A319/A320/A321
TECHNICAL TRAINING MANUAL

MECHANICS / ELECTRICS & AVIONICS COURSE

22 AUTO FLIGHT SYSTEM

This document must be used for training purpose only

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

It will not be updated.

22 AUTO FLIGHT SYSTEM

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EFFECTIVITY
ALL

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22 - AUTO FLIGHT SYSTEM

22-00-00 AUTO FLIGHT SYSTEM DESIGN PHILOSOPHY

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AUTO FLIGHT SYSTEM DESIGN PHILOSOPHY

GENERAL CONCEPT

The Auto Flight System (AFS) calculates orders to automatically control the flight controls and the engines.
The Auto Flight System computes orders and sends them to the Electrical Flight Control System (EFCS) and to the Full Authority Digital Engine Control (FADEC) to control flying surfaces and engines.
When the AFS is not active, the above mentioned components are controled by the same systems but orders are generated by specific devices (i.e. side sticks and thrust levers).

NAVIGATION

A fundamental function of the Auto Flight System is to calculate the position of the aircraft.
When computing the aircraft position, the system uses several aircraft sensors giving useful information for this purpose.

FLIGHT PLAN

The system has several flight plans in its memory. These are predetermined by the airline.
A flight plan describes a complete flight from departure to arrival, it includes vertical information and all intermediate waypoints.
It can be displayed on the instruments (CRTs).

OPERATION

There are several ways to use the Auto Flight System. The normal and recommended way to use the Auto Flight System is to use it to follow the flight plan automatically.
Knowing the position of the aircraft and the desired flight plan (chosen by the pilot), the system is able to compute the orders sent to the surfaces and engines so that the aircraft follows the flight plan.
The pilot has an important monitoring role.

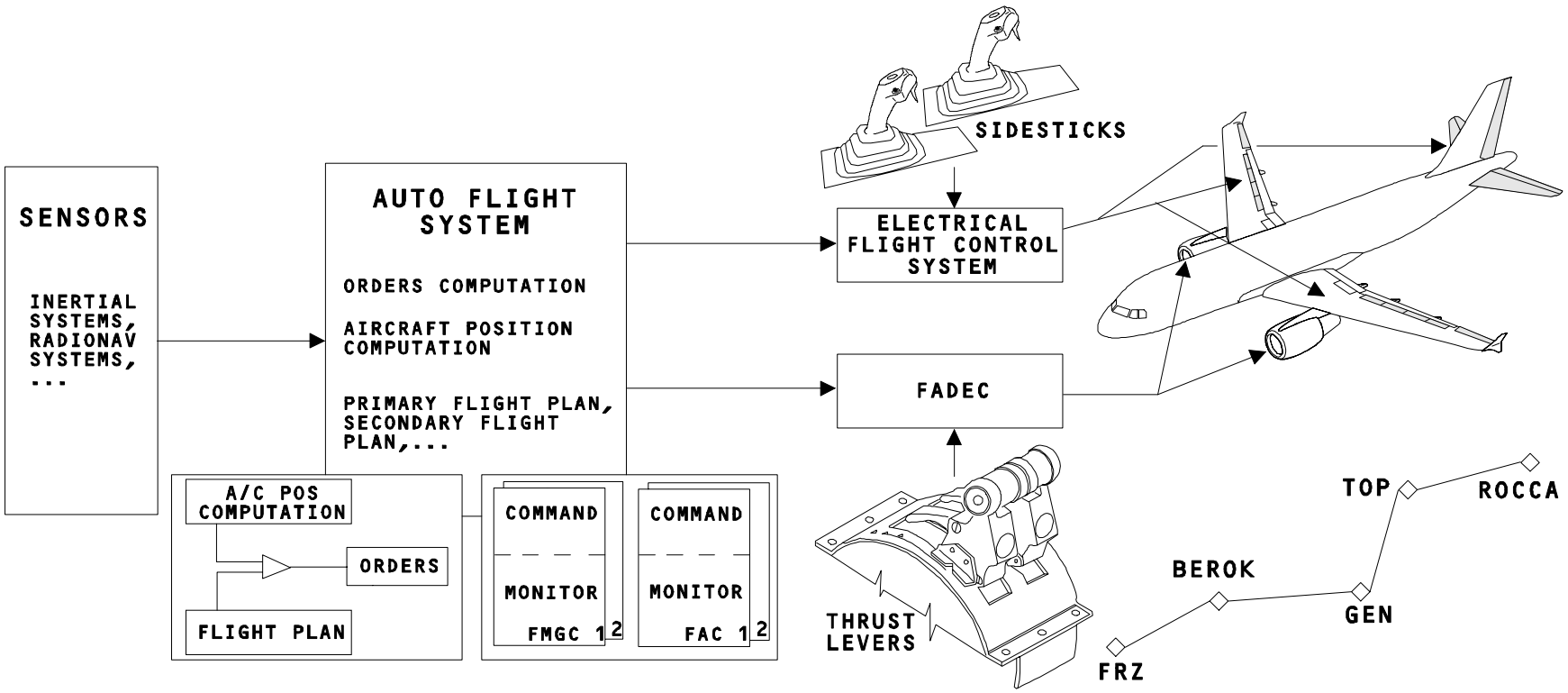
NOTE: During Auto Flight System operation, side sticks and thrust levers do not move automatically.

AFS/FLY BY WIRE

If the pilot moves the side stick when the Auto Flight System is active, it disengages the autopilot.
Back to manual flight, when the side stick is released, the Electrical Flight Control System maintains the actual aircraft attitude.

SYSTEM DESIGN

To meet the necessary reliability, the AutoFlight System is built around four computers:
Two interchangeable Flight Management and Guidance Computers (FMGCs) and two interchangeable Flight Augmentation Computers (FACs).
It is a FAIL OPERATIVE system.
Each Flight Management and Guidance Computer and each Flight Augmentation Computer has a command part and a monitor part to be FAIL PASSIVE.



AUTO FLIGHT SYSTEM DESIGN PHILOSOPHY

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22-00-00 AUTO FLIGHT SYSTEM PRESENTATION

CONTENTS:

AUTO FLIGHT SYSTEM PRESENTATION

GENERAL

The Auto Flight System (AFS) provides the pilots with functions reducing their workload and improving the safety and the regularity of the flight.
The Auto Flight System is designed around:
- 2 Flight Management and Guidance Computers (FMGCs),
- 2 Flight Augmentation Computers (FACs),
- 2 Multipurpose Control and Display Units (MCDUs),
- 1 Flight Control Unit (FCU).

CONTROLS

The FCU and the MCDUs enable the pilots to control the functions of the FMGCs.
The FAC engagement pushbuttons and the rudder trim control panel are connected to the FACs.
The MCDUs are used for long-term control of the aircraft and provide the interface between the crew and the FMGC allowing the management of the flight.
The FCU is used for short term control of the aircraft and provides the interface required for transmission of engine data from the FMGC to the Full Authority Digital Engine Control (FADEC).

FMGCs

There are two interchangeable FMGCs.
Each FMGC is made of two parts: the Flight Management part called FM part and the Flight Guidance part called FG part.
The Flight Management part provides functions related to flight plan definition, revision and monitoring.
The Flight Guidance part provides functions related to the aircraft control.

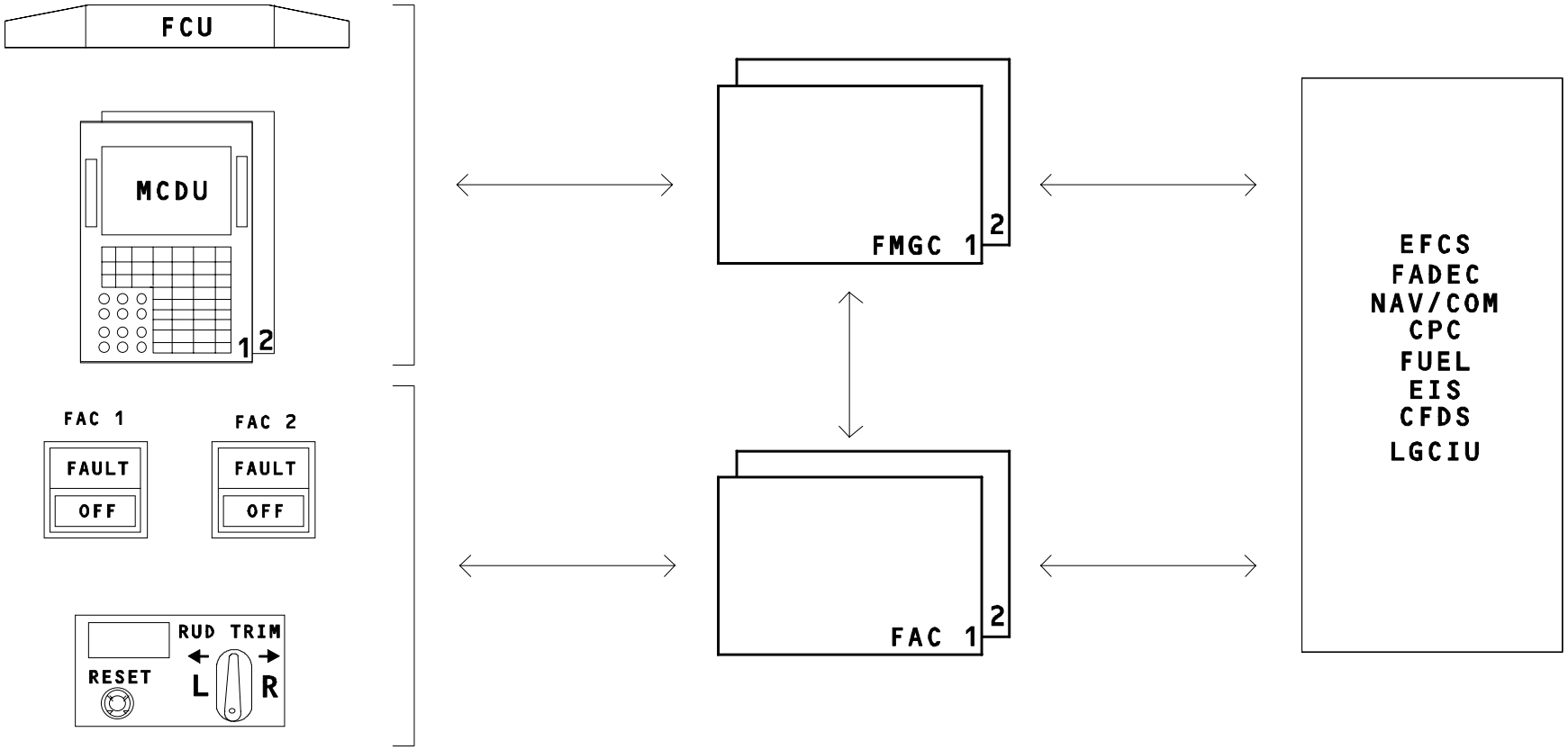
FACs

The basic functions of the FACs are the rudder control and the flight envelope protection.

NOTE: The FAC includes an interface between the Auto Flight System and the Centralized Fault Display System (CFDS) called Fault Isolation and Detection System (FIDS).
This function is activated only in position 1 (FAC 1).

OTHER SYSTEMS

The Auto Flight System is connected to the majority of the aircraft systems.
Examples of Auto Flight System data exchanges:
- Reception of the aircraft altitude and attitude from the Air Data and Inertial Reference System (ADIRS).
- Transmission of autopilot orders to the Elevator and Aileron Computers (ELACs).



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AUTO FLIGHT SYSTEM PRESENTATION

EFFECTIVITY
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SELF EXAMINATION

What are the basic functions of the FACs?

A - Management functions and flight envelope protection.
B - Rudder control and flight envelope protection.
C - Guidance functions and rudder control.

Where are the FMGC functions controlled from?

A - The MCDUs and rudder trim control panel.
B - The FCU and rudder trim control panel.
C - The FCU and MCDUs.

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22-60-00 FAC GENERAL

CONTENTS:

FAC GENERAL

FUNCTIONS

The basic functions of the Flight Augmentation Computer (FAC) are:

- yaw damper,
- rudder trim,
- rudder travel limitation,
- flight envelope protection.

YAW DAMPER

The yaw damper has four functions and controls the rudder via yaw damper actuators.
Upon Flight Management and Guidance Computer (FMGC), Elevator Aileron Computer (ELAC) or FAC orders, the yaw damper provides:

- dutch roll damping,
- turn coordination,
- engine failure compensation,
- yaw guidance order execution.

RUDDER TRIM

The rudder trim orders come from the rudder trim selector, or from the FMGC to control the rudder via the rudder trim actuator.
The rudder trim provides:

- manual trim with RUD TRIM selector,
- auto trim when the autopilot is engaged.

RUDDER TRAVEL LIMITATION

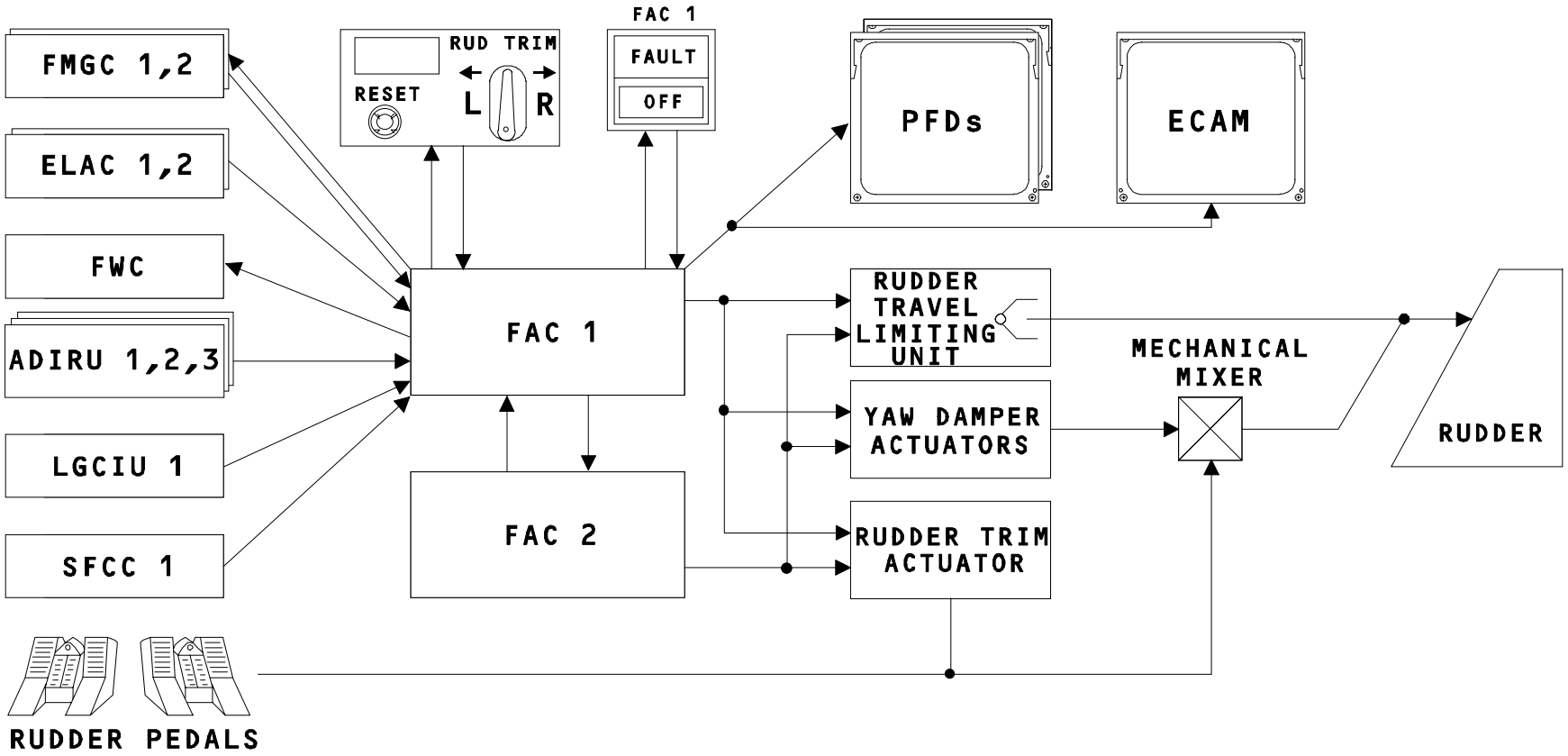
The Rudder Travel Limiting unit limits the deflection of the rudder according to the aircraft speed.
The Rudder Travel Limiting function:

- limits the deflection for structure integrity,
- prevents excessive deflections which would penalize the aircraft performance.

Aircraft speed information is provided by the Air Data Inertial Reference Units (ADIRUs).

FLIGHT ENVELOPE PROTECTION

For flight envelope protection, the FAC computes the various characteristic speeds for aircraft operation, the low energy warning, the excessive angle of attack and windshear detections.
The characteristic speeds computed using the ADIRU, Landing Gear Control and Interface Unit (LGCIU), FMGC and Slat Flap Control Computer (SFCC) data, are displayed on the PFDs.
The alpha floor (excessive angle of attack) and windshear detections are sent to the FMGCs.
The low energy warning computation is sent to the Flight Warning Computer (FWC) which generates an aural warning: "SPEED, SPEED, SPEED".


FMGC 1,2
ELAC 1,2
FWC
ADIRU 1,2,3
LGCIU 1
SFCC 1
RUDDER PEDALS
RUD TRIM
RESET
L
R
FAC 1
FAULT
OFF
FAC 1
FAC 2
PFDs
ECAM
RUDDER TRAVEL LIMITING UNIT
YAW DAMPER ACTUATORS
RUDDER TRIM ACTUATOR
MECHANICAL MIXER
RUDDER

FAC GENERAL

FAC GENERAL

CONTROLS

Each FAC receives inputs from its related pushbutton, the RUD TRIM selector and the RUD TRIM RESET pushbutton.
The RUD TRIM selector deflects the rudder.
The RESET pushbutton returns the rudder to the neutral position.

DISPLAYS

Some of the data computed by the FAC is displayed.

- The characteristic speeds computed by the FACs are shown on the speed scale of the Primary Flight Display (PFD).
- The rudder trim position is displayed on the ECAM System Display and on the RUD TRIM control panel.
- The red WINDSHEAR indication is displayed in the center of both PFDs.

NOTE: The Rudder Travel Limiting position is not displayed. Only its maximum stop positions are shown on the ECAM.

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SELF EXAMINATION

What are the functions of the FACs?

A - Yaw damper, rudder trim, rudder travel limitation, flight envelope protection.
B - Yaw damper, pitch trim, rudder trim, flight envelope protection.
C - Yaw damper, rudder trim, pitch trim.

The yaw damper provides:

A - dutch roll damping and yaw guidance order execution.
B - turn coordination and engine failure compensation.
C - A and B.

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22-00-00 FMGC GENERAL

CONTENTS:

FMGC GENERAL

CONTROLS

The Flight Management and Guidance Computer(FMGC) functions, Flight Management and Flight Guidance, are mainly controlled from the Multipurpose Control and Display Units (MCDUs) and the Flight Control Unit (FCU).
Typical actions are:

- Before departure, on the MCDUs, the pilots select the flight plan which will be followed later on by the aircraft.
- In flight, on the FCU, the pilots can engage the autopilot and can modify different flight parameters leading to an immediate change in the control of the aircraft.

MCDUs (CONTROL PART)

Basically, the MCDUs provide the long term interface between the crew and the FMGCs.
The MCDUs allow, for example:

- the introduction or the definition, the modification and the display of flight plans,
- the display, the selection and the modification of the parameters associated with the flight management functions,
- the selection of specific functions.

FCU (CONTROL PART)

Basically, the FCU provides the short term interface between the crew and the FMGCs.
The FCU allows, for example:

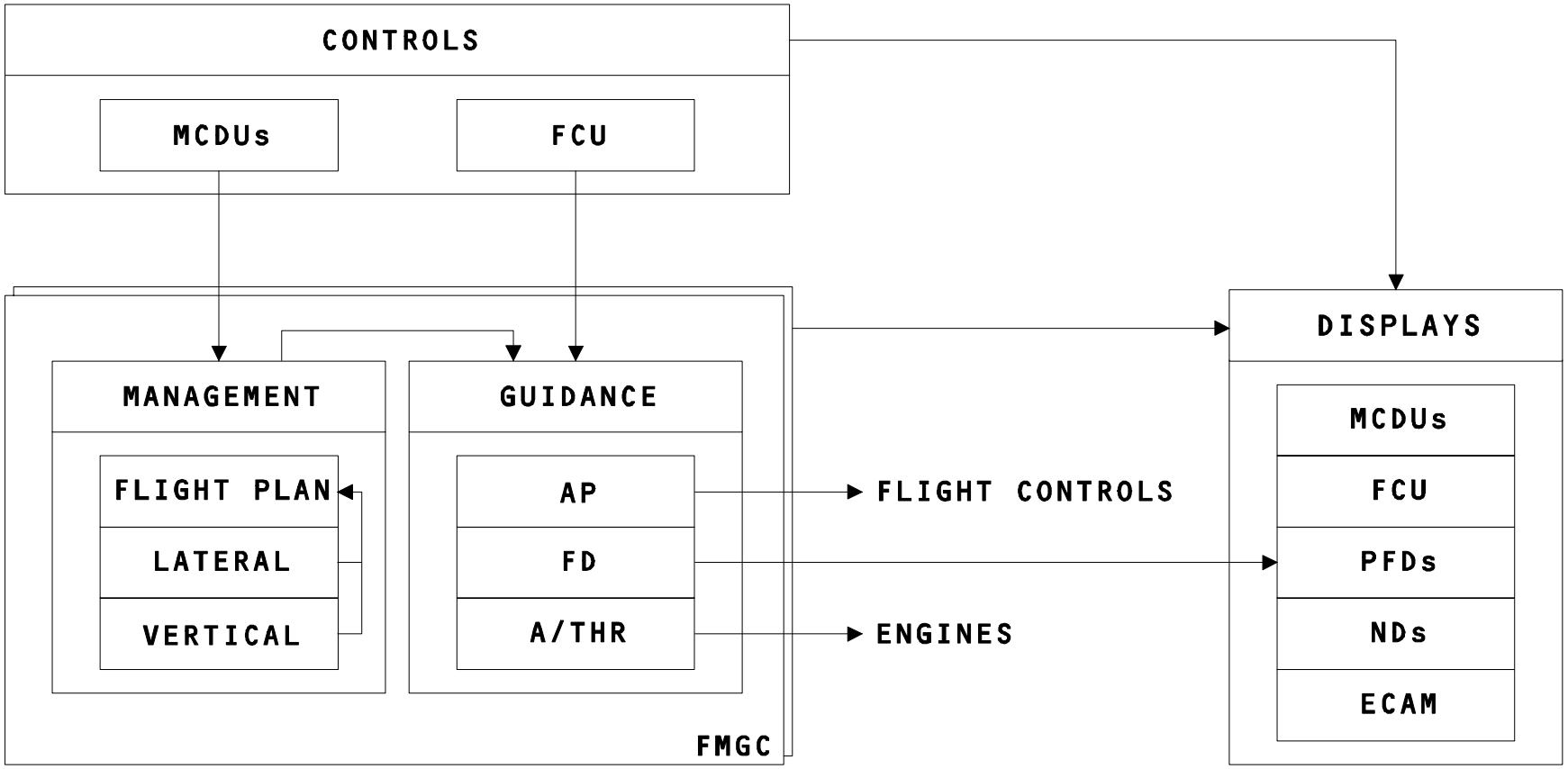
- the engagement of the autopilot, Flight Director and autothrust functions,
- the selection of required guidance modes (e.g. heading hold),
- the selection of various flight parameters (e.g. heading value).

MANAGEMENT

The Flight Management part mainly provides the flight plan selection with its lateral and vertical functions. The Flight Management part provides navigation, performance optimization, radio navigation tuning and information display management.
Data computed by the Flight Management part is occasionally used by the Flight Guidance part.

FLIGHT PLAN

A flight plan contains the various elements and constraints of the route the aircraft must fly along from take-off to landing.
A flight plan can be selected, built-up, modified and monitored through the MCDU.



FMGC GENERAL

FMGC GENERAL

LATERAL FUNCTIONS

The main lateral functions are:

- aircraft position determination,
- IRS alignment through the MCDU,
- automatic or manual (through MCDU) selection of VOR, DME, ILS, ADF frequencies,
- guidance computation along the lateral flight plan.

A navigation data base provides all necessary information to build a flight plan; however pilots can enter other data using the MCDU.

VERTICAL FUNCTIONS

The main vertical functions are:

- optimized speed computation; the resulting target speed being used as reference for guidance functions,
- performance predictions as time, fuel, altitude, wind at various points of the flight,
- guidance computation along the vertical flight plan.

A performance data base provides necessary data; however pilots have to enter other data using the MCDU.

GUIDANCE

The Flight Guidance part provides the autopilot, Flight Director and autothrust functions.
These functions work according to modes generally chosen on the FCU.

The normal way to operate the aircraft is to use the management part as reference source for the guidance part.

AP

The autopilot (AP) function calculates the signals for the flight controls in order to follow the selected modes.
The autopilot controls the pitch, roll and yaw axis according to the selected modes.
Example of autopilot mode: Altitude hold.

FD

The Flight Director (FD) displays the guidance commands on both Primary Flight Displays (PFDs), allowing the pilots to fly the aircraft manually according to the FMGC demands.
Two cases have to be considered:
Autopilot not engaged:
 -The FD function displays symbols on the PFD which gives orders to the pilot to maintain the desired parameter(s). In this case, the pilot follows these orders by acting on the flight controls.
Autopilot engaged:
 -The FD function displays symbols on the PFD representing the autopilot orders to be monitored by the pilot.

FMGC GENERAL

A/THR

The autothrust (A/THR) function calculates the signal necessary for engine control in order to follow a given mode.
Example of autothrust mode: Acquisition and holding of a speed or a Mach number

DISPLAYS

Various displays are used to present Flight Management and Guidance System (FMGS) data and information.
The main displays presenting Flight Management and Guidance information are:

- the Multipurpose Control and Display Units (MCDUs/Display part),
- the Flight Control Unit (FCU/Display Part),
- the Primary Flight Displays (PFDs),
- the Navigation Displays (NDs),
- the ECAM Engine/Warning Display (EWD) and ECAM STATUS pages.

MCDUs (DISPLAY PART)

The MCDUs display all data related to the management part.
Example: Identification of the successive waypoints of the flight plan.

FCU (DISPLAY PART)

The FCU is also considered as a display as it includes indication lights and Liquid Cristal Display (LCD) windows.

The FCU includes:

- lights giving mode indications,
- Liquid Cristal Display windows showing reference parameters.

Example: During a climb with autopilot, the altitude window displays the altitude the aircraft is going to capture.

PFDs

The PFDs mainly display the flight director symbols and the status of guidance functions and their modes. It also displays reference parameters.
Example: The target speed value is represented by a symbol on the speed scale of the PFD.

NDs

The NDs mainly display the flight plan and various navigation data.
Example: Airports or waypoints around the present position of the aircraft.

ECAM

The ECAM Engine/Warning Display (EWD) page presents warning messages related to function or computer failures.
The ECAM STATUS page displays the landing capabilities.

SELF EXAMINATION

The Flight Guidance functions are:
A - autopilot, Flight Director, autothrust.
B - autopilot modes.
C - guidance along a flight plan.

Aircraft position determination is computed by:
A - the guidance part of the FMGCs.
B - the management part of the FMGCs.
C - the FCU.

The automatic selection of navigation frequencies is made by:
A - the MCDU.
B - the guidance part of the FMGCs.
C - the management part of the FMGCs.

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22-10-00 AUTOPILOT

CONTENTS:

AUTOPILOT

GENERAL

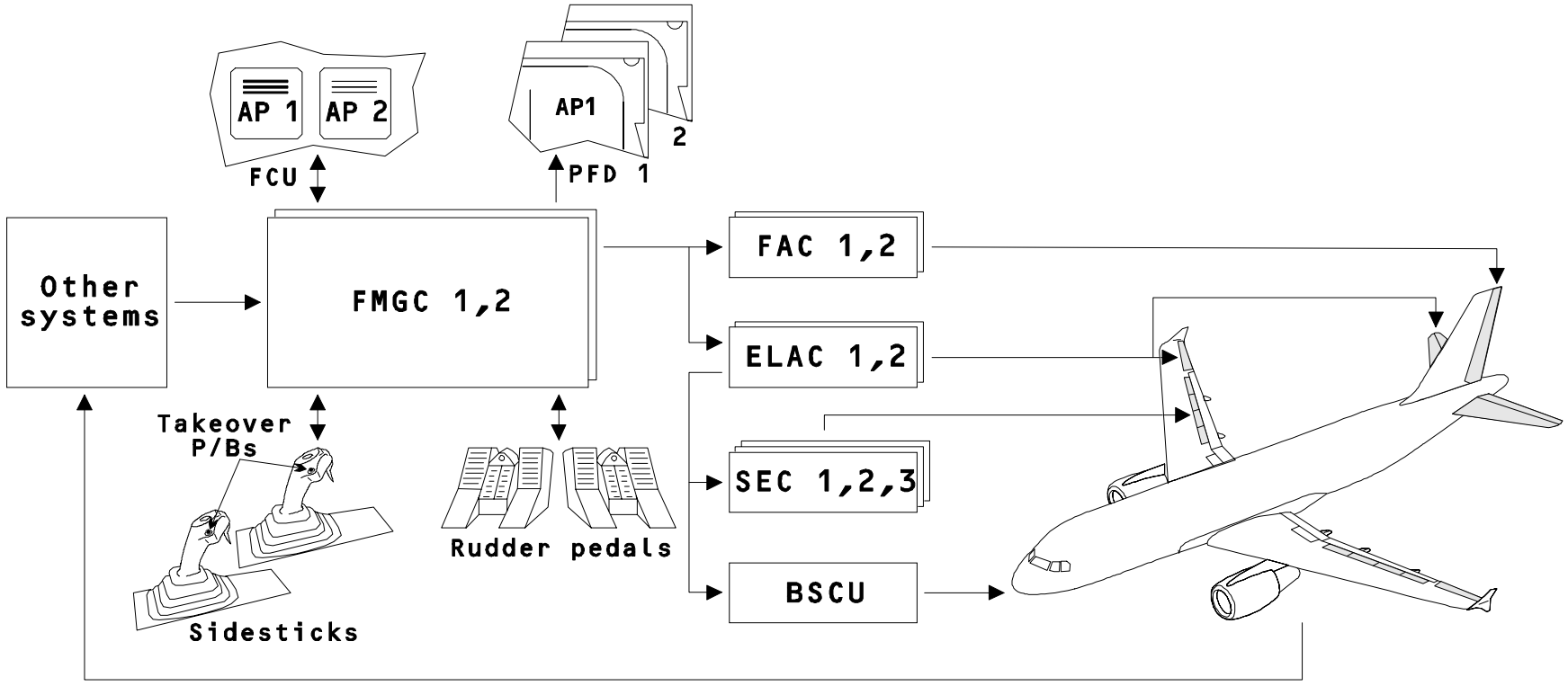
The autopilot (AP) is engaged from the Flight Control Unit (FCU) by the related pushbuttons.
Autopilot engagement is indicated by the illumination of the AP 1 pushbutton or/and the AP 2 pushbutton (Three green bars) and by the white "AP1", "AP2" or "AP1+2" indication on the top right of each Primary Flight Display (PFD).
The autopilot guidance modes are selected from the FCU or the Flight Management and Guidance Computers (FMGCs).
The autopilot function is a loop where, after a comparison between real and reference parameters, the FMGC computes orders which are sent to the flight controls.
The loop is closed by real values coming from sensors and given by other systems (e.g. ADIRS) to the FMGCs.
When the autopilot is engaged, the load thresholds on the rudder pedals and the sidesticks are increased.
If a pedal or sidestick load threshold is overriden, the autopilot disengages.

MODES

There are lateral modes and vertical modes.
Basically, one of each is chosen by the pilot or by the system.
The autopilot being engaged, one lateral mode and one vertical mode are simultaneously active.
According to flight phases, the lateral mode controls:

- the ailerons via the Elevator Aileron Computers (ELACs),
- the spoilers via the ELACs and the Spoiler Elevator Computers (SECs),
- the rudder via the Flight Augmentation Computers (FACs),
- the nose wheel via the ELACs and the Braking/Steering Control Unit (BSCU).

The vertical mode controls the elevators and the Trimmable Horizontal Stabilizer (THS) via the ELACs.



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AUTOPILOT

EFFECTIVITY
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AUTOPILOT

GROUND

For maintenance purposes, the autopilot can be engaged on ground with both engines shut down.
Hydraulic power is not required.
When an engine is started, the autopilot disengages.

TAKE-OFF

The autopilot can be engaged in flight, provided the aircraft has been airborne for at least 5 seconds.

CRUISE

In cruise, only one autopilot can be engaged at a time, priority given to the last engaged. Engaging the second autopilot disengages the first one.
The ailerons and the spoilers execute the orders of lateral modes, the elevators and the THS execute the orders of vertical modes.

NOTE: The rudder is controlled not by the autopilot but directly by the FACs.

LANDING

If the airfield is equipped with ILS installations, the autopilot can perform a complete landing with approach, flare and roll out.
A second autopilot can be engaged (AP 1 active, AP 2 in standby).

NOTE: The rudder is controlled by the autopilot via the FACs.

During roll out, the autopilot gives steering orders to the rudder and the nose wheel. These orders depend on the aircraft speed.
Aileron and spoiler autopilot orders are null.
The THS is reset to 0.5 nose up.

NOTE: The spoilers are directly controlled by the SECs as airbrakes.

During roll out, at low speed (about 60 knots), the pilot normally disengages the autopilot by pressing a takeover pushbutton located on the sidestick.

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SELF EXAMINATION

In cruise, the autopilot lateral mode orders are executed by:

A - the ailerons and the rudder.
B - the ailerons and the spoilers
C - the spoilers and the rudder.

The nose wheel can be controlled by the autopilot:

A - on ground during take-off.
B - on ground during landing.
C - on ground during take-off and landing.

The aircraft is in cruise with AP 1 engaged. What happens when AP 2 is engaged?

A - AP 1 remains active, AP 2 is in standby.
B - AP 2 becomes active with AP 1 in standby.
C - AP 2 becomes active, AP 1 is disengaged.

The aircraft is on ground:

A - It is impossible to engage the autopilot.
B - Engines running, it is impossible to engage the autopilot.
C - Engines shut down, it is impossible to engage the autopilot.

22 - AUTO FLIGHT SYSTEM

22-10-00 FLIGHT DIRECTOR

CONTENTS:

FLIGHT DIRECTOR

ENGAGEMENT

The Flight Director (FD) functions engage automatically as soon as the system is electrically supplied and logic conditions are fulfilled.
FD engagement is indicated on the Flight Control Unit (FCU) by the FD pushbutton green bars and on the top right of each Primary Flight Display (PFD).
1FD2 indication is displayed on each PFD to show that FD 1 is engaged on the Capt side and FD 2 is engaged on the F/O side.

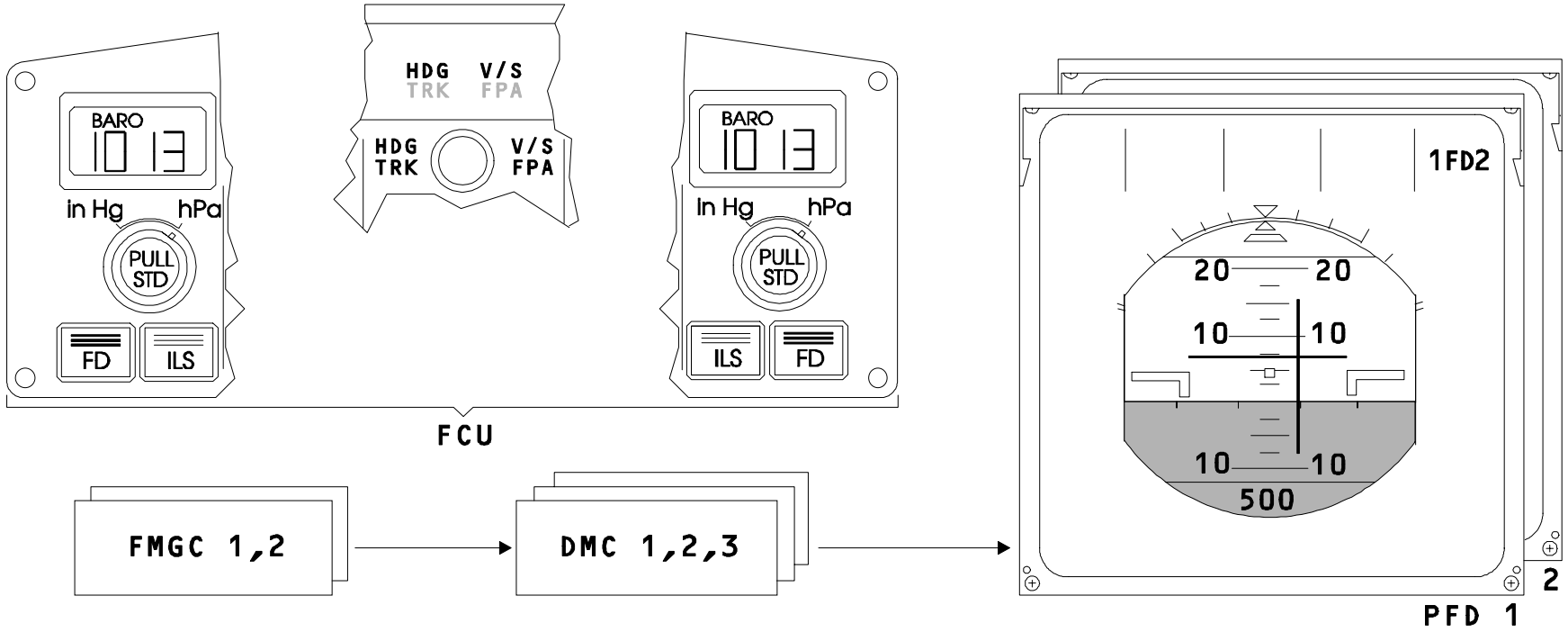
NOTE: On ground, as long as no AP/FD mode is active, there are no FD symbols on the PFDs.

PRINCIPLE

The FD displays the Flight Management and Guidance Computer (FMGC) guidance commands on both PFDs.
In manual flight, the FD displays guidance orders to help the pilots to apply commands on the controls in order to follow the optimum flight path which would be ordered by the autopilot (AP) if it were engaged.
When the AP is engaged, the FD enables the FMGC demands to be checked.
The FD modes are the same as the AP modes and are selected in the same way.
The FMGCs calculate AP/FD orders which are transformed into symbols by the Display Management Computers (DMCs).
There are two types of symbols: The FD bars, and the Flight Path Director and Flight Path Vector symbols.
The central HDG-V/S / TRK-FPA pushbutton on the FCU allows the pilots to switch between these two types of symbols.

FD PUSHBUTTONS

Upon FCU power up, or in go around, or when losing the AP during the roll out phase of the landing, the three green bars of the FD pushbuttons come on automatically.
A lit FD pushbutton means that the FD symbols can be displayed on the corresponding PFD ("Corresponding" means PFD 1 for the Capt FD pushbutton and PFD 2 for the F/O FD pushbutton).
If a lit FD pushbutton is pressed, the green bars go off. Pressing the pushbutton again puts the green bars on again.
A non lit FD pushbutton means that no FD symbols can be displayed on the corresponding PFD.
-FD2 is displayed on each PFD to show that no FD symbols can be displayed on PFD 1 and FD 2 is engaged on the F/O side.



FLIGHT DIRECTOR - ENGAGEMENT / PRINCIPLE / FD PUSHBUTTONS

FLIGHT DIRECTOR

FD BARS

The FD bars can be displayed provided HDG-V/S (Heading-Vertical Speed) is selected on the FCU.
HDG-V/S is automatically selected at system power up.

NOTE: At certain system configuration changes, the FMGCs send a command to the DMCs to make the FD bars flash for 10 seconds.

AP/FD modes are correctly followed when the FD bars are centered on the fixed aircraft model of the PFDs.
There are three FD bars:

- The pitch bar,
- the roll bar,
- and the yaw bar.

The horizontal pitch bar can be displayed if a vertical mode is active except during the roll out phase of the landing.
The vertical roll bar can be displayed if a lateral mode is active.
Below 30 feet radio altitude at take-off (when a LOC signal is available) and during landing, the roll bar is replaced by a yaw bar index. This bar is said to be centered when just below the central yellow square.

FPD/FPV SYMBOLS

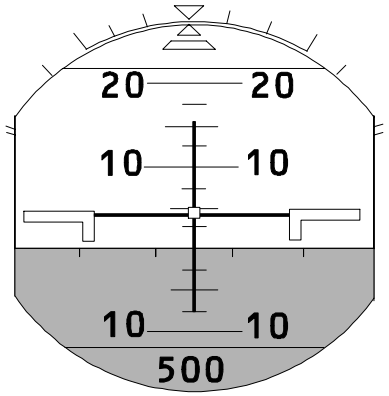
The Flight Path Director (FPD) and the Flight Path Vector (FPV) symbols can be displayed provided TRK-FPA (Track-Flight Path Angle) is selected on the FCU.

NOTE: At certain system configuration changes, the FMGCs send a command to the DMCs to make the FPD and FPV symbols flash for 10 seconds.

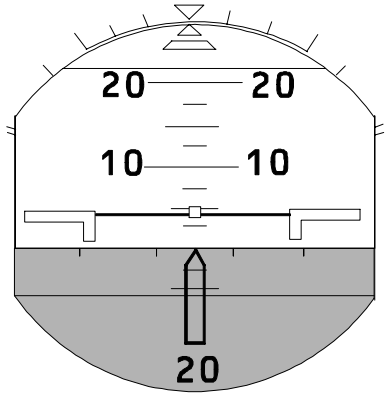
AP/FD modes are correctly followed when the FPD and FPV symbols are superimposed.
The FPD symbol provides command signals to intercept and fly the lateral and vertical flight path as defined by the FMGCs. The FPD symbol is removed if no guidance mode is provided by the FMGCs.
The FPV symbol represents lateral and vertical flight path information in terms of current track and Flight Path Angle actually being flown. The FPD symbol position is computed by the Air Data Inertial Reference System (ADIRS).

NOTE: The yaw bar is identical to the FD bar case and appears with the same conditions.

FD bars

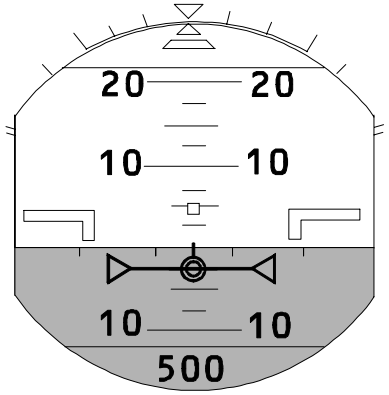


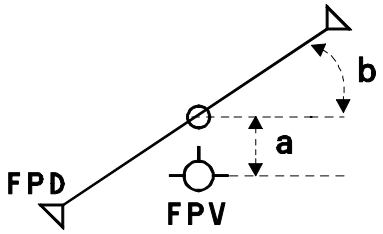
Pitch and roll bars



Pitch and yaw bars

FPD/FPV symbols





a: Flight Path Angle order
b: Roll angle order

FLIGHT DIRECTOR - FD BARS / FPD/FPV SYMBOLS

EFFECTIVITY
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SELF EXAMINATION

The FD bars are displayed:

A - on ground, when the system is electrically supplied and just after the safety tests.

B - when the FD functions are engaged, as long as HDG V/S is displayed on the FCU and an AP/FD mode is active.

C - as long as 1FD2 is displayed on the top right of each PFD.

How do the pilots change the FD bars into FPD/FPV symbols?

A - By pressing the central HDG-V/S / TRK-FPA pushbutton on the FCU.

B - By disengaging the HDG or V/S modes.

C - By pressing a FD pushbutton.

22 - AUTO FLIGHT SYSTEM

22-30-00 AUTOTHRUST

CONTENTS:

AUTOTHRUST

A/THR LOOP PRINCIPLE

To perform the autothrust (A/THR) function, the thrust target computed by the Flight Management and Guidance Computers (FMGCs) is chosen by the Flight Control Unit (FCU).
Then each FCU processor sends, along its own bus, the THR target to the Electronic Engine Controls (EECs) via the Engine Interface Units (EIUs).

A/THR ENGAGEMENT

The engagement of the A/THR function can be MANUAL or AUTOMATIC.
The A/THR is engaged MANUALLY by pressing the A/THR pushbutton on the FCU.
This is inhibited below 100 feet RA, with engines running.
The A/THR is engaged AUTOMATICALLY:

- when the autopilot/Flight Director (AP/FD) is engaged in TAKE-OFF or GO-AROUND modes,
- or in flight, when the alphafloor is detected; this is inhibited below 100 feet RA except during the 15 seconds following the lift-off.

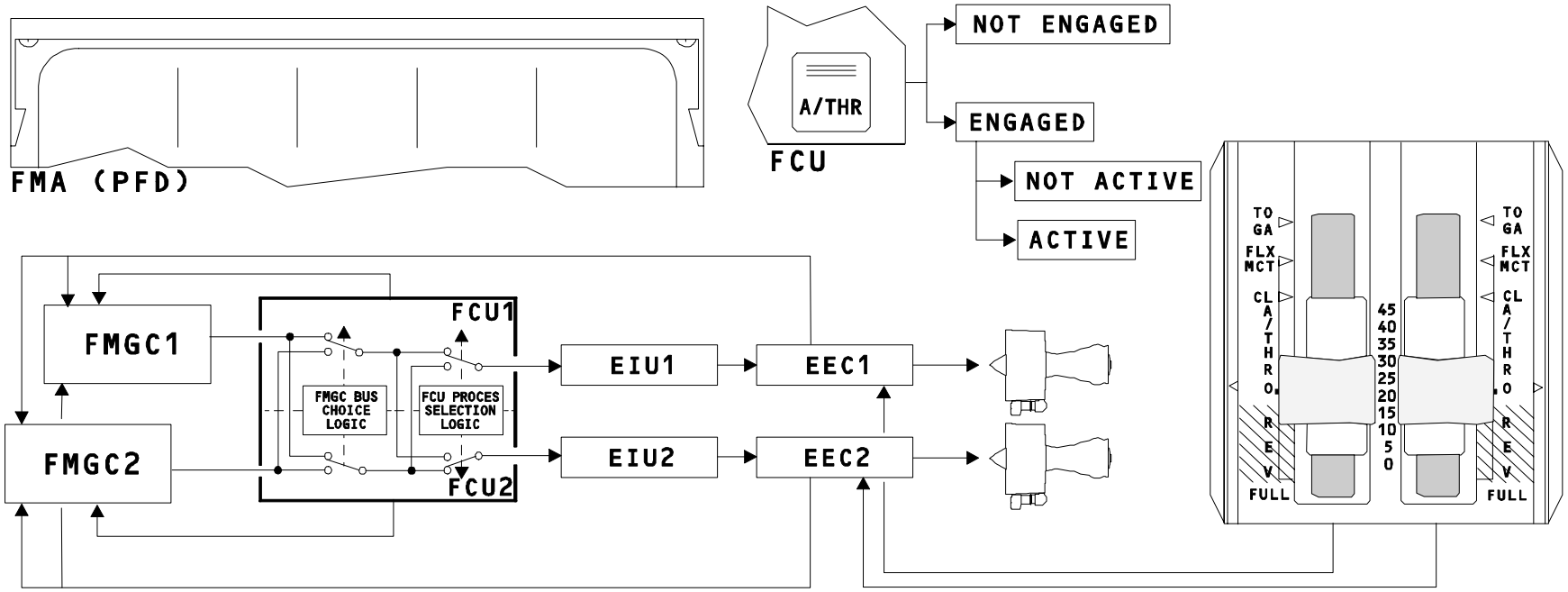
NOTE: To effectively have A/THR on the engines, the engagement of the A/THR is confirmed by a logic of activation in the EECs.

THRUST LEVERS

The thrust levers are manually operated and electrically connected to the EECs.
Note that the thrust levers never move automatically.
Each lever has 3 sectors defined by detents and stops.
The thrust levers can be moved on a sector which includes specific positions:

- Rear sector:
  for idle reverse up to max reverse.
- Center section:
  . "O": corresponds to an idle thrust,
  . "CL": corresponds to a climb thrust.
- Forward section:
  . "FLX/MCT": corresponds to a FLeXible Take-Off thrust or a Maximum Continuous Thrust after an engine failure,
  . "TO/GA": corresponds to a maximum Take-Off/ Go-Around thrust.

The EECs compute the thrust limit which depends on the position of the thrust levers.
If both thrust levers are in the same detent, the thrust limit corresponds to this detent.
If both levers are not in the same detent, the thrust limit corresponds to the next higher detent.
The FMGCs select the higher of the EEC1 and EEC2 thrust limits for thrust target computation.


FMA (PFD)
A/THR
FCU
NOT ENGAGED
ENGAGED
NOT ACTIVE
ACTIVE
FMGC1
FMGC2
FCU1
FCU2
FMGC BUS CHOICE LOGIC
FCU PROCES SELECTION LOGIC
EIU1
EIU2
EEC1
EEC2
TO GA
FLX MCT
CL
A/THR
REV
FULL
45
40
35
30
25
20
15
10
5
0

AUTOTHRUST

AUTOTHRUST

A/THR FUNCTION LOGIC

The A/THR function can be ENGAGED or DISENGAGED.
When it is engaged, it can be ACTIVE or NOT ACTIVE.

A/THR DISENGAGED
When the A/THR function is DISENGAGED:

- the thrust levers control the engines,
- on the FCU, the A/THR pushbutton light is OFF,
- the Flight Mode Annunciator (FMA) displays neither the A/THR engagement status nor the A/THR modes.

A/THR ENGAGED and ACTIVE
When the A/THR function is ENGAGED, A/THR is ACTIVE if:

- at least, one thrust lever is between the "CL" detent (included) and the "O" stop (included), and, at the most, one thrust lever is between the "FLX/MCT" detent and the "CL" detent, and there is no engine in FLEX TO mode,
- or the alphafloor protection is active independently of the thrust lever positions.

Note that in case of one engine failure, the A/THR activation zone becomes between the "FLX/MCT" detent, instead of the "CL" detent, and the "O" stop.
Because the A/THR function is active:

- the A/THR system controls the engines,
- on the FCU, the A/THR pushbutton light is ON,
- the FMA displays the A/THR engagement status (in white) and the A/THR mode.

A/THR ENGAGED and NOT ACTIVE
When the A/THR function is ENGAGED, A/THR is NOT ACTIVE if:
at least one thrust lever is above the "FLX/MCT" detent, or both thrust levers are above the "CL" detent, or at least one engine is in FLEX TO mode, with the alphafloor protection not active.
Because the A/THR function is not active:

- the thrust levers control the engines (as long as a thrust lever is outside the A/THR active area),
- the A/THR pushbutton light is ON,
- the FMA displays the A/THR engagement status (in cyan) and the MANual THRust rating.

AUTOTHRUST

MODES

The A/THR function computes a thrust target according to modes and their related reference parameters.
The reference can be:

- a SPEED or a MACH NUMBER; in this case, the source is either the FCU (value chosen by the pilot), or the FMGC itself,
- a THRUST; in that case, the sources are either the EECs (which compute the thrust limit) when the A/THR is not active, or the FMGC itself (within the thrust limit always computed by the EECs) when the A/THR is active.

The A/THR modes are SPEED/MACH, THRUST, RETARD which can be overpassed by the alphafloor protection.
The choice of the mode is automatically made by the FMGCs according to the active AP or FD vertical mode. This choice is based on a simple law: "Priority to the speed control".

- When the AP (with elevators) controls the aircraft speed, the A/THR has to control the engines by a fixed thrust demand (THRUST mode).
- When the AP controls another aircraft parameter (e.g. altitude), the A/THR has to take care of the aircraft speed by a variable thrust demand to the engines (SPEED/MACH mode).
- Beside these two modes, RETARD is only available in automatic landing when engine thrust has to be reduced to idle for the flare phase below 40 feet RA.

When no vertical mode is engaged, the A/THR operates only in SPEED/MACH modes except:

- when THRUST mode engages automatically in case of alphafloor,
- when, A/THR being in RETARD, if AP is disengaged, the A/THR function remains in RETARD mode, the aircraft being on ground.

ALPHAFLOOR PROTECTION

The A/THR function protects against an excessive Angle-Of-Attack.
The alphafloor signal is detected by each Flight Augmentation Computer (FAC).
In case of excessive Angle-Of-Attack or avoidance maneuver, the FACs send an order to the FMGCs which activate the alphafloor protection.
The A/THR automatically engages or stays engaged active and the engine thrust becomes equal to the Take-Off/Go-Around thrust for any thrust lever position.
In this condition, the green message "A.FLOOR" with an amber flashing box is displayed on the FMA.
When the alphafloor detection is no longer present in the FACs, the green message "TOGA LK" with an amber flashing box (LK for LocK) is displayed on the FMA.
The alphafloor protection can only be cancelled through the disengagement of the A/THR function.

AUTOTHRUST

A/THR OPERATION IN FLIGHT

The aircraft is on ground and ready for Take-Off.
Neither the AP nor the A/THR are engaged.
The engines are controlled by the thrust levers.
To Take-Off, the pilot sets the thrust levers to the TO/GA stop or to the FLEX/MCT detent if a flexible temperature is selected on a Multipurpose Control and Display Unit (MCDU).
This engages the A/THR function (but it is not active).
At the thrust reduction altitude, a message on the FMAs indicates to the pilot that he has to set the thrust levers into the "CL" detent.
As soon as the thrust levers are in the "CL" detent, the A/THR is active.
If a thrust lever is set into the "CL-MCT" or "O-CL" area, a message on the FMAs warns the pilot to set the thrust lever to the "CL" detent (white LVR CLB message if "CL-MCT" area, amber LVR ASYM message if "O-CL" area).
The A/THR remains active.
Then, the thrust levers remain in this position until the approach phase.
During automatic landing, before touch down, an auto call out, "RETARD", indicates to the pilot that he has to set the thrust levers to the "O" stop.
When he does it, the A/THR disengages.
This allows the automatic activation of ground spoilers if they are in armed condition.
Then, on ground, the pilot moves the thrust levers on the REVerse sector.

DISCONNECTION

Besides the normal A/THR operation, the A/THR function is disengaged either by a pilot action or in case of a system failure.
The A/THR function can be disengaged either by pressing at least one of the two red instinctive disconnect pushbuttons on the side of the thrust levers or by pressing the A/THR pushbutton on the FCU.
A/THR disengagement can also be due to an external system failure.
When the A/THR function is active, the actual engine thrust does not necessarily correspond to the thrust lever position.
Consequently, it is important to know what happens after an A/THR disconnection:
When the disconnection is made by the instinctive disconnect pushbutton, the thrust is immediatly adjusted to the thrust lever position.
In other cases, after FCU pushbutton disconnection, or failure:

- When a thrust lever is in its detent, the thrust on the corresponding engine is frozen at its last value just before the disconnection (Memo mode).
- As soon as a thrust lever is moved out the detent, or if it is not in a detent, the thrust on the corresponding engine is smoothly adapted to the thrust lever position.

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SELF EXAMINATION

What happens when the A/THR function is engaged and not active?

A - The A/THR system controls the engines and the A/THR pushbutton light is ON.
B - The thrust levers control the engines and the A/THR pushbutton light is OFF.
C - The thrust levers control the engines and the A/THR pushbutton light is ON.

When you read the green message "TOGA LK" with an amber flashing box on the FMA of the PFD, what does it mean?

A - The A/THR is active with the alphafloor protection active and the alphafloor is detected in the FACs.
B - The A/THR is active with the alphafloor protection active but with the alphafloor detection no longer present in the FACs.
C - The A/THR is engaged but not active during the Take-Off phase.

22 - AUTO FLIGHT SYSTEM

22-00-00 AUTO FLIGHT SYSTEM CONTROL AND INDICATING

CONTENTS:

AUTO FLIGHT SYSTEM CONTROL AND INDICATING

FCU

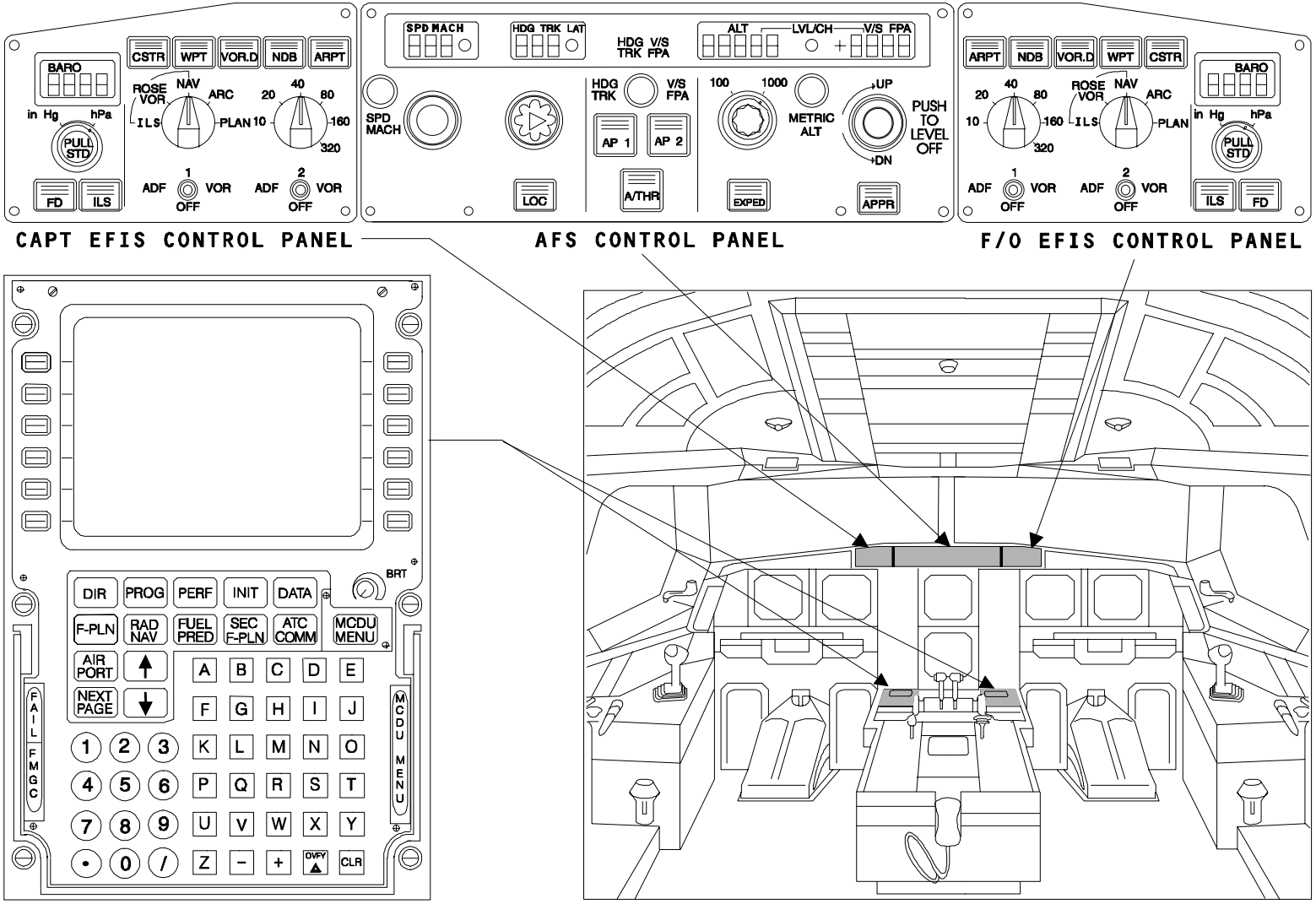
The Flight Control Unit (FCU) is installed on the glareshield. The FCU front face includes an Auto Flight System (AFS) control panel between two Electronic Flight Instrument System (EFIS) control panels.
The AFS control panel allows and displays the engagement of autopilots (APs) and autothrust (A/THR), and the selection of guidance modes and flight parameters.

NOTE: The EXPEDite pushbutton can be optionally removed from the AFS control panel.

The two EFIS control panels control and display, for each EFIS side (Capt and F/O), the Primary Flight Display and Navigation Display functions (respectively baro and Flight Director (FD) conditions, and Navigation Display modes).

MCDUs

Two Multipurpose Control and Display Units (MCDUs) are located on the center pedestal.
The MCDU is the primary entry/display interface between the pilot and the FM part of the FMGC.
MCDU allows system control parameters and flight plans to be inserted, and is used for subsequent modifications and revisions.
The MCDU displays information regarding flight progress and aircraft performances for monitoring and review by the flight crew.



