFF signal when the airplane is flying over 15000 ft.

The ECS OFF signal CLOSES the packs during takeoff if any of the following conditions occur:

- One engine inoperative and APU bleed is not available;
- Thrust levers set to MAX position and APU bleed is not available;
- T/O DATASET REF ECS set to OFF on the MCDU and APU bleed is not available;
- T/O DATASET REF ECS set to OFF and T/O DATASET REF A/I set to ALL on the MCDU.

The ECS OFF signal CLOSES both packs during go-around if any of the following conditions occur:

- One engine inoperative and APU bleed is not available up to 9700 ft;
- Thrust levers set to MAX position and APU bleed is not available;
- Thrust levers set to MAX position and Wing Ice Protection System is requested ON.

The packs are commanded ON if any of the following conditions occur:

- Thrust lever reduction below TO/GA;
- The airplane is taking off with two engines operating 500 ft above takeoff field altitude;
- The airplane is above 9700 ft, for takeoff fields at 8000 ft or below and one engine inoperative;
- The airplane is above 15000 ft, for takeoff fields above 8000 ft and one engine inoperative;
- The airplane is above 9700 ft during go around, in case one engine is inoperative.

14.02.20 PRESSURIZATION SYSTEM

CABIN PRESSURE CONTROL SYSTEM

The Cabin Pressure Control System (CPCS) controls cabin pressurization and provides maximum safety and comfort during every segment of flight and ground operations.

The CPCS operates in automatic and manual modes. Normal operation of the CPCS is automatic.

The system consists of:

- Cabin pressure controller (CPC).
- One cabin outflow valve (OFV).
- One negative pressure relief valve (NPRV).
- One positive pressure relief valve (Safety valve).
- Static Pressure Port.

SYSTEM COMPONENTS

CABIN PRESSURE CONTROLLER (CPC)

The basic function of the controller is to control cabin pressure by commanding the outflow valve to modulate airflow through the valve from the pressurized airplane volume to the surrounding environment.

The CPC has two fully independent automatic channels which are alternated following each flight.

Both channels provide a manual function as backup, enabling the crew to control cabin pressure by directly actuating the outflow valve (OFV) position.

OUTFLOW VALVE (OFV)

The outflow valve modulates airflow from the pressurized cabin into surrounding environment. It can be modulated automatically or manually.

NEGATIVE PRESSURE RELIEF VALVE (NPRV)

The negative pressure relief valve is a spring loaded check valve that works without any electrical power, and is independent of the CPCS. Its function is to protect the airplane structure against damages due to a negative differential pressure.

The negative pressure relief valve opens if differential pressure between cabin and surrounding environment exceeds -0.5 psi.

POSITIVE PRESSURE RELIEF VALVE (SAFETY VALVE)

The positive pressure relief valve is a spring loaded check valve that works without any electrical power, and is independent the CPCS. Its function is to protect the airplane's structure against damage due to positive overpressure. In case of outflow valve failure, the positive pressure relief valve opens if the pressure differential between cabin and surrounding environment exceeds 8.6 psi.

STATIC PRESSURE PORT

The static pressure port senses the environmental static pressure and mechanically transmits it to the positive pressure relief valve in order to allow the overpressure relief device to work.

The static port is electrically heated to assure there are no obstructions of sensing orifices due to ice accumulation.

OPERATING MODES

The CPCS can be operated in automatic and manual mode.

AUTOMATIC MODE

The CPCS automatic operation uses different information inputs from the airplane to control the cabin altitude, the differential pressure and the cabin altitude rate of change.

In the automatic mode the information required for the CPCS operation can be retrieved from the FMS or, if the FMS data is not available, it can be manually set by the pilot.

The CPCS internal logic is divided in flight modes to better control the cabin altitude change rate in accordance with the flight phase.

While CPCS is operating in automatic mode and the departure airport is at or near sea level, the cabin altitude indication may be below 0 ft while the airplane is on ground. This situation may also occur during climb and cruise for flights under 18000 ft. This is a normal and expected behavior, intended to improve passenger comfort during the flight.

A high altitude takeoff and landing is also supported automatically by the system.

The automatic mode incorporates logic for dumping the airplane pressure with a minimal pilot workload.

AUTOMATIC OPERATION WITH FMS DATA AVAILABLE

The CPCS uses the gross weight, the cruise altitude set by the pilot and the landing field elevation retrieved from the FMS data base to schedule the target cabin altitude and the cabin pressure variation rate.

- LANDING FIELD ELEVATION:

It is retrieved from the FMS data base after the input of a destination on the active flight plan. In this case the landing field elevation is shown green on EICAS.

- CRUISE ALTITUDE:

It is set on PERFORMANCE INIT page 3/3 > INIT CRZ ALT.

Changing the cruise altitude in flight requires an update on FMS cruise altitude to readjust the pressurization schedule of operation.

- GROSS WEIGHT:

The airplane gross weight is retrieved after the confirmation of the inputs on the PERFORMANCE INIT page 3/3.

AUTOMATIC OPERATION WITH FMS DATA NOT AVAILABLE

If any FMS data is not available, the CPCS is still capable of automatic operation:

- LANDING FIELD ELEVATION:

If not available from the FMS data base, LFE must be manually selected on the pressurization panel by the pilot.

In this case the landing field elevation is shown in cyan.

A default value of 8000 ft is used if no input is made on LFE.

- CRUISE ALTITUDE:

If it is not possible to enter the cruise altitude on the FMS, the cabin pressure schedule is calculated based on the ambient pressure.

- GROSS WEIGHT:

If the gross weight is not available from the FMS the CPCS uses a default value to determine the CABIN ALTITUDE RATE OF VARIATION.

DIFFERENTIAL PRESSURE SCHEDULE

Two nominal differential pressures are provided by the CPCS:

- If the FMS cruise level is set below 37000 ft the nominal differential pressure of up to 7.8 psi is used.
- If either the FMS cruise flight level is set higher than 37000 ft or the airplane is actually flying above 37000 ft the nominal differential pressure switches to up to 8.4 psi.

NOTE: The nominal differential pressure of up to 7.8 psi was specified in order to reduce fatigue and structural stress during flight. Selecting a cruise altitude in the FMS higher than the actual airplane altitude may unnecessarily stress the airplane structure with a higher differential pressure.

HIGH ALTITUDE OPERATION

The CPCS automatically identifies when the airplane is operating in airports above 8000 ft.

If the operation is at an airport above 9400 ft, the “CABIN ALTITUDE HI” EICAS message trigger point is automatically adjusted to a plus of 500 ft AGL.

There is no special procedure for the high altitude operation.

DUMP FUNCTION

This function is used in the event of emergency evacuation, smoke evacuation or for fast cabin depressurization.

MODE ACTIVATION

The DUMP function is activated pushing in the DUMP button on the pressurization panel.

SYSTEM OPERATION

The CPCS system automatically:

- Sets the ECS packs and recirculation fans to OFF;
- Controls the OUT FLOW VALVE to maintain the cabin altitude rate of climb at 2000 ft/min up to 12400 ft.
- When the cabin altitude reaches 12400 ft it commands the OUT FLOW VALVE full closed. From this point the cabin altitude rises by natural leak.

If the cabin altitude is above 12400 ft when the dump is activated, the cabin altitude may be rising due to a normal leak. To achieve a higher rate of climb the manual mode can be used.

DUMP MODE DEACTIVATION

Pushing out the DUMP button commands the system back to normal operation opening the ECS packs and turning on the recirculation fan.

MANUAL MODE

MODE ACTIVATION

The manual mode is activated rotating the pressurization mode selector knob to the MAN position.

When manual mode is selected, both channels of the CPCS controller revert to standby state, but only one channel performs the manual operation. The channel selection is automatic

SYSTEM OPERATION

With the pressurization system in manual mode the pilot is responsible to open or close the OUT FLOW VALVE to maintain the desired cabin altitude.

NOTE: In manual mode there is no automatic cabin depressurization on the ground (after landing).

The Dump Function is not available in Manual Mode. However, if the associated push button is pushed in, both recirculation fan and packs are turned to off.

CPCS FLIGHT MODES

The CPCS automatic mode splits a typical flight into different CPCS flight modes.

Information from engine N2, landing gear status, FADEC, ADC and FMS are used within the cabin pressure controller to determine the current flight mode.

The system calculates a target cabin pressure from the outside pressure, the maximum differential pressure limiter and a corresponding pressure rate of variation data for each of the following CPCS flight modes:

- GROUND
- TAXI
- TAKEOFF
- CLIMB
- CRUISE
- DESCENT
- GROUND
- ABORT

The CPCS sequences the flight modes in the order presented here.

During flight mode transitions, or thrust lever transitions, higher rates of pressure change might occur for a few seconds. During these transitions, the cabin pressure rate might be approximately twice as defined at each flight mode, for a maximum of 5 seconds, but still being under comfort recommendations.

GROUND MODE

MODE ACTIVATION:

- Weight on wheels status on ground and;
- Engines running below the takeoff thrust.

SYSTEM OPERATION:

- OFV - is set fully open.
- CABIN PRESSURE - is set to 0.01 psid lower than ambient pressure (causing a permanent command to position the OFV in the fully open position).
- CABIN ALTITUDE CHANGE RATE - The system internal range is between +500 ft/min and - 300 ft/min.

TAXI MODE

MODE ACTIVATION

This mode is a sequence from the GROUND mode. Starting the engines with the doors closed cause the CPCS to activate momentarily the GROUND mode and switch to TAXI mode.

- Weight on wheels status on ground;
- Doors closed and;
- Engines running at 60% N2 or higher.

SYSTEM OPERATION

During the TAXI mode, the CPCS starts the first pre-pressurization step, increasing the differential pressure.

- CABIN PRESSURE - is set to the ambient pressure plus an offset of 0.11 psid.
- CABIN ALTITUDE CHANGE RATE - The system internal range is ±300 ft/min.

TAKEOFF MODE

MODE ACTIVATION

- Weight on wheels status on ground and;
- Engines running at takeoff thrust.

SYSTEM OPERATION

- CABIN PRESSURE - is set to 0.15 psid above the ambient pressure.
- CABIN ALTITUDE CHANGE RATE - The system internal range is +500 ft/min and –400 ft/min.

CLIMB MODE

MODE ACTIVATION

- Weight on wheels status in flight.

SYSTEM OPERATION

The Climb mode operation varies depending on the availability of the cruise flight level is available in the FMS.

- CRUISE FLIGHT LEVEL DATA AVAILABLE IN THE FMS:
  - CABIN ALTITUDE CHANGE RATE - The CPCS calculates the most comfortable rate of climb according to the cruise altitude set in the FMS. The rate of climb is calculated depending on the airplane gross weight and the ambient pressure at the takeoff field. The system internal range is +750 ft/min for increasing cabin altitude and constant at -600 ft/min for decreasing cabin altitude. In case a step climb is performed, the cabin altitude will continuously increase even at the level off altitude until the airplane reaches the target cruise altitude set in the FMS.

- CRUISE FLIGHT LEVEL DATA NOT AVAILABLE IN THE FMS:
  - CABIN ALTITUDE CHANGE RATE - The target cabin altitude is calculated depending on the ambient pressure. The system internal range is +750 ft/min and –500 ft/min constant rates. In case a step climb is performed, the cabin altitude will stop increasing during level off and it will continue increasing after climb is resumed.

CRUISE MODE

MODE ACTIVATION

The CRUISE mode is set when either the airplane reaches cruise flight level set in the FMS or, if no flight level was set in the FMS, when the airplane stops climbing.

SYSTEM OPERATION

- CABIN PRESSURE:
  - If the FMS cruise altitude is set below 37000 ft the nominal differential pressure is set to a maximum of 7.8 psid and at 37000 ft the cabin altitude will be 8000 ft.
  - If either the FMS cruise altitude is set higher than 37000 ft or the airplane is actually flying above 37000 ft the nominal differential pressure is set to a maximum of 8.4 psid. At 37000 ft and above the cabin altitude remains at 8000 ft. According to the CPCS logic, when transitioning to a cruise altitude above 37000 ft, the differential pressure adjustment to a maximum of 8.4 psid may cause the cabin altitude to decrease below 8000 ft so that it will reach 8000 ft when the airplane is at a cruise altitude of 41000 ft.

  If no cruise altitude is available on the FMS the target cabin altitude depends on the ambient pressure and the differential pressure from climb mode.
- CABIN ALTITUDE CHANGE RATE - The system internal range is +500 ft/min and –300 ft/min.

DESCENT MODE

MODE ACTIVATION

The DESCENT mode is set when the airplane starts a descent after CRUISE mode activation.

- CABIN PRESSURE - The target cabin altitude during descent mode is the Landing Field Elevation. It can be automatically retrieved from the FMS data base or manually set by the pilot.
- CABIN ALTITUDE CHANGE RATE - The altitude rate of change depends on the airplane descent rate, cabin pressure, landing field pressure and ambient pressure. The systems internal range is -200 ft/min and -750 ft/min.

If the cabin altitude is below the landing field altitude the increase rate depends on the cabin pressure, landing field pressure and ambient pressure and is calculated within the range of +300 ft/min and +750 ft/min.

ABORT MODE

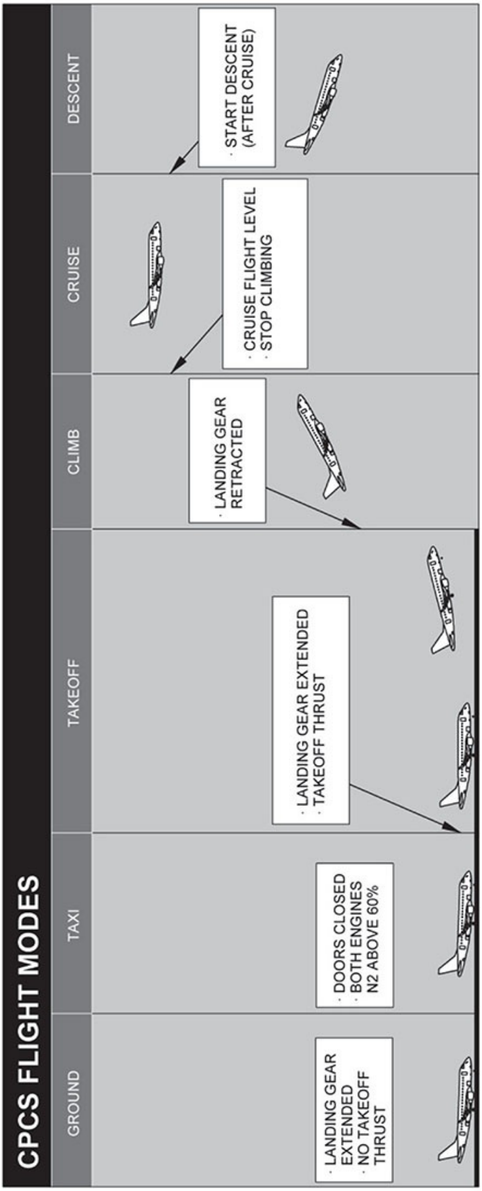
MODE ACTIVATION

The ABORT mode is set when:

- The airplane stops climbing and immediately starts descending (no cruise mode activated);
- Pressure altitude is less than 10000 ft or the airplane is less than 5000 ft above takeoff field elevation.

SYSTEM OPERATION

- CABIN PRESSURE - The cabin altitude is scheduled back to the takeoff altitude.
- CABIN ALTITUDE CHANGE RATE - The climb mode is used in reverse direction. The system internal range is +500 ft/min and –600 ft/min.



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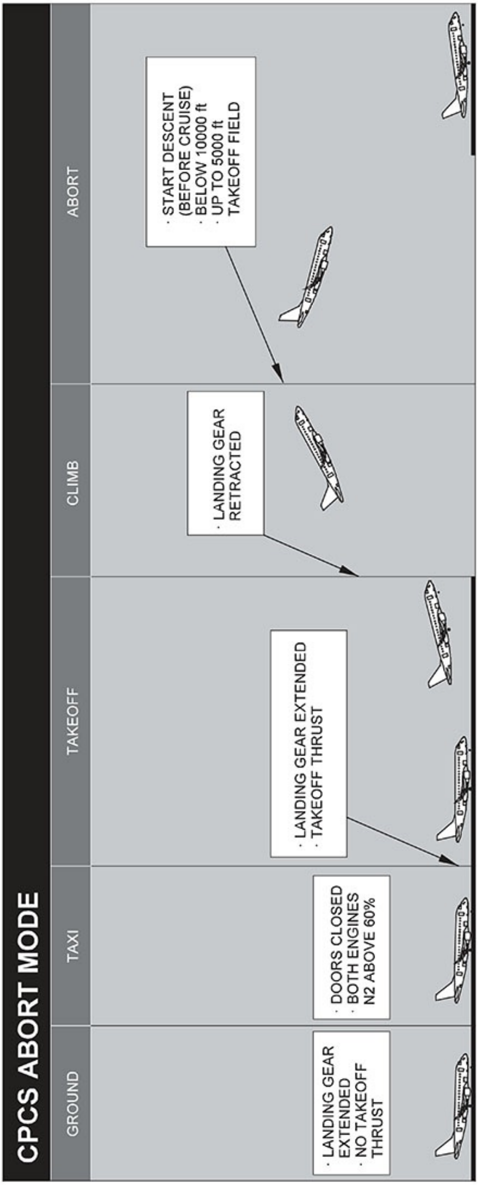

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14.02.25 EICAS MESSAGES

TYPE	MESSAGE	MEANING
WARNING	CABIN ALTITUDE HI	Cabin altitude is 9700 ft or higher, or if cabin altitude is higher than +500 ft above LFE for LFE higher than 9400 ft.
CAUTION	AMS CTRL FAIL	Both AMS controller channels have failed. AMS controller is not in control.
	BLEED 1 (2) FAIL	A bleed failure has been detected. Bleed is no longer available.
	BLEED 1 (2) LEAK	An overheat condition has been detected at the associated bleed system or pack.
	BLEED APU LEAK	An overheat condition has been detected in the APU bleed or both APU overheat detection system loops have failed.
	BLEED 1 (2) OVERPRESS	An overpressure condition has been detected at the associated bleed system or pack.
	CABIN DIFF PRESS FAIL	Cabin differential pressure is higher than 8.5 psid or lower than -0.3 psid.
	CENTER E-BAY FANS FAIL	Center E-BAY fans have failed.
	CRG FWD VENT FAIL	Forward cargo fan has failed ON or if the cargo shutoff valve is failed OPEN associated with smoke detected in the cargo compartment.
	FWD E-BAY FANS FAIL	Forward E-BAY fans have failed.
	PACK 1 (2) FAIL	Associated pack is no longer available. For airplanes equipped with Ram Air Inlet Door (RAID): when the RAID fails when it is more than 90% CLOSED.
	PACK 2 LEAK	An overheat condition has been detected at the pack 2 optional trim air ducts.
	PRESN AUTO FAIL	Both pressurization controller channels have failed in the automatic mode.
	PRESN MAN FAIL	Both pressurization controller channels have failed in the manual mode.
	RECIRC SMK DET FAIL	Smoke detector has failed.
	RECIRC SMOKE	Smoke has been detected in the recirculation bay.

TYPE	MESSAGE	MEANING
ADVISORY	AMS CTRL FAULT	One of the two AMS controller channels has failed.
	BLEED 1 (2) OFF	Associated bleed is turned off.
	PACK 1 (2) OFF	Associated pack is off in flight.
	PRESN AUTO FAULT	Loss of automatic mode redundancy. One CPCS controller channel has failed.
	RAM AIR FAULT	Forward emergency ram valve has failed closed. For airplanes equipped with Ram Air Inlet Door (RAID): on ground, when it is more than 10% OPEN, or more than 90% CLOSED.
	XBLEED FAIL	Either bleed isolation valve has failed closed and cross bleed is no longer available, or the bleed isolation valve failed open and engine is the source for the right side bleed (Bleed 2).
	XBLEED SW OFF	Bleed isolation button has been pushed out.
STATUS	BLEED APU VLV OPEN	APU bleed valve is commanded open.

14.03.01 GENERAL DESCRIPTION

The Automatic Flight Control System (AFCS) is an integrated system that processes inputs from several airplane systems and sensors. The AFCS supplies this data to the Flight Guidance Control System (FGCS) and Thrust Management System (TMS), thus enabling their operation and producing visual and aural information.

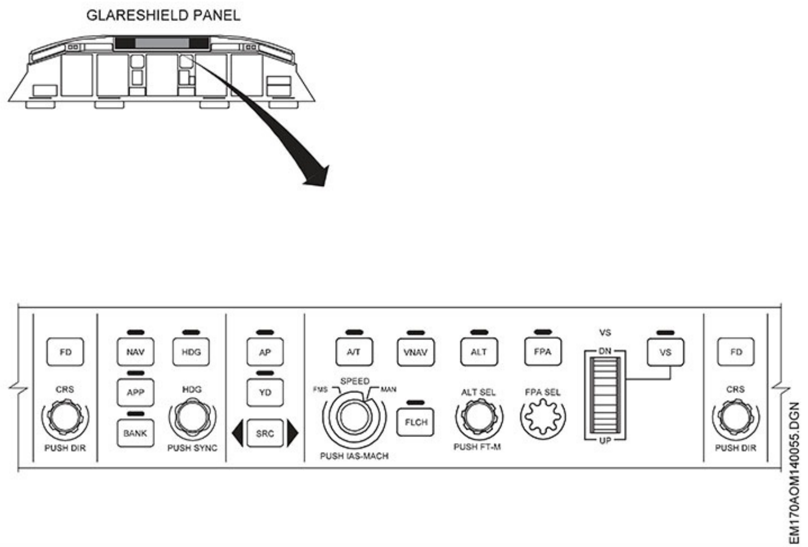
14.03.05 CONTROLS AND INDICATIONS

GUIDANCE PANEL

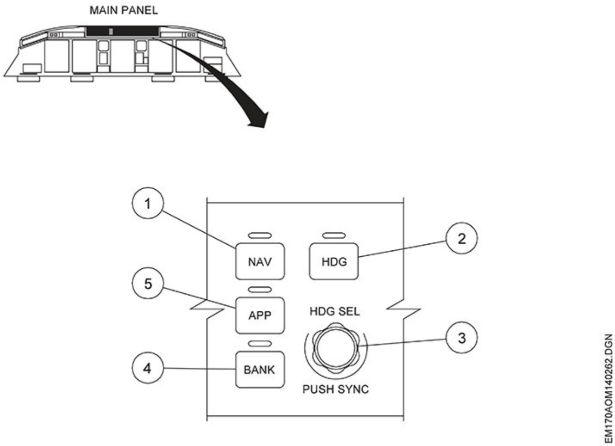
The Guidance Panel (GP) provides means for selecting functions and modes as follows:

- Lateral Guidance Control.
- AFCS Management Control.
- Vertical Guidance Control.

The GP contains two independent channels (A and B), each one providing independent communication to the FGCS.



LATERAL GUIDANCE CONTROLS



1 - NAV BUTTON

According to the presentation selected for the CDI the NAV Button engages:

- LOC: if the CDI is selected V/L (Green) and the source ILS frequency is tuned.
- LNAV: if the CDI is selected FMS (Magenta).

Pressing NAV with LOC or LNAV engaged reverts the lateral guidance to ROLL.

2 - HDG BUTTON

- Selects and deselects the heading mode.

3 - HDG CONTROLLER

- Manually selects the desired heading.
- Pressing this controller synchronizes the select heading to the current heading.

4 - BANK BUTTON

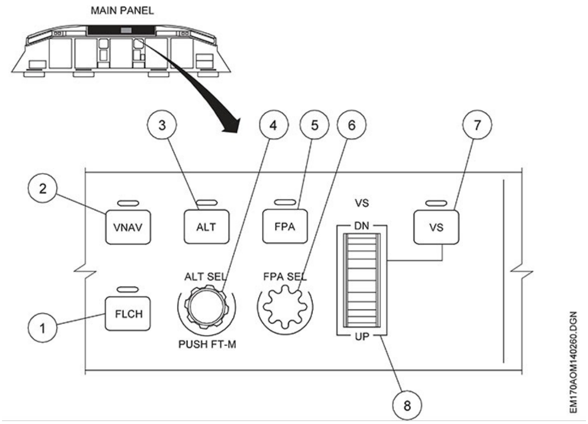
- Enables and disables bank angle limit of 15° used by the Heading Mode.

5 - APP BUTTON

- Arms, activates or deactivates approach modes based on the navigation source displayed on the respective PFD. For example, the following lateral and vertical mode annunciations are displayed on the FMA after the APP button is pressed:
  - LOC and GS for the ILS approach mode.
  - LNAV and GP for the VGP approach mode.

The Autopilot Approach Status Annunciator displays the engaged approach mode.

VERTICAL GUIDANCE CONTROLS



1 - FLCH BUTTON

- Selects and deselects the Flight Level Change mode.

2 - VNAV BUTTON

- Selects and deselects the VNAV mode (FMS vertical navigation).

3 - ALT BUTTON

- Selects and deselects the altitude holding mode (ALT).

4 - ALT SEL CONTROLLER

- Selects the desired altitude.
- Clockwise rotation: increases the altitude target.
- Counter clockwise rotation: decreases the altitude target.
- Pressing this controller displays on the PFD the following altitudes, in meters:
- The selected altitude, above the selected altitude readout window.
- The actual airplane altitude, above the altitude rolling digits readout window.

5 - FPA BUTTON

- Selects and deselects the Flight Path Angle mode.

6 - FPA SEL CONTROLLER

- Manually selects the desired Flight Path Angle.

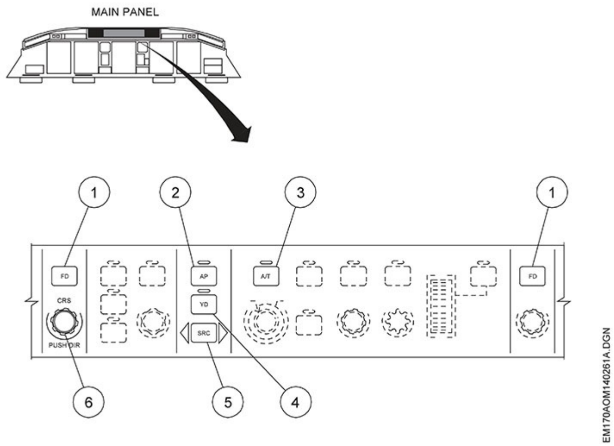
7 - VS BUTTON

- Selects and deselects the Vertical Speed mode.

8 - VS THUMB WHEEL

- The thumb wheel manually selects the desired vertical speed rate.
- Rolling the wheel upward selects the desired rate of descent.
- Rolling the wheel downward selects the desired rate of climb.

AFCS GUIDANCE CONTROLS



1 - FD BUTTON

- Turns ON and OFF the Flight Director presentation on PFD.
- If the AP is engaged it is not possible to turn off the FD presentation on the PFD being used as source for the AP.

NOTE: Pressing the FD button on the coupled side with AP disengaged, the Flight Director Modes are disengaged.

2 - AP BUTTON

- Engages or disengages the Autopilot.

3 - A/T BUTTON

- Engages or disengages the Autothrottle.

4 - YD BUTTON

- Engages or disengages the Yaw Damper/Turn Coordination function.

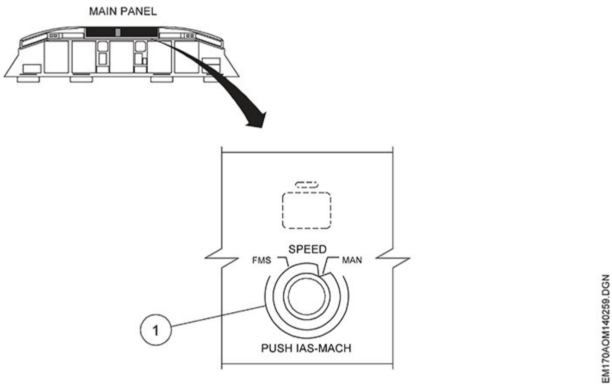
5 - SRC BUTTON

- Alternates between the left hand or right hand FMA modes as source for the autopilot. A green arrowhead on the FMA indicates the respective source selected.

6 - CRS CONTROLLER

- Manually sets the desired course on CDI as described below:
- CDI displaying FMS: sets preview course.
- CDI displaying V/L: sets CDI course.
- Pressing this controller indicates the course to the station.

SPEED AND MODE CONTROLS



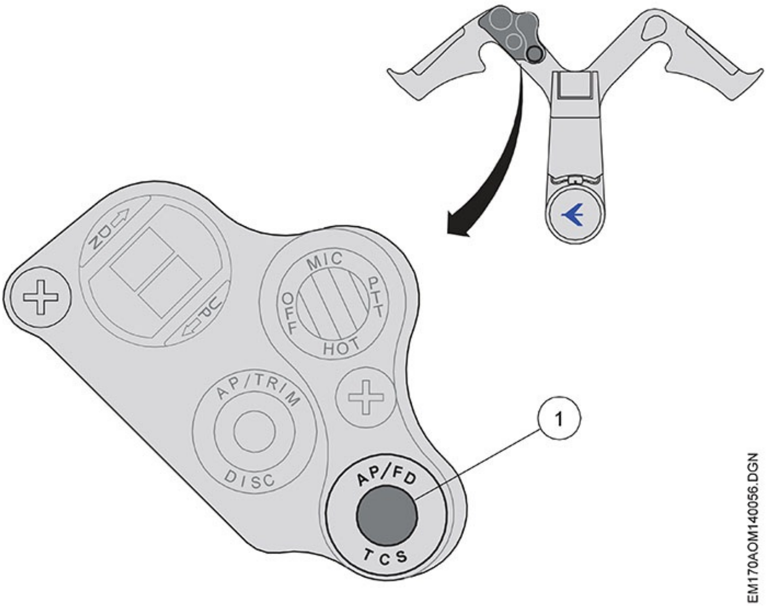
1 - SPEED KNOB

FMS: Selected airspeed readout is controlled by the FMS logic.

MAN: Selected airspeed readout is controlled manually.

- Pressing this knob alternates the speed presentation on PFD selected airspeed readout window between IAS and MACH.

AUTOPILOT/FD TCS BUTTON



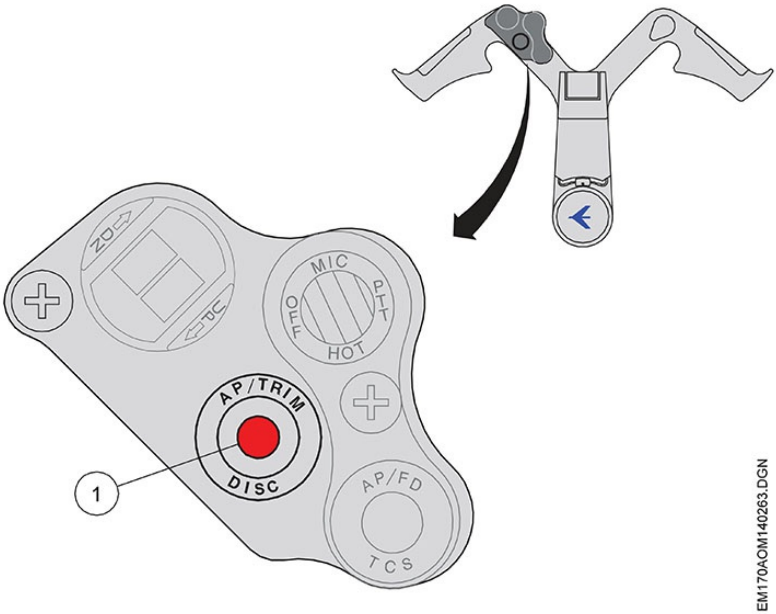
1 - TOUCH CONTROL STEERING BUTTON (TCS)

The AP/FD button has authority over the autopilot and flight director.

Flight director interface with the AP/FD button:

- Press and Hold the TCS:
  - Synchronizes the Flight Director with the current airplane attitude.
- Release the TCS:
  - The Flight Director returns to the lateral and vertical selection when the TCS was pressed.
  - With Roll/VS/FPA modes the FD maintains the airplane attitude when the TCS is released.
- Autopilot interface with the AP/FD button:
  - If the AP is engaged, pressing and holding the TCS will momentarily override the AP. Releasing the TCS, the AP resumes airplane control.

AUTOPILOT QUICK DISCONNECT BUTTON



1 - AP/TRIM DISCONNECT BUTTON

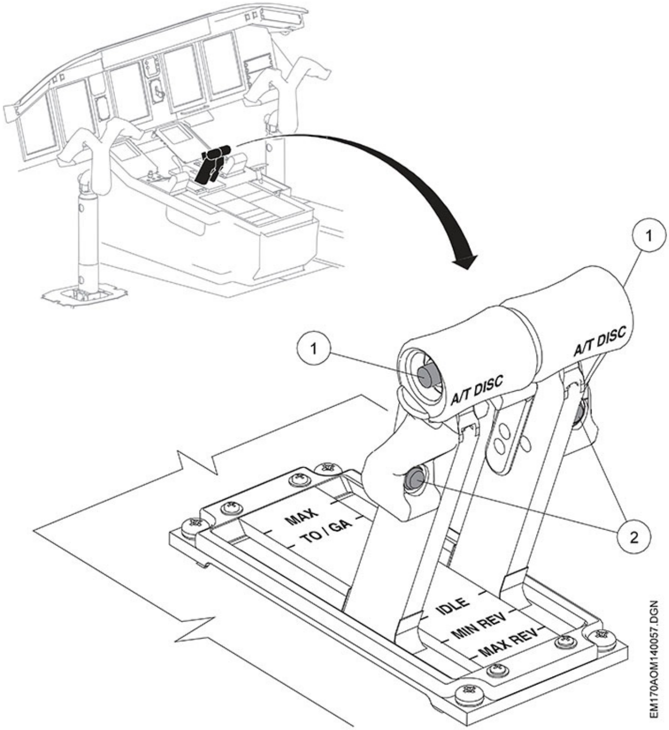
Autopilot

- Normal means of disengaging the autopilot.
- Pressing once disengages the Autopilot.
- Second press cancels the Autopilot aural alarm and FMAAP Warning.

Trim

- Refer to Flight Control.

AUTOTHROTTLE DISCONNECT AND GO AROUND BUTTONS



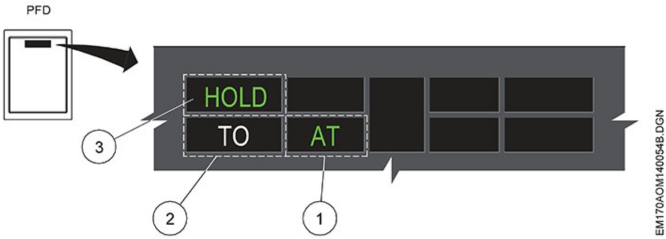
1 - AUTOTHROTTLE DISCONNECT BUTTON

- Disengages the autothrottles.

2 - TAKEOFF AND GO AROUND BUTTON

- Selects the TO, GA or Windshear Flight Director Modes.

AUTOTHROTTLE ANNUNCIATIONS ON FMA



The AT mode annunciations displayed on Flight Mode Annunciation display (FMA) are the following:

- SPD_T
- SPD_E
- TO
- GA
- HOLD
- LIM
- OVRD
- RETD

1 - AUTOTHROTTLE ENGAGEMENT ANNUNCIATION

GREEN: Autothrottle engaged.

AMBER: Autothrottle failed.

2 - AUTOTHROTTLE ARMED MODE

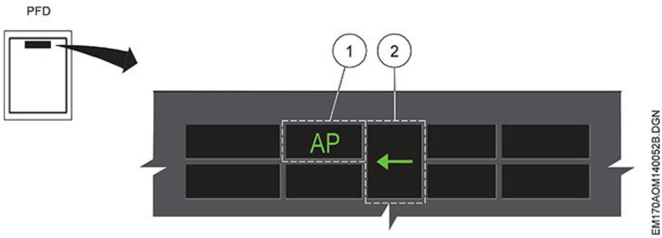
WHITE.

3 - AUTOTHROTTLE ACTIVE MODE

GREEN: Autothrottle active mode.

AMBER: LIM is displayed to indicate that vertical speed and target speed are incompatible with thrust rating available.

AUTOPILOT ANNUNCIATIONS ON FMA



1 - AUTOPILOT ENGAGED ANNUNCIATION

GREEN: Autopilot engaged.

RED: Autopilot failed.

NOTE: Pressing and holding the TCS button, the "AP" annunciation on FMA is replaced by "TCS" (green). Releasing the TCS button, "AP" is again displayed.

2 - FLIGHT DIRECTOR SOURCE ANNUNCIATOR

- A green arrow indicates the selected AFCS source.

NOTE: This annunciator is not displayed if the flight director fails.

LATERAL MODE ANNUNCIATIONS ON FMA

The lateral mode annunciations displayed on the FMA are the following:

- ROLL
- HDG
- LNAV
- LOC
- BC
- TRACK
- RLOUT
- ALIGN

1 - FGCS LATERAL ACTIVE MODE

GREEN: manually commanded on the GP.

MAGENTA: FMS commanded.

2 - FGCS LATERAL ARMED MODE

WHITE.

NOTE: If the FGCS fails the respective mode annunciation is removed.

VERTICAL MODE ANNUNCIATIONS ON FMA

The vertical mode annunciations displayed on FMA are the following:

- ALT
- ASEL
- FLARE
- D-ROT
- FLCH
- FPA
- GA
- GS
- OVSP
- TO
- GP
- PTH
- VS
- WSHR

1 - FGCS VERTICAL ACTIVE MODE

GREEN: manually commanded on the GP.

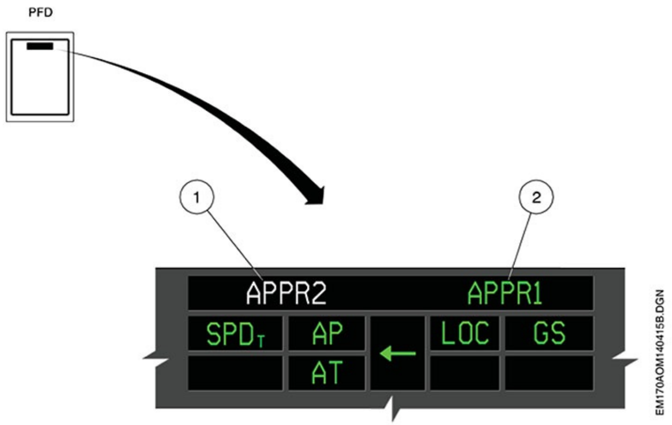
MAGENTA: FMS commanded.

2 - FGCS VERTICAL ARMED MODE

WHITE.

NOTE: If the FGCS fails the respective mode annunciation is removed.

APPROACH STATUS ANNUNCIATIONS ON FMA



The approach annunciations labels displayed on the FMA are the following:

- APPR 2
- APPR 1
- APPR 1 ONLY
- AUTOLAND 1
- NO AUTOLAND
- L/VNAV
- NO L/VNAV

1 - ARMED STATUS

WHITE: Approach mode is armed.

AMBER: Alert condition.

RED: Warning conditions

2 - ENGAGED STATUS

GREEN: Approach mode is engaged.

MAGENTA: FMS commanded mode is engaged

14.03.10 AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS)

The Automatic Flight Control System (AFCS) provides flight guidance to the PFD Display and the Autopilot.

The AFCS includes:

- Flight Director (FD);
- Autopilot (AP) with coupled Go-Around (GA) and
- Yaw Damper (YD).

FLIGHT DIRECTOR (FD)

The flight director provides lateral and vertical guidance on both PFDs from the FMS commands and through pilot selections on the guidance panel.

FLIGHT DIRECTOR PRESENTATION

A magenta diamond displayed on the Primary Flight Display (PFD) represents the FD.

REMOVAL OF FLIGHT DIRECTOR PRESENTATION

Pressing the FD button on the display control panel removes the flight director presentation on the PFD under the following conditions:

- AP engaged: the Flight Director presentation can be removed by pressing the FD button on the non-coupled display control panel side.

  On the coupled side it is not possible to remove the FD from the PFD.
- AP disengaged: the Flight Director presentation can be removed from both PFDs by pressing the FD button on the respective display control panel.

FLIGHT DIRECTOR MODES ACTIVATION

The FD automatically turns on under the following conditions:

- TO/GA button actuation or;
- Manual selection of any vertical or lateral mode or;
- Autopilot engagement or;
- Windshear detection.

Pressing the FD button on the coupled side with AP disengaged, the Flight Director Modes are disengaged (FD cue is removed from both PFDs, FD modes are removed from both FMAs and AT mode changes to SPDt tracking the airspeed target).

To turn off the flight director, press the FPA button on the guidance panel when the active mode is FPA.

If any other vertical mode is active, press FPA button once to activate the FPA mode and then press it again to turn off the Flight Director.

AUTOPILOT (AP)

The E-JETS have a single autopilot with a dual channel configuration.

One channel is active while the other works as a hot spare.

The system alternates the channel automatically in case of a failure of the active channel and also after each landing.

The autopilot has one servo for pitch control, one for roll control and one or two optionally for rudder control.

As the AP servos are connected to the controls, the AP commands may be observed by the movement of the control column, control wheel or rudder to keep pilots aware of any AP input.

AP ENGAGEMENT

Autopilot engagement is inhibited on the ground.

In flight the autopilot is engaged pushing the AP button on the guidance panel. The AP engagement is verified on the FMA on both PFDs.

With the confirmation of the AP label on the FMA the autopilot is controlling the airplane pitch, roll and yaw according to the flight director selections.

AP DISENGAGEMENT

NORMAL DISENGAGEMENT

The autopilot is normally disengaged by pressing the quick disconnect PB on either control wheel.

Pressing the button once:

- Disengages the autopilot;
- Triggers the aural warning “AUTOPILOT”;
- The FMA “AP” annunciation blinks in red.

Pressing the button the second time cancels the aural warning and the FMA annunciation.

The autopilot may be momentarily overridden by pressing the TCS button on the control wheel. Releasing the TCS, the autopilot resumes airplane control.

NON-NORMAL DISENGAGEMENT

The autopilot also disengages if one of the following conditions occurs:

- AP button is pressed on the guidance panel;
- Either manual pitch trim switch is actuated;
- Either stick shaker is activated.
- Windshear escape guidance is activated.

ABNORMAL DISENGAGEMENT

The following events cause an autopilot disconnect and EICAS message:

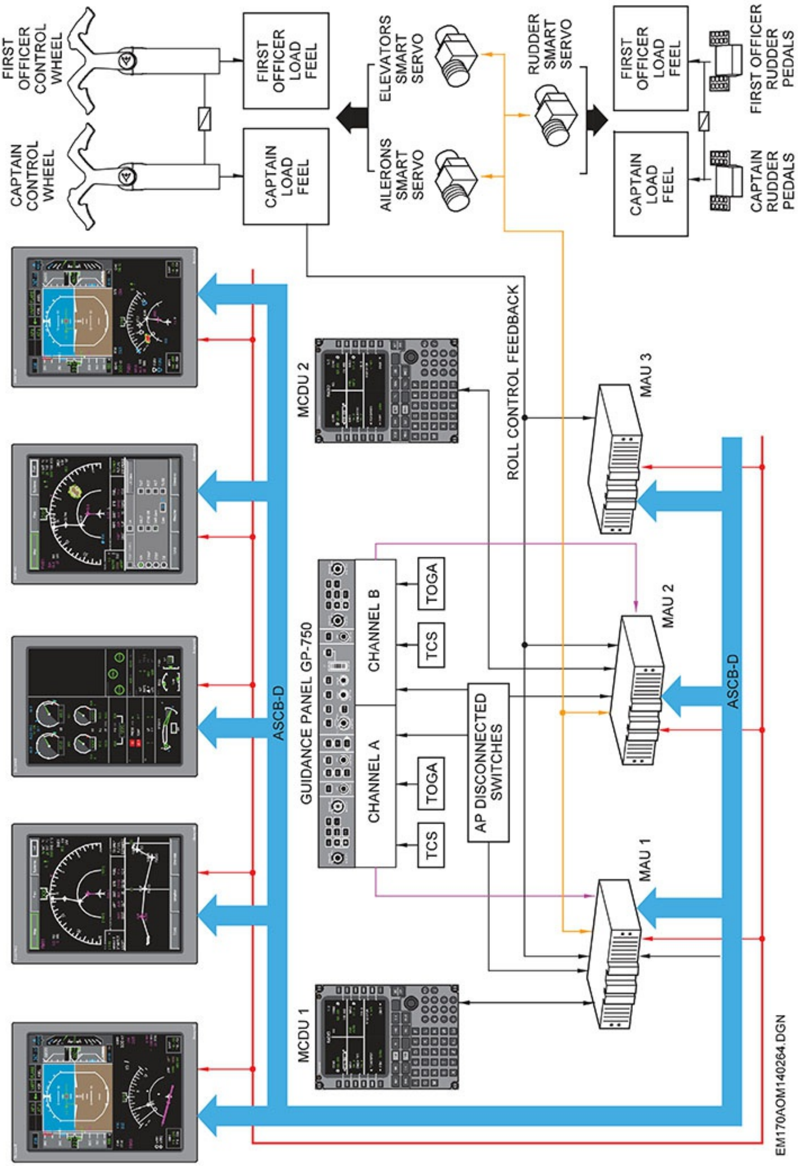
- Reversion of the fly-by-wire system to direct mode.
- Either the aileron or elevator control system is disconnected.
- A pilot input contrary to the autopilot is made on the controls with a long time light force or a short time stronger force.
- Internal monitor failure.

After Non-Normal or Abnormal Disengagement, pressing either AP disconnect button once cancels the flashing “AP” on the FMA and silences the aural alarm.

NOTE: AP disengagement by application of force on control column, through the forward and aft movement, and control wheel, lateral movement, is indicated in red on FMA. The AP disengagement by application of force only on control wheel may be indicated in red on FMA and AP FAIL message may be displayed on the EICAS.

YAW DAMPER

The yaw damper is automatically engaged after power-up of either hydraulic system 1 or 3. The yaw damper is automatically disengaged after shutdown of both hydraulic system 1 and 3. The yaw damper may also be disengaged/engaged by pressing the YD button on the AFCS guidance control panel.



AUTOPILOT/FLIGHT DIRECTOR SCHEMATIC

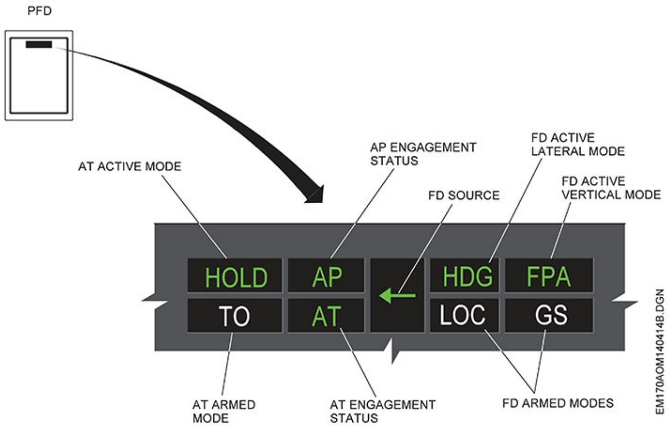
AFCS INDICATIONS ON PFD

FLIGHT MODE ANNUNCIATIONS (FMA)

The Flight Mode Annunciation display, also referred to as FMA, is located on the top of PFD and it displays annunciations for autothrottle, autopilot, approach status, lateral and vertical modes.

The FMA color code for normal operation is as follows:

MAGENTA:	FMS commanded active/engaged mode.
GREEN:	Non-FMS commanded active/engaged mode.
WHITE:	Armed mode.
AMBER:	Alert condition.
RED:	Abnormal condition.



FMA

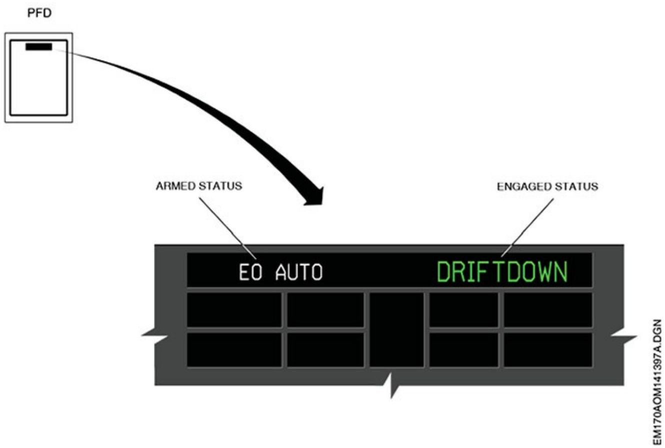
The FMA also displays annunciations for One Engine Inoperative and Engine Out Driftdown modes.

Besides the annunciation normally presented on the two FMA lines, the NG FMS also presents Engine Out and Engine Out Driftdown status indication in the single line directly above the two FMA lines.

The annunciation on the left side is the armed status (white). The right side presents either the current engaged status (green) or abnormal disengage status (amber).

The terminologies used for the annunciations are:

- EO AUTO – Engine Out Automation
- DRIFTDOWN – Driftdown with Engine Out Automation
- NO AUTO EO – Engine Out Automation disengage
- NO DRIFTDOWN – Driftdown with Engine Out Automation disengage



APPROACH STATUS ANNUNCIATIONS

The Approach Status Annunciations are displayed at the top of the FMA upon pressing the APP button on the guidance panel.

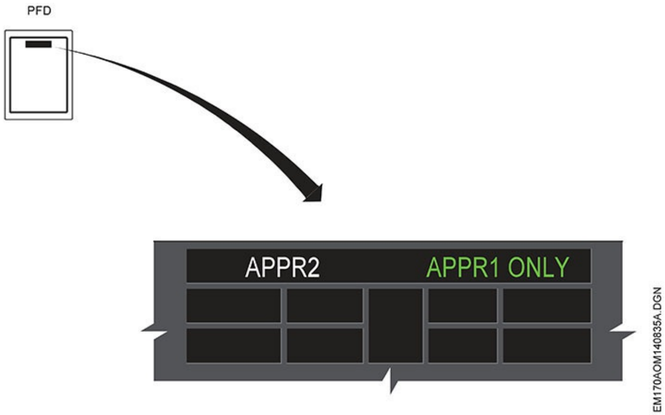
The annunciator on the left side is either the armed status (white) or a discrepancy (amber) and on the right side is the current engaged status (green).

The BARO/RA window on the PFD 1 and on the PFD 2 must be on the same selection (BARO-BARO or RA-RA)). If there is a discrepancy the BARO/RA window on the side selected to RA will flash amber.

The system will not indicate discrepancy in selected values between PFD 1 and PFD 2.

The terminology used for the system capability levels are:

- APPROACH 2 (APPR 2) – ILS CAT II capable.
- APPROACH 1 (APPR 1) – ILS CAT I capable.



FGCS LATERAL MODES

The FGCS pilot selectable lateral navigation modes are:

- Roll Hold (ROLL).
- Heading Select (HDG).
- Lateral Navigation (LNAV).
- Localizer (LOC).
- Back-course (BC).

Pilot non-selectable mode is:

- Track Hold (TRACK).

ROLL HOLD (ROLL)

This is the basic lateral mode and does not provide any airplane guidance.

Depending on the airplane bank angle at the moment of ROLL activation, the autopilot will maintain the following bank angles until another lateral mode is selected:

- Bank angle at 6° or below: AP levels the wings.
- Bank angle above 6° and below 35°: AP holds present bank angle.
- Bank angle at 35° or above: AP maintains bank angle at 35°.

ROLL MODE ACTIVATION:

The ROLL Mode is activated under any of the following conditions:

- Pressing TOGA button while on the ground and IAS is below 100 kt;
- There is no lateral mode active and a vertical mode is selected;
- Deselecting an active lateral mode;
- COURSE TO INTERCEPT on the FMS is activated.

ROLL MODE DE-ACTIVATION:

The ROLL Mode is de-activated when another lateral mode becomes active.

HEADING SELECT (HDG)

This mode provides airplane lateral guidance through the HDG SEL knob.

Pressing the center of the HDG selector knob synchronizes the heading bug to the current heading.

The FD follows the selected heading and respects the direction in which the turn on the HDG SEL knob was commanded, regardless if the turn being commanded is greater than 180°.

HDG MODE ACTIVATION

- HDG button is pressed on the Guidance Panel.

HDG MODE DE-ACTIVATION

- HDG button is pressed on the Guidance Panel.
- When another lateral mode becomes active.

LATERAL NAVIGATION (LNAV)

The LNAV engages when:

- LNAV mode is armed, LNAV will automatically engage when passing through 200 ft during climb.
- The airplane is above 200 ft and the NAV button is pressed.

The FMS becomes the source for lateral navigation providing guidance through the Flight Director.

LOCALIZER (LOC)

The LOC mode is selected via the APP button on the GP.

The FD automatically manages the LOC and Back-Course according to Localizer frequency, PFD information and airplane's position.

The FD is capable of intercepting the LOC when there is no GS signal. Other vertical navigation modes such as FPA or VS can be used for vertical navigation.

The FD opens the bank angle command limit to 35° during Localizer capture.

BACK-COURSE (BC)

The FD will automatically select a BC approach on the PFD.

The FGCS provides commands for capture and tracking of BC localizer indicated on the selected PFD.

TRACK HOLD (TRACK)

The track select mode is used to intercept and maintain an inertial derived airplane track from the IRS. This mode is used for Takeoff and Go-Around.

TAKEOFF

The automatic transition from ROLL to TRACK during takeoff occurs when:

- IAS is greater than 100 kt and;
- Bank angle is at 3° or below for more than 10 s.

GO AROUND

TRACK ACTIVATION

- TOGA button is pressed for go-around.

TRACK DE-ACTIVATION

- Another lateral mode is selected.

Canceling the vertical mode of GA does not disengage the TRACK lateral mode.

FGCS VERTICAL MODES

The FGCS vertical navigation modes are:

- Flight Path Angle (FPA).
- Takeoff (TO).
- Altitude Select (ASEL).
- Flight Level Change (FLCH).
- Altitude Hold (ALT).
- Vertical Speed (VS).
- Vertical Navigation (VNAV).
- Overspeed (OVSP).
- Glide Slope (GS).
- Go around (GA).
- VGP (VGP).

FLIGHT PATH ANGLE (FPA)

The FPA is the basic vertical mode (except for the TO).

The FPA can be used for vertical navigation by selecting a higher or lower altitude on the ALTSEL and then pressing the FPA button.

The flight path reference line (FPR) is displayed when the FPA is active. Pressing the FPR button in the display controller panel displays the FPR line, regardless of vertical mode active.

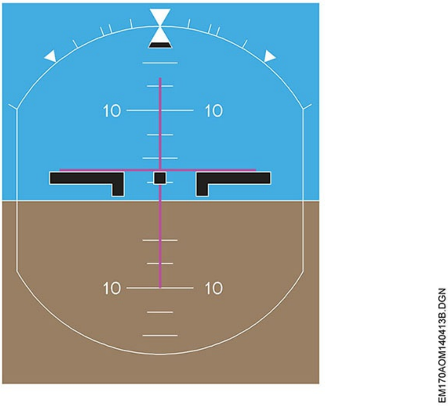
Flight path angle (± 9.9°) is selected in the FPASEL selector knob on the guidance panel.

FPA ACTIVATION:

- When the autopilot is engaged and no FD mode is active;
- Pressing the FPA button on the guidance panel.
- A lateral mode is activated and there is no vertical mode active.
- Deselecting the current vertical mode.

TAKEOFF (TO)

The takeoff mode is represented by crossbars and is used during the takeoff phase to maintain a pitch attitude based on flap selection, airplane weight and V2 speed.



PFD TAKEOFF MODE CROSSBAR

TO MODE ACTIVATION

- TOGA button is pressed on ground.

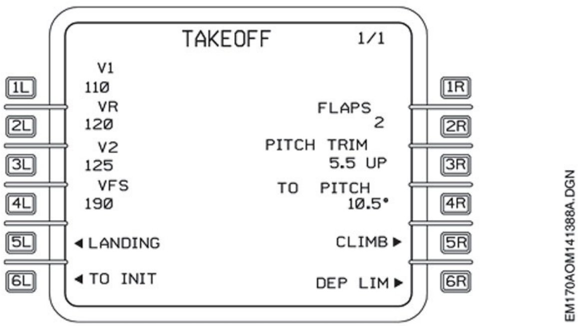
TO MODE DE-ACTIVATION

- When another vertical mode is selected.

TO PITCH ANGLE CALCULATION

To calculate the TO pitch angle the FMS uses the actual airplane weight and the following information inserted in the MCDU TAKEOFF page:

- Flap position (page 1/1)
- V2 speed (page 1/1)



TO pitch will be dashed if necessary information is not inserted.

TO PITCH ANGLE LOGIC

The system will guide the Pitch initially to the calculated angle. When airborne and IAS is greater than speed target, the guidance will be as follows:

- All engines operating: V2 + 10 kt.
- One engine inoperative:
- Engine failure below V2: guides V2.
- Engine failure between V2 and V2 + 10 kt: guides present speed.
- Engine failure above V2 + 10 kt: guides V2 + 10 kt.

In TO mode the pitch is limited to a minimum of 8° and a maximum of 18° (maximum 25° for aircraft with Steep Approach capability). The maximum speed target is Vfe - 5 kt and minimum speed target is Vshaker + 10 kt for all engines operating. For one engine inoperative the minimum speed target is Vshaker + 3 kt.

NOTE: If actual flap selection does not agree with FMS selection, the aural warning “NO TAKE OFF FLAPS” will be triggered whenever the airplane is on ground and take off thrust is applied or Take off configuration button is pressed.

ALTITUDE SELECT (ASEL)

The altitude select mode captures and levels off at the selected altitude. A green ASEL is displayed on the FMA while altitude select mode captures the pre-selected altitude, followed by a green ALT display when level off at the selected altitude.

NOTE: Altitude select is automatically armed whenever a vertical FD mode is used to fly towards the desired altitude.

FLIGHT LEVEL CHANGE (FLCH)

FLCH provides commands to Climb or Descend to the altitude selected (ALTSEL) according to the speed selected.

During FLCH the speed selected will be controlled via pitch changes through elevator inputs, and the FMA will show SPD_E.

FLCH ACTIVATION:

- Pressing the FLCH button.

FLCH DE-ACTIVATION:

- Pressing the FLCH button.
- When another vertical mode is selected.

FLCH LOGIC:

The FLCH mode can be FMS (magenta) or non-FMS (green).

During a FLCH descent, selecting an altitude above the current airplane altitude will command the airplane to climb. The airplane will not reach the altitude selected if AT is disengaged and sufficient thrust to climb is not available.

During a climb, selecting an altitude below the current airplane altitude will command the airplane to descend. The rate of descent is a result of the amount of engine thrust being used.

TRANSITION FROM MACH / IAS

The selected speed is displayed in the box on the top of the speed tape. When the altitude is approximately 29000 ft the display switches from IAS to Mach readout during climb and from Mach to IAS readout during descent.

ALTITUDE HOLD (ALT)

The ALT mode indication on the FMA indicates the altitude hold mode and the altitude selected is being maintained.

ALT MODE DISENGAGEMENT:

The ALT mode can be disengaged by selecting a different altitude via ALTSEL knob and activating a new vertical mode.

This logic is valid for all vertical modes except for Glide Slope (GS) and VGP. Switching from ALT mode to GS or VGP mode occurs without change in ALT SEL selection.

ALTITUDE HOLD BUTTON (ALT)

Pressing the ALT button on the GP engages the altitude hold mode. The altitude hold mode maintains the altitude displayed on the Altimeter at the moment the ALT button is pressed.

VERTICAL SPEED (VS)

The VS mode maintains a vertical speed rate. The VS mode is activated by pressing the VS button on the GP. Vertical speed is selected rotating the vertical speed thumbwheel on the GP.

The vertical speed command range goes from -8000 ft/min to +6000 ft/min.

The increments of the Vertical Speed target value are: 50 ft/min (below 1000 ft) and 100 ft/min (above 1000 ft).

OVERSPEED PROTECTION (OVSP)

The AFCS provides overspeed detection and protection in order to maintain the speed below V_{mo}/M_{mo} limits.

When the autopilot and/or the autothrottle are engaged, pitch and/or thrust will be adjusted to prevent overspeed.

When the FD is disengaged only aural warning (“HIGH SPEED”) will be triggered requiring pilot input to avoid overspeeds.

When the OVSP protection activates, an amber OVSP indication displays on the FMA. The previous active mode is displayed as armed (white) and becomes active again when OVSP protection is no longer active.

GLIDE SLOPE (GS)

The GS approach mode allows the ILS approach mode functions. The GS mode arms when the APP button is pressed and activates when the glide slope is captured.

GO-AROUND (GA)

The go-around mode automatically provides go-around guidance and thrust by pressing the TOGA switch. The TRACK HOLD mode is engaged when TOGA is pressed.

GA MODE ACTIVATION:

- Pressing TOGA switch when inflight.

GA MODE DE-ACTIVATION:

- When another vertical mode is selected.

NOTE: GA mode does not transition to ASEL/ALT modes if the selected altitude is within a 400 ft window from the altitude of the TOGA activation.

GA LOGIC:

The GA mode first guidance sets pitch at 8°.

When IAS is greater than the speed target, the guidance will be the speed target according to the following:

- All engines operating: V_{REF} + 20 kt.
- One engine inoperative: V_{AC} (approach climb).

The V_{REF} and V_{AC} are inserted on the MCDU (PERF > LANDING page).

If speed target is not valid, the airplane guides to pitch 8°.

In GA mode the pitch is limited to a minimum of 8° and a maximum of 18°. The maximum speed target is Vfe - 5 kt and minimum speed target is Vshaker + 10 kt for all engines operating. For one engine inoperative the minimum speed target is Vshaker + 3 kt.

WINDSHEAR (WSHR)

This mode provides FD escape guidance in case of Windshear detection below 1500 ft AGL.

The system provides flight path guidance angle limited to stick shaker, commands wings level and provides aural alerts.

The label “WSHR” is displayed when the Windshear Guidance mode is activated.

The autopilot is disengaged when the Windshear Guidance mode becomes active. Windshear alerts are associated with vertical winds and rapidly changing horizontal winds and are divided as follows:

WINDSHEAR CAUTION:

- Associated with increasing head wind and severe up drafts. A detection of a caution level Windshear is indicated by amber WSHEAR on the PFD and aural alert “CAUTION WINDSHEAR”.

WINDSHEAR WARNING:

- Associated with decreasing head wind (or increasing tail wind) and severe vertical down drafts. A detection of a warning level Windshear is indicated by a red WSHEAR on the PFD and aural alert “WINDSHEAR, WINDSHEAR, WINDSHEAR”.

WINDSHEAR GUIDANCE MODE ACTIVATION:

- Windshear warning or caution condition is detected and TOGA switch is pressed.
- Windshear Warning condition is detected and thrust lever is set to TO/GA position.
- Automatically when windshear warning condition is detected and the FD mode is in TO or GA.

A green WSHR annunciation is displayed on the FMA when the Windshear guidance mode is activated.

VERTICAL NAVIGATION (VNAV)

The VNAV engages when:

- VNAV mode is armed, VNAV automatically engages when passing through the heights previously set on the DEPARTURE LIMIT and GO-AROUND LIMIT pages on the MCDU.
- The airplane is above the preset height and the VNAV button is pressed.

According to the required vertical profile the VNAV automatically selects its sub-modes.

VARM SUB-MODE

When VNAV is selected on the GP, the initial mode is VARM. The FMS remains in VARM mode until the appropriate vertical mode to be used is determined.

While in the VARM mode the previous AFCS vertical mode remains engaged.

VFLCH SUB-MODE

VFLCH is VNAV Flight Level Change and can be automatically selected by the FMS or manually by the flight crew for climb or descent.

During climbs the VNAV sub mode will always be VFLCH.

VFLCH engages when the Alt Selector is set to an altitude different than the current airplane altitude, VNAV is engaged and the FLCH button is pressed.

VASEL SUB-MODE

VASEL is the VNAV altitude capture mode. It captures the Alt Selector altitude or the FMS waypoint altitude constraint.

VALT SUB-MODE

Maintains the altitude commanded by the FMS or the Alt Selector.

VGP SUB-MODE

The VNAV Glide Path (VGP) mode is an FMS based non-precision approach mode created to provide a constant final approach descent path. In this mode, the FMS flies a constant glide path approach from the Final Approach Fix (FAF) to the Missed Approach Point (MAP) regardless the Alt Selector altitude which may be set to the missed approach altitude.

VGP ACTIVATION

The VGP mode can be armed by pressing the APP button on the Guidance Panel when within 30 NM radial distance from the destination, and a non-localizer based approach with a published constant glide path angle is selected in the FMS. The VGP mode is engaged when the airplane is within 5 NM from the FAF along track distance or at any distance within 30 NM from the destination whenever using ACTIVATE VECTORS and the first approach waypoint is the FAF. The VGP does not engage if any change in the vertical procedure profile is made.

NOTE:
- If the glide path is below the current aircraft position and the APP button is pressed the VGP will engage and command a descend to intercept final approach path.
- If performing HOLD PATTERN the VGP should be armed only after exiting the HOLD, otherwise the VGP may intercept the final approach descent path during the HOLD track

VGP DE-ACTIVATION

- Selecting another vertical mode.
- Pressing the APP button on the GP after engagement.

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VGP ARMED AND ENGAGED

VPATH SUB-MODE

VPATH is a VNAV sub mode used for constant geometric path descents downwards to a waypoint constraint.

The FMS path angle can be defined by pilot entries, procedures within the database or by default.

By default the FMS path angle is 3 degrees.

When required it can be manually varied from 1 to 6 degrees.

VPATH LOGIC

Flying VPATH (fixed descent angle) speed changes are accomplished through thrust variations.

An amber LIM on the FMA indicates that insufficient thrust variation is available to maintain or to reach the required speed.

VPATH SPEED/ALTITUDE LIMIT LOGIC

In order to comply with Speed/Altitude limit protection selected on the PERF INIT page when the speed limit is exceeded by more than 5 kt, the system reverts to VALT or VASEL momentarily leveling the airplane thus reducing the speed. Once the desired speed is reached the system returns to VFLCH which is maintained until reaching the altitude selected in the ALTSEL window.

When the autothrottle is not engaged the FMS may continue the descent through the speed/altitude limit. In this case, manual speed control is necessary to meet the speed/altitude limit.

Speed/Altitude Limit protection is also given during VFLCH descents. Under these conditions, the FMS slows the airplane by thrust variation to the speed limit when approaching the altitude associated with it.

The deletion of SPD/ALT LIM from the FMS will dash the field and FMS will understand that no Speed/Altitude Limit applies.

VNAV APPROACH TEMPERATURE COMPENSATION

The VNAV temperature compensation technique function adjusts all FMS waypoint altitude constraints for the defined approach, approach transitions, and missed approach segments of the flight plan for non-standard day temperatures.

TEMP COMP MODES

The flight crew configures the FMS for three modes of VNAV approach temperature compensation on the TEMP COMP page:

- OFF: assumes standard day temperature.
- COLD: applies temperature compensation only when approach is flown in COLD conditions.
- HOT/COLD: applies temperature compensation when approach is flown in any temperature.

TEMP COMP REQUIREMENTS

- One of its modes (COLD or HOT/COLD) enabled.
- An arrival procedure loaded on the active flight plan.
- An outside temperature for the destination airport is entered on the LANDING page.

TEMP COMP ACTIVATION

When all requirements described above are met the TEMP COMP feature may be activated on the TEMP COMP page.

The TEMP COMP page is accessible by pressing the TEMP COMP prompt on the LANDING page or on the ACTIVE FLIGHT PLAN page when within 30 NM from destination.

Pressing the prompt a MOD FLIGHT PLAN with the proposed altitudes is shown. The flight plan must be activated to incorporate the compensated altitude constraints.

NOTE: The temperature compensation is applied only to the altitude constraints from the navigation database. No changes are applied to the pilot-entered constraints.

It is possible to remove the compensated altitudes by selecting the REMOVE prompt on the TEMP COMP page.

TEMP COMP PRESENTATION

The compensated altitudes for each of the arrival flight plan constraints are displayed in reverse video on the MCDU and VSD.

TEMP COMPENSATED MDA (da)

The TEMP COMP page displays the compensated MDA (DA).

If the procedure installed in the database does not contain a waypoint that corresponds to the MDA (DA) then four dashes are displayed in its place. Values can be entered or deleted by the flight crew to find out what is the compensated MDA (DA) for temperature inserted in the LANDING page.

SPEED CONTROL

Speed control can be manual or automatic depending on the selection on the Speed Selector Knob. The FMS selection allows the FMS to send its internally defined speeds as target speeds for FGCS.

MANUAL SPEED CONTROL

If the Speed Selector Knob is set to MANUAL the pilot is responsible for controlling the speed during all flight phases.

FMS SPEED CONTROL

In this mode the speed command is sent to the AFCS by the FMS. The departure, climb, cruise, descent, approach and go-around speeds are set in the PERFORMANCE INITIALIZATION. If a new schedule is desired, these settings can be modified in flight.

SPEED PROTECTION

The FMS incorporates speed reversion (transition from VPATH to VFLCH) and latched speed protection.

- Transition from VPATH to VFLCH: Speed reversion is active when the descent is too steep and it is not possible to maintain the selected speed. In this case, the FMS transitions to VFLCH, which maintains the speed within limits. The transition from VPATH to VFLCH automatically occurs if:
  - The speed exceeds V_{MO}/M_{MO} + 10 kt during VPATH descents;
  - FMS passes through a speed/altitude limit with a speed greater than 5 kt. In this case, the command is to level off until the speed deviation is below + 2 kt. Afterwards, the FMS commands VFLCH down to the Alt Selector altitude;
  - Landing Gear/Flap speed limit is exceeded by more than 10 kt;
  - In VPATH and the speed is less than V_{REF} – 10 kt.

NOTE: If the Auto Throttle is not engaged the pilot is responsible for maintaining the speed.

ILS APPROACH

The ILS approach is a non-FMS navigation. The automatic transition from FMS navigation into an ILS approach is done through the use of the preview mode.

The transition can also be manually done by pressing the V/L button on the guidance panel.

ILS APPROACH ACTIVATION

- Pressing the APP button on the GP when an ILS frequency is tuned.

ILS APPROACH CAPABILITY

The FMA shows current system capability based on the intended approach to be flown.

The intended approach capability is determined by the selection of the (RA/BARO) on the Guidance Panel. All other operational conditions must be met in order for the capability to be validated.

Selecting BARO indicates APPR 1 capability for an ILS CAT I approach.

Selecting RA indicates APPR 2 capability for an ILS CAT II approach.

The Altitude (BARO) or Height (RA) inserted in the BARO/RA window on the PFD through the Minimums Knob on the guidance panel determines the EGPWS callouts for the minimums (MDA or DA).

Selecting the RA/BARO to off (setting minimums to 0 ft) disables the EGPWS minimums call outs.

The system will not indicate discrepancy in selected values between PFD1 and PFD2.

CAPABILITY REQUIREMENTS

When ILS modes are requested via the APP button, the system arms for the highest capability available as long as all conditions are satisfied, according to the following:

APPR 1

The APPR 1 is the flight director mode used for ILS CAT I approaches.

The requirements to engage APPR 1 are:

- RA/BARO selector set to BARO.
- NAV frequency set to the correct LOC frequency in the MCDU.
- V/L or preview selected.

These selections are necessary only on the PFD where the FD source is pointing.

When APP button is pressed, the system attempts to arm to the highest capability available, this case APPR 1.

APPR 2

The APPR 2 is the flight director mode used for ILS CAT II approaches.

The requirements to engage APPR 2 are:

- Both RA/BARO selector knobs set to RA.
- Radio altitude between 800 ft and 1500 ft.
- Minimums displayed on both PFDs are valid.
- Both NAV frequencies set to correct LOC frequency in the MCDU.
- Both PFDs set to correct LOC inbound course (V/L or Preview).
- SLAT/FLAP 5.

These selections above are necessary on both PFDs.

The BARO/RA window on the PFD 1 and on the PFD 2 must be on the same selection (RA-RA) for CAT II approaches. If there is a discrepancy the BARO/RA window on the non coupled side will flash amber upon crossing 1500 ft when APPR mode is selected.

An EICAS message APPR 2 NOT AVAILABLE is presented inflight if the required items to engage are not met or a system failure exists.

If the flap setting is the only remaining condition to be satisfied for CAT II, the armed status will remain displayed down to 800 ft RA, suggesting there is still one pilot's action pending.

CAT II WARNINGS

LOCALIZER, GLIDE SLOPE AND RADIO ALTITUDE COMPARATORS WARNINGS

A comparison between the localizer, glide slope and radio altitude deviation indications are performed when the following conditions are met:

- On-side radio altitude valid and below 1500 ft.
- APP mode selected on Flight Guidance Panel.
- SLAT/FLAP 5.
- CAT II Decision Height setting on both Display Control Panels.
- On-side VOR/LOC active course valid.
- Cross-side data valid.
- Go-around not selected on either side.
- No back course selected.

For localizer, the following additional condition is required:

- Both LOC signals tuned and valid for at least 15 s.

If LOC indications differ by values above approximately 1/2 dot, an amber LOC annunciator will appear flashing (for 10 s). Refer to ADI/HSI Miscompares in 14-09-05 for details.

For glide slope, the following additional condition is required:

- Both glide slope signals valid and both LOC signals tuned and valid for at least 15 s.

If GS indications differ by values above approximately 2/3 dot, an amber GS annunciator will appear flashing (for 10 s). Refer to ADI/HSI Miscompares in 14-09-05 for details.

For radio altitude, the following additional condition is required:

- Both radio altimeters signals valid and on scale.

If radio altimeters indications differ more than a set point, an amber RA annunciator will appear flashing (for 10 s). Refer to ADI/HSI Miscompares in 14-09-05 for details.

EXCESSIVE LOCALIZER AND GLIDE SLOPE DEVIATION WARNINGS

The on-side localizer and glide slope excessive deviations are compared to the CAT II limits and displayed when the following conditions are met:

- APP mode selected on Guidance Panel.
- SLAT/FLAP 5.
- CAT II Decision Height setting on Guidance Panel.
- VOR/LOC is the active course is valid.
- On-side radio altitude between 500 and 80 ft.
- On-side localizer tuned and valid.
- On-side glide slope valid.
- No back course selected.
- Go-around not selected on either side.

Localizer excessive deviation:

If a localizer deviation greater than approximately 1/3 dot is detected, the excessive lateral deviation pointer will change from green to amber, the lateral deviation scale will change from white to amber, and flash. Refer to ADI Indications in 14-09-05 for details.

NOTE: The on-side excessive deviation warning is also displayed when the cross-side system has detected an excessive deviation.

Glide slope excessive deviation:

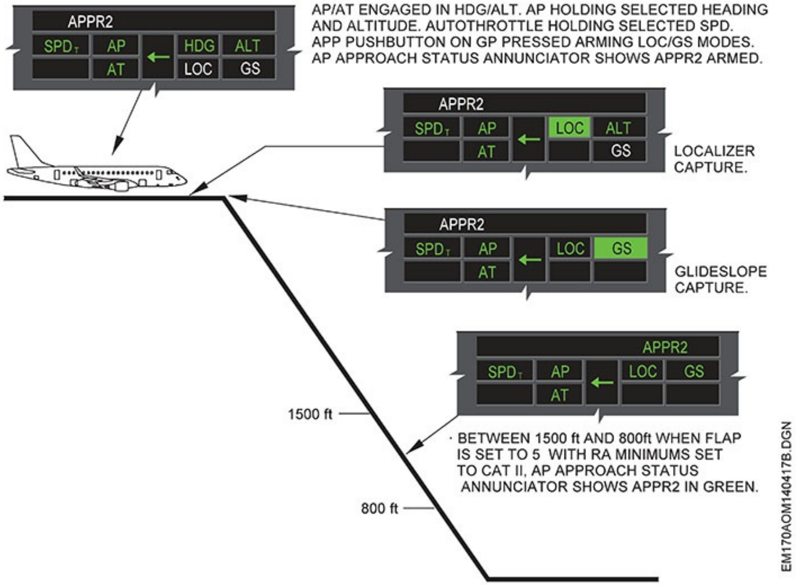
If a glide slope deviation greater than approximately one dot is detected, the GS pointer will change from green to amber, the GS scale will change from white to amber, and flash. Refer to ADI Indications in 14-09-05 for details.

NOTE: The on-side excessive deviation warning is also displayed when the cross-side system has detected an excessive deviation.

ILS APPROACH CHECK POINTS

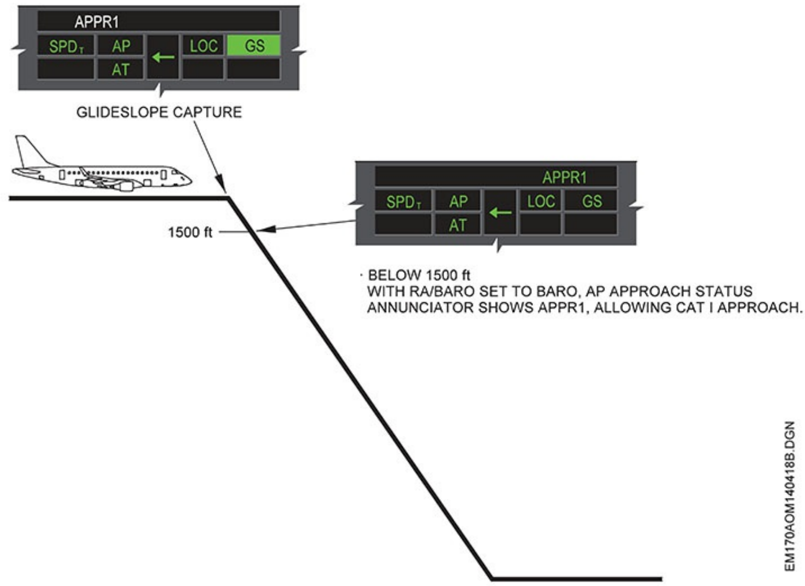
- 1500 ft RA – system starts trying to engage highest capability available.
- 800 ft RA – system “freezes” highest capability available, no longer allowing approach “upgrades”.

APPROACH SEQUENCE – CAT II



CAT II APPROACH

APPROACH SEQUENCE – CAT I

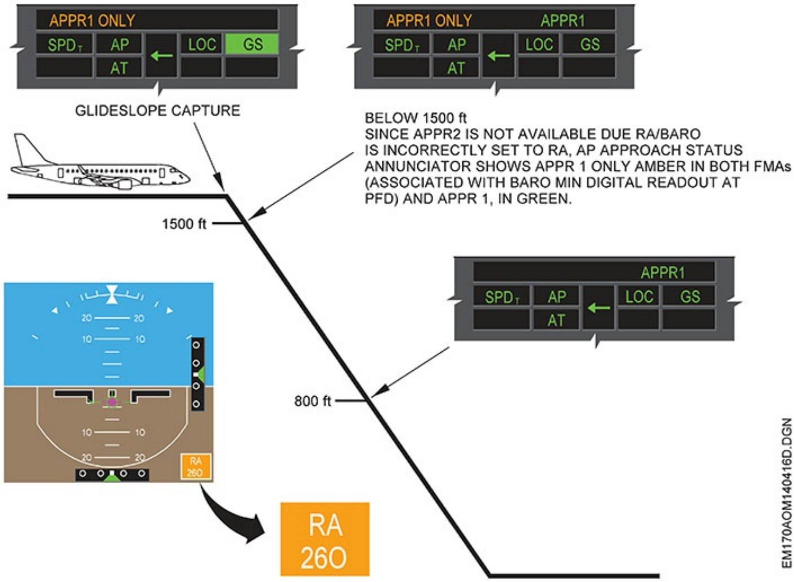


CAT I APPROACH

APPROACH SEQUENCE – CAT I (RA/BARO SET RA)

Example:

- Either BARO/RA window incorrectly set to RA.



APPR II NOT AVAILABLE

MACH TRIM (E190 ONLY)

The mach trim (MT) function positions the horizontal stabilizer surface as function of Mach number. The MT function is computed in the AFCS and the command is transmitted to HS-ACE via FCM.

Increase of Mach number moves aft the wing aerodynamic center of pressure, causing an pitch down moment. Horizontal stabilizer mach trim up command is required to compensate the pitch down moment.

MT function automatically engages when the conditions below are satisfied:

- Autopilot is not engaged.
- Indicated airspeed is above 0.70 M.
- Manual trim of horizontal stabilizer is not in progress.
- Neither of the quick disconnect switches are pressed.
- Any other trim function is not commanding.

If MT function disengages if at least one of conditions above is not satisfied. It also disengages if MT monitor detects a fault in trim rate command.

Mach trim is disabled with AP engagement due to AP trim operation.

PREVIEW FEATURE

The preview feature provides a transition from FMS navigation into ILS approach course (V/L).

When FMS is selected as the primary navigation source the system automatically selects the ILS frequency and Localizer course when:

- The airplane is within 150 NM from destination;
- The PREV function is used;
- AUTO tuning is enabled on the MCDU radio page;
- An ILS or BC procedure is part of the active flight plan in the FMS.

The PFD will automatically display the Localizer course if the PREVIEW MODE is selected with the ILS frequency already auto tuned.

NOTE: Depending on certain conditions of LOC interception, such as interception angle and speed, the FMS may inhibit LOC capture.

14.03.15 AUTOLAND

AUTOLAND 1 consists of approach, touchdown and 5 seconds of roll out and can be accomplished on CAT I, II or IIIa approaches.

Autoland can be performed with or without autothrottle and with one engine inoperative.

AUTOLAND AURAL WARNING

The "NO AUTOLAND" aural warning will be cancelled if any of the following is true:

- The TOGA button is pressed and Go-Around mode is activated,
- The Autopilot is disengaged.

AUTOLAND DISABLE/ENABLE

When airplane is powered up the autoland default is ENABLE. Autoland can be disabled/enabled via the OPR Config MCDU page. To disable/enable autoland proceed as follows:

- Press MENU button on MCDU to go to MENU page.

MENU PAGE:

- Press line select key 1L to go to MISC MENU page 1/1.

MISC MENU PAGE 1/1:

- Press line select key 4L to go to OPR Config page 1/1.

OPR Config PAGE 1/1:

To disable/enable autoland press line select key.

The status message "AUTOLAND OFF" will appear on the EICAS after the Autoland is disabled via MCDU.

NOTE: If a go around is required, flight crew shall be aware that the parallel rudder servo will actuate when Go-Around mode (GA) is active and the Autopilot is engaged, even with Autoland system disabled (OFF) via MCDU.

OPR CONFIG MCDU PAGE

CONDITIONS TO ARM/ENGAGE

The operational conditions to arm Autoland are:

- Autoland is enabled (MCDU).
- Autopilot and yaw damper engaged.
- NAV 1 on pilot's side and NAV 2 on copilot's side tuned to the same ILS frequency.
- Flight Director approach mode selected.
- Both PFDs set to correct LOC inbound course (V/L or Preview)
- Flight Directors operational on both PFDs.
- Attitude and Heading valid on both PFDs.
- Valid Airspeed and Baro Altitude on both PFDs.
- Glide slope and Localizer deviation valid on both PFDs.
- LOC 1 and LOC 2 on opposites PFDs as navigation source.
- Both RA/BARO minimums selector knobs set to RA.
- No comparison monitors tripped (FPA, Attitude, Heading, Airspeed, Baro Altitude, Localizer, Glide slope and Radio altitude) on both PFDs.
- Not in back course.
- EICAS message AUTOLAND 1 NOT AVAIL not presented.

The operational conditions to engage Autoland are:

- Flaps 5.
- Both radio altimeters indicating less than 1500 ft and more than 800 ft.

If the flap setting is the only remaining condition to be satisfied for Autoland, the armed status will remain displayed down to 800 ft RA, suggesting there is still one pilot's action pending.

AUTOLAND MODES

Five modes are related specifically to Autoland:

- Align (ALIGN): engages at 150 ft and maintains the lateral guidance while the airplane aligns with the runway centerline by means of aileron and rudder control.
- Flare (FLARE): engages at 50 ft and provides vertical guidance for the transition from glideslope to main gear touchdown.
- Retard (RETD): if the autothrottle is engaged, retard engages at 30 ft and commands throttle to idle.
- De-rotation (D-ROT): engages at main gear touchdown and commands a nose pitch down, touching nose gear down.
- Roll out (RLOUT): engages at main gear touchdown and provides lateral guidance to maintain airplane on the runway centerline.

AUTOMATIC PITCH TRIM LOGIC

Two automatic pitch trim logics are related to Autoland operations:

- A pre-trim up is commanded at 800 ft radio altitude in order to prevent a nose down transient in an event of an autopilot disconnection. In case of autopilot disconnection a pitch up is expected due to the pre-trim, requiring pilot manual trimming.
- Automatic pitch trim inhibition below 50 ft.

PARALLEL RUDDER

In Autoland-equipped airplanes, yaw axis control is also provided through an additional (parallel) rudder servo.

The parallel rudder servo engages at Autoland engagement and at go-around with AP engaged. When parallel rudder servo is engaged a self-test is accomplished by a small and slow movement of pedals in both directions, but not causing any rudder movement.

During final approach (AEO or OEI) the system logic applies the crab technique in case of crosswind landing until 150 ft, below 150 ft sideslip is applied.

Loss of rudder servo during Autoland disengages the autopilot causing the loss of Autoland capability. The autopilot also disengages if it occurs in a go around following an Autoland approach.

A rudder servo failure during engagement causes the AP RUDDER NOT AVAIL to latch. The failure is only reset on the ground by a successful electrical power up.

ILS APPROACHES – AUTOLAND ENABLED

The Autoland system may be used to execute ILS approaches CAT I, II or IIIa.

All conditions to Arm/Engage the Autoland must be satisfied and:

CAT I

- RA/BARO selector to set RA.

In order to disable the EGPWS call outs, the minimums can be set to OFF (setting minimums knob to 0 ft). After the capture of Autoland, setting the selector knob to BARO will enable the callouts.

CAT II

- RA/BARO selector set to RA and RA minimums set to 80 ft or above.

CAT IIIa

- RA/BARO selector to set RA and RA minimums set to a value of 50 ft or above.

FAIL PASSIVE AUTOLAND OPERATION

A fail passive system is one that in the event of a failure causes no significant deviation of airplane flight path or attitude. The capability to continue the operation is lost and an alternate course of action is required.

APPROACH SEQUENCE

Above 1500 ft:

- Pressing APP button on glareshield panel and with all conditions to arm Autoland satisfied causes the white “AUTOLAND 1” annunciation to be displayed on the left side of FMA. The LOC lateral mode and the GS vertical mode arm. When the Autoland engages, the “AUTOLAND 1” annunciation displays in green on the right side of FMA.
- Localizer and glideslope engage when capture.

Between 1500 ft and 800 ft:

- When flaps are set to 5 satisfying all conditions to engage Autoland, “AUTOLAND 1” changes from a white annunciation on the left side of the FMA. At this point the ALIGN and FLARE modes are armed and displayed in white.
- The following buttons are inhibited when Autoland is engaged: TCS, SRC, NAV, APP, BANK, HDG, VNAV, FLC, ALT, FPA and VS.

NOTE: Pressing the IAS/MACH button adjusts the target speed to VFE improperly. Do not use this button during autoland operations.

- At 800 ft a pre-trim up is commanded.

At 150 ft:

- ALIGN engages. RLOUT and RETD (if autothrottle is engaged) arm.

At 50 ft:

- FLARE engages.
- Automatic pitch prim is inhibited.

At 30 ft:

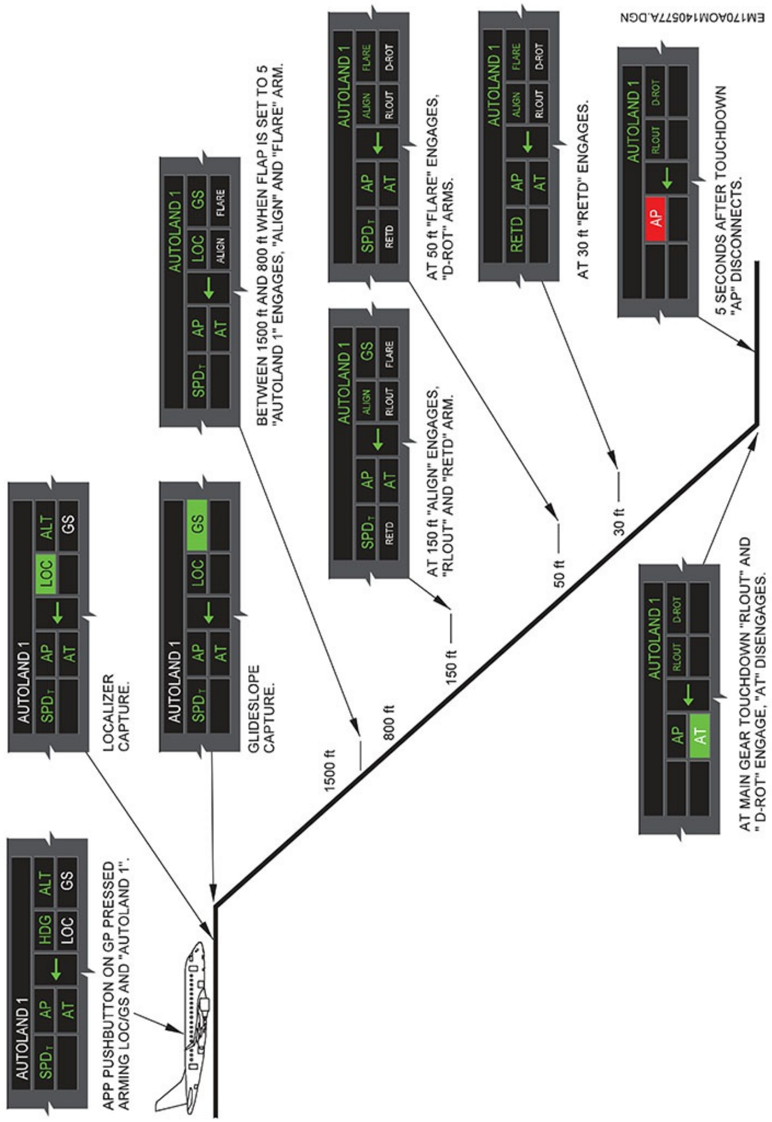
- RETD engages (if autothrottle is engaged).

At main gear touchdown:

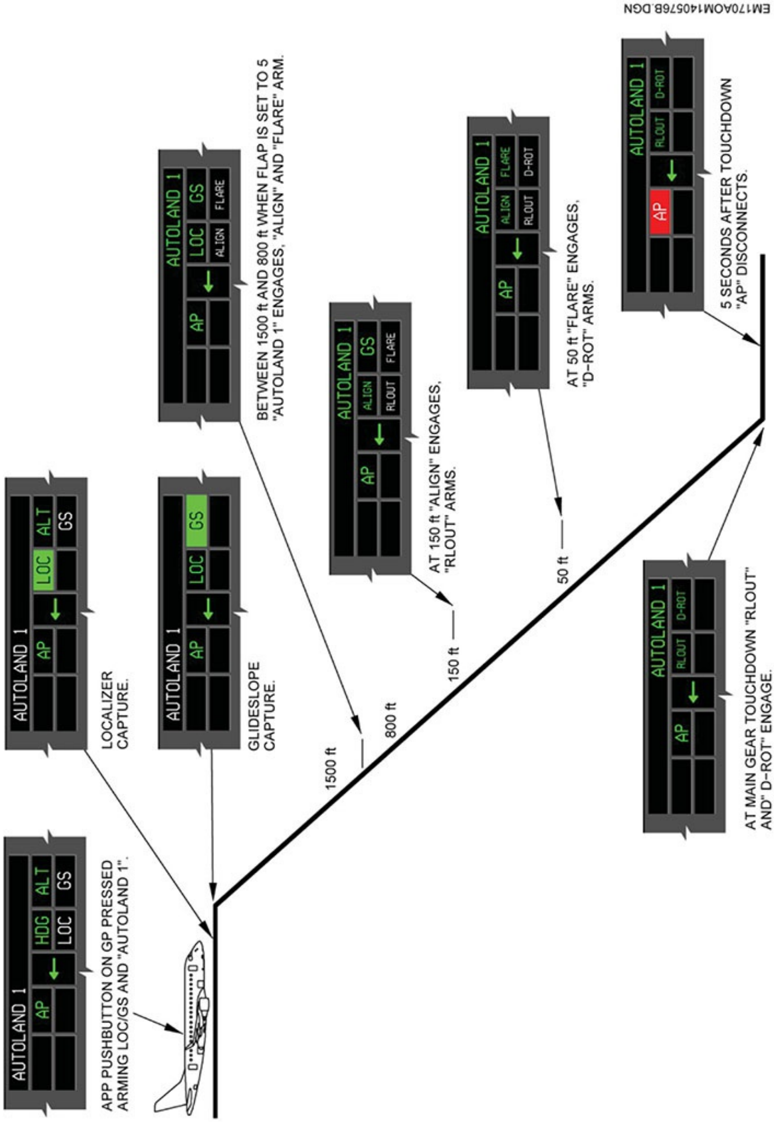
- RLOUT and D-ROT engage. Autothrottle disengages.

Autoland 1:

5 seconds after touchdown: AP disconnects.



AUTOLAND APPROACH SEQUENCE WITH AUTOTHROTTLE ENGAGED



AUTOLAND APPROACH SEQUENCE WITH AUTOTHROTTLE DISENGAGED

NOTE: The Autoland approach sequences are identical both for All Engines Operating and One Engine Inoperative conditions.

14.03.20 THRUST MANAGEMENT

THRUST MANAGEMENT SYSTEM

The thrust management system (TMS) interfaces with the flight guidance control system (FGCS) to control airplane speed and thrust. The TMS helps reduce fuel consumption and increase engine service life by limiting thrust, speed and temperatures required for different phases of flight.

The TMS consists of the following sub functions:

- Autothrottle (AT)
- Thrust Rating System (TRS).
- Thrust Lever Angle (TLA) Trim.

AUTOTHROTTLE

The autothrottle system (AT) moves the thrust levers to maintain the desired airspeed or thrust according to the appropriate mode. The AT has various modes of operation to help maintain the airplane operation within the normal operating envelope.

The AT is designed to operate in single engine condition with the same modes as in the dual engine condition.

AUTOTHROTTLE OPERATION

The AT sets the correct engine thrust with the synchronized N1 for its various operating modes.

AUTOTHROTTLE ENGAGEMENT

The AT engages on ground when all of the following conditions occur:

- no AT active failures.
- AT button pressed on the guidance panel.
- both thrust levers above 50° TLA.

The AT engages in flight when all of the following conditions occur:

- no AT active failures.
- AT button pressed on the guidance panel.
- airplane at or above 400 ft AGL.

NOTE: In order to maintain AT engaged, the thrust levers misalignment must be within the range equivalent to half a thrust lever head diameter.

LOW SPEED PROTECTION

The AT provides the following low speed protection whenever it is engaged:

ALTITUDE	FLAPS 0	FLAPS 1 TO FULL
Above 30000 ft	2% over amber Low Speed Awareness tape (LSA)	
Between 20000 ft and 30000 ft	Linear interpolation between 1.2 Vs and 2% over LSA	1.2 Vs
Below 20000 ft	1.2 Vs	

AUTOTHROTTLE NORMAL DISENGAGEMENT

Normal AT disengagement is accomplished by pressing any of the AT disconnect button on the thrust levers.

Alternatively, the AT is normally disengaged by pressing the AT button on the guidance panel.

The AT system is also automatically disengaged when one of the following conditions occurs:

- after airplane touchdown.
- thrust levers beyond the TO/GA position.
- reverse thrust operation during RTO.

NORMAL DISENGAGEMENT ANNUNCIATION

- AURAL
  The aural alarm “THROTTLE” sounds when the AT is disengaged in flight. The aural alarm is cancelled by pressing the AT disconnect button on the thrust levers again.
- FMA
  The AT annunciation on the FMA flashes in green for 5 s.

AUTOTHROTTLE NON NORMAL DISENGAGEMENT

The AT disengages when any of the following conditions occurs:

- difference in TLA greater than 8°.
- autothrottle failure.

NON NORMAL DISENGAGEMENT ANNUNCIATION

- AURAL
  The “THROTTLE” aural alarm sounds in flight. The aural alarm is cancelled by pressing any of the AT disconnect buttons on the thrust levers again.
- FMA
  The AT annunciation on the FMA flashes in red.
- EICAS
  The EICAS message AT FAIL is displayed.

AUTOTHROTTLE MODES

The AT modes are described as follows:

- takeoff (TO)
- takeoff hold (HOLD)
- speed on thrust (SPD_T)
- speed on elevator (SPD_E)
- go-around (GA)
- retard (RETD)
- limited thrust (LIM)
- override (OVRD)

TAKEOFF MODE

The TO mode is armed on ground pressing the AT button on the guidance panel. It engages when the thrust levers are beyond 50° of TLA.

TAKEOFF HOLD MODE (HOLD)

The HOLD mode prevents undesired thrust levers movement during the takeoff phase of flight.

HOLD mode is activated at or above 60 KIAS during the takeoff roll.

The AT servos are de-energized and thrust lever movements are not commanded up to 400 ft AGL.

SPEED ON THRUST MODE (SPD_T)

In this mode the system controls the selected airspeed adjusting the engine thrust by moving the thrust levers.

The flight director vertical modes related to SPD_T mode are:

- flight path angle (FPA).
- vertical speed (VS).
- glide slope (GS).
- VNAV path (PTH).
- VGP (GP)
- altitude hold (ALT)
- altitude select (ASEL)

The SPD_T is also the AT mode when the FD is turned OFF (no active modes on FMA).

SPEED ON ELEVATOR MODE (SPD_E)

The AT maintains a fixed thrust setting, and the flight director adjusts the pitch attitude to maintain the selected airspeed.

For small altitude changes the AT commands only the necessary thrust in order to maintain a comfortable predetermined schedule based on vertical speed.

For large altitude changes the AT commands:

- idle thrust for descent
- maximum thrust limited by the N1 target chevron

The vertical modes related to SPD_E mode are:

- flight level change (FLCH)
- overspeed (OVSP)
- VNAV flight level change (FLCH magenta)

NOTE: With the AT mode in the SPD_E and the AP disengaged, deviating from the flight director commands may lead to an undesired airspeed as the AT keeps the engine thrust at maximum or at idle and the pitch attitude change controls the airspeed. In this case, turn the flight director OFF to revert the AT to SPD_T. This procedure is to have engine thrust controlling airspeed.

GO-AROUND MODE (GA)

The Go-Around mode (GA) advances the thrust levers to the TO/GA position.

RETARD MODE (RETD)

The Retard mode reduces the thrust levers to idle during flare on landing. The retard mode arms when all of the following conditions occur:

- radio altimeter with valid information
- autothrottle engaged
- slat/flap lever position at 5 or FULL and landing gear down
- radio altitude below 150 ft AGL

Retard mode engages at or below 30 ft AGL.

In a normal flare, the Retard mode is scheduled to reduce thrust levers to idle so that idle thrust is achieved upon airplane touch down.

LIMITED THRUST (LIM)

Limited Thrust (LIM) is displayed on the FMA when the auto throttle authority is not sufficient to achieve or maintain the selected airspeed.

LIM is associated with Speed on Thrust mode (SPD_T).

OVERRIDE (OVRD)

The AT can be overridden by moving the thrust levers in any direction without causing its disengagement. If the AT is overridden by a pilot, a green annunciation “OVRD” is displayed on the FMA.

When the thrust levers are released the AT will once again return the thrust levers to their commanded position.

AT SINGLE ENGINE OPERATION

The AT deactivates the respective thrust lever when an engine failure occurs.

The operating engine’s thrust lever remains active for AT operation.

Reducing the thrust lever to simulate an engine failure will cause AT disengagement due to a split in thrust lever position.

TLA TRIM

The TLA trim function synchronizes the engine N1 when the AT is disengaged.

TLA trim function is accessed through the THRUST RATING SELECT page on the MCDU. TLA trim default is ON whenever the AT system is disengaged.

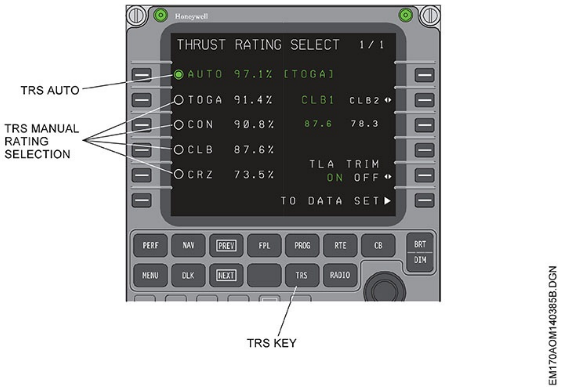
THRUST RATING SELECTION

The TRS determines the appropriate thrust rating upper limit based on the flight phase when in automatic rating mode or based on pilot selection when in manual rating mode. The selected thrust rating and thrust rating values are displayed on the EICAS.

Automatic rating or one of the manual ratings are selected through the THRUST RATING SELECT page on the MCDU.

The thrust ratings computed by the TRS are the following:

- takeoff (TO)
- go-around (GA)
- climb-1 (CLB-1)
- climb-2 (CLB-2)
- cruise (CRZ)
- continuous (CON)



THRUST RATING SELECT PAGE

AUTOMATIC OPERATION

On the THRUST RATING SELECT page, AUTO is the default mode after power up. When in this mode, the TRS determines the flight phase, the airplane configuration and the number of engines operative and automatically sets the appropriate thrust rating.

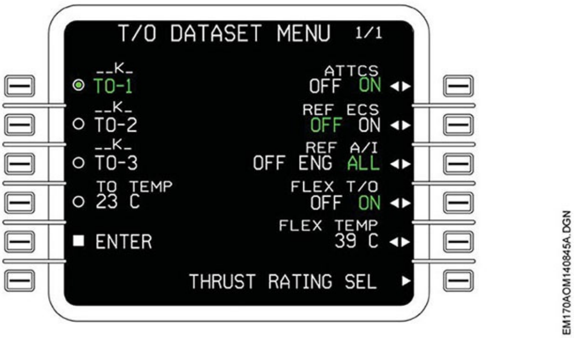
At the right side of the AUTO label, the system shows between brackets which TRS mode is active according to system logic.

The current rating label is displayed on the EICAS between both engine N1 indicators.

The resultant maximum N1 is digitally displayed above the N1 indicators and a chevron on each N1 dial provides the analog presentation.

TAKEOFF THRUST RATING (TO)

The TO thrust rating is set on the TAKEOFF DATA SET MENU page on the MCDU.



TO DATA SET MENU PAGE

During takeoff it is not possible to switch to another TRS mode on the MCDU until the airplane reaches 400 ft AGL. Below this altitude it is only possible to activate the RSV mode either automatically by the TRS or manually by setting the thrust levers to MAX position.

CLIMB THRUST RATING (CLB)

There are 2 climb modes labeled CLB 1 with highest thrust and CLB 2 with reduced thrust. The CLB 1 and CLB 2 logic is the following:

- Climb 1 (CLB 1) is the default mode after airplane power up.
- If the CLB 1 thrust is higher than the selected takeoff thrust (TO-X), the system automatically selects CLB 2 as the default until the next power down/power up.

This logic is to prevent the system from increasing thrust instead of reducing it during the transition from TO to CLB after the takeoff.

On the THRUST RATING SELECT page it is possible to switch from CLB 1 to CLB 2 with the system in automatic mode by selecting the desired mode on line select key 2R.

On the ground this selection is only possible if the selected takeoff thrust (TO-X) is higher than CLB 1, otherwise only CLB 2 is available.

During takeoff with flight director ON, the CLB mode is engaged when all of the following conditions occur:

- landing gear is retracted
- airplane altitude above 400 ft AGL
- any change in the flight director vertical mode.

During takeoff with flight director OFF, the CLB mode is engaged when all of the following conditions occur:

- landing gear retracted
- airplane altitude above 3000 ft AGL.

In flight the CLB mode is engaged when the altitude preselector is set to an altitude higher than the current airplane altitude.

CRUIZE THRUST RATING (CRZ)

The CRZ mode is engaged when all of the following conditions occur:

- Airplane is leveled at the altitude set on the altitude preselector for 90 s.
- Airspeed is within 5 kt (or 0.01 Mach) from the preselected airspeed.

GO-AROUND THRUST RATING (GA)

The GA mode is engaged anytime in flight whenever the landing gear and flaps are down.

CONTINOUS THRUST RATING (CON)

During takeoff the automatic transition from TO mode to CON only happens at 3000 ft AGL when in single engine condition.

In flight anytime a single engine condition is recognized the TRS automatically sets CON mode.

14.03.30 EICAS MESSAGES

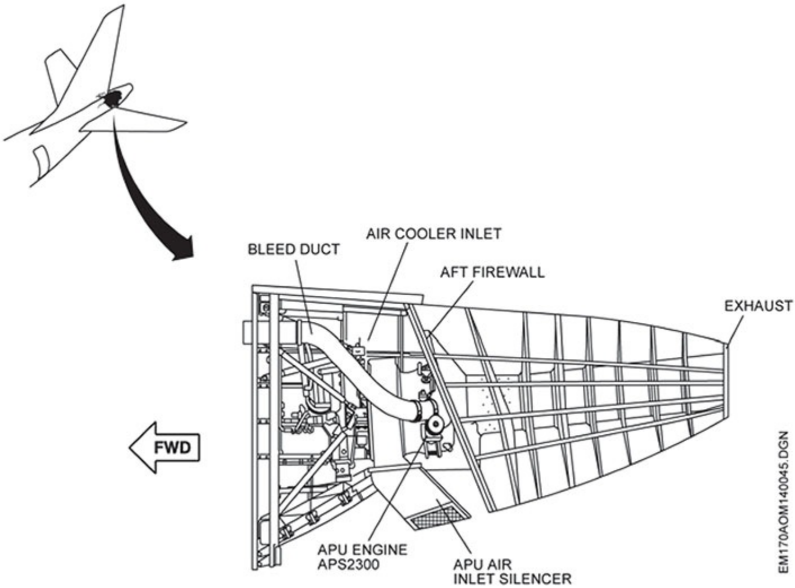
TYPE	MESSAGE	MEANING
CAUTION	AP FAIL	Autopilot function is no longer operative.
	AP PITCH MISTRIM	Pitch trim and autopilot commanding pitch trim control in opposite directions.
	AP PITCH TRIM FAIL	Autopilot stabilizer trim is no longer operative.
	AP ROLL MISTRIM	Roll trim and autopilot commanding roll trim control in opposite directions.
	AT FAIL	Both AT have failed. Selected AT function is unavailable.
	AT NOT IN HOLD	AT not in TO Hold following the transition above 60 kt during TO roll and until the airplane transitions 400 ft AGL and GA.
	FD LATERAL MODE OFF	Disconnected lateral mode due to invalid conditions.
	FD VERT MODE OFF	Disconnected vertical mode due to invalid conditions.
	SHAKER ANTICIPATED	Indication that Shaker activation angles have been advanced to conservative settings.
	STALL PROT FAIL	Stall Warning function and Stall Protection functions are inoperative.

TYPE	MESSAGE	MEANING
ADVISORY	AFCS FAULT	AFCS has detected a fault.
	AFCS PANEL FAIL	Both channels of the GP have failed.
	AFCS PANEL FAULT	A single channel of the GP has failed.
	AP FAULT	The AP has one channel failed.
	AP PITCH TRIM FAULT	The AP pitch trim has one channel failed.
	AP RUDDER NOT AVAIL	Autopilot rudder control is not available.
	APPR 2 NOT AVAIL	The AP is not capable of a CAT II precision approach.
	AT FAULT	The AT has one channel failed.
	AUTOLAND 1 NOT AVAIL	System not capable to perform Autoland.
	ENG TLA TRIM FAIL	Selected Sync function is unavailable due to an internal or required input failure. AT function is available.
	FD FAIL	FD is no longer available.
	FD FAULT	A single FD channel is inoperative.
	MACH TRIM FAIL (E190 only)	Mach Trim function in both channels is failed.
	MACH TRIM FAULT (E190 only)	Loss of one Mach Trim channel.
	SHAKER 1 (2) FAIL	Stall warning function has failed.
	STALL PROT FAULT	AOA Miscompare Monitor (Stall Warning Subsystem) has failed.
	STALL PROT ICE SPEED	The reference speed has changed. Set reference speed to ice speed. Once the ice condition is detected, the system latches the ice condition active until 30 seconds after WOW becomes valid.
	YD FAIL	Yaw damper function is inoperative.
	YD FAULT	The yaw damper has one channel failed.
	YD OFF	Yaw damper function is off.

14.04.01 GENERAL DESCRIPTION

The Auxiliary Power Unit (APU) is a gas turbine engine located in the airplane tailcone, which provides pneumatic and electrical AC power. The pneumatic power is used for engine starting and to supply bleed air to the air conditioning packs of the Environmental Control System (ECS). An electrical AC generator supplies 115 Volts 40 KVA to the electrical system.

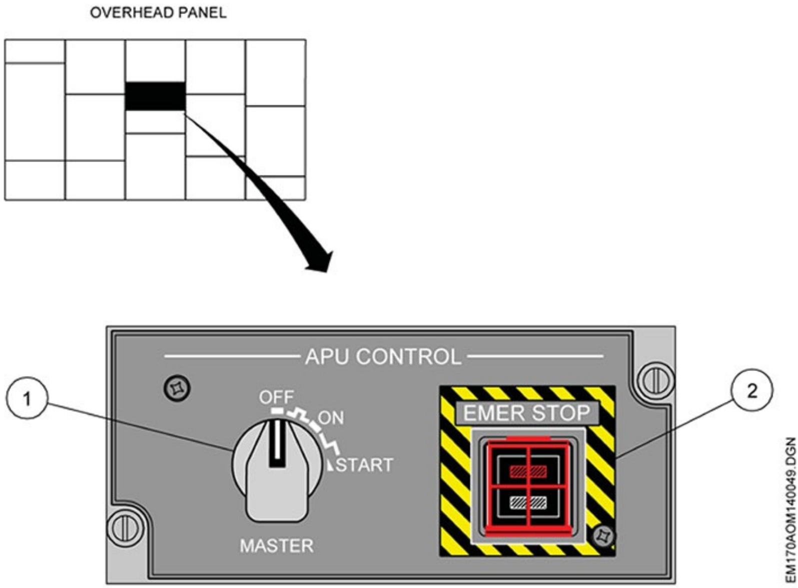
The APU is automatically monitored and controlled through a dedicated Full Authority Digital Electronic Control (FADEC) unit.



APU LOCATION

14.04.05 CONTROLS AND INDICATIONS

APU CONTROL PANEL



1 – APU MASTER SELECTOR (ROTARY ACTION)

OFF: initiates a normal APU shutdown.

ON: normal position when the APU is running.

START: (momentary action) initiates the APU start cycle. When released, the selector moves to the ON position.

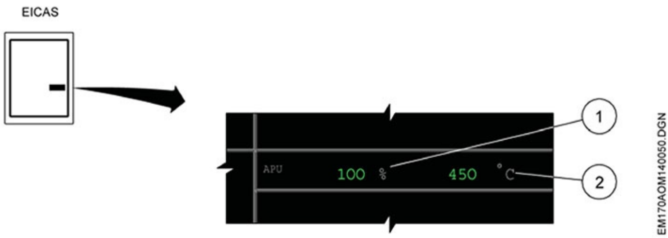
2 – APU EMERGENCY STOP BUTTON (GUARDED)

PUSH IN: closes the APU fuel shutoff valve, shutting down the APU with no cooldown period. A white striped bar illuminates on the lower half of the button.

PUSH OUT: normal position, with the fuel shut off valve open.

NOTE: When an APU fire is detected, the upper half of the button illuminates red.

EICAS INDICATION



1 – APU RPM INDICATION

- Displays the APU RPM (%).

GREEN: normal operating range.

AMBER: cautionary operating range.

RED operating limit exceeded.

2 – APU EGT (EXHAUST GAS TEMPERATURE) INDICATION

- Displays the APU temperature in degrees Celsius (°C).

GREEN: normal operating range.

AMBER: cautionary operating range.

RED operating limit exceeded.

14.04.10 APU SYSTEM DESCRIPTION

APU FUEL SUPPLY

When only DC power is available, the DC fuel pump, located in the right wing tank, provides fuel to the APU. If AC power is available and the engine is not running, fuel will be provided by the AC fuel pump.

When the engine is running, the ejector fuel pump provides fuel to the APU from the right wing tank. However, it is also possible to provide fuel to the APU from the left wing tank via a crossfeed valve.

APU BLEED

The APU supplies bleed air on the ground or in flight. However, it is used primarily as a ground pneumatic source for the air conditioning packs (ECS) and engine starting. The Air Management System (AMS) controls the operation of the APU and engine bleed valves. For logic details refer to Section 14-02 (AMS).

APU OPERATION

A dedicated Full Authority Digital Electronic Control (FADEC) monitors and controls the start/shutdown sequence, fault detection and APU status.

The flight crew controls the normal APU start/shutdown sequence, using the APU selector knob.

In an abnormal condition, the flight crew can shut down the APU through a dedicated emergency stop button.

The APU is able to supply:

- Electrical AC power up to 33000 ft.
- Bleed air for engine starting up to 21000 ft.
- Bleed air for air conditioning and pressurization up to 15000 ft.

Maximum altitude for APU start is 30000 ft.

APU START

Rotating the APU master switch to ON powers the FADEC and APU fuel shutoff valve opens.

The APU indication on the EICAS changes from OFF to the APU control parameters (speed and EGT).

NOTE: To avoid unsuccessful start attempt it is recommended to wait 30 s after the EICAS is energized to start the APU.

Rotating the APU selector knob from ON to START (momentary position), initiates the APU automatic starting cycle. During the automatic starting cycle the FADEC commands the electronic starter controller to energize the brushless starter generator, initiating APU rotation.

Three seconds after APU speed has reached 95%, electrical and pneumatic loading are available. If the APU does not reach proper speed or acceleration rate within the starting cycle time, the APU will automatically shut down.

GROUND START

The FADEC initiates ignition at approximately 6% rpm and the fuel flow after 0.5 seconds. The battery #2 energizes the electronic starter controller. After a light off occurs, the FADEC commands the starter to cutout at approximately 50% rpm.

IN FLIGHT START

The FADEC initiates ignition at approximately 7% to 17% rpm and the fuel flow after 0.5 seconds. After a light off occurs, the FADEC commands the starter to cutout at approximately 50% rpm.

APU SHUTDOWN

NORMAL APU SHUTDOWN

Rotating the APU selector knob from ON to OFF initiates a normal APU shutdown, which is monitored and controlled by the FADEC. During a normal shutdown sequence, the APU pneumatic power is removed immediately and the electrical power is removed after 1 minute. The cooldown period is 1 minute, followed by a spooldown period. The EICAS message APU SHUTTING DOWN disappears at the end of the spooldown period.

NOTE: Turning the APU selector knob back to ON position during the shutdown sequence cancels the shutdown.

EMERGENCY APU SHUTDOWN

In the event the APU emergency stop button has been selected, the APU fuel shutoff valve closes and the APU shuts down without a 1 minute cooldown period.

APU PROTECTION

The FADEC provides automatic APU shutdown protection on ground and in flight as follows. The appropriate EICAS message is displayed for each situation.

On the ground	In flight
Overspeed	Overspeed
Underspeed	Underspeed
FADEC critical fault	FADEC critical fault
APU fire	–
APU EGT overtemperature	–
APU high oil temperature	–
APU low oil pressure	–
Sensor fail	–

14.04.15 EICAS MESSAGES

TYPE	MESSAGE	MEANING
CAUTION	APU FAIL	APU automatic shutdown has occurred. APU cannot be restarted, except if the automatic shutdown occurred during the starting cycle and according to the restriction defined in the AOM.
	APU FAULT	APU automatic shutdown inhibited in-flight. An anomaly has been detected. Maintenance action is required.
	APU OIL HI TEMP	APU automatic shutdown inhibited in-flight. Oil temperature is above maximum limit.
	APU OIL LO PRESS	APU automatic shutdown inhibited in-flight. Oil pressure is below minimum limit.
	APU ALTITUDE EXCEED	APU operational ceiling has been exceeded. The airplane is flying at or above 33500 ft with the APU running.
STATUS	APU SHUTTING DOWN	A normal APU shutdown has been commanded via the APU selector knob.

14.05.01 GENERAL DESCRIPTION

The Electrical System generates and distributes both AC and DC power to airplane systems.

The AC system is composed of:

- Two integrated drive generators (IDGs).
- One auxiliary power unit (APU) generator.
- One inverter.
- One ram air turbine (RAT).
- One AC external power unit.

The DC system is composed of:

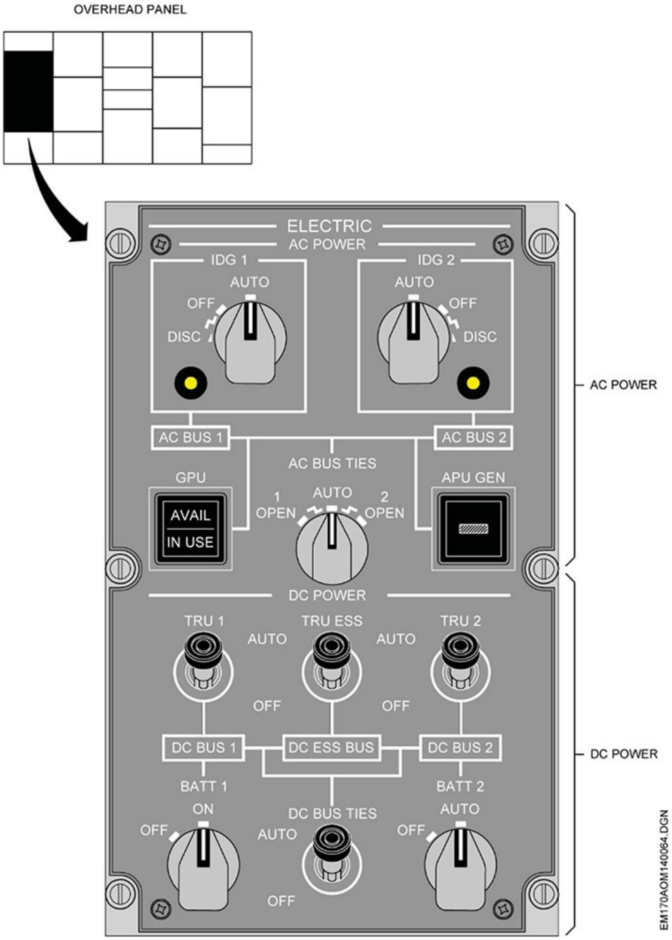
- Two NiCd batteries.
- Three transformer rectifier units (TRUs).
- One DC external power input.

Normal operation of the electrical system is automatic.

