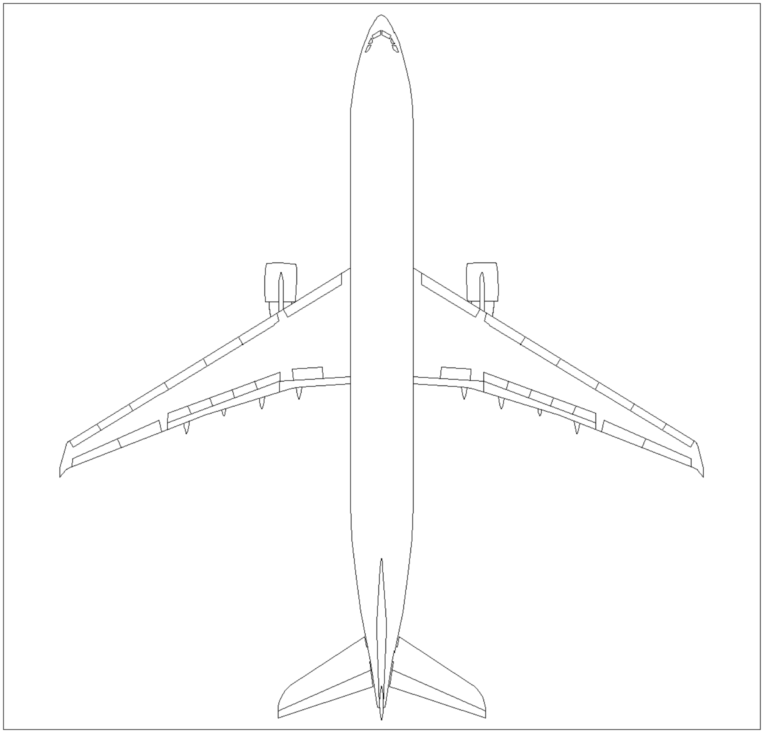
A330

FLIGHT CREW OPERATING MANUAL



SYSTEMS DESCRIPTION

1

AIRBUS®

00.00 CONTENTS

FOREWORD

R This manual complements the approved Flight Manual. Airbus has attempted to ensure that the data contained in this manual agrees with the data in the Flight Manual. If there is any disagreement, the Flight Manual is the final authority.

COMMENTS — QUESTIONS — SUGGESTIONS

All manual holders and users are encouraged to submit any Flight Crew Operating Manual questions and suggestions to :

R

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1 ROND POINT MAURICE BELLONTE
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FOR PRINTING AND DISTRIBUTION

GFC5-01-0010-001-A001AA

CONTENT

R The Flight Crew Operating Manual is the support documentation for flight crew operations.
R The Flight Crew Operating Manual provides operating crews with the technical, procedural and performance characteristics of the A330 aircraft to ensure a safe and efficient operation during normal and/or abnormal/emergency situations on ground and in flight. However, the Flight Crew Operating Manual is not intended to provide basic jet aircraft piloting techniques or information that are considered as basic airmanship for trained flight crews familiar with that type of aircraft and with its general handling characteristics.
R The Flight Crew Operating Manual is intended :
R — To be used directly as flight crew operating manual or to be the basis for elaboration of the relevant parts of the "crew manual" by the operations department of the operator in accordance with applicable requirements.
R — To be used as a flight crew training manual (initial and refresher).
However, the Flight Crew Operating Manual is not intended to be used for teaching basic piloting skills.

The content is divided into four volumes :
Vol 1 = Systems' description (description of the aircraft systems).
Vol 2 = Flight preparation (performance information, plus loading data).
Vol 3 = Flight operations (operating procedures, techniques, and performance information).
Vol 4 = FMGS pilot's guide (procedures for FMGS use).

USE

As a comprehensive set of references, the FCOM :
- can be used by an operator's Flight Operations department to supplement its own Crew Manual
- can be issued directly to crew members for training and subsequently for line operations.

WARNINGS, CAUTIONS AND NOTES

WARNING : an operating procedure, technique, etc, which may result in personnel injury or loss of life if not carefully followed.
CAUTION : an operating procedure, technique, etc, which may result in damage to equipment if not carefully followed.
NOTE : an operating procedure, technique, etc, considered essential to emphasize.

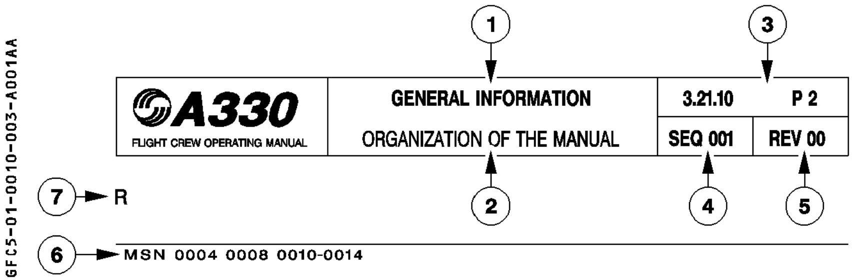
COMPLEMENTARY INFORMATION

The manual includes technical information required for training as well as complementary information.
- Where a paragraph or schematic is preceeded by the heading **FOR INFO** the details given are considered to be nice to know. Knowledge of these items is not required for the type rating qualification.
- ECAM warnings and cautions are summarized in a table at the end of each chapter of volume 1. Numeric values are given for information only.

OPTIONAL EQUIPMENT

The symbol ⩤ indicates that a paragraph or a schematic is applicable only if the related equipment is installed.

PAGINATION



(1) Chapter title

(2) Subchapter title

(3) FCOM volume number, chapter number, section number, page number

(4) Sequence number is used for Airbus Industrie management of different aircraft configurations and allows to enter into list of effective pages.

(5) Revision number of the manual at which the page has been revised.

(6) Aircraft MSN
R — 0004 0008 means that the page is applicable to aircraft MSN 0004 and MSN 0008
R — 0010-0014 means that the page is applicable from aircraft MSN 0010 to MSN 0014
— ALL means that the page is applicable to all aircraft covered by the manual.
Correspondance between MSN and registration may be found in the cross reference table.

(7) An R in front of a line indicates that the line has been revised.

REVISIONS

NORMAL REVISIONS

There are issued periodically to cover non-urgent corrections and changes and to add new data.
They are accompanied by filing instructions and an updated List of Effective Pages that includes customized pages.
A normal revision record sheet is at the front of each volume.
In addition each volume has a list of modifications affecting the manual that gives a simple explanation of the technical content of each incorporated modification and its validity per aircraft.

R **INTERMEDIATE REVISIONS**

R They are issued between normal revisions to cover changes in the definition of the aircraft
R or changes in the composition of the fleet of an airline.
R They are numbered in ascending sequence e.g. 20A, 20B, 20C ... for intermediate revisions
R issued between normal revisions 20 and 21.
R They are accompanied by filing instructions and an updated list of effective pages.

TEMPORARY REVISIONS

Printed on yellow paper the Temporary Revision (TR) are issued to cover urgent matters arising between normal revisions. They are accompanied by filing instructions and an updated, customized List of Effective TR.
A yellow temporary revision record sheet is at the front of each volume.

INCORPORATION OF SERVICE BULLETINS IN THE MANUAL

When a service bulletin has been accomplished on one or more aircraft of the operator fleet, and notified to Airbus Industrie, all affected manuals will reflect the new aircraft configuration at next revision. If judged necessary by Airbus Industrie, or requested by the
R operator, a “Temporary Revision” or an intermediate revision is issued between normal revisions.

OPERATIONS ENGINEERING BULLETINS

The Operations Engineering Bulletins (OEB) are issued as the need arises to give operators revised or new, but significant, technical or procedural information.
OEBs are provided with an OEB record sheet. This record sheet is re-issued with each normal revision to update the bulletin embodiment status.
They are accompanied by filing instructions and an updated customized list of effective OEBs.

HOW TO INSERT A REVISION

R **FILING INSTRUCTIONS**

R Use the filing instructions as follows :
R REMOVE : The page must be removed. It may be replaced by a new page if
R associated with an INSERT instruction. If not, the page is cancelled.
R INSERT : The page must be inserted. If not associated with a REMOVE instruction,
R the page is new for the operator fleet and does not replace an existing
R one.
R The column NOTE indicates EFFECTIVITY CHANGE ONLY if the page is revised due to an
R effectivity change and not due to a technical content.

R **LIST OF EFFECTIVE PAGES (LEP)**

R The manual after revision must comply with the LEP, which lists all the pages that are
R in the manual. The new pages are indicated by N and the revised pages by R.

R **BEST WAY TO GET UPDATED DOCUMENTATION**

R As soon as any change has been completed on any airplane, the best way to get
R updated documentation is to advise :
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R ATTN : Customer Service Directorate – Technical Documentation Services (AI/SE – D)

	A	Amber
	AA	Airworthiness Authorities
	AB	Abort
	ABN	Abnormal
R	A/BRK	Autobrake
	ABV	Above
	AC	Alternating Current
	A/C	Aircraft
	ACARS	ARINC Communication Addressing and Reporting System
	ACCEL	Acceleration
R	ACCU	Accumulator
	ACP	Audio Control Panel
	ACMS	Aircraft Condition Monitoring System
	ACQ	Acquire
	ADF	Automatic Direction Finder
	ADIRS	Air Data Inertial Reference System
	ADIRU	Air Data Inertial Reference Unit
	ADM	Air Data Module
	ADR	Air Data Reference
	ADV	Advisory
	AEVC	Avionic Equipment Ventilation Controller
R	AFIS	Airbus in-Flight Information Services
	AFS	Auto Flight System
	AGL	Above Ground Level
	AIDS	Aircraft Integrated Data System
	AIL	Aileron
	AIME	Autonomous Integrity Monitoring Extrapolation
R	AINS	Aircraft Information Network System
	AMJ	Advisory Material Joint
	AMU	Audio Management Unit
R	ANSU	Aircraft Network Server Unit
	ANT	Antenna
	ALT	Altitude
	ALTN	Alternate
	AOC	Airline Operational Control
	A/P	Autopilot
	AOA	Angle Of Attack
	APPR	Approach
	APPU	Assymetry Position Pick-off Unit
	APU	Auxiliary Power Unit
	ARINC	Aeronautical Radio Incorporated
	ARN	Aircraft Registration Number
	ARPT	Airport
	A/S	Airspeed

	ASAP	As Soon As Possible
	ASI	Air Speed Indicator
	A/SKID	Anti-skid
	ATC	Air Traffic Control
R	ATIS	Airbus Technical Information System
	A/THR	Auto Thrust
	ATSU	Air Traffic Service Unit
	ATT	Attitude
	AVNCS	Avionics
	AWY	Airway
	B	Blue
	BARO	Barometric
	BAT	Battery
R	BCM	Backup Control Module
	BCL	Battery Charge Limiter
R	BCRC	Bulk Crew Rest Compartment
	BITE	Built-in Test Equipment
R	BMC	Bleed Monitoring Computer
	BNR	Binary
	BRG	Bearing
	BRK	Brake
	BRT	Bright
	BSCU	Braking Steering Control Unit
	BTC	Bus Tie Contactor
	BTL	Bottle
	C	Centigrade
	CAB	Cabin
	CAPT	Captain, Capture
	CAS	Calibrated Airspeed
	CAT	Category
	C/B	Circuit Breaker
	CBMU	Circuit Breaker Monitoring Unit
R	CCRC	Cabin Crew Rest Compartment
	CDL	Configuration Deviation List
R	CDLS	Cockpit Door Locking System
R	CDSS	Cockpit Door Surveillance System
	CDU	Control Display Unit
	CED	Cooling Effect Detector
	CG	Center of Gravity
	CHG	Change
	CHK	Check
	CIDS	Cabin Intercommunication Data System

R	CINS	Cabin Information Network System
	C/L	Checklist
	CKPT	Cockpit
	CLB	Climb
	CLR	Clear
	CLSD	Closed
R	CMPTR	Computer
	CM 1(2)	Crewmember 1 (left seat) or 2 (right seat)
	CMC	Central Maintenance Computer
	CMD	Command
	CMM	Calibration Memory Module
	CMS	Central Maintenance System
	CPTR	Computer
	CNTOR	Contactor
	CO	Company
	COM	Communication
R	COND	Conditioning
	CONF	Configuration
	CONT	Continuous
	CO RTE	Company Route
	CPCU	Cabin Pressure Controller Unit
	CRC	Continuous Repetitive Chime
	CRG	Cargo
	CRS	Course
	CRT	Cathode Ray Tube
	CRZ	Cruise
	CSM/G	Constant Speed Motor/Generator
	CSTR	Constraint
	CTL	Control
	CTLR	Controller
	CTR	Center
	CTL PNL	Control Panel
	CUDU	Current Unbalance Detection Unit
	CVR	Cockpit Voice Recorder
	DA	Drift Angle
	DAR	Digital AIDS Recorder
	DC	Direct Current
	DCDU	Datalink Control and Display Unit
	DDRMI	Digital Distance and Radio Magnetic Indicator
	DECEL	Deceleration
	DEG	Degree
	DES	Descent
	DEST	Destination

	DET	Detection
	DEU	Decoder/Encoder Unit
	DFDR	Digital Flight Data Recorder
	DH	Decision Height
	DIR	Direction
	DIR TO	Direct To
	DISC	Disconnect
	DISCH	Discharge
	DIST	Distance
	DMC	Display Management Computer
	DME	Distance Measuring Equipment
	DMU	Data Management Unit (Aids)
	DN	Down
	DSCS	Door Slide Control System
	DSDL	Dedicated Serial Data Link
	DTG	Distance To Go
	DTMS	Damage Tolerance Monitoring System
	DU	Display Unit
	E	East
	ECAM	Electronic Centralized Aircraft Monitoring
R	ECAS	Emergency Cockpit Alerting System
	ECB	Electronic Control Box (APU)
	ECMU	Elec Contactor and Management Unit
	ECON	Economic
	ECP	ECAM Control Panel
	ECS	Environmental Control System
	ECU	Engine Control Unit
	EDP	Engine-Driven Pump
	EEC	Engine Electronic Control
	EFCS	Electronic Flight Control System
	EFIS	Electronic Flight Instruments System
	EFOB	Estimated Fuel On Board
R	EGPWS	Enhanced Ground Proximity Warning System
	EIU	Engine Interface Unit or Engine Interface and Vibration Monitoring Unit
	EIS	Electronic Instruments System
R	ELAN	Ethernet Local Area Network
	ELEV	Elevator, Elevation
	ELEC	Electricity
	ELT	Emergency Locater Transmitter
	EMER	Emergency
	EMER GEN	Emergency Generator
	ENG	Engine
	EO	Engine-Out

	EPGS	Electrical Power Generation System
	EPR	Engine Pressure Ratio
	ESS	Essential
	EST	Estimated
R	EROPS	Extended Range Operations
	ETA	Estimated Time of Arrival
	ETE	Estimated Time en Route
R	ETOPS	Extended Twin Operations
	ETP	Equal Time Point
	E/WD	Engine/Warning Display
	EXT PWR	External Power
	EXTN	Extension
R	F	Flaps retraction speed, Fahrenheit
	FADEC	Full Authority Digital Engine Control System
	FAF	Final Approach Fix
	FAR	Federal Aviation Regulations
	FAV	Fan Air Valve
R	F/C	Flight Crew
	FCDC	Flight Control Data Concentrator
	FCMC	Fuel Control and Monitoring Computer
R	FCOM	Flight Crew Operating Manual
R	FCRC	Flight Crew Rest Compartment
	FCU	Flight Control Unit
	FD	Flight Director
	FDIU	Flight Data Interface Unit
	F/D TEMP CTL	Flight Deck Temperature Control
	FDU	Fire Detection Unit
	FE	Flight Envelope
	FF	Fuel Flow
	FG	Flight Guidance Computer
	FL	Flight Level
	FLP, F	Flap
	FLT	Flight
	FLT CTL	Flight Control
	FLX TO	Flexible Takeoff
	FM	Flight Management
	FMA	Flight Mode Annunciator
	FMGC	Flight Management Guidance Envelope Computer
	FMGS	Flight Management Guidance Envelope System
	FMS	Flight Management System
	F/O	First Officer
	FOB	Fuel on Board
	F-PLN	Flight Plan

	FPA	Flight Path Angle
	FPPU	Feedback Position Pick-Off Unit
	FPV	Flight Path Vector
	FQI	Fuel Quantity Indication
	FREQ	Frequency
	FRV	Fuel Return Valve
	FT	Foot, Feet
	FT/MN	Feet per Minute
	FU	Fuel Used
	FWD	Forward
	FWC	Flight Warning Computer
	FWS	Flight Warning System
	G	Green
	GA	Go-Around
R	GAPCU	Ground and Auxiliary Power Control Unit
	GCU	Generator Control Unit
	GEN	Generator
	GLC	Generator Line Contactor
	GMT	Greenwich Mean Time
	GND	Ground
	GPCU	Ground Power Control Unit
	GPS	Global Positioning System
	GPSSU	Global Positioning System Sensor Unit
	GPWC	Ground Proximity Warning Computer
	GPWS	Ground Proximity Warning System
R	GRND	Ground
	GRVTY	Gravity
	GRU	Ground Refiguration Unit
	GS	Ground Speed
	G/S	Glideslope
	GW	Gross Weight
	H	Hour, Hot
	HCU	Hydraulic Control Unit
	HDG	Heading
	HDG/S	Heading Selected
	HF	High Frequency
	HI	High
	HLD	Hold
	HMU	Hydrau-Mechanical Unit
	HP	High Pressure
R	HPA	Hectopascal
	HPTCC	High Pressure Turbine Clearance Control
	HPV	High Pressure Valve

	HSMU	Hydraulic System Monitoring Unit
	HUD	Head Up Display
	HYD	Hydraulic
	HZ	Hertz
	IAS	Indicated Airspeed
	IDENT	Identification
	IDG	Integrated Drive Generator
R	IFE	In Flight Entertainment
	IFR	Instrument Flight Rules
	IGN	Ignition
	ILS	Instrument Landing System
	IMM	Immediate
	INB	Inbound
	INBO	Inboard
	INCREM	Increment
	INIT	Initialization
	INOP	Inoperative
	INR	Inner
	INST	Instrument
	INTCP	Intercept
	INV	Inverter
	I/O	Inputs/Outputs
	I/P	Input or Intercept Profile
	IP	Intermediate Pressure
	IPPU	Instrumentation Position Pick-Off Unit
	IR	Inertial Reference
R	IRS	Inertial Reference System
	ISA	International Standard Atmosphere
	ISO	International Organization for Standardization
	ISOL	Isolation
R	ISPSS	In Seat Power Supply System
	JAR	Joint Airworthiness Requirements
	KG	Kilogram
	KT	Knot
	L	Left
	LAF	Load Alleviation Function
R	LAN	Local Area Network
	LAT	Latitude
	LAT REV	Lateral Revision
	LAV	Lavatory

	LCN	Load Classification Number
	LDG	Landing
R	LF	Low Frequency
	L/G	Landing Gear
	LGCIU	Landing Gear Control Interface Unit
R	LH	Left-hand
	LIM	Limitation
R	LK	Lock
	LO	Low
	LOC	Localizer
	LONG	Longitude
	LP	Low Pressure
	LPTCC	Low Pressure Turbine Clearance Control
	LRU	Line Replaceable Unit
	LSK	Line Select Key
	LT	Light
	LVL	Level
	LVL CHG	Level Change
	LW	Landing Weight
	M	Magenta, Mach, Meter
	MABH	Minimum Approach Break off Height
	MAC	Mean Aerodynamic Chord
	MAG	Magnetic
	MAG DEC	Magnetic Declination
	MAG VAR	Magnetic Variation
	MAINT	Maintenance
	MAN	Manual
	MAX CLB	Maximum Climb
	MAX DES	Maximum Descent
	MAX END	Maximum Endurance
	MB	Milibar
	MC	Master Caution
	MCT	Maximum Continuous Thrust
	MCDU	Multipurpose Control and Display Unit
	MDA	Minimum Descent Altitude
	MDDU	Multifunction Disk Drive Unit
	MDH	Minimum Descent Height
	MECH	Mechanic
	MED	Medium
	MEL	Minimum Equipment List
R	MFA	Memorized Fault Annunciator
	MIN	Minimum, Minute
	MKR	Marker
	MLA	Maneuver Load Alleviation

MLS	Microwave Landing System
MLW	Maximum Landing Weight
MMEL	Master Minimum Equipment List
MMO	Maximum Operating Mach
R MN	Minute, Mach number
MNPS	Minimum Navigation Performance Specification
R MMR	Multi Mode Receiver
MSA	Minimum Safe Altitude
MSG	Message
MSL	Mean Sea Level
MTBF	Mean Time Between Failure
MTOW	Maximum Takeoff Weight
MW	Master Warning
MZFW	Maximum Zero Fuel Weight
N	North
N/A	Not Applicable
NACA	National Advisory Committee for Aeronautics
NAV	Navigation
NAVAID	Navigation Aid
NCD	Non Computed Data
ND	Navigation Display
NDB	Non Directional Beacon — Nav Database
NM	Nautical Mile
NORM	Normal
NW	Nosewheel
NWS	Nosewheel Steering
OAT	Outside Air Temperature
OBRM	On Board Replaceable Module
OFF/R	Off Reset
OFST	Offset
O/P	Output
OPP	Opposite
OPS	Operations
OPT	Optimum
OUTB	Outbound
OUTR	Outer
OVBD	Overboard
OVHD	Overhead
OVHT	Overheat
OVRD	Override
OVSPD	Overspeed
OXY	Oxygen

	PA	Passenger Address
	PAX	Passenger
	P-ALT	Profile Altitude
	pb sw	Push-Button Switch
	PB, pb	Pushbutton
	P-CLB	Profile Climb
	P-DES	Profile Descent
	PERF	Performance
R	PES	Passenger Entertainment System
	PFD	Primary Flight Display
	PHC	Probes Heat Computer
	PIM	Programming and Indication Module
	P-MACH	Profile Mach
	PMV	Pressure Maintenance Valve
	P/N	Part Number
	PNL	Panel
	POB	Pressure Off Brake
	P-SPEED	Profile Speed
	POS	Position
	PPOS	Present Position
	PR	Pressure
	PRAM	Prerecorded Announcement and Music
	PRED	Prediction
	PRIM	FLT CTL Primary Computer (FCPC)
	PROC	Procedure
	PROC T	Procedure Turn
	PROF	Profile
	PROG	Progress
	PROT	Protection
	PRV	Pressure Regulating valve
	PSCU	Proximity Switch Control Unit
	PT	Point
	PTLU	Pedal Travel Limiter Unit
R	PTT	Push to Talk
	PVI	Paravisual Indicator
	PWR	Power
R	PWS	Predictive Windshear System
	QAR	Quick Access Recorder
	QCCU	Quantity Calculation and Control Unit
	QFE	Field Elevation Atmosphere Pressure
	QFU	Runway Heading
	QNE	Sea Level Standard Atmosphere Pressure (1013 MB)
	QNH	Sea Level Atmosphere Pressure
	QT	Quart (US)

	QTY	Quantity
	R	Right, Red
	RA	Radio Altitude
	RACSB	Rotor Active Clearance Control Start Bleed
	RAIM	Receiver Autonomous Integrity Monitoring
	RAT	Ram Air Turbine
R	RATC	Remote ATC Box
	RCDR	Recorder
	RCL	Recall
	RCVR	Receiver
	REAC	Reactive
	REC	Recovery
	REG	Regulation
	REL	Release
	REV	Reverse
R	RH	Right-hand
	R/I	Radio/Inertial
	RMI	Radio Magnetic Indicator
	RMP	Radio Management Panel
	RNG	Range
	RNP	Required Navigation Performance
	RPLNT	Repellent
	RPM	Revolution Per Minute
	RPTG	Repeating
	RQRD	Required
	RSV	Reserves
	RSVR	Reservoir
	RTE	Route
	RTL	Rudder Travel Limit
	RTOW	Runway Takeoff Weight
	RUD	Rudder
	RVSM	Reduced Vertical Separation Minimum
	RWY	Runway
	S	South, Slats Retraction Speed
	SAE	Society of Automotive Engineers
	SAT	Static Air Temperature
	SC	Single Chime
	S/C	Step Climb
	SD	System Display
	STAT INV	Static Inverter
	S/D	Step Descent
	SDAC	System Data Acquisition Concentrator
	SDCU	Smoke Detection Control Unit

	SEC	FLT CTL Secondary Computer (FCSC)
	SEL	Selector
	S/F	Slats/Flaps
	SFCC	Slat/Flap Control Computer
	SID	Standard Instrument Departure
	SIM	Simulation
R	SIU	Server Interface Unit
	SLFT (-PM)	Sea Level Feet (-per minute)
R	SFE	Seller-Furnished Equipment
	SLT, S	Slat
	S/N	Serial Number
	SPD	Speed
	SPD LIM	Speed Limit
	SPLR	Spoiler
	SRS	Speed Reference System
	SSM	Sign Status Matrix
	STAR	Standard Terminal Arrival Route
	STAT	Static
	STBY	Standby
	STD	Standard
	STEER	Steering
	STRG	Steering
	STS	Status
	SW	Switch
	SWTG	Switching
	SYNC	Synchronize
	SYS	System
R	T	True, Turn, Total, Tons
	TACT	Tactical
	TAS	True Air Speed
	TAT	Total Air Temperature
	TAU	Time to intercept
	TBC	To be Confirmed
	TBD	To be Determined
	T/C	Top of Climb
	TCAS	Traffic Collision Alert System Avoidance System
	T/D	Top of Descent
	TEMP	Temperature
	TFTS	Terrestrial Flight Telephon System
	TGT	Target
	THR	Thrust
	THS, STAB	Trimmable Horizontal Stabilizer
	TK	Tank
	T. TK	Trim Tank

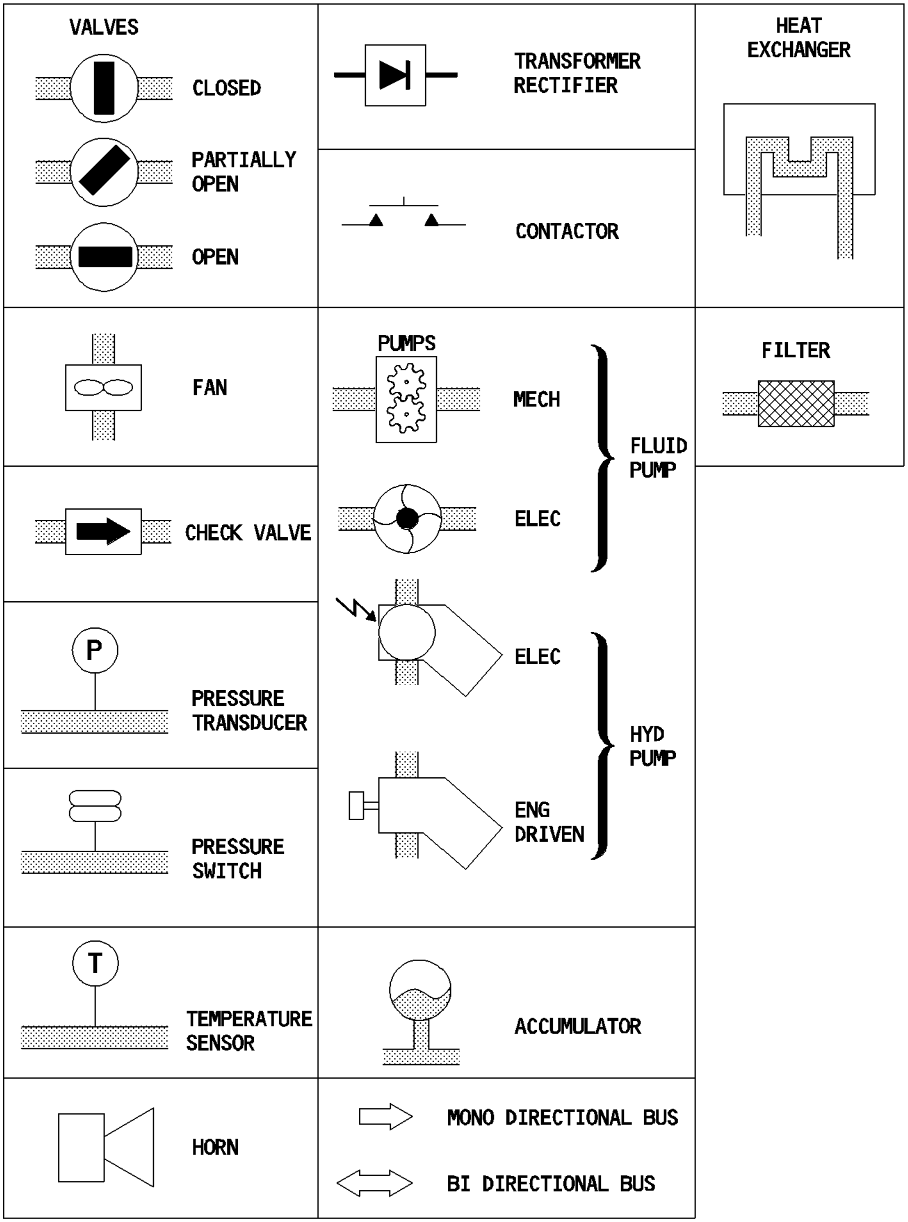
	TK	Track angle
	TKE	Track angle Error
	TMR	Timer
	TLA	Throttle Lever Angle
	T.O., T/O	Takeoff
	TOGA	Takeoff - Go-Around
	TOGW	Takeoff Gross Weight
	TOW	Takeoff Weight
	T-P	Turn Point
	TPIS	Tire Pressure Indicating System
	TR	Transformer Rectifier Unit
R	T-R	Transmitter-Receiver
	TRV	Travel
	TRANS	Transition
	TROPO	Tropopause
	TRK	Track
	TTG	Time to Go
	TVMC	Minimum Control Speed Temperature
R	TWLU	Terminal Wireless LAN Unit
R	ULB	Underwater Locator Beacon
	UNLK	Unlock
R	UP	Up, Upper
	UTC	Universal Coordinated Time
	V	Volt
	V1	Critical Engine Failure Speed
	V2	Takeoff Safety Speed
	VBV	Variable Bypass Valve
R	VCC	Video Control Center
R	VEL	Velocity
	VENT	Ventilation
	VFE	Maxi Velocity Flaps Extended
	VFEN	VFE Next
	VFTO	Velocity Final Takeoff
	VHF	Very High Frequency
R	VHV	Verify High Voltage
	VIB	Vibration
	VLE	Max Landing Gear Extended Speed
	VLS	Lowest Selectable Speed
	VLV	Valve
	VM	Maneuvering Speed
	VMAX	Maximum Allowable Speed
	VMCA	Minimum Control Speed in the Air

	VMCG	Minimum Control Speed on Ground
	VMCL	Minimim Control Speed at Landing
R	VMIN	Minimum Operating Speed
	VMO	Maximum Operating Speed
R	VMU	Minimum Unstich Speed
	VOR	VHF Omnidirectional Range
	VOR-D	VOR-DME
	VR	Rotation Speed
	VREF	Landing Reference Speed
	VS	Reference Stalling Speed
	V/S	Vertical Speed
	VSI	Vertical Speed Indicator
	VSV	Variable Stator Vane
	W	White, West, Weight
	WARN	Warning
	WBC	Weight and Balance Computer
	WBS	Weight and Balance System
	WHC	Window Heat Computer
	WNDW	Window
	WPT	Waypoint
	WSHLD	Windshield
	WT	Weight
	WTB	Wing Tip Brake
	WXR	Weather Radar
R	XBLD	Crossbleed
R	XCVR	Tranceiver
	XFR	Transfer
	XMTR	Transmitter
R	XPDR	Transponder
	XTK	Crosstrack Error
	Y	Yellow
	Z	Altitude
	ZFCG	Zero Fuel Center of Gravity
	ZFW	Zero Fuel Weight

R

	METRIC → US	US → METRIC
LENGTH	1 millimeter (mm) = 0.0394 inch (in) 1 meter (m) = 3.281 feet (ft) 1 meter (m) = 1.094 yard (yd) 1 kilometer (km) = .540 nautical mile (nm)	1 inch (in) = 25.4 millimeter (mm) 1 foot (ft) = .3048 meter (m) 1 yard (yd) meter (m) = .914 meter (m) 1 nautical mile (nm) = 1.852 kilometer (km)
SPEED	1 meter/second (m/s) = 3.281 feet/second (ft/s) 1 kilometer/hour (km/h) = .540 knot (kt)	1 foot/second (ft/s) = .3048 meter/second (m/s) 1 knot (kt) = 1.852 kilometer/hour (km/h)
WEIGHT	1 gram (g) = 0.353 ounce (oz) 1 kilogram (kg) = 2.2046 pounds (lb) 1 ton (t) = 2 204.6 pounds (lb)	1 ouce (oz) = 28.35 grams (g) 1 pound (lb) = .4536 kilogram (kg) 1 pound (lb) = .0004536 ton (t)
FORCE	1 Newton (N) = .2248 pounds (lb) 1 deca Newton (daN) = 2.248 pounds (lb)	1 pound (lb) = 4.448 Newtons (N) 1 pound (lb) = .448 deca Newton (daN)
PRESSURE	1 BAR = 14.505 pounds per square inch (P.S.I.) 1 millibar (mbar) =1hpa = .0145 P.S.I.	1 pound per square inch (P.S.I.) = .0689 bar 1 P.S.I. = 68.92 millibars (mbar) = 68.92 hpa
VOLUME	1 liter (l) = .2642 U.S. Gallons 1 cubic meter (m^3) = 264.2 U.S. Gallons 1 liter (l) = 1.0568 Qt 1 cubic meter (m^3) = 1056.8 Qts	1 US Gallon = 3.785 liters (l) 1 US Gallon = 0.03785 cubic meter (m^3) 1 Qt = = 0.94625 liter (l) 1 Qt = = 0.000946 cubicmeter(m^3)
MOMENTUM	1 meter × deca Newton (m. daN) = 88.50 pound × inch (lb. in)	1 pound × inch (lb. in) = .0113 meter × deca Newton (mdaN)
TEMPERATURE	t (°C) = 5/9 {t (°F) - 32}	t (°F) = t (°C) × 1.8 + 32

R



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THIS TABLE GIVES, FOR EACH AIRCRAFT INCLUDED IN THE MANUAL, THE CROSS REFERENCE BETWEEN :

- THE MANUFACTURING SERIAL NUMBER (MSN) WHICH APPEARS IN THE LIST OF EFFECTIVE PAGES

- THE REGISTRATION NUMBER OF THE AIRCRAFT AS KNOWN BY AIRBUS INDUSTRIE.

MSN	REGISTRATION
0054	F-OMSA
0644	

20.00 CONTENTS

20.10 INTRODUCTION

20.20 GENERAL ARRANGEMENT

GENERAL

The A330 is a subsonic medium to long range civil transport aircraft.

ENGINES

The aircraft has two high by-pass turbofan engines mounted under the wings.

COCKPIT

The cockpit is arranged for a two member-crew. It also has a place for two observers.

CABIN

The layout for passenger seating may be varied to suit operating requirements. The certificated maximum is 375 seats.

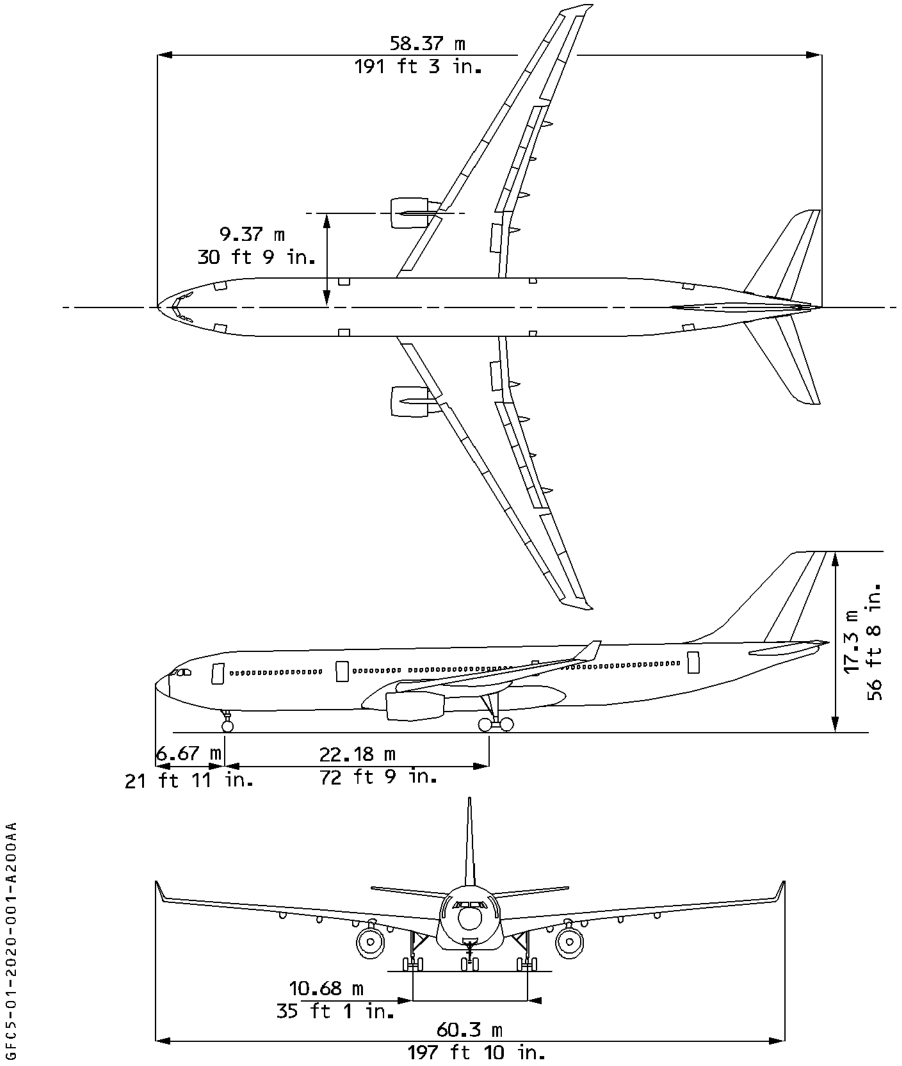
CARGO

Three cargo compartments are under the cabin floor.

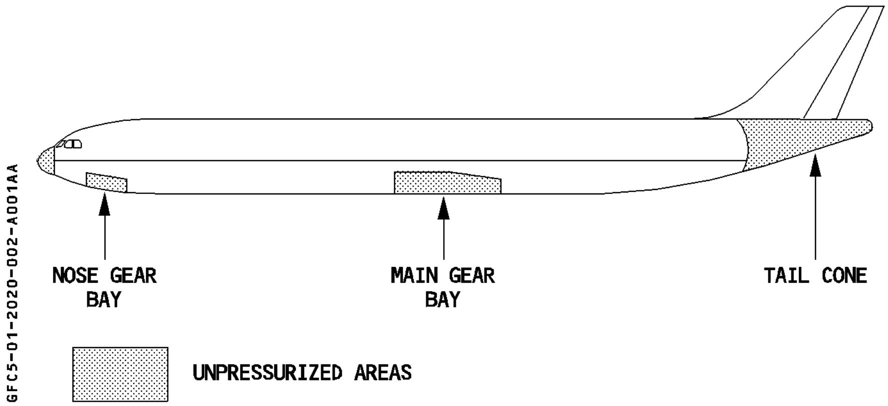
GENERAL ARRANGEMENT

This subchapter gives the principal dimensions of the aircraft, the location of unpressurized areas, antennas, ground service connections and the ground maneuvering characteristics.

PRINCIPAL DIMENSIONS

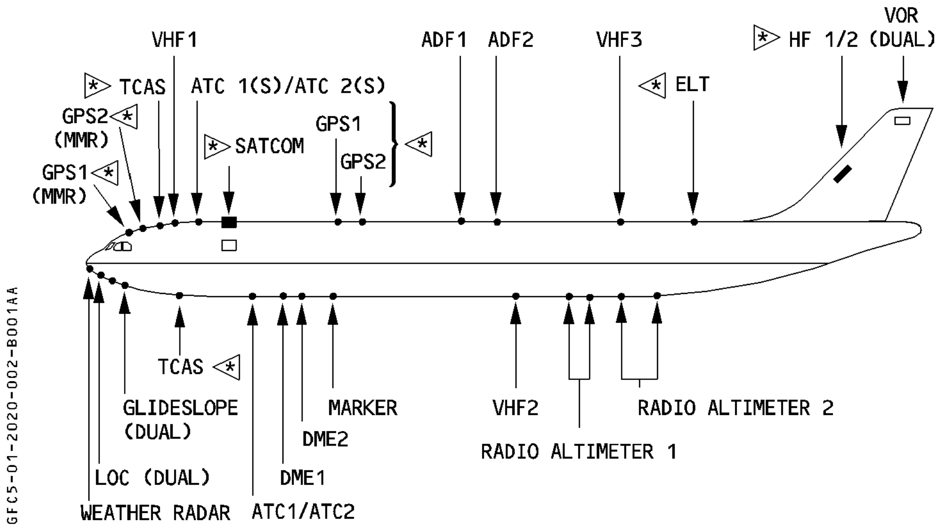


UNPRESSURIZED COMPARTMENTS



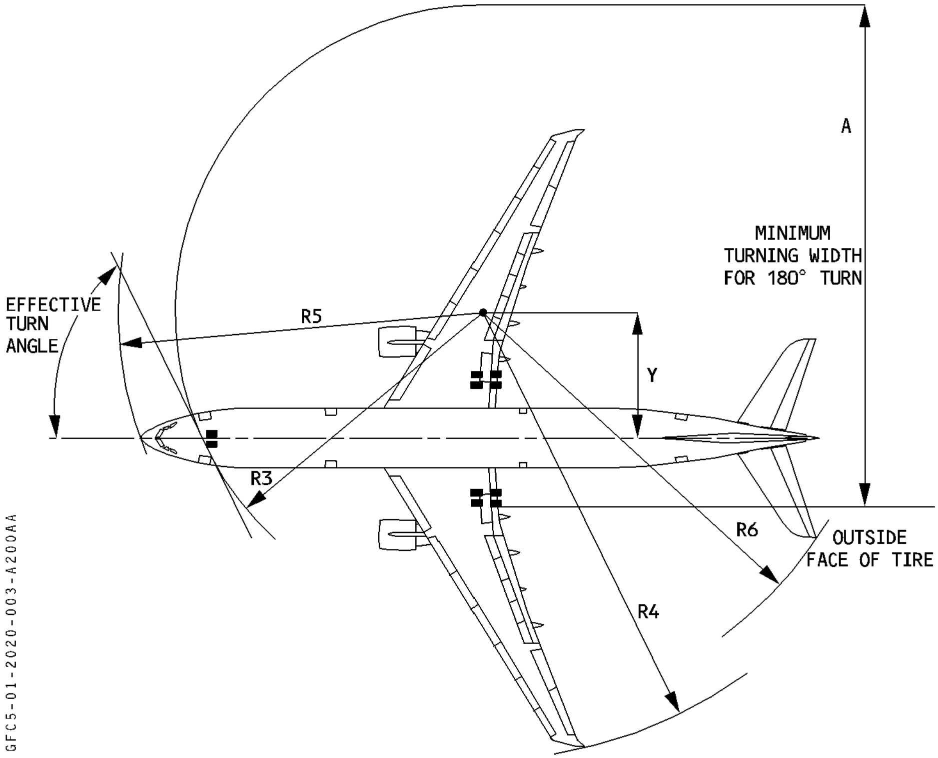
ANTENNAS LOCATION

R



GROUND MANEUVERING

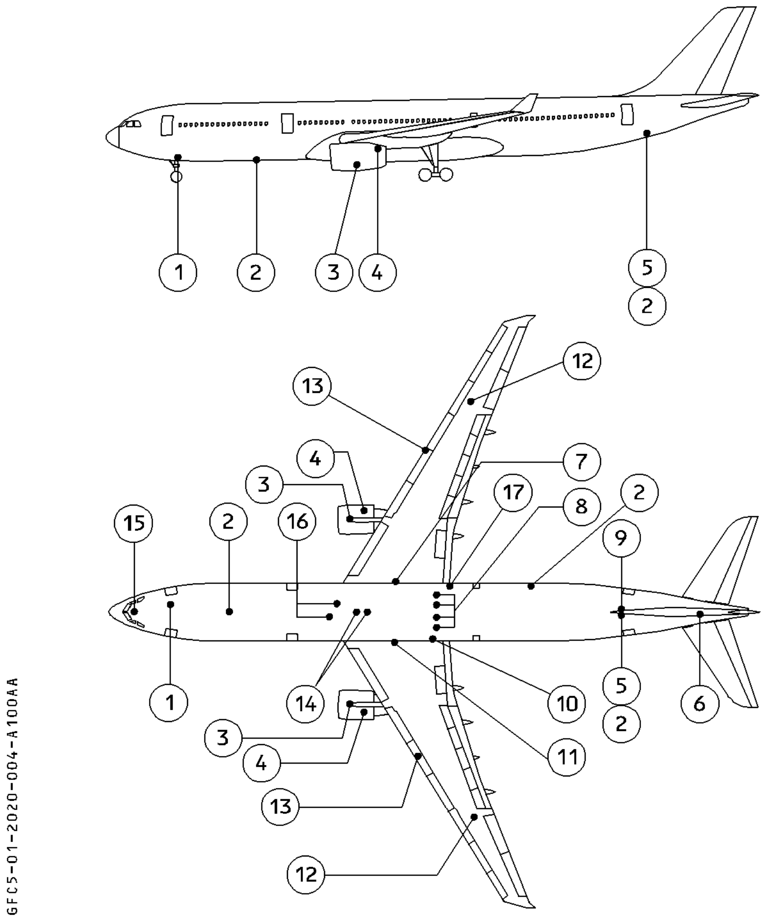
MINIMUM TURNING RADII



NWS limit angle	Y	A	R3	R4	R5	R6
72°	12 m 39 ft	44 m 142 ft	26 m 85 ft	43 m 141 ft	31 m 101 ft	37 m 121 ft

The above figures assume symmetric thrust and no differential braking.

GROUND SERVICE CONNECTIONS AND PANELS



(1) External ground power panel receptacle

(2) Remote water drain

(3) IDG oil filling

4 Engine oil filling

5 Potable water filling

6 APU oil filling

7 Hydraulic ground power (yellow)

R 8 Air charging for hydraulic accumulators

9 Toilet servicing

10 Hydraulic reservoir filling and ground power (green)

11 Hydraulic reservoir pressurization and ground power (blue)

12 Fuel gravity filling

13 Refueling/defueling

14 HP ground air supply connectors

15 Oxygen system

16 LP ground air supply connectors

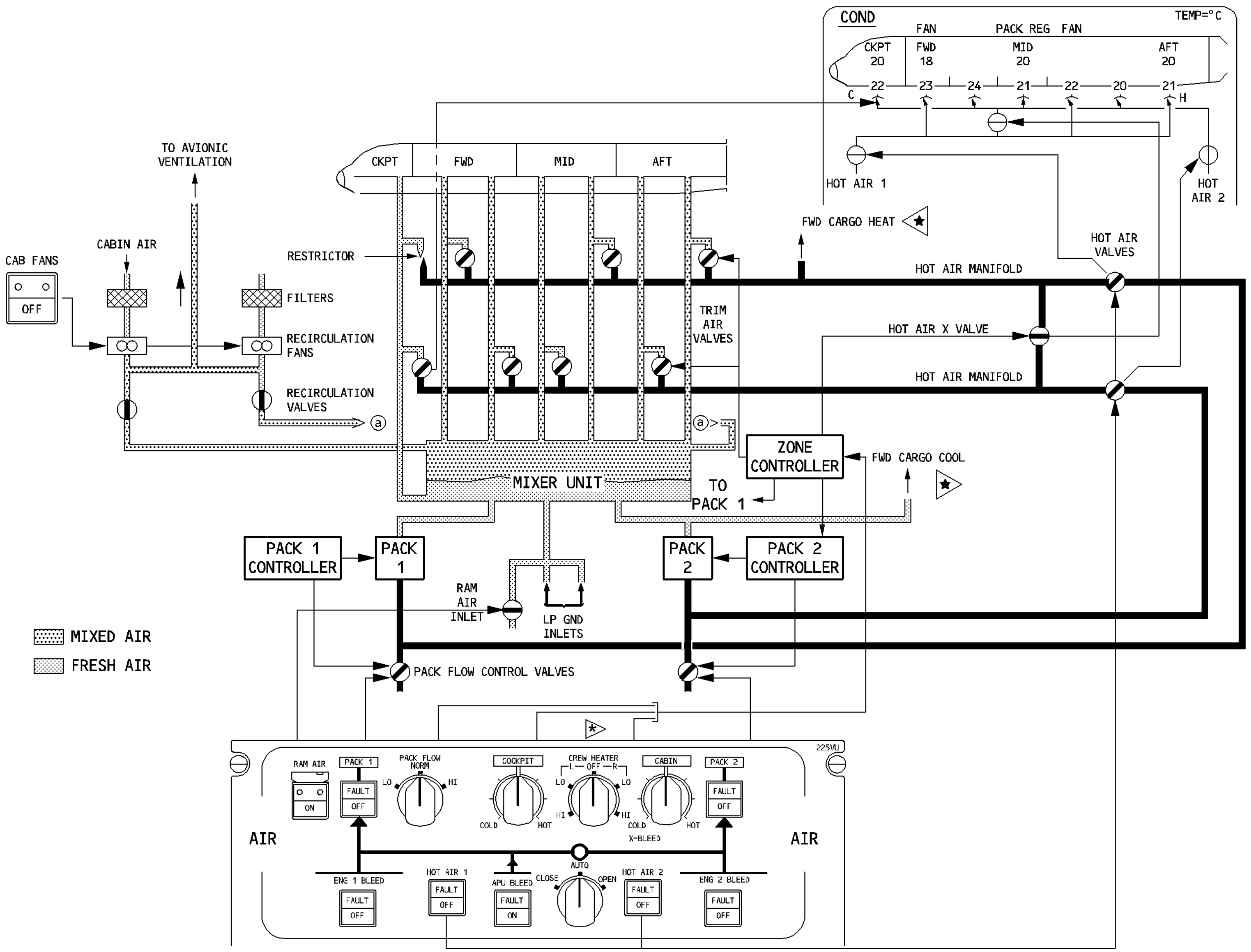
R 17 Refuel/Defuel control panel

21.00 CONTENTS

GENERAL

The air conditioning system operation is fully automatic.
It provides a continual renewal of air, and maintains a constant selected temperature in the following four zones : COCKPIT, FWD CABIN, MID CABIN, and AFT CABIN, which are independently controlled.
Air is supplied by the pneumatic system via :
– Two pack flow control valves
– Two packs
– The mixing unit, which mixes the air that comes from the cabin and the packs.
It is then distributed to the cabin and the cockpit. Temperature regulation is optimized through the two hot air pressure regulating valves and the trim air valves, which add hot air tapped upstream of the packs to the mixing unit air via the two hot air manifolds.
In an emergency, a ram air inlet can provide ambient air to the mixing unit.
Temperature regulation is controlled by a zone controller and two pack controllers.
Flight deck and cabin temperature can be selected from the AIR panel in the cockpit.
A control panel is provided on the forward attendant panel. It can modify each cabin zone temperature demand from the cockpit, during cruise, with a limited authority of ± 3°C (5.4° F).
Low pressure air is supplied to the mixing unit by a ground connection.

R



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MAIN COMPONENTS

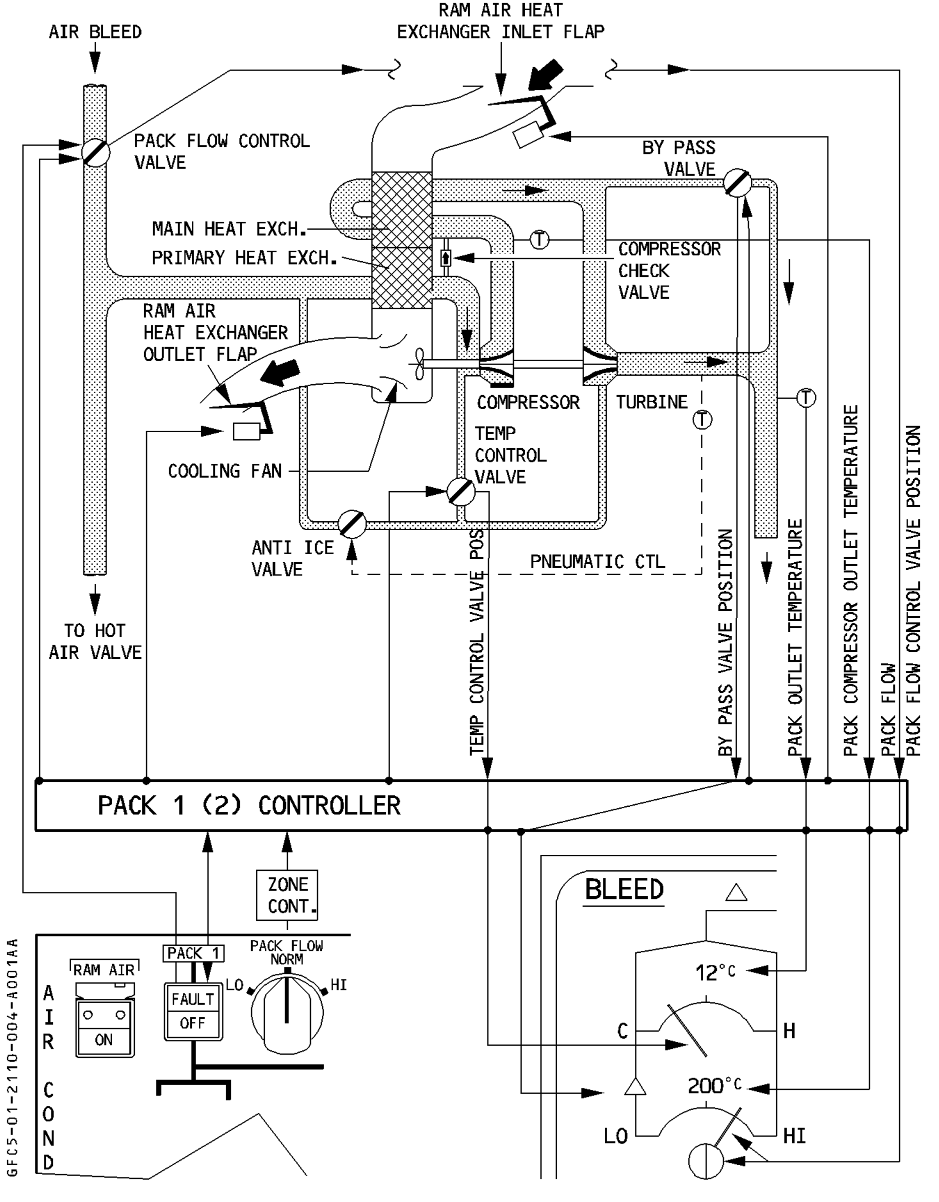
AIR CONDITIONING PACK

The two packs operate automatically and independently of each other. Pack operation is controlled by the pack controller.
Warm pre-conditioned bleed air enters the cooling path via the pack flow control valve and is ducted to the primary heat exchanger.
Then the cooled bleed air enters the compressor section of the air-cycle machine and is compressed to a higher pressure and temperature.
It is cooled again in the main heat exchanger and, enters the turbine section where it expands and in expanding generates power to drive the compressor and cooling air fan.
R The removal of energy during this process reduces the temperature of the air resulting in
R very low air temperature at turbine discharge.
The temperature control valve can modify the pack outlet temperature by adding uncooled air to the turbine outlet flow.
In case of air cycle machine failure a by pass valve allows the bleed air to be cooled by the associated heat exchanger only.

PACK SCHEMATIC

FOR INFO

R



PACK FLOW CONTROL VALVE

This valve is pneumatically-operated and electrically-controlled. It regulates the air flow in accordance with signals received from the pack controller. In the absence of air pressure, a spring keeps the valve closed. In the absence of electrical supply, the valve is open in a position equivalent to the NORM selection, provided air supply is available.
The valve closes automatically, in case of pack overheating, engine starting, operation of the fire or ditching pushbuttons, any unclosed door at engine start, or insufficient upstream pressure. The valve is controlled from the AIR panel.

RAM AIR

An emergency ram air inlet ventilates the cockpit and cabin, if both packs fail.
The emergency ram air inlet valve is controlled by the RAM AIR pushbutton on the AIR COND panel.
Operation of this pushbutton opens the ram air valve, provided that ditching is not selected.
R The outflow valves open about 50 %, provided that they are under automatic control and
R that the △P is less than one psi. They do not automatically open if they are under manual
R control, even if △P is less than one psi. If △P is greater than one psi, the check valve,
located downstream the ram air door, will not open. No airflow will then be supplied.

MIXER UNIT

This unit mixes cold fresh air from the packs with the cabin air being recirculated through the recirculation fans. The mixer unit is also connected to the emergency ram air inlet and the low pressure ground inlets.

Note : In case both packs are inoperative, the recirculation valves are partially closed.

HOT AIR VALVES

These valves regulate the pressure of hot air tapped upstream of the packs.
They are pneumatically-operated and electrically-controlled from the HOT AIR 1 and HOT AIR 2 pushbuttons on the AIR panel. In the absence of electrical supply, the hot air valves close. In the absence of air pressure, a spring keeps the valves closed.
The valve automatically closes, if the duct overheats.

TRIM AIR VALVES

These valves are electrically-controlled by the zone controller. Two trim air valves, associated with each zone, adjust the temperature by adding hot air from the two hot air manifolds. For the cockpit supply, only one trim air valve is fitted to regulate air from hot air manifold 2. Air from hot air manifold 1 passes through a restrictor.

HOT AIR X VALVE

A HOT AIR X valve is fitted between the two hot air manifolds. The valve is normally closed. It automatically opens, when one hot air supply has failed.

TEMPERATURE AND FLOW REGULATION

Temperature regulation is automatic and controlled by one zone controller and two pack controllers.

PACK CONTROLLER

Each pack controller regulates the temperature of its associated pack, in accordance with
R a demand signal from the zone controller, by modulating the temperature control valve and the ram air inlet flaps, and the ram air outlet flaps.
The ram air inlet and outlet flaps close during takeoff and landing to avoid ingestion of foreign objects.

Note : *During takeoff, the ram air inlet and outlet flaps close when the thrust lever is at or above CL and the wheel speed (sent by the BSCU) is at or above 70 knots.*
During landing, they close as soon as the main landing gear is compressed and as long as the speed is at or above 70 knots.
They open, 15 seconds after the speed drops below 70 knots.

The pack controllers also regulate flow by modulating the associated pack flow control valve according to the zone controller demand.

ZONE CONTROLLER

PACK FLOW CONTROL

The crew can use the PACK FLOW selector to adjust the pack flow for the number of passengers and the external conditions.
Whatever the crew selects, the system delivers high flow for any of the following circumstances :
– Single pack operation, or
– When the APU is supplying bleed air.

Note : *Due to ambient conditions, high flow may not be achieved.*

If the crew selects LO flow and the temperature demand cannot be satisfied, the zone controller generates an ECAM advisory message to inform the crew to manually select NORM flow.

Engine pressure demand

When the cooling demand in one zone cannot be satisfied and the bleed pressure is too
R low, the zone controller signals both Engines Interface Units (EIU) to increase the minimum
R idle speed in order to raise the bleed pressure.

APU flow demand

R When the APU bleed valve is open, the zone controller signals the ECB to increase the APU
R output flow when any zone temperature demand cannot be satisfied.

Bleed temperature demand

R When the cooling demand cannot be satisfied, the zone controller signals the BMC to decrease the bleed temperature from normal (200°C) to reduced setting (150°C). This reduction is inhibited if the wing anti ice is ON.

TEMPERATURE REGULATION

R The zone controller regulates the temperature of the three cabin zones and the cockpit.

BASIC TEMPERATURE REGULATION

R The flight crew uses the temperature selectors on the air panel in the cockpit to select the
R reference temperature which are fine tuned through the Forward Attendant Panel (FAP) for
R the cabin zones.
An automatic cabin temperature altitude correction may be added to the cockpit selected master temperature to compensate for reduction in cabin air humidity and reduction of cabin lining temperatures. The altitude correction is proportional to the flight altitude and is programmable. The initial manufacturer setting is that no altitude correction is added.
The zone controller computes a temperature demand according to the selected temperature and the actual temperature.
The actual temperature is measured by sensors located in the cockpit and at points in the
R the extraction circuit of the lavatory and galley ventilation system for the cabin.
A signal corresponding to the lowest demanded zone temperature is sent to the pack
R controller which then makes the packs produce the required outlet temperature.

OPTIMIZED TEMPERATURE REGULATION

The zone controller optimizes temperatures by acting on the trim air valves.
R The temperature selection ranges from 18°C (64°F) to 30°C (86°F).

SYSTEM OPERATION UNDER FAILURE CONDITION

Each controller consists of : A Channel 1, that is normally in control, and a Channel 2 that acts as a backup, if Channel 1 fails.

ZONE CONTROLLER

CHANNEL 1 OR 2 FAILURE

A Channel 1 or 2 failure has no effect on zone temperature regulation.

CHANNELS 1 AND 2 FAILURE

Optimized and backup temperature regulation are lost. The packs deliver a fixed pack outlet temperature of 20°C (68°F). A Channel 1 and 2 failure removes all information from the ECAM COND page, which then displays PACK REG. Flow selection from the PACK FLOW selector is lost.

PACK CONTROLLERS

CHANNEL 1 OR 2 FAILURE

A Channel 1 or 2 failure has no effect on pack regulation.

CHANNELS 1 AND 2 FAILURE

The pack outlet temperature is controlled at 12°C ± 3°C (54°F ± 5.4°F) by the corresponding anti-ice valve. The ECAM signals, associated with the corresponding pack, are lost. The
R flow control valve pneumatically regulates the pack flow to approximately 120% of the
R NORM flow.

AIR CYCLE MACHINE FAILURE

If the Air Cycle Machine (ACM) fails (compressor/turbine seizure), the affected pack may be operated in the heat-exchanger cooling mode. Warm pre-conditioned bleed air enters the cooling path, via the pack flow control valve, and goes to the primary heat exchanger. Then, the compressor check valve and the bypass valve open, and air is cooled only by the heat exchanger. The ACM seizure reduces the pack flow.
As in normal pack operation :
- The pack controller regulates temperatures, in accordance with zone controller demand, by modulating the temperature control valve and the ram air inlet and outlet flaps.
- The zone controller regulates the flow of hot air, through the trim air valves, to optimize cockpit/cabin temperature regulation. Hot air flow is less in normal pack operation, because the pack flow is reduced.

<u>Note</u> : *A pack with a seized ACM must be switched off on ground, due to the unavailability of RAM air cooling.*

HOT AIR VALVES FAILURE

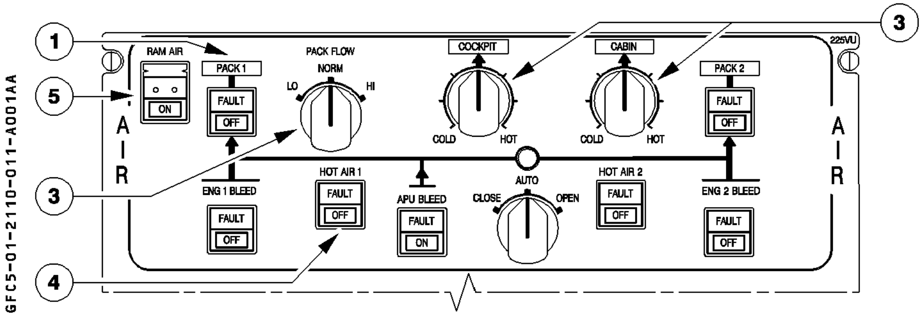
One or both valves failed open	:	No effect.
One valve failed closed	:	No effect (HOT AIR X valve opens)
Both valves failed closed	:	Optimized regulation is lost. Trim air valves are driven to full closed position. Only the packs regulate temperature.

TRIM AIR VALVE FAILURE

Failed closed	:	Optimized temperature regulation of half of the corresponding zone is lost.
Failed open	:	Corresponding hot air valve closes. Optimized temperature regulation of half of each zone is lost.

CONTROLS AND INDICATORS

OVERHEAD PANEL



(1) PACK pb sw

R On : The pack flow control valve is automatically controlled.
It opens except in the following cases:
- upstream pressure below minimum
- compressor outlet overheat
- engine start sequence:
  1. Both valves close when:
R · the MODE selector is set to IGN when on ground (valves reopen if
R MASTER switch or MAN START pushbutton are not set to ON within 30
R seconds)
     · the MODE selector is set to IGN (or CRANK) and when on either engine :
       - the MASTER switch is set to ON (or MAN START pushbutton is set to ON) and,
       - the start valve is open, and
       - N2 < 50 %.
R 2. On ground, the valve reopening is delayed 30 seconds to avoid an extra pack closure cycle during subsequent engine start.
- any door is not closed and locked, aircraft on ground and any engine running
- fire pushbutton pressed for the engine on the related side.
- ditching selected.

Note : If there is no electrical power, the flow control valves remain open and permit NORM flow.

OFF : The pack flow control valve closes provided it is electrically supplied.
R FAULT lt : Comes on amber, associated with ECAM caution, when pack flow
control valve position disagrees with selected position or in case of
R compressor outlet overheat or pack outlet overheat.

(2) PACK FLOW selector

Enables pack flow selection, depending on the number of passengers and ambient conditions (smoke removal, hot or wet conditions). LO (80 %) – NORM (100 %) – HI (125 %). In case one bleed fails, the flow is limited to 80 %. Any selection is irrelevant in single pack operation, or with APU bleed supply. In these cases, HI pack flow demand is automatically generated.

(3) Zone temperature selector

– 12 o'clock position : 24° C (76° F)
– COLD position : 18° C (64° F)
– HOT position : 30° C (86° F)

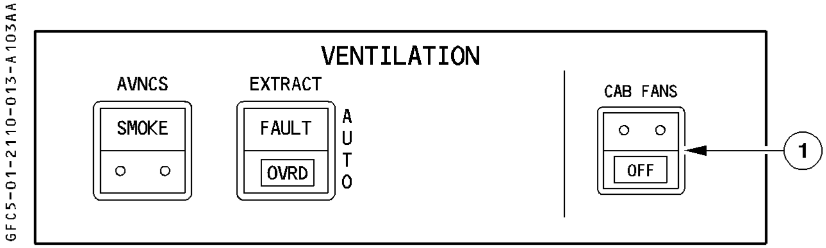
(4) HOT AIR 1 (or 2) pushbutton

On : The valve regulates hot air pressure.
OFF : The valve closes. The FAULT circuit is reset.
Forward cargo heating is lost, if HOT AIR 1 is affected.
FAULT lt : The amber light, and associated ECAM caution, come on when duct overheat is detected (88° C/190° F). The valve, and the associated trim air valves close automatically. The FAULT light goes off, when the temperature drops below 70° C, and the flight crew selects OFF.

(5) RAM AIR pushbutton (guarded)

ON : The ON light comes on white.
If the DITCHING pushbutton, on the CABIN PRESS panel, is in normal position :
– The RAM air inlet opens.
– If $\Delta P < 1$ psi : Each outflow valve opens to about 50 %, when under automatic control. They do not automatically open when under manual control. The emergency ram air flow is directly supplied to the mixer unit.
– If $\Delta P \geq 1$ psi : Each outflow valve remains normally-controlled. No emergency ram air flows in.

Off : The RAM air inlet closes, and the outflow valves return to the normal position.



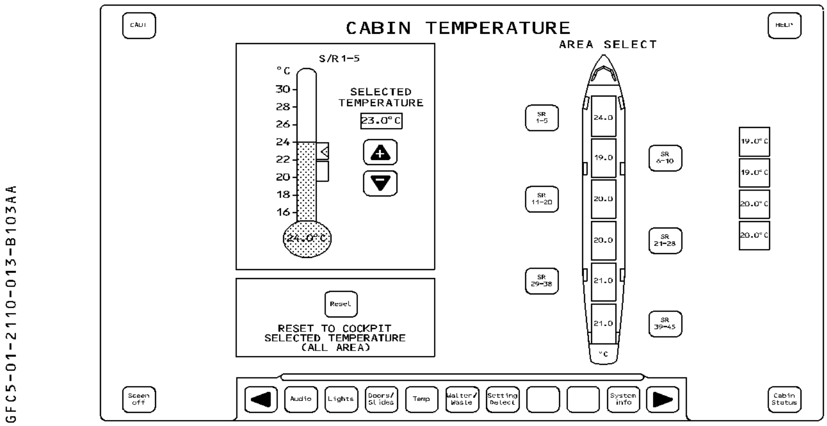
(1) CAB FANS pushbutton

On : The two cabin fans run. Air from the cabin is blown to the avionics compartment and also to the mixer unit of the conditioning systems.
OFF : The two cabin fans stop.

Note : An ECAM caution is activated, when a fan failure occurs.

FORWARD ATTENDANT PANEL

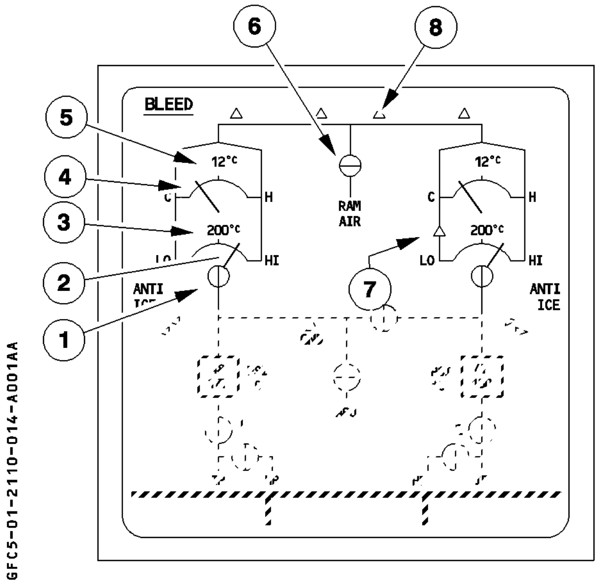
Allows fine trimming of individual zone temperature (± 3°C/±5.4°F).



ADDITIONAL ATTENDANT PANEL

The additional attendant panels can be installed in different locations.
The temperature setting of the related zone can be changed (± 3°C/± 5.4°F).

ECAM BLEED PAGE



① Pack flow control valve

In line - Green : The valve is open.
Crossline - Amber : The valve is closed.

② Pack flow indication

The needle position (green) represents the actual flow rate. The 12 o'clock position corresponds to a 100 % airflow.
R LO : 80 % airflow
R HI : 120 % airflow

③ Pack compressor outlet temperature indication

It is normally green.
It becomes amber, if the temperature is above 260°C.
R It remains amber, as long as the temperature is not below 180°.

④ Temperature control valve position indication

It is in green.
C : The valve is closed.
H : The valve is fully open.

5 Pack outlet temperature indication

It is in green.
It becomes amber, above 95°C.
R It remains amber, as long as the temperature is not below 60°C.

6 RAM AIR inlet indication

R	In line	- Green	: The valve is normally open.
R	Crossline	- Green	: The valve is normally closed.
R	In line	- Amber	: The valve is abnormally open.
R	Crossline	- Amber	: The valve is closed with the RAM AIR pushbutton selected ON.
R	In Transit	- Amber	: The valve is in transit.

7 Bypass valve indication

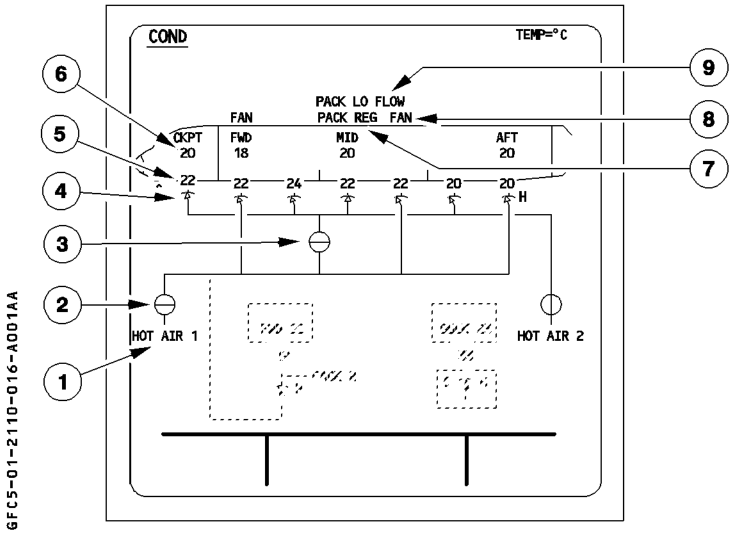
R	Green triangle	: The bypass valve is normally open.
R	Amber triangle	: The bypass valve is failed open.
	No display	: The bypass valve is fully closed.

8 Users indication

It is in green.
It becomes amber, if the two pack valves and the RAM AIR inlet are closed.

ECAM COND PAGE

R



① HOT AIR indication

Normally green.
Becomes amber if the flow control valve is fully closed.

② Hot air valve indication

⦶ green : normally open (not fully closed).
⊖ green : normally closed (fully closed).
⊖ amber : fully closed but controlled open.
⦶ amber : not fully closed and controlled closed.

③ Hot air x valve indication

Identical to the HOT AIR valve indication

4 Trim air valve position indication

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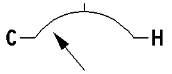


The arrow is normally in green. It becomes amber, if the valve is failed (as seen by the zone controller).
C : The valve is fully closed.
H : The valve is fully open.

Note : The number of trim air valves vary, depending on the cabin configuration.

5 Zone duct temperature indication

It is normally in green.
It becomes amber above 88°C.
R It remains amber, until the remperature is below 70°C.

6 Zone temperature indication

It is in green.

Note : This information is also displayed on the ECAM CRUISE page.

7 PACK REG indication

It is in green, when the zone controller is inoperative (both channels fail).
Temperature is regulated by the packs only.

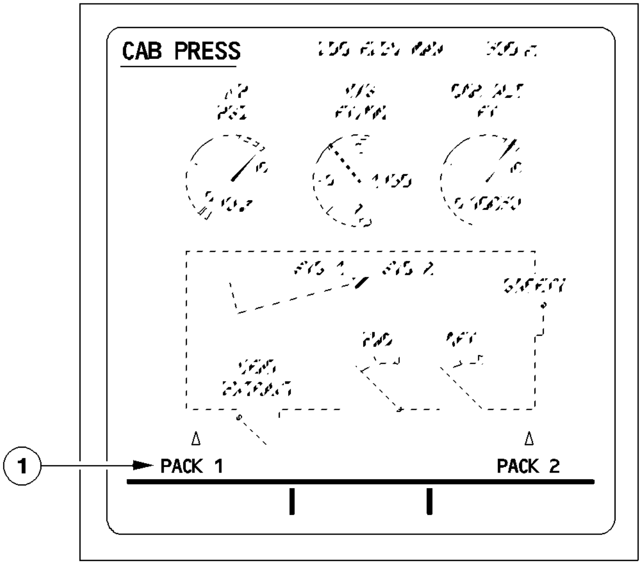
8 FAN indication

It is in amber, if the fan fails, or if it is selected OFF, via the CAB FANS pushbutton.

9 PACK LO FLOW indication

It pulses in green, when the flow is insufficient to reach the selected temperature.
This indicates that the zone controller requests an increase in flow.

ECAM CAB PRESS PAGE



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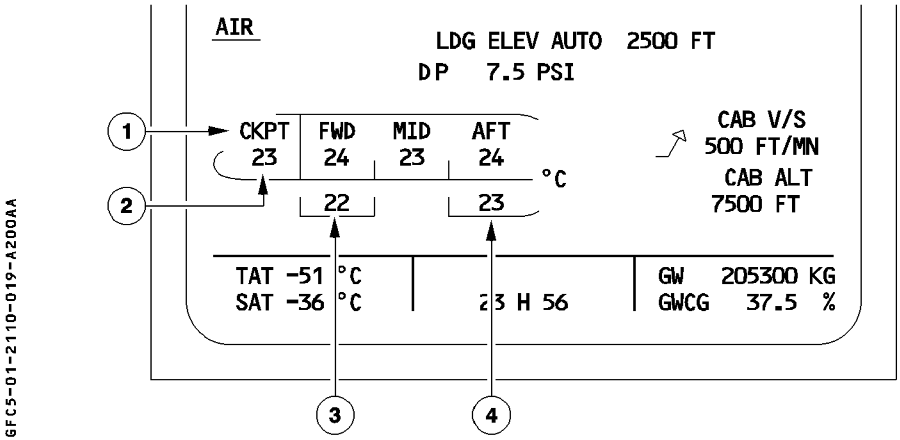
(1) PACK indication

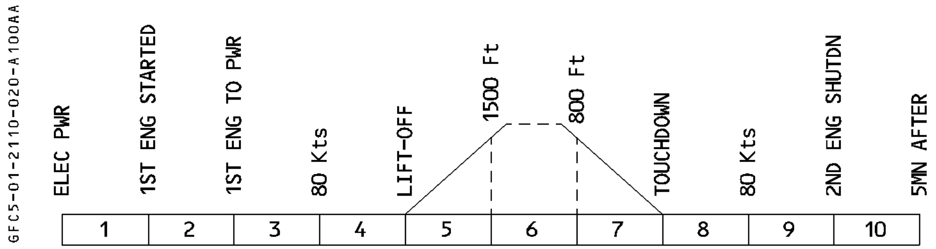
pack flow control valve open :
△ → Green
PACK 1 → White
pack flow control valve closed :
△ → Amber
PACK 1 → Amber

ECAM CRUISE PAGE



1. Zone indication
2. Zone temperature
3. Forward cargo compartment temperature
4. Bulk cargo compartment temperature

WARNINGS AND CAUTIONS



<table>
<tr><th>E/WD : FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>PACK 1(2) OVHT
Pack compressor outlet temperature > 260°C, or pack outlet temp > 95°C.</td><td rowspan="4">SINGLE CHIME</td><td rowspan="4">MASTER CAUT</td><td rowspan="5">BLEED</td><td rowspan="2">PACK FAULT lt</td><td rowspan="2">3, 4, 5, 7, 8</td></tr>
<tr><td>PACK VALVE 1(2) FAULT
Pack valve disagree with selected position.</td></tr>
<tr><td>PACK 1(2) OFF
Pack pb off with no failure.</td><td>PACK OFF lt</td><td>1 to 5
7 to 10</td></tr>
<tr><td>PACK 1+2 FAULT
One pack off, then the other fault.</td><td>PACK FAULT lt</td><td rowspan="2">3, 4, 5, 7, 8</td></tr>
<tr><td>PACK 1(2) REGUL FAULT
Pack controller failed, or air is only cooled by heat exchanger (ACM fault or RAM door failed closed, or Temperature Control Valve failed).</td><td rowspan="2">NIL</td><td rowspan="2">NIL</td><td rowspan="3">NIL</td></tr>
<tr><td>ZONE CTLR 1(2) FAULT
One channel of the zone controller is failed.</td><td>NIL</td><td>1 to 5
7, 8</td></tr>
<tr><td>ZONE REGUL FAULT
Zone controller failed or hot air valve 1+2 failed</td><td rowspan="2">SINGLE CHIME</td><td rowspan="2">MASTER CAUT</td><td rowspan="4">COND</td><td rowspan="3">3, 4, 5
7, 8</td></tr>
<tr><td>DUCT OVHT (FWD CRG, COCKPIT, FWD/MID/AFT CABIN)
Duct temp > 88°C</td><td>HOT AIR FAULT lt</td></tr>
<tr><td>HOT AIR SYS 1(2) FAULT
Hot air valve 1(2) and hot air x valve failed closed</td><td>NIL</td><td>NIL</td><td rowspan="2">NIL</td></tr>
<tr><td>L + R (L, R) CAB VENT FAULT
Cab fan or recirculation valve failure.</td><td>SINGLE CHIME</td><td>MASTER CAUT</td><td>3 *, 4, 5,
7, 8</td></tr>
</table>

* Only in case of single failure.

MEMO DISPLAY

- RAM AIR is diplayed in green, when selected ON, on the overhead panel.
  It becomes amber in flight phases 1 and 2.
- The PACK FLOW LO or HI message is displayed in green, depending on the PACK FLOW selector position.

GENERAL

In normal operation, pressurization control is fully automatic.
The system consists of:
- Two Cabin Pressure Controllers (CPC)
- Two outflow valves, each having 3 motors (2 automatic, 1 manual)
- One control panel
- Three safety valves
- One negative relief valve

Any one of the three independent electric motors can power the outflow valve.
Normally, one of the two cabin pressure controllers operates the outflow valves by means of its associated automatic motor. In case of ditching, an override switch, on the control panel, allows the flight crew to close the outflow valves, and all valves below the flotation line.

AUTOMATIC OPERATION

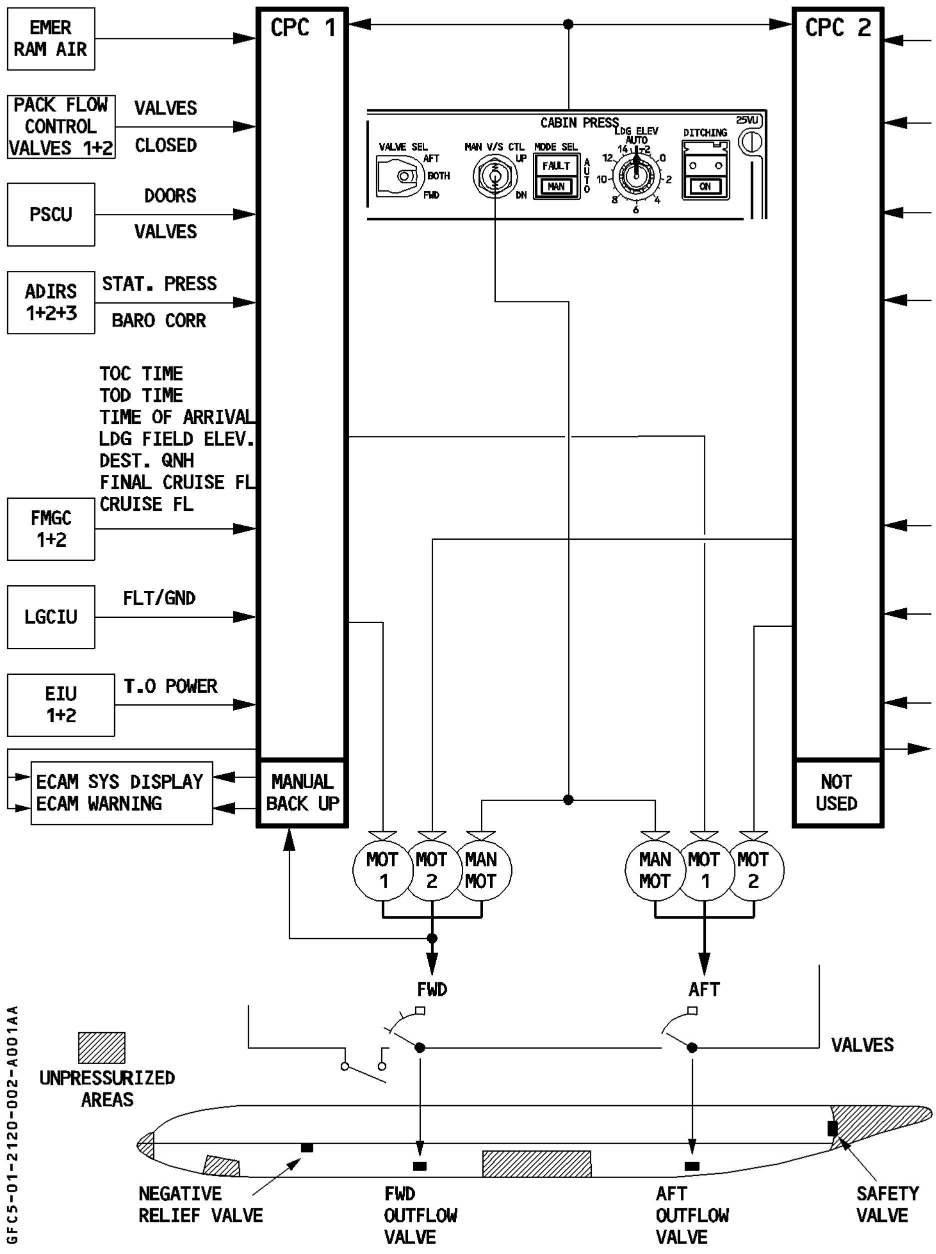
The system can be fully or semi-automatic.
In fully-automatic operation :
Cabin pressurization is achieved from internal or external schedules, when appropriate FMGS inputs are available.
In automatic operation, a $\triangle$P limiting function monitors differential pressure.
In semi-automatic operation, when FMGS data are not available, the crew needs to select the landing field elevation. The pressurization system then uses the manually-selected landing field elevation for internal schedules.

MANUAL OPERATION

In manual mode, the flight crew controls the cabin altitude via the manual motor of the outflow valves, by operating controls on the pressurization control panel.
Manual operation has priority over all other modes.

SCHEMATICS

R



MAIN COMPONENTS

CABIN PRESSURE CONTROLLERS

Two identical, independent, automatic controllers are used for cabin pressure control. They receive signals from the Air Data Inertial Reference System (ADIRS), the Flight Management and Guidance Computer (FMGS), the Engine Interface Unit (EIU), the Landing Gear Control Interface Unit (LGCIU), the Proximity Switch Control Unit (PSCU), and the pack flow control valves. They perform the automatic cabin pressure control. They generate signals for the ECAM. In automatic mode, one controller is active, the other is on standby. For operation in manual mode, each controller has a backup section, which is powered by an independent power supply in the controller N° 1 position. This section also has a pressure sensor that generates the cabin altitude and pressure signal for the ECAM, when MAN mode is selected.
The controllers communicate via a cross-channel link.

OUTFLOW VALVES

Two outflow valves are located below the flotation line. Each outflow valve assembly consists of a flush, skin-mounted, rectangular frame, carrying inward and outward opening flaps linked to the actuator. The actuator contains the drives of two automatic motors and the drive of the manual motor. Either of two electric motors operates the valve in automatic mode, and a third electric motor operates it in manual mode. To allow an easy and smooth control of the cabin's vertical speed in manual mode, the outflow valves move at a speed which is about 1/5 of that in automatic mode.
In automatic mode, the operating controller signals the position of the valve to the ECAM.
In manual mode, the backup section of the N°1 controller signals the position of the valve to the ECAM.
The outflow valves automatically close, if the cabin altitude reaches 15 000 feet, provided the valves are in automatic mode.
When one pack is OFF and $\triangle$P is above 4 psi, the aft outflow valve closes and the forward outflow valve controls the cabin pressure.

Note : *When the RAM AIR pushbutton is ON , and $\triangle$P is below 1 psi, the system drives*
R *the outflow valves about 50 % open if it is under automatic control. If the system*
R *is under manual control, the outflow valves do not automatically open, even if $\triangle$P*
R *is below 1 psi.*

SAFETY VALVES

Three independent pneumatic safety valves prevent the cabin pressure from going too high (8.85 psi above external ambient pressure) or too low (0.73 psi below external ambient pressure). They are on the rear pressure bulkhead, above the flotation line.

NEGATIVE RELIEF VALVE

It is installed below the floor level, aft of left door n° 1, above the flotation line.
It assists the safety valves in preventing the cabin pressure from negative going too low.

SYSTEM OPERATION

AUTOMATIC PRESSURE CONTROL MODE

– Two identical, independent, automatic systems (each consisting of a controller and its associated motors) control cabin pressure.
  Either system controls the two outflow valves.
  Only one controller operates at a time.
  An automatic transfer occurs :
  · 80 seconds after each landing.
  · If the operating system fails.
– The controller normally uses the landing elevation and the QNH from the FMGC, and the pressure altitude from the ADIRS.
  If FMGC data are unavailable, the controller uses the Captain Baro Reference from the ADIRS and the LDG ELEV selection.
– Pressurization is assumed through the following modes:

Ground (GND)

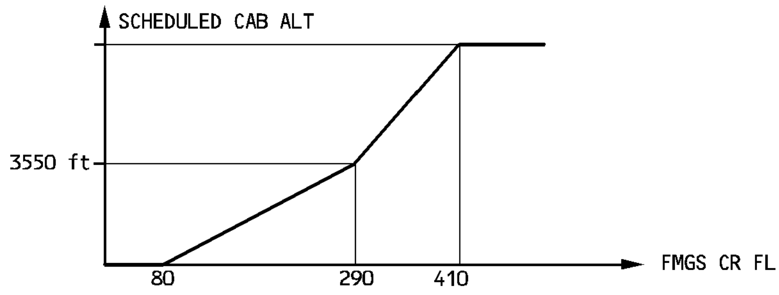
Before takeoff, and 80 seconds after landing, the system keeps the outflow valves fully open to ensure there is no residual pressure differential in the aircraft.
At touchdown, to release the remaining cabin overpressure, a depressurization sequence controls the cabin V/S at + 500 feet/minute.

Takeoff (TO)

To avoid a pressure surge at rotation, the controller prepressurizes the aircraft at a rate of – 328 feet/minute until the pressure differential reaches 0.1 psi. At lift off, the controller initiates the climb phase.

Climb in internal mode (CI)

CAB V / S varies, according to a preprogrammed law, in order to reach the scheduled CAB ALT at the top of climb defined by the FMGS cruise FL.
The CAB V / S is limited to 1000 feet/minute.



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The LDG ELEV selector has no effect in climb.
If no FMGS cruise FL is available the defaulted FL 410 is used.

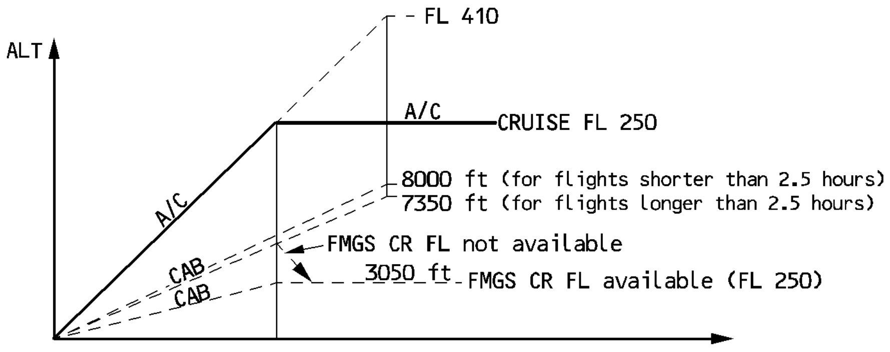
Climb external (CE)

CAB ALT varies according to FMGS estimated times and planned cruise FL.
The cabin climb rate is limited to 1000 feet / min.

Cruise (CRZ)

When the CPC switches to CRZ mode, the cabin altitude is controlled to the lower of cabin altitude reached at top of climb or the scheduled CAB ALT for the actual cruise flight level.
If the cabin altitude at top of climb is higher (no FMGS CR FL available) it will descend at a rate of 300 SLFPM to the scheduled CAB ALT.
If a LDG ELEV is selected (manual or FMGS) that is above the actual CAB ALT, the cabin altitude increases up to the higher of CAB ALT at top of climb, or (LDG ELEV - 6000 ft). The cabin altitude is limited to 7350 ft for flights longer than 2.5 hours, and 8000 ft for flights shorter than 2.5 hours.

Note : If the takeoff runway is higher than 8000 ft, the cabin altitude remains at take-off altitude until cruise.



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Descent in internal mode (DI)

Pressure rate is optimized so that cabin pressure reaches landing field pressure + 0.1 psi just prior to landing. The cabin descent rate is limited to 750 ft/min.

Descent in external mode (DE)

Cabin altitude varies according to FMGS-estimated times, and cabin pressure reaches landing field pressure + 0.1 psi just prior to landing.
The cabin descent rate is limited to 750 feet/minute.

Abort (AB)

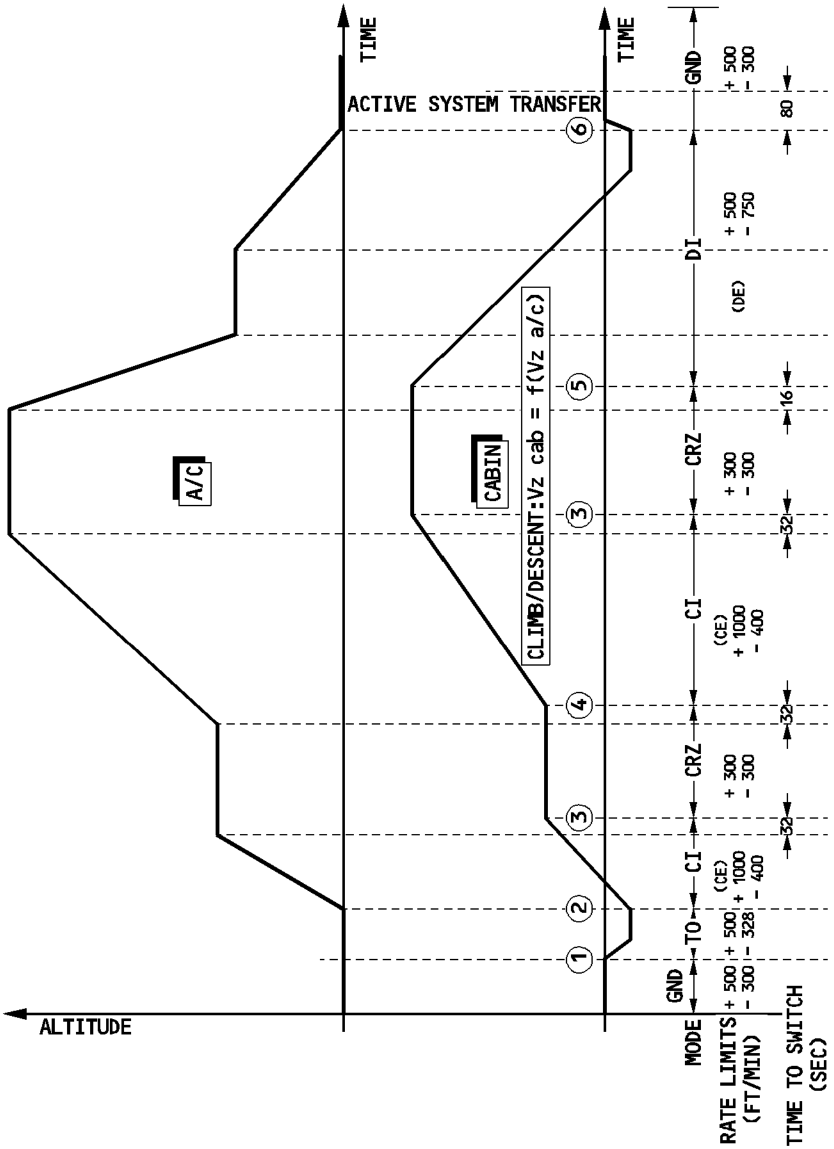
The abort mode prevents the cabin altitude from climbing, if the aircraft does not climb after
R takeoff. Cabin pressure is set back to the takeoff altitude + 0.1 psi.

Ground (after landing) (GND)

At touchdown, to release the remaining △P a depressurized sequence controls the cabin vertical speed at + 500 ft/min.
80 seconds after landing the outflow valves are controlled fully open to ensure there is no residual △P in the aircraft.

R **PRESSURIZATION FLIGHT PROFILE**

FOR INFO



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FOR INFO

PRESSURIZATION MODES SWITCHING

	from	GND	TO	GND	CL	AB	TO	CL	CRZ	CRZ	DES	DES	AB
	to	TO	CL	CL	AB	GND	GND	CRZ	CL	DES	CL	GND	CL
CONDITIONS	ENG 1 and ENG 2 TLA ⩾ CL (ENG RUNNING)	1					0						
	ENG 1 or ENG 2 TLA ⩾ CL (ENG RUNNING)		1										
	RH MAIN L/G sys 1 and sys 2 COMPRESSED	1	0	0		1	1					1	
	All doors closed	1		1									
	A/C ALT < 8000Ft or A/C ALT change since T/O < 5000Ft				1								
	A/C ALT ⩾ 8000Ft or A/C ALT change since T/O > 5000Ft							1					
	A/C RATE OF CLIMB ⩾ 50 SLFPM for 48 SEC										1		
	A/C RATE OF CLIMB ⩾ 250 SLFPM for 32 SEC								1				
	A/C RATE OF DESCENT ⩾ 250 SLFPM for 16 SEC				1					1			
	A/C RATE OF DESCENT ⩾ 50 SLFPM for 32 SEC							1					
	A/C RATE OF CLIMB ⩾ 50 SLFPM for 32 SEC												1
	A/C ALT > A/C ALT at switch into CRZ + 380 SLFT								1				
	A/C ALT > CRZ FL + 190 SLFT							1					
		1	2					3	4	5		6	

0 : CONDITION NOT VALID
1 : CONDITION VALID

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MAXIMUM DIFFERENTIAL PRESSURE LIMITER FUNCTION

This function is only available in automatic mode.

R If the differential pressure is above 8.42 psi, the CPC maintains the △p constant, to avoid
R overpressurization. As a result, the outflow valves open and the CAB V/S increases. Once the differential pressure has decreased below the threshold, normal automatic control of the valves resumes, which generally causes the valves to go towards the closed position.

CAUTION

Except for the outflow valve position indication, and the △p value on the ECAM PRESS page, there is no indication in the cockpit that the limiter function is activated.
Once the △p limiter function has opened the valves, do not counteract the automatic operation by trying to close the valves in manual mode.
Due to the slow movement of the outflow valves in manual mode, the valves cannot be closed fast enough and the cabin altitude quickly increases above 20000 feet (even if an emergency descent is initiated simultaneously). The automatic mode provides the safest and the quickest way to reduce differential pressure, and recover normal pressure control.

MANUAL PRESSURE CONTROL MODE

If both automatic systems fail, the flight crew may use the CABIN PRESS control panel to take over manual control of cabin pressurization.
· Press the MODE SEL pushbutton to select MAN, and
· Push the MAN V/S CTL toggle switch UP or DN to increase or decrease cabin altitude.
Depending on the VALVE SEL position, the flight crew manually controls both, or only one, outflow valve(s).
If only one outflow valve is selected, the other one remains under automatic control.

Note : *1. Due to the slow operation of the outflow valves in manual mode, and the limited resolution of the outflow valves' position on the ECAM, the visual ECAM indication of a change in the outflow valves' position can take up to 5 seconds.*
2. As the pressurization system is manually-controlled, the outflow valves do not automatically open at touchdown.

DITCHING

To prepare for ditching, the flight crew must press the DITCHING pushbutton on the CABIN
R PRESS control panel to close the outflow valves, the emergency ram air inlet, the avionics ventilation overboard valve, and the pack flow control valves.

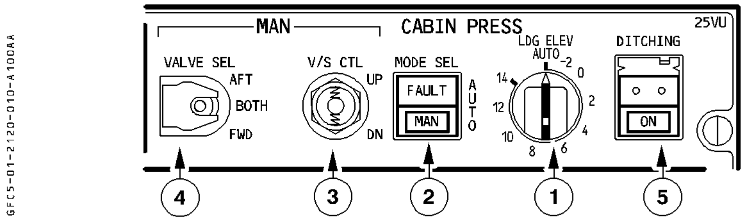
PREVENTION OF PRESSURIZATION WITH A DOOR NOT CLOSED AND LOCKED

On ground, at takeoff power application, if at least one door is not closed and locked, the CPC will remain in ground mode (outflow valves open).

Note : *As a backup, the zone controller closes the pack valves (Refer to 1.21.10).*

CONTROLS AND INDICATORS

OVERHEAD PANEL



(1) LDG ELEV sel

AUTO : The pressurization system uses the FMGEC data to construct an optimized descent pressure schedule.
To leave the AUTO position, pull out and turn the selector.

Other positions : The pressurization schedule does not use the landing elevation from the FMGEC, but instead uses the landing elevation selected with this knob (from – 2000 to 14000 feet) as its reference.

R *Note : The LDG ELEV selector scale is only given as an indication.*
R *(Refer to the ECAM information for accurate adjustment).*

(2) MODE SEL pb

AUTO : Automatic mode is operating. One of the two systems controls the outflow valve.

Note : If the pilot suspects that the operating pressurization system is not performing properly, he can attempt to select the other system by switching the MODE SEL pushbutton to MAN for at least 3 seconds, then returning it to AUTO.

MAN : This legend appears in white, and the FAULT does not come on. The flight crew then uses the MAN V/S CTL switch to control the system.

FAULT lt : This legend appears in amber and the ECAM caution light only comes on when both automatic systems are faulty.

Note : The pilot may notice a variation (up to ± 1000 feet) in CAB ALT indication on the ECAM PRESS page, when the system switches from the cabin pressure control AUTO mode to MAN mode, due to
R *the reduced resolution of the backup pressure sensor.*

③ V/S CTL toggle sw

R The switch, spring loaded to neutral, controls the position of the outflow valve selected through the VALVE SEL. It controls the MAN motor, when the MODE SEL pushbutton switch is in the MAN position.

UP : The valve(s) move towards open position.
DN : The valve(s) move towards closed position.

④ VALVE SEL guarded sel

AFT : The aft outflow valve can be manually controlled. The forward outflow valve remains under automatic control.
BOTH (guarded position) : Both outflow valves can be manually controlled.
FWD : The forward outflow valve can be manually controlled. The aft outflow valve remains under automatic control.

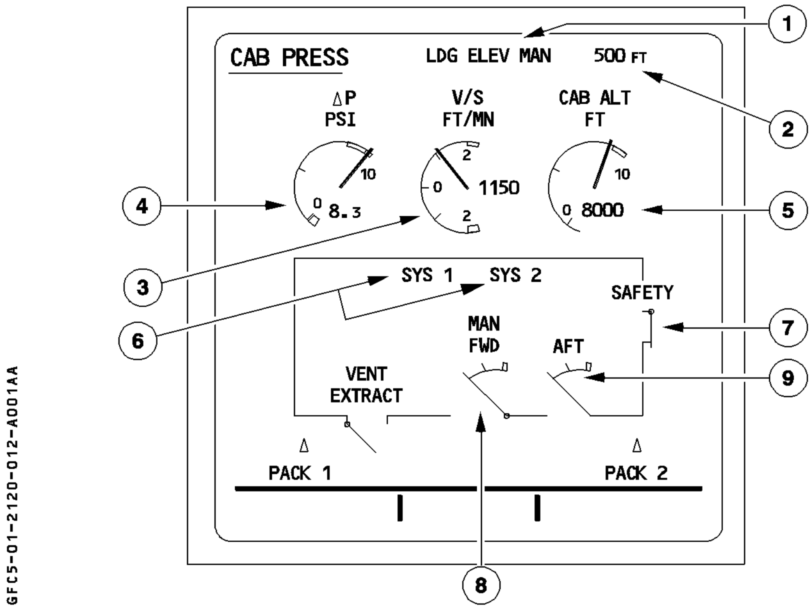
⑤ DITCHING guarded pb sw

Normal : The system functions normally.
R ON : The outflow valves, emergency ram air inlet, avionics ventilation overboard
R valve, cargo compartment isolation valves and pack flow control valves
R close. The ON light appears in white.

Note : The outflow valve(s) will not close automatically if it (they) is (are) under manual control.

CAUTION
R If the ditching pushbutton is put to ON, on ground, with low pressure ground cart
R connected and all doors closed, a differential pressure will build up.

ECAM CAB PRESS PAGE



① LDG ELEV AUTO / MAN

R - LDG ELEV AUTO appears in green when the LDG ELEV selector is in AUTO.
R Becomes amber if the landing elevation is not transmitted by
R the FMGS.
R - LDG ELEV MAN appears in green when the LDG ELEV selector is not in AUTO.
R Neither appears when the MODE SEL pushbutton is in MAN and VALVE SEL selector
R is in BOTH, or when the LDG ELEV selector is faulty.

② Landing Elevation

Landing elevation selected either automatically by the FMGS or manually by the pilot
R appears in green but not when the MODE SEL pushbutton is in MAN and the VALVE
SEL is in BOTH).

R ③ V/S FT/MIN (cabin vertical speed)

R The analog and digital presentation appear in green when V/S is in the normal range.
R The digital presentation pulses when V/S is greater than + or – 1800 feet/minute.

④ △P PSI (Cabin differential pressure)

The analog and digital presentations appear in green when △P is the normal range.
They appear in amber when △P ≤ – 0.26 psi or ≥ 8.85 psi.
The digital presentation pulses if △p > 1.5 psi (resets at 1 psi) during flight phase 7.

⑤ CAB ALT FT (cabin altitude)

The analog and digital presentations appear in green, in normal range.
They appear in red if the cabin altitude goes above 9550 feet.
The digital presentation pulses if the cabin altitude is between 8800 feet and 9550 feet.

⑥ Active system indication (SYS 1 or SYS 2 or MAN)

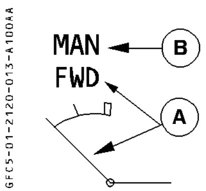
SYS 1 or SYS 2 appears in green when active and in amber when faulty. When either system is inactive, its title does not appear.

⑦ Safety valve position

SAFETY appears in white and the diagram in green when the three safety valves are fully closed.
SAFETY and the diagram appear in amber when at least one valve is not closed.

Note : The safety valves open when the cabin differential pressure is between 8.75 and 8.95 psi.

⑧ Forward outflow valve position



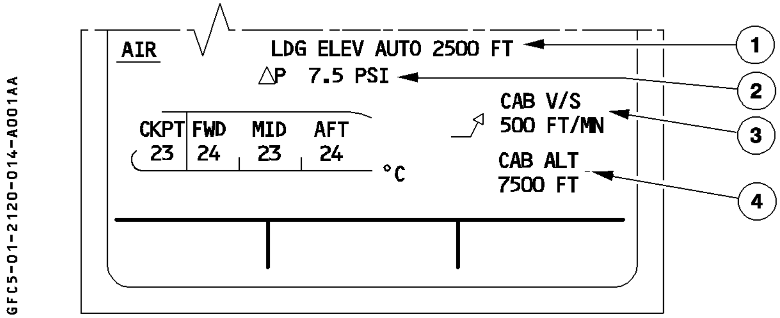
Ⓐ When the valve is operating, normally, the needle appears in green and FWD appears in white.
Both become amber when the valve :
· opens more than 95 % during flight.
· failes under automatic control.

Ⓑ When the valve is under manual control MAN appears in green.

(9) Aft outflow valve position

Identical to forward outflow valve.

ECAM CRUISE PAGE



(1) LDG ELEV AUTO / MAN

Identical to CAB PRESS page.

(2) △P indication

- Normally green.
- Pulses green between 1.5 and 8.85 psi when the aircraft is in final approach.
- Becomes amber below -0.2 psi or above + 8.85 psi.

③ CAB V/S FT/MN (cabin vertical speed indication)

In AUTO PRESS mode

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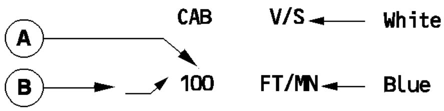

Ⓐ Absolute value of cabin vertical speed is normally green.
It pulses green above 1800 feet/minute or below – 1800 feet/minute.

Ⓑ ↗ : displayed green when the cabin vertical speed is between 25 and 1800 feet/minute.
pulsing green when the cabin vertical speed is above 1800 feet/minute.
↘ : displayed green when the cabin vertical speed is between -1800 and -25 feet/minute.
pulsing green when the cabin vertical speed is below -1800 feet/minute.
nothing is displayed when the cabin vertical speed is between -25 and +25 feet/minute.

In MAN PRESS mode (MODE SEL pushbutton switch at MAN and VALVE SEL at BOTH position):

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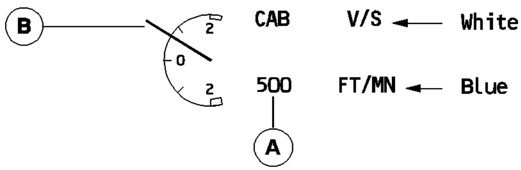


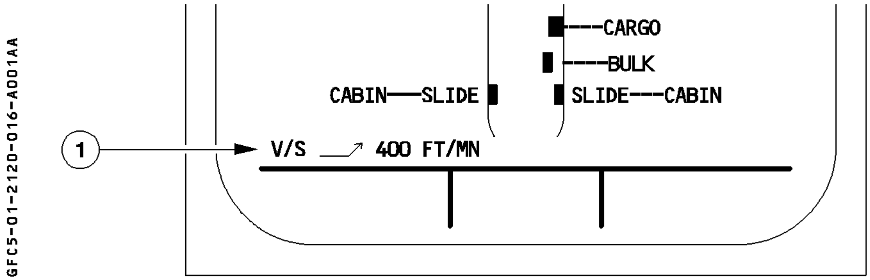
Ⓐ Identical to AUTO PRESS mode, but minus sign is added for negative values

Ⓑ The needle for the cabin vertical speed indication is normally green.
It pulses green below -1800 feet/minute or above +1800 feet/minute

④ CAB ALT FT cabin altitude indication

Refer to CAB ALT value on CAB PRESS page.

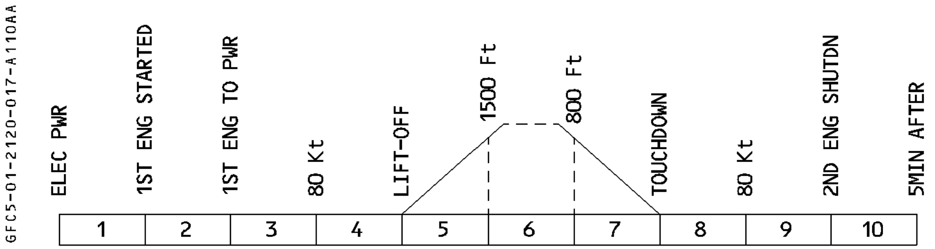
ECAM DOOR/OXY PAGE



(1) V/S (cabin vertical speed)

identical with cabin vertical speed indication on cruise page when in AUTO PRESS mode.

WARNINGS AND CAUTIONS



R

E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
EXCESS CAB ALT Cabin altitude exceeds – In CLB (DES) the higher of both : 9550 feet or takeoff (landing) field pressure altitude + 1000 feet – In CRZ 9550 feet	CRC	MASTER WARN	CAB PRESS	NIL	1 to 5 7 to 10
SYS 1 + 2 FAULT Both pressure controllers fail.	SINGLE CHIME	MASTER CAUT		MODE SEL FAULT lt	4, 5, 7, 8
LO DIFF PR Time to reach △P = 0 < 1.5 mn Not active below (landing field pressure altitude + 1500 SLFT)				NIL	1 to 5 7 to 10
FWD (AFT) OFV NOT OPEN Outflow valve not fully open on ground (time delay 80 seconds)					3 to 8
SAFETY VALVE OPEN Safety valves not fully closed.					2 to 5 7, 8
LDG ELEV FAULT No data available, with LDG ELEV sel at AUTO					1, 3, 4, 5 7 to 10
SYS 1 (2) FAULT Pressure controller fault.	NIL	NIL			3, 4, 5 7, 8

MEMO DISPLAY

– The “MAN LDG ELEV” message is displayed in green, if the LDG ELEV selector is not in the AUTO position.
This message becomes amber in Phases 1 and 2.

GENERAL

R The ventilation system includes ventilation for :
R — avionics,
R — batteries,
R — lavatories and galleys,
R — pack bay.

R *Note : For a description of cargo ventilation, see 1.21.40.*

Two computers are provided :
— the Avionic Equipments Ventilation Controller (AEVC),
— and the Ventilation Controller.

AVIONICS VENTILATION

GENERAL

The avionics ventilation system is fully automatic.
It cools the electrical and electronic components, in the electronic bay and flight deck (including the instruments).
It uses air recirculated from the cabin, and extracts air from the different panels and equipments racks.

MAIN COMPONENTS

TWO CABIN FANS

Two electric fans continuously operate, as long as the aircraft's electrical system is supplied. They can be simultaneously cut-off through the CABIN FAN pushbutton.
They make the air circulate around the avionics equipment, and blow to the mixer unit of the air conditioning system through the recirculation valves.

RECIRCULATION VALVES

They are normally open, and are partially closed automatically by the ventilation controller, when both packs are OFF (provided both CABIN FANS are ON to ensure sufficient air flow to avionics).

EXTRACT FAN

It operates continuously, as long as the aircraft's electrical system is supplied, and blows
R air through the underfloor extract or overboard extract valve.

R UNDERFLOOR AND OVERBOARD EXTRACT VALVES

These valves are fitted with actuators, controlled by the Avionics Equipment Ventilation Computer (AEVC), or by the EXTRACT pushbutton from the flight deck.
R Through the overboard extract valve, air is blown overboard.
R Through the underfloor extract valve, air is blown under the forward cargo compartment, then overboard through the outflow valve.

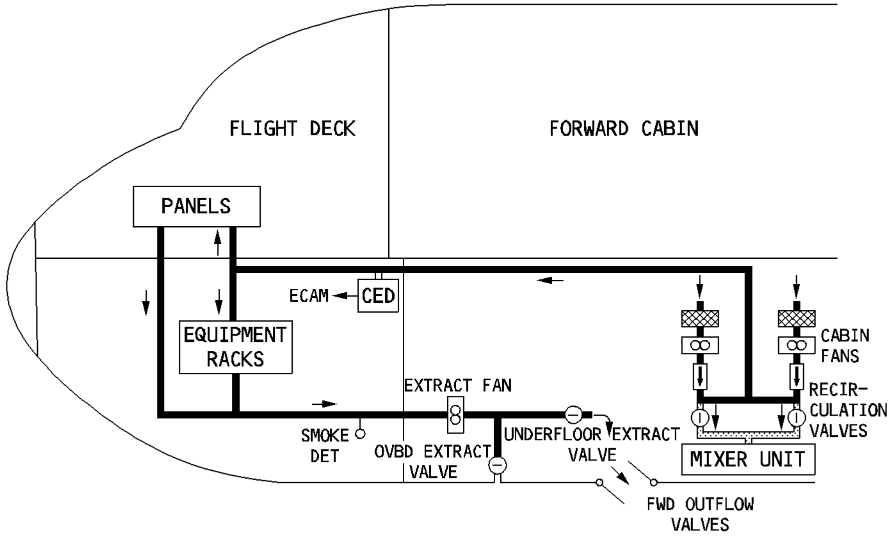
COOLING EFFECT DETECTOR (CED)

This detector triggers an ECAM caution when the cooling capacity (flow and temperature) of the blown air is abnormal. On ground, it also activates the external horn and the external warning light.

AVIONICS EQUIPMENT VENTILATION COMPUTER (AEVC)

R This Computer controls the position of the underfloor and OVBD extract valves.

R



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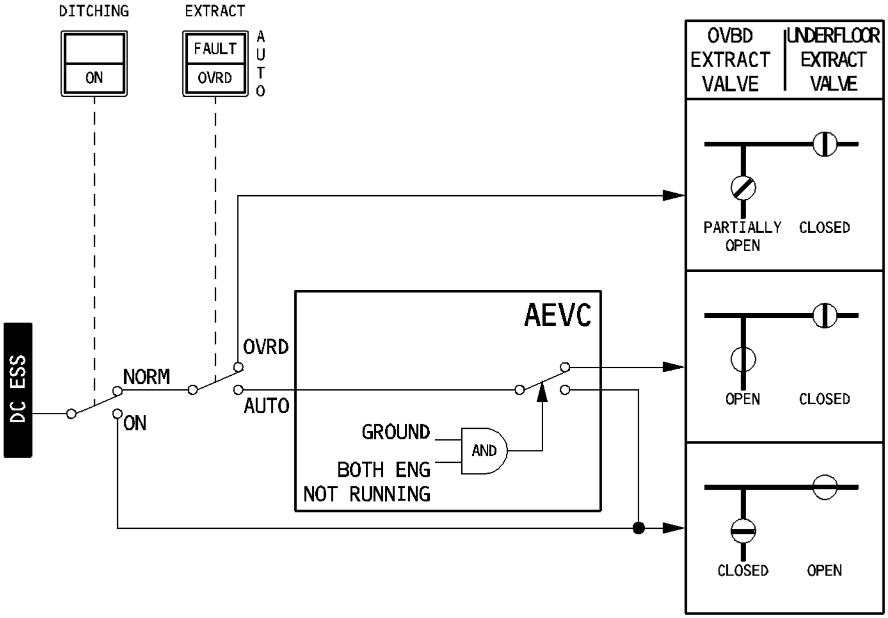
FOR INFO



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SYSTEM OPERATION

The cabin and extract fans operate continuously. Air, recirculated from the cabin, is provided to the avionics compartment and the flight deck instrument panels.

Note : In case of failure of the two cabin fans, fresh air is blown from the packs.

In normal operation, fresh air is blown by the extract fan:
R — On the ground, engines not running : Through the OVBD extract valve (the underfloor
R extract valve is closed).
R — In flight, or on ground with engines running : Through the underfloor extract valve (the
R OVBD extract valve is closed).
R If OVRD is selected on the EXTRACT pushbutton, air is blown through the OVBD extract
R valve which is partially open (underfloor extract valve is closed).
R When the DITCHING pushbutton is ON, the OVBD extract valve is closed and the underfloor
R extract valve is open, whatever the position of the EXTRACT pushbutton.

AVIONICS GROUND COOLING

NOT APPLICABLE

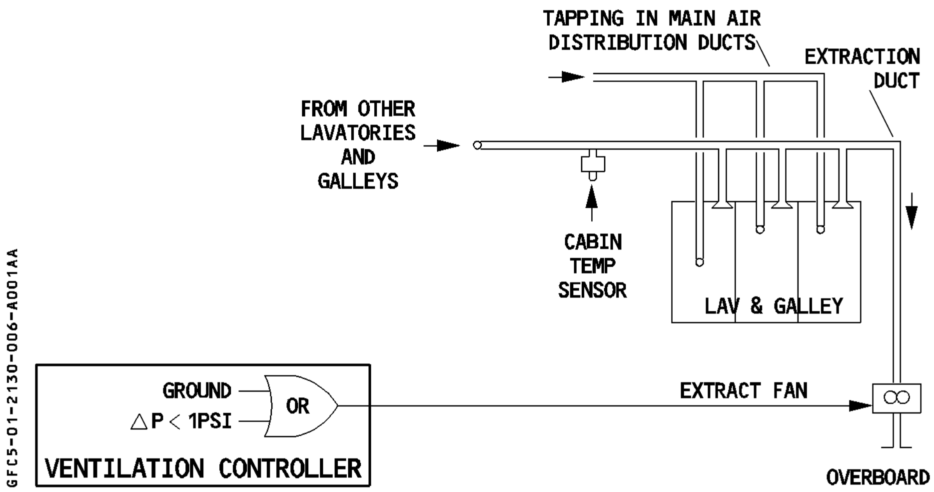
BATTERY VENTILATION

R A venturi in the skin of the aircraft draws air from the space around the batteries and vents
R it overboard. The resulting air flow ventilates the batteries.

LAVATORY AND GALLEY VENTILATION

R An extraction fan draws ambient cabin air through the lavatories and galleys and exhausts
R it through a venturi.
R On ground, or if $\Delta P < 1$ psi, the ventilation controller controls the extraction fan.
R The ventilation of the cabin temperature sensors is connected to the extraction duct.

FOR INFO

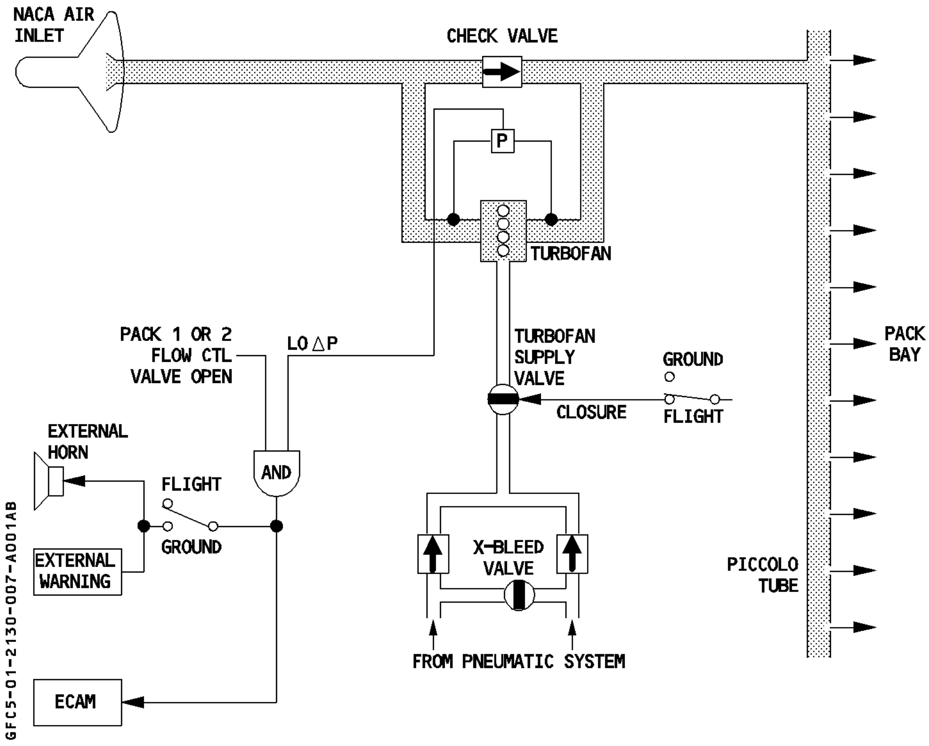


PACK BAY VENTILATION

The ventilation of the pack bay ensures air circulation in order to maintain, on ground and in flight, a mean temperature compatible with the structure constraints in the relevant area.
R In flight, air from outside flows into the pack bay through a NACA air inlet.
R On ground, a turbofan provides a sufficient airflow.
R The turbofan is driven by air from the bleed system which is supplied through the turbofan
R supply valve. Controlled by the AEVC, the fan operates when the aircraft is on ground
An ECAM warning associated with an external horn on ground is triggered in case of failure of the turbofan (supply valve failed closed or turbofan jammed).

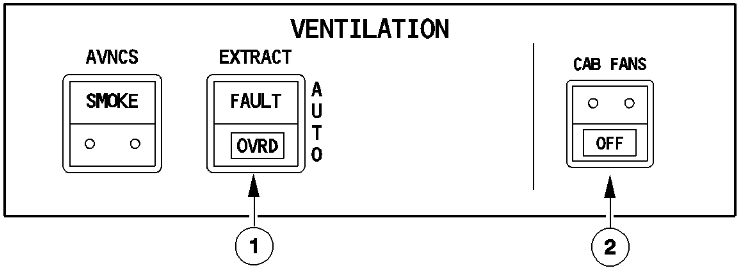
FOR INFO

R



CONTROLS AND INDICATORS

OVERHEAD PANEL



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(1) EXTRACT pb

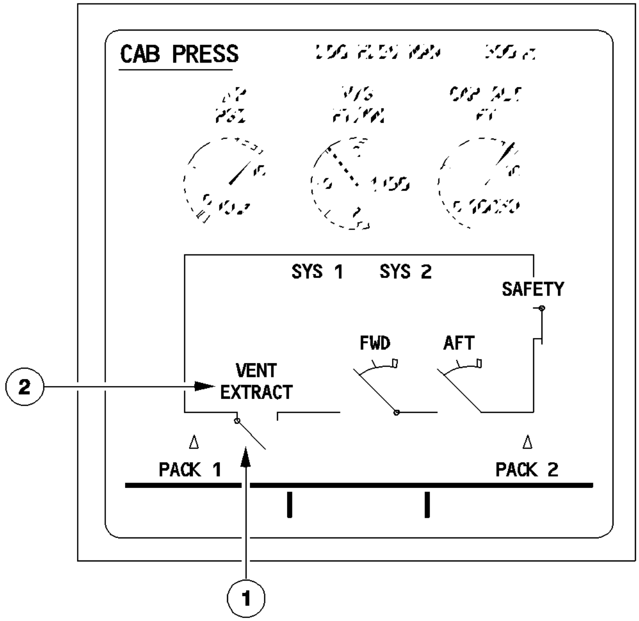
R AUTO : On ground, with both engines not running, the underfloor extract valve is
R closed and the OVBD extract valve is open, provided DITCHING is not
R selected.
R In flight, or on ground with at least one engine running, the underfloor
R extract valve is open and the OVBD extract valve is closed.
R OVRD : The underfloor extract valve closes and the OVBD extract valve partially
R opens, provided DITCHING is not selected.

FAULT lt : The amber light and associated ECAM caution come on, when an extract low flow is detected in the avionics compartment.
The FAULT light goes out when OVRD is selected.

(2) CAB FAN pb

(Refer to 1.21.10)

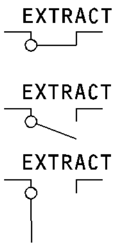
ECAM CAB PRESS PAGE



GFC5-01-2130-009-A001AA

① OVBD valve position indication

R



: This indicates that the OVBD extract valve is fully closed.

: This indicates that the OVBD extract valve is partially open.

: This indicates that the OVBD extract valve is fully open.

GFC5-01-2130-009-B001AA

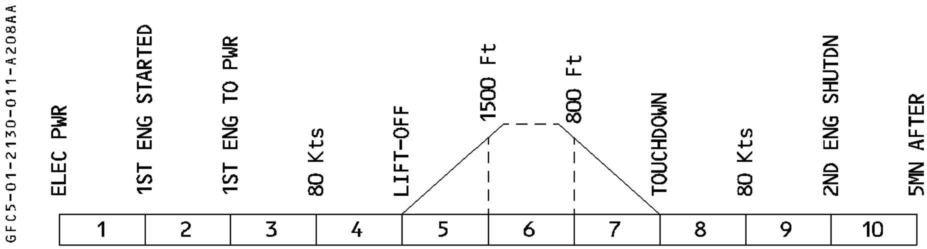
Normally, the EXTRACT indication appears in white and the valve symbol is in green. Both become amber in case of an abnormal position.

② VENT indication

This normally appears in white.
It becomes amber in case of extract low flow.

LEFT INTENTIONALLY BLANK

WARNINGS AND CAUTIONS



E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
BLOWING FAULT * Low cooling capacity detected by the CED.	SINGLE CHIME	MASTER CAUT	NIL	NIL	4, 5, 7, 8
EXTRACT FAULT * Low extract flow detected by the pressure switch.			CAB PRESS	EXTRACT FAULT light	3, 4, 5, 7, 8
OVBD VALVE FAULT Valve open at engine start, or not partially open after override.					
PACK BAY VENT FAULT * Lo △P detected accross the turbofan, with at least one pack in operation.			NIL	NIL	3 to 8
LAV + GAL VENT FAULT	NIL	NIL			

* Associated with the external ground horn, triggered after a time delay of 5 minutes.

GENERAL

The system provides ventilation and heating to the cargo compartments. It is controlled by the ventilation controller which has two channels. Channel 2 is a backup in case of channel 1 failure.

SYSTEM OPERATION

BULK CARGO COMPARTMENT

VENTILATION

Air from the cabin goes via the inlet isolation valve to the bulk cargo compartment, and is driven by an extraction fan. Air is controlled by the outlet isolation valve, goes to the bilge, then goes through the aft outflow valve.

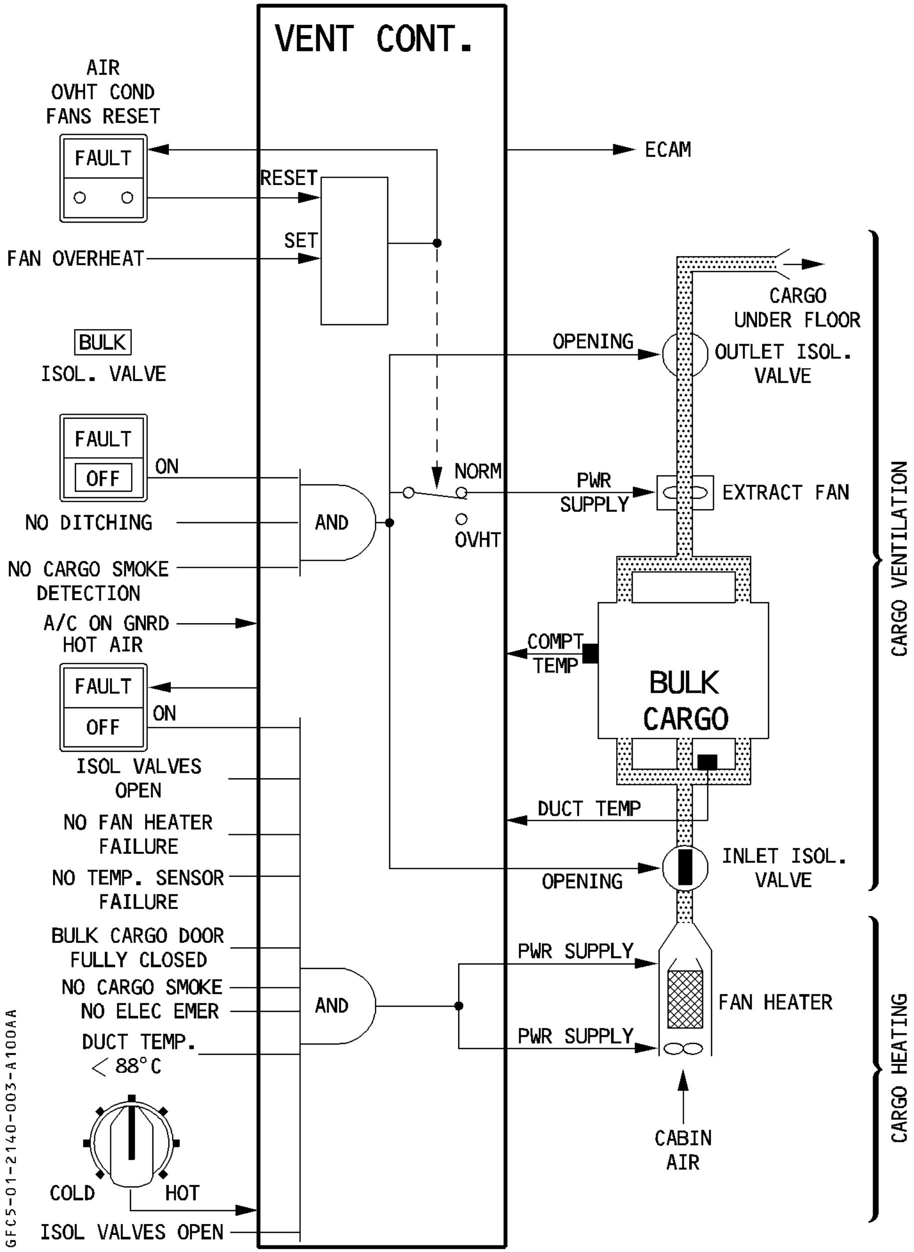
– **Normal operation**
The cargo ventilation controller controls the operation of the inlet and outlet isolation valves and the extraction fan.
The ventilation system operates when the isolation valves are fully open. To open the isolation valves, switch the BULK ISOL VALVE pushbutton to the on position.
The controller closes the isolation valves and stops the extraction fan when :
R – The flight crew sets the BULK ISOL VALVE pushbutton OFF, or
– The aft cargo smoke detection unit detects smoke.
The outlet valve closes and the extraction fan stops, when the flight crew sets the DITCHING pushbutton ON.
In case of overheat, the extraction fan is stopped and the OVHT COND FANS RESET FAULT light comes on on the maintenance panel.

HEATING

Bulk cargo compartment heating is performed by an electrical fan heater. Air from the cabin, driven by the electrical fan, goes into the compartment through a heating element.
The temperature demand is selected from the cockpit.

– **Normal operation**
Provided the cargo door is closed, the heater operates when the temperature sensors indicate that the compartment air temperature is less than the selected one.

– **On ground operation**
When the bulk cargo door is open, the electrical power no longer supplies the heating element of the fan heater. Compartment heating is not available, as long as the cargo door remains open.


VENT CONT.
AIR
OVHT COND
FANS RESET
FAULT
RESET
SET
FAN OVERHEAT
ECAM
BULK
ISOL. VALVE
FAULT
OFF
ON
NO DITCHING
AND
NO CARGO SMOKE
DETECTION
A/C ON GNRD
HOT AIR
FAULT
OFF
ON
ISOL VALVES
OPEN
NO FAN HEATER
FAILURE
NO TEMP. SENSOR
FAILURE
BULK CARGO DOOR
FULLY CLOSED
NO CARGO SMOKE
NO ELEC EMER
AND
DUCT TEMP.
< 88°C
COLD
HOT
ISOL VALVES OPEN
NORM
OVHT
OPENING
PWR
SUPPLY
COMPT
TEMP
DUCT TEMP
OPENING
PWR SUPPLY
PWR SUPPLY
CARGO
UNDER FLOOR
OUTLET ISOL.
VALVE
EXTRACT FAN
BULK
CARGO
INLET ISOL.
VALVE
FAN HEATER
CABIN
AIR
CARGO VENTILATION
CARGO HEATING
GFC5-01-2140-003-A100AA

AFT CARGO COMPARTMENT

VENTILATION

NOT APPLICABLE

FORWARD CARGO COMPARTMENT

VENTILATION AND COOLING

Due to extract fan suction, cabin air flows through the two inlet isolation valves into the forward cargo compartment via the sidewall and ceiling inlets. Air is extracted through outlets on the opposite sidewall, and goes via the extract fan and outlet isolation valve to the underfloor bilge area near the forward outflow valve.
To decrease compartment temperature, the inlet ventilation air is mixed with cold air from pack 2. The cold air valve has three positions which enable the quantity of cooled conditioned air, mixed with the ventilation air, to be adjusted. The valve position is selected from the cockpit.

Note : *1. In general, if COOLING is selected at NORM or MAX, the parameters could be different between both packs.*
2. Below 20,000 feet, the pack 2 outlet temperature is limited to 5°C, in order to avoid ice accumulation on the cold air valve.

– **Normal operation**
The cargo ventilation controller controls the inlet and outlet isolation valves and the extraction fan.
The ventilation system operates when the isolation valves are open. To open the isolation valves, switch the FORWARD ISOL VALVE pushbutton to the on position.
The controller closes the isolation valves and stops the extraction fan, when :
– The flight crew turns the FORWARD ISOL VALVE pushbutton, or
– The forward cargo smoke detection unit detects smoke.
The outlet valve closes and the extraction fan stops, when the flight crew sets the DITCHING pushbutton ON.
In case of an overheat, the extraction fan stops and the OVHT COND FANS RESET FAULT light, on the maintenance panel, comes on.
The cold air valve is fully closed when :
a) The COOLING selector is selected OFF, or
b) The forward cargo door is not fully closed, or
c) The forward cargo smoke detection system is triggered, or
d) In case of forward cooling system failure, or
e) At least one pack is off.

HEATING

To provide variable temperature, inlet air is mixed with the hot air ducted upstream of PACK 1. The forward cargo trim air valve controls the quantity of hot air added.
R The temperature is selected from the cockpit.

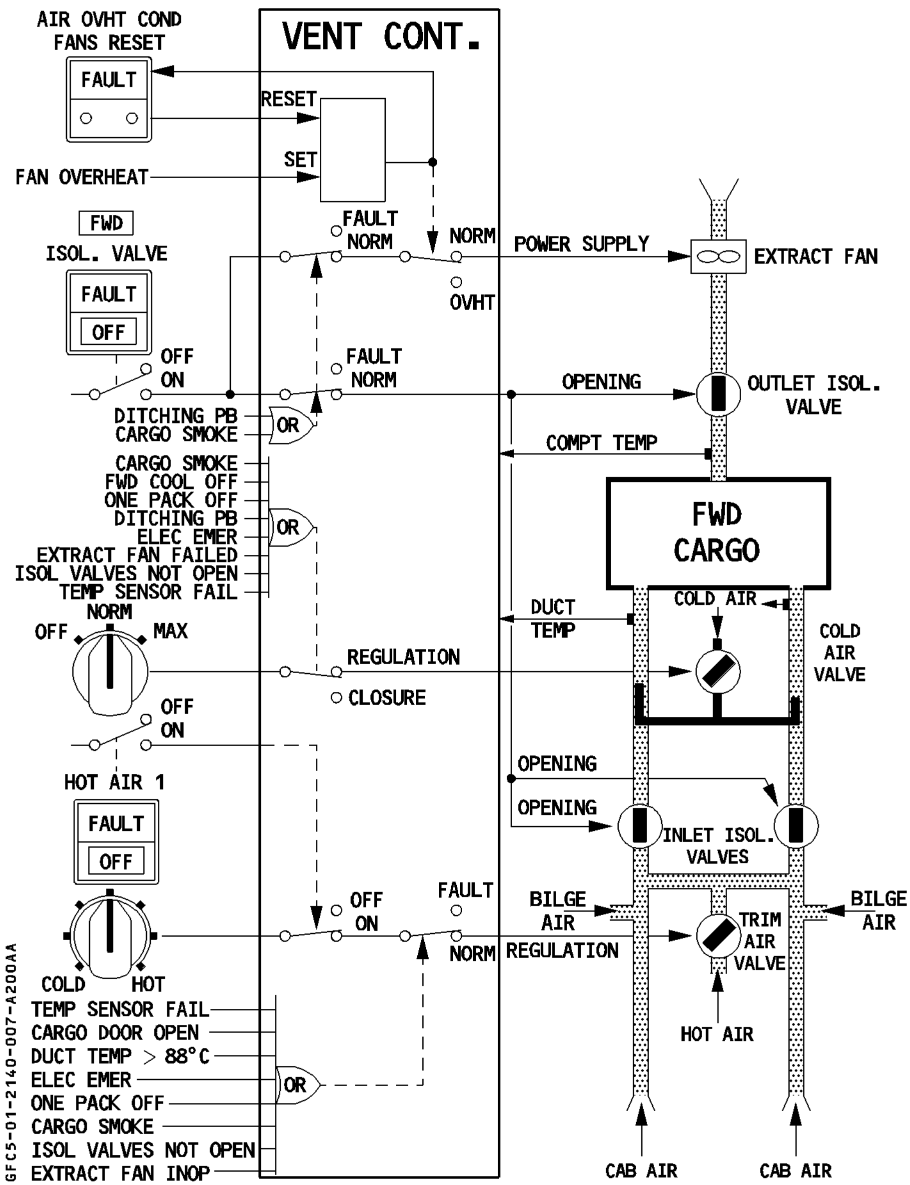
Normal operation
When the HOT AIR 1 pushbutton (Refer to Air Conditioning Overhead Control Panel, described in 1.21.10) is switched ON, hot air is added to the cargo ventilation system. A trim air valve controls the quantity of hot air. The Ventilation Controller controls the position of this trim air valve, according to the sensed duct temperature and to the selected temperature. Manually switching the HOT AIR 1 pushbutton to OFF stops the heating.

Note : If there is a failure in one of the hot air supplies, the hot air X valve opens. The forward cargo compartment supply remains either through Channel 1 (Channel 2 failure), or through Channel 2 (Channel 1 failure).

If you stop the forward cargo compartment heating system with the HOT AIR 1 pushbutton, temperature control for the respective cabin zones (Refer to 1.21.10) is also lost.

On ground operation
The trim air valve closes when the forward cargo door opens. Compartment heating is unavailable, as long as the cargo door remains open.

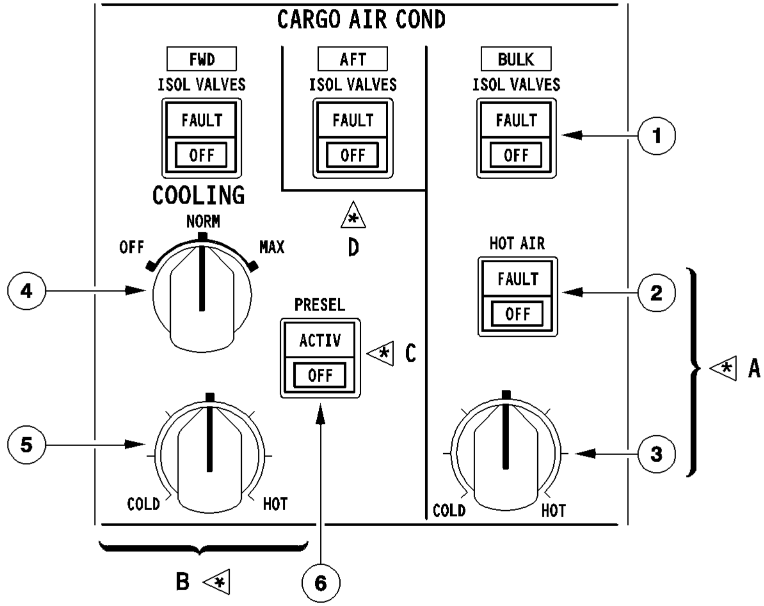
R



AIR OVHT COND
FANS RESET
FAULT
VENT CONT.
RESET
SET
FAN OVERHEAT
FWD
ISOL. VALVE
FAULT
OFF
FAULT
NORM
NORM
OVHT
POWER SUPPLY
EXTRACT FAN
OFF
ON
FAULT
NORM
OPENING
OUTLET ISOL.
VALVE
DITCHING PB
CARGO SMOKE
OR
COMPT TEMP
CARGO SMOKE
FWD COOL OFF
ONE PACK OFF
DITCHING PB
ELEC EMER
EXTRACT FAN FAILED
ISOL VALVES NOT OPEN
TEMP SENSOR FAIL
OR
FWD
CARGO
COLD AIR
DUCT
TEMP
COLD
AIR
VALVE
NORM
OFF
MAX
REGULATION
CLOSURE
OFF
ON
OPENING
OPENING
INLET ISOL.
VALVES
HOT AIR 1
FAULT
OFF
OFF
ON
FAULT
NORM
BILGE
AIR
REGULATION
TRIM
AIR
VALVE
BILGE
AIR
COLD
HOT
HOT AIR
TEMP SENSOR FAIL
CARGO DOOR OPEN
DUCT TEMP > 88°C
ELEC EMER
ONE PACK OFF
CARGO SMOKE
ISOL VALVES NOT OPEN
EXTRACT FAN INOP
OR
CAB AIR
CAB AIR
GFC5-01-2140-007-A200AA

CONTROLS AND INDICATORS

OVERHEAD CARGO AIR COND PANEL



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A ⊳ BULK CARGO HEATING
B ⊳ FWD CARGO VENTILATION AND HEATING
C ⊳ FWD CARGO TEMP PRESELECTION
D ⊳ AFT CARGO VENTILATION

(1) ISOL VALVE pb sw

R On : The inlet and outlet isolation valves open, and the extraction fan runs.
R If smoke is detected in the cargo compartment the inlet and outlet
R isolation valves close and the fan stops.
R OFF : The inlet and outlet isolation valves close and the fan stops.
FAULT lt : Comes on amber associated with ECAM caution when either inlet or
R outlet isolation valve is not in the selected position or when the smoke
R warning is triggered.

② HOT AIR ◁

ON : The fan heater operates, provided the BULK cargo compartment temperature is below the selected one, and the BULK cargo door is closed.
OFF : The fan heater stops. Inlet air is not heated.
FAULT lt : The amber light, and associated ECAM message, come on when the duct overheats (88°C - 190°F). The light goes off when the temperature drops below 70°C (158°F), and OFF is selected. The fan heater stops.

③ Temperature selector ◁

R COLD position : 5°C (41°F)
R HOT position : 25°C (77°F)
R Middle position : 15°C (59°F)

R *Note : Cargo compartment temperature may vary due to such factors as flight*
R *duration, outside temperature, and cabin temperature. As a result, the actual*
R *temperature may be higher than the one indicated by the selector position.*

④ COOLING selector ◁

OFF : The cold air valve is closed. No cold air is added to the ventilation air.
NORM : The cold air valve is partially open for normal operation.
MAX : The cold air valve is fully open. Maximum quantity of cold air is supplied to cool the forward cargo compartment.

⑤ Temperature selector ◁

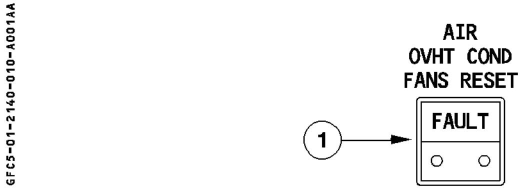
COLD position : 5°C (41°F)
HOT position : 25°C (77°F)
Middle position : 15°C (59°F)

⑥ FWD PRESEL ◁

ACTIV lt : The light comes on green, when FWD PRESEL is selected, or the cargo compartment service panel's ON/OFF toggle is momentarily switched to
R ON. Once this toggle switch is ON, the temperature can be preselected
R on the forward cargo compartment service panel.
OFF : ACTIV light goes out. Temperature selection from the cockpit overrides the temperature preselected from the service panel.

Note : The preselection system is automatically set to OFF, when the forward cargo door is opened after flight.

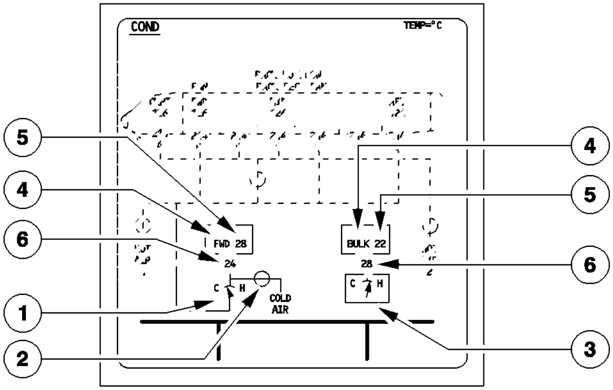
OVERHEAD MAINTENANCE PANEL



1 OVHT COND FANS RESET pushbutton

FAULT lt : Comes on amber when extract fan overheat occurs. Fan is stopped. To resume fan operation press the OVHT COND FANS RESET pushbutton (FAULT light goes out).

ECAM COND PAGE



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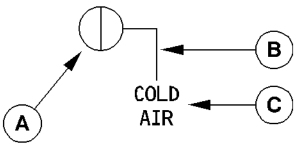
(1) Trim air valve (Heating)

H - Hot (Green) : Valve is open.
C - Cold (Green) : Valve is closed.
Amber, if the valve fails.

(2) Cold air valve



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R (A) In line – Green : Valve is fully open.
R In line – Amber : Valve is failed open.
R In transit – Green : Valve is partially open.
R In transit – Amber : Valve is failed partially open, or in transit.
R Cross line – Green : Valve is fully closed.
R Cross line – Amber : Valve is failed closed.

Note : The color of the symbol changes from green to amber, if one of the two pack flow control valves is fully closed, independent of the cold air valve position.

(B) This indication is in green either when the pack flow control valves are not fully closed, or when positions are not available. It becomes amber when one of the two valves is fully closed.

(C) This indication is in white.

3 Bulk fan heater

R The arrow is normally green. It becomes amber, if the heater fails.
R H - Hot (green) : The heater operates at its highest level.
R C - Cold (green) : The heater operates at its lowest level.

4 Compartment indication

It is in white.

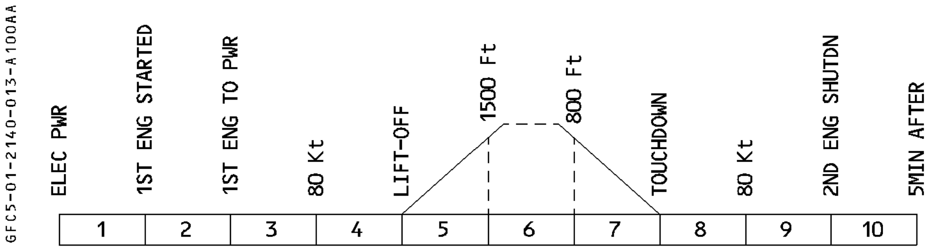
5 Compartment temperature

It is in green.

6 Duct temperature

It is normally in green. It becomes amber, when the temperature is above 88°C.

WARNINGS AND CAUTIONS



<table>
<tr><th>E/WD : FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>VENT SYS FAULT
Ventilation controller failure.</td><td>SINGLE CHIME</td><td>MASTER CAUT</td><td rowspan="2">COND</td><td rowspan="3">NIL</td><td rowspan="7">3, 4, 5, 7, 8</td></tr>
<tr><td>BULK (FWD) CRG HEAT FAULT ◁
Heating system failure.</td><td rowspan="4">NIL</td><td rowspan="4">NIL</td></tr>
<tr><td>BULK (FWD) (AFT) CRG VENT FAULT◁
Ventilation system failure.</td><td rowspan="3">NIL</td></tr>
<tr><td>BULK (FWD) (AFT) CRG ISOL FAULT ◁
Cargo isolation valve disagreement.</td><td>ISOL VALVE FAULT lt</td></tr>
<tr><td>FWD CRG COOL FAULT ◁
Cooling system failure.</td><td>NIL</td></tr>
<tr><td>BULK CRG DUCT OVHT ◁
Duct temp > 88°C or above 80°C
4 times in one flight.</td><td>SINGLE CHIME</td><td>MASTER CAUT</td><td>COND</td><td>HOT AIR FAULT lt</td></tr>
<tr><td>IFE BAY VENT FAULT ◁</td><td>NIL</td><td>NIL</td><td>NIL</td><td>NIL</td></tr>
</table>

BUS EQUIPMENT LIST

R

			NORM			EMER ELEC		
			AC	DC	DC BAT	AC ESS	DC ESS	HOT
AIR COND	PACK CONTROLLER	1 channel 1 channel 2	AC1 AC1	DC1 DC1				
		2 channel 1 channel 2	AC2 AC2	DC2 DC2				
	ZONE CONTROLLER	channel 1 channel 2		DC1 DC2				
	PACK VALVES CLOSURE						X	
	RAM AIR INLET						X	
PRESS	CAB PRESS CONT	1					X	
		2		DC2				
		MANUAL CONTROL			X			
VENT	CABIN FANS	1	AC1					
		2	AC2					
	AVIONIC	AEVC	AC1					
		EXTRACT FAN	AC1					
CARGO	VENT CONT			DC2			SHED	
	BULK	EXTRACT FAN	AC2					
		ISOL VALVES (3)	AC2					
		FAN HEATER◁	AC2					
	AFT	EXTRACT FAN◁	AC1					
		ISOL. VALVES◁	AC1					
	FWD	EXTRACT FAN◁	AC2					
		ISOL. VALVES◁	AC2					
		COLD AIR VALVE◁	AC2					
		HOT AIR VALVE◁		DC2			SHED	

22.00 CONTENTS

PREAMBLE

The Auto Flight System is described in the volume 1 and 4 :
- the volume 1 chapter 22 gives a general description of the system and the different functions (architecture, modes, FMA, functions...).
- the volume 4 "FMGS PILOT'S GUIDE" is devoted to the FMGS System operation (MCDU pages, MCDU message, Procedures).

DESCRIPTION

The Flight Management Guidance and envelope System (FMGS) contains the following units :
- Two Flight Management Guidance and envelope Computers (FMGC).
- Three Multipurpose Control and Display Units (MCDU)
- One Flight Control Unit (FCU)
- One Flight Management source selection device.

GENERAL PHILOSOPHY

The Flight Management and Guidance System (FMGS) provides predictions of flight time, mileage, speed, economy profiles and altitude. It reduces cockpit workload, improves efficiency and eliminates many routine operations normally performed by the pilots.
During cockpit preparation the pilot inserts a preplanned route from origin to destination via the Multifunction Control and Display Units (MCDUs). This route includes the departure, enroute waypoints, arrival, approach, missed approach and alternate route as selected from the navigation database. The system generates optimum vertical and lateral flight profiles and predicted progress along the entire flight path. Either FMGC performs all operations if one FMGC fails.
The pilot may modify any flight parameter on a short term basis (SPD, V/S, HDG...) and the FMGS will guide the aircraft to the manually selected target. This pilot controlled guidance is called "selected".
There are two types of GUIDANCE :
- Managed guidance : The aircraft is guided along the preplanned route, vertical, lateral, and speed/Mach profile. This type of preplanned guidance is called "Managed". Predicted targets are computed by the FMGS.
- Selected guidance : The aircraft is guided to the selected target modified by the pilot. Targets are selected on the flight control unit located on the pilots glareshield. The decision to engage a "selected" or a "managed" guidance is always under the control of the pilot.
  Selected guidance has priority over managed guidance.

FLIGHT MANAGEMENT GUIDANCE COMPUTER (FMGC)

Each FMGC is divided into four main parts :
- The Flight Management (FM) part controls the following functions :
  - Navigation and management of navigation radios
  - Flight planning management
  - Performance prediction and optimization
  - Display management
- The Flight Guidance (FG) part performs the following functions :
  - Autopilot (AP) command
  - Flight Director (FD) command
  - Autothrust (A/THR) command
- The Flight Envelope (FE) part controls the following functions :
  - Data computation for the flight envelope and speed functions
  - Monitoring of parameters used by FG and FE parts
  - Windshear and aft Center of Gravity (CG) detection
  - Computation of GW and CG information
- The Fault Isolation and Detection System (FIDS) part performs the following functions :
  - Maintenance data acquisition and concentration
  - Interface with the Central Maintenance Computer (CMC)

Each FMGC has its own set of databases. The individual databases can be independently
R loaded into their respective FMGC, or independently copied from one FMGC to the other.
Each FMGC contains these main databases :

1. The Navigation database (2.8 Mbytes) contains standard navigation data : Navaids, waypoints, airways, enroute information, holding patterns, airports, runways, procedures (SIDs, STARSs, etc.), company routes, alternates.
   The airline updates this part every 28 days, and is responsible for defining, acquiring, updating, loading, and using this data.
   R The updating operation takes 20 minutes to complete, or 5 minutes if crossloaded from
   R the opposite FMGC.
2. The Airline Modifiable Information (AMI), also referred to as the FM Airline Configuration file, contains :
   - Airline policy values :THR RED altitude, ACC altitude, EO ACC altitude, PERF factor, IDLE factor.
   - Fuel policy values : Fuel for taxi, % of route reserve, maximum and minimum values of route reserve, etc.
   - ACARS interface customization
3. The Aircraft Performance database, includes the Engine model, Aerodynamic model, and Performance model. The airline cannot modify this database.
4. The Magnetic Variation database.

In addition, each FMGC contains pilot-stored elements that enable the pilot to create 20 waypoints, 10 runways, 20 navaids, and 5 routes.

MULTIPURPOSE CONTROL AND DISPLAY UNIT (MCDU)

Three MCDUs are installed on the pedestal for flight crew loading and display of data. The use of MCDU allows the flight crew to interface with the FMGC by selection of a flight plan for lateral and vertical trajectories and speed profiles. The crew may also modify selected navigation or performance data and specific functions of Flight Management (revised flight plan, engine-out, secondary flight plan, etc.). Additional data from peripherals (Centralized Maintenance System (CMS), aircraft Communications Addressing and Reporting System (ACARS) can also be displayed. Data that are entered into the MCDU that are illogical or beyond the aircraft capabilities will either be disregarded or will generate an advisory message.
The MCDUs allow back up navigation in case of dual FM failure.

FLIGHT CONTROL UNIT (FCU)

The FCU located on the glareshield, is the short-term interface between the crew and the FMGC. It is used to select any flight parameters or modify those selected in the MCDU. The autopilots and autothrust functions may be engaged or disengaged. Different guidance modes can be selected to change various targets (speed, heading, track, altitude, flight path angle, vertical speed).

FM SOURCE SELECTOR

This selector allow to switch the FMGC data to the offside MCDU and EFIS display in case of one FM failure.

OTHER CREW INTERFACES

THRUST LEVERS

The thrust levers are the main interface between the Flight Management Guidance Computer, the Full Authority Digital Engine Control System (FADEC), and the flight crew. They :
- arm the autothrust at takeoff, when “FLX “ or “TOGA” is selected,
- limit the maximum thrust by their position when autothrust is active,
- disconnect the autothrust system when the flight crew sets them to “IDLE”,
- command the thrust manually when autothrust is not active,
- engage the common modes (takeoff or go around) when TOGA (or “FLX” for takeoff) is set,
- when positionned between IDLE and CL detent (MCT in engine out), set the autothrust to the active mode.

ELECTRONIC FLIGHT INSTRUMENTS (EFIS)

Two Primary Flight Displays (PFD) and Navigation Displays (ND) provide the crew with full time flight guidance, navigation and system advisory information for all flight phases. An EFIS control panel is located at each end of the glareshield and is used to control both Primary and Navigation Displays. This panel includes controls to select various modes within the PFD. A selector allows the barometric altimeter setting to be displayed on the PFD. Various distance ranges can be selected on the ND, and two toggle switches allow display of either the left or right VOR/ADF bearing pointers to be displayed on the ND.

PRIMARY FLIGHT DISPLAYS

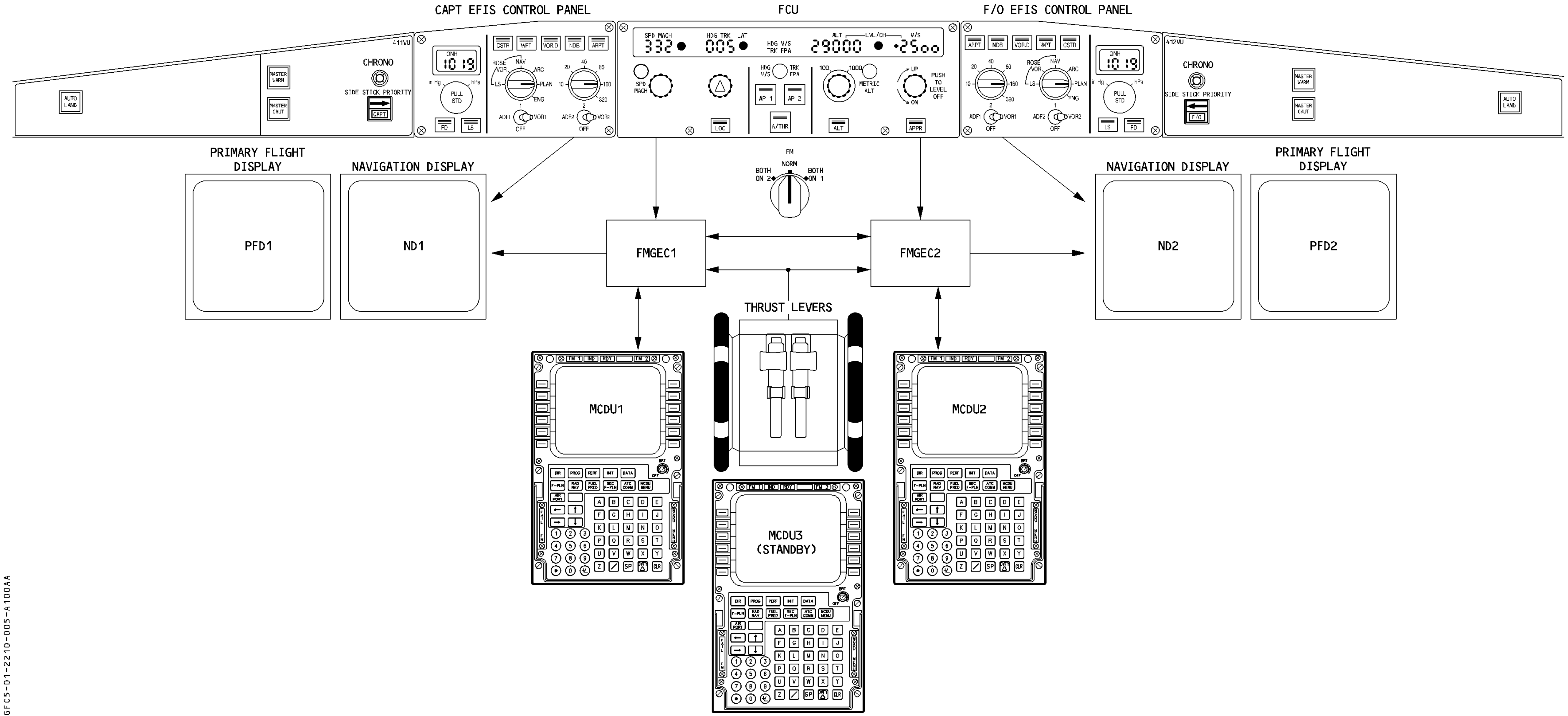
The PFDs combine several conventional flight instrument indications on one color display panel, for centralized reference of flight data.
This centralized color display includes :
- Flight Director attitude guidance targets
- Armed and engaged modes
- Navigation and instrument approach information
- Altimeter setting
- Barometric altitude
- System messages.

NAVIGATION DISPLAYS

Five different color navigation compass displays can be selected :
- ARC (map mode)
- ROSE NAV (map mode)
- ROSE VOR
- R ROSE LS
- PLAN

Information displayed on these modes uses the aircraft’s position as a reference point for the flight plan navigation data (lateral and vertical information).

R **CREW INTERFACE WITH FMGEC**



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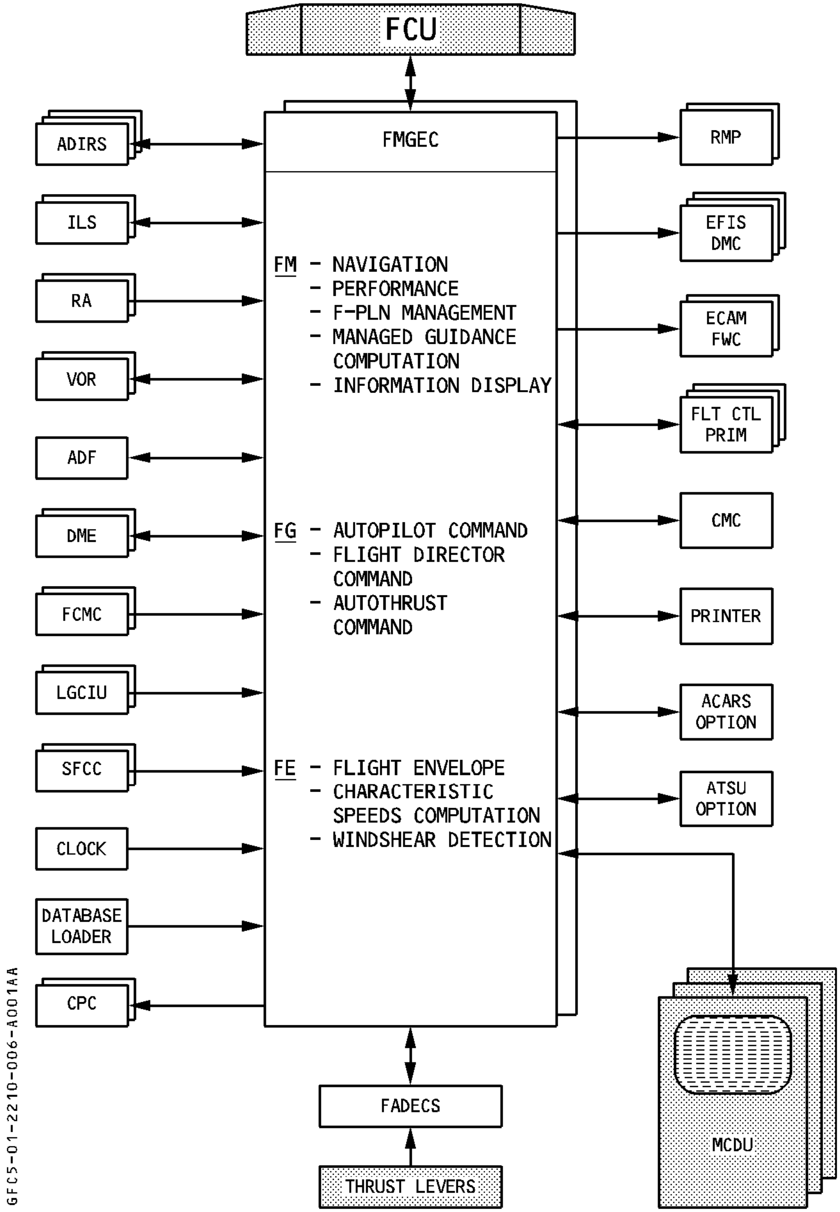
SYSTEM INTERFACE DIAGRAM

R

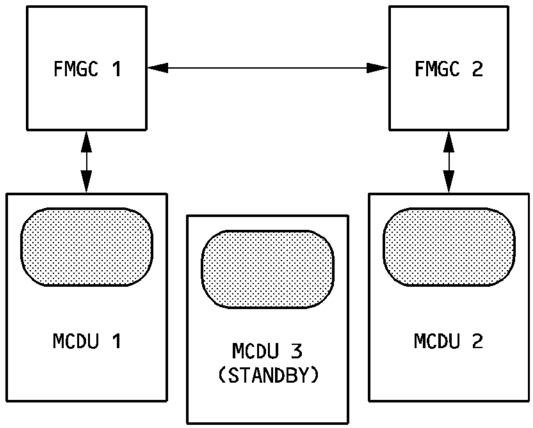


FMGS MODES OF OPERATION

The FMGS has four modes of operation :
- dual mode (the normal mode)
- independent mode. Each FMGC being controlled by its associated MCDU.
- single mode (using one FMGC only)
- back up navigation mode

DUAL MODE

This is the normal mode. The two FMGCs are synchronized : each performs its own computations and exchanges data with the other through a crosstalk bus.
One FMGC is the master, the other the slave, so that some data in the slave FMGC comes from the master. All data inserted into any MCDU is transferred to both FMGCs and to all peripherals.



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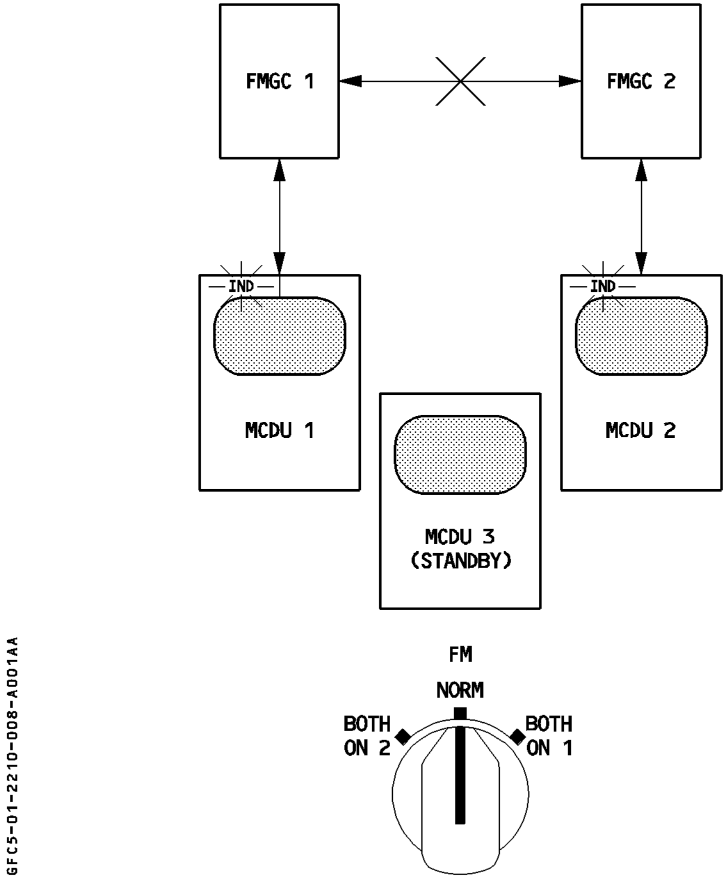
MASTER FMGC LOGIC :

- If one autopilot (AP) is engaged, the related FMGC is master :
  - · it uses the onside FD for guidance
  - · it controls the A/THR
  - · it controls the FMA 1 and 2
- If two APs are engaged, FMGC1 is master.
- If no AP is engaged and
  - · the FD1 pushbutton is on, then FMGC1 is master.
  - · the FD1 pushbutton is off, and FD2 pushbutton on then FMGC2 is master.

R — if no AP/FD is engaged, A/THR is controlled by FMGC1.

INDEPENDENT MODE

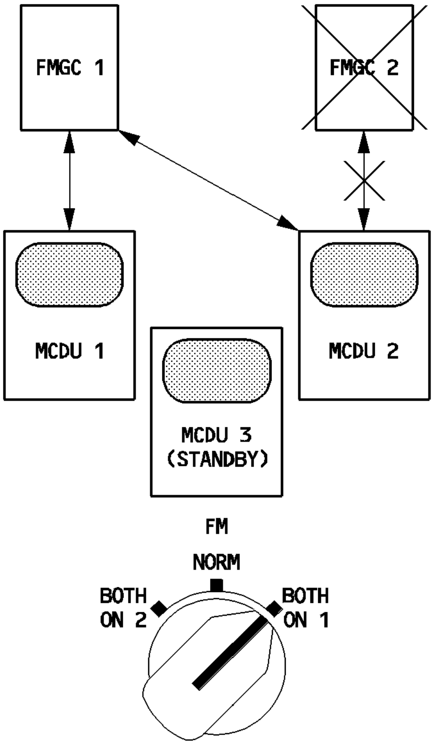
The system selects this degraded mode automatically if it has a major mismatch (database incompatibility, operations program incompatibility . . .). Both FMGCs work independently and are linked only to peripherals on their own sides of the flight deck ("onside" peripherals).
When this occurs, "INDEPENDENT OPERATION" appears on the MCDU scratchpad.
The "IND" annunciator light illuminates amber on the top of the MCDU when the onside FMGC detects an independant operation.
Each MCDU transmits data it receives only to its onside FMGC, and it affects only the onside EFIS (Electronic Flight Instrument System) and RMP (Radio Management Panel).



R For independent mode procedure refer to 4.06.10.

SINGLE MODE

The system selects this degraded mode automatically if one FMGC fails. The pilot selects the FM source selector to transfer the remaining FMGC data to the offside MCDU and EFIS display. The remaining FMGC drives all the peripherals, so, for example, any entry on one
R MCDU goes to both MCDUs.
The ND on the side with the failed FMGC displays “OFF SIDE FM CONTROL” in amber.



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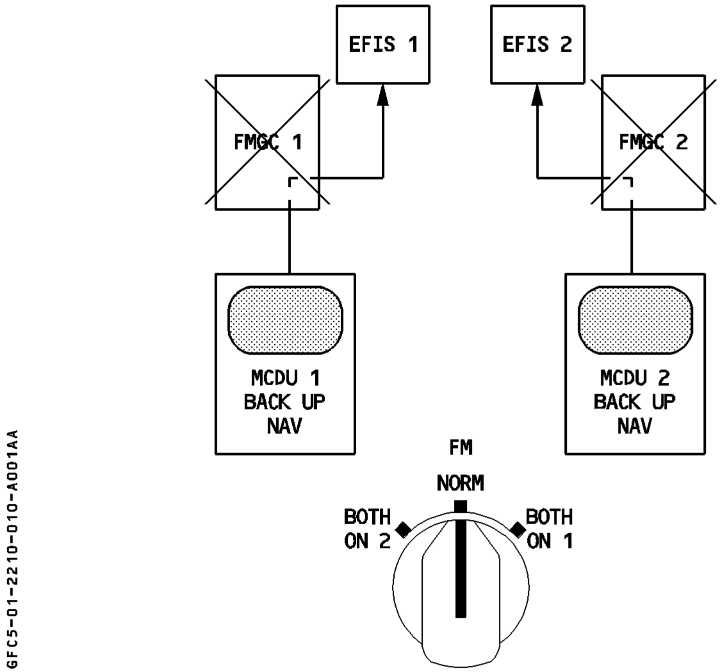
R For single mode procedure refer to 4.06.10.

BACK UP NAVIGATION MODE

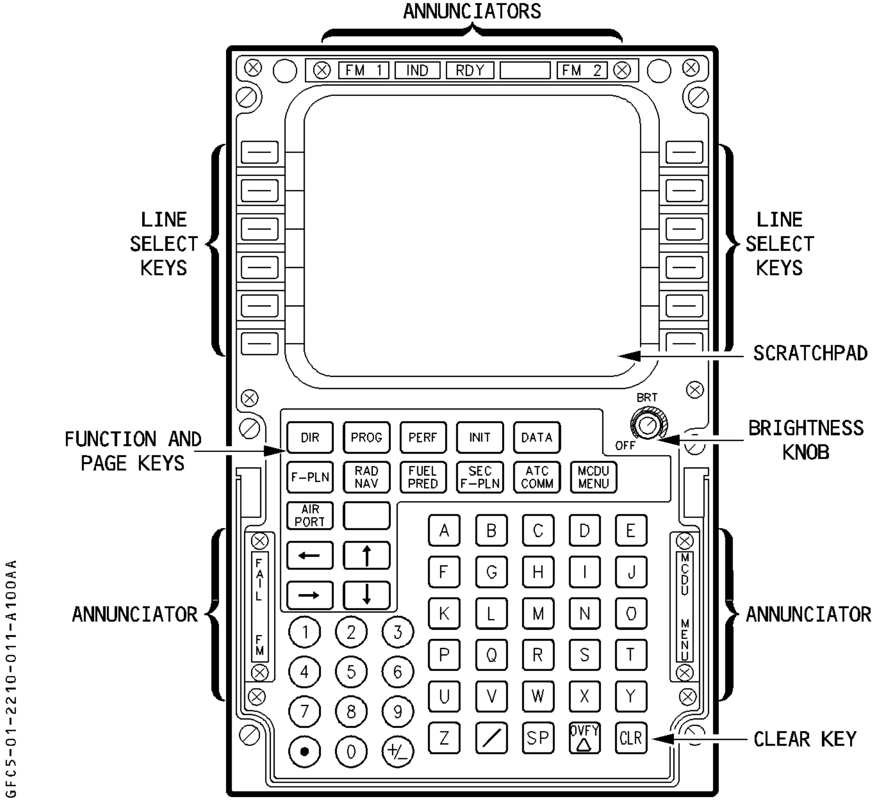
The pilot selects on the MCDU menu page this degraded mode when both FMGC fail. He recovers the navigation function through the MCDU and IRS.
The MCDU memorizes the flight plan which has been continuously down loaded in its memory by the FMGC until it failed.
The following features are provided:
- Flight Planning
- Aircraft position using onside IRS or IRS 3
- F-PLN display on ND
- No AP/FD NAV mode
- Limited lateral revision
- F-PLN automatic sequencing



Note : MCDU 3 is not able to operate as back up navigation even when it replaces MCDU 1 or 2.
The back up navigation mode is only accessible on the MCDU MENU page if the FM source selector is set to NORM position.

PILOT INTERFACE

MULTI PURPOSE CONTROL DISPLAY UNIT (MCDU)



GENERAL

The MCDU is a cathode ray tube that generates 14 lines of 24 characters each :
- a title line that gives the name of the current page in large letters,
- six label lines, each of which names the data displayed just below it (on the data field line),
- six data field lines that display computed data or data inserted by the pilot
- The scratchpad line which displays :
  - specific messages
  - information the pilot has entered by means of the number and letter keys and which he can then move to one of the data fields.

LINE SELECT KEYS

There is a column of keys on each side of the screen. The pilot uses these to:
- Move a parameter he has entered in the scratchpad to the appropriate line on the main screen.
- Call up a specific function page indicated by a prompt displayed on the adjacent line.
- Call up lateral or vertical revision pages from the flight plan page.

KEYBOARD

The keyboard includes :
- Function and

Page keys	Call up functions and pages the pilot uses for flight management functions and computations.
↑ ↓ (or SLEW) keys	Move a page up or down to display portions that are off the screen.
← → key	Moves to the next page of a multi-page element. An arrow in the top right corner indicates that another page is available.
AIRPORT key	Calls up the flight plan page that contains the next airport along the current flight plan. Successive pushes on the key show the alternate airport, the origin airport (before takeoff), and the next airport again.

- Number and letter keys allow the pilot to insert data in the scratchpad so that he can use a key to enter it in the main display.
- Three keys have special functions :

CLR (clear) key	Erases material (messages or inserted data) from the scratchpad or from certain areas of displayed pages.
OVFY (overfly) key	Allows the aircraft to overfly a selected waypoint.
SP (space) key	Allows to insert a space in specific messages.

ANNUNCIATORS (on the side of the keyboard)

FAIL (amber)	Indicates that the Multipurpose Control and Display Unit (MCDU) has failed.
MCDU MENU (white)	Indicates that the pilot should call up a peripheral linked to the MCDU (such as ACARS or CMS).
R FM (white)	Comes on while the crew is using the MCDU to display peripherals.

ANNUNCIATORS (on the top of the keyboard)

FM 1 and FM 2 (amber) : the onside FM is failed

Note : – The FM failure annunciator on MCDU 3 comes on only if MCDU 3 operates as a back up of MCDU 1 or 2
– A MCDU has never both FM failure annunciators ON.

IND (amber) : The onside FM detects an independent mode of operation while both FM are healthy.

RDY (green) : MCDU has passed its power up test after its BRT knob was
R turned to OFF.

BRT KNOB

Controls the light intensity of the entire MCDU.

Note : In case of MCDU 1 or 2 failure, its brightness knob has to be switched off to allow the MCDU3 connection to the corresponding FMGC.

DATA ENTRY

The pilot enters data by typing it into the scratchpad on the MCDU. Next, pressing the line select key will load the data from the scratchpad into the desired field. An error message displays if the data are out of range or not formatted correctly. To correct data, the pilot may clear the message with the clear (CLR) key and then retype the message into the scratchpad. Pressing the CLR key when the scratchpad is empty displays "CLR". To clear data from a field, line select CLR from the scratchpad to the data field to be cleared.

MCDU ENTRY FORMAT

The pilot enters information into the MCDU at the bottom line of the scratchpad. When data has lead zeros, they may be omitted if desired. For example a three-digit wind direction of 060 may be typed as 60. The display will still show 060. To enter an altitude below 1000 feet, the lead zero must be added as 0400 for 400 feet. This differentiates the altitude from a flight level.
To enter a double data entry such a speed/altitude, the separating slash must be used. If entering only the first part of a double entry, omit the slash. To enter only the second part of a double entry, a leading slash must be used i.e./0400 feet.

MESSAGES

The scratchpad displays various messages for pilot information. Theses messages are prioritized by importance to the pilot as either amber or white.
Amber messages are :
- Navigation messages
- Data entry message
- EFIS repeat messages

Amber messages are categorized into two types :
- Type 1 message that is a direct result of a pilot action. Type 1 messages are displayed immediately in the scratchpad ahead of other messages.
- Type 2 messages inform the pilot of a given situation or request a specific action. Stored in "last in", "first out" message queue that holds maximum of 5 messages.
  Type 2 messages are displayed in the scratchpad only if there are no Type 1 messages or other data and will remain until all the messages have been viewed and cleared with the CLR key.

White messages are advisory only.

CHARACTERS

Small and large fonts are displayed according to the following rules:
- The title line and the scratchpad are displayed in large font.
- Datafields are usually displayed in large font.
- Label lines are displayed in small font.
- Pilot entries and modifiable data are displayed in large font.
- Defaulted / computed and non modifiable data are displayed in small font.

COLORS

DATA	MCDU COLOR
TITLES, COMMENTS <, >, ↑ ↓ ← → DASHES, MINOR MESSAGES	WHITE
MODIFIABLE DATA SELECTABLE DATA BRACKETS	BLUE
NON MODIFIABLE DATA ACTIVE DATA	GREEN
– MANDATORY DATA (BOXES) – PILOT ACTION REQUIRED – IMPORTANT MESSAGES – MISSED CONSTRAINT	AMBER
CONSTRAINTS MAX ALTITUDE	MAGENTA
PRIMARY F-PLN	GREEN WAYPOINTS, WHITE LEGS
TEMPORARY F-PLN	YELLOW WAYPOINTS, WHITE LEGS
SECONDARY F-PLN	WHITE WAYPOINTS AND LEGS
MISSED APPROACH (not active)	BLUE WAYPOINTS, WHITE LEGS
ALTERNATE F-PLN (not active)	BLUE WAYPOINTS, WHITE LEGS
OFFSET	GREEN WAYPOINTS, WHITE LEGS OFST IN THE TITLE OF F-PLN PAGE
TUNED NAVAID TO WAYPOINT AND DESTINATION	BLUE WHITE

SCREEN PROMPTS

R

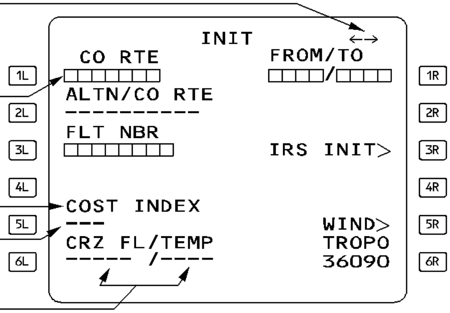
←→ UPPER RIGHT CORNER OF THE SCREEN: INDICATES THAT THE NEXT PAGE IS AVAILABLE BY PRESSING THE → KEY.

□□□ : DATA ENTRY IS MANDATORY TO ALLOW THE FMGC TO PERFORM ALL ITS FUNCTIONS.

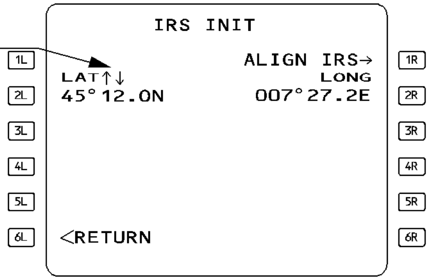
LABEL LINE

DATALINE OR DATA FIELD

--- : THIS DATA WILL BE COMPUTED BY THE FMGC IF IT HAS ENOUGH INFORMATION, PROVIDED IT IS OUT OF THE DATABASE, OR INSERTED BY THE CREW.



↑↓ : WHEN THESE ARROWS ARE NEXT TO A LABEL LINE, IT IS POSSIBLE TO INCREASE OR DECREASE THE VALUE DISPLAYED BELOW BY PRESSING THE ↑ OR ↓ KEYS ON THE KEYBOARD.



←→ A TURN (LEFT← OR RIGHT→) IS SPECIFIED ON THE LEG WHICH STARTS AT THE WAYPOINT ADJACENT TO THE ARROW.

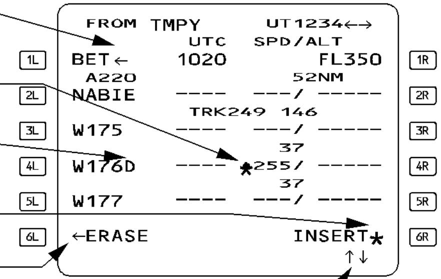
* : INDICATES THAT A CONSTRAINT HAS BEEN INSERTED. ONLY DISPLAYED IF PREDICTIONS AVAILABLE.

D : DISPLAYED BESIDE A FIXED WAYPOINT ON THE F-PLN PAGE TO INDICATE THAT THE A/C MUST OVERFLY THE FIXED WAYPOINT.

* : INDICATES THAT PRESSING THE ADJACENT LS KEY WILL CHANGE PARAMETERS AFFECTING THE ACTIVE SITUATION.

←→ : INDICATES THAT PRESSING THE ADJACENT LS KEY WILL ACTIVATE THE PROMPT OR SELECT SOME DATA.

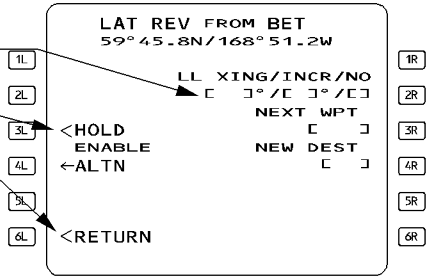
↑↓ : SCROLLING IS AVAILABLE BY PRESSING THE ↑ OR ↓ KEY ON THE KEYBOARD. THE PAGE IS NOT LARGE ENOUGH TO DISPLAY ALL OF THE INFORMATION.



[ ] : DATA INSERTION IS POSSIBLE.

<OR> : MEANS THAT ANOTHER PAGE MAY BE ACCESSED BY PRESSING THE ADJACENT LS KEY.

+,-:WHEN AN ALTITUDE CONSTRAINT HAS BEEN ENTERED AT A WAYPOINT, THE CONSTRAINT VALUE IS DISPLAYED ON THE VERT REV PAGE. A PLUS (+) IS DISPLAYED FOR AN "AT OR ABOVE" ALTITUDE CONSTRAINT AND A MINUS (-) FOR AN "AT OR BELOW" ALTITUDE CONSTRAINT.



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MCDU FUNCTION KEYS

The Multipurpose Control and Display Unit (MCDU) function keys enable pilots to quickly call up MCDU pages.
The following summarizes the purpose of each key. A complete description of the pages is provided in Volume 4 : FMGS Pilot's Guide.

DIR — Calls up the DIR TO page, and enables the pilot to proceed directly from the present position to any waypoint, entered manually or selected in the active flight plan.

PROG — Calls up the progress page corresponding to the active flight plan phase that is in progress.
This page displays navigation information and active data, such as the optimum and maximum recommended cruise flight levels. It enables the pilot to update the FMGS position, and obtain a bearing and distance to any location.

PERF — Calls up the performance pages, which display the optimum speed or Mach number for each phase. The pilot can amend these pages. The first displayed page is the one corresponding to the current flight phase (except for preflight and done phases).
The pilot can then use the appropriate 6L or 6R key to call up pages corresponding to future flight phases.

INIT — Calls up the flight plan initialization (INIT) A page, which also gives access to the B page and IRS INIT page. The pilot uses the INIT pages to initialize Flight Management for the flight.
R The pilot primarily uses the INIT A page to insert the flight plan. The pilot uses the IRS INIT page to align the inertial reference system.
The pilot uses the INIT B page to insert aircraft weight, Fuel on Board, CG, and other fuel requirements. The FMGS uses this data to compute predictions and fuel planning parameters.
The pilot can access the INIT A page, for Flight Plan initialization, only in the preflight phase. In flight, he can only modify the Alternate Flight Plan.
IRS INIT page is accessed via the IRS INIT> prompt on the INIT A page. In the flight phase, it is only accessible for information purposes.
The INIT B page (not accessible after engine start) is called up by pressing the "← →" (NEXT PAGE) key.

DATA	Calls up the data index page. This gives the pilot access to various reference pages that show aircraft position, aircraft status, runways, waypoints, navaids, routes and data stored by the pilot.
F-PLN	Calls up the flight plan A and B pages, which contain a leg-by-leg description of the active primary flight plan. The pilot can use the slewing keys to review the entire active flight plan. He can make all lateral and vertical revisions to the flight plan through these pages, using the left keys for lateral revision and the right keys for vertical revision.
RAD NAV	Calls up the RADIO NAV page. This page displays the radio navaids tuned automatically or manually through the FMGC.
FUEL PRED	Calls up the fuel prediction page. Once the engines are started, this page displays the fuel predicted to be remaining at the destination and the alternate, as well as fuel management data.
SEC F-PLN	Calls up the index page for the secondary flight plan.The pilot can use this page to call up the secondary flight plan and all the functions related to it (copying, deleting, reviewing, activating, and the INIT and PERF pages).
ATC COMM	Calls up the ATC applications (not activated)
MCDU MENU	Calls up the MCDU MENU page, which displays the subsystems currently addressed via the MCDU. The key next to the name of a subsystem enables the crew to select that subsystem. When the MCDU MENU annunciator lights up, the pilot should press the MCDU MENU key. The menu will have [REQ] displayed next to the name of the subsystem that requires attention.
AIRPORT	Calls up the flight plan page which includes the next airport along the current flight plan. The first push on AIRPORT key displays the destination. Successive pushes show the alternate, the origine, and the destination again.

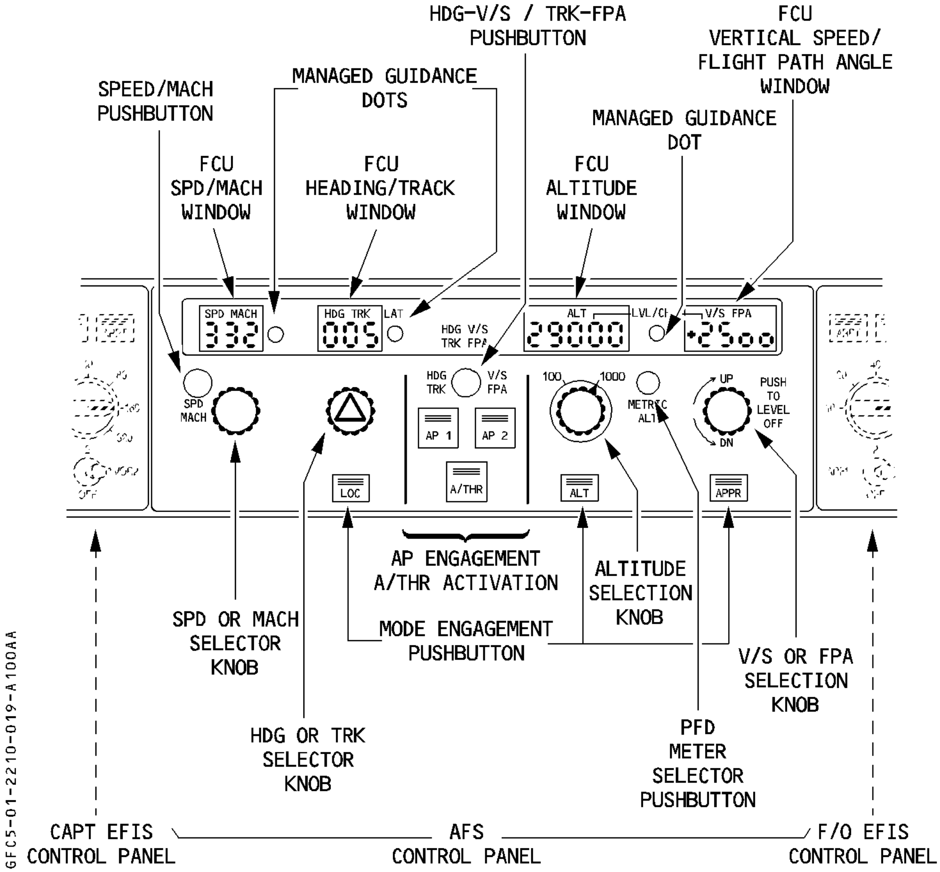
MCDU PAGES

(Refer to FCOM 4.30.20).

FLIGHT CONTROL UNIT (FCU)

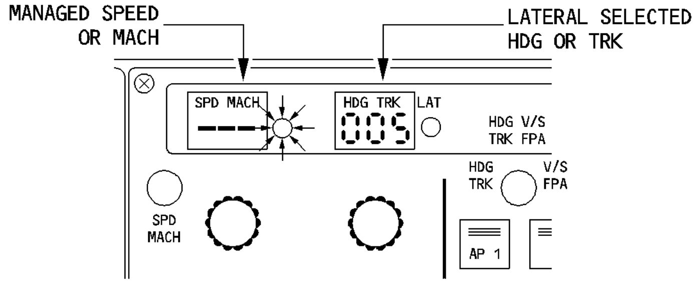
The FCU, which is on the glareshield, actually consists of three control panels : One for the automatic flight controls, and two for the Electronic Flight Instrument System (EFIS).
For a description of the EFIS control panel, see Chapter 1.31.
The FCU has two channels, each of which can independently command the central panel.
If one channel fails, the other channel can control all the functions.

R



FCU PHILOSOPHY

The pilot can use two types of guidance to control the aircraft in auto flight. One type is managed by the Flight Management Guidance System (FMGS) ; the other uses target quantities which are manually entered by the pilot.
When the aircraft uses target quantities from the FMGS (managed guidance), the FCU windows display dashes and the white dots next to those windows light up.
When the aircraft is uses target quantities entered by the pilot (selected guidance), the windows display the selected numbers and the white dots do not light up.



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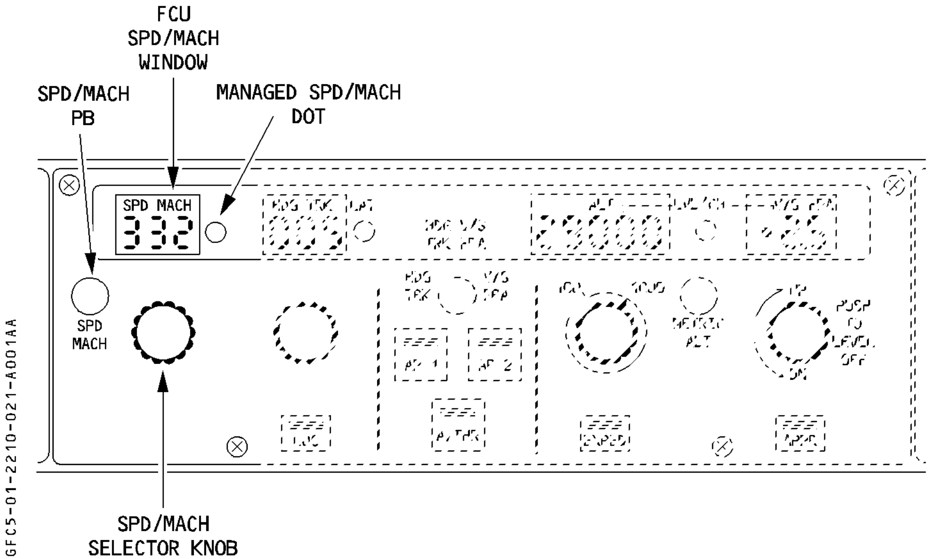
Note : The altitude window always displays an altitude selected by the pilot (never dashes).

The FCU has four selector knobs :
- SPD-MACH
- HDG-TRK
- ALT
- V/S-FPA

The selector knobs and can be rotated, pushed in, and pulled out.
· In order to arm or engage managed guidance for a given mode, the pilot pushes in the associated selector knob. If, for example, he pushes in the HDG selector knob, he engages
R or arms the NAV mode.
· In order to engage a selected guidance mode, the pilot turns the selector knob to set the desired value, then pulls the knob out to engage the mode with its target value equal to the selected value.

R *Note : In managed guidance (lateral, vertical guidance or managed speed), the*
R *corresponding windown is dashed. Turning a selector knob without pulling it*
R *displays a value that is the sum of the current target and the turn action value. The*
R *display remain 45 seconds before the dashes reappear. This rule does not apply to*
R *the ALT selector knob/window.*

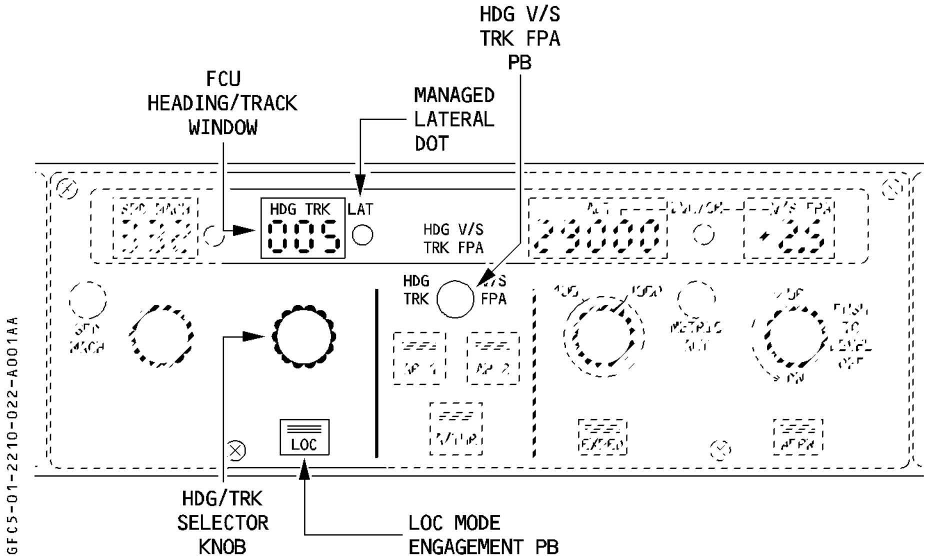
SPEED/MACH CONTROL AREA



· **SPD/MACH selector knob**
Display range : between 100 and 399 knots for speed, between 0.10 and 0.99 for Mach number.
One rotation of the knob corresponds to approximately 30 knots or 0.3 Mach.

· **SPD/MACH pushbutton**
Pushing this pushbutton changes the SPD target to the corresponding MACH target and vice versa.

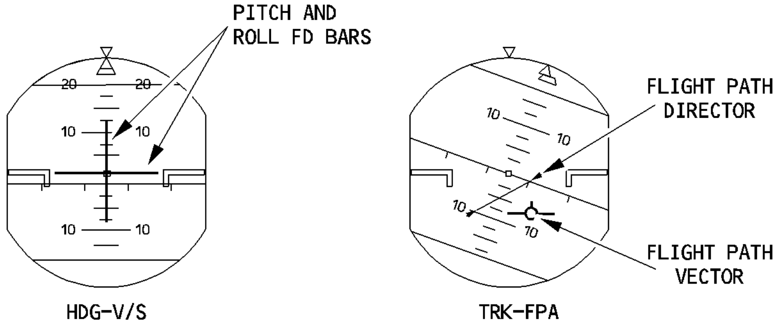
LATERAL CONTROL AREA



- **HDG/TRK selector knob**
  Display range : between 0° and 359°.
  One rotation of the knob corresponds to 30° (1° per click).

- **LOC pushbutton**
  Pushing this pushbutton arms, engages, or disengages the LOC mode.

- **HDG V / S - TRK FPA pushbutton**
  The pilot uses this pushbutton to select HDG (associated with V/S) or TRK (associated with FPA). Pushing it :
  - Displays the Flight Path Vector (FPV) on the Primary Flight Display (PFD) or deletes it.
  - Changes heading reference into track reference in the HDG/TRK window and vice versa.
  - Changes vertical speed reference target into flight path angle reference target in the V/S-FPA window and vice versa.



