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Indicating/Recording Systems

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EASA Part-66
B1/B2

Training Manual

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- The LTT production process ensures that the Training Manual contains a complete set of all necessary pages in the latest finalized revision.

ATA 31 INDICATING/RECORDING SYSTEMS

31–00 GENERAL

GENERAL DESCRIPTION (PHILOSOPHY)

Cockpit Philosophy

All the aircraft and system controls are arranged to be within easy reach of the two crew members. The concentration of system controls on the overhead panel is achieved by extensive use of illuminated pushbuttons directly installed on the system synoptic panel.

In normal operation, what means in flight, no lights are illuminated in the cockpit.

This is called the ”**lights out philosophy**”.

Figure 1 ELEC Panel, Example

PUSHBUTTON PRINCIPLE

General

Status and failure indications are integrated whenever possible into the relevant illuminated pushbuttons which must be operated for corrective action.

Pushbuttons with two stable Positions

Most of the illuminated pushbuttons have two stable positions: pressed in and released out; each position corresponding to a control signal sent to a system.

Pressed in (Recessed):

- Normally used system activation (AUTO or ON)
- Temporarily used system activation (ON)
- System activated for maintenance operation (ON) or override (OVRD).

Pushbuttons with one stable Position

Some pushbuttons have only one stable position: released out. When pushed they send a control signal to the system.

Released out (flush with the panel):

- System deactivation (OFF)
- Manual activation of a system (ON)
- Activation of an alternate system (ALTN).

PRESSED IN
NO LIGHT
SYSTEM ACTIVATED

CORRECT OPERATION

PRESSED IN
FAULT LIGHT ON
SYSTEM ACTIVATED

FAULTY CONDITION

RELEASED OUT
OFF LIGHT ON

SYSTEM DEACTIVATED

Figure 2 Pushbutton Principle

COLOR PHILOSOPHY

The illuminated pushbutton and annunciator lights are of different colors according to their function.

In normal operation, only green lights and sometimes blue lights are illuminated.

NOTE: The color philosophy for white, blue and green in the pushbutton have a different meaning as on the display units.

RED IS USED FOR A FAILURE NEEDING IMMEDIATE ACTION

AMBER IS USED FOR A FAILURE NEEDING AWARENESS BUT NO IMMEDIATE ACTION

WHITE IS USED TO INDICATE A PUSHBUTTON IN AN ABNORMAL POSITION OR MAINTENANCE OPERATION

GREEN IS USED TO INDICATE NORMAL OPERATION OF A BACKUP SYSTEM

BLUE IS USED TO INDICATE NORMAL OPERATION OF A TEMPORARILY USED SYSTEM

Figure 3 Pushbutton Colors

31–60 ELECTRONIC INSTRUMENT SYSTEM (EIS)

ELECTRONIC INSTRUMENT SYSTEM INTRODUCTION

EIS General

The EIS (**E**lectronic **I**nstrument **S**ystem) presents Data for:

- EFIS (**E**lectronic **F**light **I**nstrument **S**ystem),
- ECAM (**E**lectronic **C**entralized **A**ircraft **M**onitoring).

The 6 DUs (**D**isplay **U**nits) are identical and interchangeable.

EFIS General

The PFD (**P**rimary **F**light **D**isplay) presents all the flight parameters necessary for short term aircraft control.
The ND (**N**avigation **D**isplay) presents navigation and radar information.

The EFIS Displays are:

- PFD and
- ND.

ECAM General

The E/WD (**E**ngine and **W**arning **D**isplay) presents engine primary indications, fuel quantity, Warning or Memo Messages and Flaps/Slats position.
The lower display, called SD (**S**ystem **D**isplay), presents either system pages (synoptic diagrams) or status messages and flight data.

The ECAM displays are:

- E/WD and
- SD.

Attention Getters

The warning messages are accompanied by either a MASTER WARNING, or a MASTER CAUTION and an aural warning.

- The ”MASTER WARN” light flashes red for any red warning.
- The ”MASTER CAUT” light comes on amber for level 2 amber warnings.

Aural warnings are broadcast by two loudspeakers.

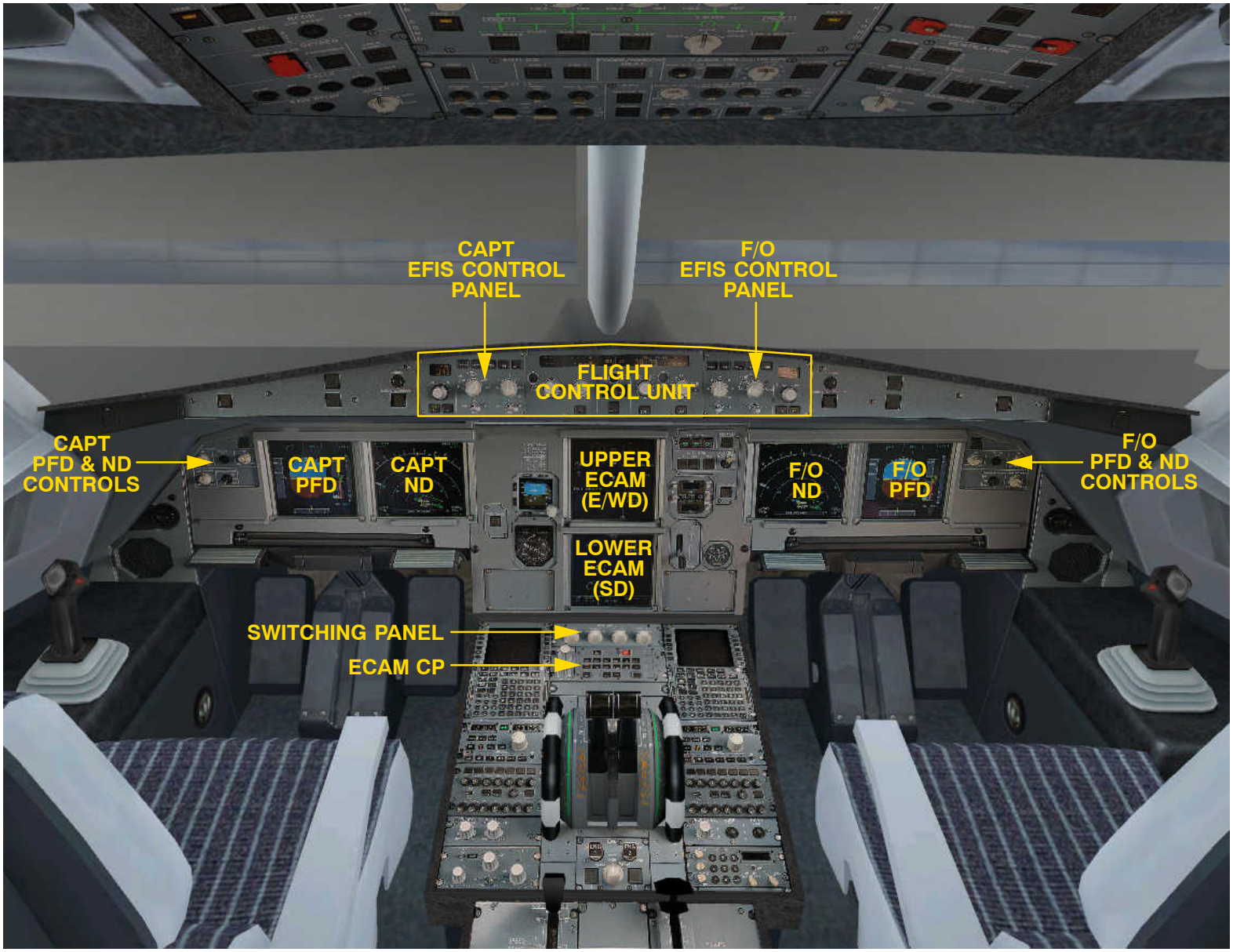


Figure 4 EIS Displays and Controls Introduction

EFIS AND ECAM INTRODUCTION

The EIS (**E**lectronic **I**nstrument **S**ystem) presents on DUs (**D**isplay **U**nits):

- EFIS (**E**lectronic **F**light **I**nstrument **S**ystem) information, (i. e. flight parameters and navigation data).
- ECAM (**E**lectronic **C**entralized **A**ircraft **M**onitor) information.

Display Unit Layout

The layout of the 6 DUs and the breakdown of the information displayed on them is presented as follows:

- 2 DUs are installed on the center instrument panel, one above the other. They display ECAM information.
- 2 DUs are installed side by side in front of each pilot.

They display flight and navigation data.

On each main instrument panel, in normal configuration, the outer DU (**D**isplay **U**nit) will be allocated to the PFD (**P**rimary **F**light **D**isplay) function, and the inner DU to the ND (**N**avigation **D**isplay) function.

Each pilot is given the possibility to display ECAM information instead of navigation information on its inner DU, in order to cover failure cases.

INFORMATION PRESENTED ON EFIS DUS

The EFIS DUs enable display of flight path control and navigation data for the crew.

Each pilot has two CRT display units at his disposal, one PFD and one ND, on which is displayed the following information:

- Attitude,
- Horizontal Situation,
- Mach/Airspeed,
- Altitude,
- Vertical Speed,
- Radio Altitude,
- Weather Radar Information,
- Marker Beacon Indication and
- Flight Mode Annunciation (autopilot/flight director modes).

Primary Flight Display

The PFD displays all the primary flight indications necessary for short–term aircraft control.

Navigation Display

The ND displays the navigation information necessary as for the flight progresses, and in the mode chosen by the pilot Rose, (with NAV, VOR, ILS submodes), ARC, PLAN.

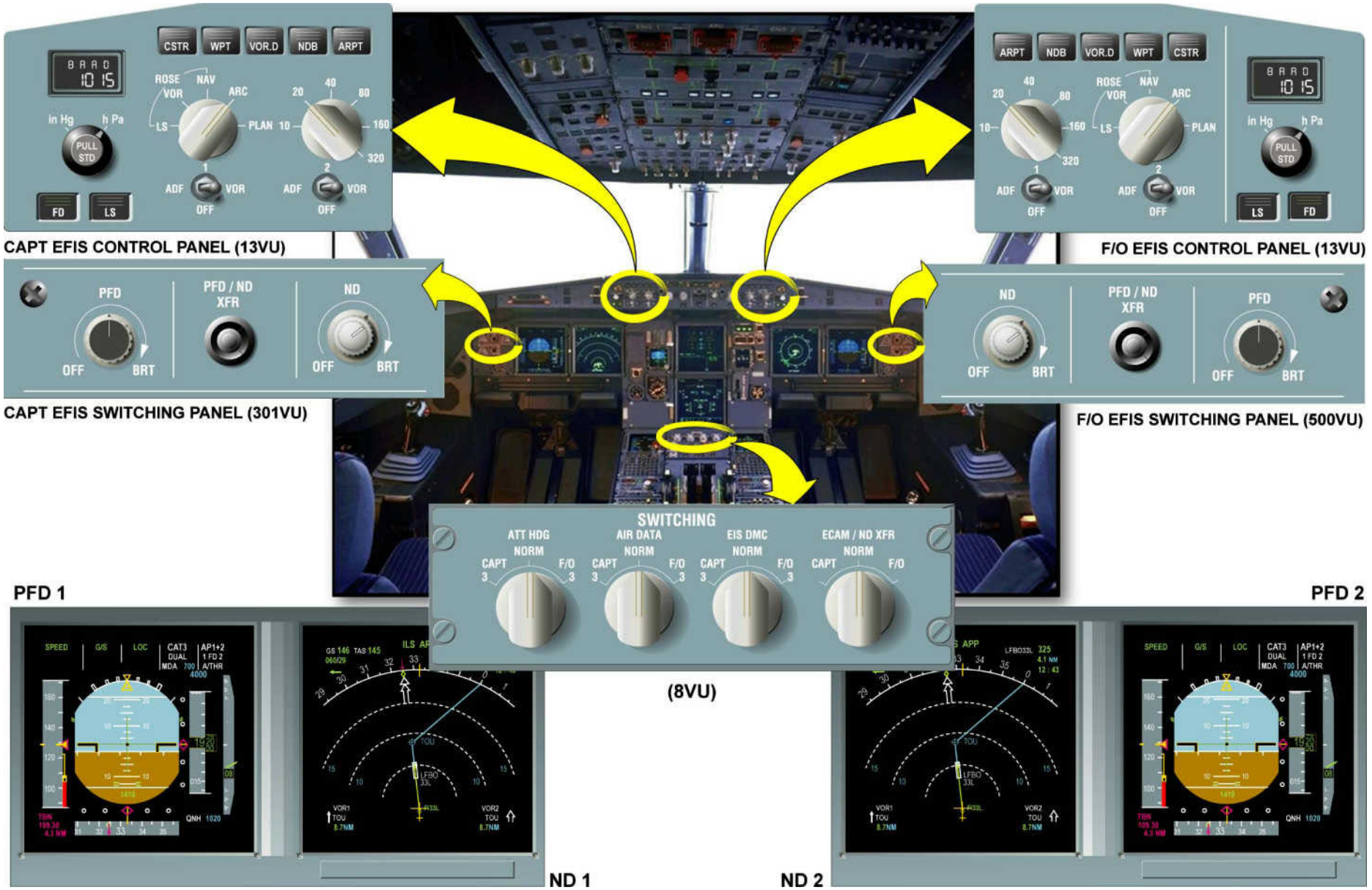


Figure 5 EFIS Cockpit Layout

INFORMATION PRESENTED ON ECAM DUS

Engine/Warning Display (E/WD)

In normal operation the top two thirds of the display will present engine indications, plus fuel quantity and flaps/slats position indications.

The bottom third will present:

- either MEMO messages, i. e. a reminder of functions/systems which are temporally used (e. g. APU running),
- or MEMO messages including some key items of the normal check/list in the Take–Off and the Approach phases,
- or warning/caution messages, giving the title of the failure and the corresponding procedures/actions to be performed.

System Display (SD)

In normal operation, the display unit will present:

1. Either an A/C system synoptic diagram, corresponding to the current phase of flight or to the crew manual selection, or to the caution/ warning that is being shown to the crew eventually.
2. Or status messages which will appear once the crew has cleared all the pages corresponding to the current warning/caution, or upon manual call. At last, the two bottom lines are reserved for the display of A/C parameters such as TAT, SAT, A/C Gross weight.

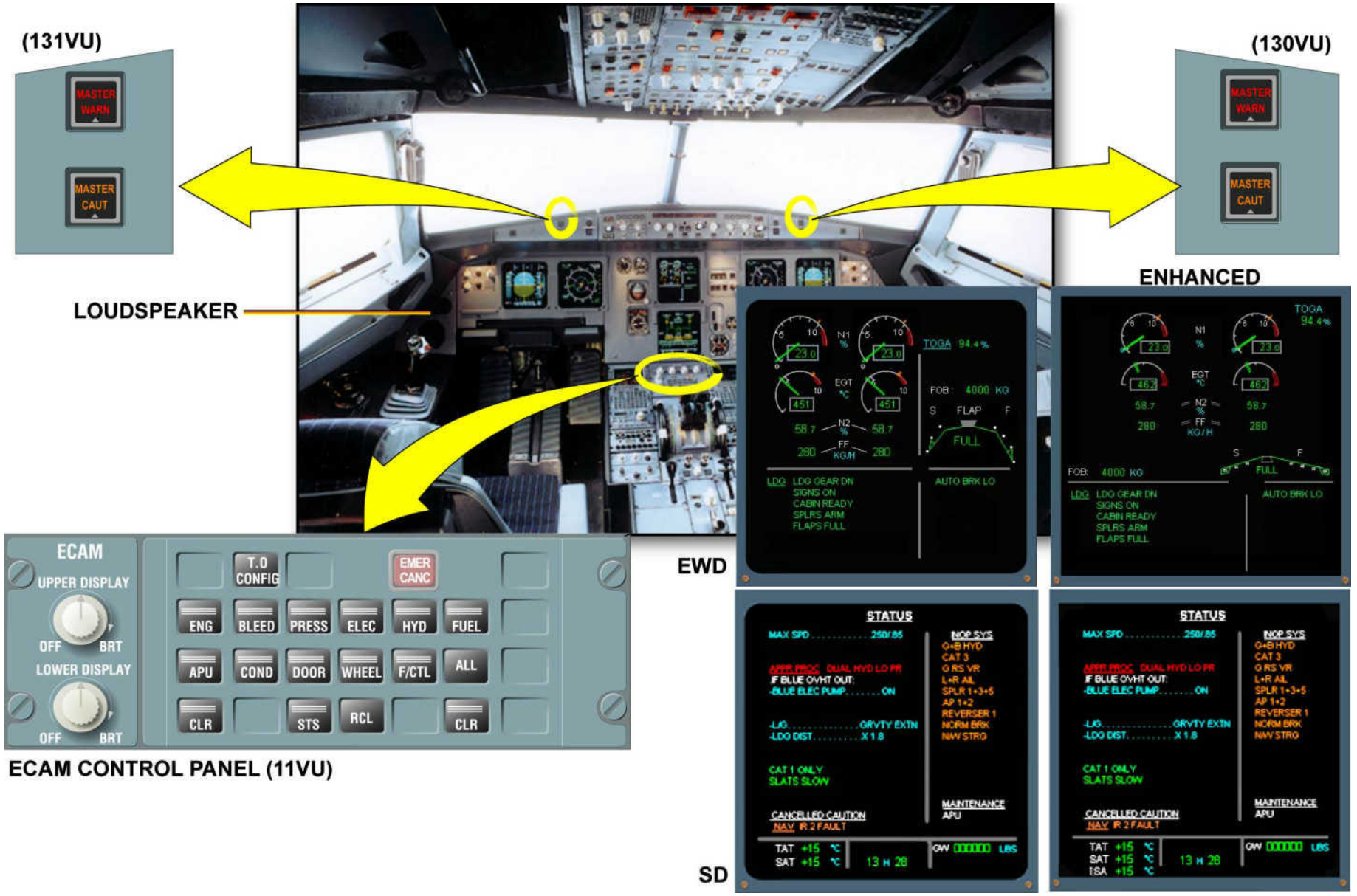


Figure 6 ECAM Cockpit Layout

PRIMARY FLIGHT DISPLAY GENERAL LAYOUT

PFD STRUCTURE

A grey background is displayed on speed, heading and altitude PFD windows.

In case of avionics Ventilation Blower and Extract Fault, the grey background is suppressed in order to limit PFD tubes consumption and to prevent them from overheating.

Attitude

The aircraft attitude is shown on the central part of the display by a cutsphere shaped window which features a conventional Attitude Display Indicator.

Speed

The Airspeed Scale on the left hand side contains all the data of a conventional Airspeed Indicator plus significant limit protections and Target Speed.

Altitude

The Altitude Scale on the right side displays the aircraft actual Altitude according to the selected baro setting reference.

Vertical Speed

A green pointer and a numerical value display the aircraft Vertical Speed at the extreme right of the Primary Flight Display.

Actual and Selected Heading or Track Information is shown at the bottom of the display.

Guidance

Flight Director Bars or Flight Director Symbol display guidance orders on the attitude sphere.

Trajectory Deviation

Lateral and vertical scales provide trajectory deviation information during an ILS or R NAV approach.

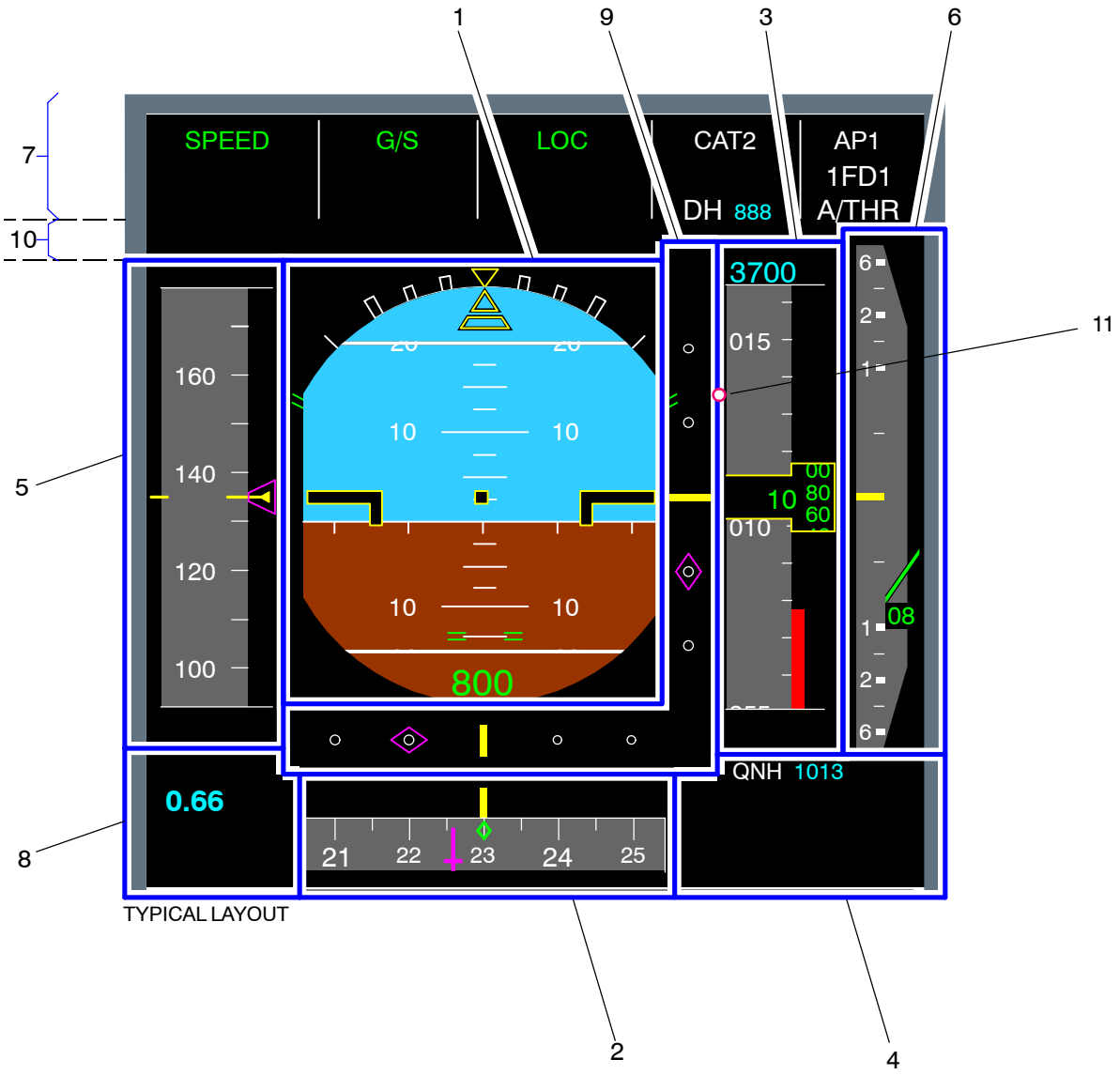
Flight Mode Annunciator

Annunciations and messages regarding Flight Management and Guidance System operation are displayed at the top of the PFD which is divided into 5 columns and 3 lines.

Vertical Deviation

This symbol appears next to the altitude corresponding to the theoretical vertical profile computed by the FMGC. It is displayed from the top of descent down to the MAP altitude.

The pilot can read the VDEV directly from the altitude scale. The range is +/- 500 feet. When the VDEV value exceeds +/- 500 feet, the symbol stays at the range limit and the PROG page displays the exact value.



(1) ATTITUDE, GUIDANCE & RADIO HEIGHT

(2) HEADING

(3) ALTITUDE

(4) ALTITUDE BARO SETTINGS

(5) AIR SPEED (SPEED AND SPEED LIMITS)

(6) VERTICAL SPEED

(7) FLIGHT MODE ANNUNCIATOR (FMA)

(8) MACH / ILS DATA

(9) APPROACH TRAJECTORY DEVIATION

(10) SYSTEM MESSAGES

(11) VERTICAL DEVIATION

Figure 7 PFD Zones and General Layout

NAVIGATION DISPLAY GENERAL LAYOUT

General

The indication on the ND (**N**avigation **D**isplay) depends on the position of the Mode Selector Switch on the EFIS Control Panel.

Each DU receives digital signals from its related DMC through an Digital Serial Data Bus Link (DSDL), and also through an high–speed bus for the weather radar link.

The NDs provide this information according to the modes selected on the EFIS control panel (part of the Flight Control Unit). The modes are ROSE–ILS, ROSE–VOR, ROSE–NAV, ARC, and PLAN.

Around the middle area, the ND horizontal–display window is divided into different areas:

- Top left corner for Ground Speed (GS), True Airspeed (TAS) and wind indications
- Top right corner for waypoints and VOR and ILS station indications
- Bottom right and left areas for navigation stations and DME indications
- Top middle area for approach type and grid track indications, TRUE heading message and approach messages
- Right area for WXR and GPWS messages
- Bottom middle area for TCAS and FMS messages
- Left area for FMS messages and chronometer indications.

Color Choice

Seven different colors are used for EFIS system, plus two particular colors for the PFD such as sky and earth (blue and brown).

The general rules for color choice below are followed:

- **Red**:

  Used for the flight envelope limit indications, and for the failure indications concerning the various sensors.
- **Amber**:

  Used for information or messages requiring attention but not quick action or decision.
- **Yellow**:

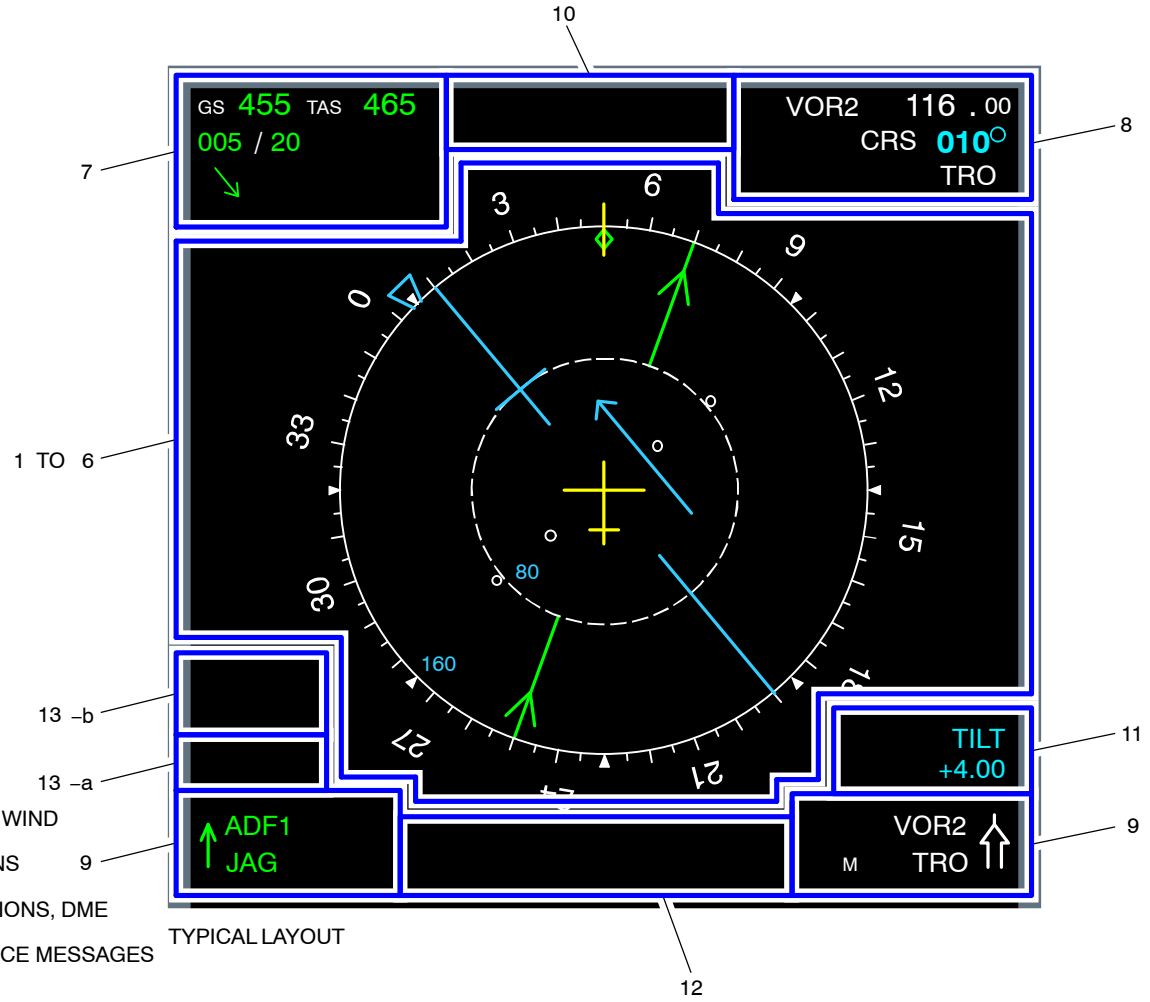
  Used for aircraft references (e. g.:aircraft symbol, lubber line...)
- **White**:

  Used for scales, for VOR indications.
- **Green**:

  Used for current values (e. g.:ground speed, track).
- **Cyan**:

  Used for selectable values (e. g.:selectable speed, armed mode, tuned navaids), and units (e. g.: NM).
- **Magenta**:

  Used for ILS. (LOC and GLIDE SLOPE) deviations, and optional information displayed on the map such as VOR–D, NDB, ARPT,...



TYPICAL LAYOUT

(1) TO (6) MAP AREA

(7) TOP LEFT CORNER – GROUND SPEED, TRUE AIR SPEED, WIND

(8) TOP RIGHT CORNER – WAYPOINTS, VOR AND LS STATIONS

(9) BOTTOM RIGHT AND LEFT CORNERS – NAVIGATION STATIONS, DME

(10) TOP MIDDLE AREA – APPROACH AND HEADING REFERENCE MESSAGES

(11) RIGHT AREA – WXR AND GPWS MESSAGES

(12) BOTTOM MIDDLE AREA – TCAS AND FMS MESSAGES

(13) LEFT AREA – (a) CHRONOMETER, (b) FMS MESSAGES

Figure 8 ND Modes (1)

ND MODES

ROSE ILS Mode

This Mode corresponds to the conventional HSI with Localizer– and Glideslope-Indication.

ROSE VOR Mode

This Mode corresponds to the conventional HSI with VOR Course and VOR Deviation.

ROSE NAV Mode

This Mode corresponds to the conventional HSI without VOR Course resp. VOR Deviation but with Flight Plan indications (from the FMGC) and Weather Radar Indication.

ARC Mode

This mode shows a sector of 90 degrees in front of the aircraft. The aircraft symbol is at the bottom of the DU.

Flight Plan information and Weather Radar are displayed like in the ROSE NAV mode.

PLAN Mode

In this mode a map is displayed with North up. In the middle of the display there is a waypoint as a reference point.

Depending on the selected range other waypoints and the planned Flight Path are displayed. An aircraft symbol is displayed according to the Present Position.

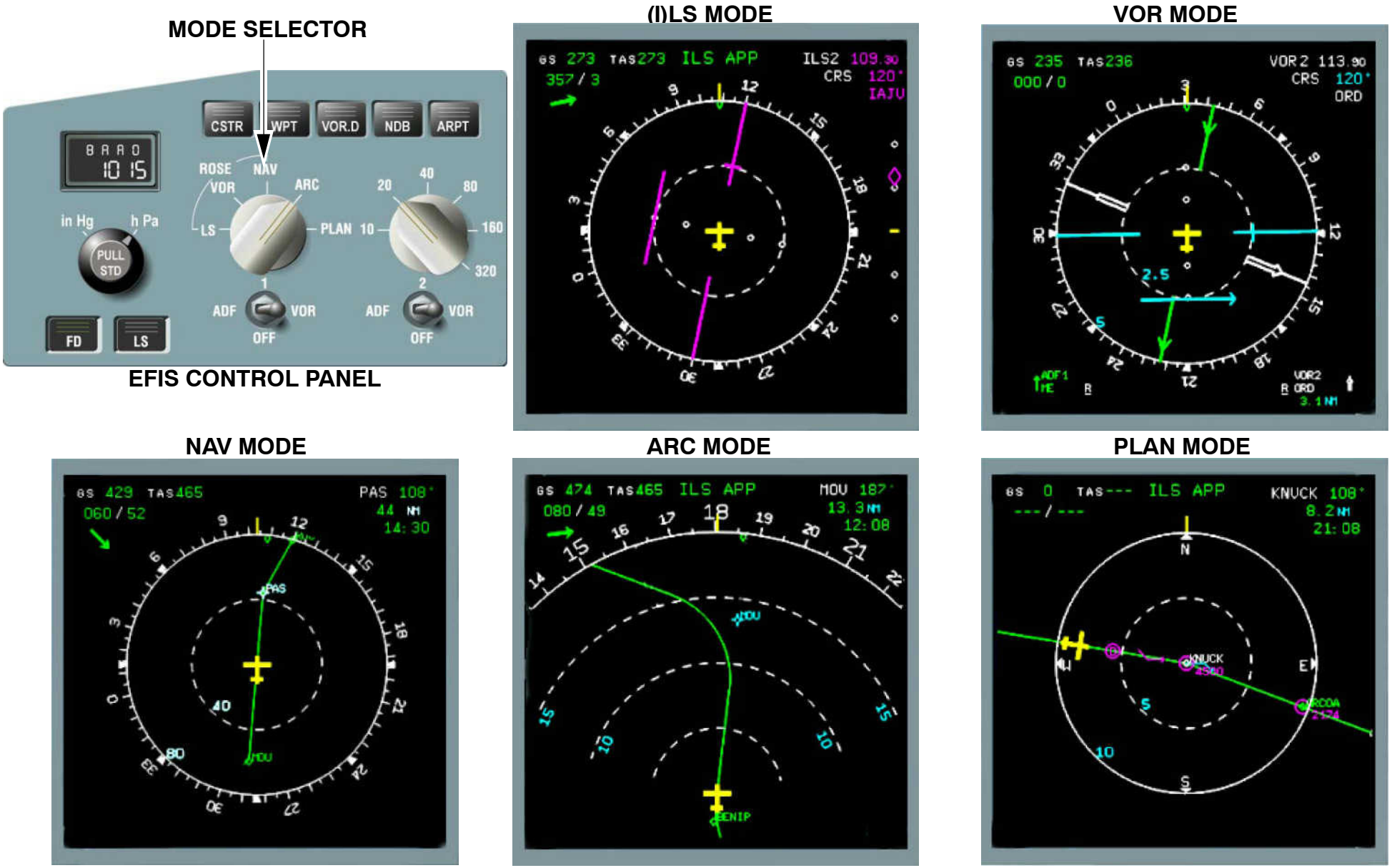


Figure 9 ND Modes

ENGINE WARNING DISPLAY GENERAL LAYOUT

General Description

The upper ECAM DU is called E/WD (**E**ngine/**W**arning **D**isplay) unit.

The upper zone (approximately two thirds of the screen surface) shows all the engine primary parameter indications, plus the onboard fuel quantity and the flaps/slats position indications.

The lower zone presents various kinds of messages, explicit described in 31–50–00:

- MEMO and aircraft configuration items
- WARNING/CAUTION messages
- TITLES of aircraft system pages related to WARNING/CAUTION.

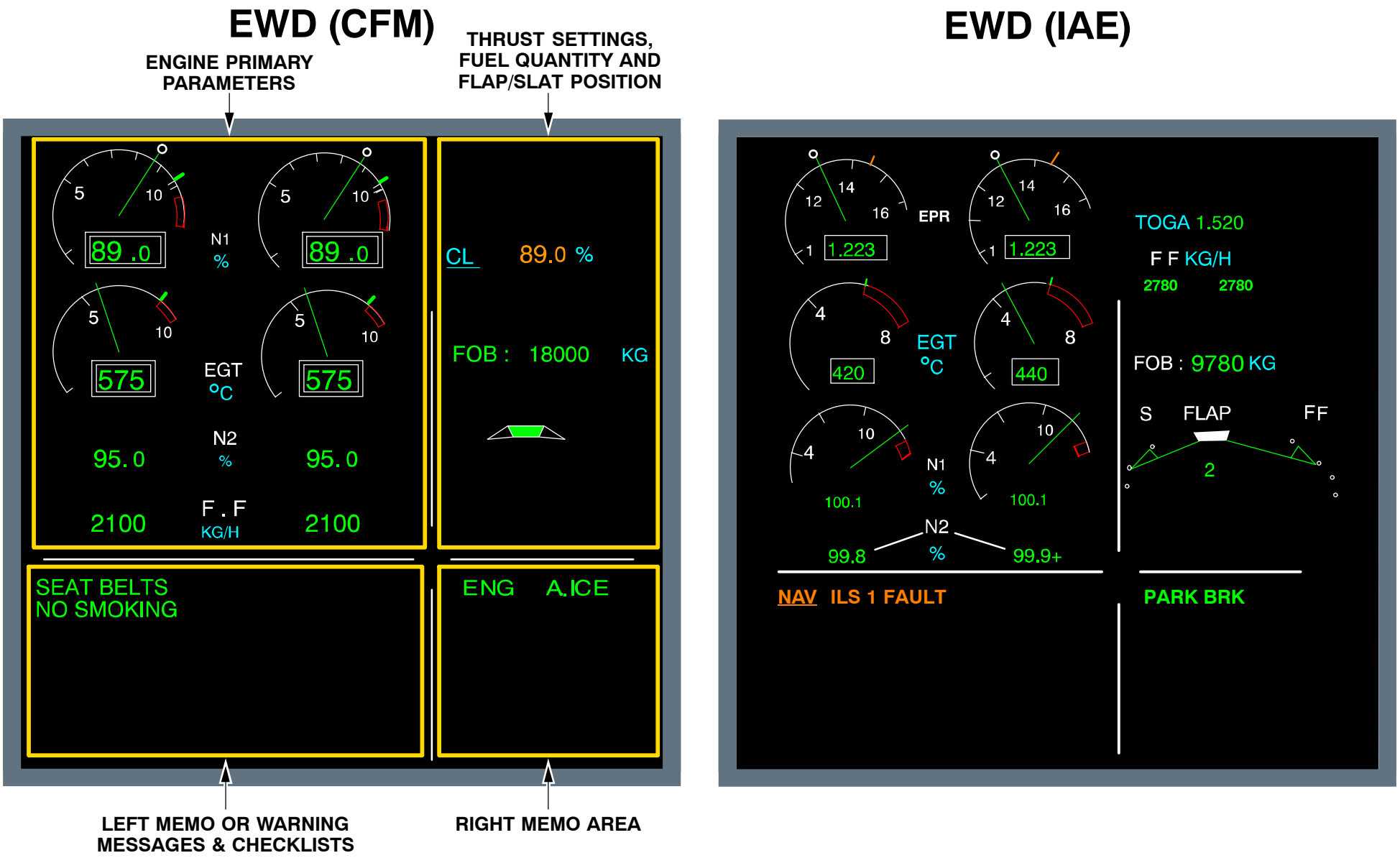


Figure 10 Engine/Warning Display Layout

SYSTEM DISPLAY (SD) GENERAL LAYOUT

General

The lower ECAM DU is called System or Status Display Unit.

The upper zone (approximately three quarters of the screen surface) shows:

- Either aircraft system synoptic diagrams or
- STATUS messages, described in 31–50–00.

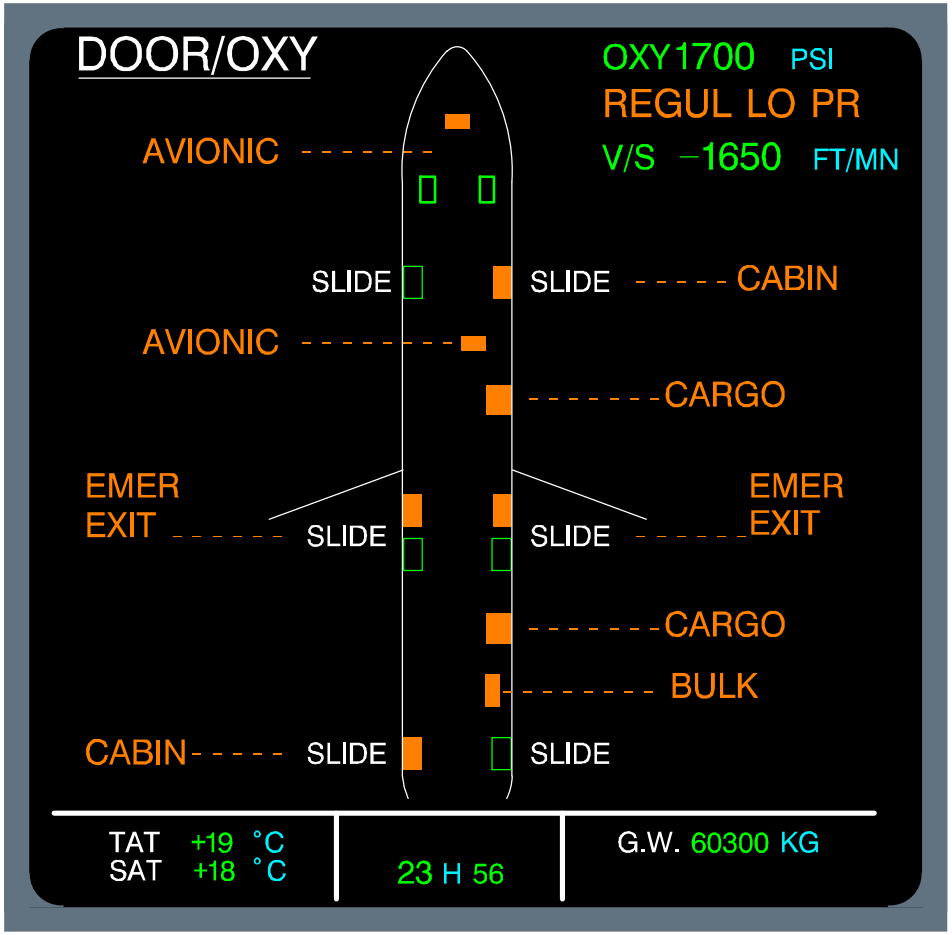
The lower zone presents several permanent parameter values such as:

- TAT (**T**otal **A**ir **T**emperature),
- SAT (**S**tatic **A**ir **T**emperature),
- UTC (**U**niversal **T**ime **C**oordinated),
- A/C grossweight (**GW**),
- A/C G. LOAD (only when it is excessive) and at last the
- selected altitude value expressed in meters on pilot's request.

In normal configuration, without aircraft system failure, the ECAM system improves crew comfort by eliminating the need for frequent scanning of the various system panels for:

- Routine system monitoring: system synoptic diagrams are displayed on the lower DU and automatically adapted to the present flight phase or manually called.
- System parameter monitoring: some system parameters are monitored the whole flight and automatically displayed on the relevant system page when their value drifts out of normal range but well before the warning level is reached.

DOOR PAGE



STATUS PAGE

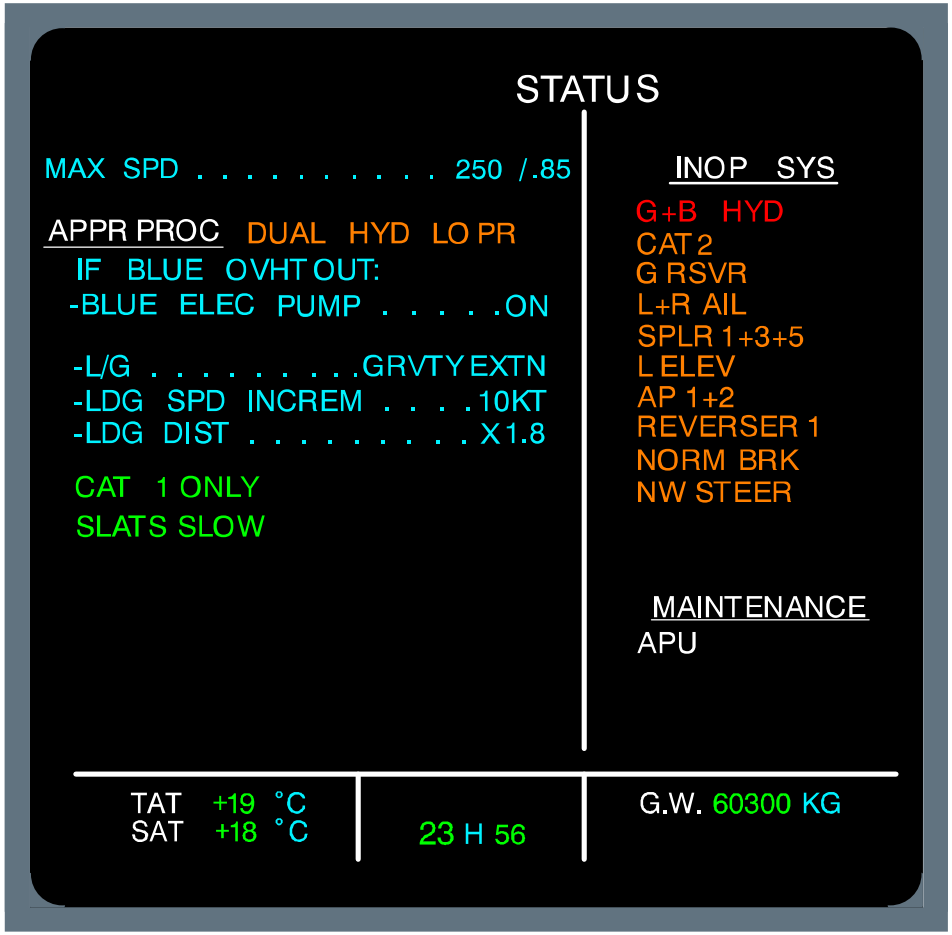


Figure 11 System Display (Examples)

EIS CONTROLS PRESENTATION

DU ON/OFF BRIGHTNESS Potentiometers

By either side of the main instrument panel PFD and ND brightness controls are provided for each pilot.

The PFD brightness is manually controlled through a single potentiometer which works in conjunction with the automatic brightness control system provided by the light sensors located on the face of each display unit. This system provides adjustment of the DU symbology brightness in order to cope with the changes of the cockpit environmental lighting conditions. If it fails, manual control is retained.

When the potentiometer is set to the minimum (but not to OFF), the brightness of the display remains at a certain low threshold to show to the pilot that the DU is still in operation.

The extreme left position of the potentiometer switches off the PFD.

If a pilot switches off his PFD, the PFD image is automatically displayed on the adjacent display unit (the ND) instead of the ND image. In this case, the pilot can recover the ND image by means of the PFD/ND XFR pushbutton switch.

The ND brightness is manually controlled through a potentiometer made up of two concentric knobs:

- the outer knob enables a separate adjustment of the brightness of the weather radar image only.
- the inner knob enables adjustment of the general brightness of the ND symbology.

The extreme left position of the inner knob switches off the ND. In this case, the ND image is not automatically displayed on the PFD.

To do this, the pilot have to use the PFD/ND XFR pushbutton switch. As in the case of the PFD, these manual controls work in conjunction with the automatic brightness control system.

PFD/ND Transfer Manual Control

On either pilot instrument panel, a PFD/ND XFR pushbutton switch enables each pilot to cross–change the images between the PFD and ND.

At each action on this pushbutton switch, there is an inversion between the 2 images:

- the one which was displayed on the left DU is displayed on the right DU and vice versa.

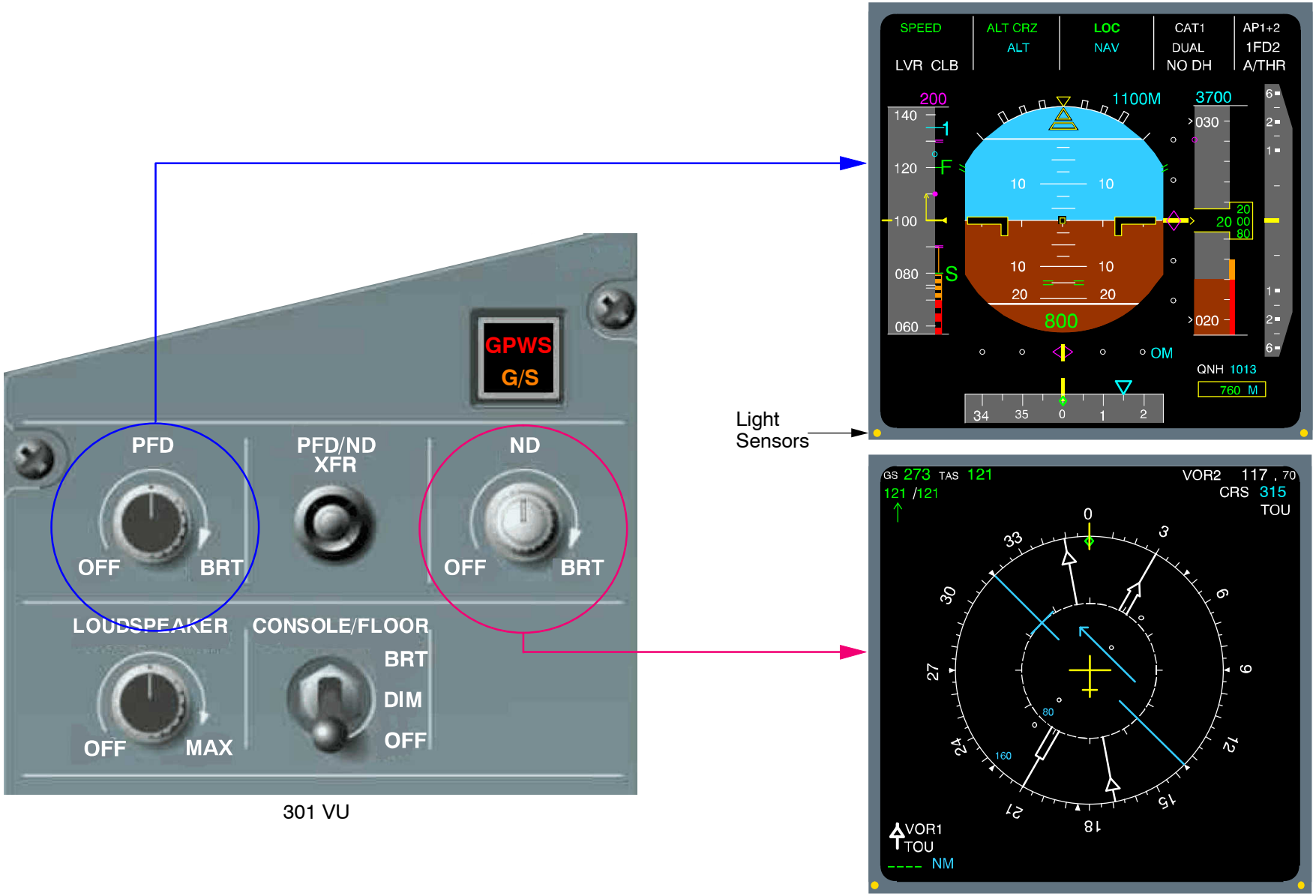


Figure 12 EIS Controls Presentation

EFIS CONTROLS PRESENTATION

The EFIS control panels, which are part of the Flight Control Unit, are divided into PFD controls and ND controls.

PFD Controls

Both EFIS Control Panels have the same controls:

- **Hg/hPa Selector Knob**
  for changing the QNH units (in Hg or hPa).
- BARO Setting Knob
  for QNH setting. Pulling the knob selects the standard value. In this case, STD is displayed in the Baro Reference Window.
- FD Pushbutton Switch
  for switching the FD Bars resp. FPD–Symbols.
- LS Pushbutton Switch
  for switching of LOC and GLIDE Scales and deviation symbols on the PFD.
- Baro Reference Window
  is used to display the pressure reference value and the reference used.

ND Controls

For the Navigation Display there are following controls:

- **Mode Selector Switch**
  to use the ND in different modes. In the Rose Modes the aircraft symbol is in the middle of the ND, in the ARC Mode it is at the bottom of the DU. PLAN corresponds to a map displayed on the ND.
- **Scale Selector Switch**
  to select the range on the ND.
  For example, if ”320” is selected in the ARC mode the distance between aircraft symbol and compass rose corresponds to a distance of 320 nautical miles.
- **ADF/VOR selector**
  enables ADF or VOR bearing pointers to be selected on the associated ND as well as the corresponding navigation station characteristics in any mode except PLAN mode.
- **Data base display Pushbuttons**
  these five P/Bs enable additional data to be displayed on the ND. When pressed these P/Bs respectively display Airports, ADF stations, VOR/DME stations, Waypoints and Constraints.

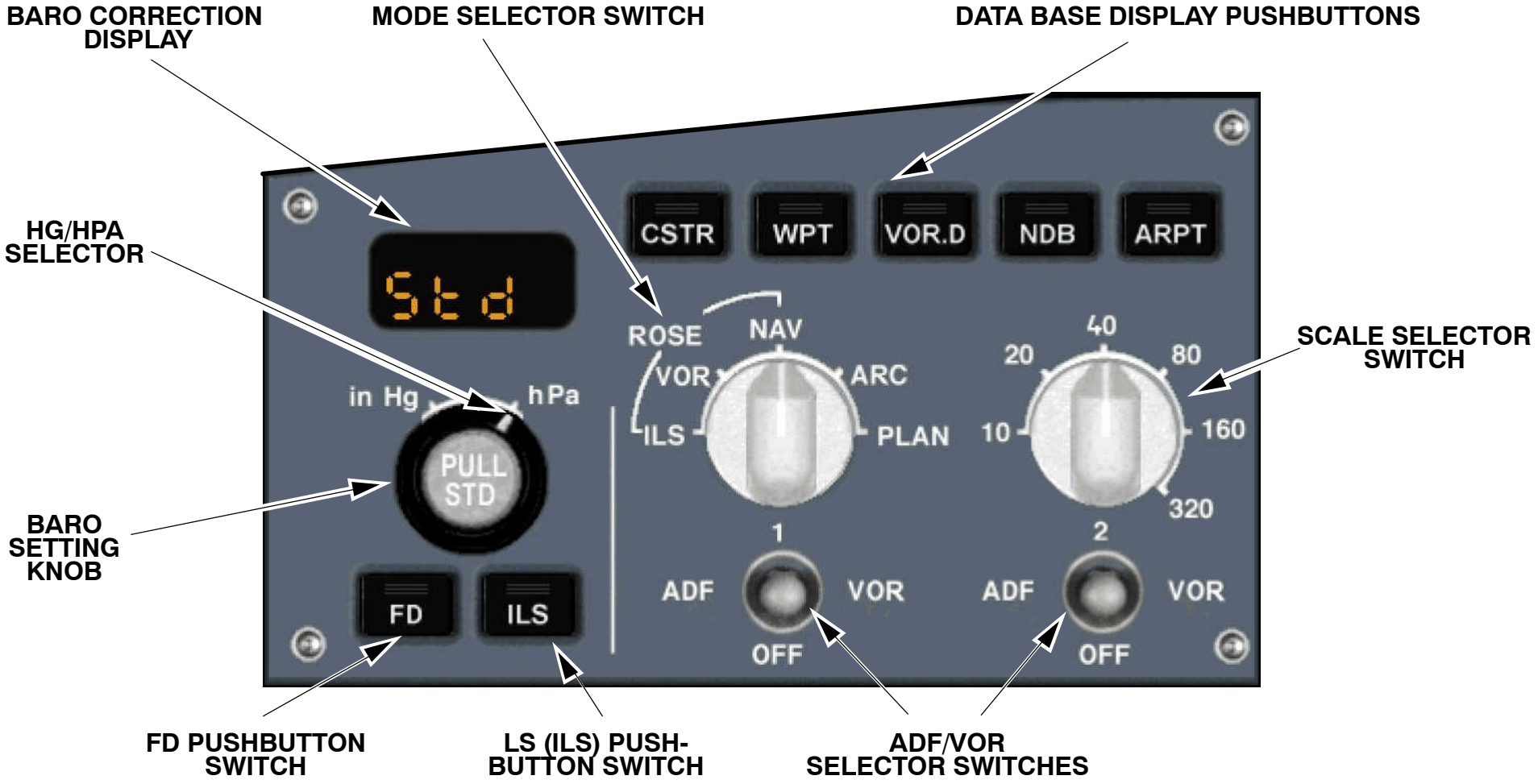


Figure 13 EFIS Control Panel (Captain)

ECAM CONTROL PANEL INTRODUCTION

General

The ECP (**E**CAM **C**ontrol **P**anel) includes controls required for operation of the ECAM system, as regards the display of various messages (memo, warning, caution, procedures, status) and the display of the different A/C system pages (synoptic diagrams).

For explicit description refer to ATA 31–50 CWS.

Briefly, it provides the following controls:

- upper and lower ECAM DU brightness–ON/OFF potentiometers.
- system keys for manual selection of the A/C system page.
- ALL key for the cyclic display of all the A/C system pages, at 1 second intervals approx., which enables the crew to choose a given page in case of failure of the above system keys (the page on display is that present when the ALL key is released).
- RCL key for recalling an alert which had been inhibited or suppressed.
- STS key for calling the STATUS page on the lower ECAM DU.
- 2 CLR keys which enable the crew to clear the warning/caution messages and to get automatically the A/C system pages in relation with the detected warnings or cautions.
- EMER CANC guarded key for cancelling any aural warning including GPWS ones and cancelling amber cautions on the EWD for the rest of the flight.

NOTE: The “Cruise Page“ is not selectable on the ECP and is displayed automatically in flight.

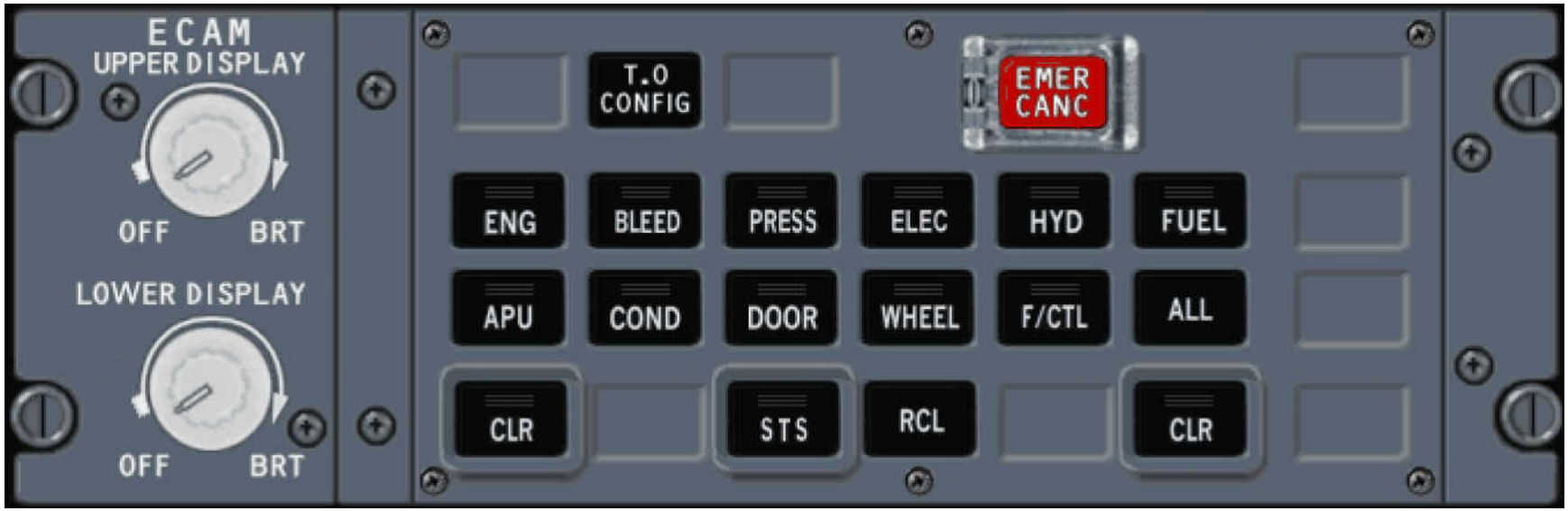


Figure 14 ECAM Control Panel Layout

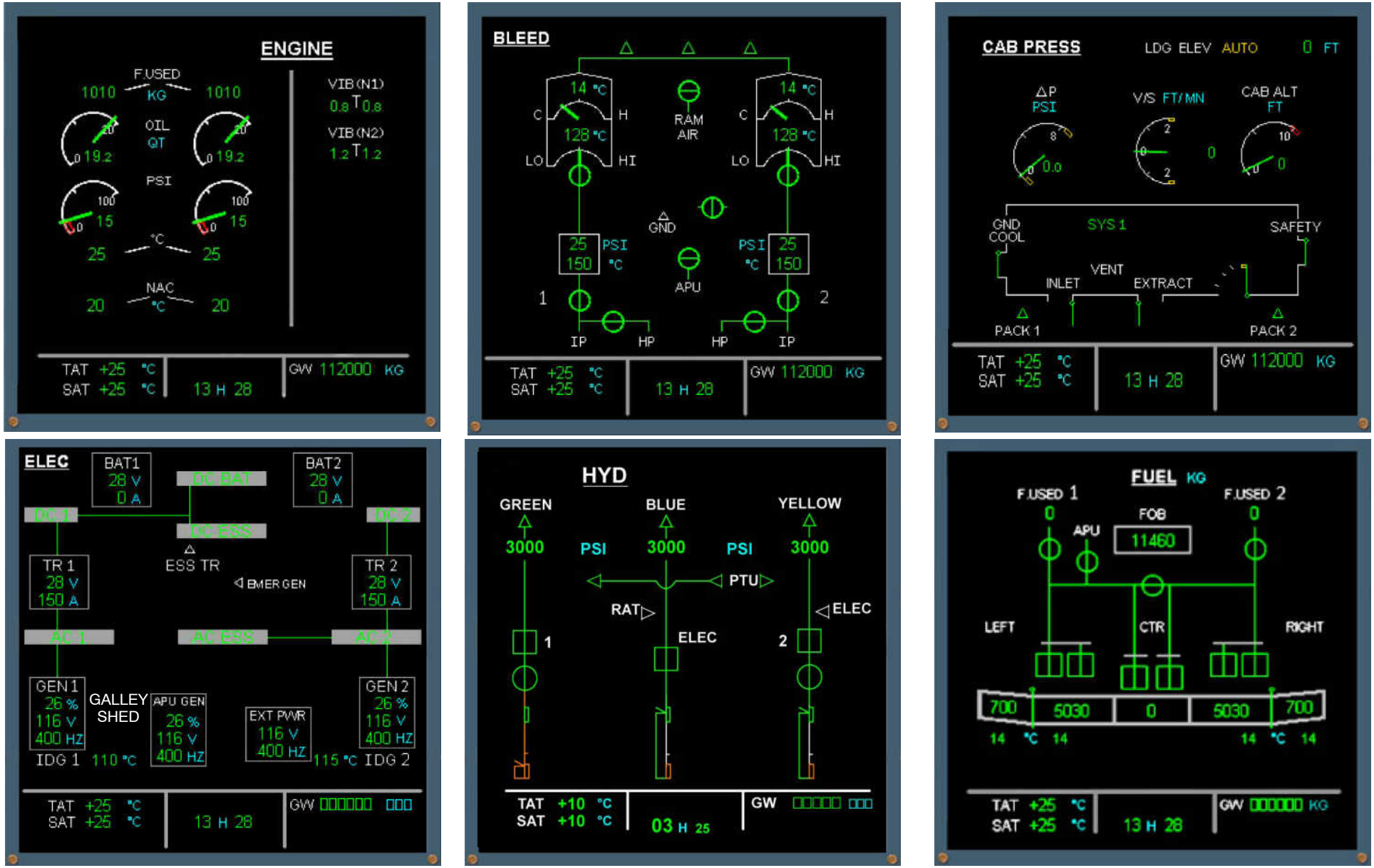


Figure 15 ECAM System Pages (1)

Figure 16 ECAM System Pages (2)

EIS GENERAL LAYOUT

Description

Three convertible DMCs are installed in the A 320. Each DMC is able to drive one PFD, one ND and either ECAM display unit.