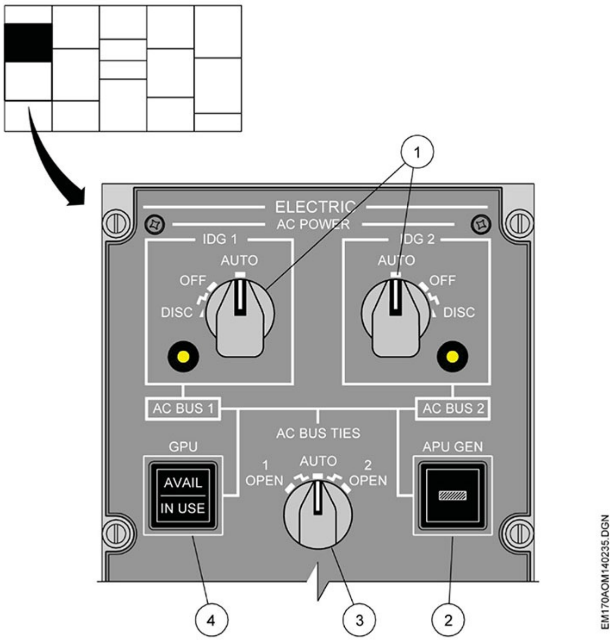
Two independent networks provide complete segregation for electrical fault isolation purposes. In the event of a power-generating source failure, bus ties automatically connect between the networks with no significant operational degradation nor additional workload.

14.05.05 CONTROLS AND INDICATIONS

ELECTRICAL POWER CONTROLS AND INDICATIONS



ELECTRICAL AC POWER PANEL



1 – IDG 1 AND IDG 2 SELECTORS

AUTO: allows automatic operation of the electrical system.

OFF: opens the IDG contactor isolating the IDG from the respective AC BUS.

DISC: must be held in this position for one second to mechanically disconnect the IDG.

NOTE: The IDG fault indication LED associated with the EICAS message IDG 1 (2) OIL illuminates indicating to the flight crew which IDG must be disconnected. The LED extinguishes after IDG disconnection.

2 – APU GEN BUTTON

PUSH IN: allows automatic operation of the electrical system.

PUSH OUT: opens the APU generator contactor and isolates the APU generator from the AC BUS TIE.

3 – AC BUS TIES SELECTOR

1 OPEN: opens the Bus Tie Contactor (BTC) 1, segregating AC BUS 1 from AC BUS 2.

AUTO: this position controls the operation of the BTCs, according to system operational logic.

2 OPEN: opens the Bus Tie Contactor (BTC) 2, segregating AC BUS 2 from AC BUS 1.

4 – GROUND POWER UNIT (GPU) BUTTON

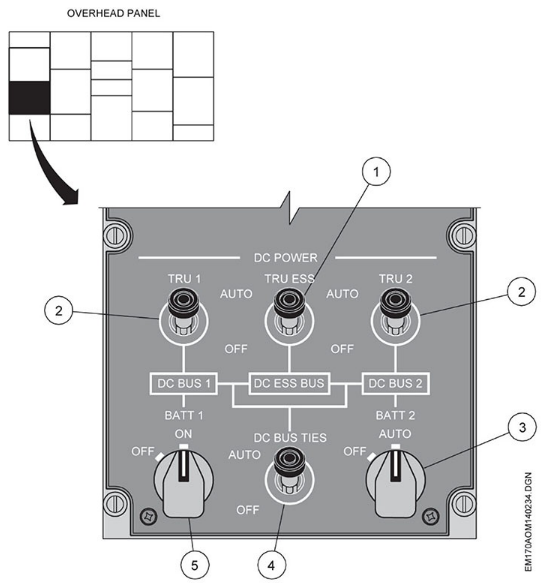
PUSH IN: connects the AC GPU to the AC system, according to the source priority.

PUSH OUT: isolates the AC GPU from the system.

AVAIL: illuminates inside the button when the AC GPU is connected to the airplane and AC power quality requirements (voltage/ampere/frequency) are satisfied.

IN USE: illuminates inside the button when the AC GPU is powering the airplane AC electrical system.

ELECTRICAL DC POWER PANEL



1 – TRU ESS SWITCH

AUTO: allows automatic operation of the electrical system.

OFF: isolates the TRU ESS from the DC ESS BUS 3.

2 – TRU 1 AND TRU 2 SWITCHES

AUTO: allows automatic operation of the electrical system.

OFF: isolates the TRU from the respective DC BUS.

3 – BATT 2 KNOB

AUTO: allows automatic operation of the electrical system.

OFF: the battery supplies power to the HOT BATT BUS 2 only and is no longer connected to the airplane electrical system.

4 – DC BUS TIE WITCH

AUTO: allows automatic operation of the electrical system.

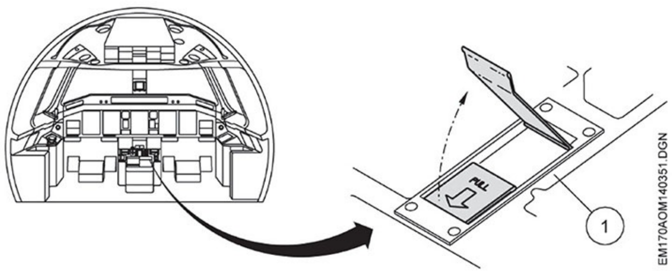
OFF: opens both essential tie contactors (ETCs) and a DC tie contactor (DCTC).

5 – BATT 1 KNOB

ON: the battery is connected to the DC ESS BUS 1.

OFF: the battery supplies power to the HOT BATT BUS 1 only and is no longer connected to the airplane electrical system.

RAM AIR TURBINE DEPLOYMENT HANDLE

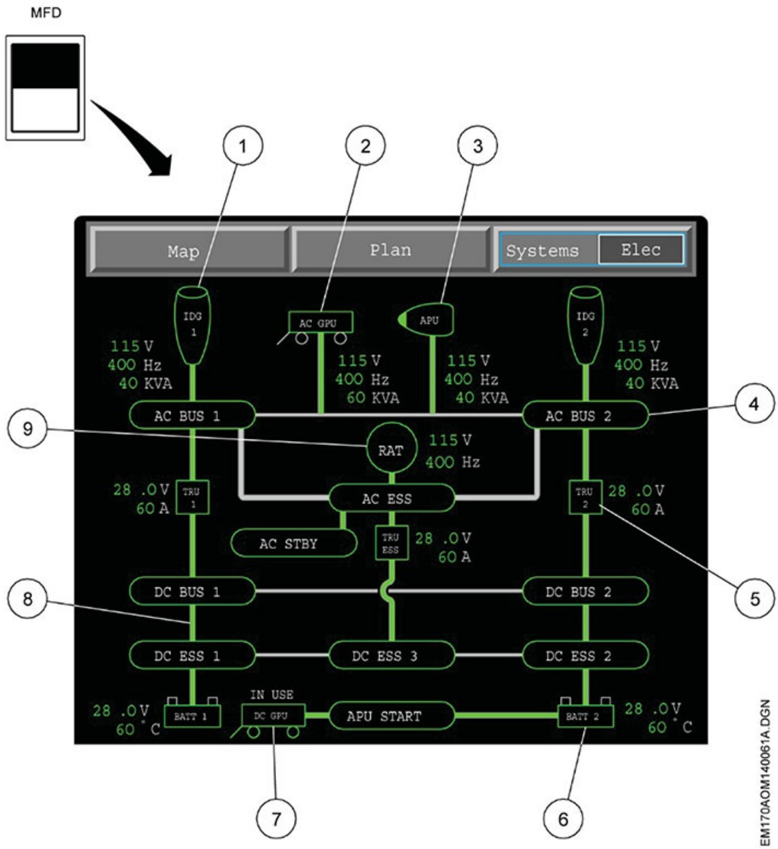


1 – RAM AIR TURBINE DEPLOYMENT HANDLE

- Manually deploys the Ram Air Turbine.

ELECTRICAL SYNOPTIC PAGE ON MFD

The electrical synoptic page provides a visual representation of the electrical system operation and parameters, and can be selected for viewing by the flight crew on either MFD.



1 – IDG (INTEGRATED DRIVE GENERATOR)

- The IDG icon and its outputs (voltage/frequency/amperage) are always displayed, even when readings are zero. If an output is invalid or out of range, the digits are replaced by three amber dashes.
- IDG icon:

GREEN:	IDG available and the IDG selector knob in AUTO position.
WHITE:	IDG available and the IDG selector knob in OFF position, or the engine is not running.
AMBER DASHED:	invalid information.

- IDG parameters (voltage, frequency and amperage):

GREEN:	for valid information.
AMBER DASHED:	for invalid information or a value out of the valid range.

When IDG oil pressure drops below 140 psi +/- 25 psi, or the IDG oil temperature reaches 168°C +/- 5°C, the EICAS message IDG 1 (2) OIL is displayed and an amber LED illuminates near the IDG selector knob on the overhead panel. This LED indicates which IDG must be disconnected.

Manual IDG disconnection is achieved by selecting and holding the respective IDG knob to the DISC position for one second.

NOTE: Do not hold IDG knob to the DISC position for more than three seconds.

After IDG disconnection:

- The EICAS message IDG 1 (2) OIL is displayed while the IDG oil pressure or temperature are not within limits.
- The EICAS message IDG 1 (2) OFF BUS is displayed. This message extinguishes when the engine is turned off and it is displayed after the next engine start.
- The IDG fault indication LED extinguishes. The LED illuminates again after airplane power-down-power-up and engine start. In this case, repeat the disconnection procedure to extinguish the IDG fault indication LED.

2 – AC EXTERNAL POWER (AC GPU)

- The AC GPU icon and its outputs (voltage/frequency/amperage) are displayed only when the AC GPU is connected and available. If any output is invalid or out of range, the digits are replaced by three amber dashes.
- AC GPU icon:

GREEN:	AC GPU connected and the GPU button is pushed in.
WHITE:	AC GPU connected and the GPU button is pushed out.
AMBER DASHED:	invalid information.

- AC GPU parameters:

GREEN:	AC GPU is available and the information is valid.
AMBER DASHED:	invalid information.

3 – APU

- The APU icon and its outputs (voltage/frequency/amperage) are not displayed until the APU is available (3 seconds after 95% rpm). If any output is invalid or out of range, the digits are replaced by three amber dashes.
- APU icon:

GREEN:	APU available and the APU GEN button pushed in.
WHITE:	APU available and the APU GEN button pushed out.
AMBER DASHED:	invalid information.

NOTE: Whenever the EICAS CAUTION message APU FAIL is displayed, the APU icon will be white beneath an amber cross.

- APU parameters (voltage/frequency/amperage):

GREEN:	for valid information.
AMBER DASHED:	for invalid information or a value out of the valid range.

4 – ELECTRICAL BUSES

- The electrical bus icons are always displayed.
- BUS icons:

GREEN:	energized bus.
WHITE:	de-energized bus.
AMBER DASHED:	invalid information.

5 – TRU (TRANSFORMER RECTIFIER UNIT)

- The TRU icon and its outputs (voltage/amperage) are always displayed.
- TRU icon:

GREEN:	TRU available, and the associated toggle switch is in AUTO position.
WHITE:	TRU available, and the associated toggle switch is in OFF position.
AMBER DASHED:	invalid information.

NOTE: Whenever the EICAS CAUTION message TRU 1 (2) FAIL is displayed, the TRU icon will be white beneath an amber cross.

- TRU parameters (voltage/amperage):

GREEN:	for valid information.
AMBER DASHED:	for invalid information or a value out of the valid range.

6 – BATTERIES

- Battery icons and their outputs (voltage/temperature) are always displayed.
- BATTERY icons:

GREEN:	voltages are greater than 18 Volts.
WHITE:	voltages are less than 18 Volts.
AMBER DASHED:	invalid information or a value out of the valid range.

- BATTERY parameters (voltage/temperature):

GREEN:	for valid information.
AMBER DASHED:	for invalid information.

7 – DC EXTERNAL POWER (DC GPU)

- The DC GPU icon is displayed only when the DC GPU is connected and available.
- DC GPU icon:

GREEN:	DC GPU connected and available.
AMBER DASHED:	invalid information.

NOTE: A cyan IN USE indication is displayed, centered above the DC GPU icon, whenever the DC GPU is connected and supplying power to the airplane electrical system.

8 – ELECTRICAL FLOW LINE

- Flow line icons illustrate voltage sensing.
- FLOW LINE icon:

GREEN:	voltage is sensed.
WHITE:	voltage is not sensed.
AMBER DASHED:	invalid information.

9 – RAT (RAM AIR TURBINE)

- The RAT icon and its output (voltage and frequency) are displayed only when the RAT is deployed.
- RAT icon:

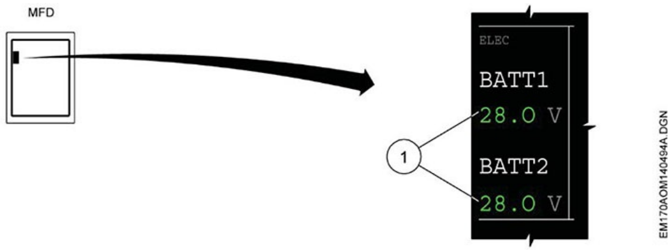
GREEN:	RAT is deployed and operating.
AMBER DASHED:	invalid information.

- RAT parameter (voltage and frequency):

GREEN:	for valid information.
AMBER DASHED:	for invalid information or a value out of the valid range.

STATUS PAGE ON MFD

Batteries voltage is displayed on the synoptic status page. It can be selected by flight crew on either MFDs.



1 – BATTERIES VOLTAGE INDICATION

- Displays batteries 1 and 2 voltage.

GREEN:	valid battery voltage.
AMBER DASHED:	invalid information.

14.05.10 AC SYSTEM

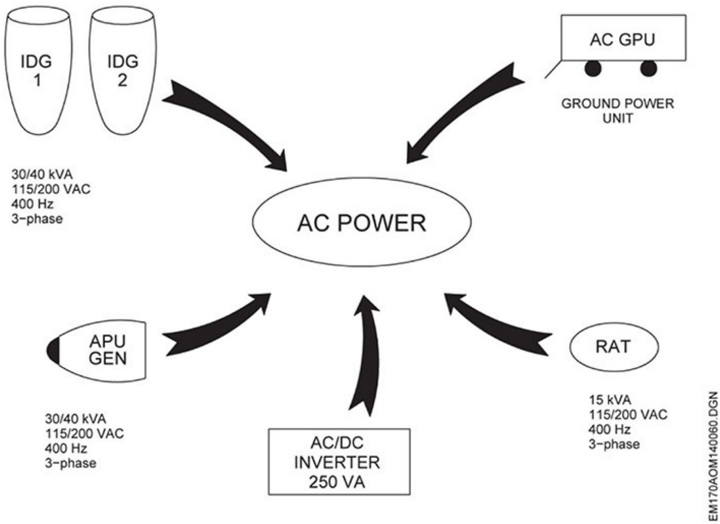
AC ELECTRICAL POWER DESCRIPTION

AC electrical power is the main source for airplane systems and comprises:

- Two integrated drive generators (IDGs).
- An auxiliary power unit (APU) generator.
- A ram air turbine (RAT).
- A static inverter (AC/DC inverter).

Both IDGs and the APU generator are rated at 40 KVA, 115 VAC, 400 HZ, three-phase.

On ground, the APU AC generator or AC ground power unit (AC GPU) can supply power to all AC BUSES. The APU generator may also be used in flight, as a replacement to an IDG, according to the APU operational envelope. In flight, the RAT is used as an emergency generator, supplying power to the ESS BUSES when both AC BUSES 1 and 2 are not powered.



AC COMPONENTS AND OPERATION

INTEGRATED DRIVE GENERATOR (IDG)

Each engine has an IDG monitored and controlled by a dedicated generator control unit (GCU). When an engine starts, the IDG will automatically come on line, powering the respective AC BUS. The previous power source is disconnected from that AC BUS.

For automatic operation of the electrical system, the IDG selector knob must be set to the AUTO position. Moving the selector knob to OFF position, the generator line contactor opens, tripping off-line and de-exciting the selected IDG.

When the IDG oil pressure drops below 140 psi ± 25 psi, or the IDG oil temperature reaches 168°C ± 5°C, the EICAS message IDG 1 (2) OIL is displayed and an amber led illuminates near the IDG selector knob on the overhead panel. This led indicates which IDG must be disconnected and extinguishes after the IDG disconnection.

Manual IDG disconnection is achieved by selecting the respective IDG knob to the DISC position and holding for 1 s.

NOTE: Do not hold the IDG knob to the DISC position for more than 3 s.

Automatic IDG disconnection occurs when manual disconnection is not performed and the IDG oil temperature reaches 185.6°C.

In both cases, the disconnection is mechanical and the flight crew cannot reconnect the IDG.

APU GENERATOR

Before engine starting, when the APU becomes available, the APU generator automatically connects to the AC BUS TIES, disconnecting the AC GPU.

During the APU starting cycle, BATT 2 is isolated from the network, powering the APU START BUS exclusively. In flight, the APU can be started up within operational limits, and replaces any IDG sources with no operational degradation.

AC EXTERNAL POWER SOURCE (AC GPU)

The AC GPU button, located on the electrical system panel, controls the AC external power. Once the AC GPU is connected to the airplane and power quality requirements (voltage/amperage/frequency) are within accepted limits, an AVAIL light illuminates on the GPU button. The AC GPU has priority over the batteries to power the electrical system.

Pushing the AC GPU button in connects external power to the AC BUS TIE, according to AC source priority. The AVAIL light extinguishes and an IN USE light illuminates.

When the APU is started, the system operational logic automatically isolates the GPU from the AC BUS TIE. In this case, the IN USE light extinguishes and an AVAIL light illuminates on the GPU button.

NOTE: Before disconnecting the AC GPU from the airplane, the flight crew must push out the AC GPU pushbutton, even if the IN USE light has already extinguished. The AC GPU pushbutton has to be pushed out for the next connection.

Ground staff can connect the GPU directly to the AC/DC GND SVC BUSES for ground maintenance and flight preparation, by pushing the respective button located on the front ramp panel or on the flight attendant panel at the forward right galley.

INVERTER

The static inverter (AC/DC inverter) converts 28 Volts DC power from batteries to 115 Volts AC power to supply the STANDBY AC BUS when an AC power source is not available.

RAM AIR TURBINE (RAT)

The RAT is an AC electrical device installed in the airplane nose section, which converts the kinetic energy of airflow across the turbine into AC power. The electrical power produced is rated at 15 KVA, 115 Volts, 400 Hz, three-phase.

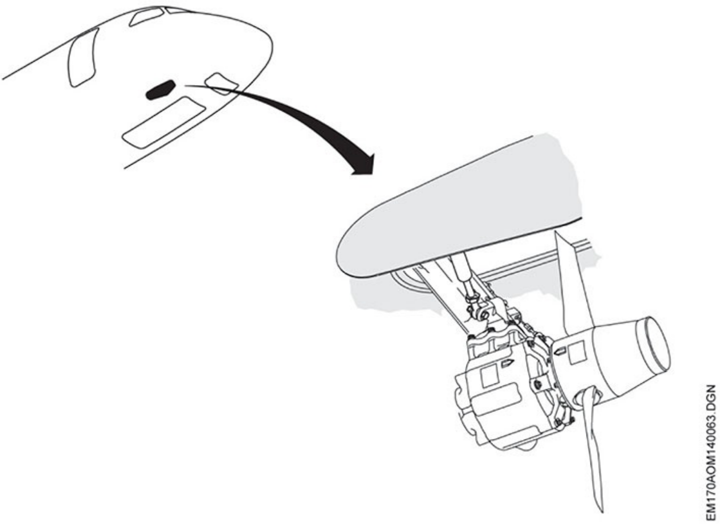
Whenever AC power sources are not powering AC buses, the RAT is automatically deployed, and after 8 seconds, supplies power to the AC ESS BUS. Once deployed it will create a very loud noise due to the high rotation speed, and cannot be stowed back in flight, even if normal electrical power is reestablished. DC ESS BUSES are powered through the ESS TRU. To avoid total loss of power during this 8-second period, batteries are used as backup to power the DC ESS BUSES and the STANDBY AC BUS.

The RAT electrical power drives the AC Motor-driven Pump (ACMP 3A) for primary flight control tasks. These include high lift system actuation and power for essential avionics, communication and battery recharging.

In flight, there is no altitude restriction for RAT deployment.

130 knots is required to ensure the RAT continues supplying AC/DC ESS BUSES. At speeds below this, the RAT may only supply the AC ESS BUS, and the batteries will automatically provide electrical power to the DC ESS BUSES and the STANDBY AC BUS through the static inverter (AC/DC inverter). As airspeed decreases, load shedding occurs and the AC ESS BUS is no longer powered.

In case of automatic RAT deployment failure, a deployment handle is provided to manually deploy the RAT.



NO BREAK POWER TRANSFER (NBPT)

The E-Jets Electrical System has a protection feature, the NBPT, which avoids electrical transient in case of power transfer when the airplane is on the ground. The NBPT allows the momentary paralleling between two AC power sources: the IDGs, GPU and the APU generator, at any possible combination.

After achieving the auto-parallel condition, the system is able to parallel the sources for a short period (milliseconds). If the system does not achieve the auto-parallel requirements within the allowed time delay, the transfer will be concluded with a break-transfer of minimum power interruption.

14.05.15 DC SYSTEM

DC ELECTRICAL POWER DESCRIPTION

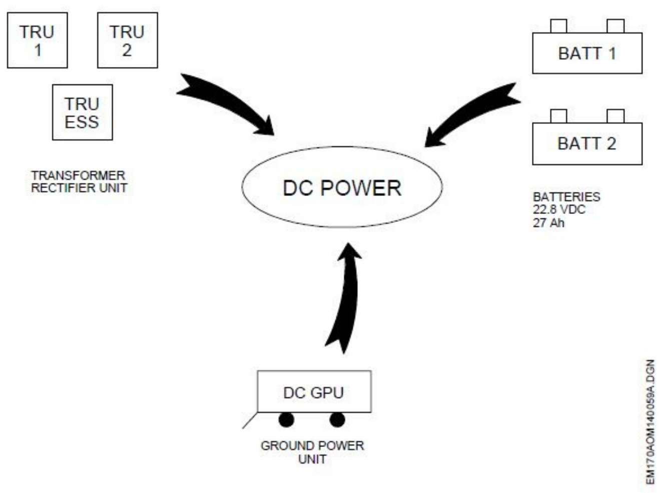
The DC electrical system consists of:

- Three transformer rectifier units (TRUs);
- Two batteries.

On ground, a DC ground power unit (DC GPU) can be connected to the airplane supplying power to only the APU START BUS.

The TRUs, rated at 300 A, are used as a primary source of the DC electrical system, converting AC power from the AC BUSES into DC power.

In certain conditions, batteries #1 and #2 are used to backup all DC ESS BUSES and the AC STBY BUS. Battery #2 also supplies the APU START BUS, during APU starting.



DC COMPONENTS AND OPERATION

TRANSFORMER RECTIFIER UNIT (TRU)

Three TRUs convert 115 VAC power into 28 VDC. Each TRU works in isolation. If one of them fails, the BUSES are automatically powered by the remaining TRUs, as long as the DC BUS TIES toggle switch is selected to AUTO.

TRU 1 provides DC power to DC BUS 1, DC ESS BUS 1, DC GND SVC BUS, HOT BATT BUS 1 and battery #1 charging.

TRU 2 provides DC power to DC BUS 2, DC ESS BUS 2, HOT BATT BUS 2 and battery #2 charging.

TRU ESS provides DC power to DC ESS BUS 3.

BATTERIES

Two NiCd 22.8 VDC, 27 A batteries power up the airplane and are also used as a backup for the DC essential electrical system.

The batteries are constantly charged by any AC source through the TRUs, including the AC GPU and the RAT.

In an ELECTRICAL EMERGENCY, while the RAT is not fully deployed and also if RAT stall speed is reached, batteries supply essential loads for 10 min.

Whenever the battery temperature reaches 70°C for at least 2 s, the associated indication becomes red and the EICAS WARNING message BATT 1 (2) OVERTEMP is triggered.

The minimum battery #2 operating temperature for APU starting is -20°C.

On ground, if the airplane is powered only by the batteries for more than 5 min, a horn sounds to alert the ground personnel.

NOTE: The check for batteries voltage is not valid if any AC source is powering the airplane. In this case, TRU voltage is indicated instead of the batteries voltage.

DC External Power Source (DC GPU)

When DC GPU is connected during the APU starting cycle, the DC external power source, and not battery #2, provides 28 VDC power to the APU START BUS.

The DC GPU is used when the battery is no longer available.

A suitable DC GPU should be able to supply the APU start with at least 24 VDC and no more than 32 VDC, when in use. The voltage may be checked on the synoptic page on MFD.

14.05.20 ELECTRICAL POWER DISTRIBUTION AND CONTROL

GENERAL

Four Integrated Control Centers (ICCs) and two Secondary Power Distribution Assemblies (SPDAs) provide distribution and control of the electrical power, and interface with other systems.

INTEGRATED CONTROL CENTER (ICC)

The ICC is an electrical-electronic integrated device, providing power distribution and protection for the airplane electrical loads, the secondary power distribution assemblies (SPDAs) and the circuit breakers that are located on the cockpit sidewall panels.

A total of four ICCs are implemented in the electrical system.

- Left Integrated Control Center (LICC).
- Right Integrated Control Center (RICC).
- Emergency Integrated Control Center (EICC).
- Auxiliary Integrated Control Center (AICC).

Each ICC, installed in the electronics bay, incorporates thermal circuit breakers (CBs), line replaceable units (LRUs), line replaceable modules (LRMs) and AC/DC electrical buses. The LRUs and LRMs allow quick access and easy replacement of electrical components, thereby minimizing any delays due to maintenance servicing.

AC/DC electrical buses are the primary source of electrical power distribution. These buses are located inside the respective ICCs:

LICC	RICC	EICC	AICC
AC BUS 1	AC BUS 2	AC ESS BUS	HOT BATTT BUS 2
AC GND SVC BUS	DC BUS	STBY AC BUS	APU START BUS
DC GND SVC BUS	DC ESS BUS 2	DC ESS BUS 1	
DC BUS 1		DC ESS BUS 3	
		HOT BATT BUS 1	

SECONDARY POWER DISTRIBUTION ASSEMBLIES (SPDA)

An SPDA is an electrical load management unit, which receives power from the ICC AC/DC electrical buses and distributes it to the airplane systems, according to system distribution logic.

Two independent SPDAs replace thermal circuit breakers (CBs) and electromechanical relays used in other airplanes, thereby reducing the amount of electrical hardware as well as flight crew workload.

SPDAs also have the advantage of integrating protection, logic/control and power supply.

Each SPDA has a specific number of slots, into which different electronic modules are plugged. Each module has an associated function such as providing communication, data processing and power distribution.

Communication modules use ARINC 429 to integrate SPDAs, ICCs and multi-function control units (MCDUs).

Four independent DC BUSES power the SPDAs providing redundancy and ensuring system segregation:

SPDA1	**SPDA2**
DC BUS 1	DC BUS 2
DC ESS BUS 1	DC ESS BUS 1
DC ESS BUS 2	DC ESS BUS 2
DC GND SVC	DC GND SVC

SPDA 1 is located at the forward electronics bay and SPDA 2 is located at the center electronics bay.

Each SPDA incorporates ELECTRONIC CBs (solid state power controllers - SSPC), which protect load distribution to the following systems.

Air Management System (AMS)	Oxygen
Electrical	Engine ignition and starting
Fuel	Water
Hydraulic	APU
Anti-ice	Fire protection
Lighting	

14.05.30 CIRCUIT BREAKERS

CIRCUIT BREAKERS (CB)

Circuit Breakers are classified as either thermal or electronic CBs.

Some thermal CBs are located on the cockpit sidewall panels and others inside the ICCs in the electronics bays.

The electronic CBs are located inside the SPDAs, in the electronics bays.

All CBs situated in the electronics bays are considered remote CBs.

The flight crew can visually monitor all circuit breakers located inside the cockpit and, via MCDUs, the remote CBs in the electronics bays.

The ICC remote thermal CBs can only be reset by maintenance personal when the airplane is on ground.

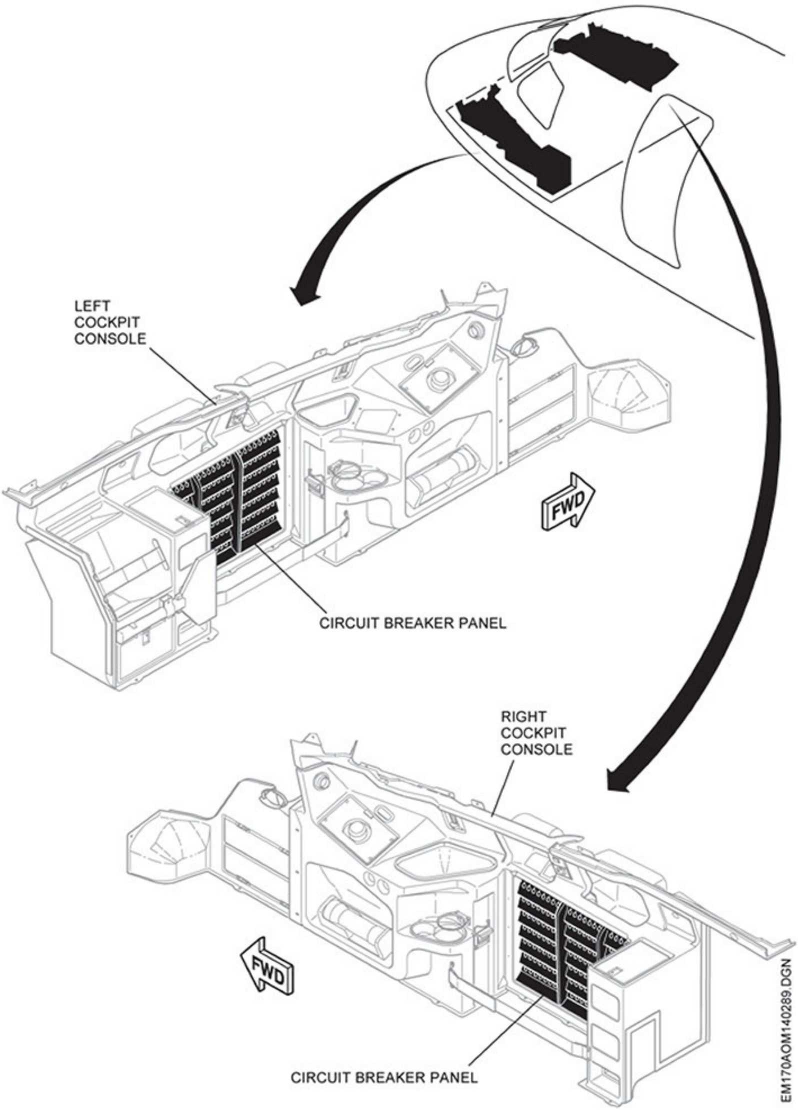
The flight crew can reset the SPDA remote electronic CBs via the MCDU.

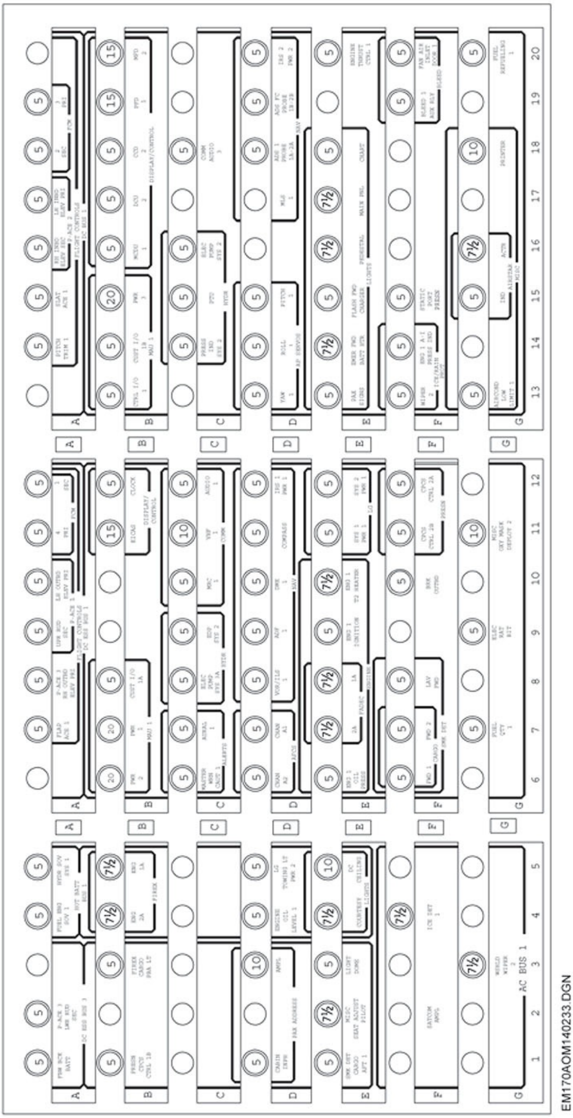
Circuit breakers types and location		
TYPE	**THERMAL**	**ELECTRONIC**
LOCATION		
Remote	ICCs	SPDAs
Non remote	Cockpit	------------

CIRCUIT BREAKER PANELS

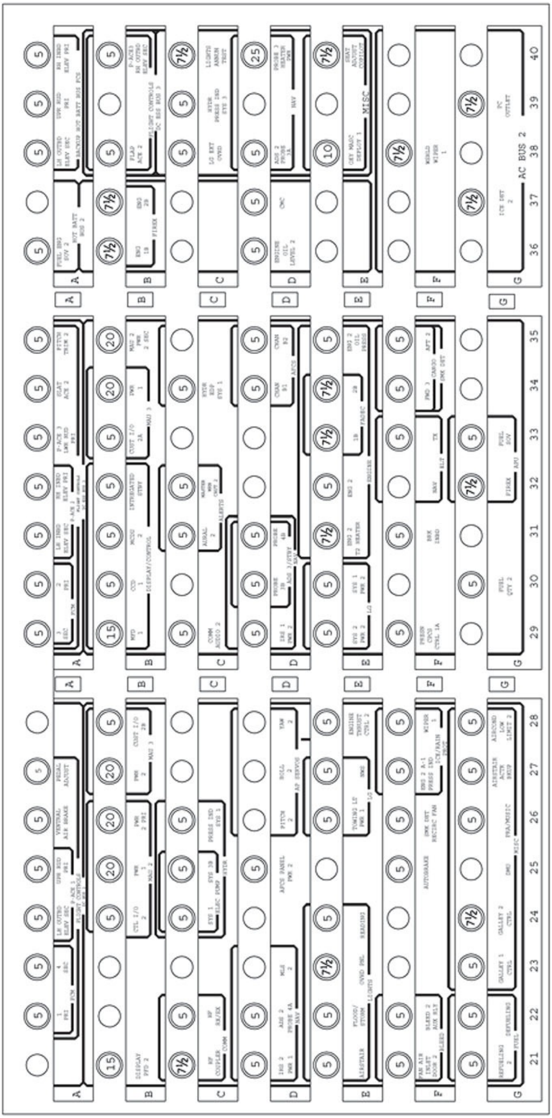
Columns and rows on the CB panel are identified through an alphanumeric naming convention.

NOTE: Only the standard CB panel configuration is presented herein as an illustrative example.


LEFT
COCKPIT
CONSOLE
CIRCUIT BREAKER PANEL
FWD
RIGHT
COCKPIT
CONSOLE
FWD
CIRCUIT BREAKER PANEL
EM170AOM140289.DGN



LEFT CB PANEL



EM170AOM140290.DGN

RIGHT CB PANEL

REMOTE CIRCUIT BREAKERS

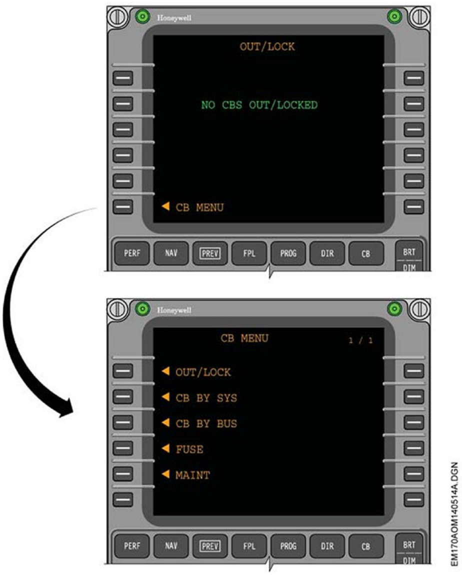
The flight crew can visually monitor remote circuit breakers located inside the electronics bays through the MCDU CB page by pressing the CB function key on the MCDU. Regardless of the page currently displayed on the MCDU, the page OUT/LOCK displays.

CB MENU status page is achieved when the line select key 6L is pressed. The following options are presented:

- OUT/LOCK (1L): displays all OUT or LOCKED CBs.
- CB BY SYS (2L): displays the status of CBs associated with the selected system.
- CB BY BUS (3L): displays the status of CBs associated with the selected BUS.
- FUSE (4L): displays fuse status.
- MAINT (5L): maintenance page.

The CB MENU page displays “NEW TRIP” on line select key 6R when a CB/SSPC trip occurs. Pressing the key (6R) displays the tripped CB/SSPC on the OUT/LOCK page. Pressing the line select key on the left side of the respective tripped remote CB/SSPC, sets the CB/SSPC condition to acknowledged and extinguishes the EICAS message REMOTE CB TRIP.

NOTE: CB menu status page is for CB status monitoring only. Report maintenance when a CB trip occurs.



CB MENU PAGE MCDU

14.05.35 AC/DC BUS LOAD DISTRIBUTION

The following list identifies the electrical buses and the equipment powered by them. An asterisk (*) precedes optional equipment.

	DC BUS 1
	ACMP 2B COMMAND
	AFT ENTRANCE LIGHTS
	AFT FLASH LIGHTS CHARGER / AFT LAV LIGHTS
*	AIRSTAIR ACTUATOR
	COCKPIT CHART LIGHTS
	COCKPIT MAIN PANEL LIGHTING
	COCKPIT PEDESTAL LIGHTING
	COPILOT CURSOR CONTROL DEVICE
	COPILOT MFD
	CURSOR CONTROL DEVICE 2
	DIGITAL AUDIO CONTROL PANEL 3
*	EFB 1 (Canadian Marconi Company – CMC)
*	EFB 1 or 2 (Goodrich)
	EMERGENCY LIGHTS POWER UNITS (ELPU)
	ENGINE 1 THRUST QUADRANT
	ENGINE 1 THRUST REV LEVER SW
	ENGINE 1 NACELLE ANTI-ICE VALVE
	FWD FLASH LIGHT CHARGER / WARDROBE LIGHT
	FWD LAVATORY LIGHTS
	FWD LAVATORY / RECIRCULATION
	FWD / MAIN ENTRANCE LIGHTS
*	GALLEY AREA LIGHTS
*	GALLEY G3 CONTROL
	GASPER VALVE
	GUIDANCE PANEL 2 (DISPLAY CONTROLLER 2)
	HS-ACE CHANNEL 1
	LEFT IDLE LOCK SOLENOID
	LH FLT ATTND READING LT 1 COMMAND
	LH FLT ATTND READING LT 2 COMMAND
	LH FLT ATTND SEAT READING LT
	MAU 1 FCM 1 POWER B
	MAU 1 FCM 2 POWER B
	MAU 1 PWR SUPPLY 3
	MICRO IRU 2 (PWR 2)
*	MLS RECEIVER 1
	OXYGEN DEPLOY 1
	P-ACE #2-1 LEFT INBOARD ELEVATOR (P)
	P-ACE #2-2 RIGHT INBOARD ELEVATOR (S)
	PASSENGER SIGNS
	PILOT MCDU
	PILOT PFD
	PITOT / STATIC / AOA1 HEATER PWR
	PITOT / STATIC / AOA1 SENSOR

	DC BUS 1
	PITOT / STATIC / AOA2 HEATER PWR
	PITOT / STATIC / AOA2 SENSOR
*	PRINTER
	RADIO ALTIMETER 1
	READING LIGHTS AFT LEFT
	READING LIGHTS FWD LEFT
	REFUEL 1
	RH FLT ATTND SEAT READING LT
*	SATCOM
	SF-ACE 1 SLAT CHANNEL 1 DC FEED
	SPDA1 PWR SUPPLY FEED 1
	TAT 1 HEATER PWR
*	VHF COMM MOD 3
	WATER AND WASTE SYSTEM CONTROLLER PWR 2
	WEATHER RADAR CONTROL 1
	WEATHER RADAR RECEIVER / TRANSMITTER (WEATHER RADAR / ANTENNA)
	WINDSHIELD HEATER 2 CONTROL
	WINDSHIELD WIPER 2 CONTROL
	WING INSPECTION LIGHTS

	DC BUS 2
	ACMP 1B COMMAND
	ACMP 3B COMMAND
*	ADF MODULE 2
*	AIRSTAIR LIGHTS
*	AUTO-BRAKE MODULE
	CARGO SOV
	COCKPIT FLOOD / STORM LIGHTS
	COCKPIT OVERHEAD PANEL LIGHTING
	COCKPIT READING LIGHTS
	COPILOT PFD
	DEFUEL
	DME MODULE 2
*	DMU
*	EFB 2 (Canadian Marconi Company – CMC)
	ENGINE 2 THRUST QUADRANT
	ENGINE 2 THRUST REV LEVER SW
	ENGINE 2 NACELLE ANTI-ICE VALVE COMMAND
	FDR / CVR 1 (DVDR 1)
*	GALLEY G1 CONTROL
*	GALLEY G2 CONTROL
	GUIDANCE PANEL 2 (GP2)
	HF RECEIVER / EMITTER
*	INFLIGHT ENTERTAINMENT
	LOGOTYPE LIGHTS
	MAU 2 PWR 2 PRIMARY

	DC BUS 2
	MAU 2 PWR SUPPLY 1
	MAU 3 FCM 3 POWER B
	MAU 3 FCM 4 POWER B
	MAU 3 PWR SUPPLY 2
	MICRO IRU 2 (PWR 1)
*	MLS RECEIVER 2
	MODE S DIVERSITY TRANSPONDER MOD 2
	NAVIGATION MODULE 2
	NOSEWHEEL STEERING
	OXYGEN DEPLOY 2
	P-ACE #1-1 LEFT OUT ELEVATOR (S)
	P-ACE #1-2 UPPER RUDDER (P)
	PEDALS ADJUSTMENTS
	PITOT / STATIC / AOA4 HEATER PWR
	PITOT / STATIC / AOA4 SENSOR
*	PRE-RECORDED ANNOUNCEMENT
*	RADIO ALTIMETER 2
	READING LIGHTS AFT RIGHT
	READING LIGHTS FWD RIGHT
	READING LIGHTS MID LEFT (E190 ONLY)
	READING LIGHTS MID RIGHT (E190 ONLY)
	REFUEL 2
	RIGHT IDLE LOCK SOLENOID
	ROLL TRIM
	SMOKE DET RECIRC FAN
	SPDA2 PWR SUPPLY FEED 1
	TAT 2 HEATER PWR
	TCAS
	VHF COMM MOD 2
	WINDSHIELD HEATER 1 CONTROL
	WINDSHIELD WIPER 1 CONTROL

	DC ESS BUS 1
	ACMP 3A COMMAND
	ADF MODULE 1
	AFT CARGO BAY BOTTLE 1 ELECTRO-EXPLOSIVE DEVICE FEED 2
	FWD CARGO BAY BOTTLE 1 ELECTRO-EXPLOSIVE DEVICE FEED 2
	AFT CARGO BAY BOTTLE 2 ELECTRO-EXPLOSIVE DEVICE FEED 2
	FWD CARGO BAY BOTTLE 2 ELECTRO-EXPLOSIVE DEVICE FEED 2
	AFT FLT ATTND PANEL IND LEDS
	APU FADEC
	AFCS CH 1A (AIOP 1A)
	AFCS CH 2A (AIOP 2A)
	BRAKE CONTROL MODULE 1
	BRAKE CONTROL SOV OUTBOARD MOD1
	BRAKE SOV SWITCHED OUTBOARD

	DC ESS BUS 1
	CABIN PRESSURIZATION CONTROL SYSTEM CONTROLLER 2A
	CABIN PRESSURIZATION CONTROL SYSTEM CONTROLLER 2B
	CLOCK
	COMPASS
	DC APU / ENGINE PUMP COMMAND
	DIGITAL AUDIO CONTROL PANEL 1
	DME MODULE 1
*	DOOR SILL HEATER COMMAND
	EICAS
	ENGINE 1 EXCITER 1A COMMAND
	ENGINE 1 START VALVE
	ENGINE 1 T2 HEATER (E175 ONLY)
	ENGINE 1 OIL PRESSURE
	FADEC 1 CHANNEL A FEED 1 & FEED 2
	FADEC 2 CHANNEL A FEED 1 & FEED 2
	FDR ACCELEROMETER
	FUEL QUANTITY 1
*	FWD GALLEY HEATER COMMAND
	FWD LAV SMOKE DETECTOR
*	GALLEY 2 FEED 1 COMMAND
*	GALLEY 3 FEED 4 COMMAND
	GUIDANCE PANEL 1 (GP1)
	IDG1 DISCONNECT SOLENOID
	INTEGRATED STANDBY
	INVERTER DC FEED
	LANDING GEAR SYS 1 PWR 1
	LANDING GEAR SYS 2 PWR 1
	MAU 1 FCM 1 POWER A
	MAU 1 FCM 2 POWER A
	MAU 1 PWR SUPPLY 1
	MAU 1 PWR SUPPLY 2
	MICRO IRU 1 (PWR 1)
	MODE S DIVERSITY TRANSPONDER MOD 1
	NAVIGATION MODULE 1
	P-ACE #1-1 LEFT OUT ELEVATOR (P)
	P-ACE #1-2 UPPER RUDDER (S)
	P-ACE #3-1 RIGHT OUT ELEVATOR (P)
	PAX OXY DEPLOY 1 (MANUAL)
	PILOT MASTER WARN / CAUTION 1
	PITCH TRIM 1 CONTROL (E190 ONLY)
	PITOT / STATIC / AOA4 COMMAND
	RAT BIT
	RAT DEPLOY SOLENOID
	RIGHT SMOKE DETECTOR F1-CARGO BAY
	RIGHT SMOKE DETECTOR F2-CARGO BAY
	SF-ACE 1 FLAP CHANNEL 1 DC FEED
	SPDA 1 PWR SUPPLY FEED 3
	SPDA 2 PWR SUPPLY FEED 3
	VHF COMM MOD 1

	DC ESS BUS 2
	AC FUEL PUMP 1 COMMAND
	AC FUEL PUMP 2 COMMAND
	ADS 3 / STBY PROBE 4B
*	AFT FLT ATTND PANEL GALLEY MASTER SW OUT
*	AFT GALLEY HEATER COMMAND
	AFT LAV SMOKE DET
	APU FIRE DETECTION
	APU FIRE EXTINGUISH
	APU FUEL SOV
	AUTOMATIC FLIGHT CONTROL SYSTEM CH 1B (AIOP 1B)
	AUTOMATIC FLIGHT CONTROL SYSTEM CH 2B (AIOP 2B)
	BRAKE CONTROL MODULE 2
	BRAKE CONTROL SOV INBOARD MOD 2
	BRAKE SOV SWITCHED INBOARD
	CABIN PRESSURIZATION CONTROL SYSTEM CONTROLLER 1A
	COPILOT MASTER WARN / CAUTION 2
	COPILOT MCDU
	CURSOR CONTROL DEVICE 1
	DC APU / ENGINE PUMP
	DIGITAL AUDIO CONTROL PANEL 2
*	EFB 1 or EFB 2 (Goodrich)
*	ELT (TRANSMITTER)
*	ELT NAV UNIT
	ENGINE 2 EXCITER 2A COMMAND
	ENGINE 2 START VALVE
	ENGINE 2 T2 HEATER (E175 ONLY)
	ENGINE 2 OIL PRESSURE
	FADEC 1 CHANNEL B FEED1 & FEED2
	FADEC 2 CHANNEL B FEED1 & FEED2
	FDR / CVR 2 (DVDR 2)
	FUEL QUANTITY 2
	GUIDANCE PANEL 1 (DISPLAY CONTROLLER 1)
	HS-ACE CHANNEL 2
	HS-ACE CHANNEL 2 PWR
	INTEGRATED STANDBY
	LEFT SMOKE DET A2-CARGO BAY
	LEFT SMOKE DET F3-CARGO BAY
	LANDING GEAR SYS 1 PWR 2
	LANDING GEAR SYS 2 PWR 1
	MAU 2 PWR SUPPLY 2
	MAU 3 FCM 3 POWER A
	MAU 3 FCM 4 POWER A
	MAU 3 PWR SUPPLY 1
	MICRO IRU 1 (PWR 2)
	P-ACE #2-1 LEFT INBOARD ELEVATOR (S)
	P-ACE #2-2 RIGHT INBOARD ELEVATOR (P)
	P-ACE #3-2 LOWER RUDDER ACT (P)

DC ESS BUS 2
PILOT CURSOR CONTROL DEVICE
PILOT MFD
PITOT / STATIC / AOA1 AND AOA2 COMMANDS
PITOT / STATIC / AOA3 HEATER PWR
PITOT / STATIC / AOA3 SENSOR
RAM AIR DOOR 1
RIGHT SMOKE DETECTOR A3-CARGO BAY (E190 ONLY)
RIGHT SMOKE DETECTOR F4-CARGO BAY (E190 ONLY)
SF-ACE 2 SLAT CHANNEL 2 DC FEED
SMOKE DET TEST
SPDA1 PWR SUPPLY FEED 2
SPDA2 PWR SUPPLY FEED 2
VALVE APU FEED MOTOR OPERATED SHUTOFF FUEL

DC ESS BUS 3
ADS 2 PROBE 3A
CABIN PRESSURIZATION CONTROL SYSTEM CONTROLLER 1B
CARGO FIRE EXTINGUISHER BUTTON LIGHTS
COCKPIT DOME LIGHTS
COCKPIT PUSH BUTTON LIGHTS
CROSS FEED VALVE
FIREX SWITCHES
AFT CARGO BAY BOTTLE 1 ELECTRO-EXPLOSIVE DEVICE FEED 1
FWD CARGO BAY BOTTLE 1 ELECTRO-EXPLOSIVE DEVICE FEED 1
AFT CARGO BAY BOTTLE 2 ELECTRO-EXPLOSIVE DEVICE FEED 1
FWD CARGO BAY BOTTLE 2 ELECTRO-EXPLOSIVE DEVICE FEED 1
* HF RECEIVER / EMITTER 1 (Dual HF)
IDG 2 DISCONNECT SOLENOID
LANDING GEAR LEVER LOCK
LANDING GEAR OVERRIDE SWITCH
MID EMERG FAN COMMAND
P-ACE #3-1 RIGHT OUT ELEVATOR (S)
P-ACE #3-2 LOWER RUDDER ACT (S)
PASSENGER ADRESS (PA)
PAX OXY DEPLOY 2 (OVRD COMMAND)
PITCH TRIM 2 CONTROL (E190 ONLY)
PROBE 3 HEATER PWR 2
RAM AIR DOOR 2
RIGHT SMOKE DETECTOR A1-CARGO BAY
RUDDER TRIM
SEAT 1 ADJUSTMENT
SEAT 2 ADJUSTMENT
SERVICES INTERPHONE CONTROL BUTTONS
SF-ACE 2 FLAP CHANNEL 2 DC FEED

DC GND SVC
AFT CARGO COMPARTMENT LIGHTS
AFT CARGO LOADING LIGHTS
AFT ENTRANCE LIGHTS
AFT FLASH LIGHTS CHARGER
AFT LAVATORY LIGHTS
COURTESY LIGHTS
FWD CARGO LIGHTS
FWD LAVATORY LIGHTS
FWD / MAIN ENTRANCE LIGHTS
* GALLEY AREA LIGHTS
SERVICE COMPARTMENT LIGHTS AFT / FWD
SPDA 1 PWR SUPPLY FEED 4
SPDA 2 PWR SUPPLY FEED 4
WATER AND WASTE SYSTEM CONTROLLER PWR1

DC HOT BAT BUS 1
BATTERY 1
COURTESY / SERVICE LIGHTS FWD
DC CEILING LIGHTS
ENGINE 1 OIL LEVEL IND
ENGINE 1A FIRE EXTINGUISH
ENGINE 2A FIRE EXTINGUISH
ENGINE FUEL SOV 1
HYDR SYS SOV 1

DC HOT BAT BUS 2
BATTERY 2
CMC
ENGINE 1B FIRE EXTINGUISH
ENGINE 2 OIL LEVEL INDICATION
ENGINE 2B FIRE EXTINGUISH
ENGINE FUEL SOV 2
HYDR SYS SOV 2
PANEL REFUEL 3
WATER AND WASTE SYSTEM CONTROLLER PWR 3

APU BUS
APU START

AC BUS 1
AC FUEL PUMP 1
ACMP 2B
ENGINE 1 EXCITER 1B
* FAN CARGO BAY
* GALLEY 2 FEED 1 (COFFEE MAKER)
* GALLEY 3 FEED 4 (STEAM OVEN)
GREEN / WHITE STBY POSITION LT'S RIGHT
ICE DETECTOR 1
LEFT LANDING LIGHT
LEFT RECIRC FAN
LEFT TAXI LIGHT
PITCH TRIM 1 AC POWER (E190 ONLY)
RED BEACON LIGHT UPPER / LOWER
RED / WHITE STBY POSITION LT'S LEFT
SF-ACE 1 SLAT CHANNEL 1 AC FEED
WINDSHIELD HEATER 2 PWR
WINDSHIELD WIPER 2 PWR

AC BUS 2
ACMP 1B
ACMP 3B
* AFT DOOR SILL HEATER
* AFT GALLEY HEATER
* COCKPIT LAPTOP AC OUTLETS
ENGINE 2 EXCITER 2B
FAN 2 FWD BAY
FAN 2 MID BAY
* FWD DOOR SILL HEATER
* GALLEY 2 FEED 3 (STEAM OVEN 1)
* GALLEY 3 FEED 1 (COFFEE MAKER)
* GALLEY 3 FEED 2 HOT JUG
* GALLEY 3 FEED 5 (CHILLER)
GREEN / WHITE MAIN POSITION LT'S RIGHT
ICE DETECTOR 2
RED / WHITE MAIN POSITION LT'S LEFT
RIGHT LANDING LIGHT
RIGHT TAXI LIGHT
SF-ACE 2 FLAP CHANNEL 2 AC FEED
STROBE LIGHTS WHITE LH / RH
WINDSHIELD HEATER 1 PWR
WINDSHIELD WIPER 1 PWR

AC ESS BUS
AC FUEL PUMP 2A
ACMP 3A
PITCH TRIM 2 AC POWER (E190 ONLY)
SF-ACE 1 FLAP CHANNEL 1 AC FEED
SF-ACE 2 SLAT CHANNEL 2 AC FEED

	AC GND SVC
	AC OUTLET PWR1
	AC OUTLET PWR2
	CEILING LIGHTS
	DRAIN MAST AFT
	DRAIN MAST FWD
	FAN 1 FWD BAY
	FAN 1 MID BAY
	FILL/DRAIN NIPPLE HEATER (E190 ONLY)
*	GALLEY 1 HOT JUG (E190 ONLY)
*	GALLEY 3 HOT JUG (E190 ONLY)
	WASTE SVC PANEL RINSE NIPPLE / VALVE HEATER (E190 ONLY)
	NOSE LANDING LIGHT
	NOSE TAXI LIGHT
	RAT HEATER
	SIDEWALL LIGHTS
	VACUUM MOTOR GEN
	WATER COMPRESSOR
	WATER HEATER AFT LAVATORY
	WATER HEATER FWD LAVATORY

STBY AC BUS
ENGINE 1 EXCITER 1A
ENGINE 2 EXCITER 2A

14.05.40 ELECTRICAL DISTRIBUTION AND SYSTEM CONFIGURATION

The electrical system normal and some abnormal operations are automatic.

ELECTRICAL SYSTEM BASIC DISTRIBUTION

ELECTRICAL POWER GENERATORS

The electrical power from the IDG, APU, GPU or batteries is directed to the electrical buses.

SPDA

From the electrical buses the power is directed to the airplane systems and components through the SPDA.

The SPDA works as circuit breaker or relay interfacing the electrical buses with the airplane systems and components.

MAU

The airplane systems that require a complex logic for the normal operation are connected to the MAUs which have the ability to process various inputs and define either ON/OFF or OPEN/CLOSE status for a specific system.

Some airplane components have an alternate direct connection with the electrical buses allowing normal operation even in the event of a SPDA or MAU failure.

ELECTRICAL SYSTEM BUSES POWER SOURCE

	ELECTRICAL POWER SOURCE	
ELECTRICAL BUS	**NORMALSOURCE**	**NON-NORMAL SOURCE**
AC BUS 1	IDG 1, APU or AC GPU on ground	AC BUS 2
AC BUS 2	IDG 2, APU or AC GPU on ground	AC BUS 1
AC ESS	AC BUS 2	AC BUS 1 RAT (electrical emergency)
AC STBY	AC ESS	INVERTER
AC GND SVC	AC BUS 1 or AC GPU on ground	N/A
DC BUS 1	TRU 1 via AC BUS 1	DC BUS 2
DC BUS 2	TRU 2 via AC BUS 2	DC BUS 1
DC ESS 1	DC BUS 1	DC ESS 3
DC ESS 2	DC BUS 2	DC ESS 3
DC ESS 3	TRU ESS through the AC ESS	DC ESS 1 or DC ESS 2
APU START BUS	BATTERY 2	N/A
HOT BATT 1	BATTERY 1	N/A
HOT BATT 2	BATTERY 2	N/A
DC GND SVC	TRU 1 through the AC GPU	N/A

ELECTRICAL SYSTEM NORMAL OPERATION

After the initial power up the electrical system is designed to operate in automatic mode provided all switches on the electrical panel are in AUTO or ON position.

The source priority order for powering the airplane is:

- Respective IDG.
- APU generator.
- GPU (on ground without APU).
- Opposite IDG.

If required the DC GPU can be used for the APU start.

ELECTRICAL SYSTEM ABNORMAL OPERATION

If a power-generating source fails, the electrical system redirects power from another available source according to the priority order.

AC BUSES

If one of the AC power sources fails, both AC electrical networks are automatically connected by bus tie contactors (BTCs).

One AC power source is sufficient to supply the whole system without significant degradation or additional workload.

LOAD SHED

For overload protection, whenever the electrical load increases beyond the system limit the SPDA commands the load shedding protection.

The components turned off by the load shedding are:

- Galleys and;
- Right windshield heating.

When possible the electrical system restores the electrical power to deprived components.

TRU FAILURE

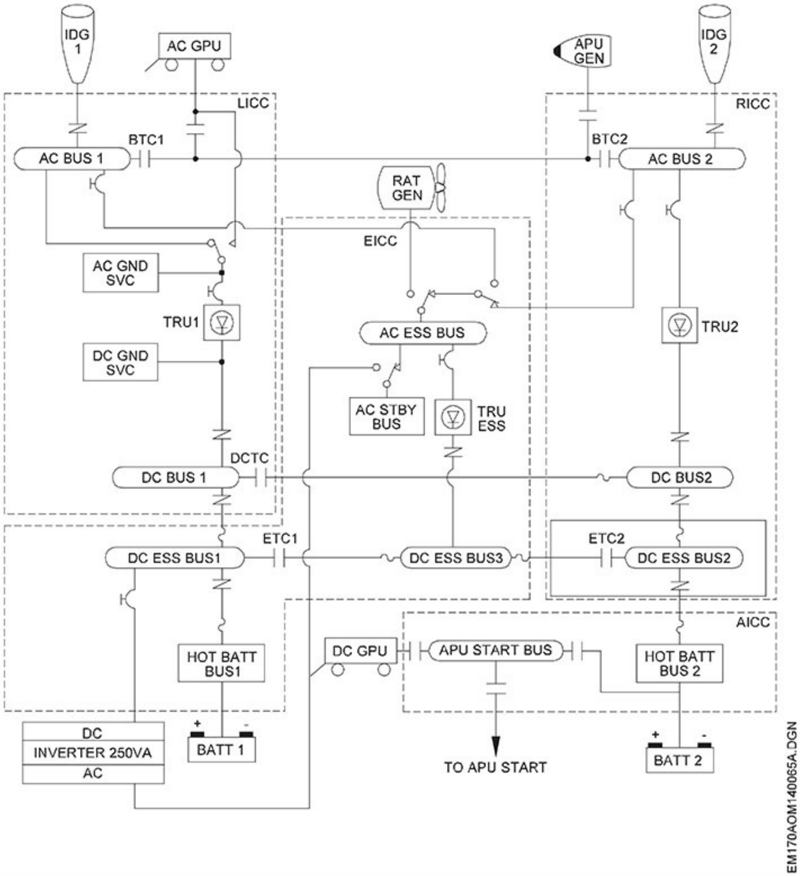
In case of a TRU failure the respective DC BUS is automatically connected to the DC electrical network through both essential tie contactors (ETCs) and a DC tie contactor (DCTC) according to the system logic.

TOTAL AC POWER SOURCE FAILURE

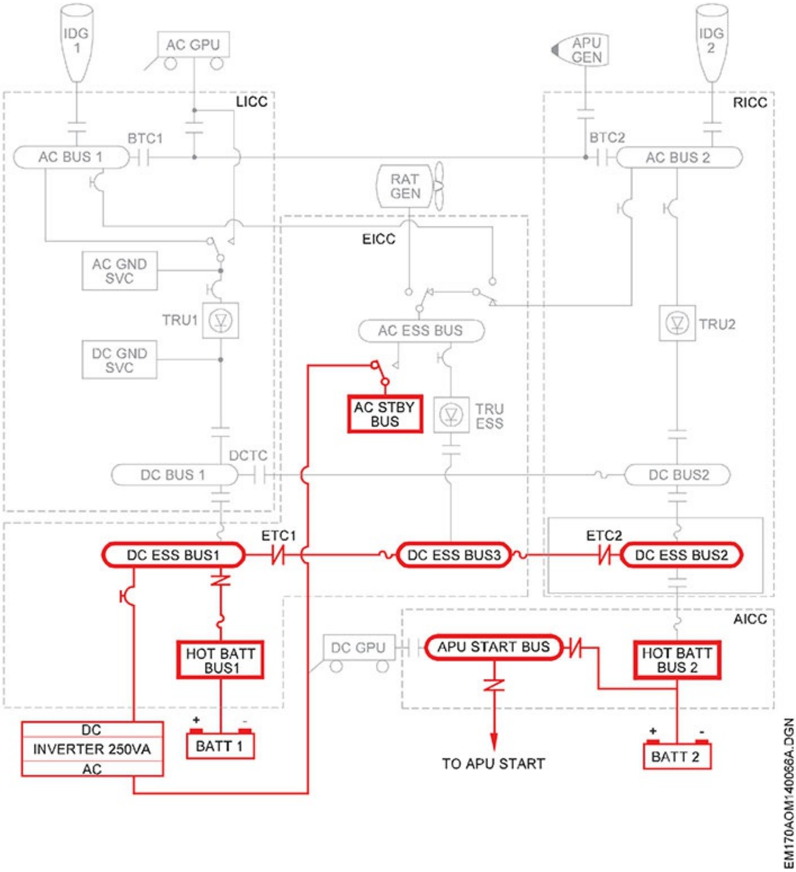
In the event of a total loss of AC power the RAT is automatically deployed and it powers all ESS buses.

SYSTEM CONFIGURATIONS

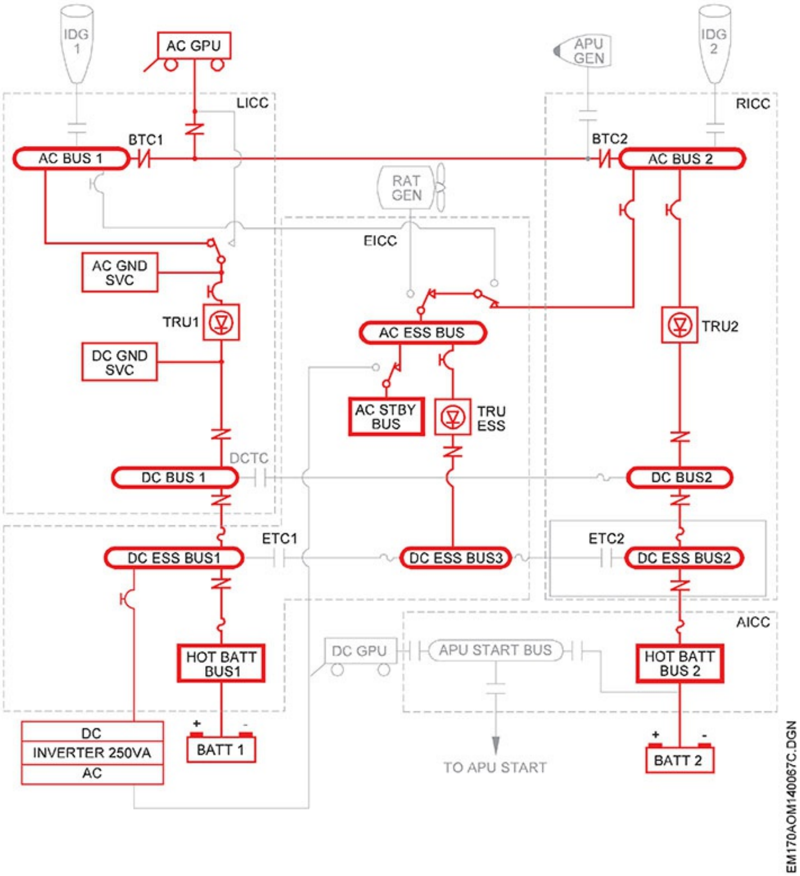
The following are some important examples of electrical load distribution achieved by the system logic.



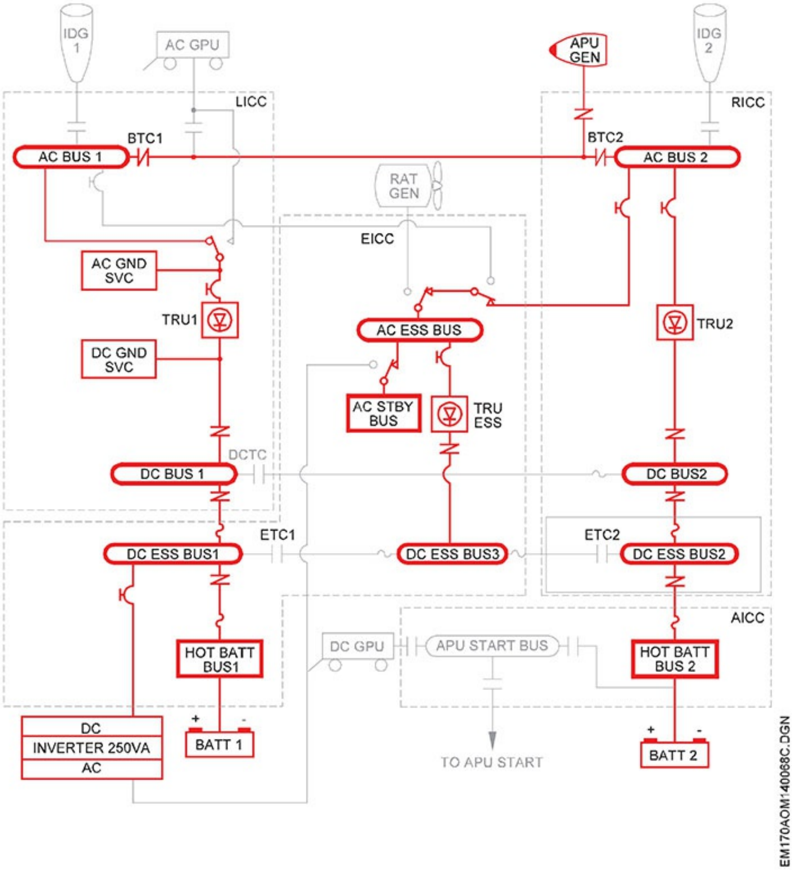
ELECTRICAL NETWORK UNPOWERED



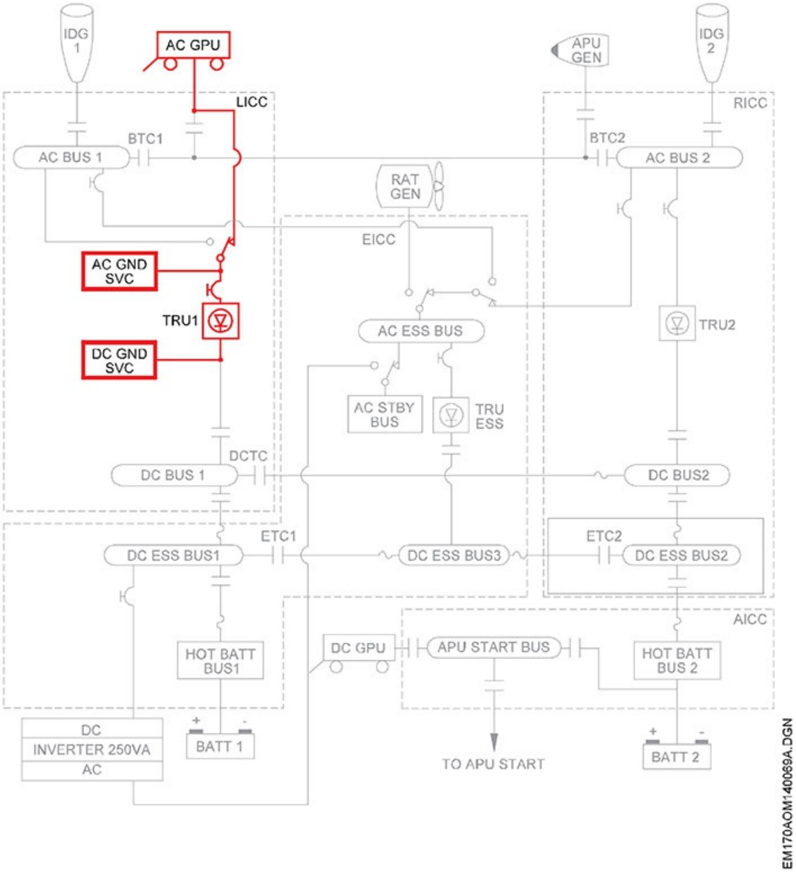
BATTERIES ONLY / APU START IN PROGRESS


IDG 1
AC GPU
APU GEN
IDG 2
LICC
RICC
BTC1
BTC2
AC BUS 1
AC BUS 2
RAT GEN
EICC
AC GND SVC
TRU1
TRU2
AC ESS BUS
DC GND SVC
AC STBY BUS
TRU ESS
DCTC
DC BUS 1
DC BUS2
ETC1
ETC2
DC ESS BUS1
DC ESS BUS3
DC ESS BUS2
AICC
DC GPU
APU START BUS
HOT BATT BUS1
HOT BATT BUS 2
DC
INVERTER 250VA
AC
BATT 1
BATT 2
TO APU START
EM170AOM140067C.DGN

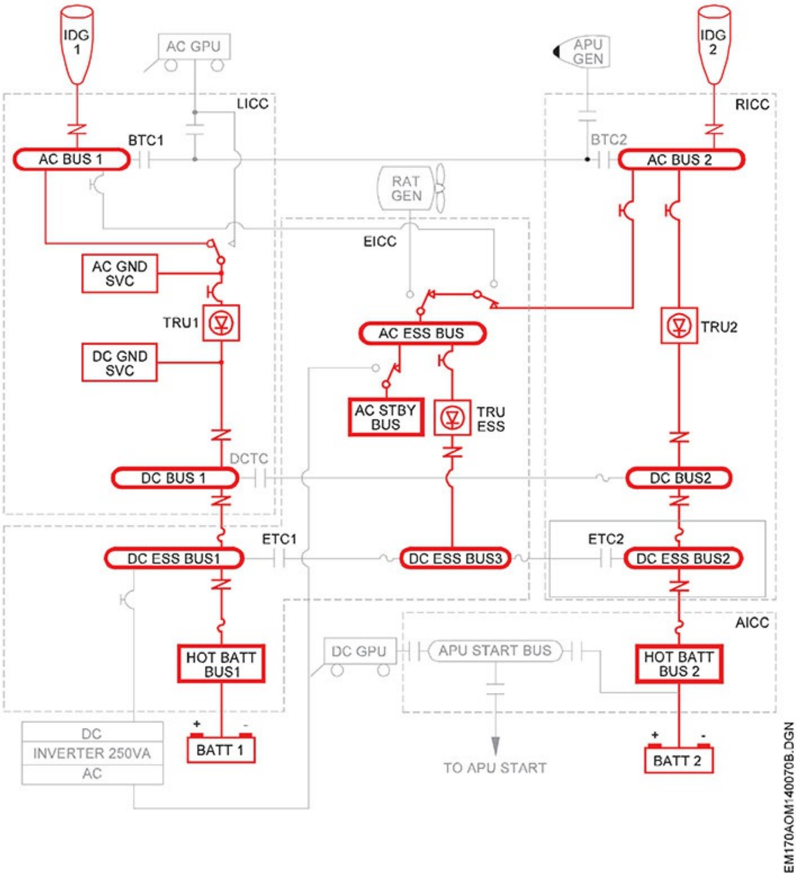
AC GPU


IDG 1
AC GPU
APU GEN
IDG 2
LICC
RICC
BTC1
BTC2
AC BUS 1
AC BUS 2
RAT GEN
EICC
AC GND SVC
TRU1
AC ESS BUS
TRU2
DC GND SVC
AC STBY BUS
TRU ESS
DCTC
DC BUS 1
DC BUS2
ETC1
ETC2
DC ESS BUS1
DC ESS BUS3
DC ESS BUS2
AICC
HOT BATT BUS1
DC GPU
APU START BUS
HOT BATT BUS 2
DC INVERTER 250VA AC
BATT 1
TO APU START
BATT 2
EM170AOM140068C.DGN

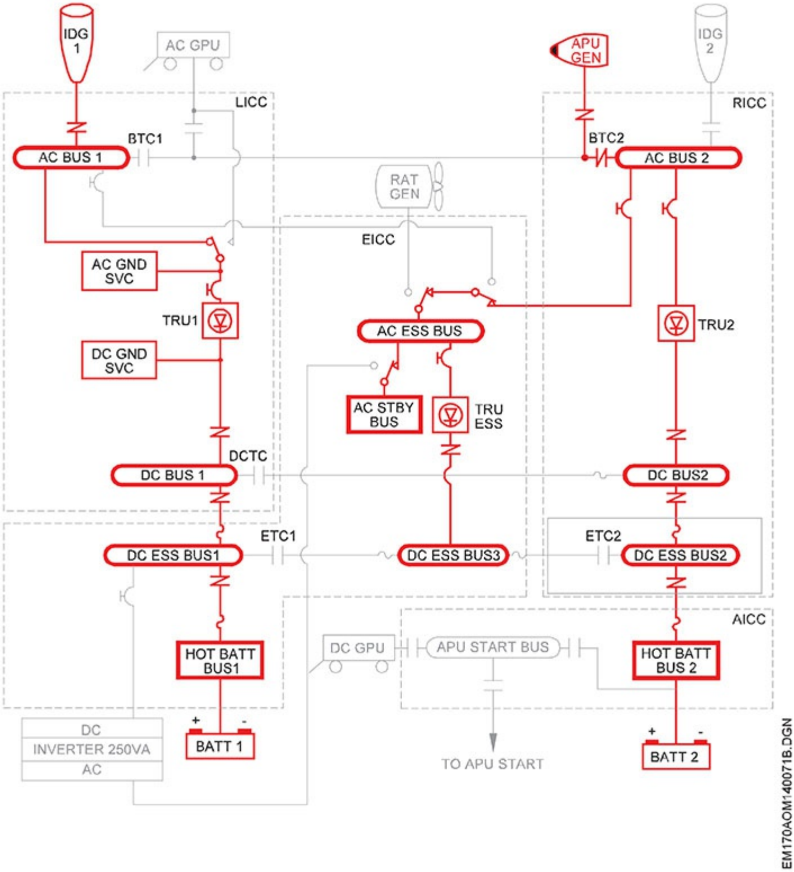
APU POWER



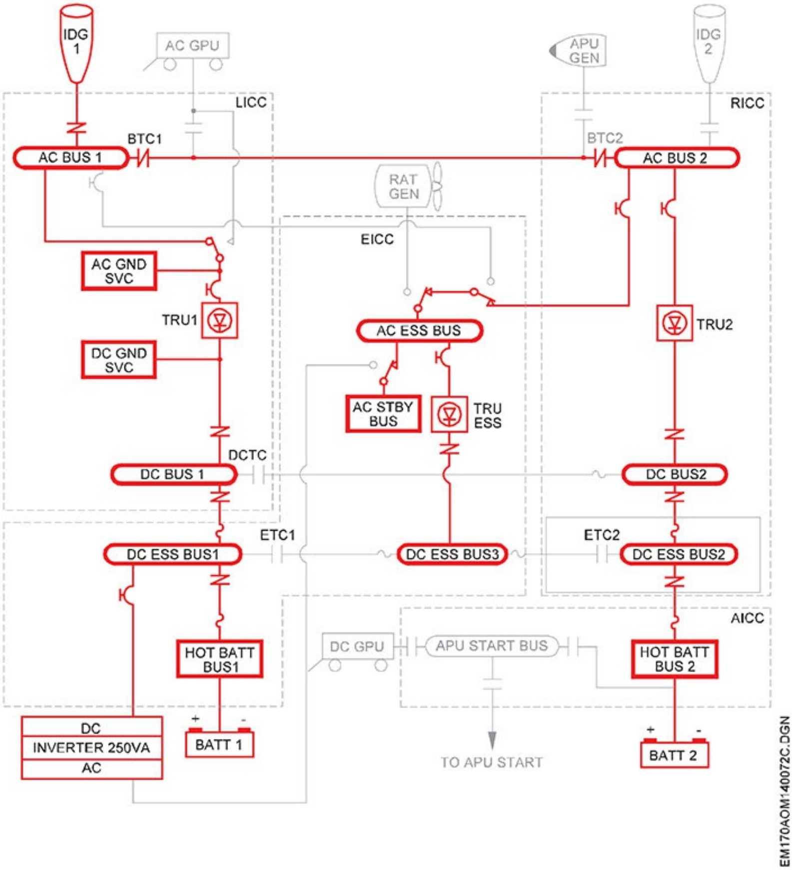
GROUND SERVICE MODE



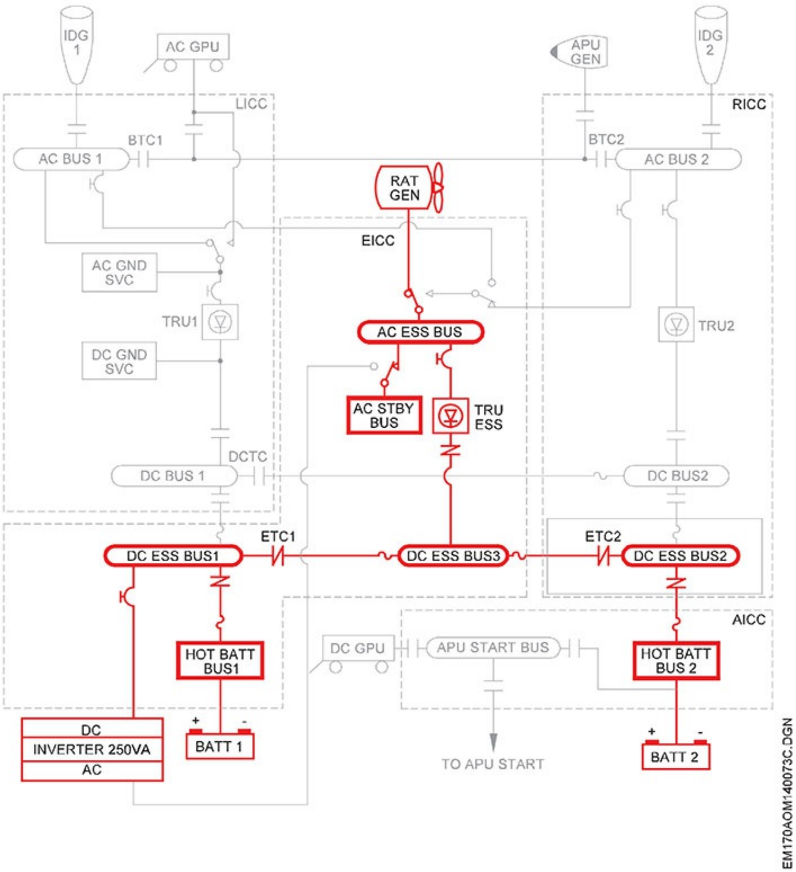
TWO IDG POWER



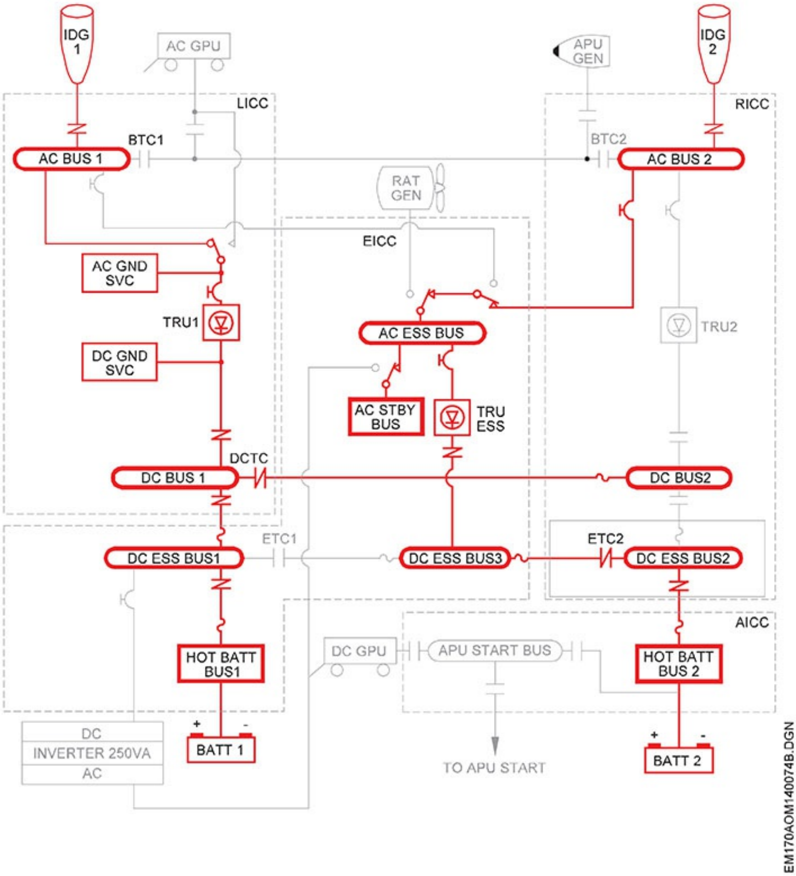
IDG FAILED AND APU GENERATOR IN USE



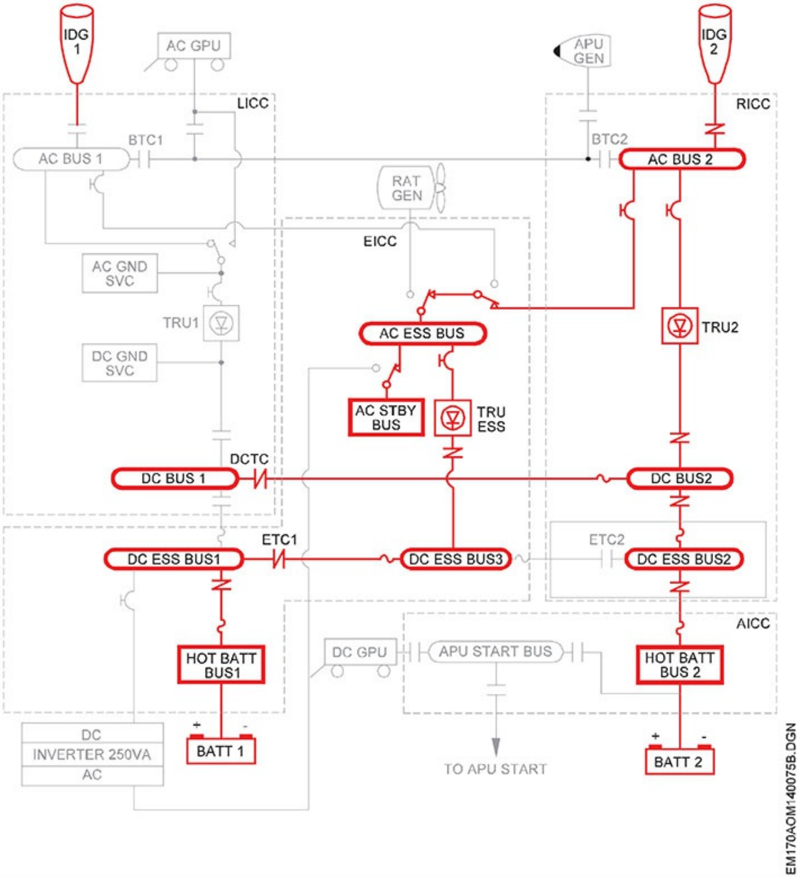
IDG FAILED AND APU GENERATOR NOT IN USE


IDG 1
AC GPU
LICC
BTC1
AC BUS 1
APU GEN
IDG 2
RICC
BTC2
AC BUS 2
RAT GEN
EICC
AC GND SVC
TRU1
DC GND SVC
AC ESS BUS
TRU2
AC STBY BUS
TRU ESS
DCTC
DC BUS 1
DC BUS2
ETC1
DC ESS BUS1
DC ESS BUS3
ETC2
DC ESS BUS2
AICC
HOT BATT BUS1
DC GPU
APU START BUS
HOT BATT BUS 2
DC
INVERTER 250VA
AC
BATT 1
TO APU START
BATT 2
EM170AOM140073C.DGN

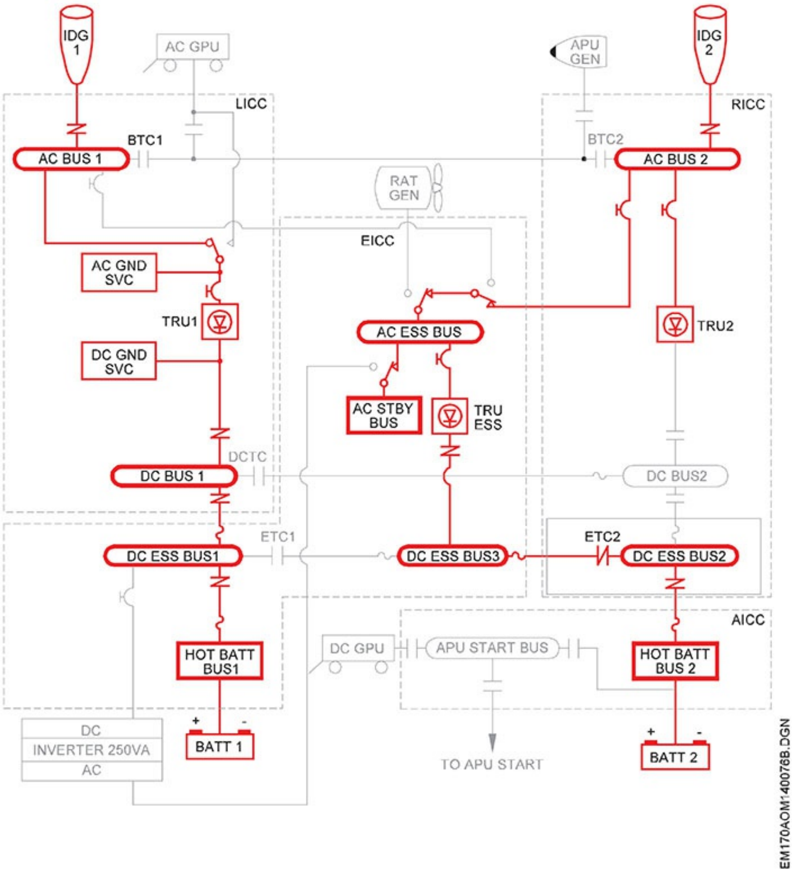
RAT POWER


IDG 1
AC GPU
APU GEN
IDG 2
LICC
RICC
BTC1
BTC2
AC BUS 1
AC BUS 2
RAT GEN
EICC
AC GND SVC
TRU1
DC GND SVC
AC ESS BUS
TRU2
AC STBY BUS
TRU ESS
DCTC
DC BUS 1
DC BUS2
ETC1
ETC2
DC ESS BUS1
DC ESS BUS3
DC ESS BUS2
AICC
HOT BATT BUS1
DC GPU
APU START BUS
HOT BATT BUS 2
DC
INVERTER 250VA
AC
BATT 1
TO APU START
BATT 2
EM170AOM140074B.DGN

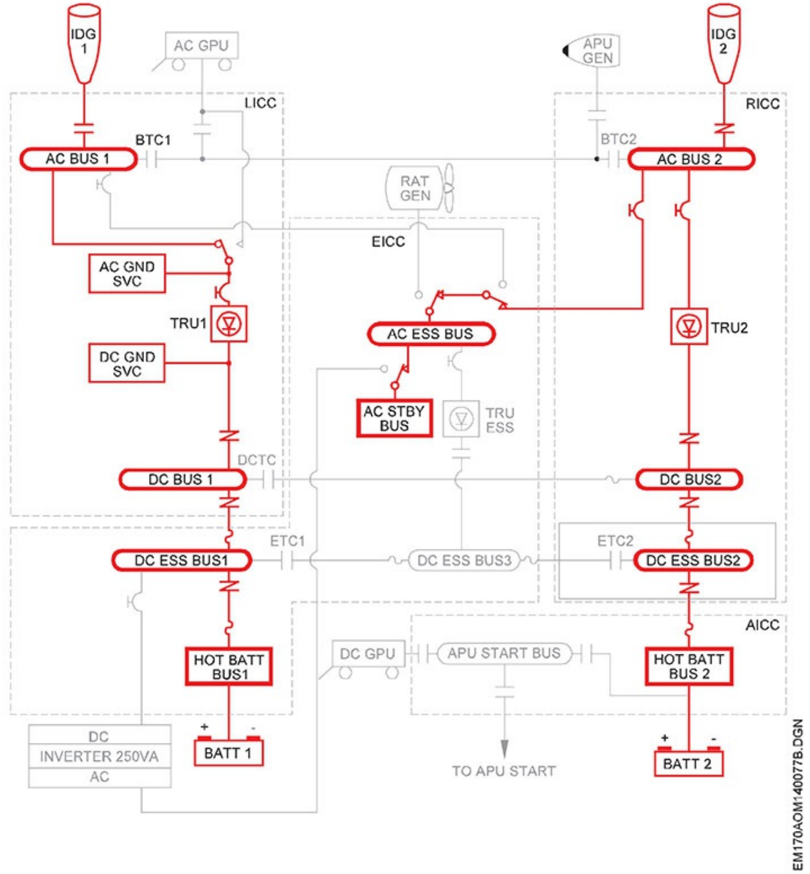
TRU FAILED


IDG 1
AC GPU
APU GEN
IDG 2
LICC
RICC
BTC1
AC BUS 1
BTC2
AC BUS 2
RAT GEN
EICC
AC GND SVC
TRU1
DC GND SVC
AC ESS BUS
TRU2
AC STBY BUS
TRU ESS
DCTC
DC BUS 1
DC BUS2
ETC1
ETC2
DC ESS BUS1
DC ESS BUS3
DC ESS BUS2
AICC
HOT BATT BUS1
DC GPU
APU START BUS
HOT BATT BUS 2
DC INVERTER 250VA AC
BATT 1
TO APU START
BATT 2
EM170AOM140075B.DGN

AC BUS OFF


IDG 1
AC GPU
APU GEN
IDG 2
LICC
RICC
BTC1
BTC2
AC BUS 1
AC BUS 2
RAT GEN
EICC
AC GND SVC
TRU1
AC ESS BUS
TRU2
DC GND SVC
AC STBY BUS
TRU ESS
DCTC
DC BUS 1
DC BUS2
ETC1
ETC2
DC ESS BUS1
DC ESS BUS3
DC ESS BUS2
AICC
HOT BATT BUS1
DC GPU
APU START BUS
HOT BATT BUS 2
DC
INVERTER 250VA
AC
BATT 1
TO APU START
BATT 2
EM170AOM140076B.DGN

DC BUS OFF



DC ESS BUS OFF

14.05.45 EICAS MESSAGES

TYPE	MESSAGE	MEANING
WARNING	BATT 1 (2) OVERTEMP	Associated battery temperature is above 70°C.
	BATT 1-2 OFF	Battery #1 and #2 are isolated from the electrical network.
	BATT DISCHARGING	Batteries are discharging in an electrical emergency with no RAT assistance, or on ground when the battery is the only power source supplying the airplane.
	ELEC EMERGENCY	In flight, AC main buses are de-energized.
CAUTION	AC BUS 1 (2) OFF	Associated AC BUS is de-energized.
	AC ESS BUS OFF	AC ESS BUS is de-energized.
	AC STBY BUS OFF	AC STBY BUS is de-energized.
	APU GEN OFF BUS	APU generator failure or APU GEN button is pushed out.
	BATT 1 (2) DISCHARGING	Associated battery is discharging due to electrical system automation failure, or when battery is the only source supplying the system.
	BATT 1 (2) OFF	Associated battery is isolated from the electrical network.
	BATT 1 (2) TEMP SENS FAULT	A discrepancy between battery sensors has been detected.
	DC BUS 1 (2) OFF	Associated DC BUS is de-energized.
	DC ESS BUS 1 (2) (3) OFF	Associated DC ESS BUS is de-energized.
	GPU CONNECTED	AC or DC GPU connected (AVAIL or IN USE indication turned on) and parking brake released.
	IDG 1 (2) OFF BUS	IDG failure or IDG control knob is turned OFF.
	IDG 1 (2) OIL	High oil temperature or low oil pressure has been detected.
	INVERTER FAIL	An inverter failure has been detected during power up built-in test.
	RAT FAIL	A failure was detected during power up built-in test in a RAT system component.
	TRU 1 (2) (ESS) FAIL	An associated TRU failure has been detected.
ADVISORY	LOAD SHED	Load shed automatically commanded.
	REMOTE CB TRIP	A remote thermal or electronic CB has been tripped.
	SPDA FAIL	A significant failure has been detected.

14.06.01 GENERAL DESCRIPTION

Two wing-mounted General Electric engines power the airplane. The engine is a high-bypass and dual rotor turbofan, fully integrated with a nacelle and thrust reverse.

- E175: CF34-8E5 FAID*
- E190: CF34-10E5

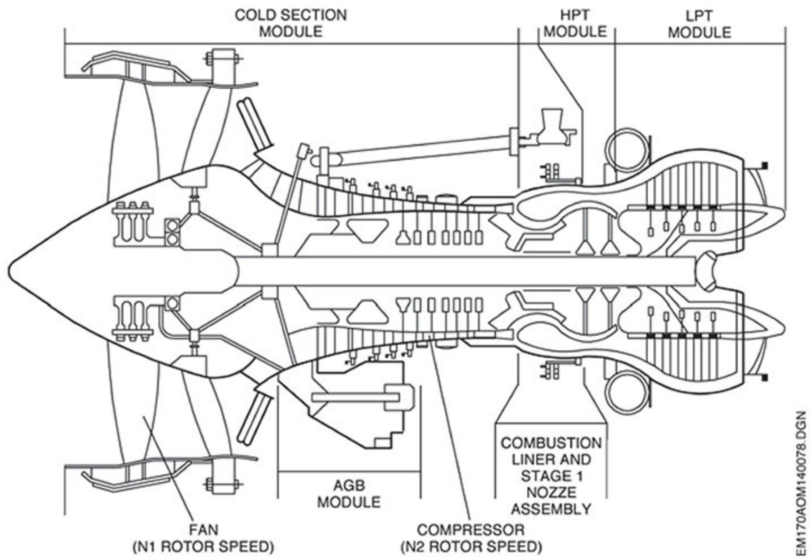
* Fan Air Inlet Door

The N1 and N2 rotors are mechanically and independently operated.

The engine is controlled via a dual channel FADEC system providing flexible engine operation and reduced workload.

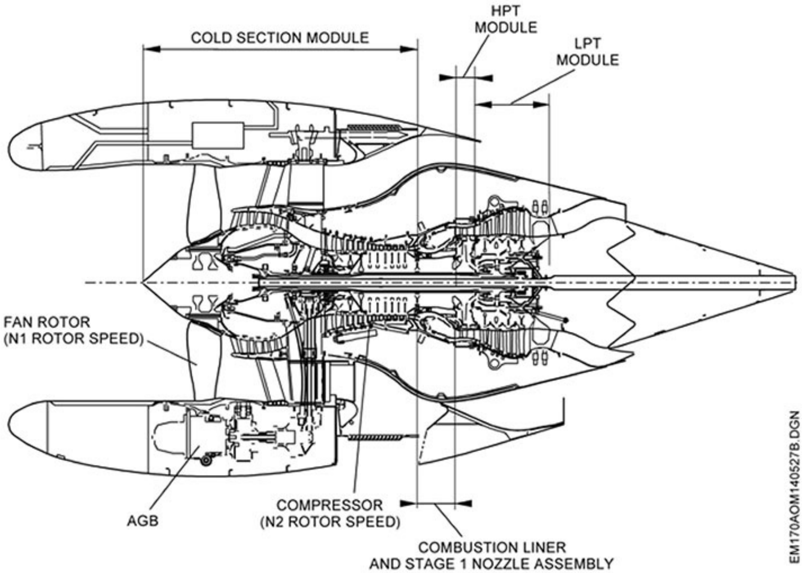
Engine indications and alerts are displayed on the Engine Indication and Crew Alerting System (EICAS).

E175:



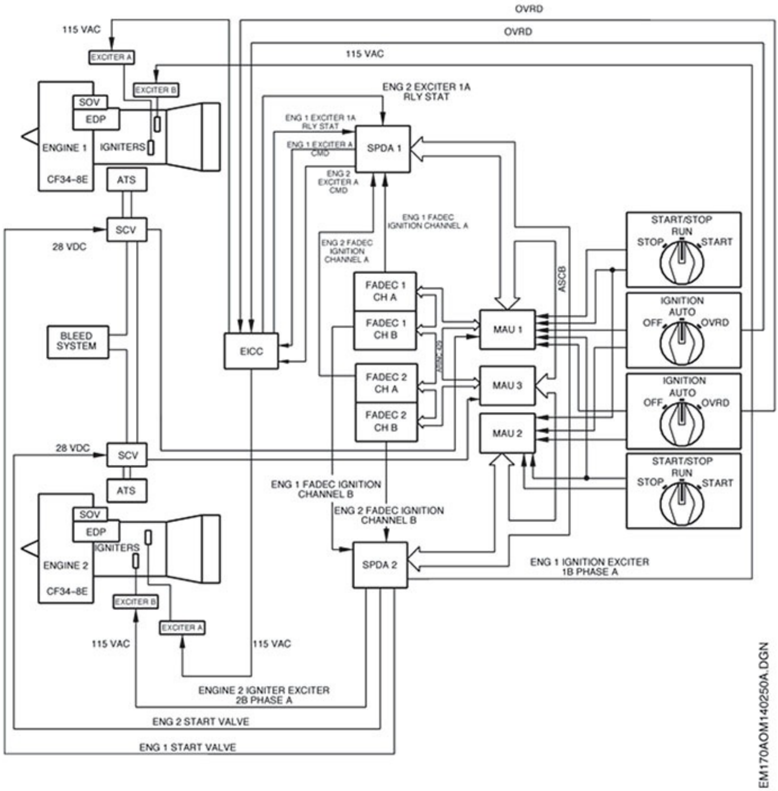
CF34-8E ENGINE

E190:



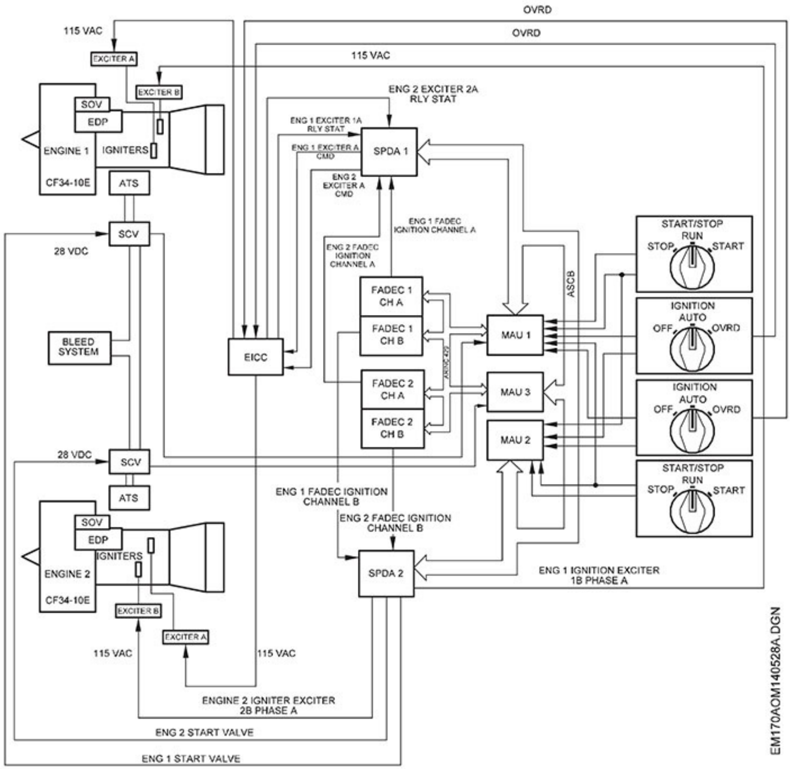
CF34-10E ENGINE

E175:



ENGINE SCHEMATIC

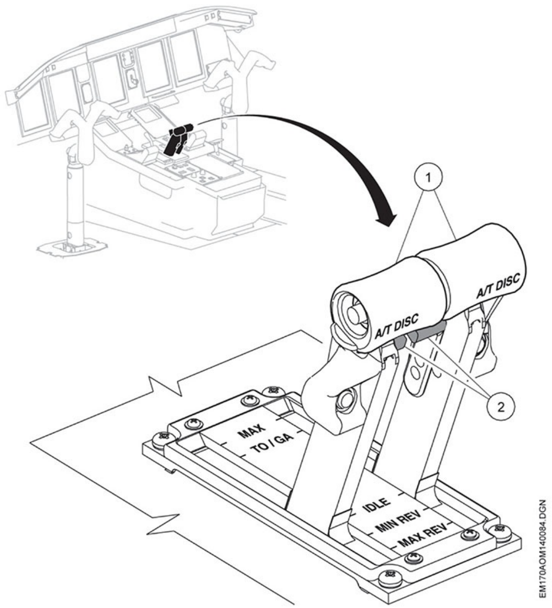
E190:



ENGINE SCHEMATIC

14.06.05 CONTROLS AND INDICATIONS

CONTROL PEDESTAL



1 – THRUST LEVER DETENTS

MAX: provides the maximum thrust rating available for dual or single engine operation.

TO/GA: selects takeoff, maximum continuous, and go-around mode settings.

IDLE: selects flight idle, approach idle, final approach idle and ground idle thrust settings.

MIN REV: provides minimum reverse thrust.

MAX REV: provides maximum reverse thrust. The thrust lever must be pulled against a spring to achieve the MAX REV position. If the thrust lever is released it goes back to MIN REV position.

NOTE: Positioning the thrust lever between the thrust control quadrant detents selects intermediate thrust settings.

2 – THRUST REVERSER TRIGGER

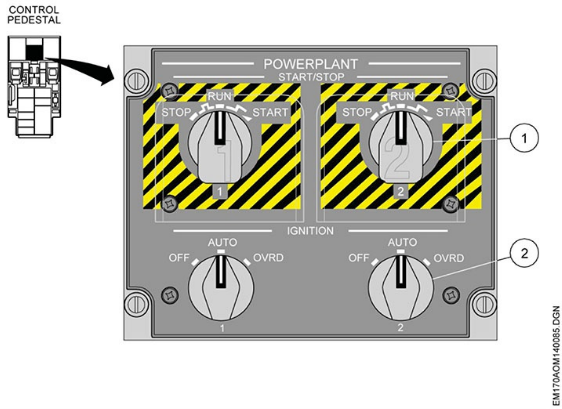
- Pulling the thrust reverser trigger allows reverser activation on the ground and REV thrust commands from IDLE to MAX REV.

For TO/GA and A/T DISC buttons descriptions, refer to Section 14-03 – Automatic Flight

FIRE HANDLE

The Fire Handle, located on the Fire Protection Control Panel, enables emergency engine shutdown. For further information on fire protection system controls, refer to Section 14-07 – Fire Protection.

ENGINE PANEL



1 – ENGINE 1 AND ENGINE 2 START/STOP SELECTORS

STOP: commands the FADEC to shut down the engine, provided the associated thrust lever is in the IDLE position.

NOTE: Normal engine shutdown on ground is possible with the associated thrust lever at maximum 5° above IDLE position. However the EICAS message ENG 1(2) TLA NOT IDLE is displayed.

RUN: normal position for engine operation.

START: (momentary action) initiates the engine start sequence.

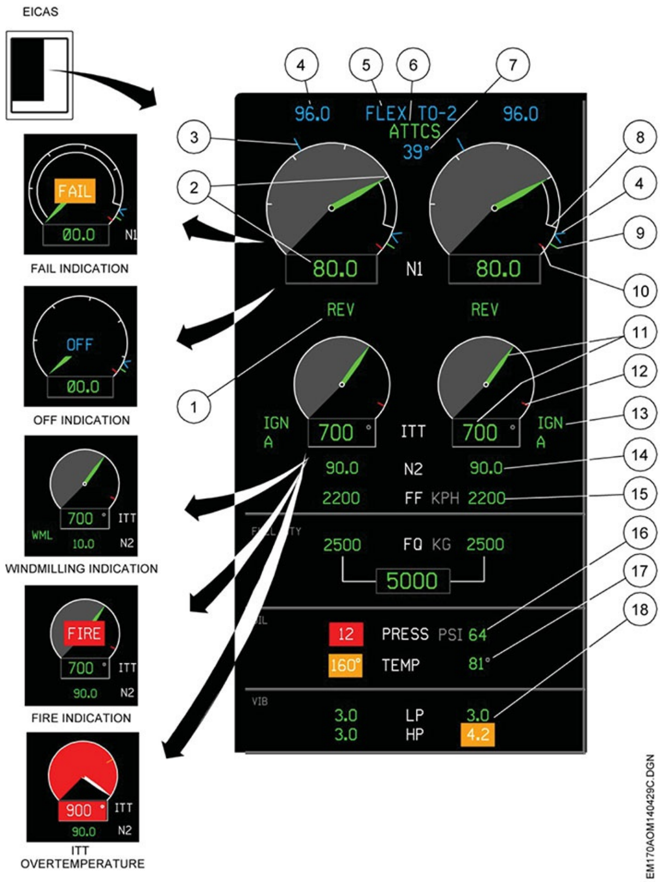
2 – IGNITION 1 and IGNITION 2 KNOBS

OFF: deactivates the ignition system. On ground, fuel flow is inhibited. FADEC disregards OFF position in flight.

AUTO: FADEC automatically controls the ignition system, depending on engine requirements.

OVRD: enables FADEC to continuously activate both exciters when the engine is running.

EICAS INDICATION



ENGINE INDICATION - EICAS

1 – THRUST REVERSER INDICATION

- Indicates the thrust reverser position.
- Label: REV

GREEN:	fully deployed.
AMBER:	in transition.
RED:	discrepancy between selected and actual reverser positions.

2 – N1 INDICATION

- Digital Indication.
  - Displays the percentage of N1 RPM.

GREEN:	normal operating range.
RED:	operating limit exceeded.
AMBER DASHED:	invalid information or value out of displayable range.

- Quantity Scale/Pointer.
  - The pointer on the scale indicates a value equal to that shown on the digital readout.
  - Scale:

GREEN:	normal operating range.
RED:	operating limit exceeded.

- The amber boxed FAIL indication is displayed on the center of the N1 dial when an engine has flamed out or shut down without pilot action. The cyan OFF indication is displayed when the engine is shut down in-flight by pilot action.

3 – N1 WING ANTI-ICE CYAN LINE

- Displayed only in icing conditions during final approach (radio altimeter below 1200 ft) with landing gear down or flaps extended.
- Indicates the minimum thrust level (N1 value) to meet bleed requirements.

4 – N1 TARGET INDICATION

- Maximum N1 for the engine thrust rating mode indicated on EICAS.
- If the requested value is invalid, the digits will be removed from the display.
- A cyan V-shaped bug represents the N1 target on the dial indicator.
- Digits:

CYAN:	normal indication.
AMBER DASHED:	invalid information or value out of displayable range.

5 – THRUST RATING MODE INDICATION

- Indicates the current thrust-rating mode. Indications are displayed in cyan.
- Label: TO-1, TO-2, TO-1 RSV, TO-2 RSV, FLEX TO-1, FLEX TO-2, CLB-1, CLB-2, CON, CRZ, GA or GA-RSV.

6 – ATTCS INDICATION

- An ATTCS indication is displayed to indicate the Automatic Takeoff Thrust Control System status.
- Label: ATTCS

GREEN:	engaged.
WHITE:	armed.
BLANK:	not selected.

7 – ASSUMED TEMPERATURE INDICATION

- Displays the temperature set on the MCDU. This indication is also used as a reference for flexible thrust.

8 – N1 REQUEST INDICATION

- Indicates the momentary difference (transient) between actual N1 and requested N1 applied by thrust lever position (TLA).

9 – MAXIMUM N1 INDICATION

- Green tick-mark.
- Indicates the maximum allowable N1 (maximum thrust) for the current thrust rating and operating conditions. If the thrust lever is set to MAX position, the N1 Request value will be equal to the Maximum N1 value.

10 – N1 RED LINE

- Indicates the N1 limit.
- The digital and dial readout colors change if this value is exceeded.

11 – INTERTURBINE TEMPERATURE (ITT) INDICATION

- Quantity Scale/Pointer.
  - The pointer on the scale indicates a value equal to that shown on the digital readout.
  - Scale:

GREEN:	normal operating range.
RED:	operating limit exceeded.

- AMBER dashes will display on digital readout when invalid information or a value out of displayable range is available.
- A red fire warning indication is displayed on the center of ITT dial to indicate engine fire condition.

12 – ITT RED/AMBER LINE

- Maximum allowable ITT for the current flight phase.
- Limits thrust, thereby avoiding the maximum allowable ITT to be exceeded.
- The red line will change to amber after the end of the takeoff phase. The red line will be shown in flight if the ITT goes above the CON thrust rating limit.

13 – IGNITION CHANNEL INDICATION

- Indicates the enabled ignition channel.
- Colors:

GREEN:	IGN A, IGN B or IGN AB.
CYAN:	IGN OFF.

- A WML icon is displayed whenever the FADEC has detected an engine flameout and the auto re-light system is actuating to restart the engine.

14 – N2 INDICATION

- Digital Indication.
- Displays the percentage of N2 RPM.

GREEN:	normal operating range.
RED:	operating limit exceeded.
AMBER DASHED:	invalid information or value out of displayable range.

15 – FUEL FLOW INDICATION

- Indicates fuel flow in kilograms per hour (KPH) or pounds per hour (PPH).
- Digit colors:

GREEN:	normal indication.
AMBER DASHED:	invalid information or value out of displayable range.

16 – OIL PRESSURE INDICATION

- Indicates the engine oil pressure.
- Digit colors:

GREEN:	normal operating range.
AMBER:	cautionary operating range.
RED:	operating limit exceeded. A zero (0) value may be an indication of Oil Pressure Transducer failure.
AMBER DASHED:	invalid information or value out of displayable range.

17 – OIL TEMPERATURE INDICATION

- Indicates the engine oil temperature.
- Digit colors:

GREEN:	normal operating range.
AMBER:	cautionary operating range.
AMBER DASHED:	invalid information or value out of displayable range.

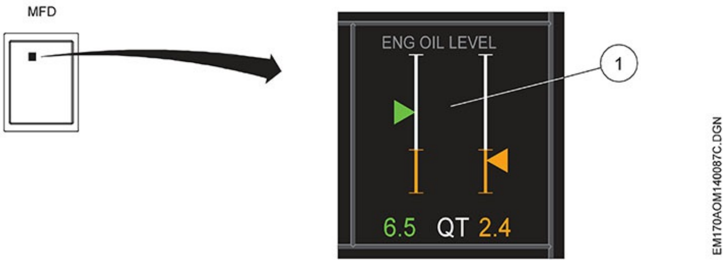
18 – ENGINE VIBRATION INDICATION

- Indicates low-pressure (LP) and high-pressure (HP) vibration levels for both engines.
- Digit colors:

GREEN:	normal operating range (0 to 3.9)
AMBER:	cautionary operating range (4.0 to 5.0).
AMBER DASHED:	invalid information or value out of displayable range.

NOTE:
- Transient LP or HP high vibration indication without any other abnormal engine parameter indication may be considered normal according to the engine manufacturer.
- E190: For the first 60 seconds during engine start with thrust levers at IDLE, the engine vibration indication will be displayed in amber for values equal or greater than 5.0 units, for HP indication only.

STATUS PAGE



ENGINE OIL LEVEL INDICATION ON MFD

1 – OIL LEVEL INDICATION

- Indication colors:

GREEN: normal operating range.

AMBER: cautionary operating range.

- AMBER dashes will display on digital readout when invalid information or a value out of displayable range is available.

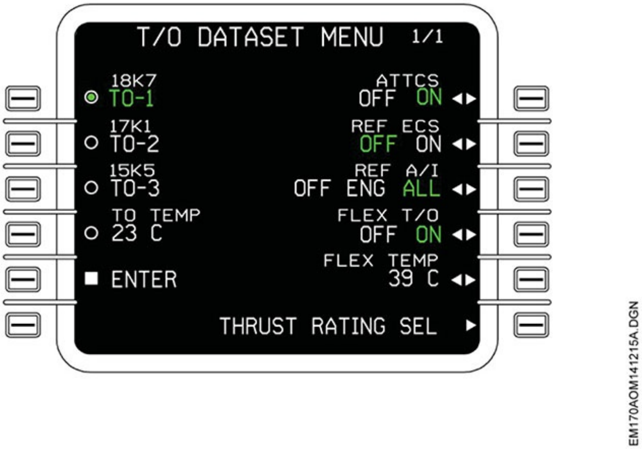
NOTE: The limit indication of amber line changes according to the engine status (running/shutdown).

MCDU INDICATION

All the inputs required by the FADEC for the takeoff N1 computations are made through the T/O DATASET MENU, on the MCDU.

The T/O dataset is performed according to the sequence:

- Press TRS (mode button).
- Press TO DATA SET (LSK 6R) on THRUST RATING SELECT page.



T/O DATASET MENU PAGE

The takeoff modes values displayed above on MCDU T/O DATASET MENU page are only intended to identify the engine model installed in the airplane. For the engine thrust ratings refer to AOM 14-06-30.

14.06.10 ENGINE FUEL SYSTEM

The engine fuel system provides fuel pressurization, filtering, heat exchange and operation of bleed valves and variable geometric actuators for the E175 and operation of engine vanes and bleed valves for the E190.

FUEL PUMP

Fuel supplied by the airplane fuel tanks flows to the engine fuel pumps. Upon exiting the tanks, the fuel flows through the low-pressure pump and then divides into two paths. One flows through the high-pressure fuel pump and returns to the fuel tank as motive flow.

E175: The second flows through the fuel/oil heat exchanger to the fuel filter. Once filtered, the flow leaves the FMU and passes through the high-pressure fuel pump, before returning to the FMU.

E190: The second flows through the fuel/oil heat exchanger to the high-pressure fuel pump. The flow leaves the pump and passes through the fuel filter. Once filtered, the fuel flows to the FMU.

FUEL/OIL HEAT EXCHANGER

The fuel-cooled oil cooler (FCOC) maintains the oil temperature within an acceptable range and heats the engine fuel to prevent freezing.

FUEL METERING UNIT (FMU)

The FMU, controlled by the FADEC, meters and distributes the proper amount of fuel for combustion to the injectors under all operating conditions. The FMU controls the shutoff valve used during all normal shutdowns and provides overspeed protection.

FUEL FILTER

The fuel filter removes contaminants from the engine fuel. The impending bypass switch indicates fuel filter blockage and an imminent bypass condition.

VARIABLE GEOMETRY ACTUATOR

E175:

The Variable Geomtery Actuator consists of two fuel driven actuators controlled by the FADEC via FMU.

The purpose of the actuators is to optimize the position of the compressor stators as a function of corrected N2 to provide optimum compressor efficiency.

VARIABLE STATOR VANES

E190:

The Variable Stator Vanes system consists of two fuel driven Variable Geometry Actuators controlled by the FADEC via FMU.

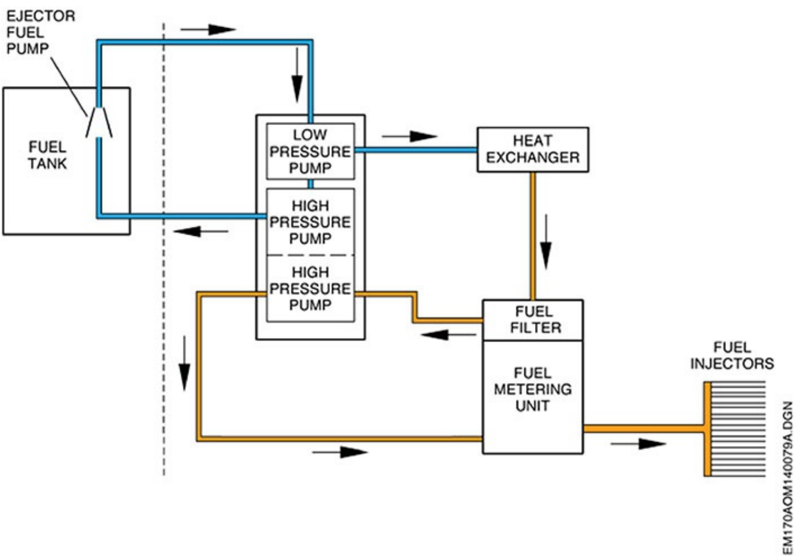
The purpose of the actuators is to optimize the position of the compressor stators as a function of corrected N2 to provide optimum compressor efficiency.

FUEL INJECTORS

The fuel injectors atomize the fuel from the FMU and direct it into the combustion chamber.