AUTO FLIGHT SYSTEM CONTROL AND INDICATING – FCU & MCDUs

EFFECTIVITY
ALL

UFF4200
TMUFGCH01-P01 LEVEL 1

AUTO FLIGHT SYSTEM CONTROL AND INDICATING

NDs

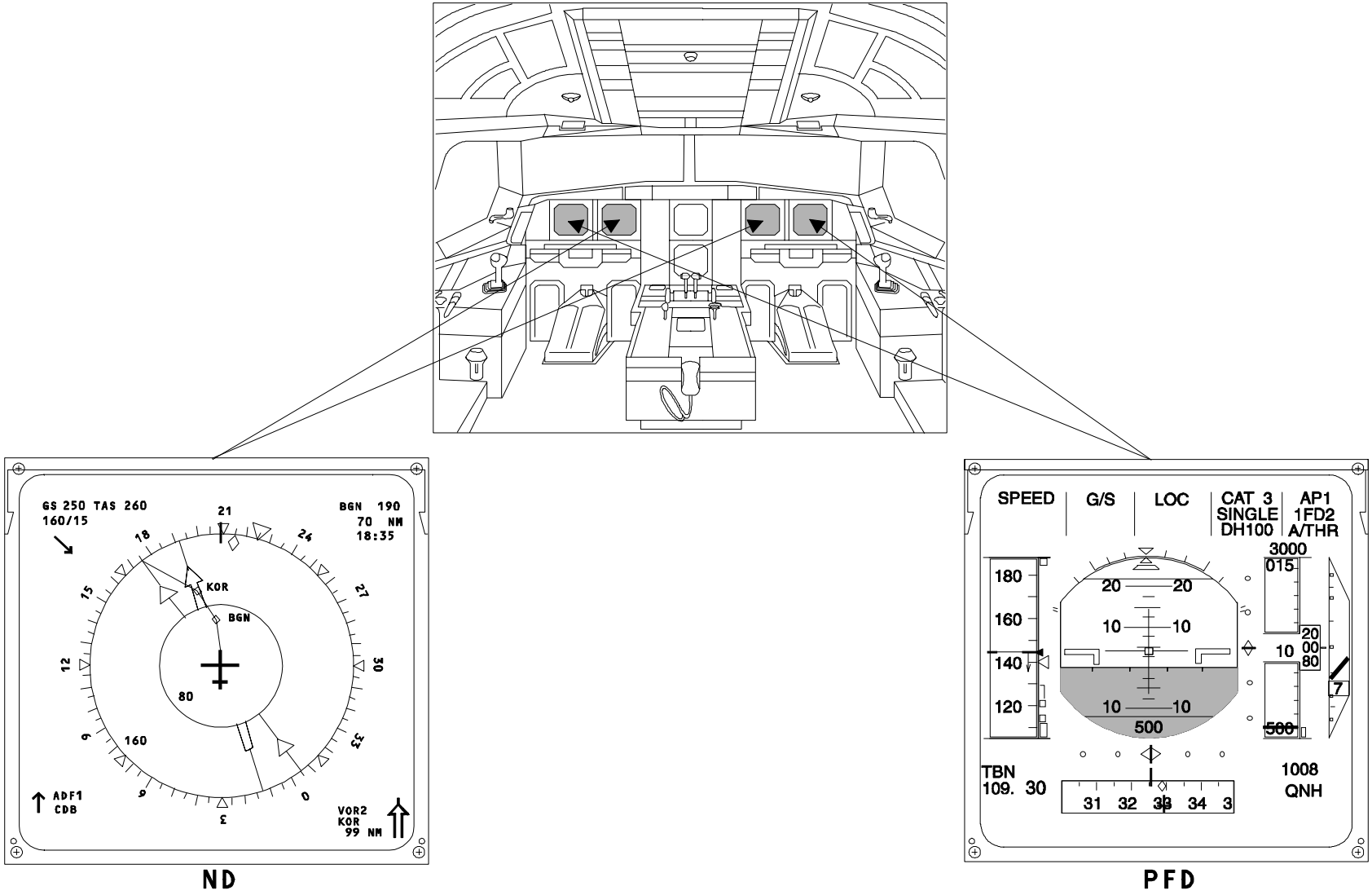
The two Navigation Displays (NDs) are located on the main instrument panel.
The Navigation Display is built from:

- flight plan data,
- data selected via the FCU,
- aircraft present position,
- wind speed/direction,
- ground speed/track.

PFDs

The two Primary Flight Displays (PFDs) are located on the main instrument panel.
The Flight Mode Annunciator (FMA) is the top part of the Primary Flight Display (PFD).
Each PFD displays:

- AP/FD/A/THR engagement status on the FMA,
- AP/FD and A/THR armed/engaged modes on the FMA,
- FD orders,
- FAC characteristic speeds on the speed scale.



ND PFD

AUTO FLIGHT SYSTEM CONTROL AND INDICATING – NDs & PFDs

AUTO FLIGHT SYSTEM CONTROL AND INDICATING

THRUST LEVERS

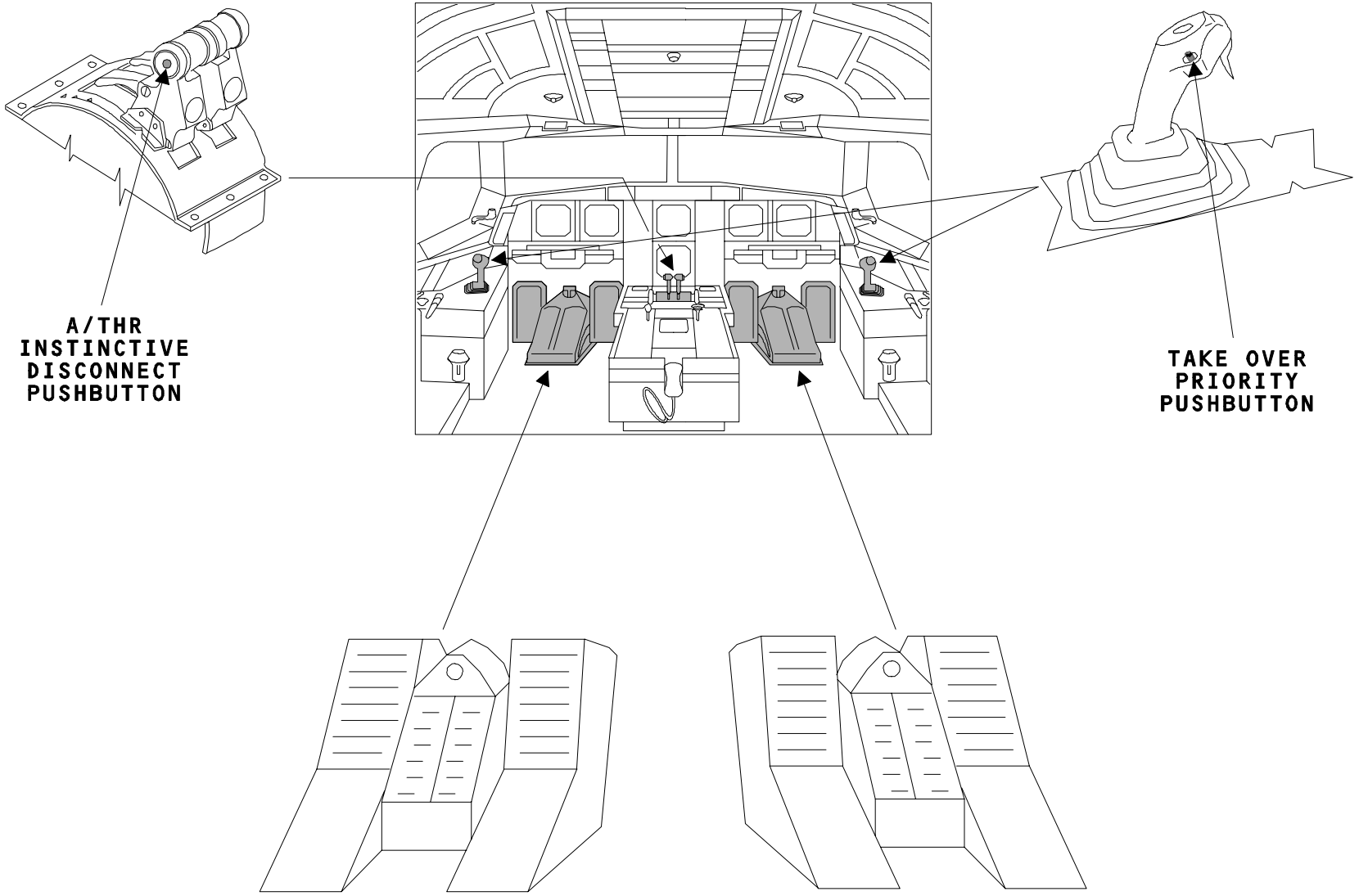
The thrust levers are located on the center pedestal.
The thrust levers allow the Take-Off/Go-Around (TO/GA) modes and the autothrust to be engaged.
Two autothrust instinctive disconnect pushbuttons located on the thrust levers allow the autothrust function to be disengaged.

SIDE STICKS

The Capt and F/O side sticks are respectively located on the Capt lateral panel and F/O lateral panel.
The autopilot is disengaged when the take over priority pushbutton on the side stick is pressed or when a force above a certain threshold is applied on the side stick.

RUDDER PEDALS

The rudder pedals are fitted in the Capt and F/O positions.
Rudder pedals override disconnects the autopilot.



AUTO FLIGHT SYSTEM CONTROL AND INDICATING - THRUST LEVERS, SIDE STICKS & RUDDER PEDALS

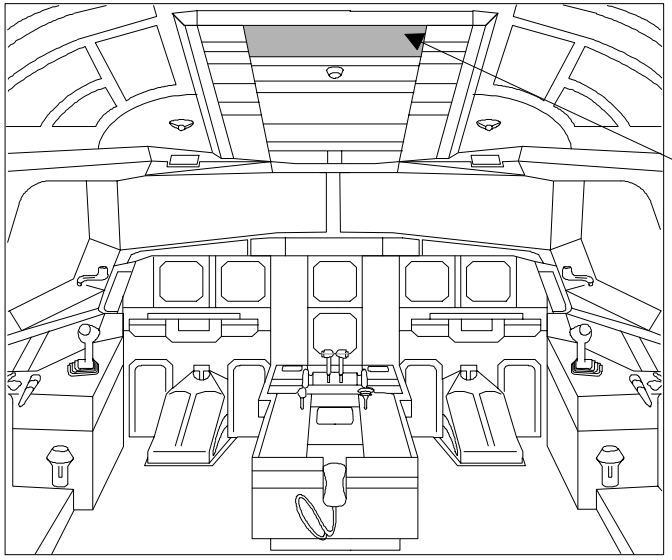
UFF4200
TMUFGCH01-P03 LEVEL 1

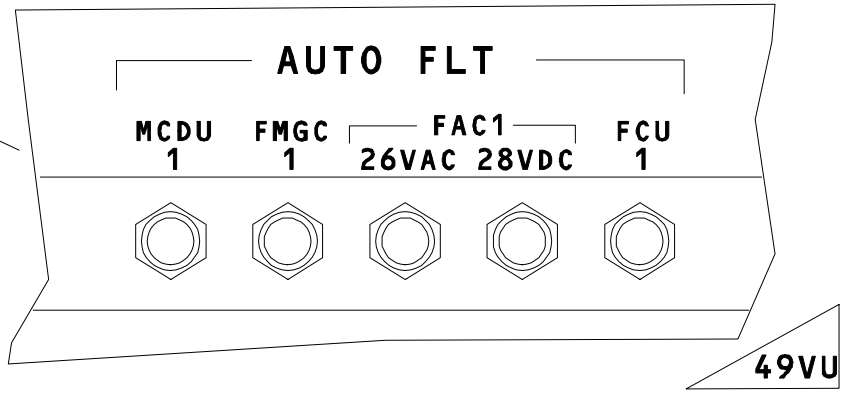
EFFECTIVITY
ALL

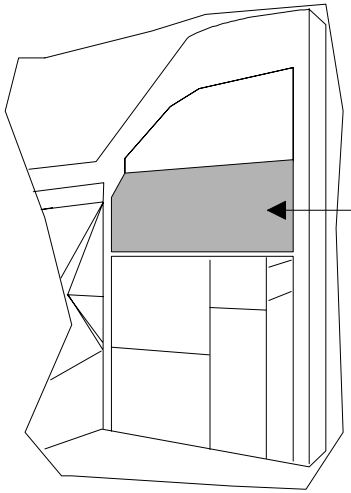
AUTO FLIGHT SYSTEM CONTROL AND INDICATING

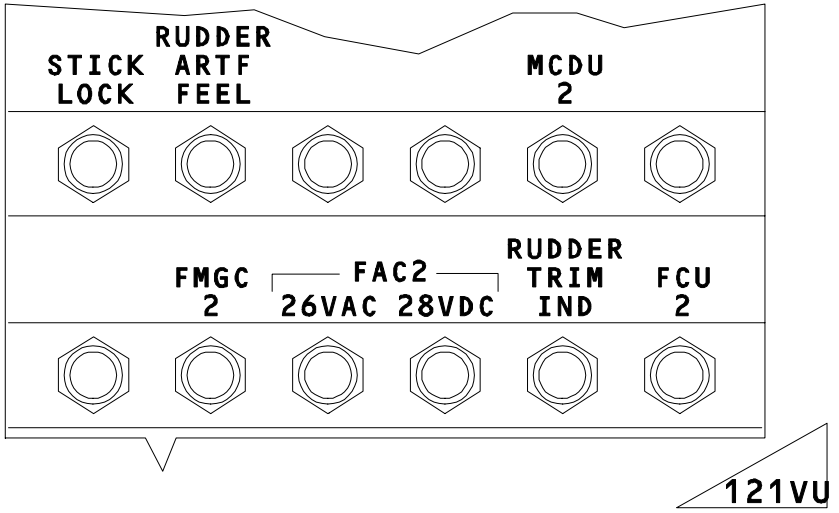
RESETS

The FMGC, FAC, FCU and MCDU resets are possible in the cockpit.
Depending on the computer (1 or 2), the circuit breakers are located either on the overhead circuit breakers panel 49VU or on the rear circuit breakers panel 121VU.









AUTO FLIGHT SYSTEM CONTROL AND INDICATING - RESETS

UFF4200
TMUFGCH01-P04 LEVEL 1

EFFECTIVITY
ALL

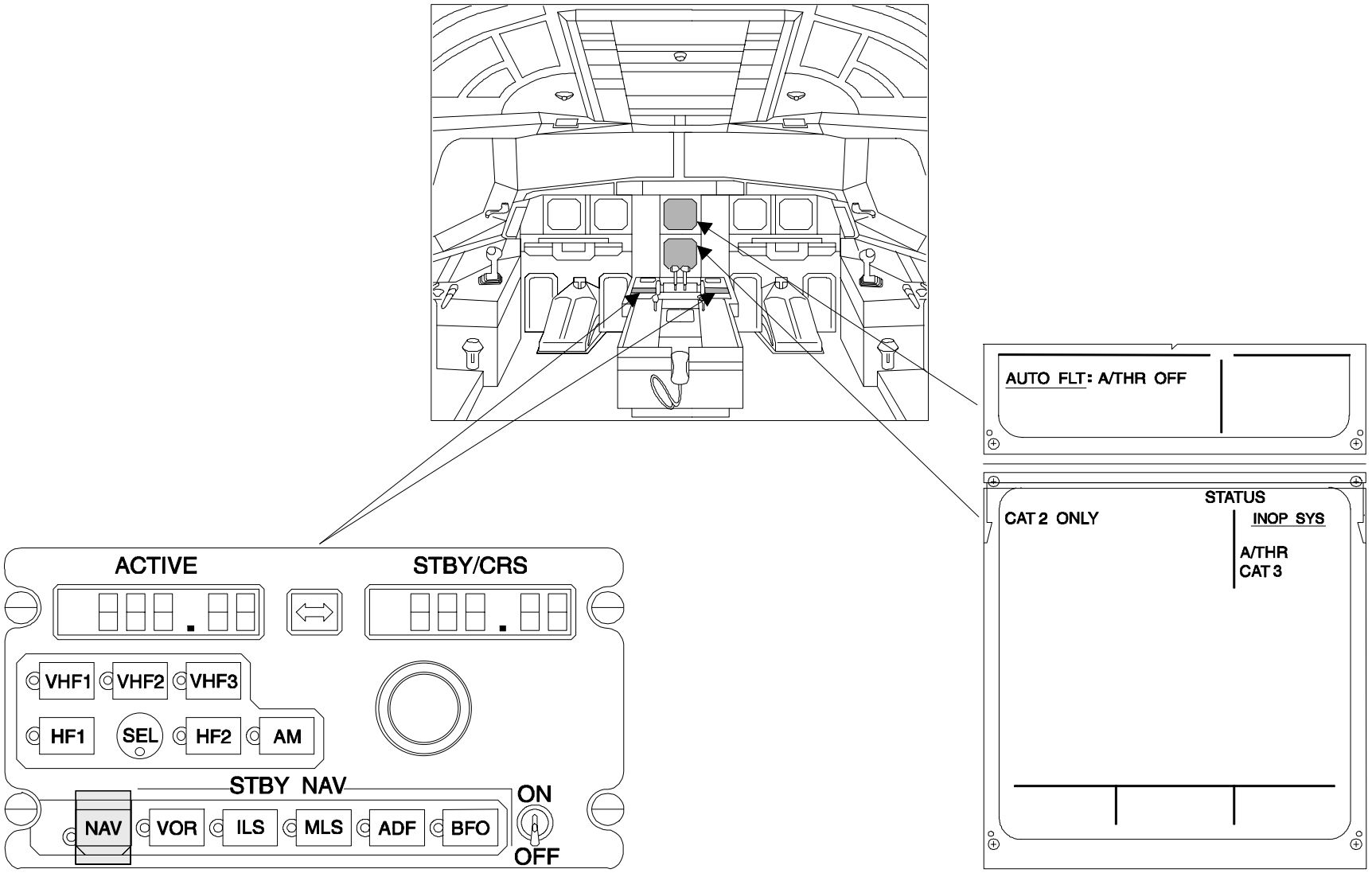
AUTO FLIGHT SYSTEM CONTROL AND INDICATING

RMPs

The Radio Management Panels (RMPs) are located on the center pedestal near Multipurpose Control and Display Units 1 and 2.
The RMPS are used for navaid standby selection.

EWD/SD

The Engine/Warning Display (EWD) and the System Display (SD) are located on the main instrument panel.
The EWD displays AFS warning messages.
The SD displays AFS information such as inoperative systems on the STATUS page or landing capabilities availability.



AUTO FLIGHT SYSTEM CONTROL AND INDICATING - RMPs & EWD/SD

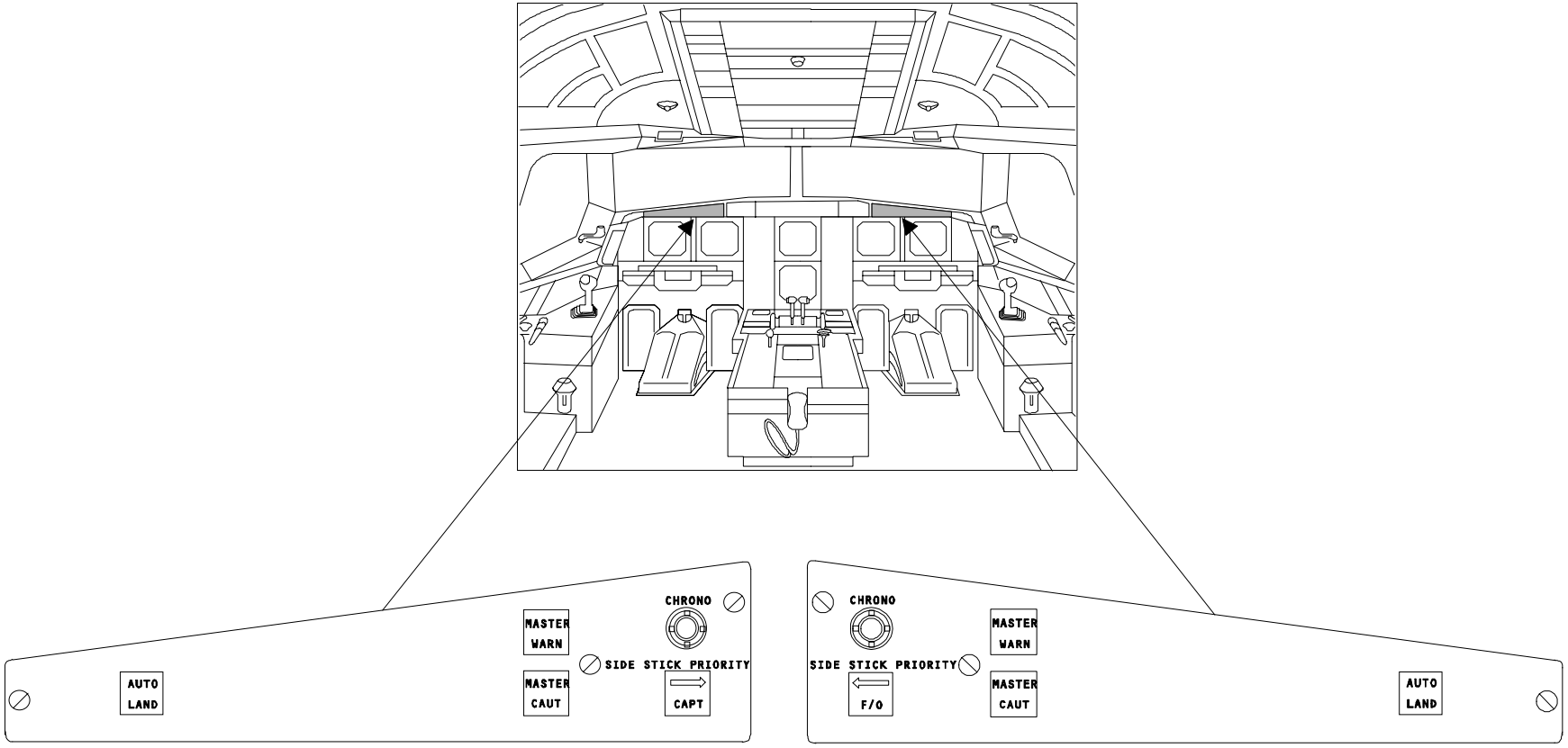
UFF4200 TMUFGCH01-P05 LEVEL 1

EFFECTIVITY
ALL

AUTO FLIGHT SYSTEM CONTROL AND INDICATING

ATTENTION GETTERS

The attention getters are located on the glareshield panel on the Capt and F/O sides.
The MASTER CAUTION and/or the MASTER WARNING are activated when an AFS disconnection occurs.
The AUTOLAND warning is activated when a problem occurs during final approach in automatic landing.



AUTO FLIGHT SYSTEM CONTROL AND INDICATING - ATTENTION GETTERS

EFFECTIVITY
ALL

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22 - AUTO FLIGHT SYSTEM

22-00-00 BASIC OPERATIONAL PRINCIPLES

CONTENTS:

BASIC OPERATIONAL PRINCIPLES

GENERAL

This sequence describes the operational use of the Flight Management and Guidance Computers (FMGCs) in a normal operation with a total availability of the concerned functions.
The short-term pilot orders are entered through the Flight Control Unit (FCU). The long-term pilot orders are entered through the Multipurpose Control and Display Unit (MCDU).
Four key-words for the control principle and both types of guidance are to be kept in mind in order to avoid handling errors.
Aircraft control is AUTOMATIC (Autopilot or autothrust), or MANUAL (Pilot action on side sticks or on thrust levers). Aircraft guidance is MANAGED (Targets are provided by the FMGC), or SELECTED (Guidance targets are selected by the pilot through the FCU).

DATA BASE LOADING

The data base must be loaded and updated to keep the system operational.

NOTE: Only the navigation data base is periodically updated.

POWER-UP TEST FD ENGAGEMENT

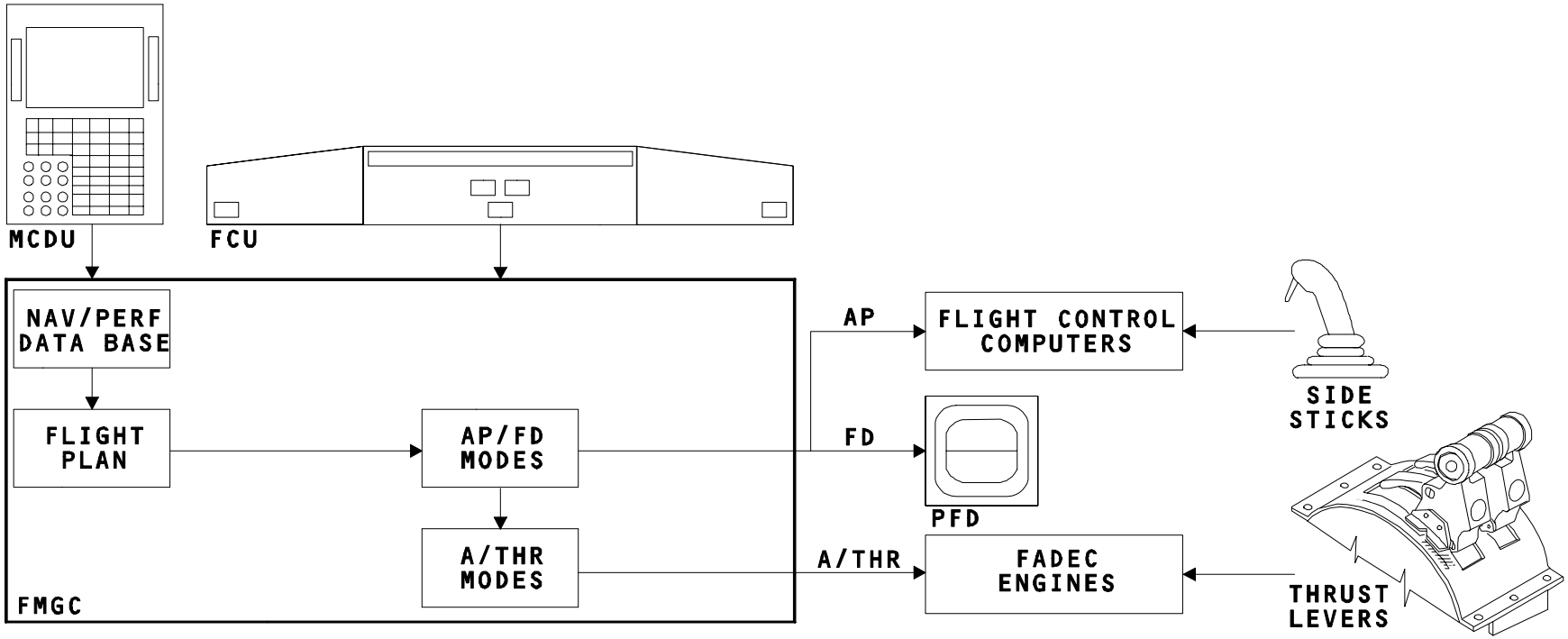
As soon as electrical power is available, the Flight Director (FD) is automatically engaged provided that the power-up test is successful.
No guidance symbols are displayed as long as no AP/FD mode is active.

MCDU INITIALIZATION

First, MCDU STATUS page is displayed. Then, the pilot uses the MCDU for flight preparation, which includes:

- choice of the data base,
- flight plan initialization,
- radio nav entries and checks,
- performance data entry (V1, VR, V2 and FLEX TEMP).

V2, at least, must be inserted in the MCDU before take-off.
Entry of the flight plan (lateral and vertical) and V2 into the MCDU is taken into account by the Flight Management (FM) part and confirmed by the lighting of the associated lights on the FCU.


MCDU
FCU
NAV/PERF DATA BASE
FLIGHT PLAN
AP/FD MODES
A/THR MODES
FMGC
AP
FD
A/THR
FLIGHT CONTROL COMPUTERS
PFD
FADEC ENGINES
SIDE STICKS
THRUST LEVERS

BASIC OPERATIONAL PRINCIPLES

A/THR ENGAGEMENT

Autothrust (A/THR) engagement occurs when the pilot moves the thrust levers to the TO/GA or FLX/MCT gate. Then:

. the FMGC automatically engages:
  - the take-off modes for yaw and longitudinal guidance (RunWaY (RWY) and Speed Reference System (SRS)),
  - the autothrust function (but it is not active).

. the FD symbols appear on the PFD (Green FD yaw bar and pitch bar).

For take-off, the thrust levers are set to the TO/GA gate or the FLEX/MCT gate if a flexible temperature has been entered on the MCDU.

At the thrust reduction altitude, the FM part warns the pilot to set the thrust levers to CLB gate.

NOTE: The thrust levers normally will not leave this position until an audio message "RETARD" requests to the pilot to set the thrust levers to IDLE gate before touchdown.

AP ENGAGEMENT

Either autopilot (AP) can only be engaged 5 seconds after lift off. Only one autopilot can be engaged at a time, the last in, being the last engaged.

After the normal climb, cruise and descent phases, selection of LAND mode (Autoland) allows both APs to be engaged together.

After touchdown, during ROLL OUT mode, APs remain engaged to control the aircraft on the runway centerline.

Then the pilot disengages the APs at low speed, taxies and stops the aircraft.

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SELF EXAMINATION

When is FD engaged?

A - As soon as at least one AP is engaged.
B - As soon as A/THR is engaged.
C - At the end of a successful power-up test.

Concerning AP engagement, which of the following is true?

A - Both APs can be engaged whatever the flight phase.
B - During the approach phase, it is recommended to engage the second AP.
C - Both APs can never be engaged at the same time (Last in, last engaged).

22 - AUTO FLIGHT SYSTEM

22-00-00 AFS MAINTENANCE SYSTEM

CONTENTS:

AFS MAINTENANCE SYSTEM

GENERAL

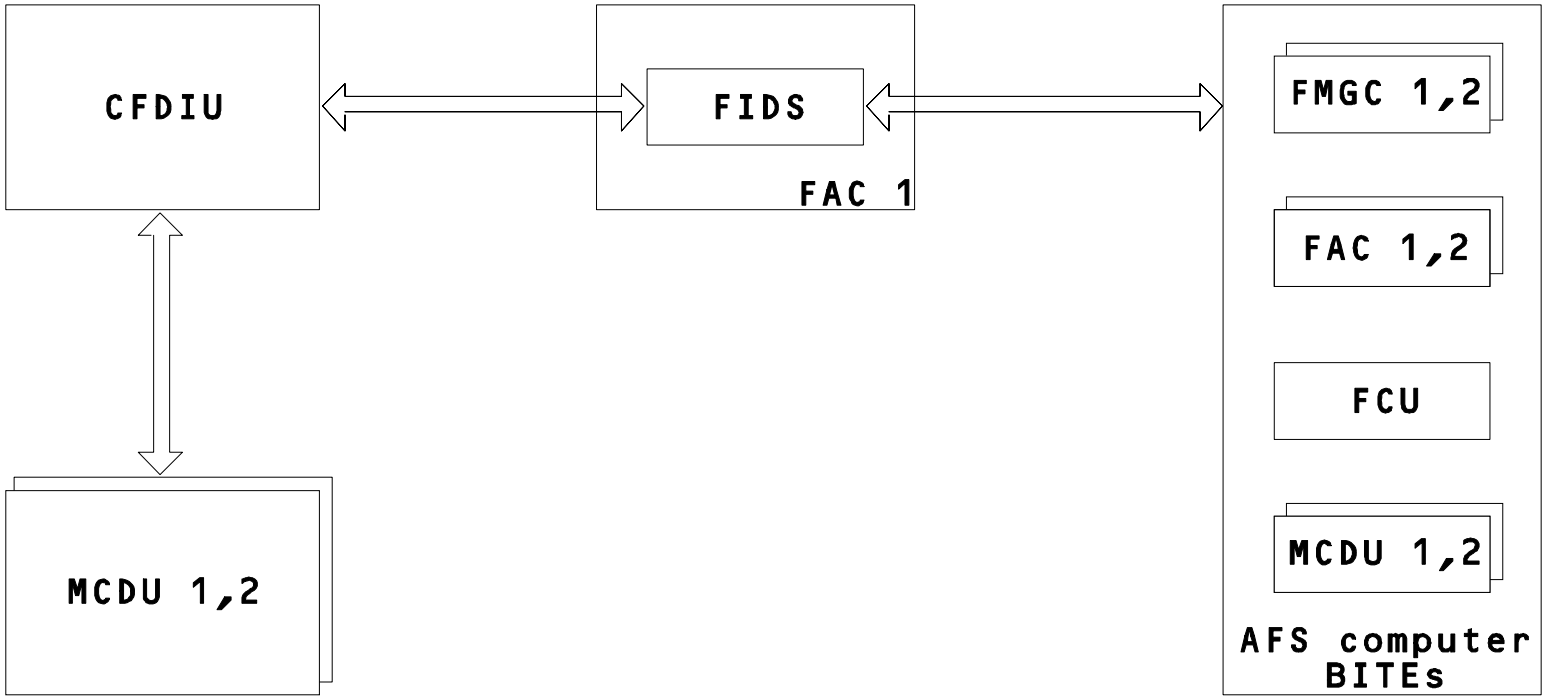
The Auto Flight System (AFS) is a type 1 system, able to maintain a two-way communication with the Centralized Fault Display Interface Unit (CFDIU).
The line maintenance of the AFS is based on the use of the Fault Isolation and Detection System (FIDS) active in the FAC 1 and of the Built In Test Equipment (BITEs) located in the various AFS computers.
Access to the fault data is made through the MCDUs via the CFDIU.
Like for other systems, the CFDIU works in NORMAL mode and MENU mode (See ATA 31-CFDS).

FIDS

The FIDS is a card physically located in each FAC. Both FACs are interchangeable, but only the FAC 1 FIDS is active due to the side 1 signal.
The FIDS is used as a system BITE to concentrate maintenance information.
The FIDS is linked in acquisition and reception to the CFDIU and is connected to the BITEs of the various AFS computers.It receives commands from the CFDIU, interprets these commands and transfers them, if applicable, to the various BITEs concerned.
It receives malfunction reports from the BITEs, manages these reports, and, if applicable, consolidates the BITE diagnosis (Occurence, correlation,...) and generates a fault message which is sent to the CFDIU.

NOTE: If the FIDS fails, the BITEs continue to work and the results can be read in the shop or after FAC 1 change.

The NORMAL mode function is the same as in other systems.
In addition to the usual system report functions, the MENU mode enables access to GROUND SCAN, AFS TEST and LAND TEST.



AFS MAINTENANCE SYSTEM – GENERAL & FIDS

EFFECTIVITY
ALL

AFS MAINTENANCE SYSTEM

BITEs

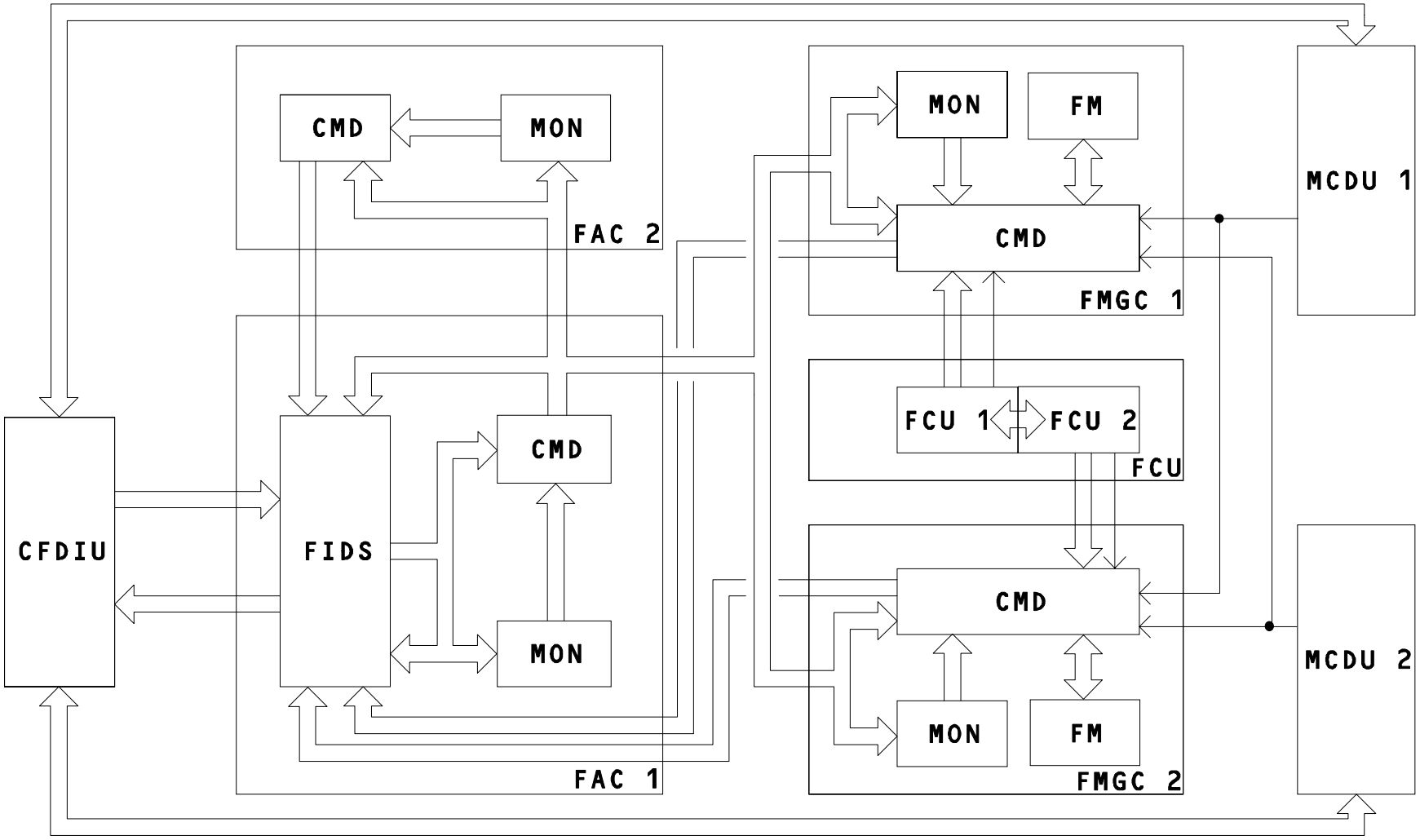
According to its internal architecture, each AFS Line Replaceable Unit has one or several BITEs.
The basic purpose of a BITE is to detect, isolate, memorize failures (FCU and MCDU BITEs only perform the detection task).
The failure detection is triggered by specific events listed in the maintenance manual.
Example of FG CMD triggering event: ILS own fail.
The failure localization corresponds to an analysis processed to identify the origin of the failure.

FAC/FM/FG BITE

As the FAC and FG have a BITE in the command (CMD) and the monitor (MON) sides, the fault analysis is generally made in each side and a synthesis is made in the command side.
Each BITE memorizes the result of the analysis, the failure context, the flight leg number, the time and date of each given failure.
Then the BITE sends the result of the analysis, with a maximum of two suspected Line Replaceable Units in order of probability, to the FIDS.

FCU BITE

Each FCU BITE computes the maintenance status of its related part and permanently sends this maintenance data to the FG command part.



AFS MAINTENANCE SYSTEM - BITEs, FAC/FM/FG BITE & FCU BITE

TMUFACK01-P02 LEVEL 1

UFF4200

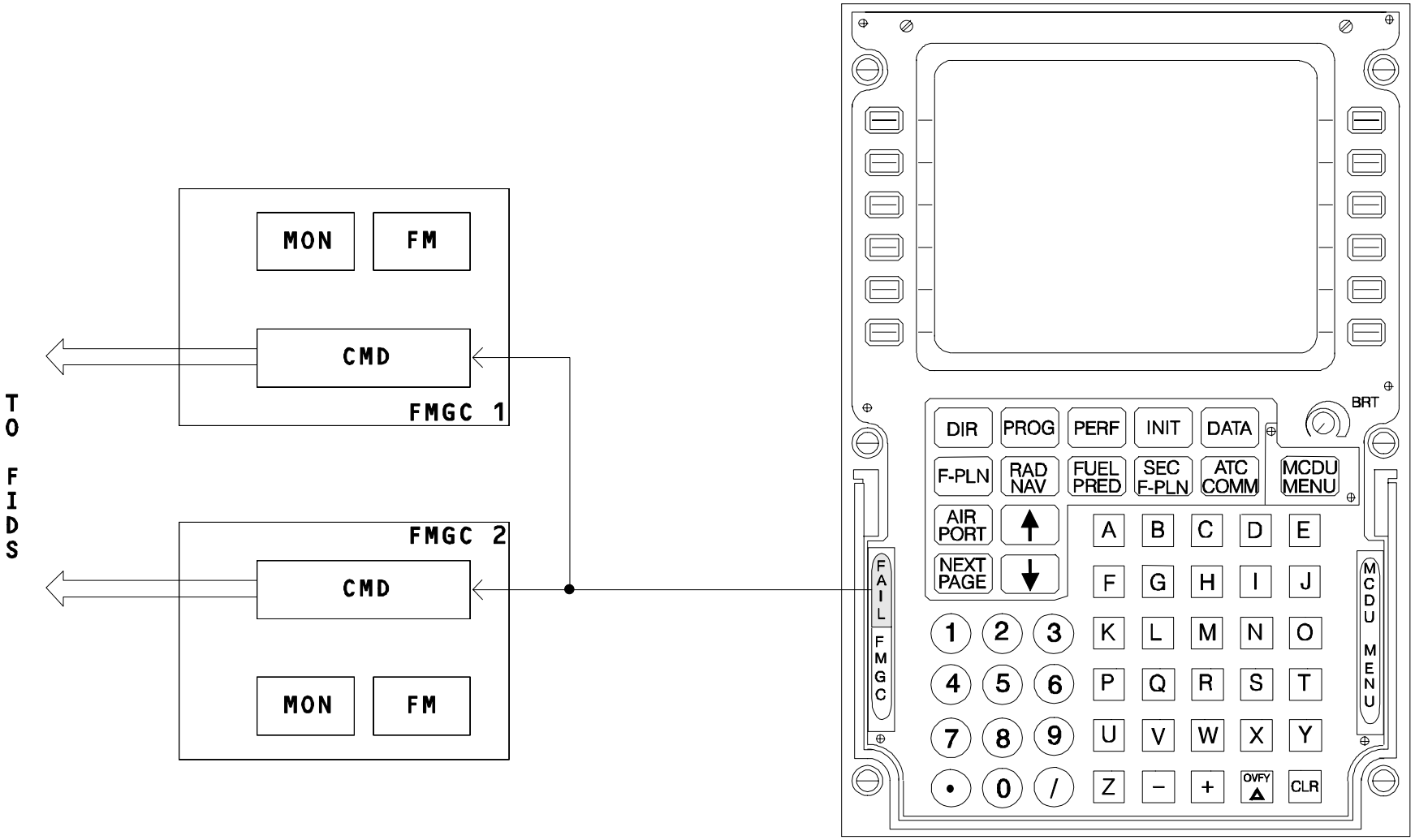
EFFECTIVITY
ALL

AFS MAINTENANCE SYSTEM

MCDU BITE

The MCDU performs tests on its processor, memory and display unit.
If a failure is found by the MCDU BITE:

- the FAIL annunciator comes on and the display is blank,
- the MCDU FAIL output discrete is set and sent to FG 1 and FG 2 command parts.



AFS MAINTENANCE SYSTEM – MCDU BITE

TMUFACK01-P03 LEVEL 1

UFF4200

EFFECTIVITY
ALL

AFS MAINTENANCE SYSTEM

GROUND SCAN

The GROUND REPORT function displays failures recorded in the ground area of the FIDS memory.
The PRESENT FAILURE SCAN function is used to isolate failures present when the function is selected.
The PROGRAM page is used by the manufacturer for development purposes.

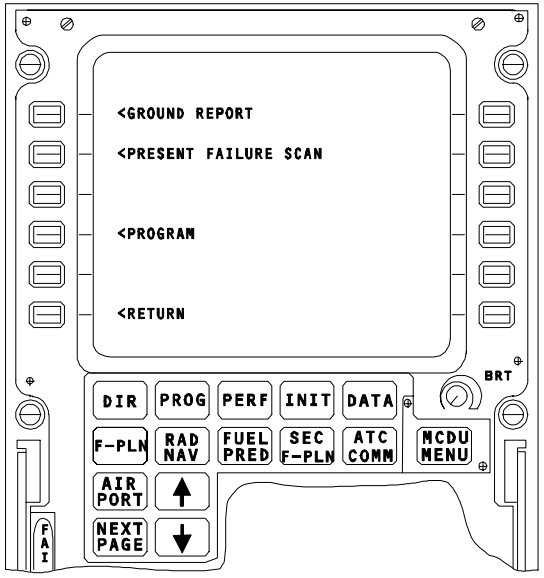
AFS TEST

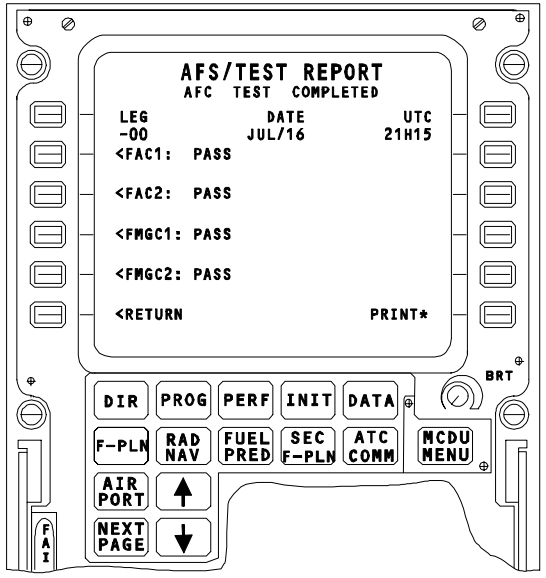
An AFS TEST is performed:

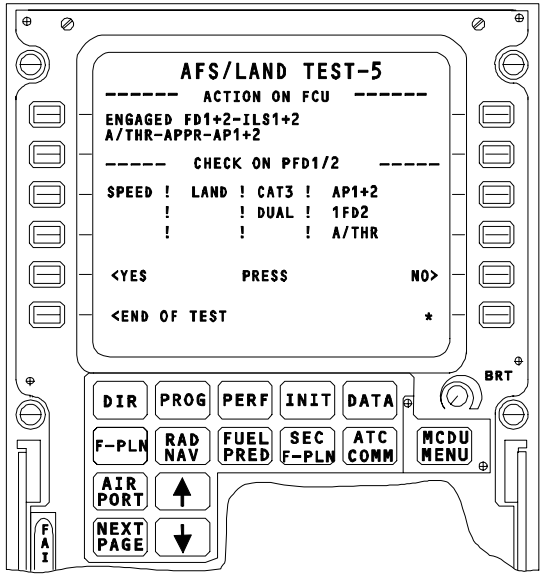
- to check an AFS Line Replaceable Unit before removal,
- to check an AFS Line Replaceable Unit after installation,
- to get trouble-shooting data (even if the test is OK).

LAND TEST

The LAND TEST enables to test the availability of the LAND mode and equipment required to obtain CAT 3.
There are several successive pages in which actions, checks and answers are requested from maintenance.







AFS MAINTENANCE SYSTEM – GROUND SCAN, AFS TEST & LAND TEST

AFS MAINTENANCE SYSTEM

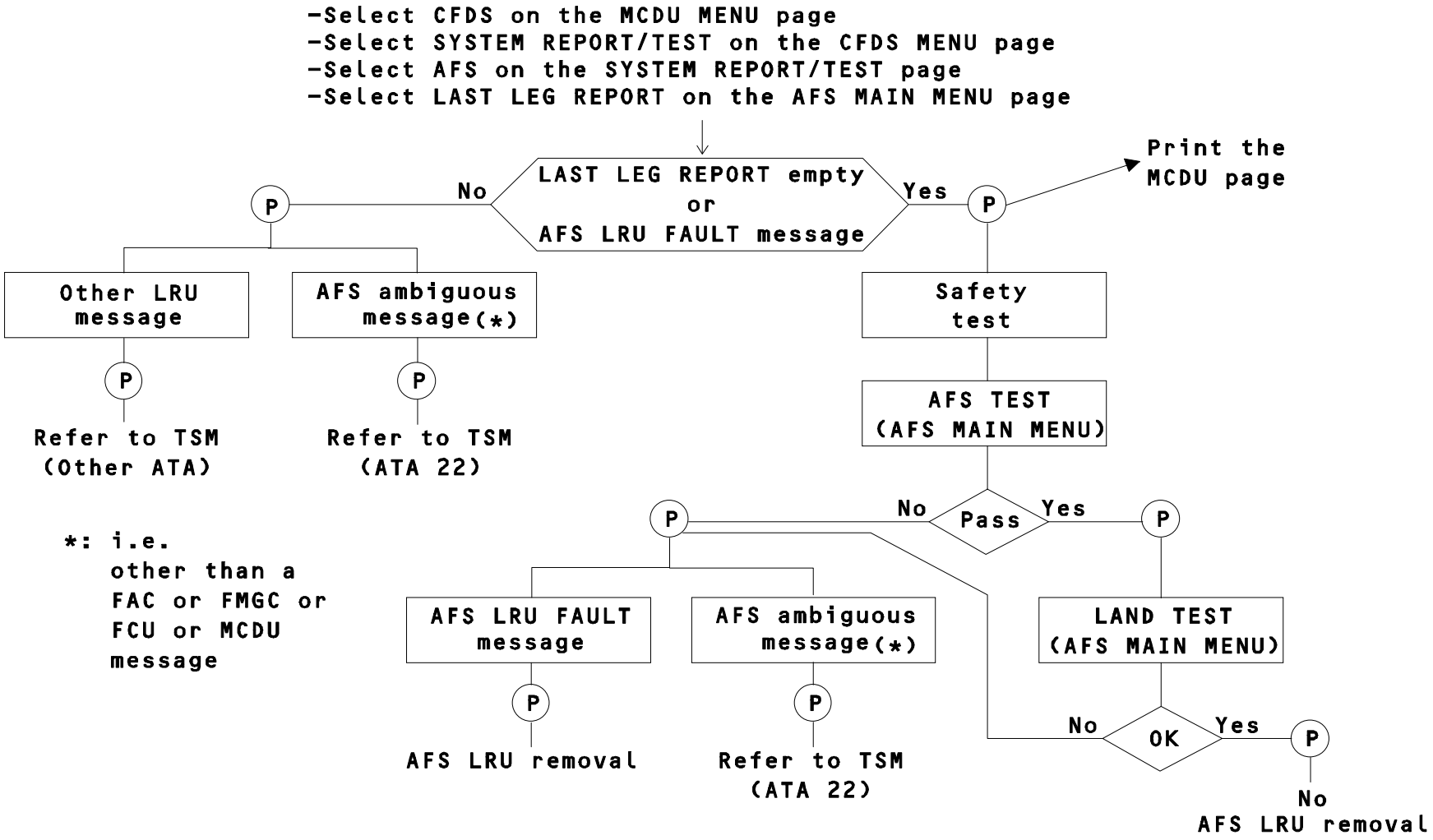
SAFETY TESTS

After long term power interruption, computers and control units of the AFS perform safety tests also called power-up tests.
These tests are only performed on ground, except for the FCU which can perform safety tests on ground or in flight.
During these tests, no action should be performed on the system.
If a unit does not pass the safety test, the unit is declared failed and is unusable and an ECAM message is displayed on the STATUS page.

NOTE: The recommended conditions to perform safety test are:
.aircraft on ground, engines stopped, hydraulic power (G/Y) for FAC only,
.pull the Circuit Breaker (C/B) of the involved computer (Both C/Bs for FCU),
.wait 15 seconds (7 minutes for FCU), then push the C/B of the involved computer,
.wait 1 minute for safety test execution.

PROCEDURE

This AFS maintenance procedure has to be followed in the event of a pilot report concerning the AFS.



AFS MAINTENANCE SYSTEM - SAFETY TESTS & PROCEDURE

UFF4200
TMUFACK01-P05 LEVEL 1

EFFECTIVITY
ALL

SELF EXAMINATION

When can the safety test of an AFS computer be performed?

A - In flight or on ground.
B - Only on ground, except for the FCU safety test which can be performed in flight or on ground.
C - Only on ground, except for the FMGC safety test which can be performed only in flight.

On ground, each AFS computer makes a safety test after every power cut-off:

A - greater than 1 minute.
B - greater than 1 minute for the FCU and only 15 seconds for the other computers.
C - greater than 7 minutes for the FCU and only 15 seconds for the other computers.

22 - AUTO FLIGHT SYSTEM

22-63-00 YAW AXIS CONTROL DESCRIPTION/OPERATION

CONTENTS:

YAW AXIS CONTROL DESCRIPTION/OPERATION

YAW DAMPER

When the autopilot is not engaged, the Elevator Aileron Computer (ELAC) calculates the yaw damper order with the normal law.
The yaw damper order calculated by the ELAC provides turn coordination, dutch roll damping and engine failure compensation.
If both ELACs fail, only the dutch roll damping (alternate law) is computed by the Flight Augmentation Computer (FAC) using the ADIRS data.

When the autopilot is engaged, the FAC calculates the yaw damper order except in LAND mode where it is computed by the Flight Management and Guidance Computer (FMGC).
When the AP is engaged:

- Dutch roll damping law is provided by the FAC using ADIRS data.
- Engine failure compensation fast law is provided by the FAC using the ADIRS data in TO, GA or RWY modes only.
- Turn coordination law computes the yaw order to the FMGC roll order.

In LAND mode, the FMGC yaw order controls the yaw damper actuators via the FAC.

RUDDER TRIM

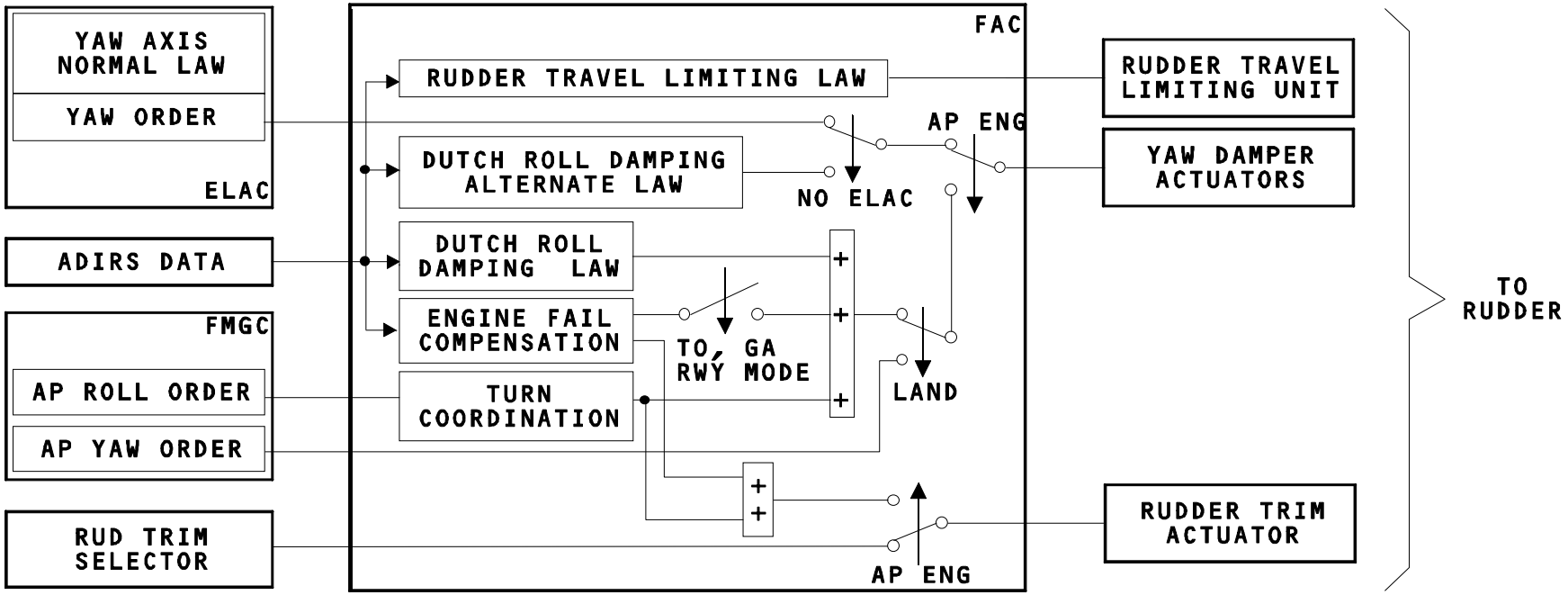
In the manual mode, the rudder trim is controlled by the RUD TRIM selector via the FAC.

In the rudder trim auto mode, the FAC computes the engine failure compensation and the turn coordination.
When the AP is engaged:

- The turn coordination law computes the yaw orders related to the FMGC roll order.
  Signals are simultaneously sent to the rudder trim actuator and the yaw damper actuators.
- The engine failure compensation slow law orders are sent to the rudder trim actuator.

RUDDER TRAVEL LIMITATION

The rudder travel limitation is computed by the FAC and sent to the Rudder Travel Limiting unit.
The FAC Rudder Travel Limiting law computes this limit using the calibrated airspeed (Vc) provided by the ADIRS.



TMUFACB01-P01 LEVEL 3

UFF4200

YAW AXIS CONTROL DESCRIPTION/OPERATION

EFFECTIVITY
ALL

SELF EXAMINATION

Which computers process the yaw damper order, if the autopilot is not engaged?

A - Either FMGC or ELAC.
B - Either ELAC or FAC.
C - FMGC and FAC.

With the AP engaged, the engine failure compensation function using the yaw damper actuators is available:

A - In cruise.
B - In LAND mode.
C - In TO, GA or RWY modes.

Which actuator(s) are used for turn coordination with the AP engaged?

A - Rudder trim actuator.
B - Rudder trim and yaw damper actuators.
C - Yaw damper actuators.

22 - AUTO FLIGHT SYSTEM

22-11-00 FAC ENGAGEMENT

CONTENTS:

FAC ENGAGEMENT

NORMAL CONFIGURATION

In normal configuration, when the Flight Augmentation Computer (FAC) pushbutton is pressed in, the FAULT and OFF lights are off, provided the internal monitoring channels are in good condition and the engagement request is present.
When the FAC pushbutton is released out, the FAC is disengaged and the white OFF light comes on.

NOTE: The FAC cannot be engaged on ground after power up during the 30 second test.
The amber FAULT light flashes.

FAC NOT ENERGIZED OR NOT FITTED

If the FAC is not energized and the pushbutton is pressed in, the FAULT light is on with an amber message on the ECAM.

SUBFUNCTION FAULT

If one or several yaw axis control functions fail, only the amber message appears on the ECAM. The FAULT light remains OFF.
If one or more of the following functions fail:

- yaw damper,
- rudder trim,
- rudder travel limitation,

only the amber message appears on the ECAM display unit.
The FAC remains engaged.

