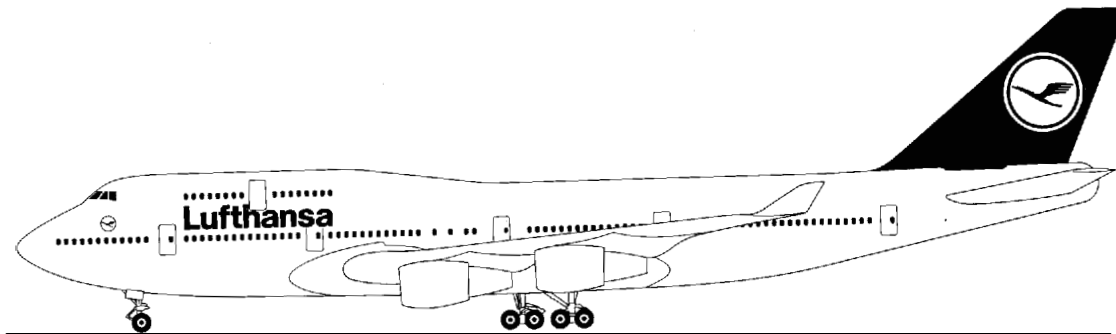




Lufthansa Technical Training

Training Manual B 747-400



ATA 31 Indicating/ Recording 31-61 Integrated Display System 31-25 Clocks Level 3



Lufthansa Technical Training

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ATA 31 INDICATING/ RECORDING SYSTEMS



31-61 INTEGRATED DISPLAY SYSTEM

INTRODUCTION

The integrated display system (IDS) is the result of the integration of the:

- electronic flight instrument system (EFIS) and the
- engine indicating and crew alerting system (EICAS)

into a single system.

Three identical EFIS/EICAS interface units (EIUs) get and process data from airplane systems for both EFIS and EICAS functions. The EFIS and EICAS information is shown on identical multicolored display units.

The 747-400 airplane is operated by a two-person crew.

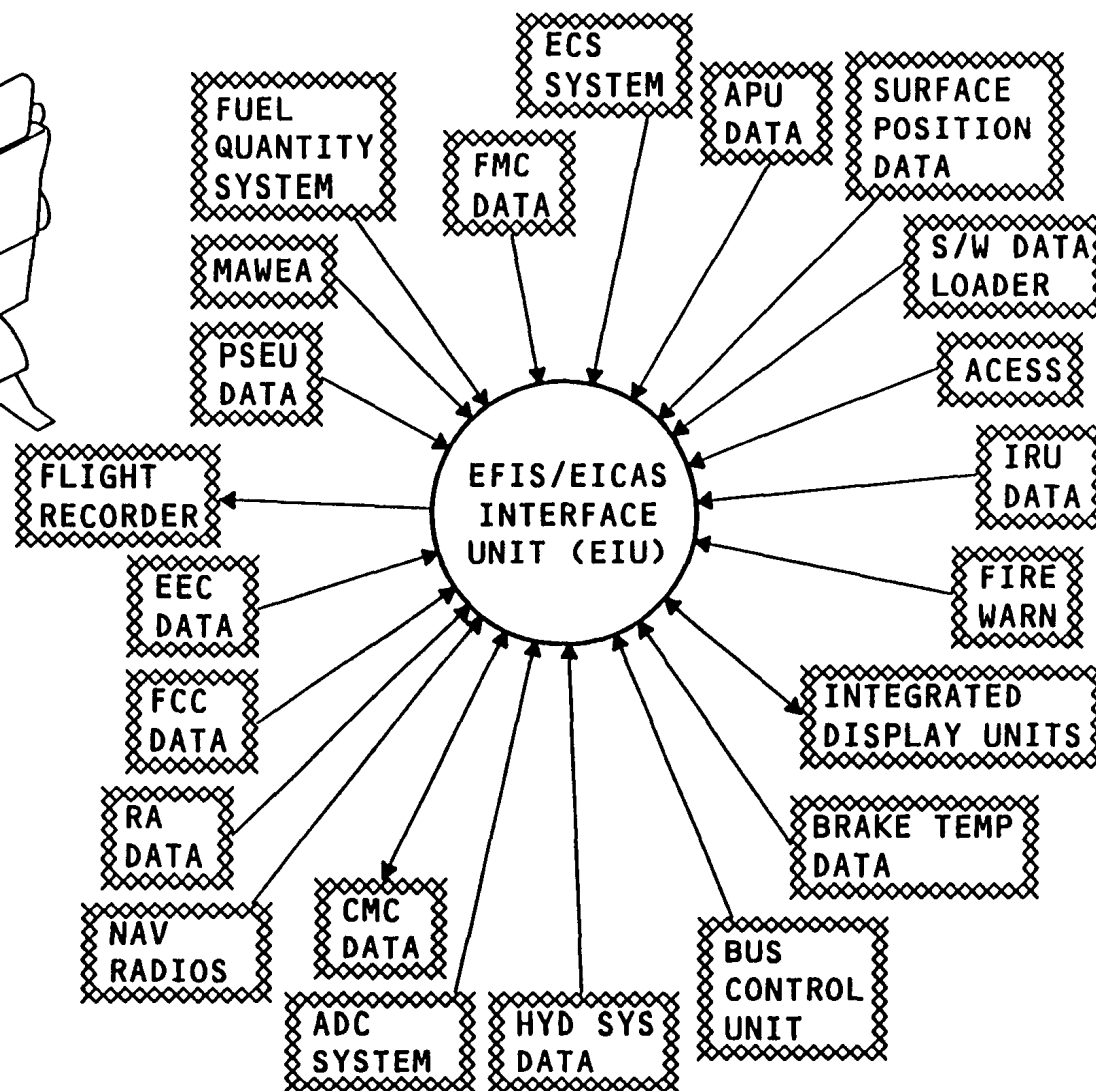
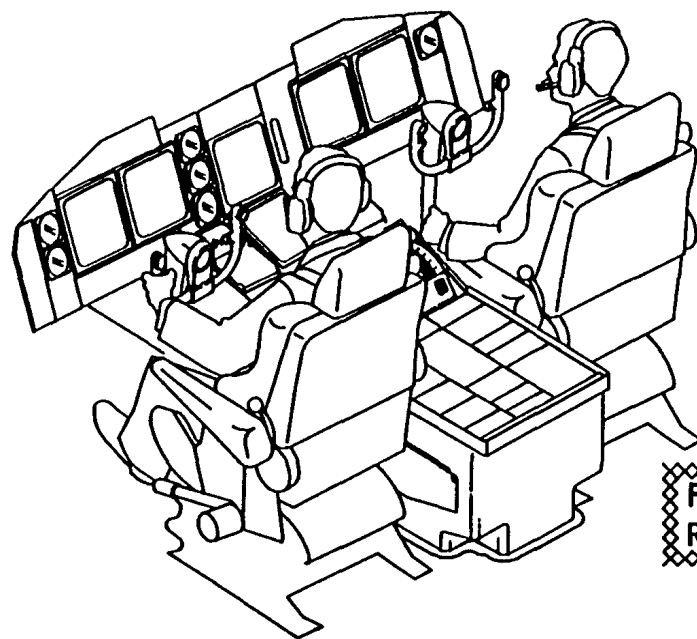


Figure 1 Integrated Display System (IDS) Introduction





INTEGRATED DISPLAY SYSTEM

Purpose

The integrated display system (IDS) provides displays of flight and airplane systems information. This information is shown on integrated display units (IDU). Normally cathode ray tubes (CRTs) are used in the flight deck for this purpose.

IDS also sends systems data to the central maintenance computer system (CMCS) and other computers.

General Description

IDS is divided into two subsystems that use the same hardware to process data. These two subsystems are the:

- Electronic flight instrument system (EFIS)
- Engine indicating and crew alerting system (EICAS)

The subsystems consist of:

- Six identical and interchangeable integrated display units (IDUs)
- Three identical and interchangeable EFIS/EICAS interface units (EIUs)
- Flight deck control panels

General Data Flow

The majority of data goes directly to the EIUs, processed inside the EIUs and sent to the IDUs for display. Some EFIS data is sent directly to the IDUs.

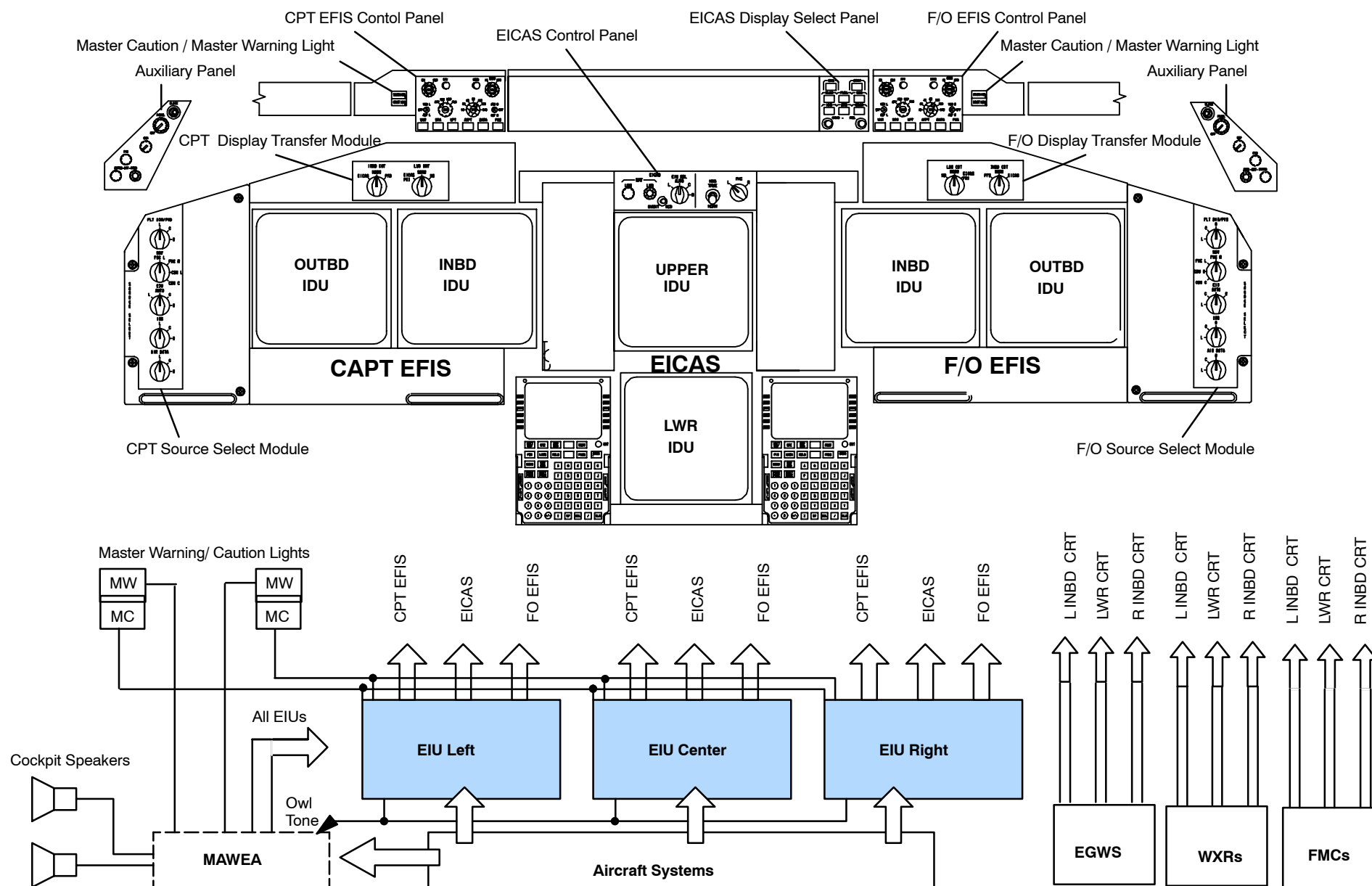


Figure 2 IDS Architecture

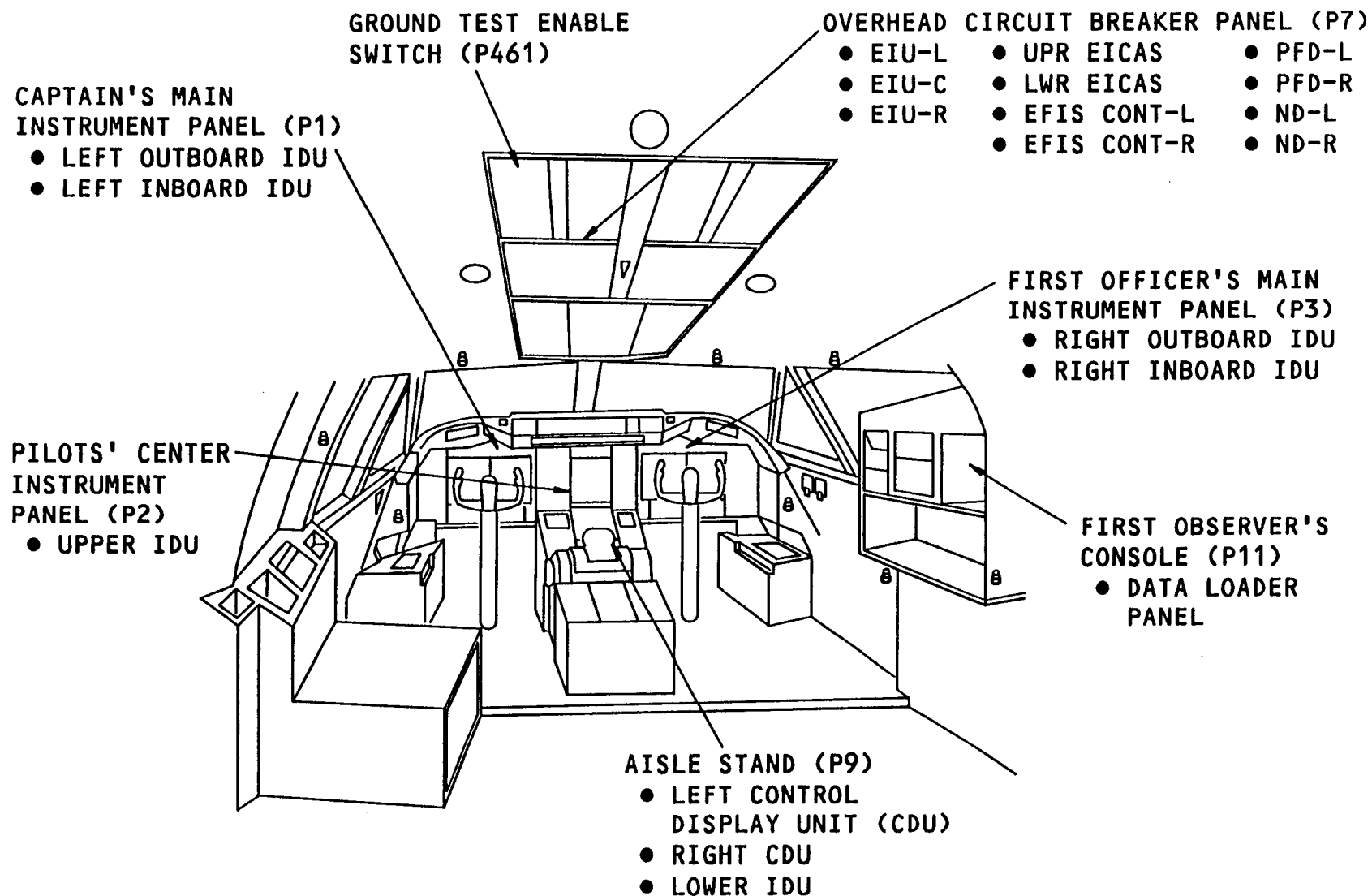
**COMPONENT LOCATIONS - FLIGHT DECK**

The IDS components in the flight deck are:

- Left outboard IDU
- Left inboard IDU
- Upper IDU
- Lower IDU
- Right outboard IDU
- Right inboard IDU
- EIU-L CB
- EIU-C CB
- EIU-R CB
- PFD-L CB
- PFD-R CB
- ND-L CB
- ND-R CB
- UPR EICAS CB
- LWR EICAS CB
- EFIS CONT-L CB
- EFIS CONT-R CB

Interface components in the flight deck are:

- Data loader panel
- LEFT CDU
- RIGHT CDU
- Ground test enable switch


Figure 3 IDS Component Locations - Flight Deck



COMPONENT LOCATIONS - FLIGHT DECK

These IDS components are also in the flight deck:

- Left and right remote light sensors
- Left inboard and outboard IDU brightness controls
- Right inboard and outboard IDU brightness controls
- Left and right EFIS control panels
- EICAS display select panel
- Captain's display transfer module
- Captain's instrument source select module
- Captain's master caution light
- EICAS control panel/FMC switch
- First officer's display transfer module
- First officer's instrument source select module
- First officer's master caution light

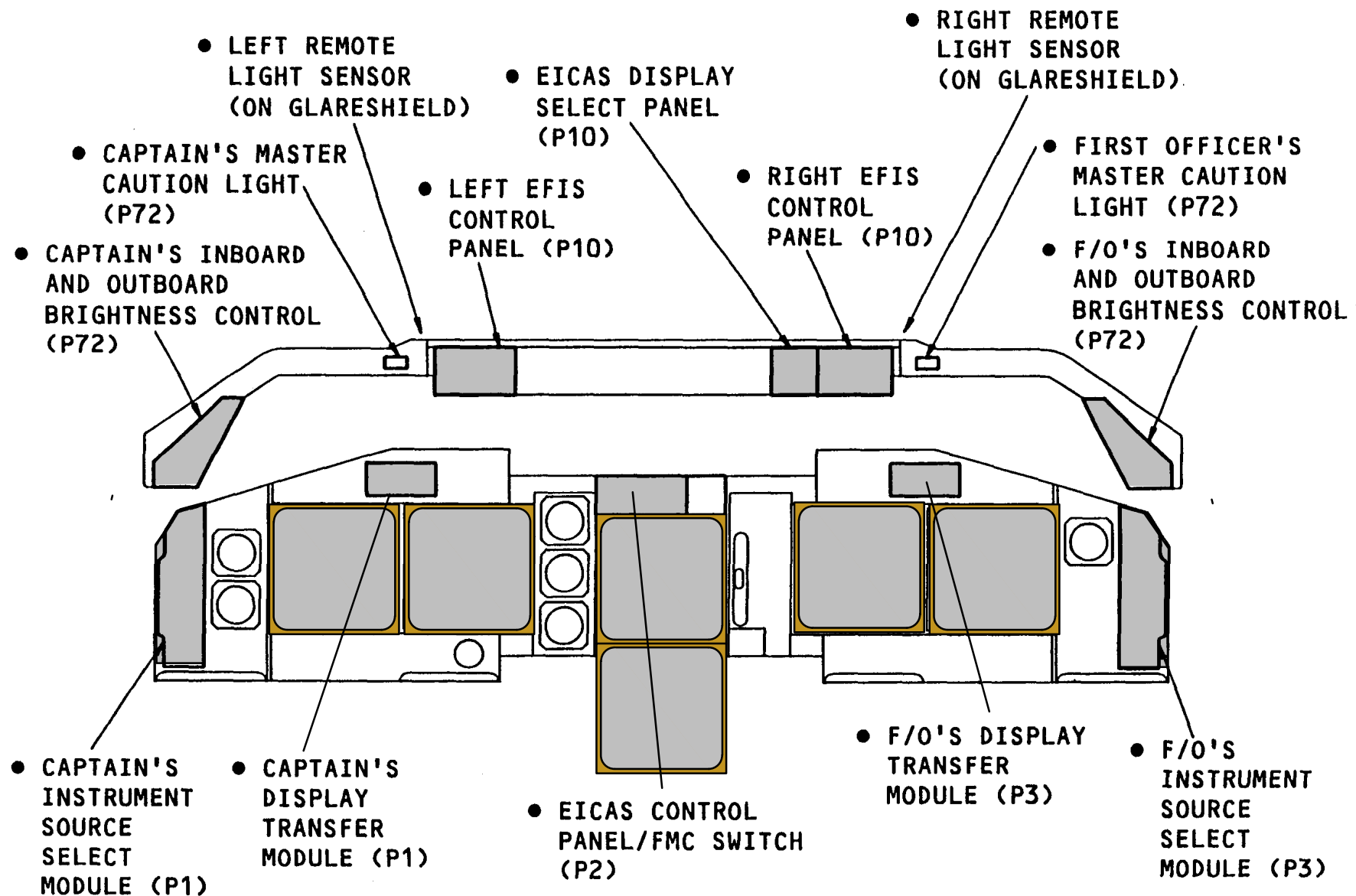


Figure 4 IDS Component Locations - Flight Deck

**COMPONENT LOCATIONS - MEC**

The IDS components located in the main equipment center are:

- Right EIU
- Center EIU
- Left EIU

CAUTION: STATIC SENSITIVE. DO NOT HANDLE BEFORE READING
PROCEDURE FOR HANDLING ELECTROSTATIC DIS-
CHARGE SENSITIVE DEVICES (REF 20-41-02/201). CON-
TAINS DEVICES THAT CAN BE DAMAGED BY STATIC DIS-
CHARGE.

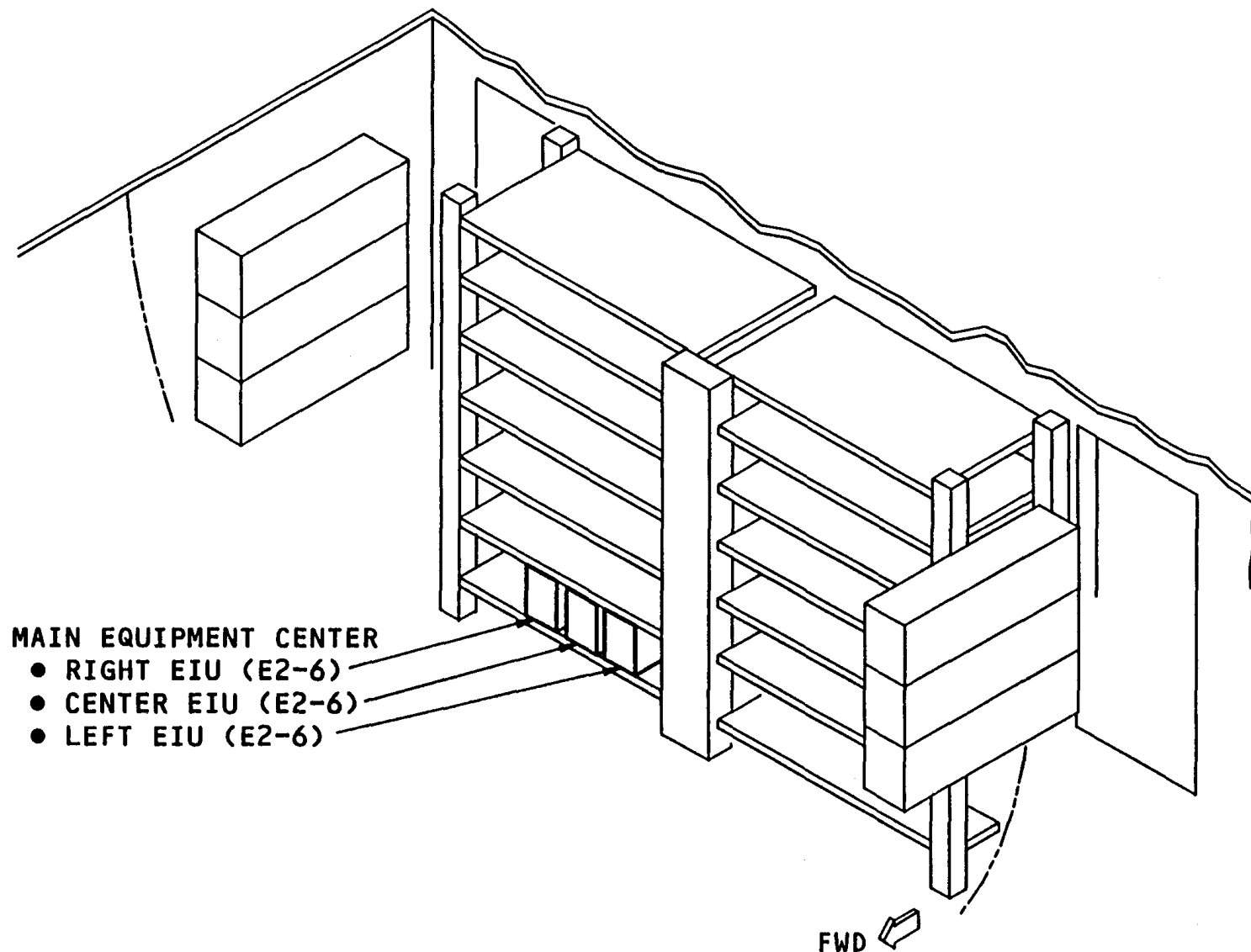


Figure 5 IDS Component Locations - Main Equipment Center





DISPLAY BRIGHTNESS CONTROL

General

The IDU brightness is controlled in three ways:

- Manual brightness controls
- Remote light sensor
- Local light sensor

Manual Brightness Controls

The two manual brightness controls for the captain's side are on the left side of the glareshield panel. These brightness control knobs are rheostats that get their voltage (+5v dc) from the related IDU.

The ND brightness control has two rheostats.

- The outer knob adjusts the overall brightness of the display.
- The inner brightness control knob controls the raster presentation (weather radar).

The upper and lower IDU manual brightness control comes from the EICAS control panel.

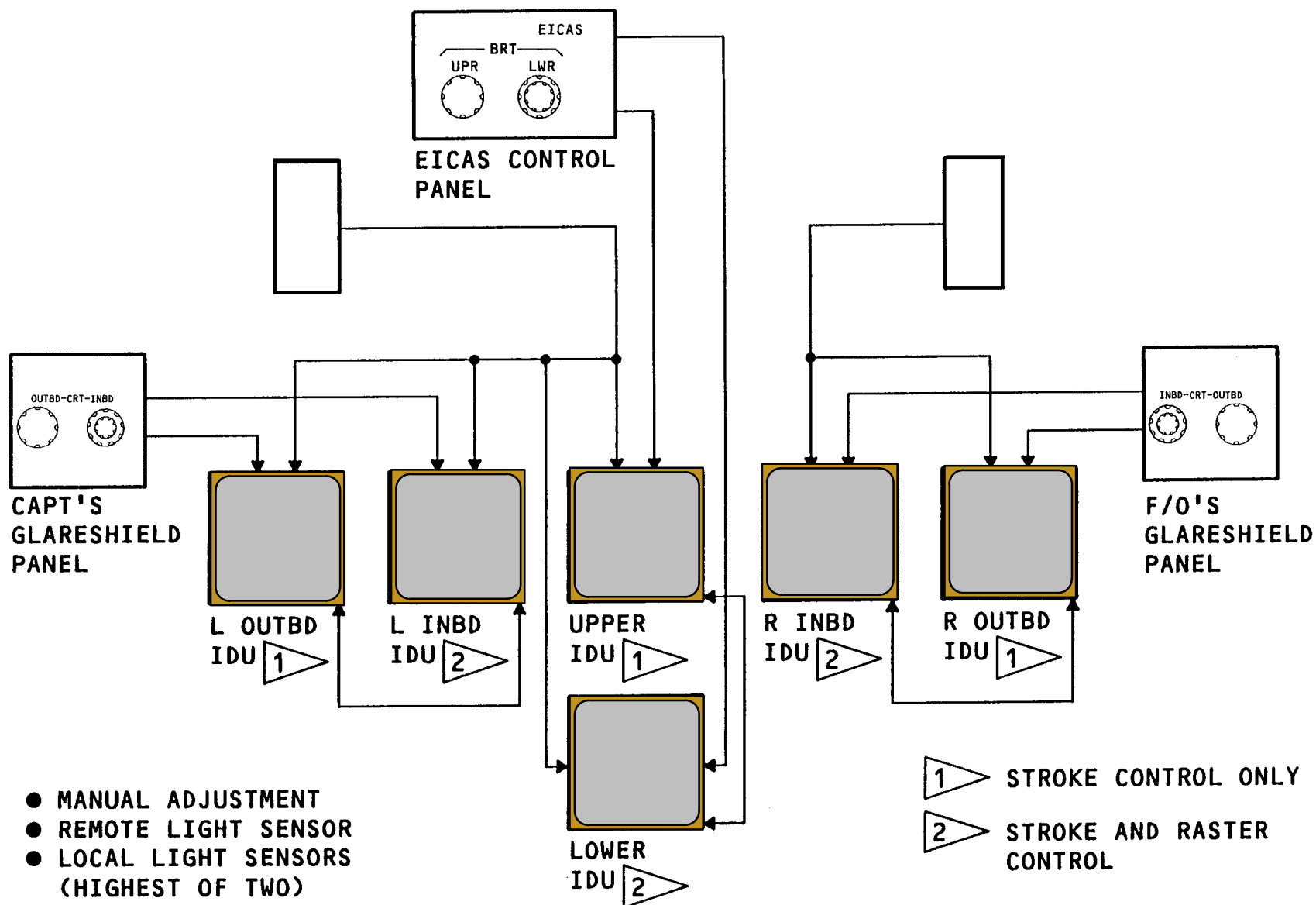
Remote Light Sensor

The right remote light sensor adjusts the brightness of the right inboard and outboard IDUs.

The left remote light sensor adjusts the brightness of the left inboard, left outboard, upper IDU and lower IDU. These light sensors adjust the display brightness with changes in outside lighting conditions.

Local Light Sensor

A local light sensor is on the front of each IDU. The local light sensor adjusts the display brightness with changes in flight deck lighting conditions. IDUs are paired together (PFD/NDs, UPR/LWR EICAS). The highest amount of ambient light sensed within each pair determines the display brightness.


Figure 6 IDS - Display Brightness Control

INDICATING/ RECORDING SYSTEMS INTEGRATED DISPLAY SYSTEM



INBOARD/OUTBOARD CRT BRIGHTNESS CONTROLS

Two glareshield panels are installed in the flight deck. There are independent brightness controls on these panels for the captain's and first officer's inboard and outboard integrated display units (IDU).

OUTBD CRT (CRT - cathode ray tube)

The outboard control knob controls overall IDU (integrated display unit) brightness.

INBD CRT

The inboard CRT control knob is a dual control and sends both stroke and raster brightness control.

The panels are not interchangeable.

EICAS CRTS BRIGHTNESS CONTROLS

the EICAS CONTROL panel is installed in the flight deck. There are independent brightness controls on these panels for the upper and lower display unit.

UPR

The UPR BRT (upper brightness) control manually adjusts the brightness of the upper IDU.

LWR

The LWR BRT (lower brightness) control has an inner and an outer knob.

The outer knob adjusts the brightness on the lower IDU.

The inner knob adjusts the raster brightness on the lower IDU when it is used as an ND.

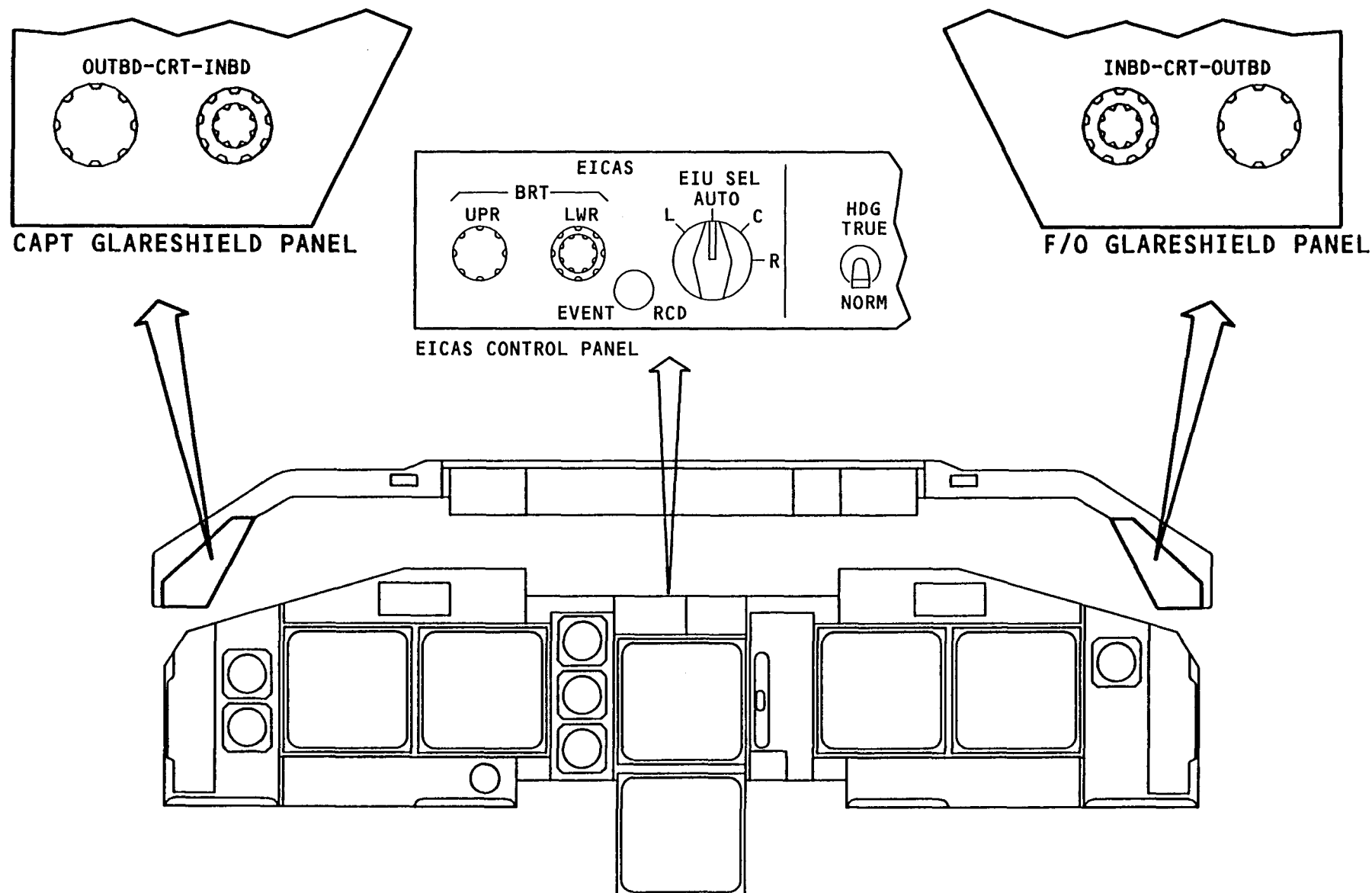


Figure 7 IDS - Inboard/Outboard CRT Brightness Controls



REMOTE LIGHT SENSOR

General

The two remote light sensors (RLSs) sense the light level outside the flight deck and change it to a linear voltage signal. The signal goes to the IDUs, which then calculate the display brightness requirements.

Each RLS has a photo diode and a plastic lens.

Maintenance Practices

Each RLS is mounted to the glareshield with two screws.

An operational check of each sensor can be made.

To do this, inhibit the light into the lens. A decrease in the brightness of the IDUs shows that the sensor works.

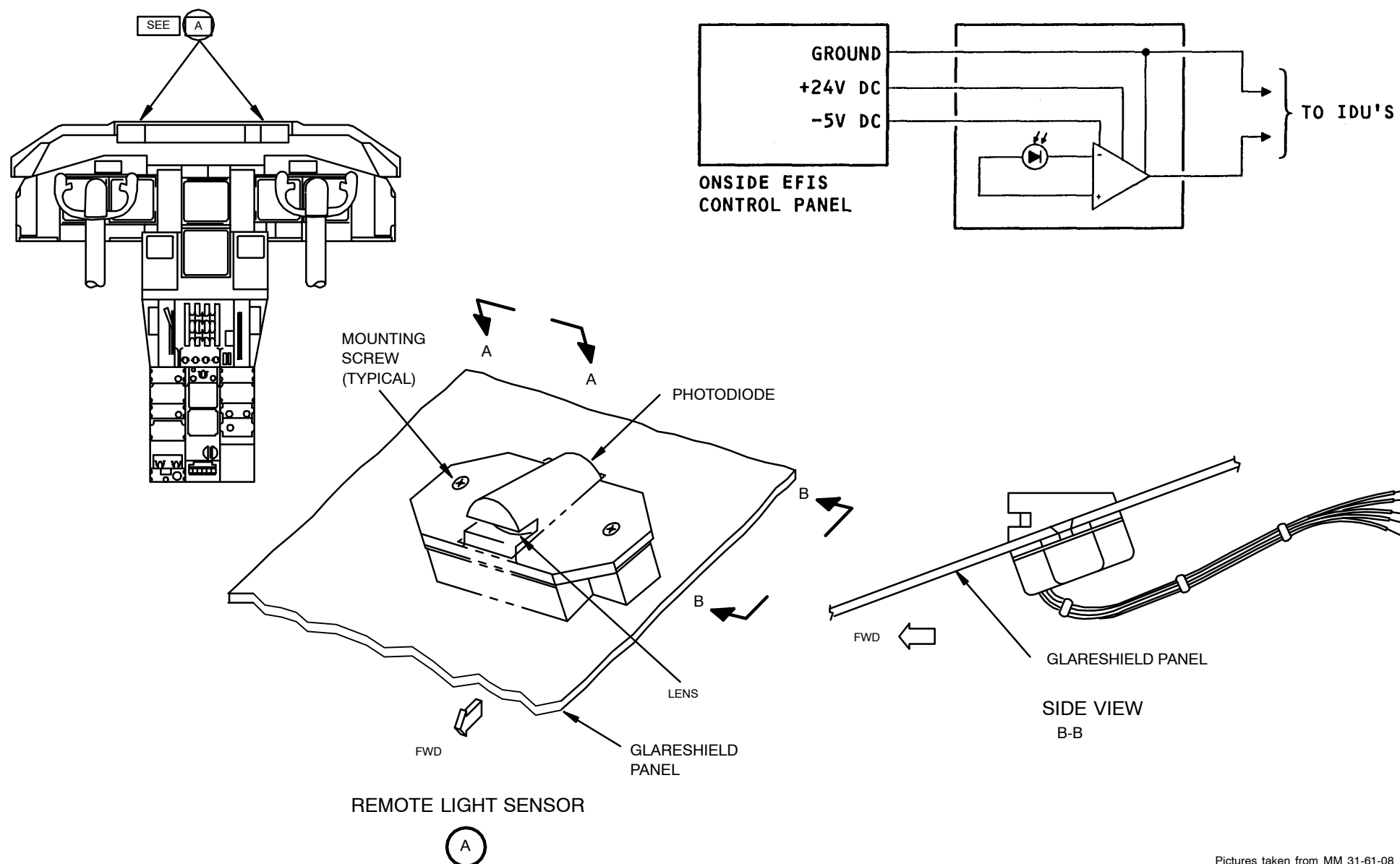


Figure 8 Remote Light Sensor

Pictures taken from MM 31-61-08

**POWER INPUTS**

Components of the IDS get 115v ac from:

- Captain's flight instrument transfer bus (CAPT FLT INST XFER BUS)
- First officer's flight instrument transfer bus (FIO FLT INST XFER BUS)
- Standby ac bus (STBY AC BUS)
- APU Standby AC bus

The captain's PFD and ND can also be powered from the APU static inverter based on the position of the battery switch.