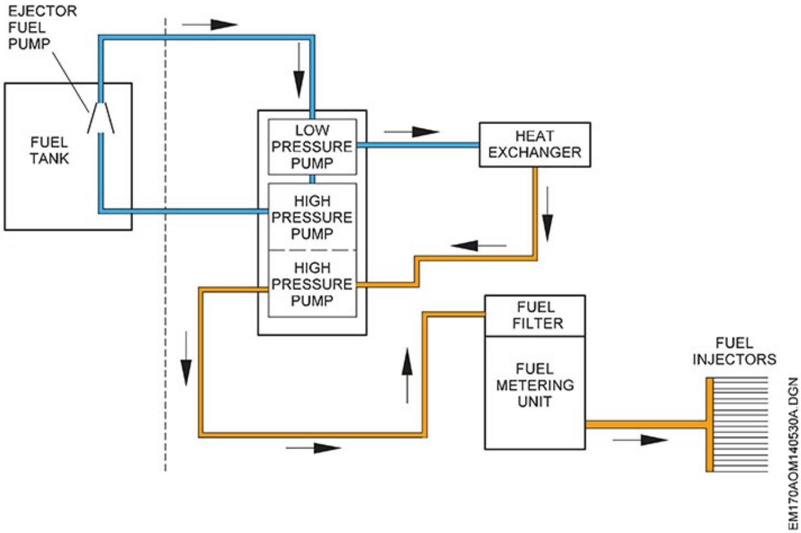
FUEL SCHEMATIC

E175:



FUEL SYSTEM SCHEMATIC

E190:



FUEL SYSTEM SCHEMATIC

14.06.15 LUBRICATION SYSTEM

GENERAL

Each engine has an independent lubrication system.

The oil system lubricates and cools the turbine engine main shaft, bearings and the accessory gearbox.

Oil is pressurized in the lubrication pump, it then passes through the filter, the fuel-oil heat exchanger and is then divided into several circuits to lubricate the engine.

OIL TANK

Oil quantity indication is provided for each engine oil tank and is displayed on the MFD.

Oil quantity sensors in the tank detect low oil quantity and trigger a low oil level caution at a specific level.

OIL PUMPS

The pump provides oil flow any time the core engine is turning.

The pump contains one supply and four scavenge pumping elements.

The lube and scavenge pumps deliver oil under pressure to the engine bearings and gears, and then recovers the oil to the tank for reuse.

NOTE: After engine shutdown the scavenge system is no longer effective. A small amount of oil may leak through the aft sump drain and pool in the engine chevron nozzle.

OIL FILTER

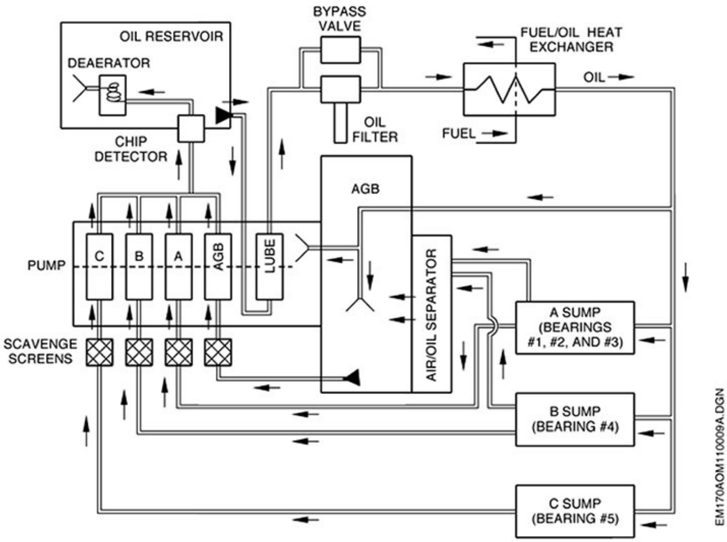
The oil filter module incorporates a filter bypass and cold start relief valve.

The oil filter bypass valve permits oil flow if the filter becomes clogged. The filter impending bypass switch monitors the differential pressure at the filter.

The filter module has a relief valve to bypass high viscosity oil during cold start conditions.

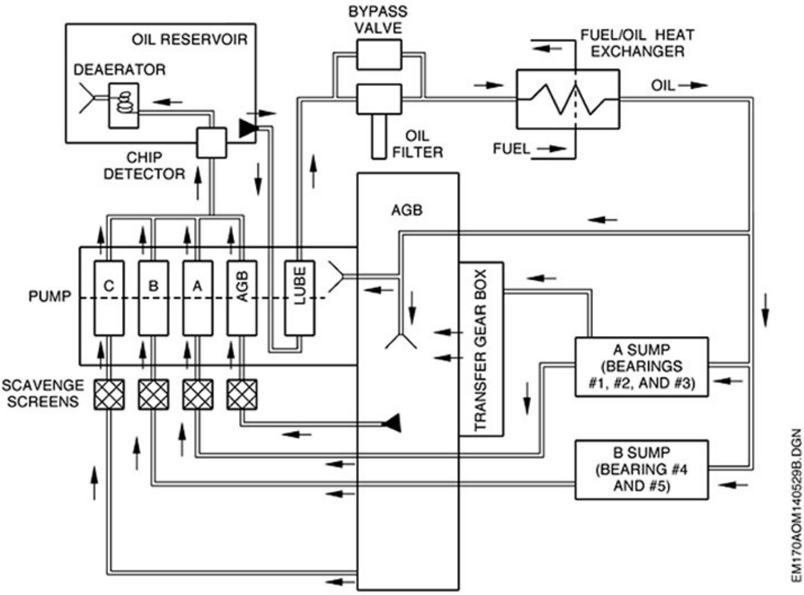
LUBRICATION SCHEMATIC

E175:



LUBRICATION SYSTEM SCHEMATIC

E190:



LUBRICATION SYSTEM SCHEMATIC

14.06.20 STARTING AND IGNITION SYSTEM

STARTING SYSTEM

The engine starting system consists of:

- Air turbine starter (ATS).
- Starter control valve (SCV).

The pneumatic system provides bleed air to the ATS to rotate the engine shaft and start the engine.

The FADEC opens the Starter Control Valve (SCV), providing bleed air from the APU, a ground source, or the opposite engine. The Air Turbine Starter (ATS) is a turbine that accelerates the engine to a self-sustaining RPM level.

The FADEC closes the SCV when the starter cutout speed is reached.

IGNITION SYSTEM

The ignition system provides an electrical spark for fuel combustion during ground/in flight start attempts and for automatic re-light.

The FADEC energizes one igniter for on-ground engine starts and both igniters for in-flight engine starts.

E175: When the ignition selector knob is placed in the OVRD position, both igniters on each engine are energized.

E190: In case of an engine airstart, engine flameout, a missed light off, cold soak condition on ground, ground start at high altitude airports, or when the ignition selector knob is placed in the OVRD position, both igniters on each engine are energized.

Igniters 1B and 2B are connected to SPDA 2. In case of SPDA 2 failure, setting the selector knob to OVRD energizes at least the igniter A.

The frequent use of ignition selector knob at the OVRD position causes the significant reduction of the igniter's lifetime.

STARTER OPERATION

The engine starter is controlled via the engine start selector knob on the powerplant control panel. For on ground starts, the SCV opens providing bleed air to the ATS to increase rotor speed for engine start.

GROUND START

E175:

The FADEC initiates ignition at approximately 7% N2 and the fuel flow (metering valve opens) at approximately 20% N2. FADEC will automatically command both ignitors if no light off is detected within 15 s after initiation of fuel flow. The start should be aborted if no light off is detected within 30 s after initiation of fuel flow.

After a light off occurs, the FADEC commands the starter to cutout at approximately 50% N2, and commands the FMU fuel metering valve to accelerate the engine to ground idle speed.

E190:

The FADEC initiates ignition at approximately 7% N2 and the fuel flow (metering valve opens) at approximately 20% to 25% N2, depending on the engine start altitude.

If no light off is detected within 15 s of fuel on, FADEC automatically turns off ignition and fuel, continue dry motoring for 30 s, then turn on single ignition and turn on fuel again.

After 7 s of single ignition is applied, FADEC commands dual ignition for 8 s.

If no light off is detected after 15 s of the reintroduction of fuel or after start duty limit is reached, whichever occurs first, the FADEC does not turn off fuel or ignition automatically.

In case of cold soaked engine or high altitude conditions and no light off is detected, FADEC inhibits the EICAS messages “ENG 1 (2) NO DISPATCH” during the first attempt cycle for engine start.

If no light off is detected within 15 s of fuel on, FADEC will automatically turn off ignition and fuel, continue dry motoring for 30 s, then turn on both igniters and turn on fuel again.

Subsequently, if no light off is detected after the reintroduction of fuel, the FADEC will not turn off fuel or ignition and the start must be manually aborted 15 s after the reintroduction of fuel flow or start duty limit, whichever occurs first.

After a light off occurs, the FADEC commands the starter to cutout at approximately 50% N2, and commands the FMU fuel metering valve to accelerate the engine to ground idle speed.

At high altitudes, the fuel flow schedule is also increased to provide higher torque and therefore quicker starts.

IN FLIGHT START

Engine cross-bleed air, APU bleed air or windmilling can be used for in-flight engine starts.

An in-flight cross-bleed start is identical to an on ground start, but the FADEC automatically controls fuel flow to initiate (metering valve opens) if N2 has not reached 20% (E175) or 15% (E190) after 15 seconds.

For windmill starting, the SCV configures the pneumatic system. The engine start is controlled by the START/STOP selector knob and the FADEC commands ignition at 7% N2 and fuel flow at a minimum of 7.2% N2, or after 15 seconds, whichever occurs first.

The FADEC has no protection for hot starts, hung starts or failure to light –off for in-flight engine starts.

E190:

NOTE: If ITT limit is exceeded during an in-flight start, the FADEC interrupts fuel flow for 4 s and then resumes the start.

The FADEC will repeat this cycle 8 times. This logic will be interrupted if engine reaches idle or pilot manually aborts the start. After 8 automatic start attempts, the logic is no longer available.

This new logic does not abort the engine start automatically. Flight crew remains responsible for monitoring engine parameters and manually abort the start.

If no light off is detected within 30 seconds after fuel flow is started, the start should be manually aborted.

AUTO RELIGHT

The FADEC monitors N2 and automatically turns on both igniters and schedules the relight fuel flow in the event of an engine flameout. In addition a WML icon is displayed next to the respective engine N2 and represents an auto relight actuation during the engine auto relight attempts.

If the engine relight does not occur within 30 seconds or N2 falls below 7.2 %, the automatic relight can be considered unsuccessful and should be manually terminated by moving the START/STOP selector knob to the STOP position.

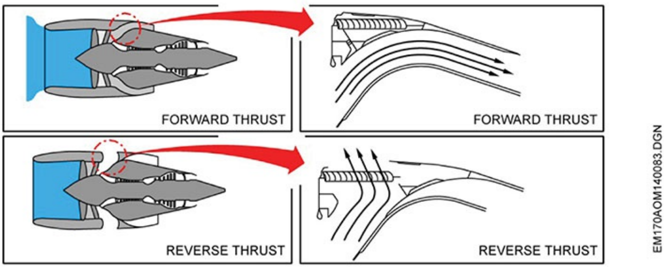
For in flight auto relight, the FADEC has no protection for hot starts, hung starts or failure to light off.

During ground operations, auto relight attempts are terminated and fuel is shutoff if the engine RPM falls below 52 percent N2.

14.06.25 THRUST REVERSER SYSTEM

The Thrust Reverser System is hydraulically actuated and controlled from the cockpit via the thrust lever.

Thrust reversers 1 & 2 operate independently, and are actuated by the respective hydraulic system.



THRUST REVERSER ACTUATION

The FADEC provides an interlock function to protect against inadvertent thrust reverser deployment and also to protect against inadvertent thrust reverser stowing.

A locking system consists of two actuator locks and the independent cowl lock. The cowl lock prevents inadvertent deployment of the thrust reverser.

THRUST REVERSER OPERATION

Moving the thrust lever to IDLE position enables the lifting of the thrust reverser trigger. Thrust reverser deployment is commanded when the associated thrust lever is moved to the reverse positions (MIN REV or MAX REV).

NOTE: Pulling the reverser triggers before airplane touchdown may lock the thrust levers in place, preventing the thrust reversers deployment. In that case, the system can be unlocked by releasing the thrust levers after airplane touchdown. Once the thrust levers are unlocked, the thrust reverses can be deployed as required.

Thrust reverser deployment occurs only if the airplane is on ground. The thrust reverser trigger can be lifted within 30 seconds after an engine inoperative condition is detected.

After this time, the thrust reverse is not released, and the respective thrust lever cannot be moved to the reverse positions.

Idle reverse thrust is commanded while the thrust reverser cowls are in transit. After total deployment of the reverser cowls, maximum reverse thrust is commanded if the thrust levers are held in MAX REV position.

In case one thrust reverser fails, when selecting both TLA to MAX REV position, the operative thrust reverser provides minimum reverse thrust only. Selecting only the operating reverser TLA to MAX REV position enables maximum reverse thrust on this engine.

The thrust reverser is not designed to operate in flight. In case of uncommanded thrust reverser deployment, the engine thrust is limited to idle.

14.06.30 ENGINE CONTROL SYSTEM

GENERAL

The engine control system performs engine control and thrust management, provides information to the cockpit, maintenance reporting and engine condition monitoring.

The engine control system consists of the FADEC, thrust lever, T2 and N1 sensors.

The FADEC uses inputs from the airplane and engine to monitor and manage the engine control system.

The thrust lever receives the inputs of the desired thrust from the pilots or from the autothrottle.

The T2 sensor monitors the engine inlet air temperature for use in FADEC control calculations.

The N1 sensor provides the fan speed data for the FADEC and airplane vibration monitoring system.

FULL AUTHORITY DIGITAL ELECTRONIC CONTROL (FADEC)

The FADEC is the main component of the engine control system.

Its functions include:

- Engine protection;
- Control of the requested and max N1;
- Control of the ATTCS.

The FADEC has two identical but isolated channels. One operates as the in-control channel and the other as a standby. The standby channel constantly processes all the data and is always ready to take control of the engine in case the active channel fails.

The FADEC in-control channel is switched on every engine start.

FADEC ELECTRICAL POWER

Above approximately 50% N2 the FADEC is powered by the Permanent Magnet Alternator (PMA). Below this value or in case the PMA becomes inoperative; the airplane's electrical system provides the backup power.

FADEC INTERFACES

The FADEC receives data from all engine control system sensors and the airplane air data system to control the operation and performance characteristics of the engine, exercising control over the:

- Engine fuel metering unit to adjust the fuel flow;
- Variable geometry valve to improve N1 efficiency;
- Bleed valve to set the engine bleed extraction;
- T2 sensor heater to prevent ice accumulation;
- Thrust reverser actuation to adjust and control N1 values and allowances;
- Engine starting to optimize the temperatures, start up time and to provide the available protections;
- Ignition for engine start and automatic dry motoring, to prevent engine flame out during operation.

AUTOMATIC TAKEOFF THRUST CONTROL SYSTEM (ATTCS)

The ATTCS is controlled by the FADEC and is available on takeoff and go around.

TAKEOFF

The ATTCS can be selected ON or OFF for takeoff. By default, ATTCS will be selected ON.

The selection is made on the MCDU - TAKEOFF DATA SET MENU page and the indication is displayed on the EICAS as follows:

- ATTCS label in white - system is armed;
- ATTCS label in green - system is engaged. The engagement only happens when the thrust levers reach the TO/GA set position.

The selection from ON to OFF must be in accordance with the performance calculations.

GO AROUND

In flight the ATTCS is automatically armed anytime the thrust rate mode is GA making the GA RSV possible whenever activation criteria are met.

ATTCS ACTIVATION LOGIC

The ATTCS automatically commands RSV whenever it is engaged, thrust levers are at TOGA position, and one of following conditions occurs:

- Difference between both engine N1 values is greater than 15%;
- One engine failure during takeoff;
- One engine failure during go-around;
- Windshear detection.

The RSV mode is manually activated by moving the thrust levers to MAX position whenever the ATTCS is engaged.

Whenever the ATTCS is activated, the green ATTCS indication on the EICAS disappears and the cyan thrust mode will be displayed with an additional "RSV" indication.

ATTCS LOGIC TABLE

Condition	Phase of Flight	ATTCS Status	Thrust Lever Set	Engine Thrust
One Engine Failure	Takeoff	ON	TOGA	TO-x RSV
			MAX	TO-x RSV
		OFF	TOGA	No Thrust Increase
			MAX	TO-x
	Go-Around	ON	TOGA	GA RSV
			MAX	GA RSV
Windshear	Takeoff	ON	TOGA	TO-x RSV
			MAX	GA RSV [1]
		OFF	TOGA	No Thrust Increase
			MAX	GA RSV [1]
	Go-Around	ON	TOGA	GA RSV
			MAX	GA RSV
All Engines Operative	Takeoff	ON	TOGA	No Thrust Increase
			MAX	TO-x RSV
		OFF	TOGA	No Thrust Increase
			MAX	TO-x
	Go-Around	ON	TOGA	No Thrust Increase
			MAX	GA RSV

[1] FADEC sets go around reserve thrust, regardless the label presented on EICAS when:

- Windshear is detected during takeoff phase, and
- TLA is MAX.

FLEXIBLE TAKEOFF

Flexible takeoff is a reduced takeoff thrust based on assumed temperature.

All takeoff modes are eligible for a flexible takeoff.

The assumed temperature must be higher than the TO TEMP and is set on the MCDU TAKEOFF DATA SET MENU page.

The indication FLEX TO-1 or FLEX TO-2 will be displayed on the EICAS for the respective flexible takeoff thrust.

The minimum flex takeoff thrust is limited to 75% maximum rated takeoff thrust or CLB-2 + 0.5% (E175) or 1% (E190) N1, whichever is higher.

Flexible takeoff is possible with ATTCS ON or OFF. When flexible takeoff mode is used, moving the thrust levers to MAX position resets the assumed temperature and sets the maximum thrust available (refer to the Thrust Ratings Table).

ENGINE THRUST RATINGS

The FADEC calculates the maximum N1 for each thrust rate mode adjusted for altitude, temperature and airspeed and displays both digital and analogical readings on the N1 indicator.

The thrust rate modes are the following:

- Takeoff (TO-1, TO-2);
- Takeoff Reserve (TO-1 RSV, TO-2 RSV);
- Go-Around (GA);
- Go Around Reserve (GA RSV);
- Maximum Continuous Thrust (CON);
- Maximum Climb (CLB-1, CLB-2);
- Maximum Cruise (CRZ);
- Idle.

TAKEOFF (TO-1, TO-2)

TO-x is the thrust used for a normal takeoff.

Based on the inputs made on MCDU – TAKEOFF DATA SET MENU page the FADEC calculates the maximum N1 for the given conditions.

The takeoff N1 is only achieved when the thrust levers are set to TO/GA position.

MAXIMUM TAKEOFF RESERVE (TO-1 RSV, TO-2 RSV)

Whenever the ATTCS is triggered, TO-x RSV automatically becomes the maximum N1, as long as the thrust levers are set to TO/GA.

The TO-x RSV can be manually activated by setting the thrust lever to MAX position, given that the ATTCS is ON and TO-x mode is active.

Go-Around (GA)

The go around mode is activated in flight whenever the landing gear and flaps are down. The GA mode can also be set from CRZ, CON or CLB by pressing the TOGA switch.

The go around thrust can be achieved anytime in flight when the thrust rate mode is other than takeoff and the thrust levers are set to TO/GA. In this situation, the engine thrust mode label on EICAS is not modified.

GO-AROUND RESERVE (GA-RSV)

The GA RSV is the highest engine thrust possible and it is to be used in extreme situations where extra thrust is required when maneuvering for landing.

MAXIMUM CONTINUOUS RATING (CON)

The maximum continuous thrust is to be used on emergency situation where thrust higher than usual is required.

It is the highest thrust the engines can operate continuously without reducing the time between overhauls.

MAXIMUM CLIMB RATING (CLB-1, CLB-2)

During aircraft power up, CLB-1 is the default mode setting. Whenever the selected takeoff thrust is lower than CLB-1 the CLB-2 mode becomes the default until the next airplane power down / power up.

Manual switching between the climb modes is possible anytime in flight on the MCDU - TRS page.

On ground the CLB-1 mode is inhibited if the take off thrust selected is lower than CLB-1 thrust.

MAXIMUM CRUISE RATING (CRZ)

The CRZ mode is the maximum N1 that can be used for a normal cruise flight.

IDLE

The IDLE modes are automatically adjusted by the FADEC in order to maintain the minimum thrust necessary to provide the required bleed pressure to the airplane.

Flight Idle N1 varies with altitude and can change as a function of ECS and anti-ice bleed requirements.

The idle mode selections are the following:

- Flight Idle;
- Approach Idle;
- Final Approach Idle;
- Ground Idle.

IDLE THRUST IN ICE CONDITIONS

Whenever ICE CONDITION is sensed the N1 for the FLIGHT IDLE and APPROACH IDLE is automatically increased to maintain the minimum bleed pressure required for the ANTI ICE system operation.

With the FINAL APPROACH IDLE there is no N1 automatic increase but a cyan dash is displayed on both EICAS N1 dial to show the minimum thrust required to maintain the bleed pressure required by the ANTI ICE system.

FLIGHT IDLE

The flight idle mode is active anytime in flight when the approach idle is not selected.

APPROACH IDLE

Approach Idle is used in flight to enable rapid acceleration to go-around thrust. Approach idle is activated as follows:

- In flight;
- Altitude less than 15000 ft;
- Flaps 1 or greater or landing gear down; and

FINAL APPROACH IDLE

Final Approach Idle is active as follows:

- Altitude lower than 1200 ft AGL;
- Landing flaps;
- Landing gear down.

GROUND IDLE

Ground Idle is the minimum thrust setting. Ground Idle provides the minimum stable engine thrust level for ground operations.

MINIMUM REVERSE

Min reverse is idle thrust with the thrust reverser cowl opened.

MAX REVERSE

Max reverse is the maximum thrust available with the thrust reverser opened.

THRUST RATINGS TABLE

Ratings		Thrust (lbf)			
Thrust Mode	ATTCS	E175		E190	
		n	n-1	n	n-1
T/O-1	ON	13000	14200	17100	18500
	OFF	13000	13000	17100	17100
T/O-2	ON	11800	13000	15450	16650
	OFF	11800	11800	15450	I15450
GA	ON	13000	14200	17100	18500
CON	–	12800	12800	16255	16255
CLB-1	–	12400	–	15950	–
CLB-2	–	11100	–	14020	–
CRZ	–	10400	–	13830	–

NOTE:
- Thrust values for sea level and ISA conditions.
- Engines with flat rated temperature up to ISA+15°C.

DERATED TAKEOFF ITT LIMITS

E175:

During the initial takeoff run the ITT red line marks the temperature limit for the actual thrust rating, changing according to the takeoff mode selected. After V_1 - 15 KIAS however, the ITT red line will mark the temperature limit for maximum takeoff thrust rating (TO-1 RSV), assuring that the engine has enough ITT margin to achieve maximum rated thrust.

E190:

During the initial takeoff run the ITT red line marks the temperature limit for TO-1.

After V1 - 15 KIAS however, the ITT red line will mark the temperature limit for maximum takeoff thrust rating (TO-1 RSV), assuring that the engine has enough ITT margin to achieve maximum rated thrust.

ENGINE PROTECTION

FADEC ENGINE PROTECTION

The FADEC provides engine start protection on the ground as follows:

- Hung start;
- Hot start;
- No light-off.

OVERSPEED PROTECTION

Whenever N2 reaches 102% the FADEC automatically commands an engine shutdown.

In the event of three consecutive overspeed detection events within 30 seconds the FADEC will not relight the engine.

OVERTEMPERATURE PROTECTION

The FADEC controls the ITT limits for engine start and throughout engine operation.

ITT limit is variable according to the engine operation phase.

ITT OVER LIMIT PROTECTION

During engine start if the ITT reaches its limit the FADEC automatically shuts off the fuel flow aborting the start sequence. In this case the start control valve is not automatically closed. Pilot intervention is needed to close the SCV by selecting the START/STOP switch to STOP.

ENGINE START HIGH ITT PREVENTION

To improve the ITT control on engine ground starts the FADEC will not allow fuel flow if ITT is above 120°C.

In this case when the pilot sets the START/STOP selector to START the start control valve is commanded open but the fuel flow only starts when the ITT drops below 120°C.

14.06.35 EICAS MESSAGES

TYPE	MESSAGE	MEANING
WARNING	ENG 1 (2) OIL LO PRESS	Engine 1 (2) oil pressure is low.
	ENG 1 (2) REV DEPLOYED	Thrust reverser deployed unexpectedly, or not stowed when commanded to stow or thrust reverser position is undetermined.
CAUTION	ENG 1 (2) CONTROL FAULT	Thrust modulation is disabled. OBV has failed open or engine will respond slowly.
	ENG 1 (2) FADEC OVERTEMP	FADEC overtemperature has been detected.
	ENG 1 (2) FAIL	Engine 1 (2) shutdown has occurred.
	ENG 1 (2) FUEL IMP BYPASS	Fuel filter impending bypass.
	ENG 1 (2) FUEL LO PRESS	Engine 1 (2) Fuel pressure low. Airplane backup fuel pump is active.
	ENG 1 (2) NO DISPATCH	No dispatch condition detected by FADEC.
	ENG 1 (2) OIL LO LEVEL	Engine 1 (2) oil level is below minimum.
	ENG 1 (2) REV FAIL	Thrust Reverser is not available.
	ENG 1 (2) REV PROT FAULT	Reverser fault detected, operation not inhibited.
	ENG 1 (2) REV TLA FAIL	Respective reverser solenoid protection has failed.
	ENG 1 (2) START VLV OPEN	Start valve not closed while engine running.
	ENG 1 (2) T2 HEAT FAIL (E175 only)	T2 heater failed.
	ENG 1 (2) TLA FAIL	Dual thrust lever angle sensor failure.
	ENG EXCEEDANCE	Engine limit exceedance detected.
	ENG NO TAKEOFF DATA	Takeoff data not entered successfully. Discrepancy between information entered in FMS for engine 1 and 2 detected.
	ENG REF A-I DISAG	Ice protection MODE Knob set to the ON position with OFF or ENG in the take-off data set (TDS) menu.
	ENG REF ECS DISAG	Discrepancy between REF ECS input and actual ECS bleed configuration.
	ENG THR RATING DISAG	Discrepancy between maximum thrust rating of engines 1 and 2. Possible asymmetric engine thrust.
	ENG TLA NOT TOGA	TLA not at TO/GA position during takeoff and/or go-around phases.

TYPE	MESSAGE	MEANING
ADVISORY	ENG 1 (2) FADEC FAULT	One FADEC channel no longer sending data.
	ENG 1 (2) FUEL SW FAIL	Fuel pressure switch indicates pressure is not low while all fuel pumps are off.
	ENG 1 (2) OIL IMP BYPASS	Oil filter impending bypass.
	ENG 1 (2) OIL SW FAIL	Oil pressure switch failure detected.
	ENG 1 (2) SHORT DISPATCH	Short-time dispatch fault condition detected by FADEC.
STATUS	ENG 1 (2) REV INHIBIT	Reverser inhibited by maintenance action.
	ENG 1 (2) TLA NOT IDLE	TLA not set to IDLE during either engine start or engine shutdown. A thrust higher than the expected will be reached if the TLA is above idle during engine start. Set TLA to IDLE position within 30 seconds to shut down the engine. If the 30 seconds period is exceeded, cycle the START/STOP selector knob to RUN then to STOP to reset the time and shutdown the engine. This message is also displayed during normal engine shutdown on ground with TLA at maximum 5° above IDLE.
	ENG TDS REF A-I ALL	REF A-I ALL is selected on take-off data set page on MCDU.
	ENG TDS REF A-I ENG	Ice protection MODE Knob set to the AUTO position and REF A-I ENG is selected on take-off data set page on MCDU.

14.07.01 GENERAL DESCRIPTION

The fire protection system provides fire detection and extinguishing capabilities for:

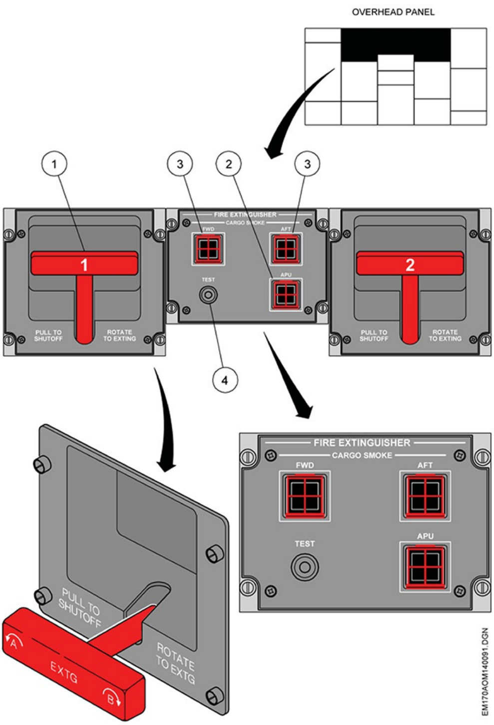
- Engines
- APU
- Cargo Compartments
- Lavatories

In addition, portable fire extinguishers are located in the cockpit and cabin.

In the event of fire protection system component failure, an EICAS message will be displayed.

14.07.05 CONTROLS AND INDICATIONS

FIRE EXTINGUISHER PANEL



1 – ENGINE FIRE EXTINGUISHER HANDLE

PULL:	closes the associated engine bleed air, fuel, hydraulic and cross bleed shutoff valves.
ROTATE (Left/right:)	discharges fire extinguisher bottles into the associated engine.

2 – FIRE EXTINGUISHER APU BUTTON (GUARDED)

Momentary action pushbutton:

- Closes the APU fuel shutoff valve and discharges the APU fire extinguisher bottle.

3 – CARGO SMOKE FWD AND AFT BUTTONS (GUARDED)

Momentary action button:

- According to system logic, discharges the high and low-rate cargo extinguisher bottles of the associated cargo compartment when the button is lit.
- Pressing the button when it is not illuminated arms the associated extinguisher bottle and the button illuminates red.

4 – FIRE EXTINGUISHER TEST BUTTON

Momentary action button:

- Tests the cargo smoke, engine and APU fire detection systems.
- If the button is kept pressed for more than 10 seconds the APU automatically shuts down.

14.07.10 ENGINE FIRE PROTECTION

ENGINE FIRE PROTECTION SYSTEM

The Engine Fire Protection System is designed to provide:

- Engine fire detection;
- Engine fire extinguishing and;
- Continuous Built-In Test to detect internal faults.

System electrical supply

The electrical power is supplied by:

- Engine fire detection:

MAU 1 (DC ESS BUS 1) and MAU 3 (DC ESS BUS 2).

- Engine fire extinguishing:

HOT BATT BUS 1 and HOT BATT BUS 2.

ENGINE FIRE DETECTION

The Engine Fire Detection System is monitored by two detector loops.

When a fire condition is detected the signal goes to the MAU which generates the associated EICAS messages and alarms.

ENGINE FIRE EICAS MESSAGES AND ALARMS

When a fire is detected the following EICAS messages and alarms are triggered:

AURAL

- aural warning;

LIGHTS

- the fire extinguisher handle illuminates;
- the master WARNING lights illuminate;

EICAS MESSAGES

- the FIRE warning light on the respective ITT indicator illuminates;
- the EICAS WARNING message ENG 1 (2) FIRE is displayed.

ENGINE FIRE EXTINGUISHING

The Engine Fire Extinguishing System is comprised of:

- two fire handles
- two fire-extinguishing bottles.

ENGINE FIRE HANDLE

Anytime the fire handle is pulled it commands the following shutoff valves to close:

- the engine fuel shutoff valve;
- the engine hydraulic shutoff valves
- the engine bleed air shutoff valve
- the cross bleed shutoff valve.

Each fire handle is associated with one engine.

ENGINE EXTINGUISHER BOTTLE

A total of two fire extinguisher bottles named A and B are installed in the airplane to serve either or both engines.

OPERATION

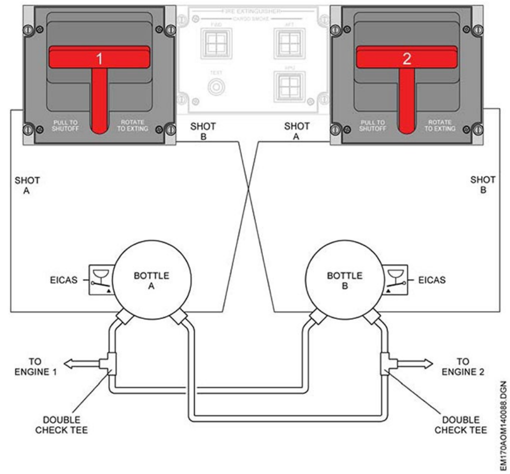
Once the FIRE HANDLE has been pulled the extinguisher bottles can be operated.

Rotating the FIRE HANDLE counter clockwise discharges extinguisher bottle A into the associated engine.

Rotating clockwise discharges extinguisher bottle B into the same engine.

NOTE: When an engine fire extinguishing bottle is discharged, fire handle illumination may be lost. In this case if the CAS message is still active the fire condition persists.

ENGINE FIRE PROTECTION SYSTEM SCHEMATIC



ENGINE FIRE PROTECTION SCHEMATIC

SYSTEM CONTINUOUS SELF MONITORING

Except for illumination of the button, all system components are continuously monitored throughout the operation.

In case of an internal failure a CAS message is generated to alert the crew of the failed condition.

14.07.15 APU FIRE PROTECTION

APU FIRE PROTECTION SYSTEM

The APU Fire Protection System is designed to provide:

- APU fire detection;
- APU fire extinguishing and;
- Continuous Built-In Test to detect internal faults.

SYSTEM ELECTRICAL SUPPLY

The electrical power is supplied by:

- APU fire detection:

MAU 1 (DC ESS BUS 1) and MAU 3 (DC ESS BUS 2).

- APU fire extinguishing:

DC ESS BUS 2.

APU FIRE DETECTION

The APU Fire Detection System is comprised of two detectors loops.

When a fire condition is detected the signal goes to the MAU which generates the associated EICAS messages and alarms.

APU FIRE EICAS MESSAGES AND ALARMS

When a fire is detected the following EICAS messages and alarms are triggered:

AURAL

- aural warning;

LIGHTS

- the red striped bar of the APU emergency stop button illuminates;

the master WARNING lights illuminate;

EICAS MESSAGES

- the EICAS WARNING message APU FIRE is displayed.

All alarms and indications cease when fire conditions are no longer present.

APU FIRE EXTINGUISHING

The APU Fire Extinguishing System is comprised of:

- one pushbutton;
- one fire extinguishing bottle.

APU FIRE EXTINGUISHER PUSHBUTTON

When the APU FIRE EXTINGUISHER pushbutton is pressed the system:

- discharges the APU fire bottle.
- shuts down the APU through the APU FADEC.
- closes the APU fuel shutoff valve (SOV).
- displays an EICAS ADVISORY message APU FIREX BTL DISCH.

APU EXTINGUISHER BOTTLE

One fire extinguishing bottle is installed in the rear fuselage.

OPERATION

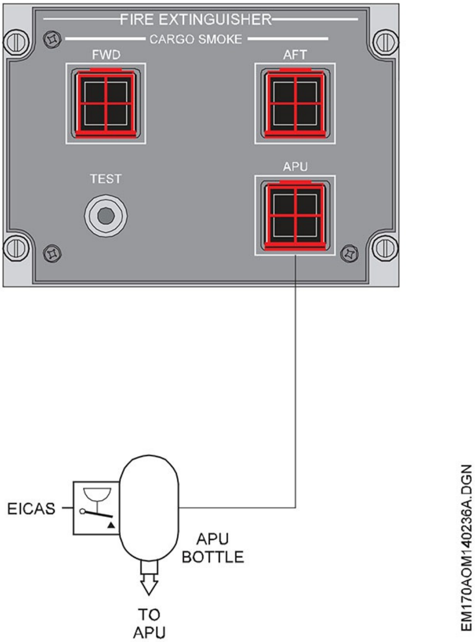
As soon as the APU EMER STOP pushbutton is pressed the red striped bar is replaced by the white striped bar, indicating that the APU has shut down. After the APU EMER STOP pushbutton is pressed, the APU fire extinguisher pushbutton illuminates entirely red. Pressing the APU fire extinguisher pushbutton discharges the extinguisher bottle. The APU fire extinguisher pushbutton illumination turns OFF when the fire input from the APU fire detectors disappears.

In case of fire and 1 min has passed without pressing the APU EMER STOP pushbutton, the APU fire extinguisher pushbutton illuminates. Pressing the APU fire extinguisher pushbutton, discharges the extinguisher bottle, shuts down the APU and turns OFF the red striped bar on the APU EMER STOP pushbutton.

APU AUTO SHUTDOWN

On ground, the APU will automatically shut down 10 seconds after the fire condition is present.

APU FIRE PROTECTION SYSTEM SCHEMATIC



APU FIRE PROTECTION SYSTEM SCHEMATIC

14.07.20 CARGO COMPARTMENT FIRE PROTECTION

CARGO COMPARTMENT FIRE PROTECTION SYSTEM

The forward and aft cargo compartments on the E-JETS are class C.

Both cargo compartments are protected by the CARGO SMOKE DETECTION SYSTEM and CARGO FIRE PROTECTION SYSTEM.

Both systems can generate EICAS messages to alert for malfunctions.

CARGO COMPARTMENT SMOKE DETECTION

Each cargo compartment has an independent smoke detection system.

The forward cargo compartment has 3 (E175) or 4 (E190) smoke detectors.

The aft cargo compartment has 2 (E175) or 3 (E190) smoke detectors.

The system is monitored by a periodic built-in test, generating the associated alarms and EICAS messages.

After smoke detection in the forward compartment, the air circulation fan in the forward compartment automatically turns off and the ventilation outflow valve closes.

SYSTEM INDICATIONS

AURAL

- Aural warning.

LIGHTS

- The master WARNING lights flashing;
- The associated cargo compartment extinguishing button illuminates.

EICAS

- CRG AFT SMOKE;
- CRG FWD SMOKE.

SYSTEM AUTOMATION

FORWARD CARGO COMPARTMENT

Because of the capability to carry live animals in the forward cargo compartment a ventilation system is installed and must be turned off in case of smoke or fire inside the forward cargo compartment.

After fire or smoke is detected in the forward cargo compartment the following actions are automatically commanded by the system:

- Air circulation fan is turned off;
- The high-rate fire extinguishing bottle is armed and;
- The forward cargo compartment ventilation outflow valve is commanded closed.

AFT CARGO COMPARTMENT

After fire or smoke is detected in the aft cargo compartment the following action is automatically commanded by the system:

- The high-rate fire extinguishing bottle is armed.

CARGO COMPARTMENT FIRE EXTINGUISHING

The Cargo Fire Extinguishing System is comprised of:

- One high-rate extinguisher bottle and;
- One low-rate extinguisher bottle.

Both extinguisher bottles are installed in the center avionics bay and used in either forward or aft cargo compartment.

ANNUNCIATED FIRE EXTINGUISHING

After the annunciation of smoke detection in the cargo compartment, pressing the associated cargo compartment button causes:

- the high-rate fire-extinguishing bottle to discharge immediately into the selected cargo compartment.
- the EICAS STATUS message CRG FIREX HI DISCH to display.

One minute later, the second fire-extinguishing bottle discharges automatically at a reduced flow rate and the agent remains in the selected cargo compartment for 75 minutes for airplanes with 60-minute diversion time allowed.

NOTE:
- Pressing the associated pushbutton before the one-minute period immediately discharges the low-rate extinguishing bottle.
- In case of fire on ground, the low-rate fire-extinguishing bottle is not automatically discharged. The flight crew must push the cargo fire-extinguishing pushbutton once again to discharge the low-rate bottle.
- After a discharge event, when the airplane is on ground, the message CRG FWD (AFT) SYS FAIL may display on EICAS.

CARGO COMPARTMENT FIRE EXTINGUISHING - WITH MESSAGE		
BOTTLE DISCHARGE	**HIGH-RATE BOTTLE**	**LOW-RATE BOTTLE**
In-flight	Push the button once	Automatic after 1 minute
On-ground	Push the button once	Push the button once

NON-ANNUNCIATED FIRE EXTINGUISHING

The system can be used even without a cargo smoke warning. In this case, the high-rate bottle is armed by pushing the respective cargo fire extinguisher button and is indicated by the red button light and the associated EICAS message. If the button is pushed again within the next two minutes, the high-rate bottle is discharged. At this time the low-rate bottle is armed. In case the flight crew does not push the button within the next two minutes, the system is reset and the high-rate bottle will not discharge.

NOTE: After a discharge event, when the airplane is on ground, the message CRG FWD (AFT) SYS FAIL may display on EICAS.

In flight, the second bottle will automatically discharge after one minute. On ground, the automatic timer feature for discharge of FIREX LO is disabled, however FIREX LO remains armed and can be manually discharged by depressing the appropriate button.

CARGO COMPARTMENT FIRE EXTINGUISHING - WITHOUT MESSAGE		
BOTTLE DISCHARGE	**HIGH-RATE BOTTLE**	**LOW-RATE BOTTLE**
In-flight	Push the button twice	Automatic after 1 minute
On-ground	Push the button twice	Push the button once

14.07.25 LAVATORY FIRE PROTECTION

LAVATORY FIRE PROTECTING SYSTEM

The Lavatory Smoke Detection and Fire Extinguishing Systems protect the forward and aft lavatories. Each lavatory has a dedicated fire protection system.

LAVATORY SMOKE DETECTION

The Lavatory Smoke Detection System consists of one smoke sensor installed on each lavatory ceiling.

If smoke is detected in either lavatory:

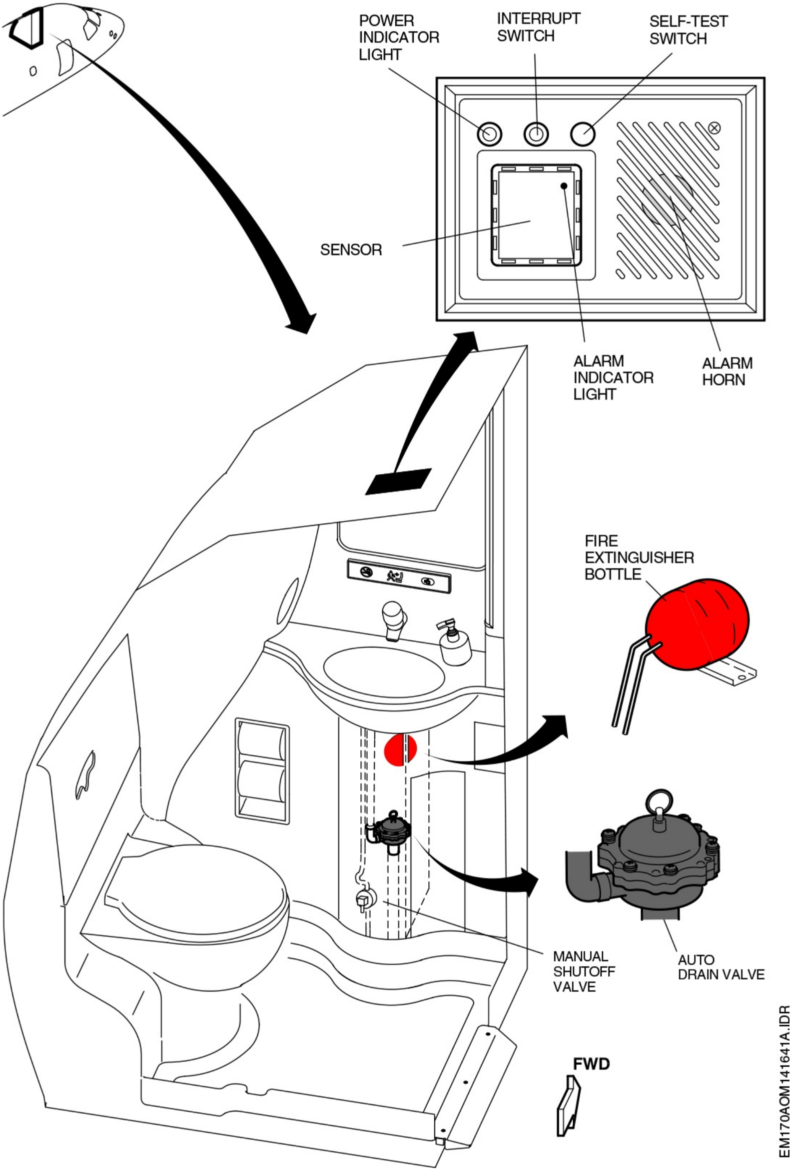
- the master WARNING lights illuminates.
- the EICAS WARNING message LAV SMOKE is displayed.
- In the lavatory where the smoke has been detected an alarm sounds and the smoke detector light comes on.
- a flashing orange light on the respective attendant lights panel (rainbow lights) illuminates.

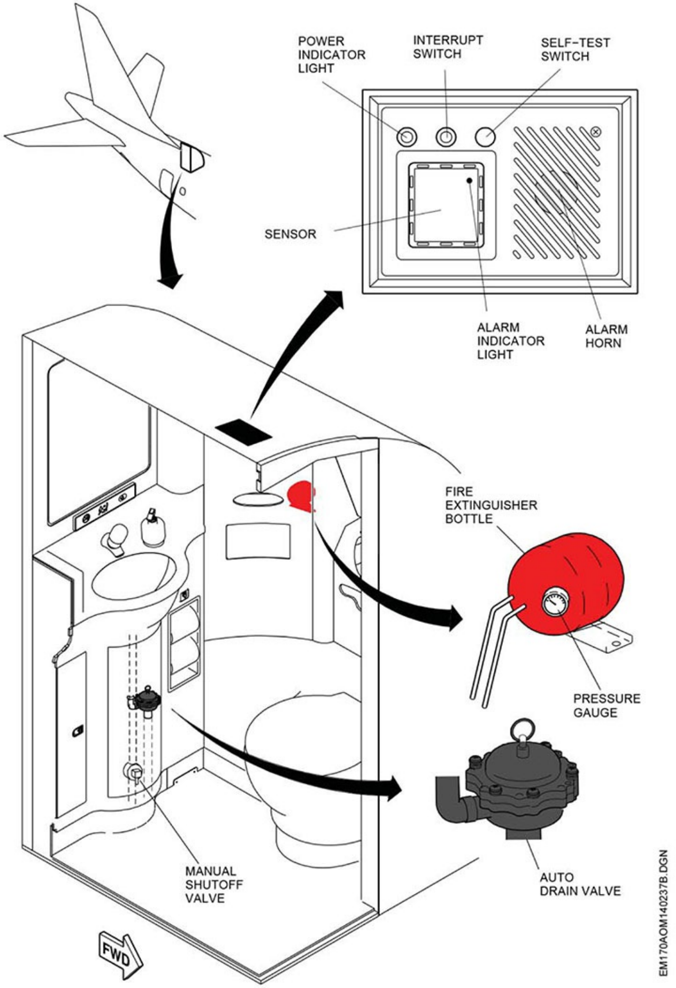
LAVATORY FIRE EXTINGUISHING

The Fire Extinguishing System consists of one fire-extinguisher bottle installed on each lavatory waste container.

When the temperature inside the waste container exceeds a certain limit, the system automatically discharges the extinguishing agent. If required, the flight attendant can suppress the fire by using a portable fire extinguisher.

LAVATORY DETECTORS AND EXTINGUISHERS LOCATION

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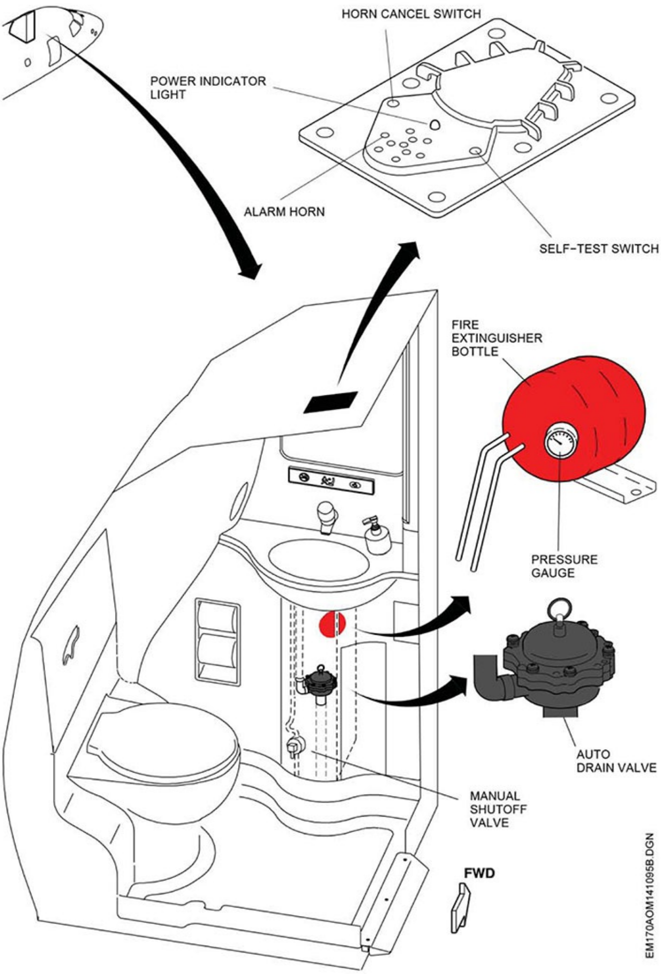
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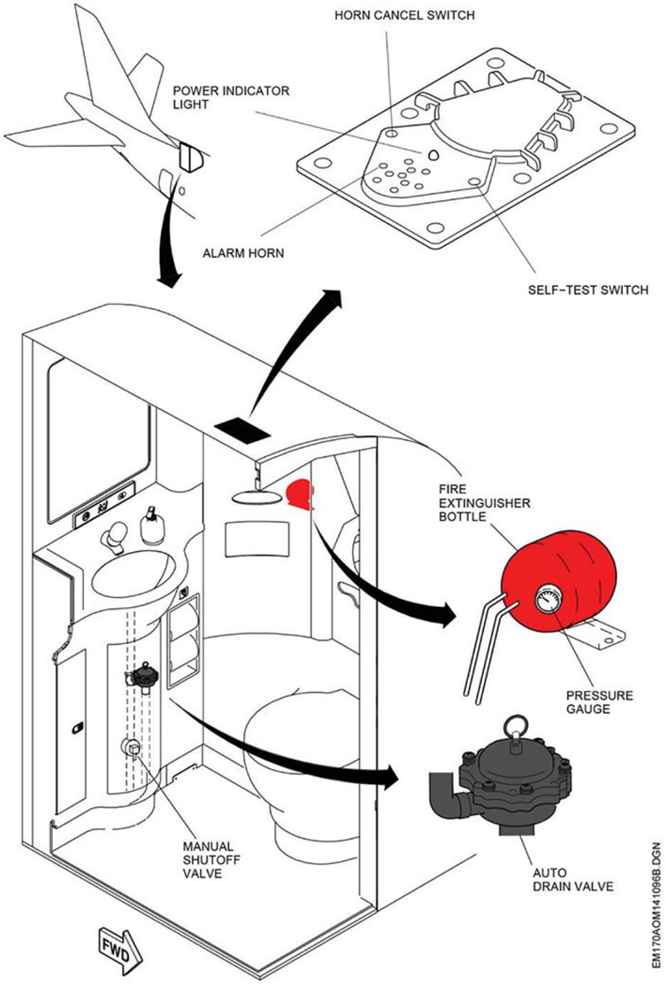
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SELF-TEST SWITCH
FIRE EXTINGUISHER BOTTLE
PRESSURE GAUGE
MANUAL SHUTOFF VALVE
AUTO DRAIN VALVE
FWD
EM170AOM141096B.DGN

14.07.30 FIRE DETECTION SYSTEM TEST

The fire detection test button on the control panel provides a manual test for the following systems:

- Engine fire detection;
- APU fire detection;
- Cargo smoke detection.

When the TEST button on the fire protection panel is pressed, it initiates the following:

AURAL

- The fire aural warnings to sound.

LIGHTS

- The master WARNING light to flash.
- The fire extinguisher handles to steady illuminate.
- The cargo fire-extinguishing buttons to steady illuminate.
- The APU fire-extinguishing button and the upper half of the APU emergency stop button to illuminate.

EICAS MESSAGES

- ENG 1 FIRE;
- ENG 2 FIRE;
- APU FIRE;
- CRG AFT SMOKE;
- CRG FWD SMOKE.

EICAS INDICATIONS

- The FIRE warning light on the ITT indicator to illuminate.

SYSTEM CONFIGURATIONS

- The forward cargo compartment fan to turn off
- The cargo compartment ventilation outflow valve to close – only when bleed air is being provided by the engines or the APU.

CAUTION: IF THE FIRE DETECTION TEST BUTTON IS PRESSED FOR 10 SECONDS, THE APU WILL SHUTDOWN.

14.07.35 EICAS MESSAGES

TYPE	MESSAGE	MEANING
WARNING	APU FIRE	A fire condition has been detected in the APU.
	CRG AFT (FWD) SMOKE	Smoke has been detected in the associated cargo compartment.
	ENG 1 (2) FIRE	A fire condition has been detected in the associated engine.
	LAV SMOKE	Smoke has been detected in the lavatory.
CAUTION	APU FIRE DET FAIL	APU fire detection system has failed.
	APU FIREX FAIL	APU fire-extinguisher bottle has failed.
	CRG AFT (FWD) FIRE SYS FAIL	All smoke detectors have failed in the associated compartment, or Pressure in any extinguisher bottle is low and the cartridges are intact, or any of the cartridge circuits are opened.
	ENG 1 (2) FIRE DET FAIL	Engine fire detection system has failed.
	LAV SMOKE DET FAIL	Lavatory smoke detection system has failed.
ADVISORY	APU FIREXBTL DISCH	APU fire-extinguisher bottle has been discharged.
	CRG FIRE PROT FAULT	Failures of smoke detectors in a Cargo Compartment or any SPDA internal failure, which does not render the smoke detection completely inoperative.
	CRG FWD (AFT) FIREX HI ARM	High rate Cargo Firex system armed either automatically or manually.
	CRG FWD (AFT) FIREX LO ARM	Low rate Cargo Firex system armed after High rate bottle discharged.
	ENG 1 (2) FIREXBTL A (B) FAIL	Associated fire-extinguisher bottle has failed.
	ENG FIREXBTL A (B) DISCH	Associated fire-extinguisher bottle has been discharged.
STATUS	CRG FIREX HI (LO) DISCH	Cargo high-rate (low-rate) discharge fire-extinguisher bottle has been discharged.

14.08.01 GENERAL DESCRIPTION

The Flight Control System is comprised of the primary and the secondary flight control systems and their associated system components.

The primary flight control system consists of:

- Ailerons and the multi function roll spoilers for roll axis control.
- Elevators for pitch axis control.
- Rudder for yaw axis control.

The secondary flight control system consists of:

- Horizontal stabilizer.
- Flaps and Slats.
- The multi-function spoiler (when used as speed brakes or ground spoilers).
- Dedicated ground spoilers.

Hydraulic actuators control the respective flight control surfaces. These are referred to as Power Control Units (PCUs).

The ailerons are commanded by conventional control cables that run from each control wheel back to a pair of hydro-mechanical actuators.

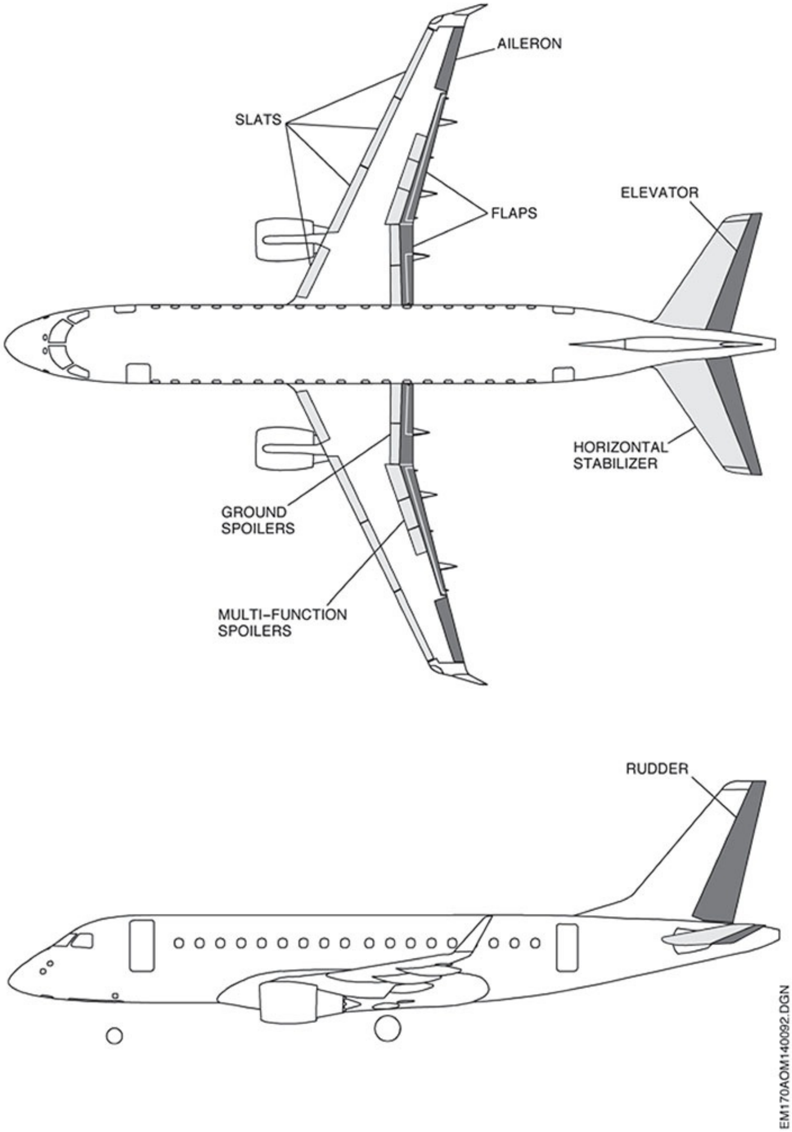
Elevators, rudders, roll spoilers as well as all secondary flight control systems, including the horizontal stabilizer, flaps and slats, ground spoilers and speed brakes, are controlled electronically using Fly-by-Wire (FBW) technology.

The primary flight control electronics include two complementary parts:

- The Primary Actuator Control Electronics (P-ACE).
- The Flight Control Module (FCM).

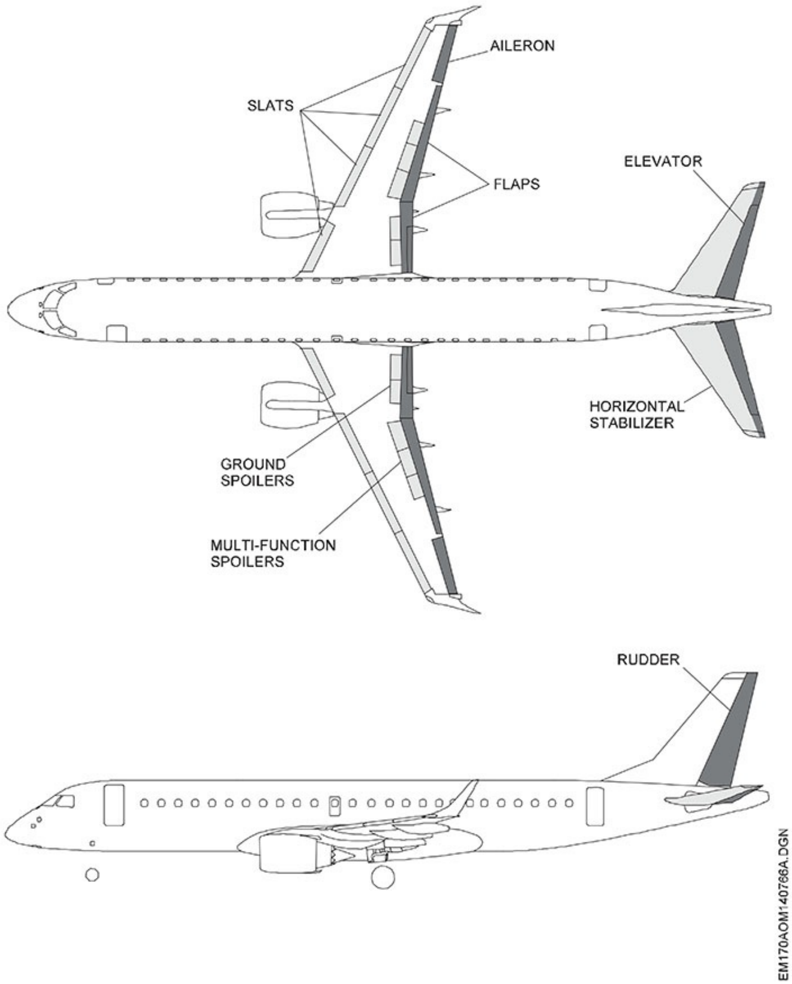
Primary Actuator Control Electronics (P-ACE) and/or Flight Control Modules (FCM) are employed to operate the respective electro-hydraulic or electro-mechanical actuators.

E175:



CONTROL SURFACE LOCATION

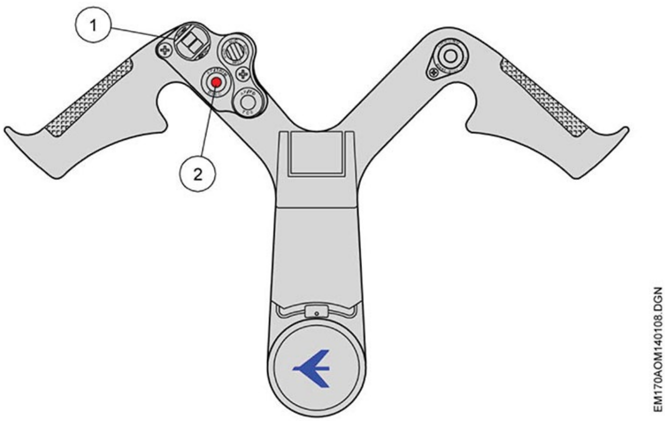
E190:



CONTROL SURFACE LOCATION

14.08.05 CONTROLS AND INDICATIONS

CONTROL WHEEL



1 – PITCH TRIM SWITCH (spring-loaded to neutral)

- Trims the airplane when the autopilot is not engaged.
- If only half of the switch is actuated for more than 7 s (E190) or 5 s (E175), the switch will be automatically deactivated.
- Manual PITCH TRIM Switch commands are limited to 3 s.

NOTE: Captain's pitch trim switch actuation has priority over the first officer's.

NOTE: Operation of the switch while the autopilot is engaged causes the autopilot to disengage.

2 – AP/TRIM DISC BUTTON

TRIM

- When pressed, disconnects the autopilot and stops any active trim command (Pitch, Roll, and Yaw).

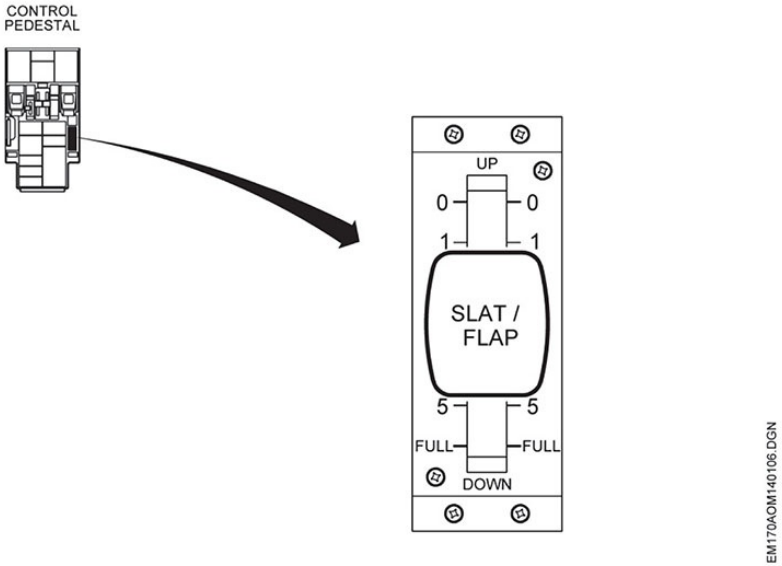
NOTE: The PITCH TRIM FAIL Caution EICAS message is displayed when the AP/TRIM DISC Button is pressed for more than 11 s.

- When released, the trim capability (Pitch, Roll, and Yaw) is restored.
- When any of the Pitch Trim SYS CUTOUT Button is pushed in, the respective AP/TRIM DISC Button PITCH TRIM DISC function is unavailable.

AUTOPILOT

Refer to Automatic Flight.

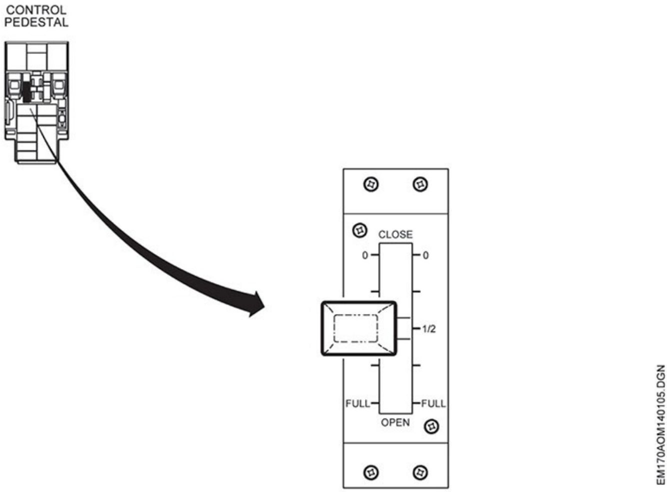
SLAT/FLAP SELECTOR LEVER



- Selects slat/flap position by unlatching the lever and lifting a trigger below the head.
- Intermediate positions are not enabled. If lever is left at an intermediate position, flaps/slats remain in the last selected position. Position 4 is gated for normal Go Around and Takeoff. Position 5 is used for landing.

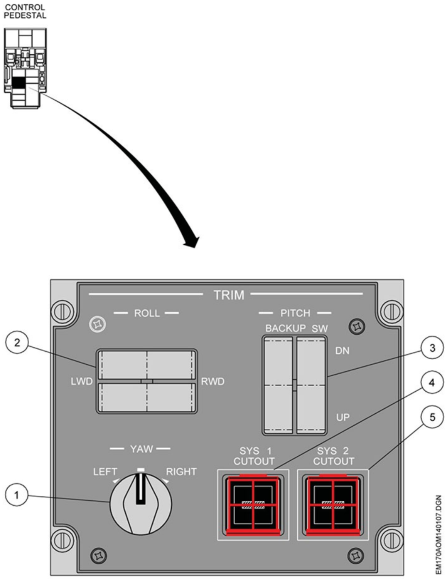
Lever position	Slat position	Flap Position		Detent/Gated
		E175	E190	
0	0º	0º	0º	Detent/Stop
1	15º	5º	7º	Detent
2	15º	10º	10º	Detent
3	15º	20º	20º	Detent
4	25º	20º	20º	Gated/Stop
5	25º	20º	20º	Detent
Full	25º	35º	37º	Detent/Stop

SPEED BRAKE LEVER



- Symmetrically deploys the multi-function panels. All multi function spoiler panels deploy at the same angle in response to the speed brake lever position.

TRIM PANEL



1 – YAW TRIM CONTROLLER (SPRING-LOADED TO NEUTRAL)

- Actuates the yaw trim to left or right.
- Manual pilot trim commands are limited to 3 s.

2 – ROLL TRIM SWITCH (SPRING-LOADED TO NEUTRAL)

- Actuates the roll trim to left or right.
- Manual pilot trim commands are limited to 3 s.

3 – PITCH TRIM BACK-UP SW SWITCH (SPRING-LOADED TO NEUTRAL)

- Operation of the switch while the autopilot is engaged causes the autopilot to disengage.
- Manual Pitch Trim BACKUP SW Switch commands are limited to 3 s.

4 – PITCH TRIM SYS 1 CUTOUT BUTTON (GUARDED)

PUSH IN: disables the HS-ACE channel 1 and the PITCH TRIM DISC function in the LH AP/TRIM DISC Button.

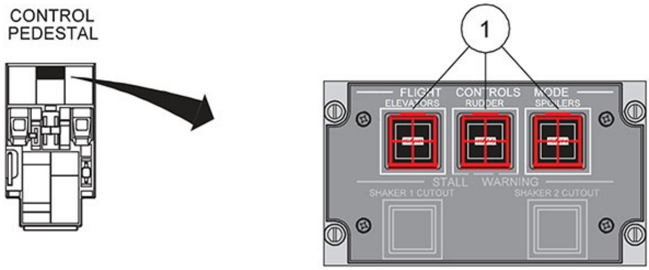
PUSH OUT: enables the HS-ACE channel 1 and the PITCH TRIM DISC function in the LH AP/TRIM DISC Button.

5 – PITCH TRIM SYS 2 CUTOUT BUTTON (GUARDED)

PUSH IN: disables the HS-ACE channel 2 and the PITCH TRIM DISC function in the RH AP/TRIM DISC Button.

PUSH OUT: enables the HS-ACE channel 2 and the PITCH TRIM DISC function in the RH AP/TRIM DISC Button.

FLIGHT CONTROLS PANEL



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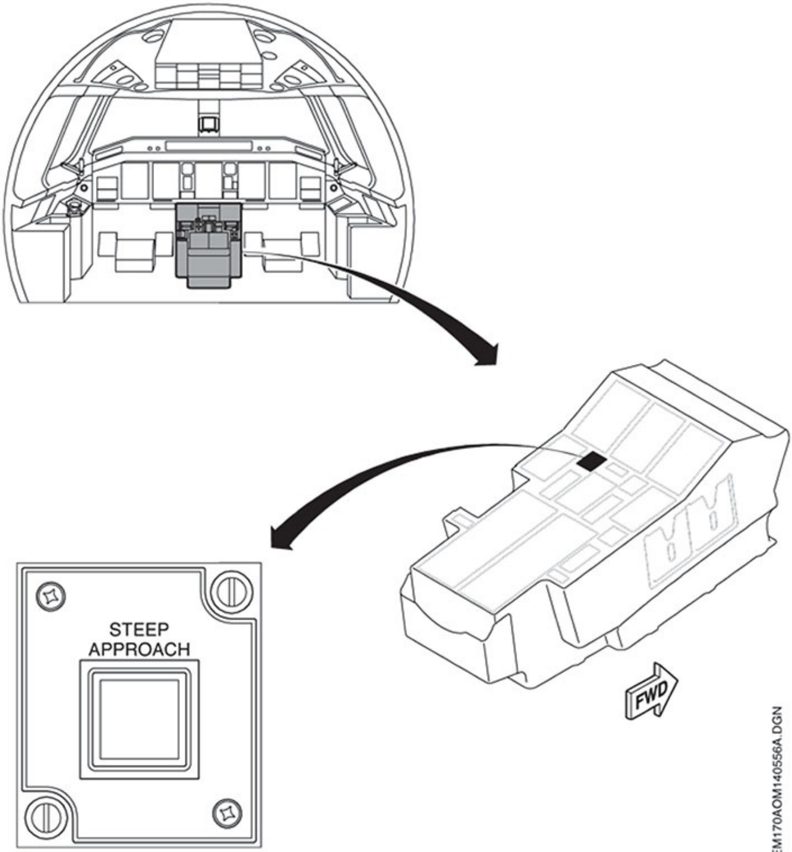
1 – FLIGHT CONTROLS MODE BUTTONS: ELEVATORS/RUDDER/SPOILERS (GUARDED)

PUSH IN: places the associated flight system into direct mode.

PUSH OUT: places the associated flight system into normal mode.

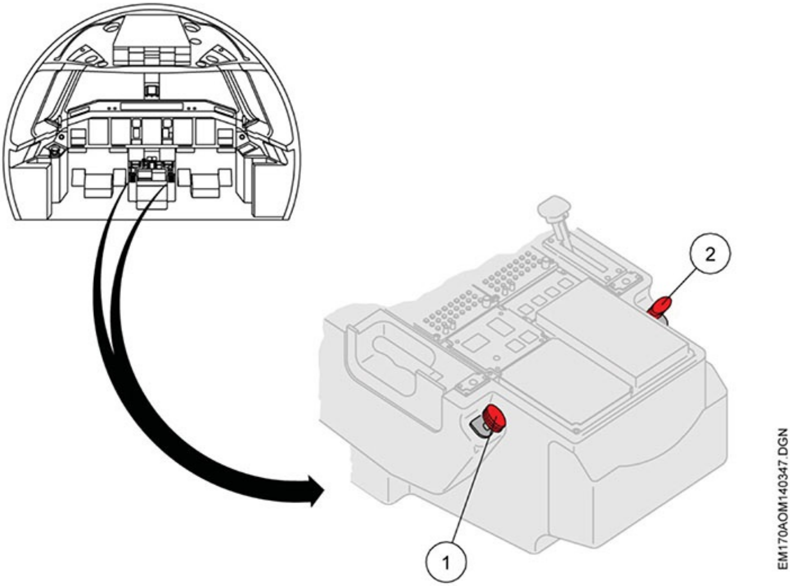
STEEP APPROACH BUTTON



1 – STEEP APPROACH BUTTON (SPRING-LOADED)

- Arms and disarms the Steep Approach Mode.

DISCONNECT HANDLE



1 – ELEVATOR DISCONNECT HANDLE

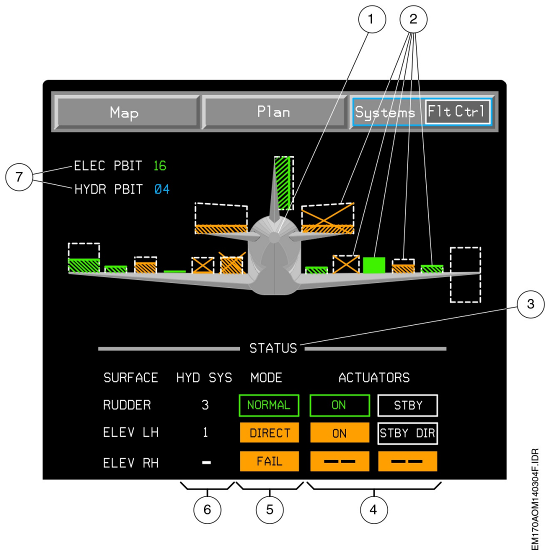
PULL: isolates the Captain and First Officer's control columns for elevator control.

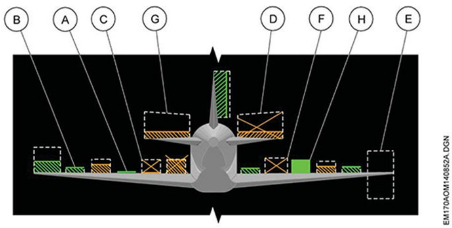
2 – AILERON DISCONNECT HANDLE

PULL: isolates the Captain and First Officer's control wheel for aileron control.

FLIGHT CONTROLS SYNOPTIC PAGE ON MFD

The flight controls synoptic page provides a visual representation of the flight control system operation and parameters, and can be selected by the flight crew for viewing on either MFD.





1 – AIRPLANE GRAPHIC

- A static display that shows the location of flight control surfaces, status of the flight control actuators and flight controls mode of operation.

2 – SURFACE POSITION STATUS

A. RETRACTED: a green line aligned with the wings, elevator or rudder.
B. DEPLOYED: a green line and the surface with green stripes. A white dashed box is shown only for surface position greater than 50% of its deflection.
C. FAILED RETRACTED: an amber line, a white dashed box and an amber cross.

D. FAILED DEPLOYED: white dashed box, surface with amber stripes and amber cross.
E. NOT AVAILABLE WITH NO FAIL INDICATION: shows a white dashed box for surfaces with deflection in one direction (e.g. spoilers) and two white dashed box for surfaces with deflection in two directions (e.g. ailerons).
F. NOT AVAILABLE WITH FAILURE INDICATION: shows a white dashed box and an amber cross for surfaces with deflection in one direction (e.g. spoilers) and two white dashed box and two amber crosses for surfaces with deflection in two directions (e.g. rudder).
G. DIRECT MODE: shows the surface with amber stripes. A white dashed box is shown only for surface position greater than 50% of its maximum deflection. As for flap zero the maximum surface deflection is about 50% of the full deflection, the white dashed box may not be shown, due to system tolerances.
H. FULL DEPLOYED: solid green box.

3 – FLIGHT CONTROL SYSTEM STATUS ANNUNCIATIONS

- The status annunciations are shown in a table format for three surfaces. Three surfaces are listed in a column labeled SURFACE: RUDDER, ELEV LH, and ELEV RH.

4 – ACTUATOR STATUS ANNUNCIATION

- The rudder has two actuators, upper and lower. Each left and right elevator surfaces have two actuators, inboard and outboard.
- NORMAL/ACTIVE: a green ON annunciation inside a green rectangle box.
- NORMAL/STANDBY: a white STBY annunciation inside a white rectangle box.
- DIRECT/STANDBY: a white STBY DIR annunciation inside a white rectangle box.
- DIRECT/ACTIVE: an ON annunciation presented in an amber rectangle box background.
- FAIL: a “—“ annunciation displayed in an amber rectangle box background.

5 – AXES MODE ANNUNCIATION

- Axes mode annunciations are shown for the rudder, the left and the right elevator. It is presented as NORMAL, DIRECT, FAIL or “-“, which indicates an invalid axes mode.

6 – HYDRAULIC SYSTEM SOURCE ANNUNCIATION

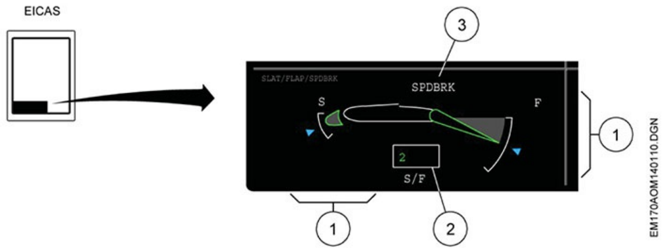
- Hydraulic system source annunciations are shown for the rudder, the left and the right elevator. It is presented as 1, 2, 3 or “-“, which indicates an invalid source.

7 – PBIT REMAINING TIME READOUT

- A digital remaining time readout displays the hours until the electrical and hydraulic PBIT expire.
- **E190:** If the value of the PBIT remaining time readout is higher or equal to 5, the numbers will be displayed in green, otherwise will be cyan. Invalid data will be represented by 2 dashes (“- -“) in amber.

EICAS INDICATIONS

SLAT/FLAP/SPEEDBRAKE INDICATION ON EICAS



1 – SLAT/FLAP POSITION

- Displays the slat/flap position. If the information is invalid, the indication will be removed from the display.

  GREEN: real-time surface position.
- The cyan pointers show the slat/flap commanded position and the green slat/flap depictions show actual slat/flap position. The flap scale has tic marks at each end, representing positions at 0º and 35º (E175) or 37º (E190) while the slat scale has tic marks at each end, representing positions at 0º and 25º.

2 – SLAT/FLAP READOUT

- Displays the slat/flap surface position. If the information is invalid, the indication will be removed from the display.

  GREEN DASHES: slat/flap in transit.

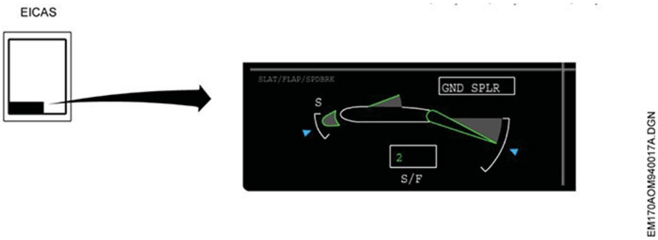
NOTE: In case of slat/flap surface jamming, an additional box will be displayed in amber, as well as the readout. Whenever two boxes are displayed the possible values are 0, 3 or FULL for the slats and 0, 1, 2, 4 or FULL for the flaps based on the value of the surface angle.

3 – SPEEDBRAKE INDICATION

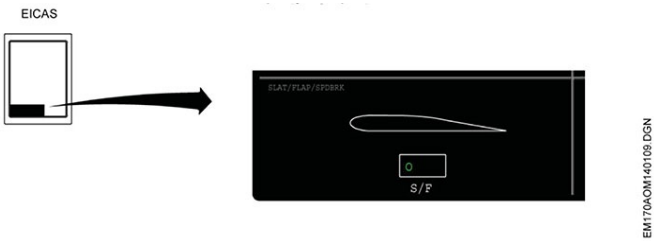
- Displays a white SPDBRK annunciation when airborne.

  AMBER BOXED: in case of failure.

NOTE: An OPEN and GREEN speedbrake position indication and a white GND SPLR annunciation display on EICAS after airplane touchdown when one of the Ground Spoiler panels open.

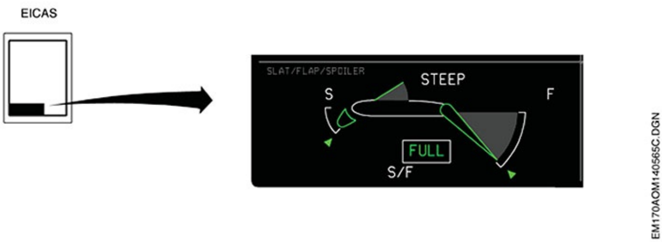


NOTE: For SLAT/FLAP/SPDBRK position 0 the legend and arrows will be removed from the display as presented below:

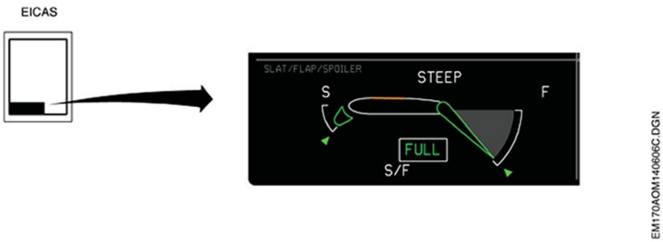


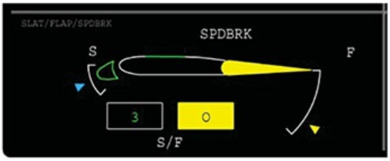
NOTE: If SLAT/FLAP surface stops in an intermediate position, the SLAT/FLAP READOUT will display the more retracted surface position. As an example, if flap fails between positions 2 and 3, the EICAS will indicate position 2. The FLAPS or SLATS indication 0 in amber indicate the surface may between 0 and 1. Thus maximum altitude for flaps extended (20000 ft) must be respected.

NOTE: An OPEN and GREEN speedbrake position indication and a white STEEP annunciation display on EICAS when the Steep Approach Mode is engaged:

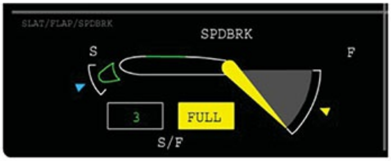


NOTE: An OPEN and GREEN speedbrake position indication and a white STEEP annunciation display on EICAS when the Steep Approach Mode is engaged:

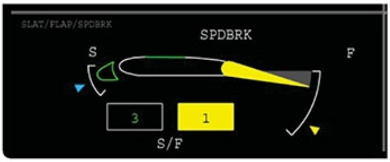




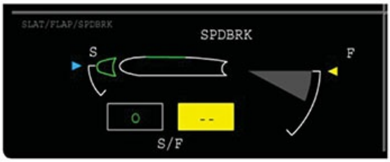
FLAP FAIL IN 0



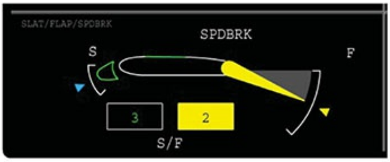
FLAP FAIL IN FULL



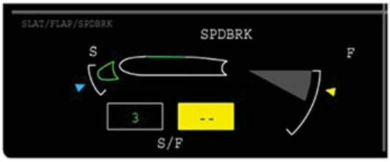
FLAP FAIL IN 1



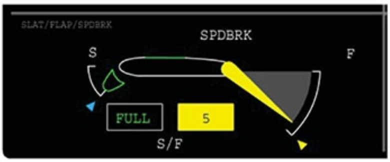
FLAP DATA INVALID OR UNAVAILABLE WHEN SLAT/ FLAP LEVER IS IN ZERO POSITION



FLAP FAIL IN 2



FLAP DATA INVALID OR UNAVAILABLE WHEN SLAT/ FLAP LEVER IS NOT IN ZERO POSITION



FLAP FAIL IN 5

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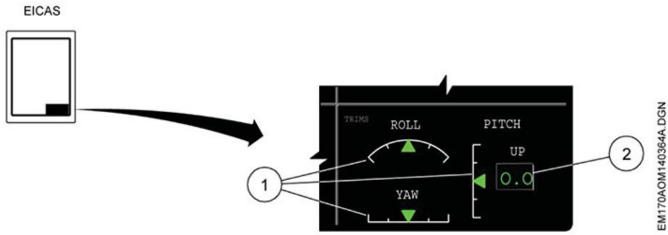
OVERALL DISPLAY SITUATION

ROLL/PITCH/YAW TRIM INDICATION ON EICAS



1 – ROLL/PITCH/YAW TRIM SCALE

- Trim position configuration is indicated by a solid green pointer in the scale.
- There are five tic marks displayed along the roll and yaw scale, positioned at –100%, –50%, 0%, 50%, 100%.
- E175: There are five tic marks displayed along the pitch trim scale, positioned at 2º DOWN and 1.75º, 5.5º, 9.25º, and 13º UP. There is a green takeoff band on the scale extending from 1º UP to 6º UP, corresponding to the allowable pitch trim position for takeoff.

  E190: There are five tic marks displayed along the pitch trim scale, positioned at 4º and 0.25º DOWN, 3.5º, 7.25º, and 11º UP. There is a green takeoff band on the scale extending from 2º DOWN to 4º UP, corresponding to the allowable pitch trim position for takeoff.

2 – PITCH TRIM DIGITAL READOUT

- Digital indication of the horizontal stabilizer trim position in tenths of a degree increments.
- An UP or DN indication displays above or below the readout according to the trim set.

AMBER DASHES: pitch trim indication is invalid.

14.08.10 FCS DESCRIPTION

FLY BY WIRE COMPONENTS

Fly-by-wire is an electronic system designed to operate the flight controls replacing the control cables of a conventional airplane.

The Embraer FBW system is composed of a set of nine Actuator Control Electronics (ACEs) and four Flight Control Modules (FCMs):

- Three Primary-ACEs (P-ACE).
- Two Slat/Flap ACEs (SF-ACE).
- One Horizontal Stabilizer ACE (HS-ACE).
- Three Spoiler ACEs (S-ACE).
- Four Flight Control Modules (FCM).

ACTUATOR CONTROL ELECTRONICS (ACE)

The ACE units connect the control column electronically to the respective control surface, providing direct analog control of the surface.

There are four different ACE units:

PRIMARY CONTROL ELECTRONICS (P-ACE)

The P-ACE units control the rudder and the elevator surfaces.

There are three P-ACE units, two installed in the forward electronics bay and one installed in the aft electronics bay.

Each P-ACE has two channels; one is the active and the other is the standby.

SLAT/FLAP ACTUATOR CONTROL ELECTRONICS (SF-ACE)

The SF-ACE units control the slat and flaps surface.

There are two SF-ACE units installed in the middle electronics bay.

Each SF-ACE has two channels; one channel for flap and one channel for slat.

HORIZONTAL STABILIZER ACTUATOR CONTROL ELECTRONICS (HS-ACE)

The Horizontal Stabilizer ACE (HS-ACE) is installed in the aft electronics bay.

The HS-ACE unit controls the horizontal stabilizer surface.

The HS-ACE has two channels that operate in active/standby configuration. The active channel changes daily. As long as one channel is operational, automatic and manual trim (via LH, RH, and BACKUP Pitch Trim Switches) are available.

SPOILER ACTUATOR CONTROL ELECTRONICS (S-ACE)

The S-ACE resides within the FCMs and is used to control the multifunction spoilers. Each FCM controls one pair of multi-function spoiler.

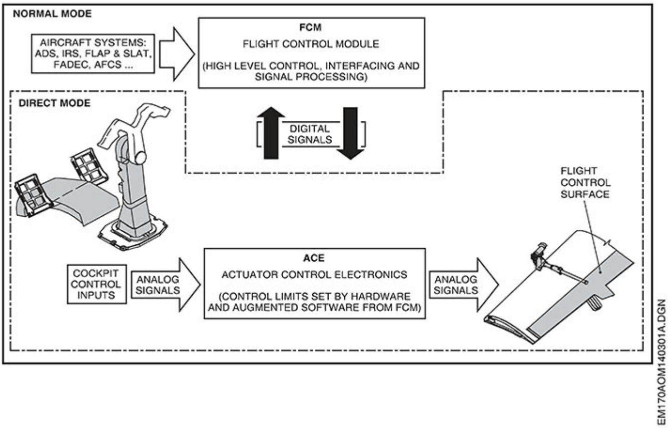
FCM #1, FCM #3 and FCM #4 have wiring to control spoilers. FCM #2 does not control any spoiler pair.

FLIGHT CONTROL MODULES (FCM)

The FCMs provide software-based assistance to the P-ACE and are required for normal-mode operation of the Flight Control System.

The FCM units are connected to the P-ACE via the Controller Area Network Bus (CAN BUS), providing digital inputs to the P-ACE, which are combined with pilot inputs. This is used to augment pilot inputs for different airspeeds and provides other high-level functions such as Angle-Of-Attack (AOA) limiting to the P-ACE units.

FCM 1 and 2 are located in the Modular Avionics Units # 1 (MAU 1) and FCM 3 and 4 are located in the Modular Avionics Unit # 3 (MAU 3).



FLY-BY-WIRE SCHEMATIC

MODES OF OPERATION

The Flight Control System provides two basic modes of operation:

- NORMAL MODE: The Flight Control Module (FCM) provides software based airspeed gain schedules and control limits to the P-ACE, as well as high level functions such as:
  - Elevator control laws scheduling with airspeed;
  - Auto-thrust compensation with elevator;
  - Angle-Of-Attack (AOA) limiting with elevator offset;
  - Rudder airspeed gain scheduling and stroke limiting;
  - Yaw damper and turn coordination via AFCS;
  - Rudder flight authority;
  - Roll spoiler scheduling with airspeed and speedbrake deployment;
  - E175: Configuration change compensation with horizontal stabilizer due to speed brakes actuation;
  - E190: Configuration change compensation with elevators and horizontal stabilizer due to landing gear, flap/slat and speed brakes actuation;
  - E190: Mach Trim as a function of Mach number.
- DIRECT MODE: The FCM is removed from the control loop (for instance, due to loss of airspeed data) and the control limits default to values set by hardware in the P-ACE.
  - Direct mode of operation is primarily the result of loss of data from all FCMs (no airspeed input) or multiple ACE failures.
  - Operation is defaulted to fixed control laws configuration.
  - Control input provided by Captain and First Officer’s sensors is sent directly to the surface.

NORMAL MODE VS DIRECT MODE SELECTION

The mode selection is automatic when a channel failure is detected or manually selected by using a “Mode Select” switch on the Flight Control Panel.

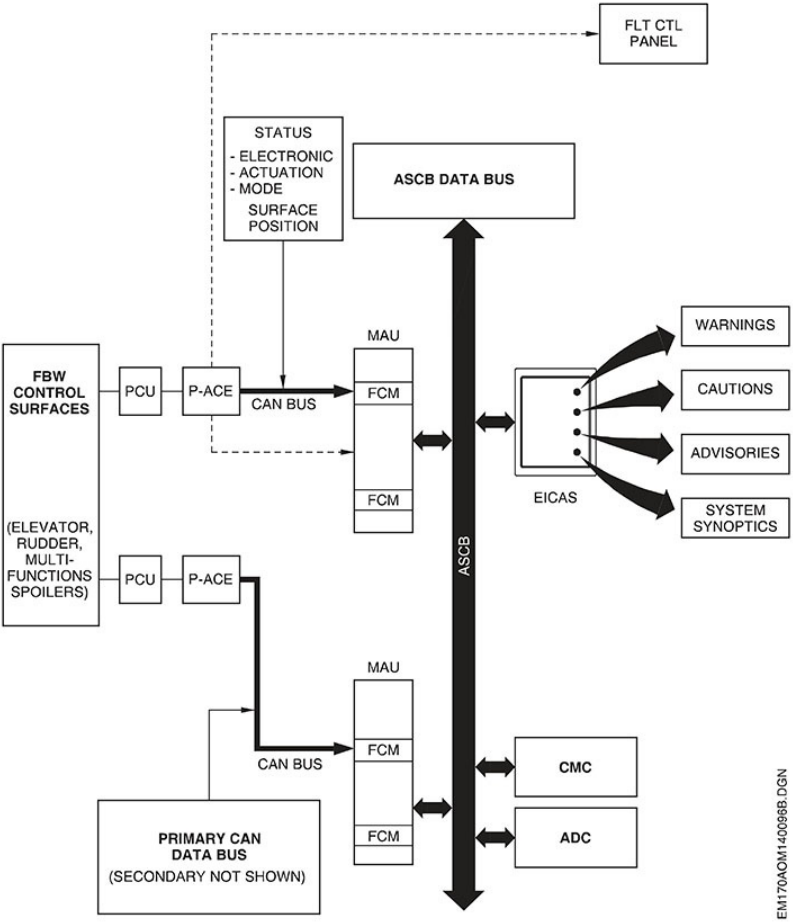
The “Mode Selection” switch provides the capability to the flight crew to reset the system to Normal Mode in case of the system defaulting to Direct Mode, or to manually default the flight control system to Direct Mode in case of a wrong gain computed by the FCMs being transmitted to the P-ACEs or S-ACEs. In this case the “Mode Selection” switch toggles the Normal Channel of the active P-ACE to the Direct Channel of the standby P-ACE.

The pilot always has supreme control authority of the airplane since the FCMs cannot override a pilot input.

FCM, P-ACE AND AIRPLANE LEVEL COMMUNICATION

The Controller Area Network BUS (CAN BUS) is the communication link between the FCMs and the P-ACE units while the Avionics Standard Communication Bus (ASCB) provides data exchange between all FCMs and with other components of the avionic system. The following systems provide data to the flight controls system:

- Smart probes and the Air Data Application (ADA) modules provide air data for various airspeed augmentation commands.
- The IRS provides airplane attitude and accelerations to the FCMs used for AOA limiting function computation.
- The Proximity Sensor Electronic Module (PSEM) provides Weight-On-Wheels (WOW) and ground spoiler position data to the FCMs.
- Brake Control Modules (BCM) provide wheel speed signals used for ground spoiler deployment.
- The FADEC provide Thrust Lever Angle (TLA) to the FCMs used for elevator thrust compensation, and the Automatic Flight Control System (AFCS) provides autopilot commands.
- Data is shared for the EICAS to display warnings, cautions, advisories and system status and is also provided to the central maintenance computer (CMC) for system diagnostics.



AIRPLANE COMMUNICATION INTERFACE

POWER UP BUILT IN TEST (PBIT)

The Power Up Built in Test (PBIT) reduces the flight control system exposition to latent faults, ensuring that the system components remain capable of executing their functions.

The PBIT is provided for both the Electrical and Hydraulic systems.

The PBIT expires after 50 hours (elapsed time) since the last successful PBIT. Once the PBIT is expired, FLT CTRL BIT EXPIRED EICAS CAUTION message is displayed. This EICAS CAUTION message is provided for both Electrical PBIT and Hydraulic PBIT. The message remains displayed on EICAS until a new Electrical or Hydraulic PBIT is successfully performed.

No action is required if the PBIT expires in-flight, as the EICAS CAUTION message will only be displayed after landing.

ELECTRICAL POWER UP BUILT IN TEST

The Electrical PBIT provides detection of out-of-tolerance conditions and failures in the FCMs, P-ACEs and SF-ACEs.

The Electrical PBIT is automatically performed during power up after the airplane is powered by any AC source and takes approximately 3 min to complete. If the FLT CTRL BIT EXPIRED message is displayed, the electrical built in test must be performed.

The FLT CTRL TEST IN PROG Status message is displayed while electrical PBIT is in progress.

If the airplane is already powered up, the crew may check the PBIT REMAINING TIME READOUT before starting the taxi out procedure. If the remaining time is sufficient for the taxi and takeoff, the crew may elect to reset the PBIT on the next flight.

The Electrical PBIT will be interrupted if any electric hydraulic pump is turned ON, if the FCP switches are cycled or if AC power is interrupted while the test is running.

HYDRAULIC POWER UP BUILT IN TEST

The Hydraulic PBIT provides functional test of the flight control actuators.

The Hydraulic PBIT is performed automatically, only on the ground when all three hydraulic systems are pressurized.

The test takes 1 minute to complete and will be interrupted if any flight control surface is moved while the test is in progress.

The FLT CTRL TEST IN PROG Status message is displayed while hydraulic PBIT is in progress.

The Hydraulic PBIT is not performed if the temperatures within the hydraulic reservoir are lower than 10°C. When FLT CTRL BIT EXPIRED is set the temperature-based inhibition is removed.

The Hydraulic PBIT does not unintentionally re-run in case of momentary loss of hydraulic validity or hydraulic pressure on a single hydraulic system. To re-run the Hydraulic PBIT all three hydraulic systems must be depressurized and then pressurized.

FLIGHT CONTROLS ODD-EVEN DAY ENGAGE CONFIGURATION

For the rudder, elevator and stabilizer control surfaces which have two controlling channels, the flight control system has a function to select which set of channels would be the active channels for a particular day.

This function, called the 'Odd-Even Day Engage' configuration is implemented to reduce the latency in the flight control system and to allow for even wear of the flight control system components.

The 'Odd-Even Day Engage' function provides the following selection grouping for the rudder, elevator and horizontal stabilizer surfaces which can be viewed in the flight controls synoptic page on either MFD.

	ODD	EVEN
Rudder	Upper Channel Hydraulics 1	Lower Channel Hydraulics 3
Left Elevator	Inboard Channel Hydraulics 2	Outboard Channel Hydraulics 1
Right Elevator	Outboard Channel Hydraulics 3	Inboard Channel Hydraulics 2

During normal operation, the Odd-Even Day Engage function may engage in a different configuration from that shown above. If this scenario occurs, no maintenance action will be required to release the airplane for service unless there is a CAS message related to the flight controls system.

FLY BY WIRE (FBW) BACKUP BATTERY

In case of an extremely improbable failure that would render complete loss of normal and emergency electrical power to the FBW, the backup power system, with no pilot intervention, keeps the appropriate number of elevator and rudder actuators operating for at least 15 min. There is no dedicated message to indicate the failure of this system; therefore there is no flight crew action required if this happens.

This backup system is comprised by a dedicated battery, distribution bus and circuit breakers.

The backup battery is charged by the DC ESS 3 bus during normal operation and consists of sealed lead acid cells with built-in-test (BIT) capability and an internal heater that guarantees the minimum battery temperature.

Although the battery is connected to the airplane buses, the use of an internal rectifier keeps it from powering back the buses, assuring isolation in case of failure in the main electrical power system.

14.08.15 PITCH CONTROL

Pitch axis control is by means of electro-hydraulic commanded elevators and an electro-mechanical horizontal stabilizer.

ELEVATOR CONTROL SYSTEM

Pilot's inputs to the elevators are through the cockpit control columns in normal or direct mode. The elevators can be automatically controlled through the FCM via the autopilot.

ELEVATOR CONTROL SYSTEM COMPONENTS

A total of four P-ACE channels are used to independently control each of the four PCUs, providing the analog elevator control functions implemented in the P-ACE units.

Four independent FCM units, located in the MAU 1 and 3, provide high-level system augmentation to the P-ACE units, such as gain scheduling as a function of airspeed, elevator thrust compensation and AOA limiting.

ELEVATOR CONTROL SYSTEM OPERATION MODE

- NORMAL MODE: With the elevator control system operating in normal mode, the elevator moves according to gain scheduling as a function of airspeed, reducing elevator movement with increasing airspeeds. In the event of loss of airspeed information, the FCM is removed from the control loop, and the associated P-ACE reverts to direct mode. FCM functions and AOA limiting are then no longer available.
- DIRECT MODE: When the FCM is removed from the control loop the elevator system is reverted to direct mode automatically and the operation is defaulted to fixed control laws configuration.

  Elevator high level functions as well as the auto pilot are no longer available.

POWER CONTROL UNIT (PCU)

The elevator surfaces are hydraulically actuated through the PCU units.

The hydraulic systems responsible for powering the actuators are:

- Hydraulic System 1: left outboard actuator.
- Hydraulic System 2: left & right inboard actuators.
- Hydraulic System 3: right outboard actuator.

Since the actuators on each surface operate on active/standby mode, the P-ACE automatically alternates the active actuator every time the elevator system is powered up. The loss of hydraulic supply forces the standby PCU to become active.

ELEVATOR JAM

If a jam in one of the elevator actuators is detected, the respective elevator surface will remain fixed at the position where the jam occurred. The pilot will be able to control the airplane using the remaining elevator.

ELEVATOR FLIGHT CONTROL PANEL BUTTON

A dedicated button on the Flight Control Mode panel provides the capability to the pilots to reset the elevator system to Normal Mode in case of the system defaulting to Direct Mode, or to manually default the elevator system to Direct Mode.

When the flight control panel elevator button is pushed in, it commands all four elevator channels to change from Normal to Direct mode. In addition, pushing the button also results in the active elevator channels transitioning to the standby state, and the channels that were previously in standby would become active. This feature is also included to allow the system to transition away from the present controlling channels.

When the flight control panel elevator button is pushed out, the system reverts to the Normal Mode.

ELEVATOR THRUST COMPENSATION FUNCTION (ETC)

This function helps to reduce the pilot workload by applying elevator commands to reduce the pitching moment produced by increasing or decreasing engine thrust. The ETC function is computed in the FCM as a function of N1, mach and pressure altitude. Elevator command is limited to plus or minus 5°, and is applied proportional to the amount of engine thrust above or below the reference thrust setting.

If one or more sensors required to perform the ETC function fail, the function is no longer available and the respective message will be displayed on the EICAS.

For long term control, ETC commands are off-loaded in order to transfer the elevator offset to the stabilizer. This function termed 'ETC Off-load' allows the elevator to retain full authority, while providing elevator control to maintain flight path condition in the presence of thrust changes.

TAIL STRIKE AVOIDANCE (TSA) – E190 ONLY

Tail Strike Avoidance (TSA) function is a fly-by-wire feature designed to help in avoiding tail strike occurrences during takeoffs and landings.

TSA function controls airplane pitch angle by reducing control column authority in the nose up direction. The maximum pitch angle that can be achieved by the airplane is a function of height above ground level (HAGL), measured at the main landing gear wheel. HAGL calculation depends on:

- Landing: HAGL calculated via two radio altimeters.
- Takeoff: estimated HAGL by means of the vertical speed.

The authority of TSA function depends on whether in takeoff or landing configuration.

TAKEOFF OPERATION

The TSA function will be ENABLED for takeoff at estimated altitudes less than 20 ft.

In order to correct airplane attitude by reducing its pitch rate, the maximum pitch down elevator deflection is limited to 8°. In case of a negative pitch rate, the maximum pitch up elevator deflection is limited to 0°.

LANDING OPERATION

The TSA function will be ENABLED for landing at estimated altitudes less than 70 ft. It is also necessary to have the flaps at position 5 or FULL. The function maximum pitch down authority is also limited to 8° of elevator deflection, while pitch up is limited to Normal Mode commands generated by other fly-by-wire functionalities.

For GO AROUND scenarios, TSA operates as follows: for HAGL calculation it is assumed that the airplane is in landing configuration, however, the elevator command authority is the same as the takeoff configuration. The TSA mode changes from landing to go-around after TOGA is selected (TLA greater than 70°) and positive rate of climb is attained.

NOTE:
- In case of exceedance of the angle of attack threshold defined by the AOA limited due to a TSA elevator command, the AOA limiter operation has priority over TSA.
- There is no cockpit indication for the flight crew that the TSA function has been activated.
- TSA commands are limited to only 8° of elevator deflection, thus do not provide full protection against tail strikes. Pitch angles should be maintained below 10° to ensure clearance.

For landings and GO AROUND with flaps 5, it is not possible to engage TSA function before 5 min have elapsed from takeoff.

ARTIFICIAL FEEL UNITS (AFU)

With no mechanical connection between the control column and the elevator surfaces, two independent feel units provide artificial feel and centering to the control columns, which increase as a function of control column displacement.

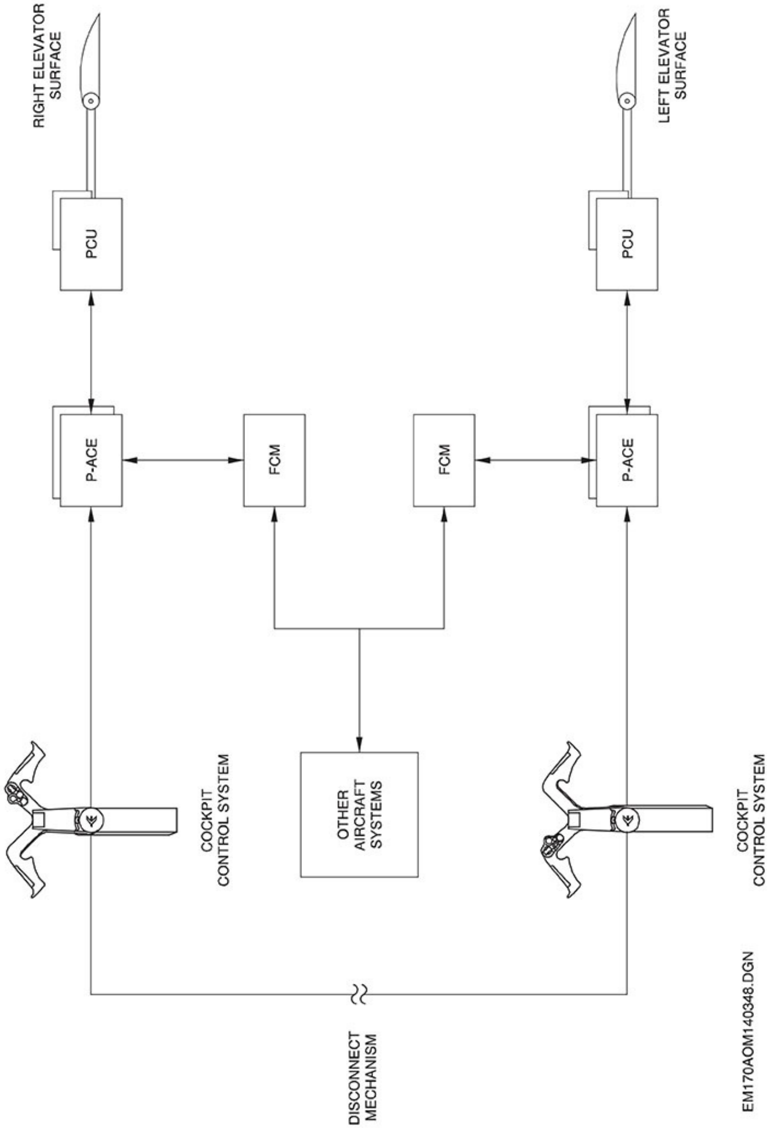
The feel units consist of a preloaded spring, which returns the columns to the neutral position. There is one feel unit attached to each torque tube; in case of separation of the control columns commands, the feel system is still active for the non-jammed column.

With the columns disconnected or with a single AFU disconnected, the feel loads on the column are reduced to one half of the normal loads.

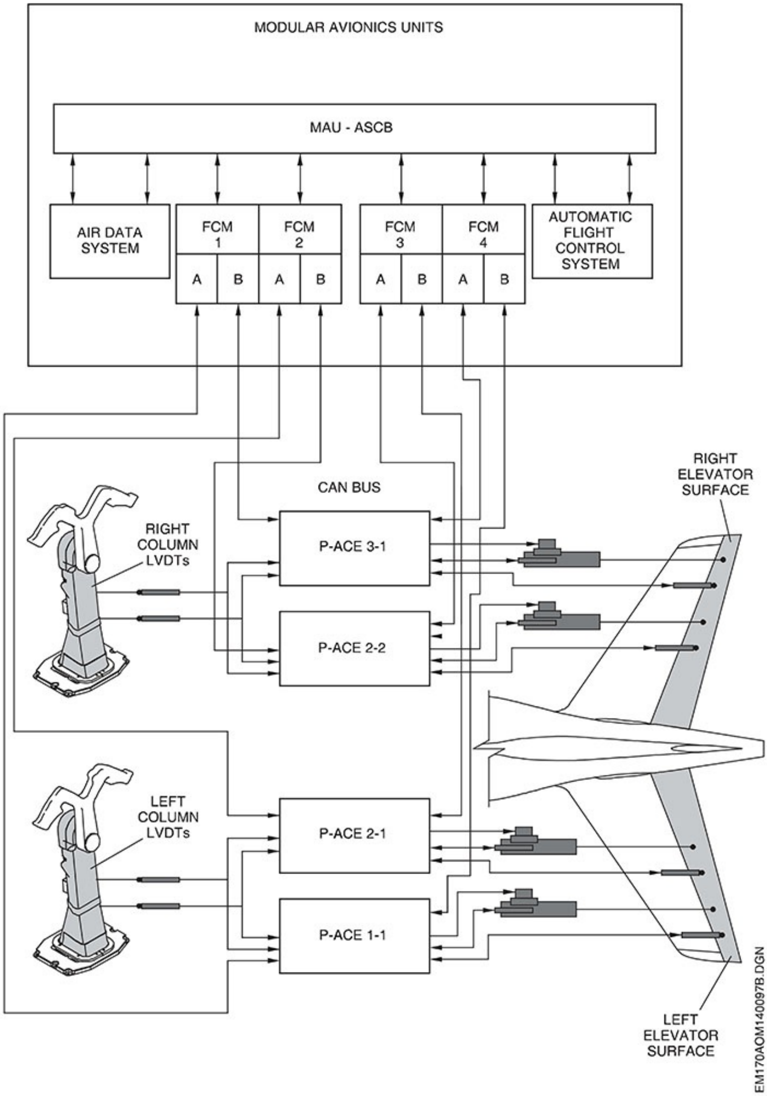
DISCONNECT MECHANISM (JAMMED COLUMN)

A disconnect mechanism is provided to allow separation of the First Officer and Captain’s control columns. In the event of a jam in one of the control columns, the disconnect mechanism can be actuated by the pilots through the disconnect handle in the cockpit.

Following a disconnection, the pilot of the non-jammed side retains pitch control by means of the on-side elevator. The system will remain disconnected for the remainder of the flight and ground maintenance is required to reset the disconnected unit.



ELEVATOR SYSTEM SCHEMATIC



ELEVATOR SYSTEM INTERFACE

HORIZONTAL STABILIZER CONTROL SYSTEM

Control of the horizontal stabilizer is by means of an electro-mechanical system commanded by either:

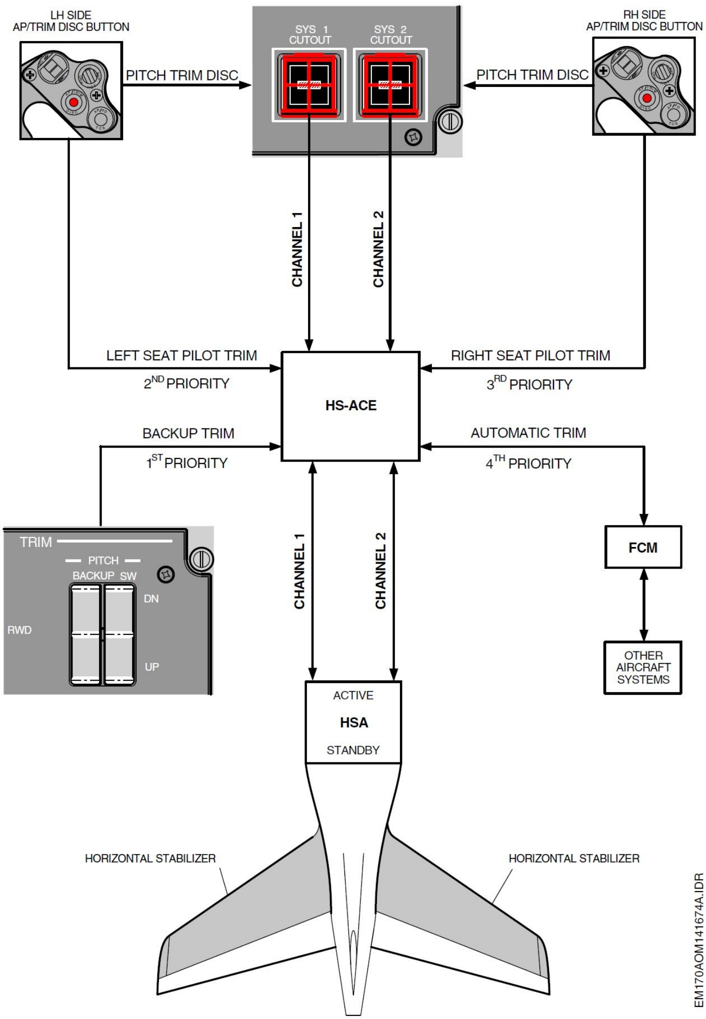
- The manual selection of any available trim switches (LH, RH, and BACKUP Switches). THe HS-ACE receives the commands from the cockpit switches and then controls an electrical servo motor coupled to the Horizontal Stabilizer Actuator (HSA).
- The Flight Control Module (FCM) for automatic trim. The HS-ACE receives the commands from the FCM and then controls an electrical servo monitor coupled to the Horizontal Stabilizer Actuator (HSA).

HORIZONTAL STABILIZER ACTUATION COMPONENTS

Horizontal Stabilizer Actuator Control Electronics (HS-ACE) and one Horizontal Stabilizer Actuator (HSA) are used to move the control surface.

HORIZONTAL STABILIZER ACTUATOR

The HSA is an irreversible, dual load path electrical-mechanical actuator. Two DC brushless motors drive the actuator in an active/standby configuration. Stabilizer position is provided to the HS-ACE and is used for monitoring and EICAS indication.


LH SIDE
AP/TRIM DISC BUTTON
PITCH TRIM DISC
SYS 1
CUTOUT
SYS 2
CUTOUT
PITCH TRIM DISC
RH SIDE
AP/TRIM DISC BUTTON
CHANNEL 1
CHANNEL 2
LEFT SEAT PILOT TRIM
2ND PRIORITY
HS-ACE
RIGHT SEAT PILOT TRIM
3RD PRIORITY
BACKUP TRIM
1ST PRIORITY
AUTOMATIC TRIM
4TH PRIORITY
TRIM
PITCH
BACKUP SW
DN
RWD
UP
CHANNEL 1
CHANNEL 2
FCM
OTHER
AIRCRAFT
SYSTEMS
ACTIVE
HSA
STANDBY
HORIZONTAL STABILIZER
HORIZONTAL STABILIZER
EM170AOM141674A.IDR

STABILIZER TRIM

MANUAL TRIM

The manual trim is commanded through switches installed on the control wheels or a backup switch located on the main pedestal. The HS-ACE receives the commands from the control wheels or the backup switches and then controls an electrical servo motor coupled to the HSA.

The control wheels and backup trim switches are dual split. Both halves of the switch must be pressed simultaneously to command the horizontal stabilizer surface.

There is no movement in the horizontal stabilizer surface when only one half of the switch is actuated. If half switch is kept actuated and this disagreement persists for more than 5 s (E175) or 7 s (E190), that switch is automatically deactivated and the applicable advisory PITCH TRIM SW FAIL message is displayed on EICAS. If this condition persists with only half switch pressed for more than 6 s (E175) or 8 s (E190), even though the horizontal stabilizer surface is not moving, the aural warning "TRIM" is activated as an indication of disagreement. The switch remains deactivated until next Power Up or PITCH TRIM SYS CUTOUT is actuated.

Manual commands via PITCH TRIM Switches and Pitch Trim BACKUP SW Switch are limited to 3 s. After the wheels or backup switches have both halves pressed for more than 3 s, the horizontal stabilizer control surface stops moving and if the switch remains pressed, the aural warning “TRIM" triggers. When the switch is no longer pressed, the aural warning stops. In case of stick shaker activation, the HS-ACE is prevented from responding to any pitch trim up commands by a stick shaker signal from the AFCS.

STABILIZER TRIM PRIORITY LOGIC

The HS-ACE responds to all trim commands with the following priority:

1. Backup switches.
2. LH PITCH TRIM Switch (Captain).
3. RH PITCH TRIM Switch (First Officer).
4. FCM (auto-trim) commands.

AUTOPILOT TRIM

The autopilot sends commands to the HS-ACE that controls an electrical servo motor coupled to the HSA when the autopilot is engaged. If the autopilot trim function is inoperative, the autopilot cannot be engaged. If this function is lost during autopilot operation, the autopilot will disengage.

Autopilot trim function will be active only if:

- Autopilot is engaged,
- Configuration trim is operational,
- Manual electric trim is not active,
- On-side autopilot channel is priority.

NOTE: In case of an electrical failure, followed by RAT deployment, the trim function will operate at low rate, for either manual trim or autopilot trim.

MACH TRIM – E190 ONLY

Automatic Mach Trim compensates pitch down tendency caused by changes on the aerodynamic center position, which moves backwards as Mach number increases.

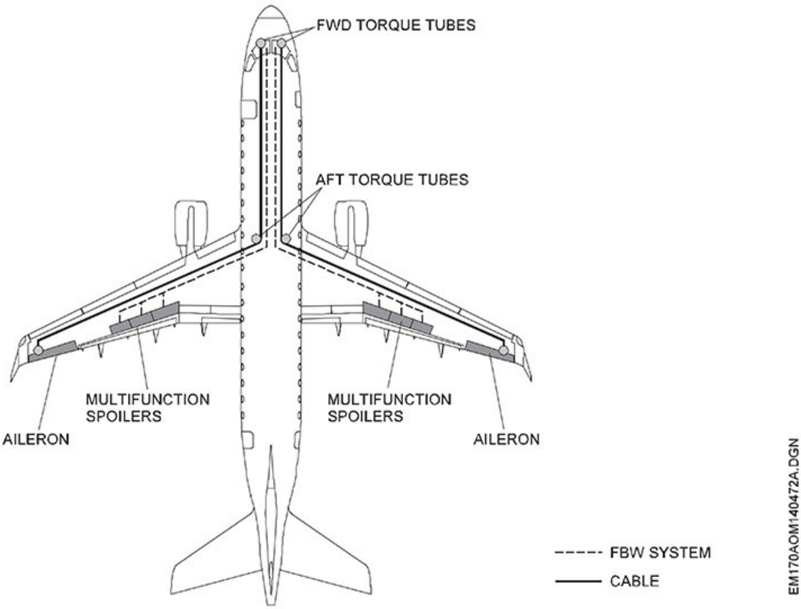
For further information on Mach Trim operation refer to chapter 14–03 Automatic Flight.