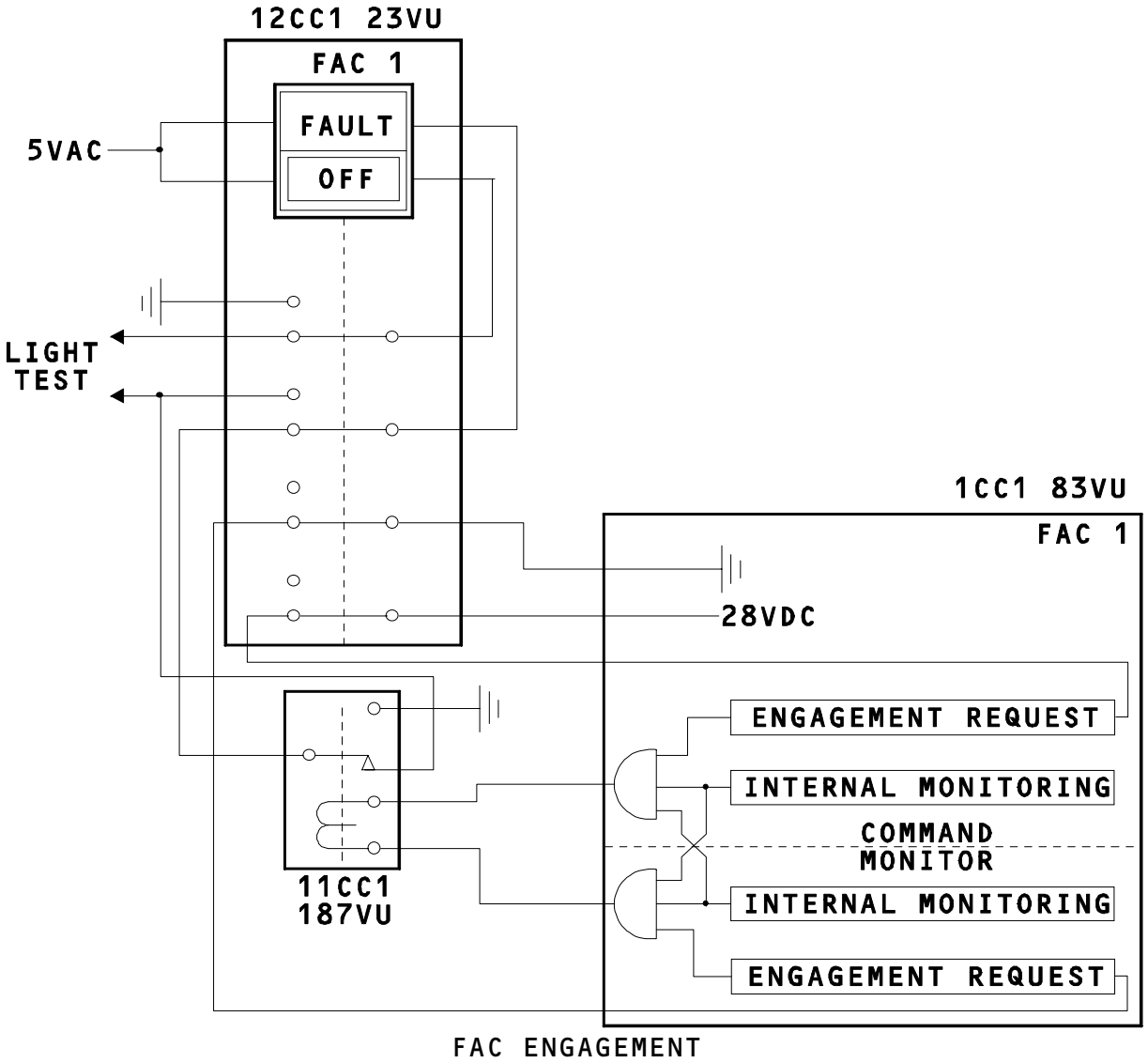
COMPUTER FAULT

When the computer itself fails, the FAC is disengaged and the FAULT light comes on with a message on the ECAM.
In this case, a FAC reset must be attempted following the ECAM procedure.

NOTE: On ground with engines shut down, the reset is automatic when the fault disappears.

TEMPORARY POWER LOSS

If a temporary power loss occurs, the FAULT light comes on with a message on the ECAM.
In flight reset is only possible using the FAC pushbutton.



FAC ENGAGEMENT

UFF4200
TMUFACC01-P01 LEVEL 3

EFFECTIVITY
ALL

SELF EXAMINATION

How is the FAC engaged?

A - By pressing in the FAC pushbutton.
B - When FAC internal monitoring (including power up test time) is healthy and engagement condition is requested.
C - A and B.

When does the FAC 1 (2) pushbutton white OFF light come on?

A - In case of FAC 1 (2) failure.
B - When FAC 1 (2) pushbutton is pressed in and FAC 1 (2) is not energized.
C - When the FAC 1 (2) pushbutton is released out.

22 - AUTO FLIGHT SYSTEM

22-61-00 RUDDER TRAVEL LIMITING FUNCTION

CONTENTS:

RUDDER TRAVEL LIMITING FUNCTION

COMPONENTS

The Rudder Travel Limiting (RTL) function is dual.
All the components are duplicated.
The RTL function is achieved by:
- an electromechanical RTL unit with two motors,
- two Rotary Variable Differential Transducers (RVDTs) integrated in the unit,
- two Flight Augmentation Computers (FAC 1 and FAC 2).

GENERAL

The Rudder Travel Limiting function acts through a control law, which is a function of the corrected airspeed, and returns to the low speed limitation in case of failure.

Normal operation:
The RTL law in the command channel of FAC 1 (active side) controls the RTL unit stops through a motor.

Return to low speed:
If both RTL functions fail, when the slats are extended, the full rudder deflection is obtained.
Priority is given to RTL of FAC 1; a changeover logic enables to switch to FAC 2 in case of failure.

LAWS

The Rudder Travel Limiting control law generates a rudder deflection order in relation to the corrected airspeed.

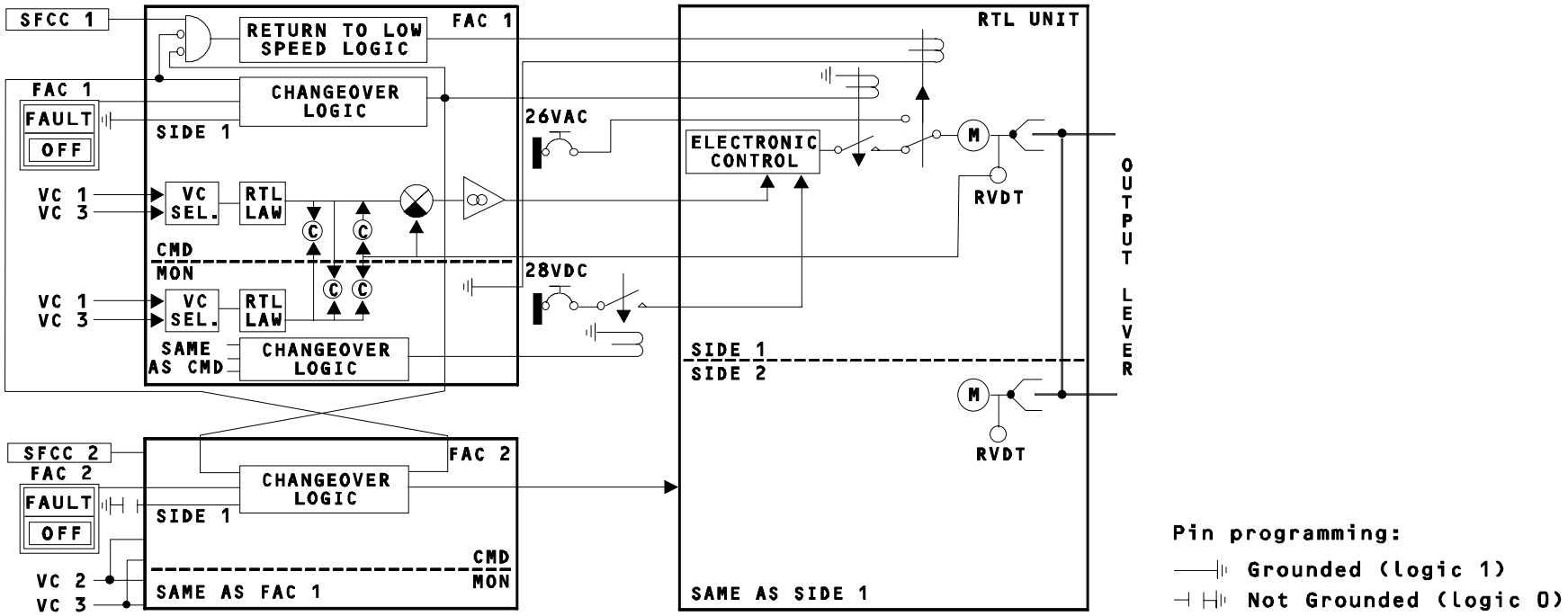
NOTE: For the A319, the maximum rudder deflection is increased from 25° to 30°.

POWER LOOP

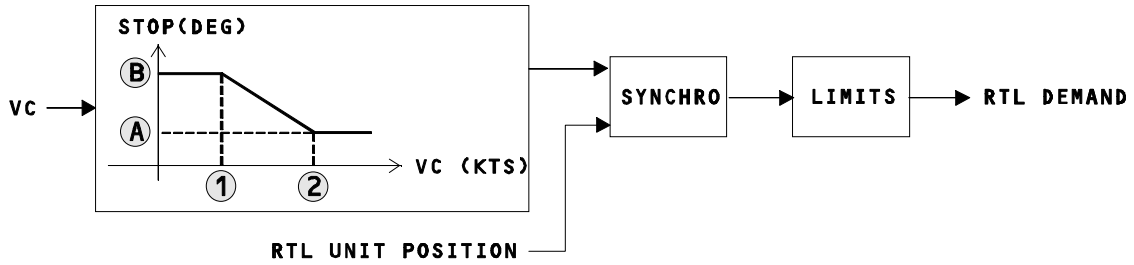
The Rudder Travel Limiting law controls the unit's motor, and the changeover logic enables the motor to be supplied.
The return to low speed function has an independent power supply.
The law computes the RTL order and sends it to its motor via an electronic control.
The feedback in the power loop is provided by one Rotary Variable Differential Transducer (RVDT) for slaving and monitoring.
The return to low speed logic connects the motor directly to 26VAC in order to recover full rudder deflection.

MONITORING

The computation and the power loop are monitored by comparators.
The computation is monitored by the comparator between the FAC command and monitor channels.
The ADIRS parameters (Vc) are monitored by a two-by-two comparison and then one of them is selected.
The power loop is monitored by the comparators between the Rudder Travel Limiting order and the RTL unit position feedback.



	A319	A320	A321
①	140	160	160
②	380	410	380
Ⓐ	3	3.5	2.9
Ⓑ	30	25	



RUDDER TRAVEL LIMITING FUNCTION

SELF EXAMINATION

In case of a double RTL failure, the return to low speed logic:

A - moves the stops to restore the maximum rudder deflection upon slat extension.
B - maintains the last position.
C - moves the stops to the maximum rudder deflection at any time.

Which parameters are used for RTL?

A - Vc parameters from the ADIRS.
B - The slats extended signal from the SFCC.
C - Vc parameters and slats position.

22 - AUTO FLIGHT SYSTEM

22-62-00 RUDDER TRIM FUNCTION

CONTENTS:

RUDDER TRIM FUNCTION

COMPONENTS

There are two rudder trims. All the components are duplicated except the RUD TRIM selector and the RESET pushbutton.
The rudder trim function is achieved by:
- an electromechanical actuator which comprises 2 asynchronous motors connected to a reduction gear by rigid linkage and 4 Rotary Variable Differential Transducers (RVDTs).
- a RUD TRIM selector for manual trim control,
- a RESET pushbutton,
- a rudder trim indicator located to the left of the RUD TRIM selector,
- two Flight Augmentation Computers (FAC 1 and FAC 2).

GENERAL

The rudder trim function has two modes: Manual mode when the autopilot is not engaged and automatic mode when the autopilot is engaged.
The autotrim order is computed by the laws, whereas the manual trim order transits through them. The order is then sent to the actuator. This order is reproduced at the rudder pedals.
Priority is given to rudder trim of FAC 1; a changeover logic enables to switch to FAC 2 in case of failure. If both rudder trims fail, the last deflection is maintained.
The rudder trim deflection is displayed on the RUD TRIM indicator.

NOTE: For the A319, the indication of the maximum rudder trim deflection is increased from + or - 20° to + or - 25°.

MANUAL MODE

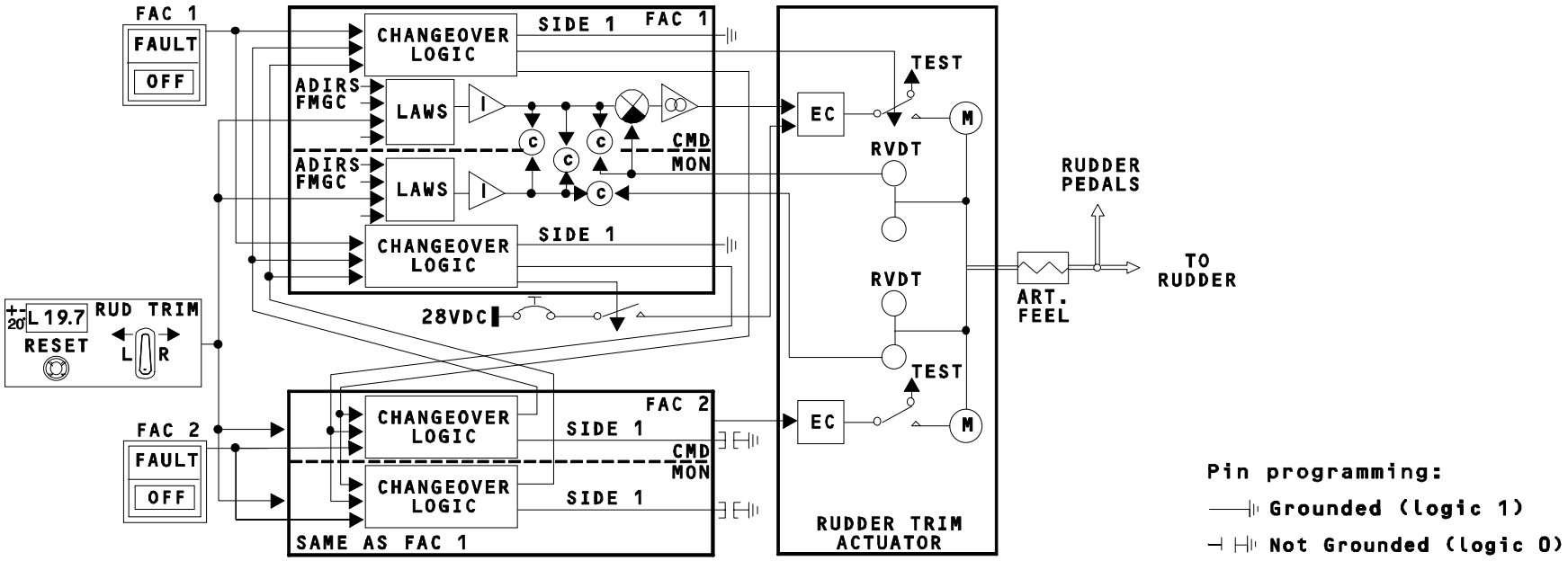
When the autopilot is not engaged, the rudder trim order is given by the RUD TRIM selector.

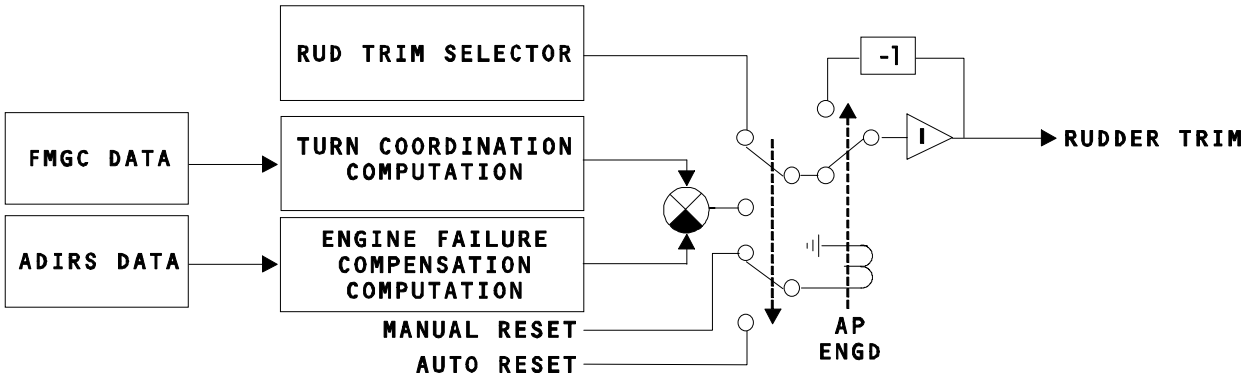
NOTE: The RESET pushbutton enables to return the rudder to the neutral position.

AUTOMATIC MODE

With the autopilot engaged, the Flight Augmentention Computer calculates the trim order using Flight Management and Guidance Computer and Air Data Inertial Reference System data.

NOTE: At touch-down, the AUTO RESET function moves the rudder to the neutral position





RUDDER TRIM FUNCTION

UFF4200
TMUFACE01-P01 LEVEL 3

EFFECTIVITY
ALL

RUDDER TRIM FUNCTION

POWER LOOP

During the autotest triggered by the FAC power up, internal actuator monitoring checks the actuator servo-loop and monitoring circuit validity, and the enabling signal reception.
Then the changeover logic enables the trim motor to be supplied and the rudder trim laws control it.
The laws compute the trim order and send it to the actuator's motor via the Electronic Control (EC).
The feedback in the power loop is provided by two Rotary Variable Differential Transducers (RVDTs) for each side.

MONITORING

The computation and the power loop are monitored by comparators. The input parameters are also monitored.
The computation is monitored by the comparators between the FAC command and monitor parts.
The FMGC and ADIRS peripheral inputs are always monitored.
The amplitude is limited to plus or minus 20°, the speed is limited to 1°/s in manual control and 5°/s in automatic control.
The power loop is monitored by the comparators between the rudder trim order and the position feedback signal.

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SELF EXAMINATION

With the autopilot engaged, RUD TRIM selector orders are:

A - Not available.
B - Available.
C - Available if the FAC pushbuttons are pressed in.

Pressing the RESET pushbutton enables to return the rudder to the neutral position:

A - When the AP is not engaged.
B - When the AP is engaged.
C - At any time.

22 - AUTO FLIGHT SYSTEM

22-63-00 YAW DAMPER FUNCTION

CONTENTS:

YAW DAMPER FUNCTION

COMPONENTS

There are two yaw dampers. In normal operation, both are engaged but only one is active. Yaw damper 1 has priority.
The yaw damper function is achieved by:
- 2 electrohydraulic actuators with an external centering element. Each actuator comprises 1 jack, 1 Linear Variable Differential Transducer (LVDT), 2 solenoid valves, 2 selector valves, 1 Pressure Switch (PS) and 1 Servo Valve (SV).
- 2 Flight Augmentation Computers (FAC 1 and FAC 2).
- 2 Rotary Variable Differential Transducers (RVDT).

GENERAL

Yaw damper 1 and 2 operate with the changeover logics. The yaw damper actuator does not move the rudder pedals.
The yaw damper function operates as follows:

- Order is computed by the laws and sent to the rudder via the related yaw damper actuator.
- Yaw damper actuator 1 is powered by the green hydraulic system.
- Yaw damper actuator 2 is powered by the yellow hydraulic system.

MANUAL MODE

In manual mode, the autopilot is not engaged and the Elevator Aileron Computer sends the turn coordination, the dutch roll damping and the engine failure compensation yaw orders to the FAC.

MANUAL ALTERNATE

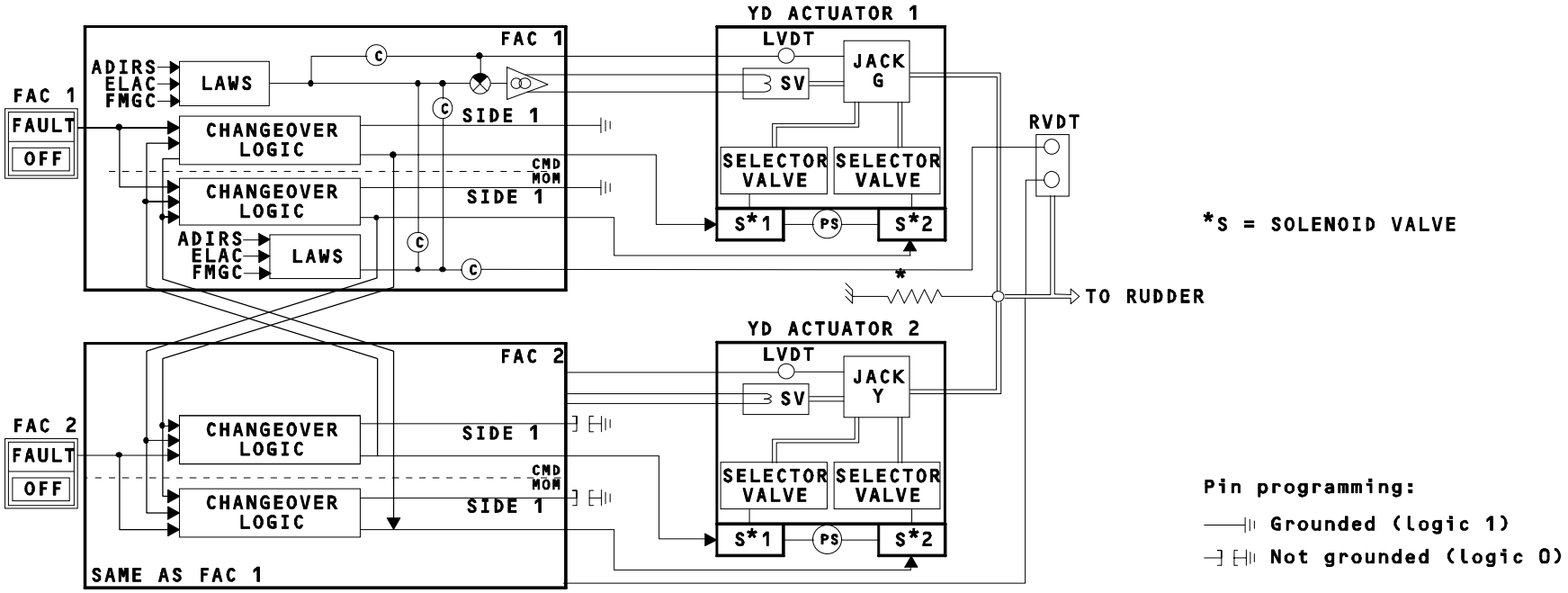
After a dual Elevator Aileron Computer failure, turn coordination and engine failure compensation are lost. Only a simplified alternate law of dutch roll damping is computed by the FAC.

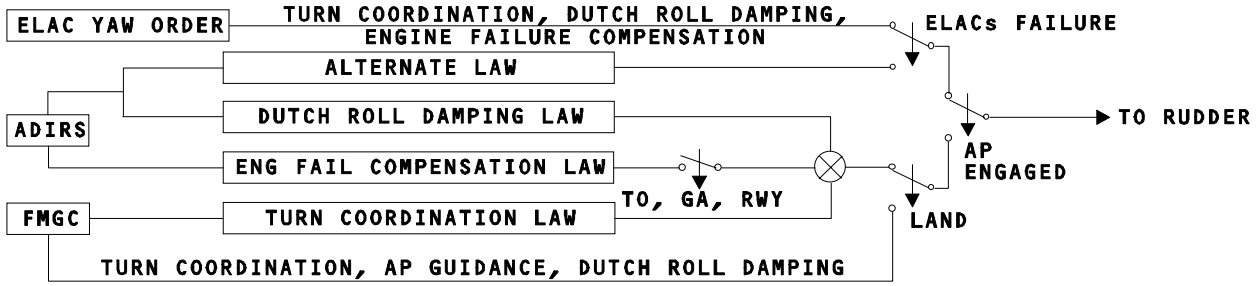
AUTO MODE

In auto mode, the FAC computes the dutch roll damping in clean configuration, the engine failure compensation in take-off, go-around and runway modes. The turn coordination law is computed by using roll orders from the FMGC.

LAND MODE

When the LAND mode is engaged, the yaw order is computed directly by the FMGC.





YAW DAMPER FUNCTION

YAW DAMPER FUNCTION

POWER LOOP

The yaw damper laws control the servovalve, and the changeover logic enables the jack to be pressurized.
The feedback in the power loop is provided by a Linear Variable Differential Transducer (LVDT) for the command side and a Rotary Variable Differential Transducer (RVDT) for the monitor side.
In case of dual yaw damper loss, a centering spring rod moves the rudder to the neutral position.

MONITORING

At power up, the yaw damper function safety tests are initiated.
The continuity between the standby yaw damper and its servo valve is tested.
The computation is monitored by the comparators between command and monitor part.
The ELAC, FMGC and ADIRS peripheral inputs are always monitored.
The power loop is monitored by a comparator between the yaw order and the rudder position feedback.
In flight, the hydraulic pressures are monitored by the FAC.
The LVDTs and the RVDTs are always monitored.

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SELF EXAMINATION

In manual mode (AP not engaged), the yaw damper orders are normally computed by the:

A - FMGCs.
B - FACs.
C - ELACs.

How is the yaw damper power loop monitored?

A - By the comparator between command part and monitor part of the FAC.
B - By the comparator between the yaw order and the rudder position feedback.
C - By the changeover logic.

Does the yaw damper actuator move the rudder pedals?

A - Yes, if hydraulic power is available.
B - Yes, in manual mode.
C - No, it does not move the rudder pedals.

22 - AUTO FLIGHT SYSTEM

22-64-00 FLIGHT ENVELOPE PROTECTION

CONTENTS:

FLIGHT ENVELOPE PROTECTION

GENERAL

The function of the Flight Augmentation Computer is independent of the FAC engagement pushbutton.
This function provides :

- characteristic speeds on the PFDs through the Display Management Computers,
- the speed limits to the FMGCs for autoflight,
- the alpha-floor detection to the FMGCs for autothrust engagement, if it is not engaged,
- low energy awareness.

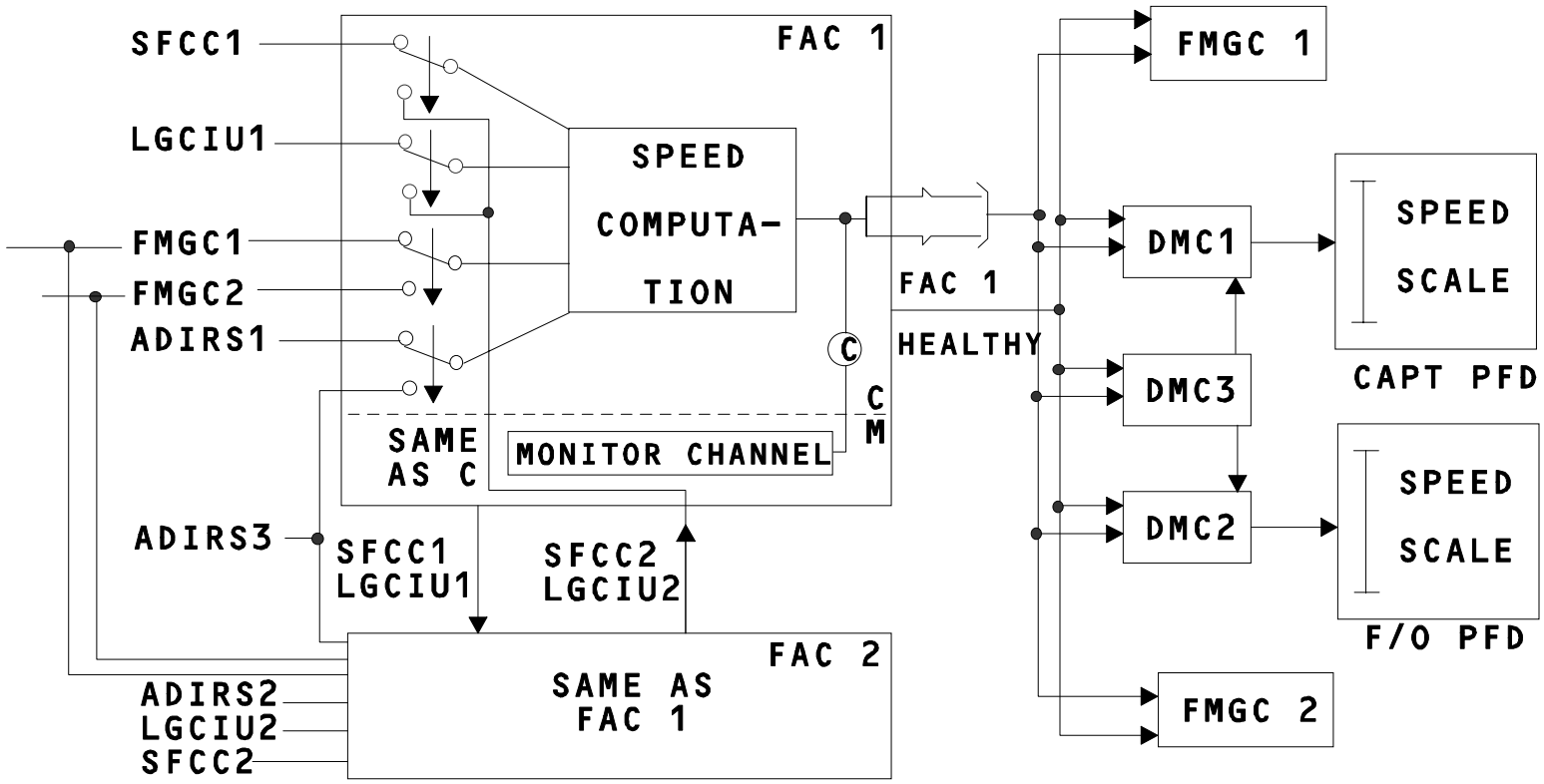
In addition, the FAC computes the weight and the center of gravity.

SPEED COMPUTATION DISPLAY

The speeds computed by the Flight Augmentation Computer are sent to the Primary Flight Display and the speed limits to the Flight Management and Guidance Computers.
In normal operation, FAC 1 data are displayed on the CAPT PFD and the FAC 2 data on the F/O PFD.
If a parameter or the computer fails, the associated PFD is automatically switched to the opposite FAC by the DMC.
If the air data source used by the FAC is different from that used by the DMC for speed display, the message ADR DISAGREE appears on the ECAM.

SPEED COMPUTATION

Aerodynamic laws and the aircraft configuration parameters are used for the characteristic speed computation.
The computation principle is based on the fact that most of the speed data are a function of the aircraft weight.
In flight, the FAC computes the weight with the ADIRS, FMGC and SFCC parameters and then, from the weight, it computes the characteristic speeds and the center of gravity.
On the ground, the FAC uses the weight provided by the FMGC.



FLIGHT ENVELOPE PROTECTION - GENERAL / SPEED COMPUTATION DISPLAY / SPEED COMPUTATION

UFF4200

TMUFACH06-P01 LEVEL 3

EFFECTIVITY
ALL

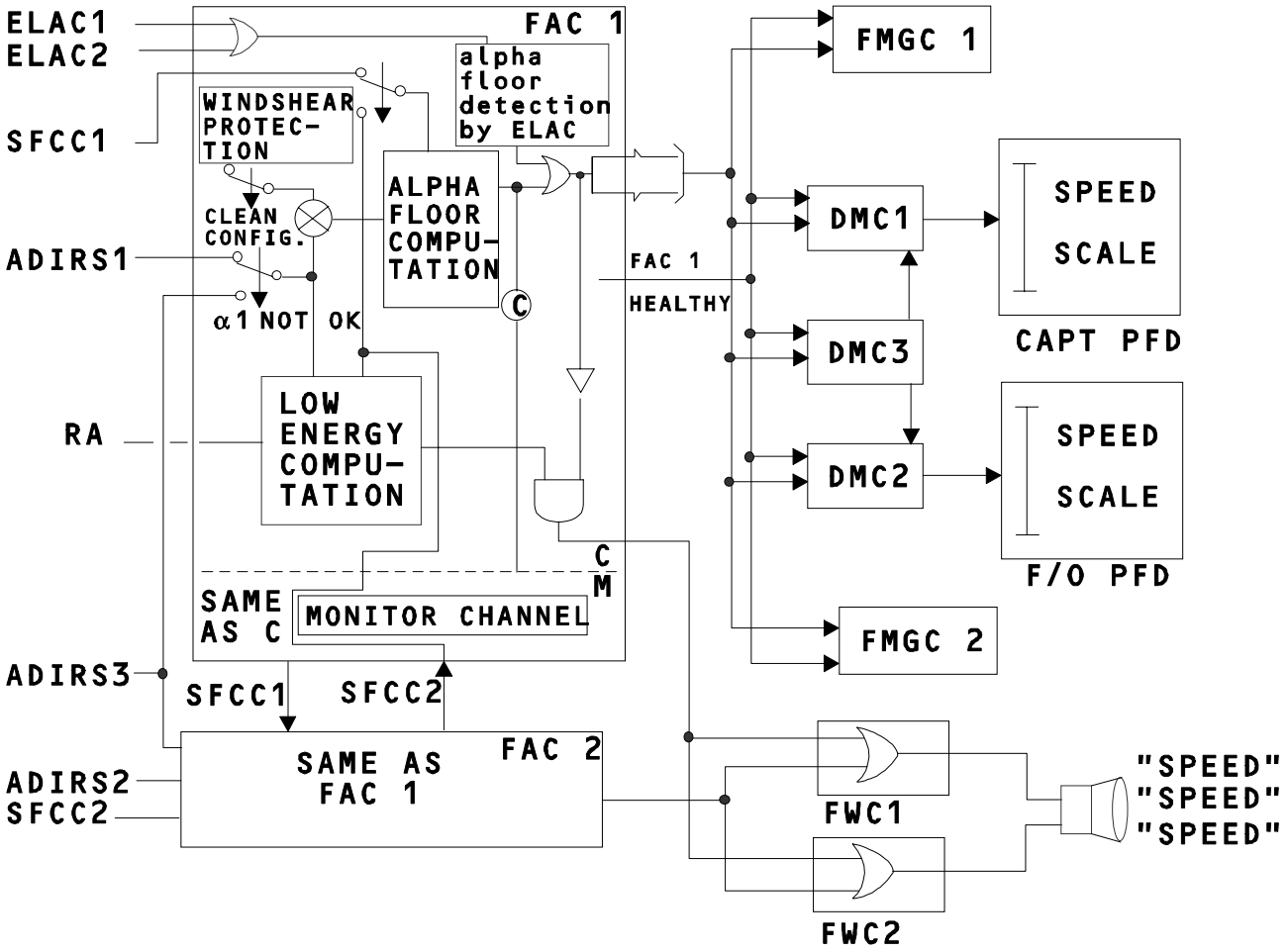
FLIGHT ENVELOPE PROTECTION

ALPHA-FLOOR AND WINDSHEAR PROTECTION

Alpha-floor detection and windshear protection are computed by the FAC or the ELAC and sent to the FMGC. This function protects the aircraft against excessive angle-of-attack.
The FAC compares the aircraft alpha (AOA) with the predetermined threshold (function of the slat/flap configuration). This threshold is decreased in case of windshear. Beyond this threshold, the FAC transmits a signal to the FMGC to engage the autothrust function and apply full thrust.
If the aircraft is in clean configuration, the windshear compensation function is not available. The ELAC will trigger alpha-floor in two cases : alpha protection condition + side stick deflection > 14 degrees, or pitch angle > 25 degrees + side stick deflection > 14 degrees.
A dual ADIRS failure results in the total loss of alpha-floor detection.

LOW ENERGY AWARENESS

Energy awareness is a software device which provides the crew with an aural warning which indicates that it is necessary to increase thrust to recover a positive flight path angle through pitch control.
The audio warning, "SPEED SPEED SPEED", is triggered before alpha-floor and depends on angle of attack, configuration deceleration rate, and flight path angle.
It is inhibited when radio altitude is greater than 2000 ft or when alpha-floor is active or when the aircraft is in clean configuration



FLIGHT ENVELOPE PROTECTION - ALPHA-FLOOR AND WINDSHEAR PROTECTION / LOW ENERGY AWARENESS

UFF4200
TMUFACH06-P02 LEVEL 3

SELF EXAMINATION

What is the consequence of an alpha-floor detection?

A - The autothrust disengages.
B - The autopilot engages.
C - The autothrust automatically engages with full thrust.

When is the windshear protection not available?

A - With slats/flaps extended.
B - With slats/flaps fully extended.
C - In clean configuration.

22 - AUTO FLIGHT SYSTEM

22-60-00 FLIGHT ENVELOPE DATA ON PFD

CONTENTS :

FLIGHT ENVELOPE DATA ON PFD

SPEED PROTECTION

The green overspeed protection symbol indicates the speed at which overspeed protection becomes active.
SPEED PROTECTION = (VMO + 6 kts / MMO + 0.01)

SPEED TREND

The yellow pointer starts from the speed symbol. The end of this arrow gives the speed value which will be attained in 10 seconds if the acceleration or deceleration remains constant.
This arrow appears only when greater than 2 knots and is removed when less than 1 knot. It is also removed in case of failure of the FACs.

TARGET AIRSPEED

This symbol is either magenta or cyan and gives the target airspeed value or the airspeed corresponding to the Mach number.
The target airspeed value is the value computed by the FMGC in managed speed mode (magenta) or manually entered on FCU for selected speed mode (cyan).
The target speed is a magenta double bar when associated with the ECON speed range. Otherwise it is a magenta or cyan triangle.
When out of speed scale, the target speed value is displayed in numeric form below or above the speed scale.

ECON SPEED RANGE

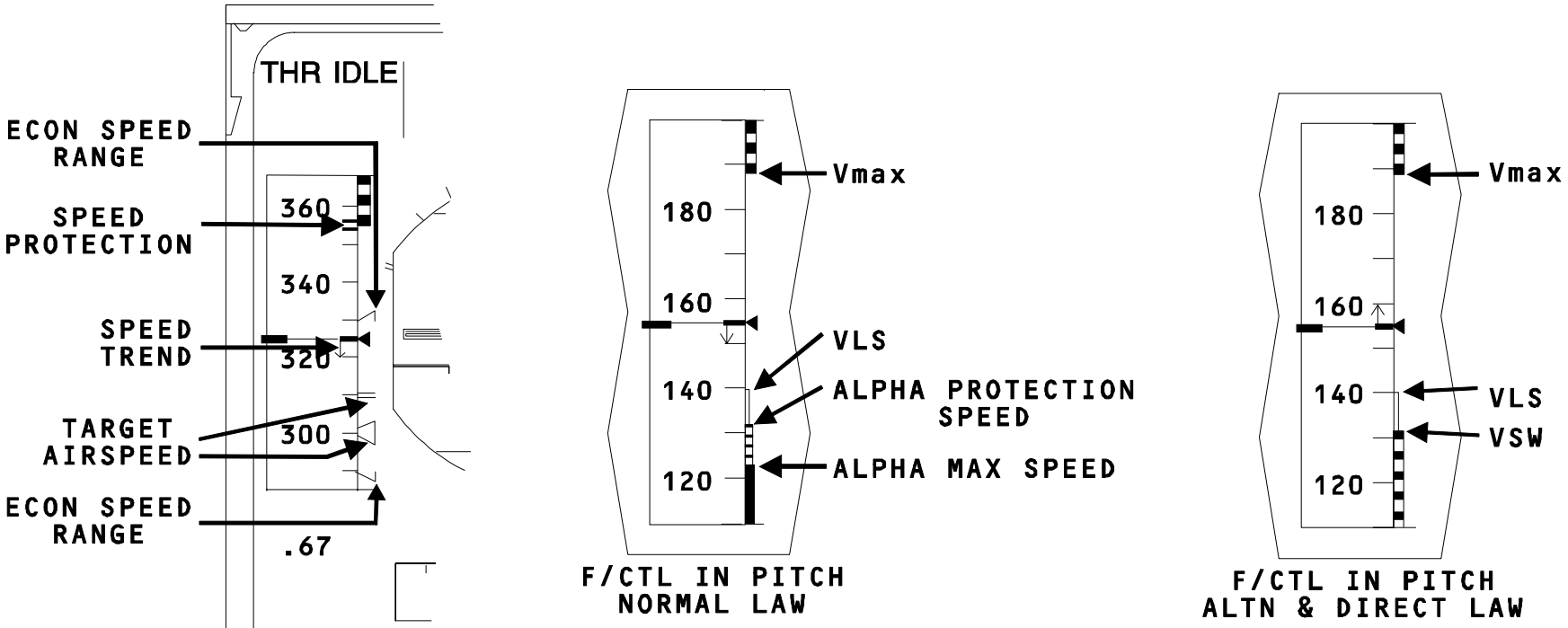
In descent mode, with the ECON mode, the selected speed symbol is replaced by two magenta half triangles : upper and lower limits calculated by the FMGC.
They indicate the range of descent speed: +20 kt and −20 kt or Vmin or VLS which ever is higher.

MINIMUM SELECTABLE SPEED VLS

It is defined by the top of an amber strip along the speed scale and computed by the FACs.
The VLS corresponds to 1.13 Vs during take-off or following touch and go. It becomes 1.23 Vs as soon as any flap or slat selection is made. It remains at this value until landing.
Above 20000 ft, VLS is corrected for Mach effect to maintain 0.2 g buffet margin.
VLS information is inhibited from touch down up to 10 seconds after lift-off.

ALPHA PROTECTION SPEED

It is defined by the top of a black and amber strip along the speed scale.
It represents the speed corresponding to the angle of attack at which alpha protection becomes active.
This speed is computed in pitch normal law by the FACs.



FLIGHT ENVELOPE DATA ON PFD

UFF4200

TMUFAC102-P01 LEVEL 3

EFFECTIVITY
ALL

FLIGHT ENVELOPE DATA ON PFD

ALPHA MAX SPEED

It is defined by the top of a red strip along the speed scale.
It represents the speed corresponding to the maximum angle of attack that may be reached in pitch normal law.
This speed is computed in pitch normal law by the FACs.

Vmax

It is defined by the lower end of a red and black strip along the speed scale and determined by the FACs.
Vmax represents the lowest of the following values:

- VMO (Maximum operating speed) or the speed corresponding to MMO (Maximum operating Mach)
- VLE (Maximum landing gear extended speed)
- VFE (Maximum flap extended speed)

VSW

It is defined by the top of a red and black strip along the speed scale.
It represents the speed corresponding to the Stall Warning.
VSW information is inhibited from touch down up to five seconds after lift-off.
It is computed in pitch alternate or pitch direct law by the FACs.

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DECISION SPEED V1

The decision speed V1 is shown by a cyan symbol.
It is manually inserted by the crew through the MCDU.
When out of indication range, it is digitally shown on the upper part of the scale. It is removed after lift-off.

MINIMUM FLAP RETRACTION SPEED

This speed is represented by a green -F symbol.
It is available when the FLAP selector is in position 3 or 2.
It is computed by the FACs.

MINIMUM SLAT RETRACTION SPEED

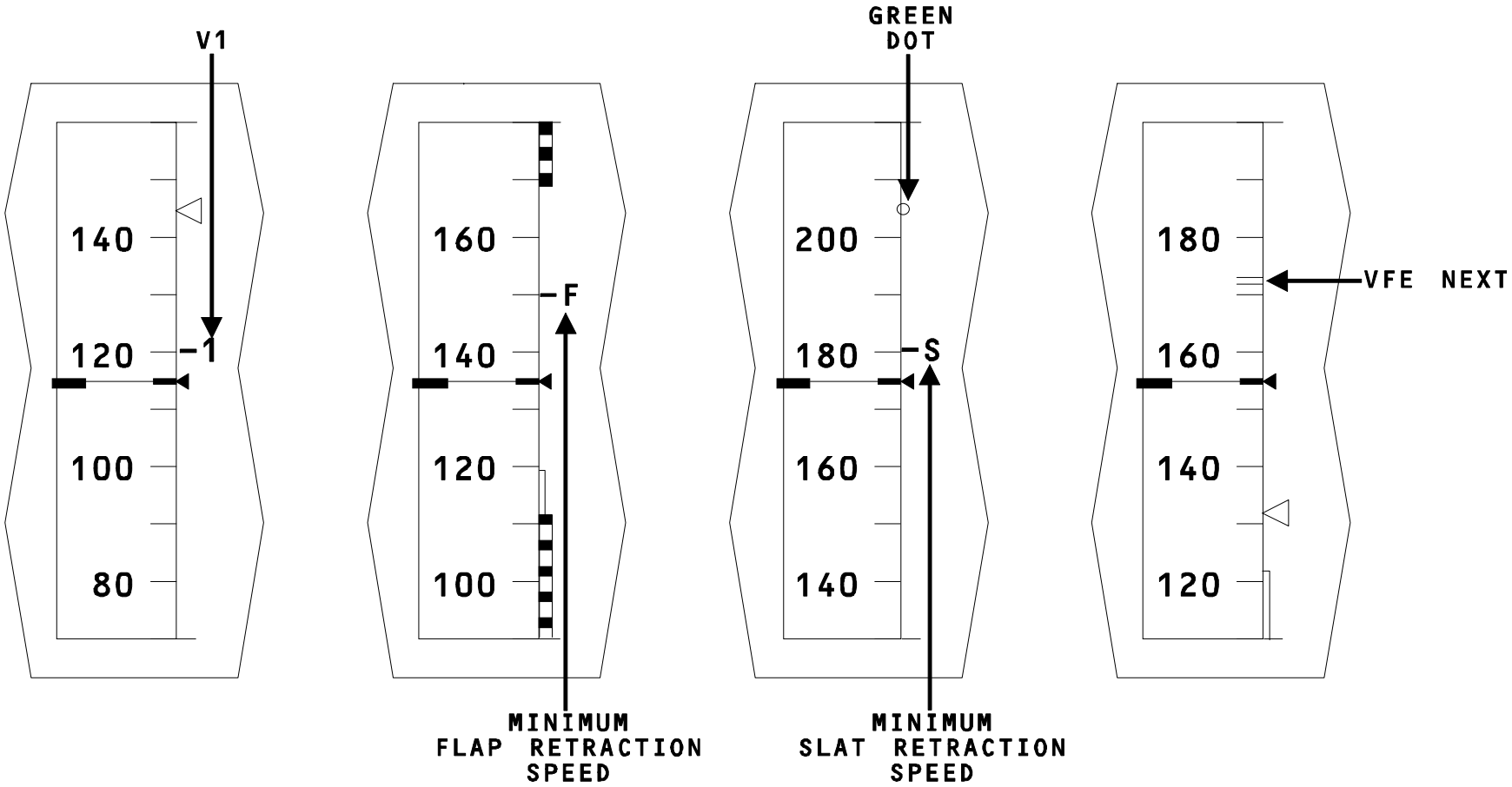
This speed is represented by a green -S symbol.
It is available when the FLAP selector is in position 1.
It is computed by the FACs.

VFE NEXT

Two amber dashes show the predicted VFE (Maximum flap extended speed) at the next flap/slat position.
It is provided by the FACs and only displayed when the aircraft altitude is below 15000 ft.

GREEN DOT

This is the engine out operating speed in clean configuration.
It is displayed in flight only by a green dot.
It represents the speed corresponding to the best lift to drag ratio.



FLIGHT ENVELOPE DATA ON PFD

SELF EXAMINATION

How is the speed trend displayed?

A - By a green dot.
B - By a yellow arrow corresponding to the speed in 15 seconds.
C - By a yellow arrow corresponding to the speed in 10 seconds.

What do the two amber dashes represent?

A - The optimum manoeuvering speed.
B - The maximum flap extended speed at next flap/slat position.
C - The maximum selectable speed for a given configuration.

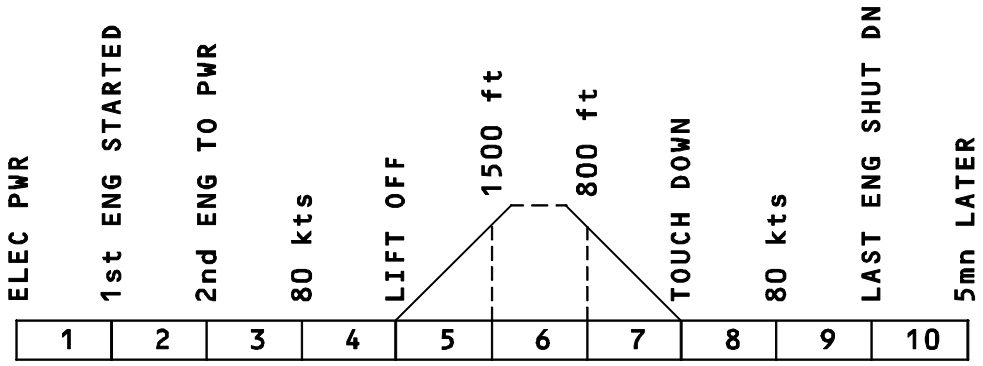
Is the green dot displayed on ground?

A - No, it is displayed only in flight.
B - Yes, provided the engines are running.
C - No, it is displayed only in flight with slats and flaps extended.

22 - AUTO FLIGHT SYSTEM

22-60-00 FAC WARNINGS

CONTENTS:



FAILURE TITLE	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLIGHT PHASE INHIBITION
FAC 1 (2) FAULT	SINGLE CHIME	MASTER CAUT	NIL	FAC 1 (2) FAULT light	3, 4, 5, 7, 8
FAC 1+2 FAULT	SINGLE CHIME	MASTER CAUT	NIL	-FAC 1 and 2 FAULT lights -red SPD LIM flag on PFDs	4, 5, 7, 8
YAW DAMPER 1 (2)	NIL	NIL	NIL	NIL	3, 4, 5, 7, 8, 10
YAW DAMPER SYS	SINGLE CHIME	MASTER CAUT	NIL	NIL	4, 5, 7, 8, 10
RUD TRIM 1 (2) FAULT	NIL	NIL	NIL	NIL	3, 4, 5, 7, 8
RUD TRIM SYS	SINGLE CHIME	MASTER CAUT	F/CTL	NIL	4, 5, 7, 8
RUD TRV LIM 1(2)	NIL	NIL	F/CTL	NIL	3, 4, 5, 7, 8
RUD TRV LIM SYS	SINGLE CHIME	MASTER CAUT	F/CTL	NIL	4, 5, 7, 8
WINDSHEAR (No ECAM message)	synthetic voice "WINDSHEAR" 3 times	NIL	NIL	red WINDSHEAR flag on PFDs	2, 3, 4, 8, 9
WINDSHEAR DET FAULT	NIL	NIL	NIL	NIL	3, 4, 5, 8, 9
LOW ENERGY WARNING (No ECAM message)	synthetic voice "SPEED" 3 times	NIL	NIL	NIL	—

FAC WARNINGS

22 - AUTO FLIGHT SYSTEM

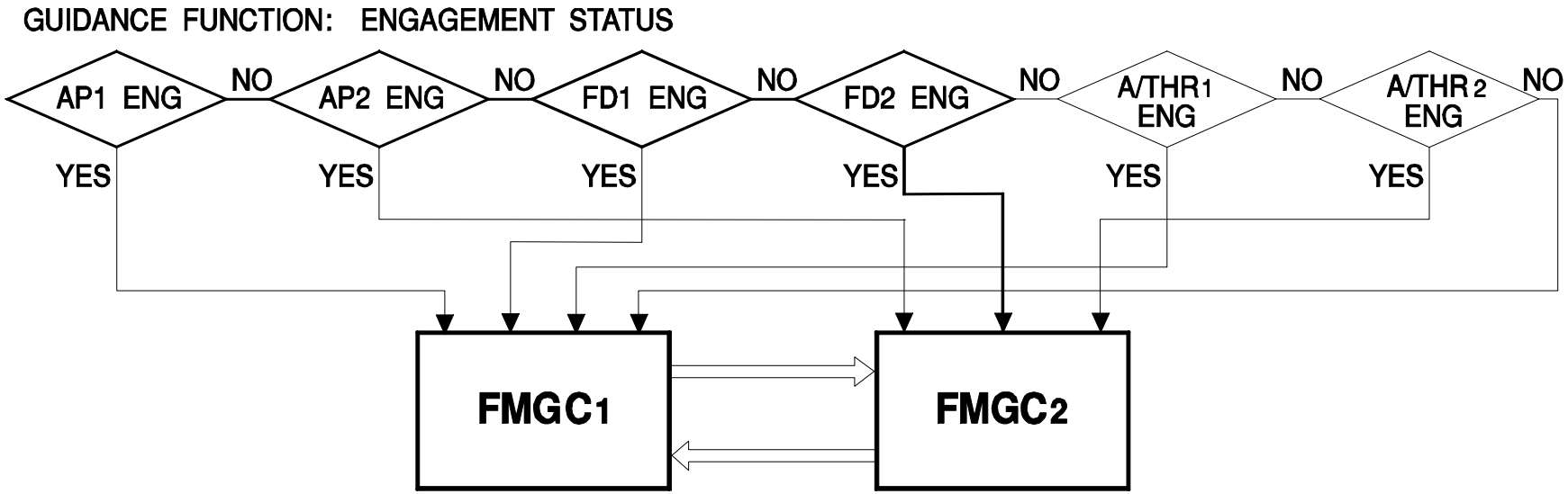
22-00-00 FLIGHT GUIDANCE PRIORITY LOGIC

CONTENTS:

FLIGHT GUIDANCE PRIORITY LOGIC

FLIGHT GUIDANCE (FG)

The engagement status of the guidance function works on the MASTER/SLAVE principle.
The master Flight Management and Guidance Computer (FMGC) imposes all the changes of AP/FD modes and/or autothrust (A/THR) engagement to the slave FMGC.
Here is an example of a master Flight Management and Guidance Computer.
Look at the flow chart to understand the priority logic.
With no Autopilot (AP), no Flight Director 1 (FD1) but Flight Director 2 (FD2) engaged, FMGC2 is the master because, following the flow chart, the first three answers are "NO", but the fourth one is "YES".

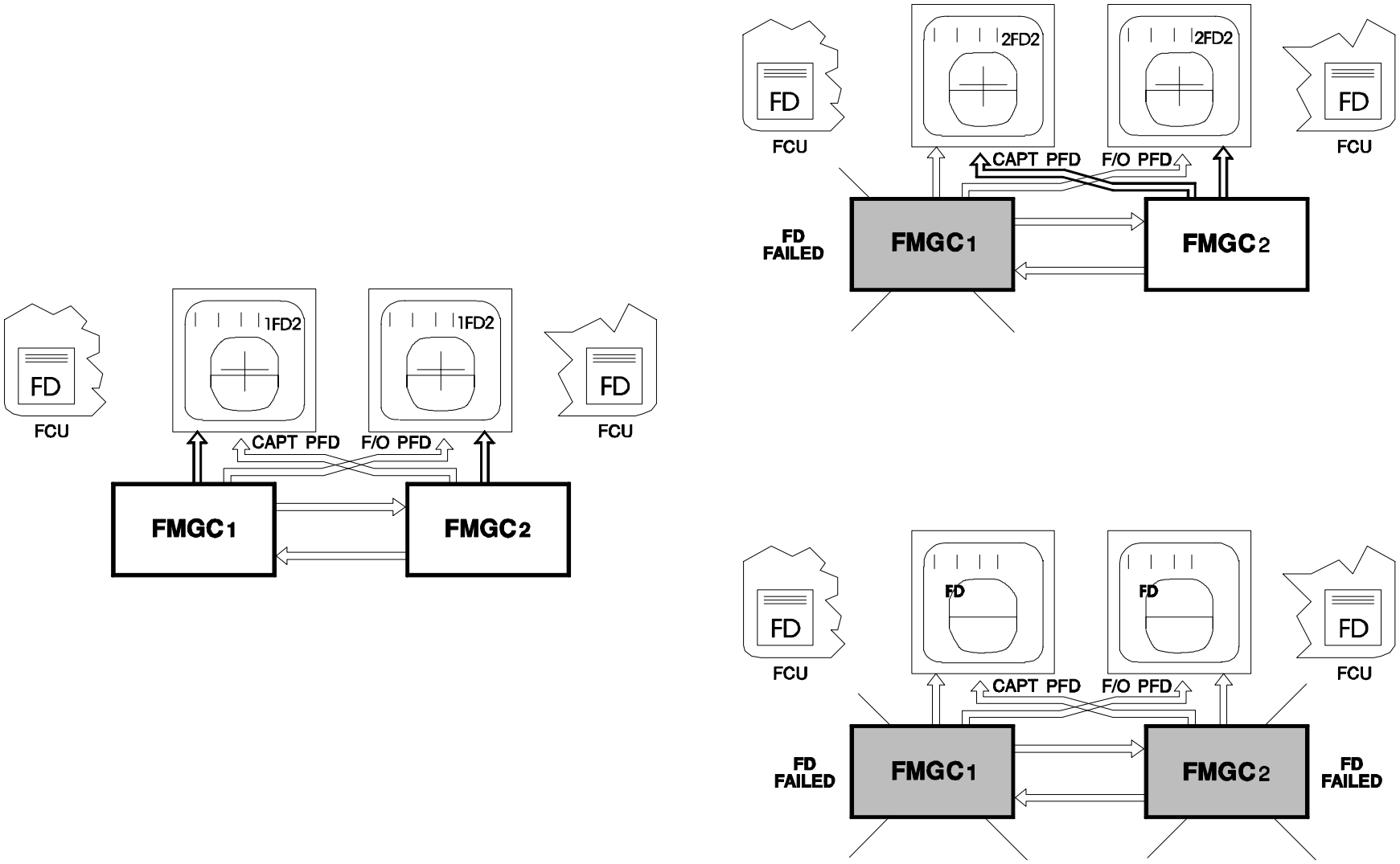


FLIGHT GUIDANCE PRIORITY LOGIC - FLIGHT GUIDANCE (FG)

FLIGHT GUIDANCE PRIORITY LOGIC

FLIGHT DIRECTOR (FD)

Upon energization, both Flight Directors (FDs) are normally engaged in split configuration.
FMGC1 normally drives the FD symbols (crossed bars or flight path director symbols) on the Captain (Capt) Primary Flight Display (PFD).
FMGC2 normally drives the FD symbols on the First Officer (F/O) PFD.
The "1FD2" indication is displayed on each Flight Mode Annunciator (FMA) to show that FD1 is engaged on Capt side and FD2 is engaged on F/O side.
If one FMGC fails, the remaining FMGC drives the FD symbols on both Primary Flight Displays.
If FMGC1 fails, the "2FD2" indication is displayed on each FMA to show that FD2 is displayed on both PFDs.
If both FDs fail, a red flag is displayed on each PFD, provided that the corresponding FD switch is "ON".

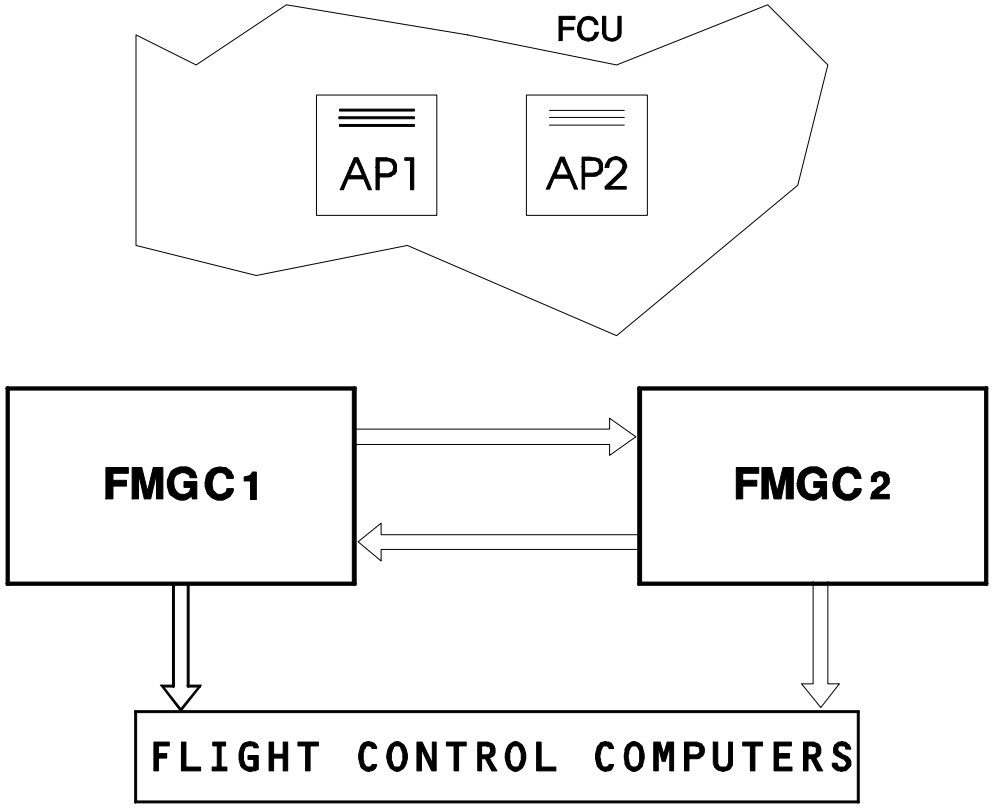


FLIGHT GUIDANCE PRIORITY LOGIC - FLIGHT DIRECTOR (FD)

FLIGHT GUIDANCE PRIORITY LOGIC

AUTOPILOT (AP)

If one AP is engaged, the corresponding FMGC controls the flight controls through the Flight Control Computers.
There is no priority logic in single operation. Last engaged autopilot is the active one.
Both autopilots can be engaged as soon as the APPROACH mode is selected on the Flight Control Unit (FCU).
AP1 has priority, AP2 is in standby.
The Flight Control Computers use the AP1 commands first. A switching is performed to the AP2 commands in case of AP1 disengagement.