The CAPT's FLT INST XFER BUS sends power to the:

- Left outboard IDU
- Left inboard IDU
- Center EIU

The STBY AC BUS sends power to the:

- Upper IDU
- Left EIU
- Left EFIS control panel
- Left remote light sensor (gets +24v dc and -5v dc from the left EFIS control panel)

The F/O FLT INST XFER BUS sends power to the:

- Right outboard IDU
- Right inboard IDU
- Right EIU
- Right EFIS control panel
- Right remote light sensor (gets +24v dc and -5v dc from the right EFIS control panel)

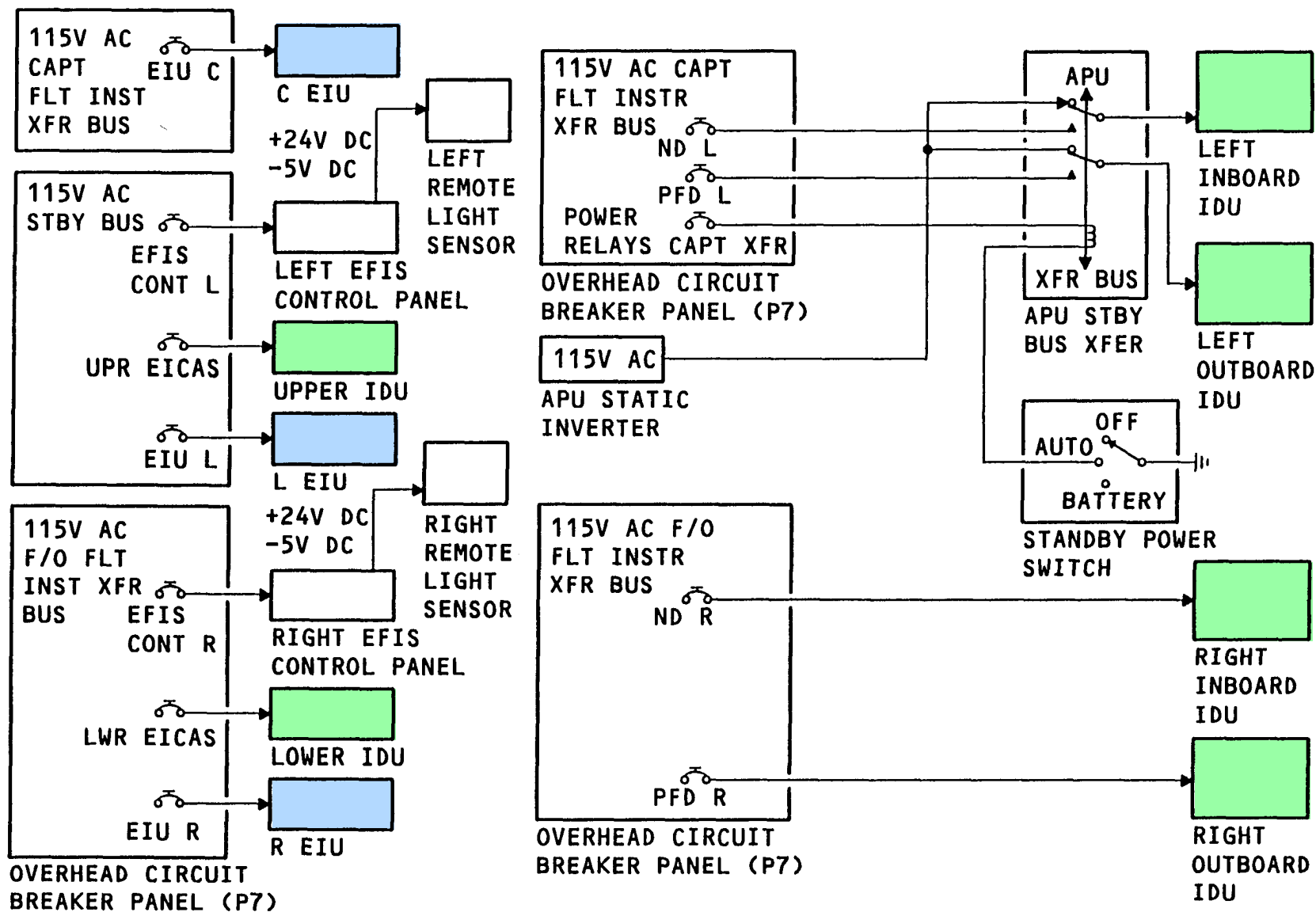


Figure 9 IDS - Power Inputs



**NORMAL DISPLAYS**

The location of an IDU determines its normal display function.

The possible display functions are:

- Primary flight display (PFD)
- Navigation display (ND)
- Main EICAS display
- Auxiliary (AUX) EICAS display

The normal display configuration is:

- PFDs on the outboard IDUs
- NDs on the inboard IDUs
- Main EICAS on the upper IDU
- AUX EICAS on the lower IDU

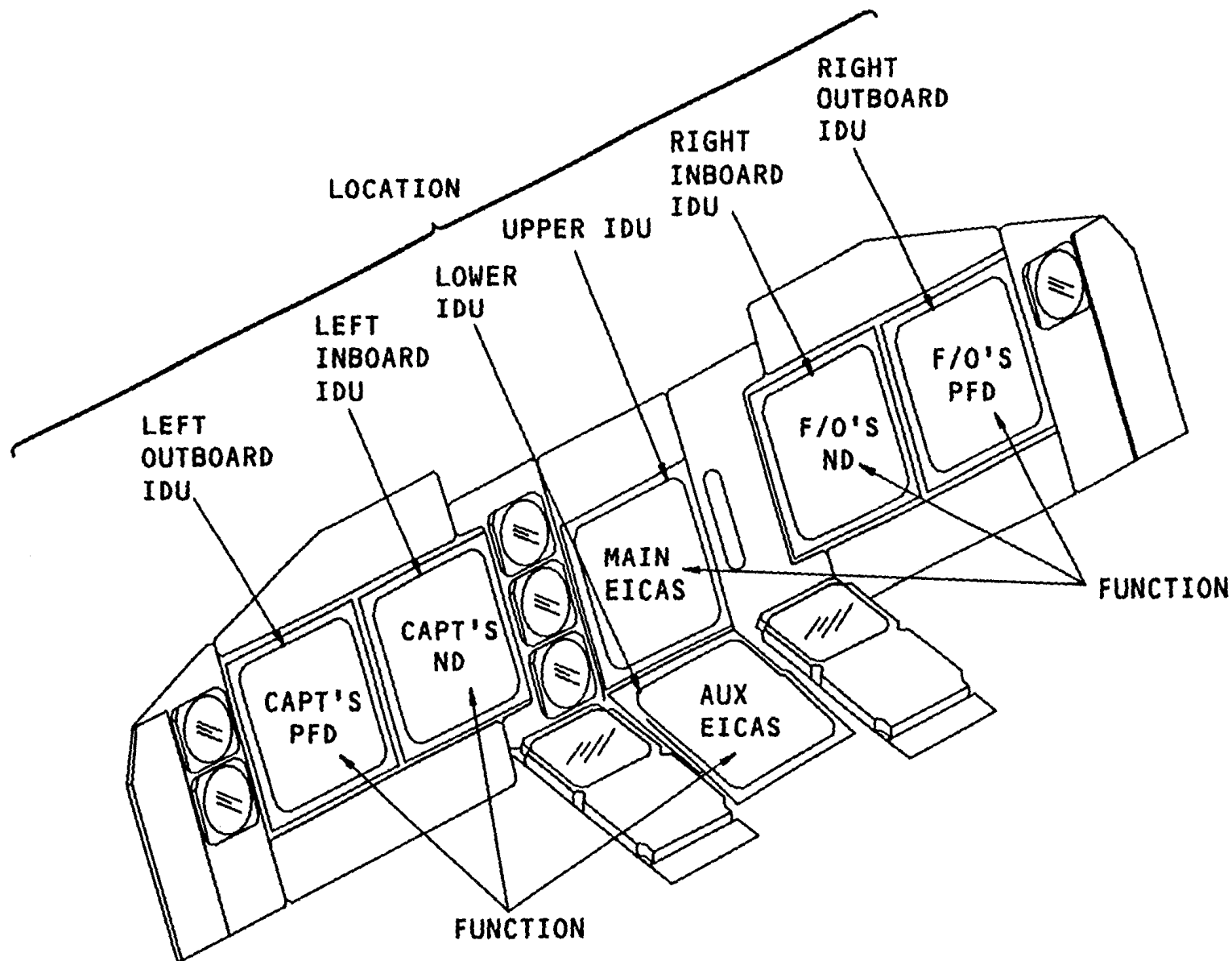


Figure 10 IDS - Normal Display





EFIS CONTROL PANEL

Purpose

The EFIS control panel controls the onside PFD and ND. This panel allows the addition, deletion or modification of data on the displays. The two EFIS control panels are on the P10 panel.

Controls

These controls are on the EFIS control panel:

- RADIO/BARO (decision height/minimum descent altitude) set
- MTRS (metric altitude display select switch)
- BARO (barometric set control)
- ND mode select switch
- Range select switch
- ND map data select switches
- VOR/ADF display select switches
- FPV (flight path vector) (optional)

RADIO/BARO Set Control

The RADIO/BARO switch is a three-function switch. The outer switch selects decision height or minimum descent altitude. The inner switch has twenty-four detent positions and selects the desired altitude level. The center non-rotating momentary pushbutton switch resets a DH alert.

MTRS Switch

The MTRS momentary pushbutton switch selects an altitude readout in meters on the PFD.

TFC Switch

The TFC pushbutton switch turns on and off the Traffic Alert and Collision Avoidance System (TCAS)

BARO Switch

The BARO set control is a three function switch. The outer switch selects barometric pressure in inches of mercury or hectopascals. The inner switch has twenty-four detent positions and selects a specific barometric pressure. The center momentary, pushbutton switch selects or removes a standard (STD) barometric pressure and readout.

ND Mode Select Switch

A four-position rotary switch selects the approach (APP), VOR, MAP, and PLAN modes. In all but the PLAN position, the center pushbutton selects a centered airplane symbol display.

Range Select Switch

The range select switch is a seven-position rotary switch that selects map and weather radar ranges of 5, 10, 20, 40, 80, 160, 320, and 640 nm.

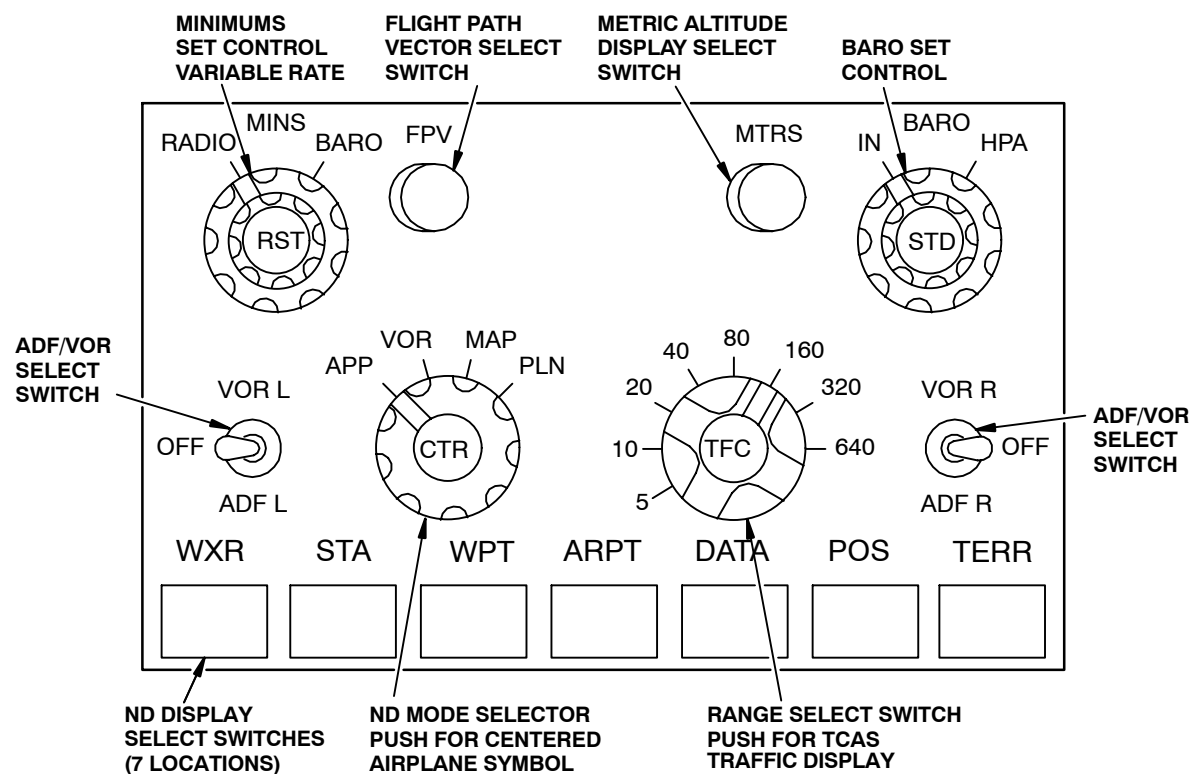


Figure 11 IDS - EFIS CONTROL PANEL





ND Map Data Select Switches

The ND select switches are seven momentary pushbuttons at the bottom of the EFIS control panel. They select or deselect additional data on the ND. These are the ND select switches and their functions:

- WXR shows weather radar returns
- STA shows navigation aids that are not part of the flight plan
- WPT shows waypoints that are not part of the flight plan
- ARPT shows airports that are not part of the flight plan
- DATA shows data about flight plan waypoints
- POS shows position fix data
- TERR shows terrain data

VOR/ADF Switches

The VOR/ADF switches select VOR or ADF bearings and DME distance to be shown on the ND.

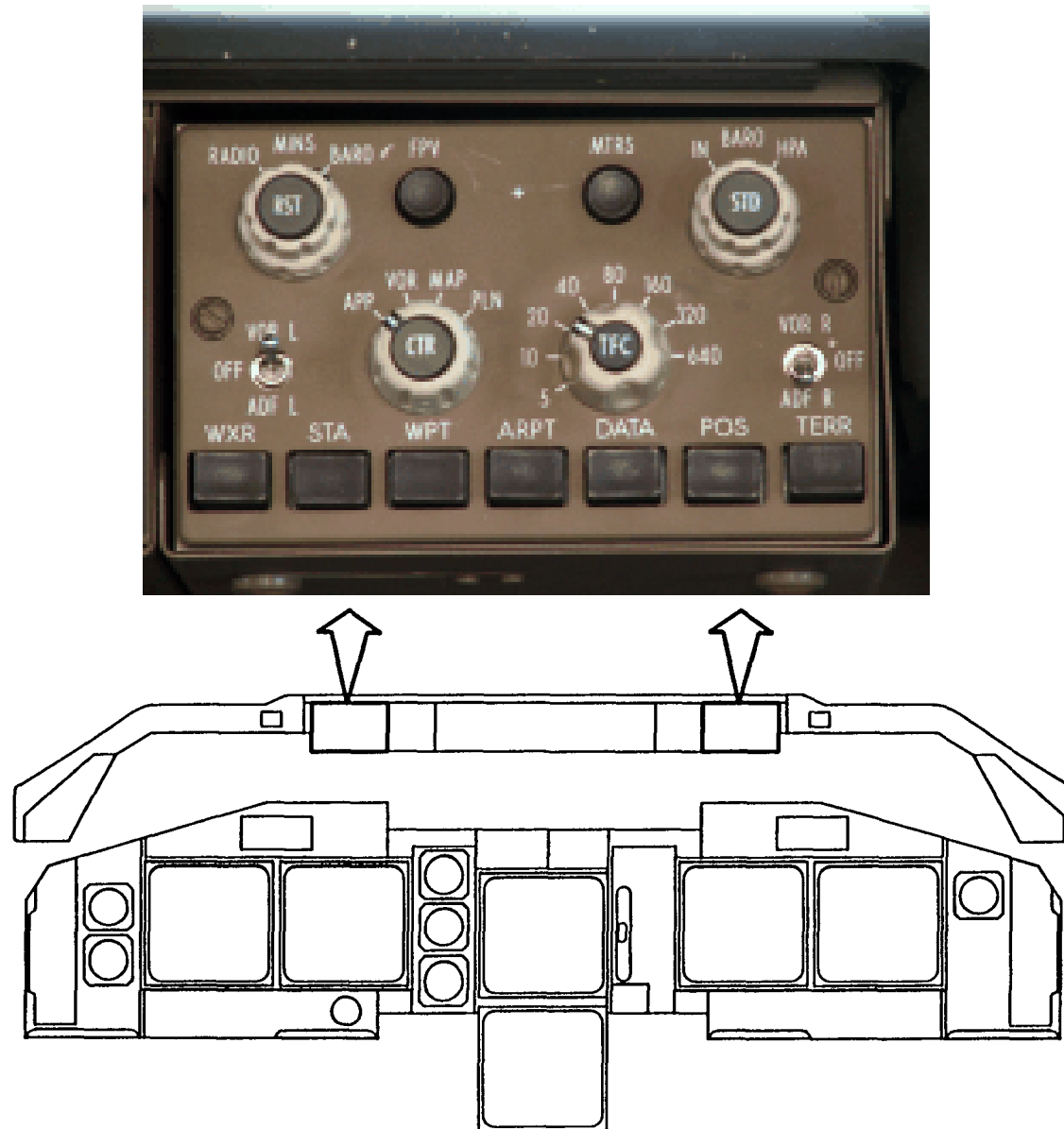


Figure 12 IDS - EFIS CONTROL PANEL



**GENERAL FEATURES (EFIS)**

EFIS gives each pilot primary flight data on the primary flight display (PFD) and navigational data on the navigation display (ND).

There is only one mode of operation for the PFD.

There are four different modes of operation available from the EFIS control panel for the ND:

- Approach (full rose and expanded)
- VOR (full rose and expanded)
- Map (center and expanded)
- Plan (expanded only)

The ND is normally the inboard display, and the PFD is normally the outboard display.

However, manual and automatic switching gives a display function redundancy if there is a failure.

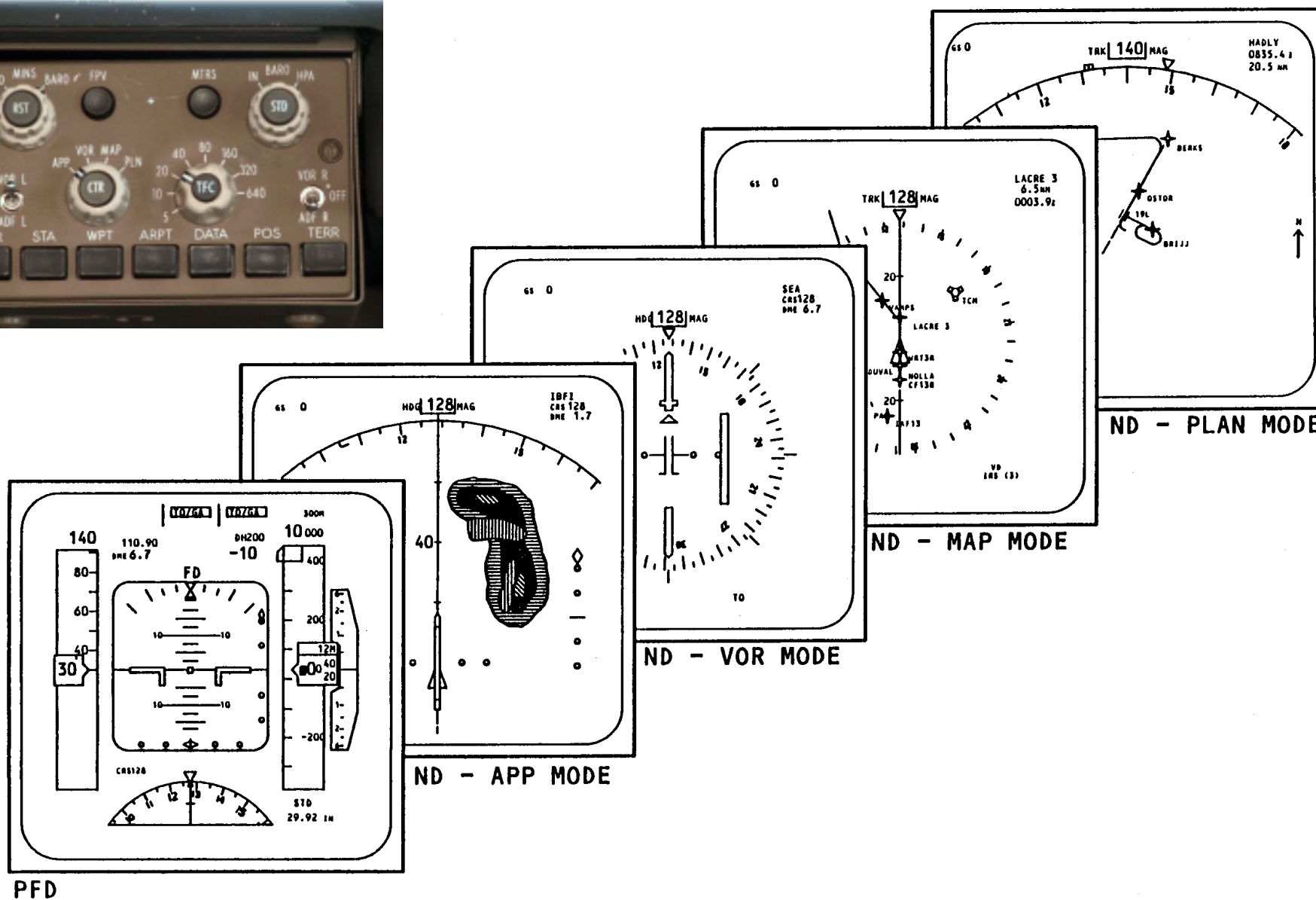


Figure 13 IDS - General Features (EFIS)



EICAS DISPLAY SELECT PANEL

General

The EICAS display select panel (DSP) selects the desired format for the AUX EICAS display and controls the EICAS messages on the primary EICAS page.

Display Select Keys

The momentary pushbutton keys on the DSP select/deselect:

- ENG (secondary EICAS page)
- STAT (status page)
- ELEC (electrical system synoptic)
- ECS (environmental control system synoptic)
- HYD (hydraulic system synoptic)
- DRS (doors synoptic)
- FUEL (fuel synoptic or mini)
- GEAR (landing gear synoptic or mini)

Cancel/ Recall

The round pushbutton keys on the DSP control primary EICAS messages:

- CANC (cancels asserted level B and C messages)
- RCL (recalls canceled messages which are still active)

The cancel/recall keys have the following additional functions:

- Monitor engine exceedances
- Alternate CMC latched status message erasure.
- Remove the starter cutout inhibit

These functions are discussed in more detail later.

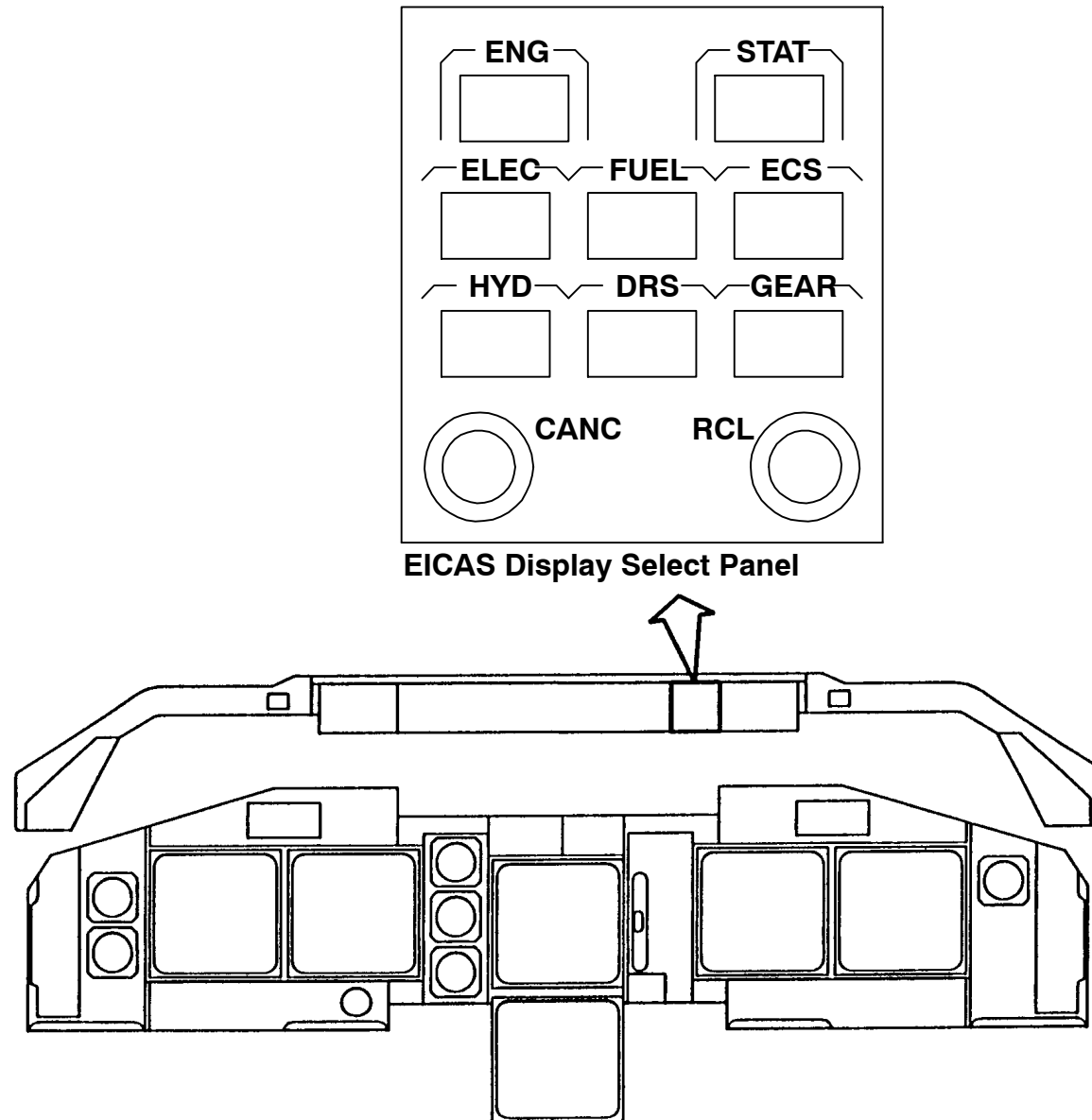


Figure 14 IDS - EICAS Display Select Panel

**GENERAL FEATURES (EICAS)**

EICAS provides engine indication and systems monitoring. EICAS consists of two displays:

- Main EICAS display
- Auxiliary (AUX) EICAS display

The main EICAS normally displays the EICAS primary format. The EICAS primary format shows primary engine parameters, crew alerting messages and total fuel.

The AUX EICAS can display these formats:

- Secondary
- Status
- Synoptics
- Maintenance pages

INDICATING/ RECORDING SYSTEMS INTEGRATED DISPLAY SYSTEM



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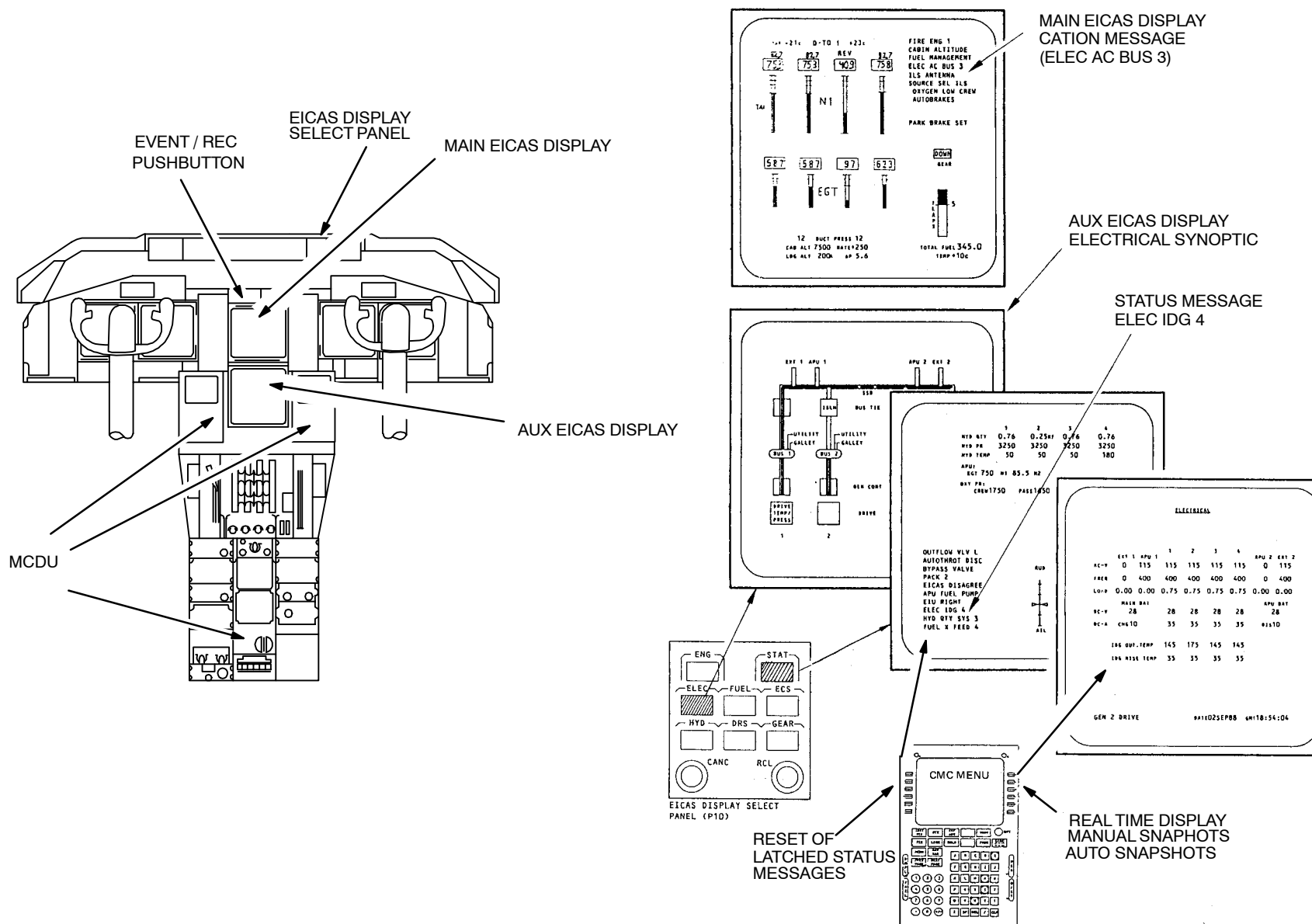


Figure 15 IDS - General Features (EICAS)





EFIS / EICAS DISPLAY SELECT PANEL - OPERATION**Switch Configuration**

The switches on the display select panel (DSP) are momentary switches with dual contacts. These switches provide discretes to the EIUs and the EFIS control panels. The contacts of each switch are connected to separate grounds. This provides a back-up ground for each switch.

Interfaces

The CANC (cancel) and RCL (recall) switches are connected directly to the EIUs and the EFIS control panels.

These switches are connected to the EFIS control panels only:

- ENG
- STAT
- FUEL
- ELEC
- ECS
- HYD
- DRS
- GEAR

EFIS Control Panel

The left and right EFIS control panels encode the discretes to a digital discrete word and transmit them to the EIUs, through the control display units (CDUs).

The switch position on the EFIS control panel are encoded in the panel and send through the control display units (CDUs) to the EIUs.

Fault Detection

The EIUs detect DSP faults by comparing DSP digital discretes from the left and right EFIS control panels.

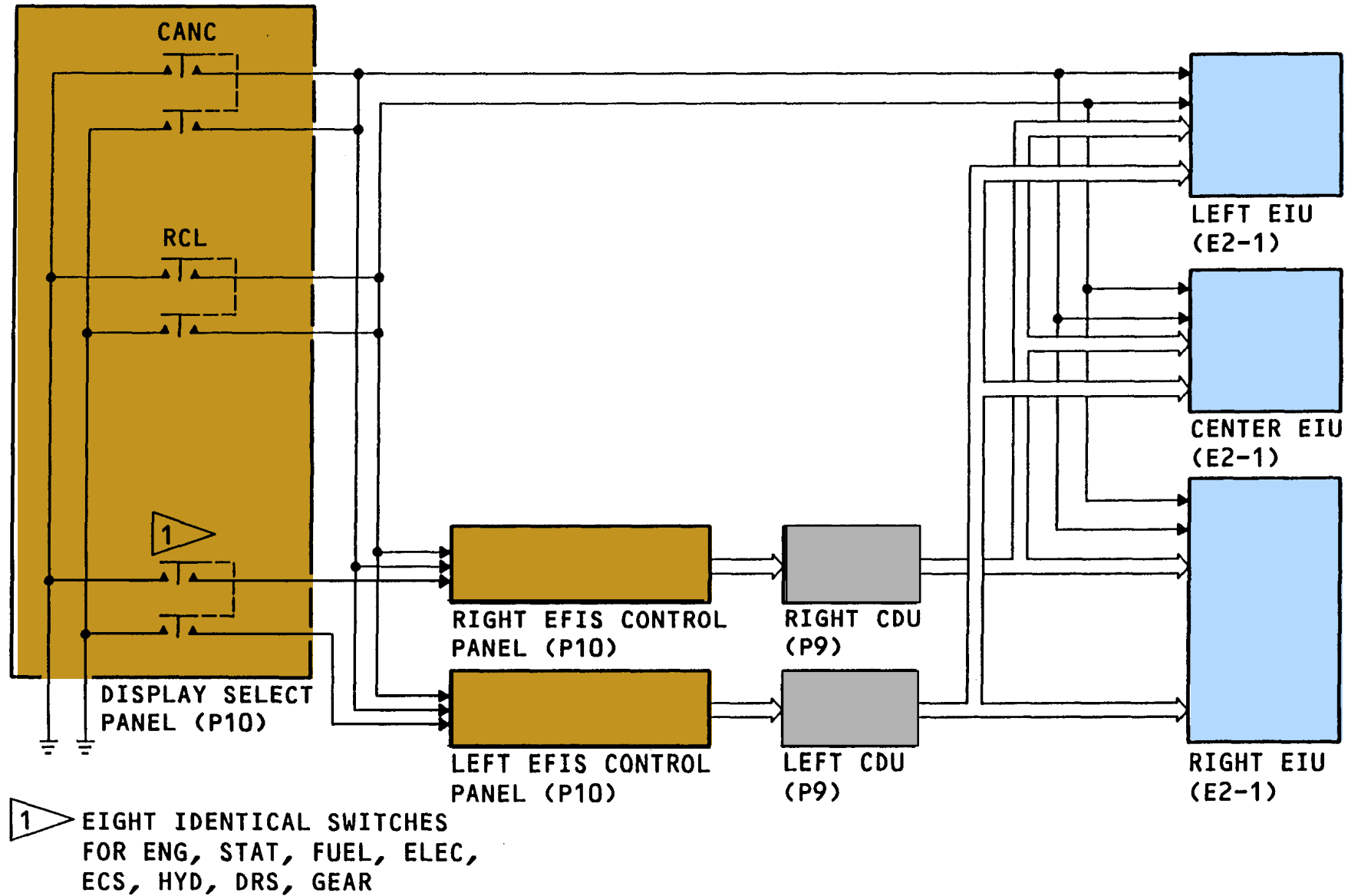


Figure 16 EFIS Panel/ EICAS Display Select Panel Operation



**ALTERNATE EFIS CONTROL PAGES****General**

The alternate EFIS control pages provide all of the same selections as the EFIS control panel. Access to these pages is through the CDU menu.

The caret symbol (>) shows when the outside EFIS control panel has failed or when the control panel is selected manually on the CDU.

The caret symbol means the line select key is active.

CDU Menu

The CDU menu provides selections of CDU functions. To use the CDU as a backup EFIS control panel, press the CDU MENU key. Press line select key 1 right (EFIS CP) and the CDU shows the EFIS CONTROL page.

EFIS Control

The EFIS CONTROL page provides selections of:

- Barometric reference
- Decision height and reset
- Range
- Mode

There is no selection available to set an MDA.

EFIS Options

The EFIS OPTIONS page provides selections of:

- Weather radar
- Map data
- Metric altitude
- Flight path vector
- Raw data (VOR/ADF): when VOR or ADF is selected, both left and right systems will show.

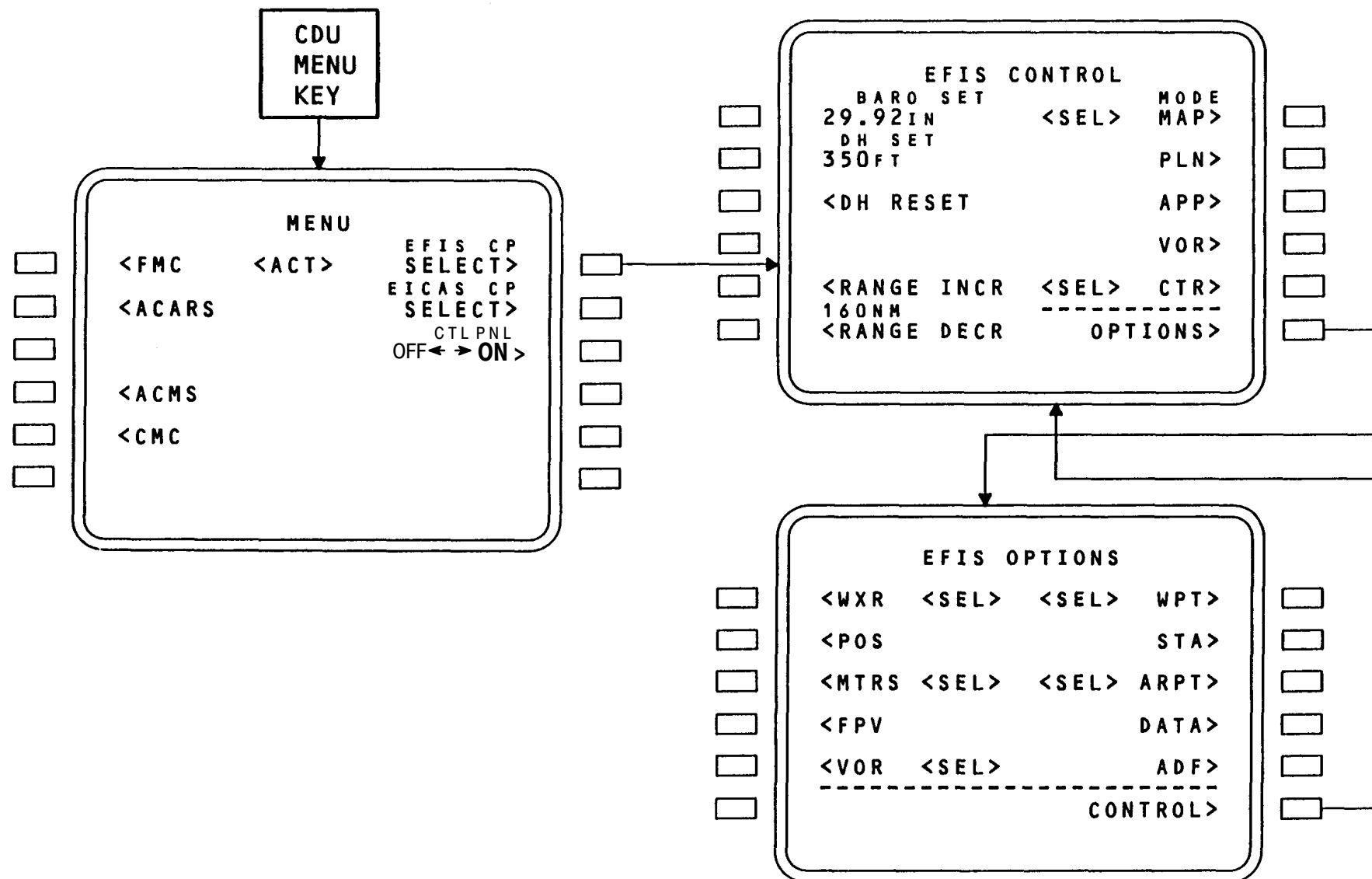


Figure 17 IDS - Alternate EFIS Control Pages



EICAS DSP ALTERNATE OPERATION

General

The EICAS DSP functions are performed on the CDU when EICAS CP SELECT is enabled on the CDU. The EICAS CP SELECT is enabled when the bus from the EFIS control panel has been inactive for one second.