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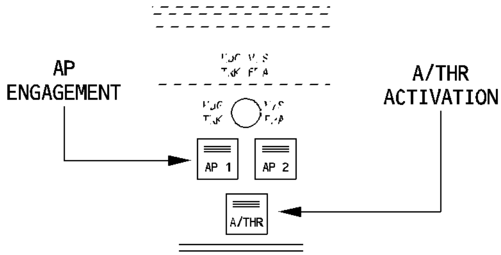
AP-A/THR CONTROL AREA



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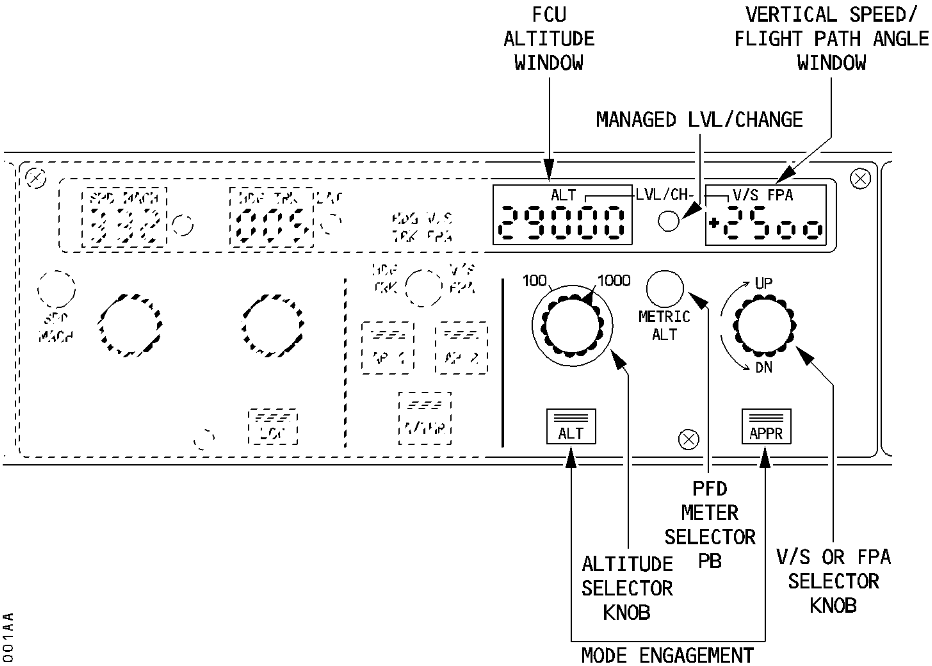
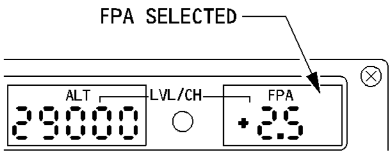
- **AP1 AP2 pushbuttons**
  The pilot uses these pushbuttons to engage or disengage the autopilots. The buttons illuminate green when the autopilot is engaged.

- **A/THR pushbutton**
  The pilot uses this pushbutton to arm, activate, or disconnect the autothrust (A/THR). This button illuminates green if the A/THR is armed or active.

VERTICAL CONTROL AREA

R





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VERTICAL CONTROL AREA (Cont'd)

The FCU altitude window always displays a target value selected by the pilot. It never displays dashes.

· **Altitude selector knob (inner and outer)**
Display range : 100 to 49000 feet
– The outer knob has two positions : 100 and 1000.
– The inner knob sets the altitude in the FCU windows in increments of 100 or 1000 feet, depending upon the position of the outer knob.

· **ALT puhsbutton**
The pilot uses this pushbutton to command an immediate level-off.

· **METRIC ALT pushbutton**
R The pilot uses this pushbutton to display the target altitude (either the FCU-selected
R altitude or the FM altitude constraint), and the current altitude in meters on the PFD.

· **V/S or FPA selector knob**
Range (V/S) : – 6000 to + 6000 feet/minute
2 clicks = 100 feet/minute
If the pilot turns the knob slowly, each click equals 100 feet/minute
Range (FPA) : – 9.9° to + 9.9°
1 click = 0.1°
The pilot turns this knob to set the value of vertical speed (V/S) or flight path angle (FPA) to be displayed in the V/S or FPA window. (He chooses which, V/S or FPA, is to be displayed by pushing the HDG V/S/TRK FPA pushbutton).
One rotation of the knob corresponds to 32 clicks. One complete rotation sets :
FPA = 3.2°
V/S = 1600 feet/minute
When the pilot pushes in the V/S or FPA knob, the system commands an immediate level-off by engaging the V/S, or FPA, mode with a target of zero. The Flight Mode Annunciator (FMA) then displays "V/S = 0" in green, when the V/S or FPA is nulled.
If the pilot now turns the knob to enter new V/S or FPA setting, the aircraft changes flight path accordingly.

· **APPR pushbutton**
This pushbutton arms, disarms, engages, or disengages the approach modes :
LOC and G/S modes, if an ILS approach is selected in the active F-PLN.
APP NAV-FINAL modes, if a non precision approach is selected in the active F-PLN.

LEFT INTENTIONALLY BLANK

GENERAL

The Flight Management part of the FMGC performs four main functions :
- Navigation
- Flight Planning (lateral and vertical)
- Prediction and optimization of performance
- Management of the displays (MCDU, ND, PFD).

NAVIGATION

Essential navigation functions are :
- Computation of position
- Evaluation of position accuracy (also see FCOM Vol 4 for a detailed description of pilot's procedure).
- Radio navigation tuning.
- Alignment of Inertial Reference System.
- Polar navigation.

POSITION COMPUTATION

Each FMGC computes its own aircraft position (called the "FM position") from a MIX IRS position (see below), and a computed radio position or GPS position.
The FMGS selects the most accurate position, considering the estimated accuracy and integrity of each positioning equipment.
GPS/INERTIAL is the basic navigation mode, provided GPS data is valid and successfully tested. Otherwise, navaids plus inertial or inertial only are used. (Refer to Navigation modes).

MIX IRS POSITION

Each FMGC receives a position from each of the three IRSs, and computes a mean-weighted average called the "MIX IRS" position.

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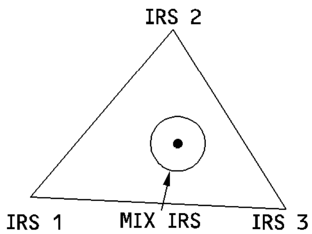

R R R – If one of the IRSs drifts abnormally, the MIX IRS position uses an algorithm that decreases the influence of the drifting IRS within the MIX IRS position.

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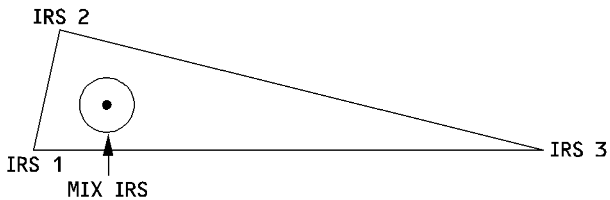

– If one of the IRSs fails, each FMGC uses only one IRS (onside IRS or IRS3). Each IRS position and inertial speed are continuously tested. If the test fails, the corresponding IRS is rejected.

GPS POSITION

Each IRS computes an hybrid position that is a mix IRS/GPS position called GPIRS. Among these 3 GPIRS hybrid positions received by each FMGC, one is selected according to a figure of merit and a priority. The selection is performed using the following hierarchy :
- onside GPIRS position
- GPIRS 3
- opposite GPIRS position

If the GPIRS data do not comply with an integrity criteria, the GPS mode is rejected and radio position updating is used, "GPS PRIMARY LOST" message is displayed on ND and MCDU scratchpad.
During non ILS approach, the loss of the GPS primary function triggers a triple click aural warning.
When the GPS primary function is recovered, the "GPS PRIMARY" message comes up on ND and MCDU scratchpad. It means that GPIRS data comply again with the required integrity criteria.
As long as GPS primary is in use, all usual required navigation performance are met.
The crew can deselect/select the GPS on the SELECTED NAVAIDS page if necessary.

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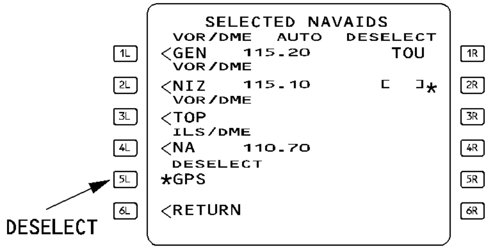

Information concerning the GPS position is displayed on GPS MONITOR page.

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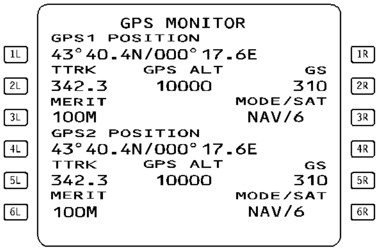
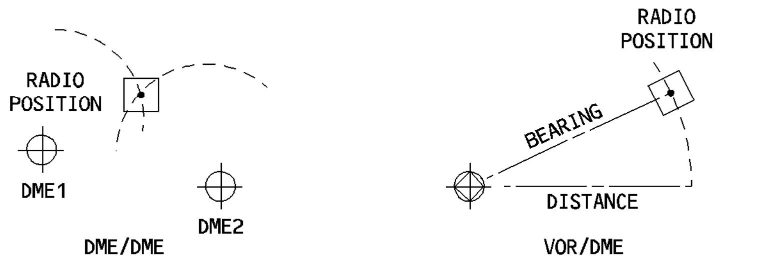


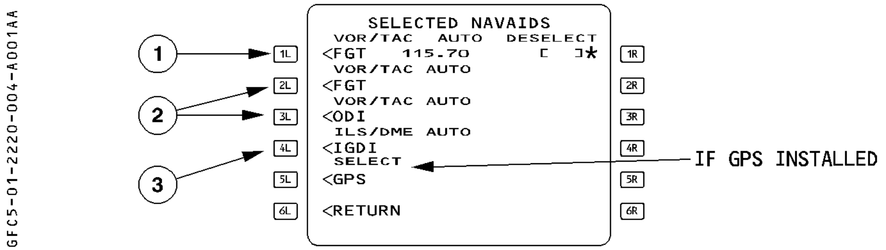
RADIO POSITION

Each FMGC uses onside navaids to compute its own radio position. These navaids are displayed on SELECTED NAVAIDS page. The navaids it can use are :

- DME/DME
- VOR/DME
- LOC
- DME/DME-LOC
- VOR/DME-LOC

It uses LOC to update the lateral position using LOC beam during ILS approach.
LOC is also used for quick update when in GPS/IRS mode (if GPS installed).
If one or more navaids fail, each FMGC can use offside navaids to compute VOR/DME or DME/DME radio position.
The radio navaid selection is displayed on DATA "SELECTED NAVAIDS" page.





(1) VOR/DME selection (auto or manual) for display (onside VOR)

(2) DMEs automatic selection for DME/DME onside radio position.

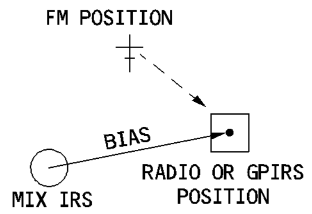
(3) ILS selection auto or manual for LOC update computation.

FM POSITION

At flight initialization, each FMGC displays an FM position that is the mixed IRS/GPS position (GPIRS).

– At takeoff, the FM position is updated to the runway threshold position, as stored in the database, possibly corrected by the takeoff shift when entered on PERF TO page.
– In flight, the FM position approaches the GPS position, or the radio position if the GPS is not valid, at a rate that depends upon the aircraft altitude.

Note : The FM position update at takeoff is inhibited when GPS PRIMARY is active.



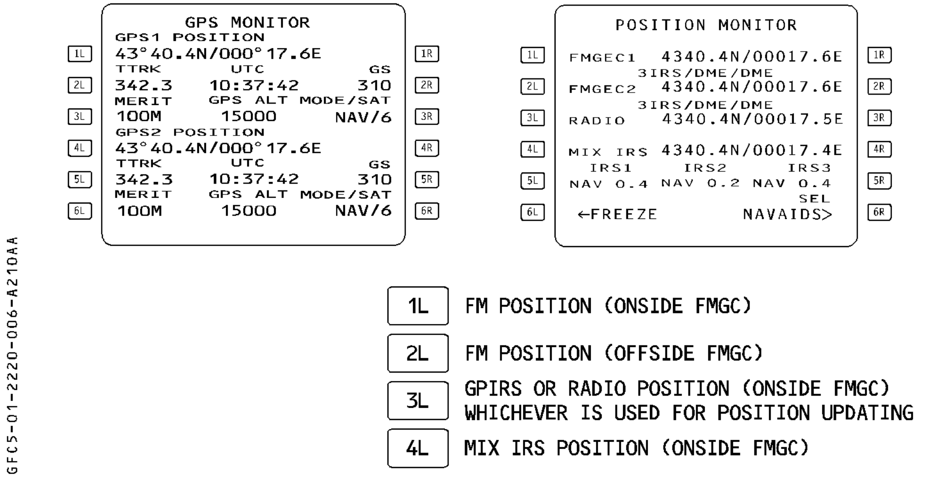
For each IRS, the FMGCs compare, the FM position with the IRS position. When this difference exceeds a threshold (depending on the elapsed time since IRS alignment), the “CHECK IRS (1, 2 or 3)/FM POSITION” message is displayed on the MCDUs (Refer to FCOM 4.03.30).
When the FWC detects an abnormal IRS drift, the ECAM triggers the FM/IR POSITION DISAGREE message. (Refer to 3.02.34).

Bias

Each FMGC computes a vector from its MIX IRS position to the radio or GPIRS position. This vector is called the “bias”. Each FMGC continuously updates its bias, if a radio position, or a GPIRS position is available.
If an FMGC loses its radio/GPIRS position, it memorizes the bias and uses it to compute the FM position, which equals the mix IRS position plus the bias.
Until the radio or the GPIRS position is restored, the bias does not change.
The crew can manually update the FM position. This also updates the bias.

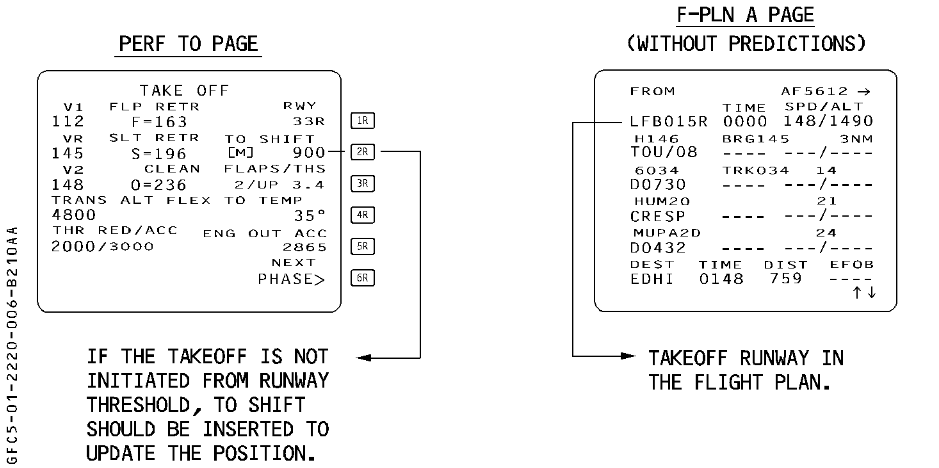
POSITION MONITOR

The crew may check the position computation using the “GPS MONITOR” or “POSITION MONITOR” page.



TAKEOFF UPDATE (GPS PRIMARY not active)

A takeoff update requires that the takeoff runway be part of the flight plan. This provides the most accurate position update.
If the takeoff run starts at an intersection, enter a takeoff shift on the PERF TO page to refine the takeoff update.
An accurate takeoff update ensures a precise aircraft position during departure.



NAVIGATION MODES

The FMGS updates the FM position by using radio navaids, or GPS, if available. It can use 4 main, different, FM navigation modes to make this update. The decreasing priority order is :
- IRS-GPS
- IRS-DME/DME
- IRS-VOR/DME
- IRS only

During ILS approaches, the system performs a temporary lateral update, using one of the following modes :
- IRS-GPS-LOC
- IRS-DME/DME-LOC
- IRS-VOR/DME-LOC
- IRS-LOC

EVALUATION OF POSITION ACCURACY

The FMGS continually computes an Estimated Position Error (EPE).
It is an estimate of how much the FM position has drifted, and is a function of the navigation mode the system is using.

CURRENT NAV MODE	**EPE (RATE or THRESHOLD)**	**REMARK**
IRS/GPS	$\sqrt{(FOM^2 + 100^2)}$ in meters	FOM = Figure of Merit of GPS If above 0.28 NM, the GPS position is rejected.
IRS/DME/DME	Tends towards 0.28 NM	EPE decreases from the initial value to 0.28 NM.
IRS/VOR/DME	0.1 NM + 0.05 X DME DIST minimum : 0.28 NM	EPE increases or decreases, as the distance between the a/c and the VOR/DME.
IRS ONLY	+ 8 NM/h for the first 21 min. + 2 NM/h after	EPE increases continuously.

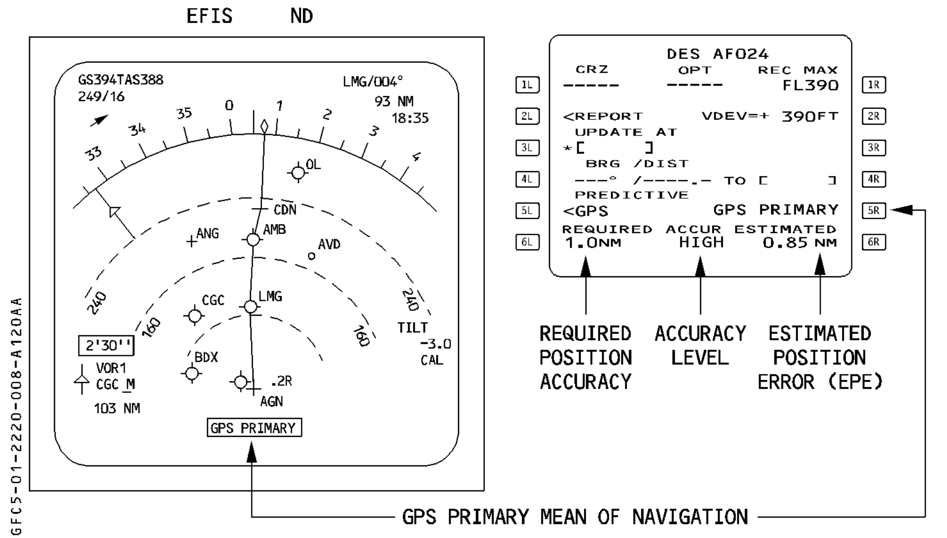
Note : After an IRS alignment, or at takeoff, the EPE is set at 0.2 NM.

The system displays the EPE to the crew, and compares it with the required navigation performance (RNP).
– If the EPE does not exceed the appropriate criteria, accuracy is HIGH.
– If the EPE exceeds the appropriate criteria, accuracy is LOW.
The number displayed in the REQUIRED NAVIGATION PERFORMANCE (RNP) field is (in decreasing order of priority) : The pilot-entered value, the database procedure value, or the system's default value. When a pilot enters a RNP that is larger than the published value, one of the following messages is displayed : "PROCEDURE RNP IS XX.XX", or "AREA RNP IS XX.XX". When this occurs, the crew should check the entered value, and modify it, if necessary.
The RNP value shall be in accordance with the specified RNP values of the navigation/approach charts (if a RNP is specified).
This message is also displayed upon a flight area change, if the new required criteria (defaulted value) is smaller than the displayed manually-entered value.

R

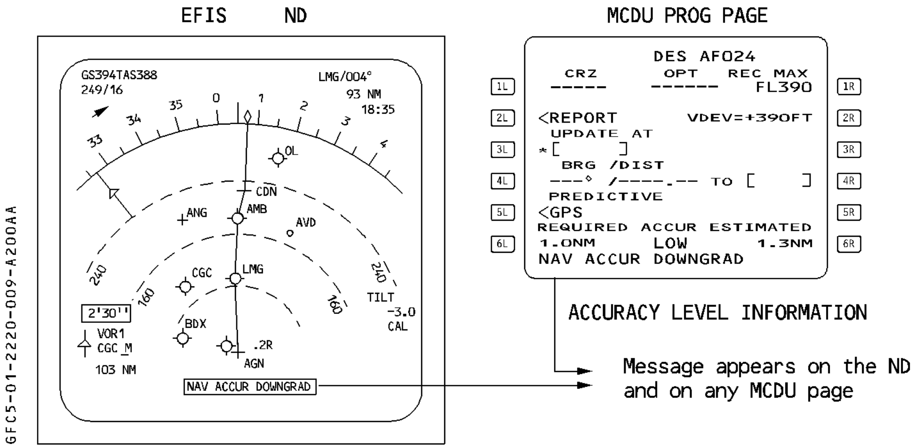
DEFAULT AREA RNP VALUES	
EN ROUTE and OCEANIC	2 NM
TERMINAL and TAKEOFF	1 NM
APPROACH	GPS/LOC 0.3 NM OTHER CASES 0.5 NM

When the position computation uses IRS/GPS mode, the EPE is always smaller than any airworthiness required value. As a result, accuracy is HIGH and GPS is the primary means of navigation. "GPS PRIMARY" is displayed on the PROG page, and temporarily on the ND.



When the GPS function is lost, a “GPS PRIMARY LOST” message is displayed on the ND and MCDU scratchpads. The MCDU message can be cleared ; the ND message cannot. During a non ILS approach, a triple click aural warning is also triggered.
When the GPS is lost, NAV accuracy does not immediately downgrade ; but only when the EPE exceeds the required criteria.

R



CAUTION
“HIGH” or “LOW” indicates FM position accuracy, based upon estimated drift.
This is why the flight crew must periodically check position accuracy, when the GPS function is lost.

When the GPS is manually deselected, the “GPS IS DESELECTED” message is displayed on the MCDU, 80 NM before T/D or at approach phase transition.

FM/GPS POSITION DISAGREEMENT

The lower ECAM displays the “NAV FM/GPS POS DISAGREE” amber caution when the GPS PRIMARY function is operative, and either of the FM positions deviate from GPS position 1 or 2 by more than :
- 0.5 minutes of latitude ;
- 0.5 minutes of longitude, when the aircraft latitude is included between 0° and 45° ;
- 0.7 minutes of longitude, when the aircraft latitude is included between 45° and 60° ;
- 1 minute of longitude, when the aircraft latitude is included between 60° and 70°.

The master caution light comes on, and the single chime sounds. This amber caution is inhibited during the takeoff phase.
Above 70° of latitude, a longitude difference does not trigger the alarm.

PREDICTIVE GPS

R The predictive GPS page is only operative with the Honeywell ADIRS equipment. All fields
R are dashed with Litton ADIRS equipment.

The predictive GPS function predicts the availability of the GPS within ± 15 minutes of ETA at destination, or at any waypoint entered by the crew.

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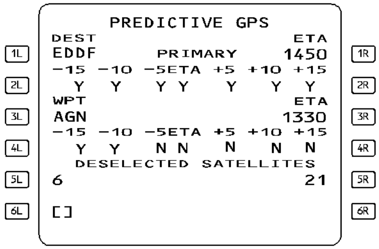


Predictions are displayed on the predictive GPS page at time intervals of 5 minutes (+15 and –15 minutes of ETA).
To access this page, press the 5L key of the PROG page.
This page also enables the deselection of up to 4 satellites at a time.

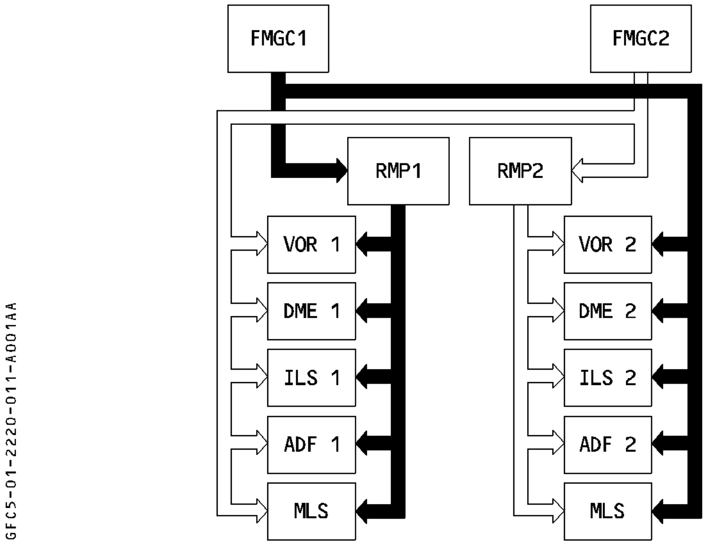
RADIO NAVIGATION TUNING

Radio navaids are tuned for two different purposes : display and computation.
Tuning for display may be performed in three different ways :
- automatic tuning (FMGC software)
- manual tuning through the MCDU RAD NAV page
- manual tuning through the Radio Management Panel (RMP) if both FMGCs or both MCDUs fail.

The FMGS automatically tunes the radio navaids for the computation of radio position.

Note : The manual selection of a VOR or VOR/DME may prevent the FMGS from tuning a VOR/DME automatically to compute position. If so, the relevant MCDU will display "TUNE BBB FFF.FF" (BBB = ident, FFF.FF = frequency).

ARCHITECTURE



- In dual mode and independent mode each FMGC tunes the navaids on its side of the console (one VOR, 5 DMEs, one ILS/MLS, and one ADF) simultaneously. In these modes, the pilot can also tune the VOR (and associated DME), ILS, and ADF manually.
- In single mode, the valid FMGC will tune both side navaids. The pilot can also use the RAD NAV page to tune both VORs, both ADFs and the ILS manually.

Manual tuning has priority over autotuning.

Note : If one radio receiver fails, both FMGCs use the operative radio receiver to compute the aircraft position.

VOR

Each FMGC may tune one VOR only (manual or automatic).
Autotuning obeys the following priorities for tuning the VOR :
1. The navaid specified for the approach
2. The navaid to be used for computing present radio position
3. For displays purposes
   - A navaid specified for the active leg
   - The “to” waypoint (TO WPT) if it is a navaid
   - The “from” waypoint (FROM WPT) if it is a navaid
   - A waypoint farther along the flight path if it is a navaid
   - The navaid closest to the aircraft’s present position

The scratchpad displays “SPECIFIC VOR-D UNAVAIL” if the VOR or VOR/DME required for tuning has been deselected.

Note : If the manual selection of a VOR does not match the VOR requested for autotuning, the relevant MCDU will display : “TUNE BBB CRS XXX”
(BBB = ident of the requested VOR) ; (XXX = course of the requested VOR)

DME

Each FMGC automatically uses its five DMEs as follows :
- One DME for display. It may be manually tuned or autotuned.
- Two DMEs in DME/DME mode for calculating the aircraft’s radio position. The FMGC autotunes these as a function of their best accuracy. The flight crew receives no indication that this process is going on.
- One DME autotuned for radio position. This occurs in the VOR/DME mode whenever DME/DME is not available and the conditions for a VOR/DME update are met. In this case, the VOR/DME used for display is identical to the VOR/DME navaid used for the computation of radio position.
- One DME linked to ILS/DME.

ADF

The FMGC autotunes one ADF in any area if the TO or FROM waypoint is an NDB, or in approach when the flight plan specifies an NDB approach and a fix in the approach is the “TO” waypoint. The scratchpad displays “SPECIFIC NDB UNAVAIL” if the NDB required for autotuning has been deselected.

ILS/MLS (ILS)

Each FMGC autotunes one ILS frequency :
- In PREFLIGHT or TAKEOFF phase, when the takeoff runway has an associated ILS/MLS.
- In CLIMB-CRUISE-DESCENT, APPROACH, or GO AROUND phase, when the type of approach in the flight plan is ILS/MLS.
- When the direct distance to destination is less than 300 NM.

The scratchpad displays "RWY/ILS MISMATCH", when the pilot has manually tuned the ILS, and the entered frequency does not match the ILS or LOC IDENT/FREQ requested for autotuning.

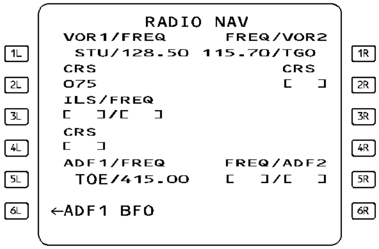
R The crew is not allowed simultaneously to tune an ILS and a MLS.

SELECTION OF NAVAIDS ON MCDU PAGES

The MCDU displays navaids tuned by the FMGC on the following two pages :
– RADIO NAV page.
– SELECTED NAVAIDS page.

· RADIO NAV page :
Shows which navaids have been automatically or manually tuned for display purposes.

R



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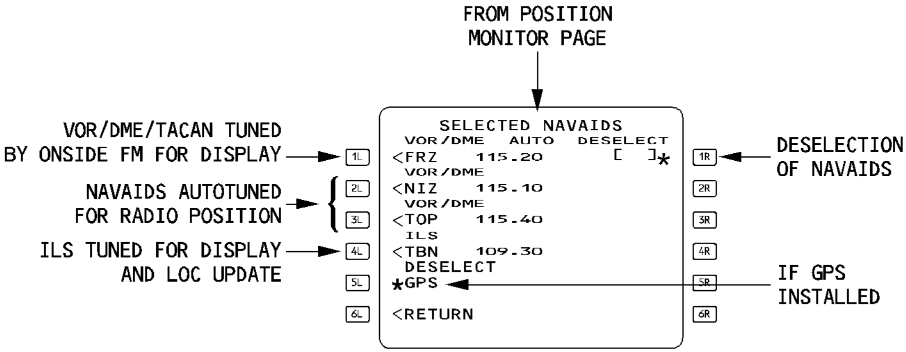
R · SELECTED NAVAIDS page :
Lists the navaids being tuned by the onside FMGC. No navaids can be modified on this page. The pilot may deselect as many as six unreliable navaids for the whole flight (using 1R key).



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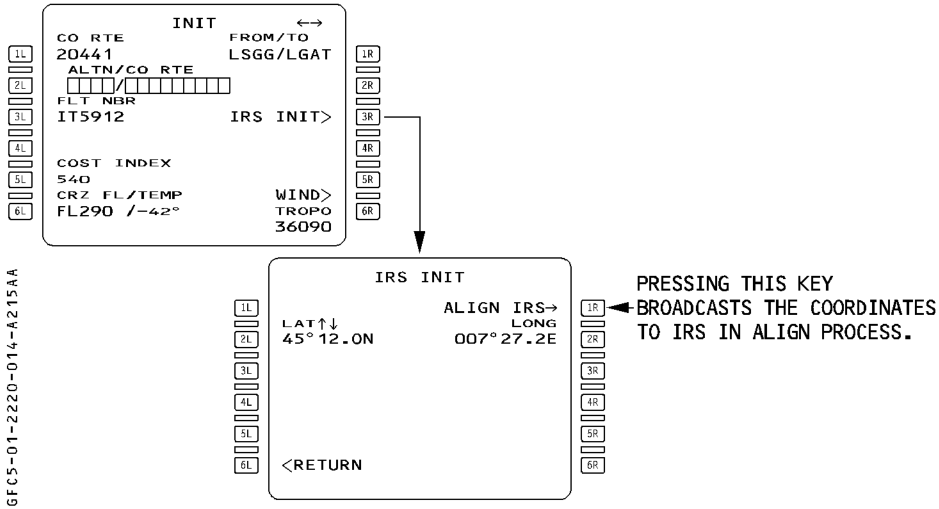
ALIGNMENT OF INERTIAL REFERENCE SYSTEM

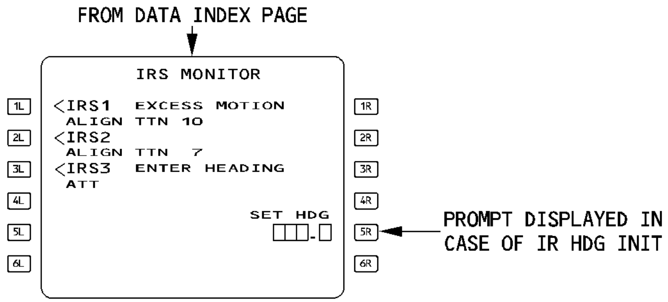
The preferred way of initializing the ADIRS is to use the GPS position, because this does not require any pilot intervention. Less than 1 minute after setting the ADIRS to NAV, the INIT page displays the GPS position without displaying the ALIGN IRS prompt.
If the pilot enters a CO RTE or FROM/TO, the INIT page displays the departure airport reference-point coordinates, and the ALIGN IRS prompt appears. If this prompt key is not pressed, the ADIRS is initialized to the GPS position at the end of the alignment time.
At any time during the alignment, the pilot can manually adjust the coordinates displayed on the INIT page. The ALIGN IRS prompt reappears.
If the ALIGN IRS prompt key is pressed, the coordinates displayed on the INIT page are sent to the ADIRS for initialization. This is the alternate method for ADIRS initialization, when the GPS position is not available.
A normal alignment takes between 5 and 10 minutes (depending on the local latitude). At latitudes between 73° and 82° (North or South), the alignment takes about 17 minutes. The ADIRS cannot be aligned beyond 82° (North or South).
A fast alignment takes about 30 seconds, and it is used for improving the ADIRS initial position accuracy, when time is limited.



Note : If the "IRS IN ALIGN" memo flashes during the alignment, this indicates that :
- *It has detected excessive motion (it automatically restarts the alignment), or*
- *It has detected a mismatch between the position the MCDU has sent to the IRS, and the last memorized IRS position, or*
- *It has detected a mismatch between the GPS position and the pilot-entered position, or*
- *It has detected a mismatch between the pilot-entered latitude (which is sent by the MCDU to the IRS) or the GPS latitude and the latitude the IRS has computed during the alignment.*

IR IN ATT MODE : HDG SET

When one IRS at least is in ATT mode, the pilot must set and periodically update the heading to have an attitude information. The entry is performed on the MCDU IRS MONITOR page.



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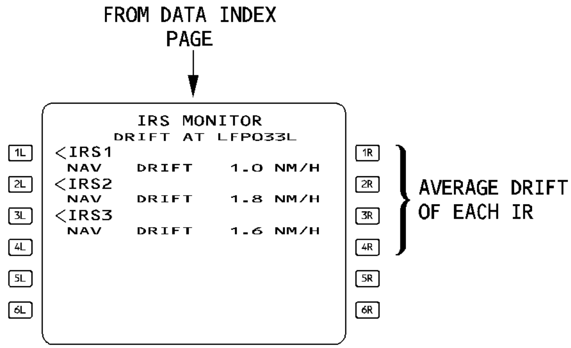
AVERAGE DRIFT COMPUTATION

The FMGC computes an average drift on the ground at the end of the flight for each IR. This drift is then displayed on the IRS page.
The drift is the difference between the IR position at landing and the geographic landing position (destination runway threshold plus a shift of 400 m).



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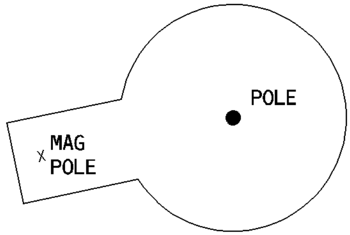
The FMGC then computes the time since last alignement.

POLAR NAVIGATION

The IRS can provide the MAG HEADING between latitudes of 82°30N and 60°30S, except in the vicinity of the North magnetic pole.
The FMGC computes the aircraft position within the polar area, even at the North Pole, by using the MIX IRS position.

Note : *The IRS may be aligned up to latitude 73°, without using any specific procedure. Between 73° and 82° (North or South), the required alignment time is longer. Beyond 82° North or South, no ADIRS alignment is possible.*



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As a general rule, the MCDU displays all parameters referenced to North, depending on the position of the NORTH REF pushbutton.
To ensure the SAFEST and most FLEXIBLE operation, a MAG/TRUE NORTH REF pushbutton is available. The EFIS ND, MCDU, and ECAM provide the pilot with various messages that indicate the reference, which is applicable to the flight area where the aircraft is located.

FLIGHT PLANNING

For flight planning, the pilot inserts the following into the FMGS via the MCDU :
– the intended lateral trajectory (lateral flight plan)
– the intended vertical trajectory, which is a speed and altitude profile (vertical flight plan)
The system must have this information in order to compute performance and guidance commands.

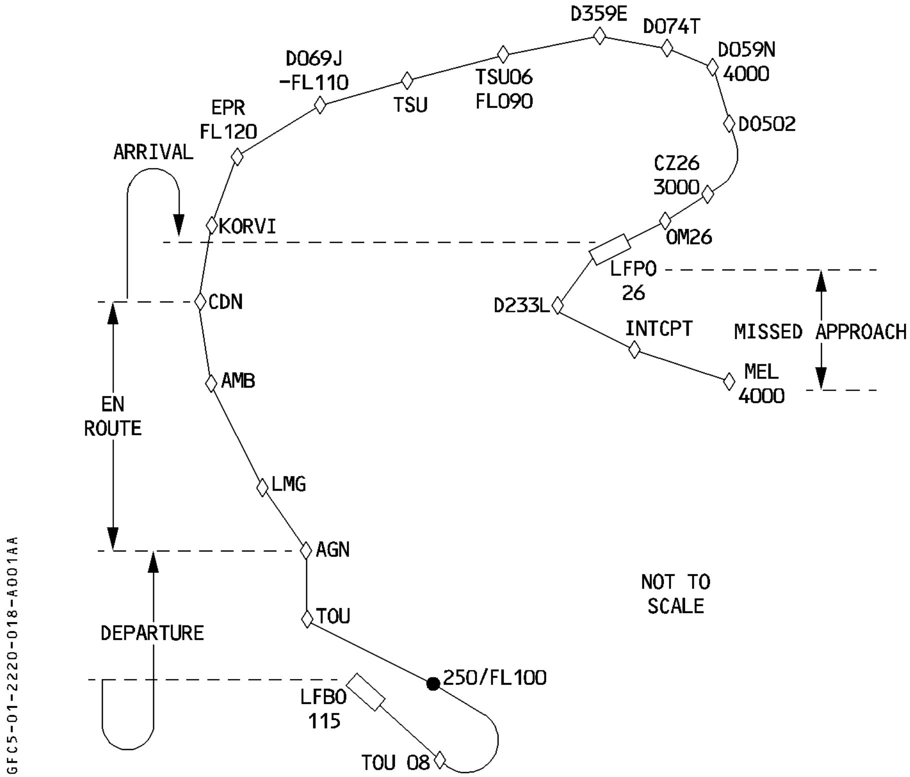
GENERAL

The FMGS can contain two different flight plans :
– the ACTIVE flight plan, which is the basis for :
  · lateral and vertical guidance
  · MCDU and ND display
  · radio navigation autotuning
  · performance predictions
  · fuel planning
– the SECONDARY flight plan which the pilot may use :
  · to prepare and store a second departure procedure before takeoff
  · to plan a diversion
  · to prepare the next flight leg
  · to compare predictions or evaluations
Each flight plan is composed of the same elements :
– the primary flight plan, from origin to destination and missed approach
– the alternate flight plan, from destination to alternate destination
The pilot enters the flight plan in either of two ways :
– automatically by selecting a company route. Such a selection will call all the elements of the route out of the database.
– manually by selecting an ORIGIN/DEST pair, and then selecting all successive waypoints, procedures, and vertical constraints on the MCDU.
The pilot may then modify the flight plan on the ground or in flight, by making lateral and vertical revisions.

LATERAL FLIGHT PLAN

The lateral flight plan includes the following elements :
- Departure
  - Takeoff runway
  - SID
  - En route transition
- En route
  - En route waypoints and airways
- Arrival
  - En route transition
  - STARs/VIAs
  - Landing runway with selected approach
  - Missed approach
- Alternate flight plan

These elements are defined by waypoints and legs between the waypoints.



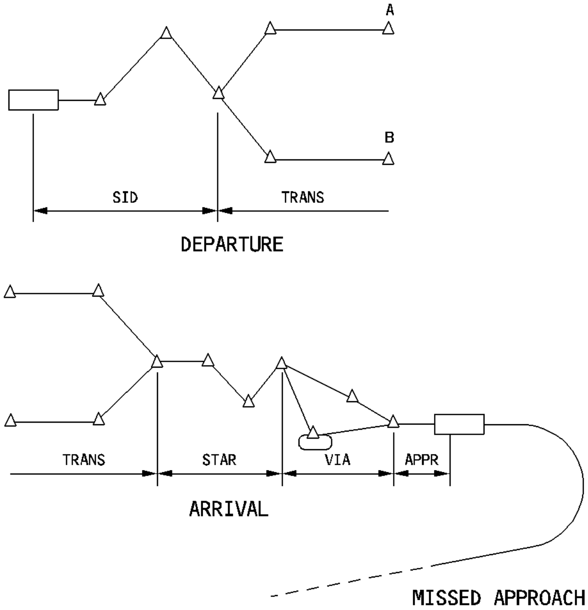
The FMGC strings the legs in sequence automatically.
The flight plan has a discontinuity if any two waypoints do not have a leg defined between them.
The computer assumes that the aircraft will fly a direct leg between the two waypoints that define the discontinuity.

Note : *When the aircraft enters a flight plan discontinuity, the NAV mode automatically switches to the HDG (TRK) mode.*

The FMGS automatically strings additional types of legs when departure or arrival procedures (SID-STAR-TRANS) are defined. Some of these legs are specific legs, such as:
- DME arc leg
- holding pattern to a fix or reverse turn
- course-to-fix leg
- heading leg
- MANUAL leg

The pilot cannot create these types of legs : they are part of the stored departure/arrival procedures he has selected.
The pilot can create only direct legs between manually defined geographic points (navaids, airports, waypoints).

Note : *The departure and arrival procedures are defined in the database to minimize the amount of memory required. They are divided as follows :*
DEPARTURE = SID + EN ROUTE TRANSITION
ARRIVAL = APPR VIA + STAR + EN ROUTE TRANSITION
The SID is the central common part of the departure procedure, as the STAR is of the arrival procedure. En route transitions (TRANS) are the various possible trajectories defined between the last point of the SID and the first en route waypoints and between the last en route waypoint and the first fix of the STAR.
"APPR VIAs" are the possible trajectories defined between the last point of the STAR and the first point of the approach.



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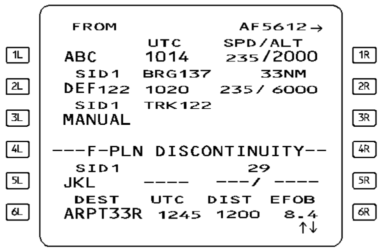
MANUAL LEGS

A MANUAL leg stays on a constant course, TRK or HDG and has no termination point. You cannot insert it into a flight plan manually (except using the DIRTO RADIAL OUT function, refer to 4.03.20) : it is part of a given procedure such as a SID or a STAR. When the aircraft is flying a MANUAL leg, the NAV mode remains engaged and predictions assume that the aircraft will fly a direct leg from its present position to the next waypoint (DIR TO). When the aircraft is cleared to fly to the next waypoint of the flight plan, the pilot performs a DIR TO.

<u>Note</u> : – *In NAV mode a MANUAL leg is sequenced only by performing a DIR TO.*
– *The use of the descent mode (DES) on a MANUAL leg is not recommended.*



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LATERAL REVISIONS

There are two types of lateral revisions :

— lateral revisions that have an immediate effect on the active flight plan
  · The pilot inserts, deletes, or changes an individual waypoint on the flight plan page.
  · The pilot creates a direct leg (DIR TO) from his present position to a selected waypoint.
— lateral revisions that lead to a temporary flight plan (TMPY) before they take effect. For these, you can select, delete, or modify waypoints that belong to an airway or to a procedure (SID, STAR, HOLD, TAKEOFF or LANDING RWY). This modification is made on specific "LAT REV" pages from the flight plan page.

Possible revisions are :

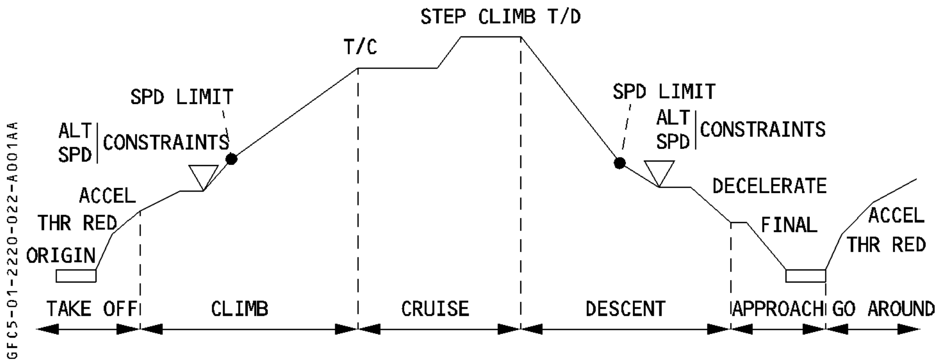
· Insert or modify departure procedure.
· Insert or modify arrival procedure.
· Insert a waypoint.
· Change the destination.
· Insert an airway.
· Insert an offset.
· Insert a holding pattern.
· Select or enable an alternate flight plan.
· FIX information.

TEMPORARY FLIGHT PLAN

The purpose of the temporary flight plan is to allow the pilot to check a revision on the MCDU and EFIS ND before he inserts the changes into the active flight plan. It is a copy of the active flight plan that has been changed according to the pilot revision. While it is displayed the aircraft will continue to follow the original active flight plan.
No predictions are computed or displayed on the pages of the temporary flight plan.
For details, refer to 4.04.10 (TEMPORARY F-PLN).

VERTICAL FLIGHT PLAN

The vertical flight plan is divided into the following flight phases.
Preflight - Takeoff - Climb - Cruise - Descent – Approach - Go Around - Done.
All but preflight and done are associated with speed and altitude profiles.



Each phase has an assigned profile of target speeds. For each phase the FMGS computes an optimum (ECON) speed as a function of the strategic parameters (CI, CRZ FL, ZFW, ZFWCG, block FUEL, wind and temperatures) and performance criteria.
ECON speed is the basis of the managed speed profile.
The ECON speed can be modified by presetting a speed or Mach number on the MCDU (PERF page) for the next phase, or by selecting on the FCU a speed or a Mach number for the active phase, or by inserting speed constraints or speed limits on the MCDU vertical revision (VERT REV) page.
The vertical flight plan includes vertical constraints (altitude, speed, time) that may be stored in the data base or entered manually by the crew through vertical revision pages.
The crew may also define step climbs or step descents for cruise purposes. If the crew plans to climb to a higher flight level or descend to a lower level, it can use a vertical revision at any waypoint to insert the new level.
When all the vertical data have been defined, the FMGC computes the vertical profile and the managed speed/Mach profile from takeoff to landing.
For details, refer to 4.03.20 (vertical revision pages).

PERFORMANCE

The performance function includes optimization and predictions.

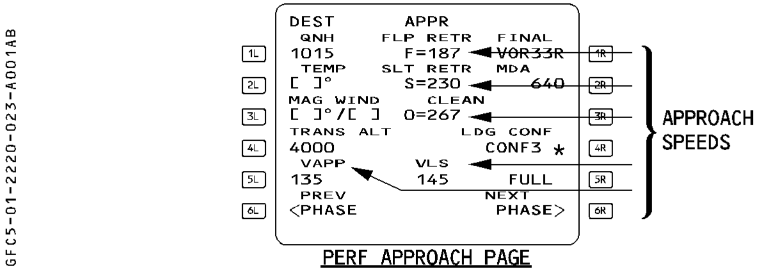
OPTIMIZATION

The FMGC minimizes cost by optimizing speed. The optimization function computes the following items :
- takeoff, approach, and go-around speeds (F, S, Green Dot, VAPP)
- an optimum target speed for CLB and DES phases (ECON CLB/DES SPD)
- an optimum target Mach number for CRZ phase (CRZ MACH)
- an optimum FL, for information purposes
- an optimum descent profile from CRZ FL down to the destination airport.

These items depend on the data the pilot inserts during lateral and vertical flight planning and revision procedures.
Most are displayed on the PERF pages associated with the appropriate flight phases.

Takeoff, approach and go-around speeds

The FMGC computes takeoff speeds (F, S, Green Dot) during the preflight and takeoff phases, using the performance model in the database and the takeoff weight.
The pilot has to insert V1, VR, and V2 in the PERF TO page manually.
The FMGC uses the performance model and either the predicted landing weight or the current gross weight at transition to the approach phase to compute approach speeds (VLS, VAPP, F, S, Green Dot). On the PERF APPR page, the selected LDG CONF determines the applicable VLS and VAPP, the latter being updated by the WIND correction that the pilot enters on the same page.
The FMGC uses the performance model and gross weight to compute go-around speeds (F, S, Green Dot).



PERF APPROACH PAGE

Optimum target speed for CLB or DES phase

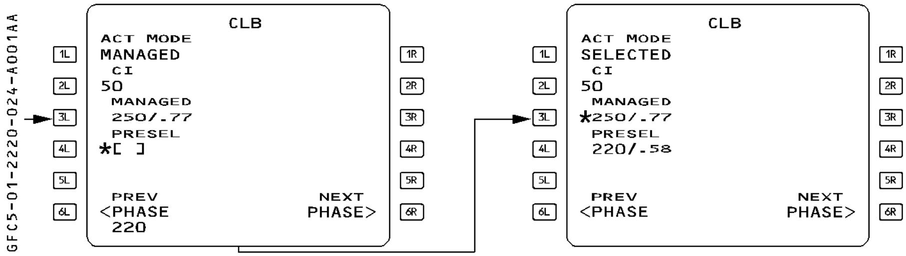
The FMGC computes optimum speeds as functions of :

— the gross weight (GW)
— the cost index (CI)
— the cruise flight level (CRZ FL)
— the wind and temperature models
— the performance factor

When there is no time or speed constraint/limit, ECON SPEED is the optimum speed for the selected cost index. It refers to fuel and time cost and not directly to fuel saving.

R FM calculates ECON CLB speed before the climb phase begins, and this speed cannot be
R changed during the climb phase itself.
R ECON DES speed is used to compute the optimum descent profile and the associated top
R of descent (T/D).

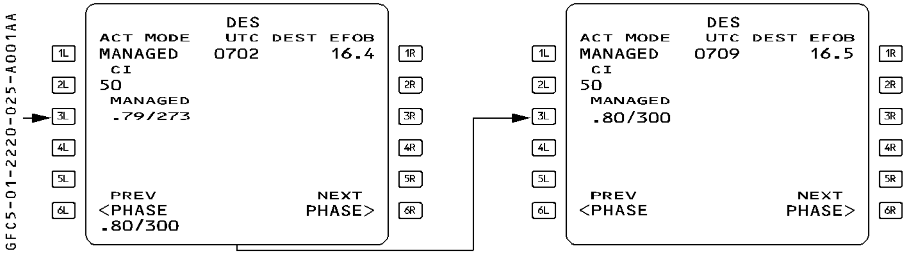
R **Preset target speed for CLB phase**
R The pilot can preselect the climb speed as long as the CLB phase is not active, by inserting
R a speed in the PRESEL field :



R The active mode field changes from MANAGED to SELECTED, and the FM will use the
R entered speed for climb predictions computation. The pilot can revert to managed mode by
R pressing the 3L key.

R **Preset target speed/Mach for DES phase**
R The pilot can change the speed and/or Mach as long as the DES phase is not active by
R inserting a speed and/or Mach in the MANAGED field.
R Although the entered speed is choosen by the pilot, the FMGS uses it to compute the
R descent profile and top of descent. It is therefore part of the managed descent profile.

R



R The pilot can revert to the optimum speed/Mach by clearing the field 3L.

Optimum target Mach number in cruise

FM computes ECON CRZ MACH as the optimum speed and updates it continually, taking into account :

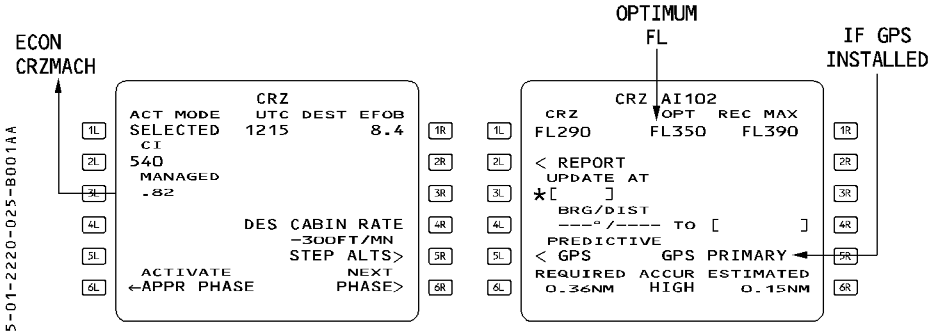
- current weather conditions
- modifications to the flight plan.

Note : Below FL 250 the FMGS calculates ECON CRZ SPD instead of ECON CRZ MACH.

Optimum flight level in cruise

The optimum flight level is the flight level at which the aircraft incurs the lowest cost for a given flight plan, cost index, and gross weight (assuming a 15 minute minimum cruise flight level at that altitude). FM updates it continuously during the cruise phase, and displays it on the PROG page. The PROG page displays dashes for this quantity :

- at least 15 NM before the top of descent
- when the system detects an engine-out condition
- when DES phase is activated.



PERF CRZ PAGE

PROG CRZ PAGE

COST INDEX

CI is the ratio flight time cost (CT) to fuel cost (CF).
CI = CT/CF KG/MIN or 100 LB/H
The cost index is used to compute the best economic speed and Mach to be flown considering the ratio between the cost of the flight time and the cost of the fuel.
CI = 0 corresponds to minimum fuel consumption (max range)
CI = 999 corresponds to minimum time
For CI = LRC refer to table volume 4 section 4.05.50
It is recommended to modify the CI in flight :
- In case a fuel problem is encountered, CI = 0 may be selected ; the ECON SPD profile is then computed to ensure minimum fuel consumption.
- In case the aircraft is behind its schedule, CI = 999 may be selected. The ECON SPD profile is then computed to ensure minimum time.

Optimum step point

Only one optimum step point may be computed from the current cruise FL to a higher cruise FL. After insertion, the optimum step point is fixed and no longer updated.
The step altitude, time and fuel savings are provided before the insertion of an optimum step climb point on the STEP ALTS page.

Optimum descent profile

Refer to 4.02.30

PREDICTIONS

The FMGC computes predictions for the primary flight plan and the secondary flight plan and displays them on the Multipurpose Control and Display Units (MCDUs) and on the Navigation Display (ND) of the Electronic Flight Instrument System (EFIS). The computations use the current state of the aircraft (GW, CG, position, altitude, speed, engaged mode of the autopilot or flight director, time, wind, temperature) for the active flight plan.

PREDICTIONS FOR THE PRIMARY FLIGHT PLAN

The predictions displayed on the MCDU assume that the FMGS will guide the aircraft along the preplanned lateral and vertical flight plans. The predictions displayed on the ND assume that the aircraft will continue to operate in the modes (selected or managed) that are currently active.
As long as the aircraft is flying the flight plan under managed guidance, the predictions on the MCDU will match those on the ND.
R If the pilot does not fly the flight plan, the MCDU predictions assume that :
– The pilot will fly back toward the flight-planned route.
R – The pilot will immediately resume flying the FMGC-managed modes.
R If the pilot does not fly the managed speed profile, the MCDU predictions assume that he
R will maintain the selected speed until he reaches :
R – In the climb or descent phase, the next speed limit or speed constraint if any, or next
R phase,
R – In cruise, the top of descent.
R Then, the predictions assume that the pilot will revert to managed speed.

UPDATE OF PREDICTIONS

The FMGCs recompute the predictions, whenever there is a modification to the :
– Lateral flight plan
– Vertical flight plan
– Forecast atmospheric conditions entered by the crew
– Cost index
– Speed control (managed/selected)

Note : During recomputation, prediction fields on the MCDU pages display dashes.

WINDS USED FOR PREDICTIONS

See VERTICAL FUNCTIONS in the FMGS Pilot's Guide (04.04.20).

EFIS ND PREDICTIONS

Refer to FLIGHT MANAGEMENT PRINCIPLES, 4.02.20.

MCDU PREDICTIONS

Refer to FLIGHT MANAGEMENT PRINCIPLES, 4.02.20.

OTHER COMPUTATIONS

Engine-out case

The FMGS computes an engine-out target speed for each flight phase.
It computes an engine-out maximum altitude (EO MAX ALT) at long-range cruise speed, and displays it on the PROG page.
The new speed target becomes green dot in climb phase or EO CRZ SPD in level flight.
The system computes the flight plan predictions down to the primary destination assuming that the cruise phase is at the lower of CRZ FL or EO MAX ALT.
For the engine out obstacle strategy the system computes a drift down altitude for level of with green dot speed.

Fuel Planning

After the F-PLN, CRZ FL, CI, ZFW, ZFWCG insertion, the FMGC may compute on crew request the minimum fuel to meet the requirements of the flight taking into account a predetermined fuel policy (Navigation Database).
Fuel predictions are automatically performed after the F-PLN, CRZ FL, ZFW insertion. The FMGC has to know the FOB either inserted by the crew (BLOCK FUEL) or computed by the system.

Equi-time point (ETP)

The ETP is a pseudo waypoint along the lateral flight plan at which the time to reach 2 reference waypoints is the same, taking distance and winds into account.

Time Marker

This pseudo waypoint may be created for display on MCDU/ND.

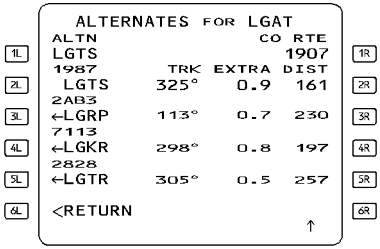
Recommended maximum altitude (REC MAX)

The recommended maximum altitude is the lowest of :
- maximum altitude the aircraft can reach with a 0.3 g buffet margin
- maximum altitude the aircraft can fly in level flight at MAX CRZ rating
- maximum altitude the aircraft can maintain a V/S of 300 feet/minute at MAX CLB thrust
- maximum altitude the aircraft can fly at a speed higher than Green Dot speed and lower than VMO/MMO
- maximum altitude the aircraft is certified (FL 410)

The REC MAX altitude is displayed on the PROG page.
A maximum altitude using a 0.2 g buffet margin is also computed. It is not displayed, but the system uses it to limit CRZ ALT entry.

Predictions for alternates

Predictions for alternates are displayed on the ALTERNATES page.



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They are based on :

- A default cruise FL equal to 220 if the airway distance is less than 200 NM. otherwise FL 310.
- Simplified wind/temperature models based on crew entries :
  - ALTN CRZ wind as entered in the primary DESCENT WIND page.
  - Wind/temperature at primary destination (APPR page).

  A zero wind and/or zero ISA deviation is assumed by default if there is no crew entry.
- Initial aircraft weight equal to landing weight at primary destination.
- A track equal to mean track between active primary and alternative destination.
- A constant delta ISA and a constant cruise wind.
- Cost index = 0 (minimum fuel)

Note : — *No step can be inserted in an alternate flight plan.*
— *No predictions are displayed for the selected alternate on flight plan pages, but the pilot can read ALTN trip fuel and time on the INIT B page before engine start, and estimated time and estimated fuel on board at alternate on the FUEL PRED page after engine start.*

Predictions for secondary flight plan

Predictions are provided on the SEC F-PLN, SEC INIT and SEC PERF pages as for the active primary flight plan.

However the predictions are provided for the SEC F-PLN on the condition that the primary and secondary flight plan have their active leg common (same TO WPT).

Predictions for fuel

Up to eight fuel policy records may be specified in the navigation database.
If a specific data is not provided in the database fuel policy, the value is the default value given here after :

PARAMETERS		DEFAULT VALUES
RTE RSV	(percentage of route reserve)	5 %
RSV MIN	(minimum value of route reserve)	0 kg
RSV MAX	(maximum value of route reserve)	25.600 kg
RSV FLT	(reserve remains computed in flight)	yes
RSV ALTN	(reserve is computed with alternate trip fuel)	no
FINAL TIME	(time for final holding pattern)	30 min
FINAL FIX	(Fuel burnt in the final holding pattern)	0 kg
FINAL ALT	(altitude of the final holding pattern)	1 500 ft AGL
TAXI	(fuel for taxi)	600 kg
FINAL DEST	(final holding pattern is flown at ALTN)	ALTN

Furthermore RTE RSV, FINAL TIME and TAXI may be modified on the MCDU through the INIT B or FUEL PRED pages.

RETURN-TO-TRAJECTORY ASSUMPTIONS

If the aircraft is not on the lateral flight plan, the FMGC assumes (for prediction) that it will return immediately to the active lateral leg with a 45° convergence angle or that it will fly direct or the "TO" waypoint whenever the required convergence angle is greater than 45°.

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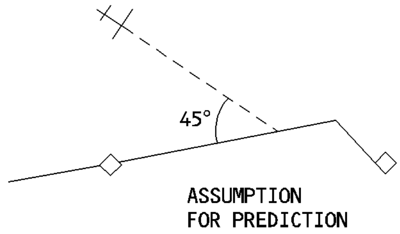


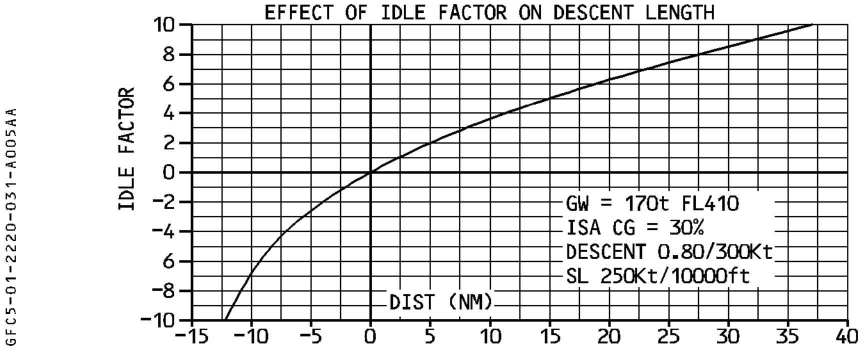
If the pilot flies outside the planned flight plan, predictions are still available, but they assume an immediate return to the flight plan.
For other computations, (Refer to FCOM 4 .02.20).

IDLE/PERF FACTORS

MCDU fuel predictions can be corrected to match the actual aircraft fuel consumption. This is done, on ground only, by modifying the IDLE/PERF factor.

IDLE FACTOR

IDLE and PERF factors use the same principle.
The PERF factor is mainly used for prediction during cruise phase, the IDLE factor is dedicated to the FM descent segment.
The aim of the IDLE factor is to adjust the FM descent predictions, in particular the position of the Top Of Descent (TOD), with the actual engine idle thrust used during descent.
A positive IDLE FACTOR gives an earlier top of descent (shallower path).
A negative IDLE FACTOR delays the top of descent (steeper path).



Example :
IDLE factor + 4 increases the computed descent of 12 NM.

PERF FACTOR

The performance factor is a positive or negative percentage that is used to correct the predicted fuel flow, used for fuel prediction computation within the FMGS. This parameter is necessary when the aircraft's performance differs from the performance model stored in the FMGS database.

This difference can be due to one or both of the following cases :

1. The FMS contains a performance database, used to compute the predictions and the performance data. Due to the numerous possible aircraft configurations, the same performance database is sometimes used for aircraft with slightly different behaviors. In these cases, a PERF factor is entered to correct the computations performed with a
R database not exactly tailored for the given configuration. As a result, the aircraft or
R engine type identification on the MCDU's A/C. STATUS page may not correspond to that
R of the actual aircraft.
2. Since the actual aircraft drag and engine performance deviate from the nominal model due to the aircraft's age, airline Flight Operations will periodically apply a correction factor to adapt fuel predictions to actual fuel consumption.

The PERF factor modifies the predicted fuel flow, according to the following formula :

FFpred = FFmodel (1 + PERF FACT/100)

FFpred is the FF used for prediction.

FFmodel is the FF from the aero-engine model.

This correction is applied throughout the flight, and modifies the performance predictions and the ECON speed or Mach. For example : Entering a PERF factor of + 1.5 means that Flight Operations have evaluated the aircraft fuel deviation as 1.5 %, compared to the basic performance model (0.0).

R **Procedure to modify the PERF factor (on ground only) :**

On the aircraft status page :

– ENTER "ARM" in the CHG CODE line's [5L] brackets.

– WRITE the new IDLE/PERF factors.

– INSERT, using the [6L] key.

A manually-entered IDLE/PERF factor is displayed in large blue fonts. Changing an IDLE/PERF factor is usually the responsibility of maintenance, or Flight Operations.

PERF Factor to be used on FMS2 at delivery, depending on the engine type :

A330–201 CF6–80E1A2 : – 1.0 %
A330–202 CF6–80E1A4 : – 1.0 %
A330–203 CF6–80E1A3 : – 1 %
A330–223 PW4168A : – 1.0 %
A330–243 TRENT772B-60 : – 1.0 %
A330–301 CF6–80E1A2 : 0.0 %
A330–302 CF6–80E1A4 : 0.0 %
A330–303 CF6–80E1A3 : 0.0 %
A330–321 PW4164 : 0.0 %
A330–322 PW4168 : 0.0 %
A330–323 PW4168A : 0.0 %
A330–324 PW4173 : 0.0 %
A330–341 TRENT768–60 : 0.0 %
A330–342 TRENT772–60 “Old Hardware”* : 0.0 %
A330–342 TRENT772–60 “New Hardware”* : – 2.0 %
A330–343 TRENT772B-60 : – 2.0 %
* “Old Hardware” : Before ESN 41054 ; “New Hardware” : since ESN 41054.

All these numbers assume that : The aircraft is brand-new, anti-ice is off, air conditioning is on economic, and the conservative Fuel Lower Heating Value (FLHV) is 18400 btu/lb.

When an aircraft pages, fuel consumption degradation will be measured to determine the so-called “monitored fuel factor”. This factor corresponds to the deviation of the aircraft’s
R actual fuel consumption from the nominal model. Generally, the FLHV that is used during
R fuel factor monitoring is higher than the FMS value. In order not to penalize FMS
R predictions, it is necessary to correct the “monitored fuel factor”. For example, add – 1%
R to the “monitored fuel factor”, when an FLHV of 18590 btu/lb is used. Once this factor is
established by the airline, it should be arithmetically-added to the above-noted performance factor.

Note :
- *At delivery, ENTER the Performance factor (given in the table above) directly in the MCDU (no correction factor is needed).*
- *When replacing an FMS legacy by an FMS2, on any given aircraft model, the performance model that is stored in the FMS2 may be different from the one that was previously stored in the FMS legacy. As a result, DISREGARD the performance factor previously entered in the MCDU. ADD the “monitored fuel factor” (when available) to the performance factor (given above), and ENTER the resulting factor in the MCDU.*

MANAGEMENT OF THE DISPLAYS

The flight management system displays navigation, performance and guidance information on :
- the Mutipurpose Control and Display Unit (MCDUs)
- the Navigation Display (ND) of the Electronic Flight Instrument System (EFIS)
- the Primary Flight Display (PFD) of the EFIS.

MCDU DISPLAY

The MCDUs display :
- Position and accuracy information
- Tuned navaids
- Lateral and vertical flight plans (waypoints, pseudo waypoints, constraints)
- Predictions (SPD, TIME, ALT, WIND)
- Fuel predictions and fuel management information (estimated fuel on board, extra fuel)
- Performance data.

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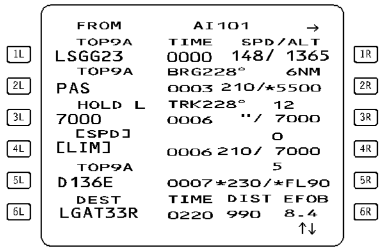
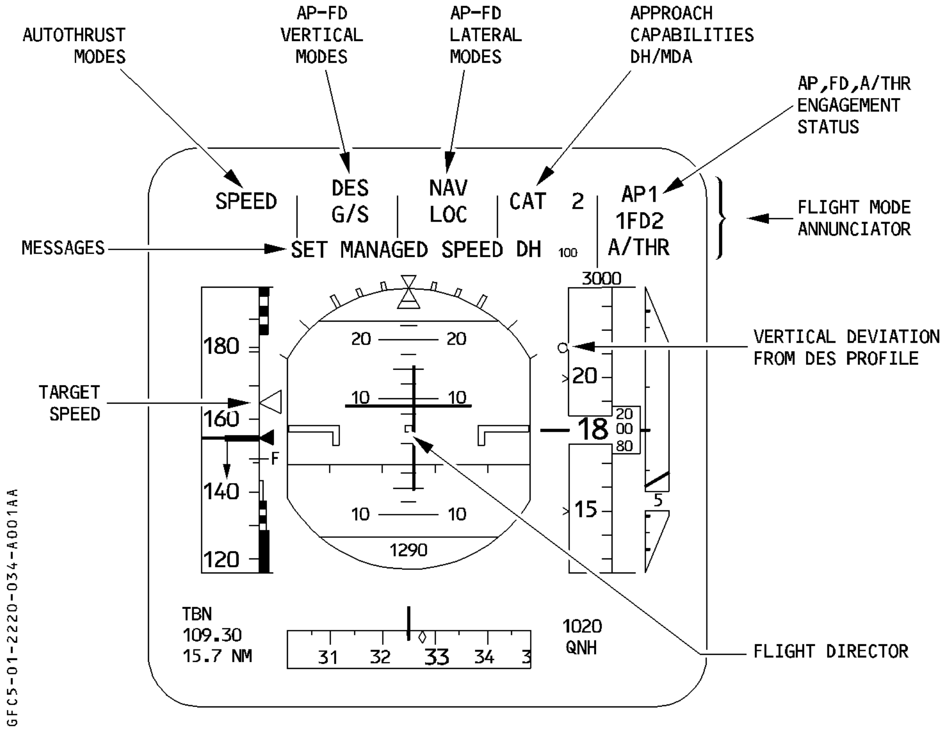


F-PLN page

EFIS PRIMARY FLIGHT DISPLAY (PFD)

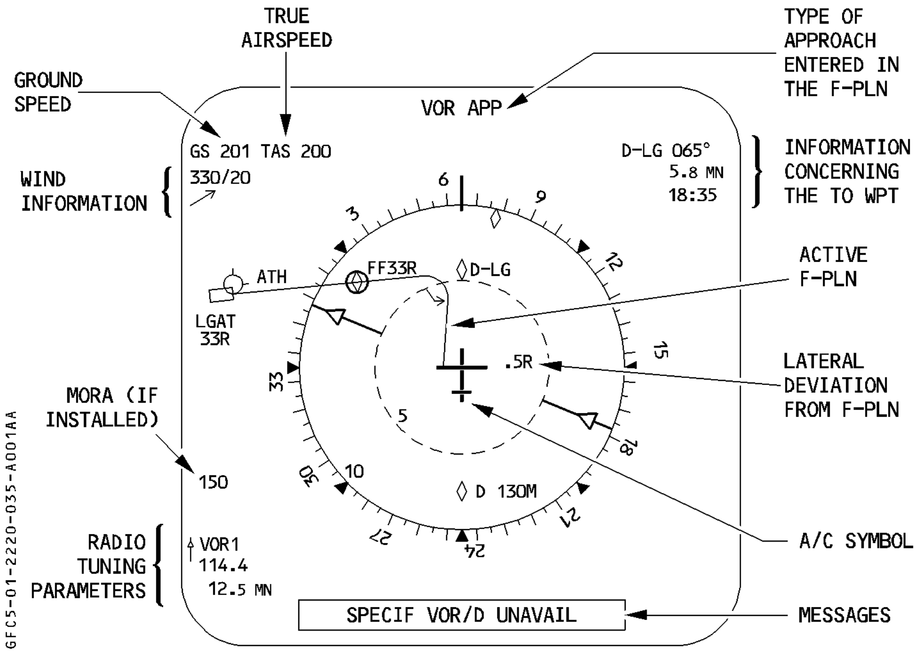
Flight Management generates the following information :
- Armed and engaged modes on the Flight Mode Annunciator (FMA)
- FMGS guidance targets (SPD, ALT, HDG)
- Vertical deviation from descent profile
- Messages
- Navigation information



R *Note : For more details concerning EFIS PFD refer to 1-31 chapter.*

EFIS NAVIGATION DISPLAY (ND)

Flight Management (FM) generates the following information :
- aircraft position
- flight plans (active, secondary, temporary, and dashed)
- lateral deviation from primary flight plan
- pseudo waypoints along the flight plan
- raw data from tuned navaids
- wind information
- various options, depending on what the pilot selects on the EFIS control panel : waypoints, navaids, NDBs, airports, constraints
- type of approach selected
- messages



Note : For more details concerning EFIS ND refer to 1.31.45.

COLORS USED FOR DISPLAYING FLIGHT PLANS

F-PLN	Color
Primary flight plan	steady green in managed, dashed green in selected
track line	steady green
alternate flight plan	dashed blue
missed approach	steady blue
offset flight plan	steady green (original flight plan dashed green)
temporary flight plan	dashed yellow
engine-out SID	steady yellow (not inserted)
secondary flight plan	steady dimmed white
abeam / radial	dashed blue

GENERAL

The guidance function is achieved by the Flight Guidance (FG) part of the FMGS which controls :
- the Flight Director (FD)
- the Auto Pilot (AP)
- the Auto Thrust (A/THR).

GUIDANCE MODES

Two types of autopilot and flight director modes are available to guide the aircraft :
- Managed modes, which steer the aircraft along the lateral, vertical, and speed profiles according to the data the pilot inserts into the MCDU. Flight Management (in the Flight Management and Guidance Computer) computes the corresponding guidance targets.
- Selected modes, which steer the aircraft according to target values that the pilot selects and the FCU windows display.

GUIDANCE	MANAGED modes	SELECTED modes
LATERAL	NAV, APP NAV B/C*, B/C, LOC*, LOC RWY RWY TRK GA TRK ROLL OUT	HDG – TRK
VERTICAL	SRS (T.O and G.A) CLB, DES ALT*, ALT ALT CSTR*, ALT CSTR G/S*, G/S FINAL, FLARE	OP CLB, OP DES V/S, FPA ALT*, ALT
SPEED	FMGC REFERENCE (ECON, Auto SPD, SPD LIM)	FCU REFERENCE

MODE SELECTION

MANAGED MODES

- At takeoff, the managed modes engage automatically when the pilot sets the thrust levers at the TO or FLX detent.
- During flight, the pilot can arm or engage the managed modes (if the aircraft meets engagement conditions) by pushing in the appropriate knobs on the Flight Control Unit (FCU).
- The pilot pushes the “DIR TO” key on the MCDU to insert a DIR TO leg. It engages or maintains the NAV mode.
- The pilot pushes the “APPR” pushbutton on the FCU to arm or engage the localizer and glide slope or “APP NAV-FINAL”, depending upon the approach type he had inserted in the flight plan.
- The “LOC” pushbutton arms or engages only the localizer mode.

SELECTED MODES

The pilot can engage the selected modes by pulling out the appropriate FCU selection knobs.

INTERACTION BETWEEN AP/FD AND A/THR MODES

The AP/FD pitch modes can control a target SPD/MACH or a vertical trajectory ; the A/THR modes can control a fixed thrust or a target SPD/MACH. AP/FD and A/THR cannot simultaneously control a target SPD/MACH. Consequently the AP/FD pitch modes and A/THR modes are integrated as follows :
- If an AP/FD pitch mode controls a vertical trajectory, the A/THR mode controls the target SPD/MACH.
- If an AP/FD pitch mode controls a target speed or Mach, the A/THR mode controls the thrust.
- If no AP/FD pitch mode is engaged, the A/THR mode reverts to SPD/MACH mode.

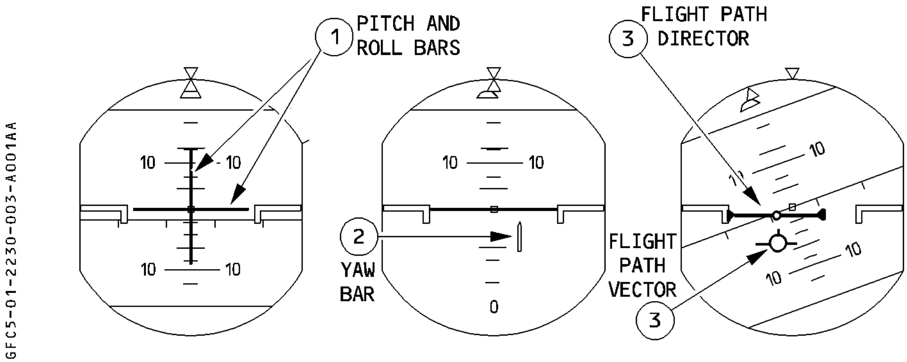
In other words, the selection of a pitch mode determines the associated A/THR mode.

AP/FD pitch modes	A/THR modes
V/S – FPA DES (geometric path) ALT*, ALT, ALT CSTR*, ALT CSTR G/S*, G/S FINAL	SPD/MACH MODE
AP/FD OFF	
OPEN CLB/OPEN DES CLB/DES (idle path) SRS	THR (CLB, IDLE) MODE
FLARE	RETARD (IDLE)

FLIGHT DIRECTOR

GENERAL

The Flight Director (FD) displays guidance commands from the Flight Management and Guidance Computer (FMGC) on the Primary Flight Display (PFD).
The pilot may fly the aircraft manually, following FMGC guidance commands, or crosscheck the FMGC orders when the autopilot is engaged.
In normal operations, FD1 displays FMGC1 orders on PFD1 and FD2 displays FMGC2 orders on PFD2.
The FDs use their respective onside FMGCs.
On the PFD :
1. The FD pitch and roll crossbars show pitch and roll demands.
2. Below 30 feet during landing and takeoff, when a localizer is available, the vertical bar is replaced by a yaw bar that gives lateral orders.
3. The Flight Path Director (FPD) symbol relates to the Flight Path Vector (FPV).



The HDG V/S – TRK FPA pushbutton on the FCU permits the pilot to select either type of reference and display.
The FD pushbutton on the Electronic Flight Instrument System (EFIS) control panel allows the FD bars to be displayed or removed.

FD bars (HDG V/S selected on the FCU)

– The pitch bar is displayed if a vertical mode is engaged. It gives pitch orders for the vertical guidance.
– The roll bar is displayed if a lateral mode is engaged. It gives roll orders for lateral guidance.

Flight Path Director (TRK FPA selected on the FCU)

The display is an alternate way of transmitting flight director commands.

- The Flight Path Vector (FPV) symbol illustrates the actual track and flight path angle being flown.
- The Flight Path Director (FPD) symbol shows the pilot how to intercept and fly the vertical and lateral flight trajectory.
  When the pilot superimposes the FPV and the FPD symbols, the aircraft flies the commanded trajectory.

FLIGHT DIRECTOR (FD) ENGAGEMENT

The FDs are automatically engaged whenever the FMGC powers up.

GROUND ENGAGEMENT

- The “1 FD2” symbol appears on both PFDs.
- No FD bars appear on the PFDs. (The PFD displays FD orders when a mode is active on the corresponding axis).
- The FCU windows display dashes.

MANUAL FLIGHT ENGAGEMENT

Provided AP/FD is off (no lateral or vertical mode displayed on FMAs, the two FDs engage in the HDG V/S or TRK FPA mode (basic modes) when FD pushbuttons are pressed.

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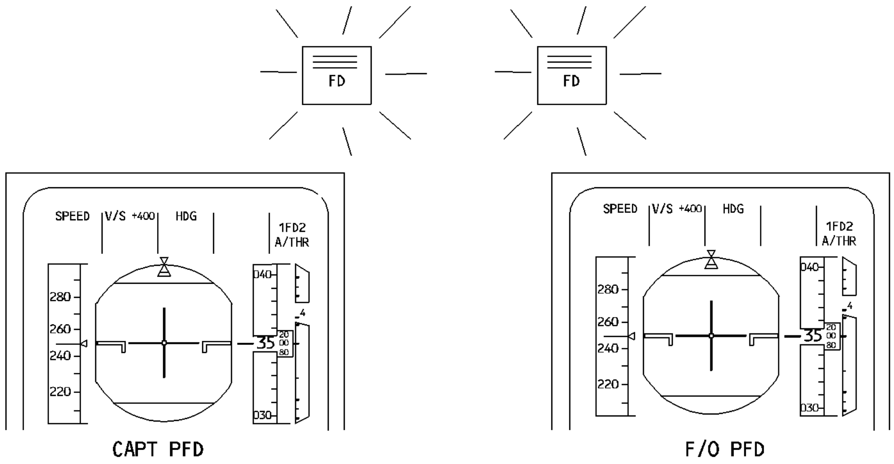


AUTOMATIC FLIGHT ENGAGEMENT

- FD bars are automatically restored in SRS/GA TRK modes at go around engagement. If FPV/FPD was previously selected, it reverts to FD bars.

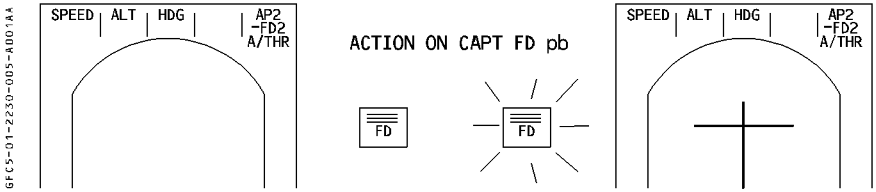
FLIGHT DIRECTOR (FD) DISENGAGEMENT

The flight crew may disengage one or two FDs manually, or FDs may disengage automatically if there is a failure.

MANUAL FLIGHT DIRECTOR DISENGAGEMENT

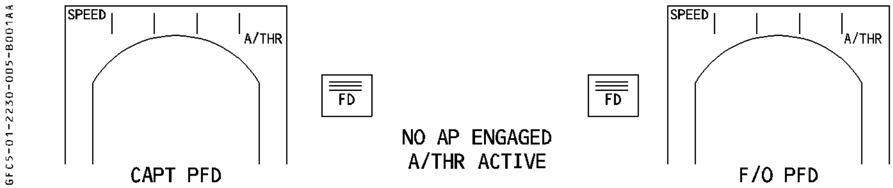
One FD off :

- The FD bars no longer appear on the associated PFD.
- The corresponding FD is disengaged.



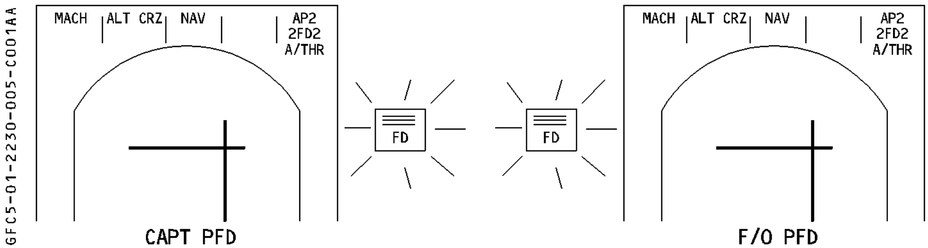
Both FDs off:

- The FD bars disappear from both PFDs.
- If no AP was engaged, lateral and vertical modes disengage. The A/THR, if active, automatically reverts to (or remains in) SPEED/MACH mode.
- If one AP was engaged when FDs are switched OFF, this AP remains engaged in the active modes but the FDs are no longer displayed.



AUTOMATIC FLIGHT DIRECTOR DISENGAGEMENT

If one FD fails or one FMGC is not valid, both PFDs display the remaining FD.



AUTOMATIC DISENGAGEMENT DUE TO SPEED PROTECTION

When APs are not engaged and if you do not fly the FD bars, an automatic disengagement of FDs and corresponding FMA modes will occur if the aircraft speed reaches VMAX in climb with CLB or OP CLB mode engaged or if the aircraft speed decreases to VLS in descent with DES, OP DES mode engaged.
Refer to Automatic speed protection in this chapter.

AUTOMATIC FD REMOVAL

- The FD pitch bar is removed when no vertical mode is engaged or when ROLL OUT is engaged.
- The roll FD bar is removed when no lateral mode is engaged or when the RWY or ROLL OUT mode is engaged.
- Both FDs are removed when the aircraft pitch exceeds 25° up or 13° down, or bank angle exceeds 45°.

Note : *If from AP/FDs off, FD2 then FD1, are engaged within 150 milliseconds (one computation cycle), a flip flop of master FMGC may occur.*
As a result, no vertical mode engages and dashes are displayed on FMA 1st column, 1st line (A/THR mode).
Engaging V/S mode manually reselects the correct FMGC and restores the display.

FD WARNINGS

FD WARNINGS	CONDITIONS
Pitch FD bar (or FPV) flashes 10 seconds	– if the ALT* mode is lost further to FCU altitude reference change of more than 250 ft. – when in APPR mode (G/S*, G/S, LAND, FINAL) FD reverts to V/S mode (pilot action or loss of vertical approach mode) – one AP or one FD is engaged while both AP/FD were previously off.
Pitch FD bar (or FPV) flashes permanently	Transmission of the GLIDE data is interrupted when in G/S, G/S* or LAND modes above 100 ft RA.
Roll FD bar (or FPV) flashes 10 seconds	– When in APPR mode (LOC*, LOC, LAND, APP NAV) FD reverts to HDG mode (Pilot action or loss of lateral approach mode). – One AP or one FD is engaged while both AP/FD were previously off.
Roll FD bar (or FPV) flashes permanently	Transmission of the LOC data is interrupted when in LOC, LOC* or LAND modes above 15 ft RA.

AUTOPILOT

GENERAL

The AP :
- stabilizes the aircraft around its center of gravity
- acquires and tracks a flight path
- flies the aircraft to an automatic landing or go-around.

The AP commands the :
- position of the flight control surfaces for pitch, roll, and yaw
- nose wheel position.

AP ENGAGEMENT

The flight crew can engage AP1 or AP2 by pressing the corresponding pushbutton on the FCU if the aircraft has been airborne for at least five seconds.
When one AP is engaged, the corresponding FCU pushbutton comes on and AP1 (or 2) is displayed on the FMAs.
In dual BACK UP NAV, AP can be engaged in selected modes if the FG part is available.
AP can be engaged when :
* Aircraft speed is within VLS and VMAX.
* Aircraft pitch angle does not exceed 10° nose down or 22° nose up.
* Bank angle is less than 40°
* On ground, if the engines are not running. It disengages when one engine is started.
* Two APs may be engaged at a time (AP1 active, AP2 in standby), when the localizer/glide-slope or roll out or go around mode is armed or engaged.
  Only one AP can be engaged at a time in all other cases.
* If one AP pushbutton is set to on with both FDs off, the AP engages in HDG V/S or TRK FPA mode, depending upon which the pilot has selected on the FCU.
* If one AP pushbutton is set to on with at least one FD already on, the AP engages in the current active FD modes.
* AP engagement increases the break out force on the sidestick controllers and on the rudder pedals.

AP engagement is indicated by the lighting of the corresponding FCU pushbutton, and by the appearance of “AP1” (or 2) on the PFD’s Flight Mode Annunciator.

AP DISENGAGEMENT

AP1 or 2 disengages when :
- The pilot presses the takeover pushbutton on the sidestick.
- The pilot presses the corresponding AP pushbutton on the FCU.
- The pilot pushes on the sidestick harder than a certain threshold. (Disengagement
R through rudder pedals is only active on ground).
- The other AP is engaged, except when localizer/glideslope modes are armed or engaged, or rollout or go-around mode is engaged.
- Both thrust levers are set above the MCT detent and the aircraft is on ground.
- The aircraft reaches the MDA – 50 feet (MDH – 50 feet), or 400 feet AGL if no MDA/MDH, with APPR mode engaged and a non-ILS approach selected.
- One of the engagement conditions is lost.
  Furthermore, in normal law with all protections available, the AP will disconnect if :
  · High speed protection is active.
  · Angle-of-attack protection is active (α prot + 1° is reached).
  · Pitch attitude exceeds 25° up, or 13° down, or bank angle exceeds 45°.

The standard way for the flight crew to disengage the AP is to press the takeover pushbutton on the sidestick.
When AP is OFF, the associated FCU pushbutton goes off, and the “AP1” (or AP2) is removed from the PFD’s FMA.

AP WARNINGS

When the AP is disengaged, the system warns the pilot :
· If the pilot disengages it with the takeover pushbutton on the sidestick, the warnings are temporary.
· If the disengagement results from either a failure, from the pilot pushing the pushbutton on the FCU, or from a force on the sidestick, the visual and audio warnings are continual.

		AP DISENGAGEMENT	
		TAKE OVER PB on SIDESTICK	**BY OTHER MEANS**
CONSEQUENCE	MASTER WARNING	flashing red during 3 sec max	flashing red
CONSEQUENCE	ECAM	red AP OFF message 9 sec maximum	red warning AUTO FLT AP OFF
CONSEQUENCE	AUDIO	cavalry charge 0.5 sec min 1.5 sec maximum	continuous cavalry charge 1.5 sec minimum
CONSEQUENCE	CLR PB on ECAM CONTROL PANEL	extinguished	illuminated
ACTION	MASTER WARNING	extinguishes M.W erases ECAM warning stops audio if pressed within 1.5 sec	extinguishes M.W stops audio after 1.5 sec
ACTION	CLR PB on ECAM CONTROL PANEL	No effect	extinguishes CLR pb erases ECAM message calls status
ACTION	TAKE OVER PB	extinguishes M.W. erases ECAM warning stops audio if pressed within 1.5 sec.	extinguishes M.W. stops audio after 1.5 sec
ECAM STATUS MESSAGE		NO	YES

AUTOLAND WARNING

The autoland red warning flashes in LAND mode when :
— the radio altitude goes below 200 feet and :
  * The aircraft gets too far off the beam (LOC or GLIDE).
  * Or both autopilots fail.
  * Or both localizer transmitters or receivers fail.
  * Or both glide slope transmitters or receivers fail.
R * Or both radio altimeters differ from more than 15 feet.

SPEED/MACH CONTROL

In flight either the AP/FD pitch control or the autothrust may acquire and hold a target speed or Mach number, according to the engaged modes.
The speed control is :
- managed when the target comes from the FMGS
- selected when the target comes from the SPD/MACH FCU window.

MANAGED SPEED/MACH TARGET

When the speed target is managed, the SPD/MACH window of the FCU shows dashes, and the corresponding dot is lighted. The PFD speed scale shows the speed target in magenta.

ENGAGEMENT CONDITIONS

The SPD target is managed whenever AP or FD is engaged and one of the following occurs:
- The pilot pushes in the SPD/MACH selector knob.
- V2 is inserted in the MCDU.
- The speed reference system (SRS) is engaged (takeoff or go-around mode).

Note : At takeoff, SRS will not engage if V2 is not available.

DISENGAGEMENT CONDITIONS

Managed speed disengages any time the pilot selects a speed target on the FCU, or if the speed was preselected.

SPEED PROFILE

The form of the managed SPD profile depends on the lateral NAV mode.
- If NAV mode is engaged, the SPD profile takes into account all the constraints linked to the flight plan.
  The SPD profile is :
  V2 - SPD LIM - SPD CSTR (if applicable) - ECON CLB SPD/MACH - ECON CRZ MACH -
R ECON or selected DES MACH/SPD - SPD LIM - SPD CSTR (if applicable) - HOLD SPD (if applicable) - VAPP

– If NAV mode is not engaged, the SPD/MACH constraints are not considered.
The SPD profile is :
R V2 - SPD LIM - ECON CLB SPD/MACH - ECON CRZ MACH - ECON or selected DES MACH/SPD - SPD LIM - VAPP.

Note : – *When both AP/FDs are OFF, A/THR reverts to selected SPEED mode except, when the approach phase is activated on MCDU where both managed and selected SPD are available.*
– *The managed speed/Mach target may be set below maneuvring speed but as long as the speed target is managed, the FMGS limits the aircraft to the maneuvring speed of the current slats/flaps configuration (VAPP, F, S, Green Dot).*
– *If the managed speed/Mach target is set above VMAX (VFE, VMO, MMO) the FMGS automatically limits the speed to VMAX.*

MINI GROUND SPEED

In approach phase the managed speed target is the Mini Ground Speed target computed by the Flight Guidance (FG) part of the FMGS. Refer to 1.22.30 Autothrust for details.

SELECTED SPEED/MACH TARGET

To use a selected speed/Mach target, the pilot uses the knob on the FCU to set the target speed, which is then displayed in the FCU window. It is also displayed in blue on the PFD speed scale.

Note : The selected speed/Mach target may be set beyond VLS or VMAX, but when autothrust is active, the guidance limits the speed to VLS or VMAX.

Selected speed has priority over managed speed. The only automatic change-over from selected to managed speed target may occur at go-around mode engagement.
In flight, if the situation calls for managed speed, both the PFD and the MCDU display a message proposing a manual change to managed speed (for example, SET MANAGED SPEED, SET HOLD SPEED).

ENGAGEMENT CONDITIONS

The aircraft has a selected speed target under any one of the following conditions :
– The pilot pulls out the SPD/MACH selector knob (5 seconds after lift-off)
– Both AP/FDs are OFF (except in APPR phase)
– The FM speed target is lost except below 700 feet RA in takeoff, LAND or go around mode.
– The MCDU has a preselected speed for the next phase, and the aircraft transitions into that phase.
– The FMGC is powered up in flight.
– 5 seconds after lift off when a takeoff is initiated without managed or selected speed.

DISENGAGEMENT CONDITIONS

The selected speed target disengages when :
- the managed speed target engages
- on ground at AP or FD engagement
- on ground at engine start

Note : *It is not possible to activate selected speed mode on the ground with engines running and FD on until after takeoff.*

SELECTED DESCENT SPEED

R A manual speed or Mach may be inserted by the crew on the PERF DES page to replace the ECON DES SPD.
In this case, although the value is selected by the crew this speed or Mach is taken into account to compute the top of descent and the descent profile.

SPEED/MACH SWITCHING

- At the crossover altitude, the FMGC automatically changes the selected speed target to the corresponding MACH target.
  The FCU displays the Mach number corresponding to the speed at the switching altitude.

  Note : *when the speed is selected, the pilot can do the switching manually by pressing the SPEED/MACH pushbutton on the FCU. The FCU then displays the aircraft Mach number.*

- When the target speed is managed, the FMGC commands the switchover automatically as a function of the ECON MACH value.

MANAGED SPEED TARGET MEMORIZATION

A dual FM failure has different consequences when it occurs in different phases of the flight. The system handles target speed and SPD mode as follows :
- During approach with LOC and G/S engaged and radio altitude < 700 feet, the target speed is set to VAPP as previously memorized, and managed SPD target is maintained.
- At go around, the target speed becomes the memorized go around speed, which is the higher of VAPP or the speed when go around was initiated. Managed SPD target is maintained.
- In all other cases managed target speed reverts to selected, the value being the speed at the moment of the failure.

SPEED/MACH FCU WINDOW SYNCHRONIZATION

When the target SPD is managed, the SPD/MACH display of the FCU shows dashes. However, the window displays the target SPD or MACH in the following situations.

- The pilot turns the SPD/MACH selector knob.
  If the pilot does not pull the knob within 45 seconds after turning it, the selection reverts to dashes.
- The pilot manually engages a selected SPD target.
- If the flight crew has manually preselected a speed or Mach number for the next phase on the MCDU PERF page, that preselected SPD/MACH engages when the aircraft enters that phase and the FCU window then displays as the target the preselected speed or Mach.
- If the FMGS is powered up in flight, the synchronized speed/Mach value is the current aircraft speed or Mach number.
- If no V2 is entered at takeoff, the V/S mode engages 5 seconds after lift-off (no speed reference system). The FCU speed target is the speed at V/S mode engagement. (A/THR becomes active when the thrust levers are set in the active range).
- If both FMGCs fail, the speed displayed is the last aircraft speed acquired before the failure.

AP/FD MODES GENERAL

The FMGS has guidance parameters for both AP/FD lateral and vertical modes.

The AP/FD lateral modes are :

RWY, RWY TRK	Runway, Runway track mode
NAV	Nav mode
HDG, TRK	Heading, track mode. Also called basic modes.
APP NAV	Approach Nav mode
LOC*, LOC	Loc capture, Loc track mode
LOC B/C	Loc back course
• LAND	Land mode. Managed submode that includes LOC and G/S modes below 400 feet RA.
• FINAL APP	Final approach mode. Managed submode that includes APP NAV and FINAL modes during non precision approach.
ROLL OUT	Roll out mode. (Autoland)
GA TRK	Go around track mode

The AP/FD vertical modes are :

SRS	SRS mode used for takeoff and go around
CLB	Climb mode
DES	Descent mode
OP CLB	Open Climb mode
OP DES	Open Descent mode
R V/S or FPA	Vertical speed mode or Flight Path Angle mode. Also called
R	basic modes.
ALT*	Altitude capture,
ALT	Altitude Hold mode
ALT CST*	Altitude constraint capture,
ALT CST	Altitude constraint hold mode
ALT CRZ*	Altitude capture of the cruise flight level
ALT CRZ	Altitude hold of the cruise flight level
G/S*	Glide slope capture,
G/S	Glide slope mode.
FINAL	Final mode (non precision approach)
FLARE	Flare mode (Autoland)

AP/FD LATERAL MODES

HEADING OR TRACK : HDG - TRK

These modes guide the aircraft laterally along a heading or track selected by the flight crew.
The HDG/TRK window of the FCU displays the target heading or track.
The pilot uses the HDG V/S -TRK FPA pushbutton to select heading or track.

ENGAGEMENT CONDITIONS

HDG or TRK is engaged when one of the following conditions is met :
- The pilot pulls out the HDG-TRK selector knob (not sooner than five seconds after lift-off).
- NAV is disengaged, either by the loss of the lateral flight plan or by the pilot entering a flight plan discontinuity.
- FINAL mode (armed or engaged) is lost when the aircraft is in APP NAV mode.
- LOC or LOC* mode is lost.
- The pilot engages the AP/FD with no other mode already engaged (basic mode of AP/FD engagement).
- LOC mode is armed when FINAL APP was previously engaged.
- LOC or LOC* being armed or engaged, the APPR pushbutton is deactivated (above 400 feet).

DISENGAGEMENT CONDITIONS

The engagement of any other lateral mode disengages HDG or TRK.

SYNCHRONIZING THE HDG/TRK WINDOW OF THE FCU

The lateral window of the FCU displays a heading or a track value when :
- The HDG/TRK mode is engaged. The displayed value is the current HDG/TRK or the manually selected value of the target.
- The pilot turns the HDG/TRK selection knob. The value in the window first synchronizes with the current HDG/TRK, then displays the manual selection. It remains displayed for 45 seconds depending upon FCU standard, then vanishes if the pilot does not pull the knob (except in HDG preset).
- A HDG/TRK is preset (see below).
- AP/FD is lost. The value becomes that of the aircraft current heading or track.

<u>Note</u> : *If HDG is switched to TRK (or vice versa), the value displayed in the window switches from heading to track (or vice versa).*

HDG/TRK PRESET

The system has a HDG/TRK preset function for takeoff and go around.
If the pilot chooses not to fly the flight plan after takeoff or go around, he may preset a HDG or a TRK on the FCU by turning the HDG/TRK selector knob. The value he sets remains displayed in the FCU HDG/TRK window until the knob is pulled.

Operation at takeoff

HDG/TRK preset is available before takeoff and up to 30 feet RA. Turning the HDG/TRK selector knob before 30 feet sets the desired HDG/TRK. As a consequence:
– NAV is disarmed
– At 30 feet, RWY TRK is annunciated until the HDG/TRK knob is pulled.

Operation at go around

Whenever the LOC*, LOC, LAND, FINAL, or GA modes are engaged, the HDG preset is available. If the pilot rotates the HDG/TRK knob to set the value, it will remain displayed in the window. Pull out the HDG/TRK knob to activate the mode and turn the aircraft on to the preset value.

Cancellation

The pilot can cancel a preset HDG/TRK by :
· engaging the NAV mode (DIR TO)
· pushing in the HDG/TRK knob (arming NAV mode)
· disengaging AP/FD

NAVIGATION (NAV)

NAV mode is a managed mode that steers the aircraft laterally along the flight plan defined in the FMGS. It is designed to have a zero cross-track error. The pilot can arm or engage the NAV mode if the MCDU contains a lateral flight plan.

ARMING CONDITIONS

Satisfying one of the following conditions arms NAV :

- The aircraft is on the ground with no HDG/TRK preset and no other lateral mode except runway mode
- The pilot pushes in the HDG/TRK selector knob, unless the LOC mode is engaged.
- The pilot presses the APPR pushbutton, if a non-ILS approach is selected.
- The pilot selects a DIR TO/INTERCEPT when in HDG or TRK mode.

DISARMING CONDITIONS

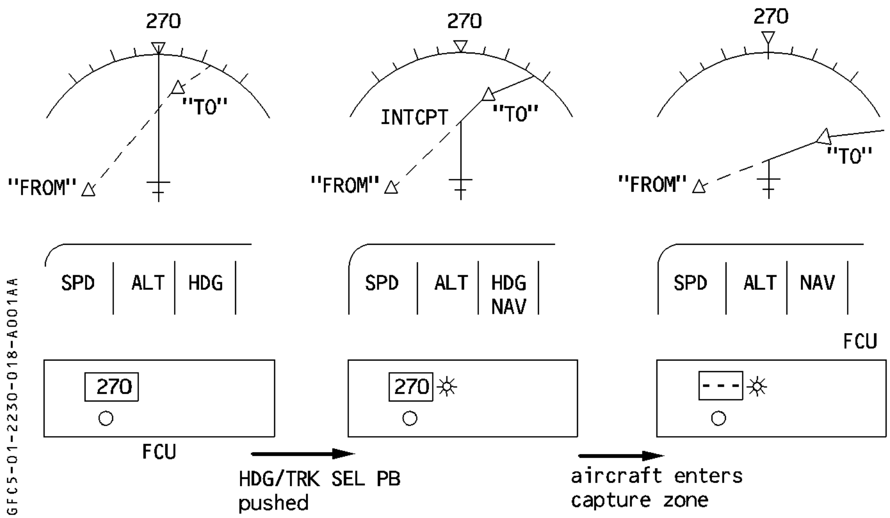
NAV mode disarms if one of the following occurs :

- The pilot pulls out the HDG/TRK selector knob.
- The pilot selects a preset HDG/TRK (TO or GA)
- The pilot arms the LOC mode by pressing the LOC pushbutton.
- The pilot selects GA mode.
- LAND mode has engaged.
- The pilot presses the APPR pushbutton to deselect the non-ILS approach.
- The pilot deselects both AP/FDs.

ENGAGEMENT CONDITIONS

NAV mode engages :

R – Automatically at 30 feet RA after takeoff (if armed on the ground).
- When the pilot orders "DIR TO" (except below 700 feet RA in LOC mode).
- When the pilot pushes in the HDG/TRK select knob when the aircraft is close to (within ~ 1 NM of) the active flight plan leg.
- Automatically in flight when NAV is armed and the aircraft reaches the capture zone for the active flight plan leg.



CAUTION

When NAV is armed, it will automatically engage if :
the aircraft track line intercepts the flight plan before the TO waypoint and the intercept waypoint (INTCPT) is displayed on the ND and the aircraft reaches the active flight plan leg.

Note : The TO waypoint is displayed in white on NDs and MCDUs.

DISENGAGEMENT CONDITIONS

The NAV mode disengages when :
- Any other lateral mode is engaged.
- The flight plan is lost or the aircraft enters a flight plan discontinuity.
- At MDA-50 feet when APP NAV is engaged.

INTERACTIONS WITH VERTICAL MODES

When NAV mode is engaged, the vertical managed modes CLB or DES or FINAL take into account altitude and speed constraints linked to waypoints on the lateral flight plan. If NAV mode is disengaged the vertical managed modes are not available and all downpath altitude and speed constraints are ignored.

LOCALIZER MODE THROUGH THE LOC PUSHBUTTON

This mode captures and tracks a localizer beam independently of the glide path beam. Pilots use it to fly localizer-only approaches or to initiate an ILS approach when intercepting the glide slope from above.

ARMING CONDITIONS

The pilot arms the LOC mode by pressing the LOC pushbutton, provided that :
- An ILS is tuned (frequency and runway course).
- The aircraft is above 400 feet RA.
- TO or GA mode is not engaged.

DISARMING CONDITIONS

LOC mode is disarmed by :
- Pressing the LOC pushbutton when LOC is armed.
- Arming the NAV mode.
- Engaging the GA mode.

Note : Engaging NAV mode by selecting DIR TO does not disarm the LOC mode.

ENGAGEMENT CONDITIONS

The LOC mode engages automatically when capture conditions are met.

DISENGAGEMENT CONDITIONS

The LOC mode disengages :
- When another lateral mode is engaged.
- When the pilot presses the LOC pushbutton again (engaging the HDG/TRK mode on the current HDG/TRK).

LOC BACK COURSE MODE (LOC B/C)

This mode captures and tracks the back beam of a LOC. This approach is considered as a non precision approach, and must be flown with AP/FD in TRK/FPA modes, A/THR being active.
See FMGS Pilot's Guide 4.05.70 for details. (FCOM Vol 4).

AP/FD VERTICAL MODES

Vertical modes guide the aircraft in the vertical plan.

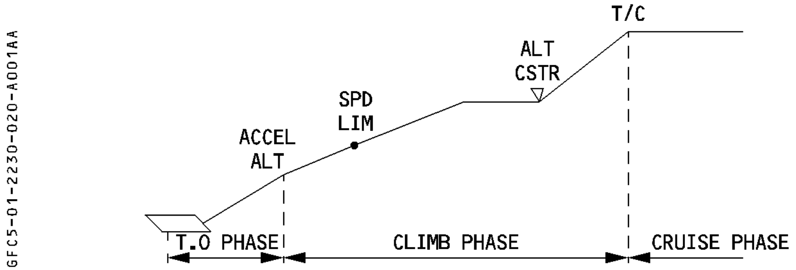
PRINCIPLES

To leave an FCU selected altitude for another target altitude, two things must happen : the pilot must turn the altitude (ALT) selector knob in order to display the new target altitude and either :
- pull out the ALT selector knob to engage the OPEN CLB/DES mode, or
- push in the ALT selector knob to engage the CLB/DES mode, or
- select a target vertical speed (V/S) and pull out the V/S FPA selector knob to engage V/S mode.

This arms ALT mode.

CLIMB MODE (CLB)

CLB mode guides the aircraft in a managed climb, at either a managed or a selected target speed, to an FCU selected altitude, taking into account altitude constraints at waypoints. The system also considers speed constraints if the target speed is managed.
The vertical flight path may include several segments :



The pilot can arm the CLB mode during the takeoff, go around, climb, and cruise phases and engage it during the climb and cruise phases.

ARMING CONDITIONS

The CLB mode is armed :
- on the ground or when SRS mode is engaged (TO or GA) if the following conditions are met :
  - No other vertical mode is engaged.
  - The ACCEL ALT (defined on the MCDU PERF TO or GA pages) is below the FCU selected altitude and the lowest altitude constraint.

- In flight, when the climb or go around phase is active, and the following conditions are met :
  - The lateral NAV mode is engaged, and
  - The FCU-selected altitude is above the aircraft's present altitude and the aircraft captures or flies an altitude constraint.

DISARMING CONDITIONS

The CLB mode is disarmed, if one of the following conditions is met :
- Another vertical mode is engaged.
- The FCU-selected altitude is lower than the present aircraft level.
- The FCU-selected altitude is set at the ALT CSTR, while ALT CSTR* or ALT CSTR mode is engaged.
- The aircraft transitions to DES or APPR phase.
- Arming requirements are no longer met.
R - Vertical flight path validity is lost, or NAV mode is lost with ALT CSTR* or ALT CSTR or
R ALT* or ALT mode engaged.

ENGAGEMENT CONDITIONS

The CLB mode can be engaged, if the following conditions are all met :
- The aircraft has been in flight for more than 5 seconds.
- The selected FCU level is above the present aircraft level.
R - The descent or approach, or go-around phase is not active.
- NAV mode is engaged.
- Glideslope (G/S) mode is not engaged.

CLB mode automatically engages when the aircraft reaches ACC ALT, or sequences a waypoint with an ALT CSTR while CLB mode is armed.
CLB mode manually engages when the pilot pushes in the ALT select knob, with the CLB mode not armed and an altitude constraint not effective.

Note : When CLB mode is engaged :
- *The V/S (FPA) window of the FCU shows dashes.*
- *The managed LVL/CH dot on the FCU lights up.*
- *The Flight Mode Annunciator displays "CLB" in Column 2.*

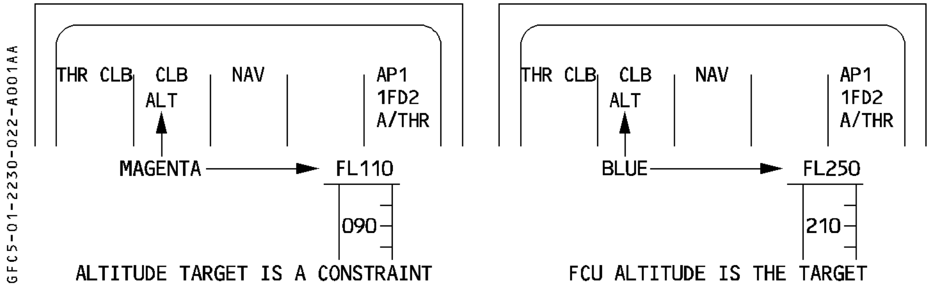
DISENGAGEMENT CONDITIONS

The CLB mode disengages, if one of the following conditions is met :
- NAV mode is lost or disengaged (OP CLB engages). If the aircraft was in CLB toward a constraint, the reversion to OP CLB is accompanied by a triple click aural warning.
- Another vertical mode engages.
- The pilot selects an altitude on the FCU that is lower than the present aircraft altitude. V/S (FPA) engages on current V/S (FPA).

GUIDANCE

Climb mode guides the aircraft up to the FCU selected altitude. It tries to respect speed and altitude constraints.
The AP/FD pitch controls the speed or Mach number target while the A/THR controls the thrust set at maximum climb thrust.
When climb mode is engaged :
The system arms ALT mode and displays the next applicable altitude target on the PFD altitude scale.

- ALT is magenta on the FMA second line and the altitude value is displayed in magenta on the PFD scale if the next altitude target is a constraint.



- ALT is blue on the FMA second line and the altitude value is displayed in blue on the PFD altitude scale if the next altitude target is the FCU selected altitude.
  In climb mode, the system does not modify the target speed to match the altitude constraints. The pilot has to select it manually using the information displayed on the PROG page.
  When the aircraft levels off at an altitude constraint, CLB mode arms. It will engage automatically when the waypoint is sequenced. (If the FCU selected altitude is above the constraint).

OPEN CLIMB

The OPEN CLB mode is a selected mode. It uses the AP/FD pitch mode to maintain a speed or a Mach (selected or managed) while the A/THR, if active, maintains maximum climb thrust.

ENGAGEMENT CONDITIONS

The OPEN CLB mode can only be engaged, if all of the following conditions are met :
- The aircraft is in flight for more than 5 seconds.
- The LAND mode is not engaged.
- The FCU-selected altitude is higher than the aircraft's present altitude.

The OPEN CLB mode is engaged, if one of the following conditions occurs :
- The pilot pulls out the ALT selector knob.
- The pilot pulls out the SPD/MACH selector knob, when TO or GA mode is engaged.
- Acceleration altitude is reached, with CLB armed, and NAV mode not engaged.
- NAV mode or vertical F-PLN is lost when CLB mode is engaged. If the aircraft was in CLB toward an altitude constraint, the reversion to OPEN CLB is accompanied by a triple R click aural warning.

R ALT mode is systematically armed when OPEN CLB engages.

DISENGAGEMENT CONDITIONS

The OPEN CLB mode is disengaged by one of the following conditions :
- Engagement of any other vertical mode.
- Selection of a lower altitude (on FCU) than the current aircraft altitude. V/S (FPA) engages on the current V/S (FPA) (See mode reversions).

GUIDANCE

When OPEN CLB is engaged, the target Speed/Mach is maintained by adjusting the pitch with the elevator, whereas thrust is maintained either by the A/THR or manually by the pilot. Speed may either be selected or managed.
The OPEN CLB mode disregards all altitude constraints up to the FCU-selected altitude.

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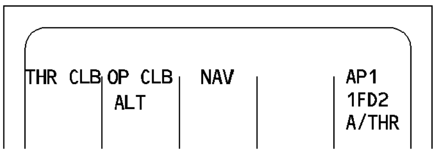
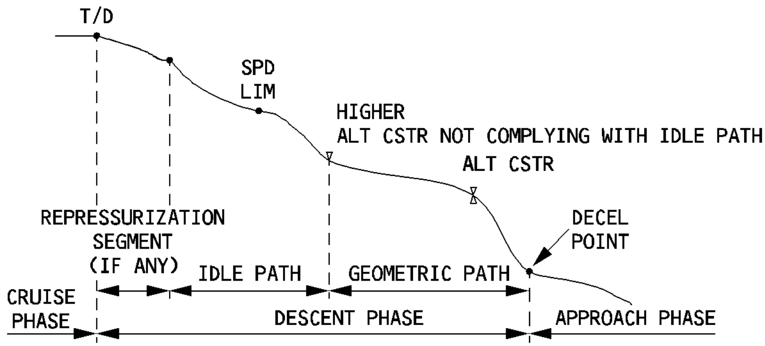


TYPICAL FMA IN OPEN CLB
THE LVL/CH LIGHT IS EXTINGUISHED ON THE FCU

Note : A level change of less than 1200 feet in OPEN CLB mode with A/THR active produces a 1000 ft/min climb.

DESCENT MODE (DES)

DES mode provides managed vertical guidance along a computed descent profile. The profile is computed from “Top of Descent” at the cruise flight level down to the “Decel” point, where guidance begins the deceleration to VAPP, to be reached at 1000 feet above touch down on the final descent path.
The descent profile takes into account wind data and data from the lateral and vertical flight plans, and it is based upon the managed descent speed profile. It does not take holding patterns into consideration.
The descent profile has several segments :
– A repressurization segment. When necessary, this produces a repressurization rate for the cabin during descent. It is a function of the destination airport altitude and the selected cabin rate (defaulted to – 350 feet/min but this can be modified).
– Idle path segment. The AP/FD controls the speed and autothrust stays at idle thrust. Guidance computes this profile from top of descent or the end of the repressurization segment to the first vertical constraint that cannot be flown at idle thrust.
– Geometric path segments. The AP/FD controls the vertical path, and autothrust controls the speed. These segments take the aircraft from the first constraint to the deceleration point.



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The descent mode is a managed mode that may be engaged during cruise. It can be armed or engaged in descent and approach phases (unless the FCU selected altitude is higher than the present aircraft altitude).

ARMING CONDITIONS

R The DES mode is armed when an ALT CSTR is captured and the following conditions are
R met :
R – The FCU-selected altitude is lower thant the aircraft current altitude
R – NAV mode or LOC* or LOC mode is engaged.
R – Flight profile is available
R – Takeoff or climb or go-around phase is not active.

DISARMING CONDITIONS

The DES mode is disarmed, if one of the following conditions is met :
- Engagement of another vertical mode.
- FCU-selected altitude is set above the aircraft's current altitude.
- Loss of NAV, LOC*, or LOC mode.
- Switching to the takeoff, climb, or go-around phase.
- Loss of vertical flight path validity.

ENGAGEMENT CONDITIONS

The DES mode can be engaged, when the following conditions are met :
- The FCU-selected altitude is lower than the present altitude.
- NAV, LOC*, or LOC is engaged.
- Takeoff, climb, or go-around phase is not active.
- Vertical flight path is valid.
- TO, CLB, G/S, LAND, FINAL or GA mode is not engaged, and :
  - The aircraft sequences a waypoint, with an ALT CSTR, and DES mode is armed. The DES mode engages automatically, or
  - The pilot presses the ALT selector knob when ALT CSTR* or ALT CSTR mode is not engaged, or
  - The pilot presses the ALT selector knob, ALT* or ALT is engaged and the current aircraft altitude is not an effective altitude constraint of the F-PLN.

Note : When DES mode is engaged :
- *The V/S (FPA) window of FCU shows dashes.*
- *The managed LVL/CH dot on the FCU lights up.*

DISENGAGEMENT CONDITIONS

The DES mode is disengaged, if one of the following conditions is met :
- R NAV mode is disengaged and V/S (FPA) engages. (See reversions). A triple click aural
R warning will sound. (Refer to 1.22.30, mode reversion).
- Another vertical mode engages.
- The pilot selects an altitude on the FCU that is higher than the aircraft's present altitude,
R and the V/S (FPA) engages on the current V/S (FPA). A triple click aural warning will
R sound. (Refer to 1.22.30 mode reversion).
- NAV mode is lost due to a discontinuity in the descent profile. AP/FD reverts to basic
R mode, and a triple click aural warning sounds.

GUIDANCE

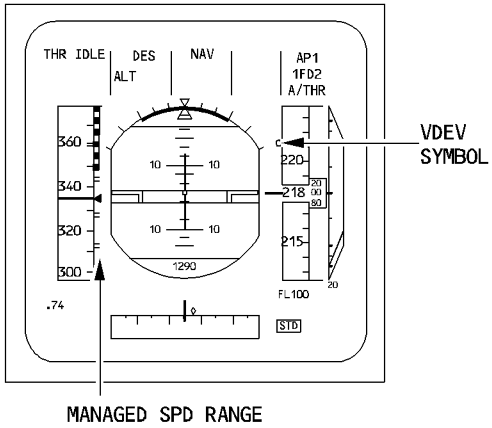
Descent initiation

In order to initiate the descent, the pilot :
- Turns the ALT selector knob to set the cleared altitude.
- Pushes in the ALT selector knob.
  - If the aircraft has not reached top of descent (T/D), it will descend immediately at a constant V/S, converging on the descent profile.
  - If the aircraft is at or beyond T/D, it descends immediately at idle thrust.

During the descent :

The pilot sees a vertical deviation symbol (VDEV) along the ALT scale on the PFD and on the PROG page, so as to monitor the aircraft vertical position on the calculated descent profile.
The aircraft may deviate from the DES path while DES mode is engaged if :
- unexpected wind conditions is encountered or,
- anti-icing is turned on or,
- lateral flight plan is modified.

R



PFD display in managed DES mode.

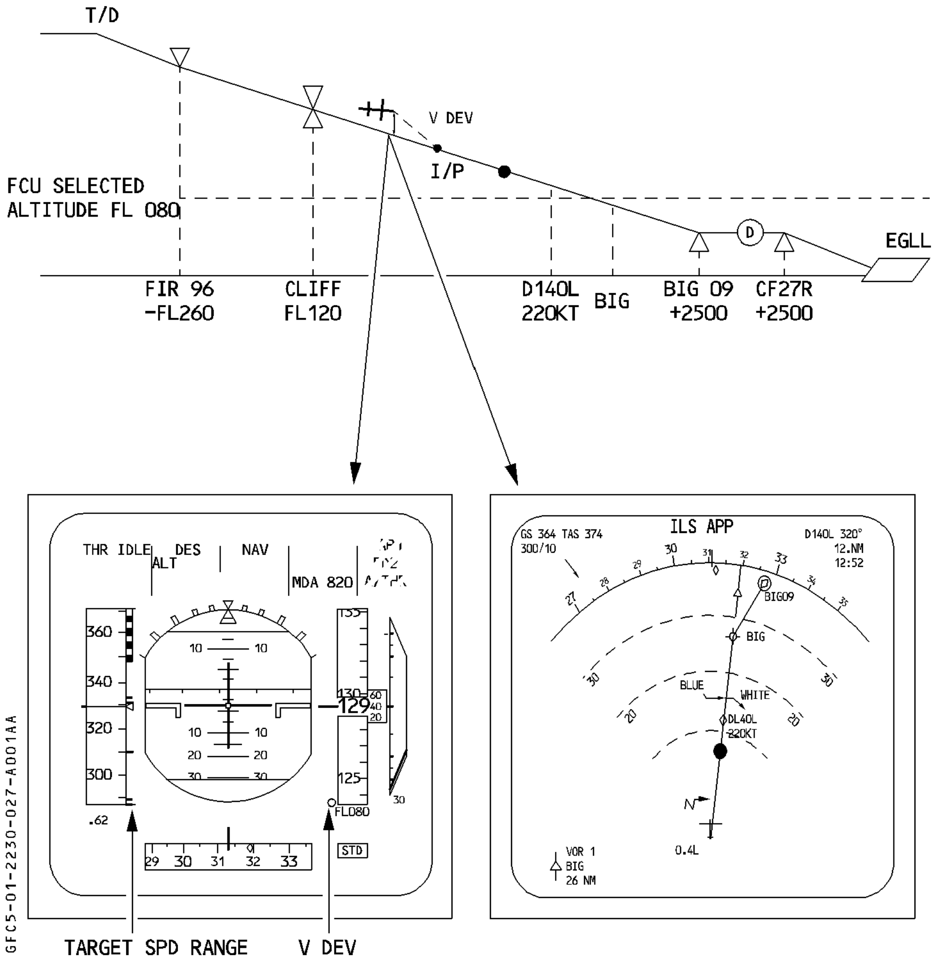
VDEV value on the PROG page

GFC5-01-2230-026-A001AA

When the speed is managed, a managed SPD range shows, on the PFD, acceptable speed variations around the nominal descent speed target (limited to ± 20 knots).

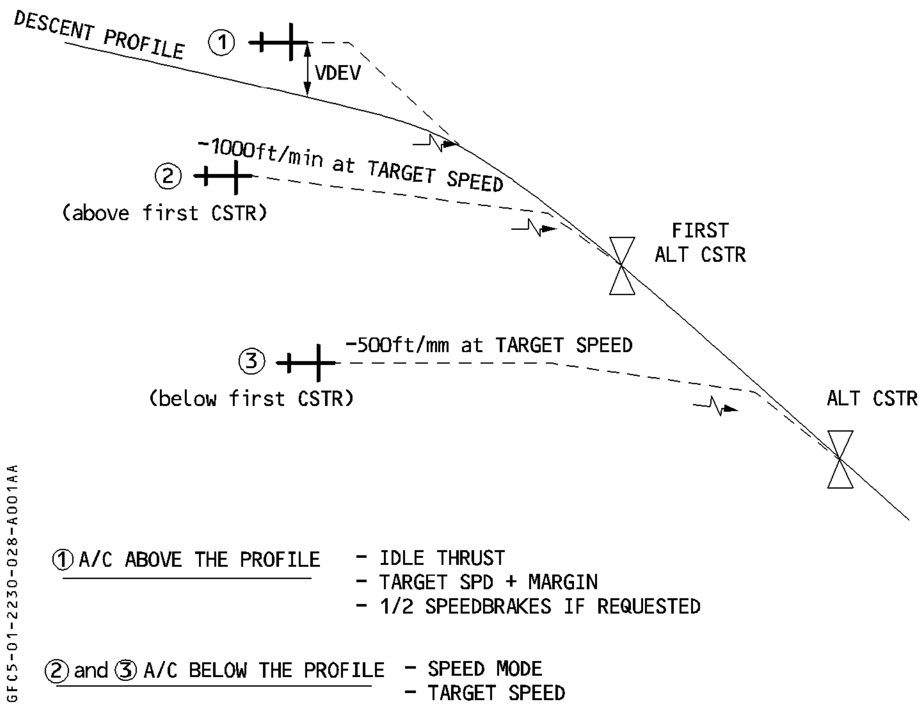
Associated with the V DEV displayed on PFD, the ND shows an intercept point ∿→ on the flight plan. It indicates the position where the system predicts that the aircraft will intercept the descent profile.

R



– **Aircraft above the descent profile :**
If the aircraft is above the descent profile, the speed will increase toward the upper limit of the managed speed range. If the speed reaches the upper limit, the aircraft will maintain the speed but will deviate from the profile (autothrust at idle).
The navigation display presents a pseudo waypoint (intercept point) along the flight plan, that assumes the aircraft will return to the profile using :
· idle thrust
· 1/2 speedbrake extension
· ECON speed plus a margin (until intercepting the profile).
Whenever the intercept point is predicted to be close to a constrained waypoint, the PFD and MCDU display an “EXTEND SPD BRK” message.

Note : With DES mode engaged, the speedbrakes extension will not necessarily increase the descent rate. It increases only if the aircraft is above path.



– **Aircraft below DES profile**

If the aircraft is below the DES profile, its speed will be maintained at target speed until it reaches the descent profile.

The intercept point on the navigation display is based on the following assumptions :

- if the aircraft is flying an idle segment :
  The FMGS maintains V/S = – 1000 ft/min and target speed, until it reaches the constraint altitude or intercepts the profile.
- if the aircraft is flying a geometric segment :
  The FMGS maintains a constant – 500 ft/min until it intercepts either the altitude constraint or the profile.

– **Leveling off at a constraint**

- If the aircraft levels off at an ALT CSTR, the DES mode arms and remains armed until the aircraft passes the constraint, then reengages (if the FCU altitude is set below the altitude of the constraint).
- if the FCU selected altitude is that of a constraint, the pilot may continue the descent below that altitude by turning the ALT SEL knob and pushing it in. This arms the DES mode, which reengages when the aircraft passes the constraint waypoint.

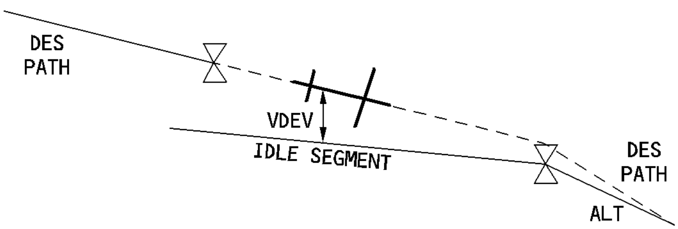
– **Guidance in a hold :**

Just before the aircraft enters a holding pattern, the speed target becomes the holding speed. In the holding pattern, the DES mode commands V/S = – 1000 ft/min while autothrust maintains the holding speed. The aircraft will level off at the next altitude constraint if it is reached during the hold.

The vertical deviation (VDEV) is based on the altitude at which the aircraft is supposed to cross the exit fix in order to be properly positioned on the descent profile.

– **Too steep path :**

A segment between two constraints is called “too steep path” when Flight Management predicts that it is impossible to fly it at the preplanned speed with 1/2 speedbrakes extended. The MCDU displays TOO STEEP PATH and FM does not furnish predictions for the waypoints included in the TOO STEEP PATH segment. When the aircraft reaches the beginning of the too steep path segment, the FM recomputes the VDEV using an idle segment from the end of the too steep path segment.



GFC5-01-2230-029-A001AA

– **FMA display**

When DES mode is engaged, the system arms ALT and displays the applicable target altitude on the PFD altitude scale.

· If the next predicted level-off is an altitude constraint, ALT is magenta on the FMA second line and the PFD displays the altitude constraint magenta below the altitude scale.
  When ALT CSTR (green) is engaged (aircraft flying at ALT CSTR), the system arms DES blue. When the aircraft meets the constraint, DES engages again automatically.

· If the next predicted level-off is the FCU altitude, ALT is blue on the FMA and the PFD displays the FCU selected altitude in blue.

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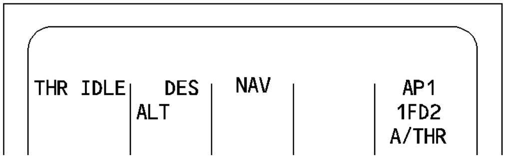

Typical FMA in DES

OPEN DESCENT MODE (OP DES)

The OPEN DESCENT mode is a selected mode. It maintains a SPD/MACH (selected or managed) with the AP/FD pitch mode, while autothrust (if active) maintains IDLE thrust. It is not to be used for final approach.

ENGAGEMENT CONDITIONS

The OPEN DES mode can only be engaged, if the following conditions are met :
- The aircraft has been in flight for more than five seconds,
- LAND mode is not engaged.
- The FCU-selected altitude is lower than the present altitude.

The OPEN DES mode is engaged by :
- Pulling out the ALT selection knob.

Note : When OP DES is engaged :
- *The FMA displays "OP DES".*
- *The managed LVL/CH dot on the FCU goes out.*
- *The system arms the ALT mode.*

DISENGAGEMENT CONDITIONS

The OPEN DES mode is disengaged by one of the following :
- Manual engagement of another vertical mode.
- Selection of an altitude higher than the present altitude. V/S (FPA) engages on the current V/S (FPA). If within 5 seconds after reversion to V/S, the pilot does not confirm the altitude target change by another expected action, a triple click aural warning sounds, and the V/S (FPA) is boxed white and flashes for 10 seconds.

GUIDANCE

When OPEN DES is engaged, pitch control maintains the target speed/ Mach number, and autothrust maintains idle thrust (or the pilot maintains it manually).
The speed target may be either selected or managed.
The OPEN DES disregards all altitude constraints.

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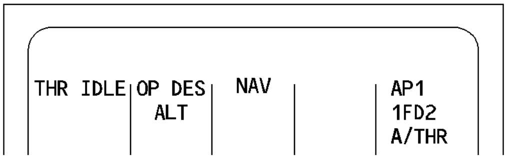


Typical FMA in OPEN DES

ALTITUDE ACQUIRE MODE (ALT*, ALT CSTR*, ALT CRZ*)

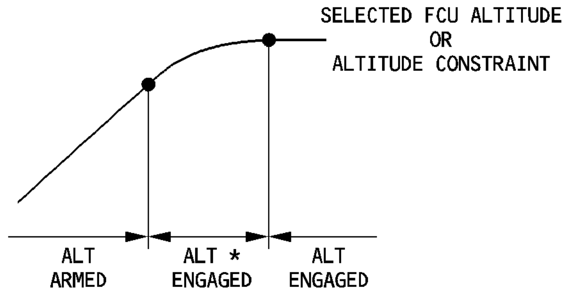
ALT* mode guides the aircraft to acquire the FCU selected altitude.
ALT CSTR* guides the aircraft to acquire an altitude constraint provided by Flight Management.
ALT CRZ* guides the aircraft to acquire the cruise altitude as selected on the FCU and the MCDU PROG page.
Once the aircraft has reached the altitude, the altitude mode ALT or ALT CSTR or ALT CRZ engages.

ARMING CONDITIONS

ALT* or ALT CSTR* or ALT CRZ* can be internally armed but the pilot does not see any display of it.

ENGAGEMENT CONDITIONS

The mode engages when the aircraft reaches the altitude capture zone defined by the aircraft vertical speed (among other parameters).



GFC5-01-2230-032-A100AA

Note : ALT and ALT CSTR* cannot be engaged below 400 feet if either the takeoff or the go around mode is engaged.*

DISENGAGEMENT CONDITIONS

- Engagement of V/S mode on current vertical speed by changing the FCU altitude selector knob by more than 250 feet.
  If within 5 seconds after the reversion to V/S (or FPA) the pilot does not confirm the altitude target change by
  - pulling the ALT knob, or
  - setting a new V/S (or FPA) target, or
  - pushing the ALT pushbutton on the FCU,

  a triple click sounds, and the V/S (or FPA) is boxed white for 10 additional seconds.
- Engagement of another vertical mode provided the FCU altitude has been changed by more than 250 feet.

GUIDANCE

The ALT* mode has internal V/S guidance that is a direct function of the difference between present altitude and the altitude target.
The system switches automatically to ALT (altitude hold) when the altitude deviation becomes less than 40 feet.

<u>Note</u> : – *If the baro setting is changed during ALT*, this may lead to an FCU target overshoot due to the change of the current value of the altitude. However ALT* mode will allow the FCU altitude to be regained.*
– *For aircraft equipped with QFE option, a switching from STD to QFE (or vice versa) in ALT CSTR*, will change the target value and a reversion to V/S may occur if the target value is modified of 250 feet or more.*

ALT* and ALT CSTR* modes have internal speed protections that decreases the vertical speed when VLS or Vmax is reached. (VLS or Vmax becomes the priority target).

ALTITUDE HOLD MODE (ALT/ALT CST/ALT CRZ)

The ALT mode maintains a target altitude. This target altitude is either the FCU selected altitude (ALT, ALT CRZ) or an altitude constraint delivered by the Flight Management (ALT CSTR).

ARMING CONDITIONS

The ALT mode arms automatically whenever the aircraft climbs or descends toward the target altitude.
When ALT is armed, the FMA displays the ALT message on its second line :
- blue when the target altitude is the FCU selected altitude
- magenta if the target altitude is an altitude constraint.

ENGAGEMENT CONDITIONS

ALT mode engages when :
- the difference between present altitude and target altitude becomes less than 40 feet with ALT* engaged.
- or when the ALT pushbutton of the FCU is pressed.

DISENGAGEMENT CONDITIONS

The ALT mode disengages when any other vertical mode engages.
The ALT pushbutton cannot be used to disengage ALT mode.

GUIDANCE

- The altitude that ALT mode holds is the altitude it memorized when engaged. It is not affected by a change of barometric reference or by a change in the barometric correction.
- When ALT is engaged, the FMA displays “ALT” in green if it is the FCU altitude or ALT CSTR in green if it is an altitude constraint.
- If the AP is engaged while FD is already engaged in ALT mode at the FCU-selected altitude, the autopilot :
  · acquires and holds the FCU altitude if present altitude is within 250 feet of it, or
  · commands a level-off if present altitude is more than 250 feet from the FCU altitude.

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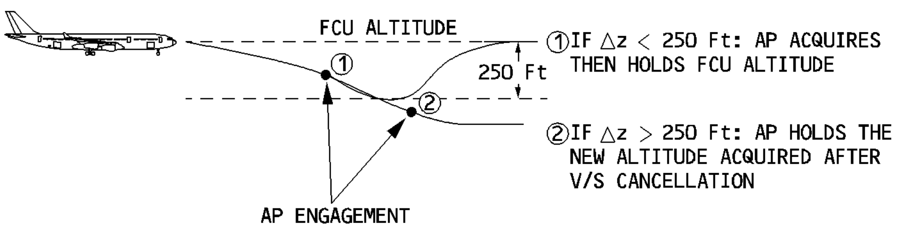
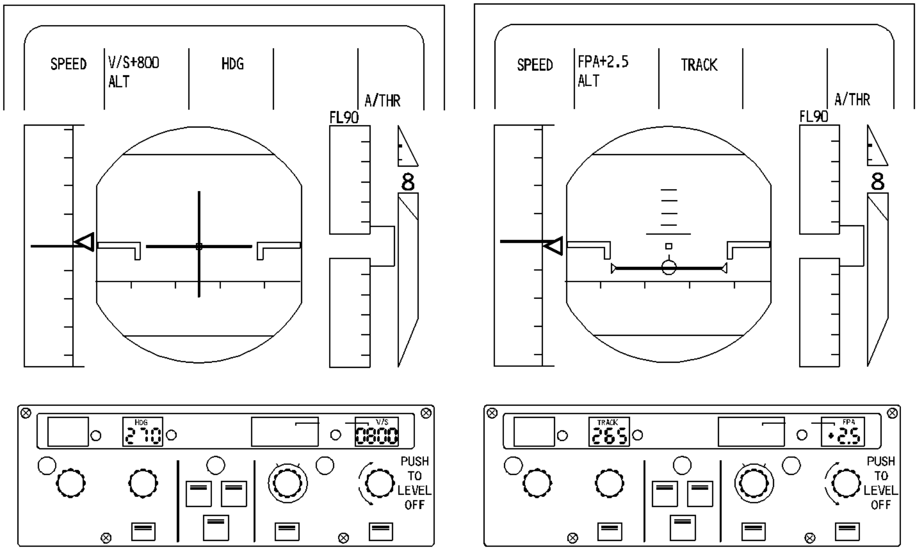


R VERTICAL SPEED MODE — FLIGHT PATH ANGLE MODE (V/S - FPA)

The V/S - FPA is a selected mode. It acquires and holds the vertical speed or the flight path angle displayed in the V/S - FPA window of the FCU.
The HDG V/S TRK FPA pushbutton on the FCU allows the pilot to select either type of reference to be used for guidance and for display on the PFD.

R



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ENGAGEMENT CONDITIONS

The pilot can engage the mode manually as follows :
- Pull out the V/S FPA selection knob (at least five seconds after lift-off) or push it in for an immediate level-off (V/S = 0).
- Engage the AP and/or FD if AP and FD were not engaged (basic mode of AP/FD engagement).
- Select a different altitude (more than 250 feet from present altitude) when in ALT*.
- Select a higher altitude than present altitude when in DES, OP DES mode.
- Select a lower altitude than present altitude when in CLB, OP CLB mode.

The mode engages automatically :
- five seconds after lift-off, if no other vertical mode is engaged
- upon loss of G/S* or G/S mode
- upon loss of FINAL mode
- upon loss of LOC* or LOC mode
- upon loss of NAV mode when DES mode is engaged
- upon loss of vertical flight path in DES mode

DISENGAGEMENT CONDITIONS

The pilot can disengage the V/S mode manually by :
– pulling or pushing the altitude selector knob
– initiating a go around.
It disengages automatically :
– when the aircraft reaches the FCU altitude or
– upon G/S* engagement.

GUIDANCE

The FMGC pitch mode guides the aircraft to the target V/S or FPA. The corresponding A/THR mode is SPEED or MACH. The FMA displays "V/S (FPA)".
The V/S (FPA) guidance has priority over the speed guidance. If the selected target V/S or FPA is too high (relative to the current thrust condition and speed), the FMGC will steer the aircraft to the target V/S or FPA, but the aircraft will also accelerate or decelerate. When the speed reaches the authorized limit, the V/S or FPA decreases automatically to maintain the minimum (or maximum) speed limit. (Also refer to reversion modes).

MODE REVERSIONS AND AUTOMATIC SPEED MODE PROTECTION

There are several types of mode reversions. Each one observes a specific logic that can be described as follows :

INTERACTION BETWEEN LATERAL MODES, VERTICAL MODES, AND MANAGED SPEED PROFILE

· **When NAV mode is engaged :**
The FMGS guides the aircraft along the flight plan and considers the constraints attached to the F-PLN waypoints. As a result, managed CLB and DES modes are available.

· **When NAV mode is not engaged :**
The FMGS considers that the flight plan is not followed, and ignores all speed and altitude contraints linked to the flight plan waypoints. As a result, the managed vertical CLB and DES modes are not available. The managed SPD profile disregards the speed constraints.

As a consequence : When NAV mode disengages (manual or automatic)

— CLB mode, when engaged, reverts to OPEN CLB.
— DES mode, when engaged, reverts to V/S mode on current value.
— Speed and altitude constraints are disregarded (but speed limit is retained).
When OPEN CLB or V/S engages following the reversion, the lateral mode is boxed white for 10 seconds. The vertical mode is boxed white.
If disengagement of the NAV mode is not confirmed by one of the following actions within 5 seconds :
· New FCU altitude target
· Level-off
· V/S selection
Then a triple click aural warning sounds. The white box flashes around the vertical mode for 10 additional seconds.

MODE REVERSION DUE TO FCU ALTITUDE CHANGE

1. When an OPEN mode is engaged, the aircraft climbs or descends towards the altitude set on the FCU. If the pilot sets the FCU altitude to a target not compatible with the active open mode, a mode reversion occurs and V/S (or FPA) engages on current V/S (or FPA). This reversion applies to CLB, OP CLB, DES, OP DES.
   e.g. : Reversion from OP CLB to V/S

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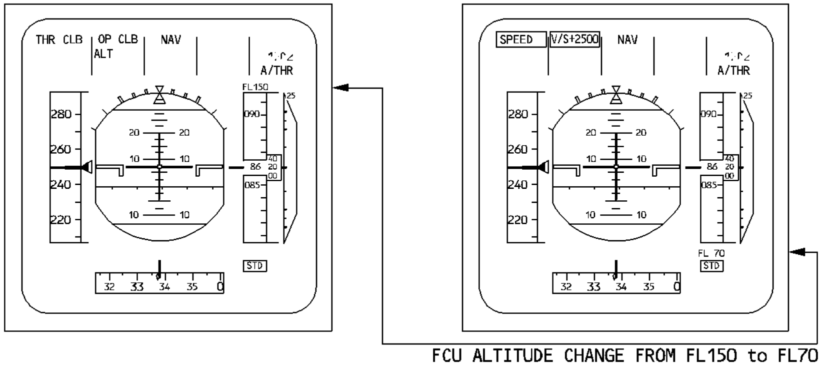

2. If ALT* being engaged, the target altitude is changed of any value greater than 250 feet, V/S (or FPA) engages on current V/S (or FPA).
   Also Refer to mode reversion table.

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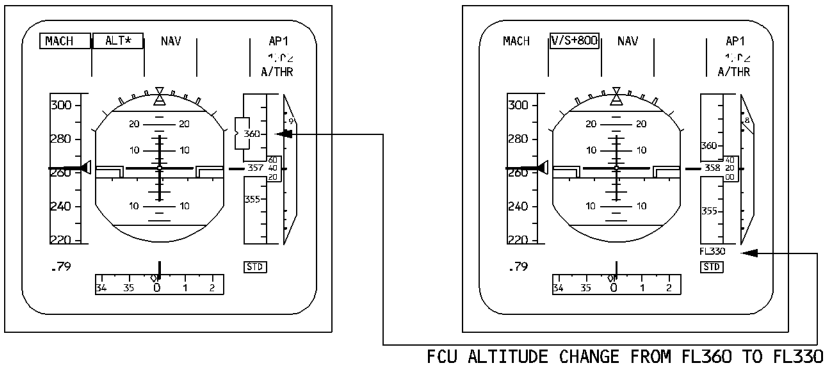


If within 5 seconds after the reversion to V/S (or FPA) the pilot does not confirm the altitude target change by
- pulling the ALT knob, or
- setting a new V/S (or FPA) target, or
- pushing the ALT pushbutton on the FCU,

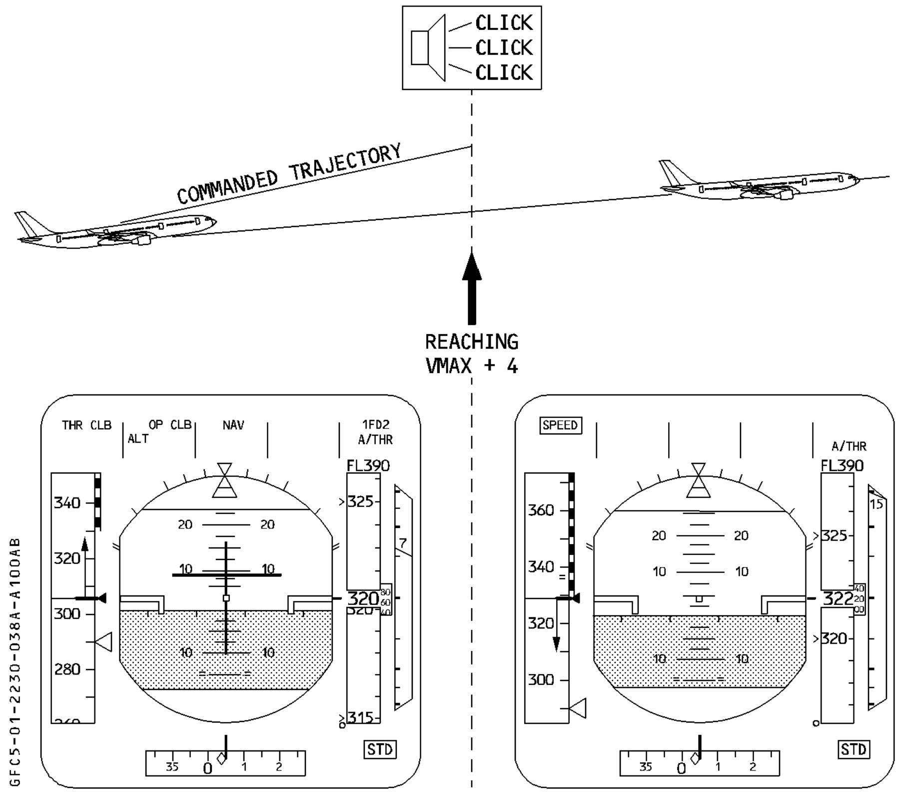
a triple click sounds, and the V/S (or FPA) is boxed white for 10 additional seconds.

AUTOMATIC SPEED MODE PROTECTION

FDs are engaged in an OPEN mode in climb with AP not engaged

If FDs are engaged in CLIMB, or OPEN CLIMB mode, and the pilot does not follow the FD bars to maintain the commanded climb (pitch too low and autothrust in maximum climb thrust), the aircraft accelerates.

Both FDs disengage when VMAX+4 is reached (VMAX being VMO, VLE or VFE). If the A/THR is active, it reverts to SPEED mode and reduces the thrust to recover the speed
R target. A triple click aural warning sounds.



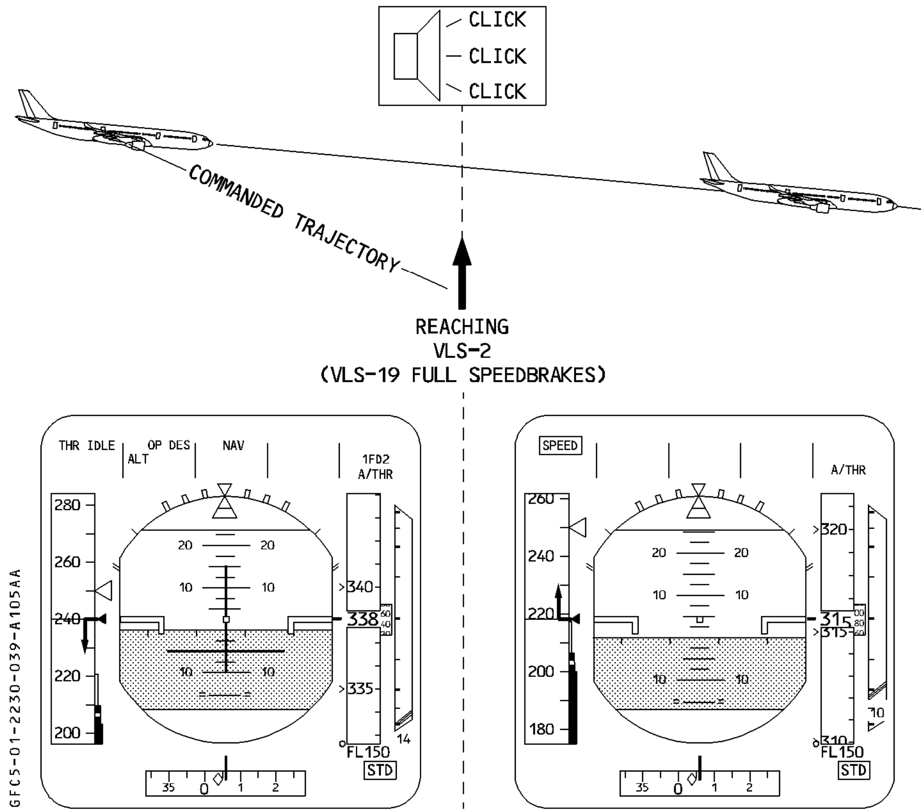
AUTOMATIC SPEED MODE PROTECTION

FDs are engaged in an OPEN mode, in descent with the AP not engaged

If the FDs are engaged in DES or OP DES mode and, if the pilot does not follow the FD bars to maintain the commanded pitch, the aircraft decelerates (insufficient descent rate and idle thrust).

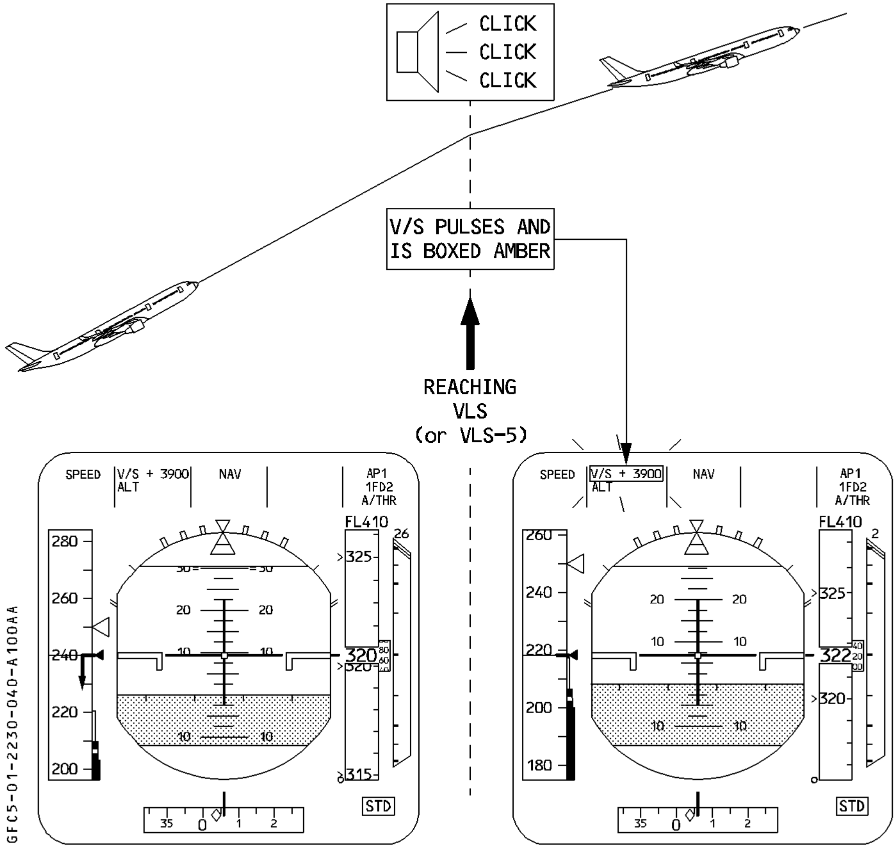
If the airspeed reaches VLS-2, both FDs disengage. (If speedbrakes are extended, the FDs disengage between VLS-2 and VLS-19, depending on the position of the speedbrakes.)

The A/THR, if active, reverts to SPEED mode upon FD bars disengagement, and increases thrust to recover the speed target. A triple-click aural warning sounds.



AUTOMATIC SPEED PROTECTION IN V/S (or FPA) MODE

R **In climb**
R When climbing with V/S mode engaged : If the selected V/S value is excessive (with
R regards to thrust and speed), the FMGS maintains the V/S target, but the airspeed
R decreases. When reaching VLS (or VLS - 5, if the speed target is VLS), the AP temporarily
R abandons the V/S target, and automatically decreases the vertical speed to maintain VLS.
R The same applies, if FPA mode is used with an excessive FPA target.
R



R V/S mode remains engaged.
R On the FMA, the V/S target is boxed with a flashing amber rectangle, and the V/S value
R pulses. Besides, an aural triple click is generated.

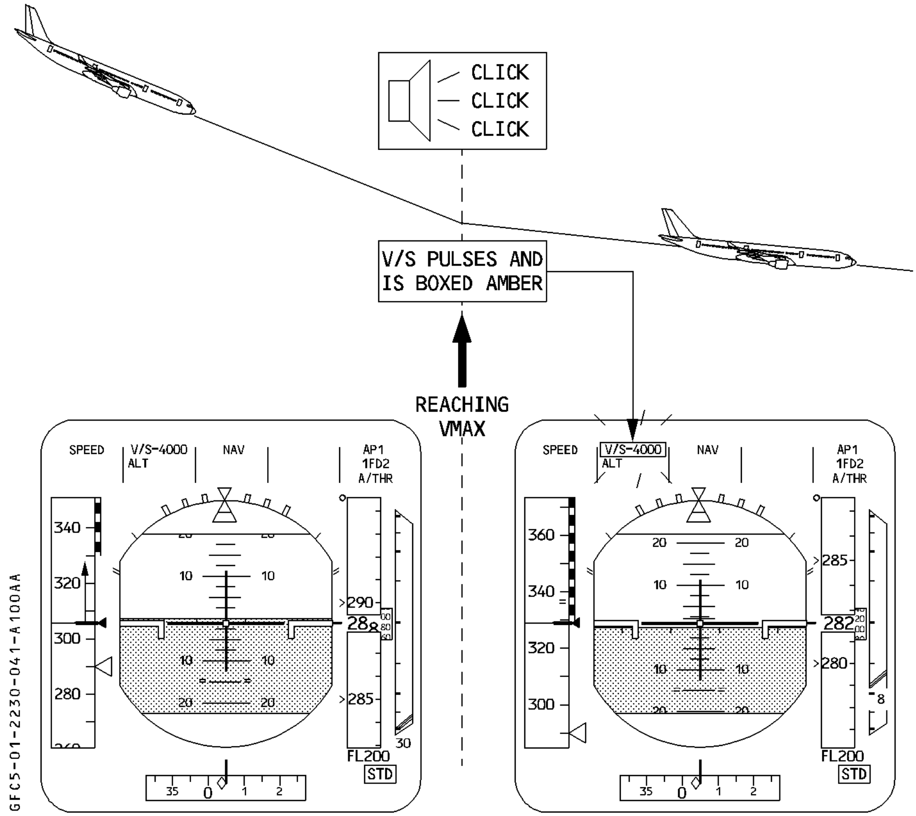
R *Note : When flying with FD bars only (AP OFF), the FMGS adjusts the pitch bar so that VLS*
R *is maintained. However, no triple click is generated and the V/S target display on*
R *the FMA remains unchanged.*

AUTOMATIC SPEED PROTECTION IN V/S (or FPA) MODE

In descent

When descending with V/S mode engaged : If the selected V/S value is excessive (with regards to thrust and speed), the FMGS maintains the V/S target, but the airspeed increases. When reaching VMAX (VMO or VLE in clean, or VFE + 4 knots), the AP temporarily abandons the V/S target, and automatically decreases the vertical speed to maintain VMAX.

The same applies, if FPA mode is used with an excessive FPA target.



V/S mode remains engaged.

On the FMA, the V/S target is boxed with a flashing amber rectangle, and the V/S value pulses. Besides, an aural triple click is generated.

Note : When flying with FD bars only (AP OFF), the FMGS adjusts the pitch bar so that VMAX is maintained. However, no triple click is generated and the V/S target display on the FMA remains unchanged.

MODE REVERSIONS

Reversion due to FCU ALTITUDE changes

CONDITIONS	ACTION	CONSEQUENCE
OP CLB engaged CLB engaged	FCU-selected ALT set below a/c altitude	V/S–FPA engages on current V/S–FPA
OP DES engaged DES engaged	FCU-selected ALT set above a/c altitude	
ALT* active	FCU-selected ALT modification (greater than 250 ft)	

Reversion due to the loss of NAV mode

CONDITIONS	EVENT	CONSEQUENCE
CLB engaged	Loss of the lateral managed mode: NAV	OP CLB engages
DES engaged		V/S engages

R
SPEED PROTECTION, when FD orders are not followed by the crew (AP NOT engaged)

R

CONDITIONS	EVENT	CONSEQUENCE
· FD engaged only (no AP) and · OP DES or DES engaged · A/THR active (IDLE thrust)	IAS = VLS – 2 (if speedbrakes are extended between VLS-2 and VLS-19)	FD bars disappear. If A/THR active, automatic engagement of SPEED mode on the A/THR. Thrust increases, and the speed is regained.
· FD engaged only (no AP) and · OP CLB or CLB engaged · A/THR active (CLIMB thrust)	IAS = VMAX + 4 VMAX = VFE or VLE or VMO/MMO	FD bars disappear. If A/THR active, automatic engagement of SPEED mode on the A/THR. Thrust increases, and the speed is regained.

R
SPEED PROTECTION due to excessive V/S

R

CONDITIONS	EVENT	CONSEQUENCE
· Excessive V/S or FPA selected in climb	IAS = VLS (or VLS-5, if target = VLS))	The selected V/S (or FPA) target is temporarily abandoned to maintain VLS in climb or VMAX in descent.
· Excessive V/S or FPA selected in descent, and · Clean configuration	IAS = VMAX	
· Excessive V/S or FPA < 0 selected in descent and · Configuration other than clean	IAS = VMAX	

Enhanced mode reversion alertness

The following sequences or mode reversions are highlighted by a triple click :

· V/S selection in ALT*
· SPD selection in SRS
· CLB to OP CLB upon lateral crew action while climbing toward a constraint
· ALT* to V/S when upon ALT target change
· FD disengagement in OPEN modes
· Alerting FMA display when V/S-FPA target is not held
· CLB to OP CLB reversion upon profile loss
· Automatic FD reengagement in basic mode
· DES to V/S upon flight plan loss or upon no lateral crew action
· FINAL DES to V/S upon NAV loss
· Reversion to V/S when selected ALT crosses the current altitude
· Automatic FD reengagement in basic lateral mode
· NAV to HDG upon NAV loss

AP/FD COMMON MODES

GENERAL

These modes are called "common" because they are related to both the lateral and the vertical axes.
The AP/FD common modes are :
– On takeoff : Runway/Runway track associated to SRS vertical modes.
– In approach : ILS approach (LAND) or non-ILS approach (FINAL APP).
– In Go-around : Go-Around Track associated to SRS vertical modes.
These modes are engaged simultaneously on both axes.

<table>
<tr><th colspan="2">COMMON MODES</th><th>VERTICAL</th><th>LATERAL</th></tr>
<tr><td colspan="2">TAKEOFF</td><td>SRS</td><td>RWY
RWY TRK</td></tr>
<tr><td rowspan="3">APPROACH MODES</td><td rowspan="2">ILS APPROACH</td><td>G/S*
G/S</td><td>LOC*
LOC</td></tr>
<tr><td colspan="2">LAND, FLARE,
ROLL OUT</td></tr>
<tr><td>NON ILS APPROACH</td><td>FINAL</td><td>APP NAV</td></tr>
<tr><td colspan="2">GO AROUND
(GA)</td><td>SRS</td><td>GA TRK</td></tr>
</table>

TAKEOFF

Takeoff mode combines the SRS (Speed Reference System) vertical mode with the RWY lateral mode.
Both are simultaneously engaged, but may be disengaged separately.
Takeoff mode is available :
– During the takeoff run and initial climb for FD bars guidance.
– Five seconds after lift-off for AP use.

SRS (SPEED REFERENCE SYSTEM)

The SRS mode controls pitch to steer the aircraft along a path in the vertical plane at a speed defined by the SRS guidance law.

– **Engagement conditions**

The SRS mode automatically engages when the thrust levers are set to the TOGA or FLX/MCT detent, or a derated level (⊲), providing :

· V2 has been inserted in the MCDU PERF TO page. If V2 has not been inserted, V/S mode engages 5 seconds after lift off on the current V/S value.

· The slats are extended.

· The aircraft has been on the ground for at least 30 seconds.

– **Disengagement conditions**

The SRS mode disengages :

R · Automatically, at the acceleration altitude (ACC ALT), or if ALT* or ALT CST* mode engages (above 400 feet RA).

R · If the crew engages another vertical mode.

R · If the crew selects a speed while in SRS mode : SRS reverts to OP CLB mode, and a triple click aural warning is heard.

R *Note : In Engine Out conditions, the SRS mode does not automatically disengage at EO ACC ALT. Refer to Engine Out procedures.*

– **Guidance**

In SRS mode, the aircraft maintains a speed target equal to V2 + 10 knots in normal engine configuration. When the FMGS detects an engine failure, the speed target becomes the highest of V2 or current speed, limited by V2 + 15 knots.

The SRS guidance law also includes :

· Attitude protection to reduce aircraft nose-up effect during takeoff (17.5° or 22.5° maximum in case of windshear).

· Flight path angle protection that ensures a minimum climb slope of 0.5°.

· A speed protection limiting the target-speed to V2 + 15 kt.

Note : If during takeoff the pilot inadvertently sets an altitude on the FCU below the current altitude, the aircraft will remain in SRS mode until the pilot takes some other action.

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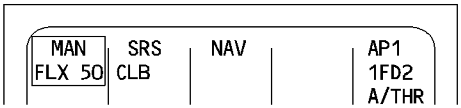


Typical FMA at takeoff with a Flex temperature

RUNWAY (RWY)

The RUNWAY mode has two submodes :
- RWY mode, which gives lateral guidance orders during takeoff roll and initial climb out (up to 30 feet RA) if a LOC signal is available
- RWY TRK mode, which gives lateral guidance on the track the aircraft was flying at mode engagement (at 30 feet RA)

— **Engagement conditions**

The RWY engagement conditions are :
- The conditions required for SRS mode engagement :
  - V2 is inserted in the MCDU PERF TO page
  - slats are extended.
  - the aircraft has been on ground for at least 30 seconds.
- The aircraft is receiving a LOC signal and LOC deviation is less than 1/2 dot.
- The aircraft heading is within 20° of the ILS related course.
- The ILS course is identical to the runway heading of the origin airport as selected for the active flight plan, if any.

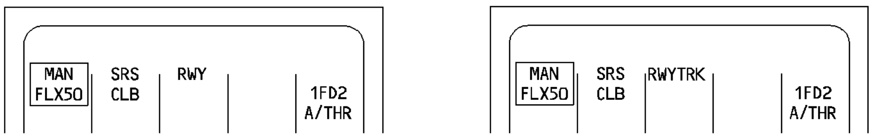
The RWY TRK mode engages automatically at 30 feet (RA) if NAV mode does not engage (NAV not armed prior to takeoff).

— **Disengagement conditions**

RWY mode disengages if :
- The LOC signal is lost below 30 feet RA or the aircraft heading and the runway heading differ by more than 20°.
- Another lateral mode is engaged.

Note : If the takeoff runway has no ILS or if an ILS back course has been selected RWY mode is not available and the PFD does not display the yaw bar nor RWY on FMA.

— **Guidance**
- The RWY mode uses the LOC signal to guide the aircraft on the runway centerline while the aircraft is on the ground.
  The PFD displays the FD yaw bar.
  The FMA displays RWY.
- The RWY TRK mode guides the aircraft on the track the aircraft was flying at mode engagement.
  The FD displays the conventional guidance bar. The FMA displays “RWY TRK”.



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Typical FMA with RWY mode engaged.

APPROACH

The aircraft can fly two different types of approaches :
— ILS (or LOC) approaches
— Non-ILS approaches (VOR/DME, VOR, NDB, RNAV)
The pilot uses an ARRIVAL lateral revison to insert these approaches into the flight plan.
The APPR pushbutton on the FCU is used to arm engage the guidance modes related to the approach inserted into the flight plan.
— For an ILS approach, the guidance modes are LOC and G/S.
— For a non-ILS approach, the guidance modes are APP NAV and FINAL (FINAL APP).

ILS APPROACH

The ILS approach mode includes the following modes :

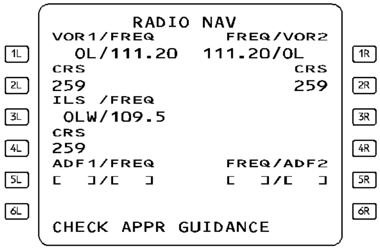
VERTICAL MODE	LATERAL MODE
G/S* (capture) G/S (track)	LOC* (capture) LOC (track)
COMMON MODES LAND - FLARE - ROLL OUT	

The sequencing of these modes is automatic once the pilot has pushed the APPR pushbutton and the conditions for engagement are met.

Selection
The ILS approach is selected when the approach pushbutton of the FCU is pressed and
— an ILS approach or a runway only or no approach is inserted in the Flight Management flight plan (arrival page), and an ILS frequency is set in on the MCDU, or
— both radio management panels are set to NAV and each has the ILS frequency and course set in.

Note : The ILS frequency will be automatically tuned when the direct distance to destination is below 300 NM.

Check approach guidance message
If the pilot inserts a non-ILS approach into the flight plan and then uses the RAD NAV page to manually tune in an ILS, the MCDU displays “CHECK APPR GUIDANCE”. This message is a reminder that the available APPR guidance modes are APP NAV and FINAL.



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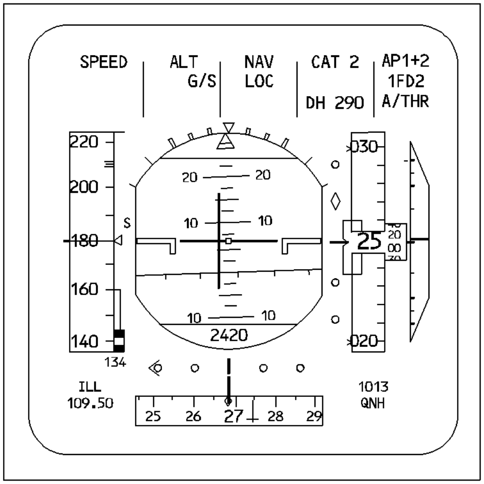
Example : OLW was manually entered on the RAD NAV page although a VOR approach is selected in the flight plan.

Arming conditions of LOC and G/S modes
The pilot arms the (ILS) APPR mode (LOC and G/S in blue on the FMA) by pushing the APPR pushbutton on the FCU, provided that :
· An ILS approach is selected,
· The aircraft is above 400 feet RA,
· The ILS is available,
· Go-around or takeoff or final mode is not engaged,
· ILS frequency and course are identically set on both receivers.
— LOC and G/S blue are displayed on the FMAs. Both modes will automatically engage when conditions are met.
— Second autopilot may be engaged.
— Current landing capability is displayed on the FMAs.

Disarming conditions of LOC and G/S modes
LS APPR mode is disarmed if the aircraft is above 400 feet and one of the following conditions is met :
— When the pilot presses the APPR pushbutton, both the LOC and the G/S modes disarm.
  · The HDG/TRK mode engages, if the LOC mode was engaged and the V/S or FPA mode engages if the G/S mode was engaged.
— When the pilot presses the LOC pushbutton, only the G/S mode disarms and the V/S or FPA mode engages, if the G/S mode was engaged.
— The pilot pulls the HDG/TRK selector knob.
— The pilot engages the go-around mode.



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LOC AND G/S ARMED

Engagement conditions of LOC and G/S modes

When ILS capture conditions are fulfilled :
- LOC* mode engages, and
- G/S* mode engages. No radio altimeter validity is required with this standard for G/S engagement.

The FMA displays "LOC*", or LOC* and G/S* in green.
Nevertheless, the G/S* mode cannot engage, if :
- LOC* mode is not engaged, or
- The aircraft is above the glide path and its trajectory does not cross the ILS G/S beam.

When the aircraft is established on LOC axis, the LOC mode engages.
When the aircraft is established on the G/S axis, the G/S mode engages.
The FMA displays "LOC" and "G/S" in green. The AP/FD guides the aircraft along the G/S down to 30 feet, and along the LOC during the flare and rollout.

R *Note : G/S* or G/S may engage at altitudes above the operative range of the radio altimeters (8000 feet for TRT, 5000 feet for Collins radio altimeter), but the landing capability displayed on the FMA will reflect the lack of radio altimeter validity (CAT 1 only) until the RAs become active.*
If the radio altimeters fail : LOC, G/S and AP/FDs will disengage and FDs will reengage on basic modes.

Disengagement conditions of LOC and G/S modes

If the aircraft is above 400 feet, the (ILS) APPR mode disengages when the :

- Pilot presses the APPR pushbutton, the system reverts to basic modes (HDG V/S or TRK FPA).
- Pilot presses the LOC pushbutton, the LOC mode remains engaged. The system reverts to V/S FPA, if G/S was engaged.
- Pilot pulls out the HDG/TRK selector knob, the system reverts to basic modes HDG V/S or TRK FPA.
- Go-around engages.
- LOC or G/S signal has been lost for 7 seconds or more above 200 feet RA. AP/FDs disengage and FDs reengage in basic modes (HDG V/S or TRK FPA).

Disengagement conditions of G/S only

- The pilot pulls out the V/S FPA selector knob. LOC mode remains engaged but G/S mode disengages, and V/S or FPA engages.
- R The pilot pushes or pulls the ALT selector knob. LOC mode remains engaged and the mode selected by the crew engages, as a function of the FCU-selected altitude.

LOC capture assistance function

In NAV mode, and when within 20NM of the destination runway, the aircraft is guided with a track angle of 20° from the LOC axis. This helps the aircraft intercept and capture the LOC beam. When the ILS frequency or the ILS ident entered on the RAD NAV page differs from the ILS of the destination runway entered in the Flight Plan :

- The aircraft loses the LOC capture assistance function.
- The "RWY/ILS MISMATCH" message is displayed on the scratchpad.
- The pilot should select HDG mode to perform the LOC capture.

Note : There is no G/S capture assistance. The pilot will ensure that the aircraft's flight path intercepts the G/S beam for G/S engagement.*

LAND MODE

Engagement conditions

LAND mode automatically engages when the LOC and G/S modes are engaged and the aircraft is below 400 feet RA. The FMA displays "LAND", indicating that LOC and G/S are locked. No action on the FCU will disengage LAND mode. FLARE and ROLL OUT modes will successively engage.

Disengagement conditions

LAND mode disengages :

- Upon engagement of the go-around mode,
- If the pilot presses the APPR pushbutton when the aircraft has been on ground for at least 10 seconds with the autopilot disconnected.

Note : When LAND is not displayed on the FMA at/or slightly below 400 feet, the landing capability degrades to CAT 1 and an aural triple click is generated. Autoland is not allowed with CAT 1 displayed on the FMA.

FLARE MODE

R Once the aircraft reaches approximately 55 feet RA (the precise value is a function of V/S),
- FLARE mode engages.
- The FMA displays "FLARE" in green.

R Around 45 feet RA, the AP/FD aligns the yaw axis with the runway centerline, and the
R aircraft starts to flare on the pitch axis. If the autothrust is active, thrust is automatically reduced to IDLE during flare (refer to A/THR RETARD mode).
When both AP/FDs are disengaged, FLARE mode disengages.
After main landing gear touchdown, the autopilot (if engaged) sends a nose down order.

Align sub-mode

R Align is a sub-mode of LAND that lines up the aircraft's axis with the ILS course at
R approximately 45 feet. Align sub-mode is not displayed to the crew.

Note : Align sub-mode is often known as "decrab" function.

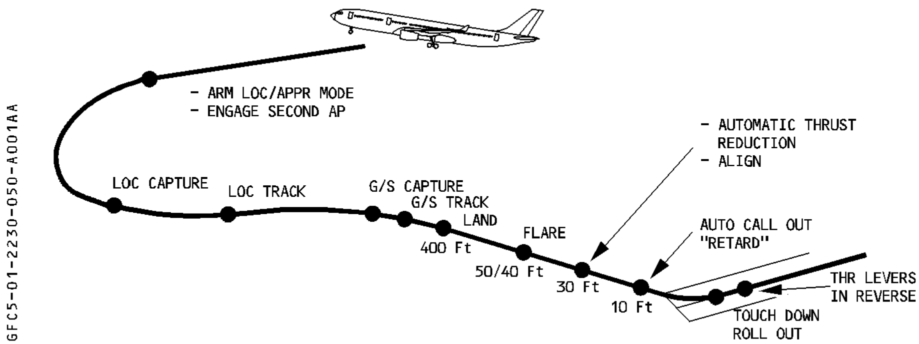
ROLL OUT MODE

At touchdown, ROLL OUT mode engages and guides the aircraft along the runway centerline. The FMA displays "ROLL OUT" in green, and the PFD displays the yaw bar and no FD bars.

SPEED CONTROL

R The autothrust, when active, controls speed. The approach speed target (VAPP) is either
R managed by the FMGS or selected by the crew :
R – When managed, the speed target is computed by the FMGS and may be modified by
R the crew through the MCDU. At 700 feet RA, the current speed target value is
R memorized by the autothrust, to ensure stabilized speed guidance, even if Flight
R Management fails. Below 700 feet, any new VAPP or WIND entry in the MCDU has no
R effect on the speed target.
R – When selected, the autothrust always targets the speed selected on the FCU.

TYPICAL ILS APPROACH



AUTOLAND WARNING LIGHT

The following situations, when occuring below 200 feet RA with the aircraft in LAND mode, trigger the flashing AUTOLAND red warning and a triple click aural warning :
- Both APs OFF below 200 feet RA
- Excessive deviation in LOC (1/4 dot above 15 feet RA) or GLIDE (1 dot above 100 feet RA). In addition, LOC and GLIDE scales flash on the PFD.
- Loss of LOC signal above 15 feet or loss of GLIDE signal above 100 feet. In addition, the FD bars flash on the PFD. The LAND mode remains engaged.
- The difference between both radio altimeter indications is greater than 15 feet.

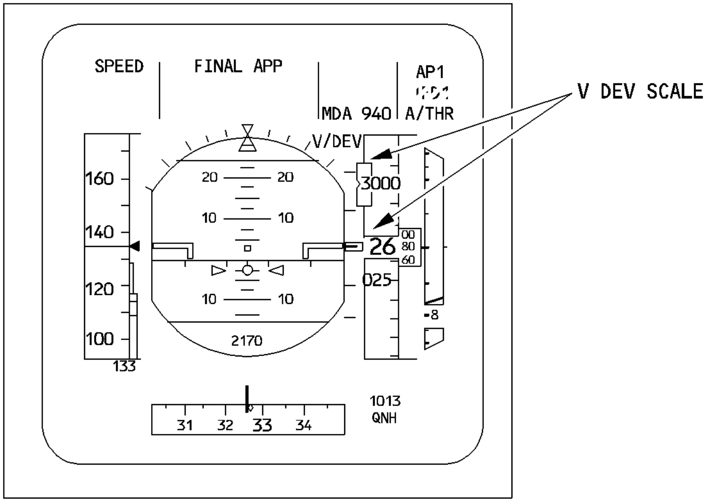
LANDING CAPABILITIES

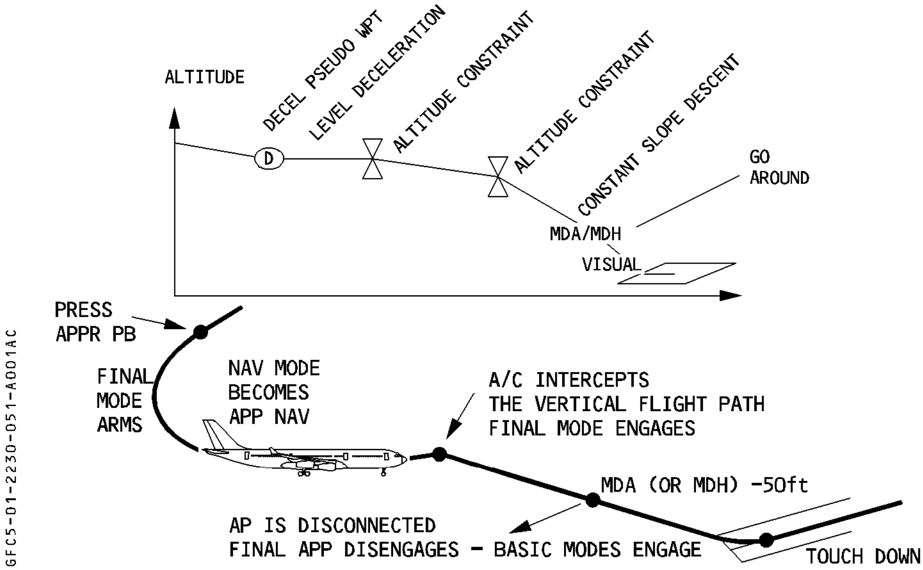
Each FMGC computes its own automatic landing capability according to the availability of computers or sensors or functions. (Refer to 4.05.70).
The FMA displays “CAT1”, “CAT2”, “CAT3 SINGLE” or “CAT 3 DUAL” messages as soon as the APPR pushbutton is pushed in to arm ILS approach modes.

NON PRECISION APPROACH MODE

This mode guides the aircraft laterally and vertically down to the Minimum Descent Altitude (MDA) or Minimum Descent Height (MDH) along the final descent profile computed by the FMGS.
This mode is used to fly a NON ILS approach (VOR, VOR/DME, NDB, RNAV...) as inserted into the flight plan.

R





A non precision approach includes the following managed modes :
- APP NAV mode for lateral guidance,
- FINAL mode for vertical guidance.

SELECTION

R The non precision approach guidance modes are available, if a non-precision approach
R (VOR, VOR/DME, NDB, RNAV) has been inserted in the active flight plan.

ARMING CONDITIONS

The crew arms APP NAV and FINAL modes by pressing the FCU's APPR pushbutton, provided all of the following conditions are met :
- The aircraft is above 400 feet AGL,
- The active flight plan is valid (lateral and vertical profile),
- R A non precision approach has been selected in the active flight plan,
- GA mode is not engaged.

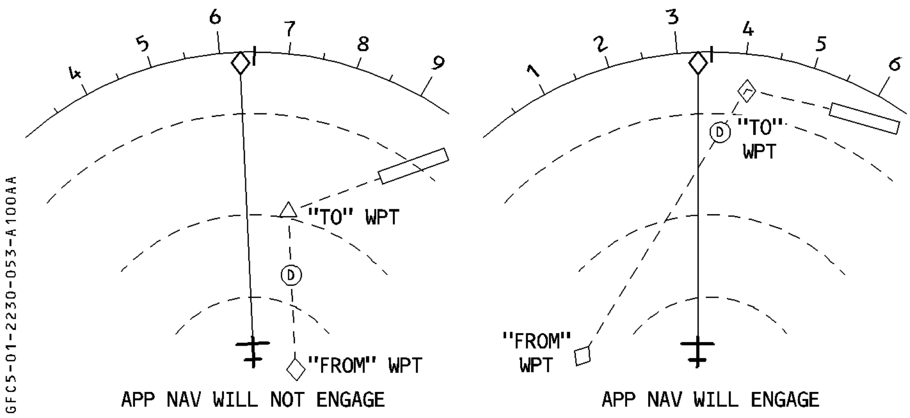
The FMA displays "FINAL" and "APP NAV" in blue.
If NAV mode was already engaged, APP NAV engages immediately.

DISARMING CONDITIONS

FINAL and NAV modes are disarmed, if the pilot :
- Presses the APPR pushbutton, or
- Presses the LOC pushbutton (thus arming LOC mode), or
- Engages GO AROUND mode.

ENGAGEMENT CONDITIONS

APP NAV and NAV modes engage under the same conditions :
If NAV mode was engaged, APP NAV engages immediately. If HDG/TRK is engaged, APP NAV engages when the intercept conditions are met (the aircraft's heading or track intercepts the flight plan's active leg).
FINAL mode engages, if :
- The APPR phase is active and the deceleration point has been sequenced, and
- APP NAV mode is engaged, and
- The crosstrack error is less than 1.5 NM, and
- FINAL mode is armed, and
  - The aircraft intercepts a descending leg of the vertical flight path, or
  - In V/S (FPA) or OP DES mode, the aircraft intercepts a level-off segment of the vertical flight profile, with a selected altitude different from this level-off segment.



DISENGAGEMENT CONDITIONS

The FINAL and APP NAV modes disengage :

- If the pilot presses the APPR pushbutton (HDG V/S or TRK FPA mode engages).
- If the pilot presses the LOC pushbutton (LOC mode arms, if an ILS is selected otherwise HDG V/S or TRK FPA mode engages).
- If the pilot pulls out the HDG TRK selector knob, the FMGS reverts to basic modes HDG V/S or TRK FPA.
- Automatically at MDA (or MDH) – 50 feet, or 400 feet AGL, if no MDA/MDH entered.
- When the GO AROUND mode engages.

Note : *If the pilot engages the V/S or FPA mode, only FINAL mode disengages and APP NAV remains engaged.*

GUIDANCE

The FINAL mode guides the aircraft on the vertical profile down to the Minimum Descent
R Altitude.

The FINAL mode :

- Displays a vertical deviation scale (± 200 feet) on the Primary Flight Display, and a VDEV symbol showing deviation from descent path.
- Anticipates leaving the altitude selected by the Flight Control Unit, when the aircraft reaches the Continue Descent symbol (blue arrow on the navigation display).
- Gives precise vertical guidance on the descent and final path, with an internal vertical speed limitation, to avoid excessive V/S.

If the autopilot is engaged while using the APP NAV/FINAL modes, it automatically disengages at MDA (or MDH) – 50 feet.

FD modes revert to basic HDG-V/S, or TRK-FPA.

WARNING

When the GPS PRIMARY function is installed, a triple-click aural warning sounds if the GPS PRIMARY function is lost during a non precision approach.

GO AROUND (GA)

Go-around mode combines the SRS (Speed Reference System) vertical mode with the GA TRK (Go-Around Track) lateral mode.

ENGAGEMENT CONDITIONS

Setting at least one thrust lever to the TOGA detent engages both SRS/GA TRK modes, if:
- The flaps lever is at least in position 1, and
- The aircraft is in flight, or
- The aircraft has been on ground for less than 30 seconds (AP disengages and can be re-engaged five seconds after lift-off).

FD bars are automatically restored in SRS/GA TRK modes.
If FPV/FPD was previously selected, it reverts to FD bars.
The FMA displays "SRS" and "GA TRK" in green.

DISENGAGEMENT CONDITIONS

- The SRS mode disengages :
R - Automatically, if ALT* or ALT CST* mode engages (above 400 feet RA).
R - If the crew engages another vertical mode.
R - If the crew selects a speed while in SRS mode : SRS reverts to OP CLB mode and
R a triple-click aural warning is heard.

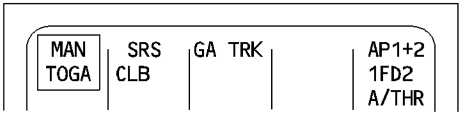
  Note : The SRS mode does not automatically disengage when climbing through the GA ACC ALT. The pilot has to manually engage OP CLB mode to increase the speed target to Green Dot speed.

R *Note : In Engine Out conditions, the SRS mode does not automatically disengage at*
R *EO ACC ALT. Refer to Engine Out procedures.*

- GA TRK disengages when the pilot engages another lateral mode above 100 feet RA. In dual AP configuration, disengagement of the Go-around mode, on either axis, causes AP2 to disconnect.

GUIDANCE

- The SRS law maintains the current speed at Go–around engagement, or VAPP, whichever is higher. Nevertheless, the SRS speed is limited to VLS + 25 kt in normal engine configuration and VLS + 15 kt in engine out. When the SRS mode disengages, the target speed becomes Green Dot speed.
- GA TRK mode guides the aircraft along the current track at Go-around initiation.



Typical FMA in Go Around

AUTOTHRUST

GENERAL

The autothrust (A/THR) is a function of the FMGS, it includes 2 independent A/THR commands, one per FMGC. Each one is able to control the thrust of both engines
R simultaneously through 2 Engine Interface Units and 2 Electronic Engine Controls (PW or
R RR engines) or 2 Engine Control Units (GE engines). Only one FMGC controls the active A/THR, it is called the master FMGC.

Thrust is controlled :
- automatically when the A/THR is active
- manually by the pilot.

The autothrust is active when the A/THR pushbutton of the FCU is lighted green and A/THR is displayed white in the FMA 5th column.

The position of the thrust levers determines whether A/THR is armed, active, or disconnected.

The autothrust system, when active :
- maintains a specific thrust in THRUST mode
- controls the aircraft speed or MACH in SPEED/MACH mode
- uses ALPHA FLOOR mode to set maximum thrust when the aircraft angle of attack exceeds a specific threshold.

The autothrust system can operate independently or with the AP/FD.
- When performing alone, A/THR always controls the speed.
- If the autothrust system is working with the AP/FD, the A/THR mode and AP/FD pitch modes are linked together. (Refer to 1.22.30 Interaction between AP/FD and A/THR modes).

  When autothrust is active, the FMGS commands the thrust according to the vertical mode logic, but uses a thrust not greater than the thrust commanded by the position of the thrust lever. For example, when the thrust levers are set at the CL (climb) detent, the autothrust system can command thrust between idle and max climb.

  The autothrust system, when armed, automatically activates if the thrust levers are moved into the active range sector. Outside of this range, thrust levers control thrust directly.

MASTER A/THR

The thrust being controlled by one A/THR only, when one AP is engaged, priority is given to the associated autothrust.

When both APs are engaged or no AP/FD engaged, A/THR 1 has the priority.

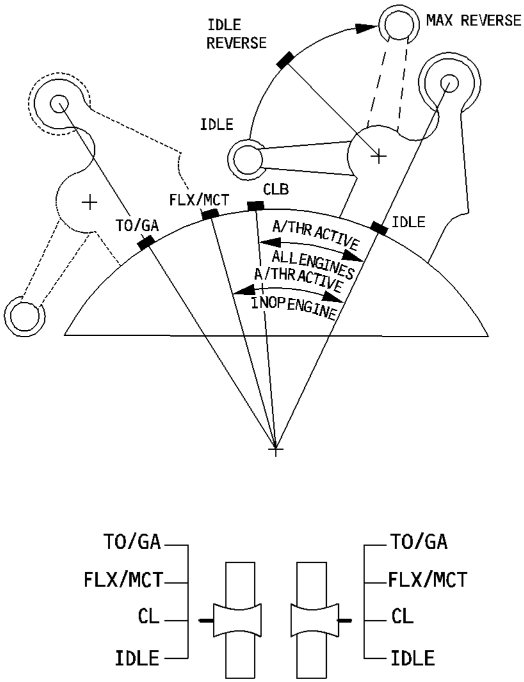
THRUST LEVERS

The pilot uses the thrust levers to do the following :
- Manually select engine thrust.
- Arm and activate autothrust (A/THR).
- Engage reverse thrust.
- Engage the takeoff and go around modes.

When autothrust is disconnected, the thrust levers control thrust directly : each lever position corresponds to a given thrust.
4 detents divide each of the thrust lever sectors into three segments. The detents are :

TO GA	:	Maximum takeoff thrust
FLX MCT	:	Maximum continuous thrust (or FLX at takeoff)
CL	:	Maximum climb thrust
IDLE	:	Idle thrust.

When the thrust levers are at the IDLE position, the pilot can pull the reverse levers.



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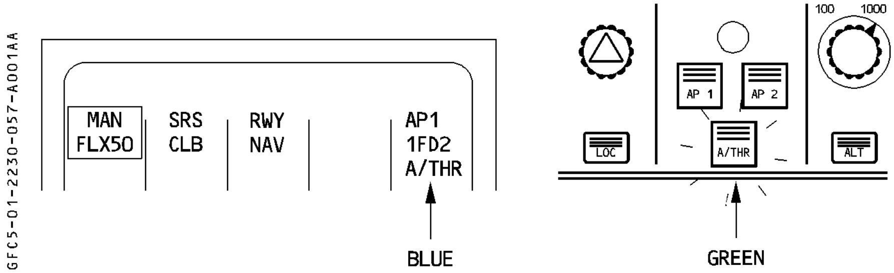
A/THR ARMING CONDITIONS

R There are a considerable number of A/THR arming conditions. The following is a list of the
R most important ones :
- One FMGC operative
- 2 ADIRS operative
- 2 FADECs operative
- One operative FCU channel
- One LGCIU operative
- A/THR is not manually disabled (instinctive disconnect pushbutton has not been pressed for more than 15 seconds).

The pilot arms the A/THR :
- On ground :
  - By pushing the A/THR pushbutton on the FCU when the engines are not running, or
  - By setting the thrust levers at the FLX or TOGA detent when the engines are running.
- In flight :
  - By pushing the A/THR pushbutton on the FCU while the thrust levers are out of the active range, or
R   - While A/THR is active (“A/THR” white on the FMA), by setting all thrust levers
R   beyond the CL detent or at least one lever above the MCT detent, or
  - By engaging the go around mode.

When the A/THR is armed :
- The FCU’s A/THR pushbutton light comes on
- “A/THR” is displayed in blue on the FMA



Note : At takeoff, if the thrust levers are set back to idle, the A/THR disengages and cannot be rearmed until airborne.

A/THR ACTIVATION

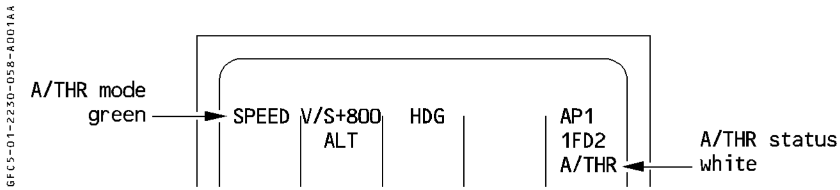
The A/THR is active when it controls thrust or speed. The position of the thrust lever determines the maximum thrust that the A/THR system can command (except in α-floor condition).
The A/THR being armed, is activated :

R — when the pilot sets both thrust levers between the CL and IDLE detents (two engines
R operative)
R — when the pilot sets one thrust lever between the MCT and IDLE detents (one engine
R inoperative).
R The A/THR being disconnected, is activated when the pilot pushes the FCU pushbutton
R while the thrust levers are within the active range, including IDLE position

R *Note : When the pilot sets both thrust levers to IDLE position, the A/THR disconnects but,*
R *if the pilot pushes the A/THR pushbutton of the FCU, he will simultaneously arm and*
R *activate the autothrust. Due to the thrust levers position, IDLE thrust will be*
R *maintained.*

— when ALPHA FLOOR is activated, regardless of the initial status of A/THR and the position of the thrust levers.

When A/THR is active :
— The A/THR pushbutton on the FCU lights up.
— The FMA displays A/THR mode in green in the first column and A/THR in white in the fifth column.



EFFECTS OF THRUST LEVER MOVEMENT WHILE A/THR IS ACTIVE

R — When both thrust levers are set above the CL detent (both engines operative) or one
R thrust lever is set above MCT (one engine operative) the A/THR reverts from active to
R armed. “A/THR” turns to blue on the FMA and the thrust levers control the thrust
R directly. The FMA displays “MAN THR” white in its first column.
R The thrust levers provide the crew with an immediate increase of thrust when both
R thrust levers are pushed above the CL detent (2 engines) or the active thrust lever above
R the MCT detent (one engine operative).
R — When both thrust levers are set below the CL detent (both engines operative) or one
R thrust lever is set below MCT (one engine operative), a repeating warning (amber
R caution, single chime, ECAM message “A/THR LIMITED”) is activated every 5 seconds
R until the pilot moves the levers back into the detent. “THR LVR” green is displayed on
R the FMA.
R “LVR CLB” (both engines operative) or “LVR MCT” (one engine operative) flashes white
R in the first column of the FMA.
R This device reminds the crew that the normal operating position of the thrust levers,
R when A/THR is active, is the CL detent (2 engines) or the MCT detent (one engine
R operative).
R — When one thrust lever is in the CL detent and the other one out of the detent, the “LVR
R ASYM” amber message comes up until both levers are set in the CL detent (only with
R both engines operative).

A/THR DISCONNECT

When the A/THR is disconnected, it is neither armed nor active.
The A/THR can be disconnected in two ways :

∗ Standard disconnection
  - The pilot pushes the instinctive disconnect pushbutton on the thrust levers (which immediately sets the thrust corresponding to the lever positions) or
  - The pilot sets both thrust levers to IDLE detent.

∗ Non-standard disconnection
  - The pilot pushes the A/THR pushbutton on the FCU while A/THR is armed/active, or
  - The system loses one of the arming conditions.

R **Below 100 feet radio altitude**

When the radio altitude is below 100 feet and the pilot sets both thrust levers above the CL detent or one above the MCT detent, the autothrust will disconnect. It will rearm automatically when at least one of the thrust levers is set to TOGA.
If the PF set thrust levers above CL detent but below TOGA and come back to CL detent, the A/THR will disconnect and remain disconnected. As a result, the thrust will increase up to CLIMB thrust. The crew has to manually set the appropriate thrust for landing (or go around).

CAUTION

R If the pilot pushes and holds one instinctive disconnect pushbutton for more than 15
R seconds, the A/THR system is disconnected for the remainder of the flight. All A/THR
R functions, including ALPHA FLOOR, are lost and they can only be recovered at the
R next FMGC power-up (on ground).

THRUST LOCK FUNCTION

The THRUST LOCK function is activated when the thrust levers are in the CL detent (or in
R the MCT detent with one engine-out), and the pilot pushes the FCU A/THR pushbutton, or
R the A/THR disconnects due to a failure.
R The thrust is locked at its level prior to disconnection. Moving the thrust levers out of the
R CL or MCT detent suppresses the thrust lock, and reverts to manual control.
R When the thrust lock function is active :

- "THR LK" flashes amber on the FMA.
- ECAM "ENG THRUST LOCKED" flashes every five seconds.
- ECAM displays "THR LEVERS...... MOVE"
- A single chime sounds and the Master Caution Light flashes every five seconds.

All warnings cease, when the pilot moves the thrust levers out of the detent.

A/THR DISCONNECT CAUTION

R The standard disconnection triggers a temporary ECAM message, and a single chime.
R The non-standard disconnection (A/THR pushbutton pressed on the FCU, or A/THR failure)
R triggers continuous visual cautions until the pilot reacts. The single chime sounds.

		A/THR DISCONNECTION	
		BY INSTINCTIVE DISCONNECT OR SETTING TWO LEVERS TO IDLE (if above 50 ft RA)	**BY OTHER MEANS**
CONSEQUENCE	MASTER CAUTION	Is on for 3 sec max	On
	ECAM MESSAGE	Amber A/THR OFF message : 9 sec maximum	Flashing "ENG THRUST LOCKED", amber AUTO FLT A/THR OFF, THR LEVERS..... MOVE (blue)
	AUDIO	Single chime	Single chime
	CLR pushbutton on ECAM CONTROL PANEL	OFF	ON
ACTION	MASTER CAUTION pushbutton	Turns off the MASTER CAUTION light, and erases ECAM message.	Turns off the MASTER CAUTION light.
	CLR puhbutton on ECAM CONTROL PANEL	No effect	Turns off the MC light and CLR pushbutton, and erases the ECAM message. Calls status.
	INSTINCTIVE DISCONNECT pushbutton	Turns off the MASTER CAUTION light, and erases the ECAM message.	Turns off the MASTER CAUTION light.
ECAM STATUS MESSAGE		NO	YES

A/THR MODES

Except in takeoff and go around situations, normal operation of the A/THR system requires the thrust levers to be :

– In the CL detent for the two-engine configuration. If they are not set in the CL detent, "LVR CLB" flashes white on the FMA.
– In MCT detent when in the one-engine-out configuration. If the appropriate lever is not set in the MCT detent, "LVR MCT" flashes white on the FMA.

The A/THR modes are selected automatically in conjunction with the AP/FD modes (except for ALPHA FLOOR).

R

A/THR in THRUST mode	AP/FD pitch mode maintains the speed : OP CLB - OP DES - CLB - SRS - FLARE and DES (IDLE path)
A/THR in SPEED/MACH mode	If neither AP nor FD is engaged
	If AP/FD controls a vertical path V/S-FPA-ALT*- ALT CST*-ALT-ALT CRZ-G/S* -G/S-FINAL and DES (geometric path)
A/THR in RETARD mode	Automatic landing (AP engaged in LAND mode).

THRUST mode

– In THRUST mode, autothrust commands a specific thrust level in conjunction with the AP/FD pitch mode. This thrust level is limited by thrust lever position.

FMA display	Meaning
THR MCT	The most advanced thrust lever is in the MCT detent (engine out)
THR CLB	The most advanced thrust lever is in the CL detent
THR LVR	Either thrust levers are below CL or MCT detent or at least one thrust lever is in CL detent and the other above CL detent.
THR IDLE	All engines at IDLE thrust
THR DCLB 1(2)	The most advanced thrust lever is in the CL detent and the crew has selected a derated climb.

Note : When the A/THR is armed for takeoff or go around, the FMA displays "MAN TOGA" (or "MAN FLX" or MAN DTO ◁) in white to remind the crew that the thrust levers have been positioned properly.

RETARD mode

The RETARD mode is only available during automatic landing (AP engaged in LAND mode).
The RETARD mode engages at approximately 40 feet RA, and remains engaged after touchdown.
The A/THR commands IDLE thrust during the flare and the FMA and engine warning display show “IDLE”.
If the autopilot is disengaged during the flare before touchdown, the SPEED mode replaces the RETARD mode, and the pilot has to manually reduce thrust.

Note : In automatic landing, the system generates a “RETARD” callout at 10 feet RA, which prompts the pilot to move the thrust levers to IDLE in order to confirm thrust reduction. In manual landing conditions, the system generates this callout, as a reminder, at 20 feet RA.

SPEED/MACH mode

In SPEED/MACH mode, the A/THR adjusts the thrust in order to acquire and hold a speed or Mach target.
The speed or Mach target may be :
- Selected on the FCU by the pilot
- Managed by the FMGC.

When in SPEED or MACH mode, the A/THR does not allow speed excursions beyond the following limits, regardless of the target speed or Mach number :
- For a selected speed target, the limits are VLS and VMAX (VMO-MMO, VFE-VLE, whichever applies).
- For a managed speed target, the limits are maneuvering speed (Green Dot, S, F, whichever applies) and maximum speed (320/.84-VFE-VLE whichever applies). In descent, the maximum managed speed target computed by the FMS are 315/.83–VFE–VLE, whichever applies.

The changeover from SPEED to MACH mode is either automatically performed by the FMGC, or manually by the pilots (in selected speed target only) by pushing the SPD/MACH changeover pushbutton.
The FMA displays “SPEED” or “MACH”.

MACH MODE IN CRUISE PHASE (A/THR SOFT MODE)

When the aircraft is in ALT CRZ mode with the autopilot engaged, autothrust engaged in
R MACH mode, and is within a +/–3 knot range of the target speed, the autothrust soft mode engages. This mode reduces the thrust variation in cruise, specifically in light turbulence. The autothrust soft mode disengages, when the speed deviation from the target becomes too large or the target is modified ; autothrust transition from soft to basic mode may lead to transient thrust variation. This mode is inhibited with the speedbrakes extended, or with an engine-out, or when the Mach target is below 0.65.

SPEED MODE IN APPROACH PHASE

When the aircraft flies an approach in managed speed, the speed target displayed on the PFD in magenta, is variable during the approach.
This managed speed target is computed in the FMGS, using the "ground speed mini" function.

GROUND SPEED MINI FUNCTION PRINCIPLE

The purpose of the ground speed mini function is to take advantage of the aircraft's inertia, when the wind conditions vary during the approach. It does so by providing the crew with an adequate indicated speed target. When the aircraft flies this indicated speed target, the energy of the aircraft is maintained above a minimum level, ensuring standard aerodynamic margins versus stall.
If the A/THR is active in SPEED mode, it will automatically follow the speed target, ensuring efficient thrust management during the approach.
The minimum energy level is the energy level the aircraft will have at touchdown, if it lands at VAPP speed with the Tower-reported wind as inserted in the PERF APPR page.
The minimum energy level is represented by the Ground Speed the aircraft will have at touchdown. This Ground Speed is called "GROUND SPD MINI".
During the approach, the FMGS continuously computes the speed target using the wind experienced by the aircraft in order to keep the ground speed at, or above, the "Ground Speed Mini".
The lowest speed target is lower limited to VAPP, and is upper limited by VFE of next configuration in CONF 1, 2, 3 and VFE – 5 in CONF FULL.
The speed target is displayed on the PFD speed scale in magenta, when approach phase and managed speed are active. It is independent of the AP/FD, and/or ATHR engagements.
Wind is a key factor in the ground speed mini function.

TWR WIND

TWR WIND is the MAG WIND entered in the PERF approach page. It is the average wind, provided by the ATIS or the Tower. Gusts must not be inserted ; they are included in the aircraft target speed computation.

TWR HEADWIND COMPONENT

The TWR HEADWIND COMPONENT is the component of the MAG WIND projected on the runway axis (landing runway entered in the flight plan). It is used to compute VAPP and GS mini. . The TWR wind is the wind announced by the ATC and entered in the PERF APPR page (MAG WIND field).