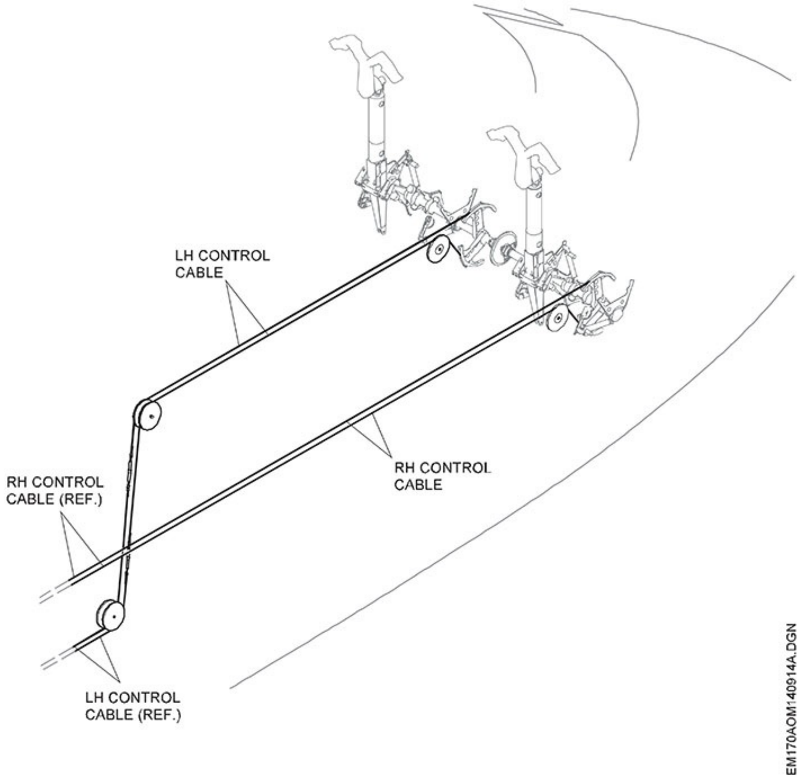
ELECTRICAL EMERGENCY

In the event of an electrical emergency, only the HS-ACE channel 2 is operational at low rate. A loss of airspeed data from the FCM also results in low rate operation of the horizontal stabilizer, providing structural protection for the surface.

14.08.20 ROLL CONTROL

Lateral control system includes both conventional ailerons and the fly by wire multi function spoilers which provides the roll axis control.





AILERON CABLES SCHEMATIC

AILERON CONTROL SYSTEM

Aileron control is accomplished through a conventional cable system, which transmits control wheel and autopilot inputs to the ailerons power control units.

The power control units are driven by the following hydraulic systems:

- Hydraulic System 2: left & right inboard PCU.
- Hydraulic System 3: left & right outboard PCU.

AILERON JAM

The aileron control system is divided into left- and right-half systems. The two halves are designed to tolerate single-point jams without loss of lateral control. In the event of a jam, the left and right sub-systems may be disconnected, thereby allowing command movements in the functional half-system.

The jammed half of the aileron system can be disconnected by actuating the aileron disconnect handle located in the cockpit.

Following a disconnect, the system remains separated for the remainder of the flight. Maintenance action is required to reconnect the disconnect device.

RIGHT AILERON JAM

The First Officer’s half of the system is jammed.

The Captain retains control of the left aileron and the pair #5 of multi-function spoilers will remain available with normal artificial feel.

LEFT AILERON JAM

The Captain’s half of the system is jammed.

The First Officer retains control of the right aileron without artificial feel and roll trim since the feel mechanism is attached to Captain’s half of the system, the pair #4 of multi-function spoilers will remain available.

PCU DISCONNECT

In the event of a disconnection of one aileron PCU from the surface or wing structure, the other PCU attached to the surface will operate normally, but the force authority will be halved. Hence the aileron PCUs normally share air-loads during flight, if the FCM detects a difference in load sharing from the actuators, a message will be displayed on the EICAS.

MULTIFUNCTION SPOILER CONTROL SYSTEM

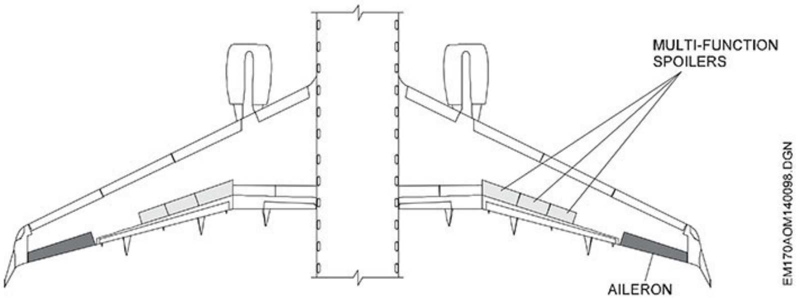
The multifunction spoiler control system consists of 6 panels numbered from inboard to outboard as:

- L3, L4, L5 (left wing) and
- R3, R4, R5 (right wing).

The roll spoiler function drives all six multifunction spoiler panel deployment asymmetrically as a function of control wheel position.

MULTIFUNCTION SPOILER OPERATION MODE

- NORMAL MODE: The Flight Control Module (FCM) provides software based airspeed gain schedules and control limits to the S-ACE, the spoiler deploys as a function of airspeed, reducing spoiler deployment with increasing airspeeds.
- DIRECT MODE: In the event of a FCM failure, the spoiler associated with the FCM turns to the direct mode. The other spoilers remain in the normal mode.



ROLL CONTROL SURFACES POSITION

MULTIFUNCTION SPOILERS JAM

In the event of a jam, the control wheel and the aileron on the jammed half of the system will be locked at the current position. The other half of the system can be separated from the jammed side through the aileron disconnect handle located at the control pedestal. In this case, the Captain controls the outboard spoilers, while the First Officer controls the middle spoilers. With disconnection due to jamming, the inboard spoilers become disabled.

ROLL TRIM

The aileron control system is manually trimmed by using the roll trim switch on the trim control panel, located in the cockpit on the center pedestal. The trim system is operated via the roll trim switch on the trim control panel, commanding the actuator to move, and repositioning neutral feel position of the aileron system.

The actuator is equipped with a timer, limiting a single trim command to three seconds. A quick disconnect switch, located on the control wheels, disables the roll trim actuator by interrupting DC power to the trim motor, as long as the switch remain depressed.

AILERON TRIM SERVO FAILURE

In the event of a runaway of the aileron trim servo, the control wheel neutral point will shift and the pilot will be required to hold a constant force to maintain neutral lateral control. The pilot will retain full lateral control authority albeit with asymmetrical control forces.

In the event a disconnection of the trim actuator occurs the feel and centering for the lateral control will be lost.

14.08.25 YAW CONTROL

Yaw control is performed by means of an electronic control system that commands electrohydraulic actuators of the rudders.

RUDDER CONTROL SYSTEM

The rudder control system is controlled by the pilots and FCM high-level functions. Additionally, it is controlled by autopilot in airplanes equipped with Autoland.

The rudder control system moves a single rudder surface attached to the vertical stabilizer. Two actuators, or PCUs, electrically commanded and hydraulically powered, are connected to the rudder control surface, receiving signals from the rudder control's Fly By Wire system (FBW).

Either the upper or the lower rudder actuator can control the rudder surface. The Captain commands only the upper actuator and the First Officer commands only the lower actuator.

The rudder actuators operate in an active/standby configuration. The P-ACEs alternate between the control channels following the Odd-Even Day Engage function. This function ensures that a particular set of control channels is selected to the active state while the other remains in the standby mode.

The hydraulic systems responsible for actuating the actuators are:

- Hydraulic System 1: upper actuator, or PCU.
- Hydraulic System 3: lower actuator, or PCU.

RUDDER CONTROL SYSTEM COMPONENTS

Two independent P-ACE modules drive the upper and lower PCU, providing the analog rudder control functions implemented in the P-ACE hardware.

Four independent FCM units, located in MAU 1 and 3, provide highlevel system augmentation on the P-ACE units, such as yaw damping, turn coordination, as well as gain scheduling as a function of airspeed.

RUDDER FLIGHT CONTROL PANEL BUTTON

A dedicated button on the Flight Control Mode panel provides the capability to the pilots to alternate from Normal mode to Direct mode and vice-versa.

- PUSHED IN
  When the flight control panel rudder button is pushed in, it commands both rudder channels to change from Normal to Direct mode.
  It also results in the active rudder channels transitioning to the standby state, and the channels that were previously in standby would become active.
  This feature also allows the system to transition away from the current controlling channels to the standby channels.
- PUSHED OUT
  When the flight control panel rudder button is pushed out, the system recovers the Normal Mode.

RUDDER CONTROL SYSTEM OPERATION MODE

NORMAL MODE: In the normal mode, the FCMs add further high-level functions to the pilot pedal inputs. With increasing airspeed, rudder gain is reduced by the FCM in order to compensate for the increase in rudder effectiveness, and providing structural protection to the rudder surface.

DIRECT MODE: In the event of loss of airspeed information to the flight control system, the P-ACEs will revert to Direct mode using a fixed gain. There are two Direct mode fixed gains that are selected as a function of flaps/slats positions:

- LOW-SPEED FIXED GAIN
  - Is selected for Flaps/Slats extended.
  - The rudder is set at the maximum authority to ensure that the pilot has sufficient authority to control the aircraft during the approach and landing.
- HIGH SPEED FIXED GAIN
  - Is selected for flaps/slats retracted.
  - Ensures that the rudder movement is limited at high speeds, providing structural protection.

RUDDER JAM

PEDAL JAMMED

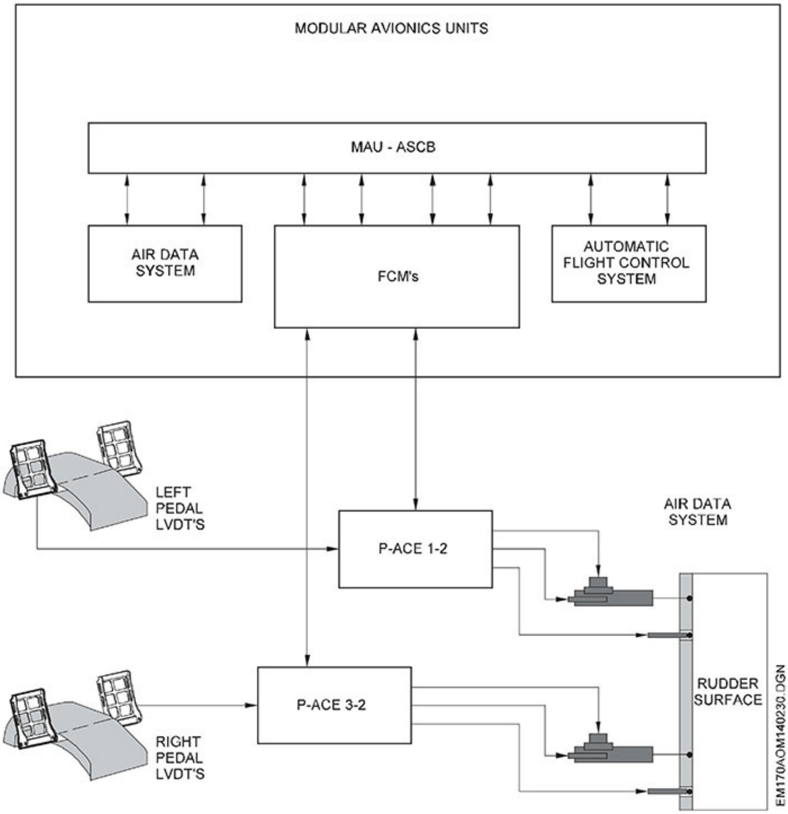
In case of pedal assemblies jammed, the rudder remains active and will be actuated by high-level functions (yaw damping and turn coordination).

PCU JAMMED

In case of a jammed PCU actuator the rudder will be hydraulically locked at the current position. Aircraft control will be established through the ailerons and roll spoilers.

RUDDER TRIM SYSTEM

Rudder trim function is limited to three seconds. If further displacement of the trim system is required the command must be released and reapplied. Position indication of the trim actuator is provided on the EICAS.



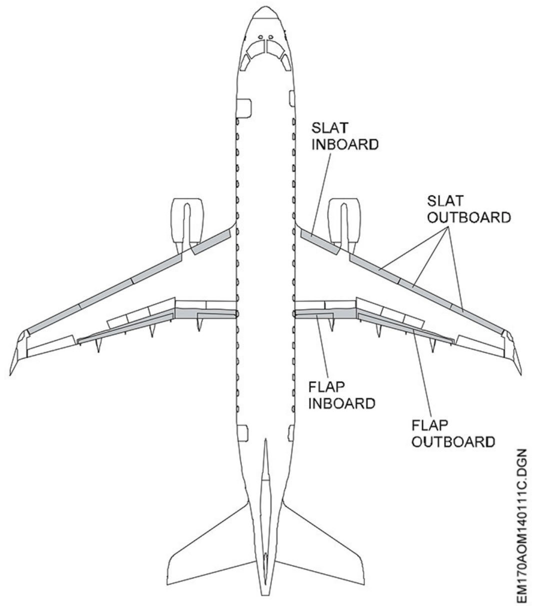
RUDDER SYSTEM INTERFACE

14.08.30 SLAT/FLAP SYSTEM

The high lift control system consists of flaps and slats.

The slat system controls eight slat surfaces on the leading edge of the wing (four per wing) and the flap system controls four double slotted flap surfaces on the trailing edge (two per wing).

Surface position commands are given to the Slat/Flap-ACE (SF-ACE) via a Slat/Flap control lever installed on the center pedestal in the cockpit.



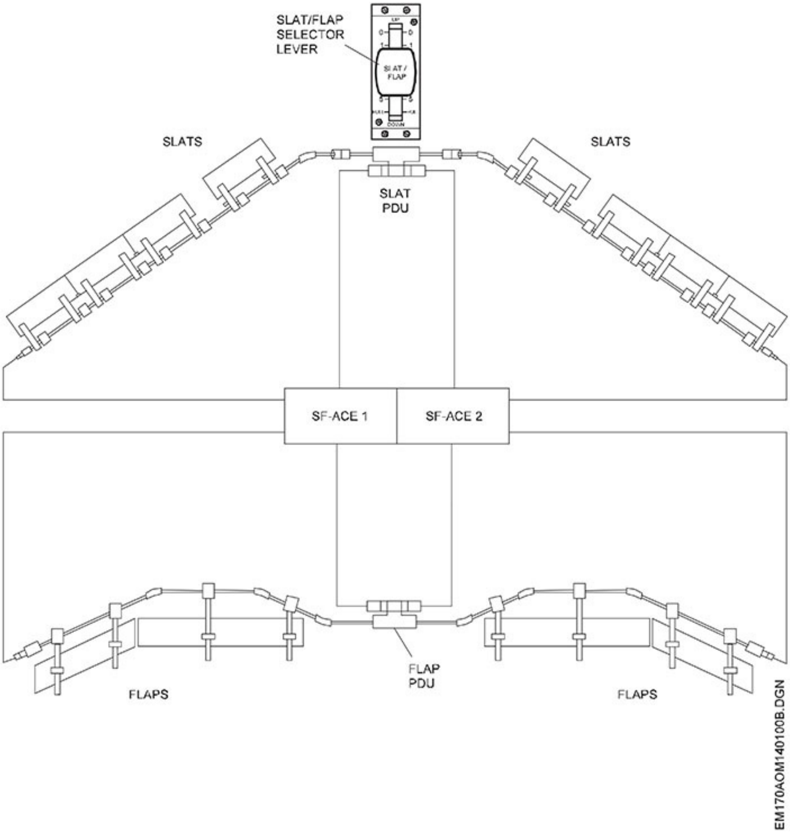
SLAT/FLAP PANEL LOCATION

There are seven slat/flap control lever positions. Slat and flap motion is sequenced such that slats extend first and flaps retract first when the motion command requires both surfaces to move. The system uses electrical power to move the surfaces.

SLAT/FLAP SYSTEM COMPONENTS

Deployment of both slats and flaps surfaces is commanded by two SF-ACEs and electrically operated using Power Driver Units (PDUs). Each SF-ACE is a dual channel unit, with one channel for flap control and one channel for slat control.

A total of four flap actuators per side provide the actuation force to extend and retract the flap panels mounted on the trailing edge of each wing. The double-slotted flap consists of a main flap panel and an aft flap panel for both inboard and outboard flaps.



SLAT/FLAP SYSTEM SCHEMATIC

SLAT/FLAP PROTECTION LOGIC

SKEW PROTECTION

Electronic skew sensors monitor differential movement between neighboring panels of flap (slat). If differential movement of a panel exceeds acceptable limits, the SF-ACES shuts down the flap (slat) system and the FLAP (SLAT) FAIL message displays on EICAS.

The SLAT-FLAP LEVER DISAG may appear if the respective surface has not reached the position selected on the Slat/Flap Lever. The affected surface is inoperative for the remainder of the flight whereas the non-affected surface operates normally (i.e., in case of FLAP FAIL the Slats operates normally and vice-versa).

STRIKE PROTECTION

The SF-ACE monitors PDU load and if an excessive load is detected it stops the electrical power to the respective PDU for further movement to the selected direction. The FLAP (SLAT) FAIL message displays and the SLAT-FLAP LEVER DISAG also displays, as the affected surface has not reached the selected position.

In such cases, the affected surface can be commanded in the opposite direction (i.e., for FLAP FAIL during retraction, the Flap can be commanded for extension and vice-versa).

When the strike protection actuates, the affected surface can be commanded in both directions if it is returned to the previously selected position. SF-ACE allows two attempts in addition to the first applied command that originated the excessive PDU load. After two unsuccessful attempts to select a position, the affected surface is de-energized since the strike protection cuts the PDU power for both directions.

SLAT/FLAP SYSTEM INTERLOCKS

OPERATING WITH RAM AIR TURBINE (RAT)

The SF-ACE has two independent channels that are powered by different electrical power sources.

If the Ram Air Turbine RAT is deployed, flaps and slats operate in half speed. Additionally, the SF-ACE prevents deployment of slats and flaps beyond position three to assure adequate airspeed for the RAT.

SLAT OR FLAP FAILURE

In case of a Flap or Slat failure, when the affected surface is de-energized, the SF-ACE still commands the non-affected surface upon S/F Lever movement. This allows improved landing performance even in the event of failure by selecting a more appropriate position of the non-affected surface.

However, there are some slat/flap combinations that are automatically protected by the system, as they would induce poor airplane controllability. Thus, the SF-ACE does not command the Flaps beyond 10° (S/F Lever on position 2) with the Slats below 15°. In this failure scenario, if the S/F Lever is commanded beyond the position 2, the SF-ACE limits the Flap deflection to 10° and the SLAT-FLAP LEVER DISAG message displays.

The slat/flap interlock is disabled on ground allowing either surface be extended or retracted to any valid position regardless of the position of the other surface.

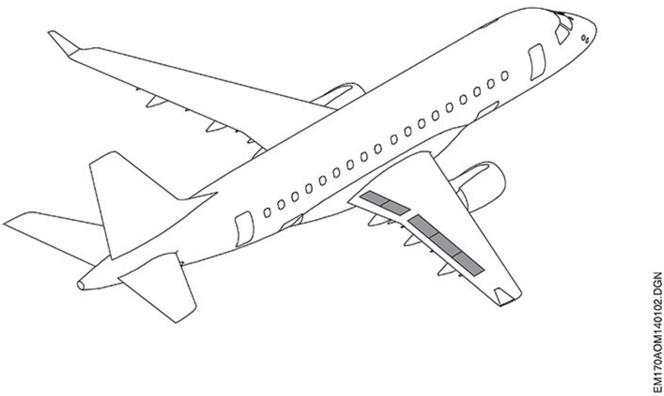
14.08.35 SPOILER SYSTEM

The spoiler control system consists of ten spoiler panels numbered inboard to outboard as follows:

- L1, L2, L3, L4, L5 (left wing) and
- R1, R2, R3, R4, R5 (right wing).

Panels L3, R3, L4, R4, L5 and R5 are called multifunction spoilers and have three modes of operation:

- Roll Control: deployed asymmetrically for roll augmentation as commanded by the pilots control wheel. Displacement angle is proportional to control wheel displacement.
- Speed Brakes: deployed symmetrically during flight by speed brake handle to increase aerodynamic drag to reduce airspeed or increase rate of descent. Panel displacement is proportional to speed brake handle position.
- Ground Spoilers: deployed symmetrically during landing roll to increase wheel braking efficiency and aerodynamic drag to reduce the stopping distance. Panels are fully and automatically extended when ground spoiler deployment conditions are met.
- Steep Approach Mode: panels L4, R4, L5 and R5 deployed symmetrically to increase aerodynamic drag and increase rate of descent. Displacement angle is proportional to control column movement.



SPOILERS LOCATION

HYDRAULIC SYSTEM ASSOCIATED WITH EACH ACTUATOR

The hydraulic systems responsible for actuating the multi function PCUs are:

- Hydraulic System 1: left and right inboard and middle PCUs (L3, R3, L4, R4).
- Hydraulic System 2: left and right outboard PCUs (L5, R5).

The hydraulic systems responsible for actuating the dedicated ground spoilers PCUs are:

- Hydraulic System 1: left and right outboard PCUs (R2, L2).
- Hydraulic System 2: left and right inboard PCUs (R1, L1).

GROUND OPERATION

The spoiler control system provides automatic ground spoiler deployment to increase wheel-braking efficiency reducing the lift generated by each wing and to reduce the stopping distance producing aerodynamic drag.

During ground operation, all spoiler panels function as ground spoilers and are commanded to the fully extended or fully retracted positions.

The ground spoiler function drives all ten spoiler panels to the limit deflection of the actuators.

MULTI-FUNCTION AND GROUND SPOILERS DEPLOYMENT

After touchdown the FCM will command all multifunction spoiler surfaces to the 40° extended position and the ground spoiler surfaces to 60° when the following conditions are simultaneously met:

- Weight on wheels on ground,
- Wheel speed is above 45 kt or airspeed is above 60 KIAS,
- Thrust Lever Angle (TLA) below 26°.

Following rollout, the spoilers will automatically retract when wheel speed is below 45 kt for at least 5 seconds. If the throttles are moved beyond 35° (TLA) after landing, the spoiler panels will automatically retract.

In a bounced landing, the FCM holds the "on ground" signal for 5 s after the WOW signals indicate "in air". However, if the pilot commands TLA greater than 24° the ground spoilers are retracted.

NOTE: In the direct mode, ground spoilers are not available.

IN-FLIGHT OPERATION

ROLL SPOILERS

The roll spoiler function drives the multifunction spoiler panels asymmetrically as a function of control wheel position.

For further information on the roll spoilers operation, refer to AOM 14-08-20.

SPEED BRAKES

When actuating as speed brakes, the spoiler control system deploys all six multi function spoiler panels symmetrically up to the in-flight limit of 30° following speed brake handle position.

If extended during approach, the speed brakes will automatically retract upon selection of slat/flap 2 or above.

Speed brakes will not be deployed if airspeed is below 180 KIAS, and will also automatically retract if airspeed decreases below this threshold.

In order to prevent inadvertent operation during a go-around maneuver the speed brakes will automatically retract anytime the thrust levers are advanced beyond Thrust Lever Angle (TLA) 70 degrees.

In the event of a disagreement of the speed brake handle position with actual surface position, the EICAS advisory message SPDBRK LEVER DISAG is displayed on the EICAS.

NOTE: In the direct mode, speed brakes are not available.

STEEP APPROACH MODE

The Steep Approach Mode is a fly-by-wire function which allows the EMBRAER 190 to perform CAT I approaches with a glide path angle of 5.5°.

When the Steep Approach Mode is engaged, the multi-function spoiler pairs 4 and 5 are partially deployed to 21°, for neutral control column, to work as drag devices, increasing the sink rate with no change to the airspeed. Additionally, the horizontal stabilizer automatically compensates the airplane pitch during Steep Approach Mode engagement and disengagement.

The spoiler panels deployment angle is modulated as a function of the control column displacement. Nose up pitch commands reduce the spoilers deployment angle, and nose down pitch commands increase the spoilers deployment angle.

The stall speed, stall characteristics, the maximum lateral control and the maneuvering capabilities for full flaps are unaffected by the steep approach mode.

14.08.45 EICAS MESSAGES

TYPE	MESSAGE	MEANING
WARNING	ELEV (RUDDER) (SPOILER) NML MODE FAIL	Normal mode of the associated system is no longer operative.
	GROUND SPOILERS FAIL	One of the ground spoiler surfaces has extended inadvertently or has failed to extend when commanded.
CAUTION	AOA LIMIT FAIL	Stall protection function has failed.
	ELEV THR COMP FAIL	One or more sensors required to perform Elevator Thrust Compensation function have failed and the function is no longer available.
	ELEVATOR FAULT	Left and right elevator control system has reverted to direct mode.
	ELEVATOR LH (RH) FAIL	Left (right) elevator control system is no longer available.
	FLAP FAIL	Both flaps electronic control channels are inoperative and the flaps system is no longer available or there is a jam in the mechanical portion that precludes the flaps from moving.
	FLT CTRL BIT EXPIRED	50 hours or more have passed since the last time PBIT was activated.
	FLT CTRL NO DISPATCH	One of the components associated with the flight control system has failed to a No-Go condition.
	PITCH TRIM FAIL	Pitch trim function is no longer available.
	RUDDER FAIL	Active and standby rudder channels have failed or rudder has jammed.
	RUDDER FAULT	Indicates that the rudder control system has reverted to direct mode.
	RUDDER LIMITER FAIL	Indicates that rudder ground authority is retained after take-off.
	SLAT FAIL	Both slats electronic control channels are inoperative and the slats system is no longer available or there is a jam in the mechanical portion that precludes the slats from moving.
	SLAT-FLAP LEVER DISAG	Difference between commanded position and surface position.
	SPOILER FAULT	Airspeed gain scheduling has failed in one or more pairs of multifunction spoilers, and the system(s) has defaulted to a fixed gain.

TYPE	MESSAGE	MEANING
CAUTION	SPOILER FAULT	Airspeed gain scheduling has failed in one or more pairs of multifunction spoilers, and the system(s) has defaulted to a fixed gain.
	STAB LOCK FAULT	The mechanical device, which locks the horizontal stabilizer, has failed. Direct mode is not allowed.
	STEEP APPR FAIL (E190 only)	Indicates that the Steep Approach mode has failed.
ADVISORY	AILERON LH (RH) FAIL	Indicates that the left (right) aileron is no longer available or there is a mechanical detachment in the left (right) aileron surface.
	AUTO CONFIG TRIM FAIL	Pitch Trim Auto Configuration function is inoperative.
	FLAP LO RATE	One of the flaps electronic control channels is inoperative and the flap system is still available but running at low speed.
	FLT CTRL FAULT	One of the components associated with the flight control system has failed.
	PITCH CONTROL DISC	Control columns are disconnected.
	PITCH TRIM BKUP FAIL	Backup pitch trim switch is inoperative.
	PITCH TRIM SW 1 FAIL	Captain’s pitch trim switch is inoperative.
	PITCH TRIM SW 2 FAIL	First Officer’s pitch trim switch is inoperative.
	PITCH TRIM LO RATE	Pitch trim system can only operate at a low rate.
	ROLL CONTROL DISC	Control wheels are disconnected.
	SLAT LO RATE	One of the Slats electronic control channels is inoperative and the slat system is still available but in low speed.
	SPDBRK FAIL	SPEED BRAKE function has failed.
	SPDBRK LEVER DISAG	A mismatch exists between the speedbrake handle position and the multifunction spoiler surfaces.
	STEEP APPR NOT AVAIL (E190 only)	The Steep Approach mode function is no longer available.
	TAILSTRIKE AVOID FAIL (E190 only)	TSA function is no longer available.
STATUS	FLT CTRL TEST IN PROG	Electrical and hydraulic PBIT in progress.

14.09.01 GENERAL DESCRIPTION

The airplane is equipped with a complete set of Communication and Navigation functions. The main interface for the system is done through the Audio Control Panel (ACP) and the Multi-function Control Display Unit (MCDU).

The MCDUs provide radio frequency and mode control. The frequencies can also be selected on the Primary Flight Displays (PFDs) through the Cursor Control Devices (CCDs). The system provides a backup tuning page that may be used when a failure is detected. This backup page is displayed on MCDU 2 and enables tuning for COM 1, NAV 1 and Transponder (XPDR) 1.

The audio system is controlled via three individual ACPs that are available to the captain, first officer and observer, and also provides interface with the Passenger Address (PA), Aural Warning, and Digital Voice and Data Recorder (DVDR) systems.

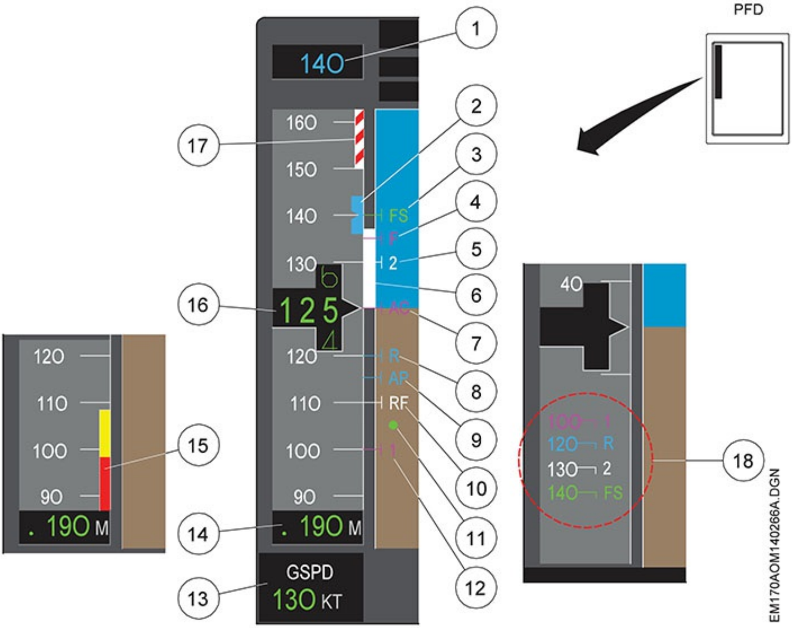
Optional communications equipment includes a third VHF COM, HF and Selcal systems.

Navigation may be performed using only the navigation radio sensors or Flight Management System (FMS) resources. The FMS uses the standard navigation radio sensors, Global Positioning System (GPS) and Inertial Reference System (IRS) for positioning and navigation.

14.09.05 CONTROLS AND INDICATIONS

FLIGHT INSTRUMENTS

AIRSPEED TAPE INDICATIONS



1 – SELECTED AIRSPEED/MACH READOUT

- Displays speed/mach values.

MAGENTA:	automatically set by the FMS.
CYAN:	manually entered by the flight crew.
AMBER DASHED:	invalid information.

2 – SELECTED AIRSPEED BUG

- Displayed when the FMS/AFCS commanded speed is in the displayed range of speed tape.

MAGENTA: automatically set by the FMS.

CYAN: manually entered by flight crew.

3 – VFS SPEED (FS)

- Takeoff final segment speed.

4 – FLAP RETRACTION SPEED REFERENCE (F)

- Flap retraction speed reference for both dual engine and single engine takeoffs.

5 – V2 SPEED (2)

- Takeoff V_2 speed.

6 – AIRSPEED TREND VECTOR

- Shows the airspeed which the airplane will be within 10 seconds, if the present acceleration/deceleration rate is maintained.

7 – VAC SPEED (AC)

- Approach climb speed.

8 – VR SPEED (R)

- Rotation speed.

9 – VAP SPEED (AP)

- Approach speed.

10 – VREF SPEED (RF)

- Reference speed.

11 – GREEN DOT

- Indicates the driftdown speed when Slat/Flap is UP and the ideal Slat/Flap extension speed for the current airplane weight. It provides a minimum margin of 1.3 g over stick shaker speed, or 40° bank angle, for wings level condition during any flight phase and Slat/Flap setting.
  Altitude, Speed in Mach, Slat/Flap position and Weight from the FMS (resolution in increments of 500 kg/1100 lb) are used to compute the green-dot.
  The green dot is calculated in Mach and then converted into IAS to be displayed on the PFD. In case of loss of IAS, loss of Slat/Flap position or position disagreement, the green dot is removed from the PFD.

NOTE:
- The green dot speed indication accounts for ice accretion.
- In case the EICAS message STALL PROT FAIL is displayed, the green dot is removed from the PFD.
- The green dot logic does not account for speed brakes actuation.

12 – V1 SPEED (1)

- Decision speed.

13 – GROUND SPEED

- Displays IRS-based ground speed.

14 – MACH AIRSPEED READOUT

- Displays the actual airplane Mach number. Mach shall be displayed when aircraft speed is 0.450 M or greater and remains displayed until the aircraft airspeed falls below 0.400 M.

GREEN:	normal range.
AMBER:	airspeed is reaching an overspeed or it is at or below shaker speed and above stall speed.
RED INVERSE VIDEO:	airspeed at or above overspeed or, at or below stall speed.
AMBER DASHED:	invalid information.

NOTE: When selected airspeed information is invalid, the digital display and label are removed.

15 – LOW SPEED AWARENESS TAPE (LSA)

- Indicates the margin to the stick shaker speed. It rises from the bottom of the speed tape and has two colored ranges:

  AMBER: cautionary operating range.

  Amber LSA and PLI are displayed simultaneously.

  RED: No operation allowed in this range.

  Red LSA and PLI are displayed simultaneously. The stick shaker is activated.

- The LSA is a function of Airspeed in Mach, Slat/Flap position, Angle of Attack, Spoiler position, Landing Gear position and Icing conditions (EICAS message STALL PROT ICE SPEED displayed).
- When EICAS messages SHAKER ANTICIPATED or STALL PROT ICE SPEED are displayed, the top of the LSA tape is repositioned upwards to match the new V_{shaker}.
- When the airspeed indication or Angle of Attack data is invalid, the LSA tape is removed.

16 – AIRSPEED ROLLING DIGITS

- Displays the actual Indicated airspeed (IAS), above 30 kt.

GREEN:	normal range.
AMBER:	airspeed trend vector (when displayed) is reaching the V_{MO}/Mmo or it is at amber low speed awareness tape or the actual airspeed is at amber low speed awareness tape.
RED INVERSE VIDEO:	airspeed trend vector (when displayed) or actual airspeed is at red low speed awareness tape or at V_{MO}/Mmo barber pole.

- The airspeed trend vector when displayed has the priority over actual airspeed to define the airspeed rolling digits color.

17 – VMO/Mmo BARBER POLE

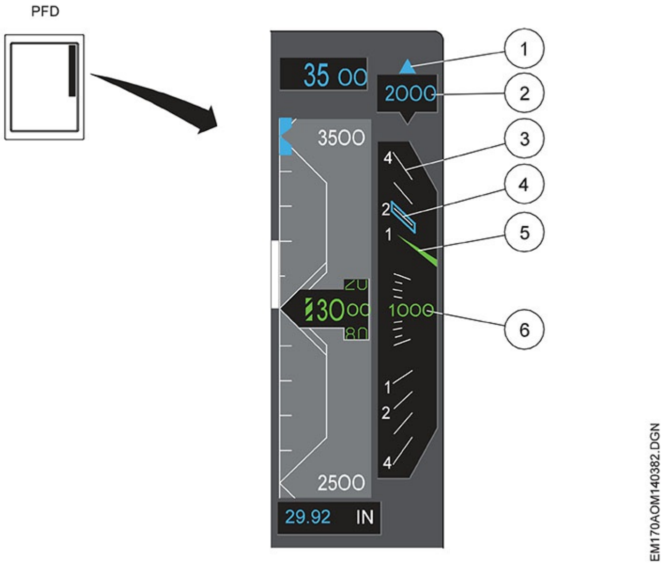
- Displayed when the V_{MO}/Mmo is within the viewable range, and covers speeds at or above V_{MO}/Mmo (red and white).

18 – SPEED DIGITAL READOUT

- Preview readout for takeoff bugs.

NOTE: During takeoff roll, above 30 kt of ground speed, the digital readouts of the preview mode are not displayed.

VERTICAL SPEED INDICATIONS



1 – SELECTED VERTICAL SPEED DIRECTION ARROW

- Indicates either up or down direction. Used in conjunction with the selected vertical speed readout.

2 – SELECTED VERTICAL SPEED READOUT

- Displays selected climb or descent rate.

3 – VERTICAL SPEED SCALE

- Extends from -4000 ft/min to 4000 ft/min, with an expanded scale between 1000 ft/min and -1000 ft/min.
- From 0 ft/min to ±500 ft/min:
- One tick mark at every 100 ft/min.
- From ±1000 ft/min to ±4000 ft/min:
- One tick mark at every 1000 ft/min.

4 – SELECTED VERTICAL SPEED BUG

- Displays selected climb or descent rate on the vertical speed scale.

5 – VERTICAL SPEED POINTER

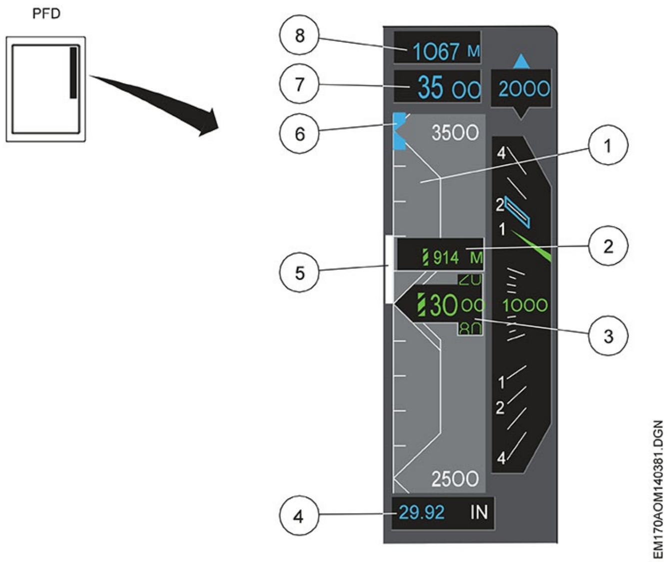
- Displays the actual vertical speed if within the viewable range; parks at the limit if beyond viewable range.
- If the current rate is greater than ±9999 ft/min, or the altitude data received is not valid, the vertical speed pointer is removed.

6 – VERTICAL SPEED READOUT

- Displayed when the vertical speed increases above 550 ft/min or decreases below -550 ft/min.
- Removed when the vertical speed decreases below 500 ft/min or increases above -500 ft/min.

GREEN:	normal range.
AMBER DASHES:	invalid information.

ALTITUDE TAPE INDICATIONS



1 – ALTITUDE TAPE

- Indicates actual airplane altitude. The altitude tape is labeled with tick marks every 100 ft and single or double-lined chevrons at 500 ft or 1000 ft intervals, respectively.

2 – METRIC ALTITUDE READOUT

- Indicates actual airplane altitude in meters, with a resolution of 5 m.
- Displayed when selected in the ALT SEL Controller.
- A green hashed box appears on the left side of the numeric digits when altitude is below 10000 m.
- A minus (-) symbol appears on the left side of the numeric digits when altitude is below sea level.

3 – ALTITUDE ROLLING DIGITS READOUT

- Indicates actual airplane altitude in feet. Digits are displayed with a resolution of 20 ft.
- A green hashed box appears on the left side of the numeric digits when altitude is below 10000 ft.
- A minus (-) symbol appears on the left side of the numeric digits when altitude is below sea level.

4 – BAROMETRIC CORRECTION

- Displays the barometric correction as selected.

5 – ALTITUDE TREND VECTOR

- Indicates the projected altitude, which the airplane will be within 6 seconds, based on the current vertical speed.
- This vector is displayed along the left edge of the altitude tape as a wide white line.

6 – SELECTED ALTITUDE BUG

- Positioned at the selected altitude.

CYAN: manually entered by the flight crew.

AMBER: actual airplane altitude is between 1000 and 200 ft from the preselected altitude. An audio alert is sounded after the airplane has captured the altitude and departs more than 200 ft from the selected altitude.

7 – SELECTED ALTITUDE READOUT

- Displays digital selected altitude in feet.

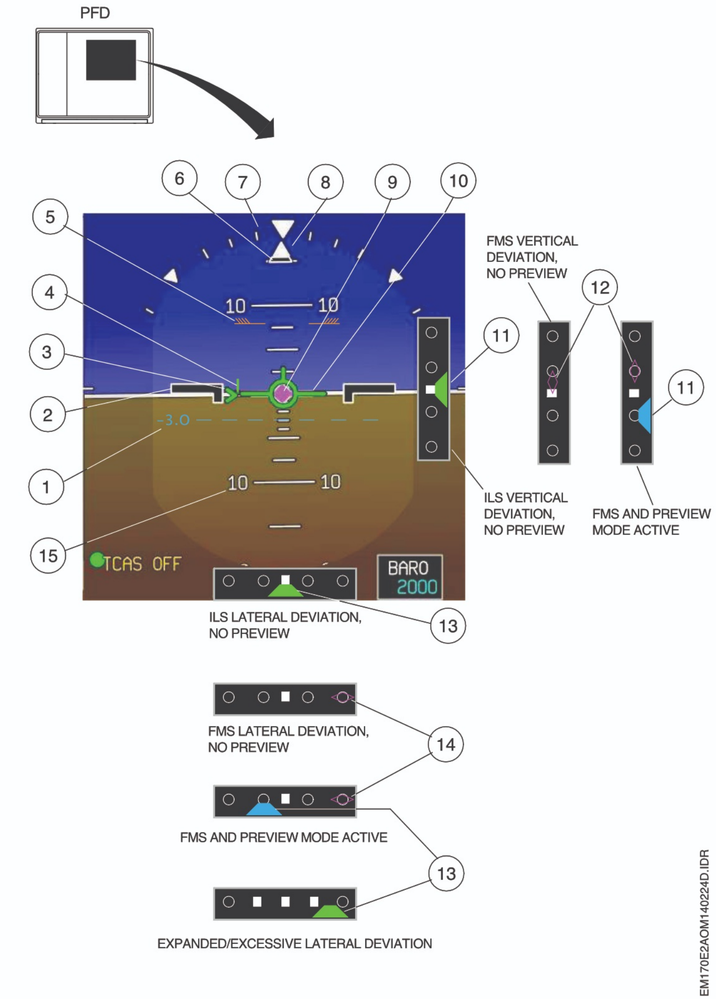
CYAN: manually entered by the flight crew.

AMBER: actual airplane altitude is between 1000 and 200 ft from the preselected altitude. An audio alert is sounded after the airplane has captured the altitude and departs more than 200 ft from the selected altitude.

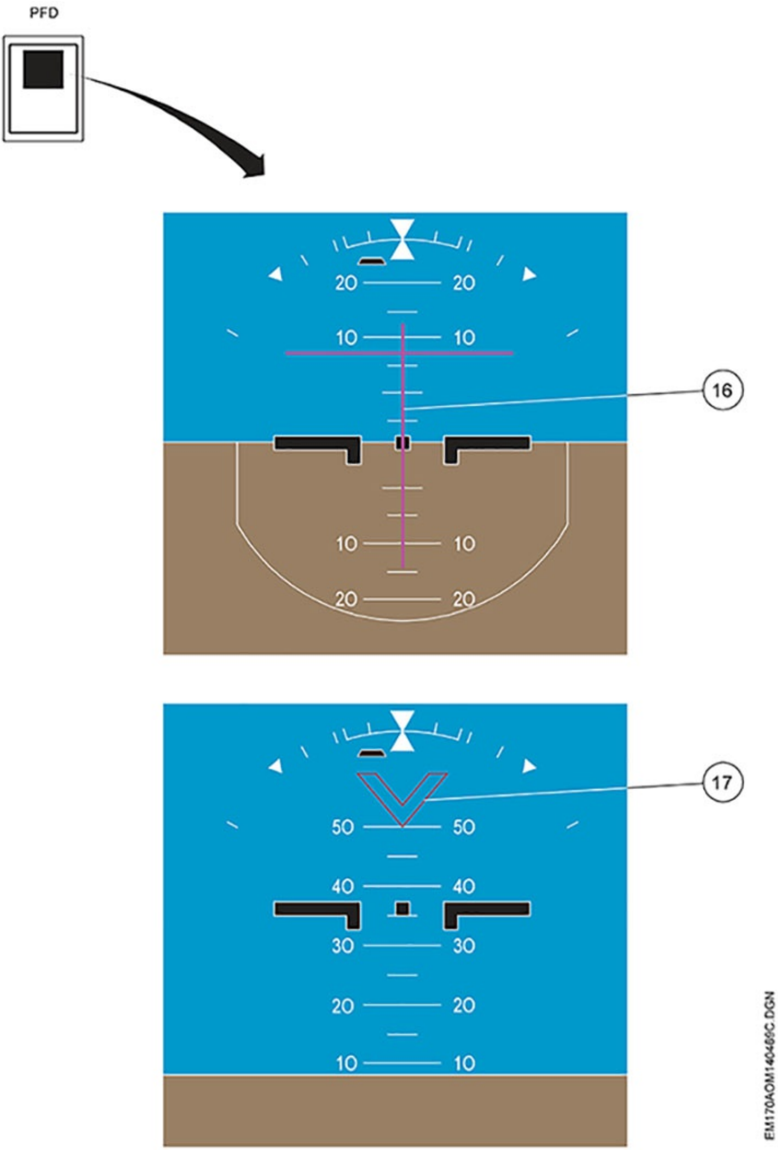
8 – METRIC SELECTED ALTITUDE READOUT

- Displays digital selected altitude in meters.
- Displayed when selected in the ALT SEL Controller.

ADI INDICATIONS



ADI INDICATIONS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EM170AOM140469C.DGN

1 – FLIGHT PATH REFERENCE LINE/READOUT (FPR)

- Indicates a selected path angle for reference, when the FPR button is pressed.

2 – AIRPLANE SYMBOL

- Fixed and used with the pitch tape to reflect airplane pitch attitude in relation to the horizon line.

3 – FLIGHT PATH VECTOR SPEED ERROR TAPE

- Indicates the difference between actual and the selected airspeed.
- Down/Up Tape indicates current airspeed is less/greater than the selected airspeed.

4 – FPA ACCELERATION POINTER

- Provides an indication of acceleration and deceleration rates along the flight path.
- Moves upward/downward for increasing/decreasing values of flight path acceleration.

5 – PITCH LIMIT INDICATOR (PLI)

- Pitch based indication of the margin (in degrees) between stick shaker Angle of Attack and airplane's Angle of Attack displayed against the airplane pitch attitude, using the Airplane Symbol as zero degrees.

GREEN:	normal operating range
AMBER:	cautionary operating range. Amber PLI and LSA are displayed simultaneously.
RED:	No operation allowed in this range. Red PLI and LSA are displayed simultaneously. The stick shaker is activated.

- The PLI is a function of Airspeed in Mach, Slat/Flap position, Angle of Attack, Spoiler position, Landing Gear position and Icing conditions (EICAS message STALL PROT ICE SPEED displayed).
- When EICAS messages SHAKER ANTICIPATED or STALL PROT ICE SPEED are displayed, the PLI is displayed on lower angles due to reduction of the margin between stick shaker Angle of Attack and airplane's Angle of Attack.
- When the airspeed indication or Angle of Attack data is invalid, the PLI is removed.

6 – SLIP/SKID INDICATOR

- Indicates slip or skid if flight is not coordinated.

7 – ROLL SCALE/LOW BANK LIMIT ARC

- Indicates the current airplane roll attitude. The scale has tick marks at 10, 20, 30 and 60 degrees and inverted triangles at 0 and 45 degrees.
- A low bank limit arc helps the pilot to fly with low bank angles during turns (0° up to 15°).

8 – ROLL POINTER

- Indicates the current airplane roll attitude.

9 – FLIGHT PATH ANGLE (FPA)

- Indicates the current flight path in reference to the horizon line (green).

10 – FLIGHT DIRECTOR

- Shows lateral and vertical FD guidance cue.

11 – ILS GLIDE SLOPE DEVIATION

- Pointer: indicates current glide slope position.

GREEN:	when neither FMS nor preview mode is in use.
CYAN:	when the preview mode is selected.
AMBER:	when the deviation from the APPR 2 vertical approach path becomes out of range of the normal scale.

- Scale: indicates deviation position:

WHITE:	indicates normal deviation from the vertical path.
AMBER FLASHING:	when the deviation from the APPR 2 vertical approach path becomes out of range of the normal scale.

12 – FMS VERTICAL DEVIATION

- Pointer: indicates current vertical path (magenta). Displayed in trapezoidal form when no ILS is in use. Otherwise it is presented in diamond format.
- Scale: indicates deviation (white).

13 – ILS/VOR LATERAL DEVIATION

- Pointer: indicates current localizer position.

GREEN:	when neither FMS nor preview mode is in use. Also displayed in the expanded mode for APPR 2 operations.
CYAN:	when the preview mode is selected.
AMBER:	when the deviation from the APPR 2 lateral approach path becomes out of range of the normal scale.

- Scale: indicates deviation position.

WHITE:	indicates normal deviation from the lateral path or expanded scale for APPR 2 operation.
AMBER FLASHING:	when the deviation from the APPR 2 lateral approach path becomes out of range of the expanded scale.

14 – FMS LATERAL DEVIATION

- Pointer: indicates current lateral path (magenta). Displayed in trapezoidal format when no ILS is in use. Otherwise, it is presented in diamond format.
- Scale: indicates deviation (white).

15 – PITCH TAPE

- Provides a pitch angle indication between the airplane symbol and the horizon line or an angle indication for the flight path angle.

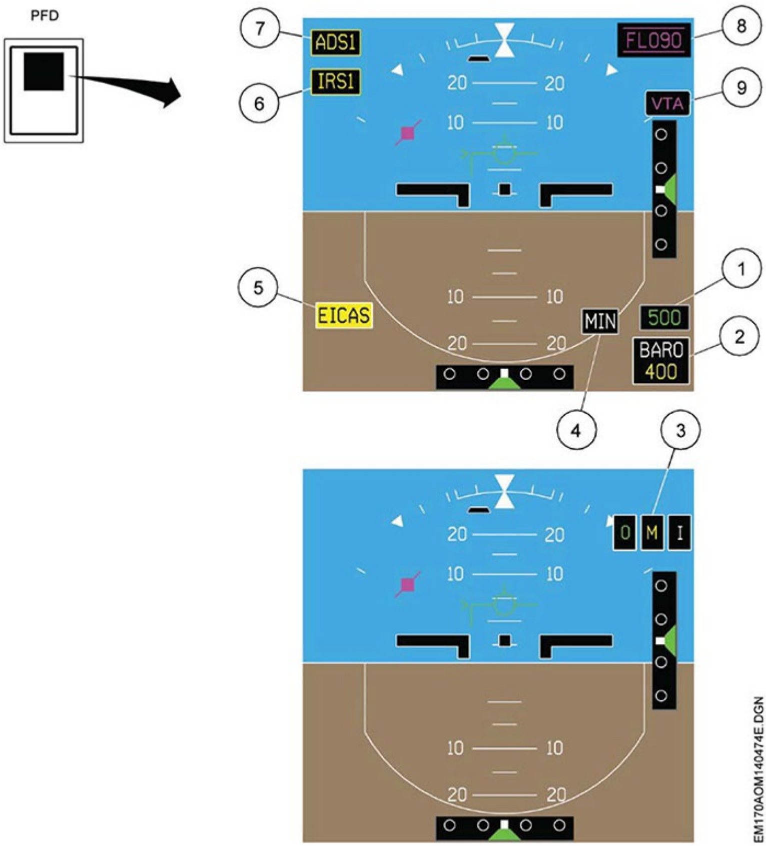
16 – TAKEOFF CROSSBAR

- In the takeoff mode, the takeoff crossbar is displayed. The horizontal line moves vertically along the center of the Airplane Symbol to provide vertical guidance. The vertical line moves horizontally along the center of the Airplane Symbol to provide horizontal guidance.

17 – EXCESSIVE PITCH CHEVRON ANNUNCIATION

- Displayed whenever excessive pitch attitude is detected.

ADI ANNUNCIATIONS



1 – RADAR ALTITUDE INDICATION

- Displays actual radar altitude.

GREEN: normal operation.

AMBER: failure of one of the radio altimeters, in a dual system installation.

2 – MINIMUMS SELECTED READOUT

- Displays the selected minimum barometric or radar altitude.

WHITE:	BARO/RA label.
CYAN:	radar or barometric altitude readout.

3 – MARKER BEACON ANNUNCIATIONS

- Displays I for inner, M for the middle or O for outer marker annunciations.

4 – MINIMUM ANNUNCIATION

- Advises that the airplane is near or at the minimum altitude preselected by the pilot.

5 – MONITOR ANNUNCIATION

- Displayed whenever the EICAS message list from both monitor warnings (MW 1 and MW 2) do not match or an ADI/HSI miscompare is detected.

6 – ATTITUDE SOURCE ANNUNCIATION

- Displays IRS1 or IRS2 to indicate that a system other than the on-side system (normal operation) is providing the data, or that both sides are using the same system.

7 – AIR DATA SOURCE ANNUNCIATION

- Displays ADS1, ADS2 or ADS3 to indicate that a system other than the on-side system (normal operation) is providing the data, or that both sides are using the same system.

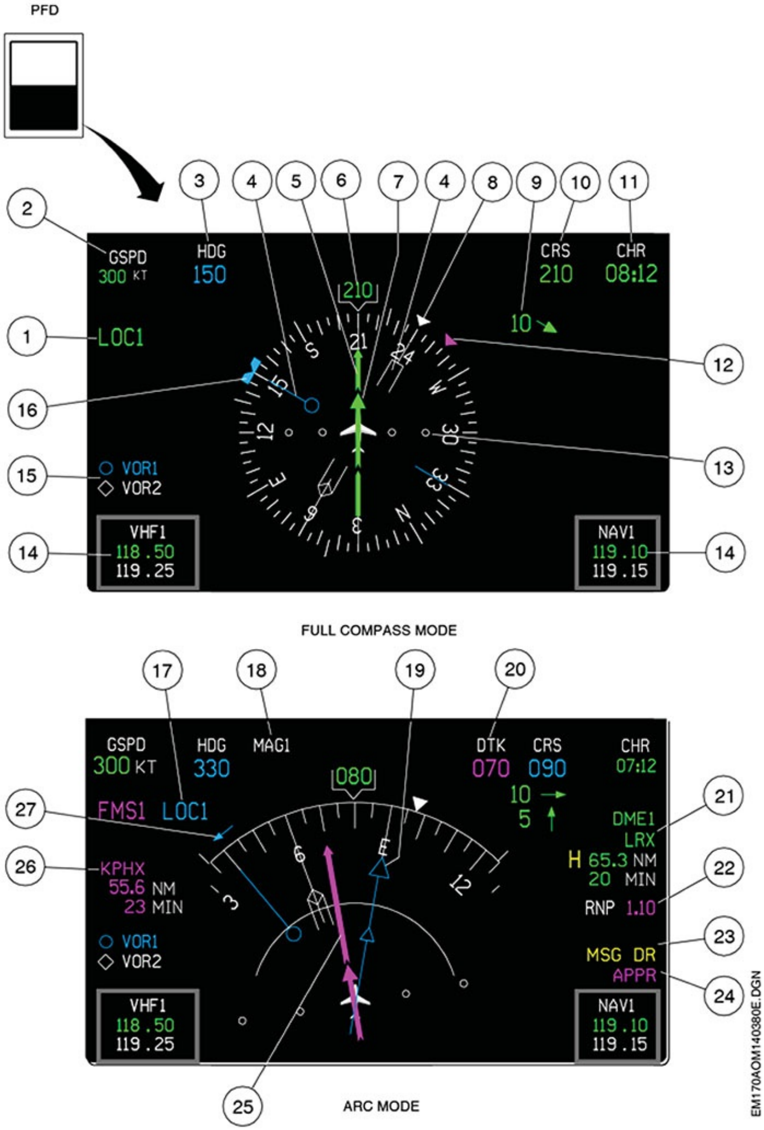
8 – VNAV ALTITUDE CONSTRAINT ANNUNCIATION

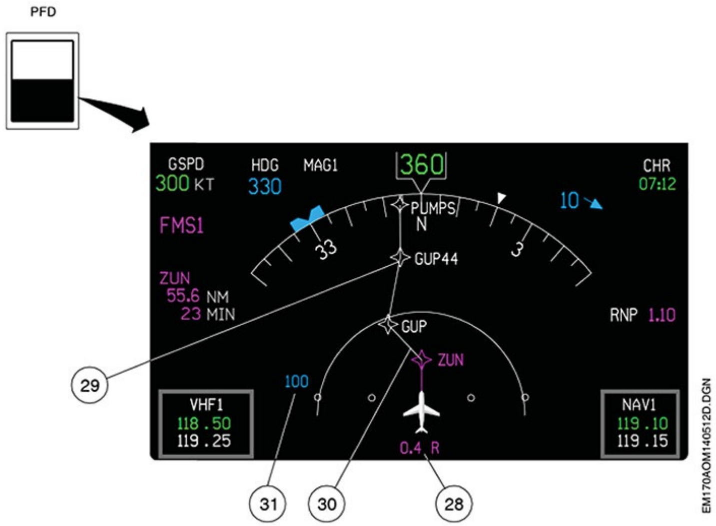
- Annunciates a VNAV waypoint constraint.
- Altitude constraints are displayed as follows:
  - At constraint: a bar is displayed above and below the altitude.
  - At or above constraint: a bar is displayed below the constraint value.
  - At or below constraint: a bar is displayed above the constraint value.
  - Constraint window: a bar is displayed above upper altitude and a bar is displayed below lower altitude.

9 – VERTICAL TRACK ALERT ANNUNCIATION

- Annunciates the transition from climbing or descending to level flight and from level flight to climbing or descending during VNAV operations.

HSI INDICATIONS





1 – PRIMARY NAVIGATION SOURCE ANNUNCIATION

- Displays the selected navigation source.

GREEN: onside V/L navigation source is selected.

AMBER: cross-side navigation or cross-side FMS navigation source is selected.

MAGENTA: FMS navigation source is selected.

2 – GROUND SPEED READOUT

- Displays Ground speed based on IRS information.

3 – SELECTED HEADING READOUT

- Displays the selected airplane heading.

CYAN: valid information.

AMBER DASHES: invalid information.

4 – BEARING POINTERS

- Displays up to two bearing pointers.

CYAN: indicates bearing for ADF1, VOR1 or FMS1 (circle head).

WHITE: indicates bearing for ADF2, VOR2 or FMS2 (diamond head).

5 – COURSE SELECT POINTER

- Displays the selected course anytime the primary navigation source is a VOR or localizer, controlled by the CRS controller on the guidance panel.

GREEN:	onside navigation source is selected.
AMBER:	cross-side navigation source is selected.
CYAN:	preview course pointer.
MAGENTA:	FMS navigation source is selected.

6 – HEADING READOUT

- Displays the actual airplane heading.

GREEN:	valid information.
AMBER DASHES:	invalid information.

- When an invalid information occurs a label HDG FAIL is also displayed.

7 – LATERAL DEVIATION INDICATOR

- Displays the deviation from the intended course. Indicates whether the airplane is flying left or right of the selected navigation reference.
- Incorporates the to/from pointer that indicates if the airplane is flying to or away from the selected navigation reference.

GREEN:	onside navigation source is selected.
AMBER:	cross-side navigation source is selected.
MAGENTA:	FMS navigation source is selected.

8 – DRIFT ANGLE BUG

- Displays the actual airplane ground track. Its offset relative to the top mark is the drift angle, that is, difference between ground track and heading.

9 – WIND DISPLAY

- Indicates wind magnitude and direction.
- Direction can be displayed as a single arrow (default) or as parallel and perpendicular arrows.

10 – COURSE SELECT/DESIRED TRACK POINTER

- Displays the selected course, controlled by the CRS controller on the guidance panel or the selected track according to data from the FMS.
- The word CRS is displayed anytime the primary navigation source is a VOR or localizer.

GREEN:	onside V/L navigation source is selected.
MAGENTA:	onside FMS navigation source is selected.
AMBER:	cross-side navigation source is selected.
CYAN:	preview course.
AMBER DASHES:	invalid information.

11 – CHRONOMETER READOUT

- Displays chronometer.
- Information removed after 30 seconds of inactivity (chronometer in stop or reset).

12 – NEXT TARGET COURSE

- During course transition the new CDI smoothly rotates with the curve. To help the crew complete the maneuver, the new symbol shows the next target course. Once the next target course is reached, the indication is removed.

13 – LATERAL DEVIATION DOTS

14 – SECONDARY RADIO TUNING

- Always displayed in left and right boxes and shows VHFNAV/COMM frequencies, when radio data is valid.
- The multifunction control display unit (MCDU) is the primary means for radio tuning, while the control cursor device (CCD) and display unit (DU) are the secondary means of radio tuning.

GREEN:	active frequency.
WHITE:	standby frequency.
AMBER DASHES:	radio data invalid.

15 – BEARING SOURCE ANNUNCIATIONS

- Display the bearing pointer sources.

CYAN (circle):	displays the related VOR1, ADF1 or FMS1 source selected.
WHITE (diamond):	displays the related VOR2, ADF2 or FMS2 source selected.

16 – SELECTED HEADING BUG

- Displays the airplane selected heading on both the full compass and arc modes controlled by the HDG Controller on the guidance panel.

17 – PREVIEW NAVIGATION SOURCE ANNUNCIATION

- Displays the preview VOR or localizer navigation.

18 – HEADING SOURCE ANNUNCIATION

- Indicates a non-normal source condition (e.g., Captain side is using IRS 2), a same source condition (e.g., both Captain and First Officer using IRS 1) or the selection of True heading reference.

19 – COURSE SELECT PREVIEW POINTER

- Displays the selected course preview (VOR or LOC) anytime the primary navigation source is a FMS, controlled by the CRS controller on the guidance panel.

20 – DESIRED TRACK READOUT

- Displays the selected track according to data from the FMS.

MAGENTA:	onside navigation source is selected.
AMBER:	cross-side navigation source is selected.
AMBER DASHES:	invalid information.

21 – DME DATA BLOCK INDICATIONS

- Display DME source, identifier, distance and time to the selected station.
- H label is displayed whenever the DME is in hold.

22 – RNP DATA BLOCK INDICATIONS

- Displayed when the FMS required navigation precision is the primary navigation source.

23 – MCDU ANNUNCIATIONS

- MSG label is displayed whenever a caution message appears in the MCDU.
- DR label is displayed whenever the FMS is operating in dead reckoning mode.
- DGRAD label is displayed whenever the FMS is operating in degrade mode.

24 – FMS MODE ANNUNCIATOR

- APPR label indicates Approach Sensitivity mode.
- TERM label indicates Terminal Approach mode.
- WPT label indicates Waypoint Alert.
- OFFSET indicates Lateral Offset.

25 – COURSE SELECT/DESIRED TRACK POINTER

- Displays the selected course controlled by the CRS controller on the guidance panel or the selected track according to data from the FMS.
- The word CRS is displayed anytime the primary navigation source is a VOR or localizer.

GREEN:	onside V/L navigation source is selected.
MAGENTA:	onside FMS navigation source is selected.
AMBER:	cross-side navigation source is selected.
CYAN:	preview course.
AMBER DASHES:	invalid information.

26 – WAYPOINT DATA BLOCK INDICATIONS

- Display the identifier, distance and time to the next waypoint.

27 – SELECTED HEADING OUT OF VIEW ARROW

- Displayed on arc mode when the selected heading is not within the viewable range, and shows which way is shortest to the selected heading.

28 – FMS LATERAL DEVIATION INDICATION

- Indicates airplane’s lateral deviation from the desired track.
- R/L label indicates right/left deviation.

29 – WAYPOINT DISPLAY

- Indicates waypoint symbol.
- If selected, also indicates waypoint identifier.

MAGENTA:	next waypoint.
WHITE:	other waypoints.

Up to five waypoints are displayed on the HSI Display subject to the range considerations.

30 – HORIZONTAL TRACK LINE

- Connects waypoints.

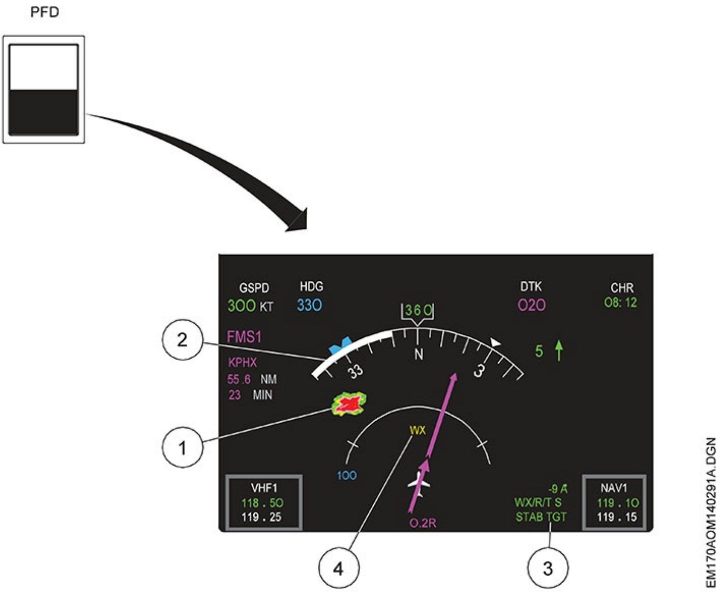
MAGENTA:	connects with next waypoint.
WHITE:	connects other waypoints.

31 – RANGE SELECTION

- Displayed only in MAP mode, provides the selected half-ring range.
- Once selected by the CCD touchpad the knob icon is displayed, indicating that the range is set and changeable by turning the CCD knob.
- The possible range values are from 2.5 up to 1000 NM.

NOTE: It is not possible to change the range when the weather overlay is active.

HSI WEATHER RADAR INDICATIONS



1 – WEATHER RADAR RETURNS

- Displays target in colors.
- WX mode: the color indicates rain intensity in order of increasing ‘intensity: green, yellow, red and magenta.
- RCT mode: attenuation is too high, hiding possible severe weather areas (cyan).
- GMAP mode: color indicates surface information: black, cyan, yellow and magenta.
- TURB mode: areas of potentially hazardous turbulence (white).

2 – ANTENNA POSITION INDICATOR

- Indicates that antenna scan is active.

3 – WEATHER RADAR ANNUNCIATIONS

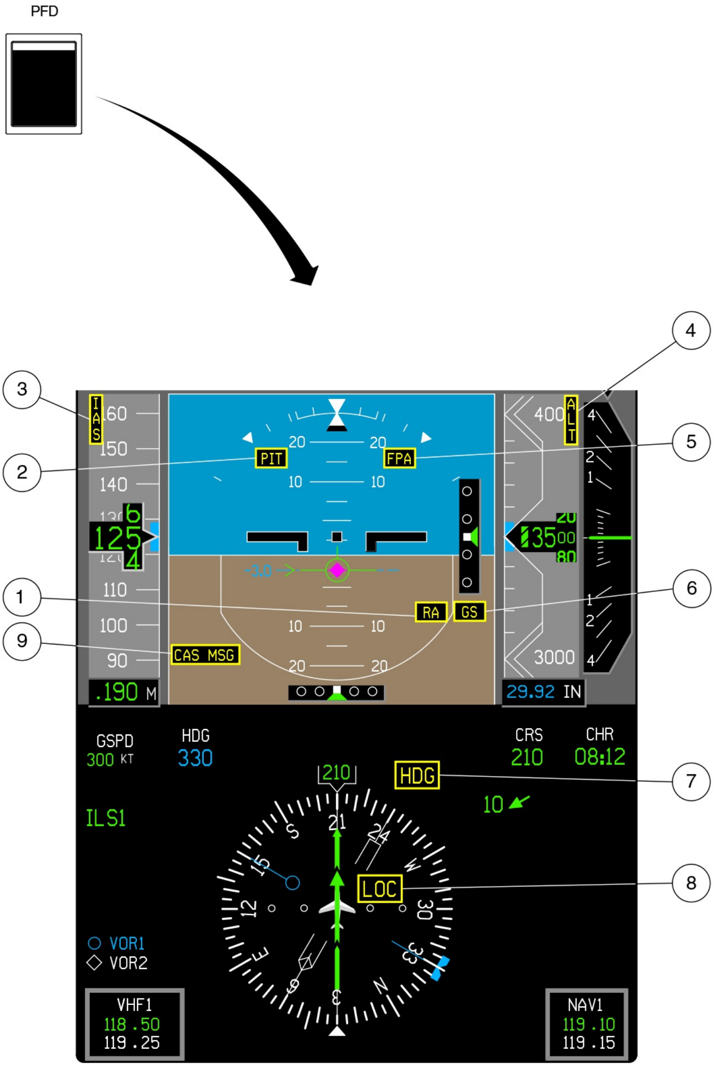
- First line:
  - CCD inner knob icon: tilt angle is modifiable.
  - Tilt angle readout: displays the tilt angle.
  - ACT annunciation: ACT is an active submode.
  - Fault code data (entire line): fault has been detected.
- Second line:
  - Weather radar mode annunciation:
  - GREEN (WX): normal WX.
  - GREEN (WX/R): normal WX with RCT.
  - GREEN (WX/T): normal WX with TURB.
  - GREEN (WX/R/T): normal WX with RCT and TURB.
  - GREEN (WX/TX): Weather transmitting, but not selected for display on the PFD or MFD, when the airplane is in air.
  - GREEN (GMAP): GMAP mode.
  - GREEN (FSBY): forced standby.
  - GREEN (TEST): test mode and no faults.
  - AMBER (WX/TX): Weather transmitting, but not selected for display on the PFD or MFD, when the airplane is on ground.
  - AMBER (WX CTRL): invalid WX control bus.
  - AMBER (FAIL): failure is detected.
  - AMBER (OVRNG): MAP range greater than 300 NM.
  - WHITE (WX OFF): WX is OFF.
  - WHITE (WAIT): power up.
  - WHITE (STBY): normal standby.
  - WHITE (S): slave mode is active.
- Third line:
  - Stabilization annunciation: radar stabilization is inhibited.
  - Target and gain mode annunciation.
  - GREEN (TGT): TGT selected.
  - FLASHING AMBER (TGT): TGT selected and alert condition.
  - AMBER (VAR): variable gain selected.

4 – WEATHER RADAR VIDEO ANNUNCIATION

- Indicates weather radar video failure.

ADI/HSI MISCOMPARES

The system is composed of a comparison monitors to annunciate a flag whenever a miscompare information is detected. The differences in indications are acceptable if no miscompare flag is displayed.



EM170AOM141637A.IDR

1 – RADIO ALTITUDE MISCOMPARE ANNUNCIATION

- Displayed whenever the radio altimeter has failed or the difference between the Captain and First Officer's radio altitude is greater than a set point.

2 – PITCH, ROLL AND ATTITUDE MISCOMPARE ANNUNCIATION

- Displayed whenever a pitch, roll or attitude miscompare is detected.
- The miscompare annunciator and triggering limits are:
- PIT: Pitch > 5°
- ROL: Rol > 6°
- ATT: ATT – Both Monitors Tripped

3 – AIRSPEED MISCOMPARE ANNUNCIATION

- Displayed whenever airspeed miscompare is detected.
- The miscompare annunciator and triggering limits are:
- IAS: > 5 KIAS

NOTE: The IAS monitor is inhibited if both airspeed indicators show below 100 KIAS.

4 – ALTITUDE MISCOMPARE ANNUNCIATION

- Displayed whenever altitude miscompare is detected.
- The miscompare annunciator and triggering limits are:
  - ALT: > 100 ft when flying in TERM areas (30 NM from departure or destination).
    ALT: > 200 ft for all other areas.

5 – FLIGHT PATH ANGLE MISCOMPARE ANNUNCIATION

- Displayed whenever miscompare is detected for FPA.
- The miscompare annunciator and triggering limits are:
  - FPA: > 2°.

6 – VERTICAL ORIENTATION SYSTEM MISCOMPARE ANNUNCIATION

- GS flag displays whenever glideslope/glidepath miscompare is detected.
- The miscompare annunciator and triggering limits are:
  - GS: > 2/3 dot

7 – HEADING MISCOMPARE ANNUNCIATION

- Displayed whenever a heading miscompare is detected.
- The miscompare annunciator and triggering limits are:
  - HDG: > 6°.

NOTE: The LOC monitor is inhibited if both navigation sources are not set to LOC.

8 – LATERAL ORIENTATION SYSTEM MISCOMPARE ANNUNCIATION

- Displayed whenever localizer miscompare is detected.
- The miscompare annunciator and triggering limit are:
  - LOC: > 1/2 dot

NOTE: The LOC monitor is inhibited if both navigation sources are not set to LOC.

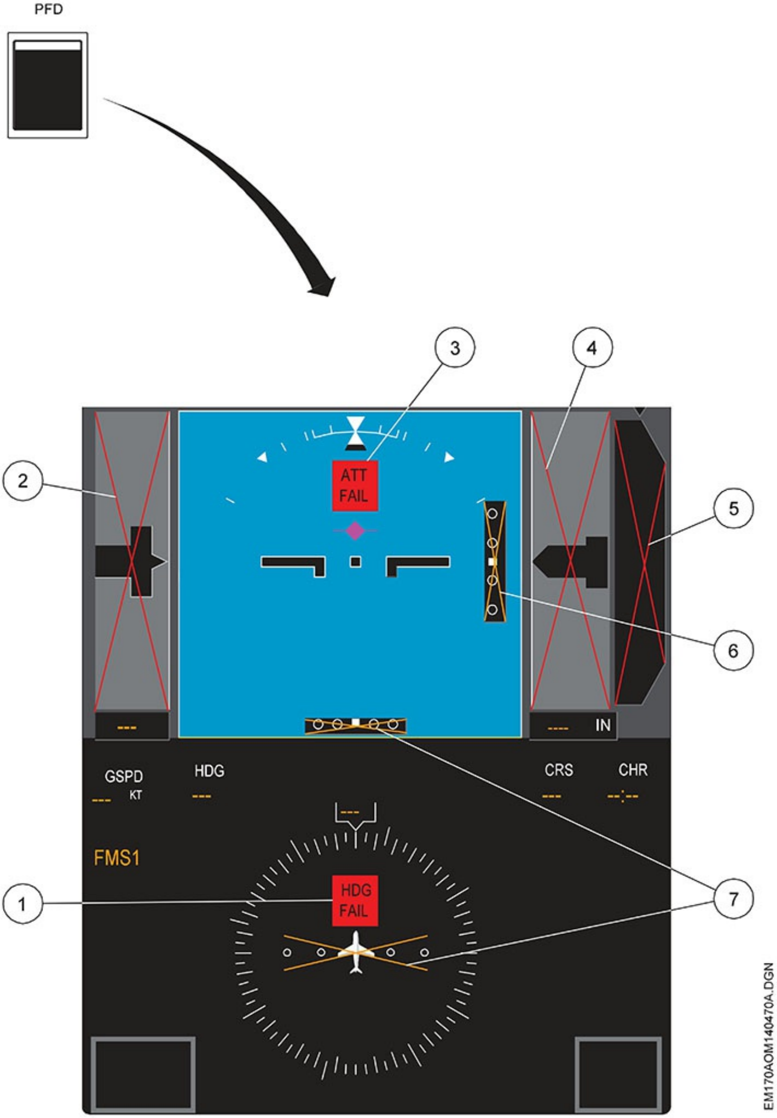
9 – EICAS MESSAGE MISCOMPARE ANNUNCIATION

- Displayed whenever the EICAS message list from both monitor warnings (MW 1 and MW 2) do not match.
- The miscompare annunciators are:

  EICAS: A Graphics Data Test Monitor failure is detected and is annunciated on the EICAS.

  CAS MSG: CAS miscompare monitoring is performed continuously on all valid sources of CAS data. If a miscompare is detected it will be annunciated on each available PFD.

ADI/HSI FAILS



1 – HDG FAIL

- An 'x' appears whenever HDG indication is lost. It is still possible to revert the HDG source from IRS 1 to IRS 2, in case of a PFD 1 Heading Indication failure, and the opposite in case of HDG 2 failure.

2 – AIRSPEED ANNUNCIATION FAIL

- Airspeed Indication disappears and an 'x' displays.

3 – ATTITUDE INDICATION FAIL

- Attitude indication disappears and a message ATT FAIL displays on PFD.

4 – ALTITUDE INDICATION FAIL

- Altitude Indication disappears and the message ALT FAIL displays on PFD. The barometric pressure correction appears dashed.

5 – VERTICAL SPEED INDICATION FAIL

- Vertical Indication disappears and an 'x' displays.

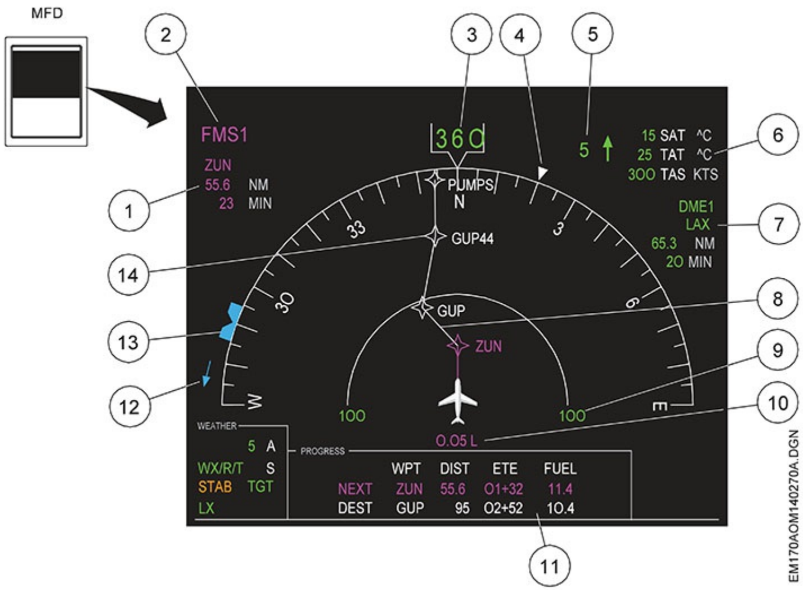
6 – ILS/FMS VERTICAL DEVIATION INDICATION FAIL

- Vertical Deviation indication disappears and an 'x' displays.

7 – LATERAL DEVIATION INDICATION FAIL

- Lateral Deviation Indication disappears and an 'x' displays.

HORIZONTAL PROFILE INDICATIONS



1 – WAYPOINT DATA BLOCK INDICATIONS

- Display the identifier, distance and time to the next waypoint.

2 – FMS SOURCE INDICATION

- Displays the selected FMS source.

MAGENTA:	onside FMS is selected.
AMBER:	cross-side FMS is selected.

3 – HEADING READOUT

- Displays airplane’s actual heading.

GREEN:	valid information.
AMBER DASHES:	invalid information.

4 – DRIFT ANGLE BUG

- Displays airplane’s actual ground track. Its offset relative to the top mark is the drift angle, that is, difference between ground track and heading.

5 – WIND DISPLAY

- Indicates wind magnitude and direction of the wind.
- Direction can be displayed as a single arrow (default) or as parallel and perpendicular arrows.

6 – AIR DATA SYSTEM INDICATIONS

- Information not available when:
  - Temperature indication of either TAT 1 or TAT 2 is above 60°C, or;
  - Airplane is on ground and any engine is running.
- Indicates static air temperature (SAT), total air temperature (TAT) and true air speed (TAS), sourced by the selected Air Data System.

GREEN:	all operating ranges.
AMBER DASHED:	invalid information or ADS failure, TAT and SAT may be different.

7 – DME DATA BLOCK INDICATIONS

- Display DME source, identifier, distance and time to the selected station.
- H label is displayed whenever the DME is in hold.

8 – HORIZONTAL TRACK LINE

- Connects waypoints.

MAGENTA:	connects with next waypoint.
WHITE:	connects other waypoints.

9 – RANGE SELECTION

- Displayed when MAP mode is selected, as an outer compass ring and an inner half-range ring. The half-range ring is labeled with the half-range distance.
- The Plan format displays only a half-range ring, which is labeled with the range distance.
- Both range labels are shown with the knob icon, indicating that the range is set and changed by turning the CCD knob.
- The possible values for range are 2.5 NM to 1000 NM.

NOTE: It is not possible to change the range when the on-side weather virtual controller is selected to OFF and the slave mode is active.

10 – FMS LATERAL DEVIATION INDICATION

- Indicates airplane's lateral deviation from the desired track.
- R/L label indicates right/left deviation.

11 – FMS PROGRESS WINDOW

- Data contained in the box is arranged in two rows. The upper row lists data for the next waypoint (NEXT) and the lower row lists data for the destination (DEST). The following information is displayed: waypoint name, distance to go, estimated time enroute and fuel remaining at the waypoint.

12 – SELECTED HEADING OUT OF VIEW ARROW

- Displayed when the selected heading is not within the viewable range, and shows which way is shortest to the selected heading.

13 – SELECTED HEADING BUG

- Displays the airplane selected heading controlled by the HDG Controller on the guidance panel.

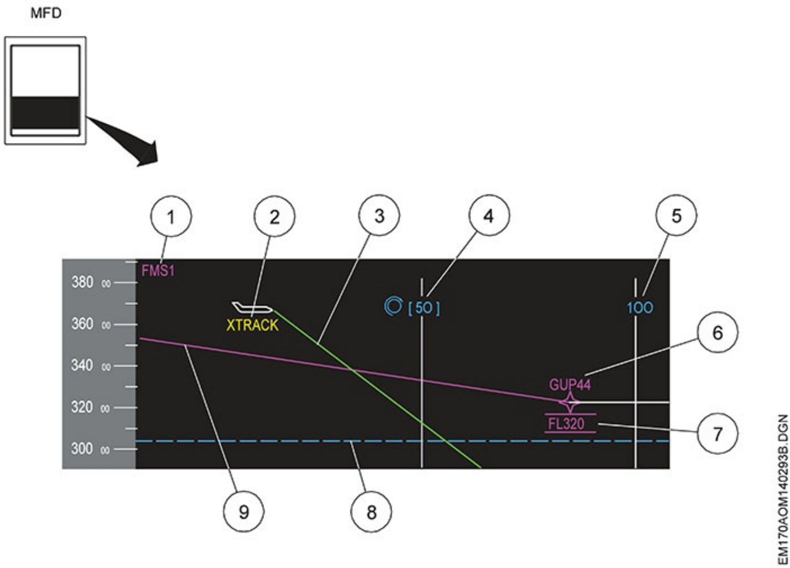
14 – WAYPOINT DISPLAY

- Indicates waypoint symbol.
- If selected, also indicates waypoint identifier.

MAGENTA: next waypoint.

WHITE: other waypoints.

VERTICAL PROFILE INDICATIONS



1 – FMS SOURCE INDICATION

- Displays the selected FMS source.

MAGENTA: on-side FMS is selected.

AMBER: cross-side FMS is selected.

2 – CROSS TRACK ANNUNCIATION

- Indicates a significant deviation from the planned horizontal flight path.
- The vertical track line from the left of the vertical profile window to the next waypoint changes to a dashed amber line.

3 – AIRPLANE TRAJECTORY LINE

- Shows the vector trend of the airplane along the vertical axis, based on the current flight path angle.

4 – HALF/FULL CURL ICON INDICATION

- Can be changed using the CCD outer knob.

5 – HALF/FULL RANGE INDICATIONS

- Show the selected horizontal ranges.

6 – WAYPOINT DISPLAY

- Indicates waypoint symbol.
- If selected, also indicates waypoint identifier with altitude and, if applicable, a HOLD label that indicates a holding pattern.

MAGENTA:	next waypoint.
WHITE:	other waypoints.

7 – VNAV ALTITUDE CONSTRAINT INDICATION

- Indicates a VNAV waypoint constraint.
- Altitude constraints are displayed as follows:
  - At an altitude: a bar is displayed above and below the constraint value.
  - At or above an altitude: a bar is displayed below the constraint value.
  - At or below an altitude: a bar is displayed above the constraint value.
  - Altitude window: a bar is displayed above the upper constraint value and a bar is displayed below the lower constraint value.

8 – SELECTED ALTITUDE INDICATION

- Indicates the selected altitude in the guidance panel.

9 – VERTICAL TRACK LINE

- Connects waypoints.

MAGENTA:	connects with next waypoint.
WHITE:	connects other waypoints.
DASHED AMBER:	airplane has significantly deviated from the planned horizontal flight path.

MFD WEATHER RADAR

1 – WEATHER RADAR RETURNS

- Displays target in colors.
- WX mode: the color indicates rain intensity. In increasing order of intensity: green, yellow, red and magenta.
- RCT mode: attenuation is too high, hiding possible severe weather areas (cyan).
- GMAP mode: color indicates surface information: black, cyan, yellow and magenta.
- TURB mode: areas of potentially hazardous turbulence (white).

2 – TARGET ALERT CHECKBOX

- Enables and disables the radar target feature. Can only be selected in the WX mode and at selected ranges of 200 NM or less.

3 – RAIN ECHO ATTENUATION COMPENSATION TECHNIQUE CHECKBOX

- Enables REACT function in all modes, except GMAP.

4 – ALTITUDE COMPENSATED TILT CHECKBOX

- Enables automatic adjustment of the antenna tilt in relation to the altitude and selected range.

5 – TURBULENCE DETECTION CHECKBOX

- Enables the turbulence function only in the WX mode and at selected ranges of 50 NM or less.

6 – GAIN INDICATION DISPLAY

- Indicates receiver sensitivity level from 0 to 100.

7 – RECEIVER GAIN CHECKBOX

- Enables manual variation of the receiver sensitivity.

8 – ANTENNA STABILIZATION CHECKBOX

- Enables/disables automatic antenna stabilization.
- An amber STAB label is displayed within the weather box when automatic antenna stabilization is disabled.

9 – SECTOR SCAN CHECKBOX

- Enables the sector scan function for both pilots' displays.

10 – OFF MODE

- Turns off the weather mode, provided OFF is selected in both weather radar virtual controllers.
- In flight only, a single virtual controller selected to OFF operates in SLAVE mode.

11 – STANDBY MODE

- Selects the radar system into a standby mode, provided STBY is selected in both weather radar virtual controllers.
- A green FSBY label is displayed within the weather box when forced standby is active, on the ground.

12 – GROUND MAPPING MODE

- Enables ground mapping mode.

13 – RADAR MODE

- In flight, activates the radar mode.

14 – FORCED STANDBY OVERRIDE

- Enables WX on the ground, when selected on both pilots' virtual control panel.

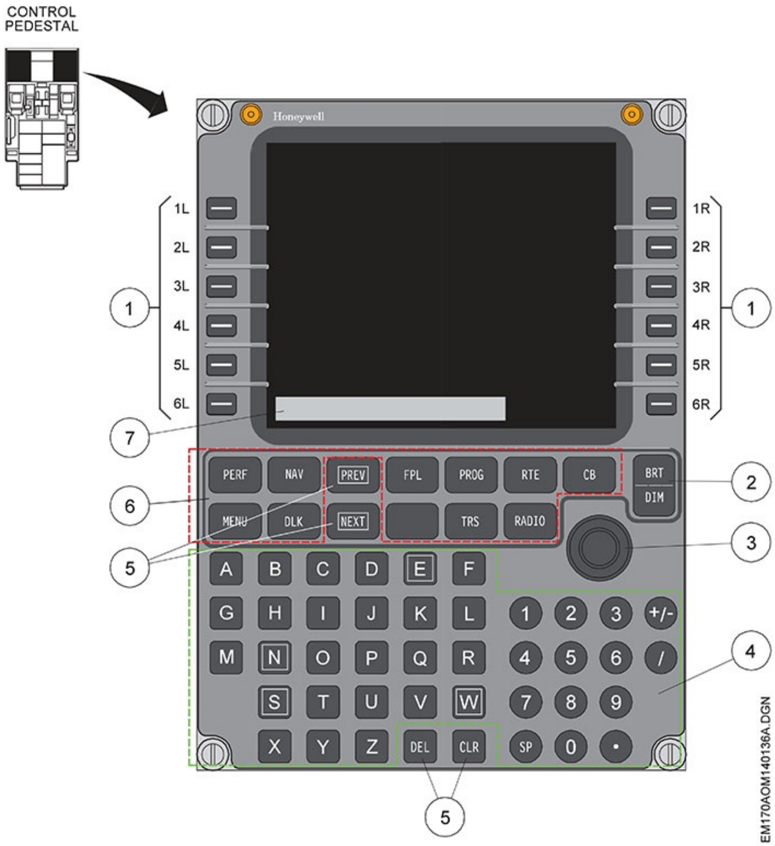
NOTE: Selection of Antenna Stabilization checkbox (STAB OFF) 4 times in less than 3 seconds enables the forced Standby Override function (FSBY OVRD).

15 – WEATHER RADAR ANNUNCIATIONS

- First line:
  - CCD inner knob icon: tilt angle is modifiable.
  - Tilt angle readout: displays the tilt angle.
  - ACT annunciation: ACT is active.
  - Fault code data (entire line): fault has been detected.
- Second line:
  - Weather radar mode annunciation:
  - GREEN (WX): normal WX.
  - GREEN (WX/R): normal WX with RCT.
  - GREEN (WX/T): normal WX with TURB.
  - GREEN (WX/R/T): normal WX with RCT and TURB.
  - GREEN (GMAP): GMAP mode.
  - GREEN (FSBY): forced standby.
  - GREEN (TEST): test mode and no faults.
  - AMBER (WX CTRL): invalid WX control bus.
  - AMBER (FAIL): failure is detected.
  - AMBER (OVRNG): MAP range greater than 300 NM.
  - WHITE (WX OFF): WX is OFF.
  - WHITE (WAIT): power up.
  - WHITE (STAB): STAB OFF function selected.
  - WHITE (STBY): normal standby.
  - WHITE (S): slave mode is active.
- Third line:
  - Stabilization annunciation: radar stabilization is inhibited.
  - Target and gain mode annunciation.

GREEN (TGT):	TGT selected.
FLASHING AMBER (TGT):	TGT selected and alert condition.
AMBER (VAR):	variable gain selected.

MCDU CONTROLS



1 – LINE SELECT KEYS

- Data is selected to a line from the scratchpad or vice-versa.
- Selects a page if the line shows an index display (arrow).

2 – BRIGHTNESS CONTROL BUTTON

- Controls display brightness.
- A control bar will be displayed in the scratchpad.

3 – TUNING CONTROLLER

- Rotating this controller selects frequencies or other numeric values.

4 – ALPHANUMERIC BUTTONS

- Enter alphanumeric inputs.
- Space key (SP) is used to insert a space.
- A toggle plus/minus key inserts the corresponding signal.

5 – PREV/NEXT AND CLR/DEL BUTTONS

- Previous (PREV): Changes the current page to the previous page.
- Next (NEXT): Changes the current page to the next page.
- Clear (CLR): Clears alphanumeric entries or messages in the scratchpad.
- Delete (DEL): Works together with line select buttons in order to delete waypoints and other items displayed. This button is inhibited when a message is displayed.

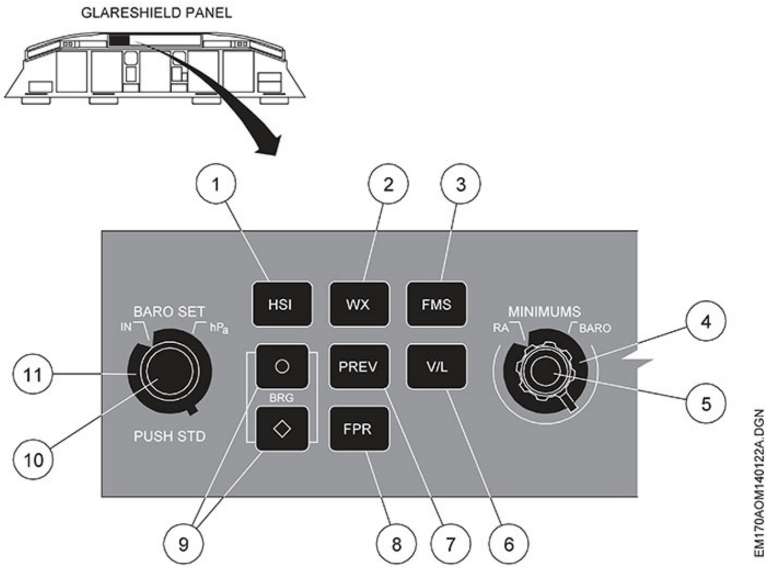
6 – FUNCTION BUTTONS

- Menu (MENU): Displays the menu page.
- Data link (DLK): Displays ACARS main menu page.
- Radio (RADIO): Displays the radio page.
- Circuit breaker (CB): Displays the circuit breaker page.
- Thrust Rating Selection (TRS): Display the engine thrust ratings for various flight phases.
- Performance (PERF): Displays the performance page (FMS function).
- Navigation (NAV): Displays the navigation page (FMS function).
- Flight plan (FPL): Displays the flight plan page (FMS function).
- Progress (PROG): Displays the progress page (FMS function).
- Route (RTE): Display the route page (FMS function).

7 – SCRATCHPAD

- It is the working area, located on the bottom line of the display, where the pilot can enter data and/or verify data before line selecting the data into its proper position.
- Data is retained on the scratchpad throughout all mode and page changes.
- The scratchpad also provides advisory and alerting messages to be displayed.

DISPLAY CONTROLLER PANEL



1 – HORIZONTAL SITUATION INDICATOR (HSI) BUTTON

- Selects between full compass, arc or map mode for the on-side PFD.

2 – WEATHER RADAR (WX) BUTTON

- Displays WX Radar information on PFD (HSI in arc or map mode only).

3 – FMS BUTTON

- Selects FMS as the primary navigation source for the on-side PFD and toggles between FMS1 and FMS2.

4 – MINIMUMS KNOB (OUTER)

- RA: sets radio altimeter minimums.
- BARO: sets barometric minimums.

5 – MINIMUMS CONTROLLER (INNER)

- Selects decision height (DH), decision altitude or minimum descent altitude based on position of RA/BARO selector knob.

6 – VOR/LOC (V/L) BUTTON

- Selects VOR or LOC as the primary navigation source for the on side PFD and toggles between VOR/LOC1 and VOR/LOC2.

7 – PREVIEW (PREV) BUTTON

- Selects the preview mode when the FMS is the primary navigation source. The course and the lateral/vertical deviation can be previewed.
  - Pressing the first time: enables the on-side VOR/LOC preview.
  - Pressing a second time: enables the opposite side VOR/LOC preview.
  - Pressing a third time: disables the preview mode.
- The previewed navigation source will automatically transition as the primary navigation source when capture on LOC mode.

8 – FLIGHT PATH REFERENCE (FPR) BUTTON

- Commands the flight path reference line and the flight path digital readout.

9 – BEARING SOURCES (BRG) BUTTONS

- CIRCLE (O): allows VOR1, ADF1 or FMS1 selection for the on-side PFD display.
- DIAMOND (◊): allows VOR2, ADF2 or FMS2 selection for the on-side PFD display.

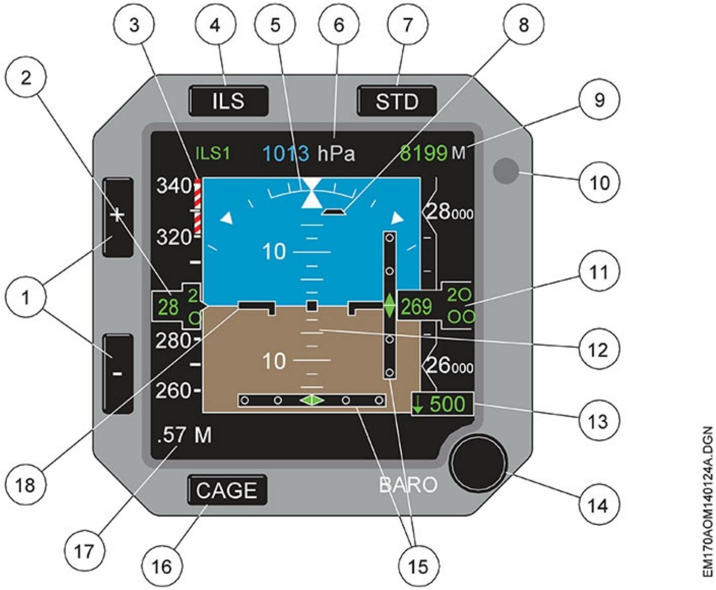
10 – BARO SET CONTROLLER (INNER)

- Sets barometric altimeter correction.
- Pushing this control knob sets barometric correction to standard.

11 – BARO SET KNOB (OUTER)

- IN: sets barometric correction format to inches of mercury.
- HPA: sets barometric correction format to hectopascals.

INTEGRATED ELECTRONIC STANDBY SYSTEM (IESS)



1 – BRIGHTNESS ADJUSTMENT BUTTONS

- Adjust brightness.

2 – AIRSPEED ROLLING DIGITS

- Indicates actual calibrated airspeed.
- In case of failure the airspeed tape and the pointer will be removed and replaced by a red cross.

3 – VMO/Mmo BARBER POLE

- Displayed when V_{MO}/Mmo is within the viewable range, and covers speeds at or above V_{MO}/Mmo (red and white).
- An amber V_{MO} Flag being displayed on the IESS means that the maximum speed indication is lost, because flap/slat information is unavailable to the standby system.

4 – ILS BUTTON

- Selects the display of ILS 1 deviations and the label LOC 1 is annunciated on the left top corner. In case of failure, a red cross replaces the annunciation.

5 – ROLL INDICATION

- Indicates the bank angle of the airplane.

6 – REFERENCE BAROMETRIC PRESSURE INDICATION

- Indicates the barometric pressure as set by the barometric rotary knob.

7 – STANDARD (STD) BUTTON

- Sets the barometric pressure to standard atmospheric pressure.

8 - SLIP/SKID INDICATION

- Indicates slip or skid angle if flight is not coordinated.

9 – METER ALTITUDE INDICATION

- Indicates the actual altitude in meters.
- A green hashed box appears on the left side of the numeric digits when altitude is below 10000 m.
- A minus (-) symbol appears on the left side of the numeric digits when altitude is below sea level.

10 – BRIGHTNESS CELL

- Automatically adjusts the instrument brightness according to the ambient lighting.

11 – ALTITUDE INDICATION

- Indicates actual altitude, with graduated scale of 20 ft.
- A NEG indication is displayed vertically in white in case of negative altitude.
- In case of failure the altitude tape will be removed and replaced by a red cross, and an ALT flag is displayed.
- A green hashed box appears on the left side of the numeric digits when altitude is below 10000 ft.
- A minus (-) symbol appears on the left side of the numeric digits when altitude is below sea level.

12 – PITCH ANGLE SCALE

- Provides a pitch angle indication between the airplane symbol and the horizon line.

13 – VERTICAL SPEED

- Indicates the actual vertical speed in feet per minute (ft/min).
- An arrow indicates climb or descent.
- In case of failure the corresponding pointer and scale will be removed.

14 – BARO CONTROLLER

- Allows barometric settings.

15 – ILS DEVIATIONS

- Vertical scale: green diamond indicates glide slope position.
- Horizontal scale: green diamond indicates localizer position.
- Vertical and horizontal scales are not displayed when ILS is not selected.
- In case of failure, the pointer and the scale are removed from view and replaced by a red cross.

16 – CAGE BUTTON

- Resets attitude to zero, eliminating accumulated drift when the button is pressed for more than two seconds.
- Not operational during the initialization mode and must be used with wings leveled on stabilized flight conditions.
- When pressed, an amber CAGE flag is displayed on the upper right corner of the IESS.

17 – MACH NUMBER INDICATION

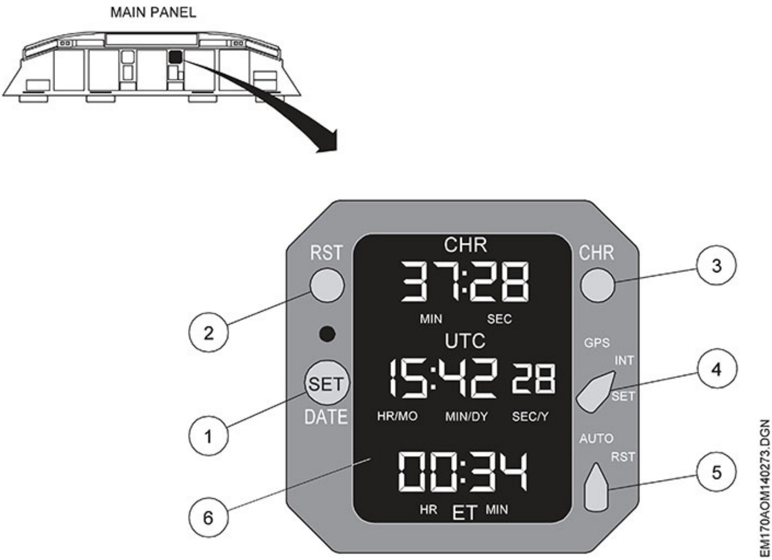
- Displayed whenever Mach increases above 0.45 and will be removed when Mach decreases below 0.40.

18 – AIRPLANE SYMBOL

- Reference for airplane attitude indication.

CLOCK/CHRONOMETER

MAIN PANEL



MAIN PANEL CHRONOMETER

1 – DATE/SET CONTROLLER/BUTTON

- Allows time setting when GPS/INT/SET knob is in the SET position. Repeated pressings of the SET button causes the selector to cycle between minute, hour, year, month and day. The desired digits flashes and the setting is obtained by rotating the DATE/SET controller clockwise to increase and counter-clockwise to decrease.
- Selects the date to be displayed on the associated indicator, when GPS/INT/SET knob is in GPS or INT.

2 – RESET (RST) BUTTON

- Reset the chronometer to zero if chronometer is stopped.
- LCD display is blanked when the RST button is pressed and the chronometer is running.

3 – CHRONOMETER (CHR) BUTTON

- Starts/stops the chronometer.

4 – GPS/INT/SET KNOB

- GPS: synchronizes with UTC and DATE from GPS.
- INT: displays information from the internal clock.
- SET: allows date and time to be set by the DATE/SET CONTROLLER/BUTTON.

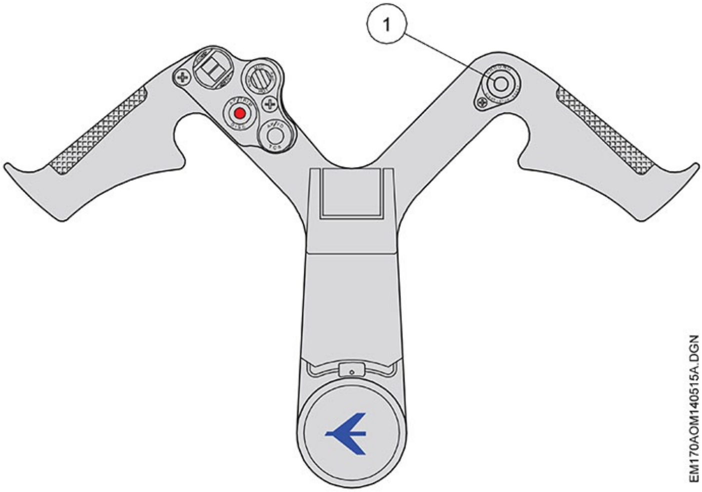
5 – ELAPSED TIME KNOB

- AUTO: automatically starts the chronometer on liftoff.
- RST (spring loaded): resets the elapsed time if WOW is present.

6 – CLOCK/CHRONOMETER DISPLAY

- Displays chronometer, time/date and elapsed time.
- If no GPS signal is detected, the clock will display dashes and only the positions INT and SET on the GPS/INT/SET knob will be available.
- The chronometer display is blanked in the non-operating mode.

CONTROL WHEEL

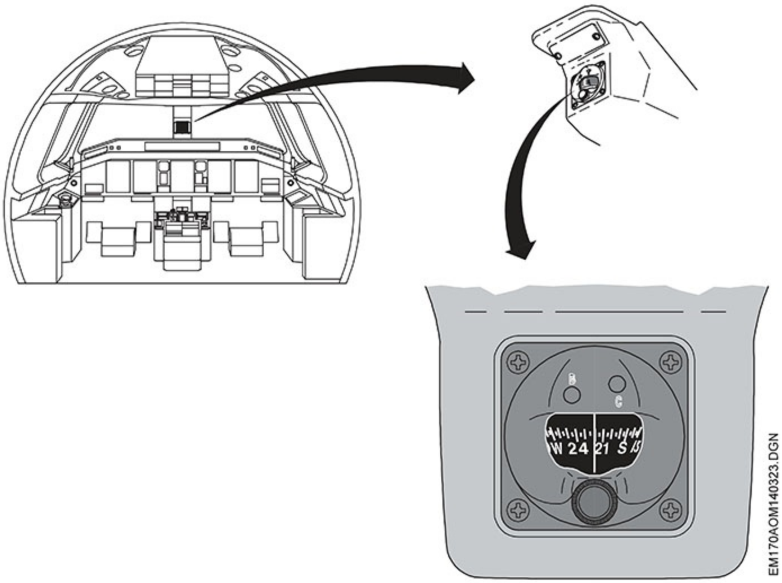


CONTROL WHEEL CHRONOMETER

1 – CHRONOMETER (CHRONO) BUTTON

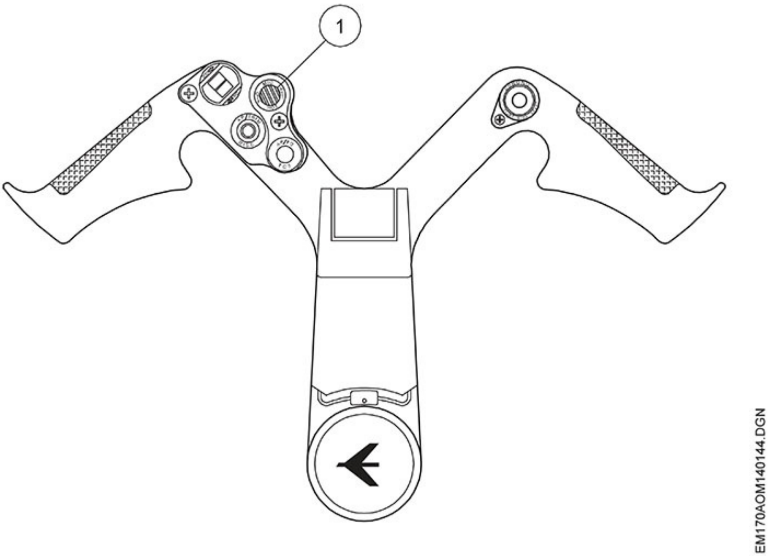
- Starts/stops/resets the chronometer displayed on PFD.
- Independent information/functioning for each control wheel.

STANDBY MAGNETIC COMPASS



COMMUNICATION

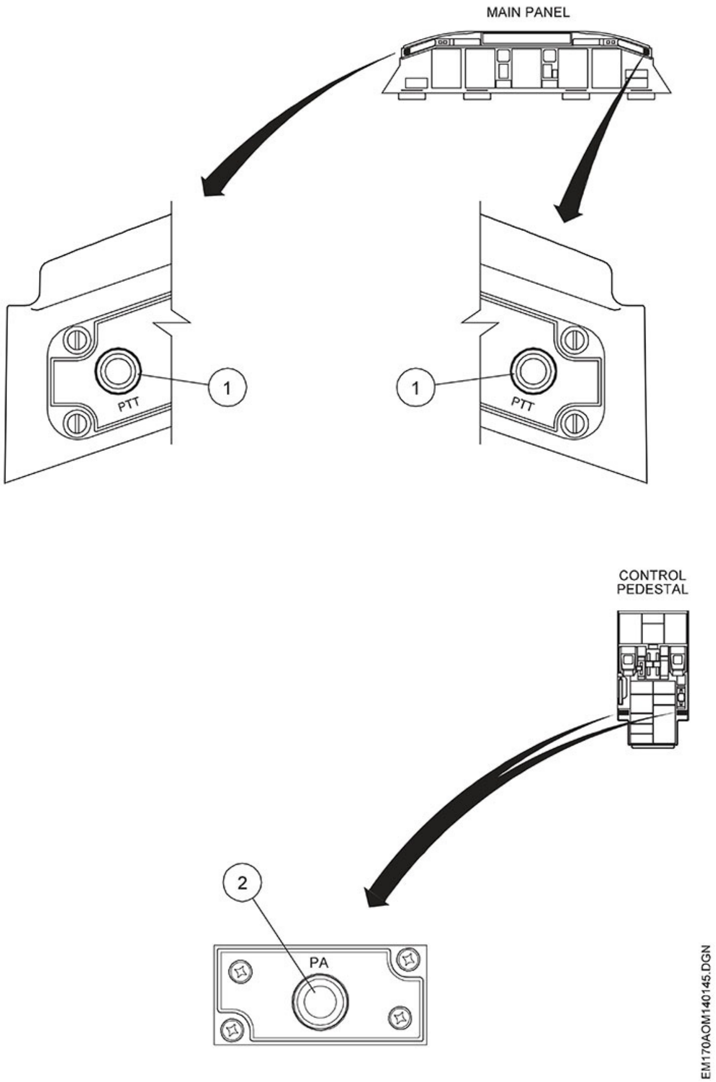
CONTROL WHEEL



1 – CONTROL WHEEL COMMUNICATIONS SWITCH

- PTT (momentary): allows VHF transmissions, as well as voice communications to passengers.
- HOT: allows communication between crewmembers and between crewmembers and ramp station.
- OFF: allows only audio reception.

GLARESHIELD COMMUNICATION



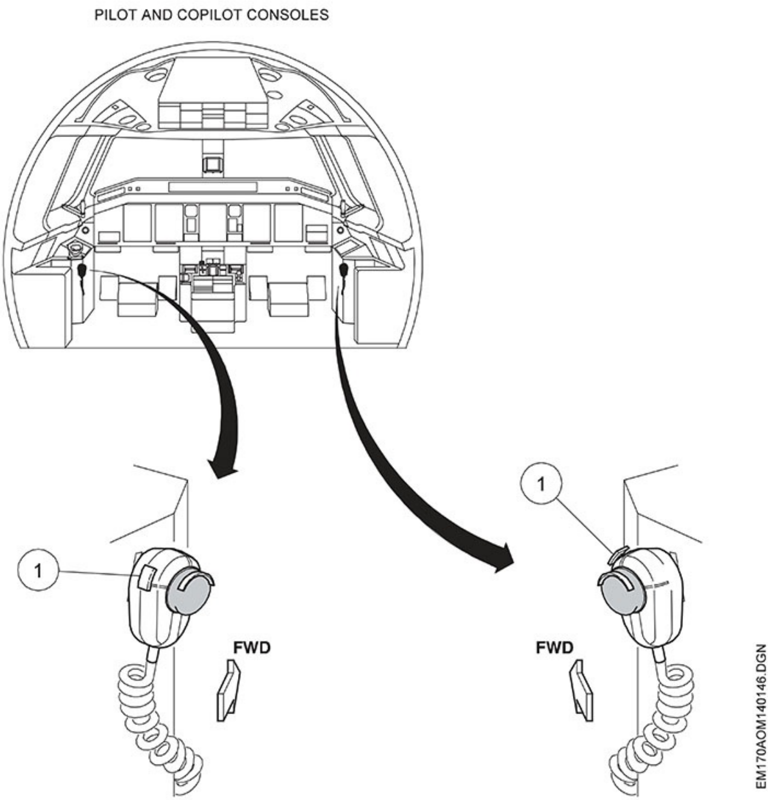
1 – GLARESHIELD PTT BUTTON

- Allows VHF transmissions and voice communications to passengers.

2 – PASSENGER ADDRESS (PA) BUTTON

- Allows voice communications to passengers, regardless of any selection in the audio control panel. While selected, it deactivates the microphone selector button (audio control panel), and in this case no radio transmission occurs since there is no VHF/HF/SATCOM microphone selection.
- When selected for more than 2 min, the communication is automatically deactivated.

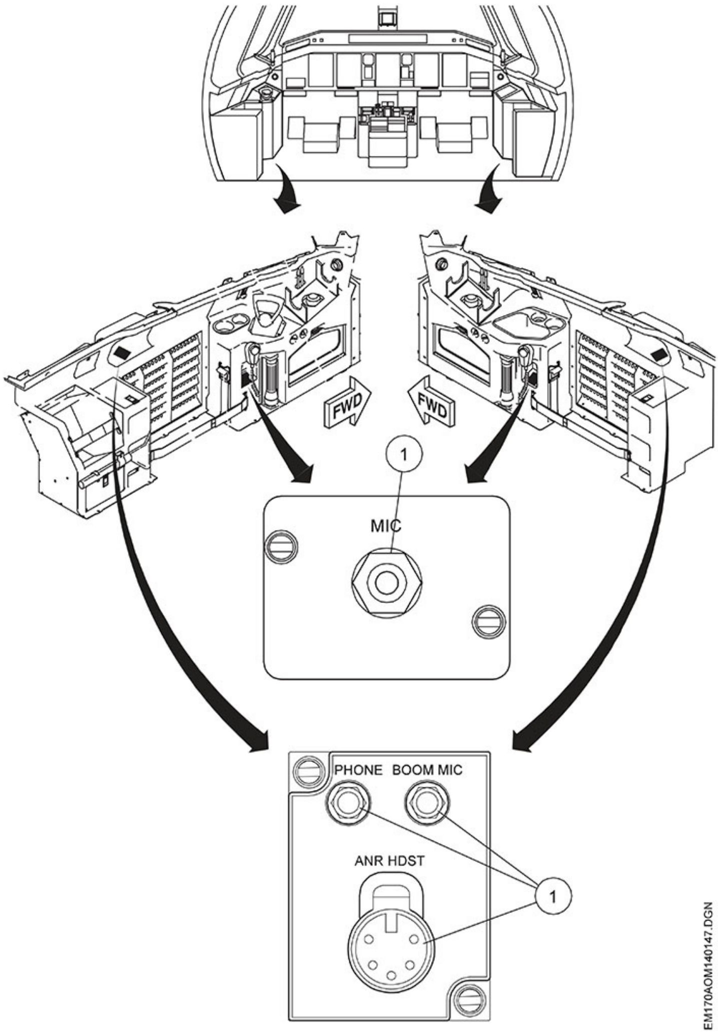
HAND MICROPHONE CONTROLS



1 – HAND MIC PTT BUTTON

- Allows transmission through the ACP, as well as communication to passengers.

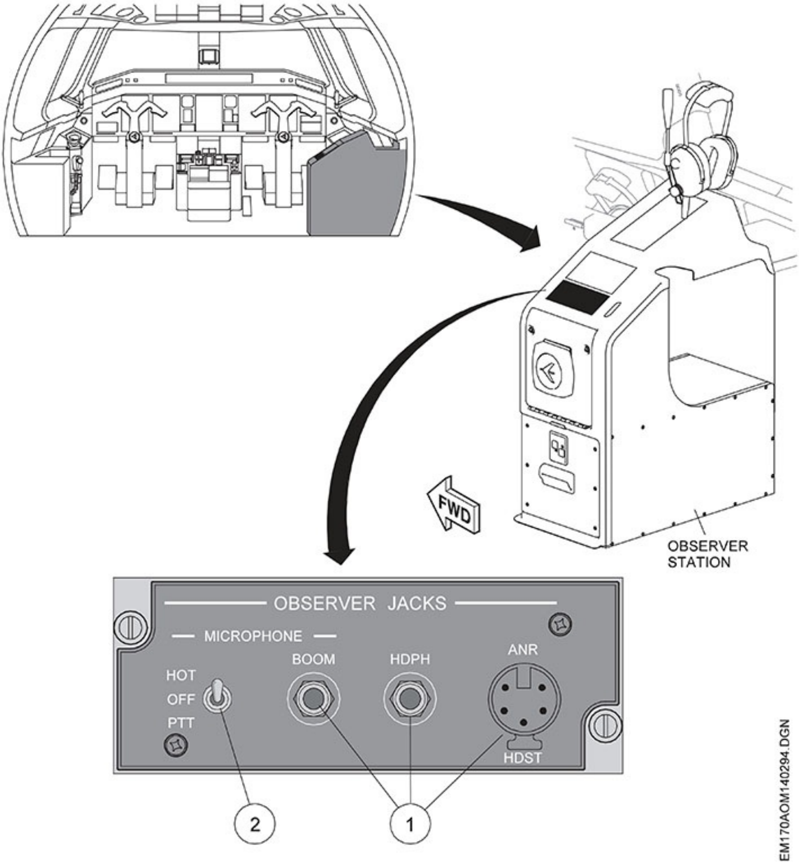
CAPTAIN AND FIRST OFFICER JACK PANELS



1 – CAPTAIN AND FIRST OFFICER JACKS

- Allows plugging in headphone (PHONE), headset (ANR HDST), hand microphone (HAND MIC) and boom microphone (BOOM MIC).

OBSERVER JACK PANEL



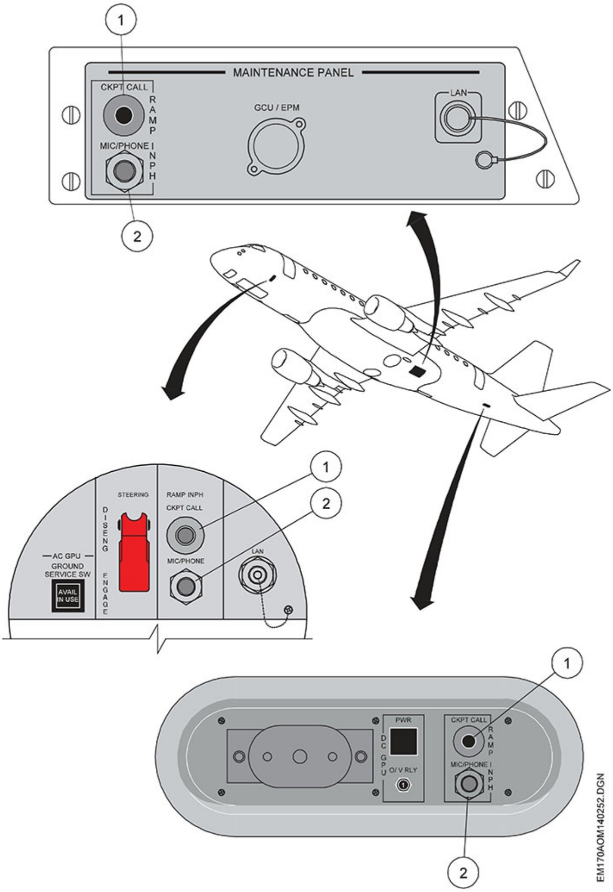
1 – OBSERVER JACKS

- Allows plugging in headphone (HDPH), headset (ANR HDST) and boom microphone (BOOM).

2 – OBSERVER COMMUNICATIONS SWITCH

- PTT (momentary): allows VHF and voice communications with passengers.
- HOT: allows communication between crewmembers and between crewmembers and ramp station.
- OFF: allows only audio reception.