In normal configuration, DMC 1 supplies captain's PFD and ND and the E/WD with data. DMC 2 supplies FO's PFD and ND and the SD.

DMC 3 is active but does not supply any DU (Hot Spare).

The DMC receive data, process them and send them to the connected DUs.

The 3 DMCs are identical. Each integrates the EFIS/ECAM functions, and is able to drive simultaneously one PFD, one ND, and either ECAM display unit.

The DMCs acquire and process all the signals received from various A/C sensors and computers, in order to generate proper codes of graphic instructions corresponding to the images to be displayed.

These codes are sent in digital form, using a very high speed (800 kbauds) RZ type transmission, through a twisted shielded pair of wires, called **dedicated serial data link (DSDL**).

The DMC comprises four parts:

- acquisition
- PFD channel
- ND channel
- ECAM channel.

The acquisition module enables the DMC to acquire all input signals such as

- discretes,
- ARINC 429,
- ARINC 453 for weather radar image and
- dedicated FWC link (RS–422).

The three channels enable the DMC to process simultaneously data for three different images: PFD, ND, and upper or lower ECAM Display Unit.

Inputs

The DMCs receive

- ARINC 429 from some systems for EFIS indication
- ARINC 429 for System Display–parameters
  (mainly via from the SDACs)
- ARINC 429 from the EFIS control panels
- ARINC 429 from the ECAM control panel (system synoptic selection)
- ARINC 453 for weather radar information
- RS 422 from the FWC message bus for messages to be displayed on the lower part of the EW/D and Status Messages for the Status Page
- A discrete from the ECAM control panel (ALL–pushbutton)
- A discrete from the annunciator lights switch
- Discretes for EIS switching.

Failures

If a DMC fails the DUs connected show a white stroke.

When DMC 3 fails in normal configuration the following message appears on the EW/D:

EIS DMC 3 Fault (in Amber)

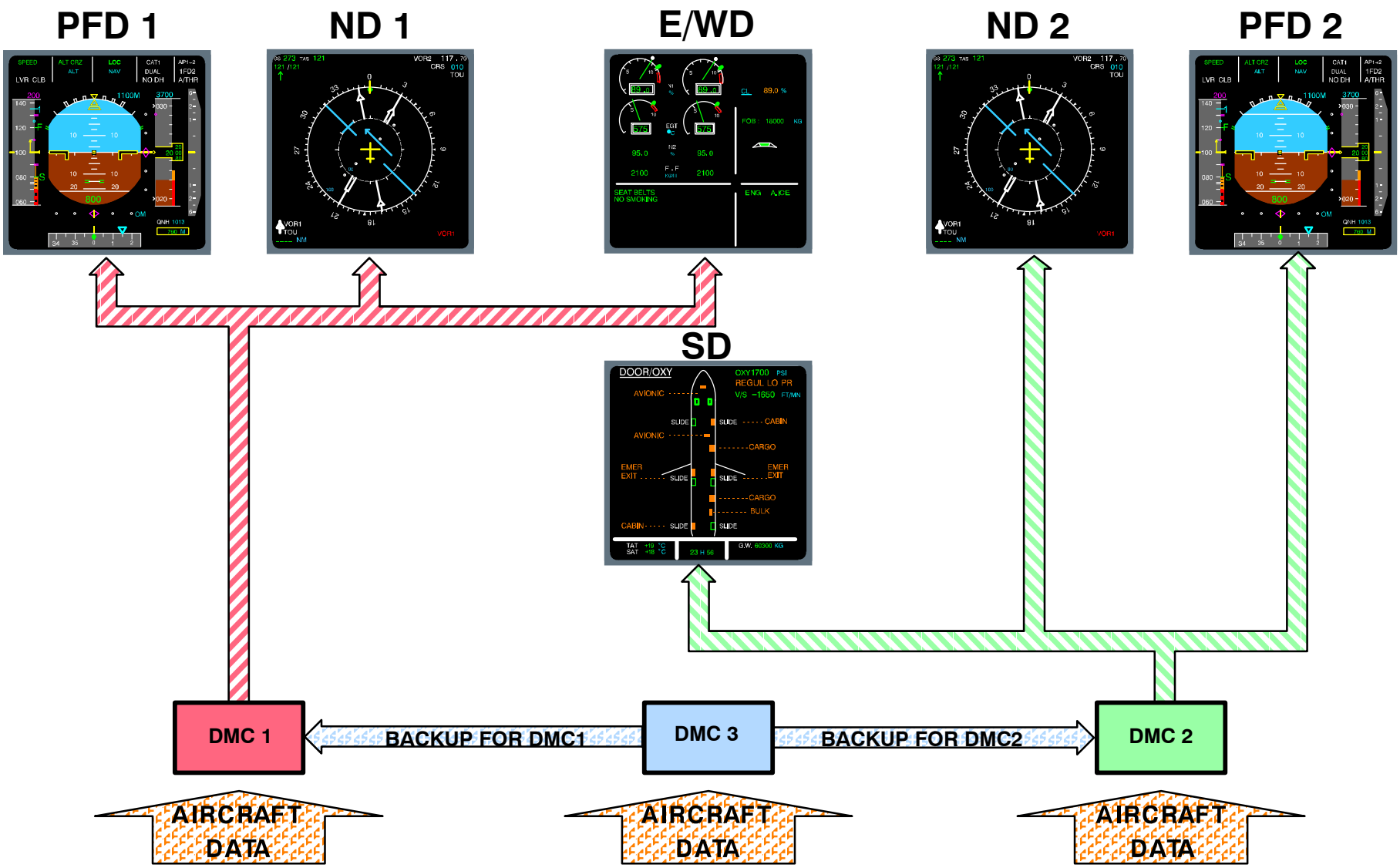


Figure 17 EIS General Layout

CATHODE RAY TUBE (CRT) DESCRIPTION

General

Six display units are installed. They normally present EFIS and ECAM information. **They are all interchangeable.**

The DUs receive all data from the DMCs. In turn the DUs send back to their driving DMC some feedback signals giving the DU status plus acknowledgement of data received from DMC.

Brightness Control

Light sensors are installed on the face of each DU in order to provide automatic adjustment of the display brightness with changing light conditions.

This automatic brightness adjustment is combined with the manual brightness control, which keeps always priority.

Overheat Protection

If cooling air is lost, the grey background areas disappear from the PFDs and the WX image from the NDs. If the DU internal temperature exceeds a given threshold, the DU is automatically cut off.

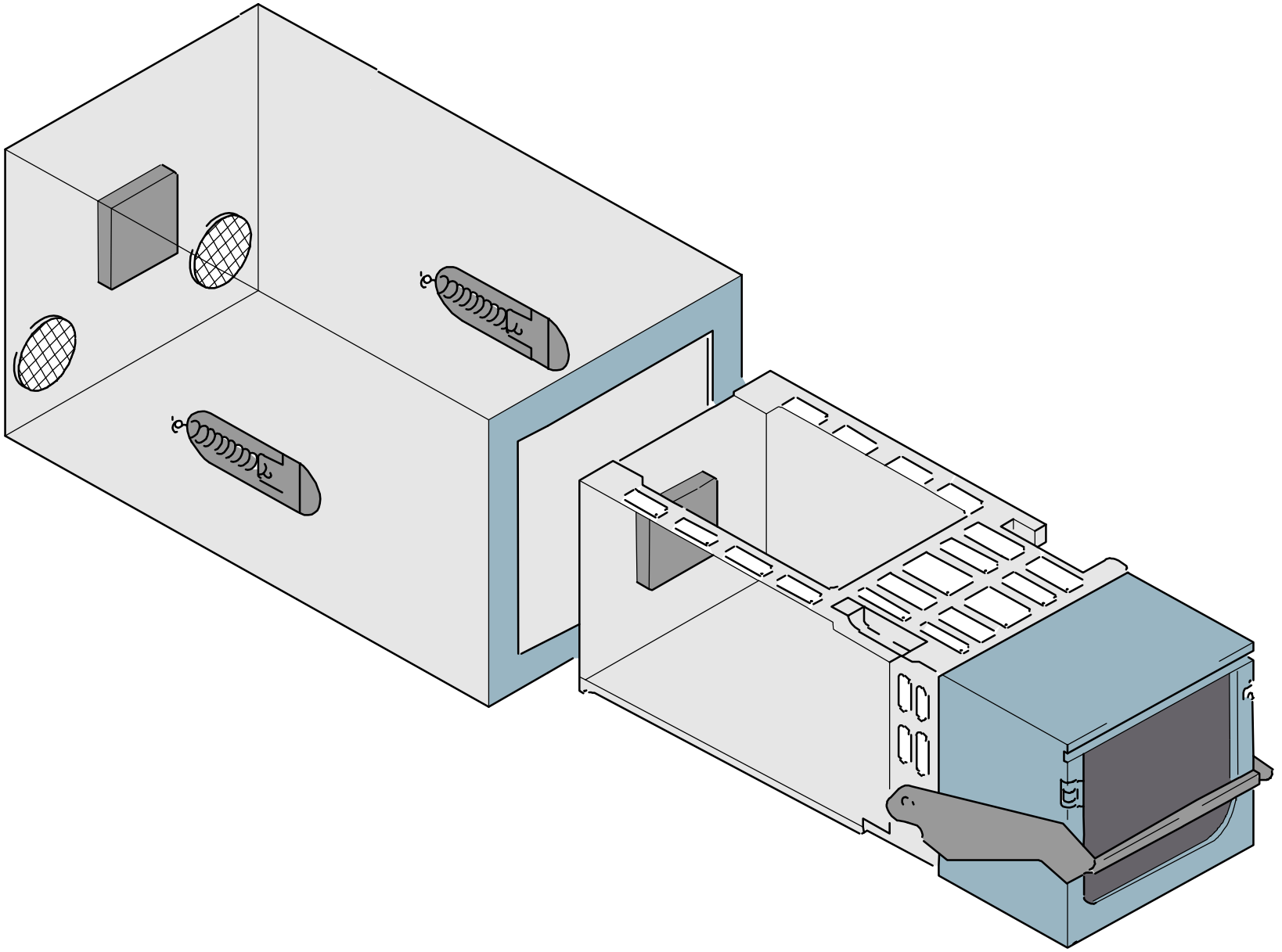


Figure 18 Cathode Ray Tube

CRT COMPONENT DESCRIPTION

Cathode Ray Tube

The cathode ray tube (CRT) consists of the following sub–assemblies:

- a high resolution color CRT (Shadow–mask type) with electrostatic focus and electromagnetic deflection,
- deflection yokes,
- magnetic shield.
- Very high voltage (VHV) power supply:

  It provides all the potentials necessary for the CRT (anode, focus and G2 electrodes).
- **One analog board; it includes:**
  - deflection amplifiers
  - convergence circuits
  - video amplifiers
  - brightness control
  - monitoring circuits
  - One symbol generator (SG) block
  - Interconnection board:

    It realizes the interconnection between the DU and the DMC and, inside the DU, between the SG board, the analog board and the power supply.
  - Low voltage (LV) power supply:

    The low voltage power supply is supplied with 115V – 400 Hz from the aircraft electrical power.

1 Cathode Ray Tube Assembly

The CRT assembly is located in the central part of the DU structure. The CRT is a Shadow–Mask color CRT potted with resin and surrounded by a metal shield. The CRT is equipped with flying leads ended by a connector, VHV lead and two photo–resistor cells.

2 Very High Voltage Power Supply

The VHV Power Supply is located on the lower part of the display unit.

It provides all the voltages required by the CRT such as for anode, focusing electrode, preacceleration anode.

It also includes the control input (VHV INH) and a test output. A defocusing circuit controls the focusing electrode. It is able to thicken the electron beam for the drawing of colored areas.

3 Analog Board

The Analog Board consists of the main following functions:

- cathode amplifiers and gamma correction,
- brightness control,
- G1 control (grid inhibition),
- deflection and convergence amplifiers and corrections,
- monitoring, protection and orbiting circuits.

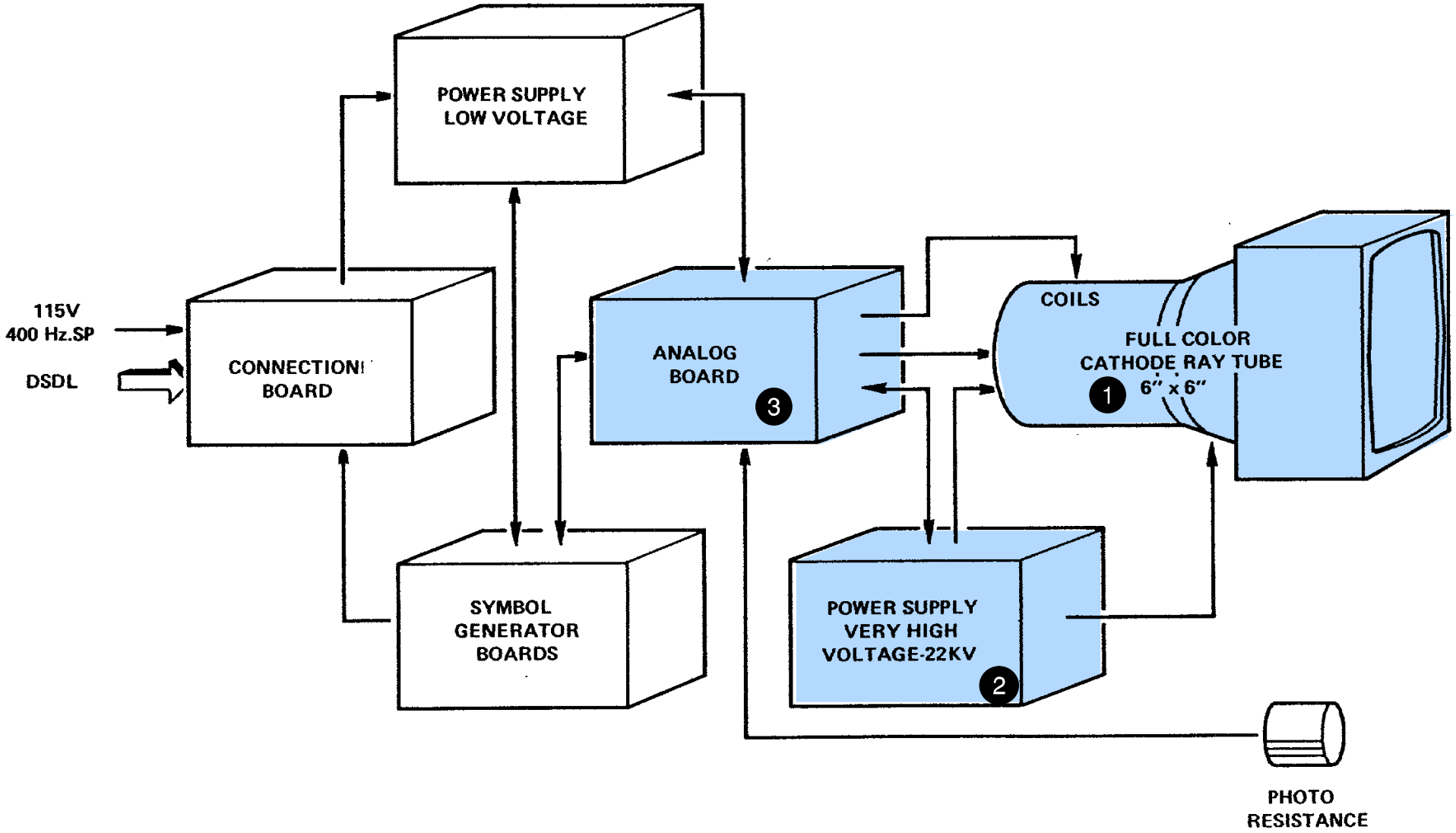


Figure 19 CRT Components (1)

4 Symbol Generator

The Symbol Generator is designed around 3 VLSI circuits. Seven other LSI circuits have been specially designed to allow the implementation of the SG unit in the DU.

The main functions of the SG are the following:

- Drawing Program Control
- Drawing Execution
- Color, Blanking and Brightness Control
- Information exchange Control with the DMC.

Inputs/outputs of the SG boards are the following:

- Inputs:
  - 3 color bits coming from the WXR board in the DMC, via three digital serial lines (8 Mbits/s per line)
  - 1 clock signal used to fetch the WXR color bits (8MHz).
- Outputs:
  - 2 analog outputs for the spot position (X and Y)
  - 3 analog outputs for RGB video.
- Inputs/outputs:
  - Dedicated serial link with the DMC (800 Kbit/s) : DSDL.

5 Interconnection Board

The interconnection board is located at the rear of the display unit and electrically interconnects the lateral boards by flexible circuit and connectors. The interconnection board includes the DU connector and several components, including lightning protection, line fuses, Normal/Alternate and DU ON/OFF relays.

NOTE: These relays are driven by discrete signals. The DU OFF discrete is generated by the brightness knob.

6 Low Voltage Power Supply

Low voltage power supply consists of two parts:

- the first one provides an intermediate pre–regulated 40 V voltage
- the second one provides, via two parallel transformers, all the necessary voltages to the different modules of the DU:
  - –6.3 V CRT
  - +25 V VHV
  - +5 V Symbol generator
  - –170 V
  - +100 V
  - +34 V
  - –34 V
  - +17 V
  - –17 V
  - +15 V
  - –15 V

This structure permits the use of small size transformers, the second part operating from a constant input voltage and thus minimizing the filtering components.

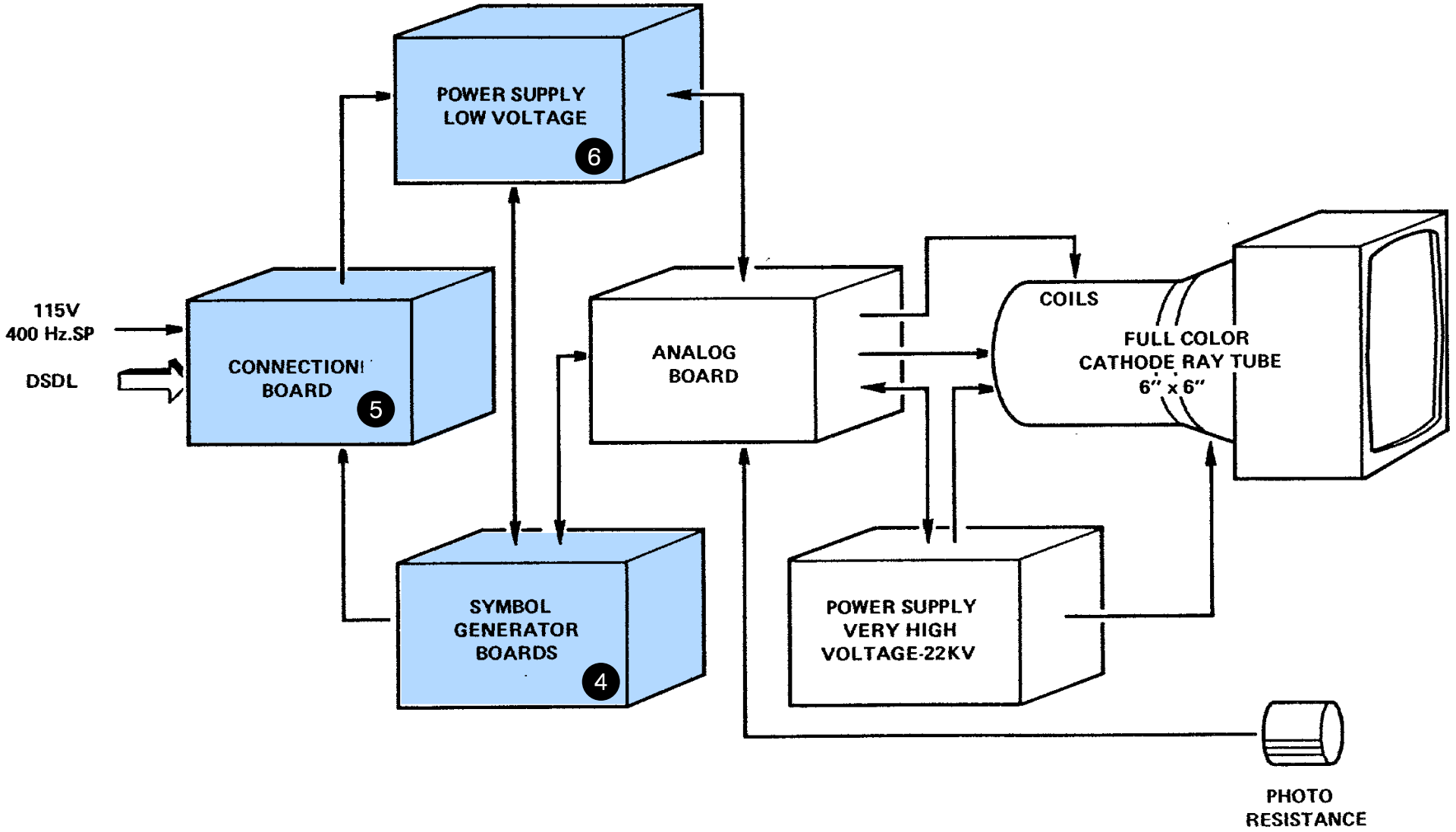


Figure 20 CRT Components (2)

DMC SYSTEM ARCHITECTURE

General

The display management computer (DMC) is a part of the EIS (Electronic Instrument System).

It receives data from different avionics systems in the aircraft, decodes it and processes it in such a way so that the connected full color display units (DUs) in the cockpit can use it in order to generate symbols and pictures on their CRT displays.

NOTE: The DMC can supply two EFIS and any but only one of the two ECAM display units simultaneously:.

Memory modules mounted in a dog–house on the face of the unit facilitate operational software changes in the unit.

The 3 DMCs are identical. Each integrates the EFIS/ECAM functions, and is able to drive simultaneously one PFD, one ND and either ECAM display unit.

The DMCs acquire and process all the signals received from various A/C sensors and computers, in order to generate proper codes of graphic instructions corresponding to the images to be displayed.

These codes are sent in digital form, using a very high speed (800 kbauds) RZ type transmission, through a twisted shielded pair of wires, called dedicated serial data link (DSDL).

Safety Aspects

Since some parameters displayed by the EIS are flight essential or flight critical, the DMC hardware and software are designed to cope with the specified safety requirements.

Considering this safety aspect, the three channels are independent and each of them takes the data needed for computation in dedicated memory area. These data are protected against inadvertent access from the other channels.

Architecture and software monitoring precautions are taken in order to cope with the classification of the software, particularly with respect to the processing of flight critical data.

For example a comparison is performed between pitch and roll data received and processed by the DMC on one hand, and the pitch and roll feedback signal received from the PFD and standing for the displayed pitch and roll information, on the other hand.

Moreover, the FWC performs an extra comparison between the pitch (and roll as well) information displayed on Captains PFD and the pitch (and roll) data delivered by the IRS2, and likewise between the First Officers PFD and IRS1 data.

Inside the DMC, the monitoring for the baro altitude and for the engine primary parameters is similar. It also consists in comparing the displayed information and the input parameters.

Inside the FWC, the comparison for the heading indications will be performed between the heading parameters used for display on side 1 and side 2.

For more Information refer to ATA 31–50 CWS.

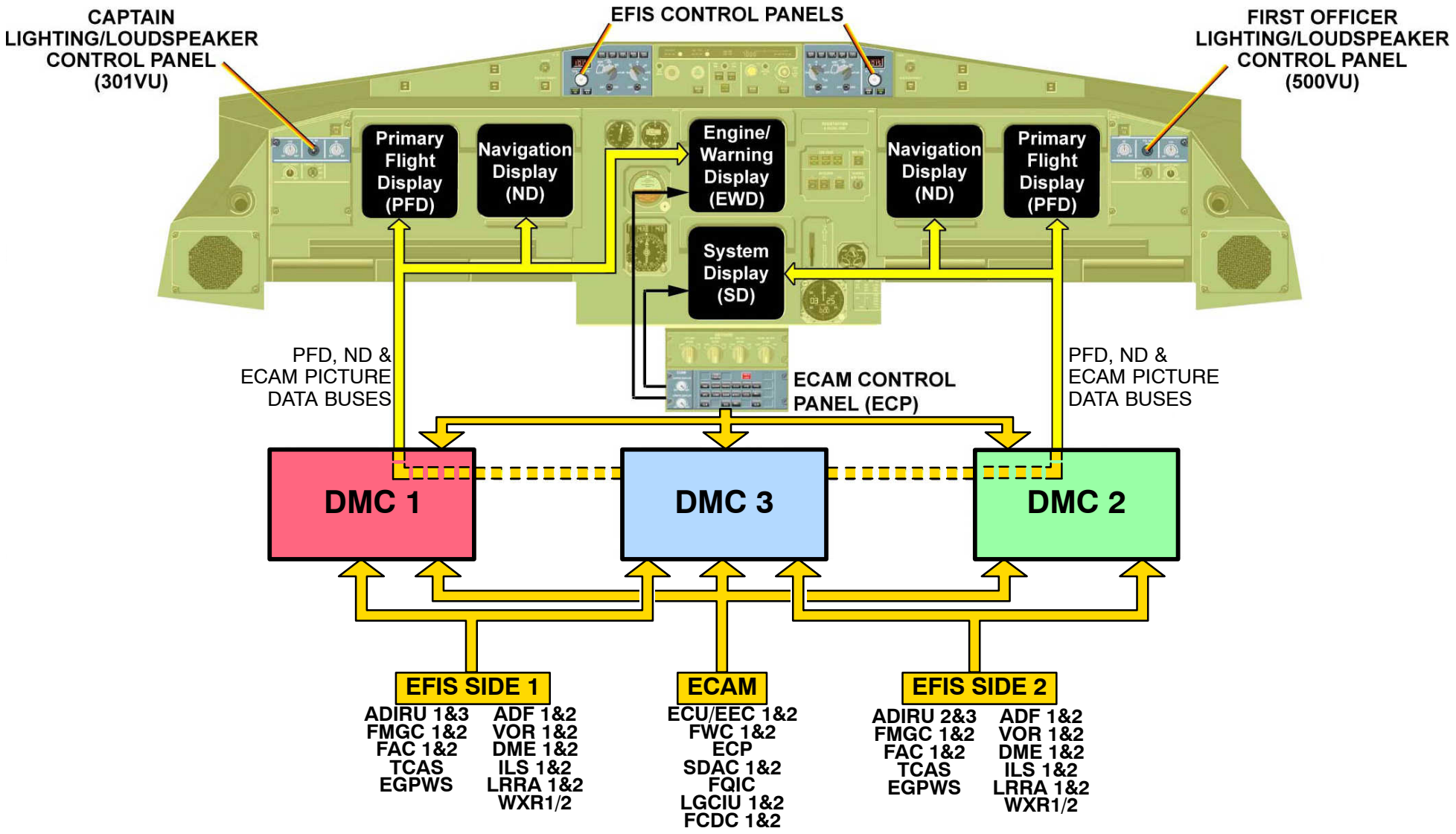


Figure 21 DMC System Architecture

DMC COMPONENT DESCRIPTION

The DMC is contained in a 6 MCU main housing, which can hold nine slide–in type electronic boards (seven used, two spares), a slide–in type power supply module and a dog–house mounted on its face.

The seven slide–in type electronic boards are as follows:

- DPU 1 (PFD) board,
- DPU 2 (ND) board,
- DPU 3 (ECAM) board,
- I/O interface 1 board,
- I/O interface 2 board,
- I/O interface 3 board and a
- W/R board.

Power Supply Module

The power supply module is a self–contained slide–in type module and holds three boards:

- Regulator/generator board,
- Controller/monitor board and a
- Filter board.

Memory Modules and Printed Circuit Boards

The dog–house, mounted on the front side of the main housing, holds three memory modules such as one for PFD, one for ND and the third one for ECAM.

Each module is placed in such a manner inside the dog–house so that it is mounted on top of the corresponding DPU board. The module consists of a separate housing containing a PCB (printed circuit board), can be individually removed from the dog–house by means of two clips. The housing has an identification a name plate and a PCB which holds the memory units.

The additional boards – protection boards 1 and 2 – are mounted on the mother board inside the DMC.

The mother board provides inter–connections between the various boards, the power supply module and the ARINC 600 connector. The ARINC 600 connector is mounted on the rear side of the main housing of the unit.

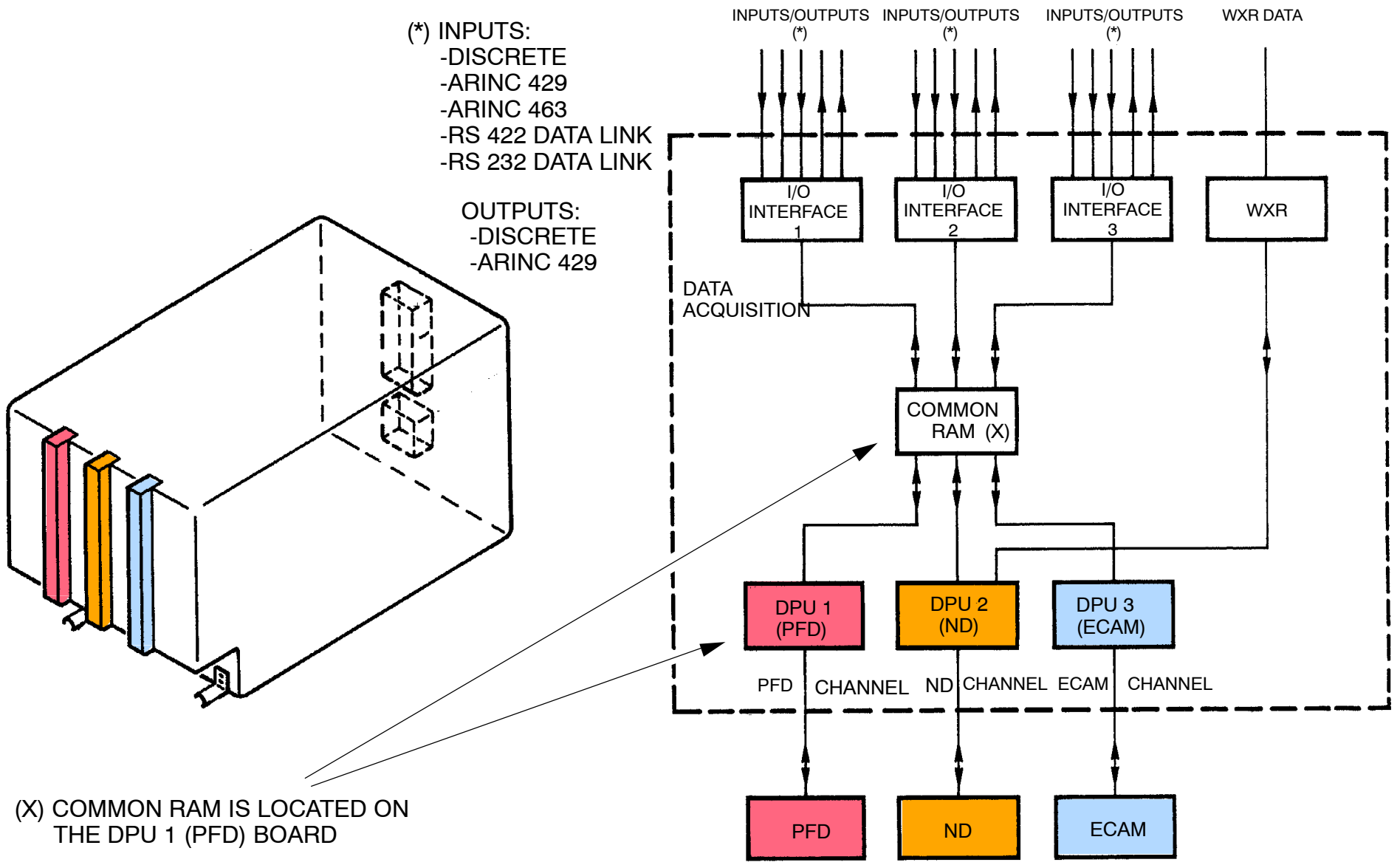


Figure 22 DMC Components

DMC/DU INTERFACE

DMC 1 and DMC 2 send data to be displayed to the connected DUs via a **Dedicated Serial Data Link** (DSDL). The pictures are generated in the DUs.

The weather radar information is sent to the EFIS DUs via 4 extra buses, 3 for color and one for synchronization.

DMC 1 sends PFD data to PFD 1. Additionally, the same bus is connected to ND 1 for transfer purposes. ND data are sent to ND 1 and PFD 1. ECAM data are sent to the EW/D.

After an EIS transfer, DMC 3 sends data through DMC 1 or DMC 2.

Feedback

Each DU uses a return DSDL to send the data received from the DMC back to the DMC together with status and BITE information. The DMC compares this feedback with its own data input.

Schematic

In the Schematic, the normal signal flow of DMC 1 is shown:

- Captain's PFD uses the PFD Master DSDL and sends a PFD feedback.
- Captain's ND uses the ND Master DSDL and the four weather radar Buses and sends a ND feedback.
- The Upper ECAM Display Unit uses ECAM Master DSDL (with Engine/Warning Display information) and sends an ECAM feedback.

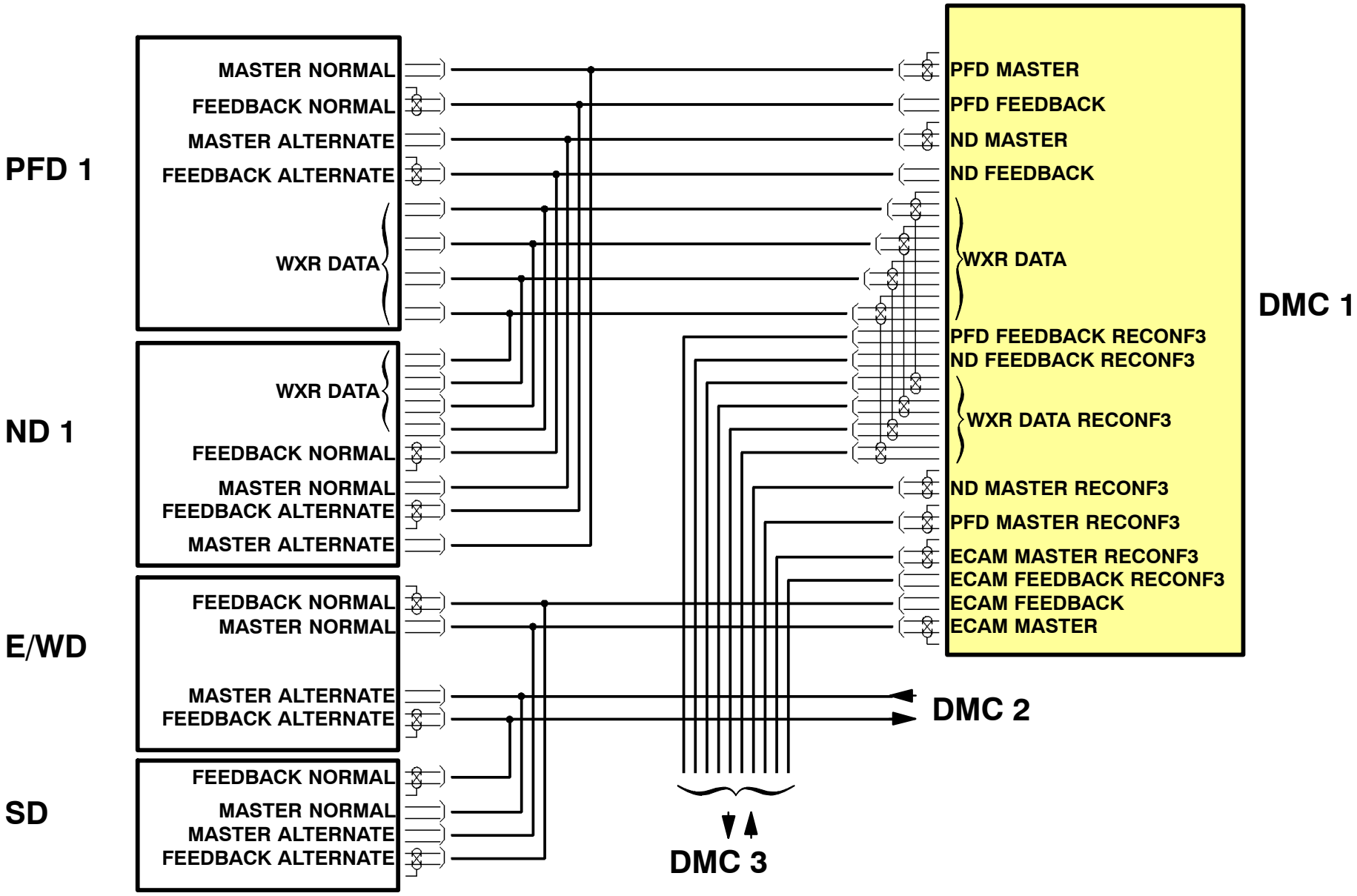


Figure 23 DMC/DU Interconnection

DMC INTERFACE (OUTPUTS)

DMC Output Buses

Each DMC sends maintenance data to the CFDIU via an ARINC 429 low speed bus.

These buses are accessible through test plugs in the avionic compartment for direct bus signal decoding by means of an appropriate portable bus reader, should the CFDIU be unserviceable.

On a different bus (ARINC 429 high speed), DMC 1 and DMC 2 send digital data to the items listed below:

- FWCs

  The Flight Warning Computers receive data for comparison function.
- ECAM CP

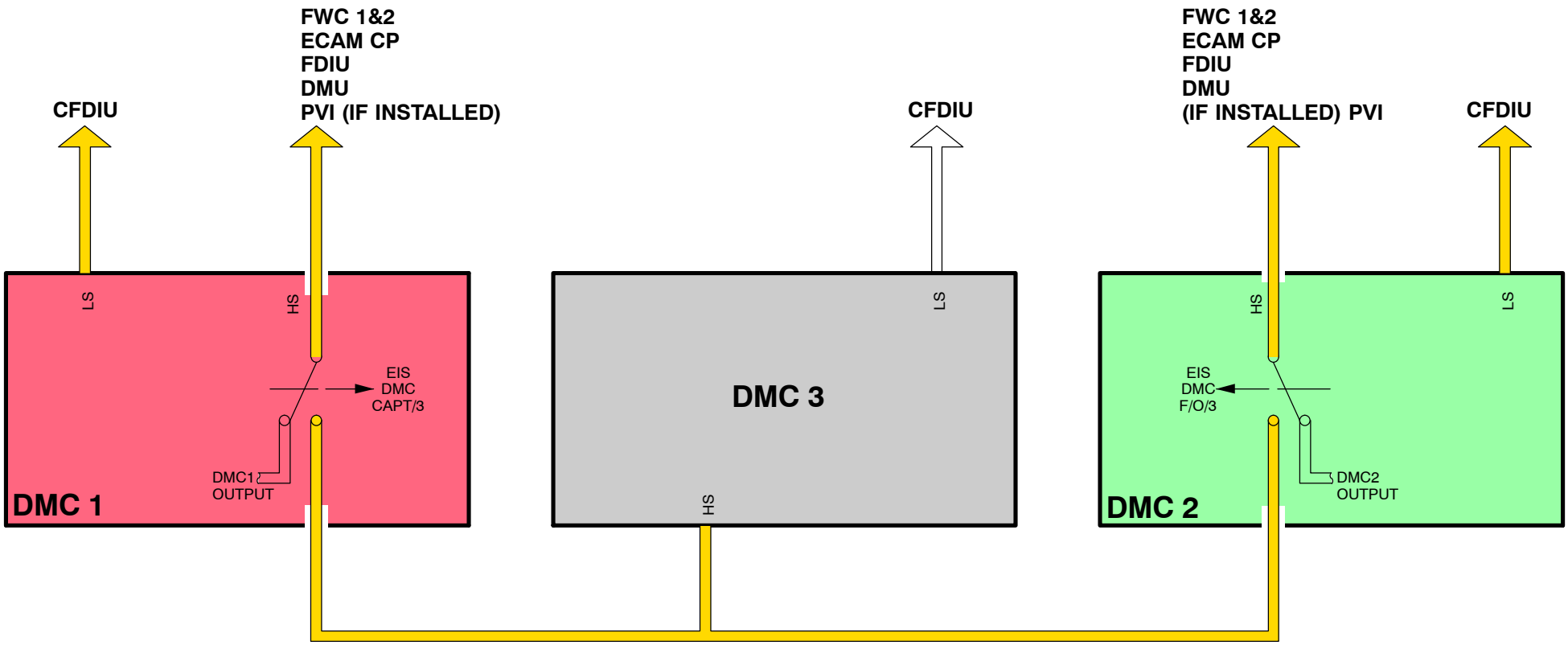
  The ECAM Control Panel receives data for pushbutton illumination.
- PVI

  The Paravisual Indicator receives data for indication.

  (Runway Heading)
- FDIU

  The Flight Data Interface Unit receives data to be recorded in the Digital Flight Data Recorder.
- DMU

  The Data Management Unit receives data to be used in the AIDS.



LS = ARINC 429 LOW SPEED BUS
HS = ARINC 429 HIGH SPEED BUS

Figure 24 DMC Outputs

DMC DISCRETE OUTPUTS

Some computers receive discrete signals from the DMCs.

AMU

The AMU receives a signal from the EFIS Control Panels and the DMCs if the ILS pushbutton switch is pressed or if the Mode Selector Switch is in ILS position. This is for switching the DME audio signal from the VOR system to ILS.

Captains discrete is from DMC 1.

F/O's discrete is from DMC 2.

After an EIS DMC transfer the DMC 3 takes over from DMC 1 or DMC 2.

NOTE: This discrete informs the AMU not to activate the "on voice" filter with the DME signal during an ILS approach. Refer to ATA 23–51.

FWC

The FWCs receive a valid discrete from each DMC.

FMGC

The FMGCs receive validity information from the PFDs. The FMGCs need this information to determine the landing category.

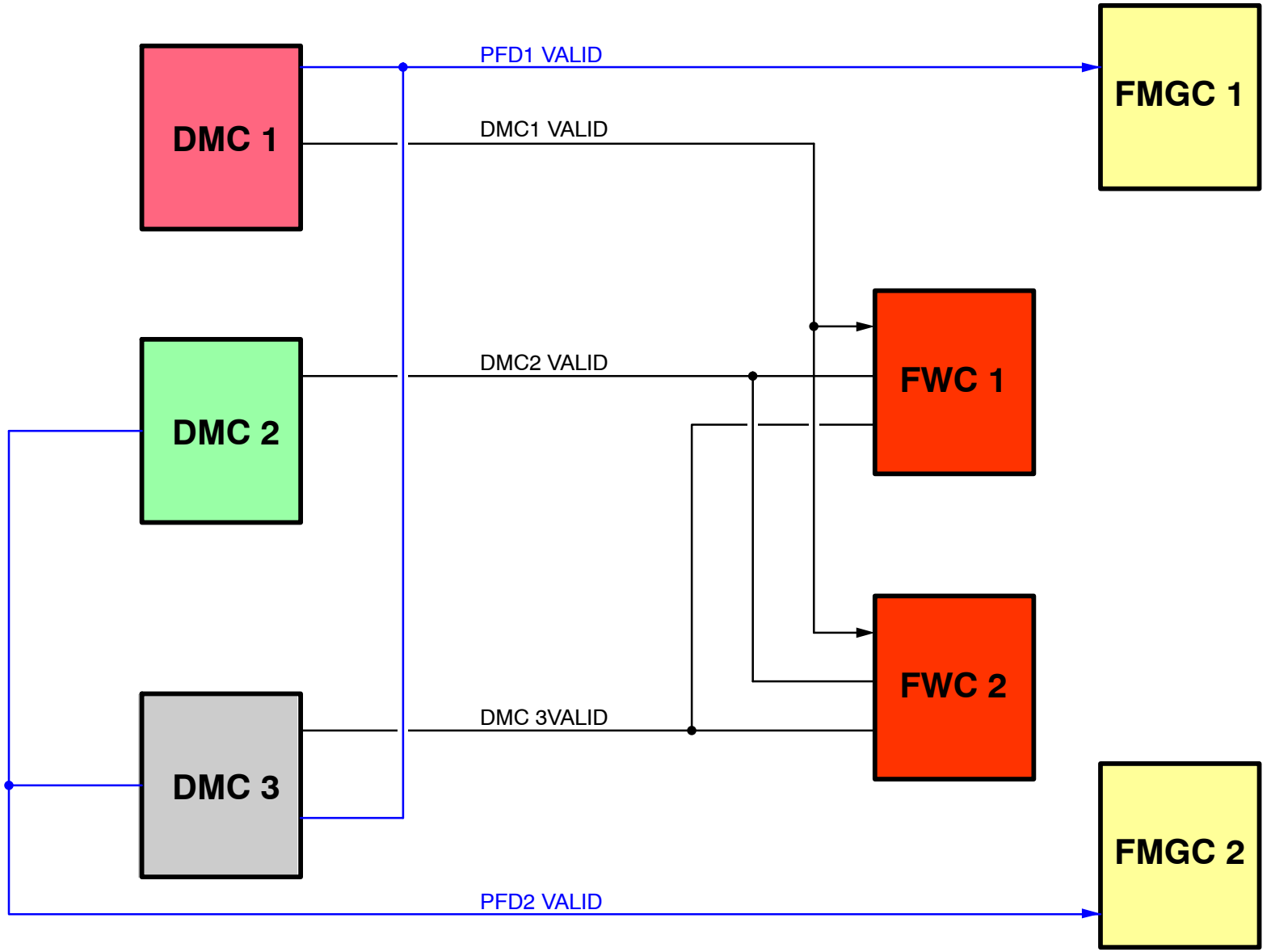


Figure 25 DMC/FWC Discrete Interface

EFIS CHRONO INDICATION OPERATION

General

On the Navigation Display a chronometer indication is available in digital form (green digits on a grey background shaded area).

This chrono gives the minutes and the seconds from 0 to 59mn 59s, then the hours and minutes up to 99h 59mn.

The chrono operation is controlled by means of the CHRONO pushbutton switch (beside the EFIS control section):

- 1st action: the display appears and the chrono starts counting on the P/B,
- 2nd action: the chrono stops counting but indication remains displayed,
- 3rd action: the display disappears and the chrono is reset.

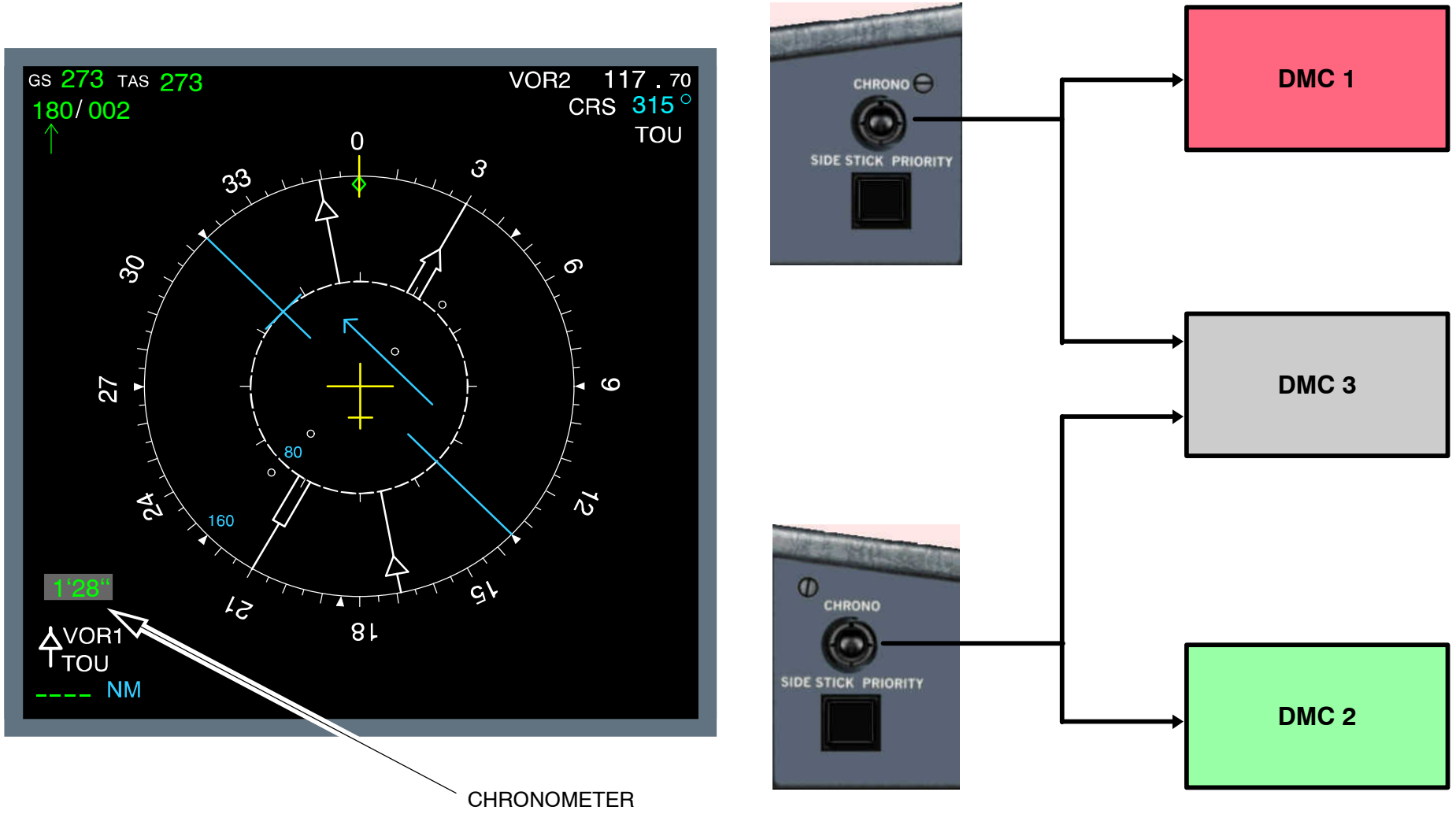


Figure 26 EFIS Chrono Function

ANNUNCIATOR LIGHT TEST SYSTEM FUNCTION

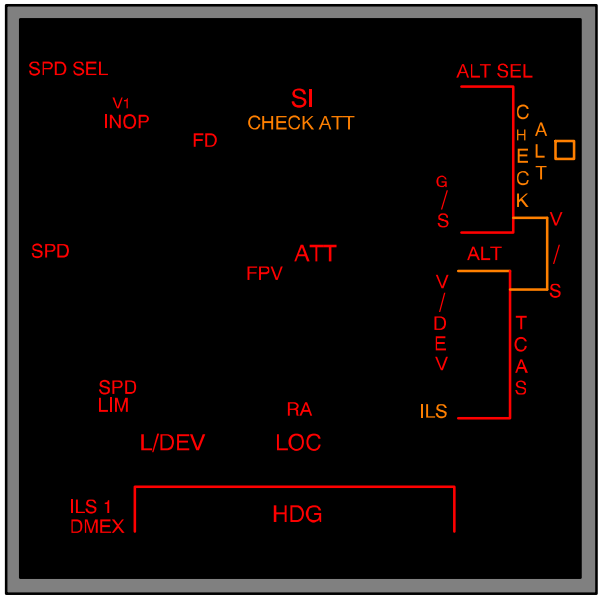
General

On the ground, when performing a cockpit light test (by means of the INT LT/ANN LT switch), all the DUs present fixed warning flag patterns, showing flags and annunciators at their proper location.

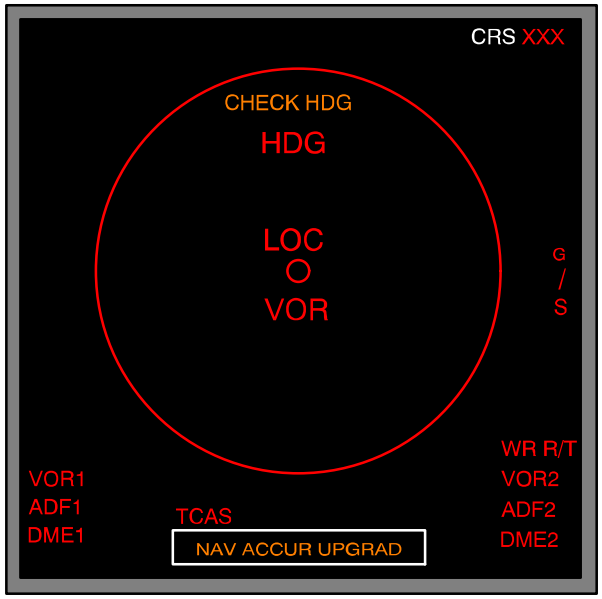
NOTE: For the EIS this mode is inhibited in flight.

OVERHEAD PANEL

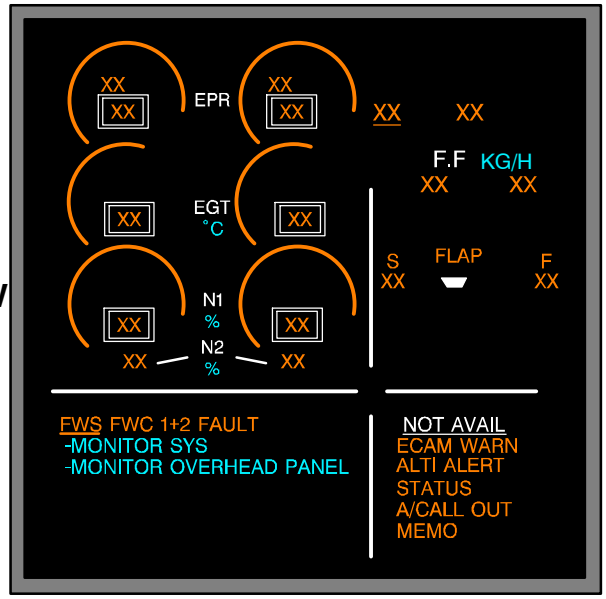
Figure 27 ANN LT Switch Location



PFD 1

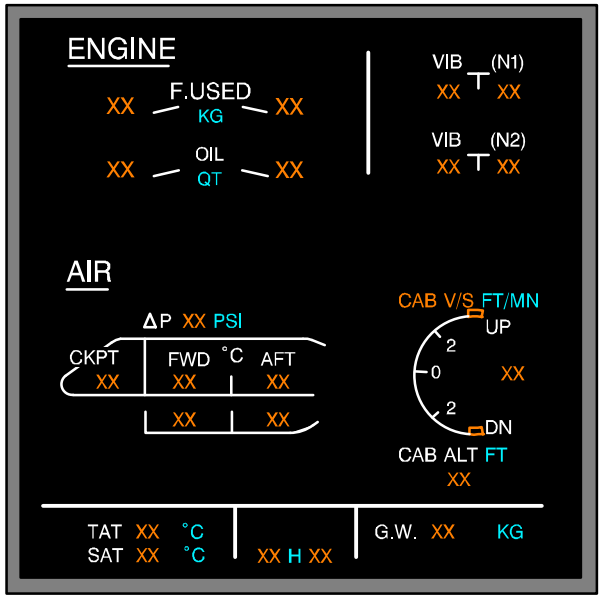


ND 1



SIMILAR INDICATIONS ON PFD 2 AND ND 2

OVERHEAD PANEL



NOTE: THE TESTSCREENS ARE INHIBITED IN FLIGHT
AND ARE NOT AVAILABLE ON THE ENHANCED EIS 2.

Figure 28 DU Indication during Light Test (IAE Engine)

DMC DISCRETE INPUT INTERFACE

DMC Light Test Discrete Input

The test is activated by the DMCs on reception of a ground discrete signal.

The display test is not available in flight.

ATTENTION: The Display Test is not available for the enhanced EIS 2 system.

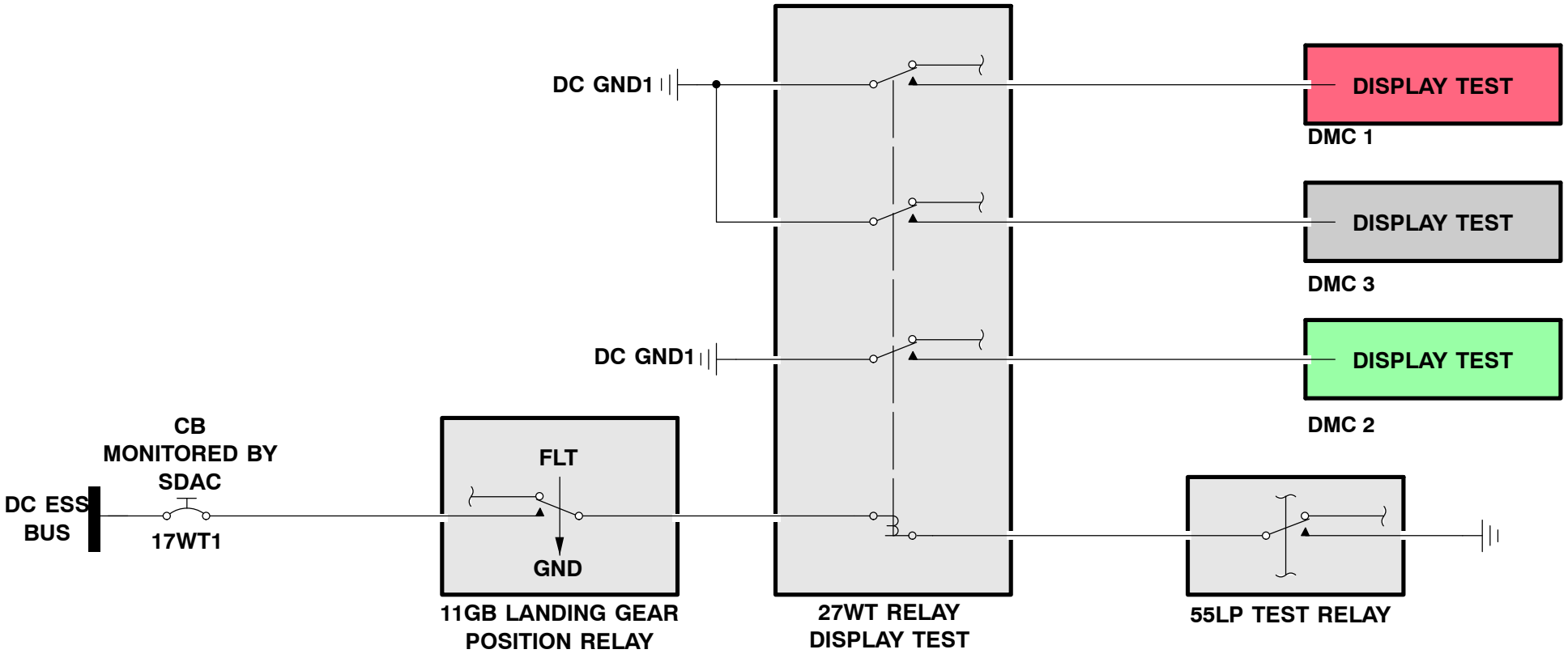


Figure 29 Light Test Discrete Schematic

31–68 EIS SWITCHING

EIS SWITCHING SYSTEM FUNCTION

Presentation

Various reconfiguration possibilities are provided in the Electronic Instrument System (EIS) in order to cope with the operational requirements below in case of failure of a Display Management Computer (DMC), a Display Unit (DU) or a Control Panel (EFIS control section of the Flight Control Unit (FCU) or ECAM Control Panel) :

- DMC transfer
  EIS DMC 1/3 or 2/3 (DMC 3 replacing DMC 1 or 2)
- PFD–ND transfer
- ECAM DU transfer
  Upper DU to lower DU
- ECAM–ND transfer:
  ECAM/CAPT ND or ECAM/F/0 ND.

Some of these transfers are performed automatically.

NOTE: There is no EFIS to ECAM transfer possible!

EFIS Switching

Each time the PFD/ND XFR pushbutton is pressed, the images displayed on the PFD and ND are interchanged. The image previously displayed on the PFD is displayed on the ND and vice versa.

The PFD potentiometer switches the PFD display unit on or off and controls the brightness in conjunction with the automatic brightness control system. In the off position, automatic and manual reconfigurations are possible.

The ND inner potentiometer switches the ND Display Unit on or off and enables general adjustment of the ND brightness.

The outer potentiometer only adjusts the brightness of the weather radar image.

NOTE: Each DMC can supply only ONE ECAM DU!