CURRENT HEADWIND COMPONENT

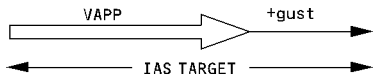
The actual wind measured by ADIRS is projected on the aircraft axis to define the CURRENT HEADWIND COMPONENT (instantaneous headwind). The CURRENT HEADWIND COMPONENT is used to compute the variable speed target during final (IAS target).

VAPP COMPUTATION

VAPP, automatically displayed on the MCDU PERF APPR page, is computed as follows :
VAPP = VLS + 1/3 of the TWR HEADWIND COMPONENT or VAPP = VLS + 5 knots, which ever is highest.
“1/3 of the TWR HEADWIND COMPONENT” has 2 limits :
· 0 knots as the minimum value (no wind or tailwind)
· +15 knots as the maximum value.
The crew can manually modify the VAPP and TWR wind values on the PERF APPR page.

SPEED TARGET COMPUTATION

The FMGS continuously computes a speed target (IAS target) that is the MCDU VAPP value plus an additional variable gust.



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The IAS target is displayed on the PFD as a magenta triangle moving with the gust variation.

Speed target computation above 400 feet :

The gust is the instantaneous difference between the CURRENT HEADWIND COMPONENT and the TWR HEADWIND COMPONENT. It is always positive (or equal to zero for no wind or tailwind) IAS targets have 2 limits :
– VAPP as minimum value
– VFE in CONF FULL or VFE - 5 knots in CONF 1,2 or 3 as the maximum value.

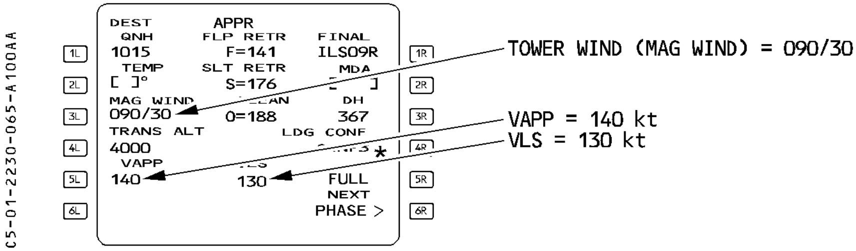
Speed target computation below 400 feet :

The gust taken into account is only 1/3 of the instantaneous difference between the CURRENT HEADWIND and the TWR HEADWIND COMPONENT. This is done to prevent any important thrust variation in late final. Min and Max values remain unchanged.

GROUND SPEED MINI (GS mini) COMPUTATION

Ground speed mini concept has been defined to prevent the aircraft energy from dropping below a minimum level during final approach. The GS mini value is not displayed to the crew.

EXAMPLE



PERF APPR PAGE (ILS APPROACH)

IAS TARGET VALUES

If we turn the previously explained speed target definition, into formulae, we obtain the following result :

Above 400 feet

If IAS TARGET = Max [VAPP, (VAPP + CURRENT HEADWIND - TWR HEADWIND)] (1)

Current wind in approach	IAS target
(a) 090/50	MAX [VAPP, (140 + 50 - 30) = 160 kt
(b) 090/10	MAX [VAPP, (140 + 10 - 30) = 140 kt
(c) 270/10	MAX [VAPP, (140 + 0 - 30) = 140 kt
(d) 090/30	MAX [VAPP, (140 + 30 - 30) = 140 kt

(1) For this computation, the TWR HEADWIND is voluntarily limited to 10 kt as a minimum.

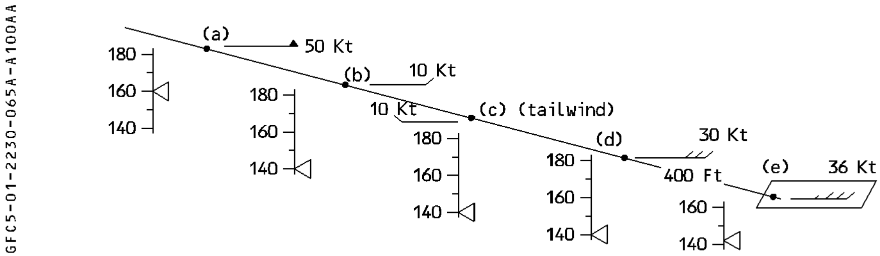
R **Below 400 feet**

IAS TARGET = Max [VAPP, VAPP + 1/3 (CURRENT HEADWIND - TWR HEADWIND)]
That is equivalent to :
IAS TARGET = Max (VAPP, VLS + 1/3 of CURRENT HEADWIND COMPONENT)

R

Current wind in approach	IAS target
(e) 090/36	MAX [VAPP, (130 + 12) = 142kt

R



A/THR MODE REVERSION

CONDITIONS	EVENT	CONSEQUENCES
• A/THR active in THR mode • AP OFF • FD engaged • DES or "OP" DES engaged (CLB or OP CLB)	aircraft speed = VLS (Vmax)	• A/THR reverts to SPD mode • FD bars are removed

For detail refer to "Speed mode protection".

Alpha floor

The ALPHA FLOOR protection is triggered when the FMGCs receive a signal elaborated by the PRIMs. This signal is sent when the aircraft angle of attack is above a predetermined threshold function of the aircraft configuration. The A/THR is automatically activated and commands TOGA thrust regardless of thrust lever positions. This protection is available from lift off to 100 feet RA in approach.

Following indications are then provided :

– A-FLOOR on the FMA and on the EWD as long as α floor conditions are met

– TOGA LK on the FMA when the aircraft leaves the α floor conditions.
  TOGA thrust is then frozen

A FLOOR and TOGA LK are displayed in green and surrounded by an amber flashing box.

In order to cancel the ALPHA FLOOR or TOGA LK thrust, disconnect the A/THR.

Note : Alpha Floor is inhibited :

– in case of engine failure with flaps extended
– in case of engine failure with derated TO selected
– below 100 feet at landing
– above M.53

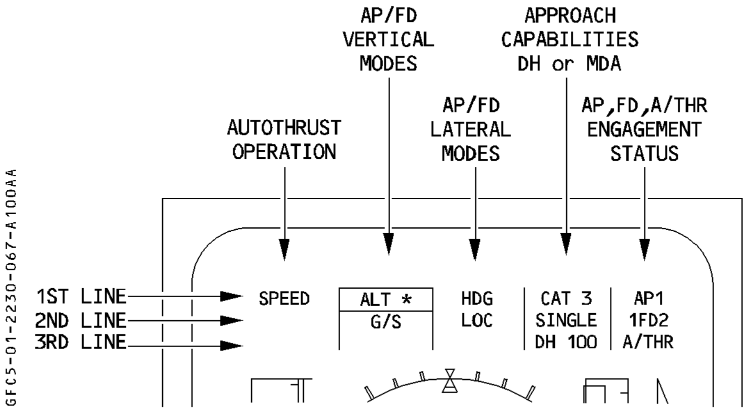
Alpha Floor protection is lost in case of A/THR failure.

CAUTION

R The system may consider an engine to be failed, when this engine's Thrust Lever
R Angle (TLA) is bellow 5°, and the TLA of other engine is above 5°. Therefore, Alpha
R Floor may be inhibited.
R In manual thrust control, when simultaneously moving both thrust levers back to
R about the IDLE position, and in order to avoid undue Alpha Floor inhibition, check that
R both levers are well-aligned and that no TLA is below 5°.

FLIGHT MODE ANNUNCIATOR (FMA)

The Flight Mode Annunciator (FMA), located on the top of the PFDs, reflects the status of the A/THR, the AP/FD vertical and lateral modes, the approach capabilities, and the AP/FD-A/THR engagement status.
A white box is displayed for 10 seconds around each new annunciation. The white box
R display time may be increased to 15 seconds in some mode reversion cases associated
R with a triple click aural warning.



In the three left columns :
The engaged modes are displayed in green on the first line.
The armed modes are displayed in blue, or in magenta, on the second line.
Modes, armed due to a constraint, are displayed in magenta.
Special messages, are displayed on the third line :
- First priority is given to messages related to flight controls :
  - MAN PITCH TRIM ONLY flashes red for 9 seconds, then remains steady
  - USE MAN PITCH TRIM pulses amber for 9 seconds, then remains steady.
- Lower priority messages related to FMGS.

In the fourth column, approach capabilities are displayed in white
DH or MDA/MDH is displayed in blue.

In the right column, AP, FD, A/THR engagement status are displayed in white
FD is boxed for 10 seconds, in case of automatic FMGC switching.
When armed, A/THR is displayed blue.

Note : The FMGS synchronizes A/THR mode, AP/FD modes, and landing capability to provide identical information on both PFDs.

AUTO THRUST ANNUNCIATIONS (FMA COLUMN 1)

First line

R

DISPLAY	COLOR	MEANING
MAN TOGA	White White box	A/THR is armed, at least one thrust lever is in TOGA detent.
MAN FLX 50	White White box	A/THR is armed, at least one thrust lever is in MCT/FLX detent, with FLX TO temp set at 50°. The other thrust lever is at, or below, the MCT/FLX detent. 50° is displayed in blue.
MAN MCT	White White box	A/THR is armed, at least one thrust lever is in MCT detent, the other is at, or below, this detent.
MAN DTO ◁	White White box	A/THR is armed, at least one thrust lever is in the MCT/FLX detent, with an entered derated level. The other thrust lever is at, or below, the MCT/FLX detent.
MAN THR	White Amber box	A/THR is armed. This indication is not displayed during T.O or GA phases. The most advanced thrust lever is above the CL detent, while the other is in CL detent, or both thrust levers are above CL detent.
THR MCT	Green	A/THR is active in thrust mode and the most advanced thrust lever is in the MCT detent (engine-out).
THR CLB	Green	A/THR is active in thrust mode, and the most advanced thrust lever is in the CL detent.
THR DCLB 1 (2) ◁	Green	A/THR is active in thrust mode ; the most advanced thrust lever is in the CL detent, and the crew has selected a derated climb.
THR IDLE	Green	A/THR is active in thrust mode, and commands idle thrust.
THR LVR	Green	A/THR is active in thrust mode with either both thrust levers out of CL, or MCT detent, or at least one thrust lever in CL detent and the other beyond CL detent.
THR DES	Green	A/THR is active in thrust mode and commands minimum thrust in DES mode.
SPEED or MACH	Green	A/THR is active in SPEED or MACH mode.
A. FLOOR	Green Amber box	A/THR is active and commands TOGA thrust, while α FLOOR conditions are met.
TOGA LK	Green Amber box	A/THR is active and TOGA thrust is frozen (α FLOOR conditions are no longer met).

Second/third lines
The second and third lines display various caution messages.

Second line

DISPLAY	COLOR	MEANING
LVR CLB (flashing)	White	Request to set the thrust levers in CL detent
LVR MCT (flashing)	White	Request to set the thrust levers in MCT detent.

Third line

R

DISPLAY	COLOR	MEANING
LVR ASYM	Amber	(2 engines only). One thrust lever is set out of the CL (or MCT) detent with A/THR active.
THR LK (flashing)	Amber	After A/THR disconnection (FCU pilot's action or failure) resulting in thrust being frozen.

Note : The amber caution flashes and a single chime sounds every 5 seconds, as long as
R *the pilots does not take action in the following cases :*
· THR LK
· LVR CLB (if the thrust levers are below the CLB detent)
· LVR MCT (if the thrust levers are below the FLX/MCT detent).

AP/FD VERTICAL MODES (FMA COLUMN 2)

First line

R

DISPLAY	COLOR	MEANING
SRS	Green	Takeoff or go-around mode is engaged.
CLB	Green	Climb mode is engaged. The FMGS target altitude is higher than the actual altitude. ALT CSTR are taken into account.
OP CLB	Green	Open Climb mode is engaged. The FCU-selected altitude is higher than the actual altitude.
ALT*	Green	ALT CAPTURE at the FCU-selected altitude is engaged.
ALT CST*	Green	ALT CAPTURE at the ALT CSTR altitude (vertical profile) is engaged.
ALT CRZ*	Green	ALT CAPTURE at the CRZ FL is engaged.
ALT CST	Green	An ALT CSTR is held (vertical profile).
ALT	Green	ALT mode is engaged. The FCU-selected altitude is held
ALT CRZ	Green	SOFT ALT mode and NAV mode are engaged.
DES	Green	Descent mode is engaged. The FMGS target altitude is lower than the actual altitude. ALT CSTR are taken into account.
OP DES	Green	Open Descent mode is engaged. The FCU-selected altitude is lower than the actual altitude.
G/S*	Green	Glide Slope capture mode is engaged.
G/S	Green	Glide Slope mode is engaged.
V/S ± XXXX	Green	Vertical speed mode is engaged to acquire and hold the V/S selected on the FCU. Target is displayed in blue. If the aircraft reaches VLS or Vmax and cannot maintain the target, the indication is boxed amber and flashes, and the target pulses.
FPA ± X.X°	Green	Flight Path Angle mode is engaged to acquire and hold the FPA selected on the FCU. Target is displayed in blue. If the aircraft reaches VLS or Vmax and cannot maintain the target, the indication is boxed amber and flashes, and the target pulses.

Second line

DISPLAY	COLOR	MEANING
CLB	Blue	Climb mode is armed before the climb phase.
OP CLB	Blue	Open Climb mode is armed.
ALT	Blue or Magenta	Altitude mode is armed. – Blue, when the target altitude is the FCU-selected altitude. – Magenta, when the target altitude is an ALT CSTR.
ALT CRZ	Blue	Altitude mode is armed. Target altitude is the CRZ FL.
DES	Blue	Descent mode is armed before the descent phase.
G/S	Blue	Glide Slope mode is armed.
FINAL	Blue	Final descent mode is armed.

Note : Two modes may be armed at the same time : ALT G/S, ALT FINAL, DES G/S, DES FINAL.

Third line

DISPLAY	COLOR	MEANING
SPEED SEL XXX	Blue	Indicates a preset speed associated with the cruise, climb or descent phase.
MACH SEL. XX	Blue	Indicates a preset Mach associated with the cruise, climb or descent phase.

Note : These two messages are displayed in the first and second columns (third line).

AP/FD LATERAL MODES (FMA COLUMN 3)

First line

R

DISPLAY	COLOR	MEANING
RWY	Green	RWY mode is engaged.
RWY TRK	Green	RWY mode is engaged once airborne at, or above, 30 feet.
TRACK	Green	TRACK mode is engaged.
HDG	Green	HEADING mode is engaged.
NAV	Green	NAV mode is engaged to guide the aircraft along the FM lateral F-PLN.
LOC*	Green	LOC capture mode is engaged.
LOC	Green	LOC track mode is engaged.
LOC B/C*	Green	Back beam capture mode is engaged.
LOC B/C	Green	Back beam mode is engaged.
APP NAV	Green	NAV mode is engaged during a NON ILS approach.
GA TRK	Green	GO AROUND track mode is engaged.

Second line

DISPLAY	COLOR	MEANING
LOC B/C	Blue	Back beam mode is armed.
LOC	Blue	LOC mode is armed.
APP NAV	Blue	NAV mode is armed for a NON ILS approach.
NAV	Blue	NAV mode is armed.

AP/FD COMMON MODES (FMA COLUMN 2 AND 3)

DISPLAY	COLOR	MEANING
ROLL OUT	Green	Roll out mode is engaged.
FLARE	Green	Flare mode is engaged.
LAND	Green	Land mode is engaged below 400 feet RA.
FINAL APP	Green	APP NAV and FINAL modes are engaged during a NON ILS approach

APPROACH CAPABILITIES (FMA COLUMN 4)

First line

DISPLAY	COLOR	MEANING
CAT 1	White	CAT 1 capability available
CAT 2	White	CAT 2 capability available
CAT 3	White	CAT 3 capability available

Second line

DISPLAY	COLOR	MEANING
SINGLE	White	CAT 3 capability available, with FAIL PASSIVE condition.
DUAL	White	CAT 3 capability available, with FAIL OPERATIONAL condition.

Third line

DISPLAY	COLOR	MEANING
MDA/MDH XXX	White Blue	Minimum descent altitude or minimum descent height as inserted by the pilot on PERF APPR page.
DH XXX/NO DH	White Blue	Decision height as inserted by the pilot on PERF APPR page. NO DH: when NO inserted on PERF APPR page.

AP/FD – A/THR ENGAGEMENT STATUS (FMA COLUMN 5)

First line

DISPLAY	COLOR	MEANING
AP 1 + 2	White	Autopilot 1 and 2 are engaged.
AP 1	White	Autopilot 1 is engaged.
AP 2	White	Autopilot 2 is engaged.

Second line

DISPLAY	COLOR	MEANING
X FD Y	White	X and Y give the FD engagement status on PFD 1 and PFD 2. X and Y can be 1, 2, –. – : no FD is engaged on the corresponding PFD 1 : FD 1 is engaged. 2 : FD 2 is engaged. e.g. : the normal status (FD 1 and 2 are engaged) is 1FD2.

Third line

DISPLAY	COLOR	MEANING
A/THR	White	A/THR is active.
A/THR	Blue	A/THR is armed and not active.

SPECIAL MESSAGES (FMA COLUMNS 2 AND 3)

Three types of messages are displayed on the third line :
– first priority is given to F/CTL messages
– then vertical FM messages
– then EFIS reconfiguration messages

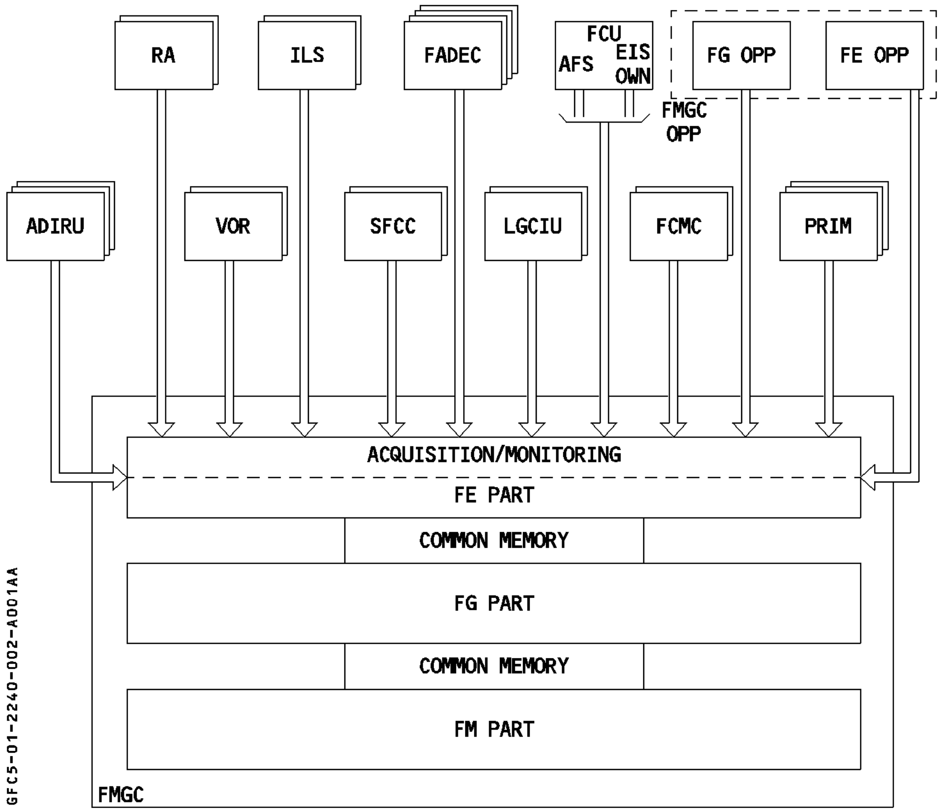
DISPLAY	COLOR	CONDITIONS
MAN PITCH TRIM ONLY	Red	Displayed in case of loss of L + R elevators.
USE MAN PITCH TRIM	Amber	F/CTL are in direct law or in flare law with dual RA failure.
CHECK APP SELECTION	White	The aircraft is in cruise at less than 100 NM from the top of descent or in descent or in approach and: – a non ILS approach has been selected. – an ILS frequency is tuned on the RAD NAV page
SET MANAGED SPEED	White	The SPEED target is selected and a preselected SPEED does not exist for the next flight phase
SET GREEN DOT SPEED	White	The aircraft is in Engine Out mode and the SPEED target is selected. This message is displayed if: the FCU selected speed is : ≤ Green Dot – 10 kt or ≥ Green Dot + 10 kt except in ALT*, ALT mode
SET HOLD SPEED	White	The aircraft is in selected SPEED control, an HM leg is inserted in the F-PLN and the aircraft is 30 seconds before the deceleration zone to the precomputed HOLD SPEED.
DECELERATE	White	This message is displayed if the thrust is not reduced when passing the top of descent, and the aircraft is above the flight profile.
EXTEND SPD BRK	White	DES mode is engaged, idle is selected, and: – either the aircraft is above the vertical profile and the predicted intercept point of the theoretical profile is at less than 2 NM from the next ALT CSTR and the predicted aircraft altitude at next ALT CSTR is greater than ALT CSTR – 500 feet. – or in auto speed control if the aircraft enters in an speedbrake decelerating segment (next speed limit or speed constraint)
RETRACT SPD BRK	White	Speedbrakes are extended, DES mode is engaged and : – ALT* or ALT mode engages or – aircraft is below the path. – CONF 3 or FULL is reached.
EFIS SINGLE SOURCE 1 or EFIS SINGLE SOURCE 2	White	CAPT and F/O Display Units are fed by the same source : either captain side source (1) or first officer side source (2). Range and mode selections can be done only by the appropriate side.
EFIS SWTG NOT ALLOWED	Amber	EFIS configuration selected by the pilot is not allowed: DMC 1 for F/O Display Units or DMC 2 for CAPT Display Units, and conditions for "EFIS SINGLE SOURCE" not fulfilled.

GENERAL

The Flight Envelope (FE) part of the FMGS performs the following functions:
- acquisition and monitoring of parameters used by FE and FG parts
- characteristic speeds computation
- back-up weight and CG computation
- aft CG monitoring
- windshear detection

ACQUISITION / MONITORING

Acquisition and monitoring of buses common to FM, FG or FE are performed by the FE.
Only ARINC buses specific to the FM part are acquired by the FM itself.
Dialogue between FM, FG and FE is achieved through common memories.



The FE function generates the following information:
– flight / ground conditions (LGCIU / SFCC)
– flap / slat configuration (SFCC)
– engine configuration (FADEC)
– ADR / IR parameters after filtering and consolidation (used by the control laws).

CHARACTERISTIC SPEEDS COMPUTATION

FE part computes the characteristic speeds and sends them to:
- the FG which uses them as limits for guidance modes
- the EFIS for display on the PFD speed scale

The following speeds are computed:

R **Minimum speeds**

R – **VLS**
R (Refer to 3.04.10)

R – **Maneuvering speeds F, S, O (green dot)**
R (Refer to 3.04.10)

WEIGHT AND CENTER OF GRAVITY COMPUTATION

The FMGC uses the weight and center of gravity from the FCMC (Fuel Computer) when available.
The GW and CG computed by the FE part are used:
– as back-up in case of dual FCMC failure.
– to trigger the aft CG caution and warning signals (independently of the FCMC).

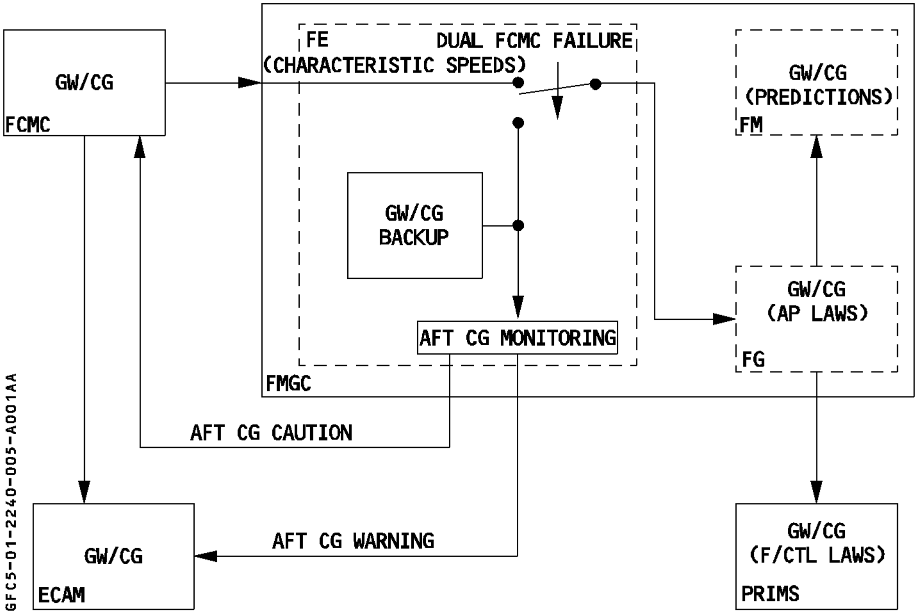
FE Weight computation (back up)
– When the aircraft is below 14625 feet and 255 knots :
R GW = f(α, CAS, N1/EPR actual, CG from FE part, altitude)
– When the aircraft is above 14625 feet or 255 knots :
GW = TOGW – WFU
TOGW: takeoff gross weight
WFU: weight fuel used acquired from FADECs.

FE Center of gravity computation (back up/aft cg computation)
The CG is computed from the position of the horizontal stabilizer and is function of the N1/EPR, Vc, ALT, MACH and GW from FE part.

AFT CG MONITORING

The flight envelope uses only its own computed gross weight (GW) and center of gravity (CG) to trigger the aft CG signals.
The current CG is compared to the aft CG limit computed from the GW.
If the CG > CG limit –1 %, an aft CG caution signal is sent to the FCMCs. The target CG is then shifted forward by 1.5 % (only one time). If the CG becomes higher than the CG limit the aft CG warning signal is sent to the FWCs which trigger a red warning.

R



R *Note : AFT CG monitoring is available above 20 000 feet if the aircraft is in clean*
R *configuration with speed brakes retracted.*

WINDSHEAR DETECTION

A windshear detection signal is generated whenever the aircraft encounters a windshear and the predicted energy level falls below a predetermined safe minimum energy threshold (reactive windshear detection).

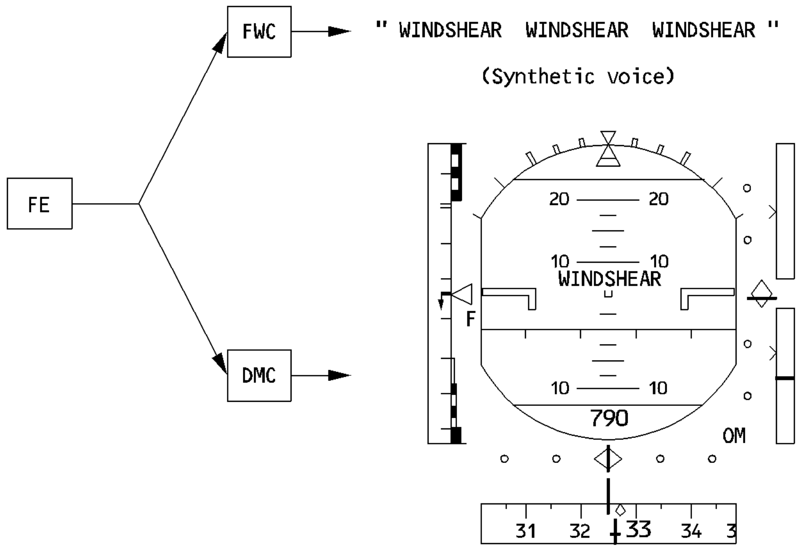
Note : *The energy threshold is expressed as an angle of attack threshold αo.*
The aircraft predicted energy level is $\alpha + \Delta\alpha$ where :
- *α is the current angle of attack*
- *$\Delta\alpha$ is the equivalent AOA computed from measured vertical drafts and longitudinal shears.*

If $\alpha + \Delta\alpha > \alpha o$ the windshear conditions are detected.

The windshear detection function is provided in takeoff and approach phase under the following conditions :
- At takeoff, from lift off up to 1300 feet
- At landing from 1300 feet to 50 feet.
- With at least CONF 1 selected.

The warning consists of :
- a visual "WINDSHEAR" red message displayed on both PFDs for a minimum of 15 seconds.
- an aural synthetic voice announcing "WINDSHEAR" three times.

R



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GENERAL

The FMS ACARS function gives an interface between a ground station and one onboard FMGC, allowing data transmission between these two computers via the ACARS Management Unit.
Two different sets of message can be exchanged :
UPLINK messages from the ground station. They consist in reception of data requested or directly sent to the crew.
DOWNLINK messages from the FMGC (master). They consist in reports or requests sent to the ground station.
The FMGS/ACARS interface enables the following ACARS capabilities.

- F-PLN initialization (flight plan and performance data)
- Takeoff data
- Wind data
- Flight reports
- Broadcast data

Crews can send message using ACARS function pages or relevant MCDU pages.
Only one FMGC talks to the ground station. This FMGC is called FMGC “master”.

GENERAL SCRATCHPAD MESSAGES

NOT XMITTED TO ACARS	:	A crew request or report was sent to the ground but the communication was not established or not acknowledged.
NO ANSWER TO REQUEST	:	A crew request was previously sent to the ground and no answer (uplink message) was received within 4 minutes.

FLIGHT PLAN INITIALIZATION FUNCTION

This function enables lateral and vertical flight plan data as well as performance data to be exchanged between the aircraft and a ground station. The aircraft may send flight plan requests for active and secondary flight plan. (downlink messages). The ground station may send flight plan and performance data (uplink messages) either under aircraft request or automatically without any request.
Each uplink message concerns either the active or secondary flight plan but never both flight plans at the same time. The data sent to the aircraft are checked for flight plan consistency.
A MCDU message comes up when an uplink message is received. "ACT (or SEC) RTE UPLINK".
If an error prevents the decoding process of the message, "INVALID RTE UPLINK" is displayed on MCDUs.
Au uplink message can be routed to the active flight plan if no engine is started and no active flight plan exists. Otherwise, it is routed to the secondary. The crew will insert it into the secondary flight plan or will reject it using the CLR key.

<u>Note</u> : *The flight plan may also be initialized using the ACARS function page selected from DATA INDEX page.*

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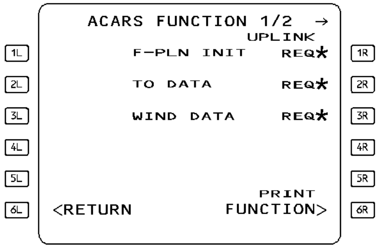


ACARS FUNCTION PAGE 1
(FROM DATA INDEX)

PERFORMANCE DATA

On ground and before engine start, the ground station may also send performance data to the aircraft.
Performance data are always associated with the uplink flight plan. It is either automatically inserted with the active flight plan data, or stored in the secondary with the corresponding flight plan.
This message contains part or all of the following data :
ZFW, ZFWCG, taxi fuel, block fuel, cruise flight level, tropopause altitude, cruise temperature, transition altitude, cost index, performance factor.

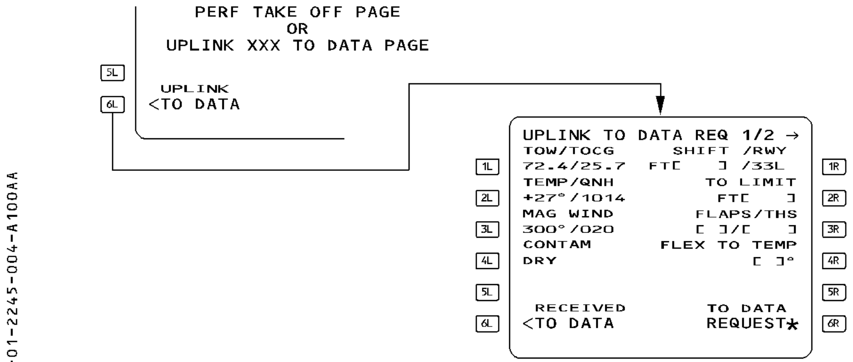
Note : After engine start an uplink performance data message is rejected automatically without any scratchpad message.

SCRATCHPAD MESSAGES RELATED TO FLIGHT PLAN AND PERFORMANCE

INVALID RTE UPLINK	An error is detected, the uplink message is rejected.
ACT or SEC RTE UPLINK	A F-PLN is stored in the active or secondary flight plan.
FLT NUMBER UPLINK	FLT NBR has been initialized within a F-PLN message without previous request.
CHECK FLT NUMBER	The uplinked FLT NBR differs from the one specified in the request.
CHECK CO RTE	The uplinked CO RTE ident differs from the one specified in the request.
INVALID FLT NBR UPLINK	The uplink contains a valid F-PLN but the FLT NBR is invalid.
PERF DATA UPLINK	Performance data is received
INVALID PERF UPLINK	Performance uplink message has been rejected
RTE DATALINK IN PROG	A flight plan modification is performed after a F-PLN INIT request has been sent ; this message is displayed until the uplink is received.
UPLINK INSERT IN PROG	This message is displayed during insertion of a Flight Plan.

TAKEOFF DATA FUNCTION

The takeoff data function is available for the active flight plan only. It is used to request to the ground station, information data for up to 2 runways and to receive this data for up to 4 runways.
The crew sends a request indicating the departure airport, runway idents, CG, GW and weather conditions (such as baro setting wind, temperature...). In response he receives the takeoff speeds for up to 4 runways but only one set of data may be inserted in the active flight plan for the selected active runway.
Takeoff speeds are computed for max and flex takeoff.
The takeoff data function has required the modification of the standard PERF TAKEOFF page and the addition of 2 news pages :
· UPLINK TO DAT REQ page that enables the crew to specify a request to the ground.
· UPLINK XXX TO DATA page (XXX for MAX or FLEX)
These 2 pages are accessed from the PERF TAKEOFF page in PREFLIGHT and DONE phase only.



UPLINK TO DATA REQ PAGE
WITH DEFAULTED VALUE.

SCRATCHPAD MESSAGES RELATED TO TAKEOFF DATA

TAKEOFF DATA UPLINK	:	Takeoff data uplink message is received
INVALID TAKEOFF UPLINK	:	The UPLINK message is rejected

WIND DATA FUNCTION

This function enables the crew to request and to receive forecasted winds associated to the active or secondary flight plan.
The uplink message (ground station to aircraft) may be received upon crew request or automatically without crew request.
The request is initiated from WIND pages or from ACARS FUNCTION page (Refer to 4.03.20).
The uplink wind data when received are directly displayed on the wind pages but not inserted in the flight plan, one set for each flight phase : CLIMB, CRUISE, DESCENT. The alternate wind at alternate cruise flight level is displayed on DESCENT page.
* Winds are associated to altitude for climb an descent phases
* Winds are associated to four altitudes for each waypoint for cruise phase and step level.
  - On ground and without entered winds (except the trip wind), an uplink message is directly inserted in the flight plan.
  - In flight, winds are temporarily stored until the crew inserts them phase per phase. Phase of flight is indicated in the WIND title page.
  - Clearing the INSERT UPLINK* prompt using the CLR key deletes the uplink wind data for the selected phase.

When uplink winds are deleted, the wind page reverts to the previous status.
The flight plan B page is modified of the uplink wind only after it is inserted by the crew. ACARS uplink winds are then considered as crew manual entries (large font).

SCRATCHPAD MESSAGES RELATED TO WIND DATA

INVALID WIND UPLINK	An error is detected, the uplink is rejected.
WIND DATA UPLINK	Uplinked winds are received.
WIND UPLINK PENDING	A temporary flight plan exists or a DIR TO page is displayed when a wind uplink is received. The message is stored.
WIND UPLINK EXISTS	A F-PLN modification (active or secondary) is attempted when uplink winds are not inserted. This message disappears automatically when the wind uplink is inserted or deleted.
CHECK DEST DATA	The aircraft is at 180 NM from destination, and the destination QNH, TEMP or WIND displayed on the PERF APPR page was received by ACARS uplink or, if following insertion of a descent wind uplink, a conflict concerning the above parameters exists.
CHECK ALTN WIND	The uplinked alternate cruise flight level differs from the default alternate cruise flight level.

FLIGHT REPORTS

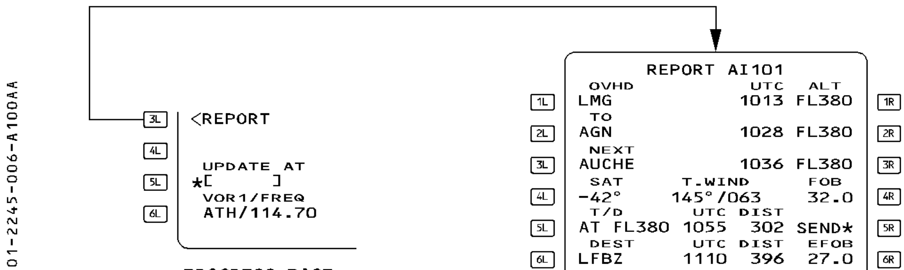
Flight reports provide real time information to the ground concerning the aircraft current situation and position.
Several types of flight reports are available :
- The Position report : provides current aircraft position
- the Progress report : provides data relative to the destination
- The Flight-Plan report : provides the active route
- the Performance Data report : provides performance data currently used by FMS.

These reports may be manually initiated via a dedicated prompt or automatically sent in response to a ground request or upon specific conditions.

POSITION REPORT

This report is sent :
- manually via a MCDU prompt or
- following a ground request or
- automatically upon sequencing a designated reporting fix (designated by the ground in a uplink message).

The manual POSITION REPORT downlink prompt is displayed on the REPORT page POS prompt.



PROGRESS PAGE

REPORT PAGE

Note : Position report are initiated from active flight plan only.

POSITION report content

The downlinked message contains exactly the REPORT page data.

PROGRESS REPORT

A progress report contains data relative to the aircraft arrival time and EFOB at destination for the active F-PLN.
This downlink message is automatically sent following :
- a ground request or
- a change of destination or
- a change of runway or
- a specific event. The possible events that can be selected in the navigation database policy file are :
  - X minutes to Top of Descent
  - Z minutes to Destination
  - ETA changes more than W minutes from the previous report.
    X, Z and W are minutes of time set in the navigation database policy file.

The progress report cannot be manually sent by the crew via a dedicated MCDU prompt.

PROGRESS report content

- Flight Number
- Arrival Airport Ident
- Destination Runway Ident
- Predicted remaining fuel
- ETA at destination
- Reason for report (specific event, ground request...).

FLIGHT PLAN REPORT

The F-PLN report broadcasts flight plan data to the ground. Only data from the active flight plan can be sent.
This downlink message is sent to the ground :
- automatically following a ground request
- manually by the crew using a prompt displayed on the ACARS FUNCTION page. (Refer to ACARS page description). This prompt may be invalidated through the navigation database policy file.

The Flight Plan report can be downlinked either while on ground or in flight during any flight phase.

FLIGHT PLAN report content

The report contains the active and alternate flight plan.

PERFORMANCE DATA REPORT

The Performance Data report is a downlink message that allows the transmission of performance data (GW, FUEL, CG...) relative to the active F-PLN.
This message is automatically sent following a ground request. Manual sending is not possible.

PERFORMANCE DATA report content

Sends to the ground :
- Current GW
- Cruise Altitude
- Current CG
- Fuel on Board
- Block Fuel
- Reserve Fuel
- Cost Index
- Top of Climb Temperature
- Climb Transition Altitude
- Tropopause Altitude
- Taxi Fuel
- ZFW
- ZFWCG

PRINT FUNCTION

The print function enables several types of data and report to be printed :
* Flight plan initialization data
* Takeoff data
* Wind data
* Preflight report
* In flight report
* Post flight report

The 3 first reports may differ when automatically or manually printed for the following reason :
The automatic process prints the uplink message although the manuall process prints the current active data as displayed on the relevant MCDU pages.
The last 3 reports being processed from the same sources are identical in automatic or manual printing.

Note : *ACARS is not necessary linked to printing process. The printing function may be activated within the FMGS and selected independently from the ACARS.*

- One or several print functions may be deactivated (refer to PRINT FUNCTION PAGE).
- If an ACARS function is not active, (not selected in the nav database policy file) the printing process is invalidated for this specific ACARS function.

ACARS/PRINTER PROGRAMMING OPTIONS ◁

Option programming for the ACARS/PRINTER functions is obtained through the Navigation Data Base policy file.
The list summarizes the possible options :

ACARS Inhibit	Disables ACARS function
F-PLN Data Request Inhibit	Disables uplink and downlink requests of F-PLN initialization data
Performance Data Request Inhibit	Disables uplink and downlink requests of Performance Initialization data
Takeoff Data Request Inhibit	Disables uplink and downlink request of Takeoff Initialization data
Wind Data Request Inhibit	Disables uplink and downlink request of predicted wind data
Flight Number Enable	Flight Number is included within the F-PLN Request or Progress Report downlinks
Position Report Inhibit	Disables a manual Position Report downlink
Progress Report Triggers	Defines the triggers for the automatic downlink of the Progress Report
F-PLN Report Inhibit	Disables the manual downlink of the F-PLN Report
Auto Print of ACARS uplink	Selects/Deselects the automatic printing of the F-PLN, INIT, TO and wind data uplinks. If Autoprint is selected, the crew can deselect it manually. If auto printing is deselected, the crew cannot manually reselect it.
Auto Print of Flight Reports	Selects/Deselects the automatic printing of the Preflight, Inflight, Postflight reports. If selected, the crew can deselect it manually. If autoprint is deselected, the crew cannot manually preselected it.

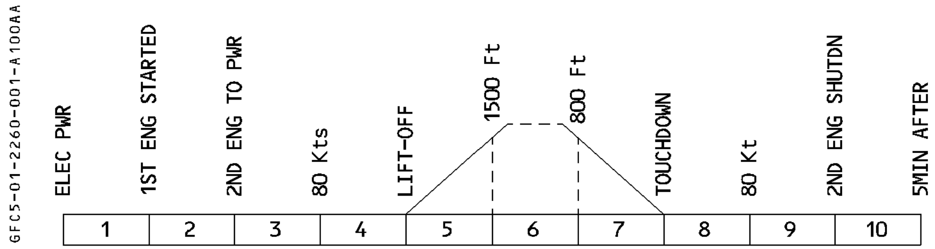
DESCRIPTION

The Fault Isolation and Detection System (FIDS) is installed in FMGC 1. The system achieves the following functions:

— detection and memorization of all internal and external failures
— tests initiation

The FIDS serves as the system BITE (maintenance data concentration).
It is connected to the BITE's of the various AFS computers (FM, FG, FE, FCU, MCDU) and linked to the CMS.
Display and interrogation of FIDS function are done by selecting appropriate key on the MCDU page.

WARNINGS AND CAUTIONS



R

<table>
<tr><th>E / WD: FAILURE TITLE
condition</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNINGS</th><th>FLT PHASE INHIB</th></tr>
<tr><td>AP OFF
Involuntary disconnection (Refer to 1.22.30).</td><td>CAVALRY CHARGE</td><td>MASTER WARN</td><td rowspan="12">NIL</td><td rowspan="2">NIL</td><td>NIL</td></tr>
<tr><td>A / THR OFF
Involuntary disconnection (Refer to 1.22.30).</td><td>SINGLE CHIME</td><td>MASTER CAUT</td><td>1,4,8,10</td></tr>
<tr><td>WINDSHEAR
(NO ECAM message)</td><td>SYNTHETIC VOICE “WINDSHEAR” repeated 3 times</td><td rowspan="3">NIL</td><td>WINDSHEAR on PFDs</td><td>2,3,4
8,9</td></tr>
<tr><td>FM1 or 2 FAULT</td><td rowspan="2">NIL</td><td>MAP NOT AVAIL on related ND</td><td rowspan="2">3,4,5
7,8</td></tr>
<tr><td>FM1 + 2 FAULT</td><td>MAP NOT AVAIL on NDs</td></tr>
<tr><td>A/THR LIMITED
A/THR is active, the thrust levers are not in the CLB or MCT detent.</td><td rowspan="3">SINGLE CHIME</td><td rowspan="3">MASTER CAUT</td><td rowspan="7">NIL</td><td>all except 6</td></tr>
<tr><td>FCU FAULT
Loss of two channels, or complete loss of the FCU.</td><td>4,5</td></tr>
<tr><td>REAC W/S DET FAULT
Windshear detection function is inoperative.</td><td>1,3,4,5
8,10</td></tr>
<tr><td>LOW ENERGY
(No ECAM message). Available between 100 and 2 000 feet.
Thrust must be increased.</td><td>SYNTHETIC VOICE “SPEED” repeated 3 times</td><td rowspan="2">NIL</td><td>1 to 4
8 to 10</td></tr>
<tr><td>– ILS Capability downgrade. Conditions required for CAT3, CAT2 are no longer fulfilled (Refer to 4.05.70).
– Mode reversions (Refer to 1.22.30).</td><td>TRIPLE CLICK</td><td rowspan="2">2, 3, 4
5, 8, 9
10</td></tr>
<tr><td>AUTOLAND (no ECAM message)
Available below 200 feet RA.</td><td>NIL</td><td>AUTO LAND (red)</td></tr>
<tr><td>FM/IR POS DISAGREE msg.
Discrepancy is detected between any FM position and IRS position.</td><td>SINGLE CHIME</td><td>MASTER CAUTION</td><td>1, 2, 3,
4, 5, 7
8, 9, 10</td></tr>
</table>

MEMO DISPLAY

FM SWTG is displayed in green when the FM switching sel is on BOTH ON 1(2) position.

BUS EQUIPMENT LIST

R

		NORM			EMER ELEC		
		AC	DC	DC BAT	AC ESS	DC ESS	HOT
FMGC	1					SHED	
	2		DC2				
FCU	A and B					X	
	C		DC2				
MCDU	1				SHED		
	2	AC 2					
	3				GND		
Sidestick locking						SHED	
Rudder artificial feel						SHED	

23.00 CONTENTS

23.10 RADIO COMMUNICATION

23.20 INTERCOMMUNICATION SYSTEMS

R **23.22 EMERGENCY COCKPIT ALERTING SYSTEM ◁**

23.30 COCKPIT VOICE RECORDER

23.35 EMERGENCY LOCATOR TRANSMITTER CONTROL

23.40 ACARS ◁

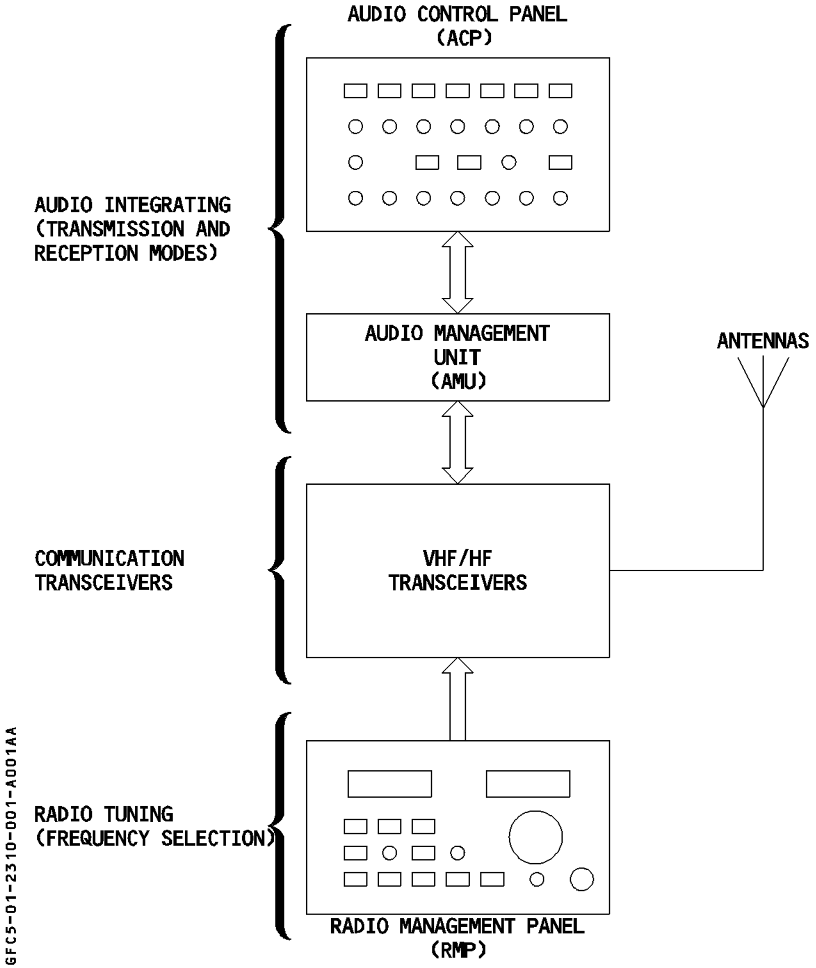
23.45 SATCOM ◁

23.50 WARNINGS AND CAUTIONS

23.60 ELECTRICAL SUPPLY

GENERAL

The communications system comprises the following subsystems:
- VHF / HF transceivers
- Radio tuning systems (Radio Management Panels)
- Audio integrating system (Audio Management Unit, Audio Control Panels)



VHF / HF / SELCAL

Each transceiver may be tuned by any of the three Radio Management Panels (RMPs). To transmit, the flight crew uses the Audio Control Panel (ACP) to select a VHF or HF system. The ACP works through the Audio Management Unit (AMU).
Each system is connected to the RMPs, for frequency selection, and to the AMU.

– **VHF**
Three identical VHF communication systems are installed. Each system has a transceiver in the avionics compartment, and an antenna on the fuselage. Only VHF 1 functions in EMER ELEC CONFIG. The range is from 118.0 to 136.975 MHZ. The VHF has an alarm to indicate that the microphone is stuck (⧏).
If a microphone is in the emission position for more than 30 seconds, an interrupted tone sounds for 5 seconds, and the emission is turned off. To reactivate the emission, the crew releases the push-to-talk button and presses it again.

– **HF**
Two HF radios (HF), with a range of 2.8 to 24.0 MHz, are installed. They are used for long- distance voice transmissions. HF1 is also used for data communications. Each system includes a transmitter receiver, installed in the avionics compartment, a tuner and a common antenna located in the vertical stabilizer. Only HF1 is supplied in EMER ELEC CONFIG. It is lost when LAND RECOVERY is selected ON.
When in data mode, digital information is transmitted between HF1 and ATSU.
HF transmission is inhibited on ground. A GND HF DATALINK pushbutton, located on the overhead panel, may override the inhibition. HF must not be used during refueling.

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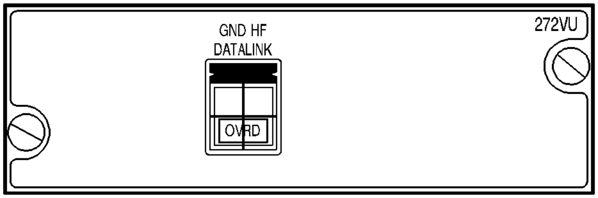
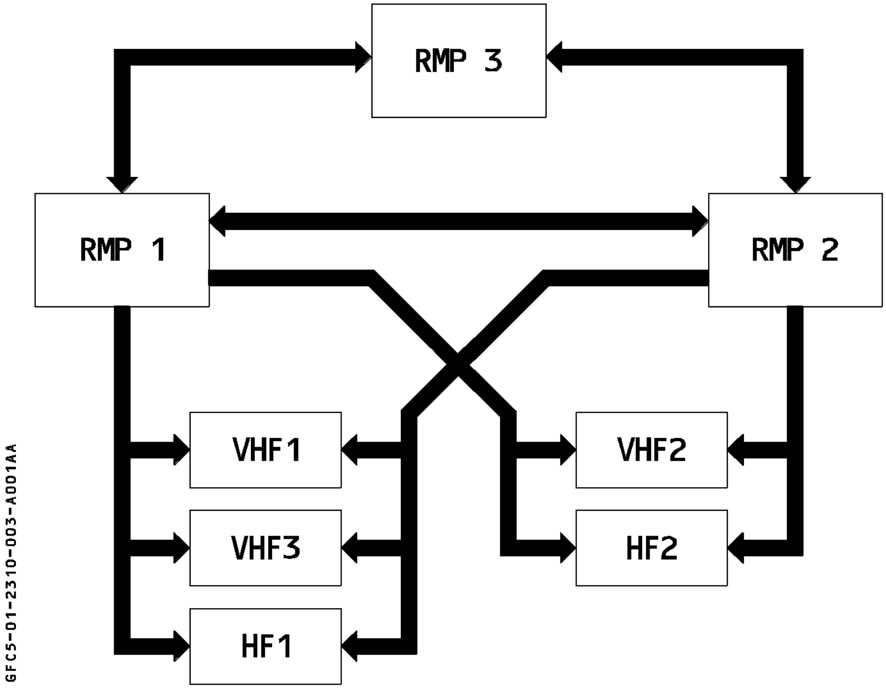


– **SELCAL (Selective Calling)**
Upon receiving a call code corresponding to that of the aircraft, the SELCAL system aurally and visually advises the flight crew that a ground station is calling the aircraft.
R The aural signal is inhibited during takeoff and landing.

RADIO TUNING

DESCRIPTION

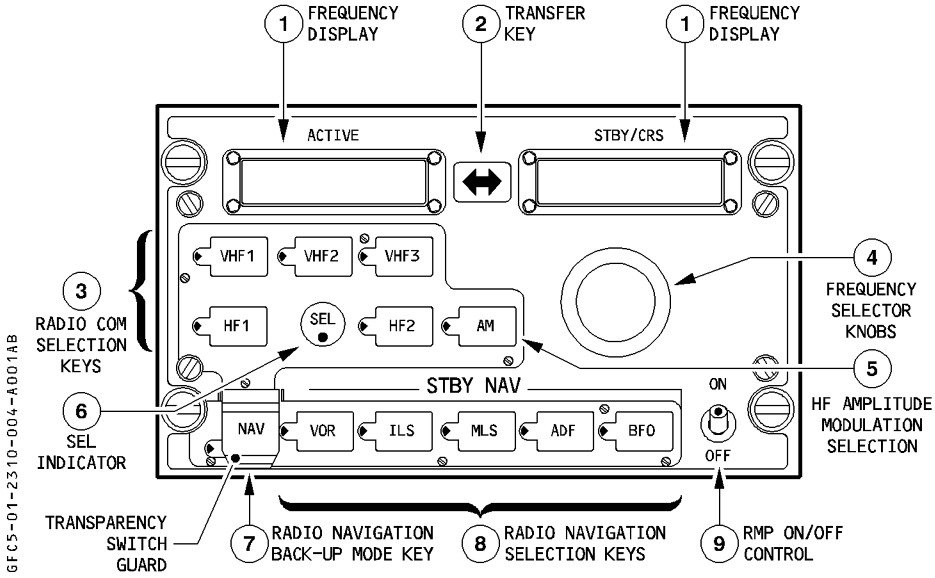
Identical RMPs :
· Give the flight crew control of all radio communication systems (VHF and HF frequency control).
· Back up to FMGCs for controlling radio navigation systems (Refer to 1.34)
Two RMPs are on the center pedestal and the third on the overhead panel.
Each RMP can control any VHF or HF transceiver. RMP1 and 2 are connected directly to all VHF and HF transceivers, whereas RMP3 is connected to them via RMP1 and 2. RMPs are connected together so that each RMP is updated to the selections made on other RMPs.
Only RMP1 functions in EMER ELEC CONFIG.



If two RMPs fail, the remaining one controls all the VHF and HF transceivers.
If ACARS is installed, do not use VHF 3 for voice communication ◁.

RADIO MANAGEMENT PANEL

R



(1) Frequency displays

· The ACTIVE display window shows the active frequency of the selected radio, which is identified by a green light on the selection key.
· The STBY/CRS (standby / course display) display window shows a standby frequency that the pilot can activate by pressing the transfer key or change by rotating the tuning knobs.
For a description of the CRS function (see 1.34).

(2) Transfer key

Pressing this key moves the active frequency to the standby window and the standby frequency to the active window.
This tunes the selected receiver to the new active frequency.

(3) Radio comm. selection keys

When the pilot presses one of these keys :
· The ACTIVE window displays the frequency set on that radio.
· The STBY/CRS window displays the selected frequency or course.
· The selected key displays a green monitor light.

(4) Frequency selector knobs

Selects STBY frequency or CRS.
Inner knob controls decimal values and outer knob the whole values.

(5) AM pb sw

Operative only if an HF transceiver has been selected.
Controls the selection of the AM mode for HF transceivers.
By default the SSB (Single Side Band) mode is selected.
Green monitor light illuminates.

(6) SEL indicator

When a transceiver normally associated with a RMP is tuned by another RMP:
· VHF1 tuned by RMP2 or 3,
· VHF2 tuned by RMP1 or 3,
· VHF3, HF1, HF2 tuned by RMP1 or 2
the SEL indicator illuminates white on both RMPs.

(7) NAV pb sw (transparent switchguard)

When depressed radio navigation selection is in back up mode. Radio Communication selection is not affected. (Refer to 1.34 chapter).

(8) Radio navigation selection keys

When depressed, green monitor light illuminates.
(Refer to 1.34).

(9) ON / OFF sw

Controls the power supply of the RMP.

Note : When RMP1 or 2 is OFF, RMP3 is still able to control VHF / HF transceivers through them.

GENERAL

Intercommunication is divided into two main systems:
- the audio management system.
- the cabin intercommunication data system.

AUDIO MANAGEMENT SYSTEM

The audio management system allows the flight crew to use :
- all the radio communication and radio navigation facilities installed on the aircraft in transmission and reception mode.
- the interphone systems
- the call systems
- the passenger address system

The audio management system includes:
- an audio management unit (AMU)
- four audio control panels (ACPs)
- sockets at each pilot's station
  - headset jack, boomset connector and hand microphone connector for pilot, copilot, third and fourth occupant
  - headset jack for the fourth occupant
- one interphone jack socket at the ground power receptacle
- boomsets for the pilot, copilot, third and fourth occupant, and four hand microphones,
- three cockpit oxygen mask microphones
- one radio press–To–Talk switch on each sidestick
- one SELCAL code selection panel
- two cockpit loudspeakers with separate volume controls
- an audio switching facility

If audio channel 1 or 2 fails due to a failure either in an ACP or the corresponding AMU, the crew can use the AUDIO SWITCHING selector to select the third audio channel.

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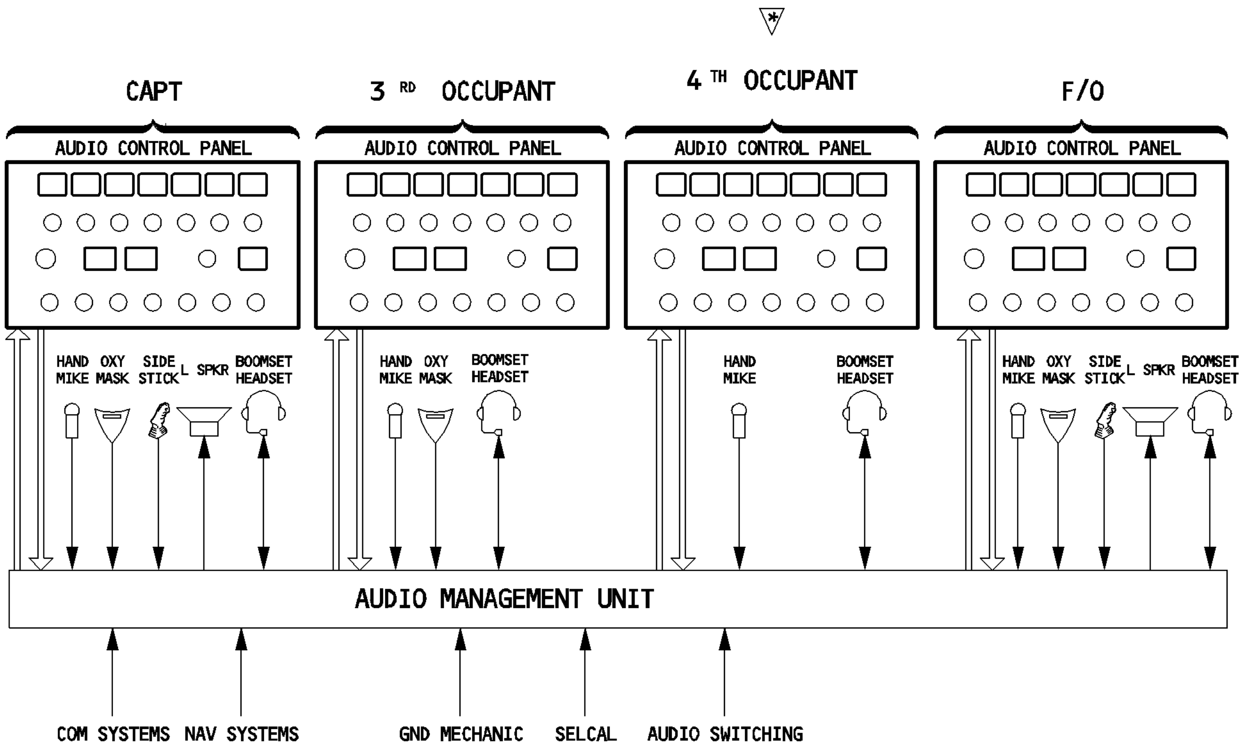
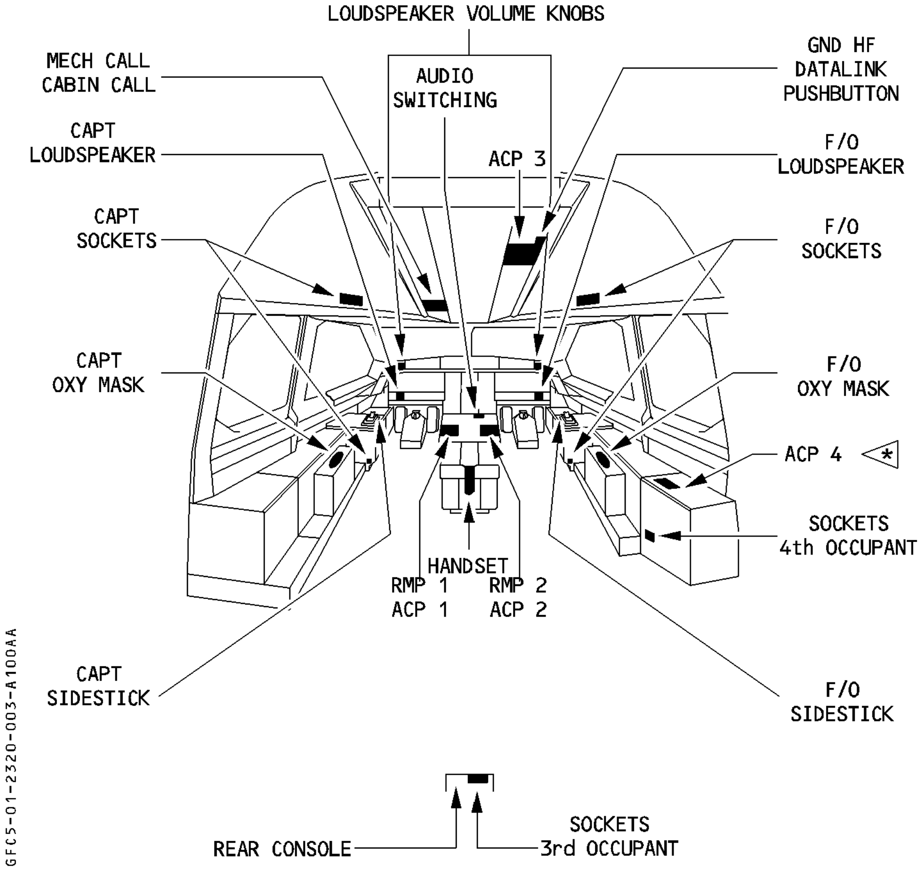


COMPONENTS' LOCATION

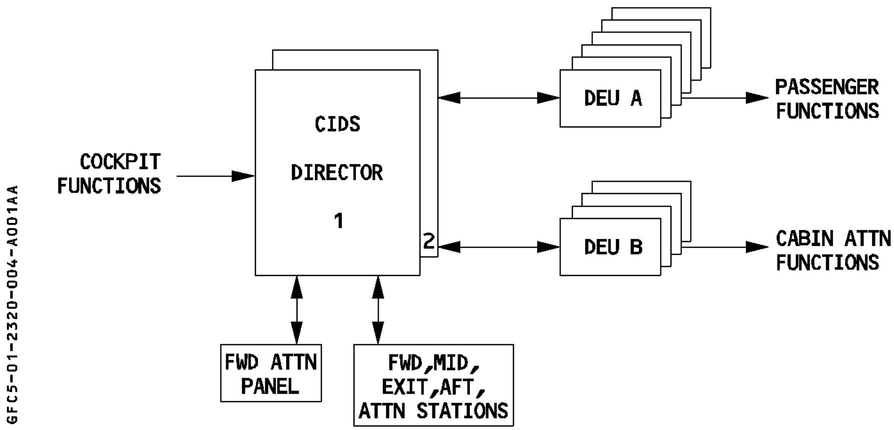


CABIN INTERCOMMUNICATION DATA SYSTEM

The Cabin Intercommunication Data System (CIDS) provides signal transmission, controls and processes signals for the following cabin systems :
- cabin and service interphone
- passenger address
- passenger signs
- reading light
- general cabin illumination
- emergency evacuation signalling
- lavatory smoke indication
- passenger entertainment music and video

The CIDS has the following main components:
- two CIDS directors connected in parallel, one active and the other in standby.
- forward attendant panel for control of the cabin systems.
- programming and test module that allows the system to be reprogrammed after changes are made in the cabin configuration.
- attendant stations (FWD, MID, EXIT, AFT).

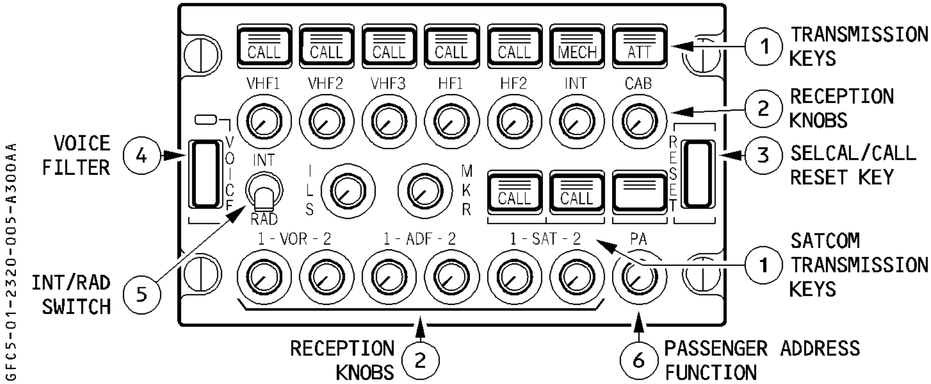
FOR INFO



Decoder/Encoder Units (DEUs) are linked to the two directors.
- *Type A units (for passengers): installed in three rows (left, center, right).*
  The loudspeakers, lighted signs, call buttons, call lights and general illumination ballast units are divided into small groups each connected to a type A DEU.
- *Type B units (for attendants) are installed on each cabin side. The area call panels, attendant handsets, slide and door pressure sensors, and attendant indicator panels are connected to type B DEUs.*

CONTROLS

AUDIO CONTROL PANEL



① Transmission keys

Pressed	:	The associated channel is selected for transmission. The three green lines come on. The pilot deselects the channel by pressing the pushbutton again, or by selecting another channel.
CALL lt	:	The legend flashes amber (and buzzer sounds) when the SELCAL system detects a call.
MECH lt	:	The legend flashes amber (and buzzer sounds) for a call from the nose gear bay. The MECH light goes off after 60 seconds, if it is not reset.
ATT lt	:	The legend flashes amber (and buzzer sounds) for a call from a cabin attendant. The ATT light goes off after 60 seconds, if it is not reset.
SAT CALL lt	:	The legend flashes amber when the SATCOM system detects a call. The three green lines flash during the establishment of air to ground calls, or when SATCOM calls are on hold. After call establishment, the three green lines remain steady.

② Reception knobs

- Pressing and releasing the knob (knob out) selects the associated audio reception channel and the integral white light comes on.
- Rotating the knob adjusts the volume.
- The ANN LT sel controls the brightness.
- Pressing the knob (knob stays in) disconnects the associated audio reception channel.

R *Note : For reception of DME audio navigation signals associated to an ILS or MLS*
R *station, the LS pushbutton on the FCU must also be selected.*

(3) RESET key

Pressing this key extinguishes CALL, MECH and ATT lights and cancells the buzzers.

(4) ON VOICE key

This key allows the flight crew to inhibit the audio navigation signals (VOR, ADF). Pressing this key filters out ident signals and turns on the green ON light.

(5) INT / RAD sw

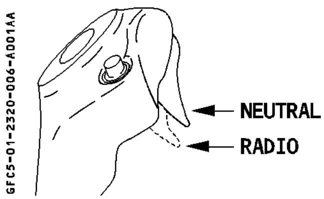
This switch operates as a Push–to–Talk switch for boom or oxygen mask mike.

INT	:	Boom and mask mikes transmit on interphone regardless of which transmission key is selected. For reception on interphone, the crew member must have INT selected (INT reception knob out).
Neutral	:	Reception is normal. Boomset and mask mikes do not transmit.
RAD (press and hold)	:	Boom and mask mikes transmit on the radio selected on the audio control panel.

(6) Passenger adress (PA) function

PA transmission key and reception knob.
(Refer to 1.23.20)

SIDE STICK RADIO SELECTOR

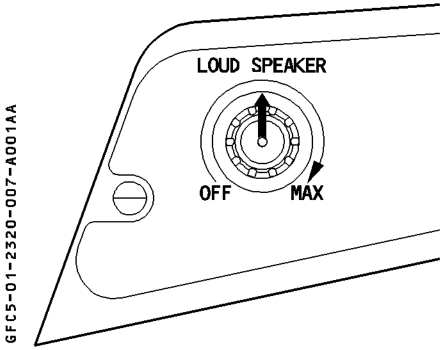


This selector has the same function as the INT / RAD switch on the ACP.

NEUTRAL (spring–loaded)	:	Boom and mask mikes are dead. Reception is normal.
RADIO (aft position)	:	Boom and mask mikes transmit through the equipment selected by the transmission key on the ACP.

Note : If RADIO is selected on the side stick when the INT/RAD switch is on INT, the radio function has priority over the interphone function.

LOUDSPEAKER VOLUME KNOB



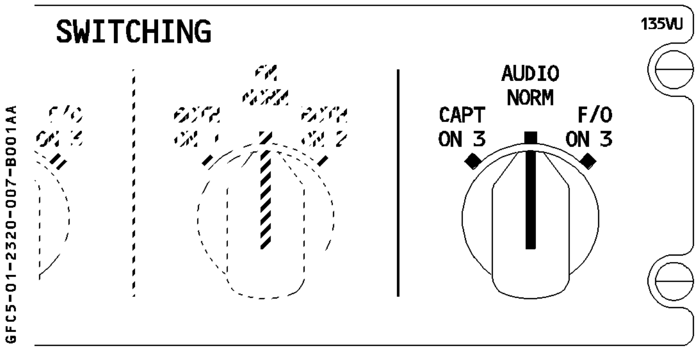
This knob adjusts the volume of the loudspeaker for radio communication.

OFF : Loudspeaker does not respond the signals from the aircraft's radio equipment.

Clockwise rotation : Loudspeaker broadcasts signal from the aircraft's radio equipment at increasing volume.

Note : This knob does not control the loudness of aural alert and voice message.

AUDIO SWITCHING



The crew can switch to the third audio channel if ACP1 or ACP2 fails.
When the crew does this, it takes away the third occupant's access to the acoustic equipment.

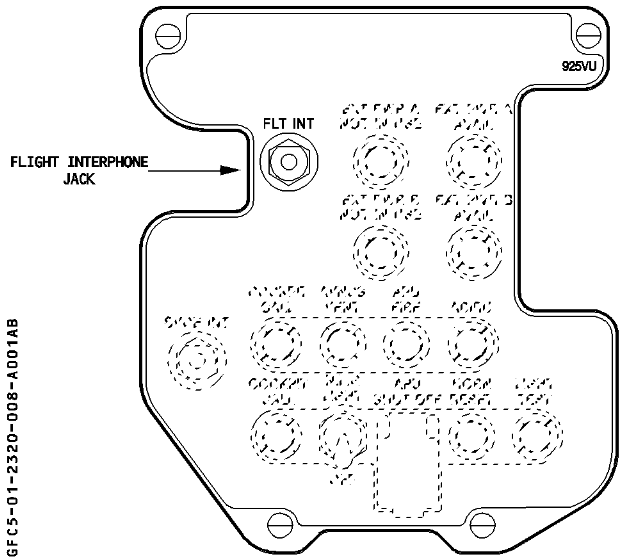
NORM : Each crew member uses his dedicated communication equipment.
CAPT ON 3 : The pilot uses his acoustic equipment and the third occupant's ACP.
F/O ON 3 : The copilot uses his acoustic equipment and the third occupant's ACP.

INTERPHONE SYSTEMS

FLIGHT INTERPHONE SYSTEM

This system allows the flight crew to communicate among themselves and, through a jack on the external power panel, with the ground mechanic.

EXTERNAL POWER PANEL

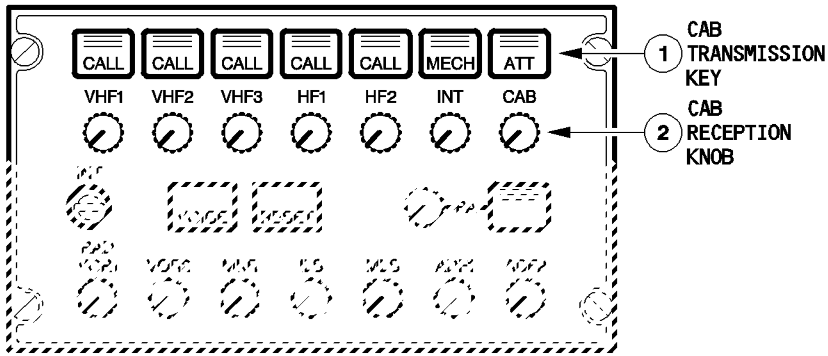


COCKPIT OPERATION FOR GROUND MECHANIC COMMUNICATION

	MECH TRANSMISSION KEY ON ACP	INT RECEPTION KNOB ON ACP	INT/RAD SW ON ACP	PUSH TO TALK ON HANDMIKE
BOOMSET OR OXYGEN MASK	PRESSED	OUT	INT OR RAD (maintained)	
HANDMIKE	PRESSED	OUT		PRESSED

CABIN INTERPHONE SYSTEM

The system provides communication and call facilities between:
- flight crew and attendant stations
- two attendant stations



GFC5-01-2320-009-A001AC

① CAB transmission key

Depressed : Three green lines come on.
Boomset, mask mikes and hand mike may be used for cabin interphone.

② CAB reception knob

Depressed and released (knob out)	:	The integrated white light comes on. Audio signal from cabin is received. Rotate knob to adjust volume.
Depressed (knob in)	:	The white light goes off. Cabin interphone is disconnected.

COCKPIT OPERATION

	CAB TRANSMISSION KEY ON ACP	CAB RECEPTION KNOB ON ACP	INT/RAD SW ON ACP	PUSH TO TALK ON HANDMIKE
BOOMSET OR OXYGEN MASK	DEPRESSED	OUT	RAD	–
HANDMIKE	DEPRESSED	OUT	–	PRESSED

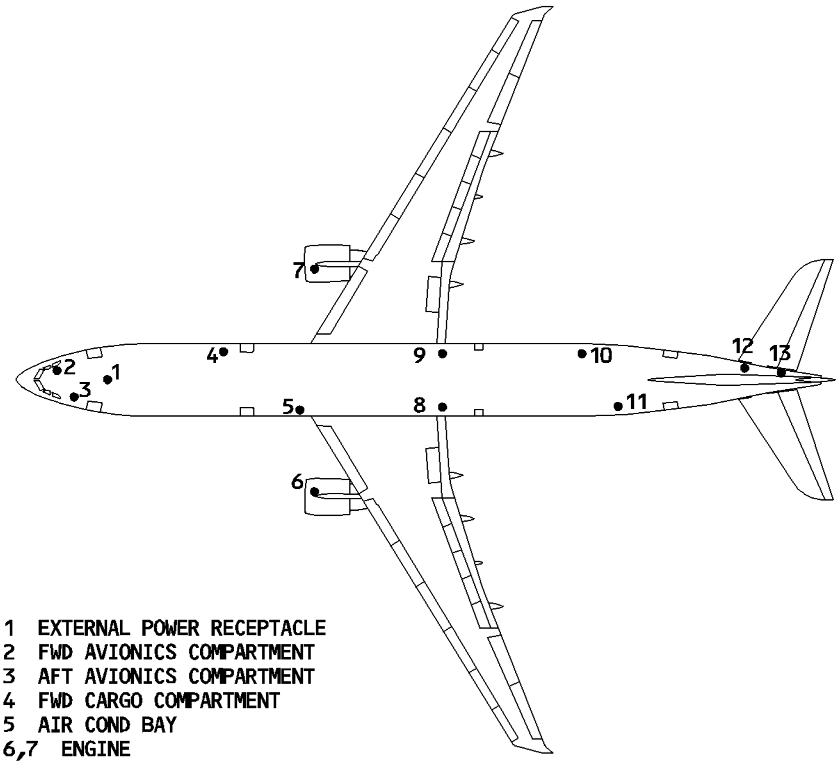
SERVICE INTERPHONE SYSTEM

The system provides communication between:
- the flight crew and the service interphone jacks
- the flight attendant stations and the service interphone jacks
- the different service interphone jacks

The service interphone system comprises:
- thirteen interphone jacks
- an OVRD switch located on the overhead panel

The audio lines from the interphone jacks are connected to both CIDS directors.

LOCATION OF INTERPHONE JACKS

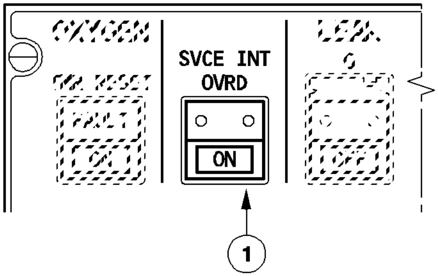


1 EXTERNAL POWER RECEPTACLE
2 FWD AVIONICS COMPARTMENT
3 AFT AVIONICS COMPARTMENT
4 FWD CARGO COMPARTMENT
5 AIR COND BAY
6,7 ENGINE
8,9 HYDRAULIC COMPARTMENT
10 AFT CARGO COMPARTMENT
11 DIGITAL FLIGHT DATA RECORDER
12 TRIM ACTUATOR
13 APU COMPARTMENT

GFC5-01-2320-010-A001AB

CONTROLS AND INDICATORS ON OVERHEAD PANEL

For maintenance purpose only.



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(1) SVCE INT OVRD pb sw

Auto : Ground personnel can communicate with the flight crew by means of the service interphone jacks after the aircraft has landed. The landing gear must be compressed.

ON : Communication is possible when the landing gear is not compressed.
The ON light is white.

COCKPIT OPERATION

	CAB TRANSMISSION KEY ON ACP	CAB RECEPTION KNOB ON ACP	INT/RAD SW ON ACP	PUSH TO TALK ON HANDMIKE	SVCE INT OVRD PB SW
BOOMSET	PRESSED	OUT	RAD (maintained)		ON IF L/G NOT COMPRESSED
HANDMIKE	PRESSED	OUT		PRESSED	

CALL SYSTEMS

GROUND MECHANIC CALL

The system allows the flight crew and the ground mechanics to communicate each other.

CONTROLS AND INDICATORS ON OVERHEAD PANEL

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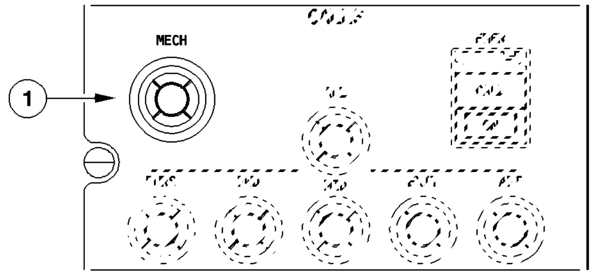
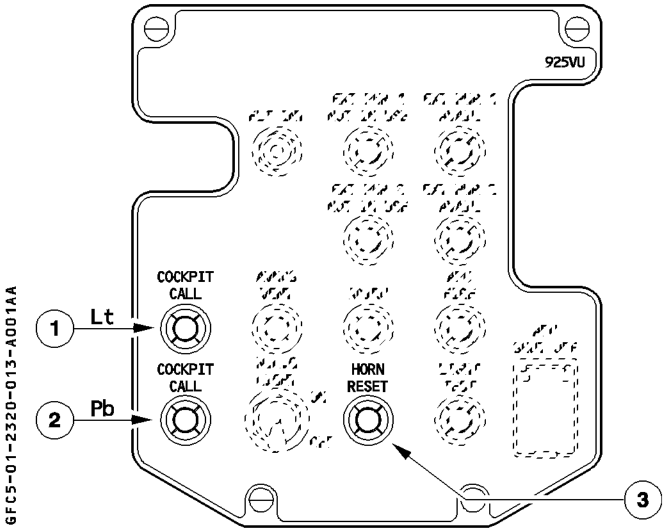


(1) MECH pb

R Pressed (and held) : COCKPIT CALL lights up blue on the external power panel.
R An external horn sounds.
R Released : COCKPIT CALL remains lighted.
R The ground mechanic can extinguish it by pressing the
R HORN RESET pushbutton on the external power panel. The
R external horn stops sounding.

Note : To communicate with the ground mechanic, the flight crew must select the MECH key and the INT reception knob on the ACP.

CONTROLS AND INDICATORS ON EXTERNAL POWER PANEL



(1) COCKPIT CALL lt

The blue light appears when cockpit calls the ground mechanic. An external horn also sounds.

(2) COCKPIT CALL pb

Pressed : This calls the cockpit.
The MECH lights flash amber on the ACPs and a buzzer sounds.
Released : The MECH lights go out after 60 seconds if they are not reset on the ACPs. The buzzer stops.

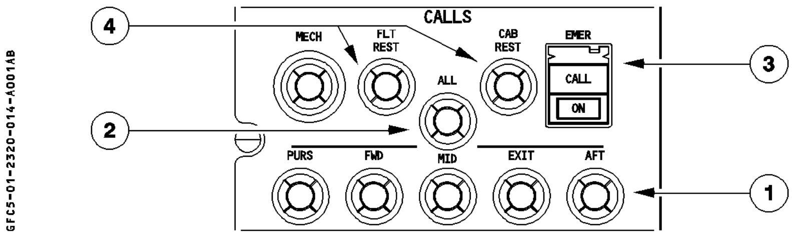
(3) HORN RESET pb

Pressed : The COCKPIT CALL light goes out.
The external horn stops sounding.

CABIN CALL SYSTEM

This system is for communication between the cockpit and the cabin.

CALL FROM THE COCKPIT



(1) PURS / FWD / MID / EXIT / AFT pb

Pressed : A steady pink light comes on at the corresponding area call panel. CAPTAIN CALL appears at the corresponding attendant indication panel and a green light comes on.
A high–low chime sounds through corresponding loudspeaker.

(2) ALL pb

Pressed : All stations respond as above simultaneously. CALL ALL CAPT appears on the attendant indication panels.

(3) EMER pb sw (guarded)

ON : Pink light illuminates at all area control panels.
CALL PRIO CAPT message appears at all attendant indication panel and a red light comes on. High–low chime (repeated 3 times) sounds through all loudspeakers.
ATT amber lights flash on Audio Control Panels.

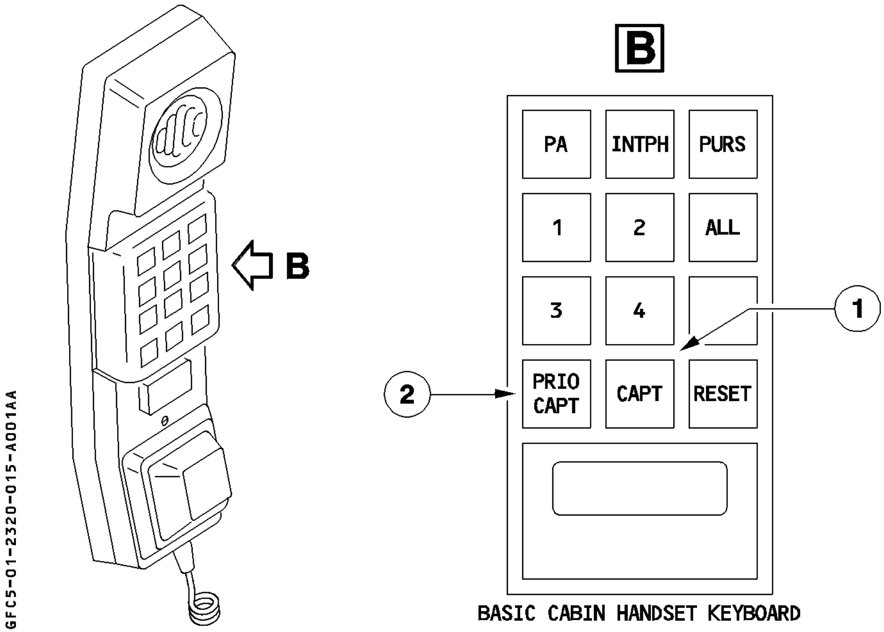
R ON lt : This light flashes white for an emergency call from the cockpit to the
R cabin.

CALL lt : This light flashes amber for an emergency call from the cockpit or cabin.
For an emergency call from the cabin to the cockpit:
– The white ON light and amber CALL light flash.
– The amber ATT lights flash on the audio control panels
– Three long buzzers sound in the cockpit.
The system reset when the attendant hangs up the relevant handset.

(4) FLT REST/CAB REST pb

These pushbuttons are not active on A330.

CALL FROM THE CABIN



BASIC CABIN HANDSET KEYBOARD

(1) CAPT key

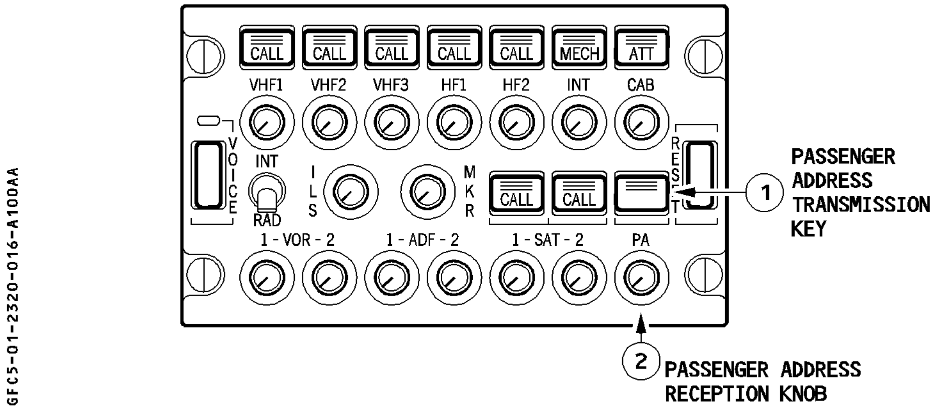
Pressed : In the cockpit, the "ATT" lights up on the ACP and a buzzer sounds.
In the cabin, "CAPTAIN" appears at the AIP, where the CAPT button was
R pressed. The buzzer is inhibited during takeoff and landing.

(2) PRIO CAPT key

Pressed : This key is used for emergency calls. In the cockpit, the "ATT" lights up on the ACP, and three buzzers sound.
In the cabin, "PRIO CAPTAIN" appears at the AIP, where the PRIO CAPT
R button was pressed. The buzzer is inhibited during takeoff and landing.

PASSENGER ADDRESS

The passenger address system enables cabin announcements to passengers via loudspeakers. It can either be operated from the cockpit (using ACP or handset), or from the cabin (attendant stations).



(1) PA transmission key

Pressed and held : The flight crew may use a boom, mask, or hand mike to make an announcement.
Three green lines come on.

Note : The flight crew may use a cockpit handset to make PA announcements without action on the ACPs.

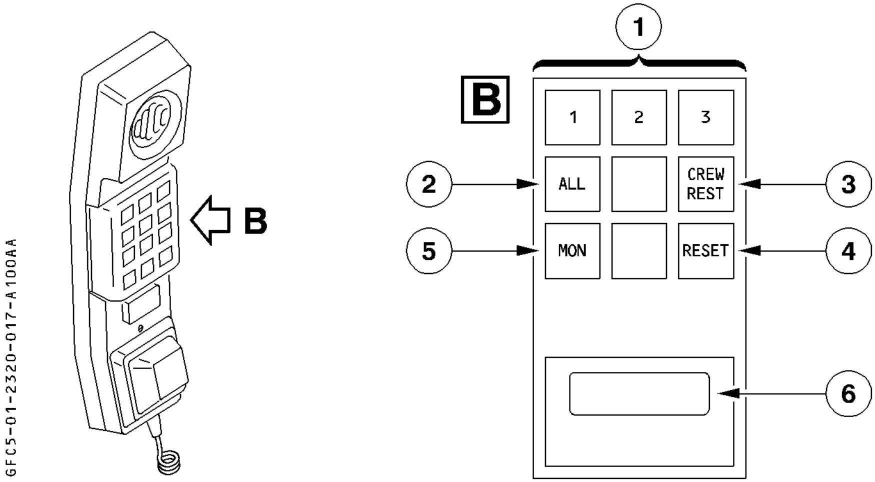
(2) PA reception knob

Pressed and released (knob out) : The message goes to the loudspeakers and the integral white light comes on.
R The flight crew can rotate the knob to adjust the volume.

Pressed (knob in) : The PA system is disconnected.
The white light goes out.

Cockpit handset

The cockpit handset, located at the bottom of the pedestal, is only dedicated to PA announcements.



① Cabin zone key

For three cabin zones, as defined in the airline specific cabin configuration, this key has to be pressed before making an announcement for the applicable cabin zone.
"PA X IN USE" will be displayed on the attendant indication panels.

② ALL key

The ALL key must be pressed prior to making an announcement for all cabin zones. The announcement is not broadcasted in the crew rest compartments.
"PA ALL IN USE" will be displayed on all attendant indication panels.

③ CREW REST key

If an announcement is intended for a crew rest compartment, the CREW REST key has to be pressed in addition to the 1/2 cabin zone key for the upper/lower deck crew rest compartment.
"PA CR (X)" will be displayed on the attendant indication panels.

4 RESET key

When pressed, the previously selected function is cancelled.

5 MON key

Pressing the MON key allows any ongoing PA announcement to be heard through the handset earphone.

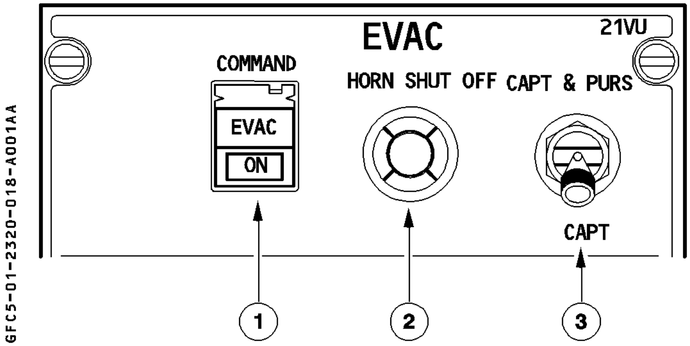
6 PUSH TO TALK pushbutton (PTT)

After dialing an adressee, the PTT pushbutton has to be pressed to broadcast an announcement.
If pressed without performing a dial procedure, the announcement is broadcasted to all cabin zones and all crew rest compartments. “DIRECT PA IN USE” will be displayed on the attendant information panel.

PA from cockpit

	PA TRANSMISSION KEY ON ACP	PA RECEPTION KNOB ON ACP	PUSH TO TALK ON HANDMIKE	PUSH TO TALK ON HANDSET
BOOMSET OR OXYGEN MASK	PRESSED (maintained)	OUT	–	–
HANDMIKE	PRESSED (maintained)	OUT	PRESSED	–
HANDSET	–	–	–	PRESSED

EMER EVAC (◁)



(1) COMMAND pb

ON : In the cockpit : – EVAC light flashes red.
In the cabin : – EVAC lights flash at all attendant panels.
– "EVACUATION ALERT" appears on all attendant indication panels and a red light flashes.
– Specific evacuation tone sounds.

Off : The alert is stopped.

The EVAC light flashes red when the alert is activated.

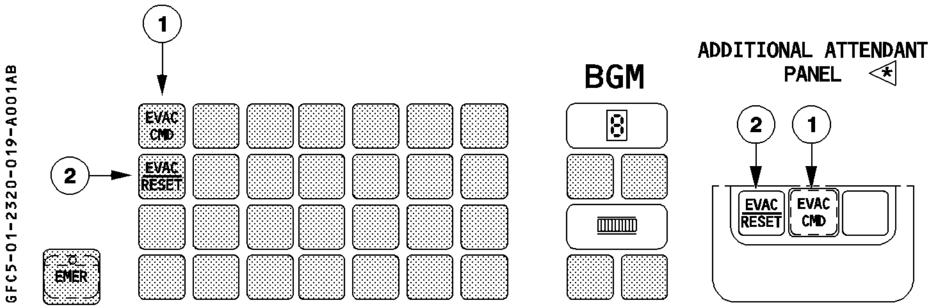
(2) HORN SHUT OFF pb

This button silences the cockpit horn (generated when evacuation is activated from the cabin).

(3) CAPT and PURS / CAPT sw

CAPT and PURS : The alert may either be activated from the cockpit or the cabin.
CAPT : The alert may only be activated from the cockpit.
R If one of the cabin EVAC CMD keys is pressed, only the cockpit
R horn sounds for 3 seconds.

R **PURSER STATION**



(1) EVAC CMD key

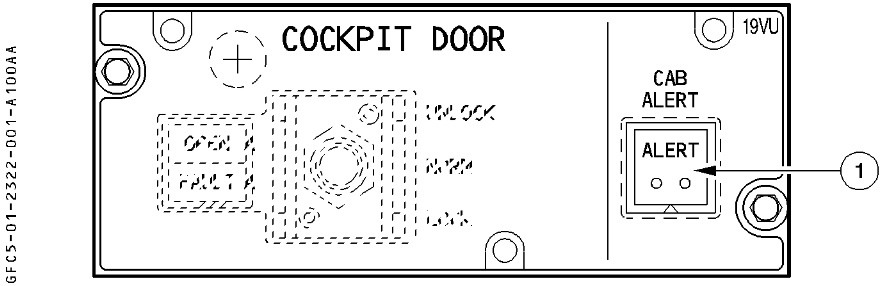
Pressed momentarily :
In the cockpit, the EVAC light flashes red and a specific horn sounds.
In the cabin, the EVAC RESET lights flash red at all attendant stations, the EVAC CMD light comes on green on forward attendant panel, "EVACUATION ALERT" appears at all the AIPs and a red light flashes, and a specific evacuation tone sounds.

(2) EVAC RESET key

Pressing momentarily this button silences the evacuation tone.

CABIN TO COCKPIT ALERT

This function enables the cabin crew to rapidly and discretely alert pilots of any threat in the cabin, such as cockpit intrusion.
The cabin crew activates the alert by pressing one of the pushbuttons located in each attendant's area for a minimum of one second.
When the alert has been activated by the cabin crew, the buzzer sounds continuously in the cockpit, and the cockpit's center pedestal CAB ALERT pushbutton comes on.

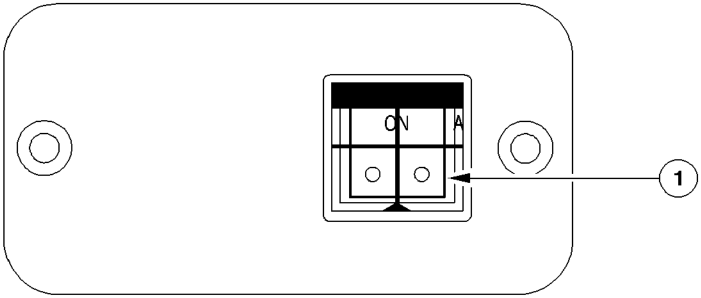


(1) CAB ALERT pushbutton

- ALERT light : This light comes on red, and a buzzer sounds in the cockpit, when an alert has been initiated from the cabin.
- Off : When the cockpit crew pushes the ALERT pushbutton, the buzzer stops and the red ALERT light goes off.

COCKPIT TO CABIN ALERT

This function enables the flight crew to inform the cabin crew, via the CIDS network, of any threat in the cockpit. The pilots activate this alert by pressing one of the two pushbuttons installed in the cockpit.
This also means that the hijacking code will be automatically transmitted to the ATC. (Refer to 1.34.50)



GFC5-01-2322-002-A200AA

(1) Remote ATC box (guarded) pushbutton

Pressed : The alert buzzer sounds in the cabin, and the red alert lights come on, in each attendant's area.
The ON light only comes on when hijacking code is correctly transmitted to ATC (Refer to 1.34.50).

DESCRIPTION

The Cockpit Voice Recorder is designed to record:
- direct conversations between crew members and all aural warnings in the cockpit,
- communications received and transmitted by radio,
- intercom conversations between crew members,
- announcements transmitted over the passenger address system provided PA reception is selected on third audio control panel.

Only the last 2 hours of recording are retained.
The CVR system consists of:
- a remote microphone located behind overhead panel,
- a crashproof four track recorder located in the aft section of the aircraft. It is equipped with an Underwater Locating Beacon,
- a control panel located on the overhead panel.

It is automatically energized:
- on ground during the first five minutes following energization of the aircraft electrical network,
- on ground with one engine running,
- in flight

It is automatically stopped five minutes after last engine shutdown.
On ground CVR can be manually energized by pressing GND CTL pb.

CONTROLS AND INDICATOR ON OVERHEAD PANEL

RECORDER

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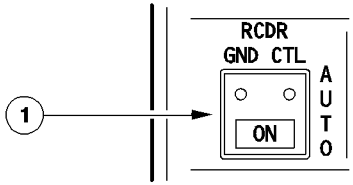
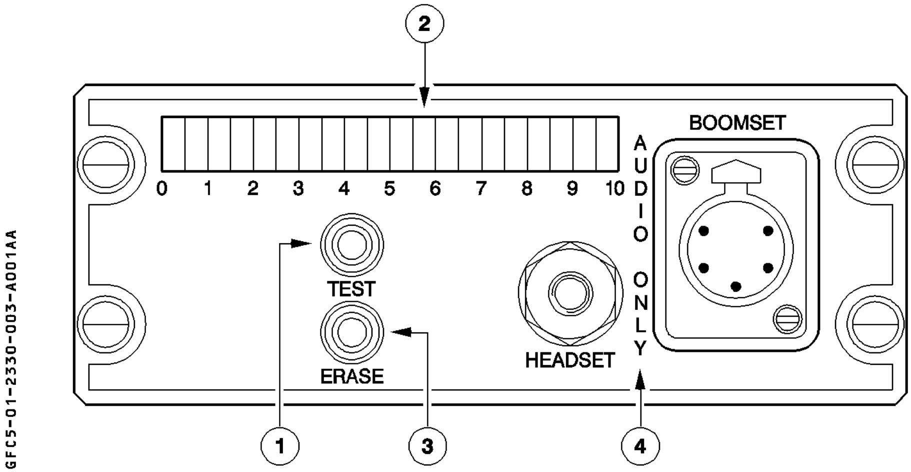


(1) GND CTL sw (spring loaded switch)

ON : The CVR, the digital flight data recorder (DFDR) and QAR ◁ are manually energized.
The ON light comes on blue.

AUTO : The CVR, DFDR and ◁ QAR are automatically energized according to the logic (see page 1).
The ON light goes out.

CVR PANEL



(1) TEST pb

Pressed : This activates the test, if the CVR is energized.
The result of the test is visible on the test result indicator.
If an acoustic equipment is plugged into the jack, the test will be heard as low frequency signal.

(2) Test result indicator

The indicator is composed of green and red LEDs.
R The illumination of one or more green LEDs indicates that the test result is good.

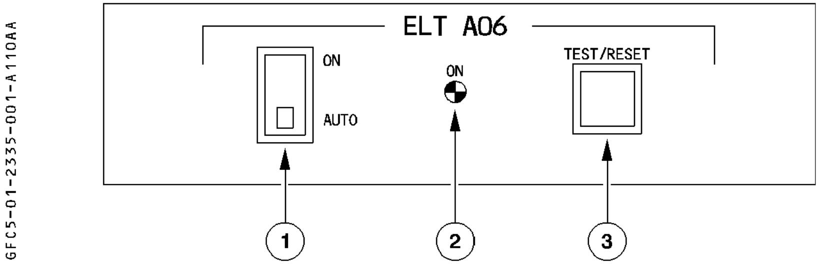
(3) ERASE pb

Pressed for 2 seconds : : This completely erases the tape, if the aircraft is on ground and the parking brake is ON.

(4) Headset and Boomset jacks

When a headset or boomset is plugged into the jack :
– Cockpit sounds, picked up by the microphone, are audible.
– The test tone is audible, when the TEST pushbutton is pressed.
– The erase tone is audible, when the ERASE pushbutton is pressed.

CONTROLS AND INDICATORS



1 ELT sw

The guard keeps this switch in the ARMED position.

AUTO : In case of impact, the Emergency Locator Transmitter (ELT) transmits an emergency signal (on 121.5, 243 and 406.025 Mhz).

ON : The ELT transmits an emergency signal.

2 ON lt

This light comes on amber when the emergency signal is transmitted or during ELT autotest.

3 TEST/RESET pb

Pressing this pushbutton starts the ELT auto test.

Note : If the ELT is triggered by an impact in ARMED mode, pressing this pushbutton resets the ELT and stops the signal transmission.

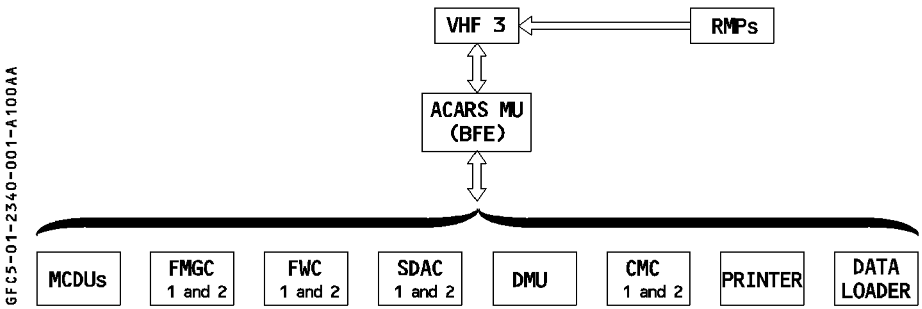
GENERAL

INTRODUCTION

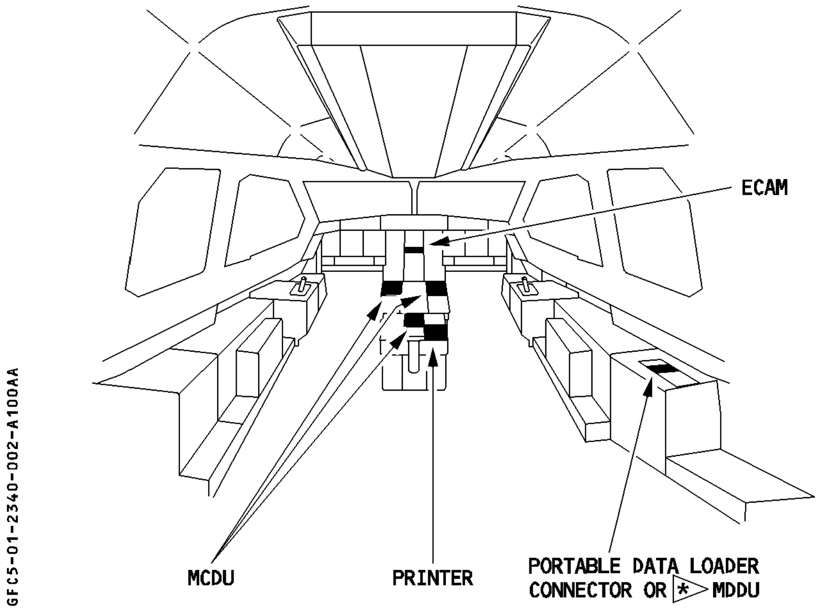
The Aircraft Communication Addressing and Reporting System (ACARS) allows direct exchange of data between aircraft and airline ground computer through the VHF 3.
Aircraft to ground messages (downlink) comprise operational, maintenance, monitoring, performance and cabin data.
Ground to aircraft messages (uplink) contain crew information (wind for example) or might request for transmission of data which are sent either automatically or by crew action.
Automatic downlink of reports is carried out by ACARS Management Unit (MU), which is programmed according to airline needs (Buyer Furnishing Equipment).
Due to the highly customized programming, the ACARS function may vary for different airlines and therefore are not described in detail.

SYSTEM ARCHITECTURE

The ACARS system consists of a Management Unit (MU) connected to the following elements :



COCKPIT ARRANGEMENT



ACARS operation is performed through the already available cockpit equipment:

- ECAM for operational indications.
- MCDU for control of ACARS related functions.
- PRINTER for hard-copies.
- Either connector for portable data loader or Multifunction Disk Drive Unit (MDDU) (◁).

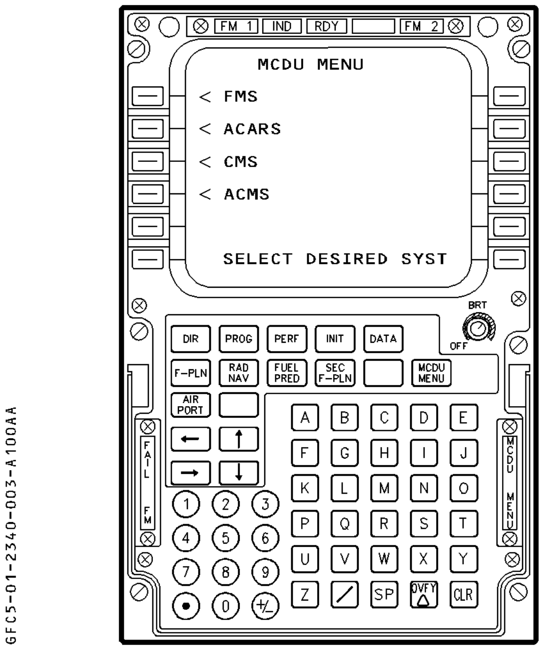
OPERATION MODES

MANUAL ACCESS TO ACARS FUNCTIONS

ACARS functions are manually selected through MCDU. They are obtained for FMGC, CMS or ACMS by selecting the corresponding key. Pressing the MCDU MENU key gives access to MCDU MENU page. ACARS functions related to one system are accessible by pressing the concerned system key. Cabin management functions (if available) are accessible through the cabin installed system.

R

MCDU



(NOTE : DEPENDING ON OPTIONS, MCDU FRONT FACE MAY SLIGHTLY DIFFER)

Pressing of a system key will display the system pages as defined in the airline customized MU programming.

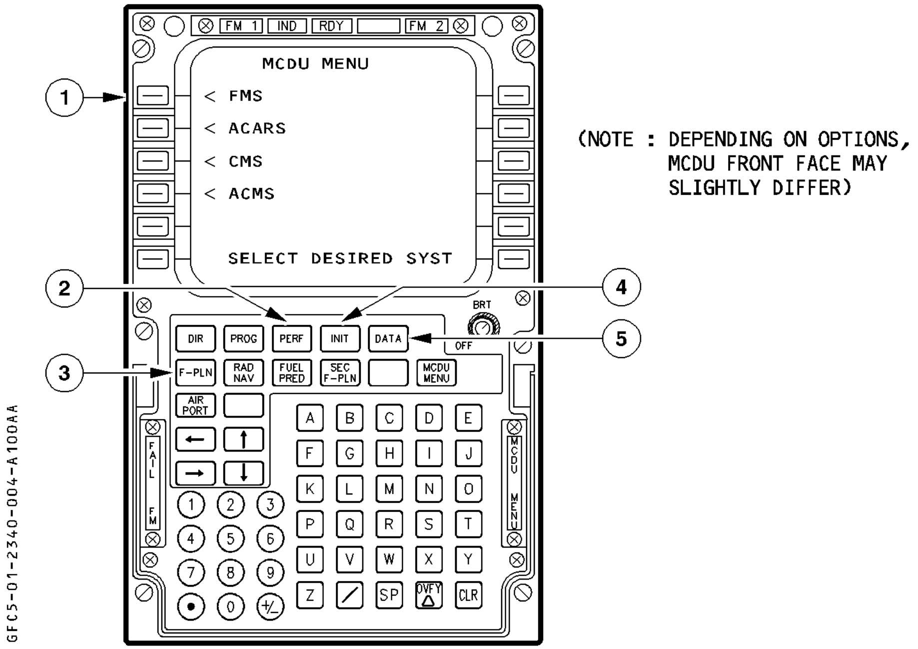
AUTOMATIC ACCESS TO ACARS FUNCTIONS

Automatic data transmission can be initiated by MU or aircraft systems programming or an uplink message. There is no cockpit indication nor crew action is required. It is a dialogue between ground and aircraft computers.

ACARS FUNCTIONS

Data and reports of a particular system are available through AIRBUS defined interfaces (Seller Furnishing Equipment).

R **FMS**



(1) Pressing key selects related system, then

(2) Pressing key gives access to takeoff data (Uplink only)

(3) Pressing key gives access to wind data (F-PLN page)

(4) Pressing key gives access to F-PLN initialisation and wind data (Uplink only)

(5) Pressing key gives access to Pre-flight, Post-flight report and ACARS print/program (downlink only).
See FMGS PILOT GUIDE (Refer to 4.04.50).

ACARS

Pressing ACARS key will display airline defined functions (e.g. message transmission , event times for example).

CMS (Refer to 1.45.20)

Through the CMS interface it is possible to downlink the following data :

- Post flight report (on the ground) or current flight report (in flight) which concerns :
  - all failure messages detected by the BITEs
  - the warnings displayed to the crew during the last or current flight leg.

  Reports can be downlinked upon crew or ACARS MU request.
- Avionics data which concerns the individual system BITE data (manual downlink only).
- Failure messages and warnings (broadcast data transmitted in real-time to the MU).
- Class 3 report (on the ground) containing all class 3 failures detected during the last flight leg. The report can be downlinked upon crew or ACARS MU request.

ACMS

The ACMS ACARS interface provides the capability to transmit to the ACARS MU the data for the following applications:

- Aircraft Performance Monitoring (APM),
- Engine Condition Monitoring (ECM),
- APU Health Monitoring (AHM).

Any of the ACMS DMU reports can be downlinked (transmitted to the MU):

- manual on the ground or in flight upon crew request,
- automatically in real-time,
- upon ACARS MU (ground or automatic) request.

AUTOMATIC DOWNLINK OF REPORTS

Automatic downlink of reports are provided by ACARS. Each report generated by a peripheral system may be downlinked depending on each airline MU programming.

UPLINK MESSAGES

Two types of uplink messages are provided :

· Messages not indicated to the crew :
There is no indication given to the crew, neither for uplink message nor for downlink answer. It is a dialogue between ground and aircraft computers.

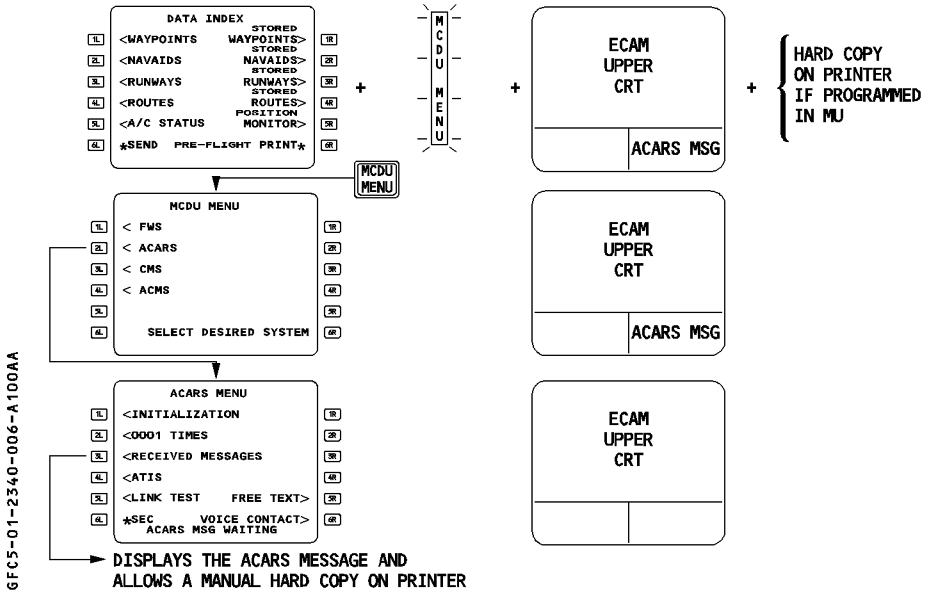
· Messages indicated to the crew by :

– "ACARS MSG" advisory (in green) on ECAM Memo

Note : A steady green "ACARS STBY" advisory is displayed in case of ACARS communications loss between aircraft and ground.

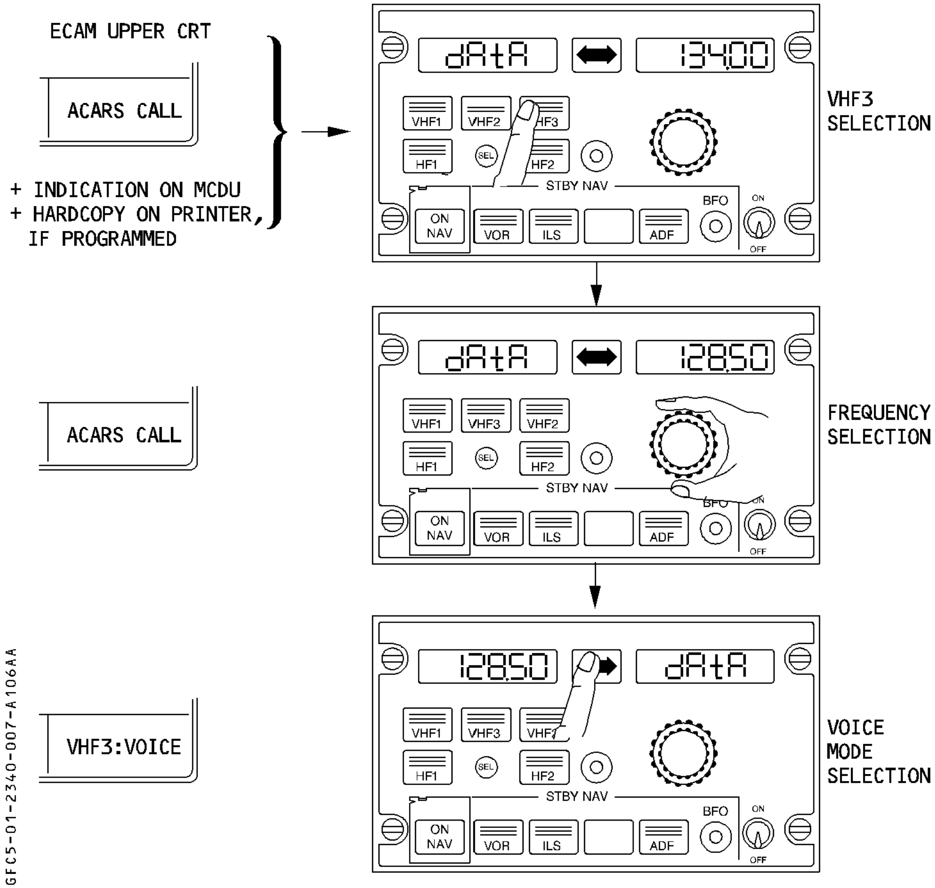
– Message on MCDU (ACARS MSG WAITING for example) or MCDU MENU light illumination if the MCDU is not in the mode where uplink message can be displayed in order to select the correct mode (FMS, ACARS, ACMS, CMS)

– Hard copy on cockpit printer depending on MU programming.
Example of uplink message indication with MCDU in FMS mode :



VOICE/ACARS transfer on VHF 3

VHF 3 can be used in VOICE mode, in case of a :
- VHF 1, or VHF 2, failure
- ACARS CALL
  The "ACARS CALL" advisory pulses in green, and indicates that a message (requesting a voice conversation) has been received from the ground.
  The green "VHF 3 : VOICE" advisory indicates that the VHF 3 transceiver operates in voice mode. Therefore, ACARS communication is interrupted.
  Depending on the MU programming, ACARS frequency may either be automatically tuned by the ACARS MU, or manually tuned through the RMP.
  In this case, the ACARS/VOICE transfer is made directly on any of the RMPs (without using the MCDU).

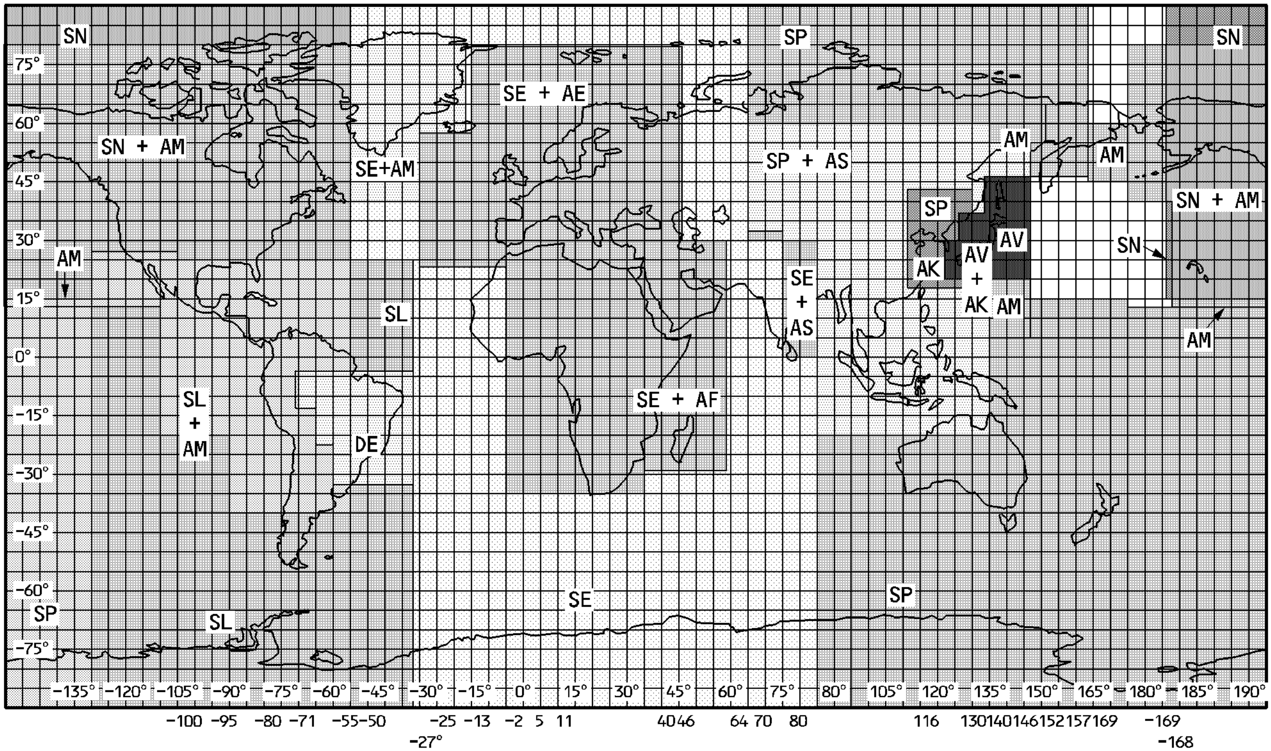


It is possible to return to ACARS mode by pressing the RMP's transfer key again.

R

WORLD MAP ACARS FREQUENCIES

GFC5-01-2340-008-A100AA



SOUTH
ACARS WORLD MAP

WORLD MAP ACARS FREQUENCIES (CONT'D)

The table below defines the world zone abbreviations, indicates their associated Service Provider, MCDU label, and ACARS frequency.

ABBREVIATION	SERVICE PROVIDER	MCDU LABEL	FREQUENCY	Family
SP	SITA PACIFIC	SIT-PAC	131.550 MHz	SITA
SN	SITA NORTH AMERICA	SIT-NAM	136.850 MHz	SITA
SL	SITA LATIN AMERICA	SIT-LAM	131.725 MHz	SITA
SE	SITA EUROPE	SIT-E/A	131.725 MHz	SITA
DE	DEPV BRAZIL	DEPV	131.550 MHz	SITA
AV	AVICOM	AVICOM	131.450 MHz	SITA
AM	ARINC AMERICA	ARI-AM	131.550 MHz	ARINC
AE	ARINC EUROPE	ARI-EUR	136.925 MHz	ARINC
AF	ARINC AFRICA	ARI-AFR	126.900 MHz	ARINC
AK	ARINC KOREA	ARI-KOR	131.725 MHz	ARINC
AS	ARINC ASIA	ARI-ASI	131.450 MHz	ARINC

GENERAL

The Satellite Communication (SATCOM) system allows the exchange of information between the aircraft and a Ground Earth Station (GES), via geosynchroneous satellites.
R It provides up to six independent channels :
R One channel is used for data transmissions (ACARS). Two or five channels are used for
R voice transmissions (cockpit or cabin voice). The cockpit voice function must be activated,
R in order for it to be available. The cabin telephone system must be installed, to be able to
R use cabin voice function.
The ACARS normally transmits via VHF3. It automatically switches to SATCOM when VHF3 is not available.
The cockpit voice interface is controlled by the Audio Control Panels (ACPs) for call set-up and call termination, and by the MCDU for the call number selection. It allows the crew :
- To initiate air to ground calls and to receive ground to air calls.
- To select the call priority, in case of air to ground calls.
- To use manual dial or pre-recorded phone numbers.

If a SATCOM telephone handset is installed in the cockpit, the crew can set up a call without the use of the MCDU.
SATCOM functions are programmed through the Owner Requirement Table (ORT), according to airline needs.
Due to the highly customized programming, the SATCOM functions may vary for different airlines and are, threrefore, not described in detail.

CONTROLS AND INDICATORS

ACP INTERFACE

Refer to the 1.23.20 description.

MCDU INTERFACE

SATCOM MAIN MENU PAGE

The crew accesses this page by selecting SAT on the MCDU MAIN page.

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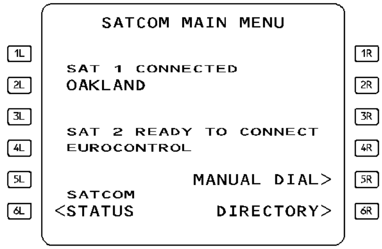

2L (4L) (Label line)	:	This field displays the SATCOM channel 1 (2) status :		
		– READY TO CONNECT	:	The channel is ready to support a call.
		– NOT AVAILABLE	:	The channel is not available (failed or not logged).
		– DIALING	:	Cockpit call in progress.
		– INCOMING CALL	:	Advises of an incoming ground to air call.
		– CONNECTED	:	The circuit is connected.
		– CALL FAILED	:	The transmission is interrupted.

2L (4L) (Data line) : This field displays :
- The title of the selected phone number, in case of an air to ground call.
- The number, if the MANUAL DIAL option is used.
- GRND-AIR CALL, in case of a ground to air call.

5R : This key provides access to the Manual Dial page. This page allows the dialing of a phone number.

6L : This key provides access to the SATCOM STATUS page, which contains LOG ON and channel status information.

6R : This key provides access to the SATCOM DIRECTORY PAGE.

SATCOM DIRECTORY PAGE

This page provides access to 4 phone number lists, where phone numbers can be memorized, according to their priority.

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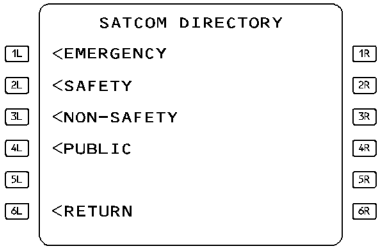

1L : EMERGENCY for Priority 1 - Reserved for emergency and distress phone numbers only.
2L : SAFETY for Priority 2 - Reserved for regulatory and flight safety phone numbers only.
3L : NON-SAFETY for Priority 3 - Reserved for non flight safety phone numbers.
4L : PUBLIC for Priority 4 - Reserved for personal phone numbers.
6L : This key is used to return to the SATCOM MAIN MENU page.

SATCOM CATEGORY NUMBERS PAGE

The CATEGORY NUMBERS page provides access to the pre-recorded phone numbers. As an example, the following figure shows the SAFETY CATEGORY NUMBER page.

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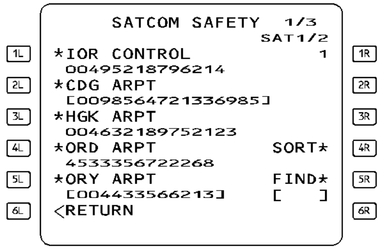
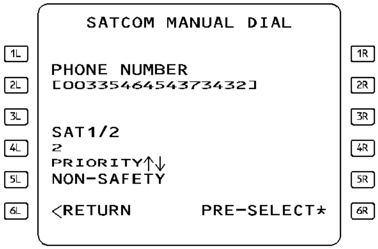


1L, 2L, 3L, 4L, 5L	:	These fields display the phone numbers and their titles. When one of these keys is pressed, the corresponding phone number is dialed. There are two types of numbers : - Protected : Displayed in green - Unprotected : Displayed in blue brackets
1R	:	This field displays the selected SATCOM channel.
4R	:	This function alphabetically sorts the phone numbers within the category, according to tittle.
5R	:	This function automatically searches for a phone number from the beginning of this category, by entering up to the first three letters of the title into the scratchpad, and by pressing 5R.
6L	:	This key is used to return to the SATCOM DIRECTORY page.

SATCOM MANUAL DIAL PAGE

The MANUAL DIAL PAGE enables the crew to initiate an air to ground call by manually entering a phone number.



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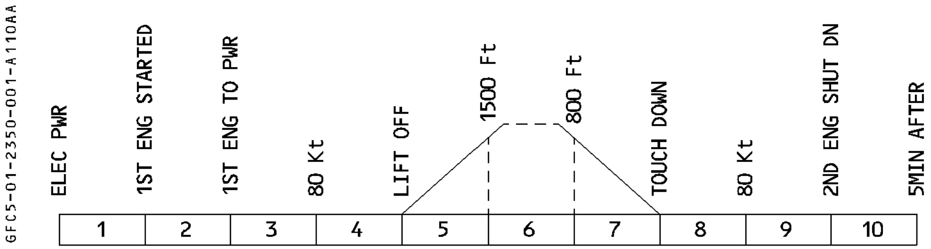
2L (data line)	:	This field displays the phone number in blue brackets, after having been entered in the scratchpad.
4L	:	This field displays the selected SATCOM channel.
5L	:	This field displays the priority for the manual dial number. The priority can be changed by pressing the slew up or down keys on the MCDU keyboard.
6L	:	This key is used to return to the SATCOM MAIN MENU page.

DESCRIPTION



R

<table>
<tr><th>E / WD: FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>VHF 1 (2) (3) EMITTING
HF 1 (2) EMITTING
Transceiver emitting more than 60 seconds</td><td rowspan="3">SINGLE CHIME</td><td rowspan="3">MASTER CAUT</td><td rowspan="8">NIL</td><td rowspan="8">NIL</td><td rowspan="4">3,4,5
7,8</td></tr>
<tr><td>CIDS 1 + 2 FAULT
Total loss of CIDS</td></tr>
<tr><td>CIDS PA FAULT
Loss of passenger address part</td></tr>
<tr><td>ACARS 1 (2)(1+2) FAULT ◁</td><td>NIL</td><td>NIL</td></tr>
<tr><td>SATCOM FAULT ◁
Telephone and ACARS transmissions are lost.</td><td rowspan="4">SINGLE CHIME</td><td rowspan="4">MASTER CAUT</td><td>1 *, 3, 4, 5,
7, 8, 10 *</td></tr>
<tr><td>SATCOM DATA FAULT ◁
ACARS transmissions are lost.
Telephone transmissions are still available.</td><td>3,4,5
7,8</td></tr>
<tr><td>SATCOM VOICE FAULT ◁
Telephone transmissions are lost, ACARS is still transmitted via SATCOM.</td><td rowspan="2">3, 4, 5,
7, 8</td></tr>
<tr><td>VHF 3 DATA FAULT ◁</td></tr>
</table>

* SATCOM FAULT message is inhibited in flight phases 1 and 10 when IRS are not aligned.

MEMO DISPLAY

- Displays "SEAT BELTS" and "NO SMOKING" messages in green, when the corresponding sign on the overhead panel is on.
- Displays "AUDIO SWTG" in green, if the AUDIO SWITCHING selector is not on NORM.
- Displays "PA IN USE" (optional) in green, during passenger address operation.
- Displays "VIDEO IN USE" (optional) in green, during video operation in the cabin.
- Displays "CABIN READY" in green (pulses 10 seconds, then steady), when a signal is sent from the cabin crew, and in the takeoff and landing memo.⊲

In addition, if ACARS is installed without ATSU, the display shows :

- VHF3 VOICE in green, if VHF3 is operating in voice mode and ACARS communication is interrupted.
- ACARS MSG in green, flashes for 10 seconds and a continuous buzzer sounds, if ACARS has received a message from the ground.
- ACARS STBY in green, if ACARS communications between the aircraft and the ground are lost.
- ACARS CALL in green, flashes for 10 seconds, when an uplink message requests voice communication.
- ACARS ALERT in green, when an uplink alert message has been received.

If ATSU is installed, the displays shows :

- VHF3 VOICE in green, if VHF3 is operating in voice mode.
- HF : VOICE in green, flashes for 10 seconds if both HFs (⊲) are operating in voice mode.
- HF DATA OVRD in green, if HF (⊲) is operating in data mode on ground.

If SATCOM is installed, the display shows "SATCOM ALERT" in green, when a message with a priority level below 4 is received from the ground.

BUS EQUIPMENT LIST

		NORM			EMER ELEC		
		AC	DC	DC BAT	AC ESS	DC ESS	HOT
RADIO COMMUNICATION	VHF1					X	
	VHF2		DC 2				
	VHF3		DC 1				
	HF1				SHED (1)		
	HF2	AC 2					
	RMP1					X	
	RMP2		DC 2				
	RMP3		DC 1				
	CAPT ACP					X	
	F/O ACP					X	
	THIRD ACP		DC 1				
	SELCAL		DC 1				
	FLT INTERPHONE					X	
	CAPT LOUDSPEAKER					X (2)	
	F/O LOUDSPEAKER					X (2)	
	EXT HORN						HOT 2
CABIN INTERCOMM DATA SYS	CIDS1		GND/FLT			X	
	CIDS2		GND/FLT			X	
	DEU (A/B)		GND/FLT			X	
COCKPIT VOICE RECORDER	CVR CTL		DC 1				
	CVR				SHED		
ACARS ◁	MV	AC 1					

(1) This supply is lost when LAND RCVRY is selected ON.
(2) Normal supply is from DC ESS BUS, DC BUS 1 supplies CAPT (or F/O) loudspeaker when AUDIO SWITCHING selector is set to CAPT (or F/O) on 3.

24.00 CONTENTS

24.10 DESCRIPTION

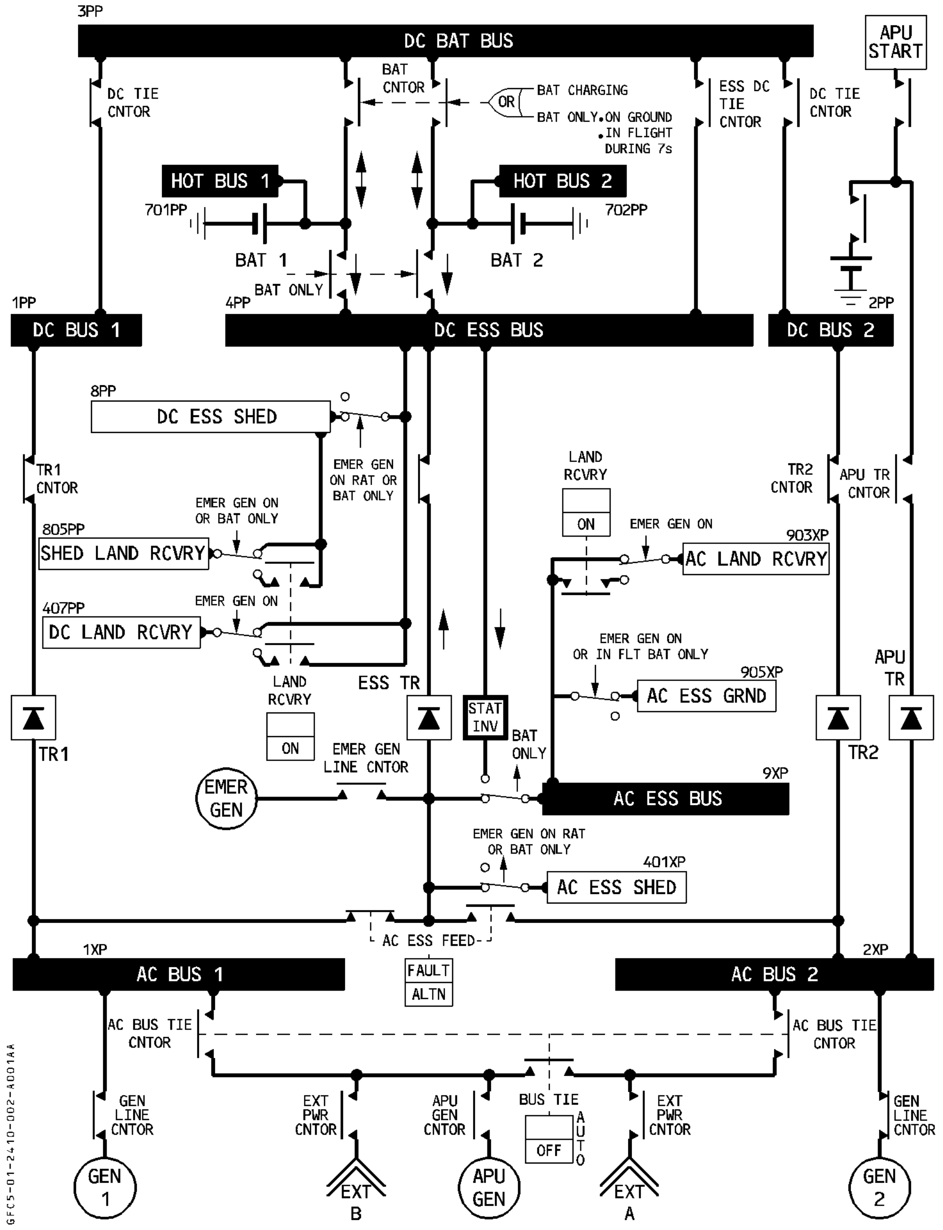
24.20 CONTROLS AND INDICATORS

GENERAL

The electrical power system consists of a three phase 115 / 200 volt 400 hertz constant frequency AC system and a 28 volt DC system.
Electrical transients are acceptable for equipment.
Commercial supply has secondary priority.
Normally, the system produces alternating current, some of which then transform into direct current for certain applications.
Each of the aircraft's three generators can supply the whole network.
If all normal AC generation is lost, an emergency generator can supply AC power.
If all AC generation is lost, the system can transform DC power from the batteries into AC power.

FOR INFO

R



3PP
DC BAT BUS
APU START
DC TIE CNTOR
BAT CNTOR
OR
BAT CHARGING
BAT ONLY •ON GROUND •IN FLIGHT DURING 7s
ESS DC TIE CNTOR
DC TIE CNTOR
HOT BUS 1
HOT BUS 2
701PP
702PP
BAT 1
BAT 2
BAT ONLY
1PP
4PP
2PP
DC BUS 1
DC ESS BUS
DC BUS 2
8PP
DC ESS SHED
EMER GEN ON RAT OR BAT ONLY
TR1 CNTOR
TR2 CNTOR
APU TR CNTOR
LAND RCVRY
ON
EMER GEN ON OR BAT ONLY
805PP
SHED LAND RCVRY
EMER GEN ON
903XP
AC LAND RCVRY
407PP
DC LAND RCVRY
EMER GEN ON
EMER GEN ON OR IN FLT BAT ONLY
905XP
AC ESS GRND
LAND RCVRY
ON
ESS TR
APU TR
TR1
STAT INV
BAT ONLY
TR2
EMER GEN
EMER GEN LINE CNTOR
9XP
AC ESS BUS
EMER GEN ON RAT OR BAT ONLY
401XP
AC ESS SHED
AC ESS FEED
1XP
2XP
AC BUS 1
FAULT
ALTN
AC BUS 2
AC BUS TIE CNTOR
AC BUS TIE CNTOR
GEN LINE CNTOR
EXT PWR CNTOR
APU GEN CNTOR
BUS TIE
AUTO
OFF
EXT PWR CNTOR
GEN LINE CNTOR
GEN 1
EXT B
APU GEN
EXT A
GEN 2
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GENERATION OF ELECTRICAL POWER

AC GENERATION

MAIN GENERATORS

Two three-phase AC generators (GEN 1, GEN 2), one driven by each main engine through an integrated drive, supply aircraft electrical power. Each generator can supply up to 115 KVA of three phase 115/200 volt 400 hertz power.
A third generator (APU GEN), driven directly by the APU and producing the same output as each main engine generator, can replace either or both main engine generators at any time.
A generator control unit (GCU) controls the output of each generator. The main functions of each GCU are :
– Control the frequency and voltage of the generator output.
– Protect the network by controlling the associated generator line contactor (GLC).

EXTERNAL POWER

Two ground power connector near the nose wheel allow ground power to be supplied to all bus bars (with some galleys shed in case of overload). The aircraft can be supplied by two ground power units (90 kVA max each).
A Ground Power Control Unit (GPCU) protects the network by controlling the External Power Contactor, and generates a reference frequency used by GCU for synchronisation before No Break Power Transfer (NBPT).

EMERGENCY GENERATOR

The green hydraulic circuit drives an emergency generator that automatically supplies emergency AC power to the aircraft electrical system if all three main generators fail. This generator supplies 8.6 KVA of three-phase 115/200-volt 400-hertz power, except when the
R ram air turbine powers the green hydraulic circuit and the aircraft speed is below 260 knots. In this case it delivers only 3.5 kVA, leading to some shedding.
A generator control unit (GCU) :
– keeps the emergency generator at a constant speed
– controls the generator's output voltage
– protects the network by controlling the emergency generator line contactor
– controls the emergency generator start-up

STATIC INVERTER

A static inverter transforms DC power from the DC essential bus into 2.5 KVA of single-phase 115-volt 400-hertz AC power, which is then supplied to part of the AC essential bus. In flight, the inverter is activated automatically if nothing but the batteries is supplying electrical power to the aircraft, regardless of the positions of the BAT1 and BAT2 pushbutton switches.
On the ground, the inverter is activated if nothing but the batteries is supplying electrical power to the aircraft and the BAT1 and BAT2 pushbutton switches are both on.

DC GENERATION

TRANSFORMER RECTIFIERS (TRS)

Two main Transformer Rectifiers, TR1 and TR2 (200 A) and one essential TR (100 A), supply the aircraft electrical system with DC current.
A fourth TR (100 A) is dedicated to APU start or APU battery charging.
Each TR controls its contactor by internal logic.

BATTERIES

Two main batteries, each with a normal capacity 37 ampere-hours, are permanently connected to the two hot buses.
A third battery (37 Ah) is dedicated to APU start.
Each battery has an associated Battery Charge Limiter (BCL).
The BCL monitors battery charging and controls its battery contactor.

CONTACTORS

Two identical electrical Contactor Management Units (ECMUs) provide :
- AC and DC contactors control (excepted TR contactors which are controlled by the TR itself).
- galley shedding control.
- No Break Power Transfer control (NBPT).
- monitoring and indicating.

For this purpose, each ECMU receives following information:
- Voltage of all normal busbars
- position of all AC and DC contactors
- availability of all generators or power source (from GCU or GPCU)
- position of all galleys contactors
- TR status
- pushbutton position (BUS TIE, GALLEY SHED and COMMERCIAL)
- flight/ground signal from associated LGCIU.

AC AND DC CONTACTOR CONTROL

ECMU 1 controls :
- The Generator Line Contactor (GLC) 1.
- The AC Bus Tie Contactor (BTC) 1.
- The APU Generator Contactor.
- Both DC Tie Contactors.
- The BUS TIE contactor
- The External Power Contactor B

ECMU 2 controls :
- The Generator Line Contactor (GLC) 2.
- The AC Bus Tie Contactor (BTC) 2.
- The External Power Contactor A.
- Both DC tie Contactors.

NO BREAK POWER TRANSFER

This function avoids busbar power interruption during supply source transfer on ground in normal configuration. It is inhibited in flight.
ECMU controls simultaneous connection of the two sources for a short time. To achieve this, both sources are synchronized on a frequency reference signal sent by the GPCU.
Synchronization may take up to 15 seconds for APU GEN with GPU, and some milliseconds in all other cases.
If synchronization is not achieved within allowed time transfer is performed anyway (without simultaneous connection of two sources). This function has a back-up in the GCU.

MONITORING AND INDICATING

Each ECMU sends the following information to the ECAM:
- Bus bars supplied or not
- contactor status
- galley supply status, and galley switch position

CIRCUIT BREAKERS

All circuit breakers are in the electronic equipment bay.
A Circuit Breaker Monitoring Unit (CBMU) monitors the circuit breakers status. It sends this information to the ECAM system.

OPERATIONS

GENERAL

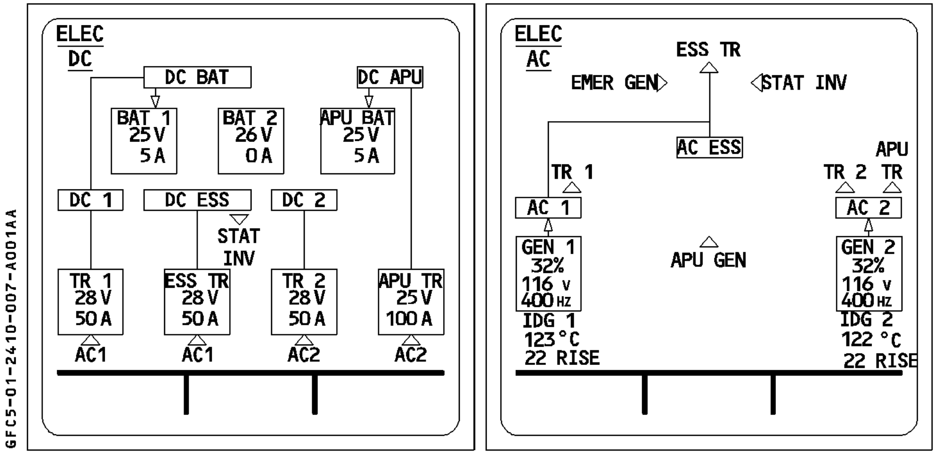
Each AC BUS is supplied in priority order by :
- the corresponding engine generator.
- the APU generator or the external power A (if both are connected, the APU generator has priority for the left side bars, and the external power has priority for the right side bars.
- the external power B (if both external power are connected, B has priority for the left side bars and A has priority for the right side bars).
- the other side engine generator.

The APU generator or the external power may supply all the network.
One generator can supply all the network (with galley shedding in case of overload detection).
The generators cannot be connected in parallel (except on ground during No Break Power Transfers).

NORMAL CONFIGURATION

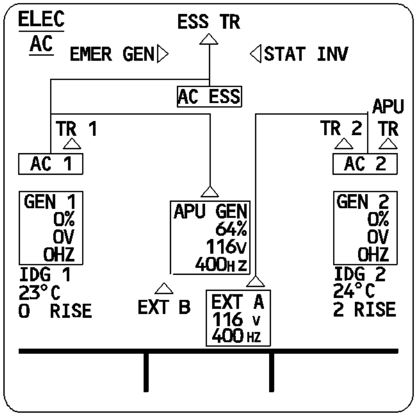
IN FLIGHT

Each engine-driven generator supplies its associated AC BUS (1 and 2) via its Generator Line Contactor (GLC 1 and GLC 2).
AC BUS 1 normally supplies the AC ESS BUS via a contactor.
AC BUS 1 supplies TR 1 which normally supplies DC BUS 1, DC BAT BUS.
AC BUS 2 supplies TR 2 which normally supplies DC BUS 2.
AC BUS 1 supplies ESS TR which normally supplies DC ESS BUS.
The two batteries are connected to the DC BAT BUS if they need charging. When they are fully charged the Battery Charge Limiter disconnects them.

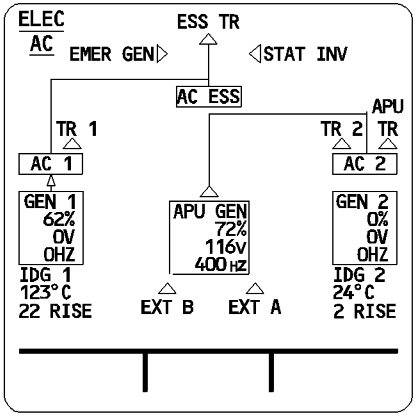


ON GROUND

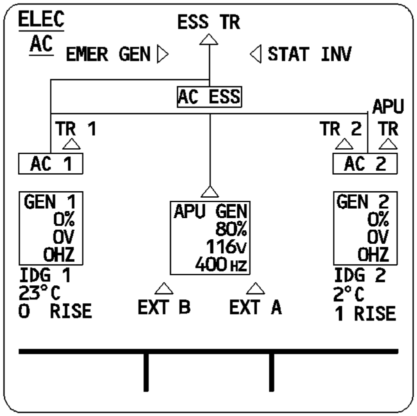
Either the APU generator or external power may supply the complete system (with some galley shedding in case of overload).



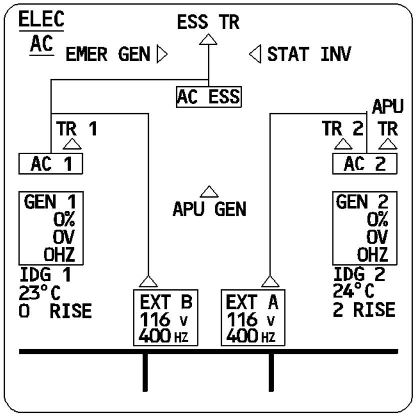
APU GEN + EXTERNAL POWER



APU GEN + GEN 1



APU GEN ONLY



EXTERNAL POWER ONLY

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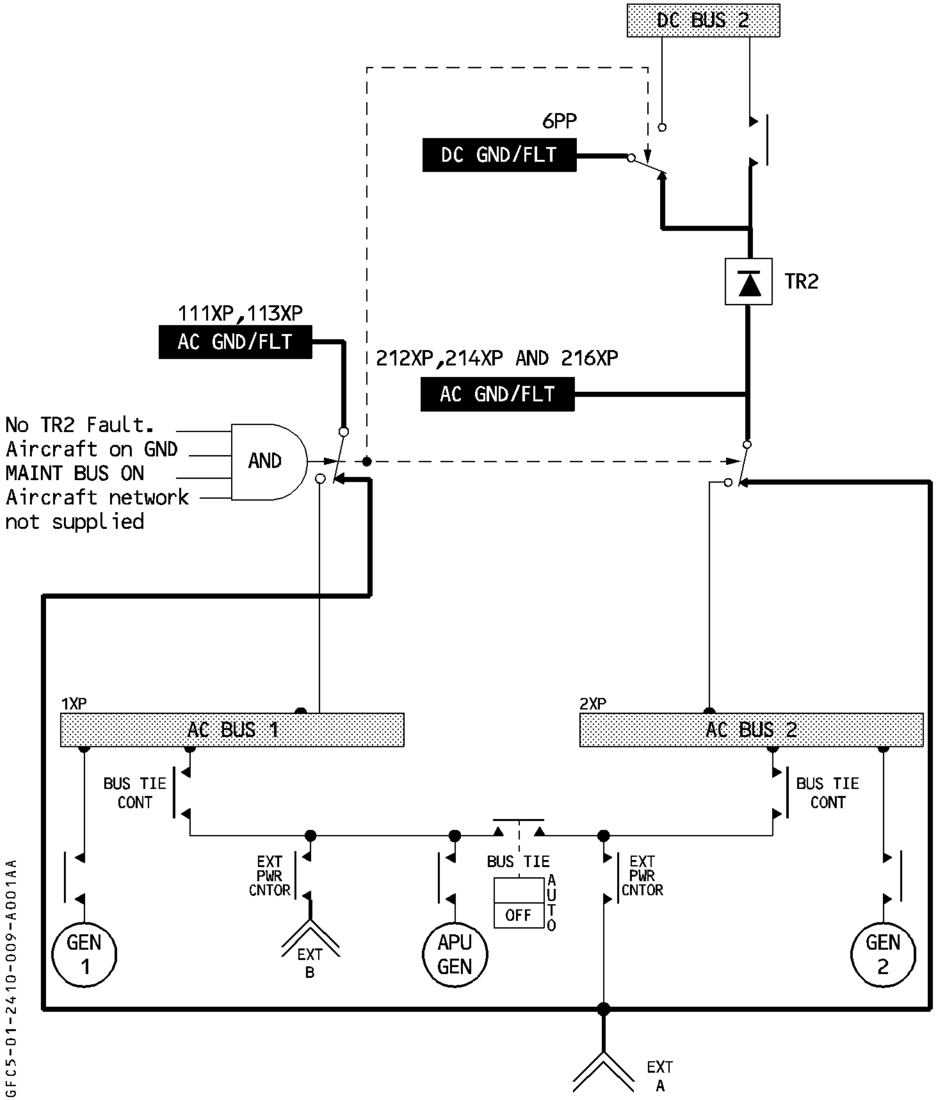
If external power A and external power B plus APU supply the complete system, the APU has priority over external power B.
Situation then will be as displayed for case APU plus external power

On ground, when only ground services are required, external power can supply the AC and DC GRND/FLT buses directly, without supplying the aircraft's entire network.

R This configuration is selected via the MAINT BUS switch located in the forward entrance area.

FOR INFO

R



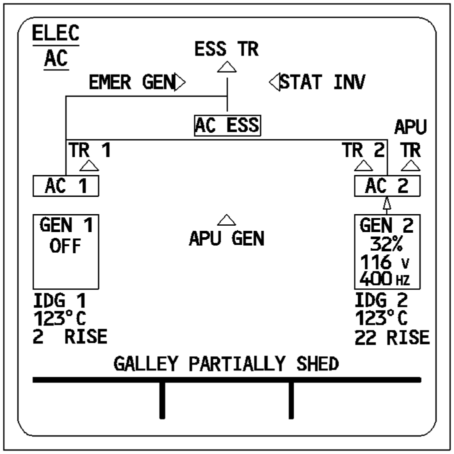
ABNORMAL CONFIGURATIONS

FAILURE OF ONE ENGINE GENERATOR

ECMU provides automatic reconfiguration.
Complete network remains supplied.

Note : *If a generator is lost due to overcurrent detection, reconfiguration does not occur and the related AC BUS is lost.*

The system automatically replaces the failed generator with :
– The APU generator if available or,
– The other engine generator (automatically shedding part of the galley load).



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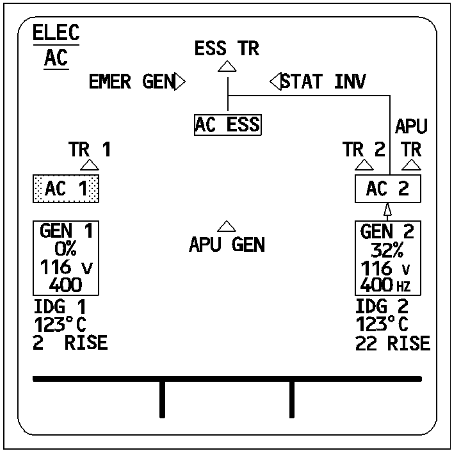
FAILURE OF THE AC BUS 1

The AC BUS 2 supplies the AC ESS BUS and the ESS TR automatically.



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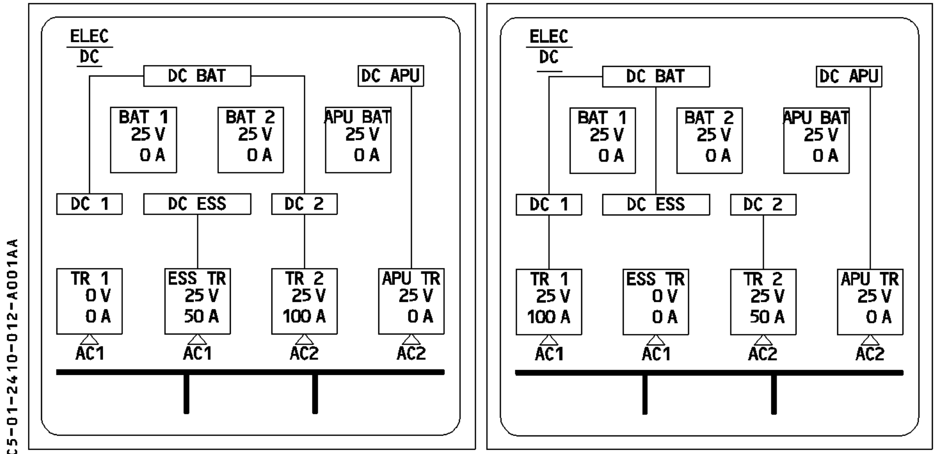
TR FAILURES

The contactor of each TR opens automatically in case of:
- overheat
- minimum current
- overcurrent
- open or short circuit

ECMU provides automatic reconfiguration (except for APU TR)

Note : If a TR is lost due to overcurrent detection, reconfiguration does not occur and the related DC BUS is lost.

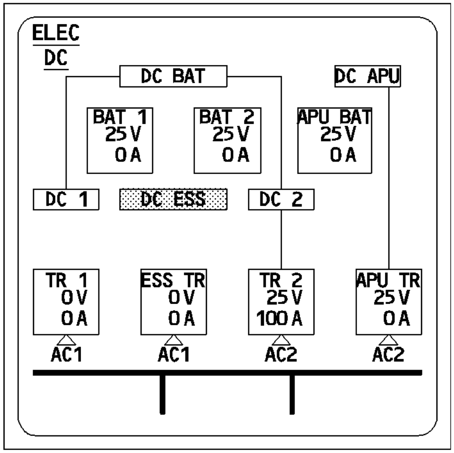
Failure of one TR
· TR 1 or 2 lost : the availableTR replaces the faulty one.
· ESS TR lost : the TR 1 replaces the ESS TR.



TR1 FAULT ESS TR FAULT

Failure of ESS TR and TR 1 (or TR 2)

The remaining TR supplies the two DC norm busses and the DC BAT bus.
The DC ESS bus is lost.



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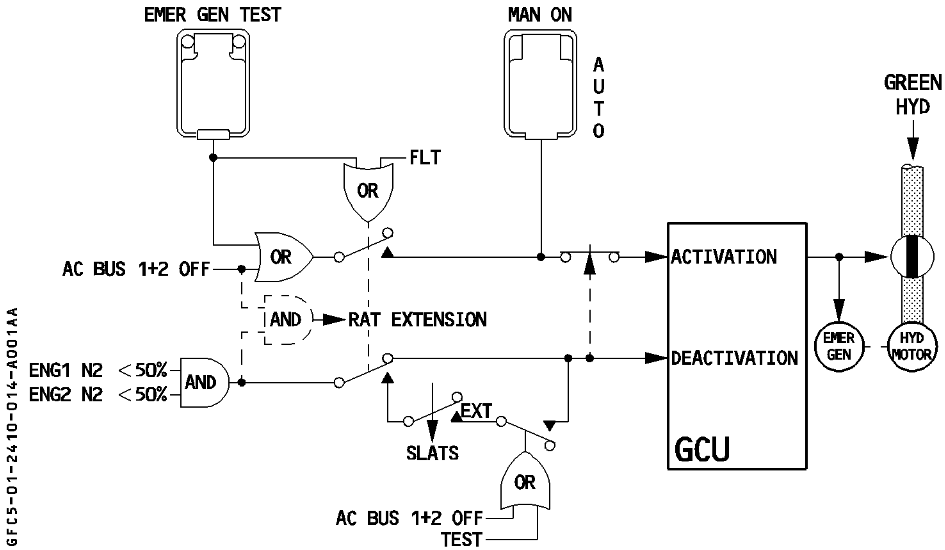
EMERGENCY GENERATION AFTER LOSS OF ALL MAIN GENERATORS

If both buses, AC 1 and 2, are lost and if both engines are lost, the Ram Air Turbine (RAT) extends automatically.
If powered by the RAT only, the EMER GEN is inhibited when slats are extended.
The emergency generator can be manually activated through the MAN ON pushbutton.
Emergency generator deactivation occurs only automatically:
- In flight: at slats extension if powered by the RAT only (both engines are lost) it can be reactivated after slats retraction through the MAN ON pushbutton.
- On the ground: after both engines shutdown.

EMER GEN TEST pushbutton allows to activate the emergency generator and to connect it to the essential network. This test is inhibited when the slats are extended.

FOR INFO



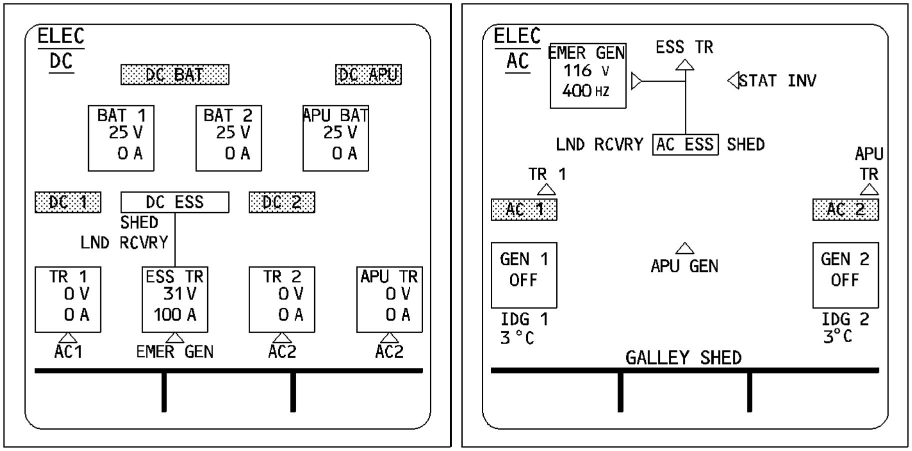
- If the green hydraulic system, which actuates the emergency generator, is powered by an engine-driven pump, the emergency generator supplies the :
  - AC ESS BUS,
  - AC ESS SHED.

    And, through the ESS TR, the :
  - DC ESS BUS, and
  - DC ESS SHED.
- If the green hydraulic system is powered by the Ram Air Turbine, the emergency generator supplies the :
  - AC ESS BUS, and
  - DC ESS BUS, through the ESS TR.

All LAND RECOVERY AC and DC BUS bars are shed. They are recovered when the LAND RECOVERY pushbutton is ON.

The AC ESS GND is lost.

R



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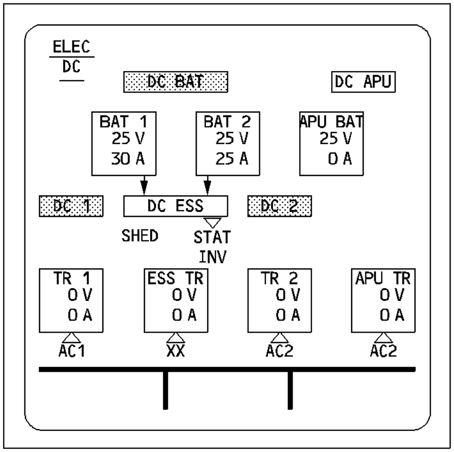
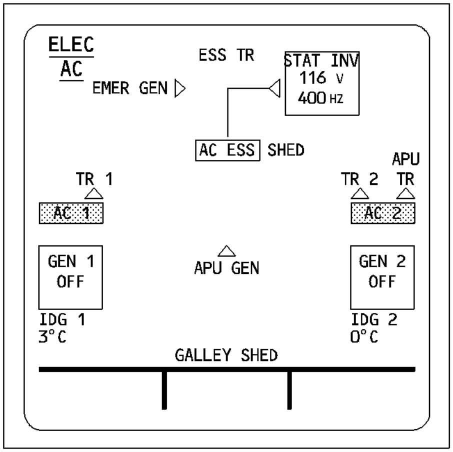
FLIGHT WITH BATTERIES ONLY

When emergency generator is not available, the batteries supply :
– the DC ESS BUS
– the DC LAND RECOVERY (whatever the LAND RECOVERY pushbutton position is)
and through the STAT INV :
– the AC ESS BUS
– the AC LAND RECOVERY (whatever the LAND RECOVERY pushbutton position is)
The AC ESS SHED, the DC ESS SHED and the SHED LAND RECOVERY are not supplied.
The AC ESS GND is lost.
Example : flight with batteries only.

R





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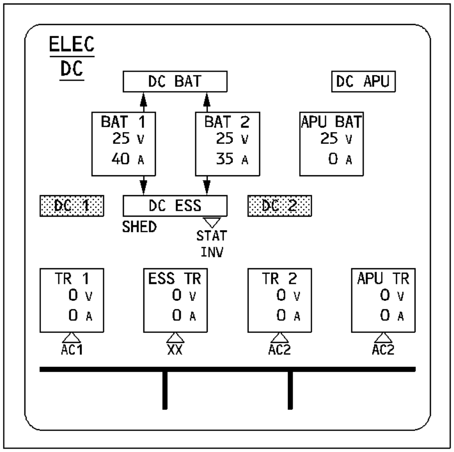
ON GROUND, BATTERIES ONLY

Provided they are both selected AUTO, the batteries supply:
- the DC ESS BUS
- the DC BAT BUS
- the DC LAND RECOVERY (whatever the LAND RECOVERY pushbutton position is)

and through the static inverter:
- the AC ESS BUS
- the AC ESS GND
- the AC LAND RECOVERY (whatever the LAND RECOVERY pusbutton position is)

The AC ESS SHED, the DC ESS SHED and the SHED LAND RECOVERY are not supplied.



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Note : ELEC AC ECAM page is identical to flight with batteries only case.

DISTRIBUTION TABLE

	AC BUS 1	AC BUS 2	AC ESS BUS	AC ESS GND	AC ESS SHED	DC BUS 1	DC BUS 2	DC BAT BUS	DC ESS BUS	DC ESS SHED
NORM CONFIG	GEN 1	GEN 2	GEN 1	GEN 1	GEN 1	TR 1 GEN 1	TR 2 GEN 2	TR 1 GEN 1	ESS TR GEN 1	ESS TR GEN 1
GEN 1 INOP	GEN 2 (3)	GEN 2	GEN 2 (3)	GEN 2 (3)	GEN 2 (3)	TR 1 GEN 2 (3)	TR 2 GEN 2	TR 1 GEN 2 (3)	ESS TR GEN 2 (3)	ESS TR GEN 2 (3)
GEN 2 INOP	GEN 1	GEN 1 (3)	GEN 1	GEN 1	GEN 1	TR 1 GEN 1	TR 2 GEN 1 (3)	TR 1 GEN 1	ESS TR GEN 1	ESS TR GEN 1
AC BUS 1 lost	-	GEN 2	GEN 2	GEN 2	GEN 2	TR 2 GEN 2	TR 2 GEN 2	TR 2 GEN 2	ESS TR GEN 2	ESS TR GEN 2
AC BUS 2 lost	GEN 1	-	GEN 1	GEN 1	GEN 1	TR 1 GEN 1	TR 1 GEN 1	TR 1 GEN 1	ESS TR GEN 1	ESS TR GEN 1
TR 1 FAULT						TR 2 GEN 2 (2)	TR 2 GEN 2	TR 2 GEN 2 (2)	ESS TR GEN 1	ESS TR GEN 1
TR 2 FAULT						TR 1 GEN 1	TR 1 GEN 1 (2)	TR 1 GEN 1	ESS TR GEN 1	ESS TR GEN 1
TR 1 + 2 FAULT						-	-	-	ESS TR GEN 1	ESS TR GEN 1
ESS TR			NOT AFFECTED			TR 1 GEN 1	TR 2 GEN 2	TR 1 GEN 1	TR 1 GEN 1 (2)	TR 1 GEN 1 (2)
TR 1 FAULT and ESS TR FAULT						TR 2 GEN 2 (2)	TR 2 GEN 2	TR 2 GEN 2 (2)	-	-
TR 2 FAULT and ESS TR FAULT						TR 1 GEN 1	TR 1 GEN 1 (2)	TR 1 GEN 1	-	-

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White compartments : same supply as in normal configuration
Shaded compartments : back up supply

DISTRIBUTION TABLE (cont'd)

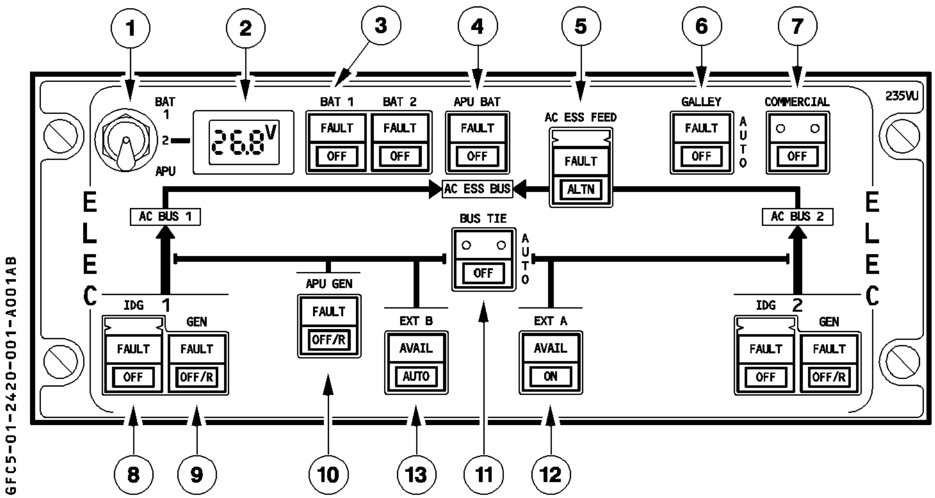
EMER CONFIG	AC BUS 1	AC BUS 2	AC ESS BUS	AC ESS GND	AC ESS SHED	AC LAND REC	DC BUS 1	DC BUS 2	DC BAT BUS	DC ESS BUS	DC ESS SHED	DC LAND REC	SHED LAND REC
• BATTERIES ONLY (in flight)	–	–	STAT INV BAT 1-2	–	–	STAT INV BAT 1-2	–	–	(4)	BAT 1-2	–	BAT 1-2	–
• EMER GEN SUPPLIED BY ENGINE DRIVEN PUMP	–	–	EMER GEN	–	EMER GEN	EMER GEN (1)	–	–	–	ESS TR EMER GEN	ESS TR EMER GEN	ESS TR EMER GEN (1)	ESS TR EMER GEN (1)
• EMER GEN SUPPLIED BY RAT	–	–	EMER GEN	–	–	EMER GEN (1)	–	–	–	ESS TR EMER GEN	–	ESS TR EMER GEN (1)	–

ON GROUND	AC BUS 1	AC BUS 2	AC ESS BUS	AC ESS GND	AC ESS SHED	AC LAND REC	DC BUS 1	DC BUS 2	DC BAT BUS	DC ESS BUS	DC ESS SHED	DC LAND REC	SHED LAND REC
BAT only, V>50 Kt	–	–	STAT INV BAT 1-2		–	STAT INV BAT 1-2	–	–		BAT 1-2	–	BAT 1-2	–
BAT only, V<50 Kt	–	–	STAT INV BAT 1-2	STAT INV BAT 1-2		STAT INV BAT 1-2	–	–	BAT 1-2	BAT 1-2	–	BAT 1-2	–

(1) supplied when LAND RECOVERY pushbutton is at ON
(2) lost in case of overcurrent on the faulty TR.
(3) In case of differential protection failure
- the affected generator is not replaced
- the associated TR is switched off.

(4) Lost after 7 seconds.

OVERHEAD PANEL



(1) BAT 1 (2 or APU) sel

Selects the battery for voltage indication.

(2) BAT 1 (2 or APU) voltage indication

Selected battery voltage.

③ BAT 1 (2) pb sw

Controls the operation of the corresponding battery charge limiter.

Auto : The battery charge limiter controls automatically the connection and the disconnection of the corresponding battery to the DC BAT BUS by closing and opening of the battery line contactor.

- The batteries are connected to the DC BAT BUS in the following cases :
  - Battery voltage below 26.5 volt (battery charge). The charging cycle ends when battery charge current goes below 4 Amperes (for 10 seconds on ground, 30 minutes in flight).
  - On the ground (with speed below 50 knots), when batteries only are supplying the aircraft.
  - In flight DC generation lost (limited to 7 seconds).
- The batteries are connected to the DC ESS BUS when batteries only are supplying :
  - in flight
  - on the ground (speed below 50 knots) provided they are both selected auto.

Note : 1. In normal configuration the batteries are disconnected most of the time.

2. A battery automatic cut off logic prevents batteries from discharging completely when the aircraft is on the ground (parking).

Automatic battery contactors open when :

- *the aircraft is on the ground*
- *the main power supply (external power plus all generators) is cut off.*
- *the battery voltage is lower than 23 volt for more than 16 seconds.*

The flight crew can reset the contactors by switching the BAT pushbutton switch to OFF then to AUTO.

OFF : The battery charge limiter is not operating, the DC ESS BUS is not connected to the battery (except in flight in emergency configuration).
OFF comes on white if the DC BAT BUS is powered.
Hot buses remain supplied.

FAULT lt : Comes on amber, accompanied by an ECAM caution, when the charging current for corresponding battery is outside limits.
In this case the battery contactor opens.

④ APU BAT pb sw

Controls the operation of the APU battery charge limiter.

Auto : The APU battery charge limiter controls automatically the closing and opening of the line APU BAT contactor.
The battery is connected in the following cases :
· To ensure battery charge (as for BAT 1 or 2)
· When the APU start sequence is initiated.

Note : Automatic cut-off, as for BAT 1 or 2, is provided.

OFF : The battery charge limiter is not operating, the battery line contactor is open. OFF light comes on.

FAULT lt : Comes on amber, associated to ECAM caution as for BAT 1 or 2. In this case the battery contactor opens.

⑤ AC ESS FEED pb sw

NORMAL : The AC ESS BUS is normally supplied from AC BUS 1.
It is automatically supplied by the AC BUS 2 when the AC BUS 1 is lost.

ALTN : The AC ESS BUS is supplied from AC BUS 2.

FAULT lt : Comes on amber, and ECAM caution comes on when the AC ESS BUS is not electrically supplied.

Note : In case of total loss of main generators, the AC ESS BUS is automatically supplied by the emergency generator or by the static inverter if the emergency generator is not available.

⑥ GALLEY pb sw

AUTO : The galleys are normally supplied. The ECMU automatically sheds one or more galleys in case of generator(s) failure or in case of overload detection. On the ground when APU generator or the external power supplies, all galleys are supplied provided no overload is detected.

OFF : All galleys are shed and water/waste (drain mast) ice protections is lost.

FAULT lt : Comes on amber and ECAM caution comes on, when an overload is detected, and if the automatic shedding is not performed.

Note : Switching OFF then AUTO resets the galleys which have been automatically shed by the ECMU due to an overload detection. Galleys which have been shed due to the loss of generator(s) are not reset.

7 COMMERCIAL pb

OFF : The following equipment is shed :
- galleys
- passenger entertainment system (music and video)
- cargo loading system
- electrical service
- escape slide lock mechanism ice protection
- water/waste (drain mast) ice protection
- lavatory and cabin lights
- water heater
- R in-seat power supply ◁

8 IDG 1(2) (Integrated Drive Generator) pb

CAUTION
1. Holding in this pushbutton for more than about three seconds may damage the disconnection mechanism.
2. IDG disconnection is inhibited when engine N2 is below the low speed threshold.

IDG switches are normally spring loaded out.
Pressing this switch disconnects the IDG from its drive shaft. Only maintenance personnel can reconnect it.
FAULT lt : Lights up amber and ECAM caution comes on if :
· IDG oil outlet overheat (above 185° C), or
· IDG oil pressure low. Inhibited at low engine speed (N2 below 14 %).
It extinguishes when the IDG is disconnected.

9 GEN 1(2) pb

ON : The generator field is energized and the line contactor closes, if electrical parameters are normal.
OFF/R : The generator field is de-energized and the line contactor opens.
The fault circuit is reset.
FAULT lt : Lights up amber and ECAM caution comes on, if the associated Generator Control Unit (GCU) trips it.
The line contactor opens.

Note : If a differential fault trips the protection reset action has no effect after two attempts.

(10) APU GEN pb sw

ON : The APU generator field is energized and the line contactor closes if parameters are normal.
Each bus tie contactor 1 and (or) 2 closes automatically if its associated generator is not operating.

OFF/R : The generator field is de-energized and the line contactor opens. The fault circuit is reset.

FAULT lt : Same as GEN FAULT.
The APU GEN FAULT light is inhibited when APU speed is too low.

(11) BUS TIE pb sw

AUTO : The three BUS TIE contactors open or close automatically according to the priority logic in order to maintain power supply to all AC busses.
The three contactors close when :
– only one engine generator supplies the aircraft, or
– only the APU generator or single ground power unit supplies the aircraft.

OFF : The three BUS TIE contactors open.

(12) EXT A pb : (momentary action)

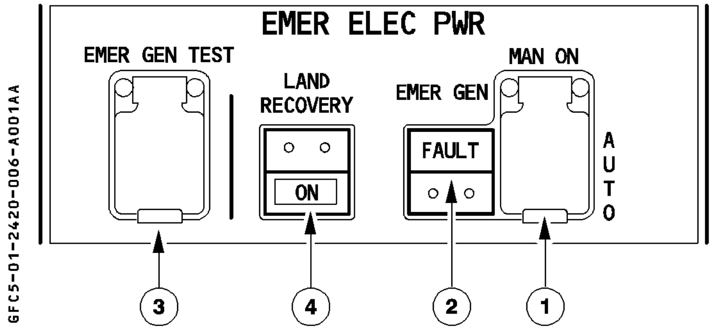
AVAIL lt : Comes on green if external power parameters are normal.

Pressed momentarily :
– If the AVAIL light was on :
  · The external power line contactor closes
  · The AVAIL light goes off
  · The ON light comes on blue
– If the ON light was on :
  · The external power line contactor opens
  · The ON light goes off
  · The AVAIL light comes on.

(13) EXT B pb : (momentary action)

AVAIL : Comes on green if external power parameters are normal.
Pressed momentarily : – If the AVAIL light was on :
· Provided the APU is off the external power line contactor closes
· The AVAIL light goes off
· The AUTO light comes on.
– If the AUTO light was on :
· The external power line contactor opens
· The AUTO light goes off
· The AVAIL light comes on.

Note : 1. The APU generator has priority over external power (A and B) for AC BUS 1.
The external power A has priority over the APU generator for AC BUS 2.
The engine generators have priority over the external power.
The APU generator has priority over external power B for AC BUS 2.
The external power B has priority over external power A for AC BUS 1.
R *2. When external power B is selected AUTO, AUTO light remains illuminated even when the APU generator has taken over.*



(1) MAN ON pb (guarded)

AUTO : In flight, in case of normal AC supply loss, the emergency generator is automatically started.
Pressed : The emergency generator runs and is connected to the aircraft network.

(2) EMER GEN FAULT lt

The light comes on red if the emergency generator is not supplying power and normal AC supply is lost in flight.

③ TEST pb (guarded)

Pressed and held : The emergency generator runs (provided the green hydraulic system is pressurized) and supplies the DC ESS BUS and the AC ESS BUS.

④ LAND RECOVERY pb

ON : When pressed in emergency generator configuration, the AC LAND RECOVERY and the DC LAND RECOVERY buses are recovered and the following equipment is restored :
- LGCIU 1
- SFCC 1 (flap channel is not recovered, if the emergency generator is powered by the RAT or batteries).
- BSCU channel 1 (not recovered, if the emergency generator is powered by the RAT or batteries)
- LH windshield anti-ice (not recovered, if the emergency generator is powered by the RAT or batteries)
- LH landing light (not recovered, if the emergency generator is powered by the RAT or batteries)

The remaining fuel pump (if any) is lost.

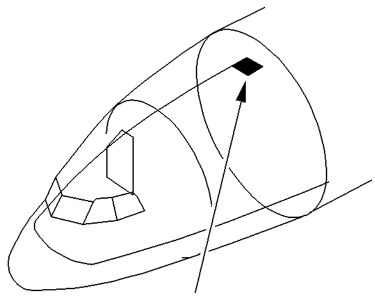
Note : The remaining fuel pump will be shed at 260 knots, if the emergency generator is powered by the RAT, or upon LAND RECOVERY selection, whichever occurs first.

The following equipment is shed :
- HF 1, ADR 3 and, consequently, AP 1.
- Weather radar 1.

Note : The AC LAND RECOVERY and the DC LAND RECOVERY buses are supplied on batteries only, whatever the position of the LAND RECOVERY pushbutton.

FORWARD CABIN

MAINT BUS switch



This switch enables maintenance and ground service personnel to energize electrical circuits for ground servicing, without energizing the aircraft's entire electrical system.

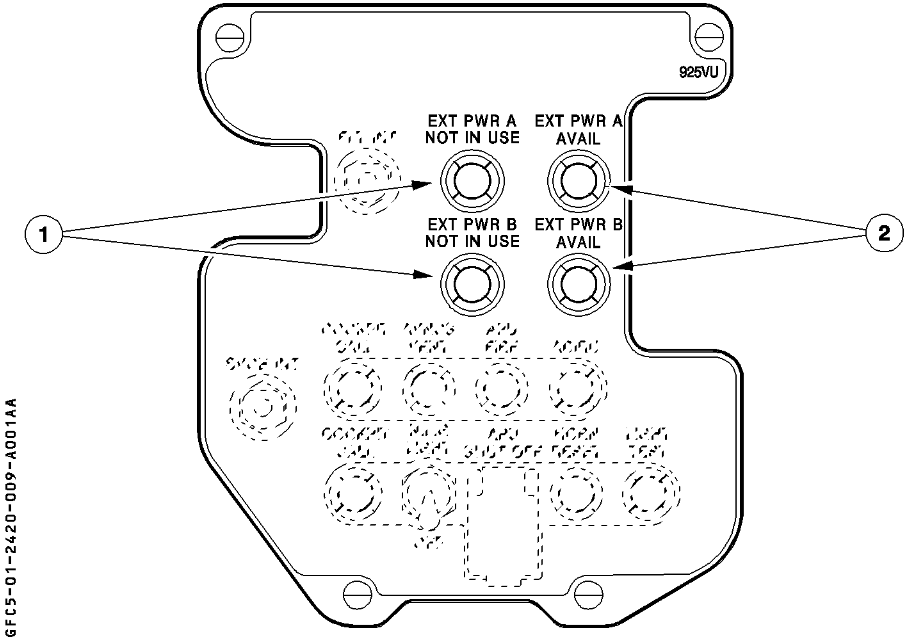
ON : The selector latches magnetically, if external power is connected and normal (AVAIL light is on). The AC and DC GRND/FLT busbars are supplied, and the following services can be energized :
- Passenger compartment lighting
- Galley lighting
- Entrance area lights
- Lavatory lighting and service
- Vacuum cleaner sockets
- Flight compartment service outlets
- Flight compartment flood lighting
- Cargo door hydraulic pump
- Fuel quantity indications
- Refueling
- Lower deck cargo compartment lighting and power outlets
- Main and nose landing gear compartment lighting
- Hydraulic compartment lighting
- Landing Gear Compartment service outlets
- Ground call
- Equipment compartment lights and service outlets
- Navigation lights
- Parking brake
- R Escape slide locking mechanism ice protection

The switch trips, when the external source is removed.

OFF : The AC and DC GRND/FLT busbars are connected to AC BUS 2 and DC BUS 2.

EXTERNAL POWER PANEL

(This panel is located closed to the external power connector)



① EXT PWR A (B) NOT IN USE

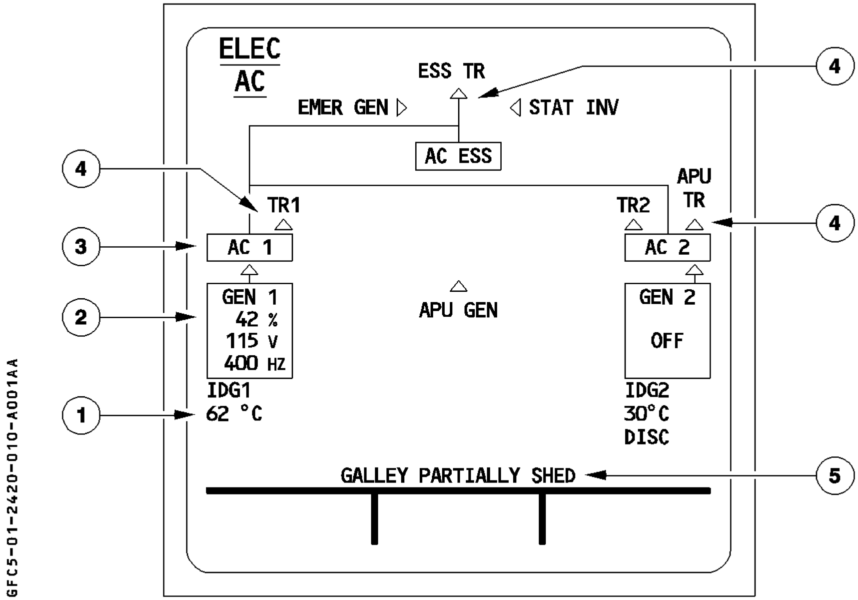
This white light comes on to inform ground personnel that the ground power unit is not supplying the aircraft network and can be removed. It goes off when EXT A (B) is in use.

② EXT PWR A (B) AVAIL

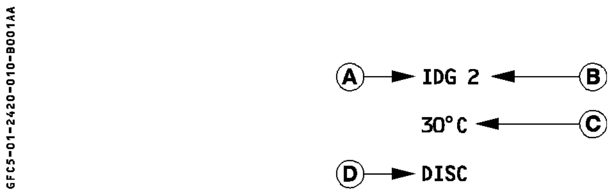
This amber light comes on to indicate that external power is available and the voltage is correct.

ECAM ELEC AC PAGE

FLIGHT CONFIGURATION



(1) IDG indications



(A) IDG legend :
The "IDG" legend, normally white, becomes amber if :
· Oil outlet temperature > 185° C.
· Oil pressure gets too low.
· IDG becomes disconnected.

(B) IDG number :
The "IDG" number is white if associated engine is running, becomes amber if stopped.

Ⓒ Oil outlet temperature :
This legend is normally in green, and appears in amber if T > 185° C.
It flashes, if 142° C < T < 185° C (advisory).

Ⓓ DISC/LO PR indication :
This legend appears in amber, when the IDG is disconnected.
"LO PR" appears in amber, when IDG low pressure is detected.
R It is inhibited at low engine speed (N2 below 14 %).

② GEN 1 (or 2) indications

– GEN pushbutton is OFF :

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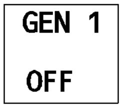

"GEN" is amber.
"OFF" indication is white.
"1" or "2" indication is in white, if the associated engine is running ; it is in amber, if it is not.
– GEN pushbutton is ON :

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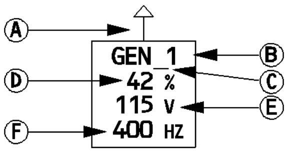


Ⓐ Arrow indication :
Appears green, when the generator line contactor is in line.

(B) The GEN number is white, if the associated engine is running. It becomes amber, when the associated engine stops.

R (C) The GEN indication is normally white. It becomes amber, when the generator fails,
R or when the associated engine stops.

(D) The GEN load is normally green. It becomes amber, if the load is greater than 108 %, for more than 10 seconds.

(E) The GEN voltage is normally green. It becomes amber below 110 V or, above 120 V.

(F) The GEN frequency is normally green. It becomes amber below 390 Hz, or above 410 Hz.

(3) Bus indication

The bus indication is normally green. It becomes amber, when the corresponding bus is off.

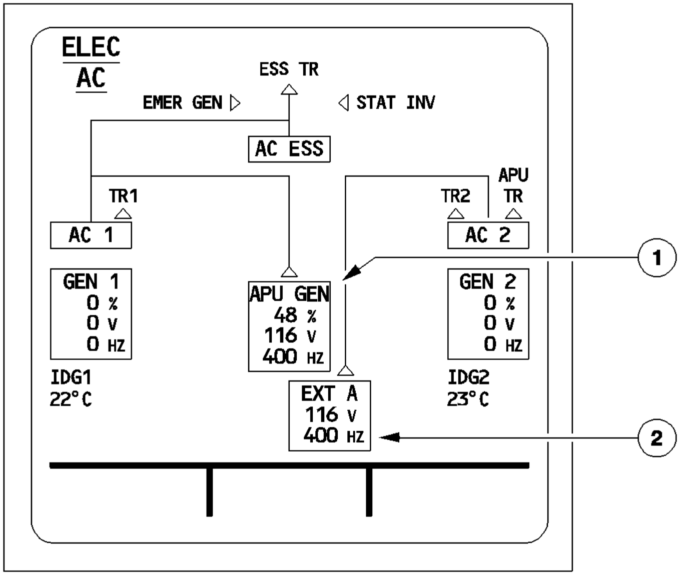
(4) TR indication

The TR indication is normally white. It becomes amber, when the TR fails or in case of abnormal current.

(5) Galley indication

The following legend appears in white, when applicable, depending on the order of priority :
(1 = highest priority) :
1. COMMERCIAL OFF
2. GALLEY SHED
3. GALLEY PARTIALLY SHED

GROUND CONFIGURATION



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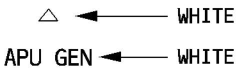
(1) APU Generator

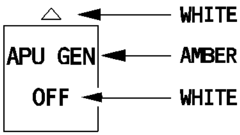
– When APU MASTER SW pushbutton is off :

R



GFC5-01-2420-013-B001AA

– When APU MASTER SW pushbutton is ON and APU GEN pushbutton is OFF :



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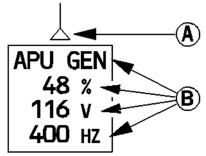
– When APU MASTER SW pushbutton is ON and APU GEN pushbutton is on :

GFC5-01-2420-014-A001AA



Ⓐ – green when APU generator supplies one or more AC bus bar
– white otherwise

Ⓑ same logic as engine generator

R ② <u>External power A (External power B symbol appears beside with the same principle) :</u>

(only displayed when aircraft is on ground)
– When external power is not available

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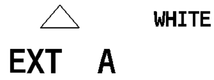

– When external power is available

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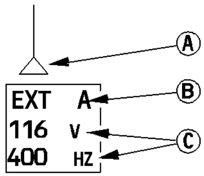
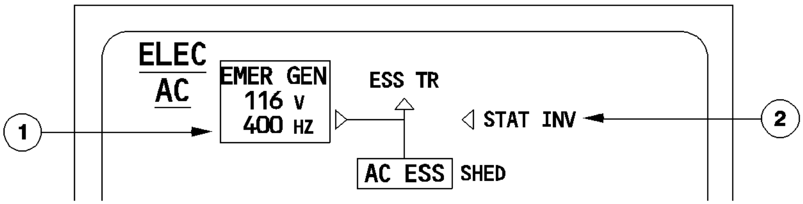


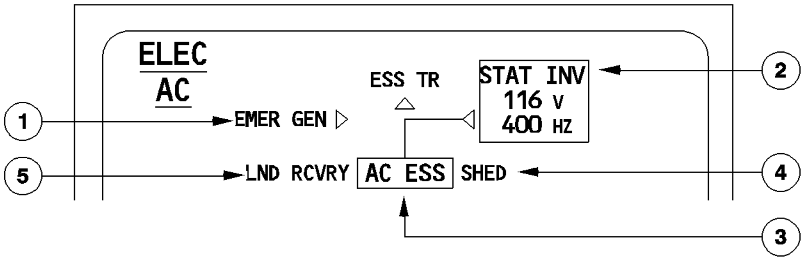
Ⓐ – green when external power supplies one or more bus bar
– white otherwise

Ⓑ white

Ⓒ same as engine generator

EMER CONFIGURATION

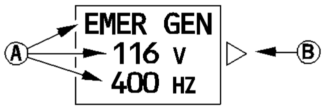




GFC5-01-2420-015-A001AA

1 Emergency generator

– When the emergency generator contactor is closed :



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A same logic as engine generator

B green

– When the emergency generator contactor is open :
EMER GEN ▷ : white
EMER GEN : becomes amber when faulty

2 Static inverter

Same logic as emergency generator

3 AC ESS BUS

This legend, normally green, becomes amber when the bus is not supplied.

4 SHED indication

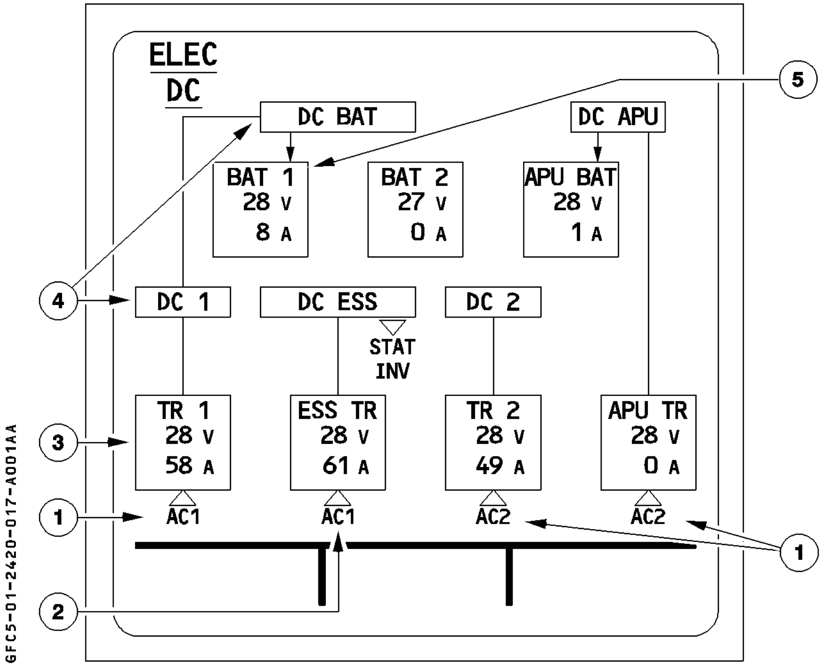
This label comes on amber when AC ESS SHED BUS is not supplied.

5 LND RCVRY indication

This label comes on green when LAND RECOVERY pushbutton is pressed.

ELEC DC ECAM PAGE

NORMAL CONFIGURATION



1. TR 1 (or TR 2 or APU TR) power supply

   This legend is normally white but becomes amber when the bus bar is not powered.

(2) ESS TR power supply

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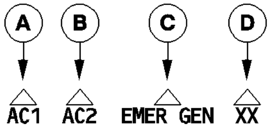

(A) appears in white when AC 1 bus bar supplies the TR.

(B) appears in white when AC 2 bus bar supplies the TR.

(C) appears : in white when the emergency generator supplies the TR and is not faulty
in amber when the emergency generator is connected to the TR and is faulty.

(D) appears amber in all other cases (ESS TR not supplied or information not available).

(3) Transformer rectifier (1, 2, APU and ESS)

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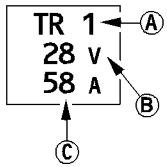

(A) TR indication
— normally white
— amber when the voltage or the current value is abnormal or when the TR is faulty (overheat, minimum current, overcurrent or open or short circuit)

(B) Voltage
— normally green
— amber below 25V or above 31V

Note : For APU TR, voltage remains green even if abnormal during APU start.

(C) Current
green

4 DC BUS bars

— normally green
— amber if no voltage on the bar

5 Batteries

— if BAT pushbutton is selected OFF

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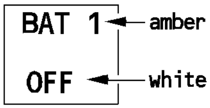
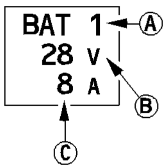


— if BAT pushbutton is selected AUTO

GFC5-01-2420-019-B001AA



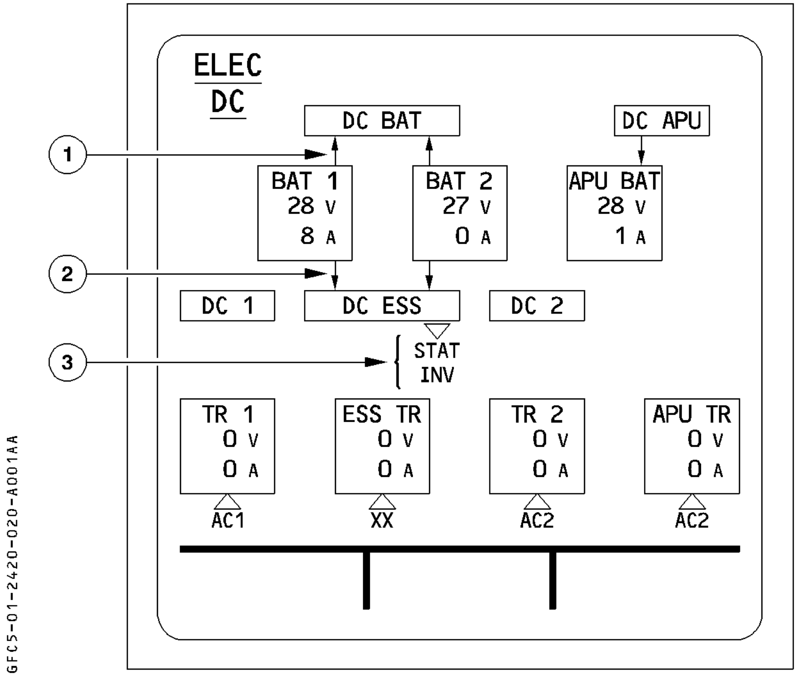
A BAT indication
— normally white
— amber if the battery is faulty

B Voltage
— normally green
— amber below 25V or above 31V

C Current (charge or discharge)
— normally green
— amber if discharge current is above 5A.

Note : *For APU battery, even if voltage or current is abnormal, the values remain green during APU start.*

EMERGENCY CONFIGURATION



1 DC BAT – BAT connection

- Battery Line Contactor open :
  nothing displayed
- Battery Line Contactor closed :
  ↓ green : battery charge
  ↑ amber : battery discharge

2 DC ESS – BAT connection

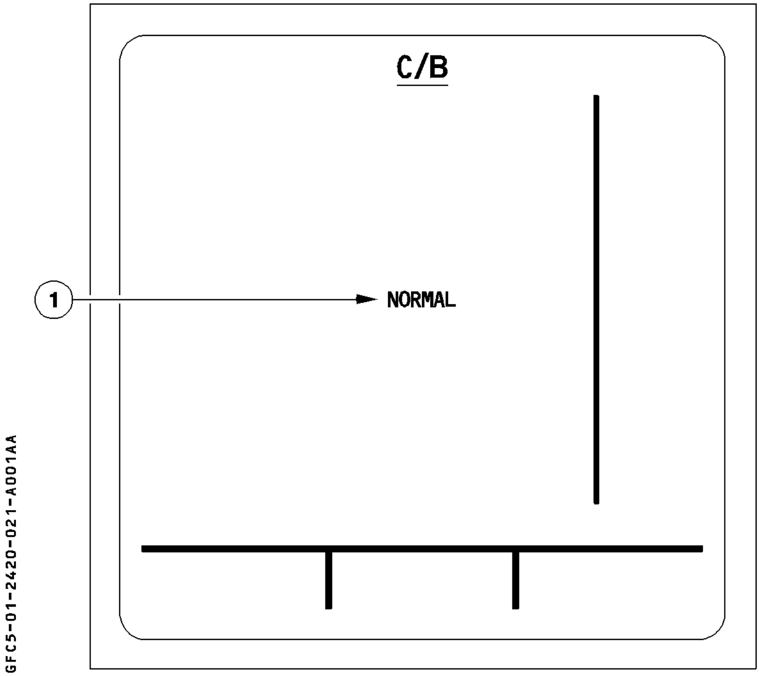
↓ amber : appears when the contactor is closed. (Battery supplying DC ESS bus)

3 Static inverter

- normally white
- amber when the static inverter is faulty.

C / B ECAM PAGE

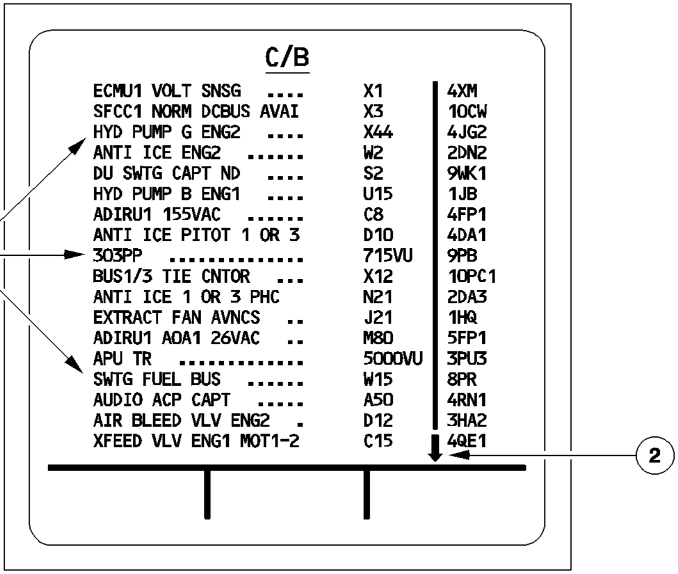
NO C / B PULLED



① NORMAL

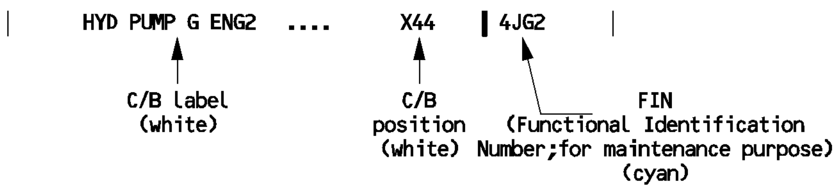
Displayed in green when no circuit breaker is pulled.