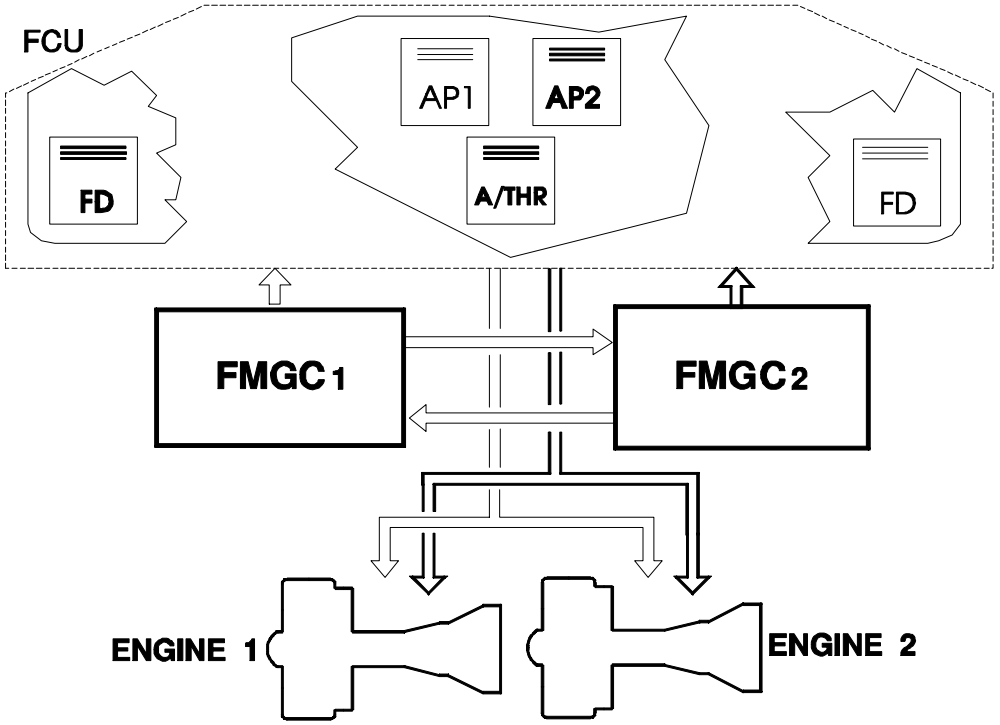


FLIGHT GUIDANCE PRIORITY LOGIC - AUTOPILOT (AP)

FLIGHT GUIDANCE PRIORITY LOGIC

AUTOTHRUST (A/THR)

A single autothrust pushbutton switch located on the FCU enables the engagement or disengagement of the autothrust function.
The autothrust function is, in fact, composed of two systems (A/THR1 and A/THR2) which are ready to be engaged at the same time, but only one system is selected.
However, the selection of A/THR1 or A/THR2 depends on the engagement of the AP and FD, i.e. of the master/slave principle which is known by the FCU and summarized in the table.
When the selected autothrust function is active (according to the thrust lever position), the master FMGC controls the engines, via the FCU.
Consequently, in automatic control, it is the same FMGC which controls the engines and the flight controls.
To recover the A/THR function, when one AP (AP1 or AP2) is engaged and its own A/THR has failed, the opposite AP should be engaged to switch from the master FMGC to the other (which now becomes the master) and to switch to the opposite A/THR.



ENGAGT OF AP		ENGAGT OF FD		SELECTED A/THR
1	2	1	2	
ON	*	*	*	A/THR1
OFF	**ON**	*	*	**A/THR2**
OFF	OFF	ON	*	A/THR1
OFF	OFF	OFF	ON	A/THR2
OFF	OFF	OFF	OFF	A/THR1 OR ATHR2 IF ATHR1 FAIL

* ON or OFF

UFF4200
TMUFGCI04-P04 LEVEL 1

FLIGHT GUIDANCE PRIORITY LOGIC – AUTOTHRUST (A/THR)

EFFECTIVITY
ALL

FLIGHT GUIDANCE PRIORITY LOGIC

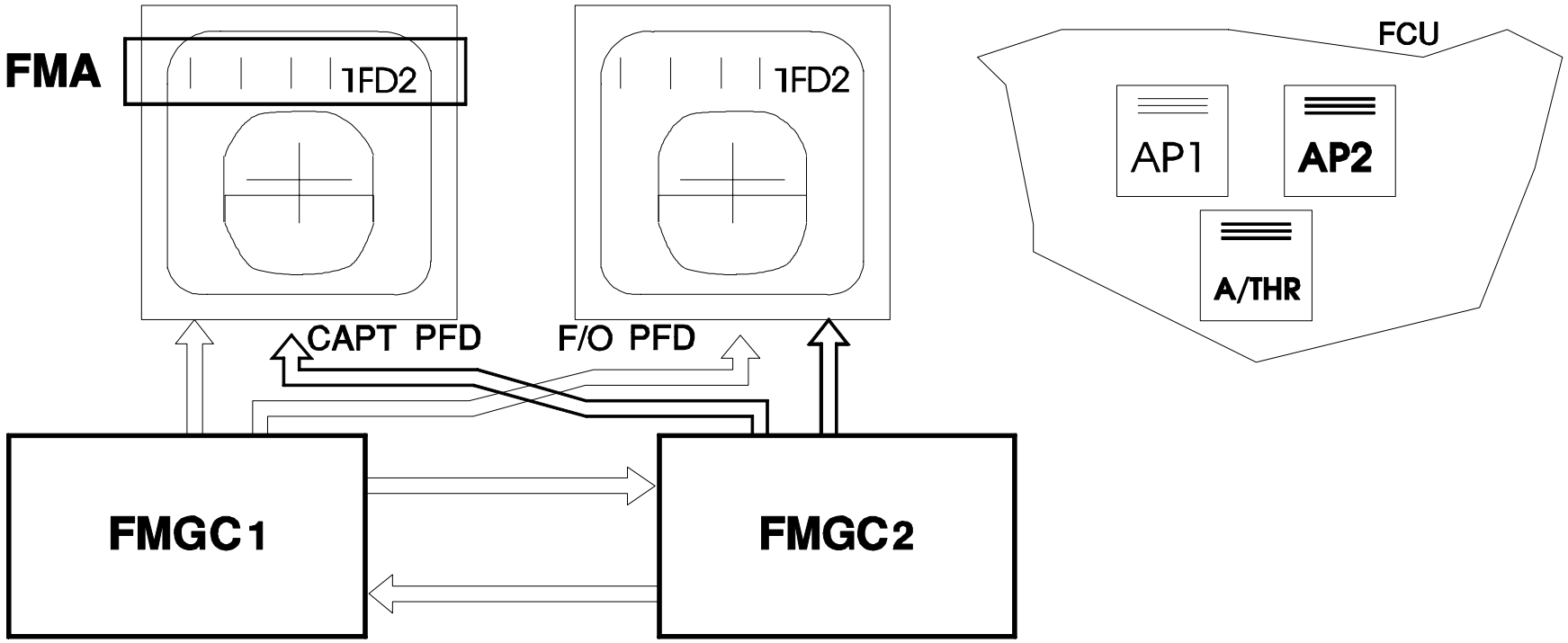
FLIGHT MODE ANNUNCIATOR (FMA)

The three types of information on the Flight Mode Annunciator (FMA) are:

- Autothrust mode/status,
- Autopilot/Flight Director mode and status,
- Flight Management messages.

The autothrust information is displayed by the master FMGC which supplies both FMAs.
The autopilot/Flight Director information is displayed according to the following logic:

- With at least one AP, the master FMGC supplies both FMAs.
- Without AP, with the FDs engaged, FMGC1 supplies FMA1, FMGC2 supplies FMA2.
- Without AP, with one FD failed or manually disengaged, the opposite FMGC supplies both FMAs.



FLIGHT GUIDANCE PRIORITY LOGIC - FLIGHT MODE ANNUNCIATOR (FMA)

SELF EXAMINATION

Which is the master FMGC with no FD engaged and AP2 engaged?

A - FMGC1.
B - FMGC2.
C - Either FMGC 1 or FMGC 2, independently of AP, FD and A/THR engagement status.

AP1 is engaged, FDs are engaged, A/THR1 is engaged. How do the FMGCs work in normal conditions?

A - Each FMGC drives its own FD symbols, FMGC1 supplies both FMAs and controls the flight controls and engines.
B - FMGC1 drives FD symbols on both PFDs, supplies both FMAs and controls the flight controls and engines.
C - FMGC1 drives FD symbols on the Captain PFD, supplies FMA on Captain PFD and controls the flight controls. FMGC2 controls the engines.

22 - AUTO FLIGHT SYSTEM

22-81-00 FLIGHT CONTROL UNIT DESCRIPTION/OPERATION

CONTENTS:

FLIGHT CONTROL UNIT DESCRIPTION/OPERATION

GENERAL

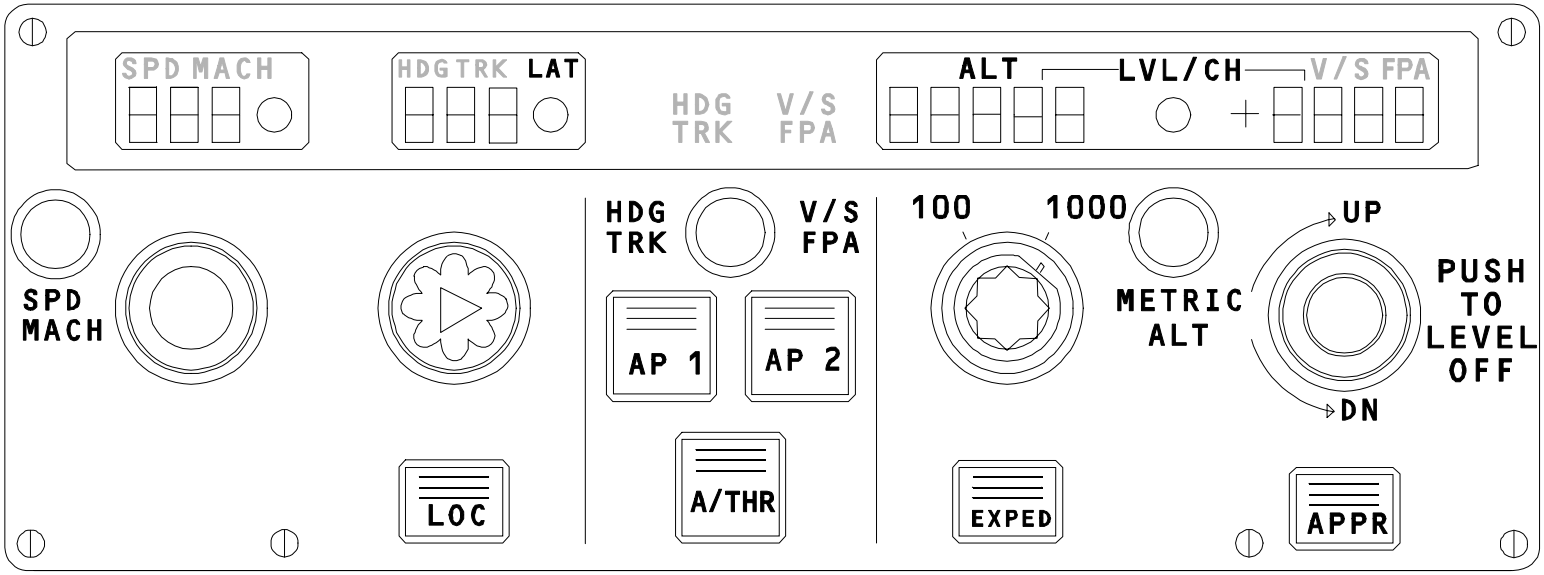
This description only deals with the central part of the Flight Control Unit (FCU).
In general, the FCU provides the short term interface between the crew and the Flight Management and Guidance System.
The FCU is the main interface to engage functions and guidance modes and to select parameters.

NOTE: In fact, there is one FCU PANEL which controls two identical processing channels: FCU 1 and FCU 2.
Only one channel is active at a time, the other is in standby. If both channels fail, all FCU controls are inoperative: AUTOTHRUST, AP/FD 1 and AP/FD 2 are not available.

DISPLAY

Here are listed some examples of function engagement, selection of required guidance modes and flight parameters.
The FCU allows:

- engagement of autopilots, Flight Directors and autothrust,
- selection of guidance modes; e.g. heading, Vertical Speed or track, Flight Path Angle,
- selection and display of the various guidance targets whenever a manual selection is required (SPD – HDG – TRK – V/S – FPA – ALT).


SPD MACH
HDG TRK LAT
HDG TRK
V/S FPA
ALT
LVL/CH
V/S FPA
SPD MACH
HDG TRK
V/S FPA
AP 1
AP 2
100
1000
METRIC ALT
UP
DN
PUSH TO LEVEL OFF
LOC
A/THR
EXPED
APPR
EXPED
Optionally removed

FLIGHT CONTROL UNIT DESCRIPTION/OPERATION

SPEED/MACH REFERENCE CONTROL KNOB

The speed/Mach reference control knob can be pushed or pulled. It is spring-loaded to neutral. It can also be turned.

PULLED:
When pulled, the FMGC uses a selected reference speed which is displayed on the FCU. The associated MANAGED SPD/MACH DOT light is off.

- If the speed window was previously dashed, the value which appears is generally the last managed reference speed.
- If not, there is no change in the window.

TURNED:
When turned, it changes the displayed speed.

- If a speed was previously displayed, the selected reference speed is modified.
- If the speed window was previously dashed, the first click changes the dashes into the managed reference speed. When turned more, this value changes.
  If the knob is not pulled within 45 seconds the display reverts to dashes.

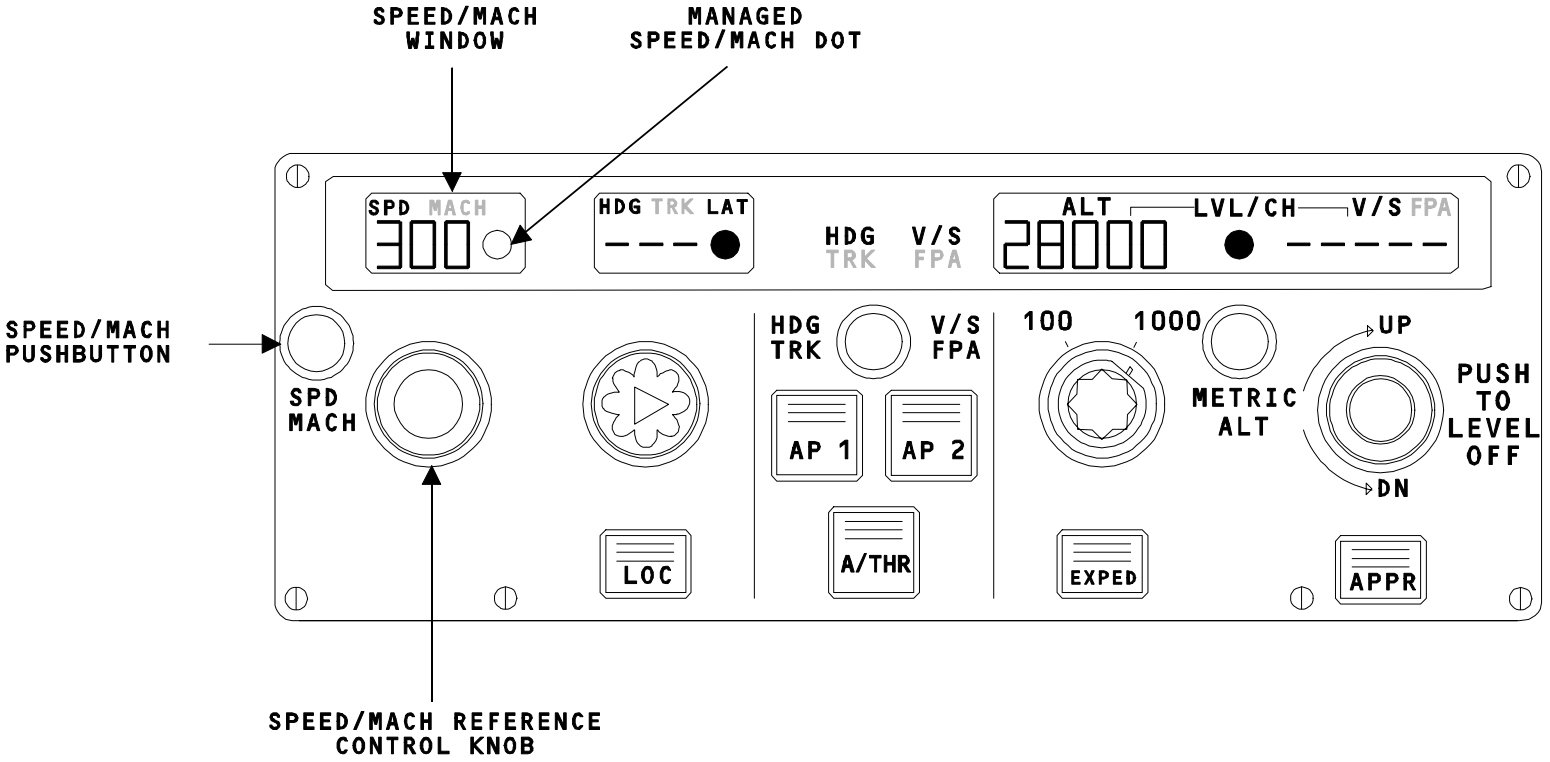
PUSHED:
When pushed, dashes are displayed and the associated MANAGED SPD/MACH DOT light comes on.
The FMGC uses a managed reference speed.

- If dashes are displayed, there is no change.
- If a speed was previously displayed, dashes appear and the light comes on.
  The reference becomes a managed speed.

NOTE: For Take-Off, Go-Around and expedite, the FMGS automatically uses memorized speeds such as V2, VAPP and Green dot.
Dashes are displayed and the light is on.

SPEED/MACH SWITCHING

The speed/Mach pushbutton is only active when a value is displayed in the speed window.
In all cases, the speed/Mach switching is automatic. The pilot can only perform the switching using the speed/Mach pushbutton when the reference is selected. The appropriate indication (SPD or MACH) is then displayed.


SPEED/MACH WINDOW
MANAGED SPEED/MACH DOT
SPD MACH
300
HDG TRK LAT
HDG TRK
V/S FPA
ALT
LVL/CH
V/S FPA
28000
SPEED/MACH PUSHBUTTON
SPD MACH
HDG TRK
V/S FPA
100
1000
METRIC ALT
UP
DN
PUSH TO LEVEL OFF
AP 1
AP 2
LOC
A/THR
EXPED
APPR
SPEED/MACH REFERENCE CONTROL KNOB

FLIGHT CONTROL UNIT DESCRIPTION/OPERATION

HEADING/TRACK LATERAL CONTROL KNOB

The lateral control knob can be pushed or pulled. It is spring-loaded to neutral. It can also be turned.
The LAT window displays a value when heading or track mode is active or when a heading or track preset has been performed. It is dashed in all other cases.
The light is on when a managed lateral mode is armed (e.g. NAV, RWY, LAND...)

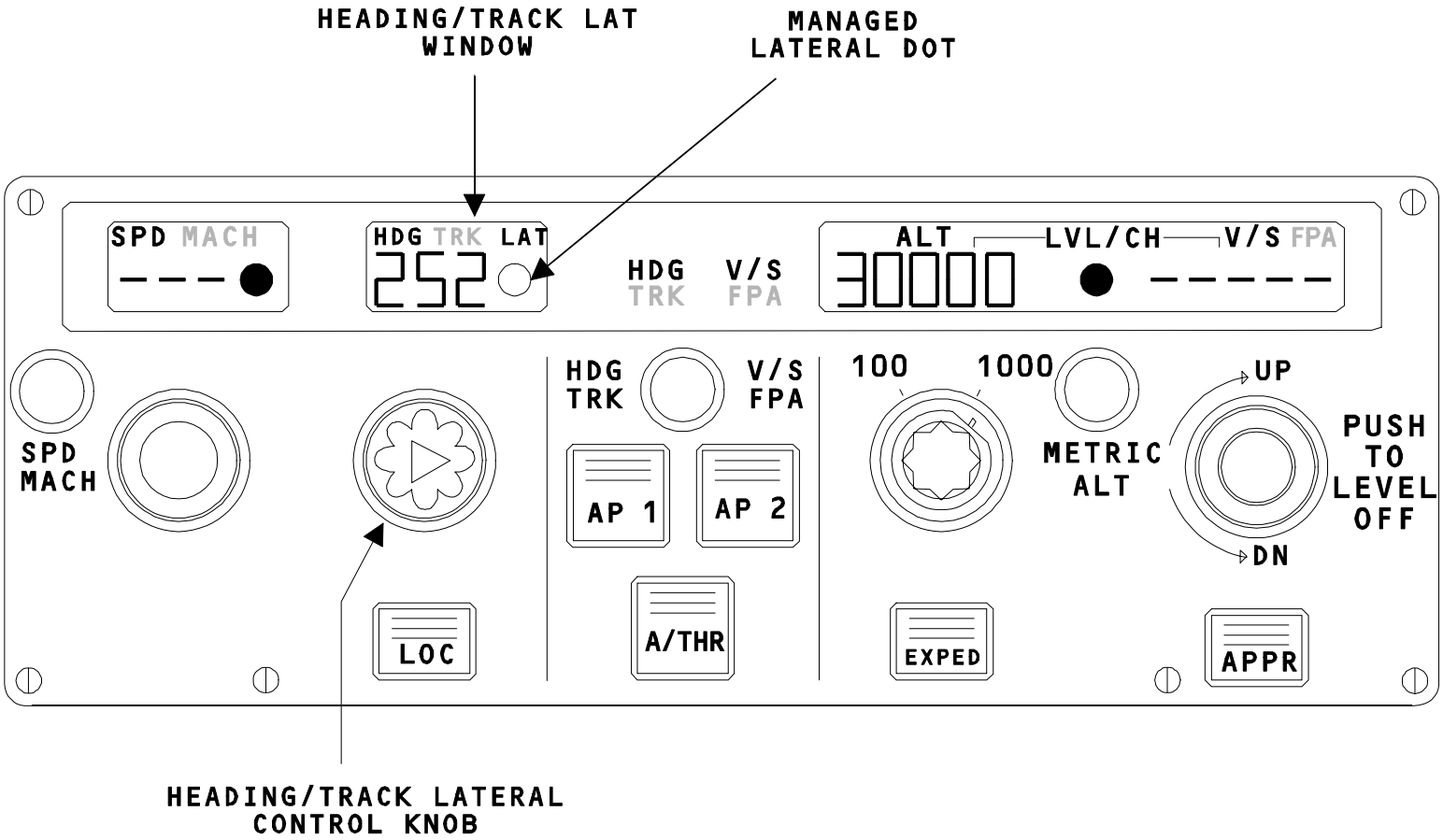
PULLED:
When pulled, heading or track mode engages with a reference displayed on the FCU. The associated light is off.

- If the LAT window was previously dashed, the value which appears is the present heading or track.
- If not, there is no change in the window.

TURNED:
When turned, it changes the displayed heading or track.

- If a heading or track was previously displayed, the selected reference is modified.
- If the LAT window was previously dashed, the first click changes the dashes into the present A/C heading or track. When turned more, the value changes.
  If the knob is not pulled within 45 seconds the display reverts to dashes.

PUSHED:
When pushed, the navigation mode is armed.
During the arming phase, the heading or track is displayed until interception of the flight plan.
Then, dashes will replace the heading or track.
During the arming and active phases, the light is on.



FLIGHT CONTROL UNIT DESCRIPTION/OPERATION - HEADING/TRACK LATERAL CONTROL KNOB

UFF4200

TMUFM2004-P03 LEVEL 3

EFFECTIVITY
ALL

FLIGHT CONTROL UNIT DESCRIPTION/OPERATION

ALTITUDE SELECTOR KNOB

The outer knob has 2 selectable positions, 100 feet and 1000 feet.
The inner knob sets the altitude in the FCU altitude window with increments depending on the outer knob position (100 or 1000).
The inner knob can be pushed or pulled and is spring-loaded to neutral. It can also be turned.

PULLED:
When pulled, open climb or open descent mode engages if the displayed altitude is different from the present aircraft altitude. The level change light is off.
Aircraft immediately climbs (or descends) towards the selected altitude.

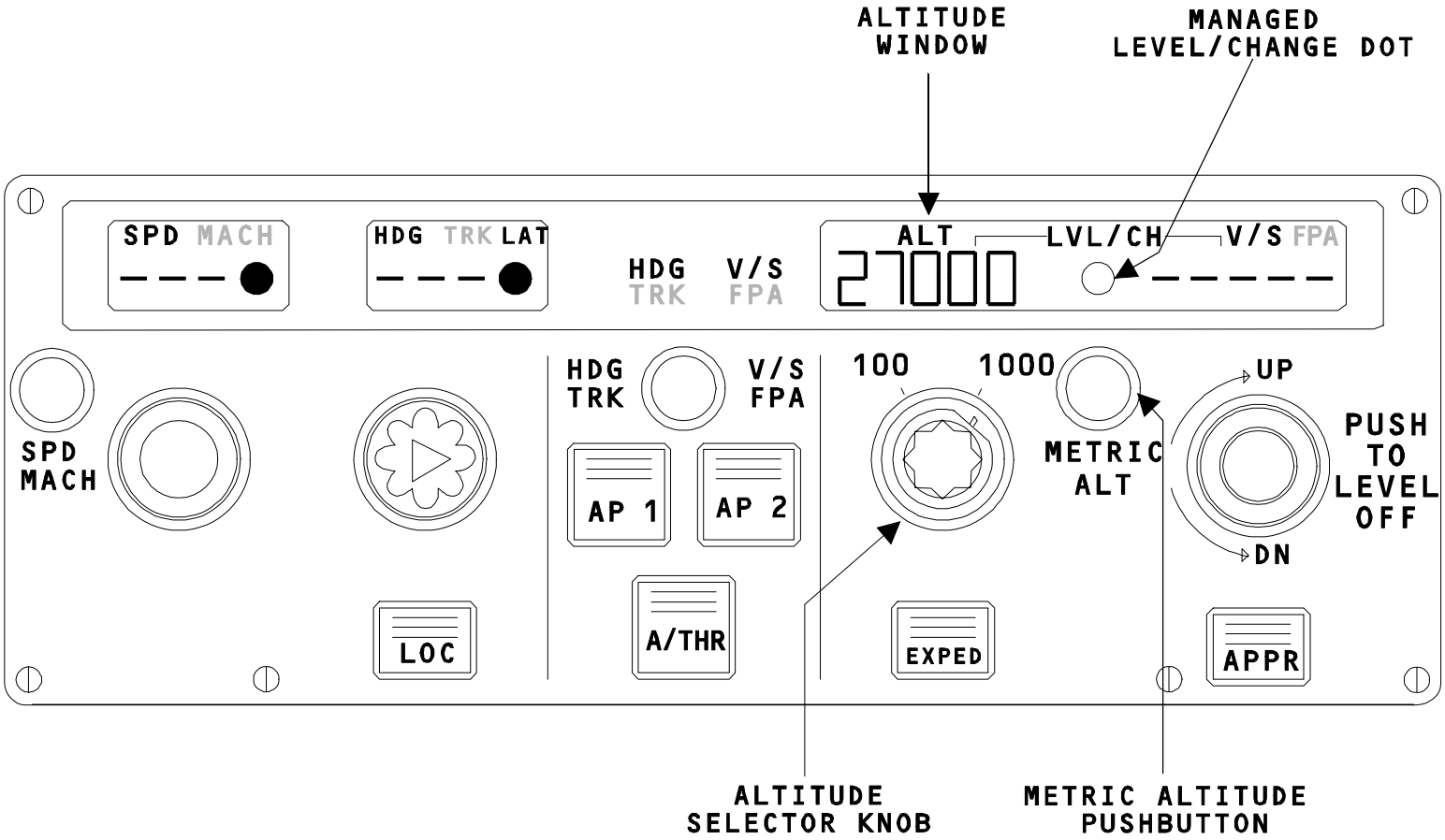
TURNED:
When turned, the displayed altitude changes by thousands or hundreds feet, depending on the outer knob selection.
The selected altitude changes.

PUSHED:
When pushed, climb or descent mode engages if the displayed altitude (in the FCU) is different from the present aircraft altitude. The level change is managed and the level change light is on.

NOTE: The ALT window always displays a target value selected by the crew. The window is never dashed.

METRIC ALTITUDE PUSHBUTTON

This METRIC ALT pushbutton is used to display the FCU altitude target in meters on the lower ECAM display unit.
Note that the altitude target, on the FCU, is always in feet.



TMUFM2004-P04 LEVEL 3

UFF4200

FLIGHT CONTROL UNIT DESCRIPTION/OPERATION -
ALTITUDE SELECTOR KNOB / METRIC ALTITUDE PUSHBUTTON

EFFECTIVITY
ALL

FLIGHT CONTROL UNIT DESCRIPTION/OPERATION

VERTICAL SPEED/FLIGHT PATH ANGLE CONTROL KNOB

The Vertical Speed/Flight Path Angle control knob can be pushed or pulled. It is spring-loaded to neutral. It can also be turned.

PULLED:
When pulled, Vertical Speed or Flight Path Angle mode engages with a reference displayed on the FCU. The level change light is off.
If the associated window was previously dashed, the value which appears is the present Vertical Speed or Flight Path Angle.
The range are:

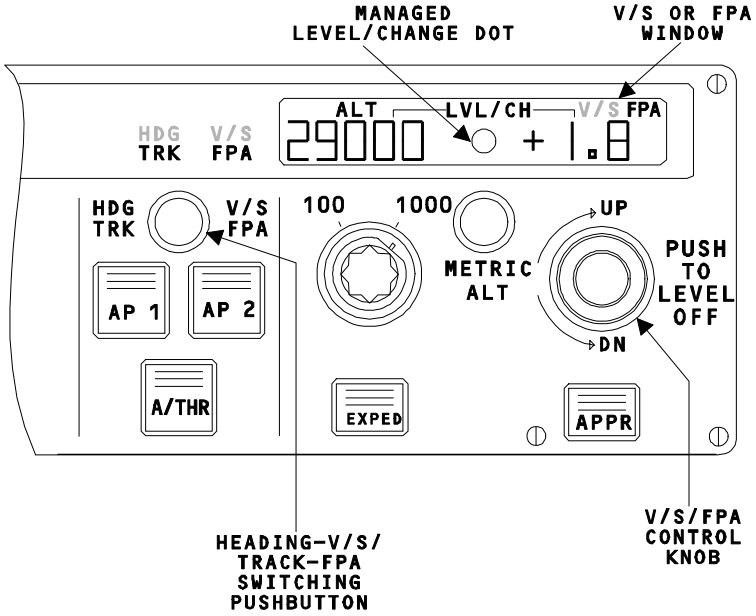
- between -9.9° and +9.9° for FPA,
- between -6000 and +6000 feet per minute for V/S.

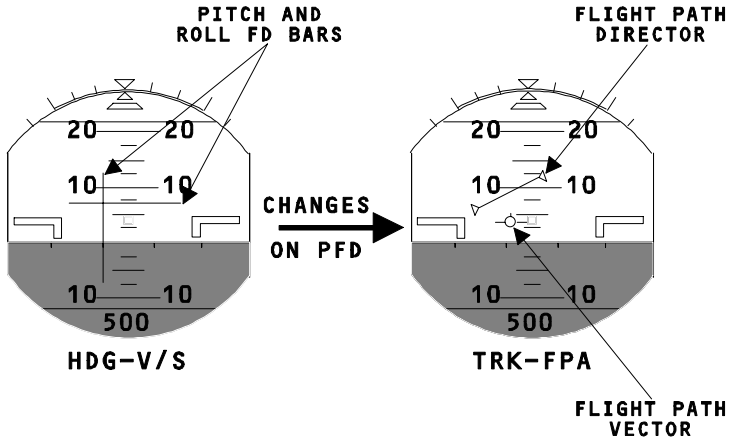
TURNED:
When turned, it changes the displayed Vertical Speed (or FLight Path Angle).
If the associated window was previously dashed, the first click changes the dashes into the present A/C V/S or FPA. When turned more, the value changes.
If the knob is not pulled within 45 seconds, the display reverts to dashes.

PUSHED:
Pushing the V/S/FPA rotary knob will command an immediate level off by engaging the V/S/FPA mode with a zero target as diplayed in the FCU window. FMA annunciation will turn to ALT green when levelled off.
Any new setting of a V/S or FPA (selector turned) will lead to A/C movement accordingly.

HEADING-V/S/TRACK-FPA SWITCHING PUSHBUTTON

This pushbutton allows selection of heading and Vertical Speed or track and Flight Path Angle modes.
If any of the modes (HDG, V/S, TRK, FPA) are active, pressing the pushbutton changes the mode(s) into the corresponding one(s) (HDG TRK and V/S FPA).
Pressing the pushbutton, changes the HDG V/S into TRK FPA on the center of the FCU and vice versa.
Note that the flight director symbology on the PFD changes and the flight path vector and the flight path director appears.





UFF4200

TMUFM2004-P05 LEVEL 3

FLIGHT CONTROL UNIT DESCRIPTION/OPERATION -
VERTICAL SPEED/FLIGHT PATH ANGLE CONTROL KNOB / HEADING-V/S/TRACK-FPA SWITCHING PUSHBUTTON

EFFECTIVITY
ALL

FLIGHT CONTROL UNIT DESCRIPTION/OPERATION

AUTOPILOT 1 & 2 ENGAGEMENT PUSHBUTTONS

The autopilot 1 or 2 can be engaged five seconds after lift off, by pressing the related pushbutton.

- PRESSED ON: Autopilot engagement is confirmed by the three green bars coming on.
- PRESSED OFF: The related autopilot disengages.

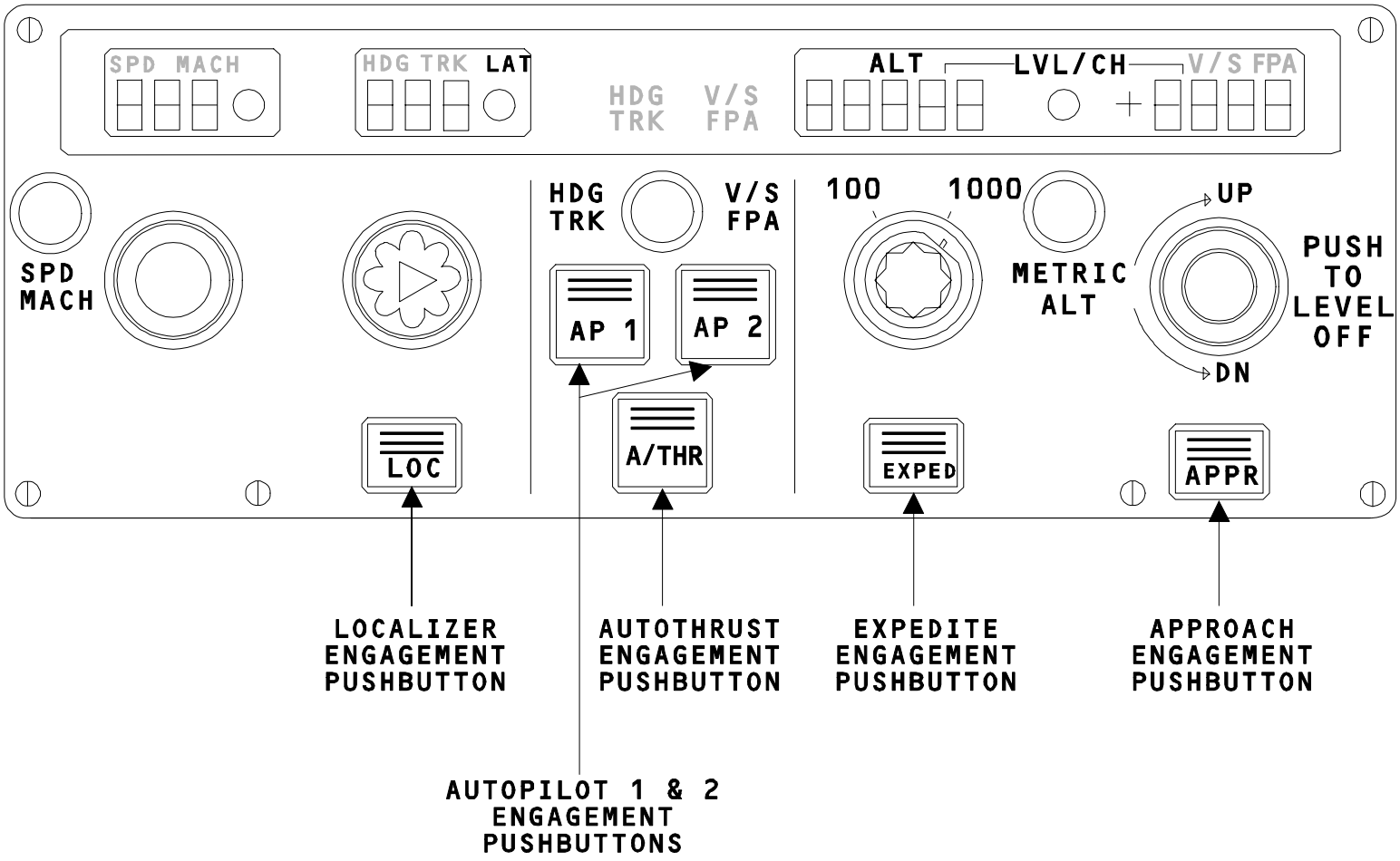
AUTOTHRUST ENGAGEMENT PUSHBUTTON

When pressed on, the A/THR pushbutton manually engages the autothrust function, provided the aircraft is not on the ground with the engines running.

- PRESSED ON: Autothrust engagement is confirmed by the three green bars coming on.

NOTE: On ground, autothrust is automatically engaged when take-off is initiated with the thrust levers.

- PRESSED OFF: The autothrust function disengages.



FLIGHT CONTROL UNIT DESCRIPTION/OPERATION –
AUTOPILOT 1 & 2, AUTOTHRUST, EXPEDITE, APPROACH, LOCALIZER ENGAGEMENT PUSHBUTTONS

EFFECTIVITY
ALL

FLIGHT CONTROL UNIT DESCRIPTION/OPERATION

EXPEDITE ENGAGEMENT PUSHBUTTON

The expedite mode can be engaged either to climb or descend, by pressing the EXPED pushbutton.

- PRESSED ON: The expedite engagement is confirmed by the three green bars coming on. This function allows maximum climb or descent profile within the performance envelope of the aircraft.
- Disengagement is only possible by engagement of another longitudinal mode

NOTE: The expedite function can be optionally deleted. In this case, the associated EXPED pushbutton is also removed.

APPROACH ENGAGEMENT PUSHBUTTON

When pressed on, the APPR pushbutton arms the LAND mode.

- PRESSED ON: Glide-Slope and localizer modes are armed for capture and tracking if ILS is available, or APPR NAV/FINAL if ILS is not available.
- PRESSED OFF: Above 400 ft, LAND or APPR NAV mode is disarmed or disengaged.

NOTE: Below 400 ft, LAND mode can only be disengaged by activating GO-AROUND.

LOCALIZER ENGAGEMENT PUSHBUTTON

When pressed on, the LOC pushbutton arms the localizer mode.

- PRESSED ON: Localizer mode is generally used when the Glide-Slope is not available.
- PRESSED OFF:
  - before capture, localizer mode is disarmed
  - after capture, localizer mode is disengaged.

  In this case the HDG/TRK mode is engaged on the present aircraft heading/track.

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SELF EXAMINATION

During Take-Off and Go-Around, the speed window on the FCU displays:

A - the speed manually inserted by the crew into the FCU. The light is off.
B - the speed manually inserted by the crew into the MCDU. The light is on.
C - dashes and the light is on = Managed speed such as V2 or memorized VAPP are automatically used by the FMGC.

The speed/Mach switching during a managed flight:

A - is automatic .
B - must be performed by the crew for the climb phase only.
C - must be performed by the crew both for the climb and the descent phases.

When NAVigation and the Vertical Speed modes are active, what happens if the pilot presses the HDG-V/S/TRK-FPA pushbutton?

A - The NAVigation mode remains active and the FPA mode engages.
B - The track and FPA modes engage.
C - There is no effect.

Below 400 feet, during an ILS approach, the LAND active mode:

A - can be de-activated by pressing the LOC p/b.
B - can be de-activated by a GO-AROUND engagement.
C - can be de-activated if the APPR pushbutton is pressed.

22 - AUTO FLIGHT SYSTEM

22-00-00 FLIGHT MODE ANNUNCIATOR DESCRIPTION/OPERATION

CONTENTS:

FLIGHT MODE ANNUNCIATOR DESCRIPTION/OPERATION

GENERAL

Information about modes and engagement status of guidance functions, plus some specific messages, are displayed on the Flight Mode Annunciator located at the top of each Primary Flight Display.
The Flight Mode Annunciator (FMA) is divided into fives zones: A/THR information, vertical and lateral AP/FD modes, landing capability, engagement status of guidance functions. Message use the third line of the second and third zones.

COLOURS

Five colors are used:

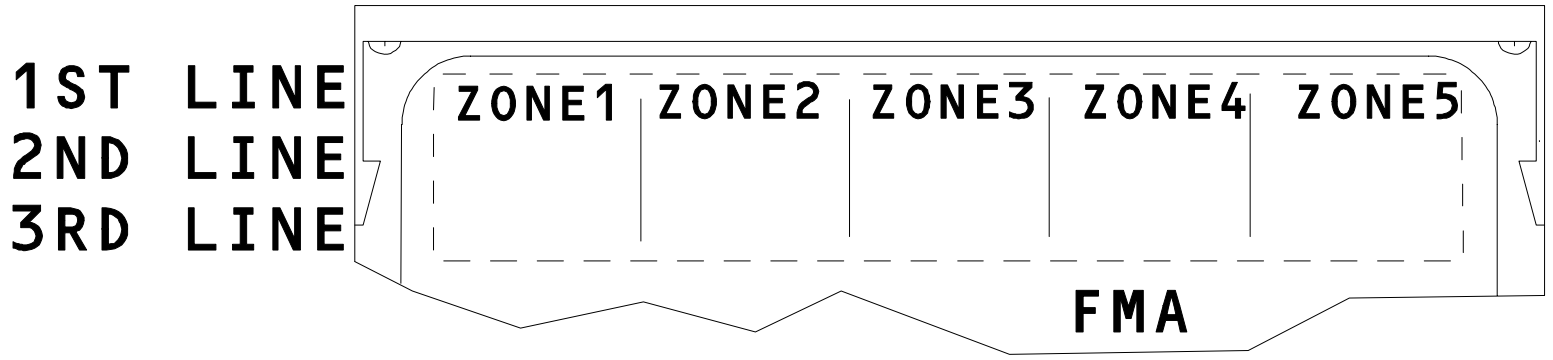
- GREEN: A/THR and AP/FD active modes.
- CYAN: AP/FD armed mode, A/THR engaged (not active), V/S, FPA, FLX TEMP, MDA, MDH and DH numeric values, selected Mach and speed.
- WHITE: Flight Guidance function engaged, A/THR activated, landing categories, manual thrusts (surrounded by boxes) which are held when A/THR is not active, messages.
  Mode change and guidance function engagement make a white box appear for ten seconds.
- AMBER: Messages, boxes around certain thrust modes.
- RED: MAN PITCH TRIM ONLY message.

A/THR ZONE

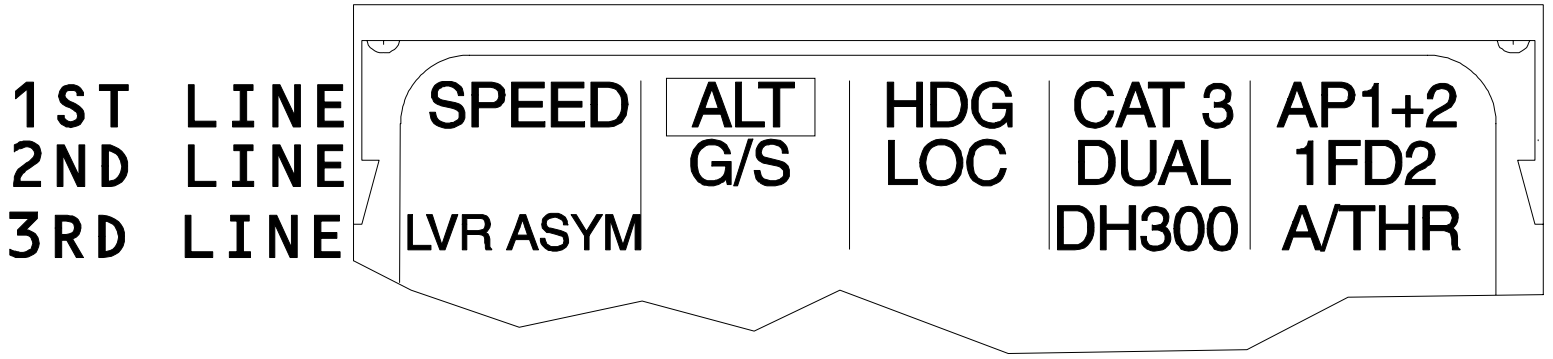
Here are all the possible displays in the autothrust zone.
Autothrust function information:

- First line in green: SPEED, MACH, THR MCT, THR CLB, THR IDLE, THR LVR.
- First line in green with a flashing amber box: A.FLOOR, TOGA LK.
- First and second lines in white: MAN TOGA, MAN FLXxx ,MAN THR, MAN MCT.
- Third line, flashing white: LVR CLB, LVR MCT. Third line in amber: LVR ASYM.

NOTE: In MAN FLXxx, xx is the value of the selected flexible take-off temperature in degrees Celsius in cyan.



PRIMARY FLIGHT DISPLAY (PFD)



FLIGHT MODE ANNUNCIATOR DESCRIPTION/OPERATION

UFF4200
TMUFGCR04-P01 LEVEL 3

EFFECTIVITY
ALL

FLIGHT MODE ANNUNCIATOR DESCRIPTION/OPERATION

AP/FD VERTICAL ZONE

Here is a list of the possible messages in the autopilot/Flight Director vertical zone.
Vertical modes:

- First line in green: SRS, ALT*, ALT, ALT CRZ*, ALT CRZ, ALT CST*, ALT CST, EXP CLB, EXP DES, G/S*, G/S, OP CLB, OP DES, CLB, DES.
  And common to vertical and lateral areas: LAND, FLARE, ROLL OUT, FINAL APP.
- First line in green and cyan: FPA±xx°, V/S±xxxx.
- Second line in cyan: ALT, CLB, G/S, DES, OP CLB, OP DES, FINAL and SPEED SEL:xxx, MACH SEL:.xx which are seen in lateral and vertical areas (xxx is a preset speed, .xx is a preset Mach).

AP/FD LATERAL ZONE

Here is a list of possible messages in the autopilot/flight director lateral zone.
Lateral modes:

- First line in green: RWY, RWY TRK, HDG, TRK, LOC*, LOC, GA TRK, APP NAV, NAV.
  And common to vertical and lateral areas: LAND, FLARE, ROLL OUT, FINAL APP.
- Second line in cyan: NAV, LOC, APP NAV.

LANDING CATEGORY ZONE

Here is a list of the possible messages in the landing category zone.
Landing categories:

- On the first and second lines, the possible white displays are: CAT1, CAT2, CAT3 SINGLE, CAT3 DUAL.
- On the third line, messages in white and numeric values in cyan: DHxxx, NO DH, MDAxxxx, MDHxxxx.

NOTE: Information appears in this zone as soon as land mode is armed or active.

FLIGHT MODE ANNUNCIATOR DESCRIPTION/OPERATION

ENGAGEMENT STATUS

Here is a list of the possible messages in the engagement status zone.
Engagement status:

- First line in white: AP1+2, AP1, AP2.
- Second line in white: 1FD- (FD1 is engaged on Captain side), -FD1 (FD1 is engaged on F/O side), -FD2 (FD2 is engaged on F/O side), 2FD- (FD2 is engaged on Captain side), 1FD2 (both FDs are engaged, one on each side), 1FD1 (FD2 is failed, FD1 is engaged), 2FD2 (FD1 is failed, FD2 is engaged).
- Third line in cyan: A/THR (engaged and not active).
  Third line in white: A/THR (engaged and active).

Flight Director (FD) indications flash for several seconds after Flight Director engagement or display transfer.

MESSAGES

Here are examples of the possible messages.
Advisory messages appear in white on the third line in zones 2 and 3, for example: MORE DRAG.
There is one red message dedicated to this display area, that is: MAN PITCH TRIM ONLY.

SELF EXAMINATION

Green color is used for:
A - armed modes.
B - active modes.
C - engagement status.

A/THR cyan indication in the engagement status zone indicates that the:
A - autothrust is disengaged.
B - autothrust is engaged and not active.
C - autothrust is engaged and active.

The landing category and decision height value appear when:
A - the autopilot is engaged.
B - LAND mode is armed or active.
C - an ILS frequency is autotuned.

22 - AUTO FLIGHT SYSTEM

22-70-00 FLIGHT MANAGEMENT PRIORITY LOGIC

CONTENTS:

FLIGHT MANAGEMENT PRIORITY LOGIC

FM OPERATING MODES

There are three operating modes: NORMAL, INDEPENDENT and SINGLE.
At Flight Management (FM) initialization, that means at power up, both FM parts exchange information.
Initial cross-comparison is made on the following parameters: Navigation data base identification, performance data base identification, FM operational program identification, aircraft program pin data and engine program pin data.

NORMAL MODE

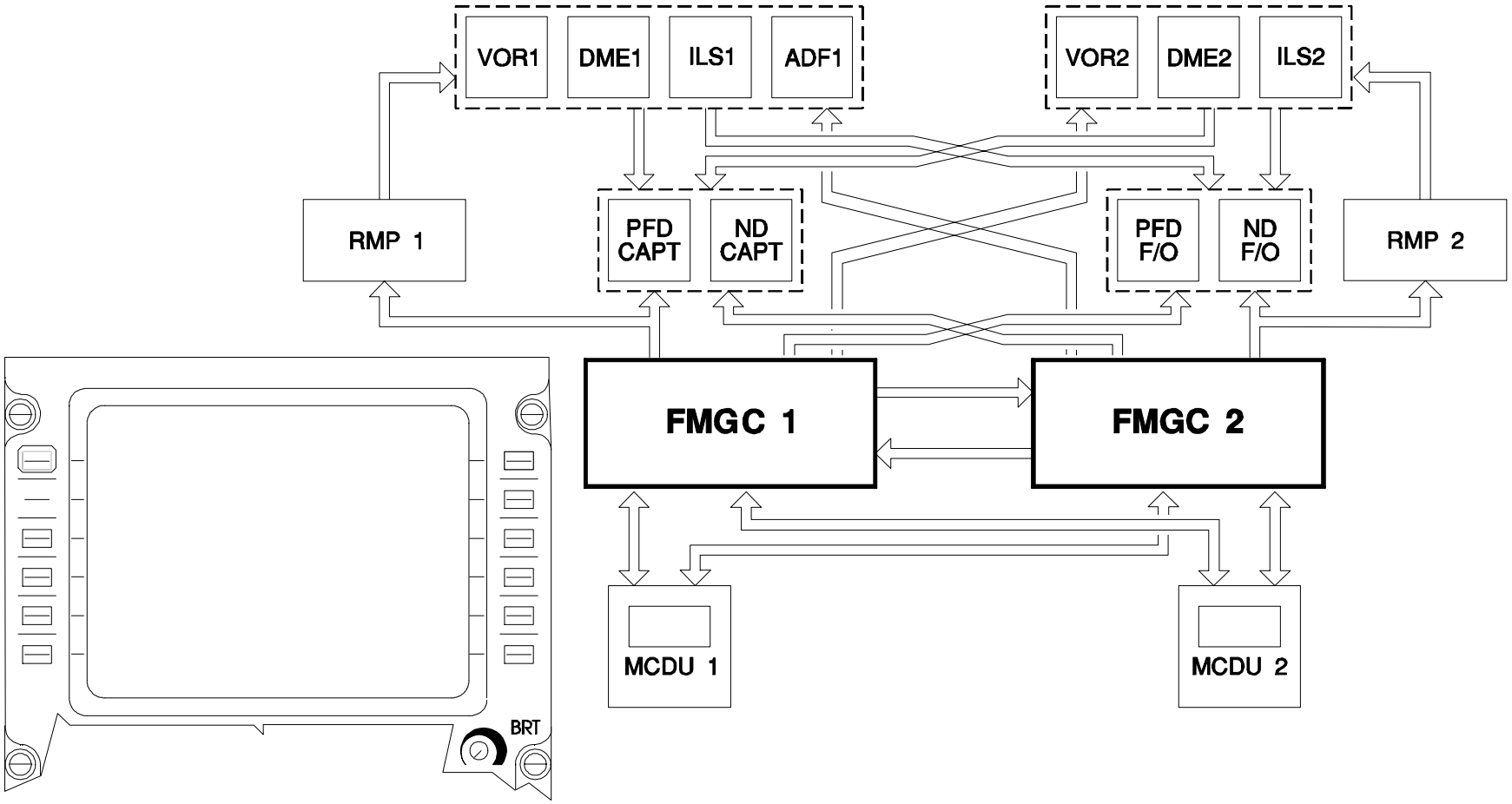
If the Flight Management parts agree, NORMAL mode is active.
When keys are pressed, they are immediately processed by both FMs, regardless of the Multipurpose Control Display Unit (MCDU) from which they originate.

INDEPENDENT MODE

If the FM parts disagree, a white message "FMS1/FMS2 A/C STS DIFF" is displayed on the MCDUs and the system then reverts to INDEPENDENT mode.
Each FM part manages its own MCDU.
A failure in the Flight Management and Guidance Computers (FMGCs) inter system buses results in the amber MCDU message "INDEPENDENT OPERATION".

SINGLE MODE

If one FM part has failed, SINGLE mode is active.
Both MCDUs are driven by the remaining FM part.
A white message "OPP FMGC IN PROGRESS" is displayed on the MCDU corresponding to the failed FMGC.



TMUFM0601-P01 LEVEL 1

UFF4200

FLIGHT MANAGEMENT PRIORITY LOGIC

EFFECTIVITY
ALL

FLIGHT MANAGEMENT PRIORITY LOGIC

MODE OPERATION

NORMAL MODE
In NORMAL mode, the Flight Management part receives the master/slave activation from the Flight Guidance (FG) part.
The MASTER computer imposes the following parameters upon the SLAVE computer:

- flight phase,
- flight plan sequencing,
- active performance mode and speeds,
- clearance and maximum altitudes,
- ILS frequencies and courses, if any.

After a flight plan change, there is a comparison on the active leg and, every second, on the active performance mode and active guidance mode. If it is different, the slave computer will synchronize itself to the master one by copying the master values.
Also, aircraft position, Gross Weight and target speeds from master and slave computers are compared every second.
If the difference is greater than 5 Nm, 2 tons or 2 Kts respectively, an appropriate message is displayed on the MCDUs:

- "FMS1/FMS2 POS DIFF"
- "FMS1/FMS2 GW DIFF"
- "FMS1/FMS2 SPD TGT DIFF"

Pilot action is then required.

INDEPENDENT MODE
In INDEPENDENT mode, there is no interaction from one system to the other one. The FMGCs only send their status information to each other (e.g., in this case, the INDEPENDENT mode).

SINGLE MODE
In SINGLE mode, both MCDUs are driven by the same FM part, but they can still display different pages. Messages linked to the navigation process are displayed on both MCDUs.

FLIGHT MANAGEMENT PRIORITY LOGIC

MCDU

As already presented in the FM OPERATING MODES topic, the MCDUs work differently.
In NORMAL mode, the MCDUs can be used simultaneously on different pages. Any modification or entry on one MCDU is transmitted to the other MCDU via the FMGC crosstalk.
In INDEPENDENT mode, both MCDUs operate separately. Although the crosstalk is present, an entry on one MCDU is not applied to the other one.
In SINGLE mode, both MCDUs basically work as in normal mode, but with the valid FMGC only.

DISPLAYS

Flight Management information is displayed on Navigation Displays (NDs) and on Primary Flight Displays (PFDs).
For FM information, in NORMAL or INDEPENDENT modes, FMGC1 supplies PFD1 and ND1, FMGC2 supplies PFD2 and ND2.
In SINGLE mode, the remaining FMGC supplies all the displays.

RADIO NAVIGATION

The schematic shows the architecture of the radio navigation receivers controlled by the FMGCs in NORMAL or INDEPENDENT modes.
For the selection of radio navigation frequencies and courses, in normal or independent modes, each FMGC controls its own side receivers through a Radio Management Panel (RMP).
Only the actual frequencies and courses from the receivers are displayed on the PFDs and the NDs.
In case of an FMGC failure, the valid FMGC controls its own side receivers as usual, through an RMP, but also the other side receivers, directly without going through an RMP.
If both FMGCs fail, the crew must use the RMPs to select the frequencies and courses.

SELF EXAMINATION

How do the FMGCs operate in the INDEPENDENT mode?

A - Side 1 and side 2 Flight Guidance functions are independent.
B - Side 1 and side 2 Flight Management functions are independent.
C - One side is inoperative and the remaining FMGC controls both sides.

How are the PFDs and NDs supplied with Flight Management information when both FMGCs are operative?

A - The master FMGC supplies both PFDs and NDs.
B - The slave FMGC supplies both PFDs and NDs.
C - Each FMGC supplies its related PFD and ND.

22 - AUTO FLIGHT SYSTEM

22-70-00 FLIGHT PLANNING

CONTENTS:

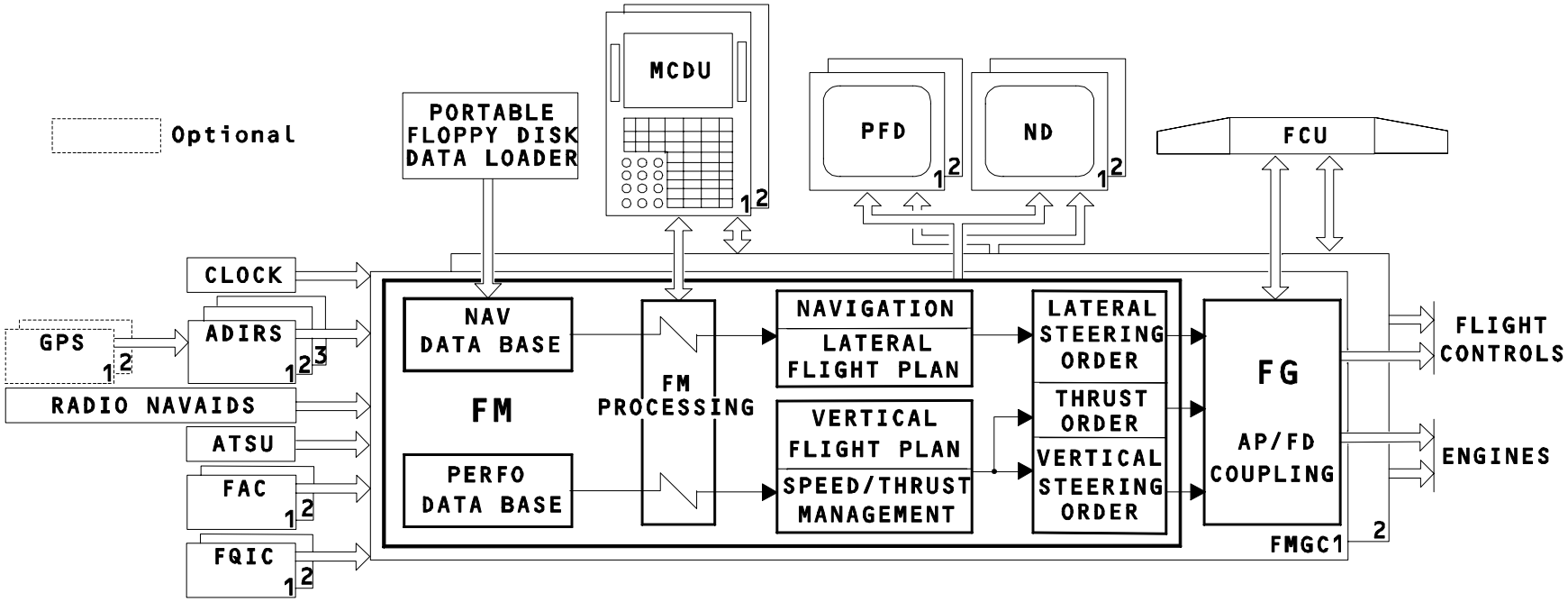
FLIGHT PLANNING

FLIGHT PLAN

The flight plan is defined by various elements which indicate the routes the aircraft must follow with the limitations along these routes.
The elements are mainly taken from the data bases or directly entered by the pilot.
The limitations are mainly speed, altitude or time constraints originated by the Air Traffic Control (ATC).
The function that integrates these elements and limitations to construct a flight plan is called flight planning.
In addition to this, the Flight Management (FM) part provides the aircraft position and the follow-up of the flight plan, this is called navigation.
Everything can be prepared prior to the take-off but can also be modified quickly and easily during the flight operation.
In case of an FM problem, the remaining valid FMGC is used as sole source to command both MCDUs and NDs after automatic switching.