NOTE: IF THE DSP FAILS WITHOUT FAILURE OF AN EFIS CONTROL PANEL, ONE OF THE EFIS CONTROL PANEL CIRCUIT BREAKERS MUST BE PULLED TO ACCESS THE ALTERNATE EICAS FUNCTION.

Operation

When the prompt (>) is shown on line select key (LSK) 2R, the DSP functions can be performed on the CDU.

LSK 2R, when pushed, puts the EICAS MODES page on the CDU.

LSK 6R on the EICAS MODES page, when pushed, puts the EICAS SYNOPTICS page on the CDU.

During alternate DSP operation, push the LSK next to DSP functions to cause the same response as the DSP key that it replaces.

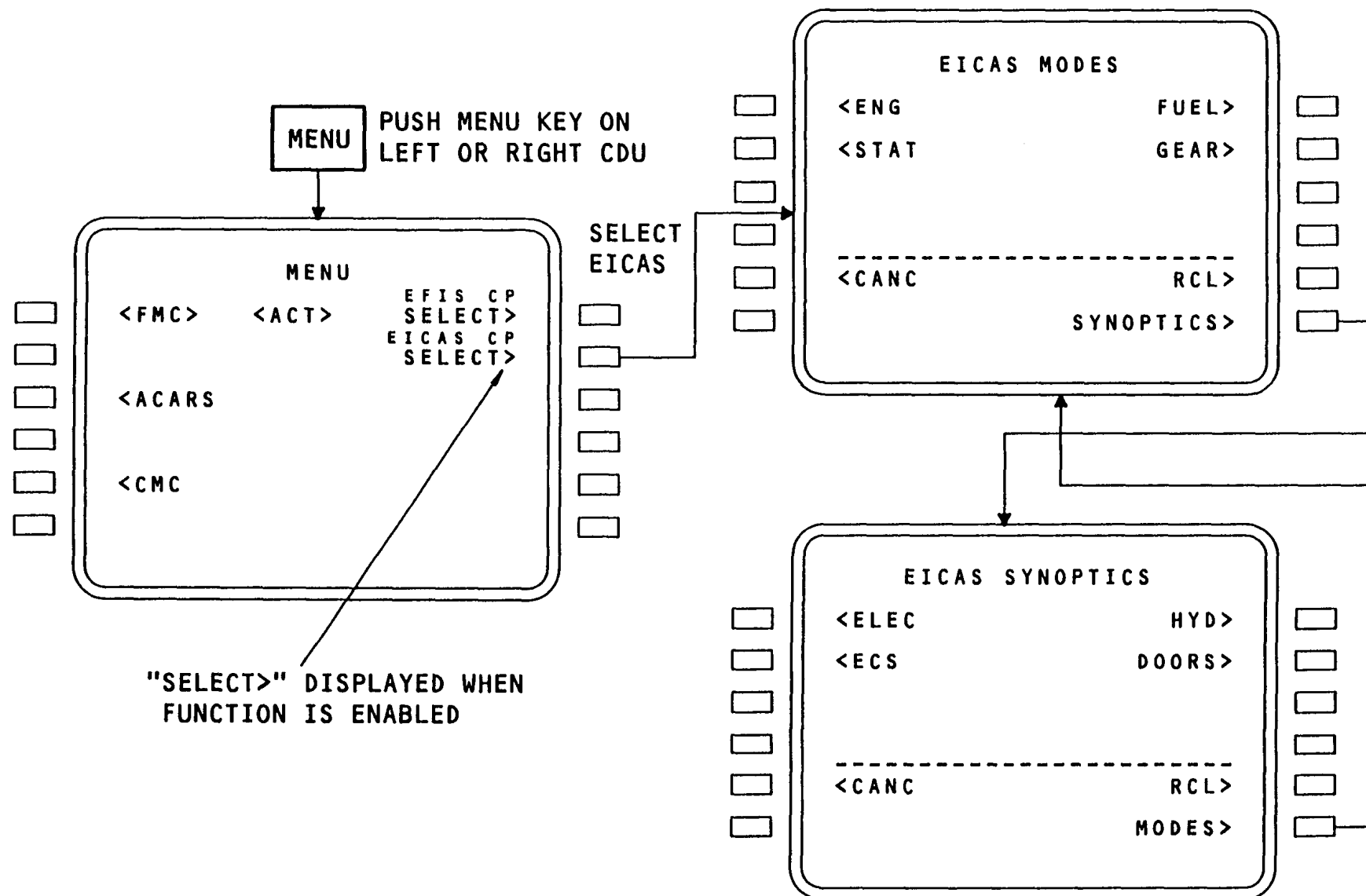


Figure 18 IDS - EICAS Display Select Panel Alternate Operation



SOURCE SELECTION

General

IDS has these types of data selections:

- Data input to EIU source selection EIU source selection

Data Input to EIU Source Selection

The captain's and first officer's instrument source select modules (ISSMs) control the EIU input source selection for different systems. These systems are:

- Flight control computers (FCCs)
- Flight management computers (FMCs)
- Inertial reference units (IRUs)
- Air data computers (ADCs)

The ISSMs give inputs to the EIUs, which then process the source selection logic.

EIU Source Selection

The EIU source select switch (on the ISSM) gives the EIU selection for the EFIS displays. The EICAS control panel EIU source select switch gives EIU selection for the EICAS displays. The control signals from the EIU source select switches go directly to the correct IDUs.

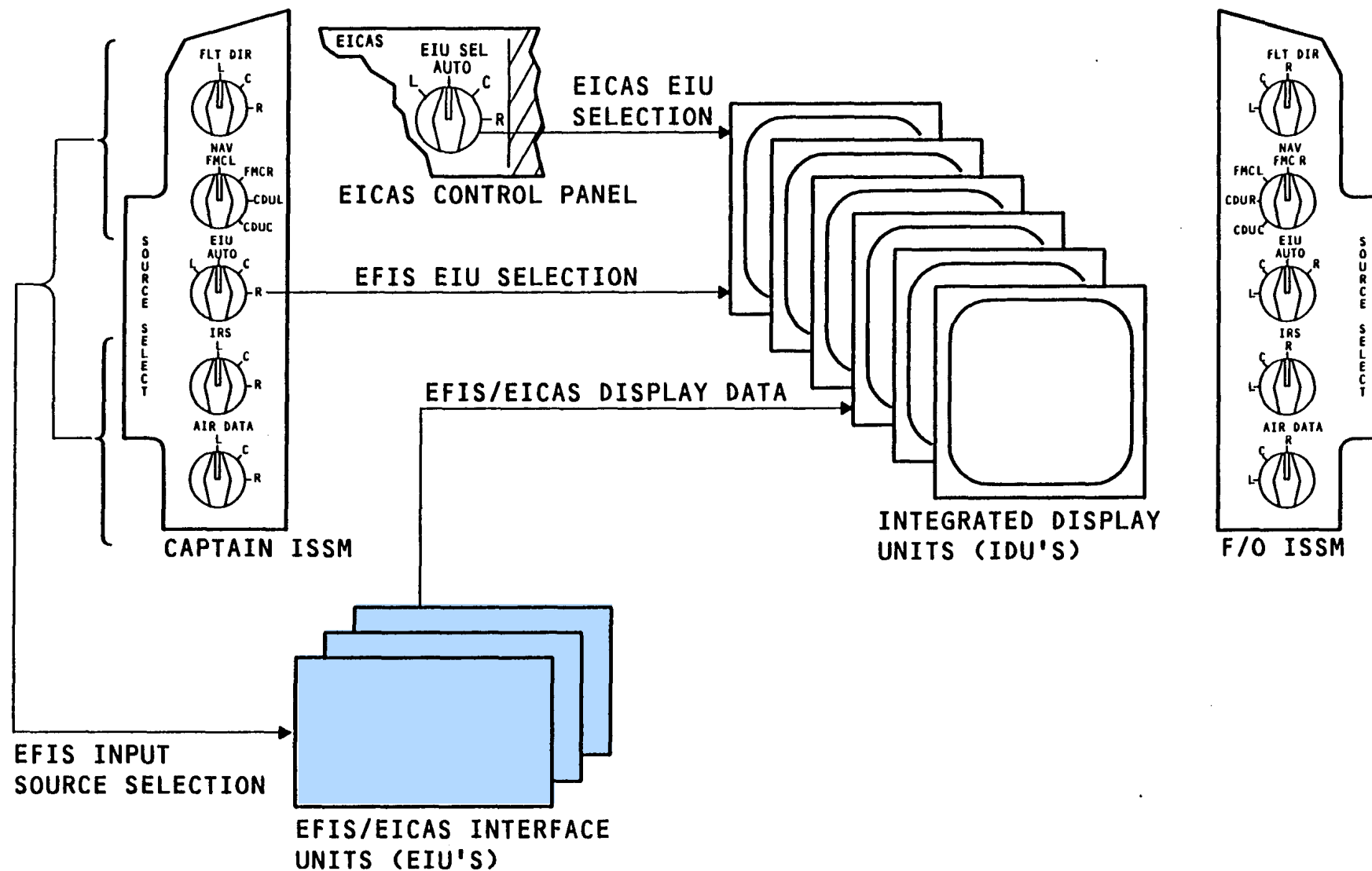


Figure 19 IDS - Source Selection



INSTRUMENT SOURCE SELECT MODULES

Purpose

The instrument source select modules give the flight crew the ability to select alternate sources of data for their displays. The two modules allow the left and right EFIS displays to be controlled independently.

Data Source Selection

Each instrument source select module has these switches:

- FLT DIR (flight director)
- NAV (navigation source)
- EIU (EFIS/EICAS interface unit)
- IRS (inertial reference system)
- AIR DATA (air data computer)

During normal operation all the switches are aligned vertically.

EICAS CONTROL PANEL/ FMC SWITCH

General

The EICAS control panel has these controls:

- EICAS EIU source selection (EIU SEL)
- EICAS display brightness adjustment (UPR BRT and LWR BRT)
- Manual event recording (EVENT RCD)

EIU Source Selection

During normal operation, the EIU switch is in the AUTO position. This causes the left EIU to give inputs to the EICAS displays.

If there is an EIU failure, the left, center and right EIUs have first, second and third priority in this sequence.

Switch positions L (left), C (center) and R (right) allow for manual EIU source selection.

Manual Event Recording

When the EVENT RCD button is pushed, it stores each EICAS maintenance page in the EIU memory. These pages may then be accessed later through the CMC menus.

Heading Reference Switch

The switch allows flight deck compass displays to use magnetic or true north as a reference.

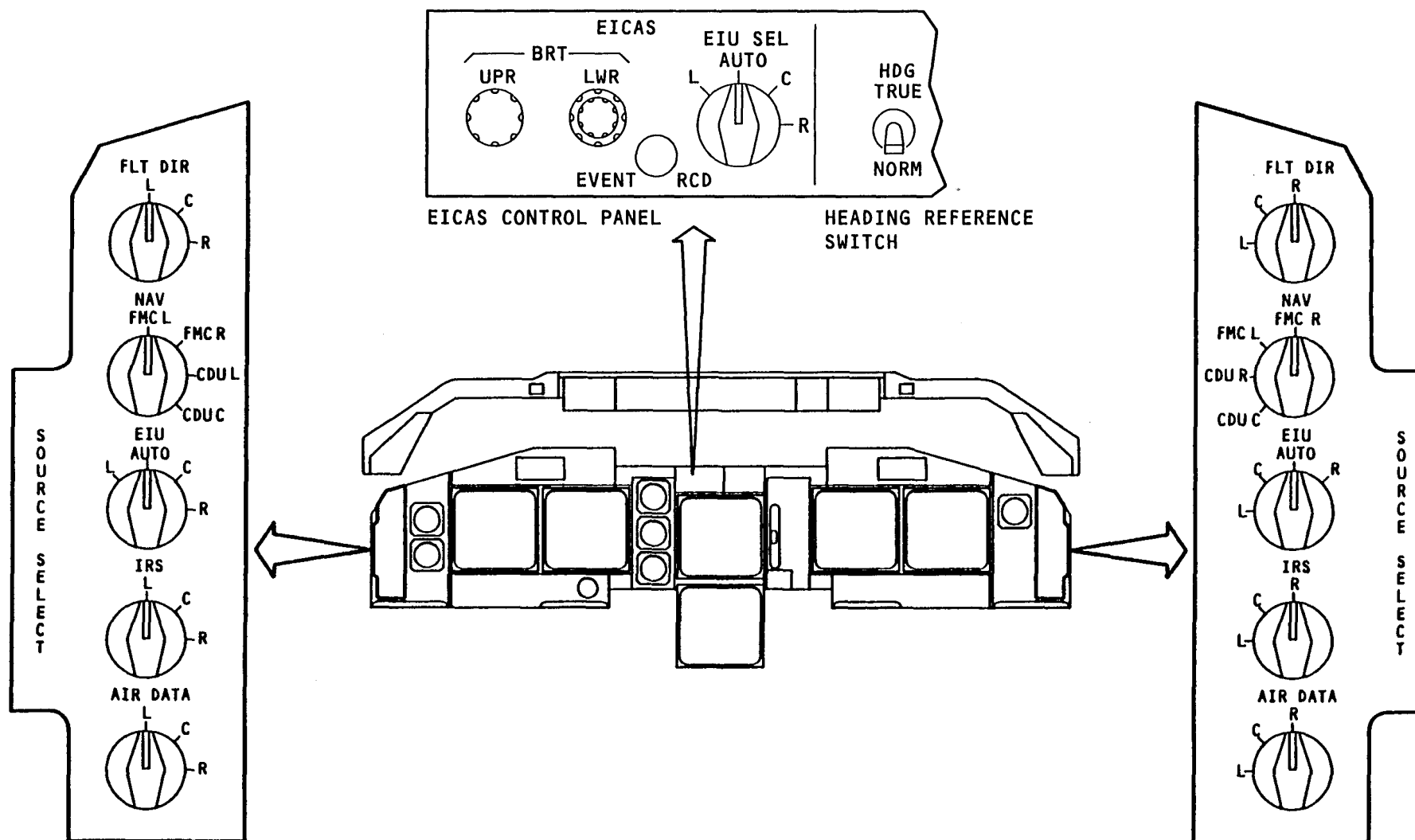


Figure 20 IDS - Instrument Source Select Modules (ISSM)



DISPLAY UNITS

Control Inputs

Displays are controlled by inputs from:

- Left and right EFIS control panels
- Left or right control display units (CDU)
- EICAS display select panel (DSP)
- EICAS control panel

The EFIS control panels give onside control of the primary flight display (PFD) and the navigation display (ND). The output bus of the EFIS control panels goes through the onside CDU.

The EICAS DSP gives EICAS display control. Cancel/Recall discretes are routed directly to the EIUs. Display control discretes are routed through the EFIS control panels and the CDUs.

In the event of an EFIS control panel failure, the onside CDU functions as an alternate EFIS control panel or as an alternate EICAS display select panel.

The EICAS control panel sends an event record discrete to the EIUs to take and store maintenance page snapshots.

Airplane Systems Inputs

Most of the data inputs for the IDS system come directly to the EIUs. The data comes in these forms:

- Digital (ARINC 429)
- Digital discretes (ARINC 429)
- Analog
- Analog discretes
- Analog variables

Some EFIS data inputs go directly to the IDUs. These inputs are from:

- Flight management computer (ARINC 429)
- CDU (ARINC 429)
- Weather radar R/Ts (ARINC 453)

EIU/IDU Interconnections

Each EIU sends digital data to each IDU for display. The IDUs then use the correct data for display.

Each IDU also has an output bus that goes to each EIU. The bus contains status data.

EIU CROSSTALK

Each EIU sends the following data to the other two EIUs on ARINC 429 buses:

- BITE data (internal fault data and LRU fault data from other IDS components)
- EIU status
- EICAS message data (any message generated in an EIU causes the other EIUs to generate that message)

Each EIU also sends an analog fail discrete to the other two EIUs. When an EIU fails, the discrete is an open.

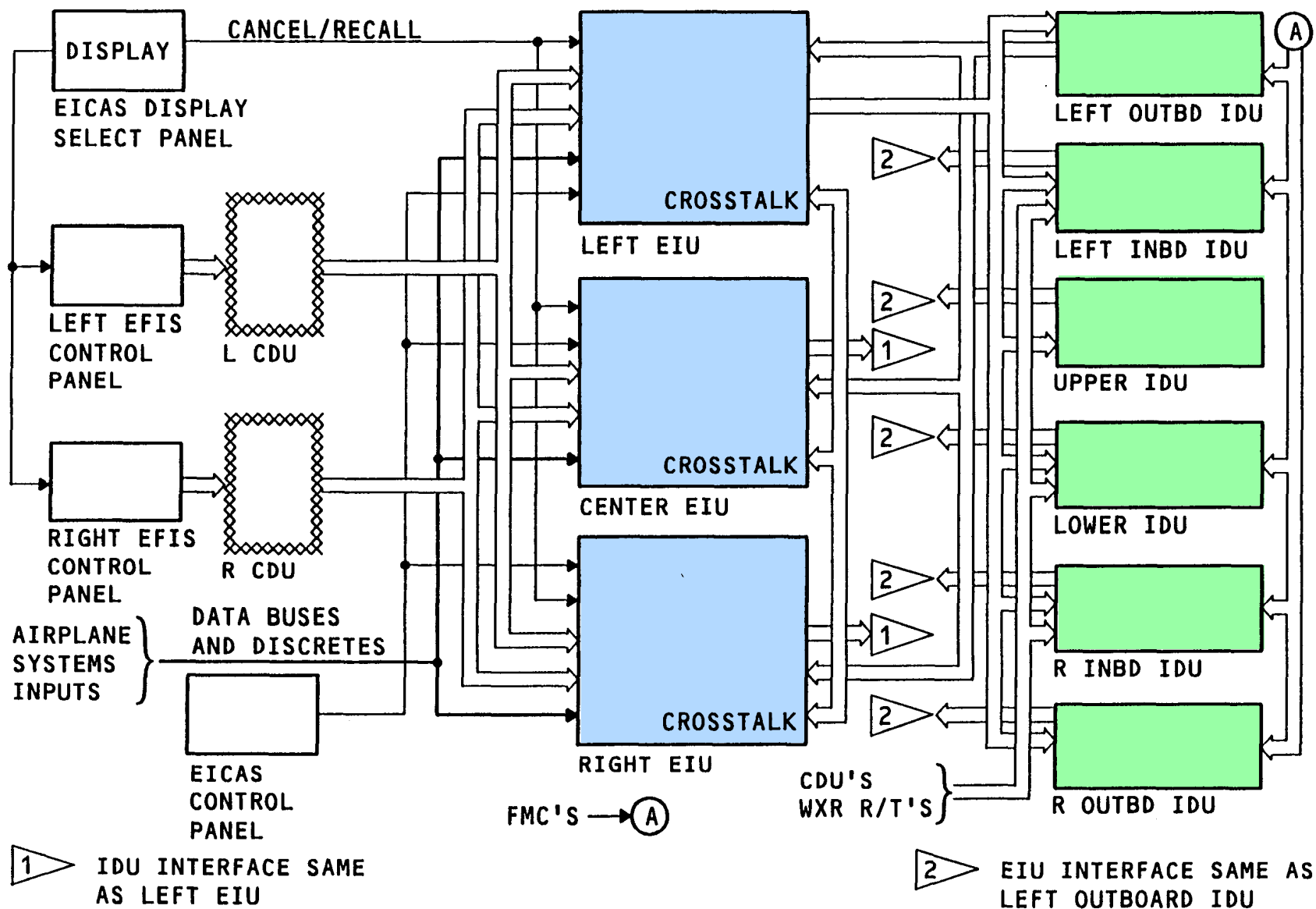


Figure 21 IDS - Display Diagram



EIU DIGITAL BUS OUTPUTS

General Purpose Data Bus

The general purpose data bus from the EIUs sends data to:

- The left and right flight management computers (FMCs)
- The configuration card (in MAWEA)
- The crew alerting card (in MAWEA)

The bus contains data on airplane conditions. This data includes:

- Engine data for use in the FMCs (thrust management function)
- Cabin pressure and doors configuration for use in the crew alerting card
- Thrust lever positions and cabin pressure for use in the configuration card

Engine Data Bus

The engine data bus sends data to the left and right FMCs (thrust management function).

Flight Recorder Data Bus

The EIUs transmit the airplane data to the digital flight data acquisition card (DFDAC) which sends it to the flight recorder. The data includes system parameters, flight deck annunciations and EICAS maintenance page snapshots.

Central Maintenance Computer (CMC) Bus

The EIUs supply the CMCs with flight deck effects (FDEs). These are EICAS messages, EFIS flags or EICAS maintenance page snapshots. The EIUs also send system fault data to the CMCs.

ACMS Data

The EIUs supply the ACMS data management unit with data on airplane systems.

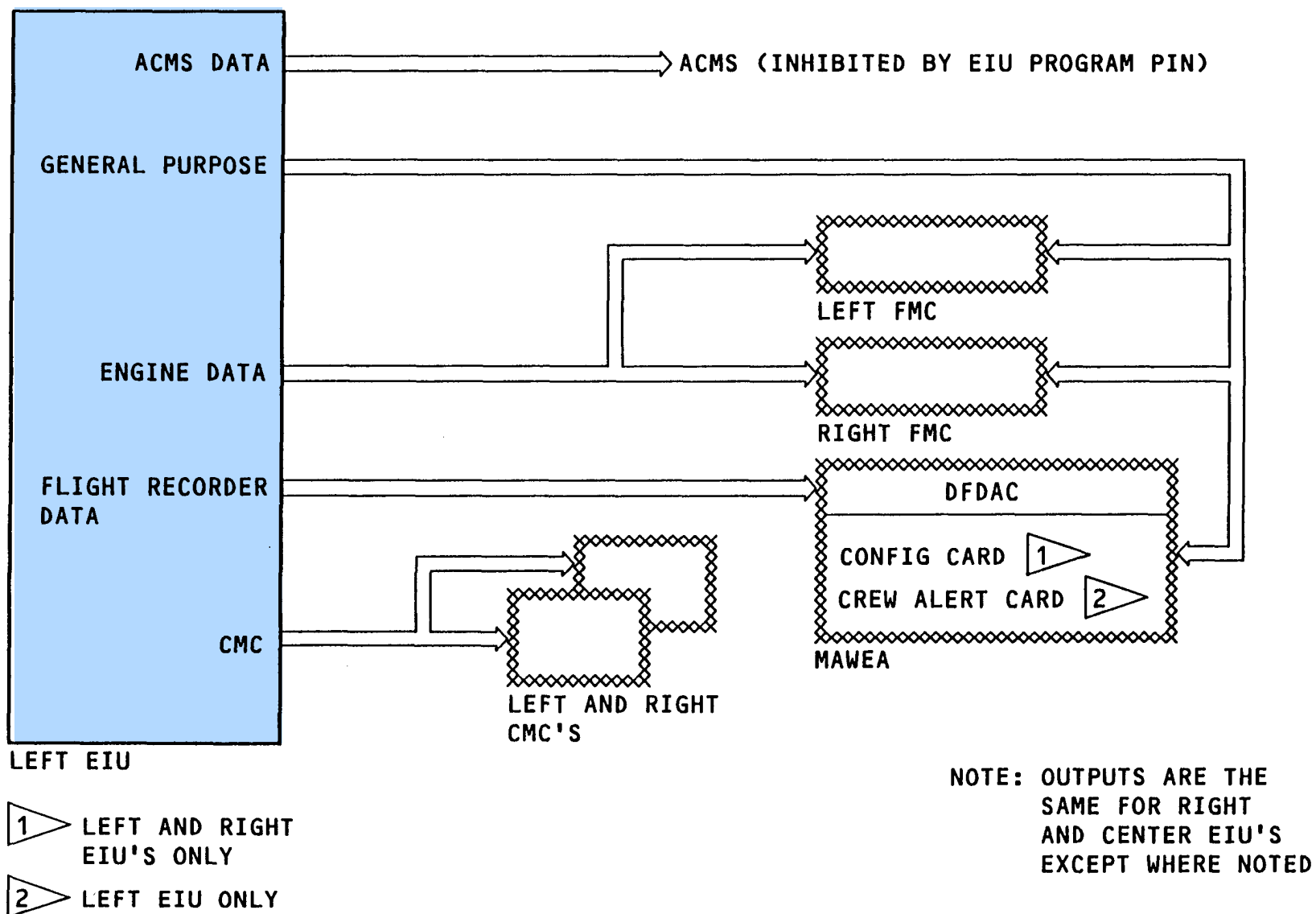


Figure 22 IDS - EIU Digital Bus Outputs





EIU ANALOG DISCRETE OUTPUTS

MAWEA Interfaces

The EIUs send these analog discrete signals to the MAWEA:

- Engine takeoff thrust to the configuration warning card for takeoff configuration
- Master caution aural commands to the aural synthesizer cards (level B tone generation)

Master Caution Light Interface

When a new EICAS Level B condition is detected in the EIUs, the EIUs send analog discretes to the left and right master caution lights. This turns the lights on.

When one of the master caution lights is pushed, a preset discrete is sent to the EIUs. The EIUs then turn the master caution lights off.

EIU Fail

When an EIU operates, the EIU FAIL output is held low (ground). When an EIU fails or has power reduced, the output is open and shows the other EIUs that a failure has occurred.

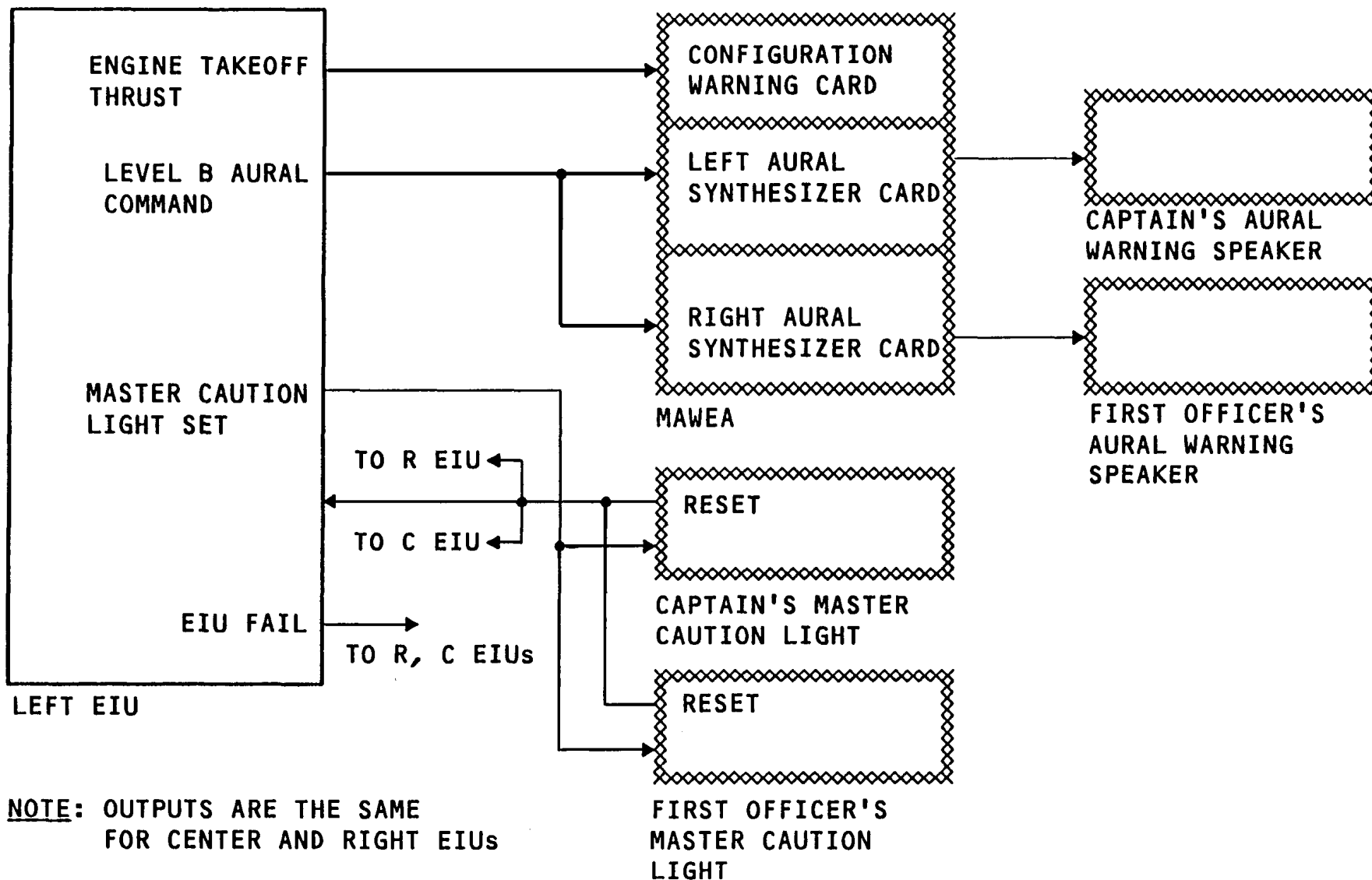


Figure 23 IDS - EIU Analog Discrete Outputs





EFIS/EICAS INTERFACE UNIT

Purpose

The EFIS/EICAS interface unit (EIU) is the main interface between the IDS and the airplane systems. The EIU sends data to the IDUs and to other systems.

Physical Characteristics

The EIU is 15.0 x 10.3 x 7.7 inches and weighs 26 pounds. It is an 8-mcu box. The electrical interface is through an 800 pin connector.

CAUTION: STATIC SENSITIVE. DO NOT HANDLE BEFORE READING PROCEDURE FOR HANDLING ELECTROSTATIC DISCHARGE SENSITIVE DEVICES (REF 20-41-02/201). CONTAINS DEVICES THAT CAN BE DAMAGED BY STATIC DISCHARGE.

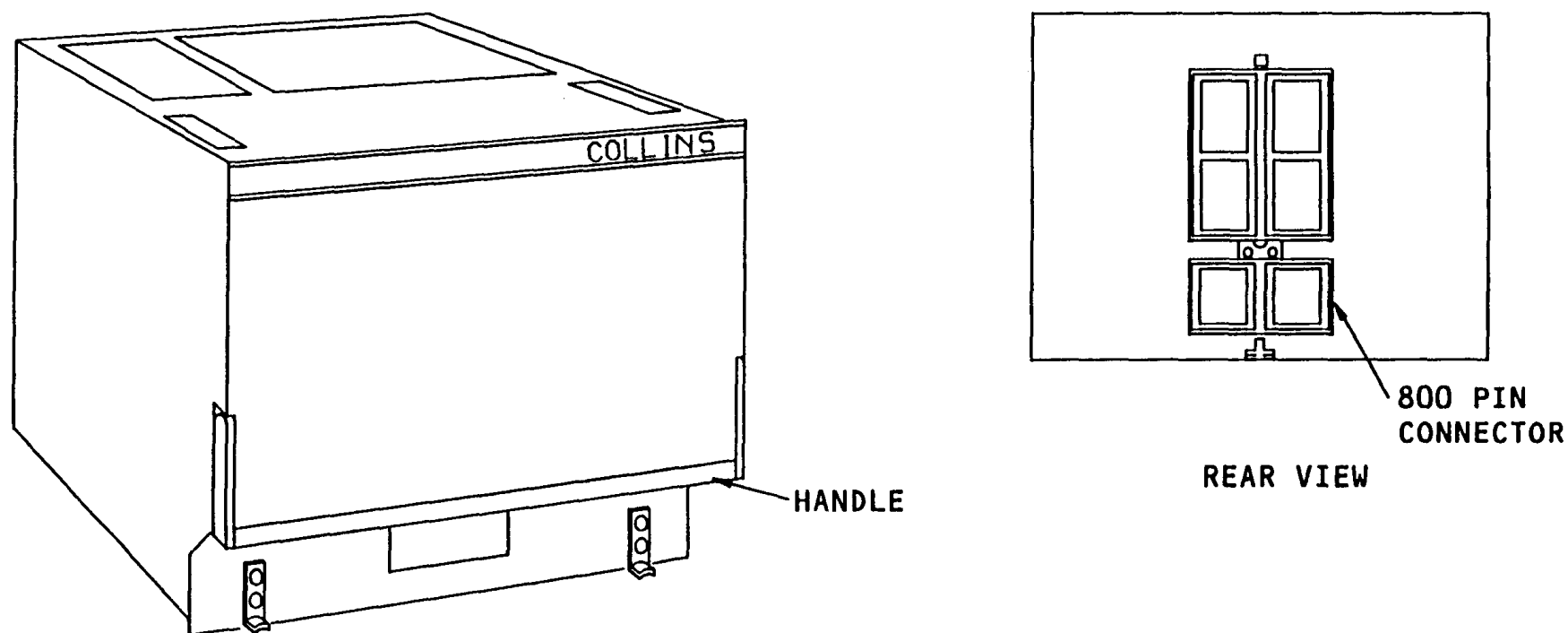


Figure 24 IDS - EFIS/EICAS Interface Unit (EIU)



INTEGRATED DISPLAY UNIT (IDU)

Purpose

The integrated display unit (IDU) shows EFIS and EICAS displays. The IDU has display-processing hardware and software and a color cathode ray tube (CRT). An IDU can show any of these four IDS display functions:

- Primary flight display (PFD)
- Navigation display (ND)
- Main EICAS
- Auxiliary (AUX) EICAS

Physical Characteristics

The IDU is 14.0 x 8.0 x 8.0 inches and weighs 25 pounds.

Electrical Characteristics

The IDU electrical interface is through an ARINC 600, 150-pin connector at the rear of the unit. The unit requires 115v ac, 400 Hz single-phase power.

Unique Practices

The CRT screens can be cleaned with glass cleaner.

If the displays are to get power for a long time, decrease the IDUs to their minimum brightness level.

If the display unit overheats, the cause may be a clogged cooling air inlet screen. A display unit overheat causes the raster-generated display to go away first (110°C) and then causes the entire display to go blank (125°C). If this occurs, remove the display unit and clean the cooling screen. If the unit has sufficiently cooled down, it may then be returned to service.

A protective cover is provided for the lower IDU to prevent damage during flight deck maintenance activities.

Removal/Installation

To remove or install an IDU, loosen or tighten the screws that attach the swingdown handle to the top part of the IDU. The screws are captive-mounted to the handle. Keep pressure on the handle while the screws are loosened and tightened to prevent stripping of the threads.

CAUTION: ENSURE EQUIPMENT COOLING SYSTEM IS OPERATING BEFORE TURN-ON OF THE INTEGRATED DISPLAY SYSTEM (IDS), OR DAMAGE TO EQUIPMENT MAY RESULT.

CAUTION: BEFORE INSTALLING SOFTWARE INTO THE DU, CONSULT AUTHORIZED AIRLINE DEPARTMENT FOR THE CORRECT SOFTWARE PART NUMBER. THE IDS SOFTWARE PART NUMBER MAY BE OBTAINED FROM THE BOEING INSTALLATION DRAWING PL284U1496, OR FROM FAA APPROVED SERVICE BULLETINS.

CAUTION: STATIC SENSITIVE. DO NOT HANDLE BEFORE READING PROCEDURE FOR HANDLING ELECTROSTATIC DISCHARGE SENSITIVE DEVICES (REF 20-41-02/201). CONTAINS DEVICES THAT CAN BE DAMAGED BY STATIC DISCHARGE.

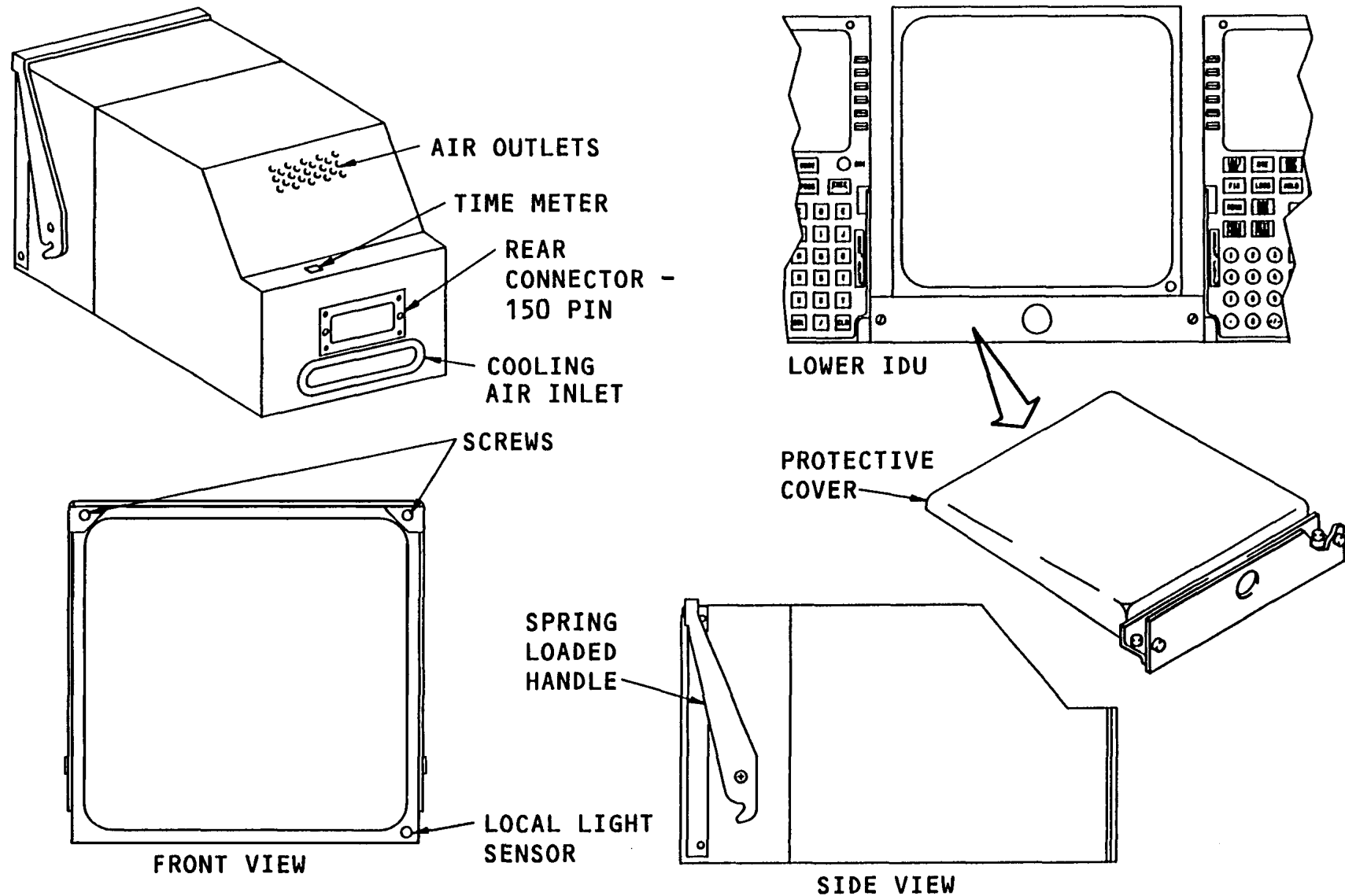


Figure 25 IDS - Integrated Display Unit (IDU)



DISPLAY TRANSFER MODULES

General

Two display transfer modules (DTMs) are installed in the flight deck:

- A captain's DTM
- A first officer's DTM

They can not be changed with each other.