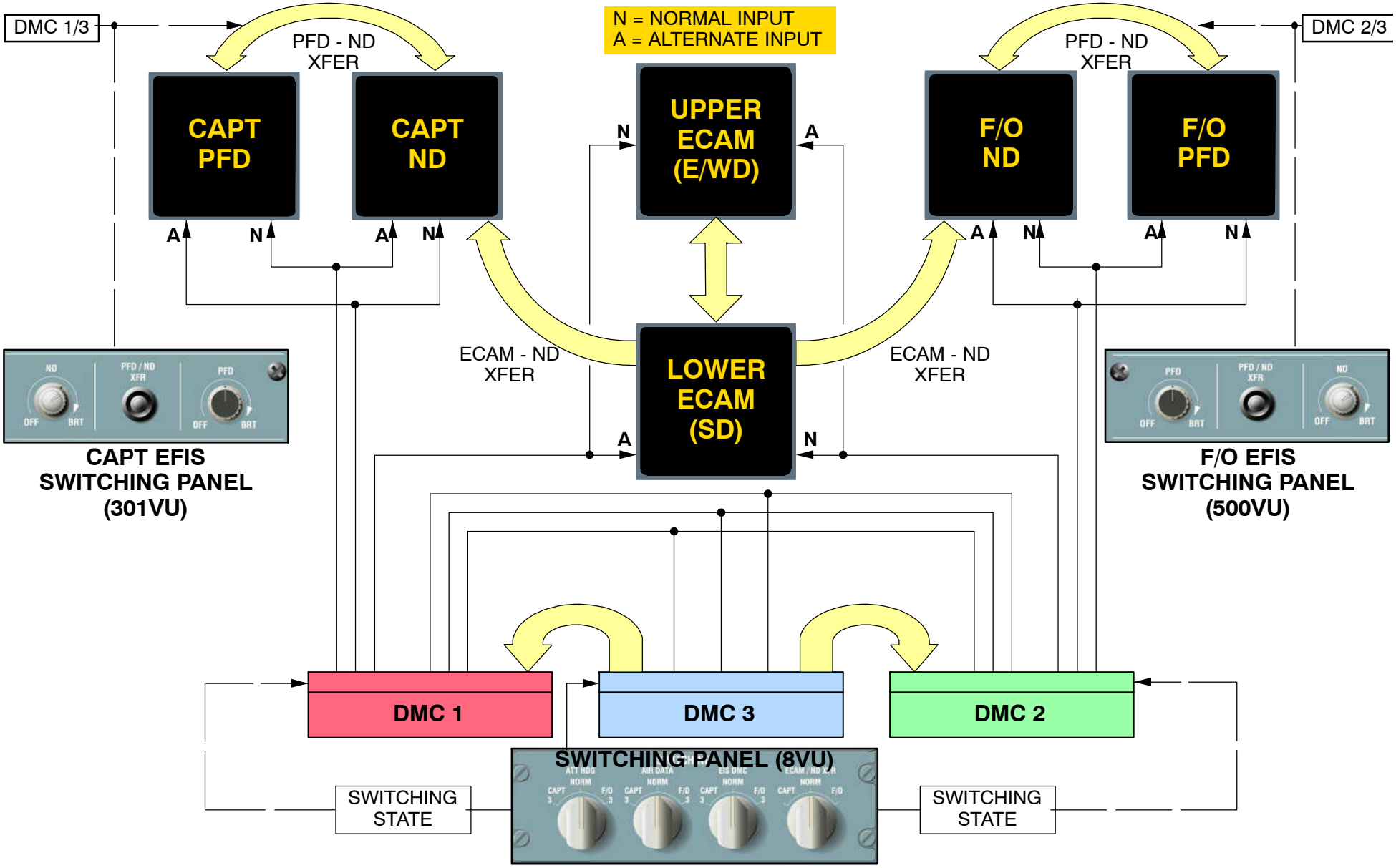


Figure 30 EIS/ECAM Reconfigurations

AUTOMATIC SWITCHING

EFIS

In case of an EFIS DU failure the ND image is lost on the corresponding pilots instrument panel. However it is possible to get the ND image back by means of the PFD/ND XFR pushbutton switch.

ECAM

In case of an ECAM DU failure the SD image is lost.

It is possible to receive the SD image back temporarily instead of the E/W image when pressing and holding ECAM CP keys.

For long term reconfiguration it is possible to display the SD image permanently on either ND instead of the ND image by means of the ECAM/ND XFR switch.

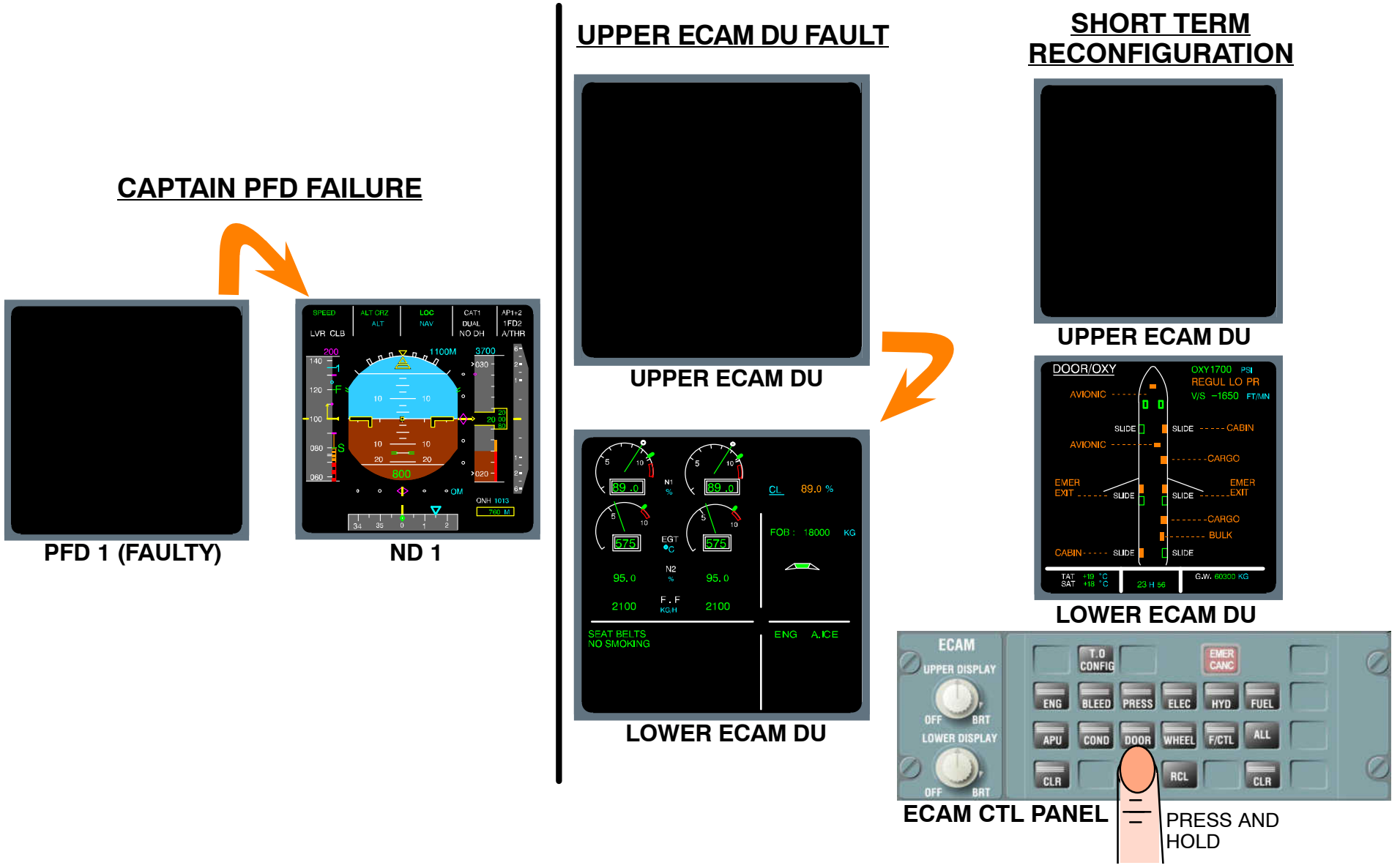


Figure 31 Automatic Switching Function

SWITCHING PANEL INTRODUCTION

ADIRS Source Switching

If a primary AIR DATA or ATTITUDE/HEADING source (side 1 or side 2) fails, the relevant flags come into view on the associated PFD and ND (Captain for side 1, First Officer for side 2).

In this case, the affected pilot can switch over to the ADIRU 3 source to recover the lost flight parameters, by setting the AIR DATA or the ATT HDG selector switch to CAPT ON 3 for side 1, or to F/O ON 3 for side 2.

These selector switches are located on the source switching panel which is aft of the ECAM control panel, on the center pedestal.

In case of complete failure of the ADIRU 1 (or 2), both selector switches (AIR DATA and ATT HDG) must be set to the switched position CAPT ON 3 (or F/O ON 3).

DMC Switching

This selector switch is used for EIS DMC switching. When rotated out of the vertical position, DMC 3 totally replaces DMC 1 or DMC 2.

ECAM/ND Transfer

This transfer facility enables the crew to display an ECAM image to either ND, in case of failure of ECAM DUs.
It is the long term reconfiguration in case of loss of one ECAM DU.

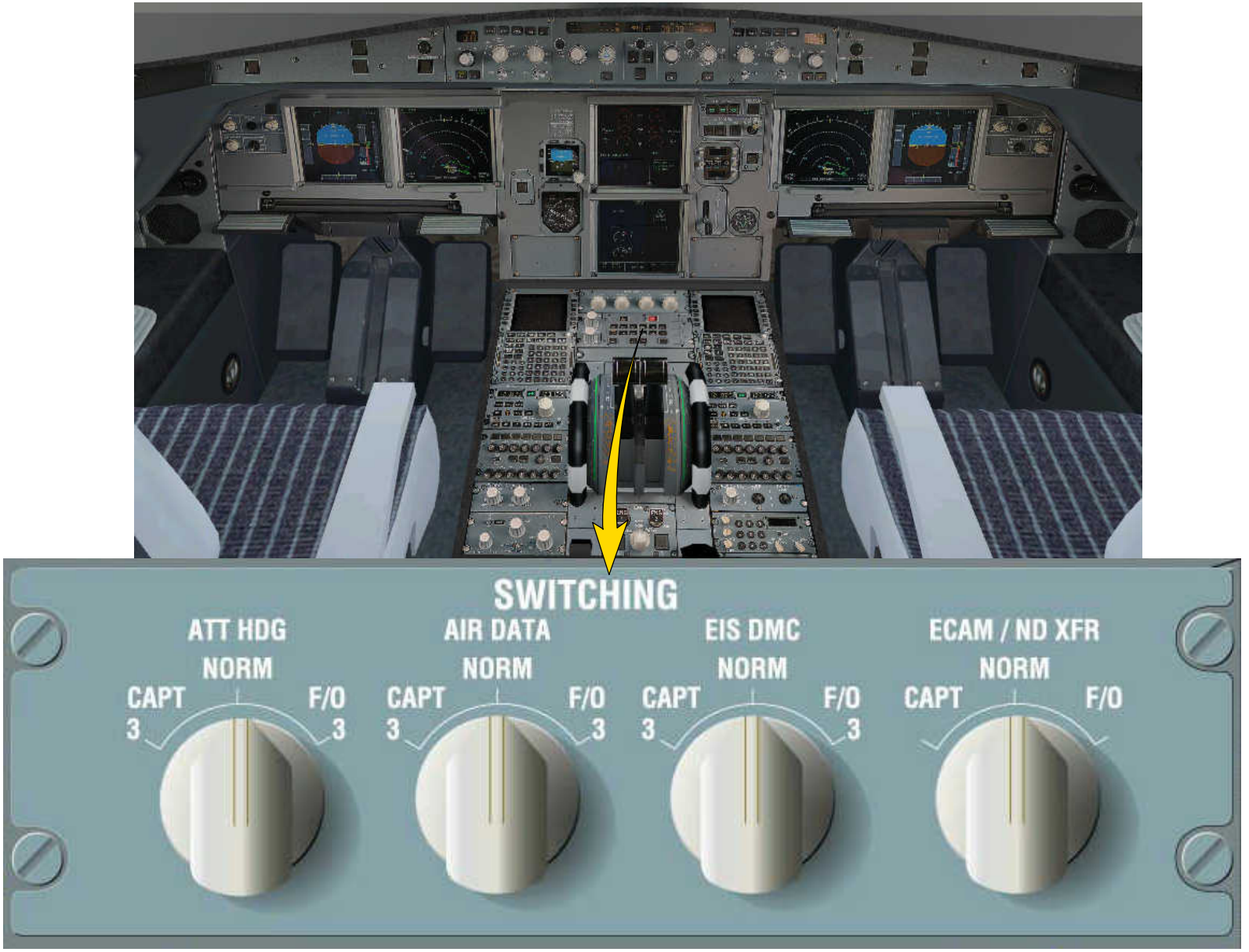
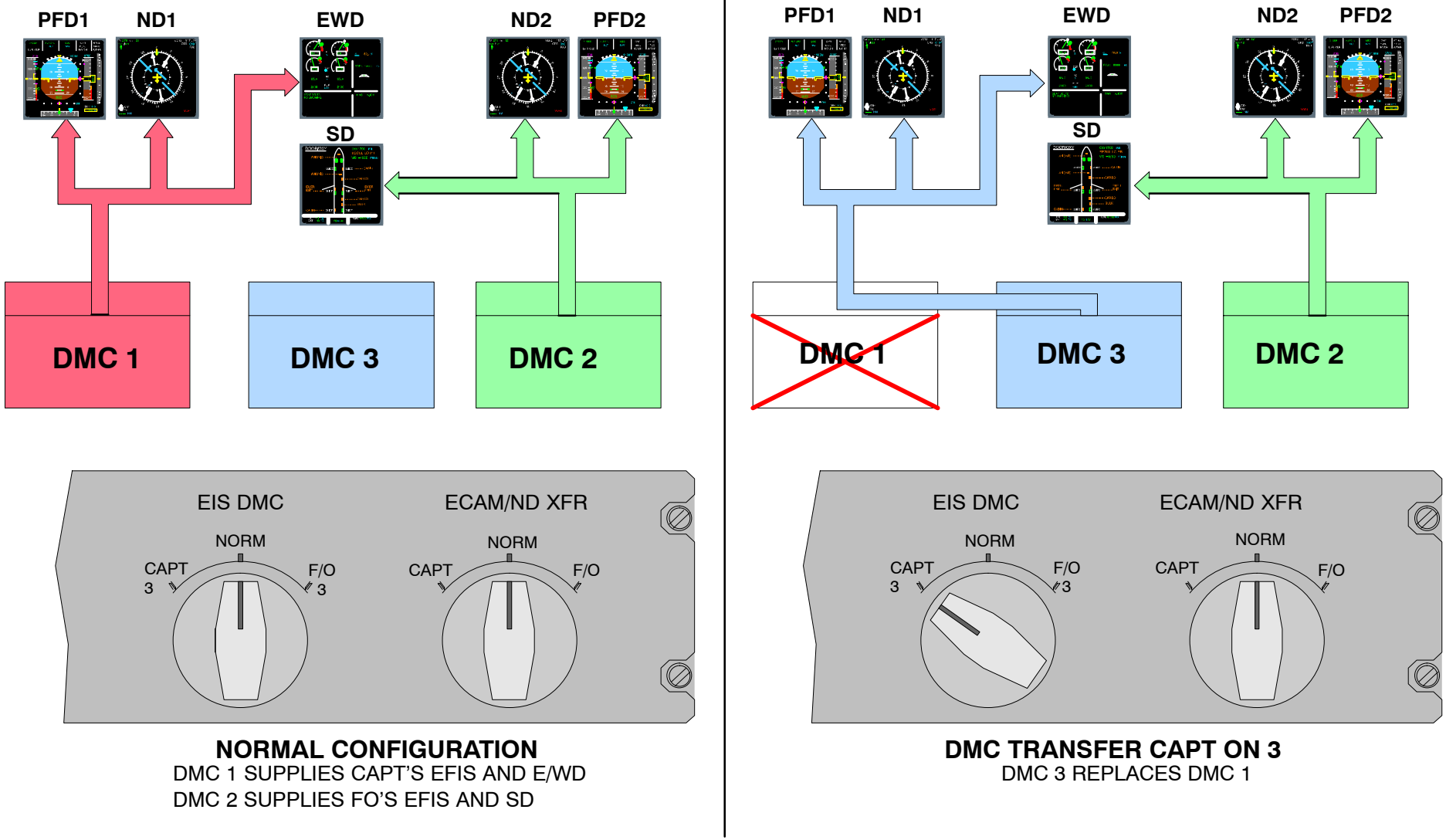


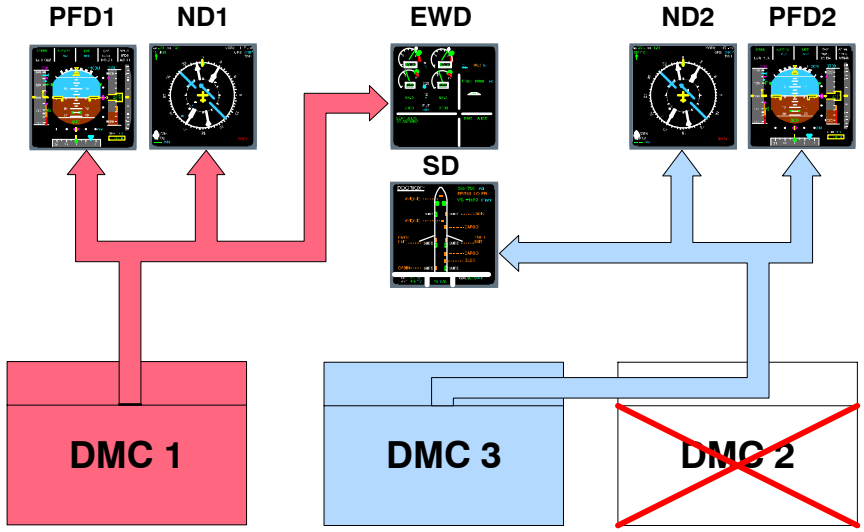
Figure 32 Switching Panel Introduction

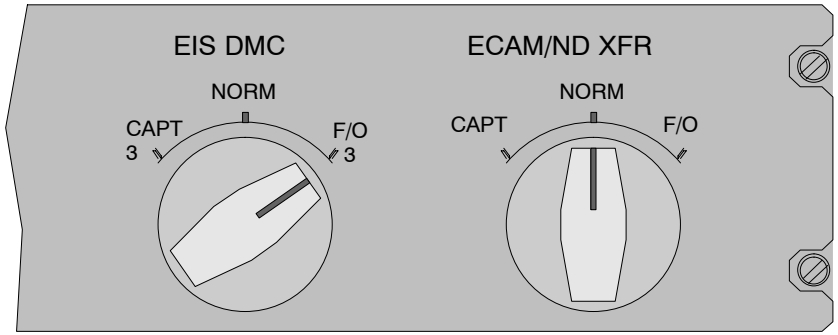


NORMAL CONFIGURATION
DMC 1 SUPPLIES CAPT'S EFIS AND E/WD
DMC 2 SUPPLIES FO'S EFIS AND SD

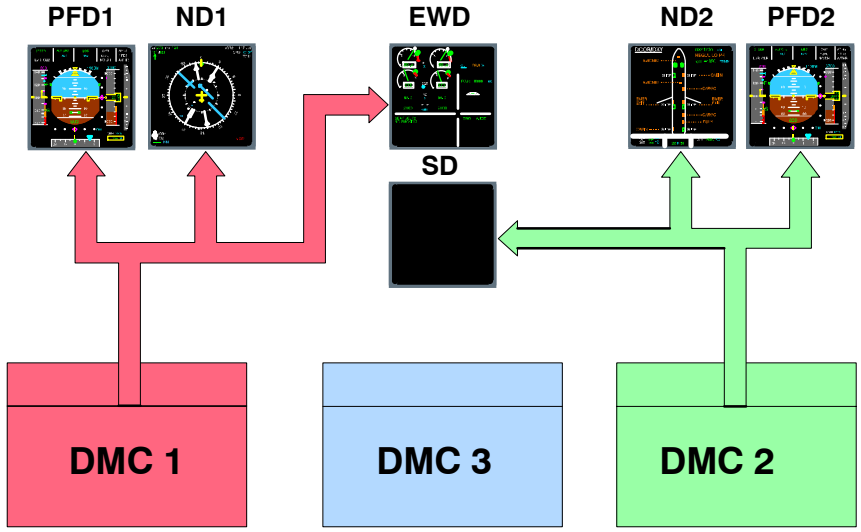
DMC TRANSFER CAPT ON 3
DMC 3 REPLACES DMC 1

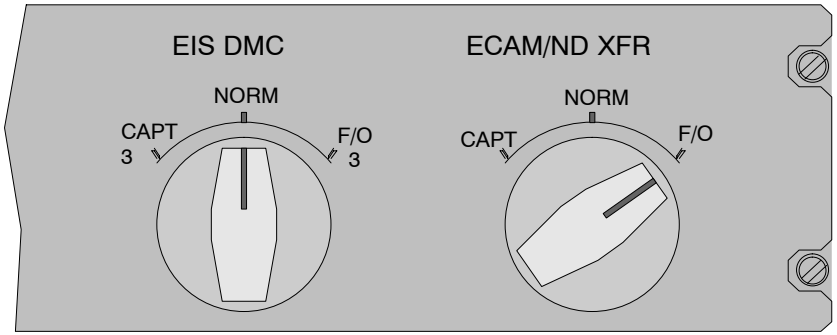
Figure 33 EIS Switching (1)





DMC TRANSFER F/O ON 3
DMC 3 REPLACES DMC 2





ECAM/ND TRANSFER F/O
SD ON F/O's ND
(LOWER ECAM DU FAILURE)

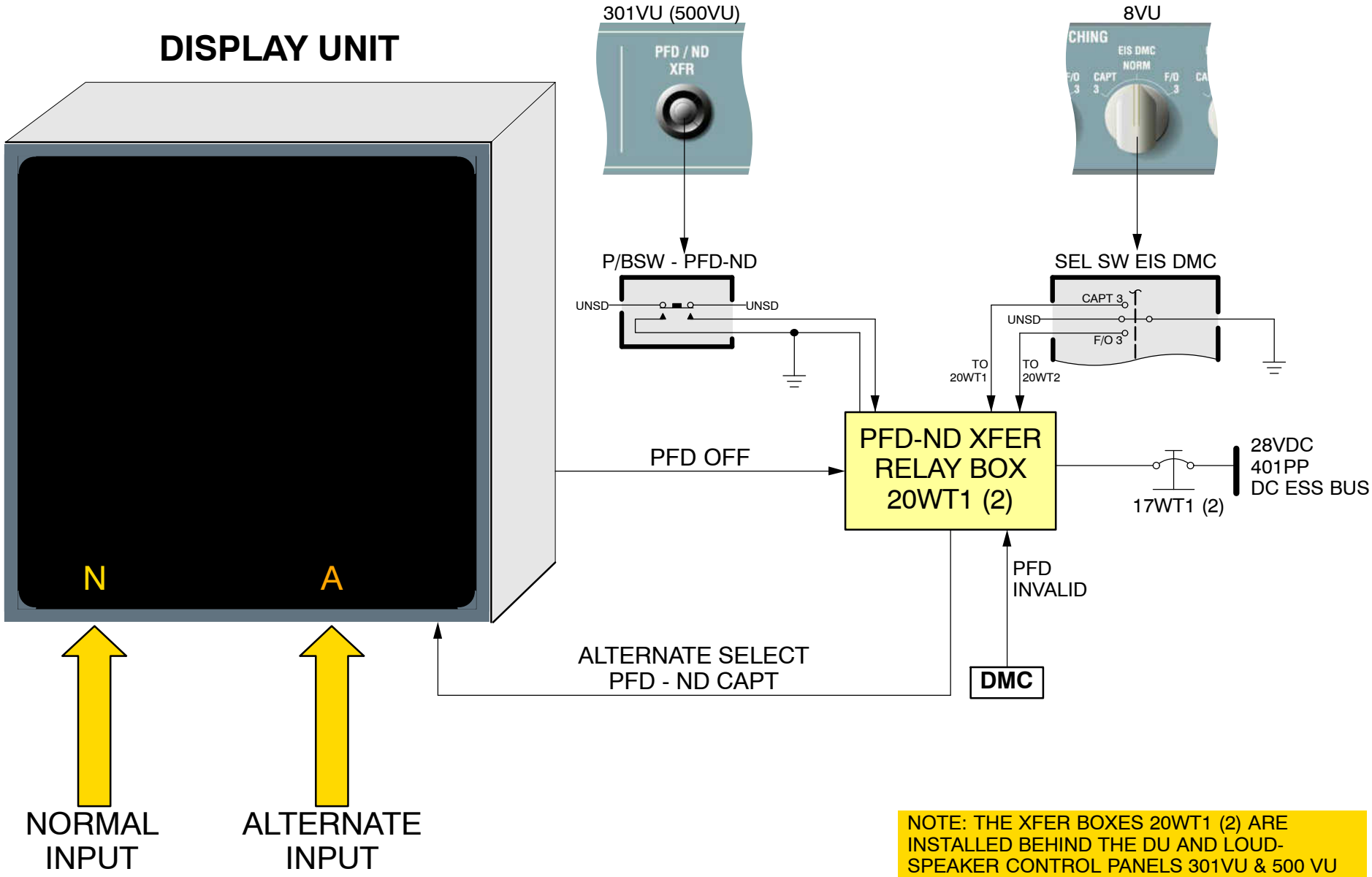
Figure 34 EIS Switching (2)

FUNCTIONAL OPERATION EIS SWITCHING

DU INPUTS SELECTION

Each display unit comprises one NORMAL and one ALTERNATE input which can be selected by a discrete signal.

NOTE: Normally, display units use the normal input. If the discrete signal (ground) is given to a display unit, it uses the alternate input signal.



NOTE: THE XFER BOXES 20WT1 (2) ARE INSTALLED BEHIND THE DU AND LOUD-SPEAKER CONTROL PANELS 301VU & 500 VU

Figure 35 DU Normal/Alternate Discrete

DU RECONFIGURATION

General

A PFD/ND transfer can be done manually or automatically. For a transfer, the DUs switch to the other input signal.

Manual PFD/ND Transfer

A manual PFD/ND transfer is done when the PFD/ND Transfer Pushbutton is pressed.

The transfer is performed by switching on the alternate input of the DUs through a relay box.

Two relay boxes are installed in the cockpit of the A319/A320/A321 behind the instrument panel. One relay box is for Captain's PFD and ND, one relay box is for F/O's PFD and ND.

The relay boxes are supplied with 28 V DC.

Automatic PFD/ND Transfer

In the case of detected failure of the DU normally displaying the PFD image, there is an automatic PFD/ND transfer. The PFD image is presented on the remaining EFIS DU.

This automatic transfer is controlled by the DMC via a discrete to the relay box.

If the PFD DU knob is turned to OFF, the relay box is activated and the PFD image is automatically displayed on the other DU.

(PFD priority over ND)

Automatic Transfer from Upper ECAM DU to Lower ECAM DU

In the event of upper ECAM DU failure, the Engine/Warning image is displayed on the lower ECAM DU instead of the system page or status page.

This switching is automatic thus on reception of the upper DU anomaly signal, through the feedback DSDL bus, the DMC 2 ECAM channel processor switches by software to an ECAM single display configuration which privileges the E/W processing.

The lower ECAM DU receives the E/W image from the DMC 2, still through its NORMAL input. The same applies when turning the UPPER DISPLAY potentiometer to OFF.

DMC TRANSFER

Each DMC comprises three channels.

Each channel is dedicated to either a PFD, a ND or an ECAM display.

Each DMC features switching capabilities for display transfer or DMC transfer.

The DMC transfer is performed by a switching inside each DMC. All the signals then come from DMC 3.

The discrete for DMC transfer is given from the EIS DMC Selector Switch. It also activates the relay box.

NOTE: The connections between the DMC 3 and the DUs are crosswired for the PFD and ND, in order to cope with a possible wire cut–off of the connection which delivers the PFD information.

In this case, when the DMC 3 supplies the PFD and the ND on one side, CAPT or F/O, the DMC 3 signals enter the PFD and the ND via their alternate inputs. The activation of the DU alternate inputs and the deactivation of the normal inputs is made by grounding a discrete input on the DU connector. This is achieved by an A/C circuitry which takes into account all the conditions leading to the change of inputs (normal or alternate).

ECAM/ND TRANSFER

The transfer between ECAM and ND is performed inside the DMCs.

Position CAPT

With the ECAM/ND transfer switch in this position, captain's ND operates like a lower ECAM DU.

DMC 1 can process only one ECAM picture, so the upper ECAM DU will receive no input and display a diagonal stroke.

The lower ECAM DU operates as a E/WD now. It still receives its data from DMC 2.

Position F/O

With the ECAM/ND transfer switch in this position, FO's ND operates like a lower ECAM DU.

DMC 2 can process only one ECAM picture, so the lower ECAM DU will receive no input and display a diagonal stroke.

The upper ECAM DU still operates as E/WD and it still receives data from DMC 1.

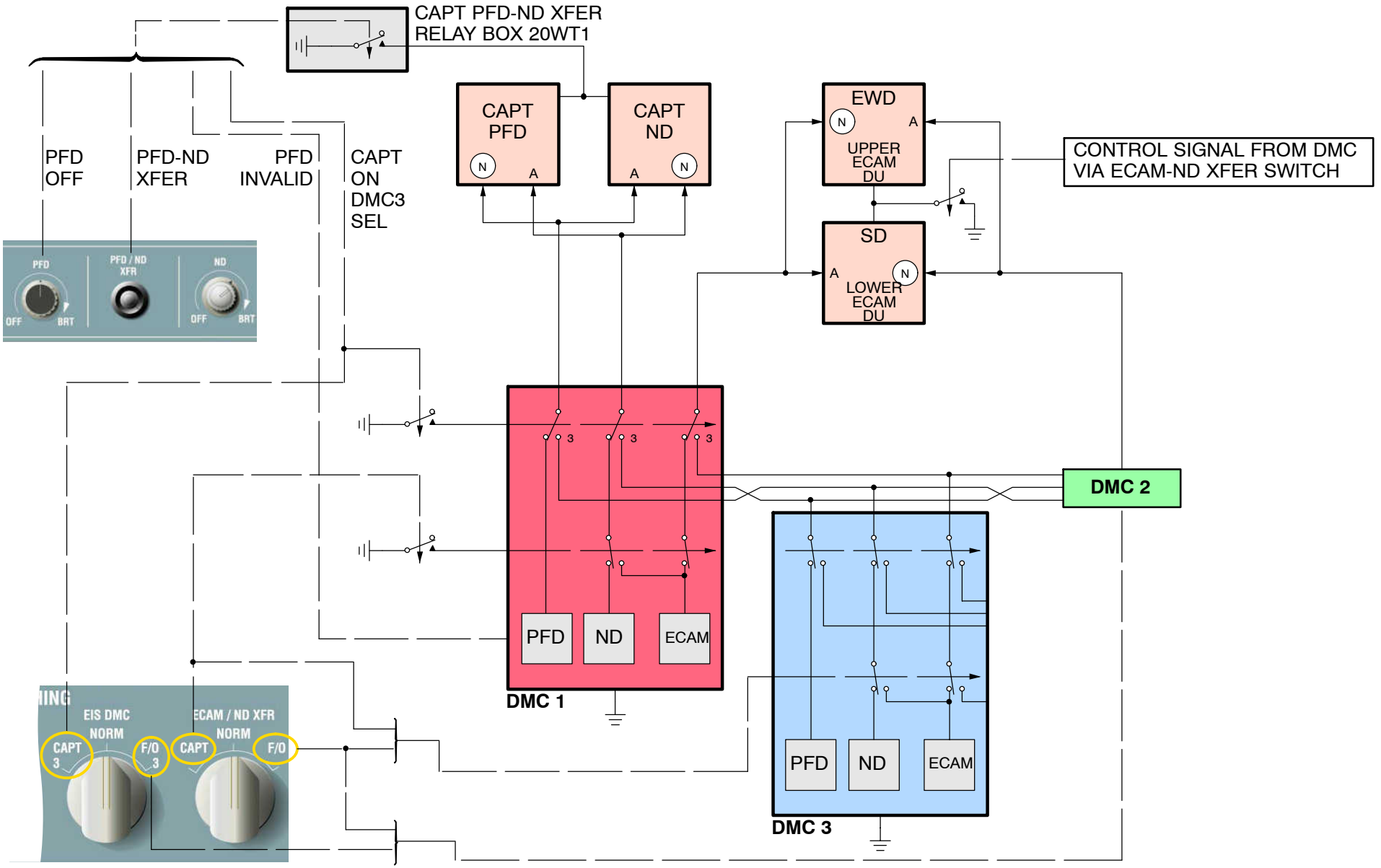


Figure 36 EFIS Transfers (Captain)

ECAM ALTERNATE SWITCHING

If one of the ECAM DUs is inoperative, the cockpit crew may select with the “ECAM/ND XFER“ switch wether the SD image is displayed on captains or F/O ND.

The DMC which displays then the SD image on the ND is not able to display the E/WD image on the remaining ECAM DU.

If the situation occurs that the remaining ECAM DU is connected on its normal input with this DMC, a discrete is sent to the ECAM DU to use its alternate input.

On the example given below the lower ECAM DU is lost.

To receive the SD image again the “ECAM/ND XFER“ switch is selected to the “CAPT“ position. The DMC1 ECAM image is switched to the ND1, the DMC1 is not longer able to provide data to the upper ECAM DU. Therefore DMC1 sends a discrete to the ECAM DU to select its alternate input. So the upper ECAM DU receives its E/WD image data from DMC2 via the alternate input.

EIS CONFIGURATION

These switching possibilities results to the third picture showing the connection of the DUs to the DMCs. All possible switching configurations are mentioned.

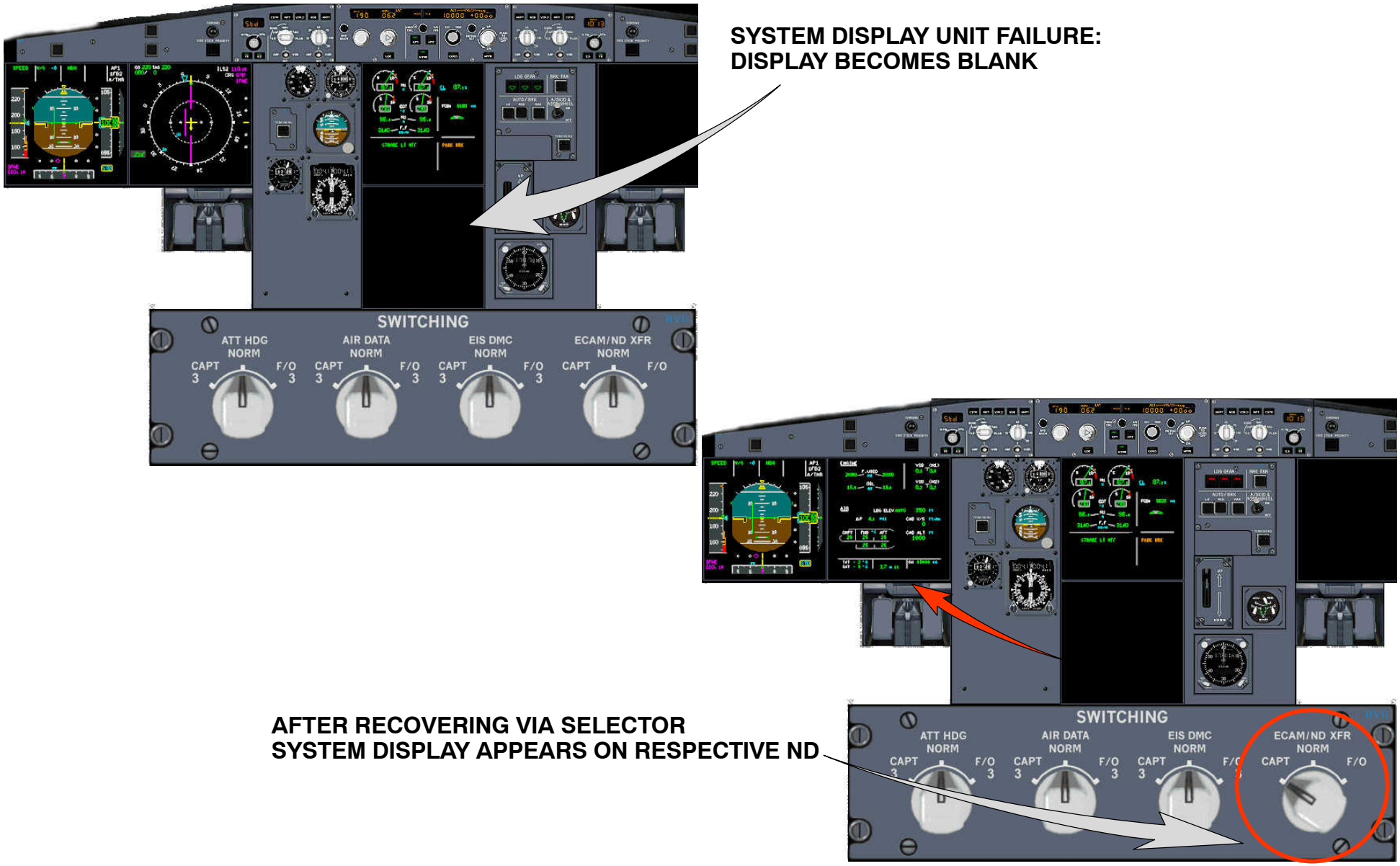


Figure 37 ECAM Alternate Switching Example

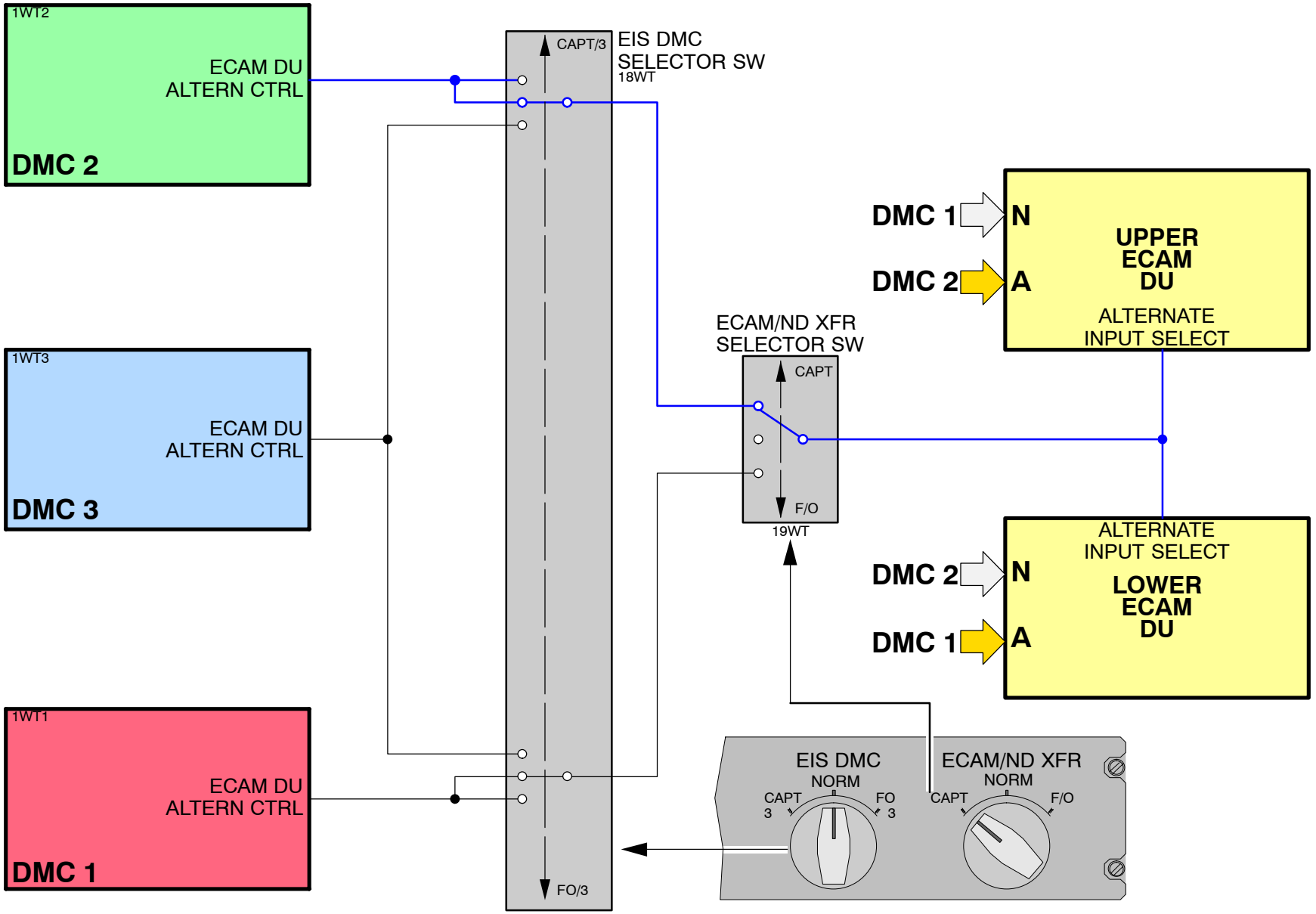


Figure 38 ECAM Alternate Switching Example Schematic

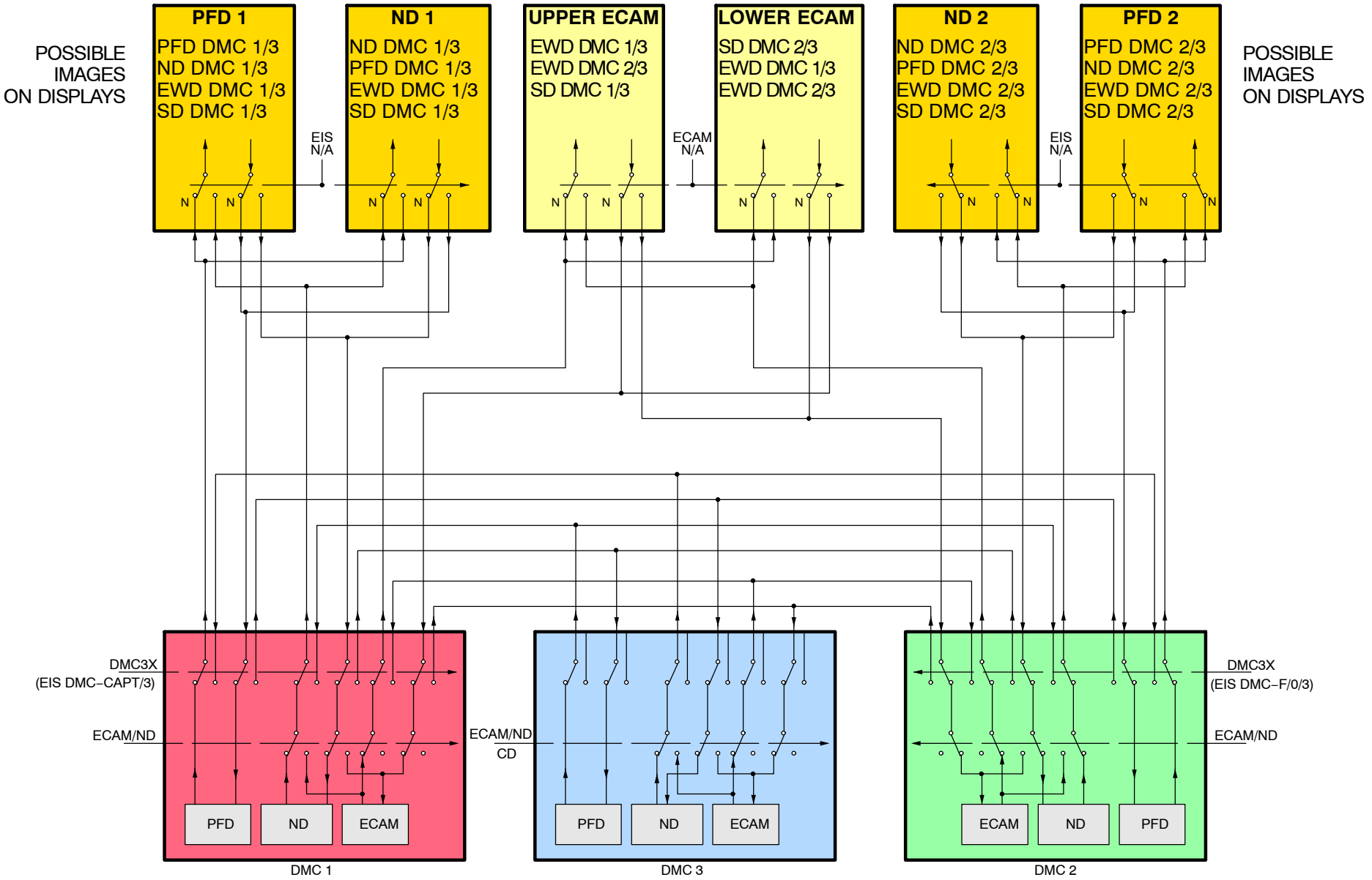


Figure 39 EIS Configuration Operation

31–50 CENTRAL WARNING SYSTEM

INTRODUCTION

General Description

The central warning system called the Flight Warning System comprises various items of equipment which allow the crew to be aware, by means of audio and visual devices and two display units (the ECAM display units), of the main aircraft equipment behavior, and aircraft dangerous configurations. It also provides the appropriate corrective actions.

The Electronic Instrument System comprises seven computers:

- three identical DMC (**D**isplay **M**anagement **C**omputer),
- two identical FWC (**F**light **W**arning **C**omputer),
- two identical SDAC (**S**ystem **D**ata **A**cquisition **C**oncentrators).

ECAM

Each DMC uses A/C system data which is processed by the System Data Acquisition Concentrators (SDACs) and Flight Warning Computers (FWCs) before being presented on E/WD and SD.

The SDACs digitalize aircraft system data and transmit it to the DMCs. The DMCs using SDACs outputs, generate aircraft system information for system display on the SD.

NOTE: The DMCs receive directly A/C system data for display on the upper part of the E/WD.

The DMCs use the outputs of the FWCs to display aircraft information on the lower part of the E/WD (messages).

The SDACs receive A/C system information concerning amber cautions and transmit it to the FWCs.
The FWCs receive A/C system data concerning red warnings and memos, they generate messages, audio signals and activate attention getters.

ECAM Control Panel

The ECAM Control Panel indirectly controls the ECAM Display Units:

- via the DMCs for system display selection,
- via the FWCs for the management of messages. When messages are cleared manually, the system display can show an other synoptic or the status page automatically.

Redundancy

A great redundancy between systems is used to minimize the loss of information.

Loss of a SDAC, or a FWC, or a DMC does not affect EIS operation.

The system still operates normally with one SDAC, one FWC and one DMC inoperative.

The FWCs generate the warning message for the Engine/Warning Display, illuminate the master warning lights and generate an aural warning.

Drawing the crew members attention

1. **By visual devices**

   A red MASTER WARN light and an amber MASTER CAUT light are installed on the glareshield in front of each pilot as attention getters to draw his attention to the ECAM DUs if a warning or a caution occurs. These lights are of the spring–loaded pushbutton switch type.

   Each FWC controls both CAPT and F/O lights.

2. **By aural devices**

   Two loudspeakers are installed in the cockpit, one in front of each pilot. They provide the crew with general communication voices and sounds, GPWS aural warnings, automatic call–out synthetic voices, and at last warning and caution aural warnings.

   The ON/OFF and volume control potentiometers can only control the general communication voices and sounds.

NOTE: The local warning lights on the system pushbuttons on the overhead panel and on other cockpit panels are **NOT** triggered by the central warning system computers FWC & SDAC!

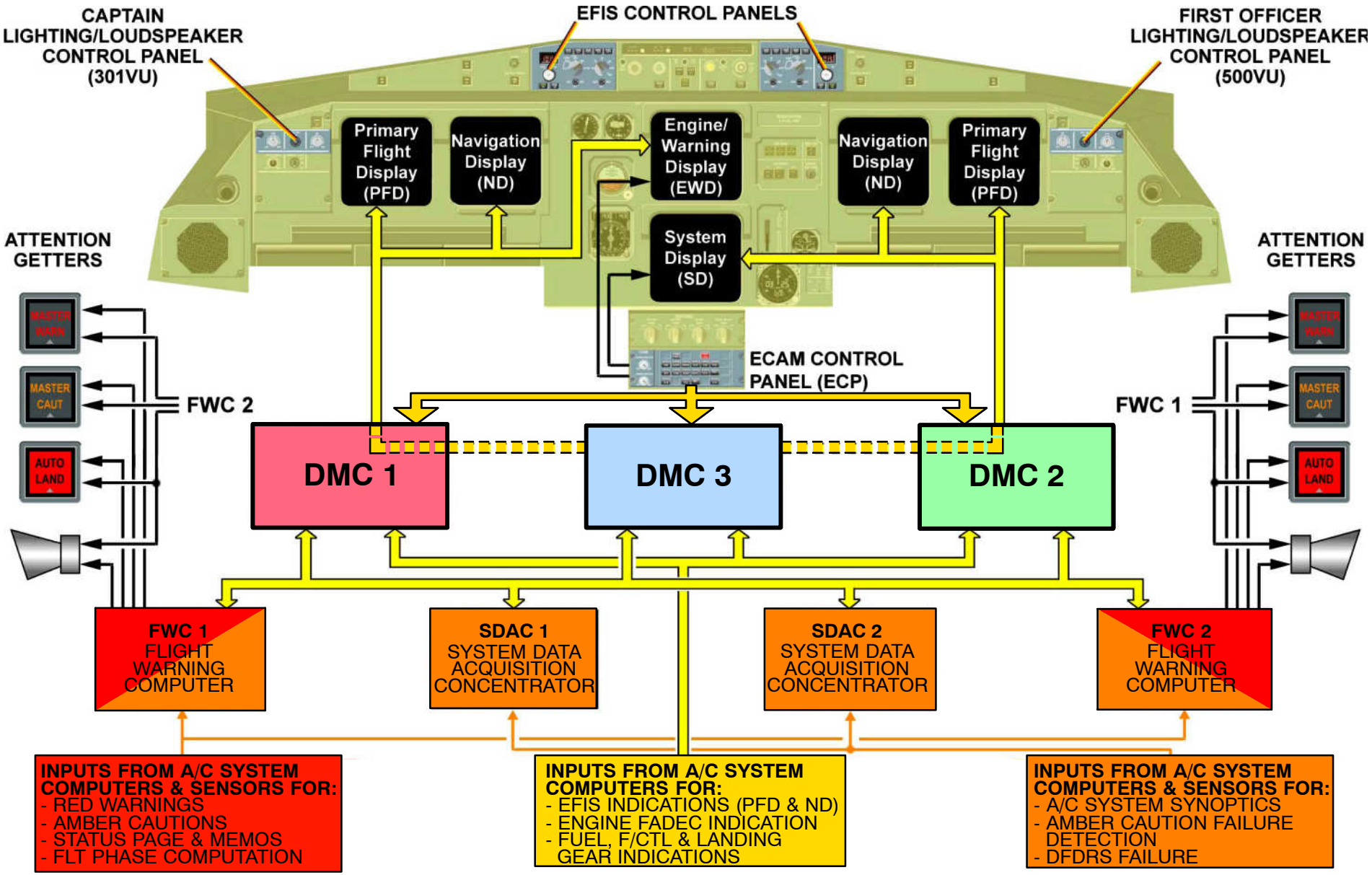


Figure 40 General Layout ECAM System

ENGINE/WARNING DISPLAY LAYOUT

The upper part of the E/WD is dedicated to the Engine Control parameters.

On the right part of the EW/D the fuel on board is indicated.

A word, a number and a specific symbol indicates the Slats and Flaps position.

On the lower part of the E/WD the Memo Messages present the aircraft systems or functions temporary selected.

Normal check lists like Take Off or Landing are displayed.

As soon as a failure is detected a special message is displayed which has priority on the Memo Page.

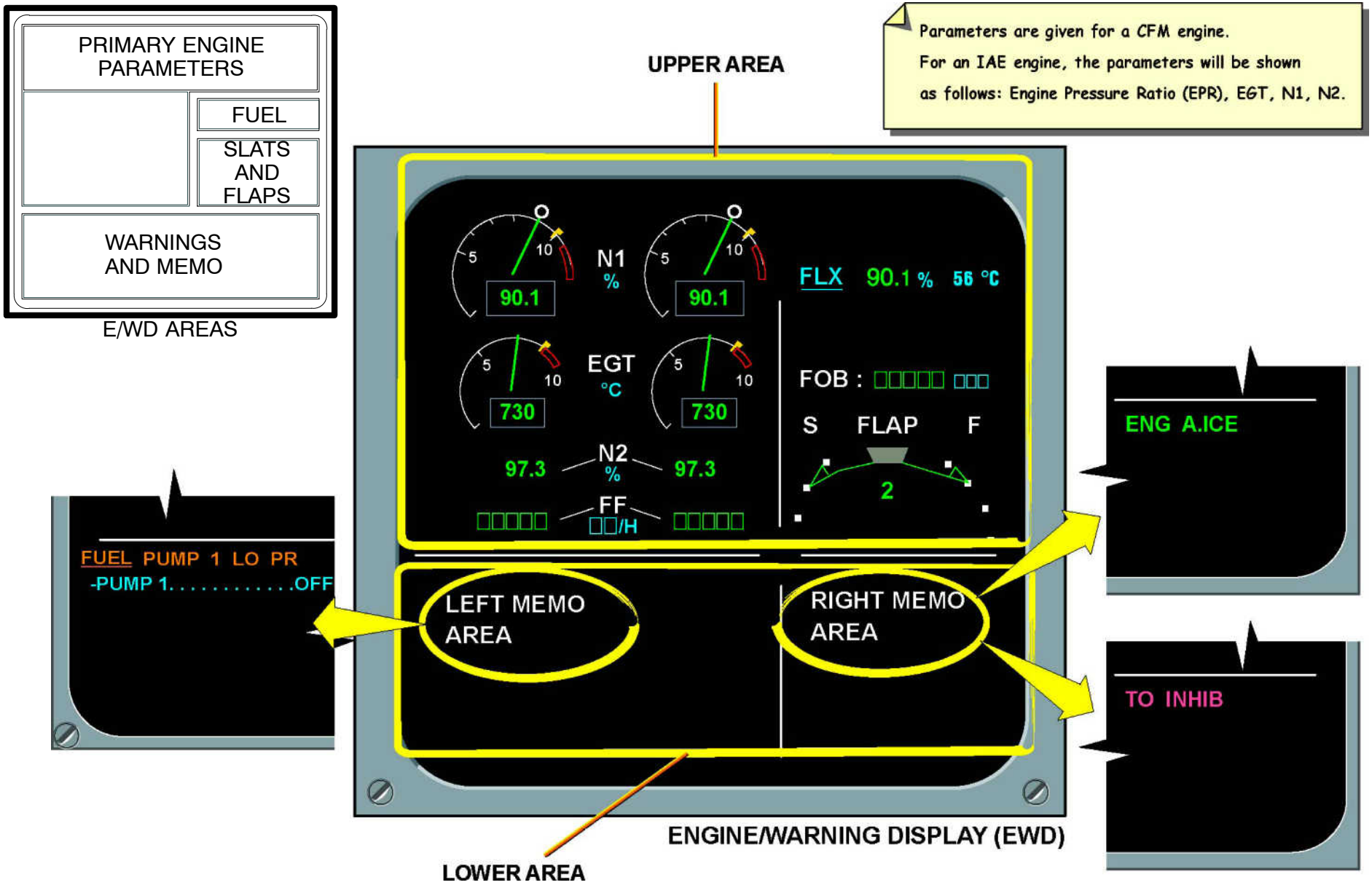


Figure 41 Engine/Warning Display

SYSTEM DISPLAY EXAMPLE

The Status and System Page presents one of the twelve aircraft System Pages.

By example, the door page as shown in the following figure.

Green color means the system is ready for flight.

Amber color is used for failure indication or system not in flight condition.

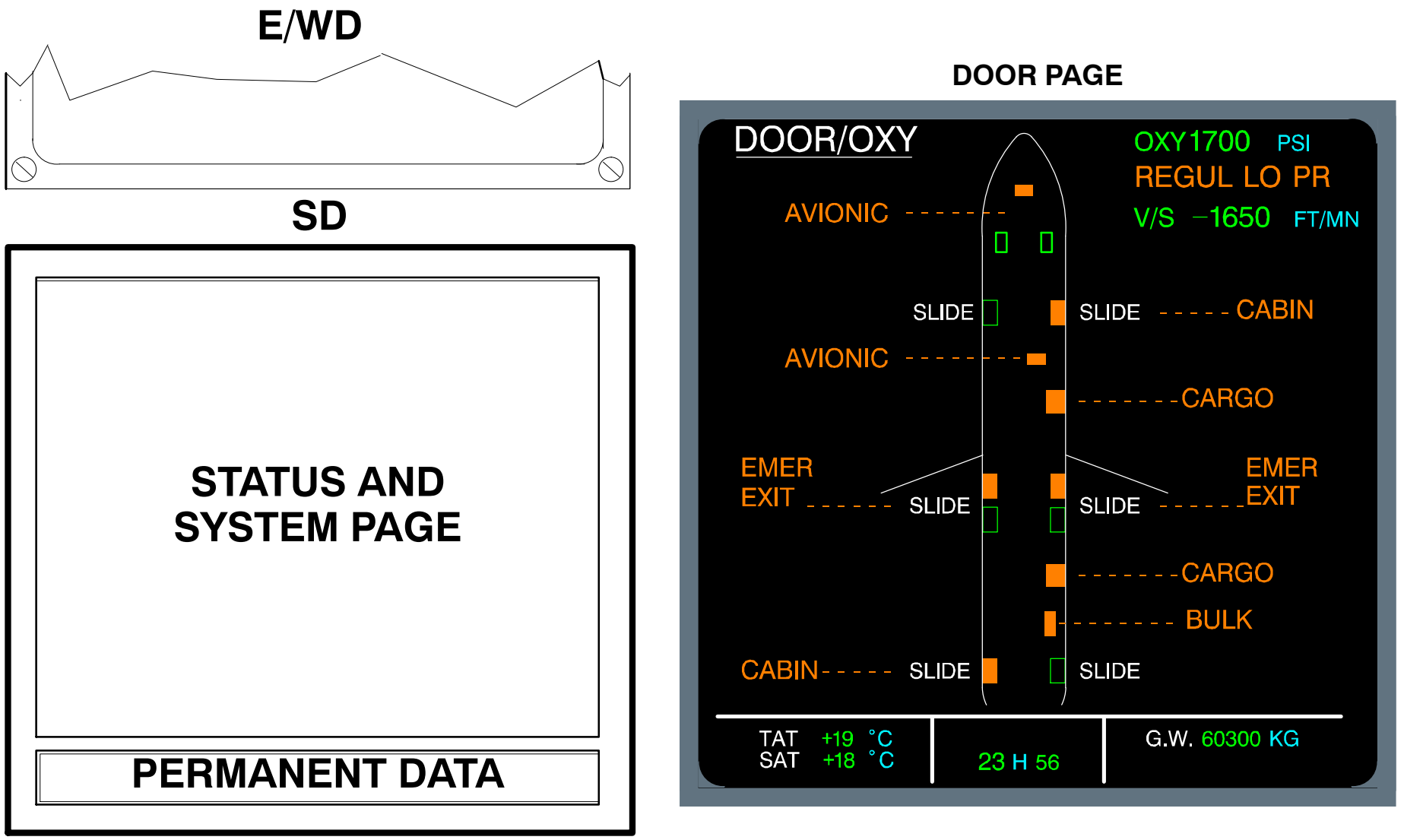


Figure 42 System Display Example: Hydraulic Page

STATUS PAGE EXAMPLE

After a failure the Status and System Page provides the operational summary of the aircraft systems.

The left part of the Status Page displays in blue the limitations and the postponable procedures, in green the landing capability and some reminder information.

The cancelled cautions are displayed at the bottom.

The right part indicates the inoperative systems and the maintenance status.

NOTE: When the Status Page disappears, a message “STS“ appears on the Engine and Warning Display to indicate that the Status Page is no more empty.

On the lower part of the Status and System Page some data are displayed.

STATUS PAGE

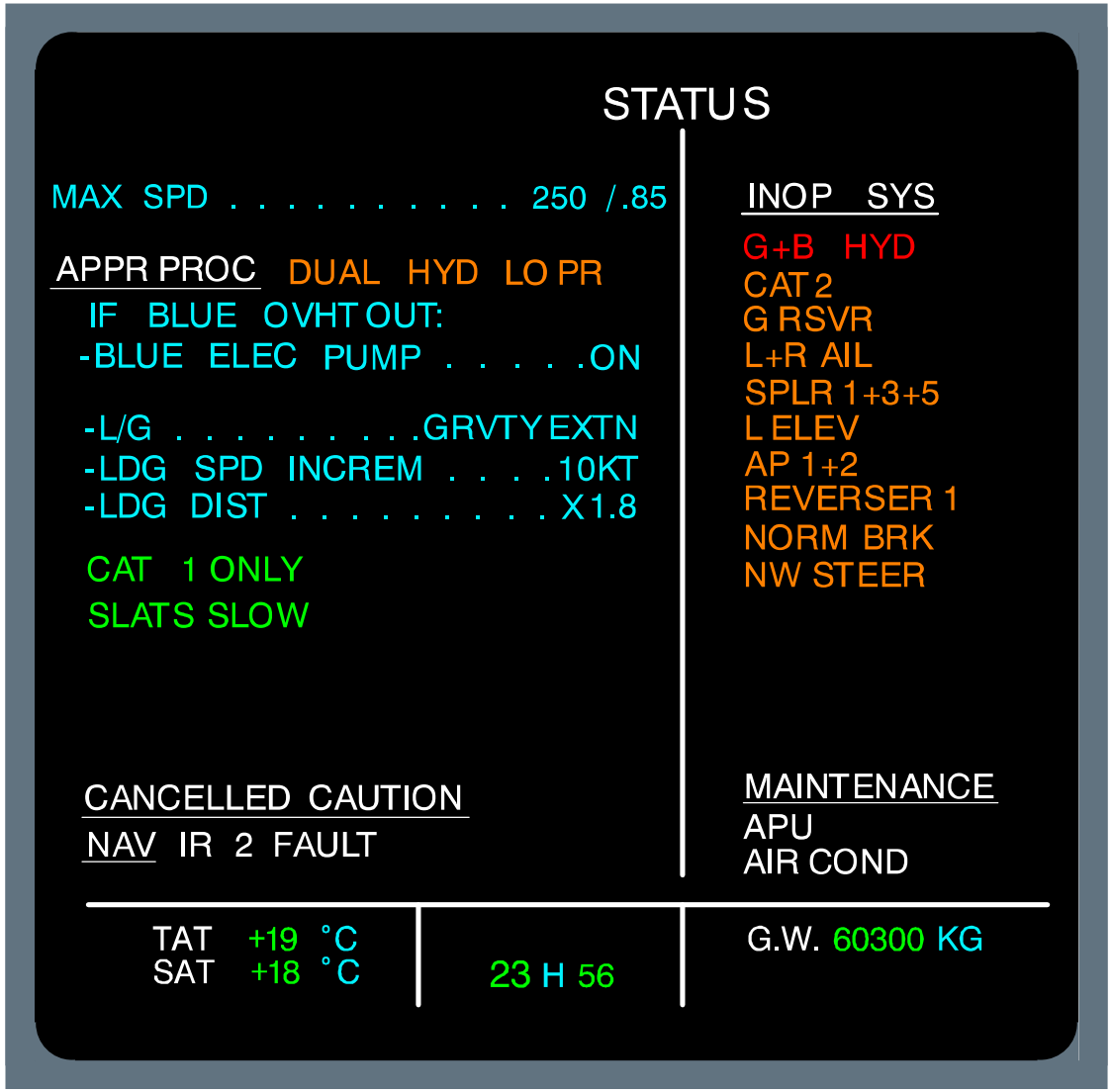


Figure 43 Status Page Example

OVERFLOW, STATUS & ADVISORY PRESENTATION

Overflow Indication

When the text of warning/caution messages exceeds the capacity of the Engine/Warning Display, a green overflow arrow appears below the grey stripe. This arrow concerns only warning messages and does not deal with memo messages. This arrow remains displayed on the screen as long as there are texts still waiting for display.

