A330-200
TECHNICAL TRAINING MANUAL

MECHANICS / ELECTRICS & AVIONICS COURSE

31 INDICATING/RECORDING SYSTEMS

GE Metric

For Training Purposes Only
Isseued By SPL/GK March 2006

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Under no circumstances
should this document be used as a reference.

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ELECTRICAL CLOCK PRESENTATION

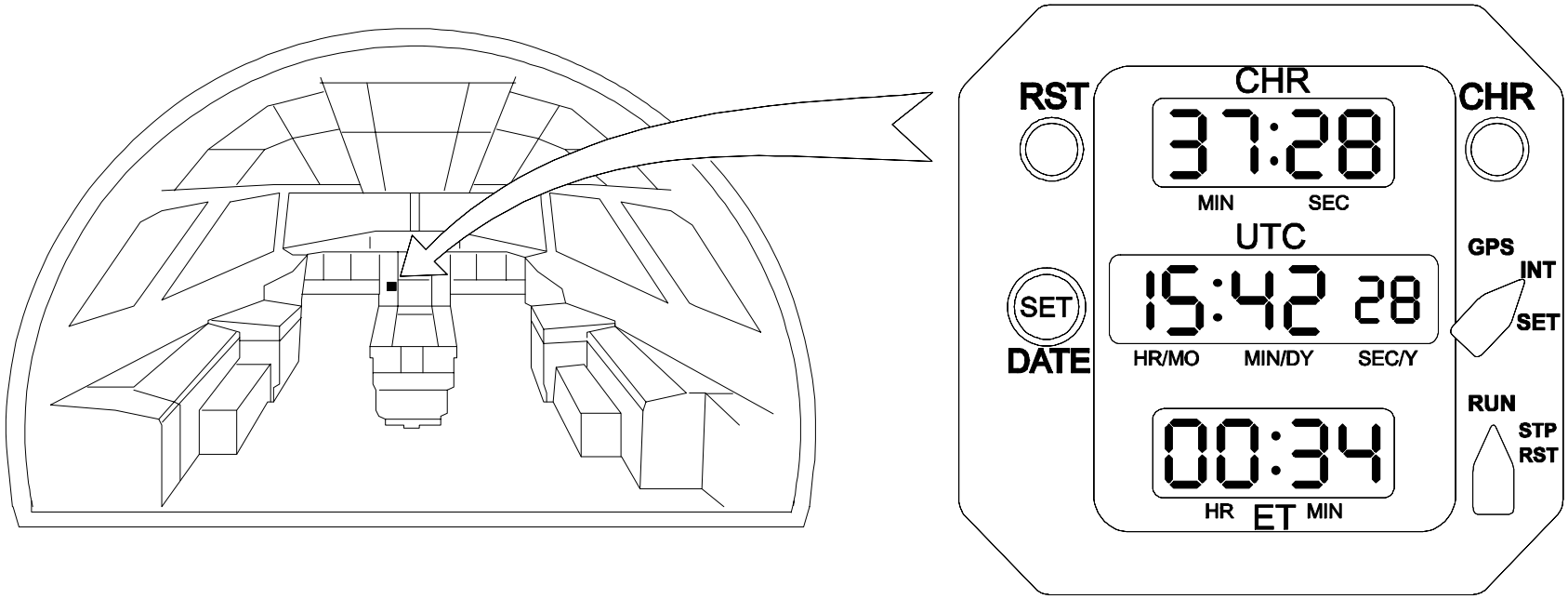
General
Universal Time Coordinated (UTC) and Date
Elapsed Time (ET)
Chronometer

GENERAL

The Electrical Clock is located on the main instrument panel and provides Universal Time Coordinated (UTC), Elapsed Time (ET), Chronometer and Date.

The clock provides Universal Time Coordinated via an ARINC 429 format bus for:

- 2 Central Maintenance Computers (CMCs),
- The Flight Data Interface Unit (FDIU) and
- 2 Flight Management, Guidance and Envelope Computers (FMGECs).



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UNIVERSAL TIME COORDINATED (UTC) AND DATE

The Time and Date are displayed in digital form by two digits for the hours and months, two digits for the minutes and days and two digits for the seconds and years.

The UTC selector has three positions which provide the following functions:

- GPS: the clock is synchronized on the GPS signal.
- INT: the clock is running in internal mode using its own time base.
- SET: setting of UTC or DATE.

Time and Date setting is performed using the SET turn and push button.

The SET turn and push button provides the following functions:

- In normal mode, the date is displayed each time the SET button is pressed.
- In setting mode, the time and date is adjusted by turning and pushing the SET button.

For example:

UTC = 15hr 42min 28sec.

ELAPSED TIME (ET)

The Elapsed Time is displayed in digital form by two digits for the hours and two digits for the minutes.
It can totalise up to 99 hours and 59 minutes.

Elapsed time operation is controlled by the ET selector.

The Elapsed Time selector has three positions:

- RUN (stable position): the counter runs.
- STP (stable position): the counter stops, display is frozen.
- RST (spring loaded position): the counter is reset to zero and displays go off.

For example:

ET = 00hr 34min.

CHRONOMETER

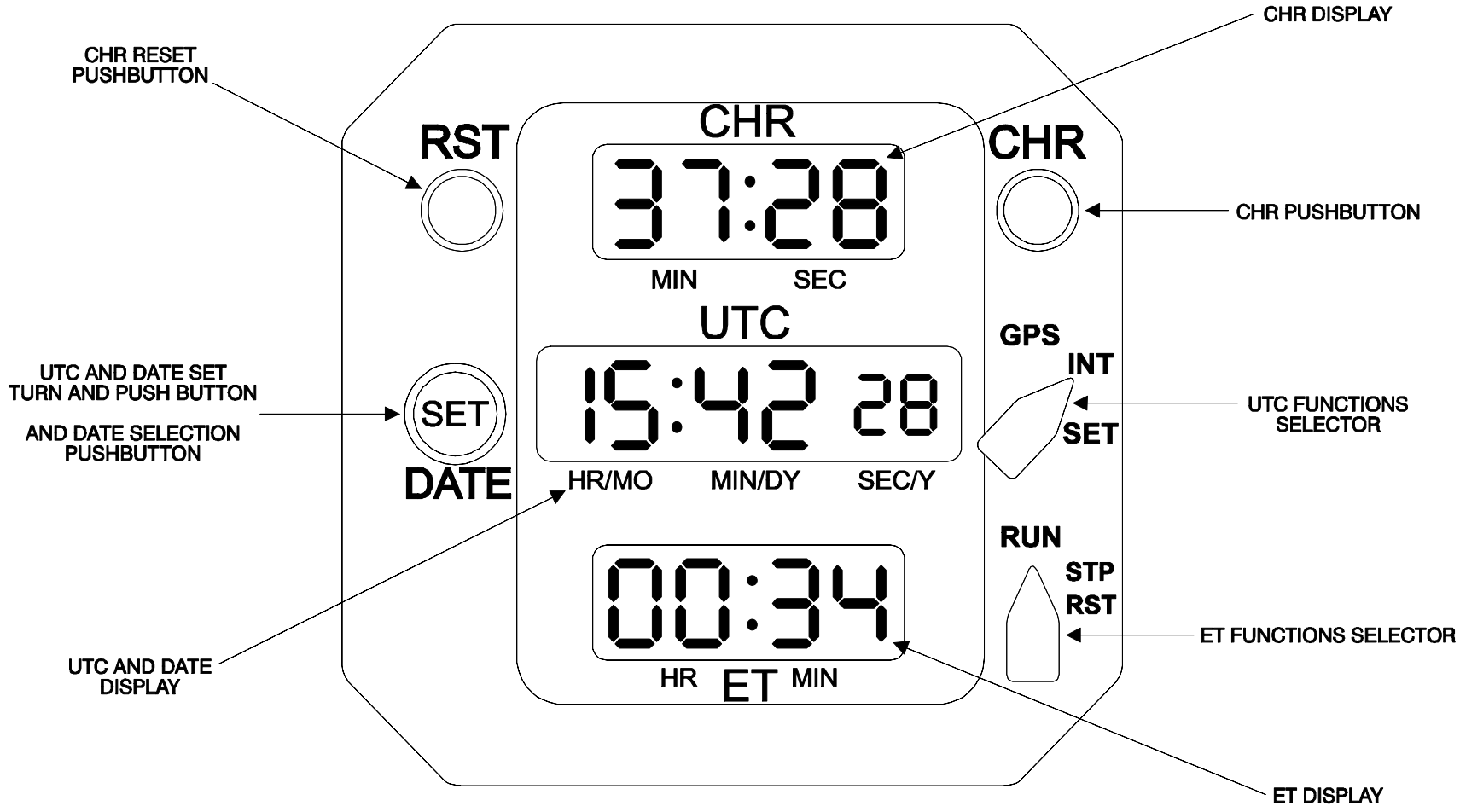
The Chronometer information is displayed in digital form by two digits for the minutes and two digits for the seconds.

The Chronometer is operated using the CHR pushbutton.

A first press on the CHR pushbutton starts the chronometer, a second press stops it and freezes the display, and a press on the RST pushbutton resets it and the display goes off.

For example:

CHR = 37min 28sec.



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STUDENT NOTES

CLOCK UTILIZATION

Test
Universal Time Coordinated (UTC) and Date
Universal Time Coordinated (UTC) Setting
Data Setting
Chronometer
Elapsed Time
Failure

TEST

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

UNIVERSAL TIME COORDINATED (UTC) AND DATE

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

UNIVERSAL TIME COORDINATED (UTC) SETTING

The setting of the 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 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

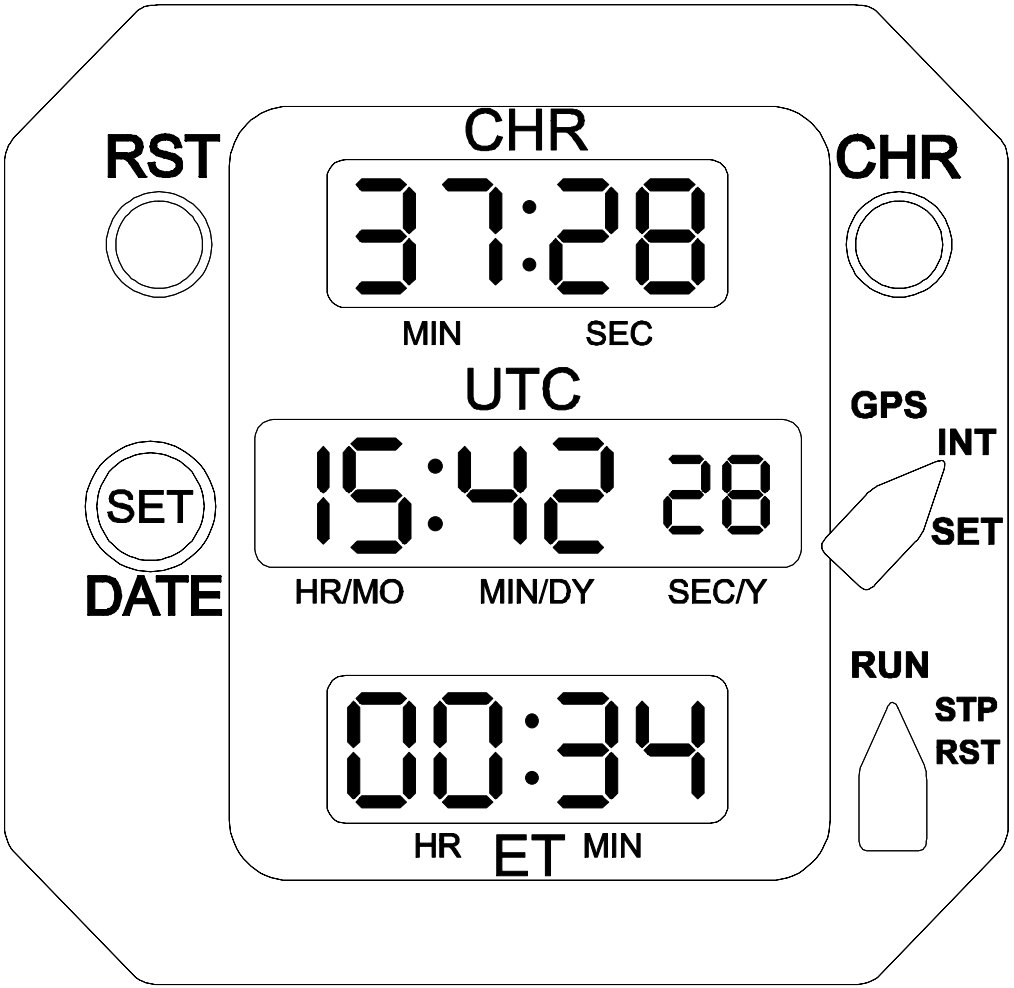
A first press on the CHR pushbutton starts the chronometer, a second press stops it and freezes the display, and a press on the RST pushbutton resets it.

ELAPSED TIME

To activate the 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.

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 chrono and ET functions.



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STUDENT NOTES

ELECTRONIC INSTRUMENT SYSTEM (EIS) PRESENTATION

General
Electronic Flight Instrument System (EFIS)
Electronic Centralized Aircraft Monitoring (ECAM)
Attention Getters
EFIS Control
ECAM Control

GENERAL

The Electronic Instrument System (EIS) replaces conventional instruments by new technology.
It presents data to the pilots on six identical and interchangeable Cathode Ray Tubes (CRTs).

The Electronic Instrument System is divided into two parts :

* an Electronic Flight Instrument System (EFIS) comprising :

  - two Primary Flight Displays (PFDs).
  - two Navigation Displays (NDs).

* an Electronic Centralized Aircraft Monitoring (ECAM) comprising :

  - an Engine and Warning Display (E/WD).
  - a System Display (SD).
  - attention getters.

ELECTRONIC FLIGHT INSTRUMENT SYSTEM (EFIS)

EFIS information is presented in front of each pilot on a Primary Flight Display and a Navigation Display.
The PFD displays the flight information required for short term flight. The ND displays the flight information required for navigation.

ELECTRONIC CENTRALIZED AIRCRAFT MONITORING (ECAM)

ECAM information is presented on the center instrument panel on an Engine and Warning Display and a System Display.
The E/WD displays the engine and fuel parameters, the check list and warning messages, and certain information relevant to system operation. The SD displays synoptics giving the configuration of various A/C systems and some permanent data.

ATTENTION GETTERS

Attention getters are visual and audio.

Pilot attention is drawn by :

- two Master Warning lights.
- two Master Caution lights.
- two Autoland lights.
- Audio signals (sounds) and Auto Call out (synthetic voices) broadcast by two loudspeakers.

EFIS CONTROLS

EFIS controls are provided by independent controls for each pilot, for display selection or reconfiguration.

The EFIS controls are :

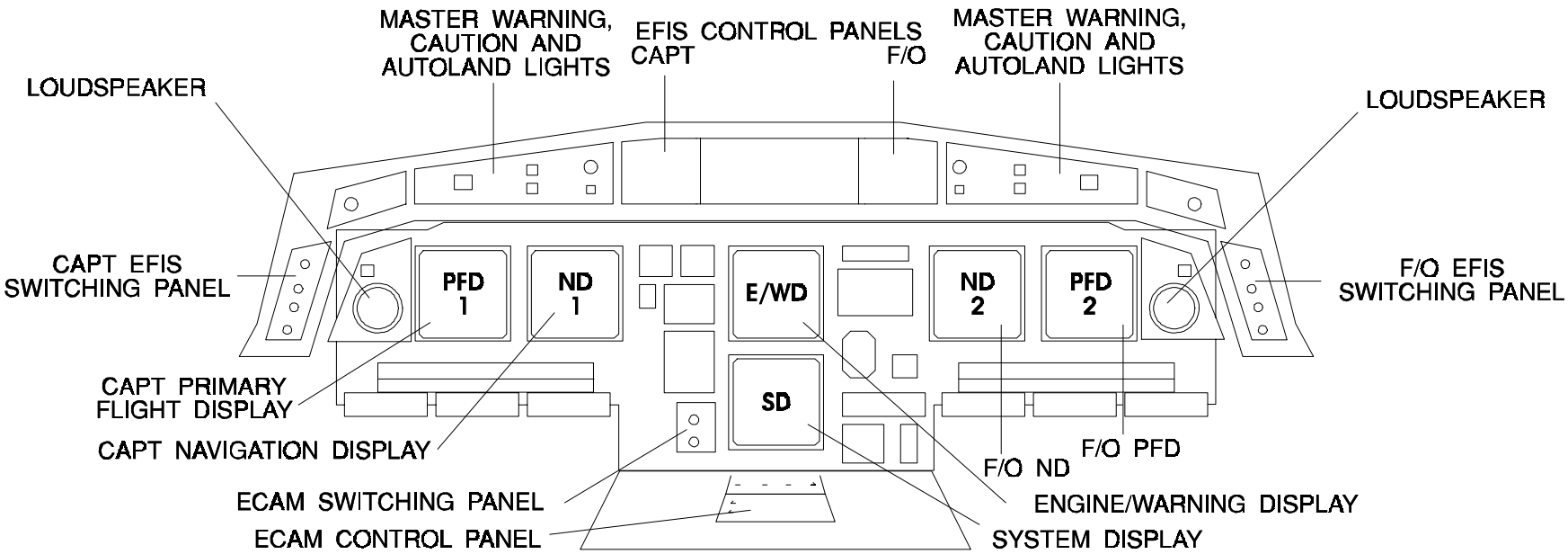
- 2 EFIS switching panels.
- 2 EFIS control panels.

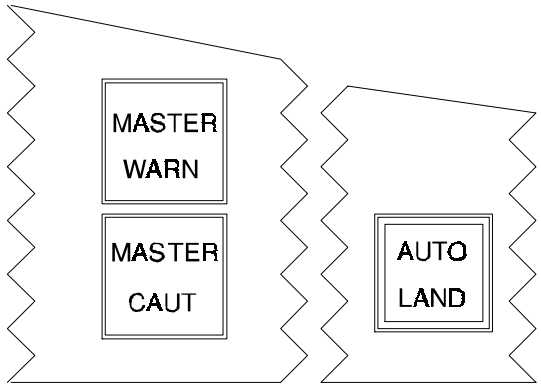
ECAM CONTROLS

ECAM controls are provided by controls on center panel and pedestal for display selection and reconfiguration.

The ECAM controls are :

- 1 ECAM switching panel.
- 1 ECAM control panel.





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STUDENT NOTES:

EIS ARCHITECTURE

General
EFIS
ECAM
Control Panels
Redundancy

GENERAL

The Electronic Instrument System is an avionic system connected with most of the aircraft systems to perform the EFIS and ECAM functions.
The EFIS provides flight information and the ECAM provides system and warning information. The Electronic Instrument System comprises seven computers:

- three identical Display Management Computers (DMCs)
- two identical Flight Warning Computers (FWCs)
- two identical System Data Acquisition Concentrators (SDACs).

The DMCs comprise two independent parts: one for the EFIS function and one for the ECAM function.

EFIS

The EFIS part of the DMCs decodes and processes data from the aircraft systems in such a way to generate images on PFDs and NDs. The three DMCs receive identical information, in normal operation DMC 3 is in standby.

ECAM

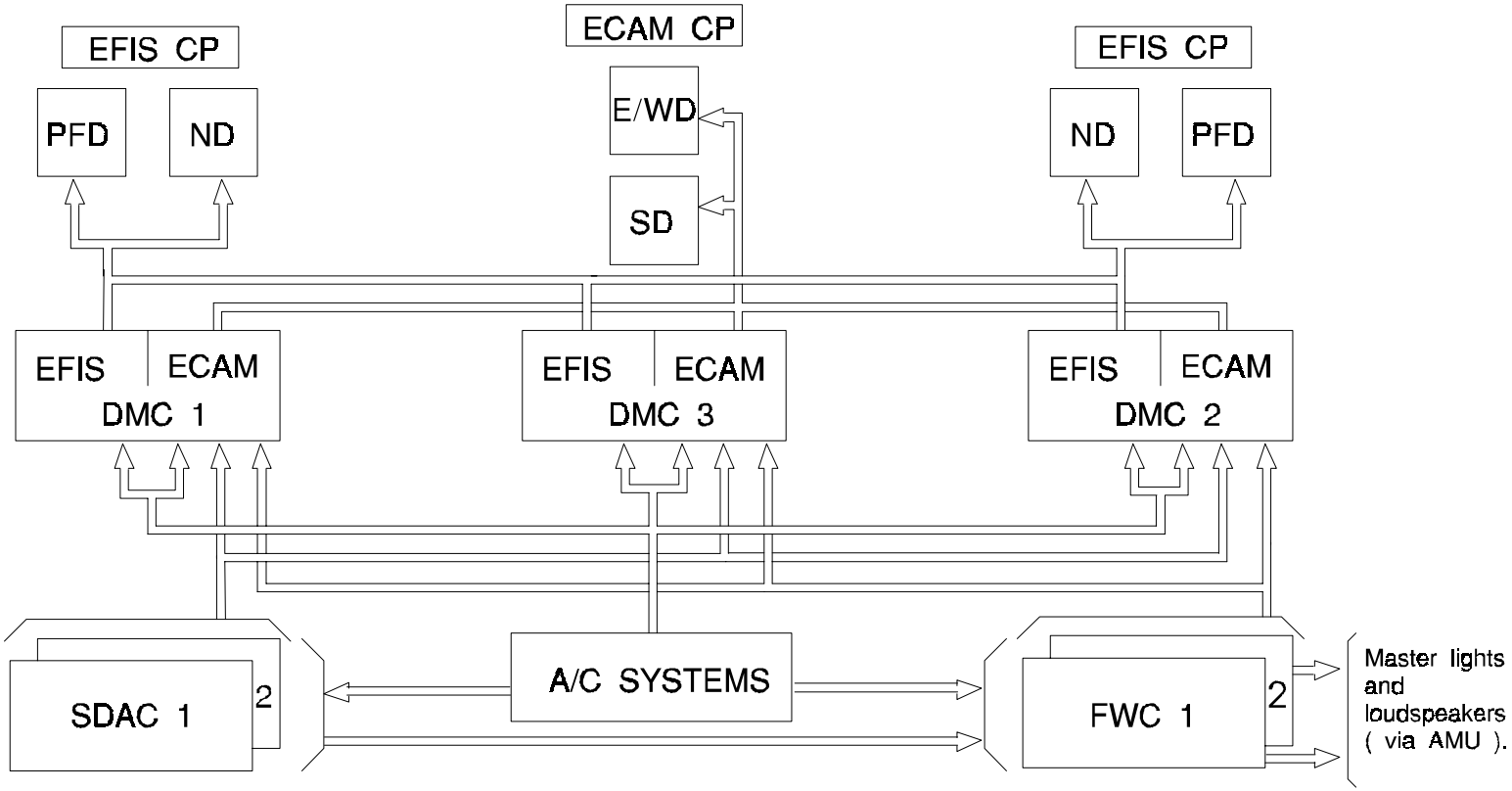
DMC3 ECAM part is used in normal configuration. The ECAM uses A/C system data which is processed by the System Data Acquisition Concentrators (SDACs), Flight Warning Computers (FWCs) and DMCs before being presented on E/WD and SD.
The SDACs digitalize aircraft system data and transmit it to the DMCs. The DMCs using SDACs outputs, generate aircraft system information for 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 FWCs outputs to display aircraft information on the lower part of the E/WD.
The SDACs receive A/C system information concerning amber cautions and transmit it to the FWCs.
The FWCs recieve A/C system data concerning red warnings and memos; they generate messages and activate attention getters (Audio signals through AMU) AMU: Audio Management Unit.

CONTROL PANELS

Three Control Panels are provided for EFIS and ECAM controls. Control panels are physical interfaces between the crew members and the EIS.

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. As shown on the drawing, the system still operates normally with one SDAC, one FWC and one DMC inoperative.



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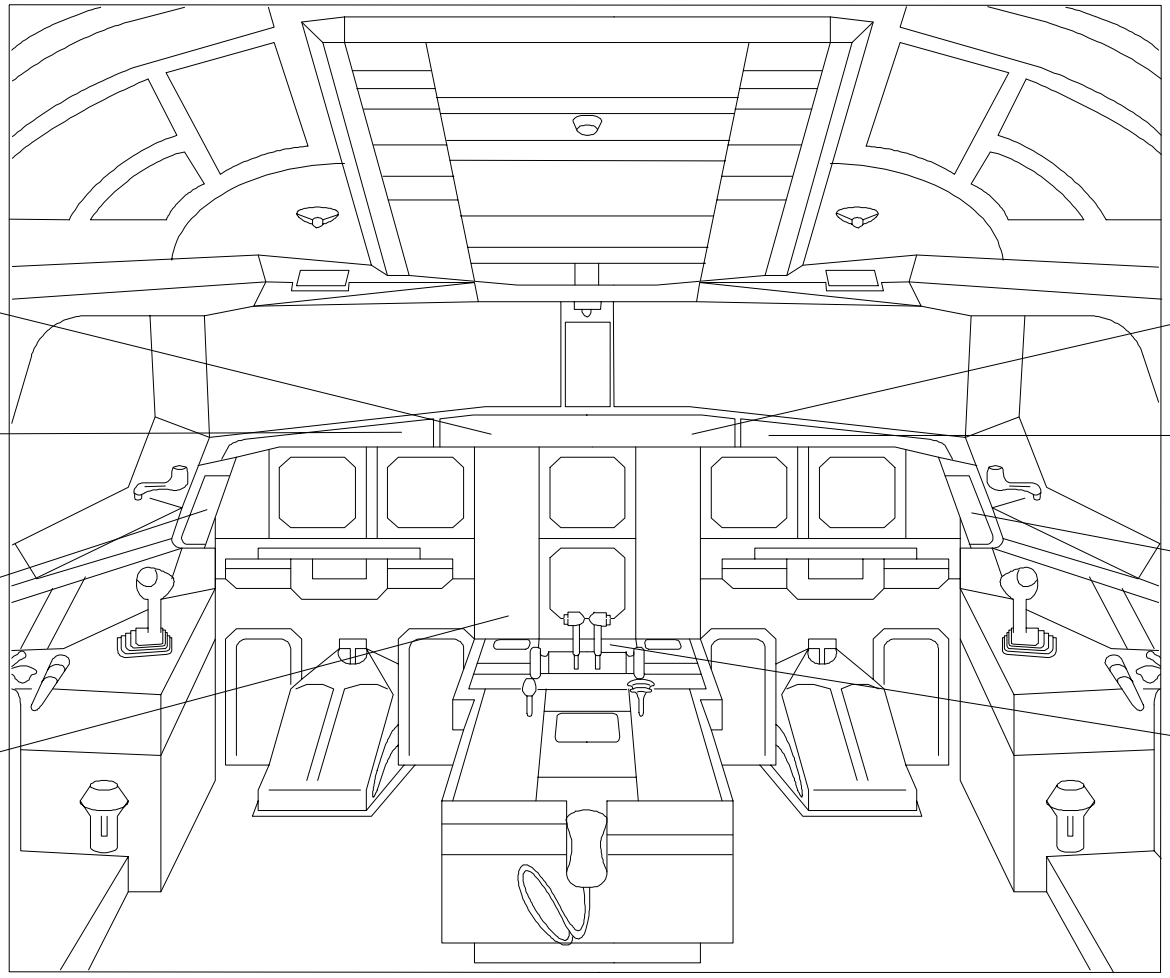
STUDENT NOTES:

EIS CONTROLS PRESENTATION

General
EFIS Control Panel
EFIS Switching Panel
ECAM Control Panel
ECAM Switching Panel
Attention Getters

GENERAL

The EIS panels are located on the glareshield, on the main instrument panel and on the pedestal. The captain and first officer panels have the same functions.



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EFIS CONTROL PANEL

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

PFD controls :

* LS P/B: enables the Loc and Glide scales and deviation symbols to be displayed on the associated PFD.

* FD P/B: enables the Flight Director bars to be displayed or not on the associated PFD.

* Baro reference selector knob: the outer knob enables the measurement unit to be selected, either hecto Pascal (hPa) or inches of Mercury (inHg), on the baro reference window.The inner knob is rotated to select the reference value, pulled to select the standard value (1013 hPa) and pushed to display the QNH. When QNH is selected, pressing the knob selects QFE, pressing
it again selects QNH.

* Baro reference window: used to display the pressure reference value and the reference used.

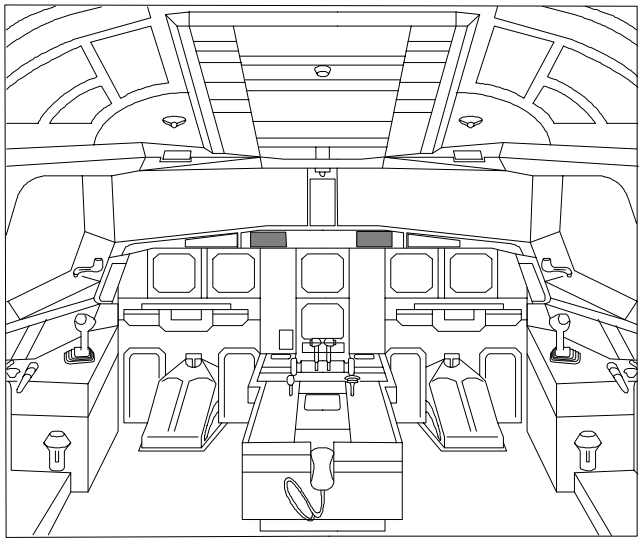
ND controls :

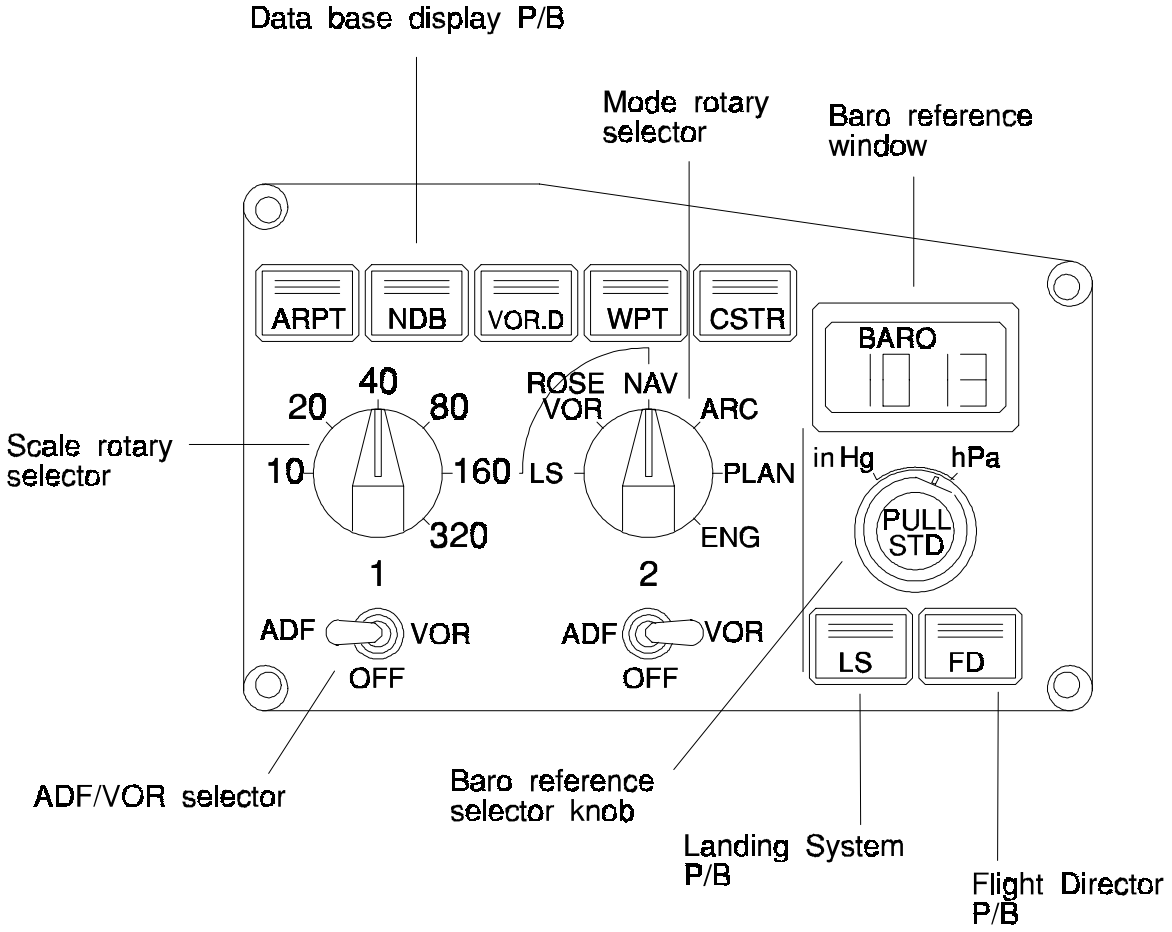
* Data base display P/Bs: these five P/Bs enable additional data to be displayed on the ND. When pressed these P/Bs respectively display Airports, ADF stations, VOR/DME stations, Waypoints and Constraints.

* Scale rotary selector: enables the scale to be selected in miles on the associated ND for the Rose NAV, ARC and PLAN modes.

* Mode rotary selector: enables the desired presentation of navigation information to be selected on the associated ND.

* 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.





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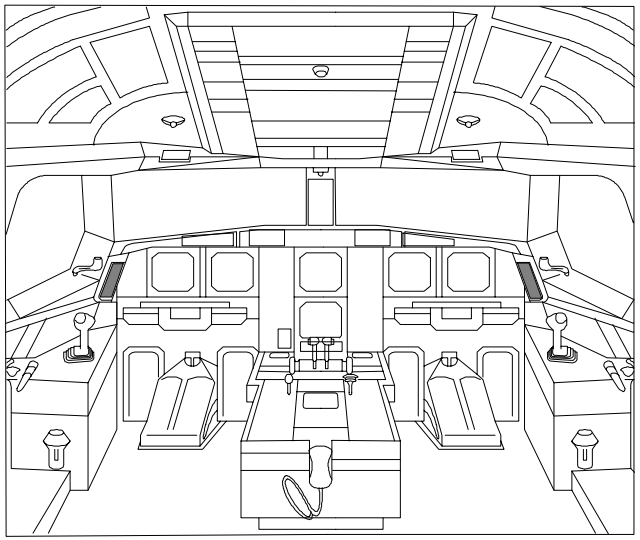
EFIS SWITCHING PANEL

The EFIS switching panel is located on either side of the glareshield.
The EFIS DMC rotary selector is used to select another DMC when EFIS DMC2 (or EFIS DMC1 for captain) has failed. This selector has no effect on the ECAM display.

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 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 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.

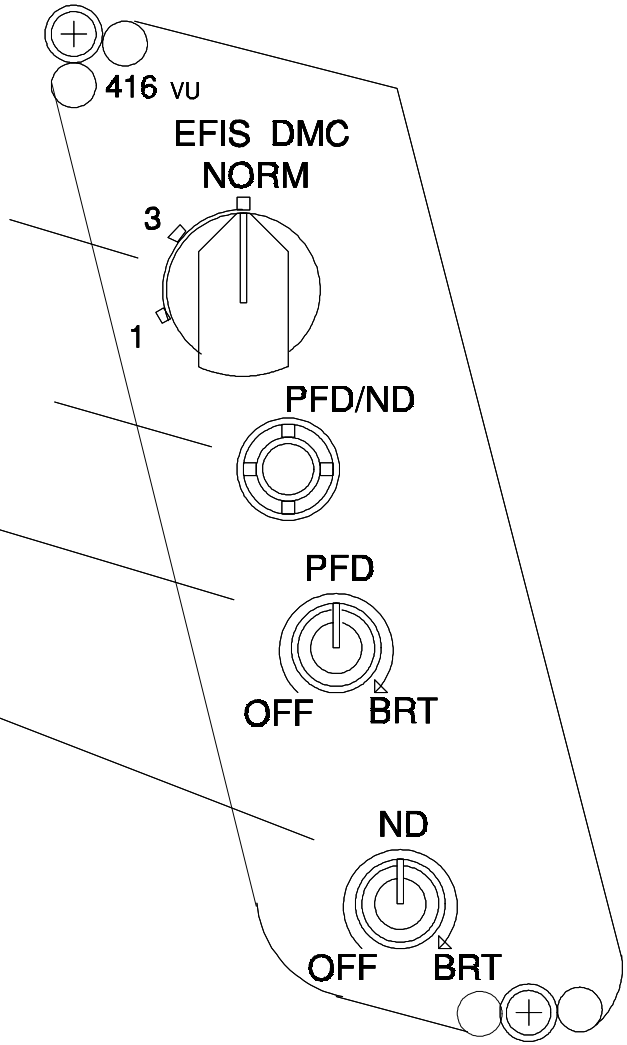


EFIS DMC rotary selector

PFD/ND pushbutton

PFD OFF/BRT potentiometer

ND OFF/BRT potentiometer



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ECAM CONTROL PANEL

The ECAM control panel located on the pedestal, includes the brightness potentiometers and the controls required for operation of the ECAM system.

* UPPER and LOWER ECAM OFF/BRT potentiometers: the potentiometers switch the ECAM Display Unit on or off and control the brigtness in conjunction with automatic brightness control system. In the OFF position, automatic and manual reconfigurations are possible.

* CLR (clear) P/B: when the P/B light is on, the warning and caution messages displayed on the lower part of the E/WD can be cleared.

* STS (status) P/B: is used to call the Status page on the SD. If there are no status messages, the "normal" indication is displayed for 5 seconds on the SD.

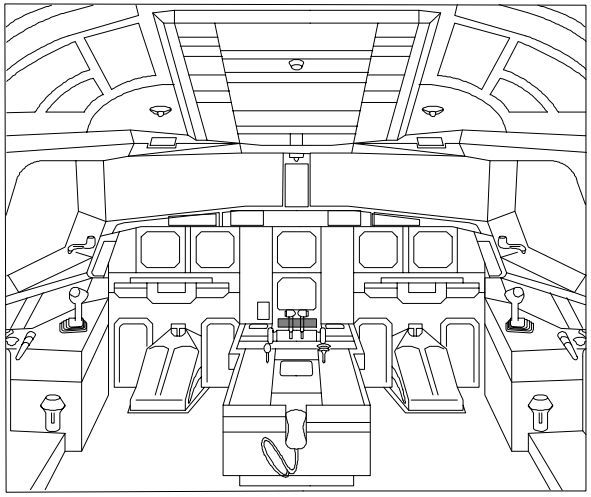
* RCL (recall) P/B: is used to recall warning and caution messages inhibited by the CLR P/B or by the flight phase automatic inhibition. If there are no warning or caution messages, the "normal" indication is displayed for 5 seconds on the E/WD.

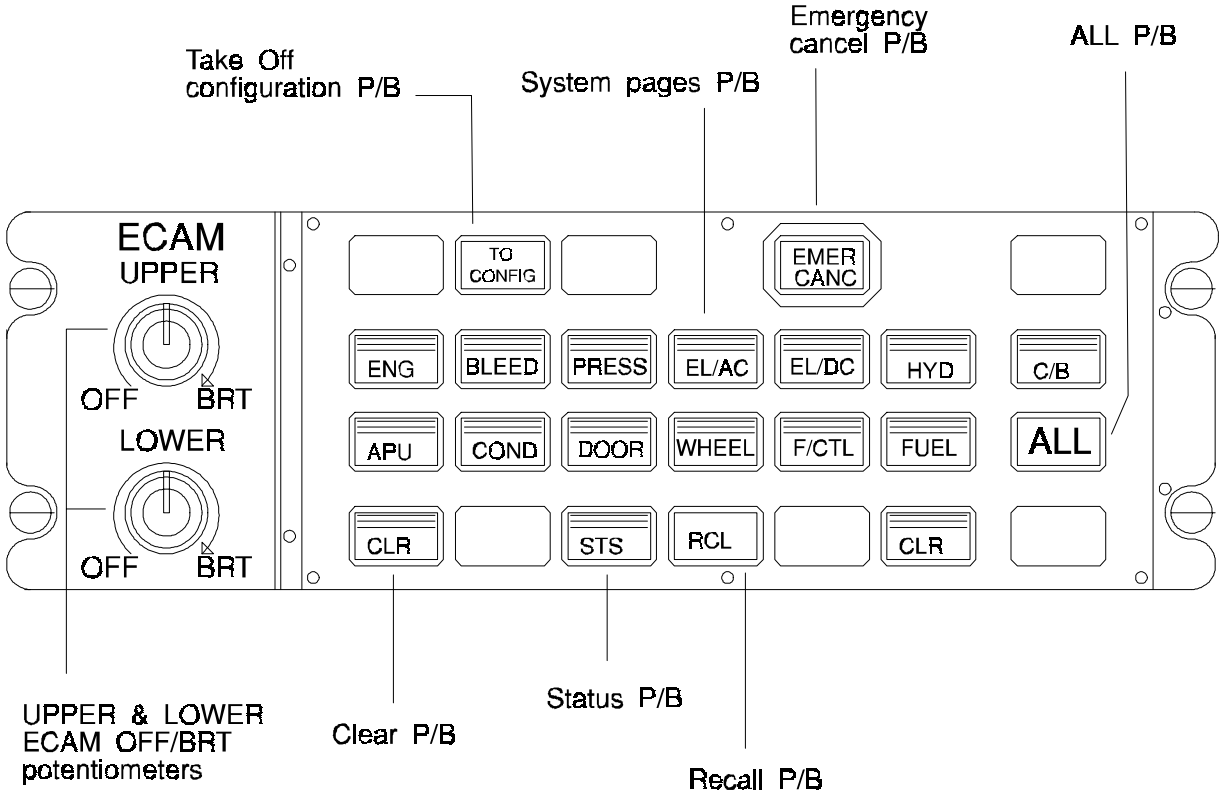
* System page P/B: these 13 P/Bs allow the system synoptic diagrams to be manually selected on the SD. When a P/B is pressed a second time, the system page is replaced by the page corresponding to the current flight phase. Note: a new Circuit/Breaker (C/B) page enables to show the circuit breakers tripped.

* ALL P/B: it allows the 13 system pages to be successively displayed at 1 second intervals. The ALL P/B remains active after a complete failure of the ECAM control panel.

* T.O. (take off) configuration P/B: is used to check that the A/C is in the correct configuration before take off. If the configuration is correct, TO.CONFIG.NORMAL is displayed on the E/WD.

* EMER CANCel (emergency cancel) P/B: is used to cancel aural warnings and caution messages. Caution messages may be recalled by pressing the RCL P/B.





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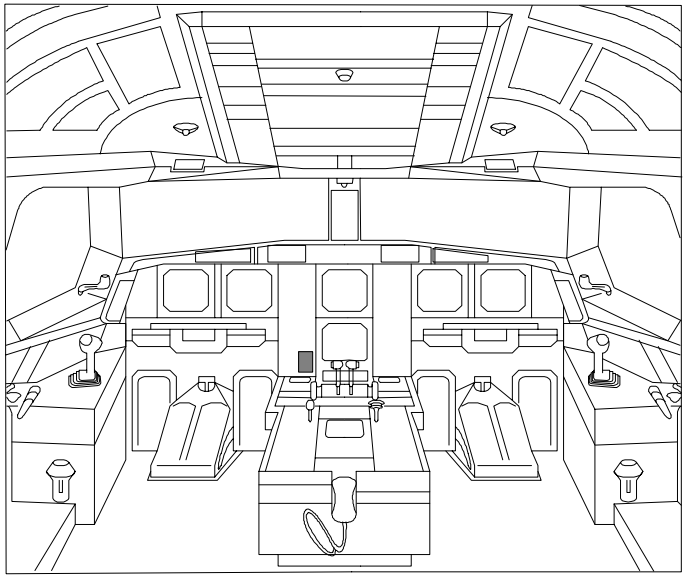
ECAM SWITCHING PANEL

The ECAM switching panel is located on the main instrument panel on the left side of the System Display.

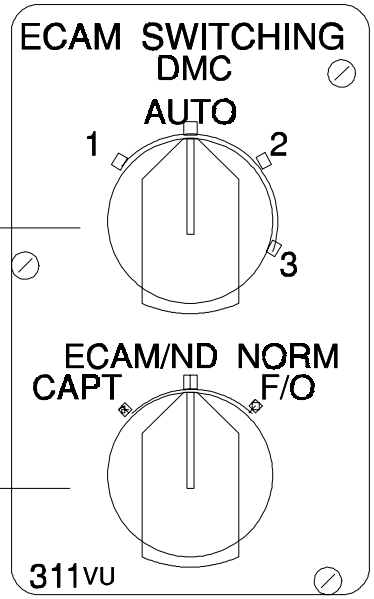
The ECAM DMC rotary selector is used to select the ECAM DMC.
In Auto position, only ECAM DMC3 is active. ECAM DMC1 automatically takes over in case of ECAM DMC3 failure.
In position 1, 2, 3, the selected ECAM DMC is active and automatic transfer is not possible.
Note: this selector has no effect on the EFIS display.

The ECAM/ND rotary selector enables an ECAM image to be displayed on one of the ND Display Units. The NORMal position corresponds to a normal operation. CAPT or F/O positions enable ECAM images to be respectively displayed on the CAPT or F/O ND Display Units.



ECAM DMC rotary selector

ECAM/ND rotary selector



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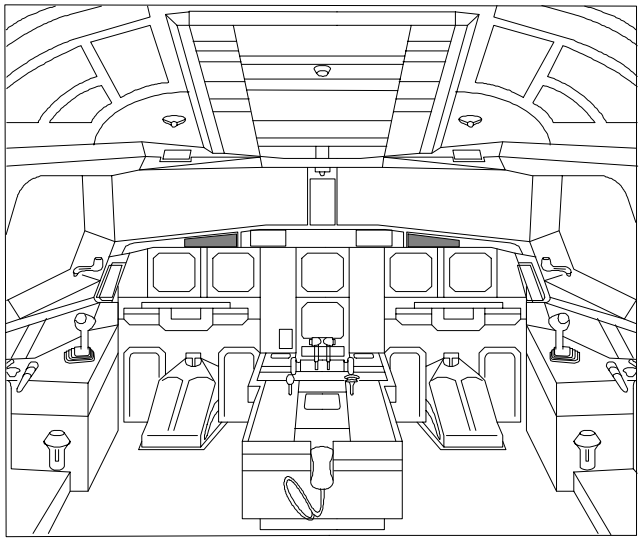
ATTENTION GETTERS

A set of attention getters is installed in front of each pilot. It consists of a Master Warning light and a Master Caution light.

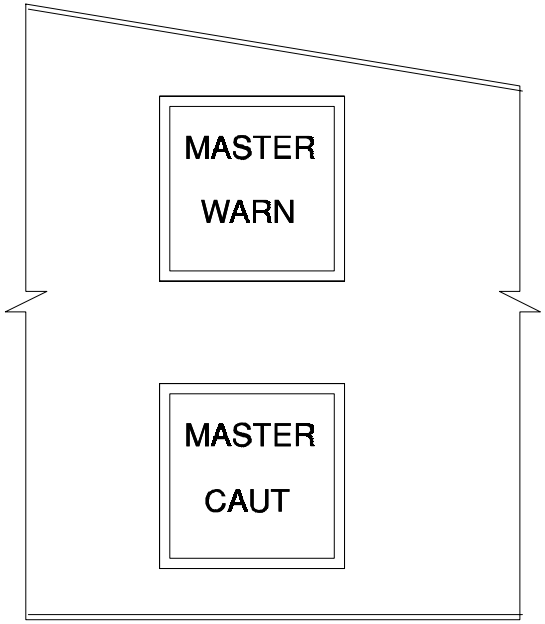
When a warning occurs, the Master Warning light flashes in red continously. The crew may cancel it, in most cases, as well as the associated aural warning by pushing the warning light.

When a caution occurs, the Master caution light comes on amber and stays on associated with a single chime. If the crew pushes the caution light, it goes off.



Master warning light

Master caution light



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STUDENT NOTES

ECAM AUDIO SIGNALS

General

GENERAL

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

SIGNALS	DEFINITION	CANCELLATION
SINGLE CHIME	amber caution	automatic
CONTINUOUS REPETITIVE CHIME	red warning	EMER CANCEL MASTER WARN
CAVALRY CHARGE	AP disconnection	MASTER WARN Instinctive disconnect P/B
TRIPLE CLICK	land.capability change	automatic
CRICKET - STALL	stall	EMER CANCEL
BUZZER	call (selcal or cabin)	reset on ACP
AUTO CALL OUT	radio height, hundred above, minimum, retard	
C CHORD	altitude alert	
WINDSHEAR	windshear warning	EMER CANCEL
PRIORITY L (R)	side stick priority	automatic

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STUDENT NOTES

ENGINE/WARNING DISPLAY PRESENTATION

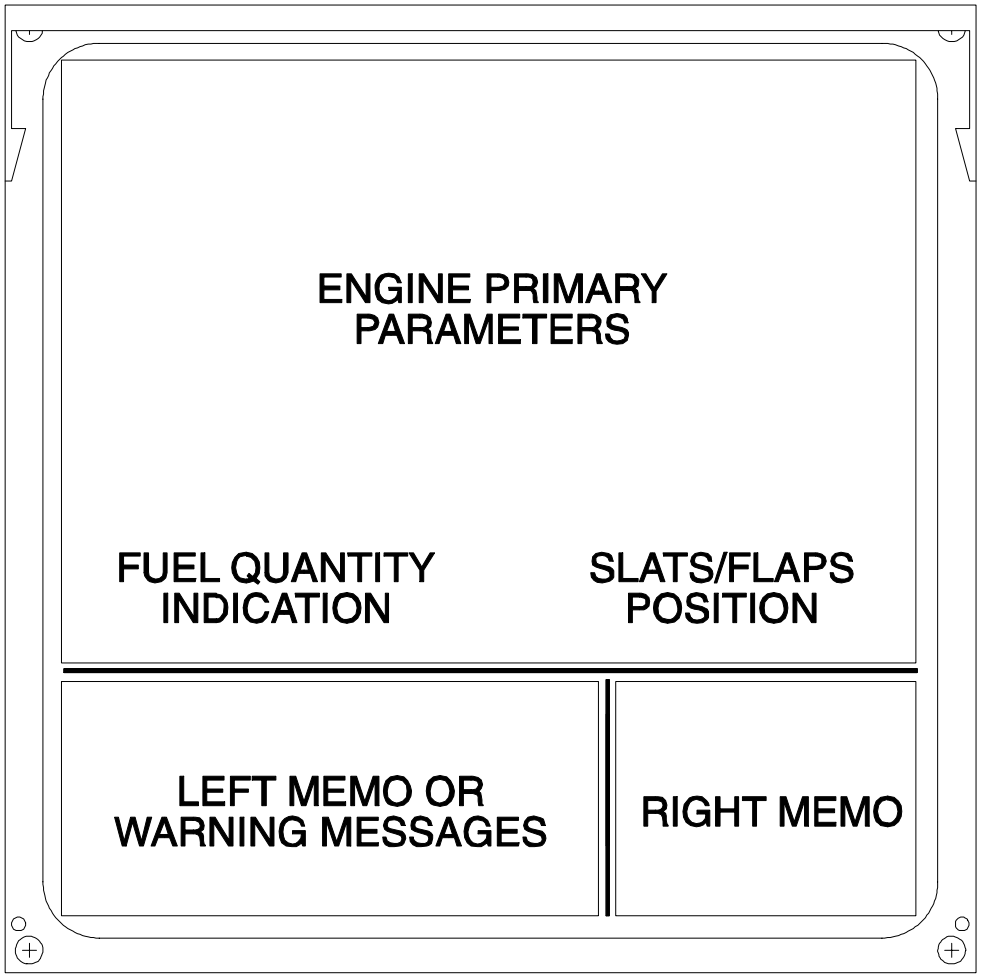
General
Upper Area
Left Memo Area
Right Memo Area
Advisory And Overflow Status

GENERAL

The Engine and Warning Display is normally on the upper ECAM Display Unit. It's divided into two areas: the upper area and the lower area.

The upper area displays:
- engine primary parameters,
- fuel quantity,
- slats and flaps position.

The lower area is used for:
- warning and caution messages,
- memo messages.



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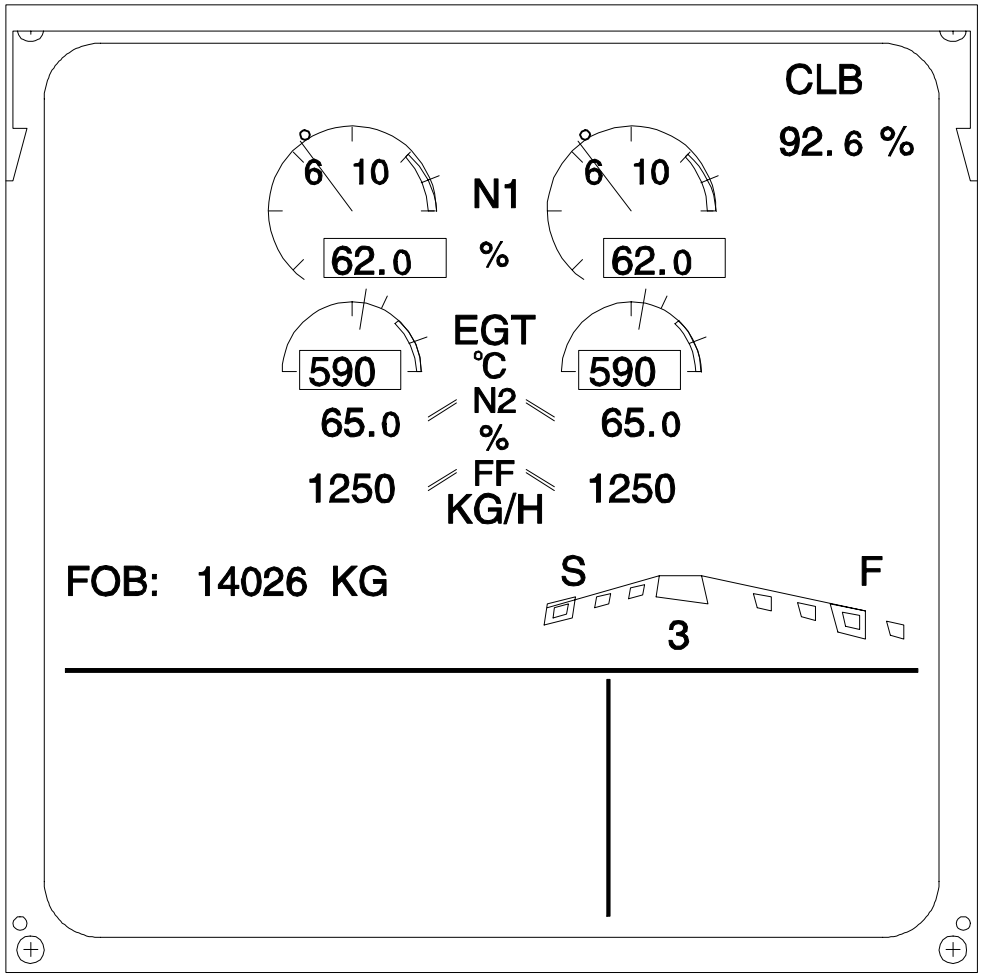
UPPER AREA

The symbols of the upper area are permanently displayed.
The parameters are provided in the form of analog and/or digital indications (refer to corresponding chapter for detailed description).
Note: this is an example of the representation for General Electric CF6-80 engines.



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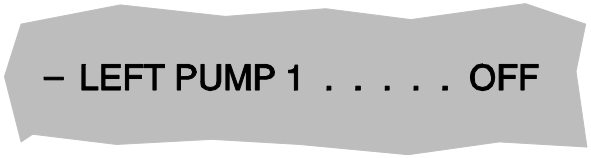
LEFT MEMO AREA

Take off or landing memo, normal memo, independent or primary failure messages and actions to be performed are displayed in the left memo area. For example when there is a failure of the Fuel left pump 1 lo pressure,

appears on the left memo area.
It is associated with an action to be performed:



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

If the warning is affected by an Operations Engineering Bulletin (OEB), which is a temporary correction, the message,

is displayed. In this case, the warning is incorrect or incomplete.

The ECAM warning title remains unaltered and the complete procedure is cleared and replaced by - REFER TO QRH PROC -. The Quick Reference Handbook (QRH) contains the reference of the corrected procedure.

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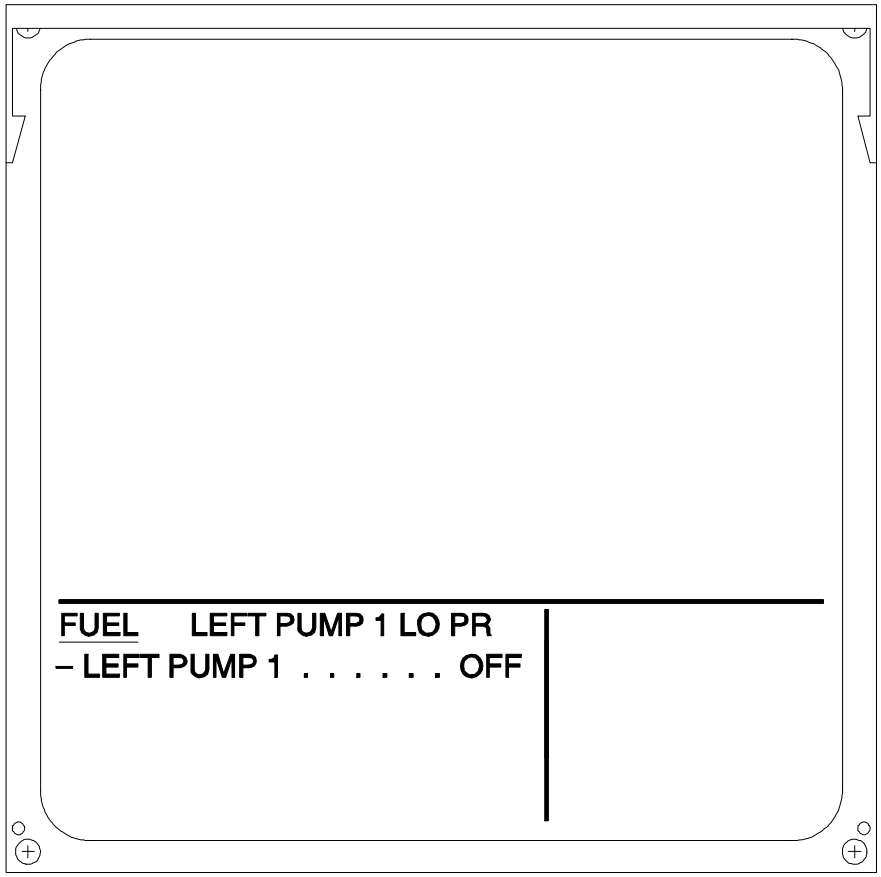

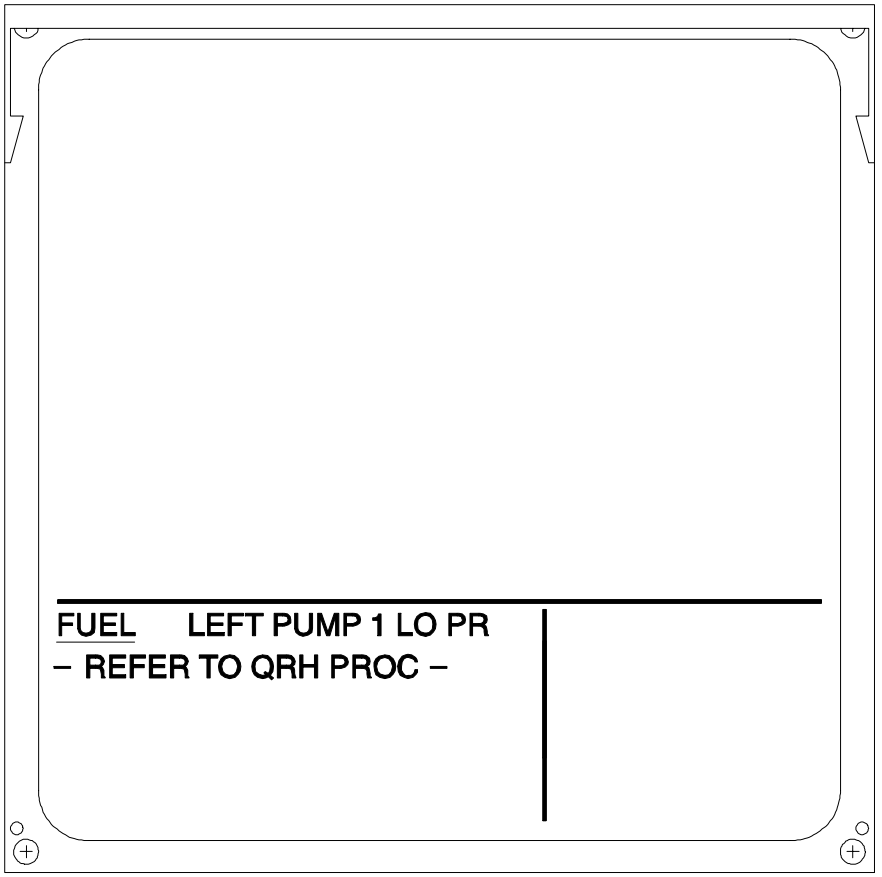

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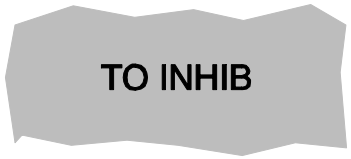
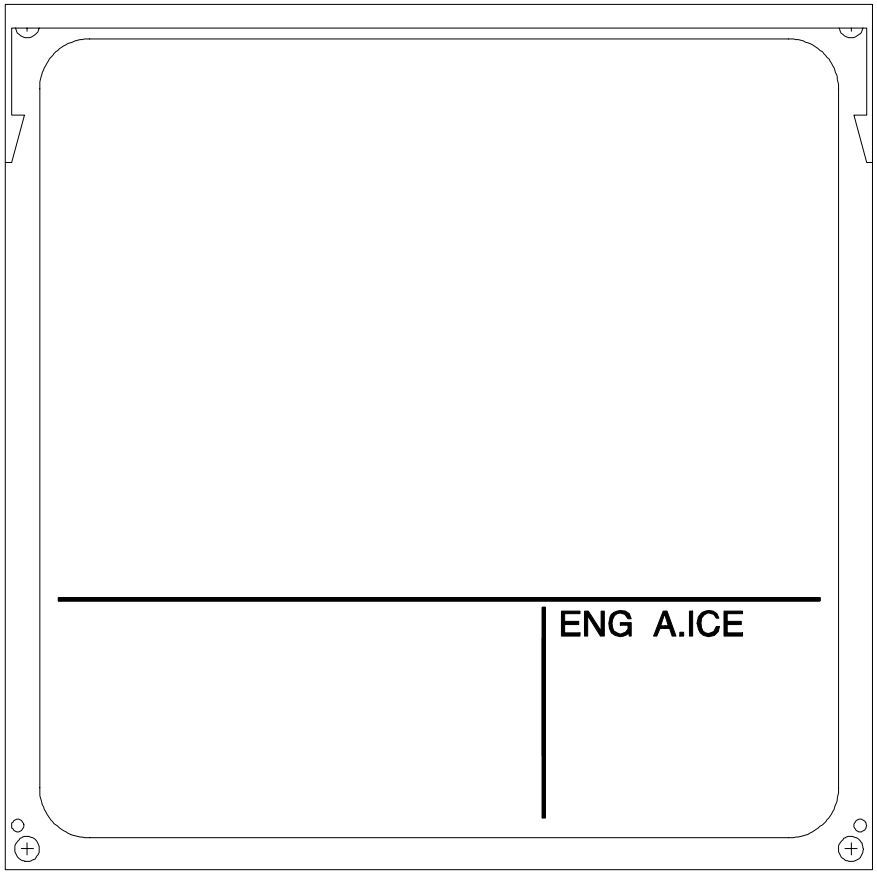
RIGHT MEMO AREA

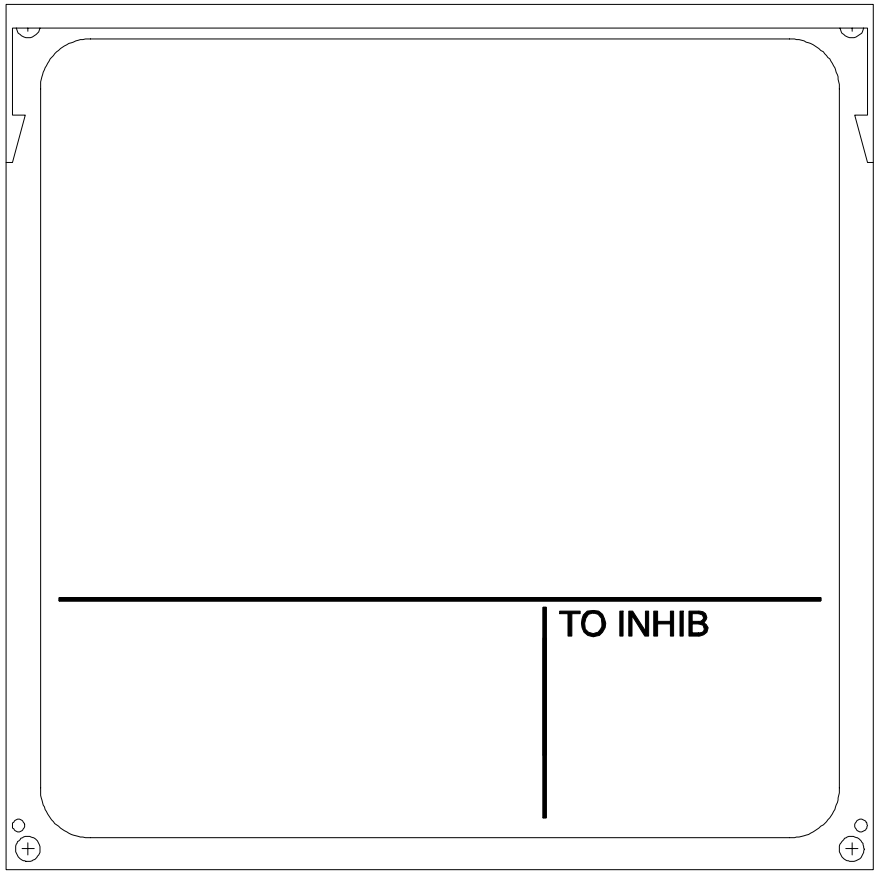
Normal memo and secondary failure messages are displayed in the right memo area.
For example when one Engine Anti Ice P/B is set to ON,

appears on the right memo area.
During take off and landing, most of the warnings are inhibited to avoid distraction of the crew.
For example, at take off, when the second engine is set to take off power and until the aircraft has reached 1500 ft,



is displayed.





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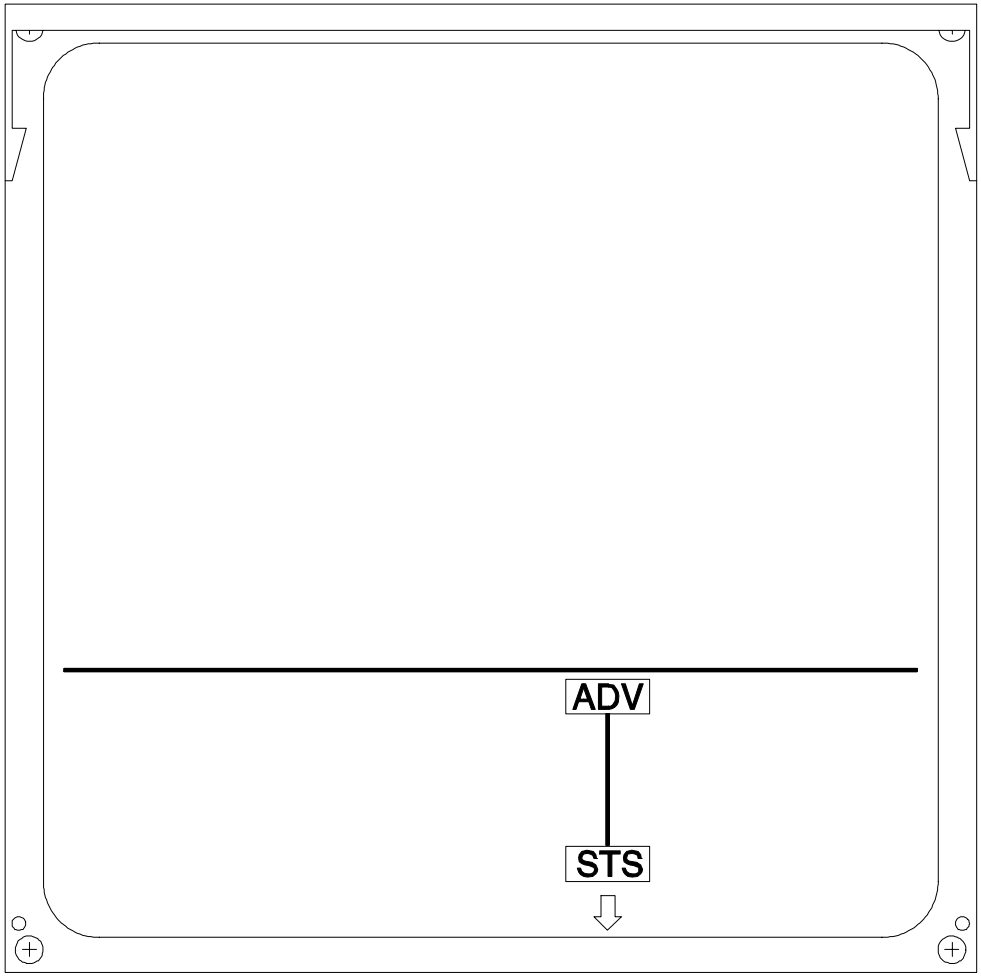
ADVISORY AND OVERFLOW STATUS

Status, Advisory and Overflow indications are 'attention getters' on the display.

ADV: Advisory appears pulsing in white to indicate that an aircraft system parameter has drifted out of its normal range.

STS: Status indicates that a status message is present on the ECAM page.

Overflow arrow : only concerns the warning messages and indicates that the messages exceed the capacity of the display on the left memo area. In this case, the heading titles of the warning messages are displayed on the right memo area.



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STUDENT NOTES:

SYSTEM DISPLAY PRESENTATION

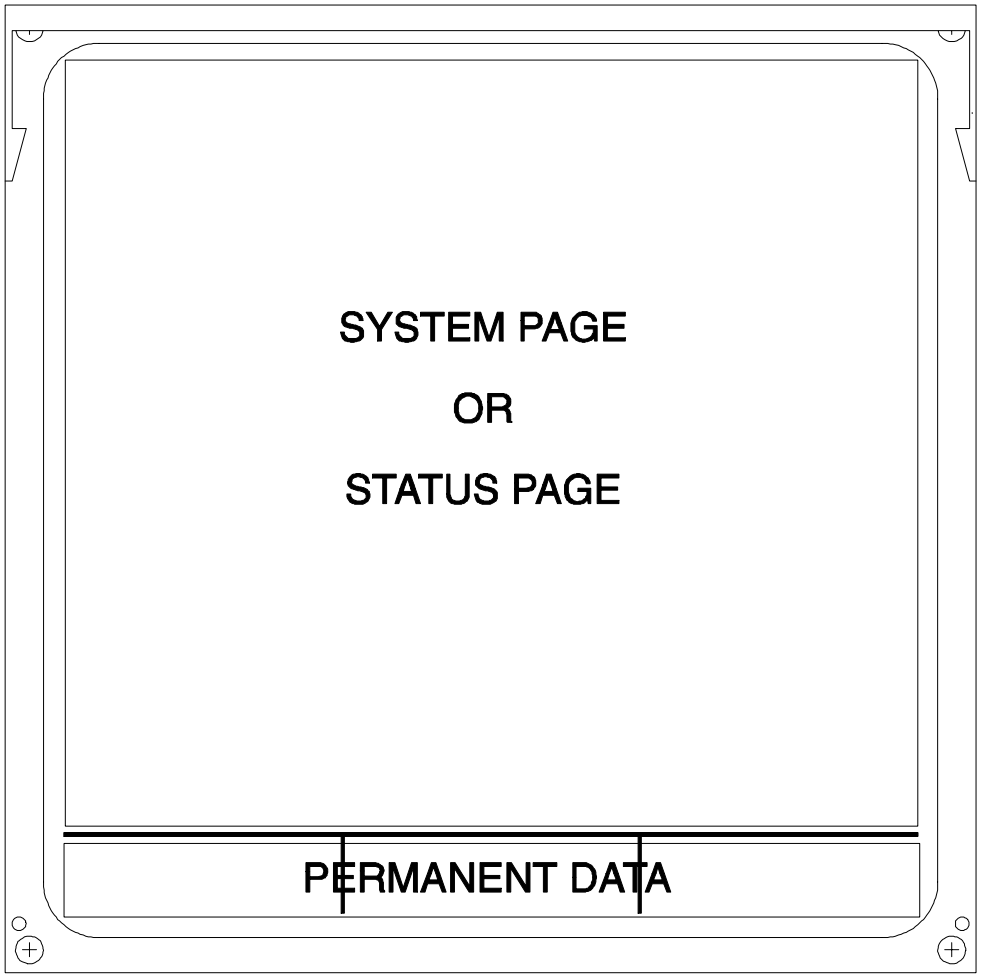
General
System Page
Status Page
Permanent Data
System Page Logic

GENERAL

The System Display is normally on the lower ECAM Display Unit. It is divided into two areas.

The upper area displays system or status pages, the lower area permanent data.

The system or status pages can be called automatically after a failure or manually upon crew request by pressing the related P/B on the ECAM control panel.



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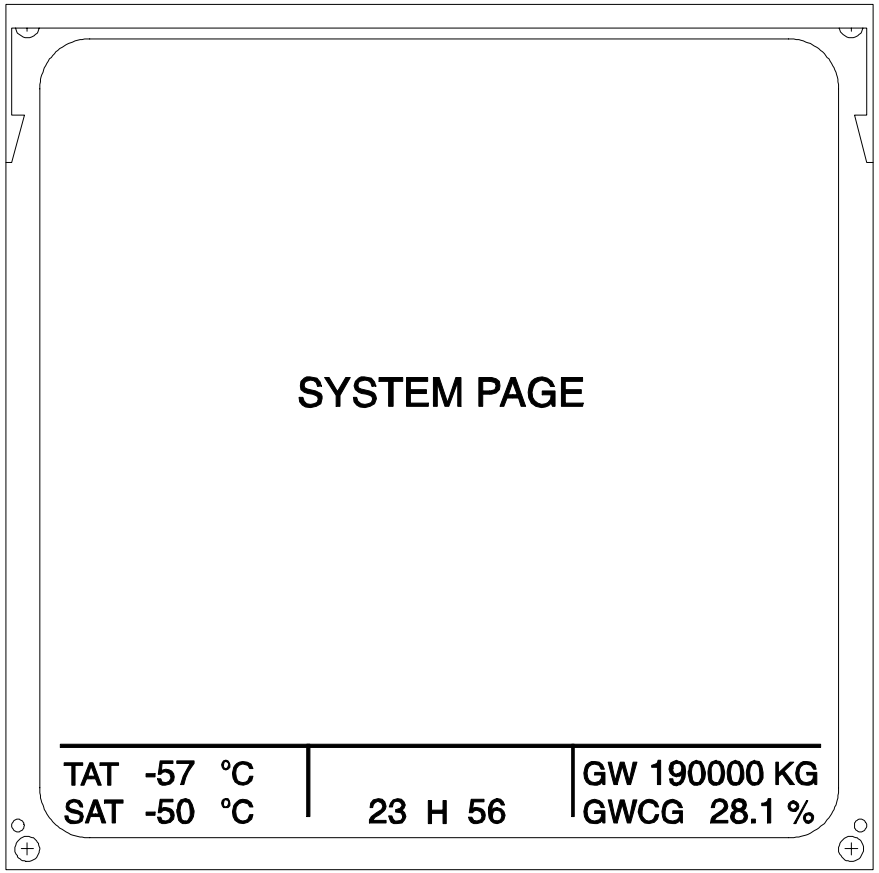
SYSTEM PAGE

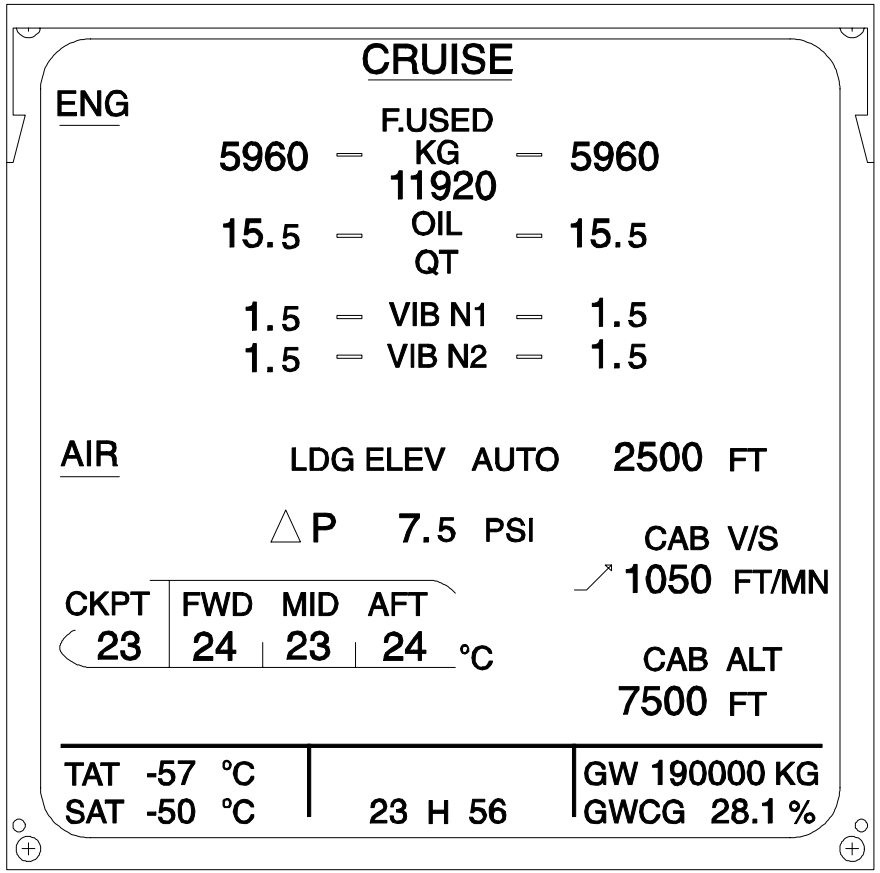
13 system pages can be displayed manually or automatically. Refer to each chapter for detailed description of the pages.

The 13 system pages are:

- Air bleed (BLEED),
- Air conditioning (COND),
- Cabin pressurization (PRESS),
- Electrical power supply (EL/AC),
- Electrical power supply (EL/DC),
- Flight controls (F/CTL),
- Fuel (FUEL),
- Hydraulic power (HYD),
- APU (APU),
- Engine secondary parameters (ENG),
- Doors and oxygen (DOOR),
- Landing gear, wheels, brakes (WHEEL),
- Circuit breaker status (C/B).

The cruise page is only automatically called in flight.
The cruise page displays main systems parameters to be monitored during the flight:
- engine parameters such as fuel used, oil quantity and vibrations,
- cabin press parameters such as landing field elevation, cabin vertical speed, cabin altitude, cabin differential pressure.
- zone temperature.