RAMP STATION



1 – COCKPIT (CKPT) CALL BUTTON (momentary action)

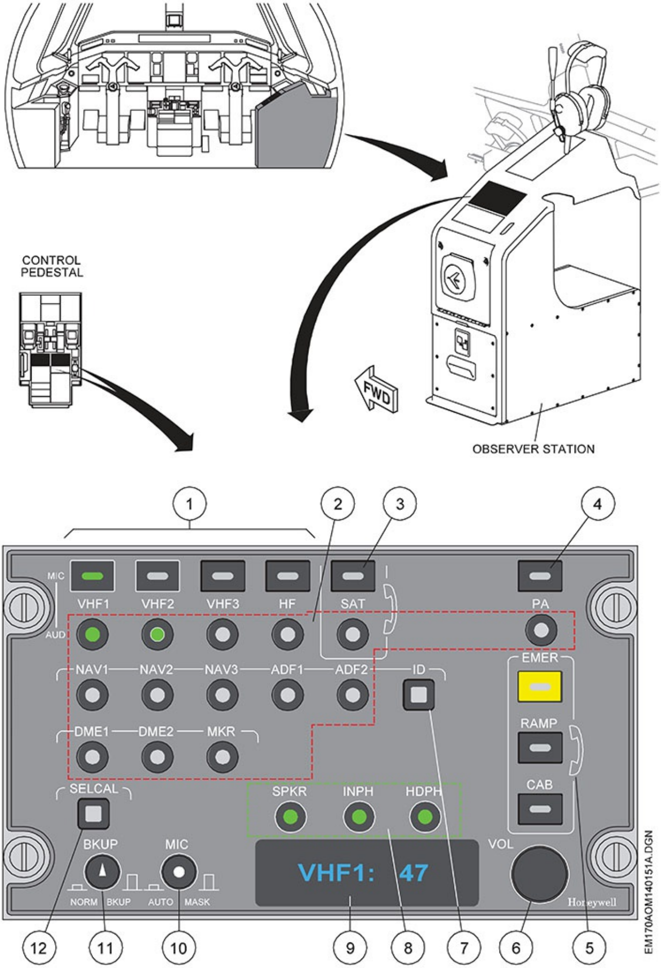
- When pressed, generates a single HI/LO tone chime and the RAMP annunciator button flashes on the audio control panel.

2 – MICROPHONE/HEADPHONE JACK

- Allows ground personnel to plug in a headphone and a microphone equipped with a PTT button.

NOTE: Ground personnel panel is linked to the hot mic once the ramp button is selected.

AUDIO CONTROL PANEL (ACP)



1 – MICROPHONE SELECTOR BUTTONS

- Related communication channel is enabled for transmission and reception.
- When selected, a green bar illuminates inside the button.

2 – AUDIO CONTROL BUTTONS

- Related audio channel is enabled for reception.
- Automatically activated when a transmission channel is selected.
- More than one audio channel may be selected at the same time.
- When selected, a green dot illuminates inside the button.

3 – SATCOM CONTROL BUTTON

- UNAVAILABLE

4 – PASSENGER ADDRESS (PA) BUTTON

- Enables PA announcements. It deactivates the microphone selector button and in this case no radio transmission occurs since there is no VHF/HF/SATCOM microphone selection.
- When selected, a green bar illuminates on the transmission button and a green dot illuminate on the reception button.
- If PTT (from Yoke, Glareshield or Hand Microphone) remains pressed for more than 2 min, after PA is selected, the communication is automatically deactivated.

5 – SERVICES INTERPHONE CONTROL BUTTONS

- EMER: enables communication with flight attendants during emergency situations (emergency mode). A triple HI/LO tone chime sounds through the PA system and illuminates a red light at the ceiling of the flight attendant station. When selected, a green bar flashes on button until the flight attendant picks up the call. Once the flight attendant picks up the call the green bar flashes faster. Pressing the button again, the light becomes steady and the communication with the flight attendant is enabled.
- RAMP: enables communication with ground personnel. For an incoming call, the ramp annunciator flashes and remains steady on when active. A single HI/LO tone chimes. A microphone selector button can be selected while RAMP is active. In this case, the RAMP button remains illuminated. Communication through the ramp interphone remains active unless PTT or PA PTT is activated for radio transmission or passenger announcements and resumes when PTT or PA PTT is released.
- CAB: enables communication with flight attendants during normal situations (normal mode). A single HI/LO tone chime sounds through the PA system and illuminates a green light at the ceiling of the flight attendant station. When selected, a green bar flashes on button until the flight attendant picks up the call. Once the flight attendant picks up the call the green bar flashes faster. Pressing the button again, the light becomes steady and the communication with the flight attendant is enabled. A microphone selector button can be selected while CAB is active. In this case, the CAB button remains illuminated. Communication through the cabin interphone remains active unless PTT or PA PTT is activated for radio transmission or passenger announcements and resumes when PTT or PA PTT is released.

NOTE: The RAMP and CAB control buttons can be selected at the same time. Also, one microphone selector button can be selected together with cabin or ramp buttons. CAB cannot be selected while EMER is active as selection of EMER deselects CAB and transfers audio communication to the EMER channel.

6 – MASTER VOLUME CONTROLLER

- Allows adjustment of the most recently selected audio.

7 – ID FILTER BUTTON

- Activates a filter that eliminates voice on VOR and ADF audio so the identification can be heard.

8 – AUDIO SELECTION BUTTONS

- Enables the respective audio to be summed into the output on the headphone (HDPH), interphone (INPH) or cockpit speaker (SPKR).
- When selected, a green dot illuminates inside the button.

9 – ACP DISPLAY

- Displays the selected transmission channel and digital volume information.

10 – AUTO/MASK MICROPHONE SWITCH

- AUTO (PUSH IN): allows audio communication via oxygen masks.
- MASK (PUSH OUT): activates oxygen masks microphone when auto mode fails.
- Oxygen mask stowage box doors must be closed and reset in order to enable hand or headset microphone booms after using the oxygen mask microphone.

11 – BACKUP VOLUME CONTROL BUTTON/KNOB

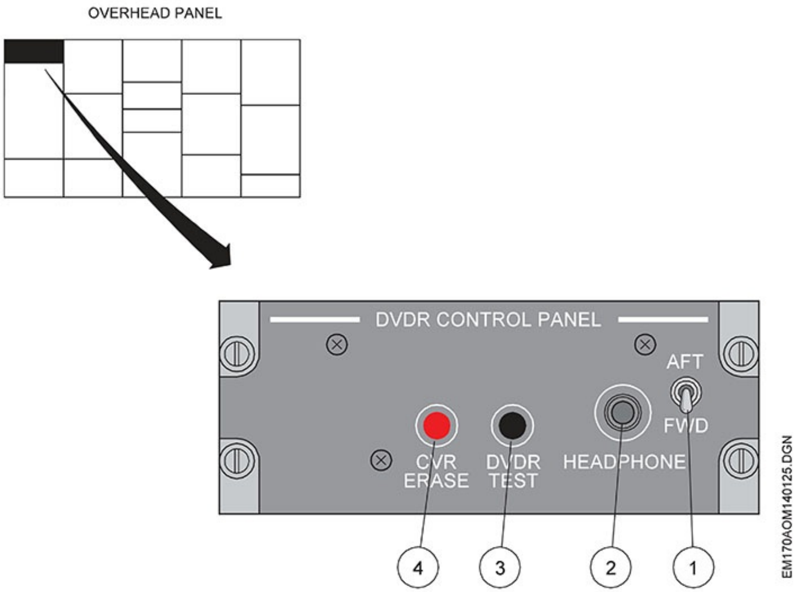
- NORM (PUSH IN): normal operation mode.
- BKUP (PUSH OUT): restores VHF communication in case of digital audio system failure.
- While in BKUP position (PUSH OUT), minimum volume is at the extreme counterclockwise position and the maximum volume is at the extreme clockwise position.
- The VHF 1 is the radio available for Captain ACP and VHF 2 is the radio available for the First Officer ACP.

12 – SELCAL ANNUNCIATOR BUTTON

- UNAVAILABLE

DIGITAL VOICE-DATA RECORDER

AIRCRAFT EQUIPPED WITH HONEYWELL OR L3 DVDR



1 – SELECTOR SWITCH

- Selects the forward and aft DVDR switch to set the source of the headphone audio for the aural indication when the DVDR test is successful (to maintenance task only).

2 – HEADPHONE JACK

- Monitors tone transmission during test or to monitor playback of voice audio.

3 – DVDR TEST BUTTON

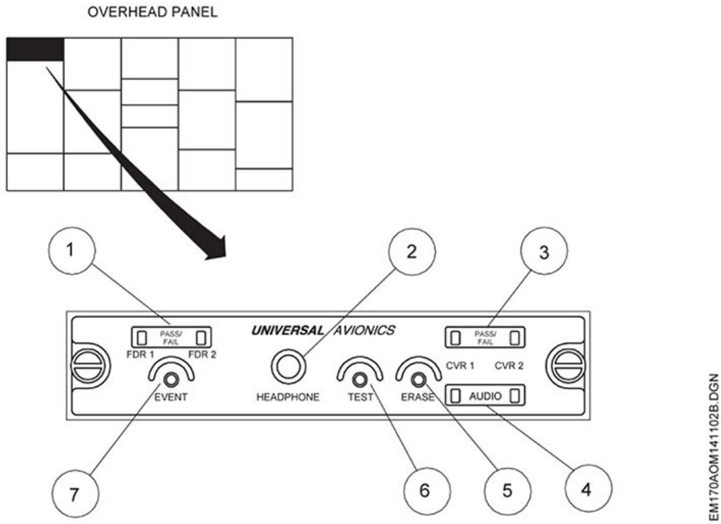
- Simultaneously tests all CVR and FDR functions on both DVDR.

4 – CVR ERASE BUTTON

- Erases the recorded audio information, provided that the airplane is on the ground and parking brake is set.

DIGITAL VOICE-DATA RECORDER

AIRCRAFT EQUIPPED WITH UNIVERSAL DVDR



1 – FDR PASS/FAIL INDICATOR

- GREEN: the associated FDR works properly.
- AMBER: the associated FDR is failed or not installed.

2 – HEAD PHONE JACK

- Monitors tone transmission during test.

3 – CVR PASS/FAIL INDICATION

- GREEN: the associated CVR works properly.
- AMBER: the associated CVR is failed or not installed.

4 – AUDIO INDICATOR

- GREEN: an audio signal at a minimum level is detected in any of the four CVR channels during the self-test.

5 – CVR ERASE BUTTON

- Erase the recorded audio information, provided that the airplane is on the ground and parking brake is set.

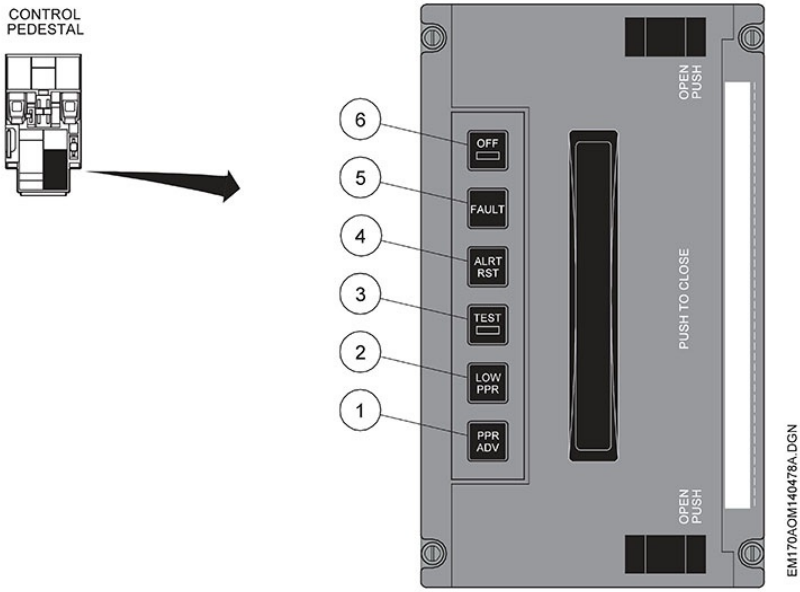
6 – TEST BUTTON

- Simultaneously tests all CVR and FDR functions on both DVDRs.

7 – EVENT BUTTON

- Not used in this configuration.

PRINTER



1 – PPR ADV BUTTON

- Continuously advances paper while button is depressed.

2 – LOW PPR BUTTON

- Illuminates when the printer senses the last remaining 10 feet of paper on the paper supply roll.

3 – TEST BUTTON

- Illuminates all indicators followed by a printout of test results and a test pattern.
- "TEST" button indicator bar will remain lit in conjunction with the "FAULT" indicator to report a self test failure.

4 – ALRT RST BUTTON

- Not functional.

5 – FAULT BUTTON

- Illuminates when senses no paper or printer door open.
- Illuminates in conjunction with test button in case of self-test failure.

6 – OFF BUTTON

Alternatively turns the printer off and on. When power is applied to the printer, it automatically is in the on state.

14.09.10 FLIGHT INSTRUMENTS

AIR DATA SYSTEM

The E-JETS are equipped with 5 independent ADSs.

Each ADS receives and computes the data collected by its components to provide air data information to the following systems:

- Airspeed indicator;
- Altimeter;
- Vertical speed indicator;
- Side slip indicator;
- Flight controls;
- IESS airspeed indicator;
- IESS altitude indicator;
- IESS vertical speed indicator;
- Static air temperature;
- Total air temperature;

Each ADS is composed by a specific set of sensors. The following list shows the structure of each system:

- ADS 1: TAT 1, ADSP 1/2 and ADA 1.
- ADS 2: TAT 2, ADSP 3/4 and ADA 2.
- ADS 3: TAT 1, ADSP 3/4 and ADA 3.
- ADS 4: ADSP 3/4 and IESS.
- ADS FCS: ADSP 1/2

The ADS 5 sends information to the flight control system.

SYSTEM COMPONENTS

The ADS components are:

- Air Data Smart Probes (ADSP);
- Total Air Temperature (TAT) probes and
- Air Data Applications (ADA).

AIR DATA SMART PROBES AND TAT PROBES

The E-JETS are equipped with four air data smart probes (ADSP).

The ADSP are composed of:

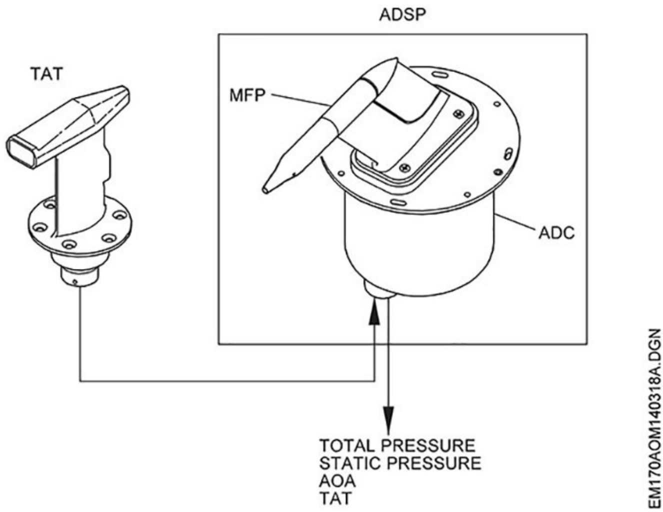
- Multi function probes and
- Air data computer.

The ADSP/TAT will sense and transmit static pressure, total pressure, angle of attack and TAT to the Air Data System.

The angle of attack is calculated based on an interface between the static pressure of the smart probes.

- ADSP 1 interfaces with ADSP 2.
- ADSP 3 interfaces with ADSP 4.

Each ADSP and TAT are heated to provide protection for icing build up maintaining continued sensor accuracy in icing conditions.



TAT AND ADSP

AIR DATA APPLICATION (ADA)

The ADA computes final air data (altitude, airspeed, etc.) and transmits this information to the appropriate airplane systems (PFD, stall protection system, flight controls system, etc).

NORMAL OPERATION

During normal operation, air data readouts are as follows:

- Left PFD ADS 1.
- Right PFD ADS 2.
- IESS – ADS 4.

ABNORMAL OPERATION

ADS FAILURE

If a failure occurs on ADS 1 or ADS 2, the affected PFD loses all air data information and a red cross is shown over the failed indication and an EICAS message is generated alerting the crew of the failure.

SENSOR FAILURE

If a single sensor failure occurs, like the static air pressure or total air pressure the affected indication will be lost or unreliable.

In case of unreliable information, the indicator presentation looks normal but the information is incorrect when compared to the other similar indicators. A flag is presented on the PFD indicating a split between similar indicators. In this case accomplish the NAV/FLIGHT INSTRUMENTS MISCOMPARE procedure, associated with the flag, presented in the QRH.

NOTE: The differences in indications are acceptable if no miscompare flag is displayed.

In case of lost information a red flag is displayed over the failed indicator.

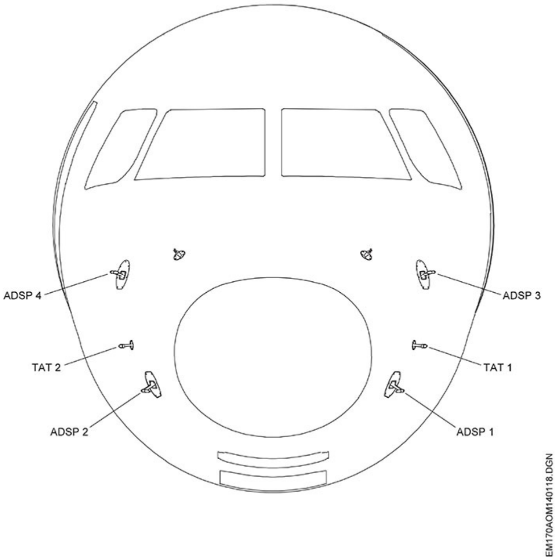
ABNORMAL OPERATION LOGIC

If a failure of the ADS occurs the failed ADS automatically reverts to ADS 3 or the pilot can manually revert to any available ADS to recover the information on the affected PFD.

After manual or automatic reversion, the selected source is displayed on a flag on the affected PFD and a stripe bar illuminates on the affected side reversionary button.

The reversionary logic cycle for the left and right PFDs are as follows:

	Reversionary logic		
	Normal operation	**1 ST Reversion**	**2 ND Reversion**
Captain	ADS 1	ADS 3	ADS 2
First Officer	ADS 2	ADS 3	ADS 1



PROBE LOCATION

RADAR ALTIMETER SYSTEM

The radar altimeter function measures the airplane height above terrain and sends this information to be displayed on the PFD and to be used by the other airplane systems.

To determine the height the radar altimeter transmits a signal to the ground and processes the time it takes to receive the signal return converting it into radio altitude.

The radar altimeter range of operation is -20 ft to 2500 ft.

When the airplane is parked at the gate or nearby, in the presence of irregular surfaces (i.e. tools, tool carts, stairs, cables, etc), the radar altimeter altitude measurements may be affected. As a result, the miscompare RA flag may be displayed on both PFDs and the EICAS message APPR 2 NOT AVAIL may be triggered.

RADIO ALTIMETER INTERFACE

The system interfaces with the TCAS, which uses the radio altitude information to inhibit descend resolution advisories. The system also interfaces with the modular avionics unit (MAU), for data distribution and integrity checking.

In addition, other interfaces are performed such as with the EGPWS, to determine airplane sink rate variation, with the DVDR system, in order to record mandatory parameters.

DUAL INSTALLATION

NORMAL OPERATION

In a dual system installation, the PFD 1 displays the system 1 radio altitude and the PFD 2 displays the system 2 radio altitude.

ABNORMAL OPERATION

If a difference between both radio altitudes occurs a flag RA in amber above the radio altitude box will be displayed.

If one radio altimeter is lost in a dual installation the remaining radio altimeter provides the radio altitude information for both PFDs. In this case the radio altitude readout is shown in amber and an EICAS message is posted indicating the failed system.

RADIO ALTIMETER TEST

The system has a self test that may be performed by the pilot on the MENU page on the MCDU performing the following steps:

- Push the LSK 1L (MISC);
- Push the LSK 4R (TEST);
- On the TEST page 2/2, push the LSK 3L (RAD ALT) and check the MCDU showing RAD ALT test ON and the radar altitude indication showing 50 ft ± 5 ft on PFD 1 and 2.
- Push the LSK 3L (OFF) to stop the test.

INTEGRATED ELECTRONIC STANDBY SYSTEM

The IESS computes and displays the primary flight information:

- Attitude (pitch and roll).
- Standard or barometric-corrected altitude and associated barometric pressure.
- Calibrated airspeed.

In addition, the IESS provides the following secondary functions or displays:

- Calibrated Mach number.
- V_{MO}/Mmo.
- Side slip indication.
- Vertical speed.
- Localizer and glide slope presentation from the NAV 1 ILS frequency.
- Barometric pressure.
- Altitude in meters.

NORMAL OPERATION

The IESS is powered as soon as the airplane battery 1 is selected to ON and airplane battery 2 is selected to AUTO. Then, the IESS starts its alignment phase.

The initial IESS alignment takes about 90 seconds to be completed and can be identified on the screen by the “INIT 90 s” flag.

NOTE: The airplane must not be moved during the first 90 seconds after power-up, while the IESS is undergoing alignment. Moving the airplane during this period can cause in-flight attitude indication errors that may not be noticeable on ground.

ABNORMAL OPERATION

In case of failure, attitude display information (e.g. brown and blue background, pitch scale, roll scale and roll pointer) is removed and replaced by a black background and a red cross, and an ATT flag is displayed. In case of a loss of data, an OUT OF ORDER page is displayed.

CLOCK

The electronic clock provides the following information:

- Chronometer (CHR)
- Universal Time Coordinated (UTC)
- Date (day/month and year)
- Elapsed time (ET).

NORMAL OPERATION

The electronic clock displays time information from either the GPS or the internal clock.

GPS TIME

With the switch set to GPS the system receives the UTC time from the GPS automatically as long as the GPS is receiving a satellite signal.

INTERNAL TIME

The clock can be set to operate without the GPS.

To adjust the internal time proceed as follows:

- Turn the GPS – INT switch to SET position;
- Rotate the SET switch to adjust the blinking field;
- Press the SET switch to move to another clock field;
- Repeat the process until all clock field are as desired;
- Turn the GPS – INT switch to INT to start the clock internal operation.

ELAPSED TIME

The elapsed time starts automatically when the airplane is airborne and stops when the airplane returns to the ground state.

There is no automatic reset between flights.

To reset the counter set the AUTO - RST switch to RST and release it.

CHRONOMETER

The CHR switch starts and stops the chronometer.

The RST switch resets the chronometer when it is stopped.

STANDBY MAGNETIC COMPASS

The illuminated magnetic compass has a rotating compass card marked with white legend on black background, with the cardinal points appropriately marked as “N”, “S”, “E”, and “W”. Each 30-degree line, except the cardinals, is identified by numerals representing degrees. Headings are read against a vertical lubber line engraved and filled white on the inside surface of the bowl.

Two calibration cards are supplied for the compass, one for normal operational condition (pitots on and windshield heating off) installed above the compass, and one for electrical emergency condition, installed on the main panel left corner.

NOTE: Magnetic compass reading shall always be done considering conditions written in applicable calibration cards.

14.09.15 COMMUNICATION

GENERAL

The communication system comprises the radio communication (VHF), interphone, audio control panels and digital data voice recorder.

RADIO COMMUNICATION SYSTEM

VERY HIGH FREQUENCY

The VHF digital radios (VDR) 1 and 2 are located in the Modular Radio Cabinets (MRC). VDR 1 and 2 the audio system through the audio/microphone busses, and with the MCDU/PFD through the ASCB. VDR channels 1 and 2 are for voice communication only.

VDR 3 interfaces with audio system and MCDU/PFD indirectly via MRC 2 and directly to MAU 1 to data transmission. The VHF radio 3 is located on a separated radio Mini Cabinet. VDR 3 provides voice communication as well as data communications through ACARS (Aircraft Communication Addressing and Reporting System) applications.

The VHF frequency is tuned/activated through the MCDU (primary mean) or CCD (PFD). The VHF communications system provides two-way, air-to-air, and air-to-ground communication in the frequency range of 118.000 to 136.975 MHz with 8.33 or 25 kHz channel spacing.

A tuning backup is available in MCDU 2 in case of loss of both MAUs. In the same way, if the audio bus is lost there are audio backups.

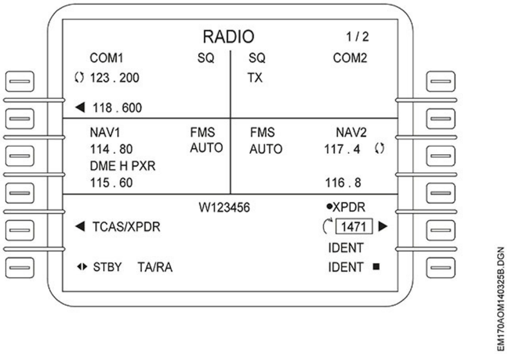
The flight crew may tune the VHF frequency on the MCDU as follows:

VHF 1/2

RADIO PAGE 1/2:

- Press RADIO button on the MCDU to go to RADIO page 1/2.

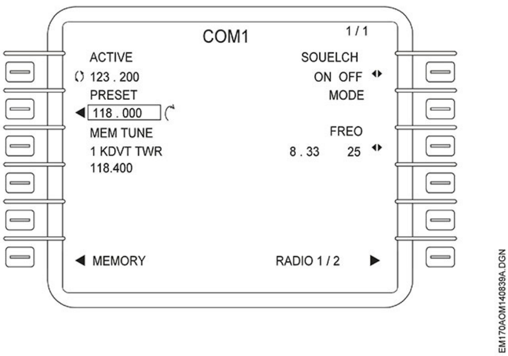
- The frequency is changed using either the scratchpad or the tuning knob on the MCDU.
- To change a frequency value with the scratchpad, use the keypad to enter the new frequency value, and then push the LSK next to the frequency to be modified. This transfers the value from the scratchpad to the selected frequency.
- To change a frequency value with the MCDU tuning knob, the standby frequency must prior be boxed pressing the LSK 2L/2R. Tune the frequency. With the cursor around the standby frequency and the swap icon displayed, push the LSK to swap the standby and active frequencies.



RADIO PAGE 1/2

COM 1 (2) PAGE 1/1:

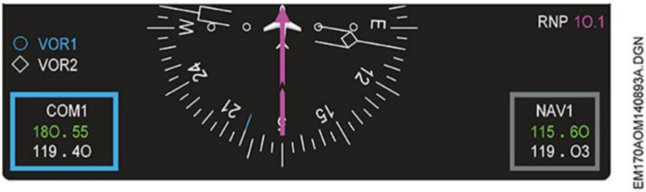
- Press the respective standby frequency twice if not boxed, otherwise press once, to go to NAV page 1.
- On the COM page it is possible to capture a frequency tuned in memory. Press LSK 3L to box the memory tune and use the tuning knob to cycle the stored frequencies. Press the active frequency to capture the selected memory tune.
- Press LSK 1R to cycle to the squelch on or off.
- Press LSK 3R to cycle to the frequency spacing:
  - 8.33: frequency has three decimal places.
  - 25: frequency has two decimal places.
- Press LSK 6L to go to COM MEMORY page 1/2.



COM PAGE 1/1

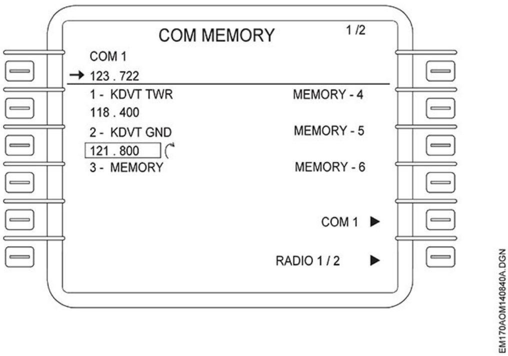
The VHF frequency selection through the CCD is as follows:

- Select the PFD through the CCD. The left and right format location buttons select respectively pilot's and copilot's PFDs.
- Through the touch pad move the cursor to the navigation frequency window.
- Tune the standby frequency through the tuning knob.
- Activate the standby frequency by pressing the enter key.



COM MEMORY PAGES:

- On the COM MEMORY page it is possible to capture a frequency tuned in memory or store a frequency/identification. To capture a frequency press the respective memory frequency to box it and press 1L to activate the frequency. To store a frequency or its identification use the alphanumeric keys and press the respective memory line select key. Additionally the frequency can also be stored pressing the receptive memory line select key and rotating the tuning knob.

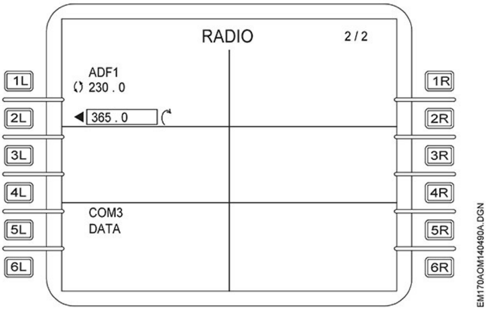


COM MEMORY PAGES

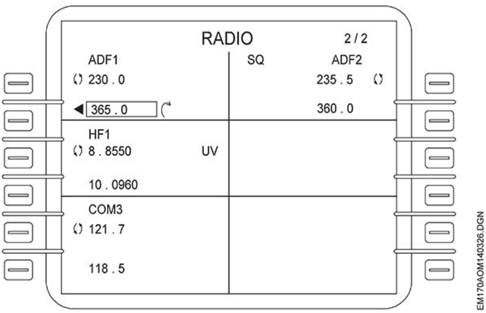
VHF 3

RADIO PAGE 2/2:

- To bring up the RADIO PAGE 2/2, with the radio PAGE 1/2 displayed, press the NEXT button.
- On RADIO page 2/2 it is possible to tune and activate the VHF 3 frequencies for voice mode. Press LSK 6L twice to go to COM 3 page 1/1, and then press LSK 2R to cycle the operational mode (data or voice). It is possible to tune a radio frequency in the same manner as VHF 1 and 2.
- The frequencies for data transmission are selected on a specific ACARS page. With data mode selected, the indication ‘DATA’ displays, otherwise VHF 3 active and standby frequencies display.



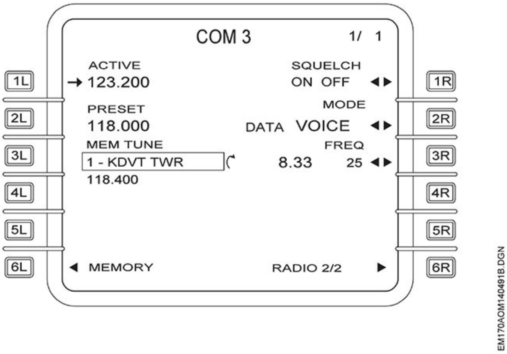
RADIO PAGE 2/2 (DATA MODE)



RADIO PAGE 2/2 (VOICE MODE)

COM 3 PAGE 1/1:

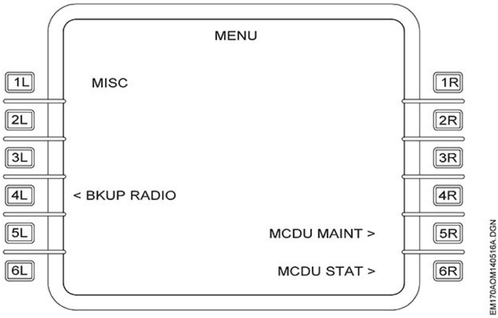
- The COM 3 page provides the same options as COM 1 (2) pages, except that is possible to select the transmission mode for VHF 3. The transmission mode is selected by pressing LSK 2R to cycle the operational mode (data or voice).



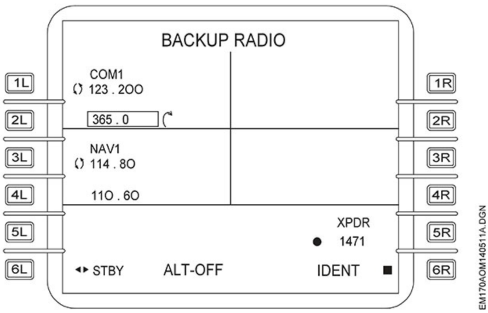
COM 3 PAGE 1/1

BACKUP RADIO PAGE

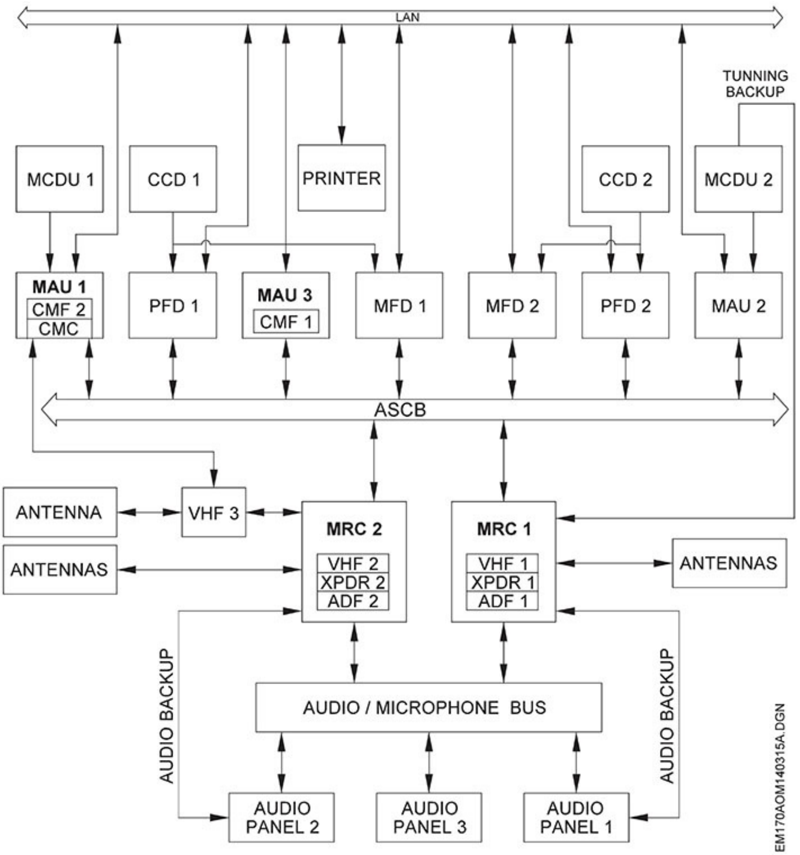
- The BACKUP RADIO page provides means for tunning COM 1, VHF NAV 1 and XPDR 1 (ALT OFF mode) in case of loss of primary and secondary tuning means (tuning using MCDU and CCD). In such cases, radio access is done via backup connection available on MCDU 2.
- The BACKUP RADIO page is available by pressing the MENU function button on the MCDU and then LSK 4L on Menu page. The BACKUP RADIO page displays automatically on MCDU 2 for some failure conditions.



MENU PAGE 1/1



BACKUP RADIO PAGE 1/1



NAVIGATION AND COMMUNICATION SYSTEM SCHEMATIC

INTERPHONE SYSTEM

GENERAL

The interphone system provides communication between the flight crew, flight attendants and ramp personnel.

The flight attendants communicate between flight attendant stations or with the flight crew using any of the attendant handsets.

Communication between flight crew and flight attendants may be done through the ACP.

Call chimes are annunciated at the beginning of the call from the cockpit to the flight attendants and vice-versa.

PASSENGER ADDRESS (PA)

The PA system allows flight crew in the cockpit and flight attendants to make announcements to the passengers. Announcements are heard through speakers located in the cabin and in the lavatories.

The pilots can make announcements using a hand microphone, headset boom or oxygen mask microphones. The flight attendants can use the PA handset located at their stations.

Pre-recorded announcements may be provided as well as recorded music for passenger entertainment.

PA system use is prioritized. Cockpit announcements have first priority and override all others. Flight attendant announcements override the pre-recorded announcements which override the music system.

ATTENDANT CALL

The call system is used as a mean for crewmembers to gain the attention of other crewmembers and to indicate that interphone communication is desired.

Attention is gained through the use of lights and aural signals (chimes or horn). The cockpit may be called from either flight attendant station or by the ground personnel. The ground personnel may only be called from the cockpit. Flight attendants may be called from the cockpit through interphone buttons on the ACPs or flight attendant call button on the overhead panel, the other attendant station, or from any passenger seat (PSU) or lavatory. Call lights in the passenger cabin identify the source of incoming calls to the attendants.

Call system chime signals low, high or high/low tones are audible in the passenger cabin through the PA system speakers. The PA speakers also provide an alerting chime signal whenever one of the following conditions occurs:

- NO SMOKING, FASTEN SEAT BELT or RETURN TO SEAT (in the lavatory) signs illuminate or extinguish
- STERILE COCKPIT light illuminates.

The attendant call lights located on the forward and aft main ceiling panel areas provide a visual indication to attendant when there is a call from the flight crew or passengers.

ATTENDANT CALL TABLE

CALLING ORIGINATOR	CALLED POSITION	VISUAL SIGNAL AT CALLED POSITION	AURAL SIGNAL AT CALLED POSITION
Cockpit	Attendant Station	Green light	Single high/low tone chime
		Red light	Triple high/low tone chime
		Amber sterile cockpit light	Single high tone chime
	Passenger cabin, lavatories and galleys	No smoking or fasten belt signs illuminate/ extinguish	Single low tone chime
Cockpit (lateral console)	Ramp station	–	Horn in the nose wheel well
Cockpit (Overhead Panel)	Attendant station	–	Single high/low tone chime
Attendant station	Cockpit	CAB or EMERG annunciator button flashes on the ACP	Single or triple high/low tone chime for CAB or EMERG , respectively
	Attendant station	–	Single high/low tone chime
Ramp station	Cockpit	RAMP annunciator button flashes on the ACP	Single high/low tone chime
Lavatory	Attendant station	Orange light	Single high tone chime
Passenger PSU	Attendant station	Blue	Single high tone chime

AUDIO CONTROL PANEL

There are three Audio Control Panels (ACP), located at the control pedestal and observer station. Each panel controls an independent crew station audio system and allows the flight crew to select the desired radios, navigation aids, interphones and PA systems for monitoring and transmission.

The audio panel receives inputs from all audio communication channels and aural warnings. Audio warning for altitude alert, ground proximity warning system (GPWS), traffic collision avoidance system (TCAS), and windshear among others, are also heard through the speakers and headsets. These warnings cannot be controlled or turned off by the flight crew. Audio from each ACP is monitored using a headset, headphone or the related speaker, except for the observer speaker.

DIGITAL VOICE DATA RECORDER (DVDR) SYSTEM

AIRCRAFT EQUIPPED WITH HONEYWELL OR L3 DVDR.

The digital voice data recorder system (DVDR) combines a flight data recorder (FDR) and a cockpit voice recorder (CVR) in a single unit. Two solid state DVDR units are installed. DVDR 1 is installed in the forward electronic bay, and the DVDR 2 in the aft electronic bay. Each unit receives, records and preserves all required data parameters and voice recordings from the cockpit crew and area microphones.

The DVDR unit is capable of recording the last 120 min of audio information from cockpit area microphone and primary crew microphones. The FDR stores up to 276.6 h of flight data at a rate of 256 words per second.

The DVDR automatically starts recording audio information as soon as power up is performed and continues until the power down. The flight data begins to be recorded when the first engine is started.

The DVDR's FDR data is available through the MCDU for maintenance purposes only.

If the DVDR power system fails, an EICAS message is generated to indicate the failure. All DVDR EICAS messages are advisory and some of them are inhibited in critical phases of flight, such as takeoff.

AIRCRAFT EQUIPPED WITH UNIVERSAL DVDR

The digital voice data recorder system (DVDR) combines a flight data recorder (FDR) and a cockpit voice recorder (CVR) in a single unit. Two solid state DVDR units are installed. DVDR 1 is installed in the forward electronic bay, and the DVDR 2 in the aft electronic bay. Each unit receives, records and preserves all required data parameters and voice recordings from the cockpit crew and area microphones. Additionally, the DVDR 1 is equipped with an internal RIPS (Recorder Independent Power Supply) which supplies power to the CVR whenever there is an airplane power loss.

The DVDR unit is capable of recording the last 120 min of audio information from cockpit area microphone and primary crew microphones, 120 min of datalink data. The FDR stores up to 140.8 h of flight data at a rate of 512 words per second.

The DVDR automatically starts recording audio information as soon as power up is performed. Flight data recording begins when the first engine is started. After power down, the DVDR continues recording audio information for 10 min. During this time, the FDR1, FDR2 and CVR2 PASS FAIL lights illuminate steady in amber on the DVDR Control Panel.

The DVDRs FDR data is available through the MCDU for maintenance purposes only.

If the DVDR power system fails, an EICAS message is generated to indicate the failure. All DVDR EICAS messages are advisory and some of them are inhibited in critical phases of flight, such as takeoff.

COMMUNICATION MANAGEMENT FUNCTION (CMF)

The Communication Management Function (CMF) is an airborne communications router that supports communication between airplane datalink applications and their corresponding ground service providers. The following functionalities are available through the CMF:

- Character-oriented communication through the Aircraft Communications Addressing and Reporting System (ACARS) network.
- Communication between different airplane devices.

SYSTEM INTERFACES

The CMF has the following interfaces:

- Multifunction Control Display Unit

  The MCDU is the primary flight crew interface with the CMF functions, which are accessed through the ACARS MAIN MENU by pressing the DLK function key. Alternative access to the CMF functions is performed by pressing the MENU function key on the MCDU, entering the MISC page and selecting the ACARS prompt. Further access to other pages is provided through the line select keys (LSK) on the MCDU.
  Crew alerting and advisory messages are displayed on the MCDU scratchpad. Alerting messages are displayed regardless of whether CMF is active on the MCDU, while advisory messages are displayed only when the CMF is active on the MCDU. If it is the first access to the CMF pages since power up, the CMF ACARS MAIN MENU is displayed.
  If it is not the first access since power up and there are new messages, the NEW MESSAGES page is displayed. If it is not the first access since power up and there are no new messages, the last CMF page accessed is displayed.

- Printer

  The CMF uses the Local Area Network (LAN) to interface with the printer. CMF data may be printed from an MCDU by using the print prompt displayed on an active CMF page.

- Central Maintenance Computer

  The CMC receives fault and event reports from the CMF and allows communication between the CMF and the printer.

- Primary Flight Display

  The amber "MSG" annunciation is displayed on the PFD when uplink messages are received from ground Datalink Service Providers. Also, this annunciation is displayed following an alerting message on the MCDU scratchpad.

EM170AOM141231A.DGN

MSG ANNUNCIATION ON PFD

- Engine Indication and Crew Alerting System
  Advisory EICAS message related to CMF. Refer to 4-09-35 for messages description.
  - DATALINK 1 FAIL
- Aural Warning System
  - When an Air Traffic Services (ATS) message is received, a voice message "ATS MESSAGE" sounds once.
- Flight Management System
  The CMF serves only as a router to allow communication of data messages processed by the FMS, such as flight plan update requests, flight plan updates, performance data, etc.
- Digital Voice Data Recorder
  The optional CMF interface with DVDR provides the capability to record datalink message traffic between the airplane and the ground stations.

CMF PAGES ON MCDU

There are pages for Airline Operational Communication (AOC) applications, which are accessed on the ACARS MAIN MENU. Pages and messages format for AOC applications may be customized by the airline through an AMI (Airline Modifiable Information) database. The AMI pages are identified by “ACARS” on the upper left corner of each page.

There are pages for Air Traffic Service (ATS) applications. These pages are accessed through the ATS MENU option on the ACARS MAIN MENU. ATS pages are also defined in the Honeywell Generated Information (HGI) database and cannot be customized by the airline.

There are System Pages, which are primarily accessed through the SYS MENU option on the ACARS MAIN MENU. The System Pages are defined in the Honeywell Generated Information (HGI) database and cannot be customized by the airline. Pages defined in the HGI database are identified by “CMU” on the upper left corner of each page.

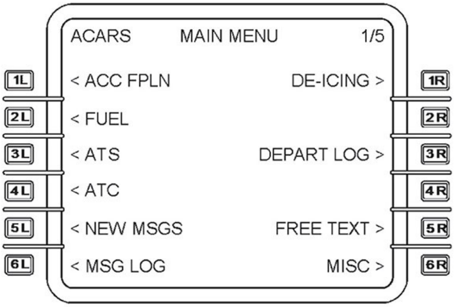
AIRCRAFT COMMUNICATIONS ADDRESSING AND REPORTING SYSTEM (ACARS)

ACARS is a data link system that allows real time communication between ground stations and the airplane.

Communication to ground stations is made through the VHF Data Radio (VDR) 3 channel.

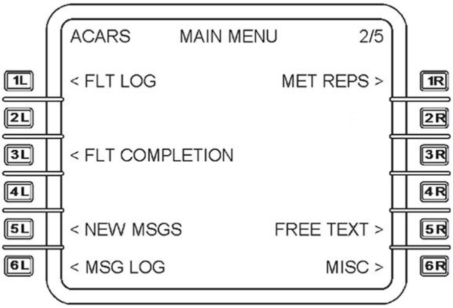
Applications that operate through ACARS are defined as Airline Operational Communications (AOC) and Air Traffic Services (ATS).

ACARS interfaces through the MCDU using a 5 page menu. The first 2 pages are normally used during routine flight operations. On pages 3, 4 and 5 special pages for Maintenance, Flight Operations, Ground Operations, Security, Passengers, Cockpit and Cabin items can be found. All menus are self explanatory.



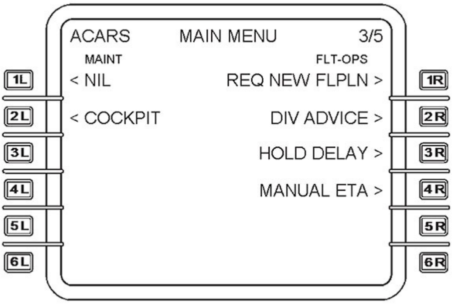
MAIN MENU 1/5

ACC FLPLN:	To accept the OFP or change OFP fuel figures. Includes a mandatory field for the OFP number.
FUEL:	Enter the fuel filled. Enter this data before Push-back or Off Blocks.
ATS:	Opens the ATS menu consisting of several ATS related services.
ATC:	Opens ATC menu (CPDLC functions).
NEW MSGS:	To view or print new ACARS messages.
DE-ICING:	To make a request for de-icing at Schiphol.
DEPART LOG:	To enter departure data; de-icing data.
FREE TEXT:	To send a freetext message.
MISC:	To view miscellaneous ACARS parameters.



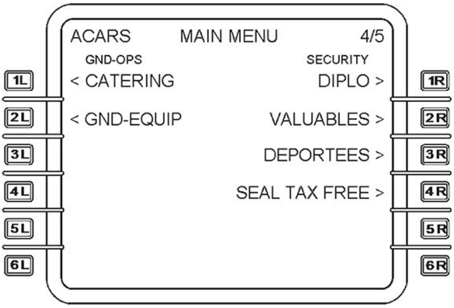
MAIN MENU 2/5

FLT LOG:	The AOC AFL page contains all data that is entered on the electronic AFL. As backup a paper AFL is stored in the flight document stowage compartment which must be used in case the Electronic AFL function is not available.
FLT COMPLETION:	To enter arrival data after parking. Data fields are: PSN of Pilot Flying during take off and/or landing, number of Go-Arounds, number of training landings (TRLDG), amount of fuel dumped or drained, autoland result and cost index flown (mandatory).
NEW MSGS:	To view and/or print newly received ACARS messages.
MSGS LOG:	To view and/or print sent ACARS messages.
MET REPS::	To obtain a METAR, TAF-FC, or TAF-FT from the ground based database. Up to 5 stations can be selected. The first station is automatically copied from the DEST airport in the FMGEC, but can be overwritten.
FREETEXT:	To send a freetext ACARS message.
MISC	To view miscellaneous ACARS parameters.



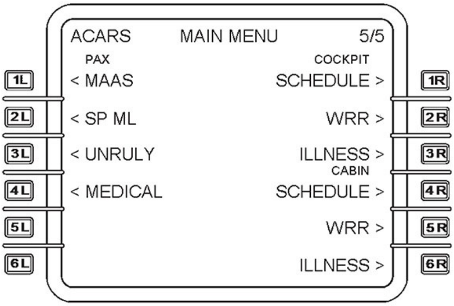
MAIN MENU 3/5

MAINT NIL:	To send a NIL-message to the Maintenance Organization, indicating "No Complaints".
MAINT COCKPIT:	To enter a cockpit related complaint (AML) and send the complaint to the Maintenance department. This does not substitute filling out the AML. Send an individual message for each individual entry.
FLT-OPS REQ NEW FPLN:	To request a new OFP after inflight re-routing.
FLT-OPS DIV ADVICE:	To contact dispatch for a diversion advice. Data fields are FUEL ON BOARD and a freetext REMARKS box.
FLT-OPS HOLD DELAY:	To inform Flight dispatch about holding delays. Data fields are EXPECT FURTHER CLEARANCE and FUEL ON BOARD.
FLT-OPS MANUAL ETA:	To send an updated ETA to Flight Dispatch.



MAIN MENU 4/5

GND-OPS CATERING:	To request for catering supply at destination station. The request box is freetext.
GND-OPS GND-EQUIP:	To make a request for ground support from catering, ground equipment, security or de-icing.
SECURITY DIPLO:	To request pick-up of diplomatic shipments.
SECURITY VALUABLES:	To request pick-up of valuable shipments.
SECURITY DEPORTEES:	To inform destination about deportees on board that are not mentioned on the PIL.
SECURITY SEAL TAX-FREE:	To inform security services about seal numbers and trolley numbers for tax-free sales. Used in case of inconsistencies.



MAIN MENU 5/5

PAX MAAS:	To request or revise passenger Meet-and-Assist service.
PAX SP ML:	To request a special meal for a passenger with a connecting flight, if this is not correctly stated on the PIL.
PAX UNRULY:	To inform destination of passenger unruly behavior.
PAX MEDICAL:	To make a request for a DOCTOR/AMBULANCE/ADVICE. Also to inform destination about a death on board.
COCKPIT SCHEDULE:	To make an inquiry about a cockpit crewmember schedule following this flight.
COCKPIT WRR:	To request the consequences for the cockpit crew on Flight- and Duty Time Limitations in case of a delay.
COCKPIT ILLNESS:	To inform dispatch about illness of a cockpit crewmember.
CABIN SCHEDULE:	To make an inquiry about a cabin crewmember schedule following this flight.
CABIN WRR:	To request the consequences for the cabin crew on Flight- and Duty Time Limitations, in case of a delay.
CABIN ILLNESS:	To inform dispatch about illness of a cabin crew member.

CONTROLLER PILOT DATALINK COMMUNICATION SYSTEM (CPDLC)

FANS 2-CPDLC system is part of the Flight Management System (FMS) and combines two different data link applications, the Future Air Navigation System 1/A+ (FANS 1/A+) and the ATN Baseline (ATN B1).

FANS 1/A+ is applicable to oceanic and remote airspaces and ATN B1, to continental airspace. To provide seamless transitions to Controller-Pilot Data Link Communication (CPDLC) in different environments, FANS 2 has been developed unifying all conditions.

For all information about FANS 1/A+ or ATN B1 systems refer to Honeywell NG FMS Pilot's Guide.

One advisory EICAS message is related to FANS 2-CPDLC. Refer to 14-09-35 for message description.

- DATALINK 1 FAIL

PRINTER

The airplane is equipped with a full-format thermal line printer device installed in the cockpit on the control pedestal. DC BUS 1 powers the printer and a CB located in the cockpit Circuit Breaker Panel provides electrical protection.

The flight crew accesses printer via MCDU by CMF during all flight phases. On ground, maintenance personnel accesses printer via MFD 2 to print maintenance reports. CMF and CMC communicate with the printer via the LAN BUS.

The printer provides a self-test which, in case of failure, illuminates the printer fault indicator in conjunction with printer test indicator. The Fault light also illuminates when printer door is open or paper out is sensed.

The printer can print up to 80 characters wide, however, there are two scenarios:

- The printer is limited to 24 characters wide when the message is printed via MCDU.
- The printer uses 80 characters wide when the information is sent via ACARS directly to the printer (C1 messages).

14.09.20 NAVIGATION

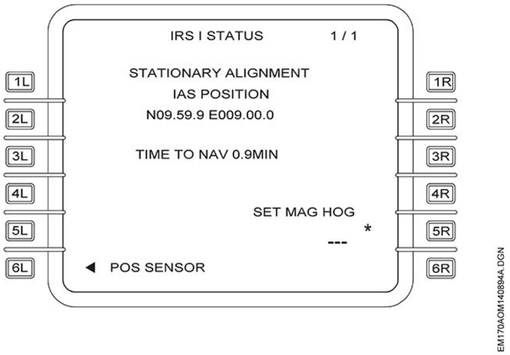
INERTIAL REFERENCE SYSTEM (IRS)

The inertial system computes airplane position, ground speed, heading and attitude.

The main component of the IRS is the Inertial Reference Unit (IRU), which interfaces with the Modular Avionic Unit (MAU), Global Positioning System (GPS) and the Air Data Computer (ADC). The IRU provides output data to the PFD, weather radar, Multifunction Control Display Unit (MCDU), Flight Management System (FMS) and reversionary panel.

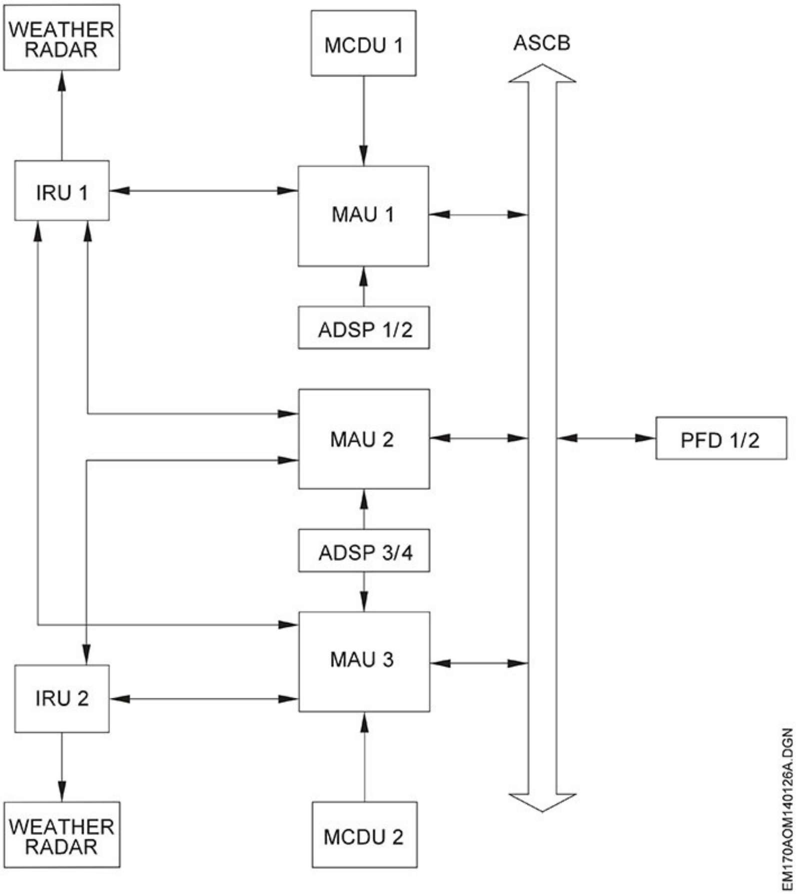
Primary source for the Captain's PFD is the IRS 1 and for the First Officer's PFD is IRS 2. In case of mode failure, power loss or loss of one IRU, the affected station can source select the other side station by means of the IRS reversionary panel button.

An automatic power up (on ground) and alignment is provided. The alignment on ground (up to 17 min) must be performed with the airplane not in movement and position manually entered primarily via MCDU or obtained automatically from the GPS. In flight alignment is also possible to recover navigation capability using data from the GPS. The alignment time can be checked on the IRS STATUS PAGE 1/1 on the MCDU.



IRU outputs digital data including the following:

- Primary airplane attitude in pitch and roll;
- Magnetic and true heading;
- Body linear acceleration;
- Body angular rate;
- Inertial velocity;
- Navigation Position;
- Wind Data;
- Calculated data.



IRS SCHEMATIC

The position can be entered on MCDU as follows:

- Press NAV button on the MCDU to go to NAV INDEX page 1/2.

NAV INDEX PAGE 1/2:

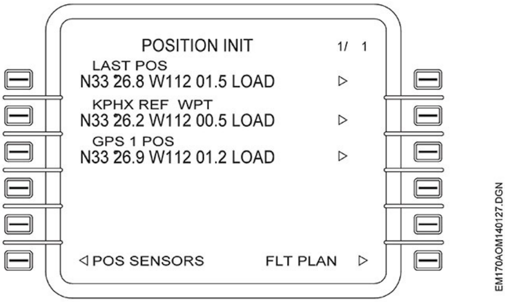
- Press line select key 1L or 4L to go respectively to NAV IDENT or POS SENSORS page 1/1.

NAV IDENT or POS SENSORS page 1/1:

- Press line select key 6R to go to POSITION INIT page 1/1.

POSITION INIT PAGE 1/1:

- The POSITION INIT page will list positions that can be line-selected for initialization of the FMS using the LOAD line select key. Any of the positions listed can be used for the initialization. The pilot may also enter the appropriate latitude/longitude or reference waypoint using the alphanumeric keys and pressing the line select key 2L.

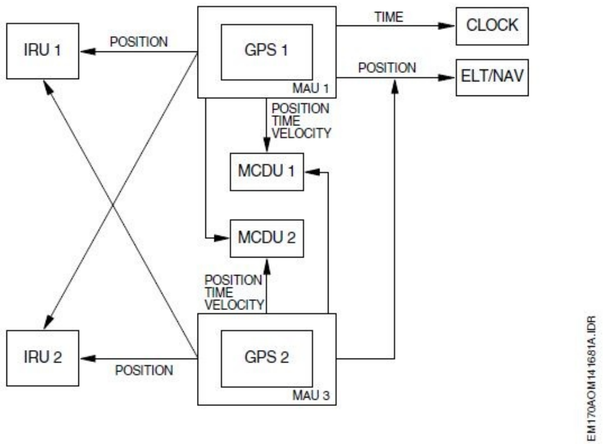


MCDU POSITION INIT PAGE

GLOBAL POSITIONING SYSTEM (GPS)

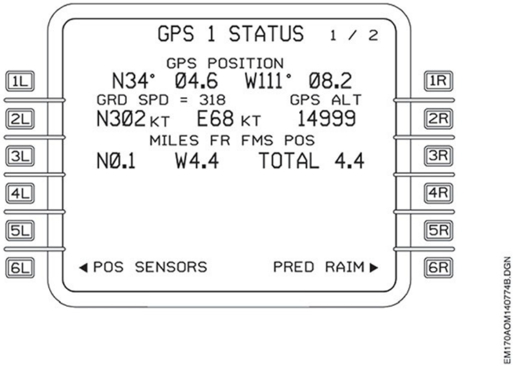
The Global Positioning System (GPS) is a satellite navigation sensor, which receives satellite signals from an active antenna in order to compute airplane position, velocity and time.

The baseline GPS module is contained within MAU 1, located in the forward fuselage avionics bay. If the optional second GPS is installed, it is contained in MAU 3.

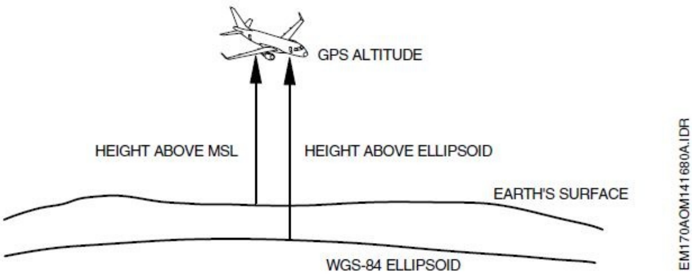


GPS SCHEMATIC

The performance of both GPS system is monitored (GPS 1(2) STATUS 1/2 and 2/2) by selecting the MCDU NAV button and selecting the POS SENSOR pages.

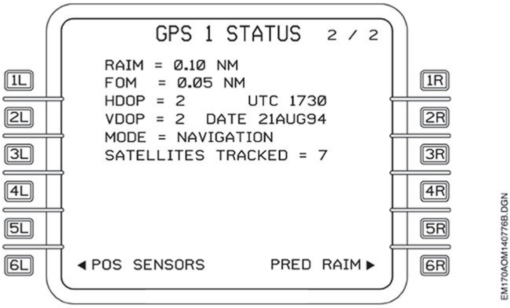


GPS altitude displayed is the World Geodetic System 1984 (WGS–84) height above the ellipsoid (geoid height + height above MSL). The GPS altitude is not relative to pressure altitude but is referenced to an earth–centered earth–fixed (ECEF) coordinate system. Pressure altitude is not relative to the same reference frame, but relative to the standard pressure or local pressure settings. Therefore, significant differences can be seen between GPS altitude and pressure altitude.



GPS ALTITUDE

GPS 1(2) STATUS PAGE 2/2 displays information about receiver autonomous integrity monitor (RAIM), figure of merit (FOM), horizontal dilution of precision (HDOP), vertical dilution of precision (VDOP), time (UTC) and date, operating mode and satellites tracked.



GPS 1 STATUS PAGE 2/2

RAIM and FOM indicate current uncertainty of position expressed in nautical miles. HDOP and VDOP are numbers that rate current satellite geometry in the horizontal and vertical axis with 1 being the best geometry. Normally, HDOP and VDOP numbers are below 10.

The fifth line displays the operational mode of the GPS. Possible operational modes are displayed as SELF–TEST, INITIALIZATION, ACQUISITION, NAVIGATION, DIFFERENTIAL, ALTITUDE AIDING, VELOCITY AIDING, FAILED. The acquisition mode is used to acquire satellites after power is applied. The GPS tracks four satellites to acquire its position. After being in the navigation mode, altitude aiding is the mode entered when fewer than four satellites are being tracked. In this mode, the GPS uses altitude from the digital air data computer (ADS) to aid in determining position.

If the GPS is operated inside a hangar or other areas where signals cannot be received, the GPS can detect this as a failure. In this case, cycling the power is necessary to restart the GPS.

The last line of the GPS STATUS page indicates the number of satellites that are being tracked and used by the GPS.

Any faults within the GPS module will be reported on the MCDU. The Message (“MSG”) indicator on the PFD will illuminate, and “GPS 1 FAILED” or “GPS 2 FAILED”, as appropriate, will be displayed in the scratchpad area.

RECEIVER AUTONOMOUS INTEGRITY MONITOR (RAIM)

The GPS module executes a RAIM test to insure the integrity of the data transmitted by the satellite. RAIM is a software function that supplies an alert to the cockpit when the integrity limit exceeds a flight phase dependant threshold.

The GPS has RAIM outputs for the current position and time in the form of horizontal and vertical integrity limit (HIL and VIL) at some future place and time.

In order to compute RAIM, the GPS must have a minimum of five satellite signals. The FMS does not accept GPS data unless a valid RAIM figure is available.

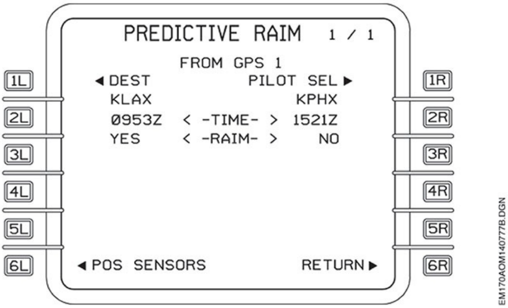
The FMS produces an alert for the flight crew on the MCDU when the GPS has lost integrity: “GPS RAIM ABOVE LIMITS”. Also an alert is generated by the FMS when the integrity will exceed the limit: “RAIM WILL EXCEED LIMIT”. A third alert will be generated by the FMS when RAIM is not available: “GPS RAIM UNAVAILABLE”.

PREDICTIVE RAIM (PRAIM)

The GPS also has a predictive RAIM function that provides the following types of RAIM predictions: Destination and Alternate waypoint (Pilot Select). Predictive RAIM uses an almanac function that is updated whenever the GPS is tracking satellites. Satellites can be manually deselected or enabled for destination and alternate waypoint prediction.

This function calculates whether the satellite geometry is acceptable for approach at the expected destination at the estimated time of arrival (ETA). On ground, in order for an ETA to be computed, the pilot must enter an ETD (ORIGIN/ETD) in line select key 1L on the initial FLT PLAN page.

The predictive RAIM page is accessed by selecting the PRED RAIM prompt from any GPS STATUS page. When selected, the PREDICTIVE RAIM page is displayed. YES indicates RAIM is predicted to be within approach criteria. NO indicates RAIM is predicted to be unacceptable or unavailable.



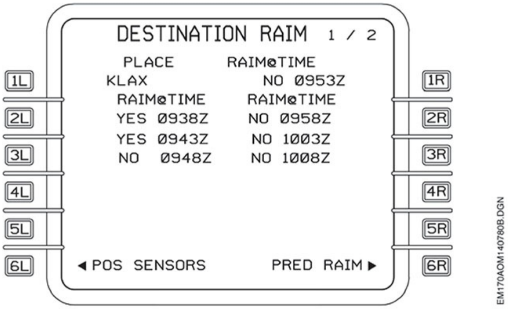
PREDICTIVE RAIM PAGE

The FMS uses the high priority GPS for predictive RAIM. The priority order for FMS 1 is GPS 1, GPS 2. The priority order for FMS 2 is GPS 2, GPS 1. If only a single GPS is available, both FMSs use it for predictive RAIM.

Should the GPS fail or the interface between the FMS and GPS not work properly, the FMS displays the message PREDICTIVE RAIM UNAVAILABLE on the PREDICTIVE RAIM page.

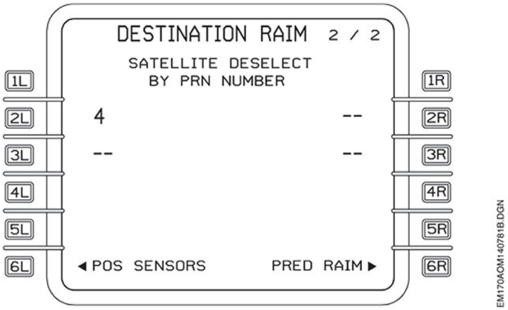
Predictive RAIM is calculated using GPS almanac information. The almanac within the GPS is automatically updated whenever the GPS is on and tracking satellites. The almanac within the GPS is set invalid if it is older than 3.5 days. Should this occur, the message ALMANAC EXPIRED is displayed on the PREDICTIVE RAIM page. The almanac takes approximately 12–25 minutes to update once the GPS is tracking satellites. RAIM predictions are not possible with an expired almanac.

Selecting the DEST prompt from the PREDICTIVE RAIM page displays DESTINATION RAIM page 1/2.



DESTINATION RAIM PAGE 1/2

DESTINATION RAIM page 2/2 supports satellite deselection. From this page, the pilot selects which GPS satellites are to be excluded from the DESTINATION RAIM predictions. The pilot enters the Pseudo–Random Noise (PRN) code for the satellite that is scheduled to be out of service according to published GPS NOTAMs.



DESTINATION RAIM PAGE 2/2

The satellite deselection can also be done in the PILOT SELECT RAIM page 2/2.

RADIO NAVIGATION SYSTEM

The radio navigation equipment is located in the Modular Radio Cabinet (MRC).

The interface with the audio is through the audio/microphone bus, and with the MCDU/PFD/MFD through the ASCB. The main components are:

- Very-high-frequency Omni-directional Range (VOR).
- Automatic Direction Finder (ADF).
- Distance Measuring Equipment (DME).
- Instrument Landing System (ILS).
- Transponder System (XPDR).

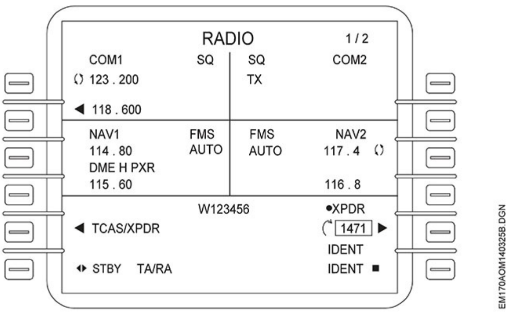
The MCDU is the primary means for radio tuning (RADIO PAGE and PROGRESS PAGE), while the CCD and PFD are the secondary means.

A tuning backup is available in MCDU 2 in case of loss of both MAUs. If the audio bus is lost there are audio backups also.

VOR/ILS

RADIO PAGE 1/2:

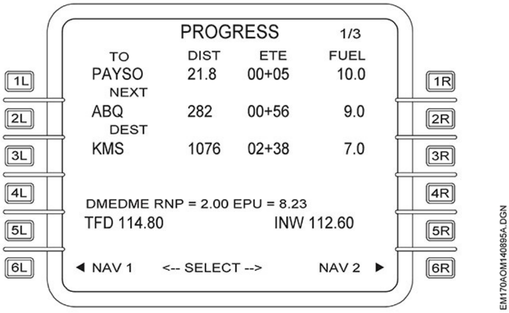
- The frequency is changed using either the scratchpad or the tuning knob on the MCDU.
- To change a frequency value with the scratchpad, use the keypad to enter the new frequency value, and then push the LSK next to the frequency to be modified. This transfers the value from the scratchpad to the selected frequency.
- To change a frequency value with the MCDU tuning knob, the standby frequency must be boxed prior to pressing the LSK 4L/4R. Tune the frequency with the cursor around the standby frequency and the swap icon displayed, push the LSK to swap the standby and active frequencies.



RADIO PAGE 1/2

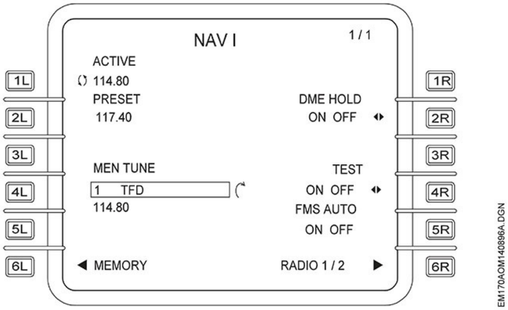
PROGRESS PAGE 1/3

- It is possible to tune the NAV radio using either the identifier or the frequency.
- Enter the identifier or the frequency value into the scratchpad and then push the LSK 5L or 5R. The FMS tunes the NAV radio on the PROGRESS PAGE.



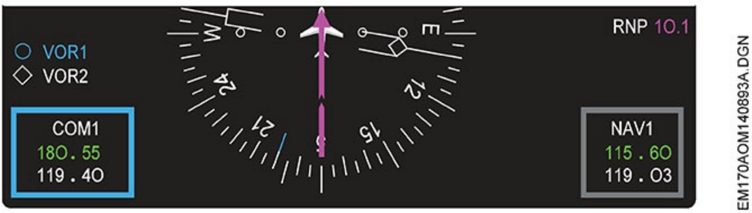
NAV PAGE 1/1:

- Press the respective standby frequency twice if it is not boxed, otherwise press once, to go to NAV page 1.
- Pushing LSK 1L swaps the active and preset frequencies (when the cursor is on field 2L).
- On the NAV page is possible to capture a frequency tuned in memory. Press 4L to box the memory tune and use the tuning knob to cycle the stored frequencies. Press the active frequency to capture the selected memory tune.
- Press LSK 2R to cycle DME hold on or off.
- Press LSK 5R to toggle the FMS autotune feature ON and OFF for the selected VHF NAV radio. Autotune is indicated by the magenta NAV active frequency on the PFD and it can be only selected ON when the primary navigation source is FMS.



The VOR/ILS frequency selection through the CCD is as follows:

- Select the PFD through the CCD. The left and right format location buttons select respectively pilot's and copilot's PFDs.
- Through the touch pad move the cursor to the navigation frequency window.
- Tune the standby frequency through the tuning knob.
- Activate the standby frequency by pressing the enter key.



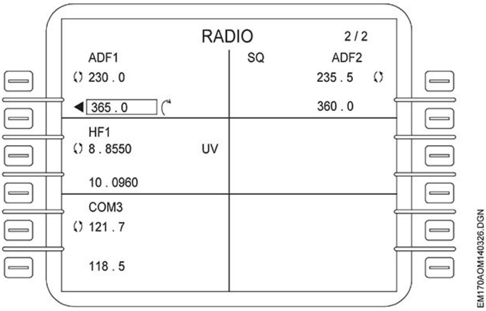
ADF

RADIO PAGE 2/2:

The frequency is changed using either the scratchpad or the tuning knob on the MCDU.

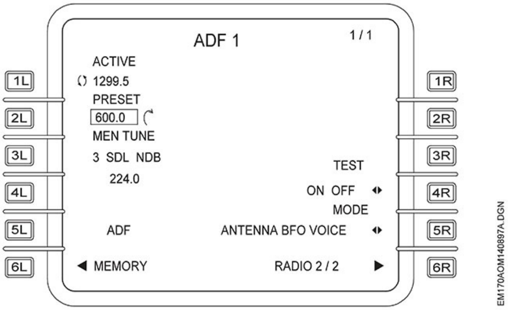
To change a frequency value with the scratchpad, use the keypad to enter the new frequency value, and then push the LSK next to the frequency to be modified. This transfers the value from the scratchpad to the selected frequency.

To change a frequency value with the MCDU tuning knob, the standby frequency must be boxed prior to pressing the LSK 4L/4R. Tune the frequency. With the cursor around the standby frequency and the swap icon displayed, push the LSK to swap the standby and active frequencies.



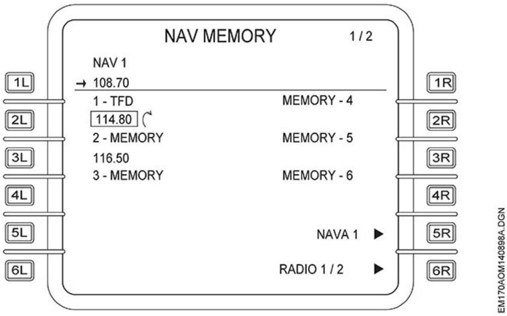
ADF PAGE 1/1:

- Press the respective standby frequency twice if it is not boxed, otherwise press once, to go to ADF page 1.
- Pushing LSK 1L swaps the active and preset frequencies (when the cursor is on field 2L).
- On the ADF page is possible to capture a frequency tuned in memory. Press LSK 4L to box the memory tune and use the tuning knob to cycle the stored frequencies. Press the active frequency to capture the selected memory tune.
- Press LSK 5R to cycle ADF mode:
  - ADF - receives static signal and computes bearing to station.
  - ANT - receives ADF static signal only.
  - BFO - adds a beat frequency oscillation for reception of signals.
  - VOICE - permits voice to be received and transmitted over radio speakers.



NAV/ADF MEMORY PAGES:

- On the NAV/ADF MEMORY pages it is possible to capture a frequency tuned in memory or store a frequency/identification. To capture a frequency press the respective memory frequency to box it and press 1L to activate the frequency. To store a frequency or its identification use the alphanumeric keys and press the respective memory line select key. Additionally the frequency can also be stored pressing the receptive memory line select key and rotating the tuning knob.



TRANSPONDER

The transponders are located in the Modular Radio Cabinet (MRC). Each transponder provides conventional ATC functions. The dual Mode S XPDR system enables secondary surveillance by transmission of airplane identification information, altitude (barometric) and coded message data to ATC ground stations and TCAS installations on other airplane.

The transponder code is entered/activated through the MCDU. A tuning backup is available in MCDU 2 in case of loss of both MAUs.

The transponder receives and transmits altitude information from the ADS of the coupled side. Flight ID information is provided by the FMS, or it can be entered by the pilot. The XPDR also receives the ICAO address programmed into the airplane personality module (APM) and the pilot enters the squawk code.

The installed transponder system is able to respond to interrogations in Modes A, C and S. It is fully compliant with the requirements in EU 1207/2011, Annex II, Part A and C.

The installed Transponder Mode S Enhanced Surveillance system satisfies the data requirements of ICAO Doc 7030/4, Regional Supplementary Procedures for SSR Mode S Enhanced Surveillance in designated European airspace.

The system is not capable to transmit the Track Angle Rate parameter.

The following table presents the XPDR and TCAS modes of operation:

MODE	XPDR Replies		TCAS
	Modes	Altitude	
STANDBY	None	No	Disabled
ALT-OFF	A and S	No	Disabled
ALT-ON	A, C and S	Yes	Disabled
TA	A, C and S	Yes	TA only
TA/RA	A, C and S	Yes	TA/RA

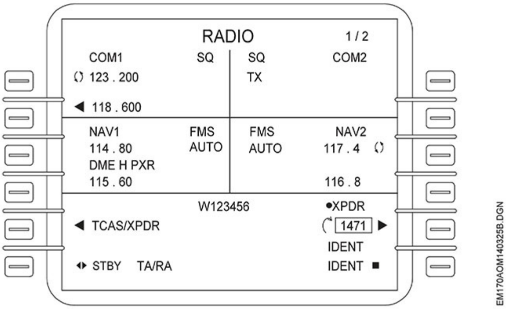
On ground, and in any mode except Standby, the XPDR only replies to discretely addressed mode S interrogations. The replies in mode A and mode C will occur when the airplane is airborne and the XPDR/TCAS mode is not set to Standby or ALT-OFF.

The flight crew may enter the transponder code on the MCDU as follows:

- Press radio button on the MCDU to go to RADIO page 1/2.

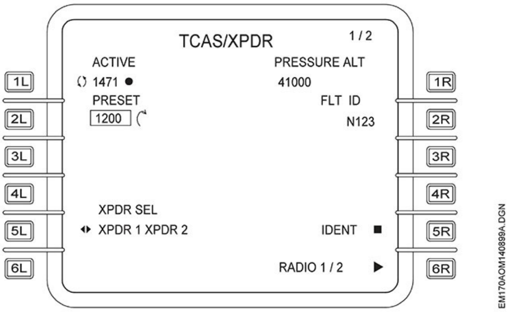
RADIO PAGE 1/2:

- On RADIO page 1/2 it is possible to enter the transponder code. The entering can be accomplished using the tuning knob or the numeric buttons. If the tuning knob will be used the transponder field must be boxed prior to pressing its respective line select key. In case of the numeric keys, enter the transponder code and press the respective line select key.
- Press LSK 5L to go to TCAS/XPDR page 1/2.
- Press LSK 6L to alternately select STBY or the selected active mode. The active mode can be set on TCAS/XPDR page 2/2.
- Press LSK 6R to select identification mode.



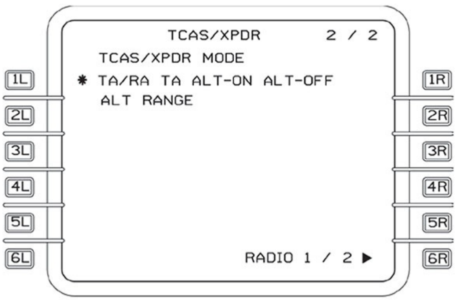
TCAS/XPDR PAGE 1/2:

- On TCAS/XPDR page 1/2 is possible to enter and activate the transponder code. The entering can be accomplish using the tuning knob or the numeric buttons. If the tuning knob will be used, the standby code must be boxed prior to pressing its respective line select key. In case of the numeric keys use, enter the standby code and press the respective line select key. To activate the standby code, press the respective active code.
- Press LSK 5L to cycle the transponder selection 1 or 2.
- Press NEXT button to go to TCAS/XPDR page 2/2.



TCAS/XPDR PAGE 2/2:

- Press LSK 1L to cycle the transponder mode:
  - TA/RA.
  - TA.
  - ALT-ON.
  - ALT-OFF.



AUTOMATIC DEPENDENT SURVEILLANCE - BROADCAST (ADS-B) OUT

ADS-B Out is a function of the transponder that allows broadcast of information such as airplane identification, position, altitude and velocity. It is enabled through the Airplane Personality Module (APM).

Transponder Mode S 1090 Extended Squitter acquires necessary data to support ADS-B Out over the existing Network Interface Module (MRC NIM) and GPS units.

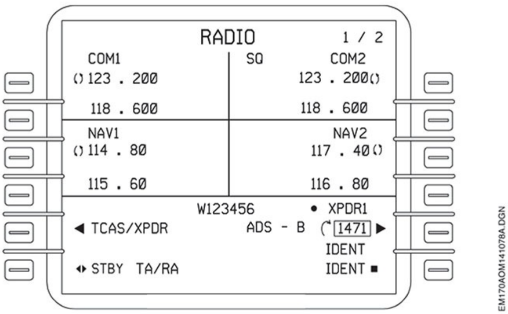
The use of ADS-B provides accurate information and frequent updates to airspace users and controllers. It supports improved use of airspace, reduced ceiling/visibility restrictions, improved surface surveillance, and enhanced safety through the conflict management.

The ADS-B Out is automatically turned on during airplane power up. The ADS-B Out is automatically turned off after airplane power down or after transponder turned off. When the ADS-B Out is deselected the XPDR operates as Mode S Enhanced Transponder.

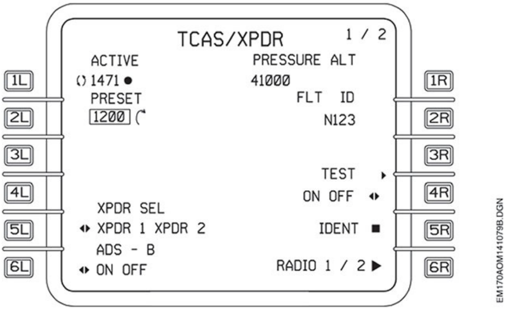
An additional label ADS-B is added to the MCDU RADIO page 1/2. The following color code for the ADS-B label should be observed:

- Green: ADS-B is selected ON, ADS-B information is valid and XPDR is ON.
- White: ADS-B is selected ON, ADS-B information is valid and XPDR is in STBY.
- Amber: ADS-B is selected ON and ADS-B information is invalid. Information is valid when the XPDR accepts the GPS information (number of satellites tracked, accuracy and integrity) as acceptable for the ADS-B function. Therefore, flight crew must be aware that after power up, with ADS-B selected ON, the ADS-B label is displayed in amber while the GPS is acquiring satellites data.

The label ADS-B OFF is displayed in white when ADS-B is selected OFF.



The ADS-B Out function may be manually selected ON or OFF on the MCDU TCAS/XPDR page 1/2.



Known system issues

ATC may report erroneous barometric vertical rates. Enhanced transponder codes are set to invalid. Only ATC can detect this. If a vertical rate issue is reported by ATC, switch to the cross-side transponder:

- Push RADIO function key on MCDU.
- Select LSK 5R on RADIO page 1/2 to access TCAS/XPDR page.
- Select LSK 5L on TCAS/XPDR page 1/2.

After landing cycle the affected transponder CB: On the MCDU (CB MENU/CB BY SYSTEM/NAV) open TRANSPONDER 1 or 2 CB (affected side), wait 10 s, then close it. Alternatively, power down and power up the airplane.

MISSED APPROACH PREVIEW

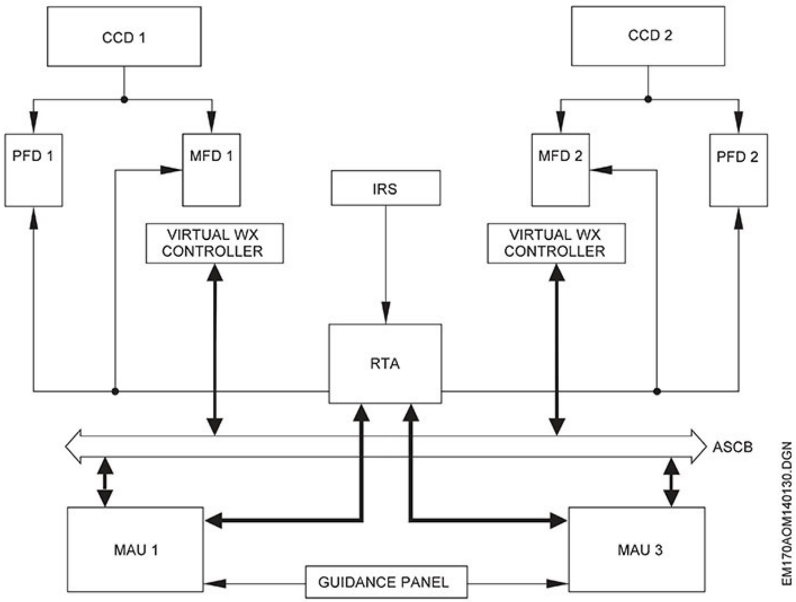
The MFDs MAP menu has the option to select the preview of the Missed Approach procedure on the MFD. The presentation is in cyan and follows the flight plan sequence.

WEATHER RADAR SYSTEM

The airplane is equipped with the WU-880 weather radar system model. The system is designed primarily for detection and analysis of the weather during flight and for ground mapping. The MFD handles the display of radar data and, in addition provides virtual controllers for weather radar control. Weather data is displayed on both MFDs, as well as on the PFDs.

When operating in ground mapping prominent landmarks are displayed which allow identification of coastlines, hilly or mountainous regions, cities or even, large structures.

The weather radar system consists of an integrated Receiver Transmitter Antenna unit (RTA) and two virtual weather radar controllers. The RTA is mounted in the nose of the airplane, whereas the virtual controllers consist of the CCDs and the weather mode information displayed on the MFDs below the weather information.



WEATHER RADAR SCHEMATIC

Display of weather data is available on the MFDs and PFDs. Selection of weather data display is accomplished via CCD actuating in the MFD using a soft key to select MAP menu. This act will enable weather information and virtual controller on the MFD.

Five modes and ten functions are available. Each one will be discussed in the following sections.

WX RADAR MODES

RADAR WEATHER DETECTION MODE (WX)

The WX mode is used to detect areas of severe weather. This will allow the pilots to avoid areas of dangerous weather conditions and possible turbulence. If WX is selected before the initial RTA warm-up period is over (approximately 90s), WAIT is displayed in the mode field. In the wait mode, the transmitter and antenna scan are inhibited.

GROUND MAPPING MODE (GMAP)

This mode is used to alert the flight crew about hazards caused by ground targets. This is especially useful in areas of rapidly changing terrain, such as hilly mountainous areas.

The selection of preset gain will generally provide the desired mapping display, however the gain can also be manually operated. It is possible to have one pilot working the GMAP while the other is using the WX mode.

It is not intended to be used or relied for ground proximity warning.

STANDBY (STBY)/FORCED STANDBY (FSBY) MODE

The weather radar remains in a ready state, with the antenna scan motionless and stowed in a tilt-up position. In addition, the transmitter is inhibited and the display memory is erased.

The following table shows the RTA modes for each WX radar configuration:

LEFT CONTROLLER	RIGHT CONTROLLER	LEFT SIDE	RIGHT SIDE	RTA MODE
OFF	OFF	OFF	OFF	OFF
OFF	Standby	Slave Standby	Standby	Standby
Standby	OFF	Standby	Slave Standby	Standby
OFF	ON	Slave ON	ON	ON
ON	OFF	ON	Slave ON	ON
Standby	ON	Standby	ON	ON
ON	Standby	ON	Standby	ON
ON	ON	ON	ON	ON
Standby	Standby	Standby	Standby	Standby

FSBY is displayed when the airplane is on the ground. The RTA is in forced standby mode when the airplane is on the ground, the transmitter and antenna scan are both inhibited, display memory is erased, and FSBY is displayed in the mode field. Overriding the forced standby requires that both pilots select the FSBY OVRD menu item on the respective weather controllers or one pilot selects the Antenna Stabilization checkbox (STAB OFF) 4 times in less than 3 seconds enabling the WX mode on ground.

OFF MODE

Turns the radar off, provided OFF is selected on both virtual controllers. The system is no longer radiating power and the antenna is stowed.

SLAVE MODE

One controller is in OFF position whereas the other controller is in an operating mode. The operating one is in control of both sweeps.

TURBULENCE DETECTION (TURB) FUNCTION

The radar processes return signals in order to determine if a turbulence signature is present. Areas of moderate, severe, or extreme turbulence are displayed in soft white. TURB may only be engaged in the WX mode and at selected ranges of 50 NM or less.

NOTE:
- It may occur that the Turbulence function annunciation in MFD and PFD to remain displayed for ranges above 50 NM even though the function is deactivated.
- Range selections of 200 NM or greater always clear Turbulence function annunciation.

ANTENNA STABILIZATION FUNCTION

The antenna is stabilized in pitch and roll using attitude information from the IRU. Momentarily selecting the STAB OFF checkbox disables antenna stabilization and causes an amber STAB to be displayed.

RECEIVER GAIN (GAIN) FUNCTION

The GAIN control varies the RTA receiver gain. There are two modes: variable and calibrated. The normal preset is calibrated mode and is used for weather avoidance. The system will be forced into calibrated gain when RCT or TGT are selected. The variable mode is useful for additional weather analysis and for ground mapping. In WX mode, variable gain can increase receiver sensitivity over the calibrated level to show weak targets or it can be reduced below the calibrated level to eliminate weak returns.

RANGE FUNCTION

The range can be manually set (CCD) to a desirable value (10 NM, 25 NM, 50 NM, 100 NM, 200 NM, 300 NM). The label OVRG is shown whenever the Map range is greater than 300 NM.

TARGET ALERT (TGT) FUNCTION

The TGT function monitors for weather beyond the selected range and 7.5° on each side of the airplane heading. If such weather is detected within the monitored heading, outside the selected range until a range of 200 NM , the TGT annunciation changes from a green-armed condition to an amber alert condition on the MFD.

This annunciation advises the flight crew that potentially hazardous weather lies directly in front and outside of the selected range. When this warning is received, the flight crew should select longer ranges to view the questionable target. Note that TGT is inactive when hazards are within the selected range

Selecting the TGT function forces the system to preset gain and turns off variable gain mode. Selections of ranges of 200 NM or greater automatically turns off TGT function and allows variable gain mode. It can only be selected in the WX mode.

NOTE:
- The TGT annunciation on MFD may occur when the range is increased to 200 NM or greater, even though the function is deactivated.
- In such cases, system logic follows the TGT function annunciation, and gain is automatically preset.
- Selection of 1000 NM range always clears TGT annunciation.

SECTOR SCAN (SECT) FUNCTION

The normal radar sweep is ± 60 degrees from the airplane nose, at a rate of 12 sweeps per minute. Selecting the SECT pushbutton reduces the angle of sweep to ± 30 degrees and increases the sweep rate to 24 sweeps per minute.

TILT FUNCTION

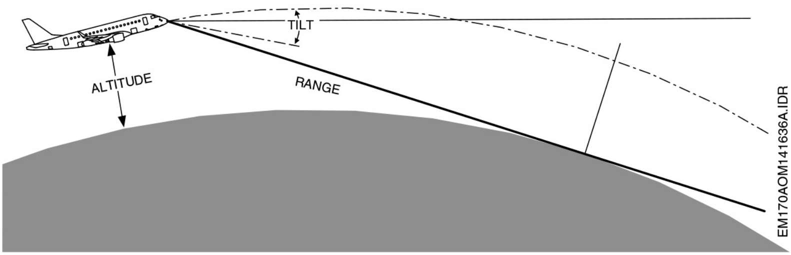
The inner knob on the CCD provides tilt control giving the pilot manual control of the antenna tilt angle. The CCD inner knob is a dedicated tilt knob if VAR Gain is not active. Tilt can be varied between 15 degrees up (clockwise rotation) and 15 degrees down (counterclockwise rotation).

Adjusts on tilt minimizes ground clutter when viewing weather targets.To find the ideal tilt angle after the airplane is airborne, adjust the TILT control so that ground clutter does not interfere with viewing of weather targets. Usually, this can be done by tilting the antenna downward in 1° increments until ground targets begin to appear at the display periphery. When ground targets are displayed, move the tilt angle upward in 1° increments until the ground targets begin to disappear.

Ground returns can be distinguished from strong storm cells by watching for closer ground targets with each small downward increment of tilt. The more downward tilt, the closer the ground targets that are displayed.

Proper tilt adjustment is a pilot judgement, but typically the best tilt angle lies where ground targets are barely visible or just off the radar image.

The following table gives the approximate tilt settings for different altitudes and ranges.



APPROXIMATE TILT SETTING FOR MINIMAL GROUND TARGET DISPLAY

APPROXIMATE TILT SETTING FOR MINIMAL GROUND TARGET DISPLAY

ALTITUDE (ft)	RANGE SCALE (NM)									LINE OF SIGHT (NM)
	0.5	1.0	2.5	5	10	25	50	100	200	
40000							-6	-3	-2	246
35000							-5	-2		230
30000	(TILT LIMITED REGION)						-4	-2		213
25000						-8	-3	-1		195
20000						-6	-2	-1		174
15000						-4	-1	0		151
10000					-8	-2	0	0		123
5000				-8	-3	0	+1			87
4000				-6	-2	0	+1		(LINE OF SIGHT LIMITED REGION)	78
3000			-9	-4	-1	+1	+1			67
2000			-6	-2	0	+1				55
1000		-7	-2	0	+1	+1				39
500	-7	-3	0	+1	+1					27

Tilt adjustments is also used for proper tilt management in order to avoid missing or underestimating weather targets. E.g. the upper levels of convective storms are the most dangerous because of the probability of violent windshears and large hail. But hail and winshear are not very reflective because they lack reflective liquid water. Convective thunderstorms become much less reflective above the freezing level. This reflectivity decreases gradually over the first 5000 ft to 10000 ft above the freezing level. Proper tilt management demands that tilt be changed continually when approaching hazardous weather so that ground targets are not painted by the radar beam.

ALTITUDE COMPENSATED TILT (ACT) FUNCTION

Automatically adjusts the antenna tilt according to the altitude and selected range. The TILT knob can be used for fixed offset corrections of up to 2.0 degrees.

RAIN ECHO ATTENUATION COMPENSATION TECHNIQUE (REACT) FUNCTION

Used in WX mode to compensate for attenuation of the radar signal as it passes through a storm. It does this by increasing the gain of the receiver as weather is detected.

The cyan field indicates areas where further compensation is not possible. This is a warning indicating that attenuation is hiding possible severe weather and should be considered dangerous.

The REACT compensation is active in all modes except GMAP mode.

The REACT compensation can be active in all modes except GMAP mode.

TEST FUNCTION

The test function is selected on MCDU avionics test page. The test is used to select a special test pattern to allow verification of system operation. If fault codes are detected they will be displayed at the same location where tilt angle is displayed in the Weather mode field.

NOTE: Output power is radiated in test mode, unless the WX radar is in FSBY mode.

14.09.25 FLIGHT MANAGEMENT SYSTEM

The Flight Management System (FMS) manages navigation sensors to produce the airplane position. The system provides data for the cockpit displays and flight control system. The FMS serves as aid to flight planning, navigation, performance, database and redundancy management. The system may be installed in a single or dual configuration.

For additional information on functions and operation, refer to the manufacturer’s manual.

For additional information on limitations, refer to the Supplemental Flight Management System Limitations of this manual (Chapter 2).

The FMS 1 and 2 reside respectively in MAU 2 and MAU 3.

The FMS interfaces with the following systems and equipment:

- GPS: the FMS uses inputs from the GPS to calculate airplane position and perform navigation functions.
- IRS: the FMS uses inputs from the IRS to obtain airplane position and perform navigation functions.
- MFD and PFD: the FMS provides data for display navigation guidance on the PFD and navigation map data on the MFD.
- VOR/DME: the FMS uses inputs from the VOR/DME to perform navigation functions.
- MCDU: the Multifunction Control Display Unit, located on the control pedestal, provides control functions management and operating modes for proper FMS operation. It is the interface between the FMS and the flight crew.

FLIGHT PLANNING

In general, flight plans may be divided in four categories: active, stored, lateral or vertical.

ACTIVE FLIGHT PLAN

This is the flight plan currently being flown. The active flight plan can be entered waypoint by waypoint, loaded from an external source, or recalled from storage.

At a minimum, active flight plans must contain a “FROM” waypoint (possibly the origin), a “TO” waypoint, and a destination. A flight plan is considered “closed” when the last waypoint is the destination.

STORED FLIGHT PLAN

The flight plan is stored when it is saved in the computer's memory and can be recalled later and become an active flight plan. When entering a flight plan to store, the flight plan must have a departure and destination airport, and both must be database waypoints.

When recalling a flight plan, entering the name of the flight plan results in the flight plan becoming active. If the name of the flight plan can not be found, the flight crew can enter the departure and destination airports. If any are found, the FLIGHT PLN LIST page is displayed to allow selection of a flight plan.

LATERAL FLIGHT PLAN

The lateral flight plan begins at the origin. The default origin in the active flight plan is the nearest airport to the present aircraft position that is within three miles, but it may be changed by the flight crew. The flight plan ends at the destination, which must be entered by the pilot as there is no default destination. The flight plan is built by inserting waypoints or strings of waypoints between the departure and destination airports. Examples of strings of waypoints are standard instrument departure procedures (SIDs), airways, standard terminal arrival procedures (STARs), and approach transitions.

VERTICAL FLIGHT PLAN (VNAV)

Vertical navigation (VNAV) is a FMS function that calculates a vertical profile, based on performance initialization data, and defines vertical modes to the FGCS.

Once the FMS has generated a vertical profile, VNAV information can be accessed any time via PROG < PROGRESS 2/3 < VNAV DATA. Moreover, FMS VNAV sends inputs for display on the PFD and MFD.

GENERAL RULES FOR VNAV OPERATION

- In order to use the VNAV function, the FMS Performance Initialization must be completed and confirmed.
- VNAV never exceeds the set altitude in the Altitude Selector.
- The airplane climbs whenever the FMS VNAV is in the climb phase, and the altitude set in the Altitude Selector is above the present airplane altitude.
- The airplane descends whenever the FMS VNAV is in the descend phase and the altitude set in the Altitude Selector is below the present airplane altitude.

- A Vertical Track Alert (VTA) is issued 60 seconds before the FMS commands a climb or a descent, or 1000 ft before the level off altitude. There is no VTA if the leveling-off is based on the altitude set in the Altitude Selector.
- VNAV, whenever existing constraints allows it, defines constant climb or descent paths.

NORMAL OPERATION

Climb: VNAV performs all climb profiles contained in the VFLCH mode. If the FMS levels-off at an altitude constraint defined over a waypoint, it resumes the climb automatically upon sequencing the waypoint. If the FMS levels-off at an altitude set on the Altitude Pre Selector, after setting the Altitude Pre Selector to a higher altitude, the FLCH button must be pressed on the guidance panel in order the VNAV to transition from VALT to VFLCH.

Cruise: The FMS will transition to cruise phase when reaching the initial cruise altitude set in the PERF INIT page. If the airplane levels at an altitude lower than the initial cruise altitude, the FMS does not transition to cruise.

If the ALT SEL is set to an altitude higher than the FMS cruise altitude, after few seconds, the cruise altitude in the PERF INIT page is reset to match with the ALT SEL selection.

NOTE: To reset the FMS cruise altitude to an altitude lower than the current FMS cruise altitude, it may be necessary to delete the current cruise altitude in the FMS CRUISE PAGE 1/1 prior to insert the new altitude.

To leave cruise level to either climb or descent, the altitude selector must be set to an altitude higher or lower than the present altitude and a vertical DIRECT-TO or VFLCH must be commanded.

When TCS is used to exit a leveled altitude, the command logic is to return to the original altitude when the change is less than 50 ft. For changes greater than 50 ft, the new achieved altitude is maintained.

TOD: The Top of Descent is calculated using the values inserted in the PERF INIT page and is displayed in the VNAV page and on the PFD/MFD.

The DES NOW prompt is displayed on the FMS DESCENT, FLIGHT PLAN and ROUTE pages providing an easy command to start the descent when the airplane is 50 NM or less from the calculated TOD.

When selected, the Flight Director commands the airplane to descent according to the airplane position relative to the predicted TOD.

- Early Descent: selecting the DES NOW prompt before the TOD is reached enables the Early Descent mode, where the FD commands a 1000 FPM descent up to the point where the planned descent path or the next altitude constraint is intercepted.
- Late Descent: selecting the DES NOW prompt after the planned TOD is reached enables the Late Descent mode, where the FD commands a descent angle 1.5° steeper than the planned descent angle to intercept the planned path.

NOTE: If this descent angle is not enough to intercept the previously planned path a UNABLE PATH INTERCEPT scratchpad message is displayed.

Descent: One minute prior to the TOD, a vertical track alert is given. When reaching the TOD, the FMS automatically starts the descent in VFLCH or VPATH if the altitude selector is set to a lower altitude.

- VFLCH Descents – The descent is in VFLCH mode if there is no altitude constraint down to 1500 ft/10 NM prior to the destination airport. VFLCH also complies with the speed/altitude limit. After an intermediate level-off at the altitude selector altitude, the next descent must be initiated selecting the altitude selector to a lower altitude and pressing FLCH on the FGP.
- VPATH Descents – The descent is in VPATH anytime an altitude constraint exists in the descent path and the airplane is within the capture logic of VPATH mode. FMS must be the navigation source and LNAV must be engaged in order the VPATH to become available. When the FMS passes through the last altitude constraint waypoint, it reverts to VFLCH to complete the descent.During VPTH descents, significant modifications of the flight plan may result the VPTH mode to drop to FPA mode.

Vertical DIRECT-TO: This operation is similar to the lateral DIRECT-TO. It is performed selecting the desired altitude from the scratch pad to the line adjacent to the desired waypoint.

The FMS calculates the predicted altitudes at which the airplane should pass the waypoints and then applies the altitude constraints to these altitudes, if necessary.

VNAV and HOLDING PATTERNS: The following applies:

- If descending on VFLCH and a holding pattern is entered, the active mode remains VFLCH;
- If a PPOS holding is entered while in VPATH, the active mode changes to VFLCH;
- If a hold is entered while in VPATH descent, the command changes to VALT.

FMS SPEED PLAN

FMS Speed Plan is a function that calculates speeds for a specified navigation based on performance initialization data, and sends speed targets to the FGCS.

Once the performance is initialized and confirmed, FMS speeds can be accessed in the ACTIVE FLT PLAN pages.

SPEED COMMAND FLIGHT PHASES

In order to perform the speed calculations and to define the FGCS targets in automatic mode, the FMS divides the flight in flight phases as follows:

Take Off: The FMS speed control does not provide guidance while in the Take Off mode. However, it sends inputs to the PFD to show the V2, until V2 is reached, then it ramps to V2 + 10 kt until the vertical mode is changed.

Departure: Speed command is the one selected on the DEP/APP speeds page. The default departure speed is 200 kt for 4 NM below 2500 ft.

Climb: Following departure, the command is the speed restriction set on the PERF INIT page 3/3. The default limit is 250 kt below 10000 ft. After clearing the limitation, the FMS commands the lower value between MACH or CAS set on the climb schedule. The default climb schedule is 280 kt/0.73 Mach. During step climbs the FMS commands climb speed schedule if the difference between the current and the intended level is more than 5000 ft, otherwise it remains in cruise speed schedule.

Cruise: When in VALT or ALT and the present altitude is equal to the cruise altitude selected on the PERF INIT, the speed command is the cruise schedule selected. If the airplane levels-off at an altitude lower than the Initial Cruise altitude, the speed command continues on the climb schedule.

Descent: The default descent speed schedule is 290 kt/0.76 Mach/3.0°. During step descents, the descent speed schedule will be the default speed commanded by the FMS. After level off FMS commands cruise speed schedule if the aircraft is before 50 NM from the TOD or descend speed schedule if it is within this range. Approaching the set limitation in the Speed/Altitude limit of the PERF INIT page 3/3, the FMS commands a speed reduction to comply with any existing speed constraint.

Approach: The transition to approach speeds is at 15 flight plan nautical miles from the destination or 5 NM from the first approach fix. This selection is made on the DEP/APP speeds pages.

When the flaps are set to position 1, the FMS commands speeds for the next flap. These speeds are calculated by the FMS for the actual airplane weight.

Go-around – When the flight director is set to GA the FMS speeds schedule changes for go-around as defined in the PERF INIT.

If a new approach is set while in go-around speed schedule the FMS reverts to approach speeds.

While in go-around, if a new destination is set, the FMS transitions to climb schedule speeds.

Waypoint Speed Constraints – If a speed is set in a flight plan waypoint, the FMS guides the AFCS to comply with this speed.

During a climb, the FMS commands the speed set in the speed constraint waypoint for all previous waypoints. After passing the speed constraint waypoint, the FMS reverts to the speed schedule set in the initialization up to the TOC.

During cruise and descent, the FMS commands the AFCS to cross the waypoint at the selected speed and applies this speed for the subsequent waypoints.

DATABASE

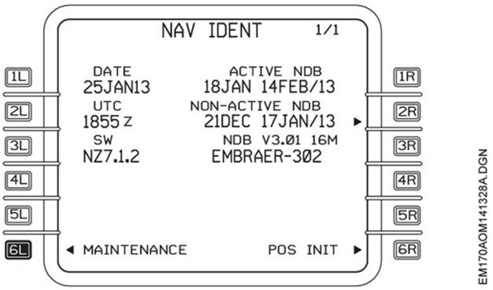
The FMS has three databases in its memory, a navigation database, a custom database, and an aircraft database.

NAVIGATION DATABASE

The FMS retrieves information from the navigation database about waypoints and procedures used in flight planning and to tune NAVAIDs for position determination. The navigation database is updated in cycles of 28 days and the last two cycles are displayed as ACTIVE NDB or NON-ACTIVE on the MCDU NAV IDENT page.

If the airplane is on ground and after a power up is performed, the FMS automatically sequences to a new database cycle at 0900Z on the date the new cycle becomes effective. Therefore, the older cycle is effective for 9 hours beyond the last day of that cycle, and the new cycle is not effective until 0900Z of its first day. Active flight plans are cleared when the active database cycle changes.

If the system is powered up at or after 0900Z on the date the new cycle becomes effective, the new cycle indication changes from amber to green and is displayed as ACTIVE NDB. The old cycle indication changes from green to amber and is displayed as NON-ACTIVE NDB.



If the system is powered up before 0900Z on the date the new cycle becomes effective, the old cycle indication is displayed in green and as ACTIVE NDB. The new cycle indication is displayed in amber and as NON-ACTIVE NDB.

NOTE: The green indicator does not reflect the actual date. It is only related to the effectiveness of the navigation base and it takes into account the 9 hours difference in the effectiveness time
.

The active database may be manually selected. If the pilot selects the new database cycle before 0900Z on the date the new cycle becomes effective, the new cycle is displayed in amber and as the ACTIVE NDB. The old cycle is displayed in green and as the NON-ACTIVE NDB. For this scenario, if takeoff and landing occur before 0900Z, the old database cycle returns to ACTIVE NDB before the Flight Complete logic.

NOTE: The FMS always follows the database cycle selected as ACTIVE NDB, regardless of the color (green or amber).

When both cycles are displayed in amber, either the date is wrong or both navigation databases are expired.

Depending on the location, the database cycle date may not agree with the current local date. Most FMSs are configured so the time displayed on the MCDU NAV IDENT page is synchronized with the GPS date and time.

CUSTOM DATABASE

The custom database contains information entered by the pilot. This is where the pilot can create and store flight plans and waypoints. This database is not updated on a scheduled basis.

AIRCRAFT DATABASE

The airplane database contains all aircraft-specific performance parameters. The performance learning function within the FMS, known as SmartPerf, has the ability to “learn” performance characteristics based on information gathered on previous flights. This performance learning requires no pilot action. Therefore, all performance data (learned and fixed) is contained in the file.

FUNCTIONS

PERFORMANCE (PERF)

This function gives access to performance related pages including performance initialization, climb, cruise, descent, wind, fuel management and takeoff and landing data. In addition, permits the initialization of stored flight plans and execute performance computations.

NAVIGATION (NAV)

This function gives access to Index providing access to position sensor data, stored flight plans, FIX INFO, selection of waypoints and maintenance pages. In addition, in this page is possible to perform data loading using a remote terminal or DMU.

FLIGHT PLAN (FPL)

This function provides flight plan data for each leg in the planned (active) flight plan, including course, distance and FPA/altitude constraints. It is also possible to create a flight plan, select a stored flight plan and loading of a flight plan from a disk.

PROGRESS (PROG)

This function summarizes important dynamic flight parameters and the airplane relationship with the active flight plan, such as Estimated Time Enroute (ETE), distance to go, fuel information, current NAV mode, number of long range NAVs used, NAVAIDS that are presently tuned, FMS navigation mode, closest NAVAIDS, and air data information (current speed, altitude and temperature).

COMPANY ROUTE (RTE)

Route planning allows a quicker flight planning by the pilot. It can be performed either by selecting a company route from the database or by entering flight plan legs and procedures using Air Traffic Control (ATC) language, saving time during the preflight phase. This function displays the active route with origin, destination, runway and company route identifier information.

FMS ANNUNCIATORS

Annunciators are displayed on the electronic display system (EDS). Magenta indicates an advisory annunciator and amber indicates an alerting annunciators.

- Dead Reckoning (DR) - DR is an alerting (amber) annunciator. This annunciator is displayed or lit when operating in the DR mode. The FMS enters DR mode after loss of required navigation performance (see DGRAD) and loss of radio updating and all other position sensors (IRS and GPS) for greater than 2 minutes.
- Degraded (DGRAD) - DGRAD is an alerting (amber) annunciator. This annunciator is displayed or lit when the FMS loses required navigation performance (RNP). This is accompanied by the UNABLE RNP scratchpad message.
- The DGRAD annunciator is displayed on the HSI and LNAV display when FMS is the selected airplane navigation source on EDS and any of the following conditions exist:
  - FMSEPU is greater than RNP.
  - FMS position integrity estimate is greater than the integrity alarm limit (this can occur when EPU is slightly less than RNP).
  - GPS is not available and GPS is required for the selected flight plan procedure.

If the DR annunciator is displayed or lit when the DGRAD annunciator is displayed or lit, the DGRAD annunciator is removed or turned off.

- Message (MSG) - MSG is an alerting (amber) annunciator. This annunciator is displayed when a message is shown in the MCDU scratchpad. The annunciator is removed or turned off after the message(s) has been cleared from the scratchpad.

Messages are displayed in the MCDU scratchpad at various times. They inform or alert the pilot as to system status. Messages are divided into the following two major groups:

- ADVISORY MESSAGES - Advisory messages are usually the result of a pilot action on the MCDU (e.g., making an entry with the incorrect format). These messages do not turn on The MSG annunciator.
- ALERTING MESSAGES - Alerting messages alert the pilot to the FMS status, assuming the pilot is not looking at the MCDU (e.g., a message annunciating a sensor failure).

Messages are stacked for display in priority order on a first in, last out basis. In cases where there are multiple messages stacked, the message annunciator remains displayed or lit until all messages are cleared. Only one message can be cleared per CLR key push.

- Approach (APPR) - APPR is an advisory (magenta) annunciator. The annunciator indicates the FMS is in the approach mode of operation. In this mode, the EDS deviation sensitivity and FMS tracking gains are increased. The approach annunciator is displayed if ALL of the following conditions are valid:
  - The FMS is the selected airplane navigation source on EDS.
  - A non–precision instrument approach must have been activated from the navigation database. If no approach, or an ILS, LOC, LOC-BC, LDA), simplified directional facility (SDF), or MLS approach is selected, the APPR annunciator does not light.
  - The airplane position is between 2 NM outside the final approach fix (FAF) and the missed approach point (MAP).
  - The DGRAD annunciator must be removed or turned off.
  - When the approach requires the use of GPS, GPS navigation mode must be valid.
- Terminal (TERM) - TERM is an advisory (Magenta) annunciator. TERM indicates the FMS is in the terminal area and that required navigation accuracy has increased.
- Lateral Track Alert (WPT) - WPT is an advisory (magenta) annunciator. FMS gives a WPT 30 seconds prior to sequencing a waypoint.
- Vertical Track Alert (VTA) - VTA is an advisory (magenta) annunciator. A vertical track annunciation is given to warn of an impending FMS vertical track command change. A VTA is issued for the following conditions:
  - The airplane is within 1000 ft of capturing an altitude constraint that is not collocated with the altitude preselect.
  - In CRUISE, one minute prior to TOD.
  - One minute prior to resuming a climb or descent from a constrained waypoint.
  - Prior to resuming a vertical flight level change (VFLCH) descent due to a speed limit altitude level-off.
  - In CRUISE, one minute prior to executing a step Climb. The VTA is also issued as an audible annunciation.
- Lateral Offset (OFFSET) - OFFSET is an advisory (magenta) annunciator. FMS gives the capability to define and fly a parallel offset of up to 30 NM on any TF or CF leg that is not included in a SID, STAR, Approach or Hold. A parallel offset can also be flown to a DF leg following the final turn.
- Altitude Alert - The altitude alert generated by the FMS is used by EDS in a fashion similar to that used to alert the flight crew of the impending altitude preselect target (i.e., amber speed tape display).
- Required Navigation Performance (RNP) - RNP is an advisory (magenta) annunciator.

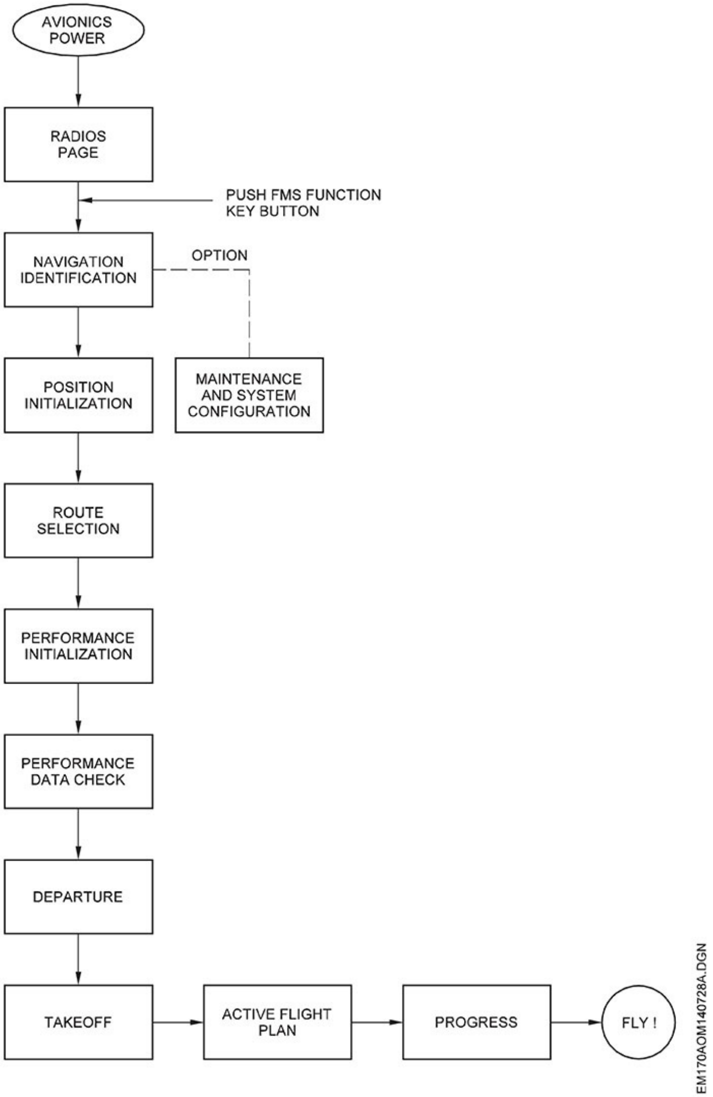
The APPR annunciator must turn on 2 NM before the final approach fix. It remains lit for the remainder of the approach. This is a positive cue to the flight crew that the sensor configurations is correct and sensor integrity is within limits for the approach. The approach annunciator is not lit during localizer based approaches since the FMS is not authorized to be coupled during localizer approaches. The DGRAD annunciator must be off throughout the approach. If DGRAD annunciator turns on, the FMS should not be used for the remainder of the approach. The flight crew can continue the approach using raw data or perform the missed approach procedure.

PREFLIGHT

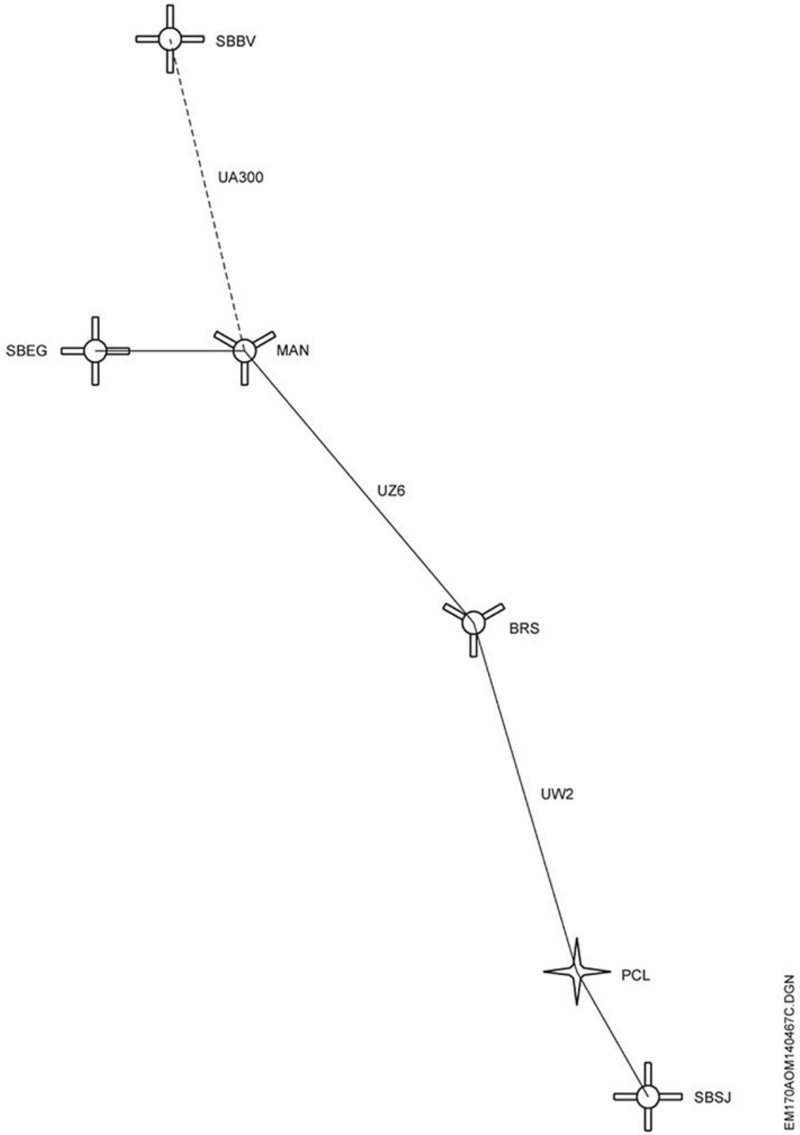
A preflight procedure for a normal flight can be accomplished on the ground with the following steps:

- Radios page.
- Navigation identification.
- Position initialization.
- Route selection.
- Departure.
- Performance initialization.
- Performance data check.
- Takeoff.
- Preflight status verification.