C / B PULLED



GFC5-01-2420-022-A001AA

① Open circuit breaker identification



GFC5-01-2420-022-B001AA

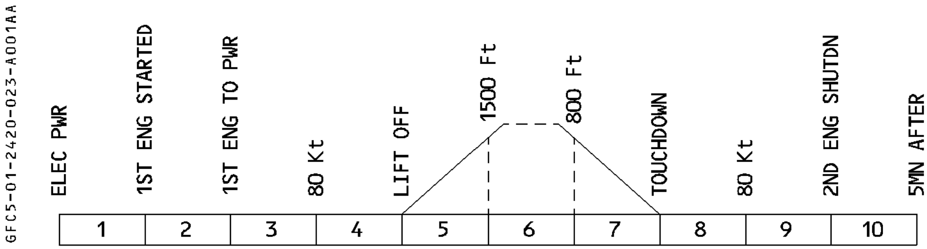
The last tripped Circuit Breaker is displayed on the top of the screen.
All Circuit Breaker are monitored except commercial Circuit Breaker.

② C / B page overflow symbol

Displayed in green when pulled Circuit Breaker list is not closed.

Note : 1. To display the next page, press again Circuit Breaker pushbutton or CLEAR pushbutton on the ECAM control panel.
2. A maximum of three pages is available.

WARNINGS AND CAUTIONS



R

<table>
<tr><th>E / WD: FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNINGS</th><th>FLT PHASE INHIB</th></tr>
<tr><td>EMER CONFIG
Loss of main generators. Both AC BUS are lost.</td><td>CRC</td><td>MASTER WARN</td><td>NIL *</td><td>EMER GEN FAULT lt</td><td rowspan="4">4, 8</td></tr>
<tr><td>AC BUS 1 FAULT
AC BUS 2 FAULT
Busbar(s) is (are) no longer supplied.</td><td rowspan="12">SINGLE CHIME</td><td rowspan="12">MASTER CAUT</td><td rowspan="12">ELEC AC</td><td>NIL</td></tr>
<tr><td>AC ESS BUS FAULT
Busbar is no longer supplied.</td><td>AC ESS FEED FAULT lt</td></tr>
<tr><td>AC ESS BUS SHED
Busbar is no longer supplied.</td><td>NIL</td></tr>
<tr><td>GEN 1(2) FAULT
. Protection trip initiated by associated GCU, or
. Opening of line contractor with GEN pb at ON</td><td>GEN 1(2) FAULT lt</td><td rowspan="2">1, 3, 4, 5, 7, 8, 10</td></tr>
<tr><td>GEN 1(2) OFF
GEN 1(2) pb at OFF with no FAULT</td><td>NIL</td></tr>
<tr><td>APU GEN FAULT
. Protection trip initiated by associated GCU, or
. Opening of line contractor with APU GEN pb at ON.</td><td>APU GEN FAULT lt</td><td rowspan="2">3, 4, 5 7, 8</td></tr>
<tr><td>GEN 1(2) or APU GEN OVERLOAD
Load of one generator is above 100 % of rated output</td><td rowspan="2">GALLEY FAULT lt</td></tr>
<tr><td>EXT PWR A (B) OVERLOAD
Load of external power is above 100 % of rated output</td><td>3 to 8</td></tr>
<tr><td>IDG 1(2) OIL LO PR
IDG oil pressure low. Inhibited if N2 < 14 %.</td><td rowspan="2">IDG 1(2) FAULT lt</td><td rowspan="2">1, 4, 5, 7, 8, 10</td></tr>
<tr><td>IDG 1(2) OIL OVHT
IDG outlet oil temp. above 185°C</td></tr>
<tr><td>IDG 1(2) DISCONNECTED on ground</td><td>IDG OFF lt</td><td>3 to 10</td></tr>
<tr><td>ECMU 1(2) FAULT</td><td>NIL</td><td>3, 4, 5, 7, 8</td></tr>
</table>

* ELEC page shall be called on upper ECAM by pressing and holding the ELEC pushbutton on the ECAM control panel.

<table>
<tr><th>E / WD: FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNINGS</th><th>FLT PHASE INHIB</th></tr>
<tr><td>C / B TRIPPED
One C / B tripped.</td><td rowspan="8">SINGLE CHIME</td><td rowspan="8">MASTER CAUT</td><td>NIL</td><td>NIL</td><td rowspan="3">3, 4, 5, 7, 8</td></tr>
<tr><td>BAT 1(2) FAULT
Charging current increases at an abnormal rate.</td><td rowspan="5">ELEC DC</td><td>BAT 1(2) FAULT lt</td></tr>
<tr><td>APU BAT FAULT
Charging current increases at an abnormal rate.</td><td>APU BAT FAULT lt</td></tr>
<tr><td>DC BUS 1 FAULT
DC BUS 2 FAULT
DC BUS 1 + 2 FAULT
DC ESS BUS FAULT
Busbar(s) is (are) no longer supplied.</td><td rowspan="11">NIL</td><td rowspan="2">4, 8</td></tr>
<tr><td>DC ESS BUS SHED
Busbar is no longer supplied.</td></tr>
<tr><td>DC BAT BUS FAULT
Busbar is no longer supplied.</td><td>3, 4, 8, 9</td></tr>
<tr><td>BUS TIE OFF
The BUS TIE pb is abnormally OFF.</td><td>NIL</td><td>3,4,5 7,8</td></tr>
<tr><td>AC ESS BUS ALTN
AC ESS BUS is abnormally supplied by AC 2 bus.</td><td>ELEC AC</td><td>4 to 8</td></tr>
<tr><td>BAT 1(2) or APU BAT OFF
BAT pb is OFF without fault.</td><td rowspan="6">NIL</td><td rowspan="6">NIL</td><td rowspan="3">ELEC DC</td><td rowspan="3">3, 4, 5 7, 8, 9, 10</td></tr>
<tr><td>TR 1 (2), APU TR or ESS TR FAULT</td></tr>
<tr><td>BAT 1(2) or APU BAT SYS FAULT</td></tr>
<tr><td>STATIC INV FAULT</td><td rowspan="3">NIL</td><td rowspan="2">3, 4, 5, 7, 8</td></tr>
<tr><td>C/B MONITOR FAULT
Loss of CBMU</td></tr>
<tr><td>IDG 1 (2) OIL SYS FAULT</td><td>2 to 8</td></tr>
</table>

MEMO DISPLAY

– EMER GEN is displayed in green, when the emergency generator is running.
– ELEC EXT PWR is displayed in green, if external power is available. This message becomes amber, if both engines are running.

25.00 CONTENTS

GENERAL

The aircraft and system controls, required for piloting the aircraft, are arranged in such a way that the crew faces forward and all crewmembers can monitor instruments and systems. The designers concentrated system controls on the overhead panel by making extensive use of pushbuttons, directly installed in the system synoptic.

Note : *The electrical circuit breaker panel is in the avionics bay to increase available space in the cockpit without any penalty in the passenger cabin.*

PRINCIPLES FOR PUSHBUTTONS WITH INTEGRATED INDICATIONS

Whenever possible, pushbuttons used for corrective actions, have integrated status and failure indications.
The pushbutton positions, and their illuminated indications, follow the "lights out" principle.

- While corresponding to particular aircraft configurations, indications also have the following color codes :
  - Warnings
    RED : A failure requiring immediate action.
  - Cautions
    AMBER : A failure, of which the flight crew should be aware, but does not call for immediate action.
  - Indications
    GREEN : For normal system operation.
    BLUE : For normal operation of a system used temporarily.
    WHITE : – For an abnormal pushbutton position.
    – For a test result or maintenance information.

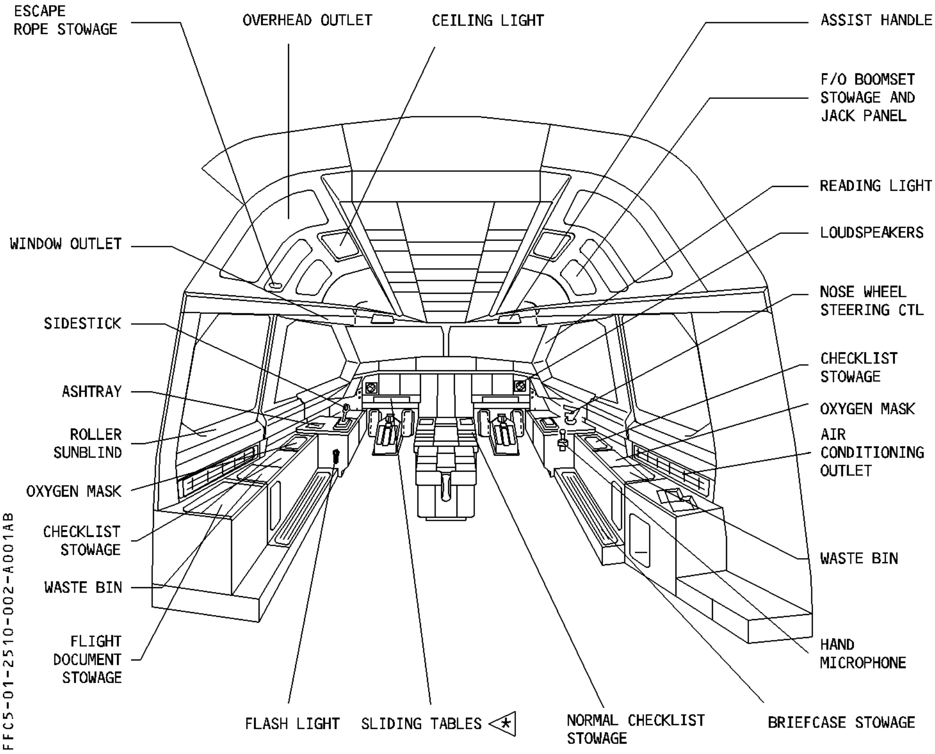
  When the aircraft is in normal configuration, only green lights can be permanently lit, whereas blue lights can be lit intermittently.
- Pushbutton positions :

POSITION	BASIC FUNCTION
Pressed In	ON, AUTO, OVRD
Released Out	OFF, MAN

Note : *1. Certain pushbutton lights have two dots, indicating that the corresponding part of the pushbutton is not used.*
R *2. Certain pushbuttons do not remain pressed in. These are referred to as*
R *"Momentary Action" pushbuttons.*

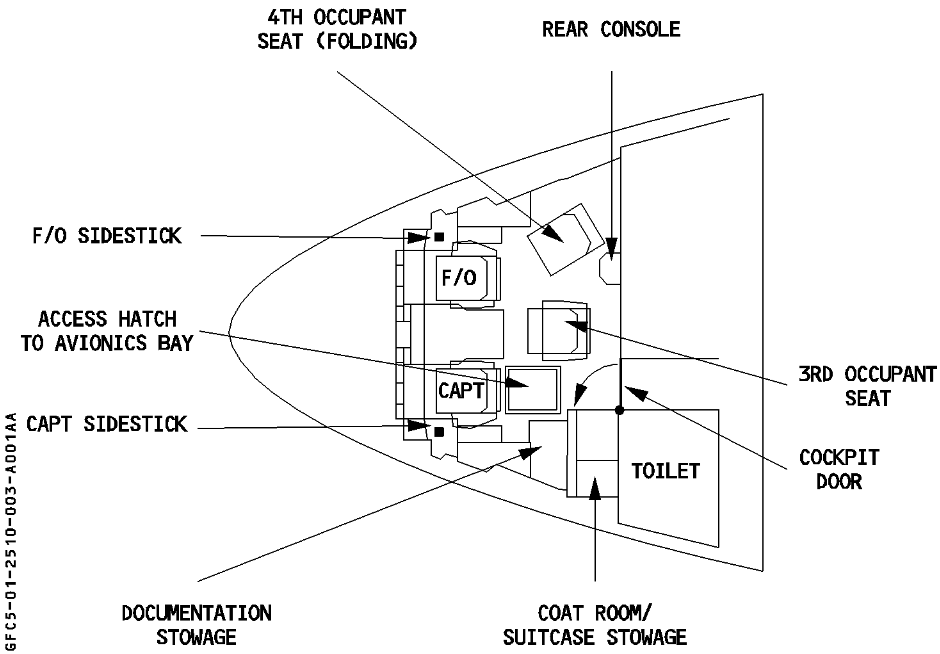
GENERAL ARRANGEMENT

R

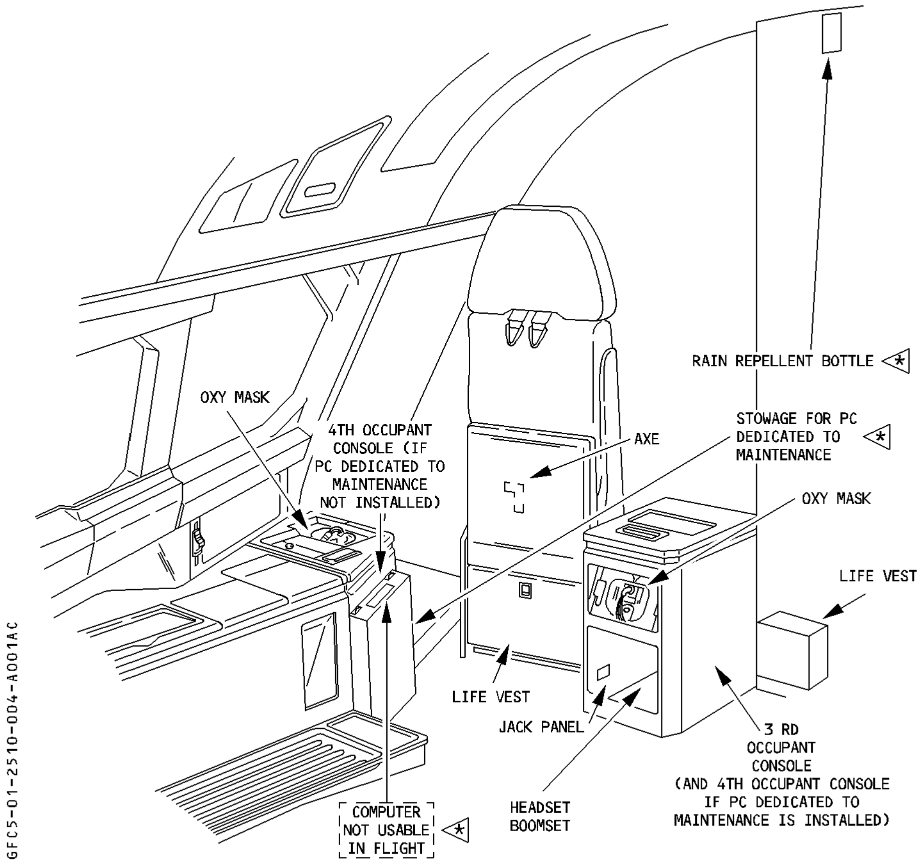


COCKPIT PLAN

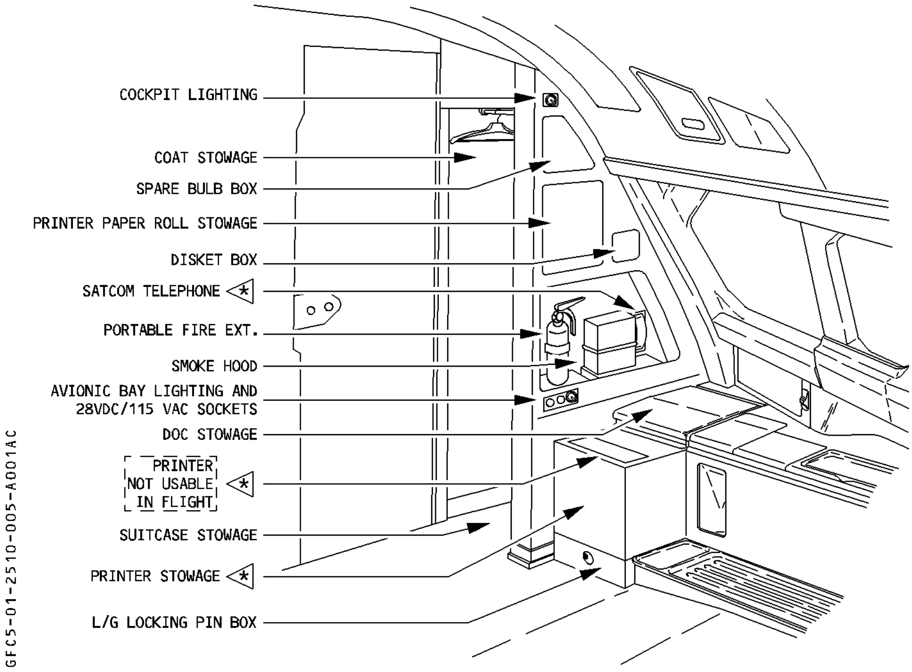
The cockpit can accomodate two crew members plus two other occupants.
The two pilot seats are mounted on columns.
The third occupant seat is also mounted on column and can rotate.
The fourth occupant's seat is a folding seat.



R RIGHT REAR CORNER



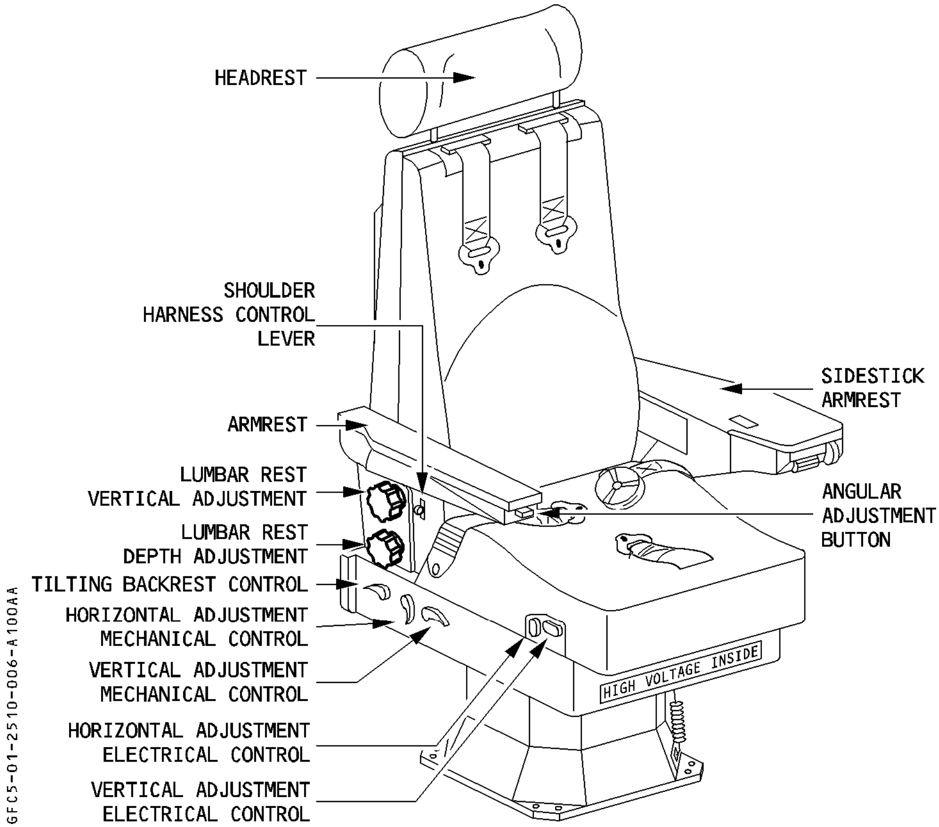
R **LEFT REAR CORNER**



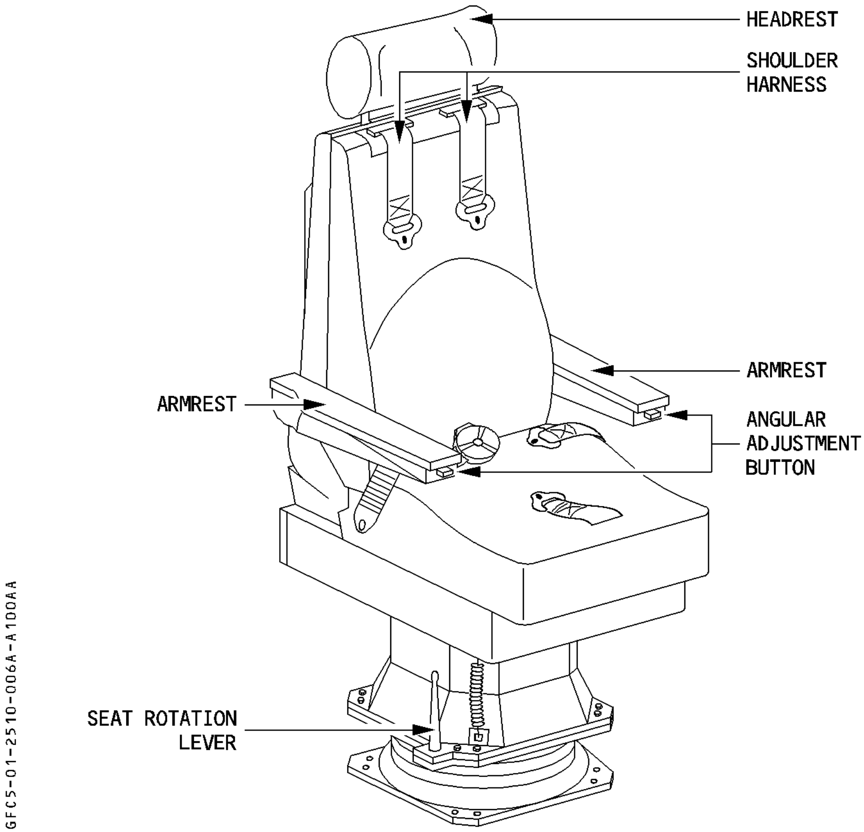
SEATS

PILOT SEATS

They are column-mounted and electrically adjustable.



THIRD OCCUPANT SEAT



PILOT AND THIRD OCCUPANT SEAT MECHANICAL ADJUSTMENT

To adjust a seat mechanically, the occupant must lift the appropriate control handle. This unlocks the seat so that it may be moved. Releasing the control handle returns it to the
R springloaded locked position. Pilot seat mechanical adjustment is a backup : The seat should be adjusted electrically.
R When aligned with the aircraft's centerline, and in the maximum forward position, the third
R occupant's seat can be rotated by using the rotation lever, located on the seat base.

R PILOT SEAT ELECTRICAL ADJUSTMENT

To adjust a seat electrically, the occupant must press the appropriate control switch in the desired direction, and release it when the seat reaches the desired position. The switch then returns to the springloaded neutral position.
To adjust the vertical position of the lumbar cushion, the occupant must :
- Pull the control out to the unlocked position,
- Turn the control to adjust the position of the cushion, and
- Push the control into the locked position.

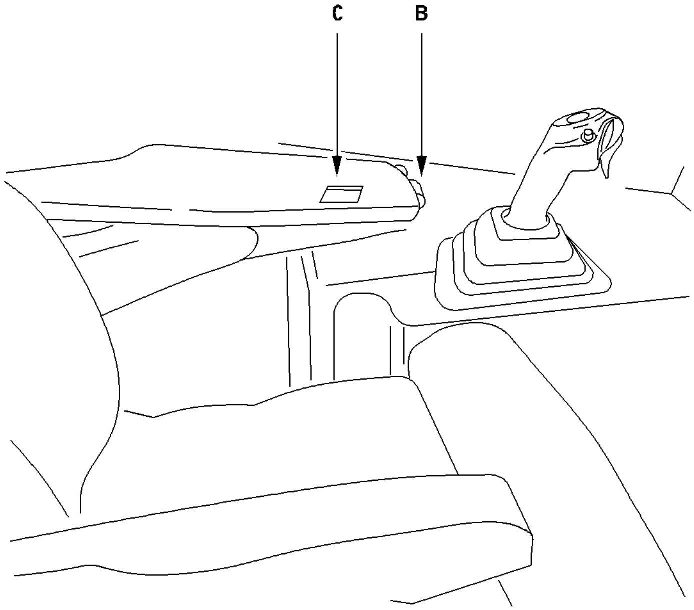
HEADREST ADJUSTMENT

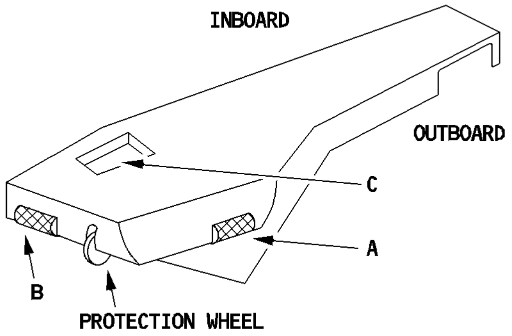
To adjust the headrest in inclination, the occupant must press the inclination control button, and release it to lock the position.
To control the height of the headrest, the occupant must push it horizontally, then adjust the height. Once released, it locks the position.

PILOT SEAT INBOARD ARMREST ADJUSTMENT

To adjust the inboard armrest, the occupant must turn the knurled knob, located on the bottom surface of the armrest.

PILOT SEAT OUTBOARD ARMREST ADJUSTMENT



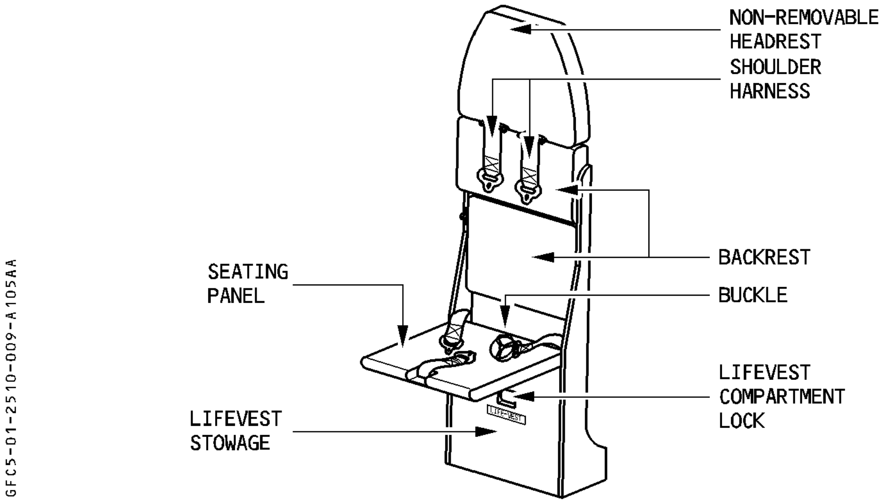


GFC5-01-2510-008-A001AA

The position of the armrest is adjustable as follows :
A – Height adjustment
B – Pitch adjustment
The armrest also has a memory display (C) that shows pitch and height.

FOURTH OCCUPANT SEAT

It is a folding seat.



COCKPIT WINDOW

The cockpit has fixed and sliding windows.

FIXED WINDOWS

There are four fixed windows :
- two windshields
- two fixed side windows

SLIDING WINDOWS

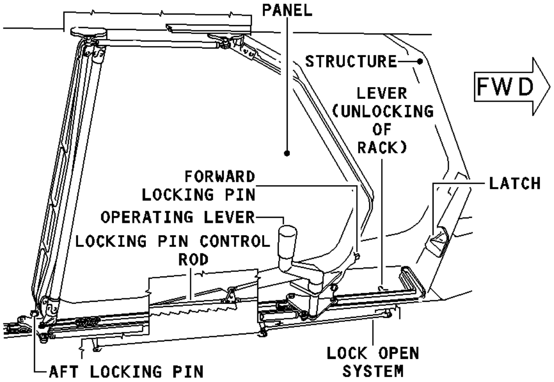
The flight crew can use the sliding window as emergency exits. Therefore they are not permitted to stow any object so that it protrudes into the window area from the side console.
Each sliding window includes a panel which as an anti-icing and defogging system, and the opening and closing mechanism.

Opening mechanism

Fully press the operating lever to disengage the locking pins from their latches.
Rotate aft the operating lever to free the window panel from its fixed structure.
At the end of the operating lever travel, pull backwards to slide the window panel aft.
Move control lever forward lock the window.

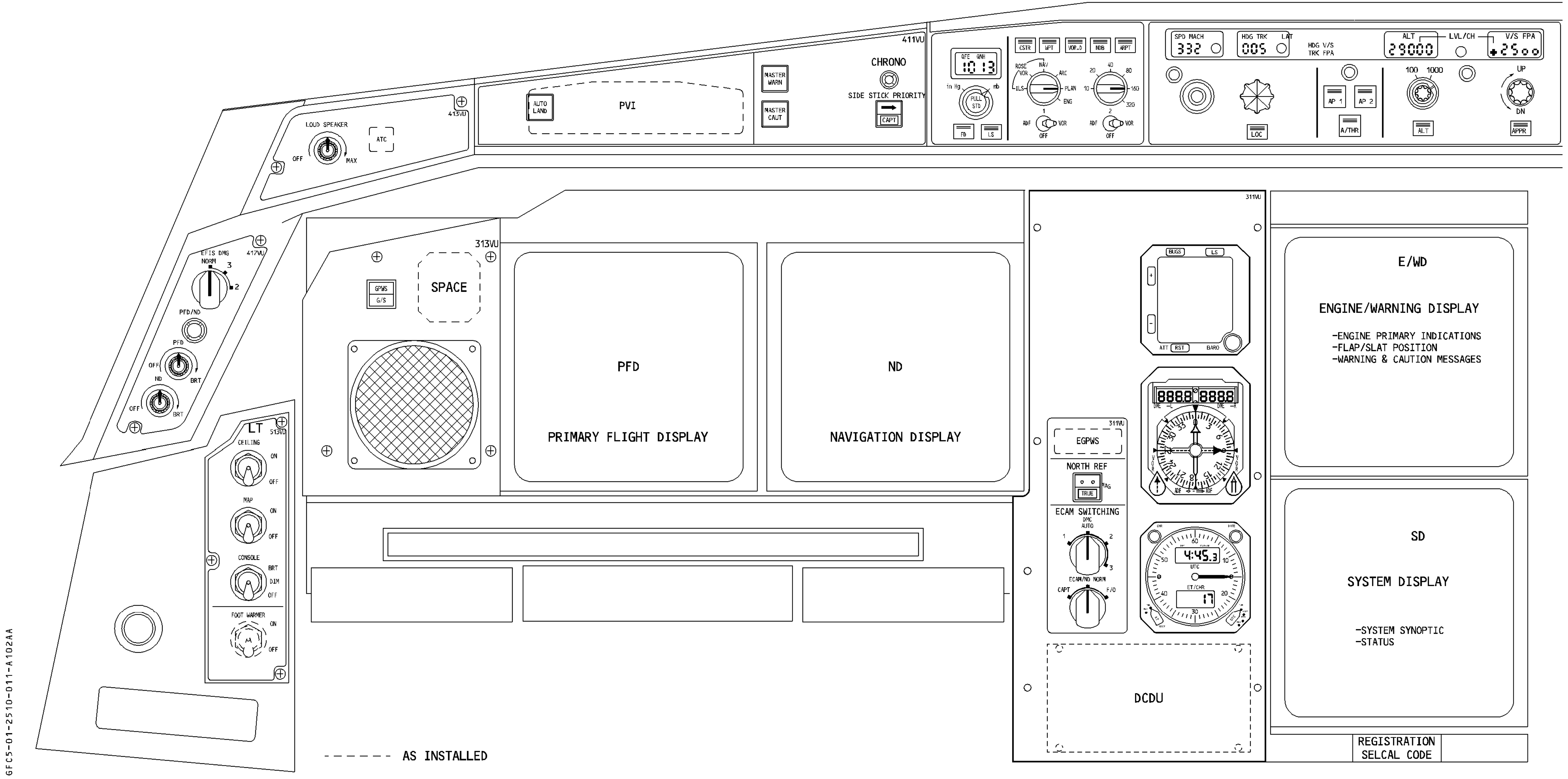
Closing mechanism

Move control lever aft unlock the window.
Push operating lever forward until the panel is in position opposite its fixed frame.
Rotate the operating lever forward to move the panel into its frame and engage the locking pins in their latches.

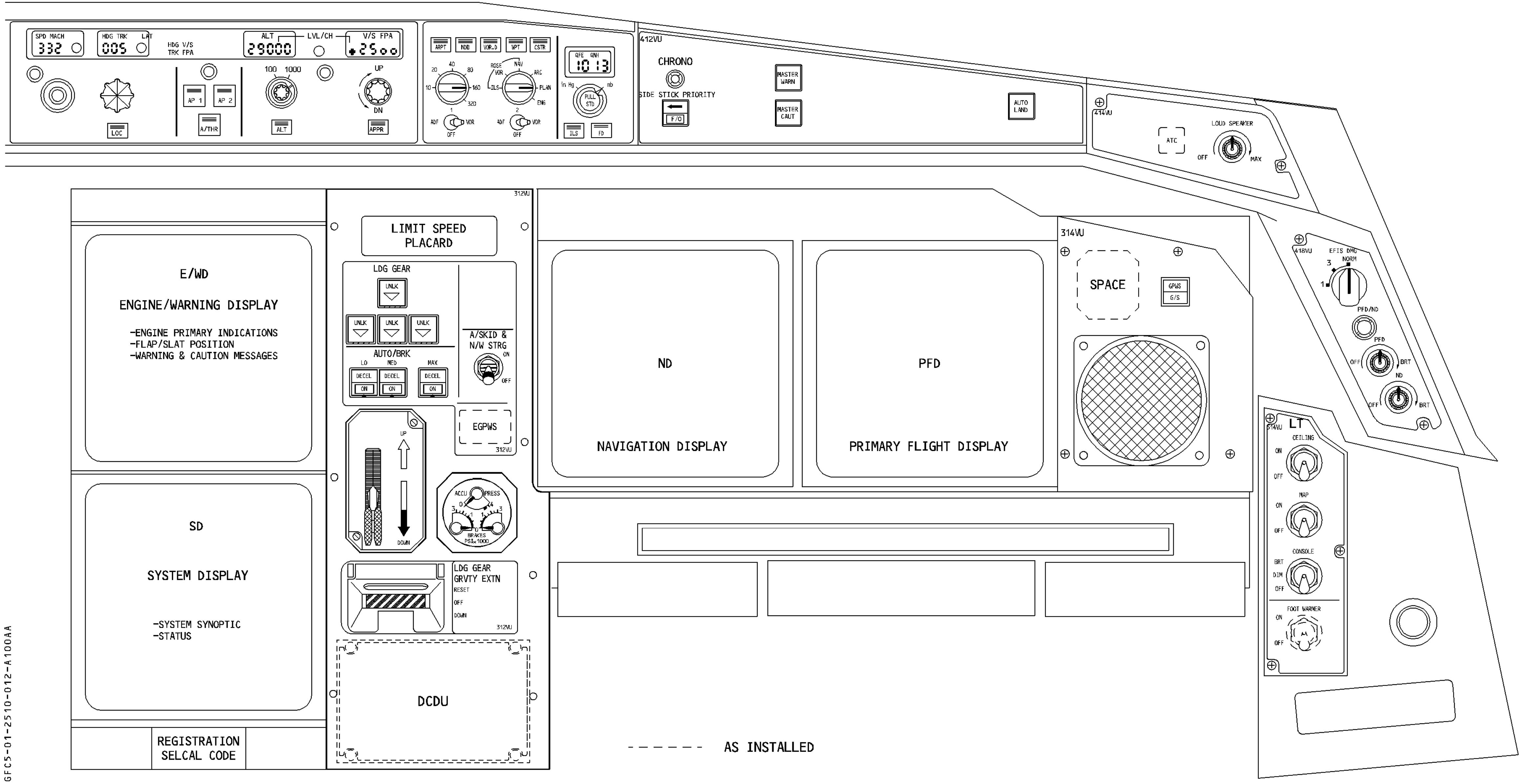


GFC5-01-2510-010-A002AA

PILOT'S INSTRUMENT PANELS

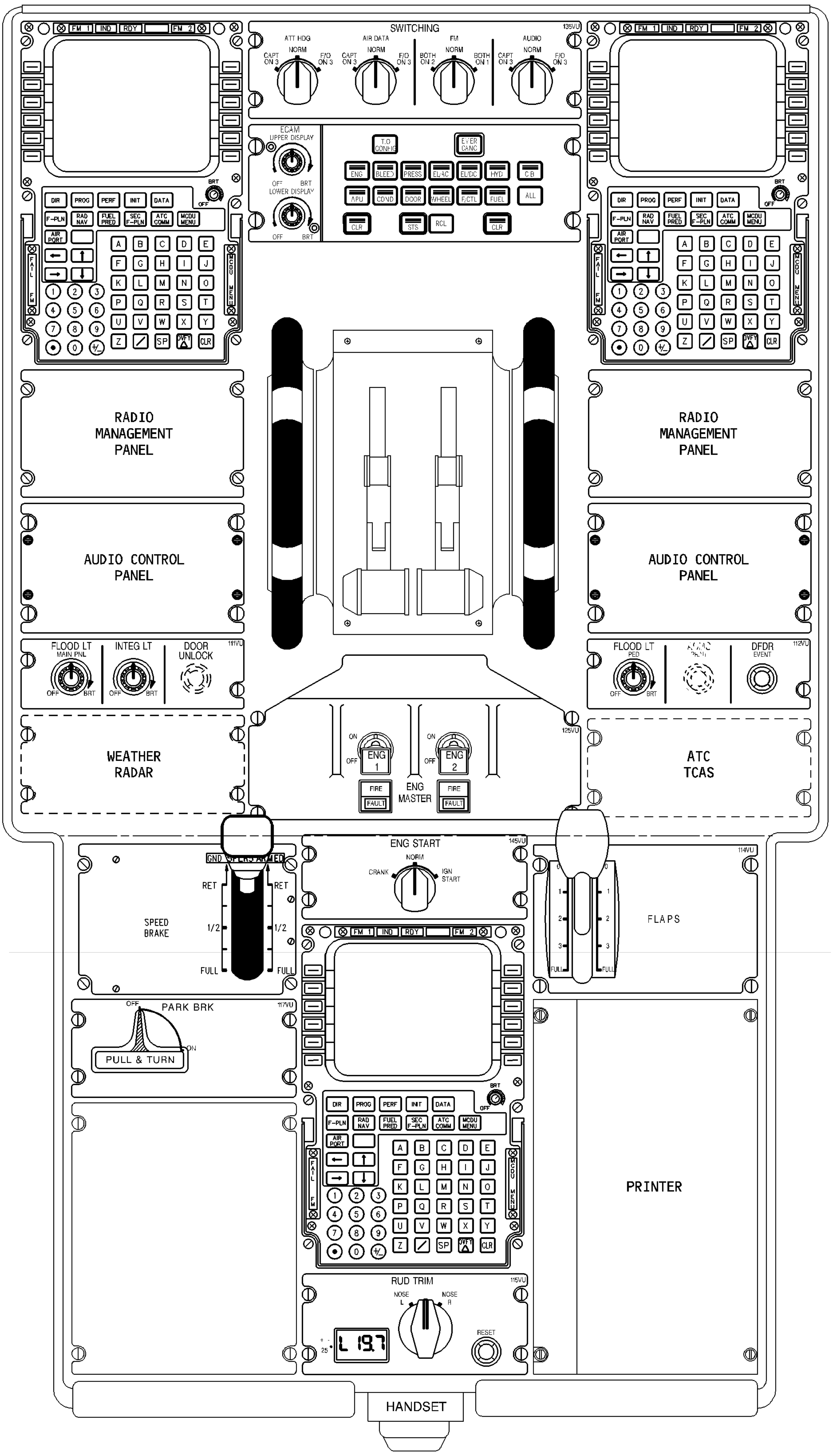


PILOT'S INSTRUMENT PANEL (cont'd)



PEDESTAL

GFC5-01-2510-013-A100AA



------- AS INSTALLED

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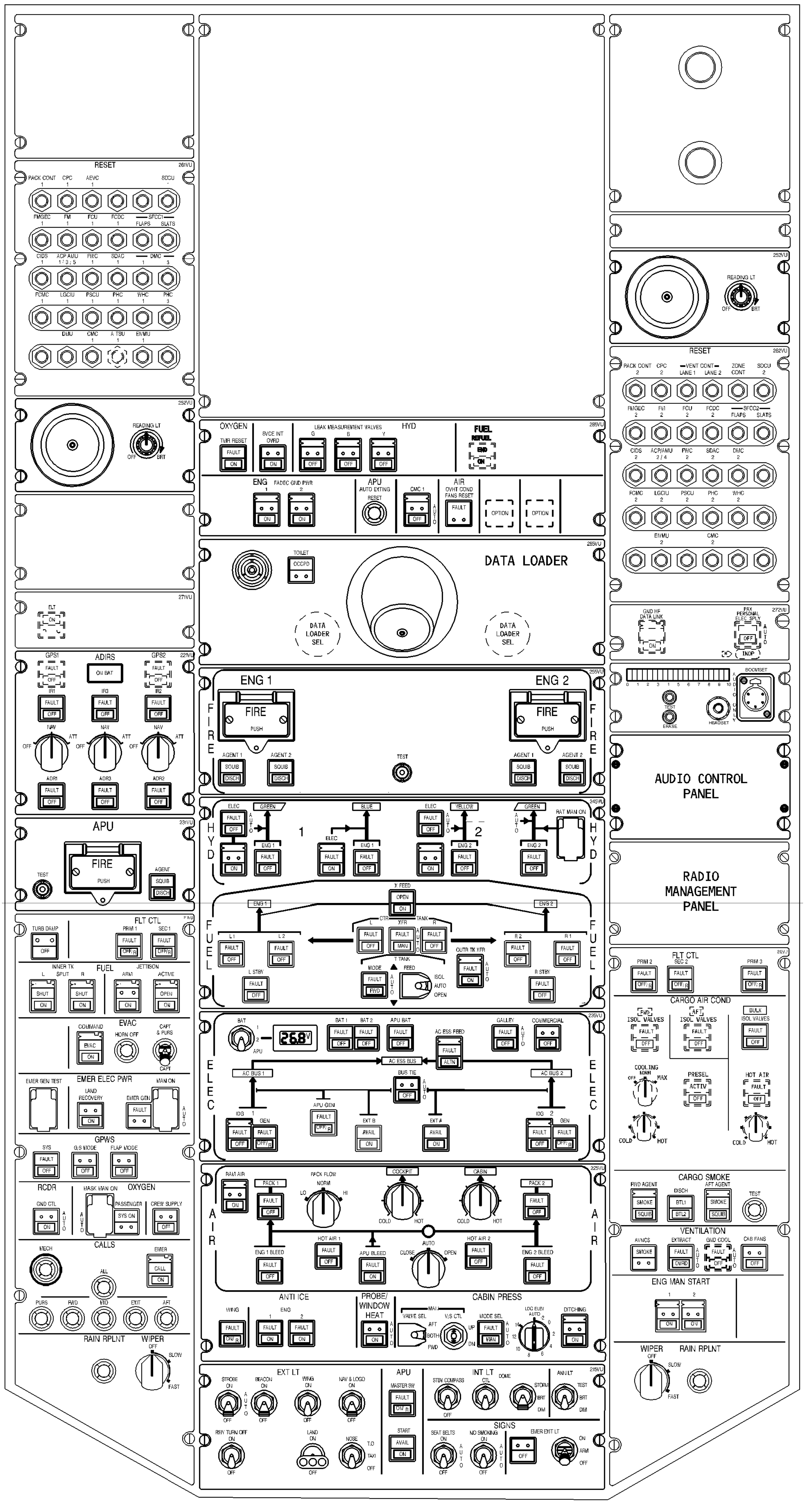


------- AS INSTALLED

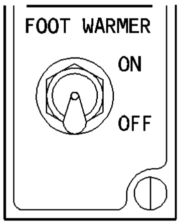
FOOT WARMER

A heating panel is attached to each pedal. The temperature of the panels is about 20°C (68°F).

CONTROLS

On the main instrument panel on captain and first officer side.

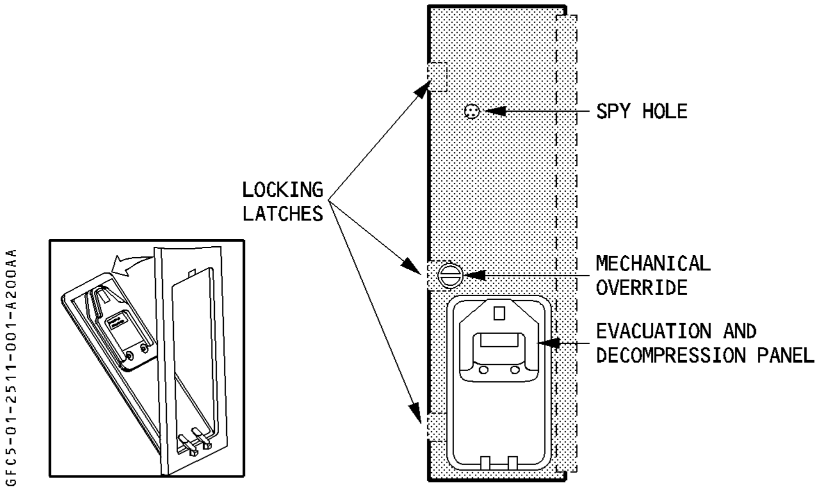
GFC5-01-2510-015-A100AA



FOOT WARMER sw
Operation of foot warmer panels on related pedals.

COCKPIT DOOR DESCRIPTION

A forward-opening hinge door separates the cockpit from the passenger compartment. It has an electric-locking latch, controlled by the pilots. In normal conditions, when the door is closed, it remains locked. Upon cockpit entry request, the flight crew can authorize entry by unlocking the door, which remains closed until it is pushed open.
When the flight crew does not respond to requests for entry, the door can also be unlocked by the cabin crew, by entering a two to seven digit code (programmed by the airline) on the keypad, installed on the door post.
The door is bulletproof and fully compliant with rapid decompression requirements.
A mechanical override enables pilots to open the door from the cockpit side.
The evacuation and decompression panel enables the flight crew to evacuate the cockpit, in case of an emergency when the door is jammed or stuck.
This panel can only be removed from the cockpit side by kicking it open.
The panel also automatically falls open in case of rapid cabin decompression (in case of rapid decompression in the cockpit, the CDLS automatically unlocks the door).
In case of an electrical supply failure, the door is automatically unlocked, but remains closed.



COCKPIT DOOR LOCKING SYSTEM (CDLS)

The Cockpit Door Locking System (CLDS) provides a means of electrically locking and unlocking the cockpit door. This system is mainly composed of :

- A keypad, located in the forward cabin, near the cockpit door,
- A toggle switch, located on the center pedestal's Cockpit Door panel,
- A control unit and its CKP DOOR CONT normal panel, located on the left-hand side of the overhead panel,
- A backup control unit, identical to the first one, and its CKP DOOR CONT backup panel, located on the right-hand side of the overhead panel,
- An additional CKPT DOOR BKUP panel, which is composed of a LKG SYS switch and a OPEN/FAULT control pushbutton,
- A buzzer.

The keypad enables the cabin crew to request access to the cockpit. There are two different access request types : "Routine" and "Emergency" access request (Refer to 3.04.25).

The toggle switch enables the flight crew to lock or unlock the cockpit door, following an access request, thereby allowing or denying entry into the cockpit.

The cockpit door control unit is the system controller, in charge of :

- Locking or unlocking the door latches, upon flight crew action.
- Unlocking the door, in case of cockpit decompression (the door then opens towards the cockpit under differential pressure).
- Indicating system failures of electrical latches and pressure sensors.
- Activating the access request buzzer and turning on the keypad LEDs.

The CDLS backup control unit is a backup for locking/unlocking the door by flight crew action, and for unlocking the door in case of decompression. The backup control has to be used only when the normal control unit has failed, or when the two pressure sensors have failed.

When operating the CDLS with the backup control unit, both the toggle switch and the keypad are inoperative. In this condition :

- The cabin crew has to use the interphone to perform any cockpit access request, and
- The flight crew has to use the OPEN/FAULT CTL P/B located on the CKPT DOOR BKUP overhead panel, to unlock the door when access to the cockpit is authorized.
- No emergency access from the cabin to the cockpit is available.

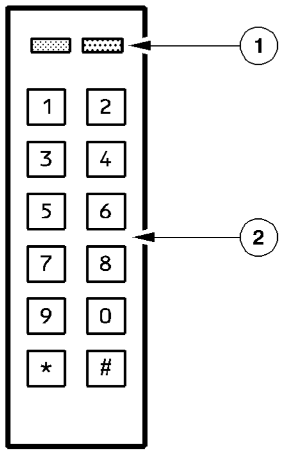
By using the CKPT DOOR BKUP LKG SYS switch, it is possible to operate the CDLS in normal condition, in backup condition, or to deactivate the system to facilitate maintenance tasks and ground operations.

The buzzer sounds in the cockpit for 1 to 9 seconds to indicate that a routine access request has been made, or sounds continuously if an emergency access procedure has been initiated.

CONTROLS

KEYPAD

R The keypad is used by the cabin crew to request pilots to open the door (Refer to 3.04.25).



GFC5-01-2511-003-A100AA

(1) LOCKED/UNLOCKED DOOR INDICATOR

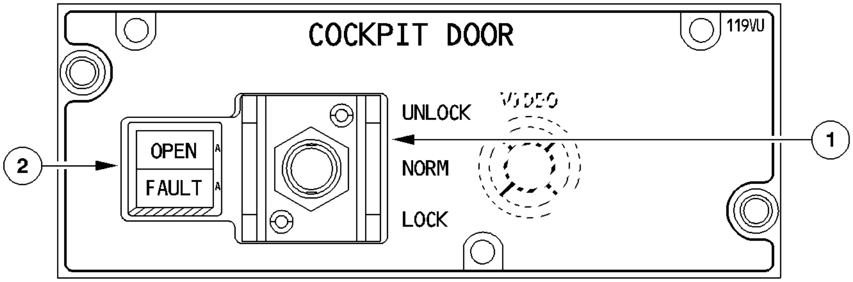
GREEN light ON	:	The door has been unlocked either by a flight crew action, or automatically (during 5 seconds) when no flight crew action has been performed during the delay, following an emergency access request. The door can be pushed open.
GREEN light flashes	:	An emergency request to enter the cockpit has been made ; the buzzer will sound continuously in the cockpit, but no action has yet been taken by the flight crew.
RED light ON	:	The flight crew has denied access, and the door remains locked.

(2) DIGITAL KEYPAD

R The keypad is used to sound the buzzer in the cockpit for one to nine seconds (three
R seconds by default), by entering a zero to seven digit code as programmed by the
R airline, followed by the '#' key.
R It is also used to enter the two to seven-digit emergency code, followed by the '#'
R key, when the flight crew does not respond.

CENTRAL PEDESTAL COCKPIT DOOR PANEL

The secured cockpit door opening is controlled by a toggle switch, located on the central pedestal.



GFC5-01-2511-004-A100AA

(1) COCKPIT DOOR toggle switch

UNLOCK position : This position is used to enable the cabin crewmember to open the door. The switch must be pulled and maintained in the unlock position until the door is pushed open.
NORM position : All latches are locked, and EMERGENCY access is possible for the cabin crew.
LOCK position : Once the switch has been moved to this position, the door is locked ; emergency access, the buzzer, and the keypad are
R inhibited for a preselected time (5 to 20 minutes).

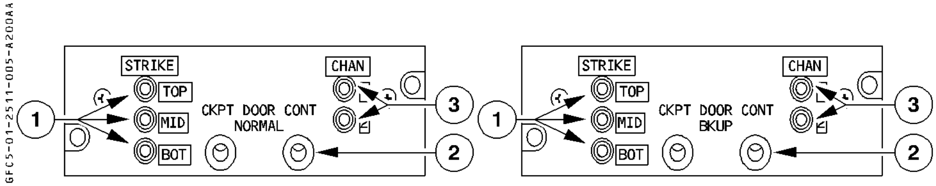
R *Note : 1. If the LOCK position has not been used by the pilot, for at least 5 to 20 minutes, the cabin crew is able to request emergency access to open the cockpit door.*
2. The UNLOCK position overrides and resets any previous selection.
3. In case of an electrical supply failure, the cockpit door is automatically unlocked, but remains closed.

(2) COCKPIT DOOR Fault Open indicator

R OPEN light ON : The door is not closed, or not locked.
OPEN light flashes : The cabin crew has started an emergency access procedure. If there is no reaction from the flight crew, the door will unlock at the end of the adjustable time delay (15 to 120 seconds).
FAULT : This light comes on when a system failure has been identified (Example : Latch, pressure sensors, control unit).
R The inoperative item can be identified by checking the strike
R and pressure sensor status lights on the CKPT DOOR CONT
R panel.

OVERHEAD CONTROL PANELS

The CDLS consists of two separate but identical control units and, therefore, there are two CKPT DOOR CONT panels (normal and backup). The normal control panel is located on the overhead left-hand side, whereas the backup is located on the right-hand side.



(1) Strikes' status lights

Off : The corresponding (upper, mid, or lower) locking latch is operative.
On : The corresponding (upper, mid, or lower) locking latch is faulty.

(2) Pressure sensor

Two redundant differential pressure sensors enable rapid pressure variation in the cockpit to be detected, in order to command simultaneous opening of all latches when a defined pressure drop is detected.

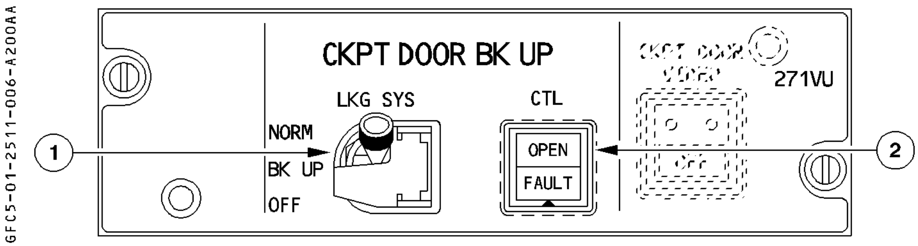
(3) Pressure sensor status lights

Off : The corresponding (1 or 2) pressure sensor is operative.
On : The corresponding (1 or 2) pressure sensor is faulty.

Note : These indicators enable the crew to identify the faulty item, when the CDLS Fault indicator light is ON, (either for the normal or backup system).

COCKPIT DOOR BACKUP

The Cockpit Door backup panel consists of a guarded three-position switch, and of a control pushbutton with a dual visual indicator.



① LKG SYS Switch

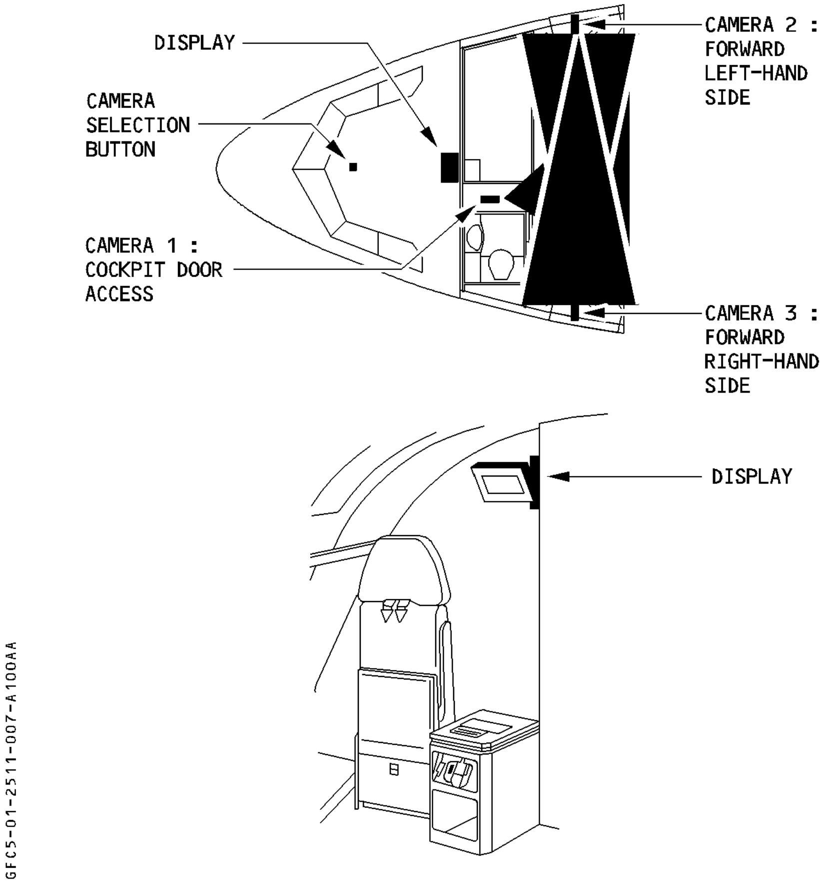
NORM : The basic system has no failure ; the normal control is operative.
BK UP : The normal control is deactivated, and backup control is activated.
OFF : The Cockpit Door Locking System is deactivated. Both normal and backup controls are inoperative. Therefore, the door is unlocked. It can be pushed open from the cabin side.

② CTL pushbutton, OPEN/FAULT Indicator

OPEN P/B : Pressing this pushbutton unlocks the door. Keep the pushbutton pressed until the door is pushed open.
OPEN light ON : The door is not closed, or not locked.
FAULT light ON : This light comes on when a backup system failure has been identified. The inoperative item can be identified by checking the strike and pressure sensor status lights on the CKPT DOOR CONT backup panel.

COCKPIT DOOR SURVEILLANCE SYSTEM

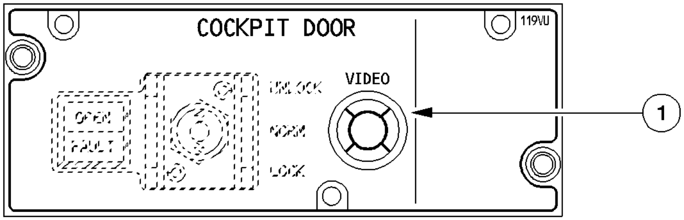
The Cockpit Door Surveillance system consists of three video cameras, which enable the flight crew to identify persons prior to authorizing their entry into the cockpit. An LCD display, located on the rear panel, shows the various camera views. It has automatic brightness adjustment and is activated by the Cockpit Door Video pushbutton.



CONTROLS

CENTRAL PEDESTAL

GFC5-01-2511-008-A100AA



(1) Cockpit Door Video pushbutton

R	Selects the various camera image displays.	
R	Camera 1 image :	Displayed by pressing the pushbutton when the screen is on standby, or after Camera 2 and 3 images have been displayed. Automatically displayed, after an entry request is performed on the keypad.
R	Camera 2 and 3 images :	Displayed on a split screen, when the pushbutton is pressed after Camera 1's image has been displayed.
R	Standby :	If no action has been taken for 5 minutes, the screen goes blank and remains on standby.

Note : *An entry request, performed on the keypad within 30 seconds following an earlier entry request, will not lead to the automatic selection of Camera 1, since the flight crew is given authority to select any desired camera image via the cockpit door video pushbutton. After these 30 seconds, the system reverts to its normal operation.*

OVERHEAD PANEL

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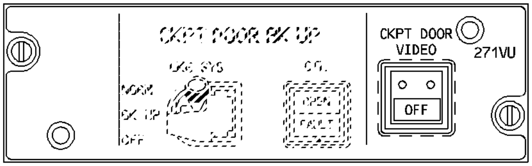


(1) Cockpit Door Video pushbutton

OFF : The Cockpit Door Surveillance System is de-energized.

LOWER DECK MOBILE CREW REST COMPARTMENT

GENERAL

Since the crew rest compartment is buyer-furnished equipment, only the common features (as stated in the Airbus interface specifications) are described in this section. For a description of the systems inside the compartment, refer to the supplier documentation.
The Lower Deck Mobile Crew Rest (LDMCR) compartment is installed in the most forward position of the lower aft cargo compartment. It is accessible from the cabin via a staircase. Berths are provided to allow the crew to relax on long-range flights.
The LDMCR interfaces with the following aircraft systems :

DOORS

For normal operation, the LDMCR is accessible through the staircase door and a hatch in the cabin floor. The LDMCR is equipped with an additional emergency hatch to evacuate directly into the cabin.

AIR CONDITIONING

The air supplied to the LDMCR is a mixture of fresh and recirculated air, taken from the cabin air supply. An air supply isolation valve is installed in the supply duct, which is controlled by the ventilation controller. The valve is closed when the access hatch is not fully open, or smoke is detected in the LDMCR or aft/bulk cargo compartment.

Note : Pressing the TEST pushbutton on the CARGO SMOKE panel, or performing the LDMCR internal smoke detection system test, closes the air supply isolation valve.

An independent electrical heating system is installed in the LDMCR. Temperature control inside the LDMCR allows the selection of a temperature within the range of +20°C to +25°C. The heating only operates in flight.

R *Note : The LDMCR heating system is lost in case of LGCIU2 or GEN 2 failure.*

COMMUNICATION

The LDMCR is equipped with an interphone station, an attendant indication panel and additional attendant panels. Passenger address and audio entertainment systems are available.

ELECTRICAL SYSTEM

AC and DC power is provided to the LDMCR.

FIRE PROTECTION

R Refer to FCOM 1.26.57.

LIGHTS

General illumination is installed. The CIDS controls the general illumination via the two Additional Attendant Panels (AAP). An independent continuous staircase illumination is also installed. Reading lights and No Smoking/Fasten Seat Belt signs are provided. The aircraft emergency lighting system controls and supplies the emergency lights and the
R emergency exit sign, installed in the LDMCR.

OXYGEN

R Chemical oxygen generators are provided in the LDMCR. The aircraft system releases the masks.

NORMAL OPERATIONS

R During taxi, takeoff and landing, the LDMCR must be unoccupied. In flight, if the LDMCR is occupied, the access hatch must stay fully open to ensure that the air supply isolation valve is open.

ABNORMAL OPERATION

PRESSURE LOSS

In case of pressure loss, a high-low chime alerts the occupants for 30 seconds and the oxygen masks drop down.

LOW AIR FLOW

R If insufficient air flow can be provided to the LDMCR, an internal buzzer (minimum 30 seconds) alerts the occupants to evacuate. The heating system is automatically turned off.

Note : Pressing the TEST pushbutton on the CARGO SMOKE panel closes the air supply
R *isolation valve that triggers the LOW AIR FLOW warning in the LDMCR.*

SMOKE DETECTION

R Refer to FCOM 1.26.57.

R LDMCR ISOLATION VALVE FAILURE

R If the LDMCR isolation valve is not closed but both hatches are closed, the “DO NOT OPEN
R HATCH” sign comes on in the staircase.
R If the air supply isolation valve fails in the open position, or if it does not close when
R commanded, the ECAM caution “COND CRG REST ISOL FAULT” is triggered.

GENERAL

NOT APPLICABLE

CONTROLS

NOT APPLICABLE

BUS EQUIPMENT LIST

R

	NORM			EMER ELEC		
	AC	DC	DC BAT	AC ESS	DC ESS	HOT
CAPTAIN SEAT	AC 1					
F/O SEAT	AC 2					
IN SEAT POWER SUPPLY◁	AC 1					
FOOT WARMER ◁	AC 1					
COCKPIT DOOR LOCKING SYSTEM ◁		DC 2				
COCKPIT DOOR LOCKING SYSTEM BACKUP ◁		DC 1				
COCKPIT DOOR SURVEILLANCE SYSTEM ◁		DC 1				

26.00 CONTENTS

DESCRIPTION

Aircraft fire protection systems comprise :

— Fire and overheat detection and extinguishing systems for :
  · the engines
  · the APU
— Smoke detection and extinguishing for :
  · the cargo compartments
  · the lavatories
— Smoke detection for :
  · the avionic bay
— Portable fire extinguishers for :
  · the flight compartment
  · the passenger cabin
  · the avionic bay ◁

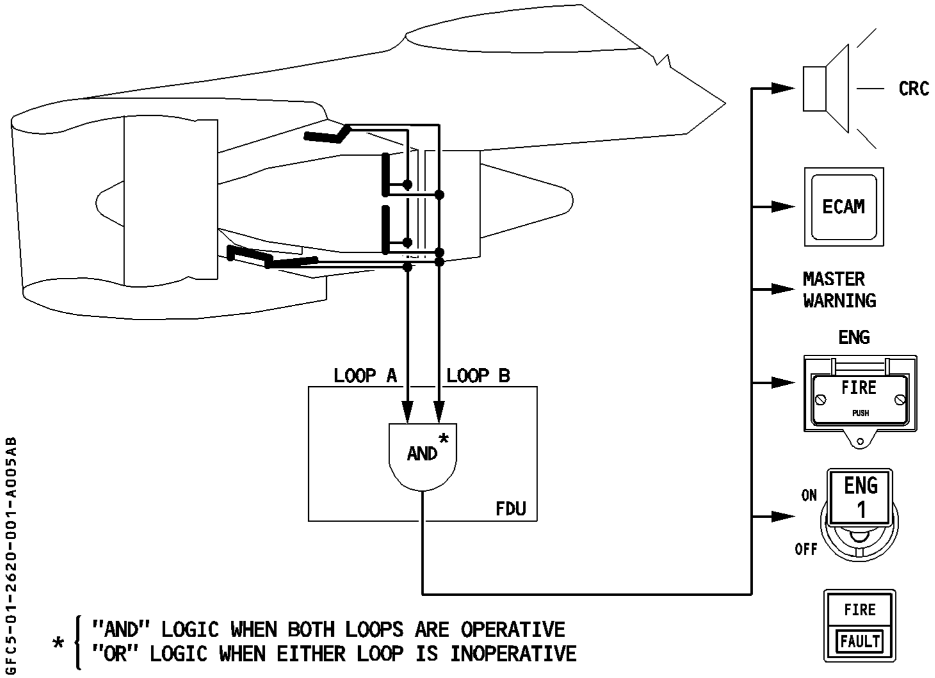
DESCRIPTION

DETECTION

Each engine and the APU is equipped with a fire and overheat detection system consisting of :
- Two identical gas detection loops (A and B) mounted in parallel.
- A Fire Detection Unit (FDU).

Each detection loop consists of :
- Four sensing elements for the engine, located in the pylon nacelle and engine core (gearbox and turbine) sections.
- One for the APU, located in the APU compartment.

When a sensing element is subject to heat, a signal is transmitted to the fire detection unit.
As soon as a preset level of temperature is detected by loop A and B, the fire warning system is triggered.
A fault in one loop (break or electrical supply loss) will not affect the warning system. Fire detection is provided by the non affected loop.
If an APU fire is detected on ground an APU automatic shut down and agent discharge will occur.



EXTINGUISHING

Each engine has two extinguisher bottles equipped with electrically operated squibs to discharge their contents. Each squib has a dual electric supply. The flight crew controls the discharge from the ENG FIRE panel in the cockpit.
The APU has one fire extinguisher bottle that has an electrically operated squib to discharge its agent. The flight crew controls the discharge from the APU FIRE panel in the cockpit. This bottle also discharges automatically if there is an APU fire when the aircraft is on the ground.

FIRE WARNINGS AND LOOP CAUTIONS

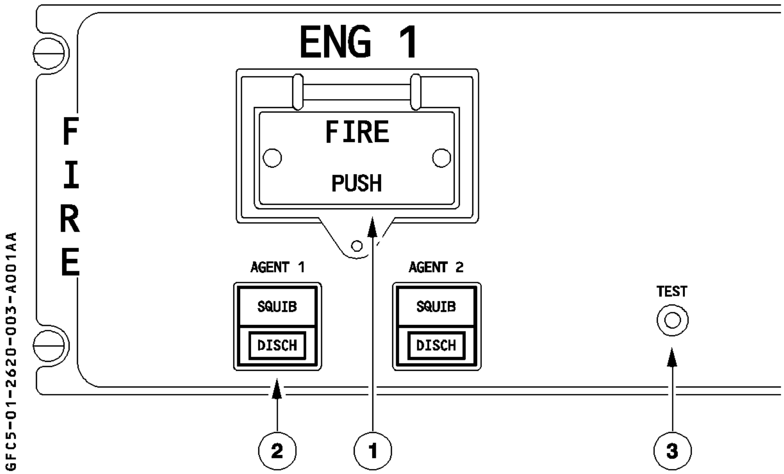
Fire detection units process all the warnings and cautions originating in the sensing elements :

- The fire warning appears in case of :
  - a fire signal from both loop A and B or,
  - a fire signal from one loop when the other is faulty, or
  - breaks in both loops occuring within 5 seconds of each other (flame effect), or
  - a test performed on the control panel.
- The loop-fault cautions appear if :
  - one loop is faulty or,
  - both loops are faulty or,
  - the fire detection unit fails.

CONTROLS AND INDICATORS

OVERHEAD PANEL

ENG FIRE PANEL



The aircraft has two identical ENG FIRE panels, which contain the following switches and indicators and include a single TEST pushbutton :

(1) ENG 1 (2) FIRE pb

This pushbutton's normal position is in and guarded.
The pilot pushes it to release it. It pops out, sending an electrical signal that performs the following for the corresponding engine :
- Silences the aural fire warning
- Arms the fire extinguisher squibs
- Closes the low-pressure fuel valve
R - Closes the hydraulic fire shut off valve
- Closes the engine bleed valve
- Closes the pack flow control valve
- Cuts off the FADEC power supply.
R - Deactivates the IDG

ENG 1 (2) FIRE lt
This red light comes on, regardless of the pushbutton's position, whenever the fire warning for the corresponding engine is activated.

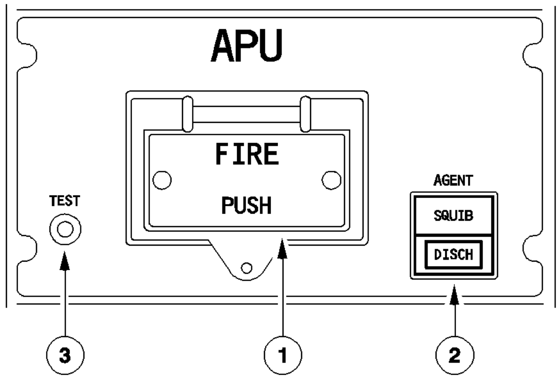
(2) AGENT 1 and AGENT 2 pb

R Both of these pushbuttons become active when the flight crew pops the ENG FIRE button
R for the associated engine.
R A brief push on the pushbutton discharges the corresponding fire bottle.
R – "SQUIB" comes on white when the flight crew pops the ENG FIRE button for its engine
R to help the flight crew identify the AGENT pushbutton to be activated.
R – "DISCH" comes on amber when its fire extinguisher bottle has lost pressure.

(3) TEST pb

R This pushbutton permits the flight crew to test simultaneously the operation of the fire
R detection and extinguishing system for both engines.
R – When the flight crew presses it :
R – A continuous repetitive chime sounds.
R – The MASTER WARN lights flash.
R – ENG FIRE warning appears on ECAM.
R On the FIRE panel :
R – The ENG FIRE pushbutton comes on red.
R – The SQUIB lights come on white if discharge supplies are available.
R – The DISCH lights come on amber.
R On the ENG panel (pedestal) :
R – The FIRE lights come on red.

APU FIRE PANEL



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(1) APU FIRE pb

R This pushbutton's normal position is in and guarded.
R The pilot pushes it to release it. It pops out, sending an electrical signal that performs
R the following for the APU :
R – shuts down the APU
R – silences the aural warning
R – arms the squib on the APU fire extinguisher
R – closes the low-pressure fuel valve
R – shuts off the APU fuel pumps (aft and forward).
R – closes the APU bleed valve and X bleed valve and deactivates the APU generator.
R The red APU FIRE light comes on when the APU fire warning is activated, regardless of
R the position of the pushbutton.

(2) AGENT pb

R This pushbutton becomes active when the pilot pops the APU FIRE button.
R The flight crew presses it briefly to discharge the fire bottle.
R – SQUIB comes on white when the pilot pops the APU FIRE button.
R – DISCH comes on amber when the fire extinguisher bottle has lost pressure.

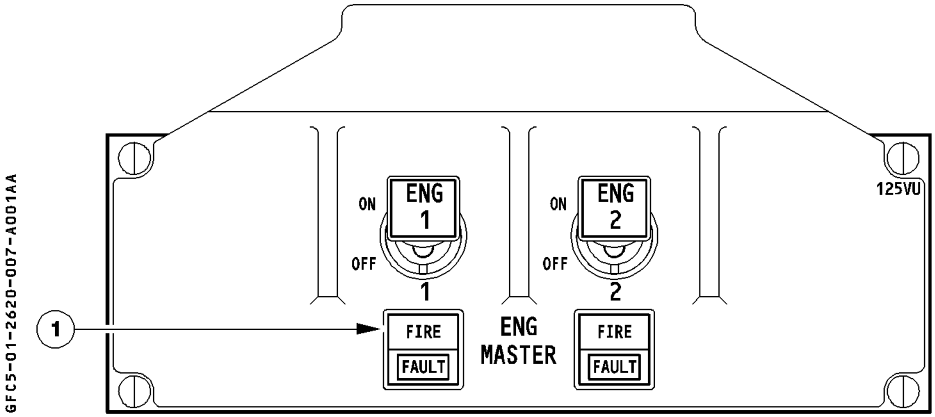
R *Note : A red disk, which is outside at the rear of the fuselage, signals that the agent*
R *is not discharged overboard due to bottle overpressure.*

③ TEST pb

R This pushbutton permits the flight crew to test the operation of the fire detection and
R extinguishing system for the APU.
R – When the flight crew presses it :
R   – A continuous repetitive chime sounds.
R   – The MASTER WARN lights flash.
R   – APU FIRE warning appears on ECAM.
R   On the APU FIRE panel :
R   – The APU FIRE pushbutton comes on red.
R   – The SQUIB light comes on white.
R   – The DISCH light comes on amber.

R *Note : The automatic shutdown of the APU on the ground will not occur while the flight*
R *crew is performing this test.*

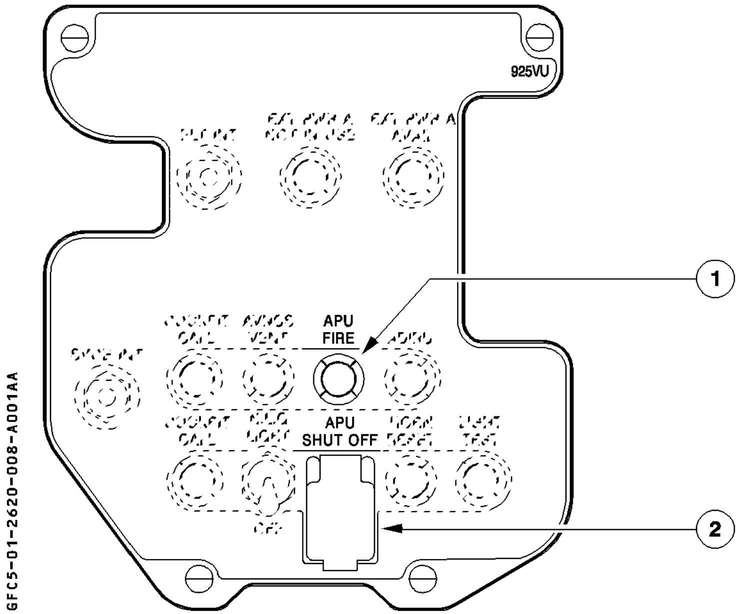
PEDESTAL



① FIRE lt

Identifies the engine to be shutdown.
Illuminates red as long as fire is detected on the respective engine.

EXTERNAL POWER PANEL



On ground only, an additional external warning is provided in the event of an APU FIRE.

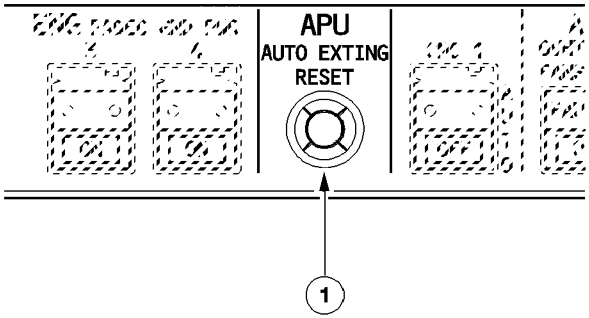
(1) APU FIRE lt

The APU FIRE light illuminates red, accompanied by an external horn warning when an APU fire is detected.
The APU fire extinguisher will automatically discharge 3 seconds after the fire warning appearance.
The light will go off after extinction of the fire.

(2) APU SHUT OFF pb

The pushbutton is guarded by a flap. When it is pressed in the event of an APU fire, automatic shutdown is confirmed and external horn warning is silenced.

MAINTENANCE PANEL



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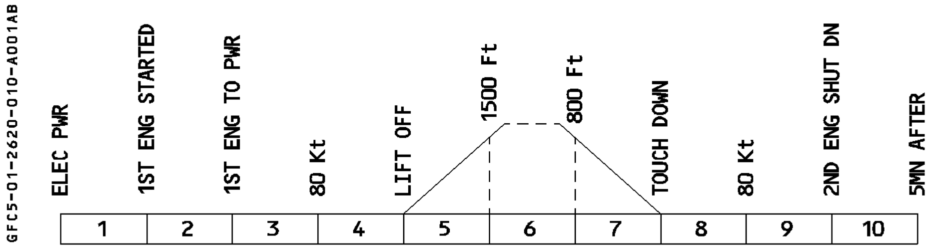
(1) APU AUTO EXTING RESET pb

When pressed all ECB (Electronic Control Box) output signals are reset and the automatic shut down function is reinitialized.
The reset is inoperative during the test or if the fire signal is active.

WARNINGS AND CAUTIONS



R

<table>
<tr><th>E / WD: FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>ENG 1 (2) FIRE
Fire detected by both loops or by one loop, the other one being faulty or break in both loops within 5 seconds</td><td rowspan="2">CRC</td><td rowspan="2">MASTER WARN</td><td>ENGINE</td><td>FIRE lts on ENG FIRE pb and on ENG panel</td><td rowspan="2">NIL</td></tr>
<tr><td>APU FIRE
Fire detected by both loops or by one loop, the other one being faulty</td><td>APU</td><td>FIRE lt on APU FIRE pb</td></tr>
<tr><td>ENG 1 (2) (APU) FIRE DET FAULT
Both loops inoperative or
Fire Detector Unit inoperative</td><td>SINGLE CHIME</td><td>MASTER CAUT</td><td rowspan="2">NIL</td><td rowspan="2">NIL</td><td rowspan="2">3, 4, 5, 7, 8</td></tr>
<tr><td>ENG 1 (2) (APU) LOOP A (B) FAULT</td><td>NIL</td><td>NIL</td></tr>
</table>

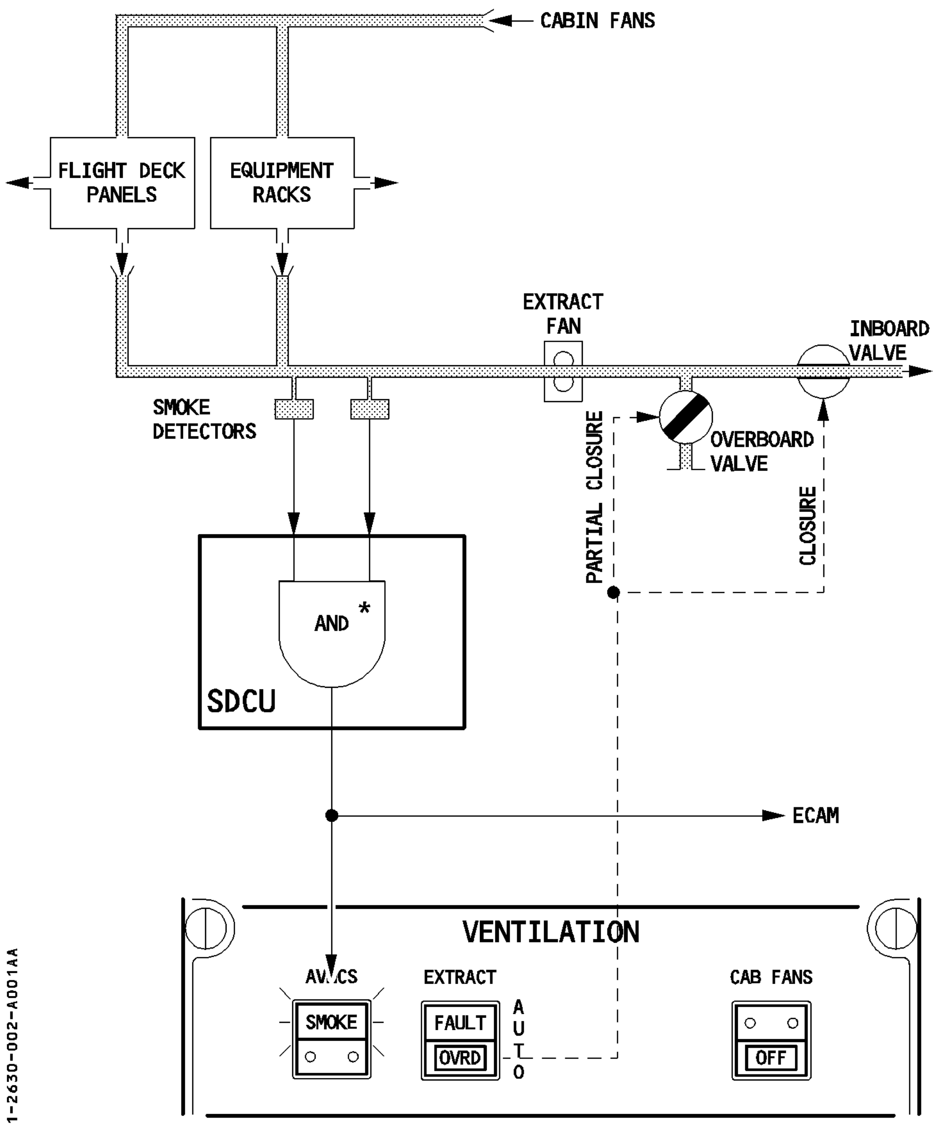
DESCRIPTION

Avionics smoke detection is provided by :
- Two smoke detectors (ionization type), installed in the air extraction duct of the avionics ventilation system. Each detector is linked to one of the two detection loops of the system (dual loop principle).
- The Smoke Detection Control Unit (SDCU), receives signals from the two detectors, and transmits them to the ECAM, which displays a warning in the cockpit.

Smoke activates the avionics smoke warning, if :
R – Both detectors detect it for more than 5 seconds, or
R – One smoke detector detects it for more than 5 seconds, and the other is inoperative.

When smoke is detected :
- The Repetitive Chime sounds.
- The MASTER WARNING light, on the glareshield, comes on.
- The ECAM displays a caution on the E/WD.
- The SMOKE light, on the VENTILATION panel, comes on.

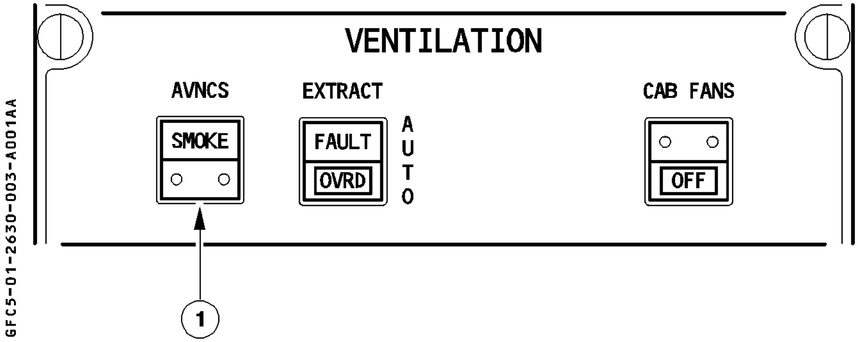
R



* "AND" LOGIC WHEN BOTH DETECTORS ARE OPERATIVE
"OR" LOGIC WHEN EITHER DETECTOR IS INOPERATIVE

CONTROLS AND INDICATORS

OVERHEAD PANEL

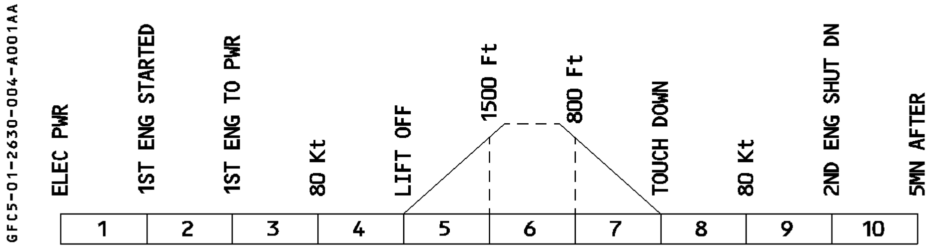


(1) AVNCS SMOKE

SMOKE lt : Illuminates red associated with an ECAM caution when smoke is detected in the avionics ventilation duct.

Note : For test, see CONTROLS AND INDICATORS (Refer to 1.26.50).

WARNINGS AND CAUTIONS

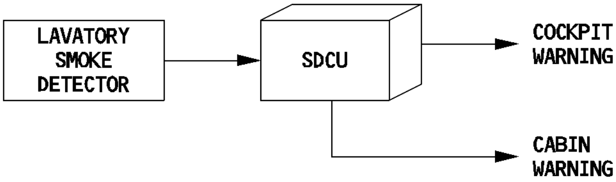


E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
AVNCS VENT SMOKE Smoke detected in the ventilation extraction duct	REPETITIVE CHIME	MASTER WARN	NIL	SMOKE lt on VENTILATION panel	4, 5, 7, 8
AVIONICS DET FAULT Loss of the avionics smoke detectors	NIL	NIL	NIL	NIL	3, 4, 5, 7, 8

DESCRIPTION

SMOKE DETECTION

The system consists of :
— ionization type smoke detectors (one in each lavatory air extraction duct)
— a double channel Smoke Detection Control Unit (SDCU).
When smoke is detected in a lavatory, the detector sends a signal to SDCU which transmits it to FWC (for warning display in the cockpit) and to CIDS (for warning in the cabin)



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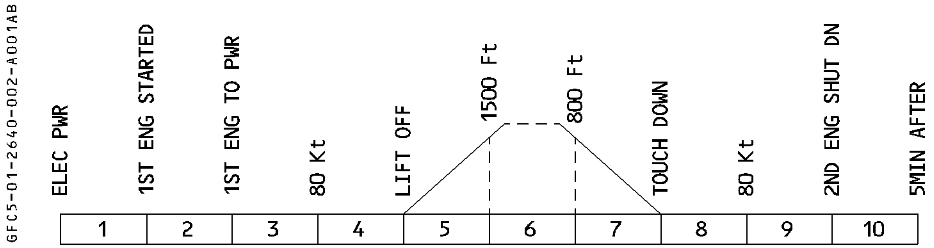
WASTE BIN FIRE EXTINGUISHING

Each lavatory waste bin is equipped with an automatic fire extinguishing system.

WARNINGS AND CAUTIONS

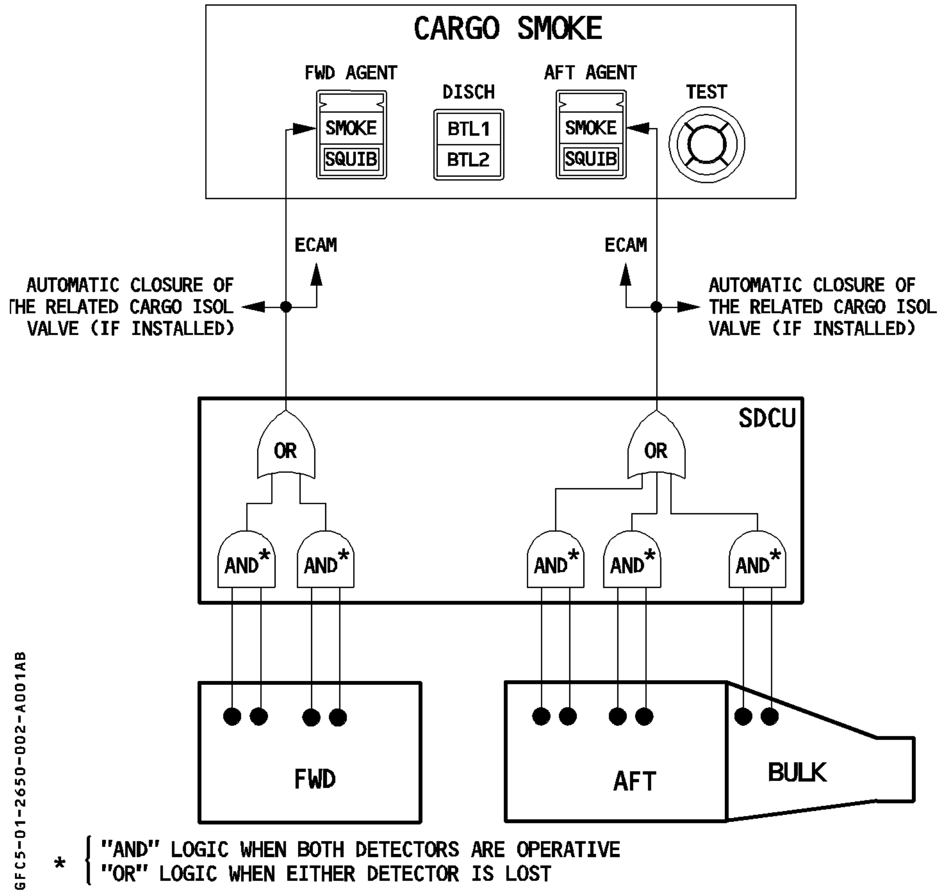


R

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
LAVATORY SMOKE Smoke detected in a lavatory	CRC	MASTER WARN	NIL	NIL	4, 5, 7, 8
LAVATORY DET FAULT Loss of the lavatory smoke detection	NIL	NIL	NIL	NIL	3, 4, 5, 7, 8
LWR STOWAGE SMOKE ◁ Smoke detected in lower deck lavatory stowage	CRC	MASTER WARN	NIL	NIL	4, 5, 7, 8
LWR STOWAGE DET FAULT ◁ Loss of lower deck lavatory stowage smoke detection	NIL	NIL	NIL	NIL	3, 4, 5, 7, 8

SMOKE DETECTION

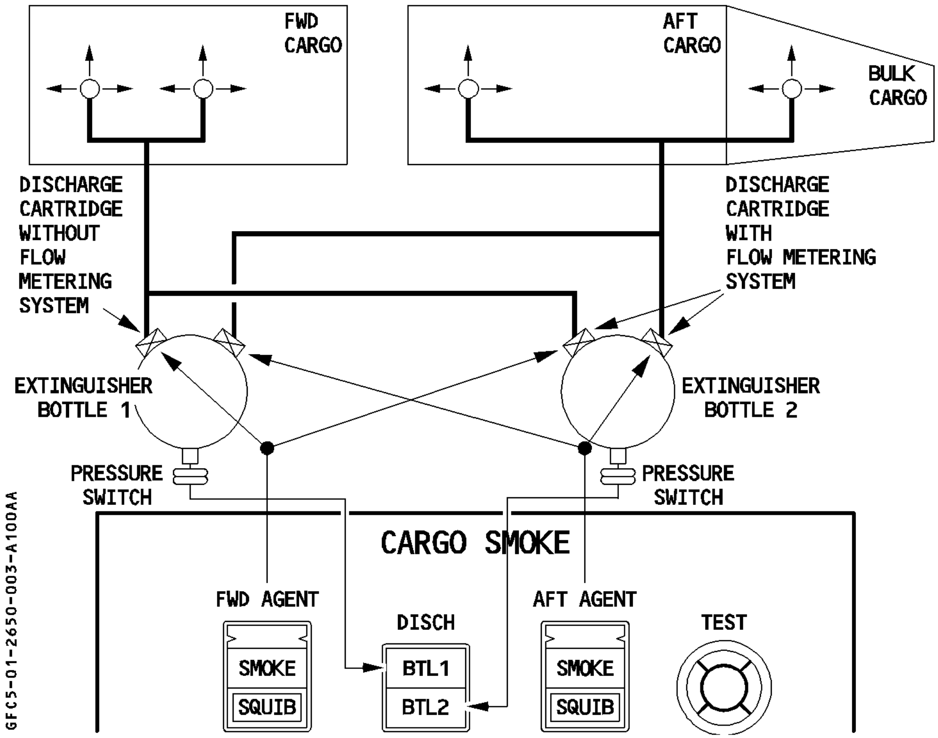
R The cargo compartments have a smoke detection system.
R – Cavities in the cargo compartment ceiling panels hold smoke detectors (ionization type).
R Each cavity has two smoke detectors, and each detector is linked to one of the two
R detection loops (dual loop principle).
R – The forward cargo compartment has two cavities.
R – The bulk cargo compartment has one cavity.
R – The aft cargo compartment has two cavities.
R – The Smoke Detection Control Unit (SDCU) receives signals from the detectors and
R transmits them to ECAM, which displays a warning in the cockpit. The SDCU has two
R identical channels.
R Smoke in one cavity activates the cargo smoke warning if :
R – both smoke detectors detect it, or
R – one smoke detector detects it and the other is inoperative.
R When the cargo smoke warning is activated, the isolation valves (if installed) of the
R affected compartment close automatically and the extraction fan stops.



* "AND" LOGIC WHEN BOTH DETECTORS ARE OPERATIVE
"OR" LOGIC WHEN EITHER DETECTOR IS LOST

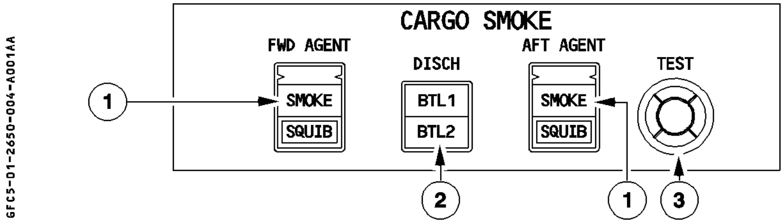
FIRE EXTINGUISHING

A fire extinguishing system protects the cargo compartments. Two fire extinguishing bottles are installed, and their contents can be discharged into either the FWD or the AFT (including BULK) cargo compartment. Each bottle has two discharge heads, one for each compartment.
Pressing the AGENT pushbutton associated to the FWD (AFT / BULK) compartment ignites the squib of the two bottles and the bottle 1 discharges extinguishing agent into that compartment, which takes about 60 seconds.
The discharge cartridge of bottle 2 comprises a flow metering system, and so fire extinguishing agent is discharged slowly into the compartment to ensure sufficient agent
R concentration for 240 minutes.
The SDCU monitors the squib integrity and bottle pressure.
When bottle 1 (2) is discharged, BTL 1 (BTL 2) light comes on white.



CONTROLS AND INDICATORS

OVERHEAD PANEL



(1) FWD (AFT) AGENT pb

When pressed, the associated squib is ignited for discharge of the extinguishing agent in the associated cargo compartment (FWD or AFT/BULK).
SMOKE lt : It comes on red, along with an associated ECAM warning, when smoke is detected in the associated compartment.
SQUIB lt : It comes on white, in case of a positive test.

(2) DISCH 1 (2) lt

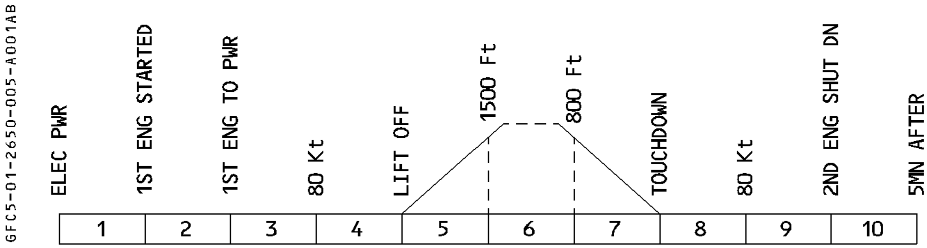
The BTL1 or BTL2 light comes on white, when the associated bottle has discharged.

R (3) TEST pb

When pressed for at least 3 seconds, and until it is released :
- The smoke detectors in the FWD, AFT, and BULK CARGO compartment and the avionic bay are tested by the SDCU in sequence.
- The ventilation system's isolation valves close.
- BTL 1 (2) lights come on white.
- SQUIB lights come on white, provided one of the two squib filaments is serviceable.
- SMOKE lights (AFT, FWD CARGO and AVNCS) come on red on the overhead panel, and are associated with ECAM warnings, and a continuous repetitive chime.

*Note : Each SDCU channels sends its own warning.
Each warning has a duration of about 25 seconds with a delay of about 30 seconds between both.*

WARNINGS AND CAUTIONS



R

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<tr><td>FWD (AFT/BULK) CARGO SMOKE
Smoke detected in the corresponding cargo</td><td>CRC</td><td>MASTER WARN</td><td rowspan="4">NIL</td><td>SMOKE lt on CARGO SMOKE panel</td><td>4, 5, 7, 8</td></tr>
<tr><td>DET FAULT
Both SDCU channels fault or
loss of all smoke detectors</td><td rowspan="2">SINGLE CHIME</td><td rowspan="2">MASTER CAUT</td><td rowspan="3">NIL</td><td rowspan="3">3, 4, 5, 7, 8</td></tr>
<tr><td>FWD (AFT) CRG BTL 1 (2) FAULT
Loss of forward or aft BTL 1 (2)</td></tr>
<tr><td>FWD (AFT/BULK) CRG DET FAULT
Loss of the smoke detection in the corresponding cargo</td><td>NIL</td><td>NIL</td></tr>
</table>

SMOKE DETECTION

LOWER DECK MOBILE CREW REST COMPARTMENT

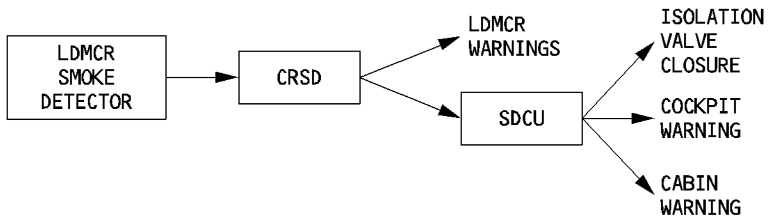
The Lower Deck Mobile Crew Rest (LDMCR) smoke detection system consists of :
- Five (six, if installed) smoke detectors
- A Crew Rest Smoke Detection (CRSD) control unit, located in the LDMCR
- A double-channel Smoke Detector Control Unit (SDCU).

When a detector detects smoke in the LDMCR, it sends a signal to the CRSD, and :
- The horn in the CRSD control unit activates.
- The related smoke-detector indicator flashes on the CRSD control unit.
- The CRSD control unit sends a smoke signal to the SDCU.

When the exit and emergency exit hatches are closed :
- The “DO NOT OPEN HATCH” sign comes on, in the staircase housing.
- The CRSD control unit automatically discharges the fire extinguisher in the LDMCR.

The SDCU transmits the smoke signal to :
- The Flight Warning Computer (FWC), for a warning display in the cockpit.
- The CIDS, for a warning display in the cabin.
- The ventilation controller, which closes the ventilation isolation valve. In the LDMCR, the
R “LEAVE MCR” sign comes on, the low-flow buzzer activates, a continuous repetitive
R chime sounds for 30 seconds, and the intensity of the lights increases to 100%.

Note : The internal smoke detection system is only available when electrical power is supplied to the LDMCR.



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STAIRCASE HOUSING

The staircase housing's smoke detection system consists of :
- One smoke detector
- A double-channel Smoke Detector Control Unit (SDCU).

When the detector detects smoke in the staircase housing, it sends a signal to the SDCU. The SDCU transmits it to the Flight Warning Computer (for a warning display in the cockpit), and to the CIDS (for a warning display in the cabin, and for a visual and aural warning in the staircase housing compartment).

Note : The internal smoke detection system is only available when electrical power is supplied to the LDMCR.

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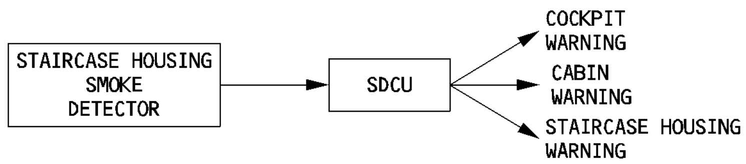

FLIGHT CREW REST COMPARTMENT

The Flight Crew Rest Compartment's (FCRC) smoke detection system consists of :
- One smoke detector
- A double-channel Smoke Detector Control Unit (SDCU).

When the detector detects smoke in the FCRC, it sends a signal to the SDCU. The SDCU transmits it to the Flight Warning Computer (for a warning display in the cockpit), and to the CIDS (for a warning display in the cabin, and for a visual and aural warning in the FCRC compartment).

Note : The internal smoke detection system is only available when electrical power is supplied to the FCRC.

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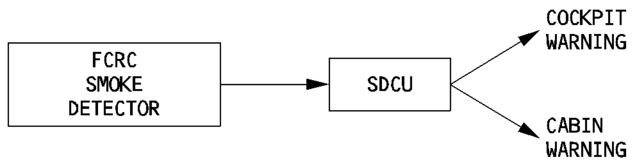


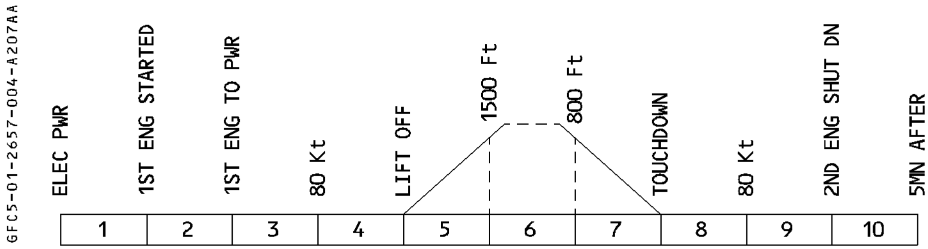
FIRE EXTINGUISHING

The fire extinguishing system operates either automatically or manually in the LDMCR.
It operates automatically through the CRSD, when :
– Smoke has been detected in the LDMCR, and
– The exit and emergency exit hatches are closed.
It operates manually, when the Fire Extinguishing System (FES) switch, in the staircase housing, is set to the position.
The automatic circuit (CRSD control unit) or the manual circuit (FES switch) ignites the squib on the fire bottle, which discharges a fire extinguishing agent through the spray nozzles in the LDMCR.

Note : The internal fire extinguishing system is only available when electrical power is supplied to the LDMCR.

CAUTION
Selecting the FES switch activates the fire extinguishing system, regardless of whether smoke has been detected or not.

WARNINGS AND CAUTIONS



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
CAB REST SMOKE Smoke has been detected in the LDMCR, or in the staircase housing.	CRC	MASTER WARN	NIL	NIL	4, 5, 7, 8
FLT REST SMOKE Smoke has been detected in the FCRC.					
CAB (FLT) REST DET FAULT	NIL	NIL	3, 4, 5, 7, 8		

BUS EQUIPMENT LIST

R

			NORM			EMER ELEC		
			AC	**DC**	**DC BAT**	**AC ESS**	**DC ESS**	**HOT**
ENG/APU	FIRE DETECTION	ENG LOOP A					X	
		ENG LOOP B		DC2				
		APU LOOP A					X	
		APU LOOP B			X			
	FIRE EXTINGUISHING	ENGINES						
		BTL 1 SQUIB A						HOT 2
		BTL 1 SQUIB B		DC 2				
		BTL 2 SQUIB A						HOT 1
		BTL 2 SQUIB B		DC 2				
		APU						
		BTL SQUIB A						HOT 1
		BTL SQUIB B			X			
		APU AUTO EXT						HOT 2
CARGO LAV AVIONICS	SDCU 1						SHED	
	SDCU 2			DC 2				
	CARGO SQUIB A							HOT 1
	CARGO SQUIB B			DC 2				
LDMCRC ◁	SMOKE DETECTION	SDCU 1					SHED	
		SDCU 2		DC 2			SHED	
	FIRE EXTINGUISHING			DC 2				
FCRC ◁	SMOKE DETECTION	SDCU 1					SHED	
		SDCU 2		DC 2				

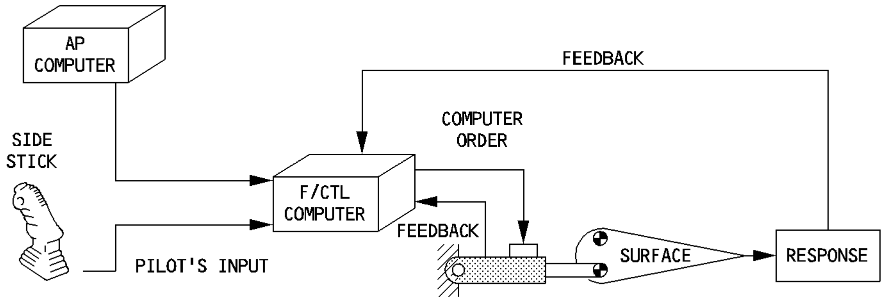
27.00 CONTENTS

GENERAL

The fly-by-wire system was designed and certified to render the new generation of aircraft even more safe, cost effective, and pleasant to fly.

BASIC PRINCIPLE

The flight control surfaces are all :
— Electrically-controlled, and
— Hydraulically-activated
The stabilizer can be mechanically-controlled.
Pilots use sidesticks to fly the aircraft in pitch and roll (and in yaw indirectly, through turn coordination).
Computers interpret pilot input and move the flight control surfaces, as necessary, to follow their orders.
However, when in normal law, regardless of the pilot's input, the computers will prevent excessive maneuvers and exceedance of the safe envelope in pitch and roll axis.
However, as on conventional aircraft, the rudder has no such protection.



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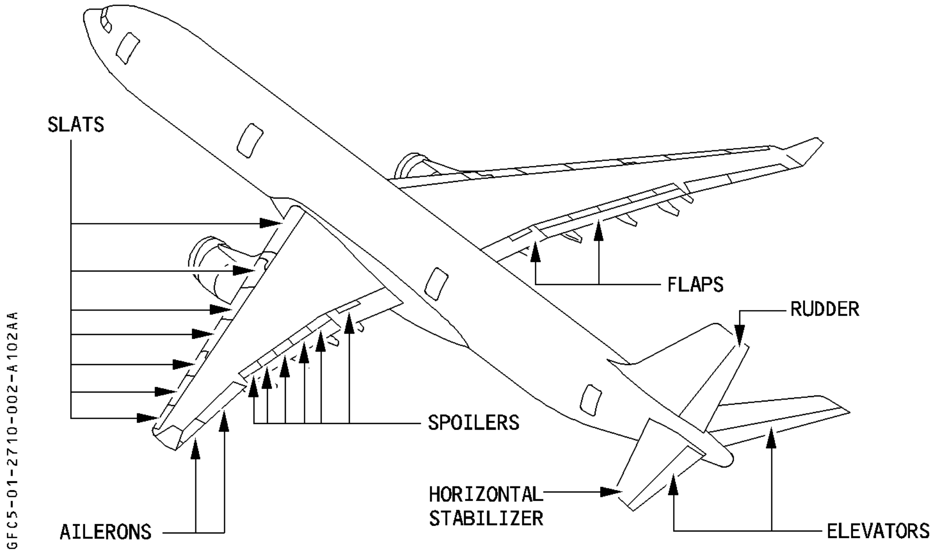
CONTROL SURFACES



The flight controls are electrically or mechanically controlled as follows:

Pitch axis
Elevator control = Electrical
Stabilizer control = Electrical for normal or alternate control.
Mechanical for manual trim control

Roll axis
Aileron control = Electrical
Spoiler control = Electrical

Yaw axis
Rudder control = Electrical

Other controls
Speedbrakes = Electrical

Note : All surfaces are hydraulically-actuated.

COCKPIT CONTROLS

- Two sidestick controllers are used for pitch and roll manual control. One is on the CAPT's lateral console, the other is on the F/O's lateral console.
  The two controllers are springloaded to neutral, and are not mechanically coupled.
  Each controller independently sends electrical signals to the flight control computers.
- Two pairs of rigidly interconnected pedals ensure electrical control of the rudder.
- A speedbrake control lever is provided in the center pedestal.
- Two handwheels, on the center pedestal, are used to mechanically control the THS.
- A switch, installed on the center pedestal, ensures the rudder trim control.
- No manual aileron trim switch is provided.

COMPUTERS

Five flight control computers process pilot and autopilot inputs according to normal, alternate or direct flight control laws.
The computers are :

3 PRIM computers
(Flight Control Primary Computer – FCPC), each of which is used for :
- Normal, alternate, and direct control laws.
- Speedbrake and ground spoiler control.
- Protection speed computation.
- Rudder travel limit.

2 SEC computers
(Flight Control Secondary Computer – FCSC), each of which is used for :
- Direct control laws, including yaw damper function.
- Rudder trim and rudder travel limit.

One computer of any type is capable of controlling the aircraft and of assuring safe flight and landing.
In normal operation, one PRIM computer is declared to be the master (P1). It processes the orders and sends them to the other computers (P1 / P2 / P3 / S1 / S2), which will then execute them on their related servo-control.
If one computer is unable to execute the orders sent by the master, another computer executes the task of the affected computer (except for spoiler control).
If the master computer (P1) cannot be the master (off or internal failure), then P2 (or P3, if P2 is not available) becomes the master.
In case all PRIM computers are lost, each SEC is its own master and controls its associated servoloop in direct law.

Note : When the green hydraulic system is lost, P2 replaces P1 as the master computer.

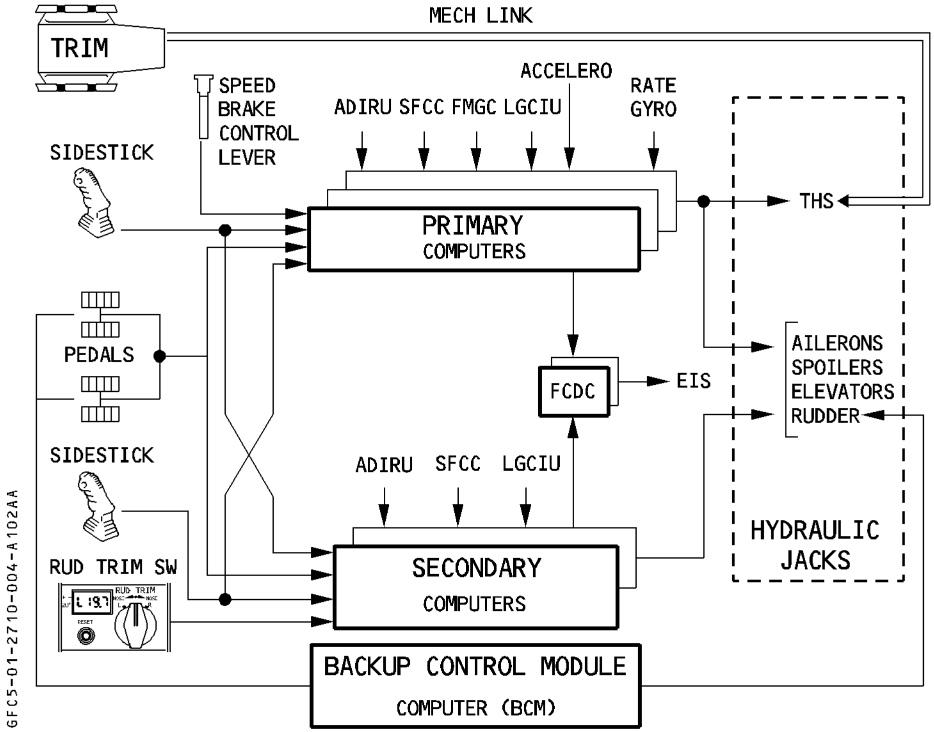
A single SEC can provide complete aircraft control in direct law.

2 Flight Control Data Concentrators (FCDC)
The FCDCs acquire data from the PRIMs and SECs and send this data to the EIS and CMC.

1 Backup Control Module (BCM) computer :
The BCM computer provides yaw damping, and direct rudder command with pedals, via an independent unit, in cases of :
- Total electrical failure, or
- Loss of rudder control due to a Flight Control Computer (PRIM and SEC) failure.

It includes :
- Its own electrical generator, referred to as the Backup Power Supply (BPS), which is supplied by the B or Y hydraulic system ;
- Its own sensors (gyrometers and pedals deflection) ;
- Control of the B and Y hydraulic actuators.

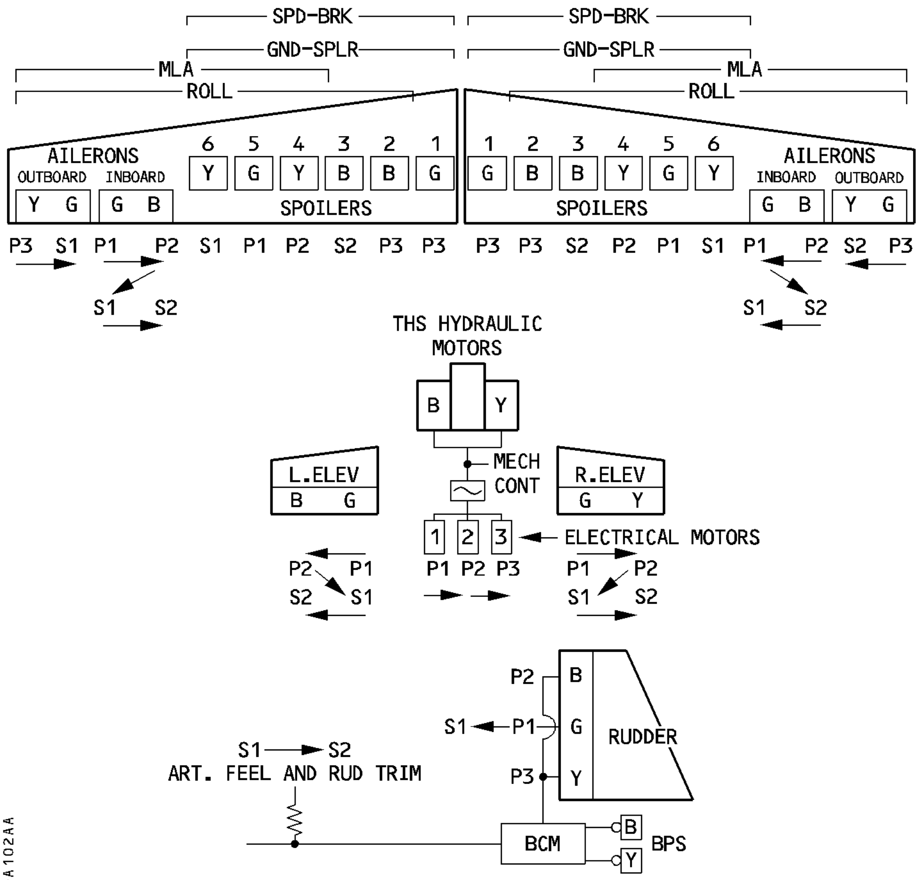
When activated, as in yaw alternate law, there is no turn coordination.



ARCHITECTURE

GENERAL ARCHITECTURE

FOR INFO



P= PRIM COMPUTERS S= SEC COMPUTERS

→ ARROWS INDICATE THE CONTROL RECONFIGURATION PRIORITIES

G B Y INDICATE THE HYDRAULIC POWER SOURCE FOR EACH SERVO CONTROL

MLA = MANEUVER LOAD ALLEVIATION

BCM = BACKUP CONTROL MODULE

BPS = BACKUP POWER SUPPLY

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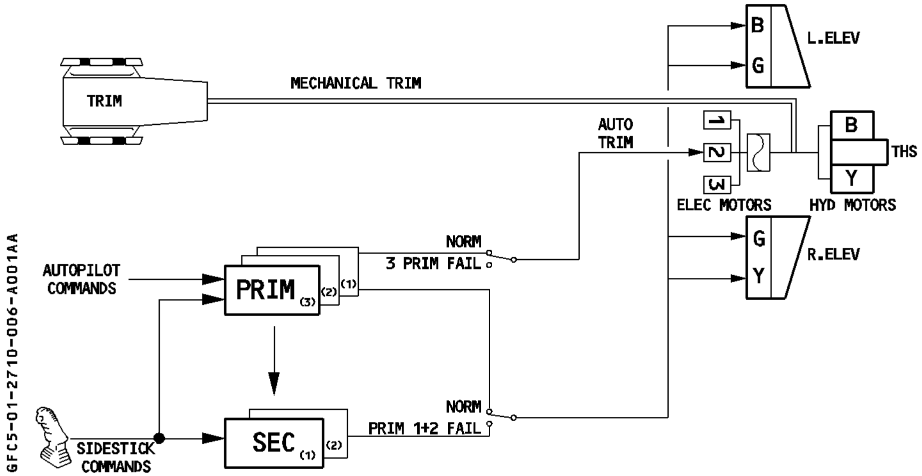
PITCH CONTROL

R



Pitch control is achieved by two elevators and the Trimmable Horizontal Stabilizer (THS). Maximum elevator deflection is 30° nose up and 15° nose down. The maximum THS deflection is 14° nose up, and 2° nose down.

ELECTRICAL CONTROL

The elevators and the stabilizer are normally controlled from the PRIM 1 in which case the left and right elevator surfaces are driven by the green hydraulic jacks.
The THS is controlled by n°1 of the three electrical motors.
If a failure occurs in PRIM 1 or associated hydraulic systems or hydraulic jacks, the pitch control is transferred to PRIM 2. The PRIM 2 then controls the left and right elevators via
R the blue and yellow hydraulic jacks and the THS via THS motor 2.
If neither PRIM 1 nor PRIM 2 are available pitch control is transferred to SEC 1 for elevator
R control and to PRIM 3 for THS control via THS motor 3.
Refer to p. 8 for actuation reconfiguration.
In case of 3 PRIM failure the elevator is controlled by SEC 1.
Electrical control of THS is lost. THS actuation is still available through manual pitch trim wheel control.

MECHANICAL CONTROL

Mechanical control by cable of the THS is available from the pitch trim wheel at any time,
R provided B or Y hydraulic is available.
Mechanical control from the pitch trim wheel has priority over electrical control.

ACTUATION

Elevators

— Two electrically controlled hydraulic servojacks are fitted on each elevator.
R Each servojack has 3 control modes.
. Active : Jack position is electrically controlled.
. Damping : Jack follows surface movement.
. Centering : Jack is hydraulically maintained in neutral position.

— In normal operation:
· One jack is in active mode.
· The other one is in damping mode.
· Some maneuvers cause the second jack to become active.

— In case of failure of the active servo jack the damped one becomes active and the failed jack is automatically switched to the damping mode.

R — If both servojacks are not electrically or hydraulically controlled they are automatically switched to the damping mode.

R — If the four elevator servojacks are not electrically controlled they are automatically
R switched to the centering mode.

Stabilizer

— Actuated by a screw jack driven by two hydraulic motors.

— These two hydraulic motors are in turn controlled by:
· one of three electric motors or
· mechanical trim wheel.

PITCH CONTROL – SCHEMATIC

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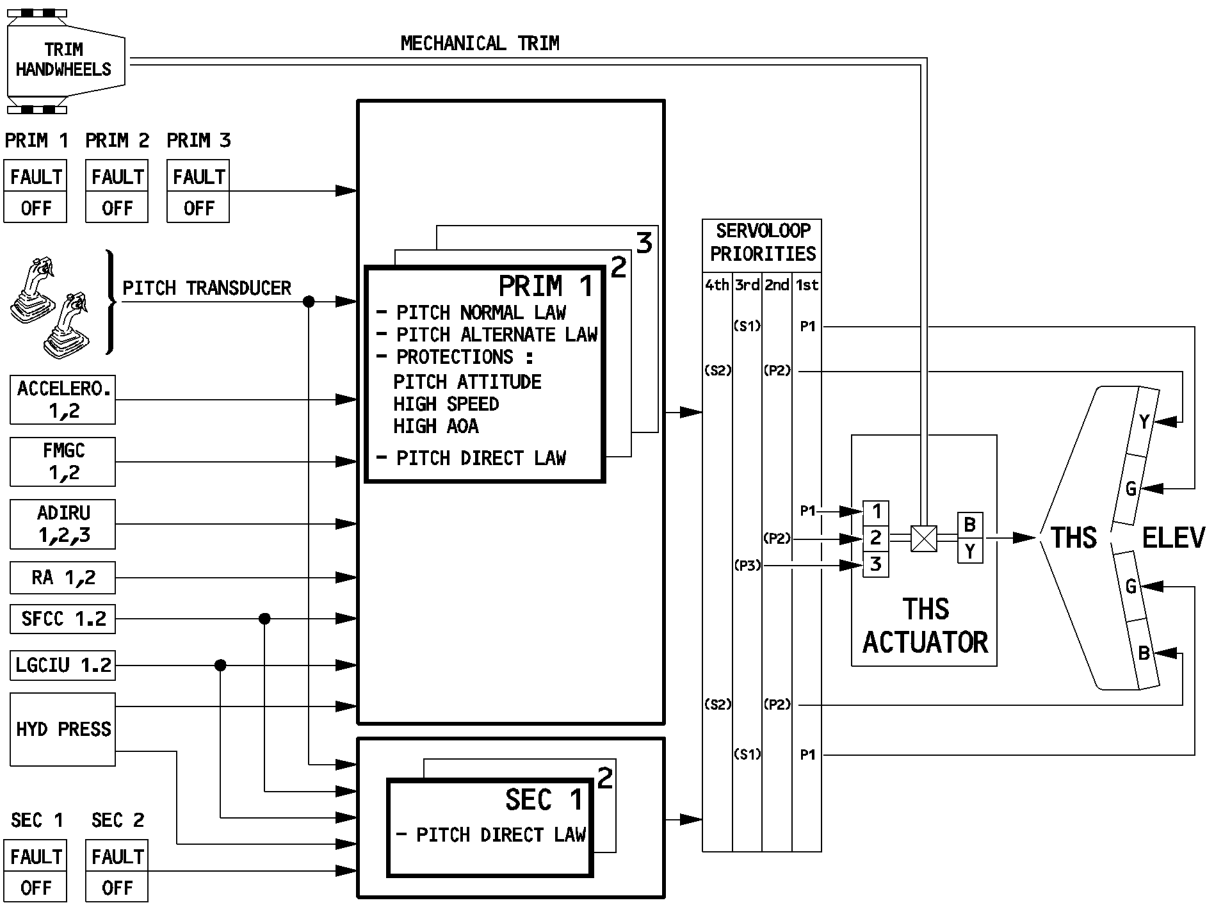
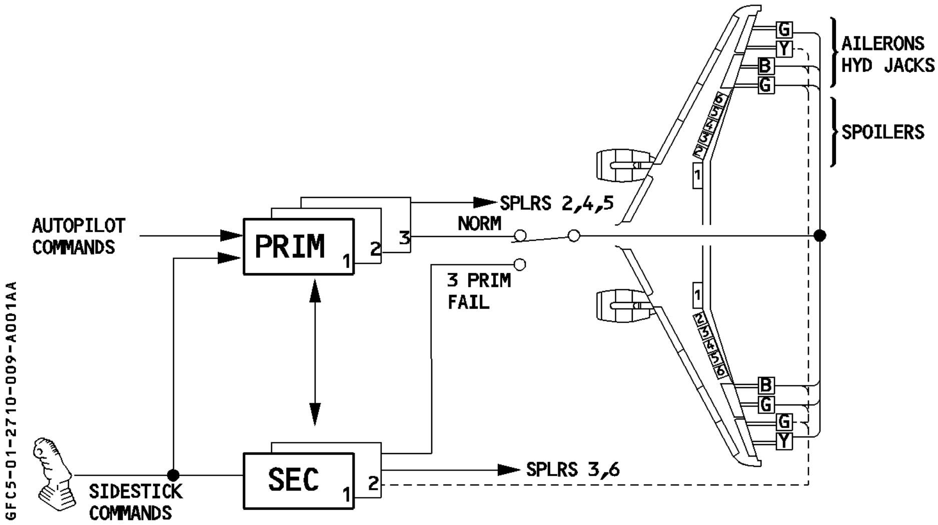


FOR INFO

ROLL CONTROL



Roll control is achieved by two ailerons and five spoilers on each wing.
Ailerons max deflection is 25° and spoilers max deflection is 35°.
Ailerons are deflected down when flaps are extended (aileron droop).

ELECTRICAL CONTROL

The inboard ailerons are normally controlled by the PRIM 1 (LH) and the PRIM 2 (RH) with each of these computers being capable of controlling both sides.

R The SEC 1 and 2 provide back up control in case of failure of PRIM 1 and 2. (see p. 13 for
R reconfiguration).

The outboard ailerons are normally controlled by the PRIM 3.

R The SEC 1 and 2 provide back up control in case of PRIM 3 failure (see p. 13 for
R reconfiguration).

Spoilers control is provided by the PRIM (spoilers 2, 4, 5) and by the SEC (spoilers 3, 6).

ACTUATION

– **Ailerons**
Each aileron has two electrically controlled hydraulic servojacks.
Each servojack has two control modes :
– Active : Jack position is electrically controlled.
– Damping : Jack follows surface movement.
The system automatically selects damping mode, in the event of green and yellow or blue and green low pressure, or if the respective computer fails.
At high speed (above 190 knots, in CONF 0), the outboard ailerons are controlled to zero deflection.
In autopilot mode, or in some failure cases, the outboard ailerons are used up to 300 knots.
When the emergency generator is supplied by the RAT only, the outboard ailerons are controlled in damping mode to reduce hydraulic power consumption.

– **Spoilers**
A servojack positions each spoiler. Each servojack receives hydraulic power from either the green, yellow, or blue hydraulic system, controlled by the PRIM or SEC (as shown in the diagram on Page 13).
The system automatically retracts the spoilers to their zero position, if it detects a fault or loses electrical control.
If the system loses hydraulic pressure, the spoiler retains the deflection it had at the time of the loss, or a lesser deflection if aerodynamic forces push it down.
R When a spoiler surface on one wing fails, the symmetric one on the other wing is
R inhibited (except for spoilers 4 and 6).

SPEEDBRAKE AND GROUND SPOILER CONTROL

SPEEDBRAKE CONTROL

The pilot controls the speedbrakes with the speedbrake lever. The speedbrakes involve spoilers 1 to 6. Speedbrake extension is inhibited, if :
– Maneuver Load Alleviation (MLA) is activated.
– Angle-of-attack protection is active.
– Low speed stability is active.
– At least one thrust lever is above MCT.
– Alpha floor activation.
If an inhibition occurs when the speedbrakes are extended, they automatically retract and stay retracted until the inhibition condition disappears, and the pilots reset the lever. (The speedbrakes can be extended again, 5 seconds after the lever is reset). When a speedbrake surface on one wing fails, the symmetric one on the other wing is inhibited.

FOR INFO

Maximum deflection : 25° for spoiler 1
30° for spoilers 2 to 6
Reduced in Conf 2, 3 and FULL.

For surfaces 2 to 6 (which perform roll and speedbrake functions),the roll function has priority : When the sum of a roll order and a simultaneous speedbrake order on one surface is greater than the maximum deflection achievable in flight, the symmetrical one is retracted until the difference between the two surfaces is equal to the roll order.

GROUND SPOILER CONTROL

Spoilers 1 to 6 act as ground spoilers.
When a ground spoiler surface on one wing fails, the symmetric one on the other wing is inhibited.

Arming :
The pilot arms the ground spoilers by pulling the speedbrake control lever up into the armed position.

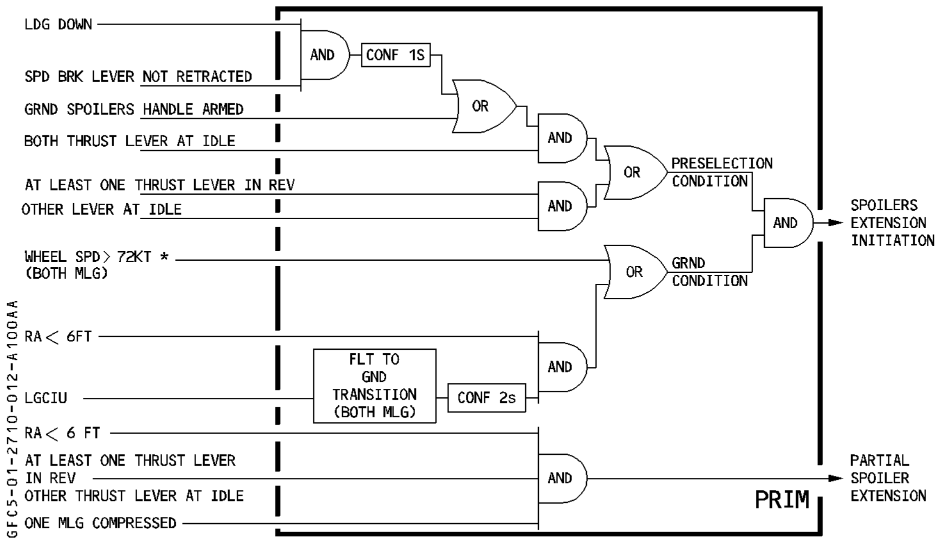
Extension :

– **Full extension**
The ground spoilers automatically extend during rejected takeoff (at a speed greater than 72 knots), or at landing, when both main landing gear have touched down, and :
· All thrust levers are set to idle, provided ground spoilers are armed, or
· Reverse is selected on at least one engine (other engine at idle).
R The spoiler roll function is inhibited when spoilers are used for the ground spoiler
R function.

– **Partial extension**
The ground spoilers partially extend, when reverse is selected on at least one engine (other engine at idle), and one main landing gear is compressed.
By decreasing the lift, this partial extension will ease the compression of the second main landing gear and will, consequently, lead to normal ground spoiler extension.

Retraction :
The ground spoilers retract, when :
– One thrust lever is above idle, or
– Both thrust levers are at forward idle, and the speedbrake control lever is pressed.

FOR INFO

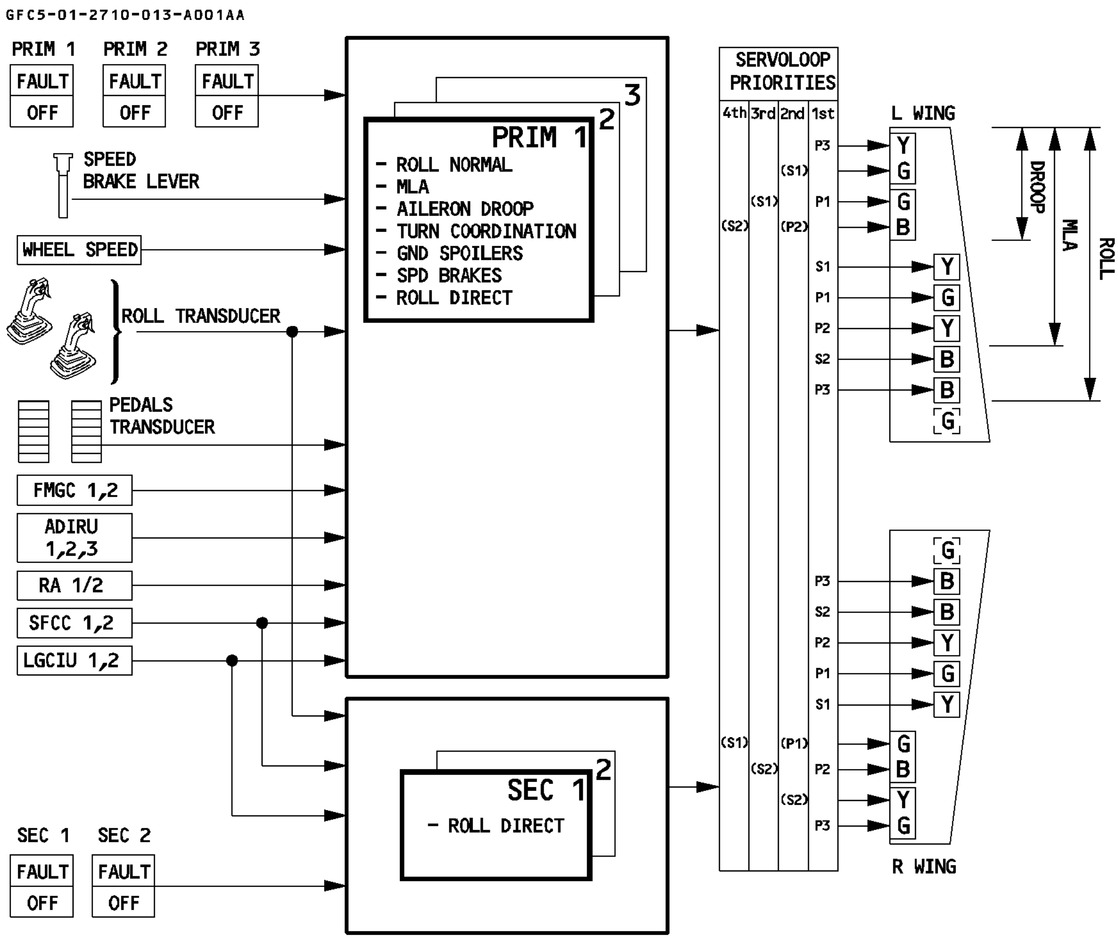


∗ Condition on wheel speed is inhibited after GND/FLT transition.
The condition is rearmed, if wheel rotation stops.
Consequently, after an aircraft bounce (aircraft airborne), if the spoilers are extended :
– They remain extended with the thrust lever at idle.
– They retract, if thrust is increased above idle (go-around), and extend again after the next touchdown.
The thrust levers are considered to be at idle, when they are below 4.7°, when the RA is above 6 feet and below 32°, when the RA is below 6 feet.

Surfaces extend partially/fully to 14°/35° for spoiler 1, and 20°/50° for spoilers 2 to 6.

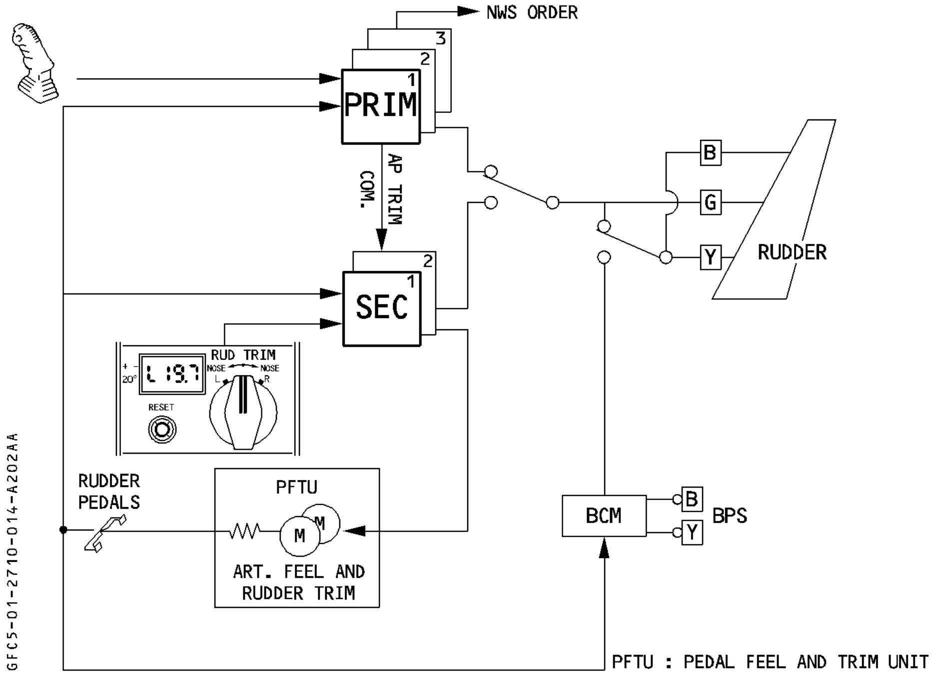
ROLL CONTROL - SCHEMATIC

R



FOR INFO

YAW CONTROL



Yaw control is achieved by one rudder surface (rudder deflection ± 35°).

ELECTRICAL RUDDER CONTROL

- In normal operation, PRIM 1 controls the green hydraulic jack, PRIM 2 controls the blue hydraulic jack, and PRIM 3 controls the yellow hydraulic jack.

R – If all the 3 PRIMs fail, SEC 1 controls the green hydraulic jack.

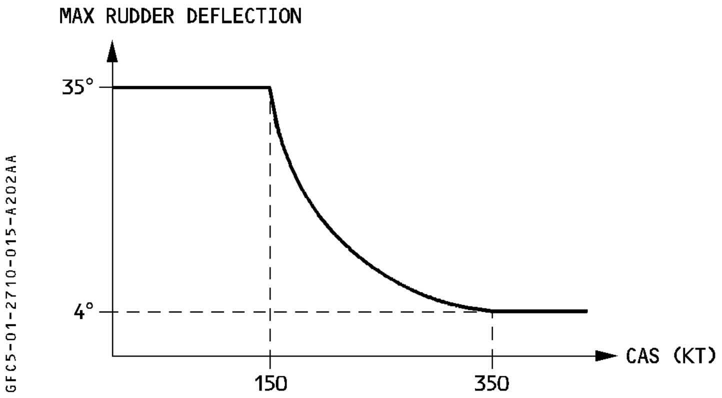
- In case of a total electrical failure, or loss of rudder control due to flight control computers failure, the Backup Control Module (BCM) controls the yellow hydraulic jack, or the blue hydraulic jack, if the yellow hydraulic jack is not available.

ACTUATION

The rudder is actuated by 3 independent hydraulic jacks operating in parallel.
- In normal operation, the 3 jacks are simultaneously in active mode.
- In case of an electrical or hydraulic failure, the corresponding jack is in damping mode.

RUDDER TRAVEL LIMIT

Rudder deflection is limited, as a function of the speed.
In case of a three ADR or three FCPC failure, the maximum rudder deflection remains at the value reached before the failure. Then, maximum deflection is available when the slats are extended.



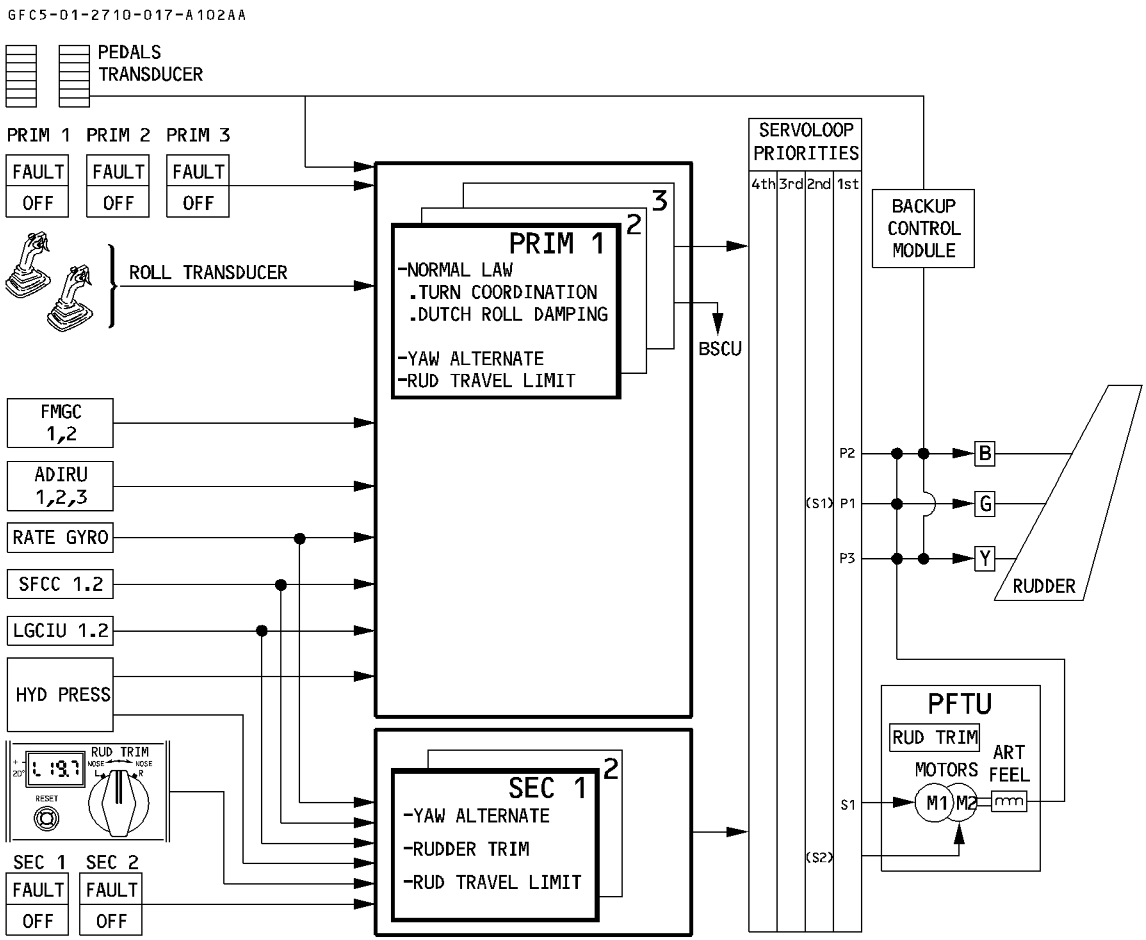
R *Note : Depending on the Mach, this Max rudder deflection value may decrease slightly*
R *(less than 1°).*

RUDDER TRIM

Inside the PFTU, artificial feel and rudder trim are achieved by two electric motors which position the artificial feel unit. In normal operation, SEC 1/MOTOR 1 are driving, and the SEC 2/MOTOR 2 remain synchornized as a backup.
In manual flight, the pilot can apply rudder trim from the RUD TRIM rotary switch, located on the pedestal.
– Authority : 85 % of max rudder deflection (limited to 29.7°).
– Rudder trim speed :
  · In clean configuration : 1°/second
  · With flaps/slats extended :
    * For input up to 1.5 seconds : 1°/second.
    * After 1.5 seconds : 3°/second.
A button is provided on the RUD TRIM panel to reset the rudder trim to zero.

Note : *With the autopilot engaged, rudder trim orders are computed by the PRIM and transmitted to the SEC for actuation. The rudder trim rotary switch is not active.*

YAW CONTROL – SCHEMATIC



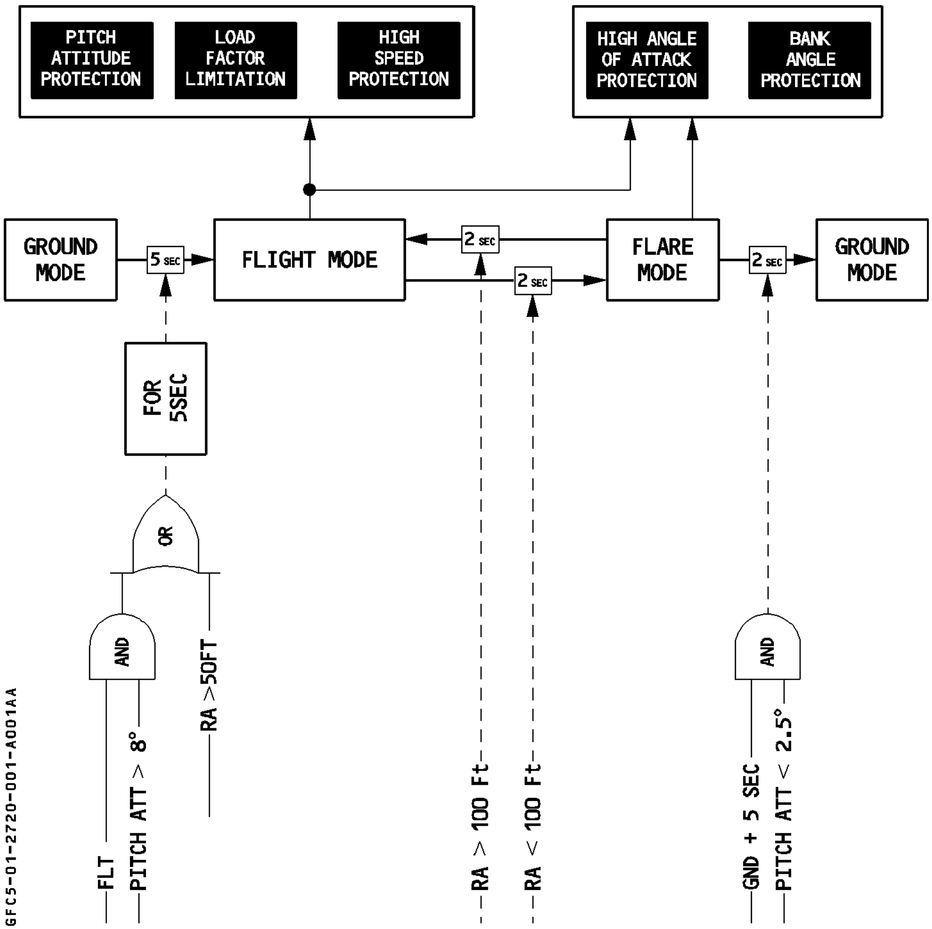
FOR INFO

GENERAL

Flight control normal law provides:
- 3 Axis control
- Flight envelope protection
- Maneuver load alleviation

FOR INFO

R



PITCH CONTROL

GROUND MODE

Ground mode is active on ground. It is a direct relationship between sidestick deflection and elevator deflection without auto trim.
The THS is automatically set at 4° UP (inside the green band). Manual setting according to CG has priority for take off.
The rotation maneuver is flown in direct law with full authority.
Immediately after the aircraft becomes airborne the flight mode is progressively blended in.
The reverse process occurs after touch down.

FLIGHT MODE

The normal law flight mode is a load factor demand law with auto trim and full flight envelope protection.
It provides control of elevator and THS from the side stick controllers to achieve a load factor proportional to stick deflection, independent of speed.
With the side stick at neutral, wings level, the system maintains 1 G in pitch corrected for pitch attitude, and there is no need for the pilot to trim with speed or configuration changes.
R Pitch trim is automatic in both manual mode and when the autopilot is engaged.
In normal turns (up to 33° of bank) no pitch correction is required once the turn is established.
The flight mode is active from TO to landing according to the logic (page 1).
Automatic pitch trim is frozen in the following cases:
- Manual trim order
- Radio altitude below 100 ft for flare
- Load factor lower than 0.5 g
- In high speed protection

When angle of attack protection is active, THS is limited between setting at entry in protection and 2° nose down (i.e. further nose up trim cannot be applied).
Similarly when the load factor is higher than 1.3 g, or when the bank angle gets outside ± 33°, the THS is limited between the actual setting and 2° nose down.

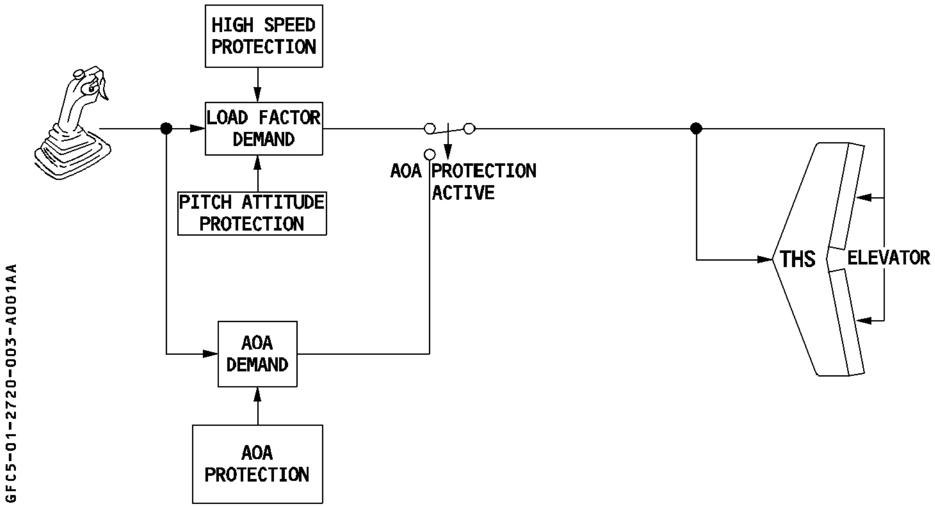
R **Control with autopilot engaged**
R – The autopilot orders are limited by the PRIM
R – A force must be overcome to move the sidestick with the autopilot engaged. If the pilot
R moves the side stick to overcome this force the autopilot will disconnect.
– All protections remain effective.

FLARE MODE

The flight mode changes to flare mode at landing, when passing 100 feet.
R Flare mode is a direct stick-to-elevator relationship (with some damping provided by load
R factor and pitch rate feedbacks). In addition, at 50 feet, a slight pitch down elevator order
R is applied, so that the pilot has to move the stick rearwards to maintain a constant path,
R so as to reproduce conventional aircraft aerodynamic characteristics.

PROTECTIONS

Normal law provides complete flight envelope protection as follows :
– Load factor limitation
– Pitch attitude protection
– High angle-of-attack (AOA) protection
– High speed protection



LOAD FACTOR LIMITATION

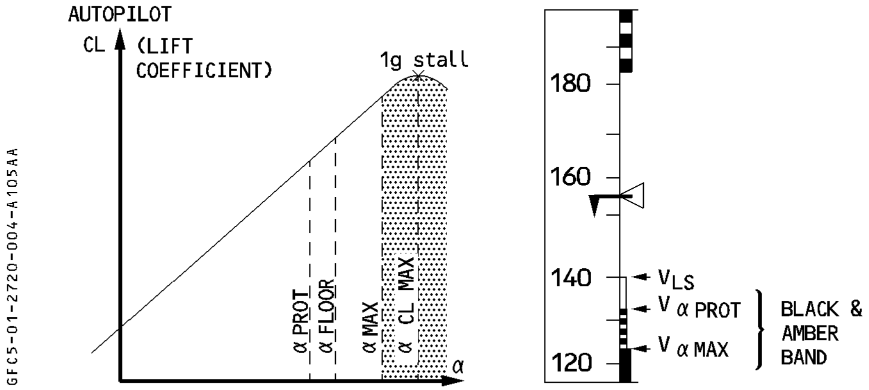
The load factor is automatically limited to:
+ 2.5 g to – 1 g, slats retracted
+ 2 g to 0, slats extended

PITCH ATTITUDE PROTECTION

Pitch attitude is limited to 30° nose up (progressively reduced to 25° at low speed), and to 15° nose down (indicated by green symbols "=" on the PFD pitch scale (Refer to 1.31.40)).

HIGH ANGLE-OF-ATTACK PROTECTION

Under normal law, when angle-of-attack becomes greater than α prot, the system switches elevator control from normal mode to a protection mode in which the angle-of-attack is proportional to the sidestick deflection. That is, in the α prot range, from α prot to α max, the sidestick commands α directly. However, the angle-of-attack will not exceed α max, even if the pilot gently pulls the sidestick all the way back. If the pilot releases the sidestick, the angle-of-attack returns to α prot and stays there.
This protection, against stall and windshear, has priority over all other protections.
The autopilot will disconnect, if the protection is active.



- Vα prot, Vα max, and Vα floor conditions vary according to weight and configuration.
- Vα prot and Vα max, displayed on the PFD, are computed by the PRIM.
- α floor activation logic is provided by the PRIM.

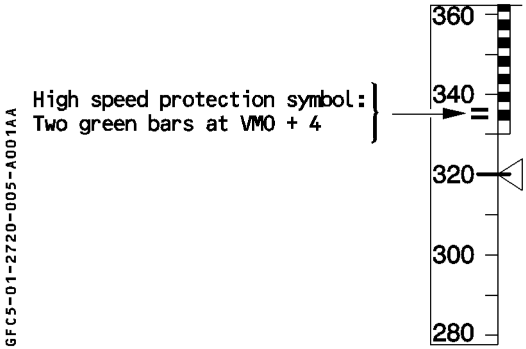
Note : 1. At takeoff, α prot is equal to α max for 5 seconds.
2. α FLOOR is activated through autothrust system, when :
- *α is greater than a threshold, depending on the aircraft configuration, the ground speed variation, and the difference between ground speed and air speed, or*
- *Sidestick deflection is above 14°, and:*
  - *Pitch altitude is greater than 25°, or*
  - *AOA protection is active.*

3. α FLOOR inhibition: (Refer to 1.22.30).

To leave the angle-of-attack protection :
- The sidestick must be pushed more than 8° forward, or
- The sidestick must be pushed more than 0° forward, for at least 1 second, when α < α max, or
- α < α prot, if the sidestick has not been deflected since the latest autopilot disconnection.

HIGH SPEED PROTECTION

The aircraft automatically recovers following a high speed upset. Depending on the flight conditions (high acceleration, low pitch attitude), the High Speed Protection is activated at/or above VMO/MMO.
R When it is activated, the pitch trim is frozen. Positive spiral static stability is introduced to
R 0° bank angle (instead of 33° in normal law), so that with the sidestick released, the aircraft
R always returns to a bank angle of 0°. The bank angle limit is reduced from 67° to 45°.
As the speed increases above VMO/MMO, the sidestick nose-down authority is progressively reduced, and a permanent nose-up order is applied to aid recovery to normal flight conditions.
The High Speed Protection is deactivated when the aircraft speed decreases below VMO/MMO, where the usual normal control laws are recovered.
The autopilot disconnects when high speed protection goes active.



Note : OVER SPEED ECAM warning is provided at:
- *VMO + 4 kt*
- *MMO + 0.006*

LOW ENERGY WARNING

R A low energy aural warning "SPEED SPEED SPEED" repeated every 5 seconds indicates to
R the pilot that the aircraft energy becomes lower than a threshold under which to recover a positive flight path angle through pitch control, the thrust must be increased.
It is available in configuration 2, 3 and full between 100 and 2000 ft.
The low energy warning is computed by the PRIM's from the following inputs:

R – Aircraft configuration
– Air speed deceleration rate
– Flight path angle

It is inhibited when:

– TOGA is selected
– Below 100 ft RA
– Above 2 000 ft RA
– Alpha floor or GPWS alert is triggered
R – In alternate or direct law
– If both RA are failed.

The low energy warning is triggered during deceleration before alpha floor (unless alpha floor is triggered by stick deflection), the delay between the two warnings depends on deceleration rate.

LATERAL CONTROL

LATERAL NORMAL LAW

When the aircraft is on the ground (in “on ground” mode), the sidestick commands the aileron and roll spoiler surface deflection. The amount of control surface deflection that results from a given amount of sidestick deflection depends upon aircraft speed. The pedals control rudder deflection.

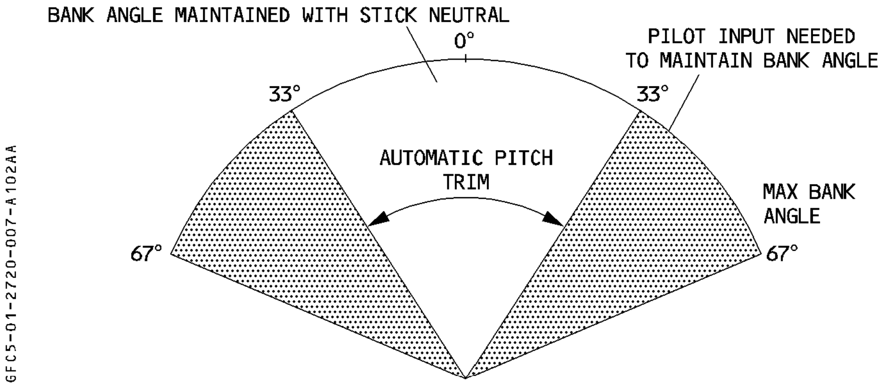
When the aircraft is in the “in flight” mode, normal law combines control of the ailerons, spoilers (except N° 1 spoilers), and rudder (for turn coordination) in the sidestick. While the system thereby gives the pilot control of the roll and heading, it also limits the roll rate and bank angle, coordinates the turns, and damps the dutch roll.

The roll rate requested by the pilot during flight is proportional to the sidestick deflection, with a maximum rate of 15° per second when the sidestick is at the stop.

When the aircraft is in “flare” mode, the lateral control is the same as in “in flight” mode.

BANK ANGLE PROTECTION

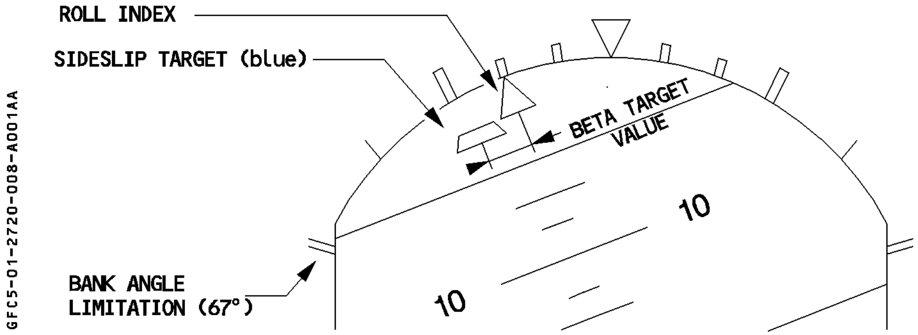
Inside the normal flight envelope, the system maintains positive spiral static stability for bank angles above 33°. If the pilot releases the sidestick at a bank angle greater than 33°, the bank angle automatically reduces to 33°. Up to 33°, the system holds the roll attitude constant when the sidestick is at neutral. If the pilot holds full lateral sidestick deflection, the bank angle goes to 67° (indicated by a pair of green bar lines “=” on the PFD) and no further.



If the angle-of-attack protection or high speed protection is operative, the bank angle goes to 45° and no further, if the pilot holds full lateral sidestick deflection. If high speed
R protection is operative, the system maintains positive spiral static stability from a bank angle of 0°, so that with the sidestick released, the aircraft always returns to a bank angle of 0°.
When bank angle protection is active, auto trim is inoperative.
If the bank angle exceeds 45°, the autopilot disconnects and the FD bars disappear. The FD bars return when the bank angle decreases to less than 40°.

SIDESLIP TARGET

Should an engine failure occur, the sideslip indication is slightly modified to ensure that optimum pilot rudder application is made to achieve optimum climb performance (ailerons to neutral and spoilers retracted).
In takeoff configuration, when asymmetrical thrust is detected (30 % N1 (GE) or 0.25 EPR (PW/RR)), and at least one engine is above 80 % N1 (GE) or 1.3 EPR (PW/RR), the sideslip indication will change from yellow to blue.



Crew response is normal and instinctive:
– Zero, beta target value for optimum performance with appropriate rudder application.
– Accelerate if beta target cannot be zeroed with full rudder.
The computation is made by the PRIM.

MANEUVER LOAD ALLEVATION (MLA)

The purpose of MLA is to redistribute the lift over the wing to relieve structural loads on the outer wing surfaces (bending moment).
The demanded load factor is maintained.
MLA utilises spoilers 4, 5, and 6 and the ailerons.
R The MLA becomes active when the sidestick is pulled more than 8°, and the load factor is more than 2g, in which case :
- The ailerons are deflected symmetrically upwards :
  · Maximum 11° added to roll demand, if any.
  · Spoilers 4, 5, 6 are symmetrically deflected :
  · Maximum 9° added to roll demand if any.
  · Deflection is proportional to load factor in excess of 2 g.
- An elevator demand is simultaneously applied to compensate for the pitching moment induced by spoilers and ailerons.

The load alleviation is only available when :
- The aircraft speed is above 250 knots.
- The FLAPS lever is in the 0 position.
- In normal or alternate law flight mode.

The MLA has priority over the speedbrakes.

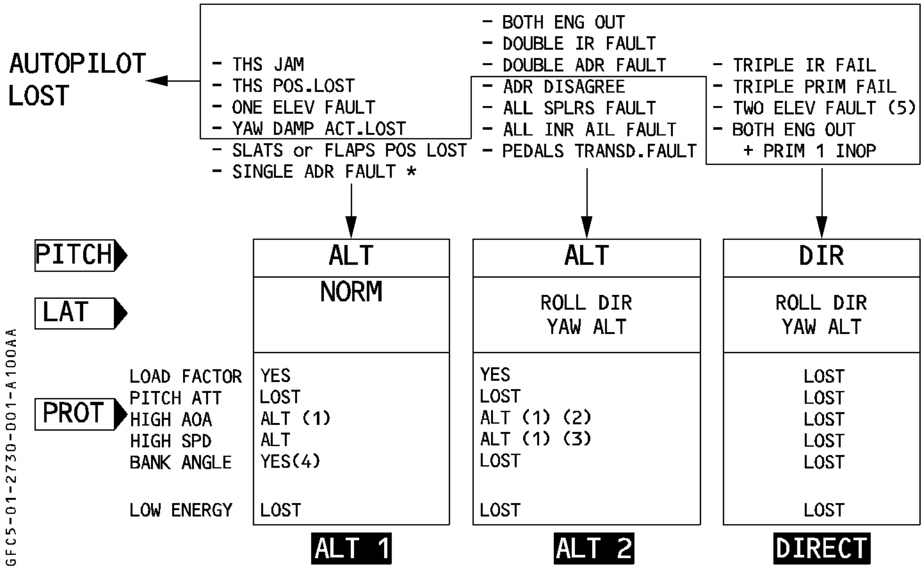
TURBULENCE DAMPING FUNCTION

The purpose of the turbulence damping function is to damp the structural modes induced by atmosphere turbulence.
The function uses the Nz accelerometer and two dedicated Ny accelerometers. The PRIMs compute a turbulence damping command, which is added to the normal law command for the elevator and the yaw damper.
This function is automatically monitored and becomes inoperative for the remainder of the flight, when a failure is detected. In addition, it may be manually inhibited by switching off the TURB DAMP pushbutton on the overhead panel, when it is considered that comfort is degraded instead of being improved, and no failure is detected.
It is only available if the following conditions are met :
- Aircraft in flight.
- Aircraft speed greater than 200 knots.
- Autopilot engaged or normal law active.
- Aircraft within the normal flight envelope.

GENERAL

Depending on the type of failures affecting the flight control system, or peripherals, there are 3 possible reconfiguration levels :
- Alternate law (ALT 1 or ALT 2)
- Direct law, or
- Mechanical.

R



* Only in case the AOA, of the remaining ADRs, disagrees with the AOA (as computed by the PRIMs).

(1) Protection is totally lost, in case of VS1g computation failure (loss of weight, or slat/flap position).

(2) Protection is lost, in case of a dual ADR failure (or ADR DISAGREE).

(3) Protection is lost, in case of a triple ADR failure (or ADR DISAGREE).

(4) Bank angle limitation remains effective in ALT 1, which uses roll normal. However, since ALT 1 is in generally an unprotected law, all protection marks on the PFD are in amber for simplicity.

R (5) When both elevators have failed, only pitch mechanical backup is available, by
R using the manual pitch trim control (THS). “MAN PITCH TRIM ONLY” is displayed in
R red on the PFDs.

Note : 1. In case of a dual RA failure, flare law is introduced when the landing gear is
R *extended and both autopilots are disengaged. The specific normal law pitch*
R *down effect at 50 feet no longer applies.*
2. In case of flight controls computer reconfiguration (due to hydraulic failure, computer failure, electrical transient...), a jerk may be noticed.

ALTERNATE LAW

ALT 1

PITCH CONTROL

Ground mode
Identical to normal law ground mode.

Flight mode
Flight law is a load factor demand law, similar to normal law, with limited pitch rate feedback and gains, depending on speed and configuration.

Flare mode
Flare law is identical to normal flare law.

LATERAL CONTROL

Lateral control is similar to normal law, except that alterations of positive spiral static stability will not occur due to the loss of high AOA and high speed protection.

PROTECTIONS

Low speed stability
At low speed, a nose down demand is introduced in reference to IAS, instead of angle of attack, and alternate law changes to direct law. It is available, whatever the slats/flaps configuration, and it is active from about 5 knots up to about 10 knots above the stall warning speed, depending on the aircraft's weight and slats/flaps configuration. A gentle progressive nose down signal is introduced, which tends to keep the speed from falling below these values. The pilot can override this demand.
Bank angle compensation is provided.
In addition, audio stall warning (crickets + "STALL" synthetic voice message) is activated at an appropriate margin from the stall condition.
The PFD speed scale is modified to show a black/red barber pole below the stall warning.
Vα prot and Vα max are replaced by Vsw (stall warning speed).
The α floor protection is inoperative.

R **High speed stability**

Above VMO/MMO a nose up demand is introduced to avoid an excessive increase in speed.
The pilot can override this demand.
The high speed protection symbol (VMO + 4) disappears.
In addition, the overspeed warning (VMO + 4 or MMO + 0.006) remains available.

Pitch attitude protection

Lost.

ALT 2

PITCH CONTROL

Identical to ALT 1 law.

LATERAL CONTROL

Roll direct law

Provides a direct stick-to-surface position relationship. The gains are automatically set according to the slats/flaps configuration.
The maximum roll rate is approximately 20 to 25° / second, depending on the speed and configuration.
Spoilers 2, 3 and 6 are inhibited, except in case of some additional failures affecting the lateral control.

Yaw alternate law

The dutch roll damping function is available, and damper authority is limited to ± 4° rudder (CONF 0) and ± 15° (other configuration).
Turn coordination is also provided, except in CONF 0.

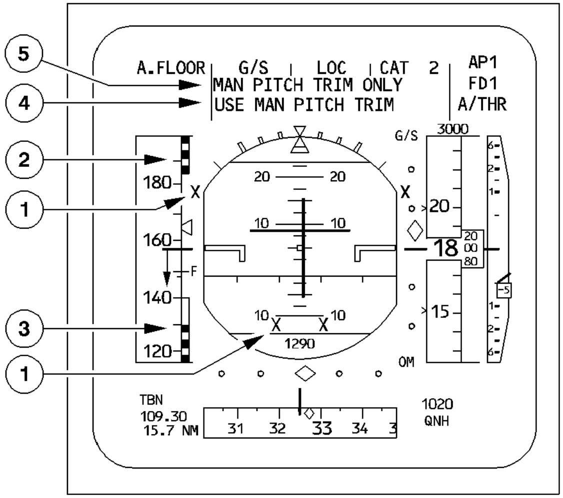
PROTECTIONS

Identical to protections in ALT 1, except that :
1. There is no bank angle protection in ALT 2 law.
R 2. In case of failure of 2 ADRs, there is no low speed stability.
R 3. In case of failure of 3 ADRs, there is no high speed stability.

DIRECT LAW

Pitch direct law is a direct stick to elevator relationship (elevator deflection is proportional to stick deflection).
In all configurations, the maximum elevator deflection varies as a function of CG.
It is a compromise between adequate controllability at forward CG, and the not-so-sensitive controllability at aft CG.
As there is no automatic trim, the pilot has to use manual trim.
The «USE MAN PITCH TRIM» amber message is displayed on the PFD.
All protections are inoperative.
The α floor function is inoperative.
As per alternate law, overspeed and stall warnings are available.

RECONFIGURATION CONTROL LAWS – PFD DISPLAY



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(1) Bank angle and pitch limitation are replaced by an amber X.

(2) The overspeed protection symbol (=) disappears.

(3) Vα prot, and Vα max are replaced by Vsw.

(4) USE MAN PITCH TRIM (amber) is displayed in direct law, or in flare law without RA.

(5) MAN PITCH TRIM ONLY (red) is displayed if a L + R elevators fault is detected.

ABNORMAL ATTITUDE LAWS

An abnormal attitude law in pitch and roll is provided, if the aircraft is in flight and in any of these conditions :

– Pitch attitude > 50° nose up or 30° nose down
– Bank angle > 125 °
– Angle of attack > 30° or < – 10°
– Speed > 440 knots or < 60 knots
– Mach > 0.96 or < 0.1

The law in pitch is the alternate law without protection (except load factor protection) and without auto trim. In roll, it is a full authority direct law with yaw alternate.
After recovery, the flight controls laws are:
In pitch : Alternate law.
In roll : Direct law with yaw alternate law.

BACKUP

To control the aircraft during a temporary complete loss of electrical power.

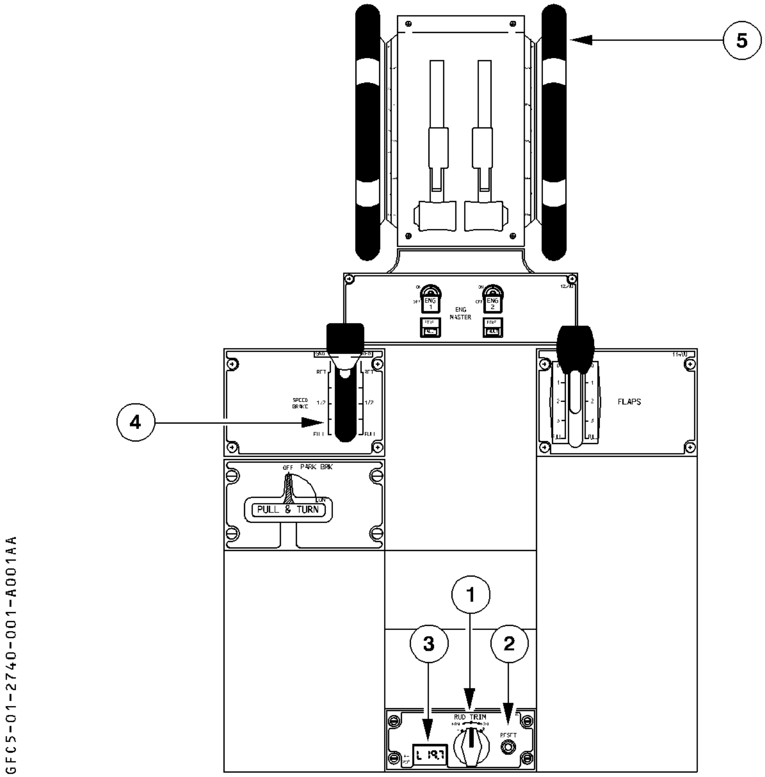
PITCH

Pitch mechanical control is achieved through the THS, using manual trim control.
«MAN PITCH TRIM ONLY» is displayed in red on the PFDs.

LATERAL

The Backup Control Module (BCM) computer provides yaw damping and direct rudder command with pedals. This computer includes its own electrical generator, supplied by the B or Y hydraulic system.

PEDESTAL



(1) RUD TRIM selector

Controls the rudder trim actuator which moves the neutral point of the artificial feel by the equivalent of :
In clean configuration : 1° / second of rudder travel
Slats/flaps extended : 1° / second of rudder travel for quick inputs
3° / second for inputs longer than 1.5 seconds

(2) RESET pushbutton

By pushing the RESET pushbutton, the zero trim position is ordered at 3° / second.

Note : The rudder trim rotary switch, and the RESET pushbutton, are not active with the autopilot engaged.

③ Position Indicator

Displays the rudder trim direction (L or R) and value (0 to 25°).

④ SPEEDBRAKE lever

The lever controls:

– The position of the speedbrake surfaces.
  To set speedbrake surfaces to a required position, the lever has to be pushed down and set to the required position. A "hardpoint" is provided at "½" SPEEDBRAKE position.
– The manual preselection of the ground spoilers.
  To arm the ground spoilers, the lever must be pulled up when in the RET position. When the lever is armed (or reverse thrust is selected), all spoilers' surfaces will automatically extend at landing, or in case of a rejected takeoff.

⑤ PITCH TRIM wheel

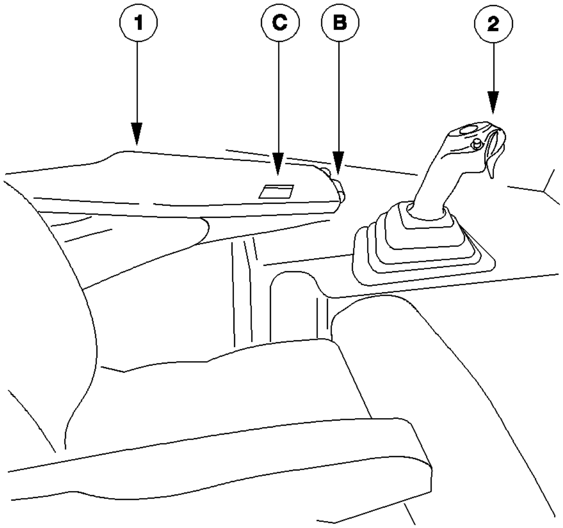
Both pitch trim wheels provide mechanical control of the THS and have priority over electrical control.

Note : *Crew action on the pitch trim wheel does not disconnect the PRIMs (micro-switches, actuated by the override mechanism, ensure that the computers remain synchronized with the manually-selected position).*

R The THS is manually-controlled on ground for the THS setting, before takeoff and in flight,
R when in direct law :
R – Before takeoff, the pilot sets the THS to the angular value, determined as a function
R of the aircraft CG, using the CG scale on the wheel. The relationship between the
R aircraft CG and the THS setting shown on the trim wheel is only applicable for takeoff.
R The limits of the THS normal setting range for takeoff are indicated by a green band
R on the pitch trim wheel
R – In flight, when in direct law, the pilot uses the THS conventionally to fly in trim. In
R flight, the aircraft pitch trim setting depends on aircraft CG, weight, altitude 2nd
R speed. Consequently, the relation between the aircraft CG, and the THS setting
R displayed on the pitch trim wheel, does not apply in flight.

Following nosewheel touchdown, as the pitch attitude becomes less than 2.5° for more than 5 seconds, pitch trim is automatically reset to 4° up.

LATERAL CONSOLES



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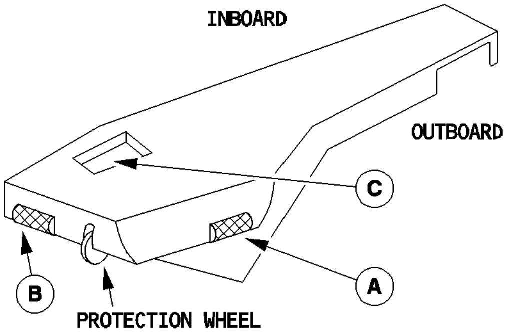
① ARM REST



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Arm rest is linked to the seat by means of a supporting arm.
The arm rest position is adjustable.
Following setting and indications are provided:

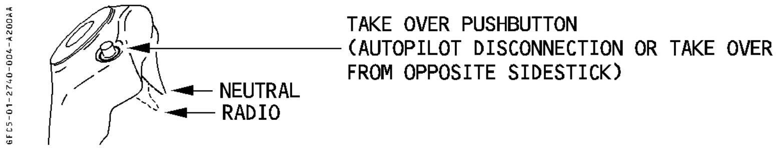
Ⓐ Height adjustment

Ⓑ Pitch adjustment

Ⓒ Armrest memory position display in pitch and in height.

(2) SIDESTICKS

Sidesticks, one on each lateral console, are used for manual pitch and roll control. They are springloaded to neutral. When the autopilot is engaged, a solenoid-operated detent locks both sidesticks in the neutral position. If the pilot applies a force above a given threshold (5daN in pitch, 3.5 daN in roll), the autopilot disengages and the sidestick unlocks and sends an input to the computers. The hand grip includes 2 pushbuttons :
- Autopilot disconnect/sidestick priority pushbutton.
- Push-to-talk button.



Sidestick priority logic
- When only one pilot operates the sidestick, his demand is sent to the computers.
- When the other pilot operates his sidestick, in the same or opposite direction, both pilot inputs are algebraically-added. The addition is limited to single-stick maximum deflection.

  Note : *In the event of simultaneous inputs on both sidesticks (2° deflection off the neutral position in any direction), the two green SIDE STICK PRIORITY lights, on the glareshield, come on and the "DUAL INPUT" voice message activates.*

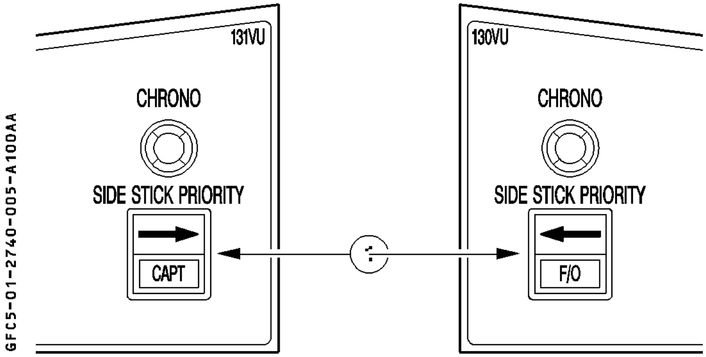
A pilot can deactivate the other sidestick, and take full control by pressing and keeping pressed his takeover pushbutton.
For latching the priority condition, it is recommended that the takeover pushbutton be pressed for more than 40 seconds. The takeover pushbutton can then be released without losing priority.
However, a deactivated sidestick can be reactivated at any time, by momentarily pressing either takeover pushbutton. If both pilots press their takeover pushbuttons, the last pilot to press their pushbutton will have priority.

Note : *If an autopilot is engaged, any action on a takeover pushbutton will disengage it.*

In a priority situation
- A red light will come on, in front of the pilot whose sidestick is deactivated.
- A green light will come on, in front of the pilot who has taken control, if the other sidestick is not in the neutral position (to indicate a potential and unwanted control demand).

Note : *If one stick is deactivated on ground, at takeoff thrust application, the takeoff «CONFIG» warning is triggered.*

GLARESHIELD

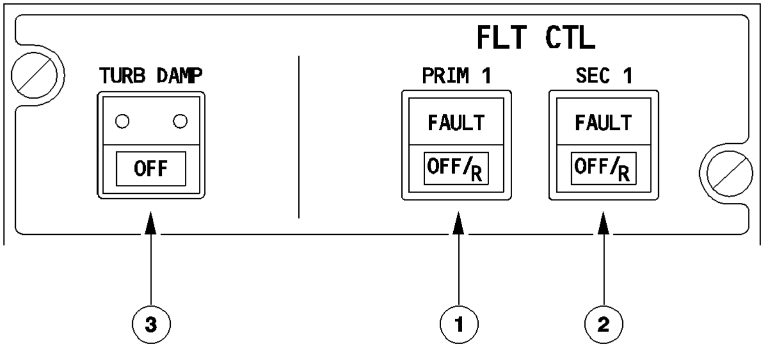


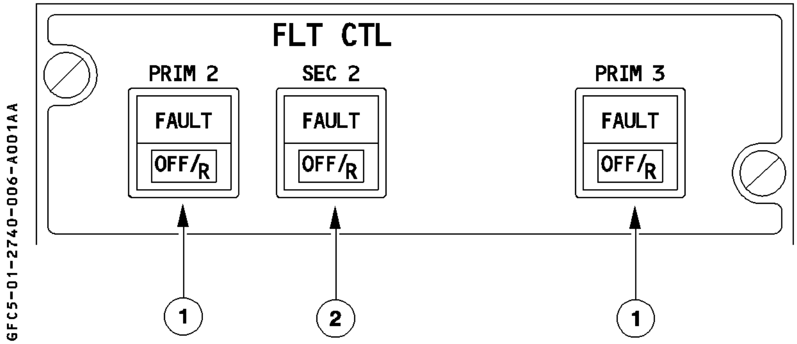
(1) SIDE STICK PRIORITY lt

Arrow red lt : – Illuminates in front of the pilot losing authority.
– Extinguishes if he has recovered his authority, ie:
· If the other takeover pb is released prior priority condition is latched.
· If he has used his takeover push button to cancel a latched priority situation.
Sidestick priority audio: a «PRIORITY LEFT» or «PRIORITY RIGHT» audio voice message is given each time priority is taken.

CAPT-F/O green lt : – Illuminates in front of the pilot who has taken priority by pressing the takeover push button if the opposite stick is not at neutral.
or
– CAPT and F/O light illuminate in case of simultaneous input on both sidesticks.
– Extinguishes when the opposite stick is returned to the neutral position.

OVERHEAD PANEL





1 PRIM pushbuttons

Control the Flight Control Primary Computers (FCPC)

ON : The following functions are provided by each computer:
- Normal pitch
- Normal lateral
- MLA
- Speedbrakes, ground spoilers control logic
- Pitch alternate
- Pitch direct
- Roll direct
- Yaw alternate
- Rudder travel
- Ailerons droop
- Abnormal attitude law
- Autopilot orders acquisition
- Characteristic speeds computation

OFF : The corresponding computer is not active. To reset, switch it OFF, then ON.

FAULT lt : The amber FAULT light, and associated ECAM caution, come on, when a failure is detected.
The FAULT light goes out, when OFF is selected, or at the end of the PRIM power-up test, provided it is satisfactory.

2 SEC pushbuttons

Control the Flight Control Secondary Computers (FCSC)

ON : The following functions are provided by each computer:
- Pitch direct
- Roll direct
- Yaw alternate
- Rudder trim
- Rudder travel

OFF : The corresponding computer is not active. To reset, switch it OFF, then ON.

FAULT lt : The amber FAULT light, and associated ECAM caution, come on, when a failure is detected.
The FAULT light goes out, when OFF is selected.
It flashes at the end of a SEC power-up test (at electrical power application).

3 TURB DAMP pushbutton

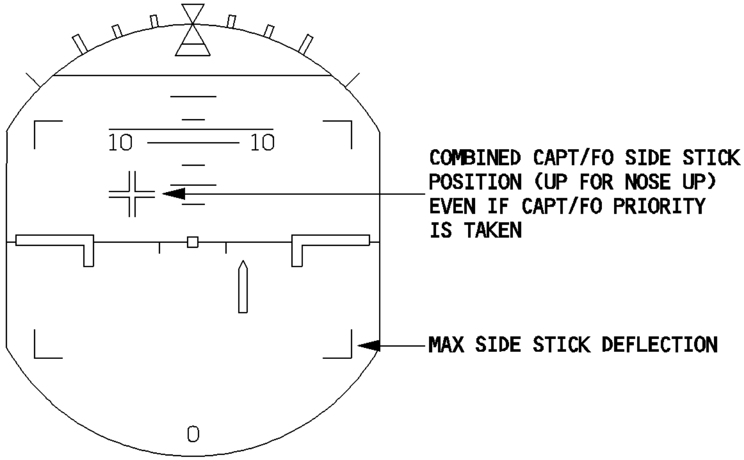
on : Command of Turbulence Damping function is added to normal law elevator and yaw damper command.

OFF : Turbulence Damping function commands are inhibited.

SIDE STICK INDICATIONS ON PFD

On ground, after first engine start, side stick position indications appear white on both PFDs.
The indication disappears when the aircraft passes from ground to flight.

R



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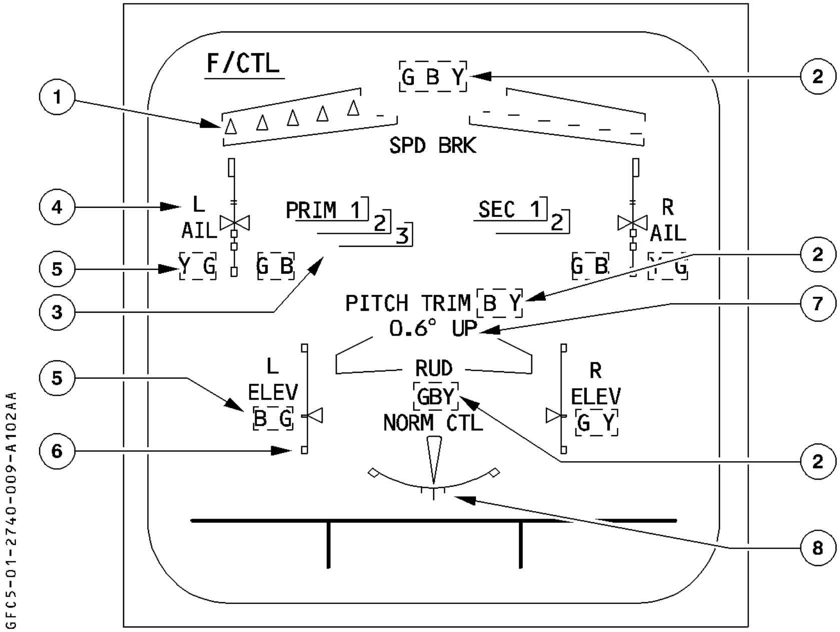
ECAM F / CTL PAGE



1 Spoilers / Speedbrakes indication

△ : Spoiler not retracted (green).
— : Spoiler retracted (green).
△ : Spoiler fault deflected (amber).
1 2 3 ... : Spoiler fault retracted (amber).

Note : Same indications are displayed on the WHEEL page.

2 Hydraulic system pressure indication

It is normally in green. It becomes amber in case of hydraulic system low pressure (downstream the leak valves).

3 PRIM / SEC indication

- PRIM and SEC labels are always displayed in white.
- The computer number is normally in green and boxed in grey. The number and box become amber, in the event of a computer failure.

④ Ailerons position indication

White scale and green indexes. Index becomes amber when both (associated) servojacks are not available.

R

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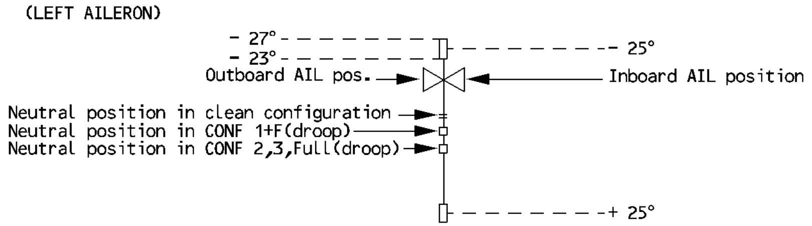

⑤ Aileron / Elevator actuators indication

G, B and Y are normally displayed in green.
Becomes amber in case of hydraulic system low pressure . It is partially boxed amber in case of electrical failure detected by the PRIM.

⑥ Elevator position indication

White scale and green index. The index becomes amber when both associated actuators are not available.

R

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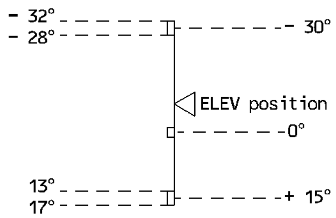
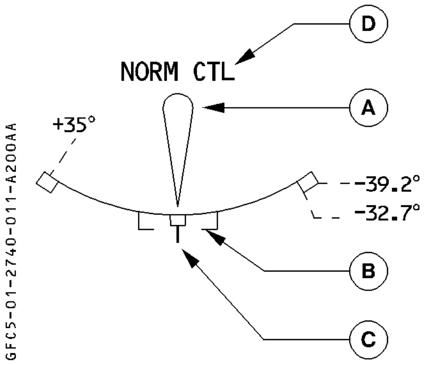


⑦ Pitch trim position indication

PITCH TRIM label : Normally white. Becomes amber in case of THS electrical control loss.
Position indication : Varies from 2° down to 14° up.
Normally green. Becomes amber in case of B + Y system low pressure.

8 Yaw control indications



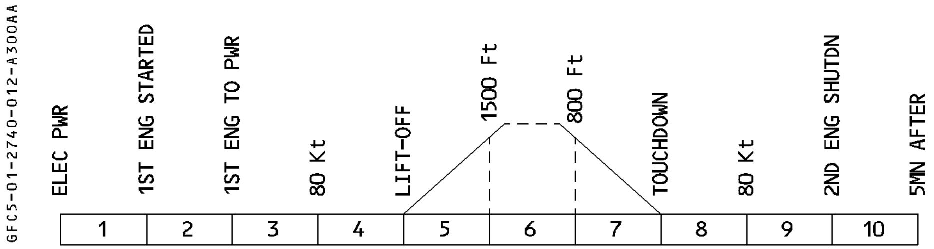
A Rudder position indication
It is normally in green.
The rudder symbol becomes amber, in the case of B + G + Y hydraulic low pressure.

B Rudder travel limiter or PTLU indication
It is normally in green.
It becomes amber, when Travel Limiters 1 and 2 are faulty.

C Rudder trim position
It is normally in blue.
The position varies from –29.2 to +29.2 degrees.
It becomes amber, if rudder trim systems 1 and 2 are inoperative.

D NORM CTL message
It appears in amber, when the normal rudder command is lost.
The rudder is then controlled by the Backup Control Module.

WARNINGS AND CAUTIONS



<table>
<tr><th>E / WD: FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>CONFIG
. SPD BRK NOT RETRACTED, or
. PITCH TRIM NOT IN TO RANGE (-7°, 0°)
. RUD TRIM NOT IN TO RANGE (± 3°)
Aircraft not in TO configuration when thrust levers are set at TO or Flex TO, or when pressing the TO CONFIG. pb.</td><td>CRC</td><td>MASTER WARN</td><td rowspan="2">F/CTL</td><td rowspan="2">NIL</td><td>5, 6, 7, 8</td></tr>
<tr><td>PITCH TRIM/MCDU/CG DISAGREE
Disagreement between the real pitch trim value, the pitch trim value calculated by the FCMC, based in the CG, and the pitch trim value entered in the MCDU.</td><td>SINGLE CHIME</td><td>MASTER CAUT</td><td>1,4,5,6, 7,8,10</td></tr>
<tr><td>CONFIG R (L) SIDESTICK FAULT
(BY TAKE OVER)
L or R sidestick is inoperative (deactivated by takeover pb) when thrust levers are set at TO or Flex TO, or when pressing TO CONFIG. pb.</td><td rowspan="2">CRC</td><td rowspan="2">MASTER WARN</td><td>NIL</td><td>Red *
SIDESTICK PRIORITY lt</td><td>4, 5, 6, 7, 8</td></tr>
<tr><td>L +R ELEV FAULT
Loss of both elevators.</td><td rowspan="6">F/CTL</td><td>PFD message</td><td rowspan="2">NIL</td></tr>
<tr><td>L (R) SIDESTICK FAULT
Transducers on pitch or roll axis are failed on one sidestick.</td><td rowspan="6">SINGLE CHIME</td><td rowspan="6">MASTER CAUT</td><td>NIL</td></tr>
<tr><td>PRIM 1 (2)(3) FAULT
Failure of 1 primary computer.</td><td>FAULT lt on PRIM pb</td><td>3, 4, 5, 7, 8</td></tr>
<tr><td>SEC 1 (2) FAULT
Failure of one secondary computer.</td><td>FAULT lt on SEC pb</td><td>3, 4, 5</td></tr>
<tr><td>FCDC 1 + 2 FAULT
Failure of both FCDCs.</td><td>NIL</td><td>4, 5, 7</td></tr>
<tr><td>DIRECT LAW
Direct laws are active.</td><td>PFD message</td><td rowspan="2">4, 5, 7, 8</td></tr>
<tr><td>ALTN LAW
Alternate laws are active.</td><td rowspan="2">NIL</td><td>NIL</td></tr>
<tr><td>DUAL INPUT
Both sidesticks are moved simultaneously</td><td>Synthetic voice repeated every 5 seconds</td><td>NIL</td><td>SIDESTICK Priority light</td><td>NIL</td></tr>
</table>

* The red SIDESTICK PRIORITY light comes on, as soon as the sidestick is inoperative.

R

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
GND SPLR FAULT Loss of ground spoiler function in all PRIM computers	SC SINGLE CHIME	MASTER CAUT	F/CTL	NIL	3, 4, 5
SPD BRK DISAGREE Position disagree between surfaces and handle pos.					
SPD BRK FAULT Spd brake lever transducers to all PRIM failed.					
SPD BRK STILL OUT SPD BRK memo is amber for more than 30 seconds or after 5 seconds, when the aircraft is under 800 feet, when the speedbrakes are extended and the flaps are in CONF FULL.			NIL		1 to 5 8 to 10
STAB CTL FAULT Loss of the electrical control of the stabilizer.			F/CTL		4, 5
L (R) ELEV FAULT Loss of both servojacks on one elevator.					
L (R) OUTR (INR) AIL FAULT Loss of both servojacks on one aileron.					
SPLR FAULT Loss of one or more spoilers.					3, 4, 5, 7
ELEV REDUND LOST Loss of the elevator redundancy for which a subsequent failure would lead to a degraded pitch control or pitch mechanical backup.			NIL		1, 4, 5, 7, 8, 10
PEDAL SENSOR FAULT					3, 4, 5, 6, 7, 8
SENSOR FAULT Loss of any sensor of F/CTL sys.					3, 4, 5, 6, 7, 8
RUD TRIM FAULT Rudder trim 1+2 fault.			F/CTL		4, 5, 7, 8
RUDDER FAULT					1, 4, 10
RUD NORM CTL FAULT					
RUD PEDAL FAULT					4, 5
ELEV SERVO FAULT Loss of one servojack on one elevator.	NIL	NIL			3, 4, 5
AIL SERVO FAULT Loss of one servojack on one aileron.					3, 4, 5, 7, 8
RUD B (Y) (G) SERVO FAULT					
FCDC 1 (2) FAULT			NIL		
RUD TRIM 1 (2) FAULT					3, 4, 5, 7, 8
RUD G (Y) (B) SERVO JAM					3 to 8
SEC 1(2) PITCH FAULT					3 to 8
PRIM 1 (2)(3) PITCH FAULT					3, 4, 5 7,8
TURB DAMP FAULT Longitudinal or lateral turbulence damping lost due to accelerometer failure.					3, 4, 5 7,8

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
RUD PRIM 1 FAULT	NIL	NIL	NIL	NIL	3, 4, 5, 7, 8
RUD SEC 1 FAULT					3 to 8

MEMO

R — SPEED BRK memo display logic :
R · When the speedbrakes are extended, in Flight Phases 2, 3, 4, and 5, the SPEED BRK memo flashes amber.
R · When the speedbrakes are extended, in Flight Phase 6, the SPEED BRK memo is displayed in green. It flashes amber, after 50 seconds, if at least one engine is above idle.
R · When the speedbrakes are extended, in Flight Phase 7, the SPEED BRK memo is displayed in green. It flashes amber after 5 seconds, with the SPD BRK STILL OUT caution, if the flaps are in CONF FULL.

— The GND SPLRS ARMED message is displayed in green, when the ground spoilers are armed.
— The TURB DAMP OFF message is displayed in green, when the TURB DAMP pushbutton is selected OFF.

DESCRIPTION

GENERAL

Lift augmentation is achieved on each wing by:
- 2 flaps surfaces
- 7 slats surfaces
- 2 ailerons (aileron droop function)

These surfaces are electrically signalled and hydraulically operated.
Slats and flaps are selected by the «FLAPS» lever located on the center pedestal. It has 5 positions.

MAIN COMPONENTS

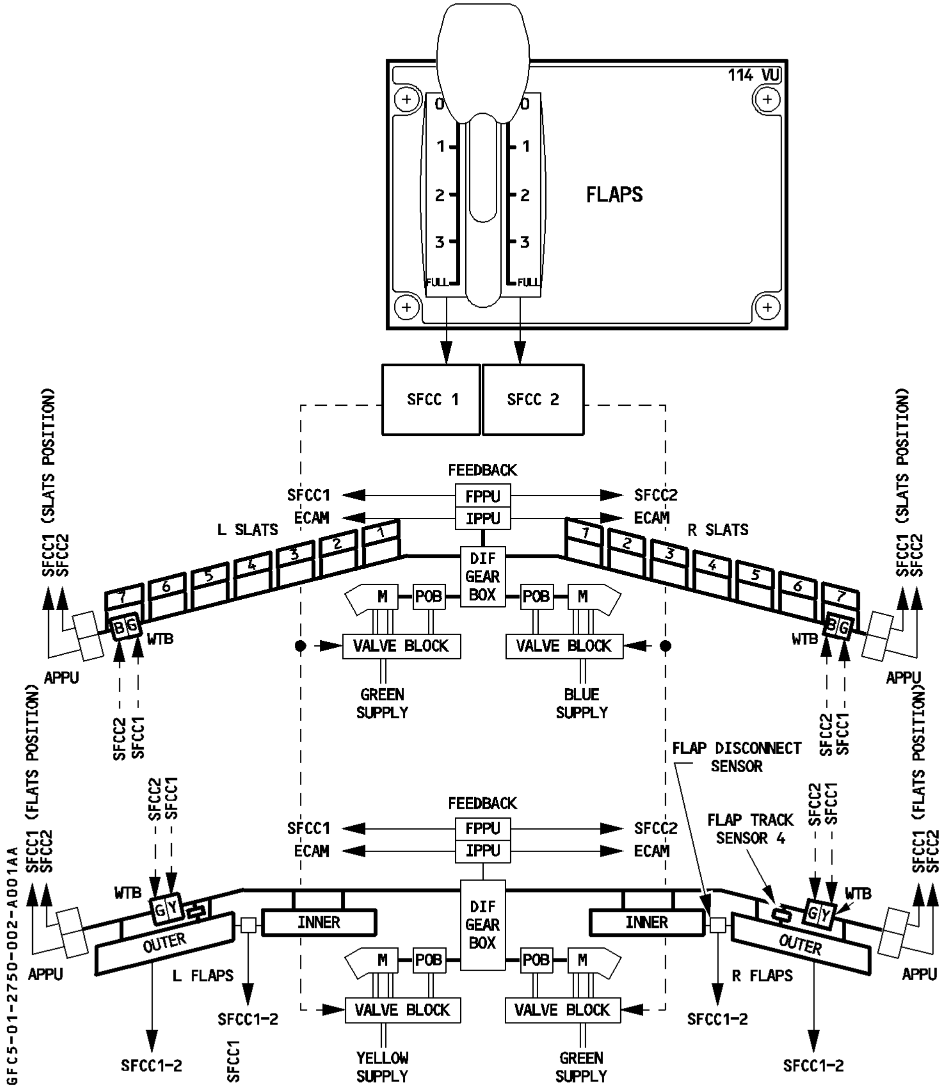
Slats and Flaps systems are similar, comprising:
- Two Slats Flaps Control Computers (SFCC) each containing one flap channel and one slat channel.
- A Power Control Unit (PCU) consisting of 2 independent hydraulic motors coupled to a differential gearbox.
  The motors driven by the related channel, are supplied by blue and green hydraulic power for the slats and green and yellow for the flaps.
  Pressure-Off Brakes (POB) are installed to lock the transmission when the flaps or slats surfaces have reached the selected position or in case of hydraulic power failure.
- 7 Slats and 2 Flaps surfaces per wing.
- R Two Asymmetry Position Pick Off Units (APPU) measuring the asymmetry between left and right wing.
- Flap disconnect detection system which detects attachment failure and inhibit flap operation in order to limit futher damage. The failure is detected by a sensor measuring excessive differential movement between inner and outer flaps.
- R Wing tip brakes (WTB), activated in case of asymmetry, overspeed or symetrical runaway.
  They cannot be released in flight.
  They are supplied by blue and green power for the slats and by green and yellow for the flaps.
- Feedback Position Pick Off Units (FPPU) provide position feed back to SFCCs.
- Indication position pick off unit (IPPU) provide position data to the ECAM.

Note : If flap wing tip brakes are activated, slat operation is still possible and vice-versa.
If one SFCC is inoperative both slats and flaps will operate at half speed.
If one hydraulic system is inoperative, the corresponding surfaces (slats or flaps) operate at half speed.

ARCHITECTURE

FOR INFO

R



CONFIGURATIONS

FLAPS lever has 5 positions: 0, 1, 2, 3 and FULL.
Two configurations correspond to FLAPS lever position 1: CONF 1 or CONF 1+F. Selection is done as below.

AUTOMATIC RETRACTION SYSTEM (ARS)

When CONF1 + F is selected, auto retraction of flaps to 0 occurs at 200 kt (before VFE which is 215 kt).