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STATUS PAGE

The status page is an operational summary of the aircraft condition. It can be displayed manually or automatically.
The information is displayed at the end of an ECAM procedure or upon crew request. The status page includes:

Left column
- limitation, approach procedures,
- information, cancelled cautions.

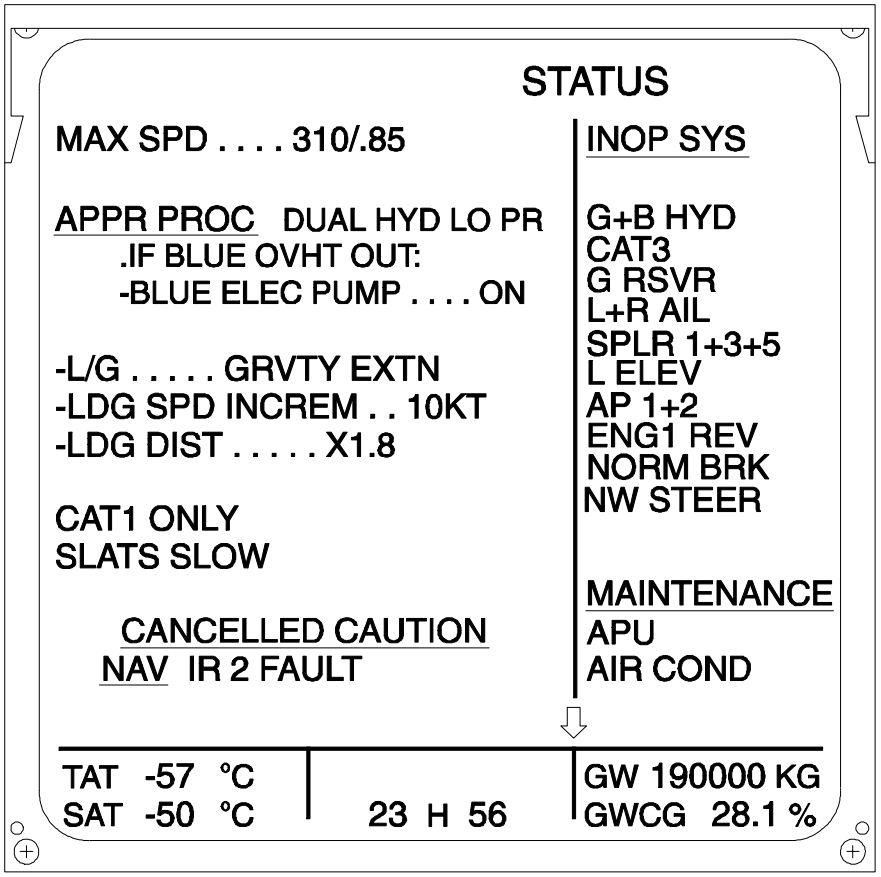
Right column
- inoperative systems,
- maintenance information.

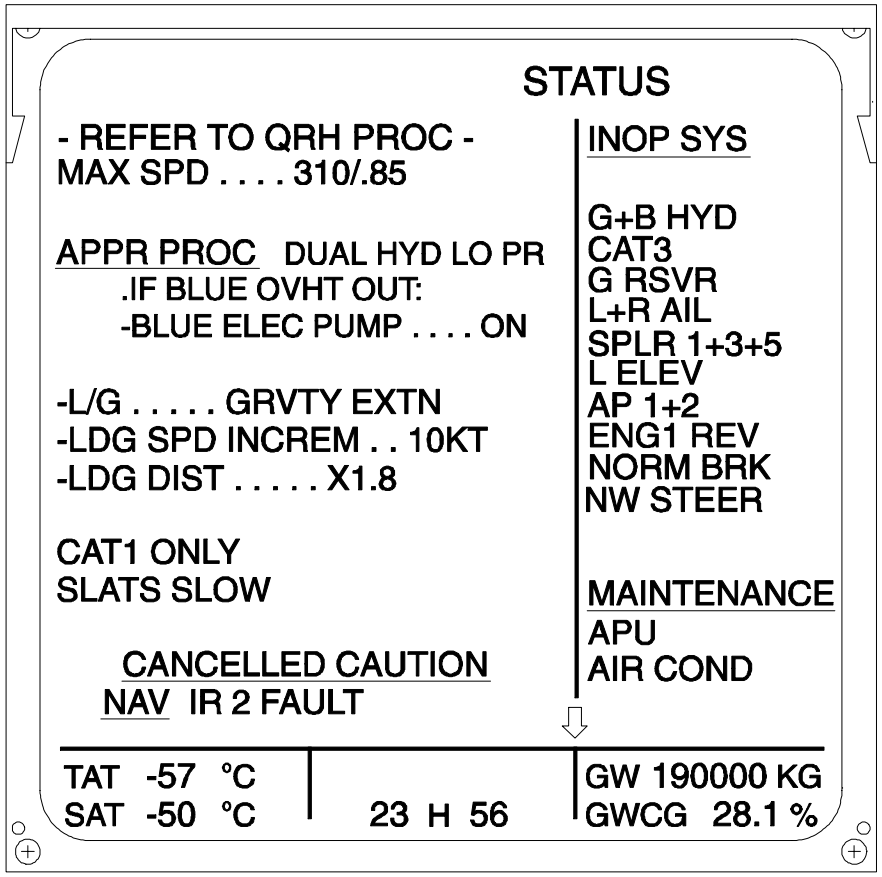
A green down arrow appears to indicate that the information exceeds the capacity of the display.

If the status is affected by an Operations Engineering Bulletin (OEB), which is a temporary correction, the message - REFER TO QRH PROC - is displayed. In this case, the status (left part only) is incorrect or incomplete.

All the procedure lines remain displayed and the message - REFER TO QRH PROC - appears on the first line.
This message does not identify the part of status which is incorrect or incomplete. The Quick Reference Handbook (QRH) contains the reference of the corrected procedure.

Note: the message - FOR STS REFER TO QRH - appears at the end of the E/WD warning message (left memo area) if only the status is affected by an OEB.





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PERMANENT DATA

At the bottom of the System Display, permanent data is always displayed whatever the page presented.
Here Temperature, Time, Gross weight and Center of Gravity are always displayed.

Total Air Temperature (TAT) and Static Air Temperature (SAT) are digital values.
*Total Air Temperature (TAT):
-57 (green) when normal,
amber xx when data not available.
*The same applies for SAT.

*Load factor is only displayed in amber when the aircraft speed is over 80 KTS and when its value is more than +1.4 G or less than +0.7 G during more than 2 seconds. Information remains displayed 5 seconds after the excessive condition has disappeared.

*Universal Time Coordinated indication is permanently displayed.
It may be:
23 H 56 (green) when normal,
amber xx when data not available.

*Gross Weight indication:
230000 (green) when normal,
230~~00~~ (2 amber lines) in case of degraded accuracy,
cyan --- when there is no computed data on ground,
amber xx when data not available.

*Center of Gravity indication:
28.1 (green) when normal,
28.1 (red) when Aft CG is detected by FE computer,
28.~~1~~ (2 amber lines) in case of degraded accuracy,
cyan --- when there is no computed data on ground,
amber xx when data not available.

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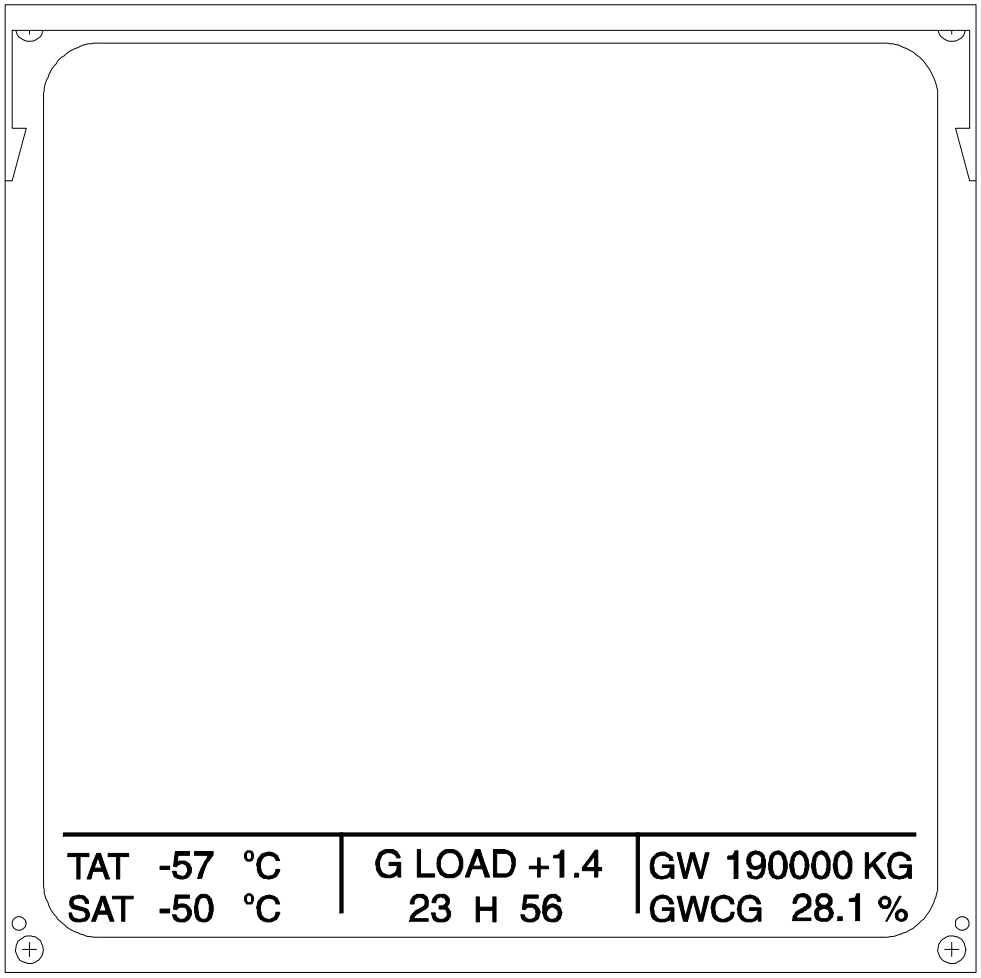

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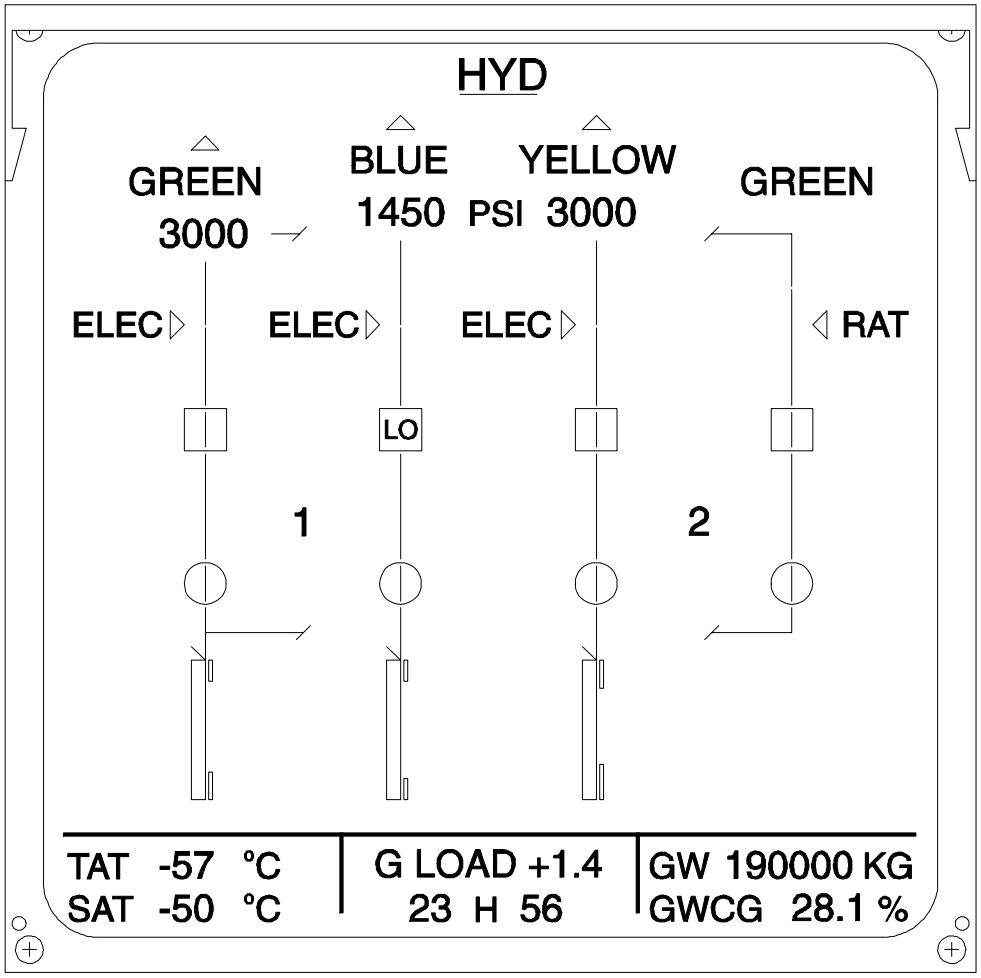
SYSTEM PAGE LOGIC

The ECAM operates in four modes for the system page presentation, with a priority order.

The four selection modes of system page presentation are:
- the manual mode, which can override all other modes,
- the failure mode,
- the advisory mode,
- the flight phase mode.

- Manual mode: selection from ECAM Control panel.
- Failure mode: automatic presentation due to a warning/caution.
- Advisory mode: automatic presentation due to a drifting parameter.
- Flight phase mode: automatic presentation due to the A/C situation.

Note: the manual mode is cancelled in case of failure or advisory.



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STUDENT NOTES

ECAM NORMAL MODE

General
Flight Phases
ECAM Pages

GENERAL

Without any aircraft system failure, the System Display automatically presents system pages in order to eliminate the need of frequent scanning of the system panels.
In normal operation, the ECAM system pages are displayed according to the current flight phase.

FLIGHT PHASES

A flight is divided into 10 phases corresponding to changes of aircraft configuration or flight conditions. The flight phases are generated by the Flight Warning Computer (FWC).

These phases are used by the Display Management Computers (DMCs) to automatically call up the system pages on the System Display and to temporarily inhibit some alerts :

- Phases 1 and 2 correspond to A/C power up and engine start
- Phases 3 and 4 correspond to take off
- Phases 5,6 and 7 correspond to flight
- Phases 8 and 9 correspond to landing and taxi
- Phase 10 corresponds to engine shutdown.

ECAM PAGES

The system pages presented in this topic are given as an example.
For detailled description of the system pages, refer to the corresponding chapter.

DOOR

The APU or Engine system pages are displayed in priority if the APU or the engines are started, in any flight phase.
The APU page appears when APU Master Switch is in ON position. It disappears when APU Master Switch is in OFF position or APU RPM above 95% for 10 s.
The Door page reappears 10 sec. after APU is available.

WHEEL

The Wheel page is displayed only when engine start has been completed.
The FLT CTL page replaces the Wheel page for 20 sec. when either sidestick is moved or when rudder deflection is above 22 degrees.

ENGINE

During this phase, most warnings are inhibited.
TO.INHIBIT is displayed on the right memo area of the E/WD.

CRUISE

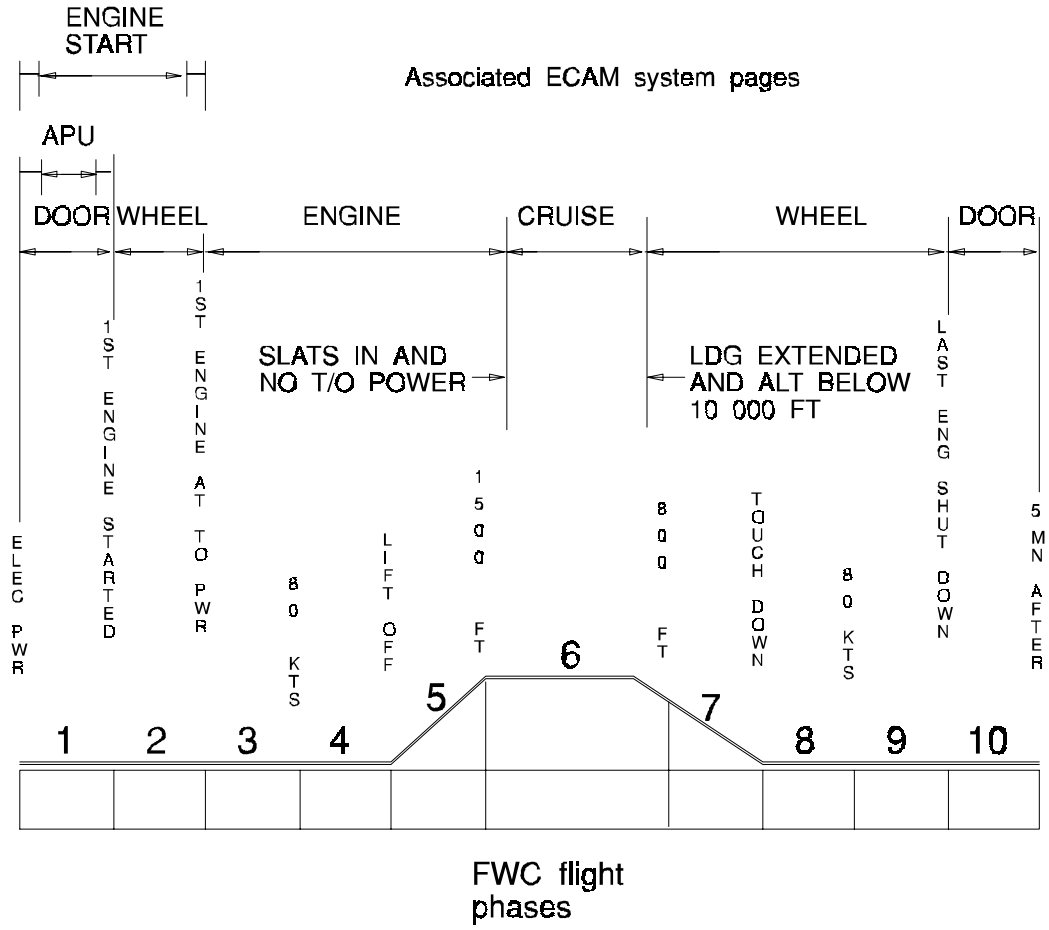
The Cruise page appears as soon as slats are in and the engines are no longer at take off power, provided that the landing gear is retracted.
The T.O. INHIBIT message disappears. The Cruise page disappears when the landing gear is selected down.

WHEEL

During this phase, most warnings are inhibited.
LDG. INHIBIT is displayed on the right memo area of the E/WD.
LDG. INHIBIT message disappears (flight phase 9).

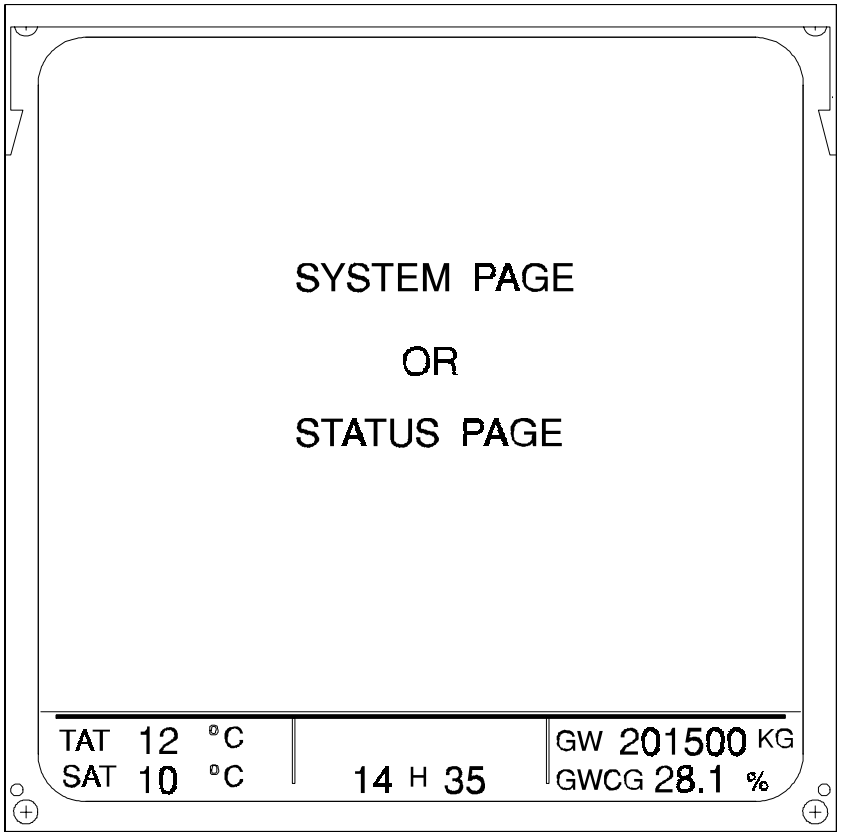
DOOR

Five minutes after the last engine shutdown, the Flight Warning Computer starts a new flight leg at phase 1.



FWC flight phases

Associated ECAM system pages



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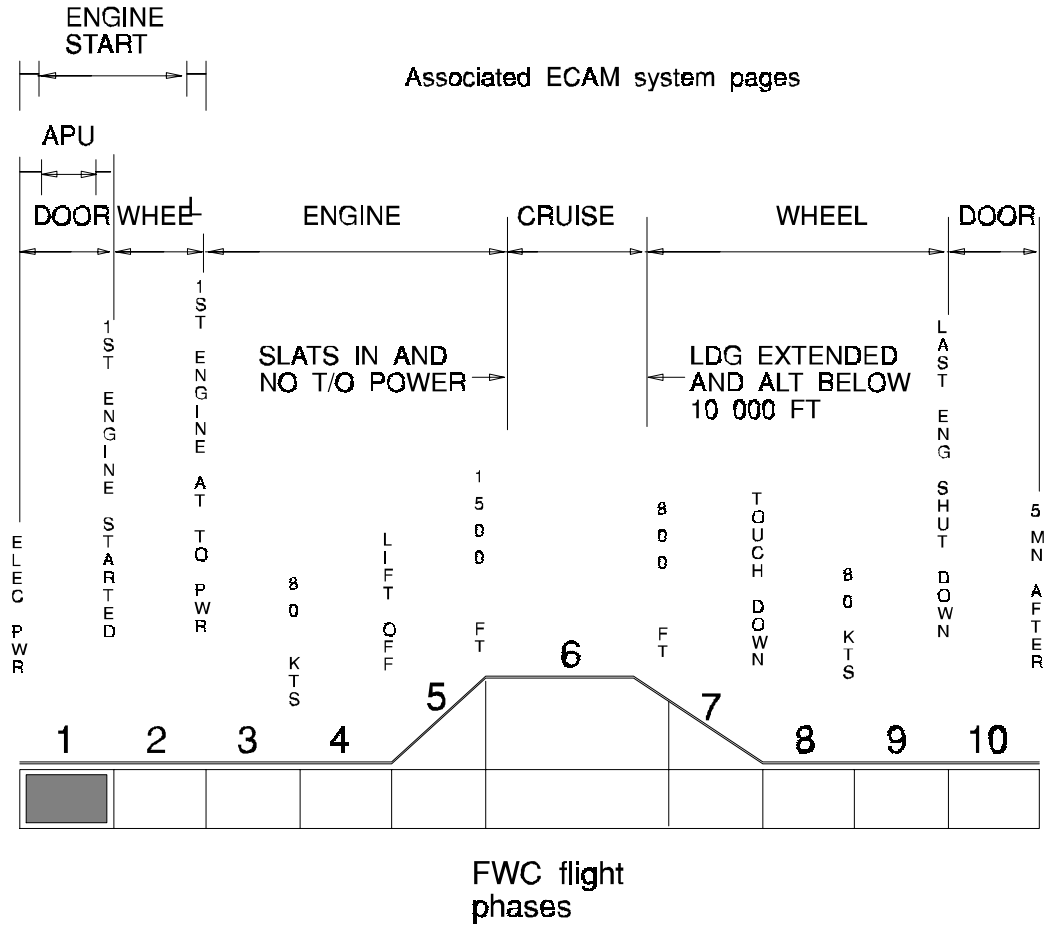
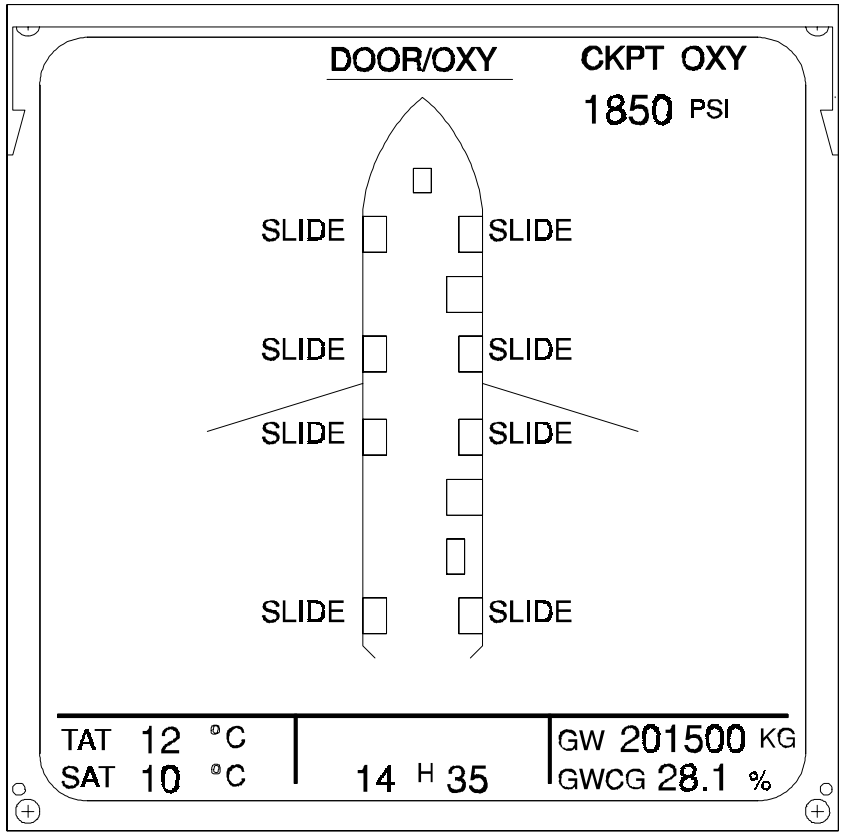


FWC flight phases

Associated ECAM system pages



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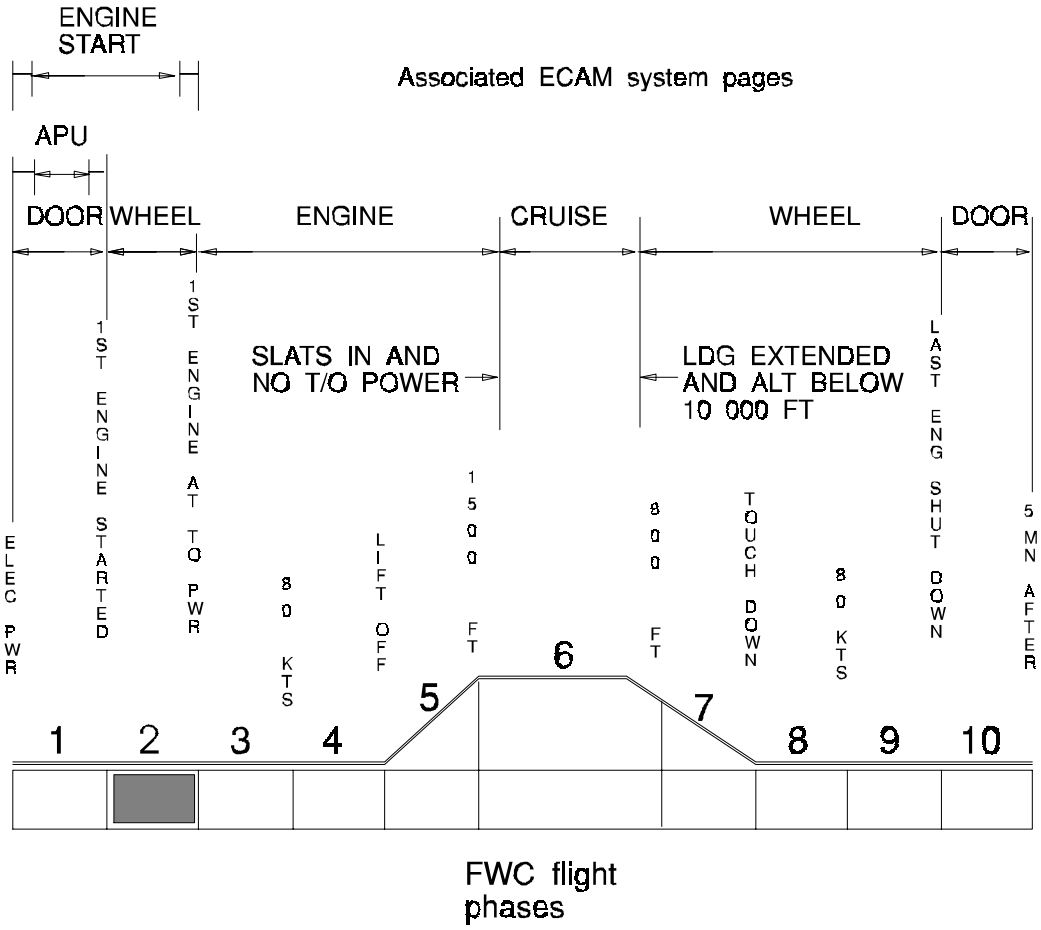
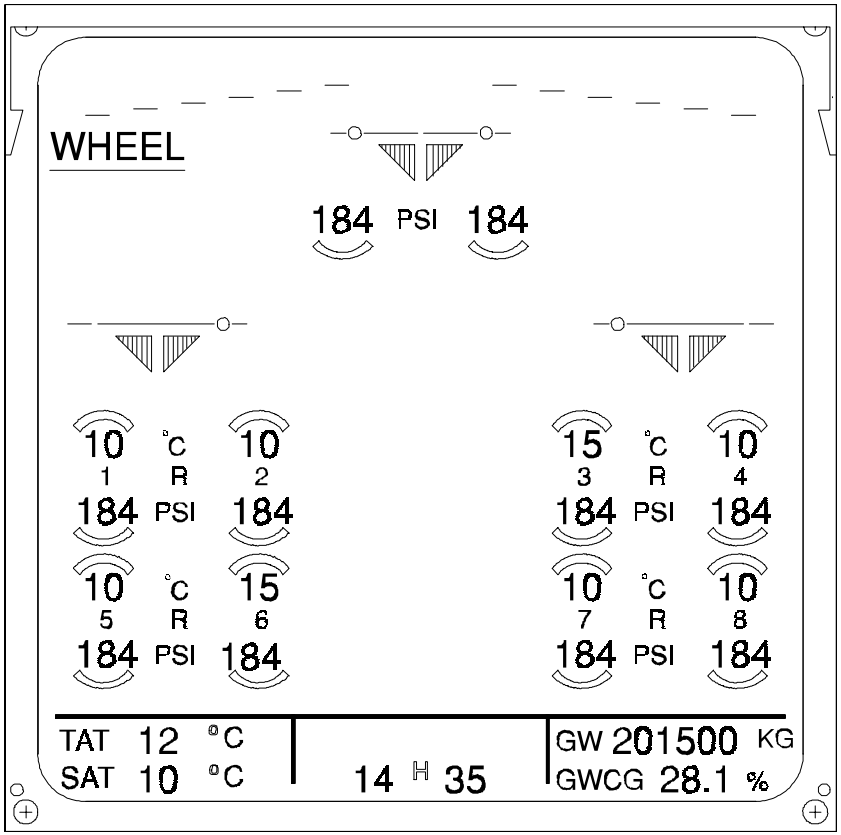


FWC flight phases

Associated ECAM system pages



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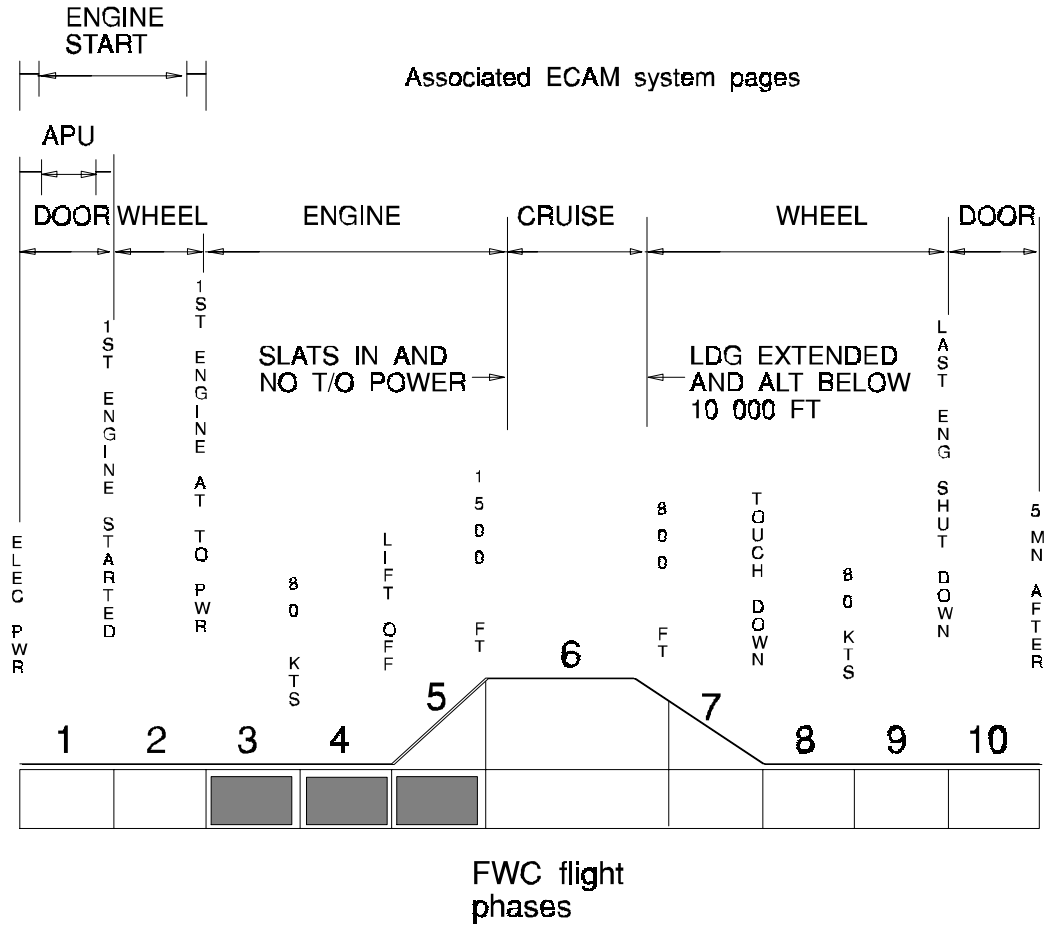
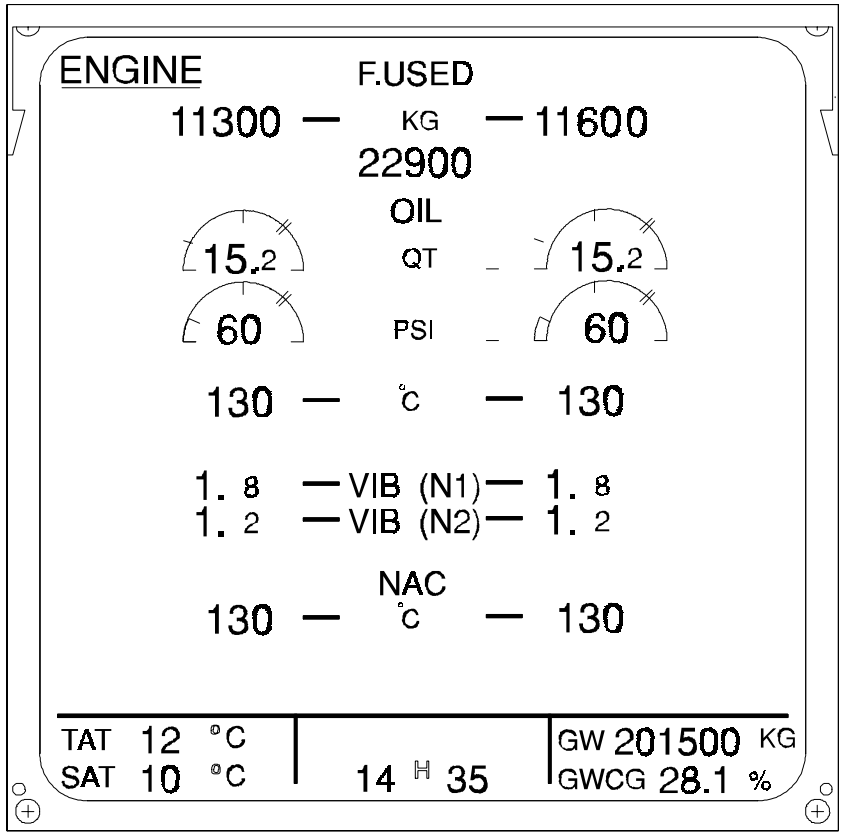
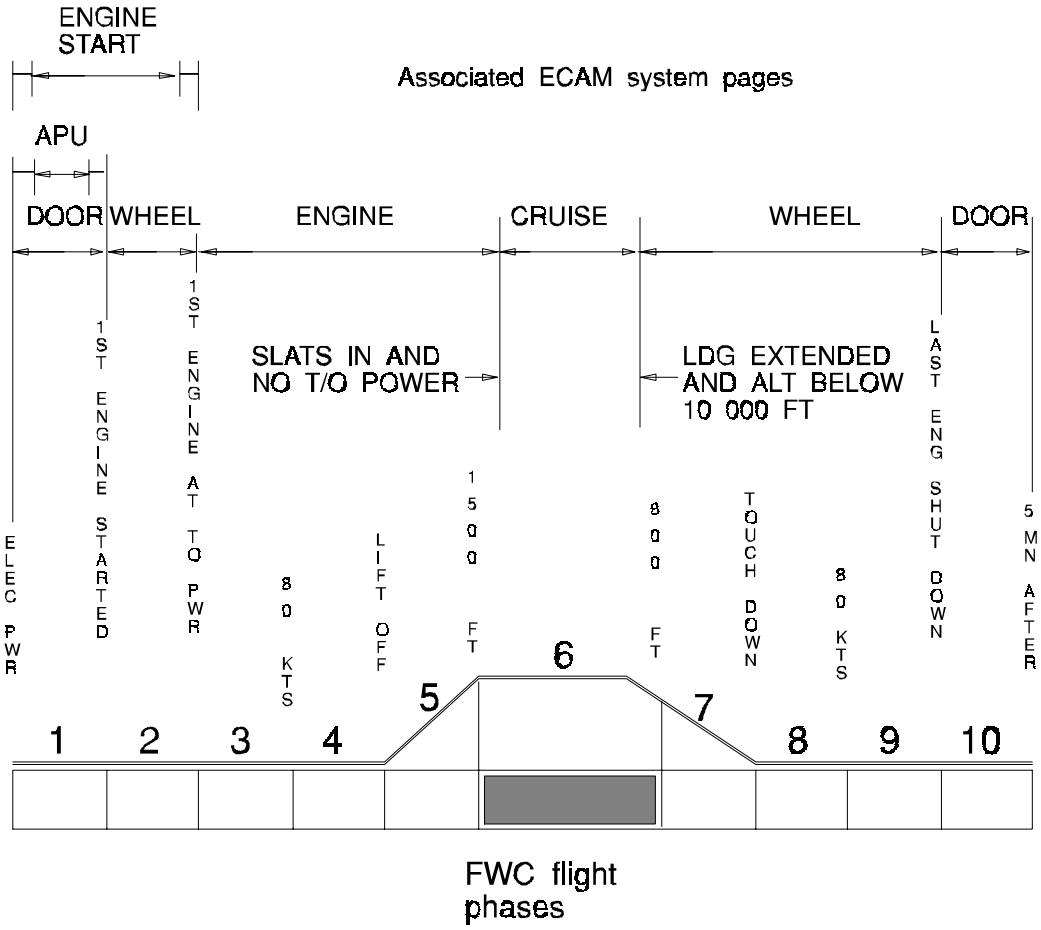


Associated ECAM system pages

FWC flight phases

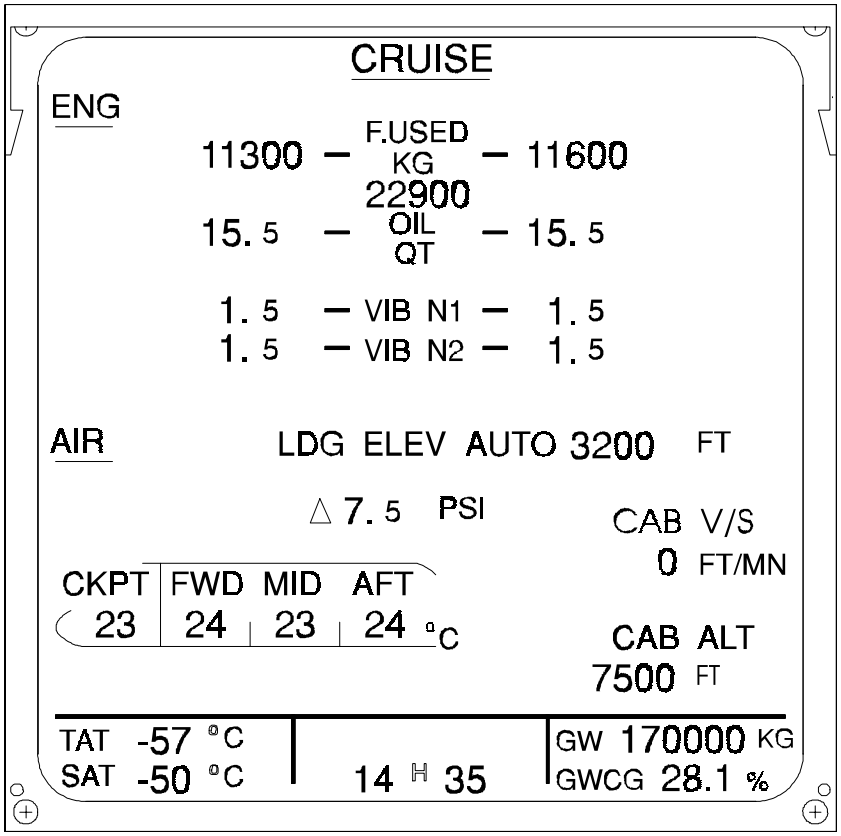


FQW4200 GE Metric



FWC flight phases

Associated ECAM system pages



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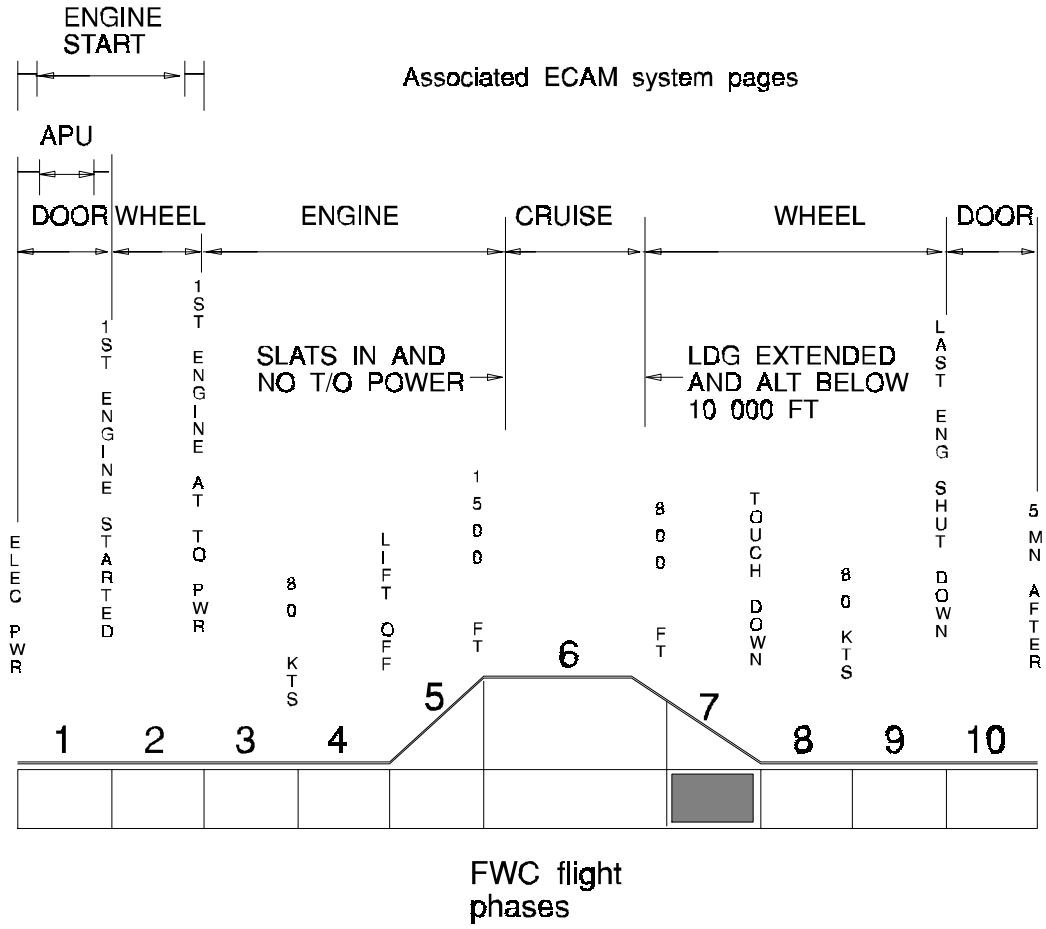
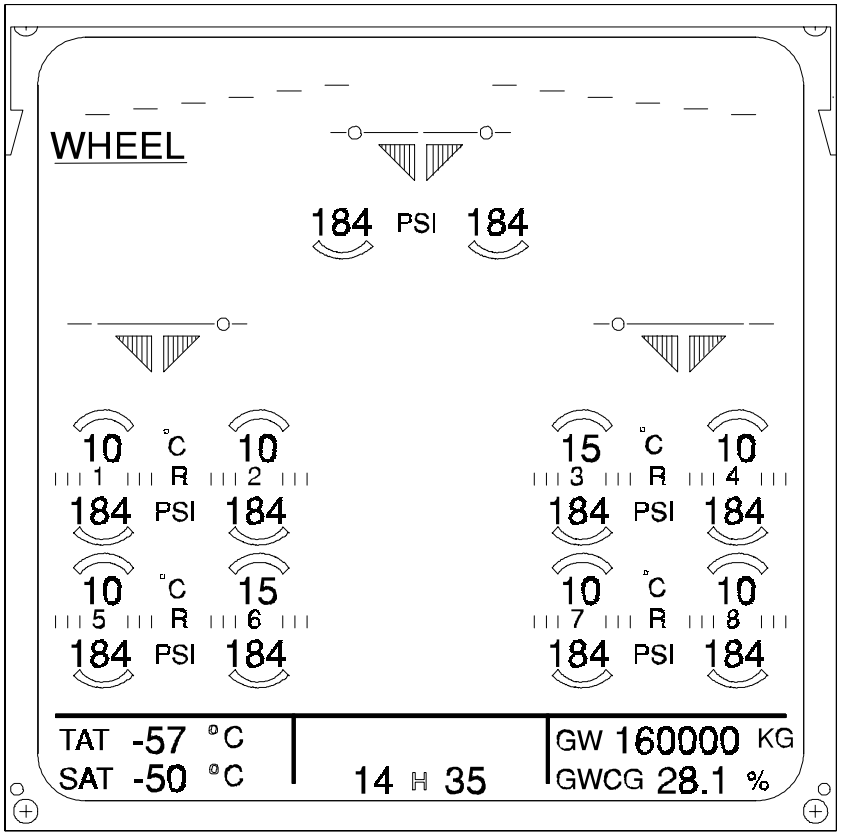
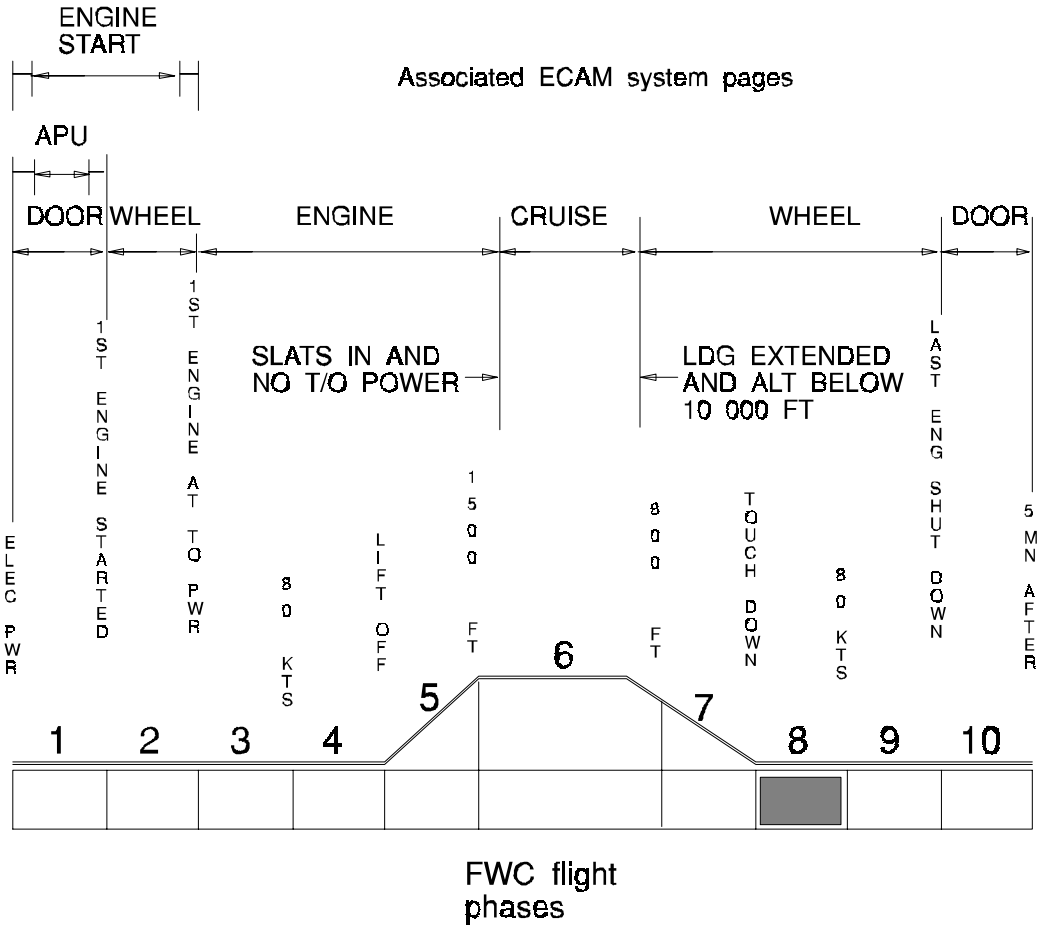


FWC flight phases

Associated ECAM system pages

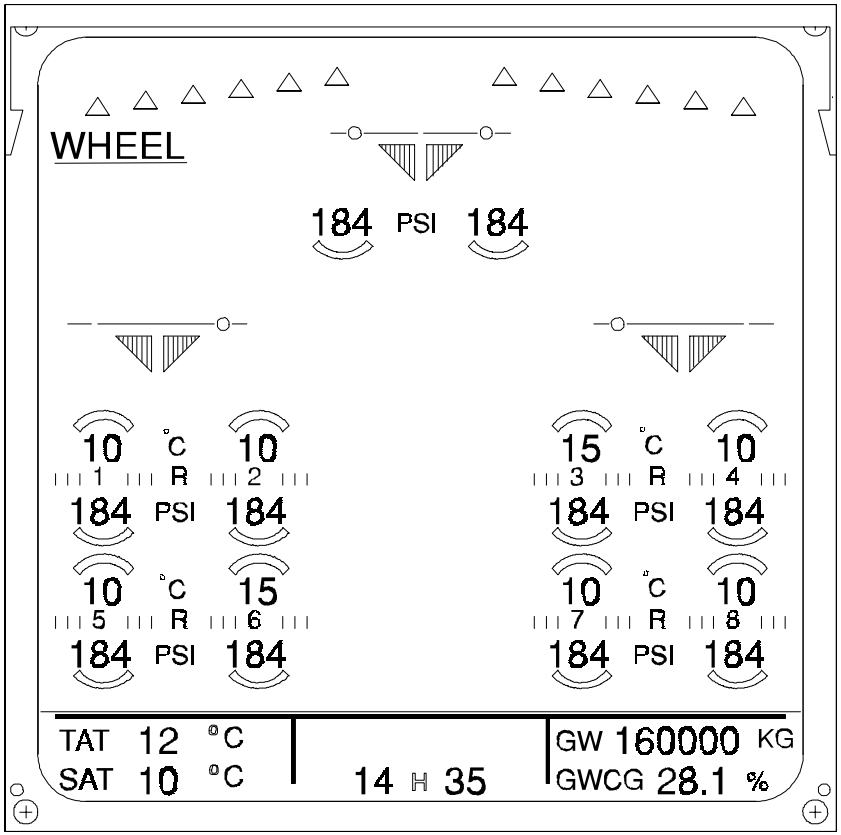


FQW4200 GE Metric

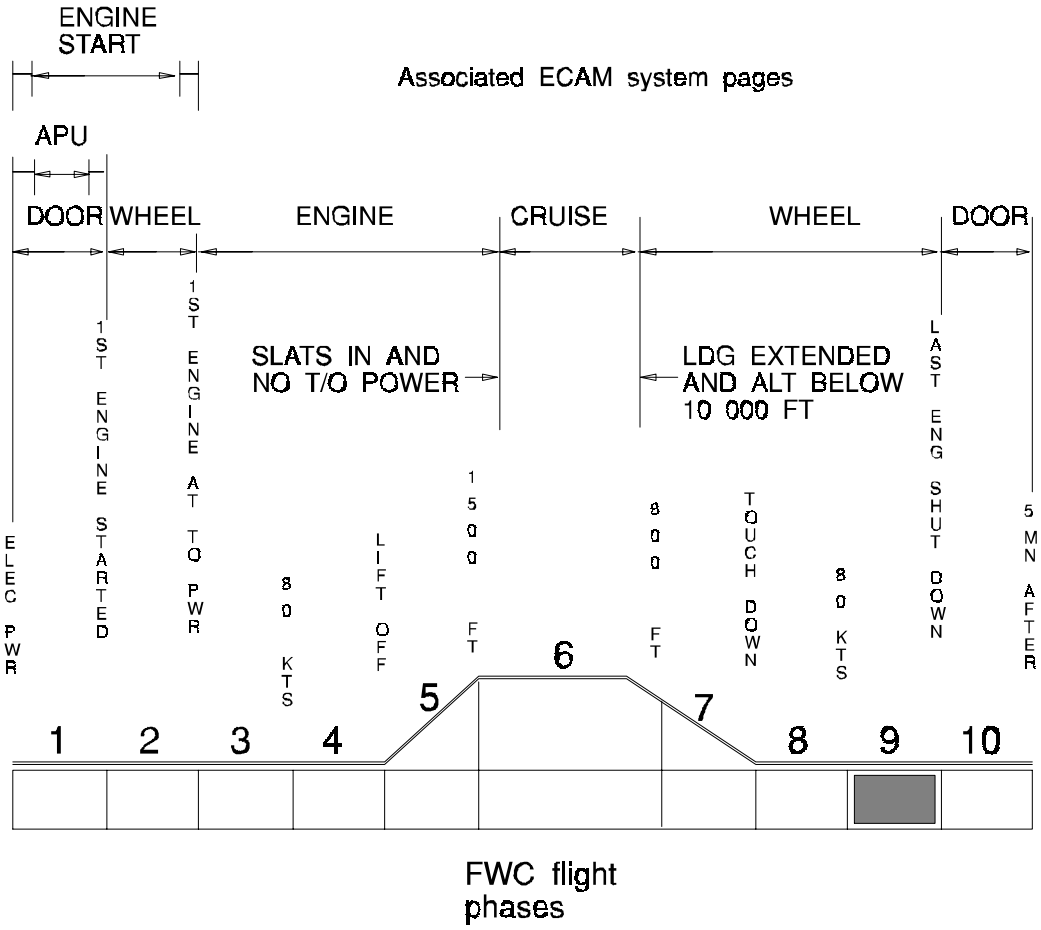


FWC flight phases

Associated ECAM system pages

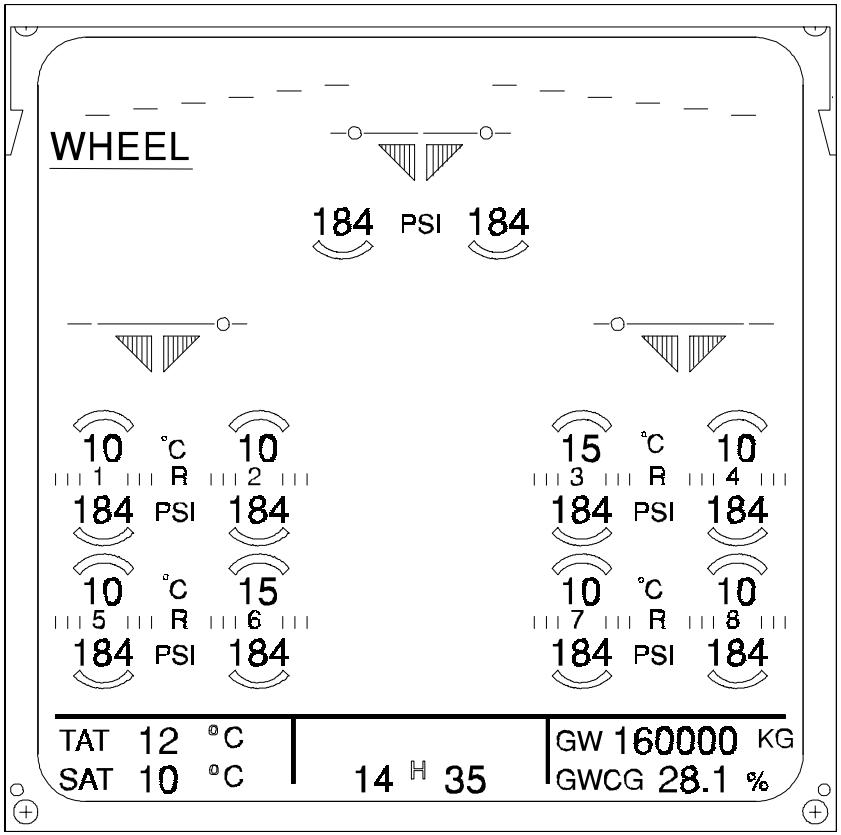


FQW4200 GE Metric

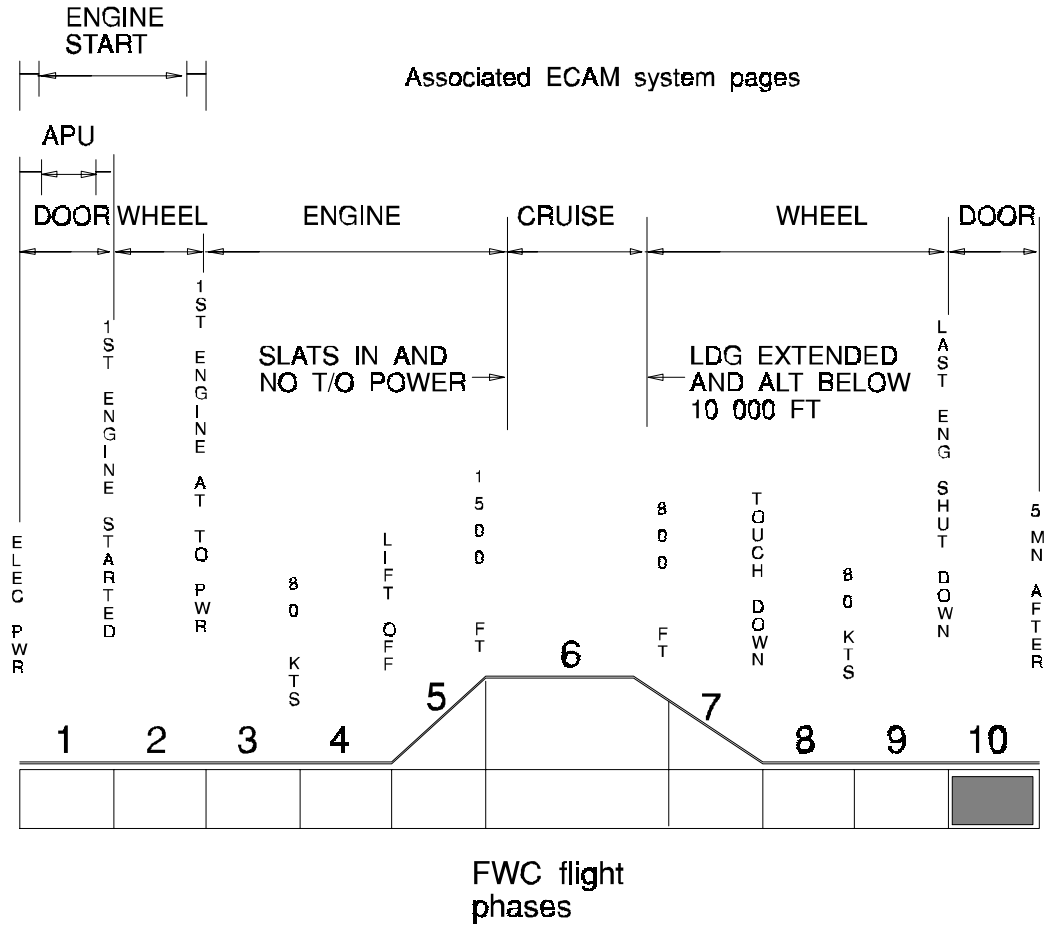


FWC flight phases

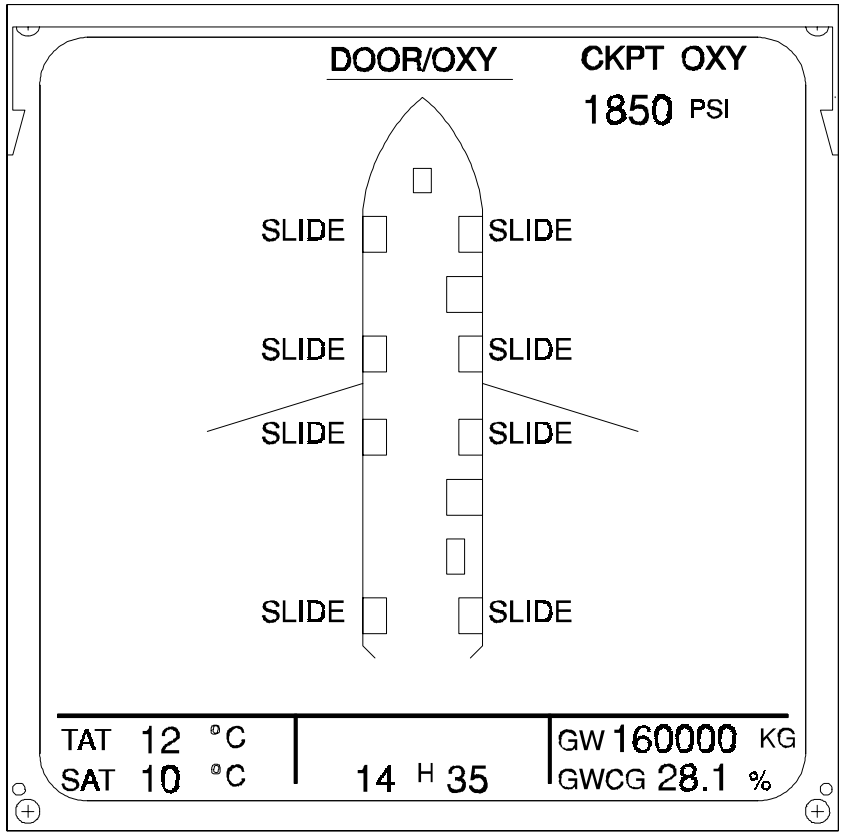
Associated ECAM system pages



FQW4200 GE Metric



FWC flight phases



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STUDENT NOTES

ECAM MANUAL MODE

System Pages
ALL Key

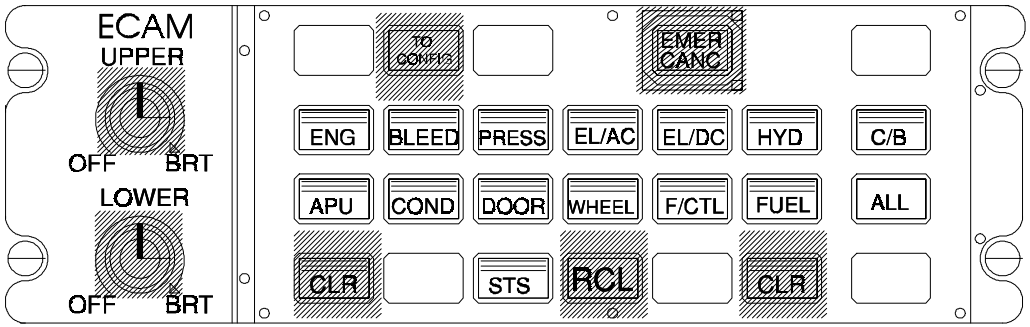
SYSTEM PAGES

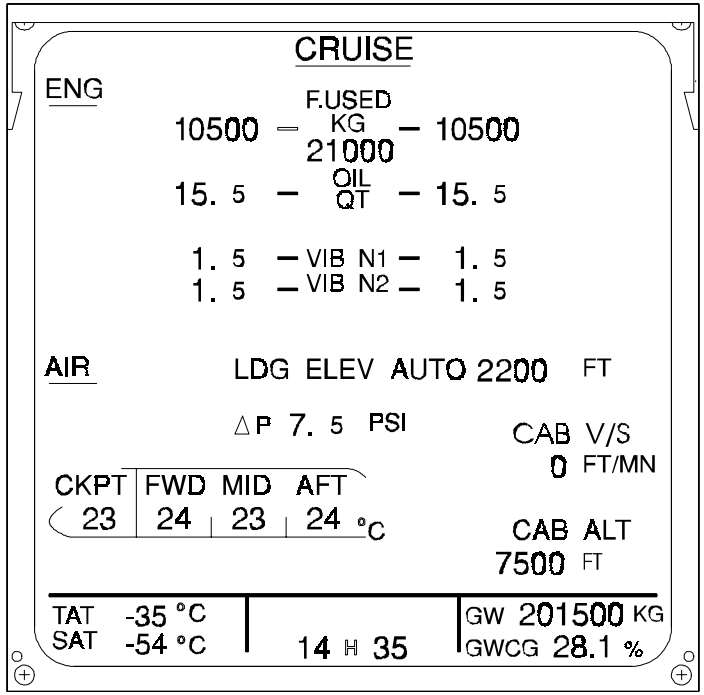
When one of the system keys, or the Status key, is depressed, the corresponding page is displayed on the System Display and the key light comes on. When the key is pressed a second time, the page corresponding to the flight phase or current warning is displayed again.

ALL KEY

When the ALL key is pressed and held, all the system pages are displayed successively at one second intervals.
In case of ECAM control panel failure, the ALL key is still available. It enables the desired page to be displayed by releasing it when the page is displayed.

Note: the system pages presented here are given as an example.