Each DTM has a LWR CRT switch and an INBD CRT switch.

(The term CRT is equivalent with IDU and means cathode ray tube).

INBD CRT Switches

Each INBD (inboard) CRT switch has three settings. They control the display for their onside inboard IDUs. They are:

- EICAS
- NORM (normal)
- PFD

LWR CRT Switches

Each LWR (lower) CRT switch has three settings. They control the display for the lower IDU. They are:

- ND
- NORM
- EICAS PRI

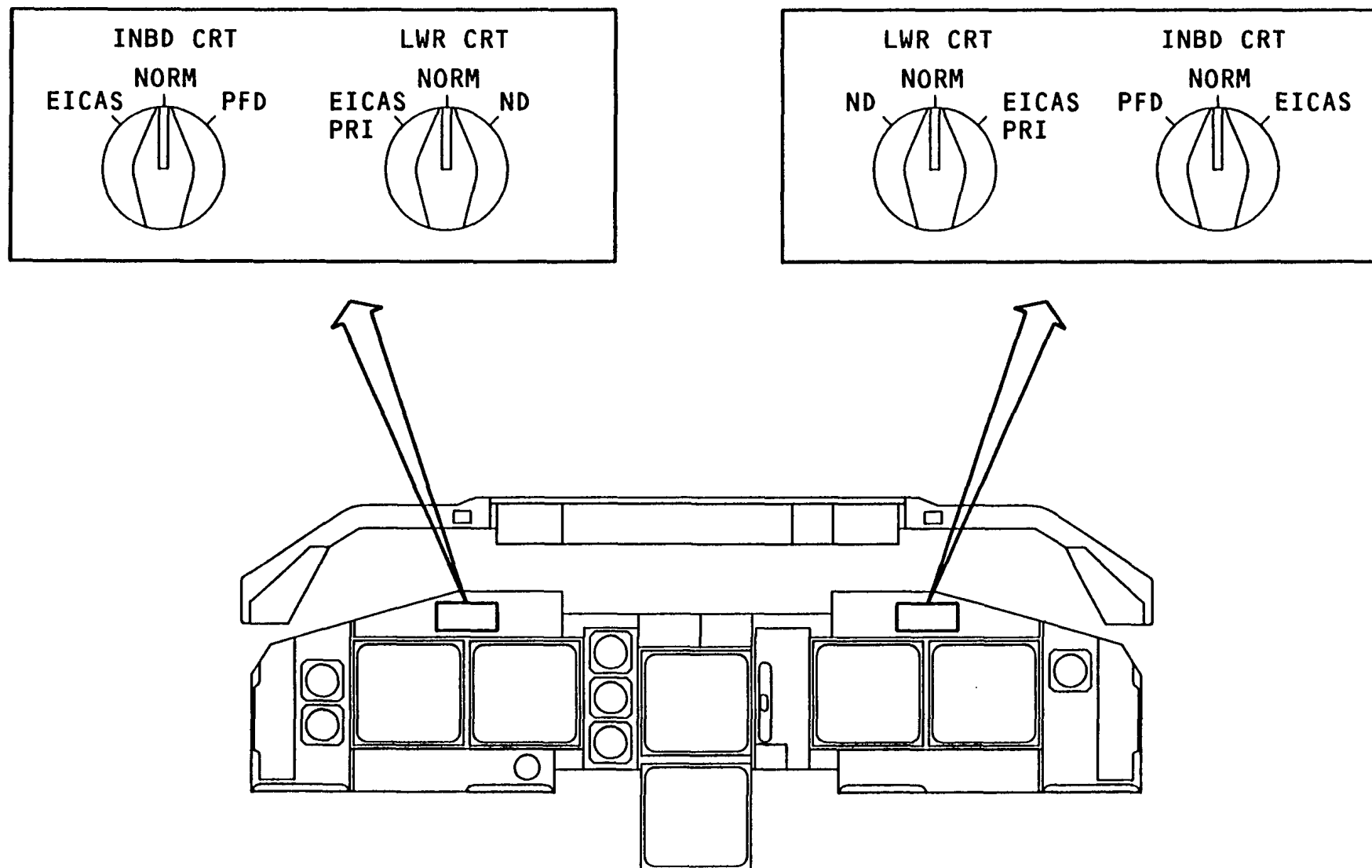


Figure 26 IDS - Display Transfer Modules



IDS DISPLAY - SWITCHING OPERATION**General**

IDS display locations are changed by:

- Manual display switching
- Automatic display switching

Manual Display Switching

Manual display switching is controlled by the INBD CRT (inboard CRT) and LWR CRT (lower CRT) switches. The switches send analog discretes to their appropriate IDU. The display switching takes place in the IDUs based on the analog discrete inputs.

Automatic Display Switching

These are the two types of automatic display transfers that can occur due to a detected failure:

- The PFD can switch from the outboard IDU to the inboard IDU
- The main EICAS display can switch from the upper IDU to the lower IDU

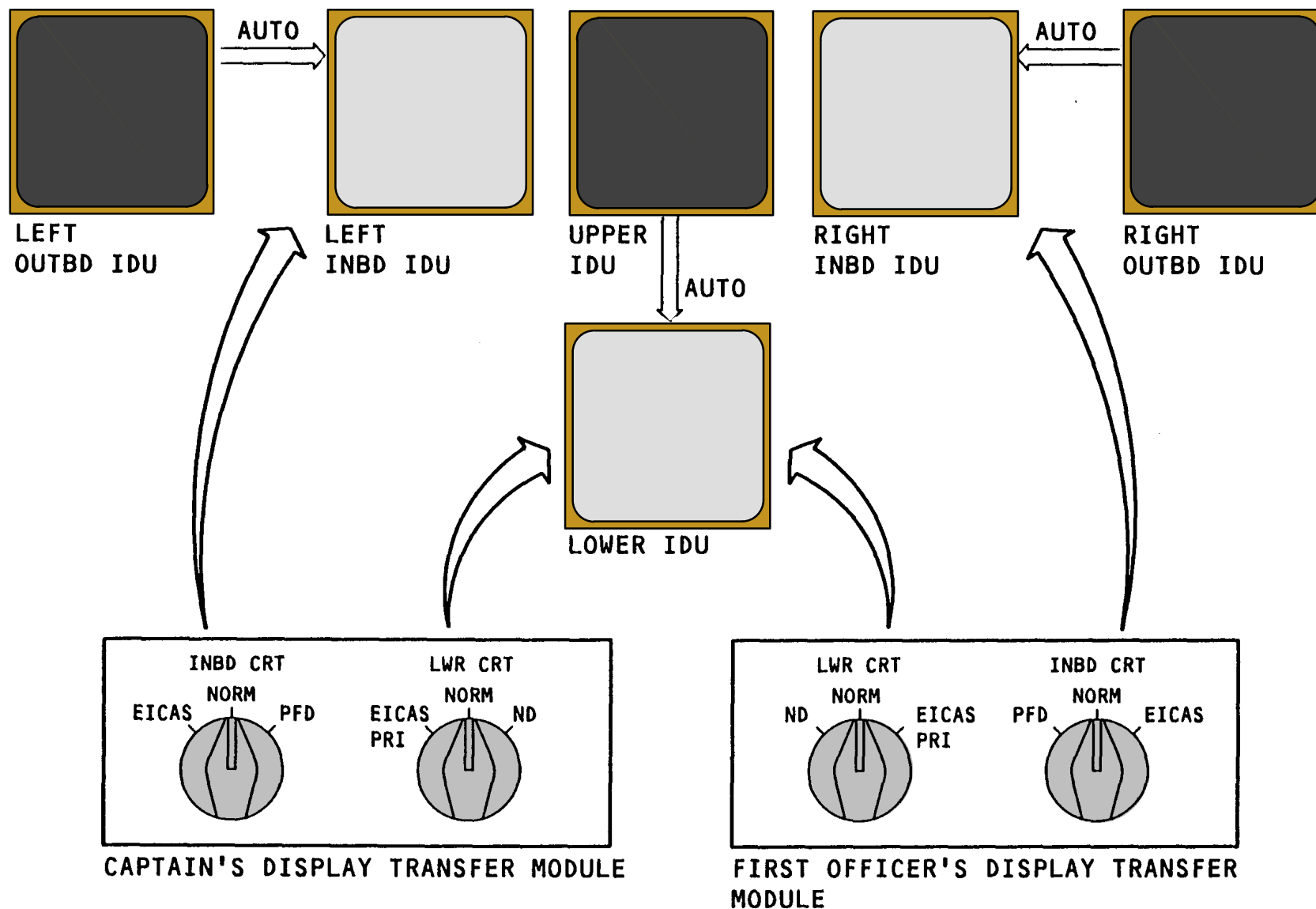


Figure 27 IDS Display - Switching Operation

**AUTOMATIC PFD SWITCHING - EXAMPLE**

When all DTM switches are in the NORM (normal) position, a failure of either outboard IDU causes the onside PFD to show on the onside inboard IDU. The PFD then replaces the ND and the inboard IDU will ignore the inputs from the display transfer module.

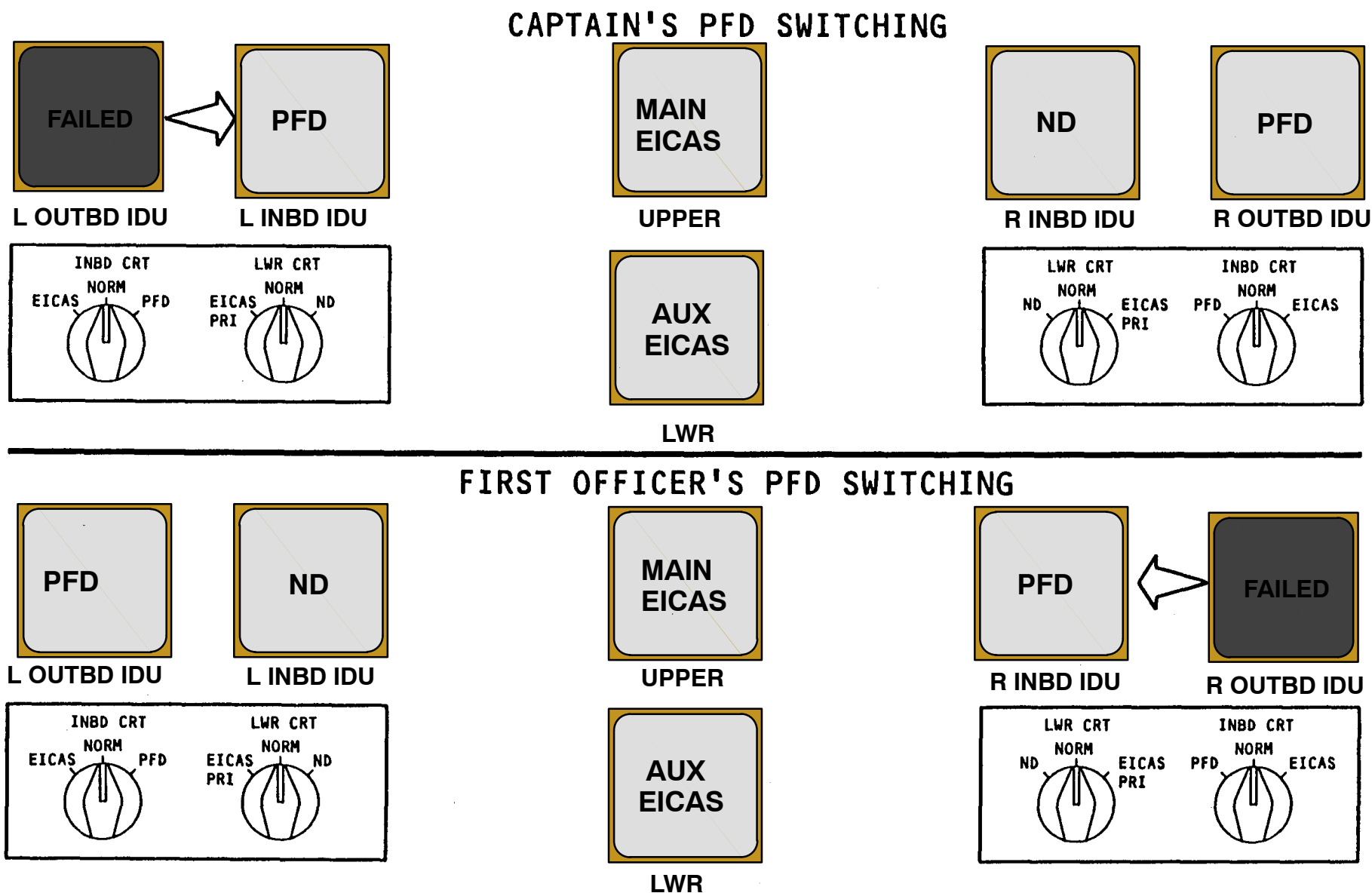


Figure 28 IDS - Automatic PFD Switching - Example

**AUTOMATIC/ MANUAL EICAS SWITCHING -EXAMPLE****Automatic Main EICAS Switching**

When all DTM transfer switches are in the NORM position, a detected failure of the upper IDU causes the main EICAS to be shown on the lower IDU. This causes a degraded EICAS display mode (only one display available for EICAS).

Manual Auxiliary EICAS Switching

When an automatic transfer of the main EICAS has occurred, the degraded EICAS is removed by either the captain's or first officer's INBD CRT switch set to the EICAS position. This causes the respective inboard IDU to show the auxiliary display.

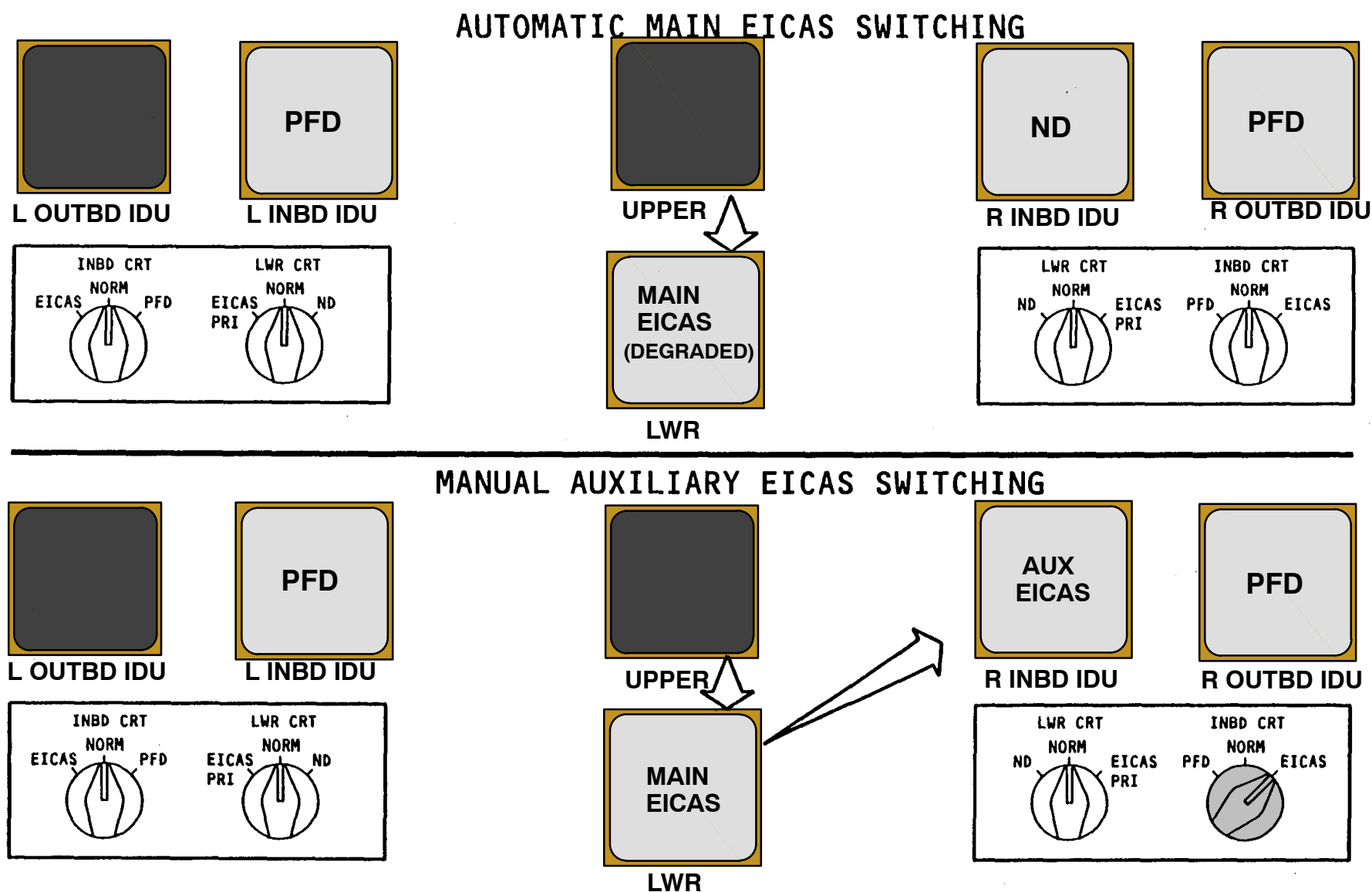


Figure 29 IDS - Automatic/Manual EICAS Switching - Example

**MANUAL ND SWITCHING - EXAMPLE**

The ND format is selected for display on the lower IDU when either LWR CRT switch is turned to ND. This is done when this occurs:

- An ND is removed because of automatic PFD switching
- An inboard IDU fails

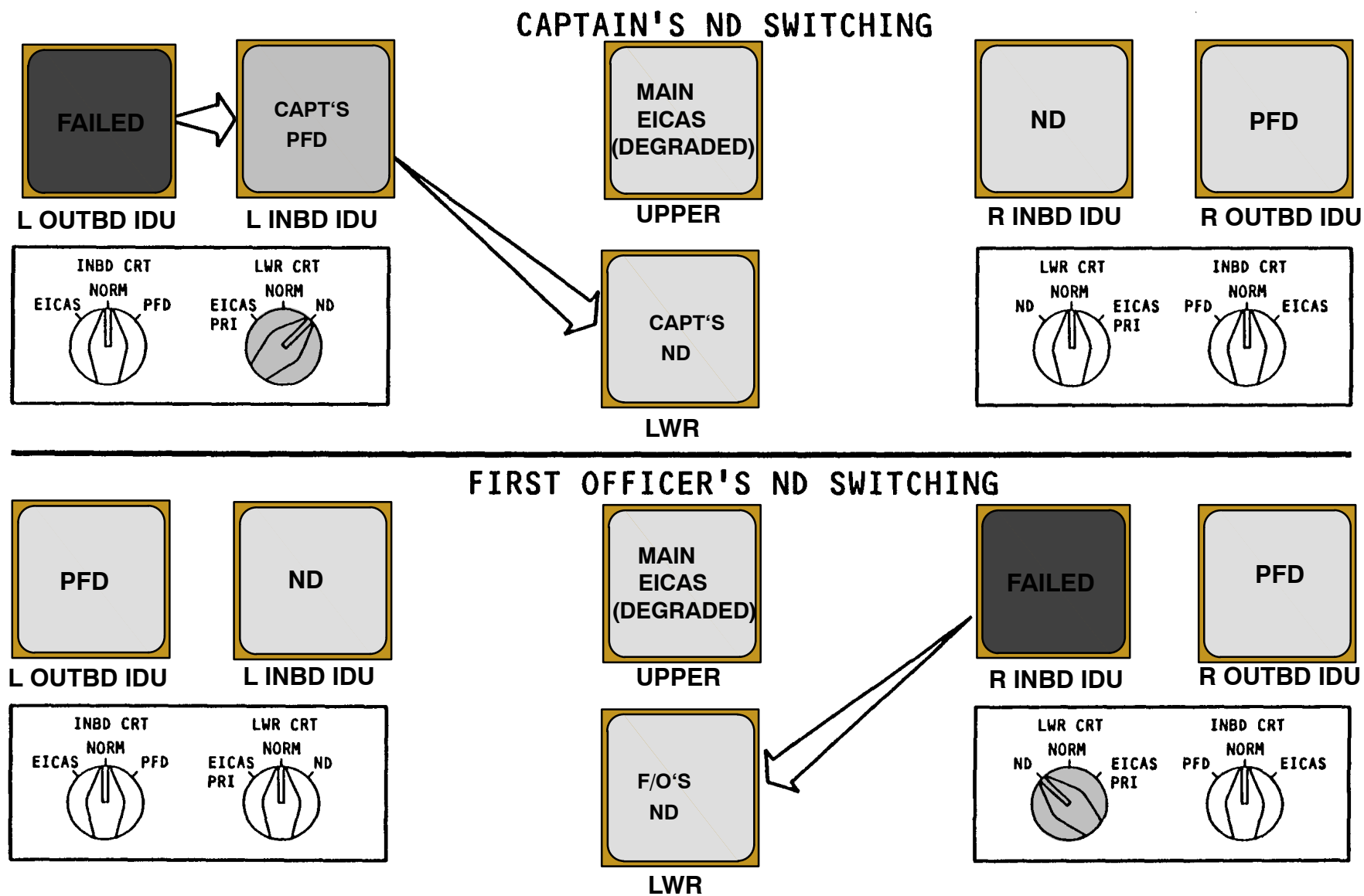


Figure 30 IDS - Manual ND Switching - Example





MANUAL SWITCHING PRIORITY - EXAMPLE**Captain's/First Officer's ND Priority**

If both the captain's and first officer's LWR CRT switches are set to ND, the captain's ND has priority over the first officer's ND selection.

EICAS PRI / ND Priority

The selection of EICAS PRI on either LWR CRT switch causes the main EICAS to be shown on the lower IDU. This has priority over the selection of ND or NORM by the other switch.

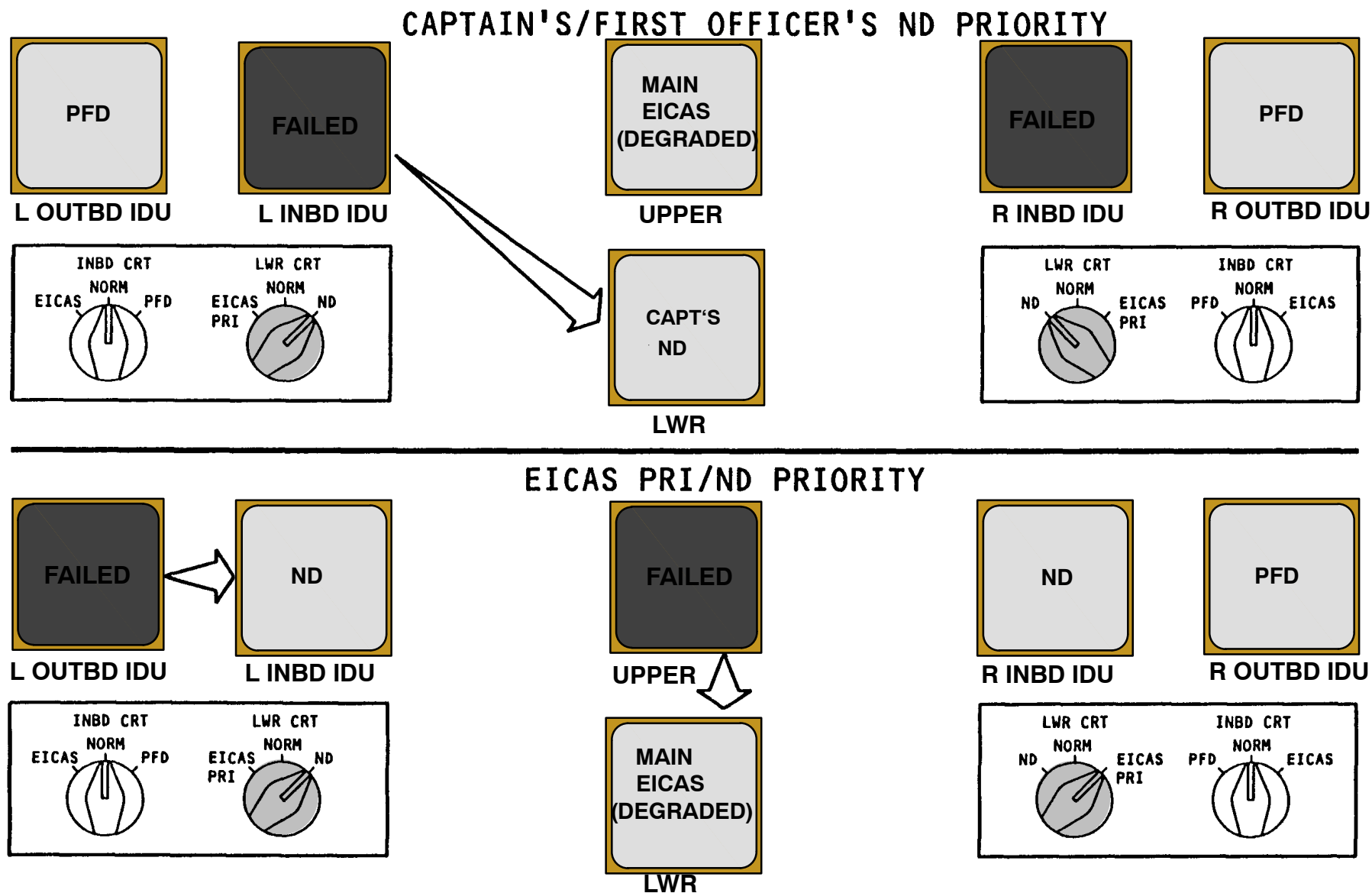


Figure 31 IDS - Manual Switching Priority - Example

**EICAS RECOVERY SWITCHING EXAMPLE**

If both the upper and lower IDUs fail, no EICAS displays are shown. The main EICAS will be displayed on the first inboard IDU to be switched to EICAS. In this condition, if both inboard IDUs are switched to EICAS, the main EICAS is shown on the left inboard IDU and the auxiliary EICAS is shown on the right inboard IDU.

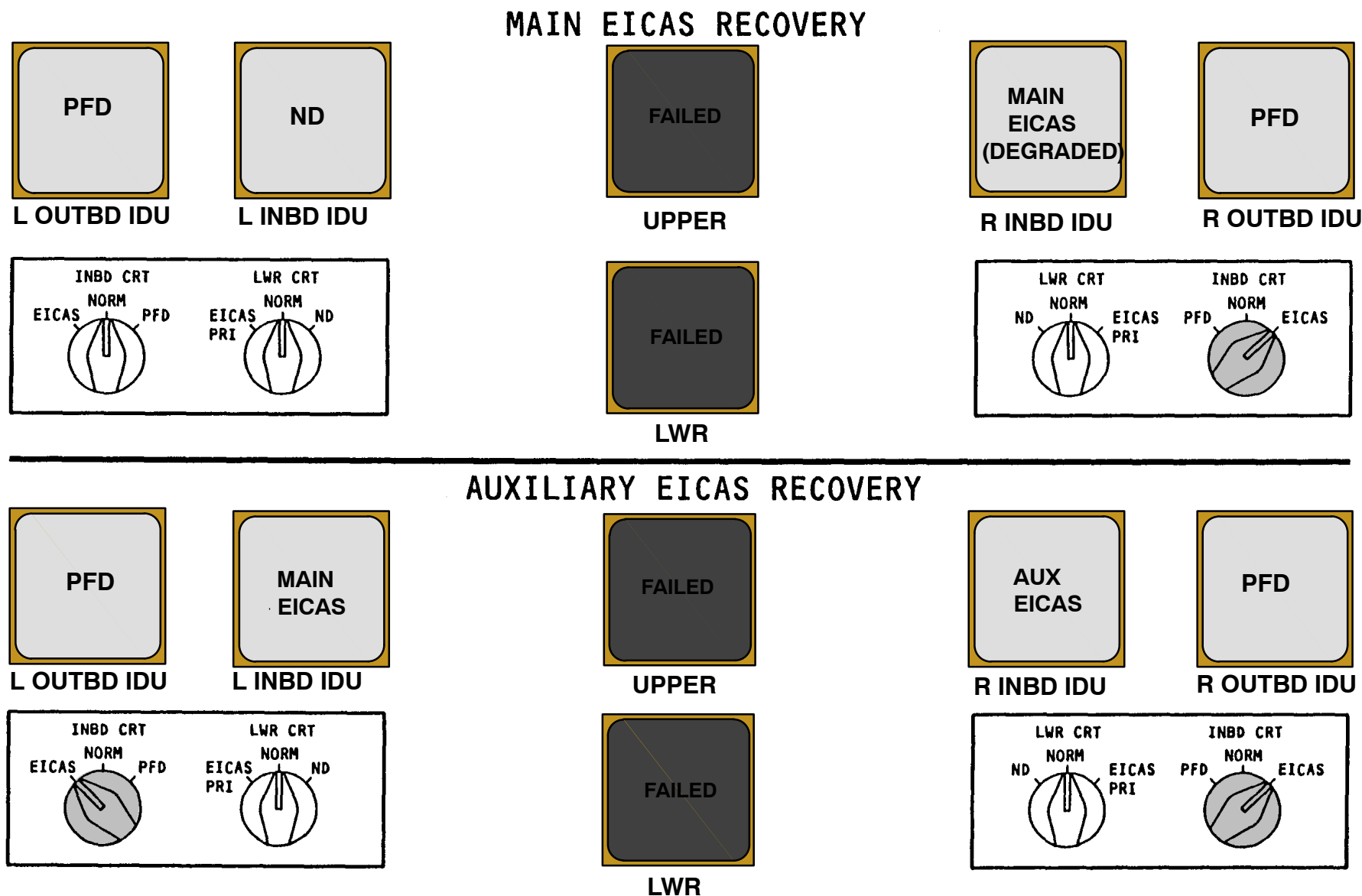


Figure 32 IDS - EICAS Recovery Switching Example





SOFTWARE DATA LOADING

General

The operational software program of the IDUs and EIUs can be updated on the airplane. The IDS software is contained on a 3.5 inch diskette with an EIU file and an IDU file.

Operation

The software data loader (airborne or portable) sends an SDL enable discrete to the LRU selected by the switch on the software data loader panel.

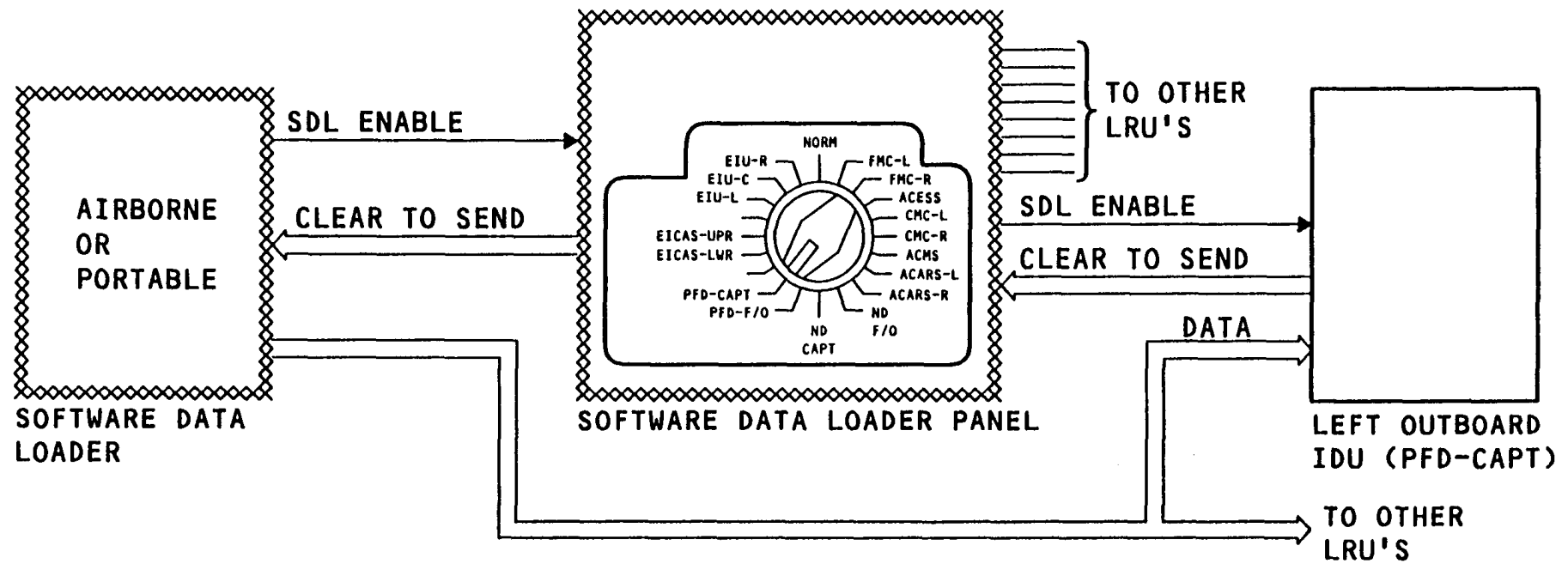
The LRU then sends back a clear-to-send acknowledgement and identification (EIU or IDU) message to the data loader through the data loader panel on a digital bus.

The data loader then sends the proper program file to the LRU.

Switch -Positions

These software data loader switch positions correspond to IDS LRUs:

- EIU-R
- EIU-C
- EIU-L
- EICAS-UPR
- EICAS-LWR
- PFD-CAPT (left outboard IDU)
- PFD-F/O (right outboard IDU)
- ND-CAPT (left inboard IDU)
- ND-F/O (right inboard IDU)

**Figure 33 IDS - Software Data Loading**



IDS - BITE**General**

IDS BITE is activated through the CMCS. IDS BITE consists of:

- IDS test
- IDS shop faults

The CMC requests IDS tests and shop faults. The test and shop faults commands go to the CMCs from any CDU.

IDS Test

The IDS test is a CMC ground test. The test checks for faulty LRUs.

The IDS test is enabled when the ground test enable switch is in the enable position and the airplane is on the ground.

Shop Faults

IDS shop faults are faults that are internal to these IDS components:

- EIUs
- IDUs
- EFIS control panels

These faults are collected in the EIUs and, when requested, transmitted to the CMCs.

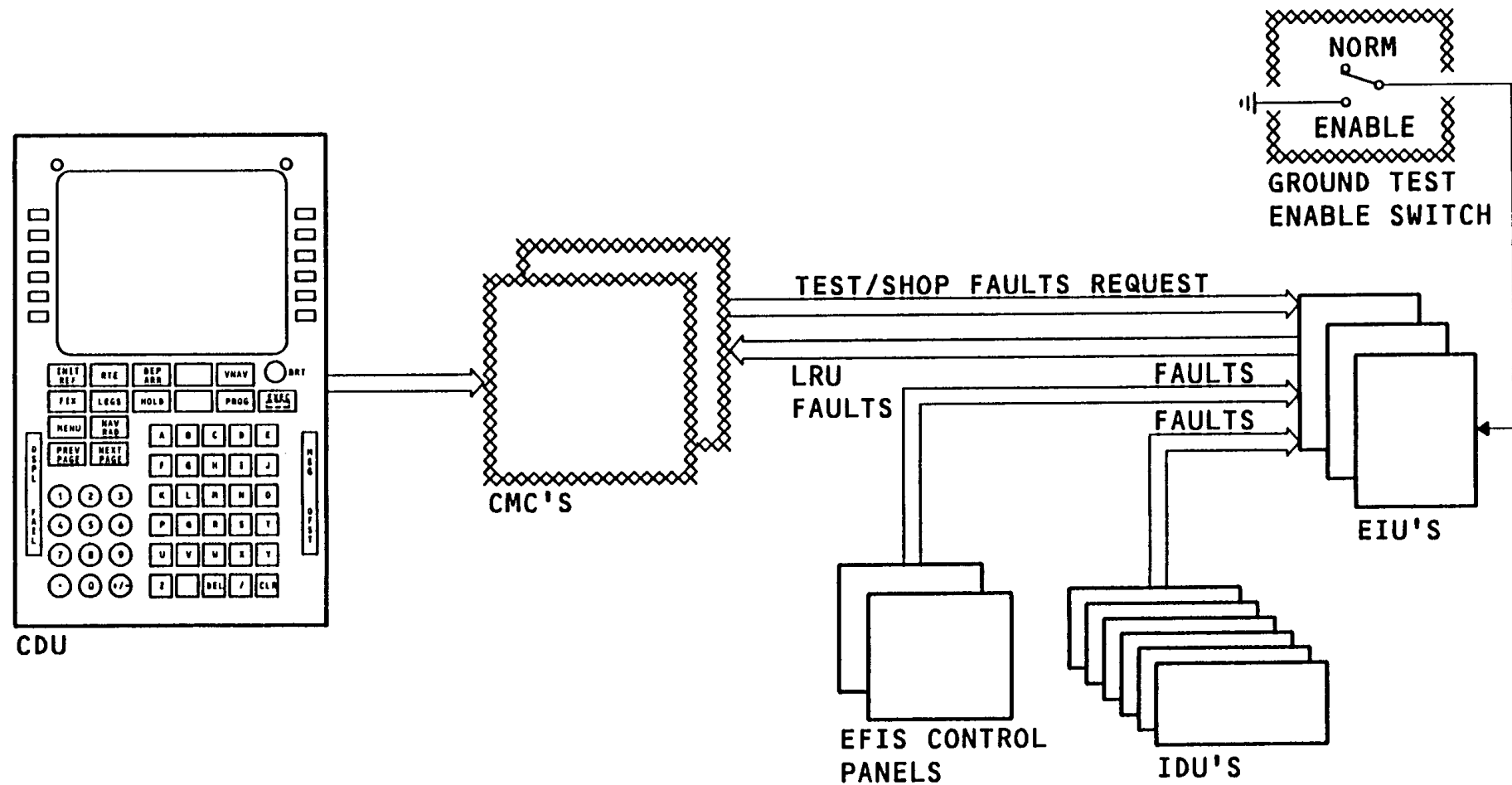


Figure 34 IDS - BITE



IDS - TEST OPERATION

General

The IDS ground test is inhibited under certain conditions. If INHIBITED shows above the IDS test selection, then the IDS test is inhibited. To enable the IDS test, push the line select key next to <IDS. The CDU shows an ENABLE screen. To enable the IDS test:

- The airplane must be on the ground, and
- The ground tests enable switch must be in the ENABLE position.