FLAP LOAD RELIEF SYSTEM (FLRS)

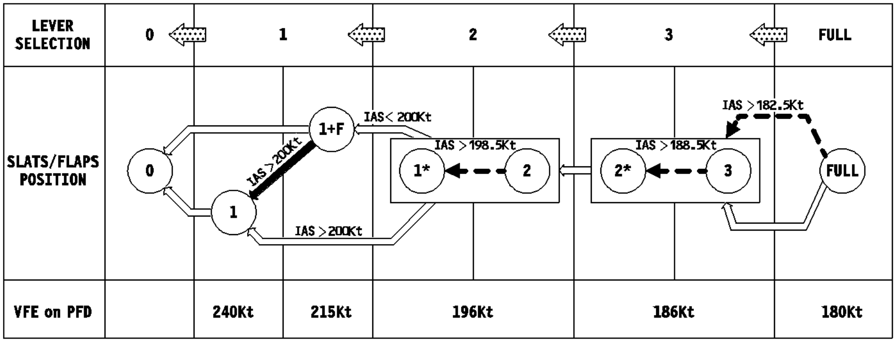
Available only in CONF 2, 3 or FULL. When activated, the system retracts the flaps to the deflection corresponding to the next further retracted lever position.
Auto retraction of flaps occurs only in case of VFE exceedance (VFE + 2.5 kt).
If speed is reduced below VFE (VFE – 2.5 kt) flaps return to normal (selected) position.
In CONF 2, auto retraction results in CONF 1* (20 slats/8° flaps).
In CONF 3, auto retraction results in CONF 2* (23 slats/14° flaps).
These configurations can be obtained only by FLRS activation.

Note :
1. *When FLAPS 1 is selected, VFE of CONF 1 or CONF 1 + F is displayed on PFD depending on actual configuration.*
   In approach VFE next is 205 kt (VFE of CONF 1)*
2. *When FLAPS 2 is selected in approach, VFE of CONF 2 or CONF 1* is displayed on PFD depending on FLRS activation.*
3. *When FLAPS 3 is selected, only VFE of CONF 3 is displayed on PFD independently of FLRS activation.*

In case of FLRS activation the ECAM upper display shows a flashing “RELIEF” message. If the speed is increased by 4 kt above the VFE corresponding to the actual flap/slat configuration, an overspeed warning is provided on ECAM.

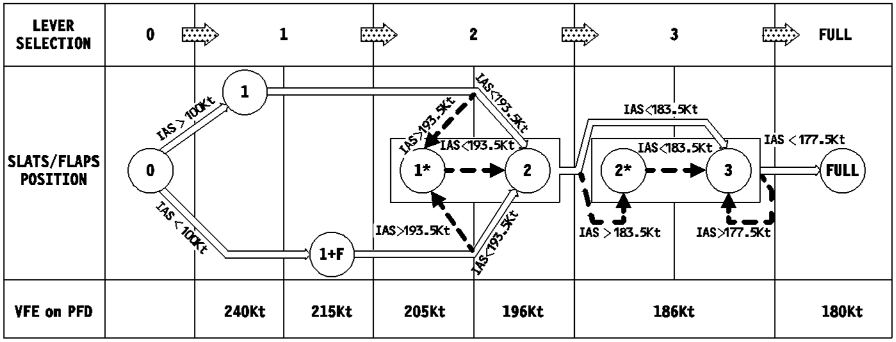
R

RETRACTION



FLAP LOAD RELIEF SYSTEM
AUTOMATIC RETRACTION SYSTEM
MANUAL SELECTION

EXTENSION



FLAP LOAD RELIEF SYSTEM
AUTOMATIC RETRACTION SYSTEM
MANUAL SELECTION

GFC5-01-2750-004-A001AA

SLATS ALPHA / SPEED LOCK FUNCTION

This function inhibits slats retraction at high angle-of-attack and/or low speed.
R The SFCC use corrected angle-of-attack (alpha) or air speed information from ADIRUs to inhibit slat retraction.
R If alpha exceeds 8.5 degrees or speed falls below 148 kt, the retraction from position 1 to 0 is inhibited.
R The inhibition is removed when alpha falls below 7.5 degrees or when the speed exceeds
R 154 kt. In this case the slats automatically retract to 0.
The function is not active if:
R – alpha exceeds 8.5 degrees or speed falls below 148 kt after the lever has been selected
R to 0
R – Aircraft on ground with speed below 60 kt.

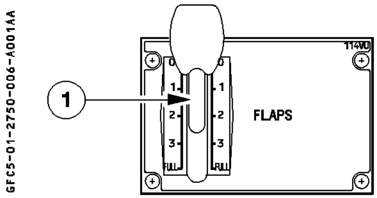
SIGNALS TO OTHER SYSTEMS

R The SFCC transmit flap/slat position to the following systems:
- PRIM and SEC
- FMGC
- ADIRU
- EIU
- CIDS
- GPWS

Note : *The ECAM system receives the position information directly from the IPPU (Instrumentation Position Pick Up Unit). This information is used for warnings and position indications on the E/WD.*

CONTROLS AND INDICATORS

PEDESTAL



(1) FLAPS lever

The FLAPS lever selects simultaneous operation of the slats and flaps.
The five lever positions correspond to the following surface positions:

R

<table>
<tr><th>Lever Position</th><th>SLATS</th><th>FLAPS</th><th>AILERONS</th><th>Ind. on ECAM</th><th colspan="3">FLIGHT PHASE</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td></td><td></td><td></td><td>CRUISE</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">16</td><td>0</td><td>0</td><td>1</td><td></td><td></td><td>HOLD</td></tr>
<tr><td>8</td><td>5</td><td>1 + F</td><td>TAKEOFF</td><td></td><td></td></tr>
<tr><td rowspan="2">2</td><td>20</td><td>8</td><td>10</td><td>2(a)</td><td></td><td></td><td rowspan="3">APPR</td></tr>
<tr><td>20</td><td>14</td><td>10</td><td>2</td><td rowspan="2">TAKEOFF</td><td></td></tr>
<tr><td>3</td><td>23</td><td>14</td><td>10</td><td>3(b)</td><td rowspan="3">LDG</td></tr>
<tr><td>3</td><td>23</td><td>22</td><td>10</td><td>3</td><td></td><td></td></tr>
<tr><td>FULL</td><td>23</td><td>32</td><td>10</td><td>FULL</td><td></td><td></td></tr>
<tr><td colspan="8">(a) This slats/flaps position corresponds to CONF 1*</td></tr>
<tr><td colspan="8">(b) This slats/flaps position corresponds to CONF 2*</td></tr>
</table>

Before selection of any position, the lever must be pulled out of detent.
Moreover, balks are provided at position 1 and 3 to avoid excessive flap / slat travel demand by a single pilot action.

Note : It is not possible to select an intermediate lever position.

Takeoff in CONF 1:
CONF 1 + F (16 / 8) is selected. The flaps automatically retract at 200 knots.

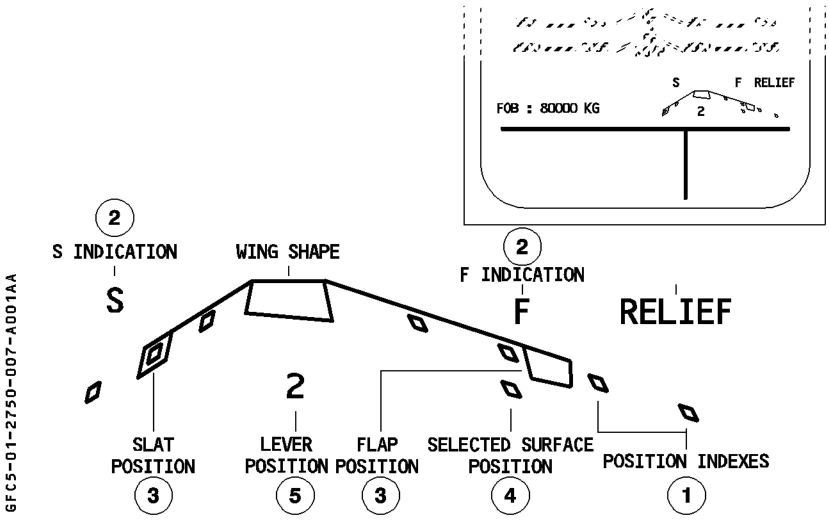
Takeoff or go-around in CONF 2 or 3:
At FLAPS 1 selection: CONF 1 + F (16 / 8) is selected if speed < 200 knots.
Then, the flaps automatically retract at 200 knots.

0 to 1 above 100 Knots:
CONF 1 (16 / 0) is selected.

Note : After flaps retraction, CONF 1+F is no longer available until speed is 100 knots or less, except if CONF 2 or more has been previously selected.

ECAM UPPER DISPLAY

R



1 Position indexes:

R A fixed grey center part and three plus four white dots show all the flaps and slats positions. The white dots are not displayed in clean configuration.

2 F and S

Normally white. Not displayed in clean configuration.
The F symbol is :
- replaced by amber F LOCKED message when wing tip brake is applied to flaps.
- replaced by green pulsing F RELIEF message when flap load relief system is activated.
- displayed in amber at flap system failure or at yellow and green hydraulic system low pressure.

The S symbol is :
- replaced by amber S LOCKED message when wing tip brake is applied to slats.
- R replaced by green pulsing A LOCK message when alpha/speed LOCK function is activated.
- displayed in amber at slat system failure or at blue and green hydraulic system low pressure

3 Flaps/Slats actual position

The green boxes move independently when flaps/slats are retracted or extended. When fully retracted boxes are side by side with wing fixed part. Signal is acquired by separate sensors not used by the SFCC.
Symbols become amber at incidence of S (F) LOCKED. Slat box is green pulsing when alpha/speed lock function is active, flap box when flap load relief system is active.

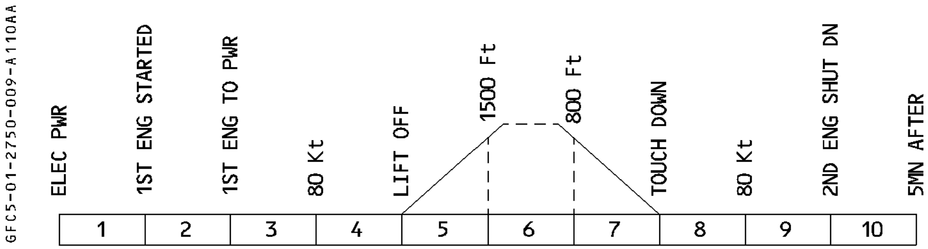
4 Selected position

Blue when the surfaces are in transit.
Disappears when the selected position has been reached.
Provided by the SFCC.

R 5 Lever position

R Numbers and letters indicate the flaps/slats position. Green when actual position agree with selected position. Blue when surfaces in transit. Not displayed in clean configuration. Provided by the SFCC.

WARNINGS AND CAUTIONS



R

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
CONFIG SLATS (FLAPS) NOT IN TO CONFIG Slats or flaps are not in takeoff configuration when thrust levers are set at TO or FLEX TO, or when pressing TO CONFIG pb.	CRC	MASTER WARN	NIL	NIL	5, 6, 7, 8
SLATS (FLAPS) FAULT Failure of both slat or flap channels	SINGLE CHIME	MASTER CAUT			4, 5, 8
SLATS (FLAPS) LOCKED Slats or flaps wing tip brakes applied.					
FLAP/MCDU DISAGREE Discrepancy between real TO flaps position and value entered into MCDU PERF TO page.					1, 2, 4 5, 6, 7 8, 9 10
LVR OUT OF DETENT The flap/slat lever is between two detents.					NIL
SLATS SYS 1 (2) FAULT Failure of slat channel in one SFCC.	NIL	NIL			3, 4, 5, 7, 8
FLAP SYS 1 (2) FAULT Failure of flap channel in one SFCC.					
SLAT (FLAP) TIP BRK FAULT Failure of one wing tip brake on slats or flaps.					
FLAP LVR NOT ZERO Slat/flap lever is not in the zero position, and altitude is above 22 000 feet.	CRC	MASTER WARN			1 to 5, 7 to 10

BUS EQUIPMENT LIST

FOR INFO

		NORM			EMER ELEC		
		AC	**DC**	**DC BAT**	**AC ESS**	**DC ESS**	**HOT**
MAIN FLT CTL COMPUTERS	PRIM 1					X	X (1)
	PRIM 2		DC2 (3)			LAND REC	
	PRIM 3		DC2				
	SEC 1					X	X (1)
	SEC 2		DC2				
	FCDC1					SHED	
	FCDC2		DC2				
FLAP SLAT COMPUTERS	SFCC 1 slats					LAND REC	
	SFCC 1 flaps					SHED (LAND REC)	
	SFCC2 slats		DC2				
	SFCC2 flaps		DC2				
SENSORS	RATE GYRO 1					X	X (1)
	RATE GYRO 2					X	X (1)
	ACCELRM 1					X	X (1)
	ACCELRM 2		DC2				
PITCH TRIM	ACTUATOR 1					SHED	
	ACTUATOR 2		DC2 (2)				
	ACTUATOR 3		DC2				
PFTU-RUDDER TRIM	ACTUATOR 1					SHED	
	ACTUATOR 2		DC2				

(1) Hot bus supplies, when DC ESS BUS fails.
(2) Normal supply is from DC BUS 2. DC BUS 1 supplies, in case of a DC BUS 2 failure.
(3) Normal supply is from DC BUS 2. DC ESS LAND REC supplies, in case of a DC BUS 2 failure.
In case of a total electrical failure, or a loss of rudder control due a to Flight Control Computer failure, the rudder is controlled by the BCM, which has its own independent electrical generator : The Backup Power Supply (BPS).

28.00 CONTENTS

28.10 DESCRIPTION

28.20 CONTROLS AND INDICATORS

28.30 ELECTRICAL SUPPLY

GENERAL

DESCRIPTION

The fuel system :
- Stores fuel.
- Controls and monitors the correct quantity of fuel.
- Supplies fuel to the engines and the Auxiliary Power Unit (APU).
- Controls the transfer of fuel to maintain the Center of Gravity (CG) within limits.
- Maintains fuel in the outer tanks for wing bending.
- Allows fuel jettison for rapid weight reduction.
- Controls refueling and defueling.

TANKS

Fuel is stored in the :
- Wings
- Center section
- Trimmable Horizontal Stabilizer (THS).

DESCRIPTION

The wings have inner and outer tanks. Each inner tank contains one collector cell that :
- Maintains a fuel reservoir for the fuel booster pumps and provide negative 'g' protection to feed the engines.
- Is maintained full and contains about 1000 kg (2200 lbs) of fuel.

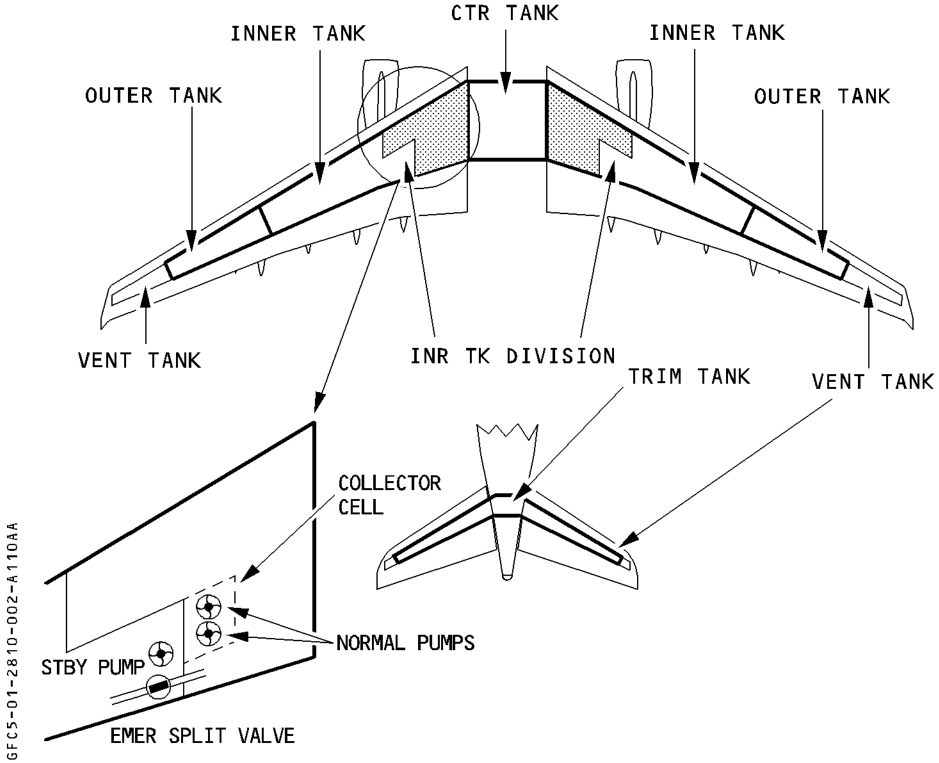
Each inner tank is divided into two parts via a SPLIT valve that normally remains open. The inner tank is used as a single tank and, if tank damage is suspected (i.e. FQI data is lost or there is a rapid FQI decrease following an engine failure), the SPLIT valve can be manually closed by using the dedicated pushbutton on the overhead panel.

In each wing, and on the right of the THS trim tank, there is a vent surge tank outboard of the outer tank.

After refueling to maximum tank capacity, fuel can expand by 2 % (20° temperature increase) without spillage.

There is an overpressure protector in each wing surge tank, in the trim surge tank, and between the center and the right inner tanks.

TANK ARRANGEMENT



USABLE FUEL						
		OUTER TANKS	INNER TANKS	CENTER TANK	TRIM TANK	TOTAL
VOLUME	(liters)	3 650 x 2	42 000 x 2	41 560	6 230	139 090
	(US gallons)	964 x 2	11 095 x 2	10 979	1 646	36 743
WEIGHT *	(KG)	2 865 x 2	32 970 x 2	32 625	4 891	109 186
	(LB)	6 317 x 2	72 686 x 2	71 925	10 782	240 713

* Fuel specific gravity: 0.785 kg/l or 6.551 lb/US Gal.

FUEL CONTROL AND MONITORING SYSTEM (FCMS)

GENERAL

The fuel system is controlled by two Fuel Control and Monitoring Computers (FCMC).
The FCMCs :
- Measure the fuel quantity and indicate it on the ECAM.
- Calculate the aircraft's Gross Weight and Center of gravity, based on the Zero Fuel Weight and the CG entered by the crew.
- Control transfer of fuel to the inner tanks for engine feed.
- Control transfer of fuel to and from the trim tank for CG control.

Magnetic level indicators are fitted in the lower surfaces of the center and wing tanks to allow the manual measurement of each tank's fuel quantity.

FUEL QUANTITY INDICATION AND LEVEL SENSING

FUEL QUANTITY INDICATION

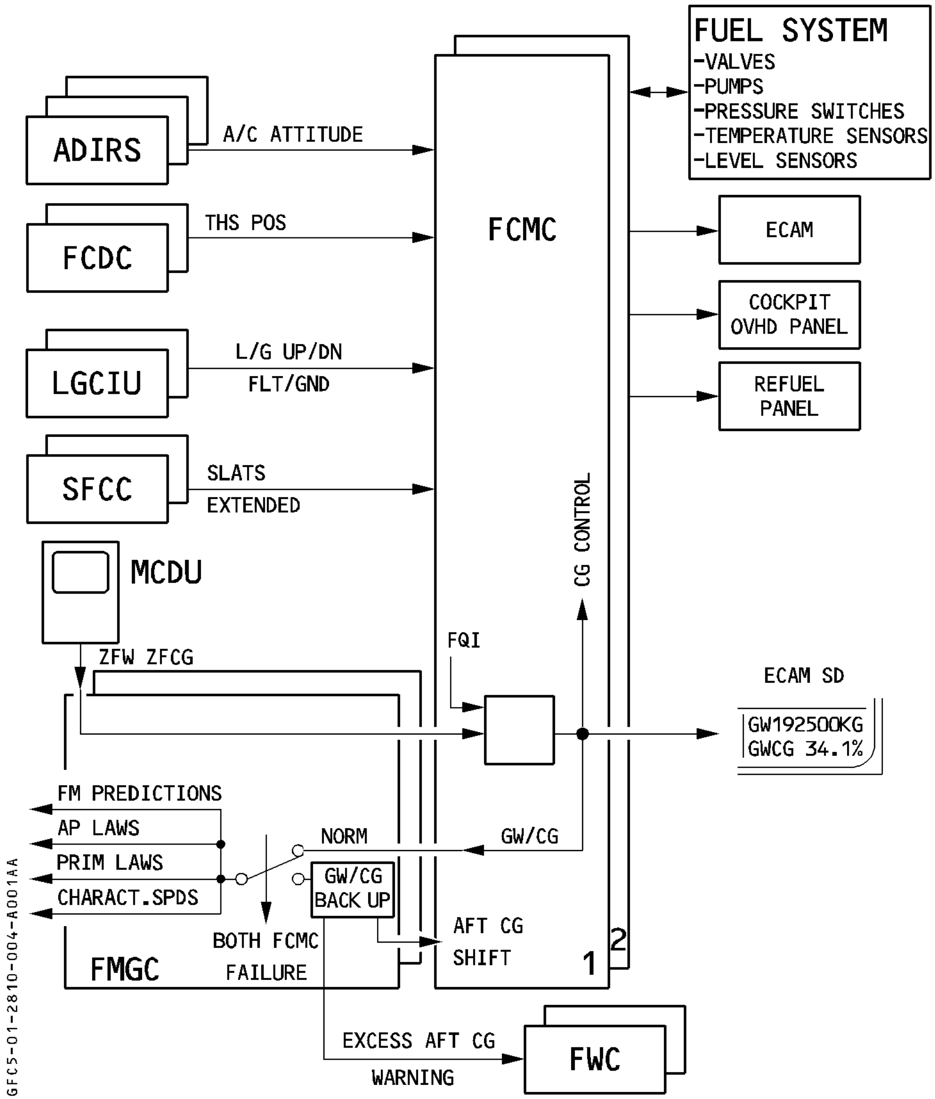
One FCMC is active and the other is on standby. If the first FCMC fails, then the other FCMC takes over.
Each FCMC calculates the fuel quantity by using the :
- Fuel volume from the fuel probes.
- Fuel density from the densitometers.
- Horizontal Stabilizer angle.
- Aircraft attitude.
- Fuel electrical characteristic from the compensators

The calculated fuel quantity is indicated on both the ECAM and the refuel control panel.

FUEL LEVEL SENSING

The FCMC also uses information from the following fuel level sensors to control transfers and to provide warnings, independently of the fuel quantity indication :
- Low level sensors :
  - To trigger low level warnings and stop jettison ⊲.
  - To control center and trim tank transfers.
- High level sensors : To stop refueling when a tank is full.
- Vent surge tank level sensor : To stop refueling, or fuel transfer, in case of tank overflow.

ARCHITECTURE



ENGINE FEED

GENERAL

The main fuel pump system supplies fuel from the inner tanks to the engines. In each wing there are three fuel pumps. Two main fuel pumps in the collector cell and one standby pump outside the collector cell. When closed, the crossfeed valve separates the system into two parts, and their associated fuel pumps supply the engines. When open, the crossfeed valve allows any pump to supply any engine.

MAIN COMPONENTS

INNER TANK PUMPS

During normal operation all main pumps run. If a main pump fails, or is switched off, then the standby pump runs. With the crossfeed valve opens, one pump is capable of supplying both engines.

CROSSFEED VALVE

The cross feed valve enables any pump to supply any engine. The X-FEED valve automatically opens in electrical emergency configuration.

ENGINE LP VALVE

The flow of fuel to an engine can be stopped by closing its respective low pressure (LP) valve via the :
– Engine master switch, or the
– ENG FIRE pushbutton.

FUEL FEED WITH ALL ENGINES FLAME OUT (ELEC EMER CONFIG)

EMER GEN POWERED BY THE RAT

- The X-FEED valve automatically opens.
- Only the left pump 2 remains powered.
- If left pump 2 fails, or is selected OFF, right pump 2 will automatically replace it.
- When the speed decreases below 260 knots, or when LAND RECOVERY is selected ON, all normal and STBY pumps are lost.

FLIGHT ON BATTERIES

- All normal and STBY pumps are lost.

ENGINE FEED

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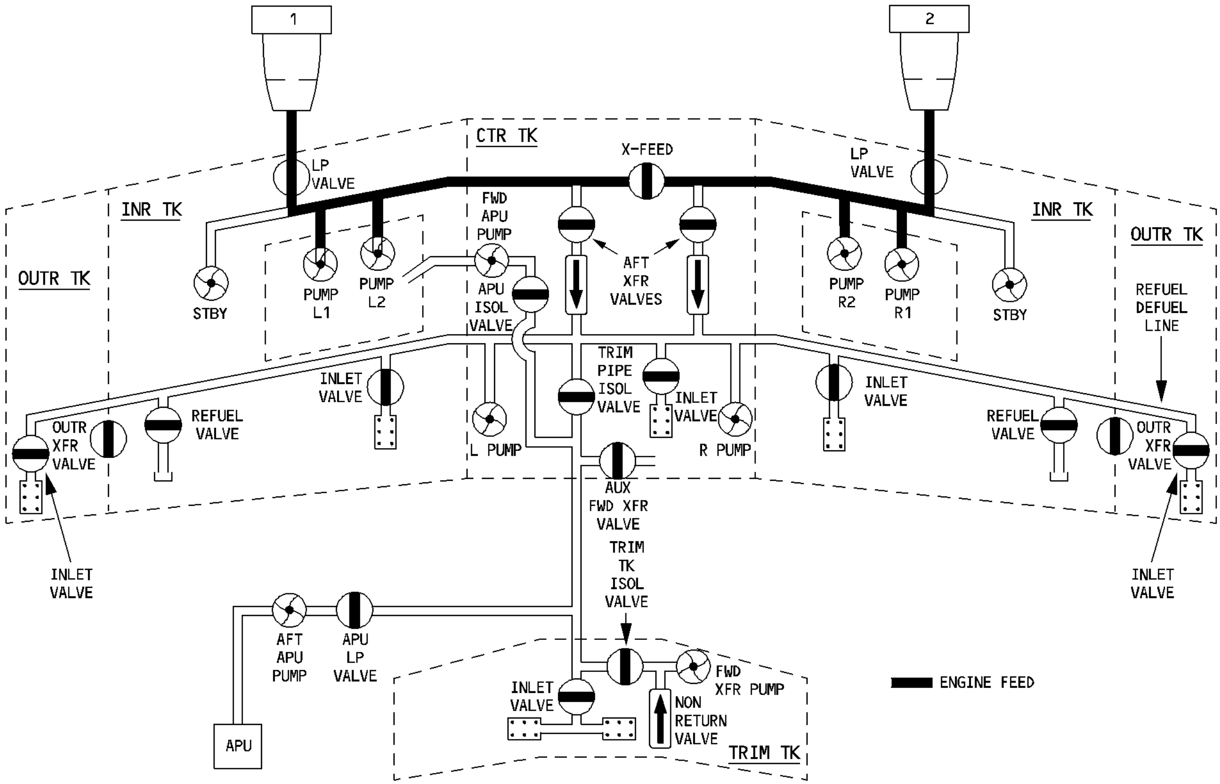

FOR INFO

FUEL FEED SEQUENCE

NORMAL OPERATION

Fuel is always fed to the engines from the inner tanks.
The fuel transfer sequence is as follows :
1. Center tank fuel transfers to the inner tanks.
R 2. Each inner tank empties down to 4000 kg (8830 lbs).
3. Trim tank fuel transfers to the inner tanks.
R 4. Each inner tank empties down to 3500 kg (7720 lbs).
5. Outer tank fuel transfers to the inner tanks.

Note : If required for CG control, the trim tank may be emptied earlier (refer to CG control).

AUTOMATIC FUEL TRANSFERS

CENTER TO INNER TANK TRANSFER

The center tank pumps run continuously whenever there is fuel in the center tank. Each inner tank inlet valve controls the transfer by cycling its inner tank contents between full
R and approximately 2000 kg (4415 lbs) below full. When the center tank is empty, both center tank pumps stop, and both inner tank inlet valves close.

OUTER TO INNER TANK TRANSFER

The outer tank transfers fuel to the inner tanks by gravity. Each outer tank transfer valve
R controls the transfer by cycling its inner tanks contents between 3500 kg (7720 lbs) and
R 4000 kg (8830 lbs). When each outer tank has been empty for five minutes, its outer tank transfer valves close.

TRIM TANK TRANSFER

Refer to CG control.

ECAM INDICATION

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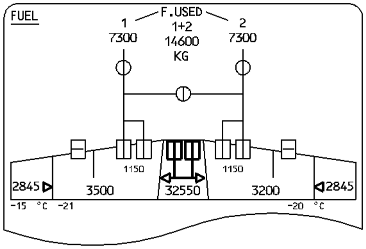
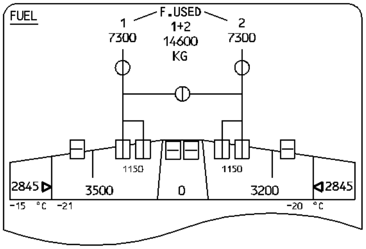


TRANSFER FROM CENTER TANK



TRANSFER FROM OUTER TANKS

MANUAL FUEL TRANSFERS

CENTER TO INNER TANK TRANSFER

Transfer from the center to inner tanks can be manually selected with the CTR TANK XFR pushbutton. When selected MAN, the inner tank inlet valves are opened and the CTR TK pumps run.
The CTR TK pumps must be selected OFF when the :
– Inner tanks are full, to manually prevent inner tank overflow.
– Center tank is empty.

R *Note* : *1. When the fuel quantity of each inner tank is below 17000 kg (37520 lbs), all center tank fuel can be transferred without any risk of overflow.*
2. When the CTR TANK XFR pushbutton is pressed, aft transfer is inhibited.

OUTER TO INNER TANK TRANSFER

Transfer from the outer to inner tanks can be manually selected with the OUTR TK XFR pushbutton. When selected ON, the outer tank fuel transfer valves, and the inner and outer inlet valves are opened.

Note : *1. During an outer to inner tank transfer, the CTR TK pumps must be selected OFF to avoid inadvertent fuel transfer from the center tank to outer tanks.*
2. When the OUTR TK XFR pushbutton is pressed, aft transfer is inhibited.

CG CONTROL – TRIM TANK TRANSFER

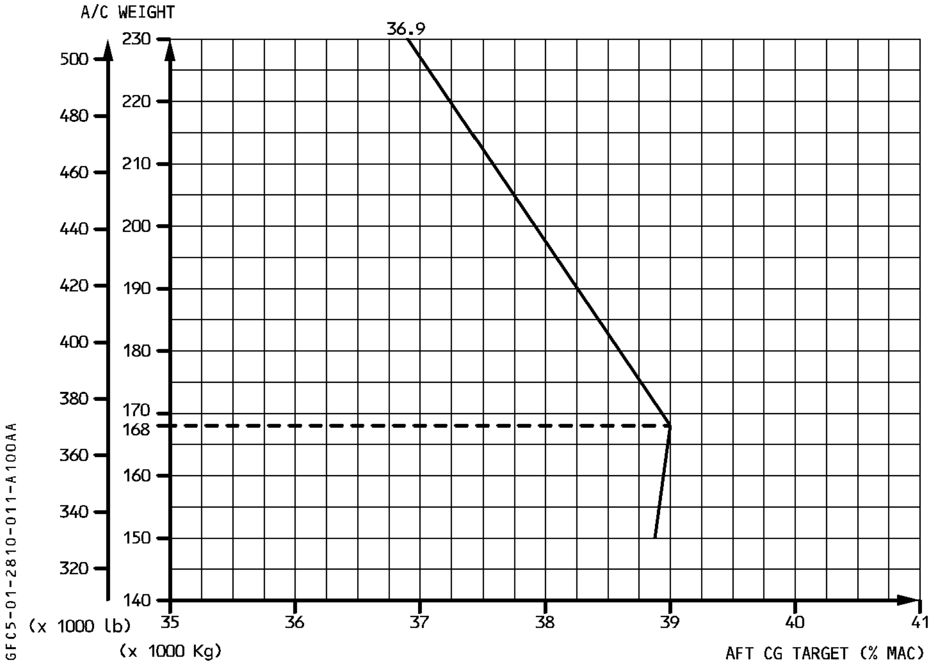
GENERAL

The trim tank transfer system controls the aircraft's Center of Gravity (CG).

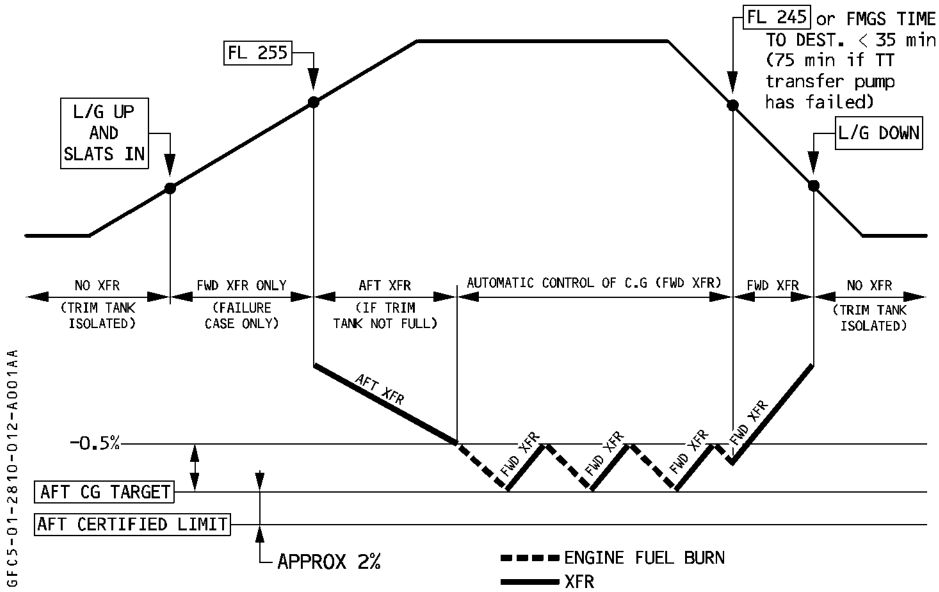
- The system either transfers fuel to the trim tank (aft transfer) or from the trim tank (forward transfer).
- This movement of fuel changes the aircraft's CG.
- When the aircraft is in cruise, the system optimizes the CG position to increase fuel economy by reducing drag.
- Normal operation is automatic, but the crew can manually select a forward fuel transfer.
- The Fuel Control and Management Computer (FCMC) calculates the aircraft's CG and compares it to a target value. (This target depends on the aircraft's actual weight. See AFT CG Target Graph below).
- Based on this calculation, the FCMC determines the quantity of fuel to be moved aft or forward in flight.

AFT CG TARGET

FOR INFO



NORMAL OPERATION



Automatic CG control :

- Begins during climb to FL 255.
- Ends at descent to FL 245, or when the FMGS time to destination is less than 35 minutes (or less than 75 minutes in the event of trim tank forward transfer pump failure).

Note : 1. *The trim pipe isolation valve and the trim tank isolation valve are closed during takeoff and landing. It is possible to reopen them, when the landing gear is up and the slats are retracted (or when the MODE SEL switch is set at REFUEL on the REFUEL panel).*

2. *If the FMGC detects a CG that is too far aft, then the target will automatically be moved forward by 1.5 %. The target also moves forward 1.5 % in the case of FQI data degradation, or if ZFCG/ZFW have not been entered, or if they need to be reinitialized in flight (modifying CG/GW via the MCDU).*

3. *The above-mentioned CG target alterations should be added together.*

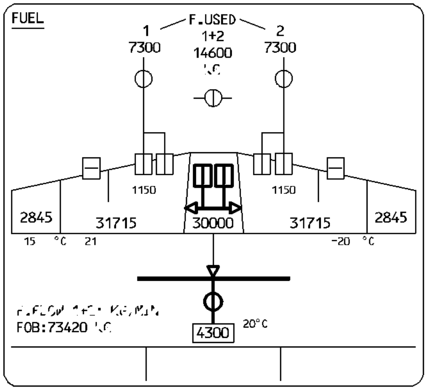
AFT FUEL TRANSFER

In flight, the FCMC only starts an AFT fuel transfer, when all of the following conditions are met :
- Landing gear is retracted.
- Slats are retracted.
- Trim tank is not full.
- Inner tank's fuel quantity is above 6250 kg (13790 lbs).
- Aircraft is above FL 255.
- Aircraft CG is not on target.

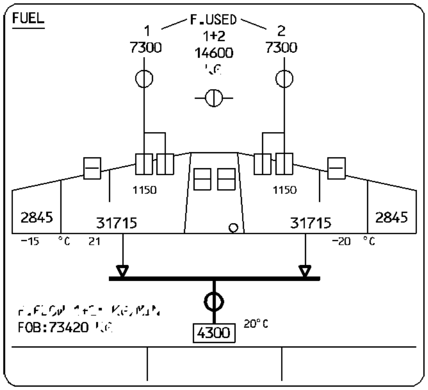
Normally, only one aft fuel transfer occurs per flight. However, if the CG in cruise is ahead of the target by more than 2 %, and the trim tank quantity is below 3000 kg (6620 lbs), an additional aft transfer will occur. An aft transfer terminates when the :
- Computed CG = Target CG - 0.5 %, or
- Trim Tank high level sensor becomes wet, or
- Inner tank's fuel quantity reaches 6250 kg (13790 lbs), or
- T Tank pushbutton is selected FWD, or
- Fuel transfer from the center or outer tanks to the inner tanks is manually selected.

Fuel for trim tank aft transfer is provided by the CTR TK, when it contains fuel, or by the inner tanks when the center tank is empty. If, during the transfer, the inner tanks are unbalanced by more than 500 kg (1100 lbs), the transfer will stop on the lightest side, and the related aft transfer valve will automatically close until fuel balance is restored.

ECAM INDICATION



AFT TRANSFER WITH CENTER TANK NOT EMPTY



AFT TRANSFER WITH CENTER TANK EMPTY

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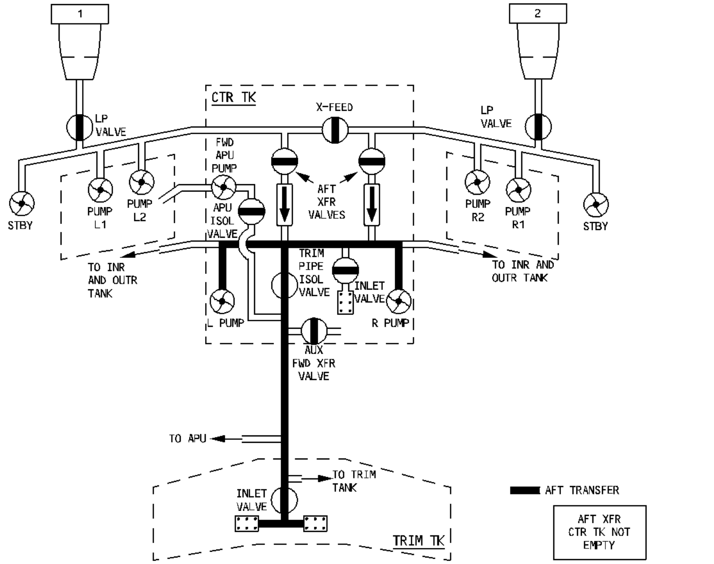
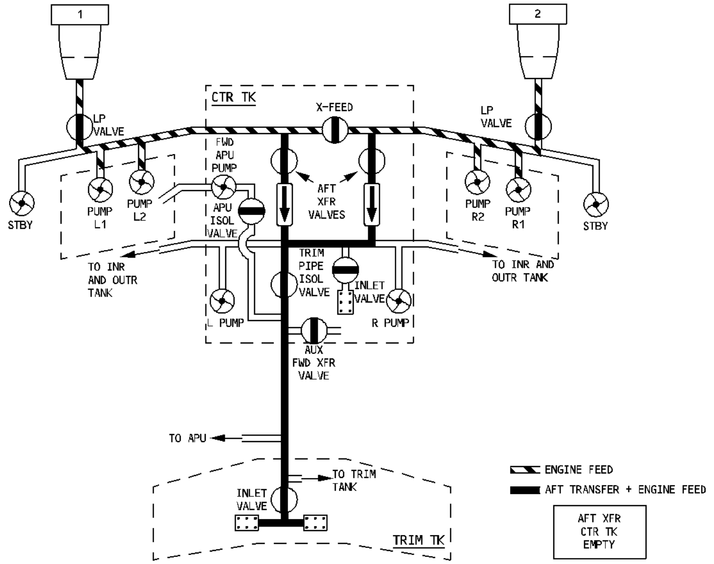
AFT FUEL TRANSFER

FOR INFO





GFC5-01-2810-014-A100AA

AUTOMATIC FORWARD FUEL TRANSFER

The FCMC sends a forward fuel transfer signal, if one of the following conditions are met:
- The calculated CG = Target. It stops when the computed CG = The target CG - 0.5 %.
- The fuel contents of one of the two inner tanks decreases to 4000 kg (8830 lbs). It stops when it reaches 5000 kg (11030 lbs).
- The FMGS sends a time-to-destination signal below the threshold, or the aircraft descends below FL 245. In this case, transfer is continuous but is controlled by the inner tank high levels to prevent overflow.
- The jettison system ⊲ is set to the open position.
- In electrical emergency configuration.

Note : If the center tank contains fuel and the CG target is forward by 23 %, the transfer will be completed in two steps :
- *When the center tank quantity reaches (17000 kg (37520 lbs), the trim tank is decreased to 2400 kg (5290 lbs).*
- *When the center tank is empty, the trim tank will be emptied.*

A forward transfer is normally directed to the inner tanks, and may be directed to the center tank when it is not empty. In emergency electrical configuration, the forward transfer is always directed to the inner tanks.
In normal operations, a forward transfer is performed by the trim tank forward transfer pump. The pump starts to operate when both the landing gear and the slats are retracted, as long as there is fuel in the trim tank and it continuously runs during the flight, until the trim tank is empty, or the T. TANK FEED selector is set to ISOL.

Note : The running trim tank forward transfer pump has no effect on the aft transfer, since the TRIM TK ISOL VALVE is normally closed during this transfer.

In the event of pump failure, forward transfer is by gravity, through the trim tank non-return valve. The FCMC :
- Inhibits the forward transfer by closing the TRIM PIPE ISOL VALVE, when the aircraft pitch exceeds 3° for more than one minute.
- Reinstate the forward transfer, when the aircraft attitude is lower than 3° for more than one minute.

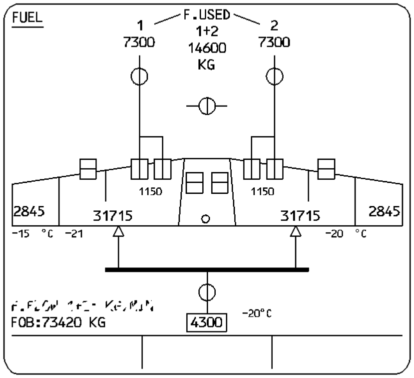
CENTER TANK EMPTY

– Fuel is transferred from the trim tank to the inner tanks.
– If an inner tank reaches the high level, the related inlet valve closes to prevent tank overflow.
– It reopens when the inner tank quantity reaches 2000 kg (4415 lbs) below high level.

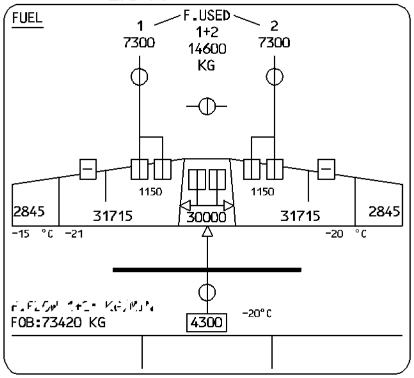
CENTER TANK NOT EMPTY

– Fuel is transferred from the trim tank to the center tank.

ECAM INDICATION



FORWARD TRANSFER
CENTER TANK
EMPTY

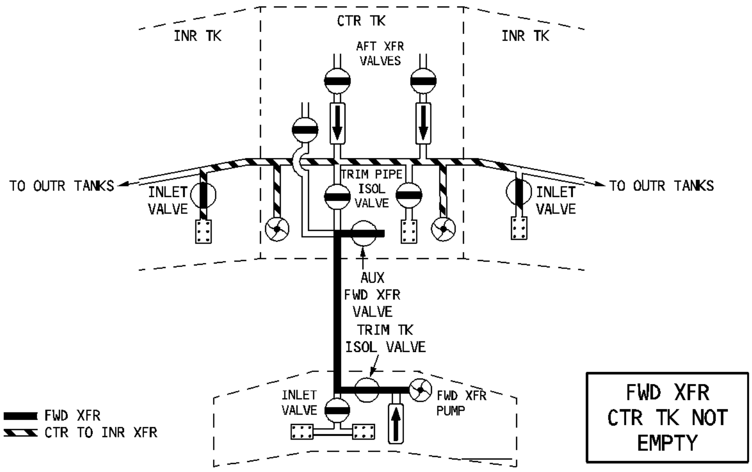


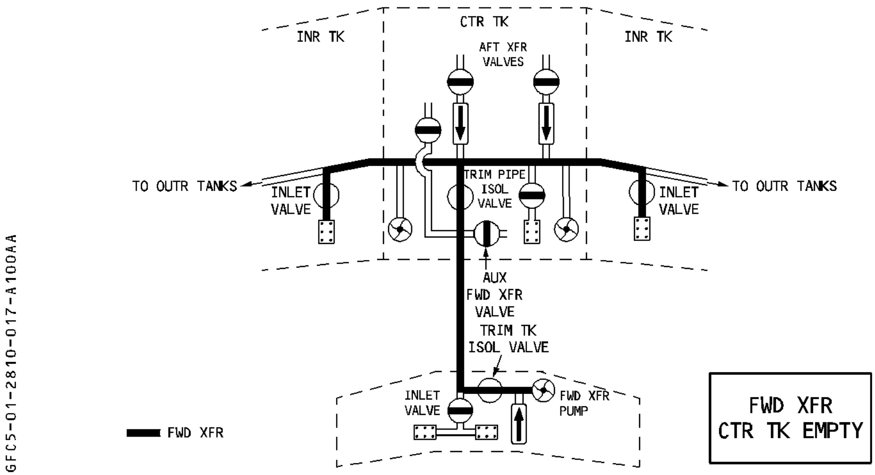
FORWARD TRANSFER
CENTER TANK
NOT EMPTY

GFC5-01-2810-016-A200AA

AUTOMATIC FORWARD FUEL TRANSFER

FOR INFO



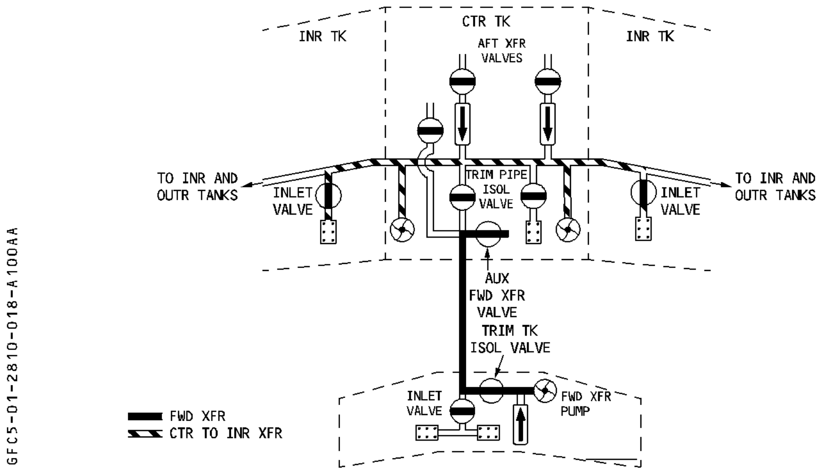


MANUAL FORWARD FUEL TRANSFER

When the T. TANK pushbutton is pressed, the FWD light comes on white, and :
- The TRIM TK ISOL valve opens.
- The AUX FWD XFR valve opens.
- The two AFT XFR valves close.
- The TRIM PIPE ISOL valve closes.

R – The trim tank forward transfer pump starts.

Fuel transfers from the trim tank to the center tank.
Center tank overflow must be manually prevented, by releasing the pushbutton when the tank is full.
When the T. TANK pushbutton is released, the forward transfer stops.



APU FEED

FWD APU PUMP FEED

The APU is fed from the Engine 1 collector cells (in the left inner tank) through the APU FWD pump and the APU ISOL valve when :
- On the ground after two minutes (except during trim tank refueling), or
- In flight below FL 255, or
- In flight above FL 255, when the trim tank is empty.

In this case, the AFT APU pump is not running.

AFT APU PUMP FEED

The APU is fed from the trim pipe :
- The first two minutes when on the ground, or
- During trim tank refueling or,
- During an aft transfer.

The APU is fed from the trim tank :
- In flight above FL 255, as long as the trim tank is not empty, or
- During a forward transfer.

In the above cases, the :
- AFT APU pump is running.
- FWD APU pump is not running.
- APU ISOL valve is closed.

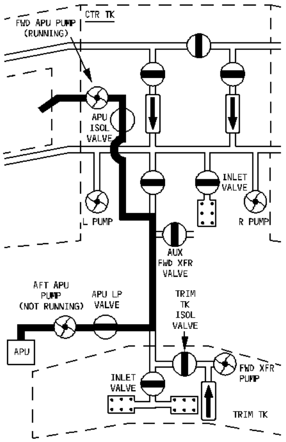
Note : The AFT APU pump will automatically start, in the event of FWD APU pump failure.

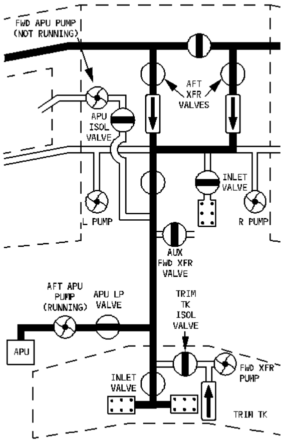
APU FEED

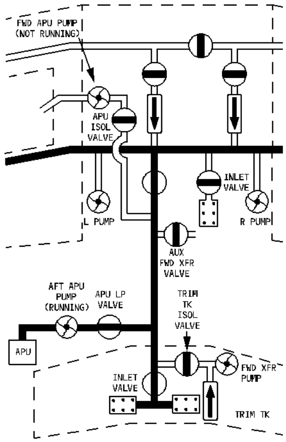
GFC5-01-2810-020-A200AA

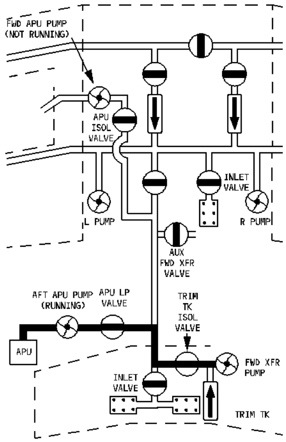
APU FEED FROM

LH INR TK	TRIM PIPE		TRIM TANK
.GROUND OPERATION .CLIMB TO FL 255 .DESCENT AND LANDING .IN FLIGHT ABOVE FL 255 WITH TRIM TK EMPTY	.ABOVE FL 255 AFT XFR	.REFUEL OF THE TRIM TANK	.ABOVE FL 255 NO XFR .FWD XFR



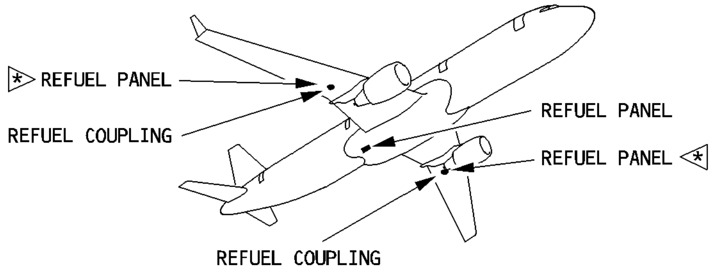






REFUELING – DEFUELING

Two refuel couplings are installed under the wings. These couplings allow refueling from both the right and left sides of the aircraft.
A refuel panel is located on the fuselage side, beneath the right wing.
A second and/or third panel ◁ is installed close to the refuel couplings.
A gallery connects the refueling coupling to the fuel inlet valve of each tank.



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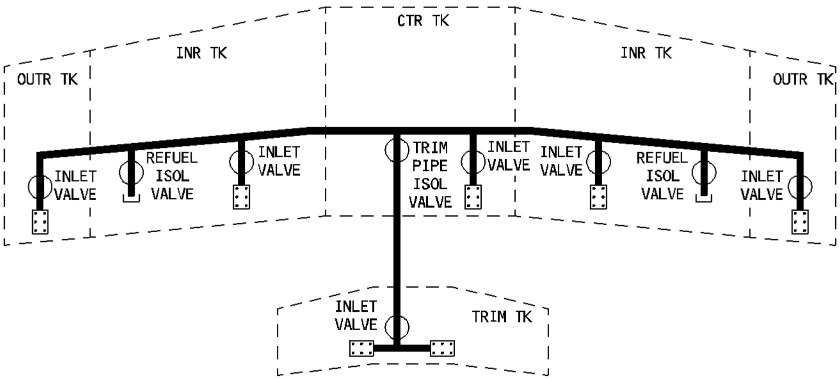
From the cockpit, refueling can be controlled with the refuel pushbutton. ◁ Although manual control is possible, it is normally automatic when the required fuel load is set on the preselector. In addition, it is possible to refuel by battery power only.
Any tanks that require refueling start to be refueled simultaneously. Refuel valves automatically close either when the required quantity is reached, or when high level is detected.
Wing tank gravity refueling is achieved via overwing refueling points. If the FCMC is powered, transfer is possible from any tank (with inner or center pumps) to outer, inner or center tanks. When both side couplings are used, refueling time at nominal pressure (50 psi) is approximately 33 minutes for all tanks.



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JETTISON

The Jettison system :
- Makes it possible to jettison fuel in flight.
- Output rate is approximately 1000 kg (2200 lbs) per minute, excluding fuel burn.
- Is manually activated by two JETTISON pushbuttons, located on the overhead panel. Both pushbuttons must be pressed to select the jettison.

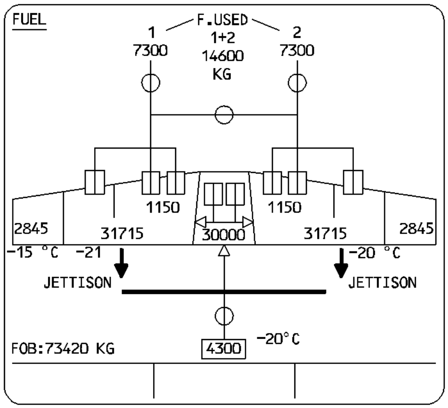
Fuel is simultaneously jettisoned from the inner and the center tanks. When the crew starts the jettison operation, all main and standby pumps run, and the crossfeed valve opens. An automatic forward transfer into the center tank is initiated, even if the slats are out, the landing gear is down, and whatever the altitude.

Note : *In case of trim tank pump failure, forward transfer is by gravity, as long as the pitch attitude is below 3°.*

The jettison operation continues, until one of the following occurs :
- The crew stops the operation.
- Both inner fuel tank low level sensors on one side become dry.
- The Fuel Control and Monitoring System (FCMS) stops the operation at a fuel content level preset on the FMGS MCDU.
- The combined inner tank fuel quantity is less than 10000 kg (22000 lbs).

Note : *The standby pumps continue to run, as long as both JETTISON pushbuttons are selected ON.*

ECAM INDICATION



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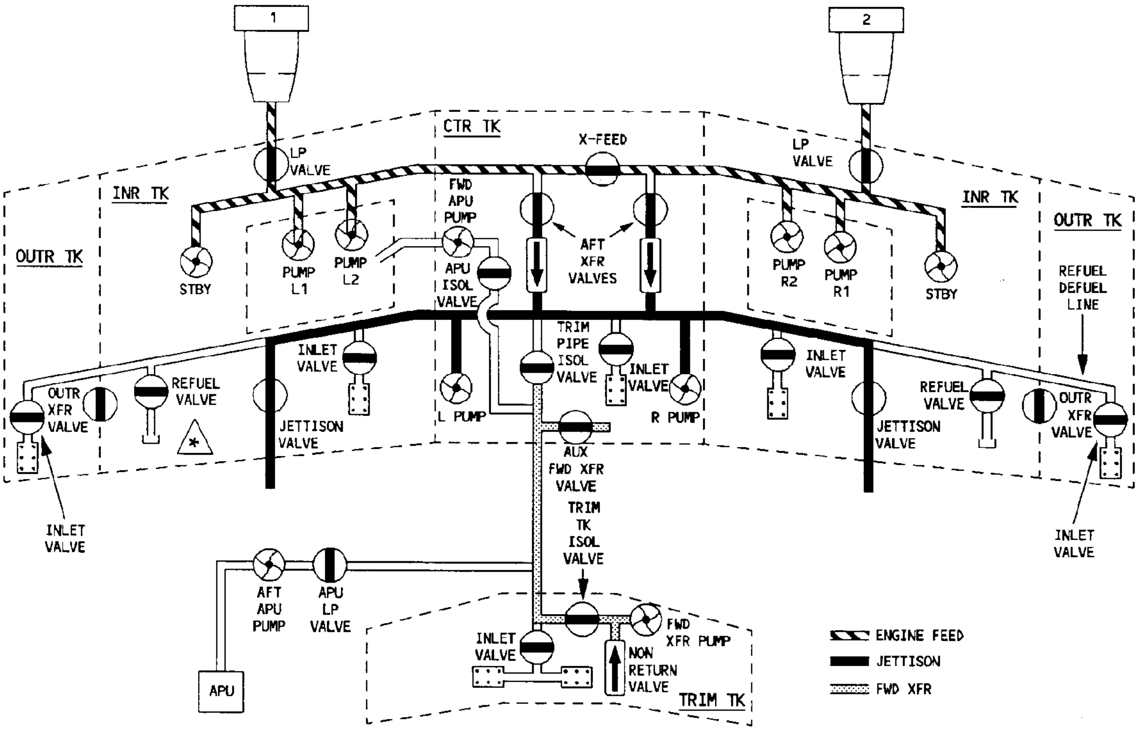
R

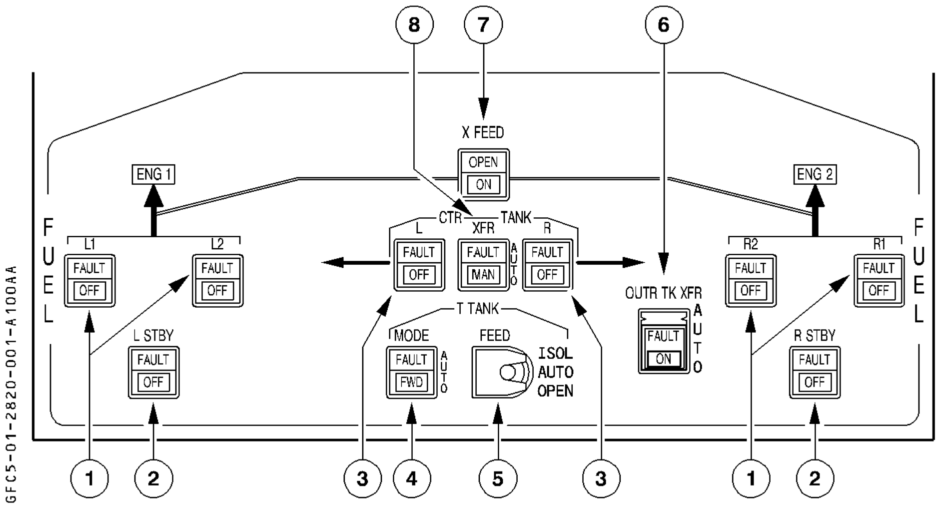
JETTISON

GFC5-01-2810-023-A100AA



FOR INFO

OVERHEAD PANEL



① L (or R) 1 (2) pb

On : Pump is on.
OFF : Pump is off.
FAULT lt : The amber light and the ECAM caution come on, when the delivery pressure drops. It is inhibited when off is selected.

② L (or R) STBY pb

On : Standby pump runs when associated main pump is failed or off.
OFF : Pump is off.
FAULT lt : The amber light and the ECAM caution come on, when the delivery pressure drops. It is inhibited when off is selected, or the main pump is running.

③ L (or R) CTR TANK pb

On : The center tank pump permanently runs. Appropriate valves control the transfer. The pump automatically stops when the tank is empty.
OFF : Pump is off.
FAULT lt : The amber light and the ECAM caution come on when :
- The delivery pressure drops.
- Or, the trim pipe isolation valve is failed open.
- Or, a manual transfer from the center tank is required (failure of automatic transfer) and both inner tank quantities are above 17000 kg (37520 lbs).
- Or, one outer or inner inlet valve is failed open and both inner tank quantities are above 17000 kg (37520 lbs).

Is inhibited when off is selected.

④ T. TANK MODE pb

AUTO : The FCMC controls the CG.
FWD : Initiates a manual forward transfer to the center tank, by opening :
- The trim tank isolation valve,
- The auxiliary forward transfer valve,

And by closing :
- The trim pipe isolation valve,
- The aft transfer valves.

And, by operating the trim tank forward transfer pump.
Center tank overflow must be manually prevented.
FAULT lt : The amber light and the ECAM caution come on when :
- The FMGS detects an excess aft CG, based on the THS position (independent of fuel quantity), or
- The FCMC is unable to carry out the forward transfer.
- The FUEL LO TEMP warning is triggered.

(5) T. TANK FEED selector

AUTO : Stops the forward transfer, when the trim tank is at low level, to maintain the transfer line full.
ISOL : The transfer line is isolated, as the following valves close :
- Trim tank isolation valve
- Trim tank inlet valve
- Auxiliary forward transfer valve
- Trim pipe isolation valve.

The trim tank forward transfer pump stops.
OPEN : The valves used during a manual forward transfer, and the trim tank inlet valve open. The valves remain open, until 3 minutes after the trim tank is low, to allow drainage of the transfer pipe.

Note : APU supply is not possible, when the pipe is drained.

(6) OUTR TANK XFR pushbutton (guarded)

Auto : The FCMC controls the outer to inner tank transfer.
ON : Initiates the outer to inner tank transfer by opening the :
- Outer transfer valves
- Outer inlet valves
- Inner inlet valves.

FAULT lt : The amber light, and ECAM caution come on, when :
R - The inner tank low level is reached and the outer tanks are not empty, or
- The FCMC is unable to carry out the transfer to the inner tanks.
- The FUEL LO TEMP warning is triggered.

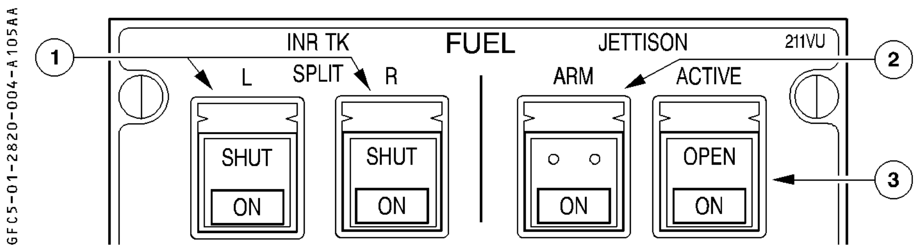
(7) X FEED pushbutton

AUTO : The valve automatically opens in electrical emergency configuration.
ON : The valve opens.
OPEN lt : The green light comes on, when the valve is fully open.

(8) CTR TANK XFR pushbutton

AUTO : The FCMC controls the center to inner tank transfer.
MAN : Initiates the center to inner tank transfer :
- By opening the inner tank inlet valves,

To avoid inner tank overflow, the center tank pumps may be selected off.
FAULT lt : The amber light, and ECAM caution come on, when :
- The inner tank low level is reached and the center tank is not empty, or
- The FCMC is unable to carry out the transfer to the inner tanks.



1 INR TK SPLIT L (or R) pushbutton (guarded)

Off : The split valve (inner tank division) is open.
The inner tank is used as a single tank.
ON : The valve closes and the inner tank is split into two parts.
R — The fuel may be used from either inner tank division.
The light comes on white.
SHUT : The light comes on blue, when the valve is shut.

2 JETTISON ARM pushbutton (guarded Off)

Off : Jettison is disarmed.
ON : Jettison is armed and can be activated via the ACTIVE pushbutton.

3 JETTISON ACTIVE pushbutton (guarded Off)

Off : Jettison is inactive.
ON : Jettison is activated, provided the ARM pushbutton is set to ON.
OPEN lt : Comes on when the jettison valves are open.

MAINTENANCE PANEL

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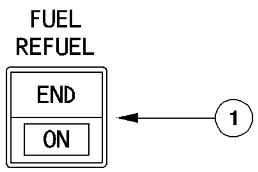
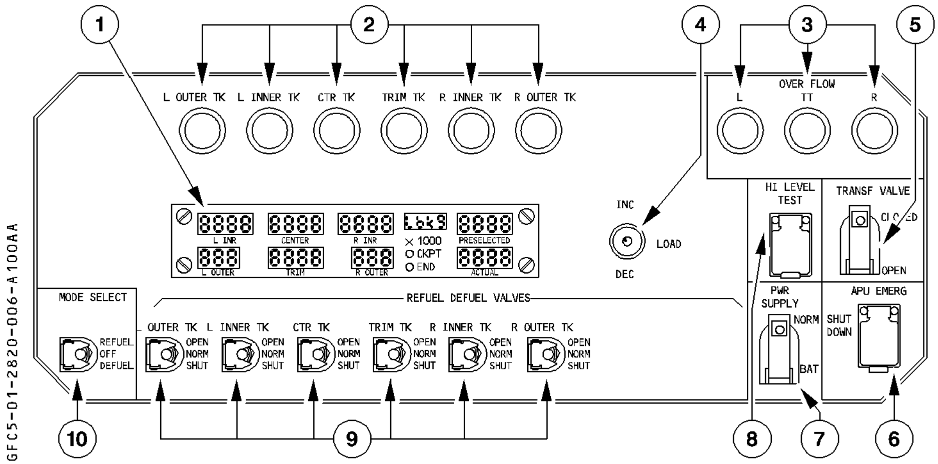


1 REFUEL pushbutton

ON : Refueling starts, depending on the BLOCK FUEL quantity displayed on the FMGS MCDU INIT B page.

END lt : Indicates that refueling is completed.
Flashes when refueling is aborted, when the high level test is negative, or when there is an imbalance of greater than 3000 kg (6620 lbs) after refueling.

REFUELING CONTROL PANEL



(1) FUEL QUANTITY indicator

Displays, in kg (or lbs) × 1000 :
- The fuel quantity of each tank.
- The pre-selected total quantity. At electrical power up (or FCMC reset), the display shows the ACTUAL value minus 500 kg (1100 lbs). Otherwise, the last pre-selected value is displayed.
- The actual total fuel on board.
- The applicable units (kg or lbs).
- The CKPT light : Comes on when a BLOCK FUEL value has been entered and confirmed on the cockpit MCDU.
- The END light, which flashes when :
  · There is an imbalance greater than 3000 kg (6620 lbs), after refueling.
  · A failure is detected during a high level test.
  · Refueling is aborted.

  Once refueling is finished, the END light stays on.

(2) HI LVL lt

- Comes on blue, when high level is detected (i.e. both high level sensors are wet).
- The corresponding refuel valve automatically closes.

③ OVERFLOW lt

— Comes on amber, when the associated vent tank overflow sensor is covered with fuel.

④ INC / DEC preselector rocker sw

— Pressing either side of the switch increases or decreases the preselected quantity.

⑤ TRANSF VALVE sw (guarded in CLOSED)

CLOSED : Transfer valves are closed.
OPEN : If the inner tank pumps are on for ground transfer, the aft transfer valves open. The trim tank inlet valve closes.

⑥ APU EMER pb (guarded)

When pressed, it initiates the APU shutdown sequence.

⑦ POWER SUPPLY sw (guarded in NORM)

NORM : Refueling / Defueling can be supplied either by external power or with the APU generator on line.
BAT : Refueling / Defueling is battery-powered.

⑧ HI LEVEL TEST sw (guarded)

During the test :
— Refueling stops.
— HI LEVEL and OVERFLOW lights come on, if their circuits are serviceable.
— CKPT and END lights come on.
— The PRESELECTED and ACTUAL fuel quantity display all 8s.
If a failure occurs during the high level test :
— The END light flashes and remains flashing after completion.
— The affected HI LVL light remains on.

⑨ REFUEL / DEFUEL VALVES sel (guarded in NORM)

NORM : Refuel / Defuel valves are automatically controlled.
OPEN : Valves open when the MODE SELECT switch is set to the REFUEL or DEFUEL position. In the REFUEL position, each refuel/defuel valve closes when high level is detected in the associated tank.
SHUT : Valves close.

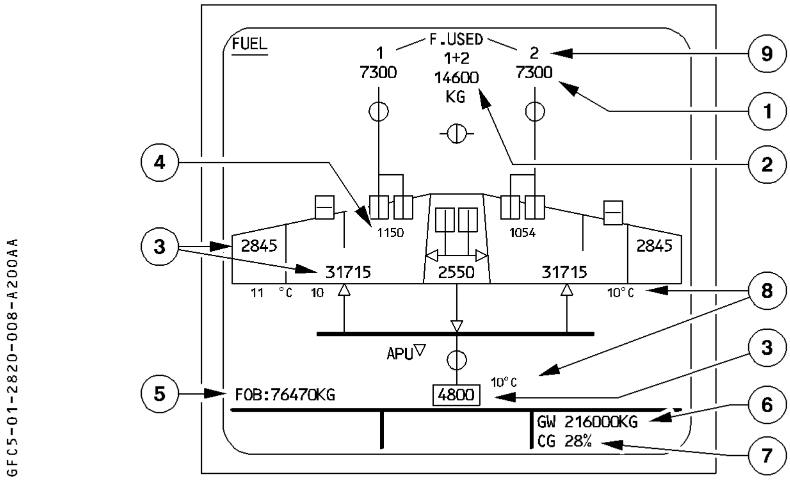
(10) MODE SELECT switch (guarded at OFF)

OFF : The refueling system is off, and the refuel valves close.
APU emergency shutdown and the high-level test remain available.
REFUEL : The refuel valves operate in automatic or manual mode, depending on the position of the REFUEL / DEFUEL VALVES switch.
DEFUEL : The refuel valves are open.

ECAM FUEL PAGE

FUEL QTY, TEMP, GW, AND CG INDICATIONS

R



(1) Fuel used indication (per engine)

- It is normally in green.
- If the fuel flow detection system fails, the FADEC computes a synthetic FU value.
- When this computed value is considered to be erroneous, by more than 136 kg (300 lbs), the displayed value is crossed out with two amber bars.
- Units may either be in KG or LB, depending on the DMC pin-program.

2 Total fuel used indication

- It is normally green.
- When either "engine fuel used" is crossed, two amber bars appear across the value.
- Units may either be in KG or LB, depending on the DMC pin program.

3 Fuel quantity indication

- It is normally green.
- When the fuel quantity indication is inaccurate, two amber bars appear across the last two digits.
- If the fuel is unusable (trim or outer tanks only), the quantity indication is displayed in an amber box.
- A partial amber box appears, if 15 tonnes of the center tank fuel is unusable.
- The fuel quantity indication becomes amber, in case of low level (inner tank only) or overflow.
- R In the event of imbalance of more than 3000 kg (6622 lbs) between the left wing tanks R and the right wing tanks, fuel quantity pulses in the inner and outer tanks.
- Units may either be in KG or LB, depending on the DMC pin program.

4 Collector cell fuel quantity indication

- It is normally green.
- When the fuel quantity indication is inaccurate, two amber bars appear across the last two digits.
- Units may either be in KG or LB, depending on the DMC pin program.

5 Fuel on board quantity indication

- It is normally green.
- In case of degraded accuracy, the last two digits are dashed.

Note : In case any tank's fuel is partially unusable, the quantity indication is displayed in a partial amber box.

6 Gross weight indication

- It is normally green.
- When the fuel quantity indication is inaccurate, two amber bars appear across the last two digits.
- When the gross weight is not computed on ground, blue dashes appear.
- Units may either be in KG or LB, depending on the DMC pin program.

7 Center of gravity indication

- It is normally green.
- When the FMGC (FE part) detects an excess aft CG, it comes on red.
- When the CG is not computed on ground, blue dashes appear.

8 Fuel temperature indication

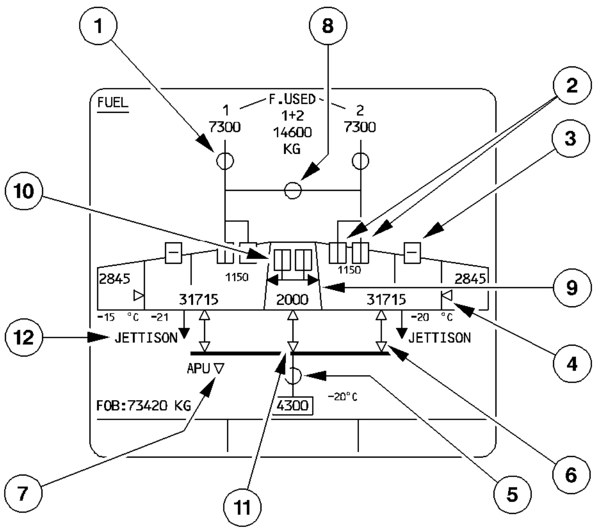
- It is normally green.
- It is amber, in the following cases :
  · Inner tanks : Above 49°C in flight, or 45°C on ground.
  · Outer or trim tanks : Below – 40°C.
  · Inner tanks : Below – 35°C.
- It disappears, when the tank quantity is below :
  · 1000 kg (2200 lbs) for the trim tank.
  · 1100 kg (2420 lbs) for the outer tank.

Note : Fuel temperature is not indicated for the right outer tank.

9 Engine number

- It is white, when the engine is running.
- It is amber, when the engine is not running.

FUEL FEED, TRANSFER AND JETTISON INDICATIONS



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1 Engine LP valves indication

In line – Green : Valve is open.
In line – Amber : Valve is jammed open.
Cross line – Amber : Valve is closed.
Transit – Amber : Valve is in transit.

2 Engine feed pumps indication

In line – Green : Pump is running.
In line – Amber : Pump abnormally running.
Cross line – Amber : Pump not running.
"LO" – Amber : Pump pressure is low. Pump is on.

3 Stand-by engine feed pumps indication

Are identical to the normal pump, except for pump not running.
Cross line – Green : Pump not running.
Cross line – Amber : Pump abnormally not running.

4 Outer to inner transfer indication

▷ Green : Normal transfer (auto).
▶ Green : Manual transfer.
▶ Amber : Abnormal transfer.
No display : No transfer.

5 Trim tank isolation indication

This valve represents the trim tank isolation valve and the trim tank inlet valve.
In line – Green : One valve is open.
Cross line – Green : Both valves are closed.
In line – Amber : One valve is abnormally open.
Cross line – Amber : Both valves are jammed closed.

(6) Trim to inner transfer indication

No display : No transfer.
Green : Normal aft (↓) or forward (↑) transfer.
Amber : Abnormal aft (↓) or forward (↑) transfer.
If fuel transfers to/from only one inner tank due to a fuel imbalance, (inner tanks are imbalanced by more than 500 kg/1100 Lbs) only one arrow is displayed in green.

(7) APU LP valve indication

APU (White) ▽ (White) : Valve is closed.
APU (White) ▽ (Green) : Fuel provided to the APU.
APU (Amber) ▼ (Amber) : Failed open.
APU (amber) : Failed closed.

(8) X-Feed valve

Cross line – Green : Valve is closed.
In line – Green : Valve is open.
Cross line – Amber : Valve is jammed closed.
In line – Amber : Valve is jammed open.
Transit – Amber : Valve is in transit.

9 Center to inner transfer indication

Identical to the transfer from outer tanks.

10 Center tank pumps indication

Identical to the standby wing tank pumps.

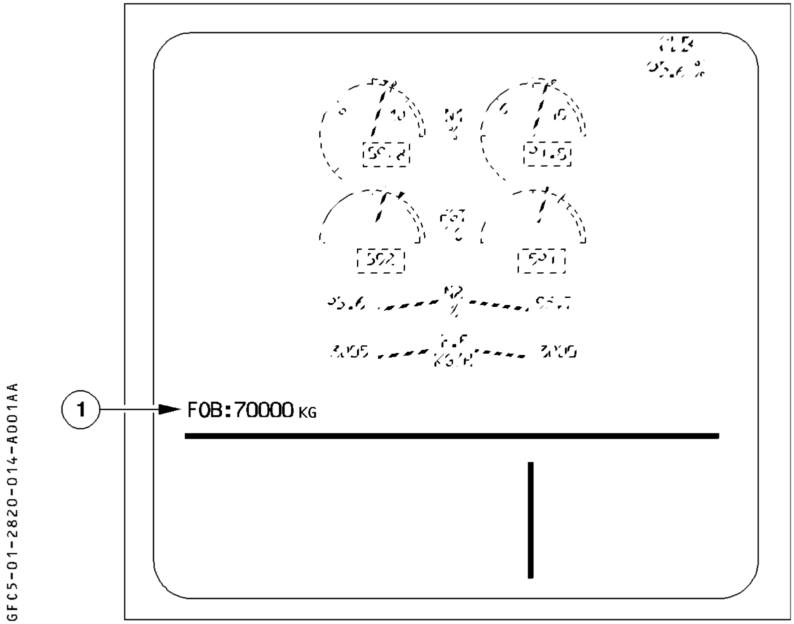
11 Trim to center transfer indication

No display	:	No transfer.
Green	:	Manual forward (↑) transfer.
Green	:	Normal aft (↓) or forward (↑) transfer (auto).
Amber	:	Abnormal aft (↓) or forward (↑) transfer.

12 Jettison indication

No display	:	No jettison.
↓ JETTISON (Green)	:	Jettison normally active.
↓ JETTISON (Amber)	:	Abnormal jettison (valve jammed open).
JETTISON (Amber)	:	Valve failed closed.

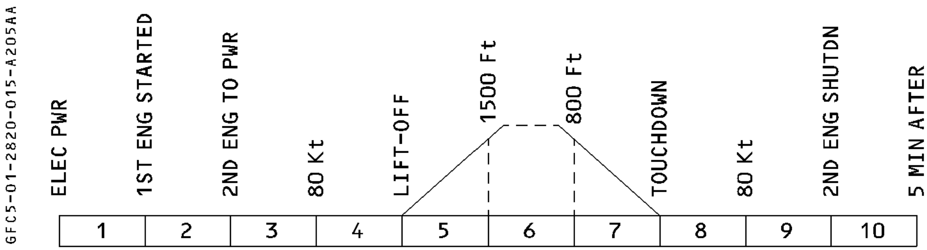
ECAM UPPER DISPLAY



① FOB - Fuel on Board indication

- It is normally green.
- An amber half box appears around FOB, when the indicated quantity is not fully usable.
- When the fuel quantity indication is inaccurate, two amber lines appear across the last two digits.
- Units may be indicated in kg or lbs.

WARNINGS AND CAUTIONS



R

E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
EXCESS AFT CG	CRC	MASTER WARN	FUEL	T TK XFR FAULT lt	2 to 4, 8 to 10
L(R) WING PUMPS LO PR All pumps of the same wing low pressure.	SINGLE CHIME	MASTER CAUT		associated PUMP FAULT lts	1, 3, 4 5, 7, 8, 10
L + R CTR PUMPS LO PR					4, 5, 7, 8
ENG 1(2) LP VALVE FAULT Valve disagree.				NIL	4, 5, 7, 8
ZFW ZFCG DISAGREE Disagree between the pilot-entered values and the FCMC values.					3 to 8
L(R) WING TK LO LVL Both level sensors of one inner tank have been dry for more than 60 seconds. Depending on the pitch attitude, the caution may be triggered between 1640 kg/3616 Lbs, and 2700 kg/5960 Lbs of fuel in either inner tank.					3, 4, 5, 7, 8, 9
L + R WING TK LO LVL All of the four level sensors in the inner tanks have been dry for more than 60 seconds.					3, 4, 5, 8
WING TK OVERFLOW One of the wing surge-tank overflow sensors has been wet for more than 25 seconds.				CTR XFR + PUMP FAULT lt	3, 4, 5, 7, 8
CTR TO INNER FAULT In case an anomaly is detected during CTR to INR XFR or an inlet valve of INR, OUTR tank is failed open.					4, 5, 7, 8
OUTR TO INR FAULT				OUTR TK XFR lt	3, 4, 5 7, 8
T TANK XFR FAULT				TRIM TK FAULT lt	
APU LP VALVE FAULT Valve disagree.				NIL	
FCMC 1 + 2 FAULT Loss of automatic control of XFR.					4, 5, 8
TRIM LINE FAULT Trim tank isolation failure.					
JETTISON NOT CLOSED Valve disagree in open position.					
JETTISON FAULT One wing tank low level sensor is failed.	NIL	NIL			3 to 5 7 to 9

<table>
<tr><th>E / WD: FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNINGS</th><th>FLT PHASE INHIB</th></tr>
<tr><td>FUEL LO TEMP
Inner fuel temp < –35°C
Outer fuel temp < –40°C
Trim fuel temp < –40°C</td><td rowspan="2">SINGLE CHIME</td><td rowspan="2">MASTER CAUT</td><td rowspan="9">FUEL</td><td>OUTR and TRIM TK FAULT lt</td><td rowspan="7">3, 4, 5, 7, 8</td></tr>
<tr><td>L(R) INR TK HI TEMP
Inner fuel temp > 49°C in flight
Inner fuel temp > 45°C on ground</td><td>NIL</td></tr>
<tr><td>L(R) PUMP 1(2) LO PR
L(R) STBY PUMP LO PR</td><td rowspan="5">NIL</td><td rowspan="5">NIL</td><td rowspan="2">associated PUMP FAULT lt</td></tr>
<tr><td>L(R) CTR PUMP LO PR</td></tr>
<tr><td>APU AFT PUMP FAULT</td><td rowspan="8">NIL</td></tr>
<tr><td>Wing XFEED FAULT
Valve disagree</td></tr>
<tr><td>FCMC 1(2) FAULT</td></tr>
<tr><td>ABNORM MAN FWD XFR
Trim TK pump failed and pitch attitude above 3.4° for more than 30 seconds
and
T TANK MODE pb sw selected FWD or
TRIM TANK FEED sel selected OPEN</td><td rowspan="5">SINGLE CHIME</td><td rowspan="5">MASTER CAUT</td><td>1, 2, 3, 9, 10</td></tr>
<tr><td>MAN XFR COMPLETED
manual XFR selected ON and center or outer tank emptied</td><td>1, 10</td></tr>
<tr><td>TRIM TK PUMP LO PR</td><td rowspan="2">NIL</td><td>3, 4, 5, 7, 8</td></tr>
<tr><td>NO WEIGHT/CG DATA
no data inserted on INIT B page at engine start</td><td>1, 3, 4, 5, 7, 8, 10</td></tr>
<tr><td>FUEL FU/FOB DISCREPANCY
Difference between initial FOB and current FOB plus fuel used data is more than 3500 kg.</td><td>FUEL</td><td>1 to 5
7 to 10</td></tr>
</table>

MEMO DISPLAY

- REFUEL IN PROCESS message is displayed in green, in phases 1 and 10, if the refuel panel is not set in the flight position.
- REFUEL PNL message is displayed in amber, in phase 2 (after engine start), if the refuel panel and the cockpit refuel pushbutton are not set in the appropriate position for flight.
- T TK XFRD message is displayed in flight phase 6, 7, 8 and 9, when the trim tank has been emptied following a forward transfer.
- TRIM TK XFR message is displayed in green, during a trim tank transfer.
- OUTR TK XFRD message is displayed in green, when the outer tank has been transferred into the inner tank.
- OUTR TK XFR message is displayed in green during an outer tank transfer.
- FUEL X FEED message is displayed in green, when the crossfeed valve is open (automatically or manually). It becomes amber during takeoff (phases 3, 4 and 5).
- JETTISON message is displayed, when one jettison valve is open.

BUS EQUIPMENT LIST

R

			NORM			EMER ELEC		
			AC	DC	DC BAT	AC ESS	DC ESS	HOT
FCMC	1	Main					SHED	
FCMC	1	Level Sensing					SHED	
FCMC	2	Main		DC2				X (1)
FCMC	2	Level Sensing					SHED	
INNER TANK PUMPS	L1		AC2	DC2				
INNER TANK PUMPS	L2					X (3)	X	
INNER TANK PUMPS	R1		AC2	DC2				
INNER TANK PUMPS	R2			DC1 (2)		X (3)	X (2)	
INNER TANK PUMPS	L STBY		AC1	DC1				
INNER TANK PUMPS	R STBY		AC1	DC1				
CTR TK TRANSFER PUMPS	1		AC1	DC1				
CTR TK TRANSFER PUMPS	2		AC2	DC2				
TRIM TK FWD XFR PUMP			AC2	DC2				
CROSS FEED VALVE	X-FEED MOTOR 1						X	
CROSS FEED VALVE	MOTOR 2			DC2				
ENGINE LP VALVES	MOTOR 1							X
ENGINE LP VALVES	MOTOR 2			DC2				
AFT XFR VALVES	LH			DC1				
AFT XFR VALVES	RH			DC2				
TRIM TK ISOL VALVE							X	
TRIM PIPE ISOL VALVE							X	X (1)
AUX FWD XFR VALVE							X	
XFR VALVES							X	
TANK INLET VALVES							X	X (1)
REFUEL VALVE(S)					X			X (1)
CENTER TANK INLET VALVE								X
APU	FWD PUMP		AC1					
APU	AFT PUMP					X (3)		X (1)
APU	ISOL VALVE							X
APU	LP VALVE				X			X

(1) HOT BUS supply during refueling on batteries
(2) Normal supply is from DC1. In emergency configuration, if the normal PUMP L2 is failed or switched OFF, then the control of the normal PUMP R2 is automatically switched to the DC ESS BUS.
(3) This supply is lost in emergency configuration
- on batteries
- if EMER GEN is powered by the RAT when LAND RECOVERY is selected or when the speed is below 260 knots (whichever occurs first)
- if EMER GEN is powered by an engine driven pump, when LAND RECOVERY is selected.

29.00 CONTENTS

GENERAL

The aircraft has three, independent, continuously-operating systems : GREEN, BLUE, and YELLOW. Each system is supplied from its own hydraulic reservoir. Normal system operating pressure is 3000 psi (2500 psi for RAT). There is no possibility to transfer hydraulic fluid from one system to another.
The system is monitored by a Hydraulic System Monitoring Unit (HSMU).

GENERATION

GREEN SYSTEM PUMPS

Two pumps, respectively driven by each engine, pressurize the green system.
In addition, an electric pump which can be manually or automatically controlled can also pressurize the green system.
If one engine fails, the electric pump runs automatically in flight, for 25 seconds, when the landing gear lever is selected up (to ensure gear retraction in a proper time).
A pump, driven by a Ram Air Turbine (RAT), pressurizes the green system in the event of an emergency.
When the RAT pressurizes the green system, the aileron, elevator, and spoiler servo control operating speeds are reduced.

BLUE SYSTEM PUMPS

A pump, driven by Engine 1, pressurizes the blue system.
A manually-controlled electric pump can also pressurize the system.
In the event of an Engine 1 failure, in addition to a PRIM 1 or PRIM 3 loss : The BLUE ELEC PUMP runs automatically in flight to ensure sufficient authority on the electrical rudder, thereby counteracting the yaw sideslip induced by asymetrical thrust.

YELLOW SYSTEM PUMPS

A pump, driven by Engine 2, pressurizes the yellow system.
In addition, an electric pump which can be manually or automatically controlled can also pressurize the yellow system. This enables ground operations, when the engines are stopped.
The electric pump runs automatically :
- In flight, in the event of an Engine 2 failure, if the FLAPS lever is not at 0 (to ensure flap retraction in a proper time at takeoff).

  Note : *In the event of an Engine 2 failure at takeoff, the yellow electric pump is automatically controlled on, if the green electric pump is not running for landing gear retraction.*

- On ground, during cargo door operation.

Crew members can also use a hand pump to pressurize the yellow system in order to operate the cargo doors when no electrical power is available.

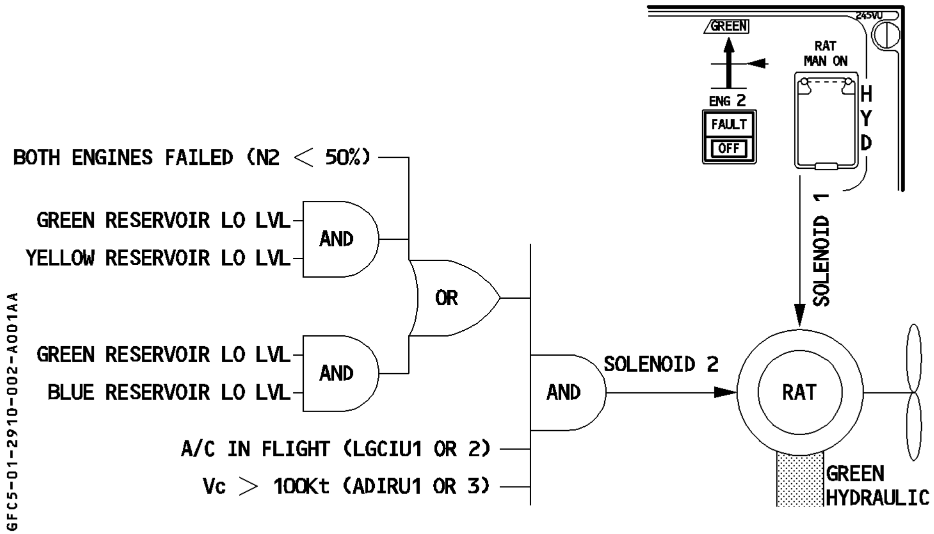
Note : On each system, the electric pump flow is about 18 % of the engine driven pump flow capacity.
They can be used to retract the surfaces but should not be used to replace the engine driven pumps.

RAM AIR TURBINE (RAT)

R A drop-out RAT coupled to a hydraulic pump allows the green system to function.
R The RAT may be extended at any time by pressing the RAT MAN ON pushbutton.
R The RAT deploys automatically in the event of both engine failure or a low level in the green and yellow or green and blue reservoirs.
It can be deployed manually from the overhead panel. It can be stowed only when the aircraft is on the gorund.

FOR INFO

R



Note : The RAT flow varies between 15 % and 45 % of an engine driven pump flow
R *capability according to the aircraft speed.*

SYSTEM ACCUMULATORS

An accumulator in each system helps to maintain a constant pressure by covering transient demands during normal operations.

FIRE SHUTOFF VALVES

A fire shut-off valve is positioned upstream of each engine-driven pump. It is closed by using the FIRE pushbutton.
Both engine green hydraulic fire shut-off valves are automatically closed by the HSMU, in the event of a green reservoir low level. If the blue and yellow reservoir levels are normal, 150 seconds after the initial closure of the fire shut-off valves, the green engine-driven pumps are automatically depressurized and the fire shut-off valves are reopened to lubricate and avoid damage to the engine-driven pumps. In case of a further blue or yellow reservoir low level, the green fire shut-off valves remain closed enabling the green system to be restored by using the RAT. The flight crew cannot re-open the fire shut-off valves in flight, once they have been automatically closed.

FILTERS

FOR INFO

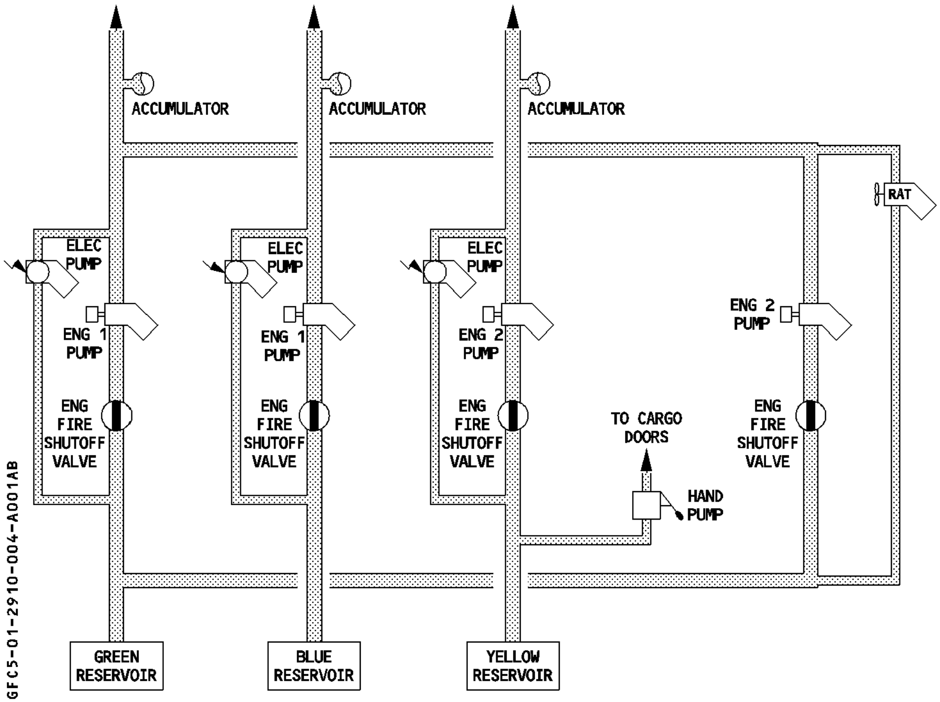
The hydraulic fluid is maintained clean by the following filters:
- *Two HP filters on the green system*
- *One HP filter on the blue system and one on the yellow system*
- *One on the reservoir filling system*
- *One on the braking system*
- *One return line filter on each system (LP filters)*
- *One case drain filter on the engine pump permits the monitoring of wear by detecting metallic particles in the filters.*

HYDRAULIC SYSTEM MONITORING UNIT (HSMU)

The HSMU monitors the hydraulic system.
It processes:
- Control of the electric pumps
- RAT extension
- Closure of both engine green hydraulic fire shut-off valves, in case of a green reservoir low level
- Hydraulic quantity indication correction for fluid temperature
- Tank overheat warning
- FAULT light illumination logic
- LEAK MEASUREMENT VALVE control (closure inhibited in flight, closure of yellow valve during cargo door operation).

HYDRAULIC GENERATION

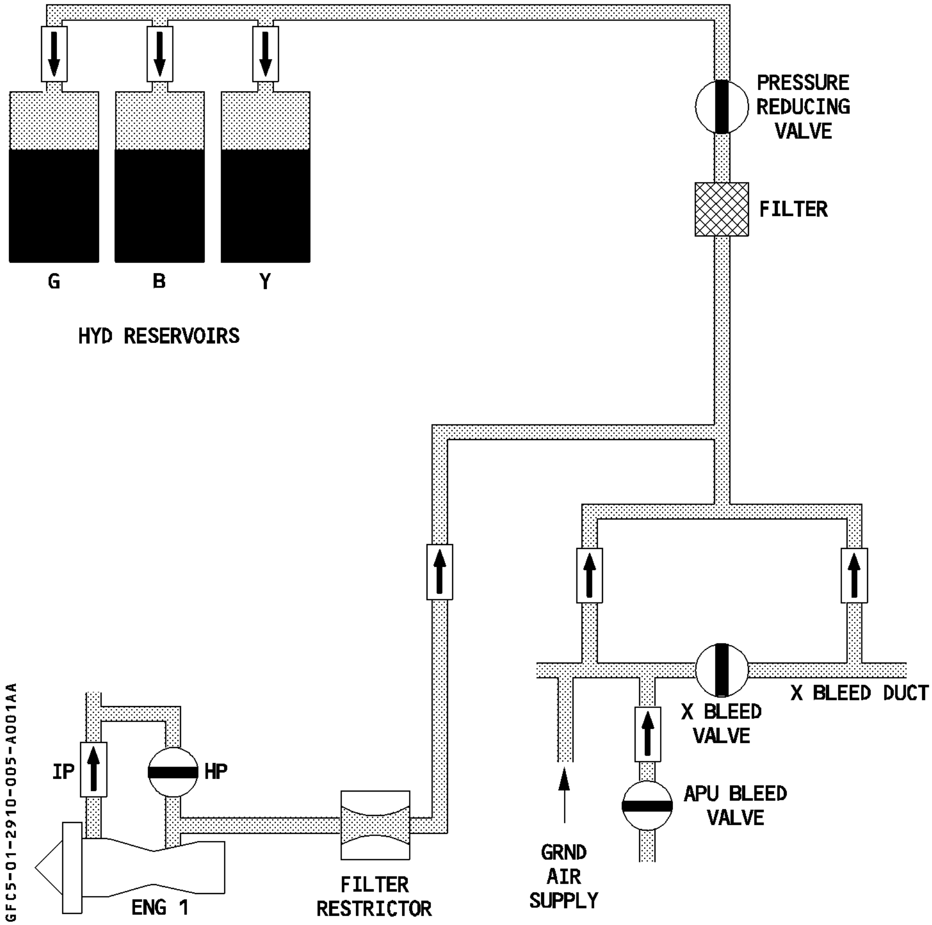
R



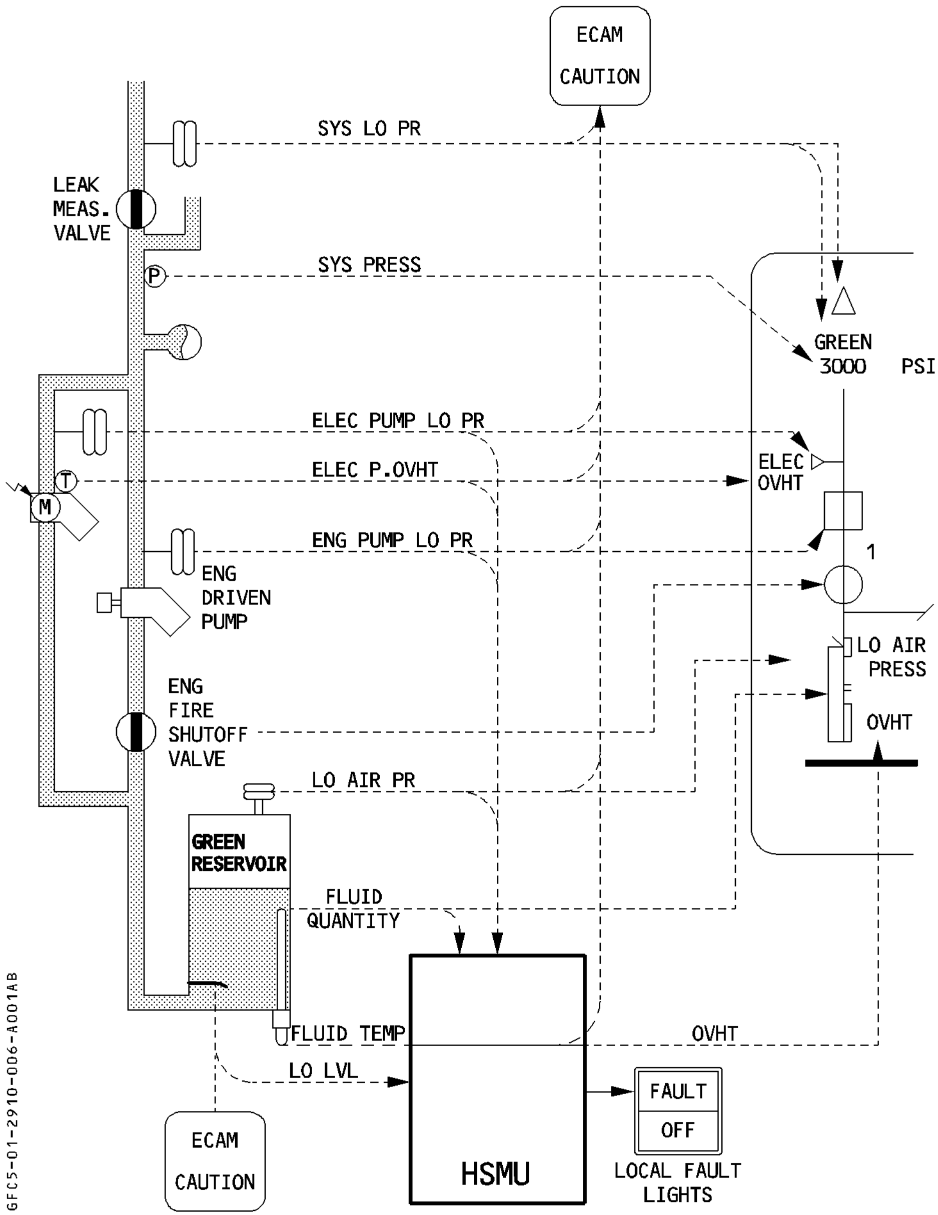
R **RESERVOIR PRESSURIZATION**

R Normally, HP bleed air from engine 1 pressurizes the hydraulic reservoirs automatically. If the bleed air pressure is too low, the system takes bleed air pressure from the crossbleed duct.
The system maintains a high through pressure to prevent their pumps from cavitating.

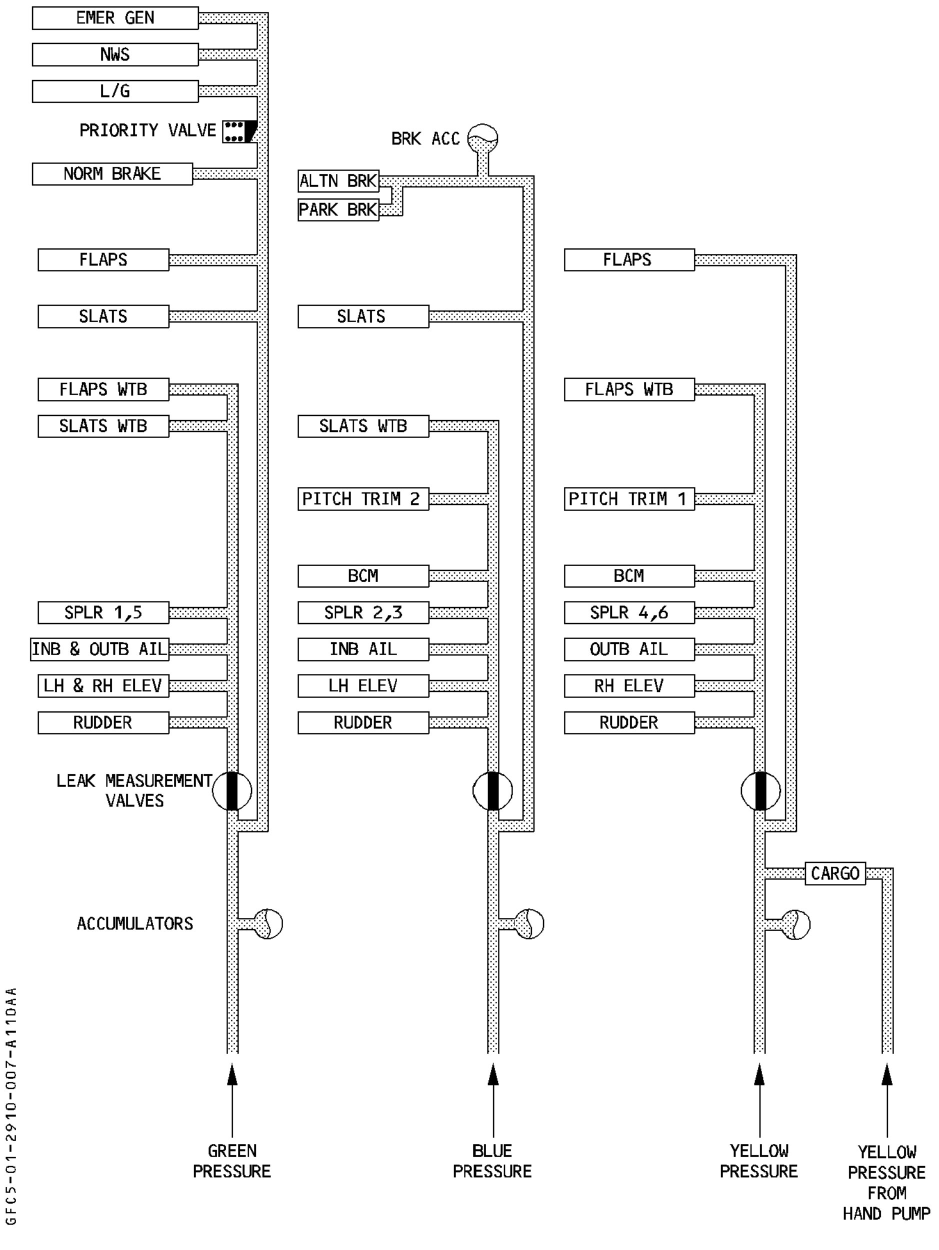
FOR INFO



R **INDICATIONS**



DISTRIBUTION



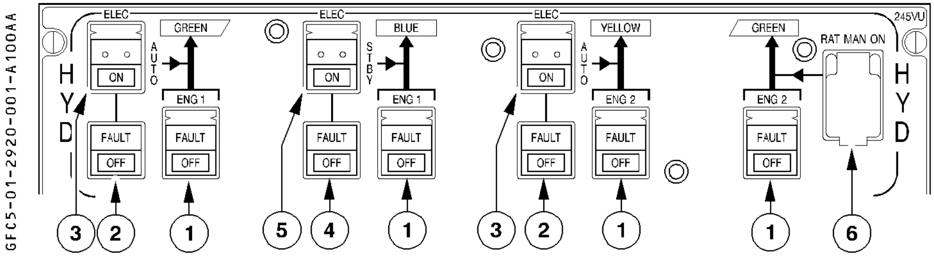
LEAK MEASUREMENT VALVES

Used only on ground.
Leak measurement valves are positioned upstream of the primary flight controls. They are used for the leak measurement of each system and may only be closed on ground, by using LEAK MEASUREMENT VALVES pushbutton on the maintenance panel. The yellow valve is automatically closed during cargo door operation.
R The HSMU inhibits the closure of the green, blue and yellow hydraulic leak measurement
R valves in flight.

PRIORITY FUNCTION

In the event of low hydraulic pressure, a priority valve cuts off hydraulic power to heavy load users (emergency generator, nosewheel steering, landing gear) in order to keep the pressure for normal braking and flight controls.
R A Pressure-Off Brake system (installed on the flaps, slats and THS actuator) ensures the same function.

OVERHEAD PANEL



R ① ENG 1 (or 2) PUMP pb sw (guarded)

On : The pump pressurizes the system when the engine is running.
OFF : The pump is depressurized. Power generation stops.
FAULT lt : Illuminates amber associated with ECAM caution in the event of :
— Reservoir low level
— Reservoir overheat
— Reservoir low air press
— Pump low press (inhibited on ground when engine stopped).
Extinguishes when OFF selected except during an overheat. (In this case, the light remains on as long as overheat is present).

(2) GREEN (or YELLOW) ELEC PUMP pushbutton

AUTO : The HSMU automatically controls the pump :
- The green electric pump runs :
  · For 25 seconds, in the event of a one-engine failure, when the landing selector lever is selected up and the aircraft speed is above 100 knots.
- The yellow electric pump runs :
  · In the event of Engine 2 failure, if the FLAPS lever is not at zero and the aircraft speed is above 100 knots, provided the green electric pump is not running for landing gear retraction. It remains running until the last engine shutdown.
  · On the ground, when the cargo door manual selector valve lever is set to the OPEN or CLOSE position. In this case, the yellow leak measurement valve closes and yellow flap motor operation is inhibited.

OFF : The pump is off.

FAULT lt : This amber light, and an associated ECAM caution come on, if :
- The reservoir level is low, or
- The reservoir overheats, or
- The air pressure in the reservoir is low, or
- The pump delivers low pressure (inhibited when the pump is not controlled on), or
- The pump overheats.

The light goes off when the crew selects OFF, except during an overheat.
R In case of a reservoir overheat, the fault light stays on, until the overheat
R stops. In case of an electrical pump overheat, the light stays on, even if the
R overheat has stopped, and until the system is reset on ground.

Note : If the yellow/green electric pump overheats, the pump automatically shuts down.

(3) GREEN (or YELLOW) ELEC PUMP ON pushbutton (springloaded-guarded)

AUTO : The electric pump is controlled by the applicable ELEC PUMP's pushbutton.

ON : The electric pump is on, provided the ELEC PUMP's pushbutton is not selected OFF.
After an electrical power interruption, the pump does not restart (ON light stays off).
The ON light comes on blue, when the pump is manually or automatically supplied.

④ BLUE ELEC PUMP pushbutton

Standby : The HSMU automatically controls the electric pump, in the event of an engine 1 failure in addition to a PRIM 1 or 3 loss.
OFF : The pump is off.
FAULT lt : The amber fault light comes on (provided the blue electrical pump is running), along with an associated ECAM caution, if :
- The reservoir level is low, or
- Air pressure in the reservoir or pump pressure is low, or
- The reservoir or the pump overheat.

The light goes off when the crew selects OFF, except during an overheat. In case of a reservoir overheat, the fault light stays on, until the overheat stops. In case of an electrical pump overheat, the light stays on, even if the overheat has stopped, and until the system is reset on ground.

Note : If the blue electric pump overheats, the pump automatically shuts down.

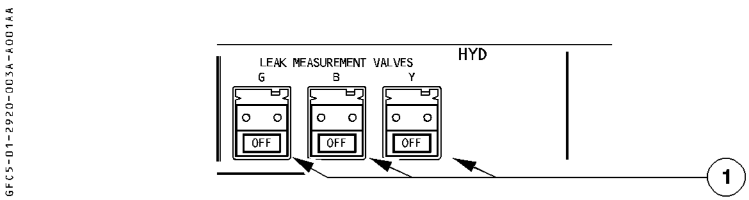
⑤ BLUE ELEC PUMP ON pushbutton (springloaded-guarded)

ON : The pump is energized, provided the BLUE ELEC PUMP pushbutton is not selected OFF. After an electrical power interruption, the pump will not restart (ON light remains off).
STBY : The electric pump is controlled by the applicable ELEC PUMP's pushbutton.

⑥ RAT MAN ON pushbutton

The RAT may be extended at any time by pressing the RAT MAN ON pushbutton.

Note : The RAT automatically extends in flight, if :
- Both engines fail, or GREEN + BLUE LO LVL, or GREEN + YELLOW LO LVL.

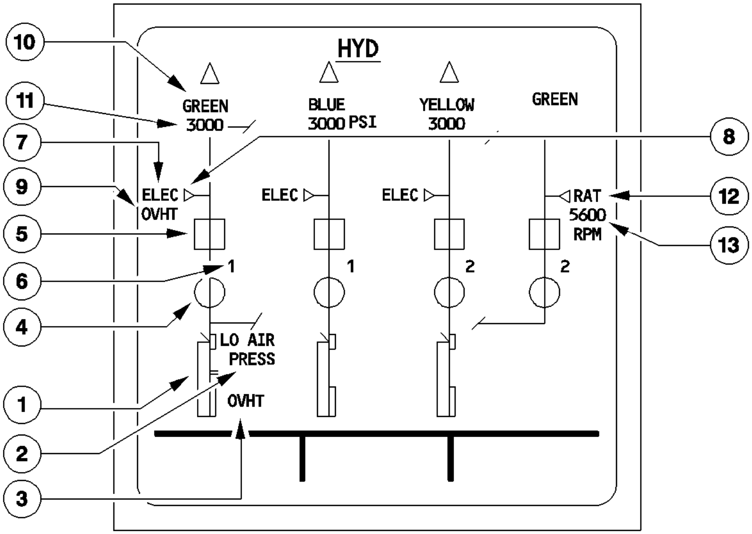


(1) LEAK MEASUREMENT VALVES pushbutton (to be used on ground only)

OFF : The corresponding electrohydraulic valve closes and shuts off hydraulic supply to the primary flight controls. This function and the OFF light are inhibited when the aircraft speed is greater than 100 knots.

Note : On ground, the yellow valve is automatically closed when the cargo door is activated (to avoid inadvertent movement of flight control surfaces).
The OFF light comes on.

ECAM HYD PAGE



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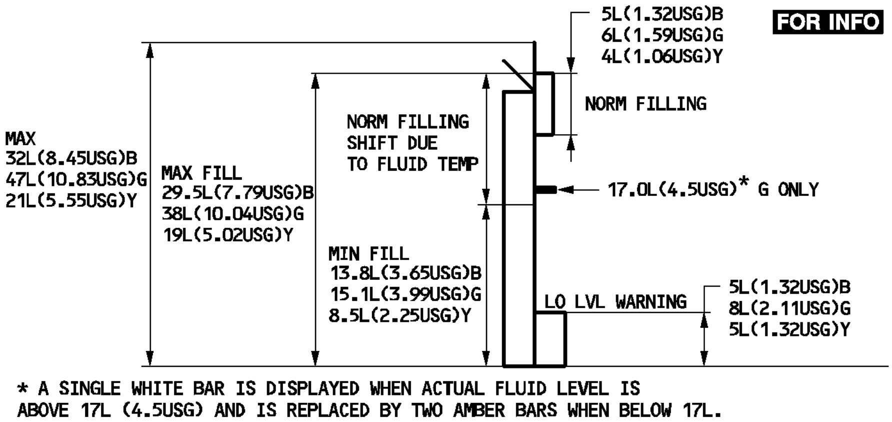
(1) Reservoir quantity

This indication is in green, unless the fluid level goes below the warning level, in which case it becomes amber.



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R *Note : The normal filling range indication is corrected for fluid temperature effect. It is normally green. When the temperature information is not available, it is no longer corrected and the indication becomes white.*

(2) Reservoir LO AIR PRESS indication

It is amber and an associated caution appears on the ECAM, if the air pressure for the indicated reservoir drops below normal.

(3) Reservoir OVHT indication

It is amber, and an associated caution appears on the ECAM, if the temperature of the returning hydraulic fluid, at the inlet to its reservoir, is above normal.

(4) FIRE SHUT OFF VALVE indication

Crossline – Amber : The valve is fully closed.
In line : – Green : The valve is partially closed.

(5) ENG PUMPS control and low pressure indication

In line – Green : The designated PUMP's pushbutton is on, and the hydraulic pressure is normal.
Crossline – Amber : The designated PUMP's pushbutton is off.
LO – Amber : The designated PUMP's pushbutton is on, and the hydraulic pressure is low.

(6) PUMP identification

It is normally white. It becomes amber when the N2 of the corresponding engine is below idle.

(7) ELEC indication

It is normally white. It becomes amber if the associated power supply fails, or if the pump is commanded on, and does not provide normal pressure.

(8) ELEC PUMP control

▷ White : – The electric pump is not commanded.
▷ Amber : – The electric pump is switched off.
▶– Green : – The electric pump is on.
▶– Amber : – The electric pump is on and the system has low pressure.

(9) Electric pumps OVHT indication

R It is amber, in case of an electric pump overheat. This indication remains displayed
R on the ECAM, even if the overheat has stopped, and until the system is reset on
R ground.

(10) System label (SYS LO PR sw)

R

	PRESS > 1750 psi (press increasing)	PRESS < 1450 PSI (press decreasing)
GREEN	white	amber
△	green	amber

(11) System pressure

R This legend, normally green, becomes amber when system pressure is below 1450 PSI

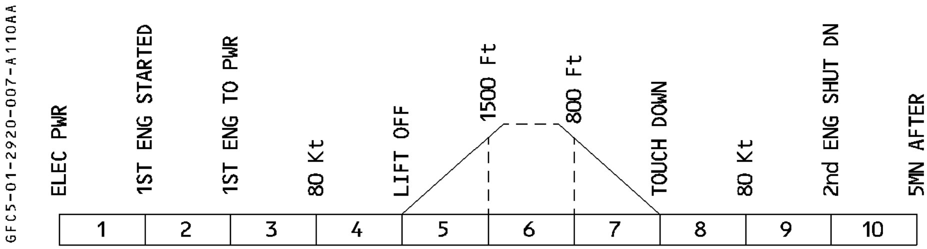
(12) RAT control

◁	RAT	MEANING
White	white	RAT stowed
Full green	white	RAT not stowed and RPM > 3000
White	amber	RAT fully stowed and stowing pressure applied
Full amber	amber	RAT not stowed and RPM < 3000

(13) RPM indication

R This appears green when the rotation speed of the RAT is above 100 RPM

WARNINGS AND CAUTIONS



R

<table>
<tr><th>E / WD: FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNINGS</th><th>FLT PHASE INHIB</th></tr>
<tr><td>B + Y SYS LO PR or
B + G SYS LO PR or
Y + G SYS LO PR
system pressure ≤ 1450 psi
reset if pressure ≥ 1750 psi</td><td>CRC</td><td>MASTER WARN</td><td rowspan="8">HYD</td><td rowspan="7">FAULT lt on associated pump(s) pb</td><td>4, 5</td></tr>
<tr><td>G (Y)(B) RSVR LO AIR PR
reservoir air pressure ≤ 22 psi
reset if air pressure ≥ 25 psi</td><td rowspan="6">SINGLE CHIME</td><td rowspan="6">MASTER CAUT</td><td rowspan="2">3, 4, 5, 7, 8</td></tr>
<tr><td>G (Y)(B) RSVR OVHT
fluid temperature ≥ 95°C</td></tr>
<tr><td>G (Y)(B) RSVR LO LVL
fluid quantity :
< 8L (2.11 USG)(Green)
< 5L (1.32 USG)(Blue–Yellow)</td><td>4, 5
7, 8</td></tr>
<tr><td>G ENG 1(2) PUMP LO PR or
G ENG 1 + 2 PUMP LO PR or
B ENG 1 PUMP LO PR or
Y ENG 2 PUMP LO PR or
Engine pump pressure ≤ 1450 PSI</td><td>3*, 4, 5, 7, 8
* only for G ENG 1 (2)</td></tr>
<tr><td>G (Y)(B) ELEC PUMP FAULT
Elec pump LO PR or ovht</td><td rowspan="2">3, 4, 5, 7, 8</td></tr>
<tr><td>G (B)(Y) SYS LO PR
system pressure ≤ 1450 psi
reset if pressure ≥ 1750 psi</td></tr>
<tr><td>RAT FAULT
RAT not fully stowed and not running, or stowing pressure applied</td><td rowspan="4">NIL</td><td rowspan="4">NIL</td><td rowspan="4">NIL</td><td>3, 4, 5, 6
7, 8</td></tr>
<tr><td>MONITORING FAULT
HSMU not racked</td><td>NIL</td><td>3, 4, 5,
7, 8</td></tr>
<tr><td>G RSVR UNDERFILLED
on ground reservoir quantity < 17 l if temp > 0°C or reservoir quantity < QTY function of temp</td><td rowspan="2">HYD</td><td>3, 4, 5, 6,
7, 8</td></tr>
<tr><td>G SYS LEAK
In flight only</td><td>1 to 5
7 to 10</td></tr>
</table>

MEMO DISPLAY

R HYD ELEC PUMP appears green when one of the three electric pumps is running (manually or automatic).
RAT OUT appears green if ram air turbine is not fully stowed. It becomes amber during flight phases 1 and 2.

BUS EQUIPMENT LIST

FOR INFO

R

		NORM			EMER ELEC		
		AC	**DC**	**DC BAT**	**AC ESS**	**DC ESS**	**HOT**
HSMU	B, G CONTROL		DC1				
	Y, G CONTROL		DC2				
ENGINE DRIVEN PUMP CONTROL	ENG 1 Green Pump		DC1				
	ENG 1 Blue Pump		DC1				
	ENG 2 Green Pump		DC2				
	ENG 2 Yellow Pump		DC2				
FIRE SHUTOFF VALVES	ENG 1 Green					X	
	ENG 1 Blue					X	
	ENG 2 Green		DC2			X (1)	
	ENG 2 Yellow		DC2			X (1)	
ELECTRIC PUMPS	Green	AC1	DC1				
	Blue	AC2	DC1				
	Yellow	AC1 (2)	DC2 (3)				
LEAK MEASUREMENT VALVES			DC GND/FLT				
RAT	MANUAL CONTROL						X
	AUTO CONTROL					X	

(1) DC ESS supplies the valve motor when NORM DC2 is lost.
(2) or directly from external power
(3) or from DC GND/FLT bus

DESCRIPTION

The ice and rain protection system allows unrestricted operation of the aircraft in icing conditions and heavy rain.

ANTI ICE

Either hot air or electrical heating protects critical areas of the aircraft as follows.

HOT AIR

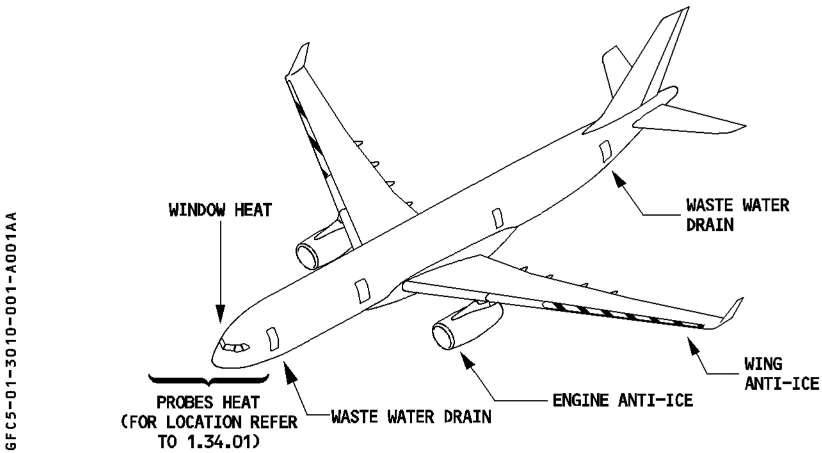
R – four outboard leading-edge slats of each wing.
– engine air intakes.

ELECTRICAL HEATING

– flight compartment windows.
R – sensors, pitot probes, static ports, TAT probes and angle-of-attack probes.
– waste-water drain mast.

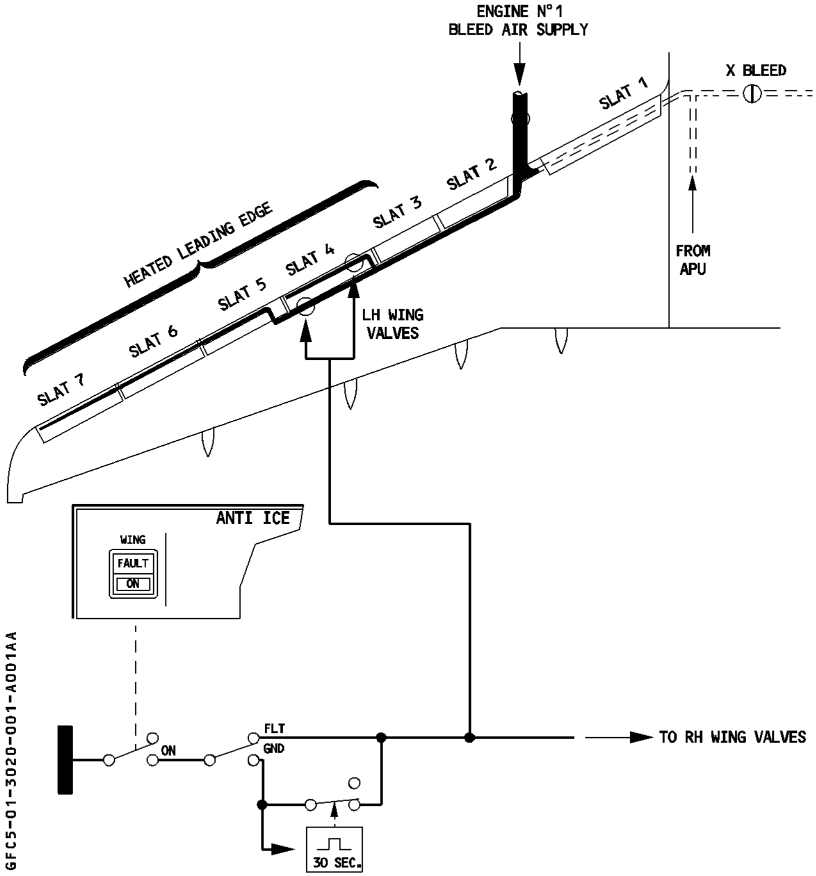
RAIN REMOVAL

Fluid rain repellent ⊲ and wipers remove rain from the front windshield panels.



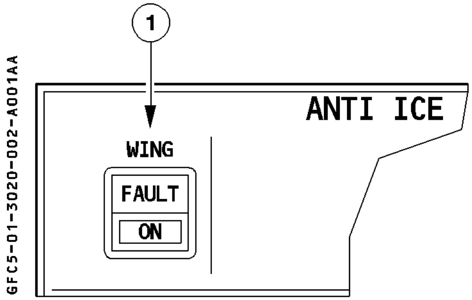
DESCRIPTION

In flight, hot air from the pneumatic system heats the four outboard slats (4-5-6-7) of each wing.
The WING pushbutton on the ANTI ICE panel controls the valves.
When the aircraft is on ground, the flight crew can initiate a 30-second test sequence by turning the system ON.
If the system detects a leak during normal operation, the affected side's wing anti-ice valve automatically closes (see 1.36.10).
R When wing anti-ice is selected, the N1 limit is automatically reduced, and the idle N1 is
R automatically increased.
In the event of an electrical power supply failure, the valves close.



CONTROLS AND INDICATORS

OVERHEAD PANEL



(1) WING ANTI ICE pushbutton

This pushbutton simultaneously controls the wing anti-ice system on the left and right sides.

ON : It comes on blue.
The WING A.ICE indication appears on the ECAM MEMO page.
Wing anti-ice control valves open, if pneumatic supply is available.
On the ground, the wing anti-ice control valves open for only 30 seconds (test sequence).

Off : The ON light goes off.
The wing anti-ice control valves close.

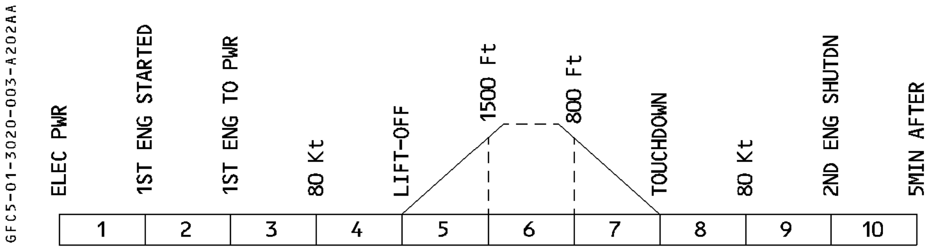
FAULT lt : The amber light comes on, and a caution appears on the ECAM, if :
— The position of the anti-ice control valve is not the required position, or
— Low pressure is detected.

Note : The amber FAULT light comes on briefly during pressure built up, or when the valves open.

ECAM BLEED PAGE

R (Refer to 1.36.20).

WARNINGS AND CAUTIONS



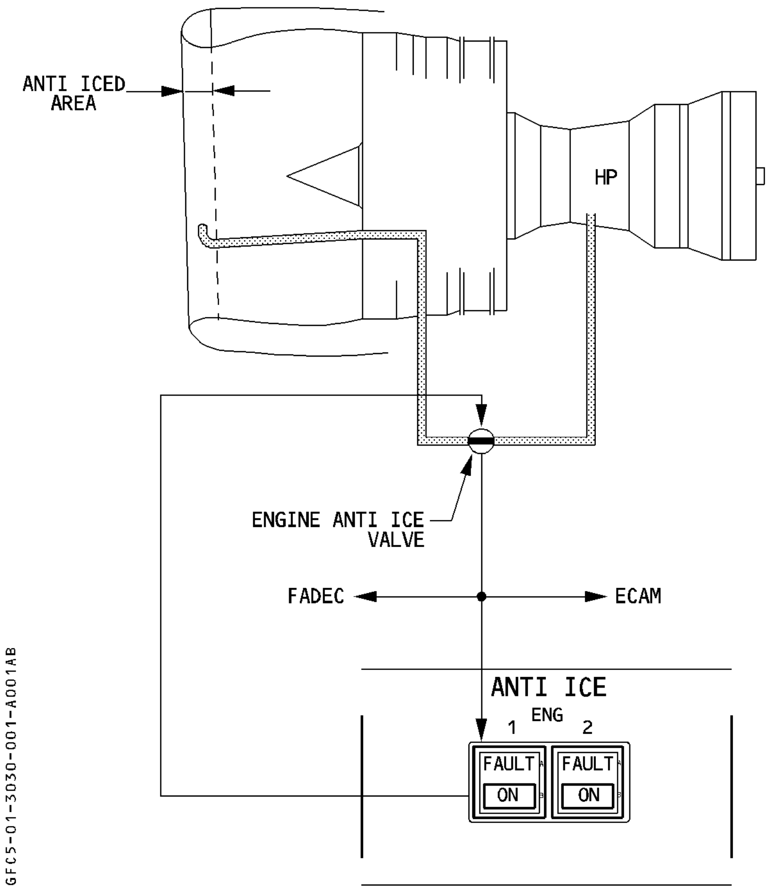
<table>
<tr><th>E / WD: FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>L(R) INR (OUTR) WING HI PR
High pressure is detected.</td><td>NIL</td><td>NIL</td><td rowspan="3">BLEED</td><td>NIL</td><td rowspan="2">3, 4, 5, 7, 8</td></tr>
<tr><td>L(R) INR (OUTR) WING LO PR
Low pressure is detected.</td><td rowspan="5">SINGLE CHIME</td><td rowspan="5">MASTER CAUT</td><td rowspan="5">WING ANTI ICE FAULT lt</td></tr>
<tr><td>L(R) INR (OUTR) WING OPEN
One wing valve remains open, when wing anti-ice is selected off.</td><td rowspan="2">4, 8</td></tr>
<tr><td>WAI SYS FAULT
Wing anti-ice relay failure.</td><td>NIL</td></tr>
<tr><td>WING VLVE NOT OPEN
One wing valve remains closed, when wing anti-ice is selected on.</td><td rowspan="2">BLEED</td><td rowspan="2">3, 4, 5, 7, 8</td></tr>
<tr><td>WING OPEN ON GND
Time delay relay failure.</td></tr>
</table>

MEMO DISPLAY

The WING A.ICE message is displayed in green, when the WING ANTI ICE pushbutton is ON.
ICE NOT DET message is displayed in green, when ice is no longer detected, after ENG ANTI ICE pushbutton switch selection at ON.

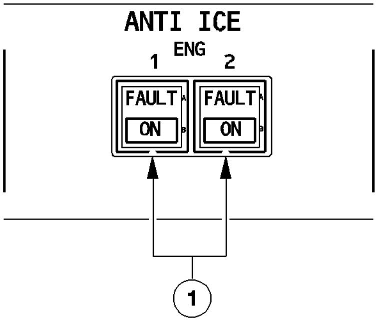
DESCRIPTION

An independent air bleed from the high pressure compressor protects each engine nacelle from ice. The air is supplied through a two-position (open and closed) valve that the flight crew controls with pushbutton switches, one for each engine.
The valve closes automatically if air is not available (engine not running).
R When an engine anti-icing valve is open, the N1 (EPR ◁) limit for that engine is reduced
R automatically and the idle N1 (EPR ◁) is automatically increased.
If electric power fails, the valves open.



CONTROLS AND INDICATORS

OVERHEAD PANEL



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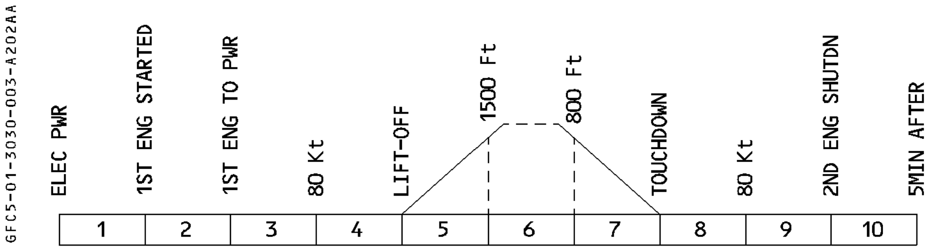
(1) ENG 1 (2) pb sw

ON : Comes on blue.
ENG A.ICE message is displayed in ECAM MEMO display.
Engine anti ice valve opens.
R Continuous ignition is automatically activated. This makes the IGNITION
R memo appear on the ECAM.

Off : ON light goes off.
Engine anti ice valve closes.

FAULT lt : Comes on amber, with ECAM caution, if anti ice valve position disagrees with ENG pushbutton selection.

WARNINGS AND CAUTIONS



E/WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
ENG 1(2) VALVE CLOSED Valve disagree.	SINGLE CHIME	MASTER CAUT	NIL	ENG affected ANTI ICE FAULT lt	4, 5, 7, 8
ENG 1(2) VALVE OPEN Valve disagree.					

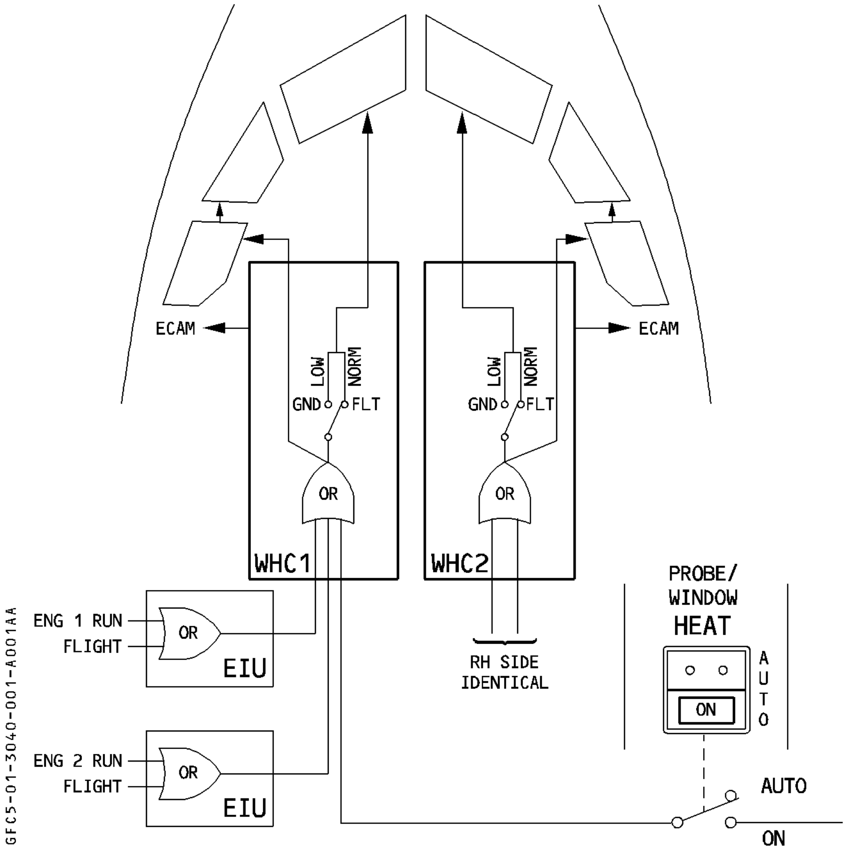
MEMO DISPLAY

This display shows ENG A.ICE in green, if either one ENG ANTI ICE pushbutton is ON, or the nacelle anti-ice valve's electrical power is lost.
ICE NOT DET appears in green, if ice is no longer detected after 130 seconds.

DESCRIPTION

The aircraft uses electrical heating for anti icing each windshield and demisting the cockpit side windows.
Two independent Window Heat Computers (WHC), one on each side, automatically regulate the system and protect it against overheating and indicate faults.
Window heating comes on :
- automatically when at least one engine is running, or in flight
- manually when the flight crew switches ON the PROBE WINDOW HEAT pushbutton switch.

R The windshield heating operates at low power on the ground and at normal power in flight.
R Only one heating level exists for the windows.
R

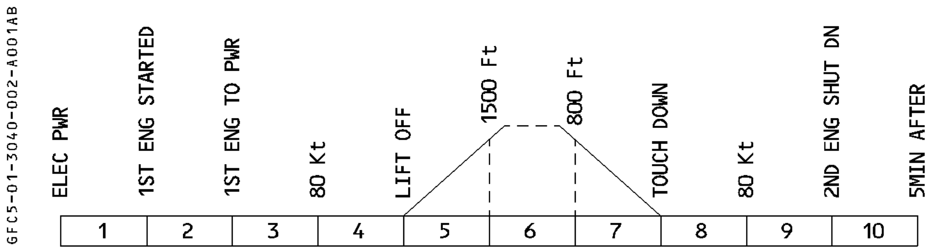


CONTROLS AND INDICATORS

OVERHEAD PANEL

R (Refer to 1.30.50)

WARNINGS AND CAUTIONS



<table>
<tr><th>E/WD: FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNINGS</th><th>FLT PHASE INHIB</th></tr>
<tr><td>L(R) WSHLD HEAT
failure of L or R windshield heating</td><td rowspan="2">SINGLE CHIME</td><td rowspan="2">MASTER CAUT</td><td rowspan="3">NIL</td><td rowspan="3">NIL</td><td rowspan="3">3, 4, 5, 7, 8</td></tr>
<tr><td>L+R WSHLD HEAT
failure of both windshield heatings</td></tr>
<tr><td>L(R)(L+R) WINDOW HEAT
failure of L, R or L+R window heatings</td><td>NIL</td><td>NIL</td></tr>
</table>

DESCRIPTION

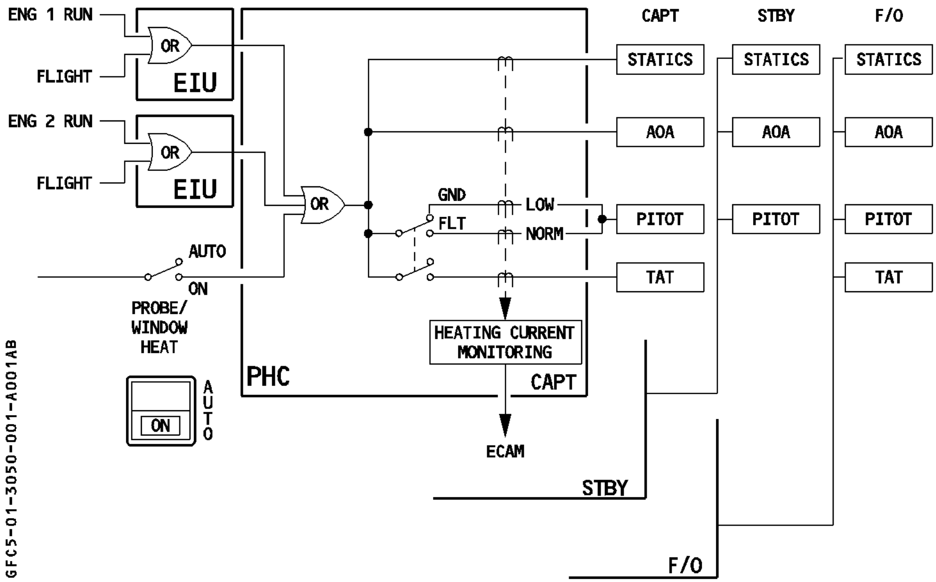
Electrical heating is provided for the protection of:
- Pitots.
- Static ports.
- Angle Of Attack (AOA) probes.
- Total Air Temperature (TAT) probes.

Three independent Probe Heat Computers (PHC) automatically control and monitor:
- Captain probes
- F/O probes
- STBY probes

They provide overheat protection and fault indication.
The probes are heated:
- automatically when at least one engine is running, or in flight
- manually by switching ON the PROBE/WINDOW HEAT pushbutton.

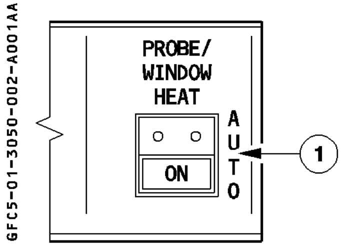
On the ground, TAT probes are not heated and pitot heating operates at low level (normal power in flight by automatic changeover).

FOR INFO



CONTROLS AND INDICATORS

OVERHEAD PANEL

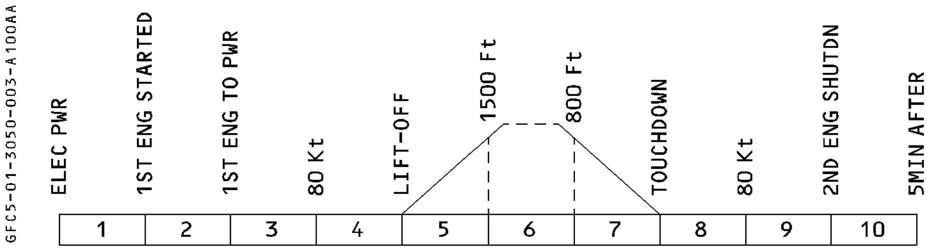


(1) PROBE / WINDOW HEAT pushbutton

AUTO : Probes / windows are automatically heated :
- In flight, or
- On ground (except TAT probes), provided one engine is running

ON lt : Comes on in blue.
R Probes / windows are heated (except TAT probes on ground).

WARNINGS AND CAUTIONS



<table>
<tr><th>E / WD: FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>CAPT (F/O)(STBY) PROBES HEAT
Failure of one Probe Heat Computer Channel (PHC)</td><td rowspan="4">SINGLE CHIME</td><td rowspan="4">MASTER CAUT</td><td rowspan="4">NIL</td><td rowspan="4">NIL</td><td>4, 5, 7, 8</td></tr>
<tr><td>CAPT (F/O)(STBY) PITOT HEAT
CAPT (F/O)(STBY) AOA HEAT
CAPT (F/O)(STBY) L(R) STAT HEAT
CAPT (F/O) TAT HEAT
Failure of corresponding probe heating</td><td>3, 4, 5, 7, 8</td></tr>
<tr><td>CAPT + F/O PITOT HEAT
CAPT + STBY PITOT HEAT
F/O + STBY PITOT HEAT
Failure of the corresponding probes heating.</td><td rowspan="2">4, 5, 8</td></tr>
<tr><td>All PITOT
Failure of CAPT, F/O and STBY probes heating.</td></tr>
</table>

DESCRIPTION

An ice protection system is installed to prevent ice formation in the waste disposal system and the potable water system. Electrical heating elements in form of flexible tapes are attached to the waste/potable water lines which are installed in areas of possible icing conditions (in the vicinity of fuselage skin). Temperature sensors are installed to detect icing conditions. The fill/drain nipples on the water service/waste panel and the two drain masts are heated. The two Water Ice-Protection Control Units (WIPCU) installed operate independently : one controls the forward section of the ice protection system, the second one the aft section.

SYSTEM OPERATION

The temperature sensors measure permanently the water line temperature. In the WIPCU, the measured value is compared with a reference temperature for the related location. This threshold can be set individually for each area by maintenance action. If the temperature drops below the reference value the heater elements for the related area are turned on. A different (higher) threshold is used to turn the heater elements off.

DESCRIPTION

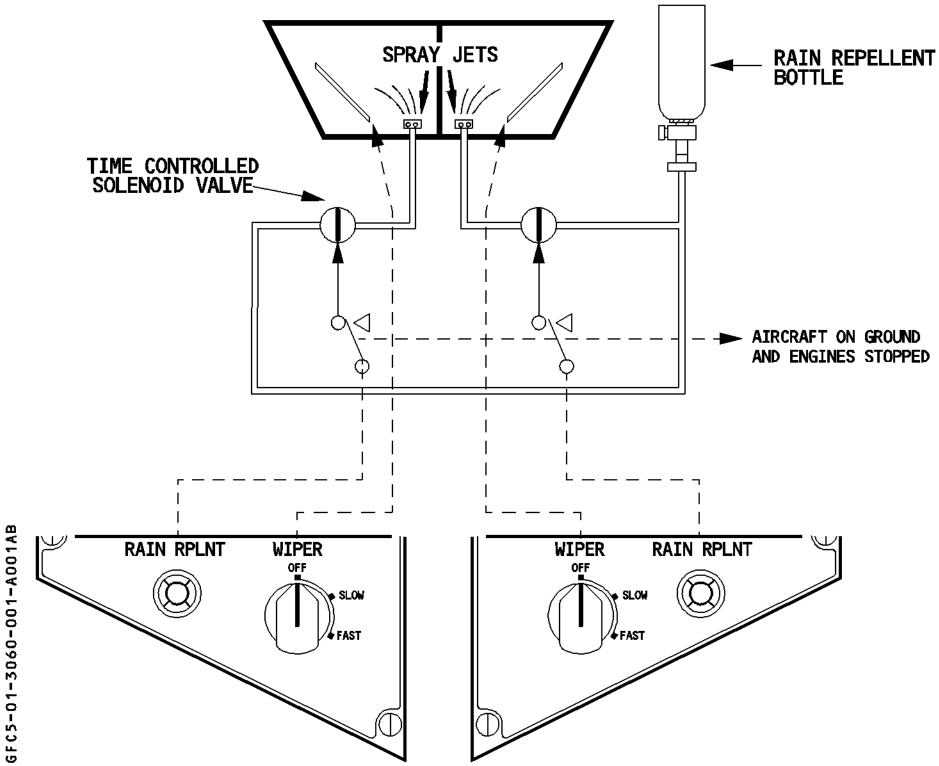
WIPERS

Each front windshield is provided with a two speed electric wiper.
Each is controlled by a rotary selector.

RAIN REPELLENT

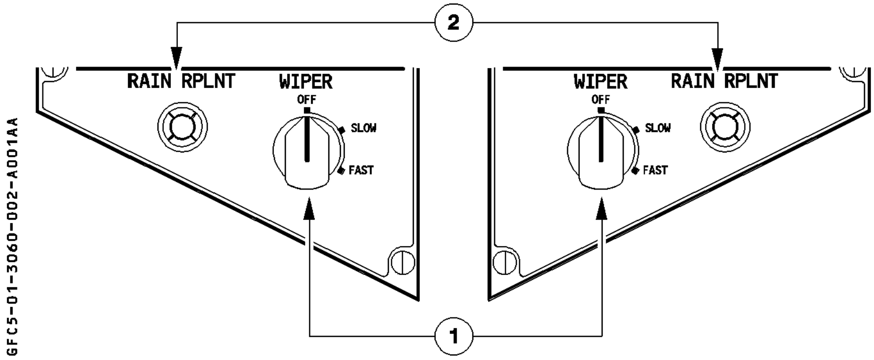
In moderate to heavy rain a rain repellent liquid may be sprayed on the windshield to improve visibility.
The window is covered by spray after about 30 seconds.
Application of rain repellent is controlled by a pushbutton.

R



CONTROLS AND INDICATORS

OVERHEAD PANEL



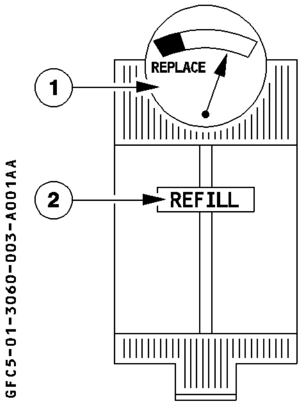
(1) WIPER sel

Each rotary selector controls its wiper at either low or high speed. When turned off the wiper stops out of view.

(2) RAIN RPLNT pb

R Each of these buttons controls the application of rain repellent fluid to one side of the
R front windshield.
R When the flight crew pushes the button, the timer applies a measured quantity of rain
R repellent to the windshield. To repeat the cycle the flight crew must push the button
R again.
R This function is inhibited when the aircraft is on the ground, engines stopped.

RIGHT AFT CORNER OF THE COCKPIT



1 RAIN RPLNT pressure indicator

Shows the nitrogen pressure in the rain repellent bottle.
When the needle is in the yellow sector the bottle should be replaced.

2 RAIN RPLNT quantity indicator

When REFILL float is in view the bottle should be replaced.

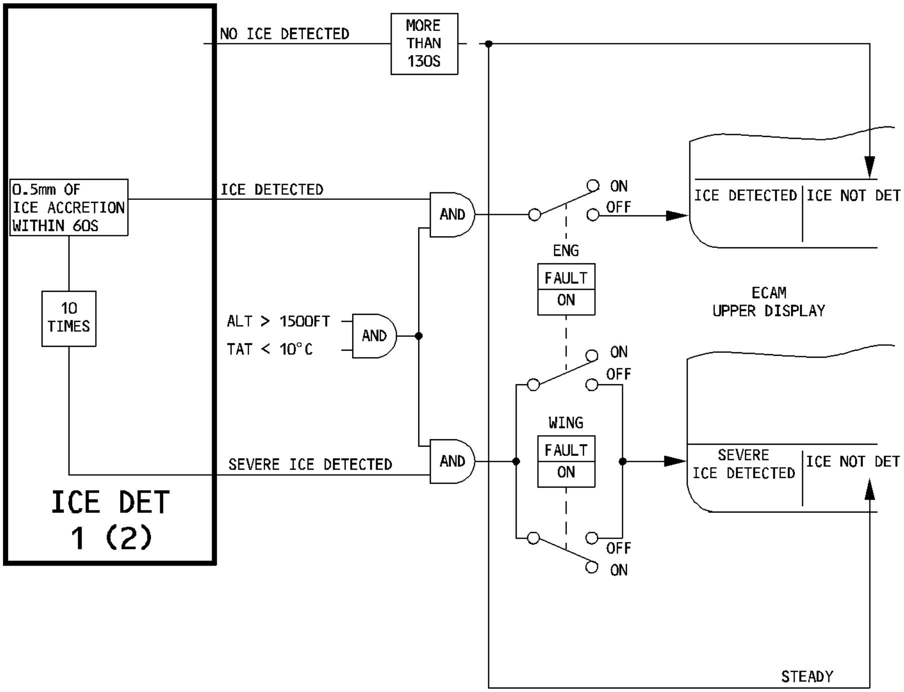
DESCRIPTION

VISUAL ICE INDICATOR

An external visual ice indicator, visible by the crew, is installed between the two windshields.
The lighting of the indicator is also provided.

ICE DETECTION SYSTEM

The ice detection system has two separate ice detector probes on the forward lower section of the fuselage.
The system operates automatically and starts at electrical power up.
The probes detect ice buildup and, via the MEMO display, they indicate that icing conditions have disappeared. The system logic generates ECAM messages according to ice detector signals and the flight crew's selection of engine or wing anti-ice systems. The ice detection system does not control the ENG or WING anti-ice systems.



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BUS EQUIPMENT LIST

			NORM			EMER ELEC		
			AC	DC	DC BAT	AC ESS	DC ESS	HOT
WING ANTI ICE	INNER VALVES						SHED	
WING ANTI ICE	OUTER VALVES						SHED	
ENG ANTI ICE CLOSURE	ENG 1			DC1				
ENG ANTI ICE CLOSURE	ENG 2			DC2				
WINDOW HEAT	WHC	1					SHED (LAND REC)	
WINDOW HEAT	WHC	2		DC2				
WINDOW HEAT	HEATING POWER	L	AC1			SHED (LAND REC) (2)		
WINDOW HEAT	HEATING POWER	R	AC2					
PROBE HEAT	PHC	CAPT OR STBY			X			
PROBE HEAT	PHC	F/O		DC2				
PROBE HEAT	STATICS	CAPT OR STBY		DC1				
PROBE HEAT	STATICS	F/O		DC2				
PROBE HEAT	PITOT	CAPT				X (1)		
PROBE HEAT	PITOT	F/O	AC2					
PROBE HEAT	PITOT	STBY	AC1 (1)					
PROBE HEAT	AOA	CAPT				SHED		
PROBE HEAT	AOA	F/O	AC2					
PROBE HEAT	AOA	STBY				SHED		
PROBE HEAT	TAT	CAPT	AC1					
PROBE HEAT	TAT	F/O	AC2					
RAIN REMOVAL	WIPER	CAPT		DC1				
RAIN REMOVAL	WIPER	F/O		DC2				
RAIN REMOVAL	RAIN REPELLENT	CAPT					X	
RAIN REMOVAL	RAIN REPELLENT	F/O		DC2				
ICE DETECT SYSTEM	ICE DETECTION	PROBE 1	AC1					
ICE DETECT SYSTEM	ICE DETECTION	PROBE 2	AC2					
WATER/WASTE ANTI ICE		WIPCU 1 and 2		DC2				
WATER/WASTE ANTI ICE		HEATING ELEMENTS AND DRAIN MAST	AC1					

(1) When AC1 is lost and AIR DATA is switched to “CAPT ON 3”, the standby pitot is switched to AC ESS BUS and Captain pitot heating is lost.
(2) Only LH windshield heating is supplied by AC ESS BUS.

31.00 CONTENTS

31.05 EIS GENERAL

31.10 ECAM DESCRIPTION

31.15 INDICATIONS ON E / WD

31.20 INDICATIONS ON SD

31.25 ECAM SEQUENCE

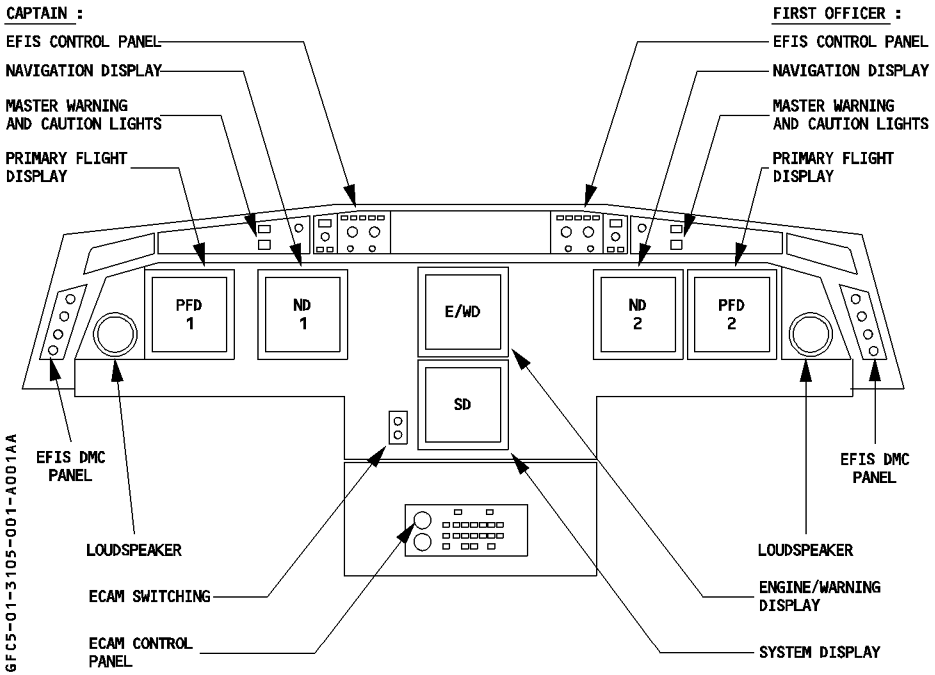
31.27 OEB REMINDER

31.30 ECAM CONTROLS

INTRODUCTION

The electronic instrument system (EIS) presents data on six identical display units (DUs):
- The electronic flight instrument system (EFIS) displays mostly flight parameters and navigation data on the primary flight displays (PFDs) and navigation displays (NDs)
- The electronic centralized aircraft monitor (ECAM) presents data on the engine/warning display (E/WD) and system display (SD) :
  · Primary engine indications, fuel quantity, flap and slat position
  · Warning and caution alerts or memos
  · Synoptic diagrams of aircraft systems, and status messages
  · Permanent flight data

COCKPIT ARRANGEMENT



ARCHITECTURE

DISPLAY UNIT (DU)

The instrument panels have six identical units.
These DUs are full-color Liquid Crystal Displays (LCD).

DISPLAY MANAGEMENT COMPUTER (DMC)

Three identical Display Management Computers acquire and process all the signals received from sensors and other computers to generate the images to be displayed on the Primary Flight Displays, Navigation Displays, Engine/Warning Display, and System Display.
Each DMC has two independent channels : An EFIS channel and an ECAM channel. Each DMC is able to simultaneously drive one PFD, one ND, and either of the ECAMs in its Engine warning or system status task.

SYSTEM DATA ACQUISITION CONCENTRATOR (SDAC)

The two identical SDACs acquire data, then generate signals. Some of these signals go to the three DMCs, which use them to generate displays of system pages and engines parameters. Others go to the Flight Warning Computers, which use them to generate ECAM messages and aural alerts.

FLIGHT WARNING COMPUTER (FWC)

The two identical FWCs generate alert messages, memos, aural alerts, and synthetic voice messages. For this purpose they acquire data :
- Directly from aircraft sensors, or systems, to generate red warnings.
- Through the SDACs to generate amber cautions.

The ECAM Display Units display the alert messages generated by the FWCs.
The FWCs also generate :
- Radio altitude callouts.
- Decision height callouts.
- Landing speed increments.

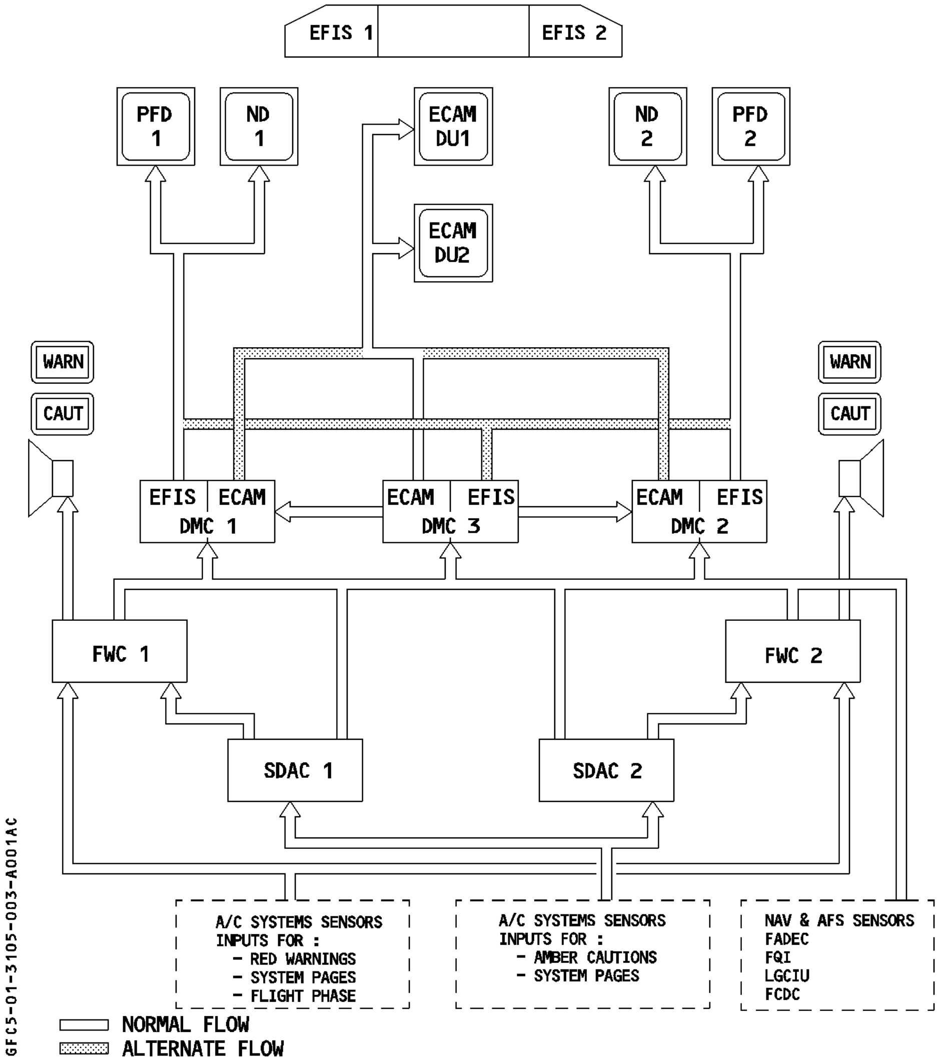
ATTENTION-GETTERS

The FWCs also drive the attention-getters. Each pilot has a set of these on the panel under the glareshield. They are :
- a master warning light that flashes “MASTER WARN” in red for red warnings
- a master caution light that illuminates “MASTER CAUT” in amber for amber cautions.

LOUDSPEAKER

The communication loudspeakers announce aural alerts and voice messages, and do so even when they are turned off.

EIS BLOCK DIAGRAM



CONTROLS AND SWITCHING

ECAM CONTROL PANEL (ECP)

This panel allows the pilot to have the ECAM display units display either warning and caution messages or system and system status images.

ECAM DMC SWITCHING

A switch on the ECAM SWITCHING panel which is on the main instrument panel allows the flight crew to replace the DMC 3 with DMC 1 or DMC 2.

ECAM/ND SWITCHING

A switch on the ECAM SWITCHING panel allows the flight crew to transfer the ECAM system display to either the captain's or the first officer's navigation display.

PFD/ND SWITCHING

A PFD/ND XFR pushbutton on each side console allows the pilot to swap displays on respective onside DUs.

EFIS DMC SWITCHING

A switch on each side console allows the pilot to manually select the DMC 3 or the opposite DMC for supply of data to the onside PFD/ND.

RECONFIGURING THE DISPLAY MANAGEMENT COMPUTER (DMC)

In normal operation :
– DMC 1 supplies data to the Captain's PFD and ND.
– DMC 2 supplies data to the First Officer's PFD and ND.
– DMC 3 supplies data to the upper and lower ECAM DU.

If a DMC fails, the corresponding DU displays the INVALID DATA message. The flight crew can replace DMC 1 or 2 with DMC 3 by turning the EFIS DMC selector, on the EFIS DMC panel, to 3.
In case of DMC 3 failure, DMC 1 automatically takes over and supplies the ECAM DUs, provided the ECAM SWITCHING selector is in the AUTO position.

RECONFIGURING DISPLAY UNITS (DUs)

FAILURE OF UPPER ECAM DU (OR CTL/BRIGHTNESS KNOB TURNED TO OFF)

If the upper ECAM display fails, or is switched off :
– The engine/warning page automatically replaces the system/status page on the lower ECAM DU.

The flight crew can display the system/status page by :
– Using the "ECAM/ND XFR" switch, on the ECAM SWITCHING panel, to move it to a navigation display unit (NDU), or
– Pushing and holding (for a maximum of 3 minutes) the related system page pushbutton, on the ECAM control panel, to temporarily display it on the lower ECAM DU (instead of the engine/warning page).

FAILURE OF LOWER ECAM DU (OR CTL/BRIGHTNESS KNOB TURNED TO OFF)

If the lower ECAM display fails, or is switched off, the flight crew can display the system/status page by :
– Using the "ECAM/ND XFR" switch, on the ECAM SWITCHING panel, to display it on the NDU, or
– Pushing and holding (for a maximum of 3 minutes) the related system page pushbutton, on the ECAM control panel, to temporarily display it on the upper ECAM DU (instead of the engine/warning page).

FAILURE OF BOTH ECAM DUs

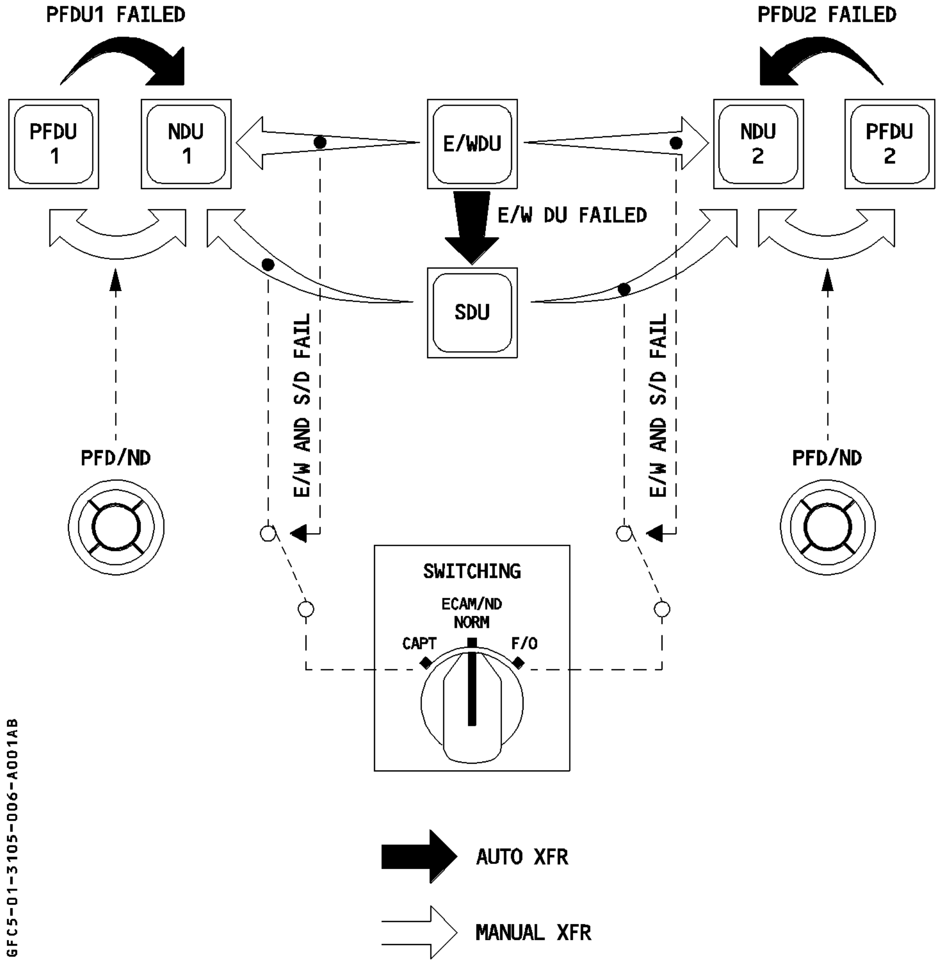
If both ECAM displays fail, the flight crew may :
– Use the "ECAM/ND XFR", on the ECAM SWITCHING panel, to display the engine/warning page on a navigation display and, if needed,
– Push and hold (for a maximum of 3 minutes) the related system page pushbutton, on the ECAM control panel, to temporarily display the system/status page on an ND.

PFDU/NDU RECONFIGURATION

If a PFDU fails, the system automatically transfers the PFD image to the NDU.
The pilot can also make this transfer manually by :
- turning the PFD ON-OFF/brightness control OFF, or
- pressing the PFD/ND/XFR pushbutton, which cross-changes the images between the PFDU and the NDU.

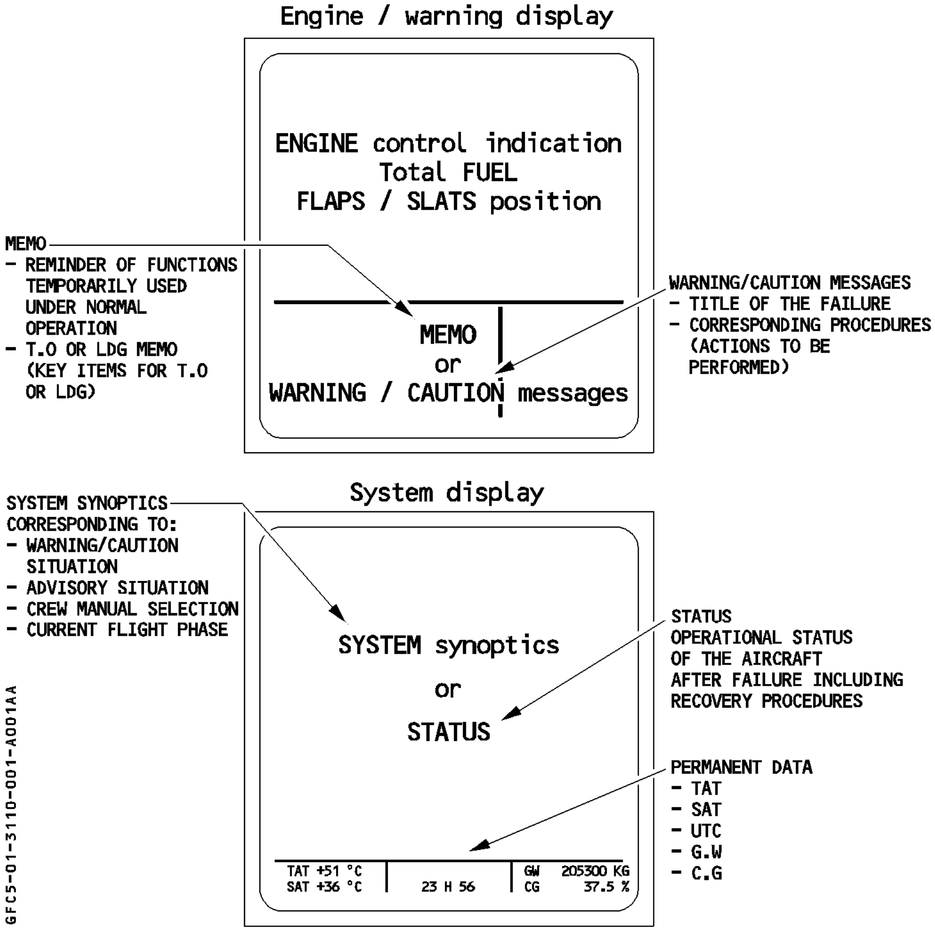
If an NDU fails, the pilot can use the PFD/ND/XFR pushbutton to transfer the ND image to the PFDU.

DU RECONFIGURATION



ECAM DU ARRANGEMENT

The ECAM has two display units :
- one for the engine/warning display (E/WD).
- one for the system/status display (SD).



COLOR CODE

The ECAM display uses a color code that indicates the importance of the failure or the indication.

RED : The configuration or failure requires immediate action.
AMBER : The flight crew should be aware of the configuration or failure, but needs not take immediate action.
GREEN : The item is operating normally.
WHITE : These titles and remarks guide the flight crew as it executes various procedures.
BLUE : These are actions to be carried out, or limitations.
MAGENTA : These are particular messages that apply to particular pieces of equipment or situations (inhibition messages, for example).

WARNING / CAUTION CLASSIFICATION

R

	LEVEL	SIGNIFICATION	AURAL	VISUAL
FAILURE MODE	Level 3	Red warning: The configuration or failure requires immediate action : – Aircraft in dangerous configuration or limit flight conditions (eg: stall, o/speed) – System failure altering flight safety (eg : Eng fire, excess cab alt)	Continuous Repetitive Chime (CRC) or specific sound or synthetic voice	– MASTER WARN light red flashing, or specific red light – Warning message (red) on E/WD – Automatic call of the relevant system page on the S/D *
	Level 2	Amber caution : The flight crew should be aware of the configuration or failure, but does not need to take any immediate action. However, time and situation permitting, these cautions should be considered without delay to prevent any further degradation of the affected system : – System failure without any direct consequence on the flight safety (eg : HYD B SYS LO PR).	Single Chime (SC)	– MASTER CAUT light, amber steady : –Caution message (amber) on E/WD – Automatic call of the relevant system page on the S/D * .
	Level 1	Amber caution : Requires crew monitoring : – Failures leading to a loss of redundancy or system degradation (eg : FCDC fault)	NONE	– Caution message (amber) on E/WD, generally without procedure.
INFORMATION	ADVISORY	System parameters' monitoring	NONE	– Automatic call of the relevant system page on the S/D. The affected parameter pulses green.
	MEMO	Information : Recalls normal or automatic selection of functions, which are temporarily used.	NONE	– Green, Amber, or Magenta message on E/WD

* except in some cases

PRIORITY RULES

There are three priority levels for warnings and cautions :
- A level 3 warning has priority over a level 2 caution which has priority over a level 1 caution.

The FWC observes these priorities.

TYPES OF FAILURES

Independent : a failure that affects an isolated system or item of equipment without degrading the performance of others in the aircraft.
Primary : a failure of a system or an item of equipment that costs the aircraft the use of other systems or items of equipment.
Secondary : the loss of a system or an item of equipment resulting from a primary failure.

AURAL INDICATORS

WARNING SIGNAL	CONDITION	DURATION	SILENCING *
CONTINUOUS REPETITIVE CHIME	RED WARNINGS	PERMANENT	Press * MASTER WARN lt
SINGLE CHIME	AMBER CAUTION	1/2 second	
CAVALRY CHARGE	AP DISCONNECTION BY TAKE OVER pb	1.5 second	Second push on TAKE OVER pb
	AP DISCONNECTION DUE TO FAILURE	PERMANENT	PressMASTER WARN lt or TAKE OVER pb
CLICK	LANDING CAPABILITY CHANGE or in case of "GPS PRIMARY LOST" (APPR) ◁ or in case of mode reversion	1/2 second (3 pulses)	
CRICKET + "STALL" message (synthetic voice)	STALL	PERMANENT	NIL
INTERMITTENT BUZZER	SELCAL CALL	PERMANENT	Press RESET key on ACP
BUZZER	CABIN CALL	3 seconds	NIL
	EMER CABIN CALL	3 seconds REPEATED 3 TIMES	NIL
	MECH CALL	As long as outside pb pressed	NIL
	ACARS ◁ CALL or ALERT	PERMANENT	Message reading on MCDU or Press MASTER CAUT
C CHORD	ALTITUDE ALERT (refer to 1.31.40)	1.5 second or PERMANENT	new ALTITUDE selection or press MASTER WARN pb
AUTO CALLOUT (synthetic voice)	HEIGHT ANNOUNCEMENT BELOW 2500 FT (refer to 1.34.40)	PERMANENT	NIL
GROUND PROXIMITY WARNING (synthetic voice)	(refer to 1.34.70)	PERMANENT	NIL
"WINDSHEAR" (synthetic voice)	WINDSHEAR	REPEATED 3 TIMES	NIL
"PRIORITY LEFT" "PRIORITY RIGHT" (synthetic voice)	AP TAKE OVER pb	1 second	NIL

* All aural warnings may be cancelled by pressing either :
- The EMER CANC pushbutton on the ECAM control panel, or
- The MASTER WARN light (except for some warnings like OVERSPEED or L/G NOT DOWN).

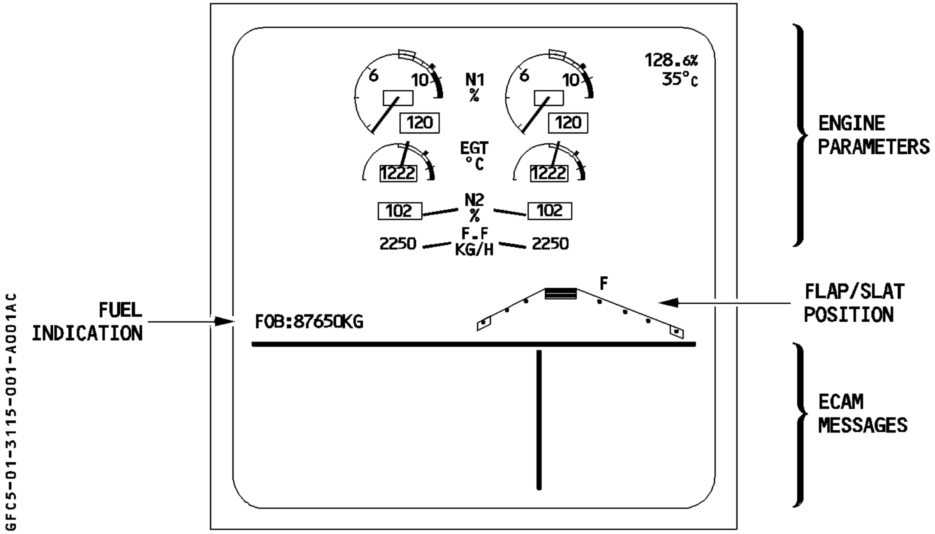
AURAL INDICATORS

WARNING SIGNAL	CONDITION	DURATION	SILENCING *
"RETARD"(synthetic voice)	THRUST LEVER NOT IN IDLE POSITION FOR LANDING	PERMANENT	THRUST LEVER
TCAS ◁ (synthetic voice)	refer to 1.34.80	PERMANENT	NIL
"SPEED, SPEED, SPEED" (Synthetic voice)	Current thrust is not sufficient to recover a positive flight through pitch control	Every 5 seconds until thrust is increased	THRUST LEVER(s)
"DUAL INPUT" (synthetic voice)	Both sidesticks are moved simultaneously	Every 5 seconds	One sidestick deactivated

* All aural warnings may be cancelled by pressing either :
– The EMER CANC pushbutton on the ECAM control panel, or
– The MASTER WARN light (except for some warnings like OVERSPEED or L/G NOT DOWN).

GENERAL

The E/WD appears on the upper ECAM display unit (DU).
– The upper part of this DU displays :
  · Engine parameters (refer to 1.70.90)
  · Fuel on board (FOB) (refer to 1.28.20)
  · Position of slats and flaps (refer to 1.27.40)
– The lower part of this DU displays messages generated by the FWC :
  · Warning and caution messages when a failure occurs
  · Memos when there is no failure.



The lower part, which is dedicated to ECAM messages, is divided into two parts of several lines each.

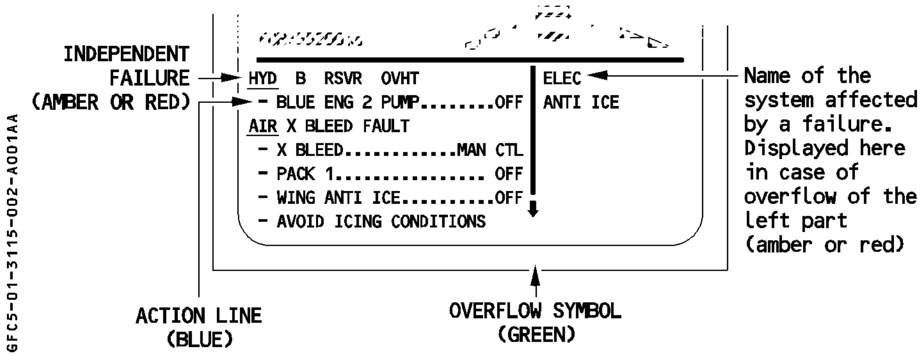
Left part : – Primary or independent warnings and cautions, or
– Memo information

Right part : – Title of system affected by a primary or independent warning or caution in case of overflow on the left part, or
– Secondary failure, or
– Memo, or
– Special lines (such as “AP OFF”, “LAND ASAP”)

As soon as the FWC detects a failure, and if there is no flight phase inhibition active, the E/WD displays the title of the failure and actions to be taken.
The action line clears automatically when the flight crew has executed the required action.

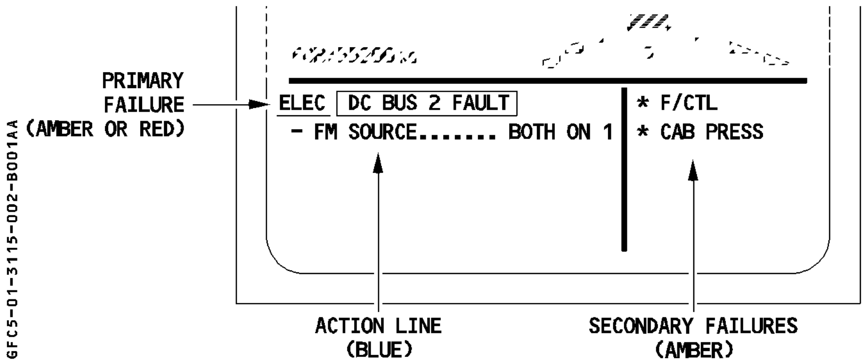
R *Note : Certain actions will not disappear after execution.*

INDEPENDENT FAILURE



If there are too many ECAM messages for the amount of space available in the lower part of the E/WD, a green arrow appears at the bottom of the display, pointing down to show that the information has overflowed off the screen. The pilot can scroll down to view additional messages by pushing the CLR pushbutton on the ECAM control panel (on the pedestal, just below the lower ECAM DU).

PRIMARY and SECONDARY FAILURES



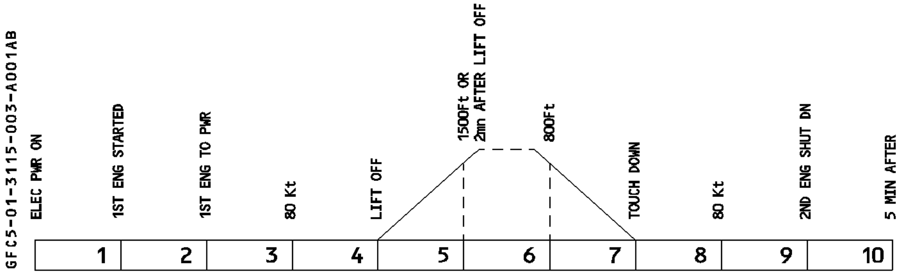
The ECAM DU displays a primary failure as a boxed title.
It identifies a secondary failure by putting a star in front of the title of the affected system.

R *Note : The DU displays the overflow symbol, if primary or secondary failures overflow. In*
R *case of ECAM SINGLE DISPLAY, the secondary failures are inhibited.*

FLIGHT PHASES

GENERAL

The FWC divides its functions according to these ten flight phases :

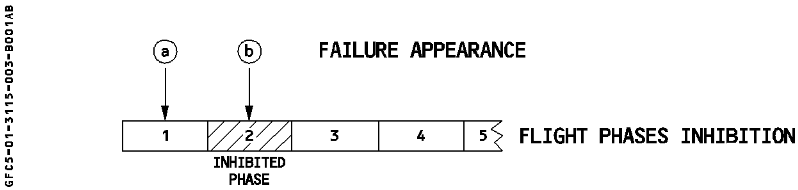


To improve its operational efficacy, the computer inhibits some warnings and cautions for certain flight phases. It does so to avoid alerting the pilots unnecessarily at times when they have high workloads, such as during takeoff or landing. In these two phases, the DU displays magenta memos : "T.O. INHIBIT" (flight phases 3, 4, and 5), and "LDG INHIBIT" (flight phases 7 and 8).

Note : *These flight phases are different from and independent of the ones that the FMGC uses.*

FLIGHT PHASE INHIBITION

Two cases are possible (for instance) :



Effect on E/WD :

ⓐ The failure occurs during phase 1. The E/WD displays the warning immediately and continues to display it as long as the failure is present, even in phase 2.

ⓑ The failure occurs during phase 2. The E/WD displays the warning only when the aircraft has entered phase 3, where it is not inhibited. Then the warning remains displayed as long as the failure is present.

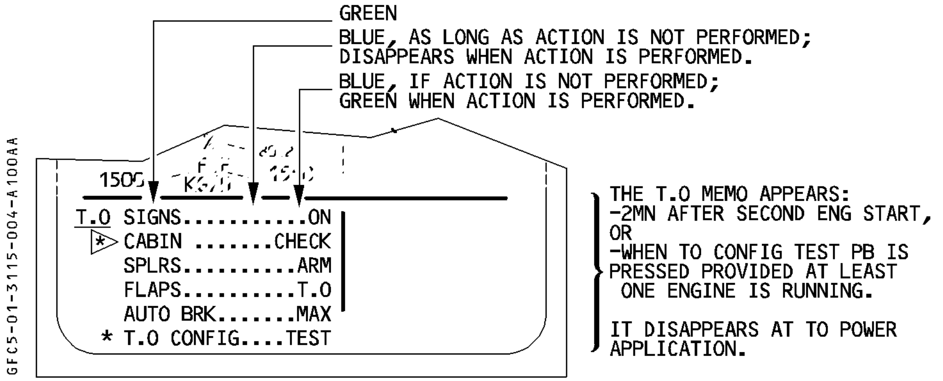
MEMO

DISPLAY

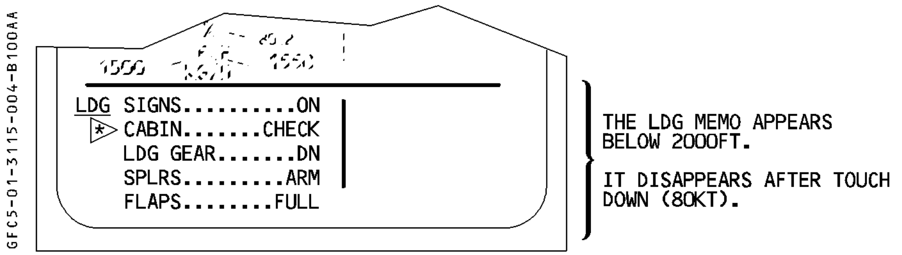
Memos appear in the lower part of the E/WD. They are normally in green, but may be amber in abnormal situations.
Memos list functions or systems that are temporarily used in normal operations.
Each chapter of the "Warning and Cautions" section of this manual lists memo messages.

TO AND LDG MEMOS

During the takeoff and landing phases, the right side of the memo area displays specific T.O. INHIBIT or LDG INHIBIT (magenta) memos.
Takeoff and landing memos are displayed, as follows, during the related flight phases :



*Note : * This line disappears when the test is completed. It is replaced by "T.O. CONFIG NORMAL", if the aircraft configuration is correct.*
Test is requested again, if the configuration becomes abnormal.



CONFIGURATION WARNINGS

The following warnings and cautions appear in the lower part of the E/WD if the aircraft is not in takeoff configuration when the pilot presses the T.O. CONFIG pushbutton on the ECAM control panel or applies takeoff power.

WARNINGS / CAUTIONS	T.O. CONFIG TEST	T.O. POWER
SLATS / FLAPS NOT IN TO CONFIG (R)	TRIGGERED	TRIGGERED
PITCH TRIM NOT IN TO RANGE (R)		
RUD TRIM NOT IN TO RANGE (R)		
SPD BRK NOT RETRACTED (R)		
SIDESTICK FAULT (R) (BY TAKE OVER)		
BRAKES HOT (A)		
DOOR (A)		
PARK BRK ON (R)	NOT TRIGGERED	
REDUCED THR NOT SET (A)		

(R) Red warning
(A) Amber caution

GENERAL

The system/status Display (SD) uses the lower ECAM DU to display :
- either an aircraft system synoptic diagram page
- or the STATUS page.

SYSTEM PAGES

The lower ECAM DU can display 14 system pages :
(For description see relevant FCOM chapter)
- ENGINE (Secondary engine parameters)
- BLEED (Air bleed)
- CAB PRESS (Cabin pressurization)
- ELEC AC (AC Electrical power)
- ELEC DC (DC Electrical power)
- HYD (Hydraulic)
- C/B (Circuit Breakers)
- APU (Auxiliary Power Unit)
- COND (Air conditioning)
- DOOR/OXY (Doors/oxygen)
- WHEEL (Landing Gear, Braking, ground spoilers, ...)
- F/CTL (Flight Controls)
- FUEL (Fuel)
- CRUISE (Cruise)

The pilot may manually call up a system page for display on the lower ECAM DU, or the system may automatically display a page.

— Manual :
  · The pilot can use the pushbutton on the ECAM control panel to call up any system page, except the CRUISE page, for display at any time.
  · The corresponding pushbutton on the ECAM control panel lights up.
R · A failure-related display automatically replaces a page the pilot has manually called up.
— Automatic, related to a failure :
  · The relevant system page automatically appears, as soon as any fault or malfunction triggers a caution or warning message.
— Automatic, advisory :
  · The relevant system page automatically appears, when a parameter drifts out of its normal range.
  · The value (shown in green) pulses, as long as it is outside its limits.
  · The advisory mode is inhibited in some flight phases.

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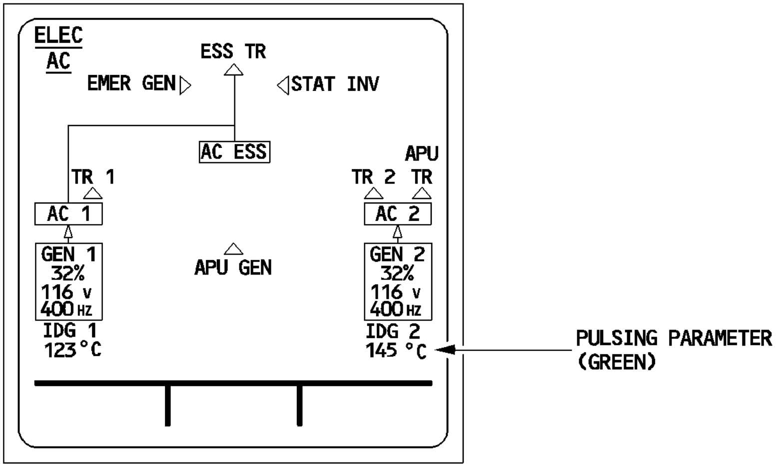

<u>Note</u> : *If an advisory is triggered when the ECAM is in the single-display configuration, an advisory message appears on the upper part of the E/WD, and the associated key on ECAM control panel flashes to identify the appropriate system page.*

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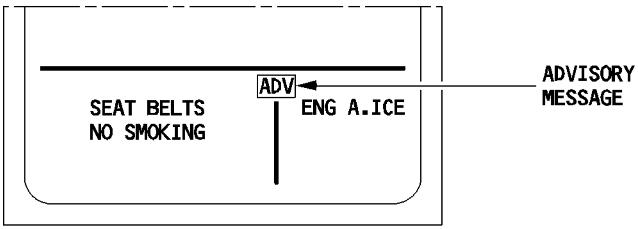
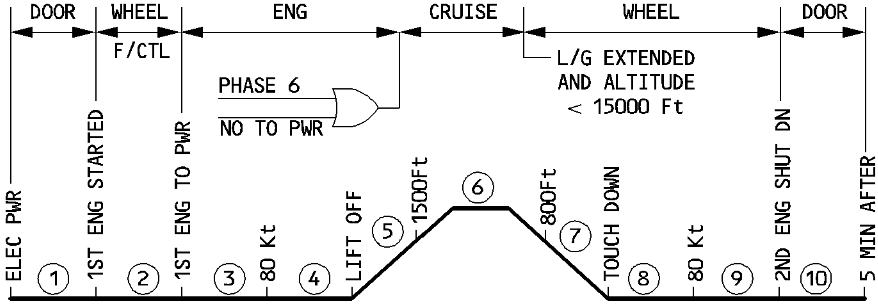


— Automatic, flight phase mode
  · If no other mode is engaged, the SD displays the system page related to the present flight phase, as shown in the following diagram.



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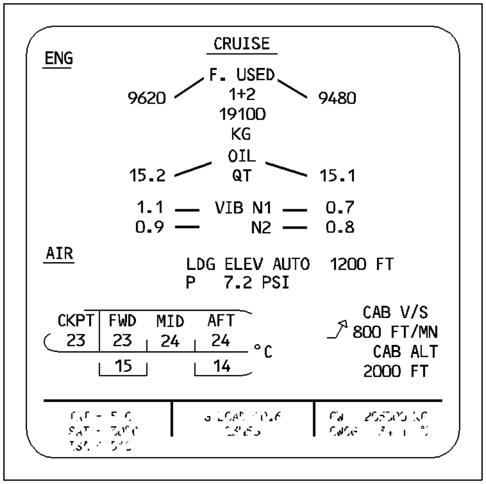
  · Phase 2 : The F/CTL page replaces the WHEEL page for 20 seconds, when either pilot moves his sidestick (more than 3° in pitch or roll), or when the rudder pedal deflection is more than 22°.
  · The APU page appears, when the APU MASTER switch is ON. It disappears when APU RPM has been above 95 % for 10 seconds, or when the APU MASTER switch is switched OFF.
  · The ENGINE page appears at the beginning of the start sequence, or when a pilot selects “CRANK”. It disappears at the end of the start sequence.

For a description of the ENGINE and AIR indications that appear, when the SD is displaying the CRUISE page, see the relevant FCOM chapter.



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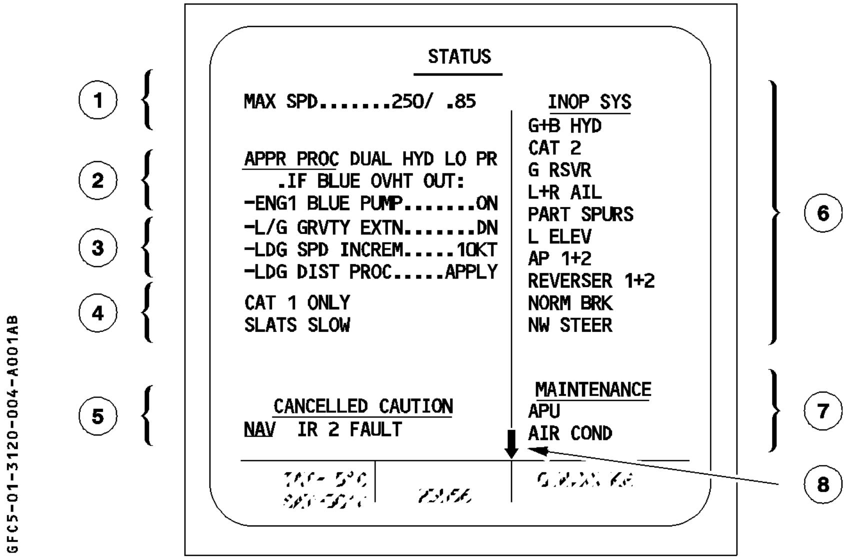
STATUS PAGE



The status page displays an operational summary of the aircraft status after the SD has displayed a failure. As shown in the illustration above, the summary includes :

(1) Limitations (speed, flight level) : Blue

(2) Approach procedures : White/Red or Amber

(3) Procedures (corrections to apply for landing) : Blue

(4) Information : Green

(5) Cancelled caution : White

(6) Inoperative system : Amber

(7) Maintenance status : White

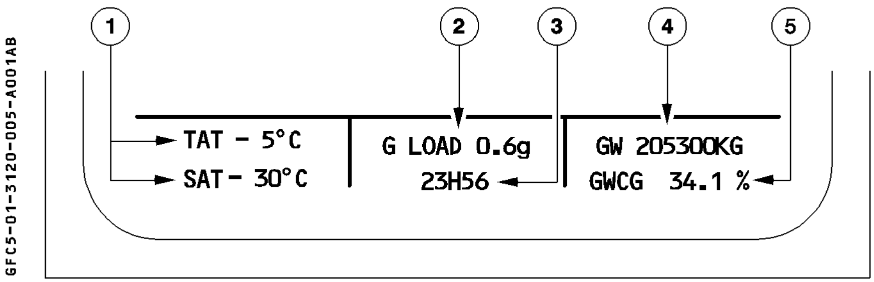
(8) Symbol displayed if data overflows the left or right area.

The pilot scrolls the display to view overflow by pressing the CLR pushbutton.

Note : The titles of the different parts of the display are white and underlined.

The STATUS page appears automatically once the crew has cleared all the pages corresponding to the current failure.
The STATUS page also appears automatically during descent when the baro reference is selected or the slats are extended.
The pilot may call up the status page manually by pressing the STS key on the ECAM control panel.
If the STATUS page holds messages other than "CANCELLED CAUTION" or the MAINTENANCE part, the E/WD screen shows "STS" (status reminder).
If the STATUS page holds messages in the MAINTENANCE part at engine shut-down, the "STS" (status reminder) flashes on the E/WD screen.
The screen displays the MAINTENANCE only when the aircraft is on the ground, before engine start-up or after engine shut-down (phases 1 and 10).

PERMANENT DATA



(1) Temperature

The screen displays total air temperature (TAT) and static air temperature (SAT) in green.

(2) Messages - G LOAD

The screen displays either of two items, one at a time :
— Load factor (G LOAD), in amber, when the value is above 1.4 g or below 0.7 g. This display is inhibited during flight phases 1 and 2.
— CHECK SD, in amber, when the DMC detects a discrepancy between acquisition and display on the DU.

(3) UTC

The screen displays Universal Time Coordinated (UTC), synchronized with the cockpit clock, in green.

(4) GW

The screen displays the Gross Weight (GW) as given by the FCMC, in green. The two last digits are dashed if accuracy is degraded. On ground, the indication is replaced by blue dashes, if no computed data are available.

(5) GWCG

The screen displays the center of gravity, as given by the FCMC, in green. In case of an
R EXCESS AFT CG warning, the indication appears in red.

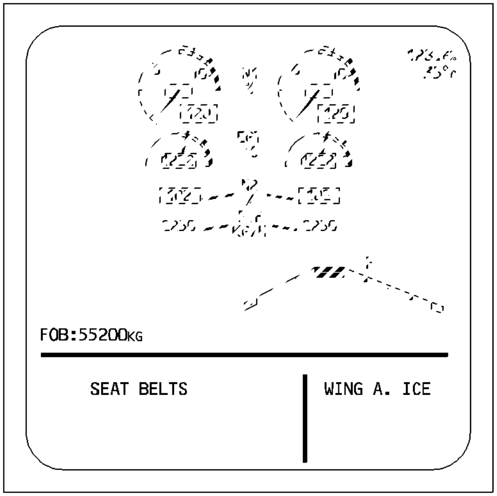
GENERAL

If ECAM detects a failure :
- The E/WD displays warning or caution messages.
- The master warning or master caution lights light up (except in the case of a level 1 caution).
- The system sounds an aural signal (except in the case of a level 1 caution).
- The system display (SD) shows the system page for the affected system.
- The CLR pushbutton on the ECAM control panel lights up.

In addition, a local warning light controlled directly by the affected system can light up.
After completing remedial procedures, the flight crew must push the CLR pushbutton repeatedly until the displays return to their normal configurations :
- MEMO messages on the E/WD
- The system page related to the present flight phase on the SD.
- The CLR light on the ECAM control panel turned off.

EXAMPLE

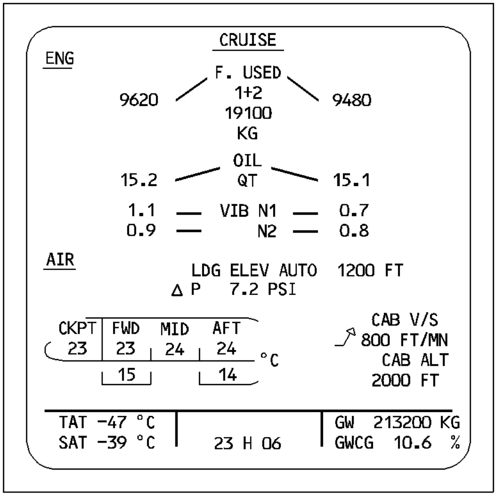
1 — THE ECAM DETECTS NO FAILURE



ECAM UPPER DISPLAY (E/WD)

- ENGINE CONTROL PARAMETERS
- FUEL QUANTITY INDICATION
- FLAP/SLAT POSITION

- MEMO INFORMATION



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ECAM LOWER DISPLAY (SD)

- FLIGHT PHASE RELATED SYSTEM PAGE (CRUISE PAGE IN THIS EXAMPLE)

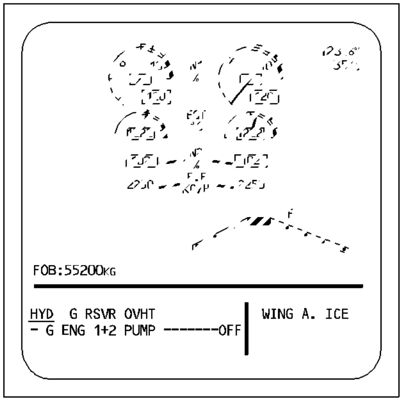
- PERMANENT DATA

2 — THE ECAM DETECTS A FAILURE

For example, a hydraulic reservoir is overheating.