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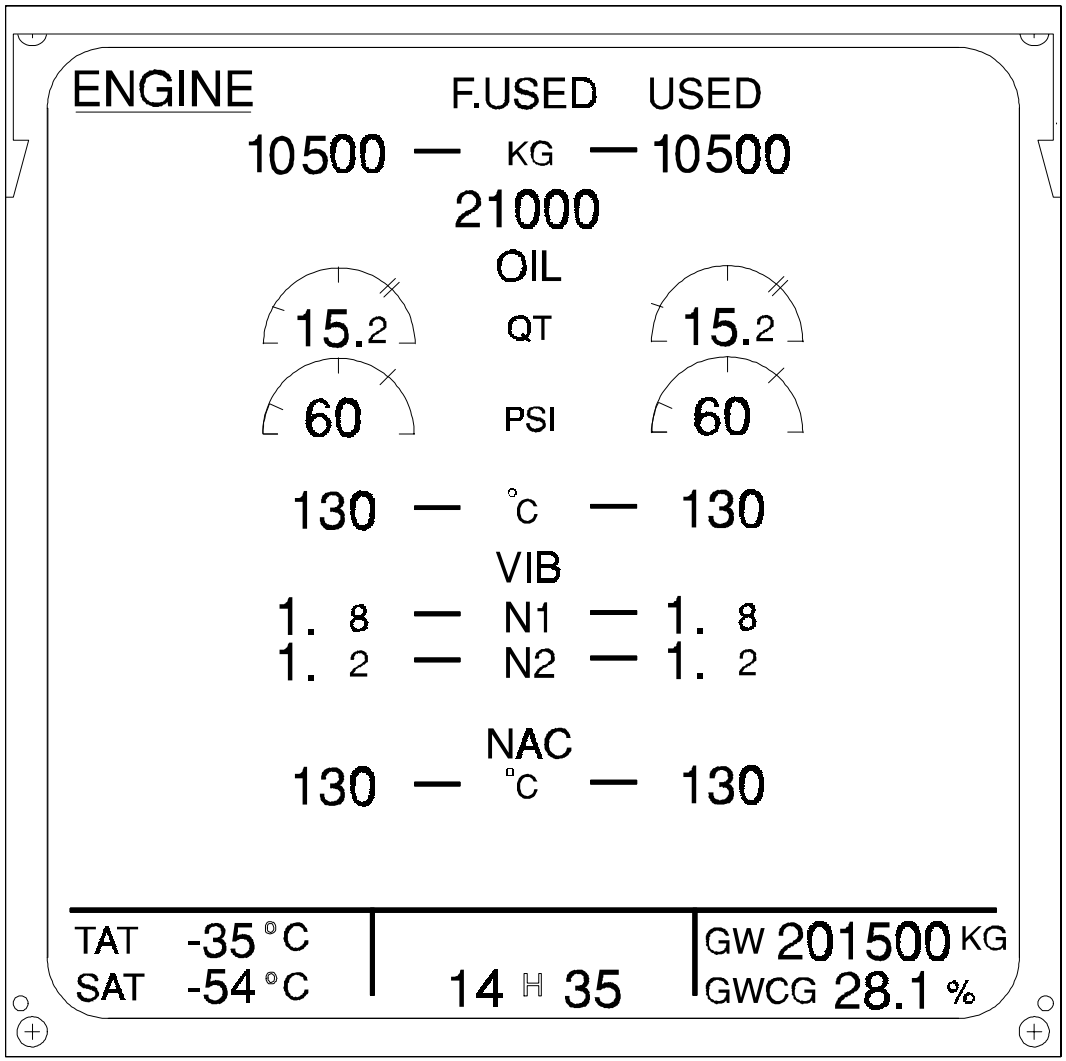

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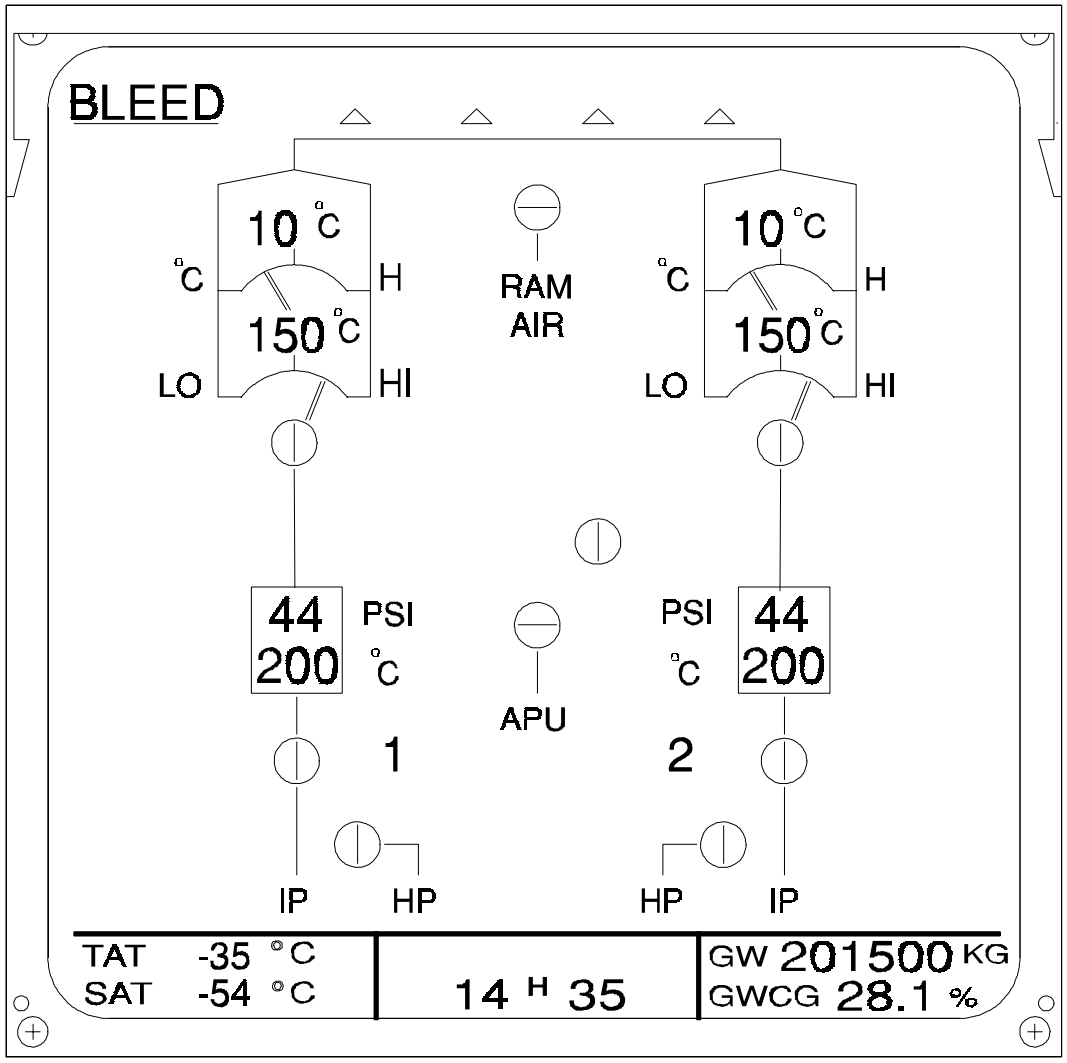

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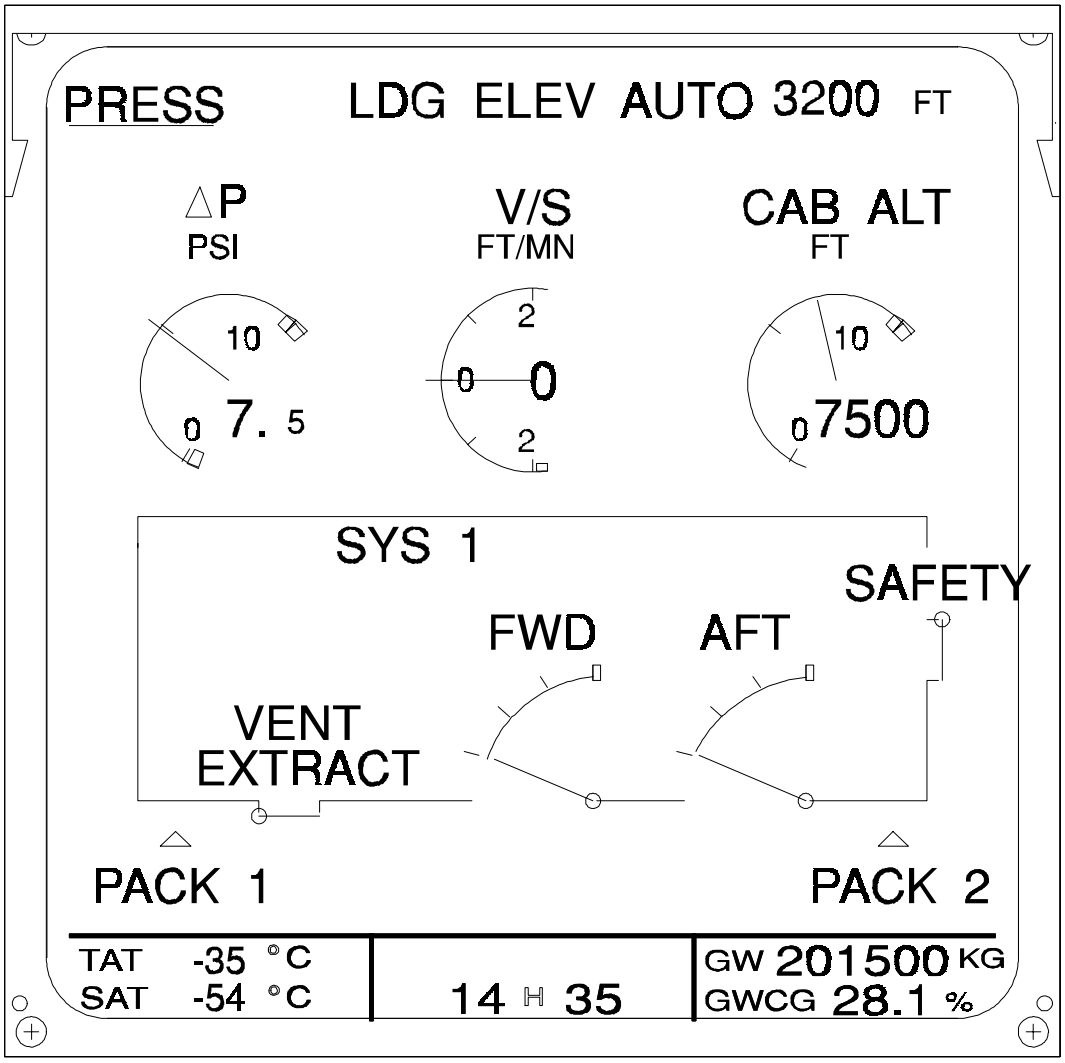

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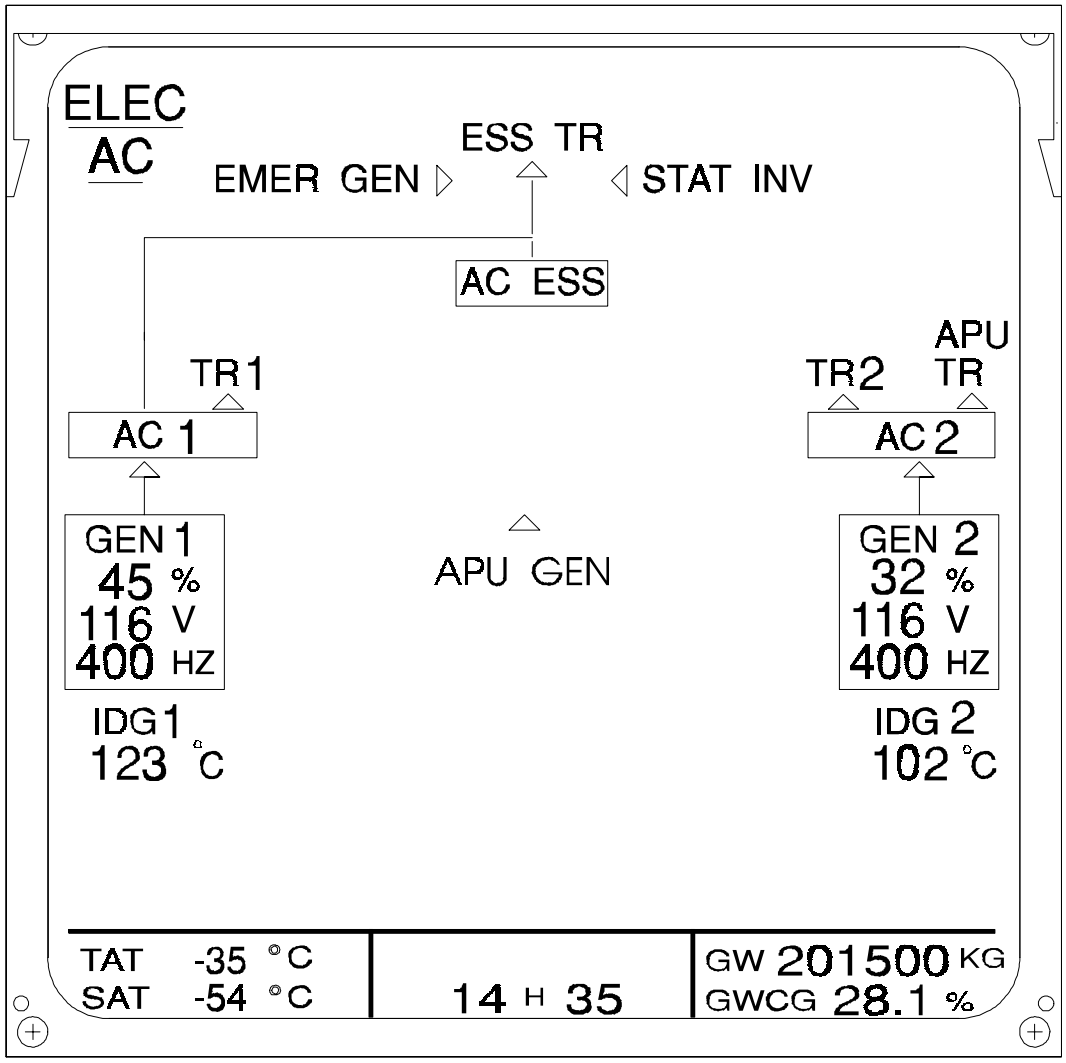

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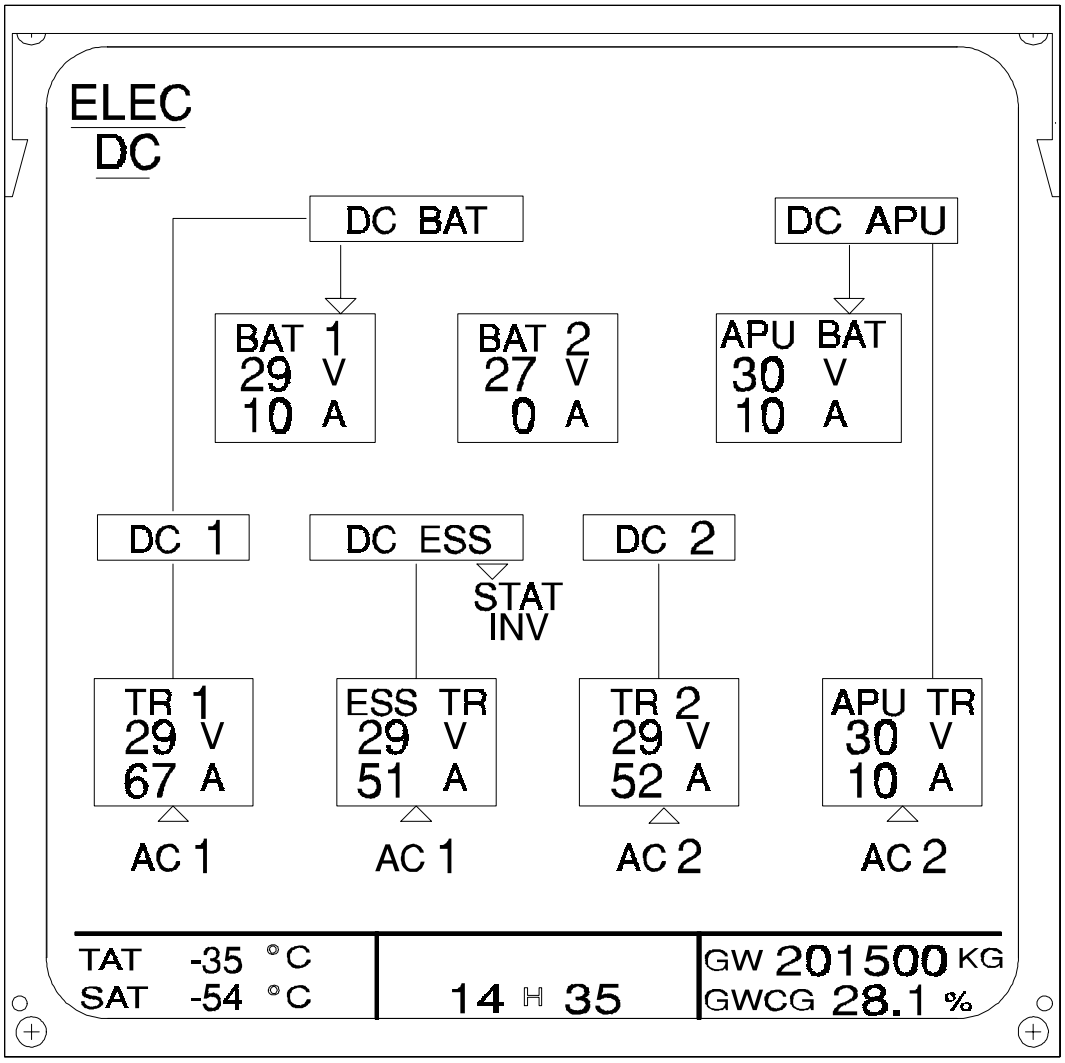

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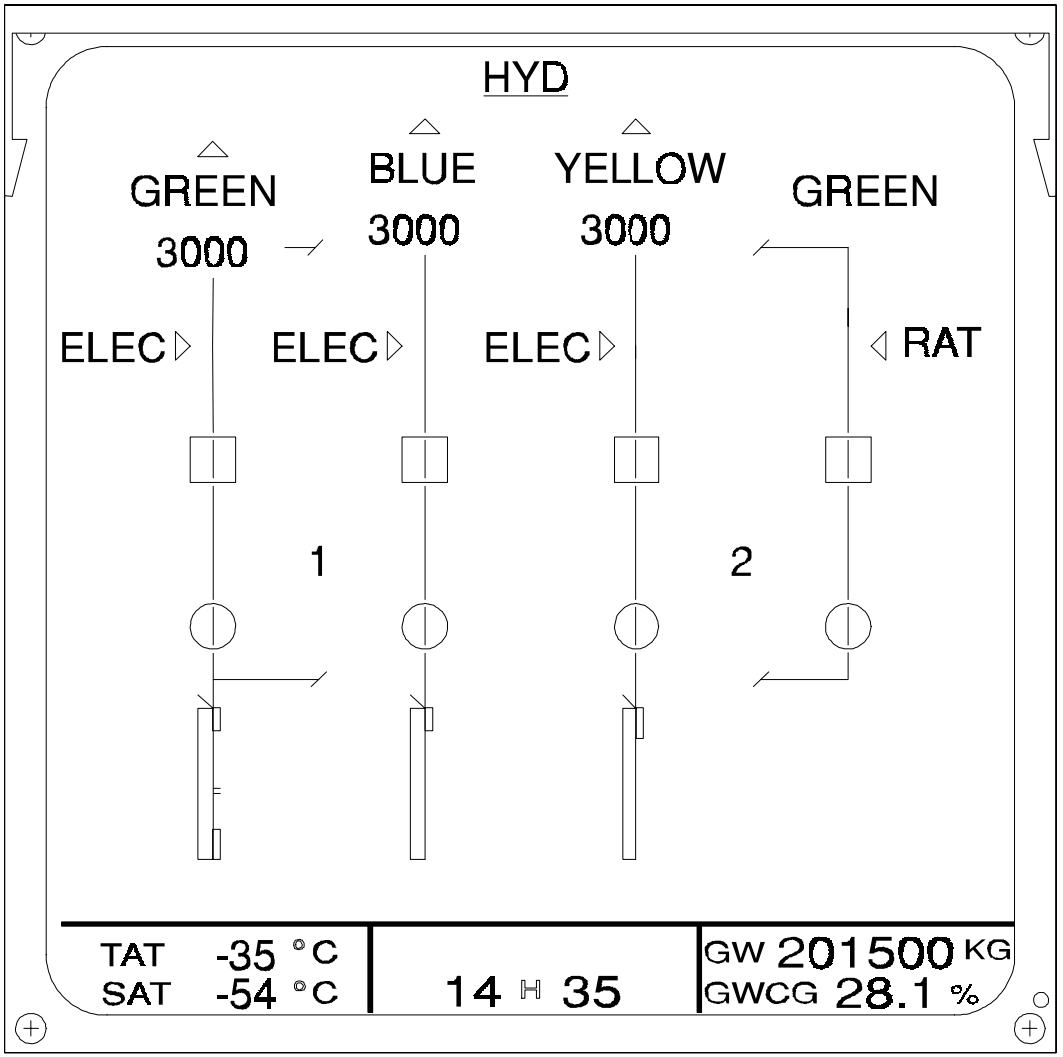

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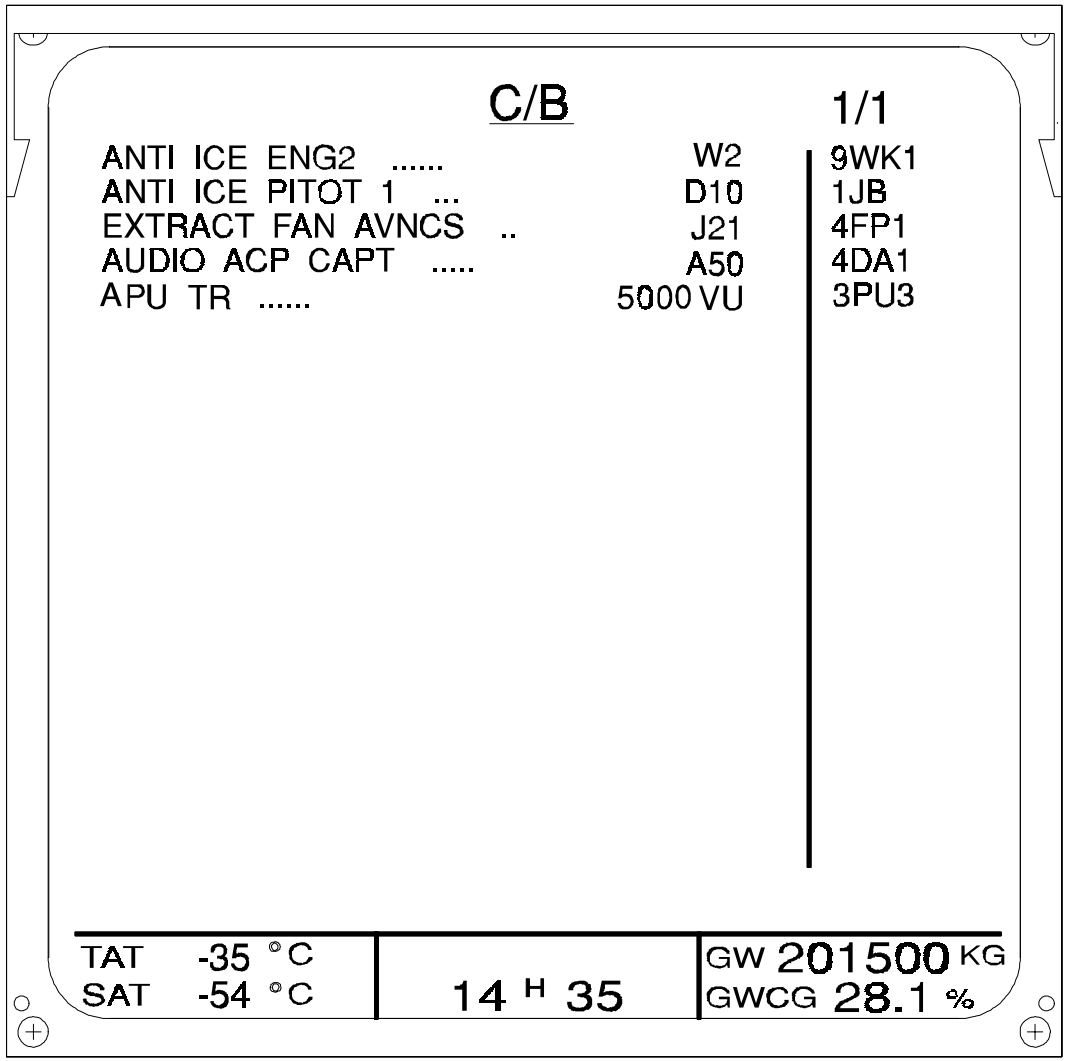

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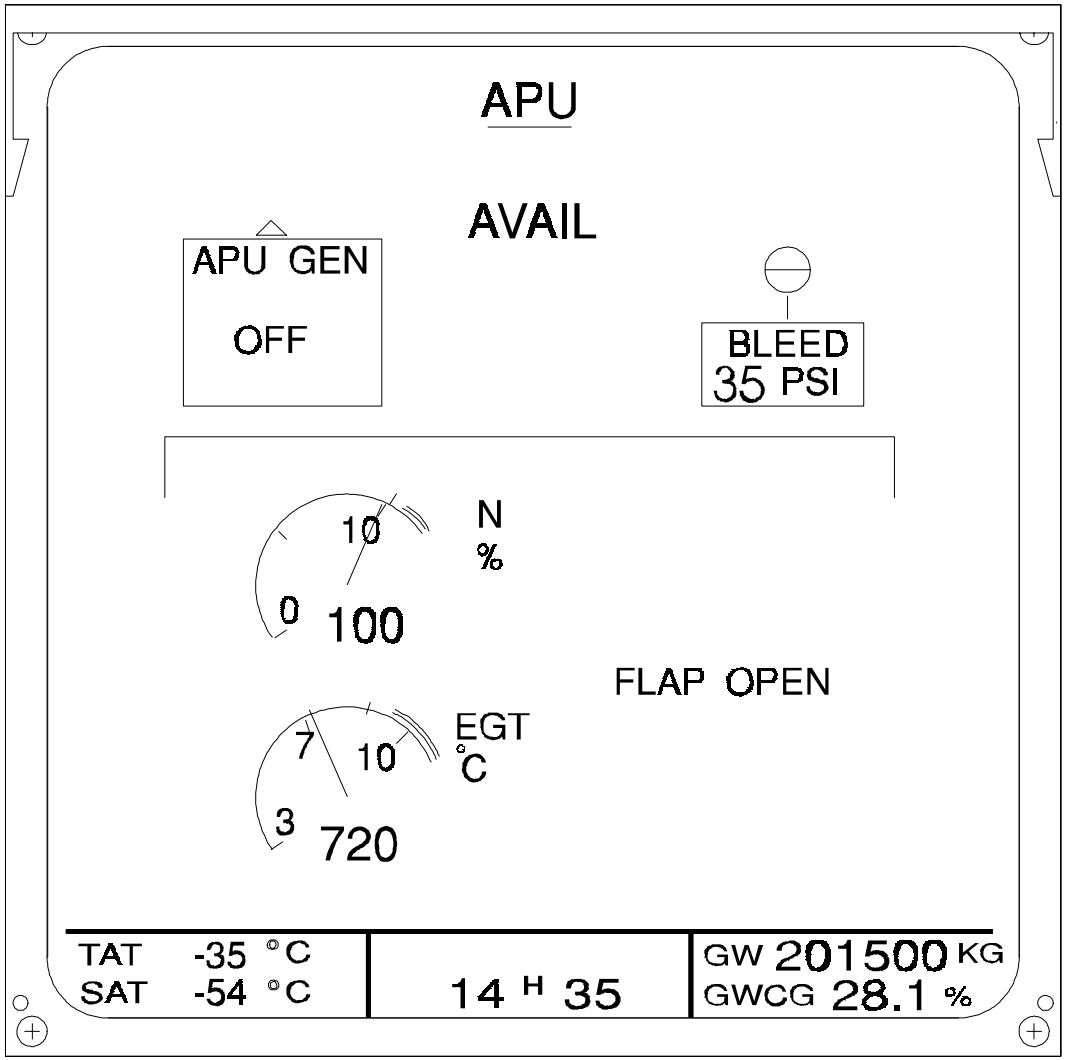

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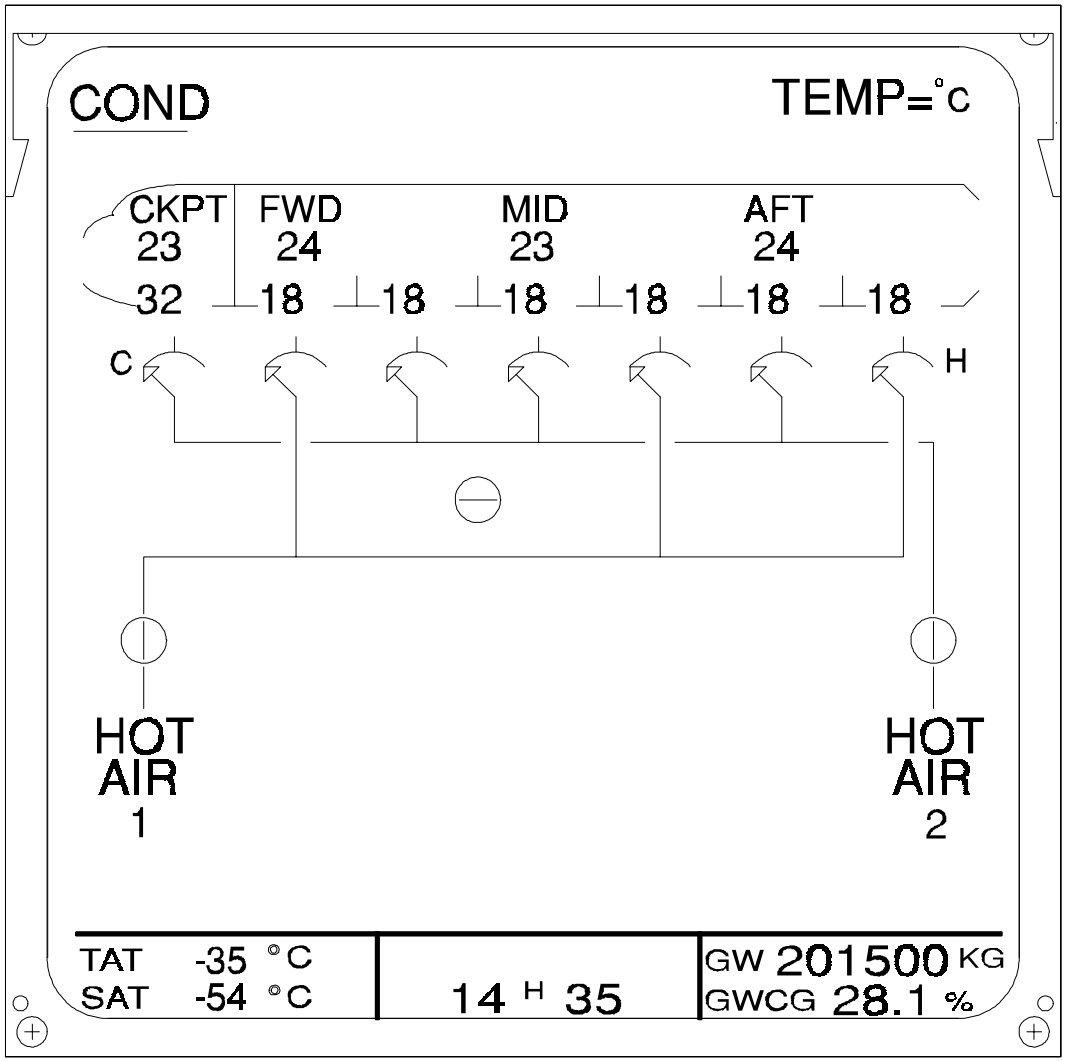

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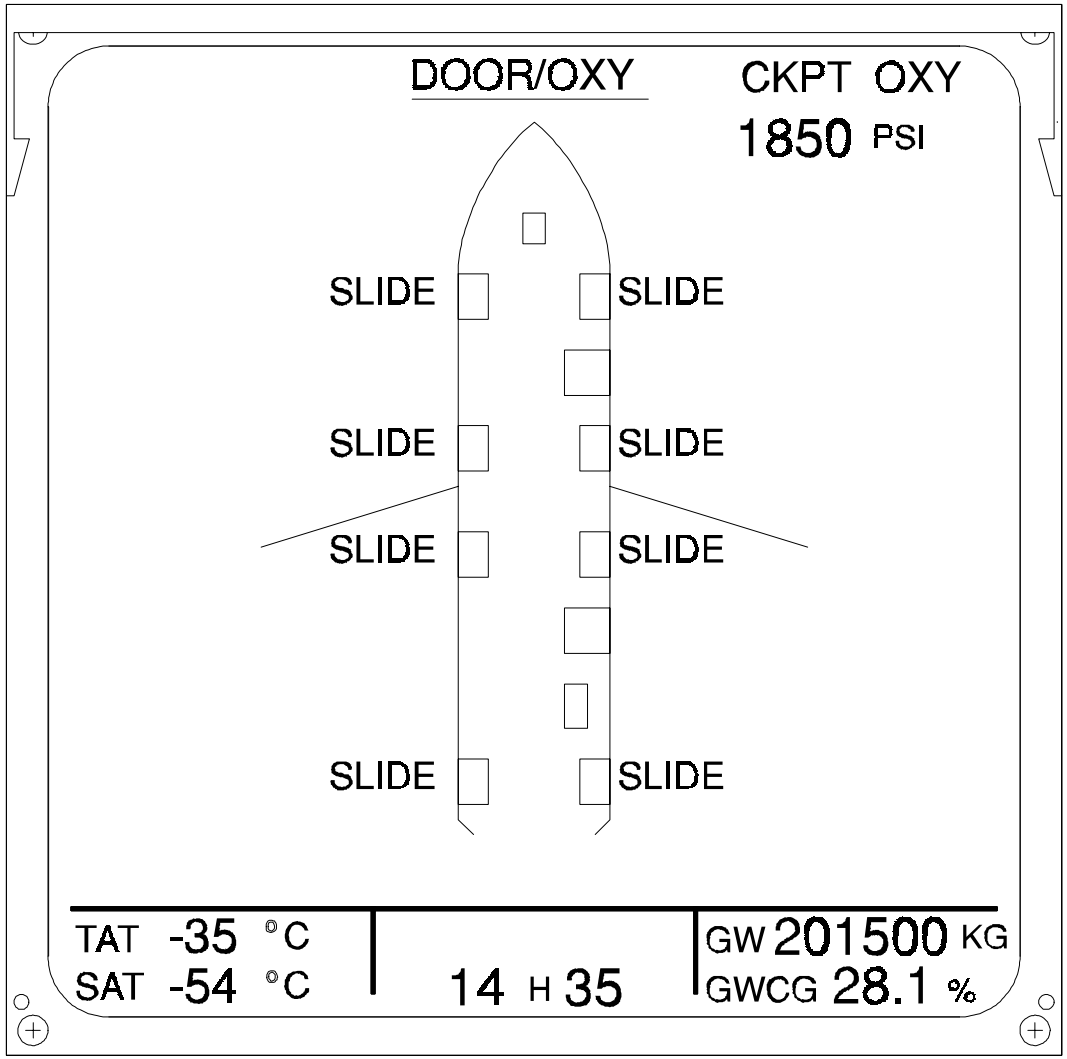

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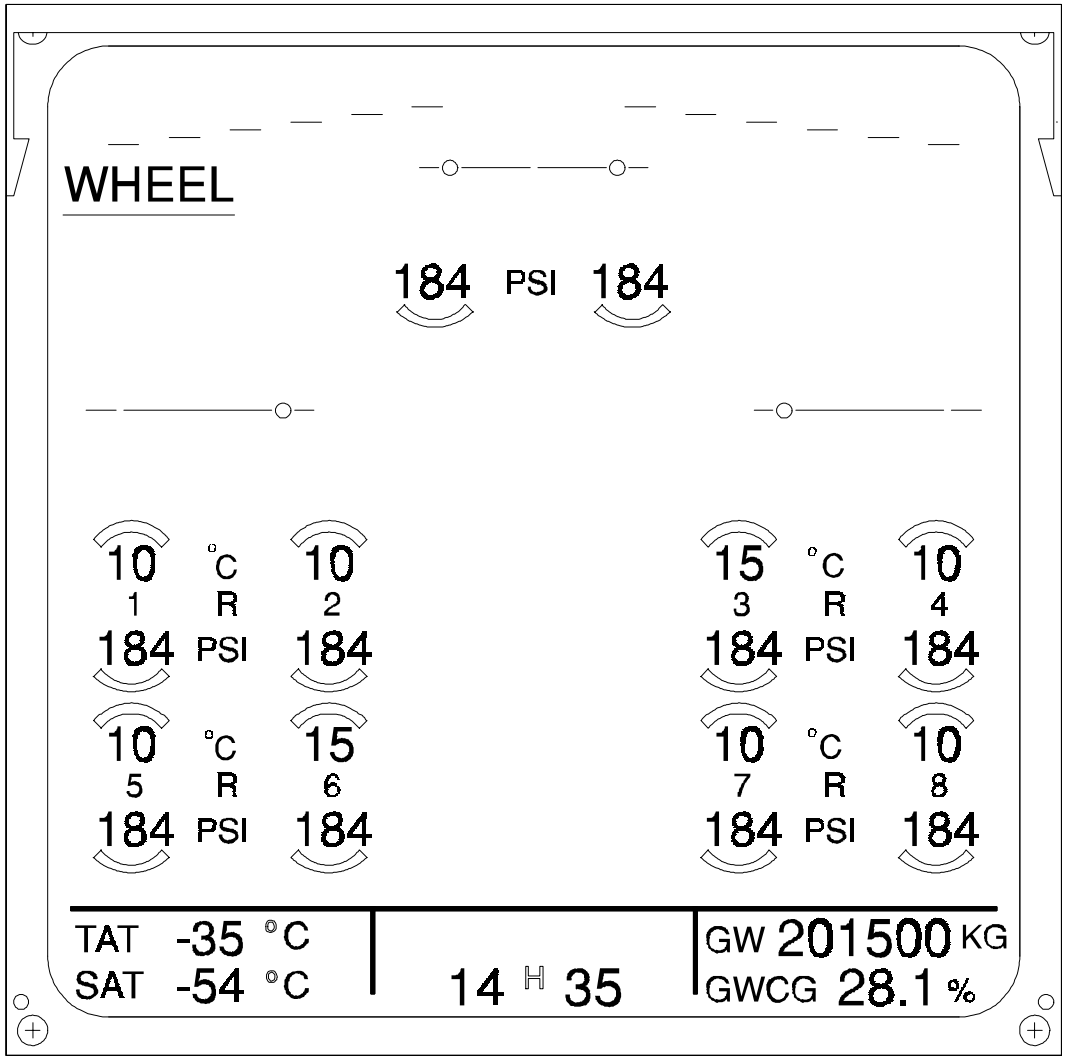

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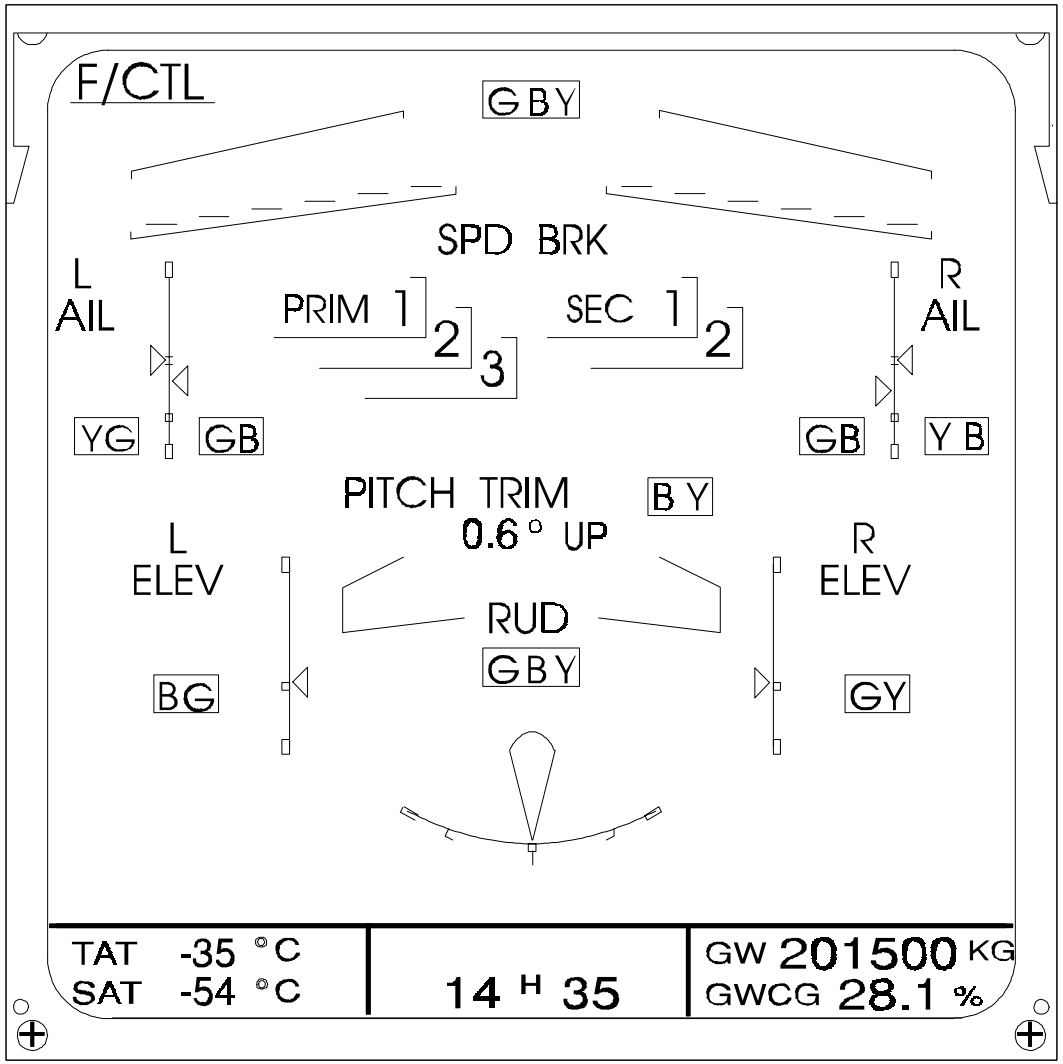

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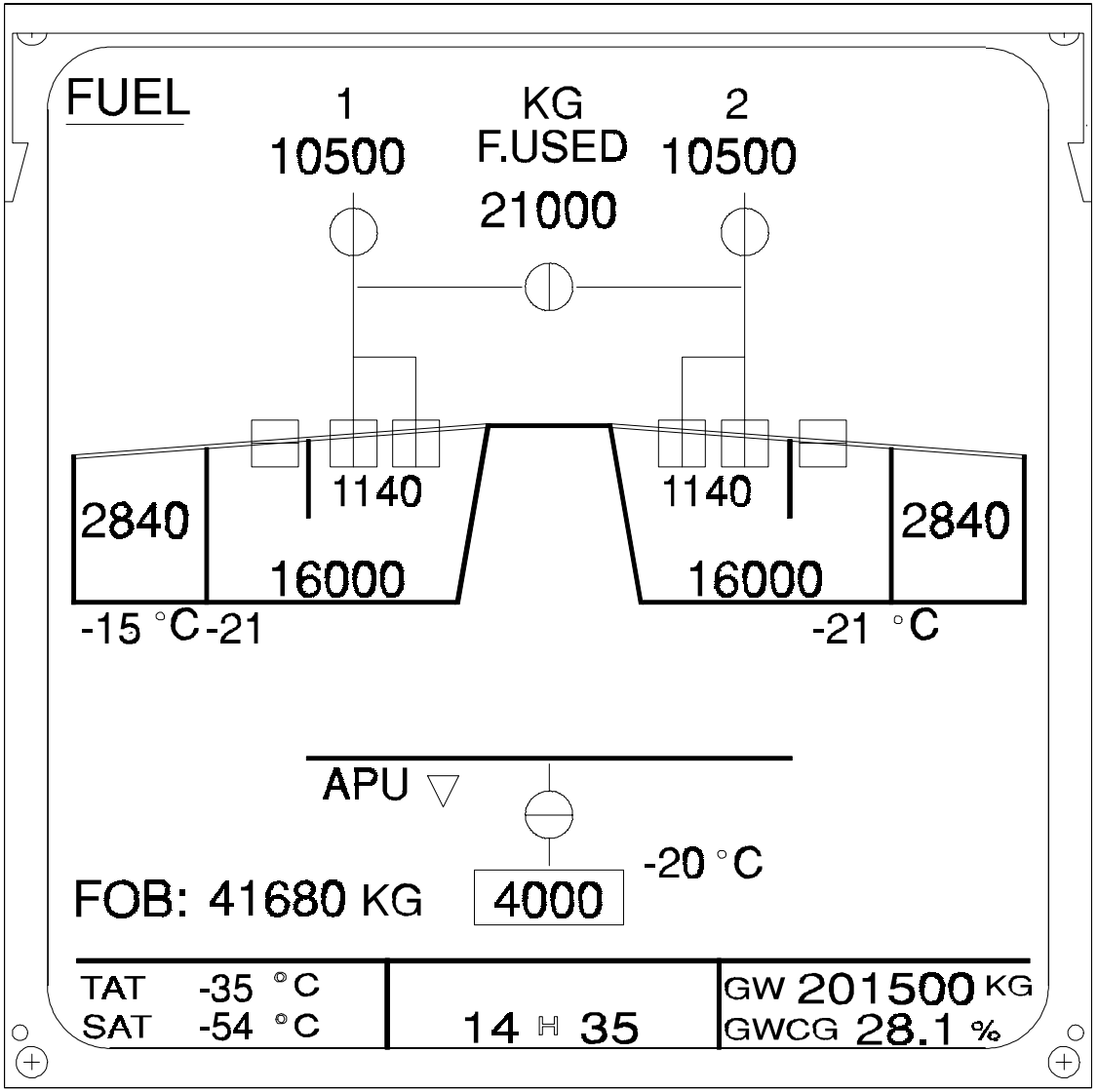
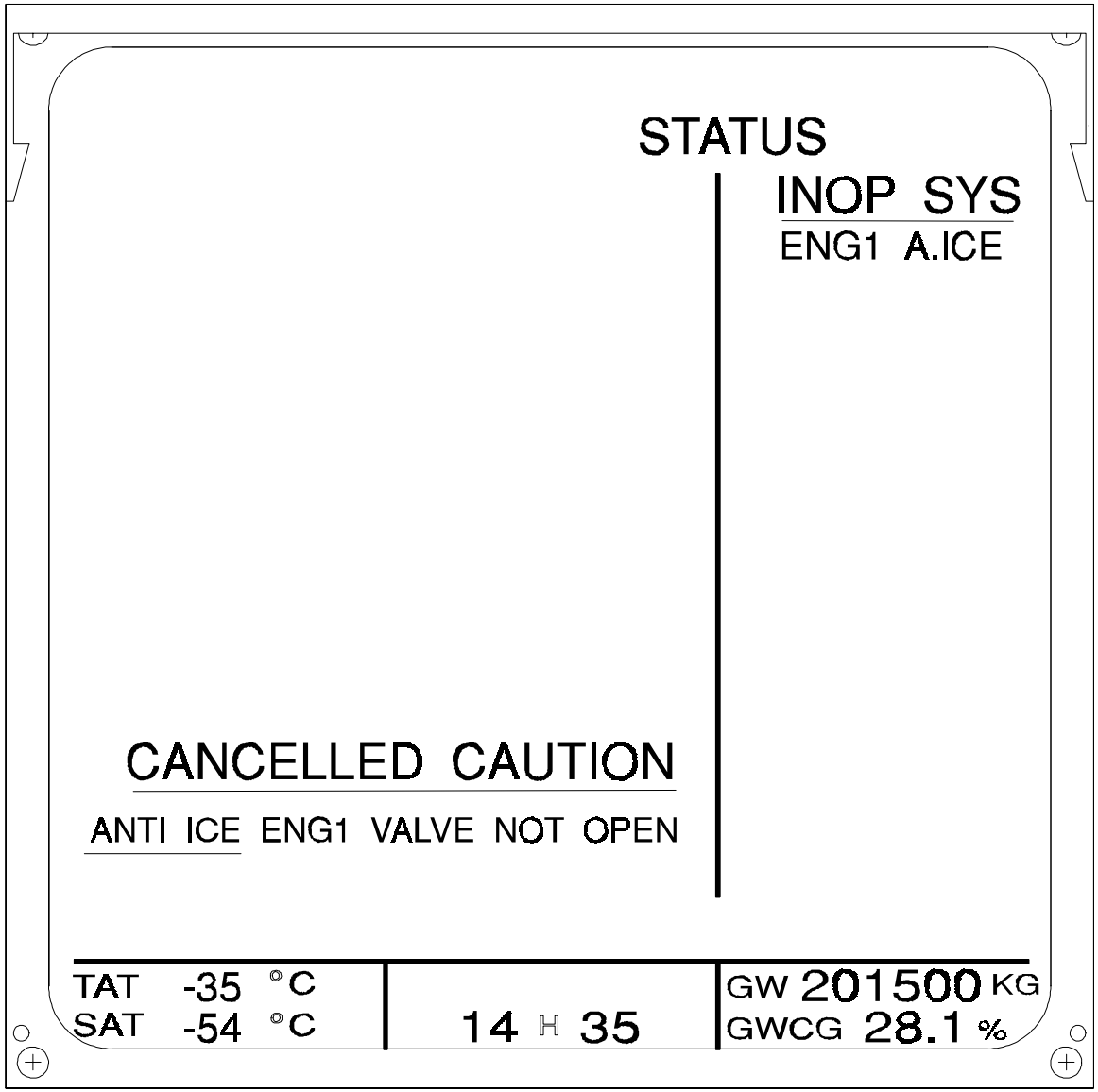


FQW4200 GE Metric



FQW4200 GE Metric

STUDENT NOTES

ECAM ADVISORY AND FAILURE RELATED MODES

Alert Classification
Type of Failure
Advisory
ECAM OEB Reminder Function

ALERT CLASSIFICATION

The alerts are classified in three levels. They depend on the importance and urgency of the corrective actions required.

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

At each level, the alert messages are also classified by priority order.

LEVEL 3

Level 3 corresponds to an emergency configuration. Corrective or palliative action must be taken by the crew.

Typical level 3 warnings are:

- Aircraft in dangerous configuration or limit flight conditions (STALL, OVERSPEED...),
- System failure altering the flight safety (ENGINE FIRE, EXCESS CABIN ALT...),
- Serious system failure (DUAL HYDRAULIC FAILURE...).

LEVEL 2

Level 2 corresponds to an abnormal configuration.
Immediate crew awareness is required, but not immediate corrective action.
The level 2 system failure has no direct consequence on flight safety.

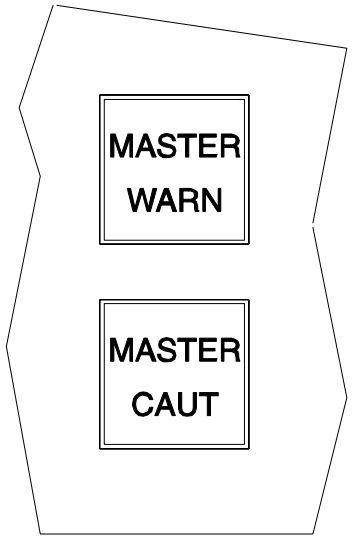
LEVEL 1

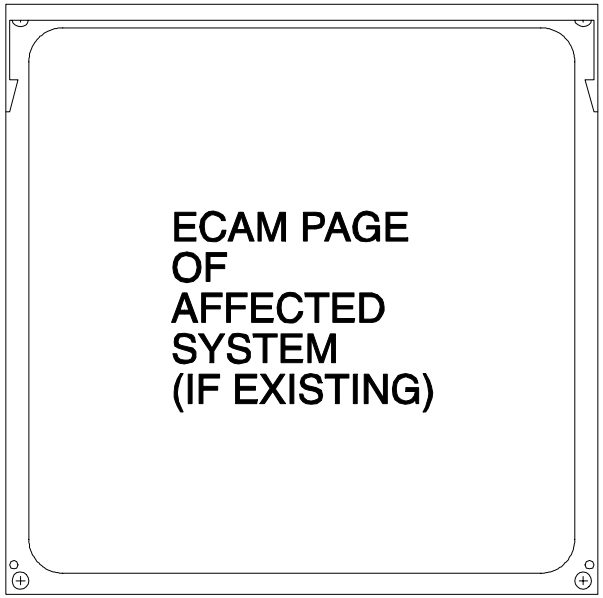
Level 1 corresponds to a configuration requiring crew monitoring, mainly failures leading to a loss of redundancy or degradation of a system.
The attention getters (lights and sounds) are not activated by a level 1 alert.

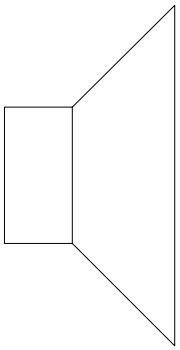
STATUS

Some defects which do not trigger warnings or cautions, but which require further maintenance actions, will be indicated to the crew by means of a status indication, pulsing after engine shutdown.
It is necessary to call the status page manually to see the title of the affected system.

LEVEL 3 ALERT







CONTINUOUS
REPETITIVE CHIME
OR
SPECIFIC SOUND
OR
SYNTHETIC VOICE.

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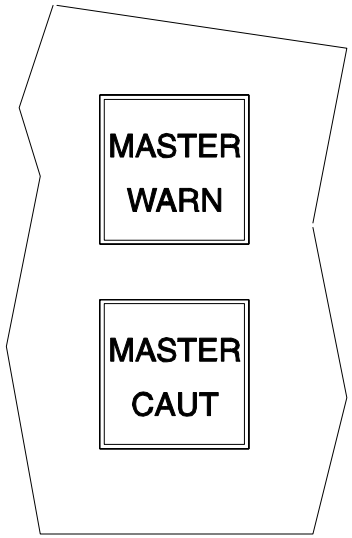
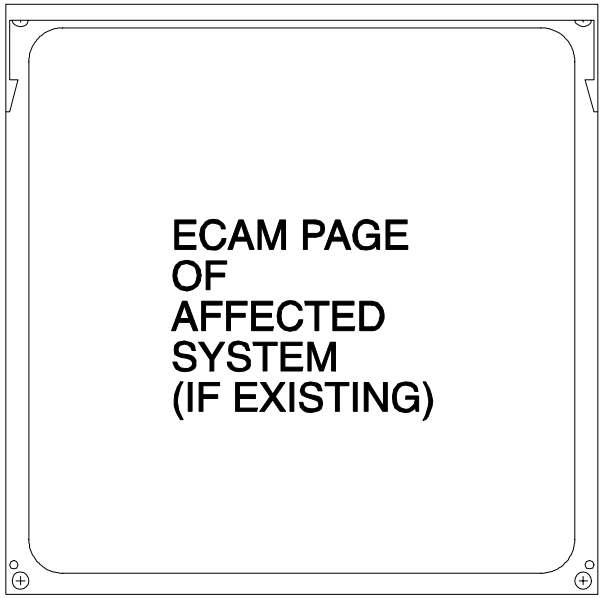
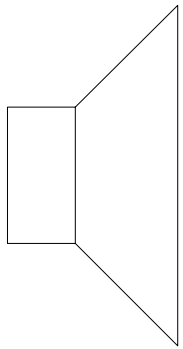


LEVEL 2 ALERT





SINGLE CHIME

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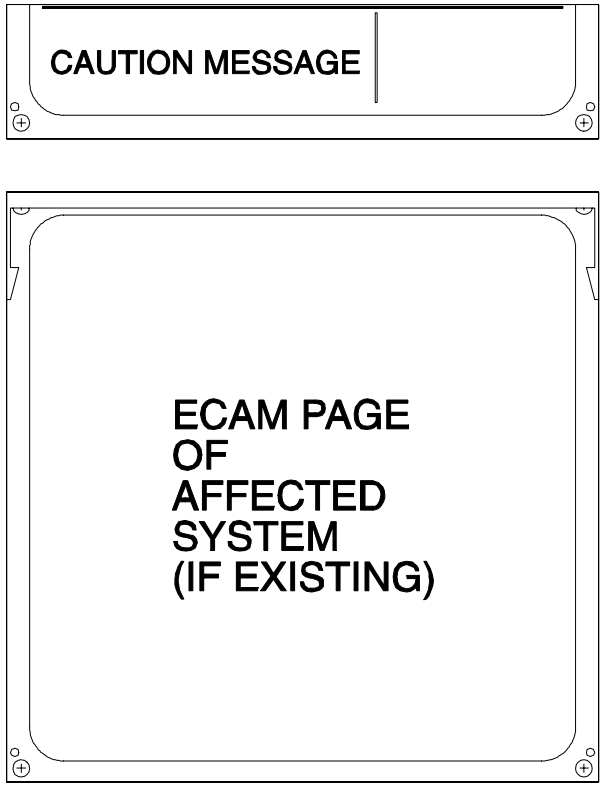
LEVEL 1 ALERT



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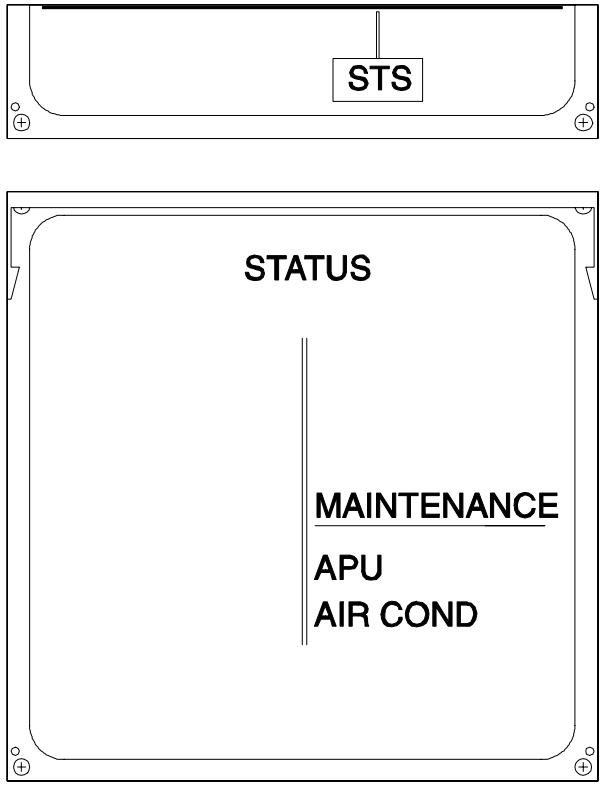

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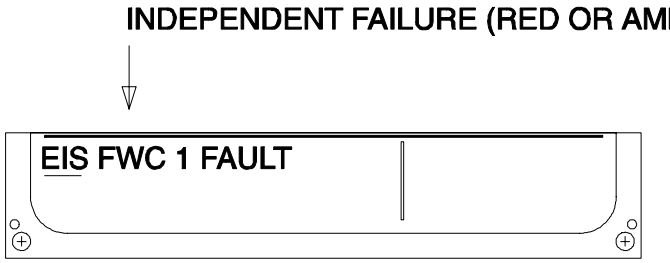
TYPE OF FAILURE

The failures may be of three different types, independently of their classification.
There are 3 separate types of warnings or cautions:

- those associated with an independent failure,
- those associated with a primary failure,
- those associated with a secondary failure.

INDEPENDENT FAILURE

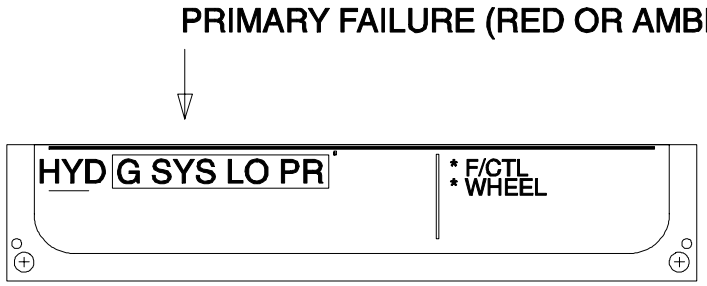
An independent failure is a failure which affects an isolated item of equipment or system without affecting another one.
Example: Flight Warning Computer 1 failure.
Note: an independent failure is displayed with the title underlined.



PRIMARY FAILURE

A primary failure is a failure of an item of equipment or system causing the loss of other equipment.
Example: Green Hydraulic System failure may lead to the loss of a pair of spoilers.

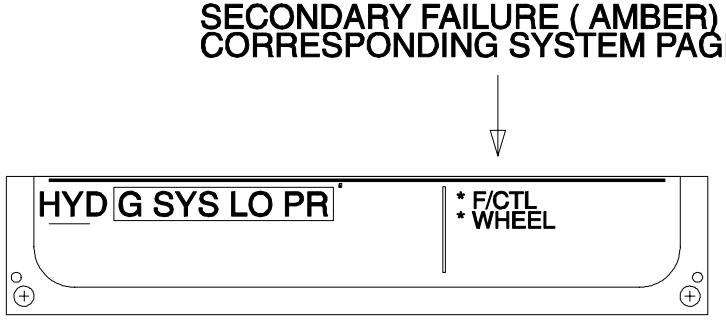
Note: a primary failure is displayed with a box around the failure.



SECONDARY FAILURE

A secondary failure is a loss of an item of equipment or system resulting from a primary failure.
Example: loss of a pair of spoilers after an hydraulic system failure.

The titles of the system pages corresponding to the secondary failures are indicated on the lower right part of the E/WD by an asterisk.
Note: this part can be used if necessary to display heading titles of warnings if the left part of the E/WD is full.



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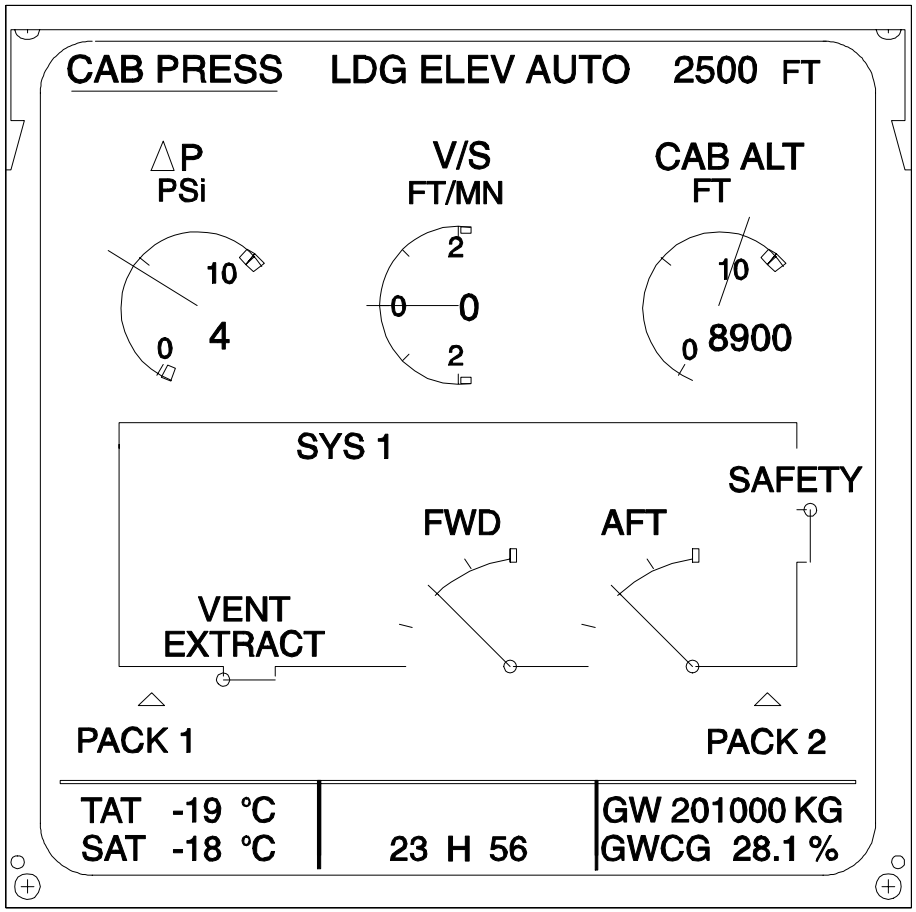
ADVISORY

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 automatically and the affected parameter pulses.
The corresponding key light on the ECAM Control Panel is on.

For example the CAB PRESS page will be displayed if the cabin altitude 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.



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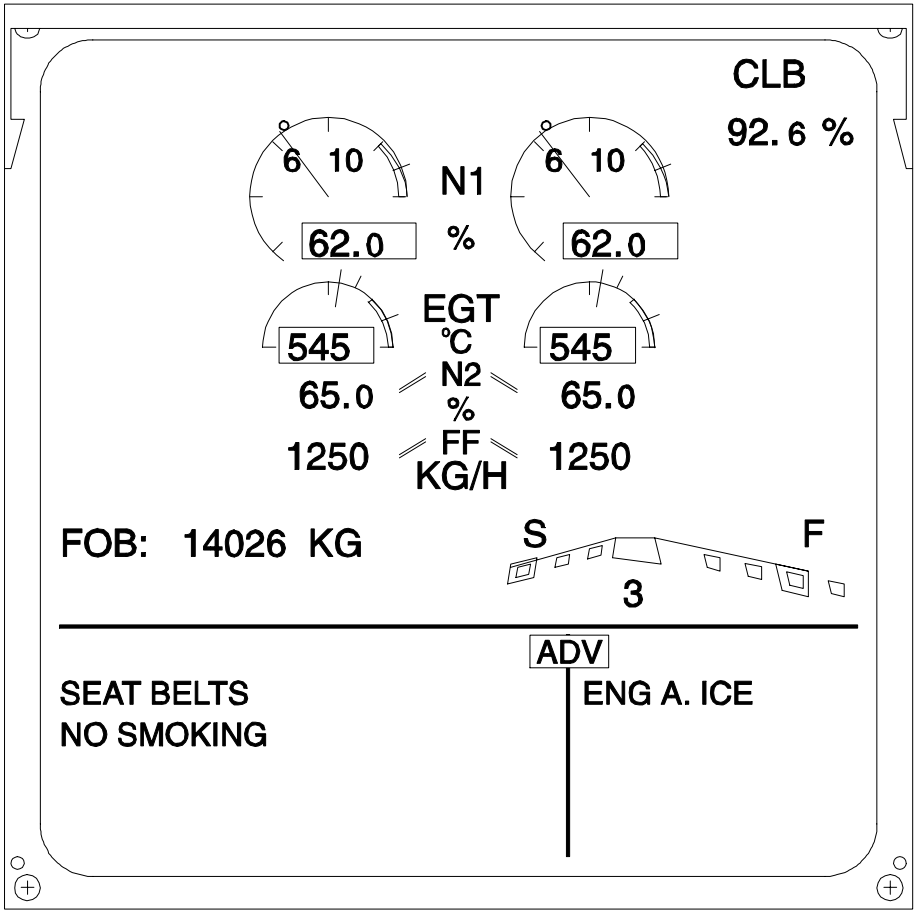
In single display mode (one ECAM CRT remaining), a white ADV message pulses at the bottom of the Engine Warning Display to attract crew attention. As the corresponding system page cannot be displayed automatically on the SD, the pilot has to fetch the information on the ECAM control panel: the associated key light flashes to indicate which system is concerned.

Note: the system pages presented here are given as an example.



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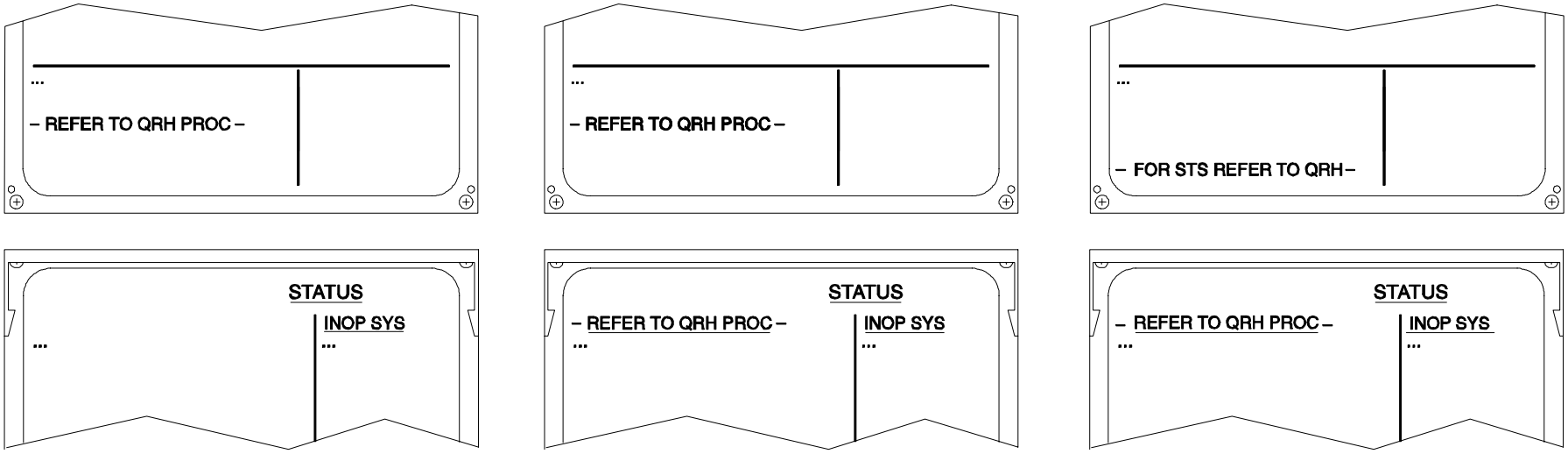
ECAM OEB REMINDER FUNCTION

When a warning and/or a status is affected by an Operations Engineering Bulletin (OEB), a message is displayed to remind the crew that an OEB exists and that they must refer to the Quick Reference Handbook (QRH) to get access to the correct procedure.

An OEB flag is displayed on the E/WD and/or the SD depending the affected item which can be:

- an ECAM warning alone,
- an ECAM warning and associated status message,
- a status message alone.

There is a procedure for checking or loading OEB flag database in the FWC through the MCDU (using the OEB data base menu accessed from the WARNING SYSTEM REPORT/TEST page).



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STUDENT NOTES:

ECAM DESCRIPTION AND OPERATION

General Architecture
System Data Acquisition Concentrator (SDAC)
Flight Warning Computer (FWC)
Display Management Computer (DMC)
Interface

GENERAL ARCHITECTURE

The Electronic Centralized Aircraft Monitoring (ECAM) performs two main functions :

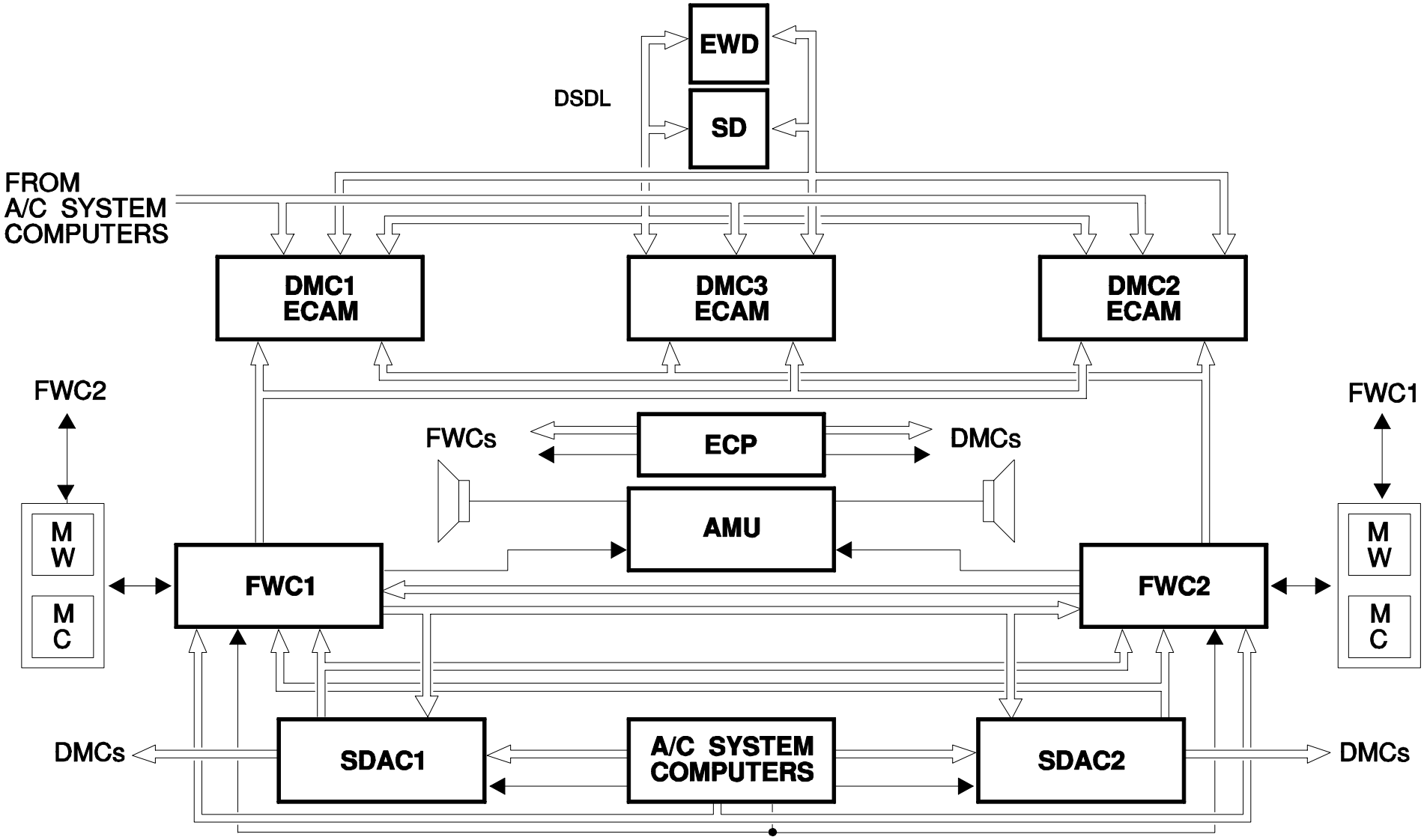
- data acquisition and concentration,
- data warning computation.

*Data acquisition is shared between
-the System Data Acquisition Concentrators (SDACs)
-the Flight Warning Computers (FWCs)
-the Display Managment Computers (DMCs).

*Data warning computation and memo information are achieved by the FWCs.

The FWCs provide aural and visual information in order to :

- know, in real time, all the system failures and dangerous configurations with their level of seriousness,
- identify the systems or circuits affected by a failure,
- take the appropriate corrective action.



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SYSTEM DATA ACQUISITION CONCENTRATOR (SDAC)

The two System Data Acquisition Concentrators (SDACs) are identical and interchangeable.

They perform three main functions :

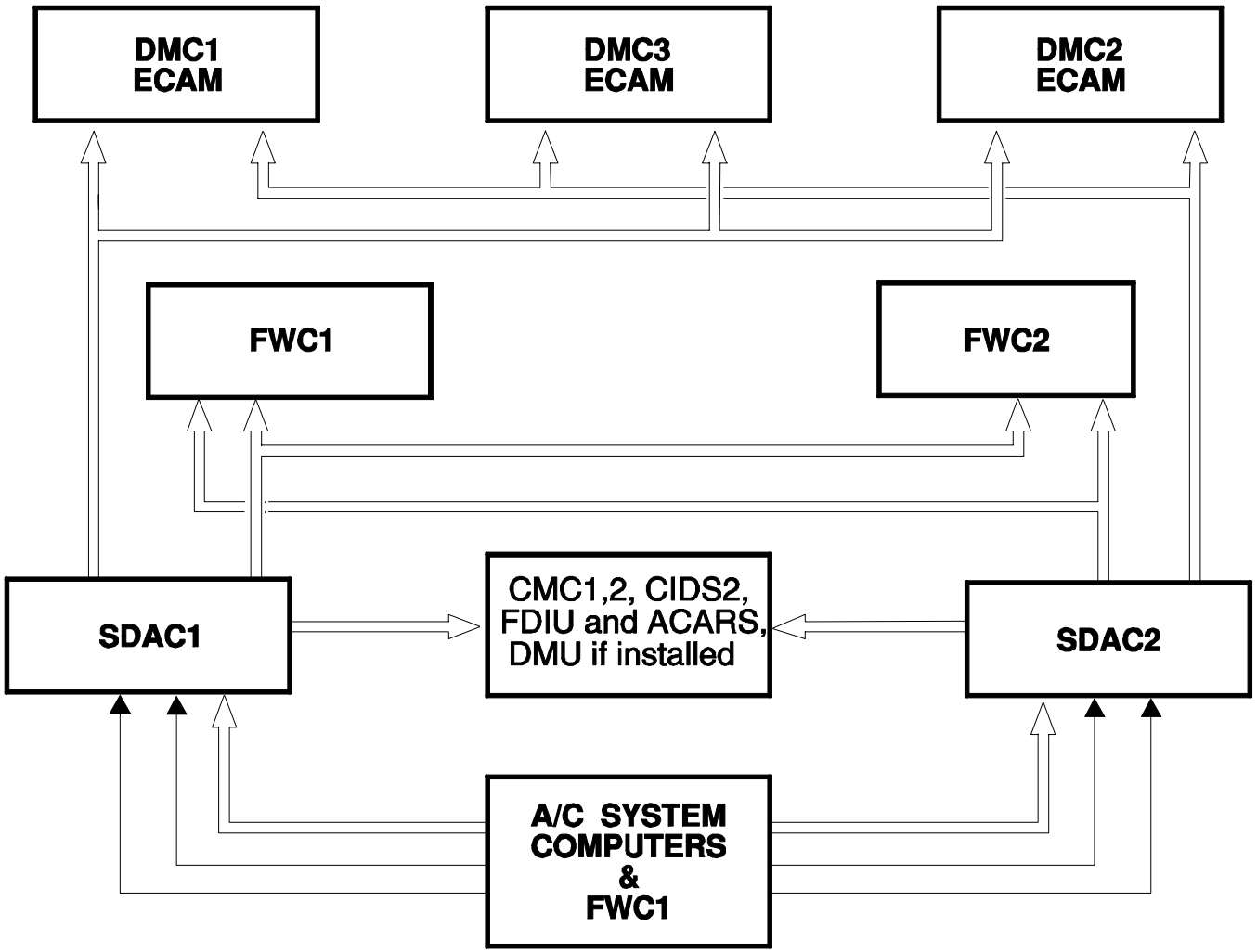
- data acquisition,
- data concentration,
- data digitalization.

The two SDACs acquire and send, to the three DMCs, all the A/C system signals necessary for the display on the System Display (SD). They are also used as data concentrators for other systems (example: FDIU).

The SDACs acquire, from the aircraft systems, the malfunction and failure data corresponding to caution situations and send it to the FWCs for generation of the corresponding alert and procedure messages.

All the signals (discrete, analog, digital) entering the SDAC are concentrated and converted into digital format.
They are delivered via the SDAC outputs on Aeronautical Radio INCorporated (ARINC) 429 high speed buses called DATA BUSES.

The SDAC operational software is contained in a specific device called OBRM (On Board Replaceable Module) in order to facilitate any software modification.



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FLIGHT WARNING COMPUTER (FWC)

The two Flight Warning Computers (FWCs) are identical and interchangeable.

They perform three main functions :

- data acquisition,
- data warning computation corresponding to warning situations,
- flight phase computation.

The FWCs also generate aural alerts as well as synthetic voices for radio height, automatic call out and other announcements.
They are sent to the Audio Management Unit (AMU) for broadcasting by the loudspeakers.

The FWCs acquire data for the red warnings.

The FWCs perform acquisition directly from the systems not connected to the SDACs, and acquisition of the SDAC DATA BUSES.

Each FWC generates alphanumeric codes corresponding to all texts and messages to be displayed on the ECAM display units.

These are :

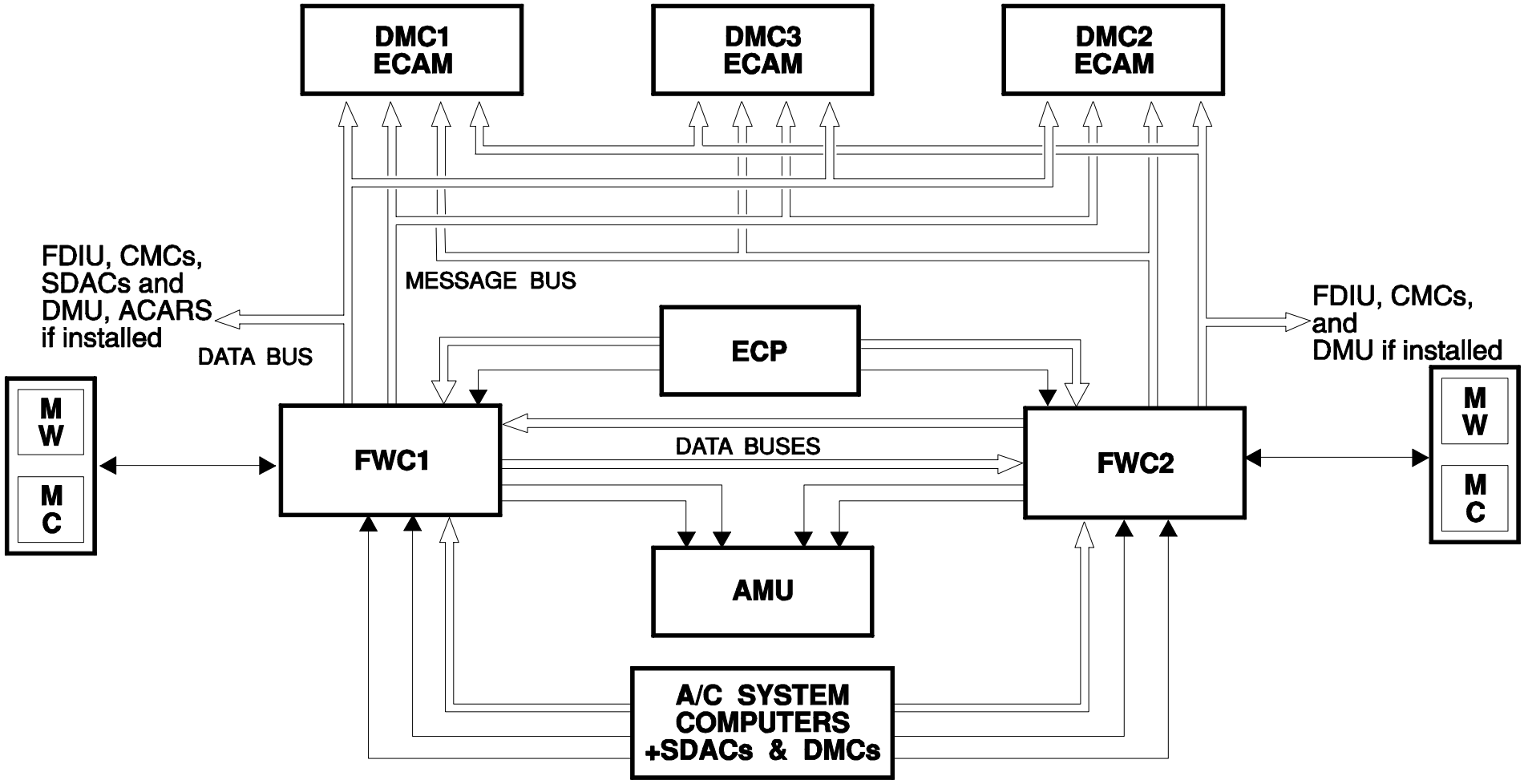
- system and warning titles,
- procedures associated with the warnings,
- status and memos.

Each FWC sends a copy of its own acquisition through the ARINC 429 bus to the opposite FWC.

The FWC outputs are :

- discretes for visual attention getters,
- discretes and analog for audio signals,
- ARINC 429 called FWC DATA BUS,
- dedicated ARINC 429 called FWC MESSAGE BUS.

The FWC operational software is divided in two main parts, each part corresponding to an OBRM.
Each FWC includes a Built In Test Equipment (BITE) to detect the failures.



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DISPLAY MANAGEMENT COMPUTER (DMC)

The three Display Management Computers (DMCs) are identical and interchangeable.
They directly receive data from the aircraft systems, or through the SDACs and FWCs.
They decode and process them in order to be displayed on the ECAM display units.

The ECAM part is independent from the Electronic Flight Instrument System (EFIS) part and has its own :

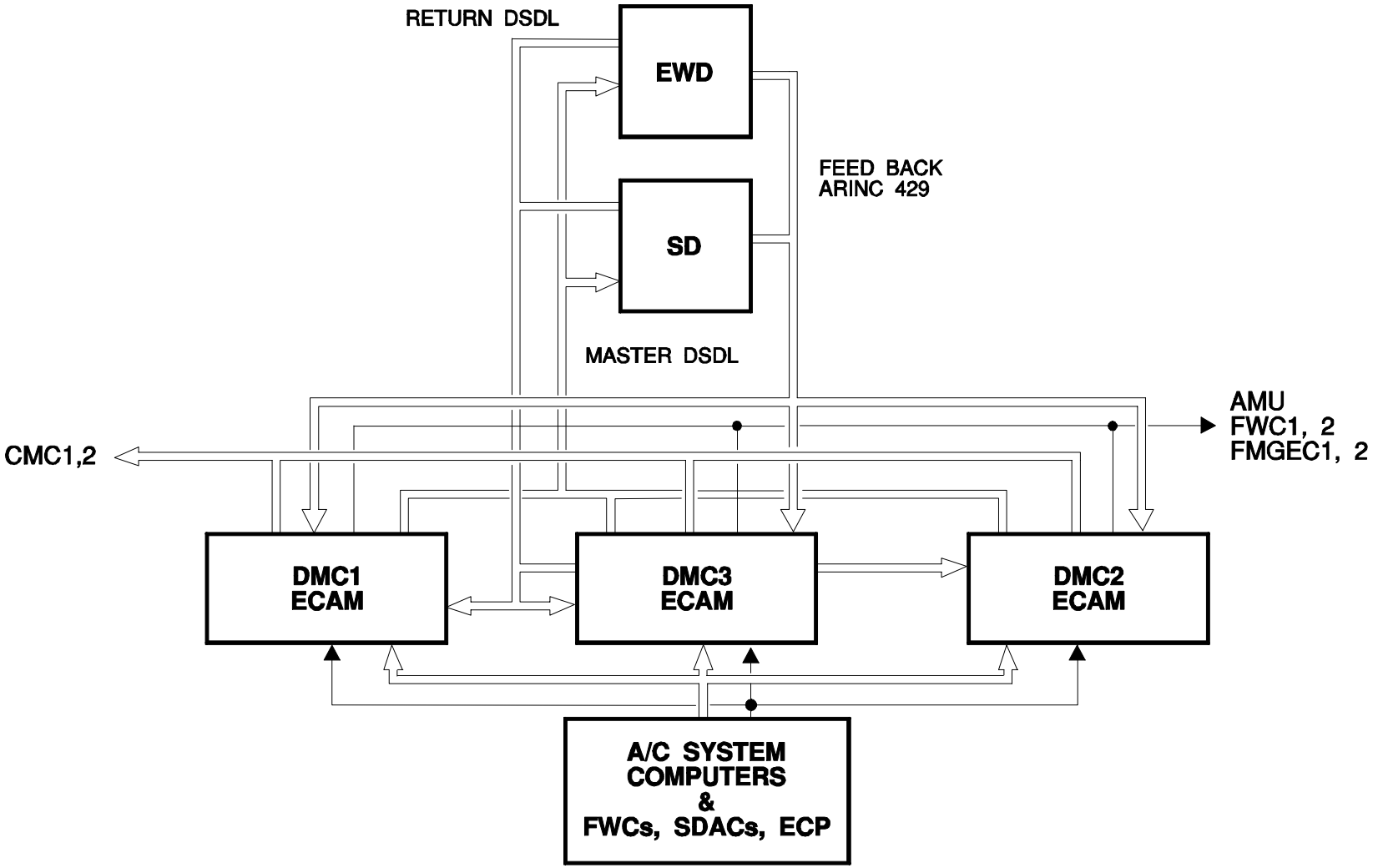
- power supply module,
- acquisition module,
- processing channel.

The two display units are identical and interchangeable.
The Engine Warning Display (EWD) and System Display (SD) receive digital signals from their related DMC through a Master Dedicated Serial Data Link (DSDL).

In feed back, the display units send to the DMCs :

- acknowledge signals by a return DSDL,
- critical parameters display monitoring (example: engine primary parameters from EWD) by an ARINC 429 bus.

Each DMC includes two OBRMs and one BITE.