An overflow arrow appears also on the Status Page when the information exceeds the capacity of the left or right areas. The STS- or CLR-Key on the ECAM Control Panel has to pressed to scroll the display to view overflow, so that the rest of the text will be displayed.

STS Message

STS appears below the grey ribbon at the same location as the overflow arrow provided that this one is away. This message indicates to the pilot that the status page is not empty.

The STS indication is not shown, when the “STATUS PAGE“ is already shown on the system display.

ADVISORY General

The value of some critical system parameters is monitored by an advisory mode.

When the value drifts from its normal range, the corresponding ECAM page is displayed and the affected parameter pulses.

For example the PRESS page will be displayed if the cabin pressure increases above its normal value, but is still well below the threshold of the warning. In this case the crew may revert to manual pressure control and prevent warning activation.

NOTE: An advisory may or may not lead to a failure. They are totally independent one from the other.

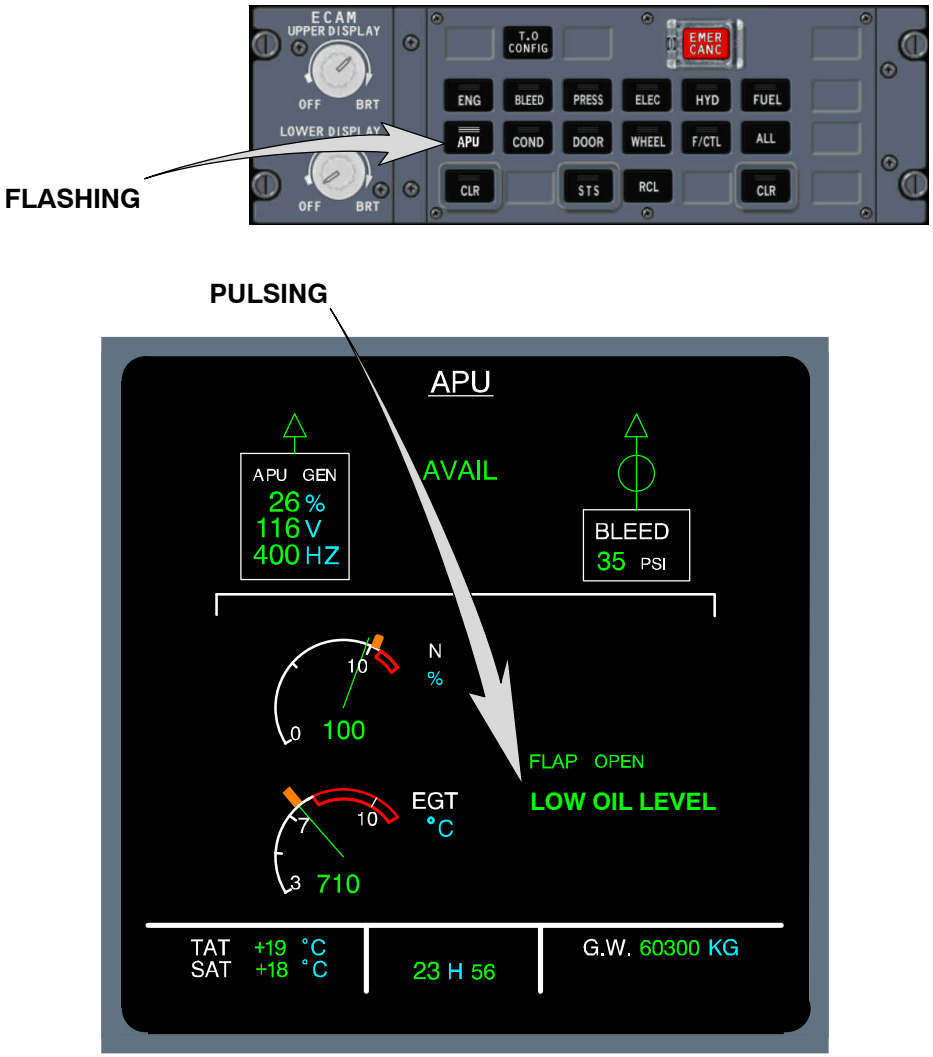


Figure 44 ADVISORY MODE indication

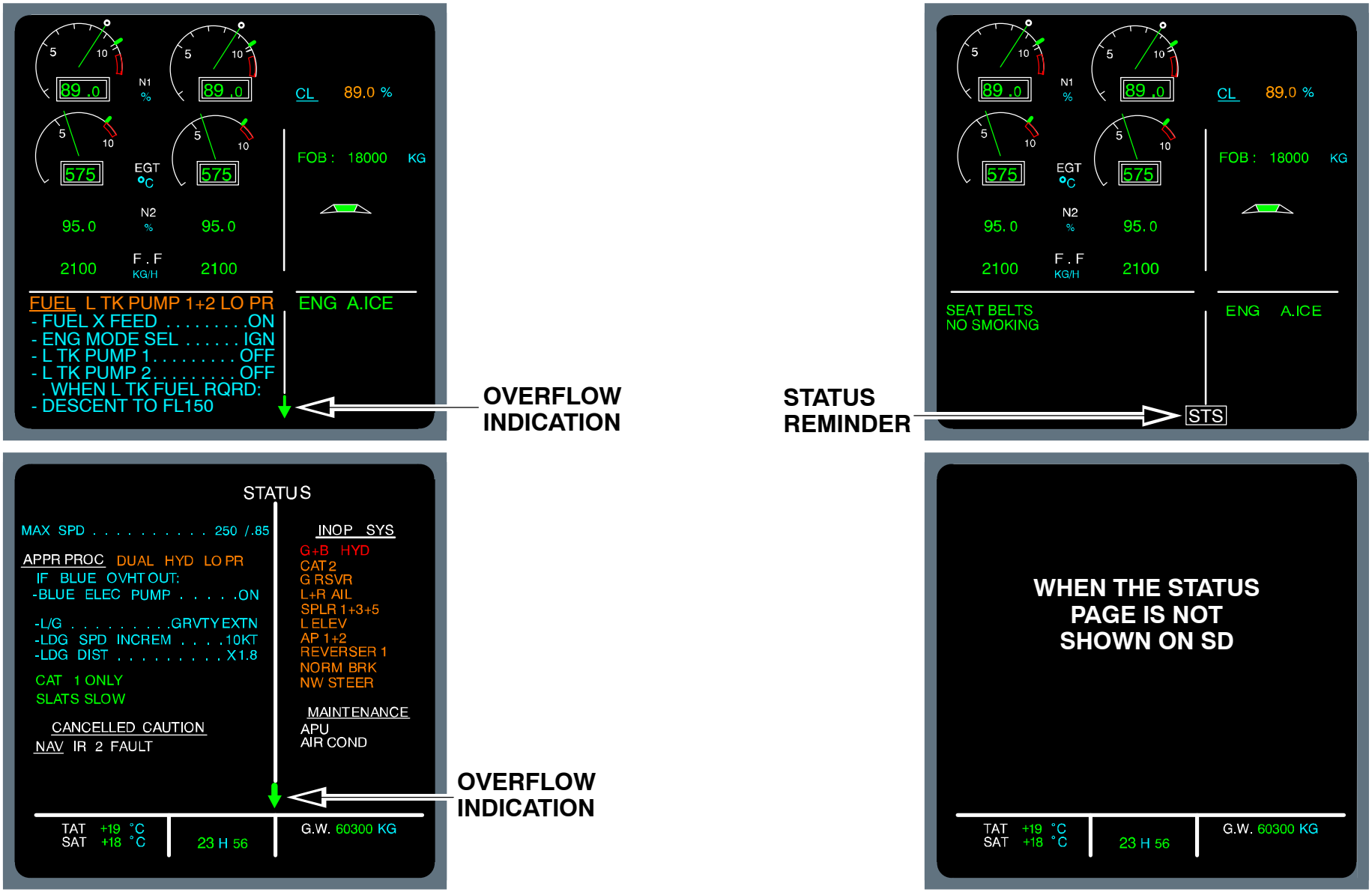


Figure 45 E/WD with STS and Overflow Indication

ECAM COLOR PHILOSOPHY DESCRIPTION

General Description

The colors of the data displayed on the Engine/Warning Display (EWD) and the System Display are depending of their definition.

- **RED**

  Configuration or failure requiring immediate action. Warning text or flags.
- **AMBER**

  Configuration or failure requiring immediate attention but not immediate action.
- **GREEN**

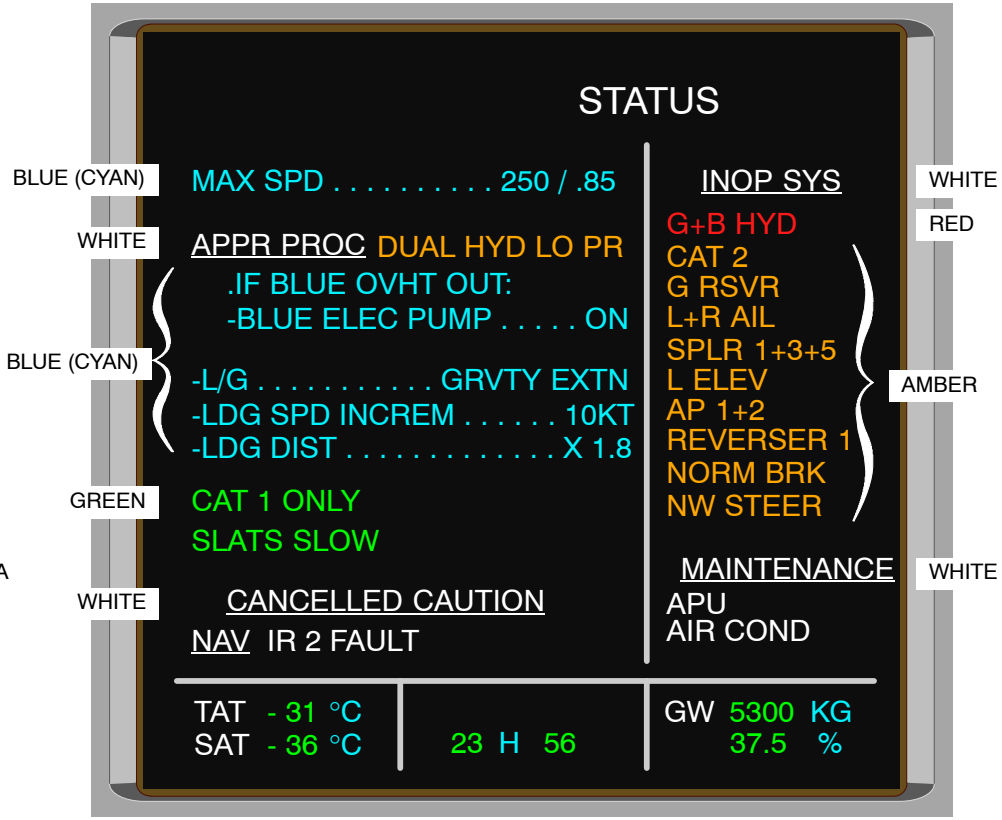
  Normal and long–term operation. No action to be performed.
- **WHITE**

  Indication of controlled function and action carried out but not corresponding to normal operation
  (e. g., setting the control of a system to the OFF position).
- **CYAN**

  Action to be carried out (e. g., procedure or reference value to be selected)
- **MAGENTA**

  Special messages (e. g. TO or LDG INHIB message on E/WD)

ENGINE / WARNING DISPLAY



SYSTEM DISPLAY

Figure 46 ECAM Color Philosophy

MEMO MESSAGES PRESENTATION

Normal Operation

When there is no current A/C system failure or when all the requested actions corresponding to the last failure have been performed and the ECAM pages related to this failure have been cleared, the upper display bottom third shows MEMO messages (and some elements of normal check list in TO or APPR) and the lower display presents the synoptic diagram related to the present flight phase.

MEMO Information

MEMO messages are presented on the lower part of the upper ECAM DU when there is no warning/caution message to be presented. Normally their color is green.

A list of possible MEMO messages is given hereafter.

NOTE: Some of the MEMOs may also be displayed in amber color depending on the aircraft situation.

LEFT PART	RIGHT PART
REFUELG	SPEED BRAKES
IRS IN ALIGN X MN	PARK BRK
IRS IN ALIGN	HYD PTU
IRS ALIGNED	RAT OUT
N. WHEEL STRG DISC	EMER GEN
SEAT BELTS	RAM AIR ON
NO SMOKING	IGNITION
STROBE LIGHT OFF	ENG A. ICE
OUTR TK FUEL XFRD	WING A. ICE
FUEL < 1.5 T	APU AVAIL
GPWS FLAP MODE OFF	APU BLEED
	LDG LT
	BRK FAN (IF INSTALLED)
	AUDIO 3 XFRD
	SWITCHING PNL

	LEFT PART	RIGHT PART
TO:	AUTO BRK MAX	GPWS FLAP 3
	SIGNS ON	TCAS STBY
	SPLRS ARM	AUTO BRK LO (MED / MAX / OFF)
	CABIN READY	MAN LDG ELEV
	FLAPS T.O	CTR TK FEEDG
	T.O CONFIG NORMAL	FUEL X FEED
LDG:	LDG GEAR DN	ACARS CALL (MAG / STBY)
	SIGNS ON	VHF3 VOICE
	SPLRS ARM	PRED W/S OFF (IF INSTALLED)
	FLAPS FULL (CONF 3)	

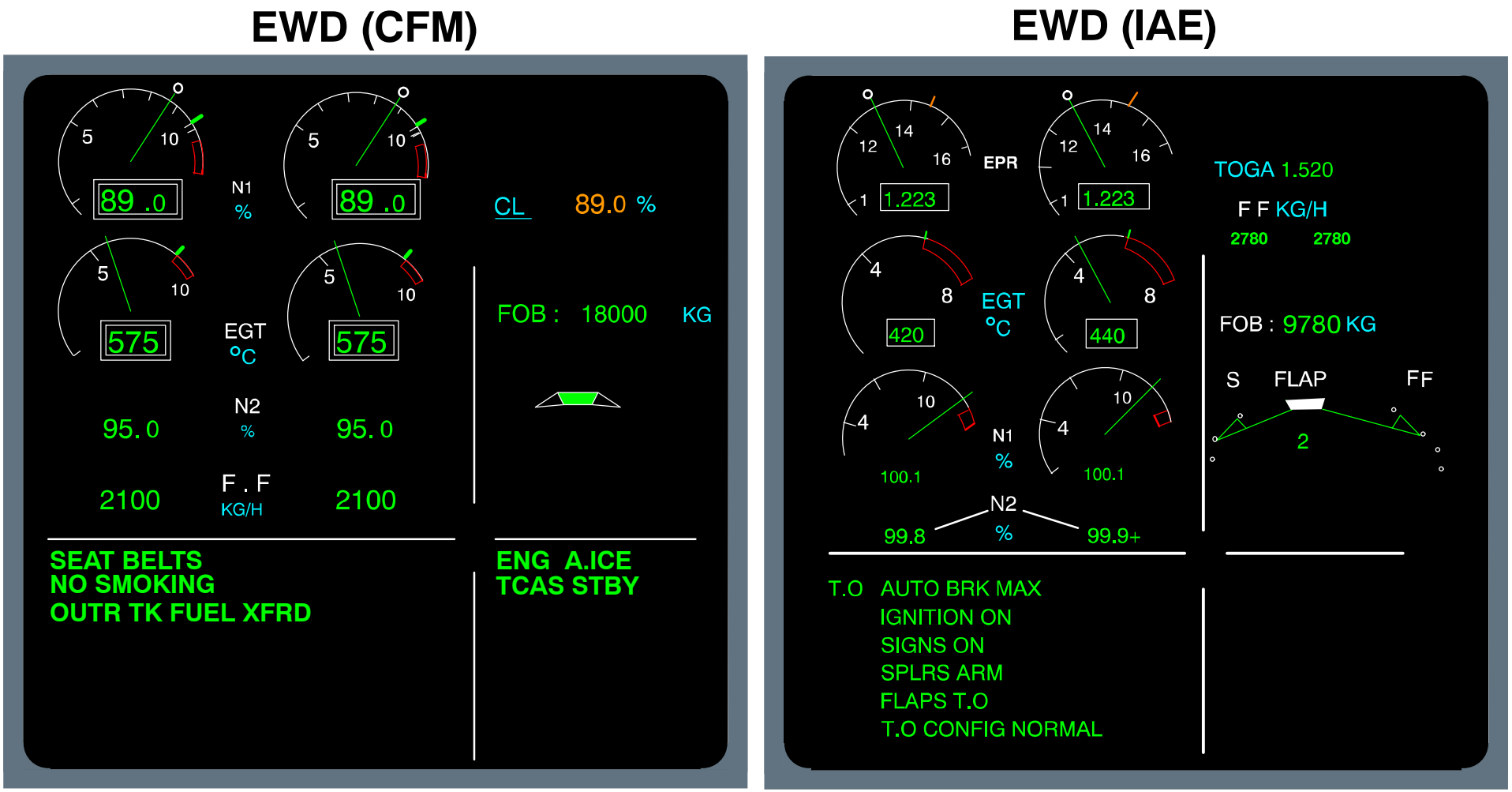


Figure 47 Example of Memo Messages

ATTENTION GETTERS INTRODUCTION

Attention Getters

A set of attention getters is installed in front of each pilot on the panels 130VU and 131VU. It consists of a Master Warning light and a Master Caution light.

When a warning occurs, the Master Warning light flashes continuously. The crew may cancel it, in most cases, as well as the associated aural warning by pushing the Master Warning Light.

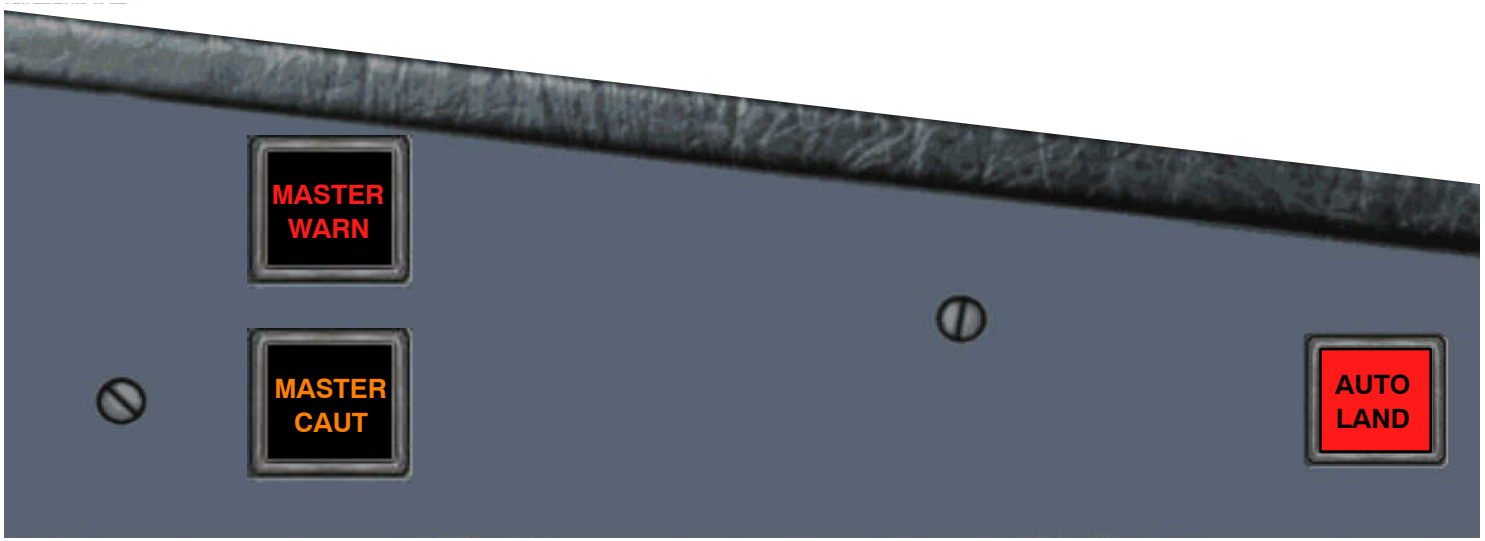
When a caution occurs, the Master Caution light comes on and stays on associated with a single chime.

The Master Caution Light extinguishes when it is pushed.

Auto Land Lights

Illumination of the AUTO LAND lights if Autopilot loss occurs below 200 ft during automatic landing.

Additionally the AUTO LAND lights come on for excessive deviations of the LOCALIZER and GLIDESLOPE indexes below 200 ft during automatic landing. This is also indicated by LOC and GLIDE indexes flashing on the PFDs and NDs.



F/OS SIDE SHOWN

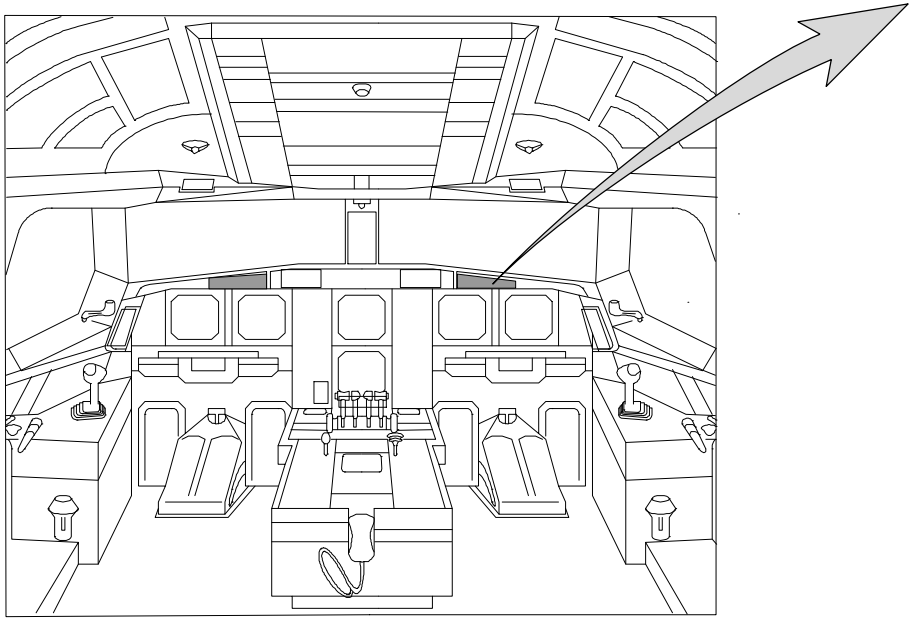


Figure 48 Attention Getters Layout

MASTER WARNING AND MASTER CAUTION OPERATION

The Attention Getters (Master Warning and Master Caution) are triggered by the FWCs. The Attention Getters have four bulbs each.

FWC 1 triggers the ”MASTER”–line of the left Master Warning Light and the Master Caution Light and the ”WARNING” resp. ”CAUTION”–line of the right Attention Getters. (FWC 2 the opposite way round). Triggering is done via a ground discrete so the circuit through the bulbs is closed.

When an Attention Getter is pushed, a ground is sent to both FWCs.

On aircraft equipped with “ATC MSG“-lights (also triggered by the FWCs) on the glareshield the interconnection logic is the same.

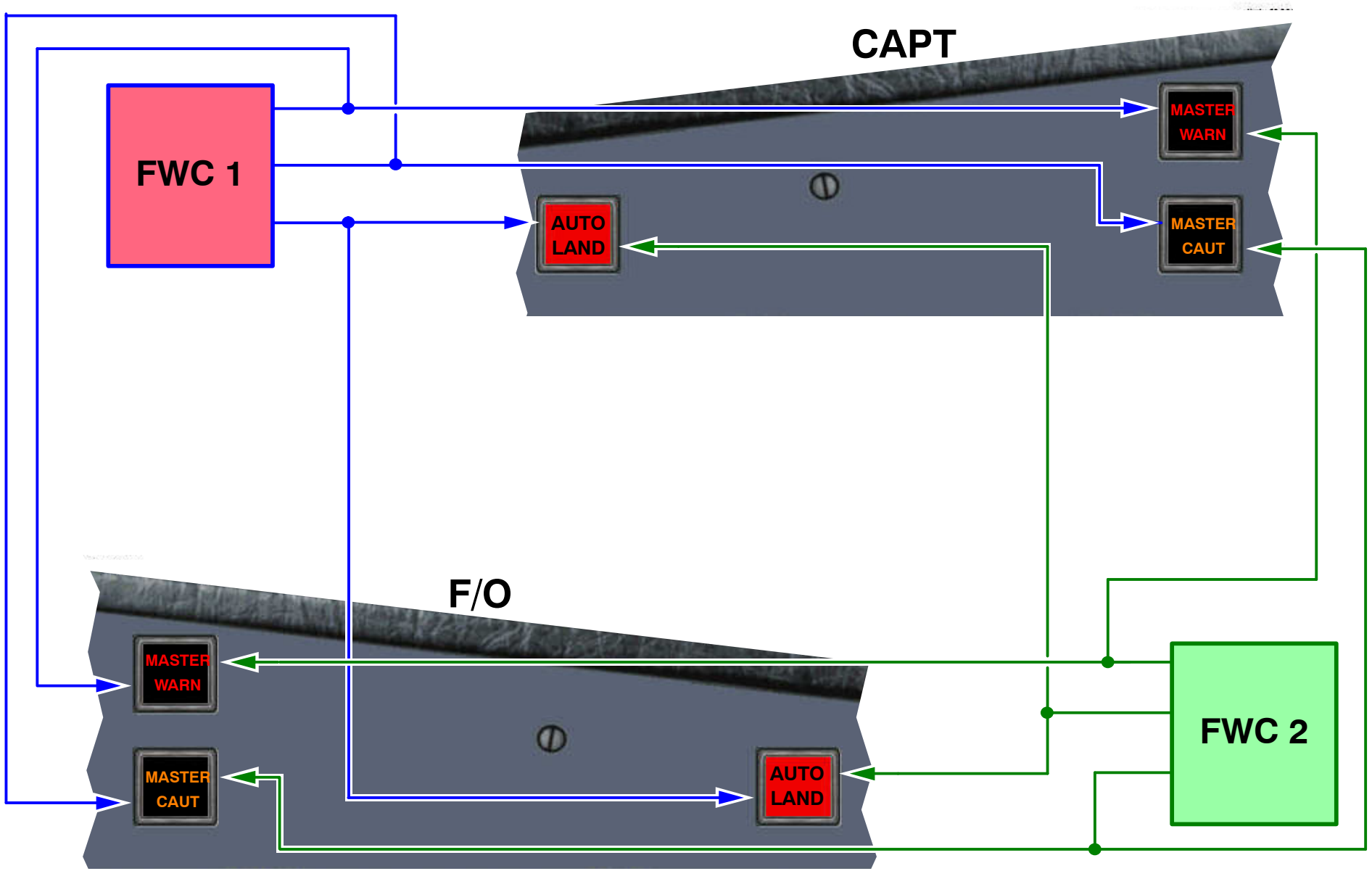


Figure 49 Interconnection FWC and Attention Getters

LOUDSPEAKERS PRESENTATION

General

The loudspeakers are installed for each pilot on the left and right instrument panels 2VU and 6VU. They deliver acoustic warnings from the FWCs.

Furthermore they provide warnings from:

- the EGPWS (**E**nhanced **G**round **P**roximity **W**arning **S**ystem),
- the TCAS (**T**raffic **C**ollision **A**voidance **S**ystem) and
- the WXR/PWS (**W**eather **R**adar **X**-ceiver equipped with **P**redictive **W**ind**S**hear).

For CVR (**C**ockpit **V**oice **R**ecorder) Test on ground they are connected to the audio output of the CVR.

The AMU (**A**udio **M**anagement **U**nit) is connected via the potentiometers to the loudspeakers.

Two loudspeaker potentiometers with incorporated switches are identified and located as follows:

- 15RN1 on instrument panel, Captain side, panel 301VU,
- 15RN2 on instrument panel, First Officer side, panel 500VU.

NOTE: The potentiometers are not affecting the volume of the warnings even when they are switched to off! They only adjust the output volume of the AMU audio signals. Refer to ATA 23.

The FWCs generates the aural alerts, as well as synthetic voice messages for radio–height automatic call–out.

All these sounds are generated by software.

NOTE: The 2 FWCs are synchronized for the audio outputs, and each of them is connected to the two loudspeakers.

Figure 50 Cockpit Loudspeaker Location

AURAL WARNINGS PRESENTATION

General

This is the list of the various audio signals generated by the Flight Warning computers and the manner of cancellation.

All aural warnings may be cancelled by pressing the EMER CANC pushbutton on the ECAM Control Panel.

Warning and Callouts Generation

All Aural Warnings and Synthetic Voice Callouts are generated in both FWCs. By means of a discrete audio synchronization signal between the FWCs the audio signals are synchronized, this means that the ”faster” FWC suppresses the other one.

Audio Warnings		
Aural Warning	**Warnings**	**Cancellation**
SINGLE CHIME	Amber Caution	Automatic
CONTINUOS REPETITIVE CHIME	Red Warning	EMER Cancel or Master Warning PBSW
CAVALRY CHARGE	AP Disconnection	Master Warning PBSW or second push on Take Over P/BSW
TRIPLE CLICK	Land Capability Change	Automatic
CRICKET	Stall	NIL
BUZZER	Call (SELCAL or Cabin)	Reset on ACP (**A**udio **S**elector **P**anel)
AUTO CALL OUTS	Radio Height	Automatic
C-CHORD	Altitude Alert	Automatic
RING	ATC Message	ATC MSG P/BSW
Aural Warnings (STALL, WINDSHEAR, SPEED, PRIORITY LEFT or RIGHT, RETARD)	Signalled by the related A/C systems (ADIRS, FAC, ELAC, FADEC)	Condition for warning no more present

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AUDIO MIXING BOX PRESENTATION

Description

An audio mixing box is installed in aircraft where the weather radar system is equipped with the **P**redictive **W**indshear **S**ystem (PWS).

The audio mixing box mix the windshear radar synthetic voice with the CVR (**C**ockpit **V**oice **R**ecorder) test (on the ground) or the TCAS voice.

The purpose of the audio mixing box is to sum low–frequency audio signals.

Location

The audio mixing box located in the fwd avionics compartment.

Loudspeaker

The Loudspeakers 7WW & 8WW have inputs from the following systems:

1. FWC 1 (Flight Warning Computer),
2. FWC 2,
3. AMU (Audio Management Unit),
4. GPWC (Ground Proximity Warning Computer),
5. TCAS (Traffic Collision Avoidance System),
6. CVR (Cockpit Voice Recorder),
7. WXR/PWS (Weather Radar equipped with Predictive Windshear System).

Due to the fact that the loudspeaker unit has only five inputs but maximum seven systems may be connected, an Audio Mixing Unit and a CVR test relay is installed.

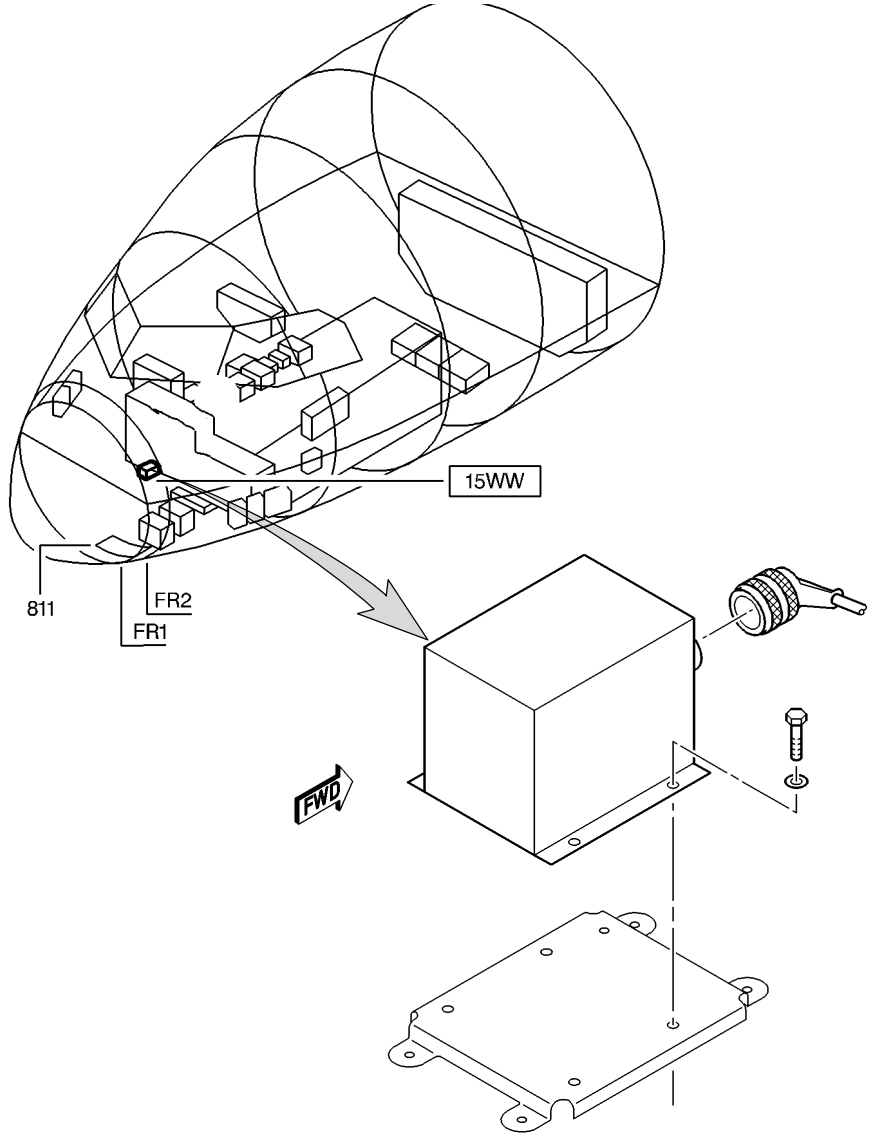


Figure 51 Audio Mixing Box Location

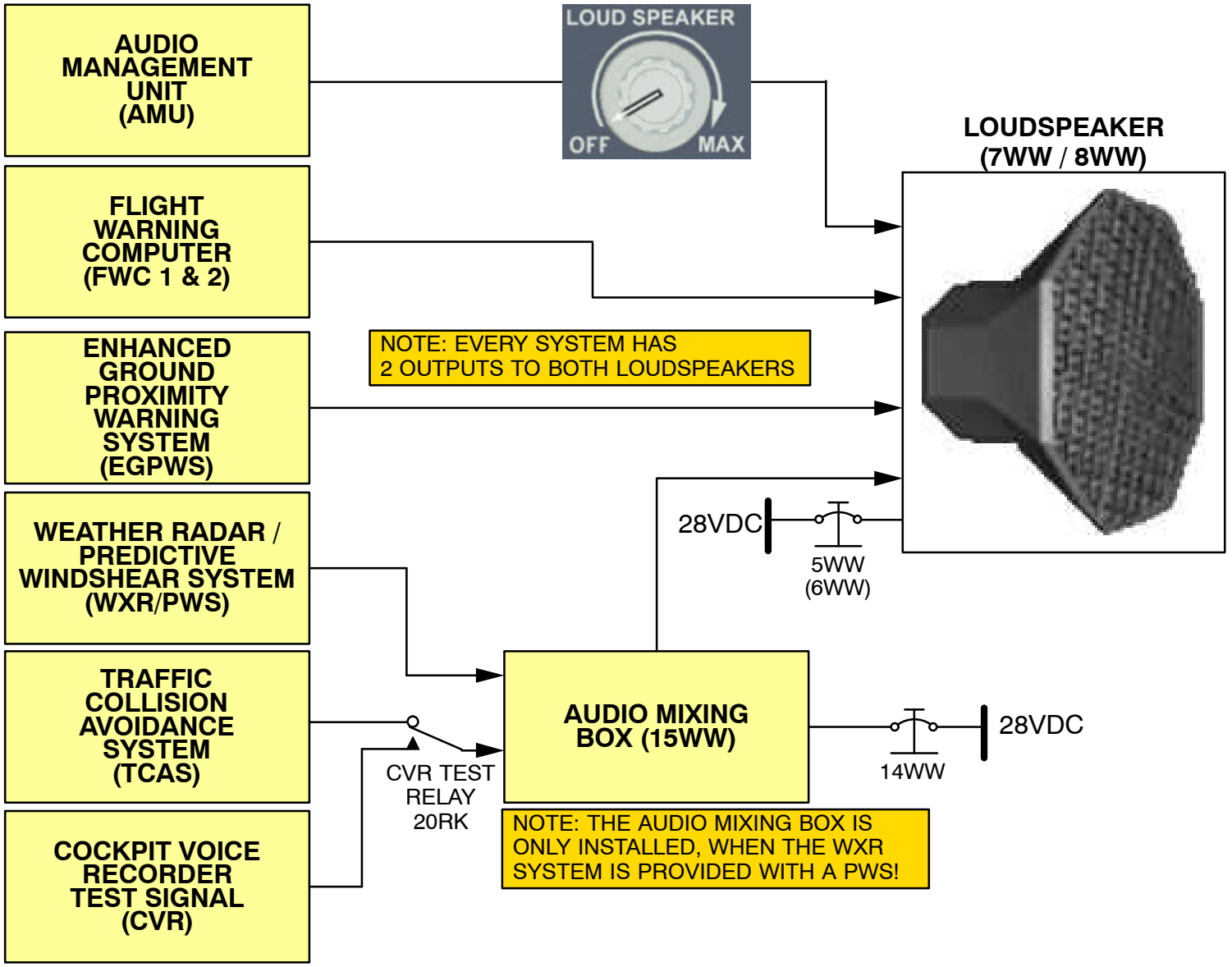


Figure 52 Loudspeaker Interfaces

ALERT LEVELS PRESENTATION

Messages have different classes and levels. The level depends on the importance of the message for flight safety.

- Level 3:
  warnings (highest priority)
- Level 2:
  cautions
- Level 1:
  - cautions
  - Status messages

Level 3 Warnings Description

All failure signals for level 3 warnings are directly connected to the FWCs.

The FWCs generate the warning message for the Engine/Warning Display, illuminate the master warning lights and generate an aural warning.

ATTENTION: Level 3 messages (warnings) have highest priority.

Level 3 warnings are caused by real emergency situations which requires an immediate action by the crew.

Typical causes for level 3 warnings are

- Aircraft in dangerous flight situation (e. g. stall or overspeed)
- System faults which concern safety
  (e. g. excessive cabin altitude or engine fire)

Level 3 warnings are connected with an aural warning (continuos repetitive chime or special call out) and the flashing master warning light.

If there is a system page for the system concerned it will be displayed on the system display.

Level 2 Warnings Description

Most failure signals for level 2 warnings have the same signal flow and result in a caution message. The FWCs additionally illuminate the master caution lights and they generate a single chime.

A level 2 message is given when a system fault does not directly affect flight safety.

It requires awareness of the crew, but no immediate action.

A typical level 2 message is ”IDG 1 OIL LO PR”.

Level 2 messages are connected with a single chime and the master caution light.

If there is a system page for the system concerned it will be displayed on the system display.

Not all failure signals flow through the SDACs to the FWCs: Some systems are directly connected to the FWCs.

Level 1 Warnings Description

When a SDAC receives a failure signal which should result in a level 1 warning it sends a signal to the FWCs. The FWCs generate the caution message for the Engine/Warning Display.

Level 1 messages point to a system which is faulty but not directly necessary for the flight, e. g. PSCU 1 fault or EFIS DMC 3 fault.

Level 1 messages appear on the E/WD without any chime.

If there is a system page for the system concerned it will be displayed on the system display.

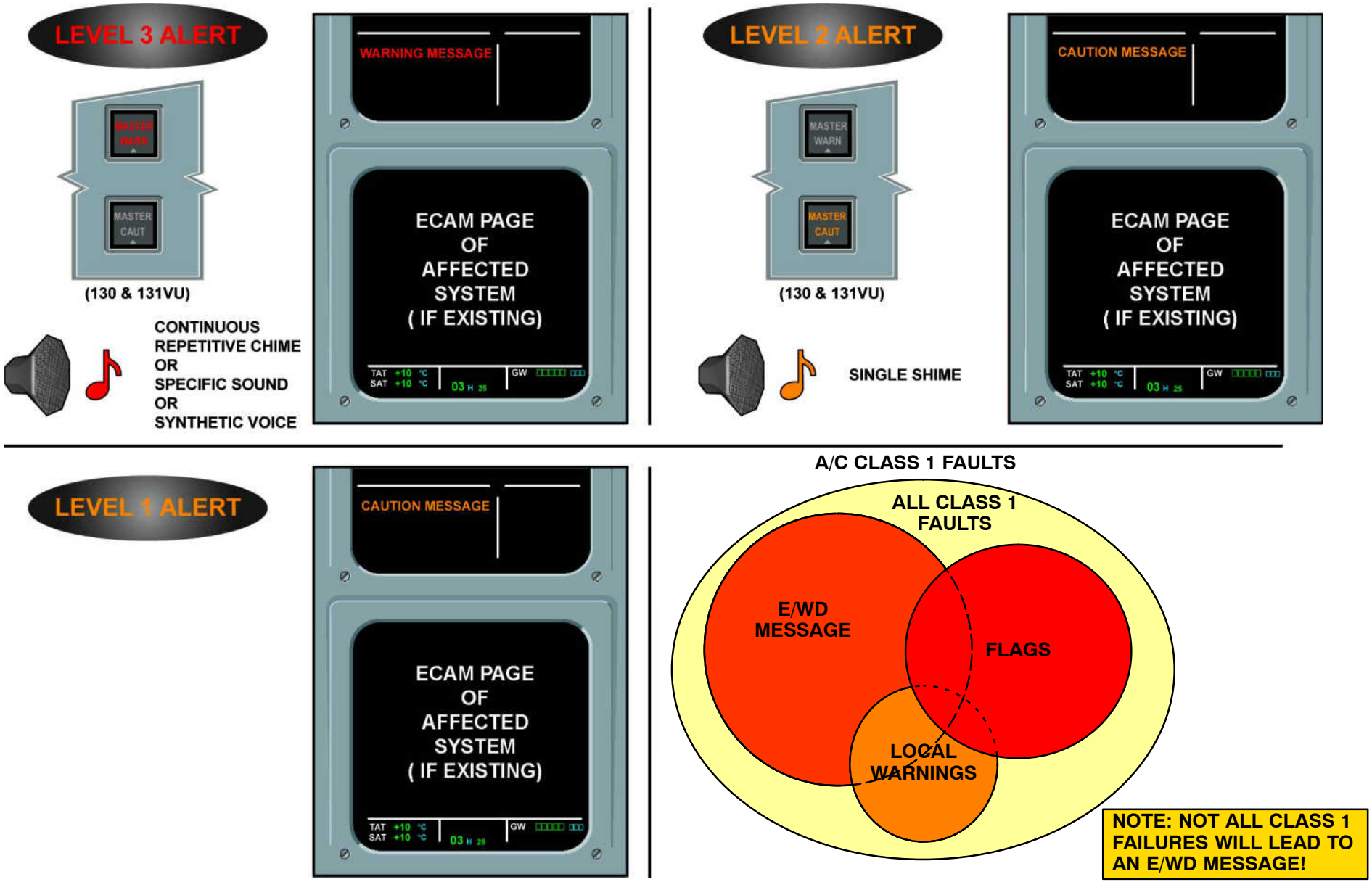


Figure 53 Class 1 Failures

DESCRIPTION OF FAILURES WITHOUT ECAM WARNINGS

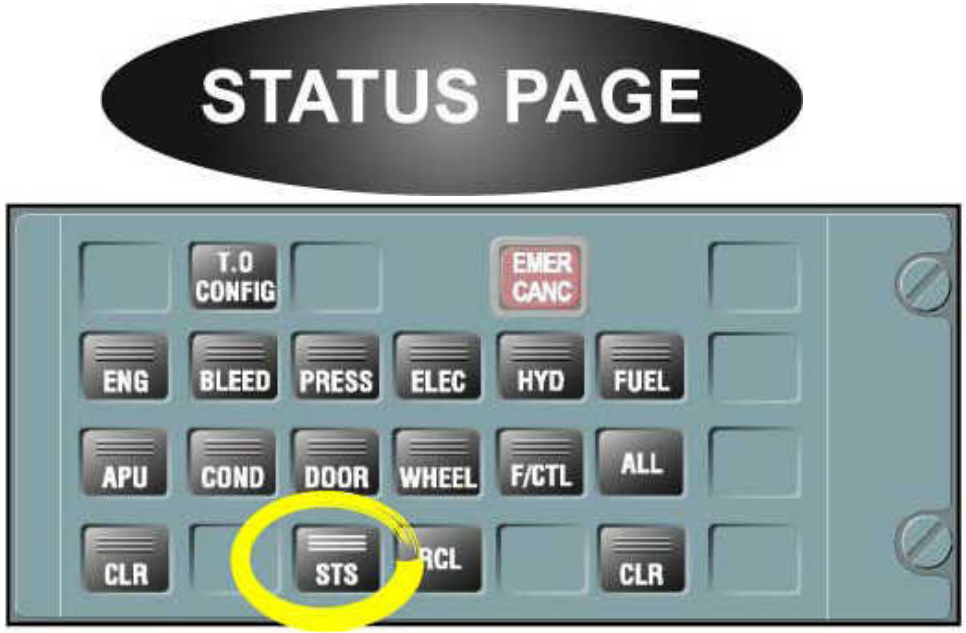
Failures which cannot be left uncorrected until the next scheduled maintenance check appear on the right side of the status page. They do not cause any warning or caution message and are not displayed on the ECAM during flight.

On ground, after engine shut down “STS“ appears on the E/WD when class 2 failures are stored. For further information the crew has to select the status page manually.

The faults are listed under the heading ”MAINTENANCE”.

NOTE: There are also CLASS 3 failures existing, but they are not displayed on the ECAM screens. Therefore they are not explained in this book.
Refer to ATA 31–32 Centralized Fault Display System.

CLASS 2 FAULTS



ECAM CONTROL PANEL (11VU)

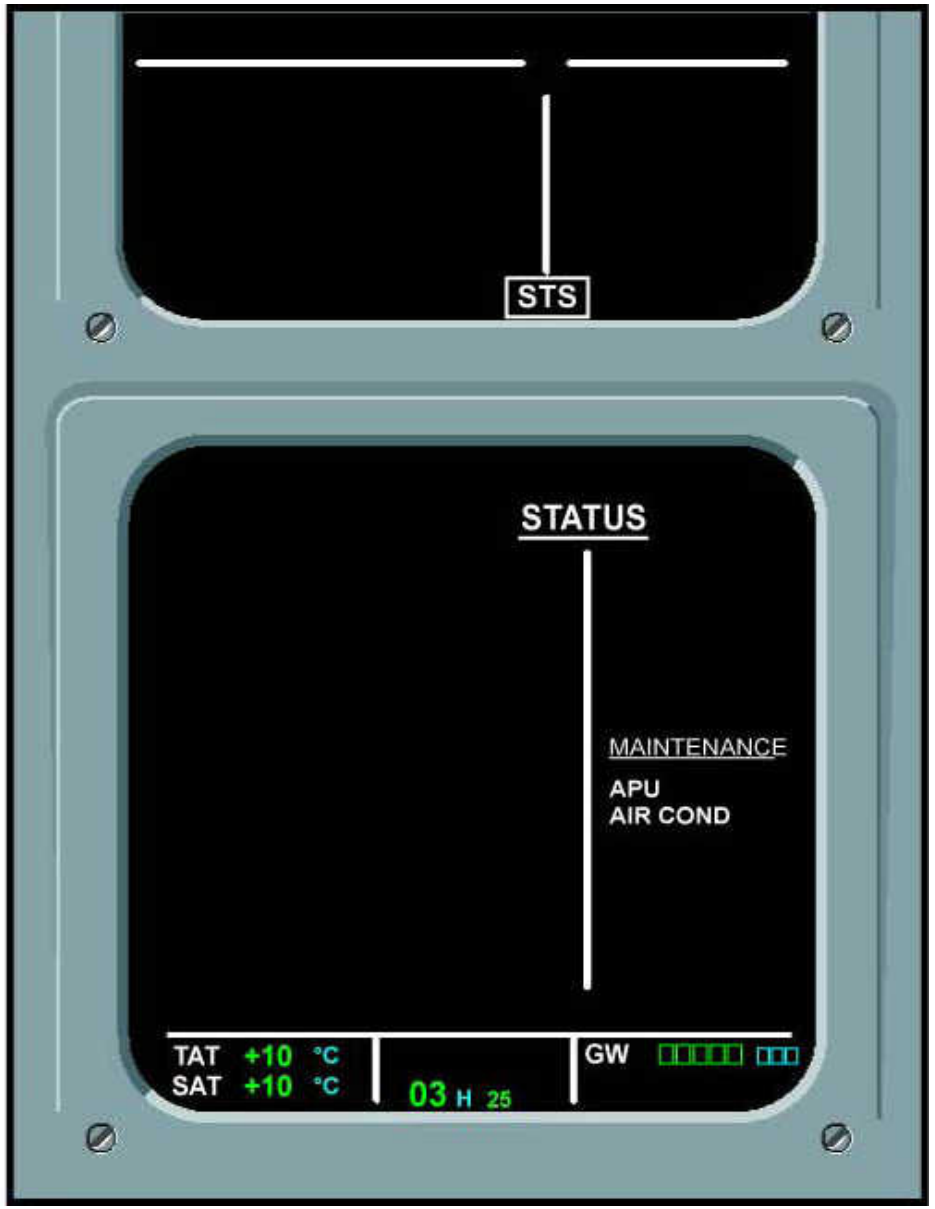


Figure 54 Class 2 Failure

TYPES OF FAILURES PRESENTATION

The ECAM indicates three types of failures.

- Independent Failure
- Primary Failure
- Secondary Failure

The failure type is independent of the alert level.

Independent Failure

An independent failure is a failure of a LRU or a system which does not concern any other system.

Example: Flight Warning Computer 1 failure.

Independent failures are indicated on the left side of the E/WD with their title underlined.

Primary Failure

This is a failure of an item of equipment or system causing the loss of other items of equipment which depend on it. This configuration constitutes a cascade of failure all originating from the same primary failure.

Primary failures are presented boxed.

e. g.: “HYD B SYS LO PR“ failure leads to the loss of: SPLRS 3.

Secondary Failure

This is the loss of an item of equipment or system resulting from a primary failure. Secondary failures have an * (asterisk) in front and are presented on the right memo area of the EWD.

This apparent failure could, in some cases, disappear after corrective crew action.

NOTE: Different failures combination may occur sequentially or simultaneously.

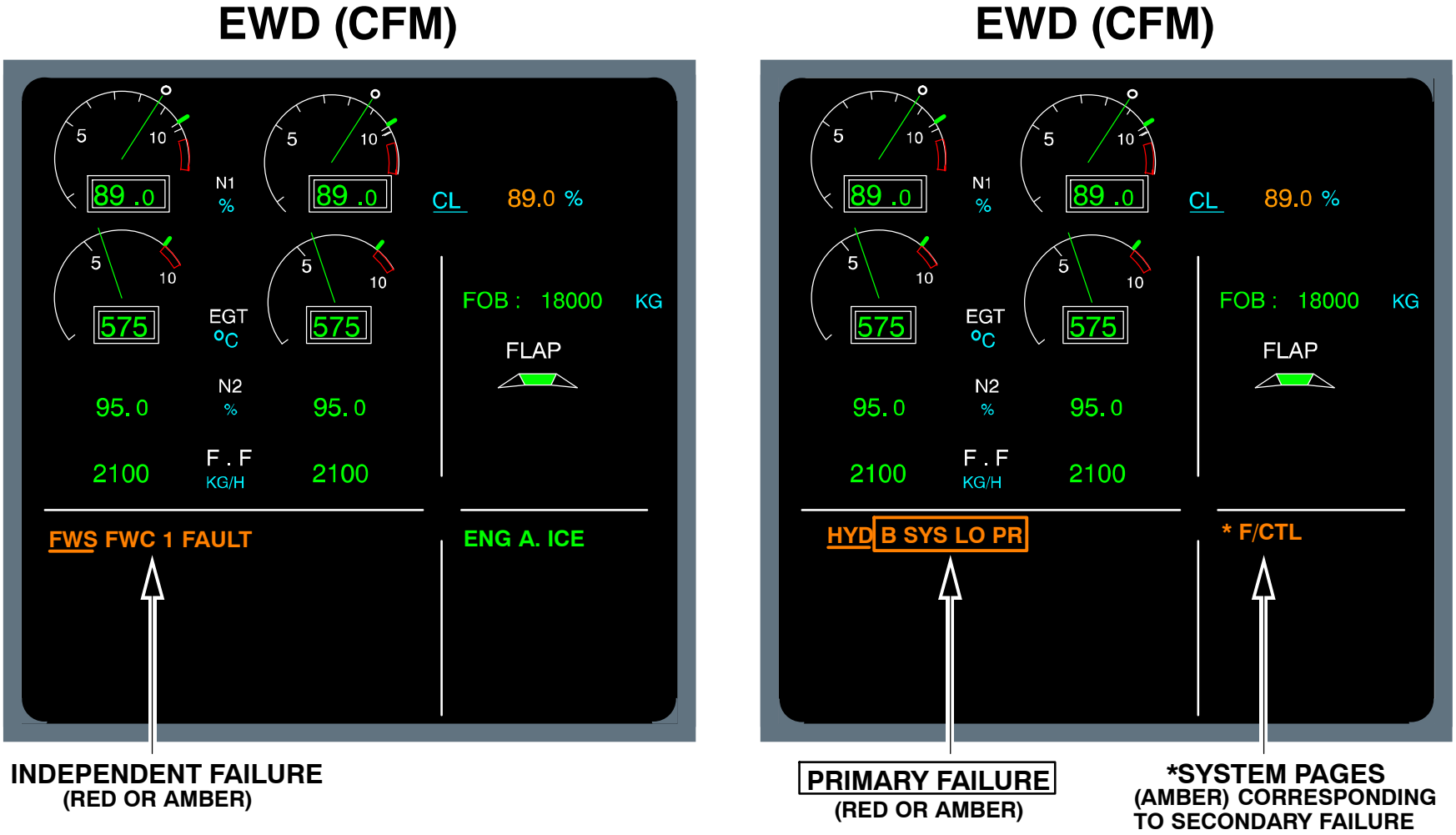


Figure 55 Types of Failures

ECAM CONTROL PANEL GENERAL DESCRIPTION

OFF/BRT knobs

These knobs control the brightness of each ECAM DU. They are associated with an automatic adjustment of the display intensity depending on the changing light conditions.

In the OFF position, the EIS reconfigures as for a DU failure. If one ECAM Display is lost the remaining one shows the E/WD. A System Display can be shown by pressing and holding the adjacent Synoptic Key on the ECAM Control Panel.

TO CONFIG

When pressed a take–off power application is simulated. If the configuration is correct the ”TO CONFIG NORMAL” message is displayed on the E/WD.

This function is only active after engine start.

This test will trigger a warning if the aircraft is not in TO configuration i. e:

- Slats or Flaps not in TO configuration
- Pitch trim not in TO configuration
- Speed brakes not retracted
- One door not closed
- Wheel brake overheat
- One sidestick not operative

NOTE: The parking brake is not included in this configuration test.

EMER CANC

When pressed:

1. Any present aural warning is cancelled.
2. In case of a red warning, the ECAM message remains displayed. Master Warning Lights and aural warnings will be cancelled.
3. In case of an amber caution, the Master Caution and ECAM messages are cancelled for the rest of the flight.

   The Status Page may be called with the white “CANCELLED CAUTION” message and the failure title.

NOTE: The EMER CANC inhibition can be manually restored by pressing RCL for more than 3 sec.

ALL

When pressed and hold all the system pages are displayed successively at one second intervals.

It also allows, by successive pressing, to display all the system pages one after the other and to stop on the desired one.

This is particularly useful in case of ECAM control panel failure because the ALL function remains available.

CLR

The light in the CLR pushbutton comes on as long as a Warning/Caution message or a Status message is present on the ECAM DU.

As long as the light in the CLR pushbutton is on, pressing it will change the ECAM display.

The first of the Warning messages will be deleted. Pressing it again will delete the next Warning message. When the last Warning message is deleted Memo messages come back.

RCL

When pressed all cleared warning messages will be recovered which are still present.

When pressed and hold, the Caution messages which have been cancelled are recalled.

STS

When pressed, the Status Page is displayed. If no Status message is present the ”NORMAL” message is displayed during 5 seconds.

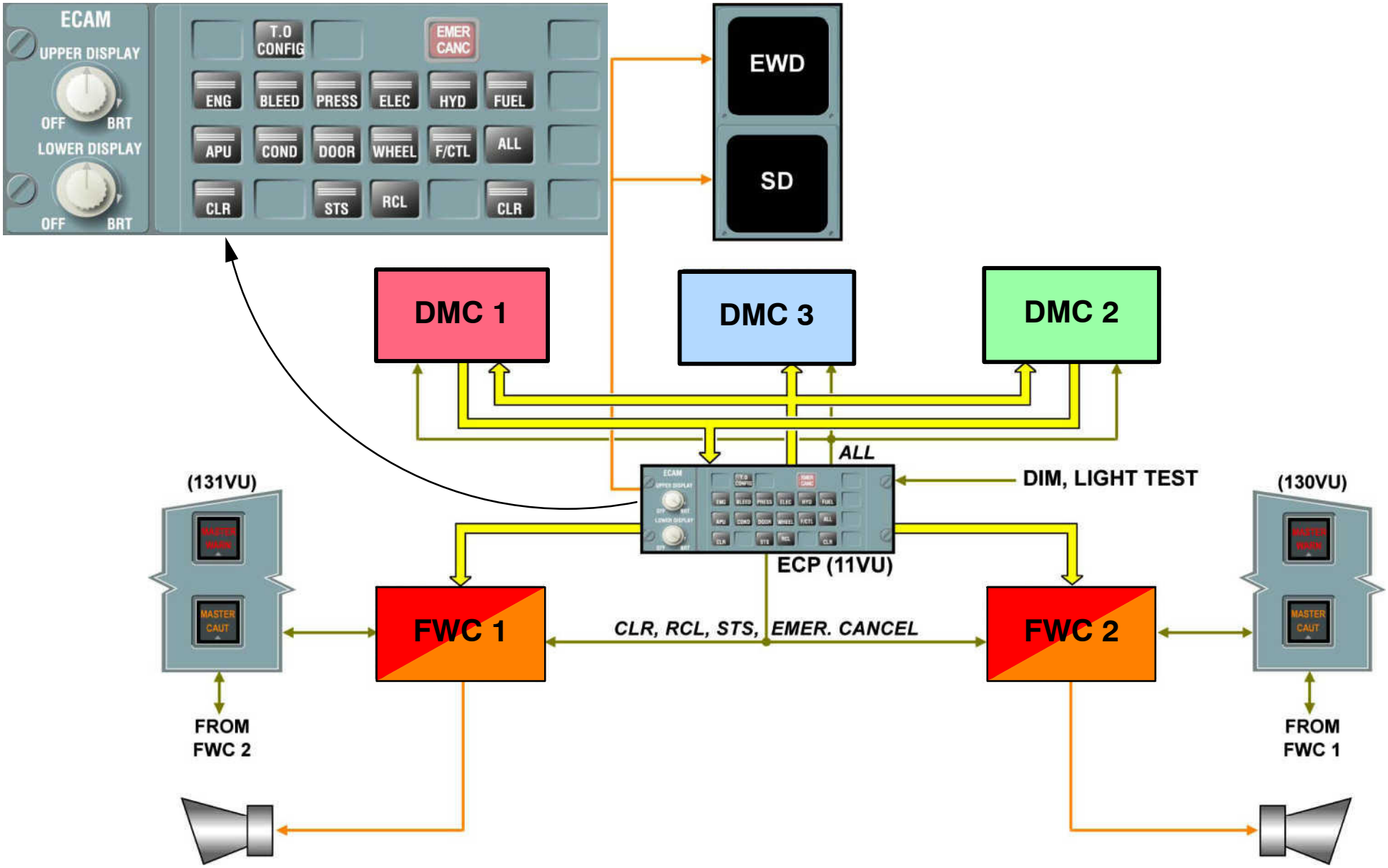


Figure 56 ECP & System Pages (1)

ECAM CONTROL PANEL INTERFACE

Description

The ECAM Control Panel works digitally.

However, some pushbuttons send a discrete signal, so they can be used in the event of an ECP failure.

The discrete outputs are:

- CLR (Clear),
- STS (Status),
- RCL (Recall),
- EMER CANC (Emergency Cancel),
- ALL.

Interface

The pushbuttons for signals to the FWCs are:

- CLR
- STS
- RCL
- EMER CANC
- TO CONFIG.

The FWCs receive BITE information via the output bus of the ECP. On the same bus, they receive information if the TO CONFIG–pushbutton is pushed.

The pushbuttons for signals to the DMCs are:

- System–pushbuttons (Digital Bus) and
- ALL.

NOTE: The ALL function stays active when the ECP fails.

ECP Pushbutton Lights Control

The Pushbutton Lights are controlled by DMC 1 and DMC 2 via a digital bus.

Failures

If the ECP power supply fails or the ECP is inoperative the analog connected pushbuttons remain operative. The ECAM–system can still be used.