NAVIGATION DATA BASE

The navigation data base provides all necessary information for flight plan construction and follow-up.
The pilot will either select an already assembled flight plan (company route (CO ROUTE)), or will build his own flight plan, using the existing data base contents.
This data base has a tailored coverage, updated every 28 days.
Some room is kept to allow manual entry of 20 navaids, 20 waypoints, 3 routes and 10 runways.
The data base cannot be erased. However and as an option, the manually entered data can be erased when the flight phase becomes DONE (i.e. aircraft on ground for 30 seconds).
Two cycle data bases can be loaded and the selection is made automatically using data from the aircraft clock or manually.
The data base loading into either FMGC is performed with the help of a portable floppy disk data loader. Then, the crossloading function allows data base loading into the other FMGC through crosstalk busses.



FLIGHT PLANNING

UFF4200
TMUFM0103-P01 LEVEL 3

EFFECTIVITY
ALL

FLIGHT PLANNING

NAVIGATION

The navigation process provides the system with current aircraft state information consisting of present position, altitude, winds, true airspeed and ground speed.
This is achieved using inputs from the Inertial Reference Systems, Air Data sensors, Global Positioning Systems (GPS) if fitted, navigation radios, Air Traffic Service Unit (ATSU) and FAC flight envelope computation.
Position can be updated manually during the flight or automatically, on the runway threshold at take-off for example.

LATERAL FLIGHT PLAN

The lateral flight plan provides the sequential track changes at each waypoint within 3 main sections.

- DEPARTURE: initial fix (origin airport), Standard Instrument Departure (SID)...
- EN ROUTE: waypoints, navigation aids...
- ARRIVAL: Standard Terminal Arrival Route (STAR), approach, missed approach, go around...

The lateral steering order can be followed by the pilot or the autopilot with the NAV mode selected.

VERTICAL FLIGHT PLAN

The vertical flight plan provides an accurate flight path prediction which requires a precise knowledge of current and forecast wind, temperature and the lateral flight path to be flown.
The vertical flight plan is divided into several flight phases:

- PREFLIGHT: fuel, weight and V2 insertions.
- TAKE-OFF: speed management, thrust reduction altitude, acceleration altitude.
- CLIMB: speed limit, speed management.
- CRUISE: top of climb, cruise altitude, top of descent.
- DESCENT: speed limit, speed management, deceleration.
- APPROACH/MISSED APPROACH/GO AROUND: thrust reduction altitude, acceleration altitude.

The vertical steering order can be followed by the pilot or the autopilot.
Any level change in the vertical profile is initiated after a push action on a level change selector, except for departure when the vertical profile is armed on ground and will automatically be active after take-Off phase.

FLIGHT PLANNING

PERFORMANCE

The performance data base contains optimal speed schedules for the expected range of operating conditions.
Several performance modes are available to the operator with the primary one being the ECON mode.
The ECON mode can be tailored to meet specific airline requirements using a selectable Cost Index (CI).
A Cost Index is defined as the ratio of cost of time to the cost of fuel .
The fuel quantity is given by the Fuel Quantity and Indication Computers (FQICs).
The speed and the thrust values associated with a given Cost Index are used to determine the climb and descent profiles.
FUEL and TIME are the main "actors" in this particular part of the FM function and direct the airline choice.

DISPLAY

According to the pilot selection on the EFIS control panel of the Flight Control Unit (FCU), the flight plan is shown in relation to the aircraft position on the ROSE-NAV or ARC modes.
The aircraft model is fixed and the chart moves.
The difference between the two modes is that the half range is available when the Navigation Display (ND) is set to ROSE-NAV mode as there is only frontal view when it is set to ARC mode.
In PLAN mode, the flight plan is shown, with NORTH at the top of the screen, centered on the TO waypoint.
Depending on the selected range, the aircraft may or may not be visualized on this display.
The PLAN display can be decentered by scrolling the flight plan on the MCDU.
The Primary Flight Display (PFD) shows the FM guidance following engagement of the AP/FD lateral and longitudinal modes.

SELF EXAMINATION

What is flight planning?

A - The function that integrates the routes the aircraft must follow and the constraints to construct a flight plan.

B - The function that provides the aircraft position and the follow-up of the flight plan.

C - The ratio of cost of time to the cost of fuel.

In which mode(s) is(are) the aircraft model represented fixed?

A - Whatever the pilot selection on the FCU (ROSE-NAV, ARC or PLAN modes), the aircraft model is fixed.

B - The aircraft model is fixed only on the PLAN mode representation.

C - The aircraft model is always fixed except on the PLAN mode representation.

22 - AUTO FLIGHT SYSTEM

22-82-00 MCDU DESCRIPTION

CONTENTS:

MCDU DESCRIPTION

GENERAL

The Multipurpose Control and Display Unit (MCDU) is the pilot interface with the Flight Management function of the Flight Management and Guidance Computer. It is also used as an interface with other aircraft systems. The MCDU is mainly used for long term actions such as flight plan construction, flight plan monitoring and revision.

BRIGHTNESS ADJUST CONTROL

The brightness (BRT) knob allows the MCDU display brightness and keyboard illumination to be adjusted.

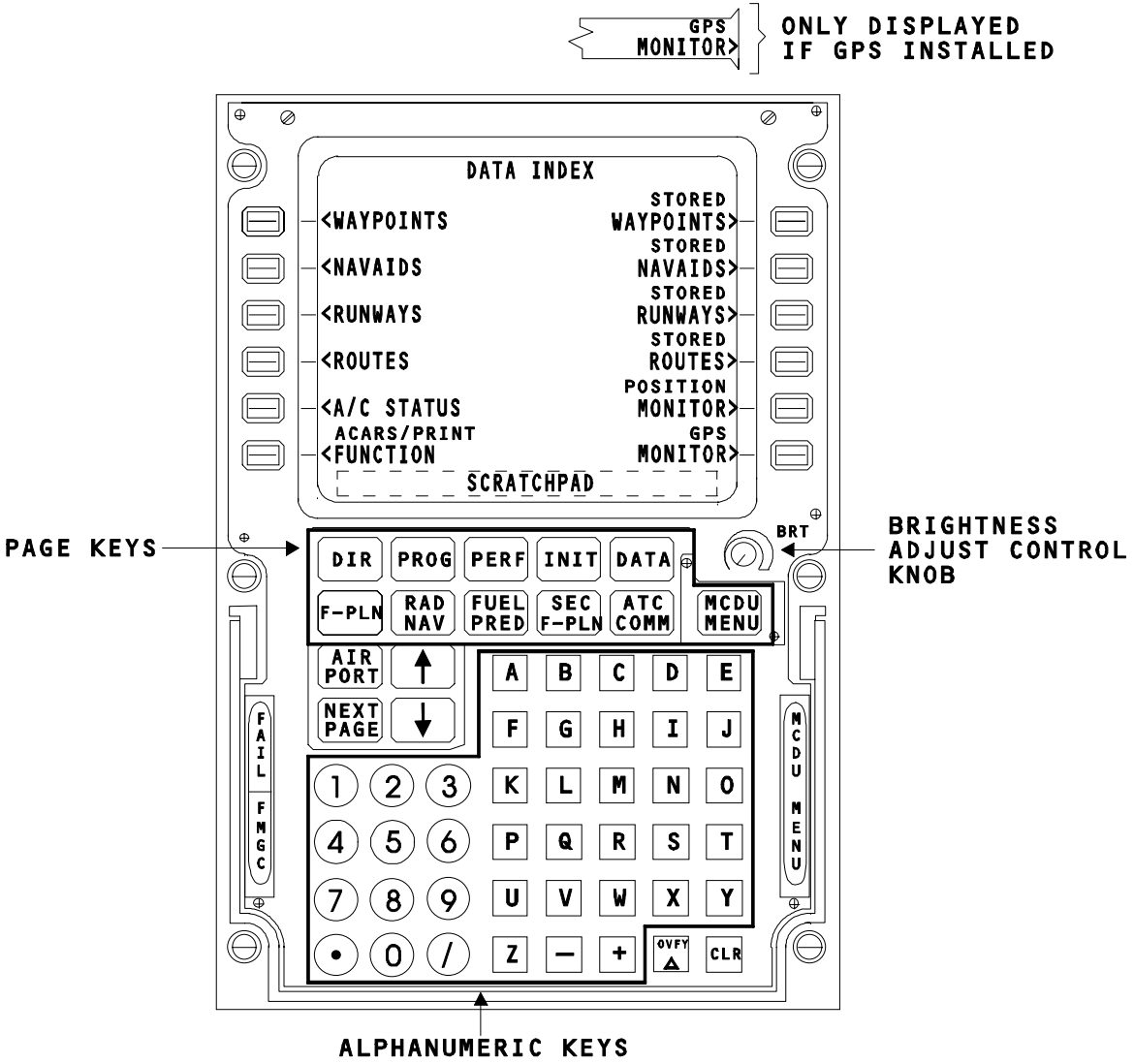
NOTE: This knob does not permit the MCDU to be switched off.

ALPHANUMERIC KEYS

The alphanumeric keys are used to write data on the bottom line of the screen, called SCRATCHPAD.

PAGE KEYS

Each management function is shown on a specific display called a page. By pressing the related key, the corresponding page is displayed.
In this example, the DATA INDEX page has been obtained by pressing the DATA key. This page allows access to the numerous data pages stored in the data base and to define and view new data.



MCDU DESCRIPTION – BRIGHTNESS ADJUST CONTROL / ALPHANUMERIC KEYS / PAGE KEYS

UFF4200
TMUFM2403-P01 LEVEL 3

EFFECTIVITY
ALL

MCDU DESCRIPTION

DISPLAY KEYS

The six display keys comprise a NEXT PAGE key, two slew keys, an AIRPORT key, a clear (CLR) key and an overfly (OVFY) key.

NEXT PAGE KEY
The NEXT PAGE key is used to display one by one all the successive pages of the last selected page key. After the last page, the first one is presented again.

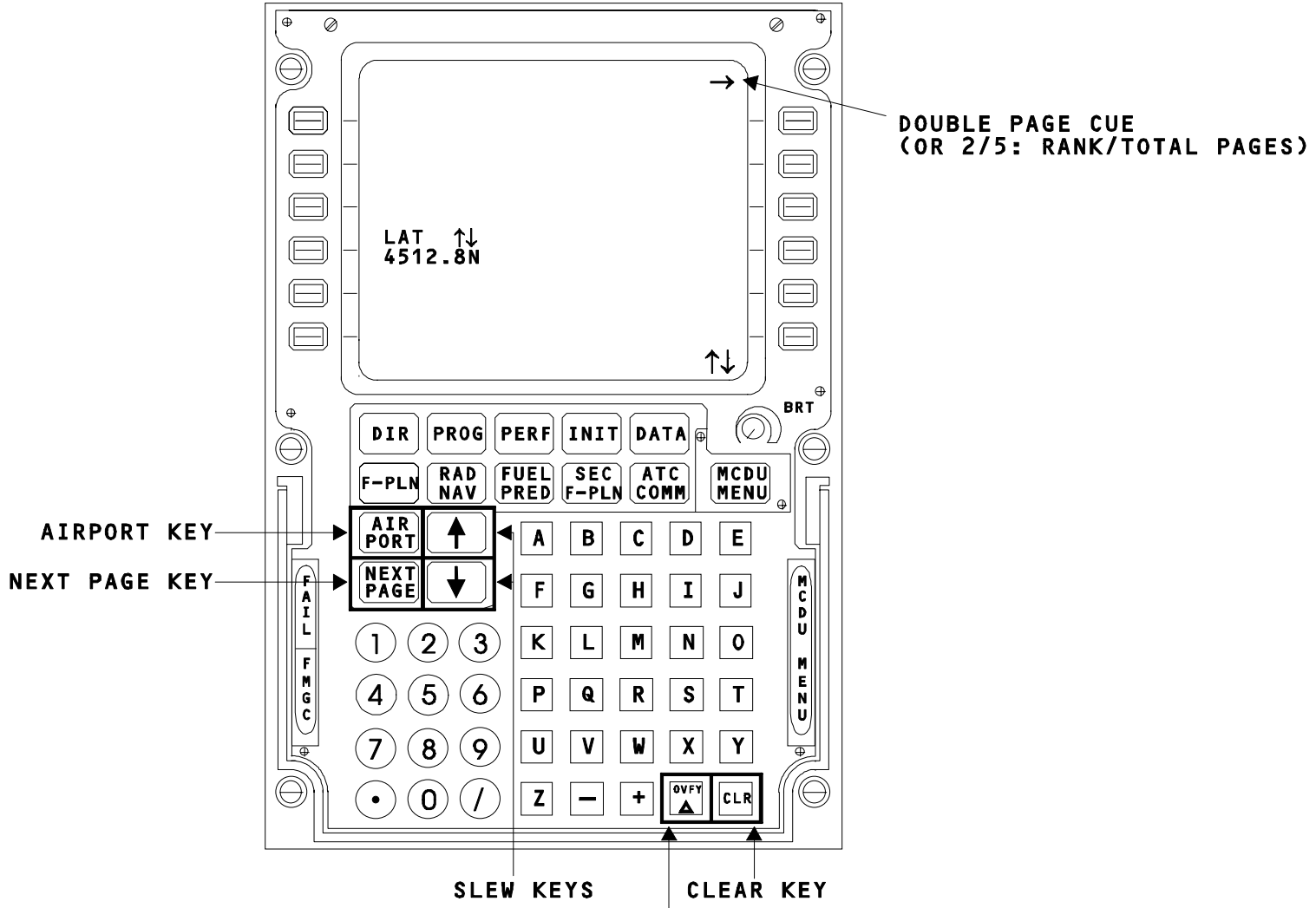
NOTE: When two pages correspond to a page key, an arrow is displayed in the top right-hand corner of the sreen.
When there are more than two pages, the page rank is displayed.

SLEW KEYS
Some pages are too long to be displayed entirely on the screen. These pages are identified with a symbol in the bottom right corner and can be scrolled up or down by pressing the related slew key.
Another use of the slew keys is to increment or decrement certain values shown on the screen. These values are identified by adjacent arrows.

AIRPORT KEY
Pressing the AIRPORT key allows flight plan pages to be shifted to the page containing the next airport along the flight plan.

CLR KEY
The clear (CLR) key is used to clear data or messages displayed on the scratchpad and also to clear various parameters displayed on the screen.

OVFY KEY
Pressing the overfly (OVFY) key allows overflight of the selected waypoint.



MCDU DESCRIPTION – DISPLAY KEYS

UFF4200
TMUFM2403-P02 LEVEL 3

EFFECTIVITY
ALL

MCDU DESCRIPTION

LINE SELECT KEYS

Line Select Keys (LSKs) are used to:

- Insert, activate, modify or delete data in the adjacent line.
- Select another page or make an action displayed in the adjacent data field.

Actions are identified by symbols, such as:
< (white) : New page called by pressing the adjacent LSK.
* (amber): FMGS function activation.
[ ] (cyan) : May be inserted in this line.
← (cyan) : To activate or select data.

ANNUNCIATORS

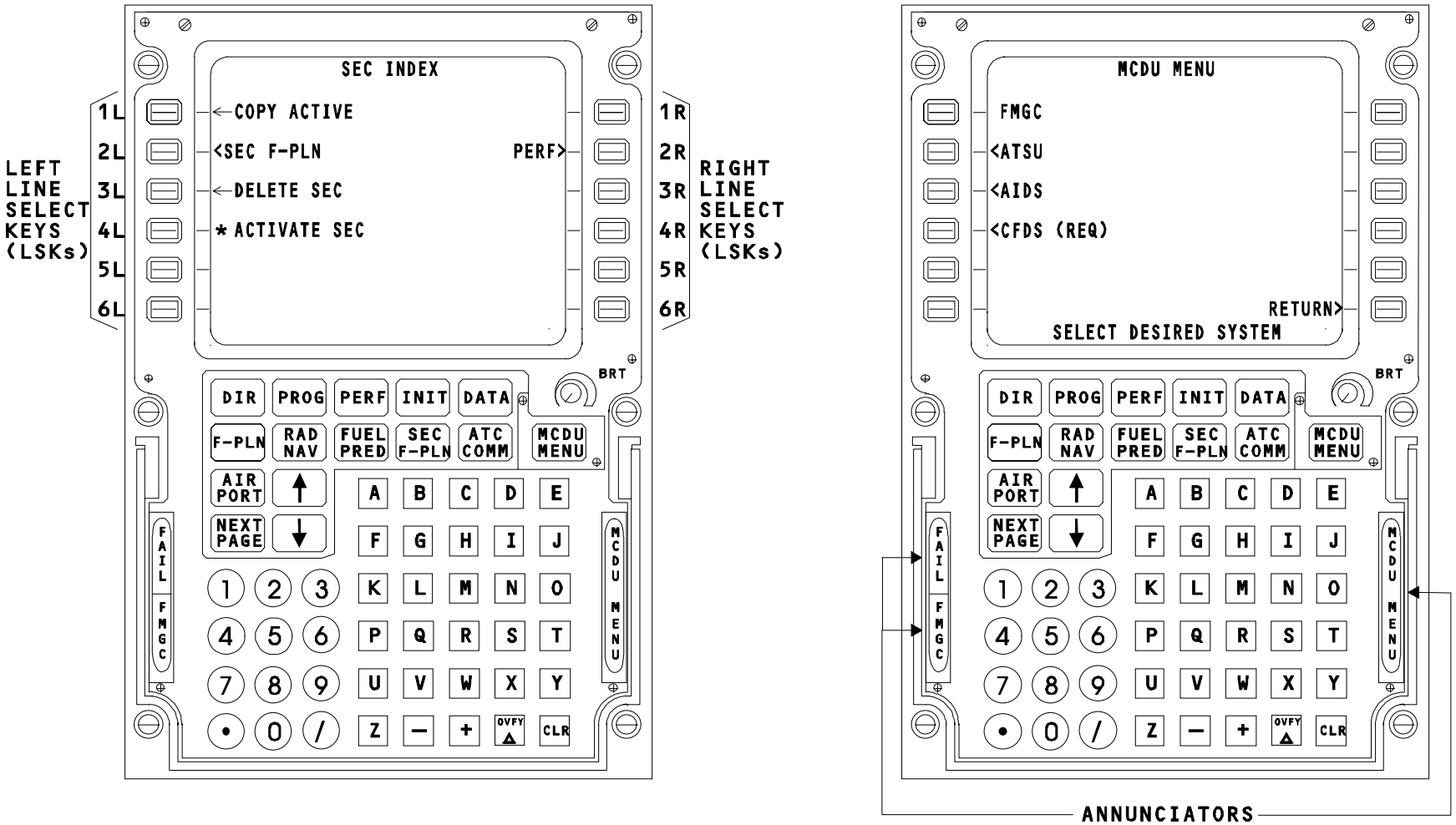
There are three annunciators located on the lower part of the MCDU.

MCDU MENU
The display shows that the MCDU is linked to the Flight Management and Guidance Computer (FMGC), Air Traffic Service Unit (ATSU), Aircraft Integrated Data System (AIDS) and Centralized Fault Display System (CFDS).
The MCDU MENU annunciator comes on white if a system linked to the MCDU, requests the display.
In this example, the FMGC is the active system (indicated by the green color and the absence of the prompt) on the MCDU but the CFDS requests the display.

NOTE: At power up, the MCDU communicates in priority with the FMGCs.

FMGC
The FMGC annuciator comes on white to alert the crew that the FMGC has an important message to display while the MCDU is linked to another system.
In this case, any key can be pressed to return to the Flight Management related display.

FAIL
The FAIL annuciator comes on amber in case of a MCDU failure.



MCDU DESCRIPTION – LINE SELECT KEYS / ANNUNCIATORS

EFFECTIVITY
ALL

22-82-00

MCDU DESCRIPTION

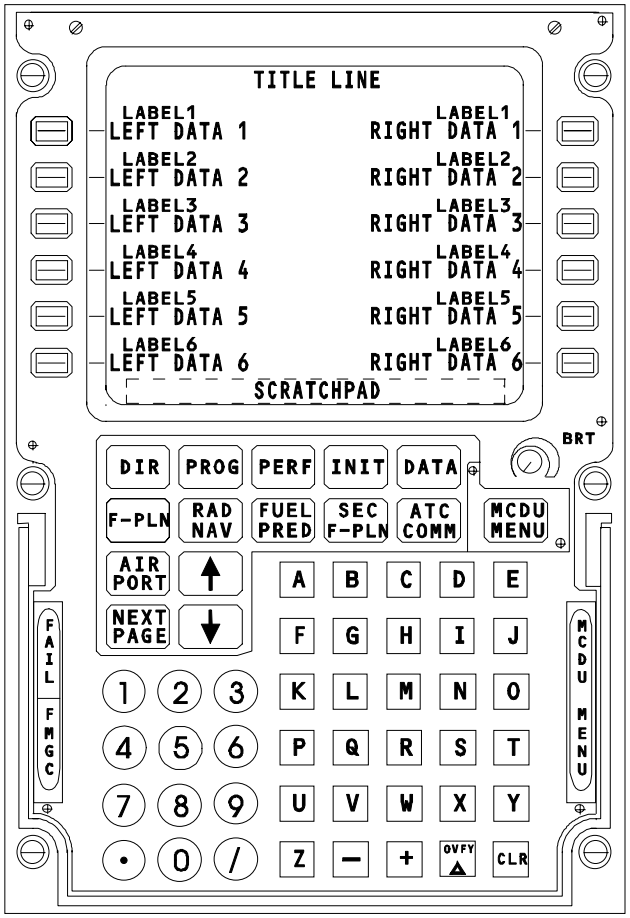
DISPLAY LAYOUT

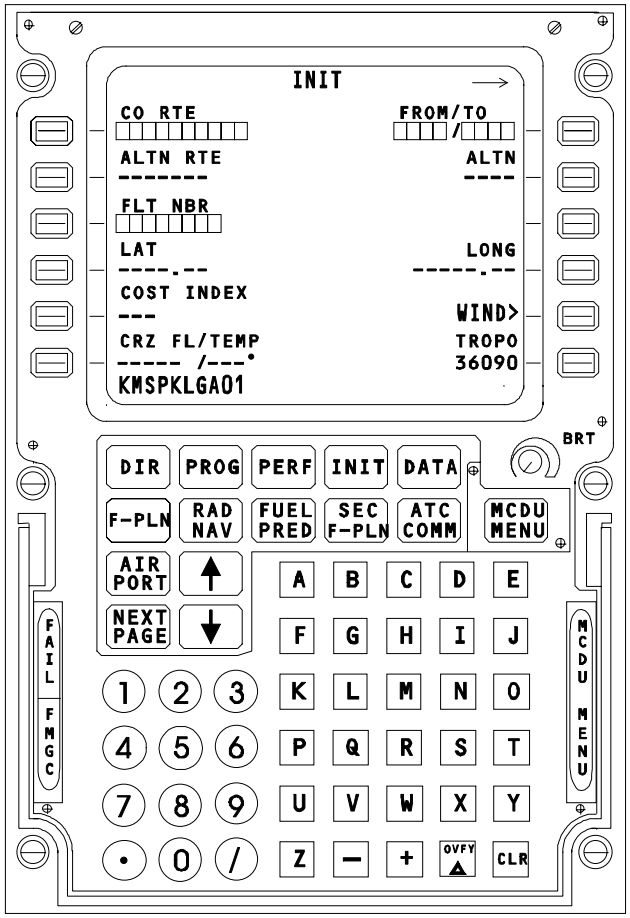
The MCDU display layout includes the title line, and the scratchpad where pilot entries are first made.
FMGC messages are also displayed on the scratchpad.
The 6 data field lines, displayed in large font, display either data from FMGC or data entered by the pilots.
6 label lines, displayed in small font, contain the title of the data field just below.

DATA ENTRY

To enter any data into the FMGC, the pilot must first write the data onto the scratchpad using the alphanumeric keyboard.
The data are then inserted into the suitable data field by pressing the corresponding Line Select Key, in this example the Line Select Key adjacent to the CO RTE field.
When the Line Select Key is pressed, the FMGC checks the data for format and acceptability.
If data is not accepted, a specific message appears in white on the scratchpad:FORMAT ERROR or NOT IN DATA BASE or NOT ALLOWED or ENTRY OUT OF RANGE.

NOTES: - Data entry in amber boxes is mandatory and white dashed lines indicate that data will be calculated and displayed by the FMGC when it has enough information to do so.
- The scratchpad is limited to a maximum of 22 characters.





MCDU DESCRIPTION – DISPLAY LAYOUT / DATA ENTRY

EFFECTIVITY
ALL

MCDU DESCRIPTION

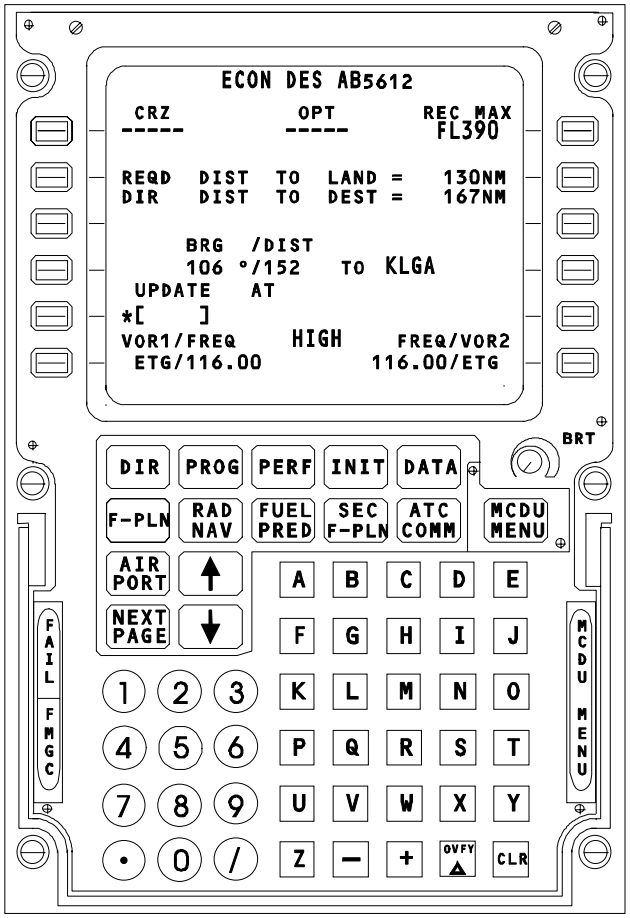
COLOR MODE

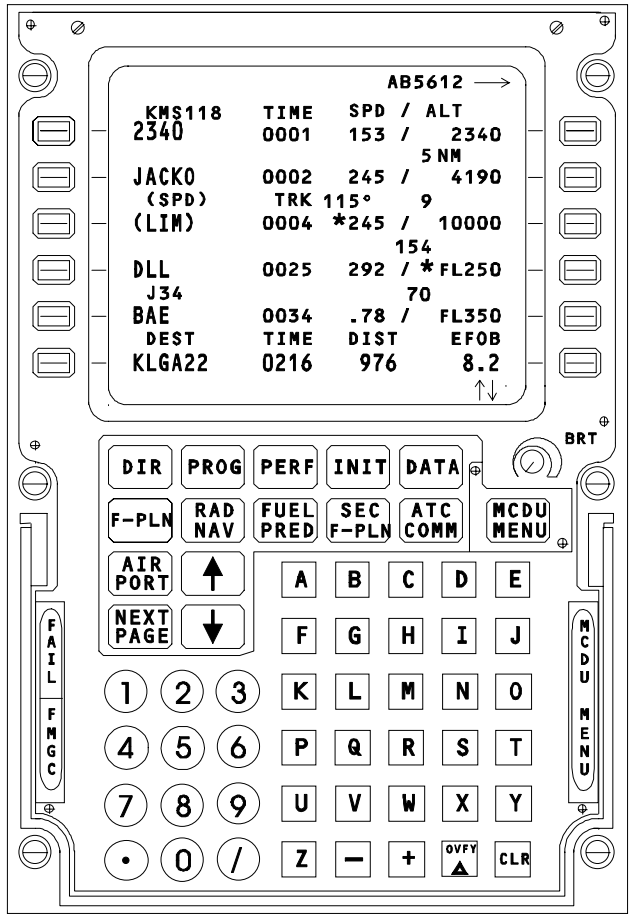
- Titles, comments, dashes, symbols and minor messages are displayed in white.
- Non modifiable data or active data are displayed in green.

However, in temporary flight plan, the same data are shown in yellow until they are validated by an insertion.

- The modifiable data and selectable data are displayed in cyan.
- Mandatory data, boxes, required pilot actions and important messages are displayed in amber.
- The maximum recommended Flight Level is indicated in magenta.
- Data associated to the flight plan constraints are also indicated in magenta.

An asterix (*) displayed adjacent to the corresponding altitude or airspeed restriction is amber to indicate "missed" or magenta to indicate "made".





MCDU DESCRIPTION – COLOR MODE

EFFECTIVITY
ALL

SELF EXAMINATION

The Multipurpose Control and Display Unit (MCDU) is:

A - the pilot interface with the Flight Management function of the FMGC.
B - the aircraft interface between the Flight Management and Flight Guidance functions of the FMGC.
C - an independent means of controlling the aircraft in manual flight.

What is the purpose of the white MCDU MENU annunciator light?

A - It alerts the crew that the MCDU has failed.
B - A system, linked to the MCDU, requests the display.
C - It alerts the crew that the MCDU MENU page is not available.

What is the correct statement?

A - Line Select Keys may be used to transfer data onto the scratchpad.
B - Modifiable data must first be entered onto the scratchpad before being transferred, by using the appropriate Line Select Key.
C - Line Select Keys may be used to delete data from the adjacent data field, without using the CLR key.

22 - AUTO FLIGHT SYSTEM

22-75-00 EFIS DISPLAY

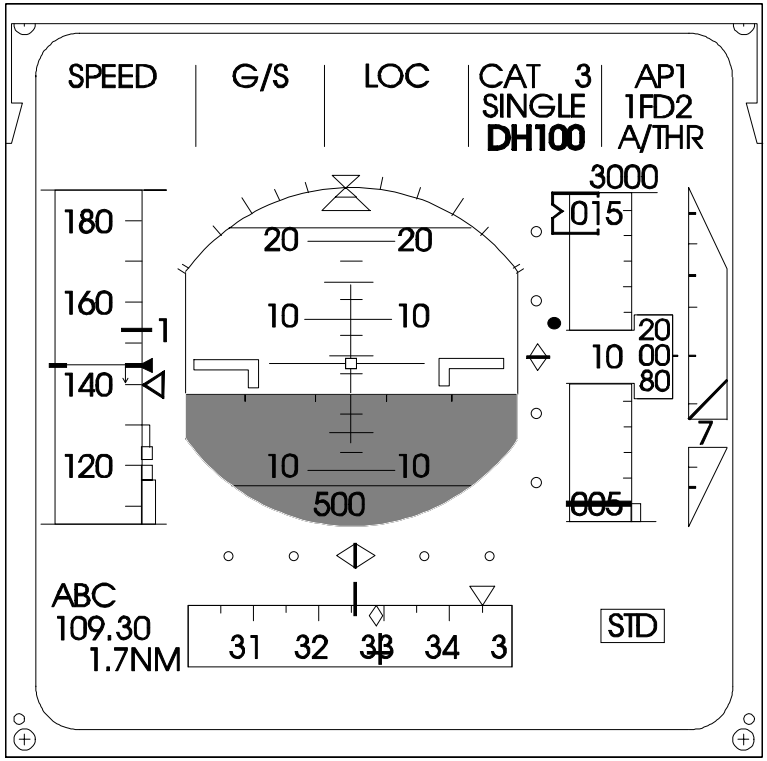
CONTENTS:

EFIS DISPLAY

FLIGHT MANAGEMENT (FM) DISPLAY ON PFD

The Primary Flight Display (PFD), as main guidance instrument, displays the data computed, or inserted on the Multipurpose Control and Display Unit (MCDU). This data can be the target speed and the altitude constraint in managed guidance modes, V1 and V2, Decision Height (DH) or Minimum Decision Altitude (MDA) in approach.
At the top of the PFD, the Flight Mode Annunciator (FMA) provides the pilot with the DH or the MDA.
The speed scale displays the Flight Management data such as the target speed and V1.
The altitude scale displays the altitude constraint from the Flight Management (FM) part and the linear vertical deviation with respect to the FM theoretical vertical flight plan (F-PLN).
Landing field elevation is also indicated by a blue horizontal bar on the altitude scale.

NOTE: The Flight Management (FM) guidance is associated to the Flight Guidance (FG) modes (NAV, CLB, DES).



DH100 DECISION HEIGHT (DH IN WHITE AND 100 IN CYAN)

MANAGED TARGET SPEED (MAGENTA) OR ECON TARGET SPEED WITH HIGH AND LOW MARGINS IN DESCENT MODE (MAGENTA)

1 V1 SPEED (CYAN)

015 ALTITUDE CONSTRAINT (MAGENTA)

• LINEAR VERTICAL DEVIATION (MAGENTA)

~~005~~ LANDING FIELD ELEVATION (CYAN)

EFIS DISPLAY - FLIGHT MANAGEMENT (FM) DISPLAY ON PFD

UFF4200
TMUFM0504-P01 LEVEL 3

EFFECTIVITY
ALL

EFIS DISPLAY

FLIGHT MANAGEMENT (FM) DISPLAY ON ND

The Navigation Display (ND) works in five different modes selected on each Electronic Flight Instrument System (EFIS) control panel of the Flight Control Unit (FCU).
In ROSE-NAV, ARC and PLAN modes, the ND displays the flight plan computed in the FM part at a scale defined by the range selected on the EFIS control panel of the FCU.
The ND represents basically: the aircraft position, the flight plan data, the range selected on the FCU and autotuned navaids.

NOTE: The aircraft position is fixed in all display modes except in PLAN mode where it moves along the flight plan.

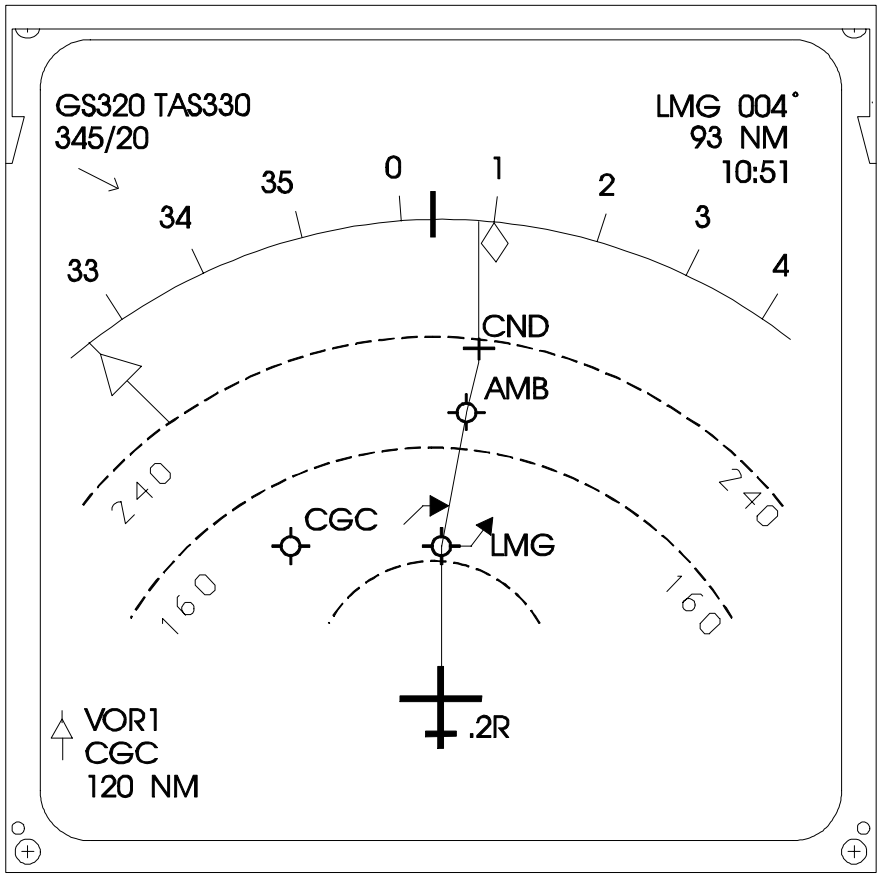
There is correspondance between the flight plan displayed on the ND and the MCDU flight plan (F-PLN) page if no scrolling has been done on this page.
The TO waypoint is displayed in white, the rest of the flight plan line and waypoints being displayed in green.
The TO waypoint characteristics are displayed at the top right hand corner of the ND:

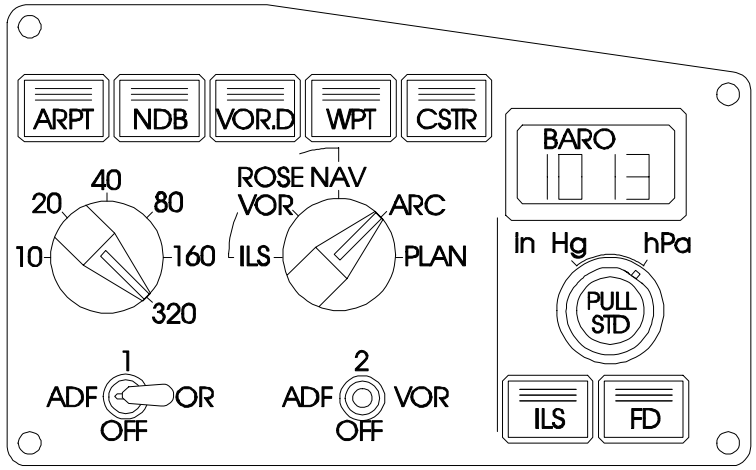
- ident (in white) and bearing (in green),
- distance to go (in green),
- Estimated Time of Arrival (in green).

A crosstrack deviation, if any, is also provided, in green, on the left or right hand side in nautical miles.

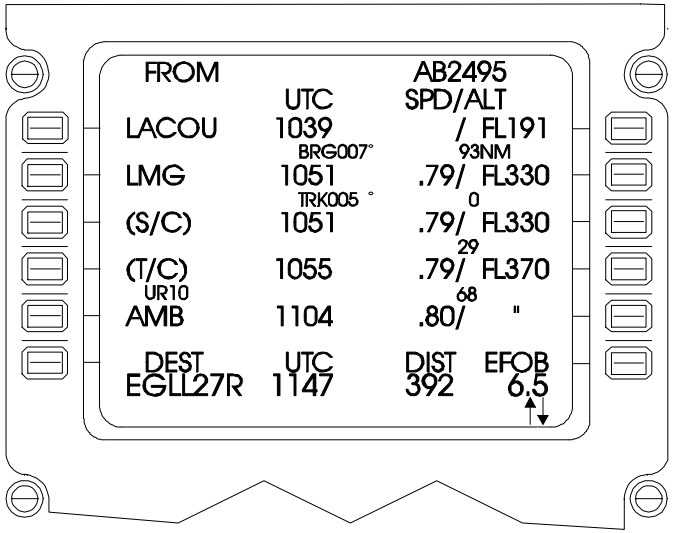
NOTE: Wind speed and direction, Ground Speed (GS) and track are computed by the FM part and transmitted to the Display Management Computers (DMCs) which also receive the same data from the Air Data and Inertial Reference Units (ADIRUs).

Radio navaids are displayed in cyan when they are autotuned by the FM part.
Specific symbols can appear, along the flight plan, corresponding to some maneuvers such as Start of Climb (S/C) in white, Top of Climb (T/C) in cyan, Top of Descent (T/D) in white, holding pattern and turn procedure.





FCU - EFIS CONTROL PANEL



MCDU - F-PLN PAGE A

EFIS DISPLAY - FLIGHT MANAGEMENT (FM) DISPLAY ON ND

UFF4200

TMUFM0504-P02 LEVEL 3

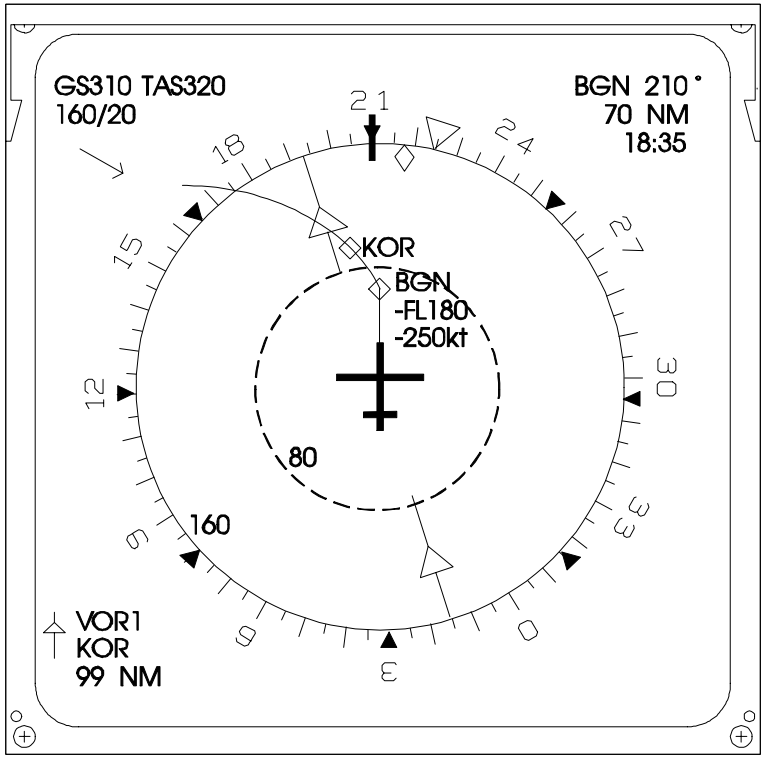
EFFECTIVITY
ALL

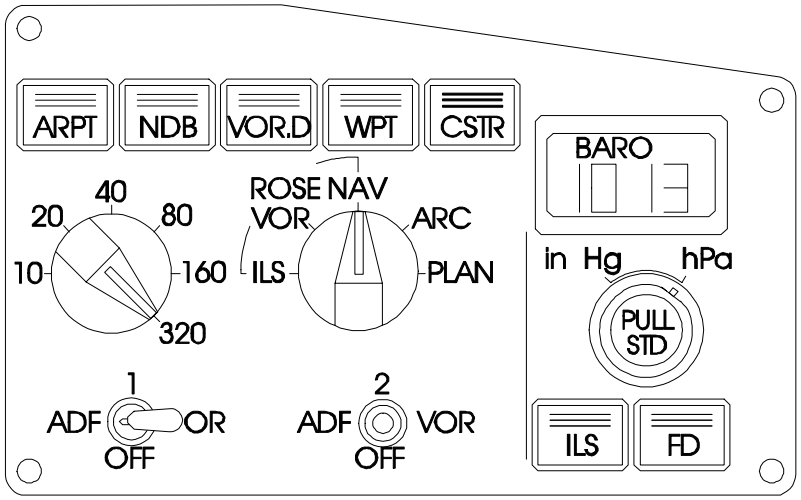
EFIS DISPLAY

DATA BASE DISPLAY P/Bs

By pressing these five interlocked pushbuttons (WPT, VOR.D, NDB, ARPT and CSTR), different information from the navigation data base is available and will be displayed in magenta.
Note that these options are exclusive and the priority is given to the last which has been selected.
When the WPT pushbutton is pressed, all waypoint locations in the related range are transmitted to the ND to be displayed.
When the VOR.D pushbutton is pressed, all VOR and/or DME stations locations in the related range are displayed on the ND.
When the NDB pushbutton is pressed, all Non Directional Beacon station locations in the related range are transmitted to the ND to be displayed.
When the ARPT pushbutton is pressed, all airport locations available to the aircraft, in the related range, are transmitted to the ND to be displayed.
When the CSTR pushbutton is pressed, all speed and altitude constraints (if any) on one or several waypoints, are transmitted to the ND to be displayed.
For example, the constraint on the BGN waypoint are:

- an altitude at or below the flight level 180, and
- a speed at or below 250 kts.





FCU - EFIS CONTROL PANEL

EFIS DISPLAY - DATA BASE DISPLAY P/Bs

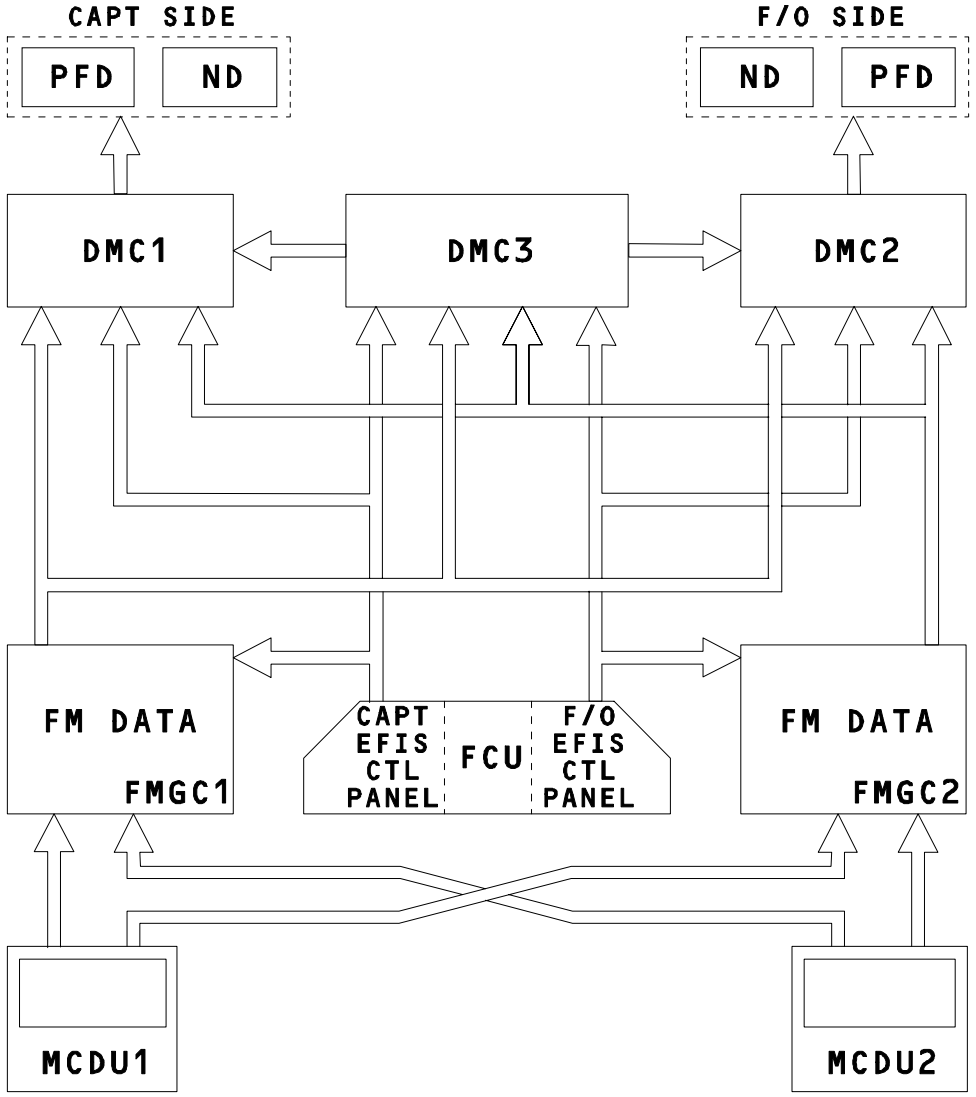
EFIS DISPLAY

FLIGHT MANAGEMENT (FM) SOURCE SWITCHING

In normal setting (FM normal operation), each PFD and ND, via each related Display Management Computer (DMC), displays EFIS data from the onside Flight Management (FM) part.
If an FM has failed, a white "OPP FMGC IN PROCESS" message is displayed in the corresponding MCDU scratchpad showing an automatic switching to FM single operation.
The PFD display remains operational.
The ND display also remains operational provided the selected range and mode is identical on both NDs.
In other cases, a red "MAP NOT AVAIL" message is displayed on the corresponding ND, with an amber "SELECT OFFSIDE RNG/MODE" request.

MCDU FAILURE

If a Multipurpose Control and Display Unit (MCDU) failure occurs on side 1 or 2, as long as the transmitting FM is healthy, the transmission to the EFIS continues despite the loss of this MCDU.



EFIS DISPLAY - FLIGHT MANAGEMENT (FM) SOURCE SWITCHING

UFF4200
TMUFM0504-P04 LEVEL 3

SELF EXAMINATION

What does the filled magenta circle on the PFD represent?

A - Located on the altitude scale, it represents the altitude constraint.
B - Located on the speed scale, it represents the ECON speed target.
C - Located on the altitude scale, it represents the linear vertical deviation.

What is the FM information displayed on the ND in ARC, PLAN and ROSE-NAV modes?

A - Flight plan data, A/C present position and wind characteristics.
B - Flight plan data, A/C present position and autotuned radio navaids.
C - Flight plan data, Decision Height and crosstrack deviation.

22 - AUTO FLIGHT SYSTEM

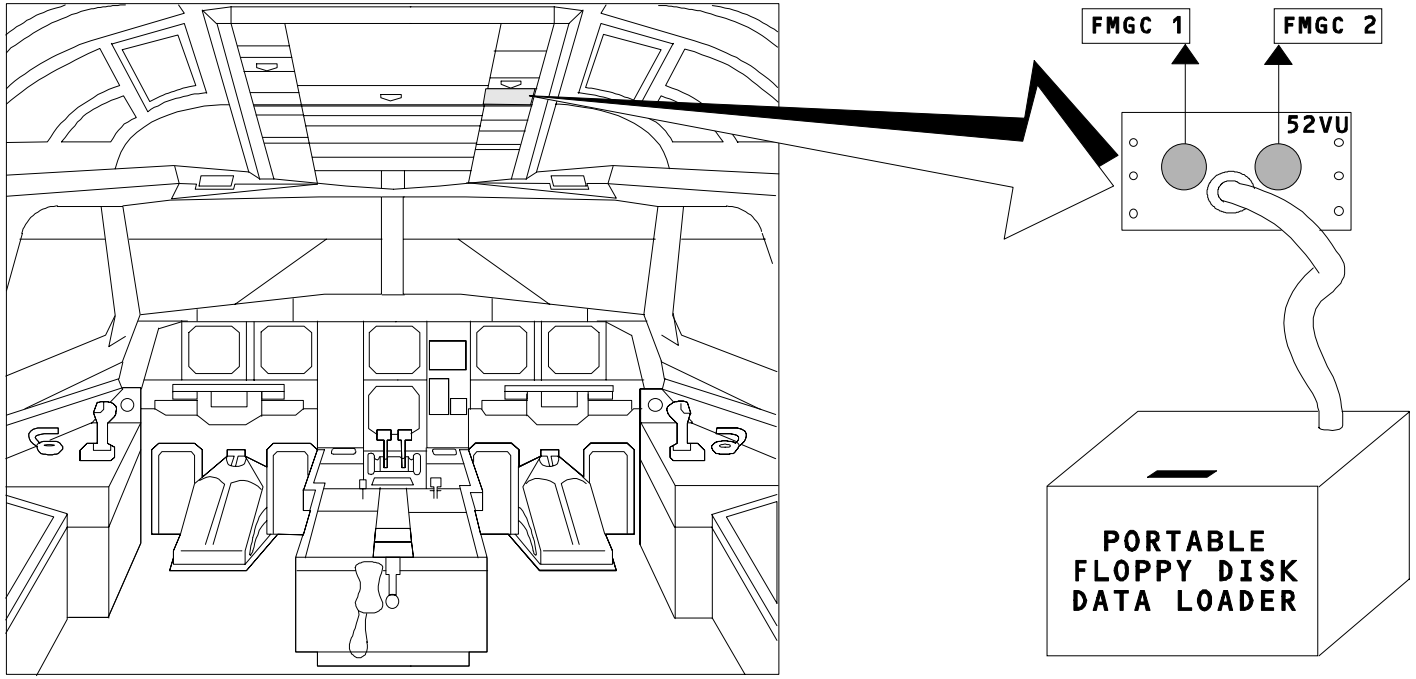
22-70-00 DATA BASE LOADING

CONTENTS:

DATA BASE LOADING

GENERAL

Every 28 days, a new navigation data base must be loaded into each Flight Management and Guidance Computer (FMGC) with the help of a portable floppy disk data loader.
In fact, the floppy disk received by the company contains 2 navigation data bases: One corresponds to the present period of 28 days and the other to the next period.
During the operation, the two data bases are loaded. The operation must be performed independently for each FMGC.
The data base loading can also be used during maintenance operations as it enables some Flight Management (FM) problems to be solved (for example, missing information on MCDU FM pages).
The basic loading (with the portable floppy disk data loader) can be performed into either FMGC 1 or FMGC 2. Then, the crossloading function allows the new navigation data base to be transferred from this FMGC to the other one.
The following table indicates the loading time for one FMGC depending on the loading type.



	Loading time for one FMGC (400 kilowords database)
Basic loading	30 minutes 30 seconds
Crossloading	7 minutes 50 seconds

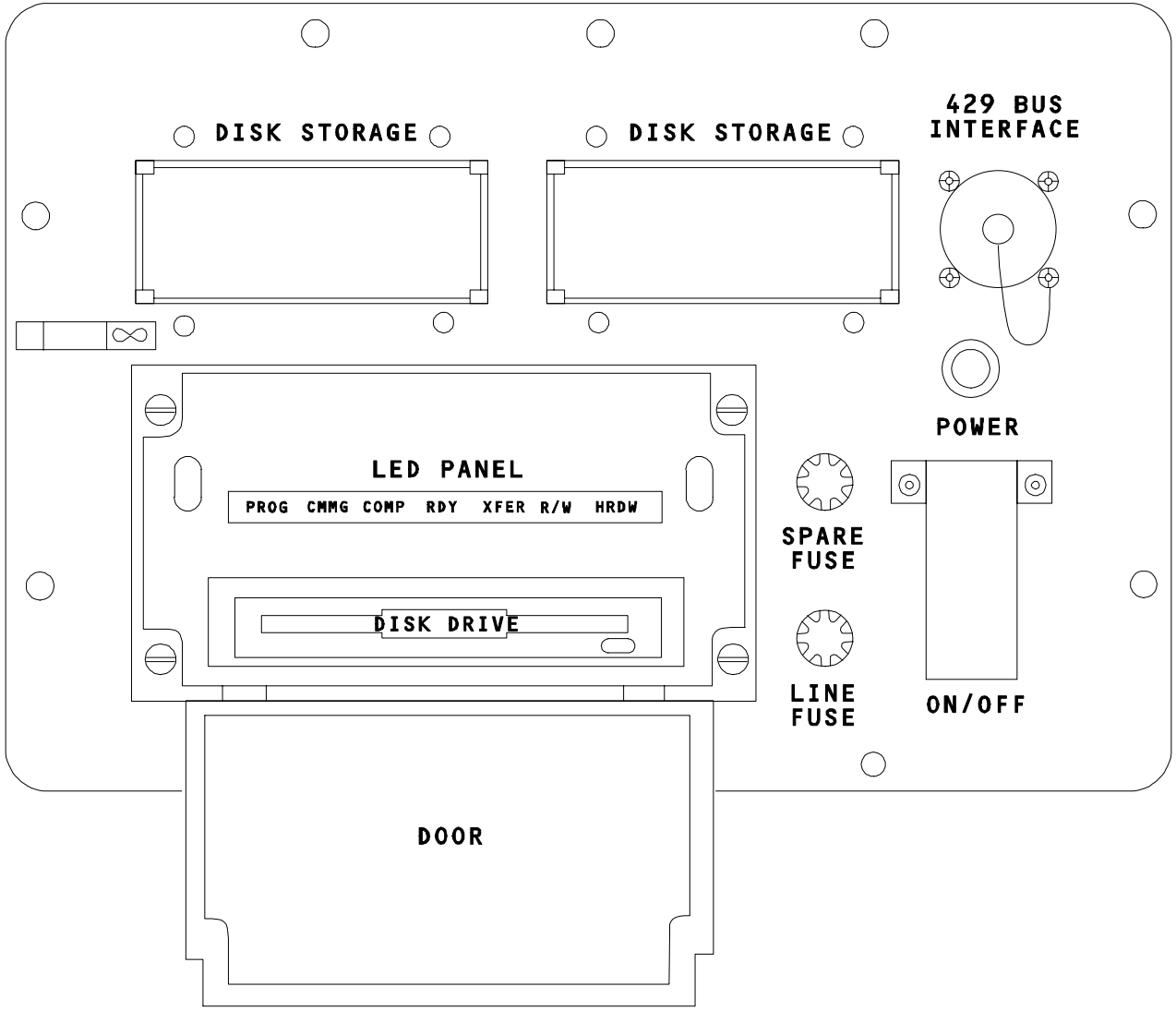
DATA BASE LOADING - GENERAL

DATA BASE LOADING

DATA LOADER DESCRIPTION

Here is the face of the data loader.
It comprises:

- a connector,
- a power indicator light,
- a guarded ON/OFF switch,
- two fuses,
- a panel (behind a door) with seven indicator lights and a disk drive,
- two disk storage boxes.



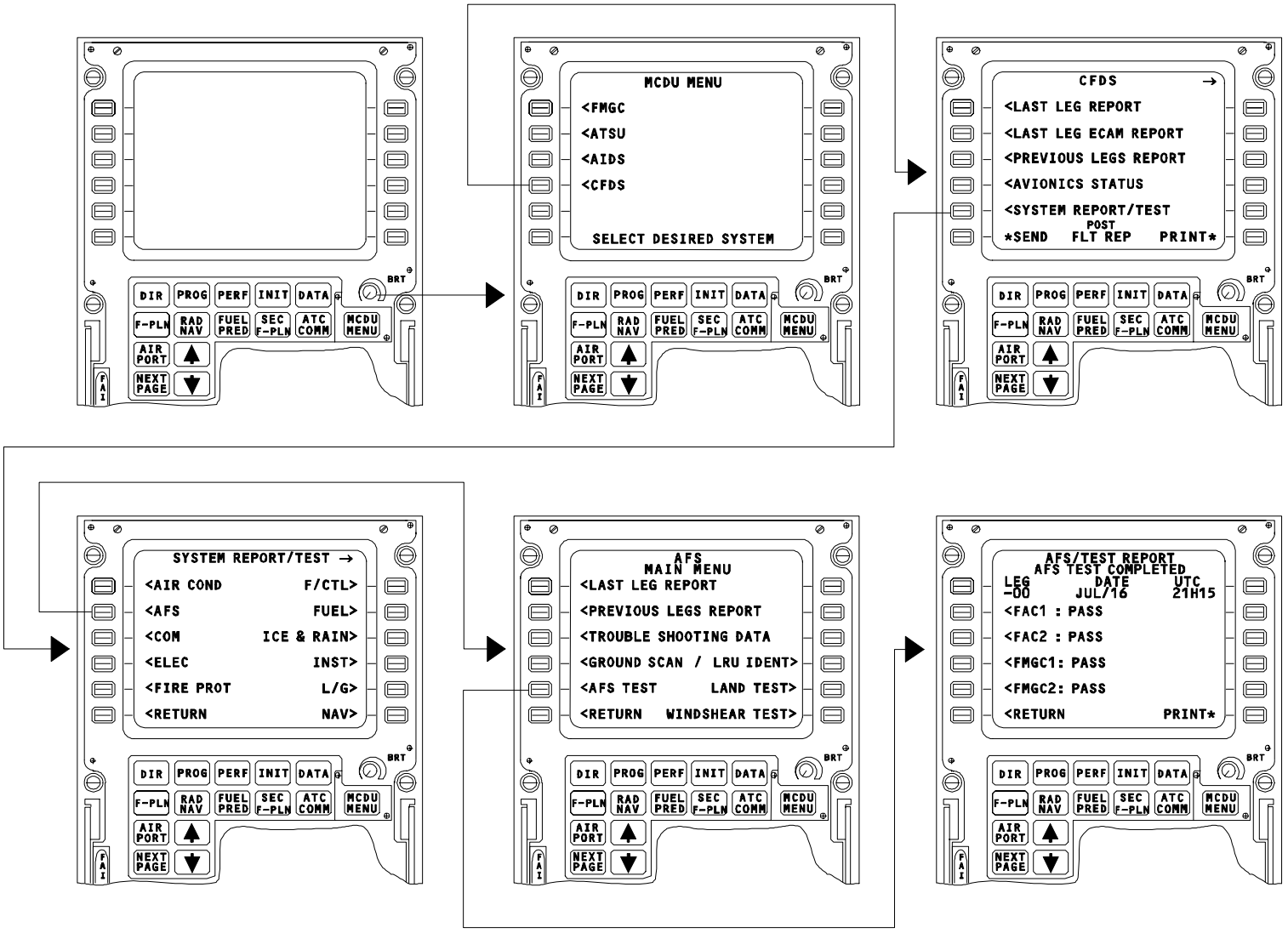
DATA BASE LOADING - DATA LOADER DESCRIPTION

DATA BASE LOADING

OPERATION

The procedure given is for FMGC 1. For FMGC 2, which is identical, refer to the information between brackets.
On MCDU 1 (2), turn the BRT knob to vary the brightness.
From the CFDS MENU page, get the SYSTEM REPORT/TEST page and perform an AFS TEST.
Check the AFS TEST result for FMGC 1 (2): Here, it is OK.