Push the line select key next to <RETURN. Push the line select key next to <IDS to start an IDS test.

Indications

The IDS test format is displayed on all IDUs during the IDS test. It will remain on the IDUs after the test until any EICAS DSP key is pressed, or any selections are made on the EFIS control panels or the ground test enable switch is set back to normal.

During the test a level B aural (owl) will sound, the master caution lights

illuminate, and the takeoff DH, and DH +50 discretes will set.

Reported Faults

These faults can be detected and sent from the EIUs to the CMCs during IDS tests:

- IDU failed
- EIU failed
- EFIS control panel failed
- EIU disagree
- EIU no test response

They are found on the CMC Ground Test Message menu.

EIU Isolation

During normal operation the EIUs function as an OR gate. If one EIU receives an input, the information is shared through the crosstalk bus and all three would output the same information. With the ground test enable switch in the enable position, the EIUs function independently. This can aid in the repair of an EIU disagree malfunction.

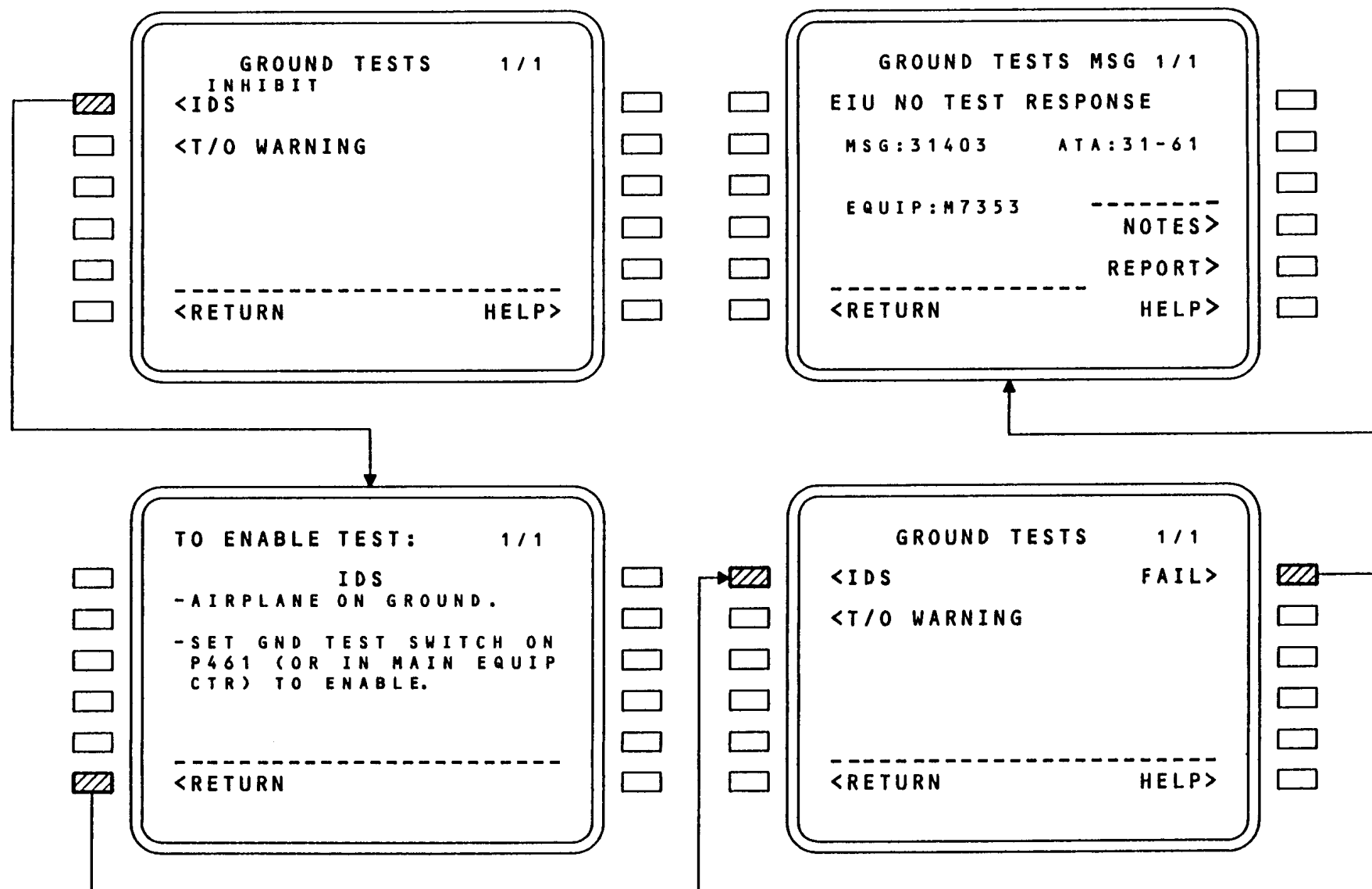


Figure 35 IDS - Test Operation



IDS TEST FORMAT

General.

The IDS test format shows on the IDUs:

- When an IDU is powered during an IDS test
- When there is an EIU program pin error

Test Indications

The IDS test format shows:

- IDS software part number
- EIU software part number
- Raster patches
- Convergence crosses
- Standard characters
- IDU position pin readout (octal)
- EIU position pin readout (octal), with ERROR message
- IDS program in readout (hexadecimal), with ERROR message

Part Numbers

The IDU and EIU software part numbers are displayed.

The EIU software part number represents the EIU that controls the IDU displaying the IDS test format.

Raster Patches

Raster patches are displayed for each of the three IDU color guns, for display brightness testing. The manual brightness controls have no effect on the raster patch brightness.

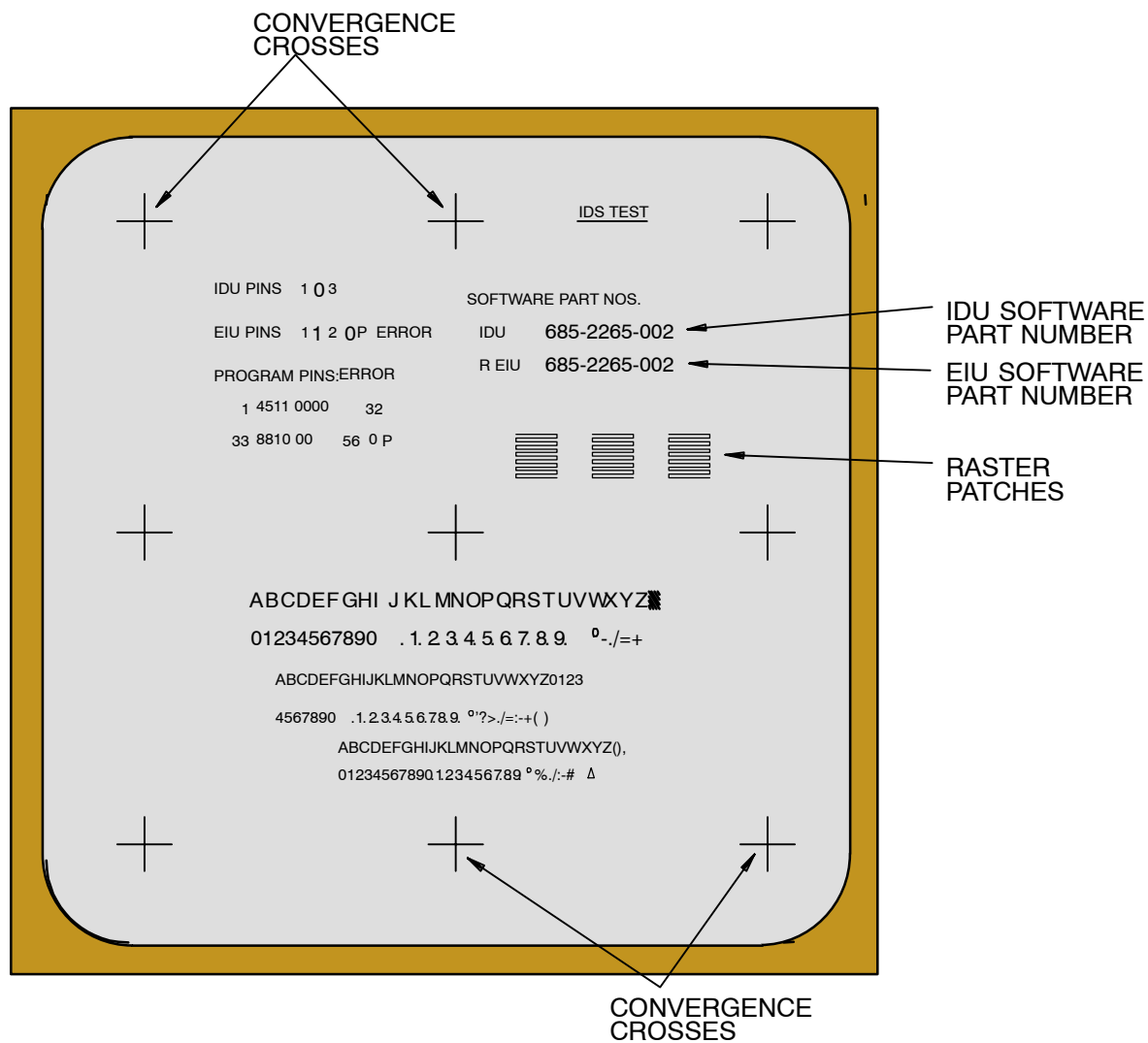
Convergence Crosses

Nine convergence crosses are displayed to verify positioning of the IDU color guns.

Standard Characters

All available characters that are stored in the IDU memory are displayed in three sizes.

All symbology should be clear and undistorted.



CAUTION: THE IDU SOFTWARE PART NUMBER, EIU SOFTWARE PART NUMBER AND PROGRAM PINS SHOWN ON THIS DISPLAY FORMAT ARE FOR DESCRIPTIVE PURPOSES ONLY. CONSULT WITH THE AUTHORIZED AIRLINE DEPARTMENT FOR THE CORRECT SOFTWARE PART NUMBERS AND PROGRAM PIN CONFIGURATION.

Picture taken from MM 31-61-00

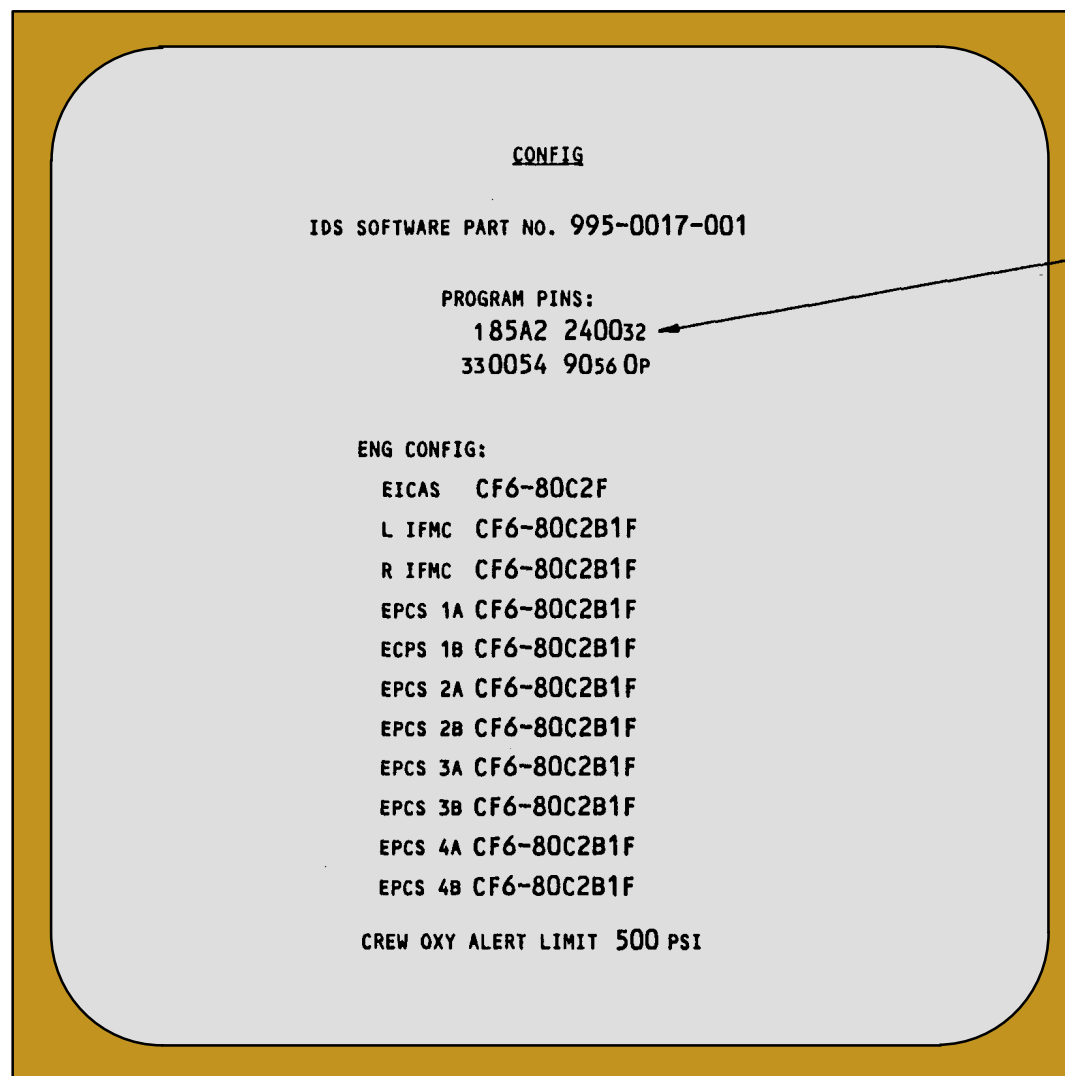
Figure 36 IDS Test Format



CONFIGURATION MAINTENANCE PAGE

The configuration maintenance page shows this data:

- IDS software part number (source: IDS program pins)
- IDS program pins in hexadecimal format (source: IDS program pins)
- EICAS engine configuration (source: IDS program pins)
- FMC engine configuration (source: FMC)
- EEC engine configuration (source: EECs)
- Crew oxygen pressure limit (source: oxygen pressure transducer)

PROGRAM PINS
(TYPICAL)

AUXILIARY EICAS DISPLAY

Figure 37 IDS - Configuration Maintenance Page



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**CONFIG. MAINT. PAGE SOFTWARE ERROR****Software Part Number**

The configuration maintenance page normally shows the IDS software part number resident in the IDU that is displaying the format. If the software part number is not the same in all IDUs and EIUs, the magenta ERROR message is shown.

Program Pins

The EIU program pins, from the EIU selected on the EICAS control panel, are shown. The hexadecimal readout reflects the real-time state of the program pins when the test discrete is set. If the test discrete is not set the latched state of the program pins is shown.

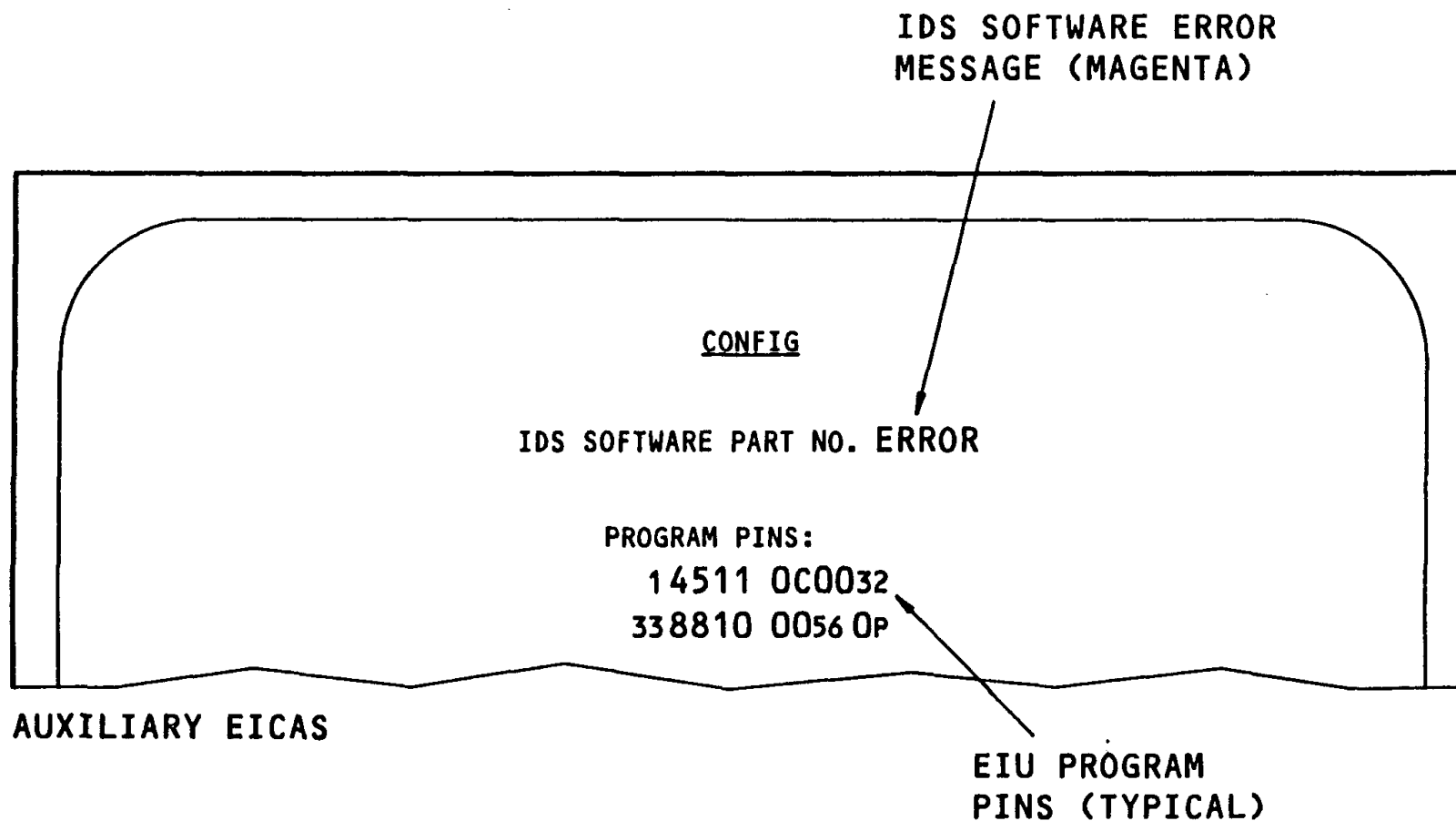


Figure 38 IDS - Configuration Maintenance Page Software Error



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ENGINE INDICATING AND CREW ALERTING SYSTEM

General

EICAS provides:

- Color coded displays and alert messages
- Comprehensive monitor of airplane systems
- Dispatch information
- Storage of maintenance related data

Main EICAS Display

The upper IDU normally shows primary engine indications, crew alert messages, flaps and landing gear status, fuel quantity and environmental control system information. The formats available on the main EICAS display include:

- Primary
- Compacted-full
- Compactedpartial
- Mini synoptics

Auxiliary EICAS Display

The lower IDU normally shows the auxiliary EICAS formats. During normal flight, the lower IDU will be blank. The available aux EICAS formats are:

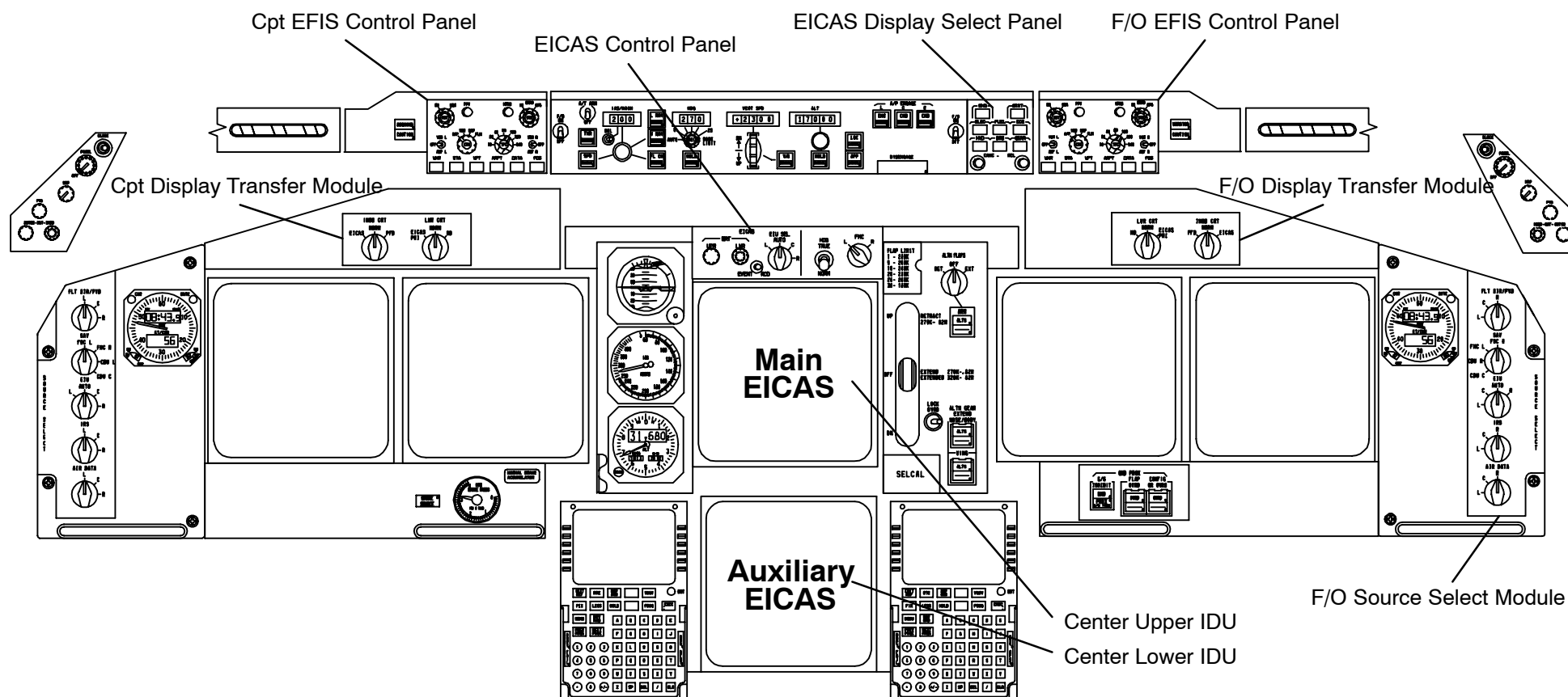
- Secondary engine
- Secondary-partial
- Status page
- Synoptics
- Maintenance pages

Control

The EICAS control panel provides EIU selection, brightness control and maintenance page snapshot control.

The display select panel provides main and aux EICAS display control and message paging control.

Maintenance pages are controlled through the central maintenance computer using any of the control display units.



Note: Display Units shown in normal configuration

MAIN EICAS FORMATS

PRIMARY
COMPACTED-FULL
COMPACTED-PARTIAL
MINI SYNOPTICS

AUXILIARY EICAS FORMATS

SECONDARY ENGINE
SECONDARY-PARTIAL
STATUS
SYNOPTICS
MAINTENANCE PAGES

Figure 39 Engine Indicating & Crew Alerting System

INDICATING/ RECORDING SYSTEMS INTEGRATED DISPLAY SYSTEM



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MAIN EICAS - PRIMARY FORMAT

General

The EICAS primary format shows on the main EICAS display at power-up and during normal operation. Color changes can indicate degraded system operation and miscellaneous prompts are used to monitor related system operation.

To maintain a "quiet, dark" flight deck, information that is not required is removed. Primary engine parameters and the fuel system data always show.

Engine Parameters

The primary engine parameters are:

- N1 rotor speed
- Exhaust gas temperature (EGT)

Message Field

The alert message field shows:

- Level A warning messages in red
- Level B caution messages in amber
- Level C advisory messages in amber and indented
- Level D memo messages in white

Gear and Flaps

The landing gear status shows when the gear is down or when a gear malfunction exists. The area blanks when the airplane is in the air and the gear has retracted normally.

The flaps indications monitor flap position and flap movement.

The indications change to show abnormal conditions or alternate flap selection. The area blanks with the flaps set at zero and the flaps fully retracted.

Fuel

Fuel system data shows:

- Total fuel in kilograms x 1000
- Fuel temperature
- Fuel to remain in a fuel jettison condition

Environmental Control System

The environmental control system data block shows:

- Duct pressure
- Cabin altitude
- Landing altitude
- Cabin differential pressure

The ECS data block shows when certain ECS related events or messages occur. The conditions that cause the data block to show are:

- Manual landing altitude shown
- Cabin altitude readout is amber/red
- Cabin delta pressure readout is amber/red
- ECS maintenance pages or ECS synoptic or EICAS secondary-full is selected

The ECS data block is available on all main EICAS formats.

FMC Data

Thrust mode and total air temperature show above the primary engine parameters.

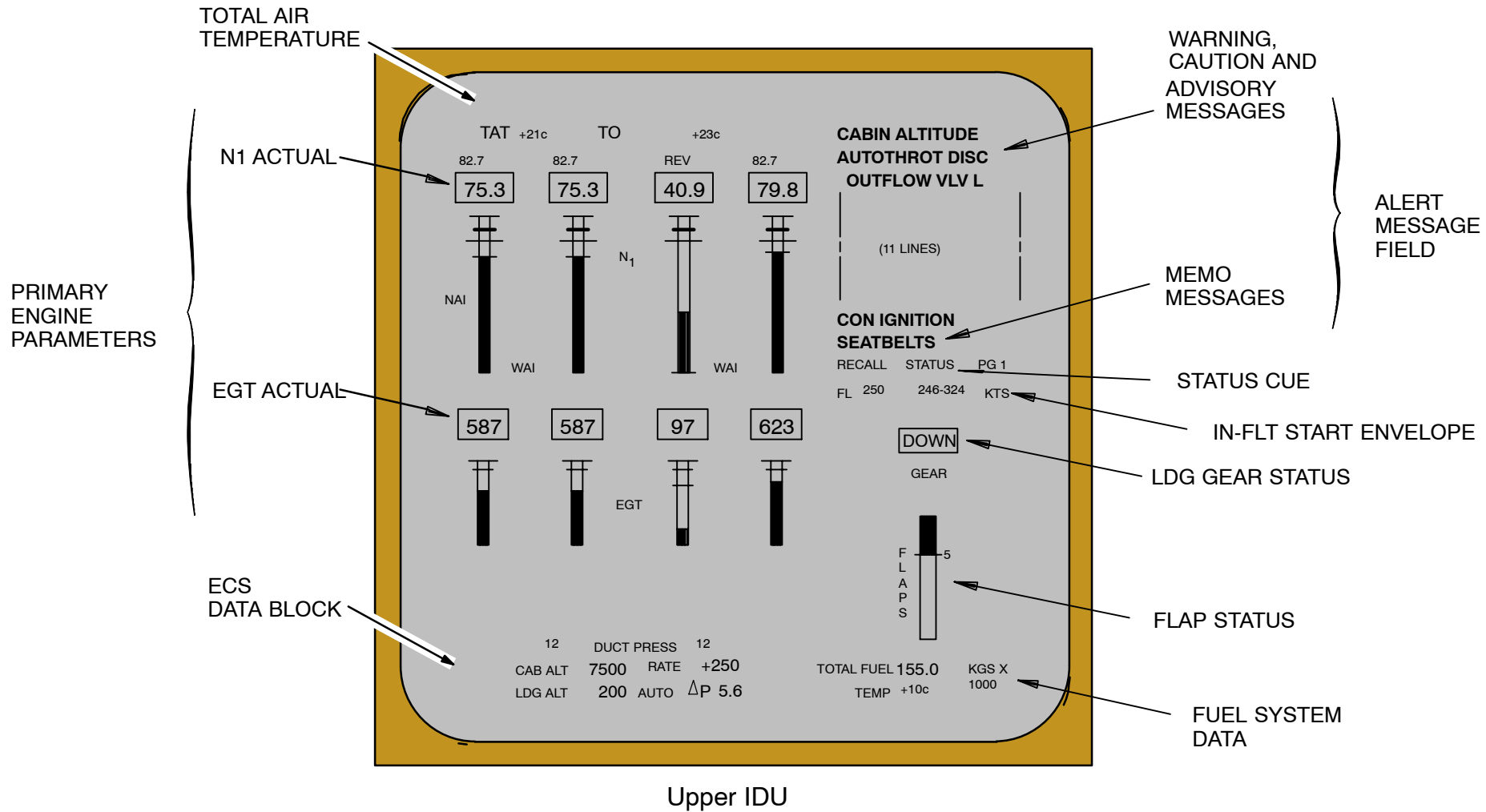


Figure 40 Main EICAS - Primary Format

**AUXILIARY EICAS - SECONDARY ENGINE FORMAT**

The secondary engine format shows on the auxiliary EICAS display at power-up. This format consists of secondary engine parameters. They are:

- N2 rotor speed in percent
- Fuel flow in lbs. or kg X1000 per hour
- Oil pressure in psi
- Oil temperature in ° C
- Oil quantity in quarts or liters
- Engine vibration in relative units

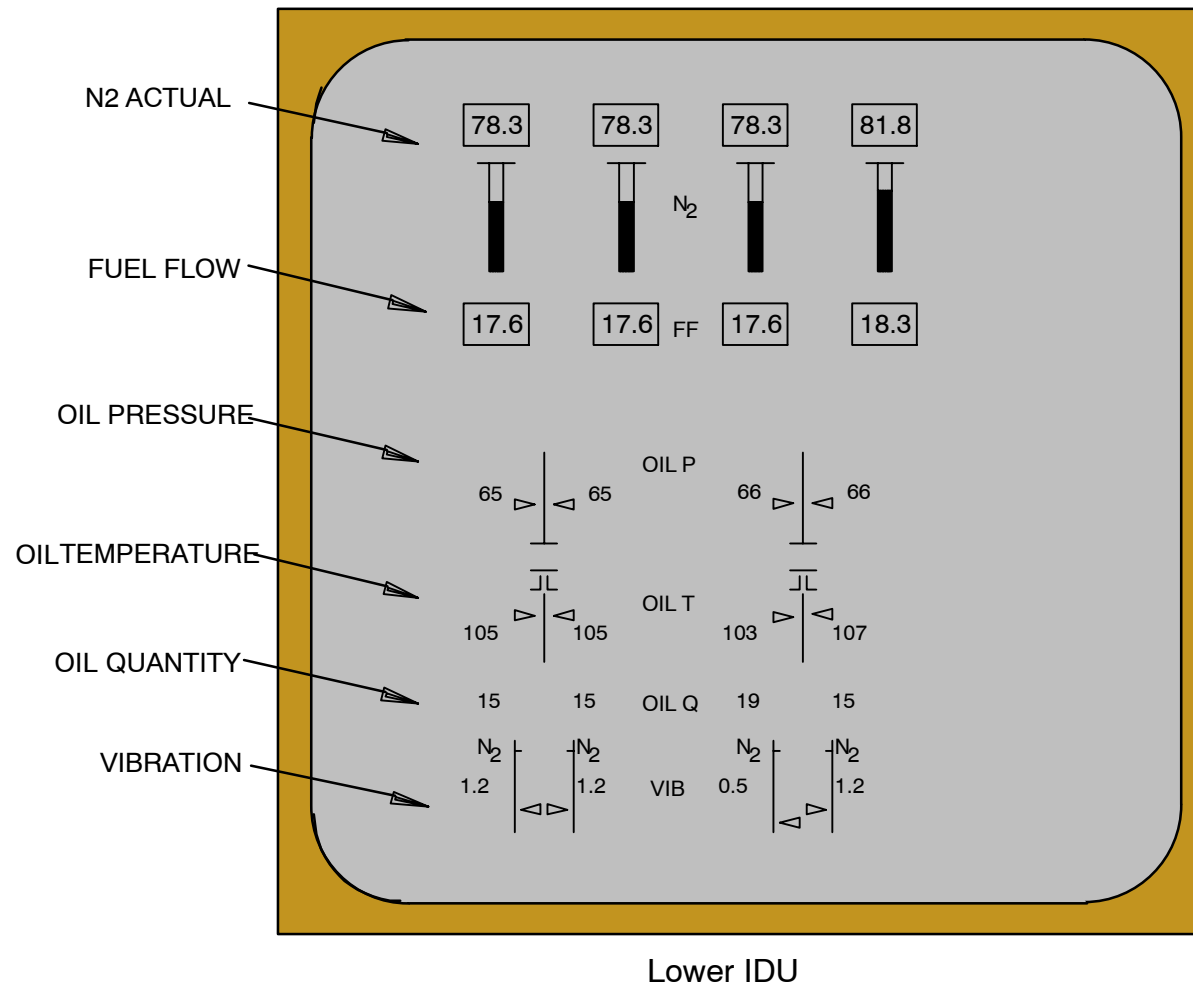


Figure 41 Auxiliary EICAS - Secondary Engine Format



EICAS ENGINE KEY - NORMAL OPERATION**General**

The EICAS secondary format page shows when the ENG (engine) key on the EICAS display select panel (DSP) is pushed.

Operation

At initial power-up, the secondary format automatically shows.

Push the ENG key (with secondary engine data already on the display) to make the auxiliary EICAS display go blank.

Normal operation in-flight is a blank auxiliary EICAS display. Push the ENG key to show the secondary engine data on the auxiliary EICAS display.

Additional functions of the engine key will be discussed later.

INDICATING/ RECORDING SYSTEMS INTEGRATED DISPLAY SYSTEM



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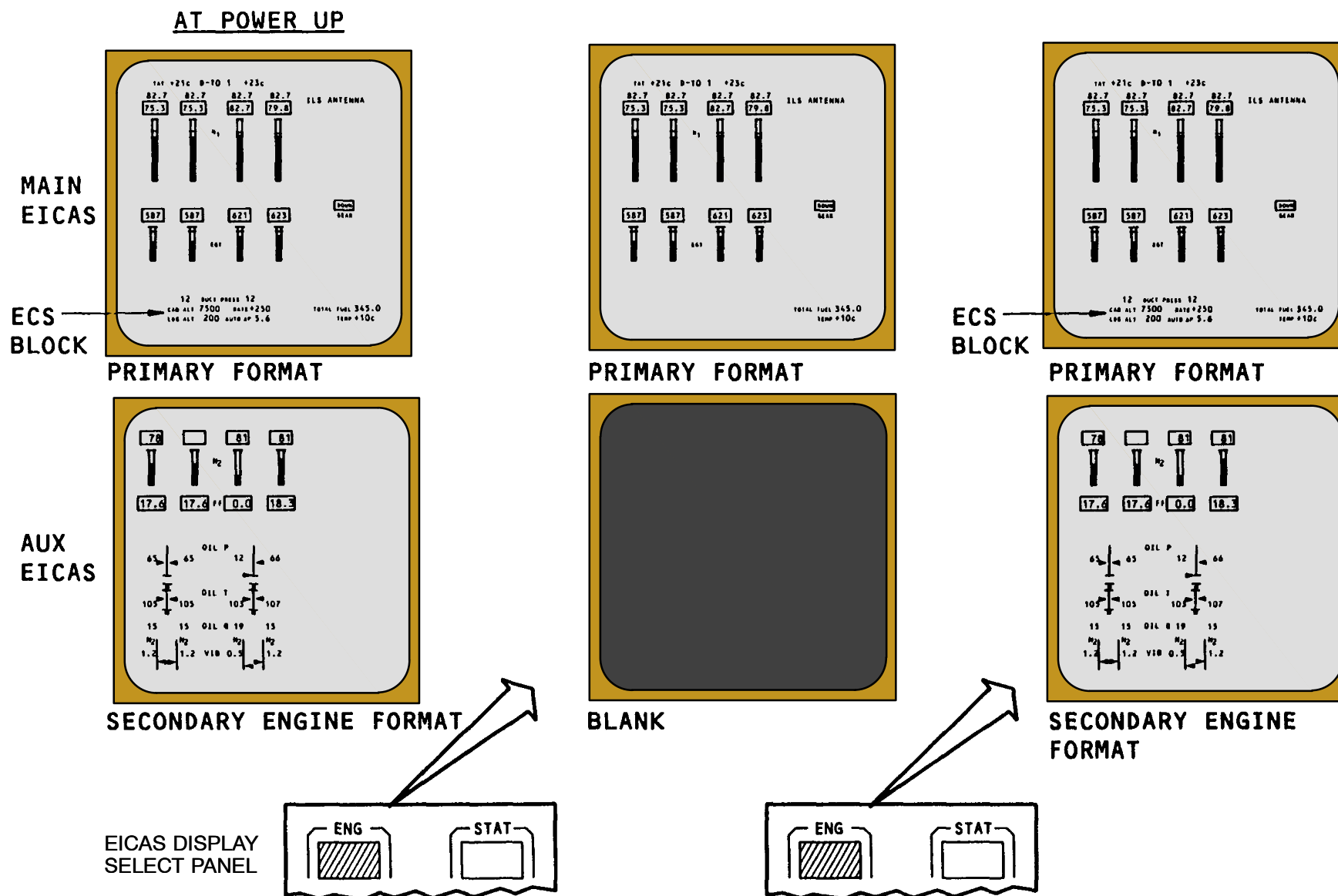


Figure 42 EICAS Engine Key - Normal Operation

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MAIN EICAS - COMPACTED - FULL FORMAT

General

The EICAS compacted format combines the EICAS primary and EICAS secondary parameters. It is displayed on the main EICAS. In the compacted format, the EICAS secondary parameters are displayed in digital format only.

Display Processing

The compacted format shows during the following conditions:

- Any time a maintenance page shows while the airplane is on the ground
- When EICAS is in a degraded mode (only one display available for EICAS)

The engine key is used to select the compacted format. Push the engine key a second time to return to the primary format.

The message field, gear, and flap information is available for display if required. The conditions for display are the same as the primary format.