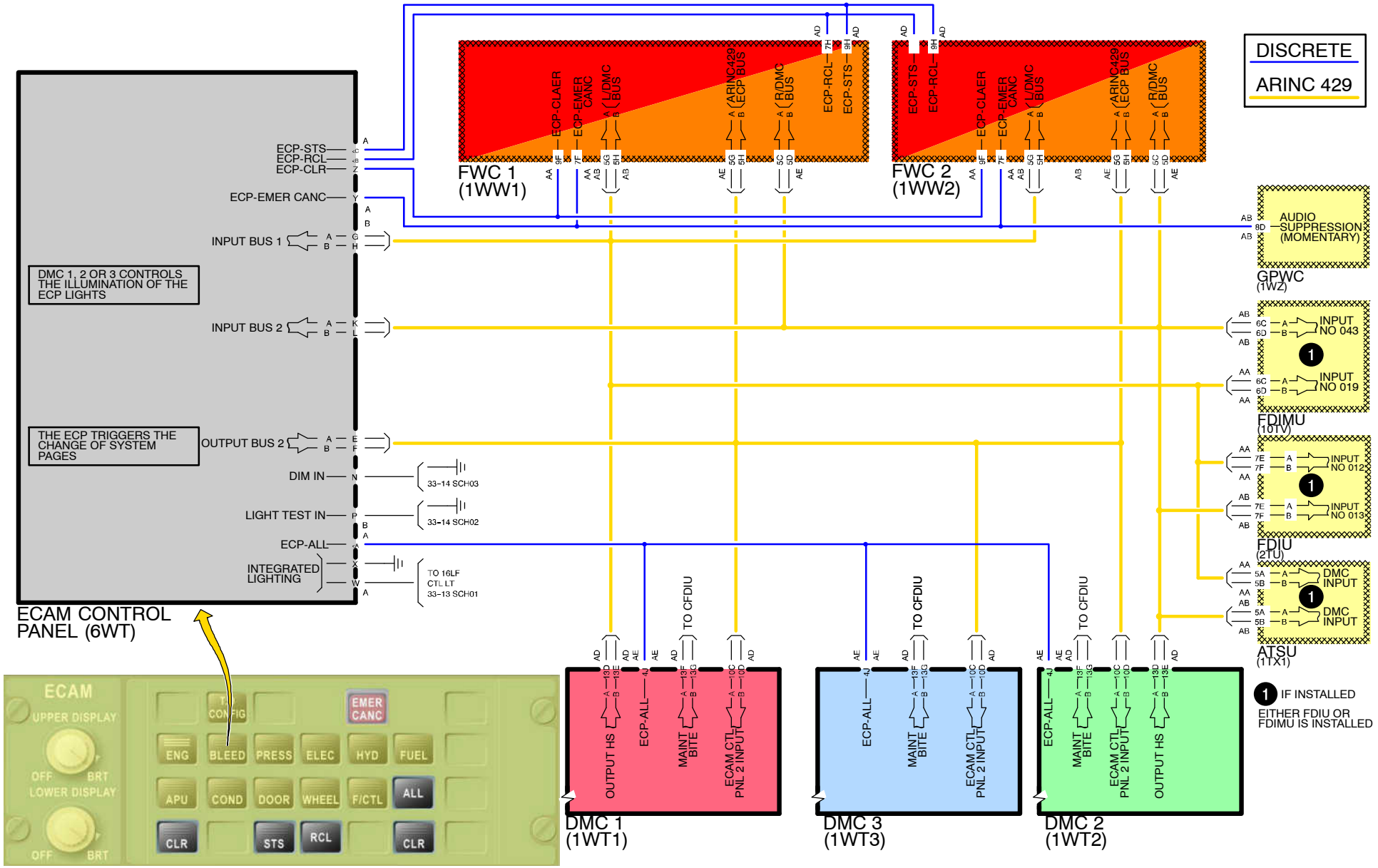


Figure 57 ECAM Control Panel Interface

FAILURE PROCEDURE EXAMPLE INTRODUCTION

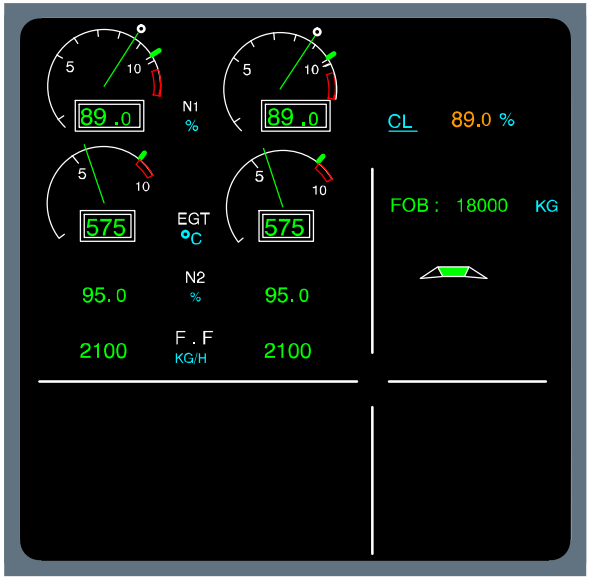
STEP 1

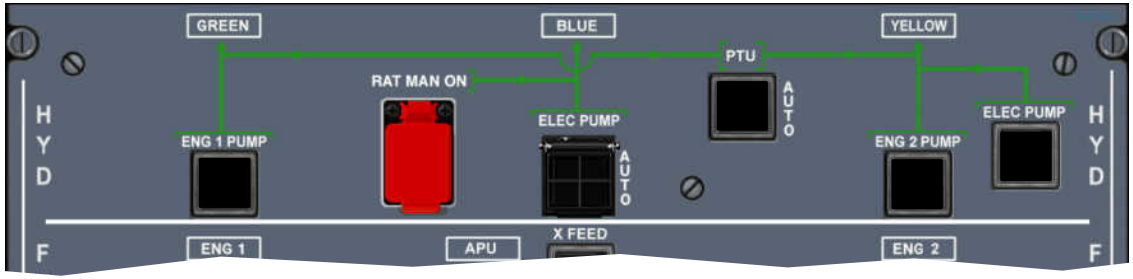
Normal Configuration

We are in flight in normal configuration. The ECAM displays indicate that all is correct. The cruise page is displayed.

NOTE: The Cruise Page is only displayed in Flight and can not be selected manually.

The System Pages related to certain flight phases will be explained after this example.





NORMAL FLIGHT

NO FAILURES

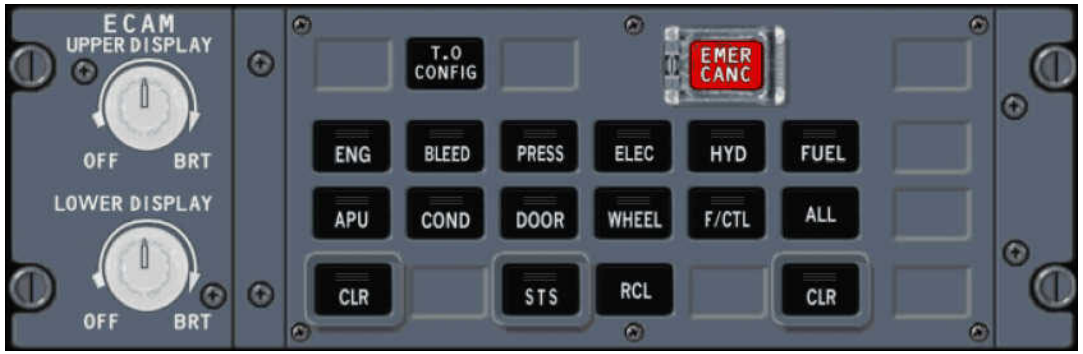


Figure 58 Failure Example Step 1

STEP 2

Green Hydraulic System has Low Level

An aural warning, the single chime, and a visual warning, the Master Caution, attract your attention.

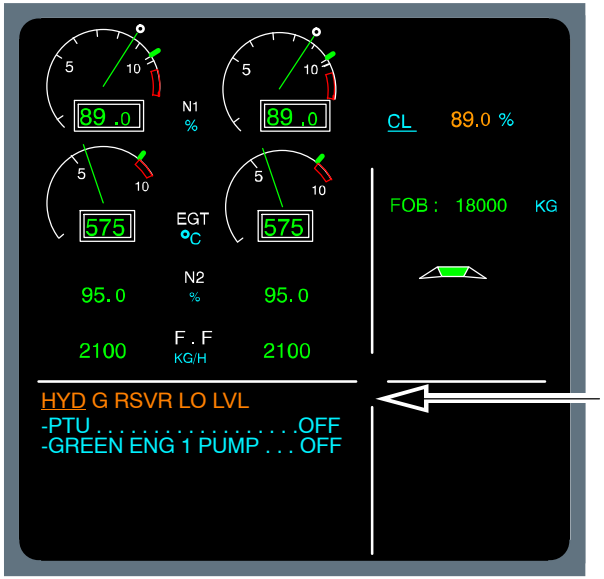
The Engine and Warning Display indicates the title of the failure and the actions to be taken.

On the Status and System Display, the Hydraulic Page is called automatically.

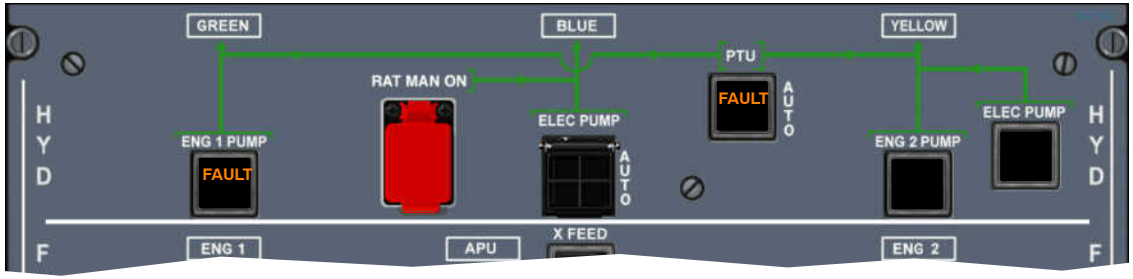
The CLR pushbuttons come on and as long as the failure is not cleared, they stay on.

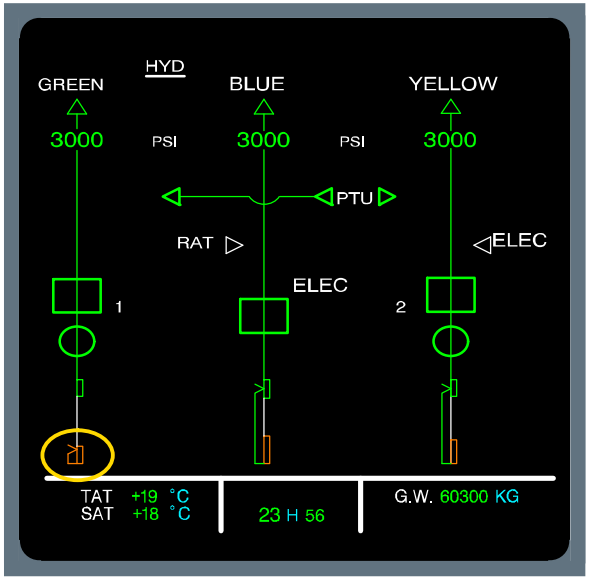
On the Hydraulic Panel FAULT lights come on, indicating the pushbuttons to release out.

The first action is to press the Master Caution pushbutton.



CAUTION MESSAGE





HYD PAGE APPEARS AUTOMATICALLY

"MASTER CAUTION", "FAULT" LIGHTS AND "CLR" PUSHBUTTON ON ECP ILLUMINATE.

Figure 59 Failure Example Step 2

STEP 3

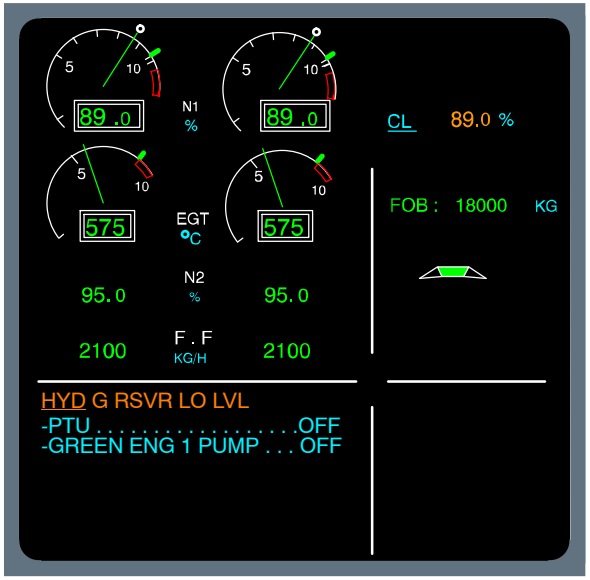
On this picture, the Master Caution pushbutton has been pushed, the light is out.

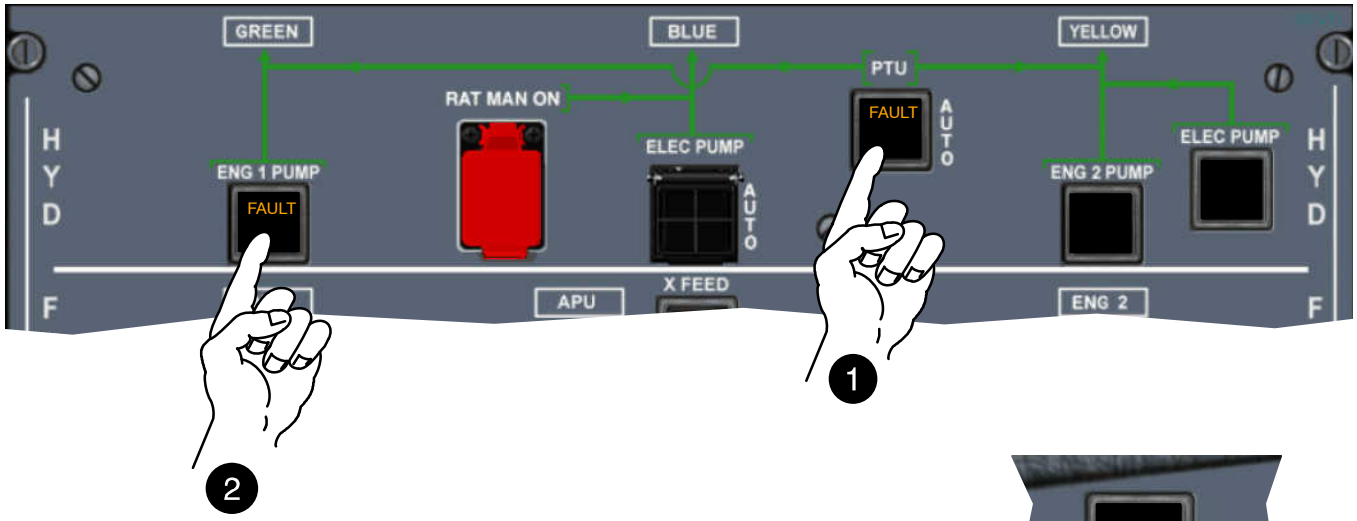
Now you have to perform the actions indicated on the Engine/Warning Display.

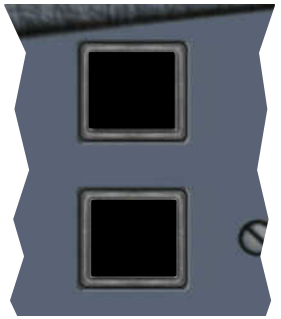
1 **At first, the PTU has to be switched off.**

2 **Then the green engine 1 pump has to be switched off.**

The checklist messages will disappear when the related action is carried out.







ACCORDING THE CHECKLIST FIRST THE PTU IS SWITCHED OFF THEN THE ENG 1 PUMP.
AFTER THIS ACTION THE CHECKLIST MESSAGES WILL DISAPPEAR.

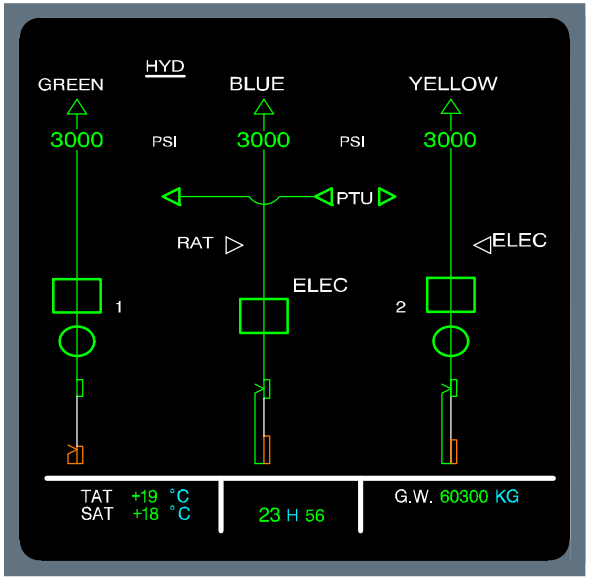


Figure 60 Failure Example Step 3

STEP 4

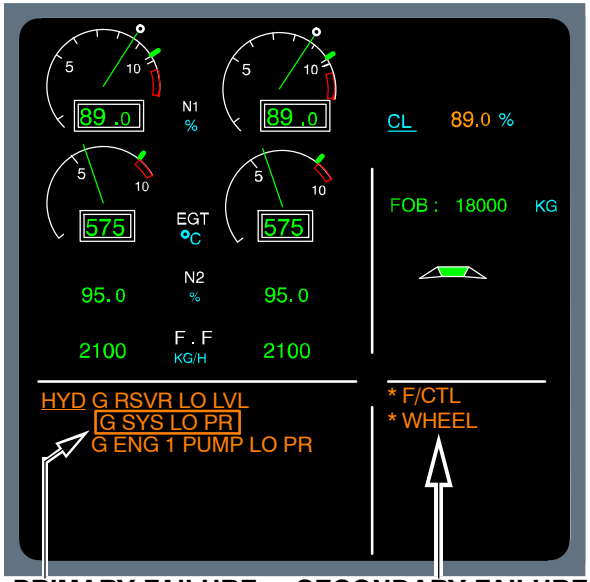
On the next figure, the corrective actions have already been taken. All the FAULT lights are off.

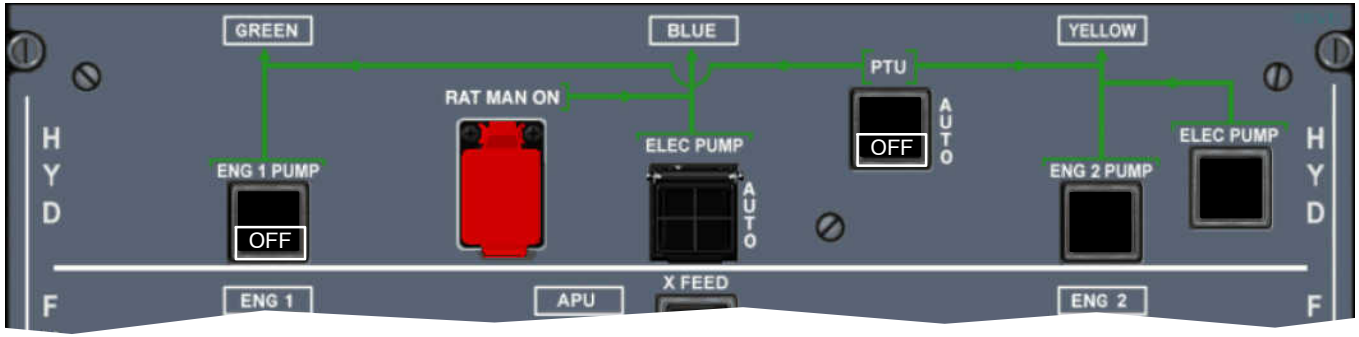
On the Engine/Warning Display, the messages associated with the corrective action have disappeared.

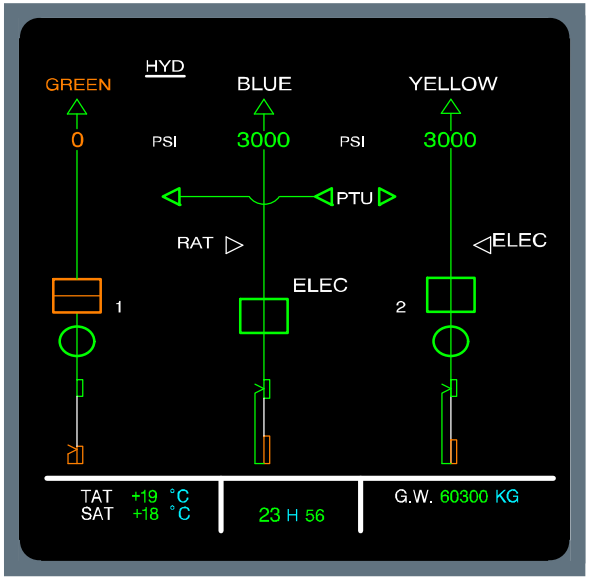
Since the green hydraulic system is now lost, this leads to a new failure message on the E/WD. Therefore the Master Caution Light illuminates again.

On the left hand side of the E/WD, the result of the failure appears indicating that it is a **primary failure**. On the right hand side, the **secondary failures** are displayed.

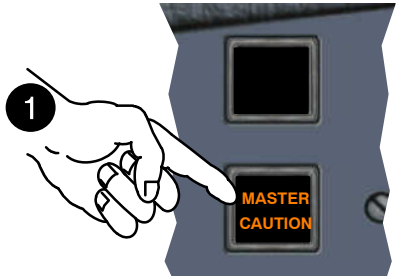
No new checklist appears, so the next action to be done after pressing the Master Caution pushbutton is to press a CLR pushbutton (STEP 5).







FIRST RESET MASTER CAUTION LIGHT. NO CHECKLIST HAS TO BE PERFORMED. WHEN “CLR“ IS PRESSED ON ECP THE SYSTEM PAGES RELATED TO THE SECONDARY FAILURES WILL APPEAR.



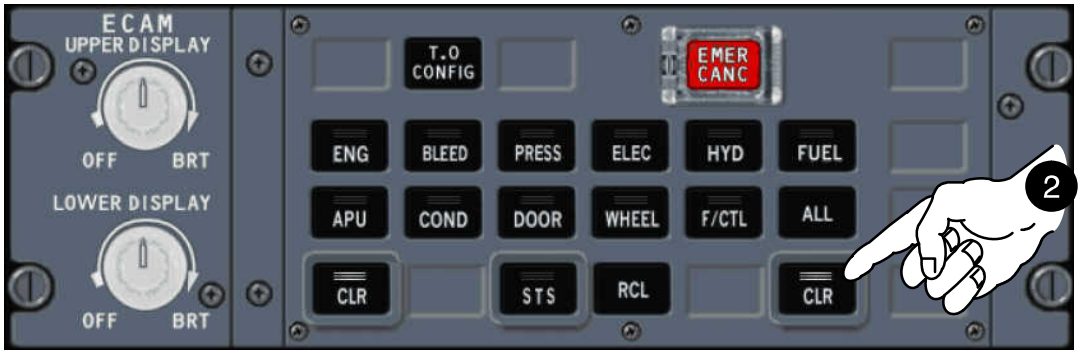


Figure 61 Failure Example Step 4

STEP 5

The Master Caution light extinguishes when the CLR pushbutton was pressed once. The HYD failures disappeared from the left hand part of the Engine/Warning Display and the Memo Messages, if any, will be displayed again on the left part (e.g SEAT BELTS).

The System Page corresponding to the first secondary failure is displayed. The pilot now has an overview about the first affected system (F/CTL).

The next action to be done is to press again a CLR pushbutton (STEP 6).

STEP 6

Now, CLR was pressed a second time. The title of the first secondary failure disappears.

The System Page associated with the next secondary failure is displayed. In this case it is the WHEEL Page.

The pilot receives an overview about the next affected system.

The next action to be done is to press the CLR pushbutton again.

STEP 7

Now, CLR was pressed a third time. The title of the second secondary failure disappeared. On the right hand part of the E/WD MEMO messages may be displayed again (e. g. ENG A. ICE)

The Status Page is displayed. The Status page provides a real time overview about the aircraft condition and inoperative systems.

The next action to be done is to press the CLR pushbutton again.

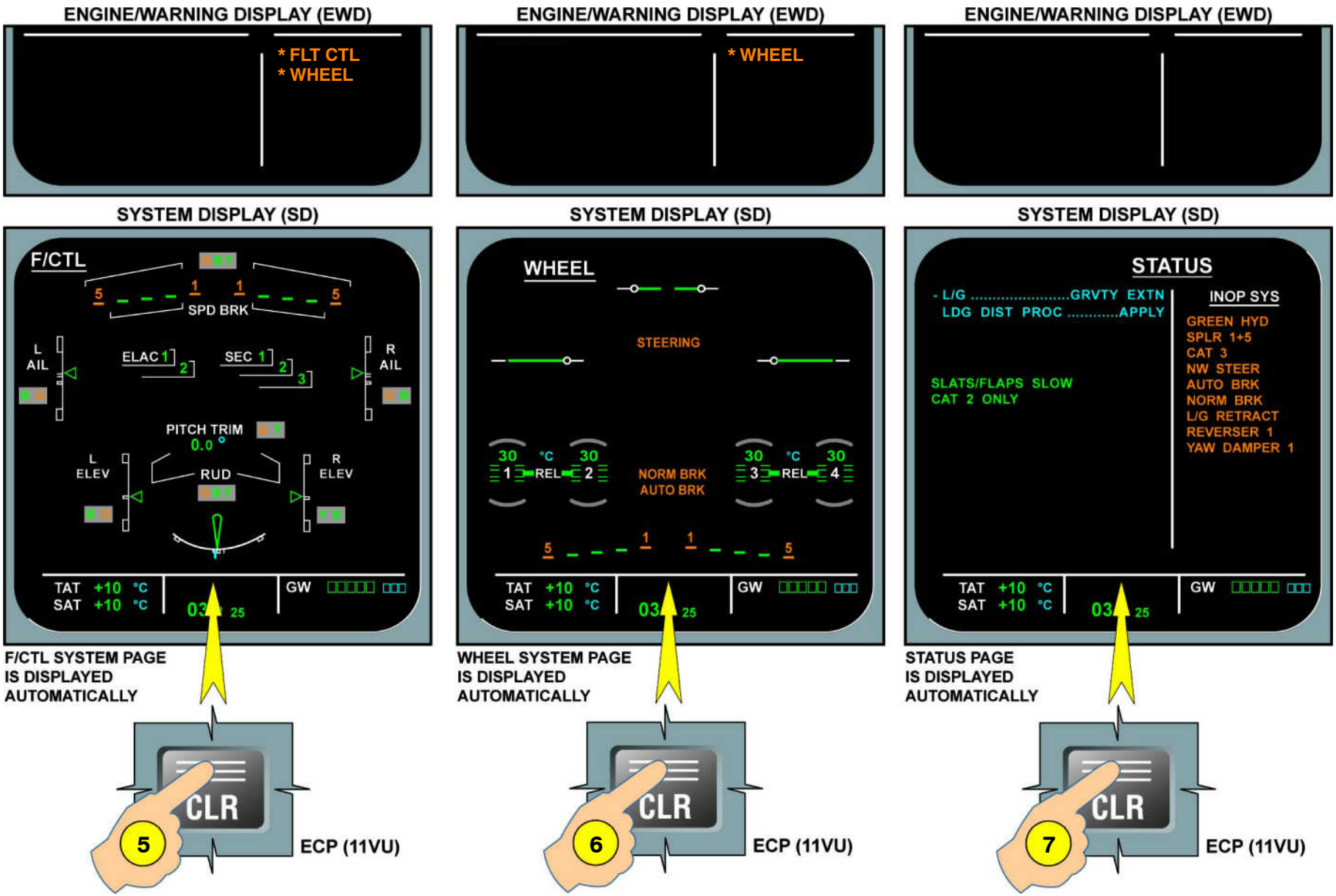


Figure 62 Failure Example Step 5 - 7

STEP 8

On this picture the CLR pushbutton was pressed a fourth time. The CLR pushbuttons are off.

On the System Display, the cruise page is back. The warning has been cleared.

The Status Reminder “STS“ indicates that the Status Page is not empty.

The RCL pushbutton allows the crew to recall warnings.

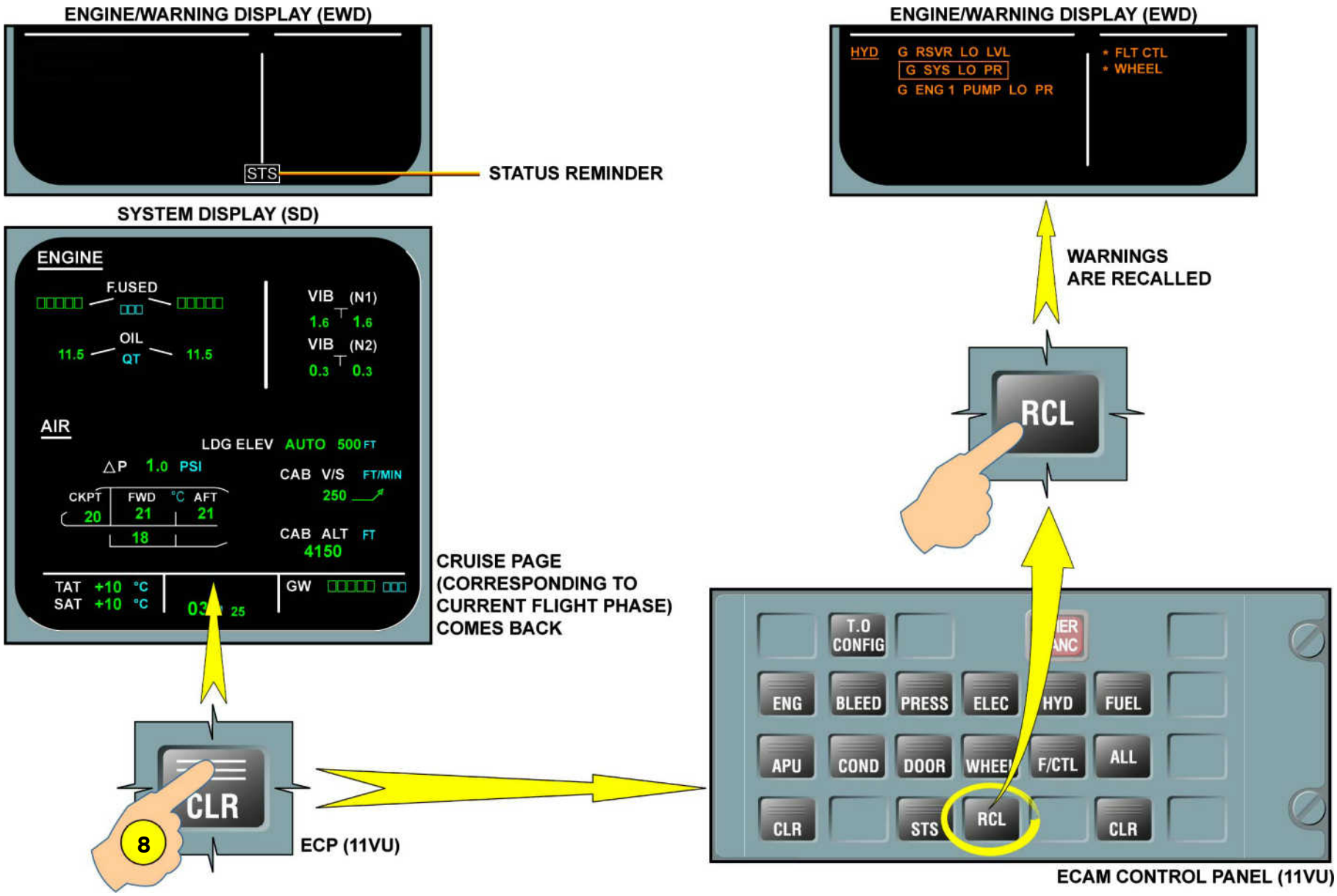


Figure 63 Failure Example Step 8

ADVISORY MODE PRESENTATION

General

The value of some critical system parameters is monitored by an advisory mode.

When the value drifts from its normal range, the corresponding ECAM page is displayed and the affected parameter pulses.

For example the PRESS page will be displayed if the cabin pressure increases above its normal value, but is still well below the threshold of the warning. In this case the crew may revert to manual pressure control and prevent warning activation.

NOTE: An advisory may or may not lead to a failure. They are totally independent one from the other.

Failure Mode

If a failure occurs which is important to be indicated the corresponding ECAM page is displayed. In the case of two or more failures occurring at the same time the FWC decides which one is to be displayed first.

With the Failure Mode the pilots automatically get the indications they need in the case of a failure.

Single Display Unit Operation

If a Parameter drifts out of normal Range when there is only one ECAM Display Unit available (Single Display Unit Operation), a white “ADV“ message pulses at the bottom of the Engine Warning Display to attract crew attention.

As the corresponding system page cannot be displayed automatically on the SD, the pilot has to fetch the information on the ECAM control panel: the associated key light flashes to indicate which system is concerned.

The System Pages can be selected only manually by pressing and holding the concerned pushbutton. After this action the advisory icon on the EWD goes out of view and the flashing key on the ECP extinguishes.

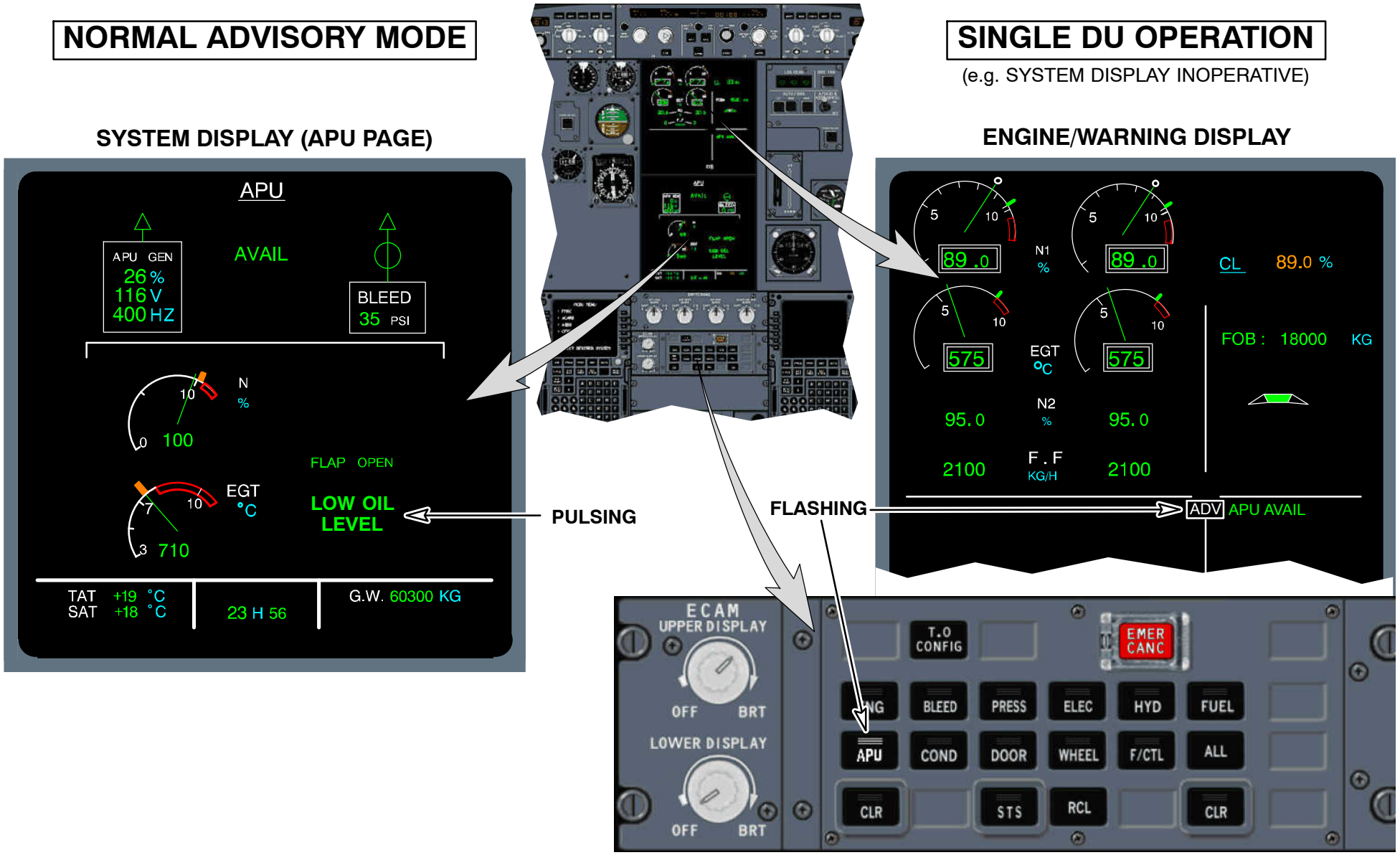


Figure 64 Advisory in Normal and Single ECAM DU Operation

FLIGHT PHASES PRESENTATION

GENERAL

A flight is divided into ten flight phases computed by the FWC. The phases depend on parameters shown on the drawing below.

The flight phases have influence on

- internal BITEs,
- ECAM warning inhibition,
- automatic selection of system pages.

AUTOMATIC MODE

Flight Phases and System Pages

Generally, the System Pages are selected automatically according to the Flight Phase.

The Flight Phases are generated in each Flight Warning Computer and transmitted to the Display Management Computers which display the System Page according to the momentary Flight Phase.

For example, when the aircraft is supplied with electrical power (Flight Phase 1) the Door Page is displayed. When Flight Phase 2 starts the Wheel Page is displayed: after Engine Start the crew has to know if the Aircraft is ready for taxiing, i. e. if the wheels are ok.

If the APU is switched on during Flight Phase 1 or 2 the APU Page has higher priority and will be displayed.

This System Page selection mode is called **Automatic Mode**. In some documents it is also called Flight Phase Mode.

A manual page call can replace the current display at any time.

The APU or engine system pages are displayed in priority if they are started. They remain displayed 10 sec. after APU AVAIL or at the end of ENG START.

Flight Phase 1

DOOR/OXYGEN Page.

This Page appears as soon as the aircraft is supplied with electrical power.

Flight Phase 2

The WHEEL page is displayed only when engine start has been completed.

The flight control page replaces the wheel page for 20 sec. when either sidestick is moved or when rudder deflection is above 22 degrees.

Flight Phases 3–5

ENGINE Page.

During this phase, most warnings are inhibited. "**TO. INHIBIT**" is displayed on the E/WD.

Flight Phase 6

The cruise page is only displayed in flight. It contains both engine and air conditioning information.

The cruise page appears as soon as slats are in and the engines are no longer at take off power.

It disappears when the landing gear is selected down (wheel page back).

The "**T. O. INHIBIT**" message disappears.

Flight Phases 7 and 8

WHEEL page.

During this phase, most warnings are inhibited.

"**LDG INHIBI**T" is displayed on the E/WD.

Flight Phase 9

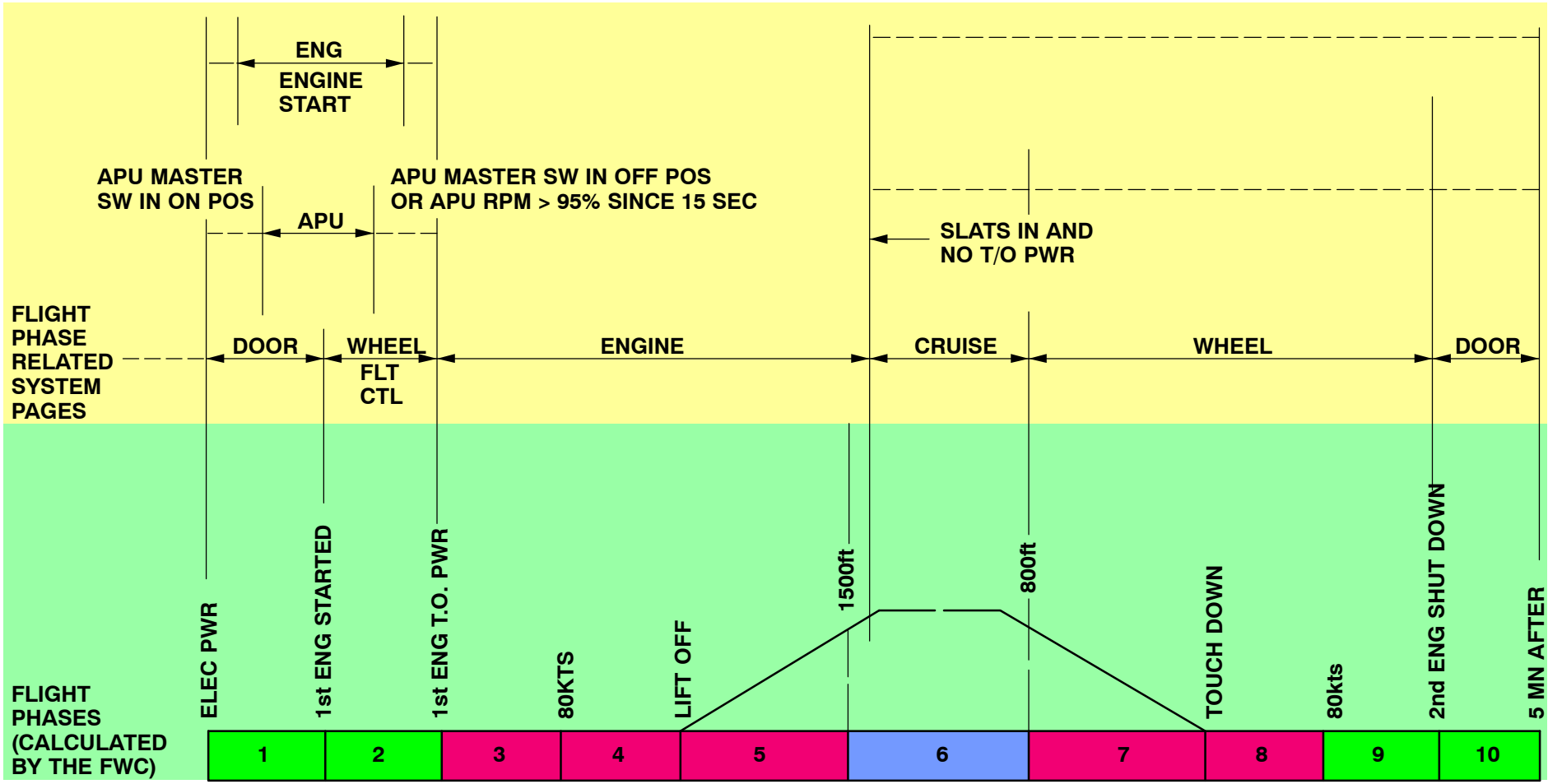
WHEEL page.

The "**LDG INHIBIT**" message disappears.

Flight Phase 10

DOOR/OXYGEN page.

Five minutes after the 2nd engine shutdown, the Flight Warning Computers start a new flight leg in phase 1.



To improve the operational use, warning & caution inhibitions related to flight phases are performed
This is to avoid disturbing alerts especially during high work load phases like take off (phases 3,4,5) or landing (phases 7,8).
In these two cases specific magenta memos are displayed on the E/WD: T.O. INHIBIT and LDG INHIBIT.
Also in flight phase 1, when many systems needed during flight are not operating no warning is generated
(e.g. HYD G SYS LO PR or ELEC GEN 1 FAULT).

NOTE: *The flight phases calculated by the FWC are different and independent from the ones used by the FMGC.*

Figure 65 Automatic Mode Related to the Phase Profile

FLIGHT PHASE ALERT INHIBITION PRESENTATION

In order to avoid alerts when not desired, inhibition follows the rules hereafter:

- Ensure proper alerts only when necessary.
- A warning or indication which has no significance on a given configuration is not activated.

  (e. g.: hydraulic low pressure warning is inhibited before engine starting).
- Avoid alerts without interest for a flight phase.

An inhibition logic filters the presentation of alerts according to the flight phase.

This logic is programmed into the Flight Warning Computer (FWC).

The figure below show an example of a failure, the corresponding failure indications and in which flight phases they are inhibited. Failure tables of all warnings can be found in the AMM. (ATA 31–51 OPERATIONAL PRESENTATION)

NOTE: Even if a warning is inhibited during flight it will be recorded on the post flight report (PFR) of the Centralized Fault Display System (CFDS). Refer to ATA 31–32.

Operating/Control and Indication

Hereafter are given examples of warning pages related to the system which mention:

- the name of the failure
- the detector (item of equipment providing the fault to the warning system)
- the system page automatically called
- the MASTER lights activated by the failure
- the ATA chapter number
- the flight phases which inhibit the failure
- the local warning
- the operational sequence of the crew actions with associated warning title.

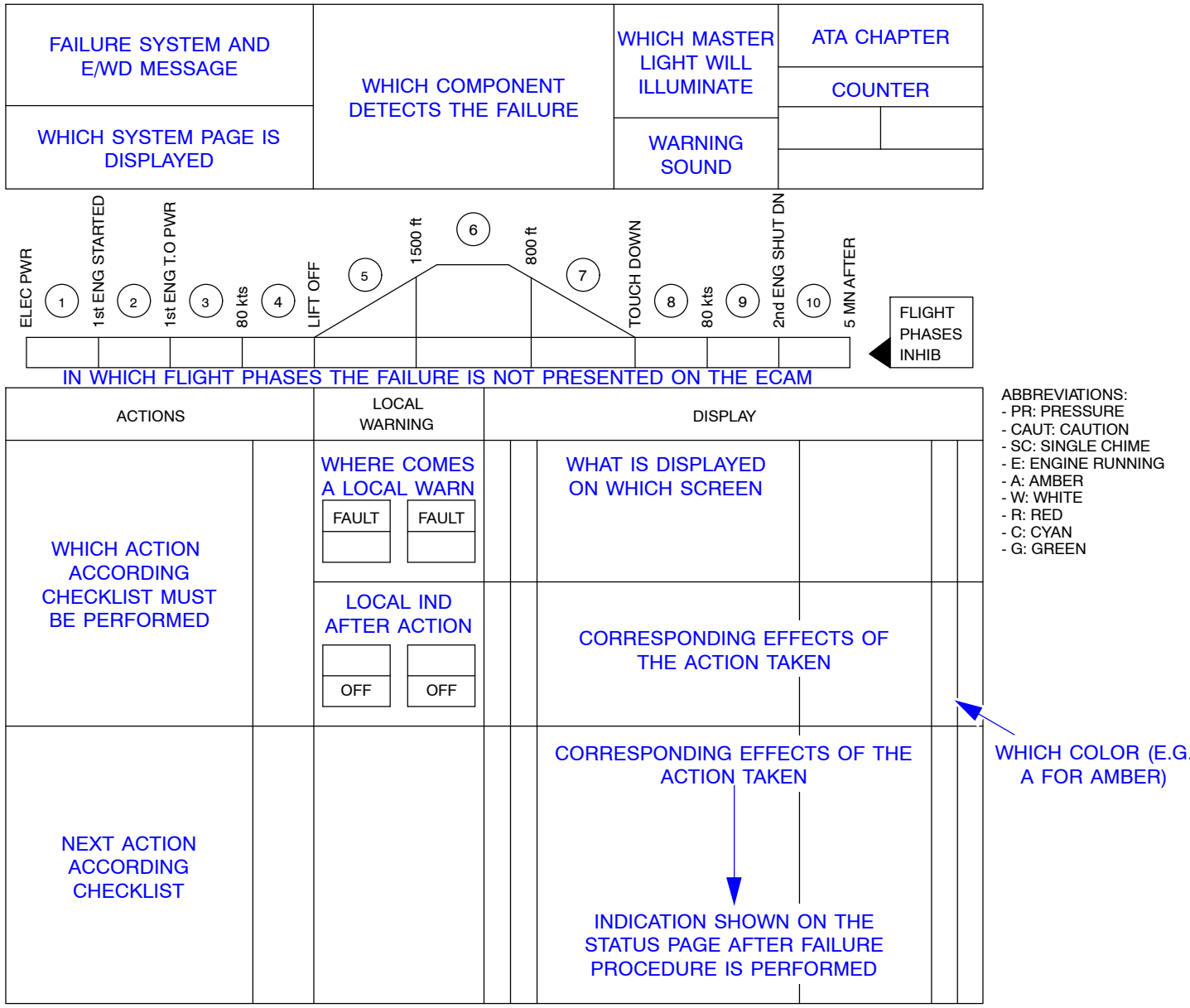


Figure 66 Fight Phase Alert, Inhibition & Indication Table

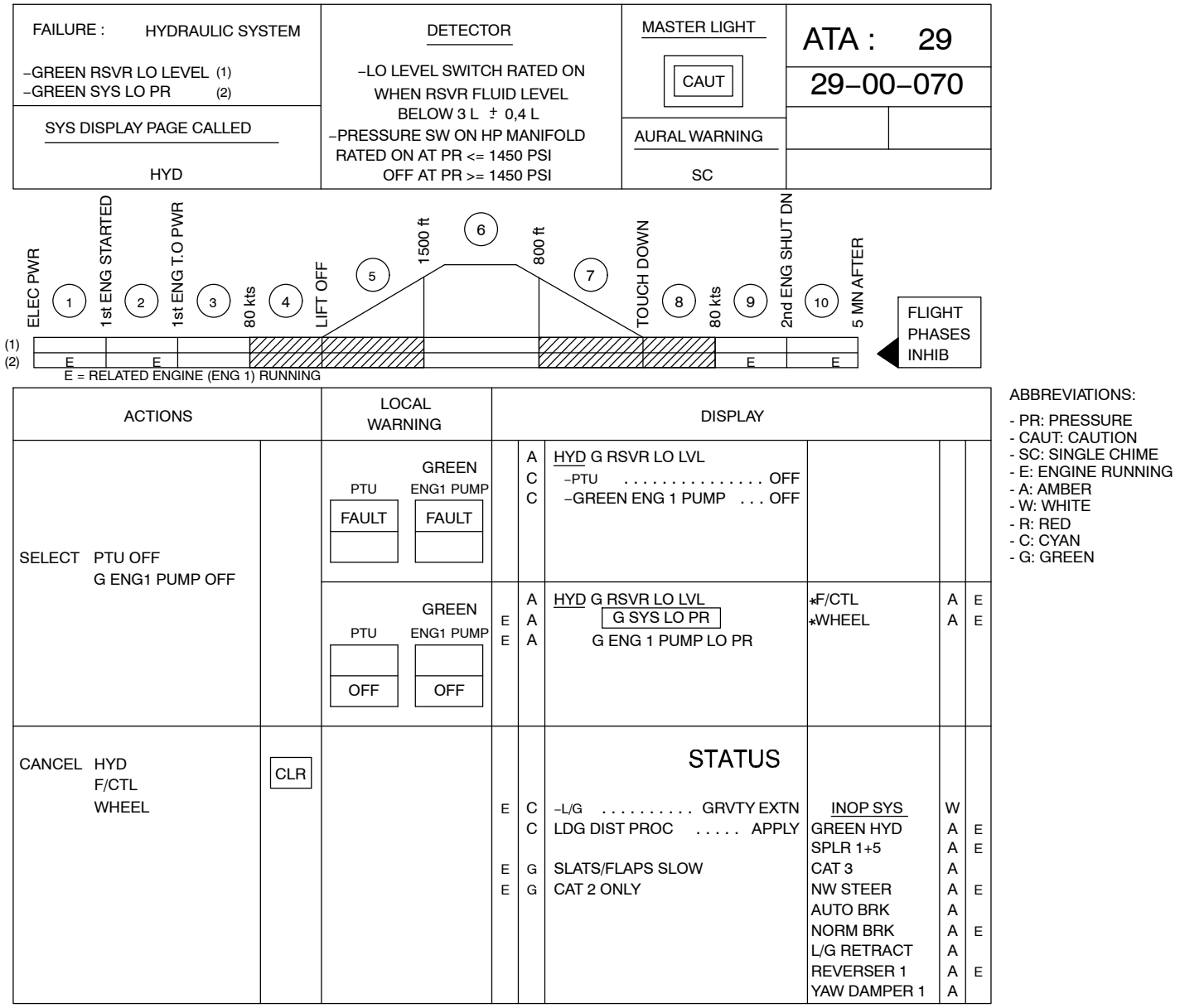


Figure 67 Fight Phase Alert, Inhibition & Indication Example (1)

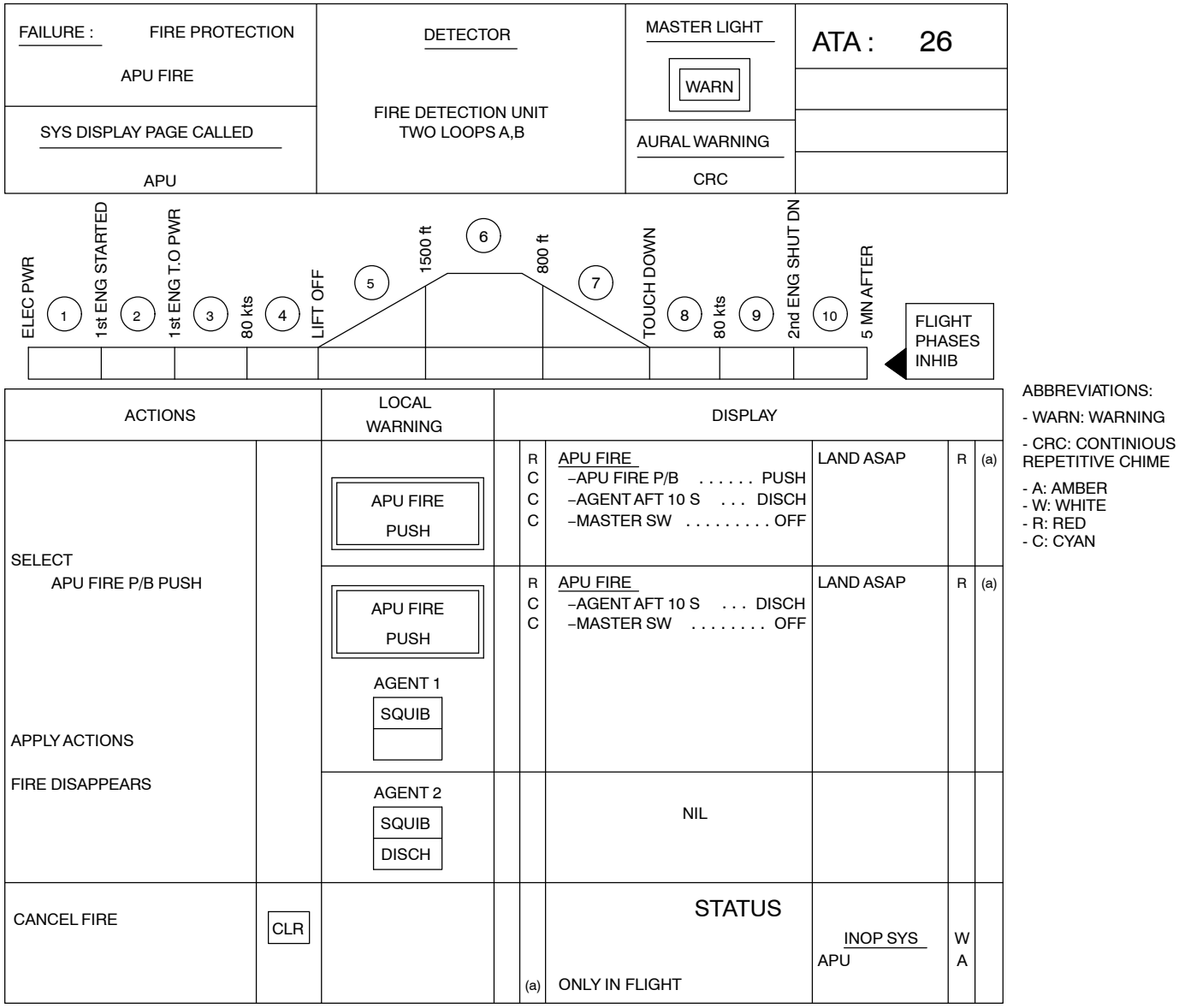


Figure 68 Fight Phase Alert, Inhibition & Indication Example (2)

FWS AND EIS INTERFACE (INPUTS)

FCU Buses (ATA 22)

There is no switching between the two buses received by the DMC, which do not uses the same information from both buses.

An invalid parameter is flagged.

FAC Buses (ATA 22)

There is a switching between the two buses received by the DMC, which normally uses the information of the bus from the same side (DMC1 uses FAC1 and DMC2 uses FAC2).

If the normal bus fails the DMC switches to the bus from the other side (the DMC1 then uses the FAC2). When this side 2 bus fails the DMC switches back to the normal bus.

FMGC Buses (ATA 22)

The same principles apply to the FMC buses.

FCDC Buses (ATA 27)

The DMC uses normally a parameter of the bus from the FCDC1 (DMC1 or DMC2 alike). When this parameter is invalid the DMC uses the parameter of the bus from the FCDC2. In this case a parameter is flagged only if invalid on both buses.

FQI Buses (ATA 28)

Each DMC receives 2 buses one from the part 1 of the FQI computer, one from the part 2. The DMC uses normally the bus 1, but switches to the bus 2 if a switching request is present on the buses, or if the bus 1 is invalid. In all the other cases the bus 1 is used. Then a parameter is flagged only if invalid on both buses.

FWC Data Bus (ATA 31)

A single information from the FWC is selected first from the FWC1, and if not valid from the FWC2.

A parameter is flagged only if invalid on both buses.

SDAC Bus (ATA 31)

A single information is selected first from the SDAC1, and if not valid from the SDAC2.

Some parameters are available either on the SDAC bus or on the FWC bus like the oil quantity.

In this case the value for the oil quantity is selected as follows:

The value is selected from the SDAC1, and if not valid from the SDAC2. If neither is available the value is selected from the FWC1, if not valid from the FWC2.

FWC Message Buses (ATA 31)

The DMC uses normally a message of the bus from the FWC1 (DMC1 or DMC2 alike). When this message is invalid the DMC uses the message of the bus from the FWC2. In this case a message is not displayed only if invalid on both buses.

LGCIU Buses (ATA 32)

There is no switching between the two buses received by the DMC, which displays the information from both buses on the SD.

ADIRU Bus (ATA 34)

The parameters of the ADIRU are selected from the one linked to the DMC, for example the DMC1 uses the ADIRU1 information, except when the pilot has selected the ADIRU3, then the ADIRU3 is used. When a parameter is linked to the ADIRU, for example the TAT, then the value displayed is flagged amber XX if it is not valid.

VOR, DME, ADF, ILS Buses (ATA 34)

There is no switching between the two buses received by the DMC, which displays the information from both buses on the same ND.

If the parameter is invalid the related display is flagged.

Radio Altimeter Buses (ATA 34)

The DMC uses normally a parameter of the bus from the same side (DMC1 uses the RA1). When this parameter is invalid the DMC uses the parameter of the bus from the other side. In this case a parameter is flagged only if invalid on both buses.

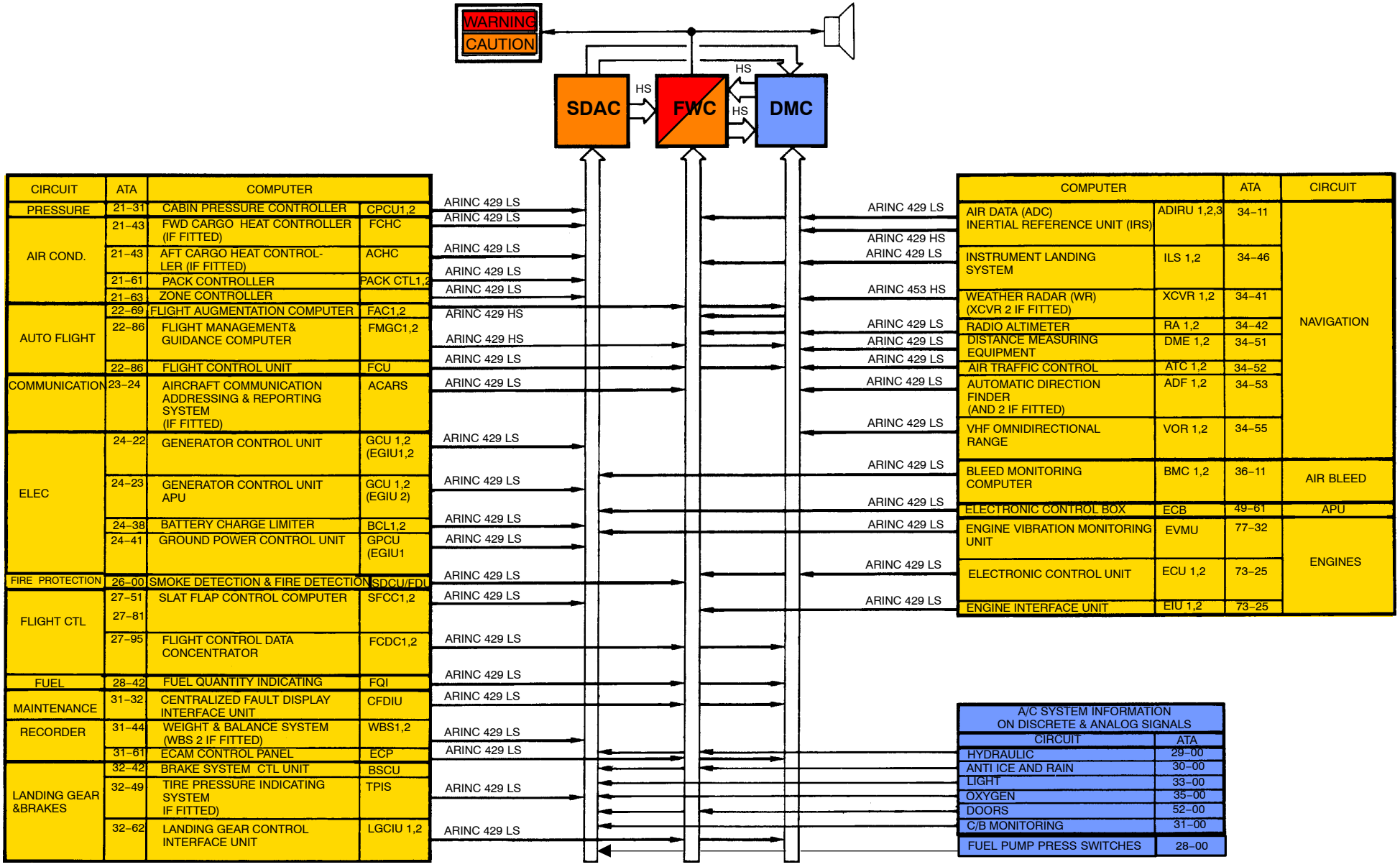


Figure 69 EIS and FWS Inputs Overview

Weather Radar Buses (ATA 34)

The weather radar supplies two buses to the DMC, normally the DMC1 uses the bus 1 and the DMC uses the bus 2, but in case of FMGC1 failure the DMC1 uses the FMGC2 and switches over to the bus 2 from the weather radar. Similarly the DMC2 use the FMGC1 in case of FMGC2 failure and switches over to the bus 1 from the weather radar.