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INTERFACE

The ECAM interface includes :

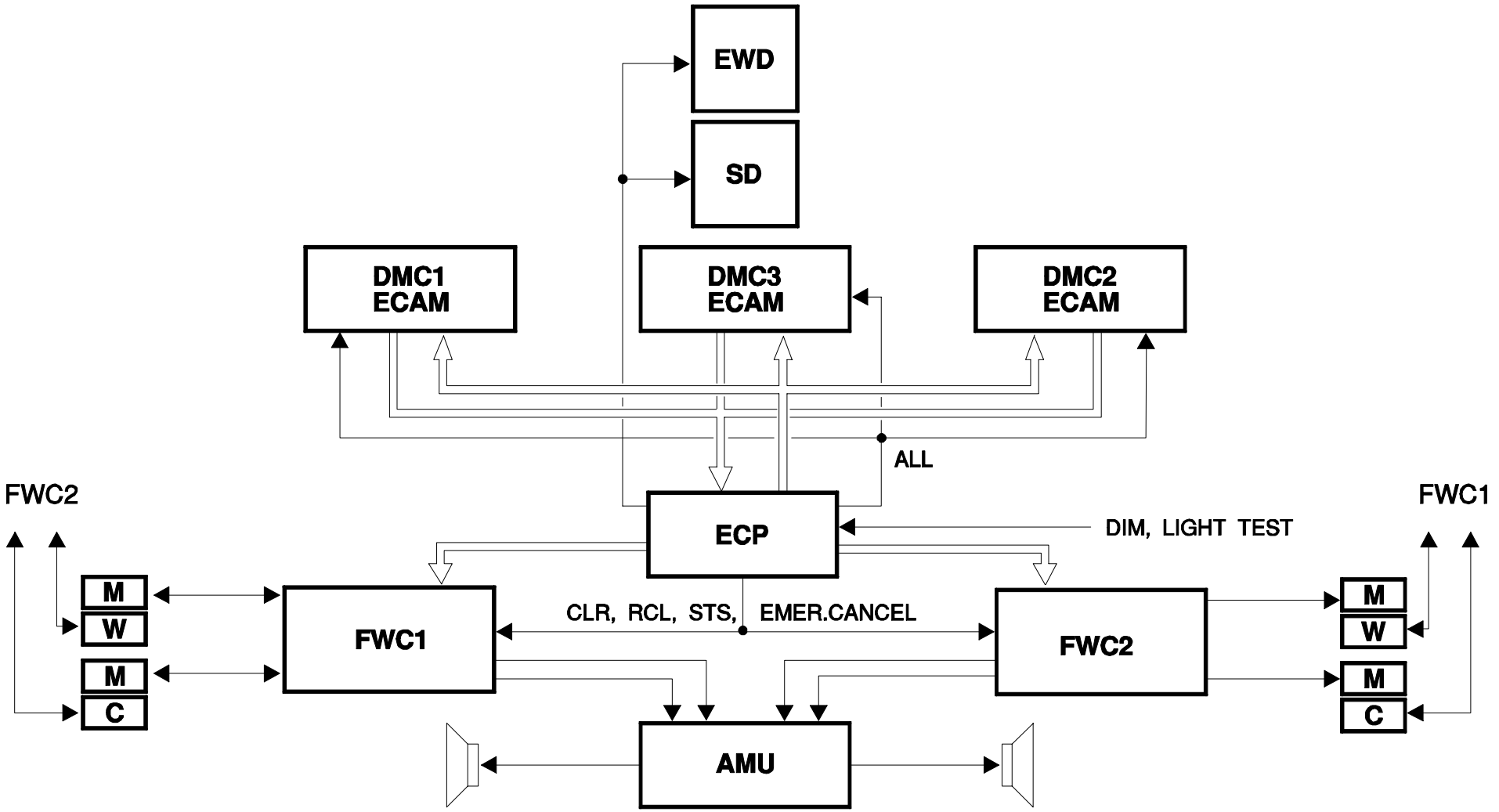
- the ECAM Control Panel (ECP),
- the warning and caution lights,
- the loudspeakers,
- the display units.

The ECAM Control Panel is a control and display unit.
It transmits the pilot selections to the FWCs and DMCs.
It receives the DMC data in order to illuminate its key lights.

The ECAM Control Panel outputs discretes for the Clear (CLR), Recall (RCL), Status (STS) and EMERgency CANCEL keys wired to the FWCs, and for the ALL key wired to the DMCs.
It is also linked to the display units for the brightness control.

Both Master warning and Master caution lights are controlled by each FWC.
The aural warning and synthetic voices are delivered, via the AMU, by the cockpit loudspeakers.

The Audio Management Unit (AMU) receives audio signals from the FWC, and synchronization signals by means of discretes.



STUDENT NOTES:

ECAM ABNORMAL OPERATION

Engine Warning Display (E/WD)
System Display (SD)
E/WD + SD
Display Management Computer (DMC) 1 or 2
DMC3
DMC3 + DMC1
DMC3 + DMC2
DMC1 + DMC2
Flight Warning Computer (FWC) 1
FWC2
FWC1 + FWC2
System Data Acquisition Concentrator (SDAC) 1
SDAC2
SDAC1 + SDAC2
ECAM Control Panel

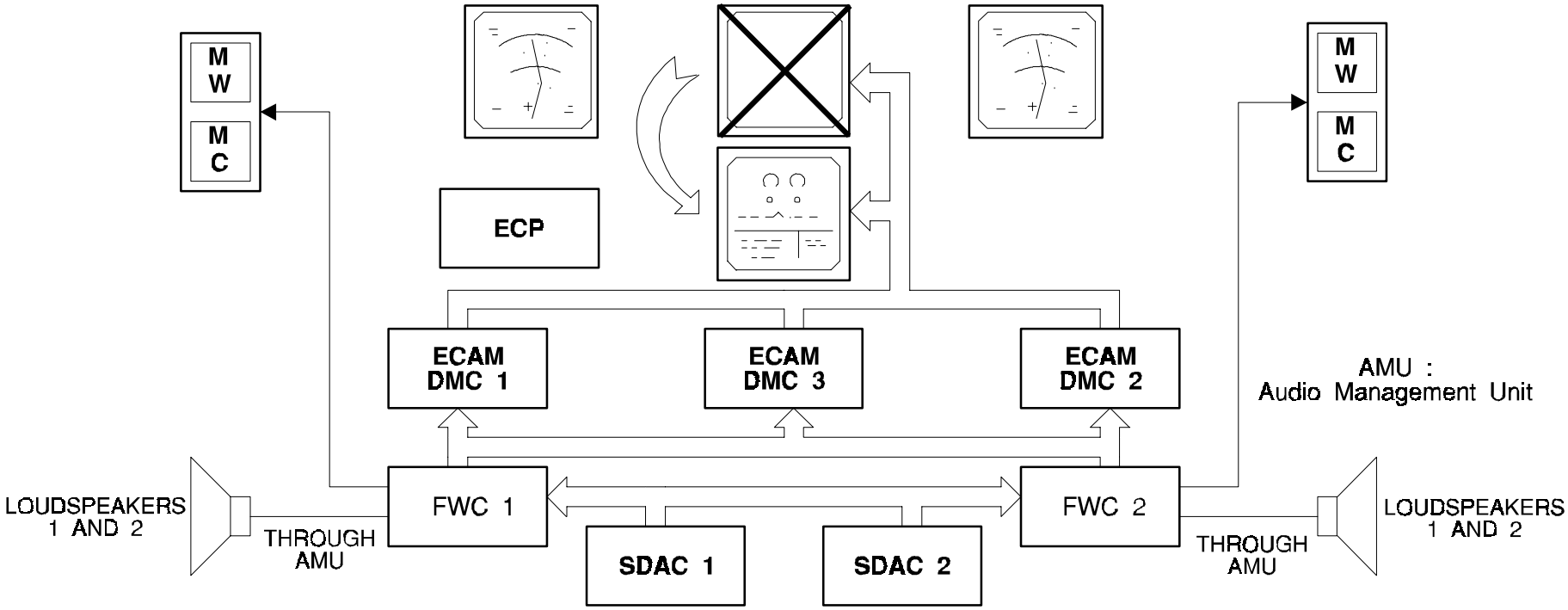
The topics indicate the failed components.

ENGINE WARNING DISPLAY (E/WD)

If the Engine Warning Display Unit fails or is switched off, the Engine Warning Display image is transferred automatically to the System Display Unit.
In this case, only one Display Unit is available to show the ECAM diplays. This is called the SINGLE DISPLAY mode.

The crew can display :

1 - the SD image on the lower DU with the ECAM Control Panel.
2 - the SD image on the ND with the ECAM/ND transfer.
This is the DUAL DISPLAY mode.



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SYSTEM DISPLAY (SD)

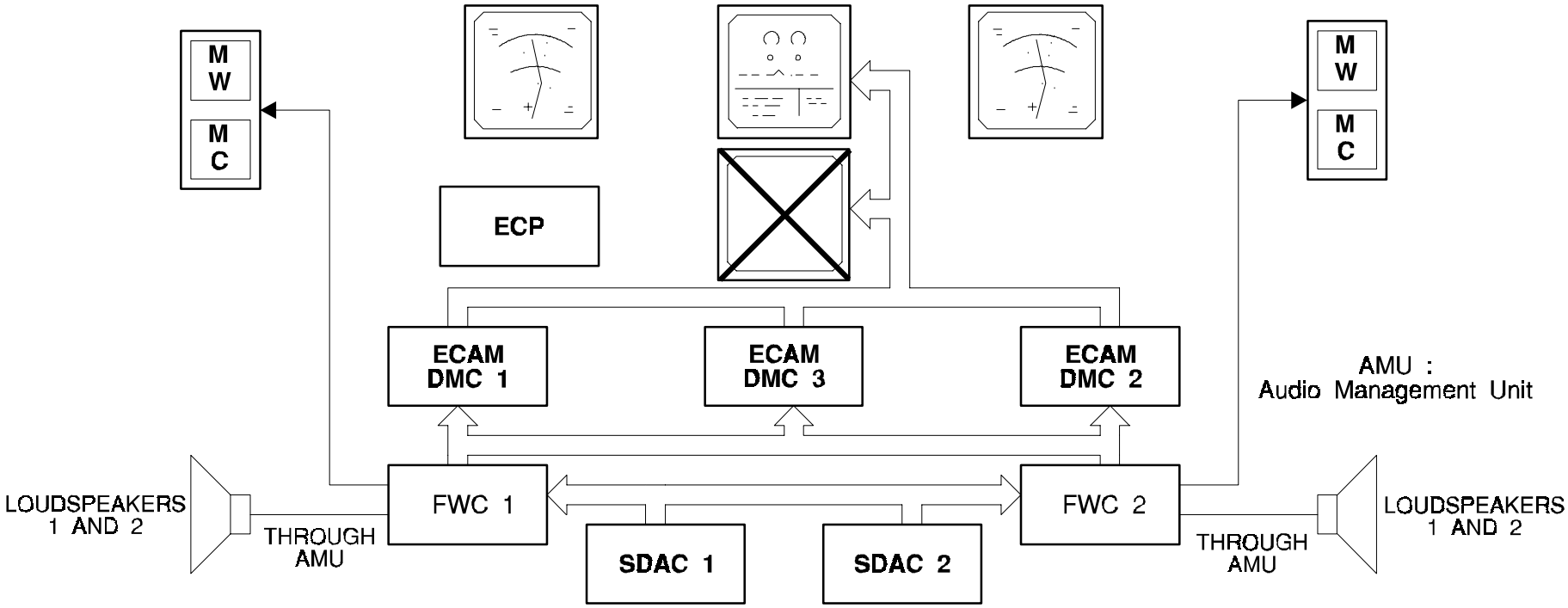
If the System Display Unit fails or is switched off, the Engine Warning Display image takes over the presentation of ECAM displays as previously described in the SINGLE DISPLAY mode.

The crew can display :

1 - the SD image on the upper DU with the ECAM Control Panel.
2 - the SD image on the ND with the ECAM/ND transfer, to be in DUAL DISPLAY mode.

E/WD + SD

If both ECAM Display Units fail or are switched off, the crew can display the Engine Warning Display image on the Navigation Display Unit with the ECAM/ND transfer.
As the system is in SINGLE DISPLAY mode, the SD image can be displayed on the ND with the ECAM Control Panel.



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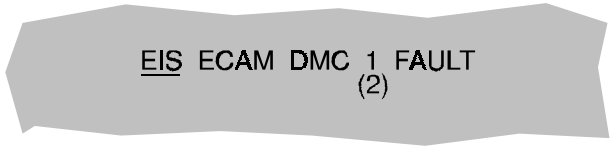
DISPLAY MANAGEMENT COMPUTER (DMC) 1 or 2

A DMC1 or DMC2 failure does not affect the ECAM Display Units as it is not used in normal configuration.

A caution message appears at the bottom of the E/WD :

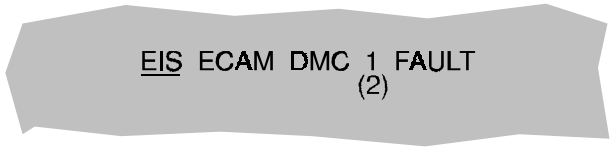


There is no action to perform.

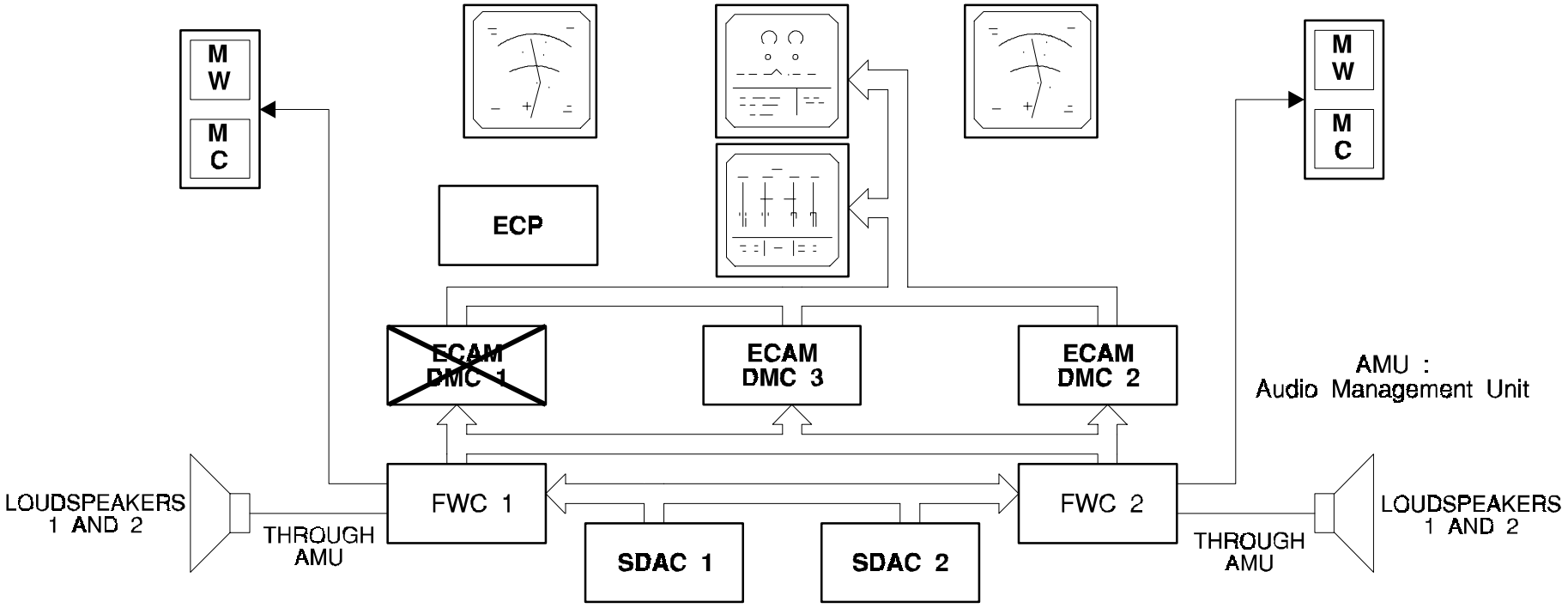
DMC1 + DMC2

The ECAM Display Units are not affected by the failure provided the ECAM switching DMC selector is in AUTO position, or in 3 position.

A caution message appears at the bottom of the E/WD :



There is no action to perform.



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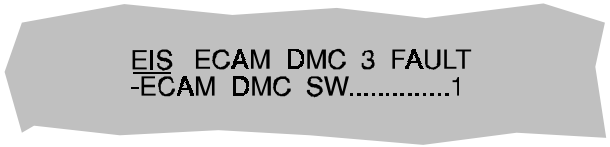
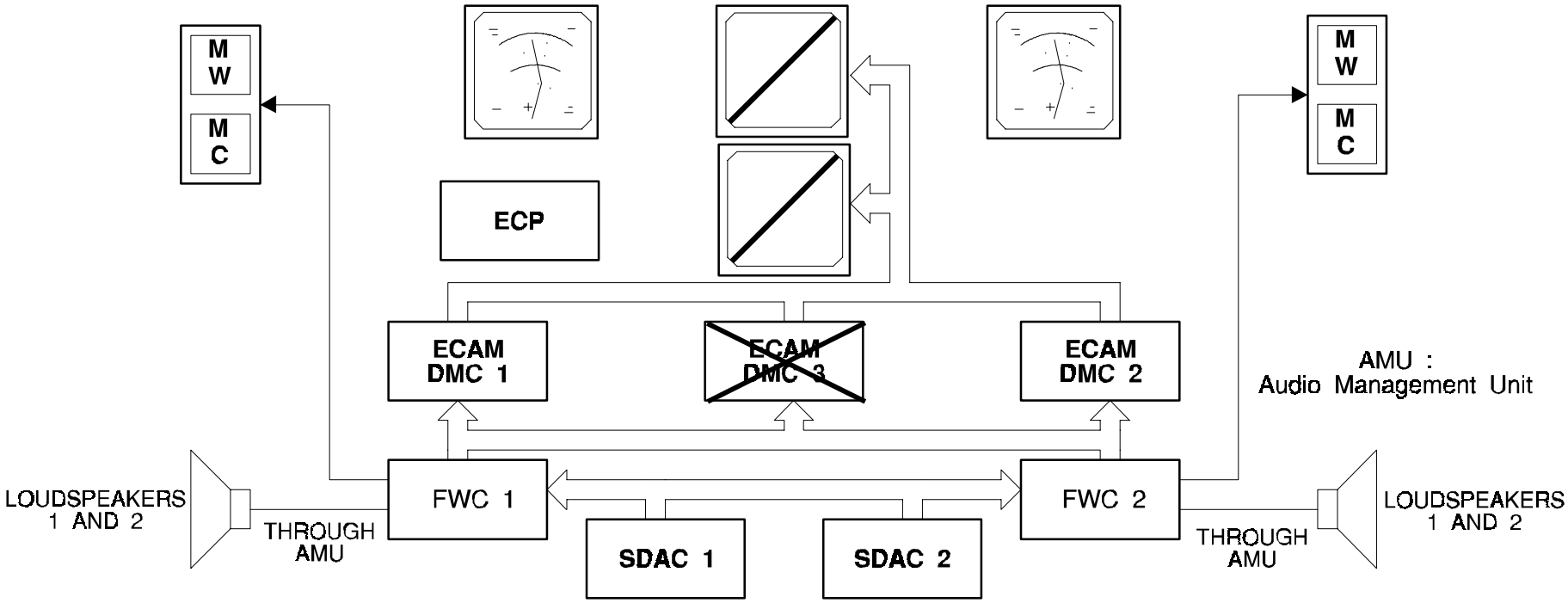
DMC3

If DMC3 fails, the ECAM Display Units are temporarily affected by the failure as DMC1 takes over automatically one second after, provided the ECAM switching DMC is in AUTO position.

A caution message appears at the bottom of the E/WD after the automatic switching.



The crew must manually confirm the selection of DMC1.



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DMC3 + DMC1

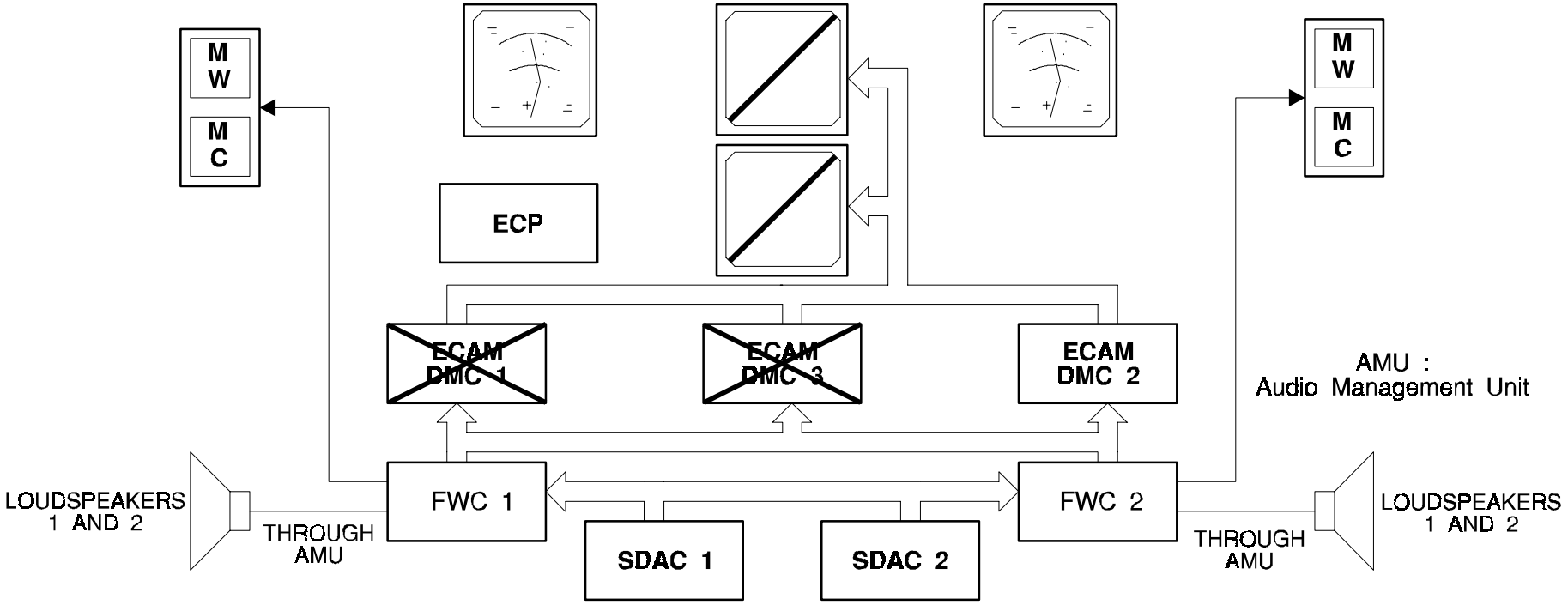
The ECAM Display Units are affected by the failure but they can be recovered provided the ECAM switching DMC selector is in DMC 2 position.

A caution message appears at the bottom of the E/WD when the crew has switched to DMC 2.

DMC3 + DMC2

The ECAM Display Units are affected by the failure but they can be recovered provided the ECAM switching DMC selector is in DMC 1 position.

A caution message appears at the bottom of the E/WD when the crew has switched to DMC 1.



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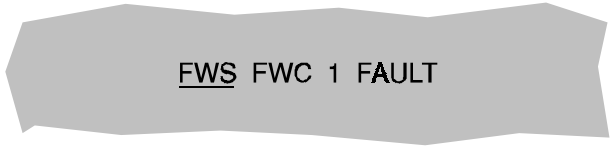
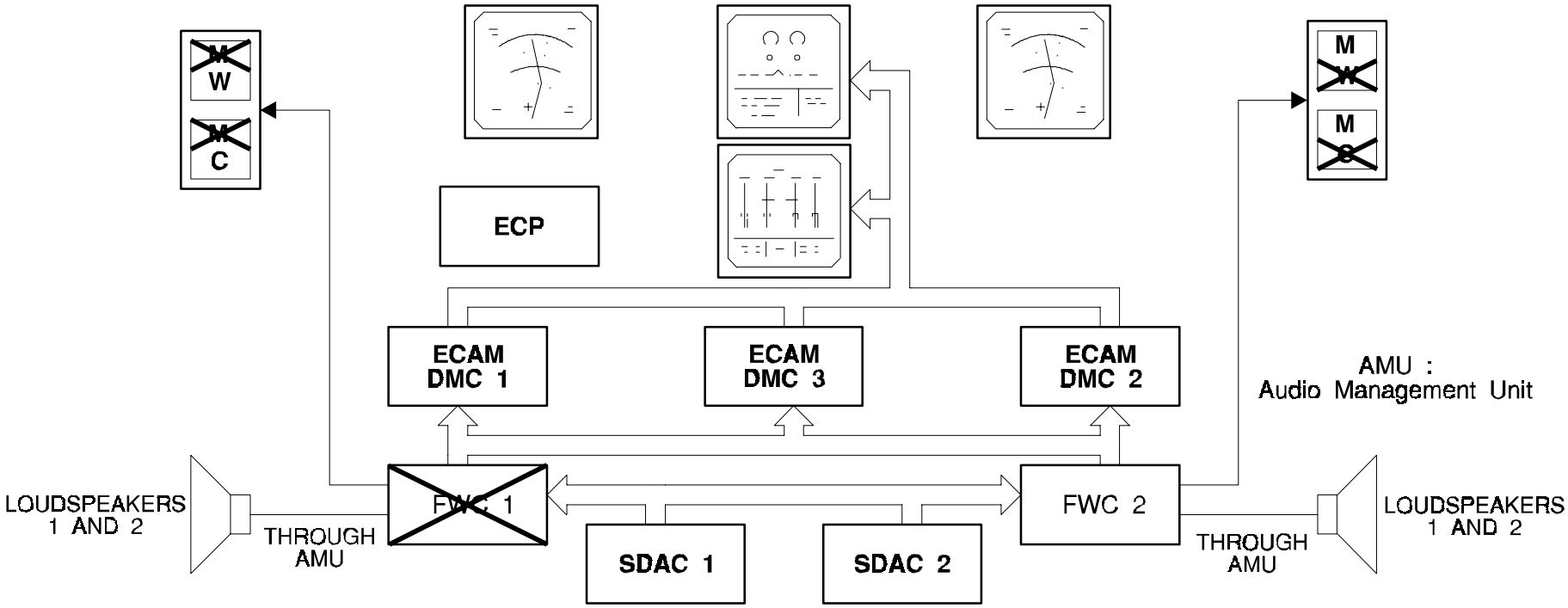
FLIGHT WARNING COMPUTER (FWC) 1

If FWC1 fails, FWC2 takes over automatically. Half of the bulbs in each Master Warning and Master Caution annunciator are lost.

A caution message appears at the bottom of the E/WD :





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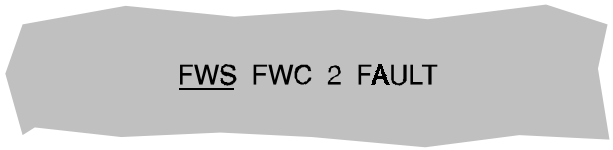
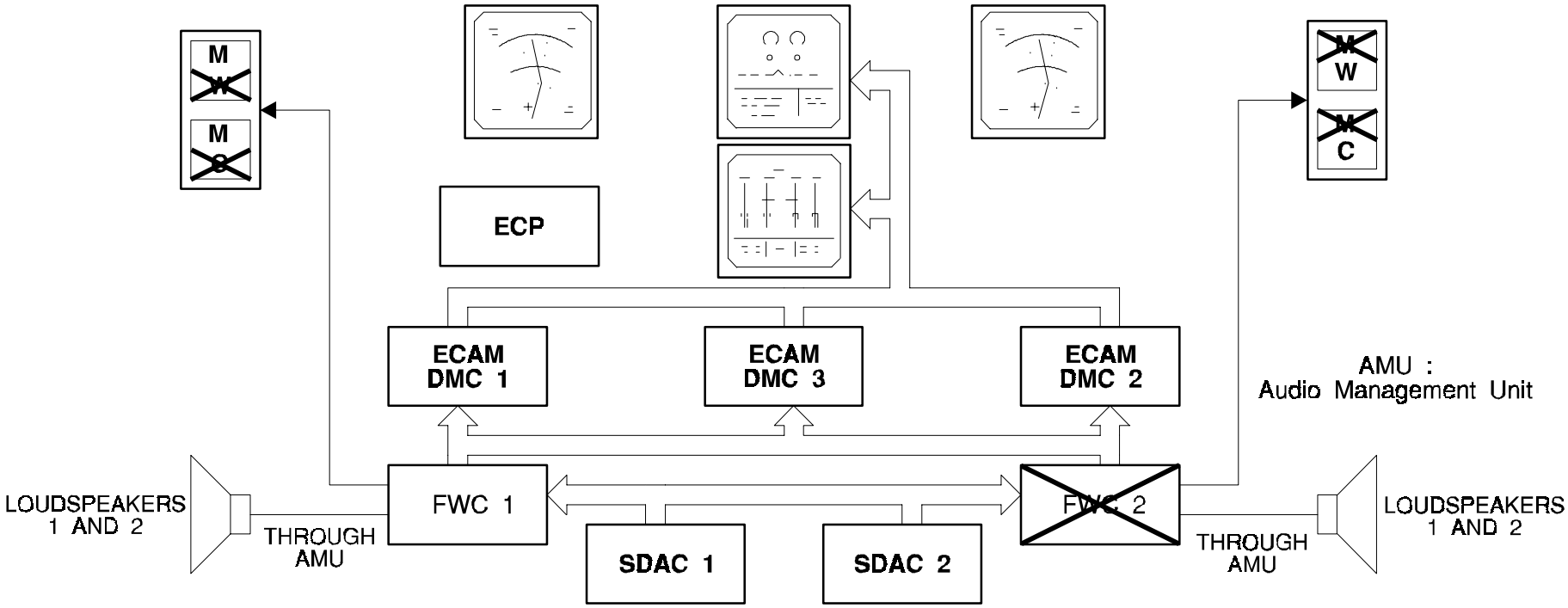
FWC2

If FWC2 fails, FWC1 takes over automatically. Half of the bulbs in each Master Warning and Master Caution annunciator are lost.

A caution message appears at the bottom of the E/WD :





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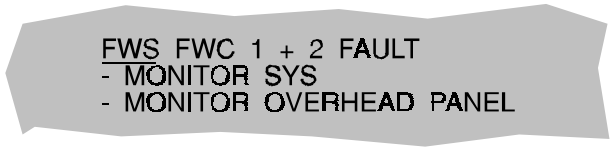
FWC1 + FWC2

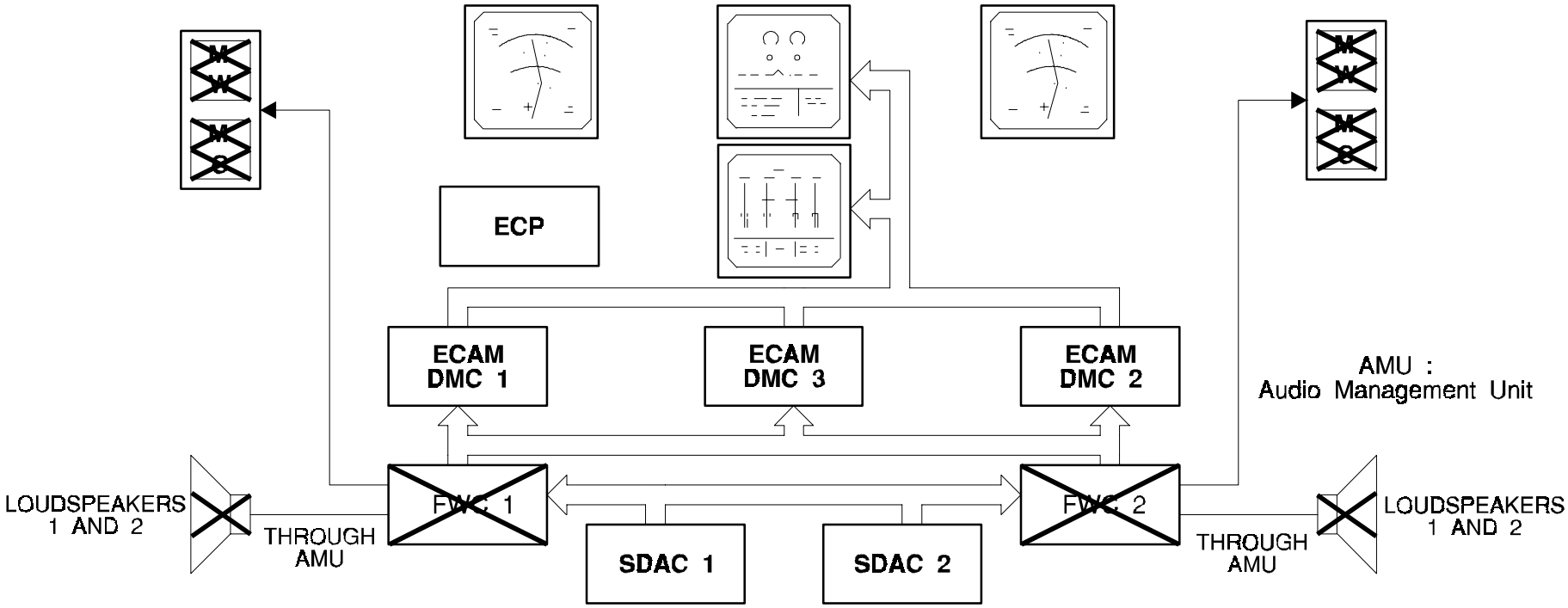
After the loss of both FWCs, the ECAM warnings are not available as well as :

- altitude alert,
- status,
- auto call out,
- memo.

A caution message appears at the bottom of the E/WD.



The SD is still available and must be used for system checks.

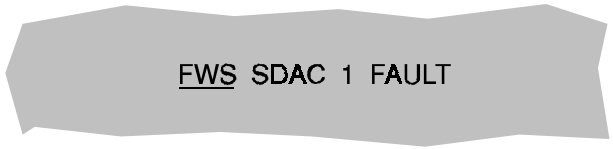


FQW4200 GE Metric

SYSTEM DATA ACQUISITION CONCENTRATOR (SDAC) 1

If SDAC1 fails, SDAC2 takes over automatically.

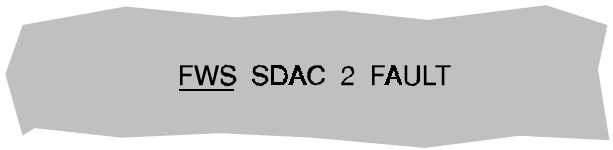
A caution message appears at the bottom of the E/WD :



SDAC 2

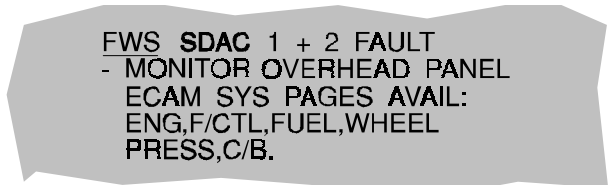
If SDAC2 fails, SDAC1 takes over automatically.

A caution message appears at the bottom of the E/WD :



SDAC1 + SDAC2

After the loss of both SDACs, most of the amber caution messages are lost but all red messages are still available on the Engine Warning Displays. On the System Display Unit, some system pages are still available.
A caution message appears at the bottom of the E/WD.

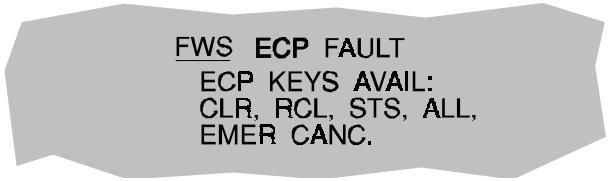


ECAM CONTROL PANEL

In case of ECAM Control Panel failure, some functions remain available. They are :

All,
Clear,
Recall,
Status,
EMER CANCEL.

A caution message appears at the bottom of the E/WD.



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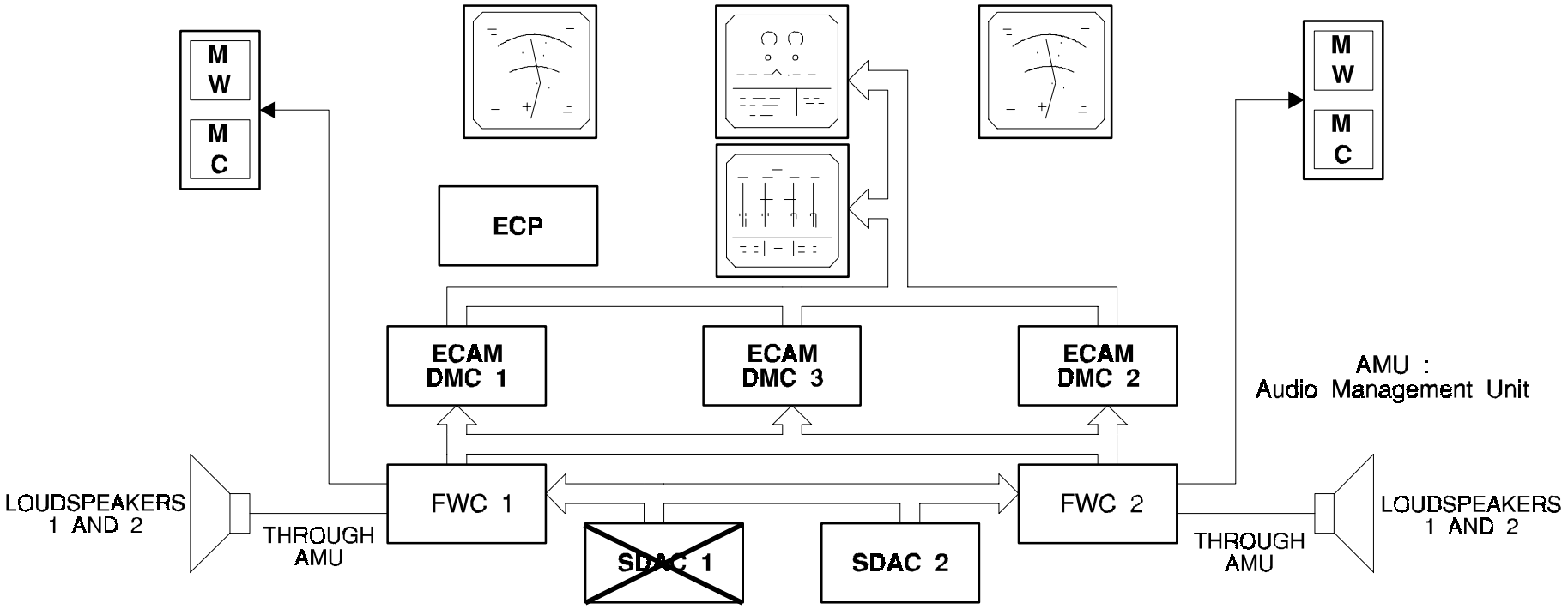


FQW4200 GE Metric

STUDENT NOTES:

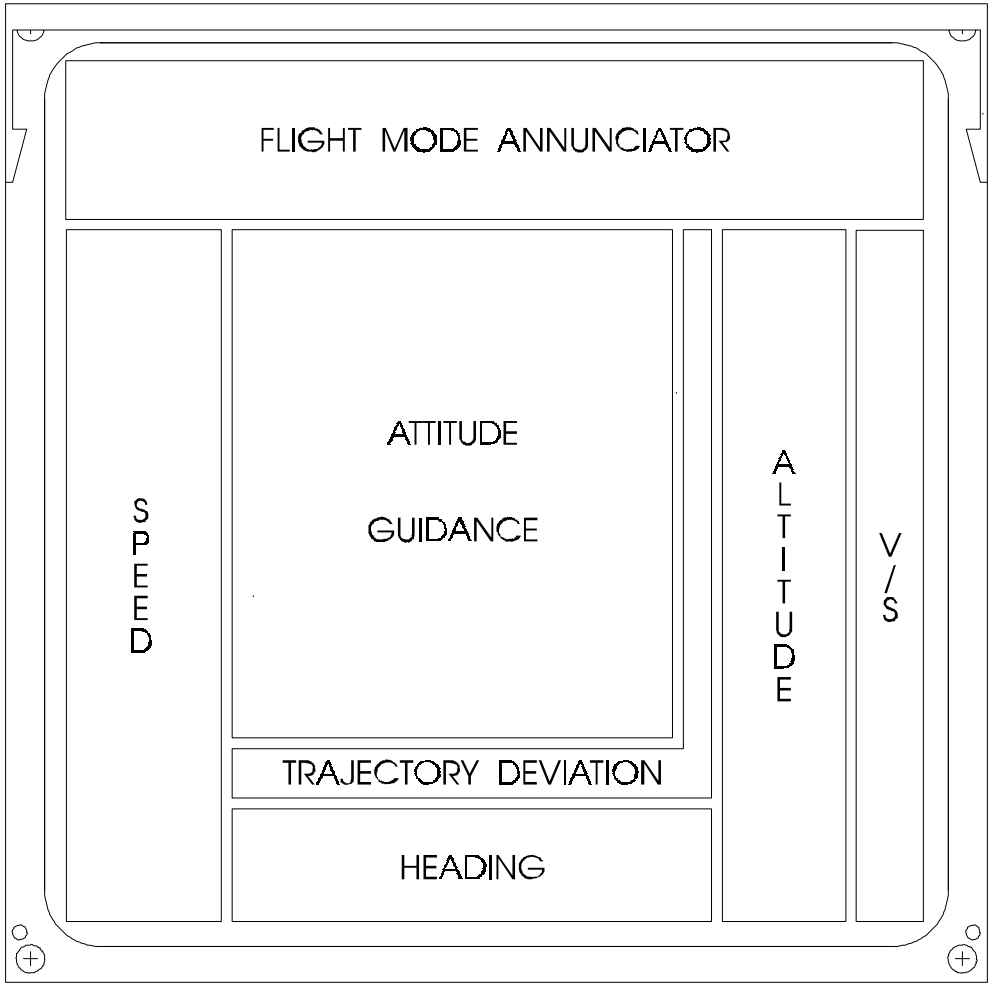
PRIMARY FLIGHT DISPLAY (PFD) PRESENTATION

General
Attitude
Guidance
Speed
Heading
Altitude
Vertical Speed
Trajectory Deviation
Flight Mode Annunciator (FMA)

GENERAL

The Primary Flight Display (PFD) is presented in front of each pilot, on the outer display unit.

The PFD presents short term information necessary for the flight.
It is divided into 7 zones.



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ATTITUDE

The Attitude is indicated in the middle of the Display Unit, in the shape of a cut sphere window which looks like a conventional Attitude Direction Indicator.

The Attitude area presents :

- A/C symbol, Pitch and Roll indications, Flight path, drift angles...

GUIDANCE

Guidance symbols may be superposed on the Attitude sphere.

SPEED

The Air Speed Scale contains all the Air Speed data displayed on a conventional Air Speed Indicator plus significant limits, protection and target speeds.

HEADING

The Heading Scale displays the aicraft actual Heading and Track.

ALTITUDE

The Altitude Scale presents the Altitude according to a baro reference setting.

VERTICAL SPEED

Next to the Altitude, the Vertical Speed is displayed.

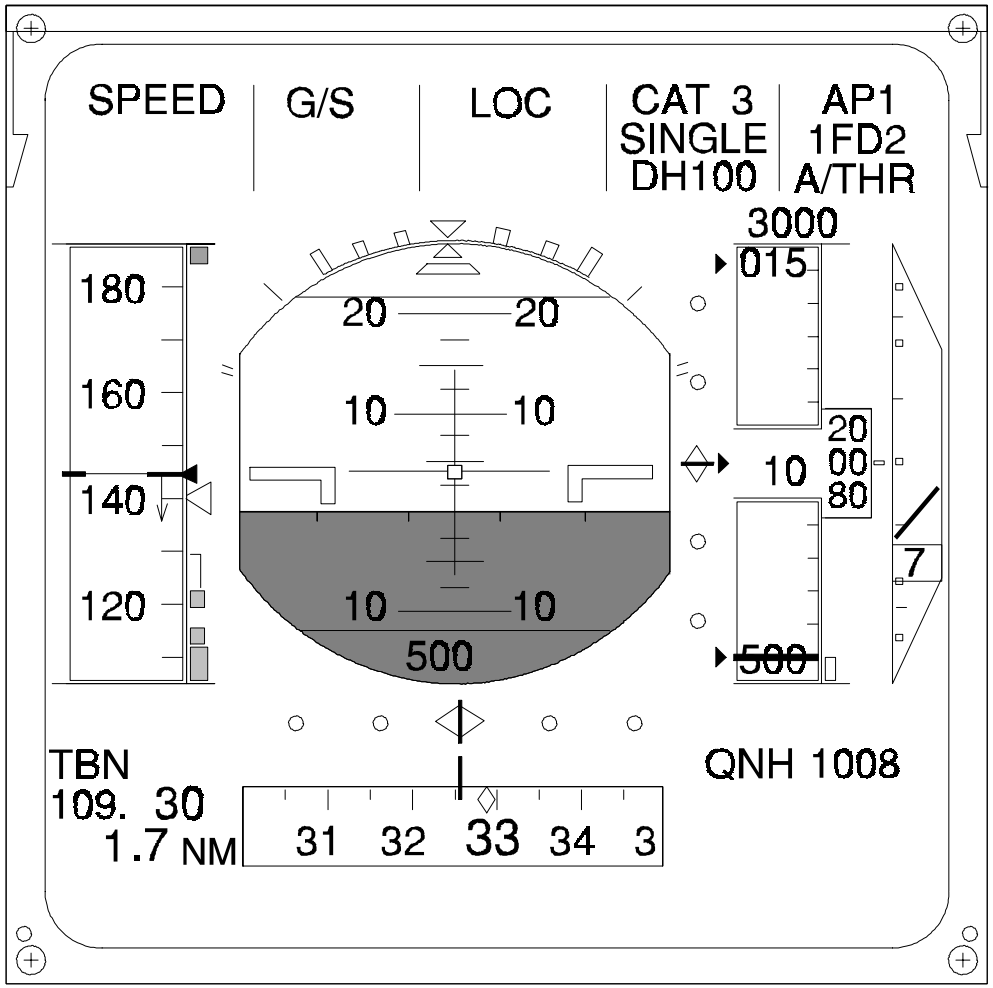
TRAJECTORY DEVIATION

For approach, the Trajectory Deviation is presented on the right, and at the bottom of the Attitude area.

ILS and DME information appear below the speed scale.

FLIGHT MODE ANNUNCIATOR (FMA)

The Flight Mode Annunciator provides the pilot with the various armed and active Automatic Flight System modes.



FQW4200 GE Metric

STUDENT NOTES

NAVIGATION DISPLAY (ND) PRESENTATION

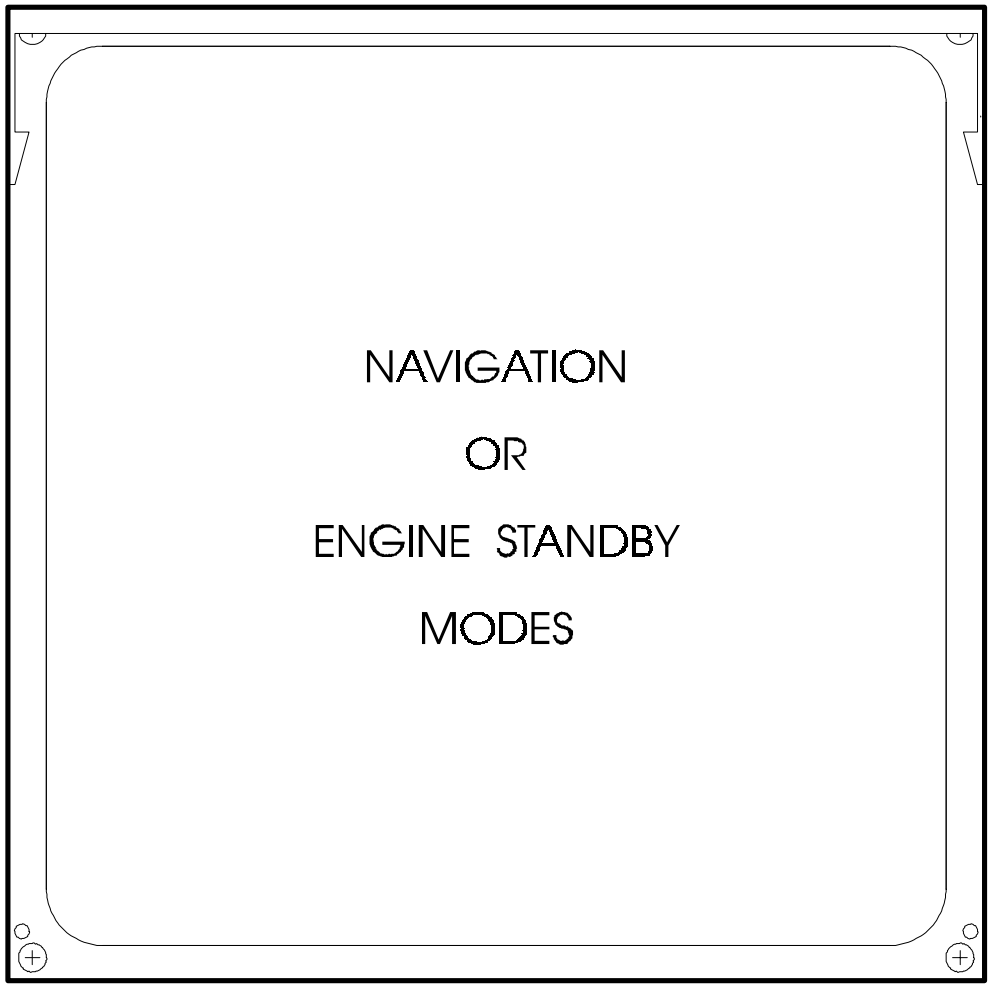
General
Rose ILS
Rose VOR
Rose NAV
Arc
Plan
Engine Standby

GENERAL

The Navigation Display presents medium term information through 5 different modes.
In addition, an Engine Standby mode is also available.

Here are the different modes selectable by the crew :

- Rose ILS
- Rose VOR
- Rose NAV
- Arc
- Plan
- Engine standby

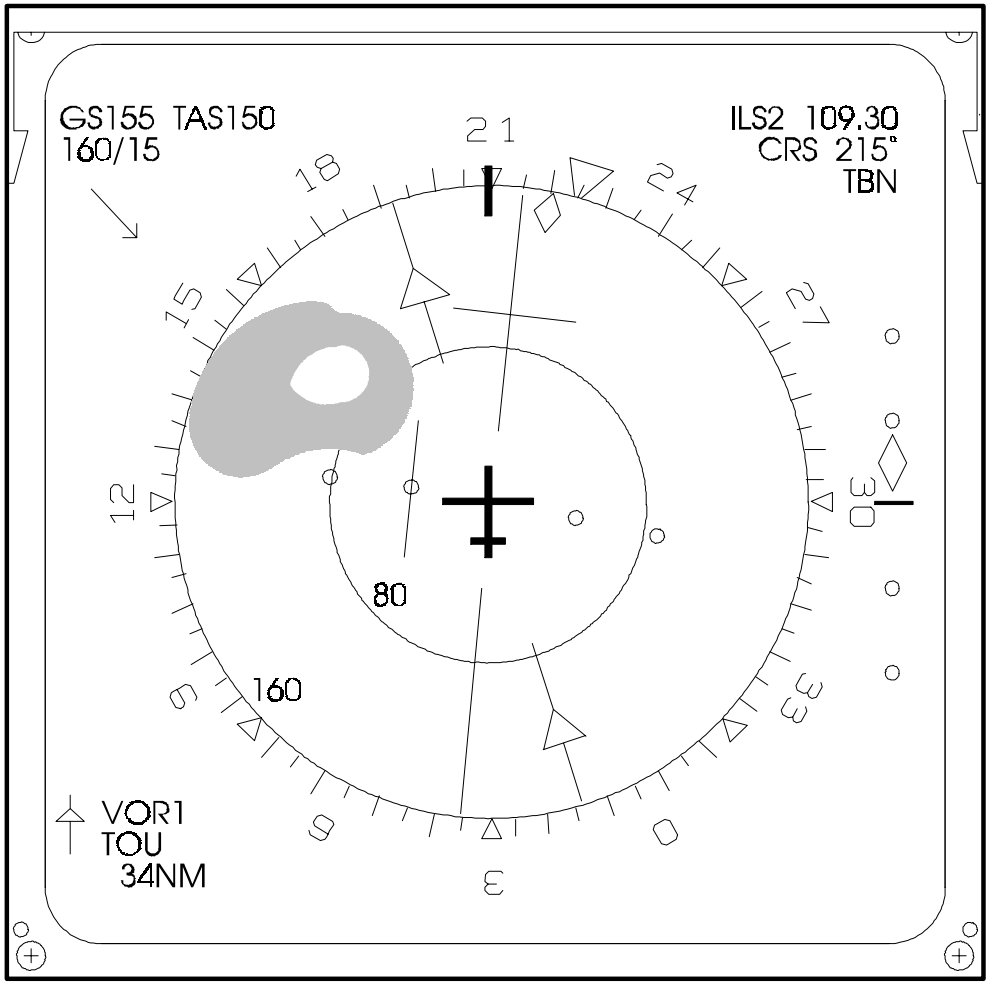


ROSE ILS

The Rose ILS mode is a basical Rose VOR display with ILS data added. No flight plan is represented.

In Rose ILS mode, the Navigation Display shows data related to the ILS :

- Loc deviation,
- Glide slope deviation and,
- ILS station characteristics.



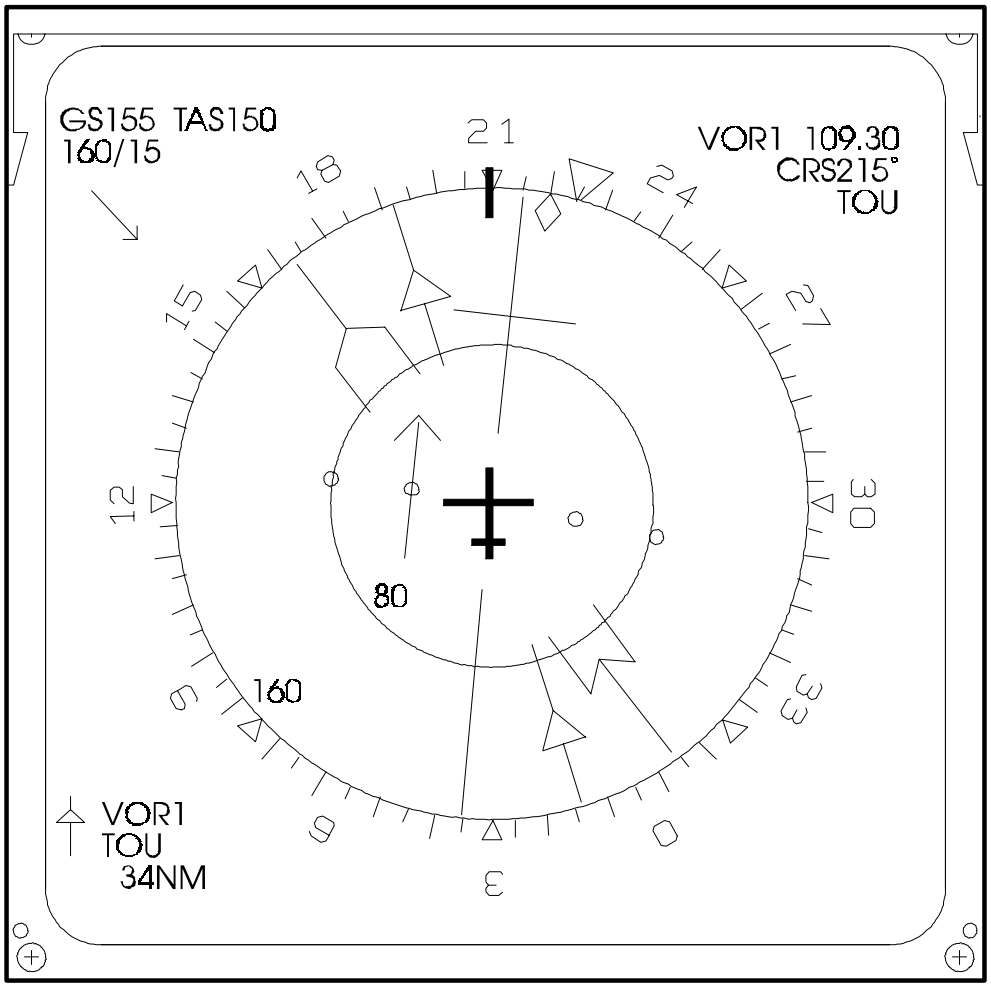
FQW4200 GE Metric

ROSE VOR

The Rose VOR mode provides a display similar to a conventional Horizontal Situation Indicator with additional information.
No flight plan appears.

Additional information presented are :

- Navigation station characteristics
- Ground Speed and True AirSpeed
- Selected track
- Wind data
- Weather Radar...



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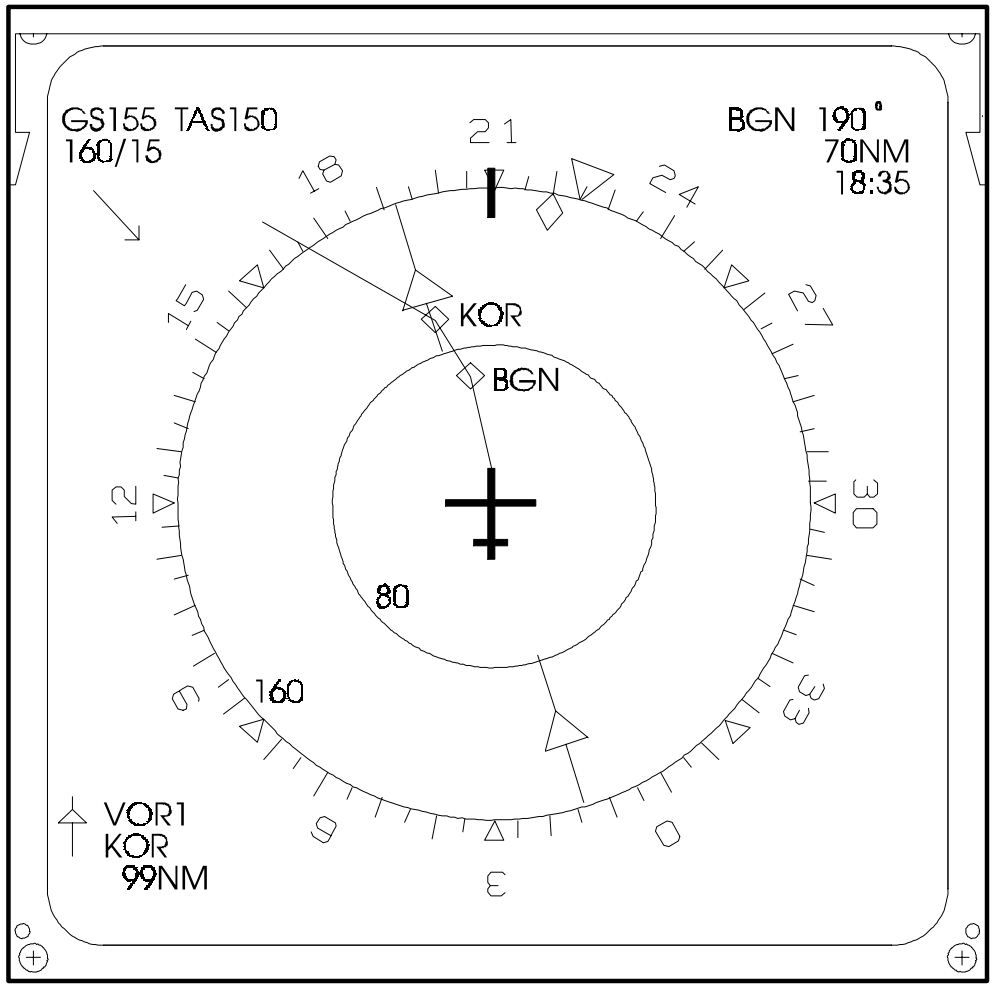
ROSE NAVIGATION

The Rose Navigation mode is the Rose VOR mode on which the flight plan and associated waypoints are superposed.

The flight plan is provided by the FMGEC (Flight Management Guidance and Envelope Computer).

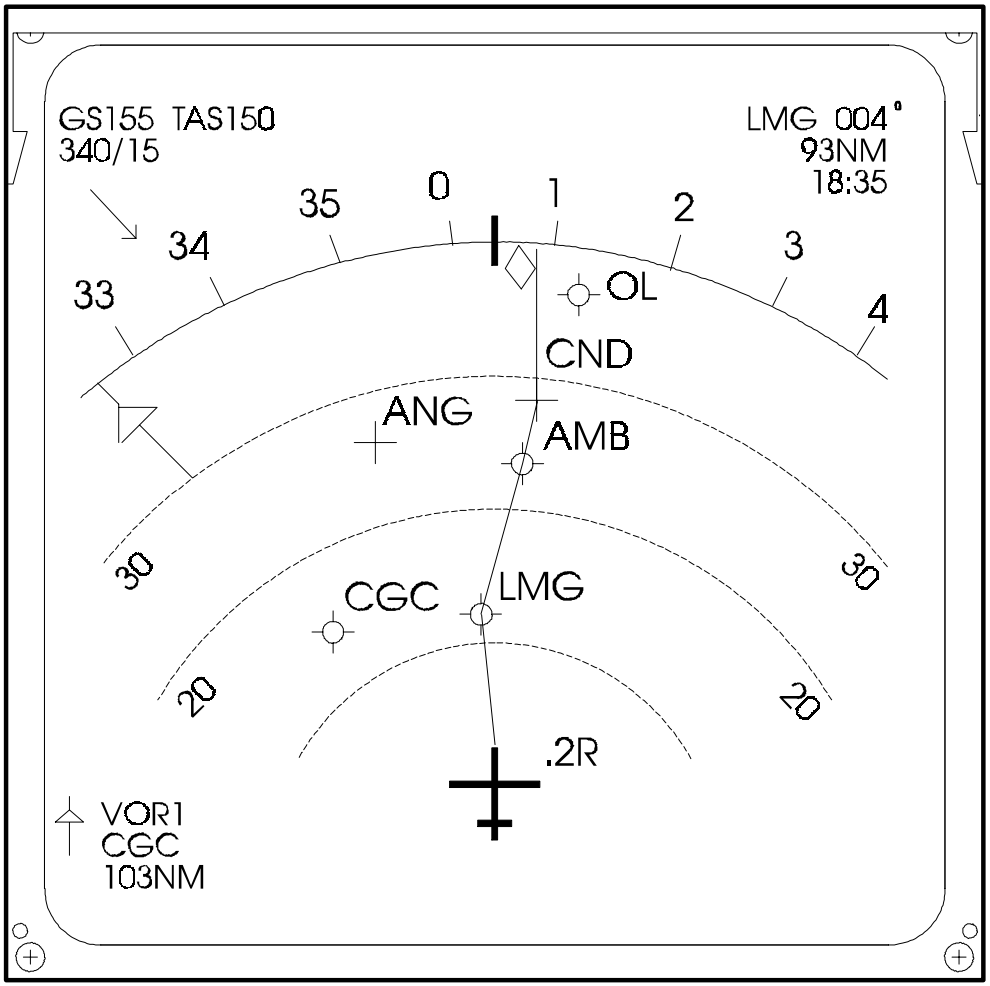


FQW4200 GE Metric

ARC

The ARC mode presents a 90 degrees sector in front of the aircraft.
In this sector the navigation flight plan and the waypoints are displayed.

On the top of the display, Ground speed, True airspeed, Wind data and navigation waypoint characteristics are shown.



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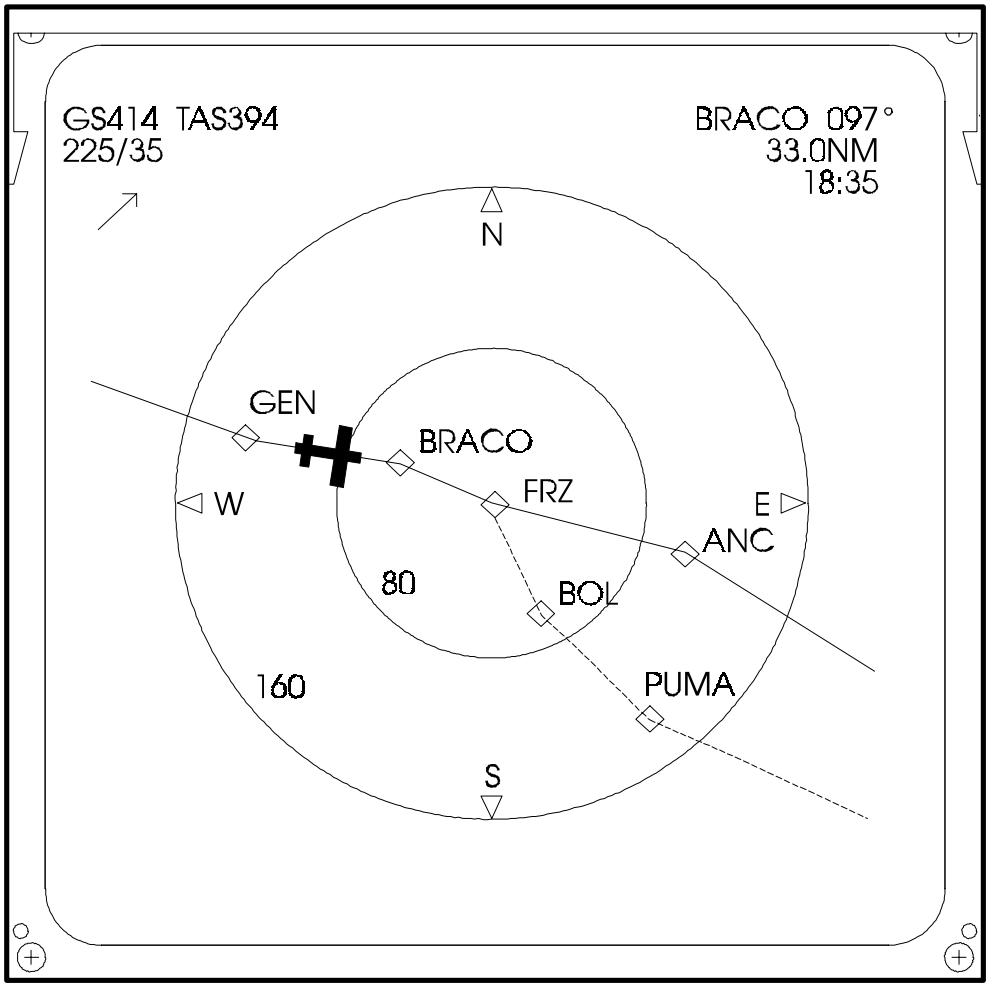
PLAN

In PLAN mode, the flight plan is orientated with respect to the true north. Any waypoint of the flight plan can be positioned in the center of the display.

Course pointers, Weather radar and heading dial are not displayed.



FQW4200 GE Metric

ENGINE STANDBY

Engine Standby mode is avalaible for displaying engine primary parameters in case of complete ECAM Display Management Computer failure.

The engine parameters are indentical to those presented on the Engine/Warning Display.

Note : this page is provided by the EFIS part of the Display Management Computer.

EFIS DESCRIPTION AND OPERATION

GENERAL

The Electronic Flight Instrument System (EFIS) performs three main functions :

- data acquisition,
- data processing,
- data display for both Captain and First Officer.

Acquisition and processing are achieved by the Display Management Computers (DMCs), and data display by the Primary Flight Displays (PFDs) and Navigation Displays (NDs).

DISPLAY MANAGEMENT COMPUTER (DMC)

The three DMCs are identical and interchangeable.
They receive data from the aircraft systems, decode and process it so that it can be displayed on the EFIS displays.

The EFIS part is independent from the Electronic Centralized Aircraft Monitoring (ECAM) part and has its own :

- power supply module,
- acquisition module, and processing channel.

The three DMCs receive aircraft system data on Aeronautical Radio INCorporated (ARINC) 429 buses, and weather radar information on ARINC 453 high speed bus.

They also acquire some discretes (for example : reconfiguration of the DUs).

They send data to the PFDs and NDs through a Master Dedicated Serial Data Link (DSDL), and weather radar information through specific RS422 buses.

The DMCs are provided with two On Board Replaceable Modules (OBRMs) and two Built In Test Equipment (BITEs) for software modifications and maintenance operations.

ELECTRONIC FLIGHT INSTRUMENT SYSTEM (EFIS) CONTROL PANEL

The EFIS Control Panels, which are part of the Flight Control Unit, are linked to the DMCs by ARINC 429 buses.

The captain EFIS Control Panel supplies DMC1 and DMC3, whereas the First Officer EFIS Control Panel supplies DMC2 and DMC3.

DISPLAY UNIT

The Display Units (DUs) are identical and interchangeable.

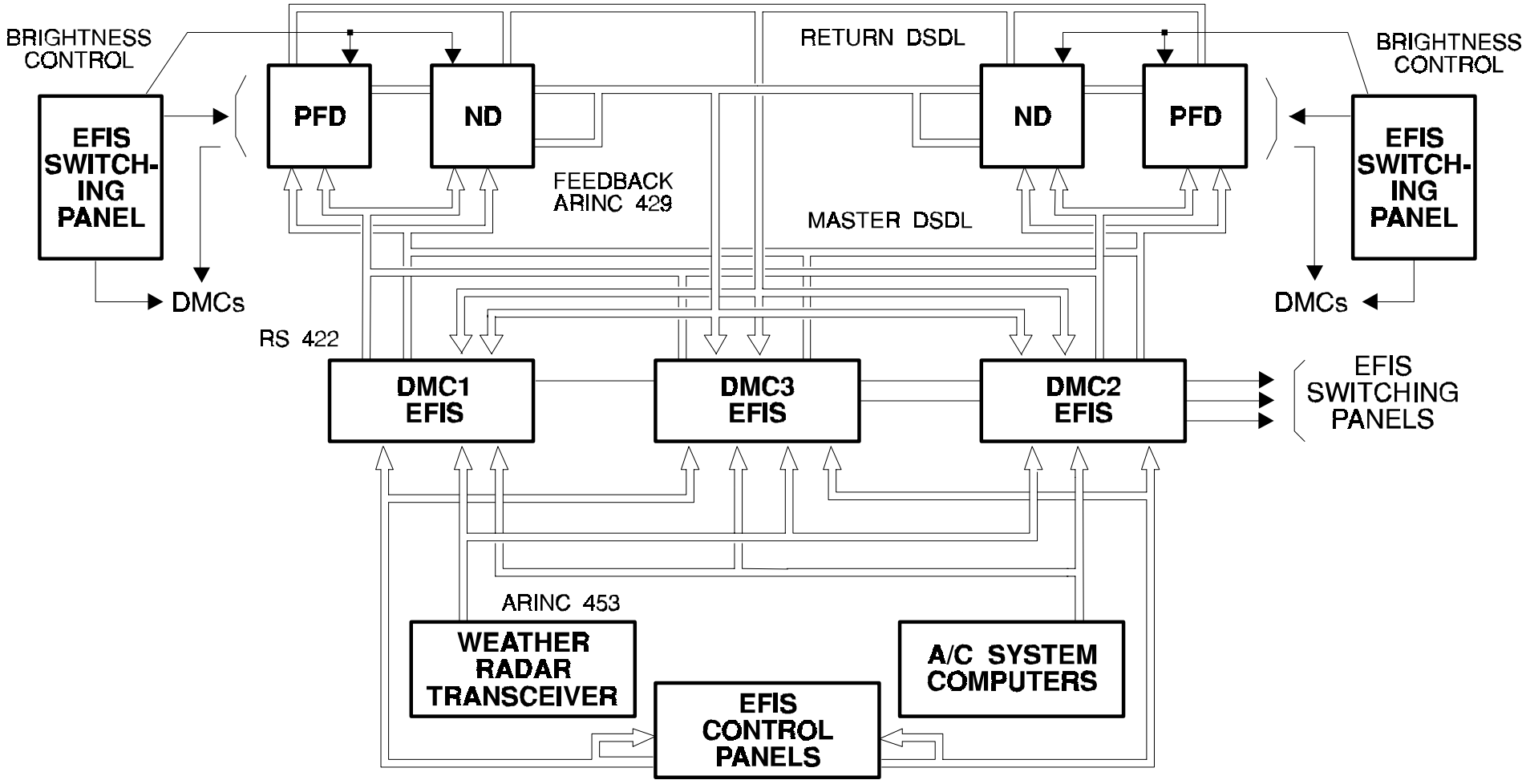
Each DU receives digital signals from its related DMC through a Master DSDL and also through a particular RS422 bus for the weather radar link (WXR), and analog and discrete signals from the EFIS switching panels.
The Master DSDL transmits the drawing parameters and re-initialization of the DUs.

In turn, the display units send back to their driving DMC some feedback signals.

The feedback signals are sent to the DMCs through :

- one DSDL for acknowledgment signals and DU failure information,

- one ARINC 429 for critical parameter feedback signals:
  pitch and roll angles, altitude, heading, aircraft position.



FQW4200 GE Metric

STUDENT NOTES:

ELECTRONIC FLIGHT INSTRUMENT SYSTEM (EFIS) ABNORMAL OPERATION

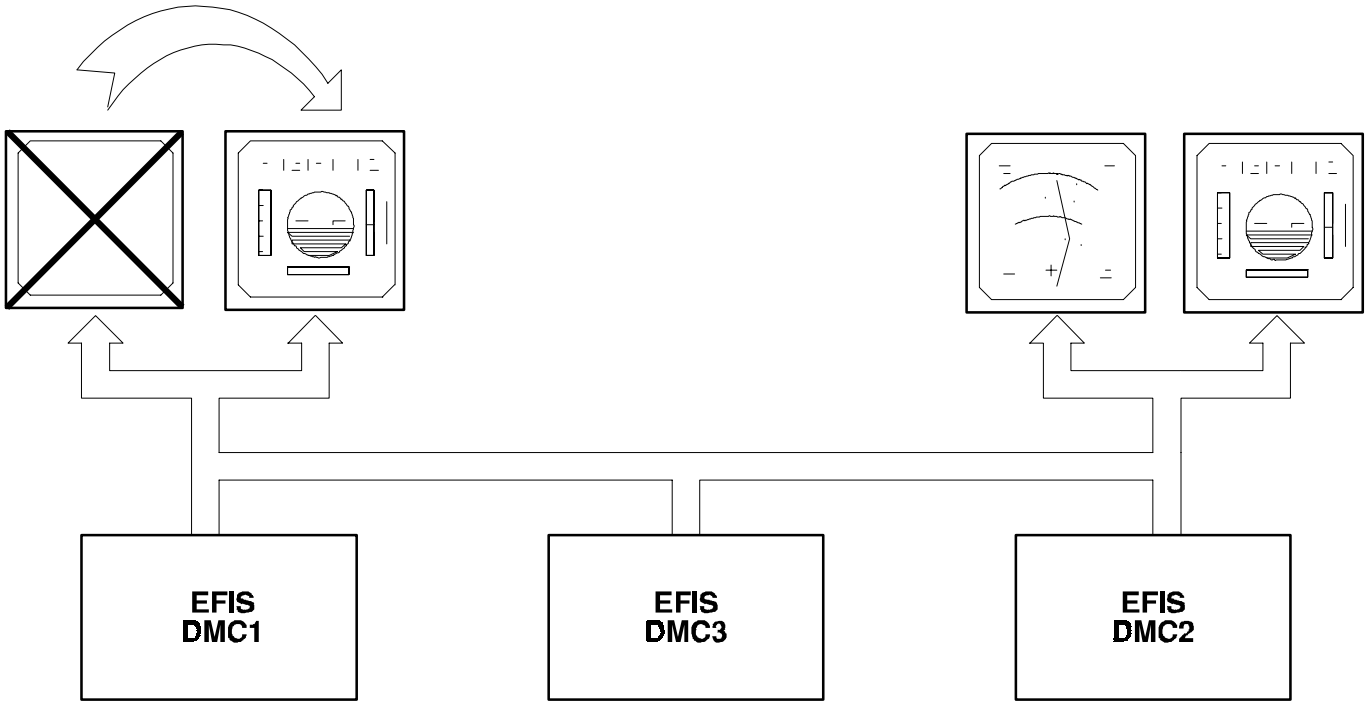
Primary Flight Display (PFD)
Navigation Display (ND)
Display Management Computer (DMC) 1
Display Management Computer (DMC) 2
Display Management Computer (DMC) 3
Display Management Computer (DMC) 1 + DMC 3
Display Management Computer (DMC) 2 + DMC 3
Display Management Computer (DMC) 1 + DMC 2
Display Management Computer (DMC) 1 + DMC 2 + DMC 3
Electronic Flight Instrument System (EFIS) Switching Not Allowed

The topics indicate the failed components.

PRIMARY FLIGHT DISPLAY (PFD)

When the PFD DU fails or is switched off, the PFD image is transferred automatically on the ND DU.

In this case, you can recover the ND image by pushing the PFD/ND transfer pushbutton.



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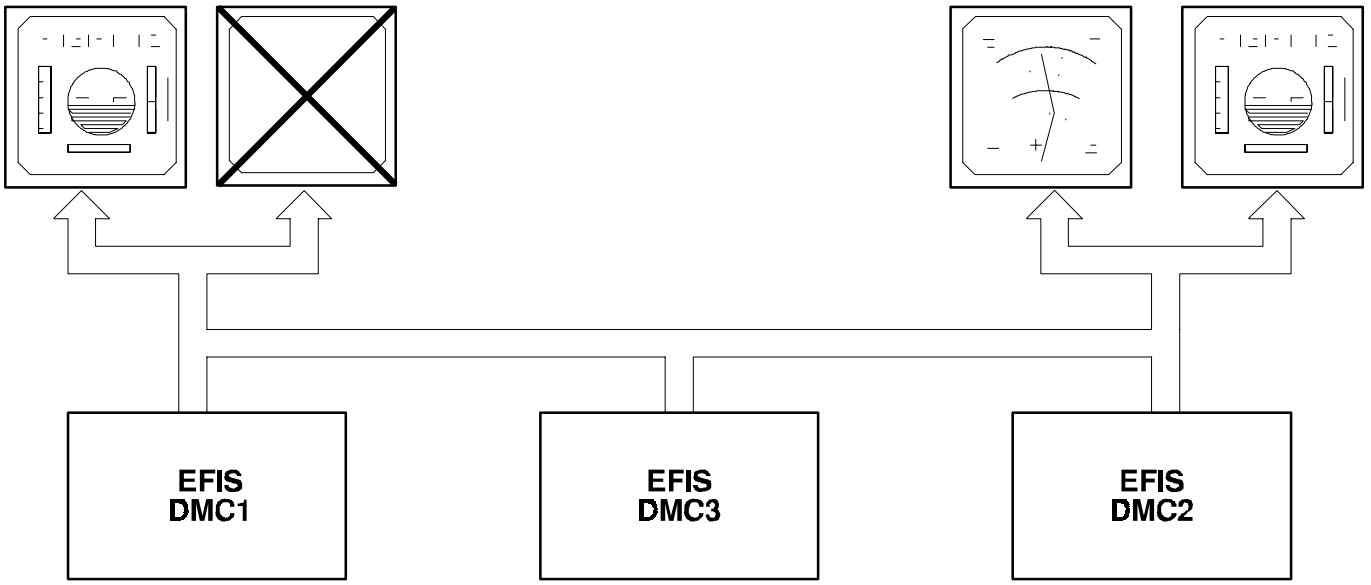
NAVIGATION DISPLAY (ND)

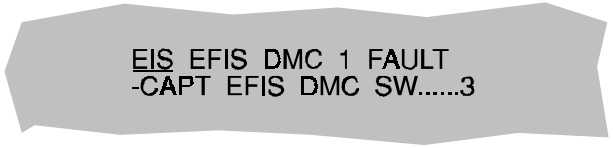
When the ND DU fails or is switched off, the ND image can be manually recovered on the PFD DU by using the PFD/ND transfer pushbutton.