NOTE: If the AFS TEST fails, open then close the FMGC 1 (2) circuit breaker and perform the test again.



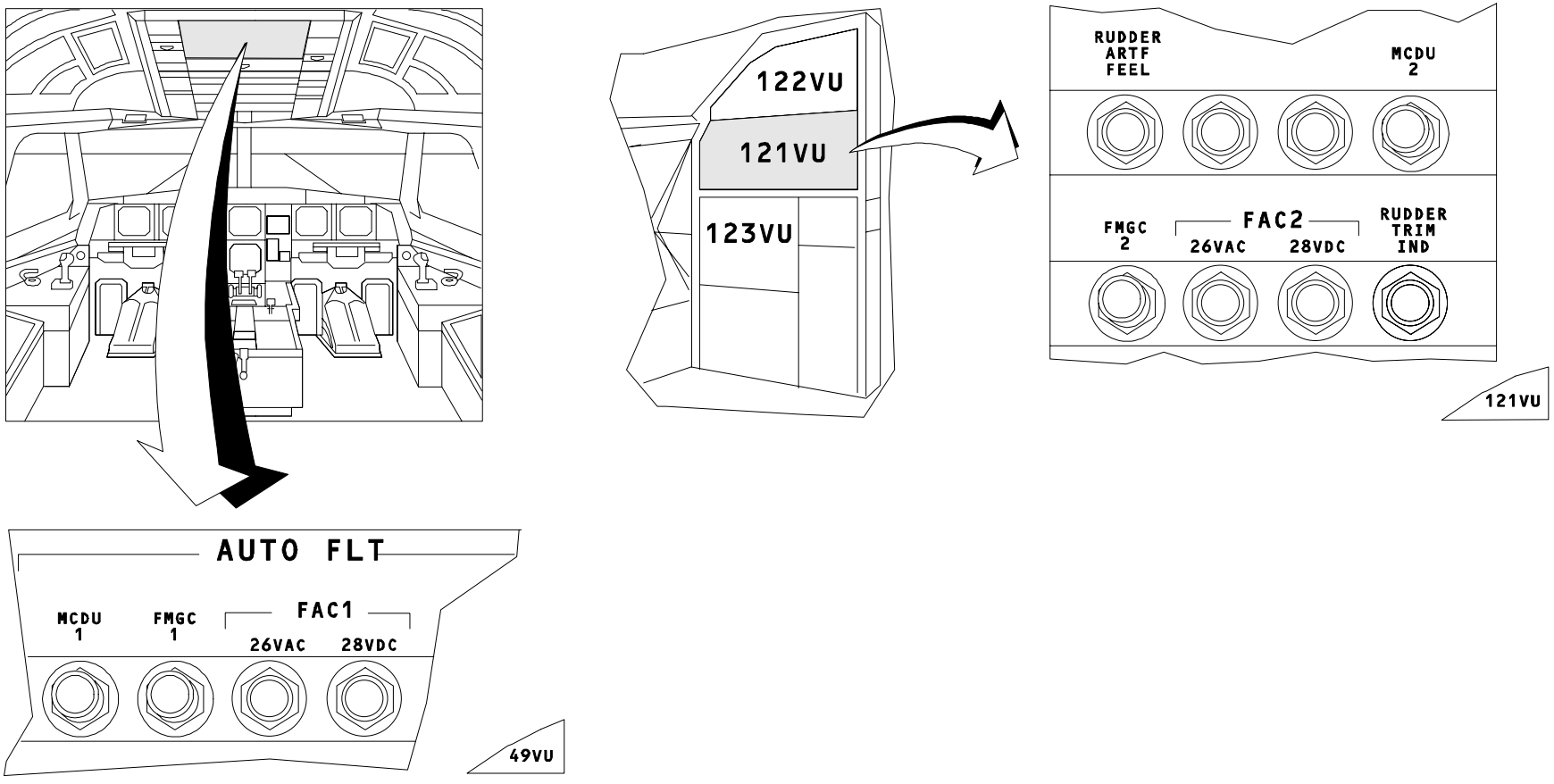
DATA BASE LOADING - OPERATION

UFF4200
TMUFGCT05-P03 LEVEL 3

DATA BASE LOADING

OPERATION (CONTINUED)

As the AFS TEST result is OK, open the FMGC 1, FMGC 2, MCDU 1 and MCDU 2 circuit breakers.



UFF4200
TMUFGCT05-P04 LEVEL 3

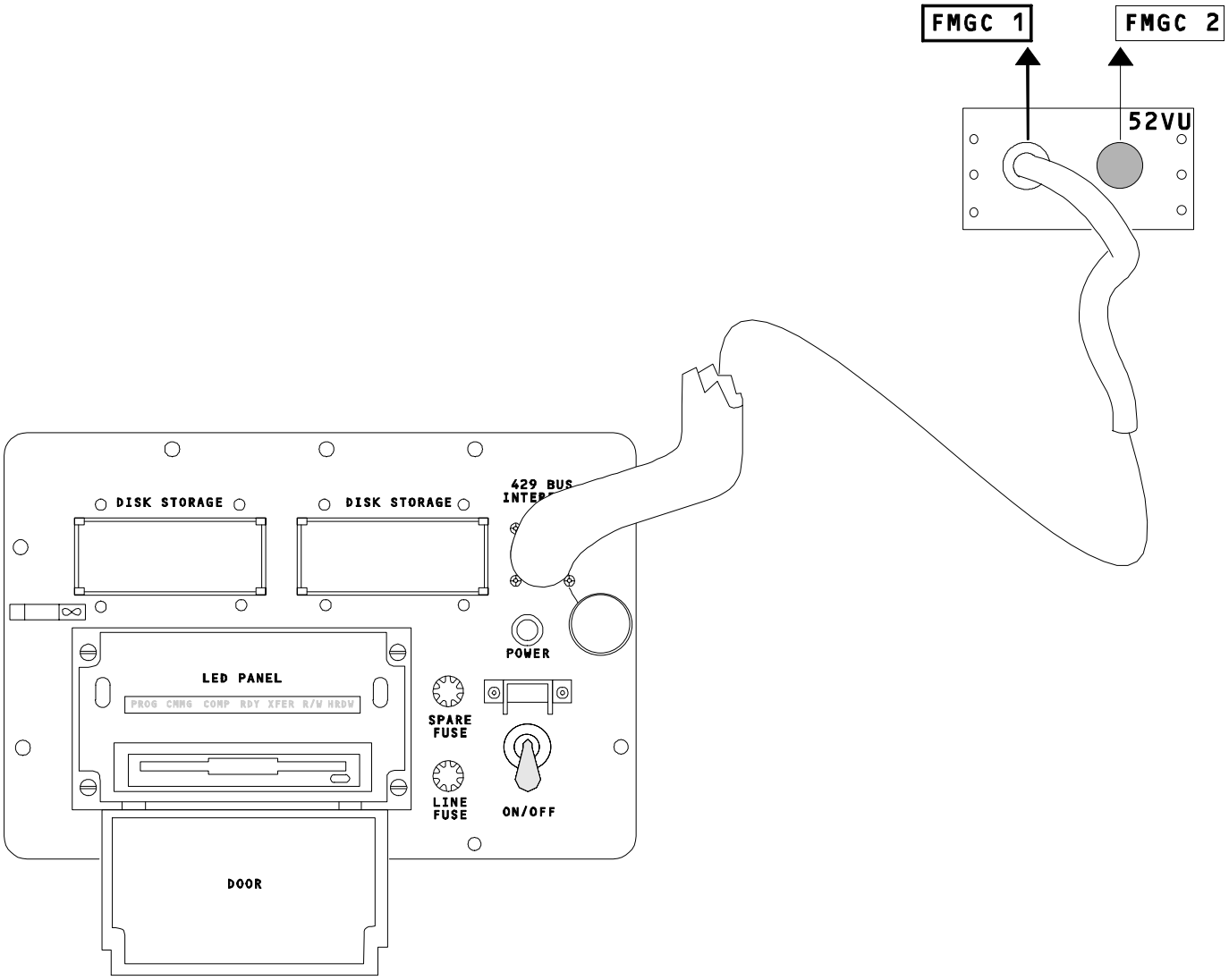
DATA BASE LOADING - OPERATION (CONTINUED)

EFFECTIVITY
ALL

DATA BASE LOADING

OPERATION (CONTINUED)

On the data loader, set the ON/OFF switch to OFF.
Connect the connection cable to the loader connector.
On panel 52VU, remove the FMS LOAD blanking plate.
Connect the connection cable to the system 1 (2) connector.

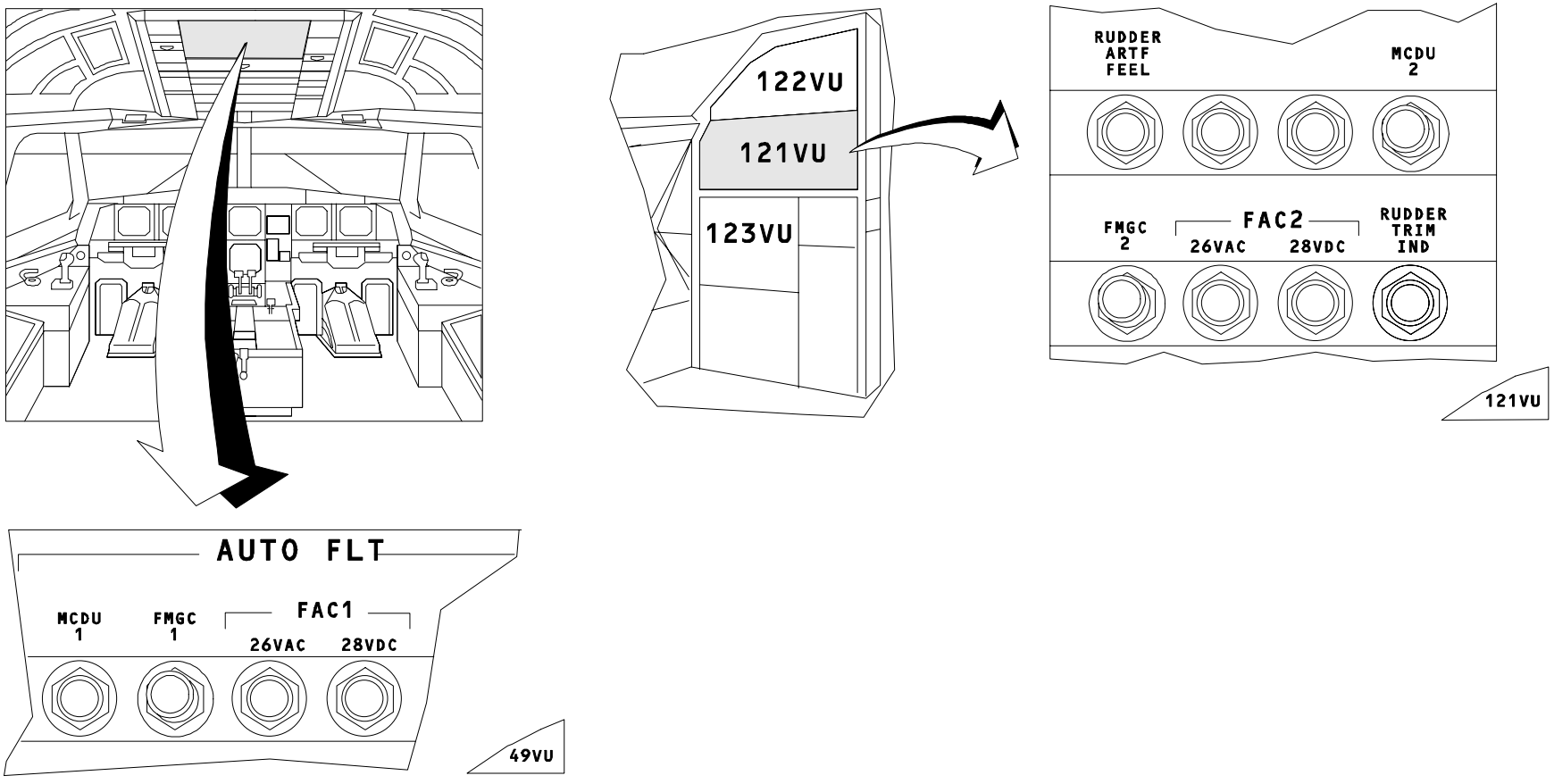


DATA BASE LOADING - OPERATION (CONTINUED)

DATA BASE LOADING

OPERATION (CONTINUED)

On distribution panel 49VU (121VU), close the MCDU 1 (2) circuit breaker.



UFF4200
TMUFGCT05-P06 LEVEL 3

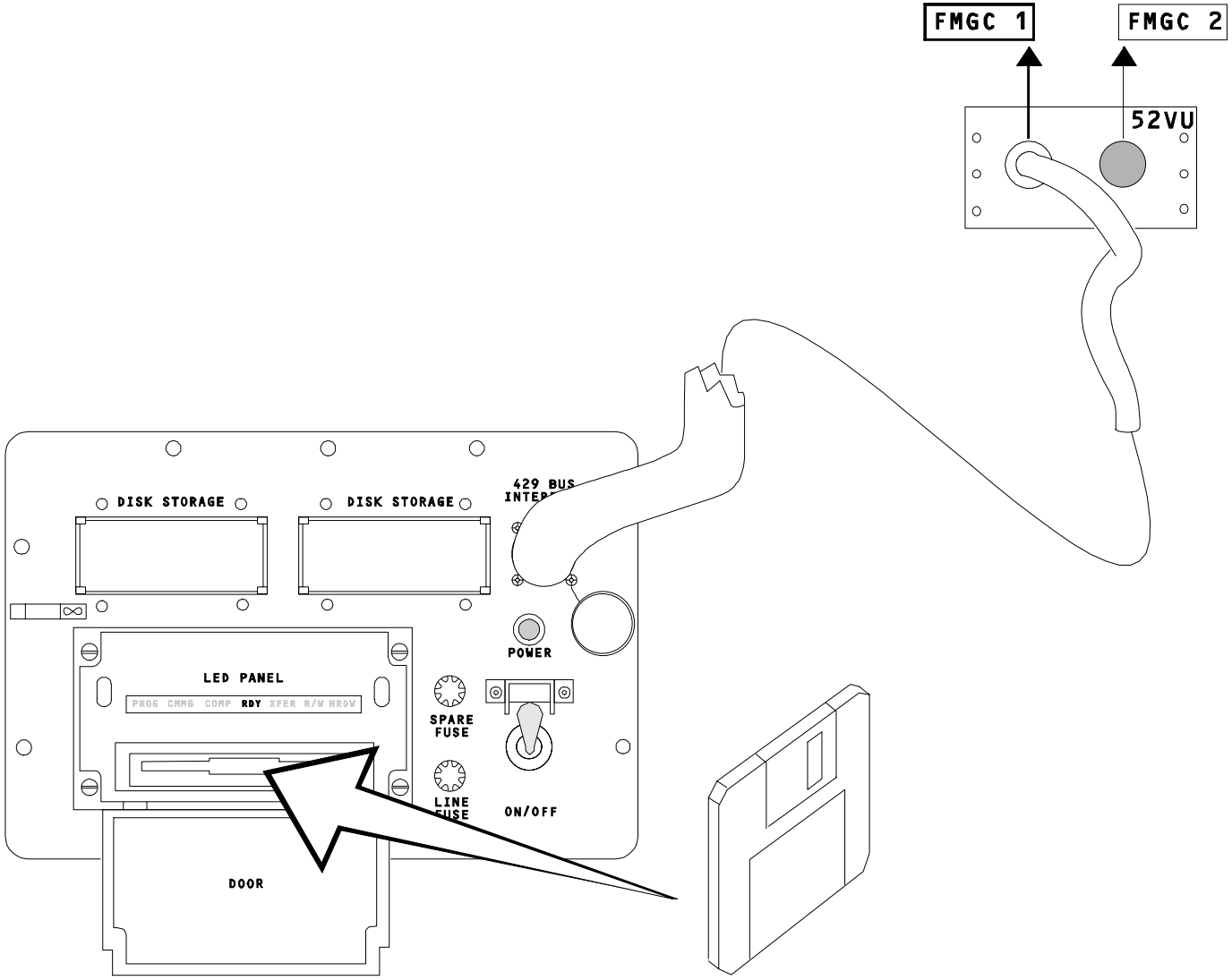
DATA BASE LOADING - OPERATION (CONTINUED)

EFFECTIVITY
ALL

DATA BASE LOADING

OPERATION (CONTINUED)

On the data loader, set the ON/OFF switch to ON.
The green power indicator light comes on.
All other lights flash, then go off.
Put the floppy disk into the loader.
The green RDY (ready) indicator light comes ON.

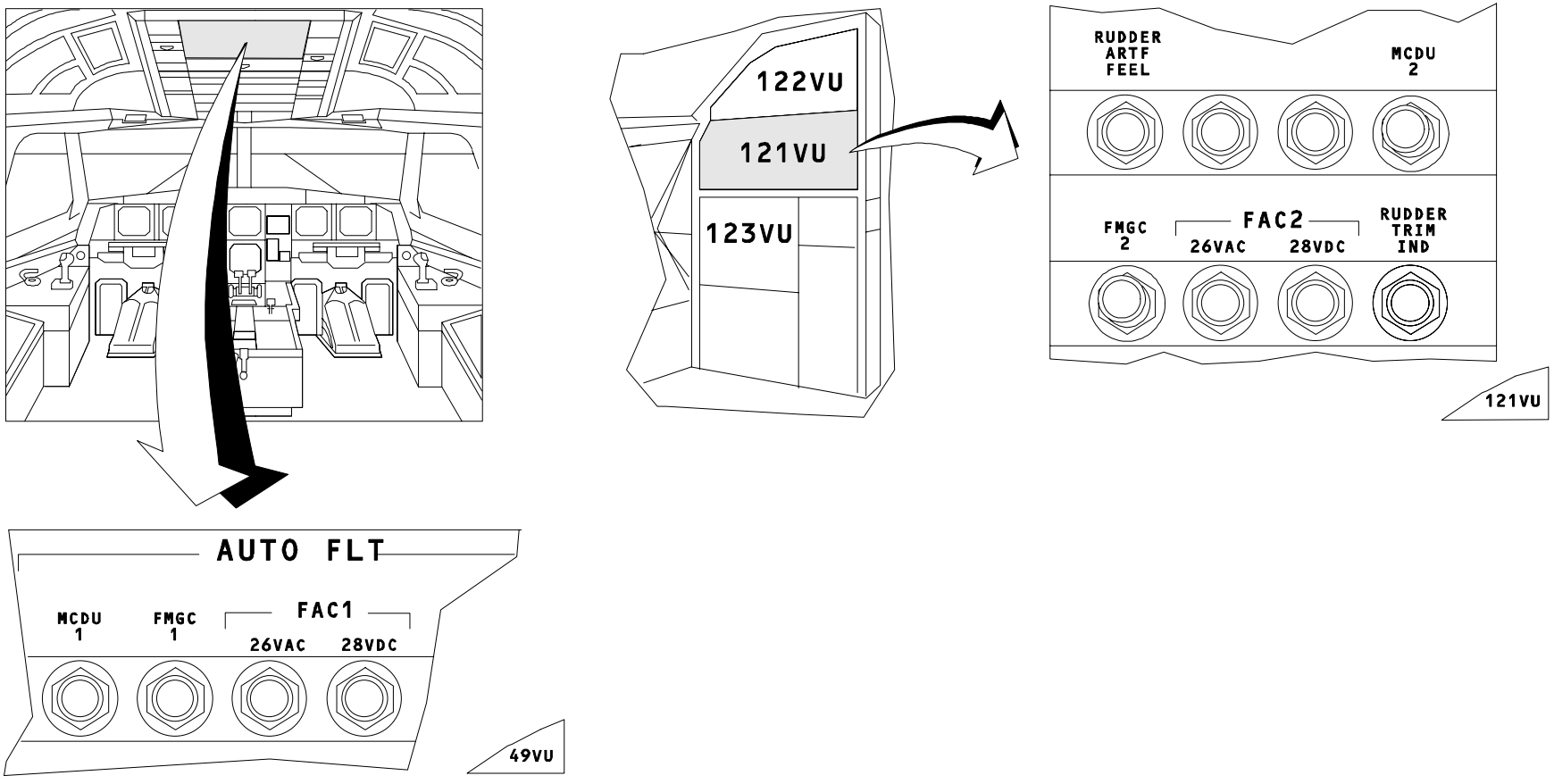


DATA BASE LOADING - OPERATION (CONTINUED)

DATA BASE LOADING

OPERATION (CONTINUED)

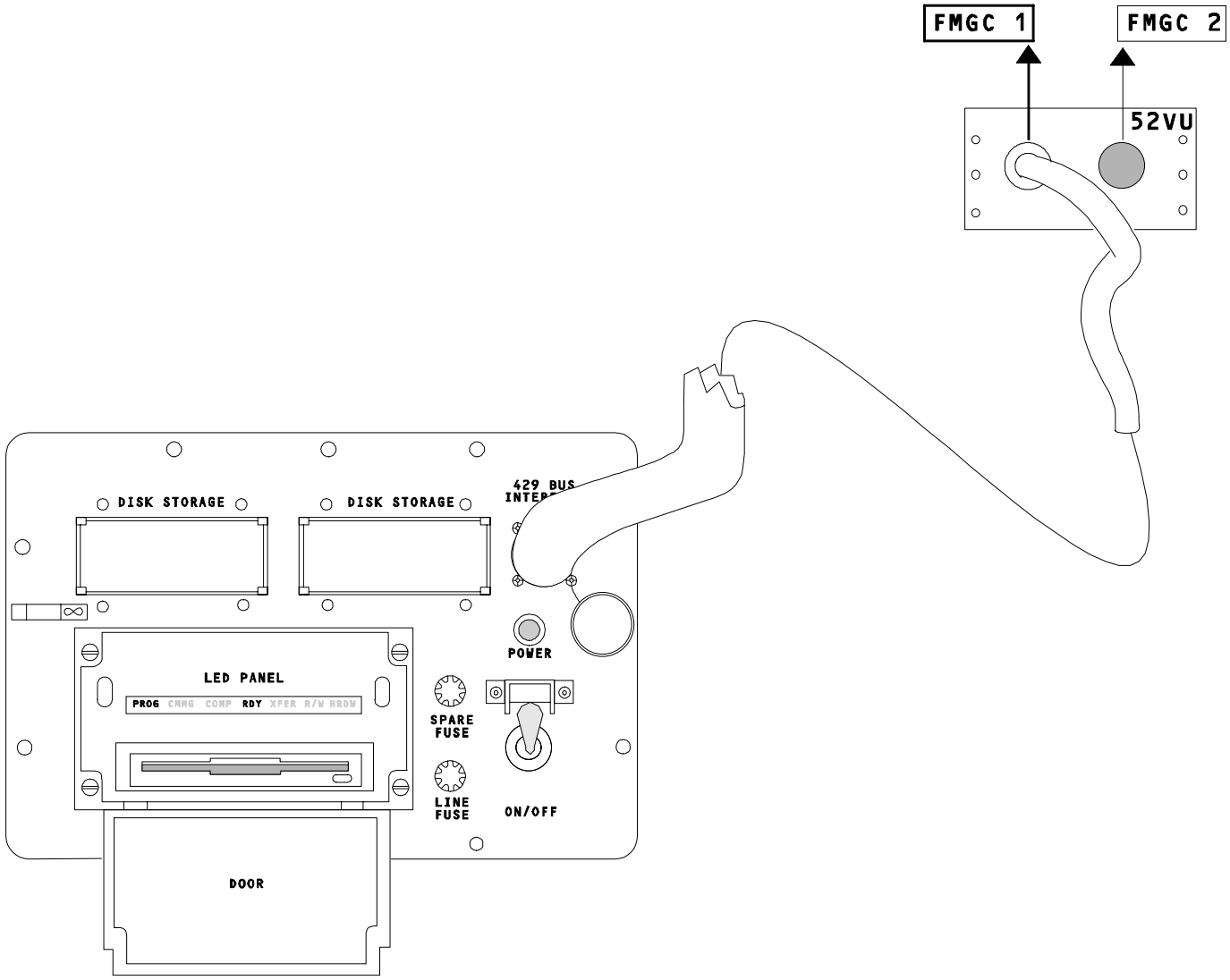
Close the FMGC 1 (2) circuit breaker.


122VU
121VU
123VU
RUDDER ARTF FEEL
MCDU 2
FMGC 2
FAC2
26VAC
28VDC
RUDDER TRIM IND
121VU
AUTO FLT
MCDU 1
FMGC 1
FAC1
26VAC
28VDC
49VU

DATA BASE LOADING

OPERATION (CONTINUED)

The power up test of the FMGC 1 (2) starts.
At the end of this test, the triple click aural warning sounds.
On the data loader, the yellow PROG (in progress) indicator light comes ON.

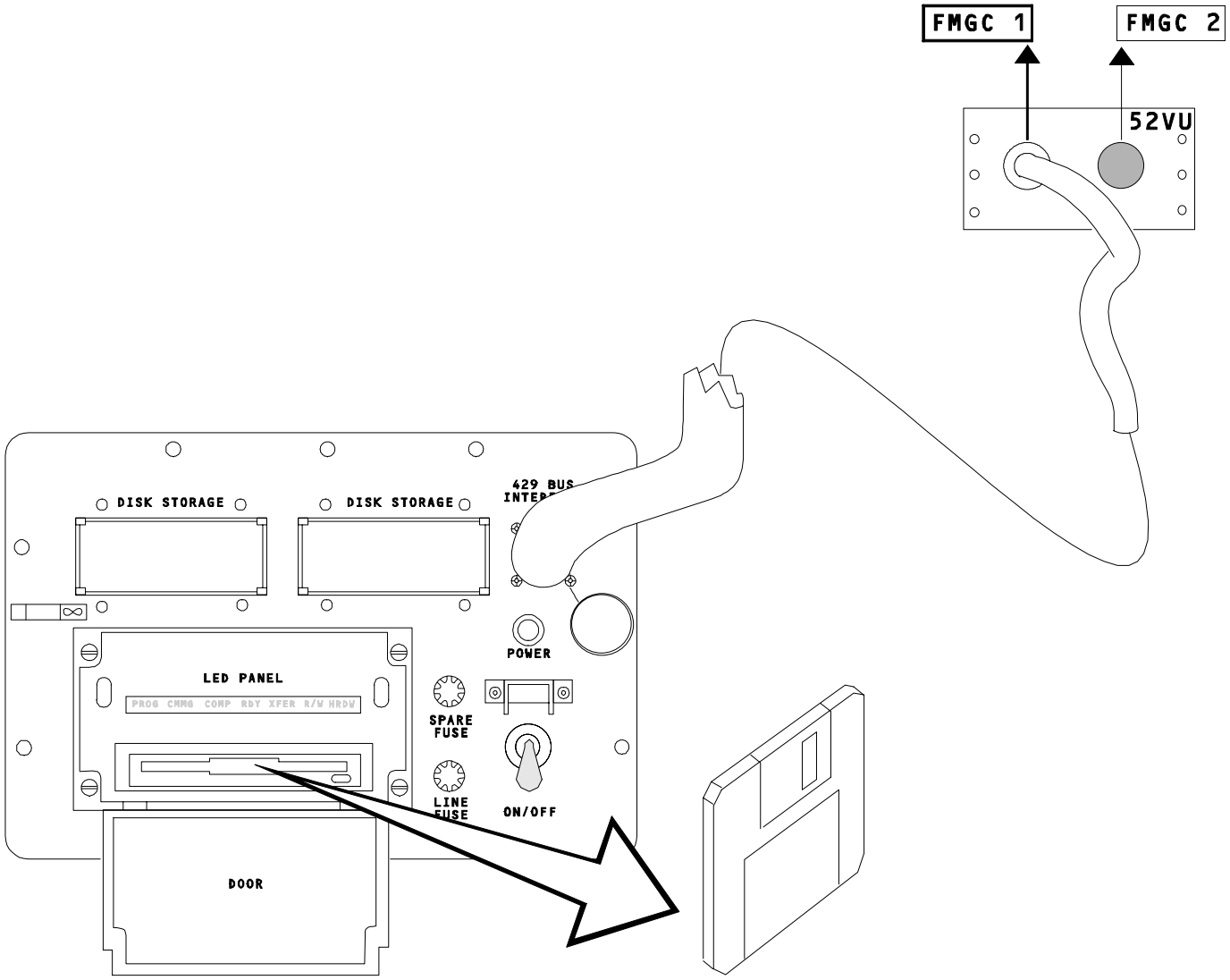


DATA BASE LOADING - OPERATION (CONTINUED)

DATA BASE LOADING

OPERATION (CONTINUED)

After 10 or 15 minutes, the RDY and PROG indicator lights go off and the yellow COMP (completed) indicator light comes on.
Eject the floppy disk.
Set the ON/OFF switch to OFF.

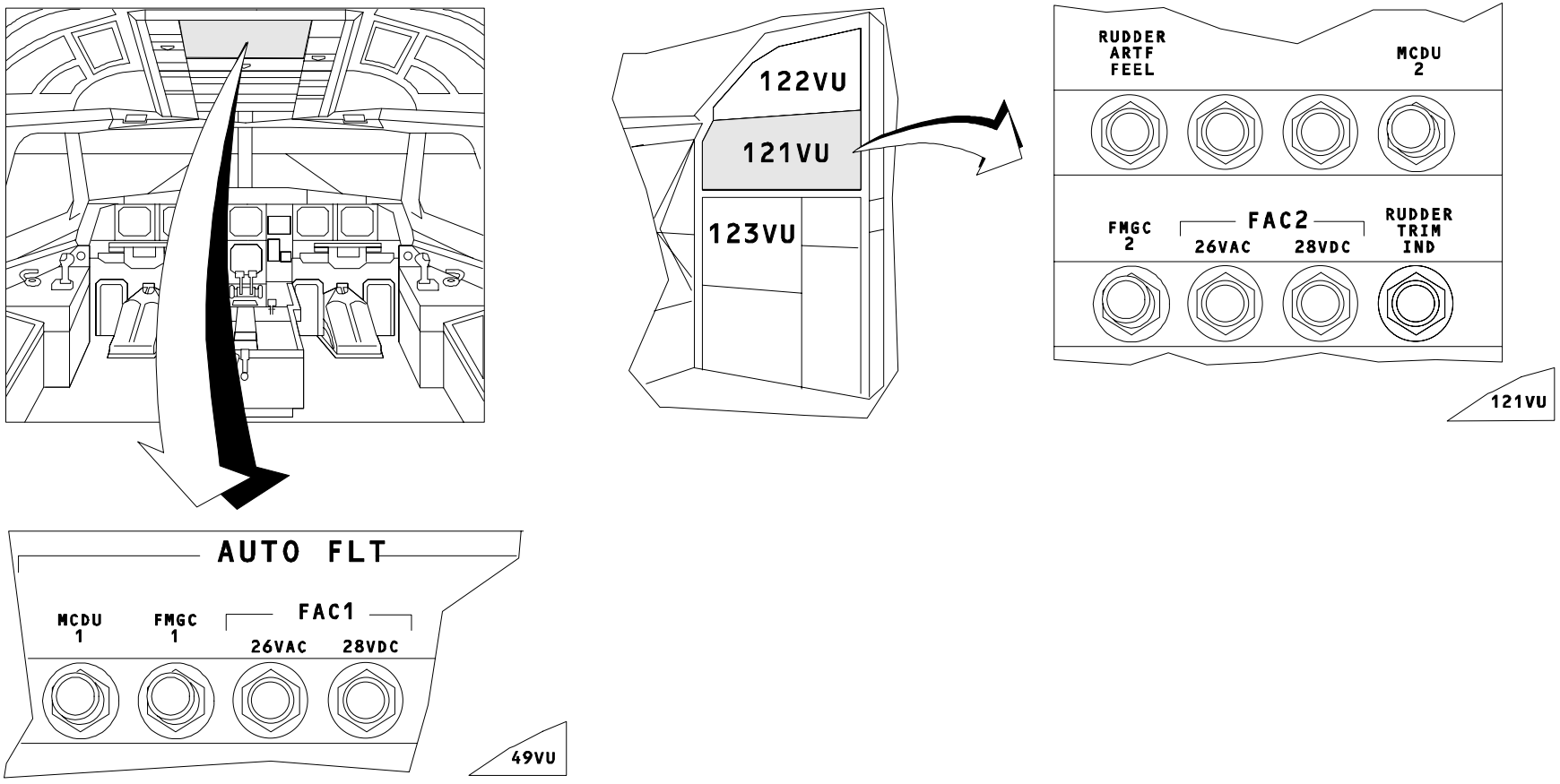


DATA BASE LOADING - OPERATION (CONTINUED)

DATA BASE LOADING

OPERATION (CONTINUED)

Open the MCDU 1 (2) and FMGC 1 (2) circuit breakers.



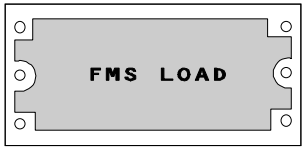
DATA BASE LOADING - OPERATION (CONTINUED)

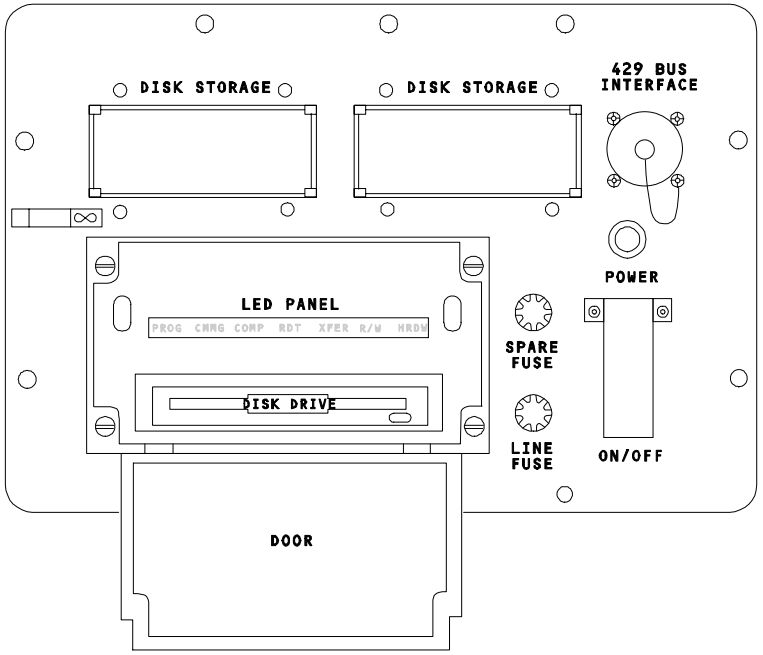
EFFECTIVITY
ALL

DATA BASE LOADING

OPERATION (CONTINUED)

On panel 52VU, disconnect the connection cable.
Install the FMS LOAD blanking plate.



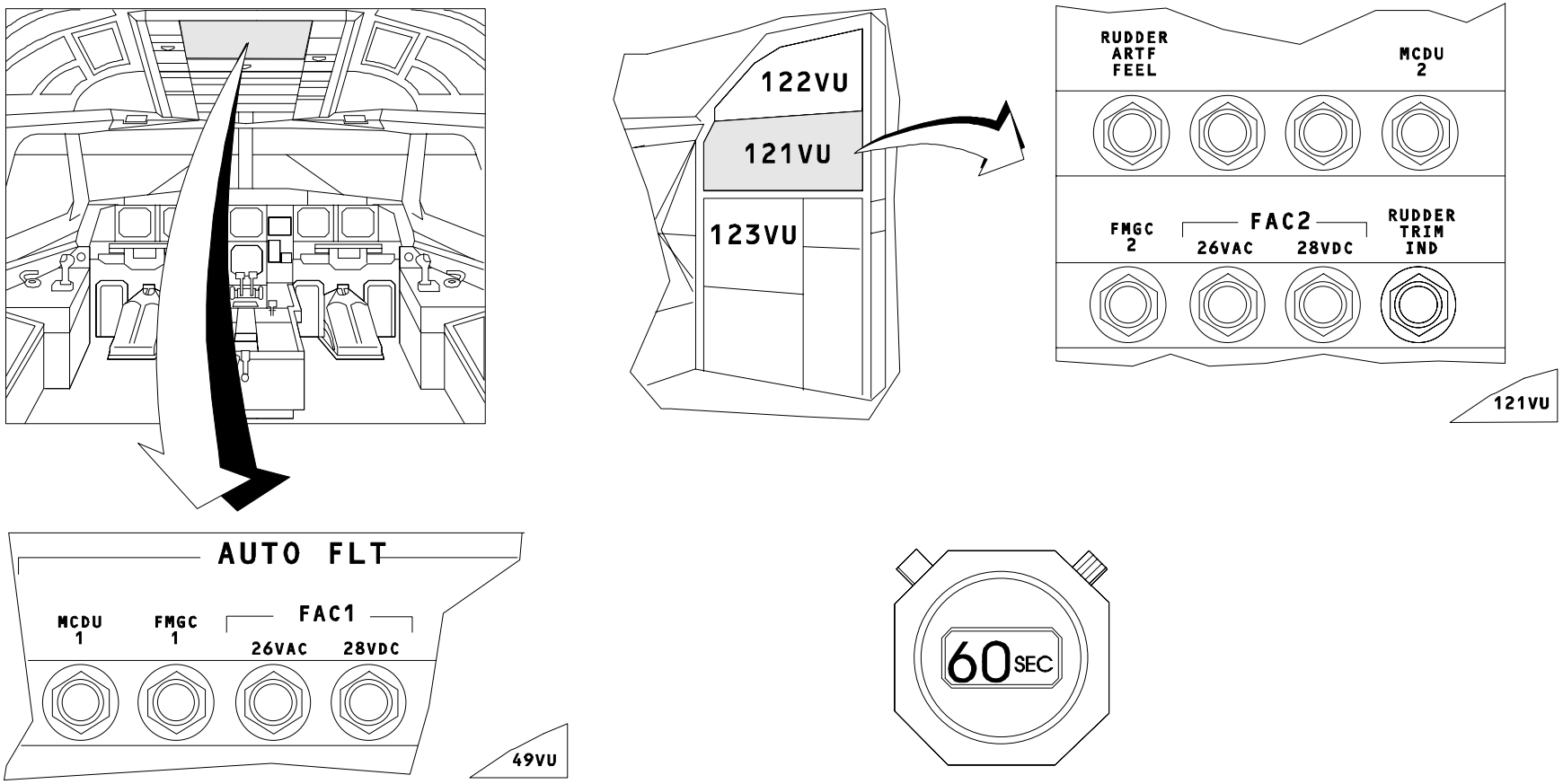


DATA BASE LOADING - OPERATION (CONTINUED)

DATA BASE LOADING

OPERATION (CONTINUED)

Close the FMGC 1, FMGC 2, MCDU 1, MCDU 2 circuit breakers and wait 1 minute.



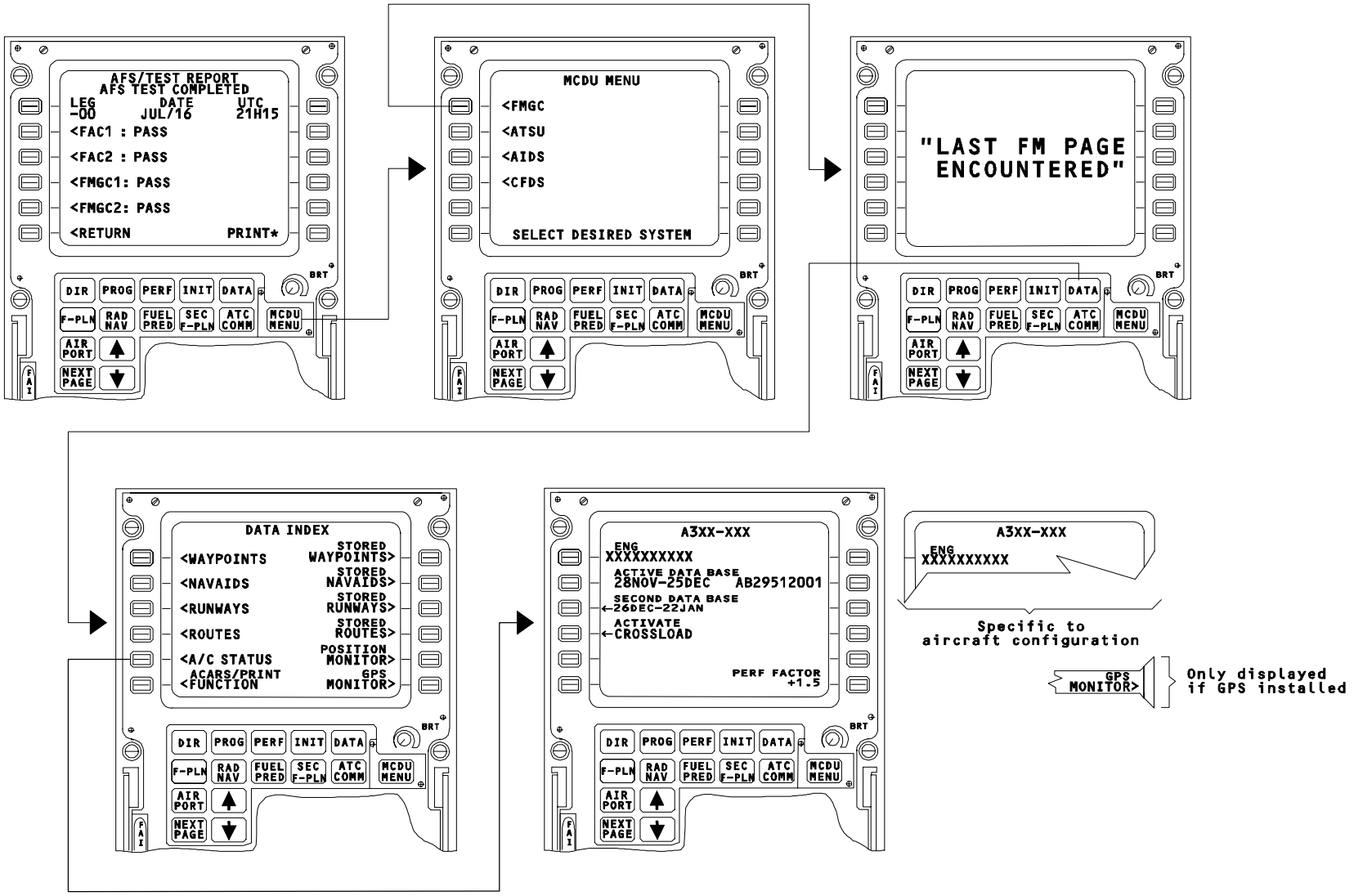
DATA BASE LOADING - OPERATION (CONTINUED)

EFFECTIVITY
ALL

DATA BASE LOADING

OPERATION (CONTINUED)

On MCDU 1 (2), press the MCDU MENU key.
Press the Line Select Key adjacent to the FMGC indication.
Press the DATA KEY.
Press the Line Select Key adjacent to the A/C STATUS indication.
On the A/C STATUS page, make sure that the active data base of the loaded FMGC is correct for the dates and the serial numbers shown.



DATA BASE LOADING - OPERATION (CONTINUED)

UFF4200

TMUFGCT05-P14 LEVEL 3

EFFECTIVITY
ALL

DATA BASE LOADING

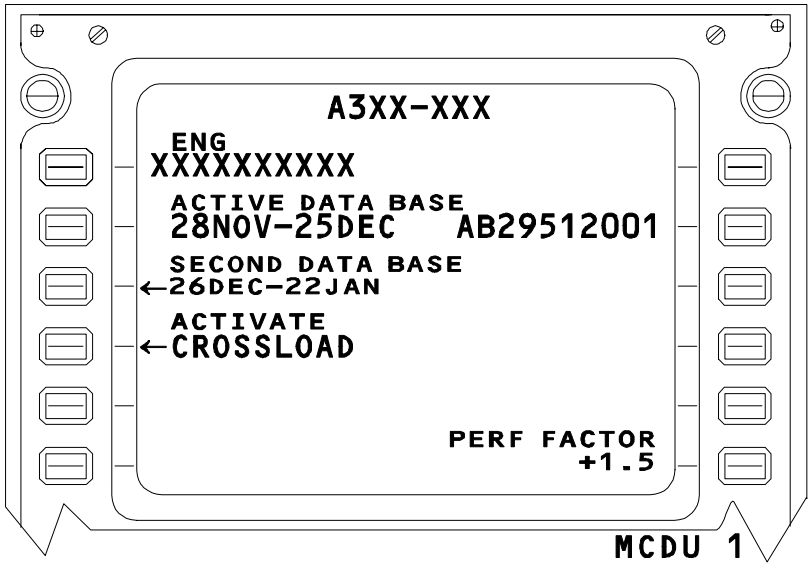
CROSSLOADING DESCRIPTION

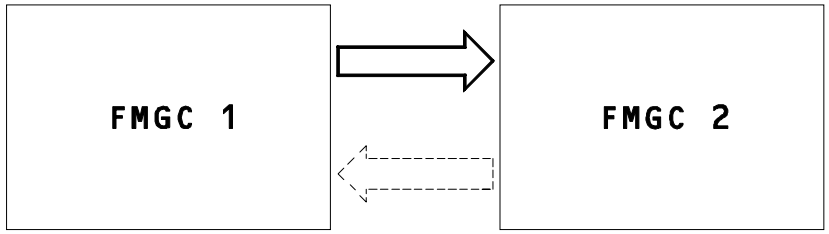
The crossloading allows an FMGC to transfer its valid navigation data base to the other FMGC through the crosstalk busses by simple MCDU selection.
The objective of the crossloading is:

- to reduce loading time for periodic updating of navigation data base.
- to avoid the use of a portable data loader in case of replacement of an FMGC.

The crossloading is initiated from either MCDU 1 or MCDU 2 (depending on which FMGC contains the valid navigation data base), via the ACTIVATE CROSSLOAD prompt on the AIRCRAFT STATUS page.
The ACTIVATE CROSSLOAD prompt is displayed when the following is true:

- the active flight phase is either PREFLIGHT or DONE,
- the FMGCs work in independent operation, meaning that the navigation data base loaded in one FMGC is different from the other one.

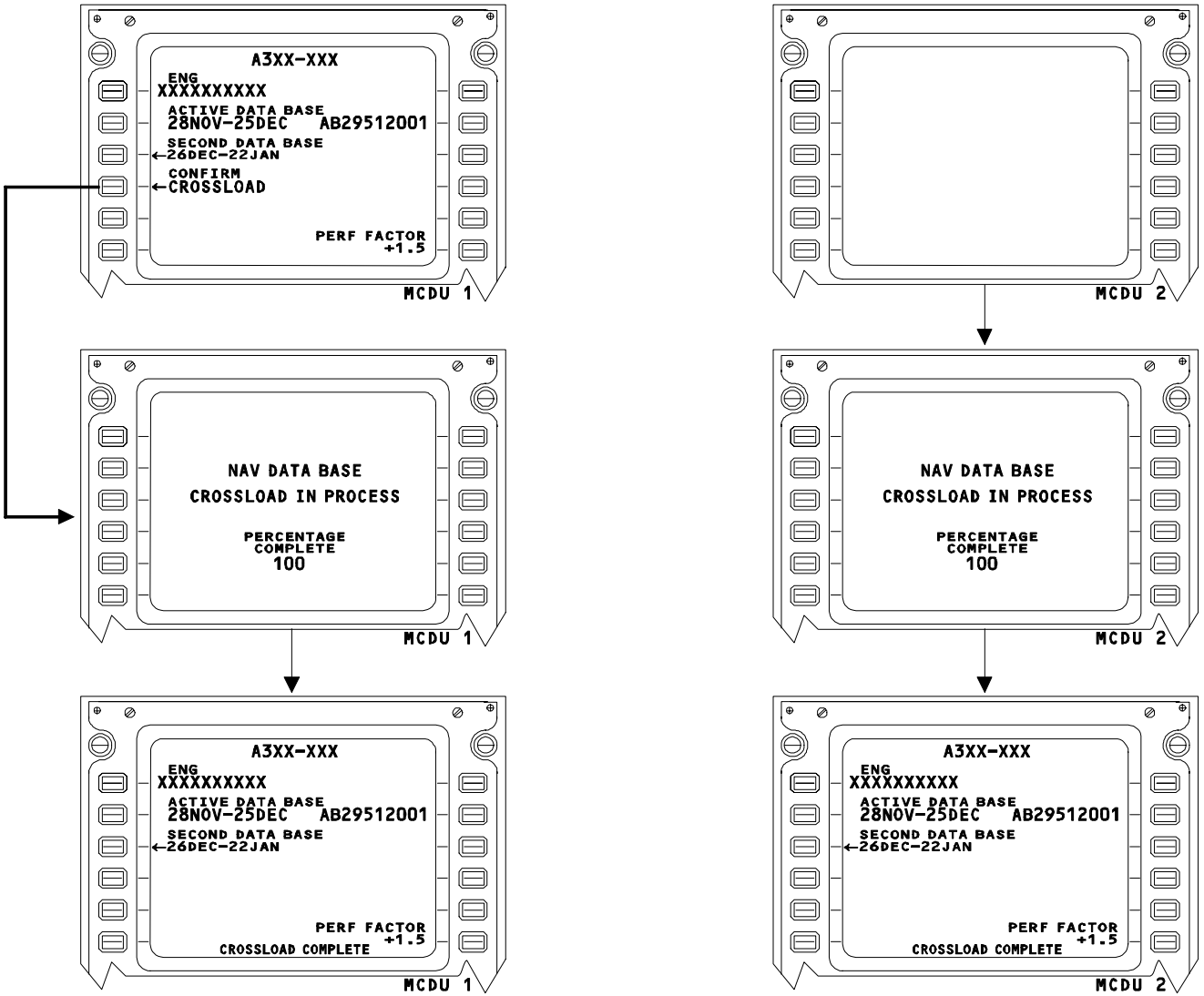

A3XX-XXX
ENG
XXXXXXXXXX
ACTIVE DATA BASE
28NOV-25DEC AB29512001
SECOND DATA BASE
←26DEC-22JAN
ACTIVATE
←CROSSLOAD
PERF FACTOR
+1.5
MCDU 1


FMGC 1
FMGC 2

DATA BASE LOADING

CROSSLOADING OPERATION

Pressing the line select key associated to the ACTIVATE CROSSLOAD prompt identifies the transmitting FMGC.
In this example, the transmitting FMGC is FMGC 1.
The CONFIRM CROSSLOAD prompt is displayed on the AIRCRAFT STATUS page of MCDU 1 and the AIRCRAFT STATUS PAGE of MCDU 2 is blanked.
As soon as the CONFIRM CROSSLOAD prompt is selected, the crossloading begins.
While crossload is in process, the current percentage of crossload completion is displayed on both MCDUs.
Upon successful completion of the crossload, both MCDUs revert to the AIRCRAFT STATUS page.
The CROSSLOAD COMPLETE message is displayed in the scratchpad of each MCDU.



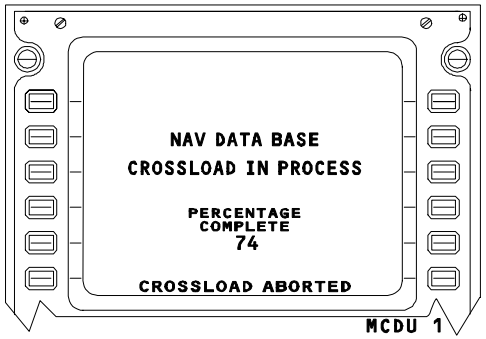
DATA BASE LOADING - CROSSLOADING OPERATION

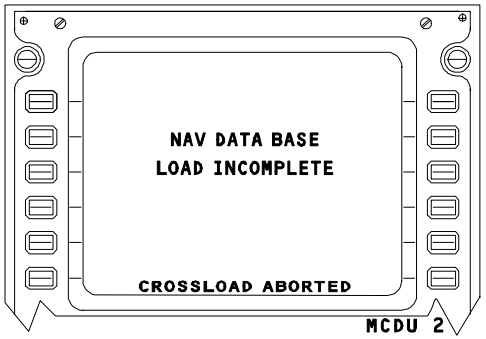
DATA BASE LOADING

CROSSLOADING OPERATION (CONTINUED)

The crossload may be unsuccessful.
The CROSSLOAD ABORTED message is then displayed in the scratchpad of each MCDU and the NAV DATA BASE LOAD INCOMPLETE message is displayed on the MCDU associated to the receiving FMGC (In this example, MCDU 2).
This may occur:

- if flight phase transitions from PREFLIGHT or DONE to another phase occur while crossload is in process,
- following a failed or incomplete data base loading operation.


NAV DATA BASE
CROSSLOAD IN PROCESS
PERCENTAGE
COMPLETE
74
CROSSLOAD ABORTED
MCDU 1


NAV DATA BASE
LOAD INCOMPLETE
CROSSLOAD ABORTED
MCDU 2

THIS PAGE LEFT INTENTIONALLY BLANK

22 - AUTO FLIGHT SYSTEM

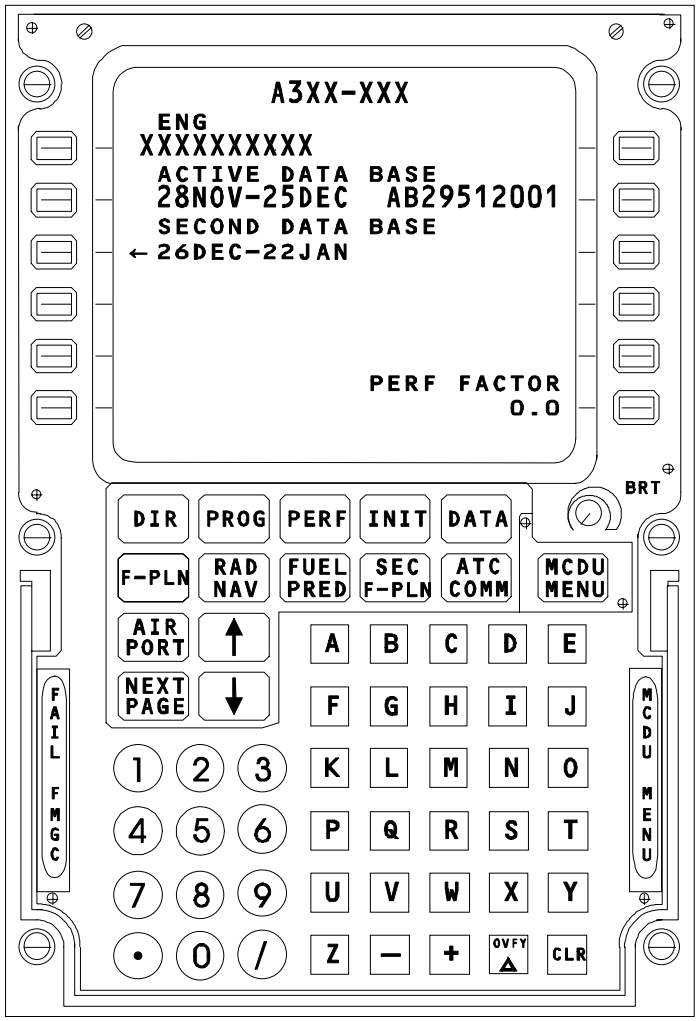
22-70-00 FMGS COCKPIT PREPARATION

CONTENTS:

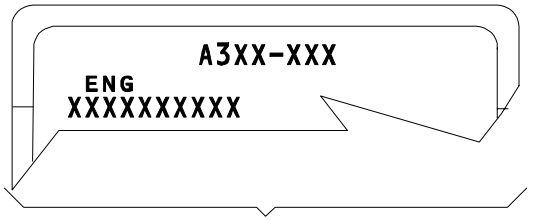
FMGS COCKPIT PREPARATION

STATUS

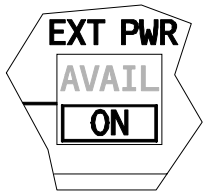
First of all, the aircraft and the Flight Management and Guidance System (FMCS) must be electrically supplied by pressing in the external power (EXT PWR) pushbutton.
After the safety test of the computers, the FCU and the MCDU are energized and Flight Director is automatically engaged.
The STATUS page is displayed.



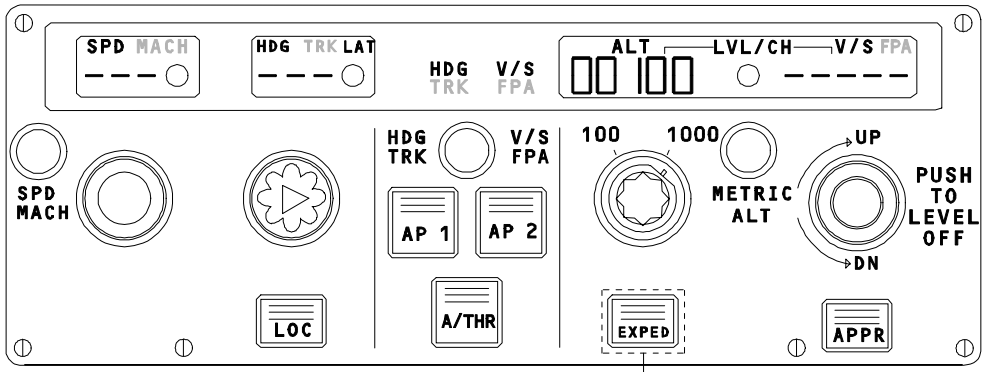
Multipurpose Control and Display Unit (MCDU)



SPECIFIC TO AIRCRAFT CONFIGURATION

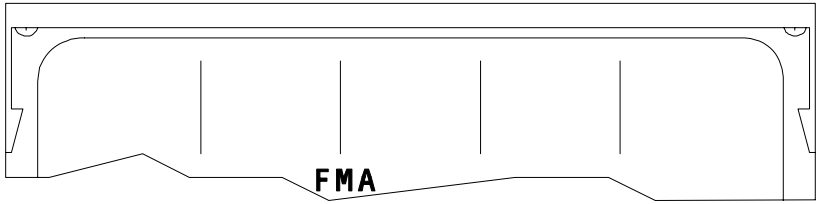


ELEC control panel



Flight Control Unit (FCU)

Optionally removed



Primary Flight Display (PFD)

FMGS COCKPIT PREPARATION – STATUS

FMGS COCKPIT PREPARATION

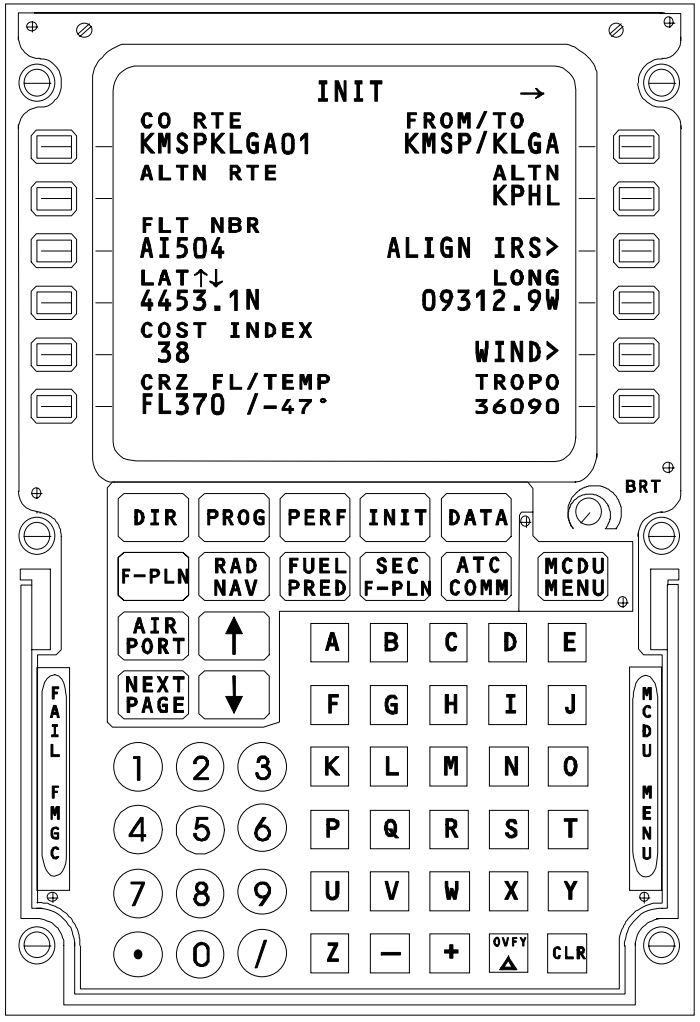
INITIALIZATION

INIT page A is obtained by pressing the INIT key on the MCDU.
The number of the company route is entered onto the scratchpad of the MCDU by using the alphanumeric keyboard.
The company route can be defined by up to 10 characters.
In our example, it is KMSPKLGA01 from KMSP to KLGA (ICAO codes for Mineapolis St Paul and New-York La Guardia airports).
Once the company route has been inserted, the departure and destination airports appear on the display automatically.
Note also, that the ALIGN IRS prompt has appeared.
The flight plan being defined, NAV is armed and indicated on the Flight Mode Annunciator (FMA) of the PFD and the LAT light comes on on the FCU.