FADEC Buses (ATA 77)

Each DMC receives 2 engine buses one from the channel A and one from the channel B (these 2 channels are redundant). The DMC uses normally the channel in control. If a parameter is invalid on this channel, the DMC switches to the other channel for this parameter. Then a parameter is flagged only if invalid on both buses.

NOTE: Most of the amber cautions are detected by the SDAC. These are systems which are connected to the SDAC.
(e. g. an hydraulic failure)
An amber caution of a system which is not connected to the SDAC (e. g. the ILS) is detected by the FWC.
All warnings and cautions are generated by the FWC.

Discrete Inputs

The EIS receives various discrete and analog inputs to determine aircraft system configurations.

FWC Inputs

Each wired discrete is assigned to a computer input pin.

- **P–** This type of discrete is defined by the two states (on data bus):
  logic 0 : the computer detects ground
  logic 1 : the computer detects absence of ground.
- **P+** This discrete is defined by the two states:
  logic 1 : the computer detects +28VDC
  logic 0 : the computer detects absence of 28VDC.
- **P– off**
  logic 0 : the computer detects disappearance of ground
  logic 1 : the computer detects a permanent ground.
- **P+ off**
  logic 1 : the computer detects disappearance of +28VDC
  logic 0 : the computer detects permanent +28VDC.

Some discretes are inversed (P– at logic 1 : ground) for their use in the logics. There are also output discretes.

Controlled by the computer, logic 1 is represented by a ground and logic 0 by open circuit. They permit illumination of an annunciator light or closing of a relay.

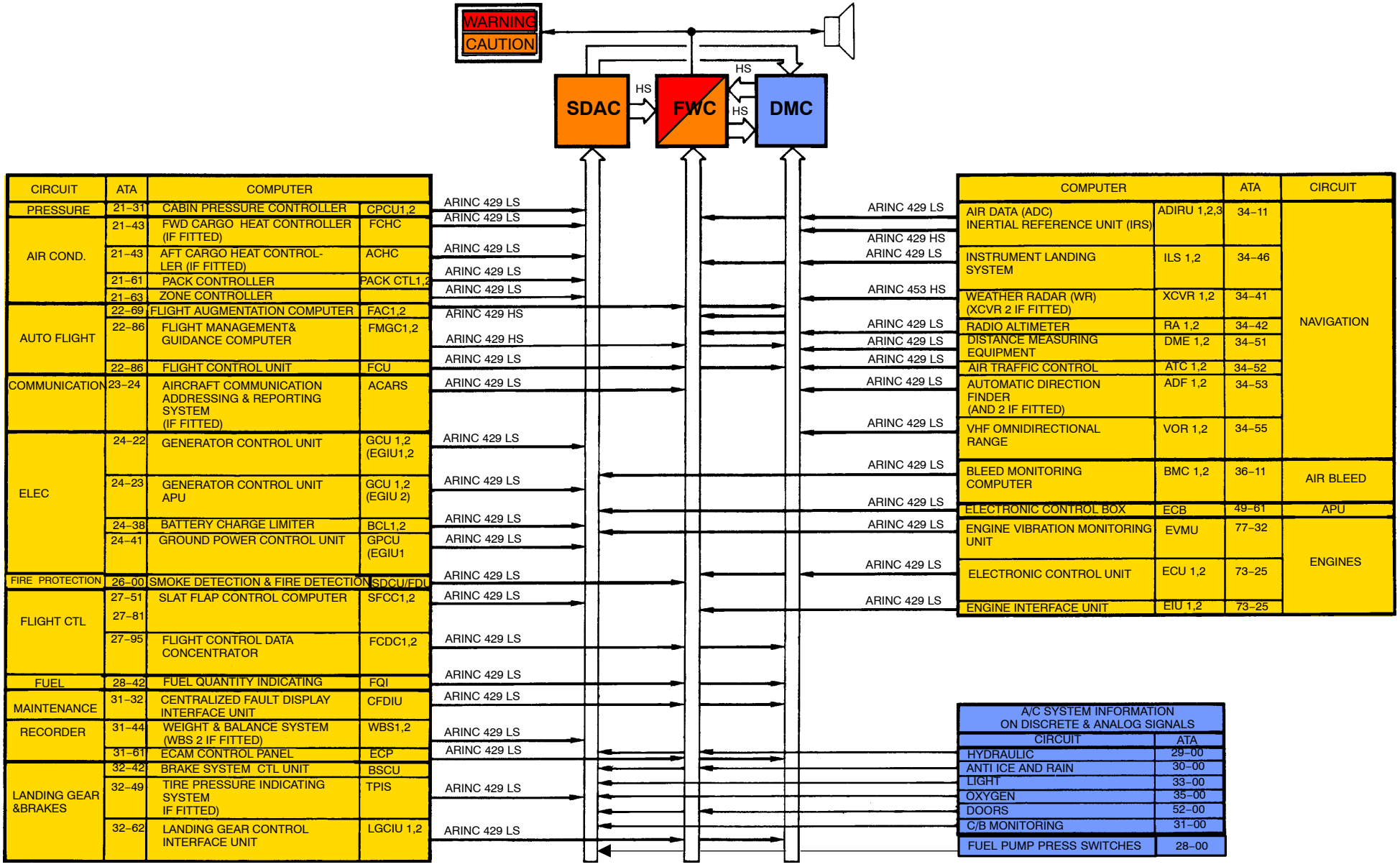


Figure 70 EIS and FWS Inputs Overview

SYSTEM DATA ACQUISITION CONCENTRATOR INTERFACE

Description

Two convertible SDACs (**S**ystem **D**ata **A**cquisition **C**oncentrator) are installed in the A320 family.

Both SDACs receive the same information.

Each SDAC receives digital and analog data and discrete signals directly from various aircraft systems. These data are concentrated by each SDAC, i. e. the numerous analog and digital inputs are processed and offered to different users in ARINC 429 format.

Most data for the System Display are processed in the SDACs.

Both SDACs also receive data about level 1 and level 2 malfunctions and failures from most aircraft systems. These data are transmitted to the FWCs. The FWCs generate the corresponding Caution Messages and Procedure Messages for the Engine/Warning Display.

The software is memorized on an OBRM (On Board Replaceable Module) so that software modifications can be done quickly.

Failures

If one SDAC fails the receiving systems still are supplied by the other SDAC. All functions are preserved.

If both SDACs fail most of the Caution Messages can not be displayed any more. On some System Pages some parameters can not be displayed any more. ” XX ” is displayed instead.

Local Warning Lights are still operative on the Overhead Panel.

Outputs

The systems listed below receive digital data from the SDACs:

- DMC 1, 2 & 3

  The Display Management Computers receive data to be displayed on the System Display.
- FWC 1 & 2

  The Flight Warning Computers receive data for Caution Messages and BITE information.
- CIDS Director 1 & 2

  The CIDS Directors receive data for door indication from SDAC 1 only.
- FDIU

  The Flight Data Interface Unit receives data to be recorded in the Digital Flight Data Recorder.
- DMU

  The Data Management Unit receives data to be used in the AIDS.
- MU ACARS

  The ACARS Management Unit receives data to be sent via VHF from SDAC 1 only.

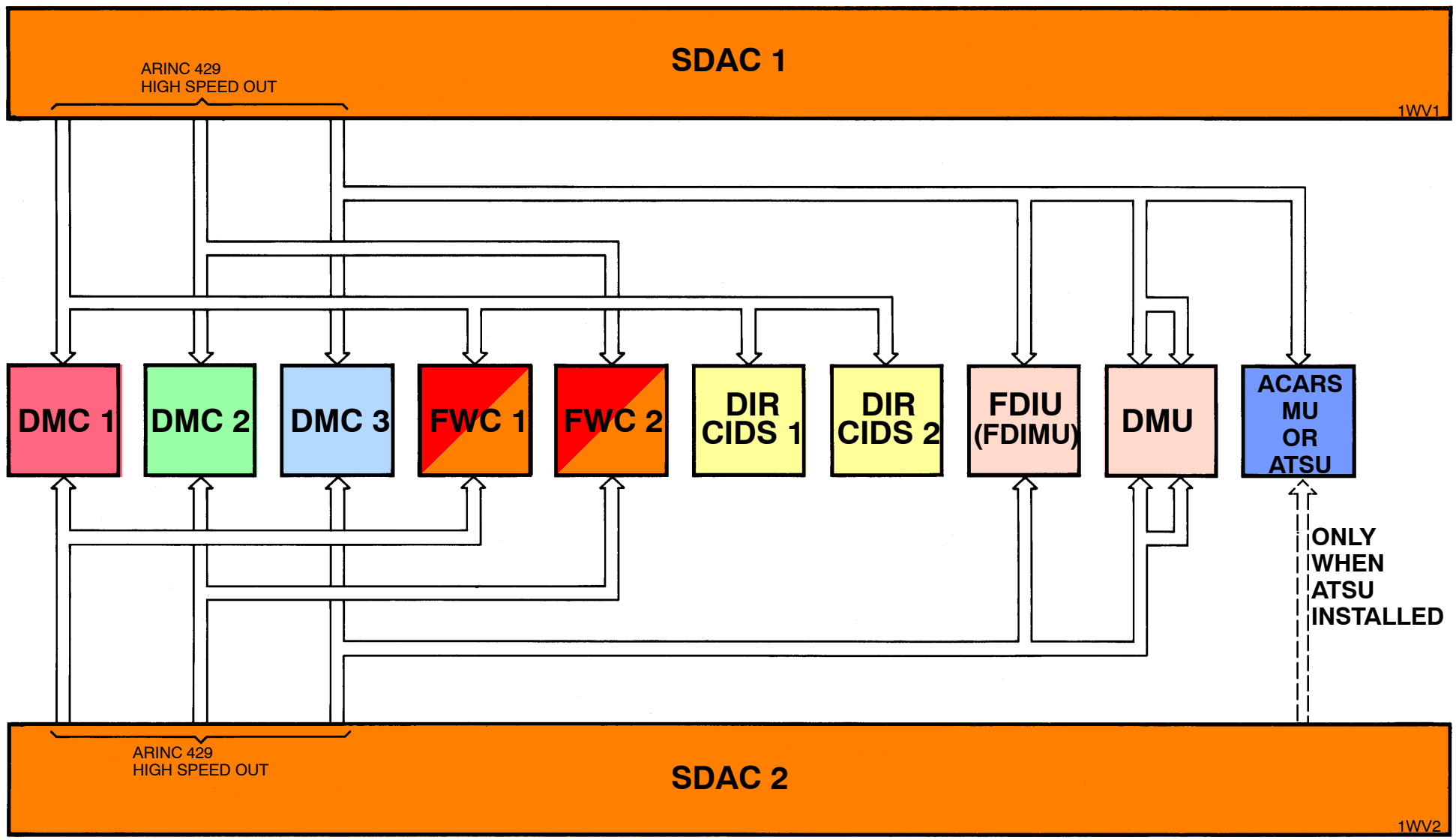


Figure 71 SDAC Outputs

FLIGHT WARNING COMPUTER SYSTEM OPERATION

Description

Two convertible FWC (**F**light **W**arning **C**omputer) are installed.

Both FWC receive the same information.

The FWCs work on following tasks:

- Triggering of Master Warning and Master Caution Lights,
- Triggering of AFS Autoland Lights,
- Generating of Warnings and Caution Messages for the E/WD,
- Generating of Procedures associated to failures,
- Generating of the Status Function,
- Generating of Memo Messages,
- Generating of Aural Warnings and Callouts,
- Generating of Flight Phases (by using input parameters) ,
- Triggering of the DMCs which System Page is to be displayed (in automatic mode),
- Establishing of the interface to CFDIU for the SDACs,
- Comparison of Heading, Attitude and Altitude Indications,
- Calculation of Overspeed Limits and
- Calculation of Stall Limits.

Both FWCs receive all data about level 3 warnings (and some data about level 1 and level 2 malfunctions) directly from the aircraft systems in analog or digital form depending on the affected system. Most data about level 1 and level 2 malfunctions are received from both SDACs. Each FWC is connected with the opposite FWC via a data bus.

Normally, the FWCs use data from SDAC 1. If this one fails SDAC 2 is used.

The software is memorized on an OBRM (On Board Replaceable Module) so that software modifications can be done quickly.

Failures

If one FWC fails the receiving systems still are supplied by the other FWC. Most functions are preserved.

If FWC 1 fails, the message " FWS FWC 1 FAULT " appears on the E/WD.

On captain's Master Warning and Master Caution Light the " Master "–line, and on copilot's side the " Warning " and " Caution "–lines can not illuminate any more because the upper and the lower bulb are triggered from different FWCs. (If FWC 2 fails "...FWC 2..." instead of FWC 1 and the Attention Getters accordingly reversed.)

If both FWCs fail the consequences are:

- no Auto Callouts,
- no Aural Warnings,
- no Memo Messages,
- no status page,
- no Master Warning Light,
- no Master Caution Light.

Outputs

The systems listed below receive digital data from the FWCs:

- DMC 1, 2 & 3

  The Display Management Computers receive Messages to be displayed on the Lower Part of the E/WD and Status Messages for the Status Page.
- CFDIU

  The Centralized Fault Display Interface Unit receives data for BITE information.
- FDIU

  The Flight Data Interface Unit receives data to be recorded in the Digital Flight Data Recorder.
- DMU

  The Data Management Unit receives data to be used in the AIDS.
- MU ACARS

  The ACARS Management Unit receives data to be sent via VHF from FWC 1 only.

Discretes trigger the Cockpit Loudspeakers, Master Warning Lights, Master Caution Lights, Auto Land Lights.

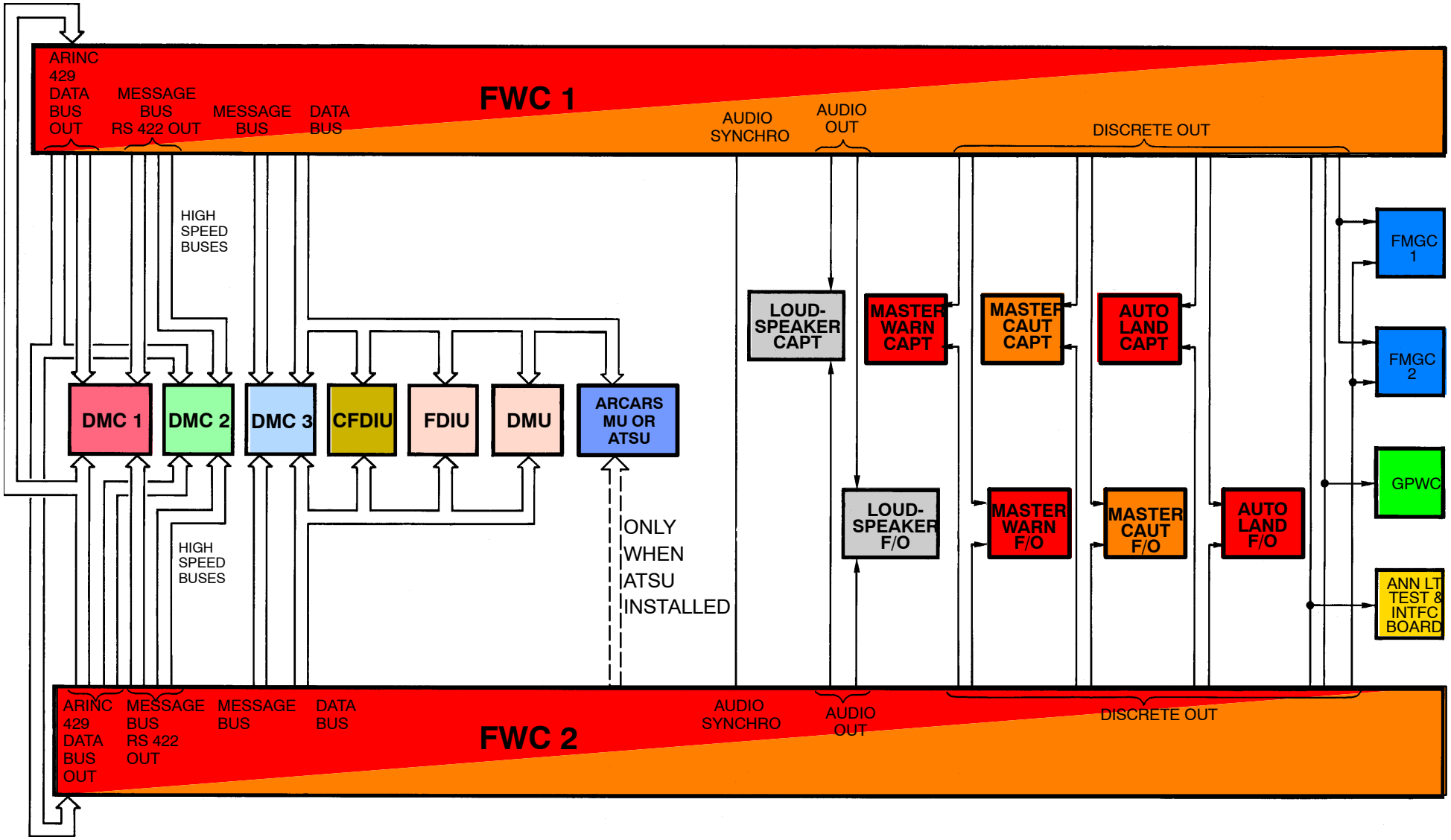


Figure 72 FWC Outputs

PARAMETER COMPARISON FUNCTIONAL OPERATION

General

Each FWC works as a comparator. If it detects differences between the displayed parameters a message is generated.

The monitored parameters are:

- Heading,
- Attitude,
- Altitude.
- Speed (not in all AC)

NOTE: The speed displayed on the PFDs is not compared. It has to be checked by the flight crew, (depending on AC eff.)

Since some parameters displayed by the EIS are flight essential or flight critical, the DMC hardware and software are designed to cope with the specified safety requirements.

Considering this safety aspect, the three channels are independent and each of them takes the data needed for computation in dedicated memory area. These data are protected against inadvertent access from the other channels.

Architecture and software monitoring precautions are taken in order to cope with the classification of the software, particularly with respect to the processing of flight critical data.

These parameters are delivered by the ADIRUs (Air Data Inertial Reference Unit). or more information refer to ATA 34–10.

Comparison Operation

A comparison is performed between pitch and roll data received and processed by the DMC on one hand, and the pitch and roll feedback signal received from the PFD standing for the displayed pitch and roll information, on the other hand.

Moreover, the FWC performs an extra comparison between the pitch (and roll as well) information displayed on Captain's PFD and the pitch (and roll) data delivered by the IRS2, and likewise between the First Officer's PFD and IRS1 data.

Inside the DMC, the monitoring for the baro altitude and for the engine primary parameters is similar: it also consists in comparing the displayed information and the input parameters.

Inside the FWC, the comparison performed for the heading indications is simple: comparison between the heading parameters used for display on side 1 and side 2.

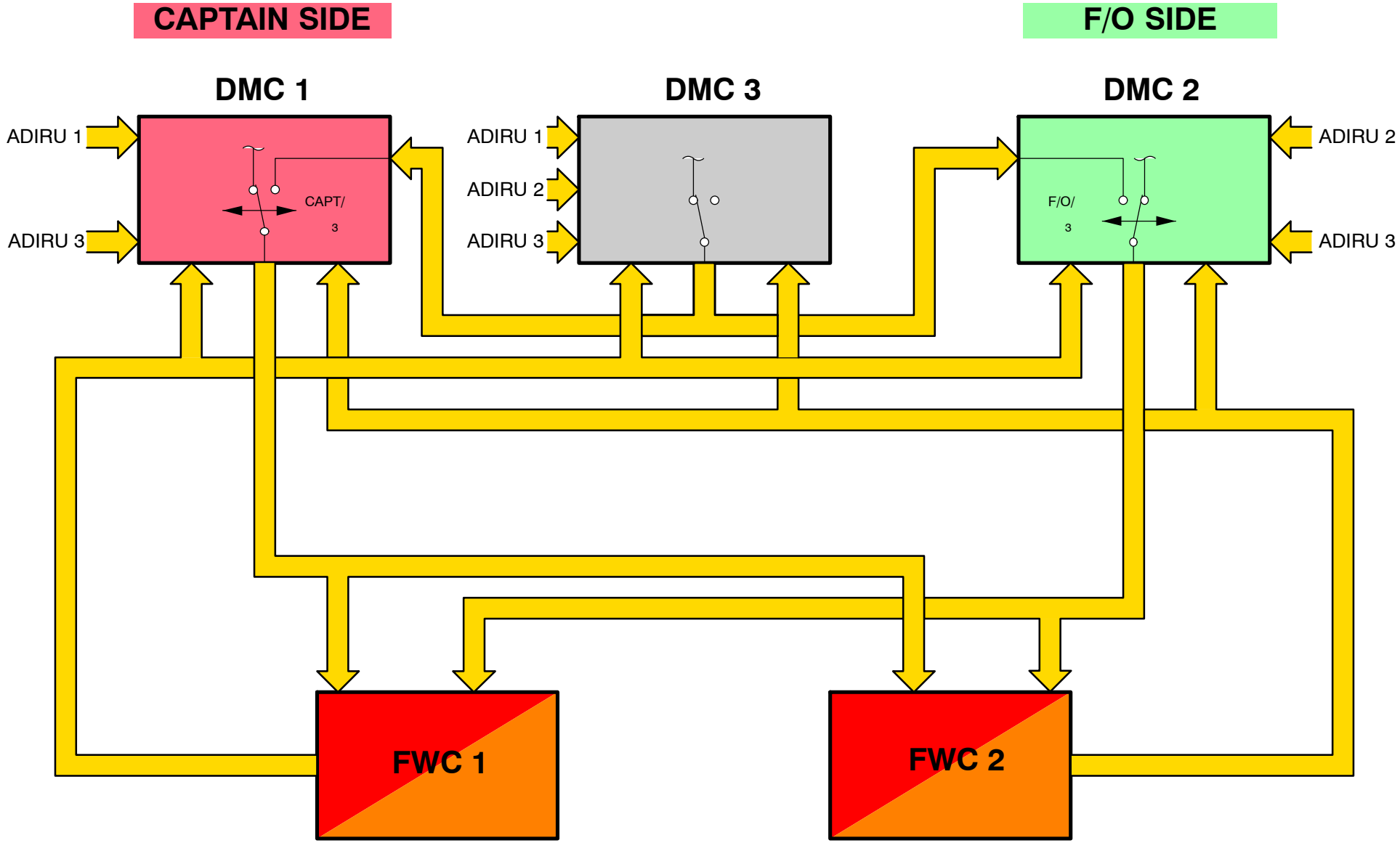


Figure 73 ATT, HDG ALT Comparison Data Link

AIR DATA COMPARISON

Altitude Comparison

If the FWC detects a difference between the altitude indications, the message ”CHECK ALT” appears on the PFD.

This message is displayed when a difference higher than plus or minus 250 ft is detected by the external comparison inside the FWCs between the baro–corrected altitude (or plus or minus 500 ft for the standard altitude).

When it is displayed:

- the MASTER CAUT lights on the glareshield come on,
- the Single Chime (SC) sounds,
- the CHECK ALT message appears on the PFD.

In this case the pilots have to compare the indications with the Standby Altimeter to do the appropriate ADIRS switching.

NOTE: The Speed displayed on the PFDs is not compared. It has to be checked by the flight crew.

Speed Comparison

If the FWC detects a difference between the speed indications, the message ”CHECK SPEED” appears on the PFD.

When it is displayed:

- the MASTER CAUT lights on the glareshield come on,
- the Single Chime (SC) sounds,
- the CHECK SPEED message appears on the PFD.
- IAS DISCREPANCY Caution activated

INERTIAL DATA COMPARISON

Heading Comparison

If the FWC detects a difference between the heading indications, the message ”CHECK HDG” appears on the heading scale of the PFD and on the ND.

This message is displayed when a difference higher than 7 deg. (or 5 deg. in true heading) is detected by comparison inside the FWCs.

When it is displayed:

- the MASTER CAUT lights on the glareshield come on,
- the Single Chime (SC) sounds
- the CHECK HDG message appears on the PFDs and NDs.

In this case the pilots have to compare the indications by switching to ADIRS3 or by checking the heading via standby compass!

Attitude Comparison

If the FWC detects a difference between the attitude indications, the message ”CHECK ATT” appears on the PFD.

This message is displayed when a difference higher than 5 deg. is detected by comparison inside the FWCs between the roll angle or the pitch angle.

When it is displayed:

- the MASTER CAUT lights on the glareshield come on,
- the Single Chime (SC) sounds,
- the CHECK ATT message appears on the PFD.

In this case the pilots have to compare the indications by switching to ADIRS3 or by checking the attitude via standby horizon!

CAPTAINS PFD

CAPTAINS ND

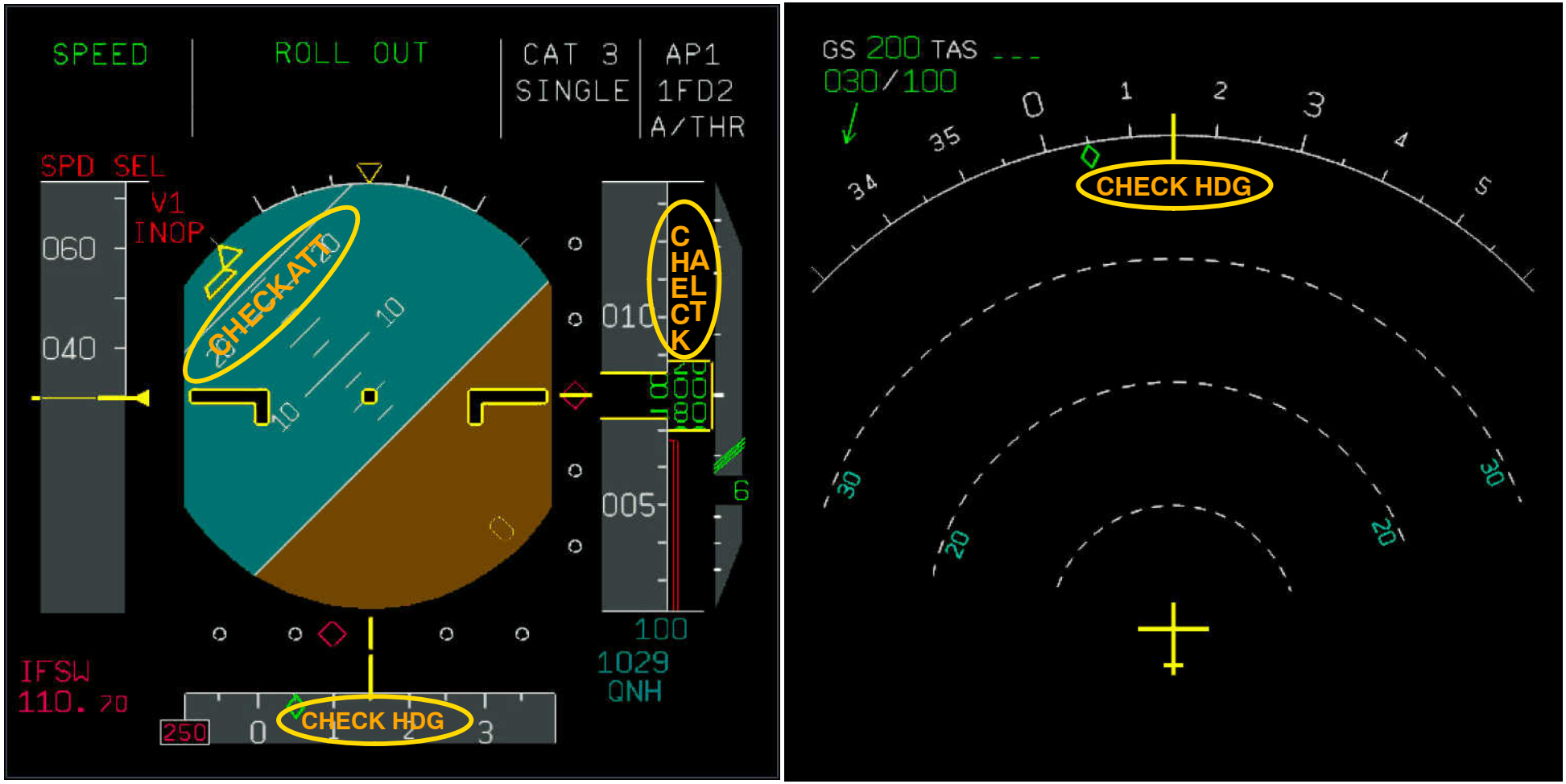


Figure 74 ALT, HDG & ATT Comparison Indication

EIS AND CWS POWER SUPPLY INTERFACE

Normal Operation

The 3 DMCs and the 6 DUs are supplied with 115V/400Hz and with 28V DC. The DC power is needed for the switching.

Emergency Operation

In the case of emergency electric configuration the emergency generator supplies the AC ESS , DC ESS and SHED buses.

Then these EIS units are still electrically supplied:

- PFD 1,
- ND 1,
- UPPER ECAM DU,
- ECAM CTL PNL,
- FCU 1,
- SDAC 1,
- FWC 1,
- MASTER CAUTION LIGHTS (half),
- MASTER WARNING LIGHTS (half),
- DMC 1 and
- DMC 3 (only when EIS DMC CAPT 3 is selected).

NOTE: In the case of emergency electric configuration with batteries only, also the SHED buses and therefore ND 1 is lost.

DMC Power Supply Switching

When DMC 1 fails the Captain selects DMC 3.

In the case of AC Bus 1 failure, the relay 26WT switches the power supply to the AC Essential Bus.

EIS and FWS power supply

The table shows the power supply of the EFIS and ECAM LRUs.

AC BUS1	AC BUS 2	DC BUS 2	AC ESS BUS	AC ESS SHED BUS	DC ESS BUS	DC ESS SHED BUS
DMC 3	DMC 2	DMC 2	DMC 1 (DMC 3)		DMC1&3	
	PFD 2	PFD 2	PFD 1		PFD 1	
	ND 2	ND 2		ND 1		ND 1
	LOWER ECAM		UPPER ECAM			
		FCU 2			FCU 1	
					ECAM CP	
	FWC 2		FWC 1			
	SDAC 2		SDAC 1			

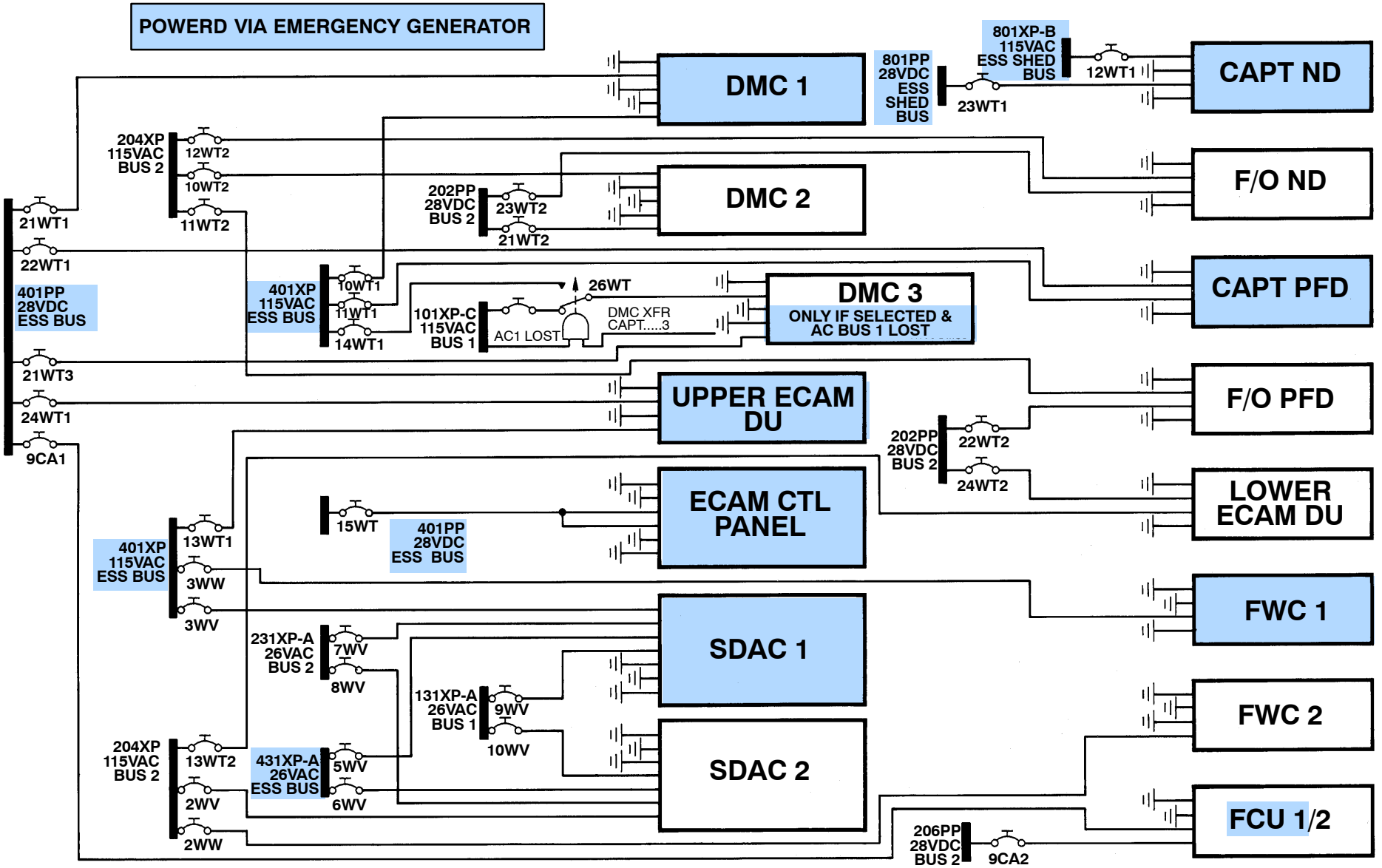


Figure 75 EIS and FWS Power Supply

31–60 ELECTRONIC INSTRUMENT SYSTEM 2 (EIS2)

GENERAL DESCRIPTION

Classic EIS

On the classic EIS, the aircraft data are seen on CRT (**C**athode **R**ay **T**ubes).

The DMC (**D**isplay **M**anagement **C**omputer) 1 drives the Captain PFD (**P**rimary **F**light **D**isplay), the CAPT ND (**N**avigation **D**isplay), and the EWD (**E**ngine and **W**arning Display). The DMC 2 drives the F/O PFD, the F/O ND and System Display (SD). The DMC software is modified by the OBRM **(O**n **B**oard **R**eplaceable **M**odule).

In case of display unit failure, the screen becomes blank, in case of DMC failure a diagonal bar is displayed on the relevant screens.

The DMCs sent the picture data to the display units in digital form, using a very high speed (800 kbauds) RZ type transmission, through a twisted shielded pair of wires, called dedicated serial data link (DSDL).

Enhanced EIS

On the enhanced EIS, the aircraft data are seen on a LCD (**L**iquid **C**rystal **D**isplay). The DMC 1 drives the CAPT PFD, the CAPT ND, the EWD and the SD. The DMC 2 drives the F/O PFD and the F/O ND. The internal DMC software is modified by using the MDDU (**M**ultipurpose **D**isk **D**rive **U**nit), or by cross loading from another DMC, via the MCDU (**M**ultipurpose **C**ontrol **D**isplay **U**nit).

In case of display unit failure „INVALID DISPLAY UNIT“ is displayed. In case of failure of the DMC ”INVALID DATA ”is displayed on the relevant screens.

The DMCs sent the picture data to the display units in digital form via two channels, called ARINC 629 data bus.

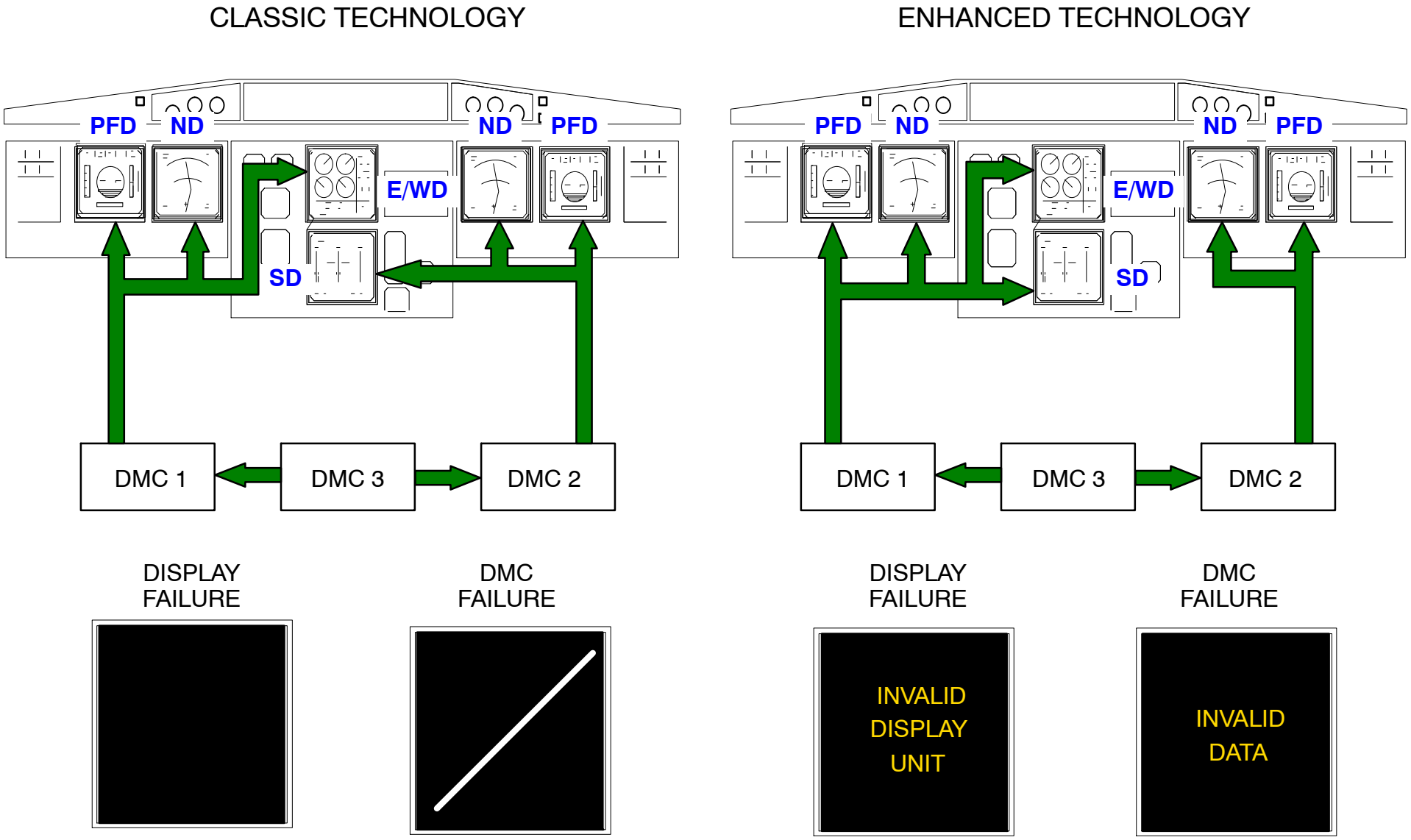


Figure 76 DMC General Layout

EIS 2 ARCHITECTURE

EFIS - ECAM

The Electronic Instrument System (EIS) is shown on 6 identical Liquid Crystal Display (LCD) units and controlled through the EIS control panels. The Electronic Centralized Aircraft Monitoring (ECAM) displays are identical and controlled through the ECAM Control Panel (ECP).

The Electronic Flight Instrument System (EFIS) displays are controlled by the EFIS control panels and the lighting/loudspeaker control panels.

DMC

The Display Management Computers (DMCs) are data concentrator and receive data from aircraft sensors and systems. They send them to the Display Units (DUs).

The DUs compute and display the images on each unit. In normal operation DMC1 drives the CAPT Primary Flight Display (PFD), the CAPT Navigation Display (ND), Engine/Warning Display (EWD) and System Display (SD).

In normal operation DMC 2 drives the F/O PFD and ND DUs. If DMC 1 fails, it is automatically replaced by DMC 2 for ECAM only. DMC 2 cannot drive the CAPT PFD and ND; a manual switching to DMC 3 is required.

DMC 3 can drive any of the six DUs. DMC 3 is a hot spare awaiting the failure of DMC 1 or 2 and can be switched to drive the DUs linked to the failed DMC.

FWC

The Flight Warning Computers (FWCs) monitor the aircraft systems.

Each FWC generates all warning and caution messages, supplies the attention getters, computes the flight phase and provides aural warnings.

SDAC

The System Data Acquisition Concentrators (SDACs) receive various signals from the aircraft systems and send them to the FWCs and to the DMCs.

INPUTS

The inputs received by the FWC are used to elaborate red warnings.

Various items of information for systems like engines, fuel, navigation and which do not agree with a warning, are directly sent to the DMCs.

The inputs received by the SDACs are used by the DMCs to display system pages and by the FWCs to generate amber warnings.

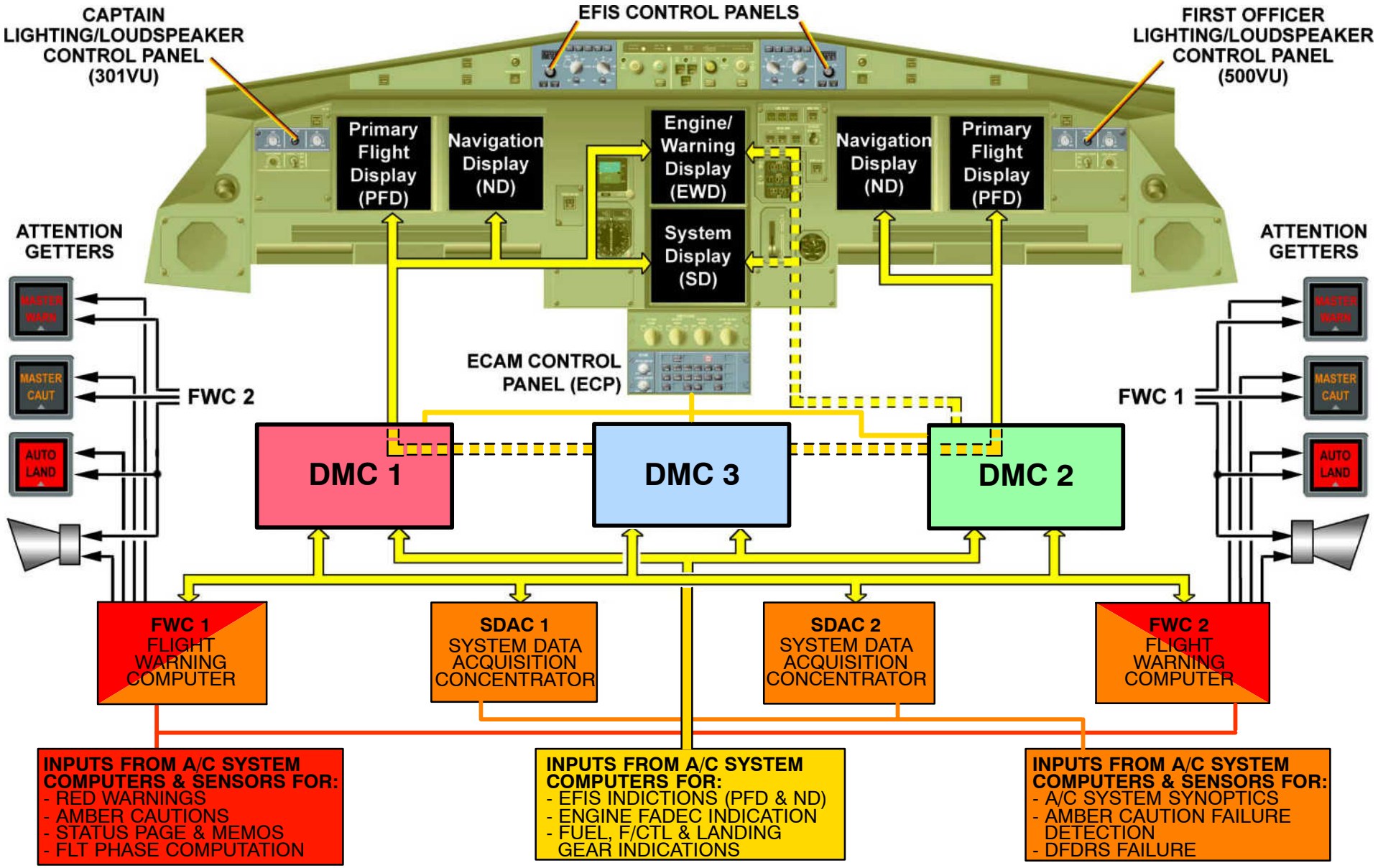


Figure 77 EIS 2 Architecture

ENGINE AND WARNING DISPLAY INTRODUCTION

Engine and Warning Display

The E/WD is normally on the upper DU, it is divided into upper and lower areas. The E/WD is dedicated to the presentation of information.

Engine and Warning Display Information

Permanently displayed on the upper area:

- Primary engine parameter,
- Slat/flap position,
- Fuel on board,
- EPR/N1 limit.

In the lower area are displayed:

- Memos,
- Failure messages,
- Actions to be performed.

NOTE: During T/O and landing most of the warnings are inhibited.

The E/WD presents at once 2 separated areas:

- the upper one (ENGINE area) is used to mainly present engine information and Flaps/Slats position,
- the lower one (WARNING area) is used to present memo, warning/caution in case of any system failure.

ENGINE Area (Upper One)

The ENGINE area is divided in three parts:

- ENGINE parameters area which gives the engine primary indications such as EPR, EGT, Fuel Flow,...
- SLATS/FLAPS area which gives the actual SLATS/FLAPS position and the crew member selection
- FUEL ON BOARD area which gives the value of the total fuel weight on board the aircraft.
- DU NOT MONITORED message indicates a loss of the feedback monitoring from one of the display units (DU OFF).
- AVAIL message is displayed in green to indicate a successful engine start on ground. It pulses in green to indicate a successful engine relight in flight. It is triggered when the engine is at, or above, idle. After a while it will disappear.

WARNING Area (Lower One)

This area is used to display in real time the WARNING/CAUTION messages.

In normal aircraft operation (no aircraft or system failure), MEMO information is displayed.

As soon as a failure is detected, the MEMO messages are replaced by warning/caution messages.

In the left part are displayed the primary failures, procedures. In the right part are displayed the name of the aircraft systems affected by the secondary failures resulting from the primary one.

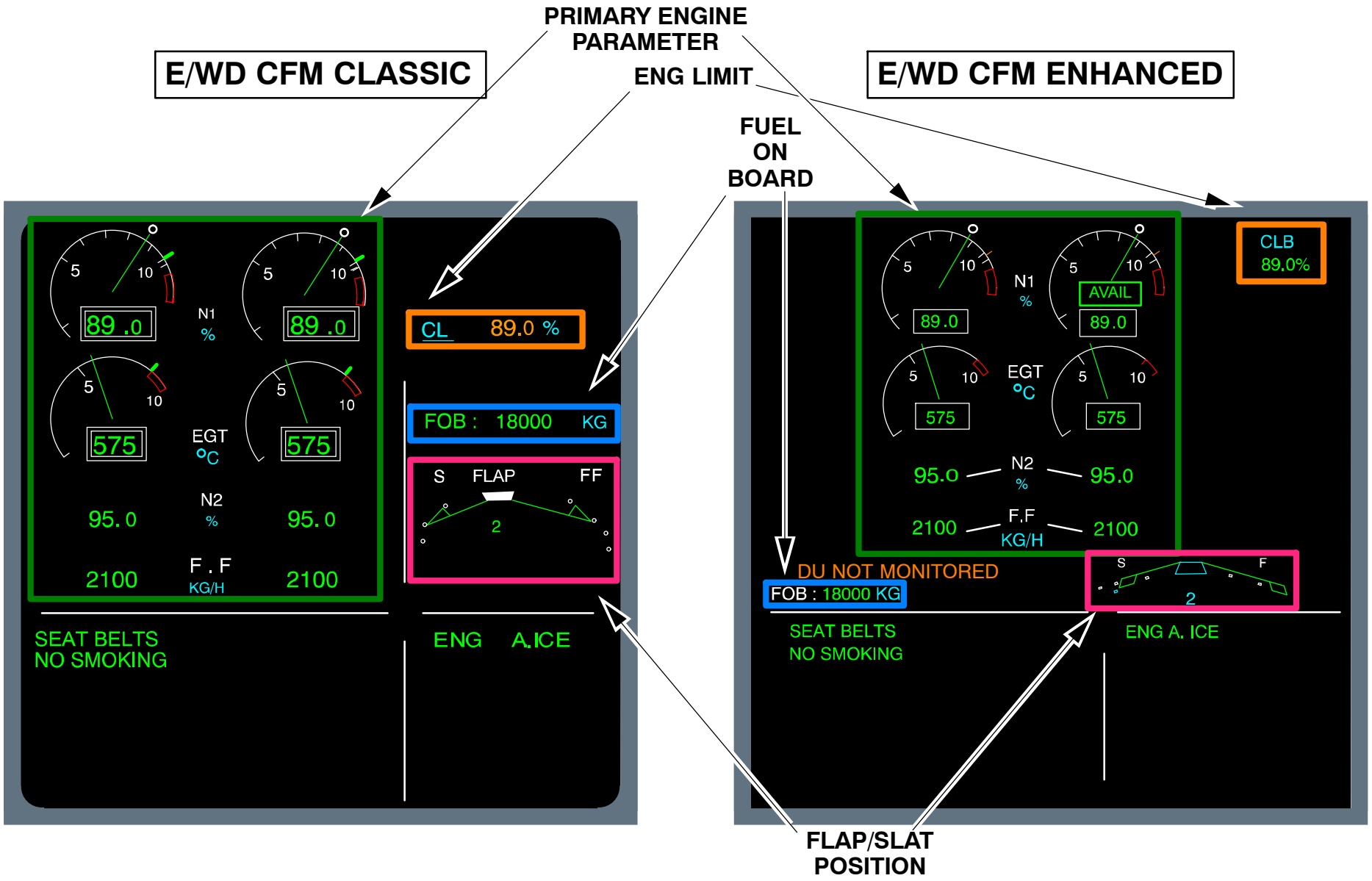


Figure 78 EWD Information Presentation

SYSTEM PAGES PRESENTATION

System Display (S/D) differences

The layout of some system displays has been changed.

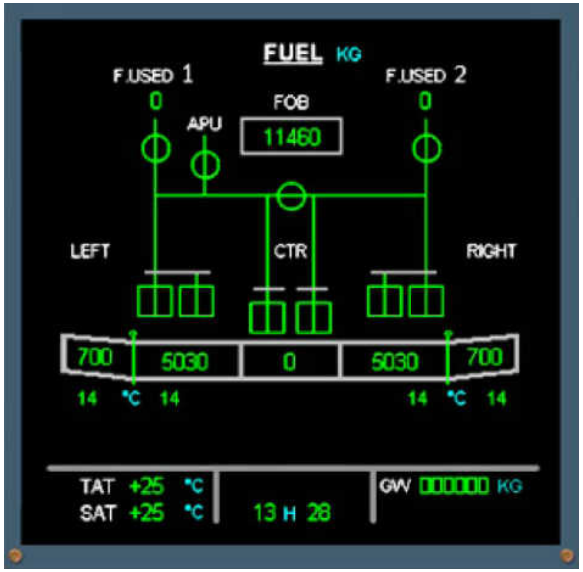
The changes are shown hereafter.

ATTENTION: With the new EIS 2 the display test is not active when the annunciator light test is performed.

EIS 1:

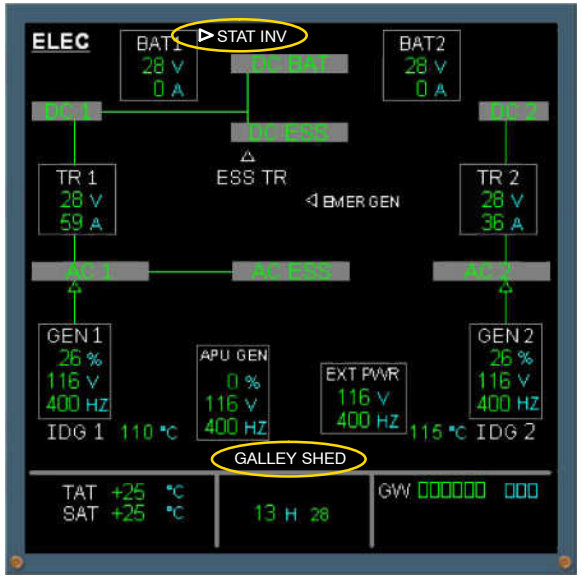
SD PRESS PAGE

SD ELEC PAGE



SD FUEL PAGE

EIS 2:



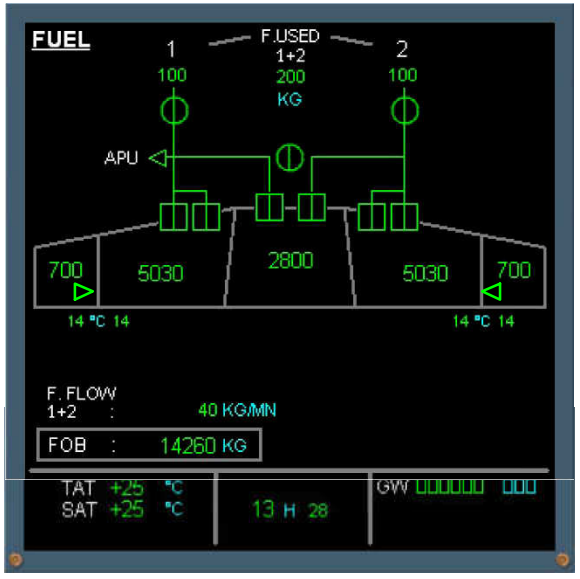


Figure 79 Changes on PRESS, ELEC and FUEL Pages

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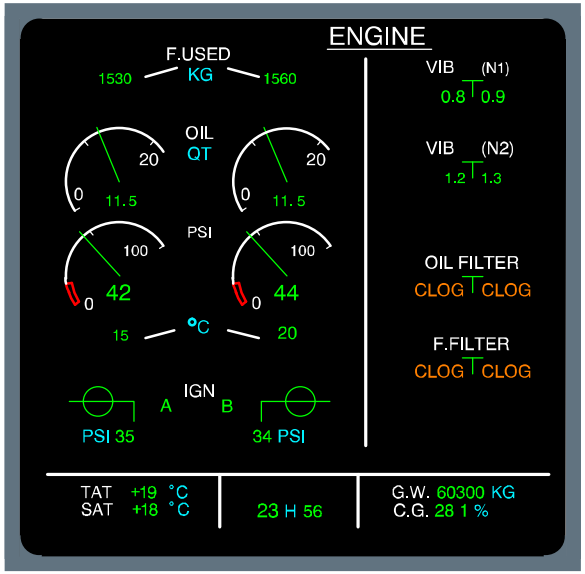
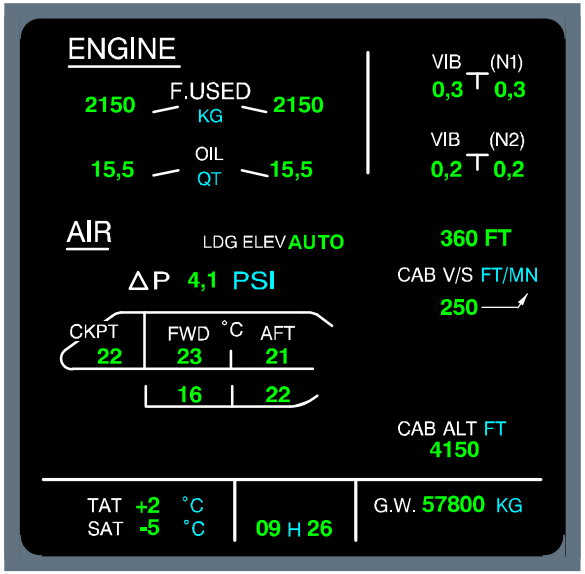
EIS 1:

SD WHEEL PAGE

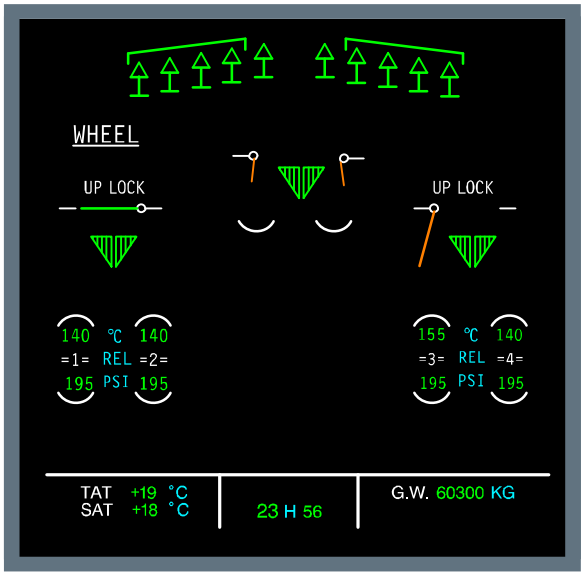


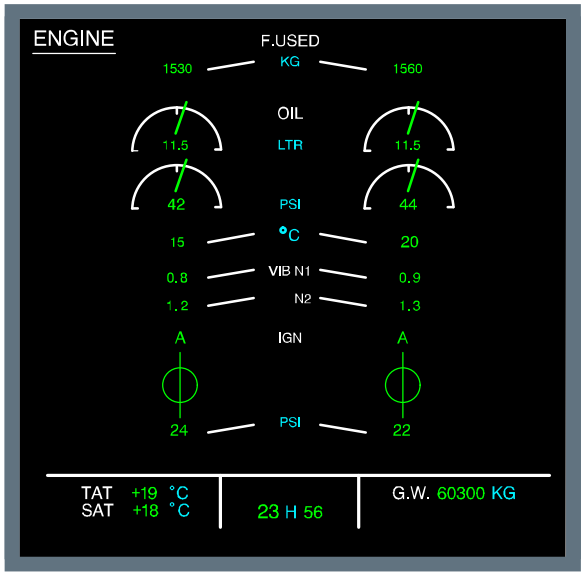
SD ENG PAGE



SD CRUISE PAGE

EIS 2:





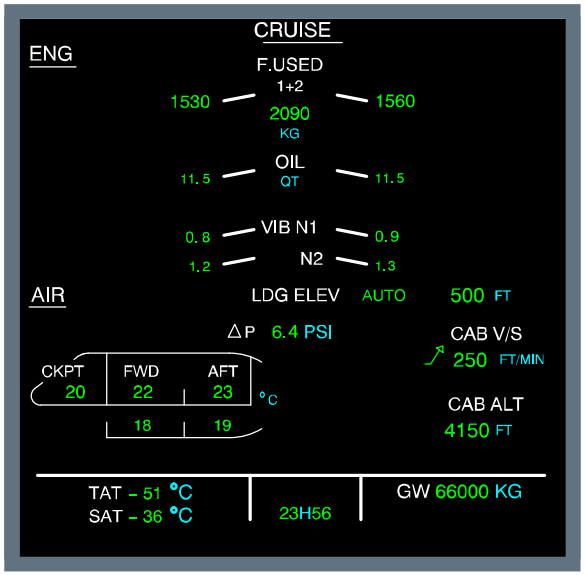


Figure 80 Changes on Wheel,ENG and CRUISE Page

EIS SWITCHING PRESENTATION

EIS Abnormal Operation

Various reconfiguration possibilities are provided in the EIS in order to cope with the operational requirements below in case of failures such as a DMC (**D**isplay **M**anagement **C**omputer), a DU (**D**isplay **U**nit), an EFIS Control Panel or ECAM Control Panel failure.

- DMC transfer:
  EIS DMC 1/3 or 2/3 (DMC 3 replacing DMC 1 or 2).
- PFD–ND transfer
- ECAM DU transfer:
  Upper DU to lower DU.
- ECAM–ND transfer:
  ECAM/CAPT ND or ECAM/F/0 ND.

Some of these transfers are performed automatically.

EFIS Switching

Each time the PFD/ND pushbutton is pressed, the images displayed on the PFD and ND are interchanged. The image previously displayed on the PFD is displayed on the ND and vice versa.

The PFD has priority over the ND. If a PFD fails or is switched OFF it is automatically transferred to the ND. Push the PFD/ND XFR switch to recover the ND. Another push on the PFD/ND XFR switch will display the PFD again.

The PFD potentiometer switches the PFD display unit on or off and controls the brightness in conjunction with the automatic brightness control system. In the off position, automatic and manual reconfigurations are possible.

The ND inner potentiometer switches the ND Display Unit on or off and enables general adjustment of the ND brightness.

The outer potentiometer only adjusts the brightness of the weather radar or EGPWS image.

ECAM Switching

The ECAM system is displayed on two DUs, the Engine and Warning Display (E/WD) on the upper DU and the System Display (SD) on the lower DU. When a system page is selected manually on the ECAM control panel, the relevant page appears on the SD.

The E/WD has the priority. When the upper display fails or is switched OFF, the EWD is automatically transferred to the lower display. This mode is called single display mode. For a short term reconfiguration pushing and holding any system key will display the selected system.

ECAM/ND XFR

In case of a ECAM DU failure the EWD is shown on the remaining DU.

For a short term reconfiguration pushing and holding any system key will display the selected system.

ATTENTION: As a precaution against jamming, if a key is pushed for more than 30 seconds (3 mn in single display mode), it is considered as failed and its inputs are invalidated.

For long–term reconfiguration, it is possible to recover the ECAM SD on the F/O or CAPT ND by using ECAM/ND XFR switching.

NOTE: When the ECAM/ND XFER switch is in the F/O position, the DMC 2 normally also takes over the upper ECAM.

ATTENTION: When an ECAM image is displayed on the ND1 or ND 2 and the related PFD/ND XFER pushbutton is pressed, the ECAM image stays on the ND and on the PFD the PFD image is replaced by the ND image. This feature is new with the enhanced EIS 2.