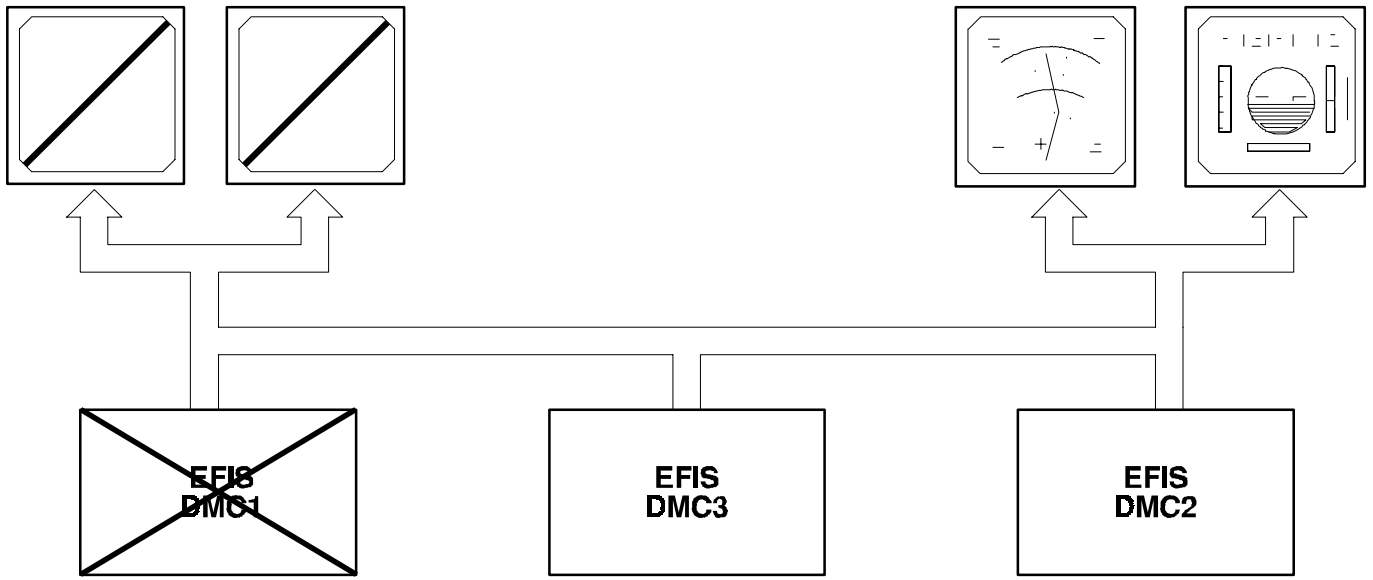


DISPLAY MANAGEMENT COMPUTER (DMC) 1

Captain PFD and ND are affected by the failure in normal configuration.

A caution message appears at the bottom of the EWD :
The Captain must switch to DMC 3.





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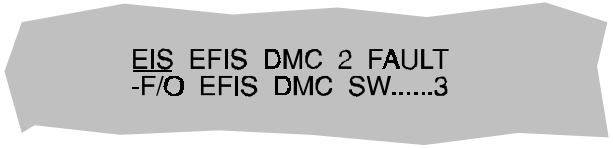
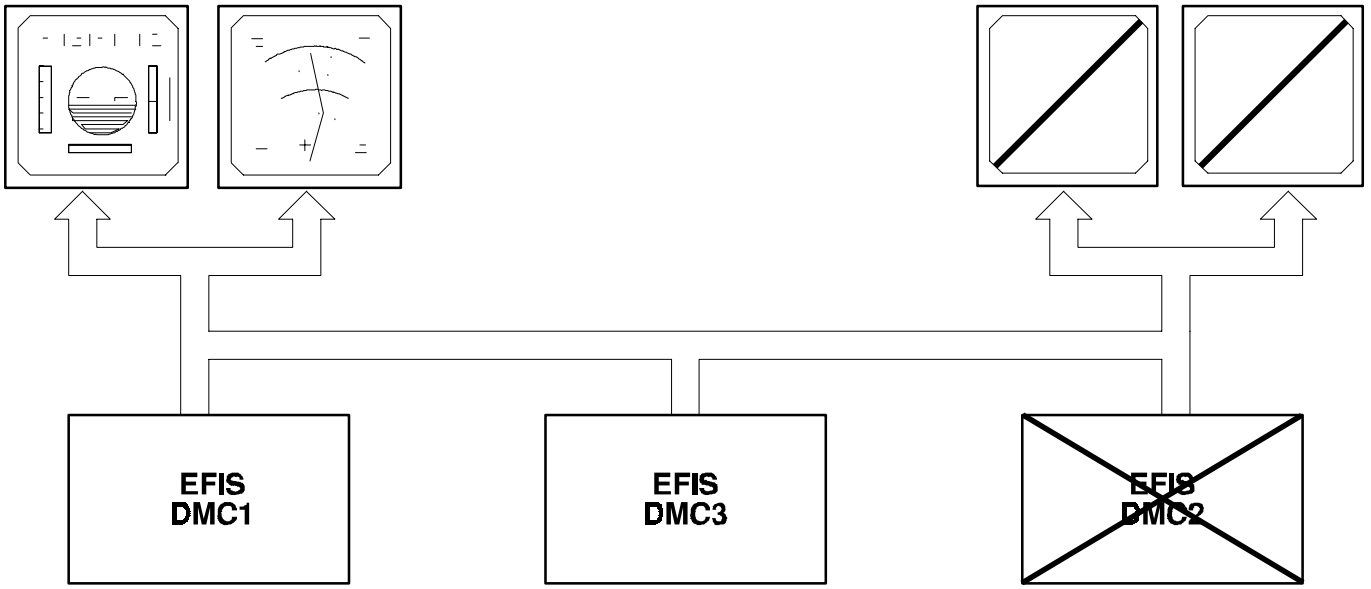
DISPLAY MANAGEMENT COMPUTER (DMC) 2

First Officer PFD and ND are affected by the failure in normal configuration.

A caution message appears at the bottom of the EWD :



The First Officer must switch to DMC 3.

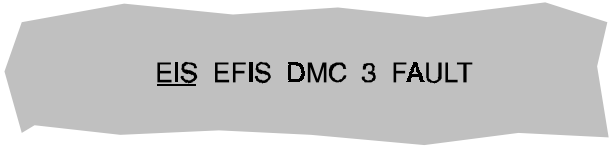


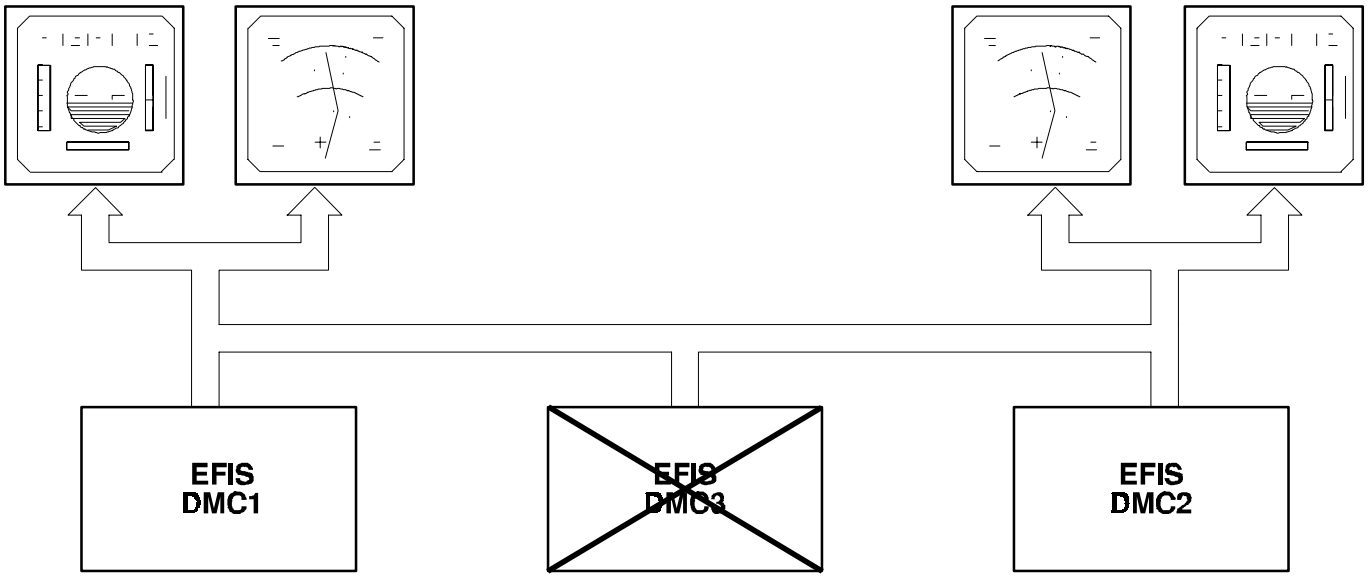
FQW4200 GE Metric

DISPLAY MANAGEMENT COMPUTER (DMC) 3

This failure has no effect on the DUs because the DMC 3 is not used in normal configuration.

A caution message appears at the bottom of the EWD.

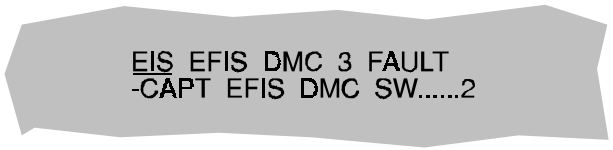




DISPLAY MANAGEMENT COMPUTER (DMC) 1 + DMC 3

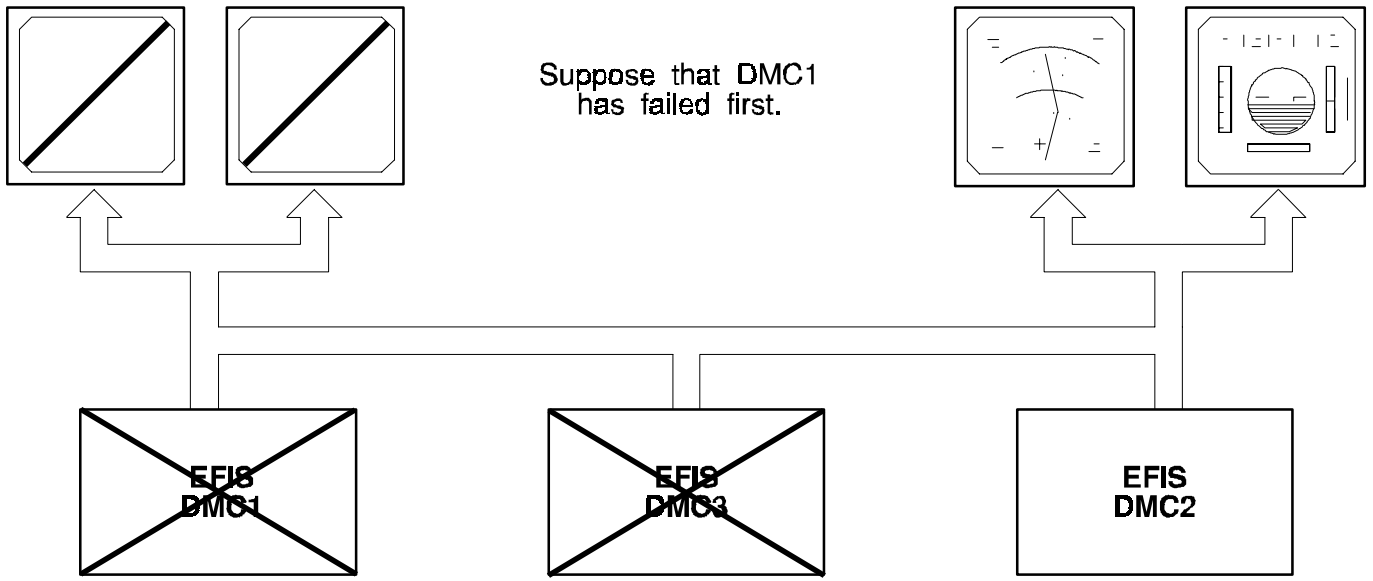
We are under a degraded redundancy, and after the switching, the copy mode takes over.
The "EFIS SINGLE SOURCE 2" message comes into view on the PFD.

A caution message appears at the bottom of the EWD :



The Captain must switch to DMC 2.

"EFIS SINGLE SOURCE 2" means that the data come from the side 2 sources only.



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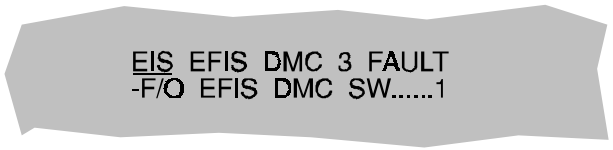
DISPLAY MANAGEMENT COMPUTER (DMC) 2 + DMC 3

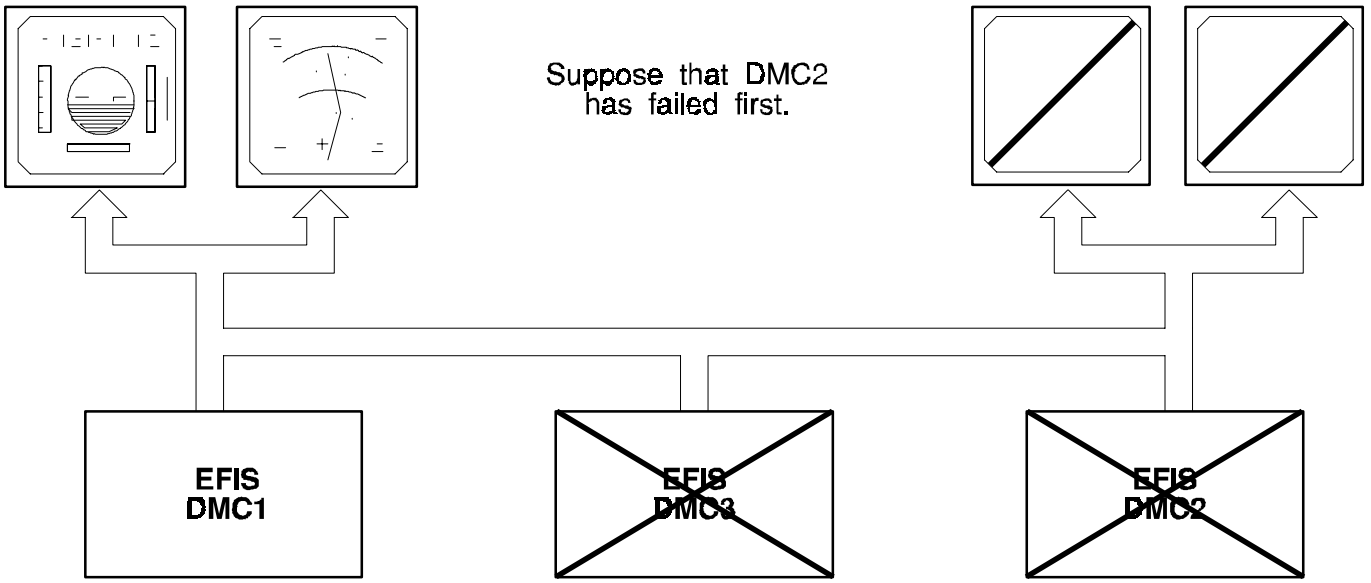
We are under a degraded redundancy, and after the switching, the copy mode takes over.
The "EFIS SINGLE SOURCE 1" message comes into view on the PFD.

A caution message appears at the bottom of the EWD :



The First Officer must switch to DMC 1.

"EFIS SINGLE SOURCE 1" means that the data come from the side 1 sources only.



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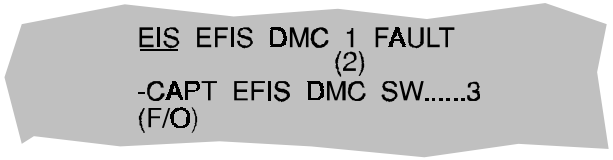
DISPLAY MANAGEMENT COMPUTER (DMC) 1 + DMC 2

We are under a degraded redundancy, and after the switching, the copy mode takes over.
The "EFIS SINGLE SOURCE 1" message comes into view on the PFD.

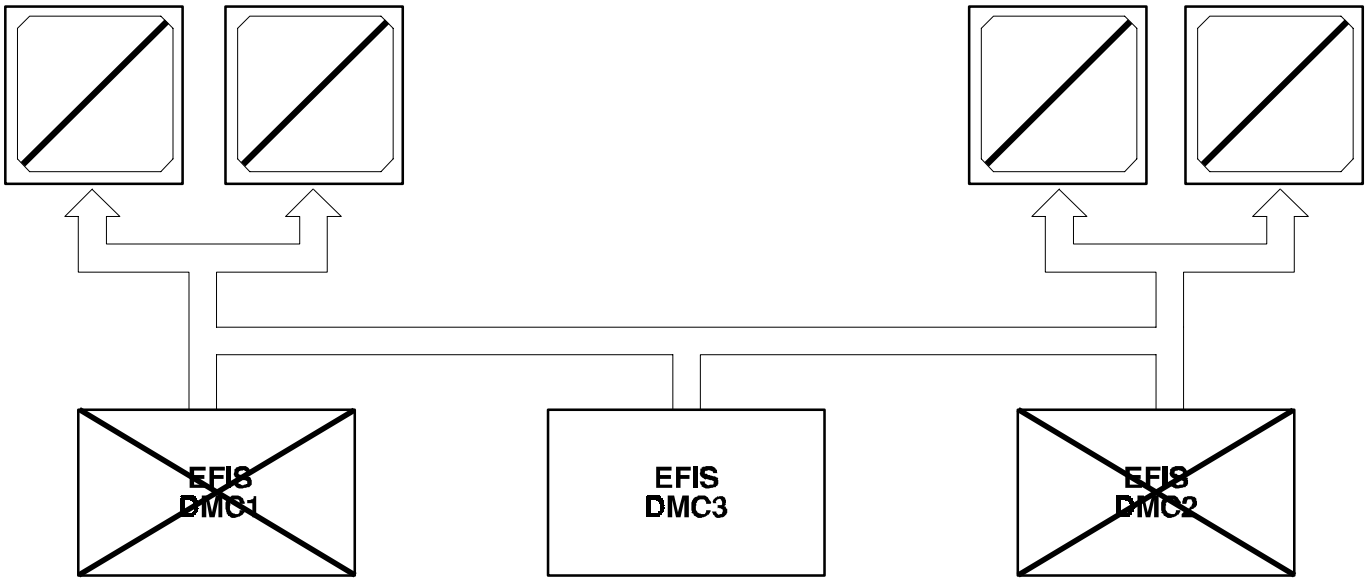
A caution message appears at the bottom of the EWD :



The Captain and the First Officer must switch to DMC 3.

DISPLAY MANAGEMENT COMPUTER (DMC) 1 + DMC 2 + DMC 3

The PFDs and NDs are no longer available. The crew uses standby indicators.



ELECTRONIC FLIGHT INSTRUMENT SYSTEM (EFIS) SWITCHING NOT ALLOWED

Some EFIS switchings are not allowed because they can cause unusual configurations of the system.

CAPT EFIS DMC	F/O EFIS DMC	MESSAGE ON PFD
DMC 2	DMC 1	EFIS SWTG NOT ALLOWED
DMC 2	DMC 3	EFIS SWTG NOT ALLOWED
DMC 3	DMC 1	EFIS SWTG NOT ALLOWED

FQW4200 GE Metric

STUDENT NOTES:

SUTDENT NOTES

EIS DISPLAY SWITCHING

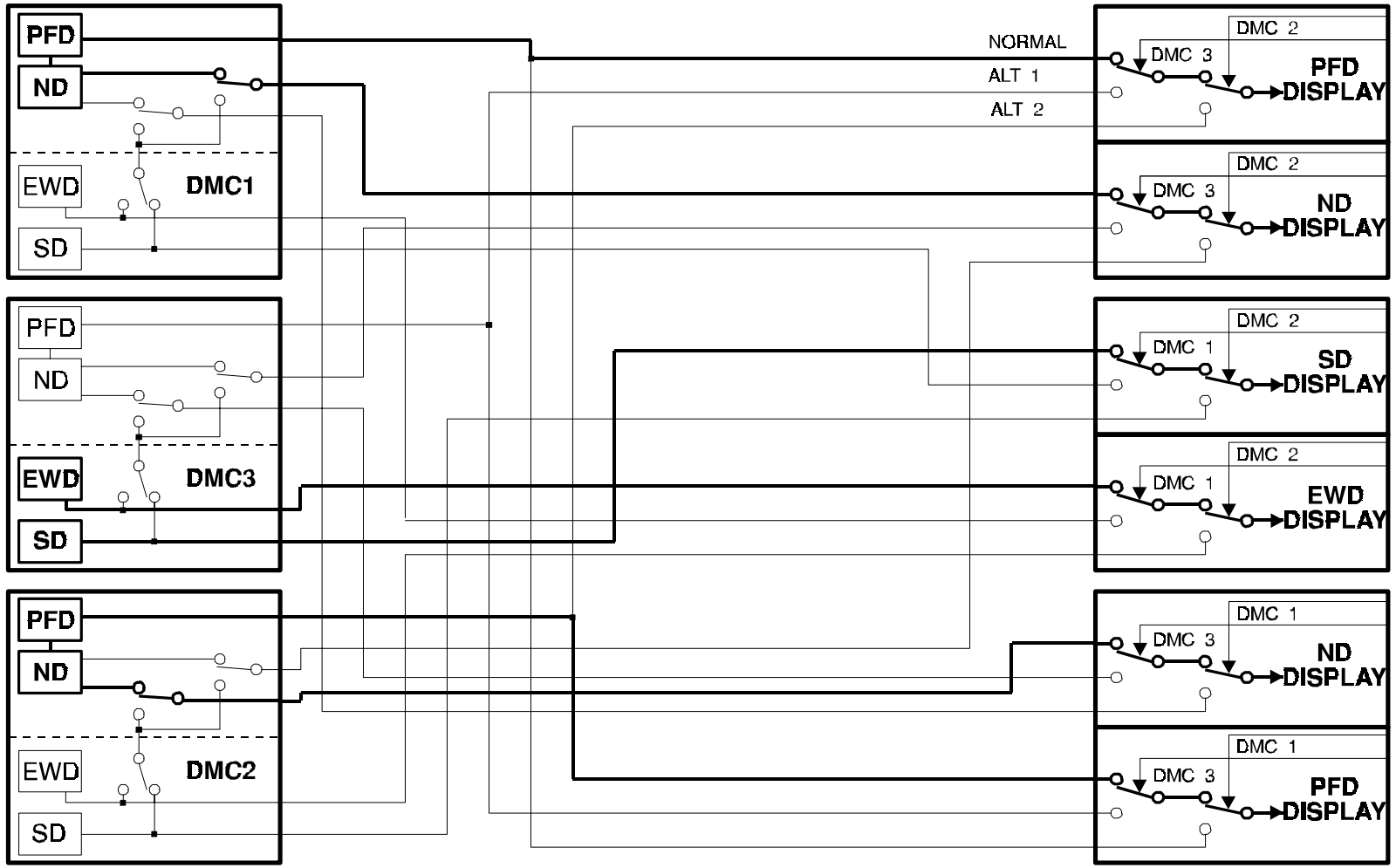
General
EFIS DMC Switching
ECAM DMC Switching
DU Reconfiguration

GENERAL

The EIS reconfiguration function is acheived by a set of switching devices and some software implements within the DMCs.

The switching or reconfiguration of the DMCs and the DUs can be automatic or manual.

The switching is performed by rotary selectors, P/B switches, control potentiometers (ON/OFF of the DUs), a set of relays which ensure an automatic switching in case of ECAM DMC3 failure and switching stages inside the DUs and DMCs.



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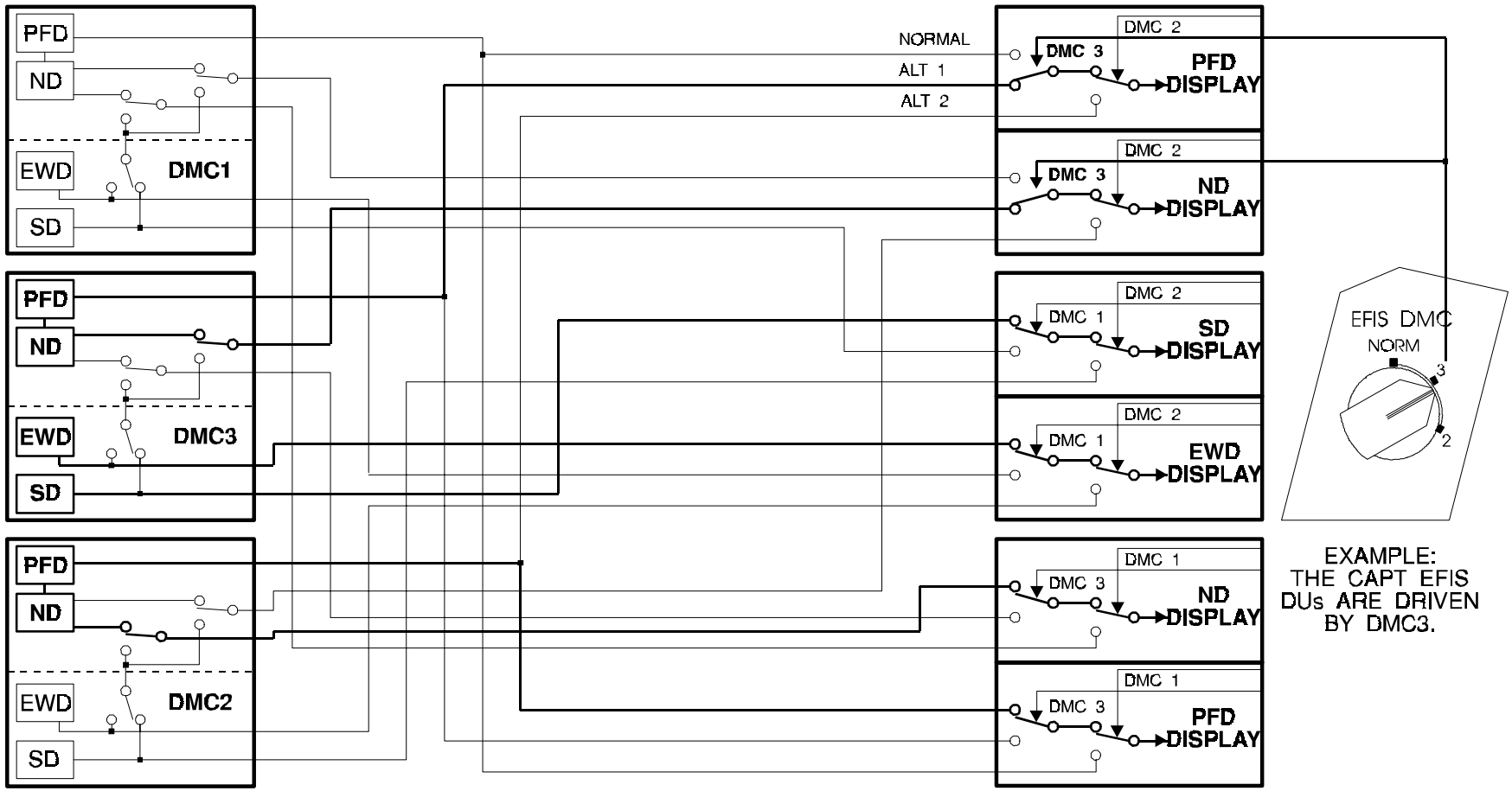
EFIS DMC SWITCHING

The switching of the EFIS DMCs is performed inside each display unit by a set of two relays. The relay contacts are connected to three Dedicated Serial Data Links, each of them coming from a different DMC.

The NORMAL DSDL input is wired to the DMC which supplies the DU in normal configuration. The ALTERNATE 1 and 2 inputs are connected to the other DMCs.

Each relay is controlled by a discrete coming from the EFIS DMC rotary selector. This discrete is a ground also connected to the DMCs.



FQW4200 GE Metric

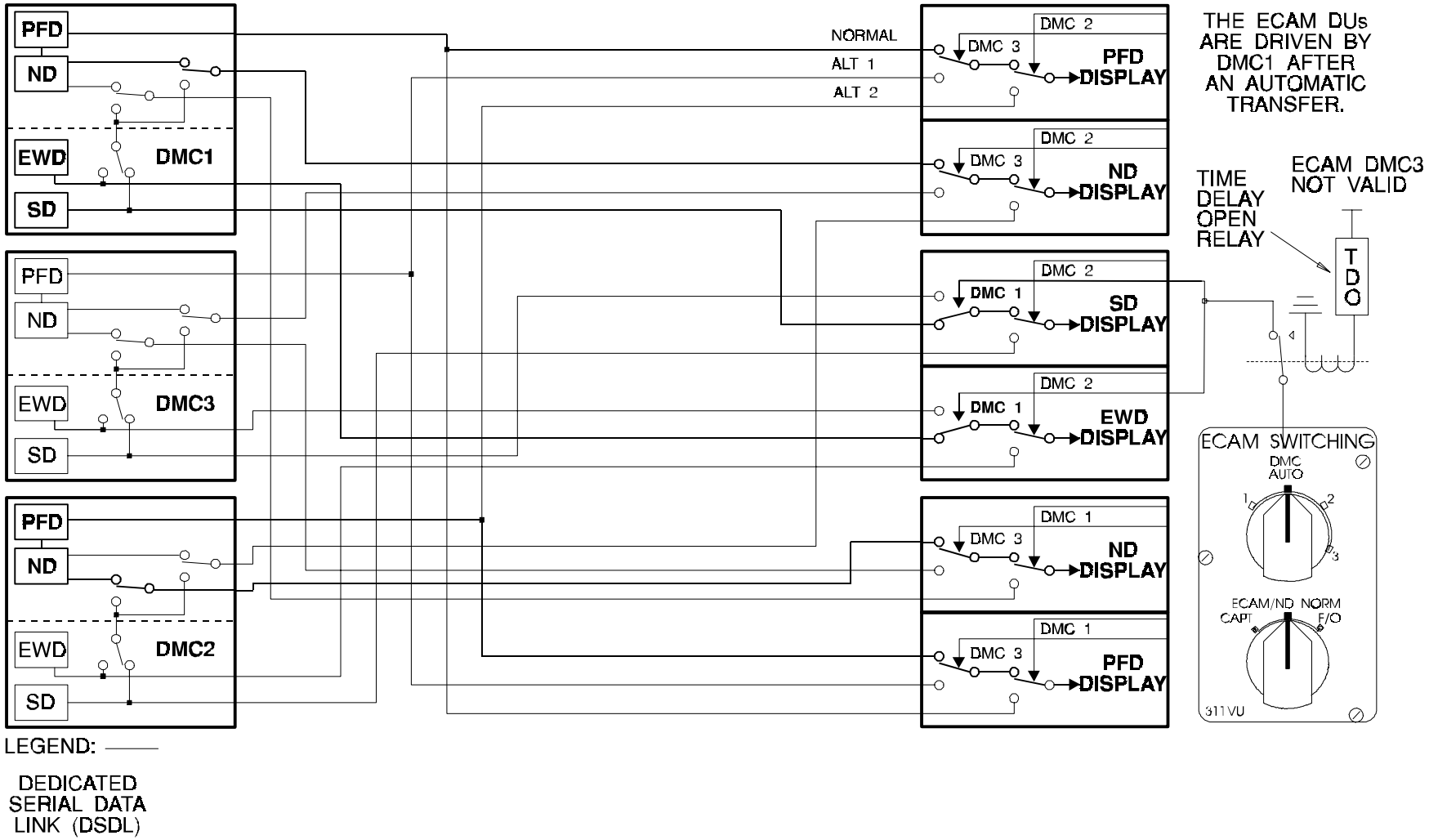
ECAM DMC SWITCHING

The switching of the ECAM DMCs is performed inside each display unit by a set of two relays. The relays contacts are connected to three Dedicated Serial Data Links, each of them coming from a different DMC.

The NORMAL DSDL input is wired to the DMC which supplies the DU in normal configuration. The ALTERNATE 1 and 2 inputs are connected to the other DMCs.

Each relay is controlled by a discrete (GROND\OPEN) coming from the ECAM SWITCHING DMC rotary selector through two external relays. One of them is a time delay open (TDO) relay (1s delay) which is de-energized when ECAM DMC3 is not valid. This discrete is a ground also connected to the DMCs.

The time delay relay is activated only when the ECAM switching DMC is on AUTO and ECAM DMC3 is lost.



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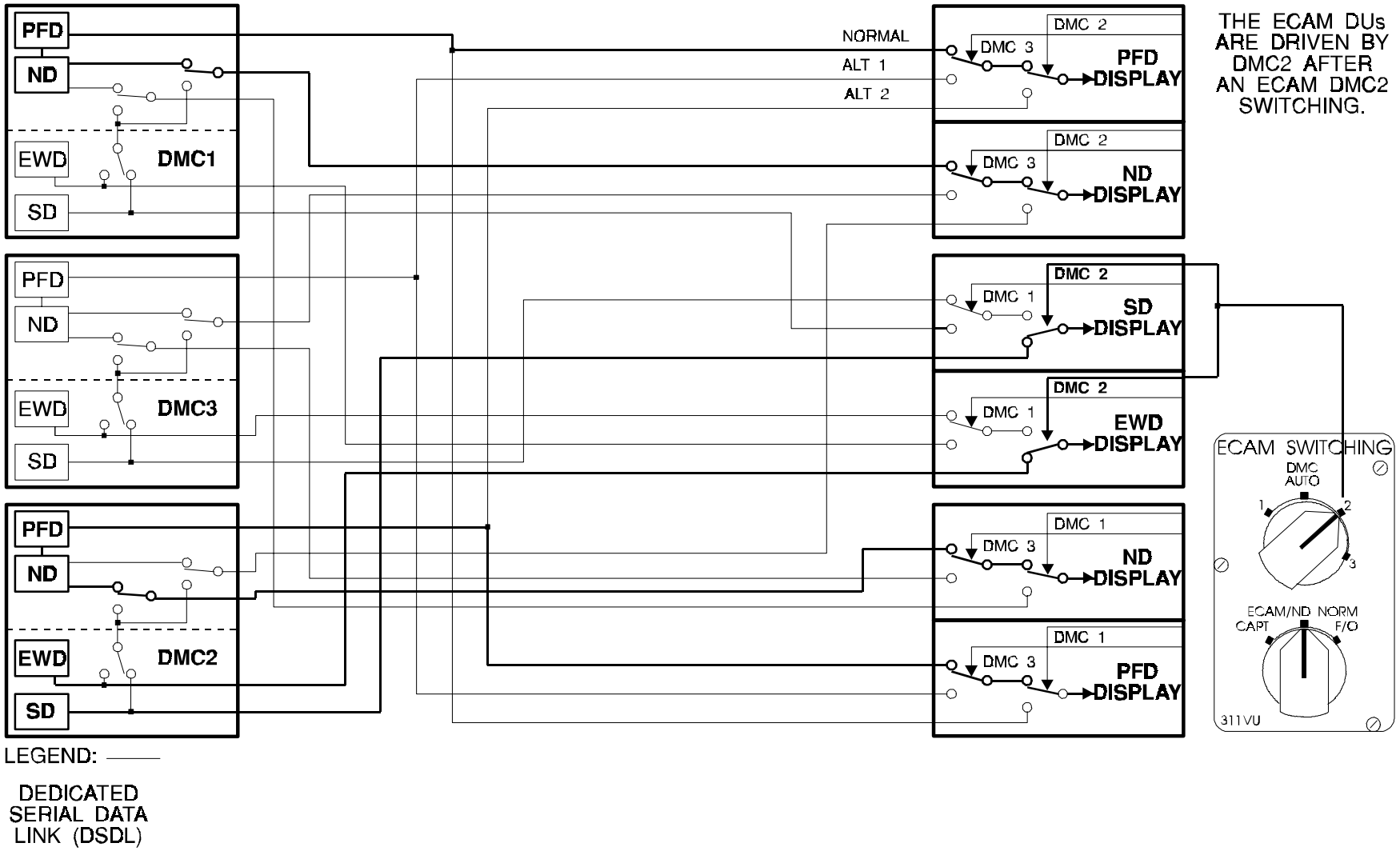
Here is an example of ECAM switching on DMC2.



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DU RECONFIGURATION

The reconfiguration of the DUs is performed inside each DMC by a set of three relays. Each DMC receives discrete control signals corresponding to the position of the rotary selectors, pushbutton switches and configuration of the DUs.

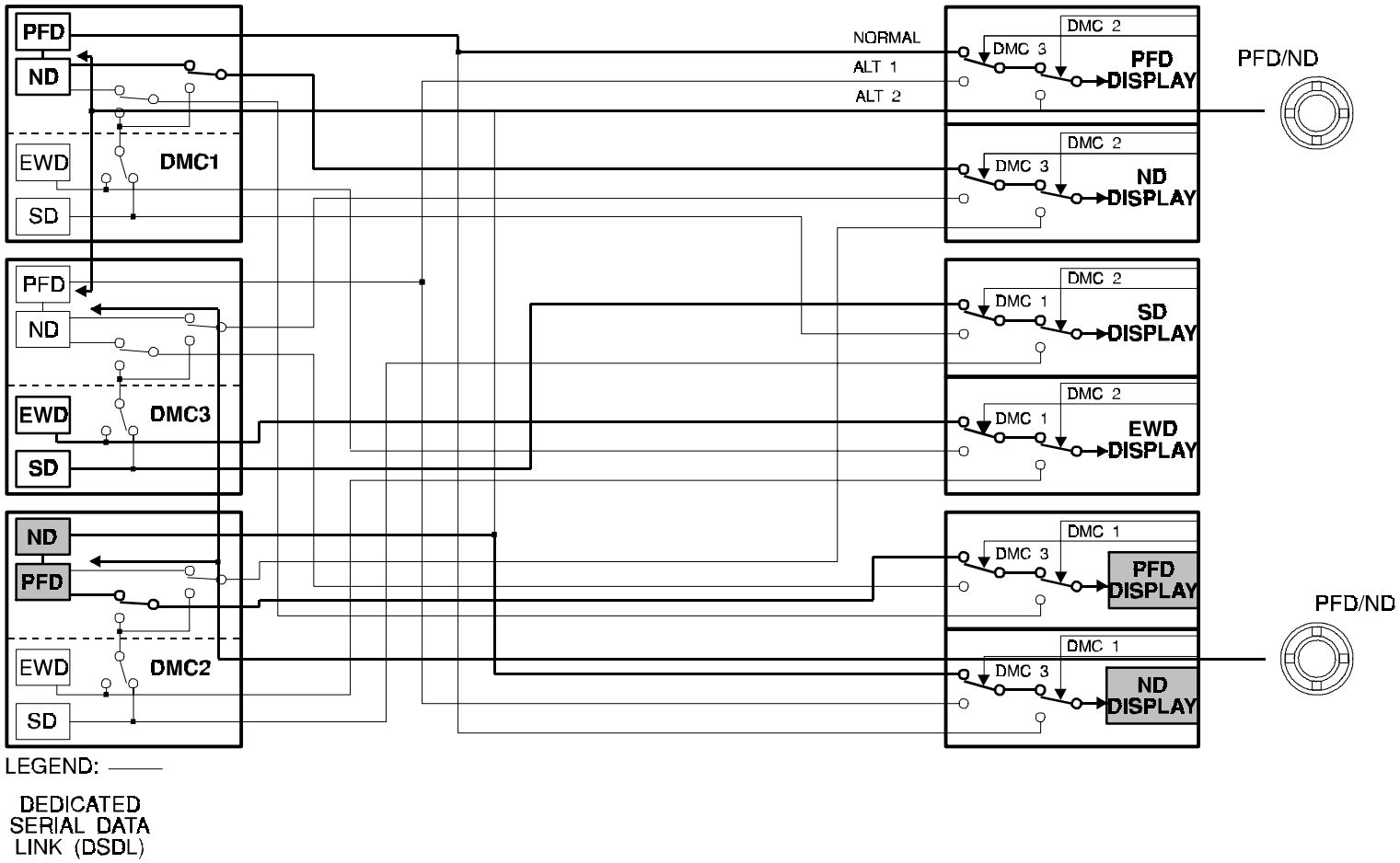
The coils of the relays are controlled by a wired logic and software implements of the DMCs.

This enables the automatic PFD to ND and EWD to SD switching in case of failed DUs, and the manual switching (PFD/ND transfer and ECAM/ND transfer).

The PFD/ND transfer only enables a software permutation inside the active and selected DMC.

The Captain PFD/ND pushbutton acts on DMC1 and DMC3, whereas the First Officer one acts on DMC2 and DMC3.

Here is an example of permutation of the display on the F/O side.



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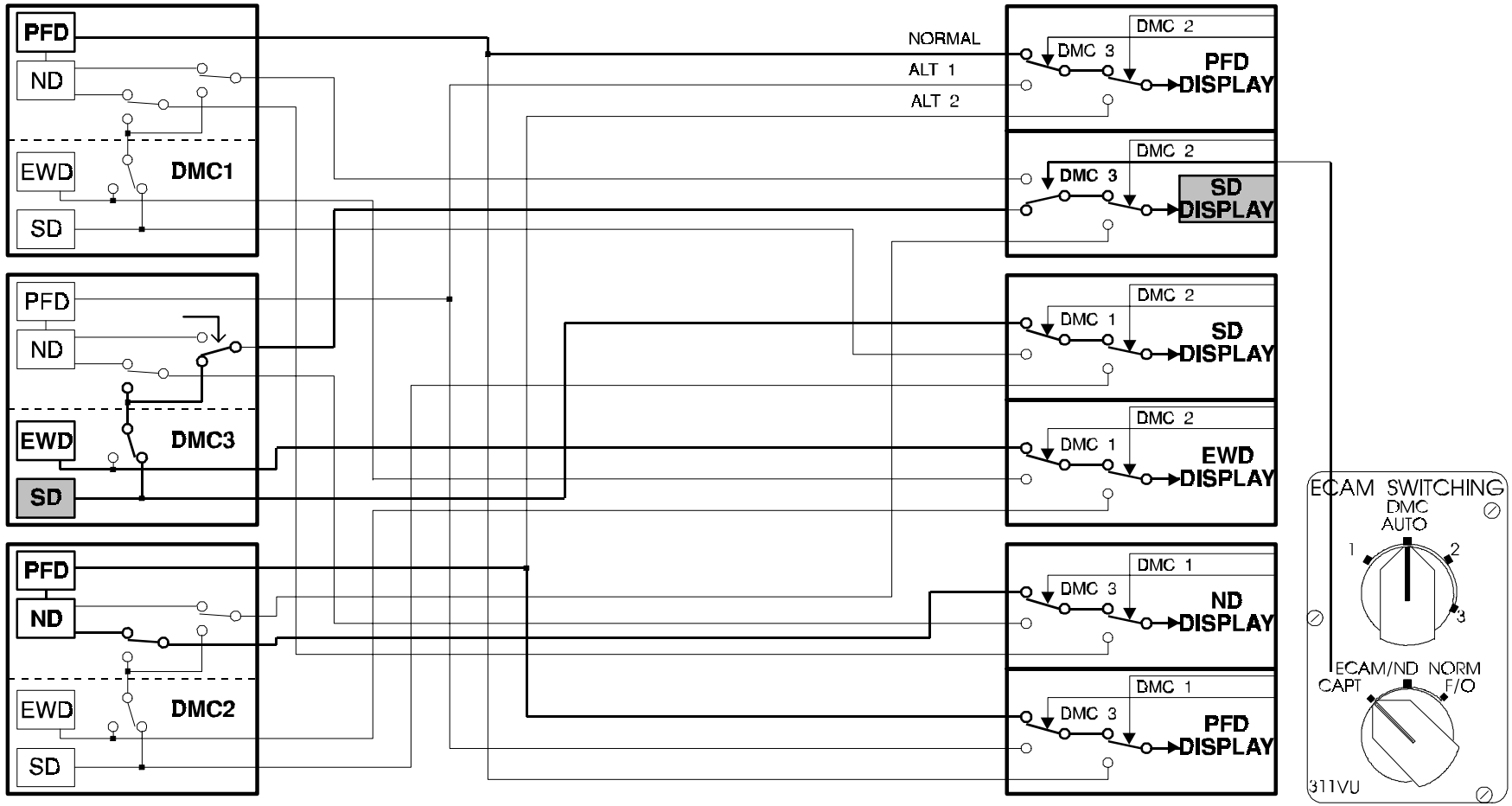
When an ECAM/ND transfer is made, the SD display functions are performed by the DMC which drives the ECAM data at the time of the selection of the transfer.

Here is an example of Captain ECAM/ND transfer. The relay inside the DU is activated by the rotary selector whereas the relay inside the DMC is activated by a wired logic.



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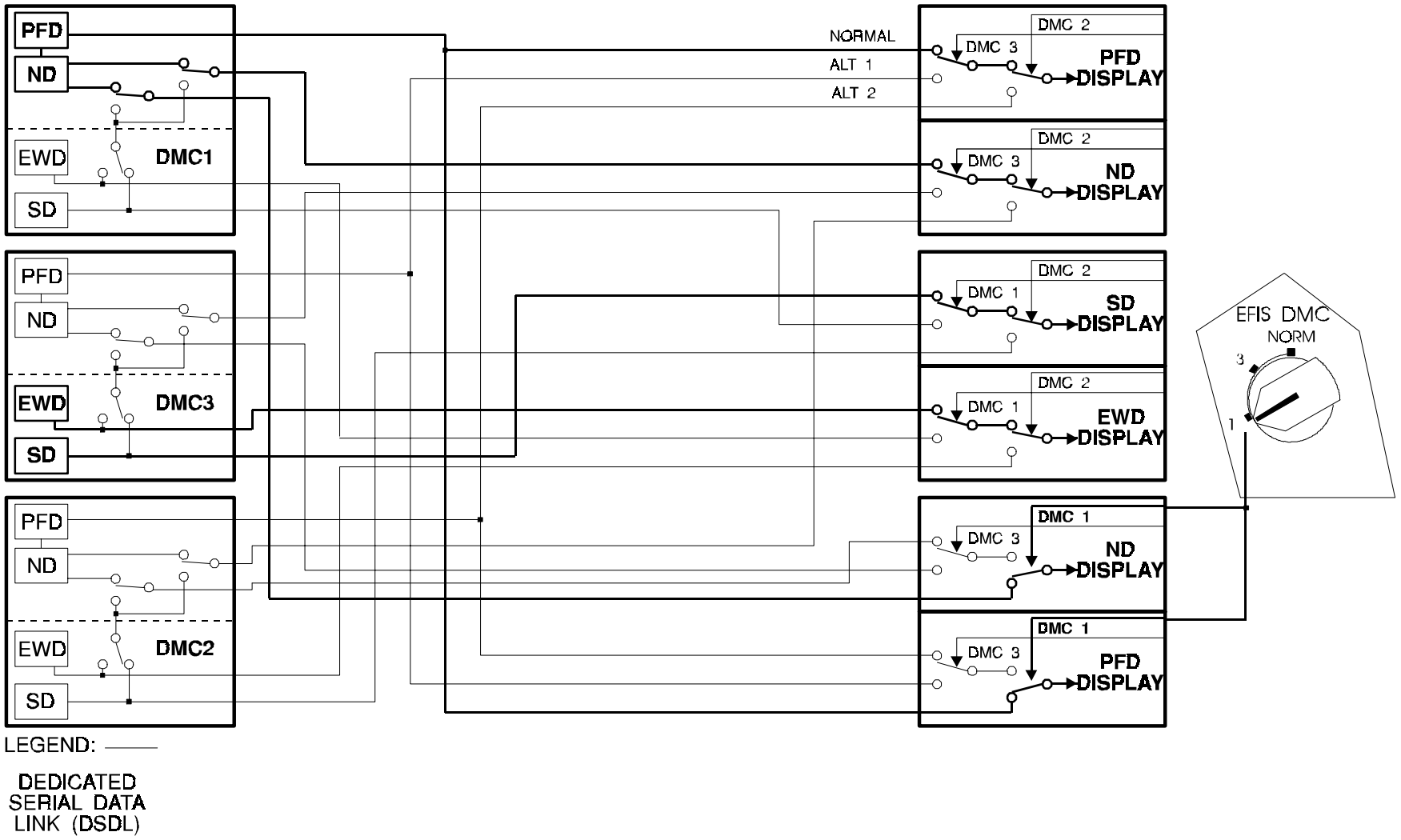
The copy mode occurs when two EFIS DMC parts are no longer available. Then, the crew recovers the EFIS displays by switching the remaining DMC.

Here is an example of the copy mode, with only DMC1 available and DMC1 selected by the F/O.



FQW4200 GE Metric

STUDENT NOTES:

DISPLAY MANAGEMENT COMPUTER (DMC) ARINC BUS RECONFIGURATION

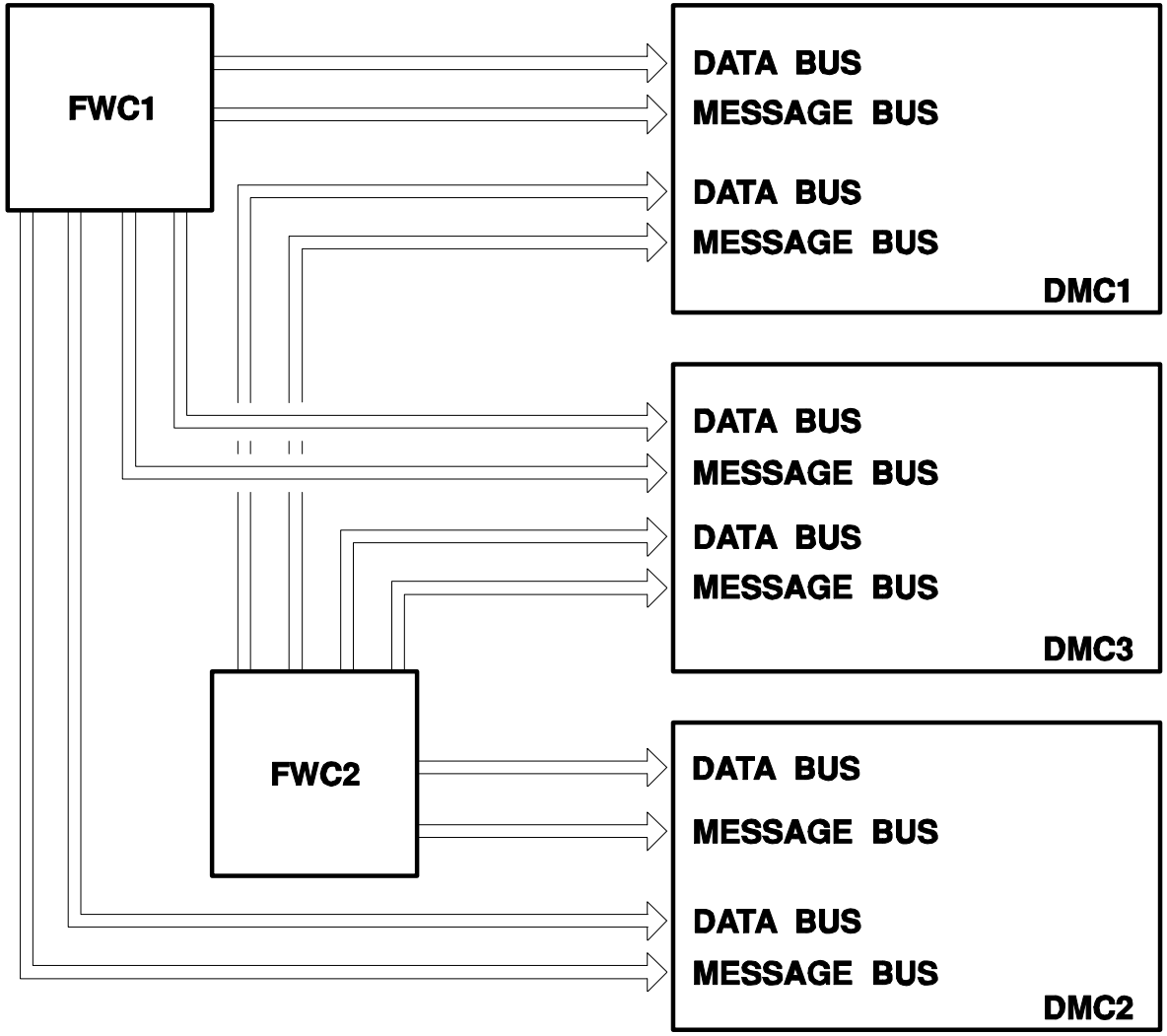
Flight Warning Computer (FWC)
System Data Acquisition Concentrator (SDAC)
EFIS Output Bus
ECAM Output Bus
Weather Radar

As a general rule, we can say that each Display Management Computer (DMC) uses the active aircraft system source for display, provided it is valid or selected.

FLIGHT WARNING COMPUTER (FWC)

The DMCs use the FWC1 or FWC2 message bus (the first which has computed the warning), provided the bus is valid.
Data bus and message bus switching is fully automatic.

If a warning occurs when an FWC is sending memos to the DMCs on its message bus, the warning will be sent to the DMCs by the opposite FWC.

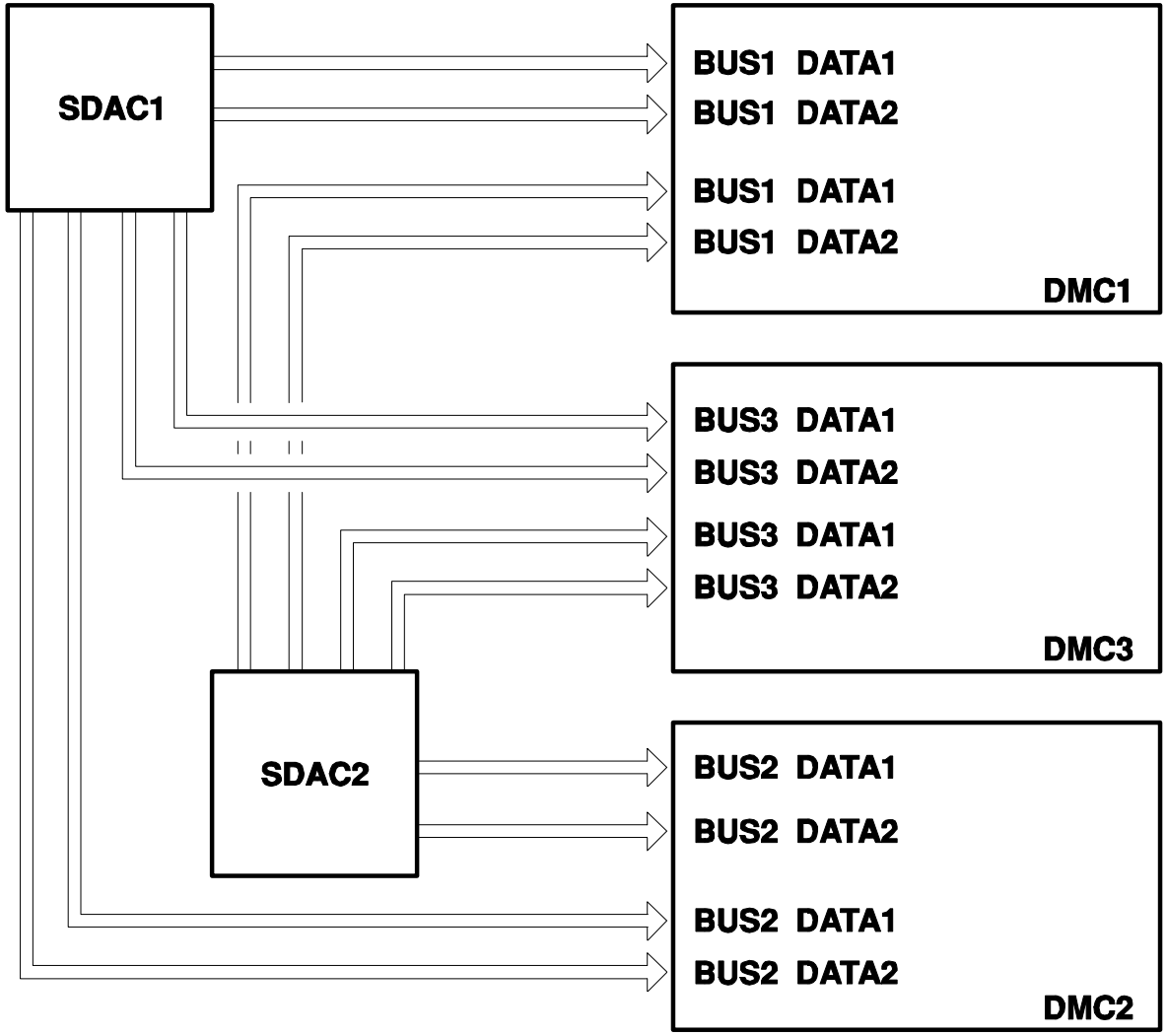


FQW4200 GE Metric

SYSTEM DATA ACQUISITION CONCENTRATOR (SDAC)

Each DMC is connected to two data buses from each of the two SDACs.
These two buses are complementary, they transmit different data.

The DMCs use SDAC1 if both SDAC1 data buses are valid.
If one bus is not valid or if SDAC1 is not valid, the DMCs will use the SDAC2 data buses.
The switching is automatic.



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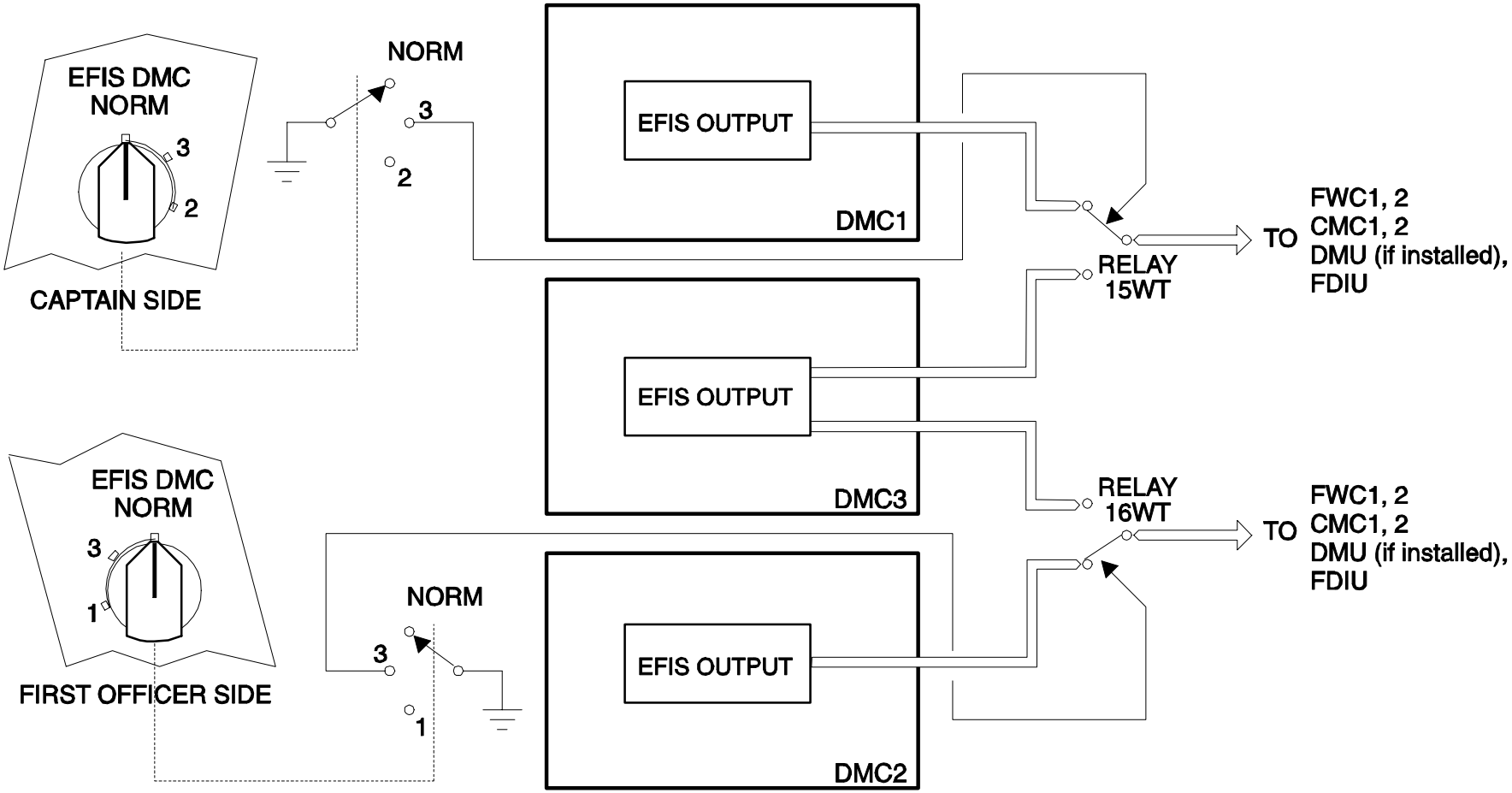
EFIS OUTPUT BUS

The switching of the EFIS output bus connected to the systems is controlled by the EFIS DMC rotary selectors and a set of two relays.

For each side, the selected DMC transmits the information on the bus to the FWCs, CMCs, DMU (if installed) and FDIU.



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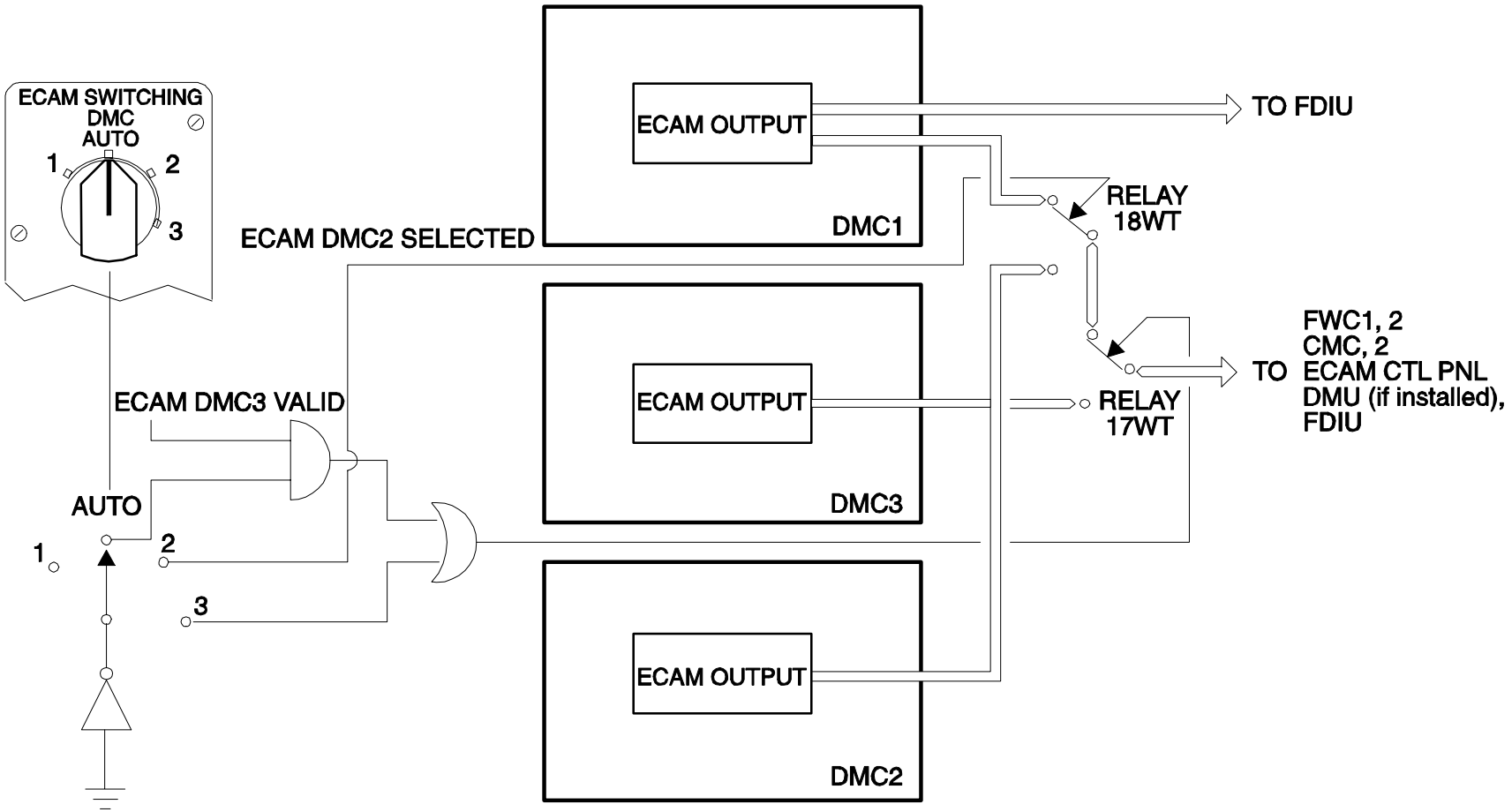
ECAM OUTPUT BUS

There are two ECAM output buses connected to other systems.
One of the Output Buses is directly connected to the Flight Data Interface Unit from the ECAM DMC1.

The switching of the second bus is performed by a set of two relays and the ECAM switching DMC rotary selector.

The active DMC transmits data on the bus to the FWCs, CMCs, ECP, DMU (if installed) and FDIU.



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WEATHER RADAR

Each DMC receives two ARINC 453 buses from Weather Radar transceiver 1 and 2 if installed.
Only one transceiver is active at a time.

Switching between BUS 1 and BUS 2 is directly linked to Flight Management. The DMC uses BUS 1 when it uses the FM1 bus, or BUS 2 when the FM2 bus is used.

The same RS422 link is sent to both the PFD and ND for the PFD/ND transfer mode.

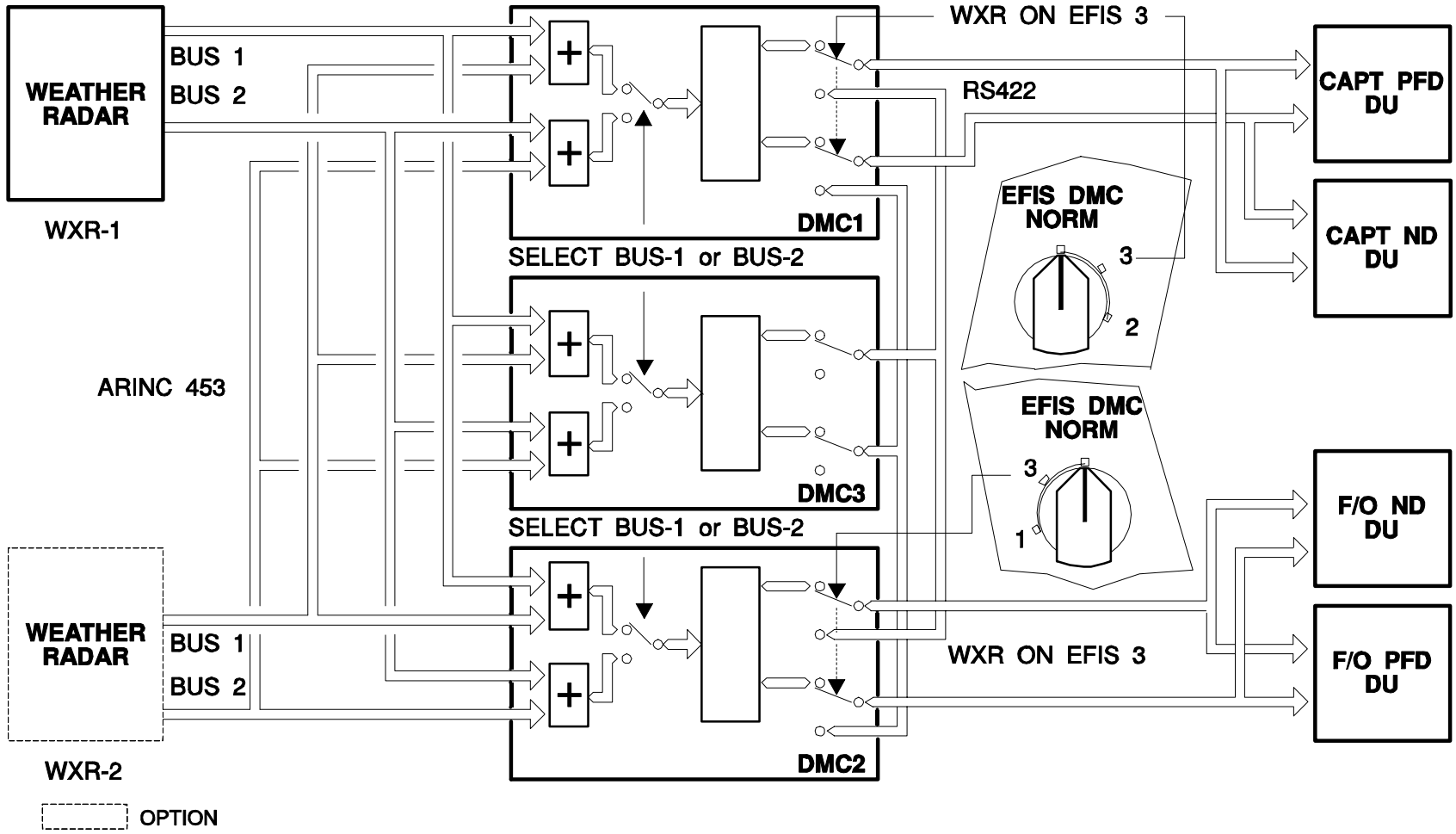
The switching is performed by a set of two relays inside each DMC.
In normal operation, EFIS DMC1 and EFIS DMC2 directly supply the CAPT and F/O DUs.

The bus 1 signals from both transceivers are electrically added in the DMC.
The same applies for the bus 2 signals.

The ARINC 453 bus is converted into two RS 422 buses.
Each Display Unit (DU) receives two complementary RS422 links.
Two buses are used to increase data flow.

When EFIS DMC3 is selected, the discrete signal WXR ON EFIS 3 is activated and the Weather Radar information is sent through DMC1 or DMC2.
The discrete signal WXR ON EFIS 3 is a ground.

Note that the Captain cannot display the Weather Radar data on his DUs by setting the EFIS DMC rotary selector to 2.
The same applies for the F/O with the EFIS DMC rotary selector set to 1.



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STUDENT NOTES:

SYSTEM WARNINGS

DFDR FAULT
FDIU FAULT
FWC 1 FAULT
FWC 1 + 2 FAULT
SDAC 2 FAULT
SDAC 1 + 2 FAULT
EFIS DMC 1 FAULT
ECP FAULT
CHECK E/WD
CHECK SD
Operating Limitation

DFDR FAULT

Flight safety is not affected by the failure of the DFDR, although there is only one.

FDIU FAULT

Flight safety is not affected by the failure of the FDIU, although there is only one.

FWC 1 FAULT

As two identical Flight Warning Computers are provided, ECAM operation is not affected.

FWC 1 + 2 FAULT

In this case, only an ECAM message is provided. The crew has to closely monitor the aircraft system through the overhead panel or ECAM system pages.

SDAC 2 FAULT

As two identical SDACs are provided, ECAM operation is not affected.

SDAC 1 + 2 FAULT

The crew has to closely monitor the overhead panel as only certain ECAM system pages are available: ENG, F/CTL, FUEL, WHEEL, PRESS, C/B.

EFIS DMC 1 FAULT

If the data of the CAPT PFD and ND are lost (diagonal line), the CAPT has to transfer to EFIS DMC 3 to recover his PFD and ND.

ECP FAULT

In case of ECAM Control Panel (ECP) failure the CLR, RCL, STS, EMER CANC and ALL pushbuttons remain operative since the contacts are directly wired to the FWCS/DMCs.

CHECK E/WD

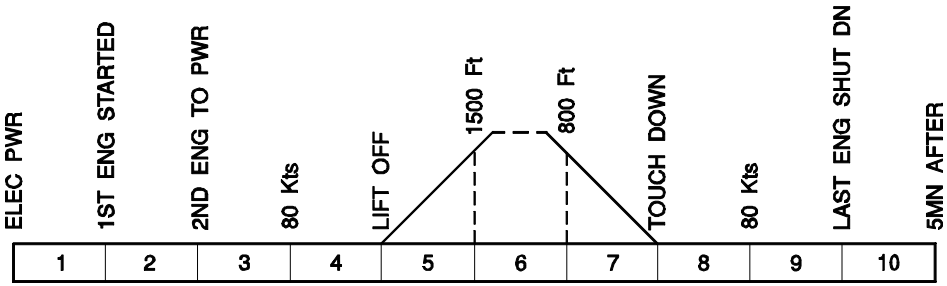
N1, EGT, N2, FF are parameters monitored by the three DMCs. The DMCs compare the N1 and EGT signals received from the Engine Control Unit (ECU) with their feedback signals which reflect the displayed position of the needle and the digital value. For the N2 and FF parameters, the DMCs compare the signals from the ECU with the displayed digital value. In case of discrepancy, an amber message "CHECK E/WD" is displayed on the E/WD and on both NDs.

CHECK SD

The 3 DMCs compare the signals sent to the SD with their feedback signals. If a dicrepancy is detected, an amber message "CHECK SD" is displayed on the SD. The crew has to use the ECAM switching panel to recover ECAM normal operation.

OPERATING LIMITATION

One among SDAC, FWC, DMC and DU may be inoperative for dispatch.



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
EFIS DMC 1 (2) (3) FAULT failure of the EFIS part of one DMC	SINGLE CHIME	MASTER CAUT	NIL	NIL	4, 5, 7, 8
ECAM DMC 1 (2) (3) FAULT failure of the ECAM part of one DMC					
CHECK E/WD CHECK SD CHECK PFD CHECK ND display discrepancy				Flag on DISPLAY UNITS	3, 4, 5, 7, 8
FWC 1 (2) FAULT	NIL	NIL		NIL	
SDAC 1 (2) FAULT					
FWC 1 + 2 FAULT					
DFDR FAULT					
FDIU FAULT					
ECP FAULT					
SDAC 1 + 2 FAULT	SINGLE CHIME	MASTER CAUT			4, 5, 7, 8

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STUDENT NOTES:

COMPONENTS

Safety Precautions
Display Unit (DU)
Display Management Computer (DMC)
Flight Warning Computer (FWC)
System Data Acquisition Concentrator (SDAC)
Ecam Control Panel (ECP)
Relays

SAFETY PRECAUTIONS

The avionic computers are Electrostatic Sensitive Devices (ESDs).
These components are susceptible to damage by electrical sources that would not damage conventional components.
The low energy source, that most commonly destroys ESDs, is the human body which generates static electricity in conjunction with the ground.

The precautions to follow are :

- de-energize all power and signal sources
- place the unit on a grounded conductive work surface
- ground any tools that will contact the unit...

When it is specified on the maintenance manual.

STUDENT NOTES

DISPLAY UNIT (DU)

	FIN	ZONE
CAPT PFD	1WK1	211
CAPT ND	3WK1	211
F/O PFD	1WK2	212
F/O ND	3WK2	212
EWD	2WK1	210
SD	2WK2	210

COMPONENT DESCRIPTION

The display units are identical and interchangeable.
They can be divided into five following basic stages.
1 - the interconnexion board is the interface between the DU and the DMCs.
2 - the digital board generates the deviation and video signals required to draw the image on the screen.
3 - the analog board controls the CRT (Cathode Ray Tube).
4 - the low and very high voltage power is used to acheive the basic voltage needed for the CRT operation.
5 - the CRT assembly displays the image.

SPECIAL DESIGN

The front face is provided with a photosensitive sensor for automatic regulation of the brightness.

REMOVAL INSTAL

Before removing the DU from the CAPT, F/O or center instrument panel, remove the thermoformed cover.

Make sure that the ventilation air inlet is in the correct condition before installing the DU.

SAFETY PRECAUTIONS

To clean the screen, use alcohol based cleaning agent (Ref 20-31-00) and absorbent surgical cotton wading.

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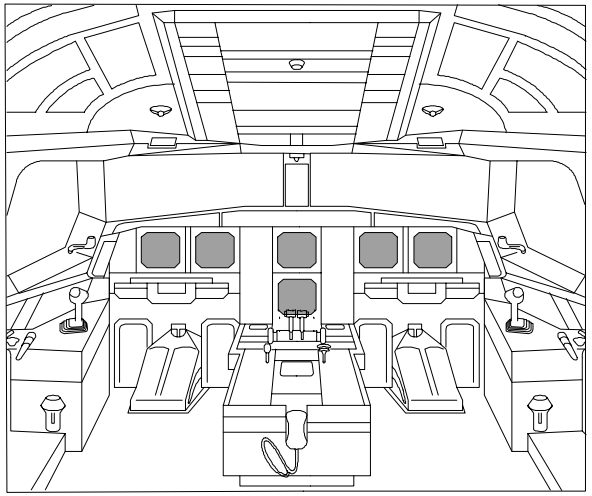

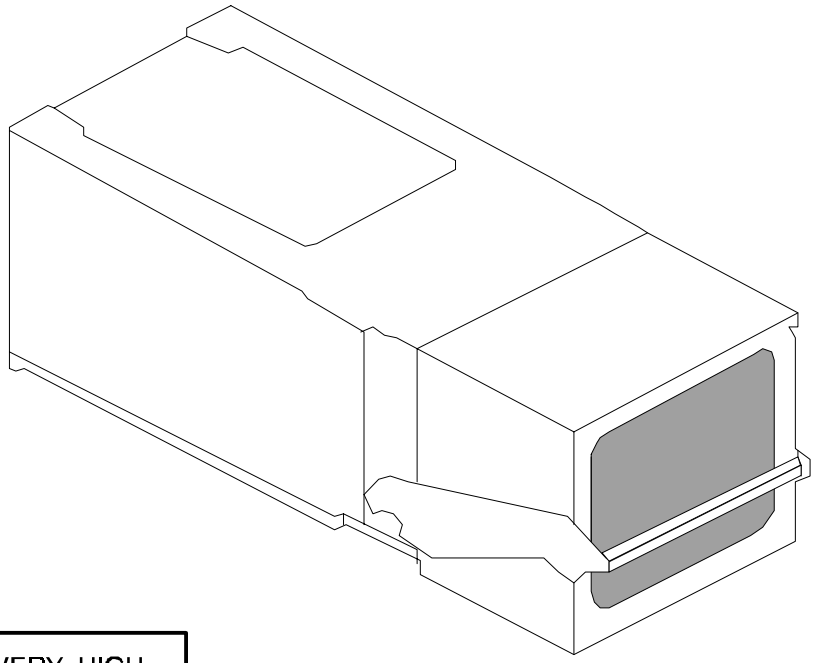

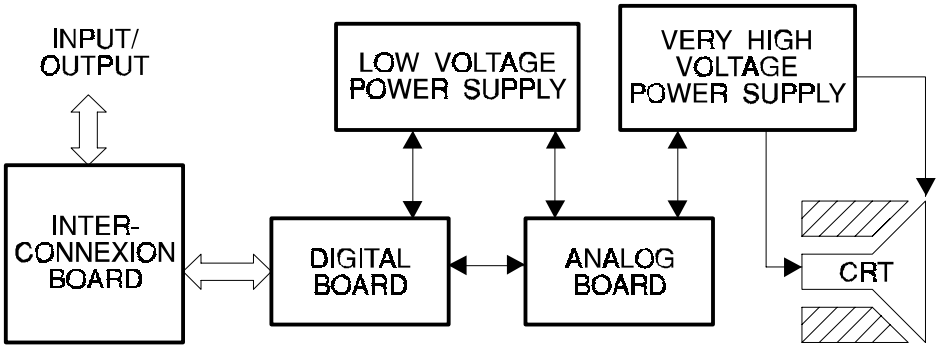

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DISPLAY MANAGEMENT COMPUTER (DMC)

	DMC1	DMC2	DMC3
FIN	1WT1	1WT2	1WT3
ZONE	121	122	122

COMPONENT DESCRIPTION

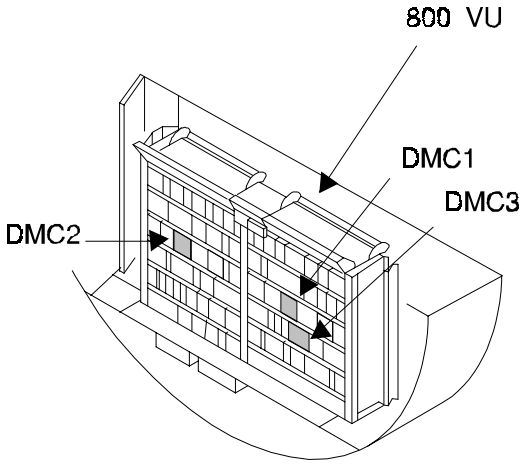
Each part of the DMC : the EFIS part and the ECAM part, is divided into several basic sections as follows :

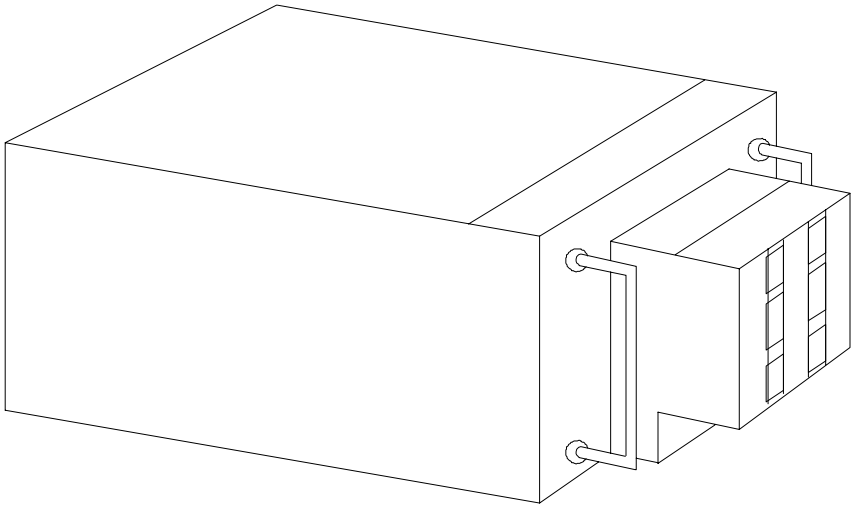
- a processing channel, including an OBRM,
- several acquisition modules,
- a power supply module.

