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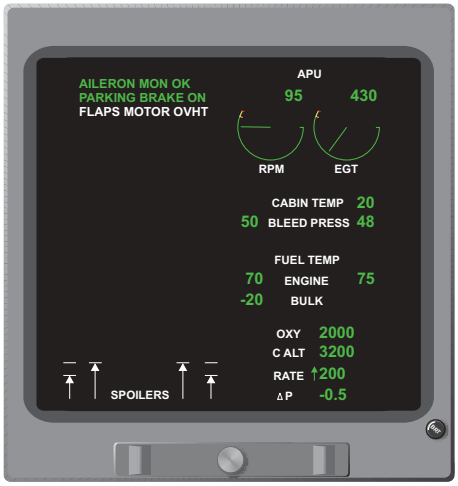
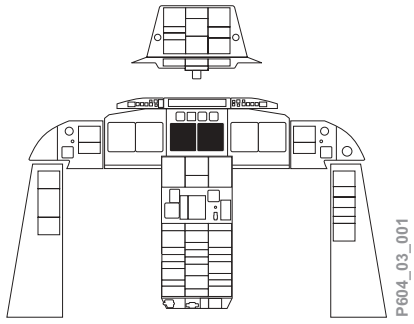
Introduction

The aural and visual warning system components provide the flight crew with aural, visual and tactile indications of potentially unsafe conditions as well as information about airplane configurations and engine data. The system also warns of airplane system malfunctions and non-normal situations.

EICAS DISPLAY 1 (ED 1)

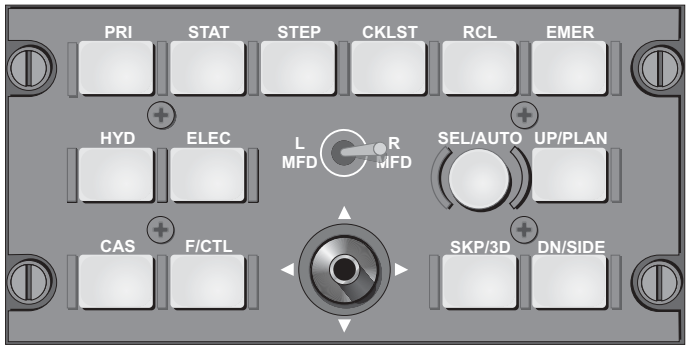


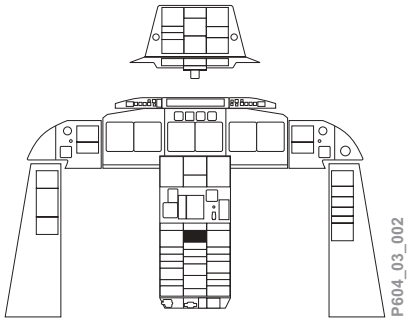
EICAS DISPLAY 2 (ED 2)



EICAS Displays Location

Figure 3-1





EICAS Control Panel (ECP)

Figure 3-2

Engine Indicating and Crew Alerting System (EICAS)

Description

The function of the EICAS is to display the engine instruments and to provide visual and aural crew-alert messages and real-time interpretation of aircraft system operation.

Two EICAS displays present the data on different selectable display pages. Some display pages are shown by default, others are available through crew selection. The EICAS control panel (ECP), located on the center pedestal, controls the displayed information.

Engine indications are provided on the EICAS primary page. Color is used to depict normal and non-normal ranges of operation.

The Crew Alerting System (CAS) provides visual and aural alerts as determined by the Data Concentrator Unit (DCU) upon occurrence of a malfunction. The CAS prioritizes messages by order of occurrence and order of importance.

Components and Operation

EICAS Control Panel

The EICAS control panel is located on the center pedestal. The panel remains illuminated during a complete AC power failure and the PRI, STAT, STEP and CAS keys remain operational.

EICAS Displays

The EICAS displays are computer-controlled video displays. EICAS display No. 1 (ED 1) is installed on the left of the center instrument panel and EICAS display No. 2 (ED 2) is installed on the right of the center panel (Figure 3-1).

The EICAS displays present system information on primary, status, synoptic and menu pages. ED 1 displays the primary page by default. ED 2 is defaulted to the status page. Page selection is accomplished via the ECP (Figure 3-2).

Data Concentrator Unit (DCU)

The data concentrator unit is the heart of the EICAS. The DCU collects data from various aircraft systems, processes the information and relays it to the proper component or display. In a standard configuration, there are two DCUs installed in the aircraft. They are designated DCU 1 and DCU 2. An optional third DCU can be installed and is labeled DCU 3 as per service bulletin 604-31-001.

All DCUs share in providing information to the EICAS displays. Internal switching logic determines how the information is provided by the two or three DCUs. If a partial or complete failure of a DCU occurs, system redundancy ensures that no displayed data is lost. In aircraft with the optional third DCU, an additional level of redundancy is provided.

Data concentrator units receive inputs from the following systems:

- Engines
- Landing gear
- Flaps
- Spoilers
- Auxiliary Power Unit (APU)
- Flight controls
- Avionics
- Stall Protection System
- Ground Proximity Warning System (GPWS)
- Traffic Alert and Collision Avoidance System (TCAS)
- Crew Alerting System (CAS)
- Air Data Computer (ADC) altitude alerting

The DCUs process and format this information then transmit the data on the ARINC bus to the following:

- EICAS displays
- Lamp Driver Unit (LDU)
- Audio Electronic Control Unit (AECU)
- Flight Data Recorder (FDR)
- Maintenance Diagnostic Computer (MDC)

The two-channel lamp driver unit receives information from the DCUs and controls the associated panel and glareshield switch/light illumination.