In order to clarify the steps required in the preflight procedure an navigation example is considered.



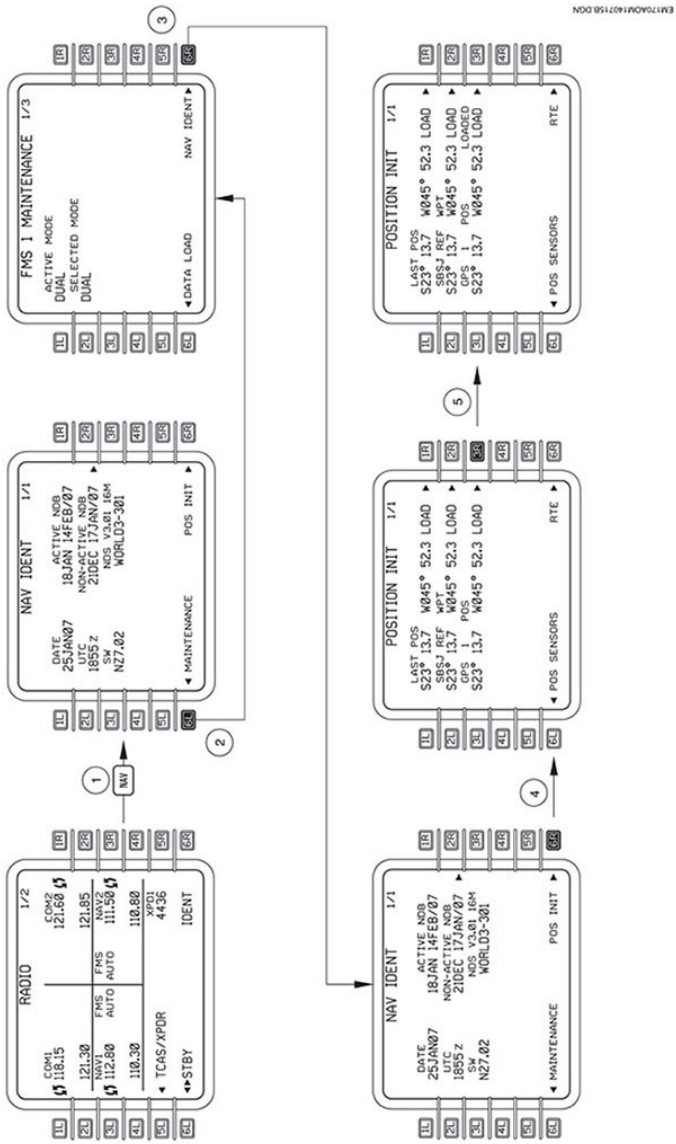
PREFLIGHT FLOW CHART



NAVIGATION EXAMPLE

NAVIGATION IDENTIFICATION AND POSITION INITIALIZATION

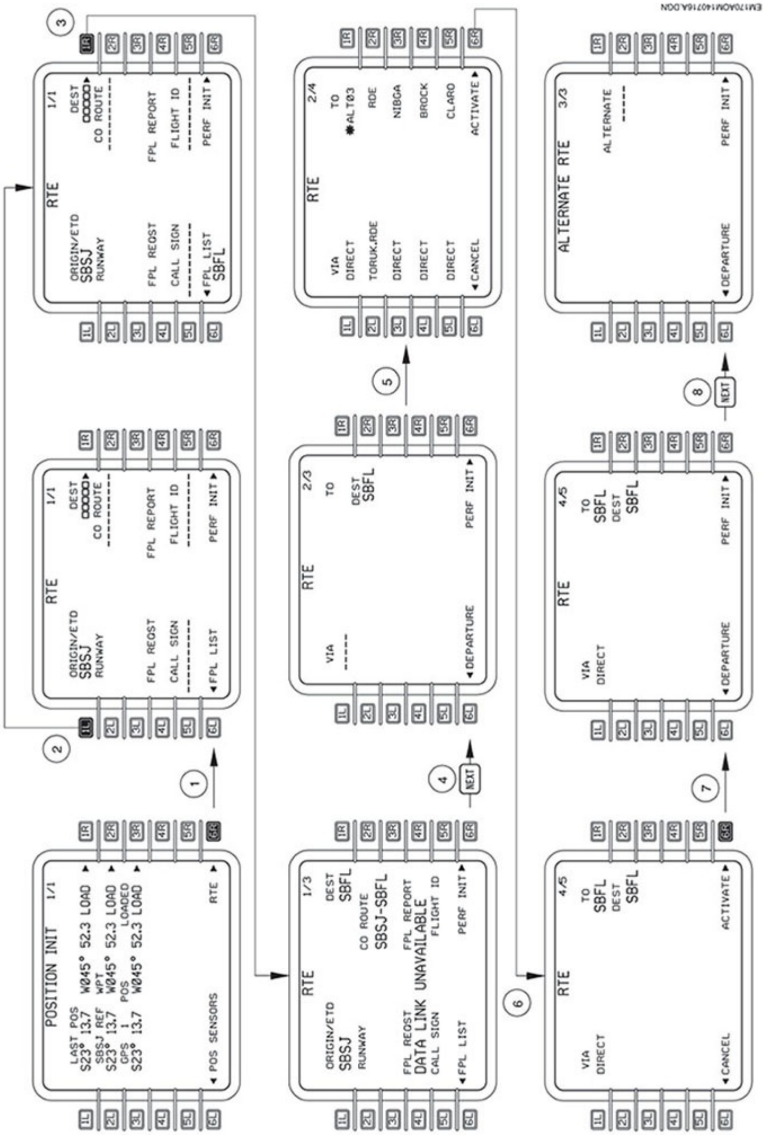
1. After power up the RADIO page will be displayed as default. Press NAV button to enter the NAV IDENT 1/1 page.
2. On NAV IDENT 1/1 page the following items must be checked:
   - Date and time: This data comes from the GPS. If the GPS is failed or the data is not valid, date and time can be changed.
   - Navigation data base: Active data base and alternate period dates.
   - Worldwide coverage.
3. Press LSK 6R (NAV IDENT) to go back to NAV IDENT 1/1 page.
4. On NAV IDENT 1/1 page press LSK 6R (POS INIT).
5. The POSITION INIT 1/1 page presents a maximum of 3 options to be loaded as initial position pressing respectively 1R, 2R or 3R:
   - Last position: The FMS stores the last position when the airplane is powered down.
   - Reference waypoint: Displays the closest ramp x or airport reference point within 3 NM of the last position. Additionally the pilot may type a waypoint or coordinates on the scratchpad through alphanumeric keys, and enter it pressing LSK 2L.
   - GPS position.



NAVIGATION IDENTIFICATION AND POSITION INITIALIZATION

ROUTE SELECTION - CREATING A FLIGHT ROUTE

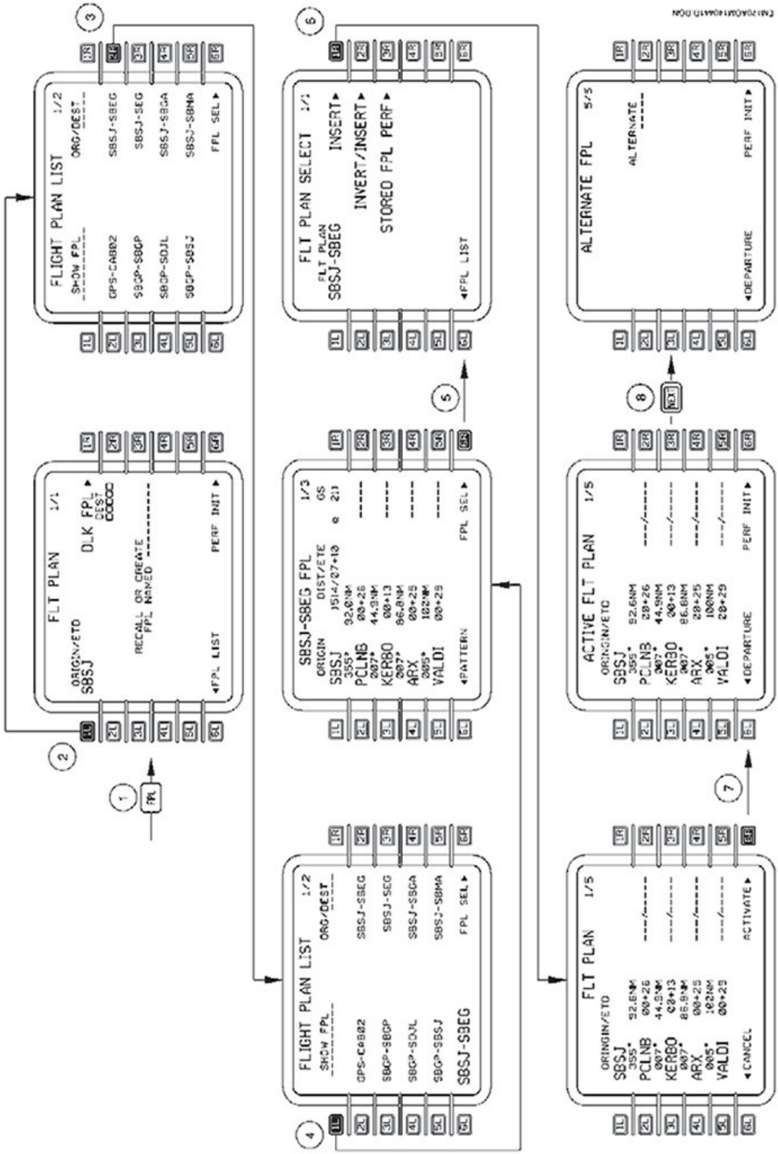
1. On POSITION INIT 1/1 page press LSK 6R (RTE). On RTE 1/1 page it is possible to create/store a flight plan or load a flight plan from the memory.
2. If the initialization coordinates are within 3 NM of the airport data base the origin airport is already loaded, otherwise enter the origin airport in the scratchpad through alphanumeric keys and press LSK 1L.
3. Enter the destination airport in the scratchpad through alphanumeric keys and press LSK 1R.
4. Press NEXT key to go to RTE 2/3 page.
5. Enter the waypoints in the scratchpad through alphanumeric keys and press LSK correspondent to VIA.TO:
    - In case of waypoints entries, enter the airway identifier followed by the last desired waypoint of the airway. Both must be separated by a period.
    - If a waypoint entry corresponds to more than one option in the memory, all options are displayed and selection of the desired one is made by pressing the respective LSK.
    - When entering a waypoint and no VIA.TO is displayed press NEXT button until VIA.TO is displayed.
6. When entry of all waypoints is finished, press LSK correspondent to DEST and press LSK correspondent to VIA.TO to close the flight plan.
7. On RTE page press LSK 6R (ACTIVATE) to activate the flight plan.
8. Access the last page (ALTERNATE RTE) by pressing the NEXT button.



CREATING A FLIGHT ROUTE

ROUTE SELECTION – LOADING A FLIGHT PLAN

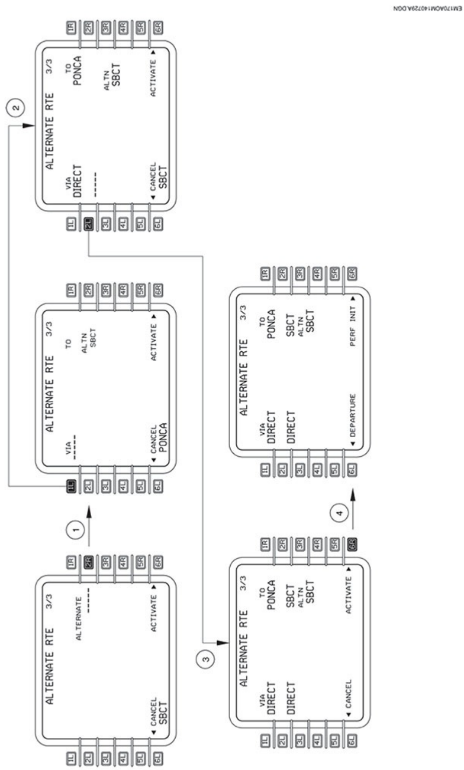
1. Press Flight Plan (FPL) key to go to FLT PLN 1/1 page. On this page it is possible to create/store a flight plan or load a flight plan from the memory.
2. Press LSK 6L (FPL LIST) or enter the flight plan name in the scratchpad through alphanumeric keys to access the FLIGHT PLAN LIST page.
3. In the FLIGHT PLAN LIST page, select the desired flight plan by pressing the respective LSK flight plan that appears in the scratchpad.
4. Press LSK 1L (SHOW FPL). Verify the loaded flight plan by pressing NEXT key to scroll on the pages.
5. Press LSK 6R (FPL SEL) to go to FLIGHT PLAN SELECT 1/1 page.
6. On FLIGHT PLAN SELECT 1/1 page press LSK 1R (INSERT) to insert the flight plan.
7. On FLT PLN page press LSK 6R (ACTIVATE) to activate the flight plan.
8. Access the last page (ALTERNATE FPL) by pressing the NEXT key.



LOADING A FLIGHT PLAN

CREATING AN ALTERNATE FLIGHT ROUTE

1. On ALTERNATE RTE page enter the alternate airport in the scratchpad through alphanumeric keys and press LSK 2R.
2. Enter the waypoints in the scratchpad through alphanumeric keys and press LSK correspondent to VIA.TO:
    - In case of waypoints entries, enter the airway identifier followed by the last desired waypoint of the airway. Both must be separated by a period.
    - If a waypoint entry corresponds to more than one option in the memory, all options are displayed and selection of the desired one is made by pressing the respective LSK.
    - When entering a waypoint and no VIA.TO is displayed press NEXT button until VIA.TO is displayed.
3. When entry of all waypoints is finished, press LSK correspondent to DEST and press LSK correspondent to VIA.TO to close the flight plan.
4. Activate the alternate flight route by pressing the LSK 6R (ACTIVATE).



ALTERNATE FLIGHT ROUTE

PERFORMANCE INITIALIZATION

1. On ALTERNATE FPL or ALTERNATE RTE page press LSK 6R (PERF INIT) to enter in the PERFORMANCE INIT page. The following items must be checked:
   - Aircraft type.
   - Tail number.
2. Select the performance mode by pressing LSK 2R to enter in the PERF MODE page. Press the respective LSK performance mode and LSK 1R (RETURN). Three modes are available for selection:
   - Full performance: The performance is based according to pilot selections. The following pages/data are only available in full performance:
   - PERF DATA pages.
   - CLIMB pages.
   - CRUISE pages.
   - DESCENT pages.
   - Point of no return page.
   - Equal time point page.
   - Optimum and maximum altitude.
   - Cruise speed schedules: long range cruise, maximum speed, maximum endurance and maximum range.

   In order to calculate the performance data the following entries are required:

   - Zero Fuel Weight.
   - Current groundspeed and fuel flow: The performance is based according to current groundspeed and fuel flow. On the ground a default value for groundspeed is used, once airborne the current value is used. The fuel flow can be overridden by a pilot entry.
   - Speed schedules and cruise fuel flow: The performance is based according to pilot entered speed schedules and cruise fuel flow.
3. Enter the climb speed in the scratchpad through alphanumeric keys and press LSK 3L. The entry can be CAS, MACH or both CAS/MACH (separated by a slash). The active speed is the one that provides the lowest TAS. Entering “delete” returns the default values.

   Selection can also be provided by pressing LSK 3R and entering the CLIMB MODES page. On CLIMB MODES page select the respective LSK climb mode and LSK 1R (RETURN).
4. Enter the cruise speed in the scratchpad through alphanumeric keys and press LSK 4L. The entry can be CAS, MACH or both CAS/MACH (separated by a slash). The active speed is the one that provides the lowest TAS. Entering “delete” returns the default values.

   Selection can also be provided by pressing LSK 4R and entering the CRUISE MODES page. On CRUISE MODES page select the respective LSK cruise mode and LSK 1R (RETURN). Four cruise mode are available:

   - Long range cruise.
   - Maximum speed.
   - Maximum endurance.
   - Maximum range speed.

If long range cruise or maximum speed are selected, the active speed at high altitudes is MACH and at low altitudes is CAS.

For maximum endurance always CAS is the active speed.

5. Enter the descent speed and angle in the scratchpad through alphanumeric keys and press LSK 3L. The entry can be CAS, MACH, ANGLE, both CAS/MACH or CAS/MACH/ANGLE (separated by slashes). The active speed is the one that provides the lowest TAS. Entering “delete” returns the default values.

   Selection can also be provided by pressing LSK 5R and entering the DESCENT MODES page. On DESCENT MODES page select the respective LSK climb mode and LSK 1R (RETURN).

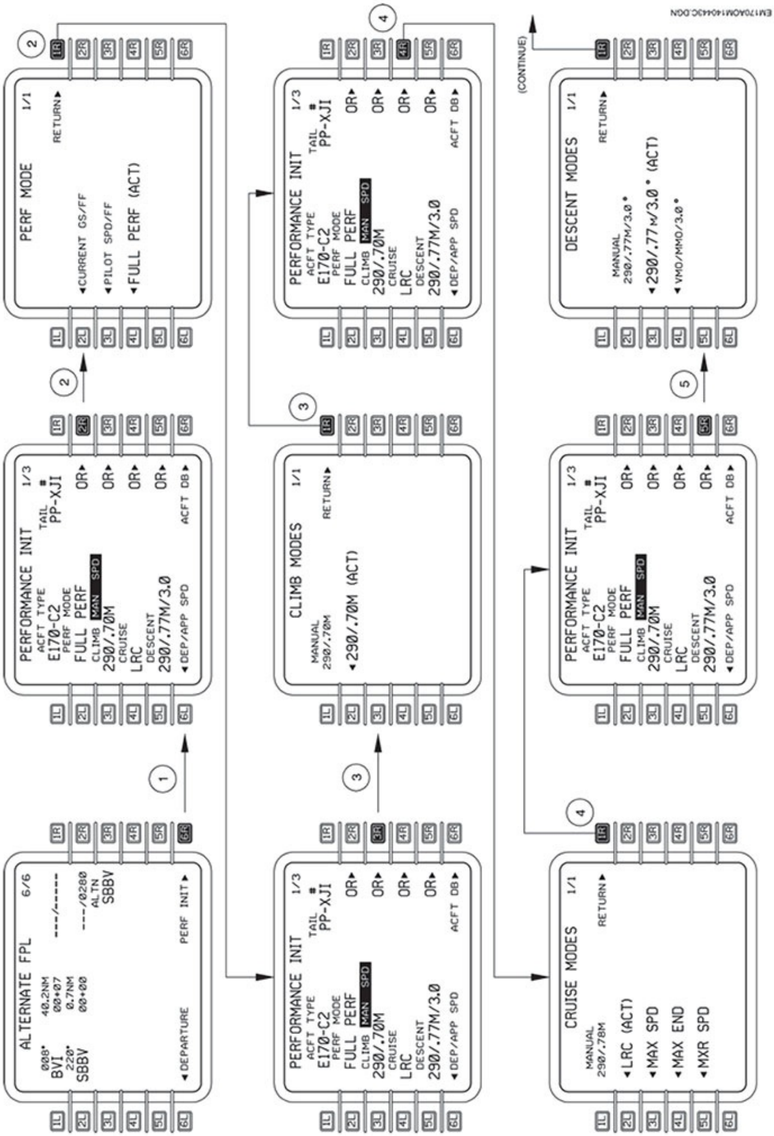
6. Press the LSK 6L to enter in the DEP/APP SPD pages. On the DEPARTURE SPEED 1/3, is possible to set the speed restriction during the departure as well as the altitude and the distance where the departure speed limit applies.
7. Press the NEXT button to go to APPROACH SPEEDS 2/3 page. On this page is possible to enter the approach speeds depending the flap setting. It is also possible to enter the approach speed limit. The FMS logic is to command the speed for the next flap up to flaps full.

   In the LSK 4L, is possible to access the radial distance in nautical miles where FMS begins the approach schedule.
   In the LSK 5R or 5L is possible to select if the approach speed schedule is to be initiate at further out distance than the one set in 4L or not.

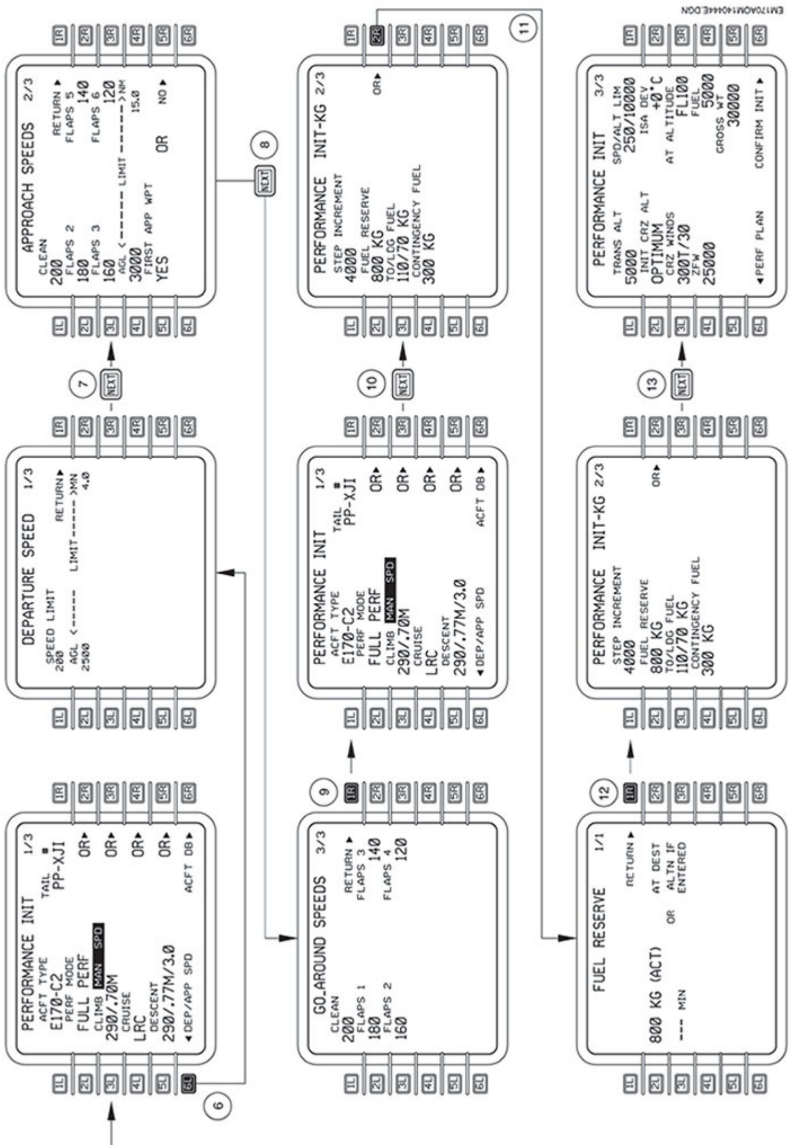
8. Press the NEXT button to go to GO-AROUND SPEEDS 3/3 page. On this page is possible to set go around speeds depending on flap settings. Press the RETURN prompt at 1R to go back to PERFORMANCE INIT 1/3.
9. Press NEXT button to go to PERFORMANCE INIT 2/3 page.
10. On PERFORMANCE INIT 2/3 page is possible to enter the data below. The entry is accomplished in the scratchpad through alphanumeric keys and pressing the respective LSK.
    - Step climb increment (unavailable).
    - Fuel reserve. Additionally fuel reserve can also be entered by pressing LSK 2R to access FUEL RESERVE page. On FUEL RESERVE page is possible to enter the fuel reserve in kilograms or in minutes. The entry is accomplished in the scratchpad through alphanumeric keys and pressing the respective LSK.
      Press LSK 1R (RETURN) to go back to PERFORMANCE INIT page.
      The fuel reserve applies at destination or at the alternate destination if one has been entered.
    - Fuel allowance for takeoff and landing.
    - Contingency fuel.

11. Press NEXT button to enter in the PERFORMANCE INIT page 3/3. On this page is possible to enter the data below. The entry is accomplished in the scratchpad through alphanumeric keys and pressing the respective LSK.
    - Transition altitude.
    - Initial cruise altitude. Altitudes above the transition altitude are displayed as flight levels and below in feet. The cruise altitude must be equal to or greater than the Altitude Selector, otherwise the message RESET ALT SEL? is displayed. If the full performance mode is selected the initial cruise altitude is displayed as OPTIMUM.
    - Average cruise wind and corresponding altitude.
    - Zero fuel weight.
    - Speed limits associated with altitudes.
    - Temperature deviation.
    - Fuel weight.

    If the maximum gross weight is exceeded the message EXCEEDS MAX GROSS WEIGHT is displayed.



PERFORMANCE INITIALIZATION 1/2

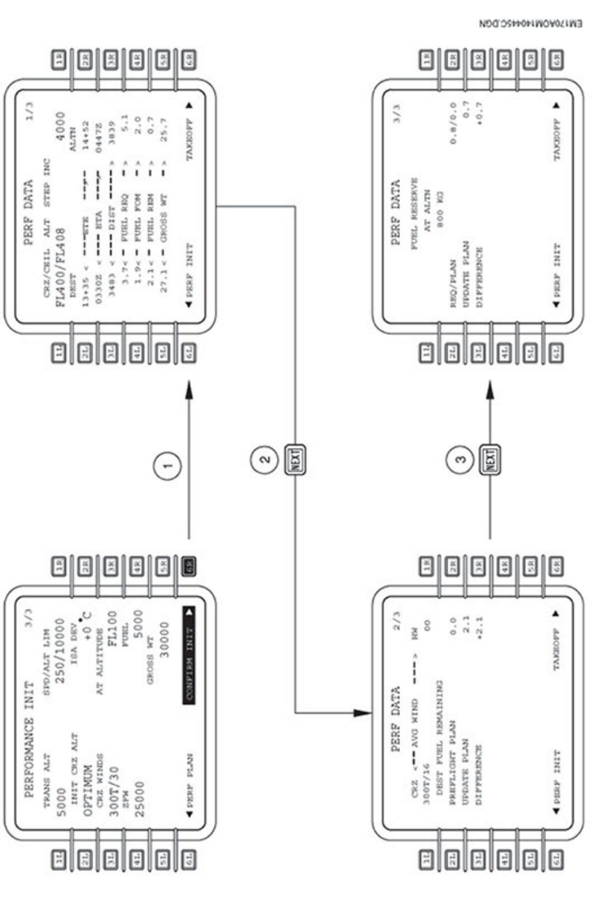


PERFORMANCE INITIALIZATION 2/2

PERFORMANCE DATA CHECK

1. On PERFORMANCE INIT 3/3 page press LSK 6R (CONFIRM INIT).
   On the PERF DATA page the following data displays for destination and alternate:
   - Cruise and ceiling altitudes.
   - Step increments.
   - Estimated time enroute.
   - Estimated time arrival.
   - Distance.
   - Fuel requirement.
   - Fuel figure of merit (accuracy of the fuel required).
   - Fuel remaining.
   - Gross weight.

   The cruise altitude and step increments can be changed by entering in the scratchpad through alphanumeric keys and pressing respectively LSK 1L or LSK 1R.
2. Press NEXT button to go to PERF DATA 2/3 page. On this page the following information is displayed:
   - Average cruise wind.
   - Preflight fuel remaining.
   - Latest estimated fuel remaining.
   - Difference between preflight and estimated fuel remaining.
3. Press NEXT button to go PERF DATA 3/3 page. On this page the following information is displayed:
   - Required fuel reserve.
   - Predicted fuel remaining.
   - Updated plan (most recent of the fuel remaining).



PERFORMANCE DATA CHECK

TAKEOFF

1. On PERF DATA page press LSK 6R (TAKEOFF) to enter in the TAKEOFF 1/3 page. On TAKEOFF 1/3 page the following information is displayed:
   - Runway heading.
   - Takeoff weight.
   - Static air temperature.
   - Surface wind.
   - Pressure altitude.
   - Baro settings.
   - Runway slope.
   - Headwind/tailwind and crosswind.
   - Runway elevation.
   - Runway condition.

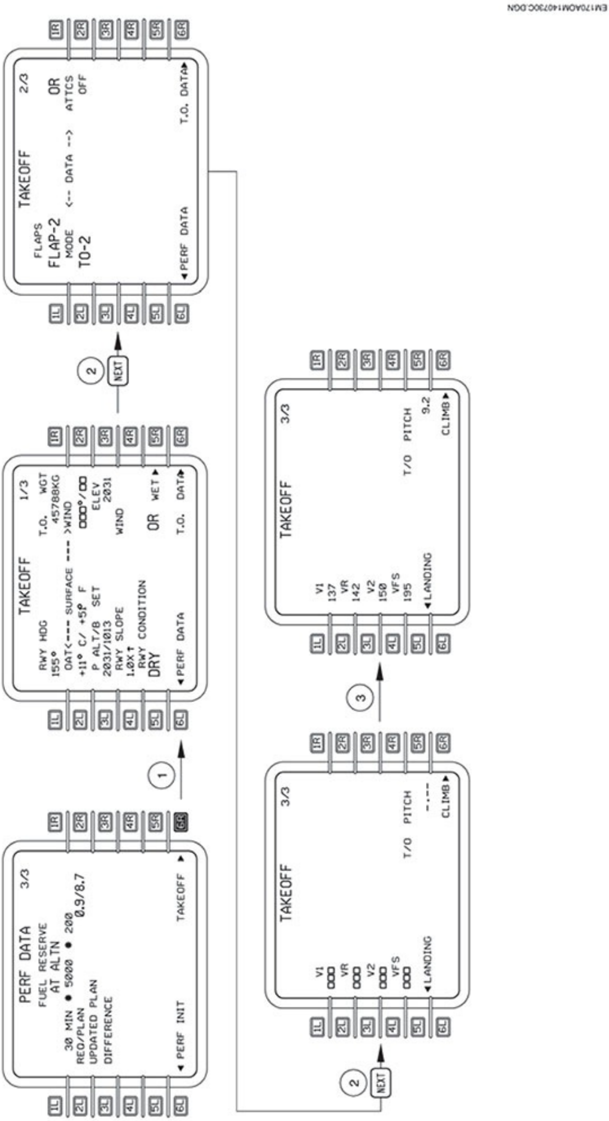
   Takeoff weight, temperature, surface wind, baro settings and runway condition can be entered. The entry is accomplished in the scratchpad through alphanumeric keys and/or pressing the respective LSK.

NOTE:
- If no departure runway is selected on the FMS or the runway heading is manually inserted by the pilot on the TAKEOFF page, the scratchpad will present the EXCEEDS P ALTITUDE LIMIT message every time the airplane climbs through 15000 ft.
- The information entered on RWY CONDITION is not used for FMS computations.

2. Press NEXT button to go to TAKEOFF 2/3 page. The following information is displayed:
   - Flaps.
   - Takeoff mode.
   - ATTCS.

   The entry of the information is accomplished in the scratchpad through the respective LSK.

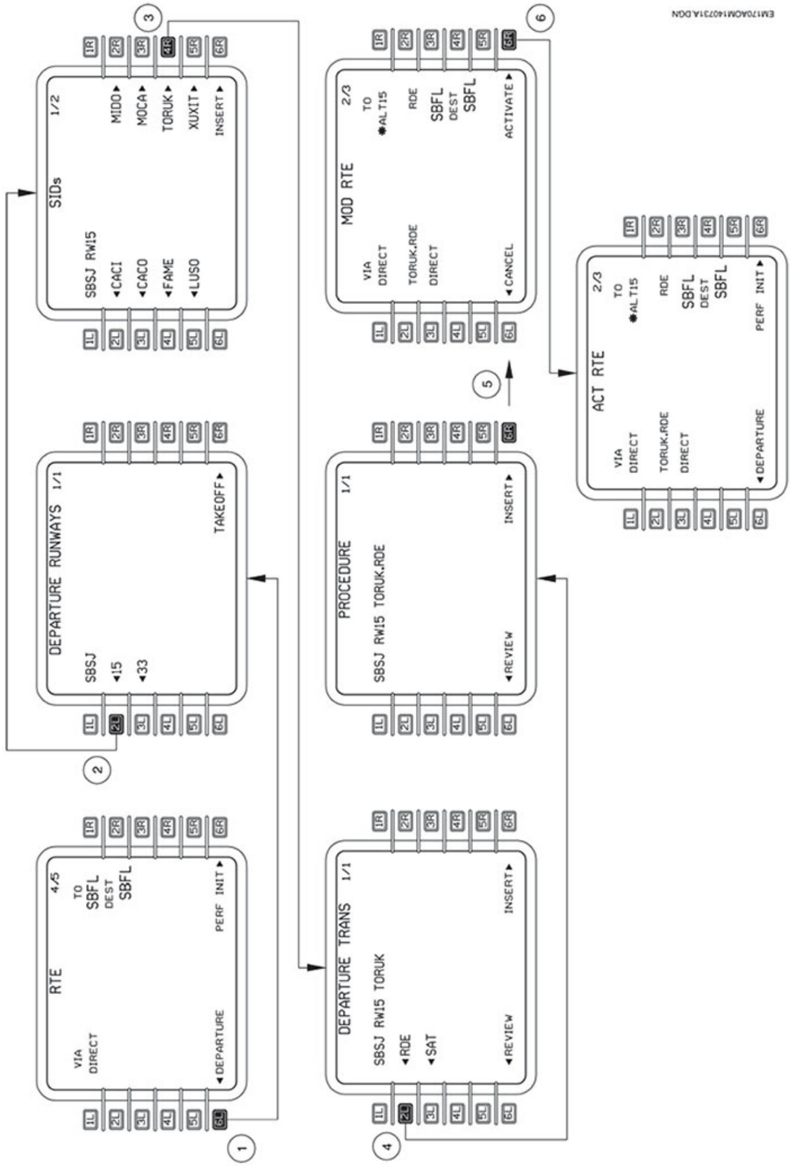
3. Press NEXT button to go to TAKEOFF page 3/3. Enter with V1, VR, V2, VFS and crosscheck the takeoff pitch angle. The entry is accomplished in the scratchpad through alphanumeric keys and pressing the respective LSK.


EM170AOM140730C.DGN
PERF DATA 3/3
FUEL RESERVE
AT ALTN
30 MIN • 5000 • 200
REQ/PLAN
UPDATED PLAN 0.9/8.7
DIFFERENCE
◄PERF INIT
TAKEOFF ►
1
TAKEOFF 1/3
RWY HDG
155°
T.O. WGT
45788KG
OAT<--- SURFACE --- >WIND
+11° C/ +52° F
P ALT/B SET
2031/1013
ELEV
2031
RWY SLOPE
1.0X↑
WIND
RWY CONDITION
DRY
OR
WET►
◄PERF DATA
T.O. DATA►
2
NEXT
TAKEOFF 2/3
FLAPS
FLAP-2
OR
MODE
TO-2
<-- DATA -->
ATTCS
OFF
◄PERF DATA
T.O. DATA►
TAKEOFF 3/3
V1
VR
V2
VFS
T/O PITCH
-.--
◄LANDING
CLIMB►
3
TAKEOFF 3/3
V1
137
VR
142
V2
150
VFS
195
T/O PITCH
9.2
◄LANDING
CLIMB►

TAKEOFF

DEPARTURE

1. The DEPARTURE page can be selected either on NAV INDEX or RTE pages by pressing the respective LSK.
2. On the DEPARTURE RUNWAYS page selects the runway by pressing the respective LSK.
3. On SIDs page selects the SID by pressing the respective LSK.
4. On the DEPARTURE TRANS page selects the departure transition by pressing the respective LSK.
5. On PROCEDURE page press LSK 6R (INSERT).
6. Activate the flight route by pressing the LSK 6R (ACTIVATE) on the MOD RTE page. Check if there is no discontinuity between waypoint scrolling with the next button.


RTE 4/5
VIA DIRECT
TO SBFL
DEST SBFL
◄DEPARTURE
PERF INIT►
DEPARTURE RUNWAYS 1/1
SBSJ
◄15
◄33
TAKEOFF►
SIDs 1/2
SBSJ RW15
◄CACI
◄CACO
◄FAME
◄LUSO
MIDO►
MOCA►
TORUK►
XUXIT►
INSERT►
DEPARTURE TRANS 1/1
SBSJ RW15 TORUK
◄RDE
◄SAT
◄REVIEW
INSERT►
PROCEDURE 1/1
SBSJ RW15 TORUK.RDE
◄REVIEW
INSERT►
MOD RTE 2/3
VIA DIRECT
TORUK.RDE
DIRECT
TO ✱ALT15
RDE
SBFL
DEST SBFL
◄CANCEL
ACTIVATE►
ACT RTE 2/3
VIA DIRECT
TORUK.RDE
DIRECT
TO ✱ALT15
RDE
SBFL
DEST SBFL
◄DEPARTURE
PERF INIT►
1
2
3
4
5
6
EM170AOM140731A.DGN

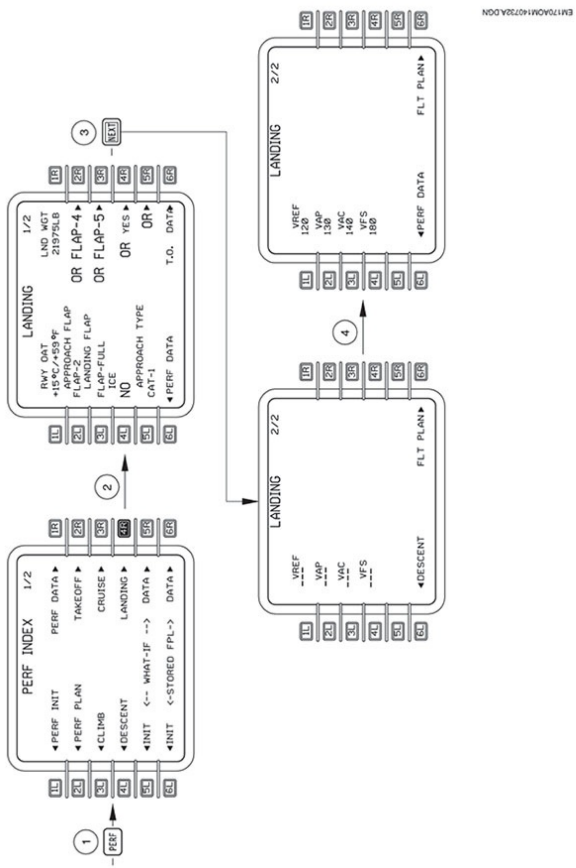
DEPARTURE

LANDING SPEEDS

1. Press PERF button to go to PERF INDEX 1/2 page.
2. Press LSK 4R (LANDING) to go to LANDING 1/2 page.

NOTE: The information entered on APPROACH FLAP, LANDING FLAP, ICE and APPROACH TYPE are not used for FMS computations.

3. Access the LANDING 2/2 page by pressing the NEXT button.
4. Enter with VREF, VAP, VAC and VFS for the departure runway. The entry is accomplished in the scratchpad through alphanumeric keys and pressing the respective LSK.



LANDING SPEEDS

PROGRESS

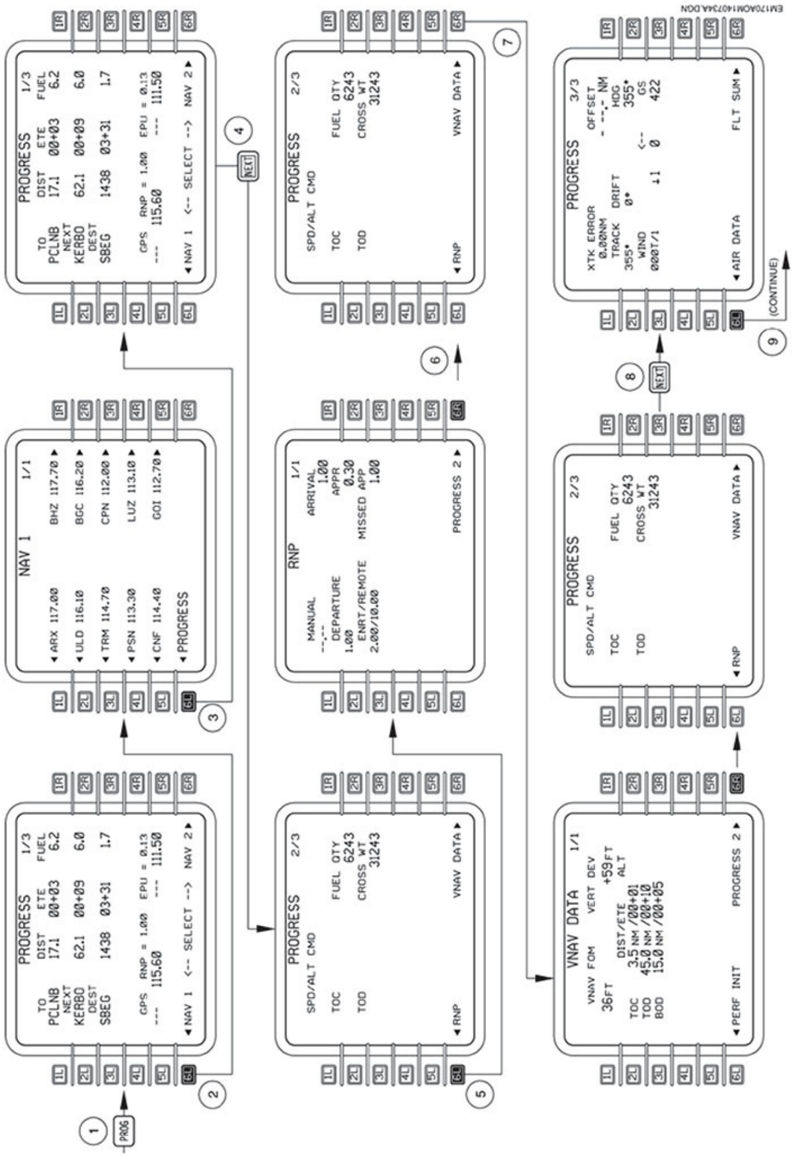
1. Press PROG button to go to PROGRESS 1/3 page.
   On PROGRESS 1/3 page the following information is displayed for the to, next and destination waypoints:
   - Distance to go.
   - Estimated time enroute.
   - Estimated fuel remaining.
   - Primary navigation source.
   - Required navigation performance (RNP) value.
   - Estimated position uncertainty (EPU) value. If EPU becomes greater than RNP the message UNABLE RNP is displayed.
   - Tuned navigation radios frequencies.

   Any active waypoint entry is permitted. The entry is accomplished in the scratchpad through alphanumeric keys and pressing the respective LSK (1L or 2L).
2. Pressing LSK 6L or 6R (NAV 1/NAV 2) enters respectively in the NAV 1 or NAV 2 page.
3. A list of 10 closest navigation frequencies is displayed. To tune a frequency press the respective LSK or press LSK 6L (PROGRESS) to return to PROGRESS 1/3 page.
4. Press NEXT button to go to PROGRESS 2/3 page. The following information is displayed:
   - Current fuel quantity.
   - Current aircraft Gross weight.
5. Pressing LSK 6L (RNP) enters in the RNP 1/1 page. The following information is displayed:
   - Manual override RNP value.
   - Departure RNP value.
   - Approach RNP value.
   - Enroute /remote RNP values.
   - Missed approach RNP value.

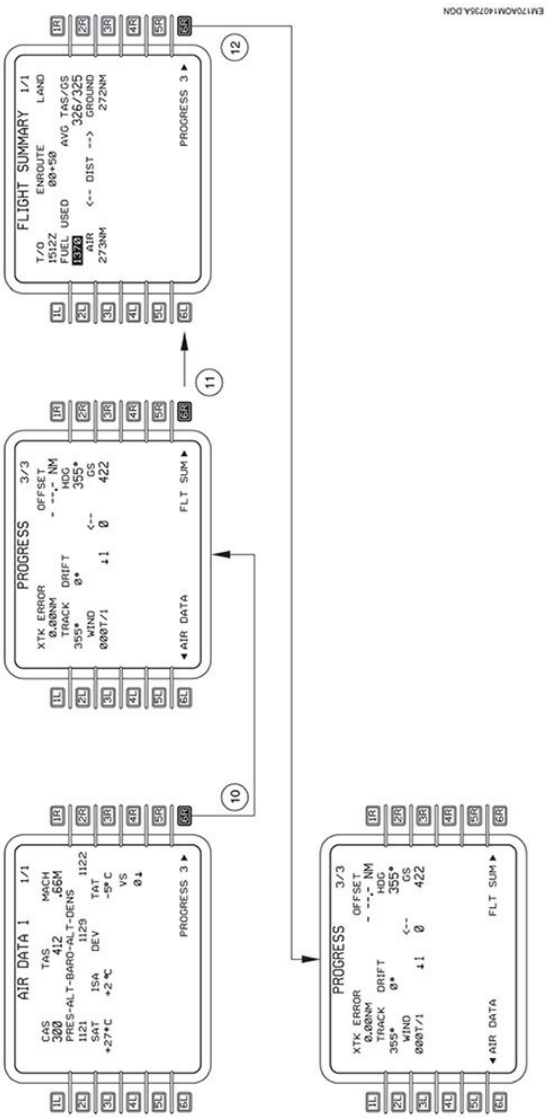
   The default RNP values for each phase of flight are displayed in small characters. The pilot can manually enter new RNP values that are displayed in large characters. The entry is accomplished in the scratchpad through alphanumeric keys and pressing the respective LSK. Entry of DELETE returns the default value.

   A confirm entry prompt is displayed if the pilot has entered a manual override RNP value that is higher than default. The selection of the YES prompt at LSK 6R accepts the entered value as the new manual override RNP value and the selection of the NO prompt at LSK 6L causes the manual override RNP to return to the original value. A lower RNP value is accepted and gives access to PROGRESS page 2.
6. Press LSK 6R (PROGRESS 2) to return to PROGRESS 2/3 page.

7. Press the LSK 6R to enter the VNAV DATA page. On this page, the following information displays.
   - VNAV Figure of Merit at LSK 1L.
   - Vertical Deviation at LSK 1R.
   - TOC pseudo waypoint distance/time to go at LSK 2L and TOC altitude at LSK 2R.
   - TOD pseudo waypoint distance/time to go at LSK 3L and TOD altitude at LSK 3R.
   - Bottom of Descent (BOD) pseudo waypoint distance/time to go at LSK 3L and BOD altitude at LSK 3R.
8. Press NEXT button to go to PROGRESS 3/3 page.
   The following information is displayed:
   - Cross track error.
   - Off set entry.
   - Airplane track.
   - Airplane drift.
   - Airplane heading.
   - Wind.
   - Ground speed.
9. Pressing LSK 6L (AIR DATA) enters in the AIR DATA 1/1 page.
   The following information is displayed:
   - Pressure altitude.
   - Barometric altitude.
   - Vertical speed.
   - Static air temperature.
   - ISA deviation.
   - Total air temperature.
10. Press LSK 6R (PROGRESS 3) to return to PROGRESS 3/3 page.
11. Pressing LSK 6R (FLT SUM) entries in the FLIGHT SUMMARY 1/1 page.
    The following information is displayed:
    - Takeoff time.
    - Enroute time.
    - Landing time.
    - Fuel used.
    - Average true air speed/ground speed.
    - Air distance.
    - Ground distance.
12. Press LSK 6R (PROGRESS 3) to return to PROGRESS 3/3 page.



PROGRESS 1/2


FLIGHT SUMMARY 1/1
T/O ENROUTE LAND
1512Z 00+50
FUEL USED AVG TAS/GS
1370 326/325
AIR <-- DIST --> GROUND
273NM 272NM
PROGRESS 3
PROGRESS 3/3
XTK ERROR OFFSET
0.00NM -.--.- NM
TRACK DRIFT HDG
355° 0° 355°
WIND GS
000T/1 ↓1 <-- 0 422
AIR DATA
FLT SUM
AIR DATA 1 1/1
CAS TAS MACH
300 412 .66M
PRES-ALT-BARO-ALT-DENS
1121 1129 1122
SAT ISA DEV TAT
+27°C +2°C -5°C
VS
0↓
PROGRESS 3
10
11
12

PROGRESS 2/2

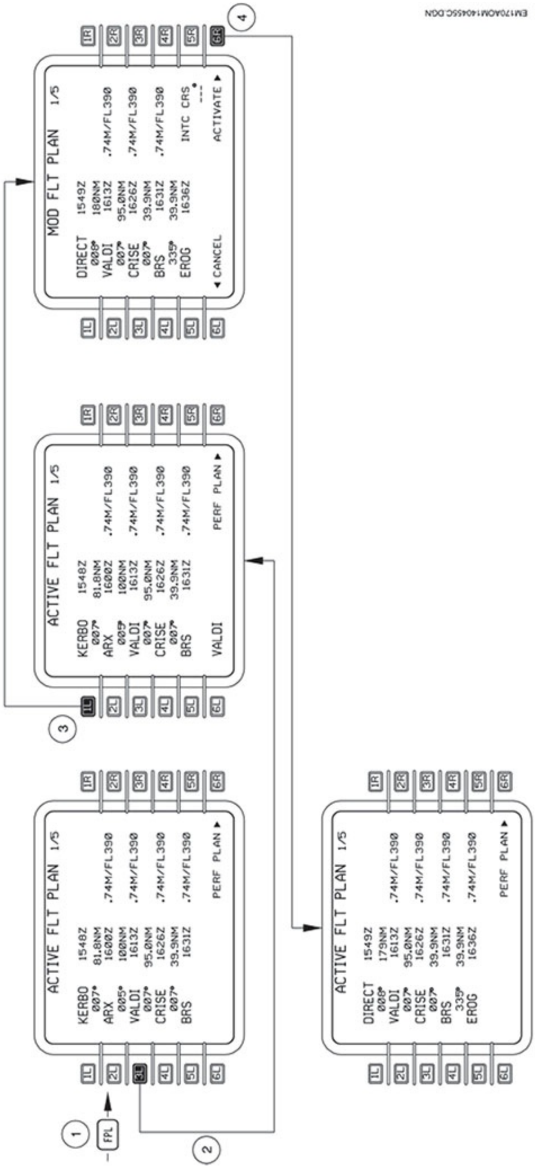
DIRECT-TO

1. Press FPL button to go to ACTIVE FLT PLAN page.
2. Press the respective LSK correspondent to the desired direct-to waypoint. If the desired direct-to waypoint is not displayed press NEXT button until it appears.
3. Press LSK 1L of the first page (previous waypoint).
4. Press LSK 1L (DIRECT) to fly direct to the desired waypoint and no other waypoints are removed.

NOTE:
- A discontinuity is inserted after the desired waypoint followed by the previous waypoint sequence.
- If the desired waypoint is the FAF, the use of DIRECT function eliminates the FAF approach Waypoint attributes and, as a result, it is not possible to engage the VGP. Moreover, the system does not recognize that it has reached the approach phase of flight so that the MISSED APPR prompt is not displayed on the Missed Approach page and the lateral missed approach procedure is not appended to the active flight plan when the TOGA button is pressed.

5. Press LSK 2L (ACTIVE) to fly direct to a waypoint in the active flight plan, deleting all preceding waypoints. Displayed only if the selected waypoint is part of the active flight plan.
6. Press LSK 3L (MISSED APPROACH) to fly direct to a waypoint in the selected missed approach procedure, deleting all preceding waypoints. Displayed only if the selected waypoint is part of the missed approach procedure inserted on the active flight plan.
7. Press LSK 4L (ALTERNATE) to fly direct to a waypoint in the alternate flight plan, deleting all preceding waypoints. Displayed only if the selected waypoint is part of the alternate flight plan.
8. Press LSK 6R (ACTIVATE).

NOTE: If the selected waypoint is not present on any of these flight phases, the DIRECT option is automatically selected and the DIRECT TO 1/1 page is not displayed.


EM170AOM140455C.DGN
ACTIVE FLT PLAN 1/5
KERBO 007° 1548Z 81.8NM 1600Z .74M/FL390
ARX 005° 100NM 1613Z .74M/FL390
VALDI 007° 95.0NM 1626Z .74M/FL390
CRISE 007° 39.9NM 1631Z .74M/FL390
BRS
PERF PLAN
ACTIVE FLT PLAN 1/5
KERBO 007° 1548Z 81.8NM 1600Z .74M/FL390
ARX 005° 100NM 1613Z .74M/FL390
VALDI 007° 95.0NM 1626Z .74M/FL390
CRISE 007° 39.9NM 1631Z .74M/FL390
BRS
VALDI
PERF PLAN
MOD FLT PLAN 1/5
DIRECT 008° 1549Z 180NM 1613Z .74M/FL390
VALDI 007° 95.0NM 1626Z .74M/FL390
CRISE 007° 39.9NM 1631Z .74M/FL390
BRS 335° 39.9NM 1636Z
EROG
INTC CRS
CANCEL
ACTIVATE
ACTIVE FLT PLAN 1/5
DIRECT 008° 1549Z 179NM 1613Z .74M/FL390
VALDI 007° 95.0NM 1626Z .74M/FL390
CRISE 007° 39.9NM 1631Z .74M/FL390
BRS 335° 39.9NM 1636Z .74M/FL390
EROG
PERF PLAN
FPL
1
2
3
4

DIRECT-TO

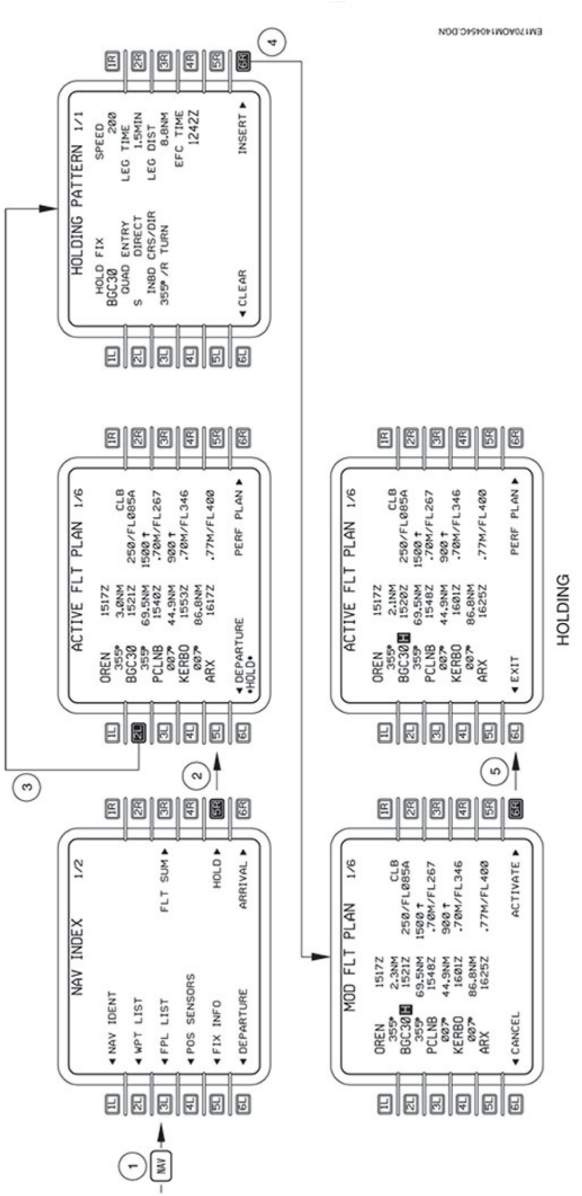
PATTERNS

HOLDING

1. Press NAV button to go to NAV INDEX 1/2 page.
2. On NAV INDEX 1/2 page press LSK 5R (HOLD).
3. On ACTIVE FLT PLAN page press the respective LSK correspondent to the desired holding waypoint. If the desired hold waypoint is not displayed press NEXT button until it appears.

   On the HOLDING PATTERN 1/1 page the following information is displayed:

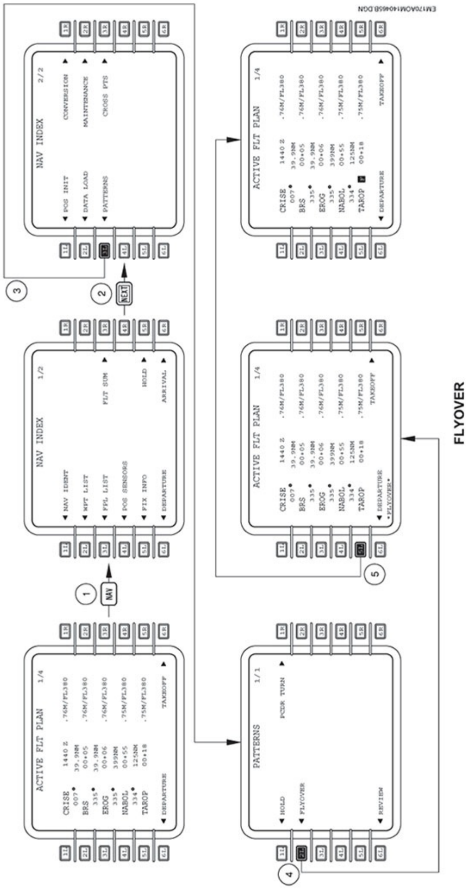
   - Hold fix name.
   - Speed.
   - Quadrant entry. The possible entries are N, NE, E, SE, S, SW, W or NW.
   - Entry type.
   - Leg time.
   - Inbound course/turn direction. The possible entries are course followed by a slash and then a L (left) or R (right), only the course or only the slash followed by a L (left) or R (right).
   - Leg distance.
   - Expected further clearance (EFC) time. When a valid Hold EFC time is inserted and activated, all time and fuel predictions for waypoints beyond the Hold are based on remaining in the hold until the expected clearance time has elapsed.
4. Press LSK 6R (INSERT).
5. On MOD FLT PLAN page press LSK 6R (ACTIVATE).


EM170AOM140454C.DGN
NAV
NAV INDEX 1/2
NAV IDENT
WPT LIST
FPL LIST
FLT SUM
POS SENSORS
FIX INFO
HOLD
DEPARTURE
ARRIVAL
ACTIVE FLT PLAN 1/6
OREN 1517Z
355° 3.0NM
BGC30 1521Z 250/FL085A
CLB
355° 69.5NM 1500↑
PCLNB 1540Z .70M/FL267
007° 44.9NM 900↑
KERBO 1553Z .70M/FL346
007° 86.8NM
ARX 1617Z .77M/FL400
DEPARTURE
•HOLD•
PERF PLAN
HOLDING PATTERN 1/1
HOLD FIX
BGC30
SPEED
200
QUAD ENTRY
S DIRECT
LEG TIME
1.5MIN
INBD CRS/DIR
355° /R TURN
LEG DIST
8.8NM
EFC TIME
1242Z
CLEAR
INSERT
MOD FLT PLAN 1/6
OREN 1517Z
355° 2.3NM
BGC30 H 1521Z 250/FL085A
CLB
355° 69.5NM 1500↑
PCLNB 1548Z .70M/FL267
007° 44.9NM 900↑
KERBO 1601Z .70M/FL346
007° 86.8NM
ARX 1625Z .77M/FL400
CANCEL
ACTIVATE
ACTIVE FLT PLAN 1/6
OREN 1517Z
355° 2.1NM
BGC30 H 1520Z 250/FL085A
CLB
355° 69.5NM 1500↑
PCLNB 1548Z .70M/FL267
007° 44.9NM 900↑
KERBO 1601Z .70M/FL346
007° 86.8NM
ARX 1625Z .77M/FL400
EXIT
PERF PLAN
HOLDING

FLYOVER

The flyover is used to proceed to a waypoint before commencing the turn.

1. Press NAV button to enter in the NAV INDEX 1/2 page.
2. Press NEXT button to go to NAV INDEX 2/2 page.
3. Press LSK 3L (PATTERNS) to enter in the PATTERNS 1/1 page.
4. Press LSK 2L (FLYOVER).
5. On ACTIVE FLT PLAN page press the respective LSK correspondent to the desired flyover waypoint. If the desired flyover waypoint is not displayed press NEXT button until it appears.

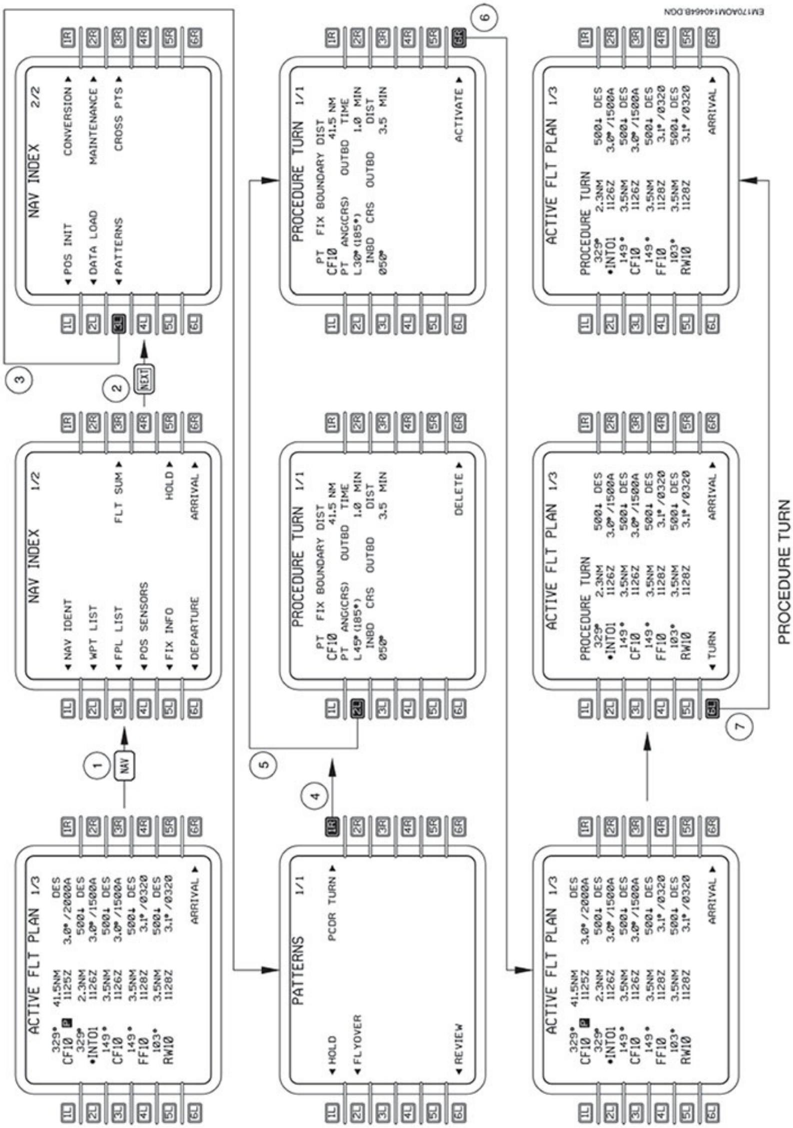


PROCEDURE TURN

The procedure turn is used to reverse the course during an approach. A procedure turn is only available from approaches in the navigation data base.

1. Press NAV button to enter in the NAV INDEX 1/2 page.
2. Press NEXT button to enter in the NAV INDEX 2/2 page.
3. Press LSK 3L (PATTERNS) to go to PATTERNS 1/1 page.
4. Press LSK 1R (PCDR TURN) to go to PROCEDURE TURN 1/1 page.
5. On the PROCEDURE TURN 1/1 page the following information is displayed:
    - Procedure turn fix.
    - Boundary distance.
    - Procedure turn angle. The entry is L (left) or R (right) followed by the turn angle.
    - Inbound course.
    - Outbound time.
    - Outbound distance.

    The outbound time/distance and procedure turn angle can be changed. The entry is accomplished in the scratchpad through alphanumeric keys and pressing the respective LSK.
6. Press LSK 6R (ACTIVATE) to go to ACTIVE FLT PLAN page.
7. fter passing the procedure turn fix press LSK 6L (TURN).


ACTIVE FLT PLAN 1/3
NAV INDEX 1/2
NAV INDEX 2/2
PATTERNS 1/1
PROCEDURE TURN 1/1
PROCEDURE TURN
EM170AOM140468B.DGN

CROSSING POINTS

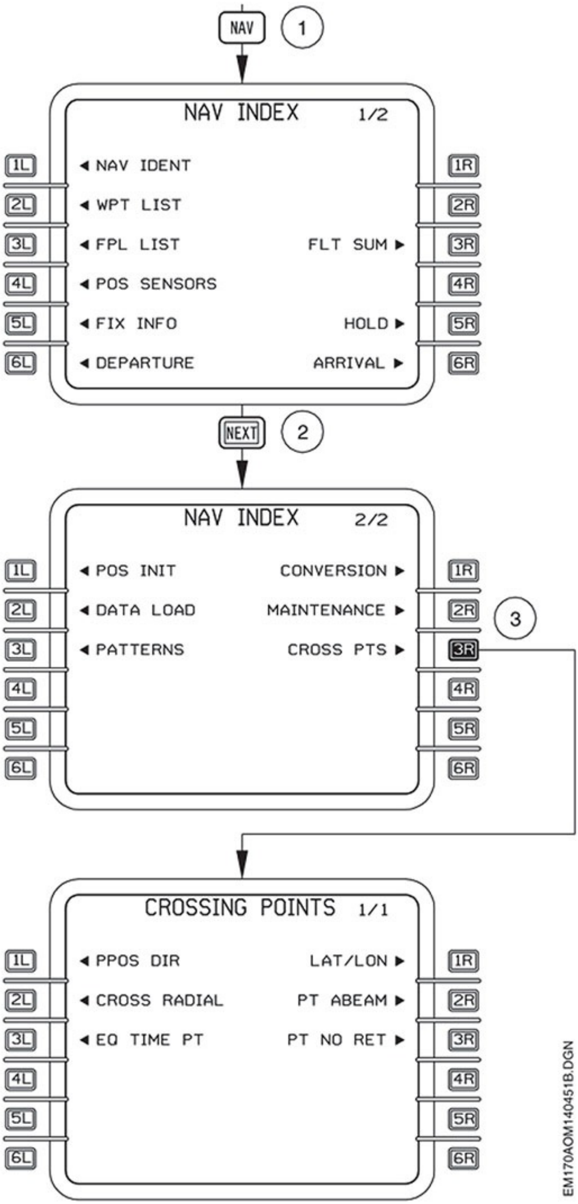
The crossing points are used to determine some information regarding a waypoint relative to the current aircraft position. The following types of crossing points are presented:

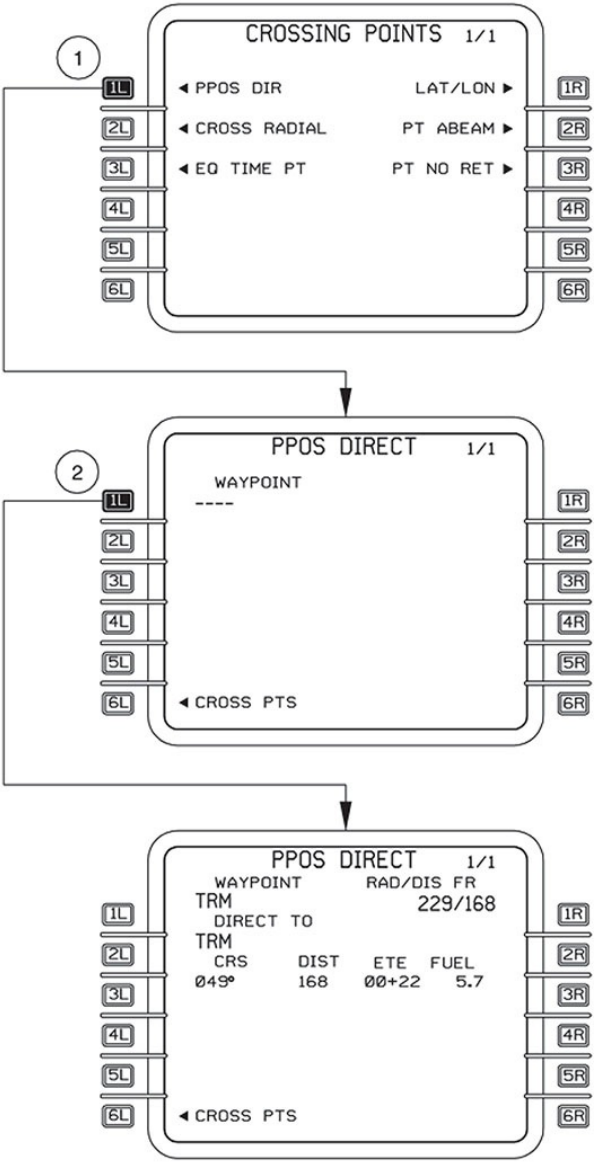
- Present position direct to a waypoint from the current airplane position.
- Crossing radial from a waypoint for the current airplane position.
- Equal time point between any two given waypoints. This option is only available when operating in full performance mode.
- Latitude/longitude crossing for the current flight plan.
- Point abeam a waypoint for current flight plan.
- Point of no return from any given waypoint. This option is only available when operating in full performance mode.

1. Press NAV button to go to NAV INDEX 1/2 page.
2. Press NEXT button to go to NAV INDEX 2/2 page.
3. Press LSK 3R (CROSS PTS) to enter in the CROSSING POINTS 1/1 page.

PRESENT POSITION DIRECT

1. On CROSSING POINTS 1/1 page press LSK 1L (PPOS DIR) to go to PPOS DIRECT 1/1 page.
2. Enter with the waypoint name. The entry is accomplished in the scratchpad through alphanumeric keys and pressing LSK 1L.
   After the entry the following information is displayed:
   - Course to the waypoint.
   - Distance to the waypoint.
   - Estimated time enroute.
   - Remaining fuel in the waypoint.

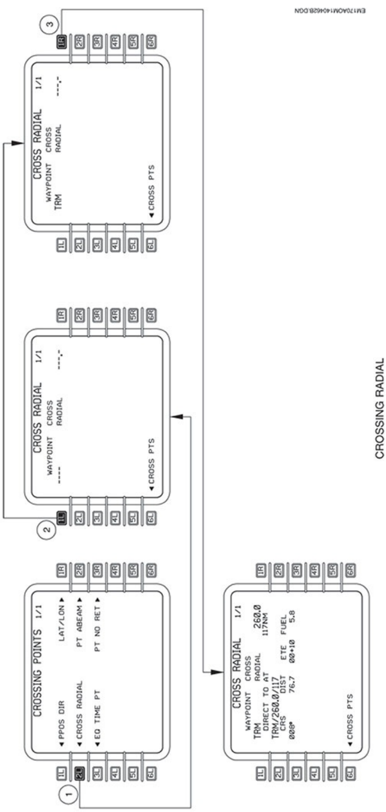

NAV
1
NAV INDEX 1/2
NAV IDENT
WPT LIST
FPL LIST
FLT SUM
POS SENSORS
FIX INFO
HOLD
DEPARTURE
ARRIVAL
NEXT
2
NAV INDEX 2/2
POS INIT
CONVERSION
DATA LOAD
MAINTENANCE
PATTERNS
CROSS PTS
3
CROSSING POINTS 1/1
PPOS DIR
LAT/LON
CROSS RADIAL
PT ABEAM
EQ TIME PT
PT NO RET
1L
2L
3L
4L
5L
6L
1R
2R
3R
4R
5R
6R
EM170AOM140451B.DGN



PRESENT POSITION DIRECT

CROSSING RADIAL

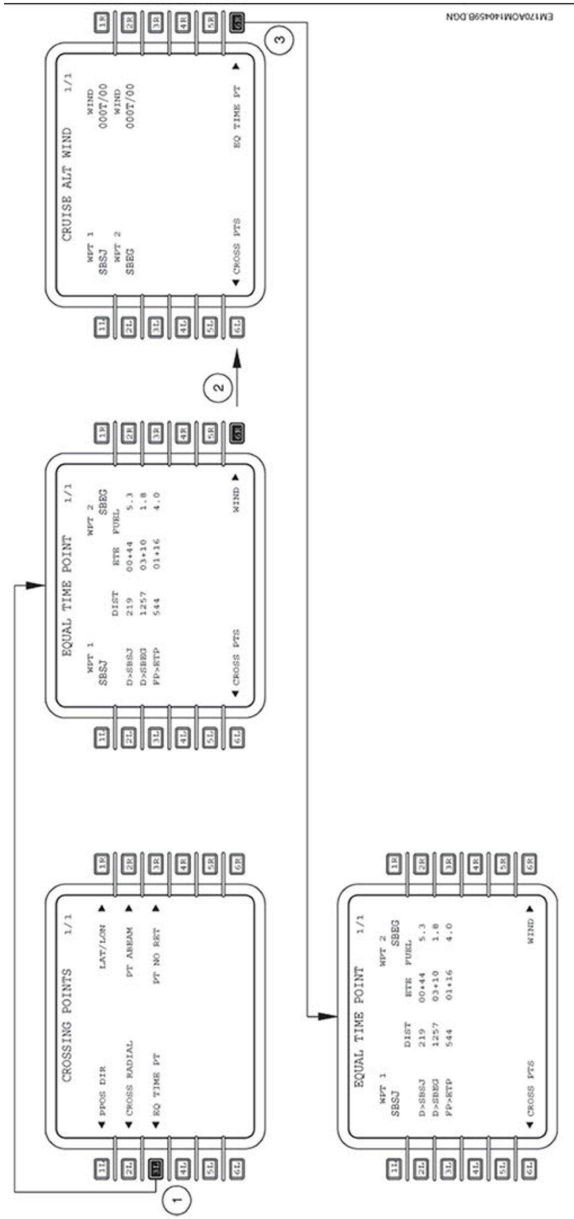
1. On the CROSSING POINTS 1/1 page press LSK 2L (CROSS RADIAL) to go to CROSS RADIAL 1/1 page.
2. Enter with the waypoint name. The entry is accomplished in the scratchpad through alphanumeric keys and pressing LSK 1L.
3. Enter with the cross radial. The entry is accomplished in the scratchpad through alphanumeric keys and pressing LSK 1R.
   After the entry the following information is displayed:
   - The distance from the waypoint where the airplane will cross the selected radial.
   - Course to the waypoint.
   - Distance to the waypoint.
   - Estimated time enroute.
   - Remaining fuel in the waypoint.



EQUAL TIME POINT

1. On the CROSSING POINTS 1/1 page press LSK 3L (EQ TIME PT) to go to EQUAL TIME POINT 1/1 page.
2. On EQUAL TIME POINT 1/1 page the following information is displayed to the waypoints 1/2 and Equal Time Point (ETP):
   - Distance to the waypoint.
   - Estimated time enroute.
   - Remaining fuel in the waypoint.

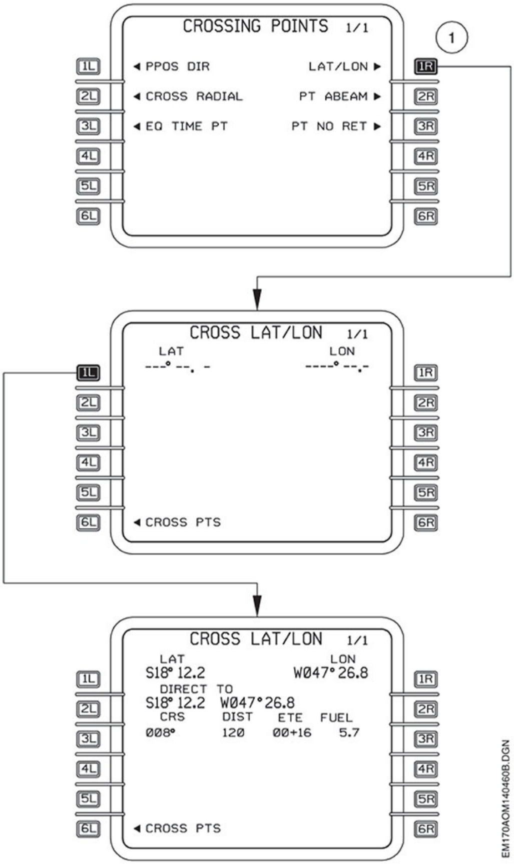
   The default waypoints are origin and destination. It is possible to enter other waypoints. The entry is accomplished in the scratchpad through alphanumeric keys and pressing LSK 1L or 1R.
   If the airplane has passed the ETP the message PAST is displayed.
3. Pressing LSK 6R (WIND) enters in the CRUISE ALT WIND 1/1 page. Cruise wind entry can be done for the selected waypoints. The entry is accomplished in the scratchpad through alphanumeric keys and pressing the respective LSK (1R or 2R).
4. Press LSK 6R (EQ TIME PT) to return to EQUAL TIME POINT 1/1 page.



EQUAL TIME POINT

LATITUDE/LONGITUDE CROSSING

1. On the CROSSING POINTS 1/1 page press LSK 1R (LAT/LON) to go to CROSS LAT/LON 1/1 page.
2. Enter with the latitude and/or longitude. The entry is accomplished in the scratchpad through alphanumeric keys and pressing the respective LSK (1L or 1R).
   After the entry the following information is displayed:
   - Course to the waypoint.
   - Distance to the waypoint.
   - Estimated time enroute.
   - Remaining fuel in the waypoint.

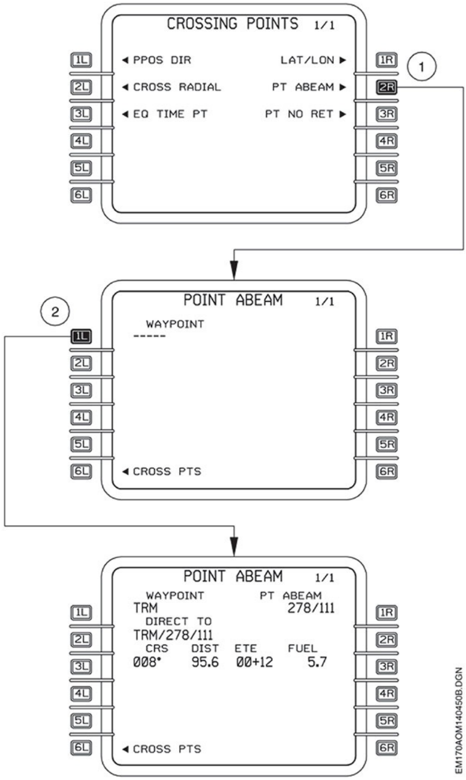


LATITUDE/LONGITUDE CROSSING

POINT ABEAM

1. On the CROSSING POINTS 1/1 page press LSK 2R (PT ABEAM) to go to POINT ABEAM 1/1 page.
2. Enter with the waypoint name. The entry is accomplished in the scratchpad through alphanumeric keys and pressing LSK 1L.
   After the entry the following information is displayed:
   - The radial and distance from the waypoint where the airplane will cross the point abeam.
   - Course to the waypoint.
   - Distance to the waypoint.
   - Estimated time enroute.
   - Remaining fuel in the waypoint.

If no point abeam exists for the current flight plan the message NO CROSSING POINT FOUND is displayed.



POINT ABEAM

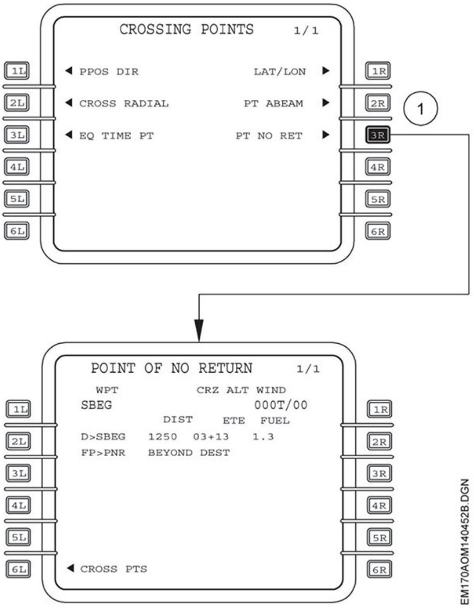
POINT OF NO RETURN

1. On the CROSSING POINTS 1/1 page press LSK 3R (PT NO RET) to go to POINT OF NO RETURN 1/1 page.
2. On POINT OF NO RETURN 1/1 page the following information is displayed for the selected waypoint and point of no return:
   - Distance to the waypoint.
   - Estimated time enroute.
   - Remaining fuel in the waypoint.

The default waypoint is the origin. It is possible to enter other waypoints and/or cruise wind. The entry is accomplished in the scratchpad through alphanumeric keys and pressing respectively LSK 1L or 1R.

If the airplane has passed the point of no return a message PAST is displayed.

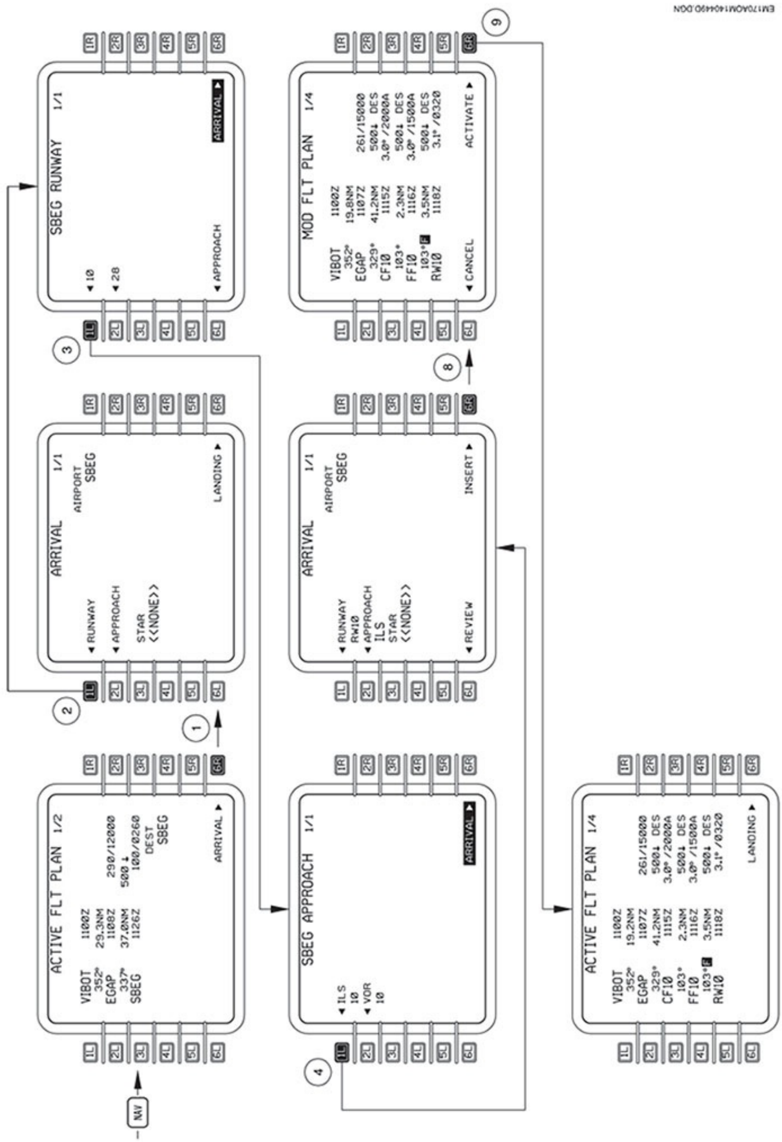
If the point of no return is beyond the destination a message BEYOND DEST is displayed.



POINT OF NO RETURN

ARRIVAL

1. Then the airplane is within 200 NM to the destination the prompt ARRIVAL appears. Press LSK 6R (ARRIVAL) to enter in the ARRIVAL 1/1 page.
2. On ARRIVAL page select LSK 1L (RUNWAY) to go to RUNWAY page.
3. On RUNWAY page select the runway by pressing the respective LSK.
4. On APPROACH page select approach procedure by pressing the respective LSK.
5. On APROACH TRANS page select the approach transition by pressing the respective LSK.
6. On STAR page select the STAR by pressing the respective LSK.
7. On STAR TRANS page select the STAR transition by pressing the respective LSK.
8. Press LSK 6R (INSERT) to insert the arrival.
9. On MOD FLT PLAN page press LSK 6R (ACTIVE) to activate the flight plan.


ACTIVE FLT PLAN 1/2
ARRIVAL 1/1
SBEG RUNWAY 1/1
SBEG APPROACH 1/1
MOD FLT PLAN 1/4
ACTIVE FLT PLAN 1/4

ARRIVAL

LANDING

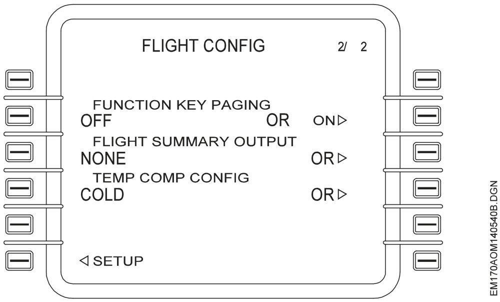
VNAV TEMPERATURE COMPENSATION

FMS provides the capability to create constant angle vertical paths for the final approach segment of the non-precision approaches and vertical descent profiles for transition to the final approach segment based on the altitude constraints in the navigation database.

These descent profiles are flown by reference to the indicated barometric altitude. However, barometric altimeters are calibrated to indicate true altitude under ISA conditions of temperature and sea level pressure.

The VNAV temperature compensation provides the capability to compensate the altitude constraints for all the waypoints in approach, approach transitions and missed approach segments of the flight plan during non-standard temperature conditions.

The temperature compensation configuration feature is presented in FLIGHT CONFIG 2/2 page. This page is accessed through the MAINTENANCE 2/3 page.



14.09.27 NG FMS

GENERAL

INTRODUCTION

This section presents basic information to the NG FMS operation. It brings an overview on the FMS initialization process and the essential features required for regular flight.

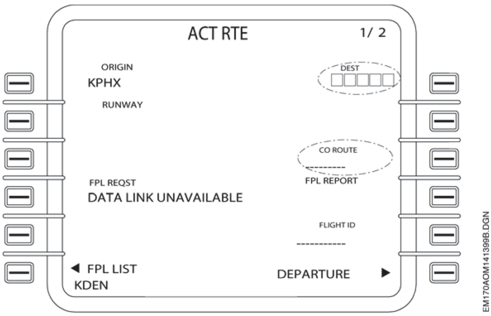
For additional information such as flight optimization or features related to abnormal events, refer to the Honeywell FMS Pilots Operating Manual P/N D201007000016.

FUNDAMENTALS

EDITABLE AND NON EDITABLE FIELDS

- Editable fields are placed close to the edge of the MCDU screen.
- Non-editable fields are placed with a space from the edge of the MCDU screen.

REQUIRED AND OPTIONAL ENTRIES



Required and optional fields

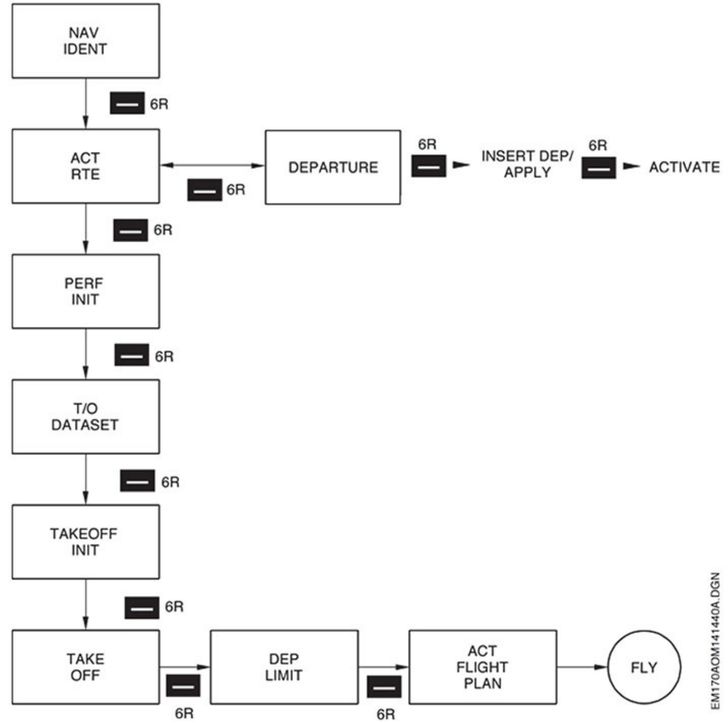
- Boxes are presented where filling the field is mandatory.
- Dashes indicate optional fields related to optional features.

TITLE OF PAGES

When filling a page, the indication "MOD", in cyan, often appears in its title, although it does not represent a new page. The change in the title simply indicates that the content of the page is being modified by the operator.

NG FMS INITIALIZATION

To initialize the NG FMS, the following flow is suggested:



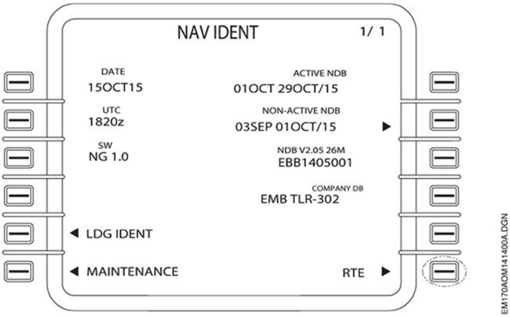
NG FMS Initialization Flow

The initialization flow was designed to guide the pilot through the initialization process using the lowest right line select key (LSK 6R). After all the necessary information from a page is set, select the LSK 6R to display the next page.

Although the suggested flow is an intuitive way to initialize the NG FMS, operators are free to develop their own.

NAV IDENT PAGE

After power-up, the RADIO page is displayed by default. Push any FMS function key to display the NAV IDENT page.



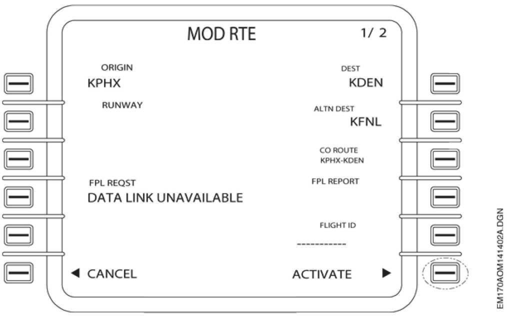
NAV IDENT page

After carefully checking its content, press LSK 6R to access the ROUTE page.

NOTE: NG FMS automatically sets the POSITION INITIALIZATION with information provided by the GPS system. In case the GPS position is not available, the POSITION INITIALIZATION page (POSITION INIT) is displayed.

ACT RTE PAGE (BEFORE THE DEPARTURE PAGE SETTING)

On the ROUTE (RTE) page, in case the initialization coordinates are within 3 NM from an airport, it is automatically loaded in the ORIGIN field.

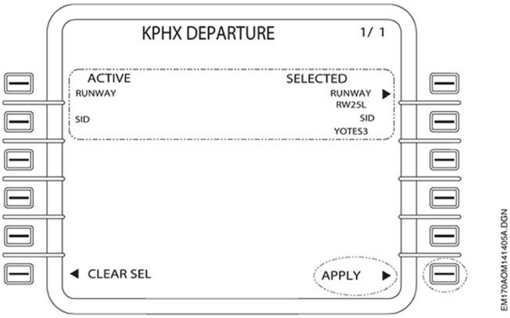


MOD RTE page

For the remaining fields, perform as follows:

- Enter the destination airport (DEST).
- Inform the flight ID (FLIGHT ID).
- Enter the alternate destination (ALTN DEST). This field becomes available only after the destination airport is set.
- When everything is set, press LSK 6R to activate the ROUTE page. The title of the page changes from MOD RTE to ACT RTE, indicating the page is active.
- Once the page is active, the DEPARTURE prompt appears at the LSK 6R. Press it to insert the applicable departure procedure.

DEPARTURE PAGE

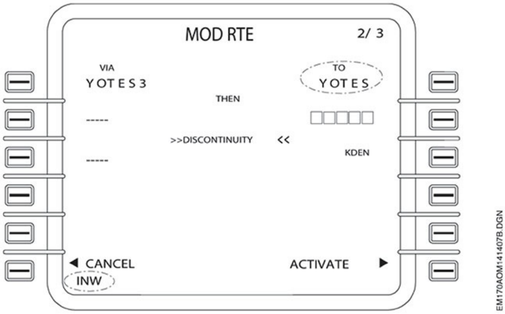


DEPARTURE page

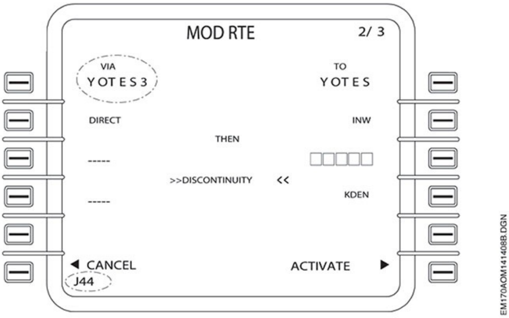
- Set and check the required information.
- Press LSK 6R to insert the applicable departure procedure to the route, creating a MOD RTE page.

ACT RTE PAGE (AFTER THE DEPARTURE PAGE SETTING)

- Insert extra waypoints (right side of FMS) and airways (left side of the FMS) on the MOD RTE page as shown in the following images:

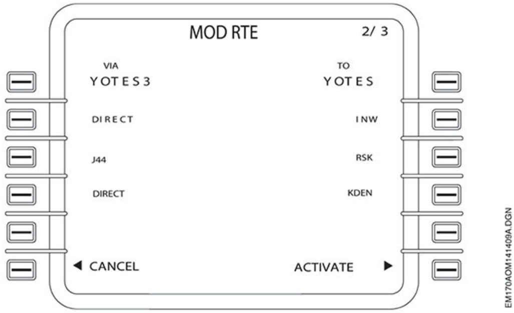


Waypoints on the right



Airways on the left

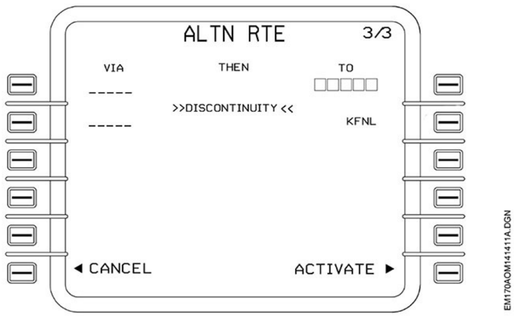
- Press the prompt ACTIVATE at LSK 6R to activate the entered information.



Activating inserted data

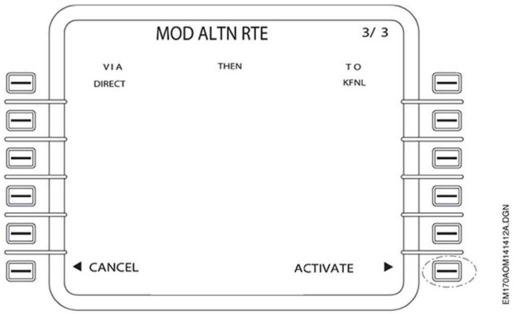
NOTE: The format AIRWAY.WAYPOINT can be used on the flight plan (FLT PLAN) page only.

- Push the NEXT key to display the ALTERNATE ROUTE page.



Alternate Route page

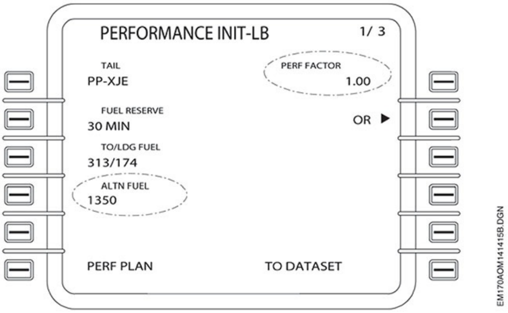
- Enter the alternate flight plan as for the ROUTE PAGE.
- Press the ACTIVATE prompt at LSK 6R to activate the flight plan with the applicable alternate plan.



Activating Alternate flight plan

- Once the RTE is completed, press PERF INIT prompt at LSK to display the PERFORMANCE INIT page.

PERF INIT PAGE



PERF FACTOR and FUEL

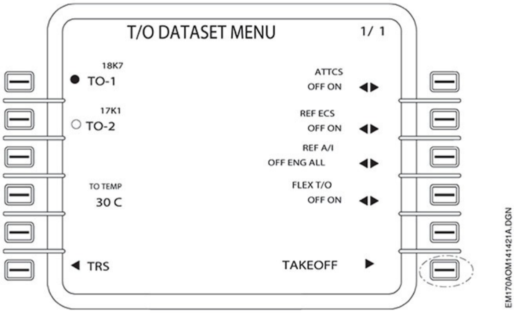
- PERF FACTOR: It is available on the NG FMS to add a fuel flow increment due to airplane or engine performance deterioration. The flight crew cannot edit this field.
- ALTERNATE FUEL: This entry is optional. Insert a value as fuel to be used in the alternate flight.

NOTE: Do not use this field as reserve fuel. Reserve fuel has its own dedicated field.

CAUTION: PERFORMANCE DATA, HOLD TIME AVAILABLE AND OTHER PERFORMANCE RELATED FEATURES USE THIS VALUE ON THEIR COMPUTATION. ANY IMPROPER VALUE SETTING AT THIS FIELD CAN CAUSE A CONSEQUENT MISCALCULATION OF THESE PERFORMANCE PARAMETERS.

- On page 2/3, enter the AZFW and T/O CG in case it is already available.
- On page 3/3, set or verify the CLIMB, CRUISE and DESCENT speed schedule.
- Once all data is entered, press TO DATASET prompt to display TO DATASET MENU page.

TO DATASET PAGE

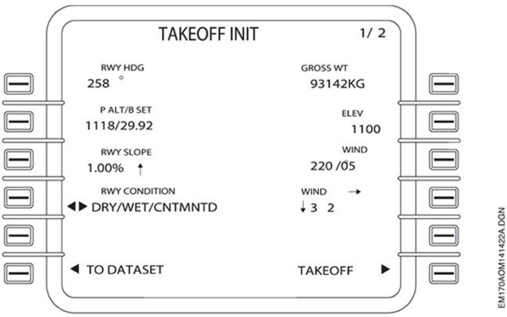


Takeoff Dataset

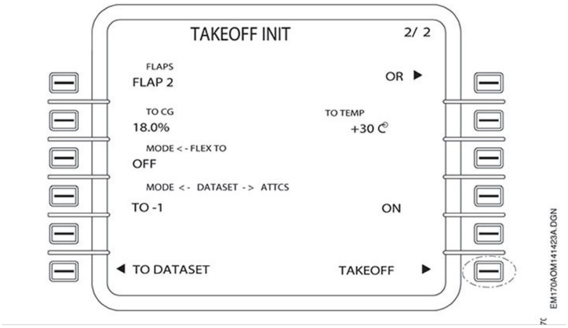
- Set the TO DATASET MENU page.
- Press TAKEOFF prompt (LSK 6R) to display TAKEOFF INIT page.

TAKEOFF INIT PAGE

- Set the TAKEOFF INIT pages 1/2 and 2/2, as shown in the following figures.
- When page 2/2 is set, press TAKEOFF prompt (LSK 6R) to display TAKEOFF page.



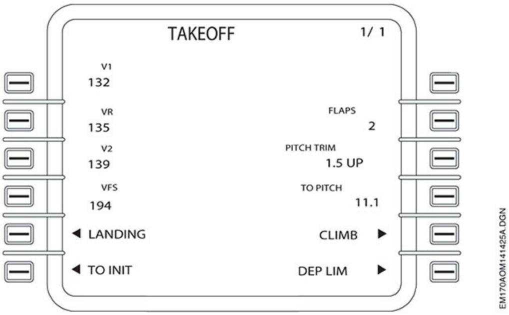
TAKEOFF INIT1/2



TAKEOFF INIT2/2

TAKEOFF PAGE

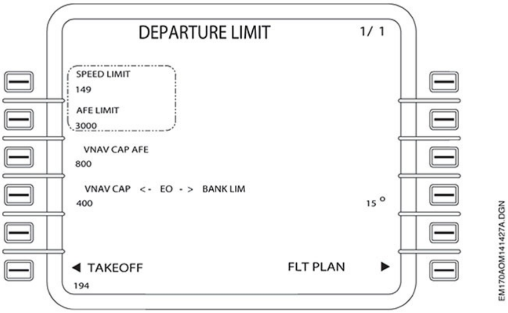
- Set Vspeeds, FLAP, and TO CG. The computed takeoff pitch and takeoff pitch trim are presented.



TAKEOFF page

- After crosschecking the TAKEOFF page, press DEP LIM prompt (LSK 6R) to display the DEPARTURE LIMIT page.

DEP LIMIT PAGE



Departure Limit page

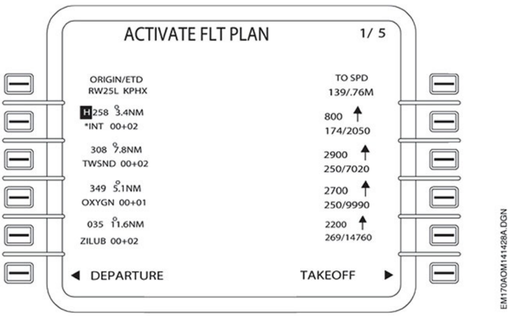
- Set the SPEED LIMIT and AFE LIMIT accordingly.

NOTE: The only way to accelerate beyond the speed limit is flying over that height (height above field elevation).

- Set VNAV CAP AFE to allow VNAV engagement at the desired height.
- VNAV CAP <- EO -> BANK LIM is applicable for engine out operations only. Set values for VNAV CAP and BANK LIM accordingly.

ACT FLIGHT PLAN PAGE

The initialization of the NG FMS is completed. To check and verify the flight information, push the FLT PLAN prompt at LSK 6R to display the Flight Plan page.

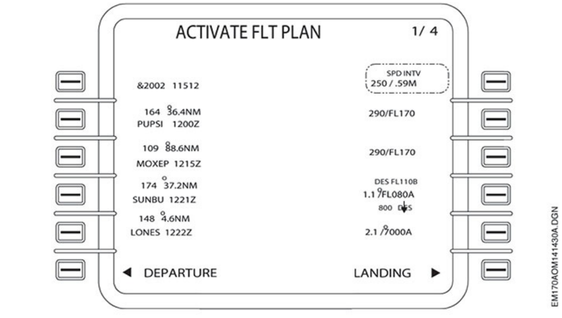


FLT PLN page

FLIGHT PLAN INTERVENTION

SPEED INTERVENTION

Informs a value in the SPD INTV field to change speed without reverting to manual speed mode, as shown in the following figure:



Speed intervention

Speed intervention is canceled at climb to cruise transition or at cruise to descent phase of flight. A scratchpad message is displayed to the pilot when it happens.

Deleting the informed value resumes the NG FMS operation with the default speed value.

NOTE: Performance calculation is not recomputed with speed intervention mode. It is seen as a manual speed change.

OFFSET

The Offset function is located in the ROUTE page.

DIRECT TO

DIRECT TO function recognizes all waypoints and their positions at different phases of flight.

PLACE/DISTANCE WAYPOINTS

Place/Distance entry is only accepted if it does not displace the next or previous waypoint, otherwise a scratchpad message is displayed to the crew.

NON DIRECTIONAL BEACONS (NDB)

To recognize NDBs, pilots must type the identifier and the NG FMS queries between VOR and NDB.

CLIMB

TAKEOFF

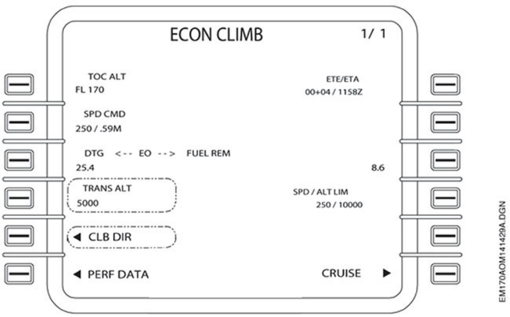
LNAV arms when TOGA is pressed.

CLIMB DIRECT

CLB DIR prompt is available whenever there are altitude constraints between the airplane altitude or flight level and the preselector altitude. If it is pressed, all NG FMS altitude constraints up to the preselector altitude are cleared.

TRANSITION ALTITUDE

The Transition Altitude field is located in the CLB page. The value is automatically retrieved from the navigation database.



Transition Altitude

DESCENT

AUTO PREVIEW

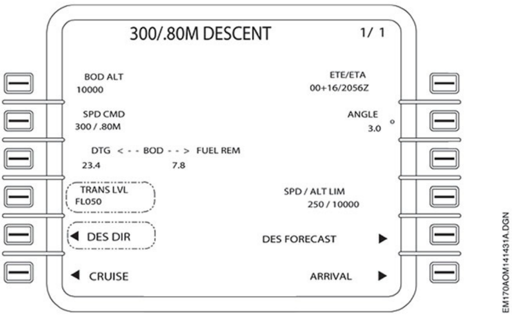
NG FMS does the auto tuning for ILS frequency at 150 NM from the airport. It also auto selects the PREVIEW for the pilots with the proper final approach course. In both cases, an ILS arrival already needs to be part of the flight plan.

DESCENT DIRECT

DES DIR prompt is available whenever there are altitude constraints between the airplane altitude or flight level and the preselector altitude. When pressed, all NG FMS altitude constraints down to the preselector altitude are cleared.

TRANSITION LEVEL

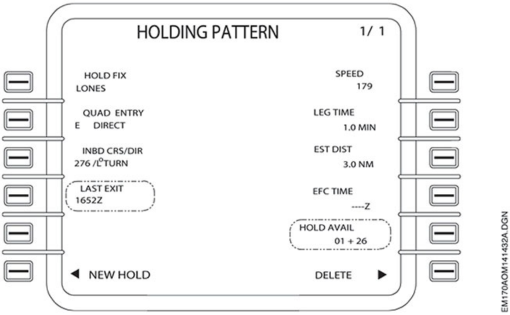
Transition Level value is displayed on DESCENT page. It is automatically retrieved from the navigation database when available.



Transiltion Level

APPROACH

HOLDING

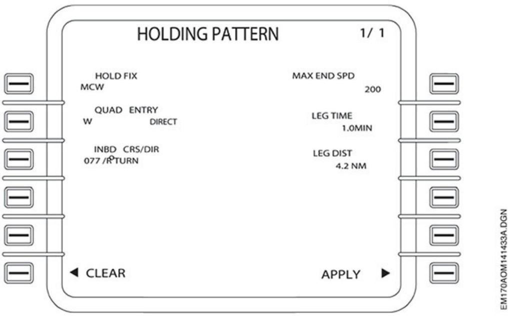


Holding Pattern

- Hold Time Available checks the total fuel on board and displays the time available. It considers the time to reach destination, performs a go-around, and goes to alternate plus reserves.
- Last Exit checks the current time plus the time available and defines the last exit time to reach the conditions previous mentioned.

HOLDING SPEEDS

The NG FMS displays a speed for holding at LSK 1R on the HOLDING PATTERN page.



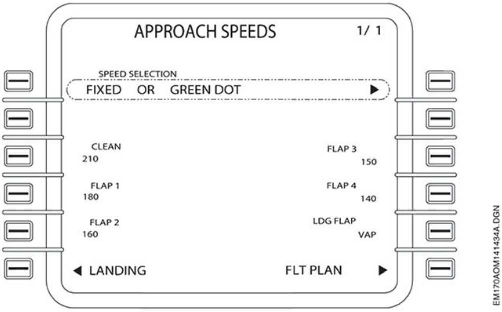
Holding Pattern

Holding speeds are displayed in the following priority:

- A pilot-entered holding speed (displayed in large cyan font).
- The maximum endurance speed (if valid).
- 210 KIAS.

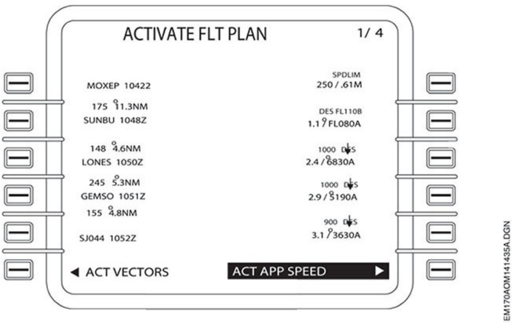
The label MAX END SPD is shown in case the hold speed corresponds to the maximum endurance speed, otherwise it is labeled as SPEED. When a flight plan speed is not available, a default of 210 KIAS is displayed.

APPROACH SPEEDS



Approach Speed

This page brings two main options: fixed speed schedule or green dot. It is possible to toggle between them during flight.



Approach Speed

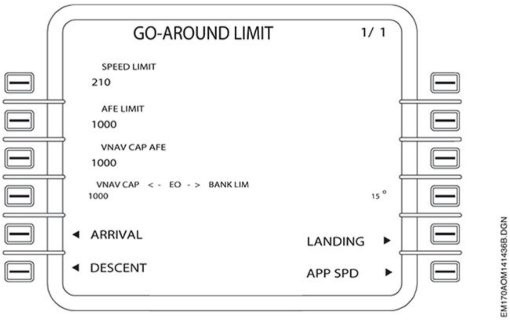
At 30 NM from the airport (TERM on PFD) with Landing Speeds previously set, the prompt ACT APP SPEEDS appears in inverse video at FLT PLAN pages.

NOTE: There is no need to press ACT APP SPEEDS as soon as it is displayed just because it is shown in inverse video. The prompt is armed to allow deceleration when the crew judges appropriate. Whenever it happens, press it to bring the airplane to minimum clean speed. Extending flaps is another way to activate approach speeds.

GO AROUND

Go Around Limit

As soon as TOGA is pressed, LNAV and VNAV are armed on the FMA, engaging in accordance with their own settings.



Go-around Limit

This page should be set as part of the approach preparation with the applicable go-around procedure information based on the approach procedure.

If the go around procedure is limited by speed, set the according value on the SPEED LIMIT field. On the AFE LIMIT field, set the height that represents the upper limit of the speed restriction. On the VNAV CAP AFE field, set the height where VNAV engages.

Above AFE LIMIT setting, the NG FMS follows one of the following speeds:

- Climb Speeds setting as in PERFORMANCE INIT (3/3) or CLIMB pages.
- Database Speeds Constraints according to NAV DATABASE.
- VFE – 10 KIAS.

14.09.35 EICAS MESSAGES

TYPE	MESSAGE	MEANING
CAUTION	ADS 1 (2) (3) FAIL	Associated ADS has failed.
	ADS 1 (2) (3) (4) HTR FAIL	At least one of the two smart probes that feed a respective Air Data System has the associated heater failed.
	AVNX ASCB FAULT	One or more ASCB buses have failed.
	DISPLAY CTRL FAIL	Display controller is no longer operating.
	DISPLAY CTRL FAULT	Loss of a display controller channel. Maintenance is required.
	FMS POS DISAG	A position disagreement between FMSs was detected.
	FMS 1 (2) GPS POS DISAG	A position disagreement between the associated FMS and GPS was detected.
	FMS-GPS POS DISAG	Associated FMS computed position and GPS position do not agree.
	IRS 1 (2) FAIL	Associated IRS has failed.
	IRS EXCESSIVE MOTION	Excessive motion of airplane is disturbing associated IRS aligning sequence.
	NAVCOM 1 (2) FAIL	All functions hosted in associated MRC are unavailable.
	NAVCOM 1 (2) OVHT	MRC NIM has suffered an overheat condition.
	VALIDATE CONFIG	Top level system part number was updated.
	VHF 1 (2) (3) OVHT	VHF COM has suffered an overheat condition.
	VHF 3 FAIL	Radio 3 COM and ACARS functions have failed.
	XPDR 1(2) IN STBY	Transponder is at STBY mode in flight.

TYPE	MESSAGE	MEANING
ADVISORY	ADS 1 (2) HTR FAULT	The electronics in the MFP heater portion of the ADSP has failed.
	ADS 3 (4) SLIPCOMP FAIL	ADS 3 (4) sideslip compensation function has failed.
	ADS-B NOT AVAIL	2 GPS have failed or GPS signal degraded.
	ADS PROBE 1 (2) (3) (4) FAIL	Integrated Pitot/Static/AOA sensor 1 (2) (3) (4) has failed.
	CMC FAIL	CMC has failed.
	CVR AFT (FWD) FAIL	Respective DVDR CVR function has failed.
	DATALINK 1 FAIL	CMF 1 has failed and Datalink connection was lost.
	FDR AFT (FWD) FAIL	Respective DVDR FDR function has failed.
	FLT CTRL ADS FAIL	The electronics in the ADC portion of the ADSP has failed.
	FMS 1 (2) FAIL	Associated FMS has failed.
	GPS 1 (2) FAIL	Associated GPS has failed.
	IRS ALIGNING	Associated IRS is in aligning sequence.
	IRS 1 (2) NAV MODE FAIL	Associated IRS is no longer providing navigation information.
	IRS PRES POS INVALID	Associated IRS did not receive present position or received an invalid one.
	LPV NOT AVAIL	LPV approach is not available.
	RALT 1 (2) FAIL	Associated Radio Altimeter has failed.
	RNP AR NOT AVAIL	RNP AR approach is not available.
	RNP AR <0.3 NOT AVAIL	RNP AR <0.3 approach is not available.
	TAT 1 (2) FAIL	Associated Total Air Temperature measurement system or its heater has failed.
	TOLD 1 (2) FAIL	MCDU Takeoff and Landing pages and associated data are unavailable.
	XPDR 1 (2) FAIL	MRC 1 (2) has detected a transponder failure.
STATUS	ADS-B NOT ON	ADS-B Out is turned off.
	PRINTER FAULT	Printer functionality is degraded.

14.10.01 GENERAL DESCRIPTION

The fuel system is designed to continuously provide fuel to the engines and APU.

Fuel is stored in two integral wing tanks, interconnected by a crossfeed valve.

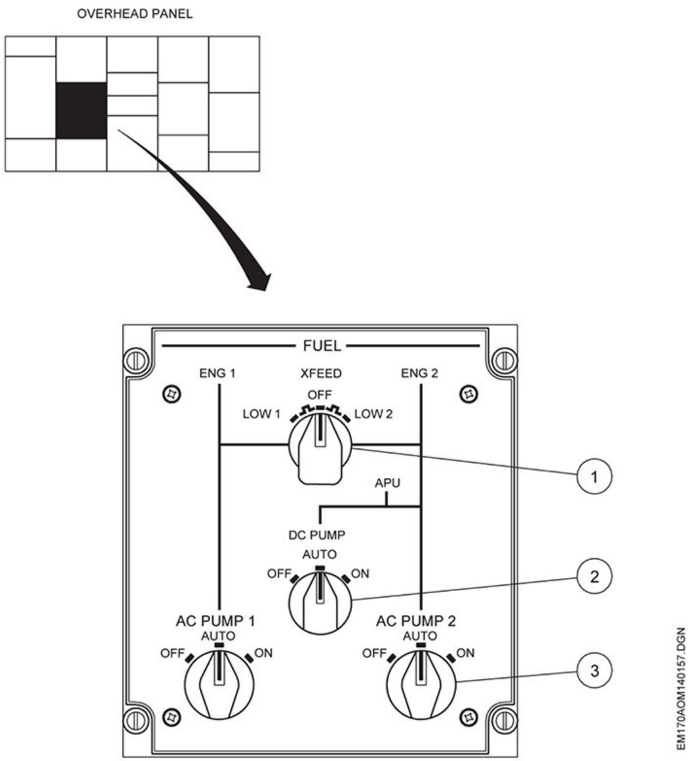
The fuel system incorporates:

- Storage: vented integral fuel tanks in the aircraft.
- Distribution: engine/APU feeding and tank refueling/defueling.
- Indication.

The fuel system parameters and indications are displayed on both MFD synoptic pages. System messages are displayed on EICAS display.

14.10.05 CONTROLS AND INDICATIONS

FUEL PANEL



1 – XFEED SELECTOR

LOW 1: opens the crossfeed valve and automatically activates the right AC fuel pump (AC PUMP 2), supplying fuel to both engines from the right wing tank.

OFF: closes the crossfeed valve.

LOW 2: opens the crossfeed valve and automatically activates the left AC fuel pump (AC PUMP 1), supplying fuel to both engines from the left wing tank.

2 – DC PUMP KNOB

OFF: deactivates the DC fuel pump.

AUTO: automatically operates the DC fuel pump according to the system's logic.

ON: activates the DC fuel pump.

3 – AC PUMP 1 AND AC PUMP 2 KNOBS

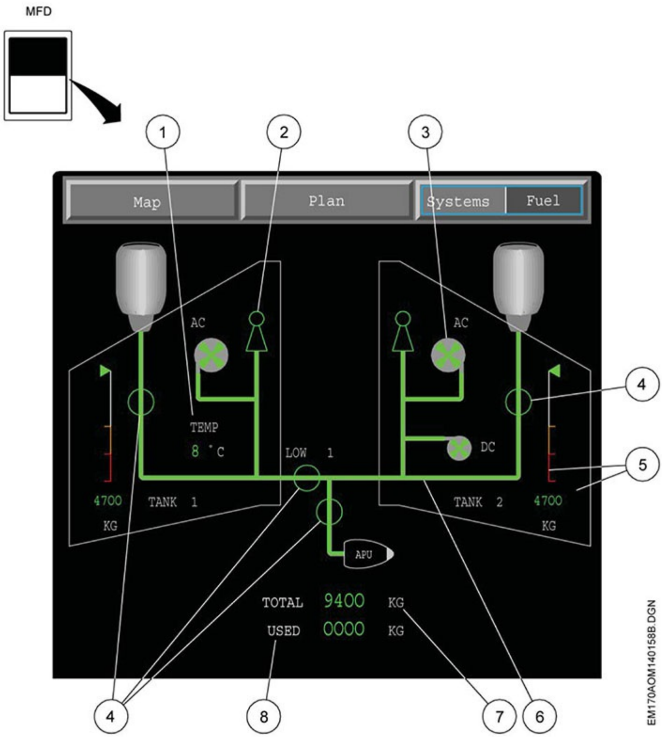
OFF: deactivates the associated AC fuel pump.

AUTO: automatically operates the associated AC fuel pump according to the system's logic.

ON: activates the associated AC fuel pump.

FUEL SYNOPTIC PAGE ON MFD

The fuel synoptic page provides a visual representation of the fuel system operation and parameters, and can be monitored by the flight crew on either MFD.



1 – TEMPERATURE INDICATION

- Digital Temperature.
  - The digital information indicates the fuel temperature measured in the left fuel tank.

GREEN:	normal operating range.
AMBER:	cautionary operating range.
AMBER DASHED:	invalid information.

2 – JET PUMP INDICATION

GREEN:	the associated jet pump is activated.
WHITE:	the associated jet pump is deactivated.
AMBER DASHED:	invalid information.

3 – ELECTRIC FUEL PUMP STATUS

- The electric pumps are depicted as circles with an internal windmill, representing the pump status.
  - ON: a gray circle with a green windmill.
  - OFF: a gray circle with a white windmill.
  - UNDETERMINED: an amber dashed circle with an amber windmill.
  - FAILED ON: a gray circle with a green windmill beneath an amber cross.
  - FAILED OFF: a gray circle with a white windmill beneath an amber cross.