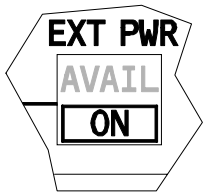
NOTE: If the pilot wants to insert a route, which does not belong to the data base, he must give the origin and destination identifier in the FROM/TO boxes. He must then build up his route waypoint by waypoint.

The flight number (FLT NBR) is entered and inserted by using the alphanumeric keyboard and the appropriate Line Select Key.
The alignment process is completed by sending the departure airport coordinates to the Inertial Reference Systems. This is done by pressing the Line Select Key adjacent to the ALIGN IRS prompt.

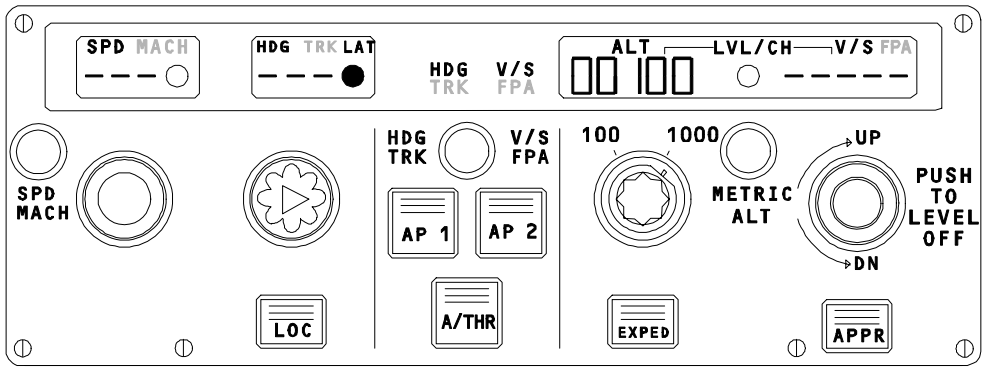
NOTE: The tropopause (TROPO) altitude default value is 36090 ft, but may be changed if necessary.



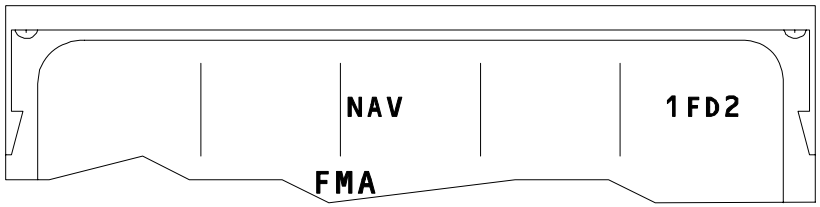
Multipurpose Control and Display Unit (MCDU)



ELEC control panel



Flight Control Unit (FCU)



Primary Flight Display (PFD)

FMGS COCKPIT PREPARATION – INITIALIZATION

EFFECTIVITY
ALL

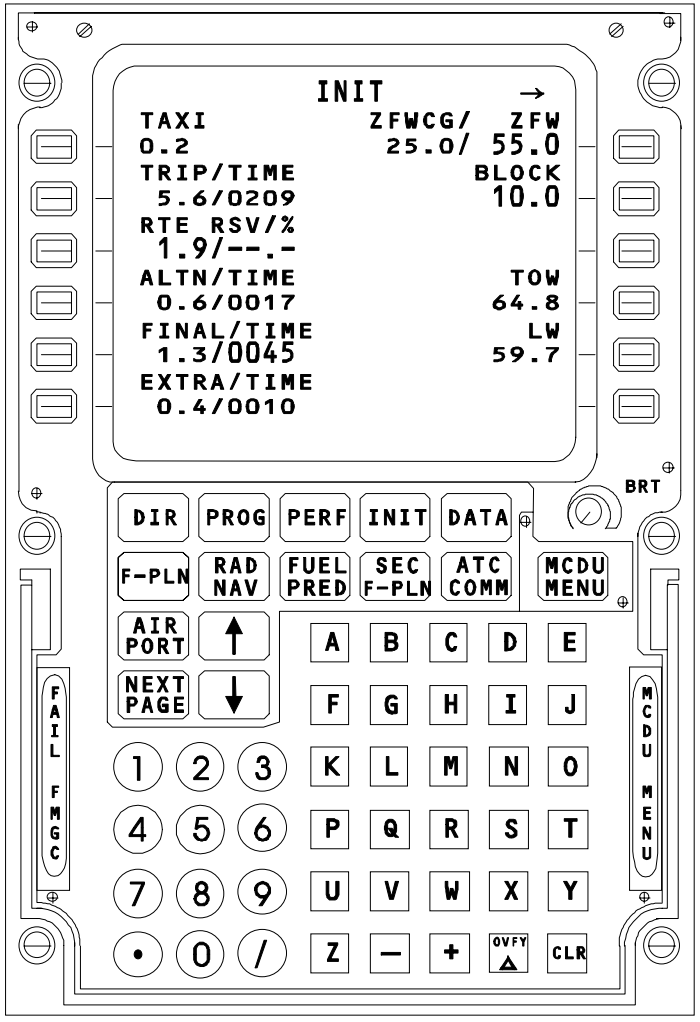
22-70-00

UFF4200
TMUFM3301-P02 LEVEL 3

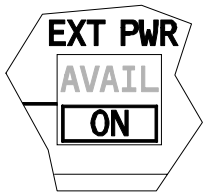
FMGS COCKPIT PREPARATION

INITIALIZATION (CONTINUED)

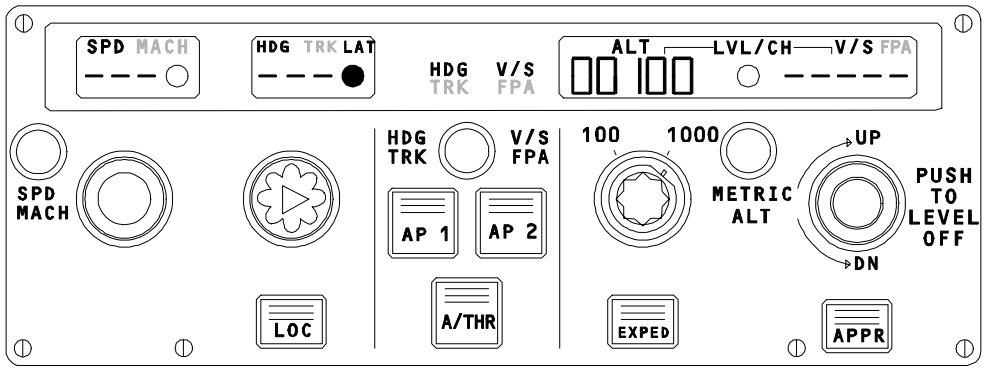
INIT page B is obtained from INIT page A by pressing the NEXT PAGE key on the MCDU.
A Zero Fuel Weight (ZFW) of 55 tons is entered and inserted.
A BLOCK fuel of 10 tons is entered and inserted.
The BLOCK entry initiates a fuel prediction computation.



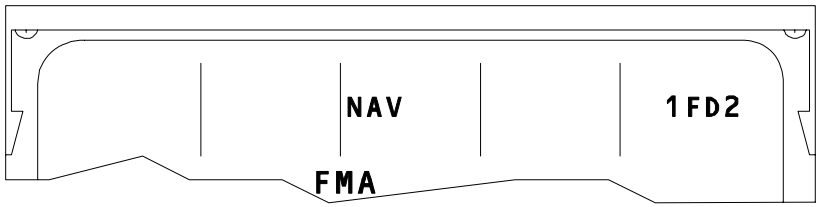
Multipurpose Control and Display Unit (MCDU)



ELEC control panel



Flight Control Unit (FCU)



Primary Flight Display (PFD)

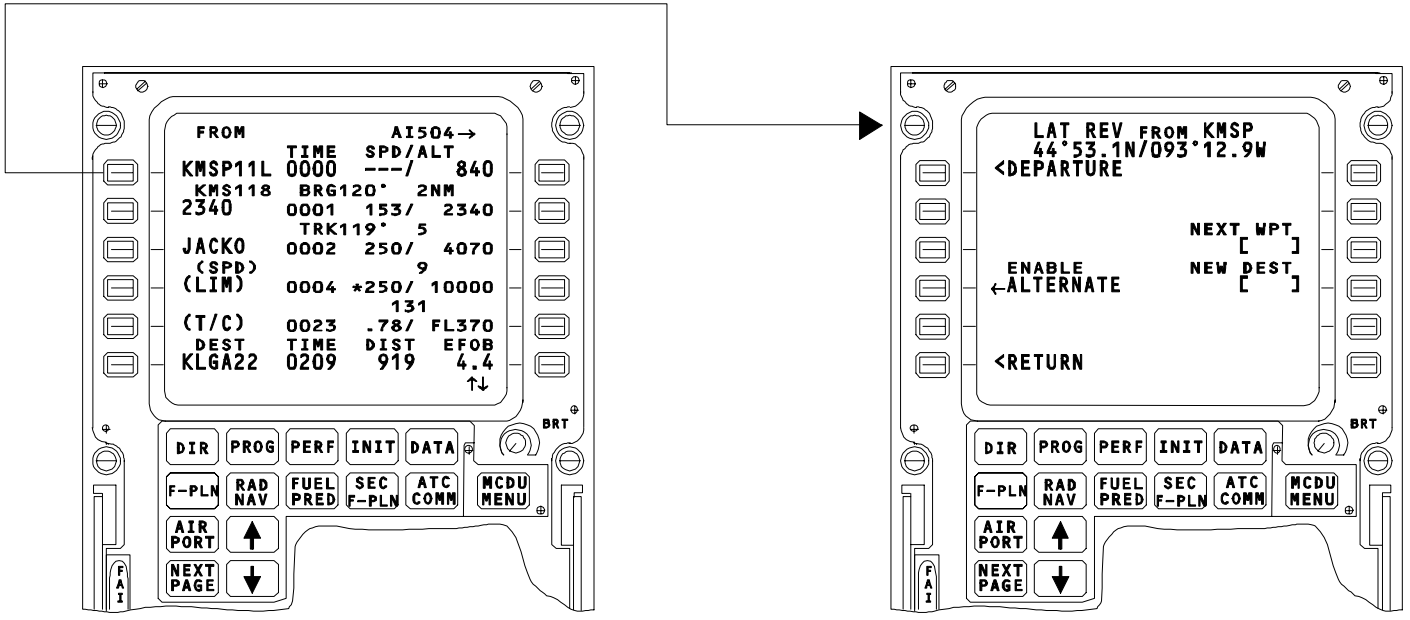
FMGS COCKPIT PREPARATION – INITIALIZATION (CONTINUED)

EFFECTIVITY
ALL

FMGS COCKPIT PREPARATION

RUNWAY CHANGE

The active runway is different from the one included in the company route. Therefore, the designated origin runway needs to be changed before inserting the critical speeds for Take-Off.
The runway included in the company route is 11L and the active one is 29L.
To change the runway in the flight plan, the F-PLN key is pressed first on the MCDU.
Flight plan page A is then displayed.
On this page, the Line Select Key, adjacent to the runway (KMSP11L) contained in the company route, is pressed.
This selection, called a lateral revision, from the current runway gives you access to the LAT REV page at origin.
From it, and by pressing the Line Select Key adjacent to the DEPARTURE prompt, you get access to the departure data.



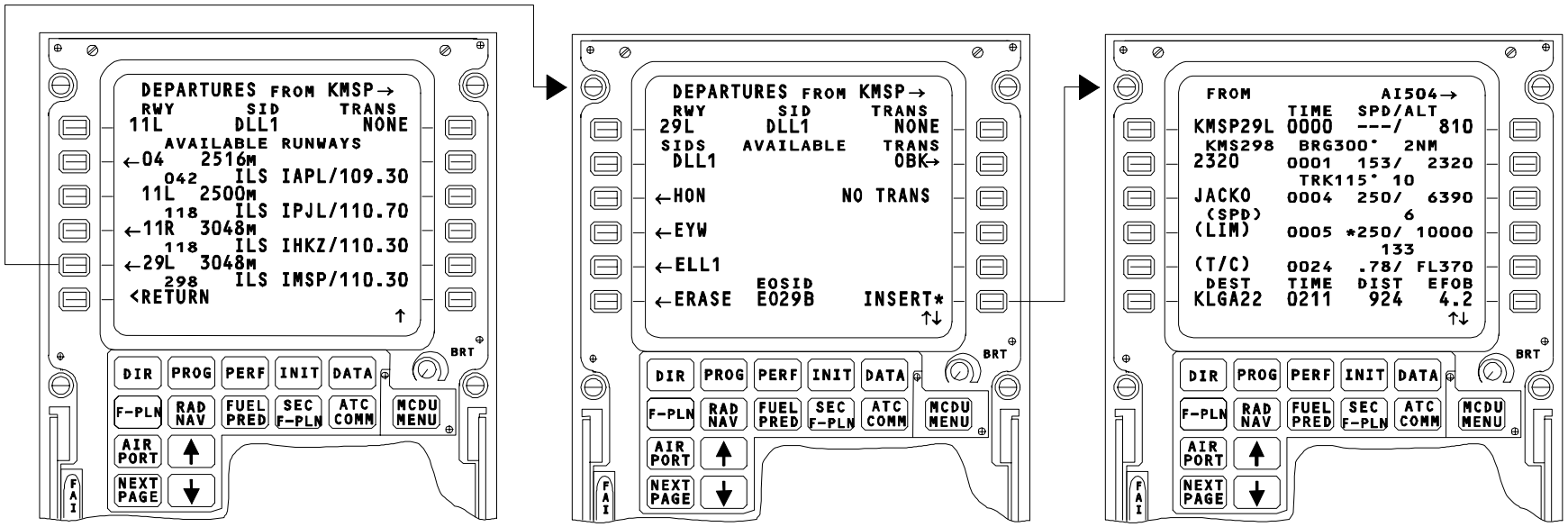
FMGS COCKPIT PREPARATION – RUNWAY CHANGE

EFFECTIVITY
ALL

FMGS COCKPIT PREPARATION

RUNWAY CHANGE (CONTINUED)

A first DEPARTURE page with available runways (RWYs) appears.
As you can see, runway 11L and its associated Standard Instrument Departure (SID) are preferential data of the company route. They are displayed in green because they are active. The remaining options are displayed in blue.
Runway 29L is selected by pressing the adjacent Line Select Key.
A second DEPARTURE page appears and allows selection of the Standard Instrument Departure for runway 29L.
On this page, yellow data indicates that the selections are temporary until their insertion into the flight plan.
By pressing the Line Select Key adjacent to the INSERT prompt, insertion is done and the revised flight plan page is displayed.



FMGS COCKPIT PREPARATION – RUNWAY CHANGE (CONTINUED)

FMGS COCKPIT PREPARATION

PERFORMANCE

TAKE OFF page is obtained by pressing the PERF key on the MCDU.
Given values on the RTOLW (Regular Take-Off and Landing Weight charts) are:

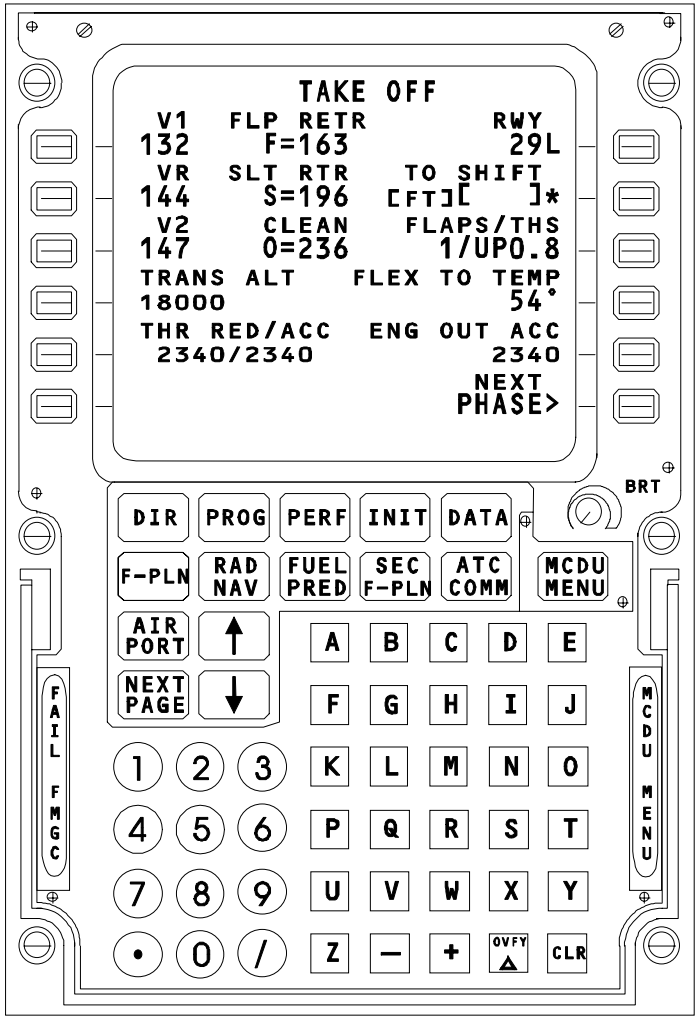
- V1: 132 knots (Critical engine failure speed),
- VR: 144 knots (Rotation speed),
- V2: 147 knots (Take-Off safety speed).

The given critical speeds for Take-Off are entered and inserted.

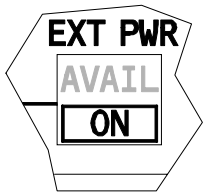
NOTE: The V1 and V2 speeds have appeared on the speed scale of the PFD, and speed managed function is active on the FCU as indicated by its related white light.

A flexible Take-Off temperature of 54 degrees is entered and inserted.
Flaps retraction speed (F), slats retraction speed (S) and Green dot speed (O) are computed by the Flight Management and Guidance Computer (FMGC) from the Take-Off Gross Weight if it is available, otherwise dashes are displayed and no computation is provided. They are displayed in green and can not be modified through the TAKE OFF page.
TO SHIFT: It is used to take into account a runway length change for an accurate FM position updating at Take-Off power setting.
FLAPS/THS: Reminder for the flaps and Trimmable Horizontal Stabilizer positions.

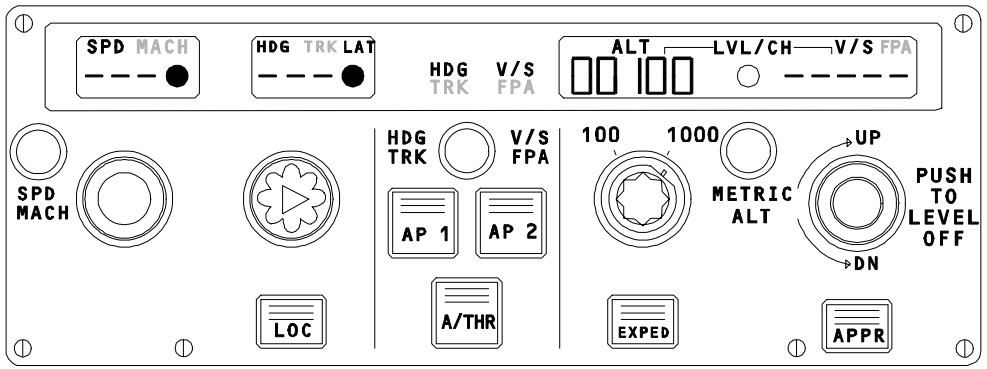
The thrust reduction (THR RED) altitude and the acceleration (ACC) altitude depend on the runway. They have a common default value (in this example, 2340 ft) but may be modified.



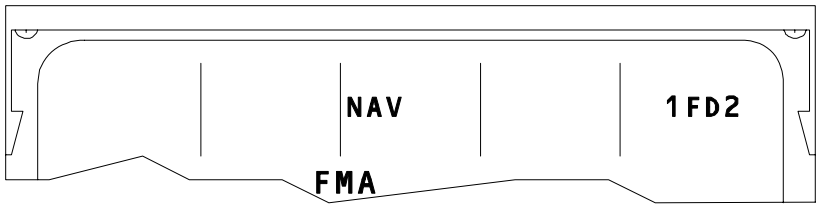
Multipurpose Control and Display Unit (MCDU)



ELEC control panel



Flight Control Unit (FCU)



Primary Flight Display (PFD)

FMGS COCKPIT PREPARATION - PERFORMANCE

EFFECTIVITY
ALL

22-70-00

UFF4200
TMUFM3301-P06 LEVEL 3

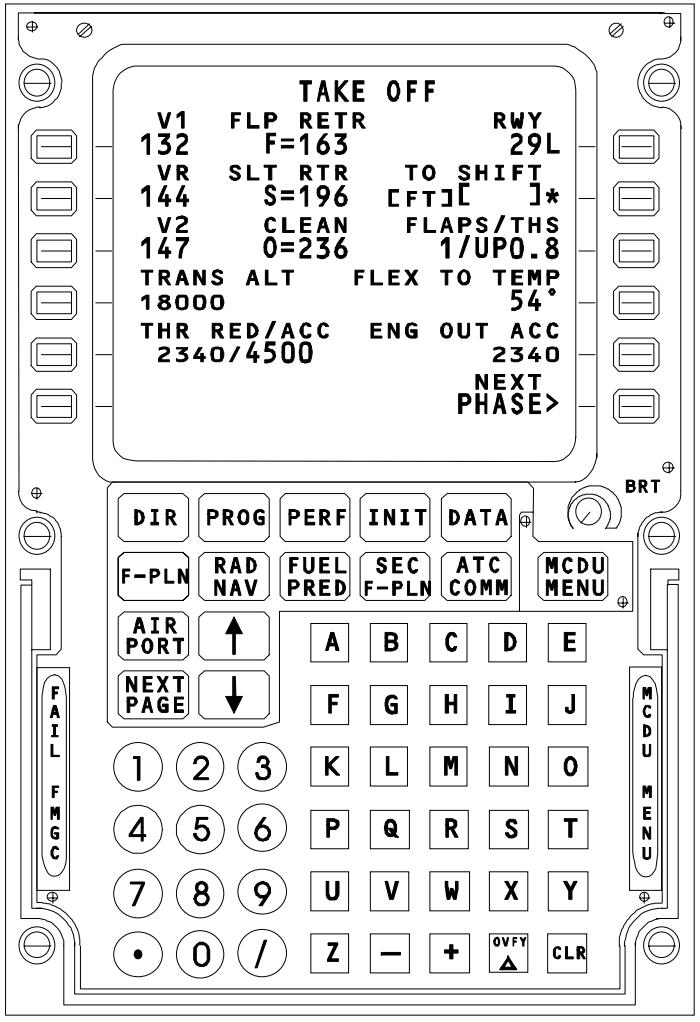
FMGS COCKPIT PREPARATION

PERFORMANCE (CONTINUED)

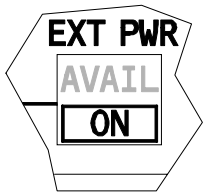
A new acceleration altitude of 4500 ft is entered and inserted.

NOTE: Pilot entries and modifiable data are displayed in large font. Default, computed and non modifiable data are displayed in small font.

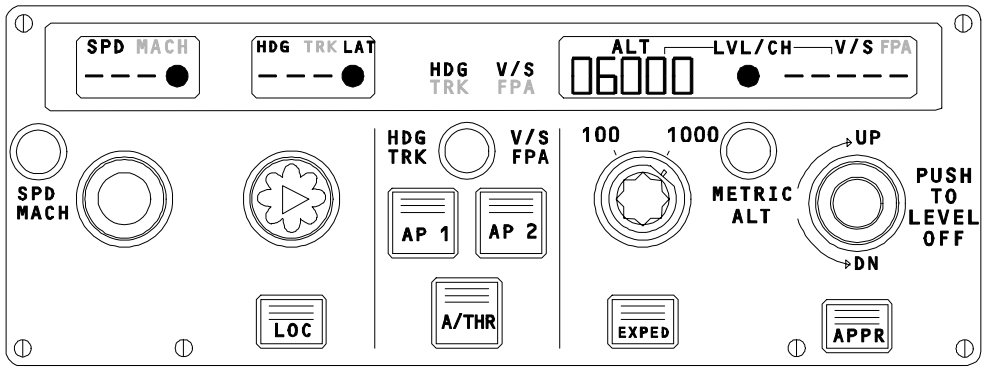
From the Standard Instrument Departure, you know the first altitude and this must be set on the FCU.
First cleared altitude is 6000 feet.
Provided that the altitude selected on the FCU is higher than the acceleration altitude, the white level change light on the FCU comes on and the climb (CLB) mode becomes armed.
CLB mode will engage when reaching the acceleration altitude (if NAV mode is engaged).



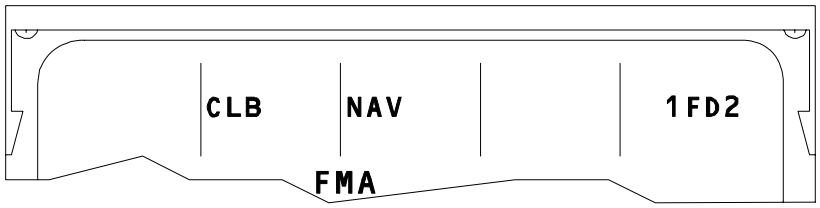
Multipurpose Control and Display Unit (MCDU)



ELEC control panel



Flight Control Unit (FCU)



Primary Flight Display (PFD)

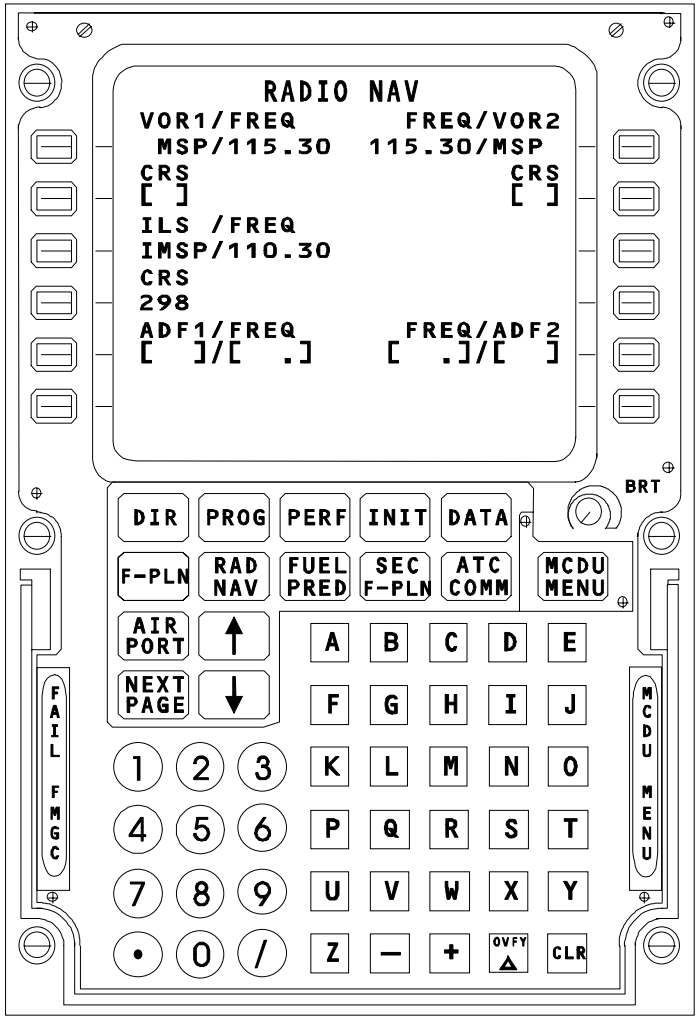
FMGS COCKPIT PREPARATION – PERFORMANCE (CONTINUED)

EFFECTIVITY
ALL

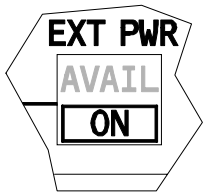
FMGS COCKPIT PREPARATION

RADIO NAVIGATION

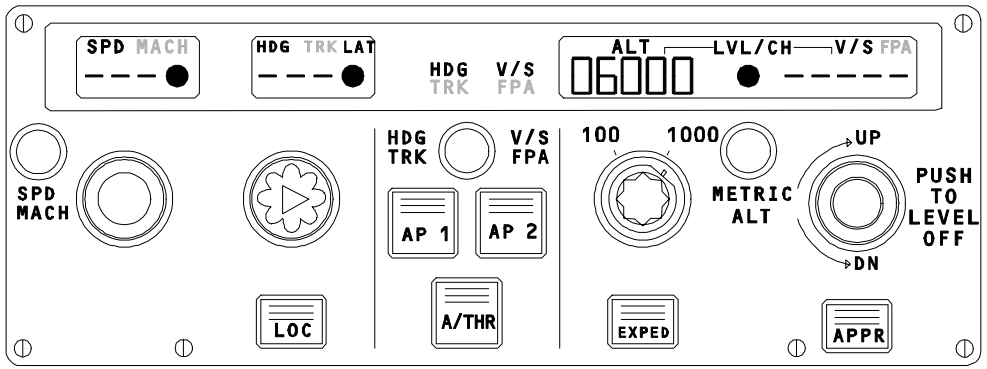
A radio navigation aids check must be performed on the RADIO NAV page before departure.
This page is accessed by pressing the RAD NAV key on the MCDU.
The FMGC has automatically selected the first encountered VOR/DME for NAV updating purposes, and the ILS associated with the selected runway for guidance purposes.
The FMGS cockpit preparation is completed.



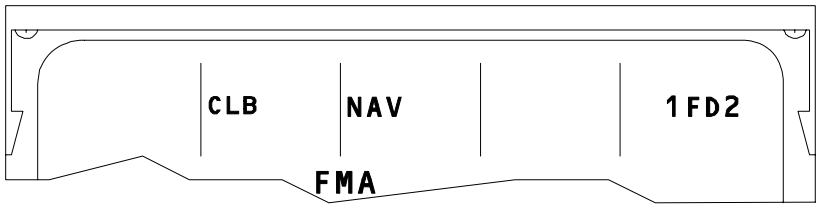
Multipurpose Control and Display Unit (MCDU)



ELEC control panel



Flight Control Unit (FCU)



Primary Flight Display (PFD)

FMGS COCKPIT PREPARATION – RADIO NAVIGATION

EFFECTIVITY
ALL

UFF4200
TMUFM3301-P08 LEVEL 3

SELF EXAMINATION

Thrust reduction and acceleration altitudes have:
- A - a common default value but may be modified.
- B - a common default value but can not be modified.
- C - no default values and may be modified.

Runway changes should be performed:
- A - on the TAKE OFF page.
- B - only by re-aligning the Inertial Reference Systems to the new runway coordinates.
- C - by making a lateral revision from the currently displayed runway on the flight plan page.

V2 speed is entered on the:
- A - FCU.
- B - MCDU TAKE OFF page.
- C - MCDU flight plan page.

If no company route exists in the data base for your flight, what must be done on INIT page A?
- A - Insert the LAT and LONG values of your present position and the identifier in the TO box.
- B - Give the origin and destination identifiers in the FROM/TO boxes.
- C - Insert the origin identifier in the FROM box and the LAT and LONG values of your destination.

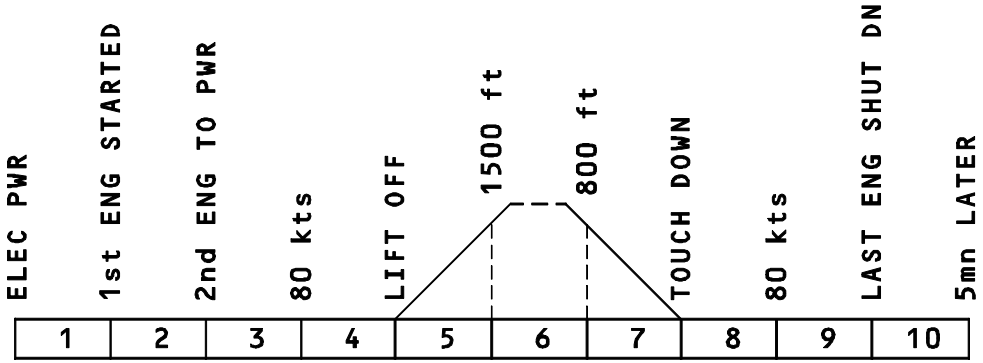
Pressing the ALIGN IRS Line Select Key on INIT page A?
- A - speeds up the alignment process of the three Inertial Reference Systems.
- B - initializes the alignment process of the three Inertial Reference Systems.
- C - completes the alignment process of the three Inertial Reference Systems using the coordinates of the origin airport.

Zero Fuel Weight is entered:
- A - on the PERF page.
- B - on INIT page A.
- C - on INIT page B.

22 - AUTO FLIGHT SYSTEM

22-00-00 FMGS WARNINGS

CONTENTS:



FAILURE TITLE	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLIGHT PHASE INHIBITION
AP OFF	CAVALRY CHARGE	MASTER WARN	NIL	NIL	—
Failure of both FDs (No ECAM message)	NIL	NIL	NIL	red FD flag on PFDs	—
A/THR OFF	SINGLE CHIME	MASTER CAUT	NIL	NIL	1, 4, 8, 10
A/THR limited	SINGLE CHIME	MASTER CAUT	NIL	NIL	1, 2, 3, 4, 8, 9, 10
Capacity change	TRIPLE CLICK	NIL	NIL	NIL	2, 3, 4, 5, 8, 9, 10
FCU 1 (2) FAULT	NIL	NIL	NIL	NIL	3, 4, 5, 7, 8
FCU 1+2 FAULT	SINGLE CHIME	MASTER CAUT	NIL	NIL	3, 4, 5, 7, 8
MCDU failure (No ECAM message)	NIL	NIL	NIL	amber FAIL annunciator on the failed MCDU	—

FMGS WARNINGS

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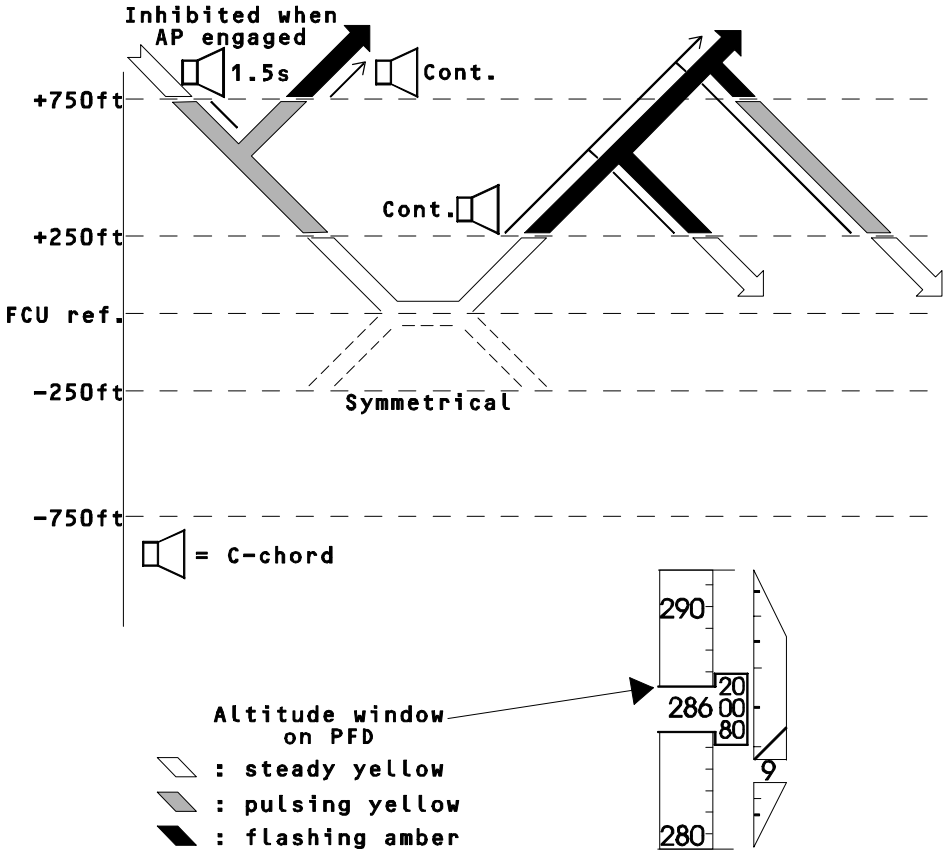
FMGS WARNINGS

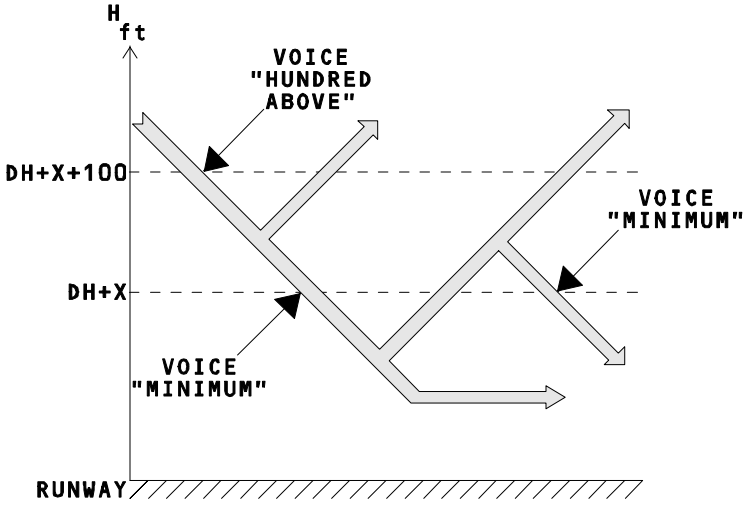
ALTITUDE ALERT

The altitude alert takes into account the difference between the aircraft altitude and the reference altitude selected on the FCU.
It has an effect on the altitude window of the PFD and can trigger the C-chord aural warning.
Altitude alert is inhibited by glide slope capture.
Altitude alert is cancelled by turning the FCU altitude knob, or by setting the landing gear lever to DOWN with slats extended or when the landing gear is downlocked.

DECISION HEIGHT (DH)

This warning corresponds to an audio call out by a synthetic voice, depending on the aircraft radio altitude and the Decision Height (DH).
X is equal to 15ft if DH is greater or equal to 90ft.
X is equal to 5ft if DH is less than 90ft.
"HUNDRED ABOVE" and/or "MINIMUM" warnings can be inhibited by pin programming.





FMGS WARNINGS - ALTITUDE ALERT / DECISION HEIGHT (DH)

FMGS WARNINGS

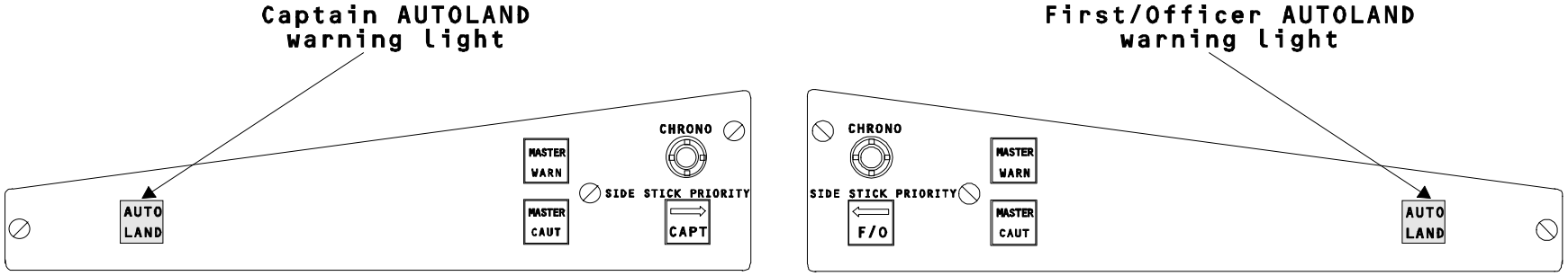
AUTOLAND

The AUTOLAND red warning informs the pilot that, depending on the procedures, he has to perform a go-around or a manual landing.
This warning can only be activated in LAND mode with at least one autopilot engaged.
The AUTOLAND red warning is triggered below 200ft in LAND mode in the following cases:

- Both AP OFF below 200ft RA.
- LOC excessive deviation (1/4 dot above 15ft RA) or GLIDE excessive deviation (1 dot above 100ft RA).
  LOC and GLIDE scales flash on the PFD.
- Loss of LOC signal above 15ft or loss of GLIDE signal above 100ft.
  The FD bars flash on the PFD. The LAND mode remains engaged.

A triple click aural warning is generated in the event of landing capacity downgrading.
The warning is cancelled by LOC mode or AP disengagement or by performing a go-around.

NOTE: A warning test can be performed by pressing the Captain or the First Officer AUTOLAND pushbutton.



FMGS WARNINGS - AUTOLAND

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22 - AUTO FLIGHT SYSTEM

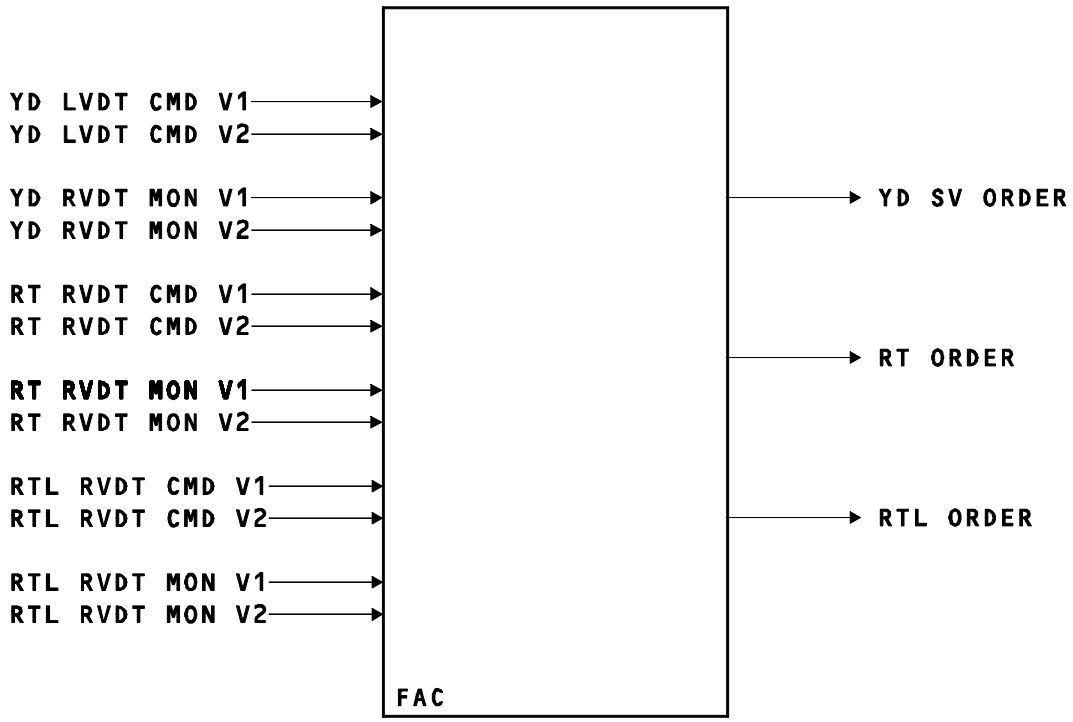
22-66-00 FAC INTERFACES

CONTENTS:

FAC INTERFACES

ANALOG INPUTS/OUTPUTS

The schematic shows the Flight Augmentation Computer (FAC) analog inputs and outputs.

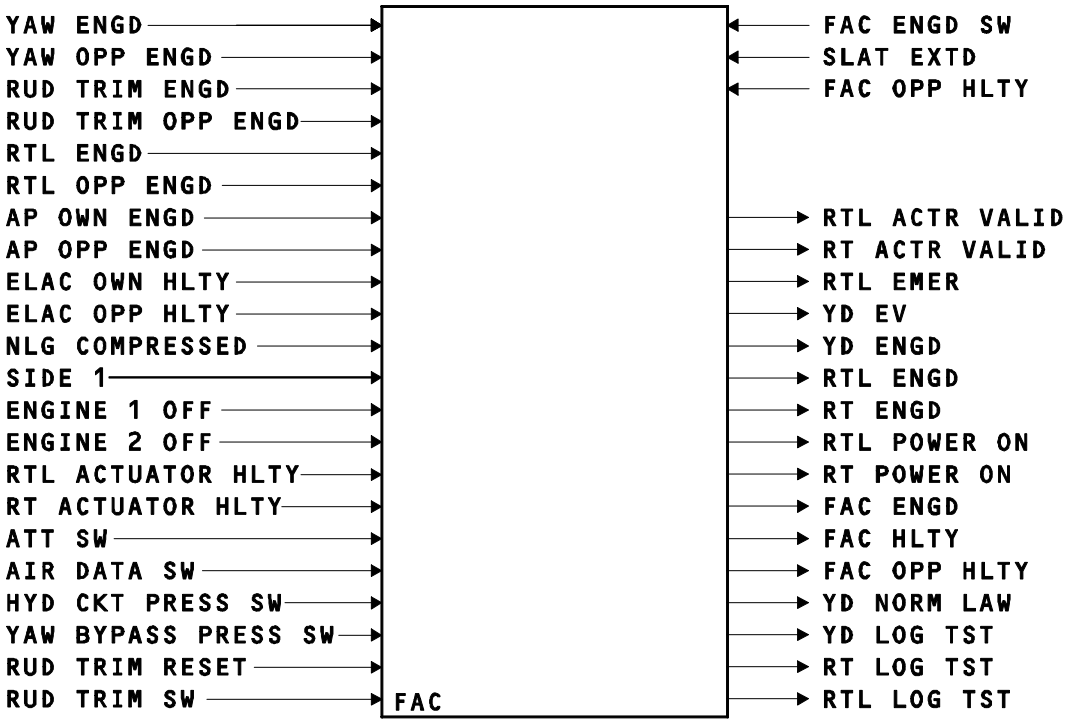


FAC INTERFACES – ANALOG INPUTS/OUTPUTS

FAC INTERFACES

DISCRETE INPUTS/OUTPUTS

The schematic shows the FAC discrete inputs and outputs.



FAC INTERFACES - DISCRETE INPUTS/OUTPUTS

UFF4200
TMUFACJ01-P02 LEVEL 3

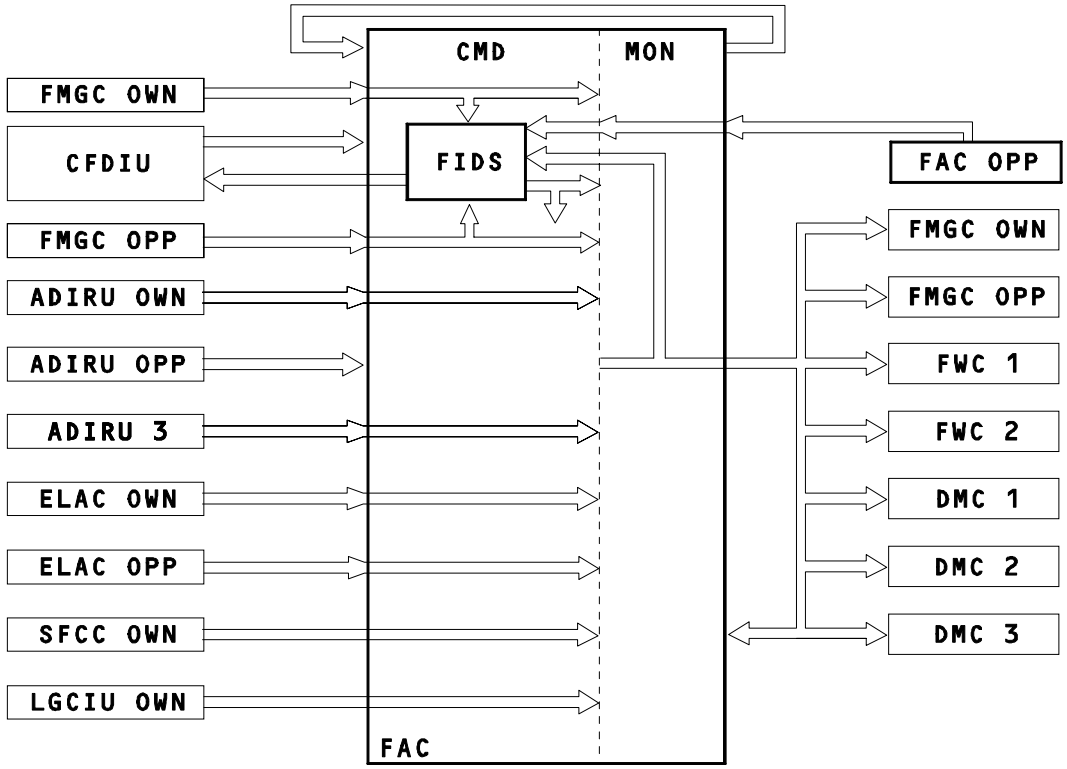
EFFECTIVITY
ALL

FAC INTERFACES

ARINC INPUTS/OUTPUTS

The FAC dialogues with the other components mainly through ARINC 429 digital buses.
The schematic shows the FAC input and output ARINC 429 buses.

NOTE : - The FAC data are transmitted to the other systems through the FAC main bus.
- The Fault Isolation and Detection System (FIDS) is only activated in FAC 1 by the SIDE 1 discrete signal.



FAC INTERFACES - ARINC INPUTS/OUTPUTS

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22 - AUTO FLIGHT SYSTEM

22-83-00 FMGC INTERFACES

CONTENTS:

FMGC INTERFACES

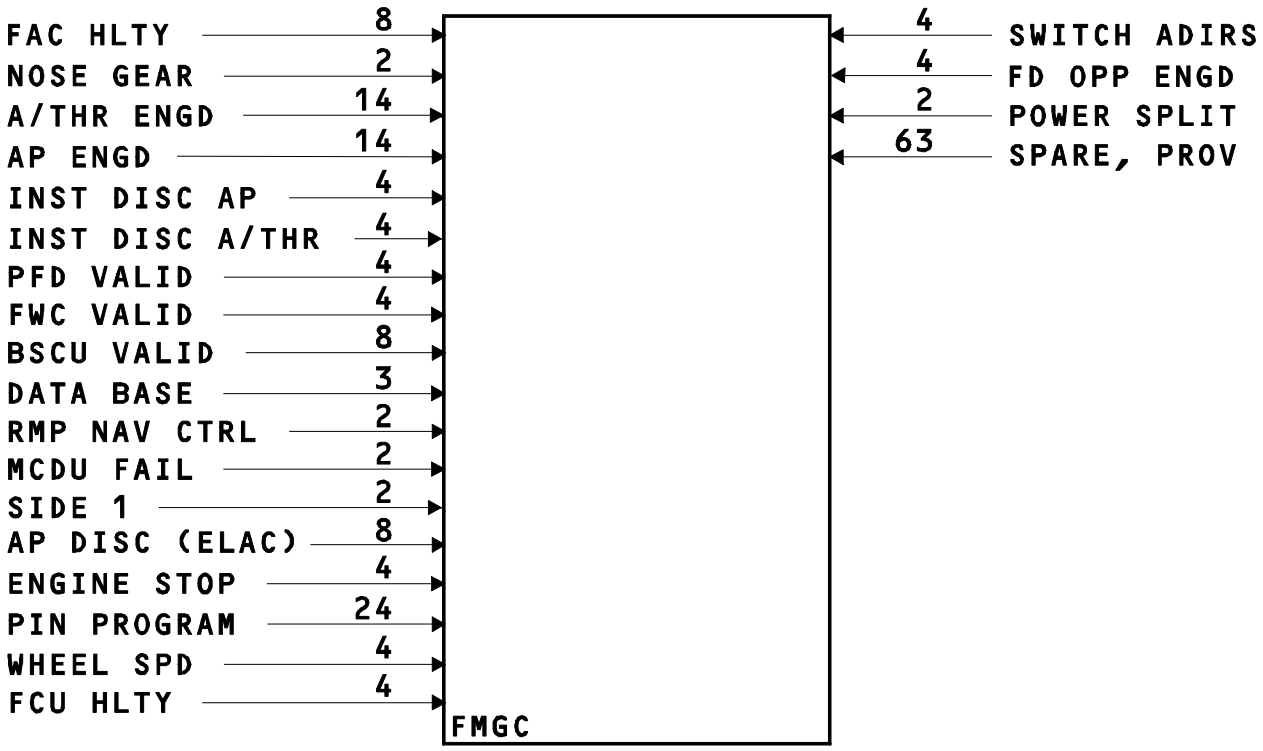
GENERAL

The Flight Management and Guidance Computer (FMGC) interfaces consist of discretes and ARINC 429 digital buses. There are no analog interfaces.

DISCRETE INPUTS

The schematic shows all types of information received by the FMGC under discrete form. All types of information are represented but the schematic is simplified; each arrow corresponds to several wires, the number of which is indicated on the schematic.

NOTE: - The validity discretes (e.g.: FWC VALID) are generally used to consolidate the ARINC 429 information in the internal logics of the FMGC.
- INST DISC AP comes from the takeover pushbutton on sidesticks.
- SIDE 1 = 1 for FMGC 1,
  SIDE 1 = 0 for FMGC 2.
- AP DISC (ELAC): AP disconnection order coming from ELAC 1 and 2.



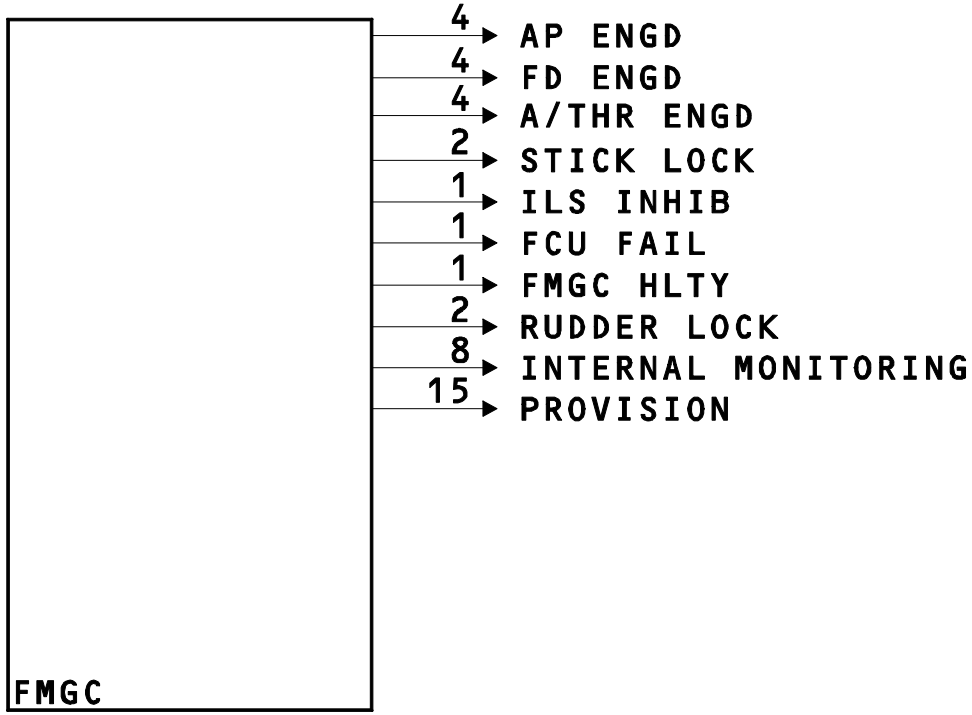
FMGC INTERFACES - DISCRETE INPUTS

FMGC INTERFACES

DISCRETE OUTPUTS

The schematic shows the information sent by the FMGC under discrete form.
Generally, an arrow corresponds to several wires.
For example, STICK LOCK corresponds to 2 wires:
- one, 28V/open (28V meaning locked), sent by the FMGC command side,
- the other, ground/open (ground meaning locked), sent by the FMGC monitor side.

NOTE: - STICK LOCK: For sidestick locking.
- ILS INHIB: To inhibit ILS test.
- RUDDER LOCK: For rudder pedal locking.
- The watch dog is part of the internal monitoring.



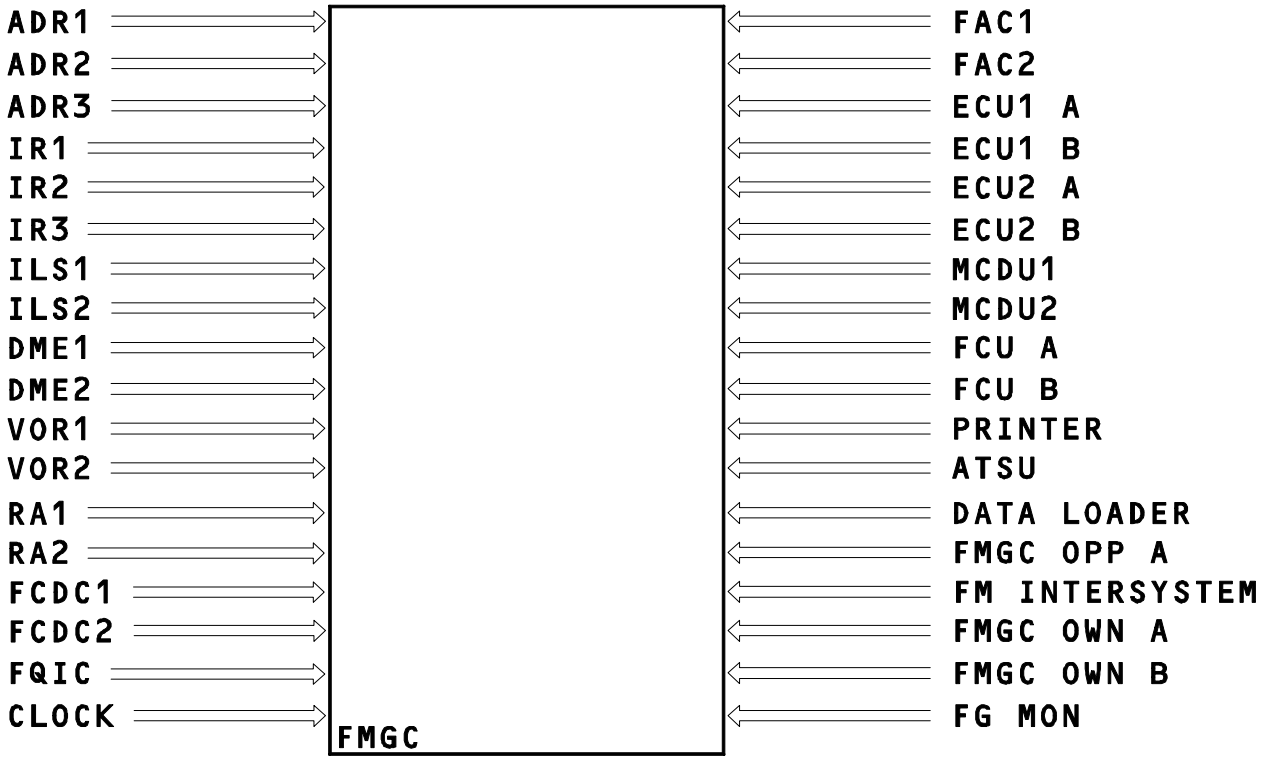
FMGC INTERFACES - DISCRETE OUTPUTS

FMGC INTERFACES

ARINC INPUTS

The schematic shows the FMGC input ARINC 429 buses.

NOTE: - OWN: Of the considered side.
- OPP: Of the opposite side.
- Air Data Reference (ADR) and Inertial Reference (IR) buses come from the ADIRS.
- FG MON is a bus coming from the FMGC monitor side and going to the command side of the same FMGC.