When a DCU generates an EICAS message, the data is sent to the LDU. The LDU then interprets the information and illuminates the switch/light on the appropriate control panel.

Should one channel of the LDU fail, the remaining channel continues to operate. Testing the LDU and panel lamps is accomplished by using the test switch located on the miscellaneous test panel. The three-position LAMP TEST switch is spring-loaded to the center OFF position. Holding the switch to position 1 or 2 tests the associated LDU channel and lamps.

NOTE

AC power is required to perform the lamp test.

Controls and Indicators

Master Warning Switch/Lights

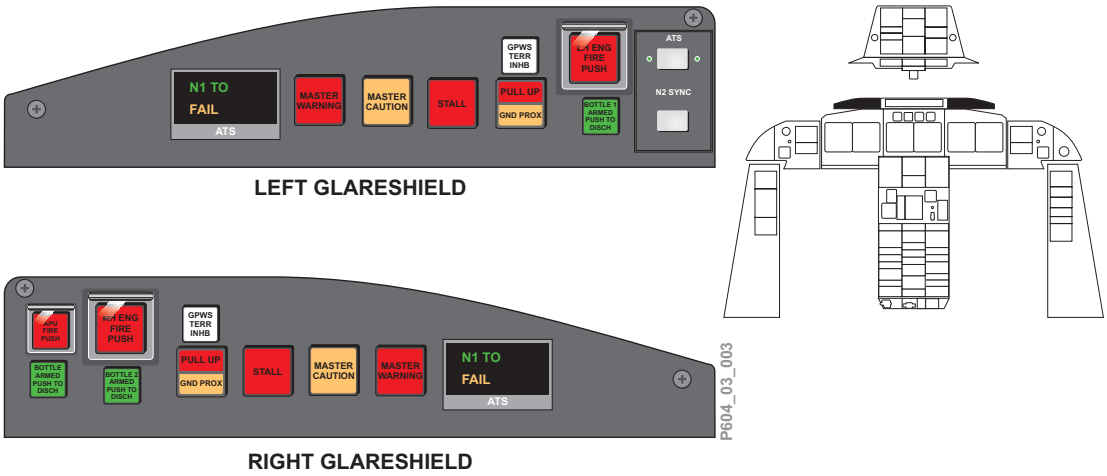
The master warning switch/lights are located on the glareshield. When the DCUs generate a warning message, the two master warning switch/lights flash red. A triple attenson always accompanies the master warning lights and, in addition, dedicated tones or voice messages may sound.

When the switch/light is pressed, the flashing red light and the audio alerts are reset.

Master Caution Switch/Lights

The master caution switch/lights are located on the glareshield. When the DCUs generate a caution message, the two master caution switch/lights flash amber. A single attenson always accompanies the master caution lights.

When the switch/light is pressed, the flashing amber light is reset.



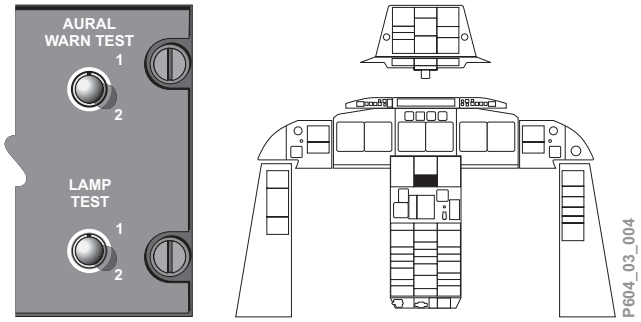
Master Warning and Caution Lights

Figure 3-3

Aural Warning Testing

A two-position spring-loaded to neutral AURAL WARN TEST switch is located on the miscellaneous test panel. The switch is used to test the audio outputs of the DCUs.

When the switch is selected to position 1 or 2 and released, DCU 1 or DCU 2 aural and voice warnings are sounded sequentially. When the switch is selected again, the test is interrupted.



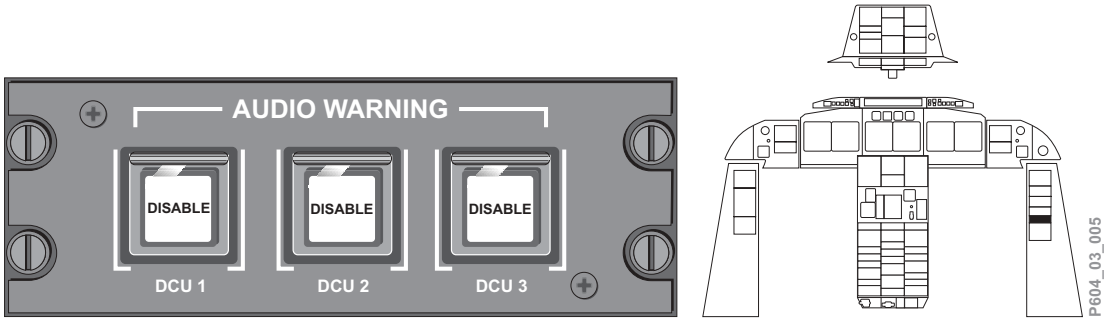
AURAL WARN / LAMP TEST Panel
Figure 3-4

SOUND	INDICATION
WARBLER	STALL
FIRE BELL	FIRE WARNING
CLACKER	VMO / MMO, FLAP OVERSPEED
CLACKER “DRUM ROLL”	EXCESSIVE STAB TRIM MOVEMENT
CAVALRY CHARGE	AUTOPILOT DISCONNECT
HORN	GEAR NOT DOWN
C-CHORD	ALTITUDE ALERT
DOUBLE C-CHORD	VERTICAL TRACK ALERT
TRIPLE ATTENSON	PRECEDES ANY WARNING MESSAGE
SINGLE ATTENSON	PRECEDES ANY CAUTION MESSAGE
VOICE	VOICE WARNINGS