4 – FUEL SYSTEM VALVES STATUS

- The fuel system valves are depicted as circles with an internal line representing the valve position. Above the fuel crossfeed valve, the label LOW 1 or LOW 2 is indicated whenever one engine is being fed by the opposite wing tank.
  - OPEN: a green circle with a green line aligned with the flow line.
  - CLOSED: a white circle with a white line perpendicular to the flow line.
  - UNDETERMINED: an amber dashed circle with no line.
  - IN TRANSIT: a white circle with a white line diagonal to the flow line.
  - FAILED CLOSED: a white circle with a white line perpendicular to the flow line, beneath an amber cross.
  - FAILED OPEN: a green circle with a green line aligned with the flow line, beneath an amber cross.

5 – FUEL TANK QUANTITY INDICATION (TANK 1 and TANK 2)

- The fuel tank quantity indication is the total amount of fuel remaining in the associated wing tank.
  - Digital Quantity:

GREEN:	normal operating range.
AMBER:	cautionary operating range.
RED:	low fuel quantity.

  - Scale:

WHITE:	normal operating range.
AMBER:	cautionary operating range.
RED:	low fuel quantity.

6 – FUEL FLOW LINE

GREEN:	the associated flow line is pressurized.
WHITE:	the associated flow line is not pressurized.
AMBER DASHED:	the associated flow line pressure is undetermined

NOTE: When Engine N2 speeds are below 60% it is a normal system behavior to display no fuel flow in the fuel lines (white).

7 – TOTAL FUEL QUANTITY INDICATION

- Indicates the total fuel quantity in all tanks.

GREEN:	normal operating range.
AMBER:	cautionary operating range.
AMBER DASHED:	invalid information.
RED:	low level.

8 – TOTAL FUEL USED INDICATION

- Indicates the total fuel used.

GREEN:	normal operating range.
AMBER DASHED:	invalid information.

EICAS INDICATION

1 – FUEL FLOW INDICATION

- Indicates the left and right engine fuel flow.

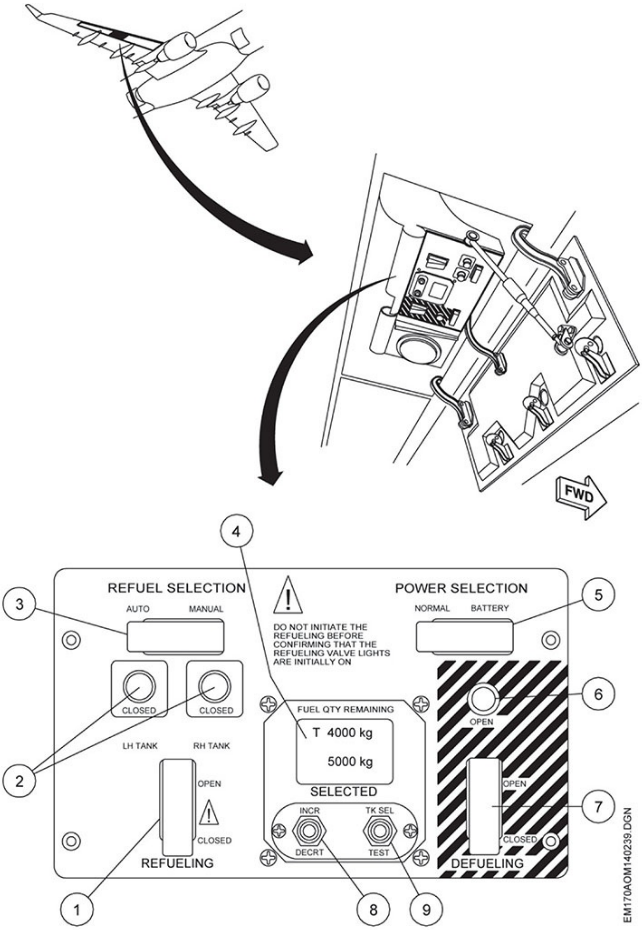
GREEN:	normal operating range.
AMBER DASHED:	invalid information.

2 – FUEL QUANTITY INDICATION

- Indicates left and right fuel tank quantities separately. Total fuel in all tanks is indicated inside a gray box.

GREEN:	normal operating range.
AMBER DASHED:	invalid information.
AMBER:	cautionary operating range.
RED:	low fuel quantity.

REFUELING/DEFUELING CONTROL PANEL



1 – REFUELING SWITCH (GUARDED)

OPEN: opens the refueling valve.

CLOSED: closes the refueling valve.

2 – REFUELING CLOSED LIGHTS

- Illuminate indicating that the refueling shutoff valve is closed.

3 – REFUEL SELECTION SWITCH (GUARDED)

AUTO: automatic mode of operation.

MANUAL: manual mode of operation.

4 – DISPLAY

- The upper display indicates the fuel remaining in the associated tank as selected by the TK SEL/TEST switch (L for the left tank, R for the right tank and T for both tanks).
- The lower display indicates the total fuel quantity pre-selected via the INCR/DECRT switch. Zero is indicated when the refueling compartment door is opened.

5 – POWER SELECTION SWITCH (GUARDED)

NORMAL: DC BUS 1 and 2 power the refueling system.

BATTERY: HOT BATT BUS 2 powers the refueling system.

6 – DEFUELING OPEN LIGHT

- Illuminates indicating that the defueling shutoff valve is open.

7 – DEFUELING SWITCH (GUARDED)

OPEN: opens the defueling valve.

CLOSED: closes the defueling valve.

8 – INCR/DECRT SWITCH

- Spring-loaded switch.
- Increases or decreases the value for fuel quantity selected.

9 – TK SEL/TEST SWITCH

- Spring-loaded switch.

TK SEL: selects the fuel quantity that is indicated on the upper display. When the display is first powered on, the total fuel quantity is shown. Sequentially actuating the switch will select, in order: left tank fuel quantity, right tank fuel quantity and total fuel quantity.

TEST: initiates a test procedure.

14.10.10 FUEL SYSTEM DESCRIPTION

FUEL TANKS

The fuel system comprises two integral fuel tanks, with one tank located in each wing. Each wing tank incorporates:

- a collector tank.
- a surge tank.

The collector tank (inboard section) keeps the fuel pumps submerged, ensuring a constant fuel flow to the respective engine. The surge tank is designed to collect any fuel that may enter the vent system during wing down and uncoordinated maneuvers.

A vent system is designed to ensure that the differential pressure between the tank and surrounding environment remains within structural limits and to prevent fuel spillage during flight maneuvers and hard braking. Each fuel tank is vented through a vent tank in the outboard section (surge tank) of the wing. Vent lines provide adequate capacity for tank venting and are supplemented by a high capacity pressure relief valve to protect from fuel tank over-pressurization.

E175: Two water drain valves collect water by gravity in each tank.

E190: One water drain valve collects water by gravity in each tank.

FUEL QUANTITY INDICATION

Several electrical sensors measure the fuel quantity in each tank. One additional independent fuel low-level sensor is installed in each tank and it detects a fuel low-level condition.

On ground, three magnetic fuel level indicators (dripsticks) mounted under each wing provide an alternate means for fuel measuring. They are numbered as LH3, LH2 and LH1 (left hand wing – from outboard to inboard) and RH1, RH2 and RH3 (right hand wing – from inboard to outboard). The stick indication is related to the fuel quantity through the correlation table provided on AOM – Ground Service – Fuel Servicing.

The maximum fuel quantities indicated to the flight crew are given below:

TANK	LITERS		WEIGHT	
	E175	E190	E175	E190
1 (left)	5812.5 l	8076.5 l	4714 kg	6550 kg
2 (right)	5812.5 l	8076.5 l	4714 kg	6550 kg
TOTAL	11625 l	16153.0 l	9428 kg	13100 kg

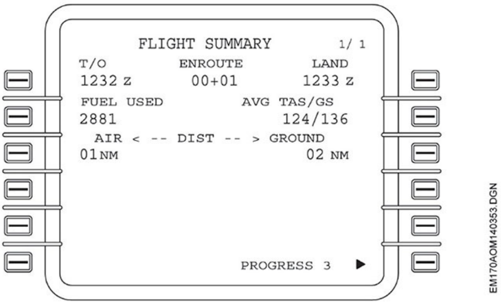
Fuel density = 0.811 kg/l.

MCDU FUEL USED RESET

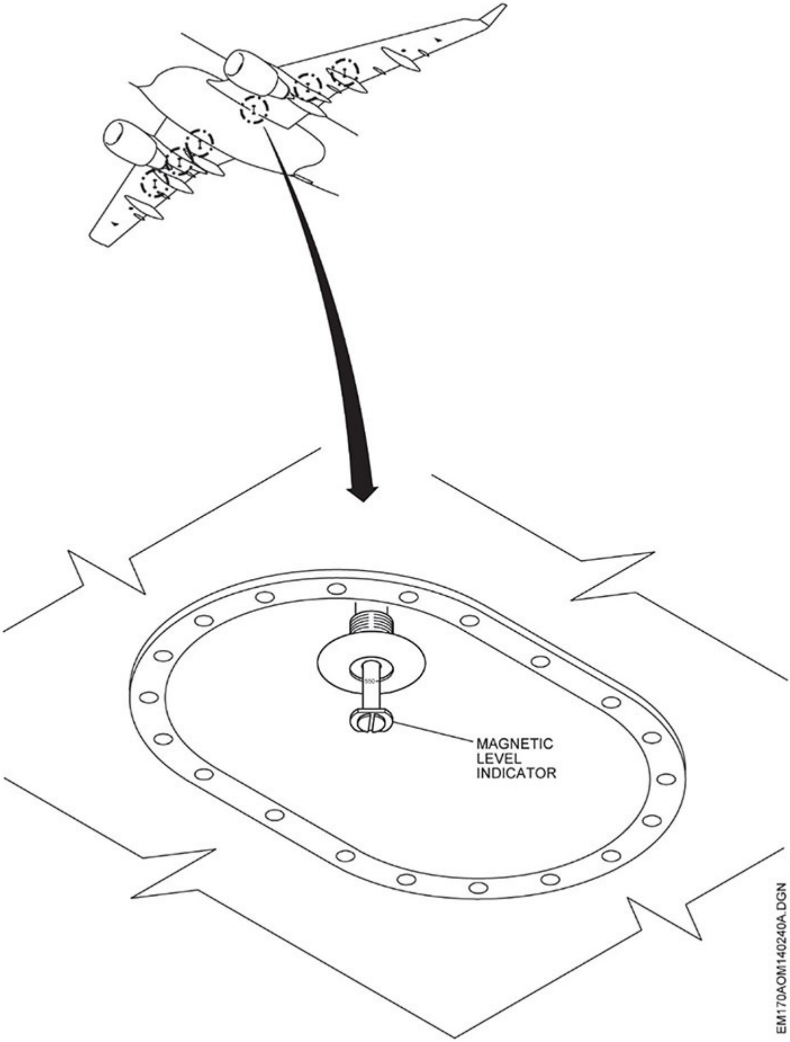
The used fuel reset is performed through the MCDU as follows:

- Press NAV button to enter in the navigation index page.
- Press LSK 3R (FLT SUM) to enter in the flight summary page.
- Press DEL button.
- Press LSK 2L to select the fuel used.

NOTE: The FUEL USED indication is automatically reset by the FMS upon the first engine start.



MCDU FLIGHT SUMMARY PAGE



MAGNETIC LEVEL INDICATORS

FUEL PUMPS

Each fuel tank contains the following pumps:

- Ejector fuel pump.
- AC electric fuel pump.
- Three scavenge ejector pumps.
- DC electric fuel pump (right tank only).

EJECTOR FUEL PUMP

The primary fuel pump is a venturi ejector pump (jet pump) with no moving parts, and is powered by the respective engine motive flow. It is a self-sustained pump and does not require electrical power to operate.

AC FUEL PUMP

The AC electric fuel pump supplies fuel to the following components:

- Onside engine during engine starts.
- Cross side engine during crossfeed operations.
- APU, when engine is not running.

It is also a backup pump in the event of ejector pump failure.

The left AC electric fuel pump (AC PUMP 1) is powered by AC BUS 1. The right AC electric fuel pump (AC PUMP 2) is powered by AC ESS BUS.

SCAVENGE PUMPS

Three scavenge jet pumps maintain the fuel level in the collector tank, ensuring a constant flow of fuel to the engine during normal flight.

DC FUEL PUMP

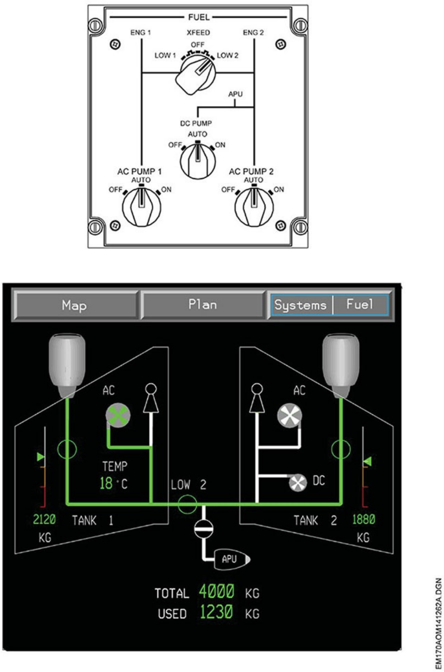
A DC electric fuel pump is installed only in the right wing tank. It provides pressurized fuel for APU and engine starts, when AC power or the AC fuel pump is not available. The DC electric fuel pump is powered by the DC ESS BUS 2 and can be used in flight or on ground.

FUEL CROSSFEED

The crossfeed valve permits fuel supply to both engines from one tank in order to correct and avoid fuel imbalance condition during dual and single engine operations. Setting the crossfeed selector knob to LOW 1 position opens the crossfeed valve and activates the AC PUMP 2, feeding both engines from wing tank 2. Setting the crossfeed selector knob to LOW 2 position opens the crossfeed valve and activates AC PUMP 1, feeding both engines from tank 1.

When the crossfeed knob is selected to LOW 1 or LOW 2, the amount of fuel supplied to the lower level side is higher than the actual fuel burn of the engine on that side. This characteristic causes fuel to be transferred from one tank to the other.

NOTE:
- Setting AC PUMP 1 or 2 selector knob to any position different than AUTO overrides fuel crossfeed pumps command.
- During crossfeed normal operation, the ejectors and electrical pumps that are not in use and their respective fuel lines are displayed in white on the MFD fuel synoptic page.



CROSSFEED ACTIVATION AND INDICATION ON MFD

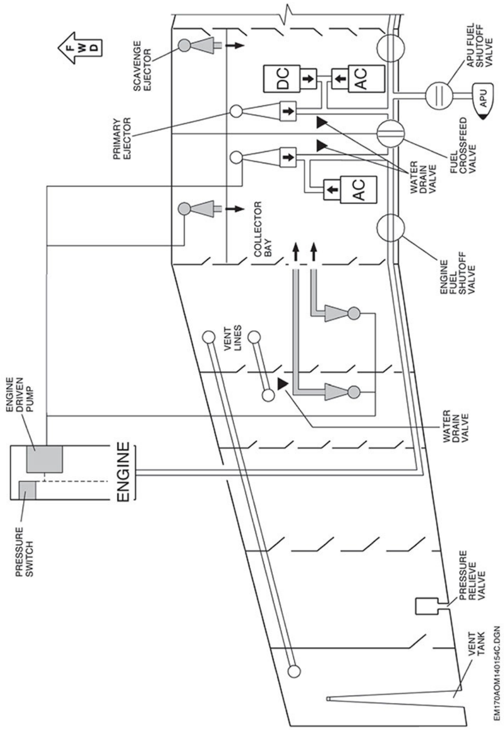
When the fuel imbalance reaches its maximum operational limit (360 kg), the EICAS CAUTION message FUEL IMBALANCE displays. When the imbalance reduces to 45 kg, the EICAS ADVISORY message FUEL EQUAL – XFEED OPEN displays indicating that there is no fuel imbalance condition and the crossfeed valve is open.

NOTE: If the crossfeed valve is open prior to reaching the fuel imbalance condition (360 kg), the message FUEL EQUAL – XFEED OPEN displays even if fuel imbalance is more than 45 kg.

ENGINE FUEL SHUTOFF VALVE

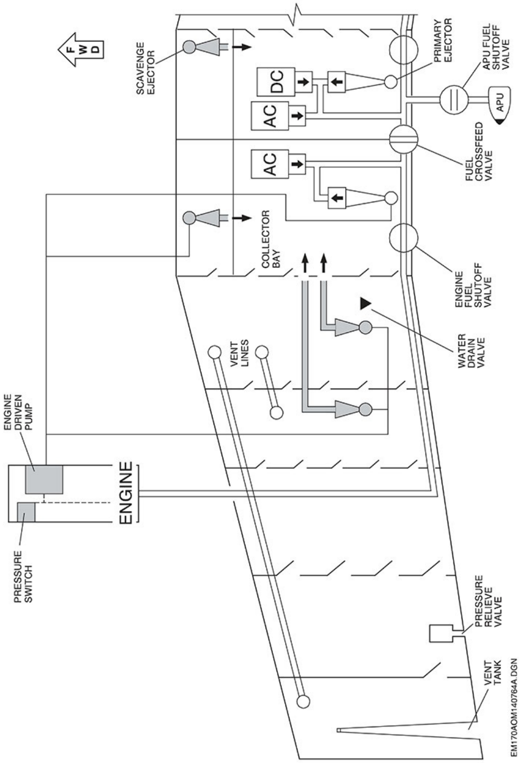
The engine fuel shutoff valve is installed in each wing feed line to prevent hazardous quantities of fuel from flowing into the fire zones. The shutoff valves are normally open. Only the actuation of the fire handles on the cockpit closes the shutoff valves.

E175:



NORMAL ENGINE FEED OPERATION

E190:



NORMAL ENGINE FEED OPERATION

FUEL LOW LEVEL WARNING

Each tank has a dedicated Fuel Low Level sensor located in the collector box. The Fuel Low Level sensor is independent of the fuel quantity indication system. Whenever the fuel level in the collector box is below the sensor level, it sends a fuel low level signal to the warning system, thus triggering the FUEL LO LEVEL warning EICAS message.

NOTE: FUEL 1 (2) LO LEVEL may appear spuriously when flying with high pitch and/or bank angles.

Under normal conditions, the low level warning activation point is set at 300 kg (E175) or 400 kg (E190) of fuel in the associated wing tank.

If any scavenge pump stops transferring fuel to the Collector Box, which might be caused by an engine failure, loss of motive flow or scavenge pumps failure/blockage, the fuel contained in the Collector Box flows out so that the fuel level inside the Collector Box and the rest of the tank reaches the same level.

Under this condition, if there is up to 1800 kg (E175) or 2800 kg (E190) (approximately) of fuel inside that tank it is possible that the level equivalent to the low level warning activation point will be reached as the fuel level inside the Collector Box decreases, then FUEL 1 (2) LO LEVEL warning EICAS Message displays indicating that fuel level is below the low level sensor.

Therefore, in case of loss of the transfer system, the EICAS Warning message FUEL 1 (2) LO LEVEL may display even though fuel quantity indication on the EICAS or MFD Fuel System Synoptic Page is up to 1800 kg (E175) or 2800 kg (E190) in that tank.

NOTE:

- In case of loss of the transfer system to the Collector Box followed by the EICAS warning message, fuel quantity indication monitoring during the flight is achieved through EICAS or MFD Fuel System synoptic page.
- Engine flameout due to fuel starvation may occur if the airplane is subjected to attitudes greater than 15º nose up or down, uncoordinated maneuvers or negative g.

REFUELING AND DEFUELING

There is a single pressurized refueling point and a refuel/defuel control panel located under the right wing. When the access panel door is opened, an overhead panel lamp comes on for night or low light operation.

Pressurized refueling is performed with the airplane energized either by AC or battery power. A switch located on the refueling panel enables selection of either power sources.

Refueling operation modes can be either AUTO or MANUAL. When the refueling switch is in the OPEN position, the refuel control valve opens enabling fuel flow. In AUTO mode the FCU (Fuel Conditioning Unit) controls the refuel shutoff valve, automatically halting refueling when the pre-selected value is reached. In MANUAL mode, the FCU is bypassed. Selection of the CLOSED position in the refueling control switch halts refueling.

In automatic mode, the desired fuel quantity may be selected on the fuel quantity remaining display via the INCR/DECRT switch.

In the pressurized refueling, the system will automatically close the shutoff valve to prevent overfilling whenever the fuel rises up to a certain level. Moreover, the STOP L/R OVER message(s) will appear on the Refueling/Defueling control panel display when the quantity in the right, left or both tanks, respectively, is above its capacity.

The fuel tanks may be partially or completely refueled using the gravity refuel port located on top of each wing. The individual fuel quantity can be determined using the EICAS or the magnetic level indicators.

NOTE: The maximum fuel quantities indicated on the AFM are not achieved through pressurized refueling only. To achieve the maximum tank capacities, gravity refueling must be used to fill the remainder of the tank.

The airplane can be defueled by suction and/or pressure. The defuel shutoff valve is controlled by the DEFUEL switch located on the refuel/defuel control panel.

14.10.15 EICAS MESSAGES

TYPE	MESSAGE	MEANING
WARNING	FUEL 1 (2) LO LEVEL	Low-level sensors indicate that 300 kg (E175) or 400 kg (E190) of fuel remains in the respective tank.
CAUTION	APU FUEL SOV FAIL	Shutoff valve is not in the commanded position.
	ENG 1 (2) FUEL SOV FAIL	Associated shutoff valve is not in the commanded position.
	FUEL IMBALANCE	Indicates an imbalance of fuel between the two tanks greater than or equal to 360 kg. It remains displayed until the imbalance is reduced to 45 kg.
	FUEL TANK LO TEMP	Temperature sensed in the left collector bay is less than or equal to –37°C.
	FUEL XFEED FAIL	Indicates a discrepancy between the cockpit control position and either the valve position or the affected pump status.
ADVISORY	DEFUEL SOV OPEN	Defuel shutoff valve is open.
	FUEL AC PUMP 1 (2) FAIL	Indicates a discrepancy between the commanded and actual associated pump state.
	FUEL DC PUMP FAIL	Indicates a discrepancy between the commanded and actual pump state.
	FUEL EQUAL-XFEED OPEN	Crossfeed valve commanded open prior to fuel imbalance has reached 360 kg (882 lb) and the FUEL IMBALANCE message has been triggered or crossfeed valve is still open and fuel imbalance condition is suppressed after FUEL IMBALANCE message has been triggered.
	FUEL FEED 1 (2) FAULT	Respective backup AC fuel pump is ON due to failure of the associated main engine fuel feed system (motive flow).
	FUEL KG-LB MISMATCH	Label units defined at FCU do not agree with label units set on the EICAS.
STATUS	APU FUEL SOV CLOSED	APU fuel shutoff valve is fully closed.
	ENG 1 (2) FUEL SOV CLOSED	Associated engine shutoff valve is fully closed.
	FUEL XFEED SOV OPEN	Crossfeed valve is open and associated AC fuel pump is operating.

NOTE: FUEL 1 (2) LO LEVEL may appear spuriously when flying with high pitch and/or bank angles.

14.11.01 GENERAL DESCRIPTION

The airplane has three independent hydraulic systems to provide power for:

- Flight controls;
- Spoilers;
- Landing gear;
- Nose wheel steering;
- Wheel brakes;
- Thrust reversers.

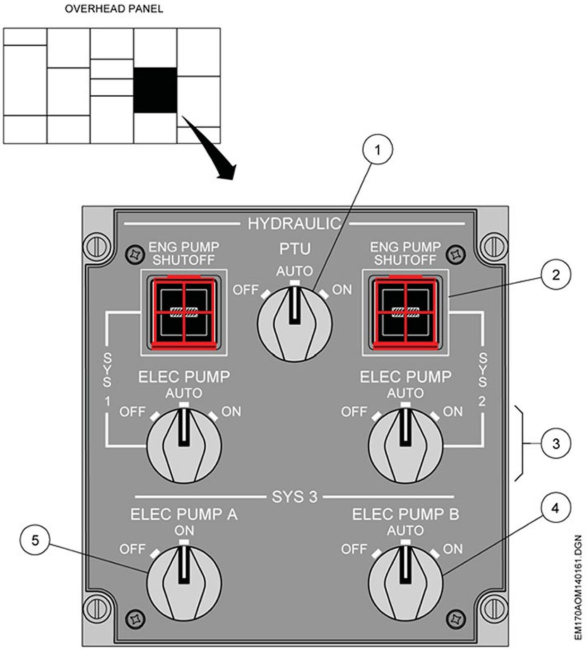
Normal operation of the hydraulic system is automatic.

The hydraulic systems do not have any fluid communication point, therefore, hydraulic fluid cannot be transferred from one system to another. All three systems use skydrol hydraulic fluid and operate at a nominal pressure of 3000 psi.

The hydraulic system's parameters and indications are displayed on both MFD synoptic pages. System messages are displayed on the EICAS display.

14.11.05 CONTROLS AND INDICATIONS

HYDRAULIC SYSTEM PANEL



HYDRAULIC SYSTEM PANEL

1 – POWER TRANSFER UNIT (PTU) KNOB

OFF: turns the PTU off.

AUTO: allows the PTU to operate automatically, according to hydraulic system logic.

ON: operates the PTU continuously, overriding the hydraulic system logic.

2 – SYS 1 AND SYS 2 ENG PUMP SHUTOFF BUTTONS (GUARDED)

- Closes the hydraulic shutoff valve (SOV), isolating the respective engine driven pump (EDP) from the associated hydraulic system.

3 – SYS 1 AND SYS 2 ELEC PUMP KNOBS

OFF: turns the associated electrical pump off.

AUTO: allows the associated electrical pump to operate automatically, according to hydraulic system logic.

ON: operates the associated electrical pump continuously, overriding the system logic.

4 – SYS 3 ELEC PUMP B KNOB

OFF: turns the electrical pump off.

AUTO: allows the electrical pump to operate automatically, according to hydraulic system logic.

ON: operates the electrical pump continuously, overriding the system logic.

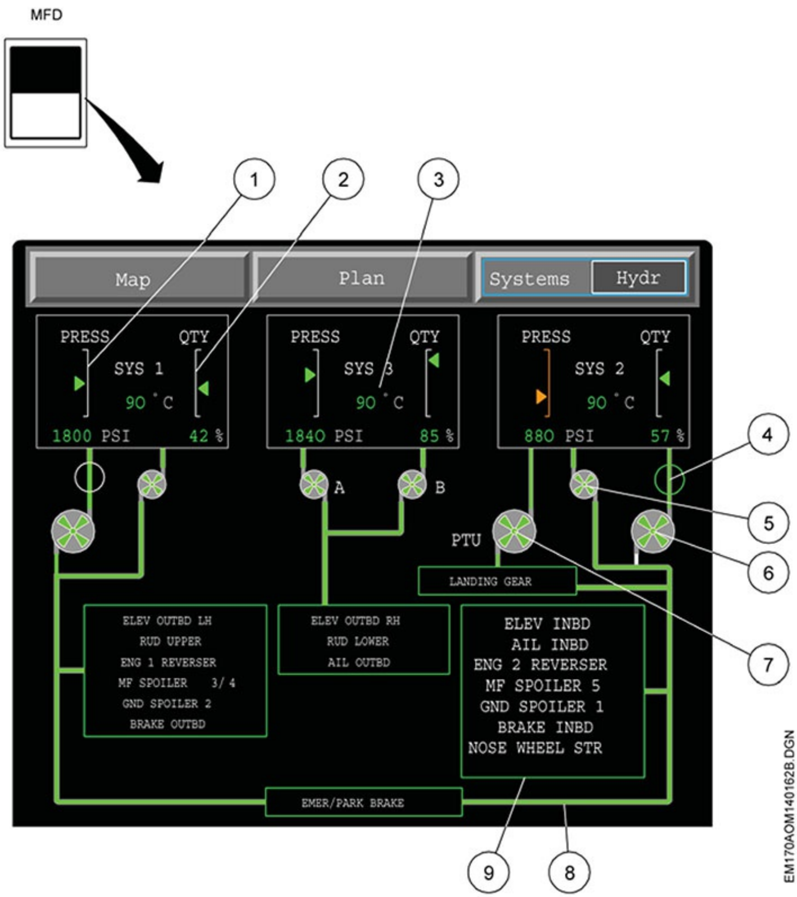
5 – SYS 3 ELEC PUMP A KNOB

OFF: turns the electrical pump off.

ON: turns the electrical pump on.

HYDRAULIC SYNOPTIC PAGE ON MFD

The hydraulic synoptic page provides a visual representation of the hydraulic system operation and parameters. The page can be selected by the flight crew for viewing on either MFD. In the event of any system failure, the size of the letters inside the associated distribution box (9) increases to attract the attention of the flight crew.



1 – PRESSURE INDICATION

- Digital Pressure

GREEN:	normal operating range.
AMBER:	cautionary operating range.
GRAY:	label (PSI).
AMBER DASHED:	invalid information or a value out of the valid range.

- Pressure Scale/Pointer
  - The pointer on the scale indicates a value equal to that shown on the digital display. If the value is invalid, the pointer will be removed from the display.
  - Scale:

WHITE:	normal operating range.
AMBER:	cautionary operating range.

  - Pointer:

GREEN:	normal operating range.
AMBER:	cautionary operating range.

2 – QUANTITY INDICATION

- Digital Quantity
  - Displays the percentage of fluid remaining for each hydraulic system.

GREEN:	normal quantity.
CYAN:	reservoir requires refilling.
AMBER DASHED:	invalid information or a value out of displayable range.
GRAY:	label (%).

- Quantity Scale/Pointer
  - The pointer on the scale indicates a value equal to that shown on the digital display. If the value is invalid, the pointer will be removed from the display.
  - Scale:

WHITE:	normal quantity.
CYAN:	reservoir requires refilling.

  - Pointer:

GREEN:	normal quantity.
CYAN:	reservoir requires refilling.

3 – TEMPERATURE INDICATION

- Digital Temperature
  - Indicates the hydraulic fluid temperature measured in the reservoir.

GREEN:	normal operating range.
AMBER:	cautionary operating range.
RED:	operating limit exceeded.
AMBER DASHED:	invalid information or a value out of the valid range.

4 – ENGINE PUMP SHUTOFF VALVE STATUS

- On the synoptic page, the shutoff valve is depicted as a circle with an internal line representing the valve position.
  - OPEN: a green circle and a green line aligned with the flow line.
  - CLOSED: a white circle and a white line perpendicular to the flow line.
  - UNDETERMINED: an amber dashed circle with no line.
  - IN TRANSIT: a white circle and a white line diagonal to the flow line.
  - FAILED: a white circle beneath an amber cross.

5 – ELECTRIC HYDRAULIC PUMP STATUS

- On the synoptic page, the electrical pump is depicted as a circle with an internal windmill.
  - ON: a gray circle and a green windmill.
  - OFF: a gray circle and a white windmill.
  - UNDETERMINED: an amber dashed circle and an amber windmill.
  - FAILED: a gray circle and a white windmill beneath an amber cross.

NOTE: The icons that represent electrical pumps are smaller than the engine-driven pump and PTU icons.

6 – ENGINE DRIVEN HYDRAULIC PUMP STATUS

- On the synoptic page, the engine pump is depicted as a circle with an internal windmill.
  - ON: a gray circle and a green windmill.
  - OFF: a gray circle and a white windmill.
  - UNDETERMINED: an amber dashed circle and an amber windmill.
  - FAILED: a gray circle and a white windmill beneath an amber cross.

7 – POWER TRANSFER UNIT STATUS

- On the synoptic page, the PTU is depicted as a circle with an internal windmill.
  - ON: a gray circle and a green windmill.
  - OFF: a gray circle and a white windmill.
  - UNDETERMINED: an amber dashed circle and an amber windmill.
  - FAILED: a gray circle and a white windmill beneath an amber cross.

8 – HYDRAULIC FLOW LINE

- On the synoptic page, the flow line is depicted as a color filled line.

GREEN: the associated flow line is pressurized.

WHITE: the associated flow line is not pressurized.

WHITE/AMBER DASHED: the associated flow line pressure is undetermined.

9 – HYDRAULIC SYSTEM DISTRIBUTION BOX

- Each distribution box indicates the airplane’s systems supplied by the respective hydraulic system.

GREEN: the associated hydraulic system is pressurized.

WHITE: the associated hydraulic system is not pressurized.

WHITE/AMBER DASHED: the associated hydraulic system pressure is undetermined.

14.11.10 HYDRAULIC SYSTEM DESCRIPTION

HYDRAULIC SYSTEM

The airplane has three independent hydraulic systems, which provide power to the primary and secondary flight controls, the landing gear, the brakes, the nose wheel steering and the thrust reversers.

The hydraulic system is designed in such a way that even a failure of two hydraulic systems will not result in a complete loss of flight-critical functions.

NORMAL OPERATION

The operation of the hydraulic system is mostly automatic and requires little pilot action. The system architecture and level of redundancy allows it to accommodate most system failures without degradation to the airplane's safe operation.

HYDRAULIC SYSTEM 1

Hydraulic System 1 is comprised of one reservoir, one Engine Driven Pump (EDP 1), one electric hydraulic pump and one accumulator. Hydraulic System 1 supplies the following systems:

- Elevator (left hand outboard actuators);
- Rudder (upper actuator);
- Thrust reverser (engine 1);
- Multi-function spoilers (left and right panels 3 and 4);
- Ground spoilers (left and right panel 2);
- Outboard brake;
- Emergency parking brake.

ABNORMAL OPERATION

The hydraulic system 1 is equipped with an overheating protection system.

When the hydraulic fluid temperature increases to 100ºC, the HYD 1 HI TEMP EICAS caution message is displayed.

If the fluid temperature reaches 125ºC, the shutoff valve (SOV) automatically actuates, thus isolating the EDP 1 from the respective hydraulic flow line.

In the event of hydraulic system overheat (fluid temperature above 145ºC), the HYD 1 OVERHEAT EICAS warning message is displayed. In this case, the SOV can be manually commanded through a guarded pushbutton on the hydraulic system control panel.

Also, in the event of engine flameout, the FADEC automatically commands the unload of the respective EDP, which reduces the hydraulic system pressure. This depressurization reduces the torque loads on the engine and facilitates a windmill restart.

HYDRAULIC SYSTEM 1 RESERVOIR

A mechanical piston pressurizes the Hydraulic System 1 Reservoir, which supplies fluid to the pump. From the pump, fluid is then directed to the manifold, where it is filtered and routed to user systems.

In the return line, all the fluid is re-filtered and depending on the temperature, part of the fluid will either be routed to the heat exchanger or directed back to the reservoir.

A quantity measuring system and a temperature transducer are located at the reservoir, providing information to both MFD (synoptic page) and EICAS displays.

ENGINE DRIVEN PUMP (EDP) 1

The EDP 1 is connected to the engine 1 accessories gearbox and it is the primary power source for Hydraulic System 1. Its normal operation requires no pilot action.

ELECTRIC HYDRAULIC PUMP 1

The Electric Hydraulic Pump 1 (ACMP 1B) is an alternating current motor pump. It serves as a backup for the EDP 1 and it is powered by the AC BUS 2.

A three-position selector knob located on the hydraulic panel enables the flight crew to select OFF, AUTO or ON positions. In normal operation, selected position is AUTO.

In flight, with the selector knob set to AUTO position, the Hydraulic System logic activates the electric pump in case of:

- EDP or engine fail, or
- Flaps selected to any position greater than 0°.

During landing operations, the Electric Hydraulic Pumps remain activated for 60 seconds to avoid abrupt hydraulic pressure variations in an event of engine failure.

On ground, with the selector knob set to AUTO position, the Hydraulic System logic activates the electric pump in case of:

- Flaps selected to any position greater the 0° and:
  - Thrust levers set to takeoff thrust, or
  - Airspeed greater than 50 kt.

Also, during takeoff when thrust levers are set to TOGA, the Electric Hydraulic Pumps will be activated for 60 seconds to avoid abrupt hydraulic pressure variations in an event of engine failure.

HYDRAULIC SYSTEM 1 ACCUMULATOR

A pressure accumulator is designed to maintain a constant pressure during periods of transient flow demands in the operation of the Hydraulic System. The accumulator also keeps a residual pressure in the hydraulic reservoir in order to avoid pump cavitations.

HYDRAULIC SYSTEM 2

Hydraulic System 2 is comprised of one reservoir, one engine driven pump (EDP 2), one electric hydraulic pump, one accumulator and one PTU. The Hydraulic System 2 supplies the following systems:

- Elevator (left and right hand inboard actuators);
- Ailerons (right and left inboard actuators);
- Thrust reverser (engine 2);
- Multi-function spoilers (left and right panels 5);
- Ground spoilers (left and right panel 1);
- Inboard brake;
- Nose wheel steering;
- Landing gear (retraction and extension);
- Emergency parking brake.

ABNORMAL OPERATION

The Hydraulic System 2 is also equipped with an overheat protection system.

When the hydraulic fluid temperature reaches 100°C, the HYD 2 HI TEMP EICAS caution message will be displayed.

If the fluid temperature reaches 125ºC, the shutoff valve (SOV) will automatically actuate, thus isolating the EDP 2 from the respective hydraulic flow line.

In the event of hydraulic system overheat (fluid temperature above 145ºC), the HYD 2 OVERHEAT EICAS warning message will be displayed. In this case, the SOV can be manually actuated through a guarded pushbutton on the hydraulic system control panel.

Also, In the event of engine flameout, the FADEC will depressurize the respective EDP in order to reduce the torque loads on the engine and facilitate a windmill restart.

HYDRAULIC SYSTEM 2 RESERVOIR

E175: The reservoir is hydraulically pressurized by a mechanical piston and is similar to Hydraulic System 1 and 3 reservoirs.

E190: The reservoir is hydraulically pressurized by a mechanical piston and has a greater capacity than Hydraulic System 1 reservoir.

ENGINE DRIVEN PUMP (EDP 2)

The engine driven pump is connected to the engine 2 accessories gearbox and it is the primary power source for Hydraulic System 2. Its normal operation is identical to EDP 1.

ELECTRIC HYDRAULIC PUMP 2

The Electric Hydraulic Pump 2 (ACMP 2B) is an alternating current motor pump. It is used as a backup for the engine driven pump (EDP 2) and it is powered by the AC BUS 1.

The operation of the Electric Hydraulic Pump 2 is similar to Electric Hydraulic Pump 1.

Also, on ground, the Electric Hydraulic Pump 2 will be automatically activated when any of the following conditions occur:

- Engine 1 running and parking brake released;
- During Engine 1 start (N2≥ 40%) if parking brake has been applied within the last 6 minutes.

NOTE: The Electric Hydraulic Pump 2 will be automatically turned off after 6 minutes have elapsed from parking brake application.

HYDRAULIC SYSTEM 2 ACCUMULATOR

The Hydraulic System 2 Accumulator is similar to the Hydraulic System 1 accumulator and their operation is identical.

POWER TRANSFER UNIT (PTU)

The PTU consists of a hydraulic pump in Hydraulic System 2 driven by a hydraulic motor installed in Hydraulic System 1.

The PTU assists the landing gear retraction or extension, should a right engine or right EDP failure occur.

NORMAL OPERATION

A three-position selector knob located on the hydraulic panel enables the flight crew to select OFF, AUTO or ON positions. Normal operation is automatic.

During takeoff and landing, with the selector knob in the AUTO position the hydraulic system logic activates the PTU if the engine 2 or EDP 2 fails. The PTU will be automatically started when all the following conditions are met:

- Flaps not set to zero or Landing Gear not up and locked;
- EDP 1 not fail;
- Hydraulic reservoir 2 quantity above 12%.

NOTE: PTU will not be activated if the airplane is on ground.

ABNORMAL OPERATION

If any malfunction is detected in the PTU, the HYD PTU FAIL EICAS caution message will be displayed. In this case, the PTU selector knob may be set to ON or OFF position, overriding the system logic, according to the applicable abnormal procedure.

HYDRAULIC SYSTEM 3

Hydraulic System 3 is comprised of one reservoir, two electric hydraulic pumps and one accumulator. The Hydraulic System 3 supplies the following systems:

- Elevator (right hand outboard actuators);
- Rudder (lower actuator);
- Ailerons (left and right outboard actuators).

ABNORMAL OPERATION

The Hydraulic System 3 is also equipped with an overheat protection system.

When the hydraulic fluid temperature reaches 100ºC, the HYD 3 HI TEMP EICAS caution message will be displayed.

If the fluid temperature increases up to 125ºC, both Electric Hydraulic Pumps (3A and 3B) will automatically be turned OFF.

In the event of hydraulic system overheating (fluid temperature above 145ºC), the HYD 3 OVERHEAT EICAS warning message will be displayed. In this case, the flight crew can manually switch OFF pumps 3A and 3B on the hydraulic system control panel.

NOTE: During an Electrical Emergency condition the Hydraulic System 3 overheating protection system will be inhibited, therefore preventing the Electric Hydraulic Pumps from being turned off automatically. In this condition, the associated EICAS messages HYD 3 HI TEMP and HYD 3 OVERHEAT will also be inhibited, preventing the flight crew from switching off the only source of hydraulic power available.

HYDRAULIC SYSTEM 3 RESERVOIR

The reservoir is also hydraulically pressurized by a mechanical piston and is similar to Hydraulic Systems 1 and 2 reservoirs.

ELECTRIC HYDRAULIC PUMPS

Both Electric Hydraulic Pumps are alternating current motor pumps (ACMP). Electric Hydraulic Pump 3A (ACMP 3A) is the primary power source for Hydraulic System 3 and it is powered by the AC ESS BUS.

A two-position selector knob located on the hydraulic panel enables the flight crew to select OFF or ON positions. There is no automation associated with this pump. So in normal operation, the flight crew will turn the pump ON and OFF during engine start and shut down, respectively.

Electric Hydraulic Pump 3B (ACMP 3B) is the backup for the Electric Hydraulic Pump 3A and it is powered by the AC BUS 2. The flight crew selects manual or automatic operation through the three-position selector knob on the hydraulic control panel. Normal operation is automatic.

In flight, with the selector knob in the AUTO position, the hydraulic system logic turns on the electric pump 3B whenever the electric pump 3A fails. When the selector knob is set to the ON position, the electric pump operates continuously overriding the system automation.

HYDRAULIC SYSTEM 3 ACCUMULATOR

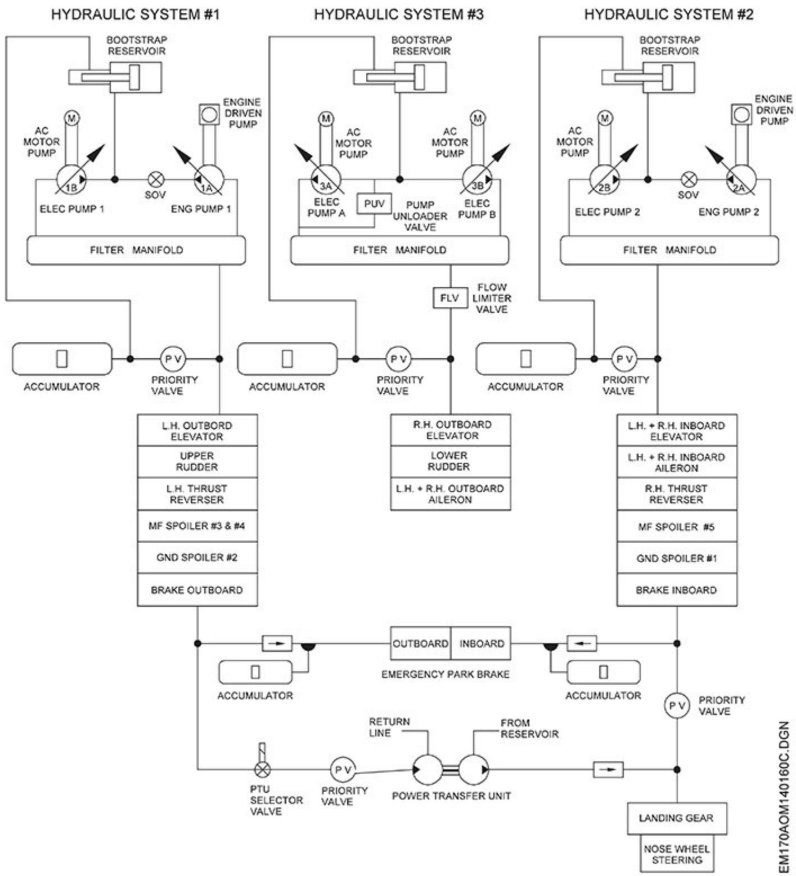
The Hydraulic System 3 accumulator is similar to the Hydraulic System 1 and 2 accumulators, except for its operation during an electrical emergency. In this condition, the Hydraulic System 3 accumulator will provide hydraulic power to the associated flight controls from the beginning of RAT deployment until the ACMP 3A is powered by the AC ESS BUS.

PUMP UNLOADER VALVE/FLOW LIMITER VALVE

Hydraulic system 3 has two dedicated valves which are used only in an electrical emergency to avoid overload in the RAT.

The pump unloader valve is used to reduce the discharge pressure of ACMP 3A during its start-up. This will reduce the pump torque and therefore reduce the electrical power required to start the pump.

The flow limiter valve is used to reduce the amount of flow provided by the ACMP 3A. This will limit the electrical power that the pump can draw and prevent the electric hydraulic pump from stalling the RAT.



HYDRAULIC SYSTEM SCHEMATIC

14.11.15 EICAS MESSAGES

TYPE	MESSAGE	MEANING
WARNING	HYD 1 (2) (3) OVERHEAT	Associated hydraulic system temperature exceeded the caution operational range.
CAUTION	HYD 1 (2) (3) HI TEMP	Associated hydraulic system temperature exceeded the normal operational range.
	HYD 1 (2) (3) LO PRESS	Associated hydraulic system pressure is low.
	HYD PTU FAIL	PTU is not supplying hydraulic power to hydraulic system 2 or PTU automatic operation is compromised.
	HYD 1 (2) EDP NOT D-PRESS	Depressurization of the associated engine-driven pump has failed.
	HYD 3 VLV FAIL	One or both hydraulic system # 3 valves, used during an electrical emergency condition, have failed.
ADVISORY	HYD 1 (2) EDP FAIL	Associated engine-driven pump is not providing hydraulic power to the system.
	HYD 1 (2) ELEC PUMP FAIL	Associated electric pump is not providing hydraulic power to the system.
	HYD3 ELEC PUMP A (B) FAIL	Associated system 3 electric pump is not providing hydraulic power to the system.
	HYD 1 (2) (3) LO QTY	Fluid level in the associated reservoir is low.
	HYD 1 (2) SOV FAIL	Associated SOV is not in commanded position.
	HYD 3 PUMP A NOT ON	ACMP 3A is not set to on position.
	HYD PTU NOT AUTO	PTU is not in auto position.
	HYD PUMP NOT AUTO	SYS 1, 2 or 3 electric pump is not in auto position.
	HYD TEMP SENS FAIL	At least one of the hydraulic temperature sensors are failed and the system is unable to monitor the temperature of that system.
STATUS	HYD 1 (2) SOV CLOSED	Associated SOV closed.

14.12.01 GENERAL DESCRIPTION

The Ice and Rain Protection System provides pneumatic anti-ice protection for the engine cowls and wing slats. The pitot and static port heating systems, windshield anti-ice system, and water lines heating system use electrical power to prevent icing.

The ice and rain protection system includes:

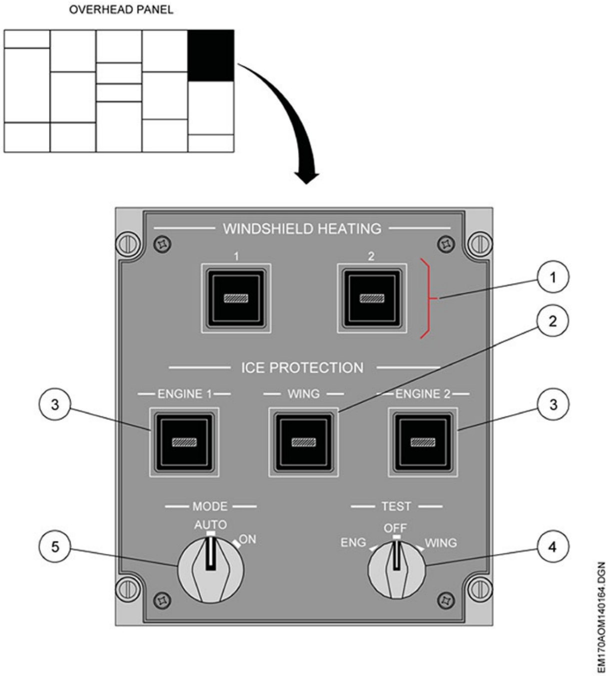
- Wing anti-ice system;
- Engine anti-ice system;
- Windshield heating system;
- Air data smart probe (ADSP)/TAT heating system;
- Windshield wiper system.

The ice and rain protection system's parameters and indications are displayed on both MFD synoptic pages. System messages are displayed on EICAS displays.

Normal operation of the anti-ice system is automatic.

14.12.05 CONTROLS AND INDICATIONS

ICE PROTECTION PANEL



1 – WINDSHIELD HEATING 1 AND 2 BUTTONS

PUSH IN: activates the associated windshield heating system.

PUSH OUT: deactivates the associated windshield heating system.

2 – ICE PROTECTION WING BUTTON

PUSH IN: automatic operation of the wing anti-ice system.

PUSH OUT: deactivates the wing anti-ice system.

3 – ICE PROTECTION ENGINE 1 AND 2 BUTTONS

PUSH IN: automatic operation of the associated engine anti-ice system.

PUSH OUT: deactivates the associated engine anti-ice system.

4 – ICE PROTECTION TEST CONTROLLER

ENG: initiates the engine anti-ice system test.

OFF: spring-loaded position.

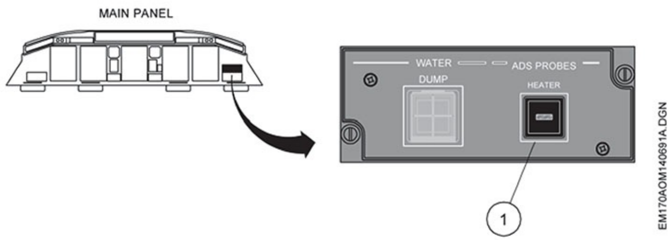
WING: provides a test for the wing anti-ice system.

5 – ICE PROTECTION MODE KNOB

AUTO: automatic operation of the wing and engine anti-ice systems.

ON: overrides the system logic inflight, activating the anti-ice system regardless of icing condition. It also activates the anti-ice on ground according to the system logic.

ADS PROBES HEATER PANEL

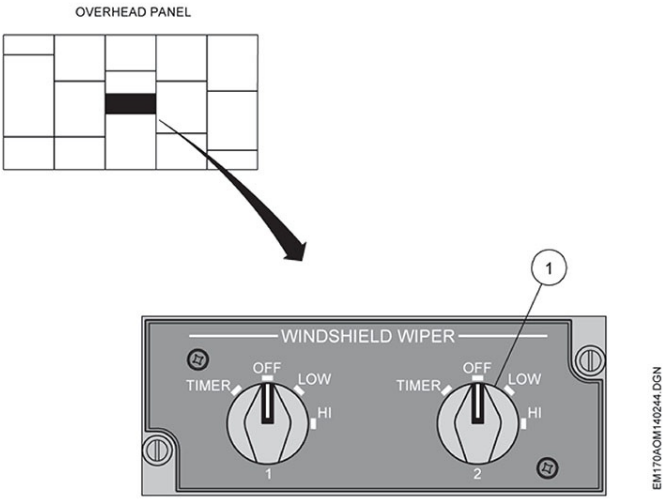


1 – HEATER BUTTON

PUSH IN: activates the ADS probes heater. A striped bar illuminates in the button.

PUSH OUT: the ADS probes heater operates in AUTO mode.

WINDSHIELD WIPER PANEL



1 – WINDSHIELD WIPER 1 AND 2 KNOBS

TIMER: eight-second intermittent operation.

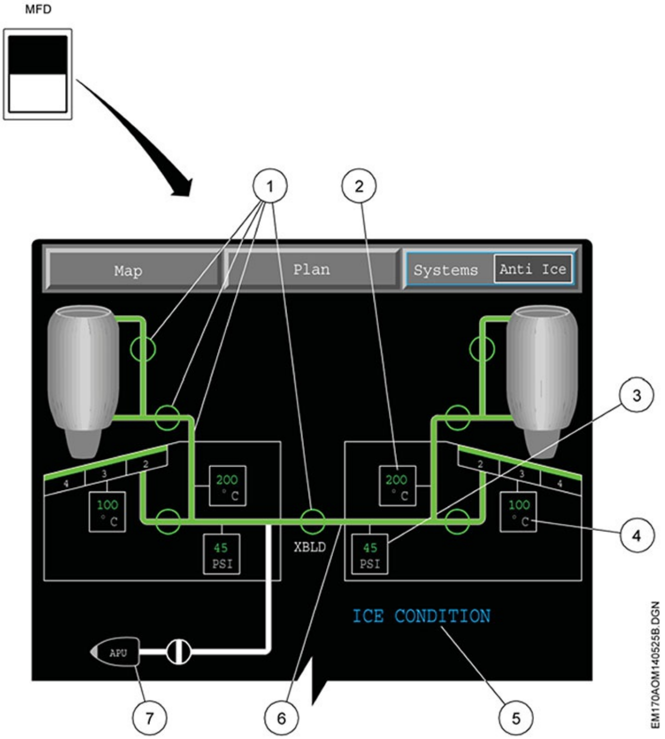
OFF: stops windshield wipers in the stowed position.

LOW: windshield wipers operate at low speed.

HIGH: windshield wipers operate at high speed.

SYNOPTIC PAGE ON MFD

The anti-ice synoptic page provides a visual representation of the anti-ice system operation and parameters, and can be selected by the flight crew for viewing on either MFD.



1 – BLEED AIR SYSTEM VALVES STATUS

- OPEN: a green circle with a green line aligned with the flow line.
- CLOSED: a white circle with a white line perpendicular to the flow line.
- UNDETERMINED: an amber dashed circle with no line.
- IN TRANSIT: a white circle with a white line diagonal to the flow line.
- FAILED CLOSED: a white circle with a white line perpendicular to the flow line beneath an amber cross.
- FAILED OPEN: a green circle with a green line aligned with the flow line, beneath an amber cross.

2 – BLEED AIR TEMPERATURE INDICATION

- Digital Temperature.

GREEN:	normal operating range.
AMBER DASHED:	invalid information or a value out of range.

3 – BLEED AIR PRESSURE INDICATION

- Digital Pressure.

GREEN:	normal operating range.
AMBER DASHED:	invalid information or a value out of range.

4 – WING ANTI-ICE TEMPERATURE INDICATION

- Digital Temperature.

GREEN:	normal operating range.
AMBER DASHED:	invalid information or a value out of the valid range.

5 – ICE CONDITION ANNUNCIATION

- The ICE CONDITION annunciation is displayed below the right bleed air manifold pressure icon, indicating that an icing condition has been detected.

6 – ANTI-ICE FLOW LINE

- The anti-ice flow line is depicted in color.

GREEN:	the associated flow line is pressurized.
WHITE:	the associated flow line is not pressurized.
AMBER:	the associated flow line is overheated.
WHITE/ AMBER DASHED:	the associated flow line pressure is undetermined.

7 – APU ICON

- The APU icon is only displayed on ground.

14.12.10 SYSTEM DESCRIPTION

ICE PROTECTION SYSTEM

The ice protection system includes the engine anti-ice, wing anti-ice, windshield heaters and the ice detectors. The engines and wings anti-ice use bleed air from the engines as a heat source.

During normal operation the system automatically controls the engine and the wing anti-ice valves operation. There is a special logic to configure and prepare the FADEC for takeoff in icing conditions.

In case of a dual ice detector failure, the anti-ice system can be manually operated.

The windshield heaters have a dedicated controller for operation.

ENGINE ICE PROTECTION SYSTEM

NORMAL OPERATION

The engines cowls are heated with air from the high stage bleed (E175) or low stage bleed (E190), extracted from the respective engine. Each engine anti-ice system is independent.

ABNORMAL OPERATION

The engine anti-ice valve is fail safe open if either the electrical or pressure signal are not present.

WING ICE PROTECTION SYSTEM

NORMAL OPERATION

All three outboard leading edges are heated by bleed air extracted from the engines. Each engine provides bleed air for the respective wing anti-ice.

The APU is not capable of supplying bleed air for the anti-ice operation.

ABNORMAL OPERATION

If one bleed air fails, the anti-ice system automatically opens the cross bleed valve and uses the opposite bleed for both wings anti-ice.

ICE DETECTORS

NORMAL OPERATION

The airplane is equipped with two ice detectors installed on the left and right side of the nose section.

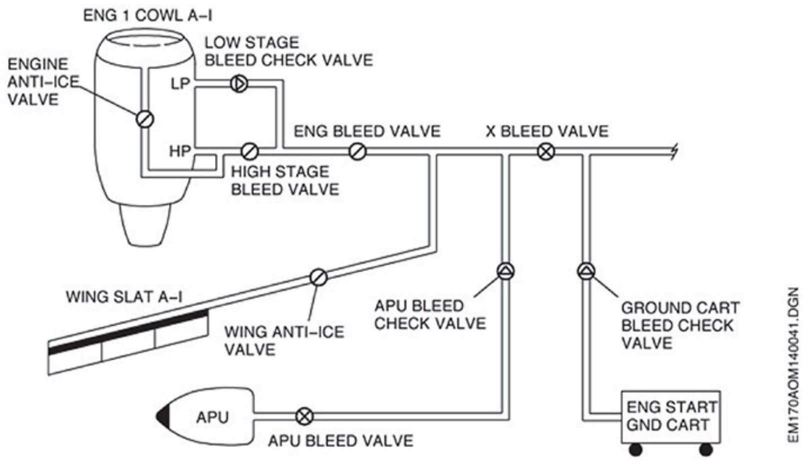
If an icing condition is detected during flight, the ice detectors command the wing and engine anti-ice valves to open and remain activated for 2 minutes after the icing condition is no longer detected.

ABNORMAL OPERATION

Failure of one ice detector results in the loss of system redundancy. If an icing condition is detected by the remaining sensor, the engine and wing anti-ice systems will automatically activate.

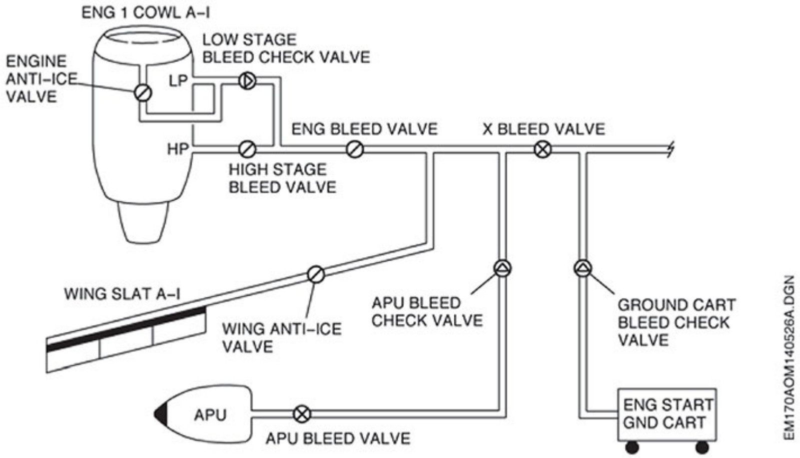
In case of a dual ice detector failure, the anti-ice operation is only possible in the manual mode.

E175:

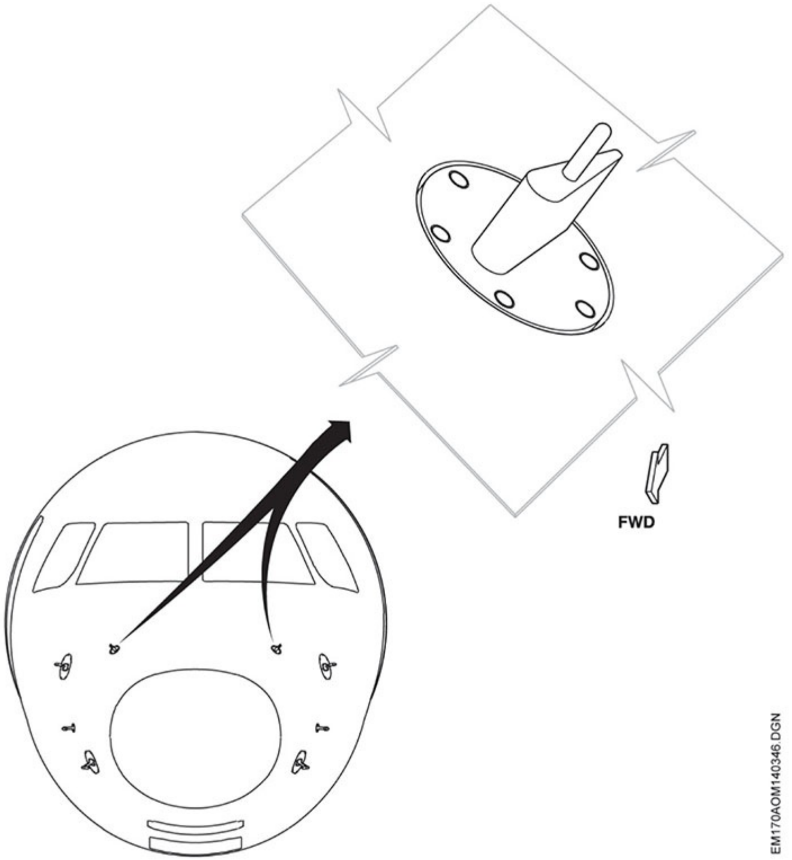


ICE PROTECTION SYSTEM SCHEMATIC

E190:



ICE PROTECTION SYSTEM SCHEMATIC



ICE DETECTORS LOCATION

ICE PROTECTION AUTO MODE

The anti-ice system automatic mode is active anytime the mode selector knob is set to AUTO position. During ground operation and takeoff, there is a specific logic for activating the anti-ice system and configuring the FADEC.

ON GROUND AND TAKEOFF OPERATION

The operation of the anti-ice valves during takeoff affects the engine performance. The FADEC needs to be configured before takeoff in icing conditions.

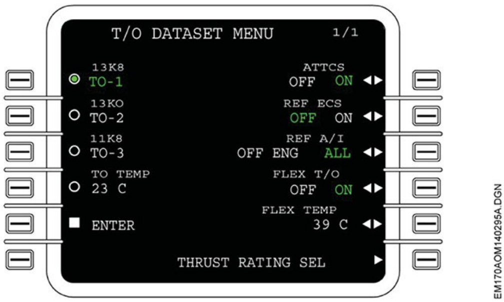
During ground operation, at low speeds and visible moisture, ice could accumulate at the engine cowls without being detected by the ice detectors.

The setting of the REF A/I modes for Before Takeoff and Takeoff phases are made on the TAKEOFF DATA SET MENU. By setting the modes on this page the engine FADEC and the ice protection system are adjusted in a single action.

MCDU SETTING

To set the anti-ice condition on the TAKE OFF DATA SET MENU page on MCDU press:

- TRS button;
- TO DATA SET (line select key – 6R).



TO DATA SET MENU PAGE

REF A/I MODES OF OPERATION

The REF A/I mode of operation can be selected on ground using the OAT/visible moisture table presented in ICING CONDITIONS, COLD WEATHER AND COLD SOAK OPERATIONS supplementary procedure in section 3-75.

The MCDU setting operates the anti-ice system and inhibits the ice detectors activation logic during takeoff until 1700 ft AGL or 2 min after liftoff, whichever occurs first. The settings actuate as described below:

OFF – The anti-ice valves will be inhibited closed until the end of takeoff phase, considered in the logic as 1700 ft AGL or 2 minutes after liftoff. After that, the engine and wing anti-ice valves will open if ice is detected.

ENG – Only the engine anti-ice valve will be kept open after engine start. The wing anti-ice valves remains inhibited closed. The EICAS status message ENG TDS REF A-I ENG will be displayed to confirm the MCDU selection.

ALL – The engine anti-ice valves are commanded open after completion of engine start and the wing anti-ice valves are commanded open with wheel speed above 40 kt. The EICAS status message ENG TDS REF A-I ALL will be displayed to confirm the MCDU selection.

In **ENG** or **ALL** operation modes, the anti-ice valves will rely on ice detection when crossing 1700 ft AGL or 2 minutes after liftoff.

In **OFF** or **ENG** operation modes and anti-ice mode selector knob set to ON position, the caution message “ENG REF A-I DISAG” and the advisory CAS message “A-I MODE NOT AUTO” will be displayed on the EICAS. In this case, the pilot needs to rotate the selector knob to AUTO position.

If the REF A/I is set to ENG on the MCDU and the OAT entered at the Takeoff Data Setting is below 5°C, the CAS message ENG REF A-I DISAG will be displayed.

The table below presents a resume for all modes:

TO DATASET MENU	MODE SELECTOR KNOB	ICE CONDITION	ENGINE A-I ACTIVATION	WING A-I ACTIVATION	EICAS CAUTION MESSAGE
OFF	AUTO	NOT DETECTED	-	-	-
		DETECTED	1700 ft AGL or 2 min after liftoff	1700 ft AGL or 2 min after liftoff	-
	ON	NOT DETECTED	ENGINE RUNNING	LIFTOFF	ENG REF A-I DISAG
		DETECTED	ENGINE RUNNING	LIFTOFF	ENG REF A-I DISAG
ENG	AUTO	NOT DETECTED	ENGINE RUNNING	-	-
		DETECTED	ENGINE RUNNING	1700 ft AGL or 2 min after liftoff	-
	ON	NOT DETECTED	ENGINE RUNNING	LIFTOFF	ENG REF A-I DISAG
		DETECTED	ENGINE RUNNING	LIFTOFFF	ENG REF A-I DISAG
ALL	AUTO	NOT DETECTED	ENGINE RUNNING	WSPEED > 40 kt	-
		DETECTED	ENGINE RUNNING	WSPEED > 40 kt	-
	ON	NOT DETECTED	ENGINE RUNNING	WSPEED > 40 kt	-
		DETECTED	ENGINE RUNNING	WSPEED > 40 kt	-

ENGINE AND WING ANTI-ICE SYSTEMS OPERATION

After takeoff, the settings in the MCDU will be ignored by the airplane and the engine and wing anti-ice valves will open anytime an icing condition is detected, or the Ice Protection Panel Mode Switch is set to ON position.

The T/O DATASET MENU page on the MCDU will become available thirty seconds after the airplane touches the ground.

After landing, the Ice Protection System should be activated if icing conditions exist.

UNDETECTED ENVELOPE ANTI-ICE LOGIC (E190 ONLY)

During specific conditions, the wing anti ice system will be activated, regardless of the airplane being in icing conditions. In this case the system will be activated but the message ICE CONDITION will not be displayed.

These conditions are the following:

- Airplane in flight.
- Altitude below 22000 ft.
- Combination of air temperature, altitude and speed indicators.
- Airspeed between 150 and 320 KIAS.
- Vertical speed between -200 ft/min and +200 ft/min.

If all these conditions are true during 2 min the system will be activated, and will stay activated by 2 min after one or more of these conditions become false.

WINDSHIELD HEATING SYSTEM

The windshields are electrically heated for anti-icing and anti-fogging purposes.

NORMAL OPERATION

The windshield heating button remains pushed in allowing the system to automatically control the windshield temperature to a specific range. Left and right windshields heating are controlled by individual pushbuttons on the overhead panel.

The system only operates if there are at least two AC electrical sources.

GROUND OPERATION

When a single AC power is available (e.g. one IDG) each windshield heating controller performs its standard power-up BIT routine, heating the corresponding windshield for 120 seconds.

ABNORMAL OPERATION

In case of a single AC electrical source in-flight only the left windshield heating is powered. If the left windshield heating system fails, the right windshield heating becomes available.

AIR DATA SMART PROBE/TAT HEATING SYSTEM

The Air Data Smart Probe (ADSP)/TAT normal heating mode is fully automatic. The ADSP heating operation can be manually overridden on ground.

A total of four smart and two TAT probes are installed on the nose fuselage section of the airplane. Each probe has a dedicated heater.

AUTO MODE

The ADSPs are heated whenever an engine is running or the airplane is airborne.

The TATs are heated when at least one of the following conditions is met:

- Whenever an engine is running,
- The airplane is airborne,
- The OAT is below 10°C (50°F) with an engine running, or
- Airspeed is above 50 kt.

Upon landing, the TAT heating disables when airspeed is below 45 kt.

MANUAL OVERRIDE

The ADSP Heater pushbutton is installed on the main control panel to allow heating of the ADSPs with airplane on the ground.

If the ADSP Heater pushbutton is pushed IN, the ADSP heating system will be powered, overriding the system logic on the ground. When the batteries are the only electrical source to the airplane, only the ADSP 3 will be heated.

The ADSP Heater pushbutton should be pushed OUT with one or both engines running.

WINDSHIELD WIPER SYSTEM

The airplane is equipped with two independent wipers operating through dedicated control knobs on the overhead panel.

The windshield wipers will stop if operated on a dry windshield. The system remains inoperative until the wiper control knob is set to the one of the three available speeds.

14.12.15 ICE PROTECTION SYSTEM

The Ice Protection TEST Controller provides a manual test for the wing and engine anti-ice systems for maintenance use.

The wing anti-ice system tests itself during flight (SAI IBIT) 10 min after takeoff or at 10000 ft AGL, whichever occurs first. At this time the Slat Anti-Ice Valves will be opened (EICAS messages A-I WING VLV OPEN and A-I Synoptic page will indicate that valves have opened).

If a failure occurs during IBIT, the message A-I WING FAIL will be displayed.

The SAI IBIT duration is 60 seconds (maximum). The test can be finished earlier if all slat temperature sensors have an increase of 10°F.

14.12.20 EICAS MESSAGES

TYPE	MESSAGE	MEANING
WARNING	A-I WING 1 (2) LEAK	An overheating or leakage is detected in the associated wing anti-ice system.
CAUTION	A-I ENG 1 (2) FAIL	Engine anti-ice bleed valve is closed when commanded open, or duct failure detected.
	A-I LO CAPACITY	Wing anti-ice bleed air pressure and temperature capacity is low.
	A-I WING FAIL	A wing anti-ice system failure has been detected.
	A-I WING NO DISPATCH	Wing anti-ice bleed valve has failed open. Maintenance action is required.
	ICE DETECTOR 1 (2) FAIL	Associated ice detector has failed.
	WINDSHIELD 1 (2) HTR FAIL	Associated windshield heating system has failed or is overheated.
ADVISORY	A-I MODE NOT AUTO	Ice protection selector knob is not in the AUTO position.
	A-I SWITCH OFF	Ice protection button for engine and/or wing anti-ice system is pushed out.
	ICE CONDITION	An icing condition has been detected.
	A-I ENG 1 (2) FAULT	Displayed during test if there is loss of the capacity to monitor the adequate functioning of the system.
	A-I ENG 1 (2) LEAK (E175 only)	E175 only: Indicates leakage in the internal pipe.
STATUS	A-I ENG 1 (2) VLV OPEN	Engine anti-ice valve is open.
	A-I WING VLV OPEN	Wing anti-ice valve is open. Also displayed during test after every takeoff (crossing 10000 ft or 10 minutes after takeoff, whichever occurs first).

14.13.01 GENERAL DESCRIPTION

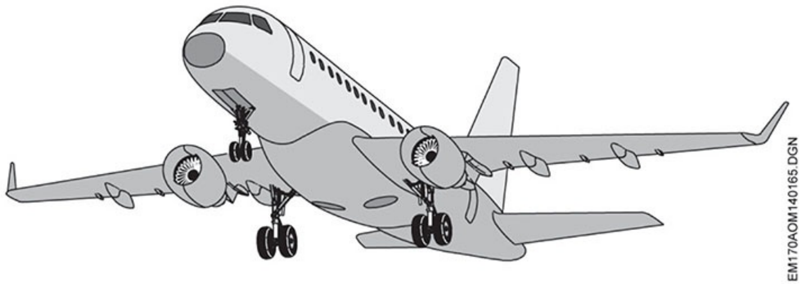
The landing gear system provides ground-rolling capability to the airplane, thus enabling take-off, landing and taxi operations.

The airplane is equipped with a retractable tricycle landing gear which is hydraulically operated. It provides structural support and shock absorber functions for safe transmission of landing, taxiing and ground loads from the wheels to the airplane structure. Each landing gear is a conventional dual wheel unit.

The nose landing gear incorporates a powered steering system, which performs the aircraft directional control on the ground.

The brake system is designed to provide manual or automatic (if applicable) airplane deceleration during ground operations.

The landing gear and brake system parameters and indications are displayed on both MFD synoptic pages. System messages are displayed on EICAS.

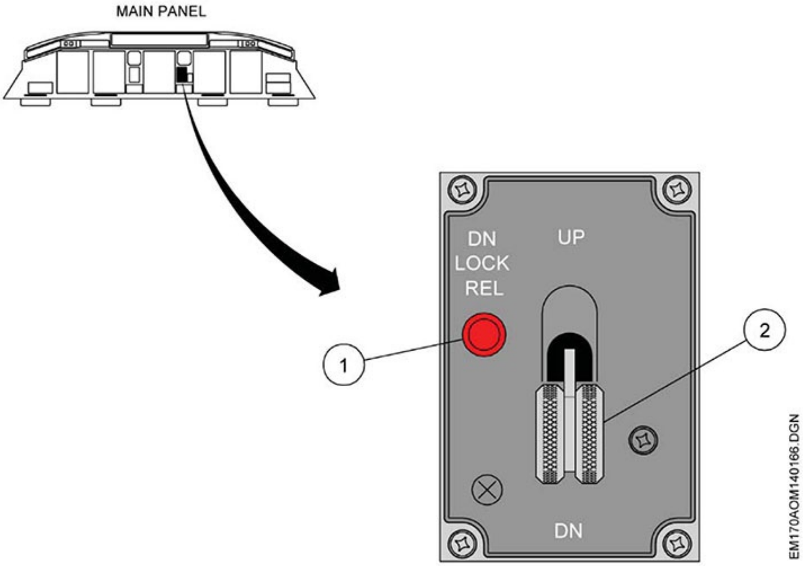


MAIN AND NOSE LANDING GEARS

14.13.05 CONTROLS AND INDICATIONS

LANDING GEAR CONTROLS AND INDICATIONS

LANDING GEAR CONTROL PANEL



1 – DOWNLOCK RELEASE (DN LOCK REL) BUTTON (MOMENTARY ACTION)

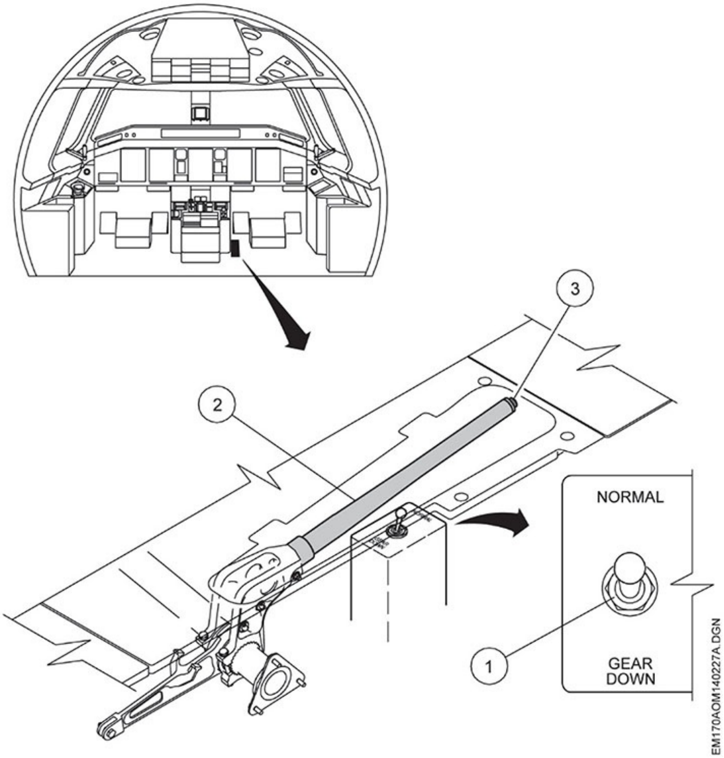
- Manually releases the landing gear lever lock.

2 – LANDING GEAR LEVER

UP: retracts the landing gear.

DOWN: extends the landing gear.

ALTERNATE GEAR EXTENSION COMPARTMENT



1 – ELECTRICAL OVERRIDE SWITCH

NORMAL: the landing gear lever performs landing gear retraction and extension.

GEAR DOWN: electronically bypasses the PSEM, opens the forward and aft doors and extends the landing gear.

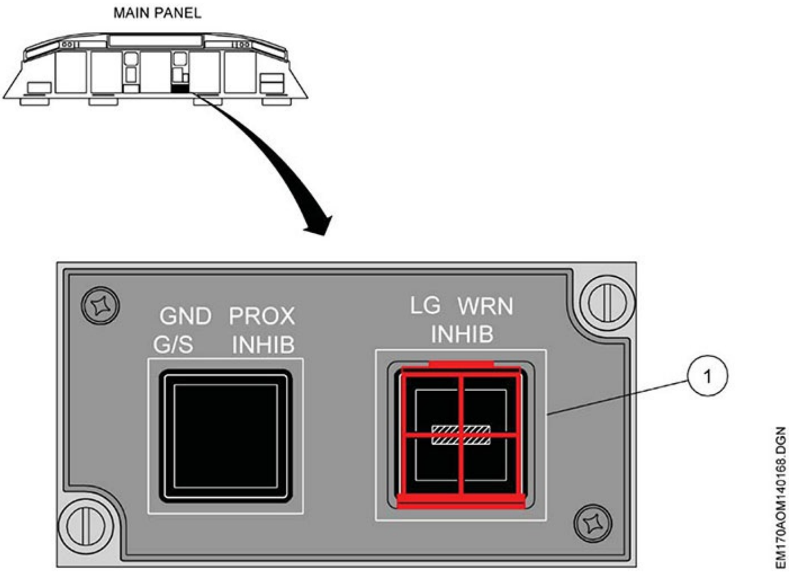
2 – ALTERNATE GEAR EXTENSION LEVER (TWO-POSITION)

- When pulled, relieves hydraulic pressure in the landing gear lines and releases all landing gear uplocks.

3 – ALTERNATE GEAR EXTENSION LEVER UNLOCK BUTTON

- When pressed, releases the handle from the actuated position.

LANDING GEAR WARNING INHIBITION BUTTON



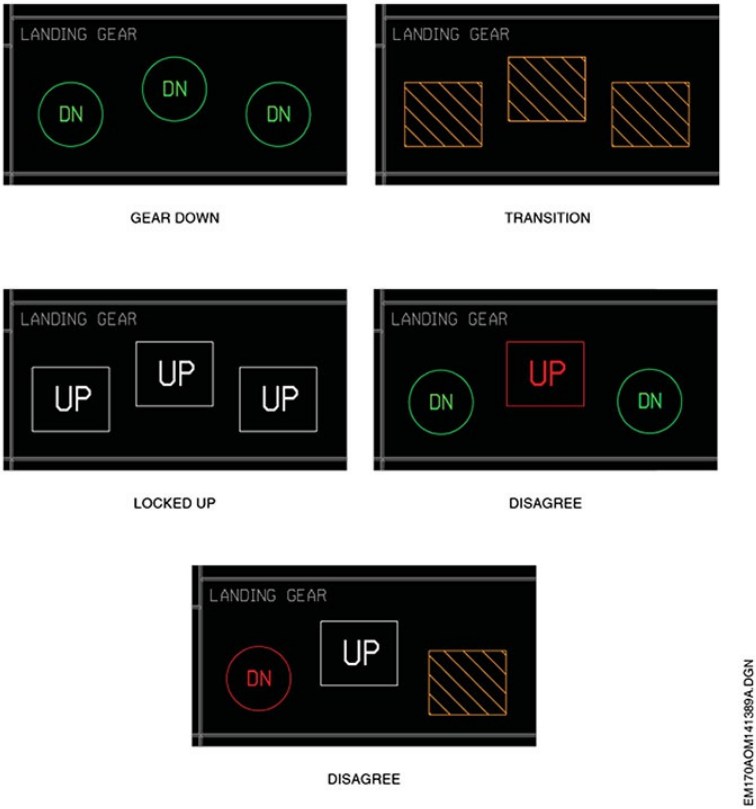
1 – LG WRN INHIB (GUARDED-MOMENTARY ACTION)

- Inhibits the landing gear aural warning in the event of dual radio altimeter failure.
- A white striped bar will illuminate when pushed.
- The white striped bar will extinguish if:
  - Thrust levers are advanced beyond 45° (E175) or 38° (E190) thrust lever angle (TLA) for two engines or;
  - Thrust levers are advanced beyond 59° (E175) or 57° (E190) TLA for one engine inoperative or;
  - The flap selector lever is set to 5 or full without any landing gear down and locked.

LANDING GEAR POSITION INDICATION

1 – LANDING GEAR POSITION INDICATION

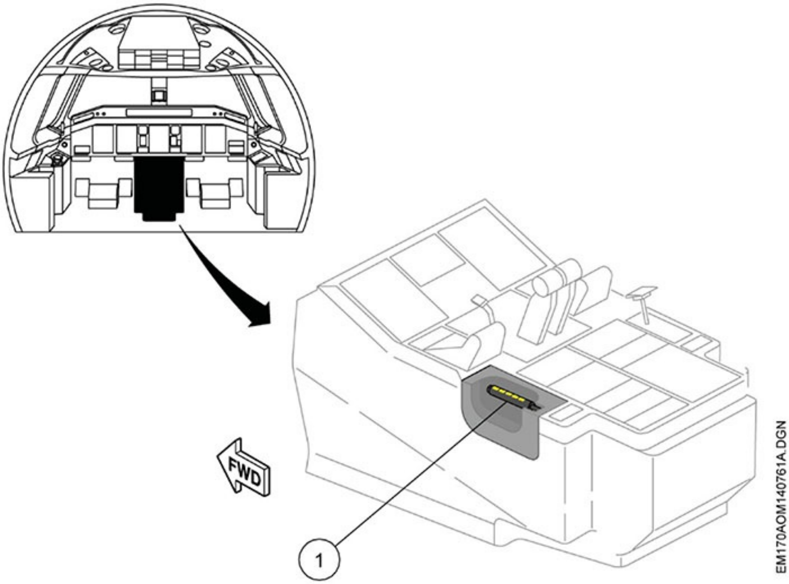
- DOWN: the green DN label inside a green circle indicates that the respective landing gear is down and locked.
- UP: the white UP label inside a white box indicates that the respective landing gear is up and locked.
- TRANSIT: the amber cross-hatched box indicates that the respective landing gear is in transit.
- DISAGREEMENT: the indication changes from its previous color to red 20 seconds after the discrepancy is detected.
  - The red cross-hatched box indicates that the respective landing gear is kept in transit and is not locked in the commanded position.
  - The red DN label inside a red circle and the red UP label inside a red box indicate a discrepancy between landing gear lever position and the respective landing gear leg position. This logic associates the red color only to the landing gear leg in disagreement.



LANDING GEAR POSITION INDICATION ON EICAS

BRAKES

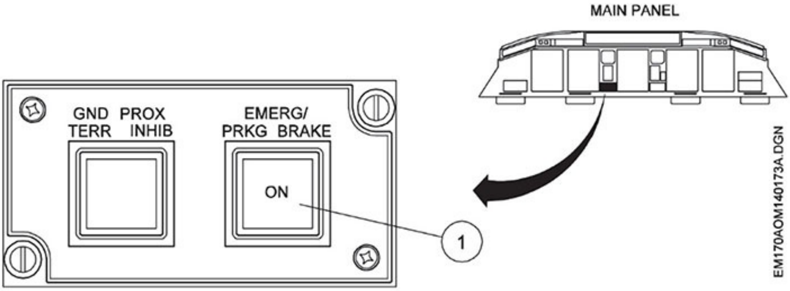
EMERGENCY PARKING BRAKE HANDLE



1 – EMERGENCY/PARKING BRAKE HANDLE

- Actuates the emergency/parking brake.
- The handle will lock when pulled up to the fully actuated position.
- To release the handle from the fully actuated position, the top button must be pressed.

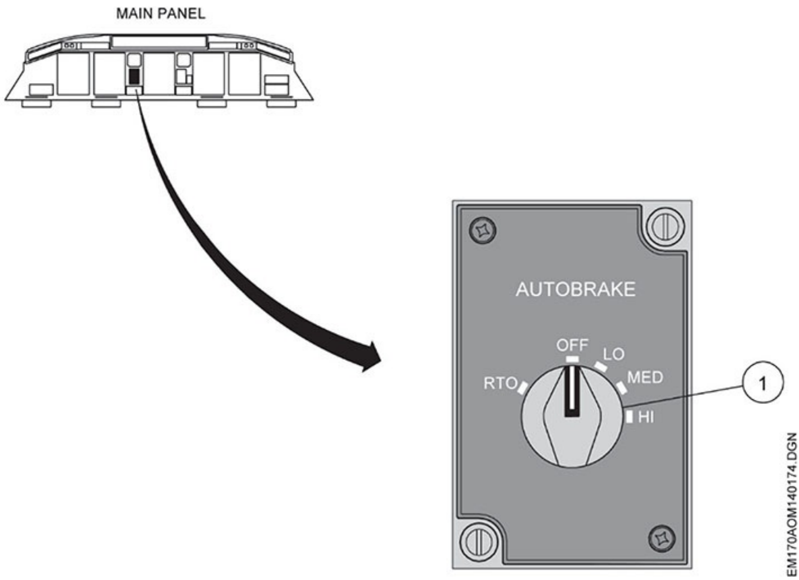
EMERGENCY PARKING BRAKE INDICATOR



1 – EMERGENCY/PARKING BRAKE INDICATOR

- ON: the indicator illuminates when the emergency/parking brake is actuated and there is hydraulic pressure on the brake line.

AUTOBRAKE SELECTION



1 – AUTOBRAKE KNOB (ROTARY ACTION)

RTO: Selects RTO deceleration rate.

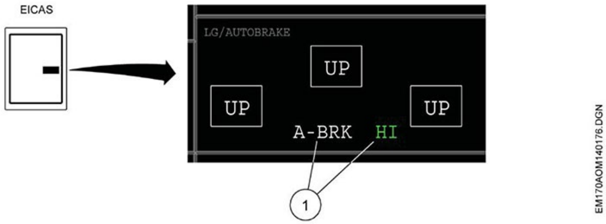
OFF: Autobrake is deactivated.

LO: Selects the low deceleration rate.

MED: Selects the medium deceleration rate.

HI: Selects the high deceleration rate.

AUTOBRAKE EICAS INDICATION

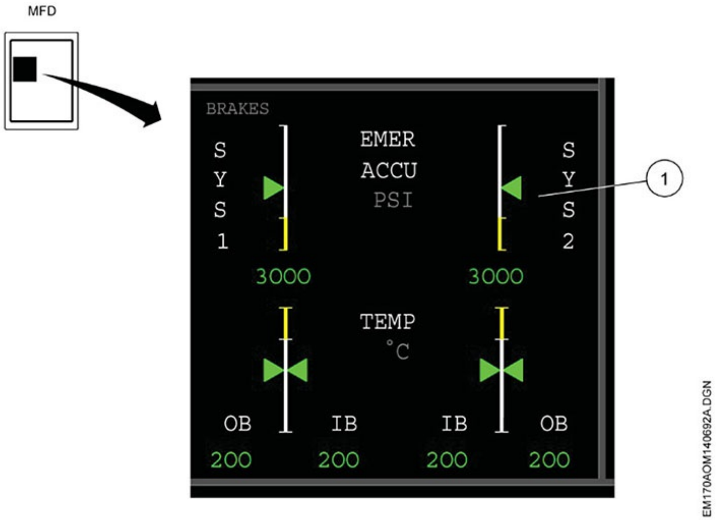


1 – AUTOBRAKE INDICATION

- A-BRK: the white A-BRK label indicates the autobrake is armed.
- RTO, HI, MED or LO: these green labels beside the A-BRK indicate the autobrake mode selected.
- AMBER DASHED: indicates that the data is invalid.

AUTOBRAKE EICAS INDICATIONS

MFD STATUS PAGE INDICATIONS



1 – EMERGENCY/PARKING BRAKE ACCUMULATOR PRESSURE INDICATION

- Digital Pressure

GREEN: normal operating range.

AMBER: emergency/parking brake effectiveness is degraded.

AMBER DASHED: invalid information or a value out of the valid range.

- Pressure Scale/Pointer
  - If the value is invalid, the pointer disappears from the display.
  - Scale:

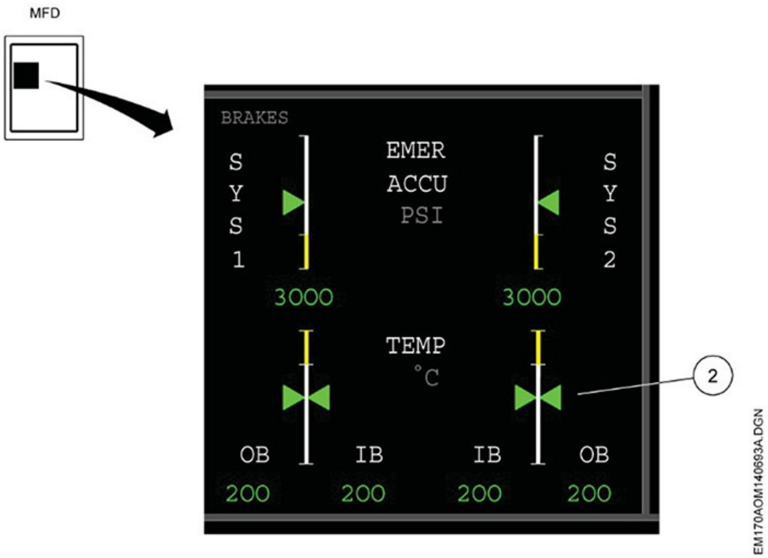
WHITE: normal operating range.

AMBER: emergency/parking brake effectiveness is degraded.

  - Pointer:

GREEN (solid): normal operating range.

AMBER (solid): emergency/parking brakes effectiveness is degraded.



2 – BRAKE TEMPERATURE INDICATION

- Digital Temperature
  - Displays brake temperature in degrees Celsius (°C).

GREEN:	normal operating range.
AMBER:	cautionary operating range (no takeoff range).
AMBER DASHED:	invalid information or a value out of the valid range.

- Temperature Scale/Pointer
  - If the value is invalid, the pointer will disappear from the display.
  - Scale:

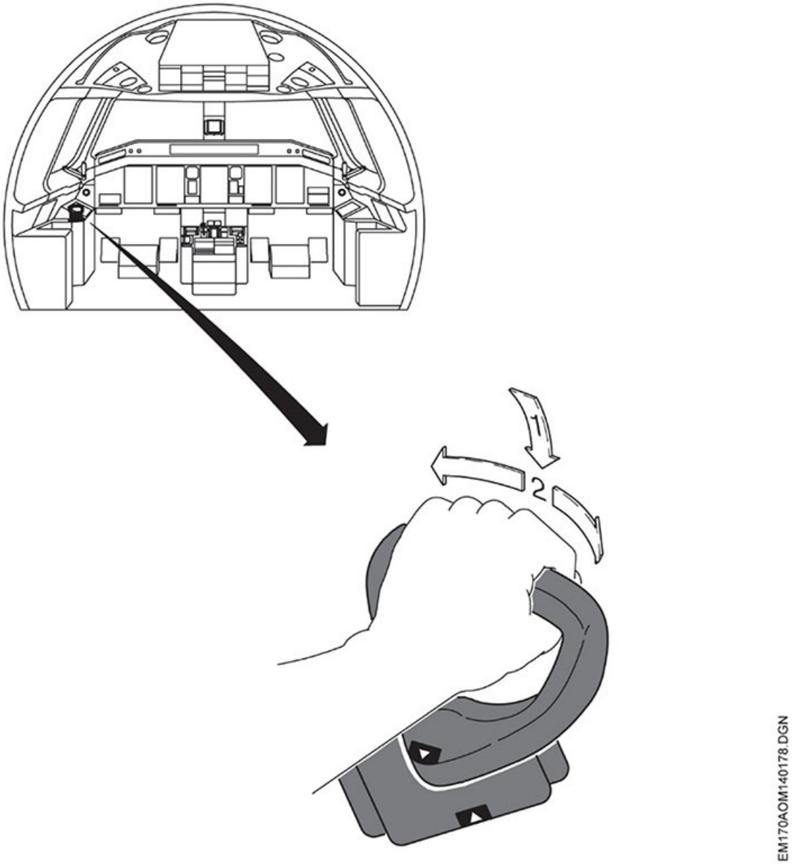
WHITE:	normal operating range.
AMBER:	cautionary operating range.

  - Pointer:

GREEN (solid):	normal operating range.
AMBER (solid):	cautionary operating range.

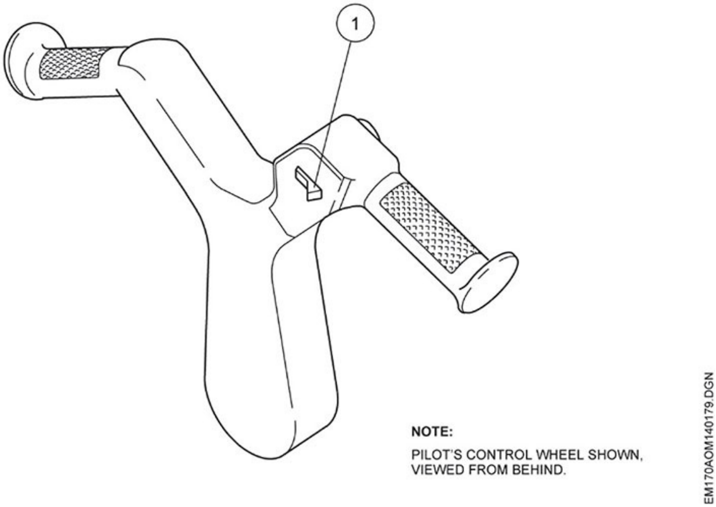
STEERING

STEERING HANDLE



- The handle must be pushed down (1) to engage the steering system. Releasing the handle will enable rudder pedals mode, keeping it pressed enables handwheel mode. Rotating the handwheel left or right (2) commands steering.

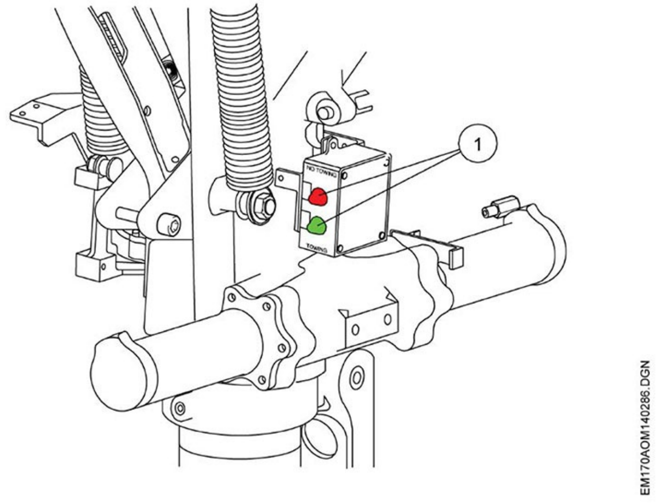
STEERING DISENGAGE SWITCH



1 - STEERING DISENGAGE SWITCH (MOMENTARY ACTION)

- Disengages the nosewheel steering system.

TOWING LIGHTS



1 – TOWING LIGHTS

- GREEN:
  - Steering disengaged through the external steering disengage switch and;
  - Parking brakes not applied and;
  - Main brakes not applied.
- RED:
  - External steering disengage switch in the engaged position or;
  - Parking brakes applied or;
  - Main brakes applied.

14.13.10 AIR/GROUND POSITIONING SYSTEM

Two proximity sensor electronic modules (PSEM) process signals from the six weight-on-wheels (WOW) proximity sensors to determine if the airplane is on ground or in flight. Two WOW sensors are installed on each landing gear.

Each PSEM monitors the six WOW proximity sensors. The inputs are logically combined by the PSEMs, and other airplane systems, to provide the overall airplane air/ground (WOW) indication to those systems.

If two WOW sensors on the same landing gear leg fail, the PSEMs will activate a logic that prevents the landing gear lever from moving up.

In this case, with the airplane on ground, the LG NO DISPATCH caution message is displayed on the EICAS. In-flight the failure is recognized through the landing gear lever stuck in the DOWN position and the EICAS message LG WOW SYS FAIL may be displayed.

14.13.12 LANDING GEAR DOORS

MAIN LANDING GEAR DOORS

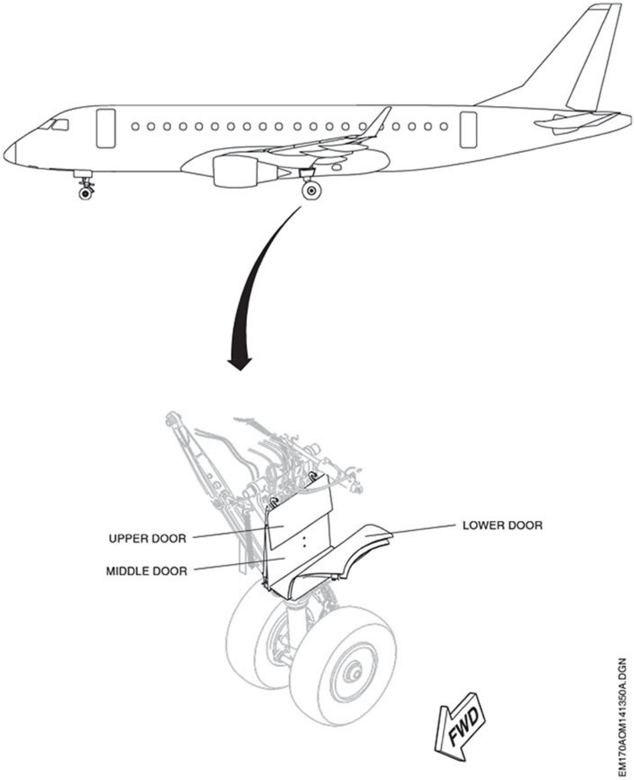
Each main landing gear (MLG) has three doors: lower, middle, and upper door.

The upper door is hinged to a rib of the MLG bay in the wing. Rods attach the upper door to the MLG main fitting.

The middle door is not hinged. It is attached by bolts directly to the MLG main fitting.

The lower door is hinged to the middle door. When the MLG extends, the lower door opens and provides clearance for the full stroke of the MLG shock absorber.

The MLG doors do not cover the wheel and tire assemblies when the MLG is fully retracted.



MAIN LANDING GEAR DOORS

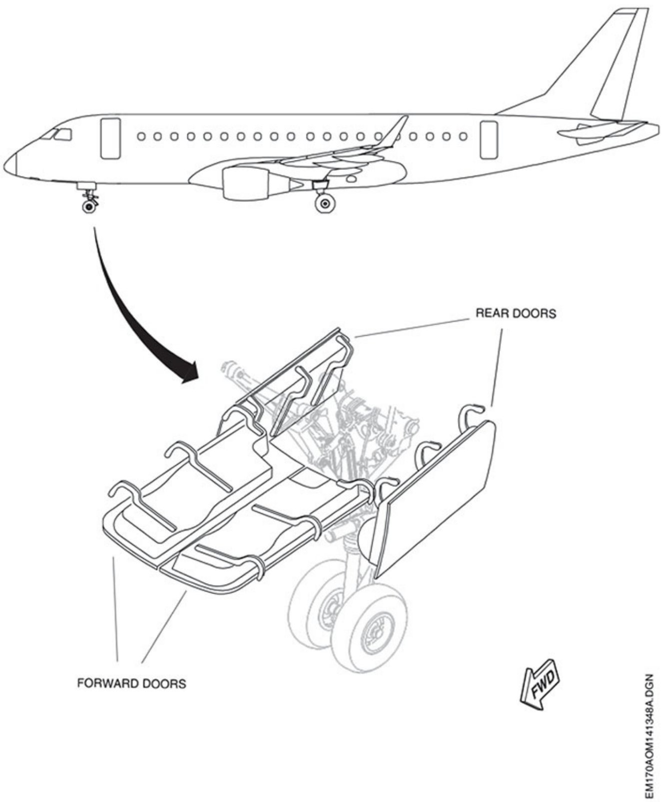
NOSE LANDING GEAR DOORS

The nose landing gear (NLG) bay has four doors: two forward doors and two rear doors. All doors are mechanically actuated by the NLG as it extends or retracts.

The rear doors are hinged to the airplane fuselage. The rear doors stay open while the NLG is extended.

The forward doors are hinged to the airplane fuselage. These doors open temporarily during NLG extension or retraction, and close after the NLG is fully extended or fully retracted.

If the NLG doors are not properly closed, the message LG NOSE DOOR OPEN is displayed in the EICAS.



NOSE LANDING GEAR DOORS

14.13.15 LANDING GEAR OPERATION

LANDING GEAR CONTROL SYSTEM

Normal operation of the landing gear is commanded through the landing gear lever located on the main instrument panel and controlled by the SPDA.

In the event of a failure of the landing gear lever, landing gear extension can be performed by the landing gear override switch located on the landing gear free fall lever compartment.

Hydraulic pressure is necessary for retraction and normal extension of the landing gear. In the event of a hydraulic pressure failure, landing gear extension is possible through the alternate landing gear lever.

The landing gear operation is monitored by the PSEM and the downlock sensors.

A landing gear aural warning alerts the crew whenever any landing gear is not down and locked and the system recognizes the intention to land.

LANDING GEAR OPERATION

LANDING GEAR RETRACTION

Positioning the landing gear lever to the UP position releases hydraulic pressure for the nose and main landing gear locks, and pressurizes the respective actuators to retract the landing gear. When retraction is completed, the landing gear is held in place by uplocks.

Whenever the PSEM computes a signal of weight on wheels (airplane on ground status) the SPDA commands the landing gear lever to lock mechanically in the DOWN position.

When the weight on wheels signal is no longer valid (airplane in-flight status) the mechanical lock is released allowing the landing gear lever to move to the UP position.

NOTE:
- If for any reason the shock absorber of any landing gear does not extend completely the PSEM keeps computing a signal of airplane on ground.
- With this condition the landing gear lever is locked down and therefore the LG WOW SYS FAIL EICAS message is displayed.
- To prevent structural damage to the airplane the landing gear must be retracted only in case of an emergency that requires climb performance improvement.

LANDING GEAR NORMAL EXTENSION

Normal landing gear extension is used when the electrical and hydraulic systems are operating normally and there is no failure in the landing gear lever control box.

Setting the landing gear lever DOWN releases hydraulic pressure for the nose and main landing gear uplocks, as well as for the retraction actuators. The landing gear doors are mechanically opened.

When extension is completed, the landing gear is locked in the fully extended position by the downlock springs.

ELECTRICAL OVERRIDE EXTENSION

When the landing gear lever control box fails the electrical override system is used to extend the landing gear.

The electrical override system bypasses the PSEM and commands gear extension in the same sequence as the normal operation.

ALTERNATE GEAR EXTENSION

If hydraulic pressure is not available for landing gear operation or the electrical system fails, landing gear extension is performed by the alternate gear extension lever.

Pulling up the alternate gear lever releases residual hydraulic pressure in the landing gear lines and opens all landing gear uplocks.

The landing gear extends in a free fall with the aid of gravitational and aerodynamic forces.

In the unlikely event that one main gear does not lock down, it may be necessary to slip the airplane using aerodynamic drag to lock the affected leg.

With the landing gear down and locked the EICAS indication displays the label DOWN.

The label will be DOWN with a red color if the landing gear lever is set to UP or in green if set to DOWN.

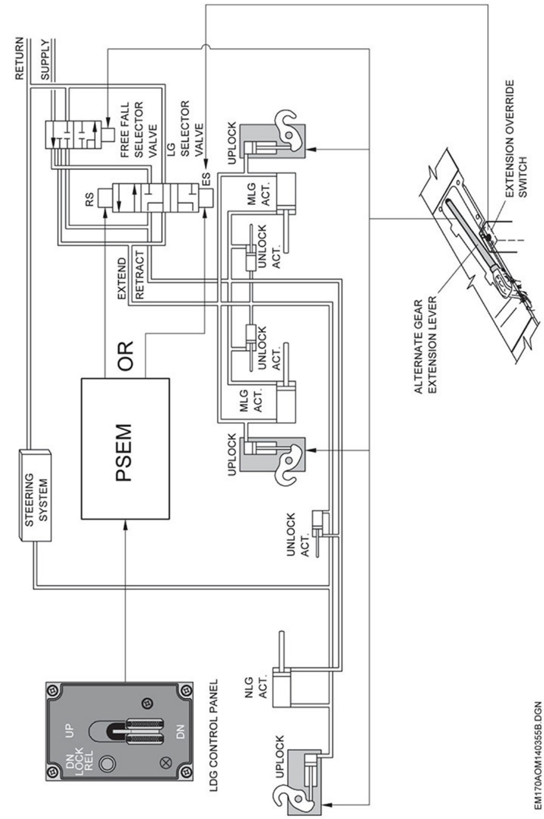
DOWN/UP LOCK SENSORS

Each landing gear has two uplock sensors and two downlock sensors.

In the event of a discrepancy between both uplock or downlock sensors of the same landing gear, the sensor in agreement with the landing gear lever position will be considered valid.

DOWNLOCK RELEASE BUTTON

The downlock release button mechanically bypasses the system protection logic. It should be used only in the event of a landing gear control lever failure or when it is necessary to clear obstacles.



LANDING GEAR OPERATION SCHEMATIC

LANDING GEAR AURAL WARNING

The landing gear aural logic uses the thrust lever angle, flap setting and radio altimeter to define the intention to land the airplane.

The aural warning “LANDING GEAR” is annunciated and cannot be silenced in the following situations:

SLAT/FLAP LEVER IN A LANDING POSITION (5 OR FULL)

Regardless of thrust lever position and radio altitude.

SLAT/FLAP LEVER IN THE 0, 1, 2, 3 OR 4 POSITION

- Radio altitude below 700 ft AGL, and
- Either thrust lever is set below 45° (E175) or 38° (E190) for two operative engines, or
- Thrust lever is set below 59° (E175) or 57° (E190) for a one-engine inoperative condition.

RADIO ALTIMETER FAIL

In the event of dual radio altimeter failure, the warning inhibition button silences the aural warning only if the SLAT/FLAP lever is in the 0, 1, 2, 3 or 4 position.

14.13.20 BRAKES

The brake system employs brake-by-wire rudder pedals located at both pilot stations. Hydraulic system 1 provides pressure to the outboard brakes and hydraulic system 2 provides pressure to the inboard brakes.

The Emergency/Parking brake has the ability to stop the airplane if a failure happens simultaneously on both hydraulic systems or if both brake control modules fail.

The brake wear can be monitored through the brake wear pins located on each main wheel.

NORMAL OPERATION

The system has two brake control modules (BCM) and one optional auto brake control module (ABM).

- BCM 1 is connected to DC ESS BUS 1 and controls the outboard brakes.
- BCM 2 is connected to DC ESS BUS 2 and controls the inboard brakes.
- ABM is connected to DC BUS 2.

During normal operation the BCM provides protection from skidding and locking of the main wheels. It also has some functions to improve the braking performance. The BCM main functions are:

- Locked wheel protection.
- Antiskid protection.
- Automatic wheel braking.
- Touchdown protection.

LOCKED WHEEL PROTECTION

Locked wheel protection is active anytime on ground and at wheel speeds above 30 kt.

The system logic compares wheel speed signals between the left and the right inboard brakes or between the left and the right outboard brakes. If a wheel speed is 33% or below its associated paired wheel speed, the brake control module commands zero pressure to the brake of the slower wheel, thus allowing speed equalization.

The tolerance between wheel speeds is provided to permit differential braking, for steering purposes.

ANTISKID PROTECTION

Anti skid protection prevents tire skidding and maximizes brake efficiency according to the runway surface.

The system controls the amount of hydraulic pressure applied to the brakes and, if necessary, reduces wheel brake pressure in order to recover wheel speed and prevent tire skidding.

For wheel speeds below 10 kt, the anti skid protection is deactivated, thus allowing the pilot to lock and pivot on a wheel for maneuvering.

Anti skid protection is not available for the emergency/parking brake system.

AUTOMATIC WHEEL BRAKING

Automatic wheel braking prevents the main landing gear from being retracted with the wheels spinning.

A dedicated device inside the nose landing gear bay stops the nose landing gear wheels from spinning.

TOUCHDOWN PROTECTION

Touchdown protection prevents the airplane from touching down with the main landing gear brakes applied.

It is deactivated:

- Three seconds after WOW has sensed the ground or;
- When wheel speed is above 50 kt.

EMERGENCY/PARKING BRAKE

The Emergency/Parking brake is operated through a handle located on the pedestal control panel and is powered by hydraulic systems 1 and 2.

The emergency/parking brake system has pressure accumulators isolated from both normal hydraulic systems. The accumulators have sufficient pressure to provide six full-brake applications.

PARKING BRAKE OPERATION

When used as a parking brake, the handle must be pulled until it locks at the upper position.

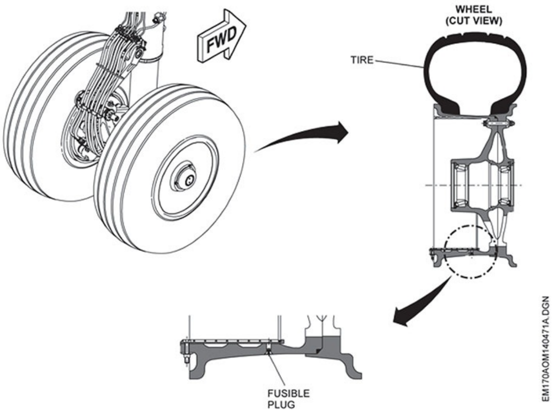
EMERGENCY BRAKE OPERATION

If both normal brakes fail the handle will actuate as an emergency brake. In this case it has to be pulled carefully and slowly as there is no anti-skid protection while braking with the Emergency/Parking brake.

At high speeds, the deflection of the emergency/parking brake handle when the brake indicating light comes ON, provides sufficient pressure to start braking. As speed decreases the required deflection increases to maintain continuous braking.

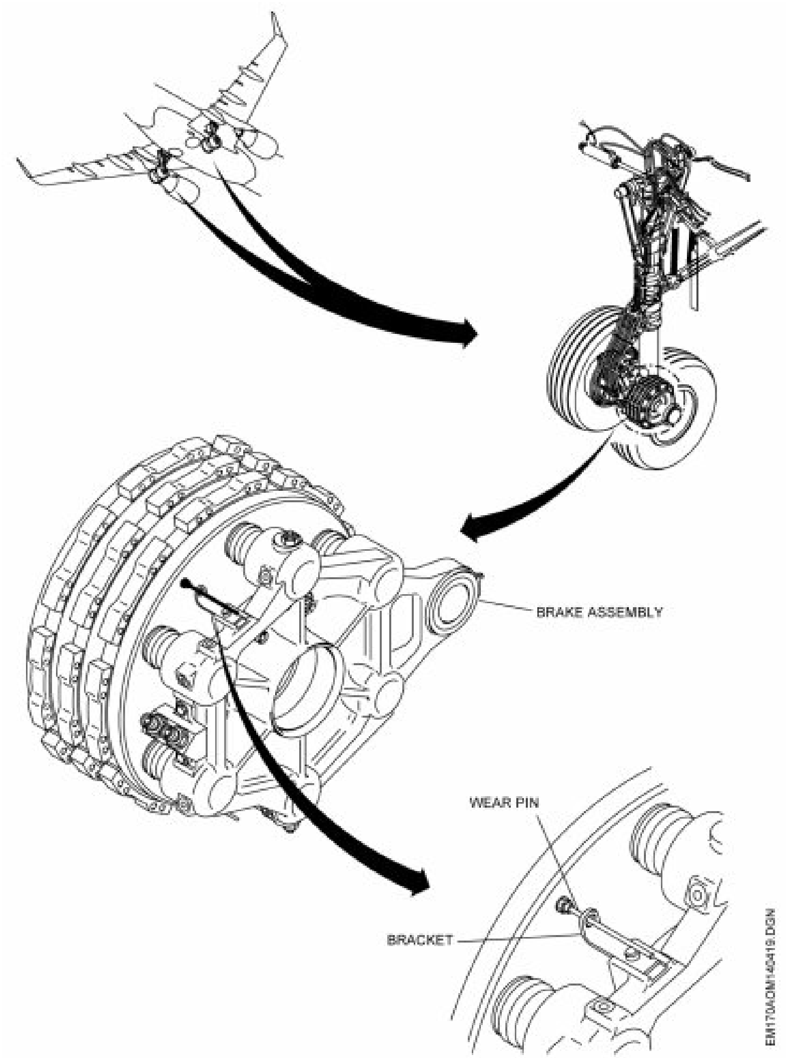
FUSIBLE PLUGS

The fusible plugs are pins attached to the wheels, which melt relieving tire pressure in case of tire overheat.



BRAKE WEAR PINS

Brake Wear Pins indicate that brakes are worn-out and when the pins are flush with Brake Bracket Outer Face assembly, the brakes need replacement.



AUTOBRAKE

The autobrake system provides automatic braking at maximum deceleration rates, which may vary according to runway conditions, for landings and rejected takeoffs. The system modulates hydraulic pressure to the brakes in order to provide a constant deceleration rate corresponding to the level selected. If reverse thrust is actuated, the autobrake system will modulate the brake pressure to maintain the deceleration rate constant.

The autobrake system can only be armed if the normal brake system is operational. Anti skid, touchdown and locked wheel protections are provided during autobrake operation.

Four autobrake levels of deceleration (RTO, LO, MED, HI) are available via a selector knob on the cockpit main instrument panel.

There are two modes of autobrake control:

- Landing mode (LO, MED, HI).
- Rejected take-off mode (RTO).

NOTE: RTO is the selected takeoff mode with the maximum deceleration rate. This deceleration is equivalent to the maximum manual braking.

AUTOBRAKE LANDING AND RTO MODE

Autobrake will be armed if the following conditions are met:

	LANDING MODE	REJECTED TAKEOFF MODE
Selector Knob Position	LO, MED or HI	RTO
WOW Indication	In flight	On the ground
Wheel Speed	Below 60 knots	
Brake Control System	No faults	
Brake Pedal Position	Not pressed	Any
Thrust Levers Position	Any	Idle or REV

Autobrake will be applied if the following conditions are met:

	LANDING MODE	REJECTED TAKEOFF MODE
Condition	ARMED	
Selector Knob Position	LO, MED or HI	RTO
WOW Indication (MLG)	On the ground	
Wheel Speed	Above 60 knots	
Brake Control System	No faults	
Brake Pedal Position	Not pressed	
Thrust Levers Position	Idle or REV	

NOTE: For landing mode, the main landing gear WOW must indicate the airplane is on ground for more than 2 seconds to allow autobrake application.

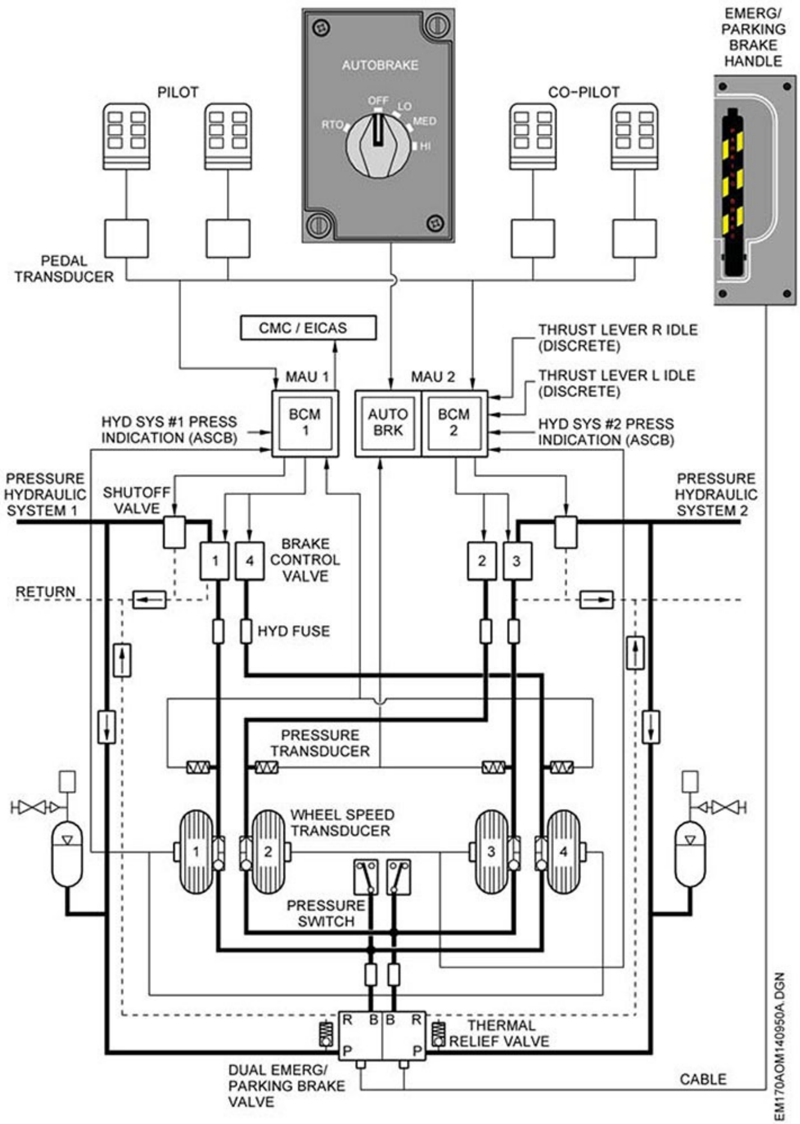
Landing and RTO modes will be disarmed if one of the following conditions occurs:

- The selector switch is set to the OFF position.
- Pedal braking is applied (while wheel speed is above 60 knots if RTO is selected).
- Brake control system failure is detected (while wheel speed is below 60 knots if RTO is selected).
- Either thrust lever is advanced beyond idle during autobrake application.

Autobrake will be disarmed if the following conditions are met:

	LANDING MODE	REJECTED TAKEOFF MODE
Selector Knob Position	OFF or RTO	OFF, LO, MED or HI
WOW Indication	-	In flight
Brake Control System	Faults detected	Faults detected below 60 knots of Wheel Speed
Brake Pedal Position	Pressed (more than 20%)	Pressed while Autobrake is being applied
Thrust Levers Position	Above Idle while Autobrake is being applied	

The aural message “AUTOBRAKE” is activated when “armed” condition (LO, MED, HI or RTO) is changed to “disarmed” by autobrake module (ABM) or brake control module (BCM) failure during parking, taxiing, takeoff roll or landing.