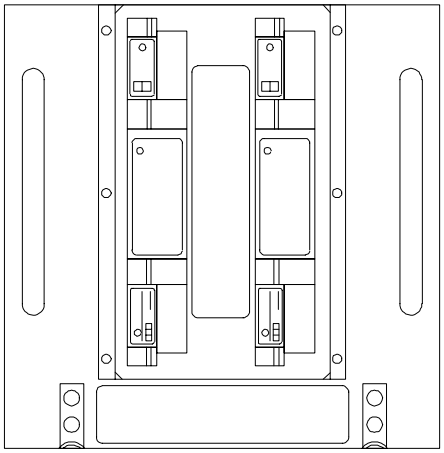
The DMC is provided with two OBRMs (On Board Replaceable Modules).

SPECIAL DESIGN

The program memory is located in the OBRM.

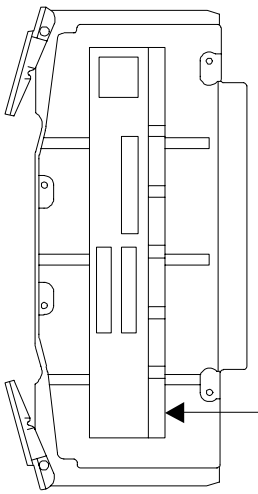


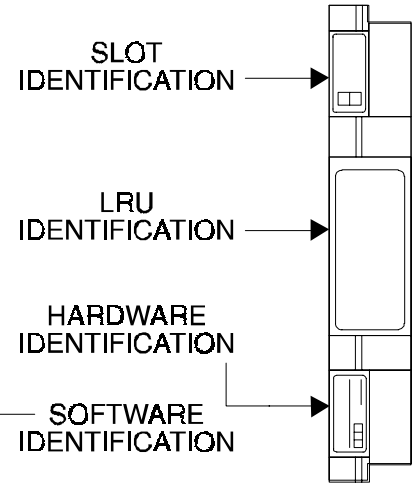




SIZE:
6 MCU

NUMBER OF
CONNECTORS
1 ARINC 600,
SIZE 3.





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FLIGHT WARNING COMPUTER (FWC)

	FWC1	FWC2
FIN	1WW1	1WW2
ZONE	121	122

COMPONENT DESCRIPTION

SIZE :	NUMBERS OF CONNECTORS
6 MCU	1 ARINC 600, SIZE 3.

The general architecture of the FWC is as follows:

- two Central Processing Unit boards,
- several acquisition module boards,
- two OBRMs,
- one power supply module.

SPECIAL DESIGN

The FWC has two OBRMs (On Board Replaceable Modules).
These memory extensions of the Central Processing Unit boards in standard module form located on the face of the unit, serve to modify the in situ computer software without removing the unit.
They are easly replaceable without specific tools.

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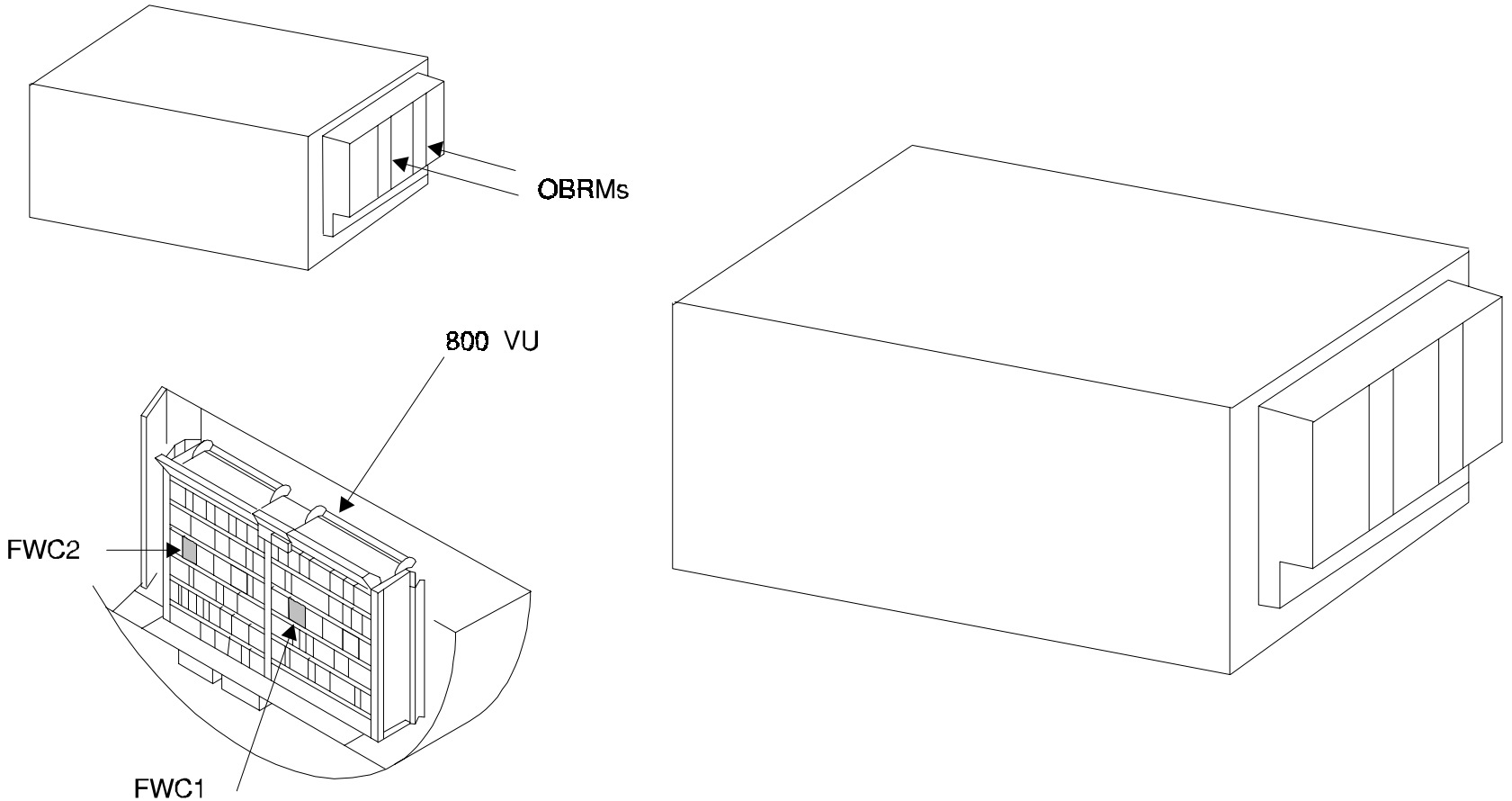

FQW4200 GE Metric

SYSTEM DATA ACQUISITION CONCENTRATOR (SDAC)

	SDAC1	SDAC2
FIN	1WV1	1WV2
ZONE	121	122

COMPONENT DESCRIPTION

SIZE :	NUMBERS OF CONNECTORS
6 MCU	1 ARINC 600, SIZE 3.

The general architecture of the SDAC is as follows:

- one Central Processing Unit board,
- several acquisition boards,
- one OBRM,
- one power supply module.

SPECIAL DESIGN

The SDAC is provided with one OBRM.

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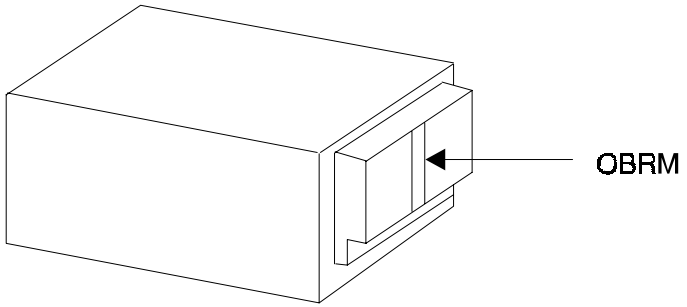

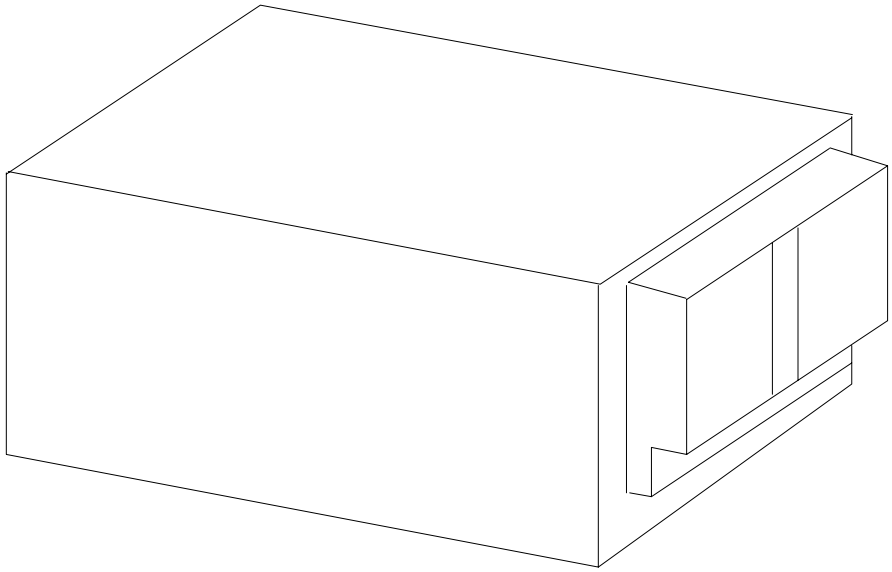

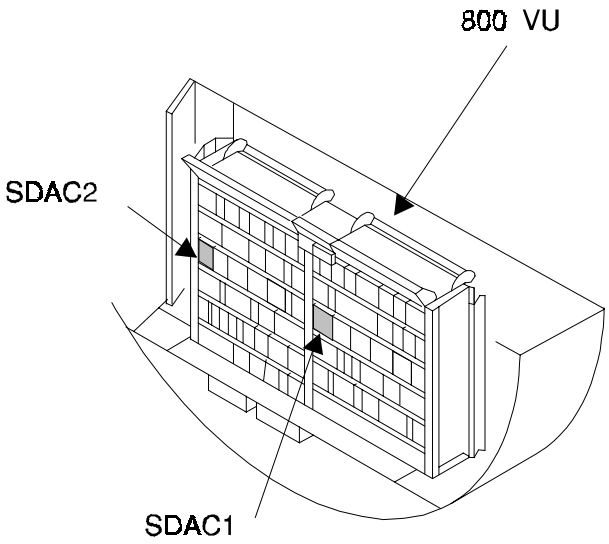

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ECAM CONTROL PANEL

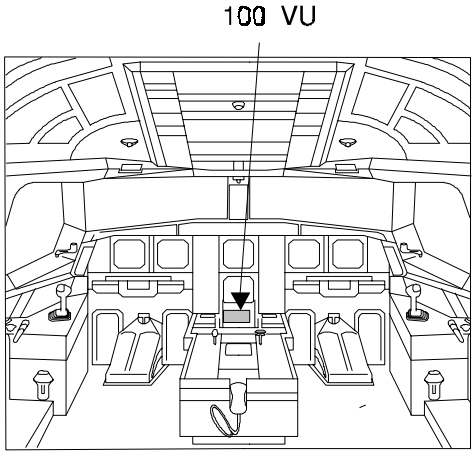
FIN : 2WM
ZONE : 210

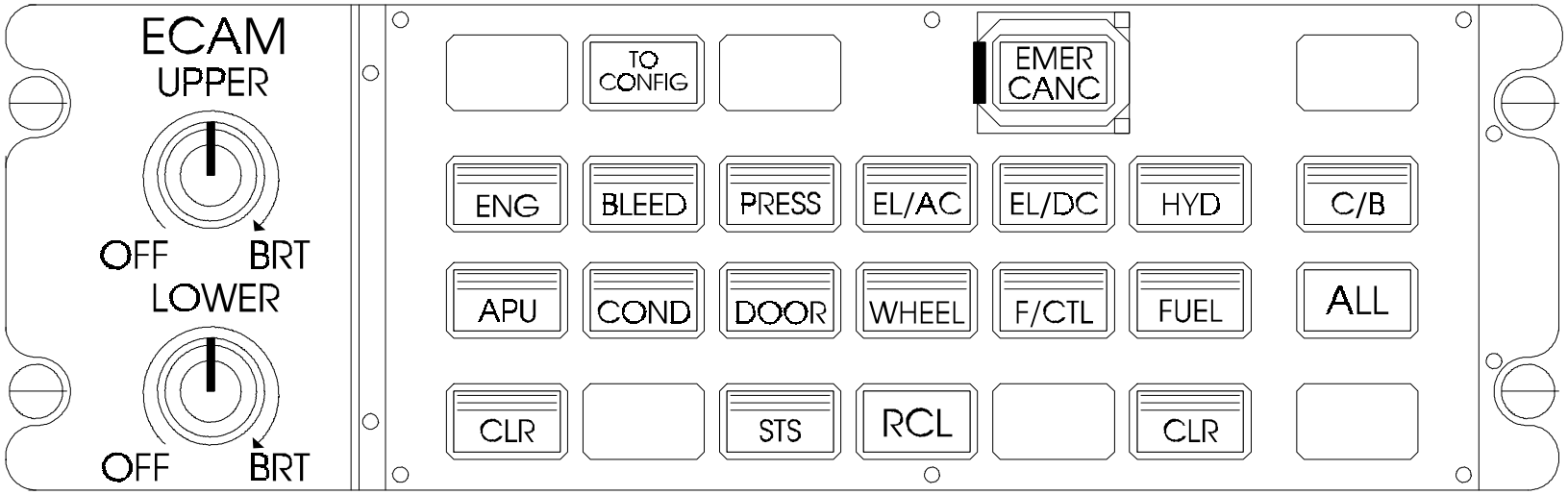
COMPONENT DESCRIPTION

size :	connection :
width : 216 mm	2 connectors
height : 75.8 mm	ASNE 0053 R18 B32
depth : 186 mm	

The general architecture of the ECAM Control Panel consists of:

- a key board,
- a Central Processing Unit board,
- a power supply board.





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RELAYS

RELAY NAME	FIN	ZONE
ECAM SWITCHING	9WS	121
ECAM SWITCHING TDO	11WS	
BUS 1 TO STAT INV BUS DMC3	5WT	
BUS 1 TO STAT INV BUS DMC1	9WT	
CAPT EFIS OUT SWITCHING	15WT	
F/O EFIS OUT SWITCHING	16WT	
ECAM DMC 1/2 OUT SWITCHING	17WT	
ECAM DMC 1/2/3 OUT SWITCHING	18WT	

COMPONENT DESCRIPTION

Relays 5WT and 9WT are interchangeable.
Relays 15WT, 16WT, 17WT and 18WT are interchangeable.

Relays 9WS and 11WS are not interchangeable.

Relay 11WS is a TDO (Time Delay Open) relay used for the ECAM DMC automatic transfer.

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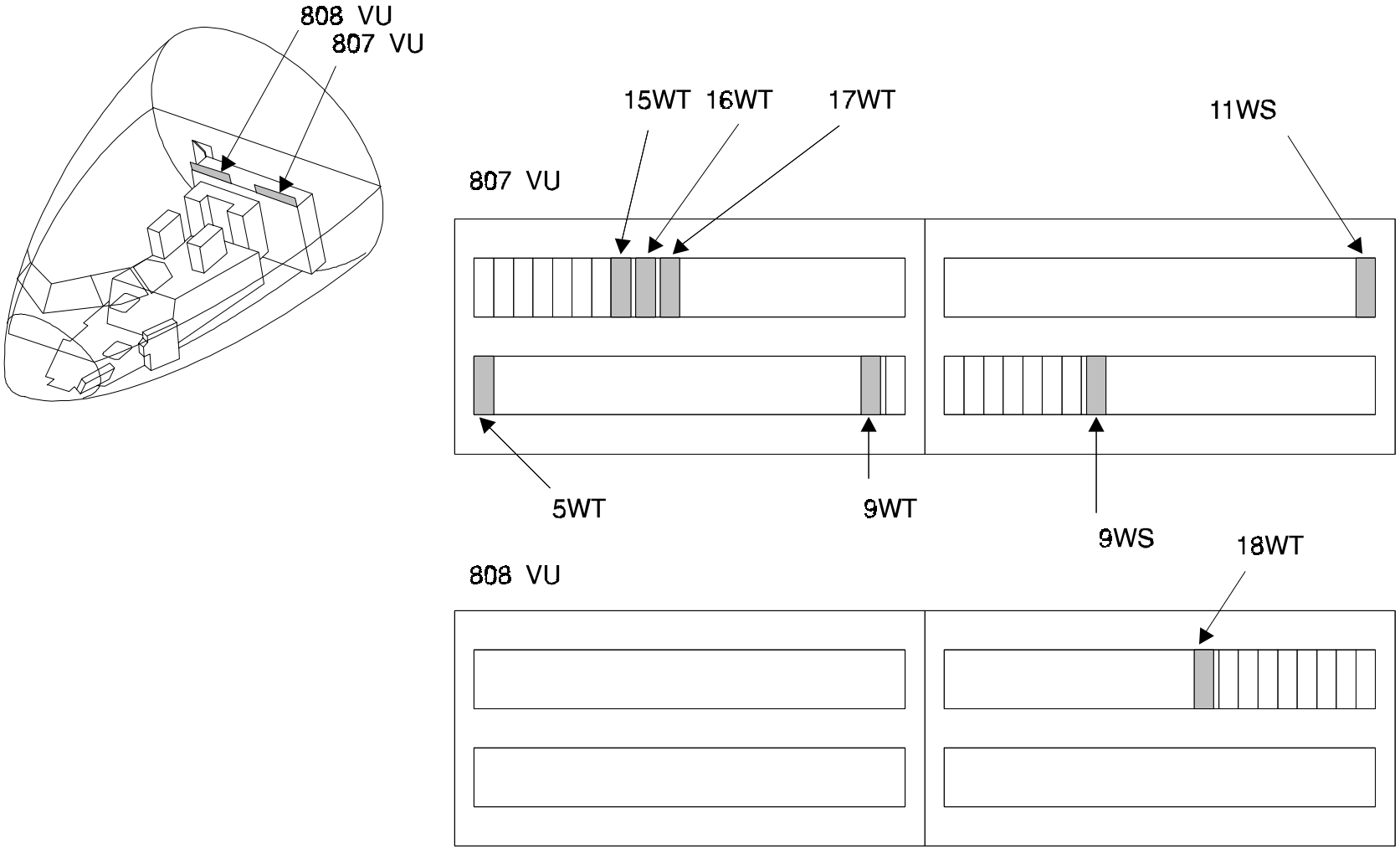

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STUDENT NOTES

DIGITAL FLIGHT DATA RECORDER SYSTEM PRESENTATION

General
Flight Data Iterface Unit (FDIU)
Flight Data Recorder (FDR)
Aircraft Systems
Linear Accelerometer (LA)
Event
Control Panel
Quick Access Recorder (QAR)

GENERAL

The purpose of the Digital Flight Data Recorder System (DFDRS) is to record various critical flight parameters in a solid state memory to fulfill the mandatory requirements of crash recording.

The DFDRS basically includes a Flight Data Interface Unit (FDIU), a Flight Data Recorder (FDR), a Linear Accelerometer (LA), an EVENT pushbutton and a control panel to meet the minimum requirements.
A Quick Access Recorder (QAR) can be optionally installed.

FLIGHT DATA INTERFACE UNIT (FDIU)

The Flight Data Interface Unit (FDIU) is a computer which collects various basic Aircraft System parameters and converts them by internal processing.

The aircraft system parameters are transmitted to the FDR for recording.
The FDIU is located in the avionics compartment.

FLIGHT DATA RECORDER (FDR)

The Flight Data Recorder (FDR) is a recorder located in the rear part (AFT) equipment compartment, which stores, in a solid state memory the data of the last twenty-five hours collected by the Flight Data Interface Unit (FDIU).

The memory board is located in a mechanical protected box.
The front face of the FDR includes an Underwater Locator Beacon (ULB).

AIRCRAFT SYSTEMS

The Aircraft Systems send basic parameters to the Flight Data Interface Unit (FDIU) via the Flight Warning Computers (FWCs), System Data Acquisition Concentrators (SDACs), Display Management Computers (DMCs), Engine Interface and Vibration Monitoring Units (EIVMUs) and Flight Control Data Concentrators (FCDCs).

The information for aircraft tail number, Airline ident, Fleet ident and FDR record version is given to the FDIU by the DFDRS Coding Panel (DCP).
The aircraft type is given to the FDIU directly by pin programming.

LINEAR ACCELEROMETER (LA)

A Linear Accelerometer (LA) is installed at the aircraft center of gravity to provide the Flight Data Interface Unit (FDIU) with the three axes acceleration data.

The FDIU receives the LA information via the System Data Acquisition Concentrator (SDAC).

EVENT

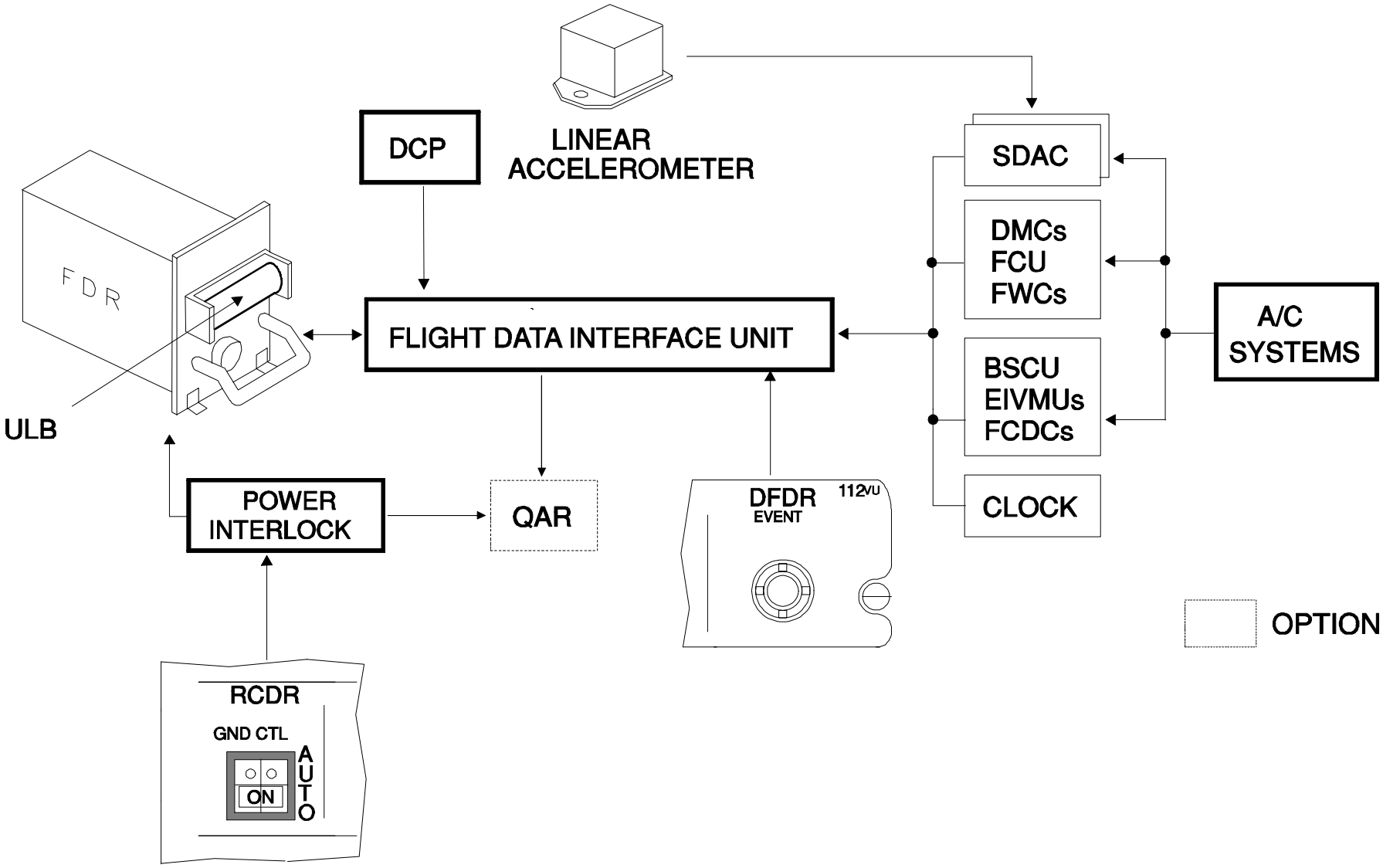
When pushed, the EVENT pushbutton is used to record an event mark in the Flight Data Recorder (FDR) memory.

The EVENT pushbutton is located on the pedestal.

CONTROL PANEL

The Flight Data Recorder (FDR) is automatically supplied with power when one engine is started and will stop five minutes after the last engine shutdown.

For test and maintenance purposes on ground as well as for preflight check, it is possible to supply power to the FDR by pressing the ground control pushbutton on the overhead panel.
Power supply switching is made via the power interlock circuit.



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QUICK ACCESS RECORDER (QAR)

The Flight Data Recorder (FDR) parameters can be recorded on an optical disk located in the Quick Access Recorder (QAR).
This allows performance or condition monitoring tasks.

Recording is controlled through the power interlock circuit simultaneously with the FDR energization.

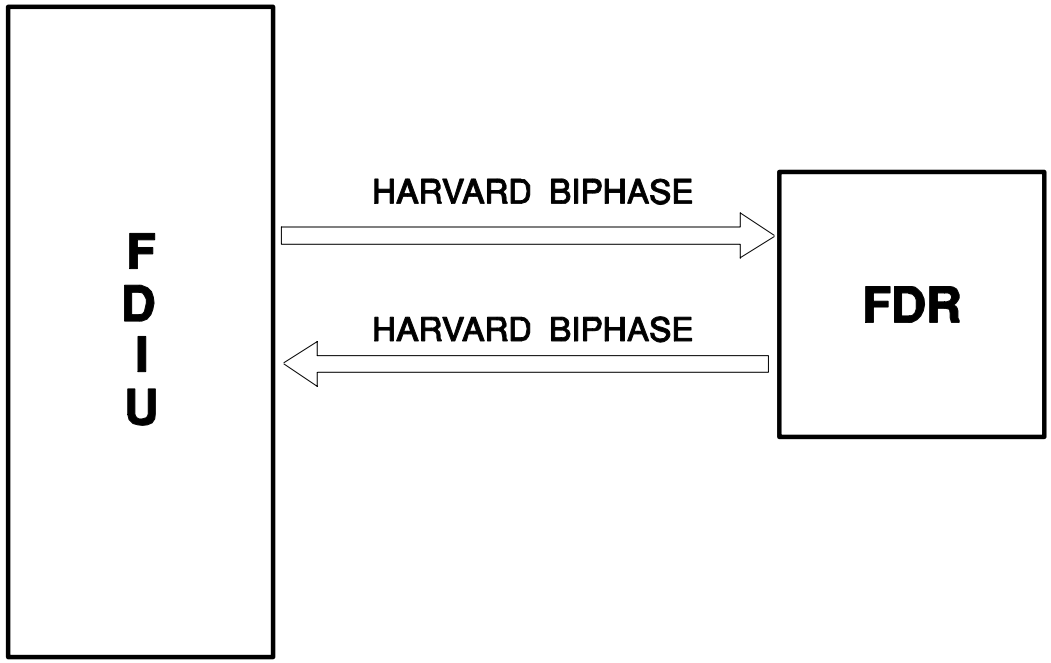
STUDENT NOTES:

STUDENT NOTES

DIGITAL FLIGHT DATA RECORDING SYSTEM (DFDRS) DATA TRANSFER

Code Comparison
Frame Description
Word Assignment
Data Source

The objective of this module is to describe the data transfer between the Flight Data Interface Unit (FDIU) and the recorders.



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CODE COMPARISON

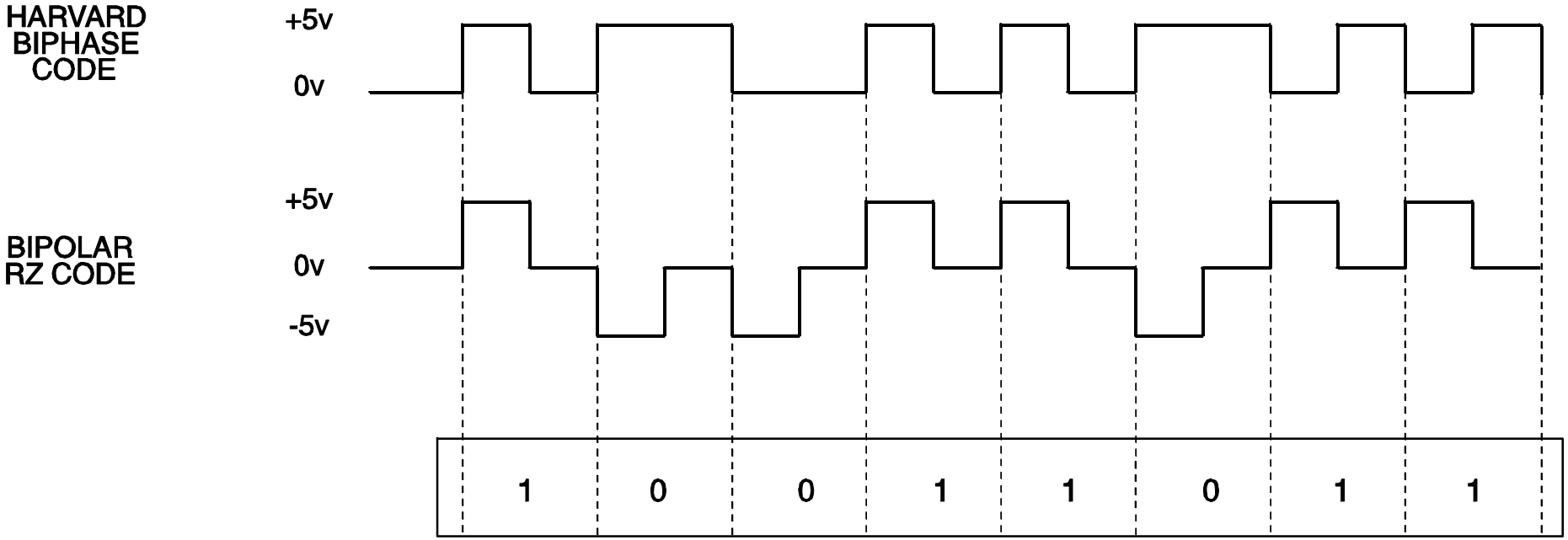
The transfer of data from the FDIU to the Flight Data Recorder (FDR) and Quick Access Recorder (QAR) (if installed) is performed via digital data links which have a specific format.

The data link format between the FDIU and the FDR is called Harvard Biphase.

The data link format between the FDIU and the QAR is called Bipolar RZ (Return to Zero).

In the example, the two codes represent the same binary word '10011011'.

Note : The ARINC 429 transmission is also Bipolar RZ.



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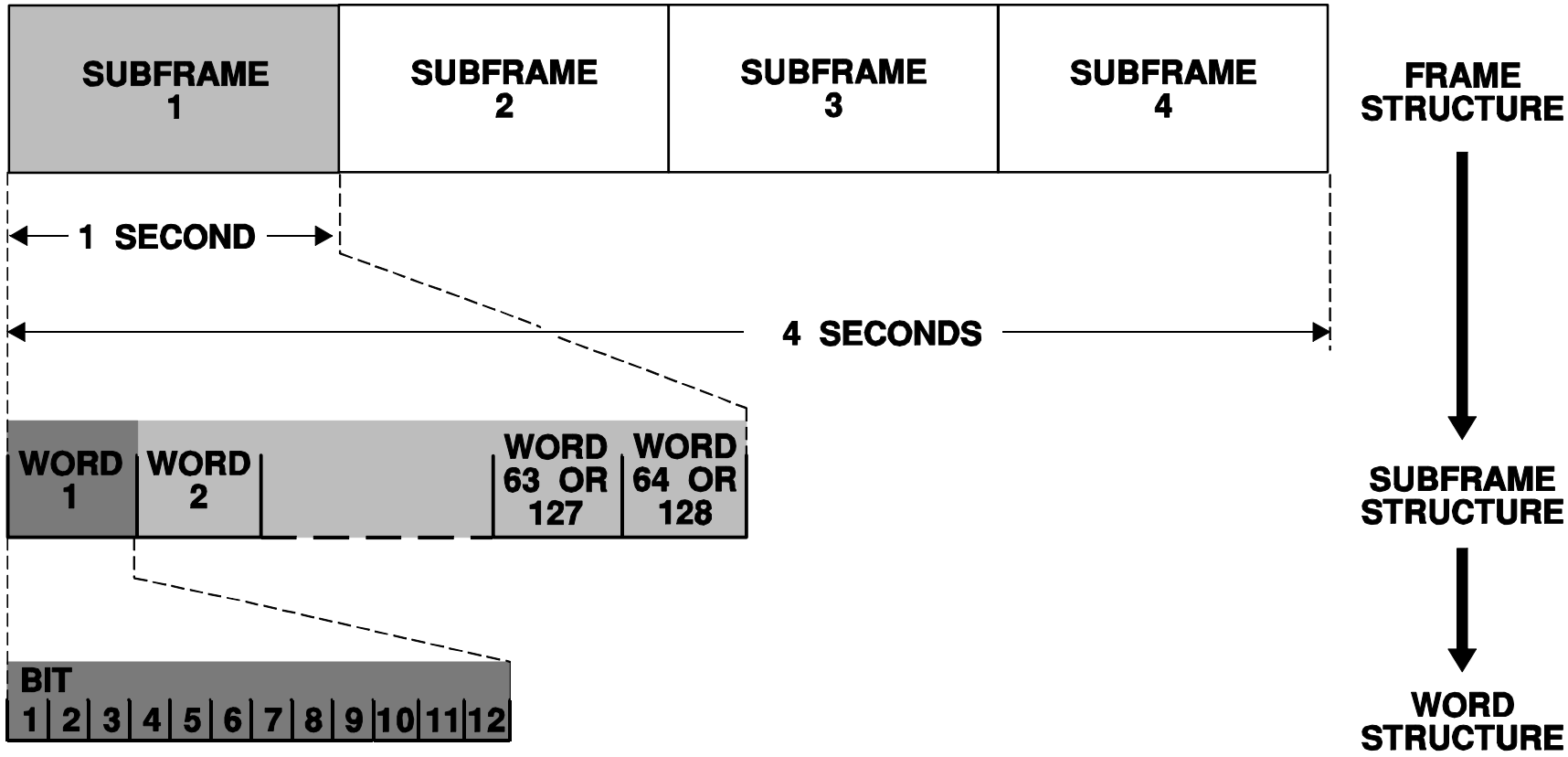
FRAME DESCRIPTION

The data is sent to the recorders on Frames which are composed of 4 subframes.

A Frame lasts 4 seconds and is repeated every 4 seconds.
Depending on the authority requirements, the subframe will contain 64 or 128 words of 12 bits.



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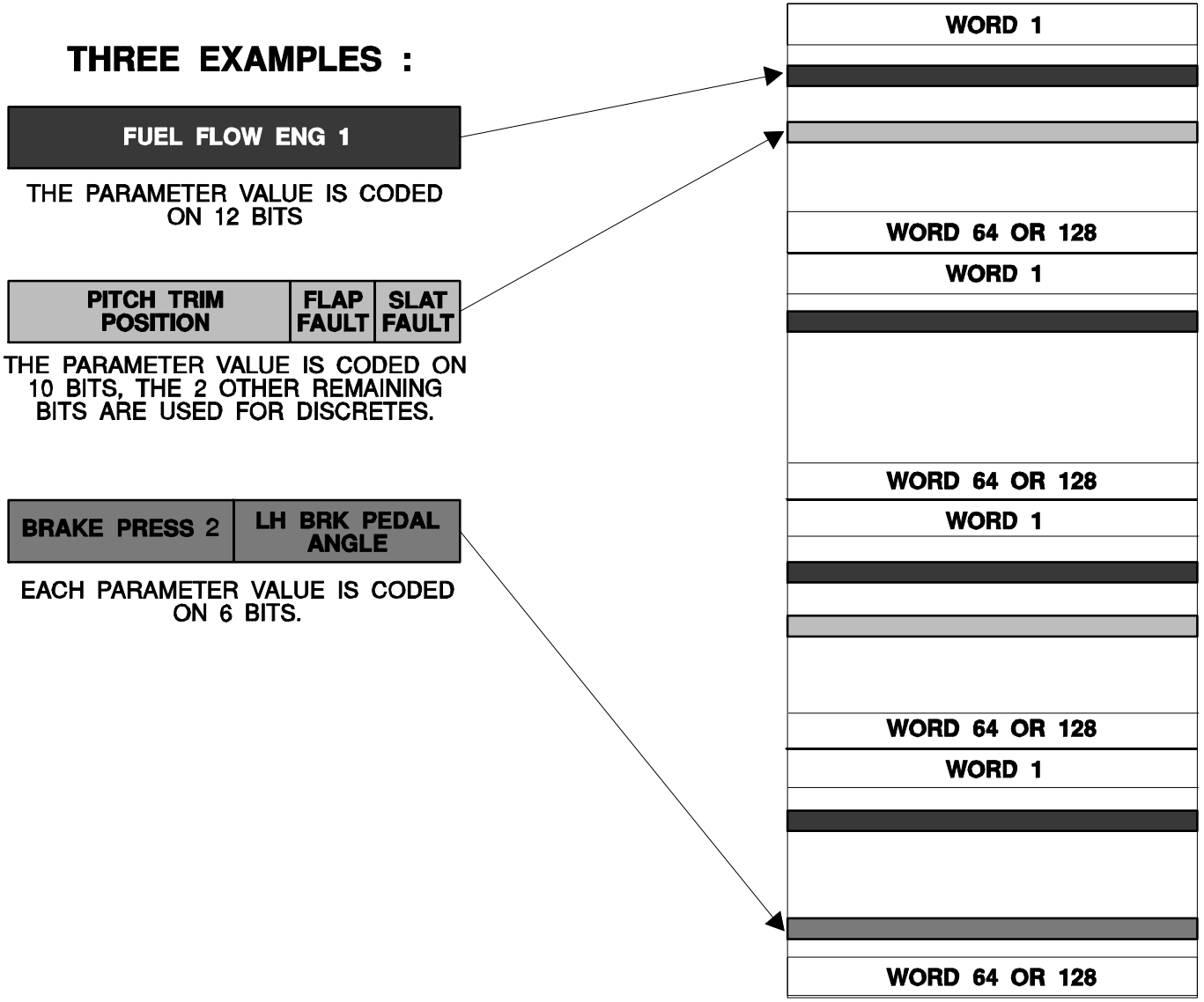
WORD ASSIGNMENT

The collected parameters are transmitted from the FDIU to the recorders and stored in defined word slots.

Most of the parameters are repeated every second, some every 2 seconds or every 4 seconds.
One word can contain one or several parameters.

It should be noted that acceleration data is transmitted more often than every second and documentary data less often than every 4 seconds.

THREE EXAMPLES :



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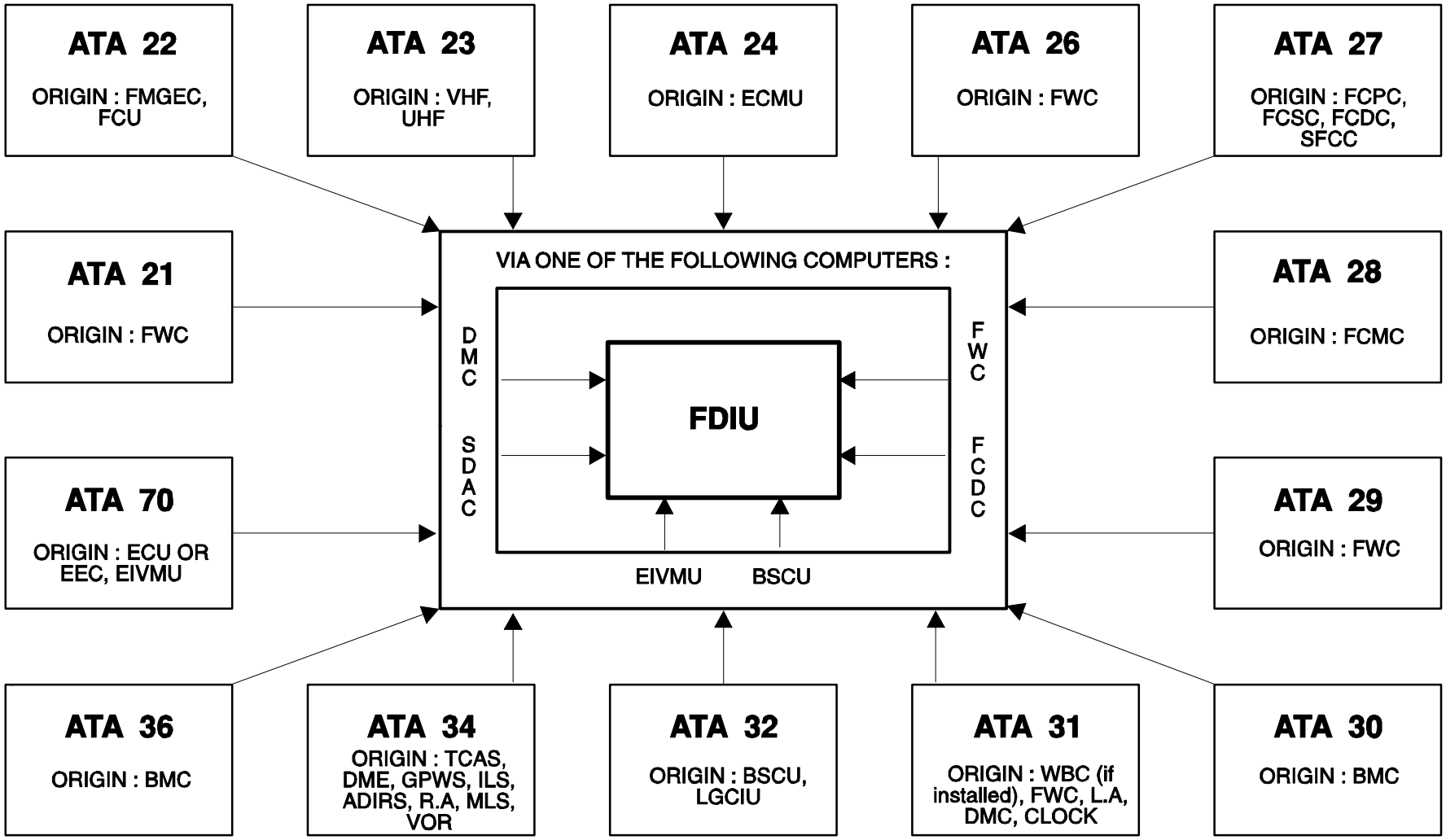
DATA SOURCE

Up to 330 mandatory parameters from 30 computers, receivers or transceivers can be transmitted to the Flight Data Interface Unit and recorded.



FQW4200 GE Metric

STUDENT NOTES:

FLIGHT DATA INTERFACE UNIT (FDIU) INTERFACES

General
Clock
System Data Acquisition Concentrator (SDAC) 1, 2
Flight Warning Computer (FWC) 1, 2
Display Management Computer (DMC) 1, 2, 3
Flight Control Data Concentrator (FCDC) 1, 2
Braking and Steering Control Unit (BSCU)
Engine Interface and Vibration Monitoring Units (EIVMUs)
Central Maintenance Computer (CMC) 1, 2
Data Management Unit (DMU) (OPTION)
DFDRS Coding Panel (DCP)
Event
Flight Data Recorder (FDR)
Quick Access Recorder (QAR) (OPTION)
Cockpit Voice Recor (CVR)

GENERAL

The Flight Data Interface Unit (FDIU) is connected by ARINC 429 buses to various computers which receive A/C and engine data to be recorded by the Flight Data Recorder (FDR) and the Quick Access Recorder (QAR) if installed; it is also connected by ARINC 429 buses to the Central Maintenance Computers (CMCs).

The FDIU is also provided with discrete Inputs/Outputs for DFDRS Coding Panel (DCP), pin programming, system status and for the EVENT pushbutton.

CLOCK

The FDIU receives the time information from the Clock on one ARINC 429 bus.

SYSTEM DATA ACQUISITION CONCENTRATOR (SDAC) 1, 2

The FDIU receives data from each System Data Acquisition Concentrator on an ARINC 429 bus.
It sends one discrete signal to each System Data Acquisition Concentrator (SDAC).

The parameters received are the following :

- the 3 axes acceleration from the Linear Accelerometer (LA),
- radio communication keying from VHF and HF transceivers,
- AC electrical power bus status from Electrical Contactor Management Units (ECMUs),
- DC electrical power bus status,
- bleed, air conditioning and pneumatic ice protection status from Bleed Monitoring Computers (BMCs),
- LP fuel valve position from Engine Electronic Controller (EECs),

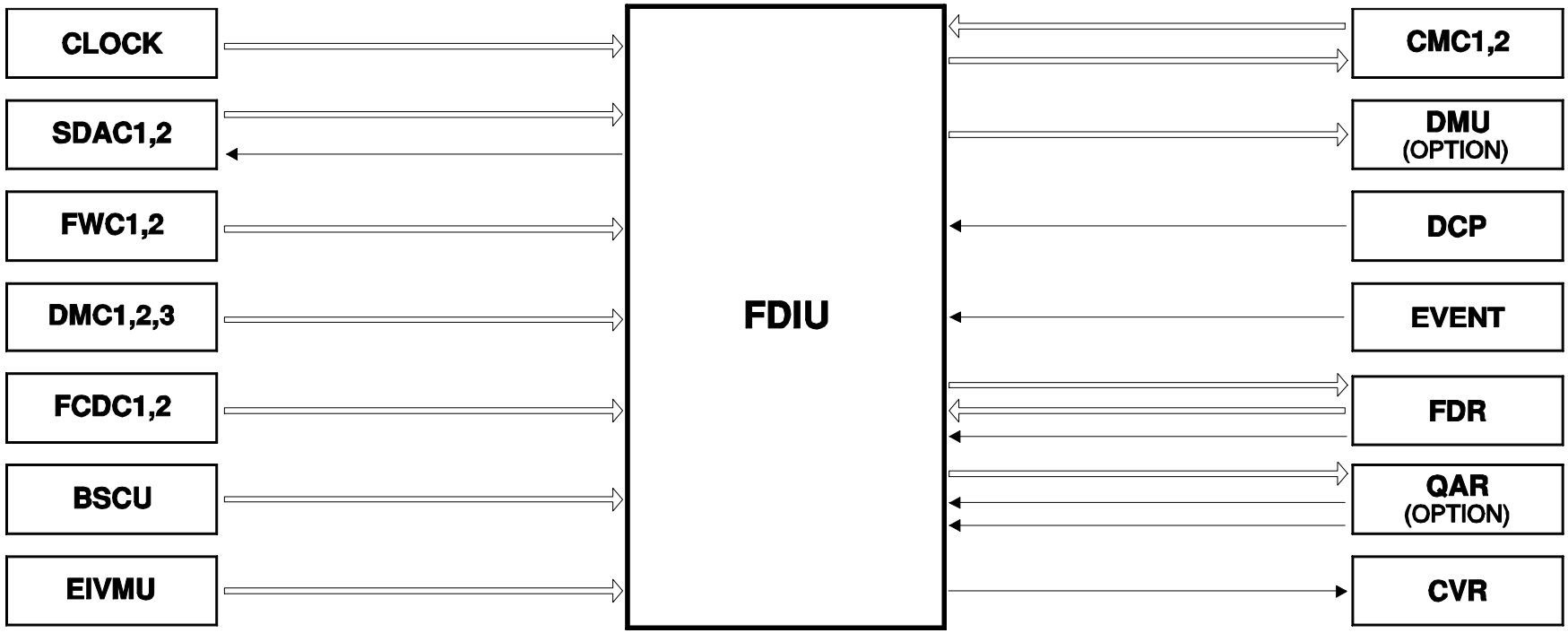
The discrete output is the FDIU status line for the CMCs.

FLIGHT WARNING COMPUTER (FWC) 1, 2

The FDIU receives data from each Flight Warning Computer (FWC) on an ARINC 429 bus.

The parameters received are the following :

- warnings and computer failures,
- landing gear status from Landing Gear Control and Interface Units (LGCIUs),
- ECAM status,
- engine start valve position from BMCs,
- flight phase information.



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DISPLAY MANAGEMENT COMPUTER (DMC) 1, 2, 3

The FDIU receives data from the Display Management Computers on ARINC 429 buses.

The parameters received are the following :

- air data and navigation information from Air Data/Inertial Reference Units (ADIRUs),
- engine information from Engine Electronic Controllers (EECs),
- flaps and slats position from Slat Flap Control Computers (SFCCs),
- auto flight system information from Flight Management Guidance and Envelope Computers (FMGECs),
- radio navigation information from ILS and VOR receivers, Radio Altimeter (RA), Distance Measuring Equipement (DME) and Traffic Collision Avoidance System (TCAS) transceivers,
- Electronic Flight Instrument System (EFIS) and flight guidance selection from Flight Control Unit (FCU),
- Electronic Centralized Aircraft Monitoring (ECAM) control and switching panel selections,
- Gross Weight and Center of Gravity from Weight and Balance Computers (WBCs) if installed,
- fuel quantity in trim tank from Fuel Control and Monitoring Computers (FCMCs),
- fuel flow from EECs.

FLIGHT CONTROL DATA CONCENTRATOR (FCDC) 1, 2

The FDIU receives data from each Flight Control Data Concentrator on an ARINC 429 bus.

The parameters received are the following :

- spoiler position and speed brake selection from Flight Control Primary Computers (FCPCs),
- roll, pitch and yaw control surface positions and pilot inputs from FCPCs and Flight Control Secondary Computers (FCSCs),
- pitch trim position from FCPCs.

BRAKING AND STEERING CONTROL UNIT (BSCU)

The FDIU receives the brake pressure, auto brake status and pedal positions from the Braking/Steering Control Unit on 2 ARINC 429 buses.

ENGINE INTERFACE AND VIBRATION MONITORING UNITs (EIVMUs)

The FDIU receives data from each Engine Interface and Vibration Monitoring Unit on an ARINC 429 bus.

The parameters received are the following :

- engine identification,
- oil quantity, engine vibration and HP fuel valve position from EECs.

CENTRAL MAINTENANCE COMPUTER (CMC) 1, 2

The FDIU sends data to Central Maintenance Computer 1 and 2 on an ARINC 429 bus and receives data from Central Maintenance Computer 1 on another one.

The FDIU dialogues with the CMCs for bite and tests; it receives flight number and city pair information from CMC1.

DATA MANAGEMENT UNIT (DMU) (OPTION)

The FDIU sends FDR parameters to the Data Management Unit through an ARINC 429 bus for recording.

DFDRS CODING PANEL (DCP)

The FDIU receives the A/C tail number, Airline ident, Fleet ident and FDR record version from the DFDRS Coding Panel on discrete inputs.

The FDIU receives the A/C type information by pin programming on discrete inputs.

EVENT

The FDIU receives the Event signal from the EVENT pushbutton on one discrete input.

FLIGHT DATA RECORDER (FDR)

The FDIU sends the data for recording to the FDR in Havard biphase format on one output bus and receives the playback data in the same format on one input bus.

The FDIU receives one discrete signal for FDR status (BITE IN), which it sends to the CMCs.

QUICK ACCESS RECORDER (QAR) (OPTION)

The FDIU sends the data for recording to the QAR in bipolar RZ format on one bus.

The FDIU receives 2 discrete signals for QAR status which it sends to the CMCs.

COCKPIT VOICE RECORDER (CVR)

The FDIU sends an audio output to the CVR via Audio Management Unit (AMU), which is encoded with the time, to provide synchronisation of the FDR and CVR.

STUDENT NOTES:

COMPONENTS

Safety Precautions
Flight Data Interface Unit (FDIU)
Flight Data Recorder (FDR)
Linear Accelerometer (LA)
DFDRS Coding Panel (DCP)

SAFETY PRECAUTIONS

The avionics computers are Electrostatic Sensitive Devices (ESDs).
These components are susceptible to damage by electrical sources that would not damage conventional components.
The low energy source, that most commonly destroys ESDs, is the human body which generates static electricity in conjunction with the ground.

The precautions to follow are:

- de-energize all power and signal sources
- place the unit on a grounded conductive work surface
- ground any tools that will contact the unit...

when it is specified on the maintenance manual.

STUDENT NOTES

FLIGHT DATA INTERFACE UNIT (FDIU)

FIN : 2TU ZONE : 120

COMPONENT DESCRIPTION

The FDIU is a unit with modules for collecting parameters and converting them into a recordable form.

FLIGHT DATA RECORDER (FDR)

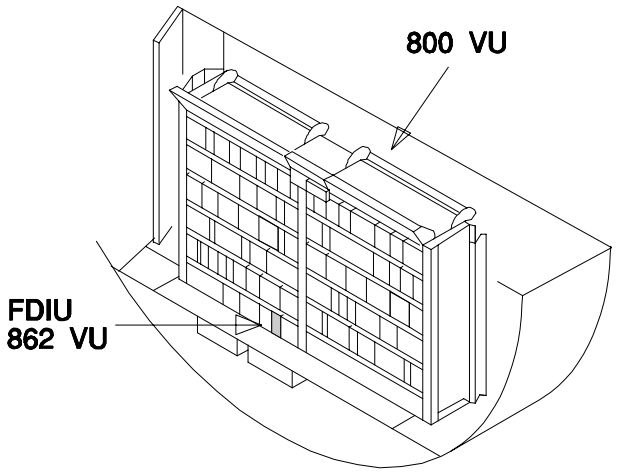
FIN : 1TU ZONE : 310

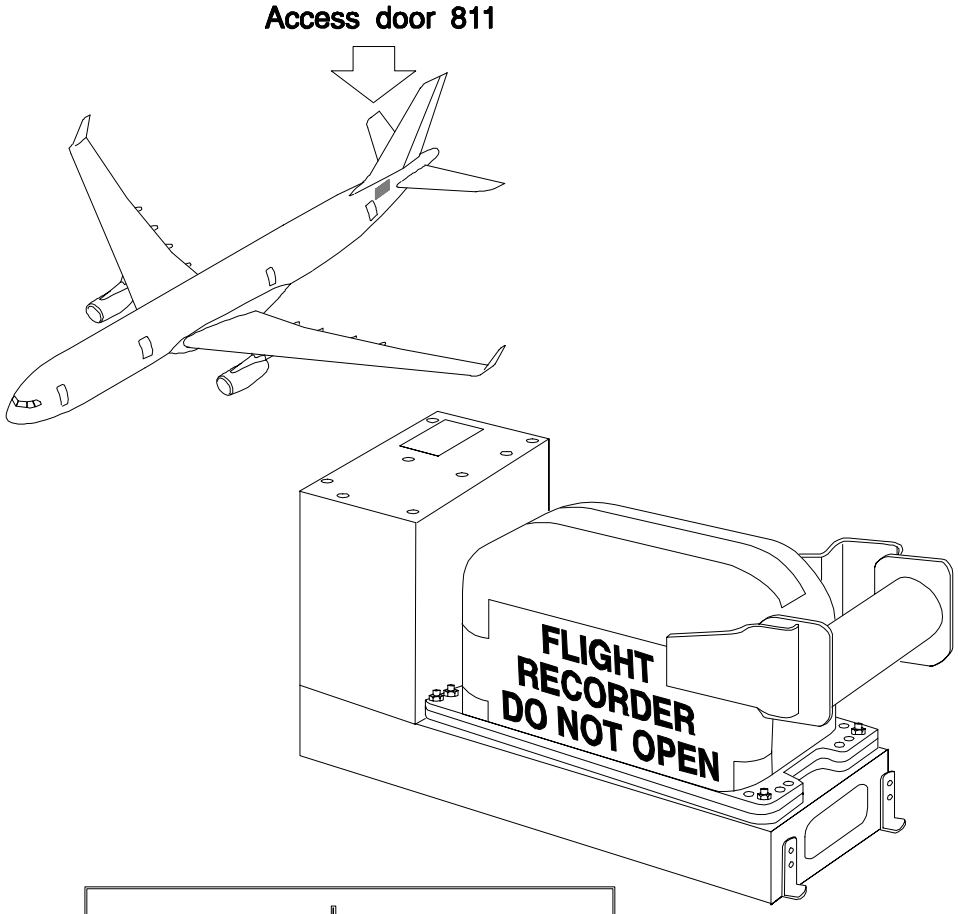
COMPONENT DESCRIPTION

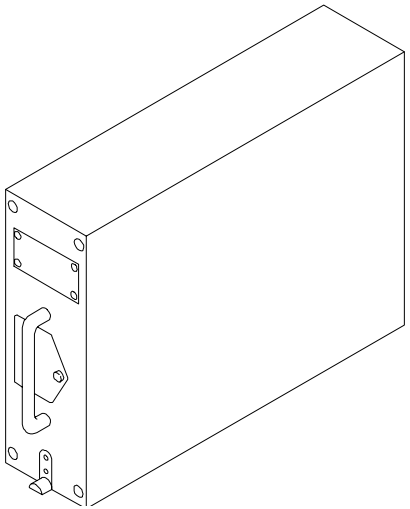
The FDR is a solid state memory recorder controlled by a microcomputer. The FDR has an Underwater Locating Beacon (ULB) attached to the front panel. Maintenance has to be performed at determined time intervals to replace the battery of the ULB. The FDR is provided with a front connector for manufacturer test equipment and data transfer to the Data Loader.

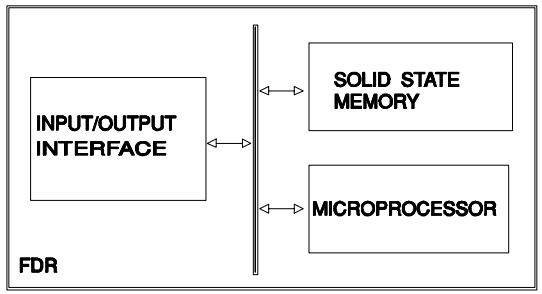
SPECIAL DESIGN

The FDR is located in the unpressurized area of the rear fuselage.









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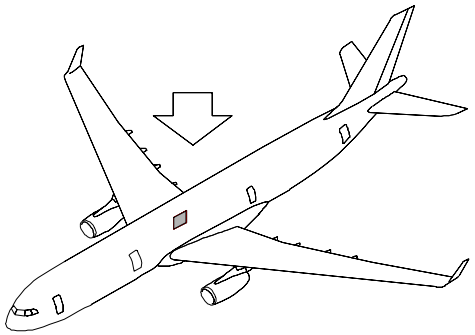
LINEAR ACCELEROMETER (LA)

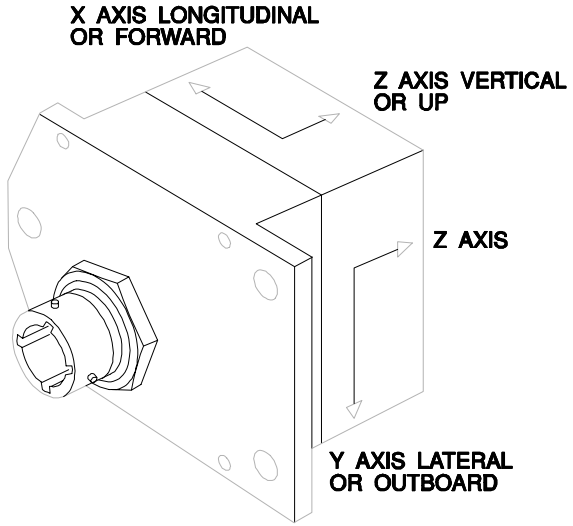
FIN : 6TU ZONE : 140

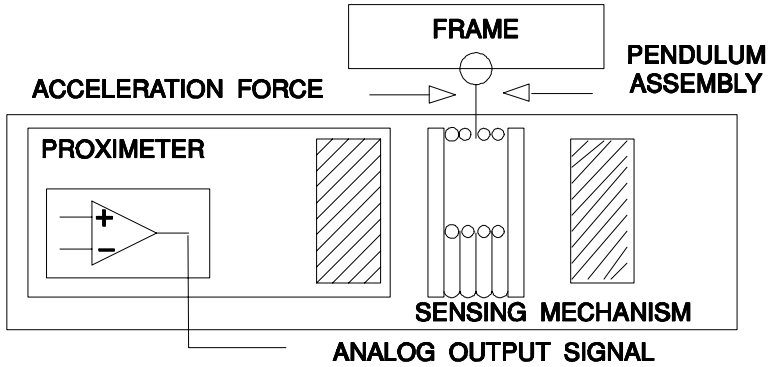
COMPONENT DESCRIPTION

The acceleration force moves a pendulum in the sensing mechanism. A proximeter senses the movement which generates a signal proportional in amplitude to the movement.



The LA is located in the center fuselage, below floor panel 251 WF.





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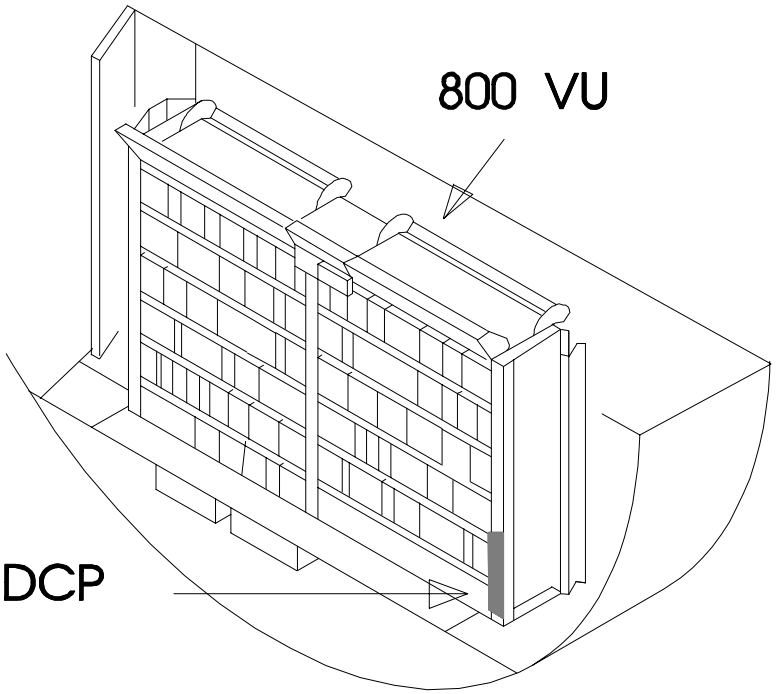
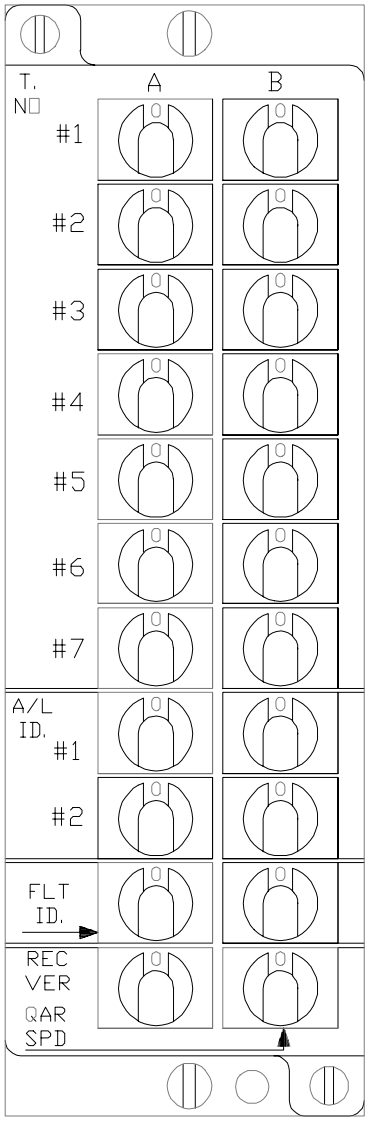
DFDRS CODING PANEL (DCP)

FIN : 14TU ZONE : 120

COMPONENT DESCRIPTION

The DCP is a device used to quickly modify the pin programming of the FDIU.
The DCP contains 22 micro rotary selector switches. Each switch has 8 set positions for octal coding.





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STUDENT NOTES

ACMS PRESENTATION

General
DMU
A/C Systems
DAR (OPTION)
MCDU
Printer
ACARS (OPTION)
MDDU (OPTION)
GSE (OPTION)

GENERAL

The main functions of the Aircraft Condition Monitoring System (ACMS) are to process aircraft performance monitoring, engine and APU condition monitoring and trouble shooting assistance.
The ACMS consists of :

- a Data Management Unit (DMU),
- a Digital ACMS Recorder (DAR) if installed,
- a readout function through the Ground Support Equipment (GSE),
- a reconfiguration function (through GSE).

Multipurpose Control Display Units (MCDU) numbers 2 and 3, Multifunction Disk Drive Unit (MDDU) if installed and printer are connected to the ACMS.

DMU

The DMU is a computer located in the avionics compartment which collects, stores and processes various aircraft system data. It is used to generate various condition reports.
The Smart ACMS Recorder (SAR) is a DMU function. This function allows the recording of compressed data, programmable through the Ground Support Equipment (GSE), in a DMU solid state memory. SAR data shall be retrieved by the MDDU, if installed.

A/C SYSTEMS

Engine parameters, APU parameters and aircraft parameters are sent to the Data Management Unit for data processing.

DAR (OPTION)

The purpose of the DAR is to store data on a replaceable cassette for on ground performance, maintenance or condition monitoring tasks.
Preprogrammed selection of data programmable through the GSE can be stored on the DAR.

MCDU

MCDUs numbers 2 and 3 are linked to the DMU. They are used to display data, program and also control the system.

PRINTER

The printer is used to print reports generated by the DMU and displays of the MCDU.
The printer can be automatically controlled by the DMU, manually controlled from the MCDU or activated using the ACMS print pushbutton.

ACARS (OPTION)

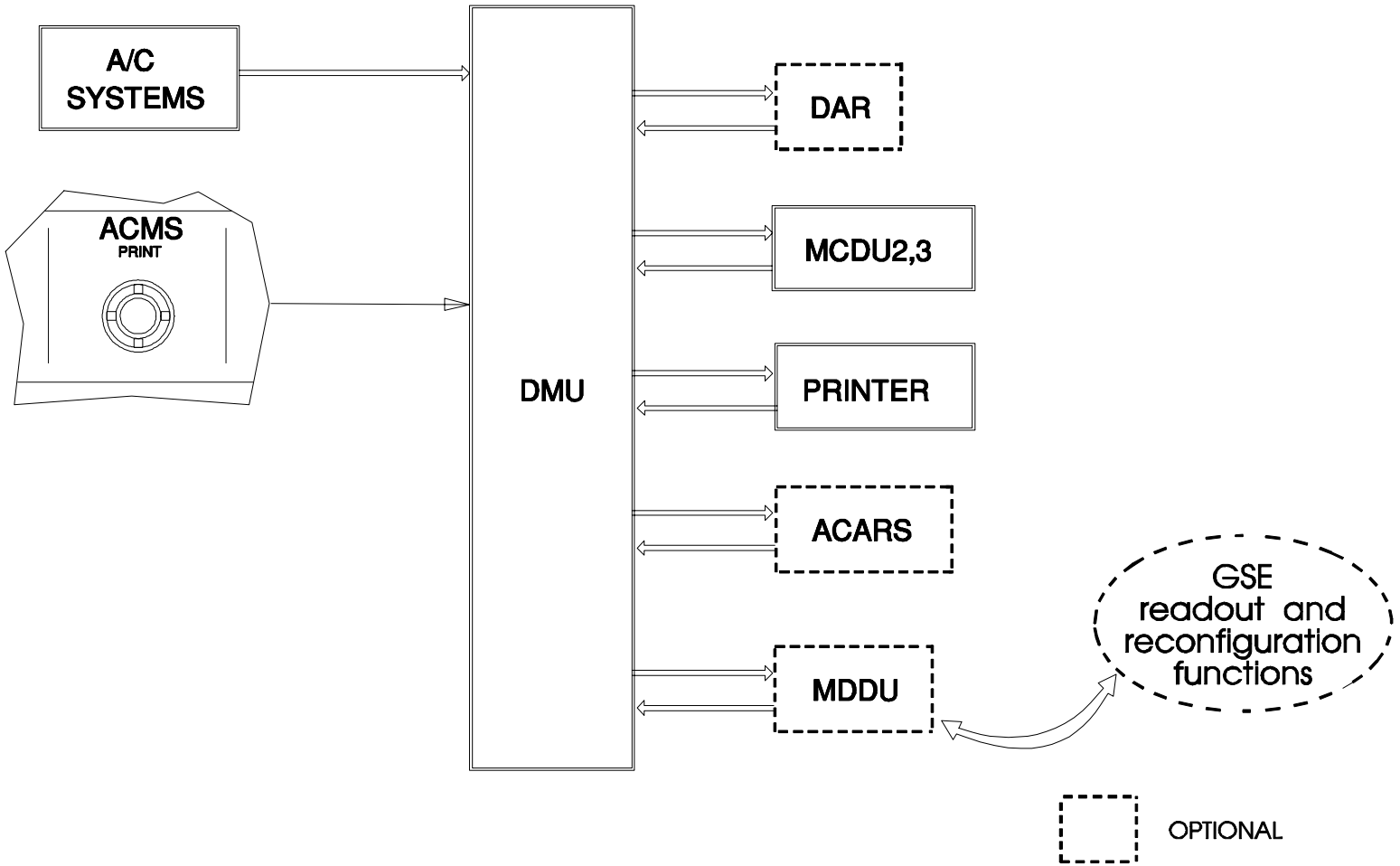
The Aircraft Communication Addressing and Reporting System Management Unit (ACARS MU) sends reports and broadcasts parameters generated by the DMU to a ground station via radio transmission. It also receives requests from the ground.

MDDU (OPTION)

The MDDU is a 3.5 inch floppy disk drive unit which allows DMU programming and data storage for ground readout.
The MDDU disk is accessed through a compatible personal computer using a set of software labelled Ground Support Equipment (GSE).

GSE (OPTION)

Readout function : the readout function allows the user to view ACMS report data and SAR data using a Personal Computer.
Reconfiguration function : the reconfiguration function allows the modification of existing monitoring functions and the implementation of additional monitoring functions.



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STUDENT NOTES:

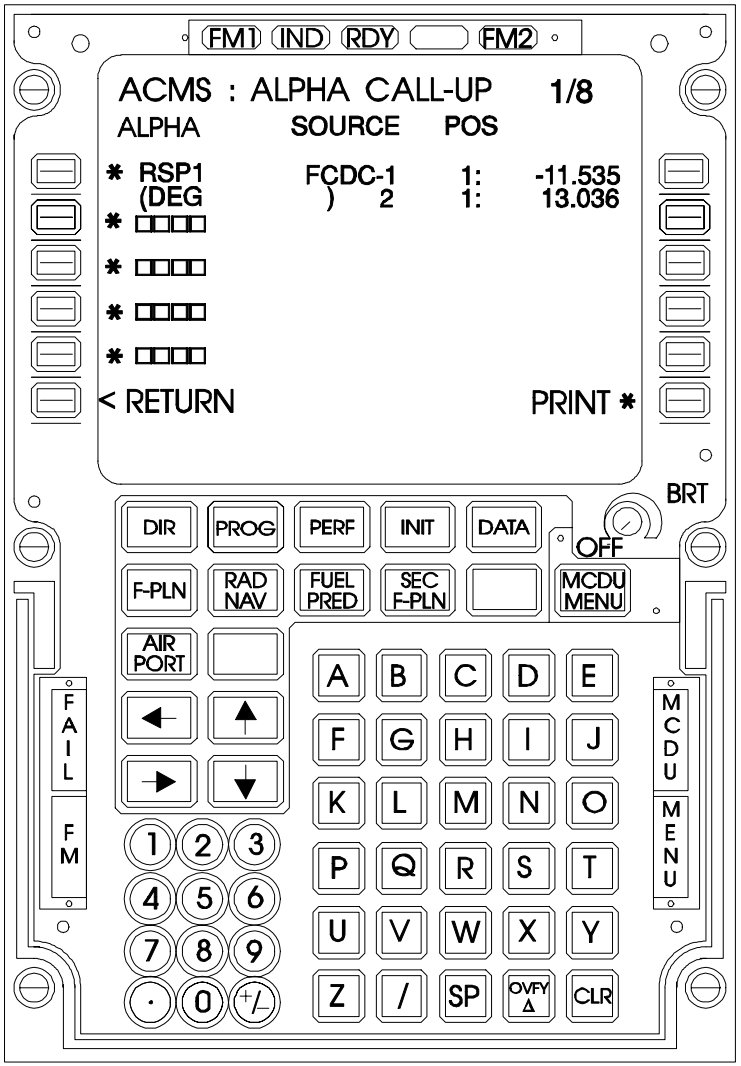
ACMS BASIC OPERATION

Real Time Parameter Read Out
ACMS Report Controls
Digital ACMS Recorder (DAR) Controls (if DAR installed)
Smart ACMS Recorder (SAR) Controls

REAL TIME PARAMETER READ OUT

Parameters delivered by aircraft systems can be called up and displayed in Real Time on the Multipurpose Control Display Unit by selecting one of the two functions : Parameter Alpha or Parameter Label.

Parameter Alpha callup will enable the display of parameters using the corresponding alpha numerical code (ie: RSP is the Roll Spoiler Position). Parameter Label will enable the display using the ARINC 429 characteristics. The user has the possibility to display all alpha callups available and DMU input ports.



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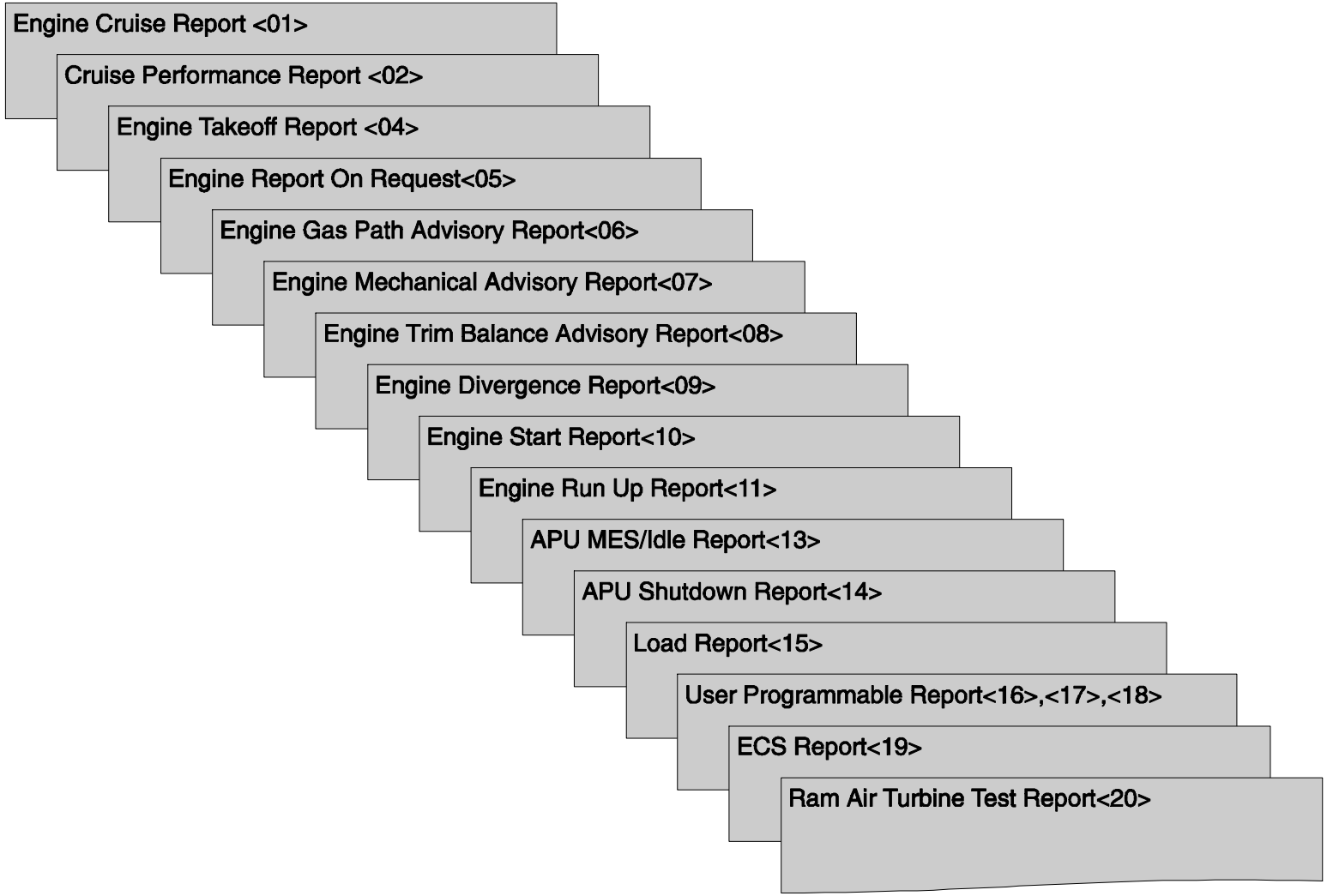
AIRCRAFT CONDITION MONITORING SYSTEM (ACMS) REPORT CONTROLS

The data stored and processed in the Data Management Unit can be read in the form of printed reports.
These reports can also be sent to the ground through the Aircraft Communication Addressing and Reporting System (ACARS) if installed or dumped on the Multipurpose Disk Drive Unit (MDDU) floppy disk if installed.
A report is a set of data related to a specific event (ie : limit exceedance of engine parameters).
There are 18 reports.