Aural Warning Test Sounds
Table 3-1

Aural Alert Disable

Two (third optional) DISABLE switch/lights, located on the AUDIO WARNING panel on the copilot side console, are used to disable and silence the aural warnings of a malfunctioning DCU. When DCU 1 is selected to DISABLE, DCU 2 will provide the aural warning function. When both DCU 1 and 2 are disabled, the optional DCU 3 (if installed) provides the aural warnings. The ground proximity warning system (GPWS) and the traffic alert and collision avoidance system (TCAS) aural warnings are not disabled by selections at the audio warning panel.



DCU Disable Controls
Figure 3-5

NOTE

In order to test DCU 3 audio warnings, DCU 1 or 2 must be disabled from the audio warning disable panel.

EICAS Control Panel

PRI

Selecting PRI causes the primary page to be displayed on ED 1.

STAT

Pressing the STAT button causes the status page to be displayed on ED 2. If the status page is already displayed, the button will remove the status message(s) and display a white MSGS icon. Pressing the STAT a second time will cause the status message(s) to reappear. DCU generation of a new status message will remove the MSGS icon and the new status message will be displayed on the top of the status message stack.

STEP

The STEP button will sequentially step through all available pages, including primary, secondary and synoptic. There are four synoptic pages. Synoptic pages use a schematic format that includes relevant system operating parameters. Three synoptic buttons can access the synoptic pages directly.

HYD

Selecting the HYD synoptic button displays the hydraulic system.

ELEC

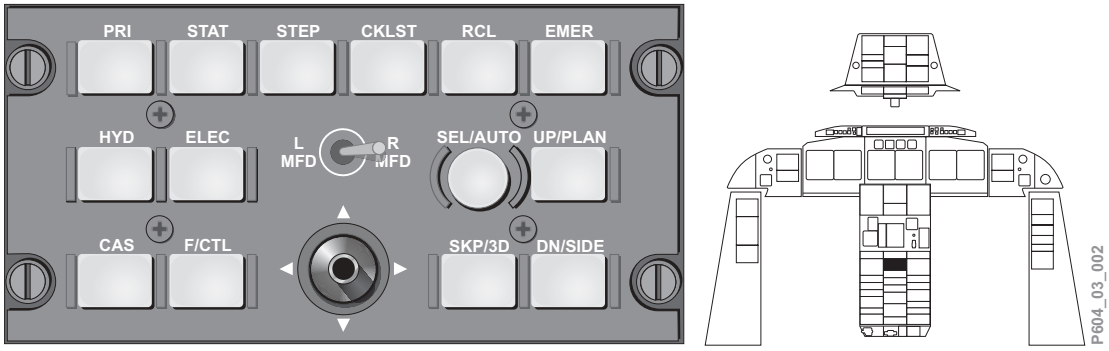
Selecting the ELEC synoptic button displays the AC electrical system. Selecting the button a second time displays the DC electrical system. Further selections will alternately cycle through the AC and DC pages.

CAS

During flight or on the ground when both engines are stabilized at idle, it is possible to remove the displayed caution message(s) from the primary page. Selecting the CAS button will remove the caution messages and display a white MSGS icon. Pressing the CAS button a second time will cause the caution message(s) to reappear. If a new caution is generated, the MSGS icon will be removed and the new message will be displayed on the top of the caution message stack.

F/CTL

Selecting the F/CTL synoptic button displays the flight control system.



EICAS Control Panel

Figure 3-6

EICAS Primary Page

ED 1's default display is the EICAS primary page.

Engine Indications

Engine indications are presented in both traditional analog gauge format and digital readouts. Displayed engine parameters include:

- N_1 speed gauge
- N_1 Takeoff thrust setting
- Inter-Turbine Temperature (ITT) gauge
- N_2 speed gauge
- fuel flow
- oil pressure
- oil temperature
- fan vibration

Fuel Quantity

In the bottom left-hand corner of the primary page, EICAS provides the pilot with a summary of current fuel quantities. This includes the individual main tank quantities, the auxiliary tank system total quantity, the tail tank system total quantity and the aircraft's total fuel quantity readout.

Crew Alerting System Messages

Warning and Caution messages are presented only on the EICAS primary page.

Cabin Pressurization

Cabin pressurization data is displayed on the primary page when the pressurization control (PRESS CONT) switch is selected to MANUAL on the Cabin Pressurization control panel. This function is further explained in the Air Conditioning/Pressurization chapter.