FMGC INTERFACES - ARINC INPUTS

UFF4200
TMUFGCG03-P03 LEVEL 3

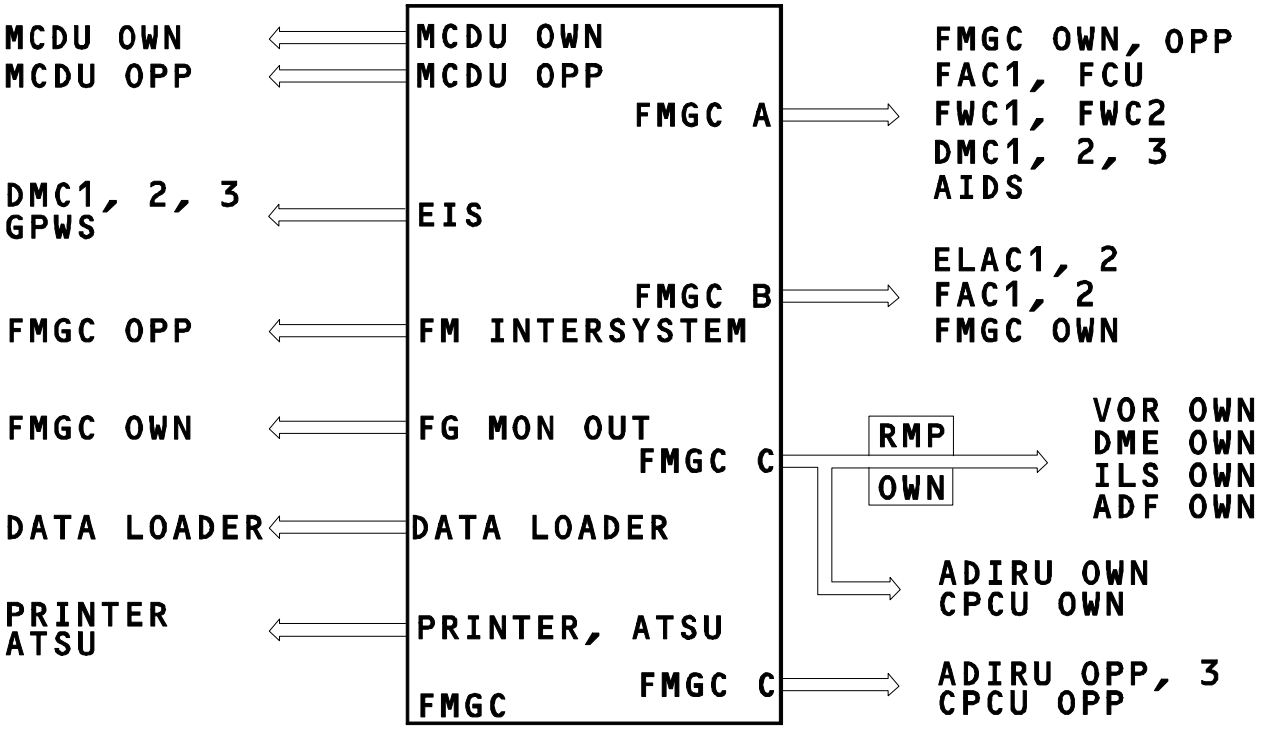
EFFECTIVITY
ALL

FMGC INTERFACES

ARINC OUTPUTS

The schematic shows the FMGC output ARINC 429 buses.

NOTE: There are 2 FMGC C buses because there are 2 output buffers.
One of them goes through the RMP, but it is cut when the RMP itself controls the radio navigation receivers.



FMGC INTERFACES - ARINC OUTPUTS

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22 - AUTO FLIGHT SYSTEM

22-80-00 FCU INTERFACES

CONTENTS:

FCU INTERFACES

GENERAL

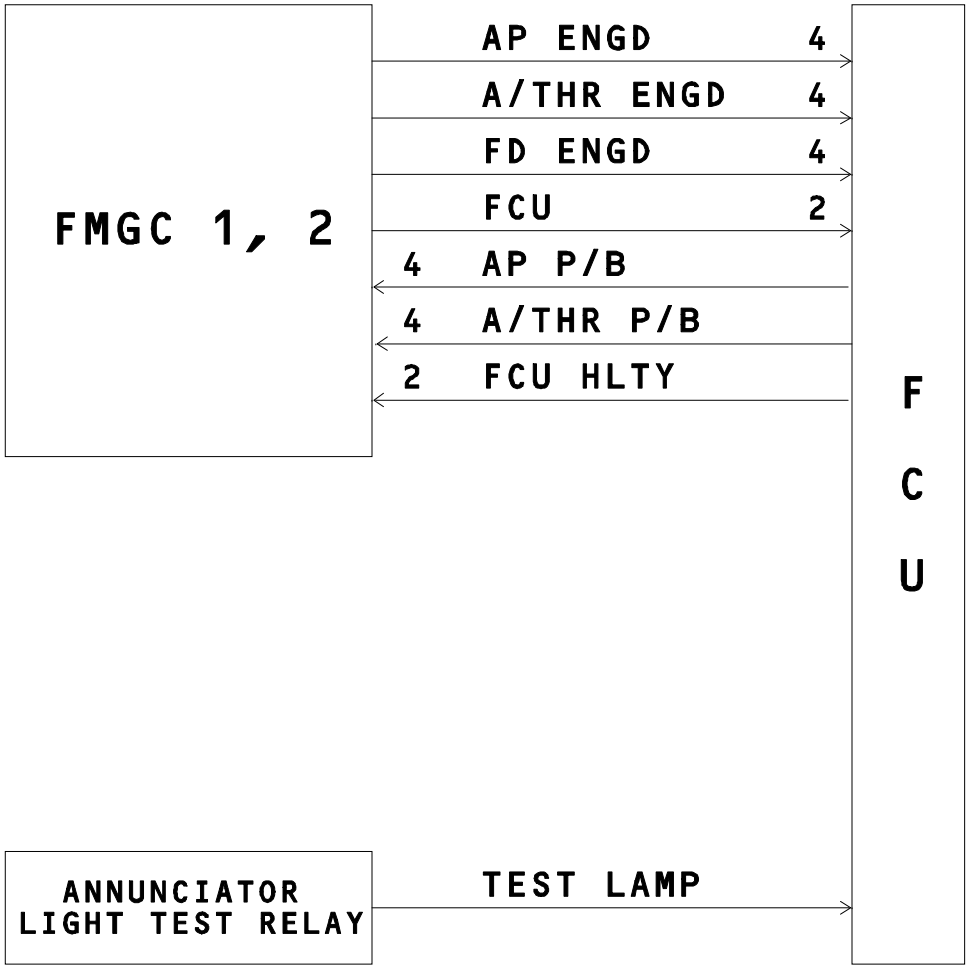
The Flight Control Unit (FCU) interfaces consist of discretes and ARINC 429 digital buses. There are no analog interfaces.

DISCRETE INPUTS

The Flight Management and Guidance Computers (FMGCs) send the autopilot (AP), Flight Director (FD) and autothrust (A/THR) engagement discretes to authorize the lighting of the associated pushbuttons on the FCU front panel.
They also send the FCU FAIL discretes which are the result of the comparison between the FMGC EPR target sent to the FCU and the FCU EPR target sent to the Electronic Engine Controls (EECs).
The annunciator light test relay sends a discrete signal to test the FCU lamps.

DISCRETE OUTPUTS

The FCU delivers control data for AP1, AP2 and A/THR engagement to each FMGC. This data is directly issued from the engagement pushbuttons.
Each FCU processor sends its own FCU HLTY (healthy) signal to the FMGCs.



FCU INTERFACES - DISCRETE INPUTS/OUTPUTS

FCU INTERFACES

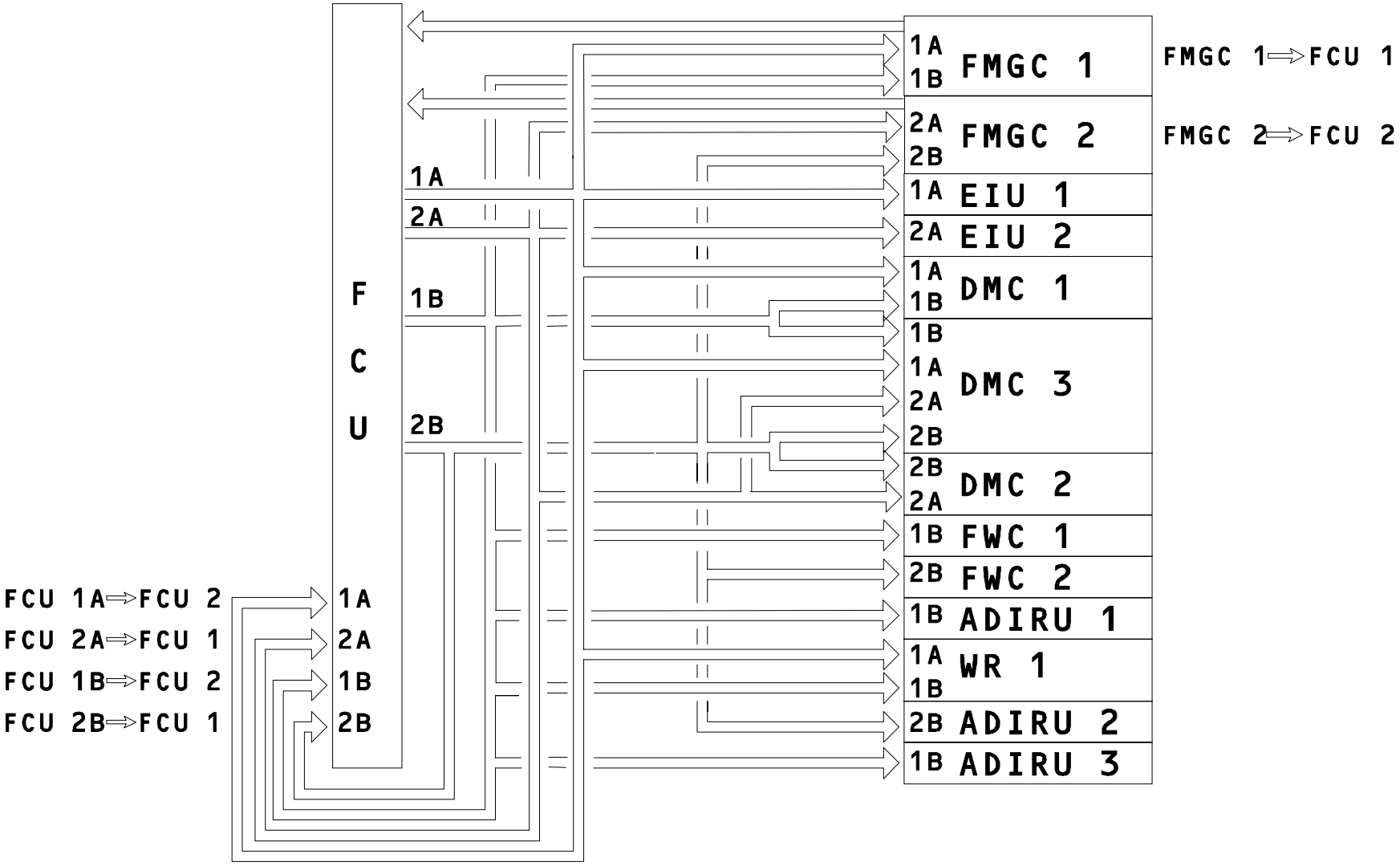
ARINC INPUTS

For synchronization and internal monitoring purposes, FCU output buses are looped back to the FCU on the respective opposite channels.
In order to avoid display modifications during reconfigurations, the non active channel of a given function, synchronizes on the values computed by the active channel.
Each FCU channel receives data, from its own FMGC on an ARINC bus, such as modes, functions, engagement status, thrust target for selection...

ARINC OUTPUTS

The FCU sends outputs on 4 ARINC bus. They are 1A, 1B, 2A, 2B.
Certain data transmitted by the FMGCs are fed back to the FMGCs through the FCU buses for comparison with the source data.
These buses also send data to :

- the Engine Interface Units (EIUs) to provide thrust target to the Electronic Engine Controls,
- the Air Data Inertial Reference Units (ADIRUs) and Weather Radar (WR) such as display information, range and mode, reference parameter selection...,
- the Display Management Computers (DMCs) for display such as baro setting, selected altitude...,
- the Flight Warning Computers (FWCs) for warnings such as selected altitude for altitude alert...



FCU INTERFACES – ARINC INPUTS/OUTPUTS

UFF4200
TMUFGCX03-P02 LEVEL 3

EFFECTIVITY
ALL

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22 - AUTOFLIGHT

22-80-00 MCDU INTERFACES

CONTENTS:

MCDU INTERFACES

GENERAL

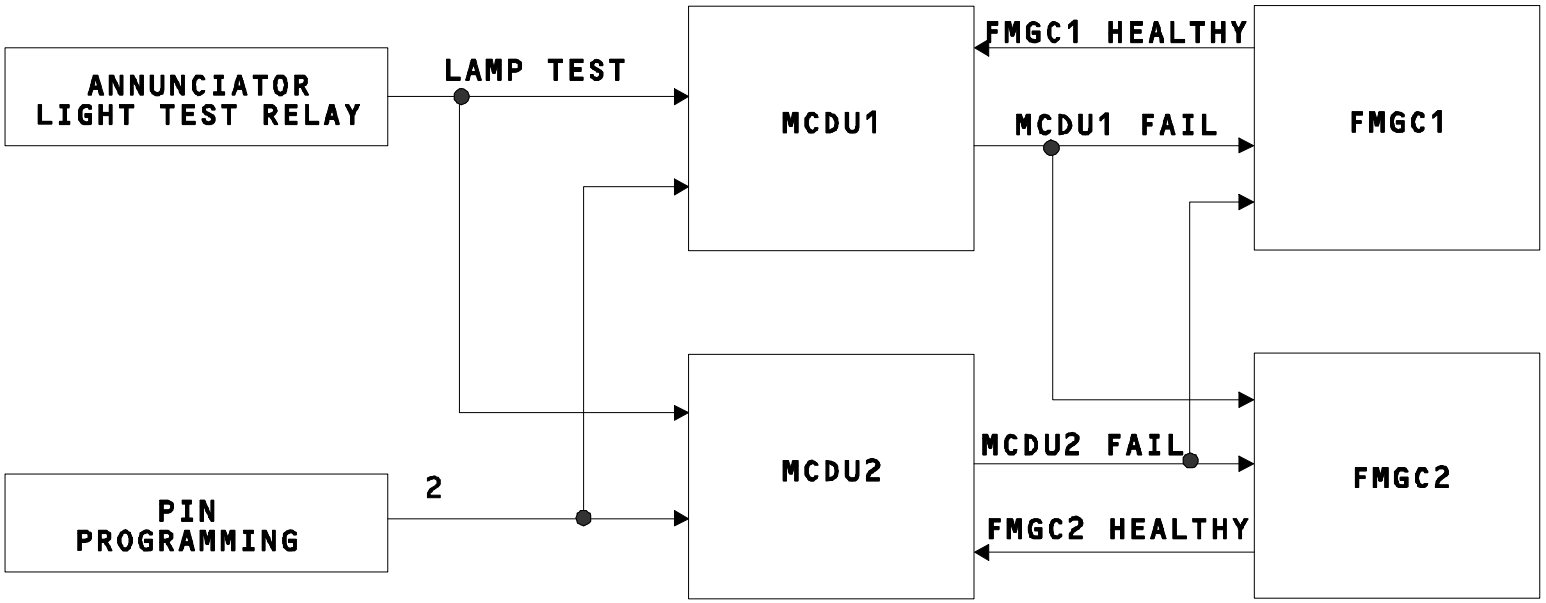
The Multipurpose Control and Display Unit (MCDU) interfaces consist of discretes and ARINC 429 digital buses.

DISCRETE INPUTS

The lights of each MCDU are tested via a discrete issued from the annunciator light test relay.
The position of the MCDU is defined by two program pins that are only read after long-term power cuts.
These pins define whether the MCDU is installed on the left side (MCDU1), or on the right side (MCDU2).
Each MCDU receives the state of its own Flight Management and Guidance Computer (FMGC) on the discrete FMGC HEALTHY.

DISCRETE OUTPUT

The FMGCs receive the MCDU FAIL signal from each MCDU.



MCDU INTERFACES - DISCRETE INPUTS/OUTPUT

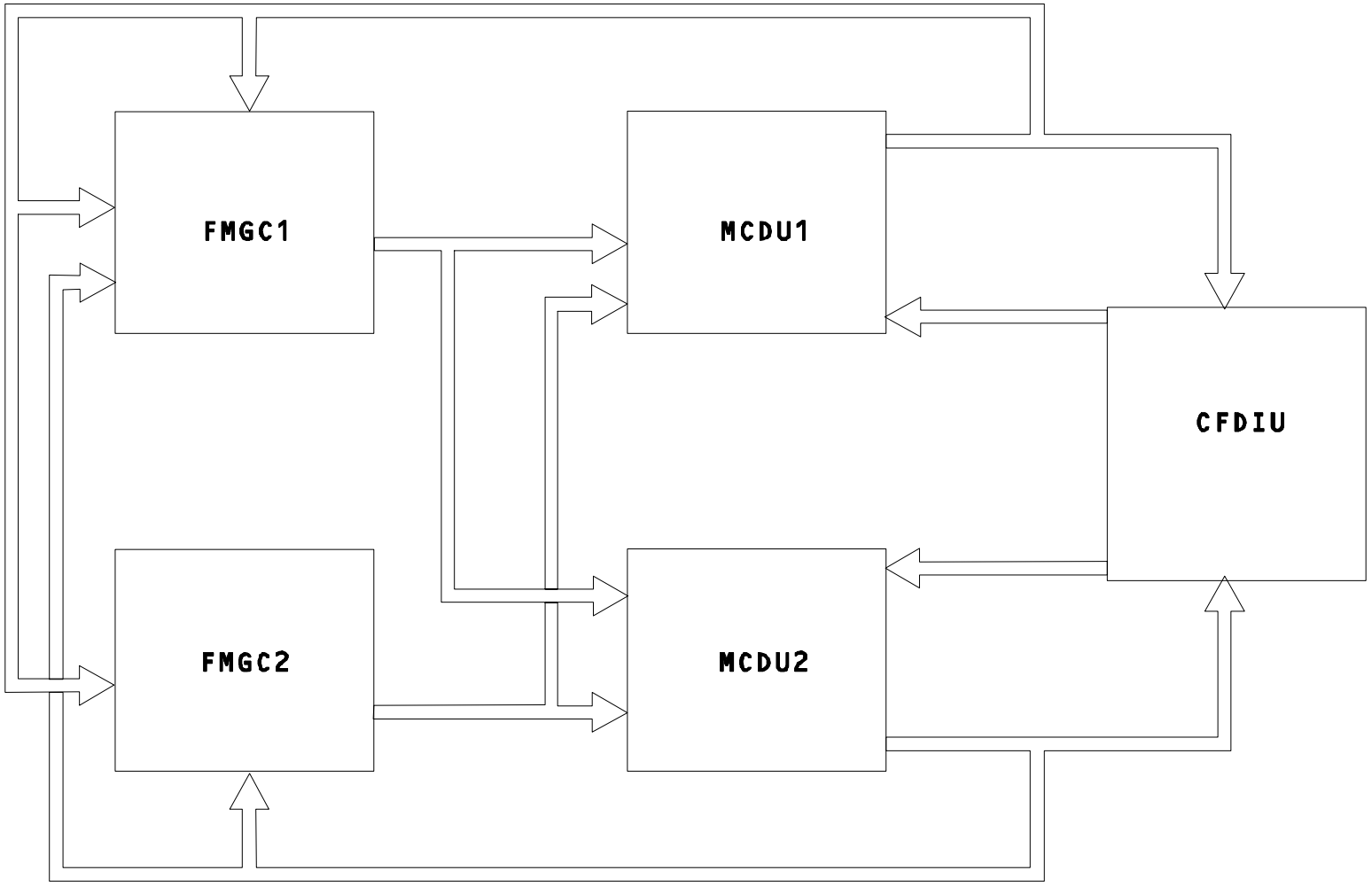
MCDU INTERFACES

ARINC INPUTS

The Centralized Fault Display Interface Unit (CFDIU) sends maintenance information to MCDUs 1 and 2.
CFDIU specific pages are then displayed (e.g. SYSTEM REPORT TEST). These CFDIU output buses allow the system test and the trouble shooting to be done.
Each FMGC transmits Flight Management data to each MCDU. This data is displayed on Flight Management specific pages.

ARINC OUTPUTS

MCDUs 1 and 2 send background and dynamic Electronic Instrument System (EIS) data to their associated FMGC. MCDUs 1 and 2 also transmit data, entered by the pilot, to the FMGCs and CFDIU. This data comprises messages and system interrogations.



MCDU INTERFACES - ARINC INPUTS/OUTPUTS

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22 - AUTO FLIGHT SYSTEM

22-00-00 AUTO FLIGHT SYSTEM COMPONENTS

CONTENTS:

AUTO FLIGHT SYSTEM COMPONENTS

FLIGHT AUGMENTATION COMPUTERS (FACs)

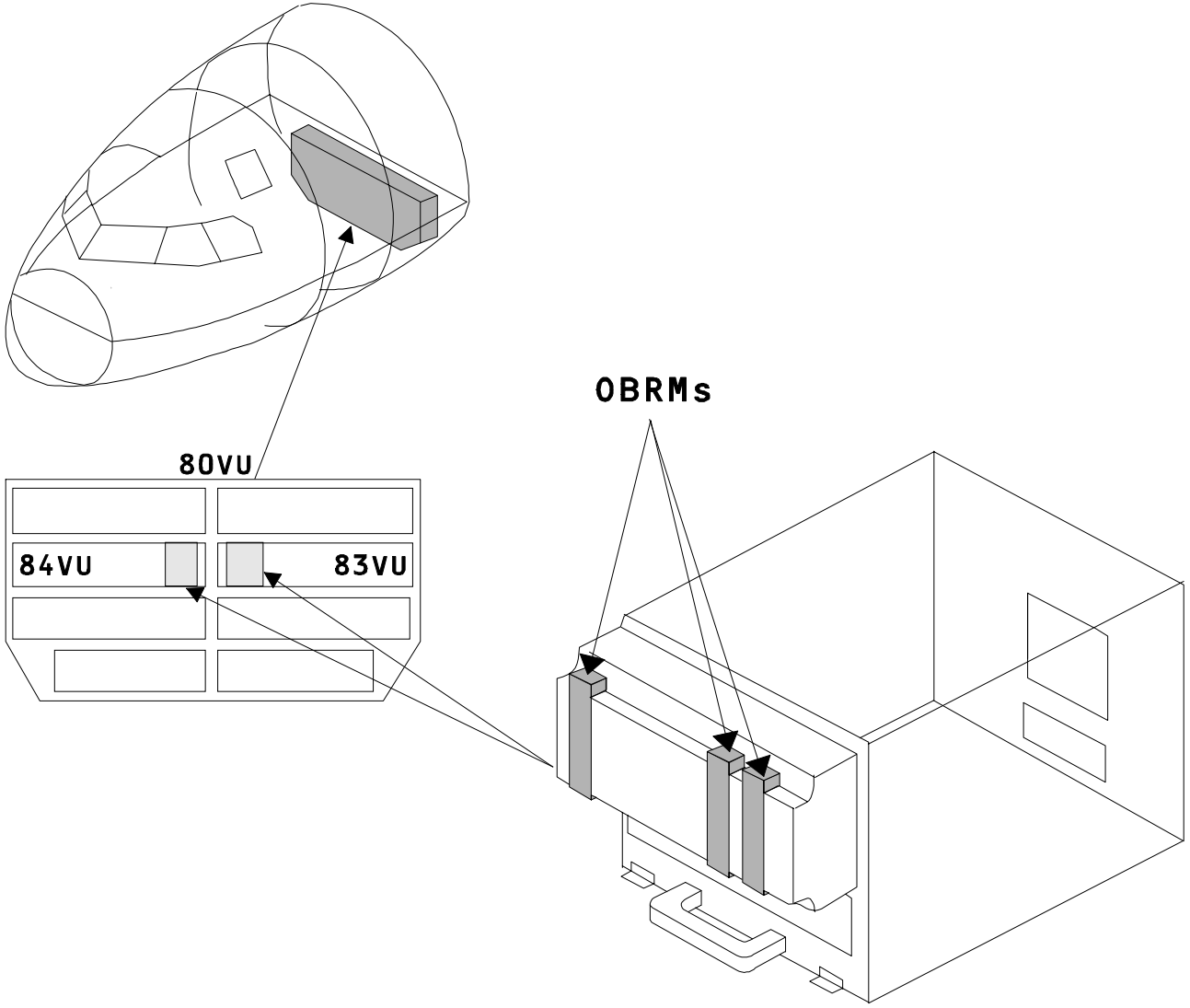
IDENTIFICATION
FIN: 1CC1, 1CC2

LOCATION
ZONE: 127, RACK 83VU (FAC1)
128, RACK 84VU (FAC2)

COMPONENT DESCRIPTION
The Flight Augmentation Computer (FAC) is an 8MCU size case in conformity with ARINC specification 600.
The FAC is of modular design.
The computer design is based on digital and analog technologies.
Some boards in the computer are equipped with a memory module, On Board Replaceable Memory (OBRM). Access to these modules is from the front face of the unit.
The computer is divided into three parts:

- Two virtually identical channels, the COMMAND channel and the MONITOR channel.
- One independent channel which performs the Fault Isolation and Detection System (FIDS) functions.

The COMMAND channel receives analog data, ARINC sensor data and discrete signals in order to compute the control laws. It then generates the flight commands used to drive the corresponding servo actuators.
The interfaces between the computer and the actuators, as well as the position feedbacks, are of the analog type.
Similarly, the MONITOR channel receives the sensor data required to compute the control laws.



AUTO FLIGHT SYSTEM COMPONENTS - FLIGHT AUGMENTATION COMPUTERS (FACs)

AUTO FLIGHT SYSTEM COMPONENTS

FLIGHT MANAGEMENT AND GUIDANCE COMPUTERS (FMGCs)

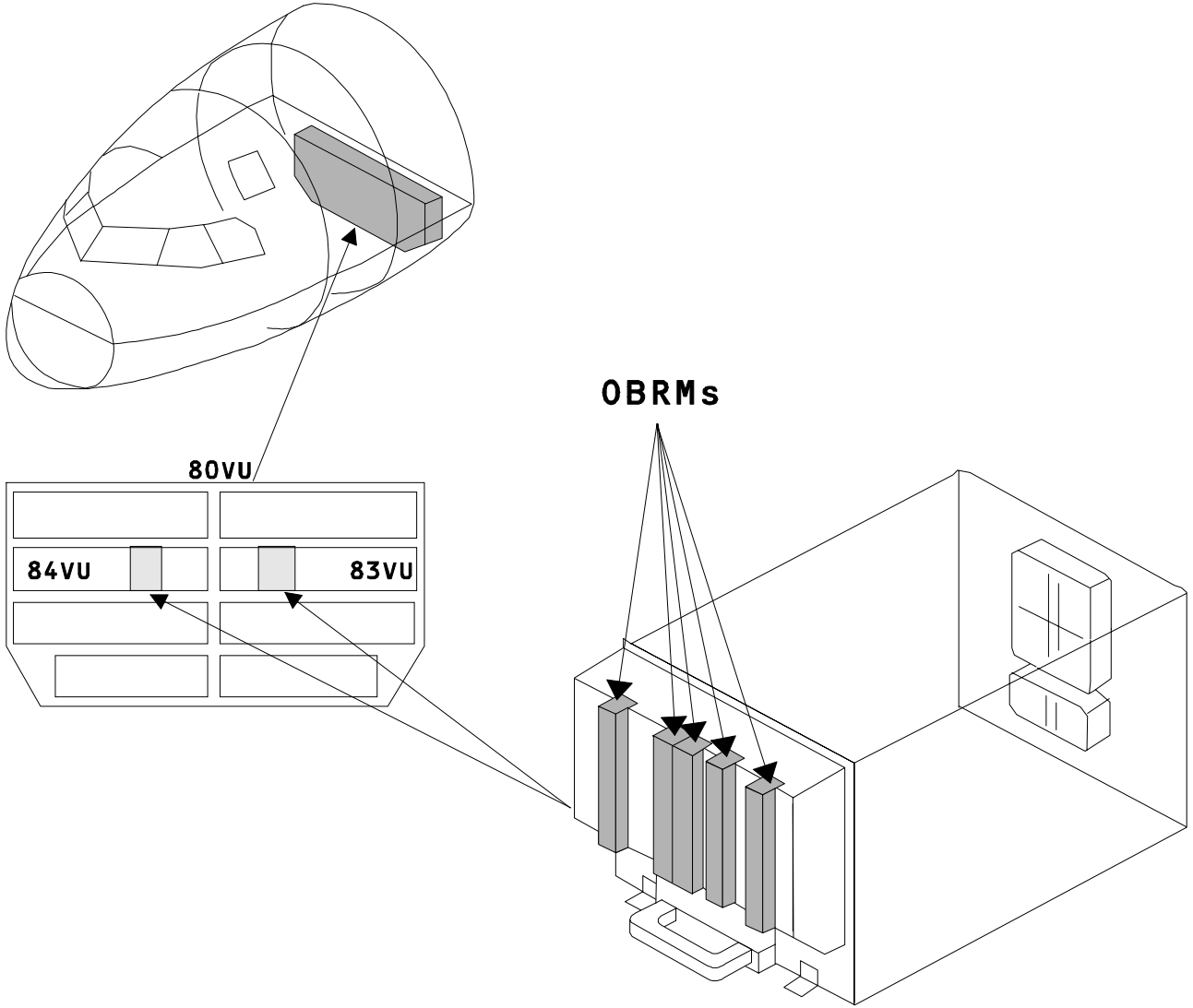
IDENTIFICATION
FIN: 1CA1, 1CA2

LOCATION
ZONE: 127, RACK 83VU (FMGC1)
128, RACK 84VU (FMGC2)

COMPONENT DESCRIPTION
The Flight Management and Guidance Computer (FMGC) is a digital computer of 8MCU size in conformity with ARINC specification 600.
It is to be noted that some boards in the computer are equipped with a memory module (OBRM). The access to these modules is from the outside of the unit.
The computer consists of two separate parts: A COMMAND channel and a MONITOR channel.
The COMMAND channel ensures two functions: The management of the flight and of the guidance.
The MONITOR channel only ensures the guidance function.
The two channels are physically separate:

- Each channel has its own power supply unit.
- The electronic boards assigned to each channel are located in different zones in the computer unit.
- The electrical routings are separate.
- The pin connections at the output connectors are duplicated and separate.

At software level, the programming languages of the COMMAND and MONITOR channels are different.
For the guidance function, the engage logic of the autopilot (AP), Flight Director (FD) and autothrust (A/THR) systems in COMMAND and MONITOR channels is achieved in hard-wired circuitry.



AUTO FLIGHT SYSTEM COMPONENTS - FLIGHT MANAGEMENT AND GUIDANCE COMPUTERS (FMGCs)

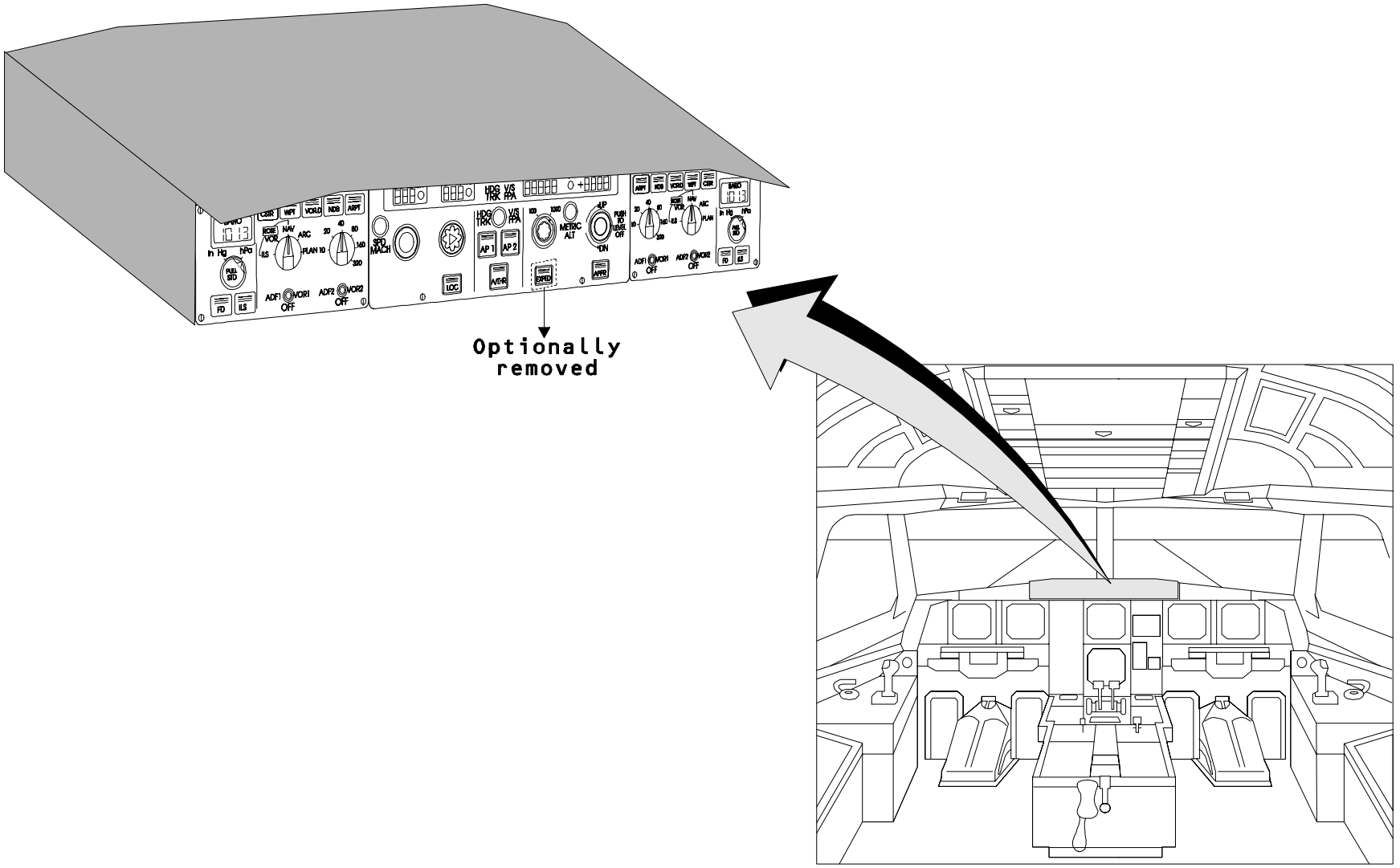
AUTO FLIGHT SYSTEM COMPONENTS

FLIGHT CONTROL UNIT (FCU)

IDENTIFICATION
FIN: 2CA

LOCATION
ZONE: 211, PANEL 13VU

COMPONENT DESCRIPTION
The Flight Control Unit (FCU) comprises the Auto Flight System (AFS) control section and the Electronic Flight Instrument System (EFIS) control sections. It is located on the glareshield.
The FCU consists of two identical totally independent computers.
The computers (SIDE 1 and SIDE 2) have separate power supplies.
They are built around an INTEL 80C31 8-bit microprocessor.
Each side is associated with the controls on the front panel of the unit.
The display is common to both sides, whereas the signals are routed via separate paths.



AUTO FLIGHT SYSTEM COMPONENTS - FLIGHT CONTROL UNIT (FCU)

AUTO FLIGHT SYSTEM COMPONENTS

MULTIPURPOSE CONTROL AND DISPLAY UNITS (MCDUs)

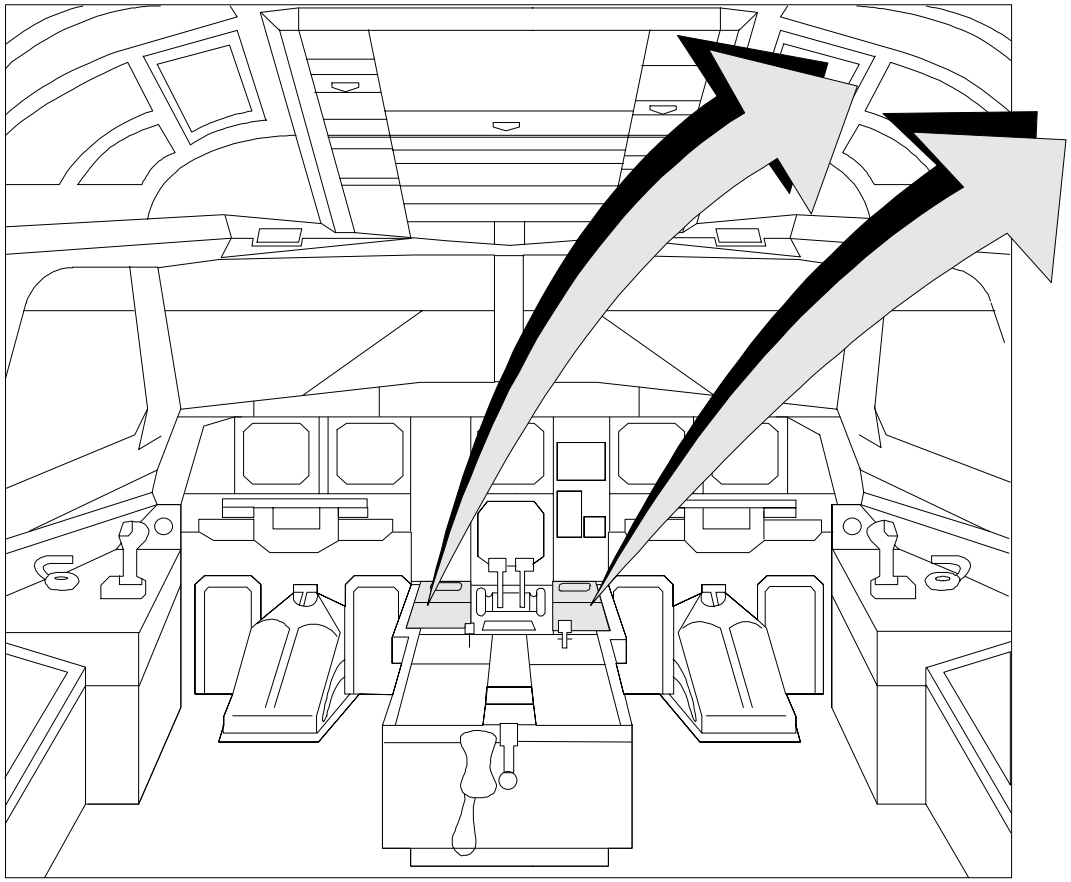
IDENTIFICATION
FIN: 3CA1, 3CA2

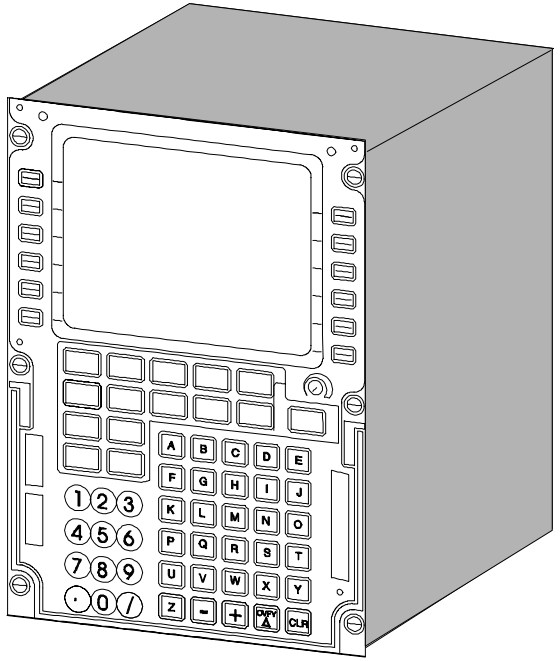
LOCATION
ZONE: 211, PANEL 11VU

COMPONENT DESCRIPTION
The Multipurpose Control and Display Units (MCDUs) provide access to the following:

- FMGC (Flight Management function),
- ATSU (Air Traffic Service Unit),
- AIDS (Aircraft Integrated Data System),
- CFDS (Centralized Fault and Display System).

They are composed of a keyboard and a screen for entry/display between the pilot or the line maintenance and the above systems.
The MCDU display contains 14 lines, each having 24 characters.
Of these 14 lines, the top line (line 1) is normally used as a title line or to display data to which the pilot does not have access. The bottom line (line 14) is the scratchpad line and is used by the pilot to alter the data in the data fields.
Lines 2 through 13 are data lines arranged into six pairs (lines 2-3, 4-5, 6-7, 8-9, 10-11, 12-13). Each pair of lines has a label line (the top of the two lines) and a data line. The data lines are adjacent to the line select keys, and the label line is just above the data line.
The line pairs are referenced by line select keys.





AUTO FLIGHT SYSTEM COMPONENTS - MULTIPURPOSE CONTROL AND DISPLAY UNITS (MCDUs)

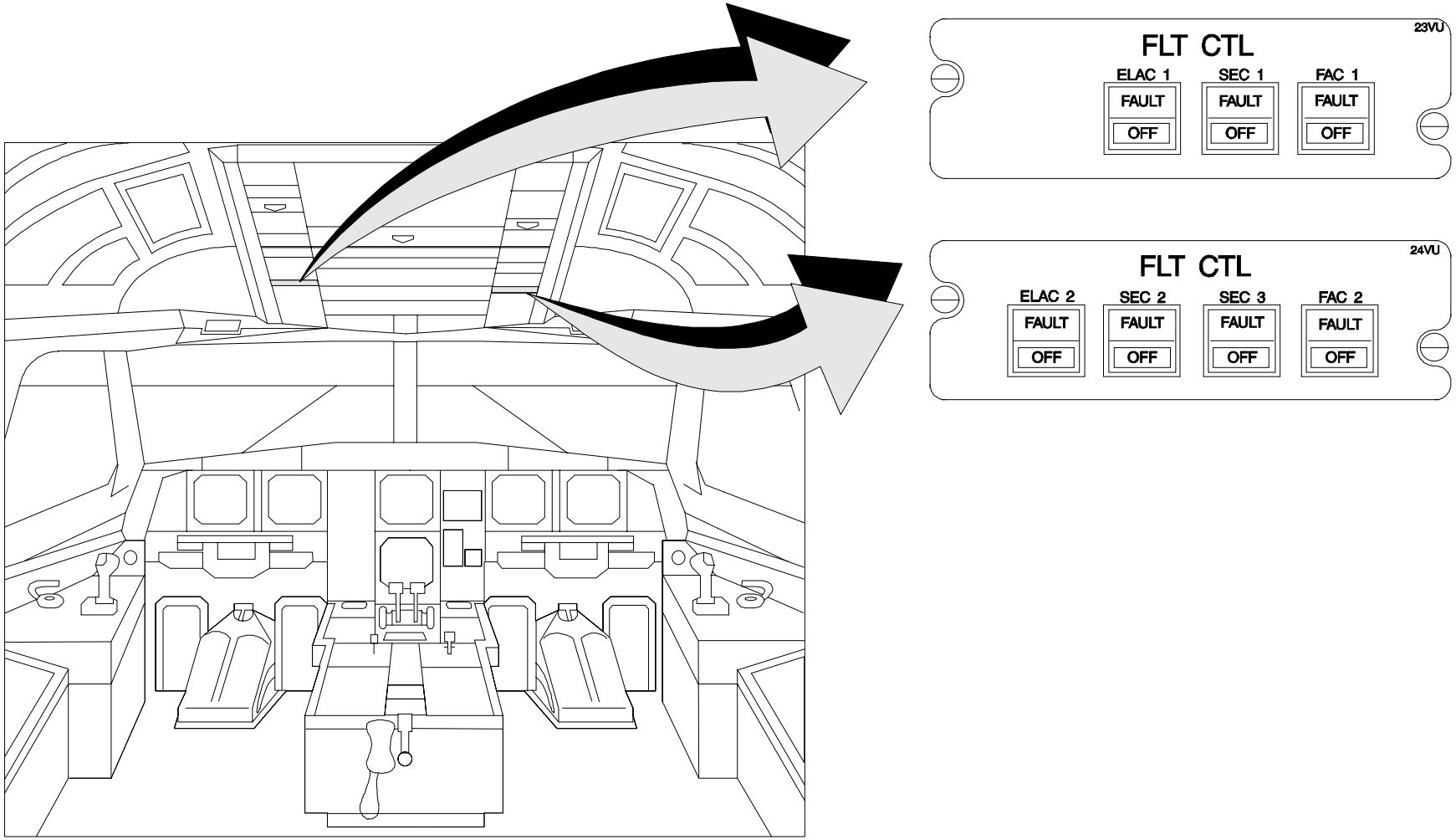
AUTO FLIGHT SYSTEM COMPONENTS

FAC PUSHBUTTON SWITCHES

IDENTIFICATION
FIN: 12CC1, 12CC2

LOCATION
ZONE:
23VU (12CC1), 24VU (12CC2)

COMPONENT DESCRIPTION
The FAC pushbutton switch monitors the status of the computer in a general way.
The FAULT indication comes on when a failure occurs affecting the normal operation of the different FAC functions.
The FAC pushbutton switch, when used, either disables the related FAC operations (OFF light on - pressed out) or enables the reset of the computer if pressed in again (OFF light off).



AUTO FLIGHT SYSTEM COMPONENTS – FAC PUSHBUTTON SWITCHES

UFF4200

TMUFGCJ02-P04 LEVEL 3

EFFECTIVITY
ALL

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22 - AUTO FLIGHT SYSTEM

22-00-00 CFDS SPECIFIC PAGE PRESENTATION

CONTENT:

CFDS SPECIFIC PAGE PRESENTATION

NOTA

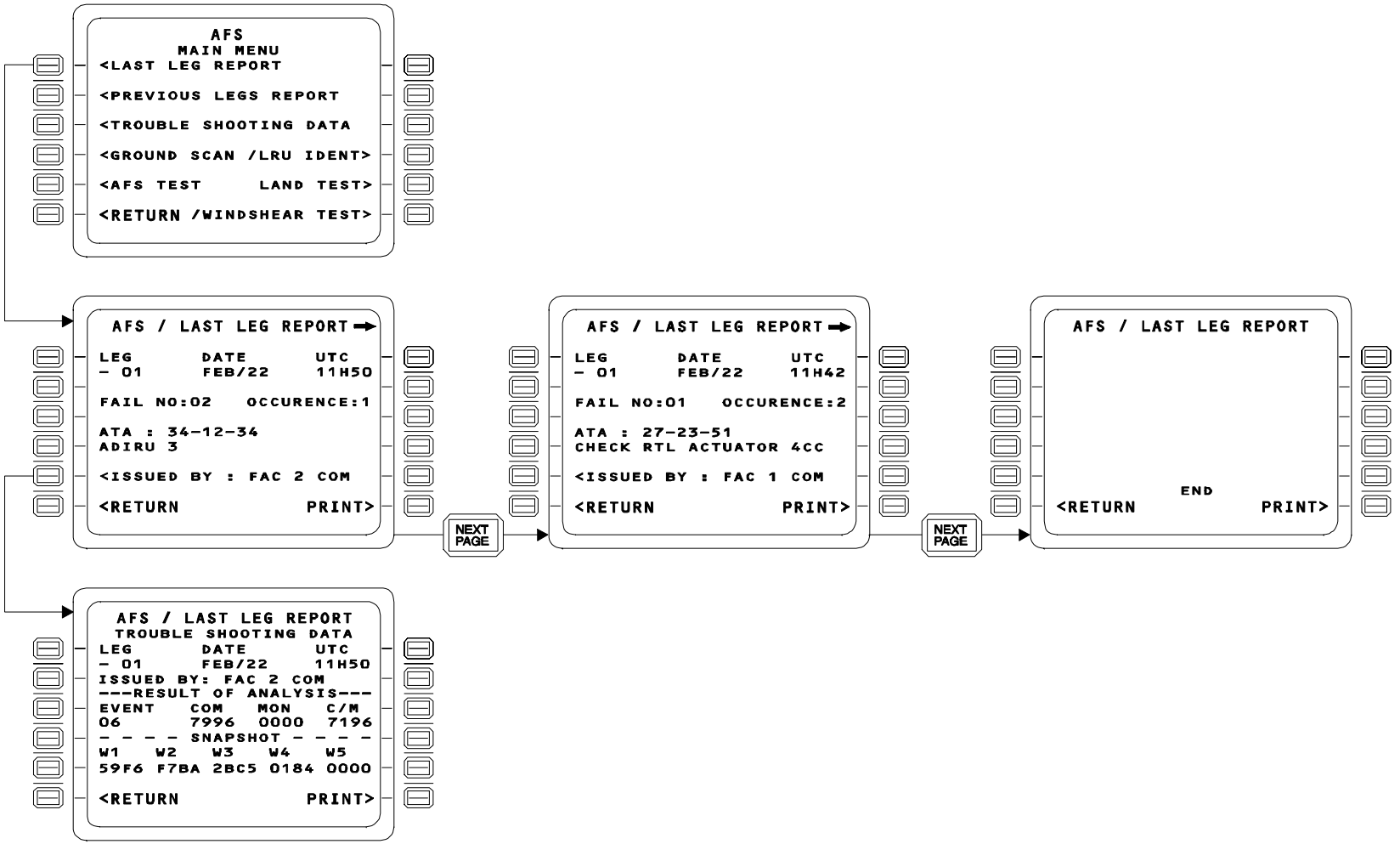
- LRU ident is not a specific option.Refer to ATA chapter 31 ("CFDS Reports").
- AFS TEST and LAND TEST functions are respectively described in dedicated modules ("Operational test of the AFS and Operational test of the LAND CAT III capability").

LAST LEG REPORT

The philosophy of the LAST LEG REPORT is the same as the one described in ATA chapter 31 ("CFDS REPORT"), but additional information is presented:

- FAIL NO : Number of presented fault. This counter is reset at the start of each flight.
- OCCURENCE : Number of times the same failure occurs within the same flight.
- ISSUED BY : Designates the computer which detected the fault. By selecting this function you have access to the primary data of the analysis (TROUBLE SHOOTING DATA page).The information presented on this page is the same as that accessible by selecting the TROUBLE SHOOTING DATA function from the AFS MAIN MENU page.

NOTE: The last fault presented occured first during the last flight (FAIL NO 01).



CFDS SPECIFIC PAGE PRESENTATION

UFF4200
TMUAFPG02-P01 LEVEL 3

EFFECTIVITY
ALL

CFDS SPECIFIC PAGE PRESENTATION

PREVIOUS LEGS REPORT

The philosophy of the PREVIOUS LEGS REPORT is the same as the one described in ATA chapter 31 ("CFDS REPORT"), and additional information presented is identical to that presented in the LAST LEG REPORT.

TROUBLE SHOOTING DATA

From the AFS/TROUBLE SHOOTING BITE SELECTION page generated by the Fault Isolation and Detection System (FIDS) you can select the BITE that you wish to examine.

NOTE:

- FAC: Flight Augmentation Computer.
- FG: Flight Guidance.
- FM: Flight Management.
- COM: Command side.
- MON: Monitor side.

When the BITE has been selected, the Fault Isolation and Detection System (FIDS) presents the content of the memories of this BITE starting by the most recent fault.
This content gives a CFDS level 3 information (engineering maintenance).
If other faults exist, they are accessible by pushing the NEXT PAGE key on the MCDU.

CFDS SPECIFIC PAGE PRESENTATION

UFF4200
TMUAFPG02-P02 LEVEL 3

EFFECTIVITY
ALL

CFDS SPECIFIC PAGE PRESENTATION

GROUND SCAN

GROUND REPORT
The GROUND REPORT function enables the failures recorded in the ground area of the FIDS memory to be displayed.
Two types of content can be displayed:

- Normally, only the internal failures that occured on ground.
- Or all internal and external failures found after selection of the PRESENT FAILURES SCAN function.

The content of this ground area is also erased during computer power up and engine start.

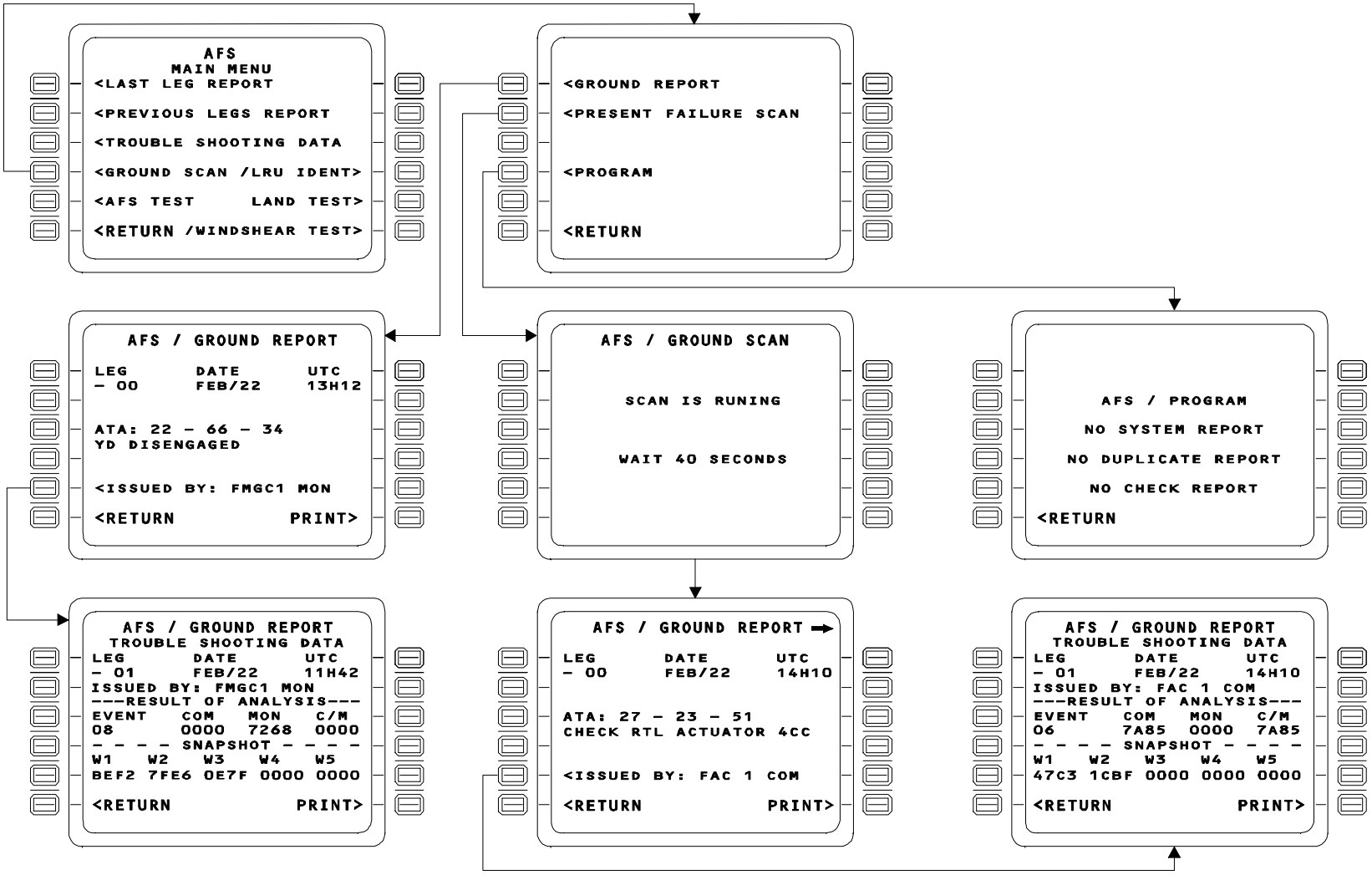
NOTE:

- The ground area of the FIDS memory has the capacity to store the 3 most recent failures, the others being eliminated.
- The option and the information displayed are similar to the LAST LEG REPORT.

PRESENT FAILURE SCAN
The philosophy of the PRESENT FAILURE SCAN function is the same as the one describe about GROUND SCANNING in ATA chapter 31 ("CFDS reports"), but results are presented in a different way (same as LAST LEG REPORT page).
The scan runs during 40 seconds, then the messages are displayed on the GROUND REPORT page. A maximum of three failures, internal or external, present at that time can be displayed.
Each processor (example : FMGC1 COM) can announce one failure only (the failure with the highest priority).
If 2 failures are present at same time No1 has to be solved first in order to announce No2 in a second PRESENT FAILURES SCAN report.

NOTE: The PRESENT FAILURE SCAN function erases the ground contexts previously recorded, so it is highly recommended to display it by using first the GROUND REPORT function.

PROGRAM
The three report options are not available for the operators. Only the manufacturer can use them through an access code for development purposes.
The AFS/PROGRAM page is independent from the ground scan function.



CFDS SPECIFIC PAGE PRESENTATION

UFF4200
TMUAFPG02-P03 LEVEL 3

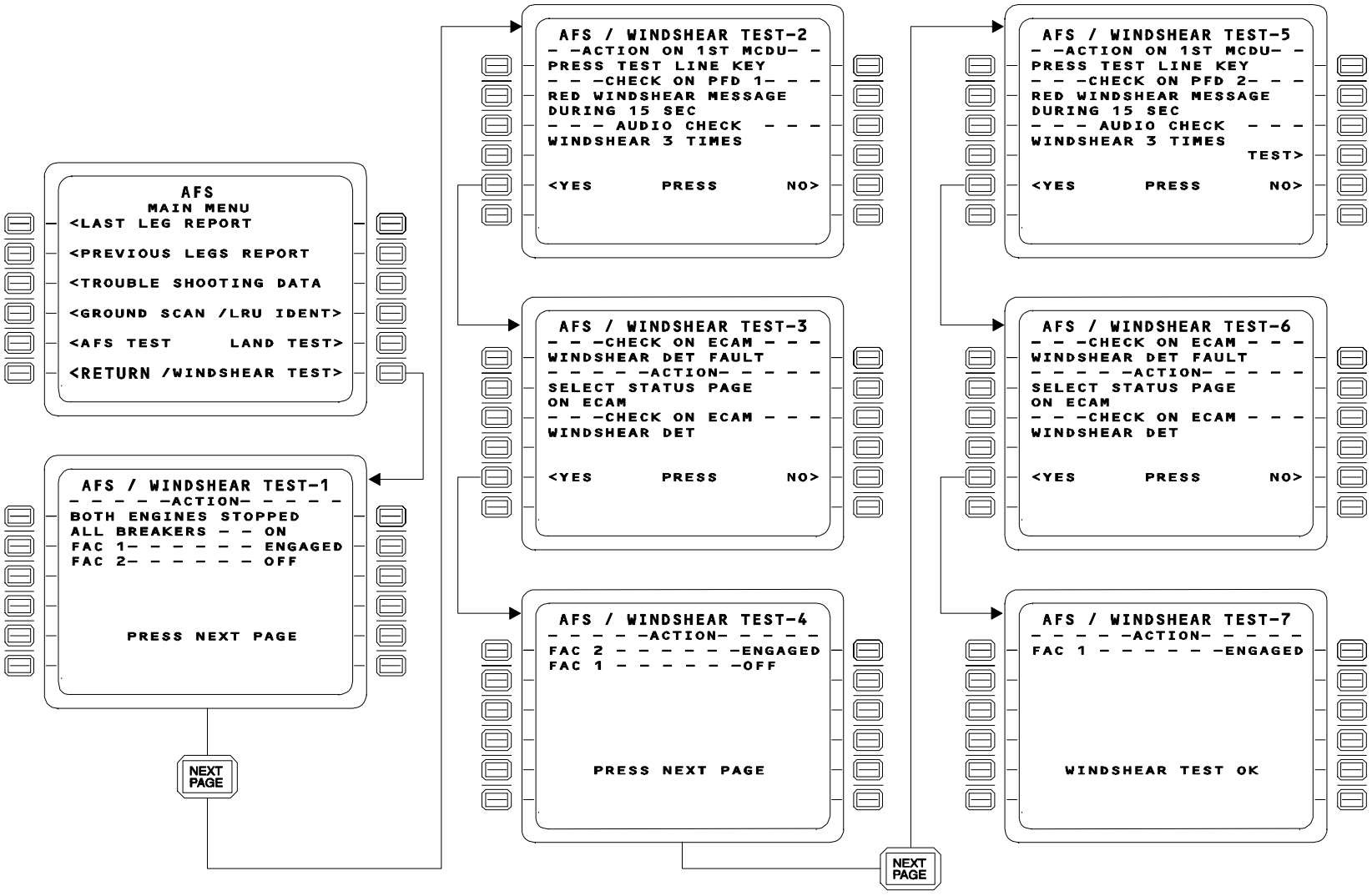
EFFECTIVITY
ALL

CFDS SPECIFIC PAGE PRESENTATION

WINDSHEAR TEST

This test checks that the system transmits and presents:

- Visual and aural indications of the WINDSHEAR warning (red WINDSHEAR legend displayed on PFDs and WINDSHEAR three times announcement generated by the FWC).
- Messages to indicate the loss of the function (WINDSHEAR DET FAULT on the upper ECAM display).



CFDS SPECIFIC PAGE PRESENTATION

UFF4200
TMUAFPG02-P04 LEVEL 3

EFFECTIVITY
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