The Data Management Unit (DMU) generates these reports depending either on predefined program triggers, manually by the MCDU, by the remote print button or by the ACARS if installed (output defined by Ground Support Equipment (GSE)).

The printout can be activated automatically or manually through the MCDU or through the remote print button.



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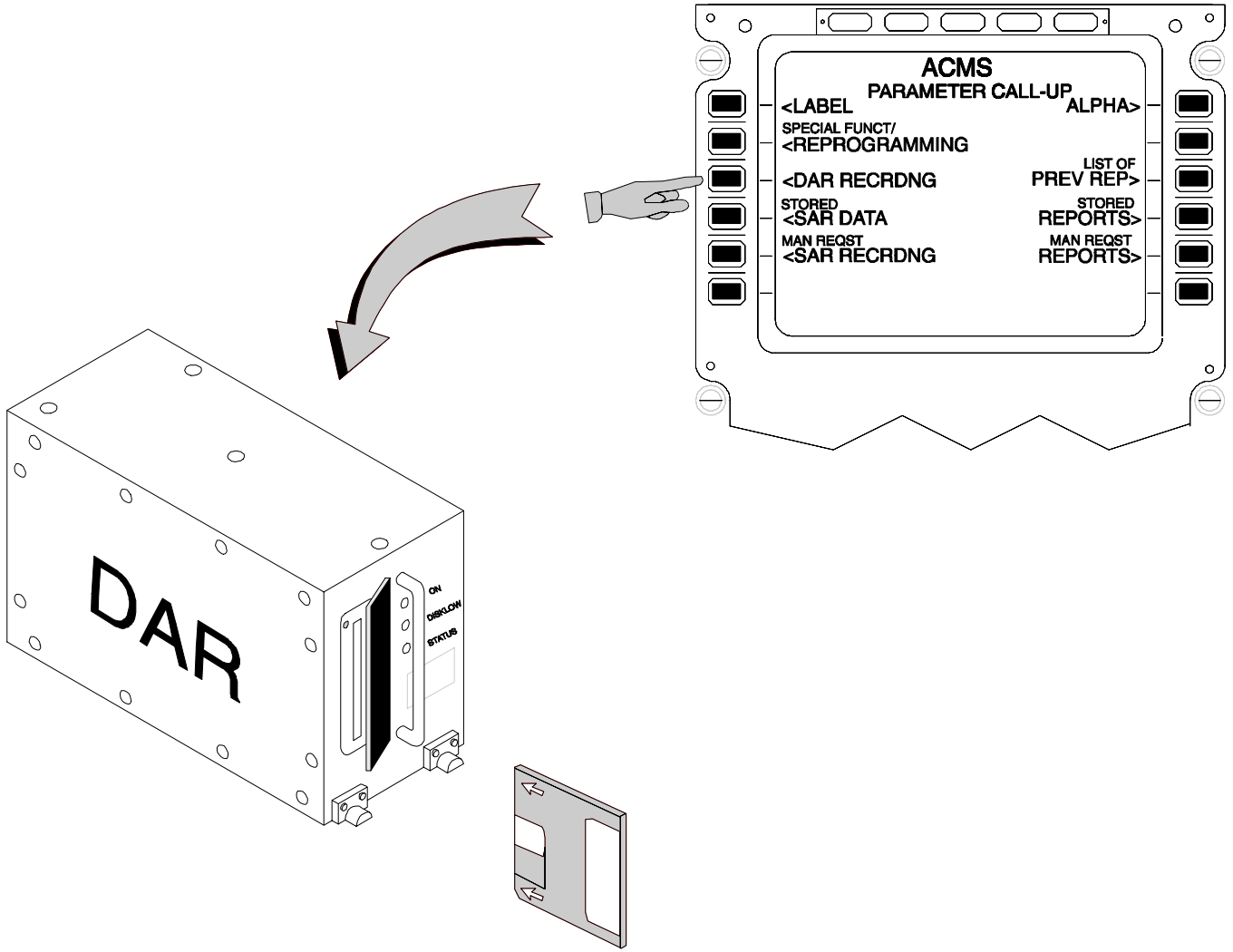
DIGITAL ACMS RECORDER (DAR) CONTROLS (IF DAR INSTALLED)

The Digital ACMS Recorder (DAR) records a specific set of data programmed in the Data Management Unit (DMU) which will be customized through the GSE.

Up to 512 words per second can be recorded.
The Digital ACMS Recorder (DAR) is started and stopped automatically by the DMU or manually through the MCDU.
The user has the possibility of real time display of up to 40 DAR data on 8 pages.



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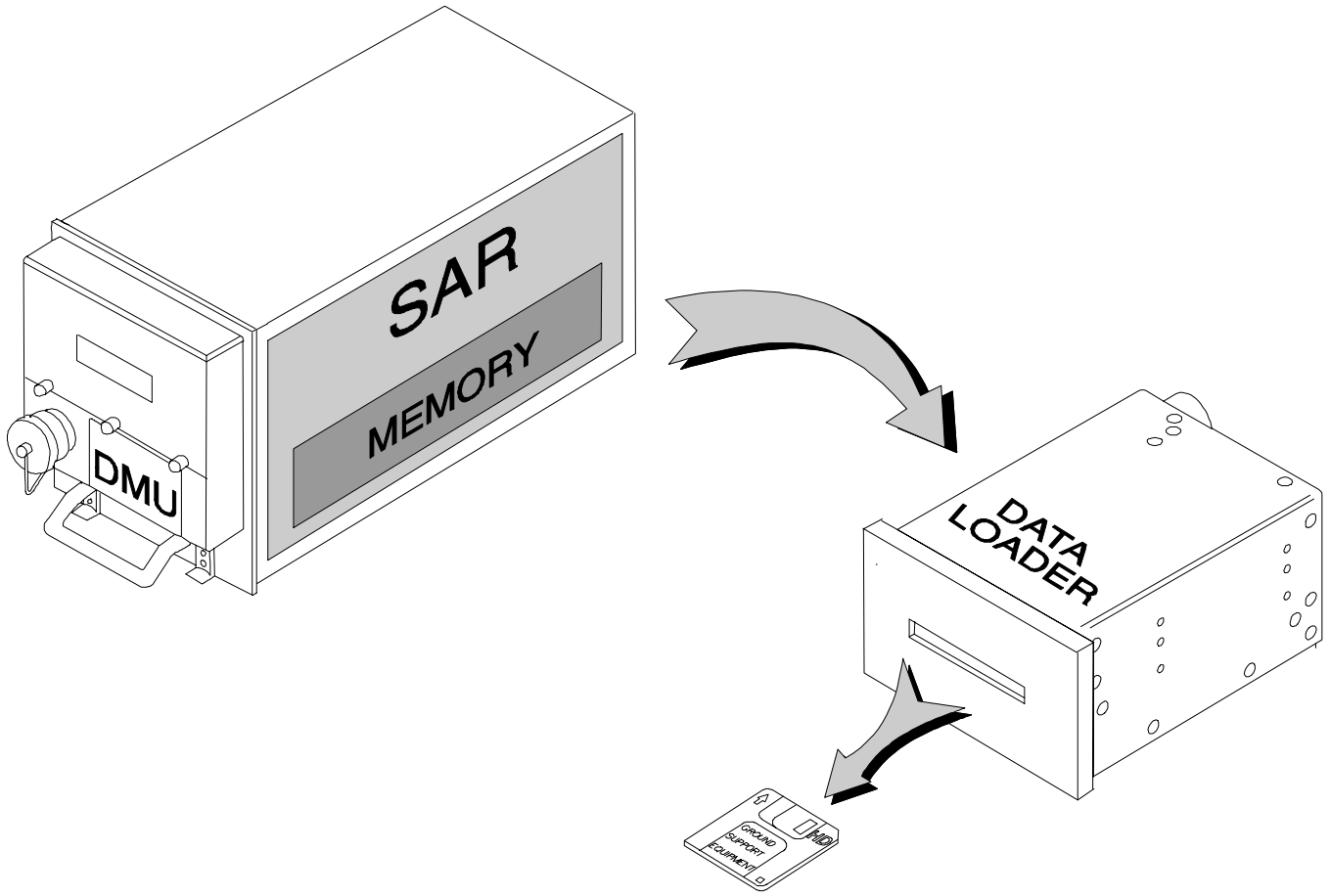
SMART ACMS RECORDER (SAR) CONTROLS

The Smart ACMS Recorder (SAR) records data in a DMU solid state memory.

The SAR recording is started and stopped automatically by the DMU or manually through the MCDU.

The stored SAR data files can be displayed on the MCDU and the stored SAR data can be dumped to the MDDU if installed.



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STUDENT NOTES:

ACMS MCDU MENU PRESENTATION

Parameter Alpha
Parameter Label
Reprogramming
Previous Reports
Stored Reports
Manual Request Reports
Stored Smart ACMS Recorder (SAR) Data
Manual Request SAR Recording
Digital ACMS Recorder (DAR) Recording Control (if DAR installed)

PARAMETER ALPHA

This function enables real time parameter read out.

The Multipurpose Control Display Unit (MCDU) may display in real time from one to 8 pages with up to 5 alpha callup parameters per page called using their alphanumeric identification. The user has the possibility to save the definitions of up to 8 sets of 40 alpha callups.

PARAMETER LABEL

The Parameter Label function also enables real time parameter read out. The parameters are called using Arinc 429 characteristics.

This function enables the display of 8 pages with up to 2 label callup parameters per page.
The display read out is in binary form.

REPROGRAMMING

This is the access to the Reprogramming Menus. This reprogramming is performed at the engineering level.
A password is necessary to reprogram the system.

The reprogrammable features are, for example :

- Inhibit of report generation,
- reset trigger logics,
- changed report constants and statistic counters,
- displayed documentary data,
- arming of the Ram Air Turbine Test.

PREVIOUS REPORT

Previous Reports displays a list of the last twenty reports generated by the Data Management Unit.

The list provides the leg, date, UTC, report number and trigger code.

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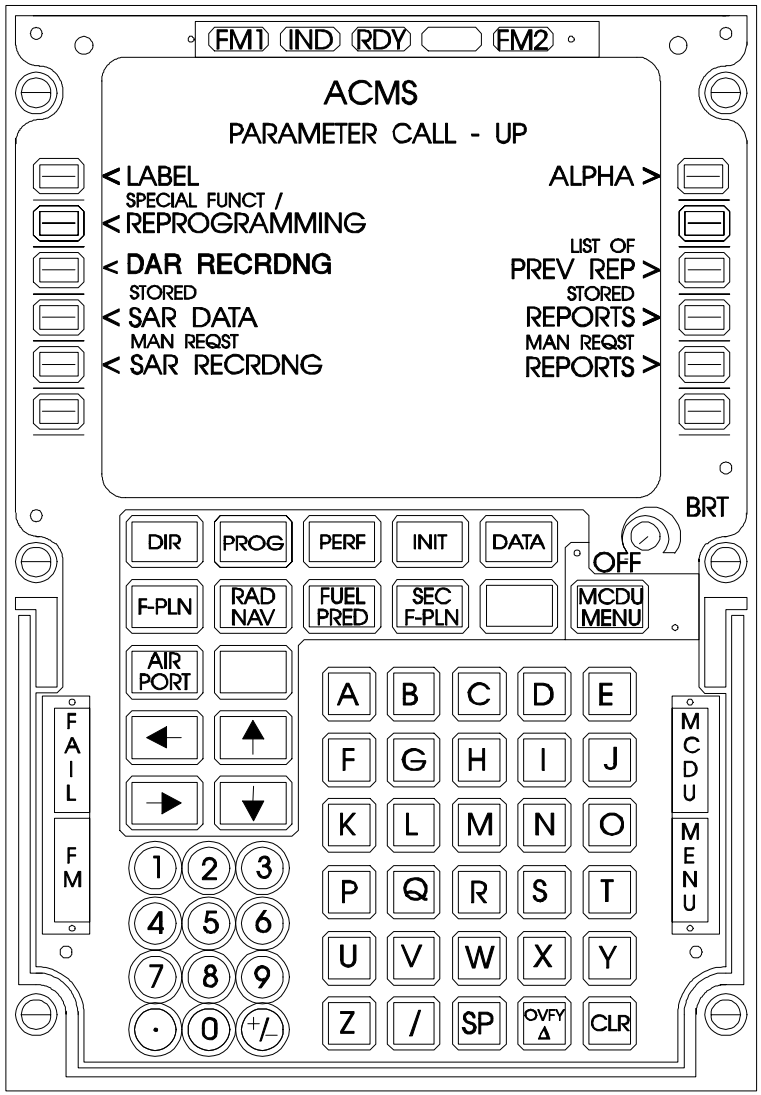

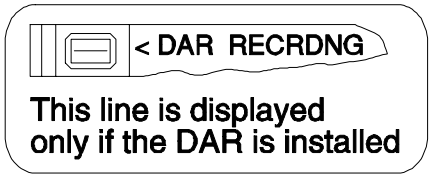

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STORED REPORTS

This option gives the possibility to print, to downlink if ACARS installed and to dump on the Multipurpose Disk Drive Unit floppy disk if installed any of the reports stored in the Data Management Unit.

MANUAL REQUEST REPORTS

This is the Manual Request Report option.
It gives all the report names and associated numbers.

The reports can be generated and then printed, sent if ACARS installed or dumped manually if MDDU installed.

STORED SMART ACMS RECORDER (SAR) DATA

This option displays all Smart ACMS Recorder files of a stored selected Smart ACMS Recorder channel.

The selected SAR channel or individual SAR file can be dumped on the MDDU floppy disk if installed.

MANUAL REQUEST SAR RECORDING

This option provides all the Smart ACMS Recorder channels with their selective start/stop controls.

DIGITAL ACMS RECORDER (DAR) RECORDING CONTROL (IF DAR INSTALLED)

This function provides manual start and stop of the DAR, allows viewing of up to 8 pages of 5 selected DAR words in real time.
It also displays information on the programming of the DAR function.

PRINT REPORT STANDARD HEADER DESCRIPTION

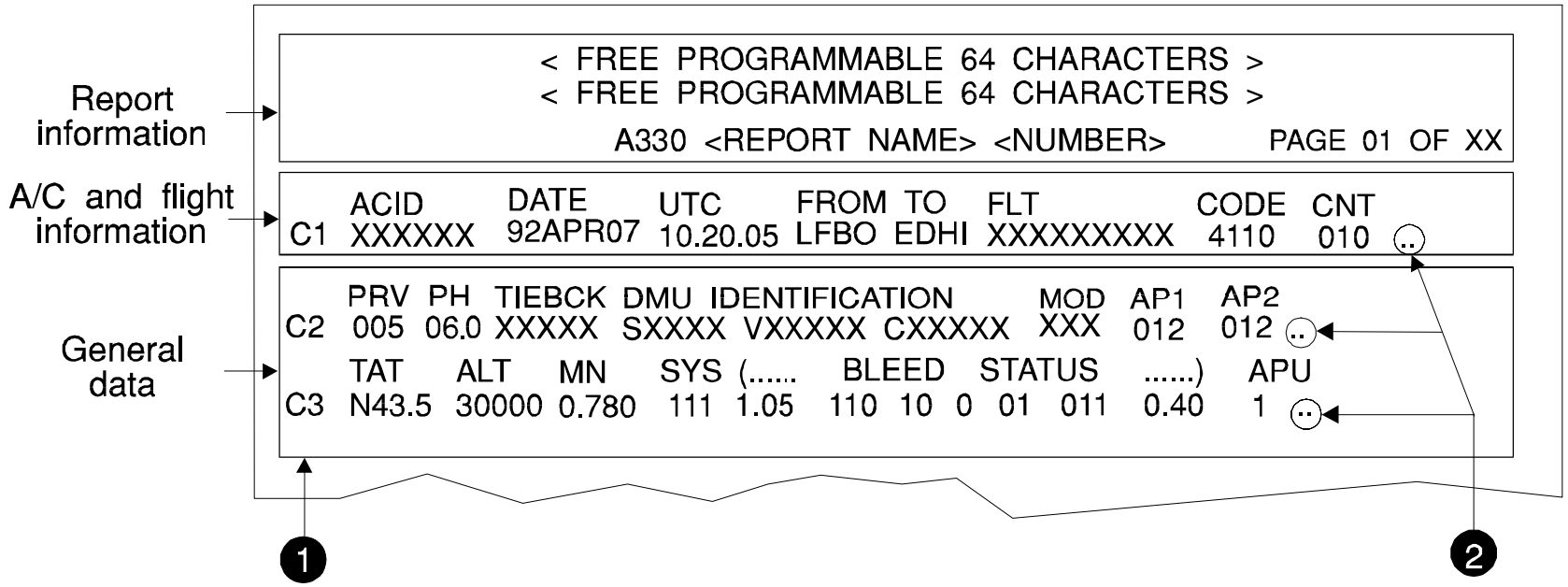
General
Report Information
Aircraft And Flight Information
Trigger Codes
General Data/1
General Data/2

GENERAL

A standard header is printed on each report.
It is composed of information about the report at the top, information about the flight and codes for report trigger conditions in the middle and general data at the bottom.

1. Each data line starts with two identification letters.

2. A checksum is printed in 2 hexadecimal characters at the end of each data line.



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REPORT INFORMATION

2 free programmable lines are available for airline specific messages. Another line contains the report identification, title and number.

A/C AND FLIGHT INFORMATION

1. A/C identification (tail number).
2. Date (year.month.day).
3. Universal Time Coordinated (hours.minutes.seconds).
4. City pair.
5. Flight number.

TRIGGER CODES

The 3 left digits of the code are the logic code number which triggered the report.
The last digit shows the number of consecutive issued reports or the letter 'T' if the report was triggered via Aircraft Communication Addressing and Reporting System (ACARS) if installed.

Trigger codes :

1000 : manual selection via Multipurpose Control and Display Unit (MCDU),

2000 : flight phase dependent manual selection via remote print button if programmed,

3XXX : programmable start logic,

4000 to 7000 : for these codes, refer to the table in the Aircraft Maintenance Manual (AMM) (ATA 31-36-00).
Reports are triggered by a combination of logic conditions.

Report count :
These 3 digits are the number of reports that were previously initiated, either automatically or by the remote print button.

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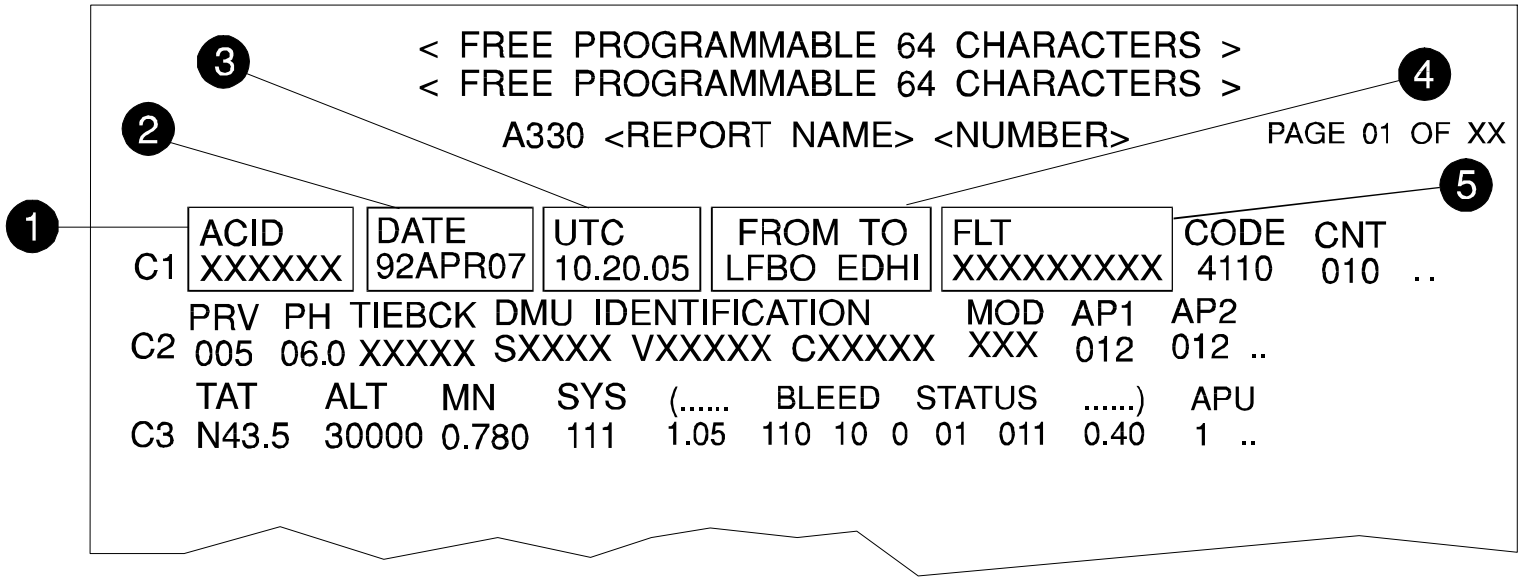

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GENERAL DATA /1

1. Previous report.
These 3 digits are the report type number of the previously generated report.

2. Flight phase.

3. When a report is generated by ACARS (if installed) a request is sent. This request contains an appropriate ACARS Tieback code with 6 characters.

4. The Data Management Unit (DMU) software is identified with 3 part numbers.
The System, the Version and the Customer software part numbers.

5. Temporary modifications.
This is a 3 digit counter which determines the expiration time of temporary modifications of constants.

6. Auto Pilot 1 or 2 status (ie:012 means altitude hold mode active).

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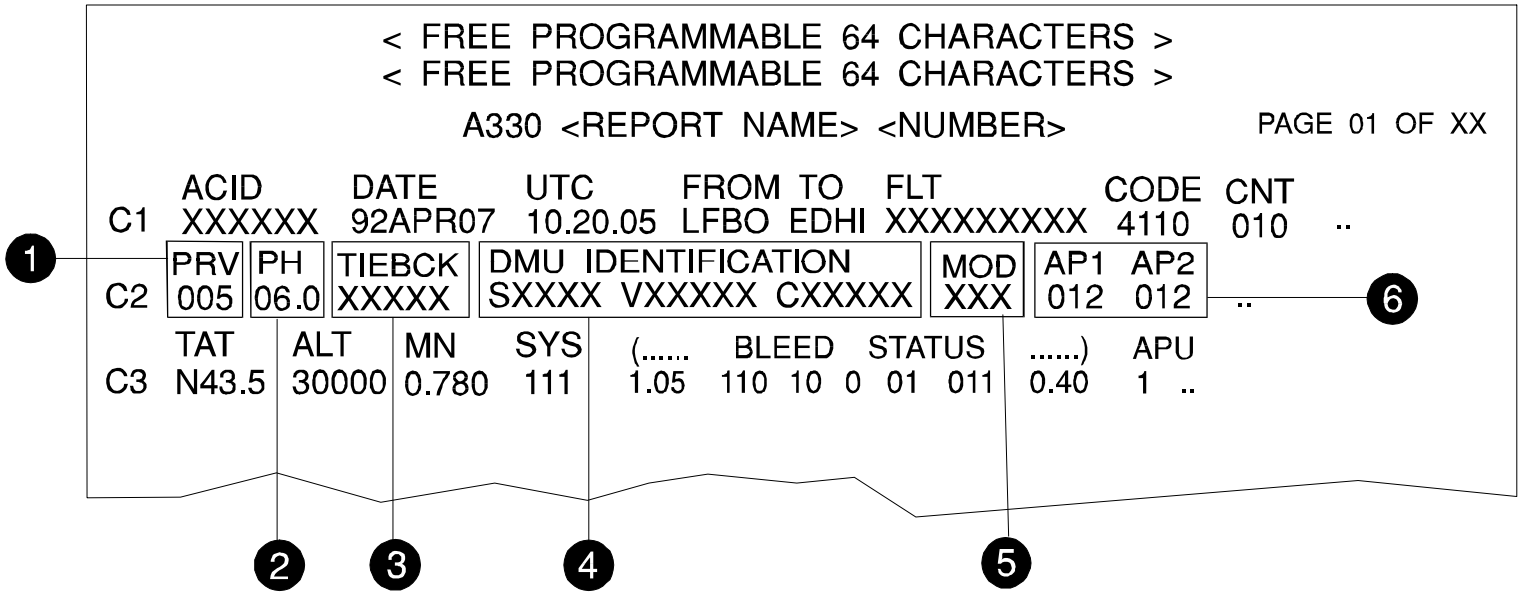

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GENERAL DATA /2

1. Total Air Temperature.
Negative value is indicated by 'N' and positive value by '0' on the first character.

2. Standard Altitude.
Negative value is indicated by 'N' on the first character.
Otherwise the first position is used for the value.

3. Mach number.

4. Each digit indicates the Air Data/Inertial Reference Unit (ADIRU) number of the respective Total Air Temperature (TAT), Altitude (ALT) and Mach Number (MN) values.

5. Indicates the Auxiliary Power Unit (APU) bleed valve position (1→ open, 0 → closed).

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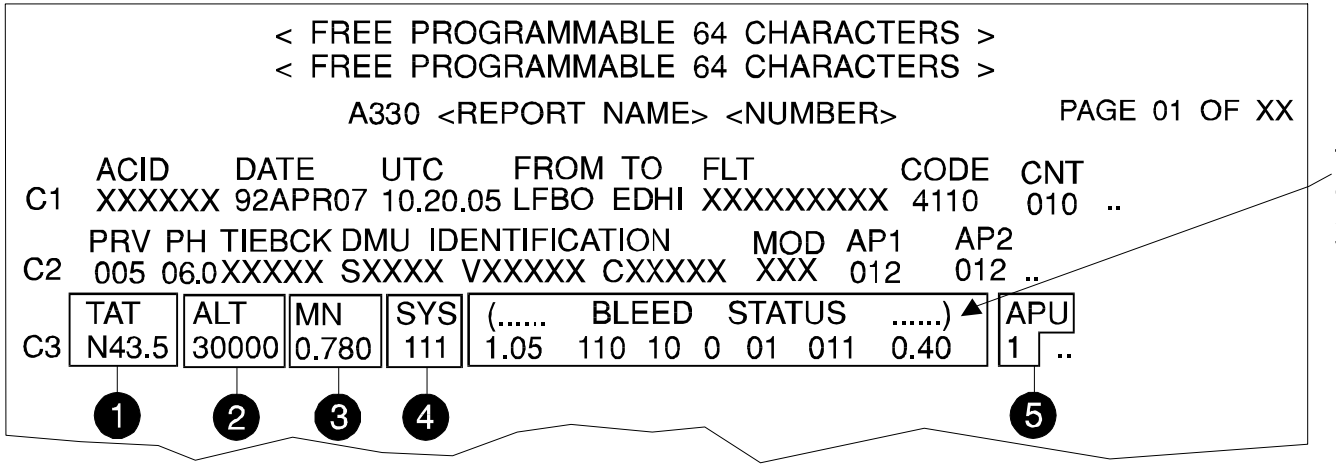

This data is the discrete coded information and numerical values for the bleed status.

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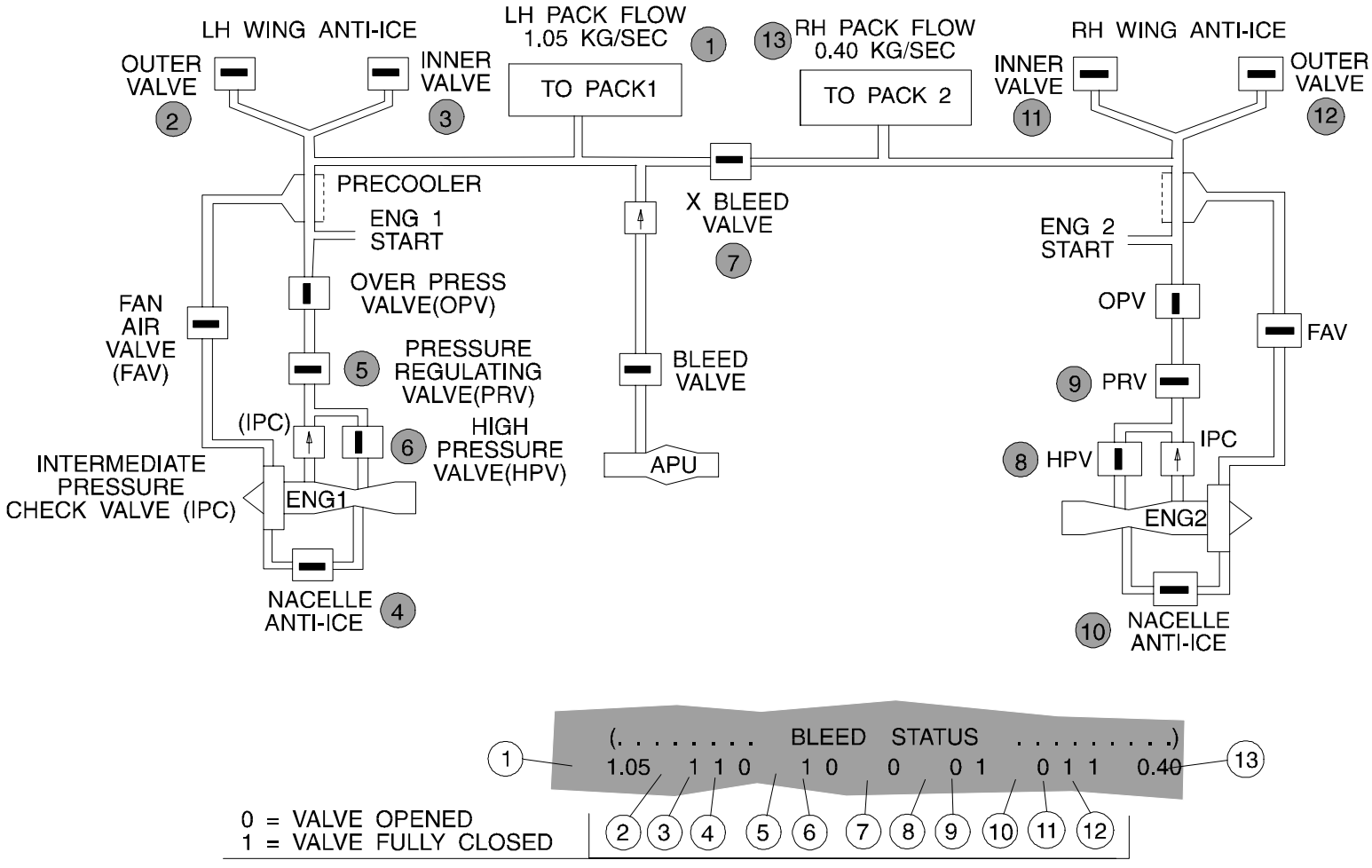

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STUDENT NOTES

STUDENT NOTES:

INDIVIDUAL PRINT REPORT DESCRIPTION

General
Engine Cruise Report <01>
Cruise Performance Report <02>
Engine Take off Report <04>
Engine Report On Request <05>
Engine Gas Path Advisory Report <06>
Engine Mechanical Advisory Report <07>
Engine Trim Balance Advisory Report <08>
Engine Divergence Report <09)
Engine Start Report <10>
Engine Run Up Report <11>
APU MES/Idle Report <13>
APU Shutdown Report <14>
Load Report <15>
User Programmable Report <16>,<17>,<18>
ECS Report <19>
Ram Air Turbine Test Report <20>

GENERAL

There are 4 categories of preprogrammed reports :
- engine monitoring,
- APU monitoring,
- environmental condition system,
- Ram Air Turbine,

and 3 programmable reports for trouble shooting assistance.

These reports are triggered and generated when specific conditions are met.

All the reports can be printed from the MCDU and some through the remote print button or sent through Aircraft Communication Addressing and Reporting System (ACARS), if installed, or dumped on the Multipurpose Disk Drive Unit (MDDU), if installed.
The parameters contained in the reports are among the 300 parameters provided with an alpha call-up.

Some Report data items are reconfigurable through Ground Support Equipment (GSE), such as :

report limits, constants, parameter conversion factor, report time and destination, triggers, remote print button functionality and report enable.

ENGINE CRUISE REPORT <01>

This report is generated when the A/C is in stable condition.
It records operating conditions of the engines.

The listed data are averages with the exception of :
- serial number,
- A/C flight hours with dedicated engine, running time, cycles,
- source status (status of FADEC sensors),
- engine control word, engine vibration status,
- oil consumption, oil system chip detection.

CRUISE PERFORMANCE REPORT <02>

This report is similar to report 01 except that data is sampled for longer periods and more information is provided about the A/C and flight controls.

A330 ENGINE CRUISE REPORT <01>

... < A330 STANDARD HEADER > ...

	ESN	EHRS	ERT	ECYC	SOURCE STATUS	ECW1	EVM	NM	QE	
C5	731205	00134	00216	00079	1111H1111111111	00010	26064	6	05	..
C6	731232	00317	00431	00223	5HH1H111111111S	00010	26064	6	05	..

	N1	N1C	N1A	N2	EGT	P49	FF	PS14	P25	
N1	086.20	086.6	086.20	090.8	0611	14.12	1351	17.42	34.12	..
N2	086.21	086.4	086.21	090.7	0613	16.23	1362	19.20	35.78	..

Engine 1 data line
Engine 2 data line

	T25	PS3	T3	T5	VSV	VBV	HPT	LPT	GLE	PD	TN	
S1	67.42	223.3	560.3	600.4	25.3	30.4	040	060	030.4	20	210	..
S2	67.09	224.8	550.3	610.2	26.2	31.2	041	062	032.8	21	217	..

Engine 1 data line
Engine 2 data line

	OIQH	OIP	OIT	OC	VF	VC	VH	VL	PHF	PHT	BBF	BBT	
T1	12.34	047	092.9	0	21.5	4.35	5.12	32.8	235	067	5.76	4.13	..
T2	11.89	046	091.4	0	22.6	3.68	5.78	31.3	229	065	4.99	4.02	..

A330 CRUISE PERFORMANCE REPORT <02>

... < A330 STANDARD HEADER > ...

	ESN	EHRS	ERT	ECYC	SOURCE STATUS	ECW1	EVM	NM	QA/QE	
C5	731205	00134	00216	00079	1111H1111111111	00010	26064	6	05	..
C6	731232	00317	00431	00223	5HH1H111111111S	00010	26064	6	05	..

	N1	N1C	N1A	N2	EGT	P49	FF	PS14	P25
N1	086.20	086.6	086.20	090.8	0611	14.12	1351	17.42	34.12 ..
N2	086.21	086.4	086.21	090.7	0613	16.23	1362	19.20	35.78 ..

	T25	PS3	T3	T5	VSV	VBV	HPT	LPT	GLE	PD	TN
S1	67.42	223.3	560.3	600.4	25.3	30.4	040	060	030.4	20	210 ..
S2	67.09	224.8	550.3	610.2	26.2	31.2	041	062	032.8	21	217 ..

	OIQH	OIP	OIT	OC	VF	VC	VH	VL	PHF	PHT	BBF	BBT
T1	12.34	047	092.9	0	21.5	4.35	5.12	32.8	235	067	5.76	4.13 ..
T2	11.89	046	091.4	0	22.6	3.68	5.78	31.3	229	065	4.99	4.02 ..

A/C and flight controls information

	ELEV	AOA	DA	CIVV	CFPG	LATP
X1	N04.2	005.3	056.4	N001	1.0065	N45.21 ..
X2	N04.5	005.1	056.2	N001	1.0039	N45.60 ..

	RUDD	RUDT	STAB	ROLL	YAW	PTCH	DRM	GW	CG
X3	000.5	002.5	002.1	N00.7	N00.2	001.5	000100	235000	24.5 ..

	RSP1	RSP2	RSP3	RSP4	RSP5	RSP6	FLAP	SLAT	THDG
X4	000.3	000.2	000.2	000.1	000.3	000.2	000.4	020.0	0035.6 ..
X5	000.2	000.1	000.2	000.3	000.4	000.2	000.2	020.4	0035.2 ..

	AILL	AILR	WS	WD	AFT	AFD
X6	N07.1	N08.3	026	0237	045.3	0.025 ..
X7	N07.3	N08.0	027	0238	045.2	0.028 ..

FQW4200 GE Metric

ENGINE TAKE OFF REPORT <04>

This report is generated a few seconds after take off.
The number of intervals between each engine take off report generation is programmable.
It collects aircraft and engine parameters during the take off flight phase.

"T/O DELTA N1 SUMMARY" is the difference between N1MX and N1 from the engine with the maximum value of N1.
This report is used to check the trend and the stress of the engines at take off.

ENGINE REPORT ON REQUEST <05>

This report provides a snapshot of the engine parameters.
Engine on request report can be generated by manual request via the remote print button or the MCDU or via the programmable triggers.
The parameters recorded are taken in 1 sec intervals from 5 sec before the request to 5 sec after.

A330 ENGINE TAKE OFF REPORT <04>

... < A330 STANDARD HEADER > ...

	ESN	EHRS	ERT	ECYC	SOURCE STATUS	ECW1	ECW2	EVM	NM	
C5	731205	00134	00216	00079	111111111111111	00000	0040A	26064	8	..
C6	731232	00317	00431	00223	1111H111111111S	00000	0040A	36064	4	..

T/O DELTA N1 SUMMARY

N1	03	02	00	00	00	01	00	00	..
N2	03	02	00	00	00	01	00	00	..

	N1	N1C	N1A	N1MX	N2	P49	EGT	FF	PO	T12	
S1	086.20	086.6	086.20	090.3	083.1	14.12	0612	1350	15.3	048.9	..
S2	086.21	086.6	086.21	090.8	082.8	16.23	0612	1362	19.2	016.2	..

	P25	T25	PS3	T3	T5	VSV	VBV	HPT	LPT	GLE	
T1	34.10	67.41	223.3	560.3	600.4	25.3	30.4	040	060	030.4	..
T2	35.78	67.09	224.8	550.3	610.2	26.2	31.2	041	062	032.8	..

	PD TN	OIP	OIT	VF	VC	VH	VL	PHF	PHT	BBF	BBT	
V1	20 210	047	092.9	21.5	3.35	5.12	32.8	235	067	5.76	4.13	..
V2	21 217	046	091.4	22.6	3.68	5.78	31.3	229	065	4.99	4.02	..

A330 ENGINE REPORT O/R <05>

... < A330 STANDARD HEADER > ...

	ESN	EHRS	ERT	ECYC	SOURCE STATUS	ECW1	EVM	NM	
C5	731205	00134	00216	00079	111111111111111	00000	26064	8	..
C6	731232	00317	00431	00223	1111H111111111S	00000	36064	4	..

PRE EVENT, 5 SEC INTERVALS

		N1A	N2	EGT	FF	PS3	VF	VC	VH	VL	PHF	PHT	
T - 5sec →	S1	086.20	086.6	0612	1351	241.2	20.4	3.50	2.99	30.8	225	180	..
	T1	086.21	086.4	0613	1344	235.4	19.2	3.41	3.25	31.3	228	181	..
T - 4sec →	·												
T - 3sec →	·												
T - 2sec →	·												
T - 1sec →	S5	086.20	086.6	0612	1351	241.2	20.4	3.50	2.99	30.8	225	180	..
	T5	086.21	086.4	0613	1344	235.4	19.2	3.41	3.25	31.3	228	181	..

AT AND POST EVENT, 5 SEC INTERVALS

		N1A	N2	EGT	FF	PS3	VF	VC	VH	VL	PHF	PHT	
T = event →	S6	086.20	086.6	0612	1351	241.2	20.4	3.50	2.99	30.8	225	180	..
	T6	086.21	086.4	0613	1344	235.4	19.2	3.41	3.25	31.3	228	181	..
T + 1sec →	·												
T + 2sec →	·												
T + 3sec →	·												
T + 4sec →	·												
T + 5sec →	1S	086.20	086.6	0612	1351	241.2	20.4	3.50	2.99	30.8	225	180	..
	1T	086.21	086.4	0613	1344	235.4	19.2	3.41	3.25	31.3	228	181	..

	TAT	ALT	MN	SYS (..... BLEED STATUS .....)	APU	
C7	N43.5	30000	0.780	111 1.05 1100 1010 0 0101 0011 0.40	1	..

FQW4200 GE Metric

ENGINE GAS PATH ADVISORY REPORT <06>

This report is generated when there is an exceedance of one of the primary engine parameters (EGT/N1/N2) or either a stall, shutdown or if a flame out condition exists on one engine.

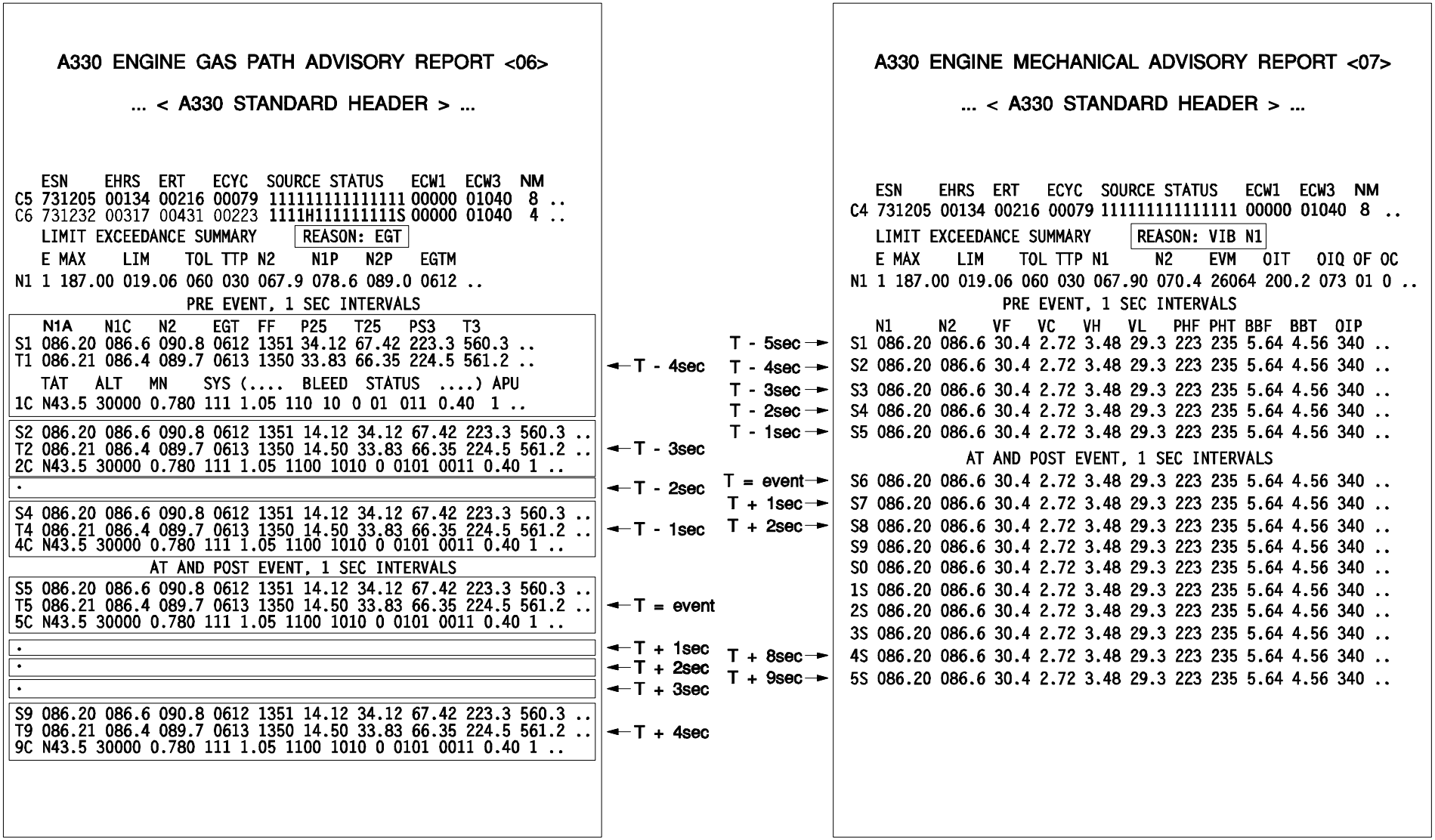
4 sets of parameters are recorded at 1 sec intervals before the event and 4 sets are recorded at 1 sec intervals after the event.

ENGINE MECHANICAL ADVISORY REPORT <07>

This report is generated when there is an exceedance of one of the following engine parameters :

- oil temperature, oil pressure, nacelle temperature, N1 and N2 vibration or a system chip detection.

5 parameter sets are recorded at 1 second intervals before the event and 9 parameter sets at 1 sec intervals after the event.
There is one report for each engine.



FQW4200 GE Metric

ENGINE TRIM BALANCE ADVISORY REPORT <08>

This report will monitor for stable engine conditions during each of five different flight phases. The data collection will be an averaged collection over the stable engine conditions for these flight phases. Each flight phase average data set contains spool speeds, engine vibrations and vibration phase angle for both the turbine and the fan for all engine positions.
The information contained on this report can be used to balance the engine spools.

ENGINE DIVERGENCE REPORT <09>

This report is generated when the EGT divergence or Nacelle Temperature divergence threshold values are exceeded on at least one engine.

3 parameter sets are recorded at 2 sec intervals before the event and 3 parameter sets at 2 sec intervals after the event.

A330 ENGINE TRIM BALANCE ADV REPORT <08>

... < A330 STANDARD HEADER > ...

```
    ESN    EHRS  ERT   ECYC  SOURCE STATUS    ECW1   NM
C5 731205 00134 00216 00079  111111111111111    00000  8 ..
C6 731232 00317 00431 00223  1111H111111111S    00000  4 ..

    UTC      PH  ALT   MN
E1 10.20.40   6.0 28349 0.68
    VF   VC   VH   VL  PHF PHT BBF BBT N1A     N2    EVM
S1 21.5 3.35 5.12 32.8 235 067 5.76 4.13 086.20 083.1 26064  ..
T1 22.6 3.68 5.78 31.3 229 065 4.99 4.02 086.21 082.8 36064  ..
```

← First set

.
.
.

```
E5 10.20.40   6.0 28349 0.68
S5 21.5 3.35 5.12 32.8 235 067 5.76 4.13  086.20  083.1 26064  ..
T5 22.6 3.68 5.78 31.3 229 065 4.99 4.02  086.21  082.8 36064  ..
```

← Fif ht set

A330 ENGINE DIVERGENCE REPORT <09>

... < A330 STANDARD HEADER > ...

```
   ESN    EHRS  ERT   ECYC  SOURCE STATUS    ECW1   NM
C5 731205 00134 00216 00079 111111111111111 00000  8   ..
C6 731232 00317 00431 00223 1111H111111111S 00000  4   ..

   DIVERGENCE SUMMARY        REASON: TN
   E EDV5  ERF5  NDV5  NRF5  EDV6  ERF6  NDV6  NRF6  K
N1 1 XXXX  XXXX  XXX.X XXX.X XXXX  XXXX  XXX.X XXX.X 10 ..
          PRE EVENT, 2 SEC INTERVALS
   N1     N1C   N1A    N2    EGT  P49   FF   TN    VSV  VBV

S1 086.20 086.6 086.20 090.8 0612 14.12 1351 210.0 25.3 30.4 ..
T1 086.21 086.4 086.21 089.7 0613 16.23 1350 212.4 25.1 30.2 ..
```

← T - 6sec

.

← T - 4sec

```
S3 086.20 086.6 086.20 090.8 0612 1351 210.0 25.3 30.4 ..
T3 086.21 086.4 086.21 089.7 0613 1350 212.4 25.1 30.2 ..
```

← T - 2sec

```
        AT AND POST EVENT, 2 SEC INTERVALS

S4 086.20 086.6 086.20 090.8 0612 1351 210.0 25.3 30.4 ..
T4 086.21 086.4 086.21 089.7 0613 1350 212.4 25.1 30.2 ..
```

← T = event

.

← T + 2sec

.

← T + 4sec

```
S7 086.20 086.6 086.20 090.8 0612 1351 210.0 25.3 30.4 ..
T7 086.21 086.4 086.21 089.7 0613 1350 212.4 25.1 30.2 ..
```

← T + 6sec

FQW4200 GE Metric

ENGINE START REPORT <10>

This report is generated when an abnormal start has been detected during main engine start and every 25 engine starts.
There is one report for each engine.

3 parameter sets are recorded at 6 sec intervals before the event and 3 parameter sets are recorded at 2 sec intervals after the event.

ENGINE RUN UP REPORT <11>

This report is usually triggered by manual request via the remote print button or through the MCDU.
It contains the same data as the engine cruise report, plus corrected parameters for the ambient temperature.

The listed data are averages over 20 seconds with the exception of :
- A/C serial number,
- flight hours with dedicated engine, cycles, control word and vibration status,
- A/C running time with dedicated engine,
- status of FADEC sensors,
- oil quantity.

A330 ENGINE START REPORT <10>

... < A330 STANDARD HEADER > ...

```
   ESN    EHRS  ERT   ECYC  SOURCE STATUS    NM
C5 731205 00134 00216 00079 111111111111111  8 ..
C6 731232 00317 00431 00223 1111H1111111111S 4 ..

   LIMIT EXCEEDANCE SUMMARY      REASON: LOW AIR PRESSURE
   E MAX     TOS TTP TTA TTF FF    PD S
N1 1 187.00 021 030 015 022 0123 26 10 ..
                  PRE EVENT, 6 SEC INTERVALS
   N1     N1A    N2    EGT  P49   FF   FMV T25   PD PS3
S1 086.20 086.20 090.8 0612 14.12 1351 040 036.7 22 231.3..
   T3    VSV  VBV  T5    OIP IOT   ECW4  ECW5
T1 500.4 25.3 30.4 357.8 125 057.8 00045 0054A ..

S2 086.20 086.20 090.8 0612 14.12 1351 040 036.7 22 231.3..
T2 500.4 25.3 30.4 357.8 125 057.8 00045 0054A ..

S3 086.20 086.20 090.8 0612 14.12 1351 040 036.7 22 231.3..
T3 500.4 25.3 30.4 357.8 125 057.8 00045 0054A ..

          AT AND POST EVENT, 2 SEC INTERVALS

S4 086.20 086.20 090.8 0612 14.12 1351 040 036.7 22 231.3..
T4 500.4 25.3 30.4 357.8 125 057.8 00045 0054A ..

S5 086.20 086.20 090.8 0612 14.12 1351 040 036.7 22 231.3..
T5 500.4 25.3 30.4 357.8 125 057.8 00045 0054A ..

S6 086.20 086.20 090.8 0612 14.12 1351 040 036.7 22 231.3..
T6 500.4 25.3 30.4 357.8 125 057.8 00045 0054A ..

S7 086.20 086.20 090.8 0612 14.12 1351 040 036.7 22 231.3..
T7 500.4 25.3 30.4 357.8 125 057.8 00045 0054A ..
```

T - 18sec
T - 12sec
T - 6sec
T = event
T + 2sec
T + 4sec
T + 6sec

A330 ENGINE RUN UP REPORT <11>

... < A330 STANDARD HEADER > ...

```
   ESN    EHRS  ERT   ECYC  SOURCE STATUS   ECW1  EVM   NM

C5 731205 00134 00216 00079 111111111111111 00000 26064 8  ..
C6 731232 00317 00431 00223 1111H111111111S 00000 36064 4  ..

   N1     N1C   N1A   N2    EGT  P49   FF   PS14  P25

N1 086.20 086.6 086.20 090.8 0611 14.12 1351 17.42 34.12 ..
N2 086.21 086.4 086.21 090.7 0613 16.23 1362 19.20 35.78 ..

   T25    PS3   T3    T5    FMV   VSV  VBV  HPT LPT GLE

S1 67.42 223.3 560.3 600.4 020.4 25.3 30.4 040 060 030.4 ..
S2 67.09 224.8 550.3 610.2 021.3 26.2 31.2 041 062 032.8 ..

   PD TN  OIQ OIP OIT   VF   VC   VH   VL   PHF PHT BBF  BBT

T1 20 210 093 047 092.9 21.5 4.35 5.12 32.8 235 067 5.76 4.13..
T2 21 217 094 046 091.4 22.6 3.68 5.78 31.3 229 065 4.99 4.02..

   EGTK N1K   N2K   FFK
V1 1042 090.2 080.4 3892 ..
V2 1010 092.4 084.6 3586 ..
```

Engine 1 data line
Engine 2 data line
corrected parameters

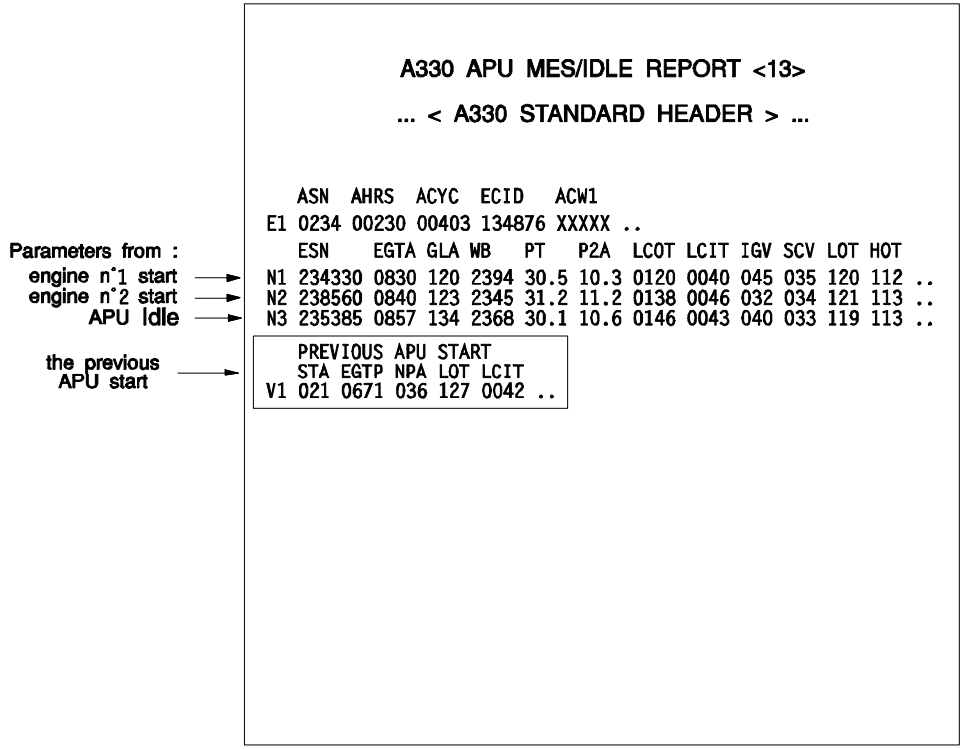
FQW4200 GE Metric

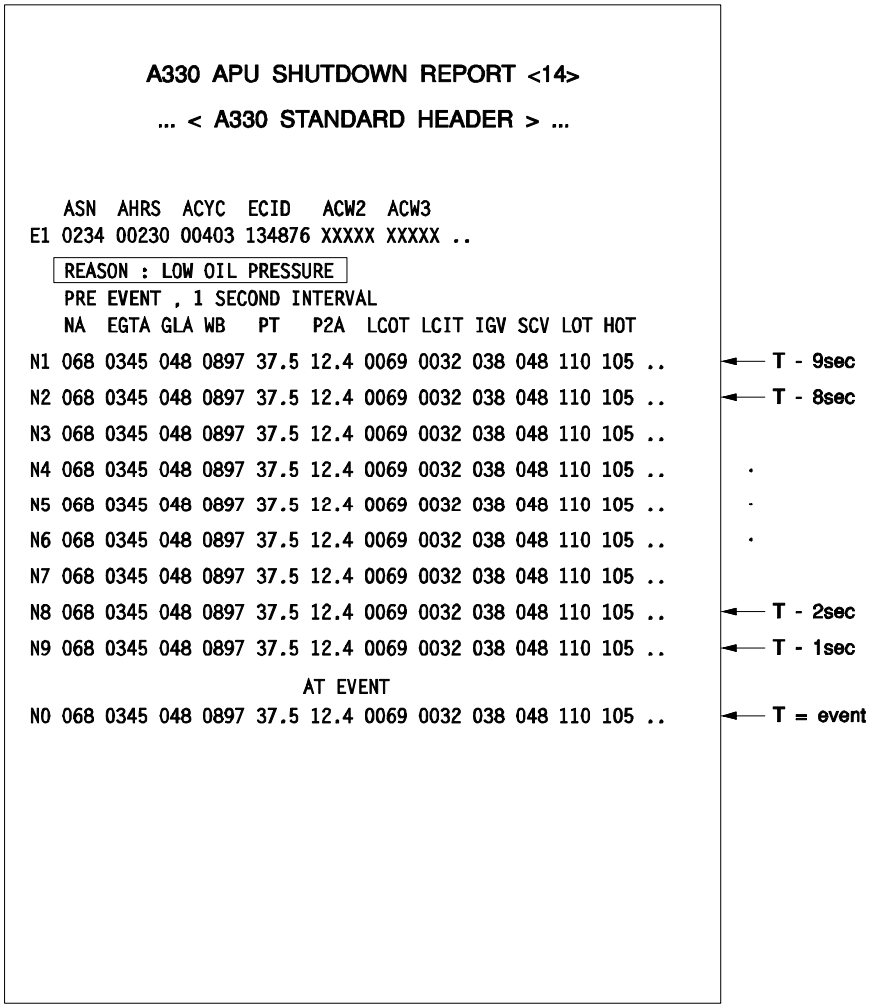
APU MES/IDLE REPORT <13>

This report is generated when the engine is started with the APU during maximum load.
It presents APU parameters during and after engine start and at APU idle.
It also presents the previous APU start parameters.

APU SHUTDOWN REPORT <14>

This report is generated when an abnormal APU shutdown is detected.
9 data sets are recorded at 1 sec intervals before the event and 1 data set at the event.





FQW4200 GE Metric

LOAD REPORT <15>

This report is generated when abnormal load conditions have occured during flight or landing (hard landing detection or A/C bounce).
Vertical acceleration is monitored as a function of flaps extended or flaps retracted condition and the report is triggered if the value is out of tolerance.
It records, at 1 sec intervals, A/C aerodynamic parameters set before, at and after a hard landing.

USER PROGRAMMABLE REPORT <16>,<17>,<18>

These reports are generated when specific conditions programmed by the airline are met.
Each data set contains up to 48 parameters chosen by the airline.
The report does not exceed 120 data lines.

The sampling intervals, the average intervals and the history times of parameters recording are chosen by the airline.
These report programmings are done through the Ground Support Equipment (GSE).

```
                    A330 LOAD REPORT <15>

                ... < A330 STANDARD HEADER > ...


    VALUES AT MAX EXCEEDANCE

    RALT CAS  GW     CG  FLAP SLAT
N1  0124  269  245000 28.3 026.4 023.6 ..
    REASON: PTCR
    MAX VALUES DURING 1 SEC PRE - AND 1 SEC POST-EVENT
    VRTG  LONG  LATG  ROLL  ROLR  PTCH  PTCR  RALR  LIM1
S0  01.129 03.879  02.210 020.3  032.8   039.4  020.3   006.7  009.372 ..
    MIN VALUES DURING 1 SEC PRE - AND 1 SEC POST-EVENT
S1  01.129 03.879  02.210 020.3  032.8   039.4  020.3   006.7  009.372 ..
                    PRE EVENT, 1 SEC INTERVAL
    VRTG  LONG  LATG  ROLL  ROLR  PTCH  PTCR  RALR  RALT
S2  01.129  03.879 02.210 020.3  032.8   039.4  020.3   006.7  0124 ..
                AT AND POST EVENT, 1 SEC INTERVAL
S3  01.129  03.879 02.210 020.3  032.8   039.4  020.3   006.7  0124 ..
S4  01.129  03.879 02.210 020.3  032.8   039.4  020.3   006.7  0124 ..

    MAX VALUES DURING 1 SEC PRE - AND 1 SEC POST-BOUNCE
    VRTG  LONG  LATG  ROLL  ROLR  PTCH  PTCR  RALR  LIM2
S5  01.129 03.879  02.210 020.3  032.8   039.4  020.3   006.7  009.372 ..
    MIN VALUES DURING 1 SEC PRE - AND 1 SEC POST-BOUNCE
S6  01.129 03.879  02.210 020.3  032.8   039.4  020.3   006.7  009.372 ..
                    PRE BOUNCE,1 SEC INTERVAL
    VRTG  LONG  LATG  ROLL  ROLR  PTCH  PTCR  RALR  RALT
S7  01.129  03.879 02.210 020.3  032.8   039.4  020.3   006.7  0124 ..
                AT AND POST BOUNCE, 1 SEC INTERVAL
S8  01.129  03.879 02.210 020.3  032.8   039.4  020.3   006.7  0124 ..
S9  01.129  03.879 02.210 020.3  032.8   039.4  020.3   006.7  0124 ..
```

PTCR = pitch rate limit exceeded

T - 1sec

T = event

T + 1sec

These lines are generated if the A/C bounced

```
                A330 PROGRAMMABLE REPORT <16>,<17>,<18>

                ... < A330 STANDARD HEADER > ...


   Y1   Y2 Y3 Y4
C4 00.0 00 01 120 ..
   EGT    N2     FF     MN     AOA    LATP    LONP    FQ
C5 116.1  116.1  116.1  006.1  006.1  004.1   004.1   114.1   ..
C6 345.01 344.01 244.01 205.01 221.01 310.DD  311.DD  074.01  ..
E1 XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXXX 99XXXX9 99XXXX9 ..

   EGT    N2     FF     RALT   ZCB
C7 116.2  116.2  116.1  026.1  026.1  ..
C8 345.10 344.10 244.10 164.01 203.11 ..
N1 XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX ..


   EGT    N2     FF
1C 116.2  116.2  116.1  ..
2C 346.10 344.10 244.10 ..
T1 XXXXXX XXXXXX XXXXXX ..

   SLAT   FLAP
5C 01B.1  01B.1  ..
6C 124.01 134.01 ..
X1 XXXXXX XXXXXX ..

E2 XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX ..
N2 XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX ..
.
V2 XXXXXX XXXXXX XXXXXX XXXXXX ..
X2 XXXXXX XXXXXX ..
.
.
OE XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX ..
ON XXXXXX XXXXXX XXXXXX XXXXXX XXXXXX ..
.
OV XXXXXX XXXXXX XXXXXX XXXXXX ..
OX XXXXXX XXXXXX ..
```

FQW4200 GE Metric

ENVIRONMENTAL CONTROL SYSTEM REPORT <19>

This report is generated when there is a malfunction in the air conditioning or pressurization system.
It records engine, A/C and environmental data at and before the event with 15 seconds intervals.

RAM AIR TURBINE TEST REPORT <20>

This report checks the condition of the RAT on ground during test.
It records the RAT RPM, the green system pressure, the main landing gear door status and the green electro pump status during one of the 3 tests and provides their results.

The 3 tests are :

- spin up and governing test,
- pump test,
- anti stall test.

The Ram Air Turbine Test Report is armed via an MCDU menu.

A330 ECS REPORT <19>

... < A330 STANDARD HEADER > ...

```
   ESN    EHRS  ERT   ECYC  SOURCE STATUS   CZL      NL  TTE
C5 731205 00134 00216 00079 1111H111111111  11111111 999 99 ..
C6 731232 00317 00431 00223 5HH1H11111111S  ..

 REASON : EXCESSIVE CABIN ALT

                        PRE EVENT
   N1     N2    PS3   T3    TPO  PD   COT RO  RI  PF   TW
E1 060.29 058.2 223.8 390.3 N039 10.3 100 050 020 0.84 N10 ..
N1 062.40 059.1 224.5 389.2 N020 09.2 090 048 018 0.87 N12 ..
                                      TP  PTV FV ZA PBV
S1 060.29 058.2 223.8 390.3 N039 10.3 100 050 1  1  0 ..
T1 062.40 059.1 224.5 389.2 N020 09.2 090 048 1  1  1 ..
   ALT   ZCB   PDC  ZLD   VSCB TAT   SAT   PCW1  PCW2  FOV
V1 30000 11045 03.5 08345 2300 012.4 034.5 XXXXX XXXXX 060 ..
   V1  V2  V3  V4  V5  V6  V7  ST1  ST2  ST3  ST4  ST5  AOV CPC
X1 040 038 040 040 038 038 039 19.3 19.3 19.2 19.8 19.4 073 1 ..
                        15 SEC INTERVALS
X2 040 038 040 040 038 038 039 19.3 19.3 19.2 19.8 19.4 073 1 ..
S6 060.29 058.2 223.8 390.3 N039 10.3 100 050 1  1  0 ..
S7 062.40 059.1 224.5 389.2 N020 09.2 090 048 1  1  1 ..
X7 040 038 040 040 038 038 039 19.3 19.3 19.2 19.8 19.4 073 1 ..
.
3X 040 038 040 040 038 038 039 19.3 19.3 19.2 19.8 19.4 073 1 ..
                          AT EVENT
7E 060.29 058.2 223.8 390.3 N039 10.3 100 050 020 0.84 N10 ..
7N 062.40 059.1 224.5 389.2 N020 09.2 090 048 018 0.87 N12 ..
7S 060.29 058.2 223.8 390.3 N039 10.3 100 050 1  1  0 ..
7T 062.40 059.1 224.5 389.2 N020 09.2 090 048 1  1  1 ..
7V 30000 11045 03.5 08345 2300 012.4 034.5 XXXXX XXXXX 060 ..
7X 040 038 040 040 038 038 039 19.3 19.3 19.2 19.8 19.4 073 1 ..
```

T - 15sec →

T = event →

A330 RAM AIR TURBINE TEST REPORT <20>

... < A330 STANDARD HEADER > ...

```
          PRE EVENT, 1 SEC INTERVAL
   NRAT HGSP LGDR HGEP
N1 3250 1225 1010 1 ..

          AT AND POST EVENT, 1 SEC INTERVAL
N1 3250 1225 1010 1 ..
N2 3250 1225 1010 1 ..
N3 3250 1225 1010 1 ..
.
.
.
S9 3250 1225 1010 1 ..
0S 3250 1225 1010 1 ..
1S 3250 1225 1010 1 ..

      TEST CONDITIONS OK
      SPIN UP TEST OK
```

Result of test →

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STUDENT NOTES:

ACMS OPERATION

Param Alpha
Param Label
Previous Reports
Stored Reports
Manual Request Reports
Stored SAR Data
Manual Request SAR Recording
DAR Recording Controls (if DAR installed)

PARAM ALPHA

For the 300 parameters which have an alpha numerical code, the selection is possible by the alpha callup function.
This page enables you to access the :
-1- display of alpha callups and
-2- the definition of alpha callup sets.

-1- It provides for display of 8 pages with up to 5 alpha callups per page.
The alpha callup is identified in the form of alphanumeric codes (max 4).
It is possible to extend the alpha callup code by the system number.

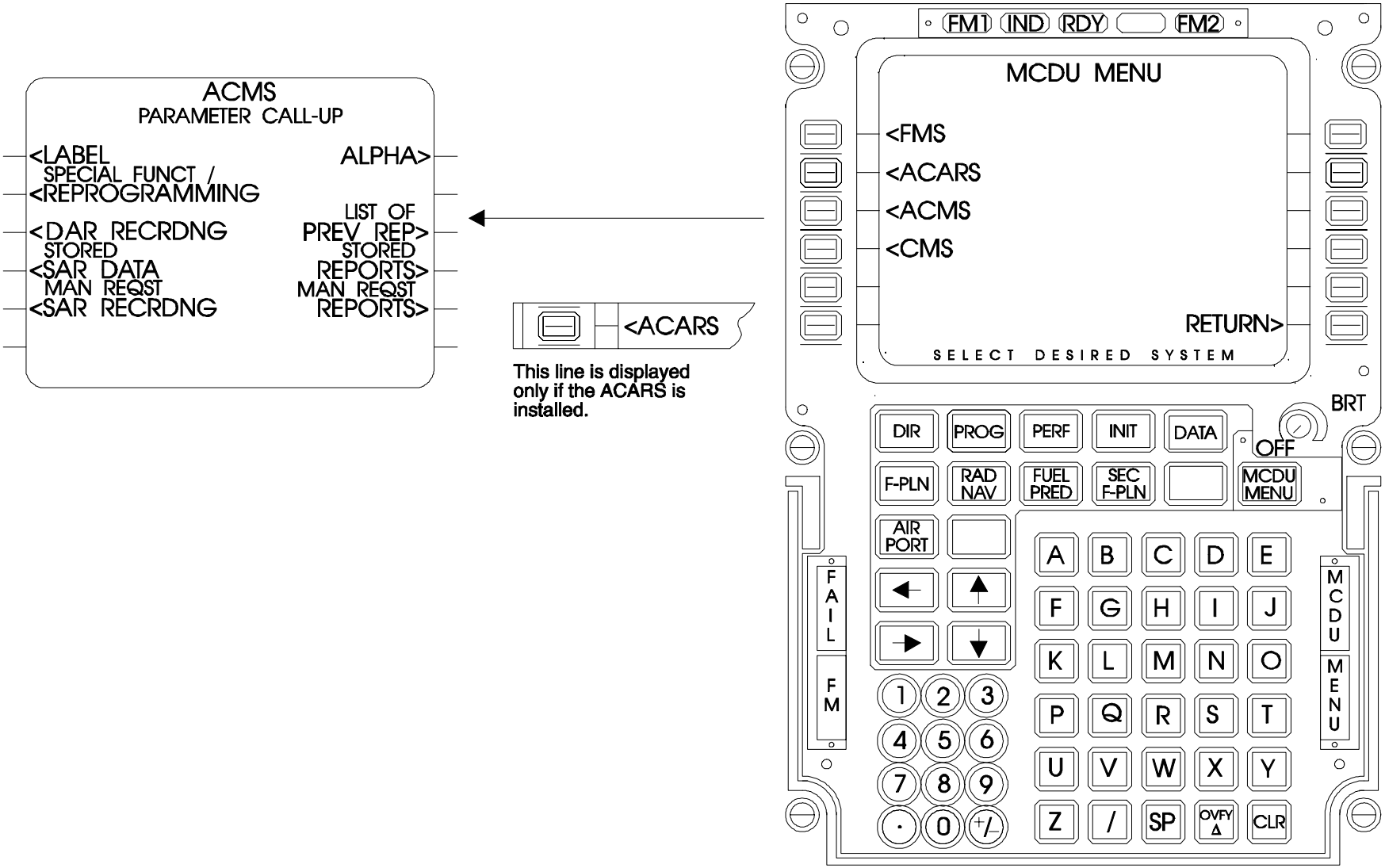
example : EGT.

The alpha code is displayed on the MCDU with the data source and the parameter values in real time and refreshed once per second.
The symbol "XXXXX" indicates that the data is not being updated.
The symbol "- - - - -" indicates that the parameter is received with invalid Sign/ Status Matrix (SSM).

ALPHA MENU CLEAR enables the user to clear the current alpha callup entries.

ALPHA LIST : an alpha callup list is provided for the user. This will help him to remember available alpha callups. If a letter is specified, the list will display only alpha callups starting with this letter.

-2- The user may define up to 8 sets of 40 alpha callups. These sets will then be easily recalled in future MCDU sessions.
SETUP NAME is used to define the name of a set. This set may then be stored or deleted. The bottom of the screen shows the name of the 8 sets already stored.
A possibility to print out the alpha callups by time series of 1 second intervals is provided.
The user will then have to define the recording time in seconds (up to 30) and then activate the START function.



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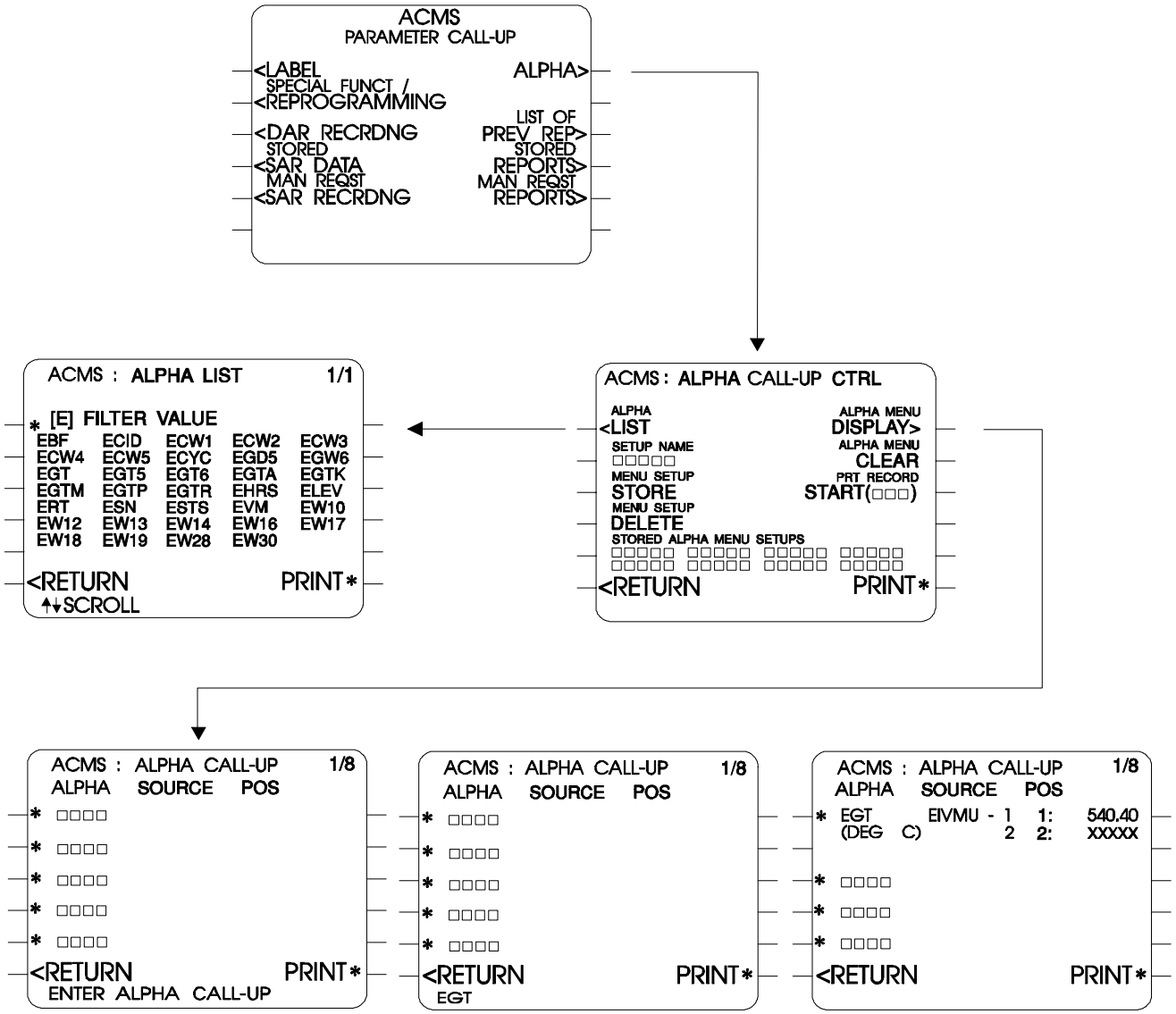
STUDENT NOTES



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PARAM LABEL

The DMU permits direct access to all parameters transmitted on the ARINC 429 data buses connected to the DMU for on line display.
This page enables you to access the :
-1- display of label callups and
-2- the definition of label callup sets.

-1- The selection is made using EQ, system source, label and SDI which are separated by a slash.
In addition, the number of data bits can be selectable.

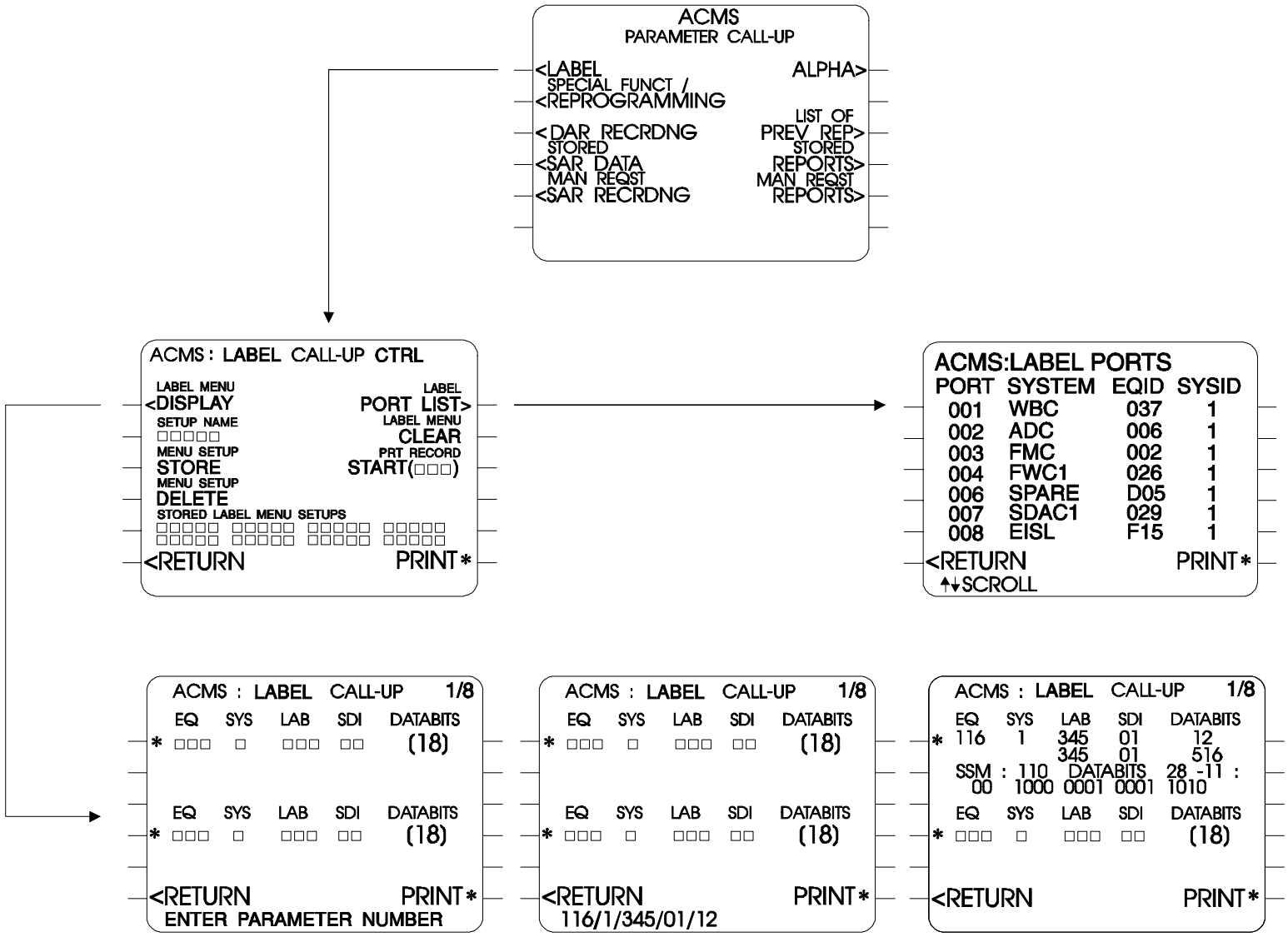
EQ : Equipment number entered by 3 hexadecimal characters,
SYS : System number (1 or 2),
LAB : parameter label entered in octal (001 to 377),
SDI : Source Destination Identifier (00,01,10 or 11),
DATA BITS : number of data bits to be displayed (1 to 18), 18 is the default value.

example : EGT.