Landing Gear and Flaps

Landing gear and flap position information is presented on the EICAS primary page. During flight, the landing gear and flap information is removed from view after 30 seconds when both of the following conditions exist:

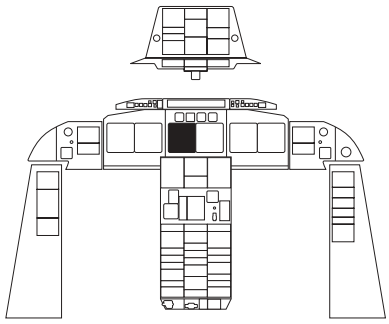
- landing gear is up and locked
- flaps are up

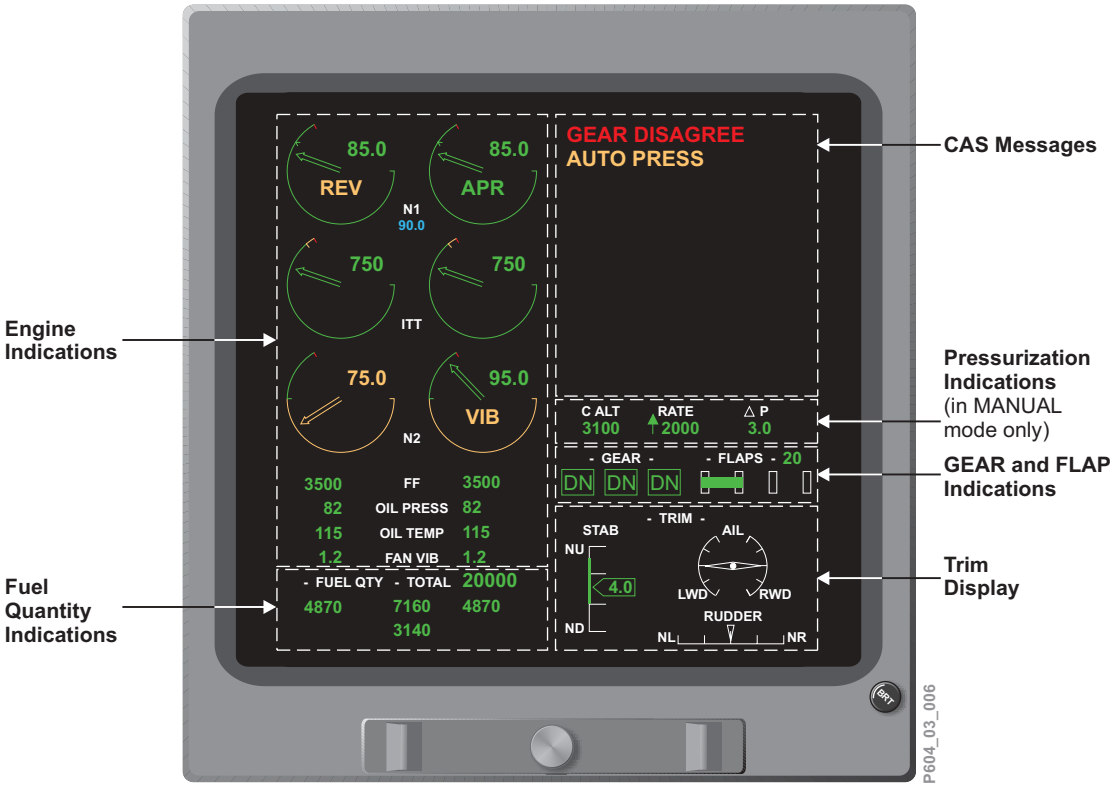
Landing Gear Horn

A landing gear horn will sound if certain parameters are not met with respect to combinations of altitude, speed, flap and power lever positions. (See Chapter 15 Landing Gear and Brakes)

Trim Settings

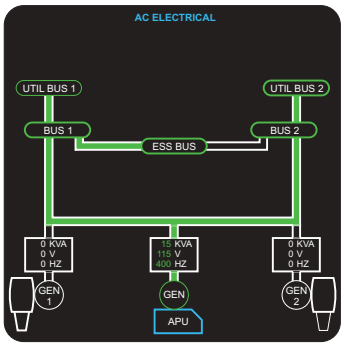
Aileron, horizontal stabilizer and rudder trim settings are continuously displayed on the primary page.