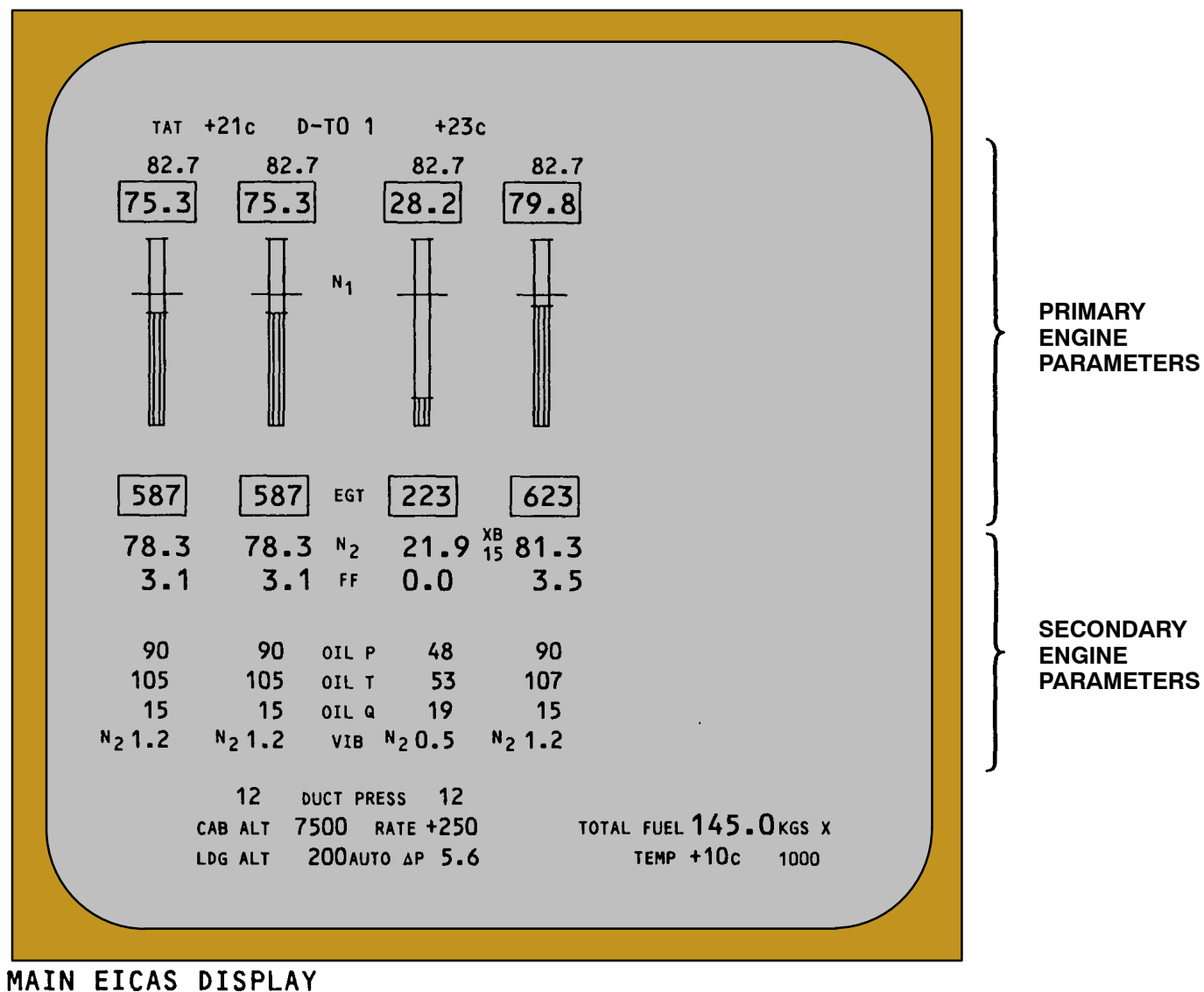


Figure 43 Main EICAS - Compacted-Full Format



AUXILIARY EICAS - SECONDARY - PARTIAL FORMAT

General

EICAS secondary-partial is the result of one or more secondary engine exceedances:

- N2 exceedances
- Engine oil exceedances
- Vibration exceedances

These indications show automatically and independently on the auxiliary EICAS display in the event of an exceedance.

N2 Exceedance

When a new N2 redline exceedance occurs, N2 indication for all four engines show.

Engine Oil Exceedances

The following are the possible engine oil exceedances:

- Low oil pressure redline
- High oil temperature redline
- High oil temperature amber limit - Low oil quantity magenta limit

In the event of any of the above engine oil exceedances, the entire engine oil indication shows.

Vibration Exceedances

Vibration exceedances occur in the following areas:

- BB (broad band vibration)
- Fan
- LPT
- N2

New Exceedances

When a new secondary exceedance occurs, the auxiliary EICAS shows the secondary-partial format, unless it is already displaying secondary-full.

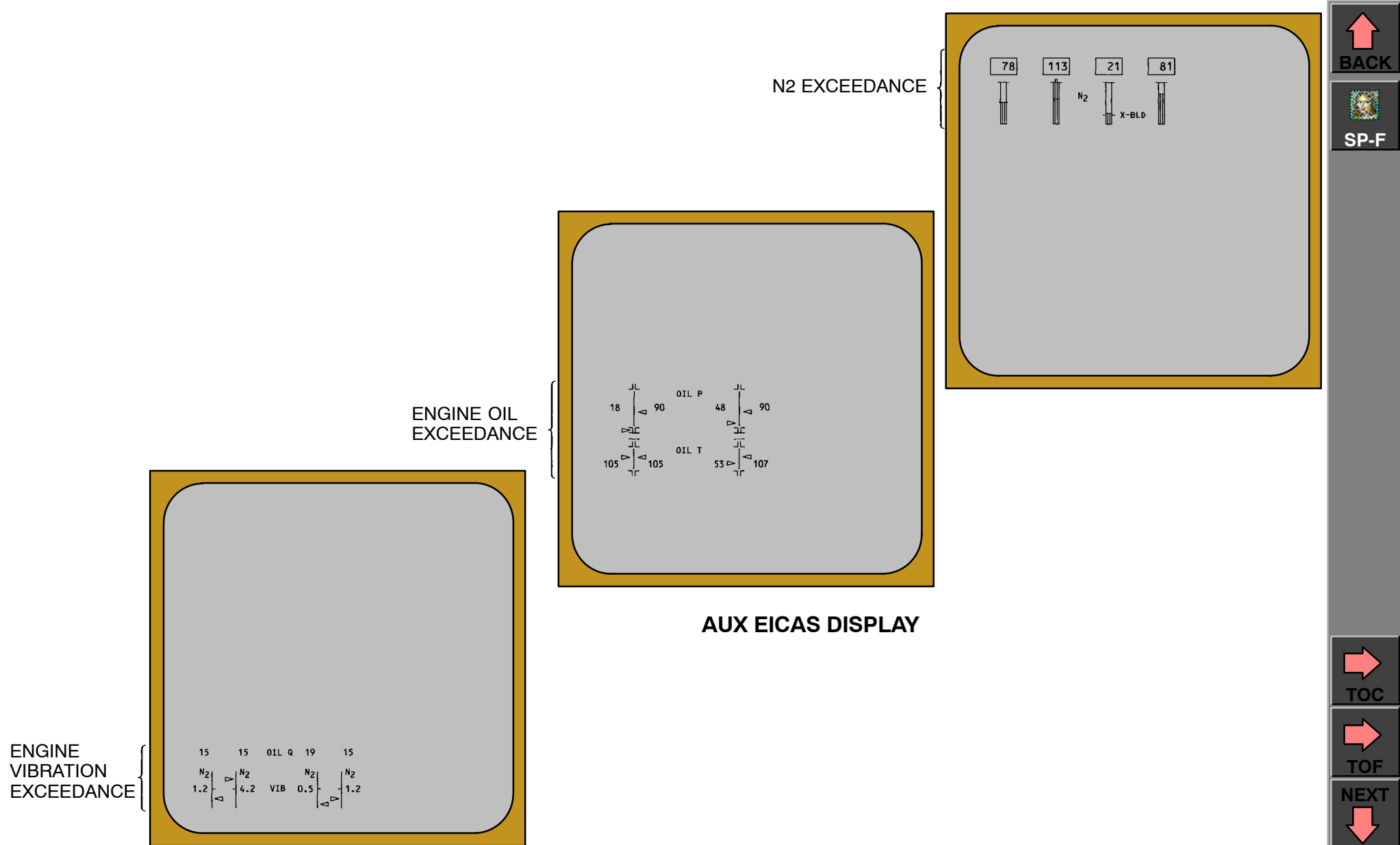


Figure 44 Auxiliary EICAS - Secondary-Partial Format

INDICATING/ RECORDING SYSTEMS INTEGRATED DISPLAY SYSTEM



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MAIN EICAS - COMPACTED-PARTIAL FORMAT

The EICAS compacted-partial format appears when a secondary-partial format shows on the AUX EICAS display and either a synoptic or the status page, or a maintenance page (in the air only) is called up.

The EICAS compacted-partial format shows:

- N1 in digital and analog indications
- EGT in digital form only

It also shows N2 (digital only) and/or oil pressure parameters (digital only) and/or vibration parameters.

Push the engine key to alternate the main EICAS display between the compacted-full and the compacted-partial format.

EICAS messages, gear, flap and ECS data will be shown as required.

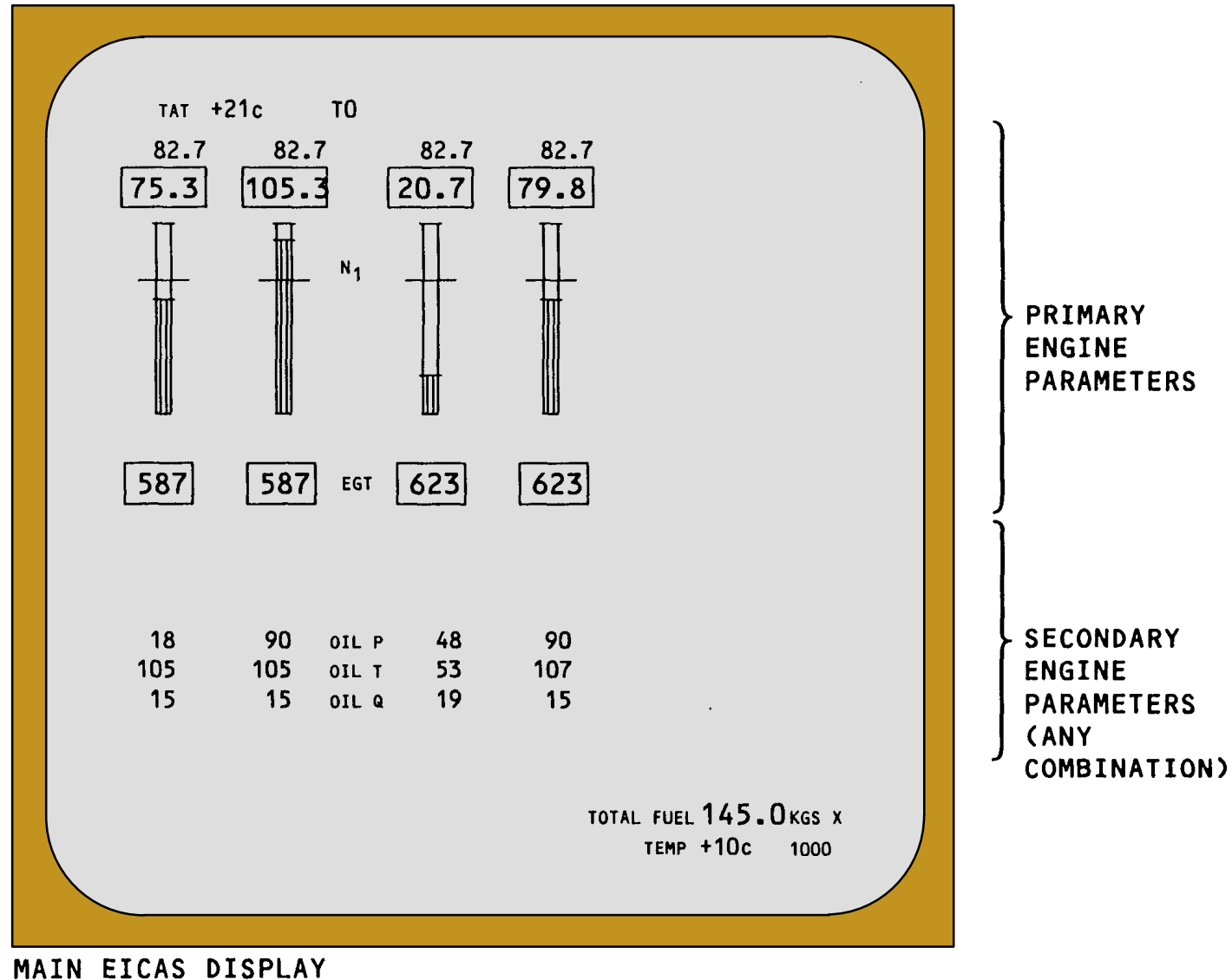


Figure 45 Main EICAS - Compacted-Partial Format



ENGINE EXCEEDANCE ANNUNCIATIONS

Redline Exceedance Annunciations

When there is an engine N1, N2, EGT redline exceedance stored in EIU engine exceedance non-volatile memory (NVM), push the RCL(recall)/CANC(cancel) keys to turn the box around the readout from red to white. Push the line select key next to the ERASE prompt on the engine exceedance maintenance page menu to erase the exceedance from NVM.

An amber engine N1, N2, EGT exceedance is not latched into memory.

Secondary Engine Data Cue

When any secondary engine parameter is in exceedance, the cyan, secondary engine data cue shows on the main EICAS display. This protects the crew against an undetected lower IDU failure.

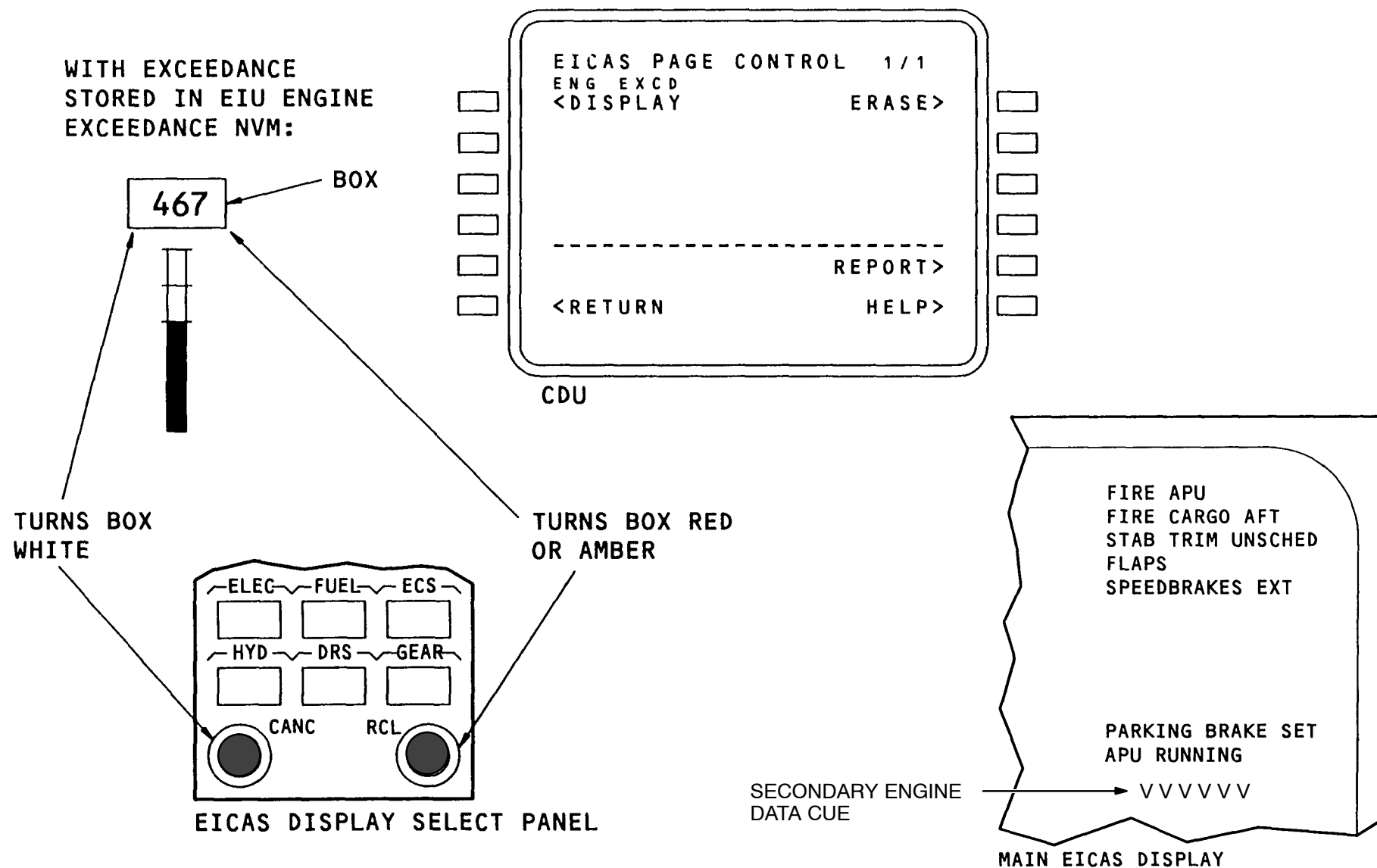


Figure 46 Engine Exceedance Annunciations





MAIN EICAS - CREW ALERTING AND MEMO MESSAGES

General

The Main EICAS formats show these types of messages:

- Warnings - Level A
- Cautions - Level B
- Advisories - Level C
- Memos - Level D

Level A, B, and C messages are alert messages. Level D messages are memos or annunciations of normal crew procedures. There are eleven messages available on each page. The cancel/recall keys are used to access overflow messages. A caret (>) preceding a message indicates that there is no quick reference handbook (QRH) procedures for that message.

Warnings - Level A

Warning messages are related to conditions that require immediate crew action. When there is a warning message, the indications are:

- A red warning message at the top of the message field. The most recent message is always on top.
- A fire bell, siren or wailer sounds over the aural warning speakers.
- Both master warning lights come on.

Level A messages cannot be cancelled. Some level A aural and the master warning light indications can be reset. Push either master warning light to reset both. The message goes away when the conditions that caused the message are no longer valid.

Cautions - Level B

Caution messages require immediate crew awareness and future crew action. Level B indications are:

- An amber message immediately below the last level A message or, if no level A message exists, at the top of the message field. The newest level B message is always on top.
- An owl sound over the aural warning speakers
- Both master caution lights come on.

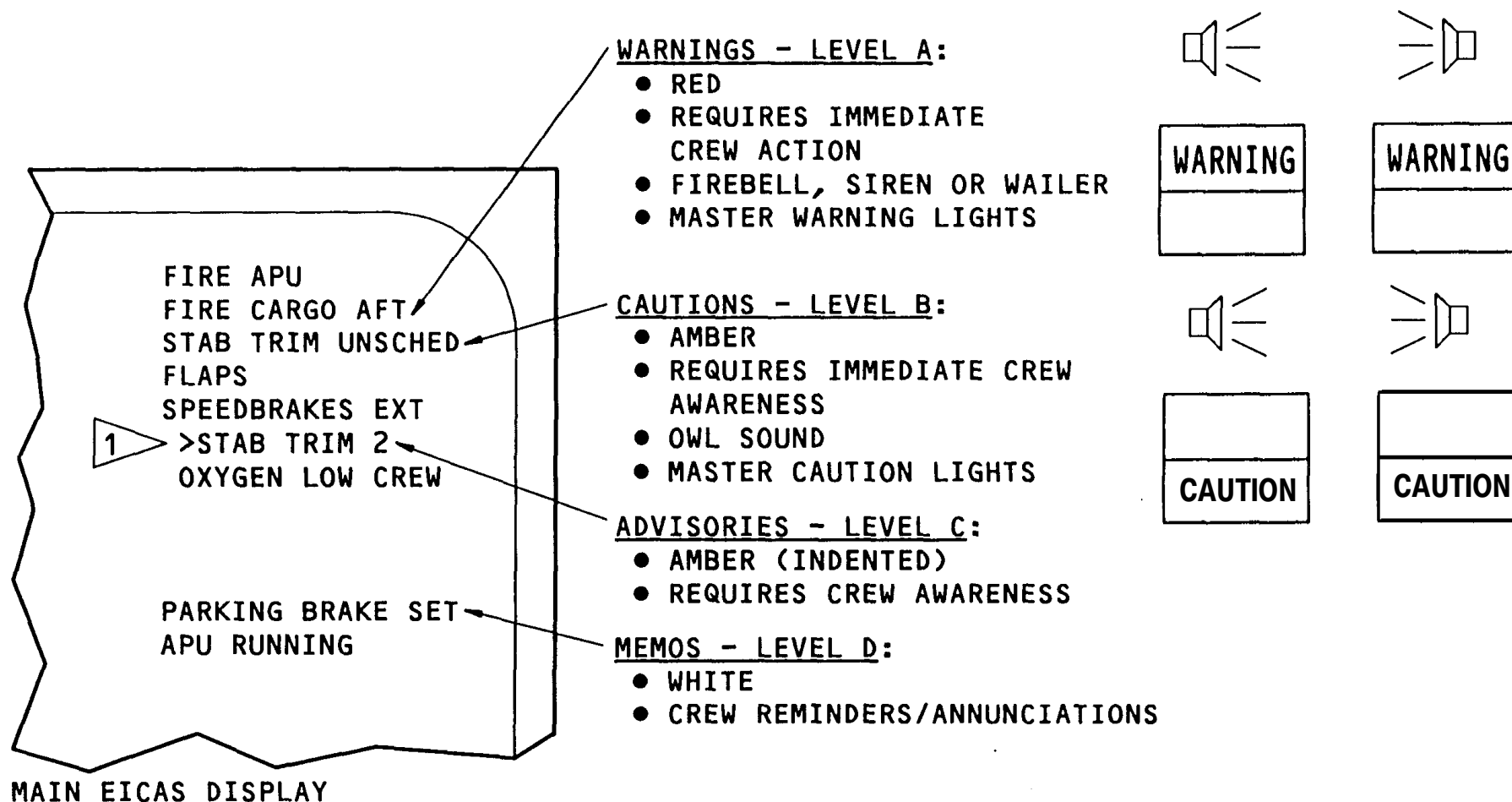
Level B messages can be cancelled (paged) to view overflow messages or to clean up the display. The master caution lights can be reset. Push either light to reset both lights. The message goes away when the condition that caused the message no longer exists.

Advisories - Level C

Level C messages require crew awareness and possible future crew action. Level C messages are amber and indented one space. There is no level C aural. The newest message is always on top, immediately following the last message of a higher priority. Level C messages can also be cancelled (paged).

Memos - Level D

Memo messages are crew reminders or annunciations of normal conditions. The messages are white and the first message shows on line eleven of the message field. The messages will move up the field with the newest message on line eleven. Memo messages can appear on different pages (overflow). Use the cancel key to page the messages. Unlike caution and advisory messages, memo messages cannot be cancelled.



1 (>) SYMBOL = NOT IN QUICK REFERENCE HANDBOOK

Figure 47 Crew Alerting And Memo Messages



MAIN EICAS - ALERT MESSAGE PAGING

The main EICAS display shows up to eleven messages at a time. If more than eleven messages exist, a (PG 1) prompt appears below and to the right of line eleven.

Push the CANC (cancel) key on the EICAS display select panel (DSP) to page or access the additional messages. Only caution and advisory messages can be paged. When the cancel key is pushed repeatedly, it causes the next page of messages to show until the message field has no caution or advisory messages. Warning messages and memo messages cannot be cancelled.

If a new message is generated during paging, it will appear at its proper location on the page being shown. If the new message is a caution or advisory message, it can be cancelled.

MAIN EICAS - ALERT MESSAGE RECALL

Push the RCL (recall) switch on the EICAS DSP to cause caution and advisory messages that were previously cancelled to show. If the conditions still exist, the messages show by priority.

A RECALL prompt appears on the display each time the RCL switch is pushed. The prompt disappears one second after the switch is released.

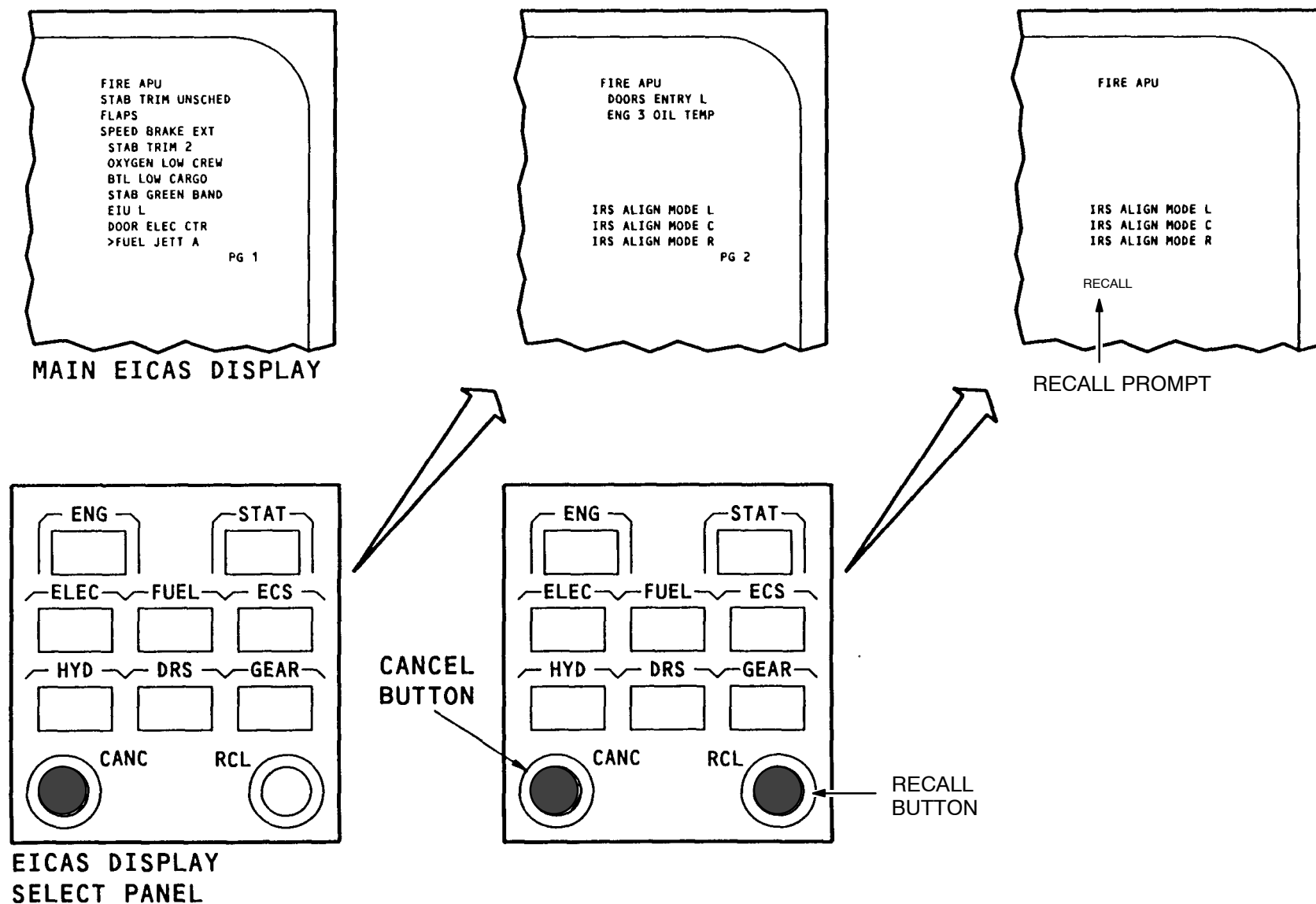


Figure 48 Main EICAS - Alert Message Paging

**EICAS - INHIBITS**

Several conditions affect the messages, aural tones, and master caution lights generated by the EFIS/EICAS interface units.

Three conditions inhibit master caution light and aural tone outputs:

- Engine shutdown inhibit
- Engine start inhibit
- Airplane takeoff inhibit

Two conditions affect the messages that show

- Starter cutout inhibit
- Engine start inhibit

The engine start inhibit also inhibits certain maintenance page automatic snapshots.

The takeoff/go-around (TO/GO) inhibit inhibits amber band exceedances during takeoff or go-around for 5 minutes.

ENGINE SHUTDOWN INHIBIT

- INHIBITS MASTER CAUTION; LIGHT AND AURAL TONE OUTPUTS

STARTER CUTOUT INHIBIT

- STARTER CUTOUT MESSAGE REPLACES ALL CAUTION, ADVISORY AND MEMO MESSAGES

ENGINE START INHIBIT

- INHIBITS MASTER CAUTION; LIGHT AND AURAL TONE OUTPUTS AND MOST CAUTION, ADVISORY AND MEMO MESSAGES AND ALL STATUS MESSAGES
- INHIBITS MAINTENANCE PAGE AUTOMATIC SNAPSHOTS (EXCLUDING ENGINE EXCEEDANCE, APU AND PERFORMANCE/EPCS PAGES)

AIRPLANE TAKEOFF INHIBIT

- INHIBITS MASTER CAUTION; LIGHT AND AURAL TONE OUTPUTS

TO/GA INHIBIT

- INHIBITS AMBER BAND EXCEEDANCES DURING TAKEOFF/GO AROUND (5 MIN)

EIU



BACK



TOC



TOF



NEXT

Figure 49 EICAS - Inhibits



AUXILIARY EICAS - STATUS PAGE

The status page is used to determine if the airplane is ready for dispatch and to show system data.

When the STAT key is pushed, the status page shows on the auxiliary EICAS display if:

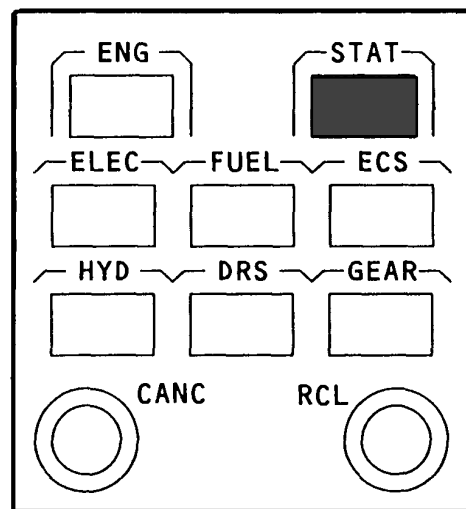
- EICAS is not in the degraded mode
- The status page is not already shown.

The status page contains:

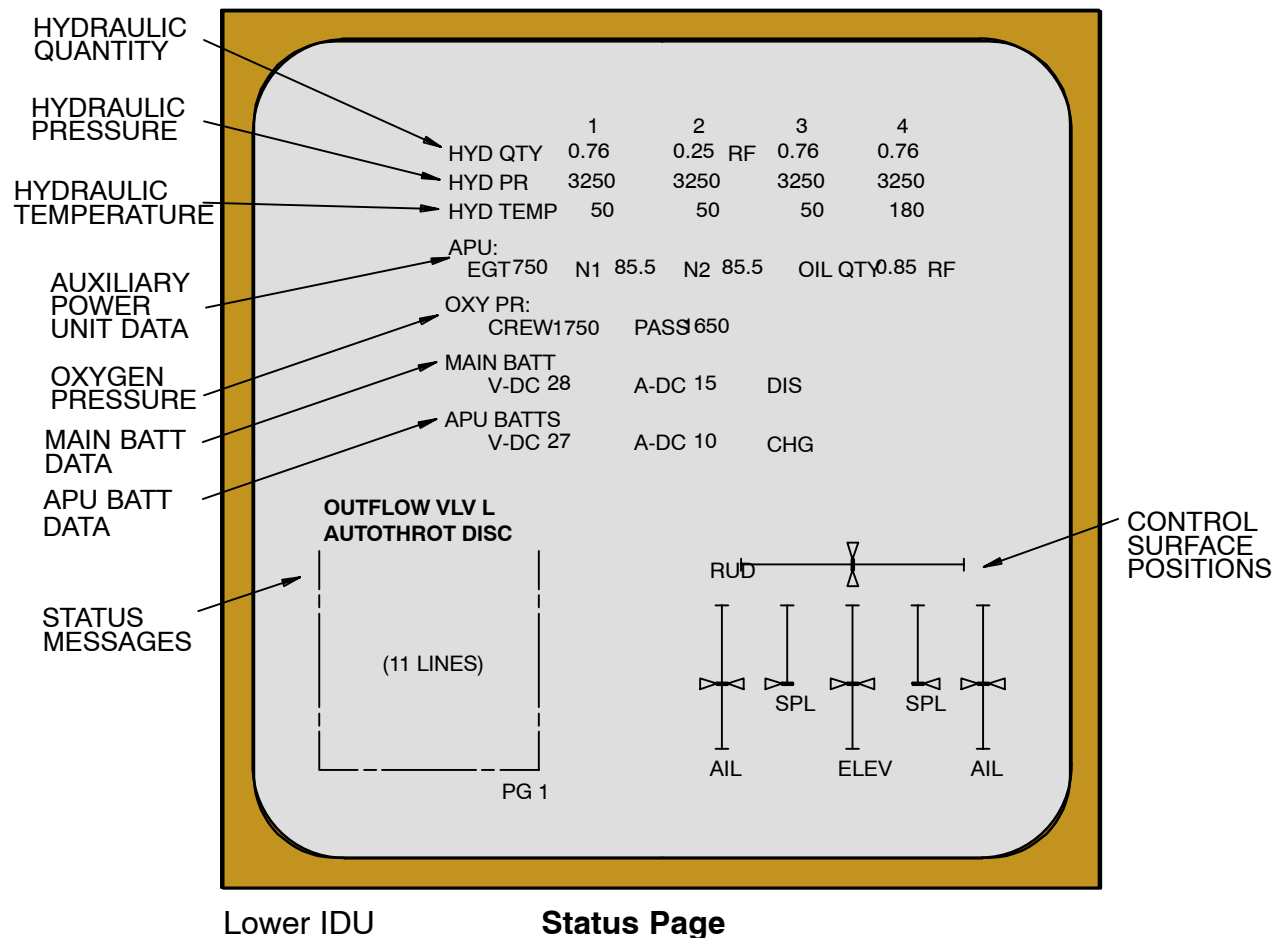
- Hydraulic system quantity, temperature and pressure information
- APU EGT, N1 N2 and oil quantity data
- Crew and passenger oxygen pressure data
- Main/APU battery data
- Dynamic flight surface position indicators
- The status message field

The status messages show the system's status for the current flight leg. Evaluation of the messages using the fault isolation manual and the minimum equipment list aid in determining the maintenance actions required to dispatch the airplane.

The message field can accommodate eleven messages. overflow messages show on additional pages as required. The newest message always appears on the top line.



**EICAS DISPLAY
SELECT PANEL**



Lower IDU

Status Page

Figure 50 Auxiliary EICAS - STATUS Page



EICAS STATUS KEY - NORMAL OPERATION**General**

The EICAS status page is selected when the STAT (status) key on the EICAS display select panel (DSP) is pushed.

Selection of the status page has no effect on the main EICAS display if there are no secondary engine exceedances.

Operation

When the STAT key is pushed, it shows the status page on the AUX EICAS. When the STAT key is pushed with the status page already shown, it causes the AUX EICAS to blank or it will show the next page of status messages. A (PG 1) prompt will appear at the bottom and to the right of the message field if there is more than one page of messages. After the last page of messages show, the display blanks if the STAT key is pushed again.

INDICATING/ RECORDING SYSTEMS INTEGRATED DISPLAY SYSTEM



**Lufthansa
Technical Training**

B747-400

31-61

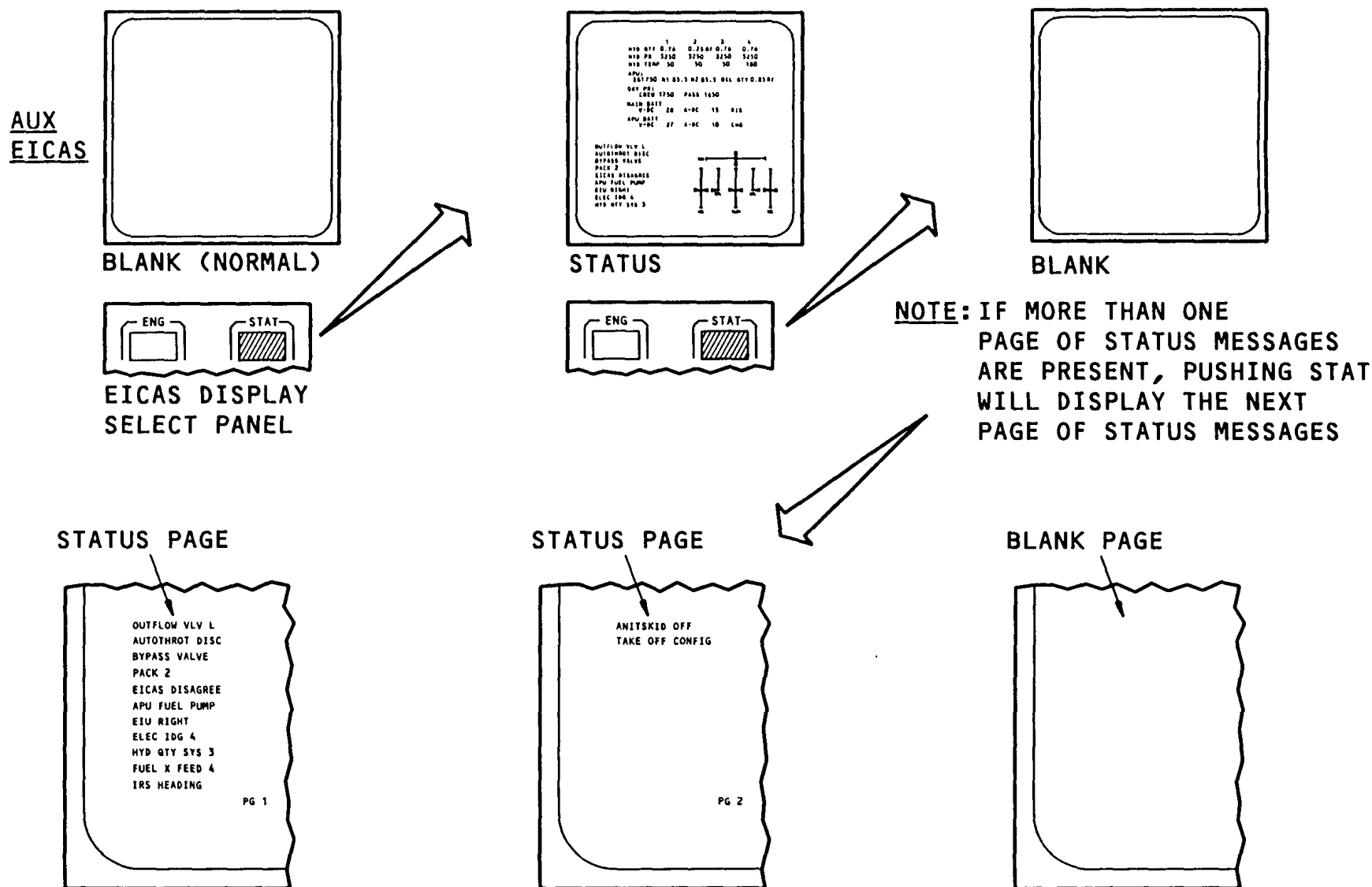


Figure 51 EICAS STATUS Key - Normal Operation





AUXILIARY EICAS - STATUS MESSAGE GENERATION

Status Messages

There are two types of status messages:

- Nonlatched
- Latched

Nonlatched status messages show on the status page when a malfunction occurs in any of the systems monitored by the EIUs. The newest message is listed first. When the condition clears that caused the message, it is automatically removed from the status page.

Latched status messages appear on the status page just as the nonlatched type. They have the same priority with the newest of either type listed first.

There are three types of latched status messages:

- Ground only
- Air only
- Unconditional (can occur anytime)

Latched status messages are stored in the EIU's nonvolatile memory. Latched status messages do not disappear when the condition clears. Special procedures are required to erase latched status messages.

Messages are latched to enable maintenance personnel to review failures that occur in specific flight phases and may not be present or active all the time.