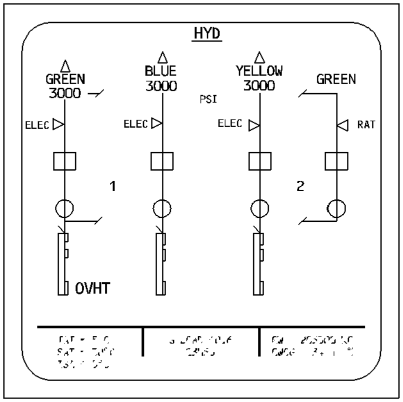
COCKPIT INDICATIONS

- A single chime sounds.
- Both MASTER CAUTION lights come on and stay on.
- A FAULT light on the overhead HYD panel comes on.
- The memo space on the E/WD displays the "HYD G RSVR OVHT" message and the "G ENG 1 + 2 PUMP . . . . . OFF" instruction.
- The lower ECAM display (SD) automatically calls up the hydraulic system's diagram and displays "OVHT" in amber next to the blue system.
- The CLR pushbutton, on the ECAM control panel, lights up.



ECAM UPPER DISPLAY (E/WD)

- LEFT PART
  - INDEPENDENT FAILURE
    - TITLE OF THE FAILURE
    - ACTIONS TO BE PERFORMED
- RIGHT PART
  - MEMO INFORMATION



ECAM LOWER DISPLAY (SD)

- SYNOPTIC OF THE AFFECTED SYSTEM AUTOMATICALLY CALLED OVHT IS DISPLAYED IN AMBER

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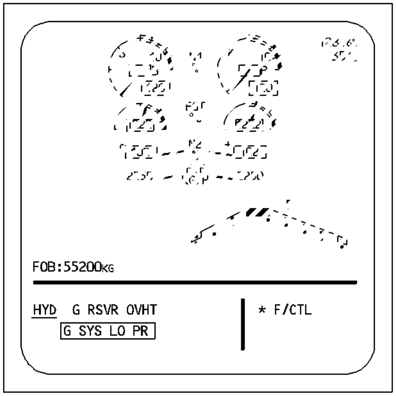
3 — THE FLIGHT CREW FOLLOWS THE INSTRUCTION DISPLAYED ON THE E/WD

The crew switches off the green ENG 1 and 2 pump, depressurizing the green hydraulic circuit.

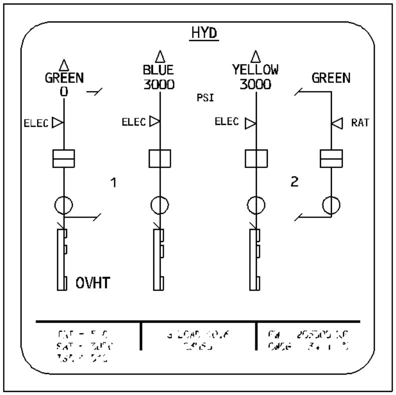
COCKPIT INDICATIONS

- A single chime sounds.
- Both MASTER CAUTION lights stay on.
- A FAULT/OFF light on the overhead panel comes on.
- The second part of the message on the E/WD changes to "G SYS LO PR".
- The system diagram on the SD displays an amber zero for the pressure in the green system, along with the amber "OVHT".
- The right side of the memo area indicates a secondary failure in the flight control system.
- The CLR pushbutton, on the ECAM control panel, remains lit.



ECAM UPPER DISPLAY (E/WD)

- LEFT PART
  - INDEPENDENT FAILURE AND PRIMARY FAILURE
- RIGHT PART
  - SECONDARY FAILURE



ECAM LOWER DISPLAY (SD)

- THE SYNOPTIC OF THE SYSTEM PAGE IS CHANGED ACCORDING TO THE NEW SYSTEM CONFIGURATION. OVHT AND THE PRESSURE ARE DISPLAYED IN AMBER

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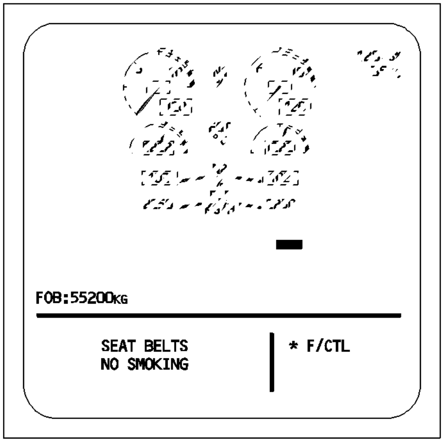
4 — ONE OF THE PILOTS PUSHES THE CLR PUSHBUTTON ON THE ECP

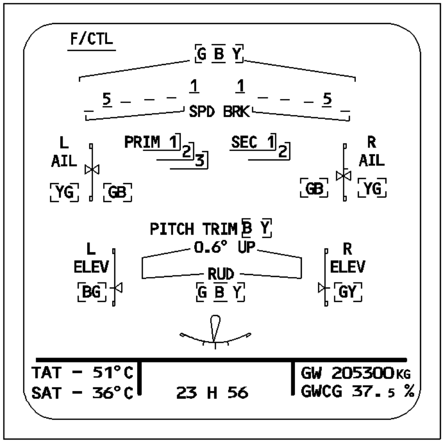
COCKPIT INDICATIONS

- The CLR pushbutton stays lighted.
- The FAULT/OFF light stays on.
- The hydraulic system messages disappear from the E/WD, and the right side of the memo area indicates a secondary failure in the flight control system.
- The SD automatically calls up the flight control system page, with surface actuator indications associated with the green hydraulic system shown in amber.



ECAM UPPER DISPLAY (E/WD)

- LEFT PART
  - MEMO INFORMATION
- RIGHT PART
  - SECONDARY FAILURE



ECAM LOWER DISPLAY (SD)

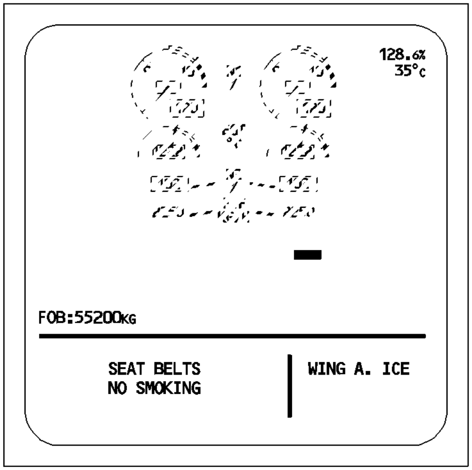
- F/CTL SYSTEM PAGE AUTOMATICALLY DISPLAYED FAULTY SPOILERS (n°1+5) AND SURFACE ACTUATOR PRESSURE INDICATION G ARE DISPLAYED IN AMBER

GFC5-01-3125-005-A001AC

5 — ONE OF THE PILOTS PUSHES THE CLR PUSHBUTTON A SECOND TIME

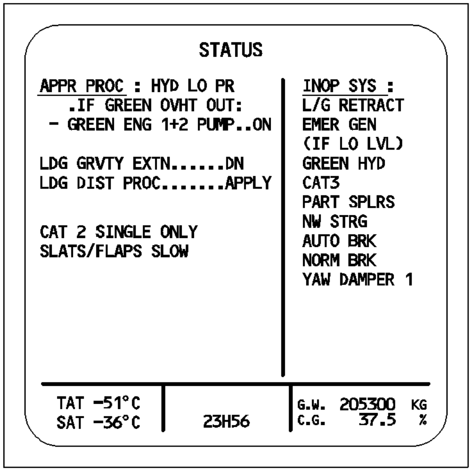
COCKPIT INDICATIONS

- The CLR and STS pushbuttons on the ECP light up.
- The FAULT/OFF lights stay on.
- The memo area on the E/WD returns to normal.
- The STATUS page appears automatically on the SD, displaying the procedures for completing the flight with faulty green system.



ECAM UPPER DISPLAY (E/WD)

- FULL MEMO DISPLAYED



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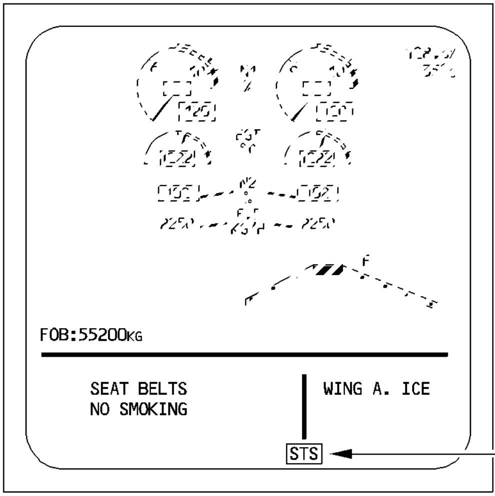
ECAM LOWER DISPLAY (SD)

- THE STATUS PAGE IS AUTOMATICALLY DISPLAYED TO
  - PROVIDE THE PROCEDURE TO APPLY FOR APPROACH
  - LIST THE INOPERATIVE SYSTEMS

6 — ONE OF THE PILOTS PUSHES THE CLR PUSHBUTTON A THIRD TIME

COCKPIT INDICATIONS

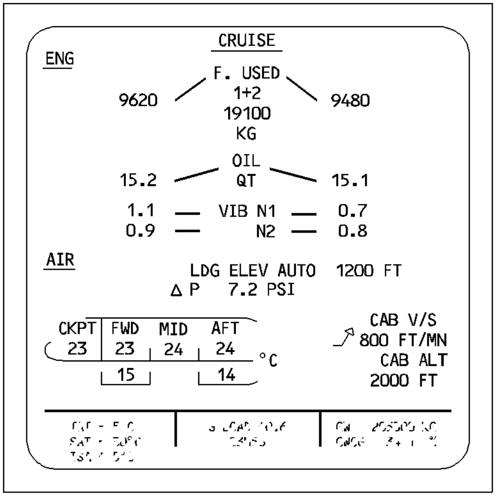
- The CLR pushbutton light goes off.
- The FAULT/OFF lights stay on.
- A status reminder appears at the bottom of the E/WD.
- The SD automatically calls up the system page for the flight phase.



ECAM UPPER DISPLAY (E/WD)

- FULL MEMO DISPLAYED

STATUS REMINDER



ECAM LOWER DISPLAY (SD)

- RETURN TO THE FLIGHT PHASE RELATED SYSTEM PAGE : CRUISE PAGE

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GENERAL

The OEB reminder function provides operational help to the crew by enabling them to clearly identify (on the ECAM) all procedures and status messages affected by an OEB.
When a situation leading to a warning/caution occurs, a message informs the crew in real time that an OEB exists for the displayed warning and/or status and, consequently, that the procedure and/or status presented on the ECAM is not applicable.
Then the crew must refer to the QRH where the correct information is provided.

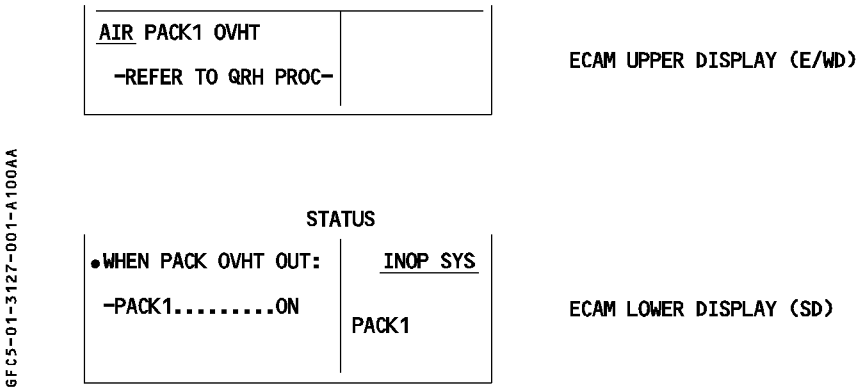
DESCRIPTION

The OEB reminder flag may apply to the :
- ECAM procedure only,
- ECAM procedure and corresponding status messages,
- Status message only.

PROCEDURE ONLY AFFECTED

- The ECAM warning title remains unaltered,
- All corresponding actions are suppressed and replaced by the "REFER TO QRH PROC" message.
- The related status messages on the ECAM system display remains unaltered.

COCKPIT INDICATION



PROCEDURE AND STATUS AFFECTED

- The ECAM warning title remains unaltered,
- All corresponding actions are suppressed and replaced by the “REFER TO QRH PROC” message.
- The related status messages on the ECAM system display remains unchanged, except for the additional “REFER TO QRH PROC” title.

COCKPIT INDICATION

AIR PACK1 OVHT -REFER TO QRH PROC-	

ECAM UPPER DISPLAY (E/WD)

STATUS

REFER TO QRH PROC	INOP SYS
•WHEN PACK OVHT OUT: -PACK1.........ON	PACK1

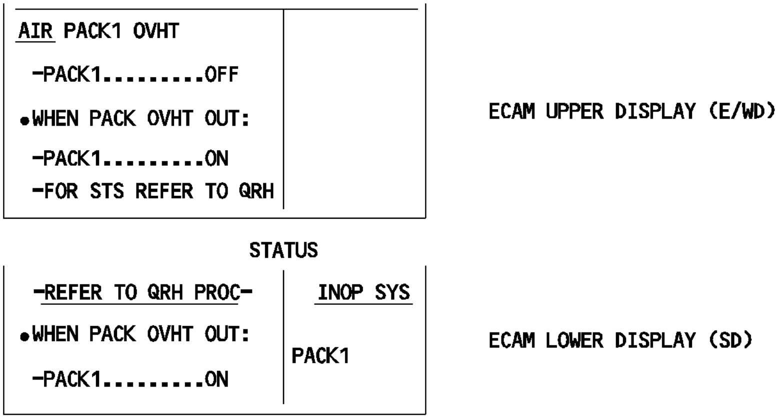
ECAM LOWER DISPLAY (SD)

GFC5-01-3127-002-A100AA

STATUS MESSAGE ONLY AFFECTED

- The ECAM warning title remains unaltered,
- The corresponding procedure remains unchanged, except for additional “FOR STS REFER TO QRH” line.
- The related status messages on the ECAM system display remains unchanged, except for additional “REFER TO QRH PROC” title.

COCKPIT INDICATION



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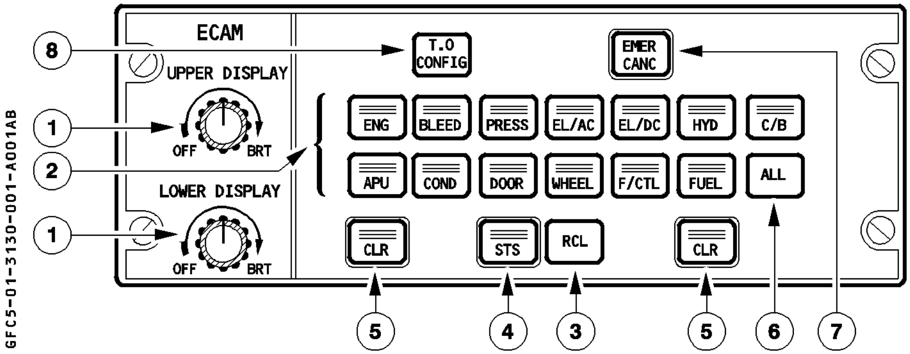
OEB DATABASE

The OEB database lists the warnings and cautions affected by OEBs.
The OEB database can be :
· Loaded manually on the aircraft via the MCDU, and stored in both FWCs.
· Crossloaded from one FWC to the other FWC.
· Updated by entering a code via the MCDU.
· Checked via the MCDU.

Note : The code provided on the OEB is designed to ensure that the OEB database is not updated before the OEB is available.

ECAM CONTROL PANEL



① OFF / BRT knobs

Used to turn the ECAM DUs on and off, and to control their brightness (automatic adjustment of brightness for ambient light conditions is superimposed on this manual control).

Note : When the pilot turns the UPPER DISPLAY knob to OFF, the engine/warning (E/W) display appears on the lower display unit (automatic transfer).

② System page pushbuttons

- Call up the corresponding system pages on the SD.
- Light up, when pushed for manual selection, or when an advisory is detected.
- Call up the aircraft system page corresponding to the present flight phase or the current warning when pushed a second time.
  When only one ECAM display is on, the pilot can display a system page for up to 3 minutes by holding the system page pushbutton.
  · If an advisory condition arises, the relevant system page is not automatically displayed, but the pushbutton light pulses.
  · If an ECAM warning is triggered, the relevant system page is not automatically displayed, and the system page pushbutton does not light up.

③ RCL pushbutton

The pilot pushes the RCL pushbutton to call up the warning messages, the caution
R messages, and the status page, that may have been suppressed by the activation of the CLR pushbutton or by flight-phase-related inhibition.
If there are no suppressed warnings or cautions, the E/WD shows “NORMAL” for five seconds.
If the pilot holds this pushbutton down for more than three seconds, the E/WD displays any caution messages that were suppressed by the EMER CANC pushbutton.

4 STS (status) pushbutton

The pilot pushes this pushbutton to display the STATUS page on the lower SD. The pushbutton remains lit, as long as the SD displays the STS page. If the system has no status messages, the status page displays "NORMAL" for five seconds.
The pilot can clear the STATUS page by pushing the CLR pushbutton, or by pushing the STS pushbutton a second time.
When only one ECAM display is on :
- It displays the STATUS page only when the pilot pushes the STATUS pushbutton and holds it. He can display the next STATUS page, if any, by releasing the pushbutton and pushing it again (before two seconds have elapsed). The new page then appears after a short delay.
- The pilot can keep the STS pushbutton pressed to display the STATUS page for a
R maximum of 3 minutes, after which the ECAM automatically displays the engine/warning page.

5 CLR pushbutton

This pushbutton remains lit as long as the E/WD is displaying a warning, or caution
R message, or a status message on the SD.
If it is lit, pressing it changes the ECAM display.

6 ALL pushbutton

When this pushbutton is pressed and held down, the SD successively displays all the system pages at two-second intervals.
If the ECAM control panel fails, the pilot can use this pushbutton to page through the system pages until he comes to the one he wants to look at. He then releases the pushbutton to select that page.

7 EMER CANC pb

This pushbutton affects the following :

— Warnings :
  · Cancel (stop) an aural warning, for as long as the failure condition continues.
  · Extinguishes the MASTER WARNINGS lights.
  · Does not affect the ECAM message display.
— Cautions :
  · Cancel any present caution (single chime, MASTER CAUTION lights, ECAM message) for the rest of the flight.
  · Automatically calls up the STATUS page, which displays “CANCELLED CAUTION” and the title of the failure that is inhibited.

The inhibition is automatically suppressed when Flight Phase 1 is initiated. The pilot may restore it manually by pressing the RECALL pushbutton for more than three seconds.

R *Note : This pushbutton should only be used to suppress spurious MASTER*
R *CAUTIONS.*

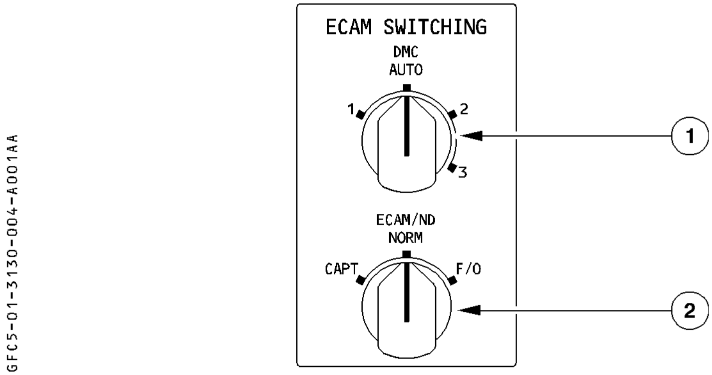
8 TO CONFIG pb

This pushbutton simulates the application of takeoff power. This is a test that triggers a warning, if the aircraft is not in takeoff configuration. (See 1.31.15).
If the configuration is correct, the E/WD displays the “TO CONFIG NORMAL” message in the TO MEMO section.

Note : If the ECAM control panel fails, the CLR, RCL, STS, EMER CANC, and ALL pushbuttons remain operative, because their contacts are directly wired to the flight warning and display management computers.

ECAM SWITCHING PANEL

ON MAIN INSTRUMENT PANEL



R ① DMC selector switch

AUTO : DMC 3 supplies data to both ECAM DUs
In case of DMC 3 failure, the DMC 1 automatically takes over.
1 : DMC 1 replaces DMC 3
2 : DMC 2 replaces DMC 3
3 : DMC 3 supplies data to both ECAM DUs

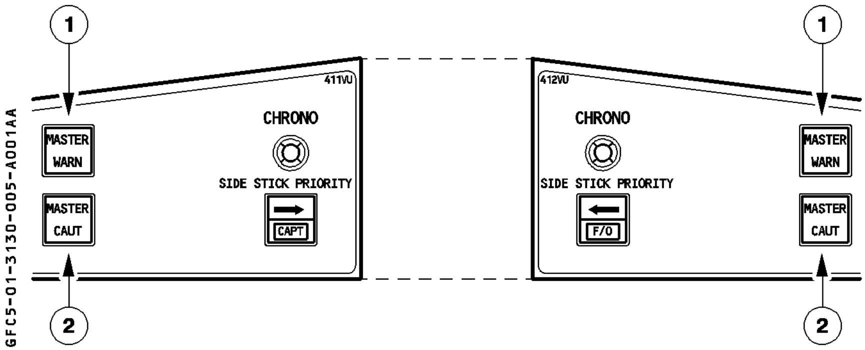
Note : If a DMC fails, each of its associated DUs displays a diagonal line.

R ② ECAM/ND transfer selector switch

R Transfers the system/status display to either the captain's or the first officer's NDU.

Note : If both ECAM DUs (E/WD and SD) fail, the flight crew can use this switch to transfer the E/W display to either navigation display.

ATTENTION GETTERS



(1) MASTER WARN lights

- Flash red for level 3 warning.
- Accompanied by an aural warning (continuous repetitive chime, specific sounds or synthetic voice).

(2) MASTER CAUT lights

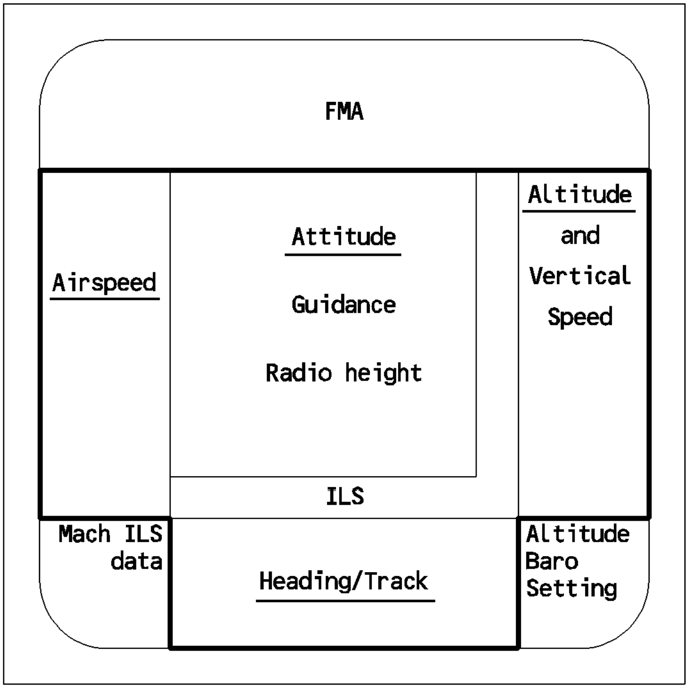
- Light up steady amber for a level 2 caution.
- Accompanied by a single chime.

These lights go out when :
- One pilot presses the light (except for some red warnings, such as the overspeed and stall warnings).
- The warning/caution situation is over.
- The pilot presses the CLR pushbutton on the ECAM control panel (except for some red warnings, such as the overspeed and stall warnings).
- The pilot presses the EMER CANC pushbutton on the ECAM control panel.

The aural warnings cease when :
- One pilot presses the MASTER WARN light (except for some red warnings, such as the overspeed and stall warnings).
- The warning situation is over.
- The pilot presses the EMER CANC pushbutton on the ECAM control panel.

GENERAL

The Primary Flight Display gives the flight crew :
- Attitude and guidance information
- Airspeed
- Altitude (baro and radio) and vertical speed
- Heading and track
- FMGS modes (flight mode annunciator)
- Vertical and lateral deviations
- Radio navigation information (ILS, DME).



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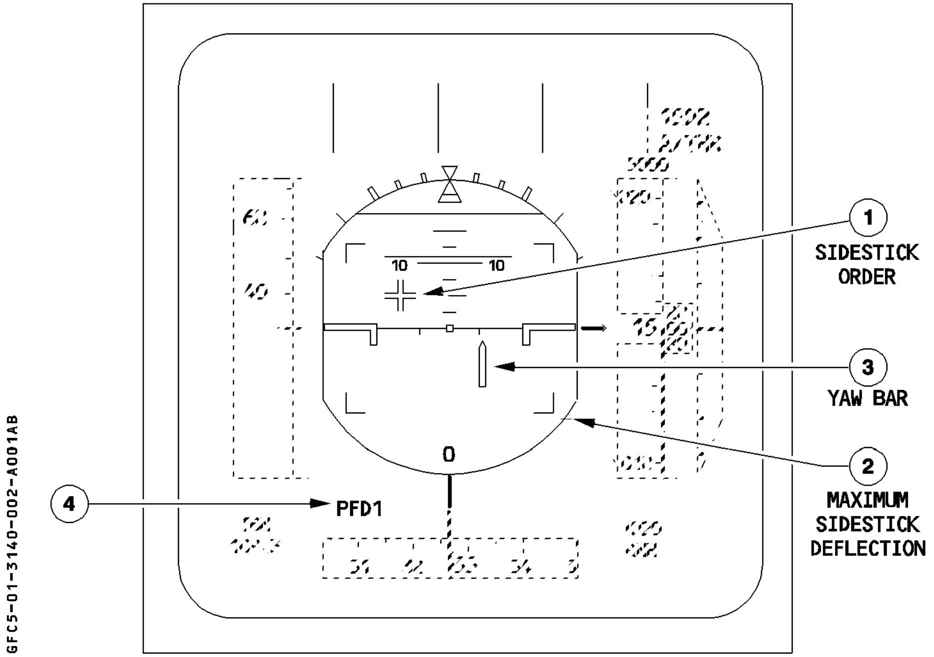
The FWC monitors main parameters such as attitude, heading, and altitude. See also "FLAGS AND MESSAGES DISPLAYED ON PFD" chapter.

Note : A grey background is displayed on speed, heading vertical speed and altitude FPD scales.
R *In case the temperature in the PFDU exceeds a certain threshold this grey*
R *background is suppressed in order to avoid a DU overheat.*

SPECIFIC GROUND INDICATIONS



(1) Sidestick order indication (white)

This is displayed, as soon as one engine is started.
It indicates the total of the pilot's and copilot's sidestick orders (shown here as left wing down, pitch up).

(2) Max Sidestick Deflection (white)

This is displayed, as soon as one engine is started.

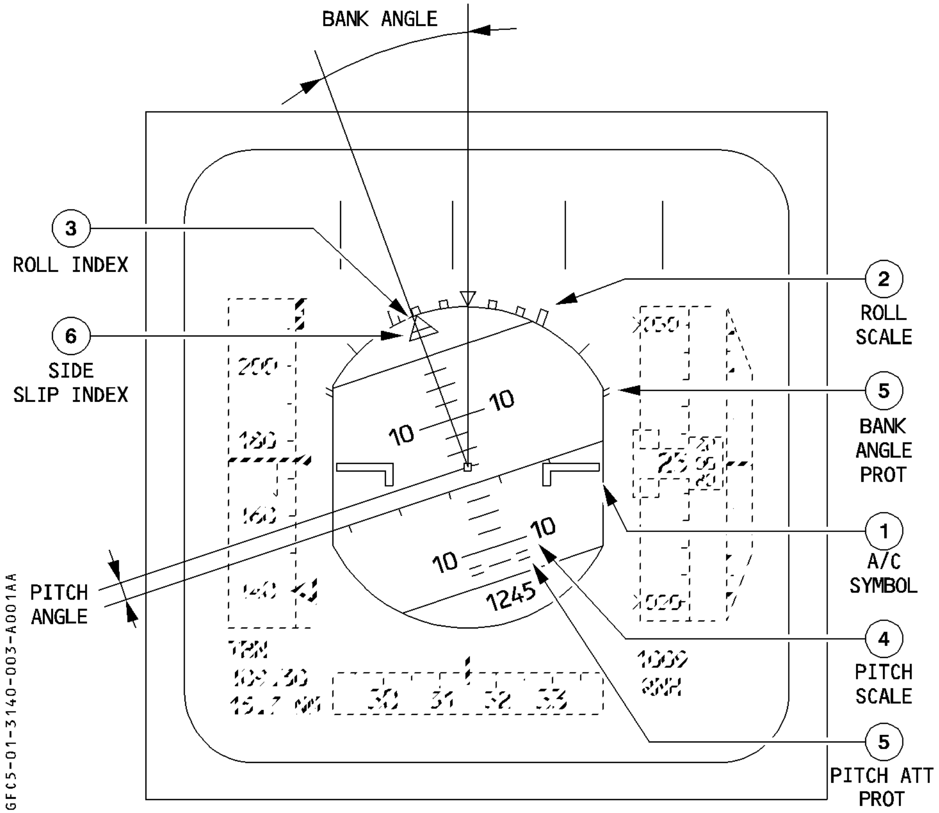
(3) Ground Roll Guidance Command Bar (green)

This symbol is displayed when the aircraft is on the ground, or below 30 feet radio
R altitude provided a localizer signal is available. It shows the flight director yaw orders to
R keep the runway center line.

(4) PFD 1 (2 or 3) message (magenta)

The display indicates which DMC drives the PFD. It only appears during test on ground.

ATTITUDE DATA



① Fixed Aircraft Symbol

This symbol is black, outlined in yellow.

② Roll Scale

This scale is in white, and has markers at 0,10, 20, 30, and 45 degrees of bank.

③ Roll Index (yellow)

This pointer indicates the bank angle. When the bank angle exceeds 45°, all the PFD symbols, except those for attitude, speed, heading, altitude, and vertical speed, disappear. The display returns to normal when the bank angle decreases below 40°.

(4) Pitch Scale (white)

This scale has markers every ten degrees between 80° nose up and 80° nose down (every 2.5° between 10° nose down and 30° nose up). When pitch angle exceeds 25° nose up or 13° nose down, all the PFD displays except attitude, speed, speed trend, heading, altitude, and vertical speed disappear. Beyond 30°, large red arrowheads indicate that the attitude has become excessive and show the direction to move the nose in order to reduce it. The display returns to normal when pitch angle becomes less than 22° nose up or 10° nose down.

(5) Flight Control Protection Symbols

The display shows these symbols in green :
· on the roll scale at ± 67° to mark the bank angle limits
· on the pitch scale at 15° nose down or 30° nose up to mark the pitch limits.
An amber × replaces these symbols if the corresponding protection is lost. (Refer to 1.27.30)

(6) Sideslip Index (yellow)

This trapezoidal index moves beneath the roll index. On the ground it represents the lateral acceleration of the aircraft : in flight it shows sideslip (as furnished by ADIRS). One centimeter of displacement indicates 0.2g. The sideslip index is against its stop at 0.3g.

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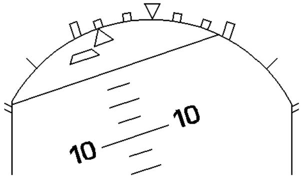
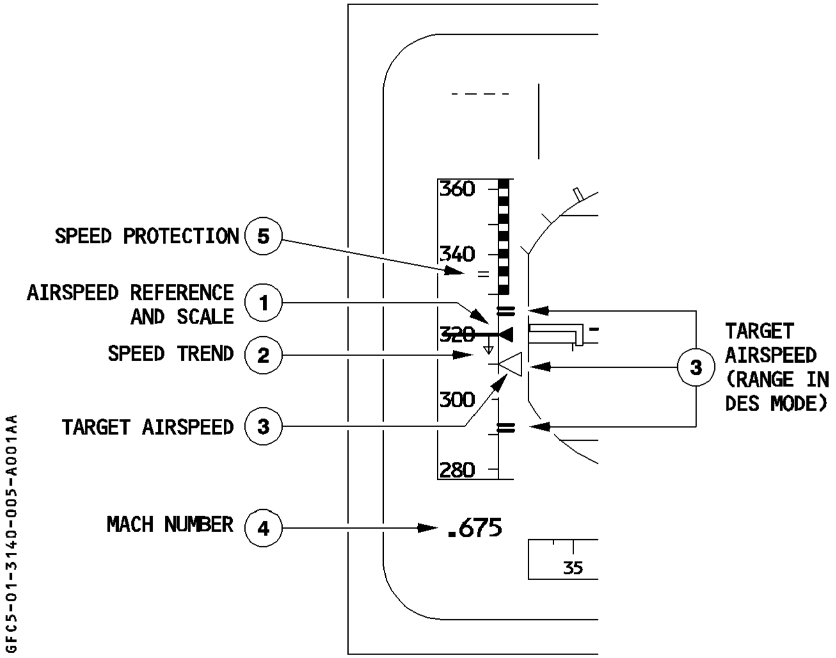


In case of engine failure at takeoff or go-around, the sideslip index changes from yellow to blue.

Note : *The sideslip target is blue if :*
– CONF 1, 2, or 3 is selected, and
– any ENG N1 > 80%, and
– difference between ENG N1 > 30%.
In this case the sideslip index is called β target.

When this index is centered with the roll index, the sideslip equals the sideslip target for optimum aircraft performance.

R **AIRSPEED**



① Actual Airspeed Reference Line and Scale

A white scale on a grey background moves in front of a fixed yellow reference line next to a yellow triangle to show airspeed. The minimum airspeed indication is 30 knots.

② Speed Trend (yellow)

This pointer starts at the speed symbol. The tip shows the speed the aircraft will reach in 10 seconds if its acceleration remains constant. The pointer appears only when it is greater than 2 knots and disappears when it is less than 1 knot.
It also disappears if the FMGCs fail.

(3) Target Airspeed (magenta or blue)

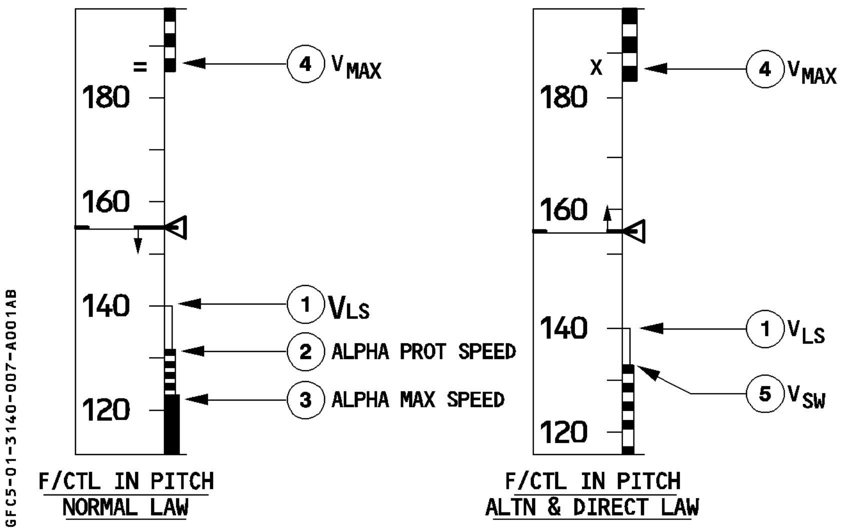
This symbol gives the target airspeed or the airspeed corresponding to the target Mach number.
The target airspeed is the airspeed computed by FMGC in managed speed mode (magenta) or entered manually on the FCU for selected speed mode (blue).
When the target speed is off the speed scale, its value is displayed as numbers below or above the speed scale.

(4) Mach Number (green)

This is displayed when it is greater than 0.5 and the LS pushbutton is not selected on the EFIS control panel.

(5) Speed Protection (green)

This symbol indicates the speed (VMO + 4 kt or MMO + 0.006) at which overspeed warning will occur. This symbol is not displayed in pitch alternate or direct law because the protection is not available. (Refer to 1.27.30).



1. Minimum Selectable Speed (VLS)

The top of the amber strip along the speed scale indicates this speed. It represents the lowest selectable speed providing an appropriate margin to the stall speed. (Refer to 3.04.10)
VLS information is inhibited from touchdown until 1 second after liftoff.

2. Alpha Protection Speed

The top of a black and amber strip along the speed scale indicates this speed.
It represents the speed corresponding to the angle of attack at which alpha protection becomes active (Refer to 1.27.20).
It is displayed when in pitch normal law.

3. Alpha Max Speed

The top of a red strip along the speed scale indicates this speed. It represents the speed corresponding to the maximum angle of attack that the aircraft can attain in pitch normal law (Refer to 1.27.20).
It is displayed when in pitch normal law.

4 VMAX

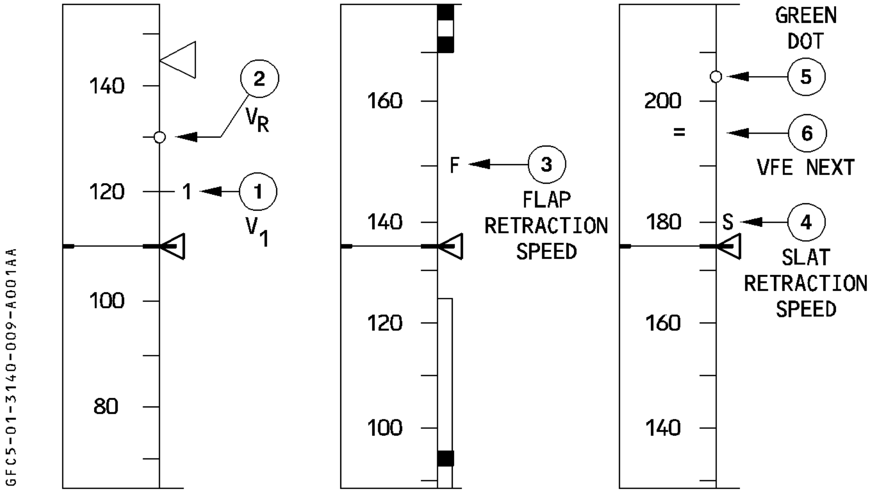
The lower end of a red and black strip along the speed scale defines this speed.
It is the lowest of the following :
- VMO or the speed corresponding to MMO
- VLE
- VFE

(Refer to 3.04.10)

5 Stall Warning Speed (VSW)

The top of a red and black strip along the speed scale defines this speed.
It is the speed corresponding to the stall warning. (Refer to 1.27.20).
VSW information is inhibited from touchdown until 5 seconds after liftoff.
It is displayed when operating in pitch alternate or pitch direct law.

R



(1) Decision Speed : (V1)

This is a blue symbol (numeric) that the crew manually inserts via the MCDU. When it is off the scale, the upper part of the scale shows it in numbers.
It disappears after liftoff. (Refer to 3.04.10)

(2) Rotation speed : (VR)

This a blue circle and corresponds to the value that the crew manually inserts via the MCDU. It appears during takeoff, while on ground.

Note : V2 is represented by the target speed index during takeoff.
V2 is manually inserted by the crew via the MCDU.

(3) Minimum Flap Retraction Speed

This is a green symbol (letter F).
It appears when the flap selector is in Position 2 or 3. (Refer to 3.04.10)

(4) Minimum Slat Retraction Speed

It is represented by a green symbol (letter S).
It appears when the flap selector is in Position 1. (Refer to 3.04.10)

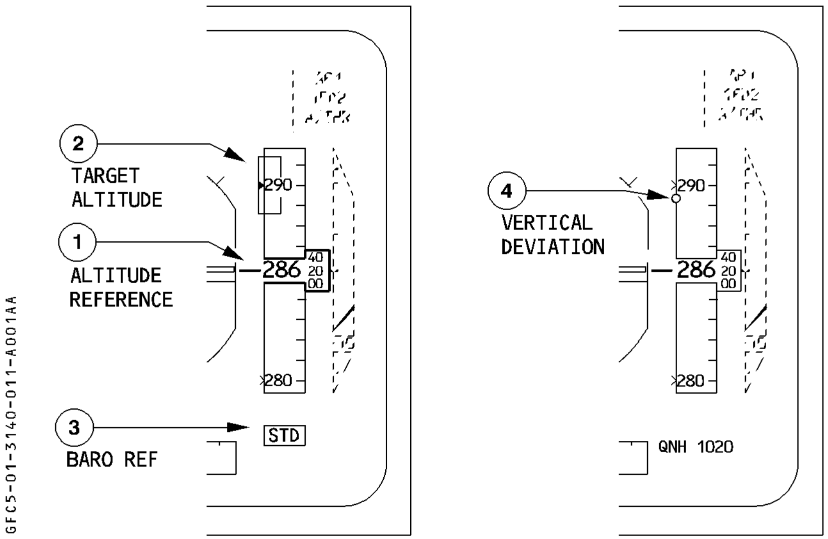
(5) Green Dot (Engine-out operating speed in clean configuration)

This green dot appears when the aircraft is flying in the clean configuration.
It shows the speed corresponding to the best lift-to-drag ratio.

(6) VFE NEXT

This symbol, an amber =, shows the VFE corresponding to the next flap lever position.
It appears when the aircraft altitude is below 20000 feet. (Refer to 3.04.10)

R **ALTITUDE**



① Altitude Indication

This appears both as a white moving scale and as a green digital readout on a grey blackground. “NEG” appears in the window in white for negative altitudes. The altitude window changes from yellow to amber, if the aircraft deviates from the FCU-selected altitude or flight level.
On any approach for which an MDA (MDH) is entered in the FMGS, the altitude numbers change from green to amber, when the aircraft goes below the MDA (MDH).

② Target Altitude or Selected Flight Level Symbol (blue)

This symbol shows the FCU-selected altitude (if QNH baro reference is selected), or the selected flight level (if STD baro reference is selected.)
When the FMGC operates in the vertical managed mode, this symbol is in magenta, if it represents a flight plan altitude constraint that the FMGC will follow. If the target altitude or flight level is on the scale, the symbol is displayed and the numerical value appears inside the symbol.
If it is off the scale, the symbol is not displayed, and the numerical value appears above or under the scale.

③ Barometric Reference

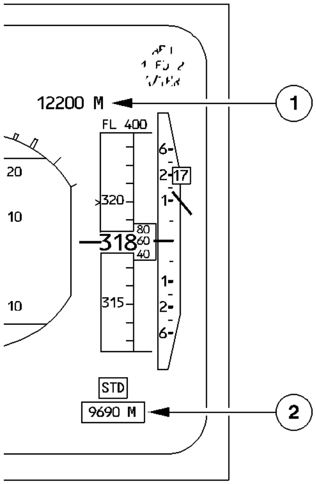
The display shows "STD", or "QNH", and the numerical setting is in hectoPascals or inches of mercury.
It pulses when the pilot's selection is incorrect (STD not selected above transition altitude in climb, or STD still selected in approach below transition level or 2500 feet radio height if transition level is not available).

④ Vertical Deviation (magenta)

This symbol appears next to the altitude corresponding to the theoretical vertical profile computed by the FMGC. It is displayed from the top of descent down to the final intercept altitude.
The pilot can read the VDEV directly from the altitude scale. The range is ± 500 feet. When the VDEV value exceeds ± 500 feet, the symbol stays at the range limit and the PROG page displays the exact value.

METRIC ALTITUDE INDICATION

If metric reference is selected on the FCU, two additional symbols are displayed on PFD.



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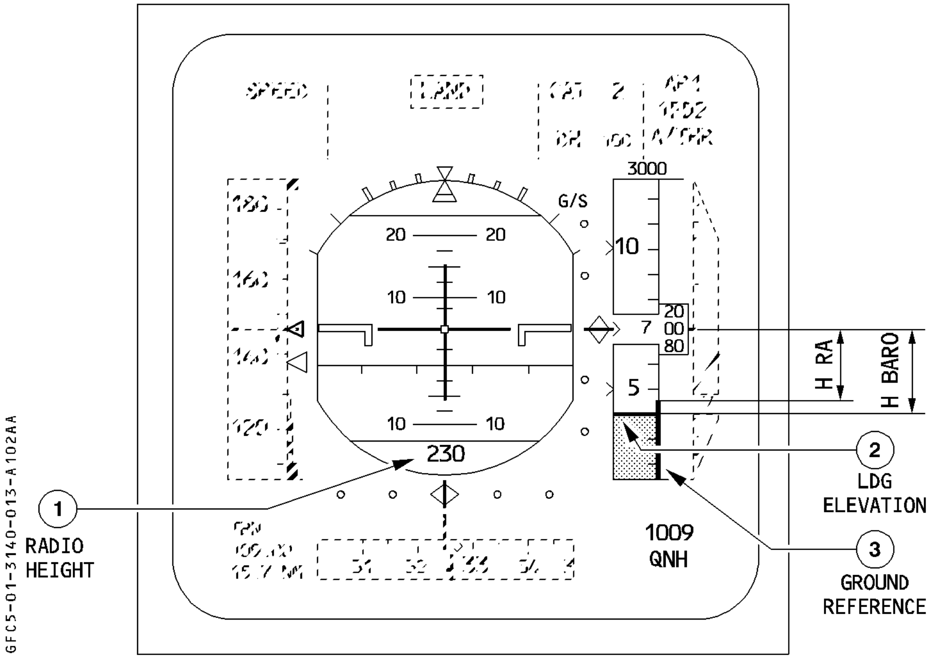
① Target altitude or selected flight level (magenta or blue)

The display shows the selected altitude value in meters.

② Altitude indication (green)

The display shows the actual aircraft altitude value in meters.



① Radio Height

This quantity appears when it is less than 2500 feet.

– If a DH has been entered, the radio height appears :
  · In green, when DH + 100 feet < RA < 2500 feet.
  · In amber, when RA < DH + 100 feet.
  If "NO" is entered as the DH on the MCDU APPROACH page, 0 feet becomes a default value.
  When the aircraft reaches the decision height selected on the MCDU, DH letters flash amber for three seconds, then stay amber above the radio height indication.
– If no DH has been entered, or if both FMGCs fail, the radio height appears :
  · In green, when 400 feet < RA < 2500 feet.
  · In amber, when RA ≤ 400 feet.

The radio altitude indication changes every 10 feet down to 50 feet, then every 5 feet down to 10 feet, then every foot.

R (2) Landing Elevation (brown)

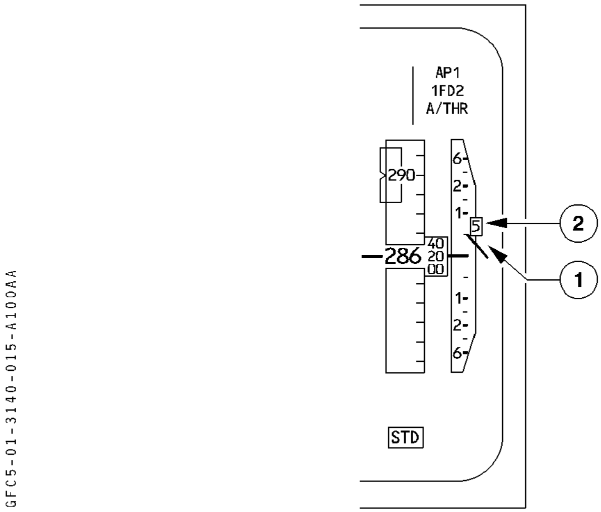
The top of the brown surface on the altitude scale represents the landing elevation at the flight-planned destination.
It is displayed :
– During flight phases 7 and 8, and
R – If the QNH reference mode is selected.

(3) Ground reference

A red ribbon on the right of the altitude scale represents the field elevation. This ribbon, which is driven by the radio altimeter signal, is displayed below 570 feet.
It moves up, as does the lower line of the attitude sphere, with the altitude scale as the aircraft descends. When the aircraft has touched down, the top of this ribbon is at the middle of the altitude window.

VERTICAL SPEED

R The displayed vertical speed information is normally based on both inertial and barometric
R data. If inertial data is not available, it is automatically replaced by barometric information. In this case, the window around the numerical value becomes amber.



(1) Analog pointer

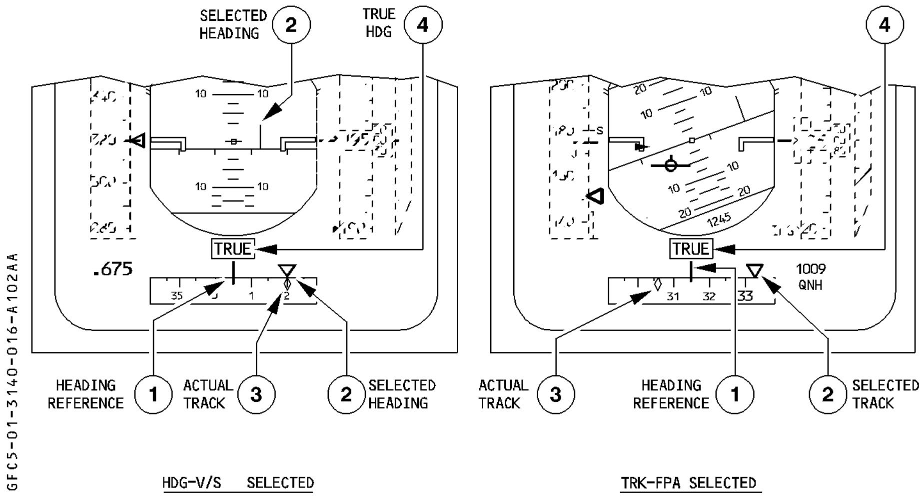
This pointer, which is normally green, points to a white vertical speed scale displayed on a grey background and graduated at intervals of 500 feet/minute.
If the V / S is greater than 6000 feet/minute, the pointer stays at the end of the scale.

(2) Digital indication

This number, normally green, is the vertical speed in hundreds of feet per minute.
It disappears if the vertical speed is less than 200 feet/minute.
The analog pointer and the digital indication become amber, if :
· V / S is greater than 6000 feet/minute, (climb or descent)
· V / S is greater than 2000 feet/minute, during descent when 1000 feet < RA < 2500 feet, or
· V / S is greater than 1200 feet/minute, during descent and RA < 1000 feet.

Note : For TCAS, refer to 1.34.80.

HEADING



① Heading Reference Line and Scale

A white scale on a grey background moves in front of a fixed yellow reference line to show the actual magnetic heading.

② Selected Heading or Track Index (blue)

The pointer indicates the heading or track selected on the FCU HDG-TRK counter.
The index is replaced by digits on the right or left side of the scale, when the selected value is off the scale.
If the FD pushbutton is OFF, a second heading or track symbol appears on the horizon line and markers are displayed every 10°.

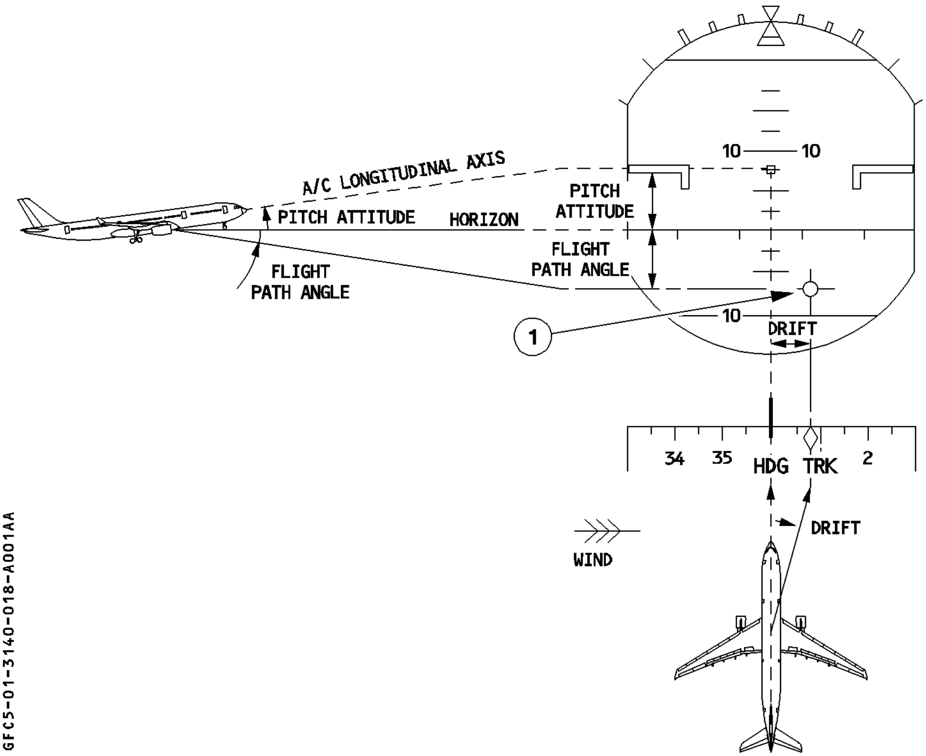
③ Actual Track Symbol

This symbol is a small green diamond.

4 True heading (blue)

At high latitude, above 82.5° North or 60.5° South (or entering the north, magnetic polar region latitude 73.5° N and longitude between 117.5° W and 92.5° W) the ADIRUs replace magnetic heading by true heading on EFIS and DDRMI.
When the aircraft is in close proximity to these regions (latitude above 82° North or 60° South or approaching the north polar region : 73° N and longitude between 90° W and 120° W) the ADIRU will trigger a "SELECT TRUE REF" message on the ND requesting to change north reference.
In true heading configuration at slats extension, "TRUE" with flash for 9 seconds then remain steady.

FLIGHT PATH VECTOR



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(1) Flight Path Vector (FPV)

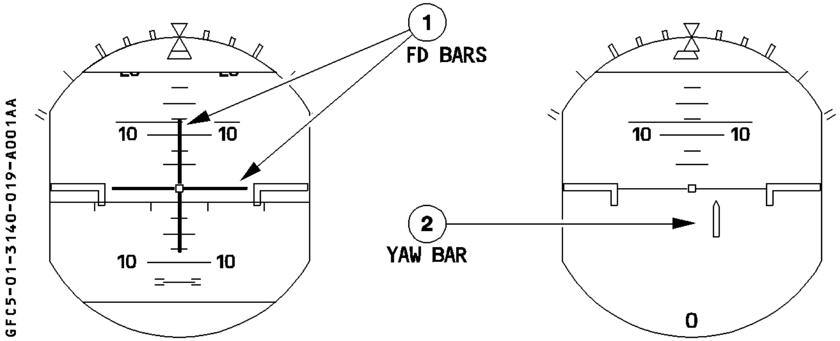
This symbol appears when the pilot selects TRK/FPA on the FCU.
The flight path vector represents the lateral and vertical trajectory of the aircraft with respect to the ground.
– On the lateral scale it indicates the aircraft's track.
– On the vertical scale it indicates the aircraft's flight path angle.
Example : The aircraft flies a track of 009 (heading 360°, wind from west) and descends with a flight path angle of – 7.5°.

GUIDANCE

Two completely different flight director modes are available, each with its own characteristic symbols. The symbol displayed corresponds to the basic operating reference the pilot has selected. – either HDG V/S or TRK FPA.
In normal operation PFD1 displays FD1 orders.
If FD1 fails, PFD1 automatically displays FD2 orders, and on the PFD1 the FD2 indication in the right column of the FMA flashes for a few seconds.
The same applies for FD2 orders normally displayed on PFD2.

IF THE CREW HAS SELECTED HDG V/S TO BE THE BASIC REFERENCE :

The PFD displays pitch and roll bars in green. They automatically move out of view at touchdown in ROLL OUT mode.
They flash for 10 seconds and then remain steady in the following conditions :
– reversion to the HDG V/S basic mode (manually or automatic)
– change of selected flight level when the autopilot is already engaged in ALT CAPTURE mode
– loss of LOC or G/S in LAND mode or loss of LAND mode
– at the first AP or FD engagement
The PFD displays a yaw bar in green below 30 feet radio altitude if a localizer signal is available:
– during takeoff (in RWY mode)
R – upon landing (in FLARE and ROLL OUT mode).

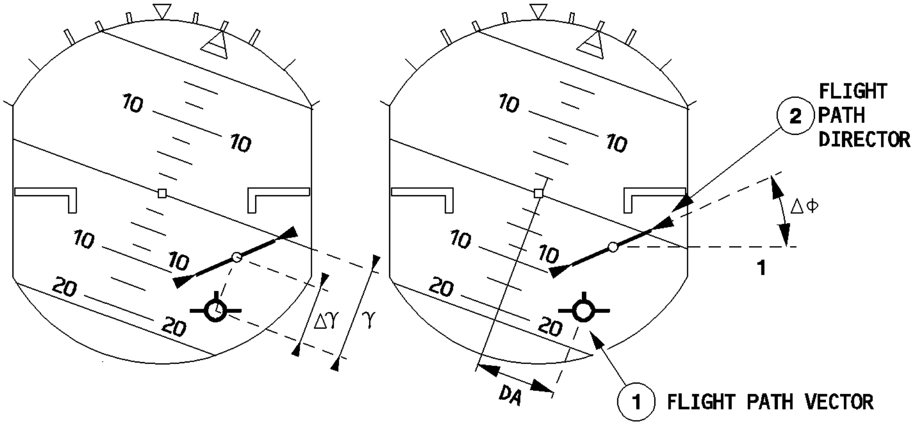


(1) FD Crossed Bars (green)

(2) Yaw Bar (green)

THE CREW HAS SELECTED TRK FPA AS THE BASIC REFERENCE :

An inertial flight path vector defines the aircraft's horizontal and vertical track, taking wind effect into account.
An associated flight path director symbol guides the flight crew onto the vertical and horizontal flight path targets.



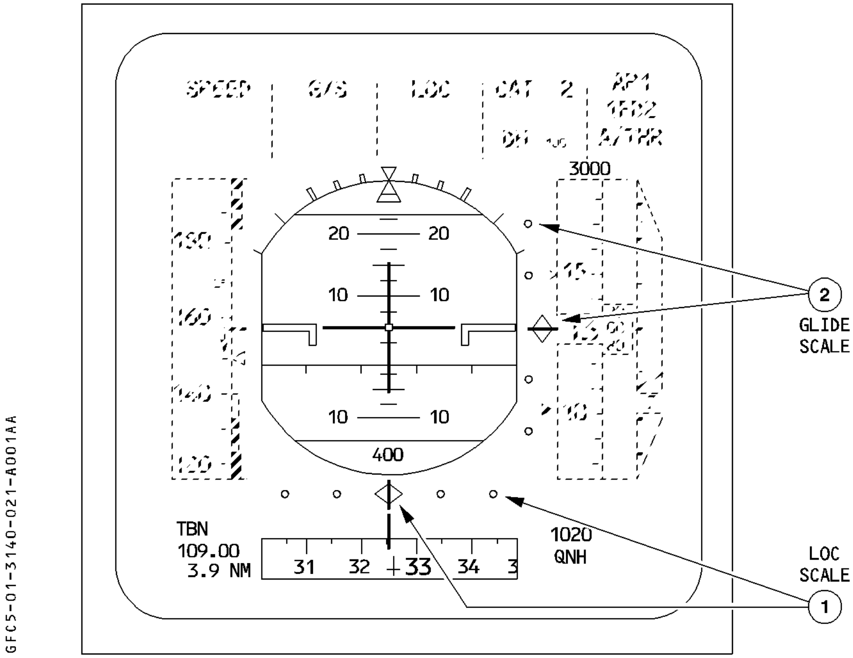
Υ REPRESENTS THE FLIGHT PATH ANGLE
DA REPRESENTS THE DRIFT ANGLE
ΔΥ REPRESENTS THE DIFFERENCE BETWEEN THE ORDERED FLIGHT PATH ANGLE AND THE ACTUAL ONE
ΔΦ REPRESENTS THE DIFFERENCE BETWEEN THE ORDERED ROLL ANGLE AND THE ACTUAL ONE

(1) Flight Path Vector (green)

(2) Flight Path Director (green)

TRAJECTORY DEVIATION

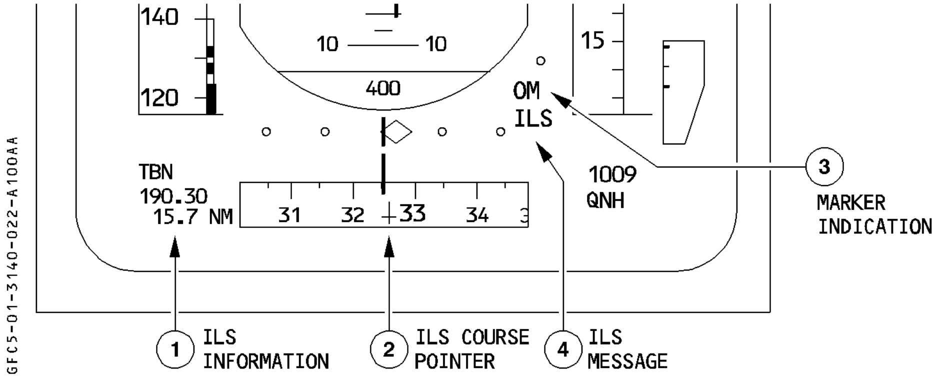
ILS APPROACH



(1) Localizer Deviation Scale and Index

(2) Glide Slope Deviation Scale and Index

Deviation scales appear as soon as the flight crew pushes an LS pushbutton switch on the EFIS control panel. Deviation indexes appear when the glide slope and localizer signals are valid if deviation scales are displayed.
When a deviation index is out of the displayed range, only half a symbol appears at the end of the scale.
The LOC scale flashes and continues to flash if the deviation exceeds 1/4 dot for two seconds (above 15 feet RA). The glide scale flashes and continues to flash if the deviation exceeds one dot for two seconds (above 100 feet RA).
"LOC" and the glide scale half index symbols flash and continue to flash when the deviation exceeds two dots for two seconds.
R One dot represents a deviation of ± 0.8 ° on the localizer scale and ± 0.4 ° on the glide
R slope scale.



(1) ILS information (magenta)

The following information appears on the PFD, when the crew has selected an ILS frequency and course and pushed the LS pushbutton :
- ILS identification as decoded by the ILS receiver
- ILS frequency
- DME distance, if the ILS has a DME

(2) ILS course Pointer (magenta)

This pointer appears on the PFD, when the crew has selected an ILS frequency and course and pushed the LS pushbutton.
It is a dagger-shaped symbol on the heading scale.
The ILS course pointer is replaced by digits on the right or left-hand side of the heading scale (in a white box), when the ILS course value is outside the displayed portion of the heading scale.

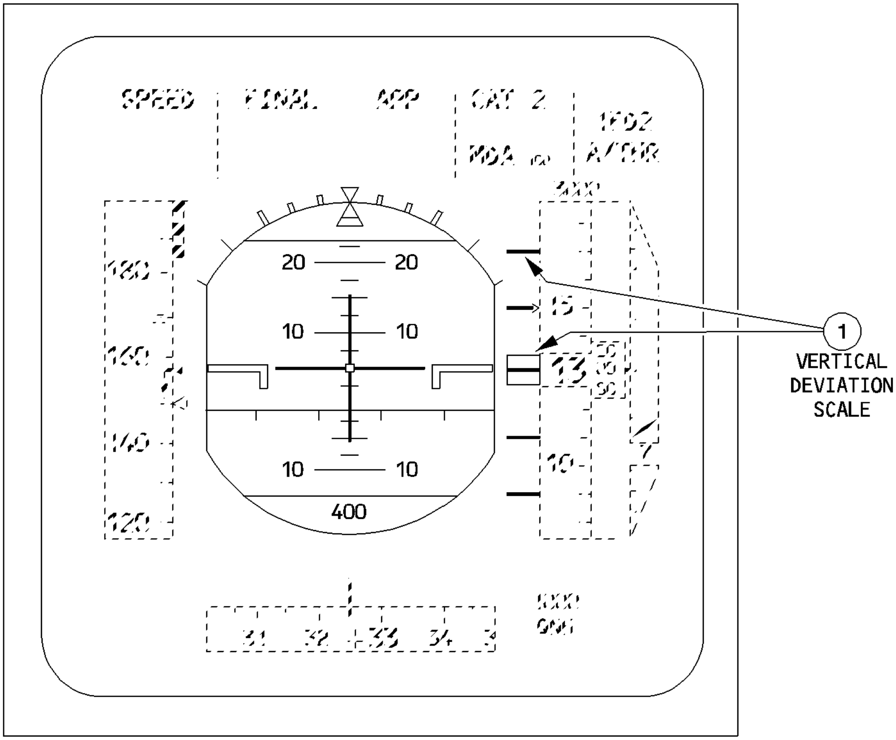
(3) Marker Indications

OM appears in blue, when the aircraft flies over the outer marker
MM appears in amber, when the aircraft flies over the middle marker
IM appears in white, when the aircraft flies over an airways marker beacon or the ILS inner marker.

(4) ILS Message

This flashes amber, when the APPR mode is armed and the ILS display is not selected.

NON PRECISION APPROACH
R



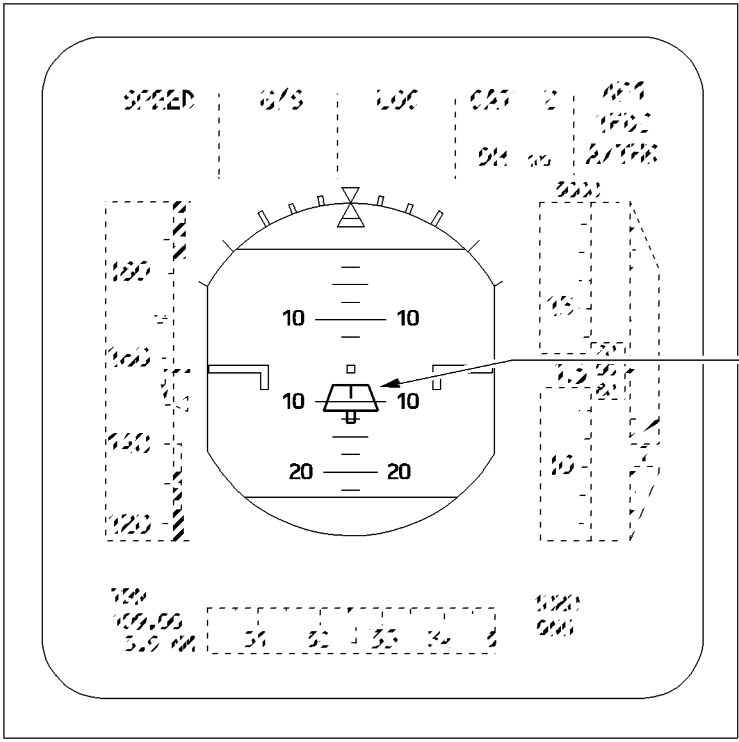
GFC5-01-3140-023-A102AA

(1) Vertical Deviation Scale and Index

R The vertical deviation scale and index appear when in approach phase and, when either
R the FINAL APP mode is armed/engaged, or a non-LS approach has been entered. They
R are displayed in the approach or go-around phase, until the MDA has been reached, or
R the MAP or the runway has been sequenced. They give the vertical deviation with respect to the trajectory defined by the FMGC.
Each index scale graduation represents 100 feet. The range limit is ± 200 feet.

Note : If the LS pushbutton is pressed, glide deviation has priority over vertical deviation
R *information. As long as V/DEV display conditions are met, and the LS pushbutton*
R *is selected, an amber V/DEV message flashes above the glide scale.*

RISING RUNWAY SYMBOL



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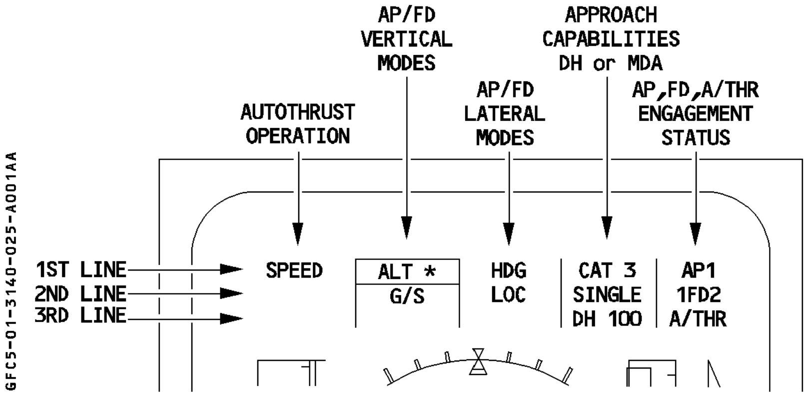
(1) Rising Runway Symbol (magenta)

If :
– The localizer signal is valid,
– The radio altitude is available, and
– The yaw bar is not displayed,
at 200 feet RA the runway symbol starts from the bottom of the pitch scale. Its vertical deviation is driven by the radio altitude and its lateral deviation by the localizer.

Note : When the rising runway option is installed, the lower line of the attitude sphere does not move for ground reference.

FLIGHT MODE ANNUNCIATOR

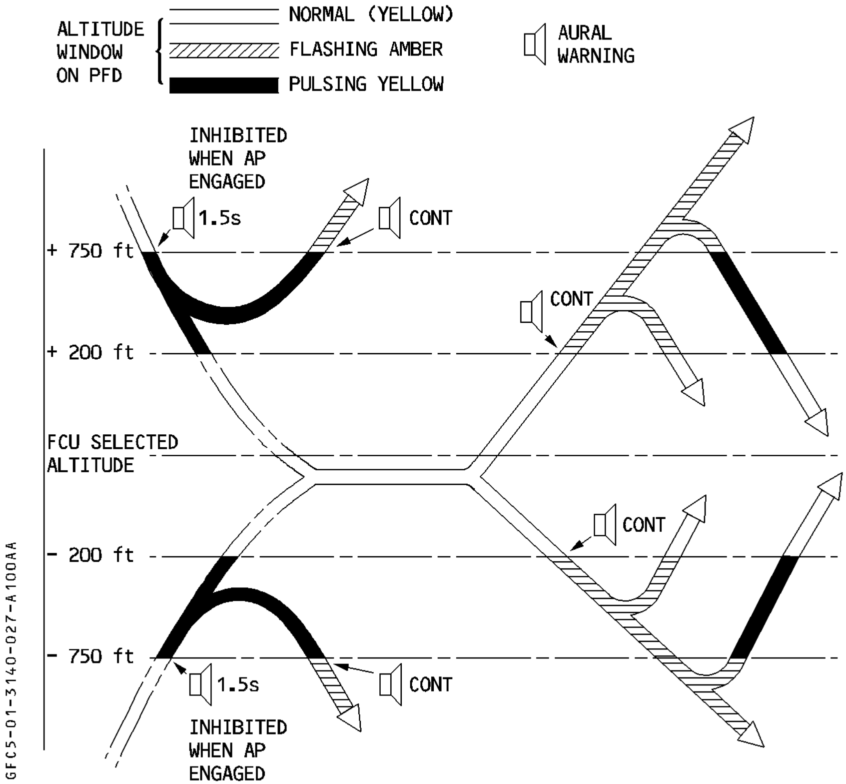


For a detailed discussion of legends and messages that may appear during FMGS operations, see autoflight chapter (Refer to 1.22.30).

LEFT INTENTIONALLY BLANK

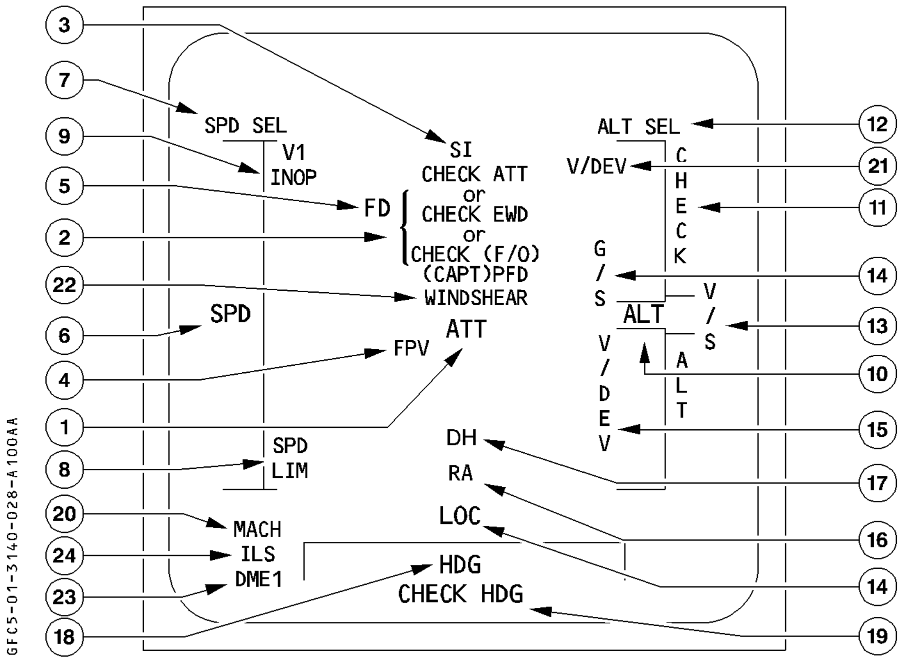
ALTITUDE ALERT

The FWC generates an altitude warning (C chord sound, and the altitude window of the PFD pulses in yellow or flashes in amber), when the aircraft approaches a preselected altitude or flight level, or when it deviates from its selected altitude or flight level.
This warning results from a comparison between the altitude (ADIRS) and the preselected altitude displayed on the FCU.



— The continuous C chord sound is either cancelled when the crew selects a new altitude, or pushes the ECAM control panel's EMER CANC pushbutton, or presses either MASTER WARN pushbutton.
— The selection of a new altitude stops the flashing of the altitude window.
— The altitude alert is inhibited, when :
  · The slats are out, with landing gear selected down, or
  · In approach after the aircraft captures the glideslope, or
  · The landing gear is locked down.

FLAGS AND MESSAGES DISPLAYED ON PFD



(1) ATT flag (red)

If the PFD loses all attitude data, its entire sphere is cleared to display the ATT flag.

(2) CHECK ATT, CHECK (F/O) (CAPT) PFD, CHECK EWD flag (amber)

"CHECK ATT" appears when there is a disagreement (of a least 5°) in the attitude information displayed by the two PFDs. The CHECK ATT flag appears on both PFDs, and a caution appears on the ECAM.
"CHECK PFD" appears when the DMC detects a disagreement between the two PFDs. The CHECK PFD flag appears on both PFDs.
When the DMC detects a discrepancy between its own computation and its displayed information, the CHECK CAPT PFD (CHECK F/O PFD) message is displayed on CAPT PFD (F/O PFD).

(3) SI flag (red)

If the sideslip information is lost, the index disappears and a red SI flag appears.

(4) FPV flag (red)

In TRK FPA mode, when the drift angle or flight path angle is not valid an FPV flag appears.

(5) FD flag (red)

If both FMGCs fail, or if both FDs are disengaged and the FD pushbutton is on and the attitude is valid, a red FD flag appears.

(6) SPD flag (red)

If speed information fails, a SPD flag replaces the speed scale.

(7) SPD SEL flag (red)

If selected speed information fails, a SPD SEL flag appears.

(8) SPD LIM flag (red)

R This flag appears when both FMGCs (flight envelope part) are inoperative, or in case of
R SFCC dual flap/slat channel failure.
In this case, the following PFD information is lost : VLS, S, F, Green Dot, Vtrend, Vmax, VFE next, VSW.
In case only Vmax or VLS is lost, the flag comes up on the PFD but the remaining valid information still appears.

(9) V1 INOP flag (red)

When the V1 signal is not valid, a V1 INOP flag replaces the digital value.

(10) ALT flag (red)

If altitude information fails, the ALT flag replaces the altitude scale.

(11) CHECK ALT flag (amber)

The CHECK ALT flag appears, as does an ECAM caution, if the difference between the two PFDs altitude indications is greater than 250 feet when QNH is selected or 500 feet when STD is selected.
The caution and the flag disappears when the pilot's and the copilot's barometer or references are different.

(12) ALT SEL flag (red)

If the selected altitude information fails, an ALT SEL flag appears.

(13) V/S flag (red)

If the vertical speed information fails, the V/S flag replaces the vertical speed scale.

(14) LOC and G/S flags (red)

If the localizer or glideslope receiver fails, a LOC or G/S flag appears on the deviation scale.

(15) V/DEV flag (red)

R If the vertical deviation information fails and the LS pushbutton is not pressed, a V/DEV flag replaces the V/DEV scale.

(16) RA flag (red)

If both radio altimeters fail, this flag appears in place of the radio height indication when the aircraft altitude is below the transition altitude. The ground reference indication (red ribbon) will disappear.

(17) DH flag (amber)

A DH flag appears, when the aircraft reaches the selected DH.

(18) HDG flag (red)

If the heading information fails, the HDG flag replaces the heading scale.

(19) CHECK HDG flag (amber)

The CHECK HDG flag appears, as does an ECAM caution, if there is a discrepancy (5°) between pilots's and copilot's heading indications.

(20) MACH flag (red)

This flag appears, if the Mach data fails.

(21) V/DEV (amber)

At the top of the glide scale, this message flashes when in approach phase and, either FINAL mode is armed/engaged, or a non-LS approach has been selected, and the LS pushbutton is selected.

(22) WINDSHEAR (red) or W/S AHEAD (red or amber) warnings

WINDSHEAR : Reactive windshear warning. Displayed, when the FMGC detects windshear.
The detection function is available at :
– Takeoff, from 3 seconds after lift-off, up to 1300 feet RA,
– Landing, from 1300 feet RA, down to 50 feet RA,
provided the aircraft is not in clean configuration.
It remains displayed at least 15 seconds after windshear detection.
Associated with an aural "WINDSHEAR" warning which is repeated 3 times.

W/S AHEAD : Predictive windshear warning. Displayed, when a windshear alert is generated by the predictive windshear system below 1500 feet RA.
The color depends on the alert level.
Three different alert levels exist, depending on windshear strength and proximity :

Alert Level	Aural Warning	PFD	ND (refer to 1.31.45)
Warning (Landing)	«GO AROUND WINDSHEAR AHEAD»	W/S AHEAD (red)	Windshear icon
Warning (Takeoff)	«WINDSHEAR AHEAD» (twice)	W/S AHEAD (red)	Windshear icon
Caution	«MONITOR RADAR DISPLAY»	W/S AHEAD (amber)	Windshear icon
Advisory	Nil	Nil	Windshear icon

Note : 1. All flags except SI, V1 INOP, DME 1 (which are steady) flash for 9 seconds then are steady.
DH flag flashes for 3 seconds then is steady.
2. For TCAS, Refer to 1.34.80.

(23) DME 1 flag (red)

When DME distance is not available, a DME 1 (on PFD 1) or DME 2 (on PFD 2) replaces the DME distance indication.

R (24) ILS flag (red)

R If an ILS frequency is not available, or if either the LOC or G/S signals fail, an ILS flag
R replaces the ILS frequency indication.

GENERAL

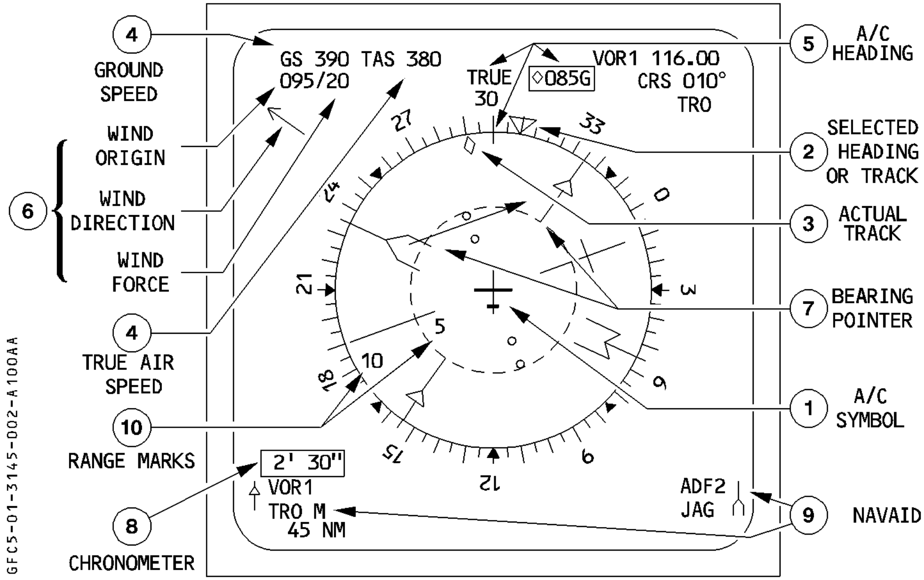
Six different displays are available (five modes to display navigation information and one to display engine primary parameters) :

R – ROSE LS
– ROSE VOR
– ROSE NAV
– ARC
– PLAN
– ENG (stand by page)

The navigation display (ND) can show a weather radar image in all modes except PLAN.

Note : *In case the temperature in the NDU exceeds a certain threshold the weather radar image is suppressed in order to avoid a DU overheat.*
If the temperature increases further the complete image is replaced by a green diagonal line to avoid DU hardware failure. The image is recovered after cool down of the DU.

ROSE MODES



① Aircraft symbol (yellow)

Fixed and centered in the display, this symbol points to the yellow lubber line.

② Selected heading or track (blue)

This pointer shows the heading or track indicated on the FCU's HDG TRK counter.

③ Actual aircraft track (green)

This symbol is a small green diamond.

④ Ground speed and true air speed (green)

ADIRS furnishes these speeds.

5 Aircraft heading

The fixed yellow lubber line points to the aircraft's magnetic heading on the moving white compass rose. Small white triangles are fixed at 45° intervals on the circumference of the compass rose.
At latitudes above 82° North or 60° South (or when entering the north magnetic polar region, latitude 73° N and longitude between 120° W and 90° W), the ADIRUs replace magnetic heading with true heading on the EFIS and DDRMI.
When the aircraft is close to these regions (-0.5° away), the ADIRU causes "SELECT TRUE REF" to appear on the ND. When the crew selects TRUE, "TRUE" appears in blue above the heading scale.
TRUE (blue) :
This appears on the ND when the compass is in the true heading configuration. The message flashes for 9 seconds, or until the slats are extended, then it is steady.
Grid track (green) :
The ND displays the grid track in numerical form, when switch is in true reference and the latitude is above 65° N or S.

6 Wind direction and speed

ADIRS furnishes the wind direction and speed. The digital direction is with respect to true north, and the analog direction (green arrow) is with respect to magnetic north. The arrow only appears, if the wind speed is greater than two knots and the true airspeed is above 100 knots.
If the display does not receive either wind speed or direction, dashes replace the numbers on the display.

7 Bearing pointer

The ND displays the bearing pointer, when bearing data is available. The pointer is :
– Green for ADF
– White for VOR
If ROSE NAV or ARC mode is selected, and the computer detects a mismatch between the aircraft and VOR reference, the bearing pointer appears in magenta. The VOR bearings are true bearings, having been corrected with the magnetic variation of the actual aircraft position (See also FMGS PILOTS GUIDE – POLAR NAVIGATION, 4.04.40).
If reception of a beacon ceases, or if the receiver fails, the associated bearing pointer disappears.

(8) Chronometer indication (white)

These numbers appear, when the onside chronometer is started.
They display the elapsed time.
The indication is in minutes and seconds from 0 to 59′ 59″, and in hours and minutes from 1 H to 99 H 59′. (Seconds are not displayed beyond 59′ 59″).

(9) Navaids

When the ADF-OFF-VOR selector on either the pilot's or co-pilot's EFIS control panel is set to ADF or VOR, the onside ND displays the following characteristics of the corresponding navaid in white for VOR, or in green for ADF (left side for receiver 1 and right side for receiver 2) :

- Type of navaid (ADF or VOR) ;
- Shape and color of the associated bearing pointer (if the bearing pointer is in view);
- Navaid identification (or frequency by default) ;
- DME distance, if a DME is collocated with the selected VOR ADF, and the DME distance are never displayed at the same time.
- Mode of tuning :
  - · M for a navaid manually tuned by the pilot via the MCDU (underlined and dimmed),
  - · R for a navaid tuned from an RMP (Radio Management Panel) (underlined and dimmed),
  - · Nothing for a navaid automatically tuned by the FMGC.

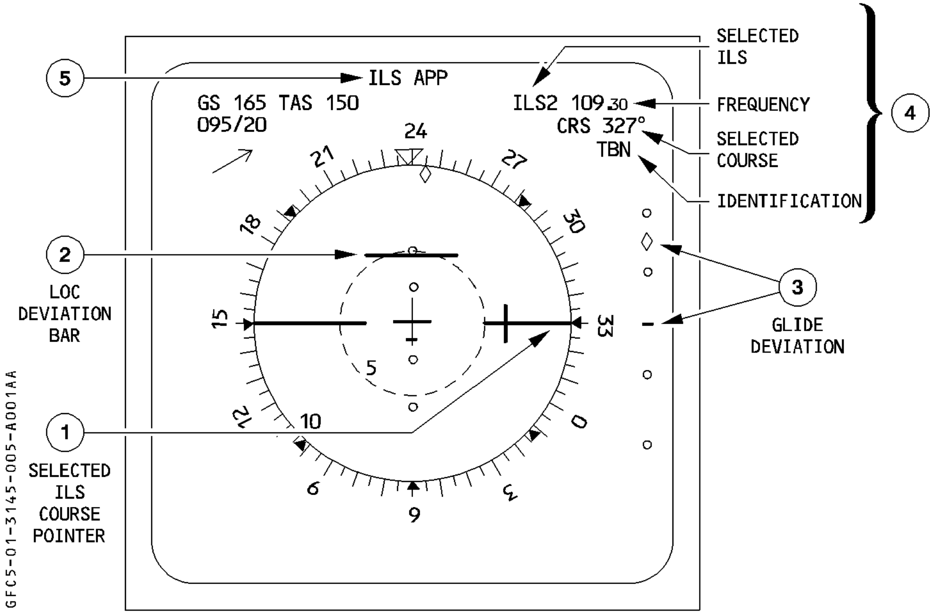
If reception fails, the ND stops displaying the associated data (except for the identification or frequency).

- If there is a mismatch between the aircraft and VOR reference, the following messages are displayed next to the navaid parameters :
  - · In case ROSE NAV or ARC mode is selected : CORR (magenta).
  - · In case ROSE VOR or ROSE LS mode is selected : MAG or TRUE (amber) according to VOR reference.
    Also see FMGS PILOTS GUIDE – POLAR NAVIGATION (Refer to 4.04.40).

(10) Range marks

The range scale value, selected on the EFIS control panel (10 to 320 NM), governs the scale of the ND.

R **ROSE LS MODE**



① ILS course pointer (magenta)

This dagger-shaped symbol points to the selected ILS course.
The ILS is selected either by the FMGC (autotuned or manually) or through the RMP in backup mode.

② Localizer deviation bar (magenta)

This bar moves laterally with respect to the course pointer. Its scale consists of two dots on each side of zero deviation. Each dot represents a deviation of about ± 0.8°.
If the deviation becomes excessive (1/4 dot, 0.2°) above 15 feet RA, the bar and the scale pulse.

(3) Glide deviation (magenta)

This diamond moves on a vertical scale consisting of two white dots on each side of the yellow reference line. Each dot represents a deviation of about ± 0.4°.
If the deviation becomes greater than one dot above 100 feet RA, the scale and the diamond flash.

(4) Selected ILS information

This display shows the ILS frequency (magenta), selected course (blue), and identification (magenta).

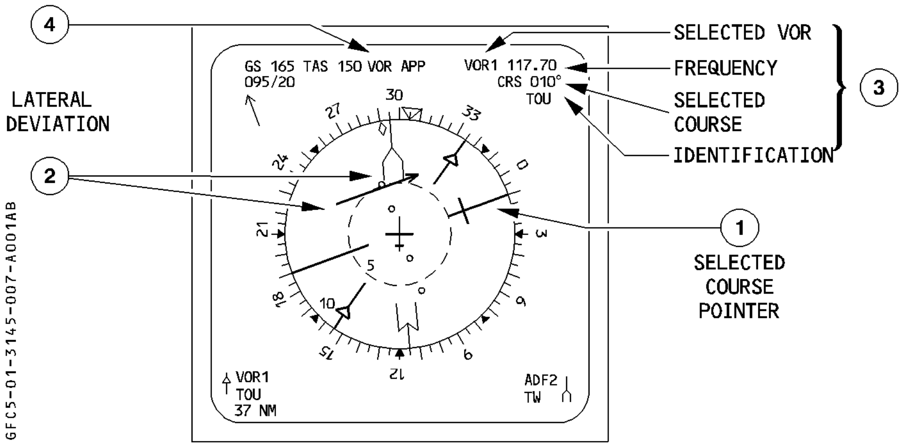
(5) ILS APP message (green)

These letters appear when an ILS approach has been selected on the MCDU.

Note : ILS1 information appears on PFD1 and ND2.
ILS2 information appears on PFD2 and ND1.

ROSE VOR MODE

R



① VOR course pointer (blue)

This dagger-shaped symbol points to the selected VOR course.
The VOR course is automatically selected by the FMGC or manually by the crew using the MCDU pages or the RMP backup mode.

② Lateral deviation bar (blue)

This bar shows the VOR deviation on a lateral scale.
Each dot represents 5°. When the lateral deviation exceeds 10°, the bar remains displayed on the outer dot.
The arrow on the bar gives the TO/FROM indication.

③ VOR information (white)

This area displays the frequency of the selected VOR and its identification (decoded by the receiver), the selected course, and the tuning mode.

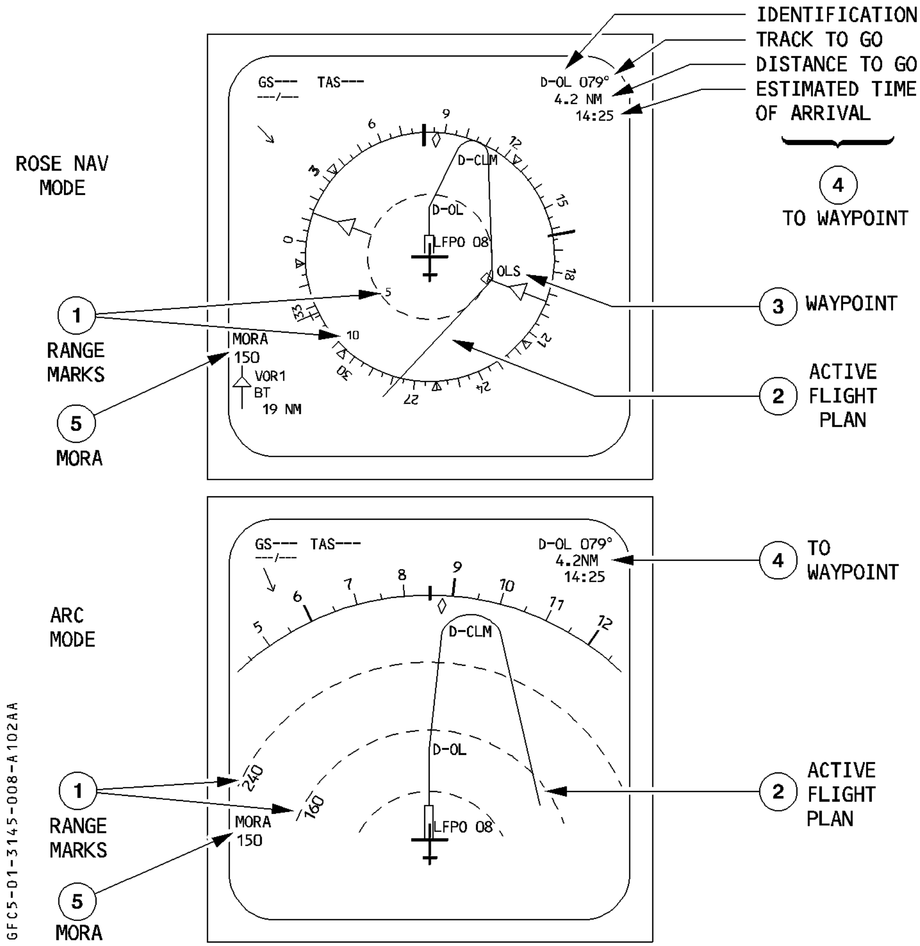
④ VOR APP message (green)

These letters appear when a VOR approach has been selected on the MCDU.

ROSE NAV MODE / ARC MODE

ROSE NAV and ARC modes give the pilot the same information, but ARC mode limits it to the forward 90° sector.
The ROSE NAV and ARC mode display are oriented with respect to the aircraft's heading.

Note : The compass rose is oriented to magnetic or true north, depending on NORTH REF pushbutton selection.



(1) Range Marks and Values

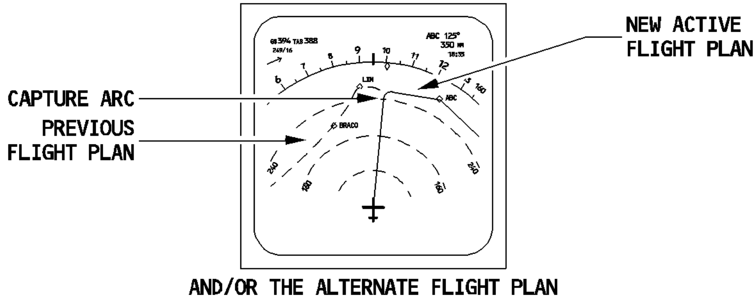
R The values displayed on the ND are :

In ROSE NAV mode	1/4 of the selected range for the inner circle.
	1/2 of the selected range for the heading scale circle.
In ARC mode	1/4 of the selected range for the first inner arc.
	1/2 of the selected range for the second inner arc.
	3/4 of the selected range for the third inner arc.

(2) Flight Plan

The crew can use the MCDU to select various types of flight plan :

· The active flight plan (the flight plan the aircraft is actually following when the NAV mode is engaged) is represented by a continuous green line. The ND shows only the part of the flight plan that is ahead of the aircraft, as well as the waypoints that are still to be overflown and the waypoint from which the aircraft is coming.
The ND does not show a SID or a STAR, except for the last waypoint of the SID and the first waypoint of the STAR, when the selected range is 160 or 320 NM.
If the primary flight plan is not active, it is represented by a dotted green line.
· A continuous blue line portrays the missed approach procedure, and a dashed blue line portrays the flight plan to the alternate.
The missed approach and the alternate flight plan are displayed when :
  — In ARC or ROSE NAV mode, a missed approach waypoint or an alternate flight plan waypoint is displayed on the onside MCDU.
  — In PLAN mode a missed approach or alternate waypoint is displayed in the 2L field of the onside MCDU.
· The secondary flight plan is represented by a continuous white line. The ND continues to display the active flight plan.
· Temporary flight plan
The revised portion of the flight plan is represented by a dotted yellow line.
· Flight plan capture
When the aircraft is off the primary flight plan and is flying toward it in HDG mode with the NAV mode armed, the ND shows the new active flight plan as a continuous green line if the FMGC has computed the intercept path.
The part of the flight plan before the interception point shows as a dotted green line.



R · Abeam/Radial vectors
R The pilot can select on the MCDU to have the display of :
R · either the radial of a selected waypoint perpendicularly to the aircraft present track
R (Abeam)
R · or the selected radial of a waypoint (Radial)
R These vectors are displayed using a dashed blue line.

③ Waypoint

The ND can display various kinds of waypoints :

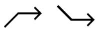
Flight plan waypoints

The ND displays these as green diamonds (white, for TO waypoints). When the pilot selects the WPT option on his EFIS control panel, all waypoints other than flight plan waypoints are displayed in magenta.

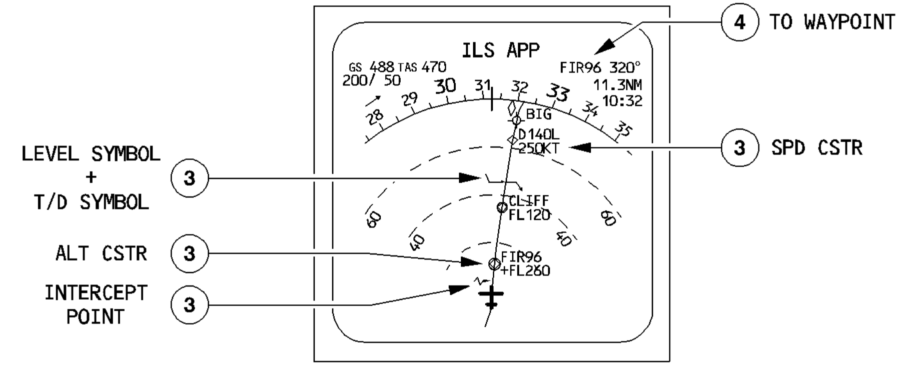
Pseudo waypoint

Point of the flight path where the aircraft is predicted to reach a selected altitude or speed.

R

Pseudo waypoint	Definition
	Level symbol (top of climb or level-off position), at the point where the aircraft will reach : · The FCU-selected altitude (blue arrow). · It is displayed in magenta, if it corresponds to a constraint. · It does not appear when the aircraft is within 100 feet above, or below, the selected altitude.
	Top of descent symbol, or continue descent, symbol : · White, if DES is not armed. · Blue, if DES is armed.
	Start of climb symbol : · White, if CLB is not armed. · Blue, if CLB is armed.
	Intercept point symbol : · Indicates the point at which the aircraft will intercept the FMGC-computed descent profile. · White, if DES is not armed. · Blue, if DES is armed.
●	Speed change symbol (magenta) : · Indicates the point at which the speed has to change.
Ⓓ	Decelerate point symbol (magenta) : · Indicates the point at which the aircraft is predicted to decelerate for approach (and thus switch to the approach phase). · Magenta, if in managed speed and NAV or approach mode is engaged. · White, if in selected speed or HDG/TRK mode. · Automatic decelerations only occur when displayed in magenta.
○	1. ALT CSTR symbol set around the constrained waypoint : · Magenta, when the ALT CSTR is predicted to be satisfied. · Amber, when the ALT CSTR is predicted to be missed. · White, when the ALT CSTR is not taken into account by the guidance, and the NAV mode is engaged. 2. Time marker or equitime point symbol appears in green, to indicate when the aircraft reaches the time marker or equitime point.
	ENERGY CIRCLE symbol (green arc) : · The radius represents the required distance to land from the present position. · It is computed by the FMGC and is only available in ROSE NAV and ARC modes.

③ Waypoint (Cont'd)



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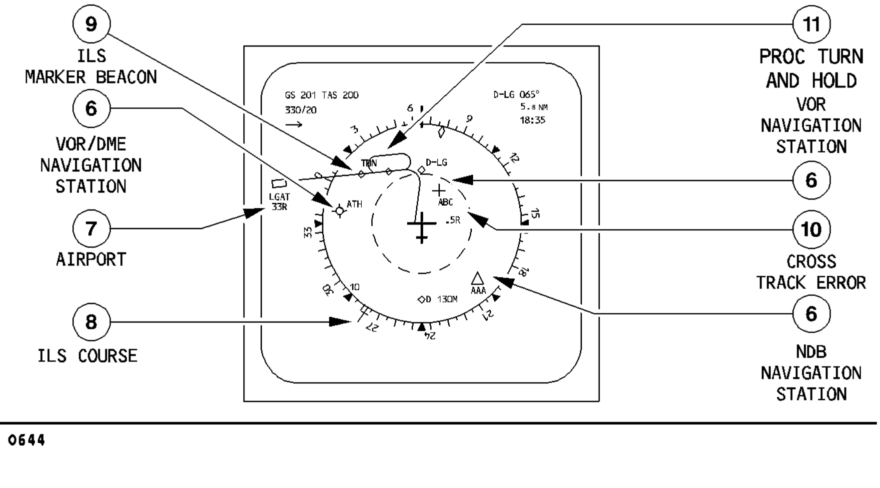
④ TO waypoint

This is the next waypoint to be overflown.
This area of the screen also shows :
- Waypoint identification (white).
- Track to go (green).
- Distance to go (green).
- Estimated time of arrival (green), assuming the aircraft will fly directly from its present position to the TO waypoint at the current ground speed.

⑤ Minimum Off Route Altitude (MORA)

Provided CSTR is selected and range is selected equal to or above 40 NM a digital readout (Flight Level) is displayed which represents the Minimum Off Route Altitude allowed in a circle of 40 NM around the aircraft. Nothing is displayed, if MORA for the chosen flight route is not available in the FMGS database.



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6 Navaids

The display uses specific symbols for navaids :
○ DME or TACAN
+ VOR
⌖ VOR/DME
△ NDB
The symbol appears :
- In green if the navaid is a current waypoint of the flight plan.
- In white if it is the TO waypoint.
- In blue when the navaid is tuned for display either automatically by the FMGC or manually through the MCDU.
- In magenta when the navaid is not part of the flight plan and is called for display as an option (corresponding option pushbutton pressed on the FCU EFIS control panel).

7 Airport

Airport included in the flight plan :
- If the runway is not specified, the airport is represented by a star and the identification is displayed in white.
  Example : * LSGG
- If the runway is specified, it is represented by an oriented runway symbol in white.

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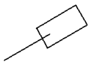

LSGG
33R

The runway is drawn to scale (paved lenght) if the selected range is 10, 20 or 40 NM.

Optional airport information
The airports that are not displayed as part of the flight plan may be called for display (ARPT pushbutton on the EFIS control panel).
They are represented by a star and the identification in magenta.

8 ILS Course (Magenta)

R When the pilot pushes the LS pushbutton switch on the EFIS control panel, and if an ILS station has been selected, the display shows an ILS course symbol.

9 ILS Marker Beacons

The screen shows these as waypoints (diamonds).
When the aircraft overflies a marker beacon, the corresponding symbol flashes :
Blue for the outer marker.
Amber for the middle marker.
White for the inner marker.

(10) Cross track error

This is the aircraft's lateral deviation from the active leg of the flight plan (related to the great circle route). It is indicated in nautical miles (NM), with the letter R (right) or L (left), according to the position of the aircraft with respect to the flight plan.

(11) Procedure turns and holding patterns

These appear only when they are part of the flight plan. For the 160 and 320 NM range scales, each one is represented by a white arrow that originates at the associated fix and indicates the direction of the turn.

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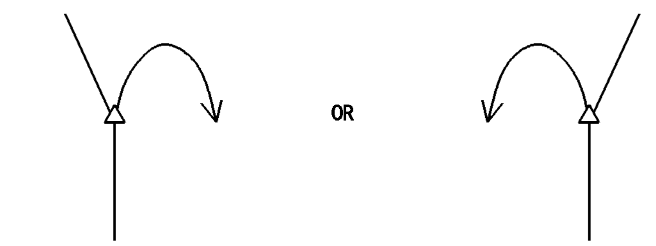

For shorter range scales and if the procedure turn or the holding pattern is in the next or the active leg, the display shows the full circuit or pattern.

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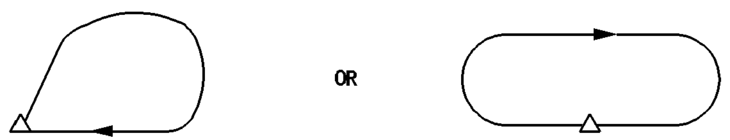
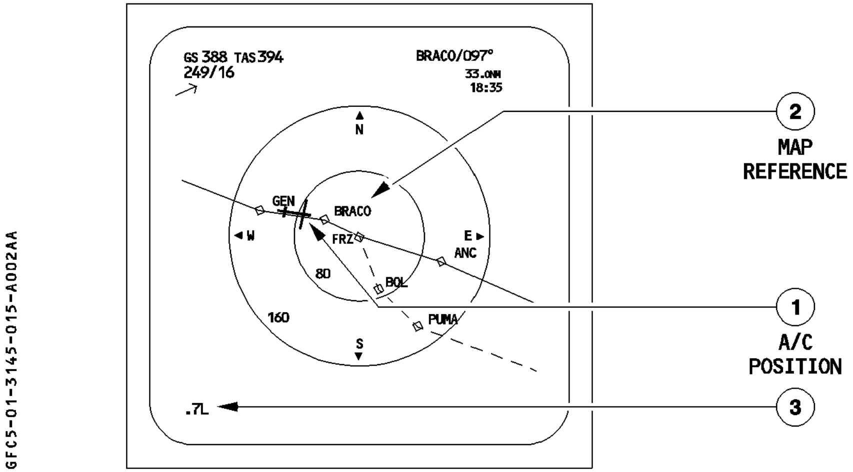


PLAN MODE

This mode statically displays the flight plan legs on a map oriented to true north. The map is centered on a map reference point that the pilot selects by slewing to it on his MCDU. The map reference point is the waypoint displayed on the second line of the MCDU F-PLN page. It can either be the active waypoint (next waypoint to be overflown), or any other waypoint of the flight plan.
The pilot can slew the overall flight plan and display it in PLAN mode.
The pilot chooses the scale of the map with the range selector. (The diameter of the outer circle corresponds to the selected range).
Data on navaids, and their characteristics and associated bearing pointers, are not available in this mode.



① Aircraft position and true track

The orientation of the yellow aircraft symbol always indicates the aircraft's true track. Its position represents the aircraft position given by the FMGS.

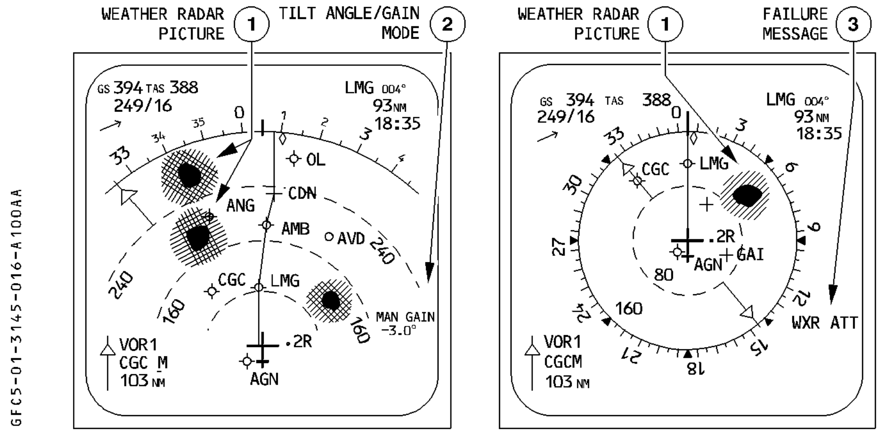
② Map reference point

③ Crosstrack error

R See ROSE NAV MODE/ARC MODE.

WEATHER RADAR

R



① Weather Radar Picture

R — When the radar is operating, and when the ND is not in PLAN mode, the ND displays
R the weather radar picture.
R — The echoes appear in different colors, depending on the precipitation rates (black,
R green, yellow, red or magenta).
R — The selected ND range will determine how often the image is refreshed.

② Tilt Angle and Gain Mode

R — The value of the tilt angle is in degrees, and quarters of a degree. It appears in blue
R in the lower right-hand corner of the screen along with MAN indication. This angle is
R the angle between the horizon and the radar beam axis.
R — "MAN GAIN" appears in white, when the manual gain mode is selected.

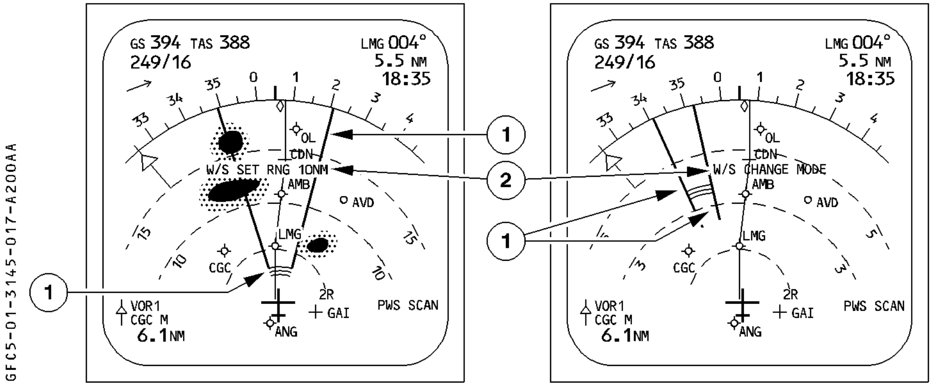
(3) Failure Messages

The ND lists the detected failures.
If the message is in "red", the ND does not display a radar image.
If the message is in "amber", the image is not affected.

WXR RT (red)	:	Radar transceiver failure.
WXR ANT (red)	:	Radar antenna failure.
WXR DU (red)	:	Overheating of the display unit
WXR CTL (red)	:	Radar control unit failure.
WXR RNG (red)	:	Range error.
WXR WEAK (amber)	:	Calibration failure.
WXR ATT (amber)	:	Attitude control failure.
WXR STAB (amber)	:	Antenna stabilization failure.

PREDICTIVE WINDSHEAR SYSTEM

R



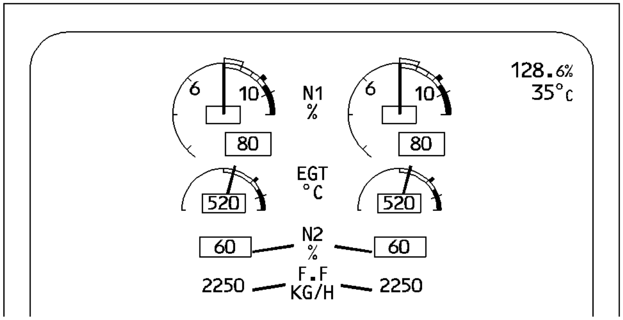
(1) Predictive windshear area indication

A PWS SCAN message is displayed, when the Predictive Windshear system is active on the ND.
The predicted windshear areas are indicated by a red and black icon and two yellow radial lines. Windshear information is available in ARC and ROSE ND modes, and is displayed even if the weather radar is switched off, provided the WINDSHEAR switch on the weather radar panel is set to AUTO.
Depending on the windshear alert level, the ND indication may be complemented by a PFD message (Refer to 1.31.40).

R (2) Windshear messages (W/S : CHANGE MODE, W/S : SET RNG 10 NM)

R These messages are displayed (in amber for caution alert, red for warning alert) on the
R ND, when a windshear event is detected and the mode (W/S:CHANGE MODE) or range
R (W/S:SET RNG 10 NM) of the ND is inadequate to display the windshear echoes.

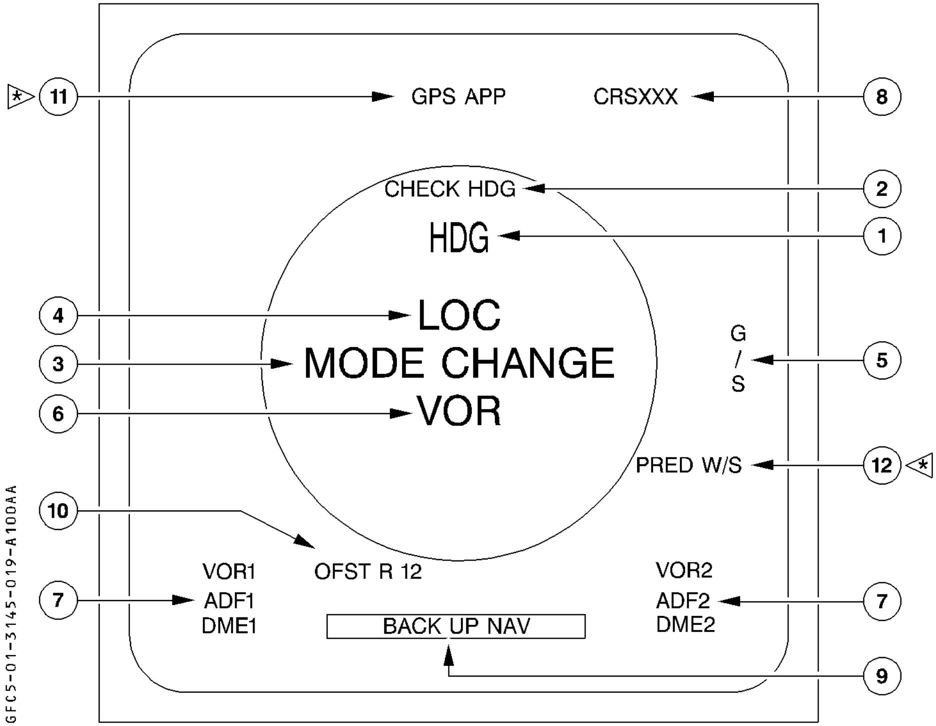
R **ENGINE STANDBY PAGE**



GFC5-01-3145-018-A001AA

In case all ECAM DMC channels fail, each pilot may display the engine standby page on their respective ND.
The displayed information is N1, N2, EGT, FF and limit modes (same presentation as the upper part of the primary engine page).
This information is generated by the DMCs’ EFIS channel.
For more information on this page, see the POWERPLANT Chapter (1.70.90).

FLAGS AND MESSAGES DISPLAYED ON ND



(1) HDG flag (red)

In case of a heading data failure, the rose/arc and associated symbols are cleared.
A HDG flag first flashes for 9 seconds, and is displayed on the upper part of the ND.

(2) CHECK HDG flag (amber)

When a discrepancy (5°) is detected by FWC between sides 1 and 2, a CHECK HDG flag flashes for nine seconds, then remains steady on both NDs associated with an ECAM caution. This message is not available when plan mode is selected.

3 Center Part Messages

- The screen displays a MODE CHANGE message in green if there is a discrepancy between the selected mode on the EFIS control panel and the mode sent from the onside FMGC, or while the DMC is preparing a new page for display.
- The screen displays a RANGE CHANGE message in green if there is a discrepancy between the range selected on the EFIS control panel and the range sent from the onside FMGC. A MODE CHANGE message has priority over a RANGE CHANGE message.
- The screen displays a MAP NOT AVAIL message in red for several reasons :
  - The MODE CHANGE or RANGE CHANGE message has been displayed more than six seconds.
  - A disagreement between DMC and FMGC has been detected while EFIS control panel is failed (default mode ROSE NAV 80 NM).
  - The FMGC is not able to indicate the flight plan reference point (back up mode) while PLAN mode is selected.
  - The FMGC has failed.
  - The FMGC has delivered an invalid aircraft position.
- The screen displays CHECK ND (1,2) message (amber) when the DMC detects a discrepancy between acquisition and display of parameters.
- The screen displays CHECK EWD message (amber) when the DMC detects a discrepancy between acquisition and display of E/WD parameters.
- The screen displays a W/S SET RNG 10 NM message if a predictive windshear alert is triggered and the range is above 10 NM.
- The screen displays a W/S CHANGE MODE message if a predictive windshear alert is triggered and the ND is not in ARC or ROSE mode. The message appears in the red or amber corresponding to the windshear alert.

4 LOC Flag (red)

If LOC data fails, this flag flashes for nine seconds, then remains steady.

5 G/S Flag (red)

If G/S data fails, this flag flashes for nine seconds, then remains steady.

6 VOR Flag (red)

In ROSE VOR mode, when the VOR bearing is not valid, this flag flashes for nine seconds, then remains steady.

7 VOR1(2) or ADF1(2) or DME1 Flag (red)

If a navigation receiver fails, the appropriate one of these flags flashes for nine seconds, then remains steady.

(8) VOR Course Flag

If the VOR course fails, a red CRSXXX flag appears.
If there is Non-Computed Data (NCD), a blue CRS - - - flag appears.

(9) Other messages

	MAP PARTLY DISPLAYED (amber)	:	In case of incomplete data transmission between the FMGC (priority criteria) and DMC, or if the DMC cannot draw the complete MAP.
	NAV ACCUR UPGRAD or (white) NAV ACCUR DOWNGRAD (amber)	:	Signals a change in navigation accuracy.
	SPECIF VOR/D UNAVAIL (amber)	:	If the navaid, which is tuned for the selected approach or departure, is not available.
	BACK UP NAV (amber)	:	If the MCDU backup navigation mode is activated (refer to 1.22).
	OFF SIDE FM CONTROL (amber)	:	If the offside FM supplies the ND.
	CHK FLT PLN POSITION (amber)	:	On ARC or ROSE NAV mode, if the DMC detects a discrepancy between the acquisition and the display of the flight plan.
	SELECT TRUE REF (amber)	:	When entering the polar area, if the TRUE North reference is not selected by the crew (MAG/TRUE pushbutton).
R R R R R	CHECK NORTH REF (amber)	:	The NORTH REF pushbutton selection does not match the airport MAG/TRUE bearing reference (as stored in the FMGS navigation database), either at the departure airport (during preflight), or at the destination airport (when entering the ARRIVAL area).
	↓ (green)	:	Overflow arrow, displayed when more than one of the following messages are present at the same time : – NAV ACCUR DOWNGRAD – NAV ACCUR UPGRAD – SPECIF VOR/D UNAVAIL – SELECT TRUE REF
R			– CHECK NORTH REF
R			– GPS PRIMARY ◁
R			– GPS PRIMARY LOST ◁
	◁ GPS PRIMARY (white, boxed white)	:	This message appears when GPS PRIMARY mode is available, or has been recovered. The pilot can clear this message by pressing the CLR key on the MCDU.
R	◁ GPS PRIMARY LOST (amber, boxed white)	:	This message appears when GPS PRIMARY is not available, and is not clearable by pilot action.

(10) OFST R(L) XX message (yellow)

Message displayed when a temporary or an offset flight plan is entered. The offset value is given in NM.

Note : For TCAS messages (Refer to 1.34.80).

(11) GPS APP (green) ◁

This message is displayed, when a GPS approach has been selected.

(12) PRED W/S flag (amber) ◁

The WINDSHEAR switch on the weather radar panel is set to AUTO, and a Predictive Windshear System Fault is detected. This message appears on ground, or when flaps and slats are extended.
It is associated with a single chime. The radar image remains available, provided the fault does not affect the radar mode.

EGPWS

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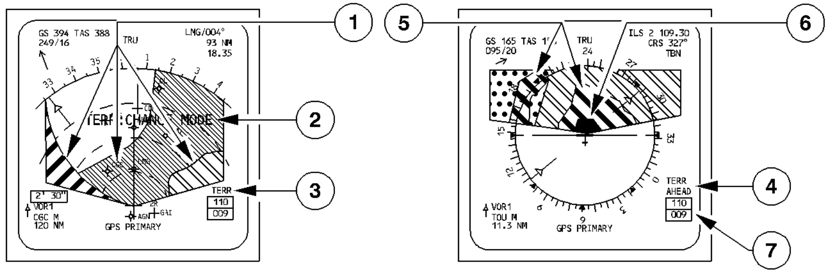
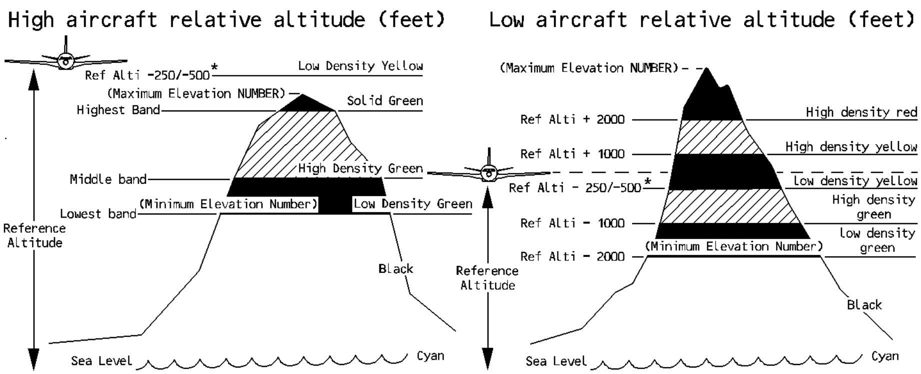


① EGPWS terrain picture

The ND presents the EGPWS terrain picture, when the TERR ON ND switch is set to ON, and the ND is not in PLAN or ENG mode. The terrain picture replaces the weather radar image. Terrain data is displayed independently of the aircraft relative altitude. The terrain appears in different colors and densities, depending on the aircraft's altitude relative to the terrain :

GFC5-01-3145-023-B200AA



* : REFERENCE ALTITUDE -250 feet, WITH GEAR DOWN.
REFERENCE ALTITUDE -500 feet, WITH GEAR UP.

<u>Note</u> : – *Areas without available terrain data in the EGPWS database appear in magenta.*
– *The reference altitude is computed based on the current aircraft altitude or, if descending more than 1000 ft/min, the altitude expected in 30 seconds.*
– *In case of flight above the maximum elevation number, the relief between the minimum and maximum displayed elevations is indicated by three different shades of green.*

(2) TERR : CHANGE MODE indication

Displayed in red (or amber), in case of a Terrain Awareness Display (TAD) warning (or caution) alert, if PLAN is the selected display mode.

(3) TERR indication

To differentiate between the terrain and weather display, weather radar TILT is replaced by a blue TERR, and the terrain display sweeps from the center outward to both NDs.

(4) Warning and caution messages

TERR AHEAD/OBST AHEAD (amber) : For a caution.
TERR AHEAD/OBST AHEAD (red) : For a warning.
When triggered, these messages flash for 9 seconds, then remain steady until the caution or warning alert condition disappears.
TERR RNG (red) : For a RANGE error warning.
TERR TST (amber) : Appears during the EGPWS test, when the terrain pattern is displayed, and there is no failure.

(5) Terrain or obstacle caution alert

Generated when a conflict exists between the terrain caution envelope, ahead of the aircraft, and the terrain/obstacles data stored in the database. The conflict area is shown in solid yellow.

(6) Terrain or obstacle warning alert

Generated when a conflict exists between the terrain warning envelope, ahead of the aircraft, and the terrain/obstacles data stored in the database. The conflict area is shown in solid red.

Note : When an alert is generated (either caution or warning), and TERR ON ND is not selected, the terrain is automatically displayed, and the TERR ON ND pushbutton ON light comes on.

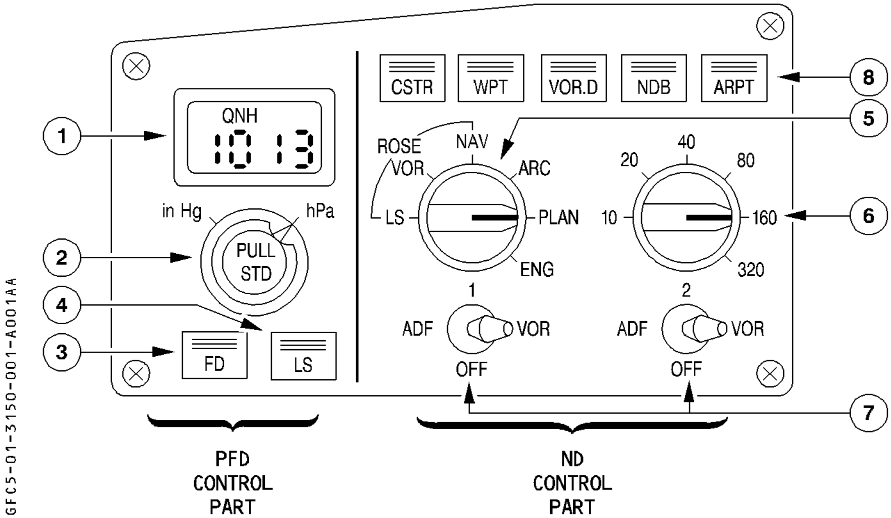
(7) Lowest and highest elevations

Lowest and highest elevation (in hundreds of feet above MSL) encountered within the selected range, are respectively displayed in this square, using the color code of paragraph 1.

Note : The elevation figures shown on the ND correspond to the terrain included in the selected ND range ahead of the aircraft. In ARC mode, the elevations are linked with the terrain displayed on ND. In ROSE mode, the elevations may not represent the lowest and highest terrain currently displayed on the ND.

R

EFIS CONTROL PANEL



(1) Barometer Reference Display Window

Range : 745 hPa to 1100 hPa.

(2) Barometer Reference Selector

a) Outer ring : For selection of the units for the barometer reference, either hectoPascals or inches of mercury.

Note : The selected unit does not appear on the PFD.

b) Inner knob : For selection of the reference value, displayed in the barometer reference display window and on the PFD below the altitude scale.
At FCU initialization, the window displays 1013 or 29.92, depending on the selected unit.
· Pulling the knob selects the standard baro reference setting. The PFD then displays "STD." (Rotating the knob has no effect.)
· Pushing the knob from the STD position makes the last selected QNH baro setting available.

③ FD Pushbutton

Pushing this button removes the FD bars from the associated PFD (or removes the flight path director symbol if the TRK FPA reference is selected).
The pushbutton light goes out.
Pushing it again restores the FD bars (or the FPD symbol) and lights the green pushbutton light.

④ LS Pushbutton

Pushing this button displays the localizer and glide slope scales on the PFD.
Deviation symbols appear if there is a valid ILS signal.
The green pushbutton light comes on.

⑤ Mode Select Switch

This switch selects a navigation display for the onside ND.

⑥ Range Select Switch

This switch selects a range scale for the onside ND.

Note : If the mode or the range data fails, the default selection is the ROSE NAV mode and 80 NM range.

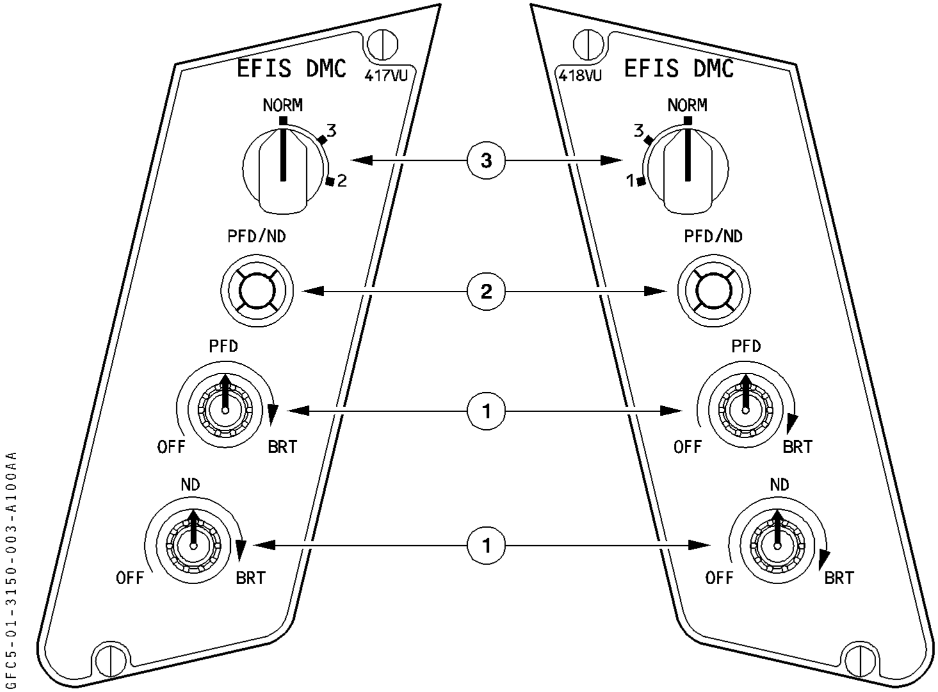
⑦ ADF-VOR Select Switches

These switches select ADF or VOR bearing pointers and DME distance on the onside ND, as well as the corresponding navaid data characteristics in any mode except PLAN mode.

⑧ Optional Data Display Pushbutton

Pushing this button displays optional data in addition to the data permanently displayed in PLAN, ARC, or ROSE NAV modes. The green pushbutton light comes on.
Only one option can be activated at a time.

EFIS DMC PANEL



(1) OFF/BRT knobs

- These knobs turn the PFD and ND display units on and off, and control their brightness.
- The display brightness automatically adjusts for changing light conditions. It may also be adjusted manually.

PFD Brightness Control Knob
Rotating this knob all the way counterclockwise switches off the PFD. In this case, the PFD image is automatically displayed on the NDU, but the pilot may recover the ND by means of the PFD-ND XFR pushbutton.
ND Brightness Control Knob
The outer knob controls the brightness of both the weather radar image and the EGPWS terrain display.
The inner knob controls the general brightness of the ND symbols.
Rotating this knob all the way counterclockwise switches off the NDU.

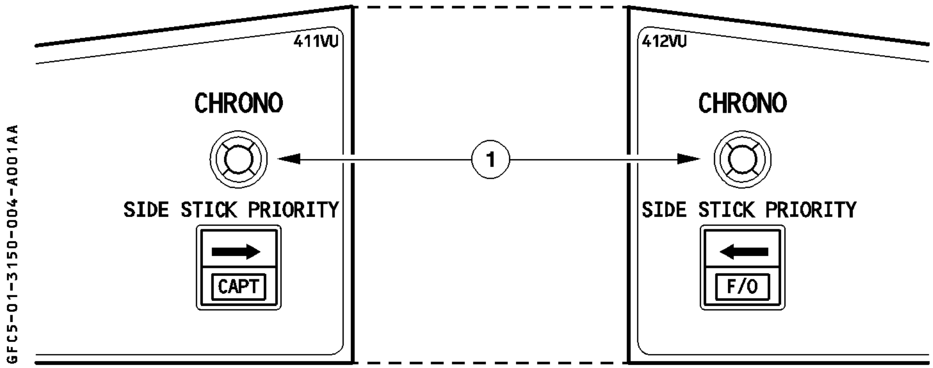
(2) PFD/ND Pushbutton

Pushing this button interchanges the PFD and the ND.
If the PFDU fails, the PFD automatically transfers to the NDU.

(3) EFIS DMC sel

NORM : The DMC 1 supplies CAPT EFIS DUs and DMC 2 supplies F/O EFIS DUs.
3 : The onside DMC is replaced by DMC3.
2 or 1 : The onside DMC is replaced by DMC 2 or 1.
R Some switching configurations generate FMA message. Refer to 1.22.30 for details.

CHRONOMETER (glareshield)



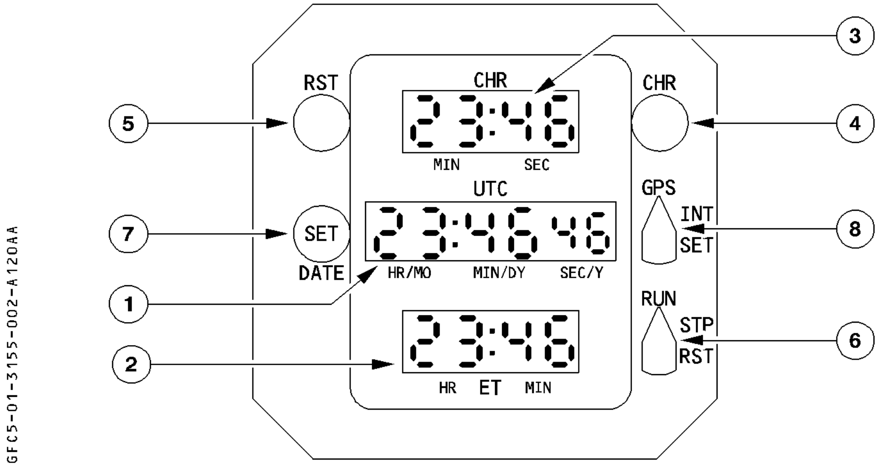
(1) CHRONO Pushbutton

Pushing this button displays chronometer time on the onside ND.
Pushing it again freezes the displayed value.
Pushing it a third time resets the chronometer, and the chronometer time disappears from the display.

GENERAL

R A fully independent clock is on the right side of the control panel.
It sends time to the central maintenance computer, the Flight Data Interface Unit, and the Flight Management and Guidance Computer.
The clock has two electrical supplies, one of which is a direct connection to the aircraft battery hot bus.
The clock performs four functions :
- It displays "UTC" (GMT) time in hours, minutes, and seconds, on the center counter.
- It displays elapsed time (ET) (from engine startup) in hours, and minutes, on the lower counter.
- It drives the chronometer (CHR), which measures a time interval (from the pushing of the CHRONO button) in minutes and seconds, and displays it with a needle and in numbers on the upper counter.
- It can replace the UTC with the date.

CONTROLS AND INDICATORS



(1) UTC (GMT) counter

This counter displays the present time in 24-hour format from 0 to 23 hours 59 minutes 59 seconds.

(2) Elapsed Time (ET) counter

This counter registers the aircraft's flight time from 0 to 99 hours 59 minutes.

(3) Chrono (CHR) counter

This counter registers elapsed time from 0 to 99 minutes 59 seconds. It is controlled by the CHR pushbutton.

④ CHR pushbutton

First push : Starts the CHR counter.
Second push : Stops the CHR counter, and keeps the display at its last indication.

⑤ Reset (RST) pushbutton

When pressed, the CHR counter restarts from 0, if the chrono is running.

⑥ ET selector

"RUN" : The ET counter starts
"STP" : The ET counter stops counting
Spring-loaded "RST": The ET counter goes blank. The selector returns to its STP position when the selector is released.

Note : A cumulative elapsed time can be achieved by alternatively setting this switch to the "RUN" and "STP" position.

⑦ DATE/SET button

First push : Sets the clock to date mode. The UTC time display is replaced by the date (day/month/year).
Second push : Sets the clock to time mode. The date display disappears.

Note : In order to select the date mode, switch the UTC selector to "GPS" or "INT".

(8) UTC selector

"GPS": Time (or date, if selected) is displayed, and this data is synchronized on GPS information.

Note : – *If the signal between the GPS and the clock is not detected, dashes are displayed. Only the "INT" and "SET" positions are then available.*
– *If the signal is detected, but GPS data is invalid, the clock automatically runs on its internal time.*
– *The clock will automatically resynchronize on the GPS information, as soon as the GPS data becomes available.*

"INT": Internal time (or date, if selected) is displayed.

Note : – *The clock's internal time is always synchronized with the latest valid GPS information.*
– *If there is no valid GPS information at power up, the internal time will be 00:00:00, until the clock is initialized, or until valid GPS information is present.*

"SET" : Allows the internal time and date to be initialized.

INTERNAL TIME AND DATE INITIALIZATON

Set the UTC selector to "SET". The minute digits flash, and the seconds' digits are blank.
To increase data, turn the DATE/SET button clockwise.
To decrease data, turn the DATE/SET button counterclockwise.
– First, push on DATE/SET : To set the hour.
– Second, push on DATE/SET: To set the year.
– Third, push on DATE/SET : To set the month.
– Fourth, push on DATE/SET : To set the day.
Switch the UTC selector to the "INT" position, and the clock starts with the seconds' digits at 00.

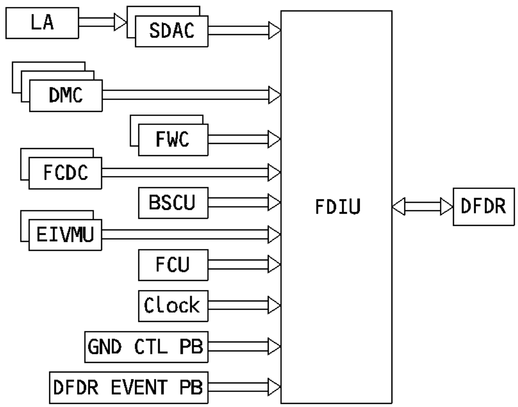
Note : This process must be completed in less than one minute. Otherwise, it will be necessary to reset the CMC in order to synchronize the lower ECAM time display with the cockpit clock display. Resetting the CMC is a maintenance operation.

FLIGHT DATA RECORDING SYSTEM

DESCRIPTION

The Flight Data Recording System, which records the mandatory parameters, consists of the following components :
- A Flight Data Interface Unit (FDIU)
- A Digital Flight Data Recorder (DFDR)
- A three-axis Linear Accelerometer (LA)

The FDIU collects and processes parameters from the SDACs, DMCs, FWCs, FCDCs, BSCU, EIVMUs, FCU, the DFDR event pushbutton, the GND CTL pushbutton and the Clock.
It stores the mandatory flight parameters in the DFDR.
The DFDR can store the last 25 hours data, at least. It stores this data on a fireproof and shockproof device. An underwater locator beacon is attached to the DFDR.
The linear accelerometer measures the acceleration of the aircraft along each of the three
R axes.
R



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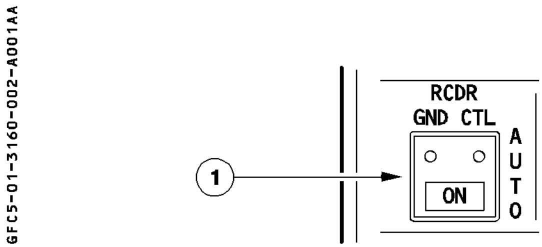
The recording system is automatically active :
- On ground, during the first five minutes after the aircraft electric network is energized.
- On ground, after the first engine start.
- In flight (whether the engines are running or not).

On ground, the recording system automatically stops five minutes after the second engine shuts down.
On ground, the crew can manually start the recording system by pressing the GND CTL pushbutton.

CONTROLS AND INDICATORS

OVERHEAD PANEL



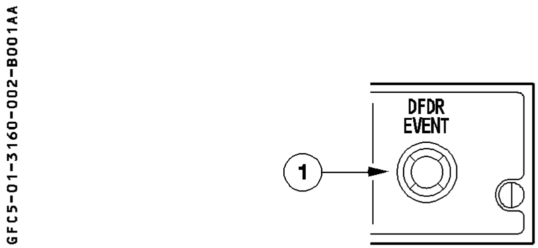
(1) RCDR GND CTL pushbutton (springloaded)

R – ON : The Cockpit Voice Recorder (CVR) and the Flight Data Recorders are active. The ON light is on.

R – AUTO : The Cockpit Voice Recorder (CVR) and the Flight Data Recorders are active, according to the logic.

The system automatically switches from ON to AUTO at the first engine start, and also in case of an electrical transient.

PEDESTAL



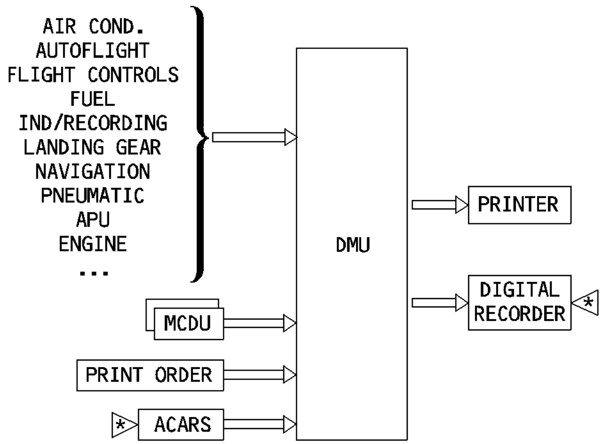
(1) DFDR EVENT pushbutton

R – Pressing this button (briefly) sets an event mark on the Flight Data records.

AIRCRAFT CONDITION MONITORING SYSTEM (ACMS)

DESCRIPTION

The ACMS is used to monitor various aircraft system parameters in order to make maintenance easier and to allow formulating operational recommendations.
The ACMS can generate system reports. The Airbus Standard Reports are preprogrammed reports available at aircraft delivery. The operator can create its own reports.
The ACMS consists of a Data Management Unit (DMU) connected as shown below.
The system may be programmed using the MCDUs. The crew can select any report to be displayed on the MCDUs.
The Printer prints the flight phase programmed reports or any report selected on the MCDU.
This printing may be automatic or in response to the ACMS PRINT pushbutton.
The ACMS may send automatic reports via ACARS (◁)
An optional Digital Recorder may be installed to extend the recording capacity.



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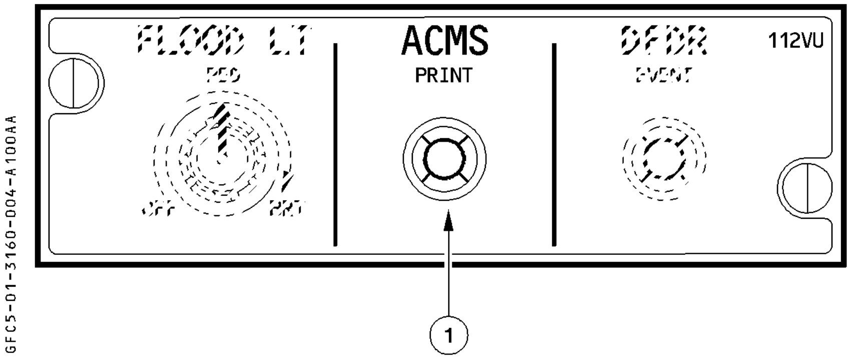
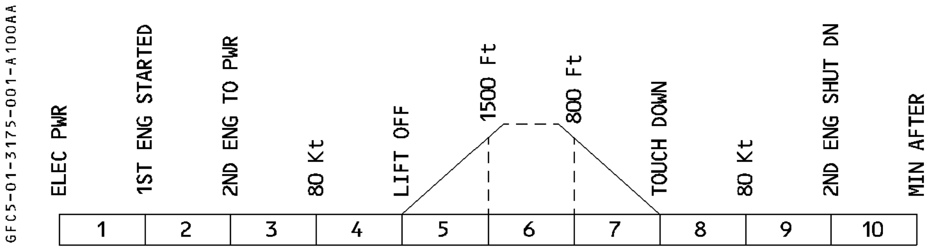
CONTROLS ON PEDESTAL



(1) ACMS PRINT pushbutton

This pushbutton is used to immediately print specific report, depending on the flight phase. The crew may then use the MCDU to select and instantly print another report.

WARNINGS AND CAUTIONS



<table>
<tr><th>E / WD: FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNINGS</th><th>FLT PHASE INHIB</th></tr>
<tr><td>EFIS DMC 1(2)(3) FAULT
failure of the EFIS part of one DMC</td><td rowspan="3">SINGLE CHIME</td><td rowspan="3">MASTER CAUT</td><td rowspan="11">NIL</td><td rowspan="2">NIL</td><td rowspan="2">4, 5, 7, 8</td></tr>
<tr><td>ECAM DMC 1(2)(3) FAULT
failure of the ECAM part of one DMC</td></tr>
<tr><td>DISPLAY DISCREPANCY
(EWD, SD, PFD or ND)</td><td>Message on related DU</td><td rowspan="3">3, 4, 5, 7, 8</td></tr>
<tr><td>FWC 1(2) FAULT</td><td rowspan="3">NIL</td><td rowspan="3">NIL</td><td rowspan="8">NIL</td></tr>
<tr><td>SDAC 1(2) FAULT</td></tr>
<tr><td>FWC 1+2 FAULT</td><td>NIL</td></tr>
<tr><td>SDAC 1+2 FAULT</td><td>SINGLE CHIME</td><td>MASTER CAUT</td><td>4, 5, 7, 8</td></tr>
<tr><td>DFDR FAULT</td><td rowspan="3">NIL</td><td rowspan="3">NIL</td><td rowspan="3">3, 4, 5, 7, 8</td></tr>
<tr><td>FDIU FAULT</td></tr>
<tr><td>ECP FAULT</td></tr>
<tr><td>OEB/FWC DISCREPANCY
FWC1 and FWC2 do not have the same OEBs listed in their OEB reminder database.</td><td>SINGLE CHIME</td><td>MASTER CAUT</td><td>3 to 8</td></tr>
</table>

MEMO DISPLAY

- ECAM SWTG message is displayed in green when the ECAM SWTG DMC selector is not in AUTO position.
- EFIS SWTG message is displayed in green when either the CAPT or the F/O EFIS DMC selector are not in NORM position.

BUS EQUIPMENT LIST

R

		NORM			EMER ELEC		
		AC	DC	DC BAT	AC ESS	DC ESS	HOT
DU	CAPT PFD				X		
	CAPT ND				SHED		
	F/O PFD	AC2					
	F/O ND	AC2					
	E/WD				X		
	SD	AC1					
DMC	DMC 1 EFIS PART				X		
	DMC 1 ECAM PART	AC1			X		
	DMC 2 EFIS PART	AC2					
	DMC 2 ECAM PART	AC2					
	DMC 3 EFIS PART	AC1			X (1)		
	DMC 3 ECAM PART				X (1)		
FWC	FWC 1				X		
	FWC 2	AC2					
SDAC	SDAC 1				X		
	SDAC 2	AC2					
ECP	ECP					X	
CLOCK						X	X
WBS ◁	WBC 1	AC2					
	WBC 1	AC2					
FLT RECORDERS	DFDR	AC2					
	FDIU	AC2					
	QAR ◁	AC1					
	LA		DC1				

(1) In case of switching only.

32.00 CONTENTS

DESCRIPTION

GENERAL

The landing gear consists of :
- two inboard retracting main gears
- a forward retracting nose gear

Gear doors enclose the landing gear bays. Gears and doors are electrically controlled and hydraulically operated.
The doors which are fitted to the landing struts are mechanically operated by the gear and close at the end of gear retraction or extension.
All gear doors open during landing gear transit. The hydraulically operated doors close at the end of each retraction and extension sequence.
Gears and doors actuation are electrically signalled by two Landing Gear Control and Interface Units (LGCIUs).
The LGCIUs process gears and doors positions, sequencing control and gear lever selection. They also provide landing gear information on ECAM, and ground/flight signals for other aircraft systems.

MAIN GEAR

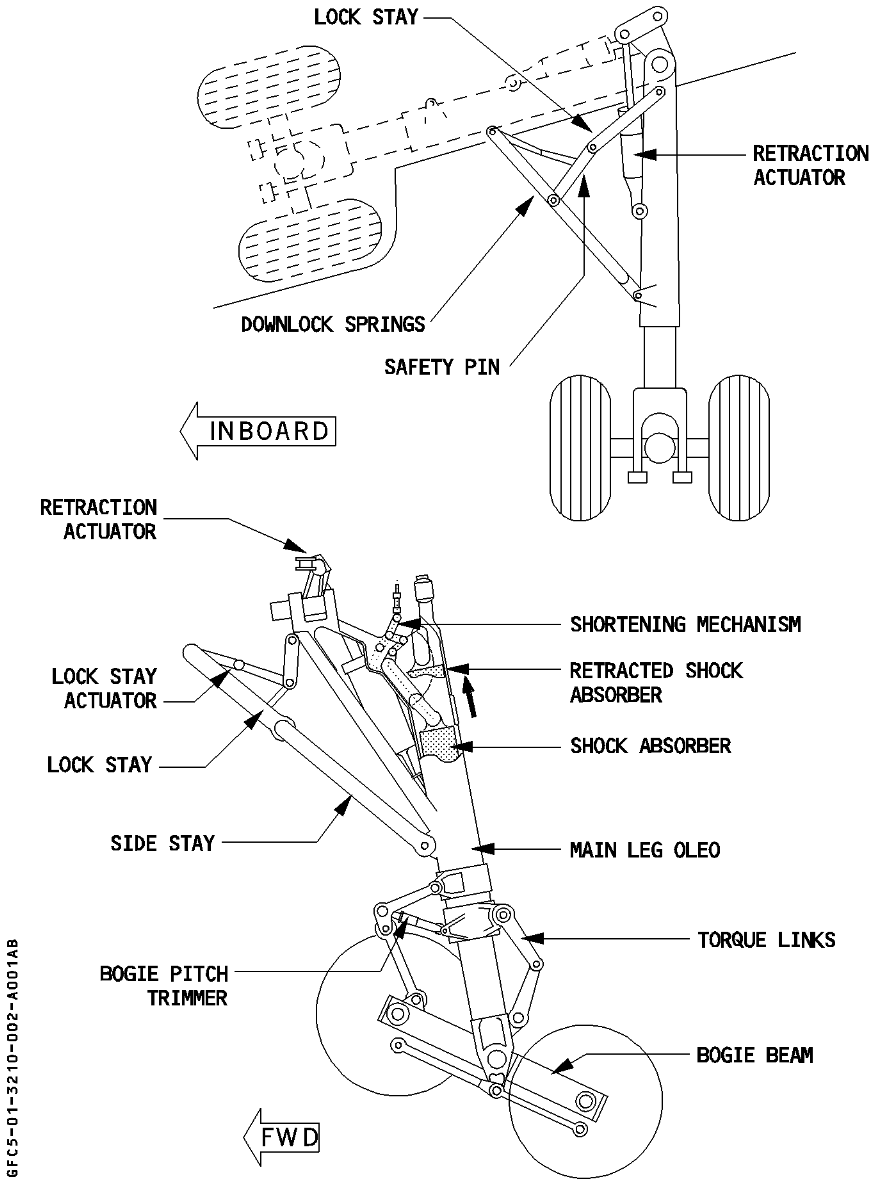
Each main gear is a four wheel, twin tandem bogie assembly having an oleopneumatic shock absorber.
Each main wheel is fitted with antiskid brake.
A shortening mechanism attached to the wing reduces main gear length by retracting the shock absorber into the main leg during retraction.
An hydraulically operated pitch trimmer on each bogie beam damps the movement and ensures return to normal position after lift off.

NOSE GEAR

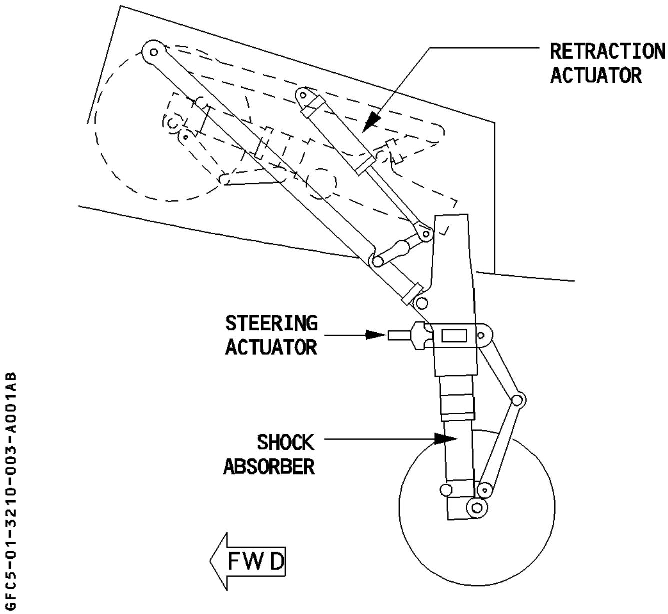
The two wheel nose gear comprises an oleopneumatic shock strut and a nose wheel steering system. It retracts forwards into the fuselage.

SCHEMATICS

MAIN L/G



NOSE L/G


RETRACTION
ACTUATOR
STEERING
ACTUATOR
SHOCK
ABSORBER
FWD
GFC5-01-3210-003-A001AB

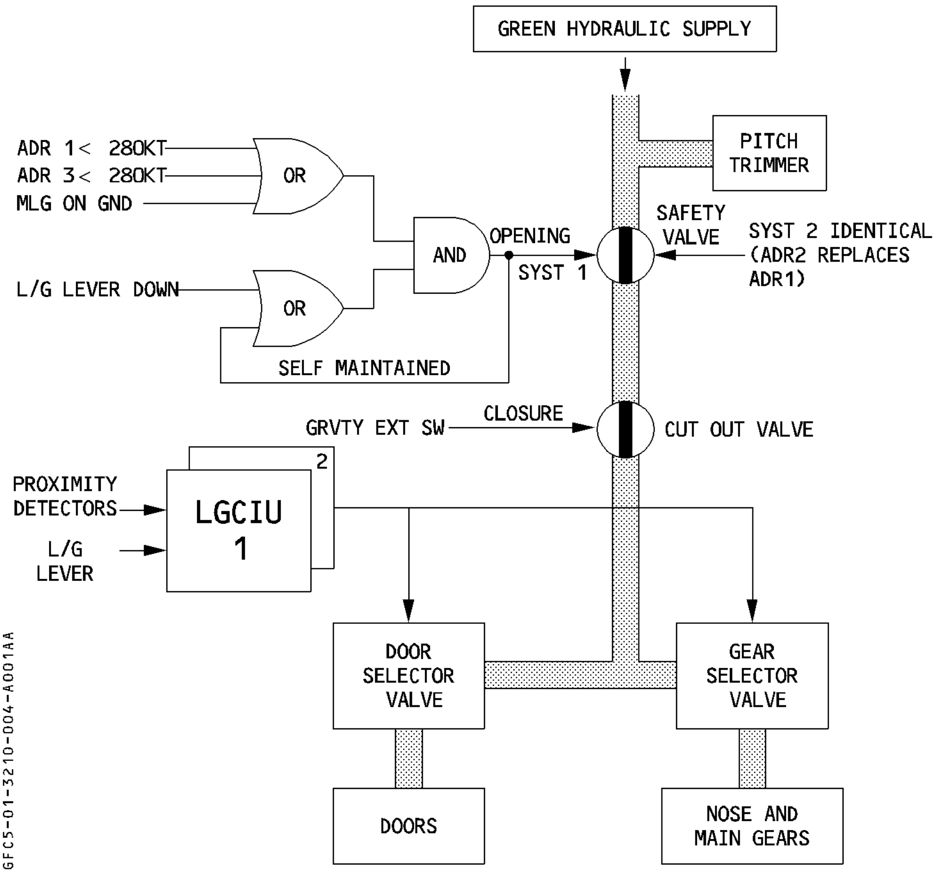
GEAR AND DOOR OPERATION

NORMAL OPERATION

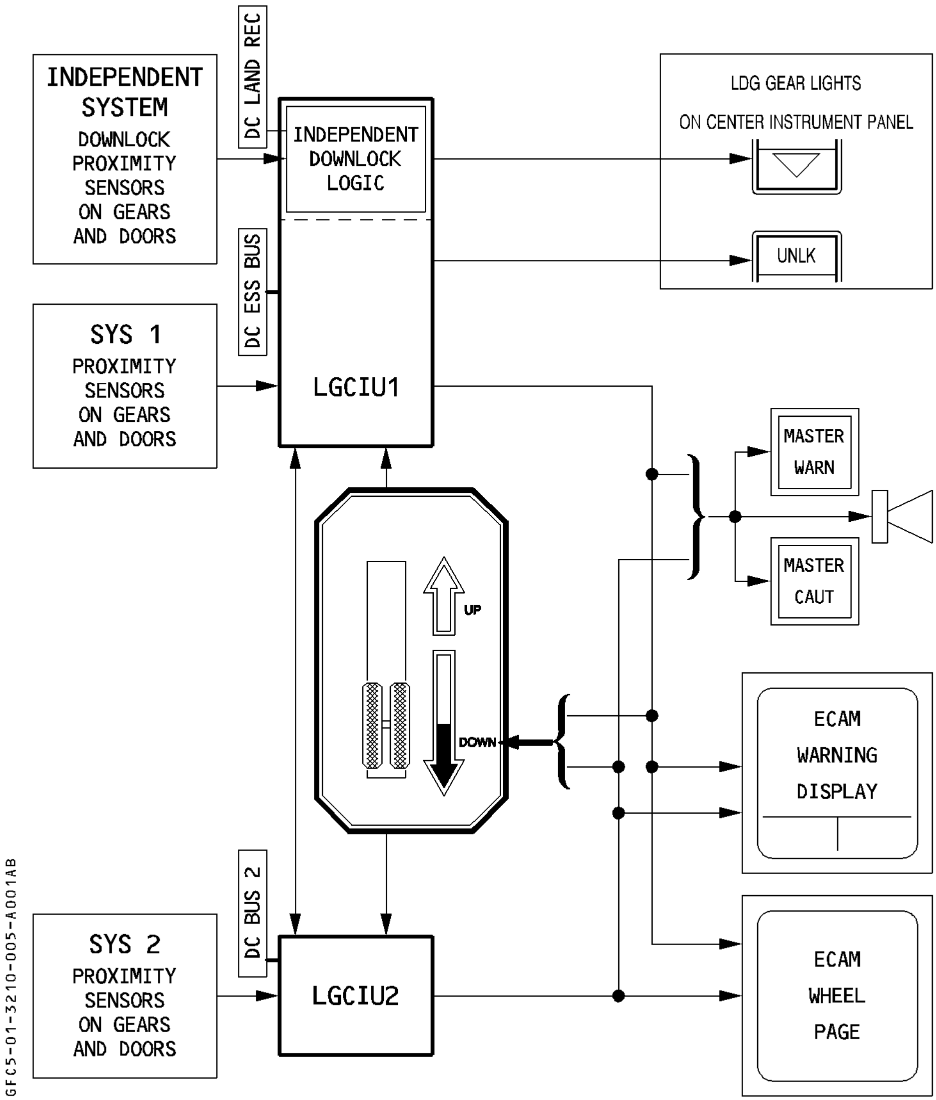
Landing gear normal operation is controlled by the lever located on the center instrument panel.
Gear and door sequencing is electrically-controlled by the LGCIUs. Each LGCIU controls one complete gear cycle and switches over automatically at each landing gear retraction cycle, or in case of failure.
All gears and doors are hydraulically-actuated by the green hydraulic system. Hydraulic supply is automatically isolated by closing a safety valve above 280 knots. It is maintained
R closed until the landing gear lever is moved to the DOWN position and the aircraft speed
R decreases below 280 knots.

FOR INFO

R



R **LANDING GEAR INDICATION AND WARNING ARCHITECTURE**



R *Note : The landing gear position indications on center instrument panel are still provided*
R *by LGCIU 1 even when LGCIU 2 is controlling gear cycle.*

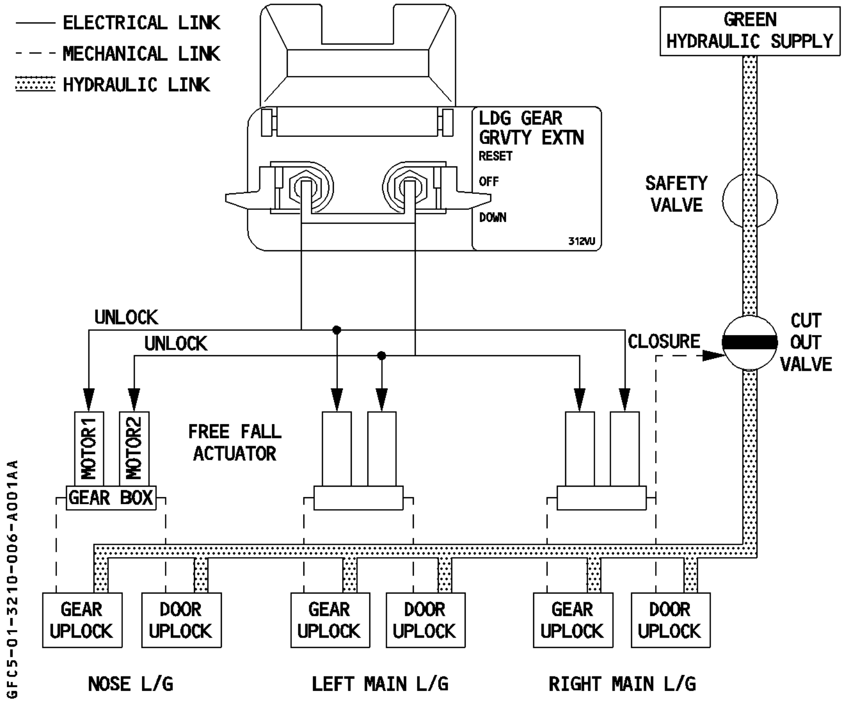
GRAVITY EXTENSION

The gravity extension system is an electromechanical system controlled through two selectors located on the center instrument panel. It permits the main and nose landing gear extension in case of normal extension system failure.

When the related electrical selector are set to DOWN :

- the landing gear hydraulic system is isolated from green hydraulic system
- the main landing gear and nose landing gear doors and gears electrically unlock
- main landing gear and nose landing gear extend by gravity
- locking springs assist the downlocking
- The main and nose landing gear doors remain open.

After a free fall extension, it is possible to restore normal operation provided the green hydraulic pressure is available.



The indications given in the cockpit are the same as those for normal extension and retraction.

R *Note : In case of landing gear gravity extension, the nose wheel steering is lost.*

LANDING GEAR SYSTEM INTERFACE

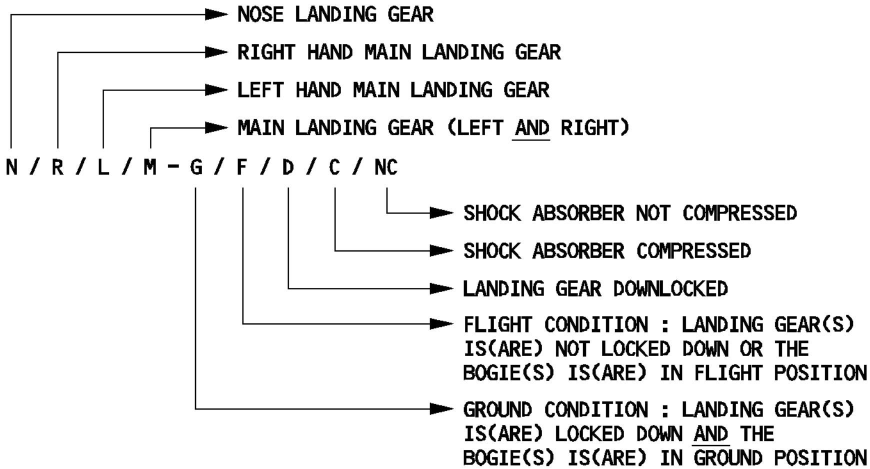
LGCIU

Two LGCIUs receive landing gear position information from the proximity detectors : landing gear downlocked or uplocked, shock absorber compressed or extended, door open or closed.
This information is sent by the LGCIU to other aircraft systems.
Proximity detector failures :
- electrical failure is detected by the LGCIU which signals the associated output to the flight position (shock absorber not compressed or landing gear uplocked).
  landing gear operation is then automatically controlled by the non affected LGCIU.
- mechanical failure is not detected by the LGCIU. The effect on the interfaced system depends on which condition is incorrectly signalled.

In case of LGCIU electrical failure :
- The landing gear is controlled by the remaining healthy LGCIU
- The outputs of the failed LGCIU are not forced to the safe (flight) position :
  some users will see "flight" condition,
  some other will see "ground" condition.

LANDING GEAR – AIRCRAFT SYSTEM INTERFACE

The two LGCIUs provide following discrete logic signals to various aircraft systems.



GFC5-01-3210-007-A001AA

A semicolon (;) separates different signals send to the same system.
Two additional discretes are provided by the LGCIUs.
OP : Applicable LGCIU is signalled operative as long as system is supplied by power.
E : External power connected.

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT
AIR COND	Packs bay ventilation	L-F	R-G
	Avionics equipment ventilation	R-G	L-G ; OP
	Fwd and aft cargo compartment vent.		R-F
	Pressure control and monitoring	R-G	R-G
	Pack control and indicating		L/R-G
	Cockpit and cabin temperature control		R-G
FM	FMGS	N-C	N-C
COMMUNICATIONS	HF System	L-F	R-F
	VHF System	L-F	L/R-F
	Satellite communication		R-F
	Cockpit to ground crew call system	N-NC	
	Audio management	L-F	
	CVR	N-C/NC	
	CIDS	N-C/D ; E	N-C/D ; E
	Radio management	L-F	L/R-F
ELEC	AC main generation	N-C	
	AC emergency generation	N-NC	
	ECMS	N-C	
	DC essential normal generation switching	N-NC	
	Battery DC generation	N-C	
	GPCU	N-C	
	Circuit breaker monitoring	N-C	
APU	Control and monitoring	L-G	
	APU generator (GCU)	N-C	
FIRE	Engine fire and overheat protection	L/R-G	L/R-G
	APU fire and cargo compartment overheat detector	M-G	M-G
	Cargo compartment smoke detector	N-C ; E	N-C ; E
	APU fire extinguishing	M-G	

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT
FLT CTL	Flaps control and monitoring	M-G	M-G
	Slats control and monitoring	M-G	M-G
	EFCS	L/R-D ; N-C	L/R-D ; N-C
FUEL	APU fuel pump system	M-G	
	FCMS	L-D ; N-C	L-D ; N-C
HYD	Green main hydraulic power	M-G	M-G
ICE	Wing ice-protection	M-F	M-F
	Probe ice-protection	L/R-G ; E N-C ; OP	L/R-G ; E N-C ; OP
	Windscreen anti-icing and defogging	L/R-G	L/R-G
EIS	FWC - acquisition interface	R-G	L-G
	SDAC- acquisition interface	R-G	L-G
	DMC - acquisition interface	R-G	L-G
GEAR	Normal extension and retraction	R-G ; E	R-G ; E
	Normal braking	L/R-G ; N-C/D	R-G ; N-D
	Brake cooling		L-D
LIGHTS	Runway turn off lights	N-D	N-D
	Taxi and take off lights	N-D	N-D
	Logo lights		M-G
	Toilet system		N-C

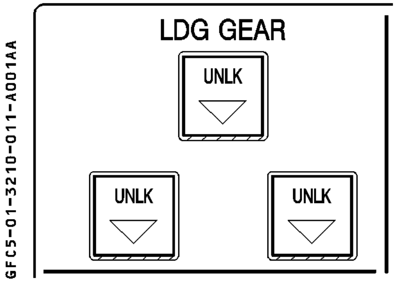
	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT
NAVIGATION	Sensors	N-C	
	Altitude and airspeed standby data	L-G	
	ILS	L-F	R-F
	Weather radar system	L-F	R-F
	Radio altimeter	L-F	L-F
	TCAS	L-G/D	
	GPWS	L-D	
	DME	L-F	R-F
	ATC/MODE S	L-G	R-G
	ADF	L-F	R-F
	VOR/MARKER	L-F	R-F
MAIN	CMS acquisition interface	N-C ; E	
	Up and down data loading system	R-G	
DOOR	Doors and escape slide control system	N-C ; E	N-C ; E
ENG	FADEC	L/R-G ; DP N-C	L/R-G ; DP N-C

The following systems get landing gear position selection data from the landing gear lever

SYSTEM	L/G lever position
Refuel on battery	DOWN
FCMS	DOWN
Normal braking	UP
Cabin emergency	UP

CONTROLS AND INDICATORS

LDG GEAR INDICATOR PANEL



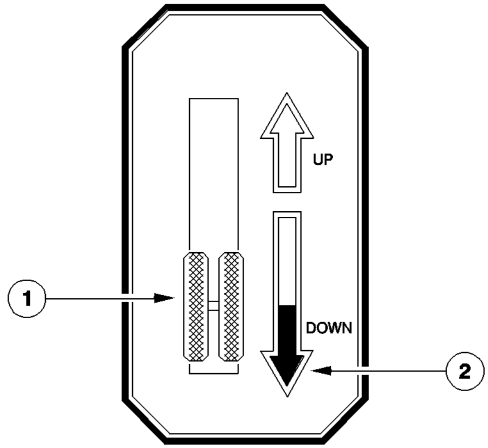
Connected to LGCIU 1 which receives signals from proximity detectors.

UNLK light : illuminates red if the landing gear is not locked in selected position.
▽ light : illuminates green if the landing gear is locked down.
Light off : indicates gear is retracted and locked up with landing gear lever selected up.

R *Note : ▽ lights on the LDG GEAR indicator panel light up as long as the LGCIU 1 is*
R *electrically supplied.*

LANDING GEAR SELECTOR LEVER

A two position selector lever provides electrical signals to the two LGCIUs which control green hydraulic supply by means of selector valves.
On selection of UP or DOWN and provided the airspeed is below 280 kt :
– all landing gear doors open then,
– landing gears move to the new selected position then,
– all doors close.



GFC5-01-3210-012-A001AA

① L/G LEVER

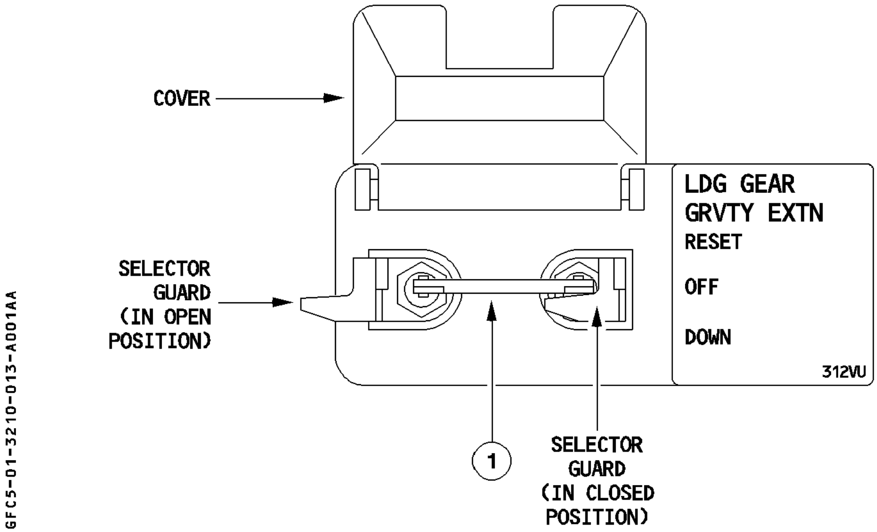
UP : The landing gear retraction is selected.
During gear door opening, main gear wheels are automatically braked by the normal brake system. The nose gear wheels are braked by a brake band in the gear well.

DOWN : The landing gear extension is selected.
An interlock mechanism prevents unsafe retraction by locking the lever in DOWN position when either :
– both main landing gear bogies are not trailed (aircraft on ground) or,
– the nose landing gear shock absorber is not fully extended and the nose wheels are not in the center position.
When the landing gear is extended the system remains pressurized (if green hydraulic pressure is available).

② RED ARROW

Illuminates red if the landing gear is not downlocked in landing configuration associated with a red ECAM warning. (Refer to WARNINGS AND CAUTIONS section).

R **GRAVITY EXTENSION**



The landing gear gravity extension selectors are locked-toggle type switches. The selectors are connected together with a link so that both are operated at the same time.
When the link is disconnected each selector can be operated independently.

(1) LDG GEAR GRVTY EXTN sel

Each selector has three positions :

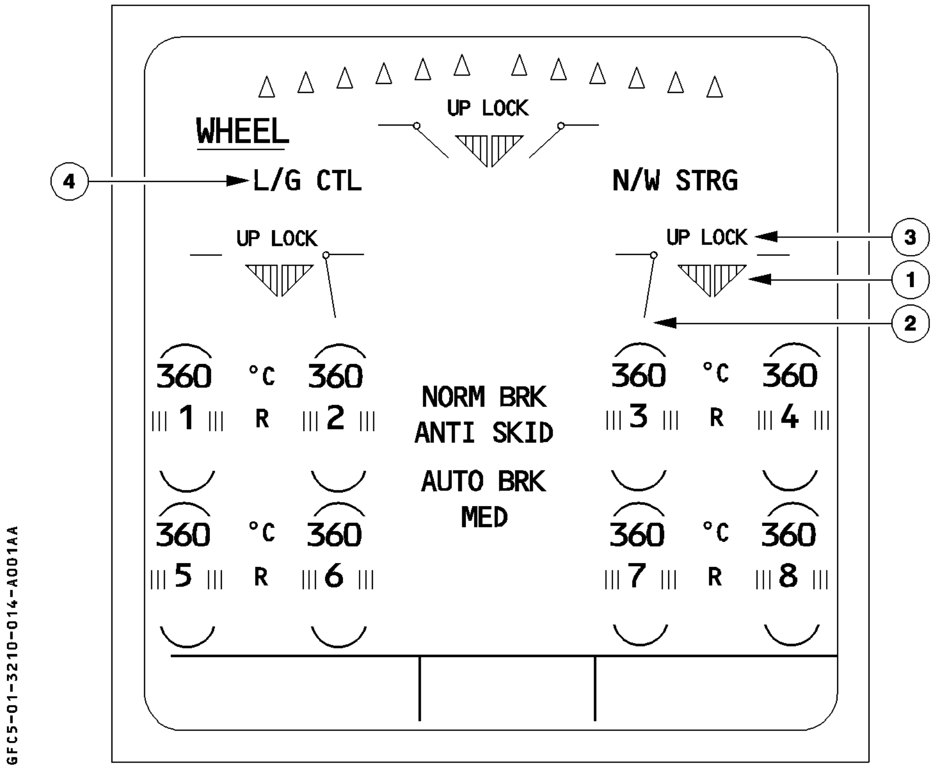
DOWN : The two motorised actuators are electrically powered to close the hydraulic cut off valve and to disengage door and gear uplocks which permit the nose and main gear to deploy by gravity and to automatically lock down.

OFF : Normal position. Landing gear operation is controlled by the LGCIU and the landing gear lever.

RESET : The actuators turn back to the initial position and automatically set the system back to the normal extension and retraction mode.
The selectors are then set to off for normal operation.

Note : To select landing gear down both selector guards have to be open.

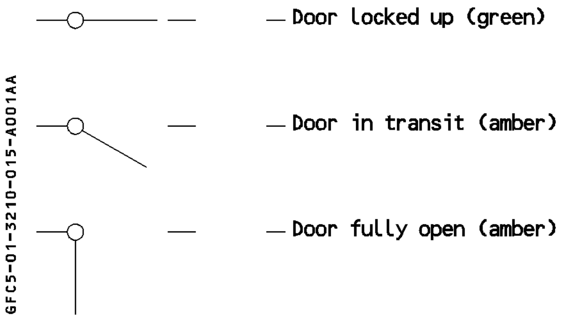
ECAM WHEEL PAGE



1 Landing gear position indication

The landing gear positions are indicated by 2 triangles for each gear. The left triangle is controlled by LGCIU 1, the right one by LGCIU 2.
- green triangle when LGCIU detects landing gear downlocked.
- red triangle when LGCIU detects landing gear in transit
- no signal when LGCIU detects landing gear uplocked
- amber crosses in case of LGCIU failure.

2. Landing gear door position indication



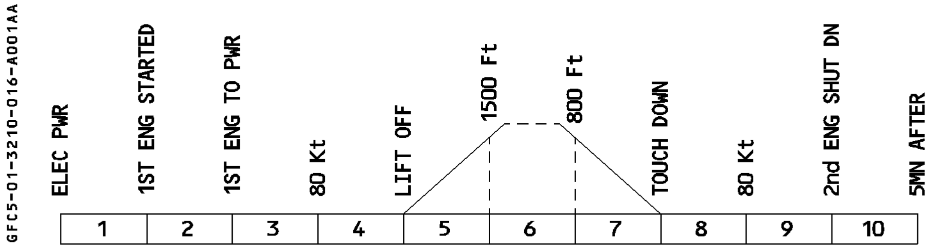
3. UPLOCK indication

Appears amber associated with an ECAM caution if landing gear uplock is engaged when landing gear is downlocked.

4. L/G CTL indication

Appears amber with a 30 seconds time delay when position of any landing gear disagrees with lever position. Associated ECAM caution is triggered.

WARNINGS AND CAUTIONS

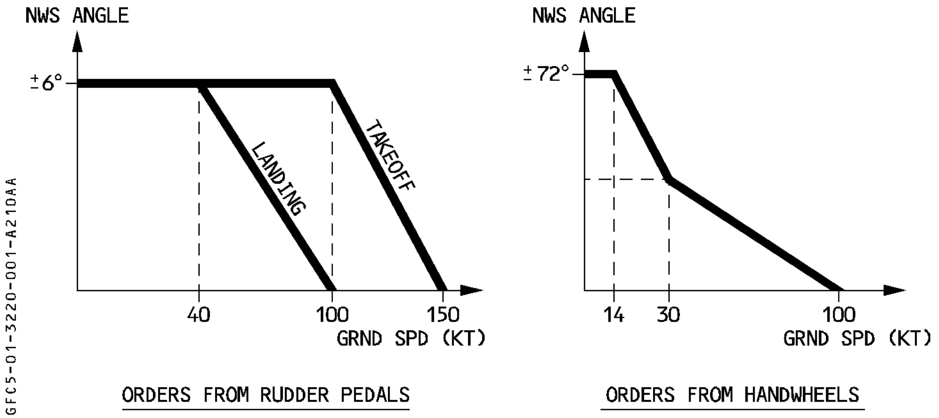


E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
GEAR NOT DOWNLOCKED One or more gear(s) not downlocked and landing gear selected down	CRC	MASTER WARN	WHEEL	UNLK on LDG GEAR panel	3, 4, 5
GEAR NOT DOWN 1) Landing gear not downlocked and radio height lower than 750 ft and both engines not at TO power. or 2) Landing gear not downlocked and radio height lower than 750 ft and flaps at 2, 3 or FULL or 3) Landing gear not downlocked and flaps at 2, 3 or FULL and both radio altimeters failed and both engines not at TO power NOTE : In the cases 2 and 3 above, the aural warning can only be cancelled by the emer canc pb.			NIL	RED ARROW lt on LDG GEAR panel	1 to 5 8 to 10
DOORS NOT CLOSED One or more gear door(s) not uplocked	SINGLE CHIME	MASTER CAUT	WHEEL	NIL	1, 3, 4, 5, 8, 9, 10
GEAR NOT UPLOCKED One or more gear(s) not uplocked and landing gear not selected down				UNLK lt on LDG GEAR panel	3, 4, 7 to 10
GEAR UPLOCK FAULT One gear uplock engaged with corresponding gear downlocked				NIL	4, 7, 8
RETRACTION FAULT Landing gear selected up and - the bogie beam not in correct position or, - the pitch trimmer not in correct position or, - nose landing gear shock absorber not in correct position			NIL		1, 3, 4, 7, 8
LENGTHENING (L)(R) FAULT landing gear downlocked but shortening mechanism has not locked in long position.					3, 4, 5, 8
LGCIU 1 + 2 FAULT			WHEEL		4, 5, 7, 8

E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
LGCIU 1 (2) FAULT SYS DISAGREE Disagree between landing gear or door positions detected by the two LGCIUs	NIL	NIL	WHEEL	NIL	3, 4, 5, 7, 8

DESCRIPTION

Nosewheel steering is provided by two actuators, powered by the green hydraulic system and electrically-signaled by the Brake and Steering Control Unit (BSCU).
The BSCU has two independent channels. Only one is active at a time, while the other is on standby.
To control the steering, the BSCU receives inputs from the steering handwheels, the rudder pedals, and the autopilot.
The BSCU transforms the pilot's orders into a nosewheel steering angle, by controlling the servo-valve to provide the requested flow for the hydraulic actuators. The following limitations apply :



Handwheel control provides up to a ± 72° nosewheel steering angle. A lever on the towing electrical box (on the nose landing gear) enables the steering system to be deactivated for towing purposes. A visual red warning on the overhead panel indicates to the crew that an oversteer (± 93°) has occured.
Pilots can disconnect rudder pedal orders to the BSCU through a pushbutton located on each steering handwheel.
An internal cam mechanism returns the nosewheel to the centered position after takeoff.

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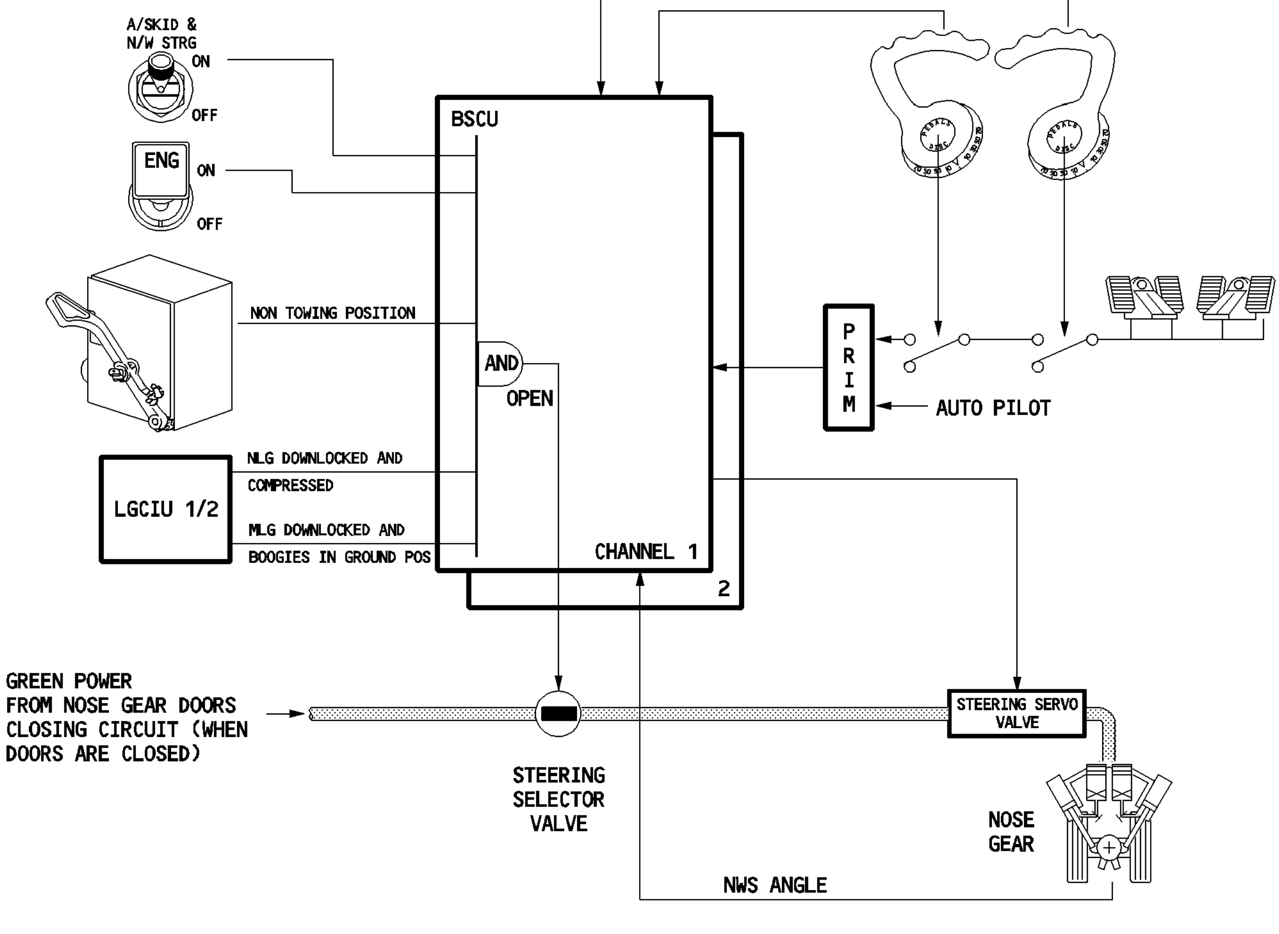


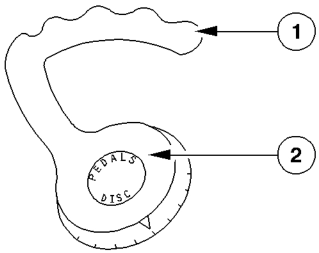
CONTROLS AND INDICATORS

RUDDER PEDALS

Rudder pedals provide nosewheel steering control below 100 kt. Control authority depends on aircraft speed. The nosewheel steering angle is a function of aircraft speed.

SIDE CONSOLES

GFC5-01-3220-003-A110AA



1 STEERING HANDWHEELS

The steering handwheels control the nosewheel steering angle up to 72° in either direction.

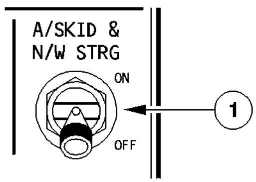
R *Note : Nosewheel steering centers itself above 100 kt for landing, and above 150 kt for*
R *takeoff.*

2 RUDDER PEDAL DISC pb

When maintained depressed, the nosewheel steering control by the pedals is disconnected.

CENTER INSTRUMENT PANEL

GFC5-01-3220-003-B110AA

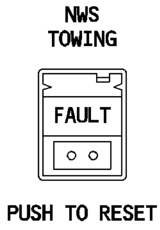


1 A/SKID and N/W STRG sw

An ON/OFF switch activates or deactivates the Nosewheel Steering and Anti-Skid (Refer to BRAKES-ANTISKID section).

OVERHEAD PANEL

GFC5-01-3220-004-A100AA

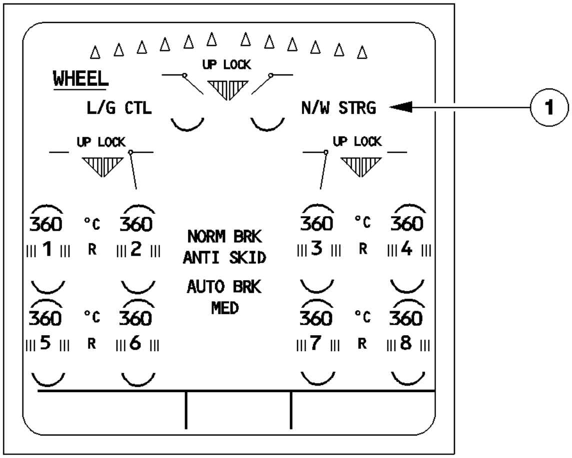


NWS TOWING pb sw (guarded)

FAULT : illuminates red, on ground, when the nose wheel steering has exceeded 93°. Associated with the illumination of the oversteer warning red light located on the nose landing gear.
Extinguishes when depressed

ECAM WHEEL PAGE

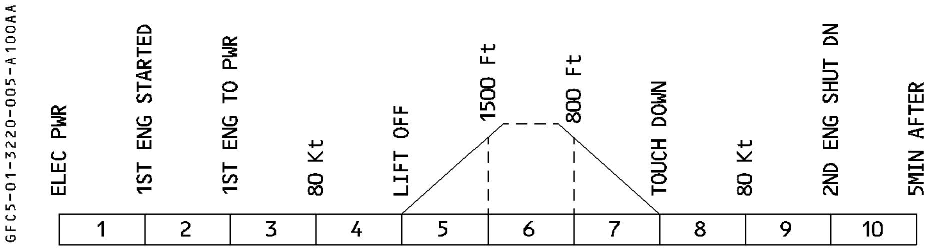
GFC5-01-3220-004-B100AA



(1) N/W STRG indication

Appears amber in case of :
- nose wheel steering failure detected by the BSCU (associated with an ECAM caution)
- A/SKID & N/W STRG switch is at OFF
- failure of both BSCU channels (associated with ECAM caution).

WARNINGS AND CAUTIONS



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
N/W STRG FAULT detected by BSCU	SINGLE CHIME	MASTER	WHEEL	NIL	3, 4, 5, 8

MEMO DISPLAY

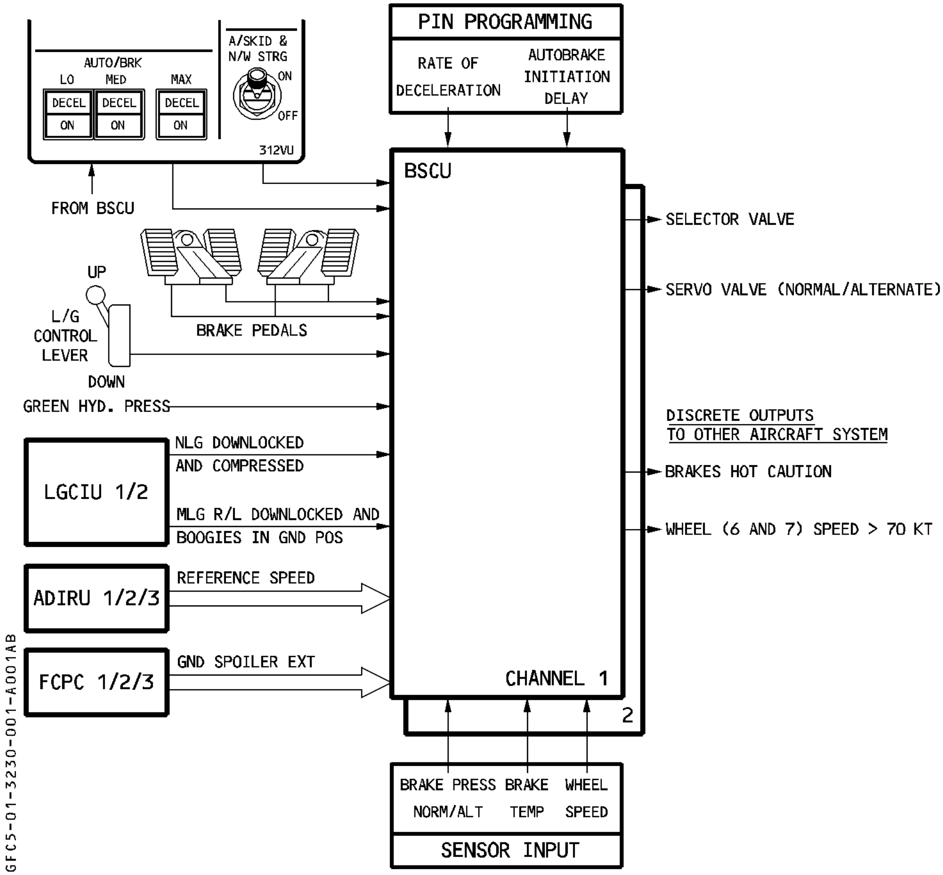
If nose wheel steering switch is in towing position, the message N/WS DISC is displayed in green. It becomes amber if one engine is running.

DESCRIPTION

GENERAL

The main wheels are equipped with carbon multidisc brake which can be actuated by either of two independent brake systems.
The normal system uses green hydraulic pressure whilst the alternate system uses the blue hydraulic system backed up by hydraulic accumulator.
An antiskid and autobrake system is also provided.

R



Braking commands come either from the brake pedals (pilot action) or the autobrake system (deceleration rate selected by the crew).
All braking functions (normal and alternate braking control, autobraking, antiskid control) are controlled by a dual channel Brake and Steering Control Unit (BSCU).
The BSCU performs following secondary functions :
– it checks a residual pressure in the brakes
– it monitors the brake temperature
– it provides discrete wheel speed information to other aircraft systems
A change over between the two systems takes place at each DOWN landing lever selection or in case one channel fails.
The main gear wheels are fitted with fusible plugs which protect against tire burst in the event of overheat.
Main gear wheels are also equipped with brakes cooling fans which permit a high speed cooling of brakes.◁

ANTISKID SYSTEM

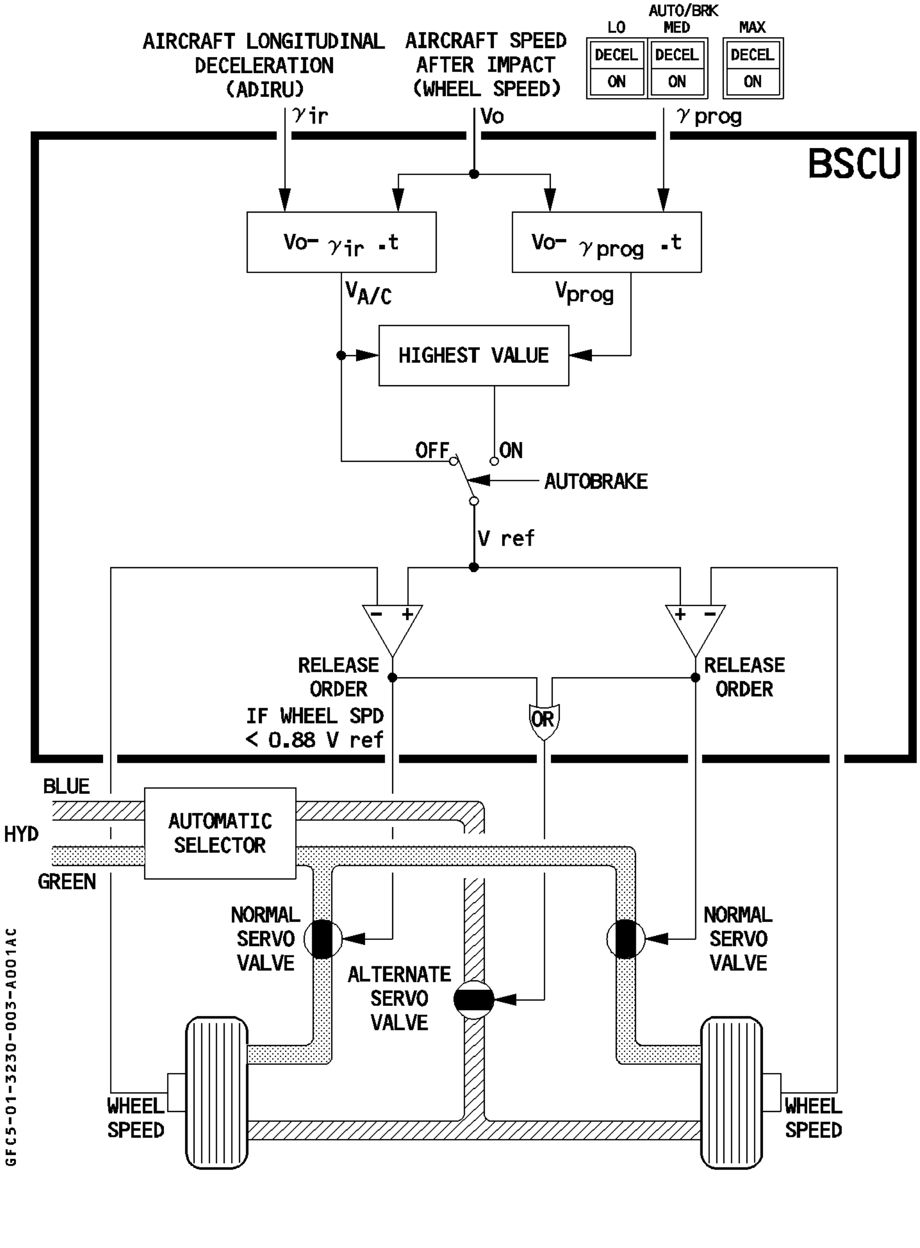
The antiskid system provides maximum braking efficiency by maintaining the wheels at the limit of an impending skid.
At skid onset brake release orders are sent to the normal and to the alternate servovalves as well as to the ECAM system which displays the released brakes.
Full braking performance is achieved only with brakes pedals at full deflection.
The antiskid system is deactivated below 10 kt (ground speed).
An ON/OFF switch activates or deactivates the antiskid system and nose wheel steering.

PRINCIPLE

The speed of each main gear wheel (given by a tachometer) is compared with the aircraft
R speed (reference speed). When the speed of a wheel decreases below 0.88 time reference speed, brake release orders are given to maintain the wheel slip at that value (best braking efficiency).
In normal operation, the reference speed is determined by BSCU from the horizontal acceleration from ADIRU 1 or ADIRU 2 or ADIRU 3.
In cases all ADIRU are failed, reference speed equals the maximum of either main landing gear wheel speeds. Deceleration is limited to a default value of 2.5 m/s^2 (8.2 ft/s^2).

ANTISKID PRINCIPLE

FOR INFO



AUTOBRAKE

The aim of this system is :
- To reduce the braking delay in the event of an accelerate-stop to improve performance.
- To establish and maintain a selected deceleration rate during landing, to improve comfort and reduce crew workload.

SYSTEM ARMING

The crew may arm the system by pressing the LO, MED, or MAX pushbutton provided all the following arming conditions are met :
- Green pressure available
- Anti-skid electrically powered
- No failure in the braking system.
- At least two PRIMs are available
- At least one ADIRU is available

Note : Autobrake may be armed with parking brake on.

SYSTEM ACTIVATION

R Automatic braking activates by the ground spoiler extension command (Refer to 1.27.10). In addition for MAX mode the nose landing gear compressed signal is required.
Consequently in the event of an acceleration stop, if the deceleration is initiated with the
R speed below 72 kt, the automatic braking will not activate because the ground spoilers will not be extended.

R SYSTEM DEACTIVATION

R The system deactivates :
R – when it is disarmed (see below)
R – when ground spoilers retract. In this case, it remains armed.

SYSTEM DISARMING

The system is disarmed by :
- Pressing the pushbutton, or
- Loss of one or more arming conditions, or
- R Applying sufficient deflection to one brake pedal when autobrake is active in MAX, MED or LO mode.
- R After take-off/touch and go.

OPERATION

These are four modes of operation :
- Normal braking.
- Alternate braking with antiskid.
- Alternate braking without antiskid.
- Parking brake.

NORMAL BRAKING

Antiskid is operative and autobrake is available.
Braking is normal when :
- green hydraulic pressure is available
- main landing gear in ground condition
- A/SKID and N/W STRG switch is ON

The control is electrically achieved through the BSCU :
- either via the pedals
- or automatically
  - on ground by autobrake system
  - in flight by setting the landing gear lever to the up position

Antiskid system is controlled by the BSCU via the normal servo valves.
No brake pressure indication is provided.

ALTERNATE BRAKING WITH ANTISKID

Autobrake is inoperative.
Active when green hydraulic pressure is insufficient and provided :
- blue hydraulic pressure is available
- A/SKID and N/W STRG switch is ON
- PARKING BRAKE is not ON

Note : Alternate braking is also active in flight when the landing gear is up.

The automatic switching between the green and blue system is achieved by an automatic hydraulic selector.
Control is achieved by the pedals through the auxiliary low hydraulic pressure distribution line acting on the dual valves. The BSCU controls antiskid system via the alternate servo valves.
The pressure delivered to the left and right brakes as well as the accumulator pressure are indicated on a triple indicator located on the center instrument panel.

ALTERNATE BRAKING WITHOUT ANTISKID

Autobrake and antiskid are inoperative.
The antiskid system is deactivated :
- electrically (A/SKID and N/W STRG switch OFF or power supply failure or BSCU failure)
- or hydraulically (B + G system low pressure, the brakes are supplied by the brake accumulator only).