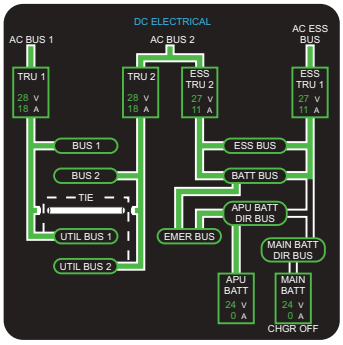


EICAS Primary Page

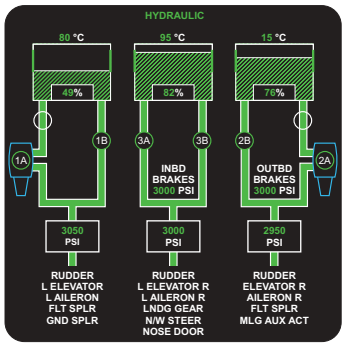
Figure 3-7



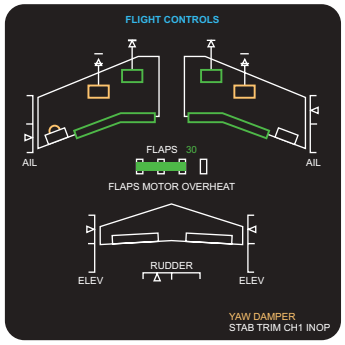
AC ELECTRICAL



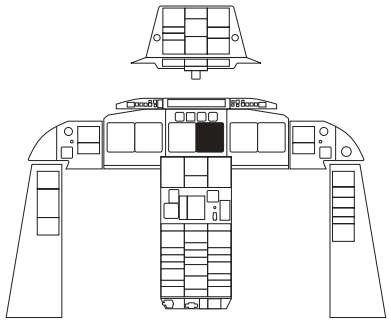
DC ELECTRICAL

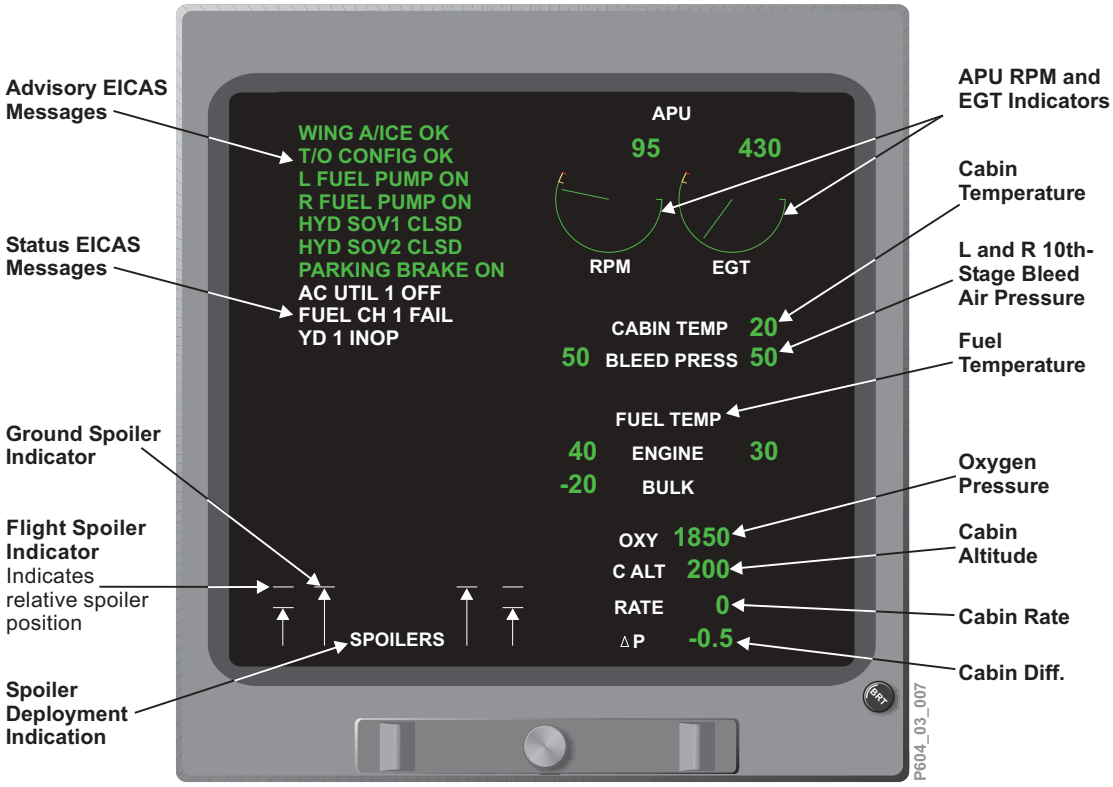


HYDRAULIC



FLIGHT CONTROLS





EICAS Status Page Displays

Figure 3-8

EICAS Status Page

The status page is the default display of ED 2.

Crew Alerting System Messages

Advisory and status messages are presented only on the EICAS status page.

Flight Spoilers

When deployed, the flight spoilers' extension will be presented at the bottom left-hand corner of the EICAS status page. When retracted, the display disappears.

Auxiliary Power Unit

The APU RPM and EGT gauges are displayed on the EICAS status page when the APU PWR FUEL switch is selected.

Cabin Temperature

The cabin temperature is displayed in degrees Celsius.

Bleed Air Pressure

The bleed air pressure of the left and right 10th-stage manifold is indicated in pounds per square inch (psi).

Fuel Temperature

The fuel temperatures at the engines and in the left main tank (bulk) is provided in degrees Celsius.

Oxygen Pressure

The gaseous oxygen pressure is continuously displayed on the status page. Green indicates normal pressure and amber identifies pressure below 800 psi.

Cabin Pressurization

Cabin pressurization is displayed on the status page. The information includes:

- cabin altitude in feet
- rate of climb or descent in feet/minute
- differential pressure in psi

Synoptic Pages

Synoptic pages are normally displayed on ED 2. In cases of ED 2 failure or crew preference, they can also be displayed on ED 1 or on a MFD.

The synoptic pages provide the pilot with real-time interpretation of aircraft hydraulic, electrical and flight controls system operation. Color logic is used to depict normal, precautionary and maximum system limit as follows:

- normal range, indication is green
- precautionary range, the system indicator turns amber
- exceeds the limits, the indicator turns red

Flow lines are used on a number of synoptic pages. Although not all pages will display the four colors, generally the color logic is as follows:

- black, indicates no flow
- amber, indicates below normal values
- green, indicates normal value
- red, indicates exceeding normal values

EICAS Messages

The Crew Alerting System (CAS) provides visual and aural alerts when the DCUs detect a malfunction. The CAS prioritizes messages by order of occurrence and categorizes them by importance as follows:

- order of occurrence: The most recent message appears on the top of its message category
- order of importance: There are four levels of CAS message importance: Warning, Caution, Advisory and Status

Warning Messages

The most urgent messages are called Warnings and are red in color. Warning messages are presented on the top of the primary page and remain in view until the problem is resolved.