BRAKE SYSTEM SCHEMATIC

14.13.25 NOSEWHEEL STEERING SYSTEM

The airplane nose landing gear has steer-by-wire control powered by hydraulic system 2 and electronically controlled by the Nosewheel Steering Control Module.

OPERATION

To engage the nose wheel steering system:

- The hydraulic system 2 needs to be pressurized.
- The external steering disengage switch must be in the engaged position.
- The handwheel steering must be pressed and released for rudder pedal steering or kept pressed for handwheel steering.

NOTE: After a power up, the first steering engagement must be performed with the airplane stopped. If this condition is not met, the hardover test might not be successfully accomplished by the system and STEER FAIL message may be displayed.

The nose wheel steering has three modes of operation: the handwheel steering mode, the rudder pedal steering mode and the free wheel steering mode.

HANDWHEEL STEERING MODE

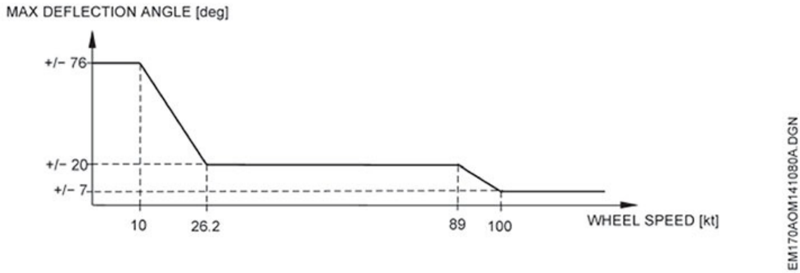
The handwheel steering mode is used for low speed control and whenever a wider turn angle is required.

OPERATION

To operate in handwheel steering mode the handwheel steering must be kept pressed.

The steering handwheel command is limited to a maximum steering angle of + 76° up to 10 kt. Over around 26 kt the maximum steering deflection is 20°. Over 100 kt the maximum deflection is + 7°.

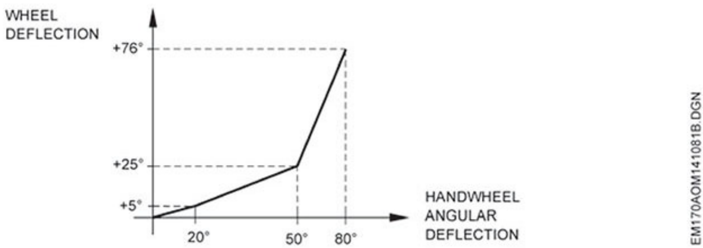
Upon releasing the handwheel steering, the system reverts to rudder pedal steering mode.



MAXIMUM STEERING ANGLE

The wheel deflection as function of the handwheel angular deflection is not linear.

The functional characteristic of the steering handwheel angle is divided into separated linear parts with different gradients.



HANDWHEEL GAIN

RUDDER PEDAL STEERING MODE

The rudder pedal steering mode is designed to be used on high speed operations on ground or whenever a wider angle turn is not required.

OPERATION

Rudder pedal steering is active on ground any time the STEER OFF message is not displayed on EICAS. If in handwheel steering mode, the handwheel steering must be pressed and released to activate rudder pedal steering mode.

The maximum steering angle of the rudder pedal is +/- 7°.

FREE WHEEL STEERING MODE

The free wheel steering mode is mostly used for towing or when the normal steering system fails.

OPERATION

The steering system can be disengaged reverting to free wheel by means of:

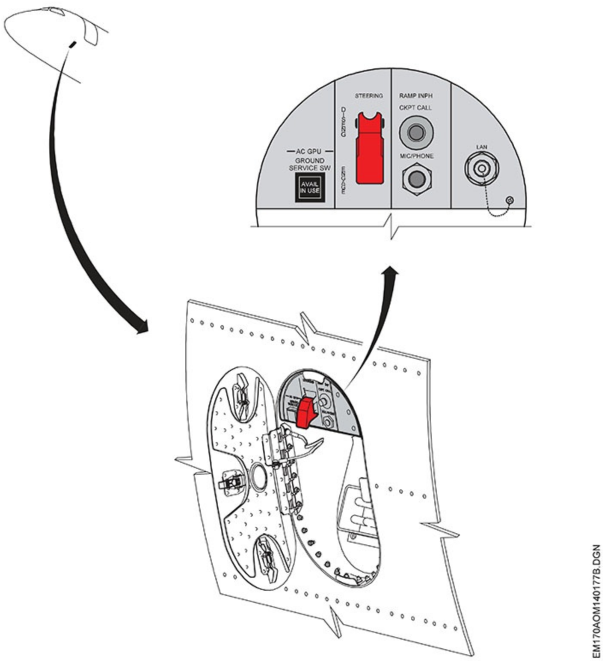
- The steering disengage button located on both control wheels.
- The external steering disengage switch located on the external power connection access.

In the free wheel mode, the airplane steering can be carried out by use of rudder, differential brake and/or asymmetrical thrust.

During taxi, smooth radius turns must be performed.

The free wheel mode is automatically selected when:

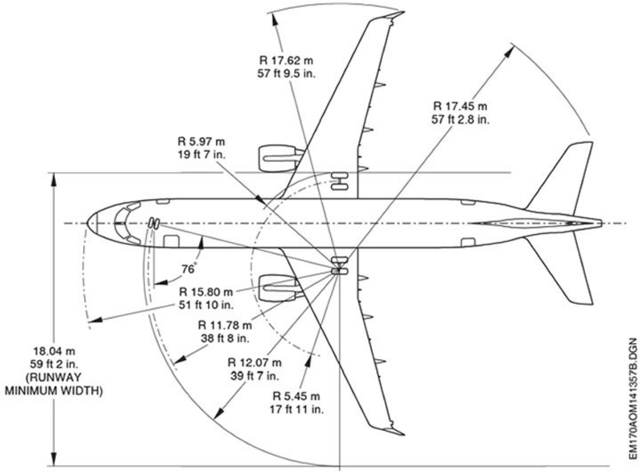
- Failure of the Air/Ground signal occurs.
- Nose wheel angle is greater than 76°.
- Nose wheel steering system failure is detected.



EXTERNAL STEERING DISENGAGEMENT SWITCH

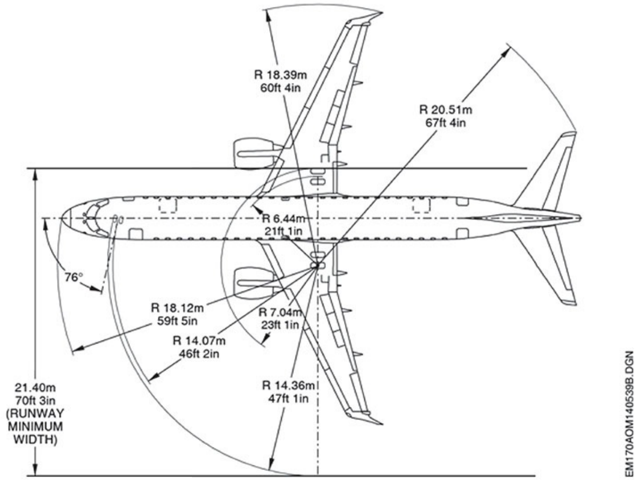
MINIMUM TURNING RADII

E175:



MINIMUM TURN RADII

E190:



MINIMUM TURN RADII

14.13.30 EICAS MESSAGES

TYPE	MESSAGE	MEANING
WARNING	LG LEVER DISAG	A discrepancy between the position of the landing gear control lever and at least one landing gear is detected.
CAUTION	AUTOBRAKE FAIL	Autobrake function is no longer available.
	BRK OVERHEAT	Brake temperature has exceeded the cautionary operating range (amber).
	BRK LH (RH) FAIL	Loss of both wheel brakes (inboard and outboard) of either the left or right landing gear.
	EMER BRK FAIL	Both brake accumulator pressures are low and low pressure of hydraulic systems 1 and 2 is detected.
	LG NO DISPATCH	Landing gear dispatch- ability is affected.
	LG NOSE DOOR OPEN	Nose landing gear is locked up and nose landing gear door is open.
	LG WOW SYS FAIL	Indicates a failure condition in the WOW indication system.
	PRKG BRK NOT RELEASED	Parking brake not fully released.
	STEER FAIL	Indicates a steering system failure condition when the landing gear is down.
ADVISORY	BRK CONTROL FAULT	Comprehends different brake control failures, which may result or not in an airplane performance degradation. In the worst case scenario, failure leads to a minor (less than 10%) braking performance degradation and no penalty on landing distance is expected.
	BRK LH (RH) FAULT	Loss of one wheel brake (inboard or outboard) of either the left or right landing gear.
	BRK PEDL LH (RH) SEAT FAIL	One pedal of the left or right hand seat has failed.
	EMER BRK FAULT	Pressure on one brake accumulator is low or the inboard and outboard park brake pressures are in disagreement.
	LG TEMP EXCEEDANCE	Indicates non-dispatch condition related to the landing gear after a brake overheat.
	STEER FAULT	Steering system is degraded.
STATUS	STEER OFF	Steering is disconnected.

14.14.01 GENERAL DESCRIPTION

The oxygen system provides supplemental oxygen to the flight crew and passengers when a lack of oxygen supply occurs on board.

The airplane oxygen system is comprised of two systems and other oxygen devices.

Oxygen system parameters and indications are displayed on both MFD synoptic pages. System messages are displayed on EICAS displays.

FLIGHT CREW OXYGEN SYSTEM

This system provides supplemental oxygen stored in a rechargeable cylinder and also provides protection to the flight crew in event of smoke and other harmful gases.

PASSENGER OXYGEN SYSTEM

This system provides only supplemental chemically generated oxygen to passengers and flight attendants.

PROTECTIVE BREATHING EQUIPMENT (PBE)

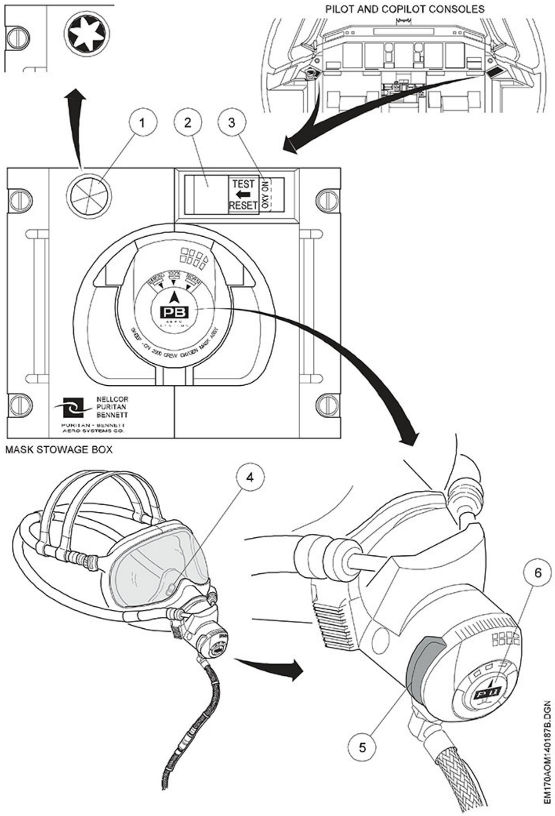
The PBE provides the crew with positive pressure oxygen for respiratory and visual protection against the effects of smoke and other harmful gases.

PORTABLE OXYGEN CYLINDERS

Portable oxygen cylinders are located throughout the airplane for use by the flight attendants to assist passengers in case of sudden decompression or first aid purposes.

14.14.05 CONTROLS AND INDICATIONS

MASK STOWAGE BOX AND CREW MASK



1 – FLOW INDICATOR

- A bright yellow star when visible indicates that oxygen is flowing.

2 – TEST/RESET BUTTON (SPRING LOADED)

- Pressing this button with the mask stowed tests the oxygen mask and activates the microphone. The flow indicator star momentarily blinks and oxygen flow will be audible through audio system.
- Pressing this button with the mask not stowed and the mask box door closed shuts off the oxygen flow, turns off mask’s microphone and returns the communication from the cockpit speakers to the headsets.

3 – OXY ON FLAG

- This flag appears whenever oxygen is supplied to the mask.

4 – PURGE VALVE

- This valve allows oxygen flow into the face seal, purging any smoke and fumes.
- This valve automatically opens when the oxygen supply control knob is rotated to the emergency mode position.

5 – HARNESS INFLATION CONTROL VALVE

- Pressing this valve inflates the harness so that the mask may be donned. Releasing the button deflates the harness securing the mask in place.

6 – OXYGEN SUPPLY CONTROL KNOB (ROTARY ACTION)

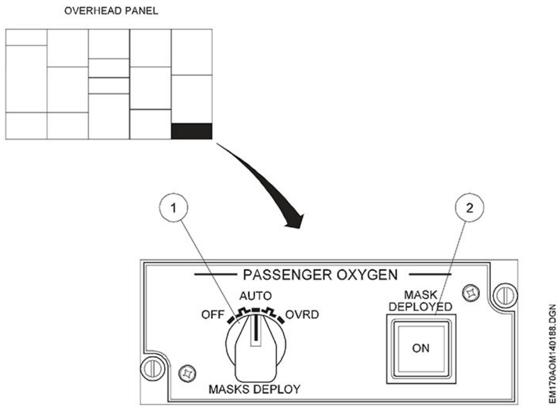
- Rotating the knob selects the mode of oxygen supply.

EMERG: supplies pure oxygen under positive pressure

100%: supplies pure oxygen at all cabin altitudes.

NORM: supplies an oxygen/air mixture on demand (the ratio depends on cabin altitude).

OXYGEN PANEL



1 – MASKS DEPLOY SELECTOR (ROTARY ACTION)

OFF: disables automatic deployment of passenger oxygen masks.

AUTO: enables automatic deployment of passenger oxygen masks when cabin pressure altitude is above 14000 ft .

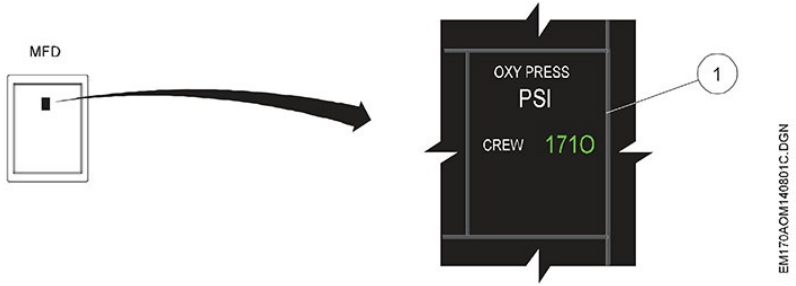
OVRD: deploys the passenger oxygen masks regardless of cabin altitude.

2 – MASK DEPLOYED INDICATOR

- An ON light illuminates, indicating that the passenger and flight attendant oxygen masks have been deployed.

SYNOPTIC PAGE ON MFD

The status synoptic page provides digital oxygen pressure indication.

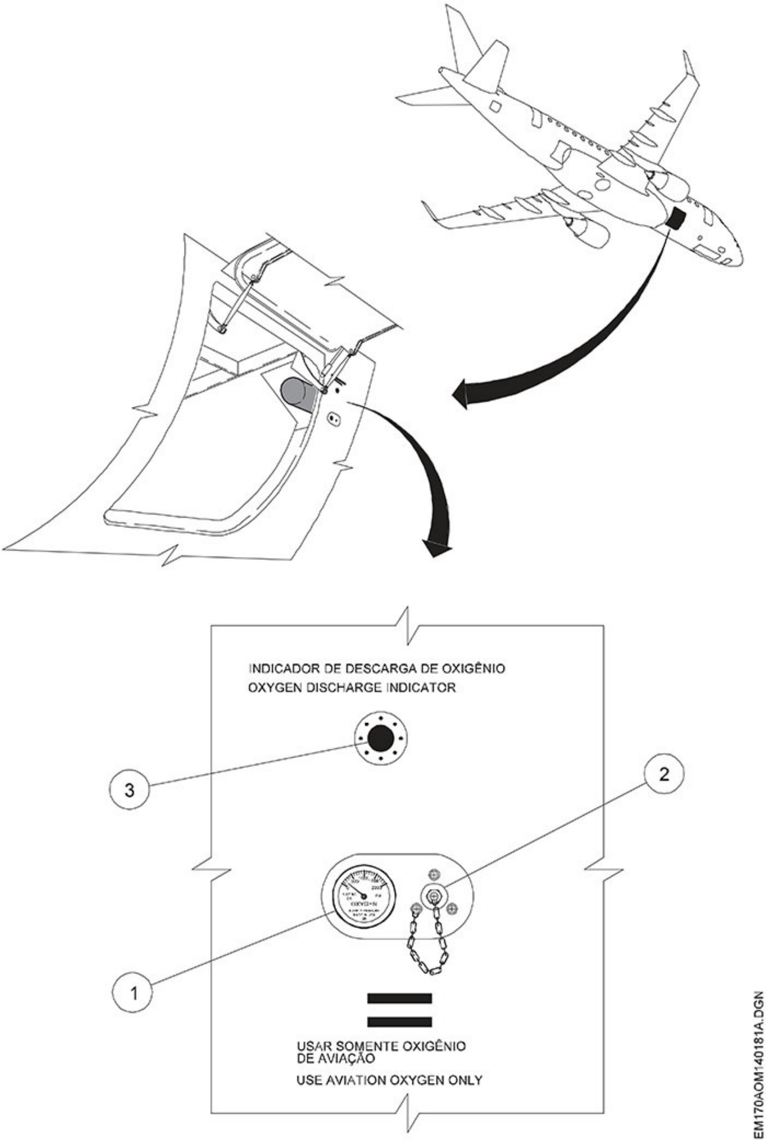


A difference in pressure indication between the MFD and the oxygen pressure gauge outside the airplane may be observed. The difference occurs due to a temperature correction in the MFD that does not occur on the oxygen pressure gauge.

1 – COCKPIT OXYGEN PRESSURE INDICATION

GREEN:	normal operating range (minimum for three crew members in the cockpit).
CYAN:	advisory operating range (minimum for two crew members in the cockpit).
AMBER:	cautionary operating range (no dispatch).
AMBER DASHED:	invalid information or a value out of the valid range.

OXYGEN CYLINDER AND REFILL POINT LOCATION



1 – OXYGEN PRESSURE GAUGE

- Displays the cylinder static pressure.

2 – OXYGEN RECHARGE VALVE

- The valve is used to recharge the cylinder by maintenance personnel

3 – DISCHARGE INDICATOR DISC

GREEN: normal operating range.

- The green oxygen cylinder pressure relief disc blows out in the event of an overpressure.

14.14.10 FLIGHT CREW OXYGEN SYSTEM

GENERAL

Flight crew oxygen is provided via a conventional, high-pressure, gaseous-type system in which the oxygen is stored in a rechargeable cylinder.

OXYGEN CYLINDER

Oxygen is stored in a 77 ft³ cylinder, pressurized up to 1850 psi at 21°C (70°F).

The cylinder is installed in the forward cargo compartment and does not need to be removed to recharge.

After loss of cabin pressure, sufficient oxygen is provided for all cockpit members to permit emergency descent from 41000 ft to 10000 ft in 22 min with mask regulator in 100% mode and continuing cruise at 10000 ft for 98 min with mask regulator in NORMAL mode.

FLIGHT CREW FULL-FACE MASKS

Flight crew and observer full-face, quick donning masks and regulators are stowed in oxygen mask storage boxes near each seat. The masks provide supplemental oxygen and protection from smoke and other harmful gases.

FLIGHT CREW FULL-FACE MASKS TEST

The masks are tested utilizing the TEST/RESET button. With the mask stowed and the regulator knob set to 100%, pressing and holding the TEST/RESET button will cause a short blink of flow indicator and an oxygen flow sound will be audible in the speakers. On the radio panel, the SPKR Indicator will illuminate. Once the mask fully pressurizes the indicator must go out showing the system is leak free. Releasing the TEST/RESET button will terminate the test.

FLIGHT CREW FULL-FACE MASKS OPERATION

Opening the stowage box’s mask automatically initiates the oxygen flow. Pressing the harness inflation control valve will inflate the harness, enabling its quick donning. Releasing the button will deflate the harness, firmly fitting it to the head. The mask is designed to be donned within 5 seconds. The oxygen will flow until the stowage box’s doors are closed.

FLIGHT CREW FULL-FACE MASKS COMMUNICATION

The mask is also connected to the communications system.

When the oxygen mask stowage box door is opened the mask's microphone is automatically activated and the headset boom microphone is deactivated.

The speakers are also automatically activated and the communication reception is possible through the speakers or the headsets.

When the oxygen mask stowage box is closed and the TEST/RESET switch is pressed the headset boom microphone is restored and the mask's microphone is turned off.

FULL FACE MASK OPERATING MODES

Normal: Normal Mode provides supplemental oxygen diluted with cabin air according to the cabin pressure altitude until a preset point where the user inhales 100% oxygen. This feature is to conserve the amount of oxygen consumed from the supply source while still maintaining protective physiological levels.

100%: 100% Mode provides non-diluted oxygen to the crew regardless of cabin altitude.

Emergency: The "EMER" setting provides non-diluted oxygen regardless of cabin altitude, with a slightly positive pressure. This setting should be used to eliminate condensation or to purge smoke and toxic fumes that may get into the mask.

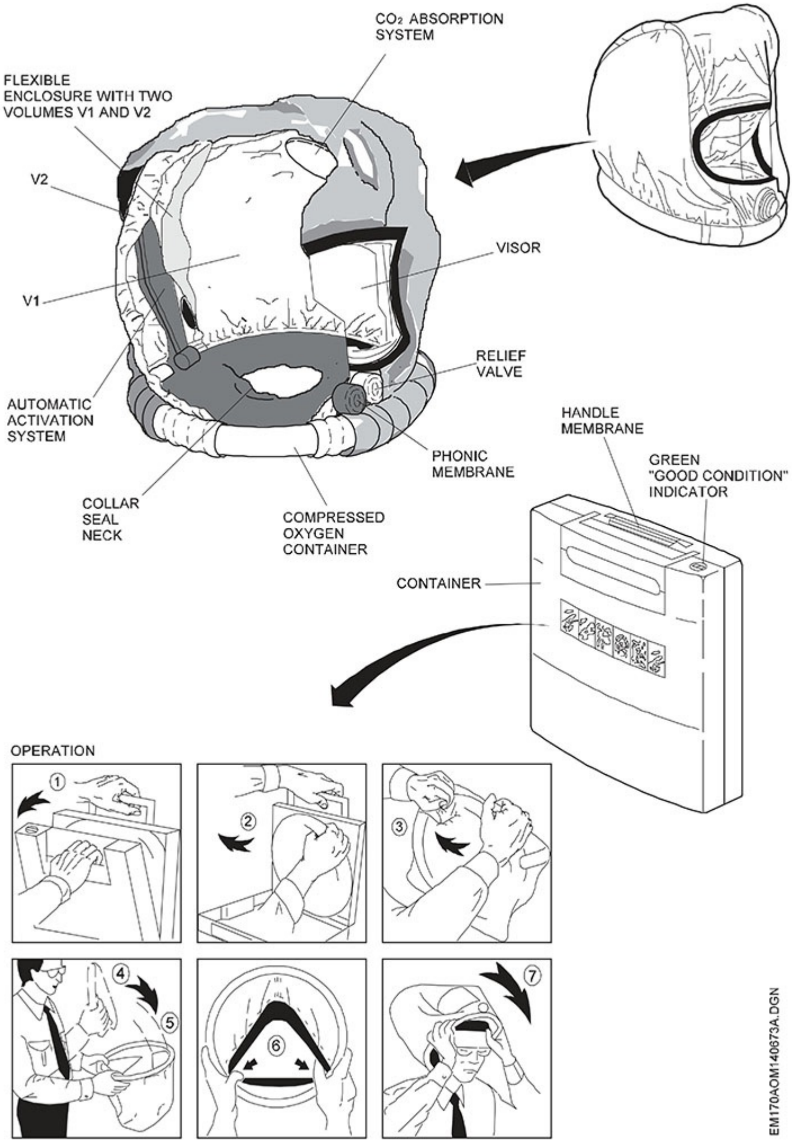
When the mask is on emergency mode, the air pressure and flow make communication more difficult. To avoid communication disruption it is recommended not to use the EMER setting continuously, selecting the mode back to 100% or Normal after the mask is clear of smoke, fumes or condensation.

PROTECTIVE BREATHING EQUIPMENT (PBE)

The PBE unit is for emergency use only. It is vacuum-sealed in a small bag inside a box. The box is equipped with a green "good condition indicator".

The equipment hood isolates the user's head from the external ambient gases by means of an elastic neck seal. Oxygen flow starts automatically after hood donning and will be supplied for at least 15 min.

The PBE unit provides the crew with positive pressure oxygen for respiratory and visual protection against the effects of smoke and other harmful gases at altitudes up to 25000 ft.



PROTECTIVE BREATHING EQUIPMENT

14.14.15 PASSENGER OXYGEN

PASSENGER OXYGEN SYSTEM

Individual chemical oxygen generators supply the passenger oxygen system during an emergency descent in the event of cabin depressurization. The passenger oxygen system provides supplemental oxygen only to the following: passenger service units (PSU), flight attendant stations, lavatories, and galley areas.

PASSENGER OXYGEN MASKS

Passenger oxygen masks are located in the PSUs above the passenger seats.

Each PSU contains either two or three masks that supply oxygen only for approximately 12 min (standard), 14 min (optional) or 22 min (optional).

The masks do not provide smoke protection and once the system starts supplying oxygen, they cannot be shut off.

OXYGEN SUPPLY

To provide the required oxygen level for the user, the mask combines the available ambient air with the air supplied by the supplemental generator. The supplemental generator supplies oxygen according with the scheduled altitude defined on the airplane emergency descent profile.

PASSENGER OXYGEN SYSTEM OPERATION

Passenger oxygen mask can be automatically or manually deployed.

PASSENGER OXYGEN MASKS AUTOMATIC DEPLOYMENT

The masks are automatically deployed when the cabin altitude is between 14000 ft to 14750 ft.

PASSENGER OXYGEN MASKS MANUAL DEPLOYMENT

Manual deployment can be performed from the cockpit by positioning the passenger oxygen selector knob to the OVRD position. A manual release tool located near each flight attendant station can be used in case dispensing unit door fails.

The flight crew monitors the passenger oxygen mask deployment status through EICAS messages and an indicator light on the overhead panel.

PASSENGER MASKS DEPLOY INDICATION

The ON light on the overhead OXYGEN PANEL illuminates indicating that the passenger mask doors are commanded open.

PASSENGER SIGNS AUTOMATION

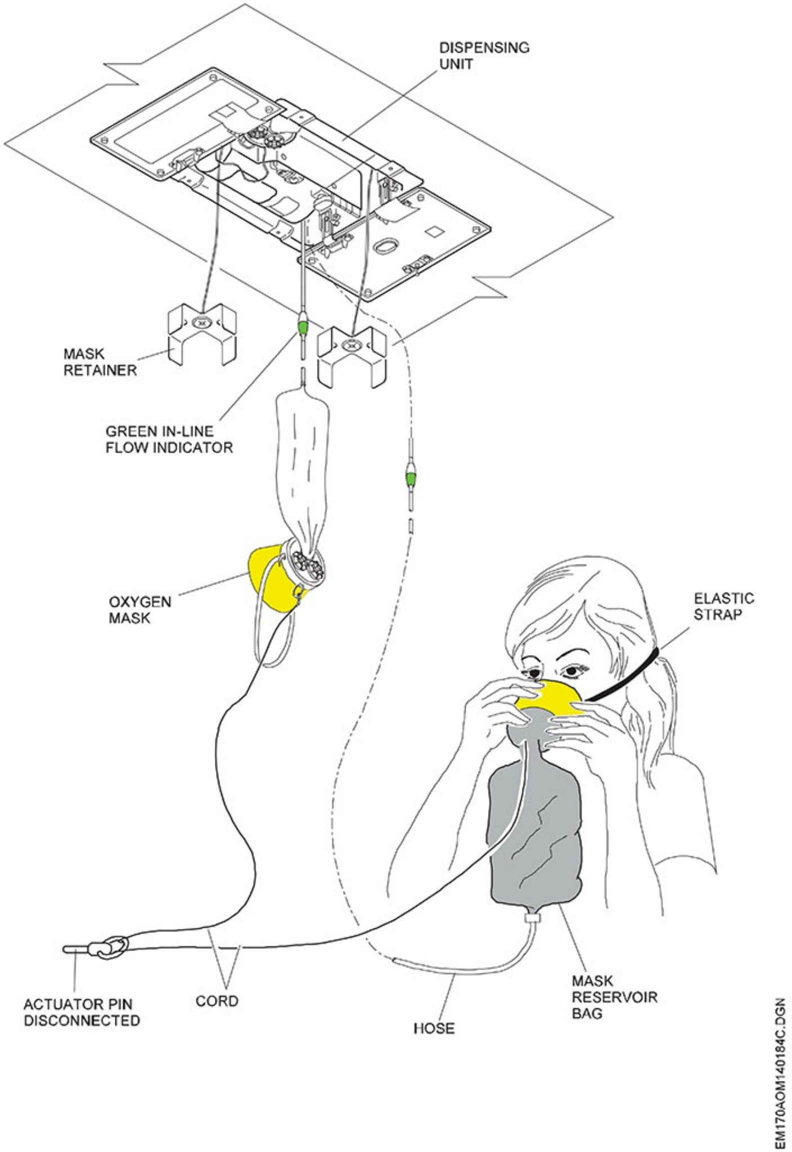
When the passenger mask doors are automatic or manual commanded open the system automatically turns ON the FASTEN SEAT BELT and the NO SMOKING (NO ELEC DEVICE optional) regardless of the switch position.

The switch normal operation is inhibited until the MASKS DEPLOY switch is set to OFF position.

PASSENGER MASKS USAGE

The oxygen masks are held in a mask retainer. The yellow mask must be pulled out of the retainer. Oxygen flows throughout all masks in the dispensing unit whenever any yellow mask hanging from the dispensing unit is pulled downward.

A green, in-line flow indicator is visible in the transparent oxygen hose whenever oxygen is flowing to the masks.



DISPENSING UNITS/PASSENGER MASKS

PORTABLE OXYGEN CYLINDER

The portable oxygen cylinders are for flight attendants use to assist passengers in case of sudden cabin decompression or for first aid purposes.

The cylinders store 200 liters of oxygen.

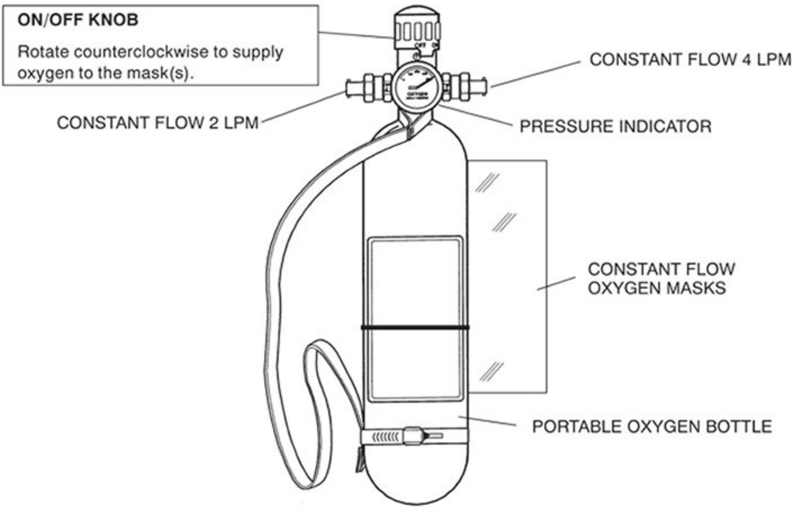
PORTABLE OXYGEN CYLINDER COMPONENTS

The cylinders are fitted with a pressure gauge, a pressure regulator and an ON/OFF valve.

A high-pressure frangible safety disk ruptures within a cylinder pressure of 2700 psi to 3000 psi.

PORTABLE OXYGEN CYLINDER USE

Two continuous flow outlets are available; one regulates flow at 2 liters per minute for walk-around use and the second provides flow at 4 liters per minute for first aid use.



PORTABLE OXYGEN CYLINDER

14.14.20 EICAS MESSAGES

TYPE	MESSAGE	MEANING
CAUTION	CREW OXY LO PRESS	Oxygen cylinder pressure is below minimum safety limits, or pressure sensor has failed.
	PAX OXY NOT DEPLOYED	Masks are not deployed after an automatic or manual command.
ADVISORY	PAX OXY SW NOT AUTO	Passenger oxygen selector is set to the OFF position.
	OBSERVER OXY LO PRESS	Oxygen cylinder pressure is below minimum safety limits for 3 crew members, or the pressure sensor has failed.

14.15.01 GENERAL DESCRIPTION

The airplane is provided with a variety of warnings to notify crew on systems status, malfunctions, and abnormal airplane configurations.

Alarm lights provide indication of a system status. An Engine Indication and Crew Alerting System (EICAS) provides the flight crew with a four-level alert messaging system. A fifth level is provided for maintenance purposes only.

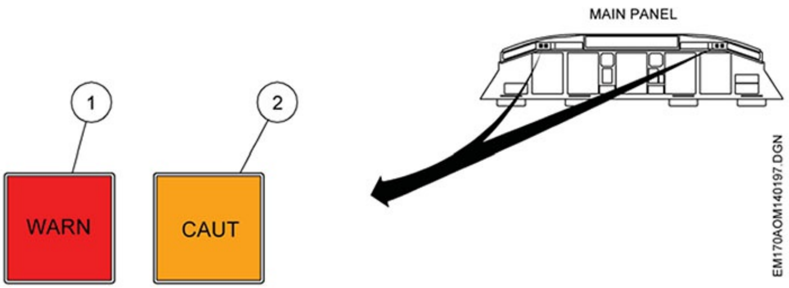
Besides the five displays in the main panel, two displays are provided through the Multi-function Control Display Unit (MCDU). Some of the more critical messages also generate an aural warning.

Sensitive warning is available through the Stall Protection System (SPS), which shakes the control column if an impending stall is verified.

To aid navigation and approach procedures, an Enhanced Ground Proximity Warning System (EGPWS), Traffic and Collision Avoidance System (TCAS), and a Windshear Detection and Escape Guidance System are also provided.

14.15.05 CONTROLS AND INDICATIONS

MASTER WARNING AND CAUTION LIGHTS/BUTTONS



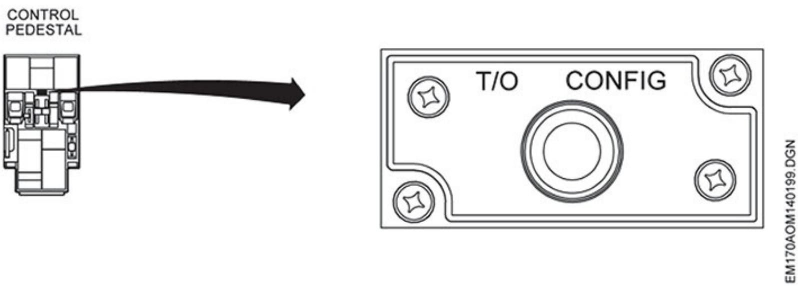
1 – MASTER WARNING BUTTON

- A red light blinks inside the button when a new warning message is displayed on the EICAS.
- Acknowledges the warning messages and extinguishes the associated blinking.

2 – MASTER CAUTION BUTTON

- An amber light blinks inside the button when a new caution message is displayed on the EICAS.
- Acknowledges the caution messages and extinguishes the associated blinking.

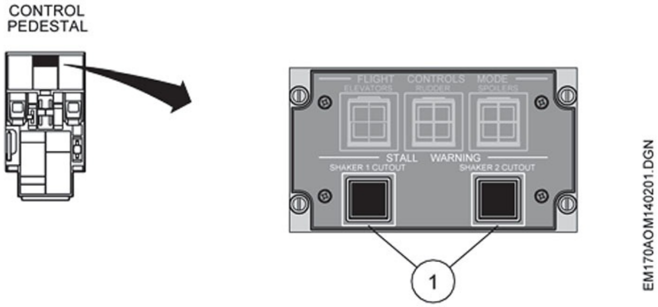
TAKEOFF CONFIG BUTTON



1 – TAKEOFF CONFIGURATION (T/O CONFIG) BUTTON

- Checks the takeoff configuration.

STALL WARNING PANEL

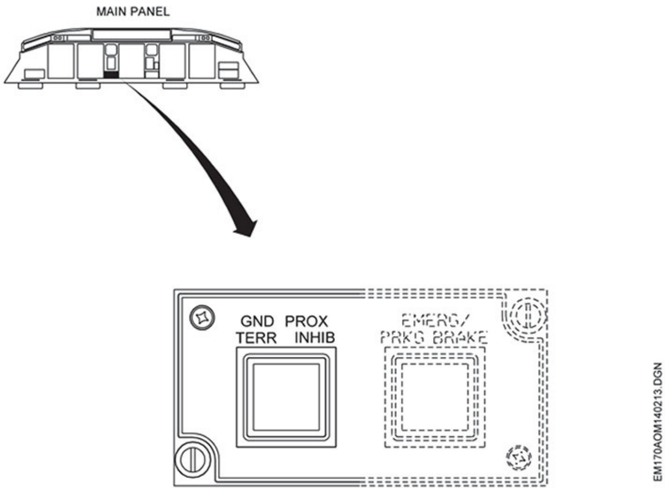


1 – SHAKER 1 AND SHAKER 2 CUTOUT BUTTONS

- When pushed in, cuts out the associated shaker channel.

GLARESHIELD EGPWS PANEL

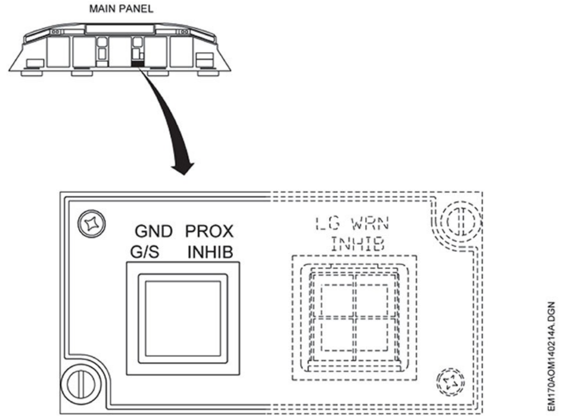
EGPWS TERRAIN SYSTEM OVERRIDE



GND PROX TERR INHIB BUTTON

- When pushed in, inhibits EGPWS and thus avoids unwanted terrain alerts in airports not covered by EGPWS database.

EGPWS GLIDESLOPE CANCELLATION

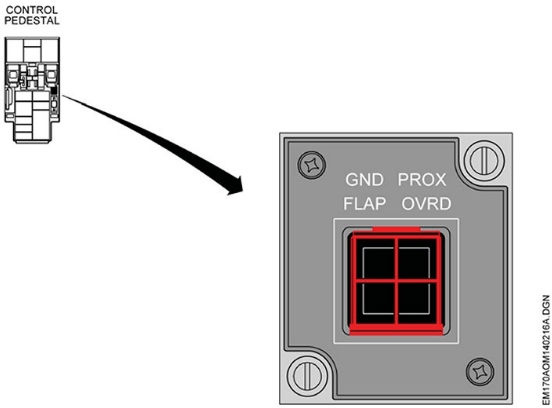


GND PROX G/S INHIB BUTTON

- Momentary button annunciator used to manually cancel glideslope alerts.
- Illuminates when pressed any time below 2000 ft nominal radar altitude and will be automatically reset (light off) by climbing above 2000 ft nominal or descending below 30 ft.

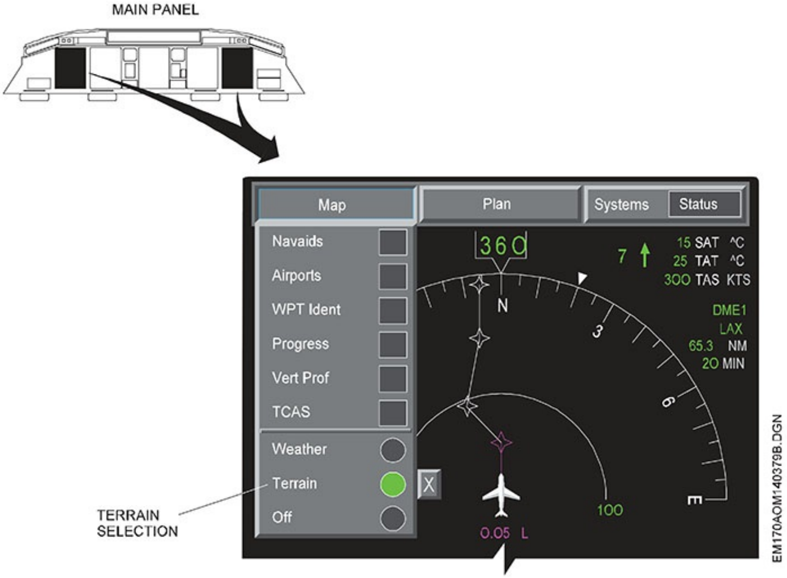
CONTROL PEDESTAL EGPWS PANEL

GND PROX FLAP OVRD BUTTON (GUARDED)



- Inhibits triggering flap alerts in case of landings where flap configuration is different from normal landing flap configuration.

EGPWS SELECTION ON MFD



EGPWS MAP MENU FUNCTION

- The TERRAIN mode enables the EGPWS terrain depiction to be displayed on the map overlay format window in solid or lower density colors including the sea level (0 ft MSL).
- The ranges allowed are: 5 NM, 10 NM, 25 NM, 50 NM, 100 NM, 200 NM, 300 NM, 500 NM, 1000 NM and 2000 NM.

EGPWS DISPLAY ON MFD

1 – TERRAIN ANNUNCIATION

- Labels and colors:
  - TERRAIN

GREEN: EGPWS is scanning the terrain.

AMBER: system failure.

  - TERRAIN INHIBIT

WHITE: terrain inhibit button is pressed in approach mode.

  - TERRAIN N/A

AMBER: terrain awareness not available due to position accuracy degradation.

  - TERRAIN TEST

WHITE: self-test activated.

2 – TERRAIN DIGITAL DISPLAY

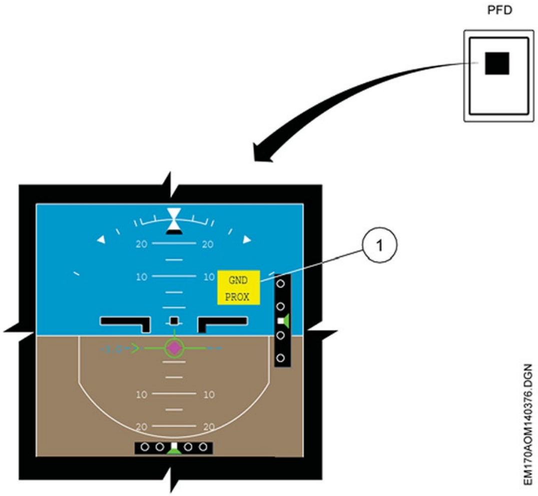
- Displays the highest and lowest terrain/obstacle.

3 – TERRAIN INDICATION

- Displays images of surrounding terrain. Different colors and their intensity represent the terrain elevation.
- Colors:

SOLID RED:	warning terrain threat area.
SOLID YELLOW:	caution terrain threat area.
HIGH DENSITY RED DOTS:	terrain more than 2000 ft above airplane altitude.
HIGH DENSITY YELLOW DOTS:	terrain between 1000 ft and 2000 ft above airplane altitude.
LOW DENSITY YELLOW DOTS:	terrain between 500 ft (250 ft with gear down) below and 1000 ft above airplane altitude.
SOLID GREEN:	the highest terrain is not within 500 ft (250 ft with gear down) of airplane altitude. It may be displayed with dotted yellow when the airplane altitude is near than 500 ft (250 ft with gear down) of terrain.
HIGH DENSITY GREEN DOTS:	terrain between 1000 ft and 500 ft below the airplane altitude.
LOW DENSITY GREEN DOTS:	terrain between 2000 ft and 1000 ft below the airplane altitude.
LOW DENSITY CYAN DOTS:	sea level

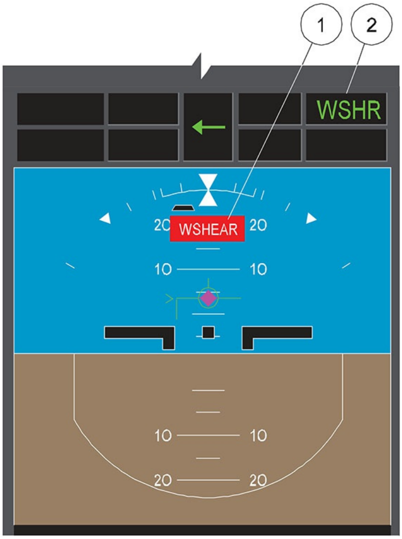
EGPWS DISPLAY ON PFD



1 – GROUND PROXIMITY/PULL UP ANNUNCIATIONS

- Label and colors:
- GND PROX
- Color: AMBER.
- PULL UP
- Color: RED

WINDSHEAR INDICATION ON PFD



EM170AOM140274A.DGN

1 – WINDSHEAR INDICATION (WSHEAR)

- Indicates that a windshear has been detected.
- Color:

AMBER: caution windshear.

RED: warning windshear.

2 – FLIGHT GUIDANCE ESCAPE MODE ENGAGEMENT

- Indicates the FGCS Windshear Escape Mode engagement.

TCAS MAP OVERLAY FORMAT WINDOW

1 – TCAS SELECTION IN MAP MENU

- Activates the TCAS information to be displayed on the map overlay format window.

2 – RESOLUTION ADVISORY (RA) INDICATION

- Symbol: Solid square.
- Color: RED.

3 – TRAFFIC ADVISORY (TA) INDICATION

- Symbol: Solid circle.
- Color: AMBER.

4 – PROXIMATE TRAFFIC INDICATION

- Symbol: Solid diamond.
- Color: CYAN.

5 – OTHER TRAFFIC INDICATION

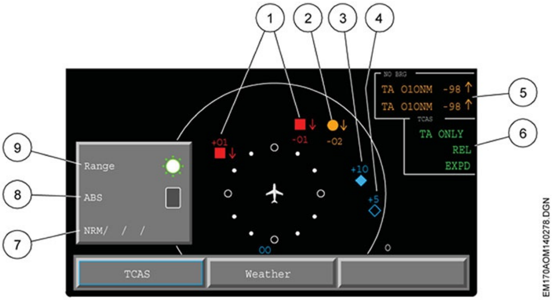
- Symbol: Hollow diamond.
- Color: CYAN.

6 – TCAS MODE

- Annunciates the TCAS operating mode.
- Labels and Colors:
  - TCAS FAIL: AMBER.
  - TCAS TEST: GREEN.
  - TCAS OFF: AMBER.
  - TA ONLY: GREEN.
  - TCAS TA/RA: GREEN.

NOTE: The TA ONLY flashes AMBER when it is the active mode and a RA condition is detected.

TCAS ZOOM FORMAT WINDOW



1 – RESOLUTION ADVISORY (RA) INDICATION

- Symbol: Solid square.
- Color: RED.

2 – TRAFFIC ADVISORY (TA) INDICATION

- Symbol: Solid circle.
- Color: AMBER.

3 – PROXIMATE TRAFFIC INDICATION

- Symbol: Solid diamond.
- Color: CYAN.

4 – OTHER TRAFFIC INDICATION

- Symbol: Hollow diamond.
- Color: CYAN.

5 – NO BEARING INDICATION

- TCAS temporarily unable to determine the bearing of other airplanes when a steep bank angle masks the directional antenna.

6 – TCAS MODE

- Annunciates the TCAS operating mode.
- Labels and Colors:
  - TCAS FAIL: AMBER.
  - TCAS TEST: GREEN.
  - TCAS OFF: AMBER.
  - TA ONLY: GREEN.
  - TCAS TA/RA: GREEN.

NOTE: The TA ONLY flashes AMBER when it is the active mode and a RA condition is detected.

7 – MODE SELECTION

- Selects the vertical mode to be displayed on TCAS.

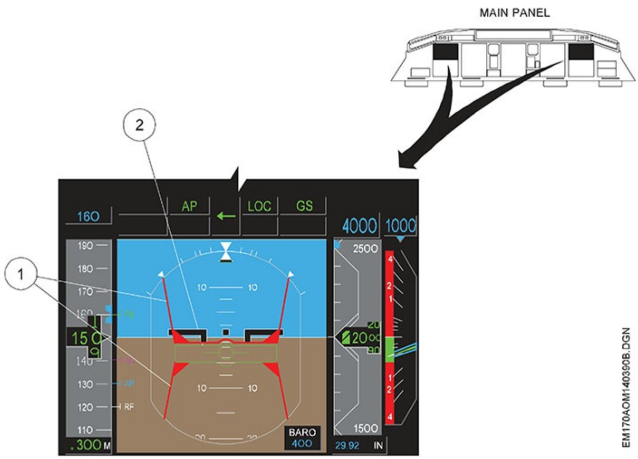
8 – ABS SELECTION

- Selects the absolute altitude mode to be displayed on TCAS. Deselecting this item enables the relative altitude mode.
- Absolute altitude mode will be replaced by relative altitude mode in the following situations:
  - RA or TA intruder is displayed;
  - Deselection of the mode ; or
  - 15 seconds after being selected.

9 – RANGE SELECTION

- Enable the selection of the range to be displayed. The selection is changed through the selector knob in the CCD.

TCAS INDICATION ON PFD



The commands provide pitch guidance information to the flight crew to recommend or prohibit a maneuver and prevent hazardous encounters with other airplane.

The vertical speed scale is used to display TCAS resolution advisories.

The red range is the avoidance zone and the green range is the fly-to zone.

1 – AVOIDANCE ZONE

- Symbol: Trapezoid.
- Color: RED.

2 – FLY-TO ZONE

- Symbol: Rectangle.
- Color: GREEN.

14.15.07 MONITOR WARNING FUNCTION (MWF)

Two monitor warning function computers in separate modular avionics units (MAUs) continually monitor the status of various airplane and avionics systems.

One MWF has priority and alerts the flight crew by generating alert messages in the CAS display window. Some warnings also have sounds (voice and/or tone). The other MWF is a backup. If the priority MWF fails, the display computer automatically selects and uses the data from the backup MWF.

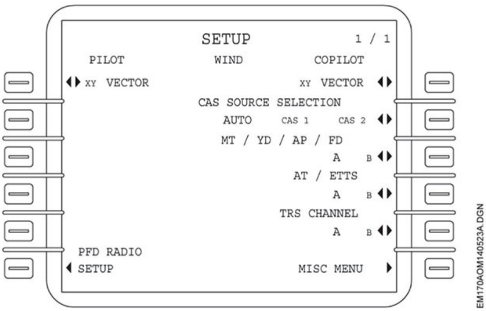
Alert messages are prioritized and color-coded for display. The MWF also controls message timing, flight crew acknowledgement, and the scrolling of the CAS messages in the CAS display window.

CAS SOURCE SELECTION

The CAS List Message Comparison Annunciation is shown on both PFDs to indicate that the CAS lists from the two monitor warning systems do not match. The annunciation consists of the letters "CAS MSG" displayed inside a cutout box. If the two CAS message lists are continuously different for 20 s, a miscompare indication is annunciated.

The CAS MSG source can be visualized or manually changed on the MCDU avionics SETUP page through LSK 2R from CAS 1 to CAS 2 or vice versa.

CAS SOURCE SELECTION options are only enabled on the MCDU SETUP page 1/1 when a miscompare is detected between CAS 1 and CAS 2 lists, otherwise just the label CAS SOURCE SELECTION is displayed.



MCDU AVIONICS SETUP PAGE

14.15.10 VISUAL WARNING

Visual warnings are provided through illuminated warning buttons, displays indications and EICAS messages.

WARNING LIGHTS

Master warning and caution lights are installed on the glareshield panel and blink when any warning or caution message shows on the EICAS or triggered by the Aural Warning Unit. It alerts to conditions that require action or caution related to the operation of the airplane.

MESSAGES ON EICAS

EICAS MESSAGES MNEMONICS

CAS messages mnemonic are generally presented in three elements, as shown in the example:

GENERAL HEADER OR SYSTEM	SPECIFIC SUBSYSTEM OR LOCATION	NATURE OF THE PROBLEM	CAS MESSAGE MNEMONIC
ENGINE	Left side	Fire detected	ENG 1 FIRE
FUEL SOV	Left side	Valve is closed	ENG 1 FUEL SOV CLOSED
ADS	Third system	ADS standby failed	ADS 3 FAIL

NOTE:
- The above format may not be applicable for all CAS messages. Therefore, although the standard is desirable, it shall be subordinated to a clear statement of the nature of the problem.
- Throughout the manual, number 1 is used to identify the left side, number 2 to identify the right side and number 3 for triple systems (usually for backup and standby systems).

EICAS MESSAGES CATEGORIZATION

There are four message priority levels:

- Warning.
- Caution.
- Advisory.
- Status.

WARNING (red): indicates an emergency or airplane system condition that requires immediate corrective or compensatory crew action.

CAUTION (amber): indicates an abnormal operational or airplane system conditions that require immediate crew awareness and should require a subsequent corrective or compensatory action.

ADVISORY (cyan): indicates operational or airplane conditions that require crew awareness. Subsequent or future crew action may be required.

STATUS (white): indicates information/status messages. The pilot can use the system efficiently when the appropriate action is accomplished.

A fifth level is provided for maintenance and is not available during flight operation. It is accessed only on ground.

Messages with the higher priority precede other messages when shown simultaneously. The EICAS displays up to 15 messages simultaneously.

The MCDU displays some messages in the event of a failure of both MFD and the EICAS.

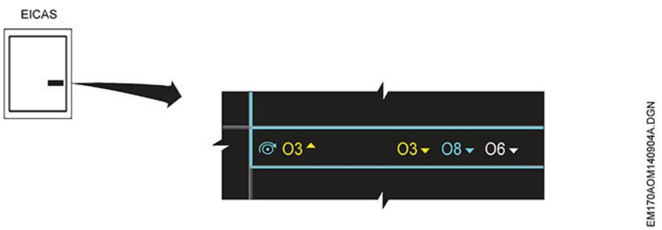
STATUS LINE

The CAS window is selected by a CCD when a cyan curl with arrow icon (meaning knob adjustable data) is displayed, and the alert window border changes from gray to cyan. In case of an overflow (exceeding the display capacity – 15 messages), turning the active CCD scroll knobs scrolls the alert message stack list under the CAS window.

The status line indicates the number (count) and type (color) of messages out of the CAS window, and if they are located above or below the window.

The out-of-view message display (digits and arrows) flashes continuously when there are unacknowledged messages out of view.

Warning messages are not scrolled out of the window.



ROOT EICAS MESSAGES

Some single failures may trigger more than one EICAS message at a time. In the event of multiple EICAS messages, identifying the true nature of the failure and taking the appropriate corrective action is an important role.

EICAS messages which may generate more messages with them are called Root EICAS messages and they are highlighted by a preceding chevron “>”.

In most cases the corrective action will be to perform only the procedure associated with the ROOT EICAS message, but some situations may require additional actions. The pilot must always review all messages displayed on the EICAS and check if they are associated to the root EICAS message and take additional actions if required.

ROOT EICAS message procedures do not necessarily have to be performed first.

If more than one root message is displayed at the same time or displayed together with a WARNING message, the priority order to be evaluated is:

- WARNING messages;
- ELECTRICAL BUSES and;
- MAU.

Following is the list of all the ROOT EICAS messages:

CENTER EBAY FANS FAIL	DC BUS 1 OFF
FWD EBAY FANS FAIL	DC BUS 2 OFF
AVNX MAU 1A FAIL	DC ESS BUS 1 OFF
AVNX MAU 1B FAIL	DC ESS BUS 2 OFF
AVNX MAU 2A FAIL	DC ESS BUS 3 OFF
AVNX MAU 2B FAIL	ELEC EMERGENCY
AVNX MAU 3A FAIL	LG WOW SYS FAIL
AVNX MAU 3B FAIL	HYD 1 LO PRESS
AC BUS 1 OFF	HYD 2 LO PRESS
AC BUS 2 OFF	HYD 3 LO PRESS
AC ESS BUS OFF	

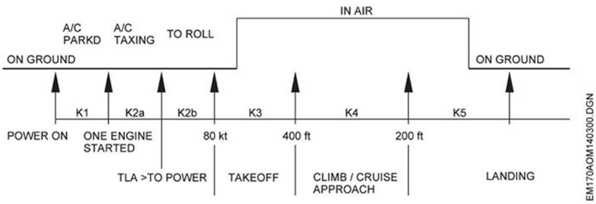
EICAS MESSAGES INHIBITION

Some EICAS messages are inhibited on takeoff or approach and landing to prevent it from being a nuisance.

Inhibition logic considers the following k-codes to inhibit the messages:

CODE	AFTER	BEFORE	DESCRIPTION
K1	Electrical Power ON	1st Engine Started	A/C parked.
K2a	1st Engine Started	TLA > TO Power	A/C taxiing.
K2b	TLA > TO Power	80 kt	TO Roll.
K3	80 kt	400 ft (takeoff)	Takeoff.
K4	400 ft (takeoff)	200 ft (landing)	Climb, cruise, approach.
K5	200 ft (landing)	30 seconds after touchdown and wheelspeed below 30 kt.	Landing.

EICAS MESSAGE INHIBITION SCHEMATIC



EICAS MESSAGES PRESENTATION

The messages are grouped and presented in a chronological order accordingly to its category. The warning category is placed at the top of the EICAS display. Below this category the system presents the Caution, Advisory and Information/Status category, in this order.

When new Warning, Caution and Advisory alert messages are displayed, they are presented flashing in inverse video for crew acknowledgment.

The warning and caution alert messages shall remain flashing in inverse video until manual crew acknowledgment via Master Warning or Caution button (respectively) is pressed. Advisory messages will automatically revert from inverse to normal video after 5 seconds they started to be displayed.

After the acknowledgment, the new message shall remain in steady normal video, at the top of its category on the EICAS display, until a new message belonging to that group appears.

In case of an overflow (exceeding the display capacity – 15 messages), an indication appears, in order to enable the flight crew to scroll the lines, allowing access to all EICAS messages.

The EICAS messages cannot be cancelable. They shall remain active as long as its activation condition exists.

The following table presents all EICAS messages. The type column indicates the message priority level:

- (W) Warning.
- (C) Caution.
- (A) Advisory.
- (S) Status.

The INHIBITION column indicates the K-codes.

SECTION	TYPE	MESSAGE	INHIBITION
14-01 AIRPLANE GENERAL	W	DOOR CRG AFT (FWD) OPEN	K3, K5
		DOOR EMER LH (RH) OPEN	None
		DOOR PAX AFT (FWD) OPEN	K3, K5
		DOOR SERV AFT (FWD) OPEN	
	C	APM FAIL	K2b, K3, K4, K5
		APM MISCOMP	
		AVNX MAU 1 (2) (3) A (B) FAIL	K3, K5
		AVNX MAU 1 (2) (3) A (B) OVHT	
		AVNX MAU 1 (2) (3) FAN FAIL	
		CMS FAIL	K2b, K3, K4, K5
		DOOR CENTER (FWD) EBAY OPEN	K3, K5
		DOOR HYD OPEN	
		EICAS FAULT	None
		EICAS OVHT	K3, K5
		EMER LT NOT ARMED	K2b, K3, K5
		EMER LT ON	
		MFD 1 (2) FAULT	None
		MFD 1 (2) OVHT	K3, K5
		PFD 1 (2) FAULT	None
		PFD 1 (2) OVHT	K3, K5
		SYS CONFIG FAIL	K2a, K2b, K3, K4, K5
	A	APM FAULT	K2b, K3, K4, K5
		AVNX DB MODULE FAIL	K2a, K2b, K3, K4, K5
		AVNX MAU 1 (2) (3) A (B) FAULT	K2b, K3, K4, K5
		AVNX MAU 1 (2) (3) FAN FAULT	K2b, K3, K4, K5
		CCD 1 (2) FAULT	K2b, K3, K5
		CMS FAULT	K2b, K3, K4, K5
		DOOR FUELING OPEN	
		EMER LT BATT FAULT	

SECTION	TYPE	MESSAGE	INHIBITION
14-02 AMS	W	CABIN ALTITUDE HI	K1, K2a, K2b, K3, K5
	C	AMS CTRL FAIL	K2b, K3, K5
		BLEED 1 (2) FAIL	
		BLEED 1 (2) LEAK	
		BLEED 1 (2) OVERPRESS	
		BLEED APU LEAK	
		CABIN DIFF PRESS FAIL	
		CENTER EBAY FANS FAIL	
		CRG FWD VENT FAIL	
		FWD EBAY FANS FAIL	
		PACK 1 (2) FAIL	
		PACK 1 (2) LEAK	
		PRESN AUTO FAIL	
		PRESN MAN FAIL	
		RECIRC SMK DET FAIL	K2a, K2b, K3, K5
		RECIRC SMOKE	K2b, K3, K5
	A	AMS CTRL FAULT	K2a, K2b, K3, K4, K5
		BLEED 1 (2) OFF	K2b, K3, K5
		PACK 1 (2) OFF	
		PRESN AUTO FAULT	
		RAM AIR FAULT	K2b, K3, K4, K5
		XBLEED FAIL	K2b, K3, K5
		XBLEED SW OFF	
	S	BLEED APU VLV OPEN	K2b, K3, K5

SECTION	TYPE	MESSAGE	INHIBITION
14-03 AUTO-MATIC FLIGHT	C	AP FAIL	K2b, K3, K5
		AP PITCH MISTRIM	K3
		AP PITCH TRIM FAIL	K2b, K3, K5
		AP ROLL MISTRIM	K3
		AT FAIL	K3, K5
		AT NOT IN HOLD	None
		FD LATERAL MODE OFF	K3
		FD VERT MODE OFF	
		SHAKER ANTICIPATED	K2b, K3, K5
		STALL PROT FAIL	K2b, K3
	A	AFCS FAULT	K2b, K3, K4, K5
		AFCS PANEL FAIL	K3, K5
		AFCS PANEL FAULT	K2a, K2b, K3, K4, K5
		AP FAULT	K2b, K3, K4, K5
		AP PITCH TRIM FAULT	
		AP RUDDER NOT AVAIL	K2b, K3
		APPR 2 NOT AVAIL	
		AT FAULT	K2b, K3, K4, K5
		AUTOLAND 1 (2) NOT AVAIL	K2b, K3
		ENG TLA TRIM FAIL	K2b, K3, K5
		FD FAIL	K3, K5
		FD FAULT	K2b, K3, K4, K5
		MACH TRIM FAIL	K2b, K3, K5
		MACH TRIM FAULT	K2b, K3, K4, K5
		SHAKER 1 (2) FAIL	K2b, K3, K5
		STALL PROT FAULT	K2b, K3, K4, K5
		STALL PROT ICE SPEED	K2b, K3, K5 and inhibited 5 minutes after weight - on-wheels off.
		YD FAIL	K2b, K3, K5
		YD FAULT	K2b, K3, K4, K5
		YD OFF	None
	S	AUTOLAND OFF	K2b, K3

SECTION	TYPE	MESSAGE	INHIBITION
14-04 APU	C	APU ALTITUDE EXCEED	K1, K2a, K2b, K3, K5
		APU FAIL	K2b, K3, K5
		APU FAULT	
		APU OIL HI TEMP	
		APU OIL LO PRESS	
	S	APU SHUTTING DOWN	K2b, K3, K5

SECTION	TYPE	MESSAGE	INHIBITION
14-05 ELEC-TRICAL	W	BATT 1 (2) OVERTEMP	None
		BATT 1-2 OFF	
		BATT DISCHARGING	
		ELEC EMERGENCY	
	C	AC BUS 1 (2) OFF	K3, K5
		AC ESS BUS OFF	
		AC STBY BUS OFF	
		APU GEN OFF BUS	
		BATT 1 (2) DISCHARGING	None
		BATT 1 (2) OFF	K3, K5
		BATT 1 (2) TEMP SENS FAULT	K2a, K2b, K3, K4, K5
		DC BUS 1 (2) OFF	K3, K5
		DC ESS BUS 1 (2) (3) OFF	
		GPU CONNECTED	K3, K4, K5
		IDG 1 (2) OFF BUS	K3, K5
		IDG 1 (2) OIL	
		INVERTER FAIL	K2a, K2b, K3, K4, K5
		RAT FAIL	
		TRU 1 (2) FAIL	K3, K5
		TRU ESS FAIL	
	A	LOAD SHED	K3, K4, K5
		REMOTE CB TRIP	K2b, K3, K4, K5
		SPDA FAIL	K3, K5

SECTION	TYPE	MESSAGE	INHIBITION
14-06 ENGINE	W	ENG 1 (2) OIL LO PRESS	K3, K5
		ENG 1 (2) REV DEPLOYED	None
	C	ENG 1 (2) CONTROL FAULT	K3, K5
		ENG 1 (2) FADEC OVERTEMP	
		ENG 1 (2) FAIL	K3
		ENG 1 (2) FUEL IMP BYPASS	K3, K5
		ENG 1 (2) FUEL LO PRESS	
		ENG 1 (2) NO DISPATCH	K2b, K3, K4, K5
		ENG 1 (2) OIL LO LEVEL	
		ENG 1 (2) REV FAIL	K3, K4, K5
		ENG 1 (2) REV PROT FAULT	
		ENG 1 (2) REV TLA FAIL	K2b, K3, K5
		ENG 1 (2) START VLV OPEN	K3, K5
		ENG 1 (2) T2 HEAT FAIL	
		ENG 1 (2) TLA FAIL	
		ENG EXCEEDANCE	K2b, K3, K4, K5
		ENG NO TAKEOFF DATA	K3, K4, K5
		ENG REF A-I DISAG	K1, K3, K4, K5
		ENG REF ECS DISAG	K2b,K3,K4,K5
		ENG THR RATING DISAG	K3, K4, K5
		ENG TLA NOT TOGA	None
	A	ENG 1 (2) FADEC FAULT	K3, K4, K5
		ENG 1 (2) FUEL SW FAIL	K3, K5
		ENG 1 (2) OIL IMP BYPASS	
		ENG 1 (2) OIL SW FAIL	K3, K4, K5
		ENG 1 (2) SHORT DISPATCH	K2b, K3, K4, K5
	S	ENG 1 (2) REV INHIBIT	K3, K5
		ENG 1 (2) TLA NOT IDLE	None
		ENG TDS REF A-I ALL	K3, K4, K5
		ENG TDS REF A-I ENG	

<table>
<tr><th>SECTION</th><th>TYPE</th><th>MESSAGE</th><th>INHIBITION</th></tr>
<tr><td rowspan="16">14-07 FIREPRO-TECTION</td><td rowspan="4">W</td><td>APU FIRE</td><td rowspan="3">None</td></tr>
<tr><td>CRG AFT (FWD) SMOKE</td></tr>
<tr><td>ENG 1 (2) FIRE</td></tr>
<tr><td>LAV SMOKE</td><td>K2b, K3, K5</td></tr>
<tr><td rowspan="5">C</td><td>APU FIRE DET FAIL</td><td rowspan="2">K3, K5</td></tr>
<tr><td>APU FIREX FAIL</td></tr>
<tr><td>CRG AFT (FWD) FIRE SYS FAIL</td><td>K2b, K3, K5</td></tr>
<tr><td>ENG 1 (2) FIRE DET FAIL</td><td>K3, K5</td></tr>
<tr><td>LAV SMOKE DET FAIL</td><td>K2a, K2b, K3, K4, K5</td></tr>
<tr><td rowspan="6">A</td><td>APU FIREX BTL DISCH</td><td>K3, K5</td></tr>
<tr><td>CRG FIRE PROT FAULT</td><td>K2a, K2b, K3, K4, K5</td></tr>
<tr><td>CRG FWD (AFT) FIREX HI ARM</td><td rowspan="2">K2b, K3, K5</td></tr>
<tr><td>CRG FWD (AFT) FIREX LO ARM</td></tr>
<tr><td>ENG 1 (2) FIREXBTL A (B) FAIL</td><td rowspan="2">K3, K5</td></tr>
<tr><td>ENG FIREX BTL A (B) DISCH</td></tr>
<tr><td>S</td><td>CRG FIREX HI (LO) DISCH</td><td>K2b, K3, K5</td></tr>
</table>

SECTION	TYPE	MESSAGE	INHIBITION
14-08 FLIGHT CON-TROLS	W	GROUND SPOILERS FAIL	None
		ELEV (RUDDER) (SPOILER) NML MODE FAIL	K1, K2a, K2b, K3, K5
	C	AOA LIMIT FAIL	K2b, K3, K5
		ELEV THR COMP FAIL	K3, K5
		ELEVATOR FAULT	K3
		ELEVATOR LH (RH) FAIL	
		FLAP FAIL	K3, K5
		FLT CTRL NO DISPATCH	K2b, K3, K4, K5
		FLT CTRL BIT EXPIRED	K2a, K2b, K3, K4, K5
		PITCH TRIM FAIL	K3, K5
		RUDDER FAIL	K3
		RUDDER FAULT	
		RUDDER LIMITER FAIL	K3, K5
		SLAT FAIL	
		SLAT-FLAP LVR DISAG	
		SPOILER FAULT	K1, K2a, K2b, K3
		STAB LOCK FAULT	K3, K5
	A	AILERON LH (RH) FAIL	K3, K5
		AUTO CONFIG TRIM FAIL	
		FLAP LO RATE	
		FLT CTRL FAULT	K3, K4, K5
		PITCH CONTROL DISC	K3, K5
		PITCH TRIM BKUP FAIL	
		PITCH TRIM LO RATE	
		PITCH TRIM SW 1 (2) FAIL	
		ROLL CONTROL DISC	
		SLAT LO RATE	
		SPDBRK LEVER DISAG	
		SPDBRK FAIL	K2b, K3, K5
		TAILSTRIKE AVOID FAIL	K1
	S	FLT CTRL TEST IN PROG	K2b, K3, K4, K5

SECTION	TYPE	MESSAGE	INHIBITION
14-09 FLIGHT INSTRU-MENTS, COMM, NAV & FMS	C	ADS 1 (2) FAIL	K3, K5
		ADS 3 FAIL	K2b, K3, K5
		ADS 1 (2) HTR FAIL	K5
		ADS 3 (4) HTR FAIL	K2b, K3, K5
		AVNX ASCB FAULT	K2b, K3, K4, K5
		DISPLAY CTRL FAIL	K3, K5
		DISPLAY CTRL FAULT	K2b, K3, K4, K5
		FMS 1 (2) GPS POS DISAG	K1, K2a, K2b, K3, K5
		FMS POS DISAG	
		HF 1 (2) FAIL	None
		IRS 1 (2) FAIL	None
		IRS EXCESSIVE MOTION	K2b, K3, K4, K5
		NAV 3 FAIL	K3, K5
		NAVCOM 1 (2) FAIL	
		NAVCOM 1 (2) OVHT	
		VALIDATE CONFIG	K2b, K3, K4, K5
		VHF 1 (2) (3) OVHT	K3, K5
		VHF 3 FAIL	
		XPDR 1(2) IN STBY	K1, K2a, K2b, K3, K5
	A	ADS 1 (2) HTR FAULT	K3, K4, K5
		ADS-B NOT AVAIL	K2b, K3, K5
		ADS 3 SLIPCOMP FAIL	K2b, K3, K5
		ADS PROBE 1 (2) (3) (4) FAIL	K2b, K3, K4, K5
		CMC FAIL	K2a, K2b, K3, K4, K5
		CVR AFT (FWD) FAIL	K3, K5
		DATALINK 1 FAIL	K3, K5
		FDR AFT (FWD) FAIL	
		FLT CTRL ADS FAIL	K2b, K3, K4, K5
		FMS 1 (2) FAIL	K3, K5
		GPS 1 (2) FAIL	K3, K5
		IRS 1 (2) (3) NAV MODE FAIL	K1, K2a, K2b, K3, K5
		IRS ALIGNING	K2b, K3, K4, K5
		IRS PRES POS INVALID	K2a, K2b, K3, K4, K5
		LPV NOT AVAIL	K3, K5
		RALT 1 (2) FAIL	None
		RNP AR NOT AVAIL	K3, K5
		RNP AR <0.3 NOT AVAIL	
		TAT 1 (2) FAIL	K3, K5
		TOLD 1 (2) FAIL	
		XPDR 1 (2) FAIL	
	S	PRINTER FAULT	K2a, K2b, K3, K5
		ADS-B NOT ON	K2b, K3, K5

SECTION	TYPE	MESSAGE	INHIBITION
14-10 FUEL	W	FUEL 1 (2) LO LEVEL	K1, K2a, K2b, K3, K5
	C	APU FUEL SOV FAIL	K3, K5
		ENG 1 (2) FUEL SOV FAIL	
		FUEL IMBALANCE	
		FUEL TANK LO TEMP	K2b, K3, K5
		FUEL XFEED FAIL	K3, K5
	A	DEFUEL SOV OPEN	K3, K4, K5
		FUEL AC 1 (2) PUMP FAIL	K3, K5
		FUEL DC PUMP FAIL	K2a, K2b, K3, K4, K5
		FUEL EQUAL-XFEED OPEN	K3, K5
		FUEL FEED 1 (2) FAULT	K2b, K3, K5
		FUEL KG-LB MISMATCH	K2a, K2b, K3, K4, K5
	S	APU FUEL SOV CLOSED	K3, K5
		ENG 1 (2) FUEL SOV CLOSED	
		FUEL XFEED SOV OPEN	
14-11 HYDRAU-LIC	W	HYD 1 (2) (3) OVERHEAT	None
	C	HYD 1 (2) EDP NOT D-PRESS	K3, K5
		HYD 1 (2) (3) HI TEMP	
		HYD 1 (2) (3) LO PRESS	K3
		HYD 3 VLV FAIL	K3, K5
		HYD PTU FAIL	K3, K5
	A	HYD 1 (2) EDP FAIL	K3, K5
		HYD 1 (2) ELEC PUMP FAIL	K2a, K2b, K3, K5
		HYD 1 (2) (3) LO QTY	K2b, K3, K5
		HYD 1 (2) SOV FAIL	K3, K5
		HYD 3 PUMP A NOT ON	K1, K3, K5
		HYD PTU NOT AUTO	K3, K5
		HYD PUMP NOT AUTO	
		HYD TEMP SENS FAIL	K2b, K3, K5
		HYD3 ELEC PUMP A FAIL	K3,K5
		HYD3 ELEC PUMP B FAIL	K2a, K2b, K3, K5
	S	HYD 1 (2) SOV CLOSED	K3, K5

SECTION	TYPE	MESSAGE	INHIBITION
14-12 ICE & RAIN PRO-TECTION	W	A-I WING 1 (2) LEAK	K3, K5
	C	A-I ENG 1 (2) FAIL	K3, K5
		A-I LO CAPACITY	K1, K2a, K2b, K3, K5
		A-I WING FAIL	K3, K5
		A-I WING NO DISPATCH	K2a, K2b, K3, K5
		ICE DETECTOR 1 (2) FAIL	K2b, K3, K5
		WINDSHIELD 1 (2) HTR FAIL	
	A	A-I MODE NOT AUTO	K2b, K3, K5
		A-I SWITCH OFF	
		A-I ENG 1 (2) FAULT	
		A-I ENG 1 (2) LEAK	
		ICE CONDITION	Inhibited on ground until 1700 ft AGL or 2 minutes after takeoff. Inhibited on ground below 40 knots, if MCDU ENG REF A/I selected to ALL.
	S	A-I ENG 1 (2) VLV OPEN	None
		A-I WING VLV OPEN	

SECTION	TYPE	MESSAGE	INHIBITION
14-13 LANDING GEAR & BRAKES	W	LG LEVER DISAG	None
	C	AUTOBRAKE FAIL	K3
		BRK OVERHEAT	
		BRK RH (LH) FAIL	
		EMER BRK FAIL	
		LG NO DISPATCH	K2b, K3, K4, K5
		LG NOSE DOOR OPEN	K3, K5
		LG WOW SYS FAIL	None
		PRKG BRK NOT RELEASED	K1, K2a, K2b, K3
		STEER FAIL	K3
	A	BRK CONTROL FAULT	K3, K5
		BRK RH (LH) FAULT	K3
		BRK PEDL RH (LH) SEAT FAIL	
		EMER BRK FAULT	K3, K4, K5
		LG TEMP EXCEEDANCE	K3, K5
		STEER FAULT	K3, K4, K5
	S	STEER OFF	K3, K4
14-14 OXYGEN	C	CREW OXY LO PRESS	K2a, K2b, K3, K5
		PAX OXY NOT DEPLOYED	
	A	PAX OXY SW NOT AUTO	K2, K3, K5
		OBSERVER OXY LO PRESS	K2a, K2b, K3, K5
14-15 WARNING SYSTEM	W	NO TAKEOFF CONFIG	K3, K4, K5
	C	AURAL WRN SYS FAIL	K3, K5
		CREW WRN SYS FAULT	K2b, K3, K4, K5
		GND PROX FAIL	K3, K5
		TERRAIN FAIL	
		REACTIVE WSHEAR FAIL	None
	A	AURAL WRN SYS FAULT	K2b, K3, K4, K5
		TCAS FAIL	K3, K5
		TERRAIN NOT AVAILABLE	

14.15.15 AURAL WARNING

The electronic display system has two aural warning drivers, which are responsible for generating and prioritizing aural warnings.

Aural warnings sound in a sequence, are never truncated, and are automatically canceled when the alerting situation no longer exists, or when they are reset manually by the pilot. In the event of multiple alerts, the highest priority alerts sound first.

Aural warnings are used when pilots need immediate knowledge of a condition without having to look at a visual display or indicator. Aural warnings are alert tones, bells, horns, clicks, beeps and voice messages.

Aural warning priority levels

There are four aural warning priority levels, from the highest to the lowest:

- Emergency (level 3).
- Abnormal (level 2).
- Advisory (level 1).
- Information (level 0).

Emergency: corresponds to a situation that requires the pilot's immediate action. The master warning annunciator is repeated with three-second intervals between alerts until the master warning reset switch is pressed.

Abnormal: corresponds to an abnormal situation such as system malfunction or failures that have no immediate impact on safety. Whenever an abnormal fault occurs, a master caution tone is presented every five seconds until the master caution reset switch is pressed.

Advisory: corresponds to the recognition of a situation such as system malfunction or failures leading to loss of redundancy or degradation of a system.

Information: corresponds to an information situation.

PRIORITY	ALERT	TONE/VOICE MESSAGE
3	EGPWS WARNING	See 14-15-30
3	TCAS CORRECTIVE ADVISORY	See 14-15-40
3	TCAS PREVENTIVE ADVISORY	See 14-15-40
3	FIRE	BELL
3	MASTER WARNING	TRIPLE CHIME
3	OVERSPEED	“HIGH SPEED”
3	LANDING GEAR (With Radar Altitude Valid)	“LANDING GEAR”
3	CABIN ALTITUDE	“CABIN”
3	NO TAKEOFF (slat/flap out of configuration)	“NO TAKEOFF FLAP”
3	NO TAKEOFF (pitch trim out of configuration)	“NO TAKEOFF TRIM”
3	NO TAKEOFF (brakes out of configuration)	“NO TAKEOFF BRAKES”
3	NO TAKEOFF (spoilers out of configuration)	“NO TAKEOFF SPOILER”
3	AUTOPILOT (normal or abnormal)	“AUTOPILOT”.
3	NO AUTOLAND	"NO AUTOLAND"
2	MASTER CAUTION	SINGLE CHIME
1	ALTITUDE ALERT (departure)	C CHORD (twice) + “ALTITUDE”
1	ALTITUDE ALERT (capture)	C CHORD
1	AUTOTHROTTLE (normal or abnormal)	“THROTTLE”
0	TAKEOFF CONFIGURATION	“TAKEOFF OK”
0	AURAL WARNING A PIT	“AURAL WARNING TEST A”
0	AURAL WARNING B PIT	“AURAL WARNING TEST B”
0	TRIM MALFUNCTION	“TRIM” (7 seconds)

VOICE MESSAGES

Voice messages are generated whenever a potentially dangerous condition exists, as determined by the EGPWS, TCAS, and windshear detection system.

Some voice messages may be canceled, but others are only canceled when the cause that activates them ceases. When a windshear, TCAS or EGPWS alert condition takes place, a special situation exists. In that case, no other voice messages are presented so that the flight crew can clearly hear the information messages. Only a stall condition takes precedence over windshear, EGPWS and TCAS alerts.

14.15.20 TAKEOFF CONFIGURATION WARNING

A dedicated aural warning indicates that airplane configuration is not in suitable takeoff condition. The aural warning is activated whenever the airplane is on the ground, thrust is applied and at least one of the following conditions is met:

- Flaps are not in takeoff position (“NO TAKEOFF FLAPS”).
- Flaps position is not in agreement with the Flaps position selected in the FMS Takeoff page 2/2 (“NO TAKEOFF FLAPS”).
- Parking brakes are applied (“NO TAKEOFF BRAKES”).
- Pitch trim is out of green range (“NO TAKEOFF TRIM”).
- Any spoiler panel is deployed (“NO TAKEOFF SPOILER”).

More than one warning may be generated if more than one condition is met.

A test button is provided to allow checking the takeoff configuration by simulating power levers in the advanced position. If the airplane is in takeoff configuration, the voice message “TAKEOFF OK” is generated. If the airplane is not set to takeoff configuration, the aural warning referred to the associated takeoff configuration deviation is generated.

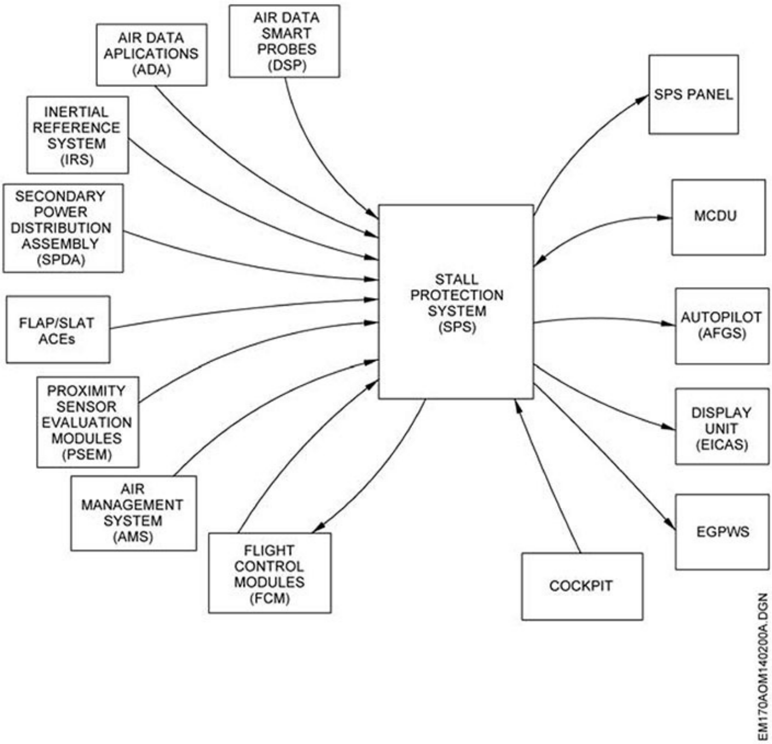
14.15.25 STALL PROTECTION SYSTEM

The stall protection system provides warning to the pilot when the airplane's speed is approaching stall speed. It is provided by the Auto Flight Control System (AFCS) by activating the stick shaker motor on the control column. The Flight Control Module (FCM) provides stall protection by means of angle-of-attack (AOA) limiting function.

Stall Protection Activation

Once the stick shaker is activated by the AFCS, the AOA limiting function reduces control column authority in the nose up direction gradually until the control column reaches the aft stop, thereby limiting the angle of attack. The FCM computes AOA limiting command using angle of attack data, control column position and inertial feedback.

If one or more sensors required performing the AOA limiting fails, the function is no longer available, and the respective message is displayed on the EICAS.



STALL PROTECTION ACTIVATION

14.15.30 ENHANCED GROUND PROXIMITY WARNING SYSTEM (EGPWS)

GENERAL

The primary purpose of the EGPWS is to give aural visual alerts and warnings in the avoidance of controlled flight into terrain and to give the flight crew detected windshear warnings.

The EGPWS uses airplane position information, airplane configuration information, and terrain database information to provide the flight crew with increased awareness of the terrain along the projected flight path.

EGPWS consists of:

- Forward Looking Terrain Awareness Function;
- Terrain Clearance Floor Function;
- Ground Proximity Warning Function;
- Terrain Awareness Display.

EGPWS INPUTS

The main systems that the EGPWS receives inputs from are the following:

- Air data system (ADS);
- Flight management system (FMS);
- Global positioning system (GPS);
- Inertial reference system (IRS);
- Radio altimeter;
- Slats and flaps control system.

EGPWS DATABASE

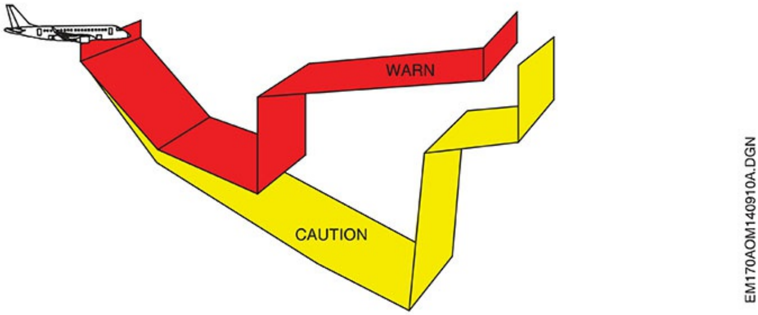
The EGPWS database consists of all hard surfaces runways greater than 1067 m (3500 ft) in length.

The EGPWS database is segregated from the FMS database. Those data shown on MCDU is not the same as used by EGPWS.

FORWARD LOOKING TERRAIN AWARENESS FUNCTION

This function is used to look ahead of the airplane and detect terrain or obstacle conflicts with greater alerting time.

The Forward Looking Terrain compare the airplane current position using both lateral and vertical positional information and flight path with the terrain database to determine if there is a potential threat of collision with terrain.

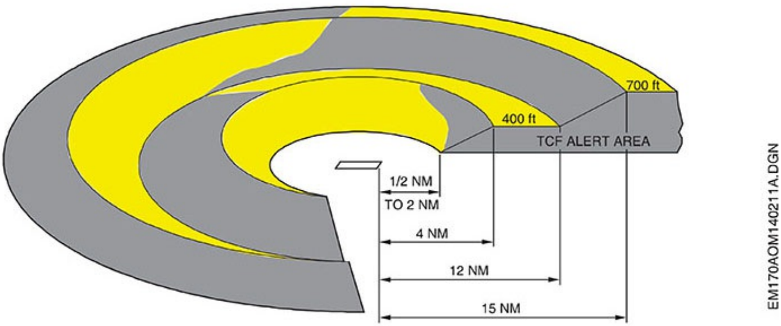


TERRAIN CLEARANCE FLOOR

The Terrain Clearance Floor (TCF) provides a circular terrain clearance envelope around the airport runway.

TCF mode complements existing mode 4 protection by providing an alert based on insufficient terrain clearance.

The TCF is active during takeoff, cruise and final approach and is based on airplane present position, nearest runway and radio altitude.



GROUND PROXIMITY WARNING FUNCTION

The EGPWS calculates these seven basic functions by comparing the airplane position to an internal terrain database to output alerts and displays that show the airplane situation.

Mode 1 - Excessive descent rates with SINK RATE and PULL UP aural warnings.

NOTE: Steep Approach operation implies higher vertical speed. Once the Steep Approach mode is activated, additional margins are applied to the SINK RATE and PULL UP logic, allowing steep approaches without unwanted alerts.

Mode 2 - Excessive terrain closure rates with TERRAIN, TERRAIN and PULL UP aural warnings.

Mode 3 - Altitude loss after takeoff with a DON`T SINK, DON`T SINK AURAL WARNING.

Mode 4 - Unsafe terrain clearance with TOO LOW TERRAIN, TOO LOW GEAR and TOO LOW FLAPS aural warnings.

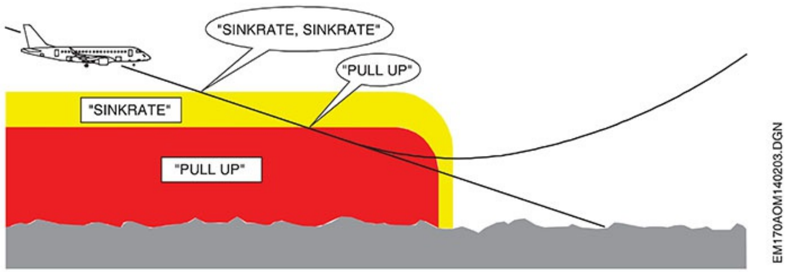
Mode 5 - Excessive deviation below glideslope with a GLIDESLOPE aural warning.

Mode 6 - Advisory callouts with BANK ANGLE, MINIMUMS and selected altitudes aural warnings.

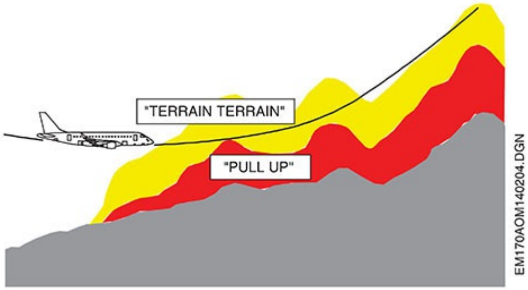
Mode 7 - Windshear alerting as CAUTION WINDSHEAR and WINDSHEAR, WINDSHEAR, WINDSHEAR.

EGPWS AURAL WARNINGS

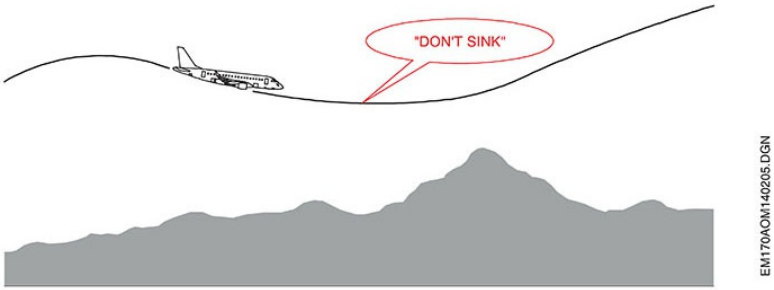
EXCESSIVE DESCENT RATE



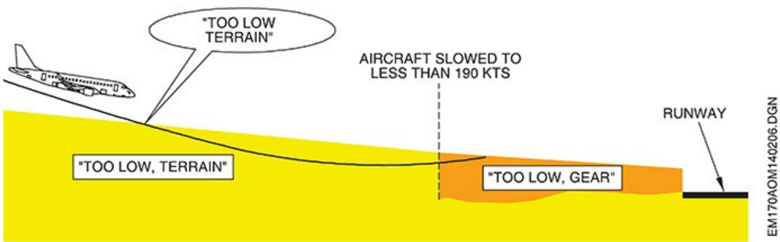
EXCESSIVE CLOSURE TO TERRAIN



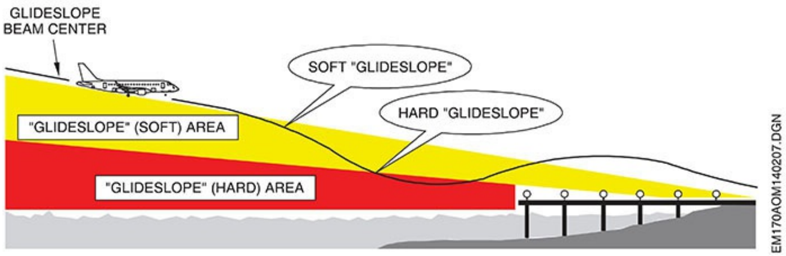
ALTITUDE LOSS AFTER TAKEOFF



UNSAFE TERRAIN CLEARANCE



DESCENT BELOW GLIDESLOPE

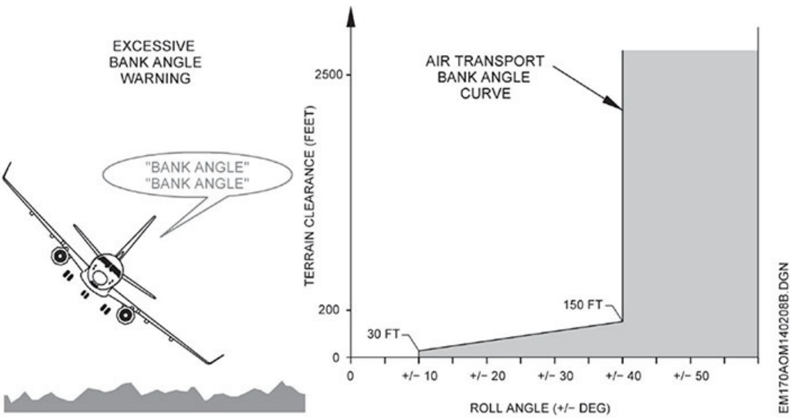


EXCESSIVE BANK ANGLE

The bank angle feature provides protection for over banking during maneuvering on approach or climb out and while at altitude.

In addition, it protects against wing or engine strikes close to the runway.

The graphic below shows the bank angle limit according to the radar altitude:



TERRAIN MAPPING SELECTION

Terrain mapping is provided by EGPWS and is displayed on the navigation map of the MFD display when selected. There are two selection modes:

- Display selection through the MFDs MAP menu function.
- EGPWS Auto pop-up request during a terrain/obstacle caution warning.

When an auto pop-up occurs, the MFD range is automatically changed to 10 NM. Terrain mapping is removable from the display via the MFD menu function. EGPWS modes and status are displayed adjacent to the navigation display. Weather radar data is disabled while terrain data is displayed. EGPWS range is controlled with the overall range control in the CCD. The range selections are 5, 10, 25, 50, 100, 200, 300 and 500 NM, 1000 NM and 2000 NM.

The TERRAIN digital display shows the highest and lowest terrain/obstacle elevations.

TERRAIN AWARENESS DISPLAY

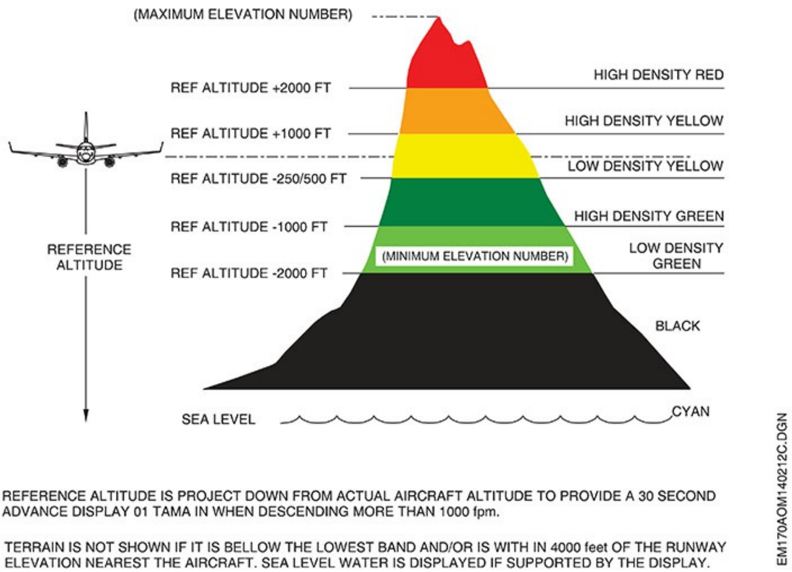
The EGPWS terrain display is designed to increase flight crew awareness of the surrounding terrain in varying density dots patterns of green, yellow and red. These dot patterns represent specific terrain separation from the airplane.

COLOR	MEANING
Solid red	Warning Terrain (Approximately 30 s from impact).
Solid yellow	Caution Terrain (Approximately 60 s from impact).
High density red dots	Terrain that is more than 2000 ft above airplane altitude.
High density yellow dots	Terrain that is between 1000 ft and 2000 ft above airplane altitude.
Low density yellow dots	Terrain that is between 500 ft (250 ft with gear down) below and 1000 ft above airplane altitude.
Solid green	Highest terrain not within 500 (250 ft with gear down) ft of airplane altitude. May appear with dotted yellow terrain when the airplane altitude is within 500 ft (250 ft with gear down) of terrain.
High density green dots	Terrain that is the middle elevation band when there is no red or yellow terrain areas within range on the display.
Low density green dots	Terrain that is the lower elevation band when there is no red or yellow terrain areas within range on the display.
Light density cyan dots	Terrain elevation equal to 0 ft MSL .

The Peaks mode is a Terrain Alerting and Display (TAD) supplemental feature providing additional terrain display features for enhanced situational awareness, dependent of both relative and absolute terrain indication.

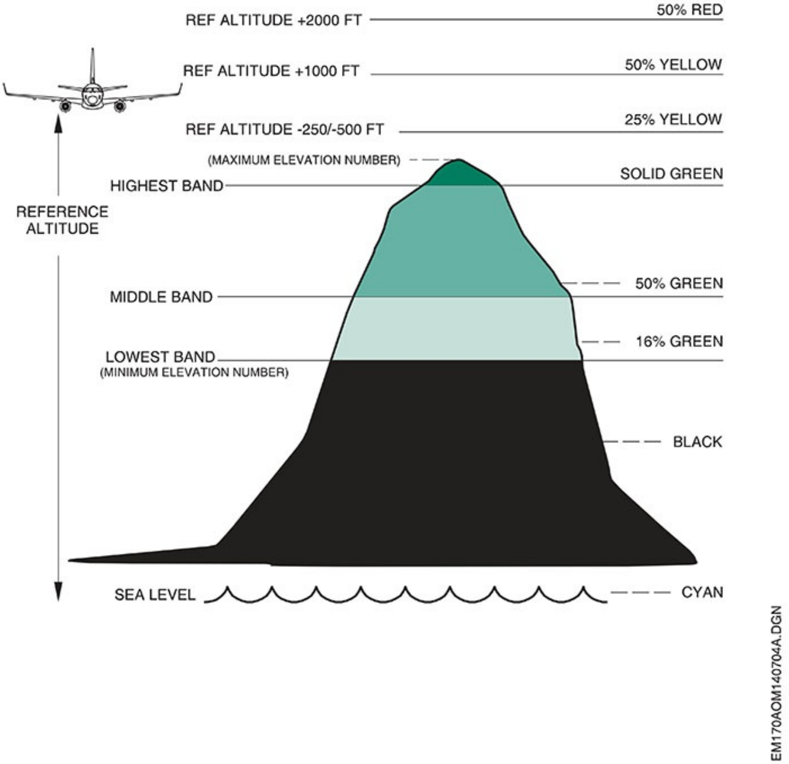
At low altitudes (with respect to displayed terrain) the terrain is displayed using colors and shading patterns corresponding to the vertical displacement between the terrain elevation and the current airplane altitude. As the airplane altitude increases (with respect to displayed terrain) the Peaks mode applies additional density patterns and color level thresholds based on absolute terrain elevations relative to the range and distribution of terrain in the display area. At altitudes safely above all terrain for the display range chosen, the terrain is displayed independent of airplane altitude emphasizing the highest and lowest elevations to provide increased situational awareness.

The illustration below shows the Peaks display at a low relative altitude:



EGPWS DISPLAY COLOR CODING

The following illustration represents the Peaks display at a high relative altitude:



EGPWS DISPLAY COLOR CODING

EGPWS MESSAGES

The EGPWS provides the following aural and visual messages:

AURAL MESSAGE	VISUAL MESSAGE	MEANING
OBSTACLE OBSTACLE, PULL UP	PULL UP; and terrain shown in red on the MAP page display.	Warning proximity to the projected impact terrain. The terrain is shown in red on the MAP page display.
CAUTION OBSTACLE; CAUTION OBSTACLE	GND PROX; Terrain shown in amber on MFD	The projected impact terrain is between 40 and 60 s from the airplane. The terrain is shown in amber on the MAP page display.
TERRAIN TERRAIN, PULL UP	PULL UP; and terrain shown in red on the MAP page display.	Warning proximity to the projected impact terrain. The terrain is shown in red on the MAP page display.
CAUTION TERRAIN; CAUTION TERRAIN	GND PROX; Terrain shown in amber on MFD	The projected impact terrain is between 40 and 60 s from the airplane. The terrain is shown in amber on the MAP page display.
TERRAIN; TERRAIN	GND PROX	Excessive and hazardous terrain closure rate. Leveled flight or even climb towards obstructing terrain also set the alarm. A continuous TERRAIN aural alert will be annunciated if landing gear and flaps are set to landing configuration.
PULL UP; PULL UP; PULL UP	PULL UP	Excessive and hazardous terrain closure rate becomes severe. Follows the TERRAIN aural annunciation.
DON'T SINK; DON'T SINK	GND PROX	Excessive loss of altitude after a takeoff or go-around.
SINKRATE; SINKRATE	GND PROX	Excessive descent rate.
PULL UP; PULL UP; PULL UP	PULL UP	Excessive descent rate becomes severe. Follows the SINKRATE aural annunciation.
GLIDESLOPE; GLIDESLOPE	GND PROX	Airplane excessively below from glideslope on ILS approach at low altitudes.
GLIDESLOPE	GND PROX	Airplane is below glideslope on ILS approach. Aural warning is annunciated at half-volume.

AURAL MESSAGE	VISUAL MESSAGE	MEANING
TOO LOW TERRAIN	GND PROX	Unsafe terrain clearance at high speed. Flaps and landing gear not in landing configuration.
TOO LOW TERRAIN	GND PROX	Descent below the approach path while too far from the airport in the database.
TOO LOW FLAPS	GND PROX	Unsafe terrain clearance at low speed. Landing gear down, but flaps not in landing configuration.
TOO LOW GEAR	GND PROX	Unsafe terrain clearance at low speed. Flaps and landing gear not in landing configuration.
BANK ANGLE; BANK ANGLE	None	Excessive roll or bank angle maneuver.
APPROACHING MINIMUMS	None	Descent below Decision Height (DH) or Minimum Descent Altitude (MDA) setting, plus 80 ft.
MINIMUMS	None	Descent below Decision Height (DH) or Minimum Descent Altitude (MDA) bug setting.
TWENTY FIVE HUNDRED	None	Radio altimeter callout for descent below 2500 ft.
ONE THOUSAND	None	Radio altimeter callout for descent below 1000 ft.
FIVE HUNDRED	None	Radio altimeter callout for descent below 500 ft.
ONE HUNDRED	None	Radio altimeter callout for descent below 100 ft.
FIFTY	None	Radio altimeter callout for descent below 50 ft.
FORTY	None	Radio altimeter callout for descent below 40 ft.
THIRTY	None	Radio altimeter callout for descent below 30 ft .
TWENTY	None	Radio altimeter callout for descent below 20 ft .
TEN	None	Radio altimeter callout for descent below 10 ft .

NOTE:
- The 2500 ft call out has the lowest priority of al EGPWS aurals. It also has the lowest priority regarding all other airplane cautions and warnings. If it is being announced and another call out is required, it will be superseded by this higher priority call out.
- Any altitude callout above 200 ft is inhibited when the DH or MDA is set within 30 ft from the subject callout altitude.

14.15.35 WINDSHEAR DETECTION AND ESCAPE

GENERAL

The E-jets are equipped with the Windshear Detection and Escape Guidance System. This system provides Detection and Escape Guidance in case of a Windshear condition is encountered.

WINDSHEAR DETECTION

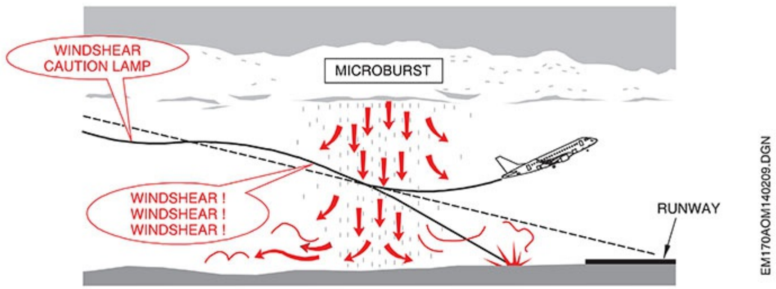
Windshear detection is activated between 10 ft and 1500 ft radio altitude during the initial takeoff, go-around and final approach phases of flight.

The label “WSHR” is displayed on the PFD when the Windshear Detection detects a windshear condition.

Windshear conditions will not be detected if either GPWS or the Radio Altimeter is unavailable.

According to the windshear insensitivity it is divided in two levels. Each one has distinctive aural and visual indications:

- Windshear Caution.
- Windshear Warning.



WINDSHEAR DETECTION

WINDSHEAR CAUTION

Increasing headwind and up drafts detection cause the annunciation of an amber WSHEAR on PFD and a CAUTION WINDSHEAR voice message.

EM170AOM140909A.DGN

WINDSHEAR WARNING

Decreasing headwind (or increasing tailwind) and down drafts detection cause the annunciation of a warning windshear condition through a red WSHEAR on PFD and a “WINDSHEAR; WINDSHEAR; WINDSHEAR” voice message.

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WINDSHEAR ESCAPE GUIDANCE MODE

The Windshear Escape Guidance Mode provides through the Flight Director a pitch command limited to stick shaker, and commands wings level to recover from a windshear, it minimizes altitude and airspeed loss during a windshear encounter.

It is indicated by a green “WSHR” annunciation on the FMA when activated.

The other flight director modes are canceled and the altitude pre-select, go-around and takeoff modes are inhibited while in a caution or warning windshear condition. No lateral mode is inhibited while in windshear mode.

WINDSHEAR ESCAPE GUIDANCE MODE ACTIVATION

The Windshear Escape Guidance Mode is activated in the following conditions:

- Manually when windshear warning or caution condition is detected and TOGA switch is pressed.
- Automatically when windshear warning condition is detected and thrust lever is set to TO/GA position.
- Automatically when windshear warning condition is detected and the FD mode is in TO or GA.

AUTOPILOT OPERATION DURING WINDSHEAR ESCAPE GUIDANCE

The Autopilot automatically disconnects and is accompanied by appropriate visual and aural alerts when the Windshear Guidance is activated.

THRUST RATE SYSTEM (TRS)

When a Windshear Caution or Warning condition is issued by the EGPWM, FADEC cancels any flex or derated thrust requirement.

When following the Windshear Escape Guidance, moving the thrust levers to MAX position will set the engine thrust to GA-RSV regardless the label presented on EICAS.

AUTOTHROTTLE OPERATION DURING ESCAPE GUIDANCE

AUTOTHROTTLE ENGAGED:

- The Autothrottle positions the Thrust levers to the TO/GA position.

NOTE: If the pilot manually advances the throttle lever beyond the TO/GA position, the Autothrottle will disconnect. The Autothrottle disconnection is accompanied by the appropriate visual and aural alerts.

AUTOTHROTTLE DISENGAGED:

- The pilot may engage the Autothrottle or manually position the thrust levers to TO/GA position.

WINDSHEAR SYSTEM TEST

All EGPWS warning functions including the windshear warning function are tested during cockpit self-test prior to takeoff. The self-test is activated using the MCDU test page.

NOTE: EGPWS self-test is inhibited if the airplane is on ground and the Steep Approach mode is activated.

During the test, an amber “REACTIVE WSHEAR FAIL” message is displayed on the EICAS. A red “WSHEAR” message is displayed on the PFD and a WINDSHEAR; WINDSHEAR; WINDSHEAR” aural message is annunciated. If the windshear warning function of the EGPWS is inoperative during the test, a “WINDSHEAR INOP” aural message is annunciated.

14.15.40 TRAFFIC COLLISION AVOIDANCE SYSTEM (TCAS)

The TCAS detects the nearby airplanes and display symbols to represent them. The relative or absolute altitude and the vertical motion of the other airplanes are information displayed with each symbol.

The TCAS monitors a potential collision hazard and alerts the flight crew. It interrogates the mode A, mode C and mode S operating transponders in other airplanes and calculates the flight path of the possible intruder airplane.

If the intruder airplane is also equipped with operating TCAS, the systems will communicate with each other to coordinate and generate guidance for the optimal avoidance maneuver.

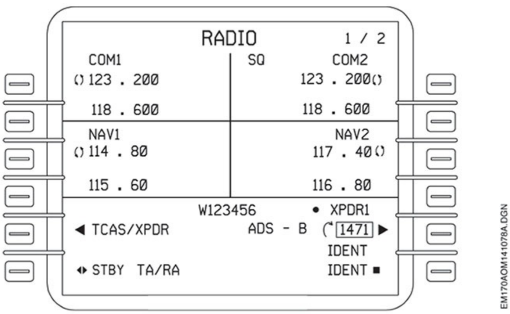
NOTE: Intruder airplanes that do not have operating transponders are invisible to the TCAS.

The installed TCAS 7.1 system is fully compliant with the requirements of EU 1332/2011.

TCAS OPERATION ON THE MCDU

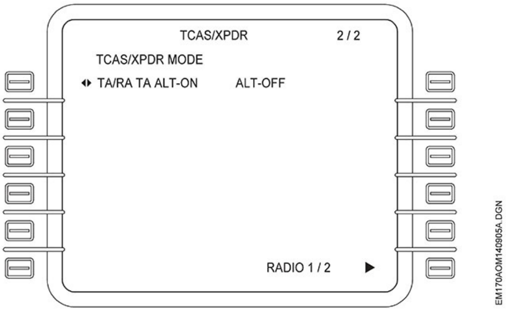
Pressing the radio button on the MCDU, the display will show the radio pages. On the lower portion of the radio menu page 1/2 is shown the TCAS/XPDR modes. By pressing the LSK 6L is possible to select the TCAS mode to TA/RA or STBY.

On LSK 4R and 6R are displayed the selected XPDR code and the IDENT request, respectively.



By pressing line select key 5L the TCAS/XPDR detail page 2 of 2 will be displayed. To select the desired mode the LSK 1L needs to be pressed as many times as needed. The modes are the following:

MODE	XPDR Replies		TCAS
	Modes	Altitude	
STANDBY	None	No	Disabled
ALT-OFF	A and S	No	Disabled
ALT-ON	A, C and S	Yes	Disabled
TA	A, C and S	Yes	TA only
TA/RA	A, C and S	Yes	TA/RA



TCAS STATUS ANNUNCIATIONS

The TCAS information is displayed on the MFD and PFD. There are six types of TCAS mode annunciations:

- TCAS FAIL – This annunciation is displayed when a TCAS failure is indicated by TCAS data, when TCAS data is invalid or when TCAS data was not correctly received for 10 s.
- TCAS TEST – This annunciation is displayed when the TCAS computer indicates functional test is active.
- TCAS OFF – This annunciation is displayed when TCAS provides a valid indication that the computer is in stand by mode.
- TA ONLY – This annunciation indicates that the TCAS is not selected to provide resolution advisories or is inhibited. The TA mode provides only surveillance of the surrounding airspace. In this mode, TCAS tracks proximate airplane and generates traffic advisories; no resolution advisories are issued in this mode.
- TA/RA – This annunciation is displayed when TCAS provides a valid indication that the computer is in TA/RA mode. This annunciation is only displayed on both TCAS MFD displays. TA/RA mode is the normal operation mode providing full TCAS coverage. In this mode, TCAS tracks airplane in the surrounding airspace and generates traffic advisories or resolution advisories, as the situation requires.
- TCAS RA FAIL – This annunciation indicates that TCAS is not able to provide resolution advisories. The annunciation is displayed if the resolution advisory data is invalid or not received for 5 s or if information required to display the TCASRA data on the PFD is missing or failed (e.g., if attitude, or groundspeed is failed or missing). This annunciation is only displayed on the PFD.

TCAS ALTITUDE RANGE MODES

The altitude range is an altitude region in which targets will be displayed from the present position altitude. There are four different ways to set the TCAS altitude range:

- NORMAL: shows targets that are within 2700 ft above or below current airplane altitude.
- ABOVE: shows targets that are within 9900 ft above and 2700 ft below current airplane altitude.
- BELOW: shows targets that are within 2700 ft above to 9900 ft below current airplane altitude.
- EXPANDED: shows targets that are within 9900 ft above or below current airplane altitude.

TRAFFIC DATA

The traffic data, made up of two or three-digit number, a plus (+) or a minus (-) sign, and which may also include an arrow, appears either above or below the intruder airplane symbol on the MFD.

- RELATIVE ALTITUDE: two digit numbers, preceded by a plus (+) or a minus (-) sign, represents the altitude in hundreds of feet. The digits are displayed above or below the symbol, according to position of other airplane.
- ABSOLUTE ALTITUDE: the default altitude display is relative to the airplane. When ABS is selected, the absolute altitude of the targets is displayed. The display automatically reverts to the relative altitude display when a TA or RA intruder is displayed or after 15 s. The flight level is displayed with three digital numbers above the symbol for airplanes above the reference. For airplanes below the reference, two digits followed by a minus (-) sign are displayed below the symbol.
- ARROW: a vertical arrow is displayed at the right side of each TA or RA symbol indicates vertical motion information greater than 550 ft/min.

TCAS PRESENTATION ON MFD

The TCAS system can be controlled through the MCDU and on the MFD by the CCD.

The TCAS map overlay and TCAS zoom format are available on the MFD. The map overlay format displays the TCAS information on the navigation MAP mode, on MFD.

To show TCAS on the Map Overlay is necessary to open the MAP menu on the MFD and then select TCAS.

The zoom format is displayed in the lower portion of MFD and has a range control. Only one format can be displayed at a time.

The range is selected using the CCD knob. The ranges selectable are 6, 12, 20, 40, 80 and 120 NM.

Zoom display shows up when the Map Overlay format is deselected.

Captain and First Officer’s TCAS controls on the MFD’s are totally independent from each other.

NOTE: If neither map overlay nor zoom format is displayed and the range is lower than 50 NM and a TA or RA condition is encountered, the zoom format is automatically displayed.

TCAS PRESENTATION ON PFD

When the TCAS detects an RA condition and a maneuver is recommended to increase the vertical separation (corrective RA), the flight director command bars are removed and one or two red trapezoidal avoidance zones and a green rectangular fly to zone are displayed. For RA condition where certain ranges of vertical speed are not recommended (preventive RA), only one red trapezoidal avoidance zone is displayed.

In the left lower portion of the PFD the TCAS status annunciation is displayed.

TCAS TRAFFIC IDENTIFICATION

The TCAS provides the following traffic identification:

RESOLUTION ADVISORY (RA)

- Is annunciated when other airplane is approximately 20 s to 30 s from the TCAS collision area.
- The TCAS provides recommended vertical maneuver to avoid traffic collision.
- Aural Warnings are sounded.
- It is represented as a red solid square.

TRAFFIC ADVISORY (TA)

- Is annunciated when other airplane is approximately 35 s to 45 s from the TCAS collision area.
- An Aural Warning is sounded.
- It is represented as an amber solid circle.

PROXIMATE TRAFFIC

- Cyan solid diamond: the other traffic is within 6.5 NM and 1200 ft above or below the airplane.
- Cyan hollow diamond: the other traffic is beyond 6.5 NM and within 2700 ft above or below the airplane.

NOTE: Other traffic is inhibited during TA or RA condition.

AURAL ANNUNCIATION

For TA conditions, the aural alert “TRAFFIC–TRAFFIC” is annunciated once.

The RA aural messages associated to displayed advisories may be the following:

- “INCREASE CLIMB; INCREASE CLIMB”: Increase immediately the rate of climb.
- “INCREASE DESCENT; INCREASE DESCENT”: Increase immediately the rate of descent.
- “CLIMB, CLIMB NOW!; CLIMB, CLIMB NOW!”: The airplane is descending and stop descending and immediate climbing is necessary to provide adequate separation.
- “DESCEND, DESCEND NOW! DESCEND, DESCEND NOW!”: The airplane is climbing and stop climbing and immediate descending is necessary to provide adequate separation.
- “CLIMB; CLIMB”: Begin to climb immediately at the indicated rate of climb.
- “DESCEND; DESCEND”: Begin to descent immediately at the indicated rate of descent.
- "LEVEL OFF, LEVEL OFF": Reduce the vertical speed to 0 ft/min.
- “CLIMB, CROSSING CLIMB; CLIMB, CROSSING CLIMB”: Start a climb at indicated rate. The flight path will cross traffic’s altitude.
- “DESCEND, CROSSING DESCEND; DESCEND, CROSSING DESCEND”: Start a descent at indicated rate. The flight path will cross traffic’s altitude.
- “MONITOR VERTICAL SPEED”: Certain changes in vertical speed may not be safe.
- “MAINTAIN VERTICAL SPEED, MAINTAIN”: Maintain vertical speed rate.
- “MAINTAIN VERTICAL SPEED, CROSSING MAINTAIN”: Adjust vertical speed to the rate indicated.

When the TCAS confirms no conflict condition and the separation is increasing, a “CLEAR OF CONFLICT” advisory is announced.

TCAS WARNING INHIBITIONS

The INCREASE DESCENT command is inhibited at altitudes below 1450 ft AGL during descent, or below 1650 ft AGL during climb.

The DESCENT command is inhibited at altitudes below 1000 ft AGL during descent, or below 1200 ft AGL during climb.

The TCAS automatically reverts to TA ONLY mode and inhibits RAs for altitudes below 900 ft AGL during descent, or below 1100 ft during climb.

The TAs are inhibited for airplanes at altitudes below 380 ft AGL.

All TCAS aural advisories are inhibited when the present position altitude is below 400 ft AGL during descent, or 600 ft AGL during climb.

No CLIMB commands or INCREASE CLIMB commands are issued at or above 34000 ft MSL. No other inhibits are implemented for the Climb or Increased Climb functions.

14.15.45 EICAS MESSAGES

TYPE	MESSAGE	MEANING
WARNING	NO TAKEOFF CONFIG	Airplane is not in a valid takeoff configuration.
CAUTION	AURAL WRN SYS FAIL	Both aural warning channels are failed or off.
	CREW WRN SYS FAULT	Monitor warning A or B has failed.
	GND PROX FAIL	Ground proximity function in EGPWS has failed or; GND PROX – G/S INHIB is pushed in for more than 15 seconds or; GND PROX – FLAP OVRD is pushed in for more than 60 seconds with airspeed above 250 kt.
	TERRAIN FAIL	Terrain function in EGPWS has failed.
	REACTIVE WSHEAR FAIL	Windshear function in EGPWS has failed.
ADVISORY	AURAL WRN SYS FAULT	One aural warning channel is failed or off.
	AVNX MAU 1 (2) (3) A (B) FAULT	The associated MAU channel suffered failure condition(s) that does not affect its functionality, but may cause loss of redundancy.
	TCAS FAIL	TCAS has failed.
	TERRAIN NOT AVAILABLE	Terrain databases not cover the airplane flying area.