The value is in real time and refreshed once per second.
The line below the parameter characteristics contains the label (345), the SDI (01) and the decimal value (516) of the selected data bits.
In the next data lines the SSM bits (110 = normal operation and positive value) and the binary data field of the selected parameters are displayed.
In the example, only 12 bits of the data field are significant (bit 28 to bit 17).

LABEL LIST: a label callup list is provided for the user. This will display a list of DMU input ports with the connected computers and the equipment/system identifications.

-2- The other functions are similar to the alpha callup ones with up to 2 label callups per page.



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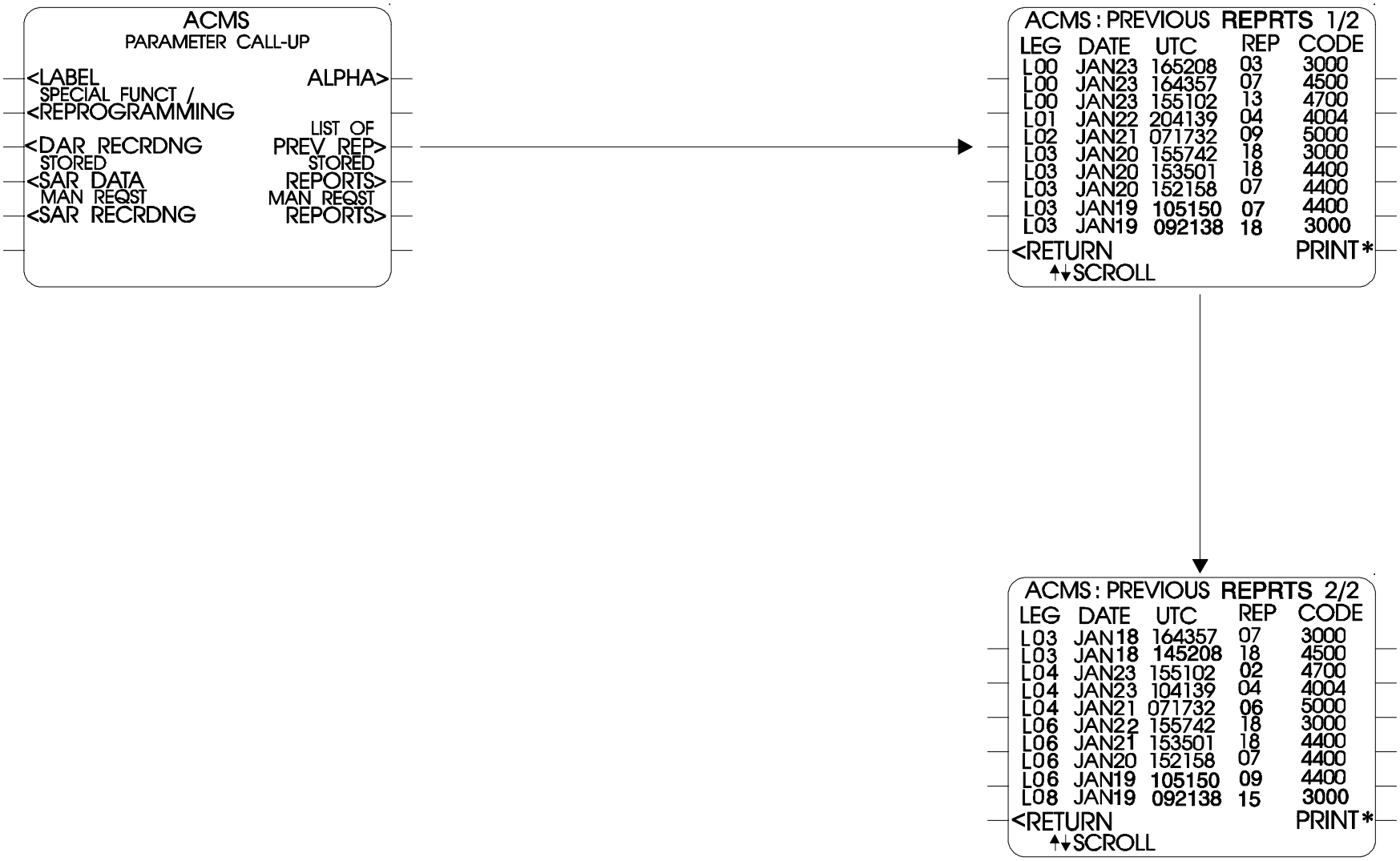
PREVIOUS REPORTS

The list of the last 20 reports generated automatically or by the remote print button, and stored in the buffer, is presented on the MCDU display.

The information for each report consists of the flight leg, date, time, report number and trigger logic code of report generation.



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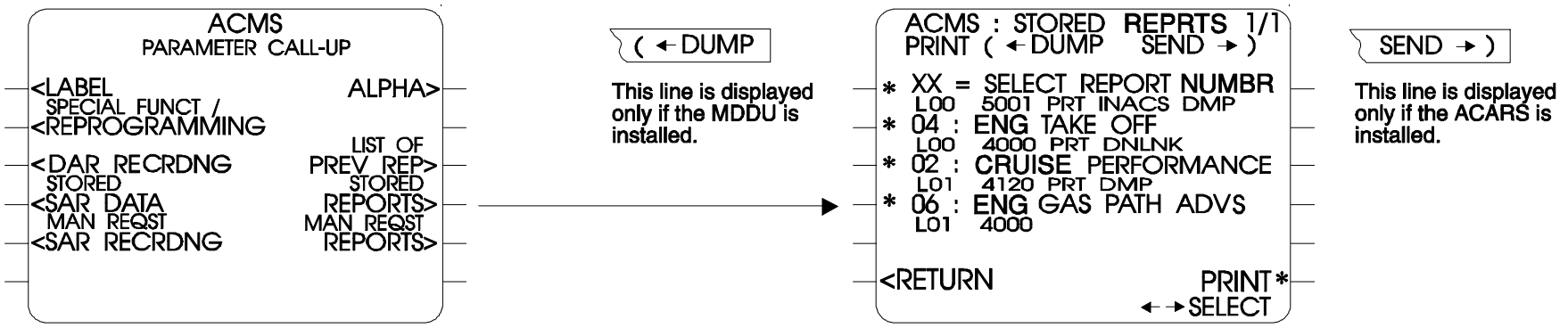
STORED REPORTS

As long as a report is stored in the report buffer, the respective report title and report number are displayed on MCDU and can be printed, sent (if ACARS installed) or dumped (if MDDU installed) (depending on the selected function of the second line of the MCDU display).

The list of stored reports includes the flight leg in which the report was generated and the related trigger code.

The character "PRT" is displayed if the report has been automatically printed.
The character "INACS" is displayed if the report has been automatically transfered to ACARS (if installed) but no acknowledgement from the ground station is received.
The character "DNLNK" is displayed when the acknowledgement from the ground station is received.
The character "DMP" is displayed if the report has been automatically dumped on a MDDU diskette (if installed).



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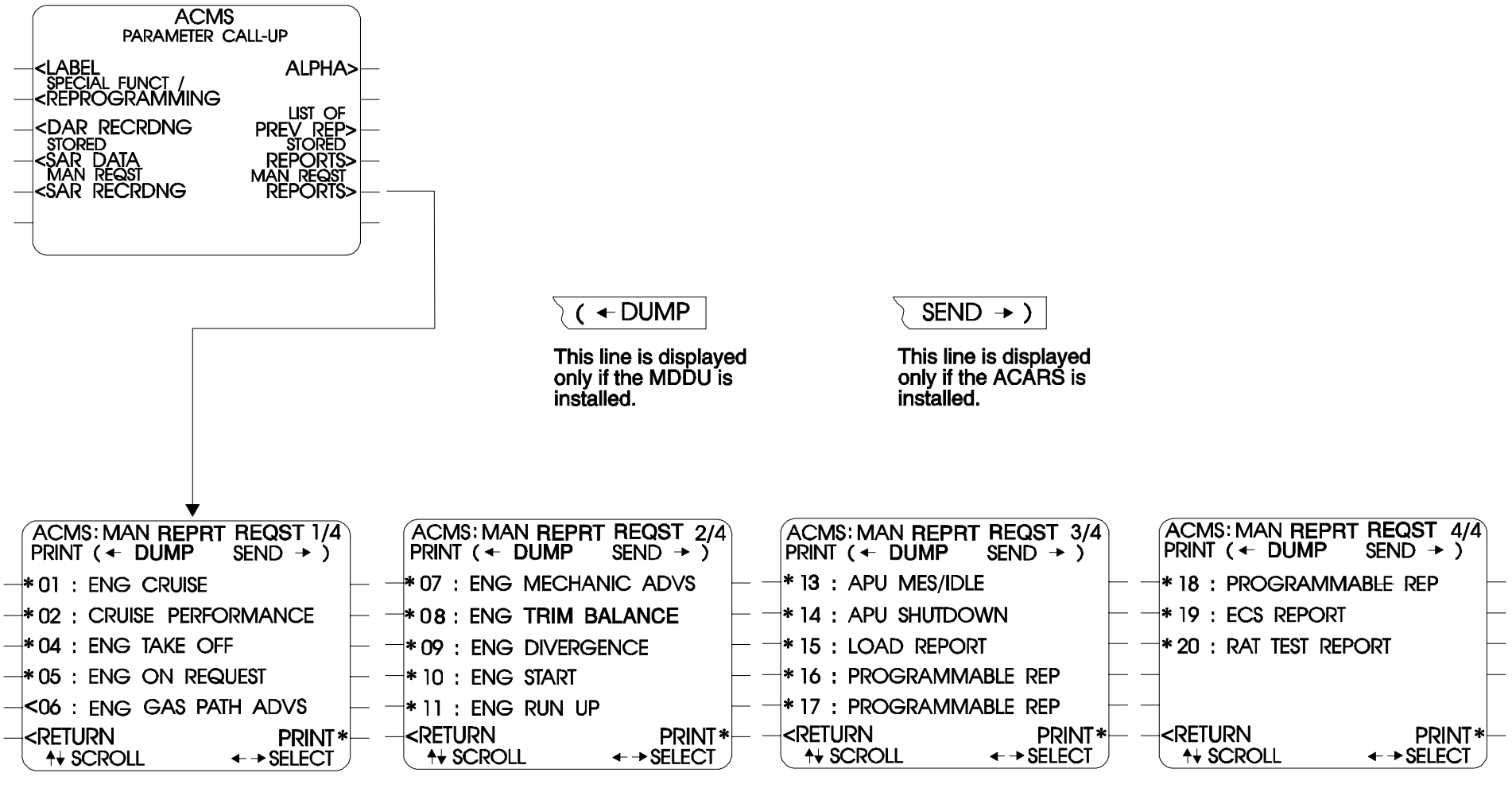
MAN REQUEST REPORTS

This function enables the immediate manual generation of reports.

These reports can be printed out, transmitted to ACARS (if installed) or dumped to an on-line disk (if installed) (depending on the selected function of the second line of the MCDU display).



This line is displayed only if the MDDU is installed.

This line is displayed only if the ACARS is installed.

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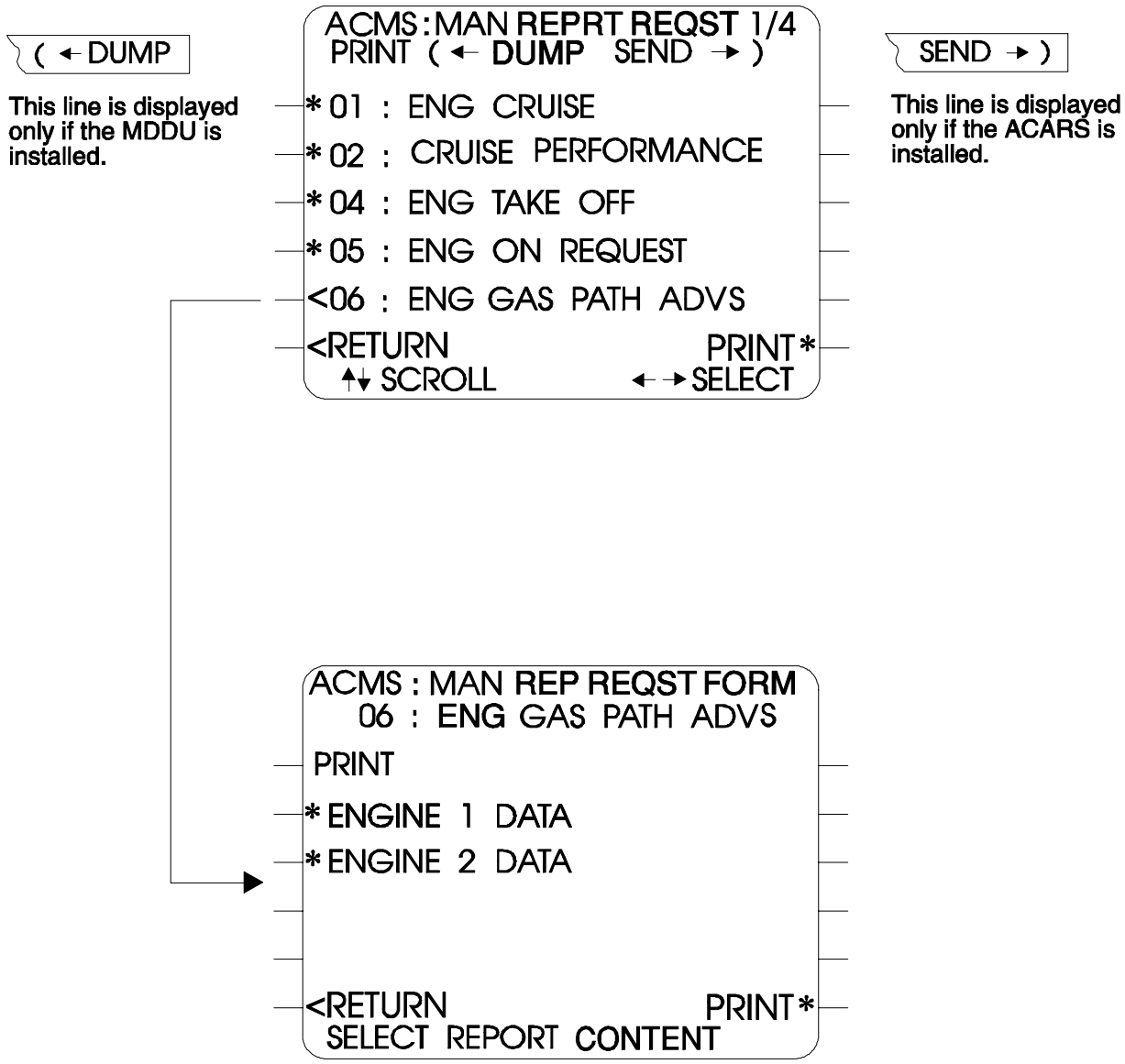
If several formats or data sets are defined for a report, another MCDU menu "MAN REQUEST DATA" can be called-up.

Here we can see the paired symmetrical engine gas path advisory reports, which can be printed in this case.



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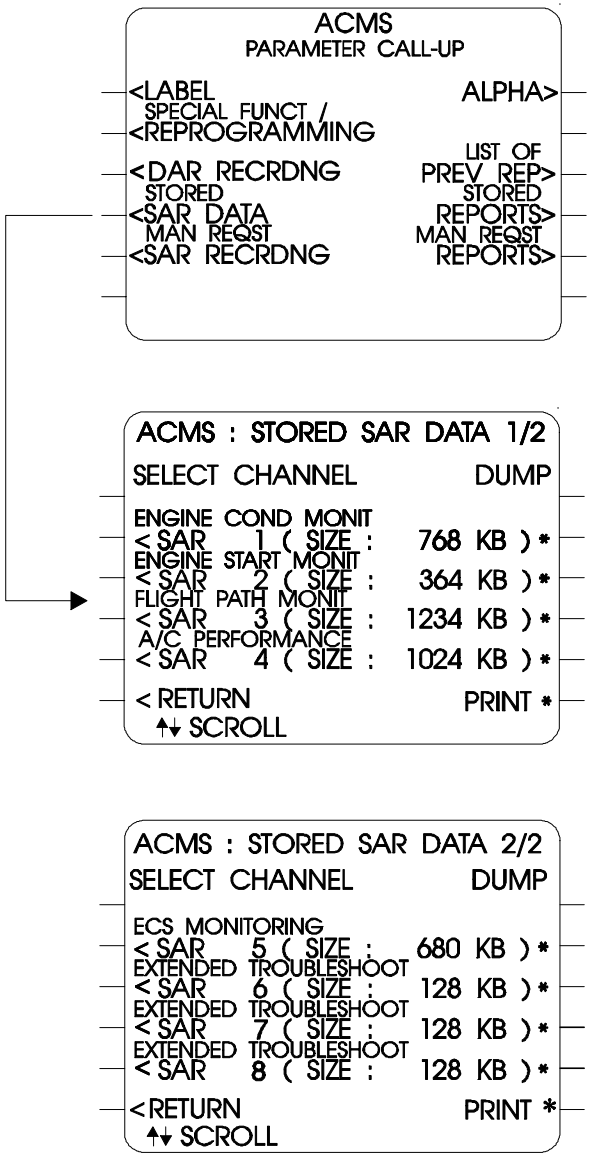
STORED SAR DATA

This function allows the display of the list of stored SAR channels with the allocated memory size.

In addition this menu allows a dump of the selected channel on a MDDU floppy disk (if installed) to be initiated.



DUMP

This line is displayed only if the MDDU is installed.

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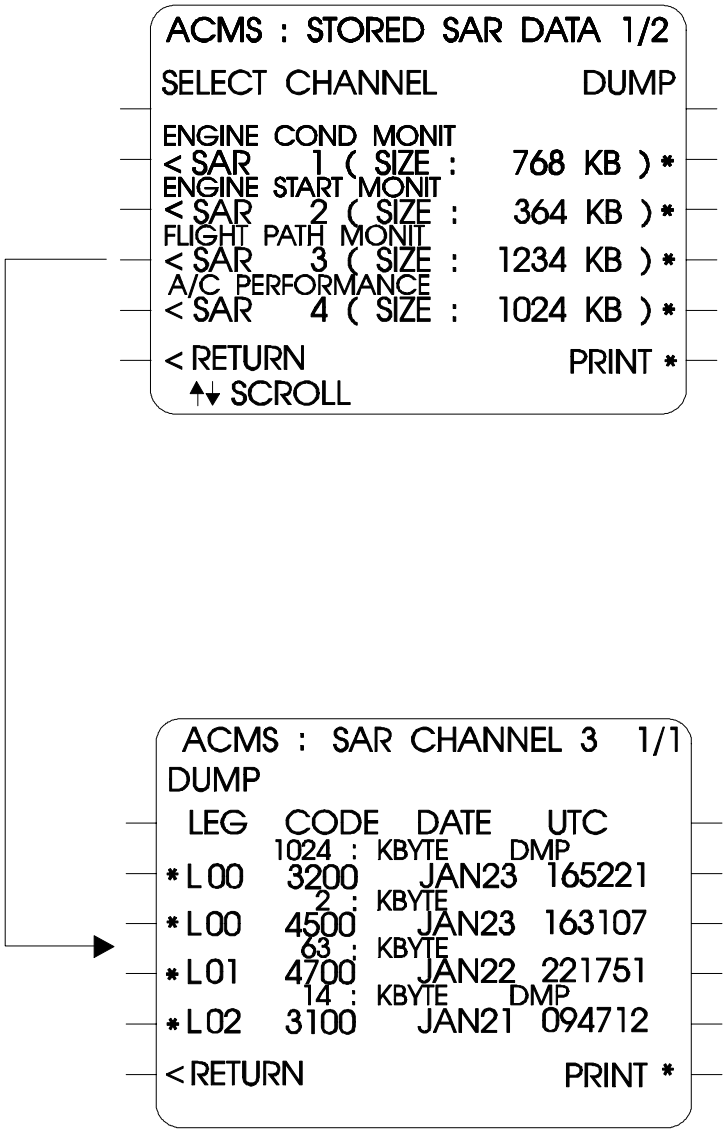
After selection of the requested SAR channel the list of stored SAR files is called-up.

This menu displays, for each stored file, the flight leg number, the associated trigger code, the date and time when the file was created.
The size of each stored SAR file is also provided by this menu.
It is possible to dump (if MDDU installed) independently each SAR file.



DUMP

This line is displayed only if the MDDU is installed.

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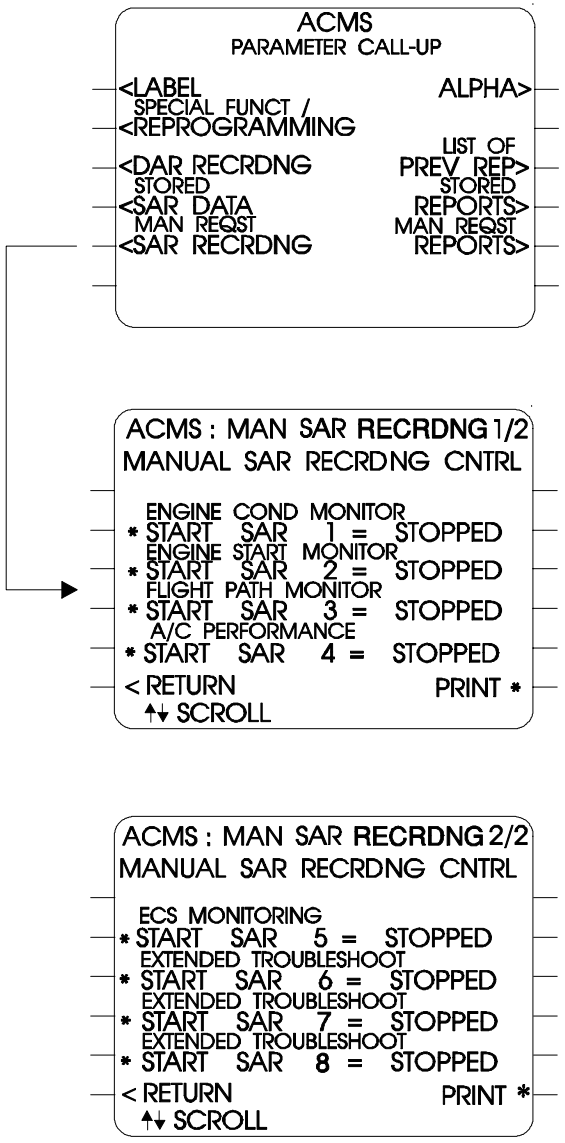
MANUAL REQUEST SAR RECORDING

This function provides selective START/STOP control for each SAR recording channel.

Each press of these keys toggles the "STOPPED/RUNNING" status of the appropriate channel.



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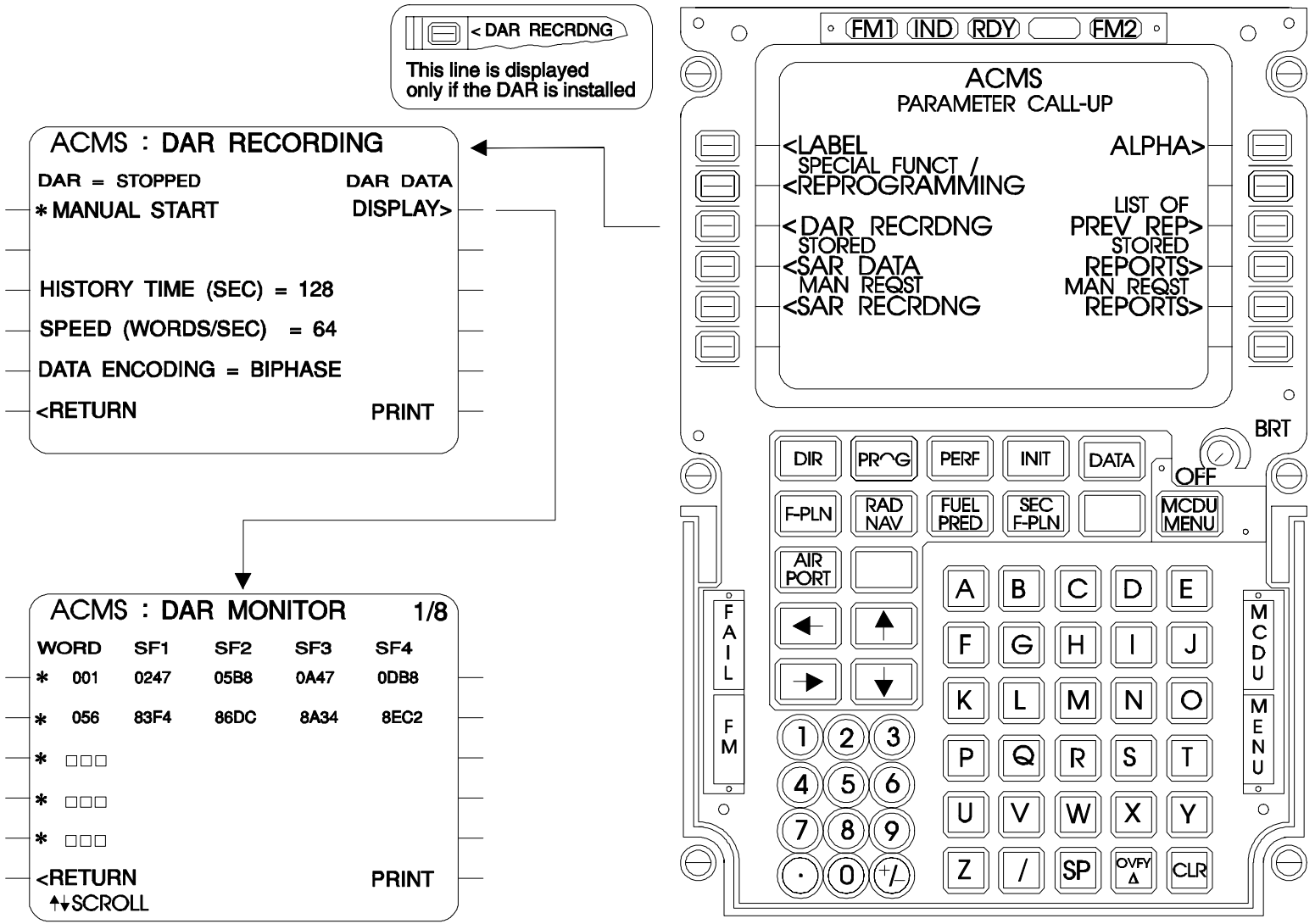
DAR RECRDNG CONTROLS (if DAR installed)

This menu provides a facility for manual start and stop of the DAR recording and for real-time display of DAR data, if the DAR is installed.
The DAR can be manually initiated via this function.
Each press of this key toggles the "STOPPED/RUNNING" status of the DAR.
Up to 8 pages of 5 DAR words are available. The data is displayed in hexadecimal format after the selection of desired word numbers.
This menu also provides information on the programming of the DAR function : amount of history, recording speed and data encoding type.



FQW4200 GE Metric

STUDENT NOTES:

ACMS PROGRAMMING

General
GSE
MCDU Programming menu

GENERAL

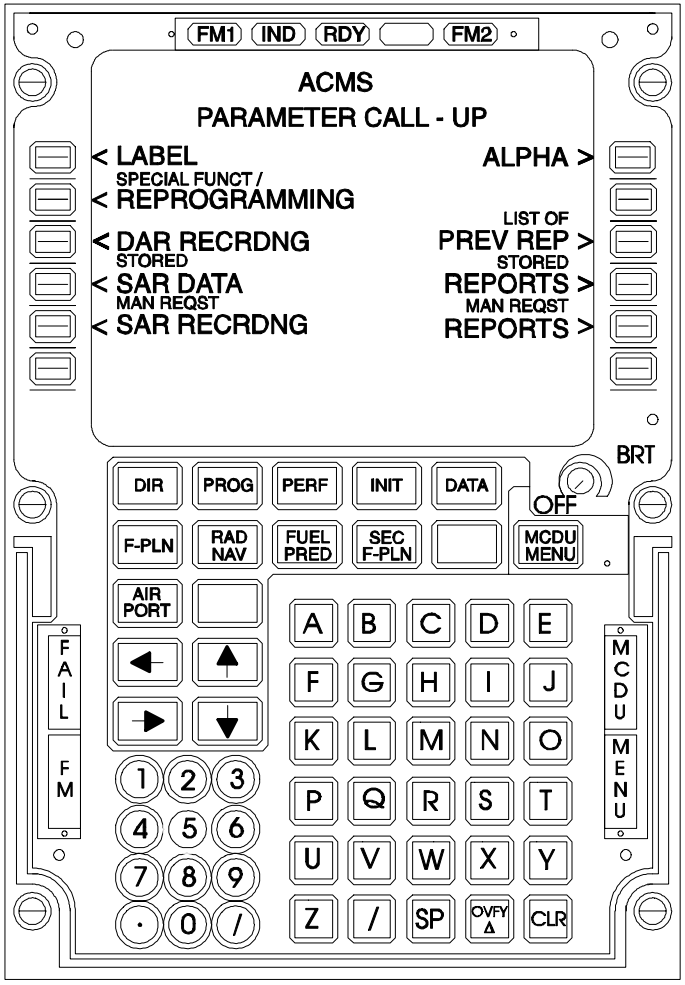
Programming of the ACMS can be done using two different means:

-1- Using Ground Support Equipment(GSE). GSE is a software tool which enables a general programming of the ACMS and data recording readout.

-2- Using the MCDU for a few characteristics of the reports such as reports inhibition, constants and statistic counters.

< DAR RECRDNG

This line is displayed
only if the DAR is installed



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GSE

GSE is a software running on a personal Computer composed of two tools (RECONFIGURATION and READOUT).

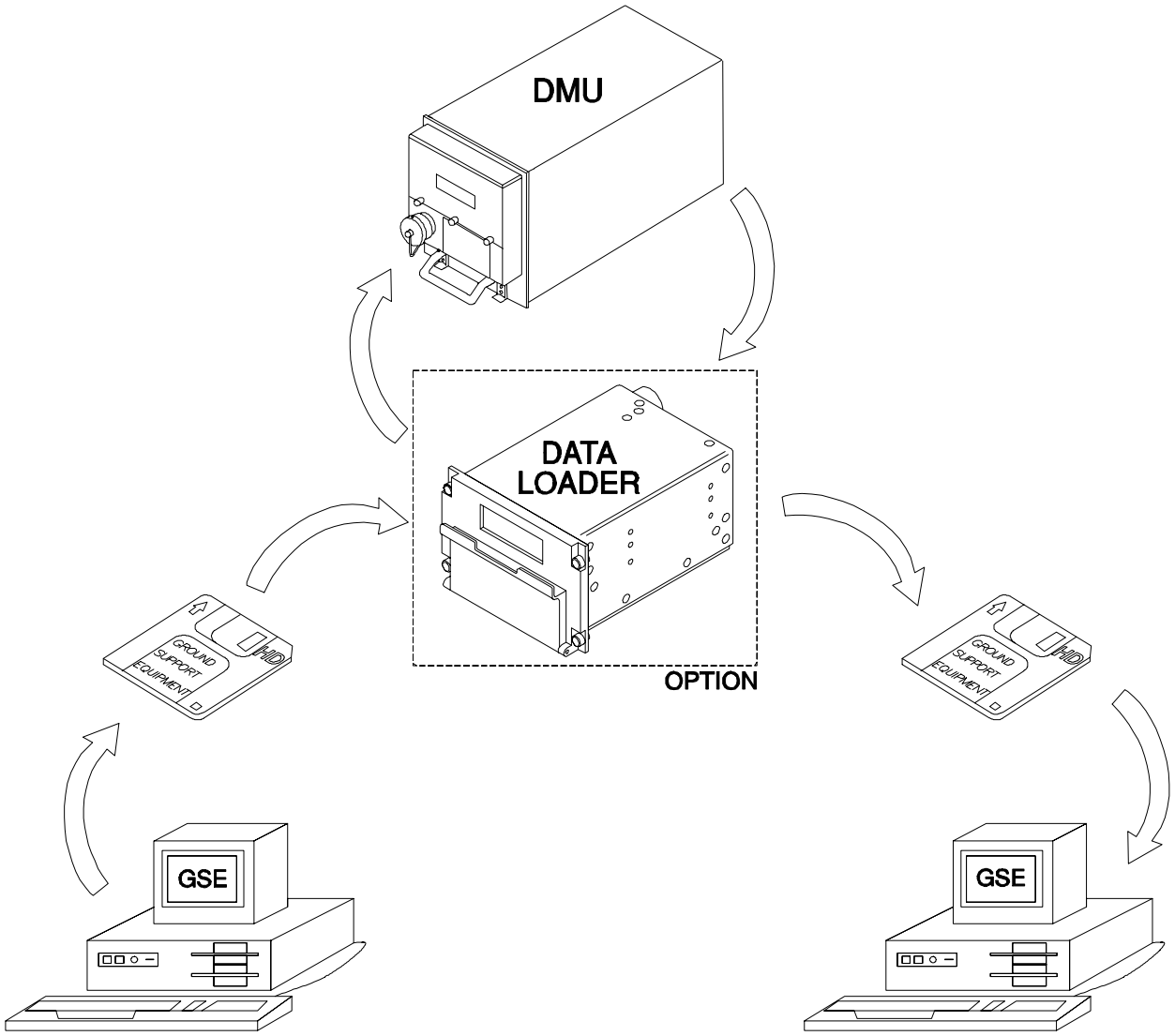
RECONFIGURATION : The reconfiguration tool allows the user to configurate the DMU setup database in a user friendly manner through a series of menus.
The major functions are :

- adjustment of standard reports,
- configuration of SAR and DAR (if installed) recording channels,
- addition of custom reports and triggers,
- configuration of DMU memory and
- controlling of additional system functions.

The database is stored on floppy disks and then transferred to the DMU through the data loader.

READOUT : The readout tool allows the user to view data from SAR recordings and reports which are stored on floppy disks after a downloading through the data loader.
The main functions are :

- catalog ACMS reports and SAR recording files,
- display and print dumped reports,
- decompression and display SAR data files and
- generation of dump disks.



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MCDU PROGRAMMING MENUS

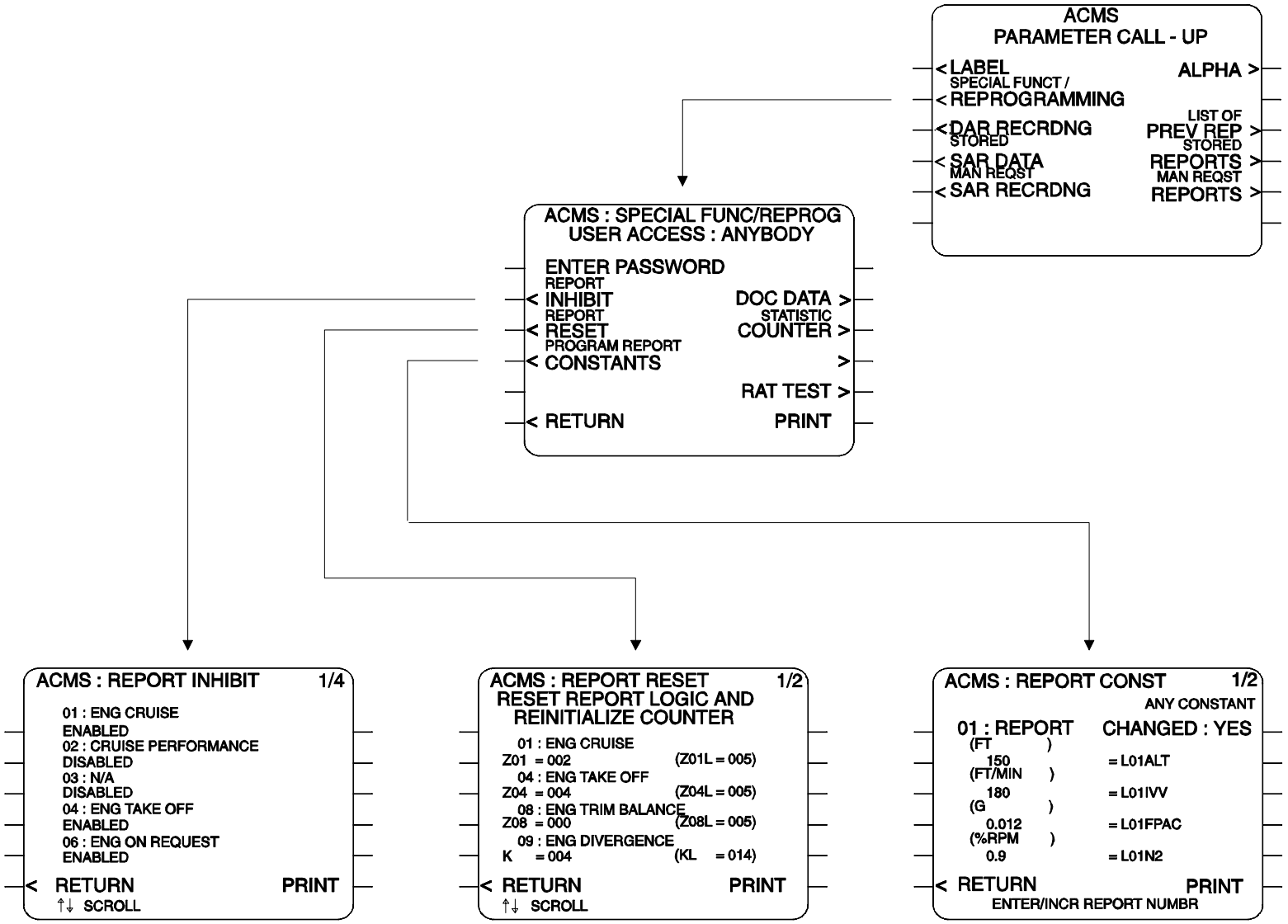
Programming is accessed by selecting the SPECIAL FUNCTION/REPROGRAMMING line key on the ACMS main menu.

A password code is required to modify data inside the following menus :

1- REPORT INHIBIT : This menu inhibits all automatic triggers for a selected report. This inhibition will not disable the generation of the ACMS reports via the MCDU Manual Report Request function.

2- REPORT RESET : This menu provides the ACMS user with the capability to reset trigger logics associated with specific ACMS reports.

3- REPORT CONSTANT PROGRAMMING : This menu modifies constants within the ACMS. Report constants are listed individually for each report.



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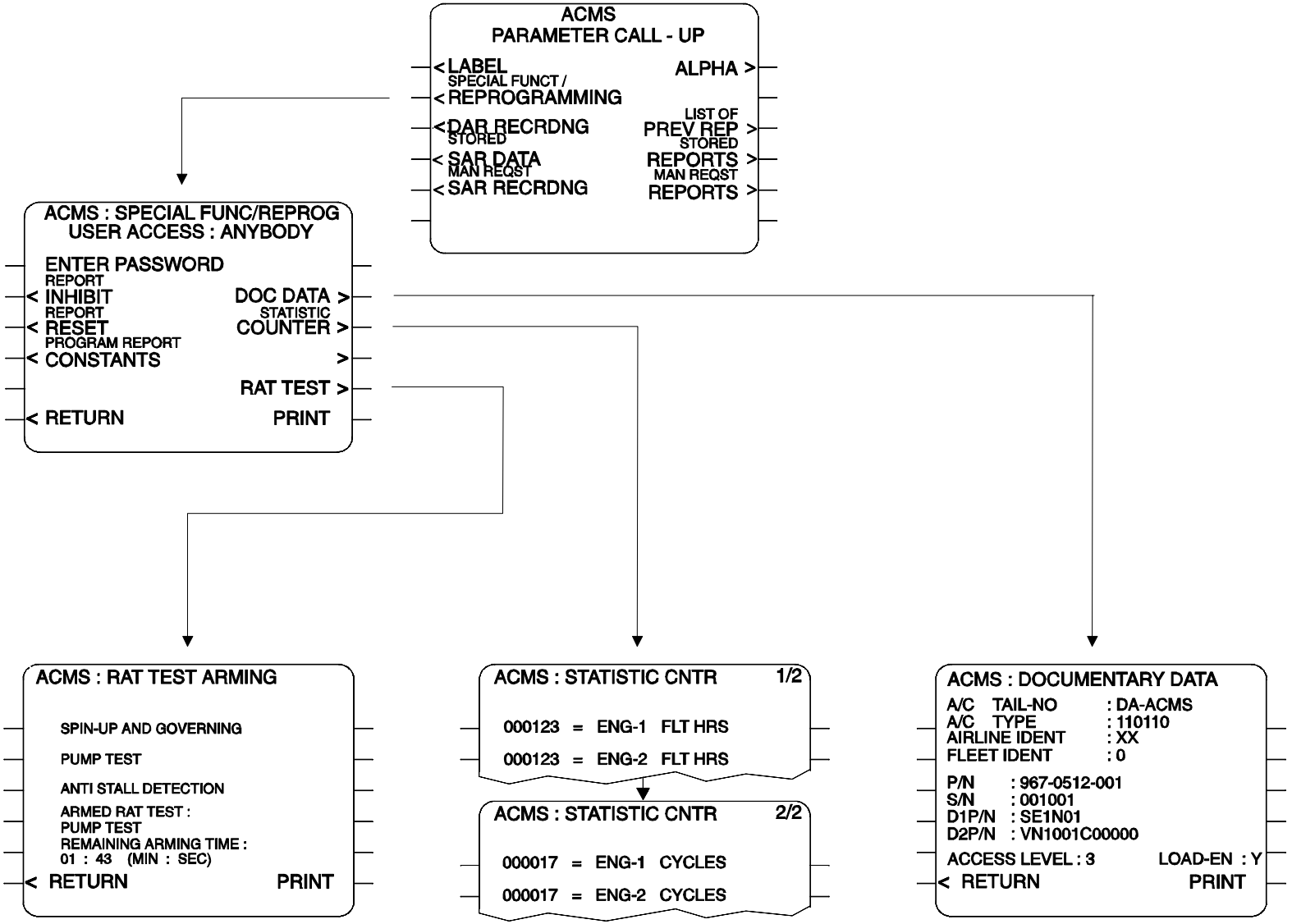
4- DOCUMENTARY DATA : This menu provides some ACMS identification information.

5- STATISTIC COUNTERS : This menu allows the display and reprogramming of engine hours and engine cycles for each engine. The ACMS DMU will reset engine hours and engine cycles for a particular engine position when a DMU recognizes a change in engine serial number. This menu allows the line maintenance personnel to program the correct value for engine hours and engine serial number after an engine has been changed.

6- RAT TEST ARMING : This menu allows the arming of the triggers for the RAM Air Turbine test report(number 20).



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STUDENT NOTES:

DMU PARAMETER INPUTS

General
Engine Interface and Vibration Monitoring Units (EIVMUs)
Bleed Air Monitoring Computers (BMCs)
Fuel Control and Monitoring Computer (FCMC) 1, 2
Air Data and Inertial Reference Unit (ADIRU) 1, 2
Cabin Pressure Controller (CPC) 1, 2
Flight Management Guidance and Envelope Computer (FMGEC) 1, 2
Electronic Control Box (ECB)
Flight Warning Computer (FWC) 1, 2
Zone Controller (ZC)
System Data Acquisition Concentrator (SDAC) 1, 2
Flight Data Interface Unit (FDIU)
Display Management Computer (DMC) 1, 2, 3
Ground Proximity Warning Computer (GPWC)
Flight Control Unit (FCU)
Landing Gear Control and Interface Unit (LGCIU) 1, 2
Weight and Balance Computer (WBC) 1, 2 (OPTION)
Slat Flap Control Computer (SFCC) 1, 2
Flight Control Data Concentrator (FCDC) 1, 2

GENERAL

The DMU receives about 12000 parameters from the A/C system computers through ARINC 429 buses.
Some spare inputs are provided for other computers if necessary.

These computers send some parameters which can be :

- called-up on the MCDU (basically 300 in clear),
- recorded by the DAR if installed/SAR,
- used to create reports.

The DMU can use the parameters directly or after processing (average, mathematical formulas...).

As all the reports have the standard header, the DMU uses data from most of the system computers to create this header.

The DMU uses specific data from the following system computers to create specific preprogrammed report contents which are :

- Engine condition and A/C performance monitoring reports,
- APU condition monitoring report,
- Load report,
- Environmental Condition System report,
- Ram Air Turbine (RAT) test report. and programmable report contents.

Note : All the system parameters can be used for the programmable reports.

ENGINE INTERFACE AND VIBRATION MONITORING UNITS (EIVMUs)

The Engine Interface and Vibration Monitoring Unit parameters are used for all the Engine and A/C performance reports, one APU report ("APU MES/IDLE report") and the Environmental Condition System report.

BLEED AIR MONITORING COMPUTERS (BMCs)

The Bleed air Monitoring Computer parameters are used for some engine and A/C performance reports and the Environmental Condition System report.

FUEL CONTROL AND MONITORING COMPUTER (FCMC) 1, 2

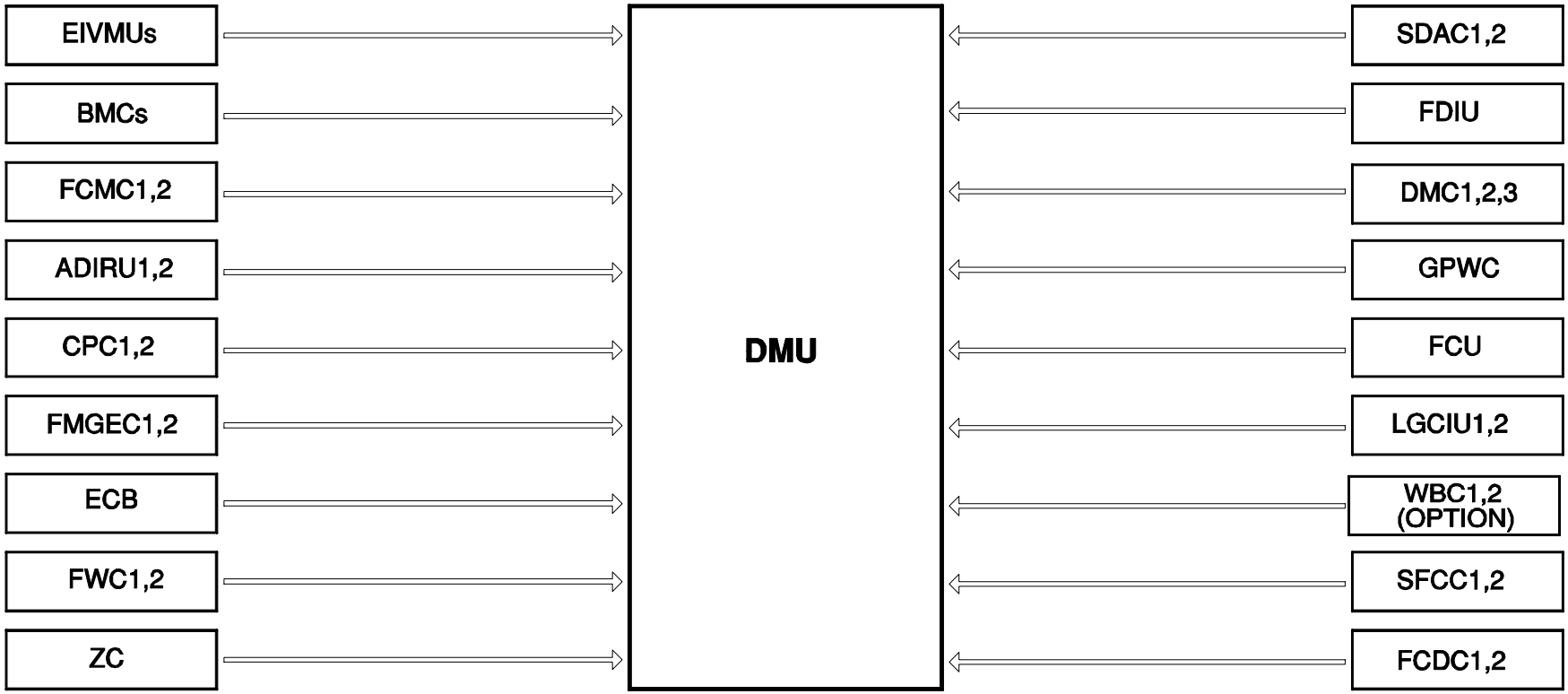
The Fuel Control and Monitoring Computer parameters are only used for one engine and A/C report ("Cruise Performance report").

AIR DATA AND INERTIAL REFERENCE UNIT (ADIRU) 1,2

The Air Data/Inertial Reference Unit parameters are used for only one engine and A/C report ("Cruise Performance report") Load report and the Environmental Condition System report.

CABIN PRESSURE CONTROLLER (CPC) 1, 2

The Cabin Pressure Controller parameters are only used for the Environmental Condition System report.



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FLIGHT MANAGEMENT GUIDANCE AND ENVELOPE COMPUTER (FMGEC) 1, 2

The Flight Management Guidance and Envelope Computer parameters are used for only one engine and A/C performance report ("Cruise performance report") and the Load report.

ELECTRONIC CONTROL BOX (ECB)

The Electronic Control Box parameters are used for the 2 APU reports.

FLIGHT WARNING COMPUTER (FWC) 1, 2

The Flight Warning Computer parameters are only used for the Load report.

ZONE CONTROLLER (ZC)

The Zone Controller parameters are only used for the Environmental Condition System report.

SYSTEM DATA ACQUISITION CONCENTRATOR (SDAC) 1, 2

The System Data Acquisition Concentrator parameters are used for some engine and A/C performance reports, the 2 APU reports and the RAT report.

FLIGHT DATA INTERFACE UNIT (FDIU)

The Flight Data Interface Unit sends Flight Data Recorder parameters to the DMU through an Arinc 429 bus so that they can be recorded on the DAR if installed.

DISPLAY MANAGEMENT COMPUTER (DMC) 1, 2, 3

The Display Management Computer parameters are not dedicated to a specific preprogrammed report.

GROUND PROXIMITY WARNING COMPUTER (GPWC)

The Ground Proximity Warning Computer parameters are not dedicated to a specific preprogrammed report.

FLIGHT CONTROL UNIT (FCU)

The Flight Control Unit parameters are not dedicated to a specific preprogrammed report.

LANDING GEAR CONTROL AND INTERFACE UNIT (LGCIU) 1, 2

The Landing Gear Control and Interface Unit parameters are only used for the RAT report.

WEIGHT AND BALANCE COMPUTER (WBC) 1, 2 (OPTION)

The Weight and Balance Computer parameters are not dedicated to a specific preprogrammed report.

SLAT FLAP CONTROL COMPUTER (SFCC) 1, 2

The Slat Flap Control Computer parameters are used for only one engine and A/C performance report ("Cruise performance report") and the Load report.

FLIGHT CONTROL DATA CONCENTRATOR (FCDC) 1, 2

The Flight Control Data Concentrator parameters are only used for one engine and A/C performance report ("Cruise performance report").

STUDENT NOTES:

STUDENT NOTES

DMU USER INTERFACES

DAR (OPTION)
MDDU (OPTION)
Acars MU (OPTION)
CMC 1, 2
Printer
MCDU
Remote Print

DAR (OPTION)

The DMU sends the data for recording to the DAR in Harvard Biphase format on one output bus.It also sends some DAR controls, on discrete outputs, such as DAR speed select and DAR run control.

The DMU receives some discrete signals from the DAR for DAR status.

MDDU (OPTION)

The DMU can download stored ACMS reports and SAR content to the Multipurpose Disk Drive Unit (MDDU) on an Arinc 429 bus.
DMU system software and setup data base can be uploaded from the MDDU on an Arinc 429 bus.

The DMU also receives a signal from the MDDU rotary selector on a discrete signal.

ACARS MU (OPTION)

The DMU can send ACMS reports to the ground station via ACARS MU on an Arinc 429 bus.
The DMU receives ACMS report trigger logic from the ground station via ACARS MU on an Arinc 429 bus.

CMC 1, 2

The DMU sends fault messages to the Central Maintenance Computers on an Arinc 429 bus.
The DMU receives control words and maintenance parameters from the Central Maintenance Computer 1 on an Arinc 429 bus.

PRINTER

The DMU sends ACMS print reports to the printer on an Arinc 429 bus. The DMU receives printer status information on an Arinc 429 bus.

MCDU

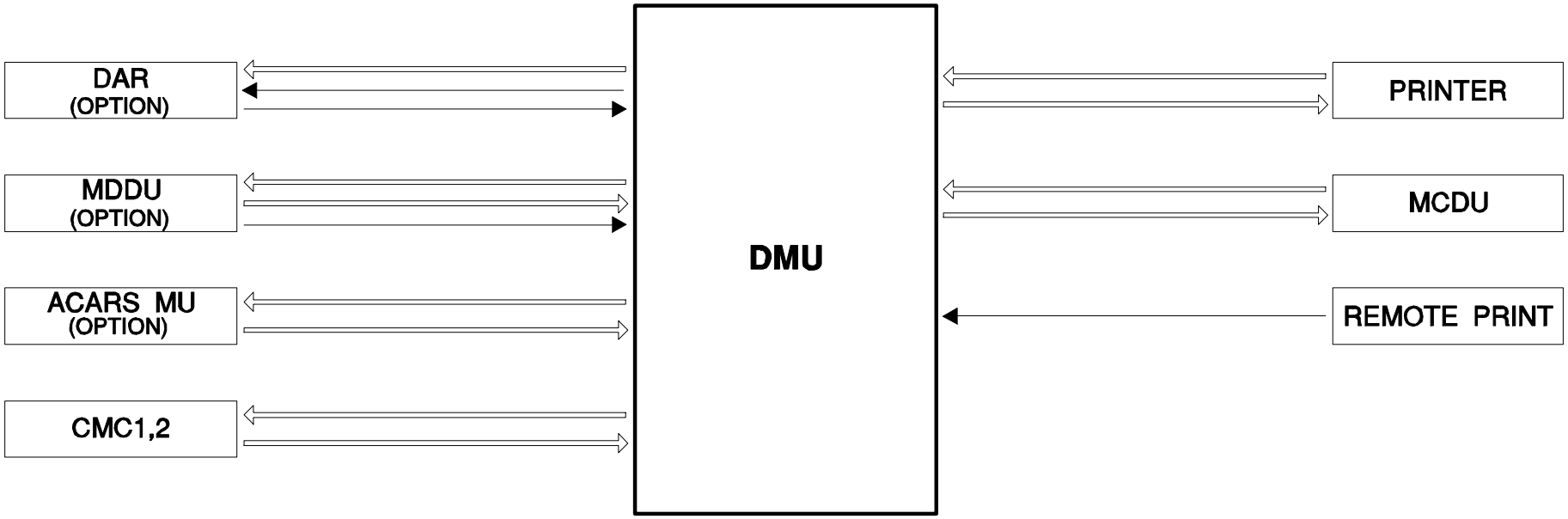
The DMU dialogues with the user through the MCDU on 2 Arinc buses.

The MCDU enables :

- parameter read-out,
- report controls,
- DAR if installed/SAR controls,
- programming.

REMOTE PRINT

The DMU receives the signal from the "ACMS PRINT" pushbutton on one discrete input.



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STUDENT NOTES:

COMPONENTS

Safety Precautions
Data Management Unit (DMU)
Optical Digital ACMS Recorder (ODAR)

SAFETY PRECAUTIONS

The avionics computers are Electrostatic Sensitive Devices (ESDs).
These components are susceptible to damage by electrical sources that would not damage conventional components.
The low energy source, that most commonly destroys ESDs, is the human body which generates static electricity in conjunction with the ground.

The precautions to follow are:

- de-energize all power and signal sources
- place the unit on a grounded conductive work surface
- ground any tools that will contact the unit ...

when it is specified in the maintenance manual.

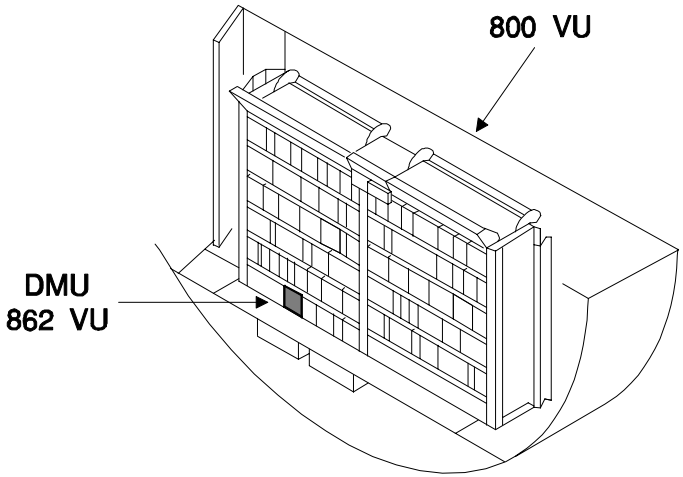
STUDENT NOTES

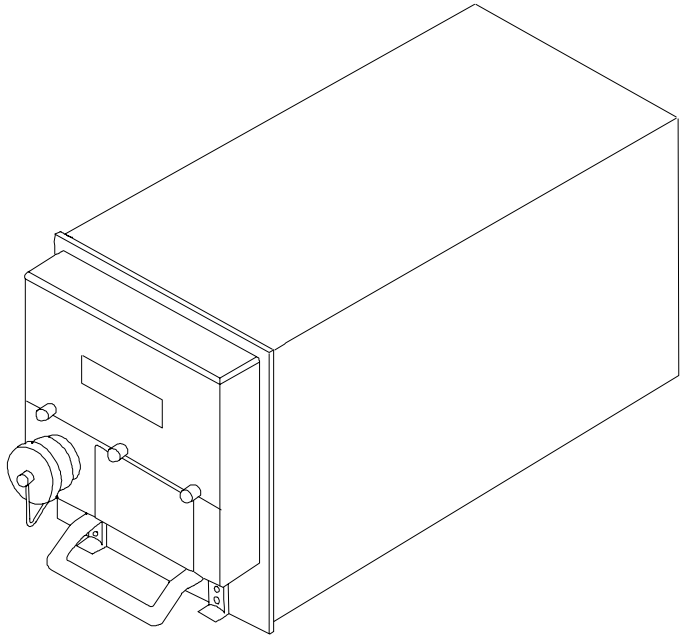
DATA MANAGEMENT UNIT (DMU)

FIN : 1TV ZONE : 122
DMU SOFTWARE DISKS FIN : 1TV1 and 1TV2

COMPONENT DESCRIPTION

The DMU is a microprocessor controlled unit with several modules for collection, processing, storage and distribution of digital ARINC 429 data.





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OPTICAL DIGITAL ACMS RECORDER (ODAR)

FIN : 2TV ZONE : 122
ODAR DISK FIN : 2TV1

COMPONENT DESCRIPTION

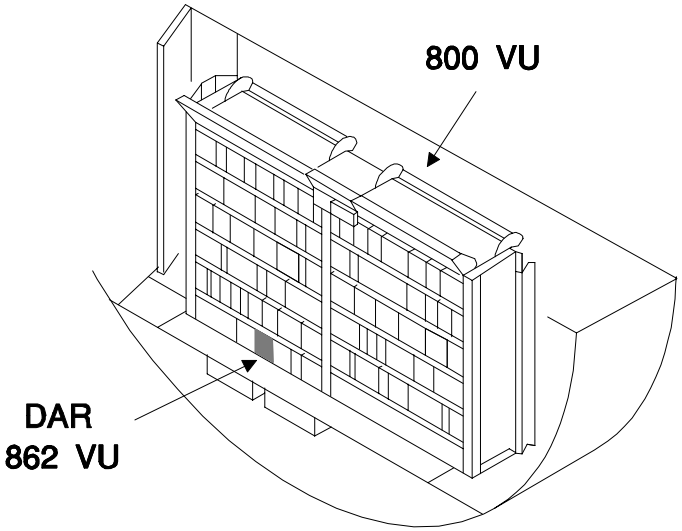
The ODAR is an optical disk recorder. It has a door, incorporated in the front panel which gives quick access to the cartridge.
A front panel control/display system comprising four pushbutton switches and two 8-character alphanumeric displays, permits direct user configuration, status monitoring and command entry.

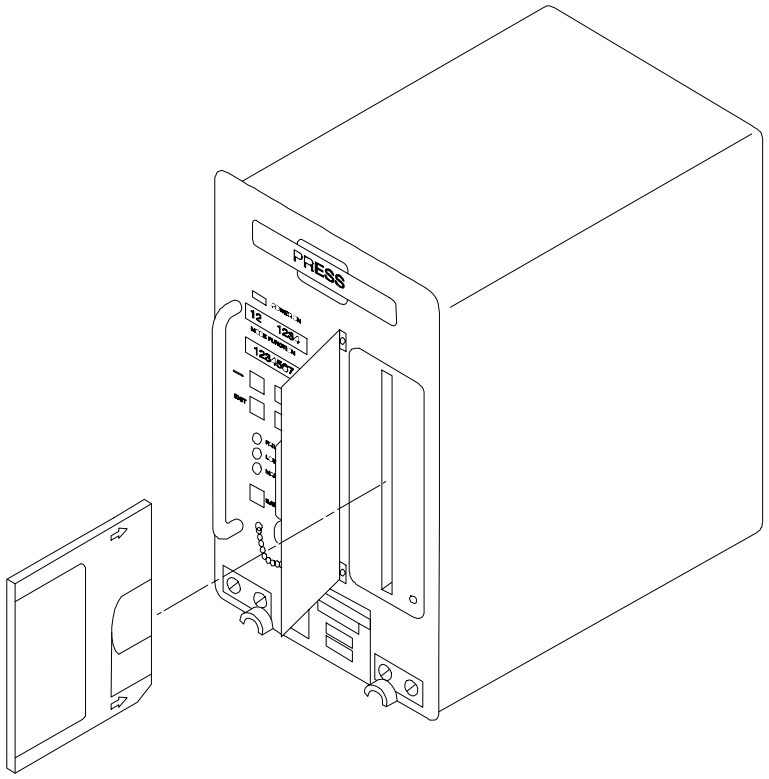
The following annunciators are provided on the front panel :

POWER ON : a green lamp which indicates the presence of power supply.
FAIL : a red LED which indicates ODAR failure.
MAINTENANCE : a yellow LED which indicates ODAR performance degradation.
LOW CAPACITY : a yellow LED which indicates if the amount of free disk space remaining is below the threshold value defined in configuration.

Changing the disk :

1) Open the front door,
2) push the eject pushbutton switch,
3) change the disk,
4) close the front door.





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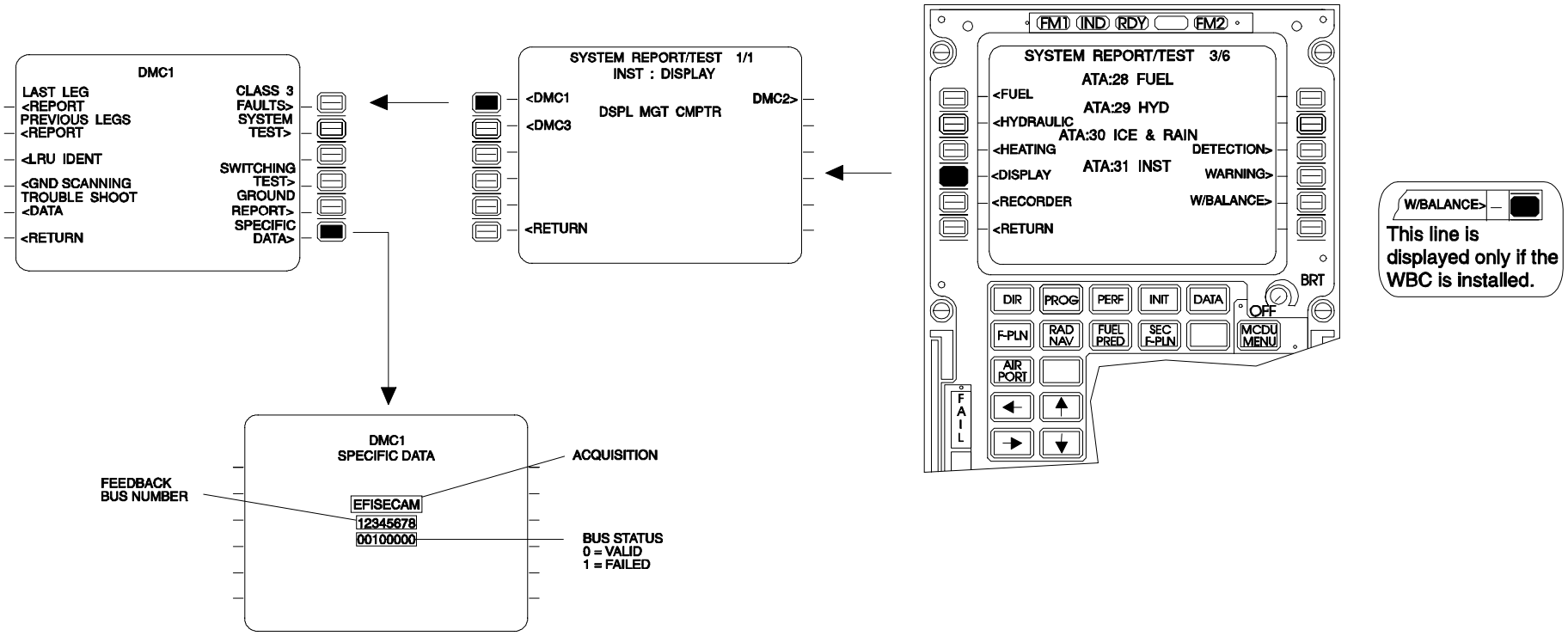
STUDENT NOTES

CMS SPECIFIC PAGES PRESENTATION

Display
Recorder
Warning
W / Balance (OPTION)

DISPLAY

Selecting DISPLAY enables access to the 3 DMC main menus.
All DMC main menus are identical.
There is a specific item which is SPECIFIC DATA.
This function displays the actual status of the 8 feedback busses of the DMC.



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RECORDER

Selecting RECORDER enables access to main menus of the FDIU and DMU (if installed).
As well as the standard CMS functions, the DFDRS menu includes a specific data item.
2 specific data items are displayed on this MCDU page.
Each parameter, recorded by the DFDR, can be displayed by selection of its Arinc characteristics (EQuipment,SYStem,LABel,SDI).
In this page another function enables the DFDR and playback data of a given word to be displayed in 4 subframes related to the word number selection.

This item displays FDIU information, such as :

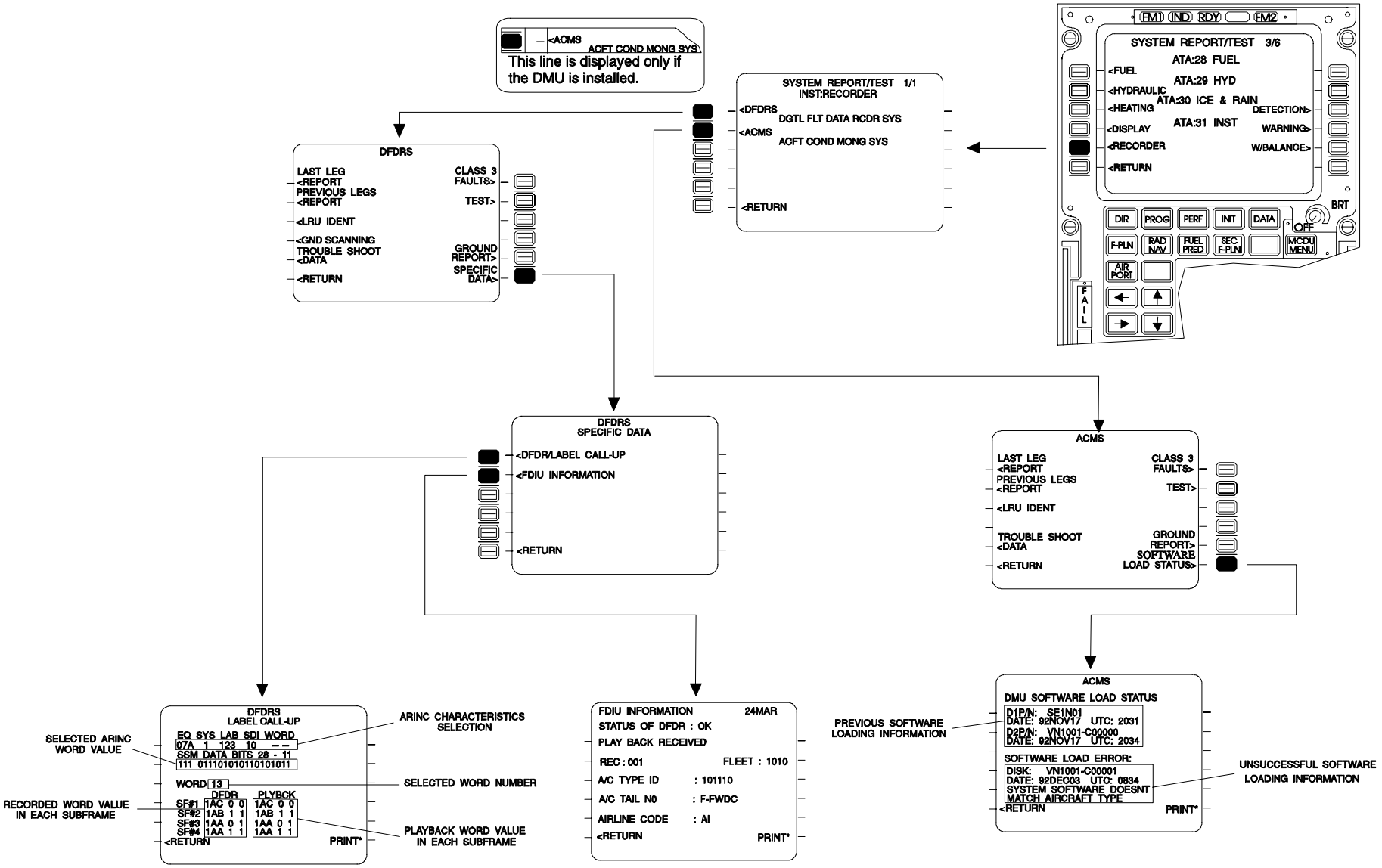
- status of Flight Data Recorder,
- result of DFDR playback check,
- record version,
- fleet identification and A/C type identification,
- A/C tail number and Airline code.

As well as the standard CMS functions, the ACMS menu includes a specific item called "SOFTWARE LOAD STATUS".
This function displays information and status concerning the software loaded in the DMU.

The software information is :

- system software version,
- date and UTC when software loading was performed.

The status lines are used to display the sofware loading statement.



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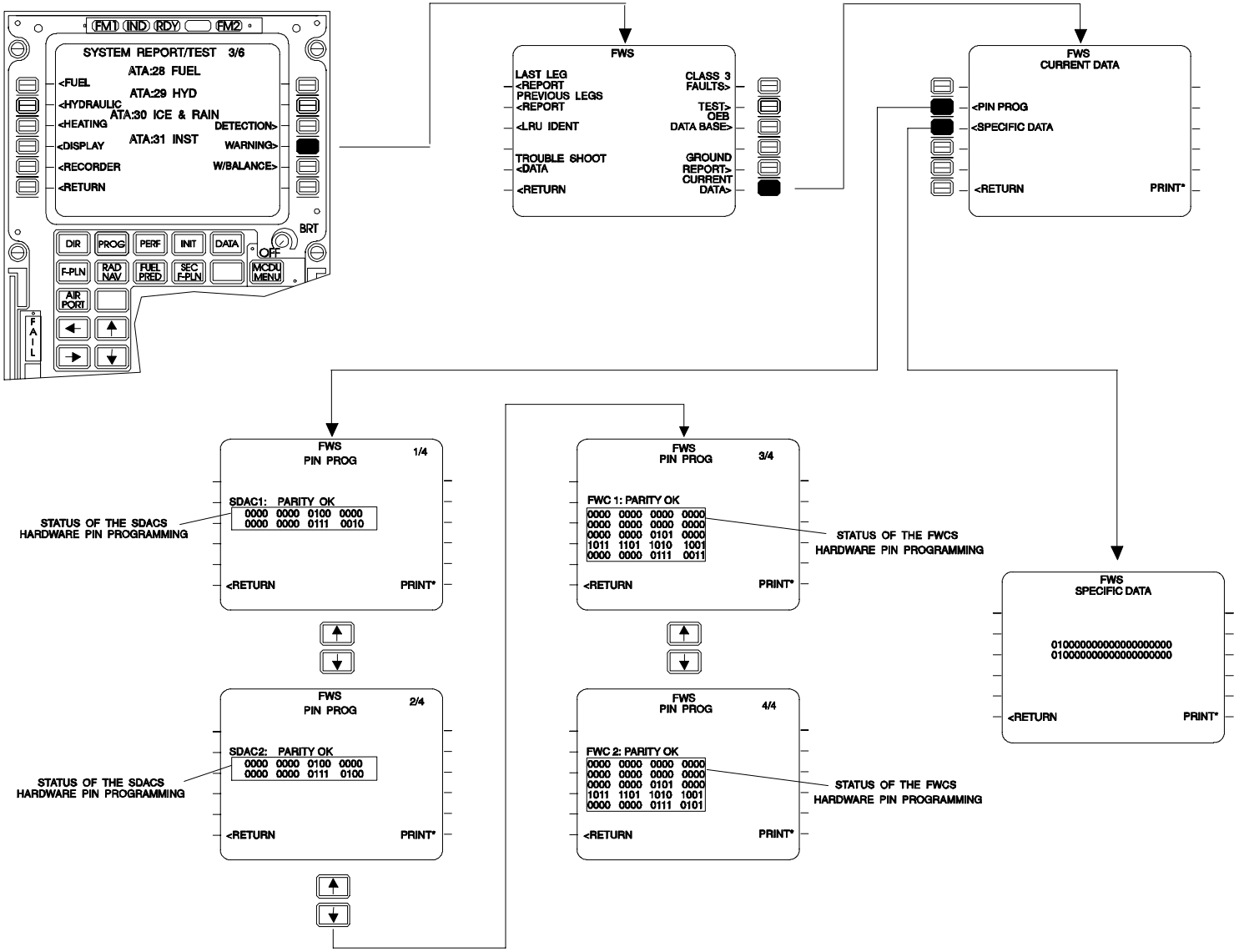
WARNING

Selecting WARNING enables direct access to the FWS main menu.
This menu is generated by the FWC1. The specific function is CURRENT DATA.
2 specific data items are displayed on this MCDU page.
The purpose of this item is to show the status of the hardware pin programs for the SDACs and the FWCs. It also shows the result of the last parity check.
The PIN PROGRAM function is displayed on 4 MCDU screens which are accessible through the scrolling keys.
This item enables a specific maintenance task which is to check at regular periods the presence of faults which are called CLASS 3 SAFETY RELATED.



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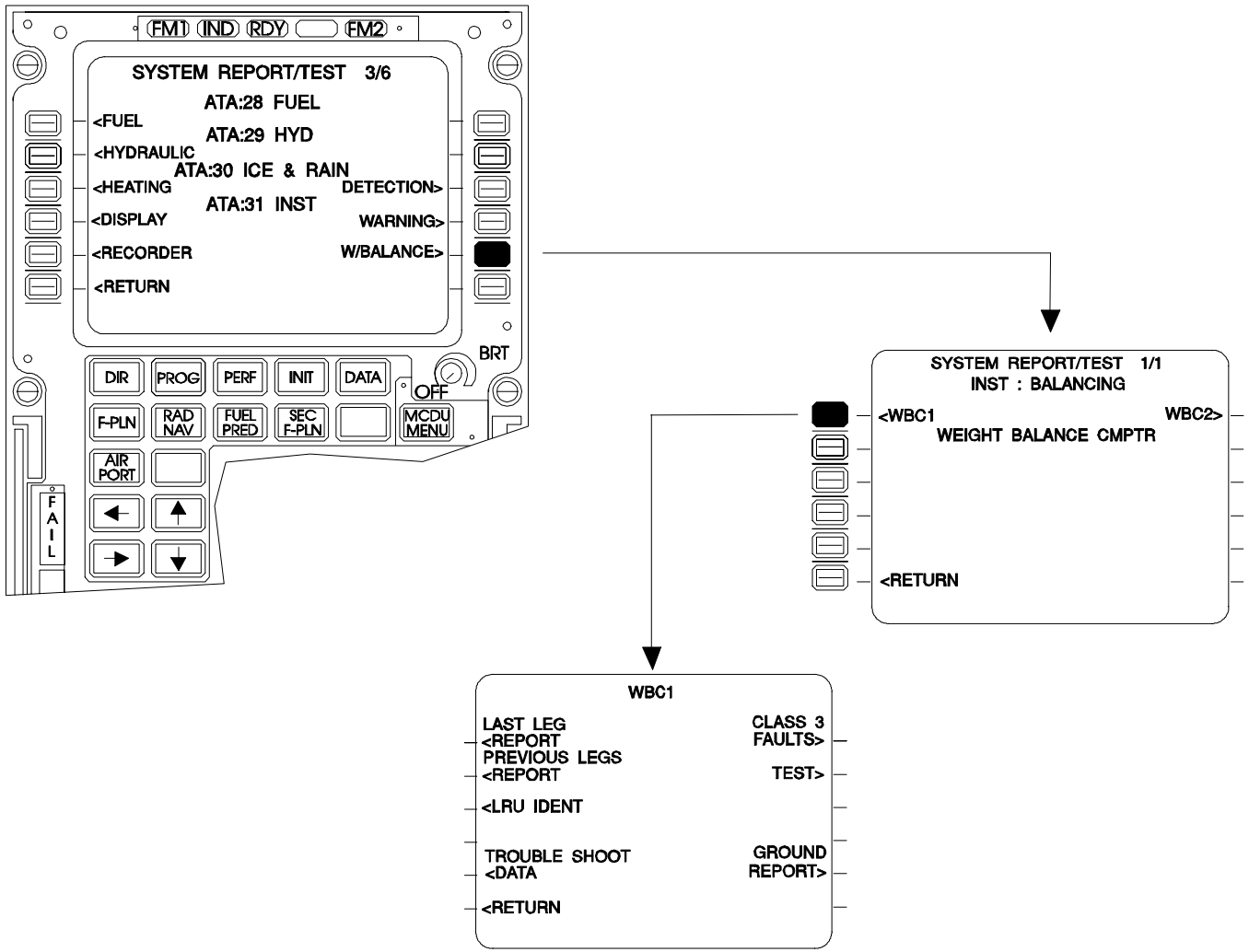
W / BALANCE (OPTION)

Selecting W / BALANCE enables access to the 2 WBC main menus.
All WBC main menus are identical.
All items of this menu are standard.



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STUDENT NOTES