Warning messages require immediate action and are always accompanied by:

- a triple attenson
- flashing master warning lights
- red light on the faulted control switch or a red indication on EFIS, EICAS, or a synoptic page

Warning messages, in addition to the above indications, can also generate one or both of the following:

- aural warning tone
- voice message

Pressing either master warning switch/light:

- silences the aural alerts
- stops the master warning lights from flashing
- resets the switch/light to allow it to indicate another fault

Caution Messages

Caution messages are second in order of importance. Caution messages are presented in amber on the primary page and appear directly below any warning messages that may be displayed. It is possible to have more than one page of caution messages. The CAS pushbutton on the ECP allows the pilot to page forward and backward to view the entire list of caution messages. During flight or on the ground when both engines are stabilized at idle, caution message(s) can be removed from view or recalled to the screen by pressing the CAS key on the ECP. A white MSGS icon will appear, advising the crew that the caution message(s) are out of view. Pressing the CAS button a second time will cause the caution message(s) to reappear. DCU generation of a new caution message will remove the MSGS icon and the new message will be displayed on the top of the caution message stack.

Caution messages require prompt action and are always accompanied by:

- a single attenson
- flashing master caution lights
- amber light on the faulted control switch or an amber indication on EFIS, EICAS, or a synoptic page

Pressing either master caution switch/light:

- stops the flashing of the master caution lights
- resets the master caution switch/light to allow it to annunciate another fault

Advisory Messages

Green advisory messages are presented at the top of the status page. Advisory messages cannot be removed from view until the cause is deselected or deactivated. Advisory messages are used to advise of:

- aircraft configuration for a particular phase of flight
- successful system test
- confirmation of SOV closure
- SELCAL

Status Messages

White status messages are presented on the status page and appear directly below any advisory messages that may be present. Status message(s) can be removed from view or recalled to the screen by pressing the STAT key on the ECP. A white MSGS icon will appear, advising the crew that the status message(s) are out of view. Pressing the STAT button a second time will allow the status message(s) to reappear. DCU generation of a new status message will remove the MSGS icon and the new message will be displayed on the top of the status message stack. Status messages are used to inform of:

- status of a specific system that has been manually or automatically activated/ deactivated
- low-priority system failures

Takeoff Configuration Warning

The Takeoff Configuration Warnings are armed on the ground when both engines accelerate as a result of thrust levers being advanced above 70% N_1. A voice warning, an EICAS warning message and flashing red Master Warning annunciators are provided for any of the following conditions:

CONDITION	VOICE WARNING	EICAS MESSAGE	MASTER WARNING
AUTOPILOT ENGAGED	“CONFIG AUTOPILOT”	CONFIG AP	FLASHES
FLAPS NOT SET FOR TAKEOFF	“CONFIG FLAPS”	CONFIG FLAPS	FLASHES
ALL SPOILERS NOT IN TAKEOFF POSITION	“CONFIG SPOILERS”	CONFIG SPOILERS	FLASHES
HORIZONTAL STAB NOT IN T/O RANGE	“CONFIG TRIM”	CONFIG STAB	FLASHES
PARKING BRAKE SET	“CONFIG BRAKES”	PARKING BRAKE	FLASHES

Takeoff Configuration Warnings
Table 3-2

All TOC warnings are canceled when the configuration error is corrected.

Inhibited EICAS Caution Messages

During takeoff and landing, the DCU logic inhibits distracting EICAS caution messages. The logic inhibits messages during takeoff when the left and right engine N_1 are greater or equal to 79% and above 80 kts with weight-on-wheels. On landing, the messages are inhibited when radio altitude is less than 400 feet above ground level (AGL) with landing gear extended.

The inhibit logic is removed when:

- left and right engine N_1 are less than 67.6%; or
- radio altitude is greater than 400 feet AGL with the landing gear extended; or
- 30 seconds after the inhibit starts; or
- 30 seconds after the air-to-ground transition

Caution messages and their associated aural alerts that are NOT inhibited during takeoff and landings are shown in the following table.

AIRPLANE SYSTEM	CAUTION MESSAGE NOT INHIBITED	TAKEOFF	LANDING
POWER PLANT	APR INOP	√	√
	APR CMD SET	√	
	L (R) REV UNLOCKED	√	√
	L (R) REV UNSAFE	√	√
AUTOMATIC FLIGHT CONTROL SYSTEM	AP TRIM IS LWD (RWD) (ND) (NU)		√
	AP PITCH TRIM		√
	YAW DAMPER		√
FIRE PROTECTION	APU BTL LO		√
	ENG BTL 1 (2) LO		√
FLIGHT CONTROLS	ELEVATOR SPLIT	√	√
	FLAPS FAIL		√
	FLT SPLRS		√
	FLT SPLRS DEPLOY		√
	GND SPLRS		√
	GND SPLRS DEPLOY	√	√
	GND SPLRS NOT ARMED		√
	STAB TRIM		√
FUEL	FUEL IMBALANCE		√
	L (R) FUEL LO PRESS	√	√
HYDRAULICS	HYD 3 LO PRESS		√
INSTRUMENTS	EFIS COMP MON	√	√
LANDING GEAR	A/SKID INBD (OUTBD)	√	√
	INBD (OUTBD) BRAKE PRESS	√	√
	PROX SYS		√
	STEERING INOP		√
	WOW INPUT OR OUTPUT		√

Caution Messages Not Inhibited during Takeoff and Landing

Table 3-3

Display Reversionary Control

EICAS Reversionary Mode

The EICAS reversionary mode provides an alternate method of displaying EICAS information should ED 1 or ED 2 fail.

In the event of ED 1 failure, the primary page is automatically transferred to ED 2. This automatic feature ensures that engine indications and warning and caution messages are always available to the pilot. There is no automatic transfer of status page information should ED 2 fail.