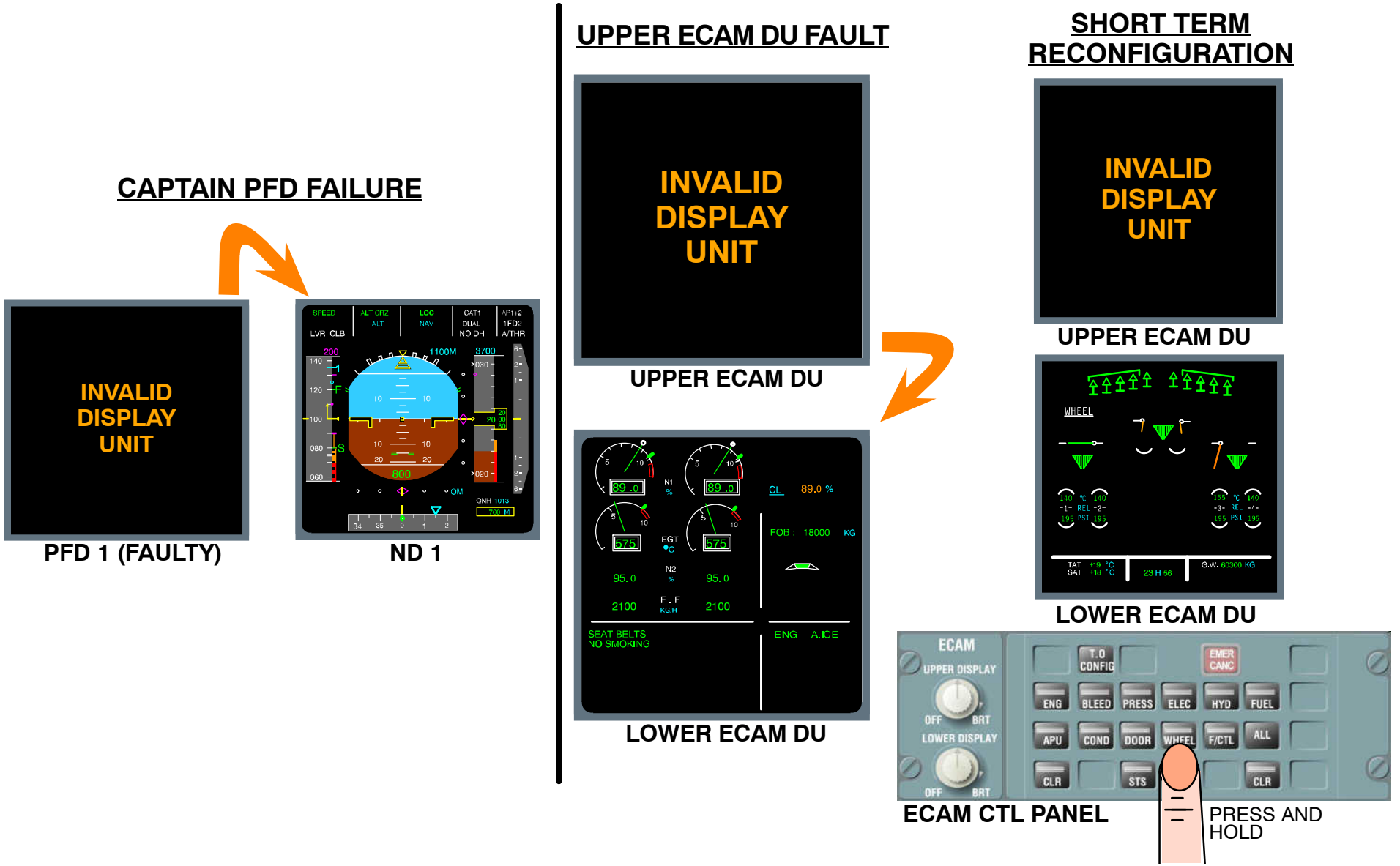
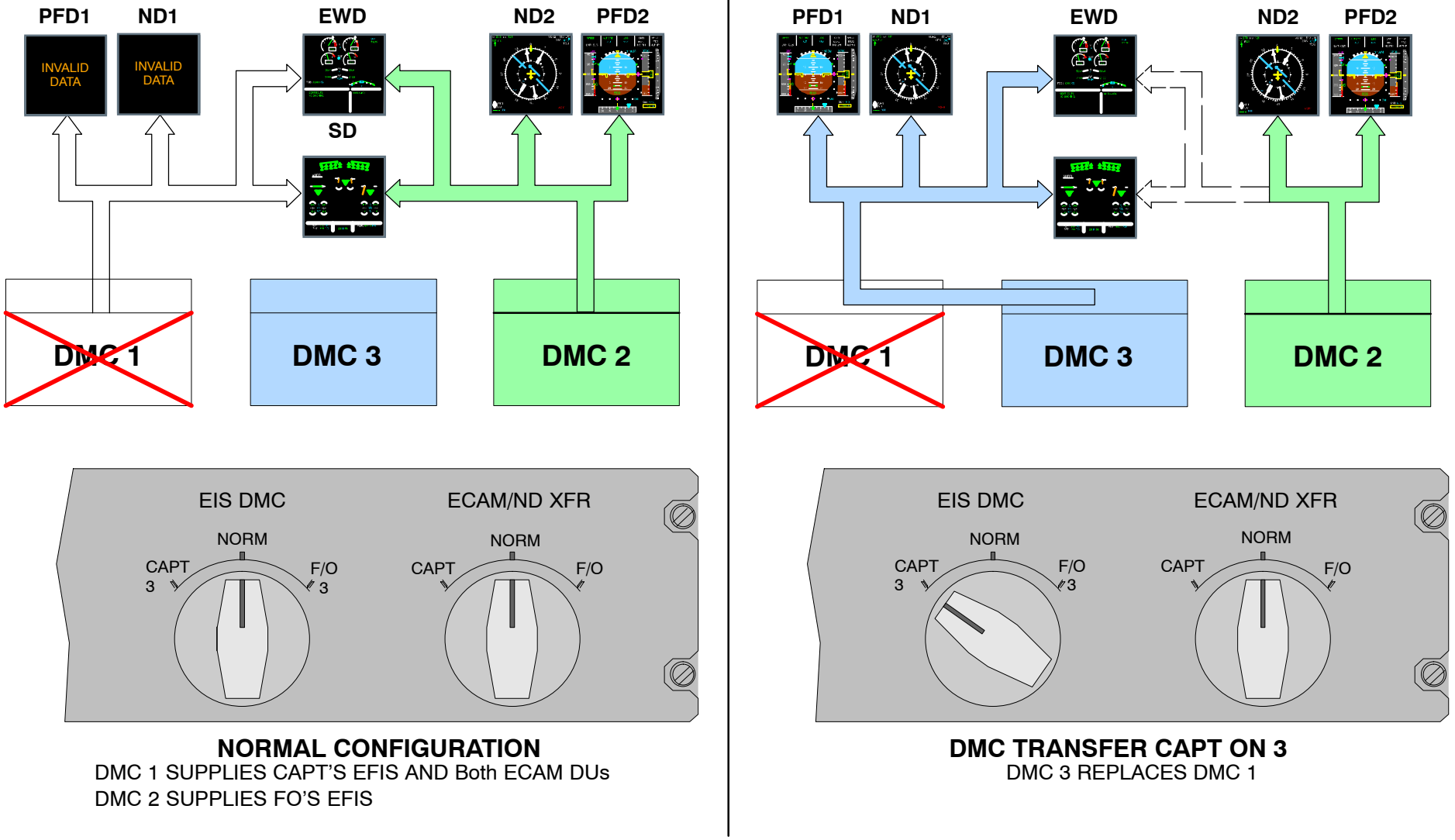


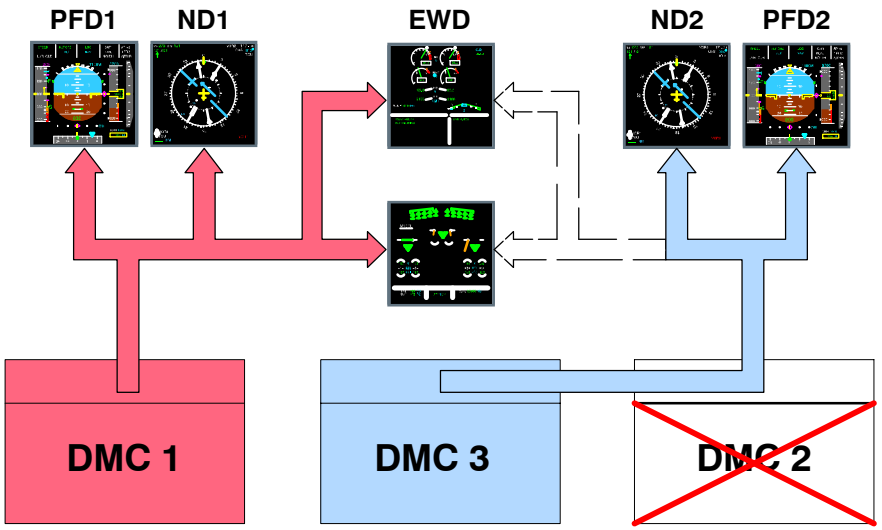
Figure 81 Automatic Switching Function

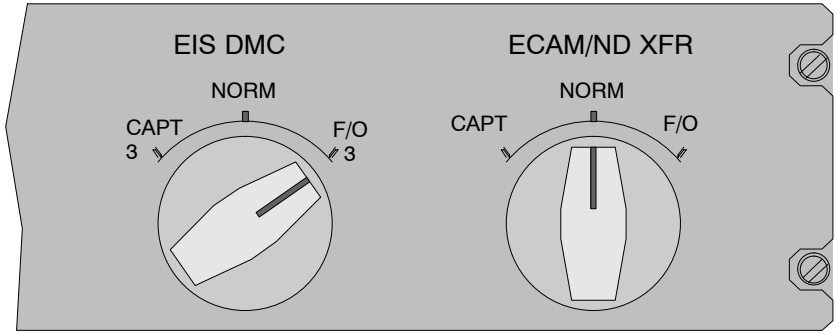


NORMAL CONFIGURATION
DMC 1 SUPPLIES CAPT'S EFIS AND Both ECAM DUs
DMC 2 SUPPLIES FO'S EFIS

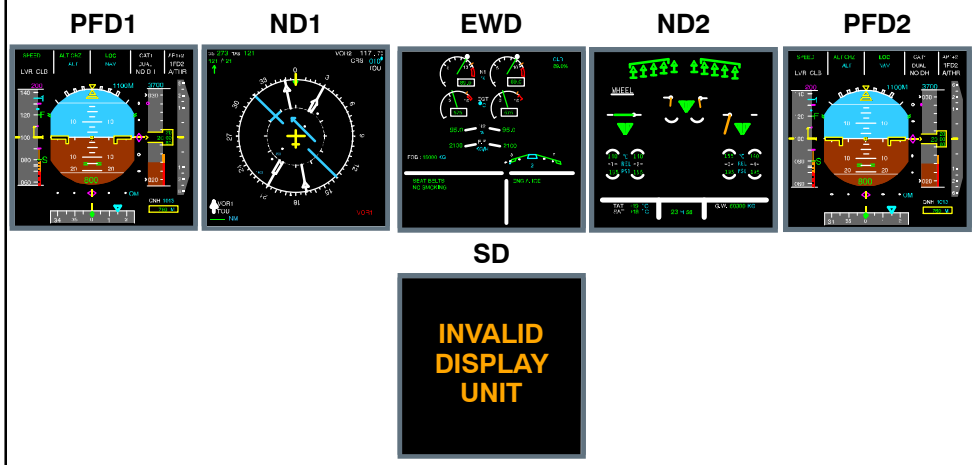
DMC TRANSFER CAPT ON 3
DMC 3 REPLACES DMC 1

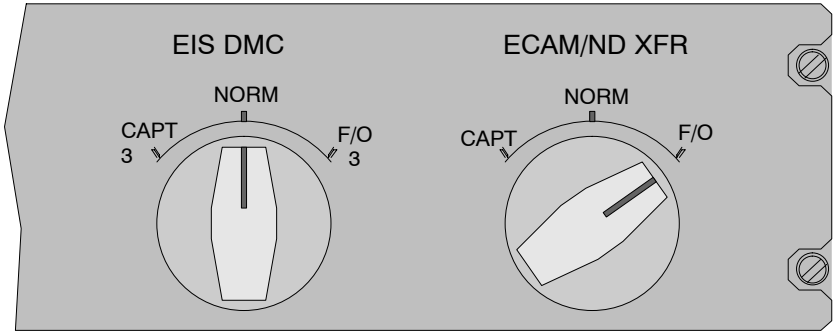
Figure 82 EIS Switching (1)





DMC TRANSFER F/O ON 3
DMC 3 REPLACES DMC 2





ECAM/ND TRANSFER F/O
SD ON F/O's ND
(LOWER ECAM DU FAILURE)

Figure 83 EIS Switching (2)

FUNCTIONAL OPERATION OF EIS SWITCHING

RECONFIGURATION IN CASE OF AN EIS COMPONENT FAILURE

In order to achieve satisfactory redundancy of the system the following principles have been adopted:

A reconfiguration takes place only when:

- the DMC which drives a display unit is faulty,
- a DU is faulty (or switched off),
- In all cases manual switching has priority over automatic switching.

DMC source reconfiguration

When one DMC normal source is faulty, the crew select the DMC3 source, manually.

The DMC which drives the CAPT PFD and ND is the DMC1 or the DMC3 according to the selector switch position EIS DMC of the switching panel:

- when the EIS DMC selector switch is in the NORM position then, the DMC1 is the data source for the PFD CAPT and the ND CAPT. The DMC2 is the data source for the PFD F/O and the ND F/O,
- When the source supplying the PFD and ND is faulty, the message INVALID DATA is displayed in the middle of the screens, to warn the pilot who changes his data source from DMC1 to DMC3 (Captain's side) or DMC2 to DMC3 (First Officer side),
- when the EIS DMC selector switch is in the position CAPT 3 then the DMC3 is the data source for the PFD CAPT and the ND CAPT, replacing the DMC1,
- when the EIS DMC selector switch is in the position F/O 3 then, the DMC3 is the data source for the PFD F/O and the ND F/O, replacing the DMC2.

EFIS REVERSE mode

In some cases it is necessary to exchange the PFD and the ND. This is the EFIS reverse mode. Furthermore, a PFD/ND transfer occurs to satisfy priority of the PFD over the ND. The PFD and ND images are then exchanged.

The reverse mode takes place when the PFD DU is no more valid but the ND DU is still valid. The reverse mode can also occur on crew request.

When a reverse mode occurs automatically, the previous normal mode is not automatically recovered if the PFD DU condition turns back to normal. But, if the reverse mode is manually (or automatically) requested, a new request reverts PFD/ND configuration to normal.

ECAM source switching

The ECAM displays normally select the DMC1 (or the DMC3 if manually selected) as a data source, but in the following cases the EWD and SD select the DMC2 (or the DMC3 if manually selected on the F/O side):

- the DMC1 (or DMC3) is faulty on the Captain's side (the First Officer side being still valid),
- an ECAM/ND XFR has been selected on the First Officer side and the DMC2 (or DMC3) is not faulty.

The pilot is aware the DMC source is not valid when the EWD and SD display the message: INVALID DATA in the middle of their screens.

ECAM REVERSE mode

In some cases it is necessary to exchange the EWD and the SD. This is the ECAM reverse mode. The ECAM reverse mode occurs automatically when the EWD DU is no more valid but the SD DU is still valid.

If the EWD DU becomes valid again, the normal mode is not automatically recovered. It can be manually requested if the pilot switches off the EWD DU and on again, or if he switches the DU to the other DMC.

EFIS DU FAILURE

The Captain's PFD/ND XFR pushbutton switch and the First Officer's PFD/ND XFR pushbutton switch enable to exchange the PFD and the ND. This is a manual way to recover one missing EFIS display.

PFD DU failure

When the PFD DU fails, the PFD is automatically transferred to the ND DU as the DMC swaps its PFD and ND outputs. However there is no automatic switching back when the PFD DU becomes valid again.

When the PFD DU is manually switched off, the same display transfer applies. If the pilot needs his ND on the ND DU he can call it back if he pushes the PFD/ND pushbutton switch. This applies to the CAPT or the F/O PFD.

ND DU failure

When the ND DU fails, the ND can be manually recovered on the PFD DU when the pilot pushes the PFD/ND pushbutton switch.

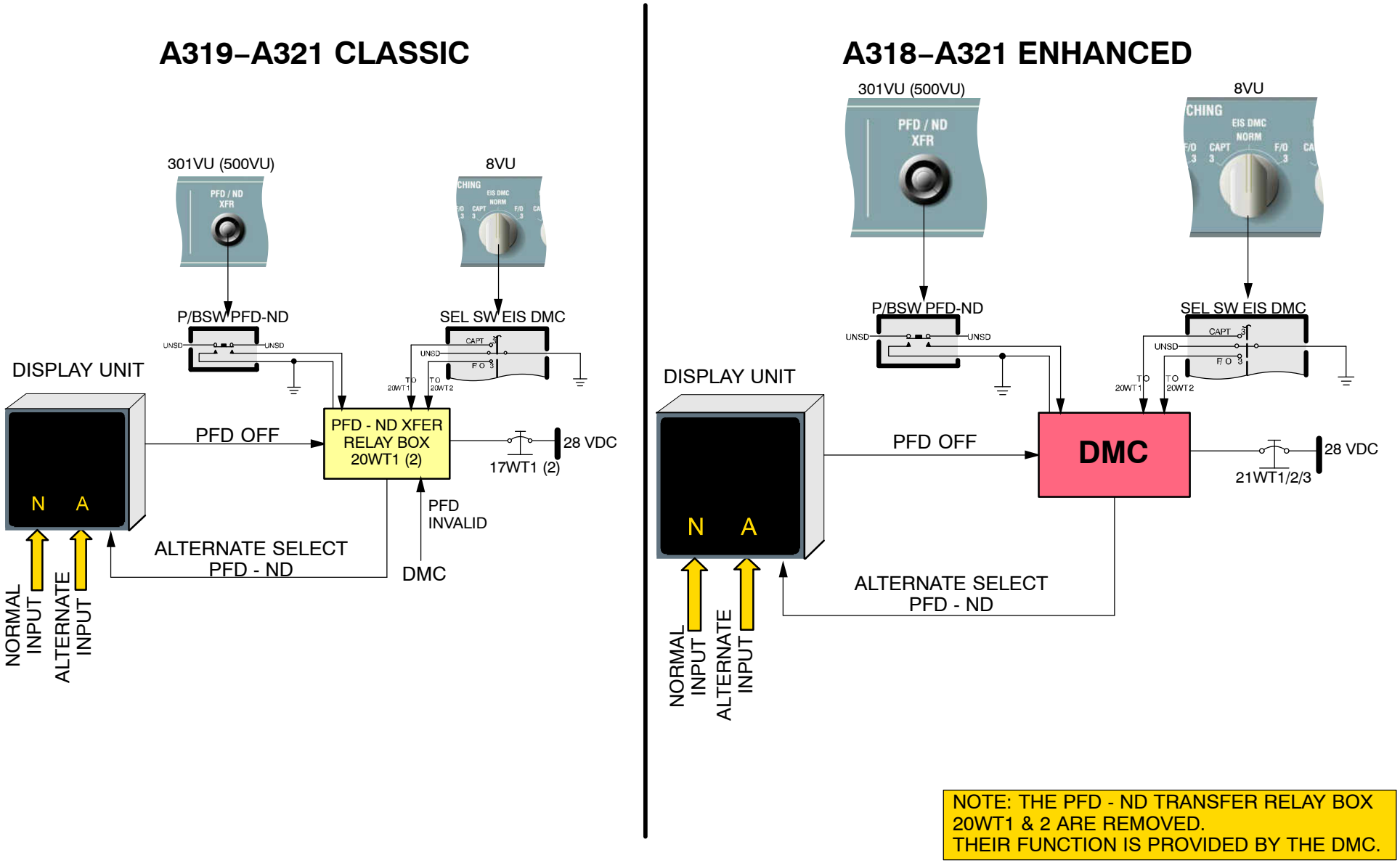


Figure 84 DU Normal/Alternate Discrete Differences

DMC -DISPLAY UNIT INTERCONNECTION

The DMC 1 (2) transmits the PFD & ND picture data via one ARINC 629 EFIS MASTER bus to the EFIS screens.

The DMC 1 transmits the EWD & SD picture data via one ARINC 629 ECAM MASTER bus to the EFIS screens.

The DMC 2 transmits the EWD & SD picture data via one ARINC 629 ECAM ALTERNATE bus to the EFIS screens.

SINGLE DMC FAILURE

When one DMC fails, the two remaining computers can control the six DUs, provided the crew has selected the DMC3 which stands as a hot spare ready to take over.

If selected, the DMC 3 transmits the PFD & ND picture data via one ARINC 629 EFIS ALTERNATE bus to the EFIS screens. This ensures reconfiguration in case of an EFIS MASTER bus wire failure.

The DMC 3 will also take over the ECAM MASTER or ALTERNATE bus depending on the switching selection.

DMC 1 Failure

When the DMC1 fails, the message ”INVALID DATA” is displayed on the CAPT PFD and ND and a single warning message is activated on the EWD.

The switching is manual. The Captain switches over his EFIS displays to the DMC3 source by means of the EIS DMC selector switch on the switching panel. This selector switch is normally on the NORM position. The pilot selects the CAPT/3 position and the EFIS images are valid again on the CAPT PFD and the CAPT ND.

DMC 2 Failure

As for the Captain, the F/O PFD and ND display the message ”INVALID DATA”. This means that the DMC2 has failed. A single warning message is triggered on the EWD. The First Officer switches over his EFIS displays to the DMC3 source by means of the EIS DMC selector switch on the switching panel. This selector switch is normally on the NORM position. The pilot selects the F/O 3 position and the EFIS images are valid again on the F/O PFD and the F/O ND.

DMC 3 Failure

When the DMC3 fails, a single warning message is then displayed on the EWD to indicate this DMC3 fault. No EFIS or ECAM image is affected by the DMC3 failure.The switching to DMC3 is then not possible.

DUAL DMC FAILURE

Dual DMC1 + DMC3 failure

If the Captain switches over his EFIS display to the DMC3 source and cannot recover a correct EFIS display, this means that neither the DMC1 nor the DMC3 is available for EFIS display. The First Officer EFIS displays are still available together with the ECAM display: the DMC2 takes over automatically. But the Captain can rely only on the set of standby instruments.

Dual DMC2 + DMC3 failure

In this case, the F/O PFD and ND are no longer driven and display a message: ”INVALID DATA”. Since the F/O EFIS displays are not available any more with the EIS DMC selector switch in the F/O 3 position the First Officer rely on the standby instruments while the ECAM display is still available

Dual DMC1 + DMC2 failure

In this case the CAPT and F/O EFIS displays are not available. Neither is the ECAM display available. One pilot must place the EIS DMC selector switch to the position CAPT 3, or F/O 3 to have his PFD and ND driven by the DMC3, together with the ECAM display which becomes available again. In the position CAPT 3 the PFD and ND of the First Officer side display the message: INVALID DATA.

In the position F/O 3 the PFD and ND of the Captain side display the message: INVALID DATA.

TRIPLE DMC FAILURE

In case of triple DMC failure, the PFDs and NDs are no longer available. The pilots use the standby indicators:

- Standby airspeed indicator, Standby altimeter next to the upper display unit, Standby horizon or an ISIS (Integrated Standby Instrument replacing these indicators),
- Standby compass (top of the windshield center post),
- DDRMI Digital Distance Radio Magnetic Indicator & Optional,
- Angle of attack indicator (optional).

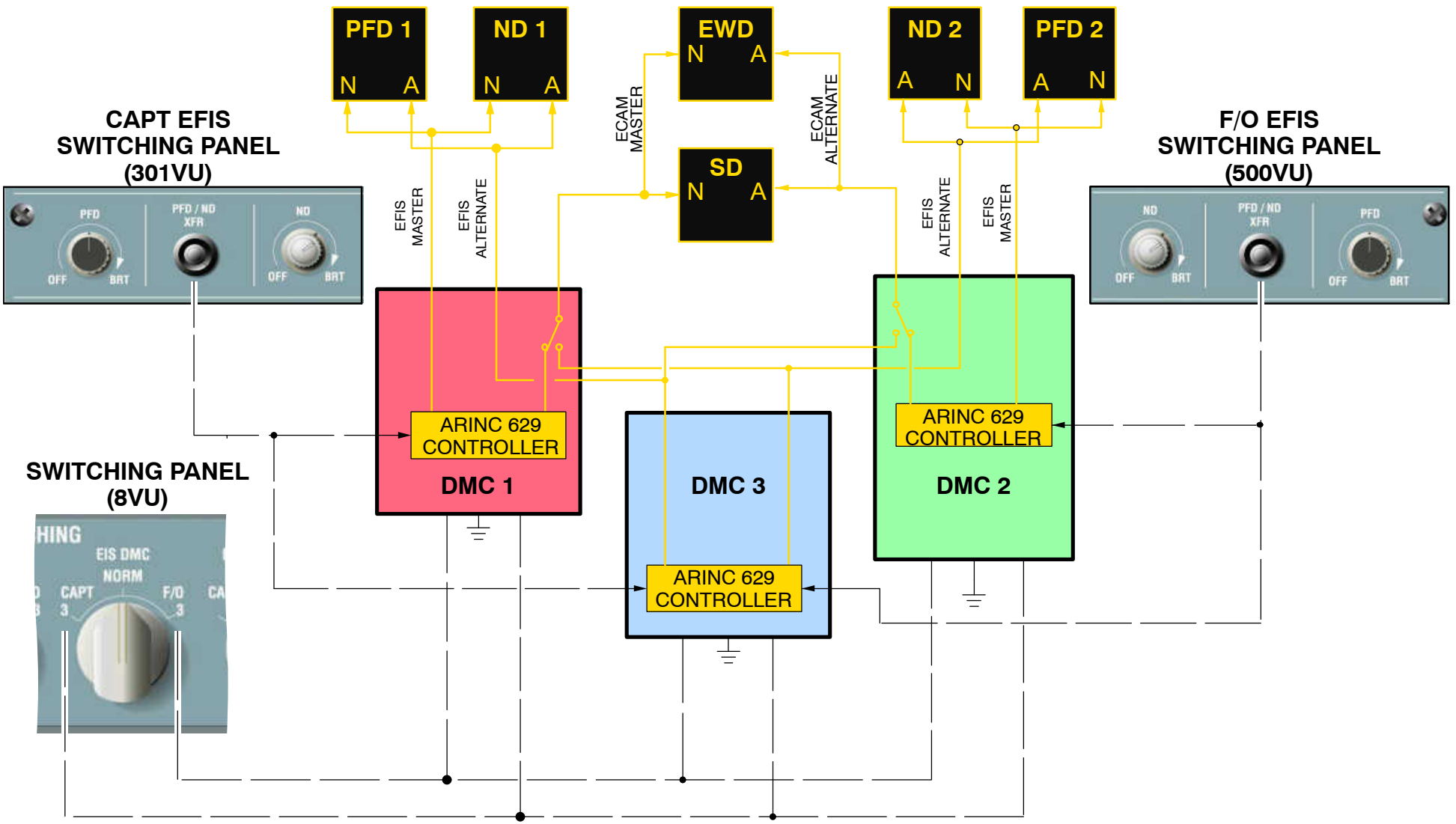


Figure 85 Enhanced EIS XFER Schematic

NEW DISPLAY UNIT COMPONENT DESCRIPTION

Size of the screen

The available size of the screen is a flat square of 6.25 X 6.25 inches, slightly larger than the former CRT technology. The weight is 7.6 kg.

Input Capacity

- discrete: 18 (type: open/ground or 28VDC/open)
- ARINC 429: 2 channels (low speed or high speed)
- ARINC 629: 2 channels used, 3 full provision channels and wrap around
- ARINC 453: 1 channel
- discrete: 1 (type: 28VDC/open)
- analog DC: 3 plus 2 reference voltages and one cell provision

Output Capacity

- A629: 1 channel
- ARINC 429: 1 channel for flight test
- discrete: 4 full provision
- RS232: 1 channel for flight test
- video SMPTE259: 2 channels (input/output) and one spare for video DU.

Component description

The 6 DUs are identical and interchangeable.

Each DU receives digital signals from its related DMC through an A629 Link and also through a particular bus (A453) for the weather radar link.

These digital signals convey instructions and data corresponding to the displays to be presented on the DUs.

The Display Unit, also called LCDU, to differentiate with the technology of the former CRT, is a display equipment including the technology of the back lighted active matrix liquid crystal.

This technology includes a triple matrix; each single point of the matrix (the pixel) is a filter to the three fundamental colors (that's why the matrix is triple) ; each point of the array (the RGB pixel) is triggerable by a set of row drivers at the top, and a set of line drivers at the side.

A set of two drivers define an X/Y coordinate which, when triggered together act on the intersect point to filter the light coming from the back in order to produce any sort of color with a large range of intensity for that point, thus taking part in the drawing of an already designed image if all the other points of the matrix are used likewise

All sorts of sketches can be drawn in this manner to feature for the pilot: the A/C attitude (PFD), the A/C en route trajectory (ND), the display of the A/C engines parameters (EWD) and also all sorts of sketches in order to feature the A/C systems behavior at any moment of the flight (SD).

DU Mechanical unit

The mechanical unit consist of:

- a structure which ensures the mechanical strength of the DU and holds in place all the subassemblies
- a cover which ensures the protection of the subassemblies and the air tightness of the DU (reduction of the ventilation air leaks).

The mechanical unit ensures the ventilation air flow and the dispersion of heat

The several subassemblies are housed in the mechanical unit, they include:

- the screen and LAM assembly

  The LAM assembly includes the screen of 6.25 X 6.25 inches which is a flat surface and the triple matrix. It receives the RGB data and several clocks signals (line, frame, pixel frequency) and continuously displays the RGB pixels.
- the BLM assembly

  This assembly provides permanent light to the LCD display.
- the PSM assembly

  The PSM assembly provides all the necessary voltages for the DU to operate properly.
- the PPM assembly

  the PPM assembly manages the I/O interface with the A/C: discrete, analog, A429, A629.
- the GPM assembly

  The GPM assembly generates the image to be displayed.

LEGEND
LAM: LCD ASSEMBLY MODULE
BLM: BACK–LIGHTING MODULE
PSM: POWER SUPPLY MODULE
ICM: INTER CONNECTING MODULE
HAM: HOUSING MODULE
GPM: GRAPHICS PROCESSING MODULE
PPM: PRE PROCESSING MODULE
VPM: VIDEO PROCESSING MODULE

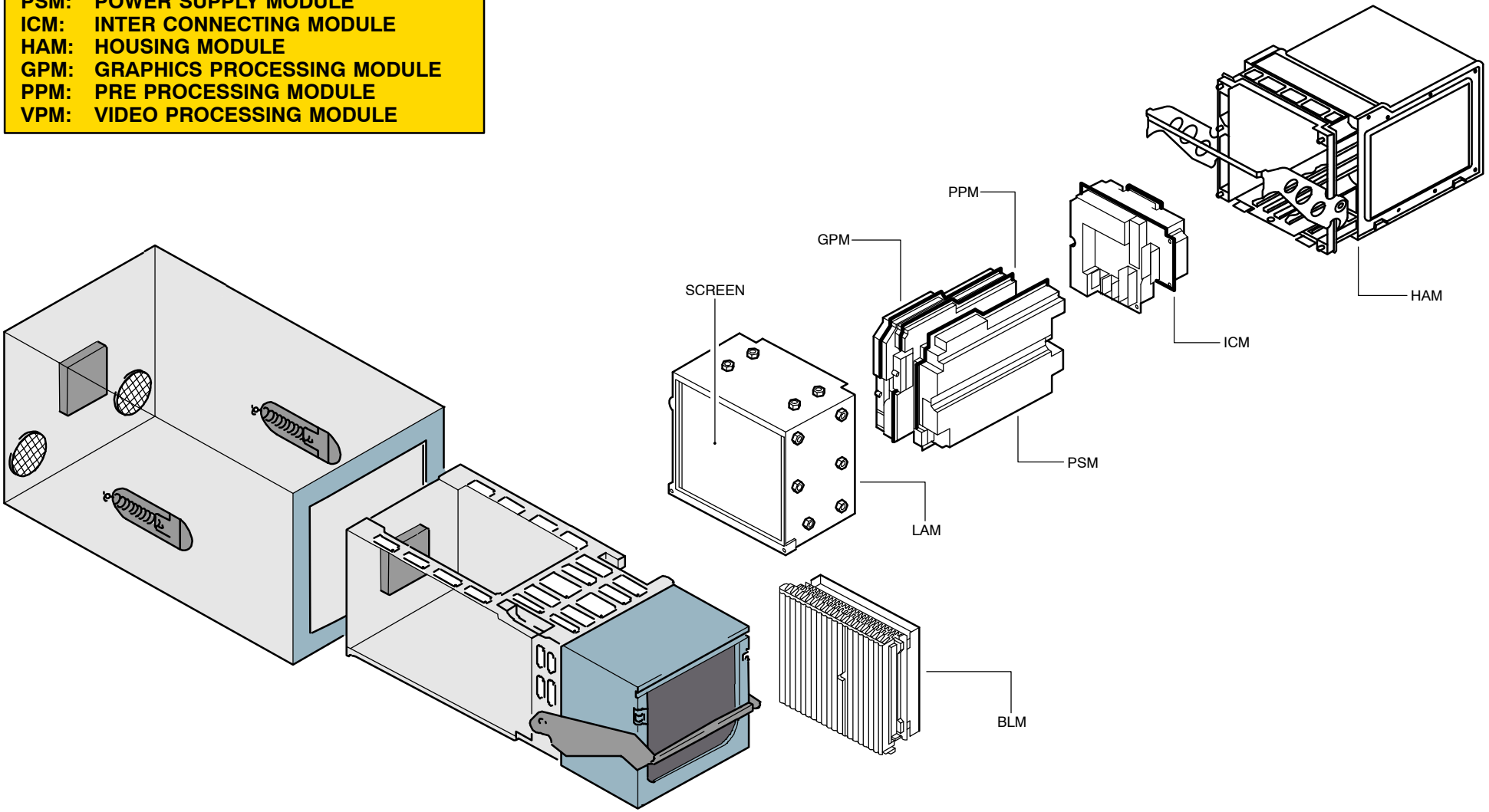


Figure 86 DU Component Description

EIS/CWS BITE SYSTEM PRESENTATION

GENERAL

FIDS and BITE Functions in the EIS

The EIS/FWS main computers include BITE (**B**uilt–**I**n–**TE**st) functions which perform a permanent monitoring of all the items of equipment involved in the EFIS and ECAM operational functions, and also of the various sources which provide the EIS/FWS with input signals.

The DMCs act as FIDS (**F**ault **I**solation and **D**etection **S**ystem) for the DUs and the A/C circuitry (wiring, control knobs, selector switches).

The FWCs act as FIDS for the SDACs and the ECAM Control Panel (ECP), the cockpit loud speakers, and the various controls and the alert lights.

The FAC (**F**light **A**ugmentation **C**omputer) 1 acts as FIDS for the AFS (**A**uto **F**light **S**ystem), and particularly for the FCU (**F**light **C**ontrol **U**nit) which includes the EFIS (**E**lectronic **F**light **I**nstrument **S**ystem) control sections.

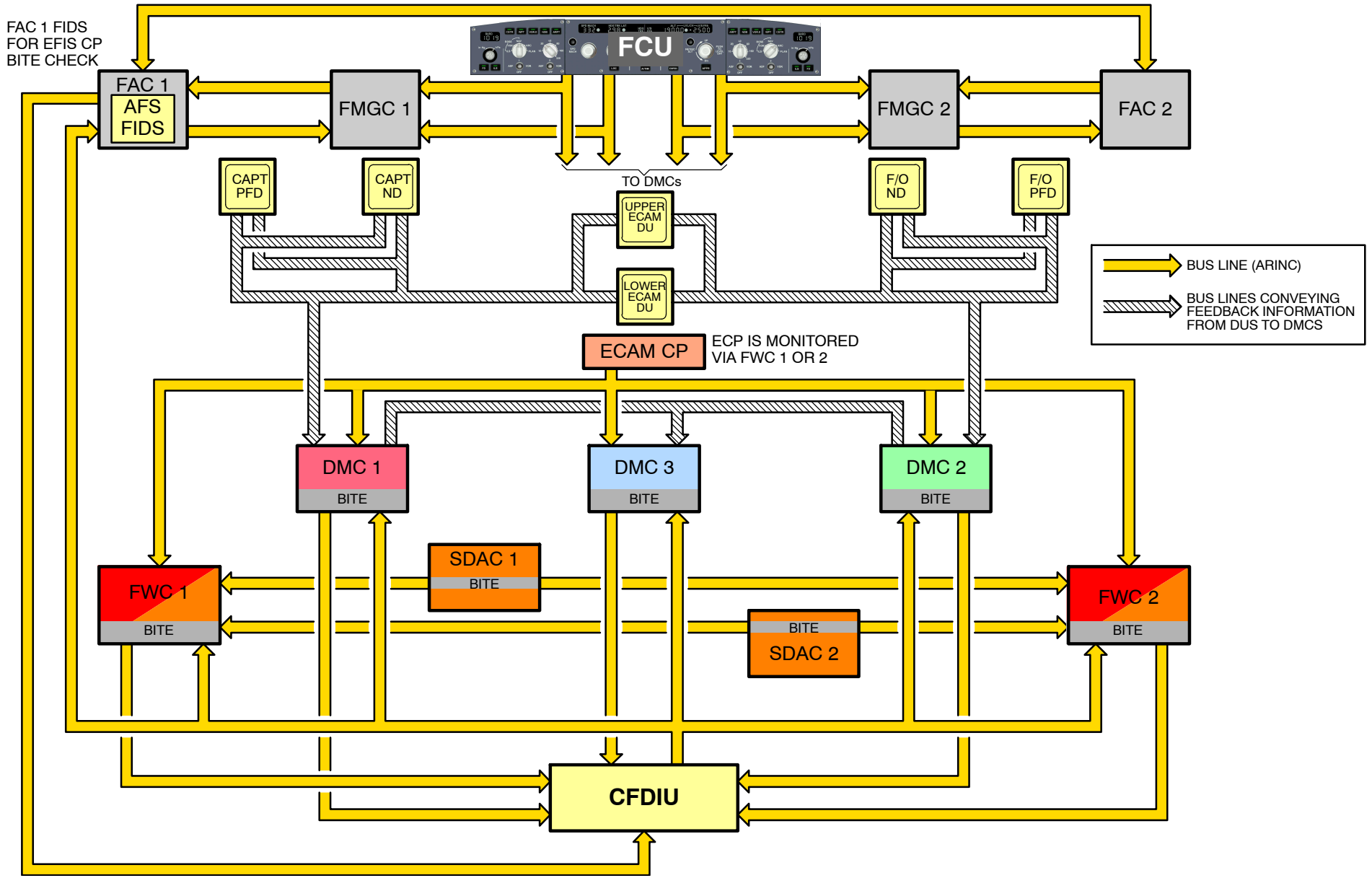


Figure 87 BITE Architecture of the EIS and ECAM

EIS BITE SYSTEM FUNCTION (CLASSIC)

The CFDIU provides interface with the BITE resident routines for maintenance and test implemented in the computers, and particularly the DMCs.

The BITE memories store all the detected events concerning the last flights: failures, abnormal disengagements..., with the associated contexts concerning these events: concerned flight leg, date, GMT at the time of the failure....

The DMCs send complete messages corresponding to the failures in plain English language to the CFDIU.

The messages are sent as soon as the failures are detected, isolated and stored in the BITE memory. They are displayed on request on the interactive MCDUs (**M**ultipurpose **C**ontrol and **D**isplay **U**nits), which are located on the center pedestal.

To read them, the crew presses the MCDU MENU mode key on the MCDU.

A menu is offered proposing: FMS, CFDS, ACARS, AIDS main functions.

The crew presses the line key adjacent to the chosen function (CFDS in our case). The MCDU then displays the list of the LRUs for which a fault has been recorded during the flight, the EIS items of equipment for our concern.

In addition, on the ground, the maintenance teams have the possibility to read the events recorded during the last flight legs, therefore to have a history of the system behavior, by means of more detailed menus displayed on the MCDUs in the maintenance or menu mode.

These menus are elaborated by the DMCs and sent to the CFDIU. For that purpose, a dialog between the CFDIU and the chosen equipment (DMC 1 or 2 or 3) is made possible by pressing the appropriate line keys on the MCDU, a given key addressing a given item of the displayed DMC menu.

In fact, two modes are provided, the normal mode (or reporting) and the menu mode (or interactive):

- in the normal mode, the following functions are carried out:
  - failure detection and analysis,
  - recording of the failure code and associated failure context (leg, date, GMT...) in the DMC BITE memory,
  - transmission of the failure messages and associated failure context in plain English language to the CFDIU,
  - response to the CFDIU controls.
- in the menu mode, which is available on the ground only, a thorough access to the BITE contents is provided through the interactive MCDU which displays the various menus elaborated by the DMCs, in particular:
  - main EIS menu with last leg and previous legs report,
  - full BITE memory dump menu.

The CFDIU permanently addresses through its common bus line the A/C computers and provides them with the following information:

- GMT, flight number, date... for numbering and marking the events stored in the BITE (system disconnection, failures, ...) and
- control words for addressing the A/C computer and requesting its BITE memory contents

The DMC menus also enable the flight and maintenance crew to perform overall system tests, easily readable and interpretable.

System test

On the ground, on request from the MCDU, the DMC performs the functional tests of all the internal functions of the system (DMC, DUs, DMC–DUs links).

Display test

On the ground, on request from the MCDU, a test pattern is displayed on the DUs. This test pattern enables the maintenance crew to assess the condition of the DUs for ageing and display quality, thus providing at a glance a confidence check of the Display Units.

I/P test

On the ground, on request from the MCDU, a thorough monitoring of all the buses from the various DMC I/P sensors and A/C computers is provided, thus signalling the hidden failures of the DMC sources which are not used in the normal configuration (e. g. FWC2, ...).

System Test Result

After initialization of the system test the maintenance crew has to go into this menu to see the results of the system test.

CLASSIC SYSTEM

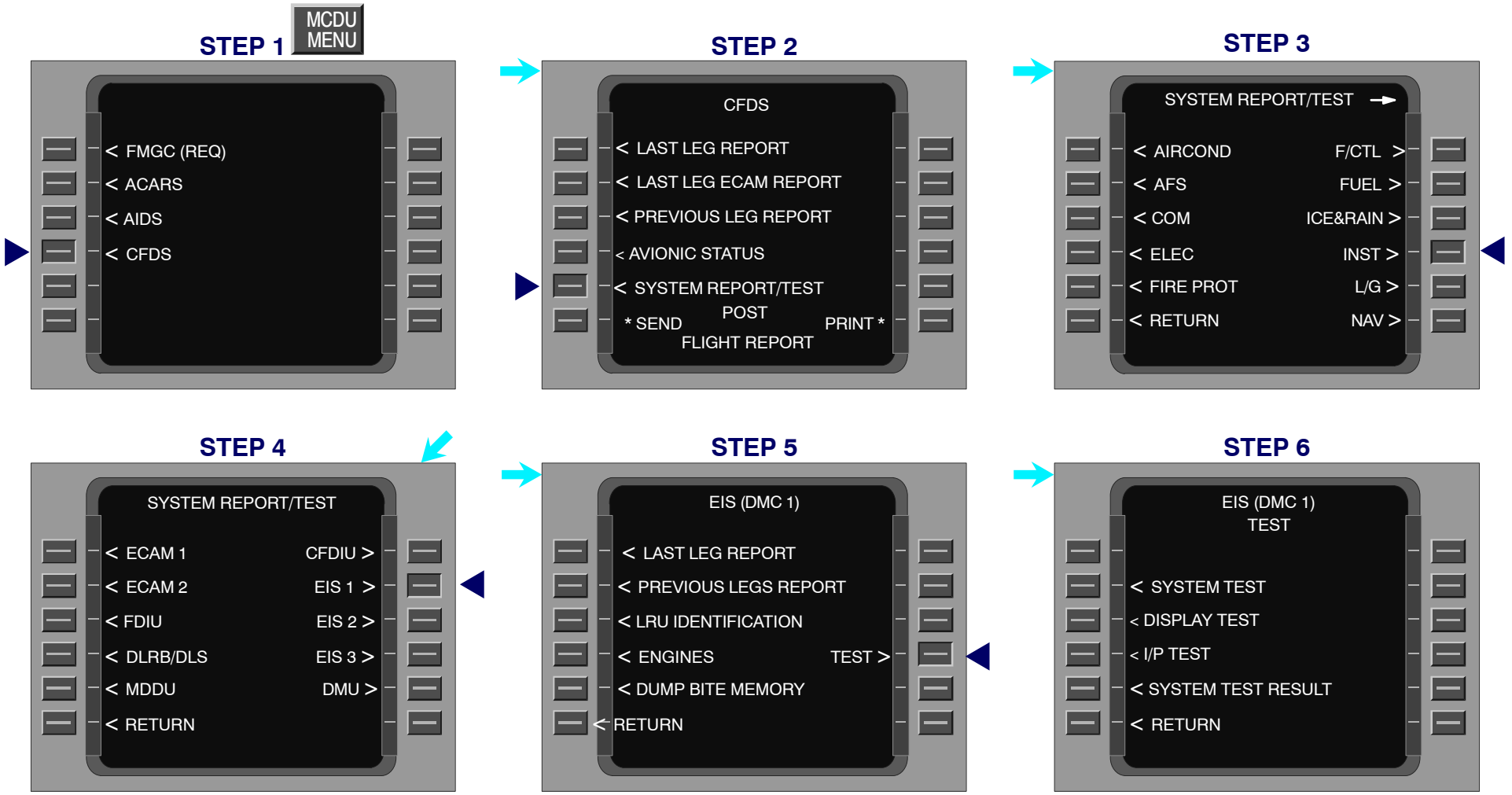


Figure 88 DMC Maintenance Menu

ENHANCED EIS 2 BITE

DMC Main Menu

- Last Leg Report

  A page which shows all faults of class 1 and 2 recorded in flight during the last leg, starting with the oldest at the top appears

- Previous Legs Report

  A page is presented to show all internal faults of class 1 and 2 recorded in flight during the last 63legs, starting with the last occurring at the top.

- LRU Ident

  The DMC LRU IDENT page is presented to show all software and hardware part numbers as well as the serial numbers of the EIS components. Several pages are necessary to list all of them.

- GROUND Scanning

  The DMC GROUND SCANNING pge is presented to show all the internal and external faults of class 1, 2 or 3 as soon as they occur. The trouble shooting data of a given fault is displayed by pressing the related key

- TROUBLE SHOOTING DATA

  The DMC TROUBLE SHOOTING DATA page is presented to show in a coded form (hexadecimal) the trouble shooting data of the class 1, 2 and 3 faults recorded in flight during the last legs.

- CLASS 3 FAULTS

  The DMC LAST LEG CLASS 3 FAULTS page is presented to show all the class 3 faults recorded in flight during the last leg.

- System Test

  The DMC SYSTEM TEST page is presented. This test, which allows to find out an EIS system misbehaviour needs some action from the operator to initialize the test. (See presentation below).

- Switching / Data Bus / Brightness Test

  The DMC SWITCHING/DATA BUS/BRIGHTNESS TEST page is presented. This page directs the operator to the choice of three tests:

  – the DATA BUS TEST by the key 2L,
  – the SWITCHING TEST by the key 3L,
  – the DU BRIGHTNESS TEST by the key 4L.

- GROUND REPORT

  After the key 5R has been pushed the page DMC GROUND REPORT is presented to show all the internal faults of class 1, 2 or 3 recorded on ground during the last leg and trouble shooting data of a given fault.

- PIN PROG/STATUS AND XLOAD

  This function is available on the DMC main menu, when the operator presses the key 6R.

  The operator gets a page where a menu is offered with:

  – DMC XLOAD

    This function of the key 2L is compulsory at the entry into service of a new DMC. It allow to load the new software program, from an already loaded DMC.

  – DU XLOAD

    This function of the key 3L is compulsory at the entry into service of a new DU.

  – DU BACKLIGHT STATUS

    This function of the key 4L allows to check all the lamps of a particular DU.

  – LCD STATUS

    This function of the key 5L allows to check the quality of the image displayed on the screen of a particular DU. Special patterns are provided for that purpose.

  – PIN PROG

    This function of the key 2R allows to check the status of all the software and hardware pin prog.

  – ENGINES

    This function of the key 3R allows to check the values of the engines overspeed, the engines EGT overtemperatures, recorded during the last flight, and to reset them.

ENHANCED SYSTEM

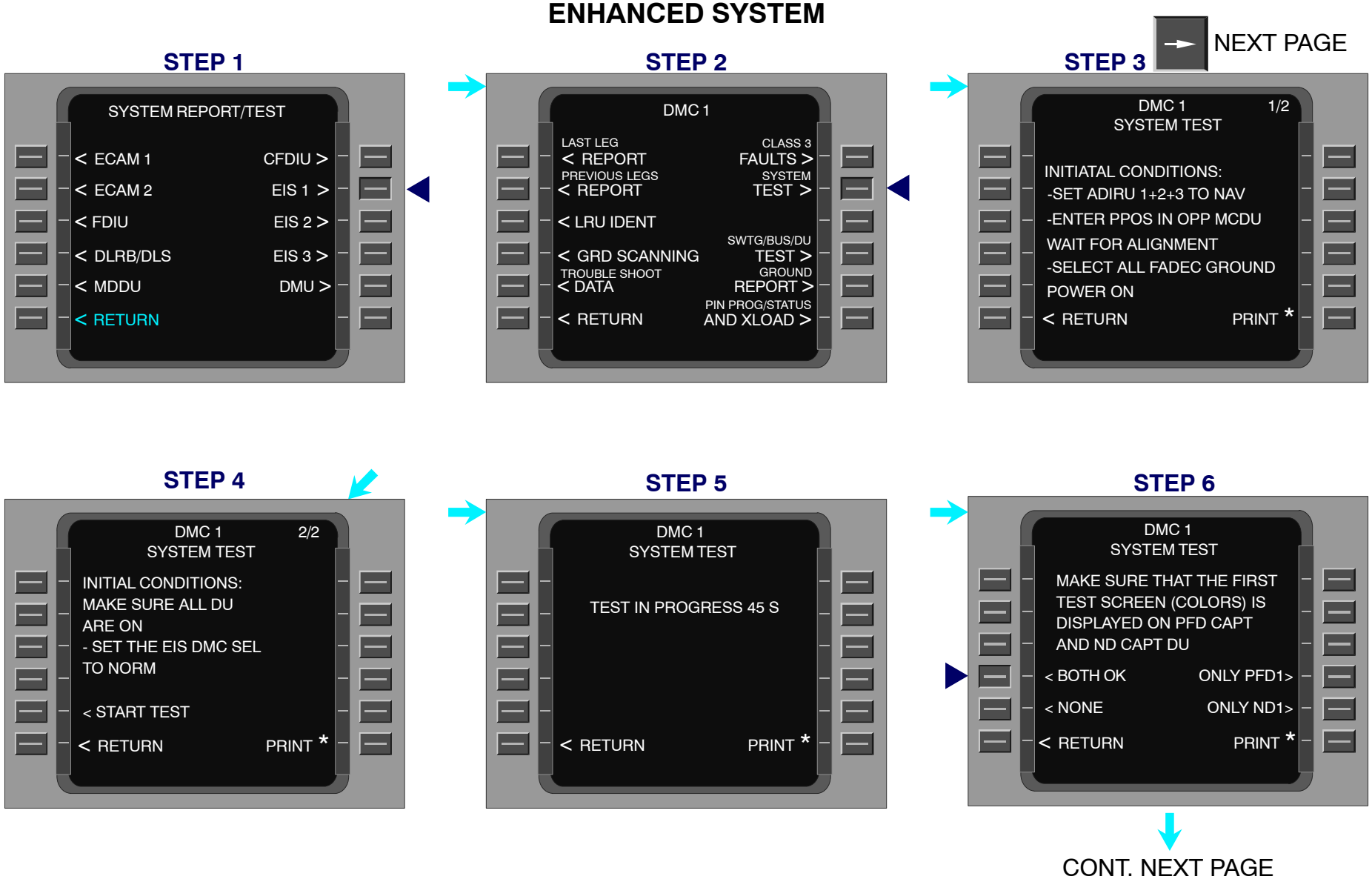


Figure 89 DMC Maintenance Menu & System Test

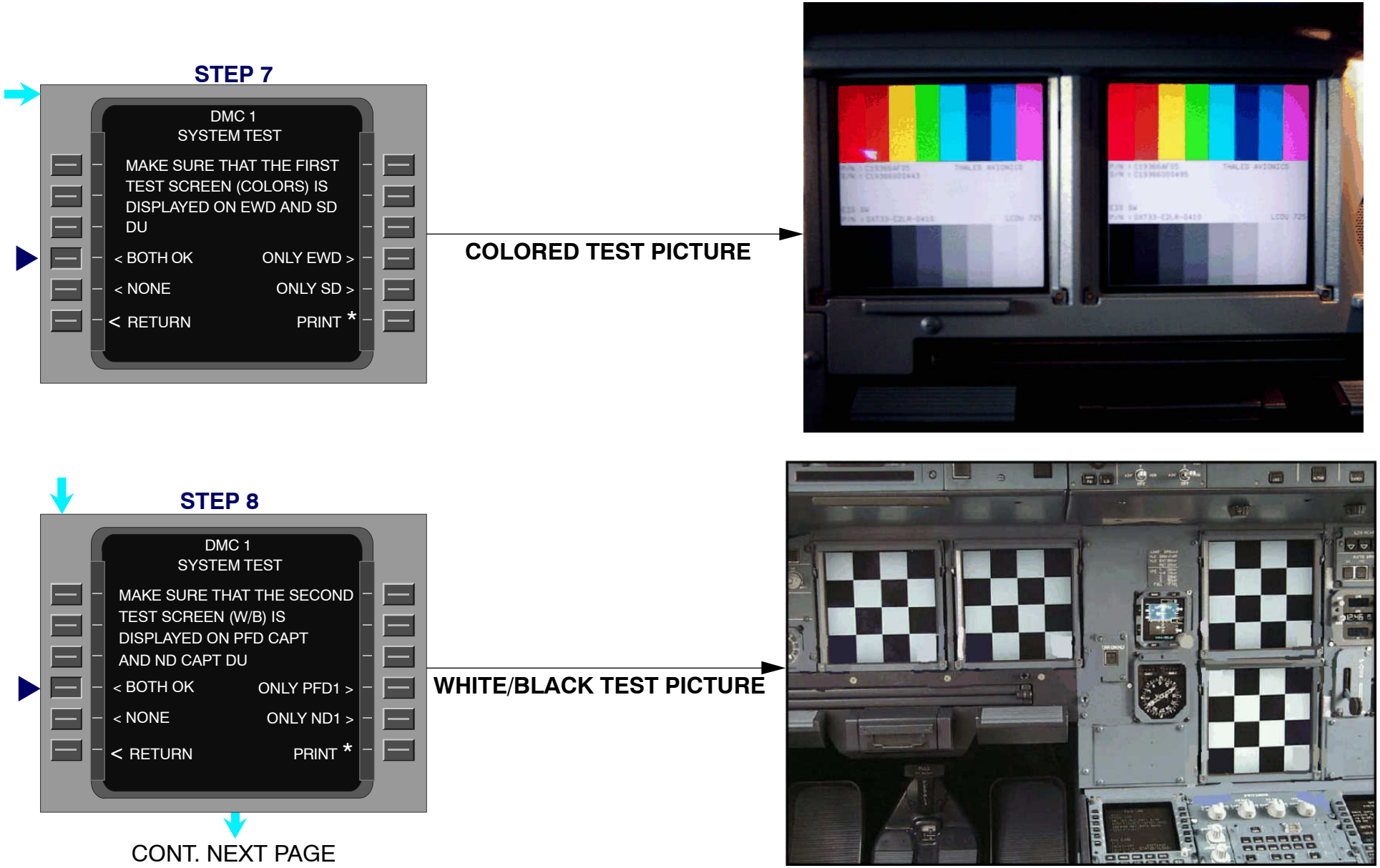


Figure 90 DU Test Pattern

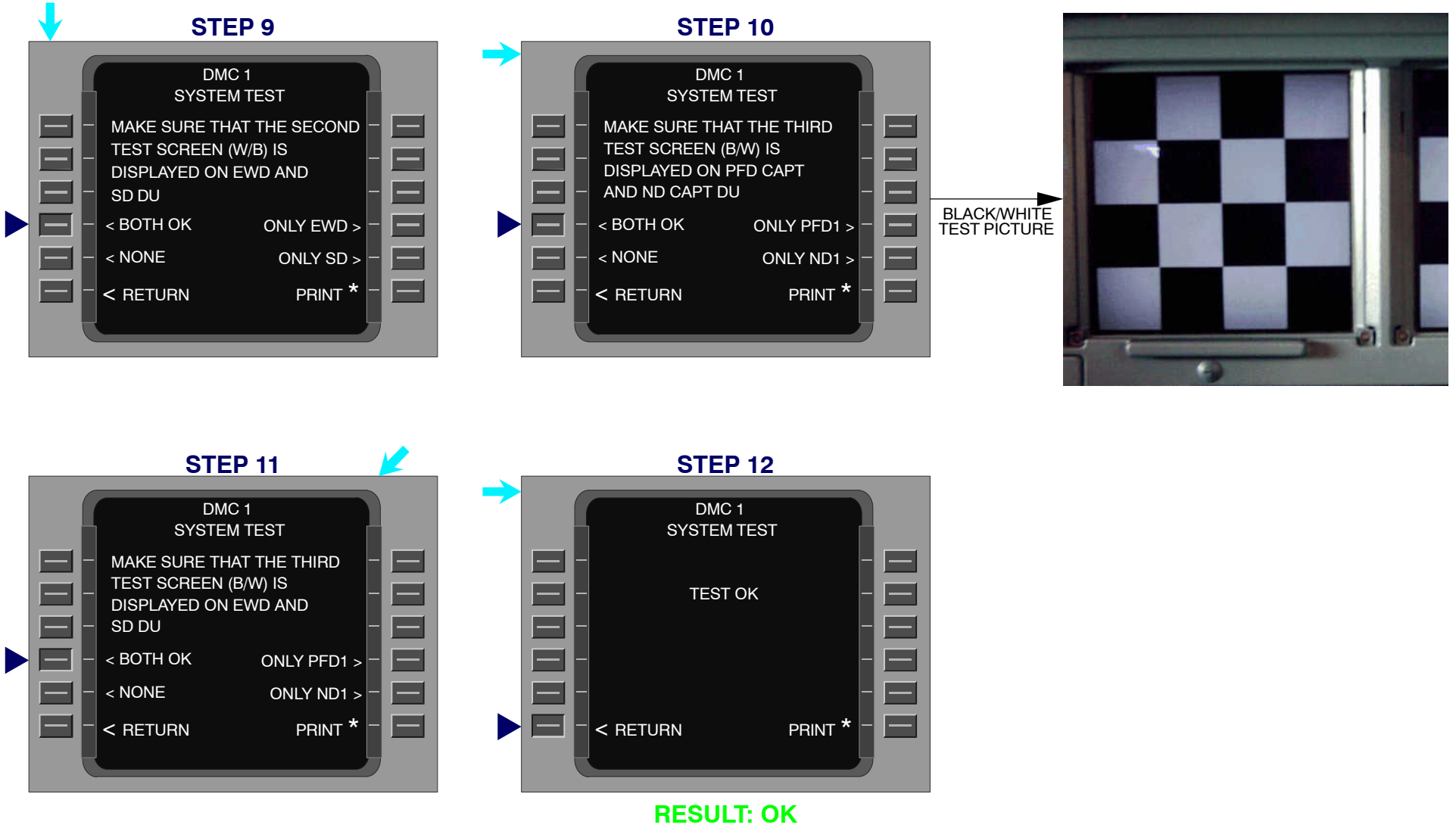


Figure 91 DMC System Test OK

DMC DATA LOADING DESCRIPTION

Enhanced DMC Software Loading Description

The three DMCs are identical and interchangeable, they receive aircraft system data on ARINC 429 buses, weather radar information on ARINC 453 high–speed bus, analog signal for the brightness control, discrete signal for the PFD/ND transfer and PFD/ND ON/OFF. DMCs send data on an ARINC 629 link to the display units.

When a new DMC 2 or 3 is installed, new software must be downloaded into it, this is done by Xload (**Cross Load**ing) from DMC 1 only via the MCDU (**M**ultipurpose **C**ontrol and **D**isplay **U**nit). If all DMCs are replaced the software must be loaded from the MDDU to DMC1. Therefore the **D**ata **L**oading **R**outing **B**ox (DLRB) must be configured from the Data Loading selector panel in the cockpit From DMC 1 it can be loaded to the other DMCs by cross loading.

The BITE (**B**uilt–**I**n **T**est **E**quipment) is performed in the DMC and the results are stored for later transfer to the CFDS (**C**entralized **F**ault **D**isplay **S**ystem). It is possible to read this information via the MCDU.

UP LOADING Procedure of the DMC1

- On the MDDU the < < MDDU READY > > indication is shown.
- On the overhead C/B control panel 49VU open the EIS/DMC1/SPLY circuit breaker 10WT1. On the Captain's PFD and ND the amber message INVALID DATA comes into view.
- On the DATA Loading selector set the ON/OFF switch to ON and push the PREV/NEXT key until you get DMC1 NOT SELECTED indication.
- Push the SEL CTL to get DMC1 SELECTED indication.
- On the MDDU put the first disk into the disk driver, with the label in the forward direction.
- On the overhead control panel 49VU close the EIS/DMC/SPLY circuit breaker 10WT1.
- On the MDDU the READY indication followed by the WAIT RESPONSE indication and immediately after the TRANSFER IN PROG indication, come into view.
- Wait for 10 minutes with the TRANSF IN PROG, after the time has elapsed the EJECT DISK message comes into view.
- On the MDDU remove the disk from the disk drive and the INSERT NEXT DISK message comes into view.
- Insert the next disks until the last disk is transferred.