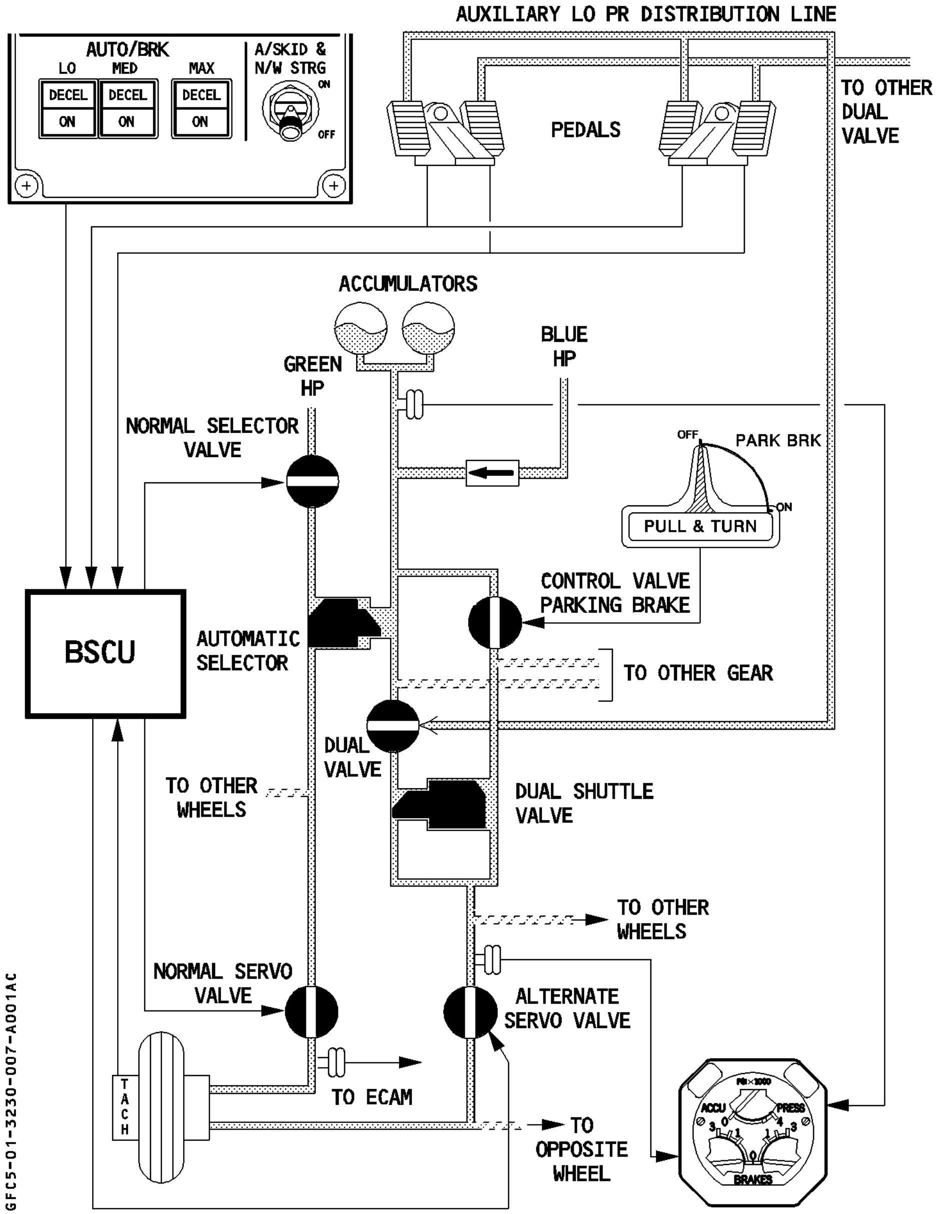
Control is achieved by the pedals (acting on the dual valves).
Alternate servo valves are fully open.
Brake pressure has to be limited by the pilot by refering to the triple indicator to avoid wheel locking.
The accumulators are dimensioned to supply at least seven full brakes applications.

PARKING BRAKE

Brakes are supplied by blue hydraulic system or accumulator pressure via the dual shuttle valve. Alternate servo valves are open allowing full pressure application.
The accumulator maintains the parking pressure for at least 12 hours.
If the parking is activated and no blue hydraulic or accumulator brake pressure is available, then the normal braking system can be applied via the brake pedals.
Blue accumulators can be pressurized by pressing the blue electrical pump switch.
Brake pressure indications are available on the triple indicator

BRAKING SCHEMATIC

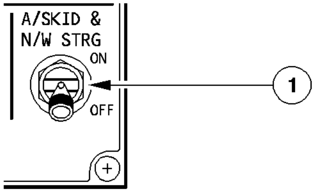
R



CONTROLS AND INDICATORS

CENTER INSTRUMENT PANEL

GFC5-01-3230-008-A100AA

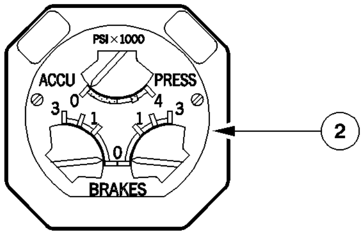


(1) A/SKID and N/W STRG switch

ON : – If green hydraulic pressure available, antiskid and nose wheel steering are available.
– If green hydraulic pressure lost
· Blue hydraulic pressure takes over automatically to supply the brakes
· Antiskid remains available
· Nose wheel steering is lost
· Brake blue pressure is displayed on the triple indicator

OFF : – Blue hydraulic supplies the brakes.
· Antiskid is deactivated. Brake pressure has to be limited by the pilot by refering to the triple indicator to avoid wheel locking
· Nose wheel steering is lost
· Differential braking remains available by pedals
· Brake blue pressure is displayed on the triple indicator.

GFC5-01-3230-008-B100AA

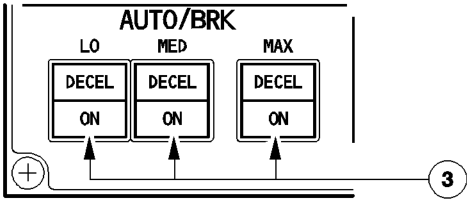


(2) BRAKE and ACCU PRESS indicator

ACCU PRESS indication : – green band : allowed pressure area in the brake accumulators. Provides full pressure to the brakes.
– amber band : forbidden pressure area. Necessitates a repressurization of the accumulators.

BRAKE pressure indication : Indicates blue pressure delivered to left and right brakes measured upstream of the alternate servovalves.

GFC5-01-3230-009-A001AA



(3) MAX, MED, LO pb sw (springloaded)

The pb controls the arming of the required deceleration rate.

– MAX mode is normally selected for take off.
  In the event of an aborted take off, maximum pressure is sent to the brakes as soon as ground spoiler deployment order is present.
– MED or LO mode is normally selected for landing.

R · When LO is selected, progressive pressure is sent to the brakes starting 1 second after ground spoiler deployment order to provide a 1.8 m/s^2 (5.9 ft/s^2) deceleration.

R · When MED is selected, progressive pressure is sent to the brakes starting at ground spoiler deployment order to provide a 3 m/s^2 (9.8 ft/s^2) deceleration.

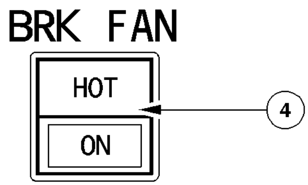
ON : The ON light illuminates blue to indicate positive arming.

R The DECEL light illuminates green only if the autobrake function is active and
R when actual aircraft deceleration corresponds to predetermined rate. (In LO or
R MED : 80% of the selected rate ; in MAX : 2.65 m/s^2 (8.7 ft/s^2)). This occurs
R approximately 8 (5) seconds after activation for LO (MED) using brakes alone.
R Predetermined rates could be achieved also by reversers alone or a
R combination of both reversers and brakes.

Note : On slippery runway, the predetermined deceleration may not be reached due to antiskid operation. In this case DECEL light will not illuminate. This does not mean that autobrake is not working.

Off : The corresponding autobrake mode is deactivated.

GFC5-01-3230-010-A100AA



④ BRK FAN pushbutton ◁

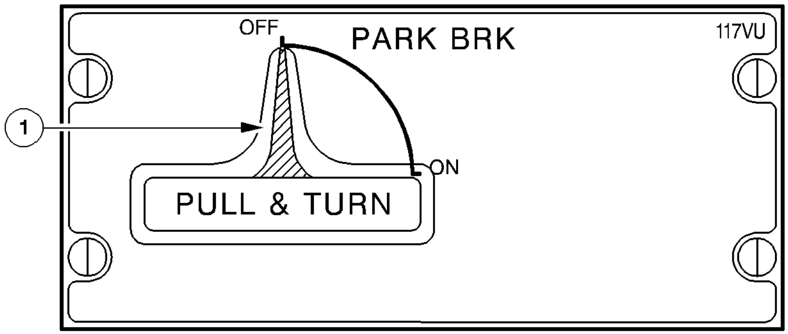
ON : The brake fans run, provided the main landing gear is downlocked.
The ON legend comes on blue.

Off : The brake fans stop.

HOT lt : Comes on amber, along with the associated ECAM caution, when one brake temperature exceeds 300°C.

PEDESTAL

GFC5-01-3230-010-B100AA



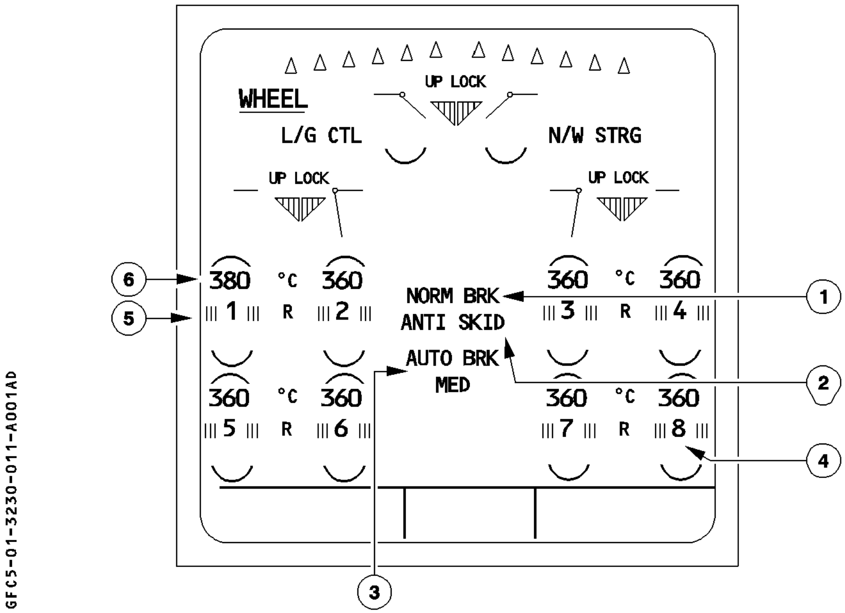
① PARK BRK handle

Pull the handle, then turn it clockwise to apply the parking brake.

R The «PARK BRK» message is displayed on the ECAM memo page.

CAUTION
As long as the handle is not in the «ON» position, the parking brake is not applied.

R **ECAM WHEEL PAGE**



① NORM BRK indication

Appears in amber in case of :
– normal braking is failed
– A/SKID & N/W STRG switch is at OFF (associated with ECAM caution)
– both BSCU channels are failed (associated with ECAM caution).

② ANTI-SKID indication

Appears amber associated with an ECAM caution in case of total BSCU failure or when the A/SKID and N/W STRG switch is OFF or in case of anti-skid failure detected by the BSCU or in flight with at least one engine running when green and blue systems are failed.

③ AUTO BRK indication

Displayed : – green when autobrake is armed
– amber associated with an ECAM caution in case of autobrake system failure or failure of both BSCU channels.

MAX, MED or LO indicates the selected rate (green). Not displayed when autobrake is faulty.

(4) Wheel number identification

It is in white.

(5) III indications

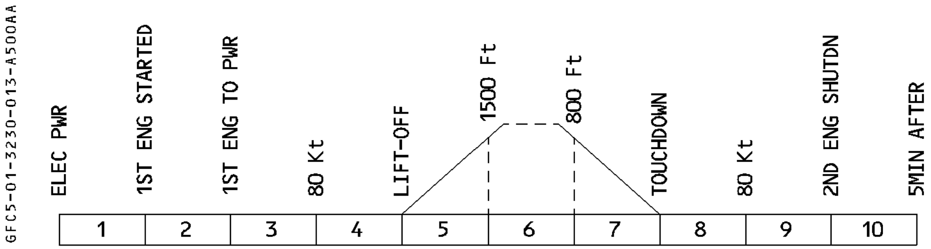
R It appears in green when :
R – In flight, the landing gear is extended and the antiskid is valid, or
R – On ground, when antiskid is activated and the brakes are released.
R It appears in amber in case of :
R – Residual pressure, or
R – Brake release fault
R The R (Release) indication is always in white.

(6) Brake temperature indications

- It is normally green (minimum indication 0°C).
- A green arc appears on the hottest wheel, when one brake temperature exceeds 100°C.
- The amber light, and associated ECAM caution, come on when the corresponding brake temperature exceeds 300°C.
  In addition, on the hottest wheel, the arc becomes amber.

Note : *Below 100°C, the indicated brake temperature may be below the actual brake temperature. This difference can reach 25°C with an actual brake temperature of 30°C, and it decreases when the temperature increases.*

WARNINGS AND CAUTIONS



<table>
<tr><th>E/WD : FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>CONFIG PARK BRK ON
Parking brake is ON, when thrust levers are set to the TO or FLX TO power position.</td><td>CRC</td><td>MASTER WARN</td><td rowspan="2">NIL</td><td rowspan="2">NIL</td><td>1, 2, 5 to 10</td></tr>
<tr><td>PARK BRK LO PR</td><td rowspan="8">SINGLE CHIME</td><td rowspan="8">MASTER CAUT</td><td>3 to 8</td></tr>
<tr><td>BRAKES HOT
One brake temperature is higher than 300°C.</td><td rowspan="6">WHEEL</td><td>BRK FAN HOT lt◁</td><td>4, 8, 9, 10</td></tr>
<tr><td>AUTO BRK FAULT
A tachometer is failed, or a servovalve is jammed closed on one or two wheels.</td><td rowspan="7">NIL</td><td>3, 4, 5</td></tr>
<tr><td>A/SKID FAULT</td><td>4, 5</td></tr>
<tr><td>A/SKID NWS OFF
Switch to the OFF position.</td><td>3, 4, 5</td></tr>
<tr><td>RELEASED
Brake of one wheel is released. It is detected when the landing gear is downlocked and at least one engine is running.</td><td>1, 4, 5 10</td></tr>
<tr><td>RESIDUAL BRAKING
Residual brake pressure is detected with pedals released :
— On at least one wheel, if on normal braking system, or
— On left or right main landing gear side (affecting the four wheels)</td><td>4, 5, 8</td></tr>
<tr><td>HYD SEL VALVE
Failure, or brake normal selector valve in the open position.</td><td rowspan="2">NIL</td><td>3, 4, 5, 8</td></tr>
<tr><td>SYS 1 (2) FAULT
One BSCU channel is failed.</td><td>NIL</td><td>NIL</td><td>3, 4, 5, 7, 8</td></tr>
</table>

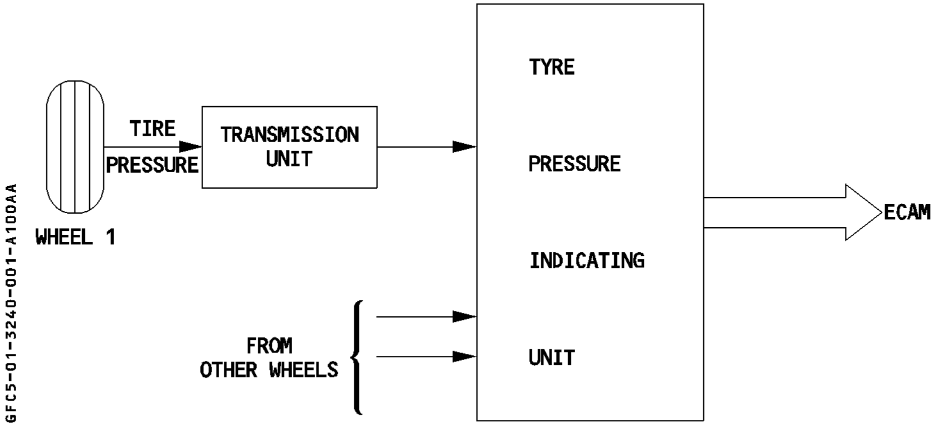
MEMO DISPLAY

— If the parking brake is on, the PARK BRK message is displayed :
 · In green, in flight phases 1, 2, 9, and 10.
 · In amber, in other flight phases.

— The BRK FAN memo is displayed in green, if the BRK FAN pushbutton is ON.◁

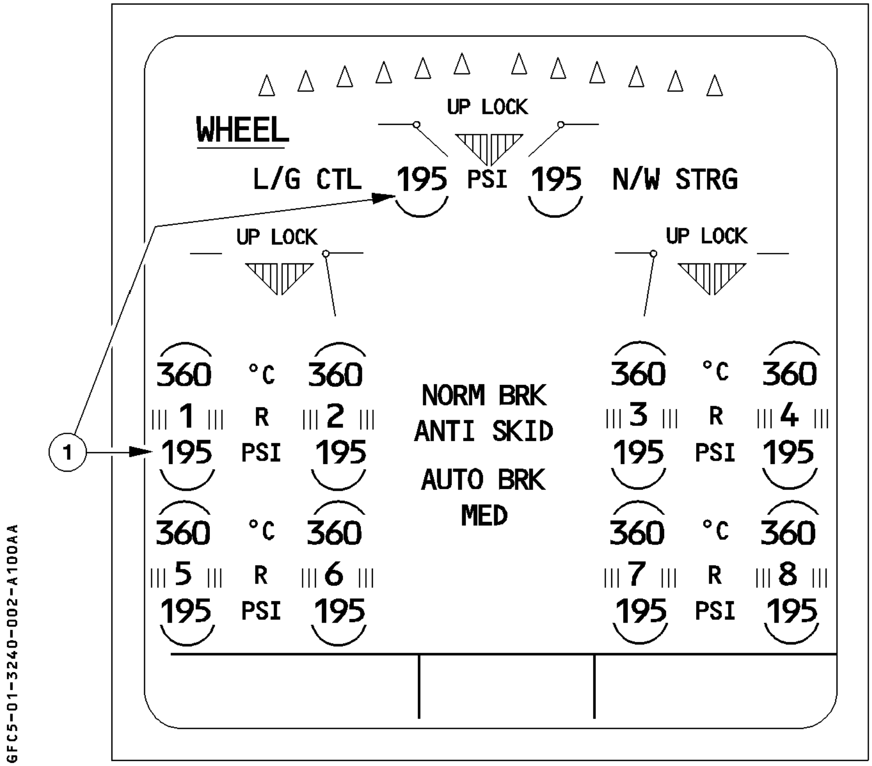
DESCRIPTION

The Tire Pressure Indicating System (TPIS) includes :
- a sensor which measures the pressure of each tire
- a transmission unit which transmits the electrical pressure signal from the sensor to the computer
- a Tire Pressure Indicating Unit (TPIU) which sends informations to the ECAM for cautions and system page display.



CONTROLS AND INDICATORS

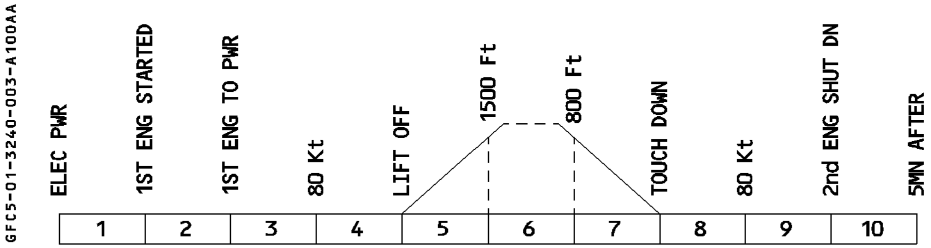
ECAM WHEEL PAGE



① Tire pressure indication

Indication is green.
Becomes amber associated with an ECAM caution when tire low pressure is detected.

WARNINGS AND CAUTIONS



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
TYRE LO PR One tyre pressure is lower than : – 74 % of nominal pressure from lift off to engines shut down – 89 % of nominal pressure in other cases. or difference of pressure between two wheels on the samme axle is higher than : – 21 % of nominal pressure from lift off to engines shut down – 15 % of nominal pressure in other cases	SINGLE CHIME	MASTER CAUT	WHEEL	NIL	4, 5, 8

BUS EQUIPMENT LIST

R

		NORM			EMER ELEC		
		AC	DC	DC BAT	AC ESS	DC ESS	HOT
LANDING GEAR	LGCIU 1					LAND REC	
	LGCIU 2		DC2				
	SAFETY VALVE		DC1/DC2				
	GRVTY EXT SYS 1						HOT 1
	GRVTY EXT SYS 2						HOT 2
	LDG GEAR INDICATOR PANEL					X	
BRAKES	BSCU CHANNEL 1					SHED (LAND REC)	
	BSCU CHANNEL 2		DC2				
	PARK BRK CTL		GND/ FLT				HOT 1
	BRK FAN CTL◁		DC2				
	COOLING FANS WHEEL 1, 2, 3, 4◁	AC2					
	COOLING FANS WHEEL 5, 6, 7, 8◁	AC1					
TIRE PRESS	TIRE PRESS INDICATING UNIT◁		DC1				

33.00 CONTENTS

GENERAL

The flight deck is provided with integral instrument lighting and flood lighting of the instrument panel.
The brightness of all panel lighting can be adjusted.
Work surfaces and side consoles are illuminated by incandescent spot lights and flood lights.
For general cockpit illumination, two dimmable DOME lights are installed.

DESCRIPTION

Instrument and panel integral lighting :
All instruments and panels installed in the cockpit (other than DU) are integrally lit.
The brightness of all instruments and panels can be adjusted.

Annunciator light test and dimming :
The brightness of all the annunciator lights in the flight deck can be changed, depending on the ANN LT TEST / BRT / DIM sw position on the overhead panel.
The lights are dimmed to a fixed level.
An annunciator light test is provided to verify cockpit annunciator lamp operation.
The test is done by selecting TEST position on ANN LT «TEST / BRT / DIM» sw and by visually checking that all lights illuminate.

Dome lights and lighting strips :
See 2 , 3 , 4
Two dome lights and lighting strips supply general cockpit illumination providing shadow free lighting.

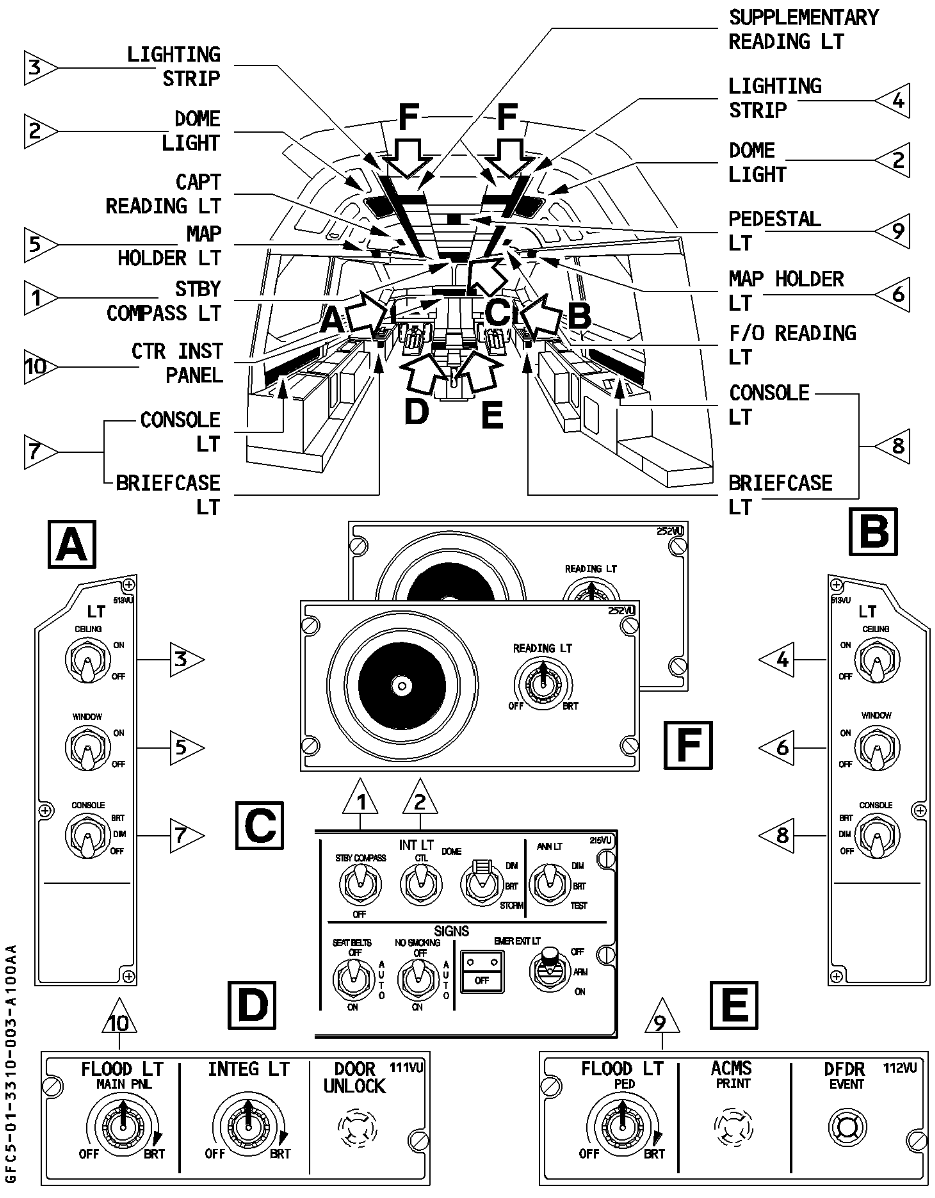
Map holder lighting :
See 5 , 6
Map chart holder is provided at the CAPT and F/O stations.

Console and floor lighting :
See 7, 8
Briefcase stowage, side console and floor lighting are provided at the CAPT and F/O stations.

Centre instrument and standby compass :
See 1, 10
The centre instrument is lighted by a set of lights located below the glareshield. The standby compass is provided with integral illumination.

Reading lights :
See detail F
Individual reading lights and supplementary reading lights are provided at the CAPT and F/O stations.

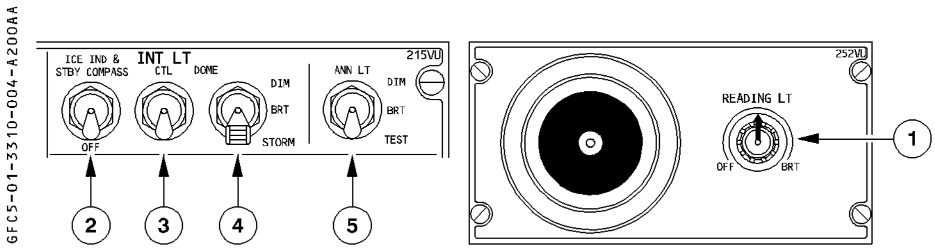
Pedestal lighting :
See 9
Located in the middle of the overhead panel, a flood light provides illumination of the centre pedestal.



LIGHTING STRIP
DOME LIGHT
CAPT READING LT
MAP HOLDER LT
STBY COMPASS LT
CTR INST PANEL
CONSOLE LT
BRIEFCASE LT
SUPPLEMENTARY READING LT
LIGHTING STRIP
DOME LIGHT
PEDESTAL LT
MAP HOLDER LT
F/O READING LT
CONSOLE LT
BRIEFCASE LT
A
B
C
D
E
F
LT
513VU
CEILING
ON
OFF
WINDOW
CONSOLE
BRT
DIM
252VU
READING LT
OFF
BRT
INT LT
STBY COMPASS
CTL
DOME
STORM
ANN LT
TEST
215VU
SIGNS
SEAT BELTS
NO SMOKING
AUTO
EMER EXIT LT
ARM
FLOOD LT
MAIN PNL
INTEG LT
DOOR UNLOCK
111VU
PED
ACMS
PRINT
DFDR
EVENT
112VU
GFC5-01-3310-003-A100AA

CONTROLS AND INDICATORS

OVERHEAD PANEL



(1) READING lt

Two reading lights are fitted on each side of the overhead panel.

(2) ICE IND & STBY COMPASS sw

Operation of standby compass integral and seat alignment indicator and ice detector lighting.

(3) CTL sw

There are two two-way switches to control the dome light. The first one is located on the left rear panel close to the cockpit door and the second one labelled CTL is located on the INT LT panel.

Note : On ground, during an accelerate stop, the right dome light automatically illuminates whatever the position of both switches is.

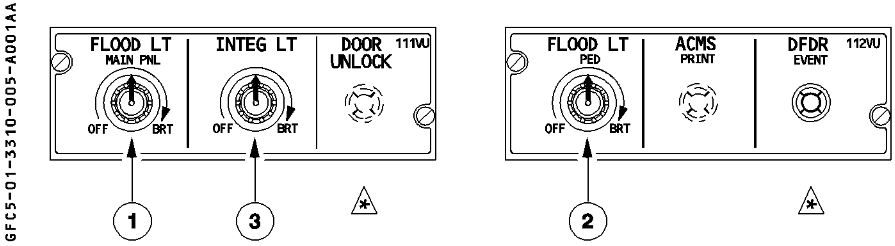
(4) DOME sel

STORM : Operation of both dome lights and main instruments panel (flood lights) at high intensity
BRT : Both dome lights on at high intensity (provided they are selected on through the CTL switch or the dome lighting switch on the rear left panel)
DIM : Both dome lights on at low intensity (provided they are selected on through the CTL switch or the dome lighting switch on the rear left panel)

5 ANN LT sel

TEST : · All flight deck annunciator lights illuminate.
· All Liquid Crystal Displays (LCD) indicate "eight".
DIM : Annunciator lights power supply voltage is reduced.
BRT : Normal operation.

PEDESTAL



1 FLOOD LT MAIN PANEL knob

Brightness adjustment of center instrument panel flood lighting.

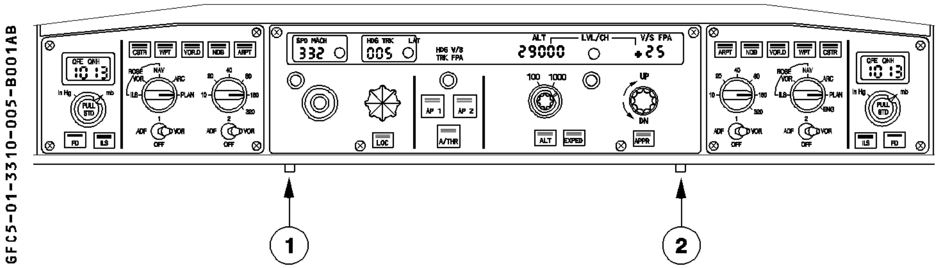
2 FLOOD LT PED knob

Brightness adjustment of pedestal flood lighting.

3 INTEG LT

Brightness adjustment of all flight deck integral lighting.

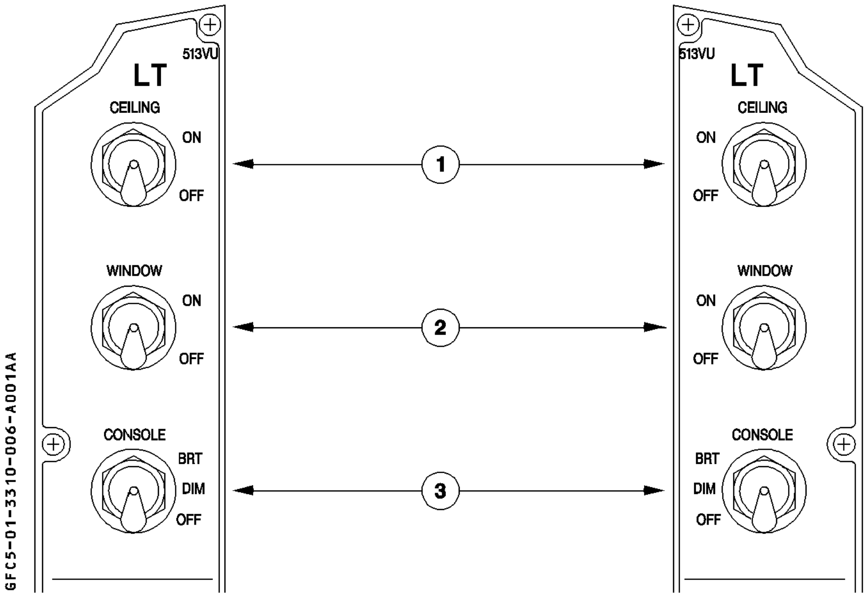
GLARESHIELD



R 1 Rotate potentiometer for glareshield integral lighting and LED on FCU lighting adjustment.

R 2 Rotate potentiometer for FCU displays lighting adjustment.

MAIN INST PANEL



(1) CEILING sw

Operation of the two lighting strips located on either side of the overhead panel.

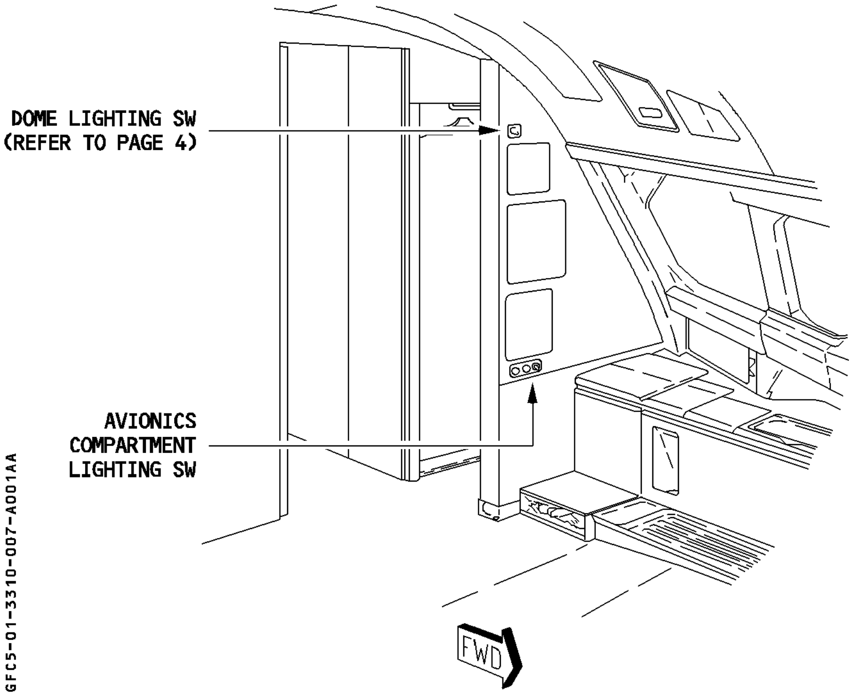
(2) WINDOW sw

Operation of the two lights located under the side windows for map holder lighting.

(3) CONSOLE sw

Permits illumination of the side consoles, briefcases, and floor around the pilots seats (two lighting levels).

LEFT REAR PANEL



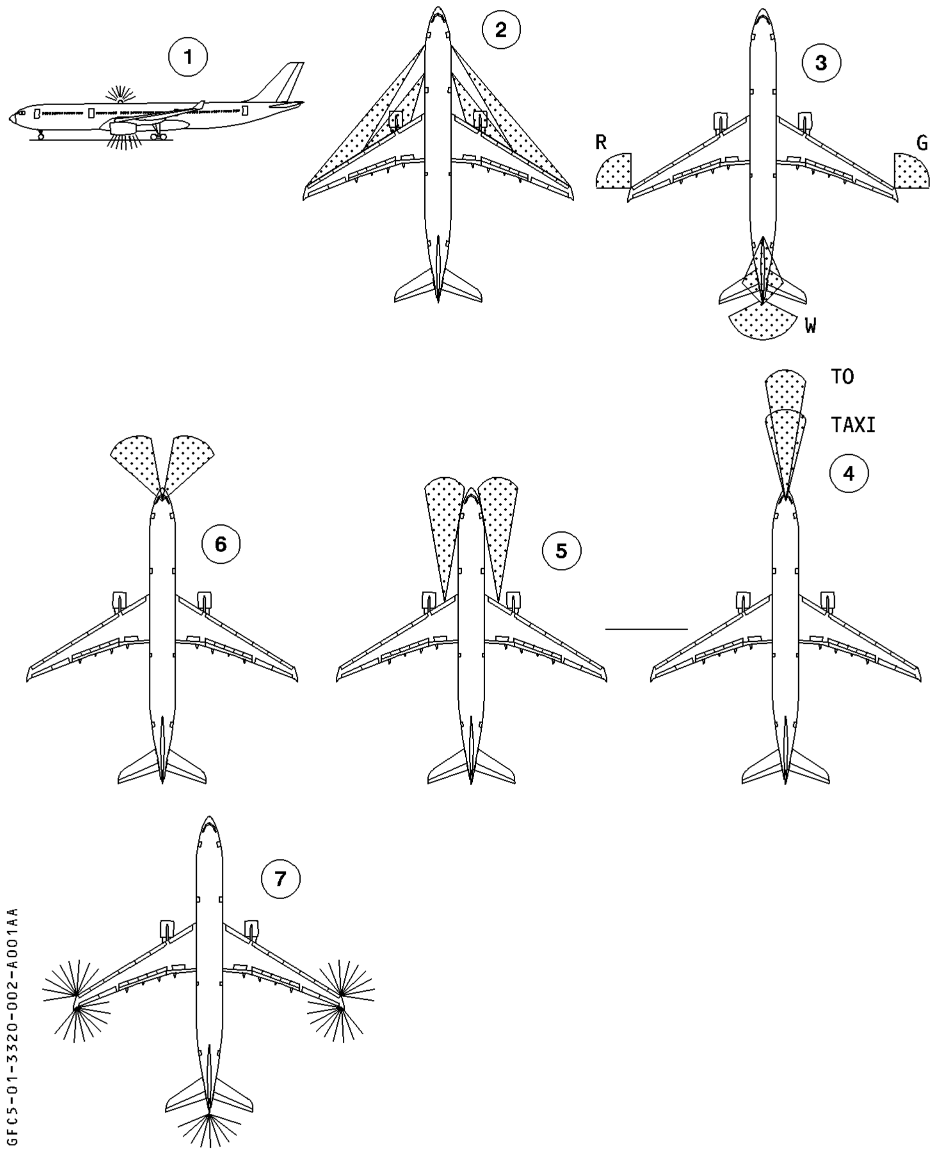
GENERAL

External lights include :
- The navigation lights
- The landing lights
- The runway turn off lights
- The TO and TAXI lts
- The logo lights
- The anticollision lights
- The wing and engine scan lights.

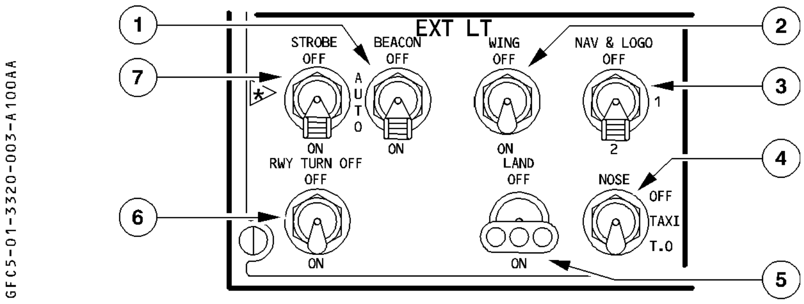
External lighting is controlled by means of switches located on the overhead panel.

CONTROLS AND INDICATORS

R



OVERHEAD PANEL



① BEACON sw

Operation of the two flashing red lights, one on top and one on bottom of the fuselage.

② WING sw

Operation of two single beam lights on each side of the fuselage, to illuminate wing leading edge and engine air intake to detect ice accretion.

③ NAV & LOGO sw

Operation of navigation and logo lights.
Dual navigation lights are located at each wing tip and in the APU tail cone.
Logo lights are installed in the upper surface of each horizontal stabilizer to illuminate the company logo on the vertical stabilizer.

1 : Circuit for first set of navigation lights is activated.
Logo lights are on when the main gear struts are compressed or the flaps are extended at 15° or more.

2 : Circuit for second set of navigation lights is activated. Logo lights are on when the main gear struts are compressed or the flaps are extended at 15° or more.

OFF : Navigation and logo lights extinguish.

④ NOSE sw

Operation of taxi and take-off lights.

T.O : Both taxi and take-off lights are illuminated.
TAXI : Only taxi light is illuminated.
OFF : Taxi and take-off lights off.

Note : These two lights, attached to the nose gear strut, go off automatically when landing gear is retracted.

(5) LAND sw

Operation of landing lights.

(6) RWY TURN OFF sw

Operation of runway turn-off light installed on the nose gear strut.

Note : These lights go off automatically when landing gear is retracted.

(7) STROBE sw ⊲

Operation of the two synchronized strobe lights on each wing tip plus one in the tail core.
ON : Strobe ligths flash white.
AUTO : Strobe lights are automatically switched on when the shock absorber is not compressed.
OFF : All lights are off.

MEMO DISPLAY

STROBE LT OFF message is displayed in green if the STROBE switch is at OFF in flight.

GENERAL

Emergency lighting includes :
- Cabin emergency lighting :
R · Proximity emergency escape path marking system (escape path and exit markers),
  · Overhead emergency lights,
  · EXIT signs.
- Escape slide lighting.

OPERATION

- The proximity emergency escape path marking, overhead emergency lighting, and EXIT signs come on, if the EMER EXIT LT sel is ON, or if the Purser panels' EMER pusbutton is pressed.
- With the EMER EXIT LT sel at ARM :
  · Cabin emergency lighting comes on automatically, if :
    * DC ESS BUS fails, or
    * Normal aircraft electrical power fails.
  · If AC BUS 1 fails, the overhead emergency lights come on automatically, in order to provide minimum cabin lighting.
- In addition, EXIT signs automatically come on when the NO SMOKING SIGNS are on, or in case of excessive cabin altitude.

  Note : *The emergency lighting system is supplied by DC ESS BUS and AC BUS 1. If DC ESS BUS fails, it is supplied by internal batteries (previously charged by the DC ESS BUS).*

- The escape slides are equipped with an integral lighting system. The escape slide lights come on automatically when the slide is armed and the door is open. They have the same supply as the cabin emergency lighting.

R

EMERGENCY LIGHTING CONTROL LOGIC

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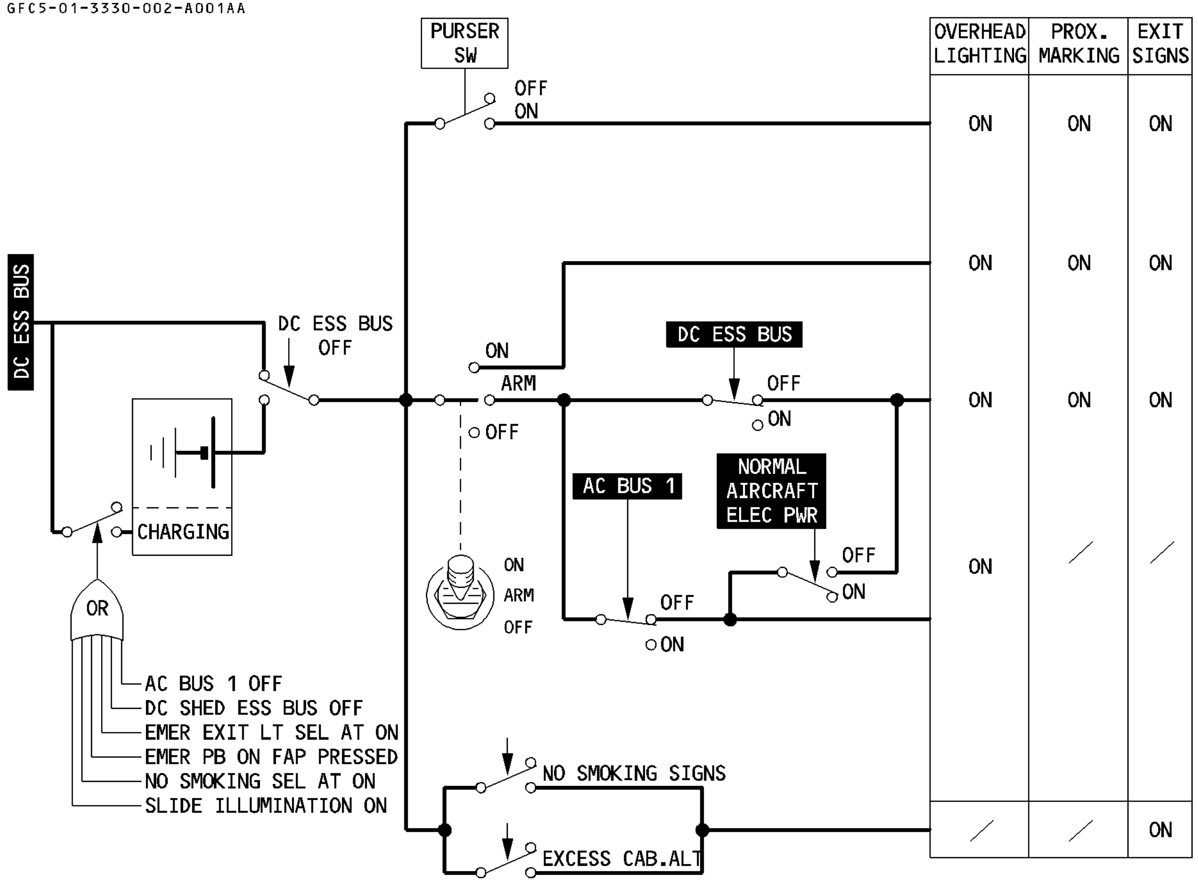
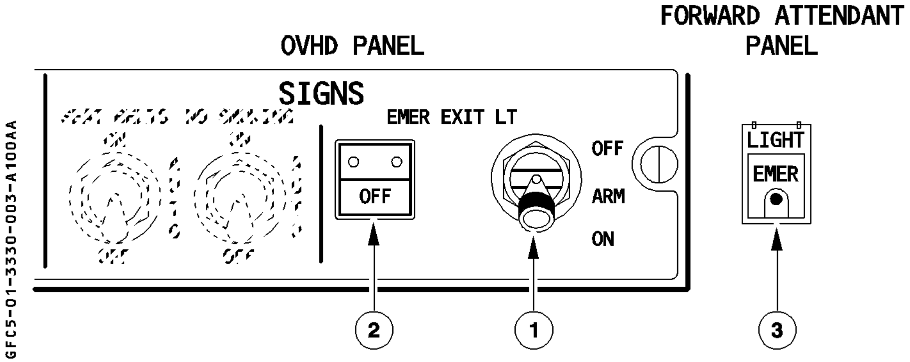


CONTROLS AND INDICATORS



① EMER EXIT LT sel

ON : The cabin emergency lighting illuminates.
OFF : The cabin emergency lighting is off.
ARM : – The cabin emergency lighting automatically illuminates if :
· DC ESS BUS fails, or
· Normal aircraft electrical power fails
– The overhead emergency lights automatically illuminate if AC BUS 1 fails, to provide minimum cabin lighting.

② EMER EXIT LT-OFF lt

Comes on amber when the EMER EXIT LT sel is selected OFF.

③ EMER pb sw

R on : Emergency lights, EXIT signs and proximity emergency escape path marking illuminate.

CONTROLS AND INDICATORS

OVERHEAD PANEL

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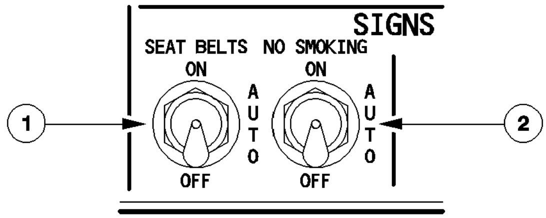


(1) SEAT BELTS sw

ON : FASTEN SEAT BELT signs (in cabin) and RETURN TO YOUR SEAT signs (in
R lavatories) come on associated with low tone chime.
R AUTO : FASTEN SEAT BELT and RETURN TO YOUR SEAT signs come on associated with low tone chime (depending on CIDS/CAM programming) when slats are
R extended (position 1, 2, 3 or FULL) or when main landing gear is extended.
OFF : Signs are off. Low tone chime sounds (depending on CIDS/CAM programming).

(2) NO SMOKING sel

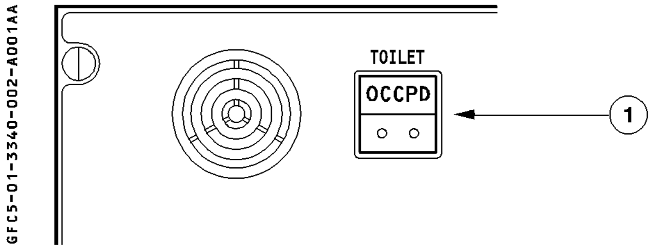
R ON : NO SMOKING and EXIT signs in cabin come on associated with low tone chime.
R AUTO : NO SMOKING and EXIT signs in cabin come on when landing gear is
R extended and go off when landing gear is retracted. Low tone chime sounds
R (depending on CIDS/CAM programming) each time the signs come on or go
R off.
R OFF : Signs are off. Low tone chime sounds (depending on CIDS/CAM programming).

Note : In the event of excessive cabin altitude (if cabin altitude equals EXCESS CAB
R *ALT limit + 1750 feet ; max 14350 feet), the cabin lights come on (depending on the CIDS/CAM programming) and the NO SMOKING, FASTEN SEAT BELT, EXIT signs come on regardless of SEAT BELTS and NO SMOKING selector switches.*

MEMO DISPLAY

SEAT BELTS and NO SMOKING messages are displayed in green when the corresponding sign is on.

OVERHEAD PANEL



(1) TOILET OCCPD lt

Illuminates when lavatory located near the forward exit is occupied.

CABIN CONTROLS

NOT APPLICABLE

BUS EQUIPMENT LIST

R

			NORM			EMER ELEC		
			AC	DC	DC BAT	AC ESS	DC ESS	HOT
COCKPIT LIGHTS	LIGHTING STRIPS, MAP HOLDER, CONSOLE	L		DC1				
		R		DC2				
	DOME LT	L		DC GND				
		R					X	
	CTR. INST PANEL			DC1			X	
	STBY COMPASS						X	
	SUPPLEMENTARY READING LT			DC1				
	PEDESTAL LT			DC1				
	CAPT F / O READING LT			DC2				
	INST, PANELS-INTEGRAL LT	LAMPS	AC 1					
		LEDS		DC1				
	ANNUN LIGHTS SUPPLY	SYS 1	AC1					
		SYS 2	AC2					
		ESS SYS				X		
	ANNUN LIGHTS TEST / DIM			DC2				
EXTERIOR LIGHTS	STROBE		AC2	DC2 (2)				
	LAND	L				SHED	SHED (LAND REC)	
		R	AC2	DC1				
	RWY TURN OFF	L	AC1	DC2				
		R	AC2	DC2				
	NOSE	L	AC1	DC2				
		R	AC2	DC2				
	NAV		AC2					
	BEACON	UPPER	AC1					
		LOWER	AC2					
	WING	L	AC1 + AC2					
		R (1)	AC1 + AC2					
	LOGO		AC2	DC2				
CABIN EMERGENCY LIGHTING			AC1				X	

(1) Both AC supplies are required for light operation.
(2) DC supply is only required for AUTO mode.

34.00 CONTENTS

DESCRIPTION

The Air Data and Inertial Reference System (ADIRS) supplies temperature, anemometric barometric and inertial parameters to the EFIS system (PFD and ND) and to other user systems (FMGC, FADEC, PRIM, SEC, FWC, SFCC, ATC, GPWS, CMC, CPC).

The system includes :

- three identical ADIRU's (Air Data and Inertial Reference Units). Each ADIRU is divided in two parts, either of witch can work separately in case of failure in the other :
  - · the ADR (Air Data Reference) part which supplies barometric altitude, speed, Mach, angle of attack, temperature and overspeed warnings.
  - · the IR (Inertial Reference) part which supplies attitude, flight path vector, track, heading, accelerations, angular rates, ground speed, vertical speed and aircraft position.

  Note : The ADIRU gives the true heading instead of magnetic heading :

R *– above 82° North*

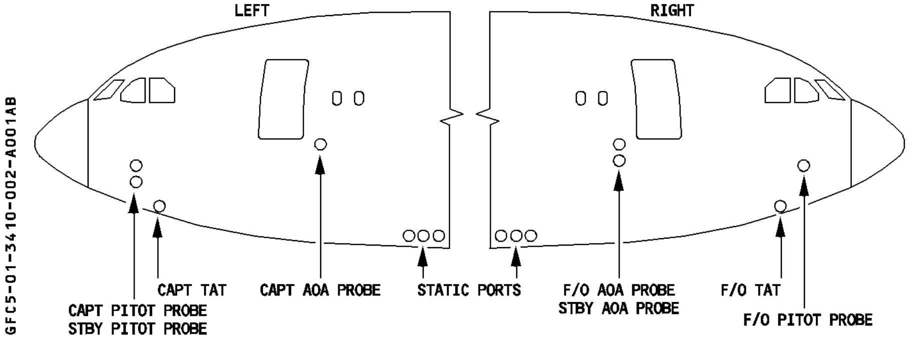
R *– above 73° North between 90° and 120° West (magnetic polar region)*

R *– above 60° South*

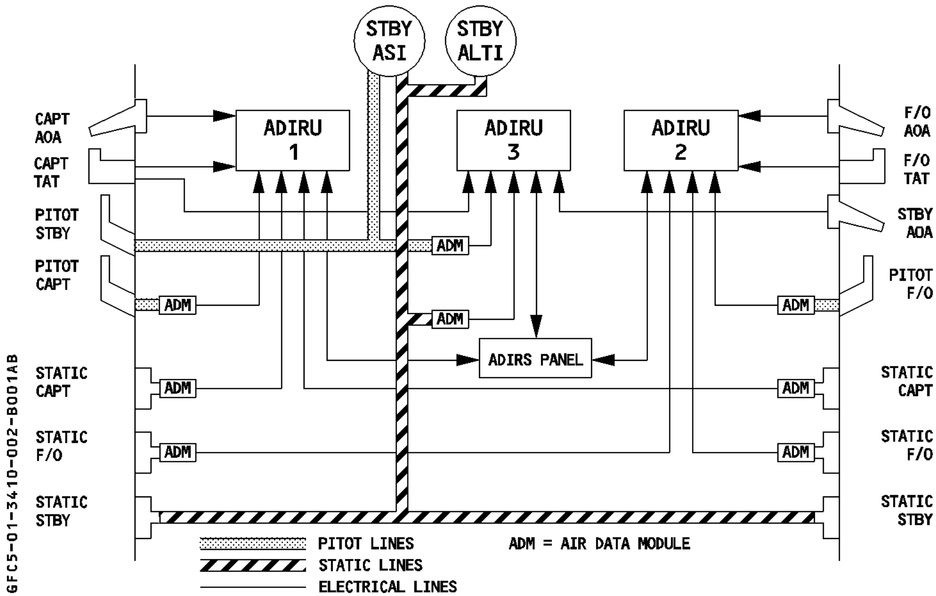
- one ADIRS control panel located on the overhead panel for modes selection (NAV, ATT, OFF) and failure indications.
- 2 GPS receivers, which are connected to the IR part of the ADIRU's for GP/IR hybrid position calculation.
- four types of sensors :
  - · pitot probes (3)
  - · static pressure probes (STAT) (6)
  - · angle of attack sensors (AOA) (3)
  - · total air temperature probes (TAT) (2)

  These sensors are electrically heated to prevent from icing up.
- eight ADMs (Air Data Modules) which convert pneumatic data from pitot and static probes into numerical data for the ADIRUs.
- a switching facility for selecting ADR3 or IR3 for instrument displays in case of ADIRU 1 or 2 failure.
- a MAG / TRUE pushbutton switch for polar navigation.
- AC BUS provides to normal electrical supply. DC BUS provides a back up possibility through internal inverter.

PROBES LOCATION

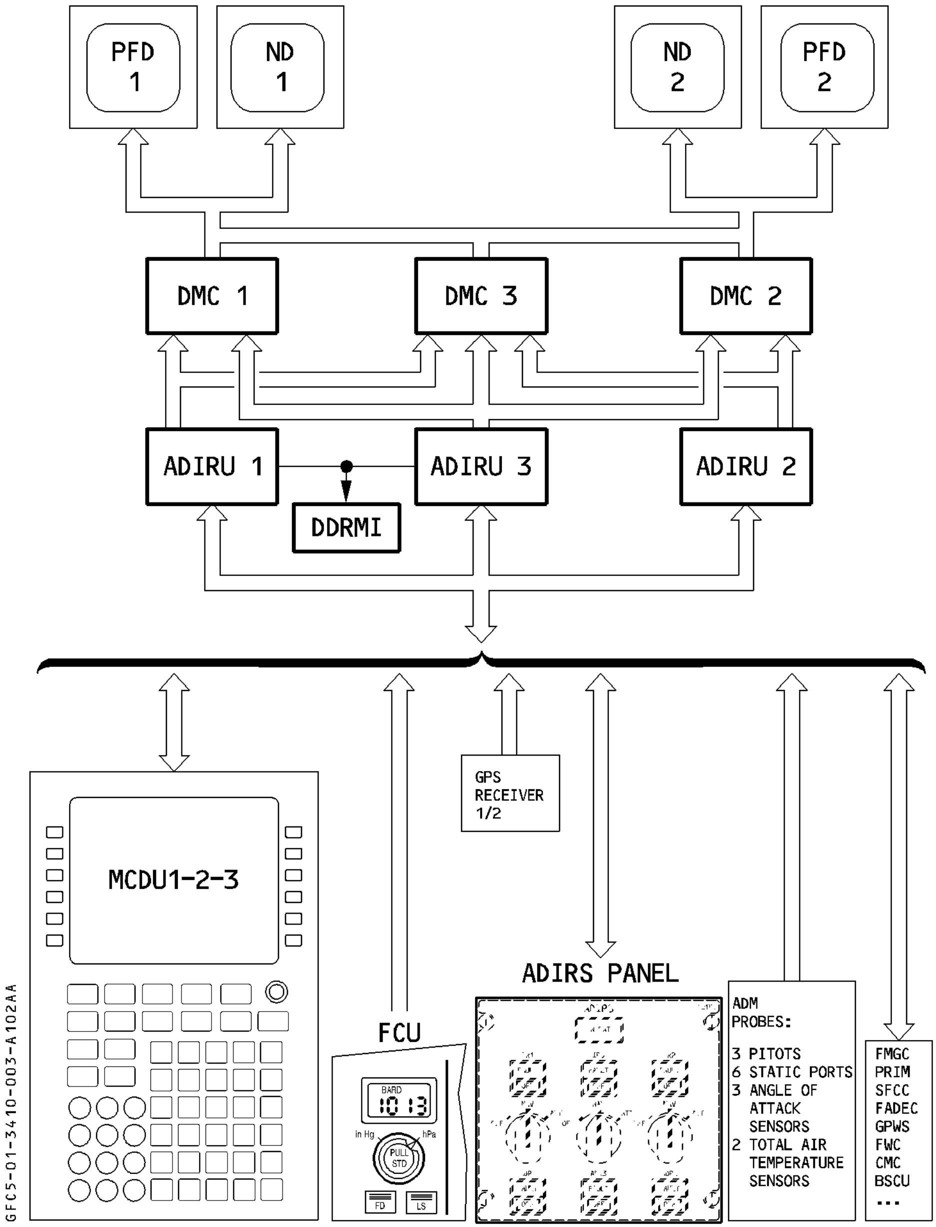


PROBES SCHEMATIC



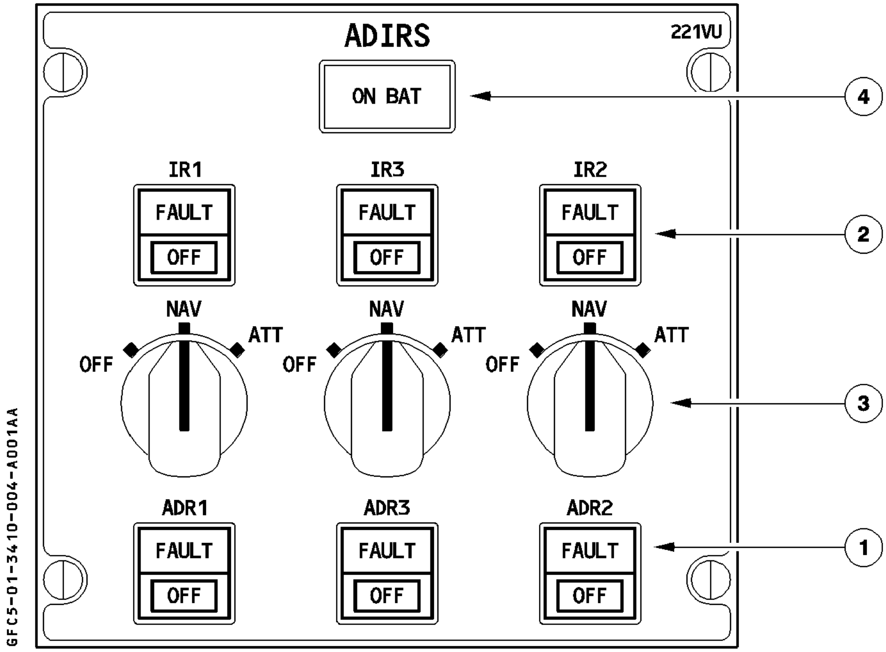
Note : ADIRU
ADIRU 1 is supplied by CAPT probes,
ADIRU 2 is supplied by F/O probes
ADIRU 3 is supplied by STBY probes and CAPT TAT

ADIRS SCHEMATIC



CONTROLS AND INDICATORS

OVERHEAD PANEL



(1) ADR pb sw

OFF : Air data output disconnected
R FAULT lt : This amber light comes on associated with an ECAM caution if a fault is detected in the air data reference part.

(2) IR pb sw

OFF : Inertial data output disconnected.
R FAULT lt : This amber light comes on associated with an ECAM caution when a
R fault affects the respective IR.
R steady : the respective IR is lost.
R flashing : the attitude and heading information may be recovered in ATT mode.

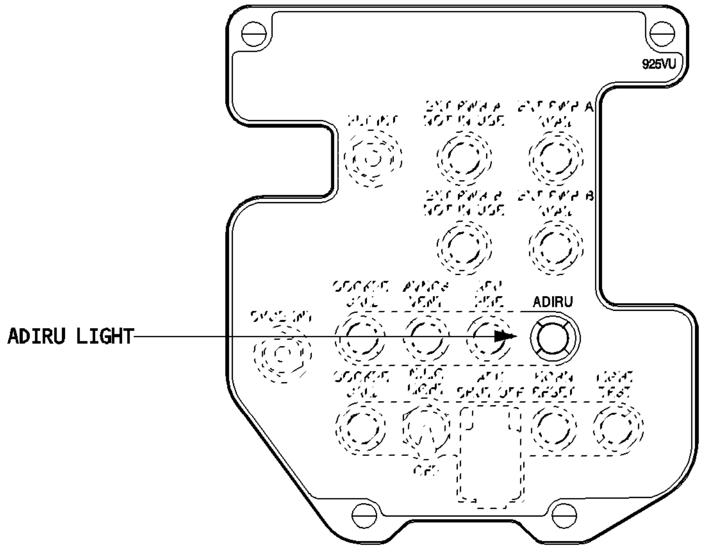
R ③ IR 1(2) (3) mode rotary sel

OFF : The ADIRU is not energized.
ADR and IR data are not available.
NAV : Normal mode of operation.
Supplies full inertial data to aircraft systems.
R ATT : IR mode supplying only attitude and heading information if the system loses
R its ability to navigate.
The heading must be entered through the MCDU and has to be reset
R frequently (about every 10 minutes).

④ ON BAT lt

R Comes on amber when one or more IRS is supplied only by the aircraft battery. It
R also comes on for a few seconds at the beginning of the alignment but not for a fast
R realignment.

R *Note : if, when the aircraft is on the ground at least one ADIRU is supplied by batteries :*
– an external horn sounds
– the ADIRU light comes on amber on the SERVICE INTERPHONE BAY panel.



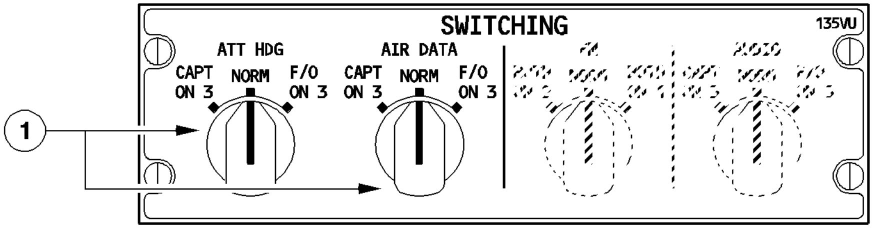
SERVICE INTERPHONE BAY PANEL

GFC5-01-3410-005-A001AA

LEFT INTENTIONALLY BLANK

PEDESTAL

GFC5-01-3410-007-A001AB



(1) AIR DATA and ATT HDG sel

NORM : ADIRU 1 supplies data to PFD1, ND1, DDRMI and ATC 1.
ADIRU 2 supplies data to PFD2, ND2 and ATC2.
CAPT ON 3 : ADR 3 or IR 3 replaces ADR 1 or IR 1
F/O ON 3 : ADR 3 or IR 3 replaces ADR 2 or IR 2

MAIN INSTRUMENTS PANEL

At high latitude above 82.5° North or 60.5° South (or entering the north magnetic polar region : latitude 73.5° N and longitude between 117.5° W and 92.5° W) the ADIRUs replace magnetic heading by true heading on EFIS and DDRMI.
R In addition the GRID track appears on ND. When the aircraft is in close proximity to these regions (latitude above 82° North or 60° South or approaching the north magnetic polar region : 73° N and longitude between 90° W and 120 W) the ADIRU will trigger a message on ND “SELECT TRUE REF” requesting to change north reference.

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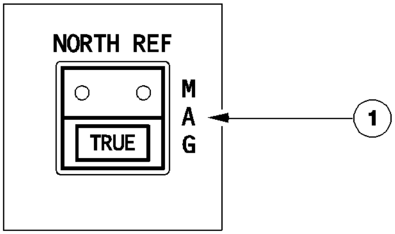
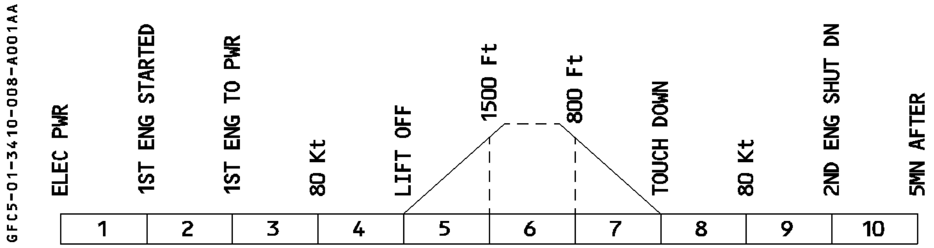


(1) NORTH REF pb sw

TRUE (in) : Pressing this pushbutton selects the true heading for instrument displays.
TRUE light comes on blue. The ND displays GRID track values if position is above 65° N or S.
MAG (out) : Magnetic heading is selected.

WARNINGS AND CAUTIONS



<table>
<tr><th>E / WD: FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>STALL WARNING (No ECAM message)
An aural stall warning is triggered when the AOA is greater than a predetermined angle
This angle depends on
– the Slats / Flap position
– the Speed / Mach
– the F / CTL law (normal, alternate / direct)</td><td>Cricket
+
STALL
(synthetic voice)</td><td rowspan="2">MASTER WARN</td><td rowspan="9">NIL</td><td rowspan="2">NIL</td><td rowspan="2">NIL</td></tr>
<tr><td>OVERSPEED
– VMO / MMO
aircraft speed / mach greater than
VMO + 4 kt / MMO + 0.006
– VLE
aircraft speed greater than VLE + 4 kt with L / G not uplocked or L / G doors not closed
– VFE
aircraft speed greater than VFE + 4 kt with slats or / and flaps extended.</td><td>CRC</td></tr>
<tr><td>ADR 1(2)(3) FAULT</td><td rowspan="7">SINGLE CHIME</td><td rowspan="7">MASTER CAUT</td><td rowspan="2">ADR FAULT lt</td><td rowspan="2">1, 4, 8, 10</td></tr>
<tr><td>ADR 1+2 (1+3)(2+3) FAULT</td></tr>
<tr><td>IR 1(2)(3) FAULT</td><td rowspan="2">IR FAULT lt</td><td>1, 4, 5, 7, 8, 10</td></tr>
<tr><td>IR 1+2 (1+3)(2+3) FAULT</td><td>1, 4, 8, 10</td></tr>
<tr><td>HDG DISCREPANCY
difference between heading on CAPT and F / O displays greater than 5° in TRUE or than 7° in MAG</td><td>CHECK HDG (on ND and PFD)</td><td rowspan="3">4, 8</td></tr>
<tr><td>ATT DISCREPANCY
difference between roll or pitch angle displayed on CAPT and F / O PFD greater than 5°</td><td>CHECK ATT (on PFD)</td></tr>
<tr><td>ALTI DISCREPANCY
difference between altitude displayed on CAPT and F / O PFD greater than :
– 500 ft if baro ref STD is selected
– 250 ft if QNH is selected</td><td>CHECK ALT (on PFD)</td></tr>
</table>

R

<table>
<tr><th>E / WD: FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>EXTREME LATITUDE
A / C enters in polar area, the crew must select true reference.</td><td rowspan="7">SINGLE CHIME</td><td rowspan="7">MASTER CAUT</td><td rowspan="7">NIL</td><td rowspan="4">NIL</td><td>4, 5, 7, 8</td></tr>
<tr><td>IR NOT ALIGNED
Problem detected during IR alignment.</td><td>NIL</td></tr>
<tr><td>FM/IR POS DISAGREE
Discrepancy between the a/c position computed by FMS and position given by IRs.</td><td>1, 2, 3, 4, 5, 7, 8, 9, 10</td></tr>
<tr><td>BARO REF DISCREPANCY
Discrepancy between the F/O and Captain baro ref.</td><td>3, 4, 8</td></tr>
<tr><td>IR DISAGREE
Disagree between two IR, the third one failed.</td><td>PFD message</td><td rowspan="2">3, 4, 5, 7</td></tr>
<tr><td>ADR DISAGREE
Disagree between two ADRs, the third one being failed or rejected by the PRIMS.</td><td rowspan="2">NIL</td></tr>
<tr><td>IAS DISCREPANCY
One ADR is rejected by the flight control computers and there is a discrepancy between the speeds displayed in both PFDs.</td><td>4, 5, 7, 8</td></tr>
</table>

MEMO DISPLAY

- "IRS IN ALIGN XXX" and "IR XXX IN ATT ALIGN" messages appear in green, during an IR alignment.
  The "IRS IN ALIGN" message becomes amber, if engines are running ; or, flashes green, if IRS alignment is faulty.
- "TRUE NORTH REF" appears in green, when the NORTH REF pushbutton is at TRUE.
  The message pulses for 10 seconds in Phase 1 or 2, or at slats' extension.
- "ADIRS SWTG" appears in green, when either AIR DATA or ATT HDG selector is not in the NORM position.

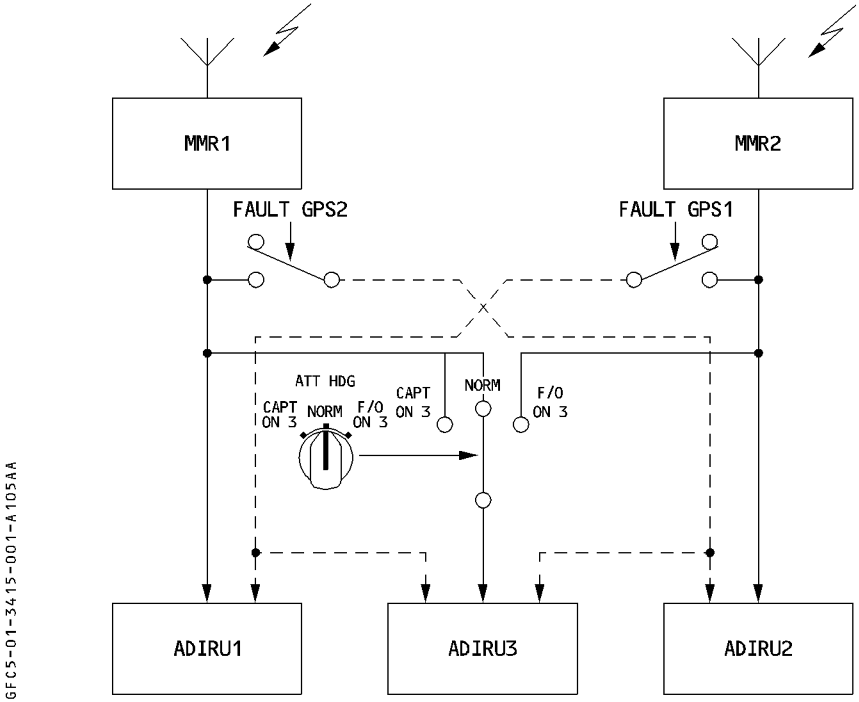
DESCRIPTION

The Global Positioning System (GPS) is a satellite based radio navigation aid.
Worldwide 24 satellites broadcast accurate navigation data that the aircraft can use for the precise determination of its position.
The aircraft has two independent GPS receivers. Each GPS receiver is integrated in a modular avionics unit called MMR (Multi Mode Receiver) (GPS 1 receiver in MMR1, GPS 2 receiver in MMR2).

R The MMR processes the data received and transfers them to the ADIRUs, which then perform a GP-IRS hydrib position calculation. The FMGCs use the hybrid position. The GPS MONITOR page on MCDU1 or MCDU2 can display pure GPS position, true track, ground speed, estimated position, accuracy level, and mode of operation for the information and use of the flight crew.

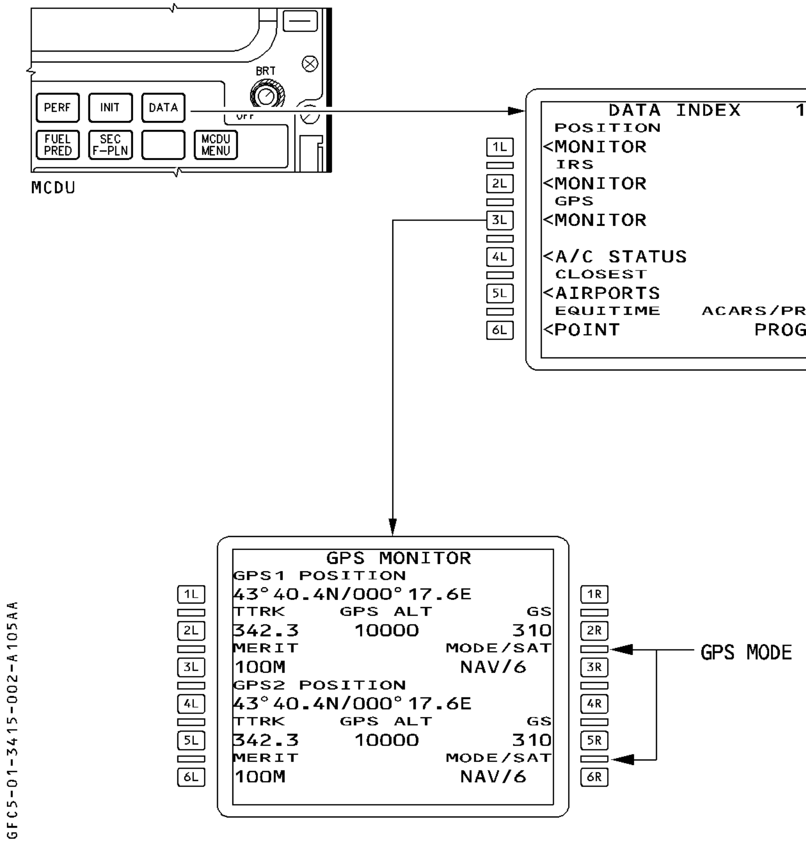
Note : *Flight crew can use the MCDU NAVAID page to deselect the use of GPS data for calculating position. (Refer to FCOM 4 03.20).*

R



NORMAL OPERATION

In normal operation, the GPS receiver 1 supplies the ADIRU 1 and 3, the GPS receiver 2 supplies ADIRU 2.
The MMR operates in different modes which are indicated on the GPS MONITOR page :
R



R – **Initialization mode (INIT)**
R When this mode is entered the MMR hardware and software are initialized.

– **Acquisition mode (ACQ)**
The MMR enters in this mode after power up or during long periods of lost satellite signal. It remains in this mode until it is able to track at least 4 satellites, then transfers into NAV mode. To enter in navigation mode more quickly, the MMR uses initial position, time and altitude from IRS.

– **Navigation Mode (NAV)**
When the MMR can track 4 or more satellites, it enters NAV mode and continuously supplies data to the ADIRUs.

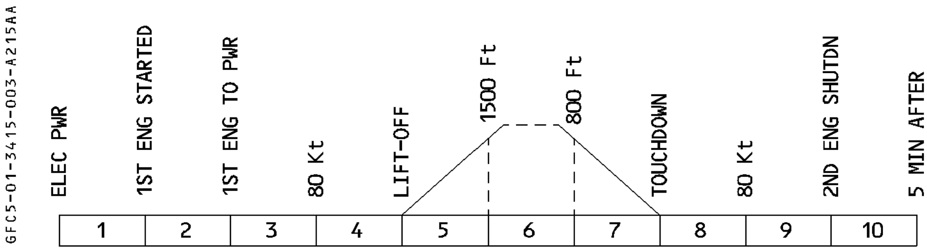
– **Altitude Aiding (ALTAID)**
If the MMR can track at least 4 satellites, it uses the GPS altitude and the IR altitude to calculate an altitude bias.
If the number of satellites drops to three, the altitude bias is frozen and the MMR enters
R ALTAID mode, using the IR altitude (corrected with the altitude bias).

– **Fault Mode (FAULT)**
The fault mode is entered when a failure, which may prevent the MMR from transmitting valid data has been detected.

OPERATION IN CASE OF FAILURE

If one GPS receiver fails, the three ADIRUs automatically select the only operative GPS receiver. If ADIRU 1 fails, ADIRU 3 is supplied by MMR 1, and ADIRU 2 is supplied by MMR 2. To maintain Side 1 and Side 2 segregation, in case ADIRU 2 fails, the ATT HDG selector must be set to F/O ON 3, so that ADIRU 3 will be supplied with MMR 2 data. If two ADIRUs fail, the remaining ADIRU is supplied by its own side GPS receiver.

WARNINGS AND CAUTIONS



E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
GPS 1 (2) FAULT	SINGLE CHIME	MASTER CAUTION	NIL	NIL	4, 5, 7, 8
FM/GPS POS DISAGREE	SINGLE CHIME	MASTER CAUTION	NIL	NIL	1, 3, 4, 10
GPS PRIMARY LOST (No ECAM Warning)	TRIPLE CLICK During non ILS approach only	NIL	NIL	ND/MCDU Message	2, 3, 4, 5 8, 9, 10

COMPASS

This instrument is on top of windshield center post.
The deviation card is above it.

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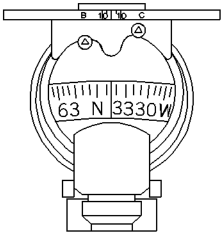
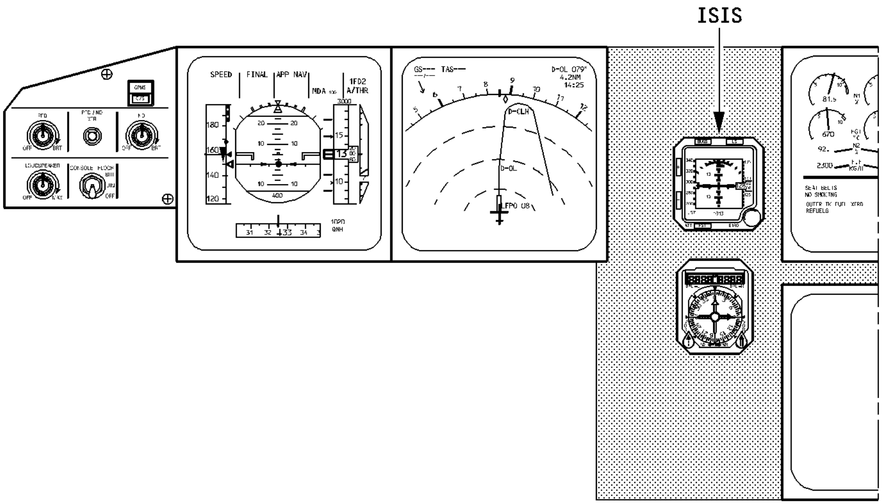


INTRODUCTION

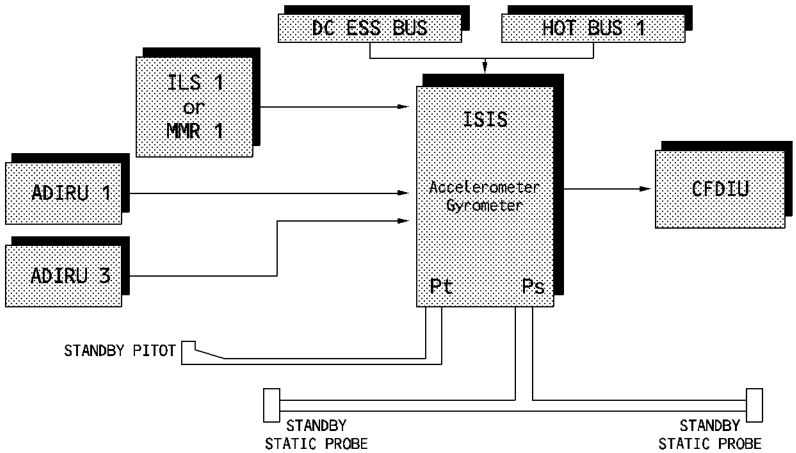
The Integrated Standby Instrument System (ISIS) provides a third source of information and display to the crew. It is mounted in the center of the instrument panel.



GFC5-01-3425-001-A100AA

ARCHITECTURE

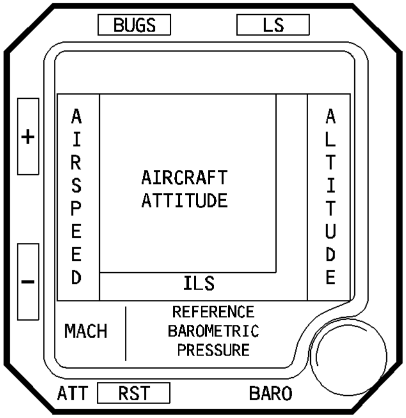
R



GFC5-01-3425-001-B100AA

GENERAL

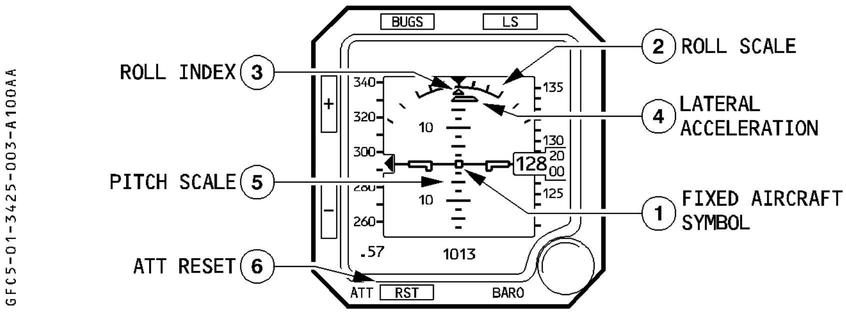
The ISIS system displays the following information :
- attitude
- airspeed and mach
- altitude
- barometric pressure
- LS function
- bugs



GFC5-01-3425-002-A100AA

ATTITUDE

R



① Fixed aircraft symbol

The fixed aircraft symbol is in black, and outlined in yellow.

② Roll scale

R The roll scale is in white. The markers are at 0 (small yellow triangle), 10, 20, 30, 45, 60 degrees of bank.

③ Roll index

R The roll index is in black, and outlined in white. It indicates the bank angle.

④ Lateral acceleration index

The trapezoidal index moves beneath the roll index. It represents the aircraft's lateral acceleration.

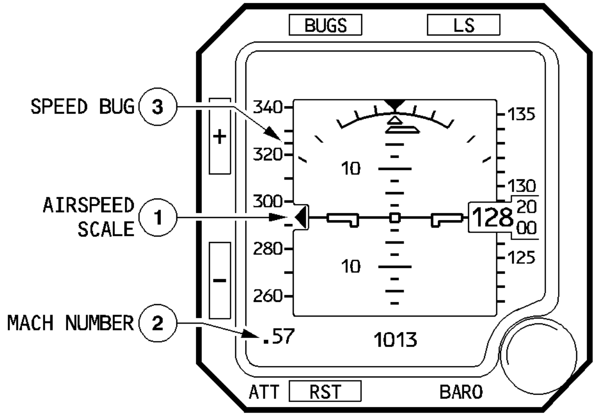
⑤ Pitch scale

The pitch scale is in white. The scale shows markers every 2.5° between 30° nose up and 30° nose down. Beyond 30°, large red arrowheads (V-shaped) indicate that the attitude has become excessive, and show the direction to follow in order to reduce it. The minimum pitch scale displayed is – 17.5° + 15° at 0° pitch.

⑥ ATT RST

The attitude indication can be reset by pressing this pushbutton for at least 2 seconds. The aircraft must be level during this procedure. During the reset time (approximately 10 seconds), the "ATT 10s" message is displayed on the screen. This pushbutton is also used to realign the system, if excessive aircraft movement is detected during the alignment phase.

AIRSPEED



GFC5-01-2425-004-A100AB

① Airspeed scale

A white scale moves in front of a yellow triangle indicating the airspeed. The scale ranges from 5 to 250 knots, with a mark every 5 knots, and from 250 to 520 knots, with a mark every 10 knots.

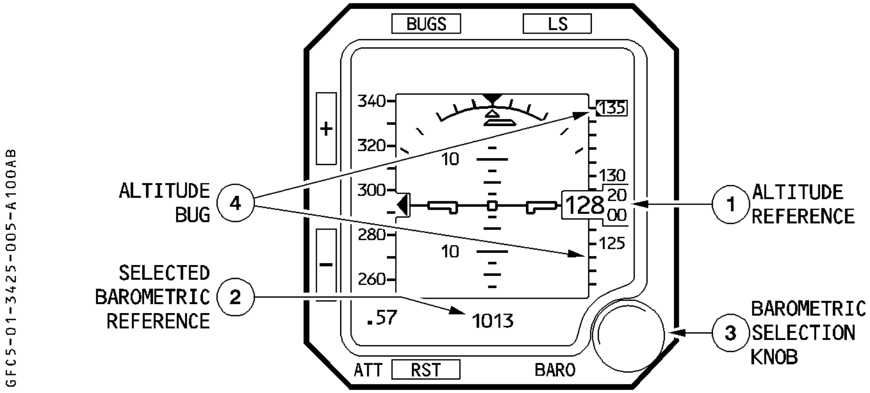
② Mach Number

R The Mach number is displayed in green, when greater than 0.5, but disappears only
R when it goes lower than 0.45.

③ Speed bug

When a speed bug is entered via the BUGS function, the corresponding speed mark is indicated by a cyan dash.

ALTITUDE



① Altitude indication

The altitude indication is given as a white moving scale and a green digital readout on a gray background.
The altitude scale ranges from – 2000 feet to 50 000 feet every 100 feet, with altitude digital indications every 500 feet.
"NEG" appears in the window in white for negative altitudes.
The altitude box changes to cyan when it also corresponds to a bug value.

② Barometric reference

The barometric reference pressure is displayed in cyan in hectoPascal (hPa). It corresponds to either the selected barometric pressure or standard pressure. The barometric pressure ranges from 745 hPa to 1100 hPa.

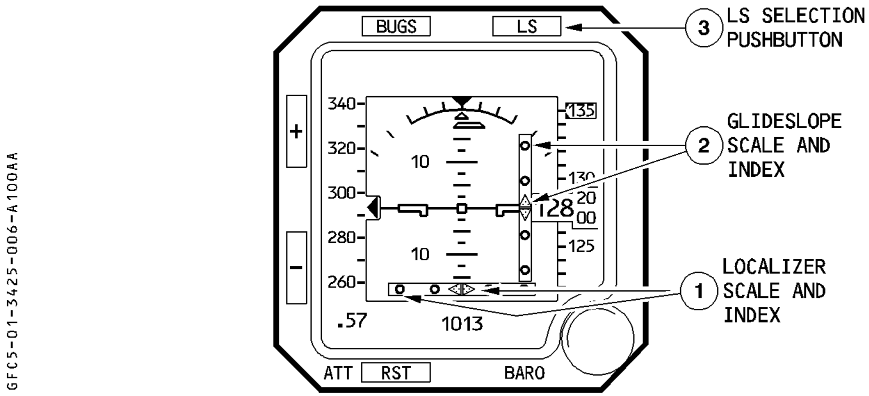
③ Barometric selection knob

It enables to select a barometric pressure, setting a variation of 10 hPa per rotation of the knob.
The standard barometric pressure can be selected by pressing the barometric knob. "STD" is then displayed in place of the pressure value.
Pressing the knob again will display the selected barometric pressure.

④ Altitude bug

When an altitude bug is entered through the bugs function, the corresponding altitude mark is indicated by a cyan dash, or a cyan box when the dash covers the digital indication on the scale .

LANDING SYSTEM FUNCTION



(1) Localizer scale and index

(2) Glideslope scale and index

The deviation scales appear when the LS pushbutton is pressed. The indexes appear when the Glideslope and Localizer signals are valid and deviation scales are displayed.

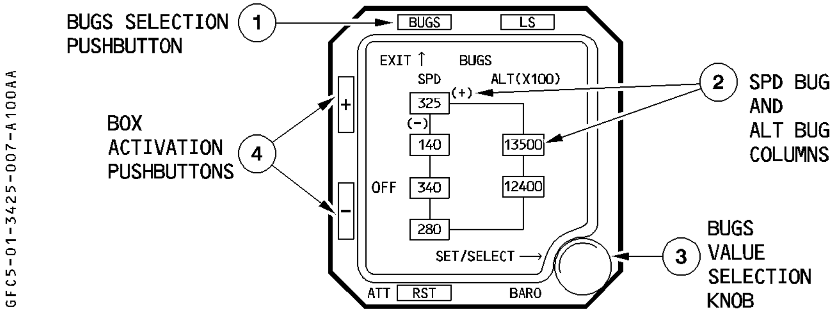
(3) LS selection pushbutton

Pressing the LS pushbutton will display the ILS scales. Pressing it again will de-select the ILS scales.

CAUTION

R Do not use the ISIS LS for takeoff using the localizer of the opposite runway, or for a
R back-course localizer approach. The LOC deviations are given in the wrong sense.

BUGS FUNCTION



(1) BUGS function selection pushbutton

Pressing the BUGS pushbutton will activate the BUGS function, and display the bug values to be selected.

(2) SPD BUG and ALT BUG columns

The SPD BUG column gives four speed values (in knots) that can be selected by the crew.
The ALT BUG column gives two altitude values (feet) to be selected by the crew.

(3) BUGS value selection knob

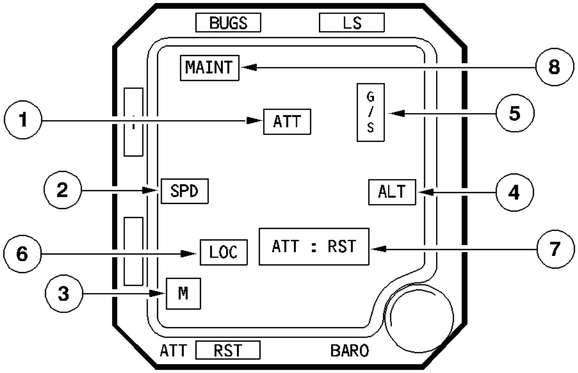
It allows the bug value to be set by rotating the BARO knob. This value cannot be lower than 30 knots for a speed bug, or a negative value for an altitude bug.
Pressing the BARO setting knob, once a bug value box is activated, will deselect the bug value. The "OFF" label comes on close to the activated box.
The entered values are memorized by the system, when exiting the screen, by pressing the BUGS pushbutton (1), or after 15 seconds without any pilot action.

(4) "+"/"–" box activation buttons

Access from one box to another is obtained by pressing the "+" or "–" pushbutton.
When a bug value is entered, access to the next box is obtained by pressing the "–" pushbutton. The box becomes active and flashes.
The " +" pushbutton can be used to return to a previous box.

R *Note : Use of the ISIS bugs function is not recommended because, in the event that both*
R *PFDs are lost in flight, when the ISIS bugs were previously set for takeoff, then*
R *for the approach, the bugs would remain at the takeoff characteristic speed*
R *settings.*

R **FLAGS**



(1) ATT flag (red)

When attitude data is lost, the red ATT flag appears.

(2) SPD flag (red)

When airspeed data is lost, the red SPD flag appears.

(3) M flag (red)

When the Mach number is lost, the red M flag appears.

(4) ALT flag (red)

When altitude data is lost, the red ALT flag appears.

(5) G/S flag (red)

When glideslope information is lost, the red G/S flag appears.

(6) LOC flag (red)

When localizer data is lost, the red LOC flag appears.

R (7) ATT : RST (yellow)

When excessive aircraft movement is detected during the alignment phase, this message appears. In this case, press the ATT reset pushbutton to realign and recover the attitude indication.

8 MAINT flag (white)

Failure, not affecting ISIS operation. Service ISIS, when convenient.

TUNING

The FMGC is the basic means for navaids tuning.
Three modes of tuning are available.

AUTOMATIC TUNING

In normal operation, the FMGC tunes navaids automatically, with each FMGC controlling its own receiver.
If one FMGC fails, the remaining one controls both side receivers, after activation of the FM selector switch.

MANUAL TUNING

The crew can use the MCDU to override the FMGC's automatic selection and tuning of navaids, and select a specific navaid for visual display.
This does not affect the automatic function of the FMGC.
R An entry on one MCDU is sent to both FMGC in dual mode, or to the remaining FMGC in
R single mode.

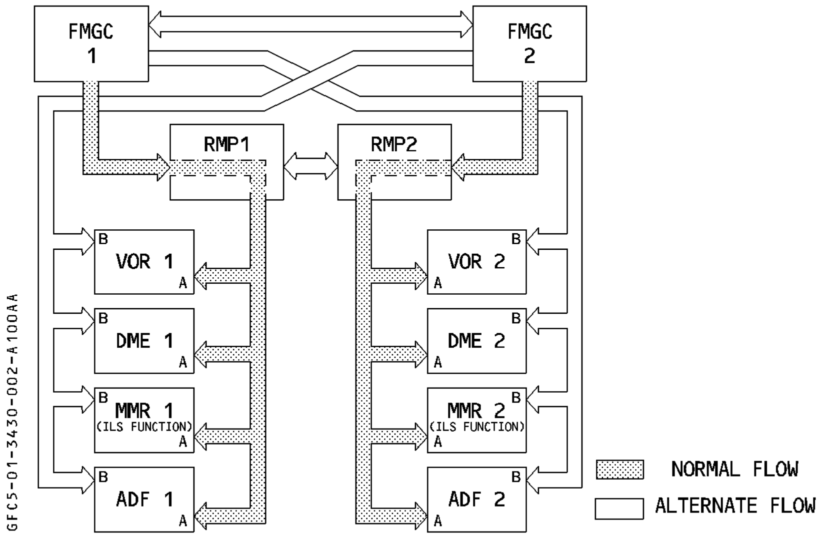
BACK UP TUNING

If both FMGCs fail, the flight crew can use the RMPs (Radio Management Panels 1 and 2) on the pedestal for back up tuning.
The CAPT RMP controls VOR 1 and ADF 1
The F/O RMP controls VOR 2 and ADF 2
Each RMP controls both ILSs (provided NAV back up is selected on RMP 1 and RMP 2)
RMP 3 is not used for navaids tuning.

ARCHITECTURE

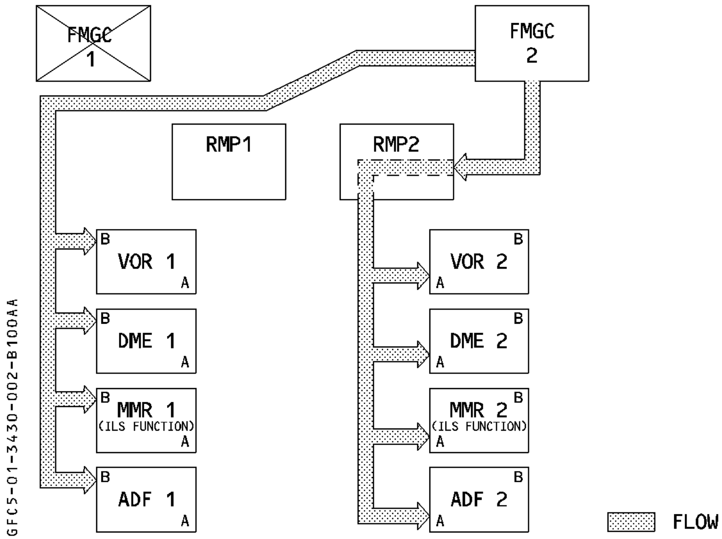
Normal operation

R

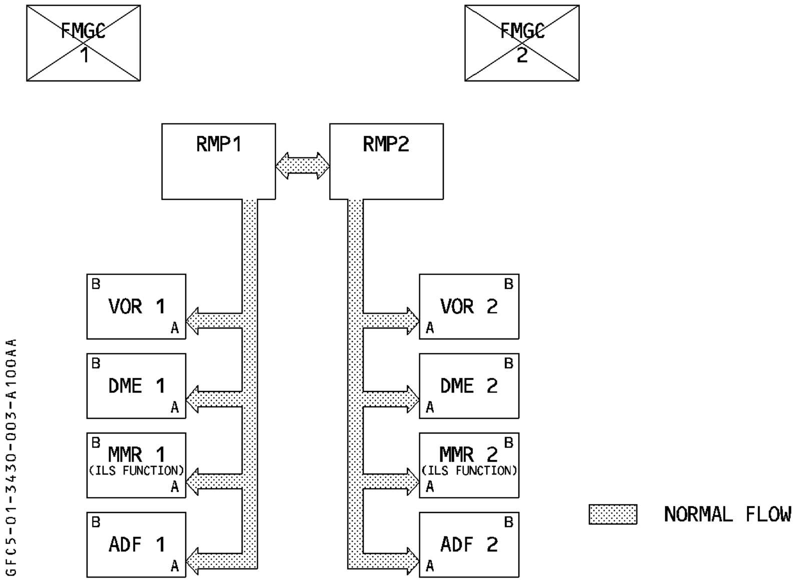


FMGC 1 failure

R



Backup tuning



NAVAIDS

VOR

The aircraft has two VOR receivers.
(For tuning, refer to the “TUNING” paragraph).

- VOR 1 and VOR 2 information is displayed on the NDs, depending on the position of the ADF/VOR selector on the EFIS control panel (Refer to 1.31).
- VOR 1 and VOR 2 bearings are also displayed on the DDRMI, located on the center instrument panel (provided heading signal is valid), depending on the position of the ADF/VOR selector on the DDRMI.

ILS

The aircraft has two ILS receivers. Each ILS receiver is integrated in a modular avionics unit called MMR (Multi Mode Receiver) (the ILS 1 receiver is in MMR1, the ILS 2 receiver is in MMR2).
(For tuning refer to “TUNING” paragraph).

- ILS 1 information is displayed on PFD 1 and ND 2.
  ILS 2 information is displayed on PFD 2 and ND 1.
- R ILS information can be displayed on each PFD by pressing the LS pushbutton on the EFIS control panel (deviation scales and deviation indexes come on).
- R ILS information is displayed on the NDs, if ROSE LS mode is selected on the EFIS control panel (Refer to 1.31).

ADF

The aircraft has two ADF systems.
(For tuning, refer to the “TUNING” paragraph).

- ADF 1 and ADF 2 information is displayed on the NDs, depending on the position of the ADF/VOR selector on the EFIS control panel (Refer to 1.31).
- ADF 1 and ADF 2 bearings are also displayed on the DDRMI, depending on the ADF/VOR selector on the DDRMI.

DME

The aircraft has two DMEs.
The frequency set automatically on the DME corresponds to that set on the VOR or ILS.
Up to 5 ground stations are tuned by the FMGEC :
- Channel 1 is used for FMS radio position in VOR/DME mode
- Channel 2 and 3 for FMS radio position in DME/DME mode
- Channel 4 for VOR/DME display
- Channel 5 for ILS/DME display

The NDs and the DDRMI can display the VOR-DME information.
The ILS-DME information is displayed on NDs, and PFDs when the flight crew has pressed
R the LS pushbutton on the EFIS control panel.

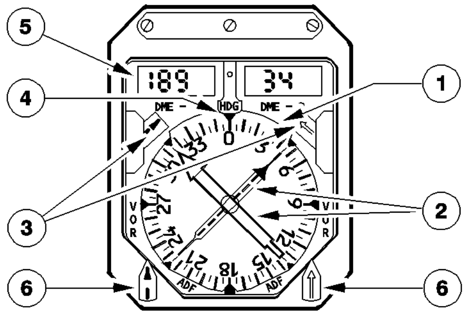
MARKER

One marker beacon system is included in VOR receiver 1.
The PFD displays the outer, middle and inner marker signals. (Refer to 1.31).

CONTROLS AND INDICATORS

DIGITAL DISTANCE AND RADIO MAGNETIC INDICATOR (DDRMI)

GFC5-01-3430-006-A001AA



① Compass card

ADIRU 1 normally supplies the signal that positions the compass card. ADIRU 3 supplies it when selected by the ATT HDG SWITCHING selector.
Display the MAG or TRUE heading, as selected by the NORTH REF pushbutton.
Above 82.5° North or 60.5° South, or in the north magnetic polar region, TRUE heading is automatically selected.

② Bearing pointers

R Indicate the magnetic bearing to the station received by VOR 1 or ADF 1 (dashed pointer)
R and VOR 2 or ADF 2 (double pointer).

③ VOR/ADF 1 (2) flags

In view in case the :
R – VOR or ADF receiver fails (VOR/ADF selector position indicates the failed receiver), or
– RMI has an internal failure, or
– Heading signal from ADIRS is invalid, or
– Power supply fails.
Associated with the flag, the relevant pointer moves to the 3 o'clock position.

R *Note : In ELEC EMER configuration, only ADF 1 or VOR 1 is available at a time, according to the position of the VOR 1/ADF 1 selector.*

(4) HDG flag

Appears, associated with VOR / ADF flags display, when:

R — The heading signal from the supplying ADIRS is invalid, or
— The RMI has an internal failure, or
— Power supply fails.

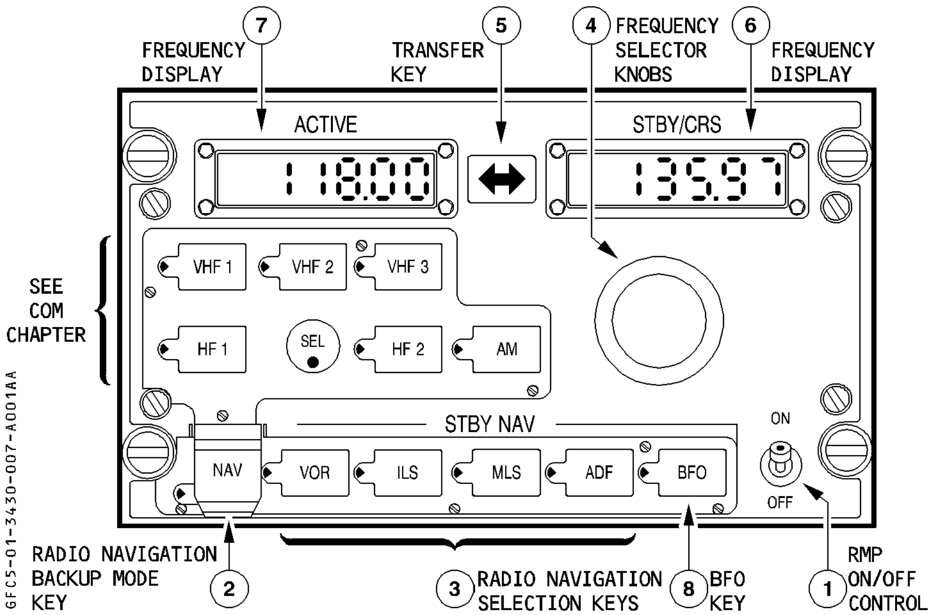
(5) DME 1 (2) counters

— DME 1 and 2 distances are indicated in NM (and 1/10th below 20 NM) Below 1 NM, 0 is shown.

(6) VOR / ADF selectors

R — VOR 1, or ADF 1, on single pointer.
R — VOR 2, or ADF 2, on double pointer.

RADIO MANAGEMENT PANEL (RMP)



R (1) ON / OFF switch

Controls the power supply to each RMP.

(2) NAV key (transparent switchguard)

When depressed : Radio navigation back up mode is engaged. The VOR ILS (MLS) and ADF receivers are controlled by the RMP and no longer by the FMGC.
Green monitor light illuminates.
NAV radio control may be returned to the FMGC by depressing the NAV key again on RMP 1 and 2.

Note : · *Back up tuning mode must be selected on RMP 1 and 2 in case of both FMGC or MCDUs failure. In emergency electrical configuration RMP1 only is supplied.*
· *Pressing the NAV key on RMP3 has no effect.*
· *In NAV back up mode, radio communication systems can be selected as in normal mode.*
· *Setting one RMP to NAV back up mode removes NAV AIDS tuning capability from both FMGCs.*

(3) STBY NAV keys

When the appropriate radio nav key is depressed, and provided the NAV key is on, the ACTIVE window displays the present frequency.
The monitor light illuminates green on the selected key, it extinguishes on the previously selected STDBY NAV or COM key.

(4) Rotating knob

Two concentric knobs allow preselection of frequency for radio com systems, stand-by nav systems and selection of the required course for VOR or ILS.
The desired frequency or course is set in the STBY / CRS window.
— frequency setting:
  The outer knob controls the most significant digits, the inner knob controls the least significant digits.
  The preselected frequency (STBY) becomes active by pressing the transfer key.
— course setting:
  Performed with inner knob only
A rate multiplier speeds up the tuning when the knob is rotated rapidly.

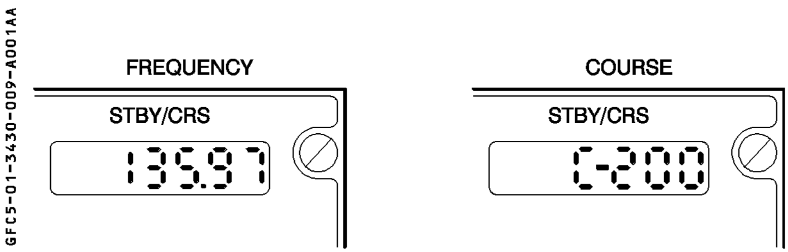
⑤ Transfer key

The flight crew presses this key to interchange ACTIVE and STBY frequencies. This action tunes the selected receiver to the new ACTIVE frequency.

⑥ STBY / CRS window

R The flight crew can make the frequency displayed in this window become the active
R frequency by pressing the transfer key, or change it by rotating the tuning knob.
R If this window displays a course, then the ACTIVE window displays the associated
R frequency.

R *Note : If the STBY/CRS window is displaying a course, then pressing the transfer key*
R *displays the active frequency in both windows.*



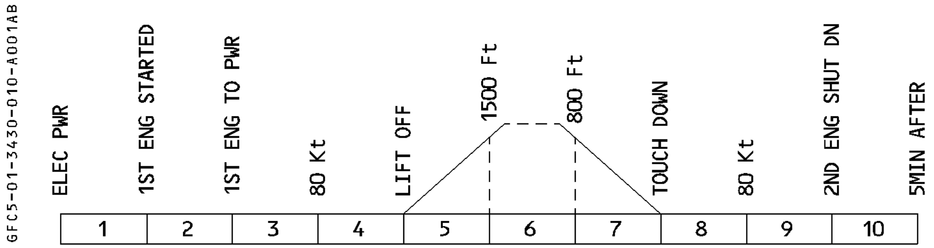
⑦ ACTIVE window

Shows the active frequency of the selected navaid, which is identified by a green monitor light on the selection key.

⑧ BFO key

R Pressing this key activates the BFO (Beat Frequency Oscillator), if the ADF receiver is
R selected.
R The green monitor light comes on.
R For most ADFs, with BFO activated, the audio identification is heard. However, there are
R some ADFs where the BFO must be deactivated, in order to hear the audio identification.

WARNINGS AND CAUTIONS



R

E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
ILS 1 (2)(1+2) FAULT	SINGLE CHIME	MASTER CAUT	NIL	Flag on PFD and ND	3, 4, 5

DESCRIPTION

The aircraft has two radio altimeters which provide the height of main landing gear above ground. Normally, the CAPT PFD displays the RA1 height, and the F/O PFD displays the RA2 height. If either radio altimeter fails, both PFDs display the height from the remaining one.

INDICATIONS ON PFD

(Refer to 1.31.40).

AUTOMATIC CALLOUT

FWC generates a synthetic voice for radio height announcement below 2500 feet. These announcements come through the cockpit loudspeakers, even if the speakers are turned off.

PREDETERMINED CALLOUTS

The altitude callout uses the following predetermined threshold :

R

height (ft)	callout
2500	TWO THOUSAND FIVE HUNDRED or TWENTY FIVE HUNDRED
2000	TWO THOUSAND
1000	ONE THOUSAND
500	FIVE HUNDRED
400	FOUR HUNDRED
300	THREE HUNDRED
200	TWO HUNDRED
100	ONE HUNDRED
50	FIFTY
40	FORTY
30	THIRTY
20	TWENTY
10	TEN
5	FIVE
DH (or MDA/MDH) + 100	HUNDRED ABOVE
DH (or MDA/MDH)	MINIMUM

Note : The reference altitude for callouts is the radio altitude for precision approaches (DH) and baro altitude (MDA/MDH) for non precision approaches.

Pin programmings allow the operator to select the callouts needed.
If aircraft remains at a height that is in the detection zone for a height callout, the corresponding message is repeated at regular intervals.

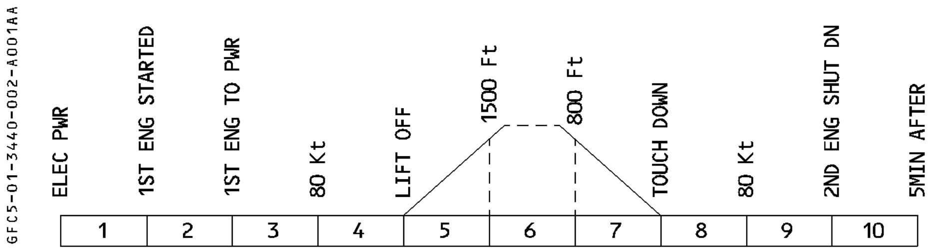
INTERMEDIATE CALL OUT

If time between two consecutive predetermined call outs exceeds a threshold, the present height is repeated at regular intervals.
The threshold is : 11 seconds above 50 feet
4 seconds below 50 feet
The repeating interval is 4 seconds.

"RETARD" ANNOUCEMENT

The loudspeaker announces "RETARD" at 20 feet, or at 10 feet if autothrust is active and one autopilot is in LAND mode.

WARNINGS AND CAUTIONS

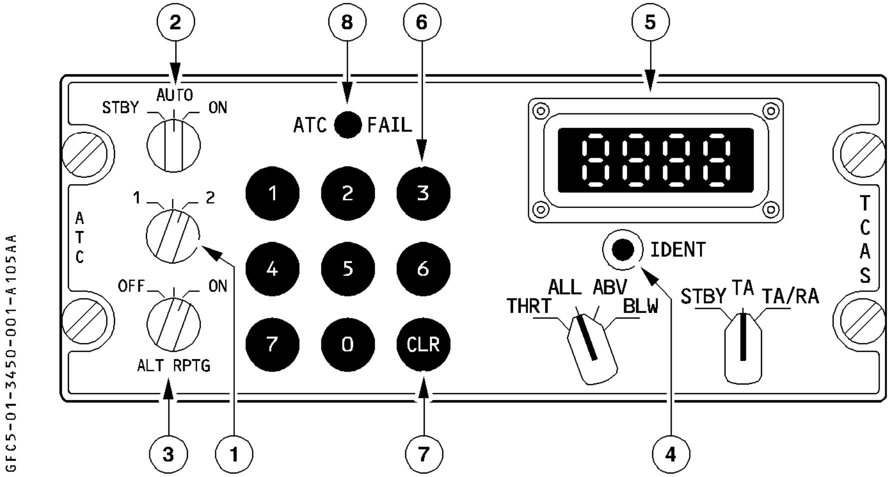


E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
RA 1 (2)(1+2) FAULT	SINGLE CHIME	MASTER CAUT	NIL	Flag on PFD	3, 4, 5, 8

DESCRIPTION

The aircraft has two ATC transponders which are controlled by a dual control box on the center pedestal.
Only the selected transponder operates.
The associated ADIRS (1 for transponder 1, etc...) supplies the altitude for altitude reporting. In case of a failure, ADIRS 3 can do this when selected by the AIR DATA SWITCHING selector.

CONTROL PANEL



(1) ATC sel

This switch selects transponder 1 or 2.

(2) Mode sel

STBY : Selected ATC transponder is electrically supplied but does not operate.
ON : Selected ATC operates.
R AUTO : In flight : Selected transponder operates ;
R On ground : Selected transponder operates only in mode S (Selective A/C
R interrogation mode).

③ ALT RPTG sw

ON : The transponder sends barometric standard altitude data.
OFF : No altitude data transmission. If the TCAS is installed, the upper ECAM displays "TCAS STBY" in green.

④ IDENT sw

The flight crew presses this button to send the aircraft identification signal.

⑤ Code display

The window displays the selected code.

⑥ Pushbuttons

The flight crew uses these pushbuttons to set the code assigned by ATC.

⑦ CLR pb

The flight crew uses this pushbutton to clear the code display.

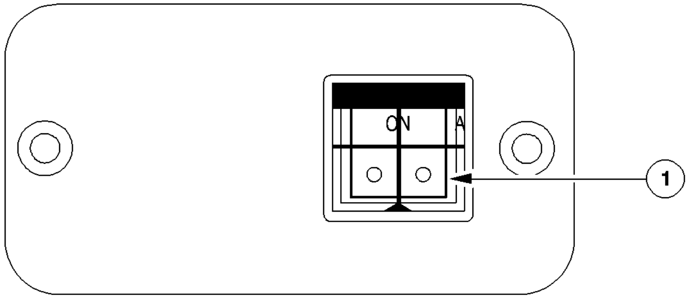
Note : As long as the four figures of the new code are not entirely written, the previous code remains.

⑧ ATC FAIL lt

This light comes on if the selected transponder fails.

REMOTE ATC BOX

This control panel enables the crew to easily and rapidly inform the ATC of an hijacking situation. By pushing one of the two pushbuttons, the crew causes the transponder 1 to emit the Hijacking code (7500) via the remote ATC box supplied by a secured power source.
In addition, the activation of one of these pushbuttons triggers aural and visual alerts in the cabin (Refer to 1.23.22).



GFC5-01-3450-003-A200AA

(1) ATC hijacking alert pushbutton ON light

ON : One of the two pushbuttons has been pressed, Transponder 1 continuously emits the hijacking code. Transponder 2 is on standby.
Off : The automatic hijacking mode has not been activated, or has been activated but Transponder 1 is failed.

Note : When activated, the hijacking mode can only be reset on ground, with the aircraft de-energized, for at least three seconds ; it is not possible to reset it in flight.
When the hijacking mode is activated, the TCAS is forced to TA only mode, to avoid any collision due to the crew's incapacity to perform any maneuver.

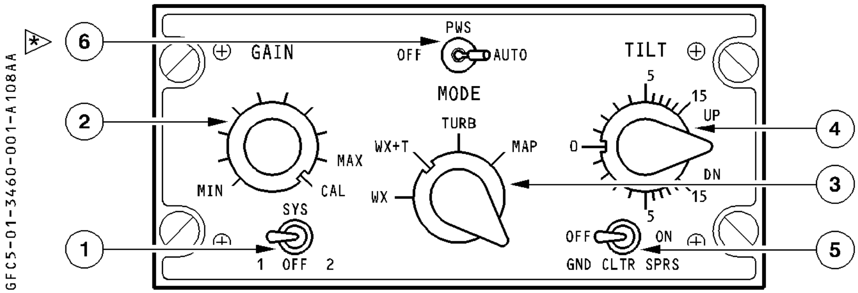
CAUTION
Do not use the ATC hijacking alert pushbutton without hijacking threat.

DESCRIPTION

The aircraft has two weather radar systems. Only one transceiver is active.
It can display the weather image on the ND in any ND mode except PLAN.
Each pilot may remove the weather image from his ND by setting the associated brightness control to the minimum (Refer to 1.31).

R *Note : Some aircraft may be fitted with one weather radar system only.*

CONTROL PANEL



(1) SYS sel

This switch allows to select one radar, or to turn both radars to off.

R *Note : When one radar only is fitted on aircraft, no weather image will be displayed*
R *when switching on system 2.*

(2) GAIN knob

This knob adjusts the sensitivity of the receiver in weather mode (WX) or ground maping mode (MAP).
"CAL" is the normal position, it adjusts the gain to a calibrated setting.

(3) Mode sel

WX : Weather mode : colors indicate the intensity of precipitation (black for the lowest intensity, green, amber and red indicating progressively higher intensities).
WX + T : The screen shows turbulence areas (in precipitation areas) in magenta (within 40 NM).
TURB : The screen shows only turbulence areas.
MAP : Radar operates in ground mapping mode : black indicates water, green, ground and amber, cities and mountains.

(4) TILT knob

This knob controls the antenna tilt.
Zero represents the horizon, as the ADIRS 1 sees it as follows :
– WX SYS 1 by ADIRS 1 (or 3, if selected).
– WX SYS 2 by ADIRS 2 (or 3, if selected).

(5) GND CLTR SPRS

ON : The Ground Clutter Suppresses the ground echo on the screen.
OFF : Normal use of the radar.

Note : Setting different scales on the ND reduces the sweep rate of each ND image. (8 seconds, instead of 4 seconds).

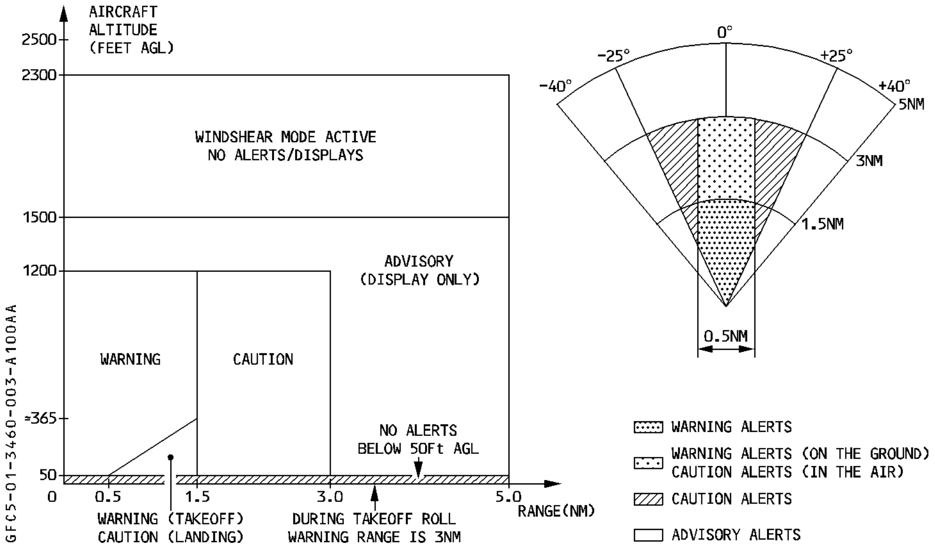
(6) PWS selector ◁ (operative, only if the windshear function is embodied)

AUTO : Windshear function is activated : Windshear areas will be detected by the antenna scanning below 1500 feet RA, even if the tranceiver selector (1) is set to off, and displayed on the ND.
R OFF : No windshear function.

WINDSHEAR PREDICTION FUNCTION

The weather radars have a predictive windshear capability.
The Predictive Windshear System (PWS) operates when :
- The PWS switch is in the AUTO position, and
- The aircraft is below 2300 feet AGL, and
- The ATC is switched to the ON or AUTO position (or PNDR ◁), and
- Either engine is running.

The system scans the airspace, within a range of 5 NM ahead of the aircraft, for windshears.
Below 1500 feet, when the system detects windshear, depending on the range selected on the ND, a warning, caution, or advisory message, appears on the ND. Predictive windshear warnings and cautions are associated with an aural warning.
Windshear alert ranges, altitudes, and locations, for the three alert levels are indicated below :



During the takeoff roll, both warnings and cautions are available within a range of 3 NM.
At takeoff, alerts are inhibited above 100 knots and up to 50 feet.
At landing :
- Alerts are inhibited below 50 feet.
- The visual and aural warning alerts are downgraded to caution alerts between 370 feet AGL and 50 feet AGL, and range between 0.5 NM and 1.5 NM.

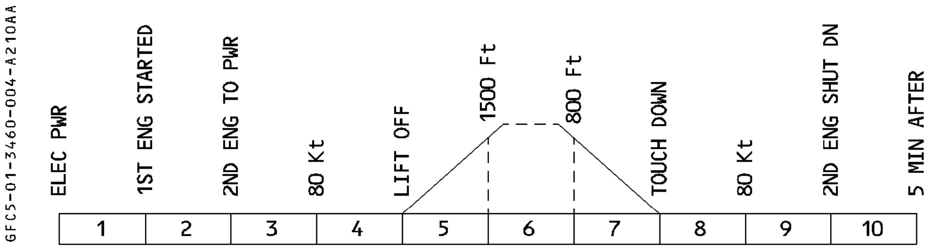
R *Note : If the selected weather radar fails when two weather radars are installed, the PWS*
R *function is recovered by selecting the non-failed weather radar on the control panel.*

R

Alert Level	Aural Warning	PFD	ND (refer to 1.31.45)
Warning (Approach)	«GO AROUND WINDSHEAR AHEAD»	W/S AHEAD (red)	Windshear icon
Warning (Take Off)	«WINDSHEAR AHEAD» (twice)	W/S AHEAD (red)	Windshear icon
Caution	«MONITOR RADAR DISPLAY»	W/S AHEAD (amber)	Windshear icon
Advisory	Nil	Nil	Windshear icon

R The predictive windshear system aural alerts :
R — have priority over TCAS, GPWS and other FWC aural warning.
R — are inhibited by windshear detection by FMGC and stall warning aural messages.

WARNING AND CAUTIONS



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
PRED. W/S DET FAULT	SINGLE CHIME	MASTER CAUTION	NIL	NIL	3, 4, 5, 8

MEMO DISPLAY

PRED W/S OFF appears when the windshear is selected OFF on the weather radar panel. It appears green when in flight phase 2, 6, and amber when in flight phase 3, 4, 5, 7, 8, 9.

DESCRIPTION

The Enhanced Ground Proximity Warning System (EGPWS) generates aural voice and visual warnings, when one of the following conditions occurs at radio altitudes between 30 and 2450 feet for modes 2, 4, 5, and between 10 and 2450 feet for modes 1 and 3.

- Mode 1 : Excessive rate of descent.
- Mode 2 : Excessive terrain closure rate.
- Mode 3 : Altitude loss after takeoff or go-around.
- Mode 4 : Unsafe terrain clearance, when not in landing configuration.
- Mode 5 : Excessive deviation below glideslope.

In addition to the basic GPWS functions, the GPWS has an enhanced function (EGPWS) which provides, based on a worldwide terrain database :

- A Terrain Awareness Display (TAD), which predicts the terrain conflict, and displays the terrain on the ND.
- A Terrain Clearance Floor (TCF), which improves the low terrain warning during landing.

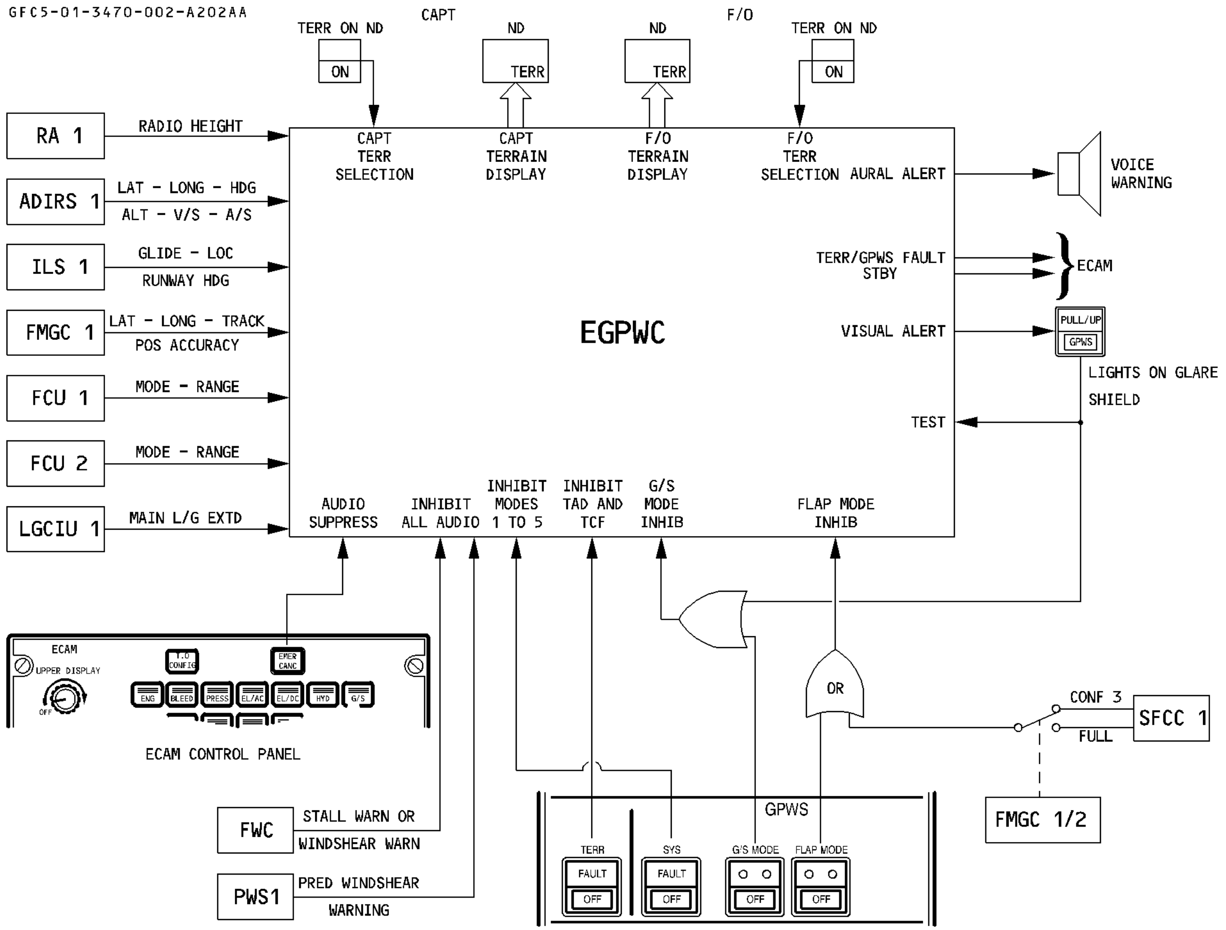
The EGPWS uses the geometric altitude. The geometric altitude is calculated by means of a specific algorithm that uses the following as inputs : The pressure altitude, GPS altitude, radio altitude, and data from the terrain database.

The cockpit loudspeakers broadcast, even if turned off, the aural warning or caution messages associated with each mode. The audio volume of these messages is not controlled by the loudspeaker volume knobs. (These knobs allow volume adjustment for radio communication).

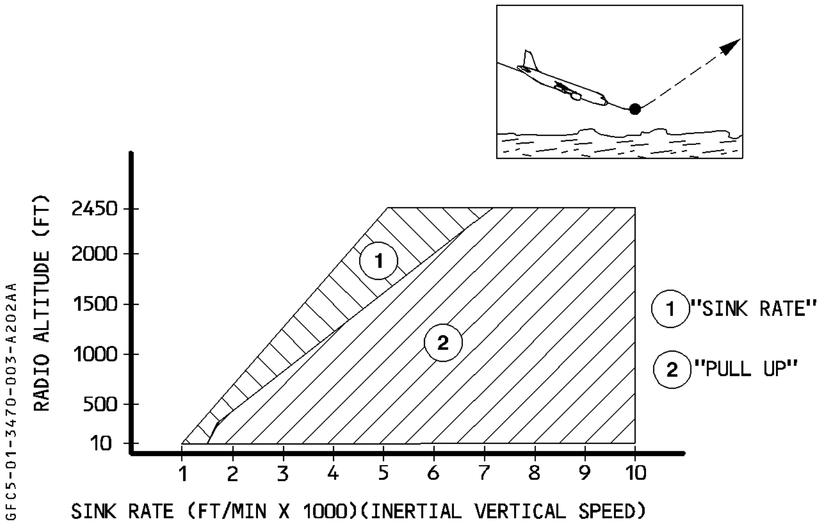
PULL UP lights come on to give a visual indication when a PULL UP warning alert is triggered for modes 1, 2, and TAD.

GPWS lights come on for caution alerts of mode 1 to 5, TAD, and TCF, on the Captain and First Officer instrument panels.

Note : *A number of airports throughout the world have approaches or departures that are not entirely compatible with standard GPWS operation. These airports are identified in the envelope modulation database, in such a way that when the GPWS recognizes such an airport, it modifies the profile to avoid nuisance warnings.*
This envelope uses the baro altitude in QNH or QFE reference, depending on a pin program (QFE is an option). If the QFE option is installed, the Enhanced GPWS uses (for GPWS basic modes) the QFE barometric reference altitude, independently of the selected barometric reference setting on the EFIS control panel.

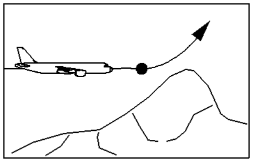

GFC5-01-3470-002-A202AA
CAPT
F/O
TERR ON ND
ON
ND
TERR
RA 1
RADIO HEIGHT
ADIRS 1
LAT - LONG - HDG
ALT - V/S - A/S
ILS 1
GLIDE - LOC
RUNWAY HDG
FMGC 1
LAT - LONG - TRACK
POS ACCURACY
FCU 1
MODE - RANGE
FCU 2
MODE - RANGE
LGCIU 1
MAIN L/G EXTD
CAPT TERR SELECTION
CAPT TERRAIN DISPLAY
F/O TERRAIN DISPLAY
F/O TERR SELECTION
AURAL ALERT
VOICE WARNING
TERR/GPWS FAULT
STBY
ECAM
EGPWC
VISUAL ALERT
PULL/UP
GPWS
LIGHTS ON GLARE SHIELD
TEST
AUDIO SUPPRESS
INHIBIT ALL AUDIO
INHIBIT MODES 1 TO 5
INHIBIT TAD AND TCF
G/S MODE INHIB
FLAP MODE INHIB
OR
CONF 3
FULL
SFCC 1
FMGC 1/2
ECAM
UPPER DISPLAY
OFF
T.O CONFIG
EMER CANC
ENG
BLEED
PRESS
EL/AC
EL/DC
HYD
G/S
ECAM CONTROL PANEL
FWC
STALL WARN OR
WINDSHEAR WARN
PWS1
PRED WINDSHEAR
WARNING
GPWS
TERR
SYS
G/S MODE
FLAP MODE
FAULT
OFF

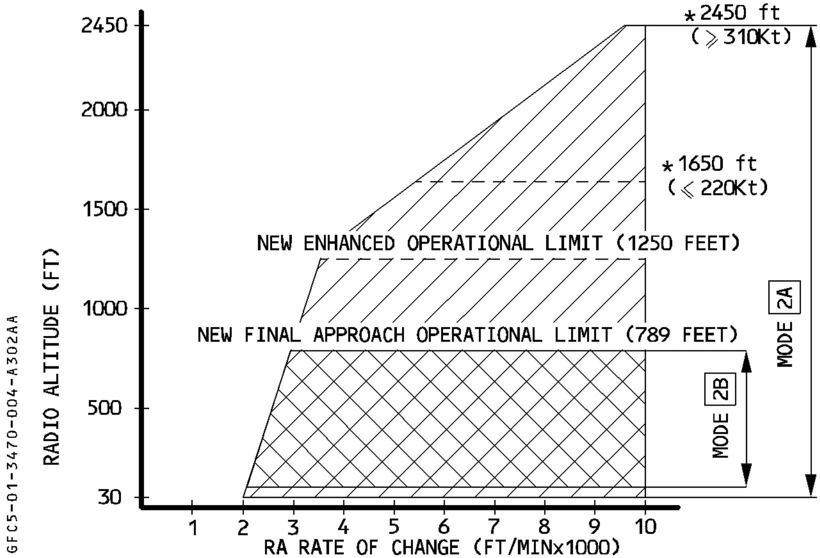
MODE 1: EXCESSIVE RATE OF DESCENT



Mode 1 has two boundaries. Penetration of the first boundary causes the GPWS lights to come on, and generates a repeated "SINK RATE" aural alert. Penetration of the second boundary generates a repetitive "PULL UP" aural alert, and causes the PULL UP light to come on.
The lower cut-off limit is 10 feet radio altitude.
The upper cut-off limit is 2450 feet radio altitude.

MODE 2 : EXCESSIVE TERRAIN CLOSURE RATE



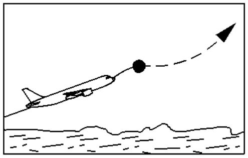


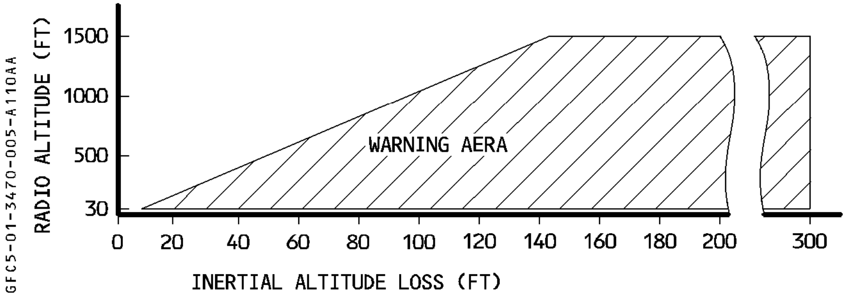
2A — Flaps not in landing configuration, and aircraft not on the glideslope beam.
Penetration of the boundary causes the GPWS lights to come on, and generates the repeated aural alert : "TERRAIN".
After "TERRAIN" has sounded twice, the warning switches to "PULL UP", and is continually repeated until the aircraft leaves the warning envelope. In addition, the PULL UP lights come on.
After the aircraft leaves the boundary, the GPWS lights replace the PULL UP ones, and the "TERRAIN" aural message persists. These alerts stop when the aircraft increases either the barometric or inertial altitude by 300 feet. If it enters another alert region during this altitude-gain time, then the whole process begins again with a new reference altitude for the 300 feet altitude gain.

* The upper cut-off limit varies from 1650 to 2450 feet radio altitude, depending on speed (between 220 to 310 knots). At certain airports, the upper boundary is limited to reduce warning sensitivity and minimize nuisance warnings.
The new enhanced operational upper limit is reduced to 1250 feet and to 789 feet in final approach, when the enhanced functions and the Geometric Altitude are of high integrity.

2B — Flaps in landing configuration
Lowering the flaps to the landing position automatically switches GPWS to Mode 2B. In this case lower boundary varies between 200 feet and 600 feet depending on radio altitude rate of change. During ILS approach (glide slope deviation < ± 2 dots) the lower boundary is fixed at 30 feet.
When the aircraft enters the envelope, the alert is the same as for mode 2A. When gear and flaps are in the landing configuration, the aural message is "TERRAIN " only and is not followed by " PULL UP" if the aircraft remains within the envelope.

MODE 3 : ALTITUDE LOSS AFTER TAKEOFF

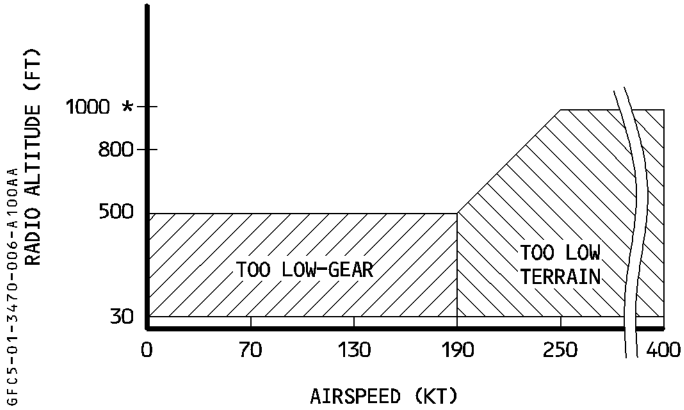




If the aircraft descents during the initial takeoff climb or during a go around, GPWS lights come on and the aural alert "DON'T SINK" sounds repeatedly.
The lower cut-off limit is 30 feet radio altitude.
Mode 3 is desensitized according to the time accumulated after departure and the radio altitude.

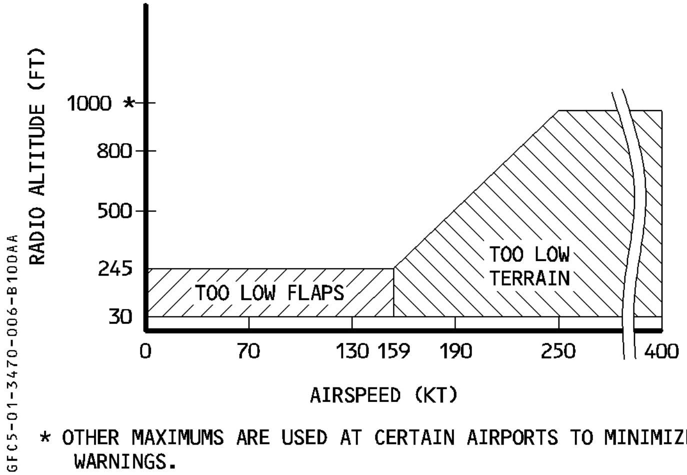
MODE 4 : UNSAFE TERRAIN CLEARANCE WHEN NOT IN LANDING CONFIGURATION

4A - Landing gear up.



Two aural warnings may be triggered, depending on the area : “TOO LOW-GEAR” or “TOO LOW-TERRAIN”. In addition, the GPWS lights come on.

4B - Landing gear down, and flaps not in landing configuration.

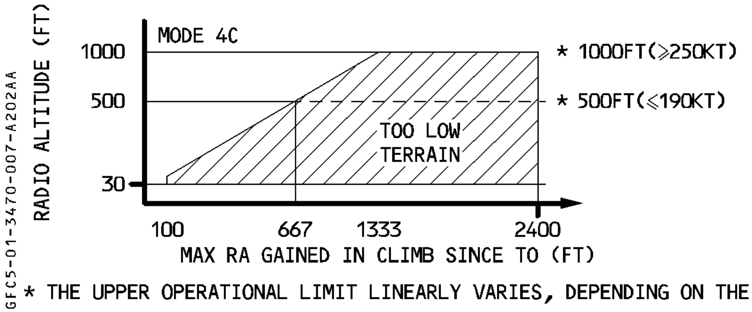


* OTHER MAXIMUMS ARE USED AT CERTAIN AIRPORTS TO MINIMIZE NUISANCE WARNINGS.

Three aural warnings may be generated, depending on the area and the configuration : “TOO LOW-GEAR”, “TOO LOW-FLAPS”, or “TOO LOW-TERRAIN”. In addition, the GPWS lights come on.

If the enhanced GPWS functions and the geometric altitude are of high integrity, the upper operational limit is reduced to 500 feet. If not, it is only reduced to 800 feet when an overflight is detected.

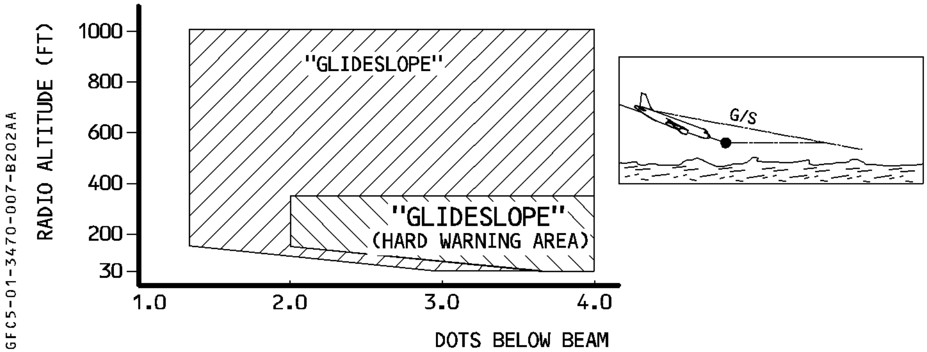
4C – Landing gear up, or flaps not in landing configuration.



* THE UPPER OPERATIONAL LIMIT LINEARLY VARIES, DEPENDING ON THE AIRCRAFT SPEED.

If the aircraft starts an inadvertent controlled flight into the ground during takeoff and climb, and penetrates the boundary, then the GPWS lights come on, and the “TOO LOW TERRAIN” aural alert sounds repeatedly.

MODE 5: DESCENT BELOW GLIDESLOPE



Note : Normally, the GLIDESLOPE alert is only triggered with the gear down. For a few airports, the gear down logic requirement is deleted, and other upper limits are used to increase the warning envelope.

In both areas, the alert is a repeated “GLIDESLOPE” aural message, and both GPWS lights come on.
The loudness and the repetition rate of the aural message increase, when the aircraft enters the hard warning areas.
The mode is armed, when ILS 1 receives a valid signal.
Pressing the PULL UP/GPWS pushbutton switch cancels the warning. This is temporary and the mode is automatically reactivated for a new envelope penetration.
The upper cut-off limit is 1000 feet radio altitude.
The lower cut-off limit is 30 feet radio altitude.

EGPWS FUNCTIONS

TERRAIN AWARENESS AND DISPLAY

The Terrain Awareness and Display (TAD) function computes a caution and a warning envelope ahead of the aircraft, depending on the aircraft altitude, the nearest runway altitude, the range to the nearest runway threshold, the ground speed, and the turn rate. When the boundary of these envelopes conflicts with the terrain, or with an obstacle memorized in the database, the system generates the relevant alert :

R

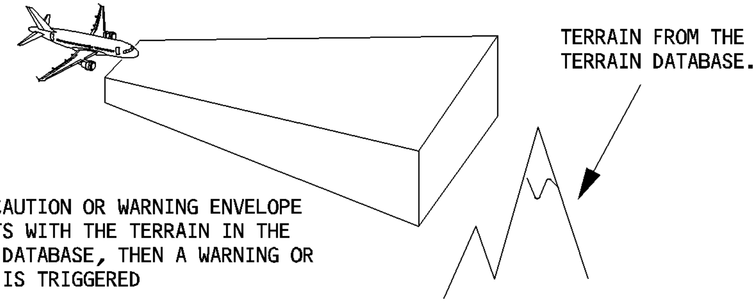
Alert Level	Aural Warning	ND (refer to 1.31.45)	Local Warning
Warning	TERRAIN AHEAD PULL UP	– Automatic terrain display * – Solid red areas – TERR AHEAD (red)	On each pilot's instrument panel, the PULL UP (red) light comes on.
	OBSTACLE AHEAD PULL UP	– Automatic terrain display * – Solid red areas – OBST AHEAD (red)	
Caution	TERRAIN AHEAD	– Automatic terrain display * – Solid yellow areas – TERR AHEAD (amber)	On each pilot's instrument panel, the GPWS (amber) light comes on.
	OBSTACLE AHEAD	– Automatic terrain display * – Solid yellow areas – OBST AHEAD (amber)	

* When the TERR ON ND pushbutton is set to ON, and ARC or ROSE mode is selected, the ND displays the terrain and the obstacles memorized in the database, depending on the aircraft's position, when ARC or ROSE mode is selected. The terrain is displayed in various densities of green, yellow, red, or magenta, depending on the threat (See 1.31.45 : INDICATIONS ON ND). If an alert is generated (caution or warning) and TERR ON ND is not selected, the terrain is automatically displayed, and the ON light of the TERR ON ND pushbutton comes on.

Note : 1. *When TERR ON ND is selected, the weather radar display image is not displayed, even if the weather radar is ON.*
2. *The Geometric Altitude function can protect against certain baro setting errors, provided the components used to compute the Geometric Altitude are sufficiently valid and accurate.*
R 3. *The TAD and Terrain Clearance Floor (TCF) functions use FMS 1 position*
R *information to perform their calculations. Therefore, in case of an FMS 1 position*
R *error, the TAD and TCF will also provide erroneous information and/or warnings.*

TERRAIN CAUTION AND WARNING ENVELOPE

R

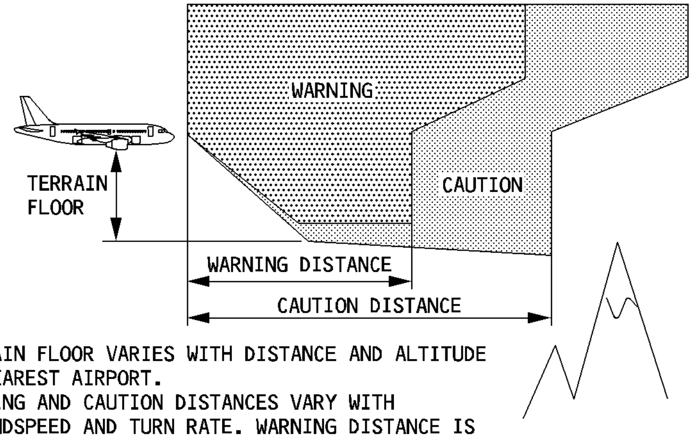


IF THE CAUTION OR WARNING ENVELOPE CONFLICTS WITH THE TERRAIN IN THE TERRAIN DATABASE, THEN A WARNING OR CAUTION IS TRIGGERED

GFC5-01-3470-009-A110AA

VERTICAL ENVELOPE

R

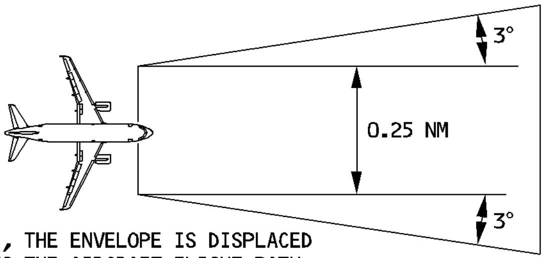


TERRAIN FLOOR VARIES WITH DISTANCE AND ALTITUDE TO NEAREST AIRPORT.
WARNING AND CAUTION DISTANCES VARY WITH GROUNDSPEED AND TURN RATE. WARNING DISTANCE IS APPROX. 30 SECONDS. CAUTION DISTANCE IS APPROX. 60 SECONDS.

GFC5-01-3470-009-B110AA

HORIZONTAL ENVELOPE

R



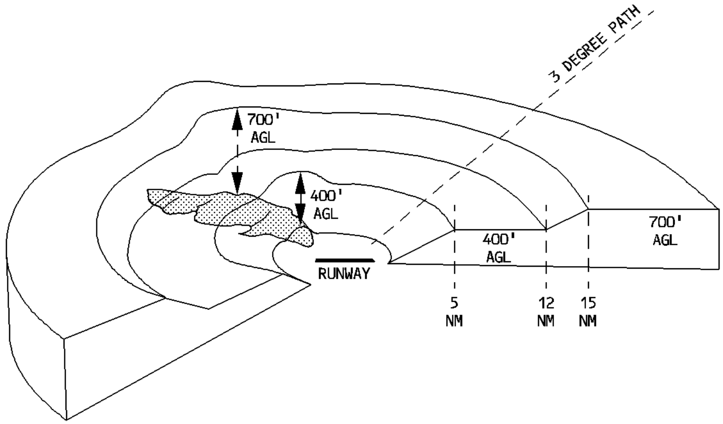
DURING TURNS, THE ENVELOPE IS DISPLACED TO LOOK ALONG THE AIRCRAFT FLIGHT PATH.

GFC5-01-3470-009-C110AB

TERRAIN CLEARANCE FLOOR

A terrain clearance floor envelope is stored in the database for each runway for which terrain data exists. The Terrain Clearance Floor (TCF) function warns of a premature descent below this floor, regardless of the aircraft's configuration.

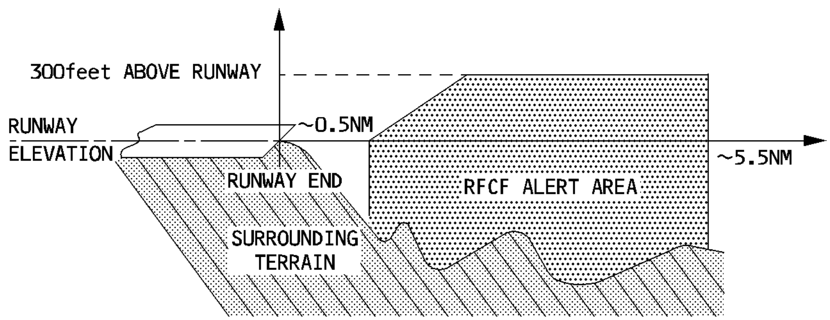
R



R If the airplane descends below this floor, a "TOO LOW TERRAIN" aural warning sounds, and
R the GPWS lights come on, on the glareshield.

R RUNWAY FIELD CLEARANCE FLOOR

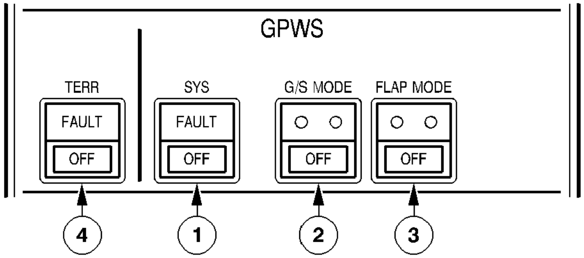
The Runway Field Clearance Floor (RFCF) is an additional envelope protection, for runways
R that are significantly higher than the surrounding terrain. It is contained in a circle within
R the 5.5 NM of the runway threshold and it is based on the geometric altitude, and the
R runway elevation.
R



CONTROLS AND INDICATORS

OVERHEAD PANEL

GFC5-01-3470-011-A110AA



(1) SYS pb sw

OFF : All basic GPWS alerts (Mode 1 to 5) are inhibited.
FAULT lt : This amber light comes on, along with an ECAM caution, if the basic GPWS mode 1 to 5 malfunctions.

Note : If ILS 1 fails, only mode 5 is inhibited. Consequently, the FAULT light does not come on and GPWS FAULT warning is not triggered.

(2) G / S MODE pb sw

OFF : Glide slope mode (mode 5) is inhibited.

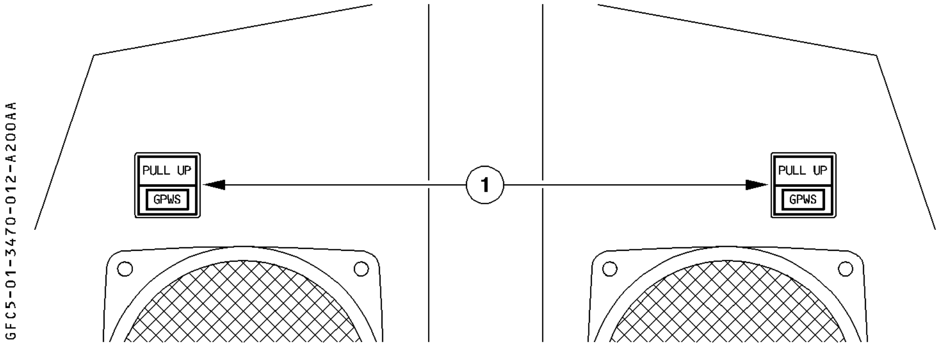
(3) FLAP MODE pb sw

OFF : Flap mode ("TOO LOW FLAPS" mode 4) is inhibited.
(To avoid nuisance warning in case of landing with reduced flaps setting).
Moreover if LDG CONF 3 is selected on MCDU the flap mode will be automatically inhibited when FLAPS 3 position is reached.

(4) TERR pb sw

OFF : Inhibits the Terrain Awareness Display (TAD) and Terrain Clearance Floor (TCF) modes, and does not affect the basic GPWS mode 1 to 5.
FAULT lt : This amber light comes on, along with an ECAM caution, if the TAD or TCF mode fails. The basic GPWS mode 1 to mode 5 are still operative if the SYS pushbutton switch lights OFF or FAULT are not illuminated.

MAIN INSTRUMENTS PANEL



(1) PULL UP – GPWS pushbutton

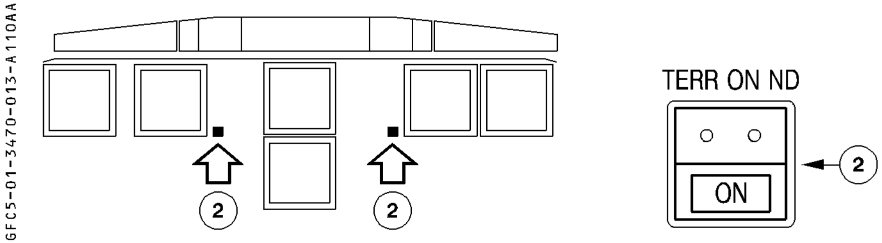
R PULL UP : Comes on to give a visual indication, when a PULL UP warning is
R triggered in Modes 1, 2, and TAD. The corresponding aural warning sounds.

GPWS : Comes on amber, when any other mode is activated. The corresponding aural warning sounds.

R *Note :* *1. If the flight crew briefly presses this button when the GPWS light is on,*
R *following a mode 5 glideslope alert, the GPWS light goes off and the aural*
R *warning stops.*

2. The GPWS can be tested by pressing this pushbutton. If the pushbutton is briefly pressed, some of the aural warnings sound and pushbutton captions, related to the GPWS, come on. If the pushbutton is pressed continuously, then all of the aural warnings sound.

R



(2) TERR ON ND pushbutton

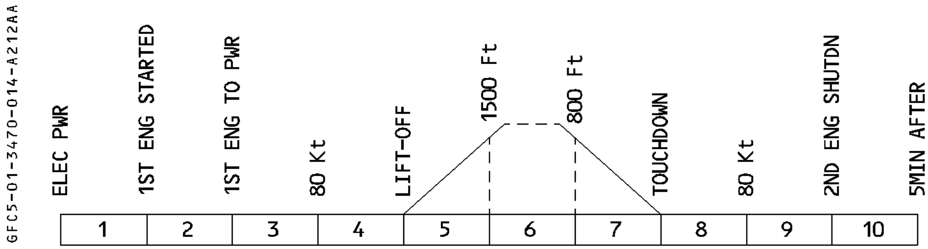
These pushbuttons are located on either side of the ECAM. Each pushbutton controls the onside terrain display.

R ON : The terrain is displayed on the ND, if the :
R – TERR pushbutton is selected ON, and
R – TERR FAULT light is not on.
R The ON light comes on.

Off : The terrain data is not displayed on the ND.

Note : · *If the Terrain Awareness Display (TAD) mode generates a caution, or a warning, while the TERR ON ND is not switched ON, terrain data is automatically displayed on the NDs (see EGPWS specific caution and warning due to TAD mode) and the ON light of the TERR ON ND pushbutton will come on.*
· *To differentiate between the terrain and the weather display, the terrain display sweeps from the center outward to both sides of the ND.*

WARNINGS AND CAUTIONS



R

E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
GPWS FAULT	SINGLE CHIME	MASTER CAUT	NIL	GPWS SYS FAULT lt	1, 3, 4, 5, 8,
GPWS TERR DET FAULT The enhanced terrain detection function is inoperative. The basic GPWS mode 1 to 5 are still operative.				GPWS TERR FAULT lt	1, 3, 4, 5 8, 10

MEMO DISPLAY

R GPWS FLP OFF is displayed in green, when the GPWS FLAP MODE pushbutton is OFF.
In flight, the TERR STBY memo appears in green when the aircraft position accuracy (provided by the FMS) is insufficient to allow the enhanced TCF and TAD modes to operate. These modes are not available until the TERR STBY memo disappears. If selected, the terrain data display on the ND is automatically deselected, when the TERR STBY memo is triggered.
TERR OFF is displayed when the EGPWS is voluntarily deselected.

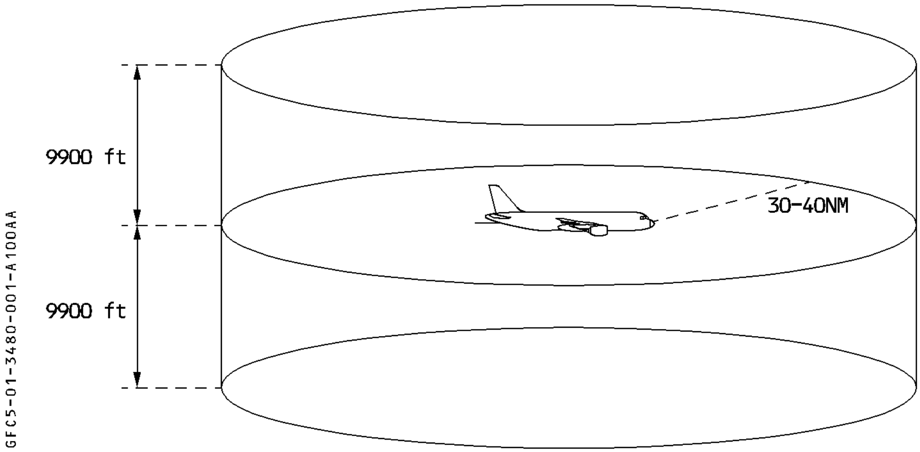
DESCRIPTION

GENERAL

The TCAS (Traffic alert and Collision Avoidance System):
- Detects any aircraft equipped with an ATC transponder flying in its vicinity
- Displays potential and predicted collision targets
- Issues vertical orders to avoid conflict.

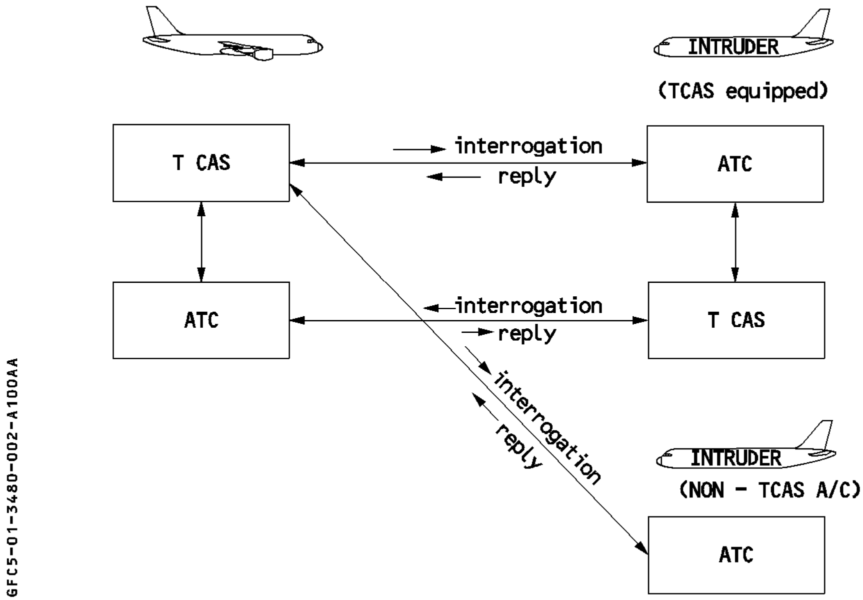
The TCAS is normally independent of the ground-based air traffic control system.

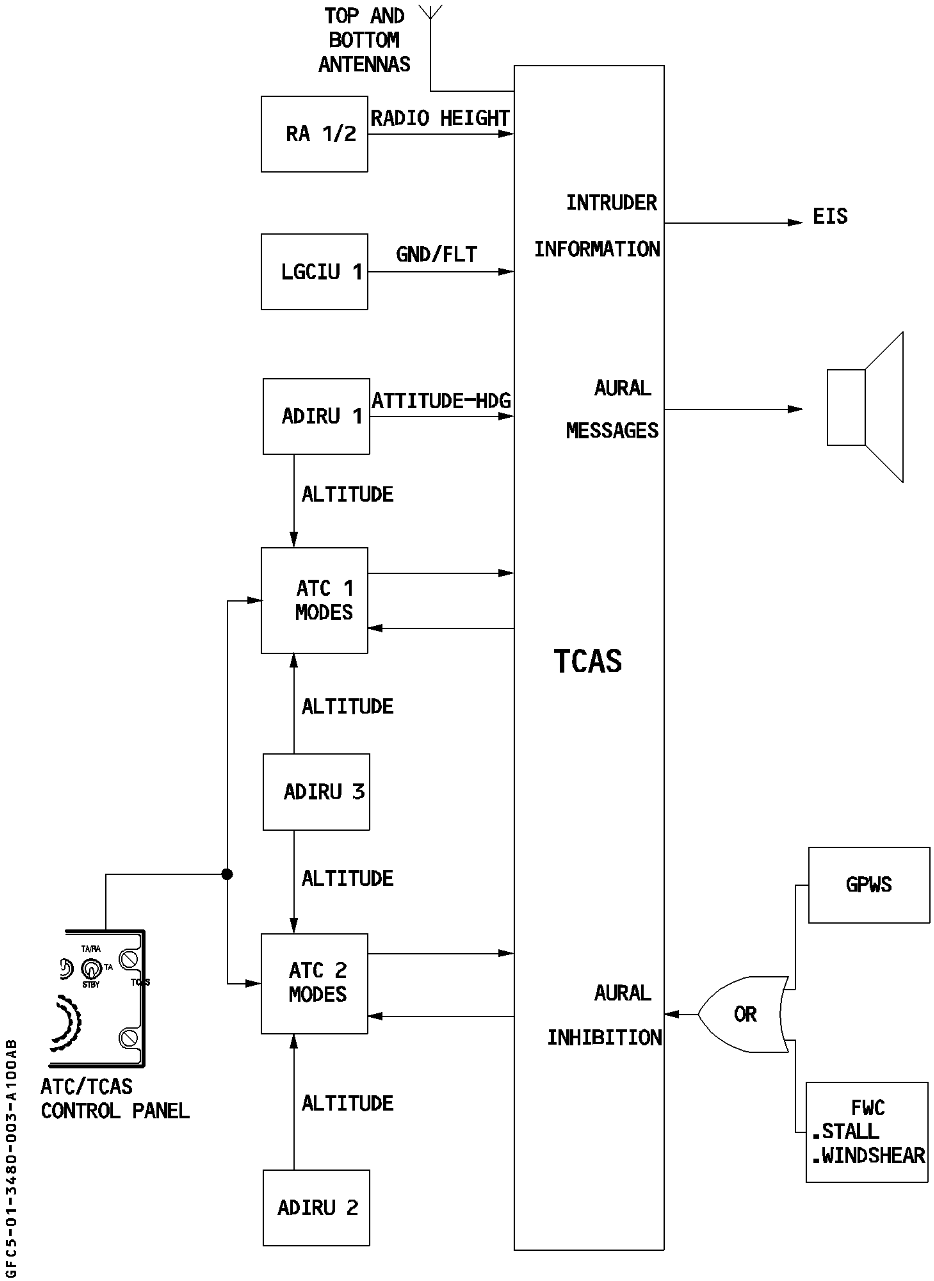
R The TCAS detection capability is limited to the intruders flying within a maximum range of
R 30-40 NM (depending on aircraft configuration and external conditions), and within a
R maximum vertical separation of 9900 feet above and below the threatened aircraft.
R



MAIN COMPONENTS

The system includes:
- A single channel TCAS computer
- Two TCAS antennas
- Two mode S ATC transponders, one active the other in standby.
  These transponders allow:
  · Interface between the ATC / TCAS control panel and the TCAS computer
  · Communication between the aircraft and intruders equipped with a TCAS system
- An ATC / TCAS control panel



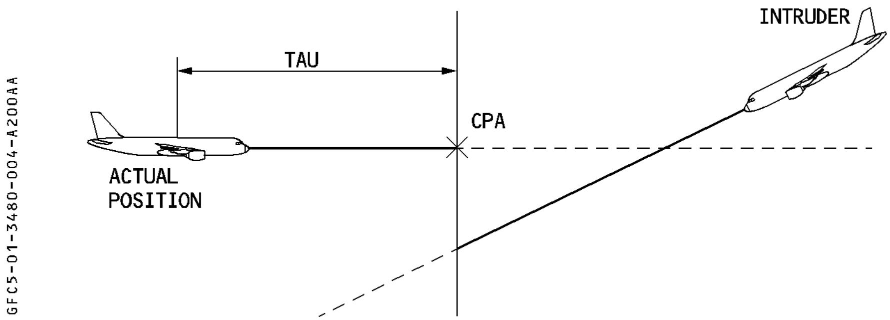


TOP AND BOTTOM ANTENNAS
RA 1/2
RADIO HEIGHT
LGCIU 1
GND/FLT
ADIRU 1
ATTITUDE-HDG
ALTITUDE
ATC 1 MODES
ALTITUDE
ADIRU 3
ALTITUDE
ATC 2 MODES
ALTITUDE
ADIRU 2
ATC/TCAS CONTROL PANEL
TCAS
INTRUDER INFORMATION
EIS
AURAL MESSAGES
AURAL INHIBITION
OR
GPWS
FWC
.STALL
.WINDSHEAR
GFC5-01-3480-003-A100AB

PRINCIPLE

The TCAS interrogates transponder of intruders. From the transponder replies, the TCAS determines for each intruder:
- its relative bearing
- its range and closure rate
- its relative altitude if available (ATC mode C or S).

Then the TCAS computes the intruder trajectory, the Closest Point of Approach (CPA) and the estimated time (TAU) before reaching the CPA.
Each time the relative position of the intruder presents a collision threat, aural and visual advisories are triggered.
TCAS optimizes vertical orders to ensure a sufficient trajectory separation and a minimal vertical speed variation considering all intruders.

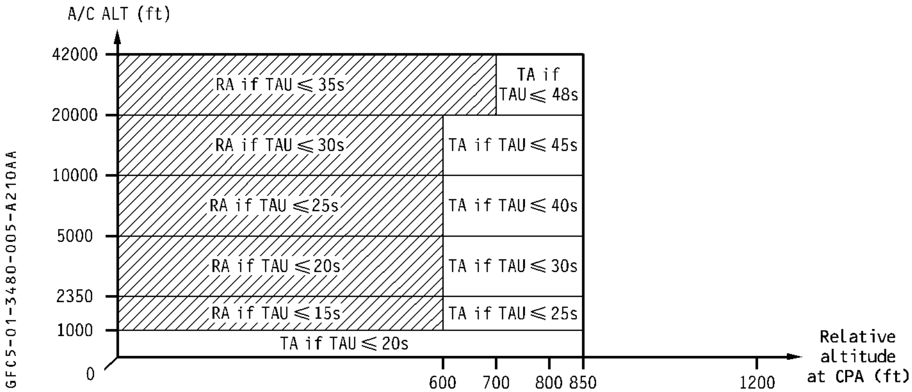


INTRUDER CLASSIFICATION

LEVEL	INTRUDER POSITION	DISPLAYED INFORMATION
Proximate	– no collision threat – intruder in vicinity to aircraft (closer than 6 NM in lateral and ± 1 200 ft in vertical direction)	– ND : intruder position
Traffic Advisory (TA)	– potential collision threat – TAU is about 40 seconds	– ND : intruder position – Aural message
Resolution Advisory (RA)	– real collision threat – TAU is about 25 seconds	– ND : intruder position – Aural messages – PFD : vertical orders . Maintain actual V / S (Preventive Advisory) or . Modify V / S (Corrective Advisory)
Other intruders	– no collision threat – any non proximate, TA, RA within the surveillance envelope (lateral range : closer than 30 NM) vertical range : refer to 1.34.80 P 7	– ND : intruder position

TA / RA THRESHOLDS

FOR INFO



TCAS MODES

The TCAS has 2 modes of operation :

TA/RA : Selected on the ATC/TCAS panel ; this mode allows the display of all intruders.

TA : Can be selected by :
- The crew, on the ATC/TCAS panel, in case of aircraft degraded performance (engine failure, landing gear extended), or when operating near closely-spaced parallel runways, or
- Automatically, when the following priority messages are triggered :
  - Windshear (◁)
  - Stall
  - GPWS messages.
- Automatically, when a hijacking alert has been initiated from the cockpit.

Consequently :
- All RAs are inhibited and converted into TAs.
- TA threshold is set to TAU ≤ 20 seconds, irrespective of aircraft altitude.
- No vertical speed advisories are indicated on the PFD
- "TA ONLY" is displayed on the NDs.

In case priority messages are triggered, all aural TCAS messages are suppressed.

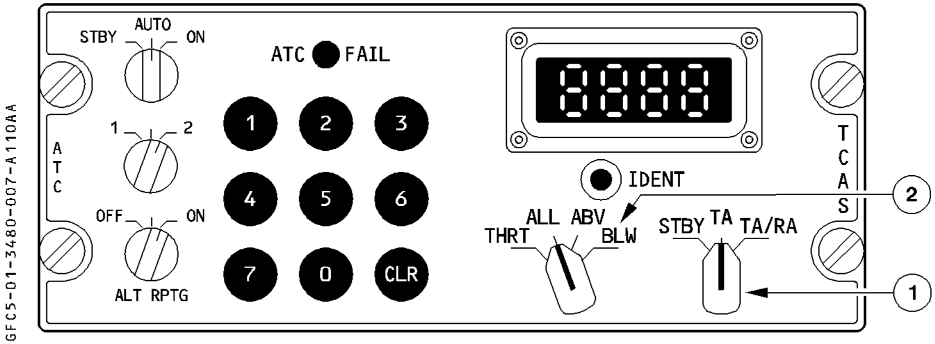
ADVISORY INHIBITION

Some advisories are inhibited, depending on the aircraft altitude :

- All intruders flying below 380 feet AGL, when the own aircraft altitude is below 1700 feet AGL.
- R All RA aural messages below 1100 feet AGL in climb, and 900 feet AGL in descent. In this case, the RAs are converted into TAs.
- R "Descend" type advisory below 1200 feet AGL in climb, or 1000 feet AGL in descent.
- R "Increase Descent" RA below 1650 feet AGL in climb, or 1450 feet AGL in descent.
- all TA aural messages below 500 feet AGL.

CONTROLS AND INDICATORS

ATC/TCAS PANEL



① Mode sel

TA/RA : Normal position.
The RAs, TAs and proximate intruders are displayed if the ALT RPTG switch is ON and the transponder is not on STBY.

TA : The TCAS does not generate any vertical orders. This mode should be used in case of aircraft degraded performance (engine failure, landing gear extended...) or on parallel runways.
All RAs are converted into TAs. TAs, proximate and other intruders are displayed if the ALT RPTG switch is ON and the transponder is not on STBY.
The TA ONLY white memo is displayed on the NDs.

STBY : The TCAS is in standby.

② TRAFFIC sel

R THRT : The other and proximate intruders are displayed only if a TA or RA is
R present and they are within 2700 feet above and 2700 feet below the
R aircraft.

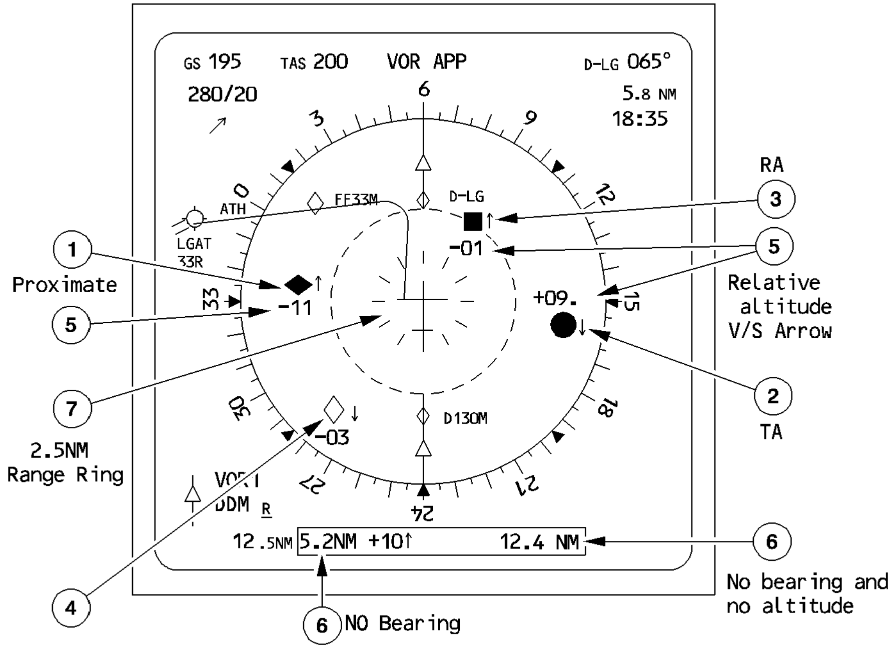
ALL : The other and proximate intruders are displayed even if no TA or RA is present. (full time function). The altitude range is – 2700 feet to + 2700 feet.

R ABV : The same as ALL except that the other intruders are displayed if within
R 9900 feet above the aircraft and 2700 feet below.

R BLW : The same as ALL except that the other intruders are displayed if within
R 9900 feet below the aircraft and 2700 feet above.

ND INDICATIONS

The traffic is displayed in all ROSE modes and ARC mode. Only the eight most threatening intruders are displayed.



GFC5-01-3480-008-A300AA

(1) Proximate intruder

R Indicated by a white diamond.

(2) TA intruder

Indicated by an amber circle.
Associated with the "TRAFFIC-TRAFFIC" aural message.

③ RA intruder

Indicated by a red square.
Associated with vertical orders displayed on the PFD and aural messages.

④ Other intruders

Indicated by a white empty diamond.

Note : *If the range of an intruder is not available, the intruder is not displayed.*
An intruder may be partially displayed when its range is out of scale.

⑤ Relative altitude / Vertical Speed arrow

Relative altitude : indicated in hundred of feet above or below the symbol depending on the intruder position.
Vertical speed arrow : displayed only if the intruder vertical speed is greater than ± 500 ft / min
Relative altitude and vertical speed arrow are displayed in the same color as the associated intruder symbol.

Note : *If the altitude of an intruder is not available, neither altitude nor vertical speed indications are displayed.*

⑥ No Bearing Intruder

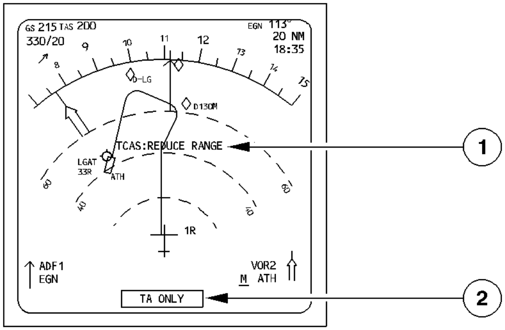
If the bearing of TA or RA intruder is not available the following data is presented in digital form at the bottom of the ND:
– range
– relative altitude and vertical speed arrow if available.
Displayed amber or red according to threat level.

⑦ Range Ring

A 2.5 NM white range ring is displayed when a 10 or 20 NM range is selected.

TCAS MESSAGES

GFC5-01-3480-010-A200AA



(1) Mode and range messages

The following messages may be displayed to get the pilot's attention :

TCAS : REDUCE RANGE : Displayed, when a TA or RA is detected, and the ND range is above 40 NM.

TCAS : CHANGE MODE : Displayed, when a TA or RA is detected, and the ND mode is PLAN.

It is displayed in amber or red, depending on the advisory level (TA or RA).

(2) TCAS operation messages

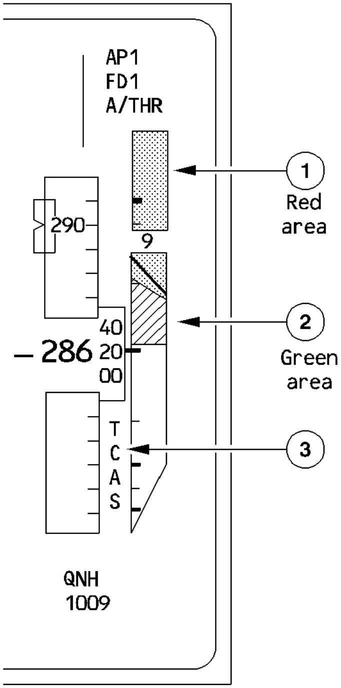
R TCAS : It is displayed in amber, in case of an internal TCAS failure. It
R flashes for 9 seconds, then remains steady.

TA ONLY : It is displayed in white, when selected by the crew.

PFD INDICATIONS

In case of RA detection, the PFD presents vertical orders on the vertical speed scale. The vertical speed scale background is normally grey, but may be partially replaced by green
R and/or red areas.

Note : When TCAS information has to be displayed on the vertical speed scale, the grey background of the air speed and heading scales are removed.



GFC5-01-3480-011-A100AA

(1) Red area

Indicates the vertical speed range, where the risk of conflict is high.

(2) Green area

Indicates the recommended vertical speed range. (FLY TO sector).

Note : — The aircraft can also fly in the grey vertical speed range without the risk of
R *conflict preventive RA).*

③ TCAS message

It appears in amber, when the TCAS cannot deliver RA data, or in case of a TCAS internal failure.

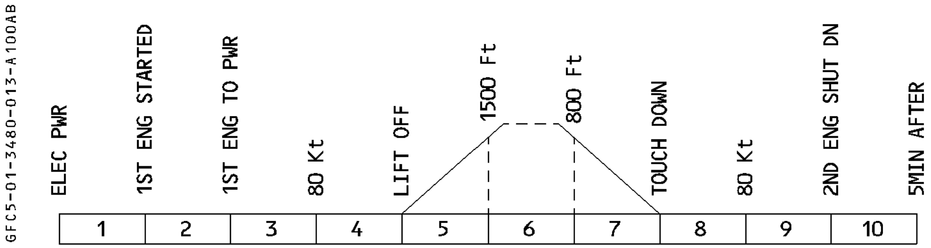
Note : When within the red area, the vertical speed needle and the digits change to red, but in a different pattern so that it is possible to clearly distinguish them from the background.

AURAL MESSAGES

TA / RA detection is associated with the following messages:

	"TRAFFIC TRAFFIC"	:	Only in case of TA detection.
	"CLIMB CLIMB"	:	Climb at the vertical speed indicated by the green area on the PFD.
	"CLIMB CROSSING CLIMB" (twice)	:	Same as above. Indicates that you will cross through the intruder altitude.
	"INCREASE CLIMB" (twice)	:	Triggered after the CLIMB message, if the vertical speed is insufficient to achieve safe vertical separation.
	"DESCEND DESCEND"	:	Descend at the vertical speed indicated by the green area on the PFD.
	"DESCEND CROSSING DESCEND" (twice)	:	Same as above. Indicates that you will cross through the intruder altitude.
	"INCREASE DESCEND" (twice)	:	Triggered after the DESCEND message, if the vertical speed is insufficient to achieve safe vertical separation.
R R R	"ADJUST VERTICAL SPEED, ADJUST"	:	Adjust the vertical speed to that indicated by the green area on the PFD, reducing climb speed or descent speed, as appropriate.
	"CLIMB, CLIMB NOW" (twice)	:	Triggered after the DESCEND message, if the intruder trajectory has changed.
	"DESCEND DESCEND NOW" (twice)	:	Triggered after the CLIMB message, if the intruder trajectory has changed.
	"MONITOR VERTICAL SPEED"	:	Ensure that vertical speed remains outside the red area. Triggered only once, in case of preventive RA.
	"MAINTAIN VERTICAL SPEED, MAINTAIN"	:	Maintain the vertical speed indicated by the green area on the PFD.
	"MAINTAIN VERTICAL SPEED, CROSSING MAINTAIN"	:	Maintain the vertical speed indicated by the green area on the PFD. Indicates that you will cross through the intruder altitude.
	"CLEAR OF CONFLICT"	:	The range increases and separation is adequate. Return to assigned clearance.

WARNINGS AND CAUTIONS



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
TCAS FAULT	NIL	NIL	NIL	Flag on PFD and ND	3, 4, 5, 7, 8

MEMO DISPLAY

R TCAS STBY appears in green when :

R – the crew selects TCAS STBY on ATC/TCAS panel, or

R – both ATCs or both RAs fail, or

R – the crew turns OFF the ALT RPTG switch.

BUS EQUIPMENT LIST

FOR INFO

		NORM			EMER ELEC		
		AC	**DC**	**DC BAT**	**AC ESS**	**DC ESS**	**HOT**
ADIRU	ADIRU 1				X		HOT 1 (1)
	AOA RESOLVER 1				X (2)		
	ADIRU 2	AC2					HOT 2 (1) during 5 mn
	AOA RESOLVER 2	AC2					
	ADIRU 3	AC1			X (3)		HOT 2 (1)
	AOA RESOLVER 3	AC1			X (2)		
STD BY INST	ISIS					X	HOT 1 (1)
	COMPASS					X	
NAVAIDS	VOR 1				X		
	VOR 2	AC2					
	MMR 1				X		
	MMR 2	AC2					
	ADF 1				X		
	ADF 2	AC2					
	DDRMI				X		
	DME 1				SHED		
	DME 2	AC2					
RADIO ALTIMETER	RA 1	AC1					
	RA 2	AC2					
ATC	ATC 1				SHED		
	ATC 2	AC2					
GPWS		AC1					
WEATHER RADAR	WX 1				SHED		
	WX 2	AC2					
TCAS ◁		AC1					
HUD ◁		AC1	DC1				

(1) Backup supply.
(2) AOA1 resolver power supply is lost, and AOA3 resolver power supply is recovered, when AC1 is lost and AIR DATA CAPT ON 3 is selected.
(3) When AC1 is lost.

DESCRIPTION

The oxygen system consists of:
- a fixed oxygen system for the cockpit
- a fixed oxygen system for the cabin
- a portable oxygen system.

The oxygen system supplies adequate breathing oxygen to the crew and passengers in case of depressurization or the presence of smoke or toxic gas.

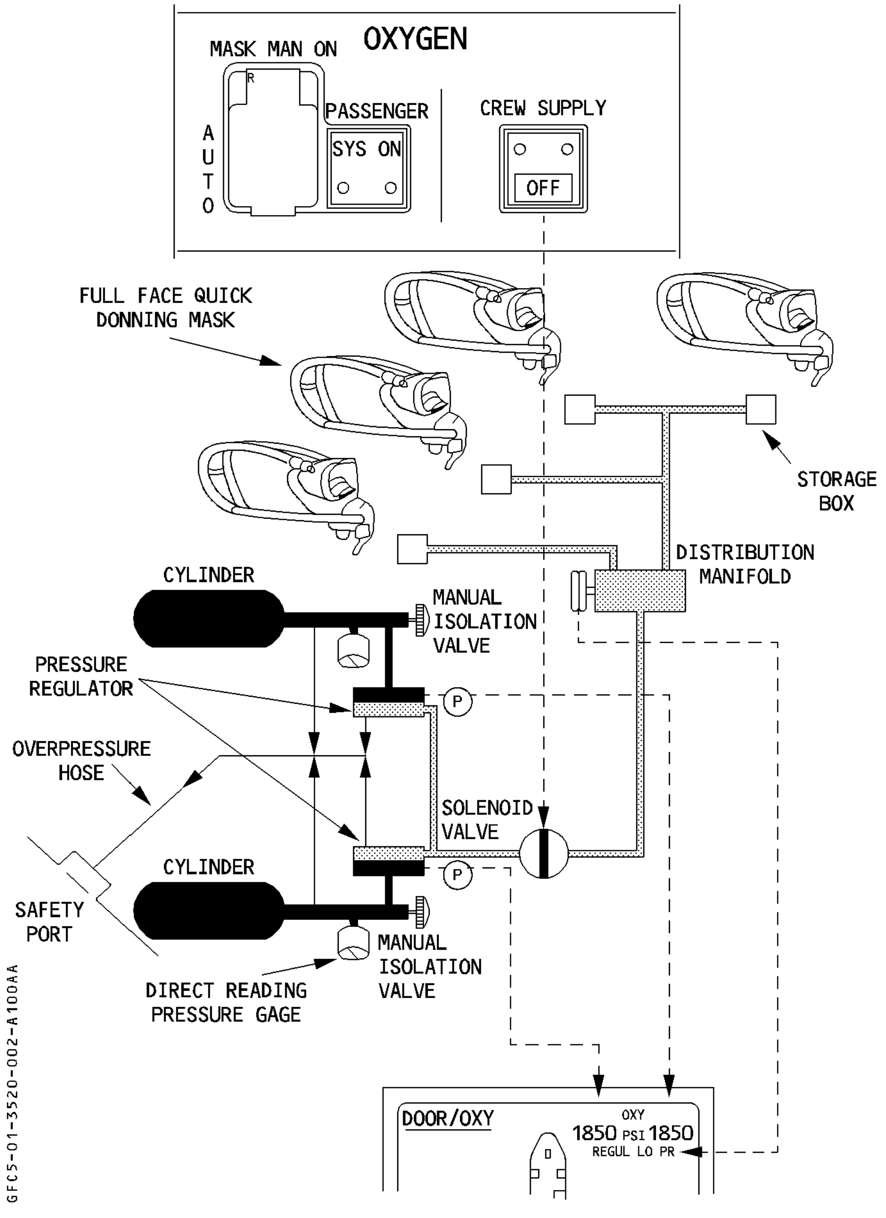
DESCRIPTION

The cockpit's fixed oxygen system consists of :
- Two high-pressure cylinders in the left-hand lower fuselage.
- Two pressure regulators, connected directly to the cylinder that delivers oxygen, at a pressure suitable for users.
- Two overpressure safety systems to vent oxygen overboard, through a safety port, if the pressure gets too high.
- A supply solenoid valve that allows the crew to shut off the distribution system.
- Four full-face, quick-donning masks, stowed in readily-accessible boxes adjacent to the crewmembers' seats (one at each seat).
- One filling port for external oxygen replenishment (As installed).

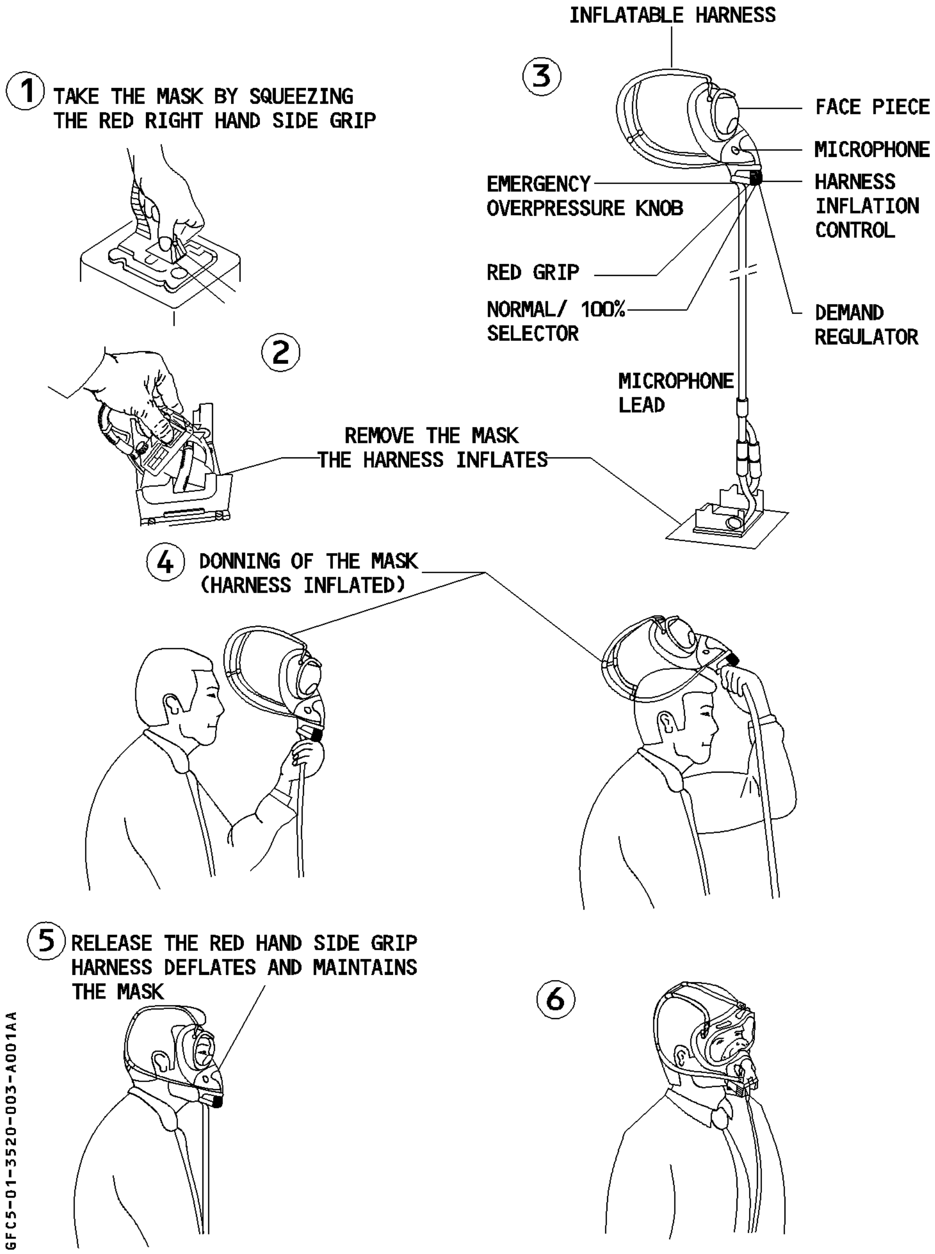
OPERATION

The crewmember squeezes the red grips to pull the mask out of its box, and this action causes the mask harness to inflate.
A mask-mounted regulator supplies a mixture of air and oxygen or pure oxygen, or performs emergency pressure control. With the regulator set to NORMAL, the user breathes a mixture of cabin air and oxygen up to the cabin altitude at which the regulator supplies 100 % oxygen. The user can select 100 %, in which case the regulator supplies pure oxygen at all cabin altitudes.
If the situation calls for it, the user can use the emergency overpressure rotating knob and receive pure oxygen at positive pressure.
The storage box contains a microphone lead, with a quick-disconnect, for connection to the appropriate mask microphone cable.

Note : Each mask may have a removable film that protects the visor against scratches. This strip is optional and may be removed from the mask at any time.

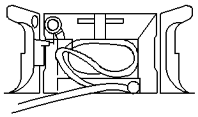

OXYGEN
MASK MAN ON
AUTO
R
PASSENGER
SYS ON
CREW SUPPLY
OFF
FULL FACE QUICK DONNING MASK
STORAGE BOX
DISTRIBUTION MANIFOLD
CYLINDER
MANUAL ISOLATION VALVE
PRESSURE REGULATOR
P
OVERPRESSURE HOSE
SOLENOID VALVE
CYLINDER
SAFETY PORT
MANUAL ISOLATION VALVE
DIRECT READING PRESSURE GAGE
DOOR/OXY
OXY
1850 PSI 1850
REGUL LO PR
GFC5-01-3520-002-A100AA

MASK DONNING

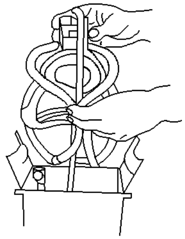


R **MASK STOWAGE**

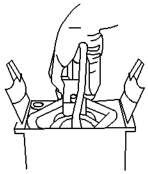
(1) - COIL THE HOSE, AND PLACE IT IN THE BOTTOM OF THE STOWAGE BOX.



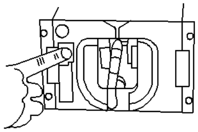
(2) - POSITION THE REMAINING HOSE IN THE MIDDLE OF THE MASK.
- FOLD THE TWO HARNESS PORTIONS TOGETHER.



(3) - PLACE THE MASK IN THE STOWAGE BOX.
- MAKE SURE THE MASK REGULATOR IS FULLY SEATED AGAINST THE STOP IN THE STOWAGE BOX.



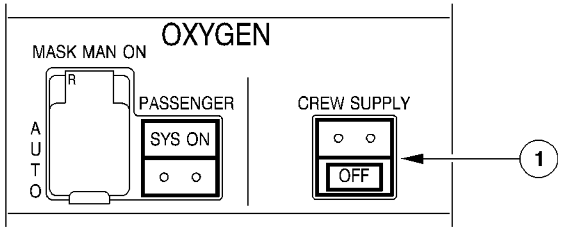
(4) - CLOSE THE DOORS, THEN FULLY PRESS THE "RESET TEST" BUTTON.
- ONCE THE "RESET TEST" BUTTON IS RELEASED, CHECK THAT THE "OXY ON" FLAG COMPLETELY DISAPPEARS.
- PRESS THE EMERGENCY PRESSURE SELECTOR, AND CHECK THAT THE BLINKER REMAINS BLACK.



GFC5-01-3520-004-A001AA

CONTROLS AND INDICATORS

OVERHEAD PANEL



GFC5-01-3520-004-B001AA

(1) CREW SUPPLY pushbutton

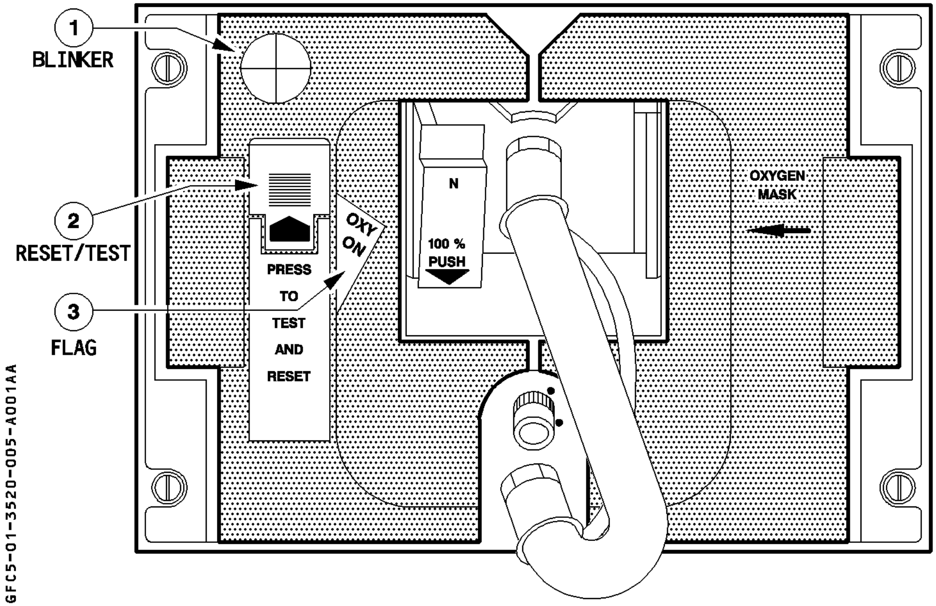
This pushbutton controls the solenoid valve.

On : The valve is open, and supplies low pressure oxygen to the masks (normal position in flight).

OFF : The valve is closed, and the white light comes on.

LATERAL CONSOLES

STOWAGE BOX



(1) Blinker flowmeter (yellow)

This indicator flashes when oxygen is flowing.

(2) RESET / TEST control slide

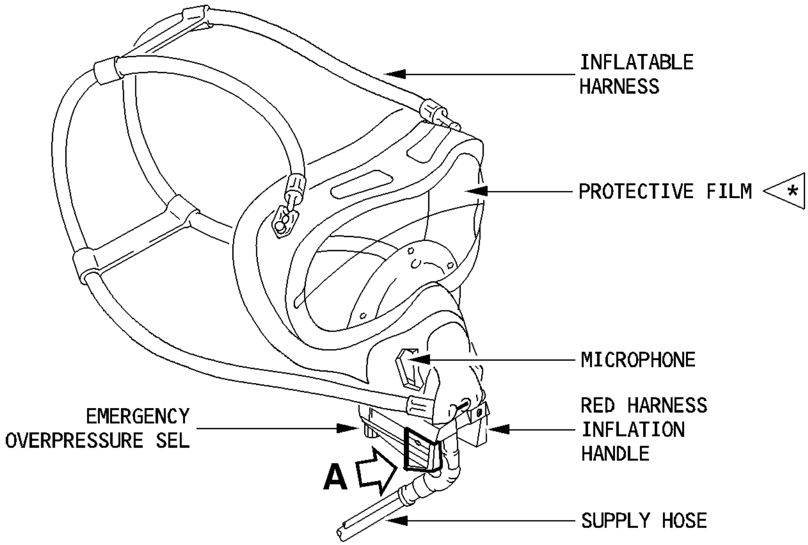
R The crewmember presses the slide, and pushes it in the direction of the arrow to test: the operation of the blinker ; the regulator supply ; system sealing downstream of the valve ; and the regulator sealing and system operation. Pressing the RESET control slide, after the oxygen mask has been used, cuts off the oxygen, and the mask microphone.

(3) OXY ON flag

R R As soon as the left flap door opens, the mask is supplied with oxygen and, once it closes (mask still supplied with oxygen), the "OXY ON" flag appears.

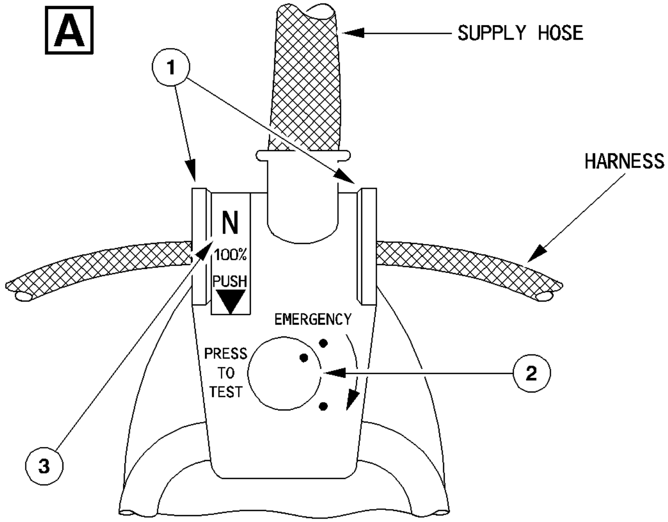
CREW OXYGEN MASK

R



GFC5-01-3520-006-A001AA

PRESSURE REGULATOR



GFC5-01-3520-006-B001AA

1 Red grips

Squeezing the righthand side grip unlocks the two-flap door and permits the harness to inflate.

2 EMERGENCY pressure selector

Use of this selector creates an overpressure which eliminates condensation and prevents smoke, smell or ashes from entering the mask.
- Pressing this knob generates an overpressure for a few seconds.
- Turning the knob, in the direction of the arrow, generates a permanent overpressure.

Note : Overpressure supply is automatically started, when cabin altitude exceeds 30000 feet.