Display Reversionary Control Panel

The display reversionary control panel is located on the center pedestal. The reversionary selector switches (L MFD, EICAS, R MFD) are used when a malfunction exists.

The L MFD and R MFD reversionary switches are identical, and have three positions designated as PFD, NORM and EICAS. In EICAS position, the status-page information is displayed by default on the MFD.

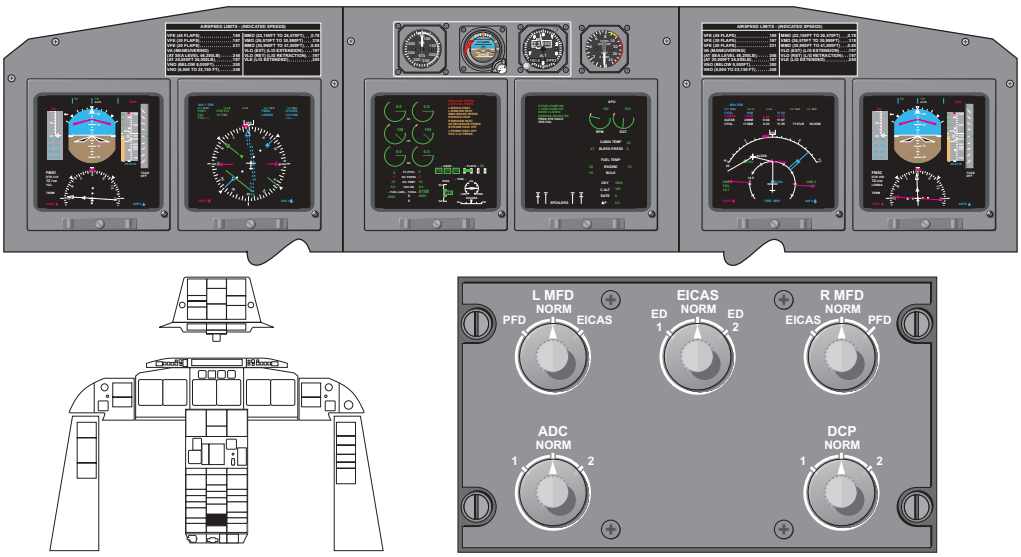
The EICAS reversionary selector is also a three-position switch designated as NORM, ED 1 and ED 2. In the NORM position, normal EICAS display is represented on ED 1 and ED 2. When the selector is moved to either ED 1 or ED 2 position, the opposite ED is disabled and blanked while the primary and secondary information is available on the selected display.

PFD Reversionary Mode

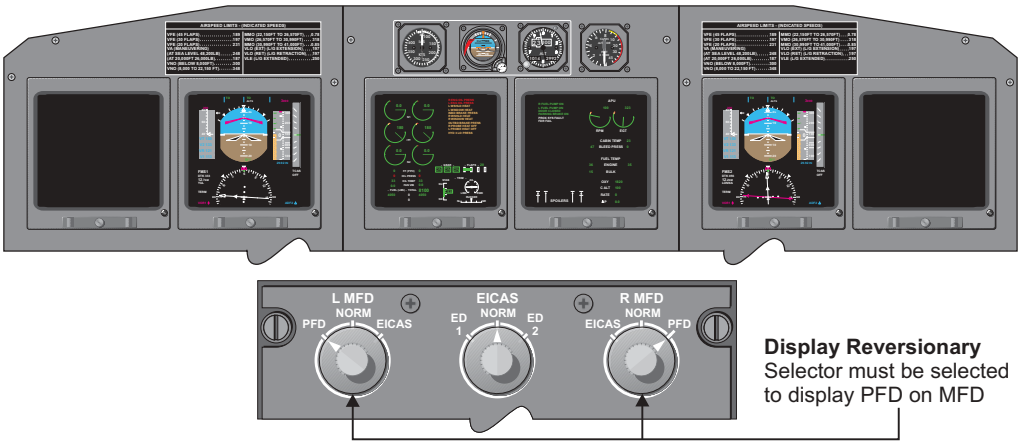
When a primary flight display (PFD) fails, the information can be transferred to the associated MFD. The L (R) MFD rotary knob on the display reversionary control panel, when selected to the PFD position, effects the transfer.

MFD Reversionary Mode

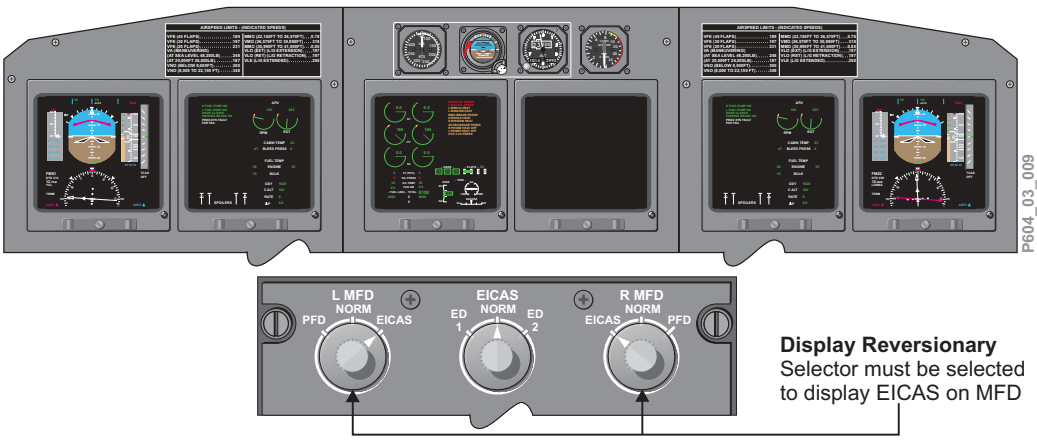
There is no reversionary mode for the data normally presented on the multifunction displays (MFDs).