  NOTE: It is not necessary to reset the DMC circuit breaker (only for the first disk).
- On the DATA LOADER control panel set the DATA LOADER selector switch to OFF.
- After 40s the DISPLAY SYSTEM VERSION INCONSISTENCY message comes into view on the CAPT PFD and ND display units.
- DO the XLOADING Procedure of the DMC2 & 3 from the DMC1.
- Do the X LOADING Procedure of the DMC1 to the PFD CAPT, ND CAPT, the EWD or the SD.
- Do the X LOADING Procedure of the DMC2 to the PFD F/O or the ND F/O

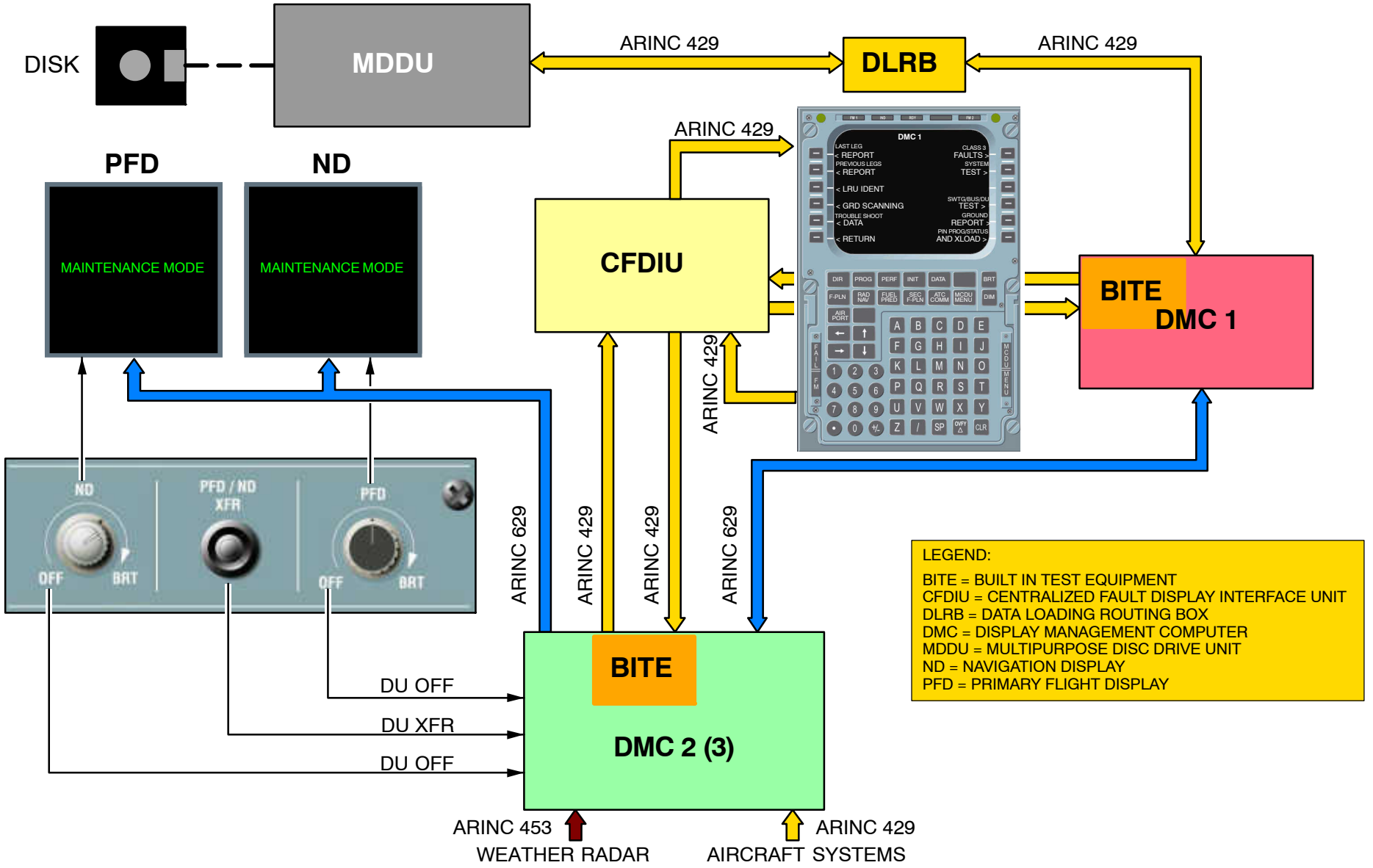


Figure 92 DMC Loading Schematic

DMC SOFTWARE LOADING CFDS PAGES PRESENTATION

PIN PROG/STATUS AND XLOAD Function

This function is available on the DMC main menu, when the operator presses the key 6R (**STEP 1**).

The operator gets a page where a menu is offered with:

- DMC XLOAD

  This function of the key 2L is compulsory at the entry into service of a new DMC. It allow to load the new software program, from an already loaded DMC.
- DU XLOAD

  This function of the key 3L is compulsory at the entry into service of a new DU.
- DU BACKLIGHT STATUS

  This function of the key 4L allows to check all the lamps of a particular DU.
- LCD STATUS

  This function of the key 5L allows to check the quality of the image displayed on the screen of a particular DU. Special patterns are provided for that purpose.
- PIN PROG

  This function of the key 2R allows to check the status of all the software and hardware pin prog.
- ENGINES

  This function of the key 3R allows to check the values of the engines overspeed, the engines EGT overtemperatures, recorded during the last flight, and to reset them.

DMC XLOAD Function

This page is available when the operator has pressed the key 2L (**STEP 2**). The DMC1 is normally the source for the other DMC, except when faulty. When it is faulty the DMC2 is the DMC source or even the DMC3.

In front of each DMC, the software part number is displayed (**STEP 3**):

- in green for the DMC source and the DMC having the same part number
- in amber for the DMC having a different part number.
- instead XLOAD NOT AVAIL is displayed in amber when the relevant DMC is not available.
- instead EMPTY is displayed in amber when the relevant DMC has never been loaded previously.

The operator presses the key 1R ACCESS XLOAD (**STEP 3**). If a DMC XLOAD is possible, which is the case when the part number is different from the DMC source, then the operator can start the transfer of software by pressing the key 5L START XLOAD (**STEP 4**).

The P/N in green, or the message XLOAD NOT AVAIL on display prevents the DMC XLOAD and leads to the display with the message: DMC XLOAD NOT ALLOWED.

Once the operator has pressed the key 5L START XLOAD (**STEP 5**), the message DMC XLOAD TRANSFER IN PROGRESS induces the operator to wait the time of the transfer. The DMC source and the DMCs to be loaded are clearly identified.

When this time has elapsed the page with the message INTEGRITY CHECK comes on automatically (Not shown on the figure below).

After the INTEGRITY CHECK another page is displayed giving the status of all DMC having undergone the transfer (**STEP 6**). The message: DMCx XLOAD COMPLETED in green means the DMC is successfully loaded. The message: DMCx XLOAD ABORTED in amber means the XLOAD failed.

A test of the DMC is the automatically performed as mentioned by the message DMC SELF TEST IN PROGRESS 40S is displayed in green, until the power ON self test of the DMC is completed.

As soon as the DMC self test is completed the operator can get back to the page DMCx XLOAD with the new part numbers. To do so he presses the key 6L RETURN.

ENHANCED SYSTEM

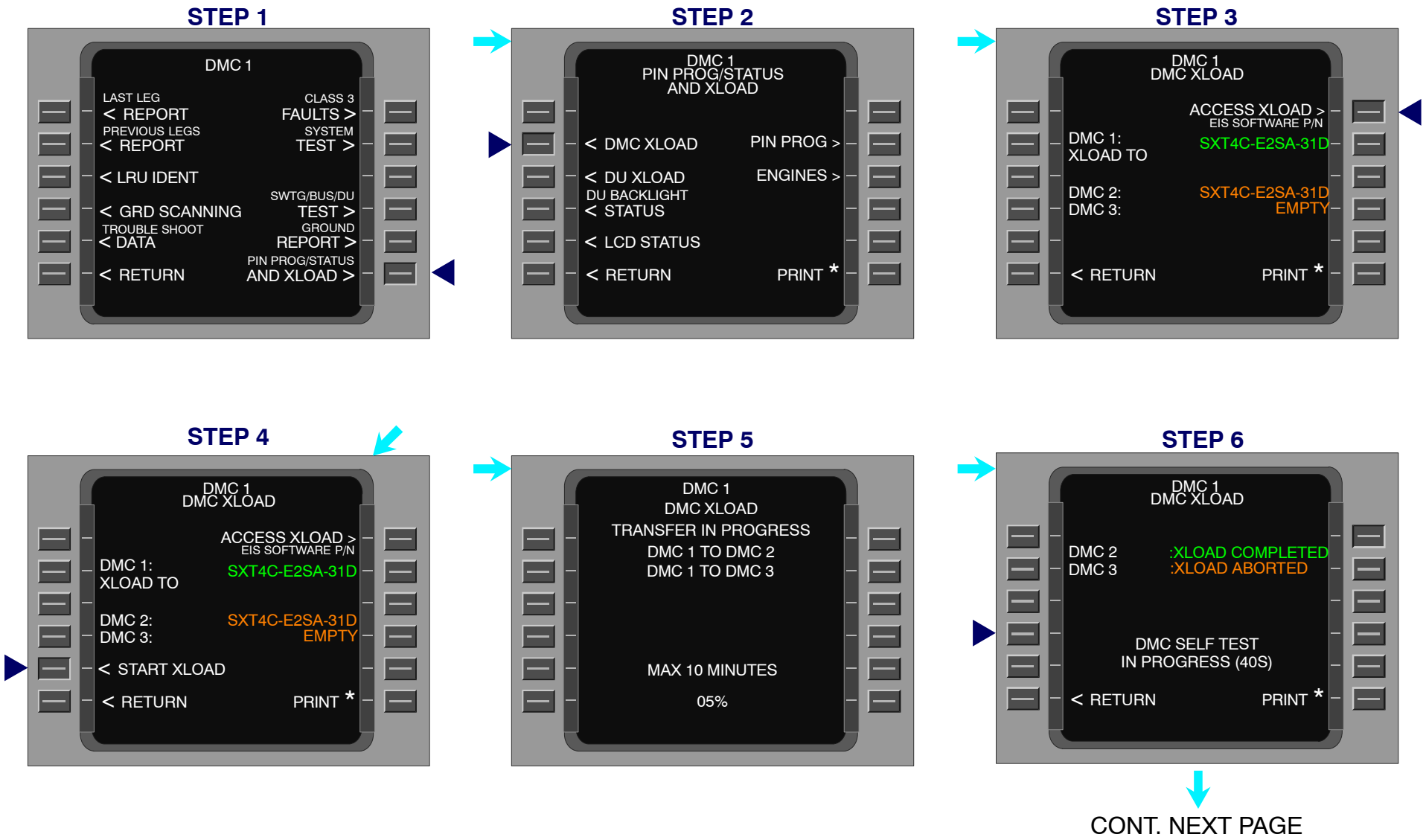


Figure 93 DMC XLOAD Procedure

DU XLOAD FUNCTION

NOTE: After replacement of a display unit the software is normally crossloaded to the new DU automatically. 40s after the energization of the DU the operational image comes into view on the screen or the newly installed DU.
If the amber message ”DISPLAY SYSTEM VERSION INCONSISTENCY” comes into view on the newly installed PFD CAPT, ND CAPT, EWD and SD then do the DU X loading procedure of the DMC.

NOTE: If you do the DU X loading procedure with DMC 3 you can upload all DUs. During the procedure the operator has to switch the DMC selector switch to the related position.

Starting from the “DMC PIN/PROG/STATUS AND XLOAD“ page the operator presses the key 3L DU XLOAD and gets the page DU XLOAD (**STEP 1**).

DMC DU XLOAD Page

All part numbers of the related DMC and DU are displayed:

- in green when the part number is the same as the DMC source,
- in amber when the part number is different from the DMC source,
- replaced by the message XLOAD NOT AVAIL in amber when the DU is not available for Xloading.
- replaced by the message EMPTY in amber when the DU has never yet been loaded.

The operator gets the next page DU XLOAD by pressing the 1R key ACCESS XLOAD (**STEP 2**).

The all part numbers of the DU being green (DU already Xloaded) or the message XLOAD NOT AVAIL is displayed the DU XLOAD is not possible and leads to the page with the message: DU XLOAD NOT ALLOWED in white.

If there is at least one amber part number, then the operator presses the key 1R ACCESS XLOAD to get the page INITIAL CONDITIONS where some instructions should be obeyed: SET THE EIS DMC SEL TO NORM, before to press the key 5L START XLOAD (**STEP 3**).

When the DU XLOAD is done with DMC 3, this action leads to the page where the operator selects the DUs of the CAPT area (key 2L) or the F/O area (key 4L).

DMC DU XLOAD Procedure

The key 2L leads to the next page , whereas the key 4L leads to the page where the INITIAL CONDITIONS are depending on the DUs to be crossloaded.

When these conditions are fulfilled the operator presses the key 5L START XLOAD to get the page TRANSFER IN PROGRESS to show which DU is being loaded (**STEP 4**). The page TRANSFER IN PROGRESS comes ON afterwards reminding the DUs to Xload.

Once the Xloading transfer has elapsed, the next page comes ON automatically with the message INTEGRITY CHECK (**STEP 5**).

Automatically the next page comes ON to show which DU has been successfully loaded. In this case the green message XLOAD COMPLETED appears in front of the DU concerned (**STEP 6**). If the Xload has failed the message XLOAD ABORTED is written in amber.

The message DU SELF TEST IN PROGRESS is shown until the test is completed.

Afterwards the operator can press the key 6L RETURN to get the page TEST CLOSE UP. Some instruction has to be obeyed before pressing the key 6L again RETURN.

ENHANCED SYSTEM

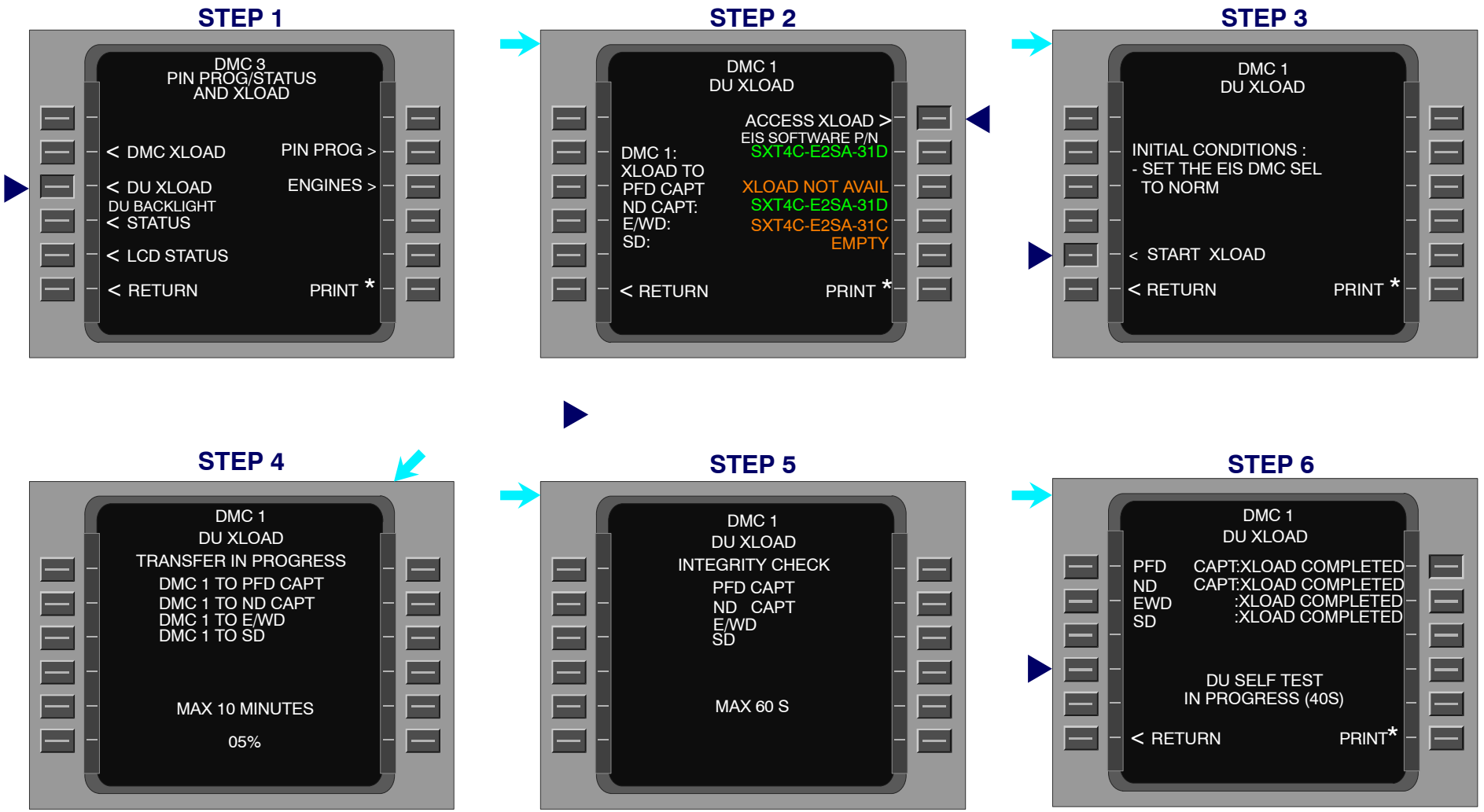


Figure 94 DU XLOAD Procedure

DMC LRU IDENT PRESENTATION

DMC CDFS Menu Pages

After the key 3L has been pushed on the page DMC1, 2,or 3.

LRU IDENT is presented to show all software and hardware part numbers as well as the serial numbers of the EIS components.

- DMC1/DMC2 software and hardware part numbers,
- DMC3/ DU PFD CAPT software and hardware part numbers,
- ND CAPT /PFD FO software and hardware part numbers,
- ND FO/DU EWD software and hardware part numbers and
- DU ND software and hardware part numbers.

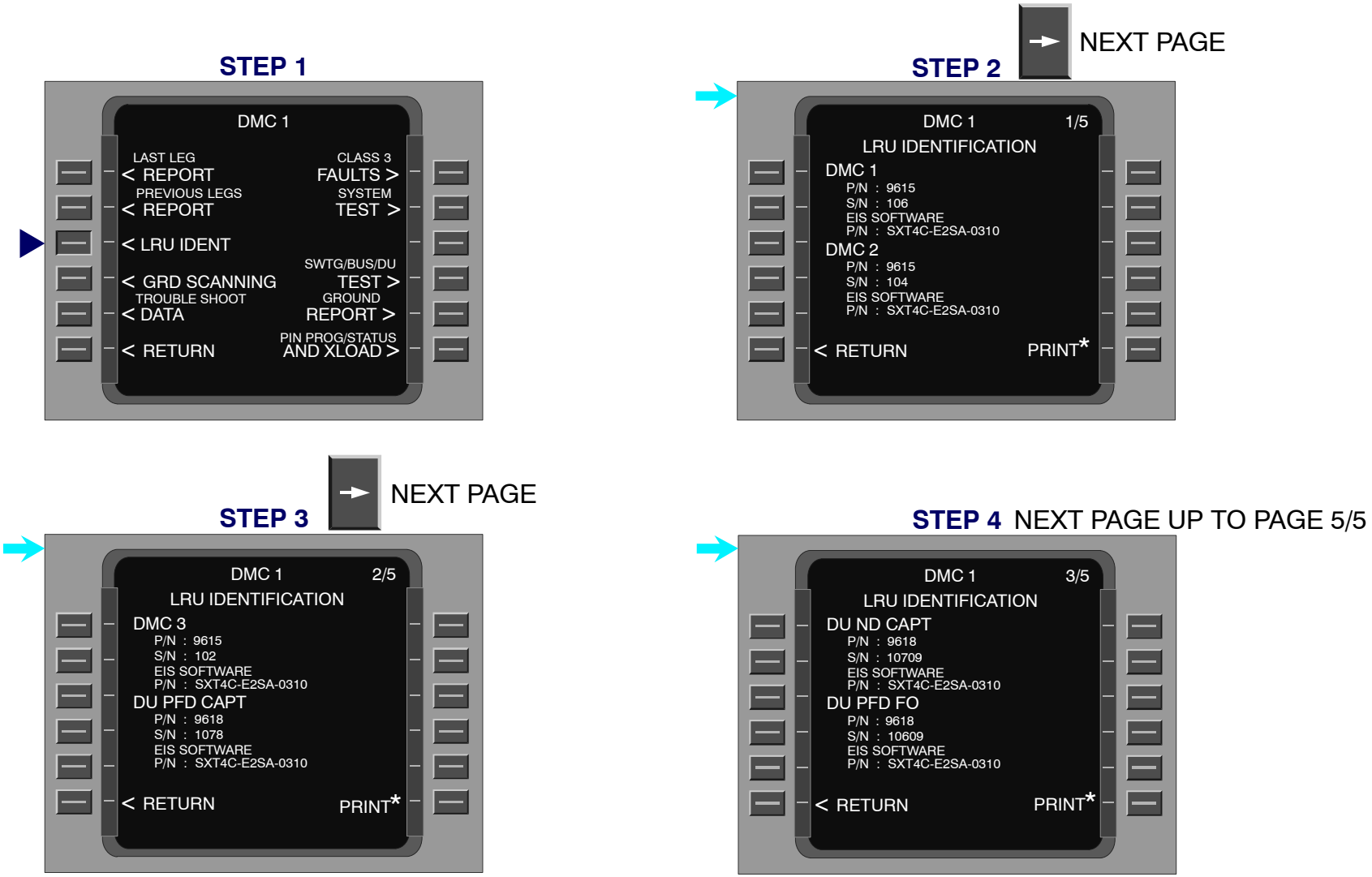


Figure 95 DMC LRU IDENT Function

ECAM BITE SYSTEM FUNCTION

General

This paragraph describes the BITE system of the FWS (**F**light **W**arning **S**ystem).

The FWS is a BITE type 1 system, that means data interchanges between the FWS and the CFDS (**C**entralized **F**ault **D**isplay **S**ystem) for maintenance purposes are performed by means of ARINC 429 HS (**H**igh **S**peed) buses.

The BITE essentially detects internal and external FWS faults, stores them in memories under certain conditions and reports them to the maintenance system.

LAST LEG REPORT

The purpose of this item is to present the list of class 1 and 2 internal and external faults detected by the FWS during the last flight. These faults are presented with the failed LRU, the associated source of detection (SDACs, FWCs, ECAM control panel) and the ATA reference.

NOTE: If several faults are detected, the total number of faults is mentioned.

PREVIOUS LEGS REPORT

The purpose of this item is to present the list of class 1 and 2 internal and external faults detected by the FWS during the last 63 flights (except the last flight).

The list contains the leg number to identify the concerned flight, the date and the time of the fault detection, the ATA reference and the fault message.

LRU IDENTIFICATION

The purpose of this item is to present the P/N (**P**art **N**umber) of the FWS components (FWCs, SDACs, ECAM control panel).

NOTE: For A/C equipped with the OEB DATABASE (OEB reminder) option: in addition to the P/N identification, the OEB data base version and the associated checksum are given for each FWC.

GROUND SCANNING

The purpose of this item is to present the internal and external faults that are applicable when the request is made and on the ground only. The date and the time of the scanning are mentioned. They are followed by the test of failures and the associated ATA reference.

CLASS 3 FAULTS

The purpose of this item is to present only the class 3 internal and external faults which are detected by the FWS (SDACs, FWCs, ECAM control panel) during the last flight.

For each fault, the text of the fault, the date and the ATA reference are given.

TROUBLE SHOOTING DATA

This item can be reached from one of the following functions:

- LAST LEG REPORT
- PREVIOUS LEGS REPORT
- GROUND SCANNING
- CLASS 3 FAULTS.

If a fault is detected, the following data are displayed by pushing the line key adjacent to the fault for which a trouble–shooting is performed:

- the fault title with the number of occurrences in parentheses.
- the fault code and the aircraft identification,
- the leg number at the fault detection and the occurrence number during this flight,
- during each occurrence, the flight phase, the time and the date at which the fault has been detected.

SYSTEM CONFIGURATION

Pushing the line key adjacent to this indication enables access to a sub–menu with a new item: ECAM PIN PROGRAM.

The purpose of this item is to show the status of the hardware pin programming for the SDACs and the FWCs. It also shows the result of the last hardware pin programming parity check.

NOTE: The pin programming is displayed in binary code:
- 0 corresponds to an activated pin (wired to ground),
- 1 corresponds to a pin not active (wired to an open circuit).

OEB DATABASE

The purpose of this item is to remind the crew of all warnings which are affected by an OEB (**O**peration **E**ngineering **B**ulletin).

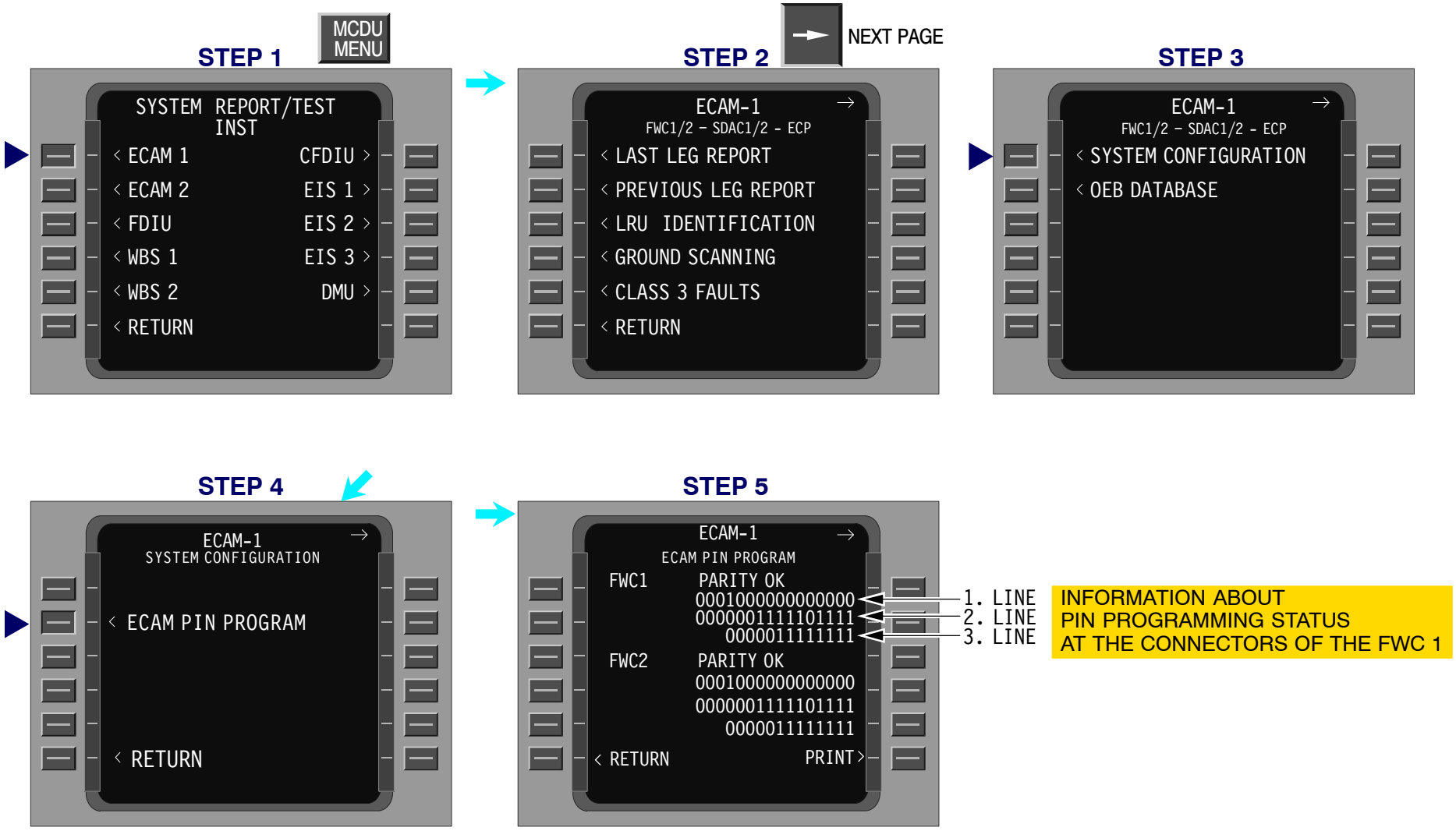


Figure 96 Access to the ECAM BITE Menu

These tables are given in the TSM

1. LINE		BIT	PIN NUMBER	PIN ALLOCATION
0	- - -	29	AA 5K	DECISION HEIGHT +100Ft CODE B
0	- - -	28	AA 4K	DECISION HEIGHT +100Ft CODE A
0	- - -	27	AA 5J	LAVATORY SMOKE GROUNDED
1	- - -	26	AA 4J	SPARE
0	- - -	25	AA 5H	AUTO CALL OUT 500Ft CONDITIONED
0	- - -	24	AA 4H	AUTO CALL OUT 1000 Ft
0	- - -	23	AA 5G	AUTO CALL OUT 500 Ft
0	- - -	22	AA 4G	AUTO CALL OUT 25 HUNDRED Ft
0	- - -	21	AA 3K	ENG IDENT B GROUNDED
0	- - -	20	AA 2K	ENG IDENT A GROUNDED
0	- - -	19	AA 3J	GPS INSTALLED
0	- - -	18	AA 2J	ICE DETECTOR INSTALLED
0	- - -	17	AA 3H	ETOPS
0	- - -	16	AA 2H	AUTO CALL OUT 2000 Ft
0	- - -	15	AA 3G	TCAS INSTALLED
0	- - -	14	AA 2G	AUTO CALL OUT 2500 Ft

2. LINE		BIT	PIN NUMBER	PIN ALLOCATION
0	- - -	29	AD 5D	PIN PROGRAM PARITY ACTIVE
0	- - -	28	AD 4D	ACARS INSTALLED
0	- - -	27	AD 5C	ALTITUDE ALERT B GROUNDED
0	- - -	26	AD 4C	ALTITUDE ALERT A GROUNDED
0	- - -	25	AD 5B	DECISION HEIGHT CODE B
0	- - -	24	AD 4B	DECISION HEIGHT CODE A
1	- - -	23	AD 5A	AUTO CALL OUT 05 Ft INHIBITION
1	- - -	22	AD 4A	AUTO CALL OUT 10 Ft INHIBITION
1	- - -	21	AD 3D	AUTO CALL OUT 20 Ft INHIBITION
1	- - -	20	AD 2D	AUTO CALL OUT 30 Ft INHIBITION
1	- - -	19	AD 3C	AUTO CALL OUT 40 Ft INHIBITION
0	- - -	18	AD 2C	AUTO CALL OUT 50 Ft VALID
1	- - -	17	AD 3B	AUTO CALL OUT 100 Ft INHIBITION
1	- - -	16	AD 2B	AUTO CALL OUT 200 Ft INHIBITION
1	- - -	15	AD 3A	AUTO CALL OUT 300 Ft INHIBITION
1	- - -	14	AD 2A	AUTO CALL OUT 400 Ft INHIBITION

3. LINE		BIT	PIN NUMBER	PIN ALLOCATION
0	- - -	28	AD 10D	CONFIG STD 1 GROUNDED
0	- - -	26	AD 10C	CONFIG AV 1 GROUNDED
0	- - -	24	AD 10B	CONFIG AV 2 GROUNDED
0	- - -	23	AD 11A	PREDICTIVE WINDSHEAR
0	- - -	22	AD 10A	PARITY
1	- - -	21	AD 11H	SPARE
1	- - -	20	AD 10H	SPARE
1	- - -	19	AD 11G	SPARE
1	- - -	18	AD 10G	SPARE
0	- - -	17	AD 11F	DUAL AUDIO ALARM
0	- - -	16	AD 10F	CABIN READY MESSAGE
0	- - -	15	AD 11E	LIP (LIFT IMPROVE PACK) INSTALLED
0	- - -	14	AD 10E	CONFIG STD 2 GROUNDED

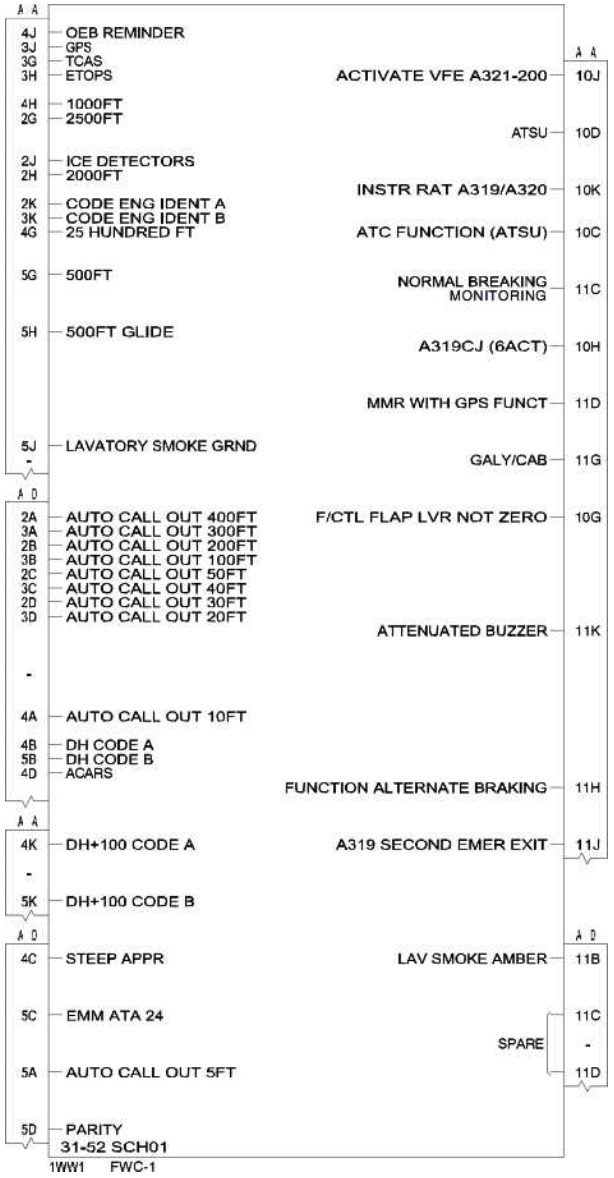


Figure 97 FWC Pin Programming Example

31–21 ELECTRICAL CLOCK

ELECTRIC CLOCK SYSTEM PRESENTATION

GENERAL

A single electrical clock gives the Universal Time Coordinated (UTC) and date as time references for the crew and all peripheral systems. It is located on the R center instrument panel 400VU.. The other functions available for crew are Elapsed Time (ET) and chronometer. The time is also displayed at the bottom of the SD.

Three different clock configurations are available

Universal Coordinated Time (UTC) is provided by a fully independent electrical clock with built–in time base, located on the R center instrument panel 400VU.

SEXTANT CLOCK

UTC and Date

The center window (UTC) indicates the current time: hours and minutes. Periods of 15 seconds are indicated by three horizontal segments.

The current date (month, day and year) is displayed when the SET knob is pressed. To keep the date displayed, the SET P/B must be held pressed in. To recover the time, the SET P/B must be released.

UTC And Date Setting

An UTC selector allows date and time updating:

- MO: to set months and years
- DY: to set day
- HR: to set hours
- MIN: to set minutes
- RUN: to start the UTC counter

The UTC selector must be pressed and turned to set it from RUN to MINute position. When a function is selected with the UTC selector (except RUN), you can set it with the SET P/B.

When pushed, the SET P/B decreases the displays. By turning it to either side, it increases the displays. After setting, the selector must be set back to RUN (pushed and turned).

Chronometer

An upper window, called CHR indicates the minutes provided the CHR P/B has been pressed. The seconds are indicated by a sweep hand. Pressing the CHR P/B activates the chronometer, pressing it again will stop it. The chronometer is reset by pressing the CHR P/B a third time.

Elapsed Time

To activate the ET function, the ET selector must be set to RUN.

When set to STOP, the ET counter stops. To reset the display, the selector must be set to RST (spring loaded position) and it returns to STOP.

Test

To test the clock, the annunciator light switch must be set to TEST. Then all the displays should show eight.

Failure

With a clock failure or a loss of power supply, the digital displays are no longer available. With a loss of main electrical power supply, the time (UTC and ET) is still counted in memory through the clock built–in–battery, except for the chronometer function.
When power is restored:
– the chronometer pointer returns to zero if previously displaced,
– the UTC and ET indications reappear, indicating current value.

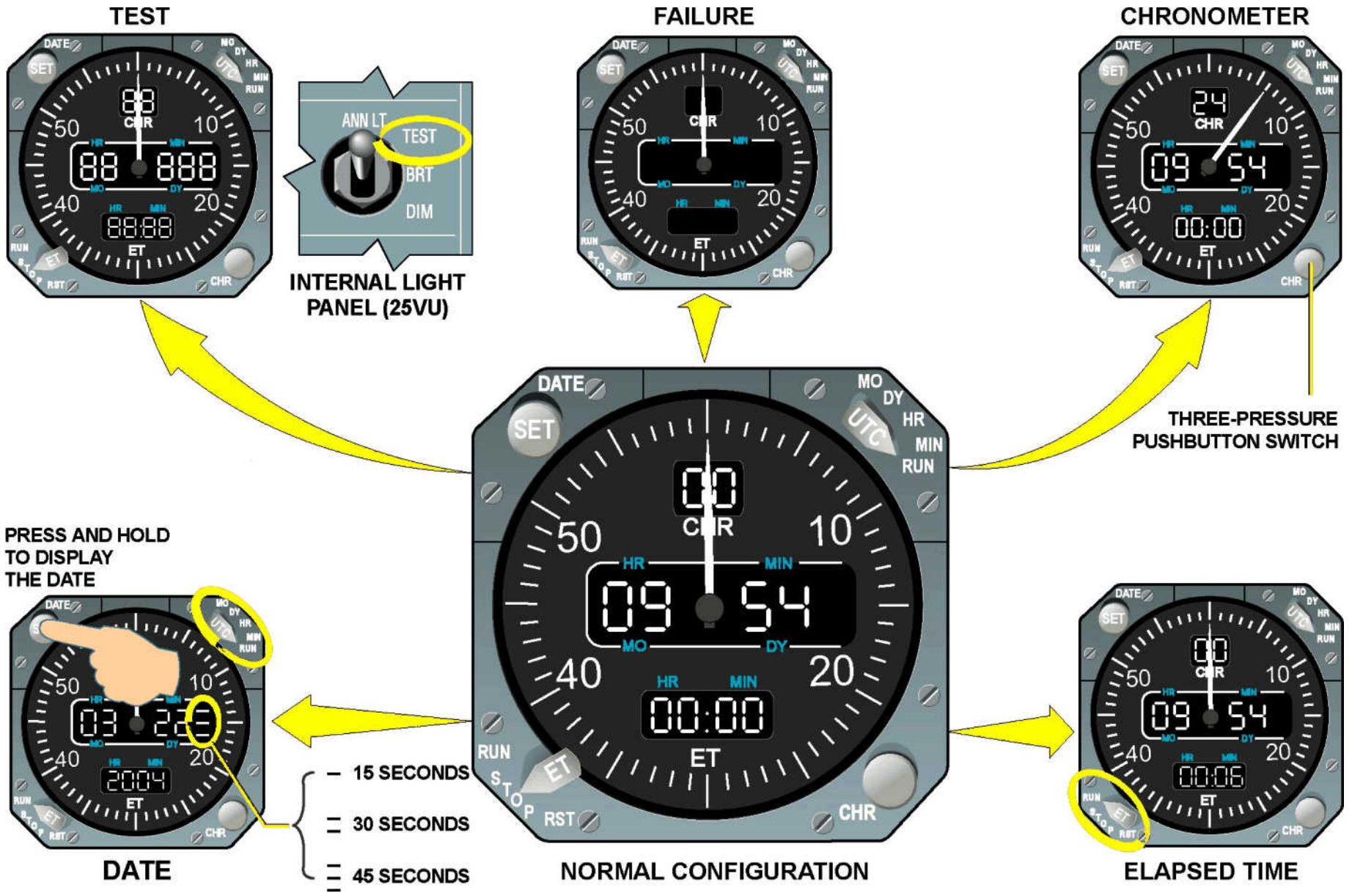


Figure 98 Sextant Clock

SMITH CLOCK

UTC and Date

When the clock is in normal configuration, it displays the time. The date is displayed by pressing the DATE P/BSW, when the time of the day is displayed. The clock displays successively the day and month and the year. By pressing the DATE P/BSW once more the time of the day will be displayed again.

UTC Setting

The setting of the UTC is done with the UTC selector. Setting the hours and minutes: the UTC switch is set to HSD. When the figure for hours is correct, the UTC switch is set to MSM. In this position, when the figure for the minutes is correct, the UTC switch is set to HLDY. Once in the HLDY position, if the time is correct, the UTC switch is set to the RUN position and the clock starts normal operation.

Date Setting

The setting of the date is done with the UTC selector. Setting the day, month and year: the date P/BSW must be pressed, then the UTC switch is set to HSD. When the figure for the day is correct, the UTC switch is set to MSM. In this position, when the figure for the month is correct, the UTC switch is set to HLDY. In this position, when the figure for the year is correct, the UTC switch is set to RUN.

Chronometer

A first press on the CHR P/B starts the chronometer, a second press stops it, and a third press resets it.

Elapsed time

To activate the ET function, the ET selector must be set to RUN. When set to HLD, the ET counter stops. To reset the display, the selector must be set to RESET (spring loaded position) and it returns to HLD.

Test

To test the clock, the annunciator light switch must be set to TEST. Then all the displays should show eight.

Failure

With a clock failure or a loss of power supply, the digital displays are no longer available. With a loss of main electrical power supply, the time is still counted in memory through the A/C battery supply, except for the CHR function.

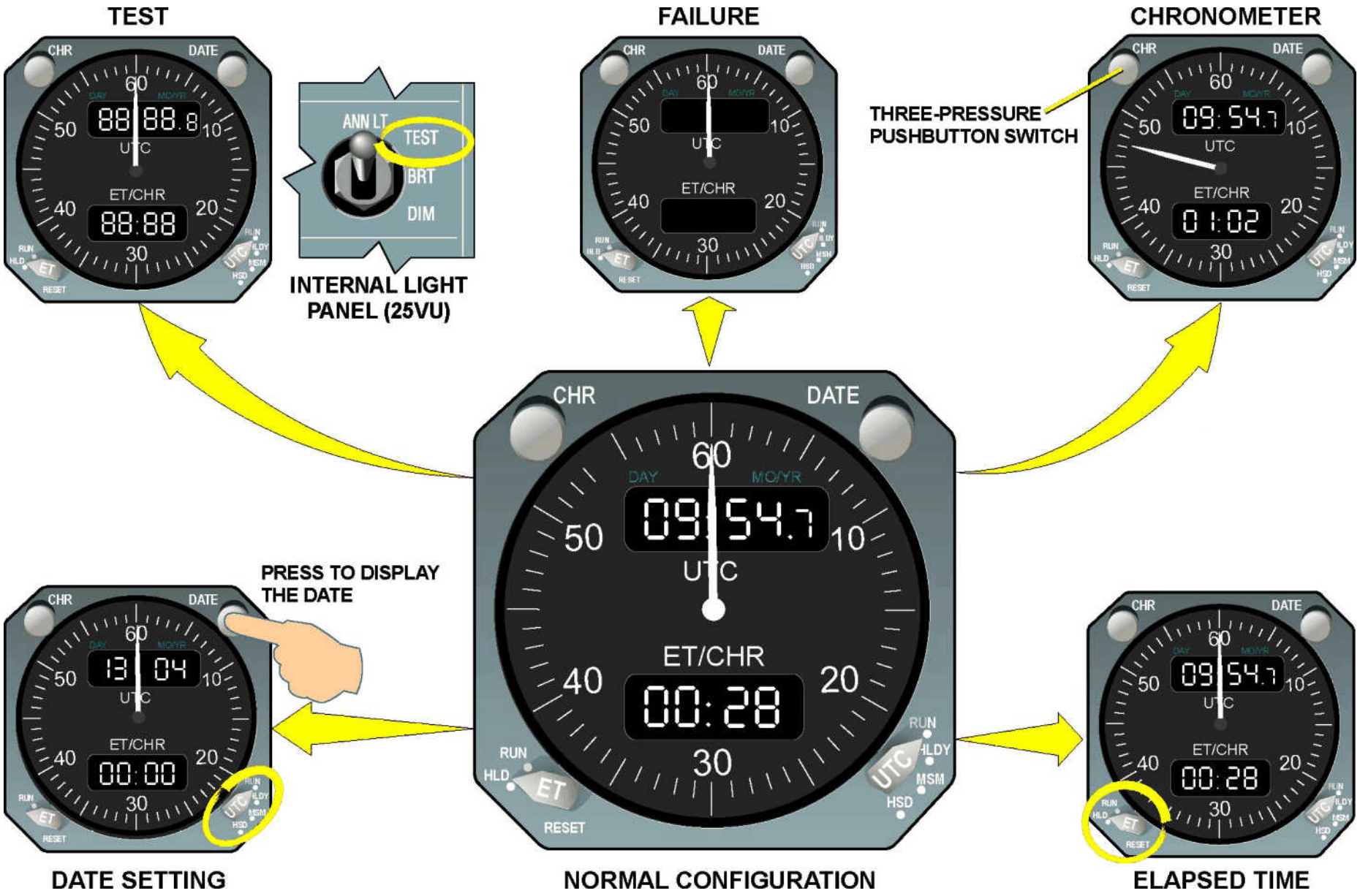


Figure 99 Smith Clock

AIR PRECISION CLOCK

UTC and Date

When the clock is in normal configuration it displays the time. The date is displayed by pressing the SET turn and P/B when the time of the day is displayed. By pressing the SET turn and P/B once more the time of the day will be displayed again.

UTC Setting

The setting of the Universal Time coordinated (UTC) is done with the UTC selector. When the selector is in SET position, the second digits are blanked, the minute digits flash and the hour digits are frozen. By rotating the SET button clockwise the minutes increase, anticlockwise the minutes decrease. By pushing the SET button the hours flash, the minutes are frozen and the seconds are blanked. By turning the SET button, hours can be adjusted. When the UTC selector is moved from SET to INT the clock starts running from the adjusted time with the second digits at 00.

When the UTC selector is in Global Positioning System (GPS) position, the clock is synchronized on the GPS time, if a GPS signal is present.

Date Setting

The setting of the date is done with the UTC selector. By pressing the SET button, the date is displayed. By setting the UTC selector in SET position, the year digits flash and the month and day digits are frozen.

By turning the SET button clockwise or anticlockwise, years can be modified to obtain the chosen value. By pushing the SET button, the months and days can be adjusted in the same way.

Chronometer

A first press on the CHRonometer P/B starts the chronometer, a second press stops it and freezes the display, and a press on the ReSeT P/B resets it.

Elapsed Time

To activate the Elapsed Time (ET) function, the ET selector must be set to RUN. When set to STP, the ET counter stops, and the display is frozen. To reset the display, the selector must be set to RST (spring loaded position) and it returns to STP.

Test

To test the clock, the annunciator light switch must be set to TEST.
Then all the displays should show eight.

Failure

With a clock failure or a loss of power supply, the digital displays are no longer available. With a loss of main electrical power supply, the time is still counted in memory through the A/C battery supply, except for the CHR and ET functions.

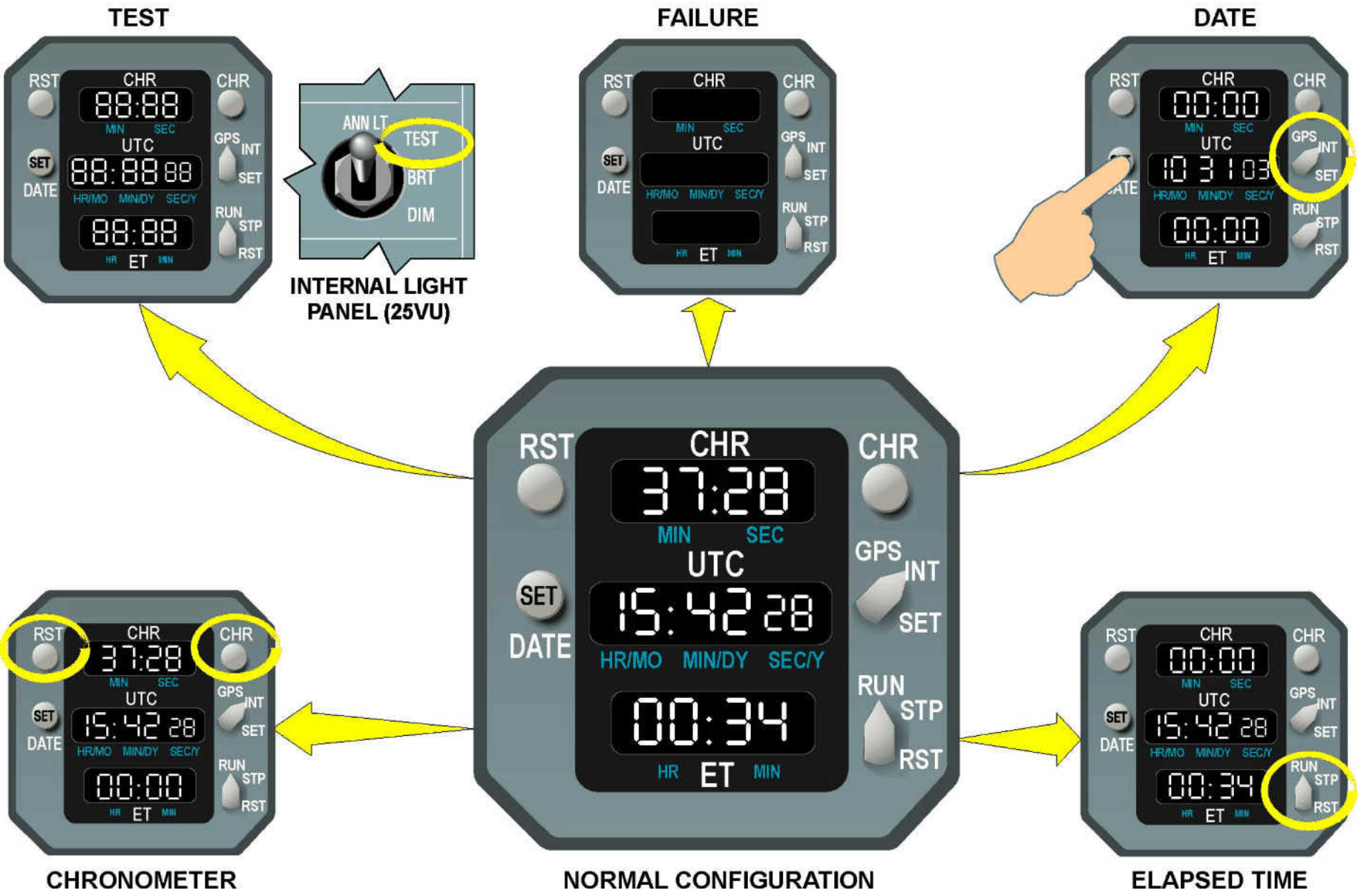


Figure 100 Air Precision Clock

ELECTRICAL CLOCK PWR SPLY/OPER. & INTERFACE

Power Supply

The clock is important for the function of the CFDS. Its electrical connection guarantees at least the supply of the time base.

- ESS BUS 401PP

  normally supplies time base and indication.
- HOT BUS 701PP

  supplies the time base when ESS BUS 401 PP is lost. The indication, however, is lost.
- The Internal Battery

  supplies the time base for maximal 15 days when ESS BUS and HOT BUS are lost.

  After main battery change it is not necessary to readjust the clock.

  By means of a shunt in the plug it is guaranteed that the clock stops working after removal. When the plug is removed the internal power supply via the internal battery is interrupted.

  Depending on airline decision the internal battery may be removed to avoid repetitive battery change costs (DLH).

Clock Interface

The clock transmits UTC (**U**niversal **T**ime **C**oordinated) in ARINC 429 format to following computers:

- CFDIU (**C**entralized **F**ault **D**isplay **I**nterface **U**nit)
- FDIU (**F**light **D**ata **I**nterface **U**nit)
- FMGCs (**F**light **M**anagement and **G**uidance **C**omputer**s**)

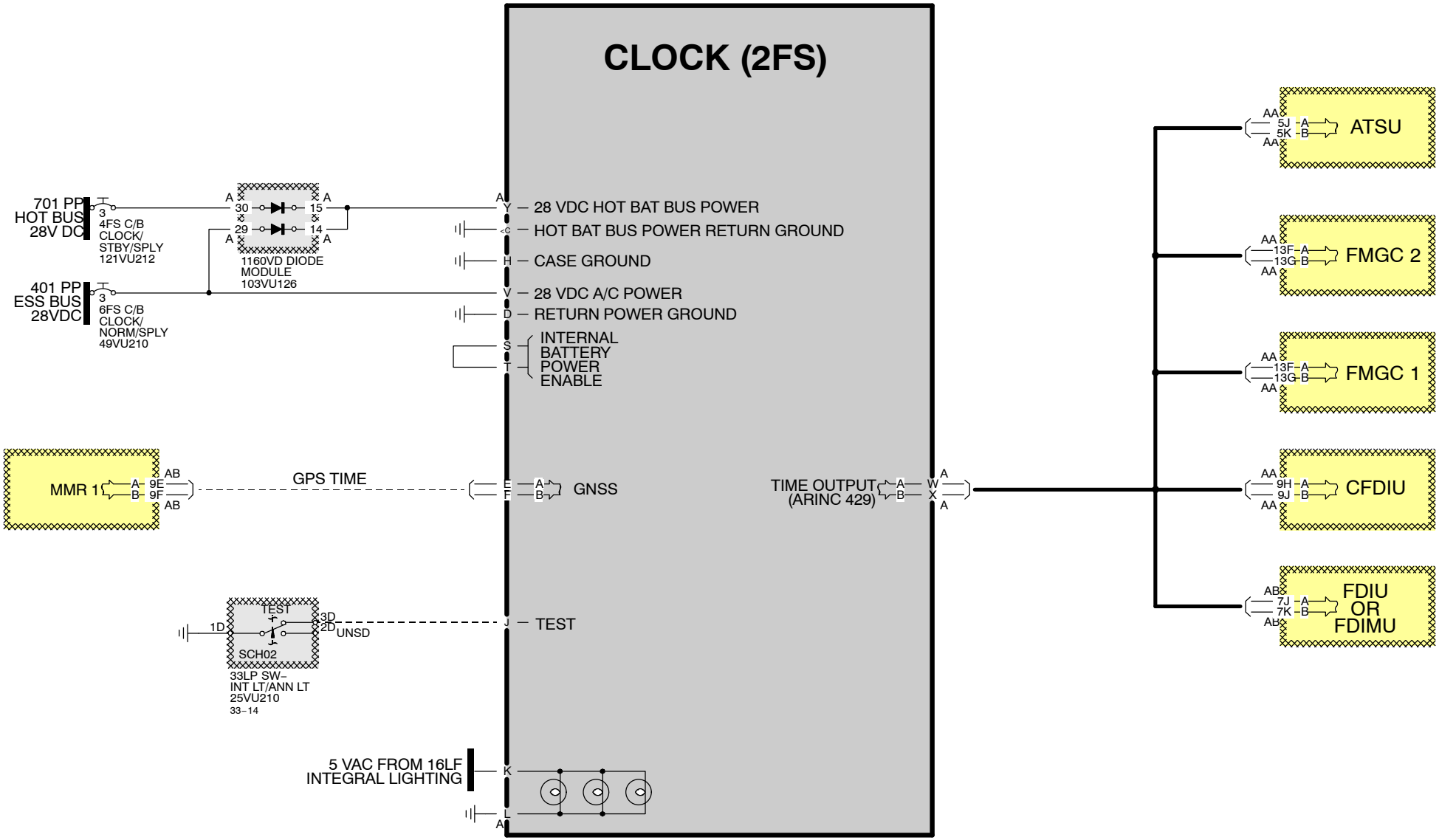


Figure 101 Clock Power Supply & Interface

CFDIU Interface with the Clock

The CFDIU is connected to the clock, located on the center instrument panel, which provides:

- GMT/Date,
- elapsed time and
- chronometer.

The clock provides the date and the time at which faults occur. The time associated with the fault messages and the ECAM warnings enables the correlation between the ECAM warnings and the fault messages memorized by the CFDIU.

In the event of loss of clock operation or incorrect operation detected by the CFDIU, the CFDIU takes over and calculates the time and the date using its internal clock. This transition does not require reinitialization if there is not a long power cutoff (> 200 ms). If there is a long power cutoff, the crew performs reinitialization using the MCDU.

The CLOCK is declared failed or invalid (= incorrect operation) by the CFDIU when one of the labels of the GMT and DATE parameters is not refreshed over 1 minute.

Clock Indication on ECAM

The CFDIU permanently acquires GMT and the date and transmits these data on its output buses, for example to the DMCs. During normal operation, DMC 2 sends data to the lower ECAM DU.

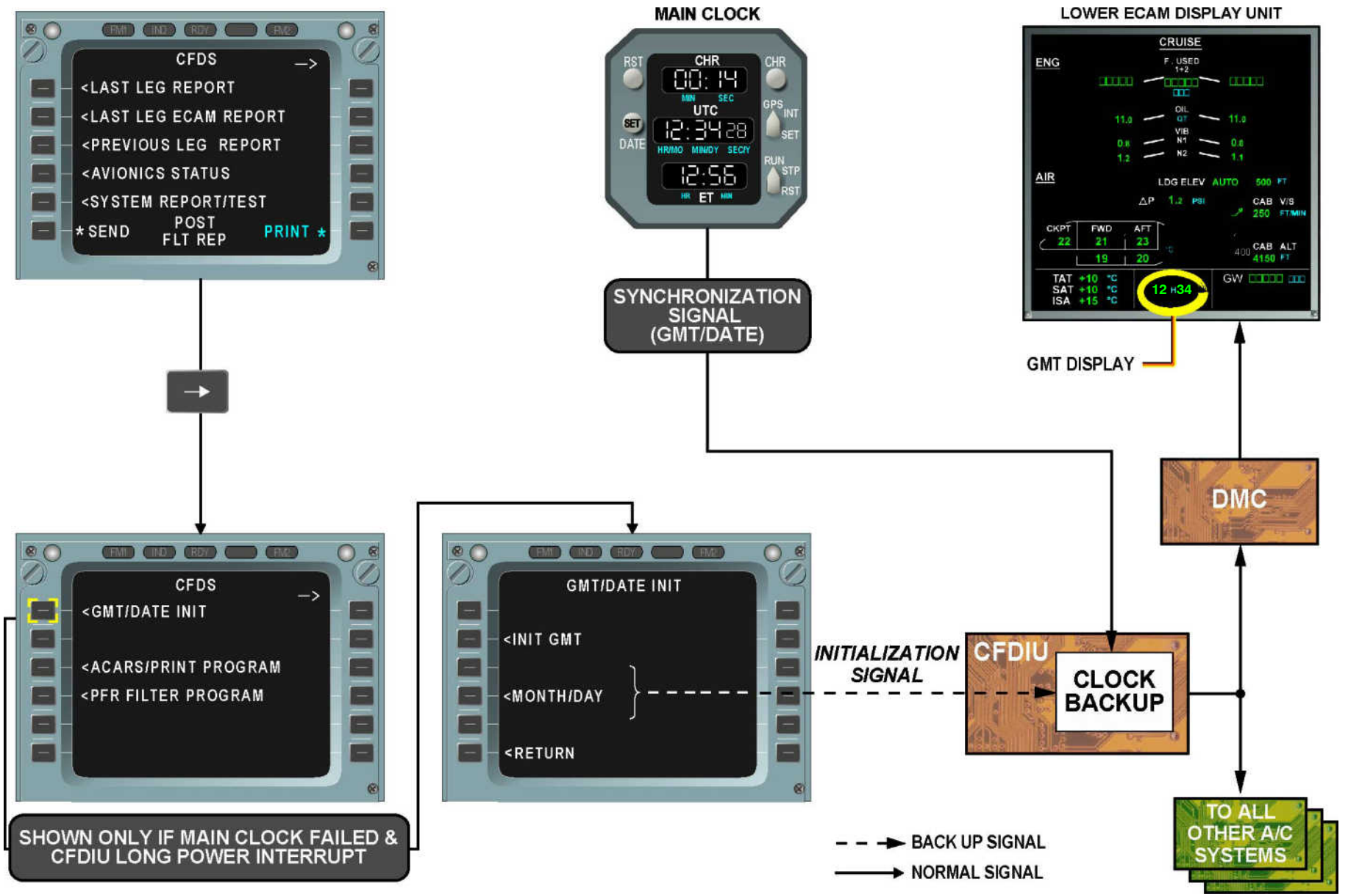


Figure 102 Clock - ECAM Interface

31–00 GENERAL

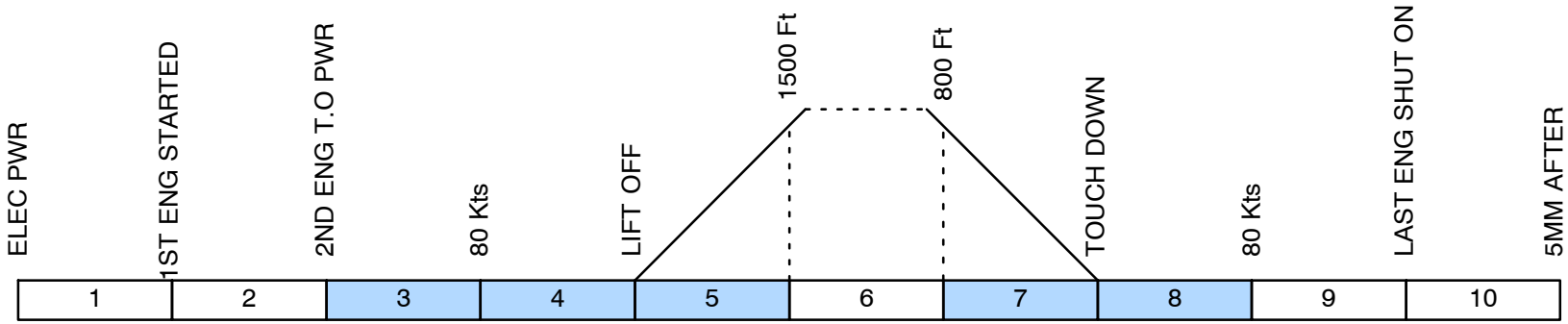
INDICATING/RECORDING SYSTEMS SYSTEM WARNINGS

Operation/Control and Indication

Hereafter are given all the warning pages related to the indicating/recording systems which mention:

- the name of the failure ,
- the system page automatically called,
- the MASTER lights actived by the failure,
- the flight phases which inhibit the failure,
- the local warning.

NOTE: The “C/B TRIPPED“ messages are described in the ATA 24 book.



E/WD FAILURE MESAGE	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLIGHT PHASE INHIBIT
SDAC 1 + 2 FAULT	SC	MASTER CAUT	NIL	NIL	4,5,7,8
DMC 1 (2) FAULT					
DMC 3 FAULT					
SDAC 1 (2) FAULT	NIL	NIL			3,4,5,7,8
FWC 1 (2) FAULT					
FWC 1 + 2 FAULT DETECTED BY THE DMC					NIL
OEB/FWC DISCREPANCY FWC1 AND FWC2 DO NOT HAVE THE SAME OEBS LISTED IN THEIR OEB REMINDER DATABASE.					3,4,5,6,7,8

Figure 103 Electronic Instrument System Warnings - ECAM Messages

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