The status messages (all types) are sent to the central maintenance computers for flight deck effect correlation.

Status Cue

The status cue appears on the main EICAS display any time a new status message is generated. There is a fifteen-second time delay before the status cue shows. The cue goes away when:

- The status page is selected on the display select panel
- The condition that caused the message clears itself

Status Cue Inhibit

Display of the status cue is inhibited at any engine start if the airplane is on the ground.

The status cue inhibit stops:

- 30 minutes after takeoff, or
- When any engine fuel control switch transitions from run to cutoff, or
- When the airplane transitions from an in air to on ground condition.

c

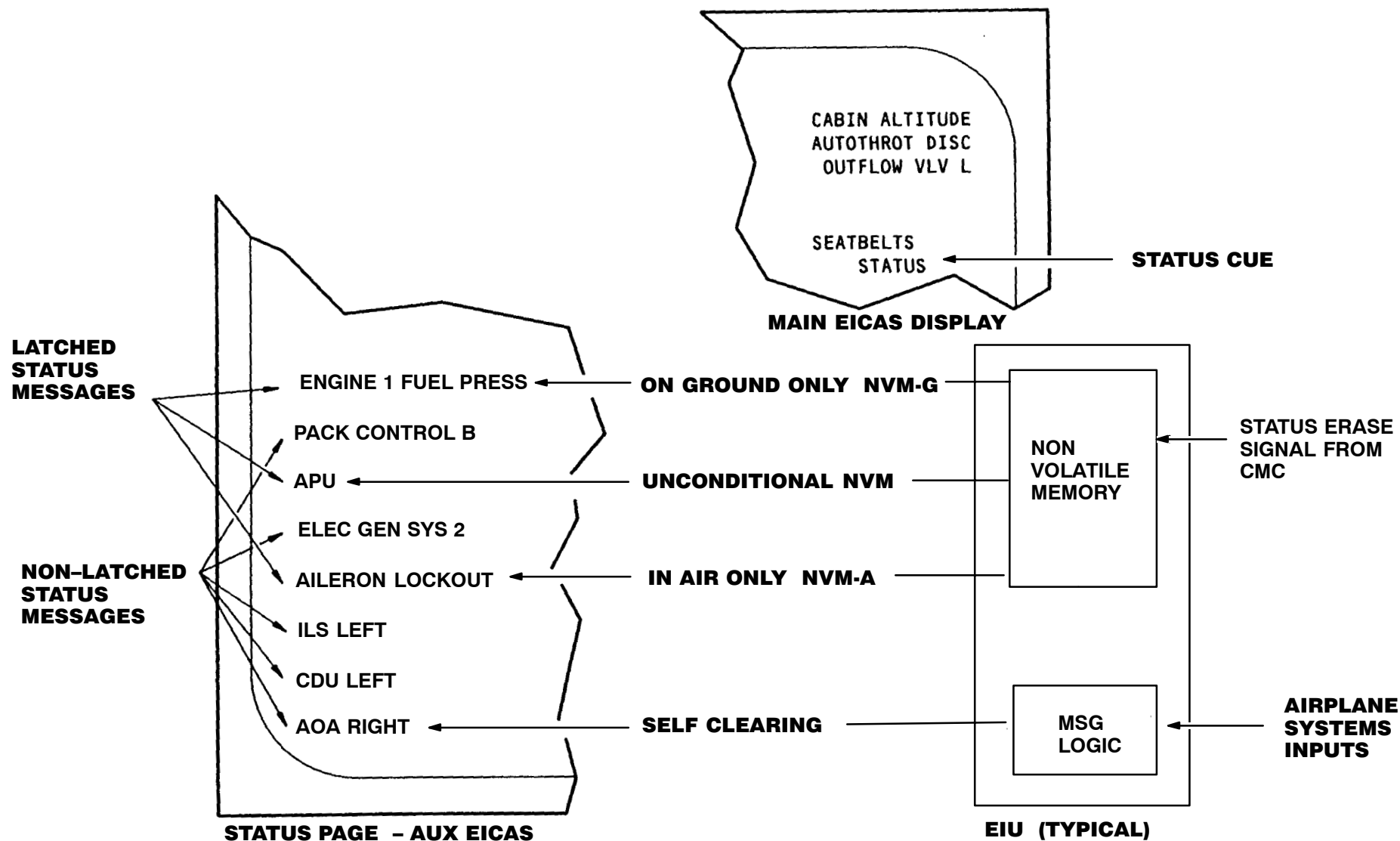


Figure 52 STATUS Message Generation



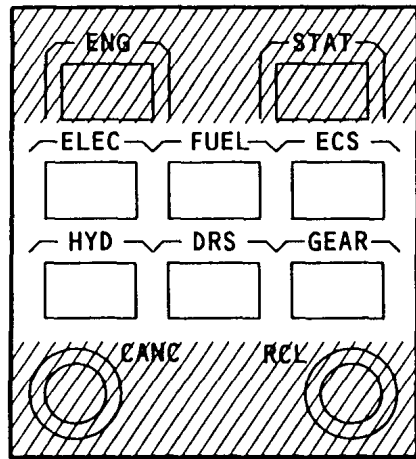
AUXILIARY EICAS - SYNOPTIC PAGES

The word SYNOPTIC is a combination of the words synopsis (summary) and optic (visual). Synoptics are dynamic displays of real-time systems data. The display is a pictorial representation similar to the configuration on the overhead panel.

The synoptics show when the appropriate key is pushed on the EICAS display select panel. Synoptics normally show on the AUX EICAS display. If the same synoptic key is pushed a second consecutive time, the AUX EICAS display blanks.

Synoptics are available for these systems:

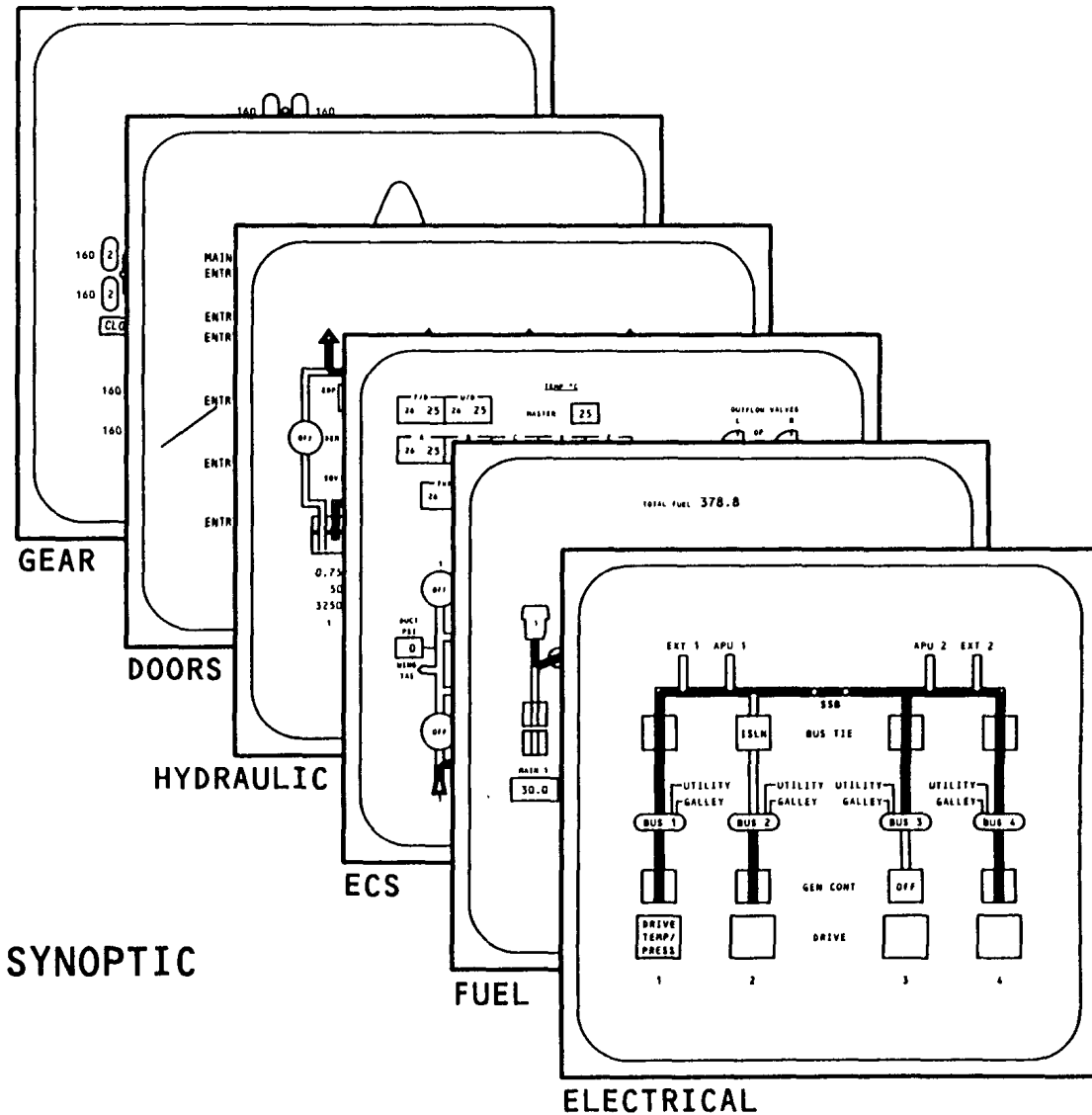
- Electrical
- Fuel
- Hydraulic
- Environmental control system
- Doors
- Gear



EICAS DISPLAY
SELECT PANEL

- REAL-TIME GRAPHIC SUMMARY
- AUXILIARY EICAS DISPLAY
- CONFIGURATION SIMILAR TO OVERHEAD PANEL

SYNOPSIS + OPTIC = SYNOPTIC



BACK

EDSP

ELEC

FUEL

ECS

HYD

DRS

GEAR

TOC

TOF

NEXT

Figure 53 Auxiliary EICAS - Synoptic Pages



AUXILIARY EICAS - SYNOPTIC (TYPICAL)

General

Synoptics use several methods to show system operation. These methods include:

- Flow bars
- Color and color changes
- Digital readouts
- Symbols

Flow Bars

Flow bars show the source and path of fluids, air or electricity. Flow bars are usually green.

Colors and Color Changes

Valves, switches and other component operations often show by colors and color changes. Generally, white is on or normal, and amber is abnormal.

Labels are normally cyan.

Digital Readouts

Numerical readouts show quantities, temperatures and pressures. Messages show component operational status.

Symbols

Symbols can show valve, pump or door status. The status can be shown by the presence, position or color of a symbol.

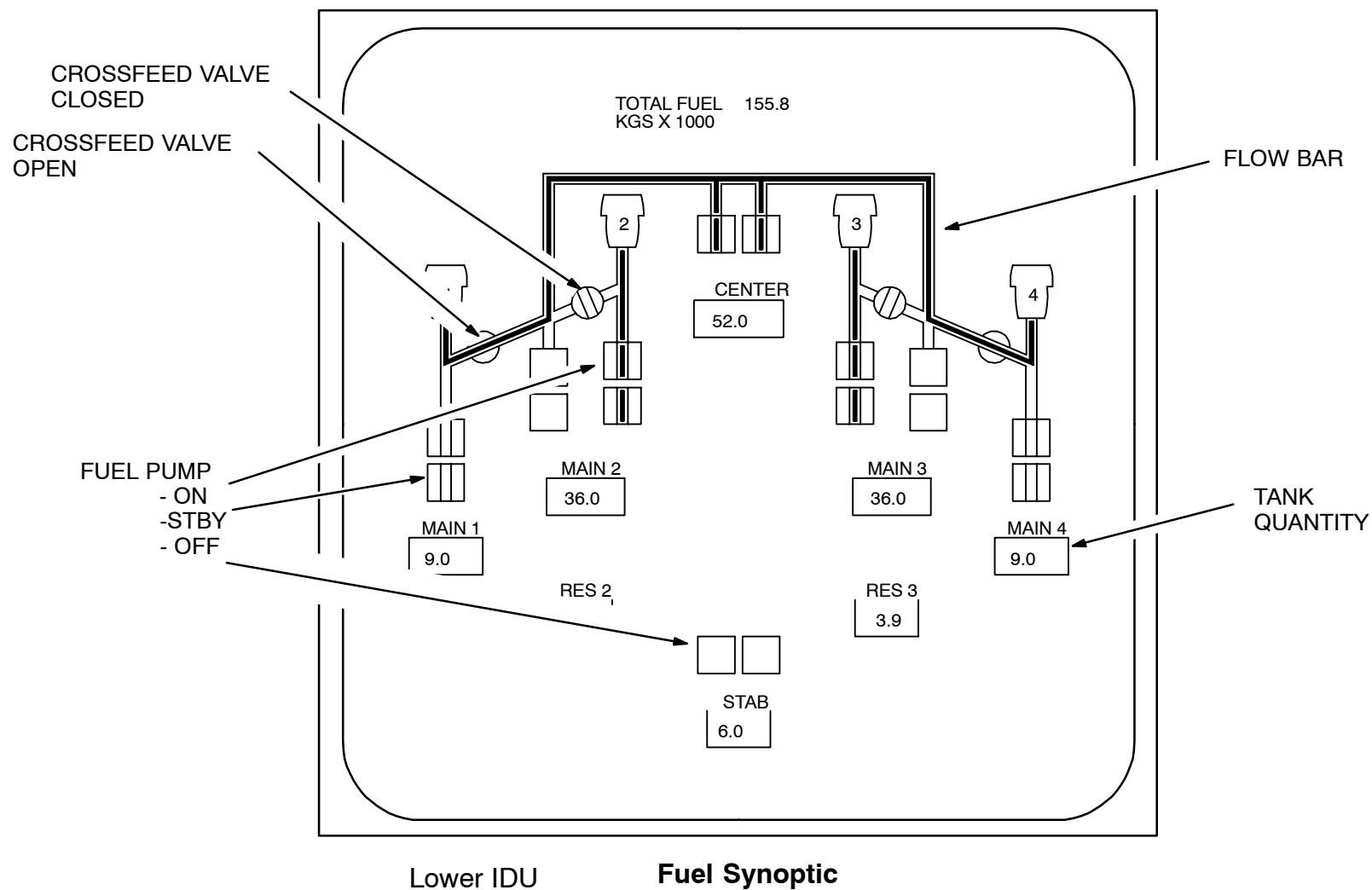


Figure 54 Auxiliary EICAS - Synoptic (Typical)



AUXILIARY EICAS - SYNOPTIC PAGES DISPLAY EFFECT**Synoptic Display Logic**

Synoptics are selected on the EICAS display select panel. They can be selected on the ground or in the air.

The selected synoptic is shown on the auxiliary EICAS display. If there are secondary engine exceedances at the time of a synoptic selection, the EICAS compacted-partial format will be shown on the main EICAS display. If there are no secondary engine exceedances, EICAS primary is shown on the main EICAS display.

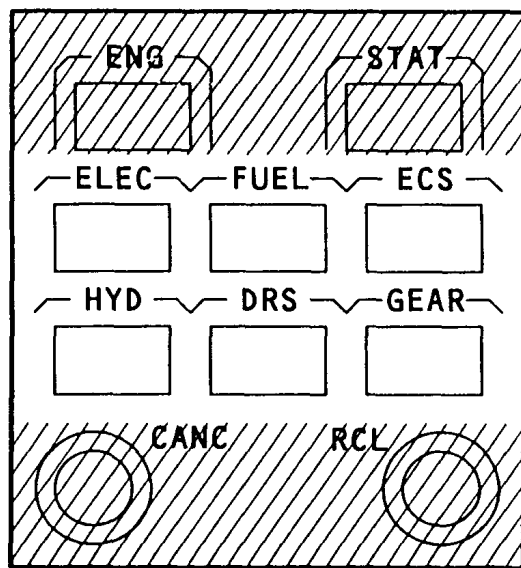
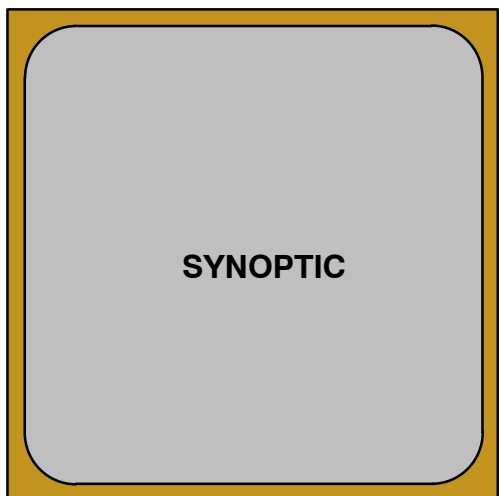
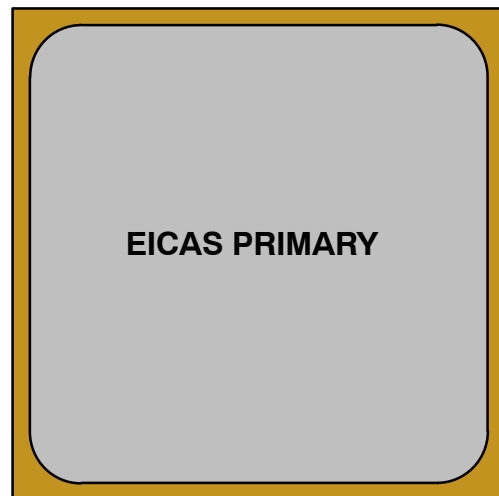
Synoptic Removal

The selected synoptic is removed when the appropriate key on the EICAS display select panel is pushed. If secondary engine exceedances are there, EICAS secondary-partial shows on the auxiliary EICAS. If secondary engine exceedances are not there, the auxiliary EICAS display goes blank.

If a new secondary exceedance occurs while a synoptic is shown, the AUX EICAS automatically shows a secondary-partial display. The synoptic can then be selected again.



- SYNOPTIC SELECTED WITH NO SECONDARY EXCEEDANCES



EICAS DISPLAY SELECT PANEL

- SYNOPTIC SELECTED WITH SECONDARY EXCEEDANCES

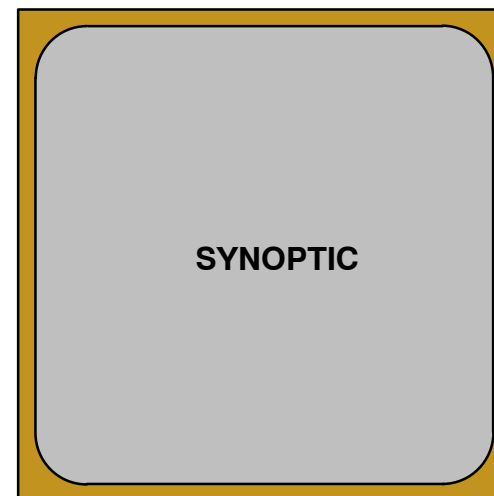
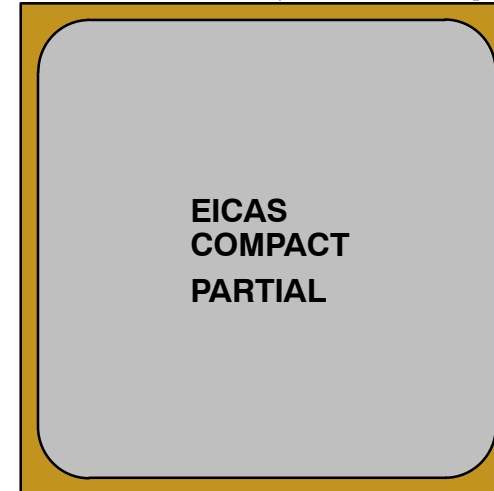


Figure 55 Aux EICAS - Synoptic Pages Display Effect



BACK



CP-F



TOC



TOF



NEXT



MAIN EICAS - MINI FORMATS

There are two mini formats available on EICAS:

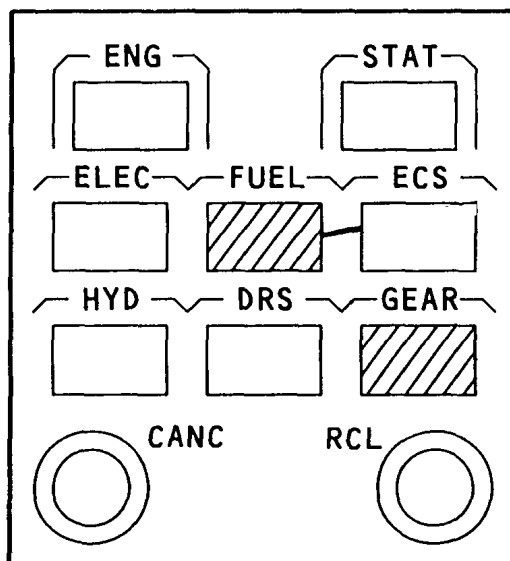
- Brake temperature
- Fuel quantity

They show during a degraded display condition (only one display available for EICAS).

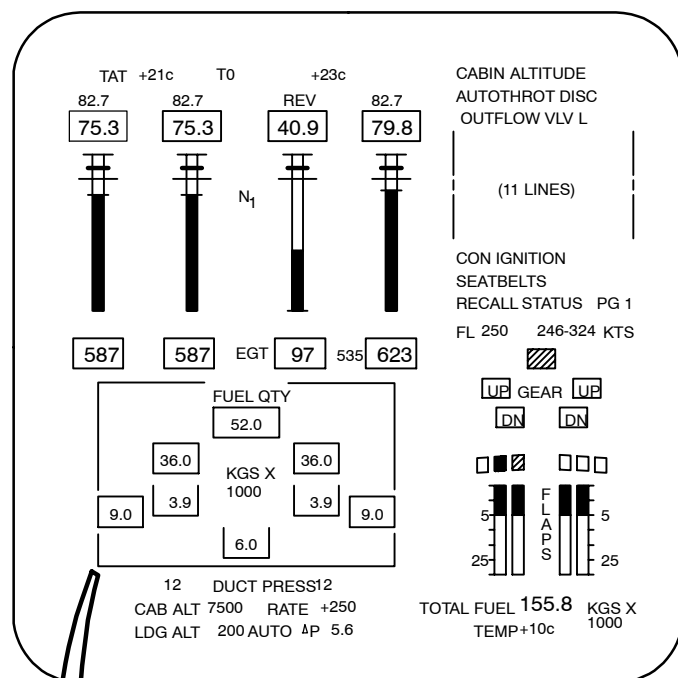
The brake temperature and fuel quantity mini formats are selected by the GEAR and FUEL keys on the DSP, respectively.

If a mini format is shown and a new secondary exceedance occurs, the mini format will automatically be replaced by the compacted-partial format. The mini format can then be reselected.

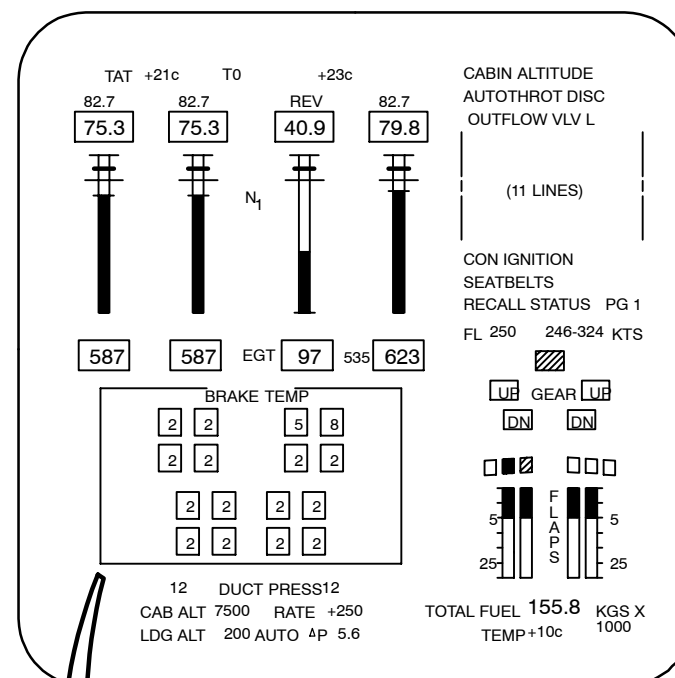
Push the engine key or the same synoptic key to replace the mini format with the compacted-full format, or with the compacted-partial format if a secondary exceedance still exists.



EICAS DISPLAY SELECT PANEL



EICAS COMPACTED WITH FUEL QTY



EICAS COMPACTED WITH BRAKE TEMP

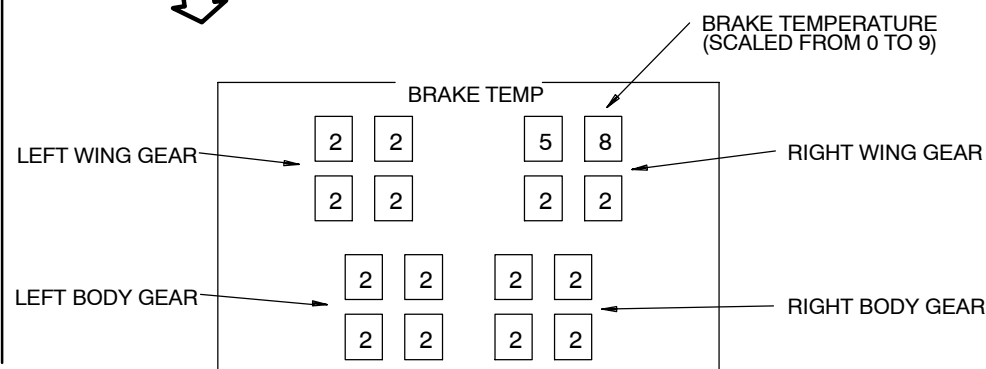
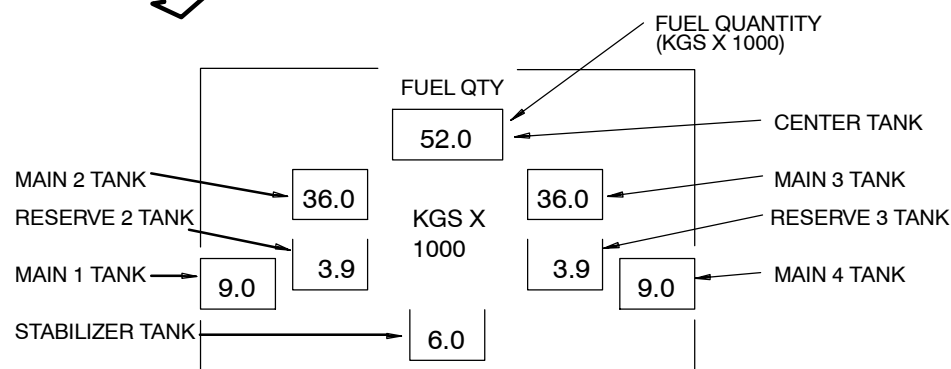


Figure 56 Main EICAS - Mini Formats



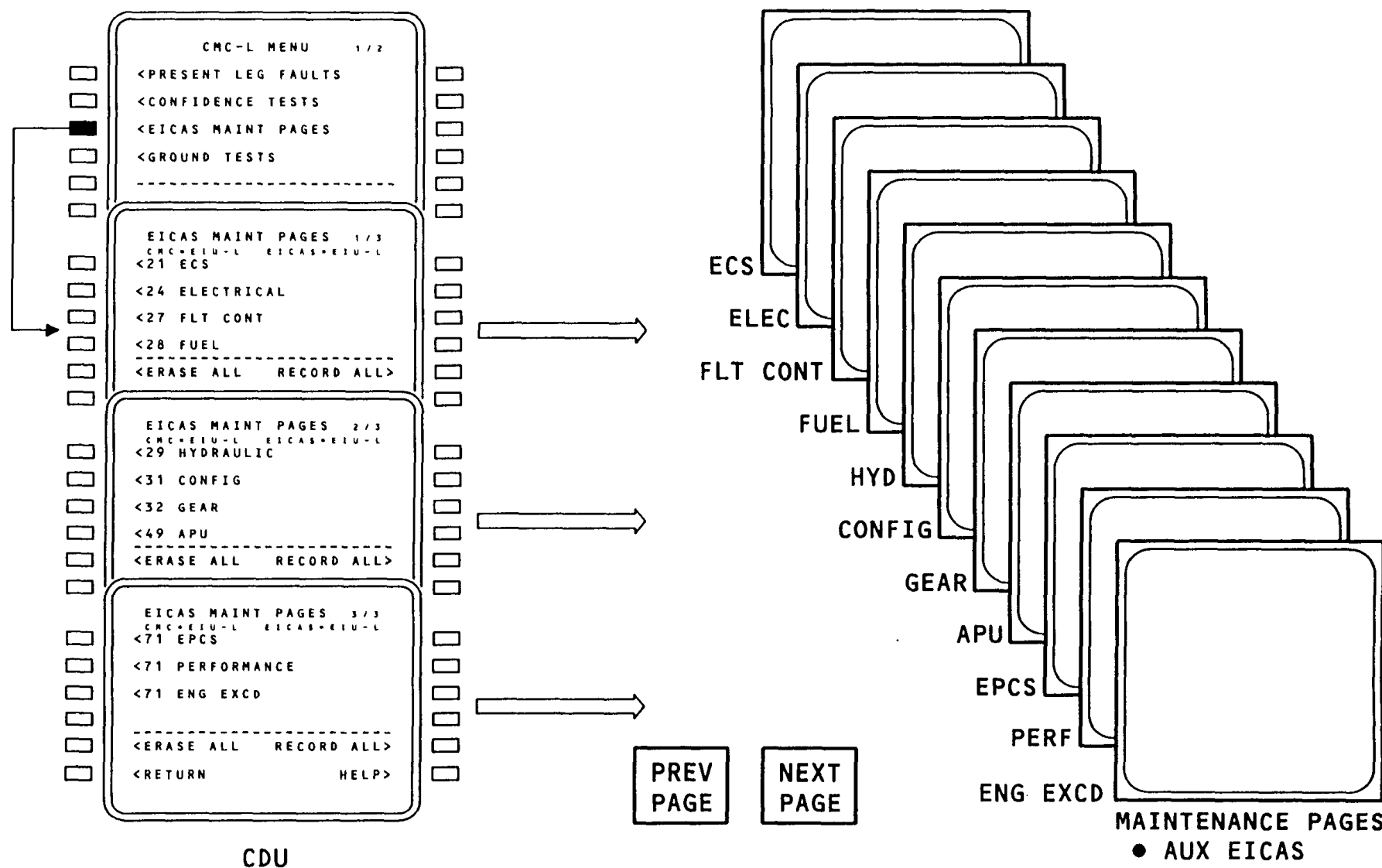
AUXILIARY EICAS - MAINTENANCE PAGES

EICAS maintenance pages provide systems data for maintenance. The maintenance pages are accessed through the CMC. These are the EICAS maintenance pages:

- Environmental control system (ECS)
- Electrical
- Flight controls
- Fuel
- Hydraulic
- Configuration
- Gear
- APU
- Electronic propulsion control system (EPCS)
- Performance
- Engine exceedance

The maintenance pages are selected on the CDU and shown on the AUX EICAS.

The next page key on the CDU is used to show the additional pages of the menu.



CDU

PREV
PAGENEXT
PAGEMAINTENANCE PAGES
• AUX EICAS

BACK

CDU

M EIC

TOC

TOF

NEXT

Figure 57 Auxiliary EICAS - Maintenance Pages



AUXILIARY EICAS - MAINTENANCE PAGES MODES**General**

Maintenance pages for specific systems show data in three modes. These modes are as follows:

- Real time (current dynamic data)
- Manual snapshot (a snapshot of the real time format due to flight or maintenance crew actions)
- Automatic snapshot (a snapshot of the real time format due to an out-of-limits condition)

Manual Snapshots

Manual snapshots are stored in manual event nonvolatile memory. Storage is available for up to 5 manual snapshots for each system.

Automatic Snapshots

Automatic (auto) snapshots are stored in auto event nonvolatile memory. Auto snapshots occur automatically for a system when parameters exceed preset values. Storage is available for up to 5 auto snapshots for each system.

Auto events for the performance, EPCS and APU maintenance pages are not inhibited. All other auto events require that any two engines are running and the parking brake is released.

Also, engine exceedance page storage is not inhibited.

REAL
TIME

ELECTRICAL									
	EXT 1	APU 1	1	2	3	4	APU 2	EXT 2	
AC-V	0	115	115	115	115	115	0	115	
FREQ	0	400	400	400	400	400	0	400	
LOAD	0.00	0.00	0.75	0.75	0.75	0.75	0.00	0.00	
	MAIN BAT						APU BAT		
DC-V	28		28	28	28	28	28		
DC-A	CHG10		35	35	35	35		DIS10	
	IDG OUT. TEMP		145	175	145	145			
	IDG RISE TEMP		35	35	35	35			
DATE 02SEP87 GMT18:54:04									

AUXILIARY EICAS

DATE AND UTC

MANUAL
SNAPSHOT

ELECTRICAL MAN									
	EXT 1	APU 1	1	2	3	4	APU 2	EXT 2	
AC-V	0	115	115	115	115	115	0	115	
FREQ	0	400	400	400	400	400	0	400	
LOAD	0.00	0.00	0.75	0.75	0.75	0.75	0.00	0.00	
	MAIN BAT				APU BAT				
DC-V		28	28	28	28	28		28	
DC-A	CHG10		35	35	35	35	DIS10		
	IDG OUT. TEMP		145	175	145	145			
	IDG RISE TEMP		35	35	35	35			
DATE 02SEP87 GMT12:24:01									

AUXILIARY EICAS

AUTO
SNAPSHOT

ELECTRICAL AUTO									
	EXT 1	APU 1	1	2	3	4	APU 2	EXT 2	
AC-V	0	115	115	115	115	115	0	115	
FREQ	0	400	400	400	400	400	0	400	
LOAD	0.00	0.00	0.75	0.75	0.75	0.75	0.00	0.00	
	MAIN BAT						APU BAT		
DC-V	28		28	28	28	28		28	
DC-A	CHG10		35	35	35	35		DIS10	
	IDG OUT. TEMP		145	255	145	145			
	IDG RISE TEMP		35	35	35	35			
ELEC DRIVE 1									
DATE02SEP87 GMT08:48:44									

AUXILIARY EICAS

EVENT WHICH CAUSED
THIS AUTO SNAPSHOT

ELEC DRIVE 1

Figure 58 Maintenance Pages Modes



EICAS - EICAS MAINTENANCE PAGES MENU

General

Use the EICAS maintenance pages menu to:

- Identify to which EIU the CMC and EICAS are selected.
- Access any of the thirteen EICAS PAGE CONTROL menus.
- Erase all snapshots from memory.
- Request a manual snapshots for all systems.
- View help text from the airline database.
- Return to the CMC menu.

Selected EIU

Line 2 shows the EIU that the CMC and EICAS are selected to.

"L", "C", or "R" show in place of the "X", to indicate which EIU the CMC is selected to (for example, CMC = EIU-L). Note that the CMC normally selects the left EIU. If the left EIU fails, the CMC will automatically switch to the center EIU and then the right.

"L", "C", or "R" show in place of the "Y" to indicate which EIU the EICAS display is selected to (for example, EICAS = EIU - L). Asterisks show if the CMC cannot determine which EIU the EICAS display is selected to (for example, EICAS = *****). Note that the EICAS displays use the EIU selected on the EICAS control panel. If AUTO is selected, the EICAS displays automatically select the left EIU followed by the center and then the right if a failure occurs.

EICAS Page Control Menu

Push the line select key next to a chapter and system to access the EICAS PAGE CONTROL menu for that system.

ERASE ALL

Push the line select key next to ERASE ALL to erase all auto and manual snapshots from the nonvolatile memory in all three EIUs.

RECORD ALL (if activated)

Push the line select key next to RECORD ALL to request a manual snapshot for all systems.

MAINTENANCE PAGE REAL-TIME DISPLAY

Display Line Select Key

Use the DISPLAY line select key on the CDU to show real-time data of the selected maintenance page on the auxiliary EICAS display.

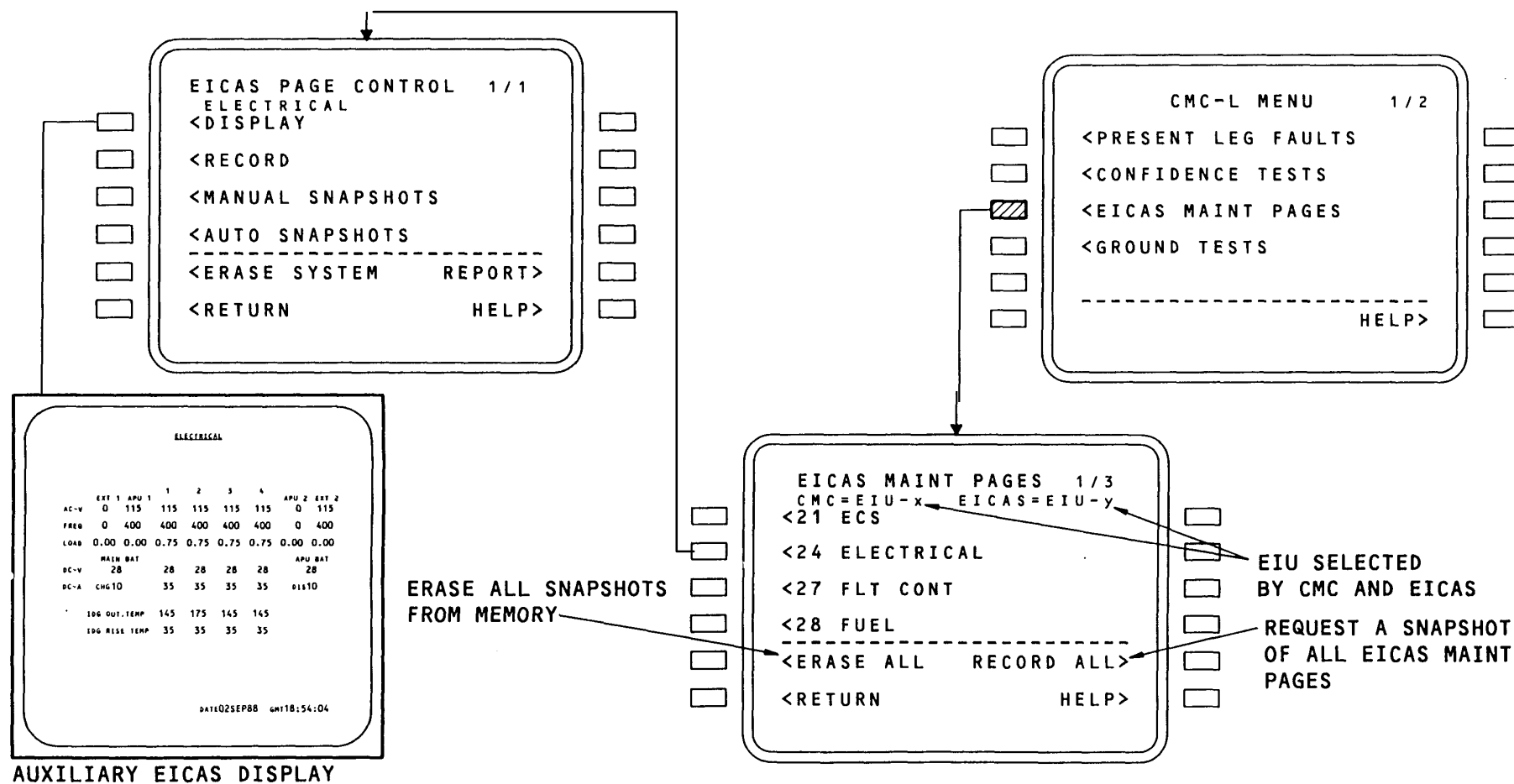
If the display key is pushed a second time, EICAS shows the primary format on the main EICAS and secondary format on the AUX EICAS.