REVERSIONARY SELECTORS -
DISPLAY REVERSIONARY CONTROL PANEL



Display Reversionary
Selector must be selected
to display PFD on MFD



Display Reversionary
Selector must be selected
to display EICAS on MFD

P604_03_009

Display Reversionary Control Panel

Figure 3-9

Maintenance Diagnostic Computer

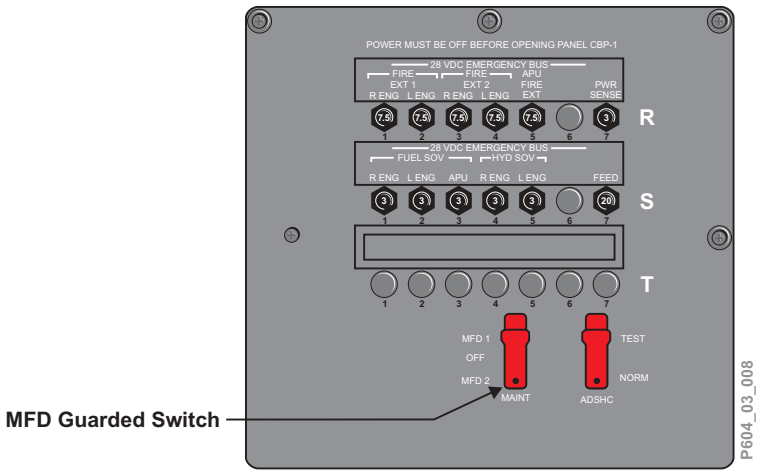
Description

The maintenance diagnostic computer (MDC) is an onboard computer that is used to record aircraft mechanical and avionics system data. Maintenance personnel can retrieve the information for use in engine trend analysis, significant event recording and for avionics/aircraft system failure detection.

Operation

The MDC continuously records data for fault analysis and engine trend monitoring. The MDC data is downloadable to a maintenance facility computer.

MDC data is available on the flight deck by means of a red guarded switch on circuit breaker panel number one (CBP 1). Data can be displayed on MFD 1 or MFD 2, as determined by switch selection. Instructions on MDC data presentation are displayed on the selected MFD.



CIRCUIT BREAKER PANEL CBP - 1
(LOWER)

Maintenance Diagnostic Computer Switch

Figure 3-10

Flight Data Recorder

Description

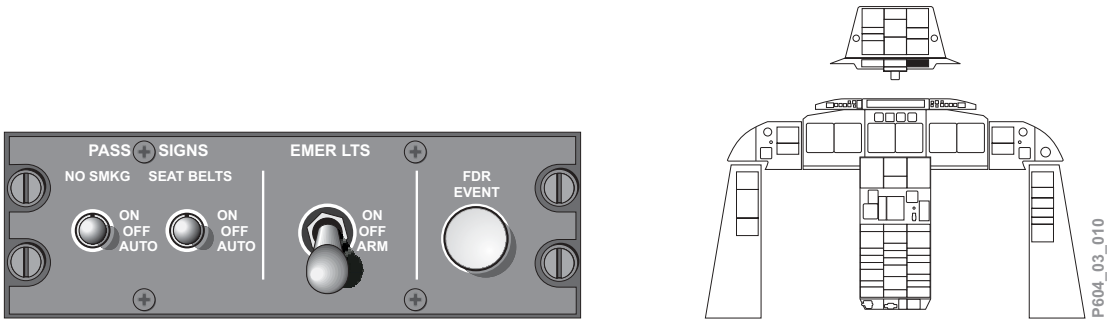
The flight data recorder (FDR) records aircraft flight parameters. The FDR system includes a digital FDR, an underwater locator device (ULD) and a triaxial accelerometer. (See also Chapter 6 Communications)

Components and Operation

The FDR is located in the aft equipment bay and records the last 25 hours of flight data in a solid-state memory. The FDR is specially constructed to survive the shock of an aircraft crash. It is automatically turned on when the right engine start switch is pushed.

FDR EVENT Switch

The FDR EVENT switch is located on the PASS SIGNS and EMER LTS panel. When the FDR EVENT switch is pushed, the DCUs place a marker into the FDR memory for quick data retrieval of the recorded event. A green advisory message FDR EVENT is then displayed on the secondary EICAS page.



FDR EVENT Switch

Figure 3-11

EICAS Messages

MESSAGE	MEANING
EICAS COMP INOP	EICAS comparator inoperative (N_1, N_2 or ITT data comparison not active).
FDR EVENT	FDR EVENT marker switch pushed and FDR installed.
CAS MISCOMP	Valid XTALK labels from another DCU are available, and a miscompare for any warning, caution, or aural messages exists for more than 20 seconds.
DCU 1, 2, (3)* AURAL INOP	DCU 1, 2, (3) * aural warning card fault/fault detection, or DCU 1, 2, (3)* AUDIO WARNING DISABLE switch/light input open.
DCU 1, 2, (3)* INOP	DCU 1, 2, (3) * fault detected.
FDR FAIL	Indicates flight data recorder failure.

* = if installed

EICAS Messages
Table 3-4