Report Line Select Key

Push the REPORT line select key to access the REPORT menu. Use the REPORT menu to select a device to which real-time maintenance data will be sent.

Other Line Select Keys

The remaining line select keys on the EICAS PAGE CONTROL menu are discussed later in this lesson.



ELECTRICAL SYSTEM
MAINTENANCE PAGE
REAL TIME DISPLAY

Figure 59 EICAS Maintenance Pages Menu



MAINTENANCE PAGES RECORDING SUMMARY

Automatic and manual snapshots are available for the various maintenance pages as indicated (X) in the table.

There are two ECS maintenance pages. Snapshots of both pages always occur at the same time.

There are four FUEL maintenance pages. Snapshots of all four pages always occur at the same time.

When a snapshot of the performance maintenance page is initiated, a snapshot of the EPCS page automatically occurs.

Engine exceedances are stored automatically in a cumulative manner. The data continues to accumulate until erased using the CMC menu page ERASE prompt.

The APU, EPCS and performance maintenance pages are not inhibited for auto snapshots. The remaining maintenance page auto snapshots are inhibited until two or more engines are running and the parking brake is released.



ATA MAINTENANCE PAGE		MANUAL	AUTO	
21	ECS	X	X	→ { AIR CONDITIONING AIR SUPPLY
24	ELECTRICAL	X	X	
27	FLIGHT CONTROLS	X	NONE	
28	FUEL	X	X	→ { MAIN 1/MAIN 4 MAIN 2/MAIN 3 RESERVE 2/RESERVE 3 CENTER MAIN/STABILIZER
29	HYDRAULIC	X	X	
31	CONFIGURATION	N/A	N/A	
32	GEAR	X	X	
49	APU	X	X	
71	EPCS	X	1	
71	PERFORMANCE	X	X	
71	ENGINE EXCEEDANCE	N/A	2	

- 1 STORE WHEN A PERFORMANCE
AUTO SNAPSHOT IS TAKEN
- 2 STORES AUTOMATICALLY
IN CUMULATIVE MANNER -
ERASED THROUGH CMC



Figure 60 Maintenance Pages Recording Summary



MAINTENANCE PAGE - MANUAL SNAPSHOTS**General**

A manual snapshot occurs when:

- The EVENT RCD button on the EICAS control panel is pushed.
- The RECORD all line select key (LSK) on the EICAS MAINT PAGES menu on the CDU is pushed.
- The RECORD line select key (LSK) on the EICAS PAGE CONTROL menu on the CDU is pushed.

Manual Snapshot of all EICAS MAINT PAGES

Push the RECORD ALL LSK on the EICAS MAINT PAGES menu on the CDU, or push the EVENT RCD button on the EICAS control panel to get a snapshot of most EICAS maintenance pages (not configuration and engine exceedance).

Manual Snapshot of One Systems EICAS MAINT PAGE

Push the RECORD LSK on the EICAS PAGE CONTROL menu to get a snapshot of the selected systems EICAS maintenance page. In this example, an electrical system snapshot is recorded in EIU memory.

Systems with Multiple EICAS MAINT PAGES

If the system has multiple pages, snapshots of all pages will be taken (fuel and ECS).

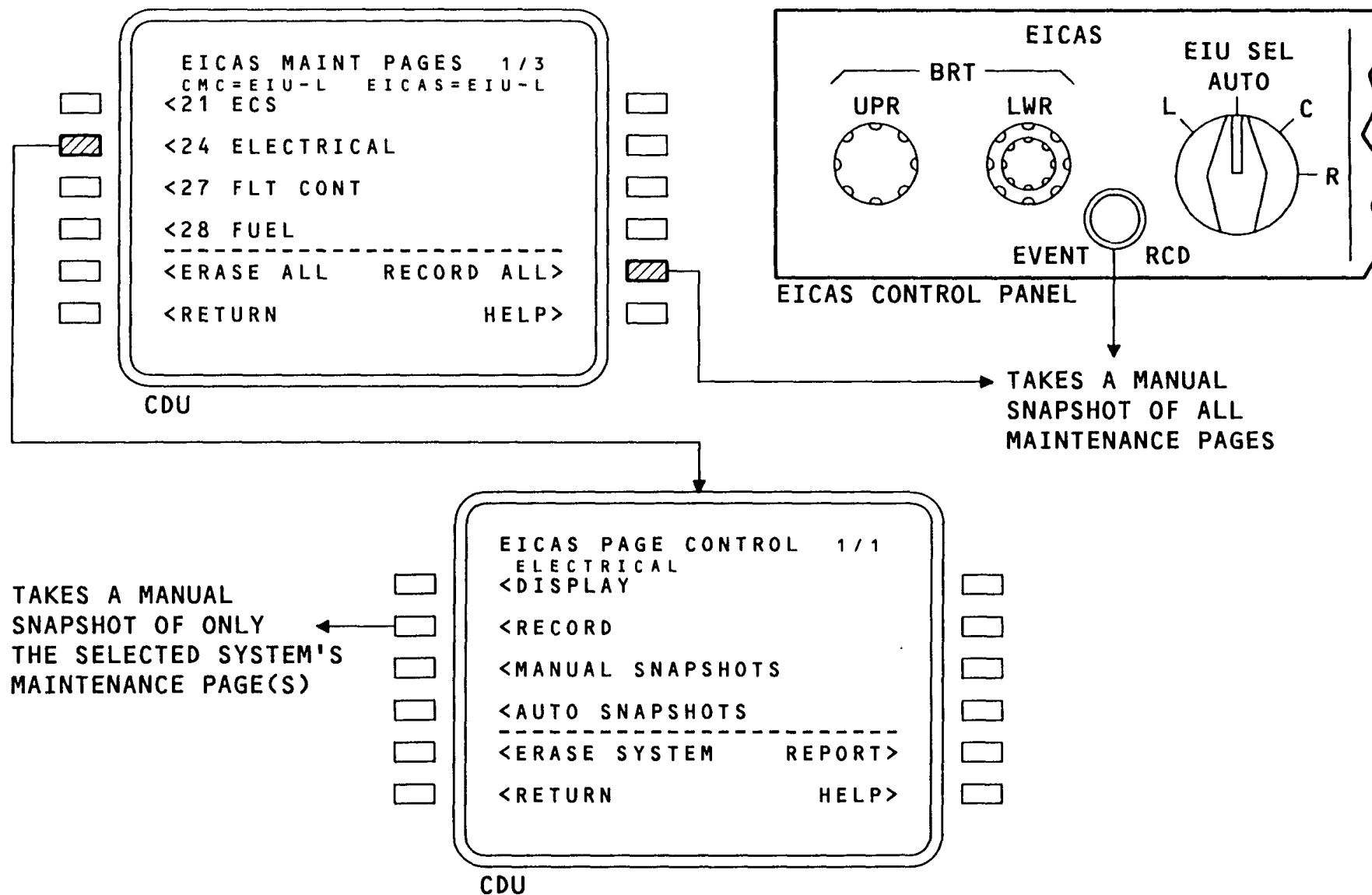










Figure 61 Maintenance Page - Manual Snapshots


**EICAS - DISPLAY OPERATION-FORMATS (2)**

Page two of the matrix shows how formats can change during degraded operation, and what additional formats are possible when secondary exceedances exist.

EVENT	PRESENT DISPLAY STATES (PAGE 2)							
	MAIN	COMP-PART	COMP-PART	COMP-PART	COMP FULL	PRIMARY	COMP PARTIAL	MINI SYNOPTIC
	AUX	MAINT	STATUS	SYNOPTIC				
ENGINE KEY DEPRESSED		PRIMARY	PRIMARY	PRIMARY	PRIMARY	COMP FULL	COMP FULL	COMP FULL
		SEC-FULL	SEC-FULL	SEC-FULL				
STATUS KEY DEPRESSED		COMP-PART	PRIMARY	COMP-PART	COMP FULL	PRIMARY	COMP PARTIAL	MINI SYNOPTIC
		STATUS	SEC-PART 	STATUS				
SYNOPTIC SELECTED		COMP-PART	COMP-PART	COMP-PART	COMP FULL 	PRIMARY 	COMP 	MINI 
		SYNOPTIC	SYNOPTIC	SYNOPTIC 				
MAINTENANCE  PAGE SELECTED		COMP-PART	COMP-PART	COMP-PART	COMP FULL	PRIMARY	COMP PARTIAL	MINI SYNOPTIC
		MAINT 	MAINT	MAINT				
NEW PRIMARY EXCEEDANCE		PRIMARY	COMP-PART	COMP-PART	COMP FULL	PRIMARY	COMP PARTIAL	MINI SYNOPTIC
		SEC-FULL	STATUS	SYNOPTIC				
NEW SECONDARY EXCEEDANCE		PRIMARY	PRIMARY	PRIMARY	COMP FULL	COMP PARTIAL	COMP PARTIAL	COMP PARTIAL
		SEC-PART	SEC-PART	SEC-PART				
DEGRADED		COMP-PART	COMP-PART	COMP-PART	N/A	N/A	N/A	N/A

 IF SAME MAINT PAGE THEN PRI/SEC-FULL

 ON THE GROUND MAIN EICAS WILL DISPLAY COMPACTED - FULL

 IF MORE THAN ONE PAGE OF MESSAGES, MESSAGE PAGING, THEN SEC-PART

 IF SAME SYNOPTIC THEN PRI/SEC-PART

 IF FUEL OR GEAR DISPLAY MINI

 IF SAME MINI, DISPLAY PRIMARY, IF OTHER MINI, DISPLAY IT, ELSE NO CHANGE

Figure 62 EICAS - Display Operation-Formats (2)





31-25 CLOCKS

INTRODUCTION

The primary function of the clock is to give time reference to other airplane systems and to display universal time coordinated (UTC).

Universal time coordinated was previously known as Greenwich Mean Time (GMT).

The secondary function of the clock is to give a display of elapsed time or chronograph time.

Universal time coordinated and elapsed time are displayed by a liquid crystal numeric type display.

Chronograph minutes are displayed by the liquid crystal display and the seconds displayed by a continuous sweep second hand.

The clock sends UTC and date to other airplane systems on an ARINC 429 bus.

A clock switch on the P72 panel is connected in parallel with the chronograph switch on the clock. This switch is used for remote control of the chronograph start, stop and reset function.

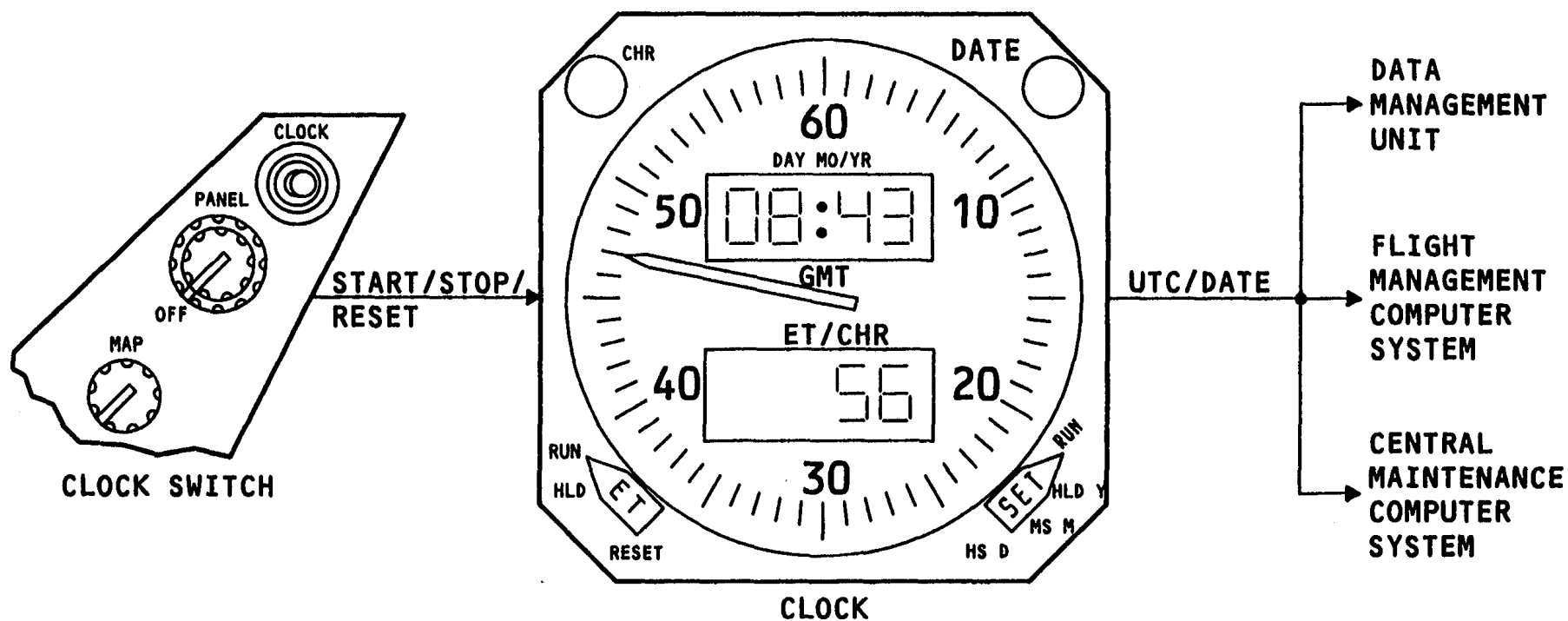


Figure 63 Introduction



COMPONENT LOCATIONS

The clock system components are:

- Captain's clock
- First officer's clock
- Captain's clock switch
- First officer's clock switch
- Clock display circuit breaker
- Electronic clock circuit breaker

CLOCK SWITCH

The clock's chronograph (CHR) function is controlled by a remote pushbutton clock switch on the P72 panel, or a pushbutton switch located on the front clock bezel labelled CHR. The internal clock circuitry is capable of accepting a signal from either switch with equal priority. The first switch actuation starts the chronograph. The second actuation holds the chronograph time accumulator, the numeric displays, and the sweep second hand. The third switch actuation resets the chronograph.

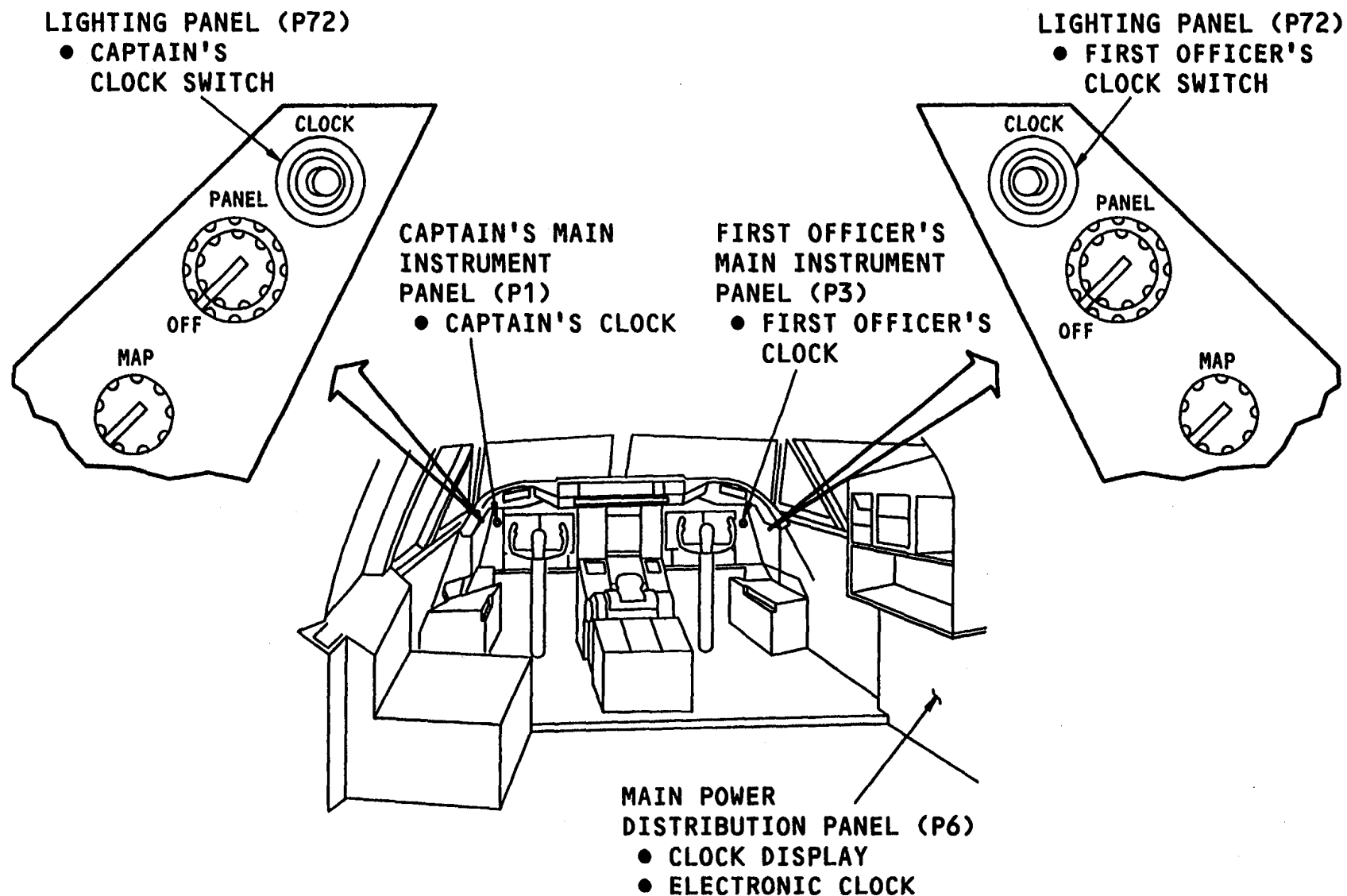


Figure 64 Components Location



INTERFACE DIAGRAM

Power

The clocks get power from the Main Hot, Battery Bus and the APU Battery Bus. With power removed from the airplane, the clock uses the 28 volt dc from the Main Hot Battery Bus as a keep alive voltage to power the clocks time base circuits. When this occurs, there will be no time display or digital output to other airplane systems. When power is applied to the airplane, the clocks monitor power from the APU Battery Bus. If the clock senses voltage on the APU Battery Bus input, power from the Main Hot Battery Bus will power the time base, display and the digital outputs.

Control

The front of the clock contains controls for:

- Elapsed time
- Chronograph
- Date/Time display
- Date/Time set

The chronograph (CHR) function can be controlled by a remote clock switch.

Output

The clocks send universal time coordinated and date from the clocks on an ARINC 429 bus to the:

- flight management computers (FMC's),
- data management unit (DMU) and
- central maintenance computers (CMCs).

L FMC Time/ Date Inputs

Primary source of date and time (UTC) is the GPSSU (Global Positioning System Sensor Unit) or MMR (Multi Mode Receiver) if installed) when INS is in operation.

Secondary source is captains clock.

Back-Up source is F/O clock (via right FMC)

R FMC Time/ Date Inputs

Primary source of date and time is the GPSSU (or Multi Mode Receiver if installed) when INS is in operation.

Secondary source is captains clock (via left FMC).

Back-Up source is F/O clock

EIU Time/ Date Inputs

Primary source of date and time is L FMC.

Secondary source of date and time is R FMC.

DMU Time/ Date Inputs

Primary source of date and time is captains clock.

Secondary source is F/O's clock.

DFDAC Time/ Date Inputs

Primary source of date and time are EIUs.

Secondary source of date and time are EIUs.

CMC Time/ DateClock Inputs

The left and right CMC get time and date from the captains clock.

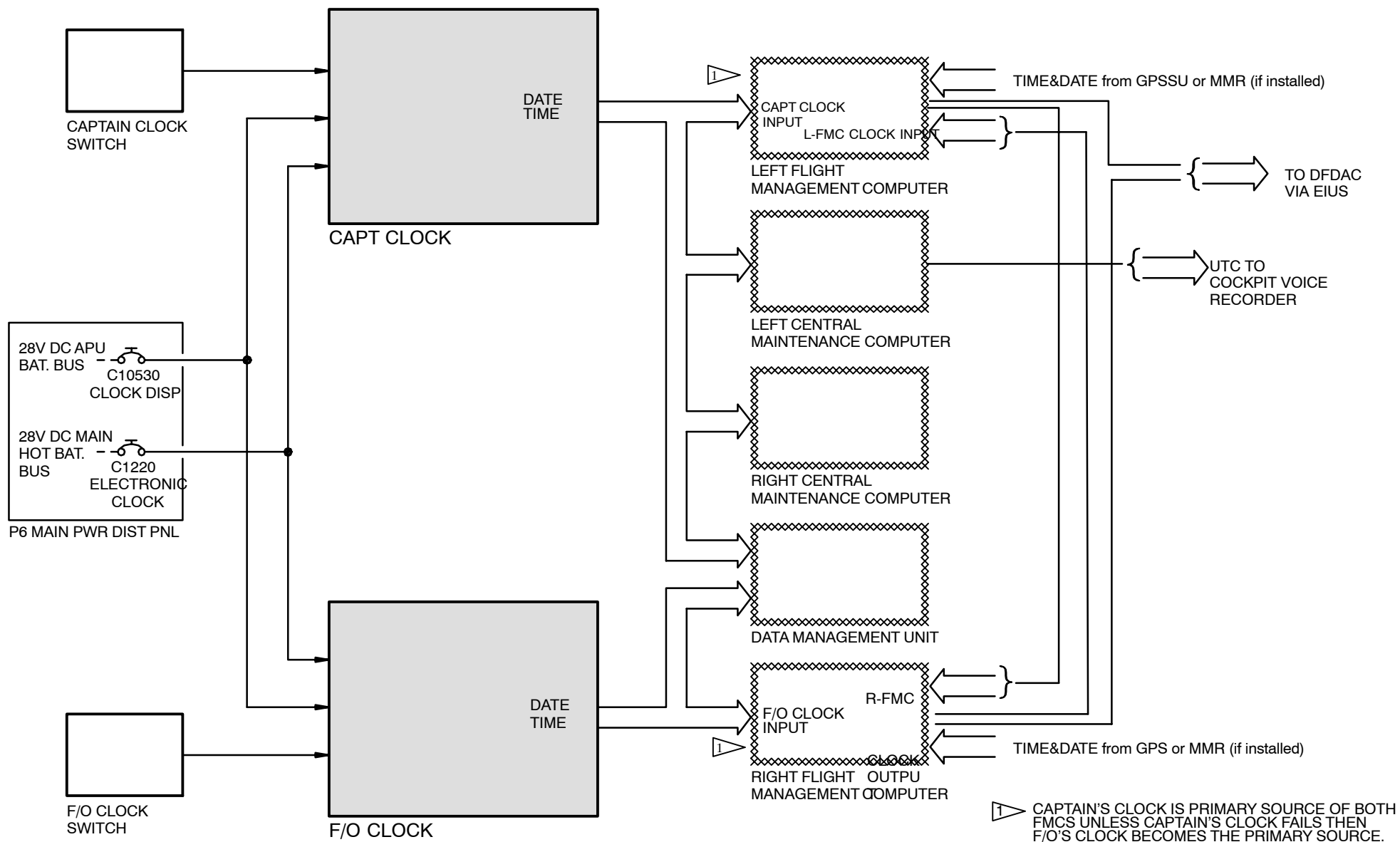


Figure 65 Clock Interface

**CLOCK****General**

The clock shows universal time coordinated (UTC) and date. It also has the capability to measure elapsed time (ET) and has a chronograph function.

Characteristics

Operational characteristics of the clock are:

- Accuracy of +/- one second per two hundred hours at 25°C.
- Power use of displays is 2.0 watts.
- Power use of timebase is 0.6 watts.

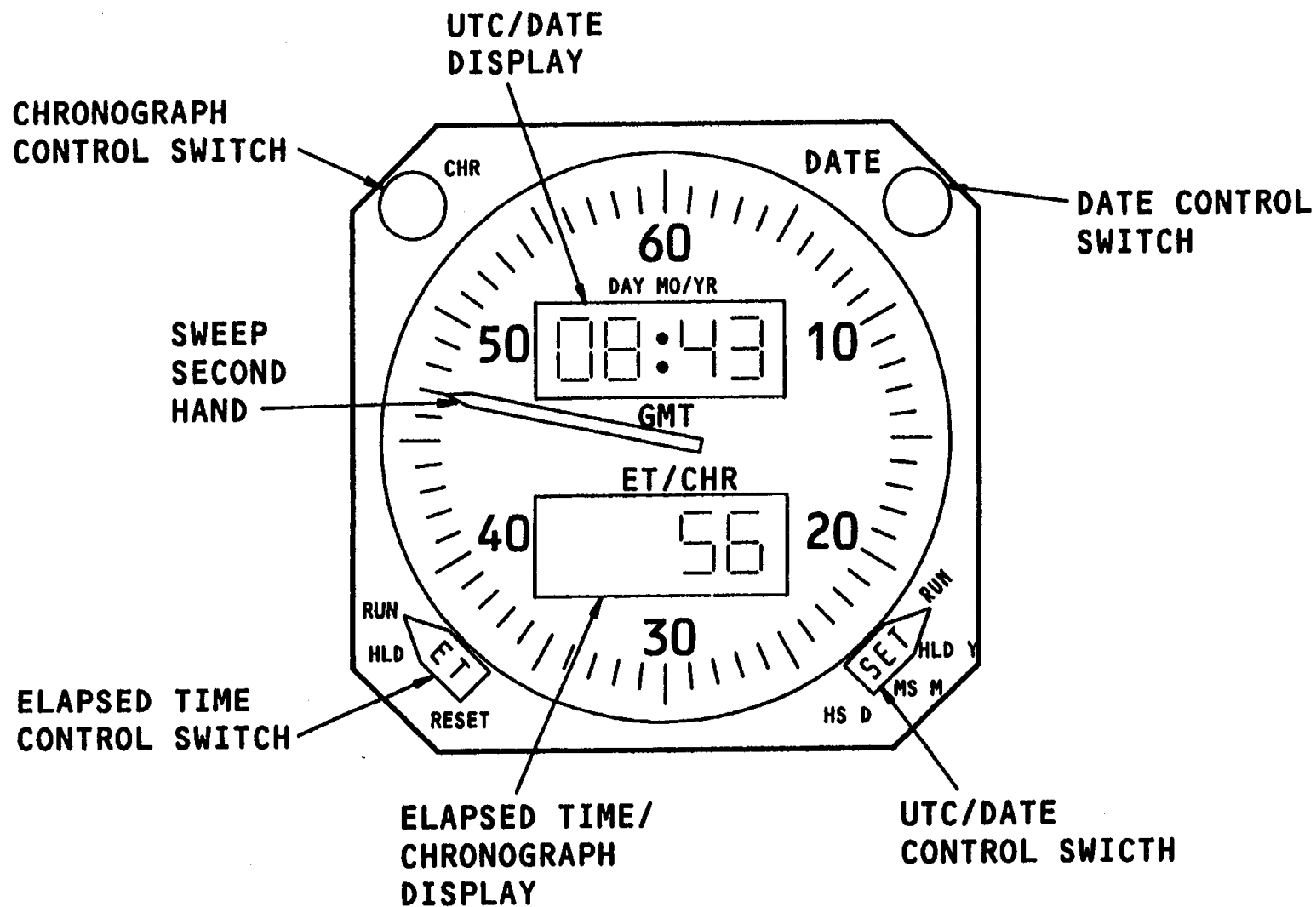


Figure 66 Clock

INDICATING/ RECORDING SYSTEMS CLOCKS



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Control and Display

UTC is shown continuously on the upper LCD from 00 hours 00 minutes, to 23 hours 59 minutes. The UTC/DATE control switch is labeled SET. It has these positions:

- RUN
- HLD Y (hold/year)
- MS M (minutes slew/month)
- HS D (hours slew/day)

When power is first applied to the clock, the LCDs show all zeros and the sweep hand is at the 60 position. This indication stays until the UTC has been advanced one digit. The date replaces UTC on the UTC/date display when the DATE switch is pushed one time. Day/month, and then year, show alternately for one second each. Day, 1 to 31, shows on the two left digits. Month, 1 to 12, shows on the two right digits. Year, 00 to 99, shows on the two right digits. The colon does not show in the date mode. UTC shows again on the display when the DATE switch is pushed a second time.

When the SET switch is in RUN, UTC shows continuously. When it is set to HLD, the UTC display stays at its present shown value. The MS position of the SET switch causes the minute display to increase at a rate of one minute per second. The HS position of the SET switch causes the hours display to increase at a rate of one hour per second.

To set the time:

Use the DATE switch to show the time.

Use the MS and HS positions of the SET switch to set the desired time.

Move the SET switch to HLD.

Move the SET switch to RUN when the time shown is the same as the actual time.

To set the date:

Push the date switch one time with the SET switch set to RUN. Make sure that the date shows in the display.

Move the UTC/CONTROL switch to the D position. The two left digits update one day per second. Move the switch out of this position when the day shown reaches the necessary value.

- Turn the UTC/CONTROL switch to the M position. Month is updated in the two right digits.

- Turn the UTC/DATE control switch to Y. Year is updated in the two right digits.

There is no required sequence for these steps. After the switch has been set the last time, return the UTC/DATE control switch to the RUN position.

Push the date switch a second time with the UTC/DATE control switch set to RUN, and the upper LCD will return to UTC.

The lower LCD shows elapsed time from 00 hours 00 minutes to 99 hours 59 minutes. The elapsed time control switch is labeled ET. It has RUN, HLD (hold) and RESET positions. The switch is used to start, stop, restart, or reset the elapsed time accumulator.

The ET switch operates as follows:

- In the RESET position, the elapsed time display is blank and the elapsed time accumulator is set to zero.
- The HLD position of the switch causes the elapsed time shown to hold at the present value.
- In the RUN position, time is accumulated from the last hold or reset condition. The elapsed time shown advances from this value.

Chronograph

Chronograph operations replace the displays of elapsed time while the chronograph is accumulating. This does not affect the internal operation of the elapsed time accumulator.

The chronograph (CHR) time is shown on the lower LCD and by the sweep second hand. It shows from 00 minutes 00 seconds to 99 minutes 59 seconds. The two left digits of the LCD are blank. The chronograph control switch is in parallel with the clock switch on the P72 panel. These switches start, stop, and reset the chronograph functions.

The two switches operate the chronograph as follows:

- Push either switch to start the chronograph.
- Push either switch a second time to hold the chronograph accumulator and display.
- Push either switch a third time to reset the chronograph accumulator to zero and return the sweep second hand to 60. Elapsed time is then shown. The display stays blank if the elapsed time accumulator contents are zero.

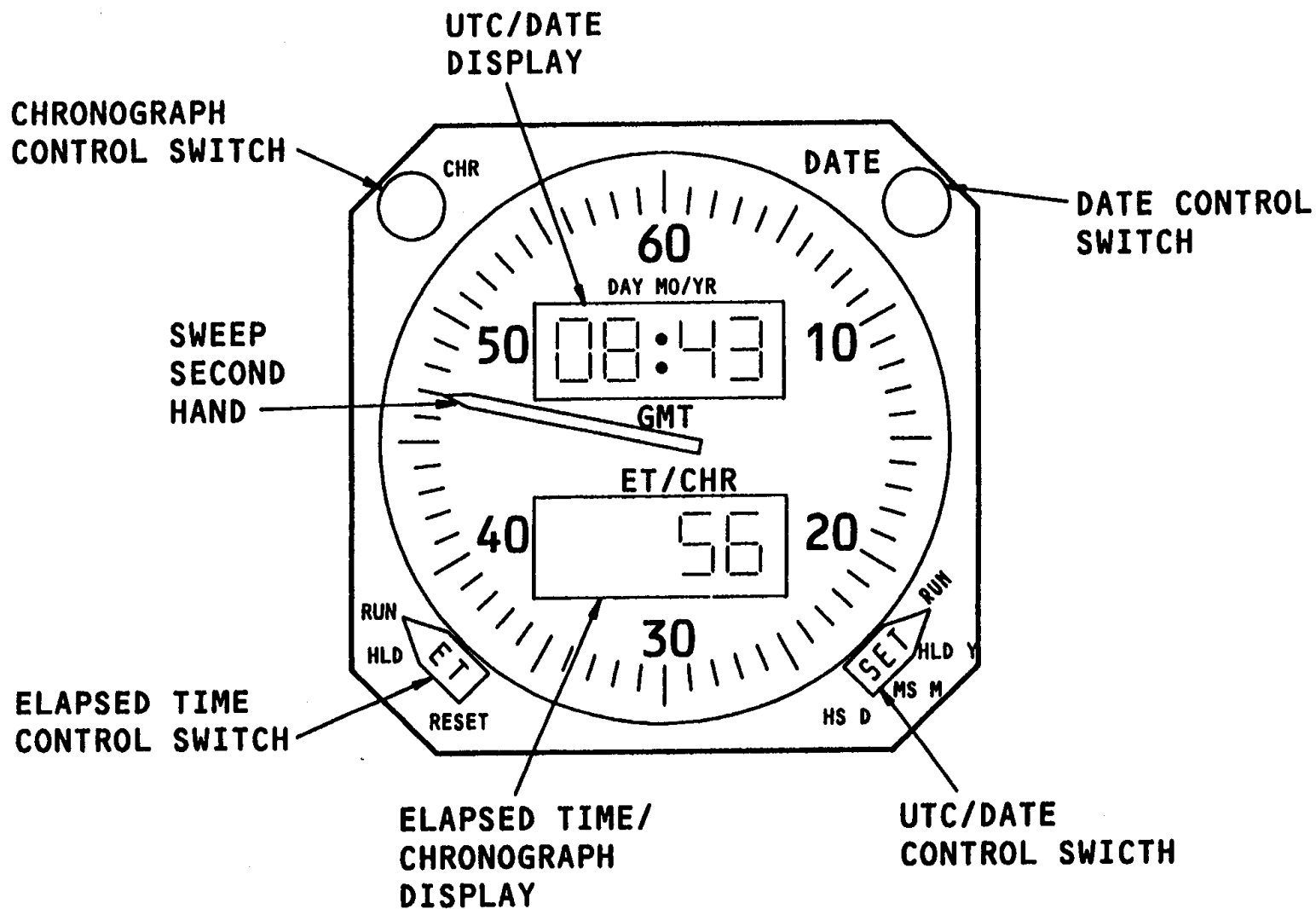


Figure 67 Clock

INDICATING/ RECORDING SYSTEMS CLOCKS



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MAINTENANCE PRACTICES

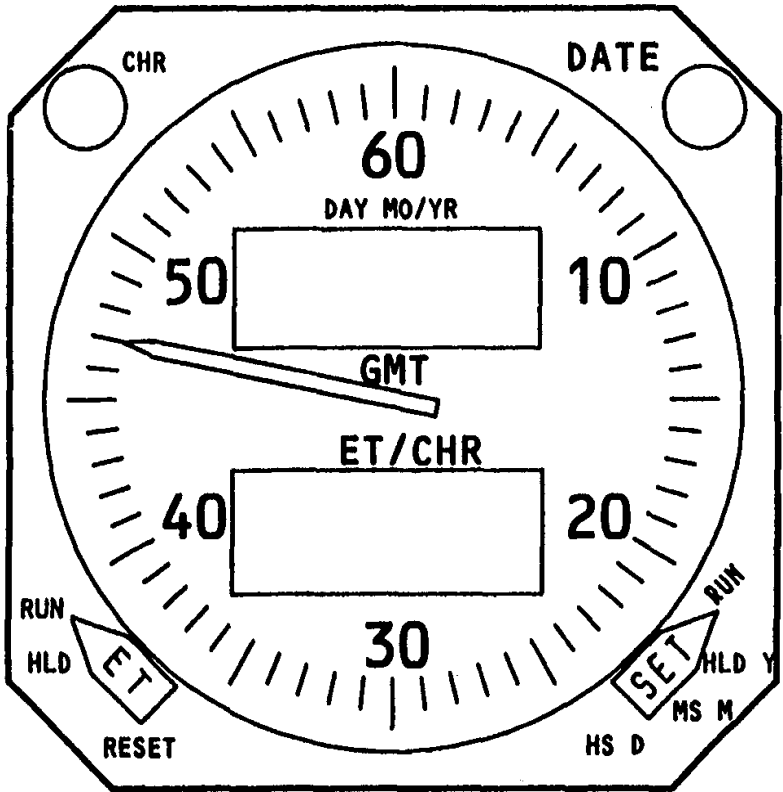
Failure

A failure of the clock will cause the LCDs to be blanked and the sweep hand to remain in its position at the time of failure.

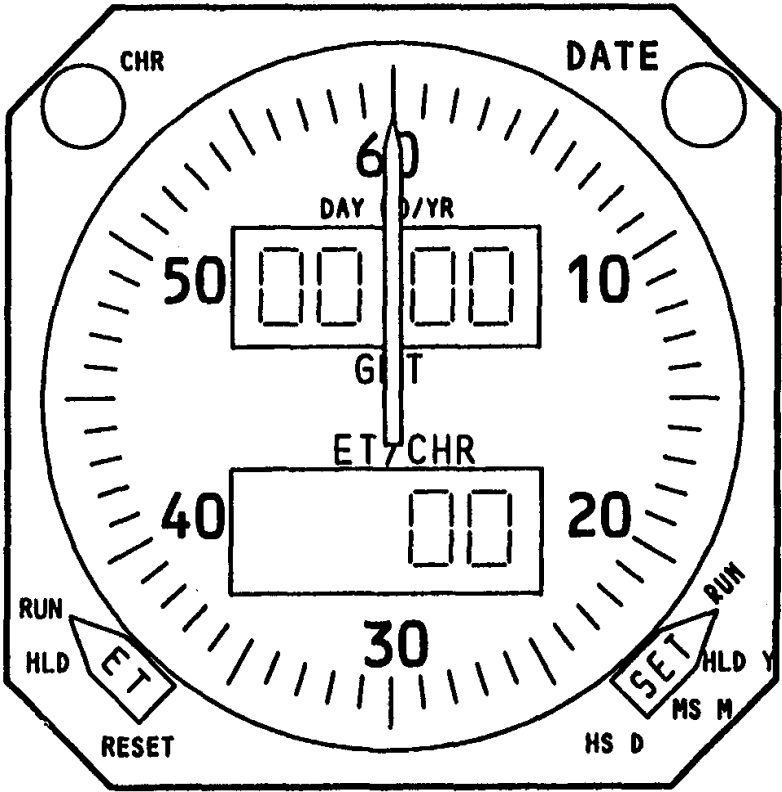
No Computed Data

When the clock has been replaced or power restored to the clock, both LCDs will indicate and hold zeros (00:00).

If the sweep second hand is at a position other than the 60-second position, it will advance to the 60second position and hold. This indication will remain unchanged until the Universal Time Coordinated is advanced one digit with the SET switch placed in the HLD Y position.



FAILED DISPLAY



NCD DISPLAY

Figure 68 Maintenance Practices

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