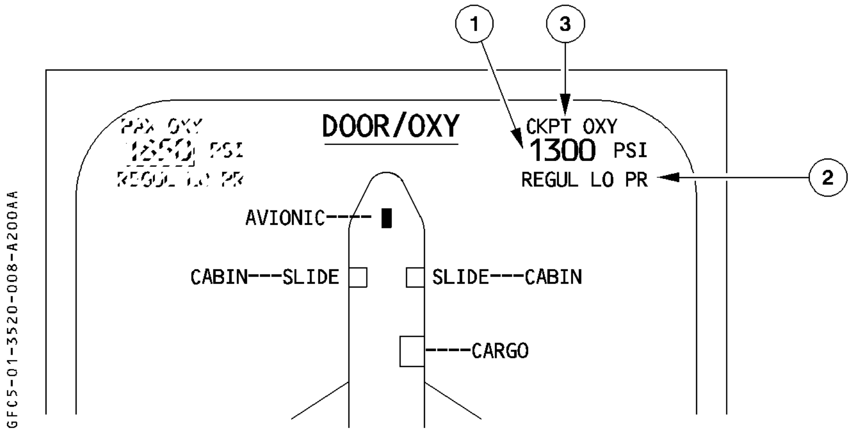
3 N/100 % Sel

This two-position button is locked down (100 % position) when the crewmember pulls
R the mask out of the stowage. Pushing up the button from underneath releases it, and it
R pops up to the N (normal) position. Pressing it again returns it to 100 %.

100 % The mask delivers 100 % oxygen.

N The mask delivers a mixture of air and oxygen, the content of which varies with cabin altitude. When cabin altitude goes above 35000 feet, the air inlet closes and the wearer breathes 100 % oxygen.

ECAM DOOR/OXY PAGE



① OXY high pressure indication

It is in green, when the pressure is greater than, or equal to, 600 psi.
It pulses in green, when pressure is less than 600 psi (the DOOR/OXY page is automatically displayed).
It is in amber, when the pressure is less than 300 psi.
- An amber half frame appears, when oxygen pressure is less than 1000 psi. In this case, the flight crew must check that the remaining quantity is not below the minimum (refer to OPERATING LIMITATIONS, 3.01.35).

② REGUL LO PR indication

It is in amber, if oxygen pressure on the low-pressure circuit is low (50 psi).

③ CKPT OXY indication

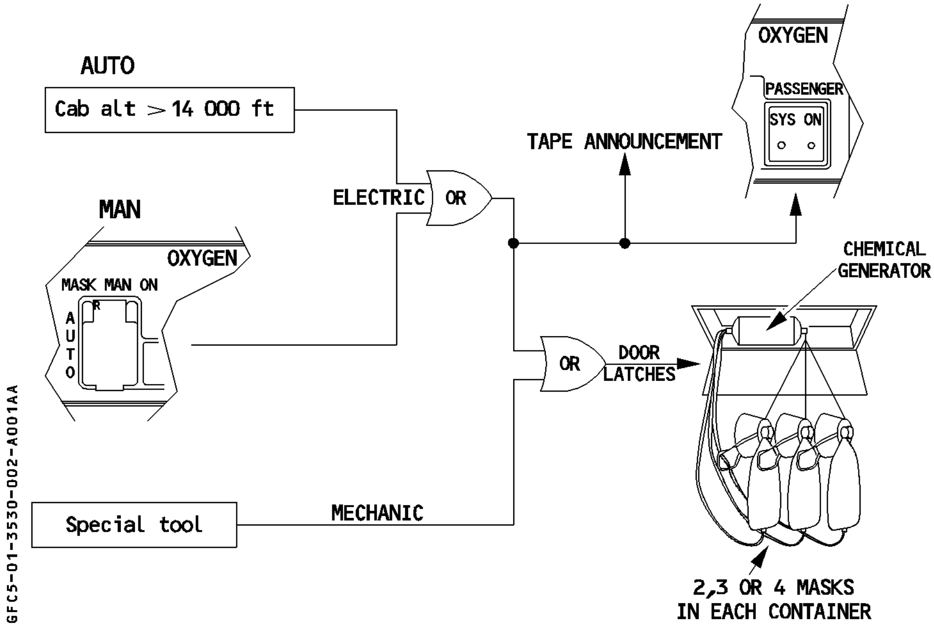
It is normally in white.
It becomes amber, when :
- The pressure goes below 300 psi.
- Low oxygen pressure is detected.
- The overhead panel's OXYGEN CREW SUPPLY pushbutton is OFF.

DESCRIPTION

The fixed oxygen system in the cabin supplies oxygen to the occupants in case of cabin depressurization.
Chemical generators produce the oxygen. Each generator feeds a group of 2, 3, or 4 masks.
Generators and masks are in containers above the passenger seats, in the lavatories, in each galley and at each cabin crew station.

OPERATION

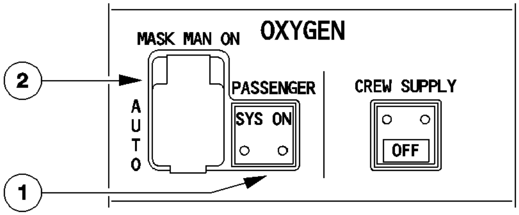
Each container has an electrical latching mechanism that opens automatically to allow the masks to drop if the cabin pressure altitude exceeds 14000 feet (+ 0, – 500 feet). Members of the flight crew can override the automatic control.
When the masks are released, the passenger address system automatically broadcasts
R prerecorded instructions (if installed) for using them.
The generation of oxygen begins when the passenger pulls the mask toward the passenger seat. The chemical reaction used for oxygen generation creates heat. Therefore, smell of burning, smokes and cabin temperature increase may be associated with the normal operation of the oxygen generators. The mask receives pure oxygen under positive pressure for about 22 minutes, until the generator is exhausted.
A reset is available for the rearming of the system after the masks are restowed. A manual release tool allows crew members to open the doors manually in case of electrical failure.


AUTO
Cab alt > 14 000 ft
MAN
OXYGEN
MASK MAN ON
R
AUTO
ELECTRIC
OR
TAPE ANNOUNCEMENT
OXYGEN
PASSENGER
SYS ON
CHEMICAL GENERATOR
OR
DOOR LATCHES
Special tool
MECHANIC
2,3 OR 4 MASKS
IN EACH CONTAINER
GFC5-01-3530-002-A001AA

CONTROLS AND INDICATORS

OVERHEAD PANEL

GFC5-01-3530-003-A001AA



(1) PASSENGERS SYS ON lt

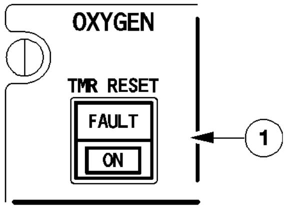
This white light comes on when the control for the oxygen mask doors is activated, and remains on until someone pushes the TMR RESET pushbutton. (See maintenance panel, below).

(2) MASK MAN ON pb

The guard keeps this button in the AUTO position.
AUTO : The mask doors open automatically when the cabin altitude exceeds
R 14 000 feet.
Pressed : The mask doors open.

MAINTENANCE PANEL

GFC5-01-3530-003-B001AA



(1) TMR RESET pb sw

The maintenance crew uses this pushbutton to reset the control circuit after the system has operated.
ON : This white light comes on, and the PASSENGER SYS ON light goes off.
FAULT : This amber light comes on when the door latch solenoids are energized for more than 30 seconds.

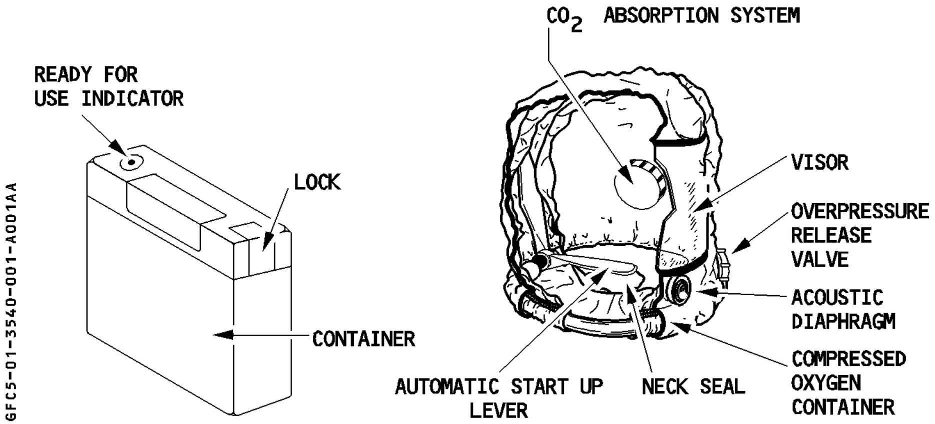
ECAM DOOR/OXY PAGE

NOT APPLICABLE

DESCRIPTION

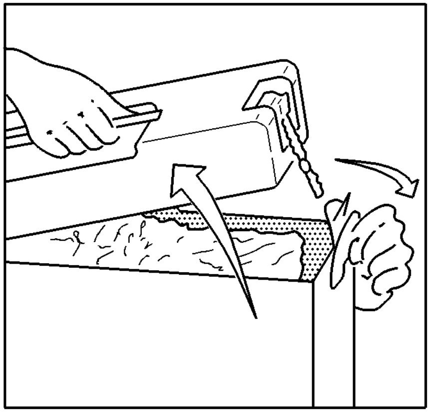
FLIGHT CREW'S PORTABLE OXYGEN SYSTEM

The smoke hood on the left back side of the cockpit protects the eyes and respiratory system of one member of the flight crew while he is fighting a fire, or if smoke or noxious gases enter the cabin, or if the cabin loses pressure.
The smoke hood is equipped with one oxygen cylinder and one CO2 absorption system which furnish an effective time of use of 15 minutes.
A « ready for use » status of the hood is ensured by checking that the indicator mounted on the hood container is not red.

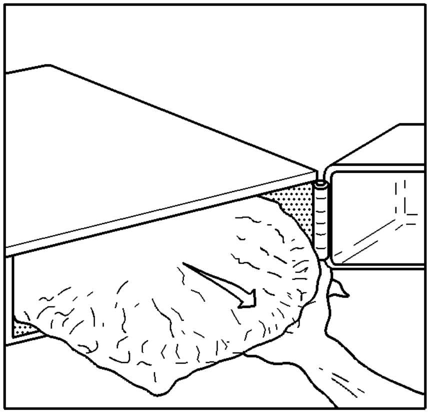


USING THE HOOD

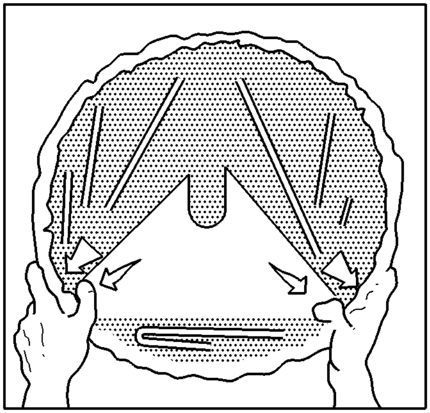
1 OPEN THE HOOD CONTAINER



2 REMOVE THE HOOD AND OPEN THE PROTECTIVE BAG



3 ENLARGE THE NECKSEAL AS INDICATED



4 THE OXYGEN SUPPLY IS AUTOMATICALLY ACTIVATED WHEN THE HOOD IS PUT

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BUS EQUIPMENT LIST

FOR INFO

		NORM			EMER ELEC		
		AC	**DC**	**DC BAT**	**AC ESS**	**DC ESS**	**HOT**
CREW OXY CTL						SHED	
PAX OXYGEN	ACTUATION				X		
	AUTOCONTROL					X	

36.00 CONTENTS

36.10 DESCRIPTION

36.20 CONTROLS AND INDICATORS

36.30 ELECTRICAL SUPPLY

GENERAL

The pneumatic system supplies high pressure air for:
- Air conditioning
- Engine starting
- Thrust reversers
- Wing anti icing
- Hydraulic reservoir pressurization
- Water pressurization
- Pack bay ventilation turbofan actuation

High pressure air is supplied from three sources:
- Engines bleed systems
- APU load compressor
- Two HP ground connections

R Engine bleed systems are interconnected by a crossbleed duct to which the APU and ground sources are connected.

A valve, mounted on the crossbleed duct, allows the left side (ENG 1) and right side (ENG 2) to be interconnected.

Pneumatic system operation is controlled and monitored by two Bleed Monitoring Computers (BMC 1 and 2), the overhead control panel and the ECAM.

The APU bleed supply is controlled by the APU Electronic Control Box (ECB).

A leak detection system is provided to detect any overheat in the vicinity of hot air ducts.

ENGINE BLEED SYSTEM

GENERAL

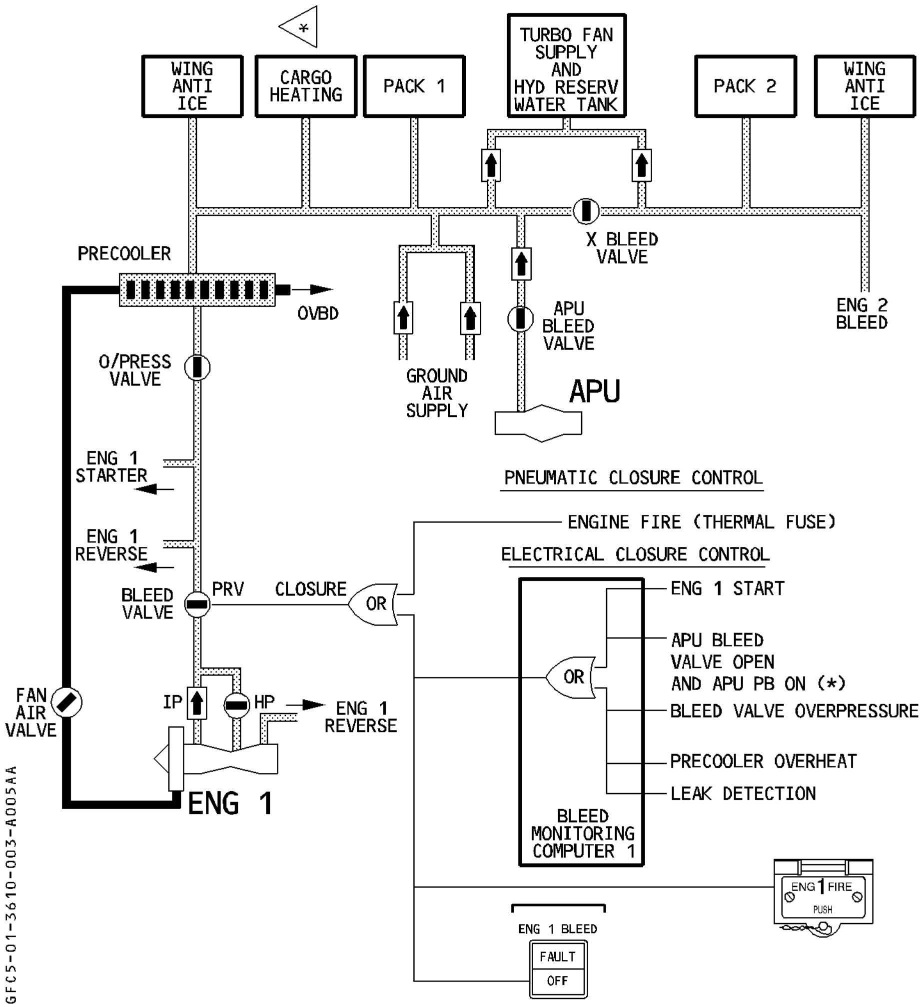
R Both engine bleed systems are similar
Each system is designed to:
- select the air source compressor stage
- regulate bleed air pressure
- regulate bleed air temperature

Each system is controlled and monitored by one Bleed Monitoring Computer.
Each BMC is provided with bleed pressure, temperature and valve position information, and is interconnected to:
- other systems involved with bleed system
- the other BMC

and provides indications and warnings to the ECAM and CMC.
In case of failure of one BMC, the other one takes over most of the monitoring functions.
Each bleed valve is electrically controlled by its associated BMC and pneumatically operated.

FOR INFO

R



(*) The Engine 2 bleed valve closes, when the APU bleed valve opens, only if the crossbleed valve is open.

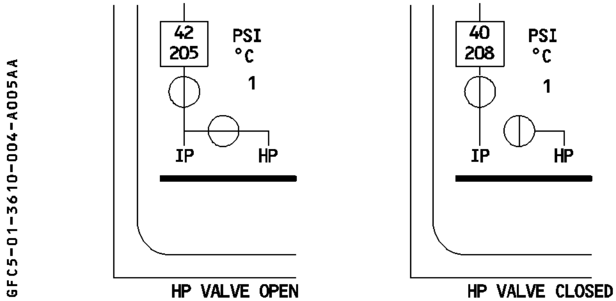
ENGINE AIR SUPPLY

Air is normally bled from the intermediate pressure stage (IP) of engine HP compressor, to minimize fuel penalty.
When pressure from IP is not sufficient (low engine speed), air is bled from the high pressure (HP) stage thru the HP valve which limits downstream pressure to 36 ± 4 psi.
An intermediate pressure check valve, mounted downstream of the IP port, closes to prevent air from HP stage being circulated to the IP stage.

FOR INFO

The HP valve is automatically closed
- *pneumatically :*
  - *in case of low upstream pressure*
  - *in case of excessive upstream pressure*
- *electrically when :*
  - *the BLEED valve is electrically controlled closed or,*
  - *wing anti-ice is OFF and upstream HP valve pressure is > 73 psi*

ECAM INDICATION



PRESSURE REGULATION AND LIMITATION

Downstream of the junction of HP and IP ducting, air is admitted into the bleed valve. This bleed valve acts as a shut-off, and as a Pressure Regulating Valve (PRV).
Delivery pressure is regulated between 44 and 52 psi, depending on the flow.
The pressure can be reduced, in case of over temperature at the precooler inlet.
In case of a pressure regulation failure, the overpressure valve (OPV) closes, when the pressure is greater than 85 psi.
The bleed valve is fully closed:
- Pneumatically, in case of:
R · Upstream pressure less than 8 psi, or
  · Engine fire (thermal fuse)
- Electrically through the :
  · BLEED pushbutton, when switched OFF.
  · ENG FIRE pushbutton, when pushed.
  · BMC, in the following cases:
    - Overtemperature
    - Overpressure
    - Leak detection
    - APU bleed ON (for Engine 2, provided the crossbleed valve is not closed).
    - Starting sequence

TEMPERATURE REGULATION AND LIMITATION

The temperature regulation of bleed air is achieved by a precooler, that is mounted downstream of the bleed valve.
The precooler is an air-to-air heat exchanger, which uses cooling air that is bled from the engine fan, to regulate the temperature to 200°C.
Fan airflow is controlled by the Fan Air Valve.
When wing anti-ice is selected off, the temperature may be regulated to 150°C, upon zone controller demand.
The fan air valve is spring-loaded closed, in the absence of pressure.

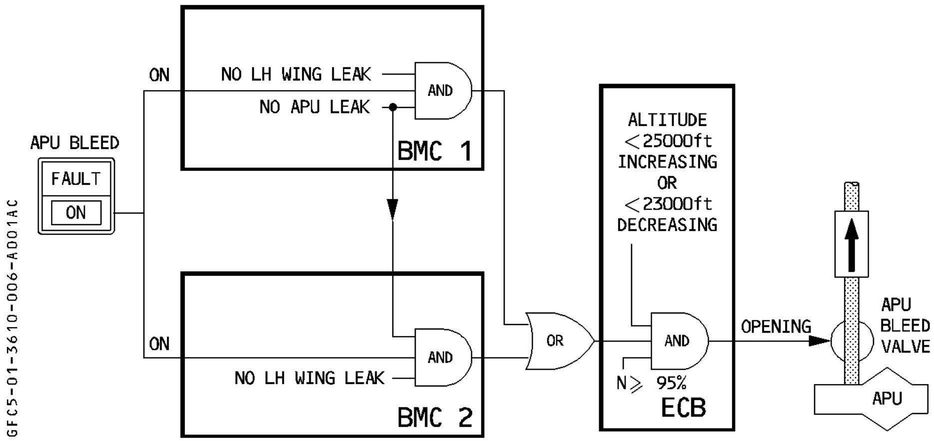
APU BLEED AIR SUPPLY

Air supplied by the APU load compressor is available on ground and in flight.
APU bleed air is controlled by the APU bleed valve which operates as shut off valve. It is electrically controlled and pneumatically operated
The APU bleed valve is controlled by the APU BLEED pushbutton on the AIR panel.
When pushbutton is selected to ON, APU bleed air supplies the pneumatic system provided APU N > 95%. This causes the X-BLEED valve to open and the engine bleed valves to close.
A non-return valve, located near the crossbleed duct, protects the APU when air is bled from another source.

APU BLEED VALVE OPENING LOGIC

FOR INFO

R



HP GROUND AIR SUPPLY

Air is supplied via two HP ground connectors to the aircraft pneumatic system. The crossbleed valve has to be opened manually to provide air for both sides.

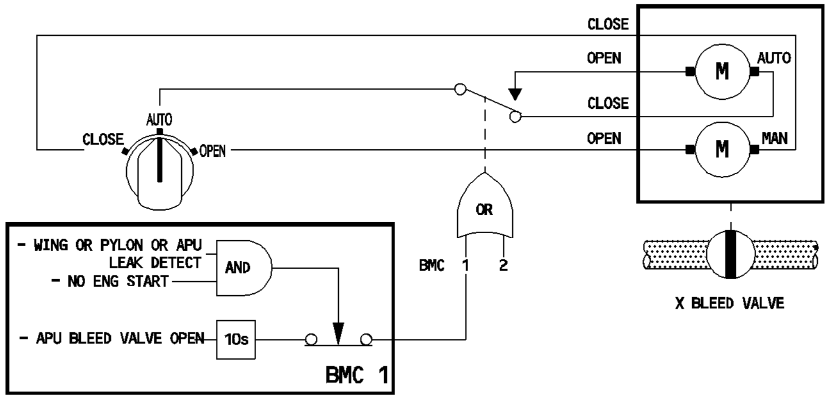
CROSSBLEED

A crossbleed valve, installed on the crossbleed duct, permits the isolation or interconnection of LH (ENG1) and RH (ENG2) air supply system.
The crossbleed valve is electrically controlled from a rotary selector located on the AIR panel.
The valve is controlled by two electric motors : one for the automatic mode, the other one for the manual mode.
In automatic mode the crossbleed valve is normally closed and opens when APU bleed air is used. In this case, it closes when any air leak is detected (except during engine start).

X-BLEED VALVE CONTROL LOGIC

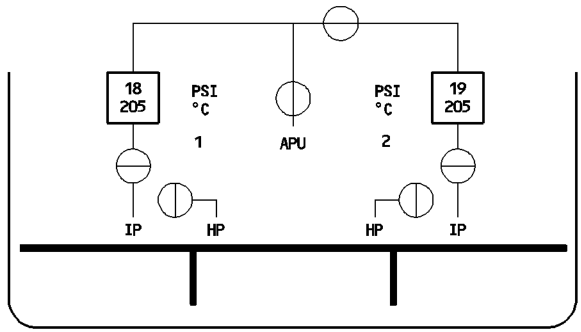
FOR INFO

R



GFC5-01-3610-007-A001AA

ECAM INDICATION



GFC5-01-3610-007-B001AA

X BLEED VALVE OPEN - AIR SUPPLIED FROM APU

LEAK DETECTION

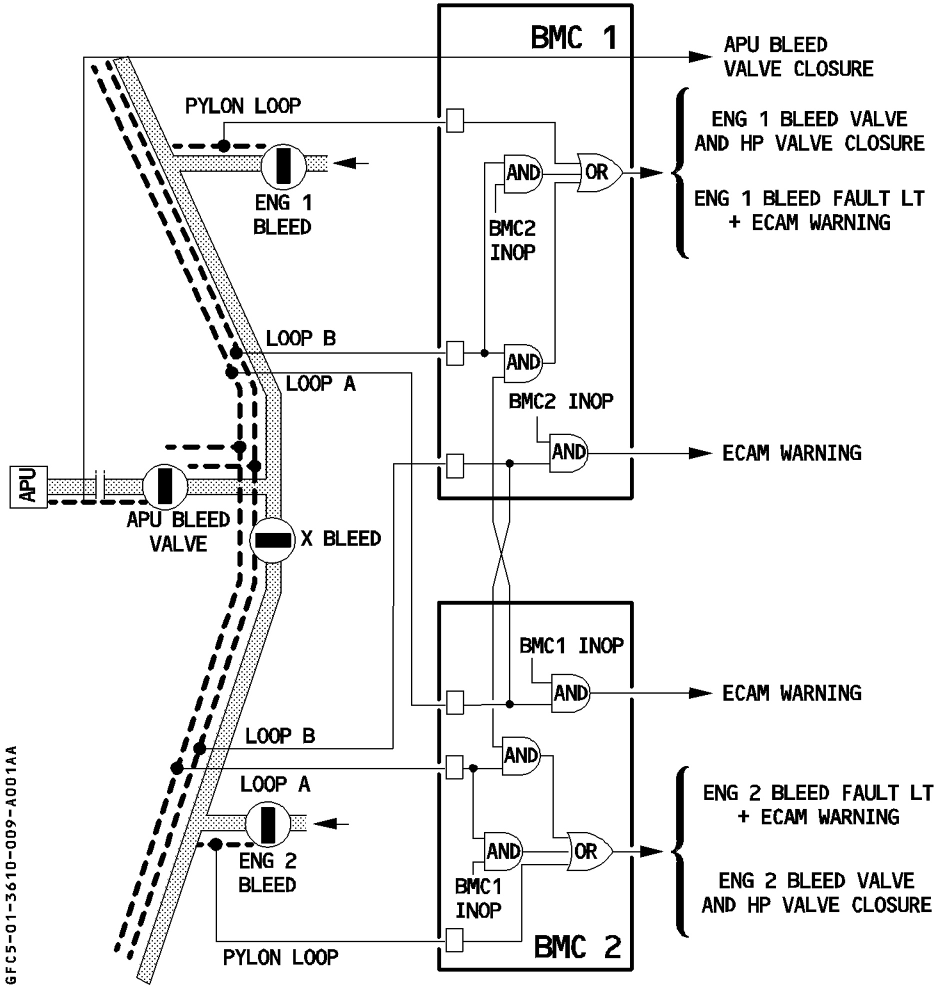
The air leakage detection loops detect any ambient overheat in the vicinity of the hot air ducts in the fuselage, pylons and wings.
The sensing elements are tied to form a single loop, for pylon and APU, or, a double loop for the wing.
A wing leak signal is activated when the two loops detect a leak, or when one loop detects the leak and the other is inoperative.
The system has identical control logic included in each BMC.

- In case of wing leak signal
  - the bleed valve and the HP valve on the related side are automatically closed.
  - the associated FAULT light on the AIR panel is illuminated
  - R the X-bleed valve automatically closes (except during an engine start or manually
    R selected open).
  - if the APU bleed valve is opened, and if the leak concerns the left wing, it automatically closes (except during engine start).
- In case of pylon leak signal
  - the bleed valve and the HP valve on the related side are automatically closed
  - the FAULT light associated with the related engine is illuminated on the AIR panel
  - R the X-bleed valve automatically closes (except during an engine start or manually
    R selected open).
- In case of APU leak signal
  - the APU bleed valve automatically closes
  - the FAULT light illuminates on the APU bleed pushbutton on the AIR panel.
  - R the X-bleed valve automatically closes (except during an engine start or manually
    R selected open).

R APU bleed leak detection is performed only by BMC 1.

FOR INFO

R



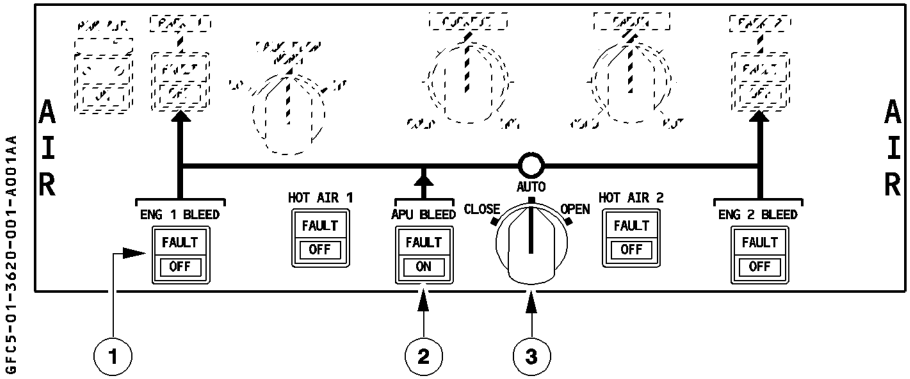
BMC 1
APU BLEED VALVE CLOSURE
PYLON LOOP
ENG 1 BLEED VALVE AND HP VALVE CLOSURE
AND
OR
ENG 1 BLEED FAULT LT + ECAM WARNING
ENG 1 BLEED
BMC2 INOP
LOOP B
AND
LOOP A
BMC2 INOP
AND
ECAM WARNING
APU
APU BLEED VALVE
X BLEED
BMC1 INOP
AND
ECAM WARNING
LOOP B
AND
LOOP A
ENG 2 BLEED FAULT LT + ECAM WARNING
ENG 2 BLEED
AND
OR
BMC1 INOP
ENG 2 BLEED VALVE AND HP VALVE CLOSURE
PYLON LOOP
BMC 2
GFC5-01-3610-009-A001AA

R **OPERATION FOLLOWING FAILURES**

BMC FAILURE

R If one BMC is failed the other BMC takes over monitoring of the bleed system and ensures the following ECAM warnings :
R – ENG BLEED FAULT (overpressure and overtemperature only)
– WING LEAK
R – BLEED LO TEMP (if wing anti ice is on)
R Nevertheless the associated FAULT light on the AIR panel is lost, and the bleed valve does not close automatically.
ENG BLEED LEAK warning is lost for the associated engine as well as APU BLEED LEAK warning if BMC1 is concerned.

OVERHEAD PANEL



(1) ENG 1 (2) BLEED pb sw

On : Bleed valve opens provided:
- Upstream pressure is above 8 psi.
- APU BLEED pushbutton is at OFF, or, APU bleed valve is closed.
R - There is no onside wing or pylon leak, overpressure or overtemperature
R detected.
R - ENG FIRE pushbutton not released out
R - Eng start valve closed

FAULT lt : illuminates amber, associated with ECAM caution, in case of:
- Bleed valve not closed during engine start
- Bleed valve not closed with APU bleed ON (and for RH engine X-bleed open)

and additionally associated with autoclosure of the bleed and HP valves :
- Overpressure downstream of the bleed valve.
- Bleed overheat
- Wing or engine leak on the related side

It extinguishes when the ENG BLEED pushbutton is at OFF provided the failure has disappeared

OFF : Bleed valve and HP valve close. OFF light illuminates white. FAULT light and autoclosure signal are reset.

(2) APU BLEED pb sw

ON : APU valve opens provided :
- N > 95 %
- Altitude < 25000 ft climbing or < 23000 ft descending
- No leak detected on APU or LH bleed (Should a leak occur on the right side, the X–bleed would close).

ON light illuminates blue.

Off : APU valves closes.

FAULT lt : illuminates amber, associated with ECAM caution, when APU leak is detected.

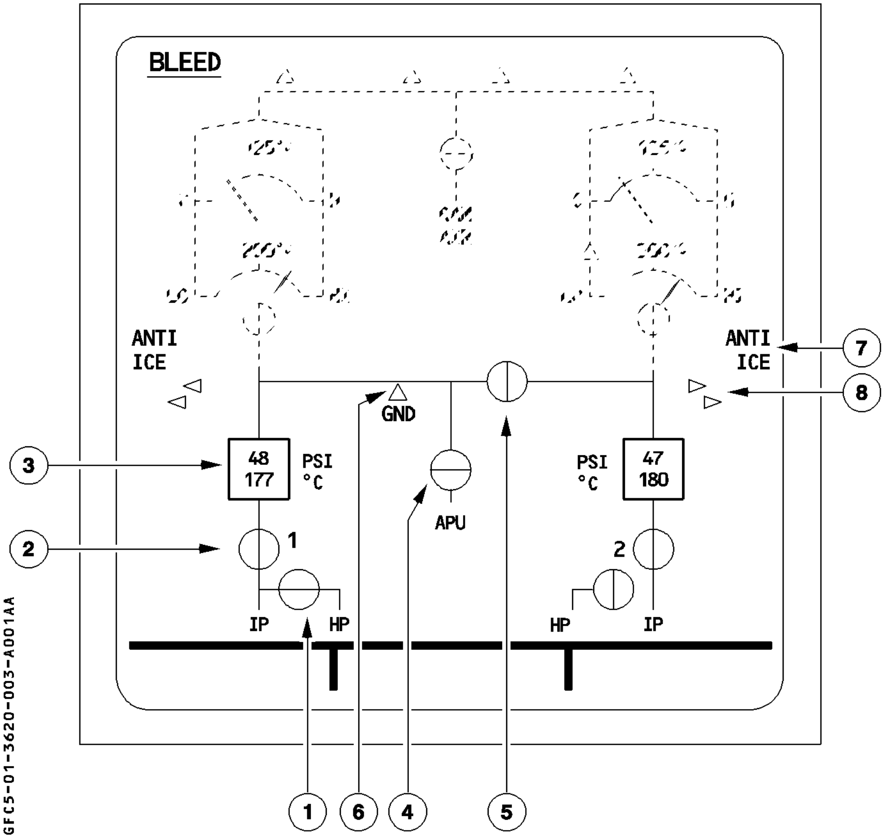
(3) X-BLEED sel

AUTO : X-bleed valve is open if APU bleed valve is open
X-bleed valve is closed if APU bleed valve is closed.

OPEN : X-bleed valve is open.

CLOSE : X-bleed valve is closed.

R **ECAM BLEED PAGE**



GFC5-01-3620-003-A001AA

① HP VALVES

ⓘ green : HP valve normally fully closed
⊖ green : HP valve not fully closed
R ⓘ amber : HP valve disagree in closed position
R or when HP valve is fully closed and the respective engine is not running.

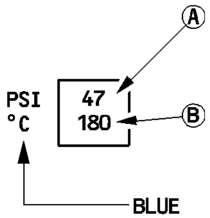
② ENGINE BLEED VALVES

R In line – Green : The bleed valve is normally open.
R Crossline – Green : The bleed valve is fully closed (by manual or automatic
R control).
R In line – Amber : The bleed valve disagrees in the open position.
R Crossline – Amber : The bleed valve disagrees in the closed position,
or the bleed valve is fully closed and the respective engine is not running.

Note : In certain circumstances (such as different engine setting, or minor bleed valve regulation drift), it is possible that one bleed valve on one side closes and will be indicated closed and green on the ECAM BLEED page. There is no operational impact on the bleed system, provided there is no associated "AIR ENG X BLEED FAULT" ECAM warning.

③ ENGINE BLEED INDICATIONS

GFC5-01-3620-004-A001AA



Ⓐ Precooler inlet pressure
Is is normally in green.
It becomes amber, if lower than 4 psi, or in case the BMC detects an overpressure (above 60 psi).

Ⓑ Precooler outlet temperature
It is normally in green.
It becomes amber, if the BMC detects an overheat or low temperature.
Overheat : Temperature exceeds :
– 290°C for more than 5 seconds, or
– 270°C for more than 15 seconds, or
– 257°C for more than 55 seconds.
Low temperature is detected, if the bleed temperature drops below 150°C, and if
R wing anti-ice is on. Low temperature may, however, only be due to low outside air
R temperature.

④ APU BLEED VALVE

R Displayed only if the APU MASTER SW is ON.
⊖ green : APU valve not fully open and APU BLEED pushbutton is OFF
R ⊖ amber : APU bleed valve is not fully open and APU BLEED pushbutton is ON.
⦶ green : APU valve fully open

⑤ CROSS BLEED VALVE

⦶ green : crossbleed valve is normally closed.
⊖ green : crossbleed valve is normally open.
⦶ amber : crossbleed valve disagrees in closed position.
⊖ amber : crossbleed valve disagrees in open position.
⊘ amber : crossbleed valve in transit

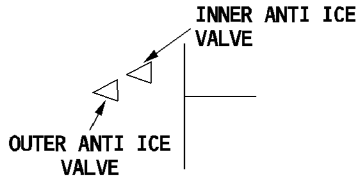
⑥ GND HP ground connection indication

△ : displayed in white on the ground
GND

⑦ ANTI ICE indication

Displayed in white when the WING pushbutton on the ANTI ICE panel is ON and both valves on the related side are open. The associated ANTI ICE indication becomes amber when:
- the position of at least one valve of the related side disagrees with the anti ice selection
- at least one arrow symbol is amber on the related side.

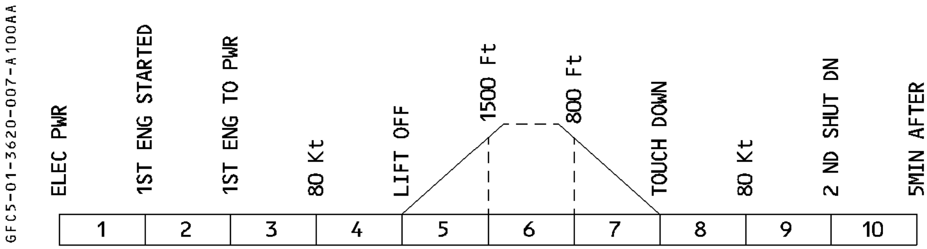
⑧ Arrows



GFC5-01-3620-006-A001AA

ARROW DISPLAY	
not displayed	Valve closed
green	Valve normally open
amber	Valve open and at least one of the following condition is met : — bleed air pressure high or low — wing anti ice pushbutton is OFF — open for more than 35 seconds while aircraft is on the ground.

WARNINGS AND CAUTIONS



<table>
<tr><th>E / WD: FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>ABNORM BLEED CONFIG
configuration of bleed system has to be changed</td><td rowspan="9">SINGLE CHIME</td><td rowspan="9">MASTER CAUT</td><td rowspan="11">BLEED</td><td>NIL</td><td>3, 4, 5, 8</td></tr>
<tr><td>ENG 1 (2) BLEED FAULT
Bleed air pressure overheat or low pressure* or high pressure</td><td rowspan="4">ENG BLEED FAULT lt</td><td>1, 3, 4, 5, 7, 8, 10</td></tr>
<tr><td>L (R) WING LEAK
temperature > 124° C detected by the loops</td><td rowspan="6">3, 4, 5, 7, 8</td></tr>
<tr><td>ENG 1 (2) BLEED LEAK
temperature > 204° C detected by the loop</td></tr>
<tr><td>ENG 1 (2) BLEED NOT CLSD
Bleed valve not automatically closed during engine start or with APU bleed selected</td></tr>
<tr><td>APU BLEED FAULT
APU available and valve disagree</td><td>NIL</td></tr>
<tr><td>APU BLEED LEAK
temperature > 124° C detected by the loop</td><td>APU BLEED FAULT lt</td></tr>
<tr><td>X BLEED FAULT
Valve disagree</td><td rowspan="5">NIL</td></tr>
<tr><td>BLEED LO TEMP
Bleed air below 150°C with wing anti ice selected on.</td><td>1 to 5
8 to 10</td></tr>
<tr><td>ENG 1 (2) HPV NOT OPEN
HP valve is abnormally closed</td><td rowspan="3">NIL</td><td rowspan="3">NIL</td><td rowspan="3">3, 4, 5, 7, 8</td></tr>
<tr><td>BMC 1(2) FAULT
Computer failure</td></tr>
<tr><td>L (R) WNG LEAK DET FAULT
Both detection loops inoperative in one wing</td><td>NIL</td></tr>
</table>

* Local warning is not triggered in case of low pressure.

MEMO DISPLAY

- APU BLEED appears in green if the APU is available and the APU BLEED pushbutton is ON.

BUS EQUIPMENT LIST

		NORM			EMER ELEC		
		AC	DC	DC BAT	AC ESS	DC ESS	HOT
BMC	1					X	
	2		DC2				
BLEED VALVES	ENG 1					X	
	ENG 2		DC2				
HP VALVES AND FAN AIR VALVES	ENG 1		DC1				
	ENG 2		DC2				
X-BLEED VALVE	AUTO CONTROL		DC2				
	MANUAL CONTROL					X	

38.00 CONTENTS

38.10 DESCRIPTION

38.20 POWER SUPPLY

GENERAL

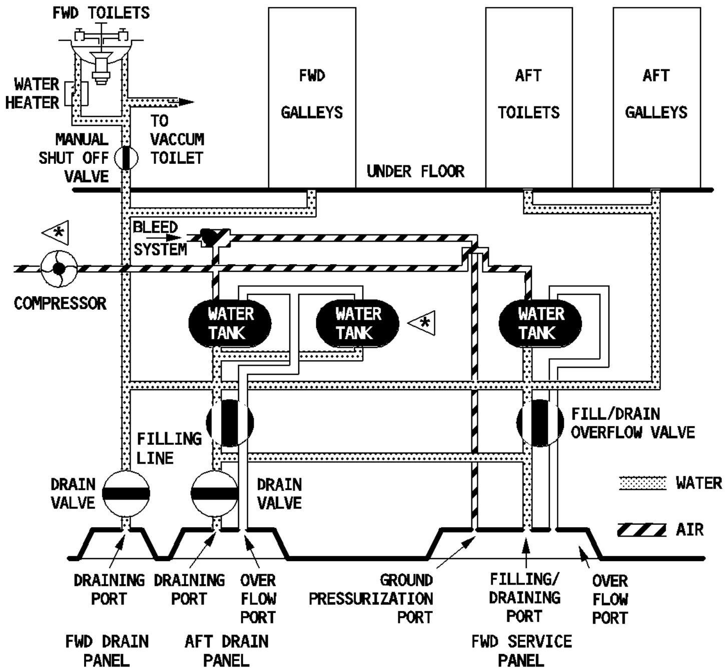
The water and waste system :
- distributes potable water to the toilets and the galleys.
- disposes waste water.
- stores toilet wastes.

The system is insulated to prevent water leaks and ice build up.
The water and waste control panel is located at the forward cabin attendant's panel.

POTABLE WATER

Potable water is stored in two (or three ◁) 350-liters tanks in the side walls of the aft cargo compartment.
While airborne, the aircraft uses bleed air to pressurize the water system ; on the ground it uses air from the service panel pressure port.
If no bleed air is available, an electrical compressor (◁) starts automatically when air pressure is not sufficient for normal operation of potable water system.
Potable water is piped to the galleys and lavatories. Manual shut-off-valves isolate the
R washbasin and toilet from the water system. These valves, easily identifiable by OPEN and
R SHUT legends, are behind an access door under the toilet bowl (on washbasin side). A placard inside the access door gives instructions on this valve operation.
The system can be filled or drained from the service panel at the bottom of the fuselage. For filling, the quantity is preselected on the forward attendant's panel.
Indicators on the forward attendants panel show how much water the water tanks contain.

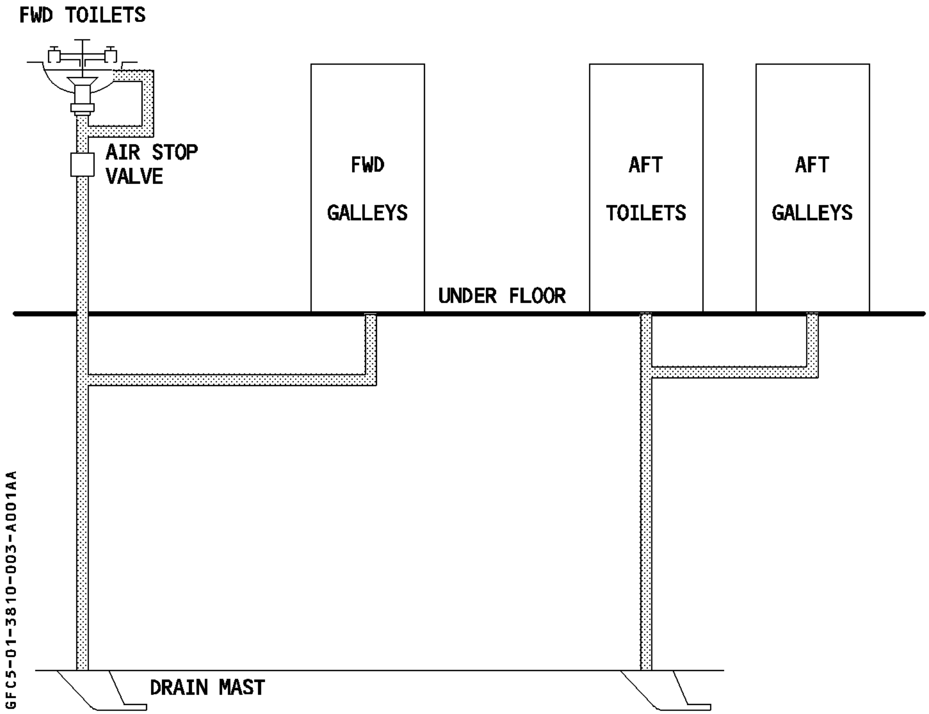
FOR INFO



WASTEWATER SYSTEM

Wastewater from the galleys and from the sinks in the lavatories drains overboard through two anti-iced drain masts.
The forward mast drains wastewater from the forward cabin ; the aft mast drains it from the aft cabin.
Differential pressure discharges the wastewater in flight, and gravity does so on the ground.

FOR INFO

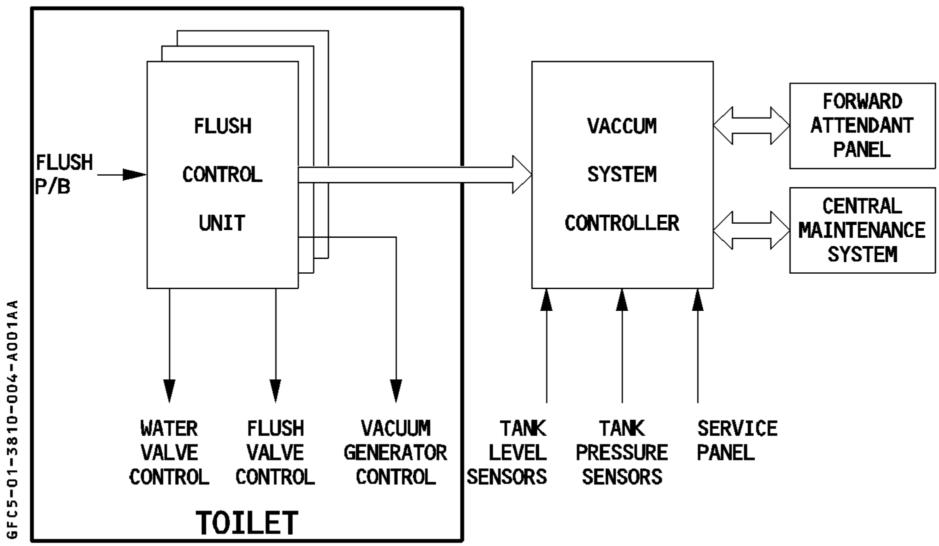


TOILET SYSTEM

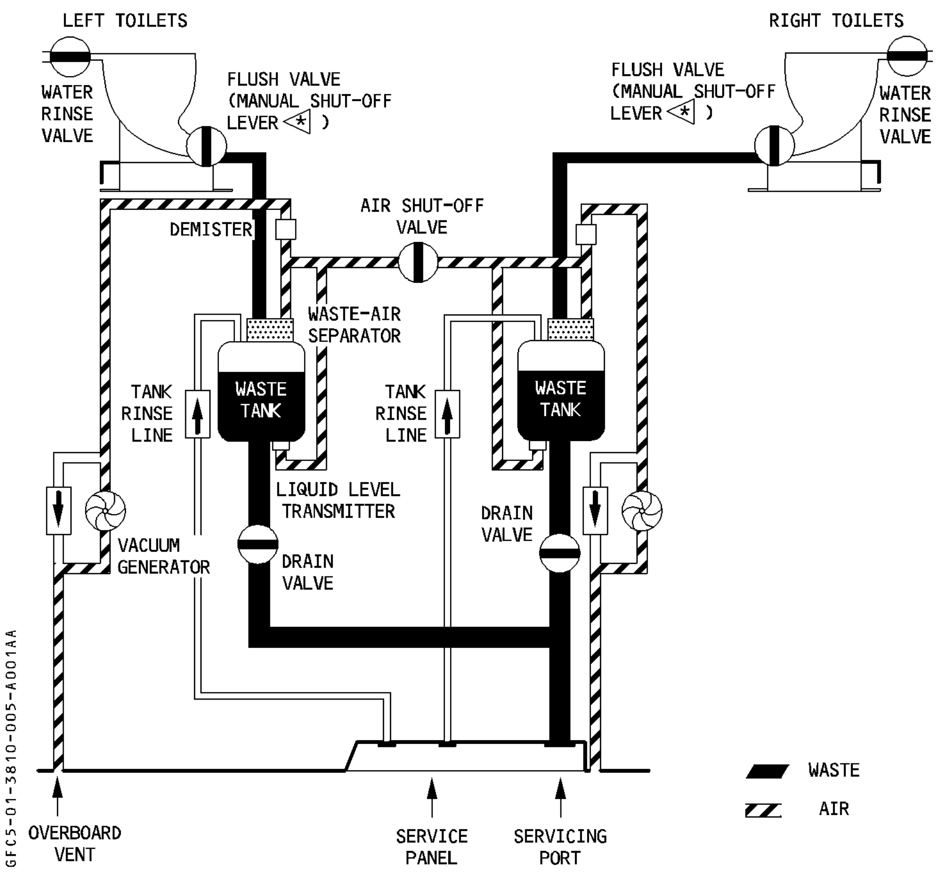
R Differential pressure forces waste from toilet bowls into 2 waste storage tanks. On ground, and at altitudes below 16000 feet, a vacuum generator produces the necessary pressure differential.
Clear water from the potable water system flushes the toilets.
A flush control unit in each toilet controls the flush sequence.
The Vacuum System Controller (VSC) furnishes operational information (including the waste level in the storage tank) to the flight attendant's panel, and maintenance information and a test program to the centralized maintenance system.
The waste tank has a total capacity of 700 liters (or 1050 liters if 3 tanks).
Ground personnel services the waste tank through a single service panel under the fuselage.
A manual shut-off valve on the lower right-hand side of the toilet bowl isolates an inoperative toilet.

ARCHITECTURE

FOR INFO



FOR INFO


LEFT TOILETS
WATER RINSE VALVE
FLUSH VALVE (MANUAL SHUT-OFF LEVER *)
RIGHT TOILETS
FLUSH VALVE (MANUAL SHUT-OFF LEVER *)
WATER RINSE VALVE
AIR SHUT-OFF VALVE
DEMISTER
WASTE-AIR SEPARATOR
TANK RINSE LINE
WASTE TANK
TANK RINSE LINE
WASTE TANK
LIQUID LEVEL TRANSMITTER
DRAIN VALVE
VACUUM GENERATOR
DRAIN VALVE
OVERBOARD VENT
SERVICE PANEL
SERVICING PORT
WASTE
AIR
GFC5-01-3810-005-A001AA

BUS EQUIPMENT LIST

FOR INFO

	NORM			EMER ELEC		
	AC	DC	DC BAT	AC ESS	DC ESS	HOT
POTABLE WATER SYS		GND/FLT				
WATER HEATER	AC1 or AC2					
VACUUM GENERATOR L	AC1					
VACUUM GENERATOR R	AC2					
PRESSURIZED WATER SYS	AC2					
FLUSH CONTROL UNITS		GND/FLT				
VACUUM SYS CONTROLLER		GND/FLT				
COMPRESSOR	GND/FLT	GND/FLT				

FOR INFO

45.00 CONTENTS

GENERAL

The purpose of the Central Maintenance System (CMS) is to facilitate maintenance tasks by directly indicating the fault messages in the cockpit, and allowing some specific tests.
Two maintenance levels are possible:
At the line stop : Equipment removal
At the main base : Troubleshooting

COMPONENTS

The CMS includes:
- The Built In Test Equipment (BITEs) of all electronic systems ;
- Two fully-redundant Central Maintenance Computers (CMCs) ;
- Three Multipurpose Control Display Units (MCDUs), also used for the FMGS, ACMS (Aircraft Condition Monitoring System) and ATSU, which dialogue with the CMC for information display or initiation of tests ;
- One printer (A4 format).

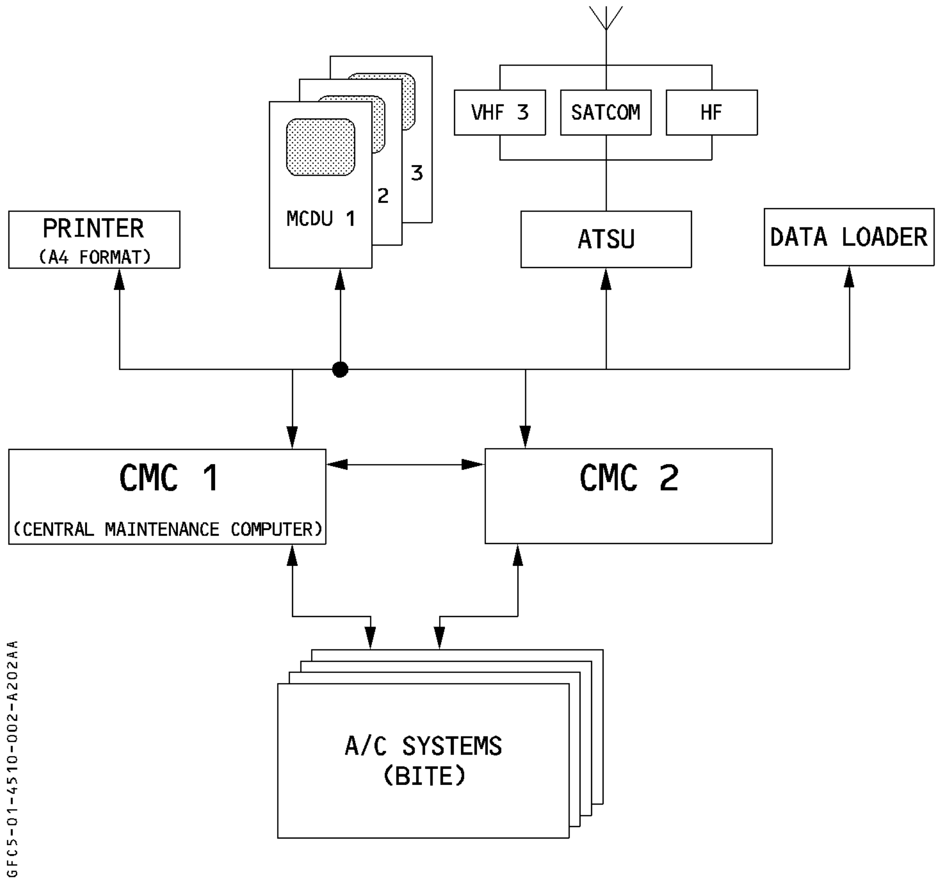
Normally, only CMC 1 is used, while CMC 2 is on standby.
CMC 2 will automatically take over, if CMC 1 fails.
A pushbutton on the overhead panel enables the transfer to CMC 2 to be forced, by setting CMC 1 to the off position.

MODES OF OPERATION

The CMS operates in two main modes:
- In flight, the NORMAL or REPORTING mode ;
- On ground, the INTERACTIVE or MENU mode.

In NORMAL mode, the CMS records and permanently displays the failure messages transmitted by each system BITE.
In INTERACTIVE mode, the CMS allows the connection of any BITE system with the MCDU, in order to initiate a TEST, or to display the maintenance data stored and formatted by the system's BITE.

ARCHITECTURE



FAILURE CLASSIFICATION

There are three classes of failure :

Class 1: Failures indicated to the flight crew by means of a flight deck effect (e.g. ECAM or instrument flags).

Class 2: Failures which can be left uncorrected until the next scheduled maintenance
R check (with a maximum delay of 600 FH).

Class 3: Failures not indicated to the flight crew, with no fixed time quoted for correction.

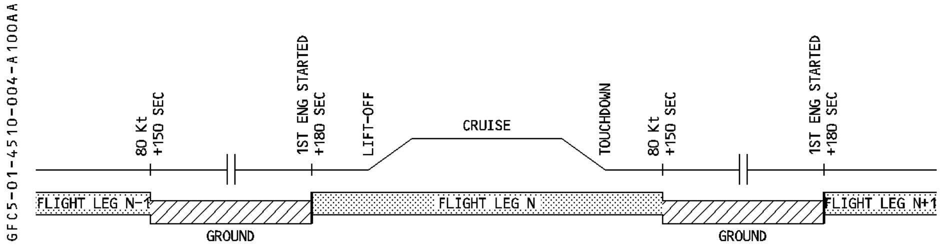
R

Failure Classes	Class 1	Class 2	Class 3
Operational consequences	YES	NO	NO
Indication to the flight crew	YES Automatically displayed in real time : - Warning or caution messages on Engine Warning Display - Flags on Primary Flight Display, or Navigation Display, or System Display - Local warning	YES STATUS flashing at the end of the flight : - Maintenance Status messages on SD	NO
Dispatch consequences	Refer to MEL may be : "GO" "GO IF" "NO GO"	MEL not applicable. "GO" without conditions. Corrections can be deferred for 600 flight hours.	MEL not applicable No fixed time quoted for corrections. However correction is recommended to improve the dispatch reliability.
Indication to the maintenance team	YES Automatically print out at the end of each flight : Failure messages on the CMC Post Flight Report		YES On request when needed Failure messages on CMC Class 3 Report

Note : Most Class 1 failures have an operational consequence on the current flight. Some Class 1 failures, such as MINOR FAULT, have no operational consequence on the current flight, but must be corrected in accordance with the MEL preamble, or the time specified in the associated dispatch condition of the MEL.

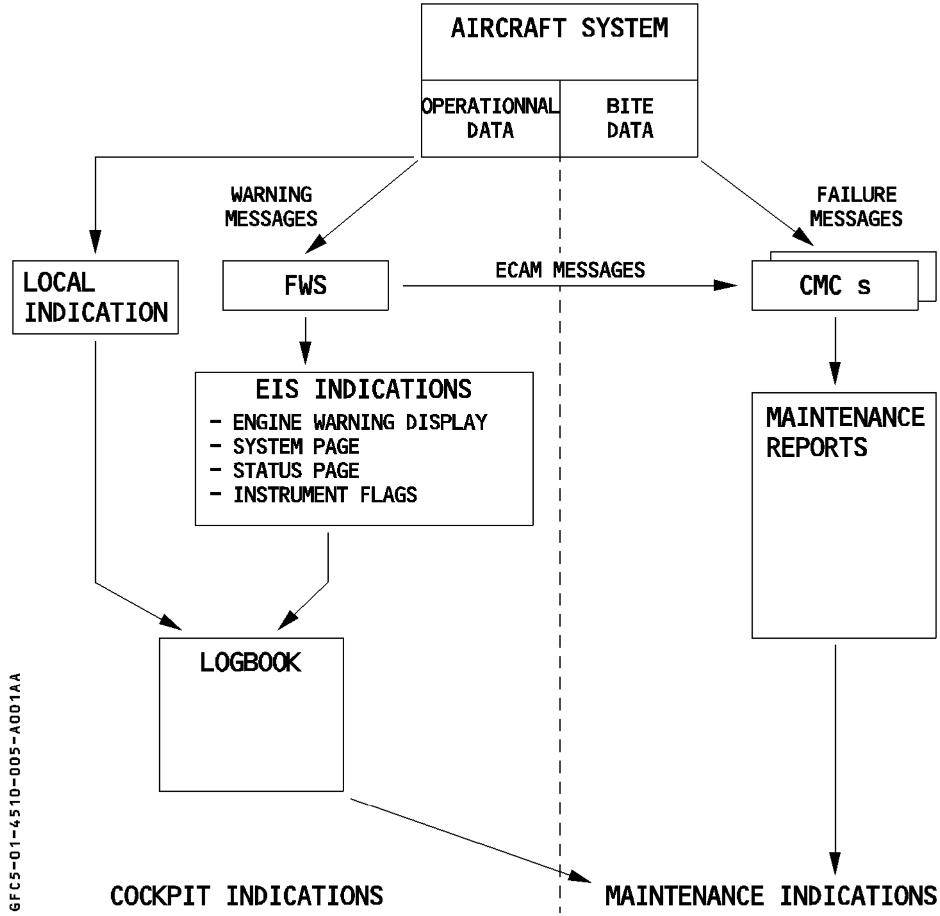
CMS FUNCTIONS

The main CMS functions are the
- Acquisition and storage of messages transmitted by the connected system BITEs, or by the Flight Warning Computer (Warning/Caution titles).
- Elaboration of the maintenance phases.



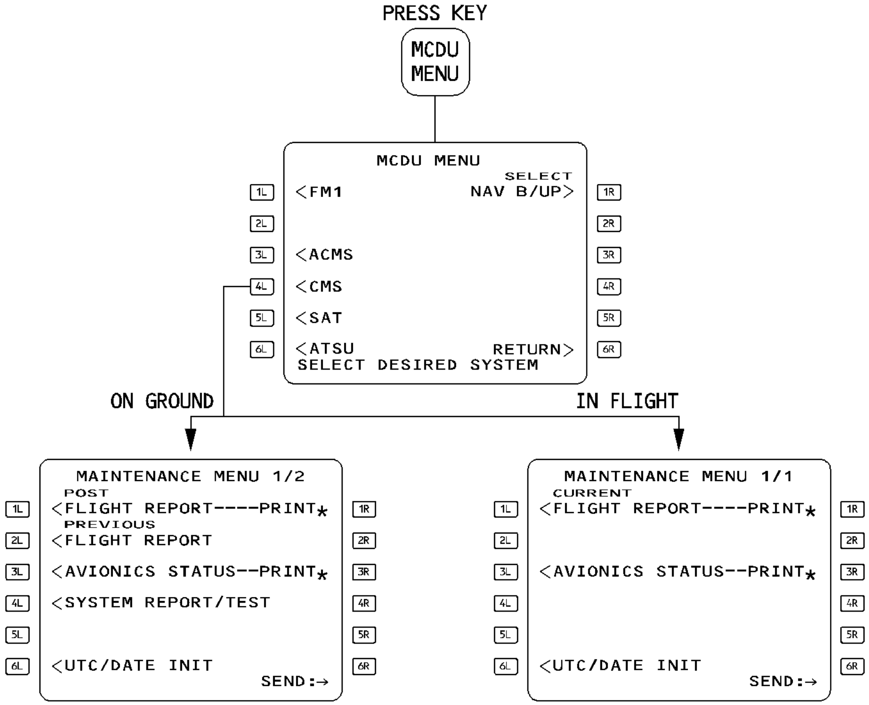
- Elaboration of the maintenance reports.
  - POST OR CURRENT FLIGHT REPORT :
    Presents all ECAM warning/caution and failure messages (Class 1 or 2 failures) recorded during the last or current flight leg.
    Available in flight and on ground.
  - PREVIOUS FLIGHT REPORT :
    Presents all ECAM and failure messages recorded during the 63 previous flight legs (post flight reports).
    Available on ground only.
  - AVIONICS STATUS :
    Presents, in real time, the systems affected by a failure.
    Available in flight and on ground.
  - CLASS 3 REPORT :
    Presents the Class 3 failure messages detected during the last flight leg.
    Available on ground only.
  - SYSTEM REPORT / TEST :
    Allows interactive dialogue between any system and the MCDU.
    Available on ground only.

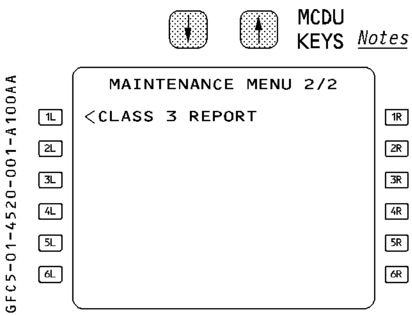
COCKPIT / CMS INTERFACE



MAINTENANCE MENU

The CMS uses menus displayed on the MCDU. The operator chooses the functions or reports via these menus.
Pressing the "MCDU MENU" key and then selecting CMS gives access to the MAINTENANCE MENU page. These pages are different in flight and on ground.

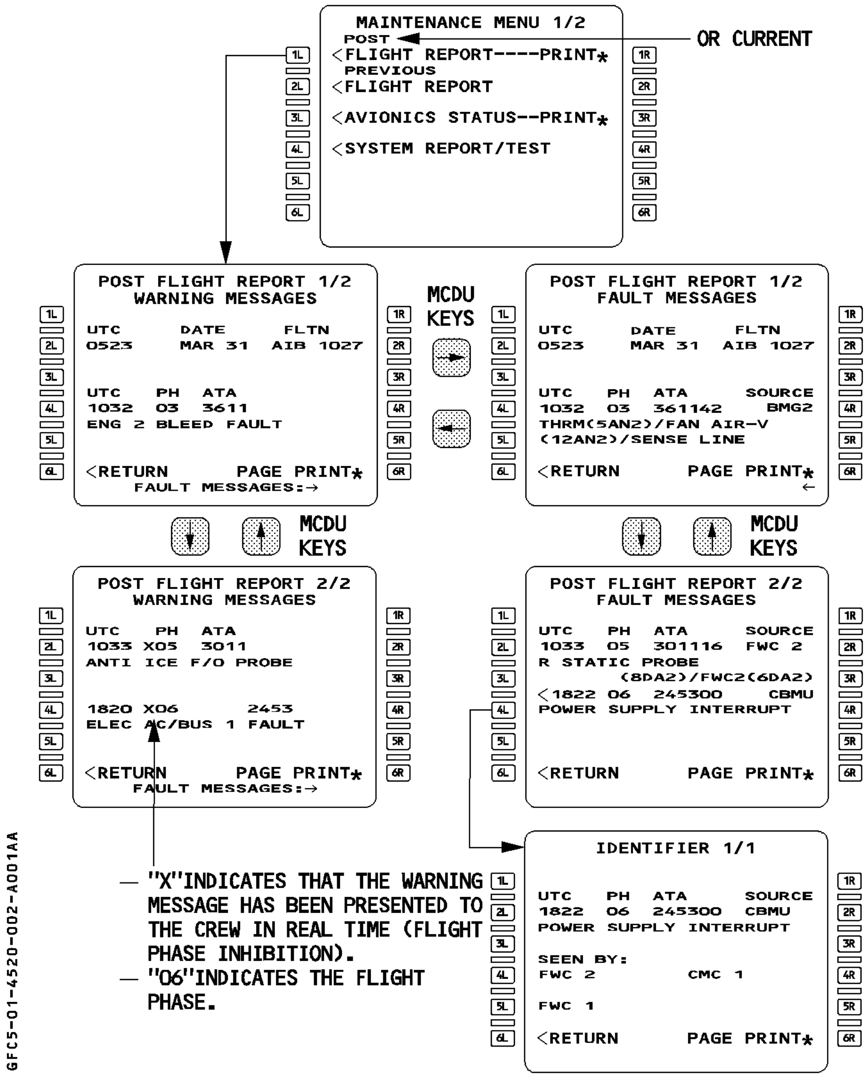




Notes :
- *On the MCDU, active systems are written in green, other systems are written in white.*
- *UTC/DATE INIT is displayed in case of cockpit clock failure or after a long power interrupt (>5 sec.)*
- *When PRINT key is pressed, the corresponding report is printed on the printer located on the pedestal.*
- *PRINT* is replaced by SEND when the → MCDU key is pressed.*

POST OR CURRENT FLIGHT REPORT

POST FLIGHT REPORT on ground or CURRENT FLIGHT REPORT in flight, presents all class 1 and 2 failures and all system failure messages received by the CMS during the last flight leg or current leg.



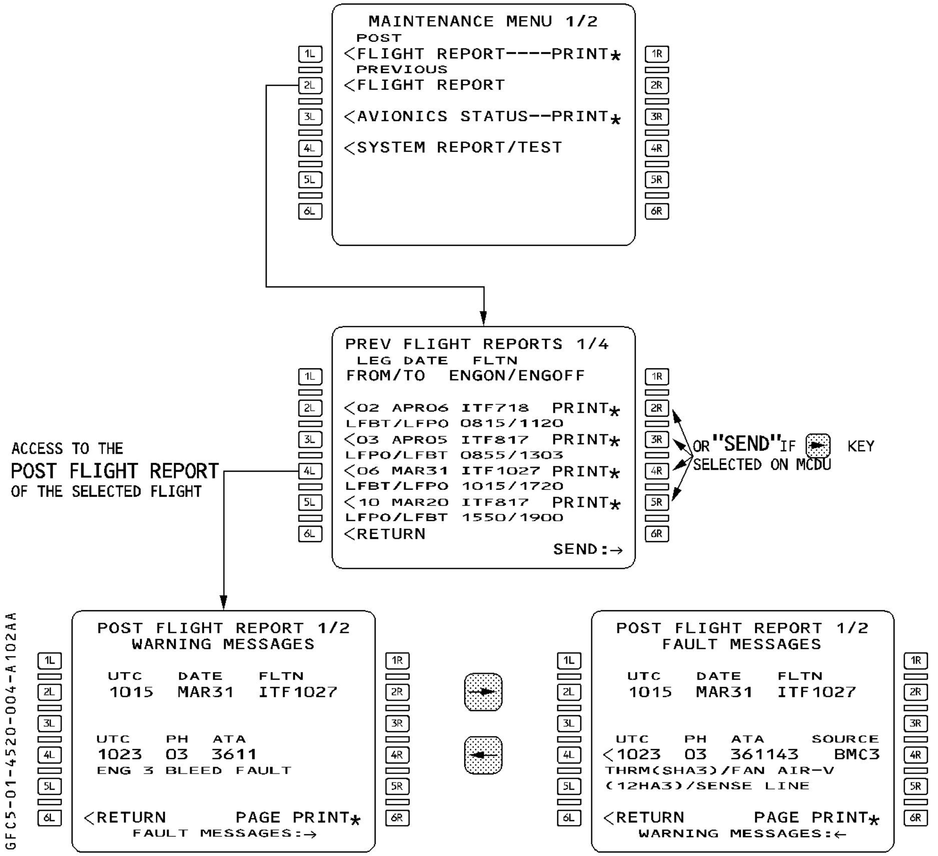
The POST or CURRENT FLIGHT REPORT is automatically printed after engine shutdown, or manually by selecting the PRINT key.
It is also automatically downlinked to the airline ground computer after engine shutdown, or manually by selecting SEND.

POST FLIGHT REPORT printout

<table>
<tr><td colspan="4">MAINTENANCE (CURRENT or) POST FLIGHT REPORT</td><td>LEG-00</td></tr>
<tr><td colspan="3">AIRCRAFT IDENTIFICATION : F-GGEA
DATE : MAR31
FLIGHT NUMBER : AIB 1027</td><td>ENGINE ON/ENGINE OFF : 1015/1720
FROM/TO : LFBO/LFBT</td><td>PRINTING
DATE : APR02
UTC : 1406</td></tr>
<tr><td colspan="2">COCKPIT EFFECTS</td><td colspan="3">FAULTS</td></tr>
<tr><td>ATA 36-11
MESSAGE DISPLAYED :
ENG 2 BLEED FAULT</td><td>UTC: 1032
FLIGHT PHASE :
TAKEOFF ROLL</td><td>ATA 36-11-42
SOURCE : BMC3
MESSAGE :
THRM (5HA3)/FAN AIR-V
(12HA3)/SENSE LINE</td><td>INTERMITTENT</td><td>CLASS 1
IDENTIFIERS :
CP1C CPC2</td></tr>
<tr><td>ATA 30-11
MESSAGE DISPLAYED :
ANTI-ICE F/O PROBE</td><td>UTC: 1033
FLIGHT PHASE :
CLIMB</td><td>ATA 36-11-16
SOURCE : PHC2
MESSAGE :
R STATIC PROBE (8DA2)/
PHC2 (6DA2)</td><td>HARD</td><td>CLASS 1
IDENTIFIERS :
ADIRU1 ADIRU2
ADIRU3</td></tr>
<tr><td>ATA 24-53
MESSAGE DISPLAYED :
ELEC AC 1.1 BUS FAULT</td><td>UTC : 1822
FLIGHT PHASE :
CRUISE</td><td>ATA 24-53-00
SOURCE : SDAC
MESSAGES :
POWER SUPPLY INTERRUPT</td><td>HARD</td><td>CLASS 1
IDENTIFIERS :
CBMU</td></tr>
<tr><td colspan="5">END OF REPORT (or CONTINUED, if more than 1 page)</td></tr>
</table>

PREVIOUS FLIGHT REPORT

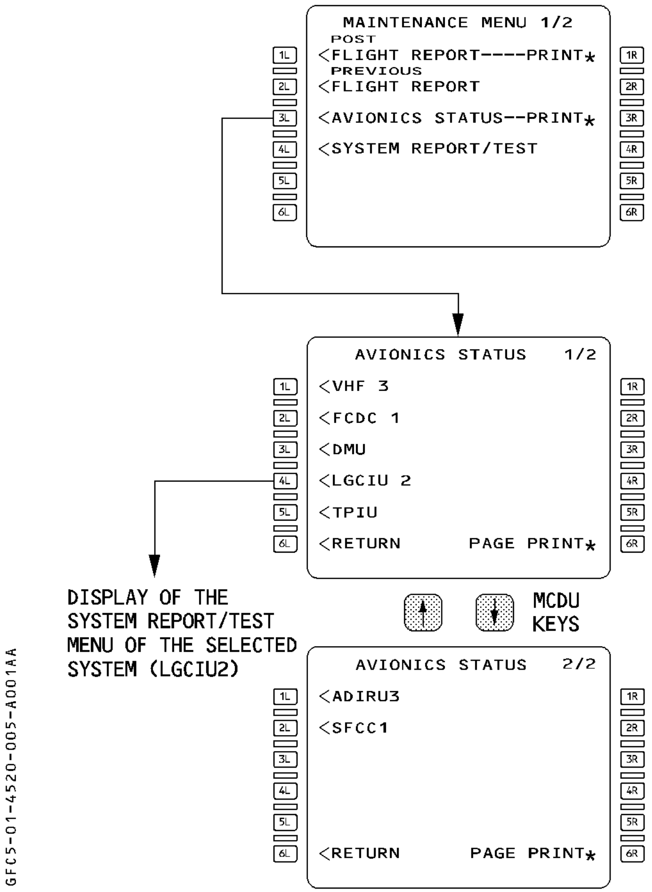
This report provides access to the POST FLIGHT REPORTS of the 63 previous flight legs.



On ground, the operator can either print a flight report or a screen copy. The format is identical to that of the POST FLIGHT REPORT. The operator can send a flight report to the airline ground computer by selecting the corresponding SEND key.

AVIONICS STATUS

R This screen displays the list of systems affected by a Class 1 or 2 failure.
R The Operator can press the button next to a system to directly call up that system page
R without going through the SYSTEM REPORT/TEST menu.
R



In flight, or on ground, the operator can either print the complete AVIONICS STATUS report, or only a copy of the screen.

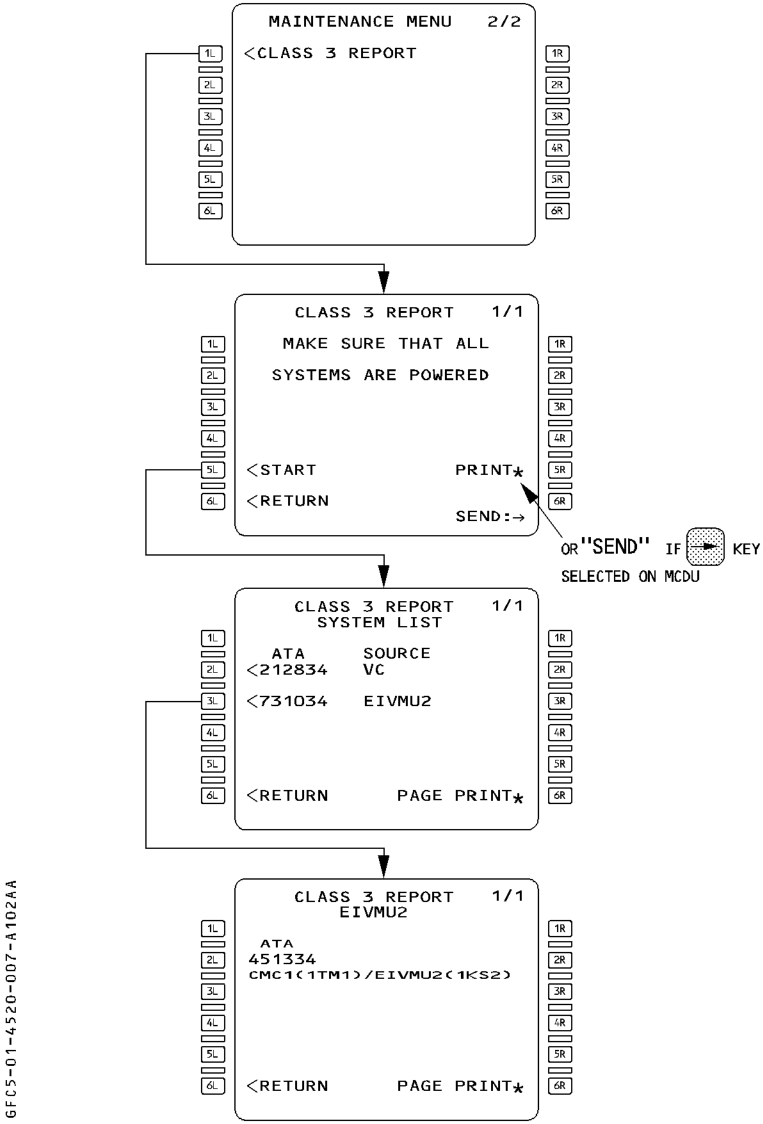
In flight or on ground, the operator can print either the complete AVIONICS STATUS report or only a screen copy.

AVIONICS STATUS print out

MAINTENANCE AVIONICS STATUS			
AIRCRAFT IDENTIFICATION : F-GGEA	PRINTING	DATE : APR10	UTC : 1830
VHF3 TPIU	FCDC1 ADIRU3	DMU SFCC1	LGCIU2
END OF REPORT (or CONTINUED, if more than 1 page)			

CLASS 3 REPORT

This report is only created on ground, upon operator request. It presents all class 3 failures detected during the last flight leg, and classifies them by ATA reference number.



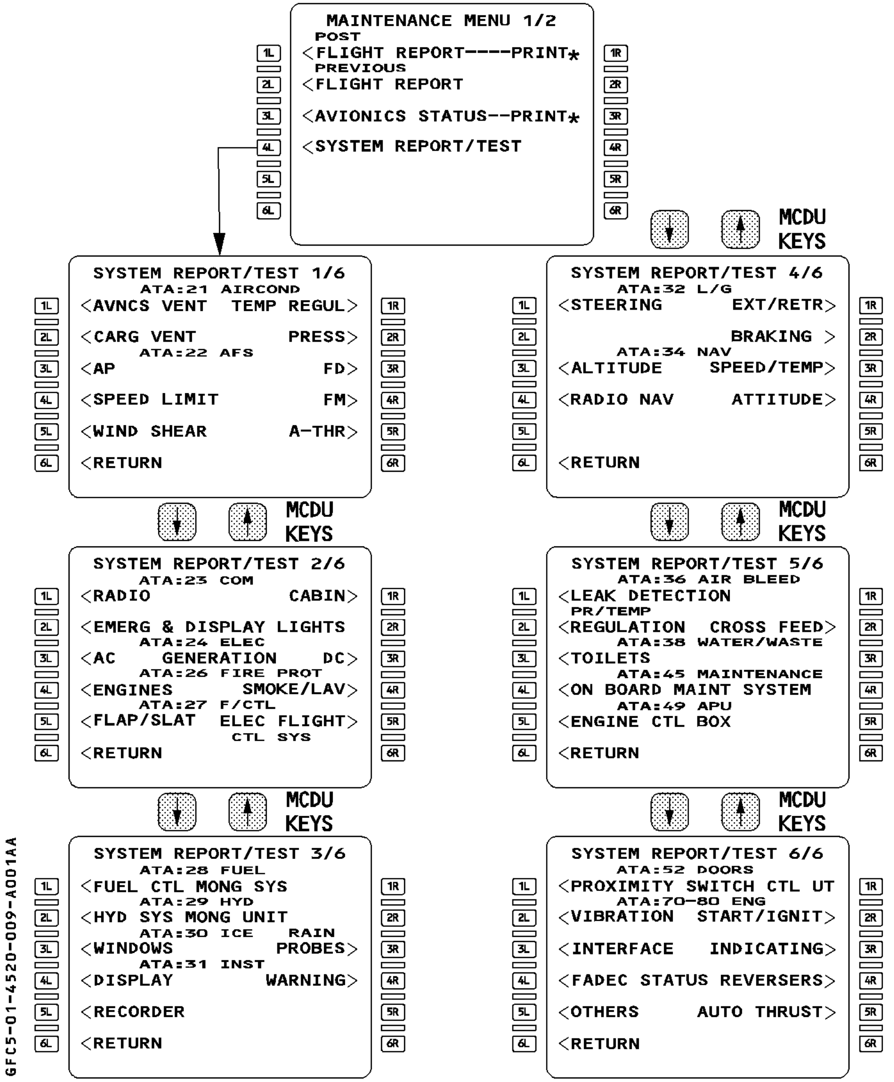
On ground, the operator can either print the complete report or a screen copy. They can also send the complete CLASS 3 REPORT to the airline ground computer.

CLASS 3 REPORT printout

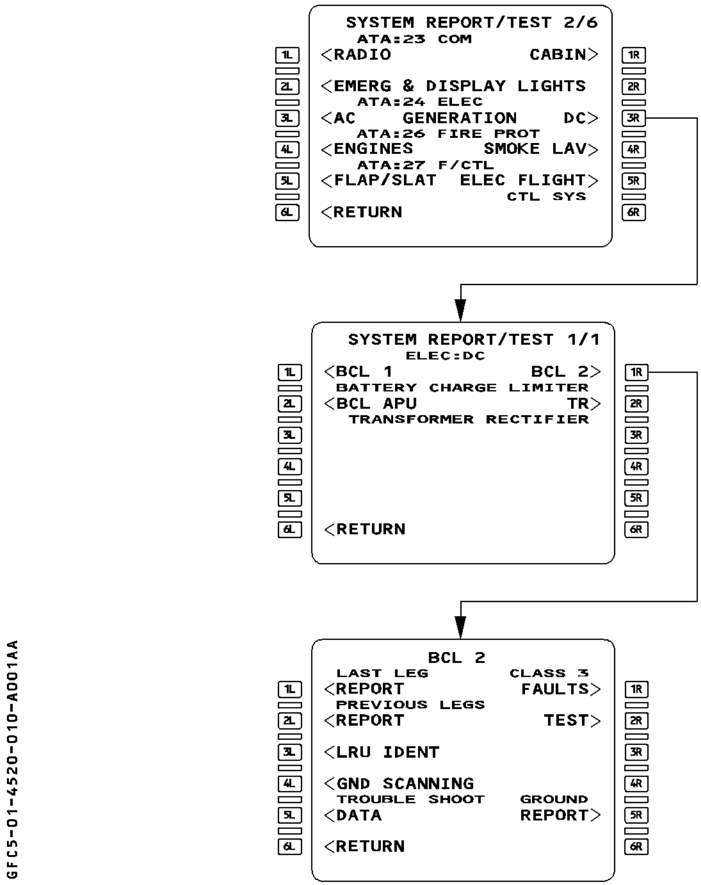
MAINTENANCE CLASS 3 REPORT			
AIRCRAFT IDENTIFICATION : F-GGEA			PRINTING DATE : APR10 UTC : 1830
SOURCE			
ATA	NAME	ATA MESSAGE :	ATA MESSAGE :
212834	VC	212830 OUTFLOW VALVE 10HL1	213020 TEMP SENSOR 23HK
		451334 CMC1(1TM1)/EIVMU3(1KS3)	
731034	EIVMU2	451334 CMC1(1TM1)/EIVMU3(1KS3)	
END OF REPORT (or CONTINUED, if more than 1 page)			

SYSTEM REPORT / TEST

It allows access to all electronic systems. After the system selection, the CMC enters into the interactive dialogue with this system.
All systems are classified by ATA chapter on six MCDU pages.



Example : access to BCL 2

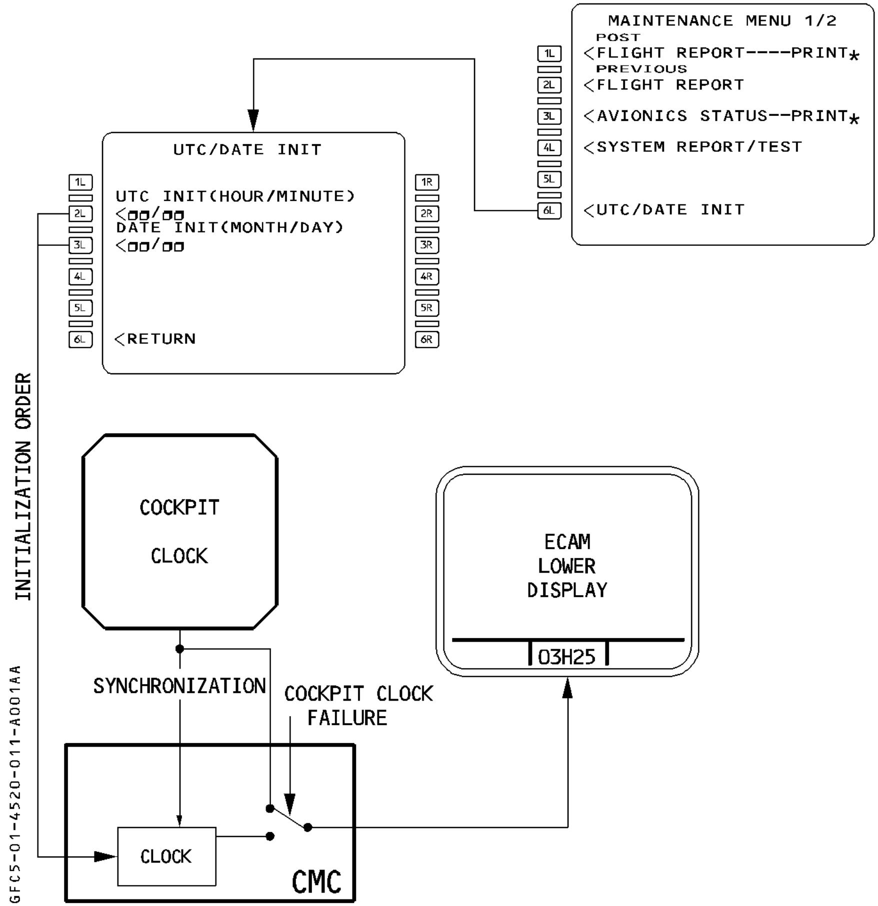


In this example, the operator has accessed to the menu of the selected systems :

- LAST or PREVIOUS LEG REPORT : presents the list of LRU affected by a failure
- LRU IDENT : contains the P / N of all LRUs of the system.
- GND SCANNING : runs the flight monitoring on ground and presents the faulty LRU
- TROUBLE SHOOT DATA : provides system internal data concerning each failure.
- CLASS 3 FAULT : presents class 3 failures detected by the system during the last flight leg.
- TEST : runs the power up test and system test (if any) and display the result.
- GROUND REPORT : presents the list of LRU affected by a failure with the aircraft on ground.

UTC / DATE INIT

The CMC transmits to the aircraft systems, and the lower ECAM displays the GMT coming
R from the main clock.
In case of a cockpit clock failure, the internal CMC clock (synchronized on the cockpit clock) takes over. If, in addition, there is a long power interruption (greater than 5 seconds), then crew action is required to initialize the GMT and DATE via the MCDU.



CMC RECONFIGURATION

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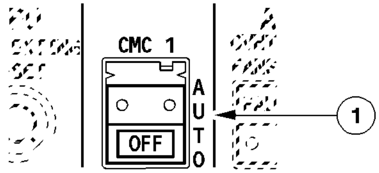

(1) CMC 1 pb sw

AUTO : CMC 1 is active while CMC 2 is in stand-by.
CMC 2 automatically takes over if CMC 1 fails.

OFF : CMC 1 selected off.
CMC 2 is active.

DESCRIPTION

With the data loading system, it is possible to either upload databases and operational software, or to download system reports from various onboard computers.
Data transfer is performed on 3.5 inch diskettes, via the aircraft fixed Multipurpose Disk Drive Unit (MDDU). The Data Loading Selector (DLS), on the overhead panel, enables the applicable aircraft system to be selected :
- The “ON/OFF” selector is used to turn the DLS ON or OFF.
- The “NEXT” and “PREV” keys are used to scroll up or down the list of applicable aircraft systems.
- “SEL CTL” is used to select or deselect the displayed system.

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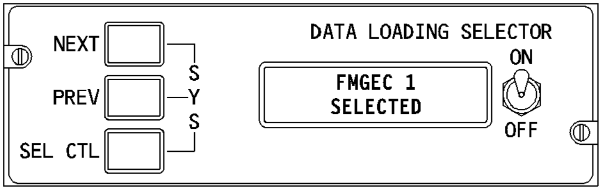


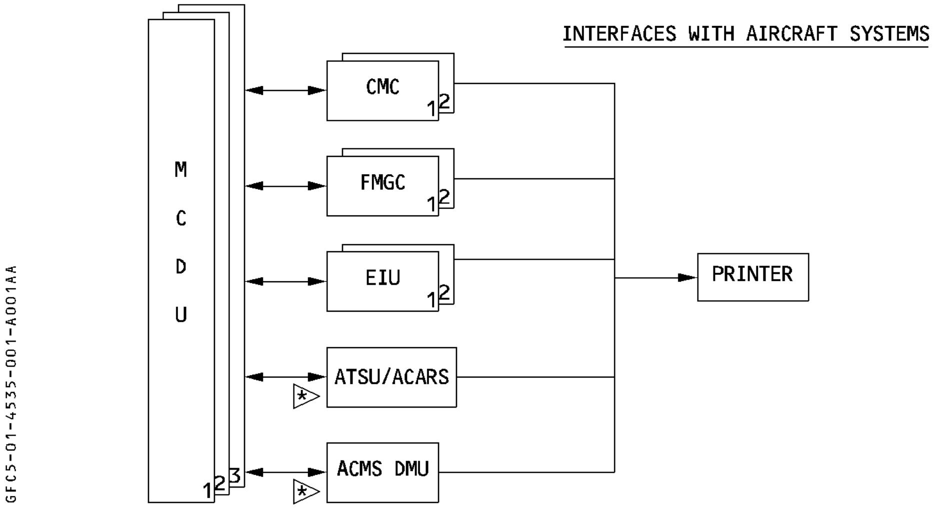
The DLS’s uploading function enables the database to be updated, or portions of the following operational software to be modified :
- FMGEC 1 and 2
- SAT COM ⊲
- HFDR 1 and 2 ⊲
- CBMU
- TCAS
- ELMU
- FDIMU
- DMC 1, 2, and 3
- BMC 1 and 2
- CMC 1 and 2
- ATSU
- EEC 1 and 2

The DLS enables the following to be downloaded :
- POST/CURRENT/PREVIOUS FLIGHT REPORT, CLASS 3 REPORT, SERVICING REPORT from CMC 1 and 2.
- ACMS DMU reports, stored in the FDIMU

DESCRIPTION

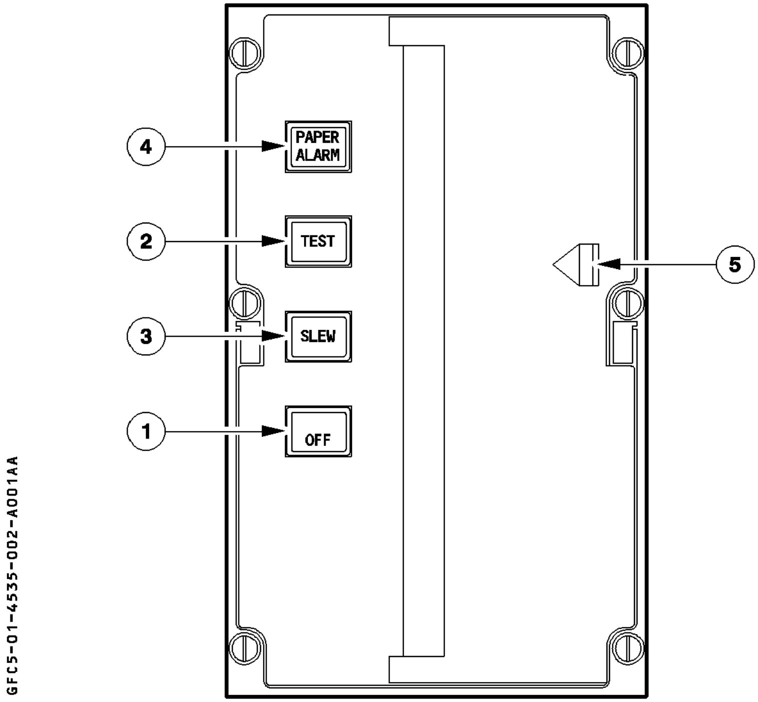
The printer is the output unit for data printing, which can be either generated manually from the MCDUs, or automatically depending on the system.
The data printouts are described in the CMC FUNCTIONS description (1.45.20), or in the related system descriptions.

R



The printer is installed at the rear of the pedestal on the F/O's side.

CONTROLS AND INDICATORS



① OFF pb sw

OFF : OFF light (amber) comes on steady, printer is off.
On : OFF light extinguishes, then after approximatly 30 seconds it illuminates for 10 seconds while power up test is performed. Then the printer is in normal operation provided :
- no indication light on front panel is illuminated
- the access door is closed
- there is paper in front of the print head.

Note : When a printer internal fault is detected the pushbutton illumination will come on steady.

(2) TEST pb

When depressed a printing of a test pattern is performed, provided the printer is not in communication with a connected system. During test the OFF light is flashing.

(3) SLEW pb sw

The SLEW pb sw is used to exit paper from the printer.

(4) PAPER ALARM pb sw

The pb sw is illuminated when there is approximatly less than 25 ft of paper available in the printer.
For testing the PAPER ALARM light the pushbutton is depressed. The illumination goes off approximatly 2 seconds after releasing the pushbutton.

Note : If SLEW and PAPER ALARM pb sw are depressed at the same time.
- *during the printout of a message, the printout is aborted. PAPER ALARM pb illuminates.*
- *while there is no printout, access door is open and paper roll outside the printer, the paper is moved rearward. This function can be used in case of a paper jam inside the printer.*

(5) PRINTER DOOR latch

The printer door latch locks the printer door. The access door is spring loaded and stays open when released. On the inner side of the door, a label gives paper loading instructions.

BUS EQUIPMENT LIST

	NORM			EMER ELEC		
	AC	DC	DC BAT	AC ESS	DC ESS	HOT
CMC 1				GND		
CMC 1 SWITCHING		DC 1				
CMC 2	AC 2					
CMC 2 SWITCHING		DC2				
DATA LOADER	AC 1					
PRINTER	AC1					

46.00 CONTENTS

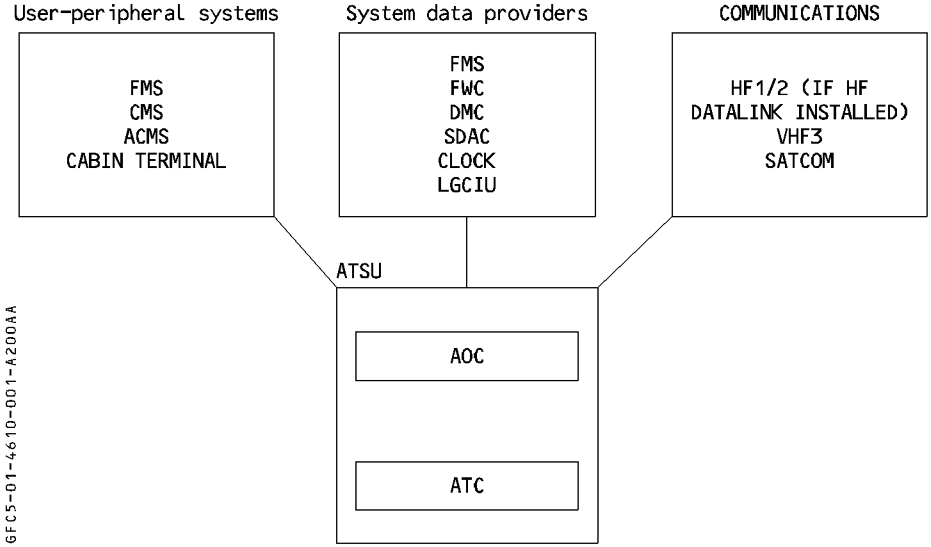
INTRODUCTION

The information system manages datalink communications and provides the crew with information coming from the airline and from the Air Traffic Control (ATC).
The information system mainly consists of an Air Traffic Service Unit (ATSU), two Datalink Control and Display Units (DCDU), located on the left and right central panels, and two illuminated "ATC MSG" pushbuttons.
The ATSU manages :
- Air-Ground communications via the appropriate communication media (SATCOM or VHF data radio or HF data radio ◁).
- The exchange of information between the aircraft and :
  - The airline, according to Airline Operational Control (AOC) applications, defined in the ATSU, or
  - Air Traffic Control.
- The information display, via the MCDU and the DCDU.
- The appropriate warning for crew information.

The ACARS functions are included in the ATSU.

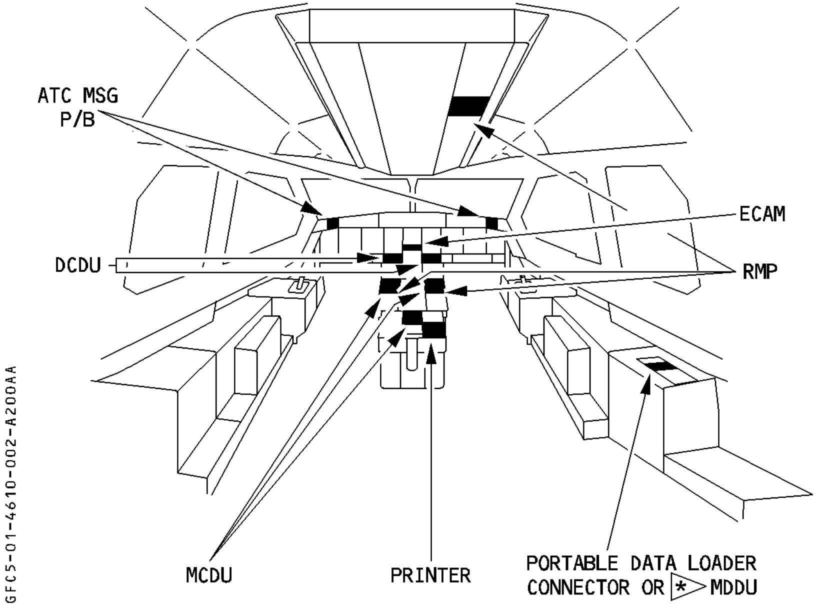
SYSTEM ARCHITECTURE

The ATSU is connected to the following systems :



The ATSU supports uplink and downlink messages.
They may be either automatically or manually handled, with or without information to the crew.

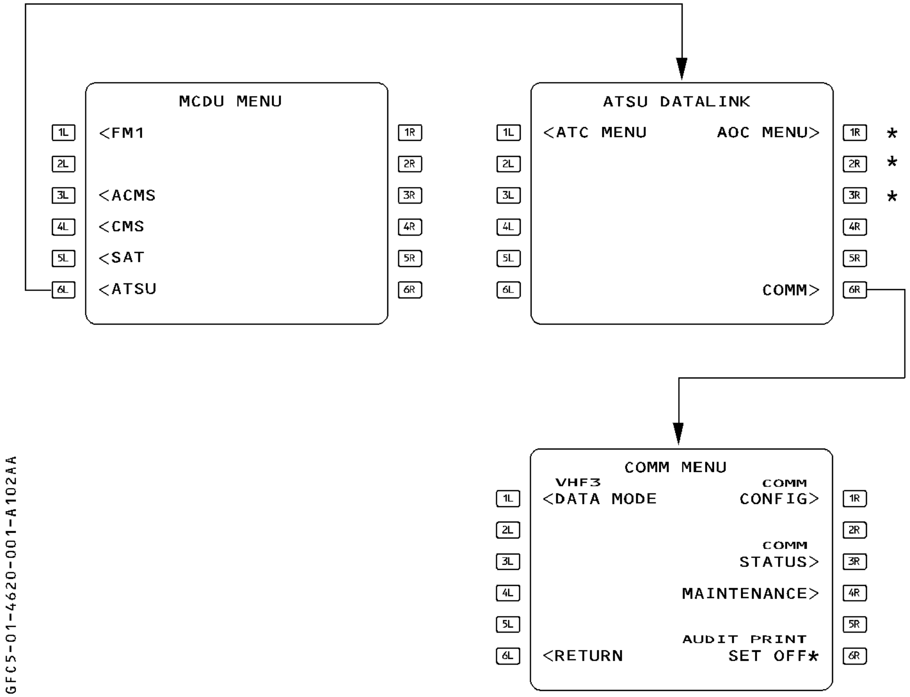
COCKPIT ARRANGEMENT



The pilot interface consists of :
- The DCDU, to display any up and downlink ATC messages.
- The “ATC MSG” pushbuttons, to alert the crew of any ATC uplink arrivals, associated with a dedicated chime.
- The MCDU, to handle the AOC and ATC functions and data transfer with the DCDU.
- The PRINTER, to print any type of messages.
- The ECAM, for operational information.
- The RMP, to allow frequencies’ tuning.

INTRODUCTION

The ATSU Communication Function manages aircraft to ground communications. This is achieved :
– Automatically, without pilot action, or
– Manually, using the MCDU pages and/or RMP.
The pilot controls communications from the MCDU's COMM MENU page.



* These fields are customized according to the airline's AOC programming.

DOWNLINK AND UPLINK MESSAGES

DOWNLINK MESSAGES

Aircraft to ground messages (downlink) include : Maintenance, monitoring, operational, performance and cabin data, and later ATC messages. A report that is generated by a peripheral system (CMS, ACMS, FMS, CABIN TERMINAL) can be automatically-downlinked by ATSU, depending on the airline's AOC programming.

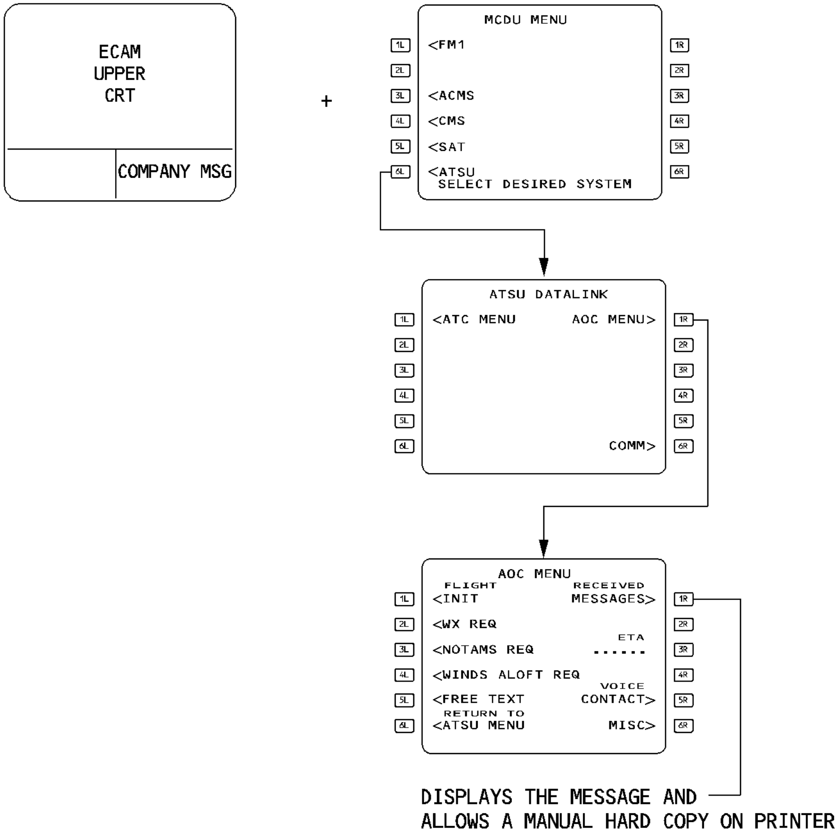
UPLINK MESSAGES

Ground to aircraft messages (uplink) contain either crew information (wind, for example), or data to be uploaded into the FMS (Flight plan, for example). Uplinks can also include requests for the transmission of specific downlink reports.
Messages are indicated (this does not include ATC messages) to the crew by a :
- "COMPANY MSG" memo, in green on the ECAM memo, or
- "COMPANY ALERT" memo, pulsing in green on the ECAM memo, or
- "COMPANY CALL" memo, in green on the ECAM memo, or
- MCDU MENU light comes on, if the MCDU is not in the mode where the uplink message can be displayed, or
- Hardcopy on the cockpit printer, depending on the airline's AOC programming.

Note : 1. *A steady green "DATALINK STBY" memo is displayed in case of communications loss between aircraft and ground.*
2. *The way to access to those COMPANY CALL messages is not presented, since they are accessed via the AOC MENU page, which is customized according to the airline's AOC programming.*

Depending on the memo displayed on ECAM the uplink message indications are available as in the following examples :

– For a "COMPANY MSG" or a "COMPANY ALERT" ECAM memo :



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On the AOC MENU page, pressing the [1R] key displays the received message and clears the ECAM memo.

Note : AOC MENU page is customized according to the AOC programming.

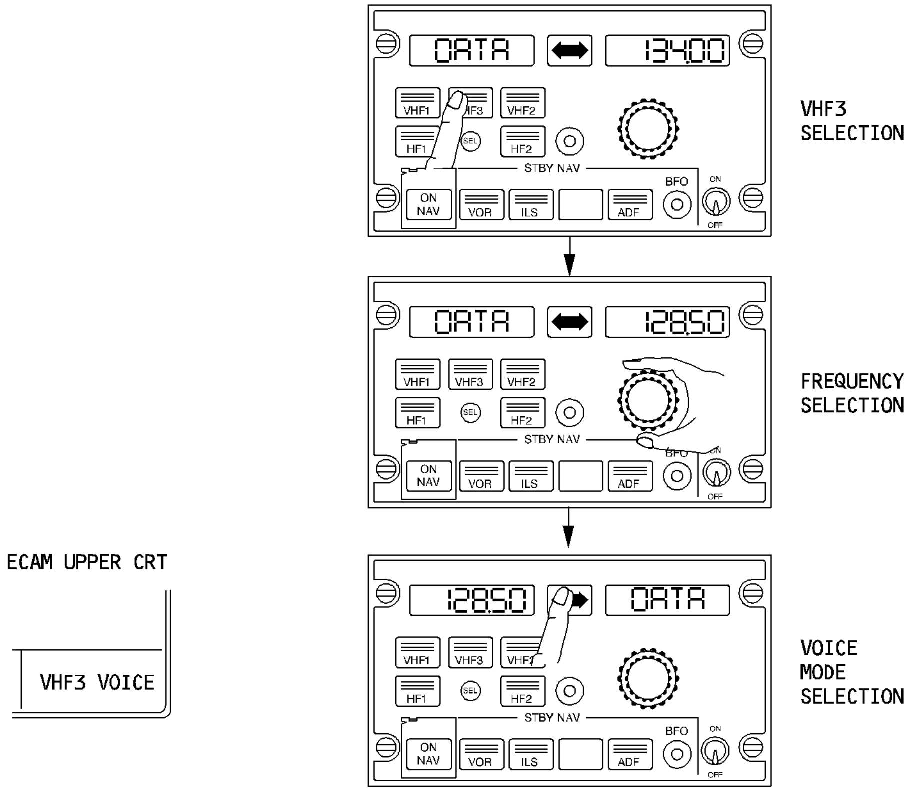
LEFT INTENTIONALLY BLANK

DATALINK/VOICE TRANSFER ON VHF3

VHF 3 can be used in voice mode, in case of a :
- VHF 1 or VHF 2 failure, or
- COMPANY CALL.

The green “COMPANY CALL” memo indicates that a request for voice contact was received from the ground.
The green “VHF 3 VOICE” memo indicates that the VHF 3 tranceiver operates in voice mode. Therefore, datalink communication is interrupted.
The voice frequency may be tuned by the crew, via the RMP. The DATALINK/VOICE transfer can be done from any of the RMPs.

DATALINK/VOICE Transfer from an RMP



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DATALINK mode resumes, when the transfer key on the RMP is pressed again.

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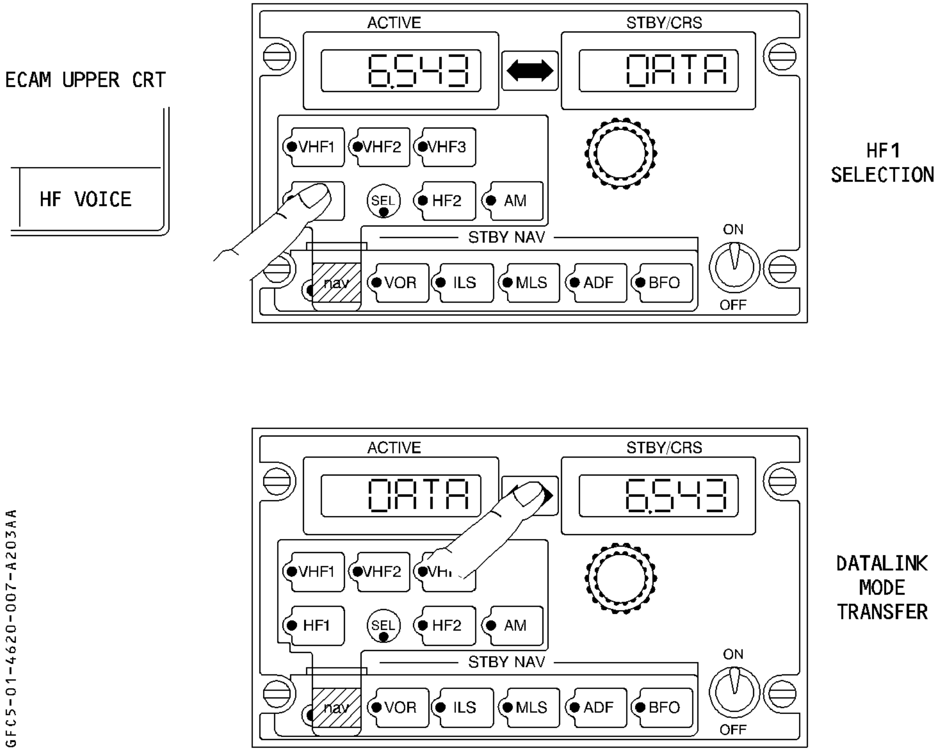
DATALINK/VOICE TRANSFER ON HF1

HF1 can also be used in data mode. It is an alternative to VHF3 and SATCOM.
Datalink HF-frequency tuning is managed automatically.
The green “HF VOICE” memo indicates that the HF transceiver operates in voice mode.
Therefore, datalink communication is interrupted.
The DATALINK/VOICE transfer can be done from any of the RMPs.

DATALINK/VOICE Transfer from an RMP :



Voice mode resumes, when the transfer key on the RMP is pressed again.

SCRATCHPAD MESSAGES ON THE COMM MENU

MESSAGE	COLOR	CONDITIONS
NOT ALLOWED	W	It is not allowed to press this key.
ENTER A/C REGISTR	A	The aircraft registration number is not valid. To enter this parameter, refer to 3.04.46.
PRINT FAILED	W	A print command was unsuccessful.
FORMAT ERROR	W	The message was entered in an inappropriate format.
VHF3 SWITCH IMPOSSIBLE	A	It is not possible to switch from VHF 3 voice mode to VHF 3 data mode.
DEFAULT VHF SP LIST *	A	The new SCAN MASK is unavailable. The system displays the default SCAN MASK instead.
SYSTEM BUSY - TRY LATER	W	The system is busy. The command, selected by the crew, cannot currently be performed.
COMMAND NOT AVAIL	W	The command is unavailable.
VHF3 CAN BE SET IN VOICE	A	VHF 3 datalink communications are lost. However, VHF 3 can be used in voice mode.
ENTER VHF3 SCAN SELECT *	A	No service provider has been selected.
ENTER ACARS A/L ID	A	The airline identification number is not valid. To enter this parameter, refer to 3.04.46.
PRT MSG PRINT FAIL	W	Automatic print of an AOC uplink message was unsuccessful.
ENTER A/C ICAO CODE	W	The aircraft ICAO code is not valid. To enter the A/C ICAO code, refer to 3.04.46.

* Depending on airline customization, access to the SCAN SELECT menu may not be possible. If it is not, the DEFAULT VHF SP LIST and ENTER VHF3 SCAN SELECT scratchpad messages are not applicable.

INTRODUCTION

Two kinds of Airline Operational Control (AOC) applications are provided :
- Remote AOC applications embedded in systems peripheral to ATSU (ACMS, CMS, FMS, CABIN TERMINAL)
- Hosted AOC applications uploaded into the ATSU.

Due to the highly customized aspect of the hosted AOC applications, only the remote AOC applications are described in this chapter.

REMOTE APPLICATIONS

The remote AOC applications are accessible by pressing the related system key on the MCDU MENU page.

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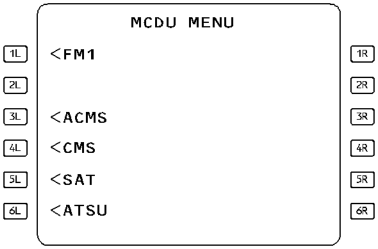

Message/reports are processed by the AOC peripherals (FMS, ACMS, CMS) ; the ATSU communication function only routes the request according to the company routing policy.

FLIGHT MANAGEMENT SYSTEM (FMS) (Refer to 1.22.45)

Through the FMS interface it is possible to access the following data :
- Wind data (F-PLN page)
- Takeoff data (uplink only)
- F-PLN initialization (uplink only)
- Pre-flight, post-flight report and ACARS print/program (downlink only)

See FMGS PILOT GUIDE (Refer to 4.04.50)

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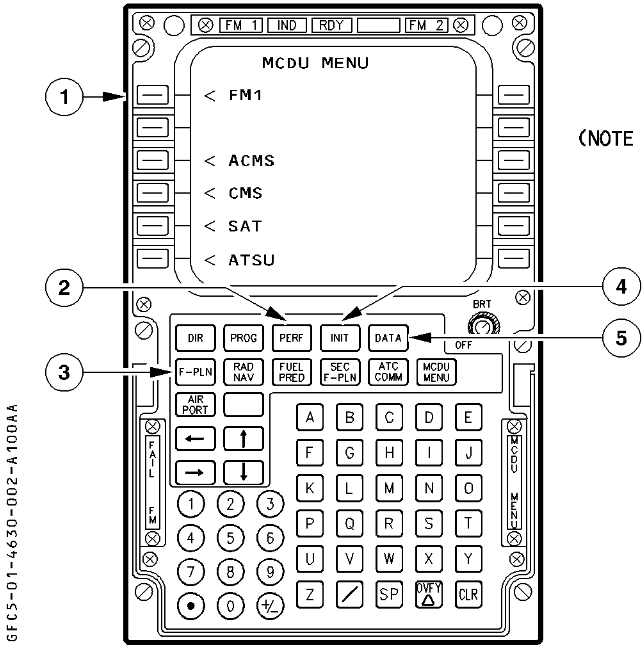


(NOTE : DEPENDING ON OPTIONS, MCDU FRONT FACE MAY SLIGHTLY DIFFER)

(1) Pressing this key selects the related system, then

(2) Pressing this key gives access to takeoff data (Uplink only)

(3) Pressing this key gives access to wind data (F-PLN page)

(4) Pressing this key gives access to the F-PLN initialization and wind data (Uplink only)

(5) Pressing this key gives access to the Pre-flight and Post-flight reports, and the ACARS print/program (downlink only).
For additional details on its operation, refer to the FMGS PILOT GUIDE (4.04.50).

Central Maintenance System (CMS) (refer to 1.45.20)

Through the CMS interface it is possible to downlink the following data :
- Post flight report (on the ground) or current flight report (in flight) which includes :
  - All failure messages detected by the BITEs
  - The warnings displayed to the crew during the last or current flight leg.

  Report can be downlinked upon crew action or upon ground request or automatically.
- Previous Flight Report (on the ground)
- Individual system BITE data (manual downlink only) (on the ground).
- Real-time failure and warning messages (in flight).
- Class 3 report (on the ground) containing all class 3 failures detected during the last flight leg. The report can be downlinked upon crew action or automatically.

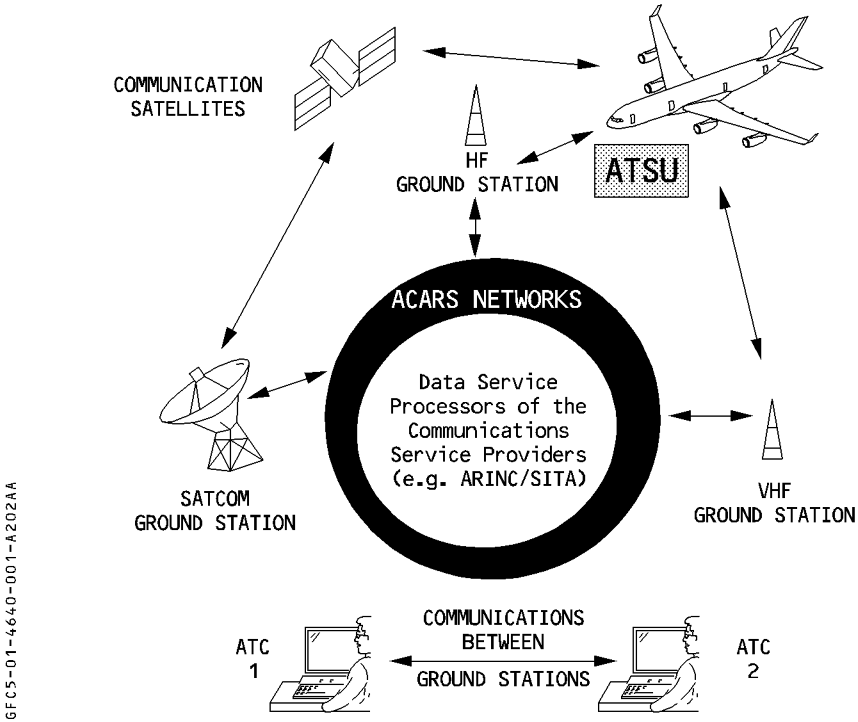
Aircraft Condition Monitoring System (ACMS)

The ACMS interface provides ATSU with the data for the following applications :
- Aircraft Performance Monitoring (APM),
- Engine Condition Monitoring (ECM),
- APU Health Monitoring (AHM).

Any of the ACMS DMU reports can be downlinked (through ATSU) :
- Manually on the ground or in flight
- Automatically in real-time,
- Upon ground request or upon automatic request from the ATSU.

INTRODUCTION

The global Communications Navigation Surveillance/Air Traffic Management (CNS/ATM) system is made up of the C (Communications), N (Navigation) and S (Surveillance) tools, developed to provide efficient Air Traffic Management methods.
Such methods include the introduction of datalink communication between pilots and controllers. This is considered to be the primary means of communication over oceans and in remote areas.
The current CNS/ATM system uses ACARS networks : These networks are mainly ARINC, and SITA (see the ACARS Chapter for world coverage). The related data communications are managed by the Air Traffic System Unit (ATSU), and can be supported by the SATCOM, the VHF or the HF.



The CNS/ATM system includes the following functions :
- The ATS Facilities Notification (AFN)
- The Controller Pilot Data Link Communications (CPDLC)
- The Automatic Dependent Surveillance (ADS).

ATS FACILITIES NOTIFICATION (AFN)

ATS Facilities Notification (AFN) is necessary in order to inform the ATC that the aircraft is capable of datalink communications, and to exchange address information. It is initiated by the pilot (See the NOTIFICATION Procedure in 3.04.46).

CONTROLLER PILOT DATA LINK COMMUNICATIONS (CPLDC)

CPLDC involves the exchange of preformatted or free text messages.
All ATC messages, either coming from the ATC center (uplink) or to be sent to the ATC center (downlink), transit through the DCDU.

UPLINK MESSAGES (FROM THE ATC TO THE CREW)

The following message categories can be uplinked :
1. Clearances (immediate or deferred, speed, heading, altitude, offset, direct to, route clearance or constraint etc...)
2. Report requests (confirm, position reports...)
3. Negotiation requests (ex : Can you accept ... ?)
4. Information messages.

Upon message reception, the ATSU triggers the ATC chime and the flashing blue "ATC MSG" pushbutton light on the glare shield.
For normal messages, the aural signal is repeated every 15 seconds (with the first signal delayed by 15 seconds). For urgent messages, the aural signal is triggered without any delay and is repeated every 5 seconds.
If the screen is empty, the message appears on the DCDU. If not, a flashing "MSG 1/2" cue is displayed.
The pilot can display the message by using the MSG + pushbutton.

Note : Urgent messages are displayed, regardless of the state of the screen.

Push one of the two "ATC MSG" pushbuttons to stop the alert. The alert can also be stopped, when the pilot performs any action regarding the latter uplink message displayed on the DCDU.

To answer the message :

- Manually prepare the message by selecting the appropriate function key (WILCO, ROGER, AFFIRM, NEGATIVE...), or automatically prepare the message via the FMGS.
- Send the message to the ground by using the SEND key.

Once the message is sent, the screen should be cleared by pressing the CLOSE key.

The RECALL function key can be used to display the last closed message.

Other messages can be reviewed from the MCDU MSG RECORD page.

To allow some delay in answering, the pilot may answer STBY. In this case, the message cannot be removed until the final answer is sent, within an expected short period of time (around 10 minutes).

The FMGS monitors most of the deferred clearances and automatically recalls messages, when applicable. This is indicated by the "MONITORING" signal on the lower part of the DCDU, which comes on in white.

Route clearances and time constraints, received on the ATSU, can be loaded into the FMGS (SEC F-PLN) by using the LOAD key on the DCDU. The result of the loading (e.g. LOAD OK or LOAD PARTIAL) is displayed on the DCDU. Report requests are sent to the FMGS, which monitors the related parameters (e.g. report passing...). In this case, and when applicable, the FMGS automatically proposes an answer (i.e. : when passing the waypoint at which the report is requested).

DOWNLINK MESSAGES (FROM THE CREW TO THE ATC)

All downlink messages must be displayed on the DCDU prior to being sent. This allows the crew to visualize the exact message (concatenated) that will be displayed on the controller screen.

The following message categories can be downlinked :

1. Answers to ATC messages by using the DCDU function keys (WILCO, UNABLE, AFFIRM...).
2. Clearance requests (vertical, lateral, speed).
3. Reports (reports when a specific condition is met, position reports upon ATC request or at waypoint sequencing, immediate confirm).
4. Negotiation requests (When can we expect ...?)
5. Emergency messages (PAN PAN PAN, MAYDAY MAYDAY MAYDAY)
6. Additional messages.

All messages, not in direct response to an ATC uplink message, are prepared on the MCDU prior to appearing on the DCDU for review before sending.

Clearance requests are prepared on the MCDU ATC MENU page (prompts VERT REQ. LAT REQ and OTHER REQ). Then, they are displayed on the DCDU using the MCDU's REQ DISPL prompt.

Most report messages are automatically proposed by the FMGS on the DCDU.

They can be modified, if required, using the MODIFY key which calls for the MCDU's MESSAGE MODIFY or POSITION REPORT page. The MODIFY key also enables the updating of FMGS parameters on the DCDU.

The crew may prepare emergency messages on the MCDU by using the EMERGENCY page.

These messages are then sent to the DCDU by using the EMERG DISPL prompt on the MCDU.

The crew must then send the DCDU-displayed messages by using the SEND key.

The message may be removed from the screen by using the CLOSE key.

AUTOMATIC DEPENDENT SURVEILLANCE (ADS)

There are three states of the Automatic Dependent Surveillance (ADS) function : “ARMED”, “CONNECTED” or “OFF”. They can be checked on the CONNECTION STATUS page.
The ADS function is normally armed. As long as the ADS is armed, up to 5 ATC/AOC centers can connect themselves. Connection is at the ATC’s discretion, and some centers do not use this function.
As soon as one ADS center is connected, the ADS status changes from “ARMED” to “CONNECTED”.
The ATSU sends surveillance data to the connected ATC centers. The ATC defines the content and frequency of the reports sent by the ATSU, in order to satisfy operational needs. This activity is automatic and transparent to the crew.
However, the crew can disconnect from the connected ATC/AOC centers on the ADS DETAIL page, via the CONNECTION STATUS page.
The ADS function can be set to off on the CONNECTION STATUS page.

GLARESHIELD

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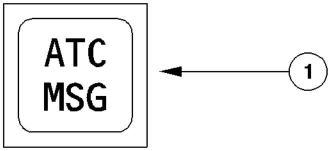
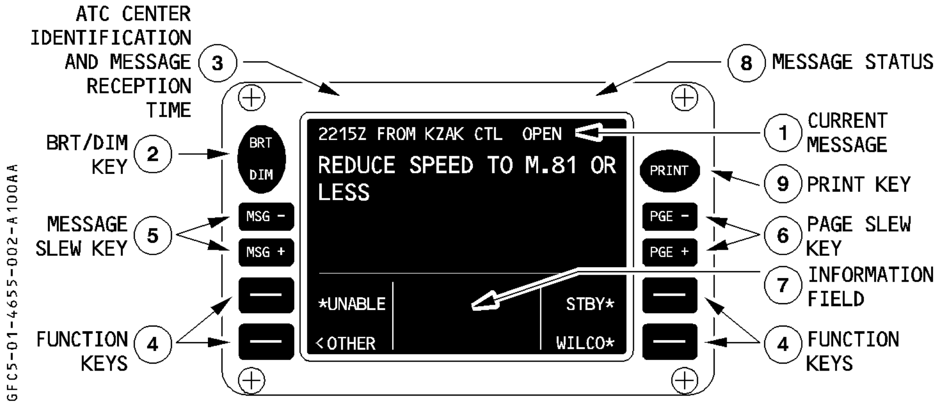


1 ATC MSG pushbutton

It flashes in blue, when a message, associated to an aural alert, is received.
Press : To stop the aural alert and the flashing light.

DATA COMMUNICATION DISPLAY UNITS (DCDU)



(1) Current Message Indication

Displays uplink and downlink messages.
Uplink messages :
- Are displayed on a black blackground.
- When received, the message appears in white and the main parameters in blue.
- When answered, the message becomes green.
- When monitored, the parameters appear in magenta and indicate that they are being monitored by the FMGS.
- When the value is attained, the parameters become green.
- When monitoring fails, the parameters become amber.

Downlink messages :
- Are displayed in black, on a colored background.
- Before sending, the background is blue.
- When sent, the background becomes green.

(2) BRT/DIM key

Adjusts the brightness of the DCDU.

(3) ATC Center Identification and Message Reception Time

- Identifies the ATC Center
- Indicates the time at which the DCDU receives the message from the ATC or the FMGS.

(4) Function Keys

The function keys are only operative, if a star or a prompt is visible.
Depending on the nature of the message, the system automatically proposes an appropriate function (Example : WILCO, or AFFIRM, or ROGER).

1. WILCO : To accept an ATC clearance.
2. ROGER : To confirm reception, and understanding of an ATC information or report request.
3. UNABLE : To reject an ATC clearance.
4. AFFIRM : To answer “yes” to an ATC question.
5. NEGAV : To answer “no” to an ATC question.
6. STBY : To inform the ATC that you need to delay the answer.
7. MODIFY : To access the MESSAGE MODIFY or POSITION REPORT page on the MCDU, in order to modify a message proposed by the FMGS. Also used to update the parameters that the FMGS provides to the DCDU.
8. CANCEL : To remove a prepared downlink message from the DCDU, or to cancel a selected reply to an uplink message.
9. SEND : To send a message or an answer, that was prepared by using the other function keys (Example: WILCO, ROGER, AFFIRMATIVE, STBY...).
10. CLOSE : To erase a message (from the screen) which has been sent to the ATC, or to erase a message from the ATC which has been answered, and send it to the MSG RECORD. This is not applicable when the answer is on STBY.
11. RECALL : To recall the last message that was removed from the screen, using the CLOSE function.
12. LOAD : To load a flight plan from the ATC, or a parameter time constraint, into the secondary flight plan.
13. CANNOT : Negative answer to an OPEN negotiation message from the ATC.
14. ANSWER : To split a message, including several questions, into different messages.
15. OTHER : To display the other functions that could be applicable to the current message, but are not currently displayed.

5 Message Slew Key

To scroll from one message to another.

6 Page Slew Key

To scroll through the different pages of a message.

7 Information Field

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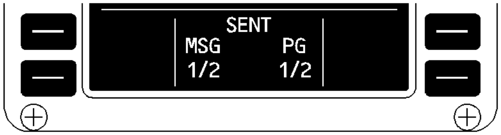


MSG 1/2
– Displayed, when several messages are available on the MCDU.
– Flashes, when a new message is received.

PG 1/2
– Displayed, when the current message contains several pages.

(7) Information Field (Cont'd)

Miscellaneous Information

SENDING (white) : The current message is being sent.
SENT (white) : The current message was sent.
MONITORING (white) : The FMGS is monitoring the parameter of the current message.
MONIT FAILED (amber) : FMGS monitoring was requested as failed.
MONIT LOST (amber) : FMGS monitoring is lost.
MONIT UNAVAIL (amber) : FMGS monitoring is not possible.
MONIT CNCLD (white) : FMGS monitoring is cancelled.
LOADING (white) : The flight plan, or time constraint, contained in the current message is being loaded in the secondary flight plan of the FMGS.
LOAD OK (white) : The loading of the flight plan, contained in the current message, was successful.
LOAD PARTIAL (amber) : The loading of the flight plan, contained in the current message, was only partially done.
LOAD FAILED (amber) : The loading of the flight plan, contained in the current message, has failed.
LOAD UNAVAIL (amber) : Loading is not possible.
REMINDER (white) : The current message was automatically recalled by the FMGS.
LINK LOST (amber) : Communication with the ATC is unavailable (displayed on any message pending when the loss occured).
COM NOT AVAIL (amber) : Communication means temporarily unavailable.
SEND FAILED (amber) : Transmission of a request or a reply to an uplink message are unsuccessful.
NO ATC REPLY (amber) : No answer received within 5 minutes.
WAIT FM DATA (white) : The FMGS is preparing an answer to the ATC's request for navigation parameters.
NO FM DATA (white) : The FMGS is unable to provide the ATC-requested parameters.
PRINTING (white) : Printing was requested from the DCDUs and printing is in progress.
PRINT FAILED (amber) : Printing was requested from the DCDUs and printing failed.
PRINTING UNAVAIL (white) : Printing was requested from the DCDUs, but the printer is unavailable.
NO MORE MSG (white) : Follows pressing of the "MSG + " or "MSG -" key, when no more messages are accessible.
NO MORE PGE (white) : Follows pressing of the "PGE+" or "PGE-" key, when no more pages are accessible.
RECALL MODE (white) : Recalls the last stored message.
ANSWER MSG (amber) : Maximum number of pending uplink messages is reached.
FILE FULL (amber) : Maximum number of downlink messages, accessible on the DCDUs, is reached.
OVERFLW STORED (white) : Maximum number of non-pending messages is reached, and a new non-pending message is registered in the file.
MCDU FOR TEXT (white) : Initiation of a negative answer for a pending uplink message.
MCDU FOR EDIT (white) : Follows pressing of the "MODIFY" key.

8 Message status

OPEN	BLUE FONTS ON A BLACK BACKGROUND: THE CURRENT UPLINKED MESSAGE HAS NOT BEEN ANSWERED, OR THE CURRENT DOWNLINK MESSAGE HAS NOT BEEN SENT.
WILCO ROGER UNABLE STBY NEGATV AFFIRM CANNOT	BLACK FONTS ON A BLUE BACKGROUND: THE CREW HAS ANSWERED THE UPLINKED MESSAGE, BUT THE ANSWER HAS NOT BEEN SENT. BLACK FONTS ON A GREEN BACKGROUND: THE ANSWER HAS BEEN SENT.
OPEN ABORT	AMBER FONTS ON A BLACK BACKGROUND: TRANSMISSION FAILURE.

GFC5-01-4655-006-A102AA

9 Print key

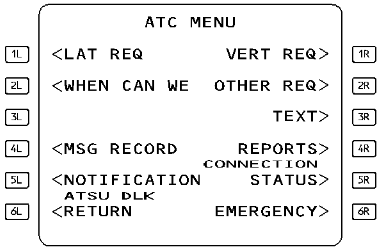
To print the current message.

MULTIPURPOSE CONTROL AND DISPLAY UNIT (MCDU)

ATC MENU PAGE

To call up the ATC MENU page, press the ATC prompt on the ATSU DATALINK page, or the ATC COMM key on the MCDU keyboard. The ATC MENU page is used to access the different functions for the ATC applications : Controller Pilot Data Link Communication (CPDLC) and Automatic Dependant Surveillance (ADS).

GFC5-01-4655-007-A102AA

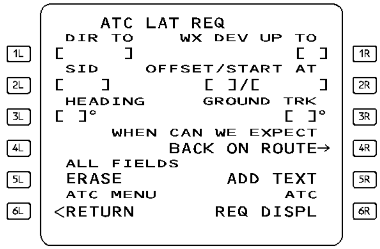


[1L] LAT REQ	To call up the ATC LAT REQ page
[2L] WHEN CAN WE	To call up the WHEN CAN WE EXPECT page
[4L] MSG RECORD	To call up the MSG RECORD page
[5L] NOTIFICATION	To call up the NOTIFICATION page
[6L] ATSU DLK RETURN	To call up the ATSU DATALINK page
[1R] VERT REQ	To call up the ATC VERT REQ page
[2R] OTHER REQ	To call up the ATC OTHER REQ page
[3R] TEXT	To call up the TEXT page
[4R] REPORTS	To call up the ATC REPORTS page
[5R] CONNECTION STATUS	To call up the CONNECTION STATUS page
[6R] EMERGENCY	To call up the EMERGENCY page

ATC LAT REQ PAGE

To prepare messages that request a lateral flight plan modification, which are sent to the ATC.

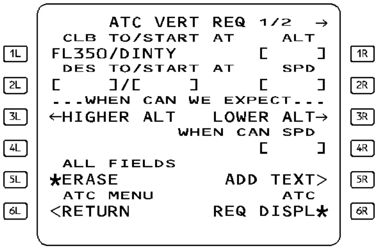
GFC5-01-4655-D08-A102AA



[1L] DIR TO	To prepare a request to go from the present position to a selected waypoint.
[2L] SID or STAR	To enter a request for a departure or arrival procedure, depending on the current flight phase. The departure procedure can only be proposed before takeoff. The arrival procedure can only be proposed after takeoff.
[3L] HEADING	To prepare a heading change request.
[5L] ALL FIELDS ERASE	To erase all the data that was entered on the page, and erase the data that was entered on the other associated pages.
[6L] ATC MENU RETURN	To call up the ATC MENU page.
[1R] WX DEV UP TO	To prepare a request for an offset from the initial route, due to weather conditions.
[2R] OFFSET/START AT	To enter an offset from the initial route. The “START AT” field is optional, and can either be filled in with a position or a time.
[3R] GROUND TRK	To prepare a track change request.
[4R] WHEN CAN WE EXPECT BACK ON ROUTE	To prepare a negotiation request to return to the initial route. The same request can be performed on the WHEN CAN WE EXPECT page ([4R] key).
[5R] ADD TEXT	To call up the TEXT page. It is active while a message is being created.
[6R] ATC REQ DISPL	To display the prepared message on the DCDU screen.

ATC VERT REQ PAGE 1

To prepare messages that request a vertical flight plan modification, which are sent to the ATC.



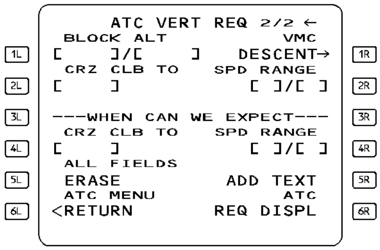
GFC5-01-4655-D09-A102AA

[1L] CLB TO/START AT	To prepare a request to climb to a new altitude. The "START AT" field is optional and can either be filled in, with a position or a time. If the request is deferred, the "START AT" field should be filled in with the starting-climb waypoint.
[2L] DES TO/START AT	To prepare a request to descend to a new altitude. If the request is deferred, the "START AT" field should be filled in with the starting-descent waypoint.
[3L] WHEN CAN WE EXPECT HIGHER ALT	To prepare a negotiation request to climb to a higher altitude. If a lower altitude has already been selected, setting a higher altitude deselects the lower altitude. The same request can be performed on the WHEN CAN WE EXPECT page ([4R] key).
[5L] ALL FIELDS ERASE	To erase all the data that was entered on the page, and erase the data that was entered on the other associated pages.
[6L] ATC MENU RETURN	To call up the ATC MENU page.
[1R] ALT	To prepare a request for a new altitude.
[2R] SPD	To prepare a request for a new speed.

[3R] WHEN CAN WE EXPECT LOWER ALT	To prepare a negotiation request to descend to a lower altitude. If a higher altitude has already been selected, setting a lower altitude deselects the higher altitude. The same request can be performed on the WHEN CAN WE EXPECT page ([4R] key).
[4R] WHEN CAN SPD	To prepare a negotiation request for a new speed-deferred clearance. The same request can be performed on the WHEN CAN WE EXPECT page ([4R] key).
[5R] ADD TEXT	To call up the TEXT page. It is active while a message is being created.
[6R] ATC REQ DISPL	To display the prepared message on the DCDU screen.

ATC VERT REQ PAGE 2

GFC5-01-4655-011-A102AA

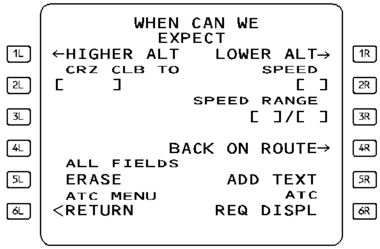


[1L] BLOCK ALT	To prepare a request to operate within an altitude interval (Example : FL370/FL410).
[2L] CRZ CLB TO	To prepare a request for a cruise-climb segment, up to the entered cruise altitude.
[4L] WHEN CAN WE EXCEPT CRZ CLB TO	To prepare a negotiation request for a cruise climb-segment, up to the entered cruise altitude. The same request can be performed on the WHEN CAN WE EXPECT page ([4R] key).
[5L] ALL FIELDS ERASE	To erase all the data that was entered on the page, and erase the data that was entered on the other associated pages.
[6L] ATC MENU RETURN	To call up the ATC MENU page.
[1R] VMC DESCENT	To prepare a request for a Visual Monitoring Condition (VMC) descent.
[2R] SPD RANGE	To prepare a request to operate within a speed range.
[4R] WHEN CAN WE EXPECT SPD RANGE	To prepare a negotiation request to operate within a speed range. The same request can be performed on the WHEN CAN WE EXPECT page ([4R] key).
[5R] ADD TEXT	To call up the TEXT page. It is active while a message is being created.
[6R] ATC REQ DISPL	To display the prepared message on the DCDU screen.

WHEN CAN WE EXPECT PAGE

To prepare message elements for “WHEN CAN WE EXPECT” negotiation requests with the ATC.

Negotiation requests that are prepared from the ATC LAT REQ or ATC VERT REQ pages automatically update the “WHEN CAN WE EXPECT” fields, and vice-versa.

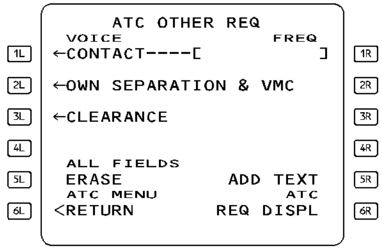


GFC5-01-4655-012-A102AA

[1L] HIGHER ALT	To prepare a negotiation request to climb to a higher altitude. If a lower altitude has already been selected, setting a higher altitude deselects the lower altitude.
[2L] CRZ CLB TO	To prepare a negotiation request to climb to a higher altitude.
[5L] ALL FIELDS ERASE	To erase all the data that was entered on the page, and erase the data that was entered on the other associated pages.
[6L] ATC MENU RETURN	To call up the ATC MENU page.
[1R] LOWER ALT	To prepare a negotiation request to descend to a lower altitude. If a higher altitude has already been selected, setting a lower altitude deselects the higher altitude.
[2R] SPEED	To prepare a negotiation request for a new speed clearance.
[3R] SPEED RANGE	To prepare a negotiation request to operate within a speed range.
[4R] BACK ON ROUTE	To prepare a negotiation request to return to the initial route.
[5R] ADD TEXT	To call up the TEXT page. It is active while a message is being created.
[6R] ATC REQ DISPL	To display the prepared message on the DCDU screen.

ATC OTHER REQ PAGE

To prepare miscellaneous request elements that cannot be generated with the LAT, VERT, and WHEN CAN WE EXPECT pages.



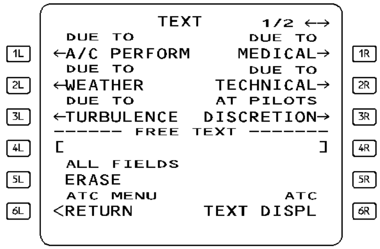
GFC5-01-4655-013-A102AA

[1L] VOICE CONTACT	To request voice contact with the ATC center.
[2L] OWN SEPARATION & VMC	To prepare a request for a Visual Monitoring Conditions (VMC) procedure, and a request to be allowed to maintain separations, at the Captain's initiative.
[3L] CLEARANCE	To prepare a request for clearance.
[5L] ALL FIELDS ERASE	To erase all the data that was entered on the page, and erase the data that was entered on the other associated pages.
[6L] ATC MENU RETURN	To call up the ATC MENU page.
[1R] FREQ	To enter the voice frequency, necessary for voice contact with the ATC.
[5R] ADD TEXT	To call up the TEXT page. It is active while a message is being created.
[6R] ATC REQ DISPL	To display the prepared message on the DCDU screen.

TEXT PAGE 1

To prepare justifications (due to aircraft performance, weather... etc), and/or for free text message elements.

GFC5-01-4655-D14-A102AA



[1L] DUE TO A/C PERFORM — Use this field, when the justification is due to aircraft performance.

[2L] DUE TO WEATHER — Use this field, when the justification is due to weather conditions.

Note : When the pilot reports an offset, due to a weather problem, the DCDU will not display the direction of the offset.

[3L] DUE TO TURBULENCE — Use this field, when the justification is due to turbulence.

[4L] FREE TEXT — To add free text to any request.
If more than one line is necessary, go to page 2.

[5L] ALL FIELDS ERASE — To erase all the data that was entered on the page, and erase the data that was entered on the other associated pages.

[6L] ATC MENU RETURN — To call up the ATC MENU page.

[1R] DUE TO MEDICAL — Use this field, when the justification is due to a medical reason.

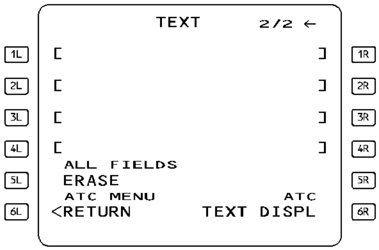
[2R] DUE TO TECHNICAL — Use this field, when the justification is due to a technical reason.

[3R] AT PILOT DISCRETION — To request authorization to freely execute clearance.

[6R] ATC XXX DISPL — To display the prepared message on the DCDU screen.
XXX refers to the page that is associated with the free text :
- TEXT (no associated page)
- REQ (request pages)
- EMERG (emergency pages)
- REP (position report pages)
- MODIF (modify page)

TEXT PAGE 2

GFC5-01-4655-015-A102AA

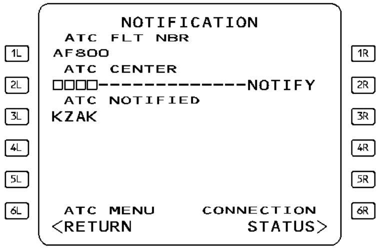


Lines 1 to 4	These lines are used to add free text to any request. If text has been written on the fourth line of page 1, this line reappears on the first line of page 2.
[5L] ALL FIELDS ERASE	To erase all the data that was entered on the page, and erase the data that was entered on the other associated pages.
[6L] ATC MENU RETURN	To call up the ATC MENU page.
[6R] ATC TEXT DISPL	To display the prepared message on the DCDU screen.

NOTIFICATION PAGE

To notify the ATC of aircraft datalink capability.

GFC5-01-4655-016-A102AA



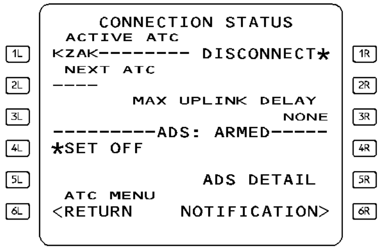
[1L] ATC FLT NBR	To display the flight number that comes from the FMGS. It cannot be modified via this page.
Line 2 ATC CENTER	Displays the logon status in front of the “ATC CENTER”. The status is either “NOTIFYING” in small white font, or “NOTIF FAILED” in small amber font : – NOTIFYING indicates that the logon is in progress. – NOTIF FAILED indicates that the logon has failed. The logon status disappears, when the logon notification is completed.
[2L] ATC CENTER	To enter the ATC’s ICAO code for notification. The entered ATC is displayed in large cyan font. *Note : At initialization, a default code is displayed in small cyan font, and corresponds to :* *– Last active ATC for which an active CPDLC (Controller Pilot Datalink Communication) connection was previously established, or* *– Last manually-entered ATC code,* *– Otherwise : 4 amber boxes appear.*
Lines 3 to 5	Display the last ATC centers (up to 3) for which a successful logon notification has been performed. *Note : “NOTIFICATION UNAVAILABLE” is displayed in Line 5, if the communication means, the aircraft position, or the flight number are unavailable.*

[2R] NOTIFY	To send a notification to the ATC. It is not active during a notification process, or if the communication means, the aircraft position, or flight number are unavailable.
[6L] ATC MENU RETURN	To call up the ATC MENU page.
[6R] CONNECTION STATUS	To call up the CONNECTION STATUS page.

CONNECTION STATUS PAGE

To display the status of CPDLC connections, and enable the crew to activate and deactivate the ADS function.

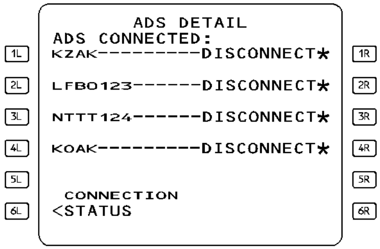
GFC5-01-4655-018-A102AA



[1L] ACTIVE ATC	To display the currently active ATC for CPDLC connection.
[2L] NEXT ATC	To display the next ATC for CPDLC connection.
Line 4	Displays the status of the ADS function (ARMED, CONNECTED, or OFF). Per default, ADS is selected ARMED.
[4L] SET OFF or SET ARMED	When the Automatic Dependent Surveillance (ADS) is OFF (respectively ARMED), this key activates (respectively deactivates) the ADS function.
[6L] ATC MENU RETURN	To call up the ATC MENU page.
[1R] DISCONNECT	To disconnect all established CPDLC connections.
[3R] MAX UPLINK DELAY	To display the maximum delay that is authorized for an ATC answer. The maximum delay is NONE by default. *Note : The crew should not modify this field, unless they have been instructed to do so.*
[5R] ADS DETAIL	To call up the ADS DETAIL page. The ADS DETAIL page can only be accessed, if ADS connections are established.
[6R] NOTIFICATION	To call up the NOTIFICATION page.

ADS DETAIL PAGE

Displays all ADS-connected ATC/AOC centers, and enables the crew to disconnect any of them.

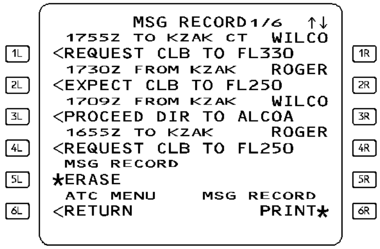


GFC5-01-4655-019-A102AA

Line 1 to 4 [L]	Display the currently ADS connected centers.
[6L] CONNECTION STATUS	To call up the CONNECTION STATUS page.
Line 1 to 4 [R]	To disconnect the corresponding ADS connected center.

<u>MSG RECORD PAGES</u> (1 to 6)
Display messages that were recorded from the DCDU.

GFC5-01-4655-020-A102AA

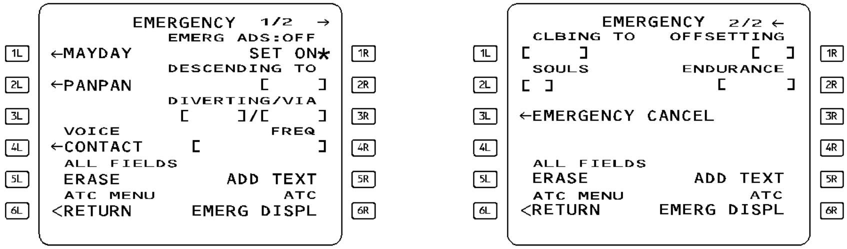


Lines 1 to 4	Display a summary of each recorded message : The time, the ATC, and the message status. The most recently recorded message is displayed on the first line. The left or right key adjacent to the message title, displays the contents of the recorded message.
[5L] MSG RECORD ERASE	To clear the contents of the message record. When pressing this key, MSG RECORD ERASE is replaced by ERASE MSG RECORD CONFIRM, to prevent from inadvertently erasing the message record.
[6L] ATC MENU RETURN	To call up the ATC MENU page.
[6R] MSG RECORD PRINT	To print the MSG RECORD page contents.

EMERGENCY PAGES

Enable the crew to prepare emergency messages.

GFC5-01-4655-021-A102AA



EMERGENCY PAGE 1/2

[1L] MAYDAY	To generate a downlink message that indicates a critical failure on board.
[2L] PANPAN	To generate a downlink message that indicates a major failure on board.
[4L] VOICE CONTACT	To request voice contact with the ATC. The default frequency is 121.5 MHz.
[5L] ALL FIELDS ERASE	To erase all the data that was entered on the page, and erase the data that was entered on the other associated pages.
[6L] ATC MENU RETURN	To call up the ATC MENU page.
[1R] SET OFF or SET ON	To activate or deactivate the ADS EMERGENCY mode. The title line displays the mode status : . EMERG ADS : ON, when the mode is activated . EMERG ADS : OFF, when the mode is not activated.
[2R] DESCENDING TO	To enter the altitude to which the aircraft is descending.
[3R] DIVERTING/VIA	To enter the route or airport to which the aircraft is diverting.
[4R] FREQ	To enter the requested voice frequency for voice contact with the ATC.
[5R] ADD TEXT	To call up the TEXT page. It is active while a message is being created.
[6R] ATC EMERG DISPL	To display the prepared message on the DCDU screen.

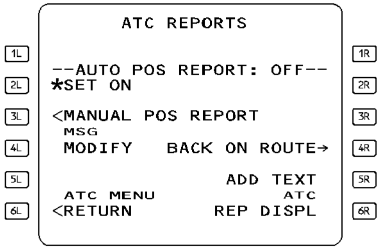
EMERGENCY PAGE 2/2

[1L] CLBING TO	To enter the altitude to which the aircraft is climbing.
[2L] SOULS	To enter the number of passengers on board. *Note : SOULS and ENDURANCE fields are linked :* *– If one field is cleared, this automatically clears the other ;* *– If one field is filled in, this automatically fills in the other.* *– If one field is empty, it is filled in with a default value (999 for SOULS and 0h00 for ENDURANCE).*
[3L] EMERGENCY CANCEL	To cancel the previous emergency message. If selected, it deselects, the PANPAN or MAYDAY items, and deactivates the ADS emergency mode.
[5L] ALL FIELDS ERASE	To erase all the data that was entered on the page, and erase the data that was entered on the other associated pages.
[6L] ATC MENU RETURN	To call up the ATC MENU page.
[1R] OFFSETTING	To enter the offset value from the flight plan.
[2R] ENDURANCE	To enter the maximum remaining flight time, limited by fuel autonomy.
[5R] ADD TEXT	To call up the TEXT page. It is active while a message is being created.
[6R] ATC EMERG DISPL	To display the prepared message on the DCDU screen.

ATC REPORTS PAGE

Enables the crew to prepare position reports to the ATC. Positions are either manually-entered by the pilot on the POSITION REPORT page, or automatically filled in by the FMGS.

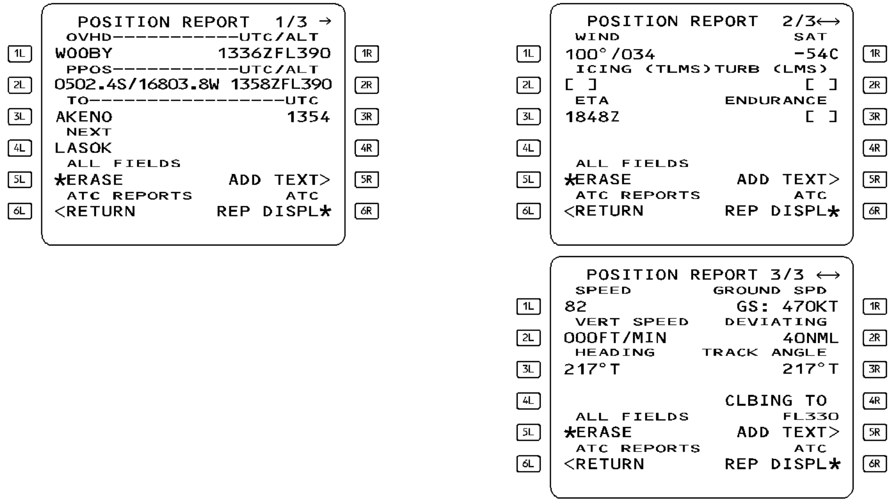
GFC5-01-4655-023-A102AA



Line 1	Displays the status of the AUTO POS REPORT function.
[2L] SET OFF or SET ON	To activate (or deactivate) the AUTOMATIC POSITION REPORT function.
[3L] MANUAL POS REPORT	To call up the POSITION REPORT page.
[4L] MSG MODIFY	To call up the MSG MODIFY page.
[6L] ATC MENU RETURN	To call up the ATC MENU page.
[4R] BACK ON ROUTE	To display the BACK ON ROUTE message on the DCDU ready to be sent.
[5R] ADD TEXT	To call up the TEXT page. It is active while a message is being created.
[6R] ATC REP DISPL	To display the prepared BACK ON ROUTE message on the DCDU screen.

POSITION REPORT PAGES

Enable the crew to prepare position reports.



GFC5-01-4655-024-A102AA

On each POSITION REPORT page

[5L] ALL FIELDS ERASE	To erase all the data that was entered on the page, and erase the data that was entered on the other associated pages.
[6L] ATC REPORTS RETURN	To call up the ATC REPORTS page.
[5R] ADD TEXT	To call up the TEXT page. It is active while a message is being created.
[6R] ATC REP DISPL	To display the prepared message on the DCDU screen.

POSITION REPORT PAGE 1/3

All data fields are automatically filled in, with data issued from the FMGS, but the pilot can overwrite this data

[1L] OVHD	Displays, the last-reported waypoint. It corresponds to the last-sequenced waypoint.
[2L] PPOS	Displays the aircraft's is present position.
[3L] TO	Displays the "TO" waypoint of the flight plan.
[4L] NEXT	Displays the "NEXT" waypoint of the flight plan.
[1R] UTC/ALT	Displays the time and altitude at the last-reported waypoint.
[2R] UTC/ALT	Displays the time and altitude at the aircraft's present position.
[3R] UTC	Displays the predicted time of arrival at the following waypoint.

POSITION REPORT PAGE 2/3

Wind, ETA, and SAT fields are automatically filled in, with data issued from the FMGS, but the pilot can overwrite this data.

[1L] WIND	Displays the current wind (speed and direction).
[2L] ICING (TLMS)	To enter the level of icing : · "T" for Trace icing · "L" for Light icing · "M" for Medium icing · "S" for Severe Icing
[3L] ETA	Displays the Estimated Time at Arrival
[1R] SAT	Displays the Static Air Temperature (SAT).
[2R] TURB (LMS)	To enter the level of turbulence : · "L" for Light turbulence · "M" for Medium turbulence · "S" for Severe turbulence
[3R] ENDURANCE	To enter the remaining fuel and the corresponding flight time.

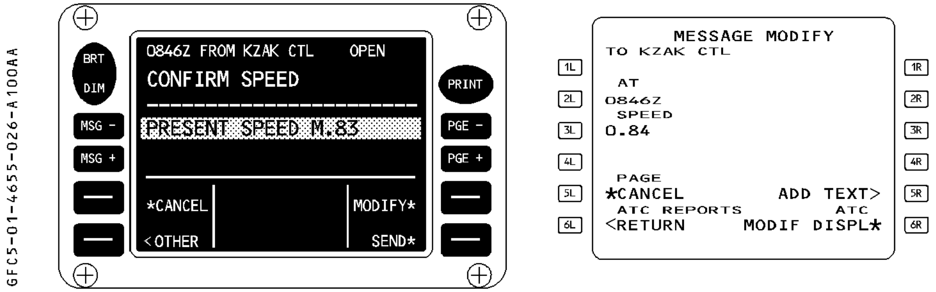
POSITION REPORT PAGE 3/3

All data fields are automatically filled in, with data issued via the FMGS, but the pilot can overwrite this data.

[1L] SPEED	Displays the current speed.
[2L] VERT SPEED	Displays the current vertical speed.
[3L] HEADING	Displays the current true heading.
[1R] GROUND SPD	Displays the current ground speed.
[2R] DEVIATING	Displays the current offset from the flight plan.
[3R] TRACK ANGLE	Displays the current track angle.
[4R] CLIMB TO/ DESCENDING TO	Displays the current target altitude.

MESSAGE MODIFY PAGE

Enables the crew to modify a downlink message that is displayed on the DCDU, prior to sending it to the ground.
It is accessed via the MODIFY prompt on various MCDU pages.

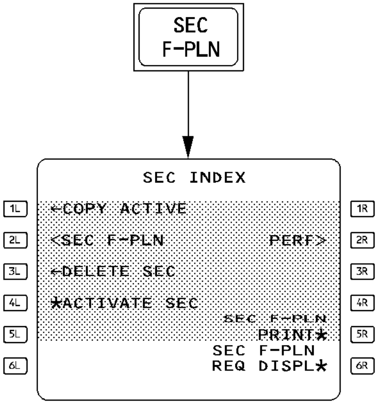


Example : ATC KZAK sends a message that requests speed confirmation. The FMGS proposes M. 83 on the DCDU. The pilot modifies the speed by entering M.84.

Line 1	Displays the name of the current ATC.
Lines 2 and 3	Display the label and parameters to be modified.
[5L] PAGE CANCEL	To call up the ATC MENU page.
[6L] ATC REPORTS RETURN	To call up the ATC REPORTS page.
[5R] ADD TEXT	To call up the TEXT page. It is active while a message is being created.
[6R] ATC MODIFY DISPL	To display the prepared message on the DCDU screen.

SEC INDEX PAGE

To call up the SEC INDEX page, press the SEC F-PLN key of the MCDU.



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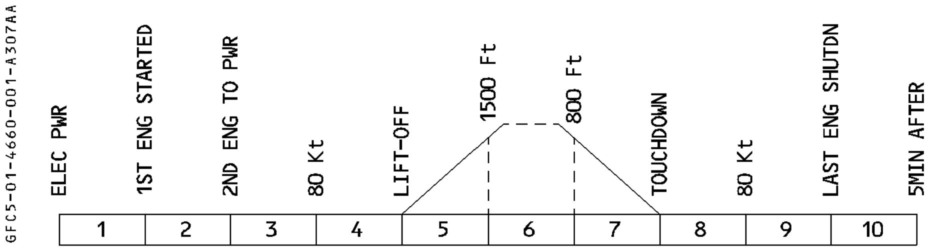
[6R] SEC F-PLN REQ DISPL : To display a flight plan request on the DCDU. The displayed flight plan is a copy of the secondary flight plan.

SCRATCHPAD MESSAGES ON THE ATC MENU FOR AFN, CPDLC AND ADS

MESSAGE	CONDITIONS
FORMAT : _ _ _	The acquisition format is not valid. An example of the required format is displayed (FORMAT : NNN, FORMAT : XXXX, etc), where : – N : Numerical data (0 to 9) – X : Alphanumerical data (0 to 9, or A to Z). To display the required format of specific data on the scratchpad message field, press on the corresponding empty field. This serves as a reference to the crew.
ENTRY OUT OF RANGE	The single value that was entered is out of range.
OUT OF RANGE	A single value of double data is out of range.
TWO ENTRIES OUT OF RANGE	The double value that was entered is out of range.
NOT ALLOWED	It is not allowed to enter data.
NON MODIFIABLE FIELD	A non-modifiable field was selected.
KEY NOT ACTIVE	It is not allowed to press this key.
ALREADY SELECTED	The selectable key has already been selected.
CLR NOT ALLOWED	An available key has been selected, but the function is not available due to CLR still displayed on the scratchpad field.
FLIGHT NBR UNAVAILABLE	Notification is not available, because the flight number is unavailable.
ENTER MANDATORY FIELDS	Selection of a command is not available, because mandatory fields are not filled in.
NO WHOLE MSG PREPARED	Selection of the ATC DISPL or ADD TEXT command is not available, because the message is not completely prepared.
A/C REGISTER NBR UNAVAIL	Notification is not available, because the Tail Number is unavailable.
A/C POS UNAVAILABLE	Notification is not available, because the Aircraft Position is unavailable.

MESSAGE	CONDITIONS
COM UNAVAILABLE	The selected command is not available, because datalink comunications means are currently unavailable.
DCDU FILE FULL	The selected command is not available, because the DCDU file is full.
MSG ALREADY DISPLAYED	The ATC DISPL command is not available, because the message is already displayed on the DCDU.
NO MSG TO PRINT	The PRINT key was selected, but the function is currently unavailable because there is no message to be printed.
PRINTER UNAVAILABLE	The PRINT key was selected, but the printer is currently unavailable.
NO INPUTS	The ALL FIELDS ERASE command is not available, because there are no items to erase.
LAST MSG ELEMENT	Maximum number of message elements for a given downlink message is reached.
TOO MANY MSG ELEMENTS	Entry of a new parameter is not allowed, because the maximum number of message elements has been reached.
NO ACTIVE ATC	The ATC DISPL or the MAX UPLINK DELAY keys were selected, but the function is currently unavailable because there is no active CPDLC connection.
NO DCDU MSG TO MODIFY	The MSG MODIFY key was selected, but the function is currently unavailable.
NO FM DATA	No FMS data are available when selecting the MODIFY key for a position report.
LAT/LON DISPL ABREVIATED	The LAT/LONG display is abbreviated only on the MCDU display field, because there is lack of space.
MSG RECORD NOT RELIABLE	Due to a technical problem, the list of messages recorded is not reliable. All CPDLC messages are deleted and new messages should not be recorded.
MSG RECORD IS EMPTY	The MSG RECORD ERASE command is not available, because there are no messages recorded.
ADS FUNCTION OFF	The ADS DETAIL key was selected, but the page cannot currently be accessed, because the ADS is OFF, and consequently no ADS connections can be established.
NO ADS CONNECTION	The ADS DETAIL key was selected, but the page cannot currently be accessed, because the ADS is ARMED but no connection is currently established.

WARNINGS AND CAUTIONS



E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNIG	FLT PHASE INHIB
ATSU FAULT Failure at ATSU initialization, if associated with ATSU INIT FAULT ECAM message.	SINGLE CHIME	MASTER CAUTION	NIL	NIL	3, 4, 5, 7, 8
ATC FAULT ATC datalink Communications failure, or ATC datalink application loss.					
COMPANY FAULT AOC datalink communications failure.	NIL	NIL	NIL	NIL	3, 4, 5, 7, 8

MEMO DISPLAY

- The COMPANY DATALINK STBY message is displayed in green, when the AOC datalink air-ground communication is temporarily unavailable, but not lost.
- The COMPANY CALL message is displayed in green, when the aircraft receives a message from the ground requesting voice communication on VHF.
- The COMPANY MSG message is displayed in green, when the aircraft receives a message from the ground.
- The COMPANY ALERT message is displayed in green, when the aircraft receives an uplink alert message, or when an AOC special condition requires a pilot action on the MCDU (depends on AOC programming). This message pulses green for 180 seconds, then remains steady. It is associated with a buzzer for 1 second.

ATC MSG ALERT

	AURAL ALERT	VISUAL ALERT	FLT PHASE INHIB
ATC MSG alert When a new ATC message arrives from the ground, or a reminder message is automatically presented within the DCDU message file.	RING	"ATC MSG" pushbuttons flashing	3,4,5, 7,8

BUS EQUIPMENT LIST

		NORM			EMER ELEC		
		AC	DC	DC BAT	AC ESS	DC ESS	HOT
ATSU	ATSU 1	AC1	DC1				
	DCDU-1		DC1				
	DCDU-2		DC2				

49.00 CONTENTS

49.10 DESCRIPTION

49.20 CONTROLS AND INDICATORS

R **49.30 ELECTRICAL SUPPLY**

GENERAL

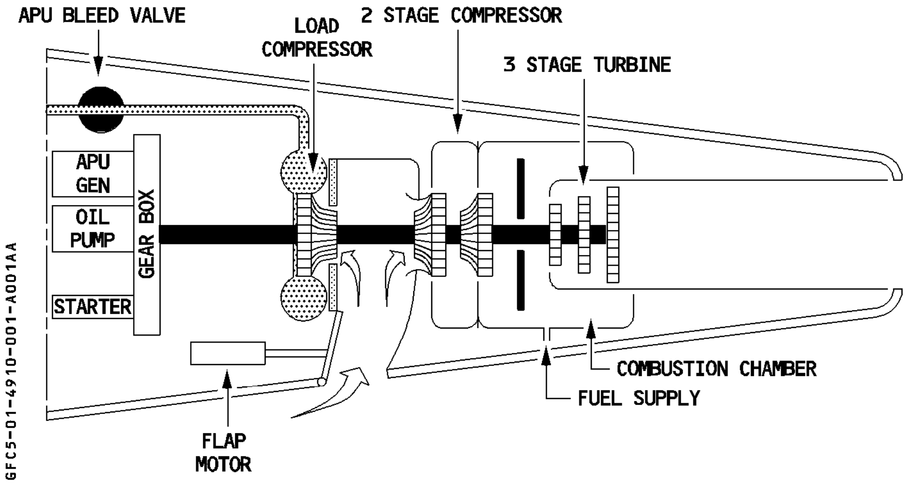
The Auxiliary Power Unit (APU) is a self-contained unit which makes the aircraft independent of external pneumatic and electrical power supply.

On ground
– It supplies bleed air for starting the engines and for the air conditioning system.
– It supplies electrical power to the electrical system.

During Take-Off
It supplies bleed air for air conditioning, thus avoiding a reduction in engine thrust caused by the use of engine bleed air for this purpose when optimum aircraft performance is required.

In Flight
· It backs up the Electrical system
· It backs up the Air conditioning
· It can be used to start the engines
The APU may obtain power for starting from the aircraft's batteries or in combination with the external power or from ground service, or normal aircraft supply.
APU starting is permitted throughout the normal flight envelope except when APU battery only is supplying (Refer to FCOM 3.01.49).
The ECAM displays APU parameters.

FOR INFO



MAIN COMPONENTS

APU ENGINE

The basic element of the APU is a single shaft gas turbine which delivers mechanical shaft power for driving the accessory gearbox (electrical generator) and produces bleed air (engine starting and pneumatic supply).

ELECTRONIC CONTROL BOX

The Electronic Control Box (ECB) is primarily a full authority digital electronic controller that performs the APU system logic for all modes of APU operation such as
- Sequence and monitoring of start
- Speed and temperature monitoring
- Monitoring of bleed air (IGV)
- Sequence of shut down (manual, protective or inhibited)

AIR INTAKE SYSTEM

The air intake and an electrically operated flap allow external air to reach the compressor inlet.

STARTER

The ECB controls the electric starter. The starter engages if the air intake is fully open and the MASTER SW and the START pushbutton are ON.

FUEL SYSTEM

The APU is supplied from the trim tank transfer line (Refer to 1.28.10)
The ECB controls the fuel flow.

OIL SYSTEM

The APU has an integral independent lubrication system (for lubrication and cooling).

INLET GUIDE VANES (IGV)

The IGVs control bleed air flow, and a fuel-pressure-powered actuator positions the IGVs. The ECB controls the actuator in response to aircraft demand.

AIR BLEED SYSTEM

The ECB controls the APU BLEED valve. It is automatically closed above 25000 ft (climbing) or 23000 ft (descending).

CONTROLS

R The flight crew uses the controls on the APU panel for routine shutdown. For emergency shutdown :
R – The flight crew can push the APU FIRE handle, or
R – The ground crew can push the APU SHUT OFF pushbutton on the interphone panel under the nose fuselage or the APU EMER SHUT DOWN pushbutton on the refueling/defueling panel.

GROUND OPERATIONS SAFETY DEVICES

– APU FIRE WITH AUTOMATIC SHUTDOWN
The APU may run, without cockpit crew supervision, when the aircraft is on ground. In case of fire in the APU compartment :
· APU fire warnings operate in the cockpit.
· A horn in the nose gear bay sounds.
· The "AVAIL" light goes off.
· The "FAULT" light on the MASTER SW comes on.
· The APU shuts down.
· The APU fire extinguisher discharges.

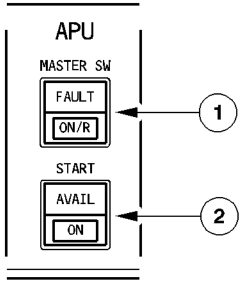
Note : On ground, the NBPT (No Break Power Transfer) function is inhibited, in case of an APU shutdown generated by one of the following conditions :
R *– APU shutdown from the APU SHUT OFF switch, provided on the external power*
R *panel (925 VU), or*
R *– APU emergency shutdown from the APU EMER SHUT DOWN switch, provided*
R *on the REFUEL/DEFUEL panel (990 VU).*
– Automatic APU shutdown, triggered by the ECB, or
– APU shutdown from the APU FIRE pushbutton.

OPERATION UNDER FAILURE CONDITIONS

– APU FAULT WITH AUTOMATIC SHUTDOWN
The following failures cause an automatic shutdown :
1. Overspeed
2. Certain critical ECB internal failures
3. Underspeed
4. Start abort
5. Low oil temperature
6. High oil temperature
7. Load compressor overtemperature
8. Generator high oil temperature
9. DC power interrupt (BAT OFF when aircraft on batteries only)
10. Overtemperature
11. Certain ECB internal failures

Failure causes 1 and 2 lead to an automatic shuddown (protective shutdown) in all flight phases. For failures 3 through 11, the automatic shutdown is inhibited to ensure APU availability (inhibited shutdown in flight phase 2 to 9).

OVERHEAD PANEL



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① MASTER SW pushbutton

This pushbutton controls the electric supply for APU operation, and its protective features. It also controls the start and shutdown sequences.

ON/R : – The blue ON light comes on.
- Electric power goes to the APU system, and the ECB performs a power-up test.
- The APU air-intake flap opens.
- The APU fuel isolation valve and APU LP valve open.
- Depending on the transfer activities of the trim tank, and on the pressure in the trim tank line, the FWD APU and AFT APU fuel pumps operate.
- If the aircraft has ground power or main generator power, the APU page appears on the ECAM display.

Off : Manual shutdown sequence.
- The ON light of the MASTER SW goes off.
- The APU keeps running for a cooling period of 105 sec. at 100% speed.
- Then, after an additional running period of 15 seconds (for No Break Power Transfer), the APU shuts down and the AVAIL light goes off.
- At N 7 %, the air-inlet flap closes.

Note : Switching OFF then ON the MASTER SW resets the ECB.

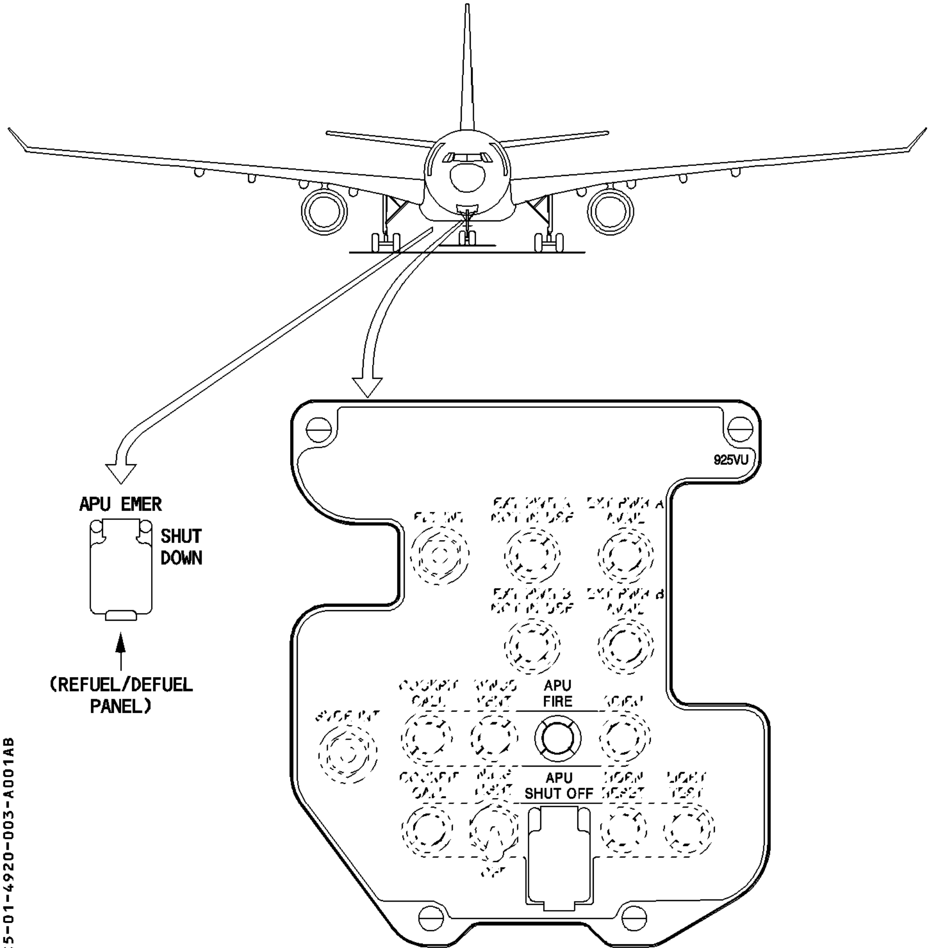
FAULT lt : This amber light comes on, and a caution appears on the ECAM, when an
R automatic APU shutdown occurs (Refer to 1.49.10).

2 START pushbutton

ON : The blue light comes on.
When the flap is completely open, the APU starter is energized.
When N = 7 %, ignition is turned on.
R When N = 50 %, the APU starter is de-energized, and ignition is turned off.
R When N = 95 %, the ON light on the START pushbutton goes off and AVAIL comes on in green.
– The APU may now supply bleed air and electrical power to the aircraft systems
10 seconds later, the APU page disappears from the ECAM display.

AVAIL lt : This light comes on green, when N reaches 95 %.

EXTERNAL CONTROLS



(EXTERNAL CONTROL PANEL)

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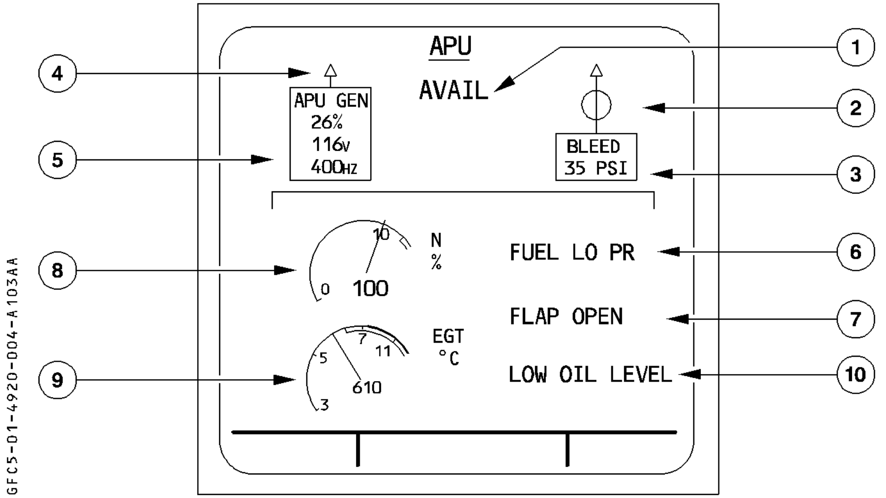
ECAM APU PAGE



(1) AVAIL indication

It is in green, when APU N is above 95 %

(2) APU bleed valve position

It is only displayed, if the APU MASTER SW is ON/R.

In line – Green	:	The APU valve is fully open.
Crossline – Green	:	The APU valve is not fully open, and the APU BLEED pushbutton is OFF.
Crossline – Amber	:	The APU valve is not fully open, if the APU BLEED pushbutton is ON.

(3) APU bleed air pressure

This box displays the relative bleed air pressure in green.
It shows an amber XX, when the ADIRS 1 is not available or selected OFF.

(4) APU GEN line contactor indication

It is in green, when the APU GEN line contactor is closed.
It is in white, if the line contactor is open.

(5) APU GEN

Identical to APU GEN parameters on ELEC page.

(6) FUEL LO PR

Displayed amber if of APU fuel low pressure detection

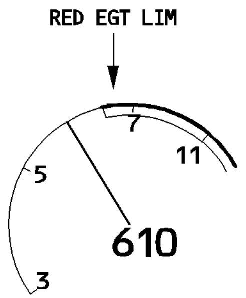
(7) FLAP OPEN

Displayed green when APU air intake flap is fully open (MASTER SW pushbutton at ON)

(8) APU N

- Displays APU speed in green
- Becomes red when N ≥107 %.

(9) APU EGT



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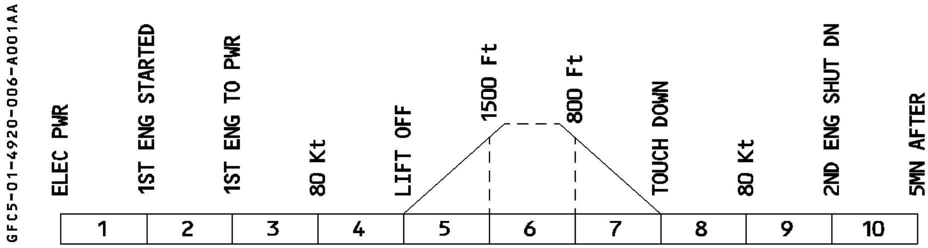
- Displays APU EGT (needle and digital indication) in green
- It pulses when the ECB detects an advisory
- Becomes red when EGT ≥ RED EGT LIM* associated with automatic shut down
  - * ECB calculates the RED EGT LIM and transmits it to the ECAM, it is equal to the lower border of the red sector. It is a function of N during start and a function of ambient temperature and pressure when APU is running.
    Maximum EGT during start : 1250° C (refers to 0 % APU speed)
    Maximum EGT with APU running : 650° C (Sea level, standard day).

(10) LOW OIL LEVEL

Advisory : displayed if the ECB detects a low APU oil level when the aircraft is on the ground and the APU is not running.

WARNINGS AND CAUTIONS



R

<table>
<tr><th>E/WD: FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>AUTO SHUT DOWN
Automatic shut down of APU for a reason other than a fire</td><td rowspan="2">SINGLE CHIME</td><td rowspan="2">MASTER CAUT</td><td rowspan="2">APU</td><td rowspan="2">APU MASTER sw FAULT lt</td><td rowspan="2">3, 4, 5
7, 8</td></tr>
<tr><td>EMER SHUT DOWN
Use of APU shut off pushbutton on interphone panel or on refueling/defueling panel or APU FIRE pushbutton pushed.
If non automatic shut down a failure has been detected by the ECB, but the APU remains available.</td></tr>
</table>

MEMO DISPLAY

– APU AVAIL message is displayed in green when APU N is above 95 %.

BUS EQUIPMENT LIST

FOR INFO

R

	NORM			EMER ELEC			
	AC	**DC**	**DC BAT**	**AC ESS**	**DC ESS**	**HOT**	**APU BAT BUS**
ECB SUPPLY					X (2)		X (1)
STARTER MOTOR	APU TR						X

R (1) *ECB is supplied by APU HOT BUS on ground if APU BAT BUS is not supplied*
R (2) *This supply is necessary only during the APU start (due to a loss of voltage on the APU BAT BUS during this phase).*

52.00 CONTENTS

52.10 DESCRIPTION

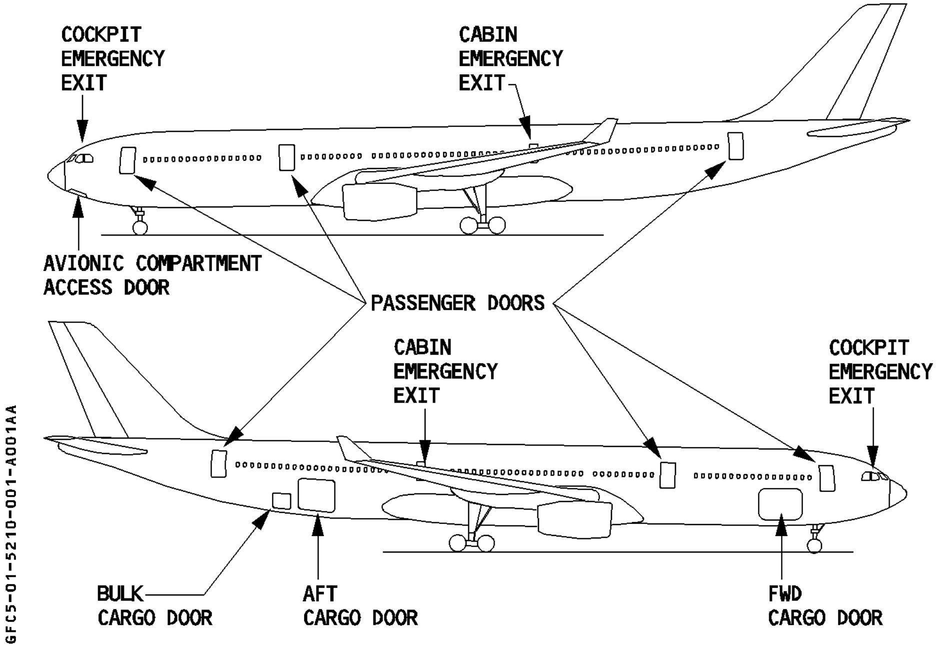
52.20 CONTROLS AND INDICATORS

52.30 ELECTRICAL SUPPLY

GENERAL

The fuselage of A330 comprises:
- six passenger doors
- two emergency exits in the cabin
- cockpit emergency exits (two sliding windows).
- three cargo compartment doors
- one avionic compartment access door.

All doors are monitored by the Door and Slide Control System (DSCS) which generates warnings on ECAM and on the doors themselves.



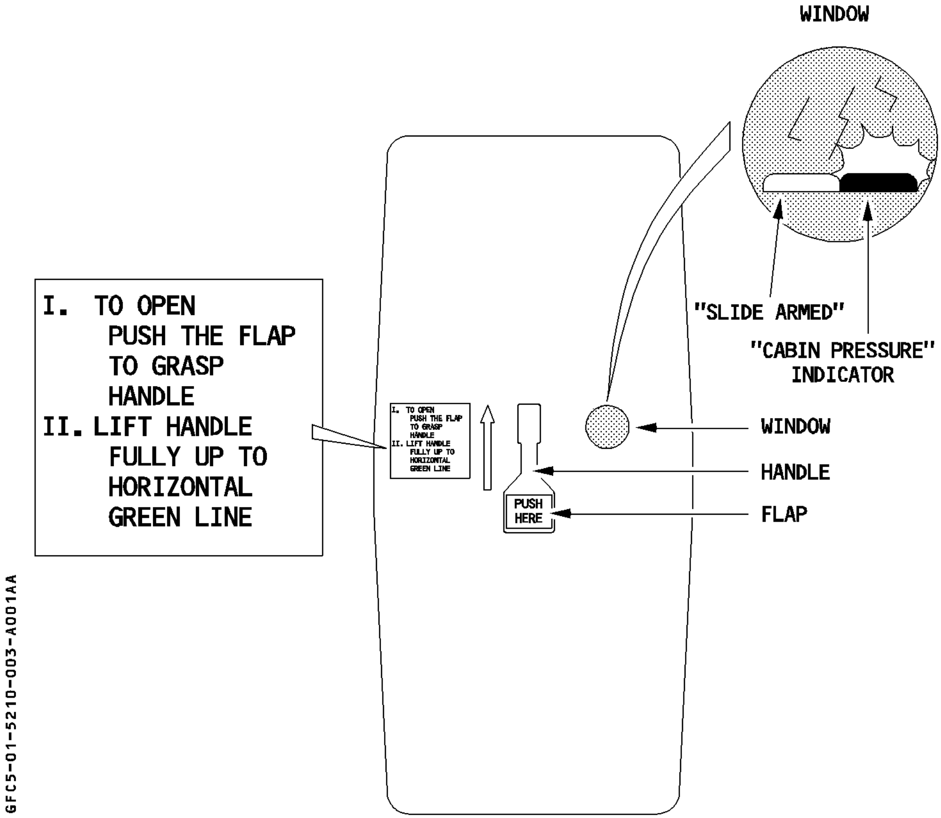
PASSENGER DOORS

Six outward and forward opening plug type doors are provided three on each side of the fuselage (two forward, two mid, two aft).
They can be operated from inside or outside. Normal operation is manual with hydraulic damping and a gust lock mechanism.
An emergency opening system is installed on each door. The system comprises:
- an escape slide stowed in a container attached to the inboard lower side of the door.
- a damper actuator which limits the door travel in normal mode and in the event of emergency, it acts as an actuator for automatic door opening.
- a slide arming lever.

When the slide arming lever is in the ARMED position, the slide is connected to the floor brackets on both sides of the door. When the door is opened, automatic inflation and deployment of the slide occurs. If the inflation bottle fails to discharge automatically, it can be activated manually.
Opening from the outside disarms the door and escape slide.
Each passenger door is fitted with:
- two mechanical locking indicators for visual check of lock/unlock position.
- one warning light to show the ARMED or DISARMED condition of the escape slide.
- one CABIN PRESSURE warning light to indicate a residual pressure in the cabin.

CABIN DOORS

OUTSIDE



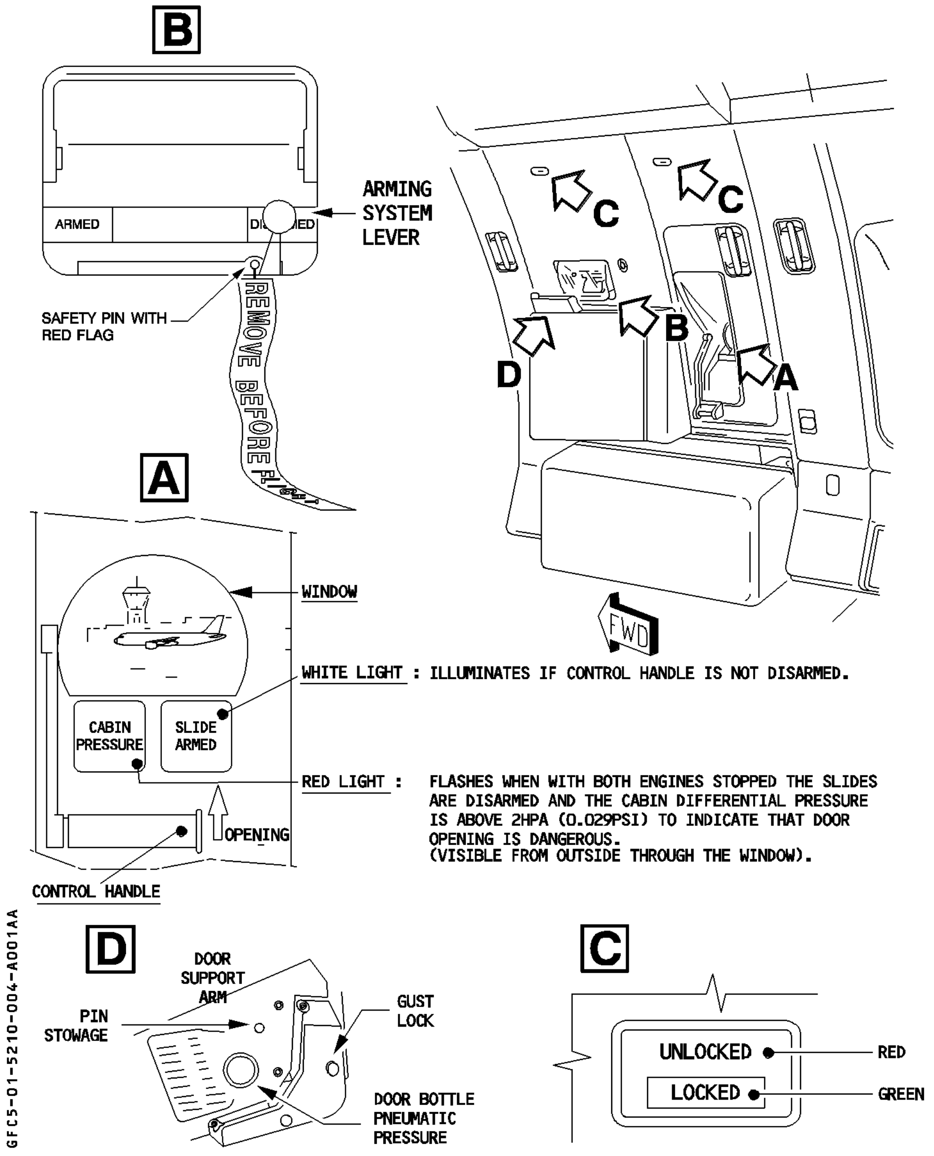
Each cabin door can be opened from the outside.
Opening instructions are written next to the opening handle.

Note : If a cabin door is opened from the outside, the automatic disarming is activated.

PASSENGERS DOORS

INSIDE

R



EMERGENCY EXITS

COCKPIT

The two sliding windows in the cockpit are flight crew emergency exits.
A small compartment, located above each window, contains an escape rope that reaches the ground, when lowered through the window on the other side of the cockpit.
The cockpit windows can only be opened from the inside.
Emergency cockpit evacuation is also possible through the cockpit door escape panel. It is designed to be pushed open in the direction of the cabin, after removal of the quick-release pins.

CABIN

One plug-type emergency exit is located on each side of the cabin.
They open outward and forward, and are each equipped with an escape slide, stowed in the compartment, below the cabin floor.

CARGO DOORS

Three cargo compartment doors are located on the right side of the fuselage, below the cabin floor.

FWD AND AFT CARGO DOORS

These outward and upward opening doors are mechanically-locked and hydraulically-operated by the yellow hydraulic system.
If the yellow system's electric pump fails, the system can be pressurized by using a hand pump, located on the hydraulic maintenance panel.
The FWD and AFT cargo doors can only be opened from the outside. A red light, fitted in the locking handle's housing area, indicates a residual cabin pressure.
The door open indicator light shows that the door is locked in the open position, allowing safe cargo loading operation.
Ten flag indicators show whether the door is fully locked. A popped-out indicator flag signifies that a hook is not locked.

Note : *When the electric pump operates the FWD or AFT cargo doors, the only other yellow system device that can operate is Engine 2 reverse. The yellow hydraulic leak measurement valves close, and an SFCC inhibition prevents any flaps movement.*

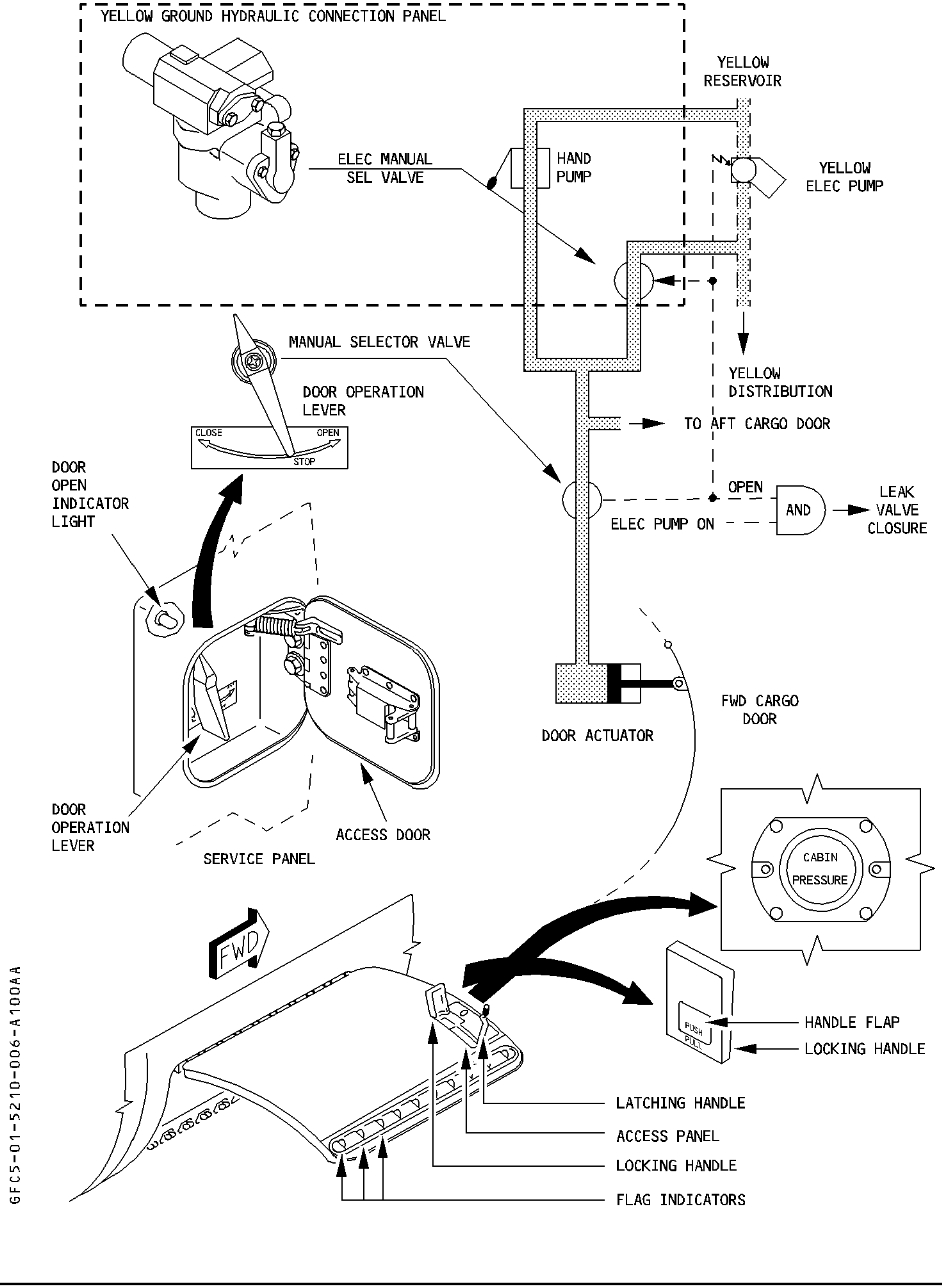
BULK CARGO DOOR

The BULK plug-type cargo door is mechanically-locked and manually-operated.
It opens inward then upward, and can either be opened from the inside or outside.

CARGO DOORS

FOR INFO

R



AVIONICS COMPARTMENT ACCESS DOOR

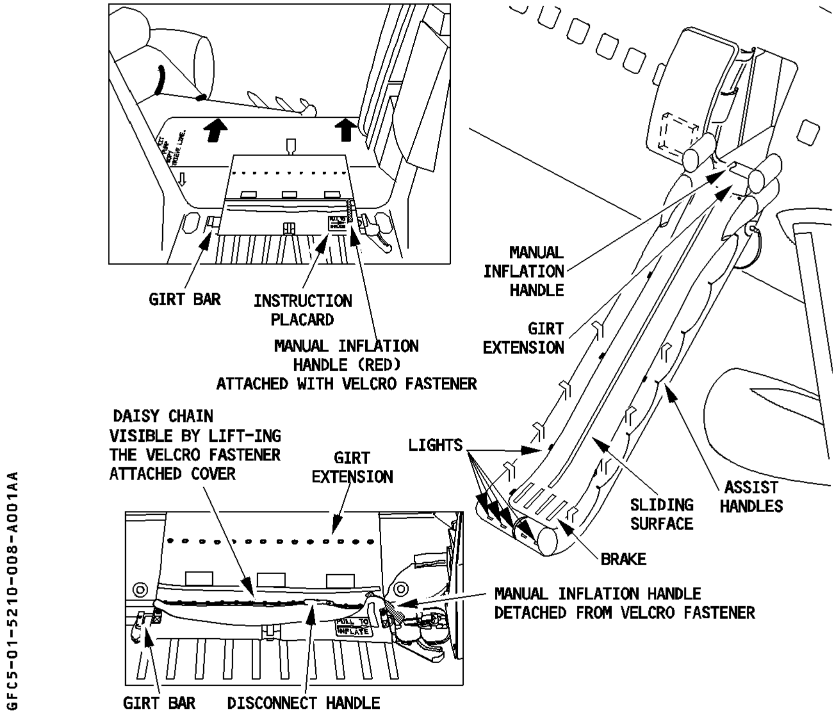
An inward-opening, manually-operated, hinged door gives access to the avionics compartment in the lower fuselage, forward of the nose landing gear bay. A ladder is stowed inside the compartment adjacent to this door, which may either be operated from the interior or exterior.
This compartment is also accessible from the cockpit, via a floor hatch located behind the captain's seat. A fixed ladder is in the avionics compartment for access from the cockpit.

COCKPIT DOOR

Refer to 1.25.11, for information about the secured cockpit door.

ESCAPE SLIDES/RAFTS

PASSENGER DOOR SLIDES/RAFTS



– **SLIDE MODE**

Automatic operation : Normally automatic inflation when slide is armed and door opens

Manual operation : If the slide falls down from the door but does not inflate, inflation can be started manually by pulling the handle which is attached at the girt extension of the slide/raft.

– **RAFT MODE**

To disconnect the slide from the aircraft, pull the disconnect handle. The slide raft is moored to the aircraft by means of the ditching line which has to be cut to completly free the slide/raft from the aircraft.

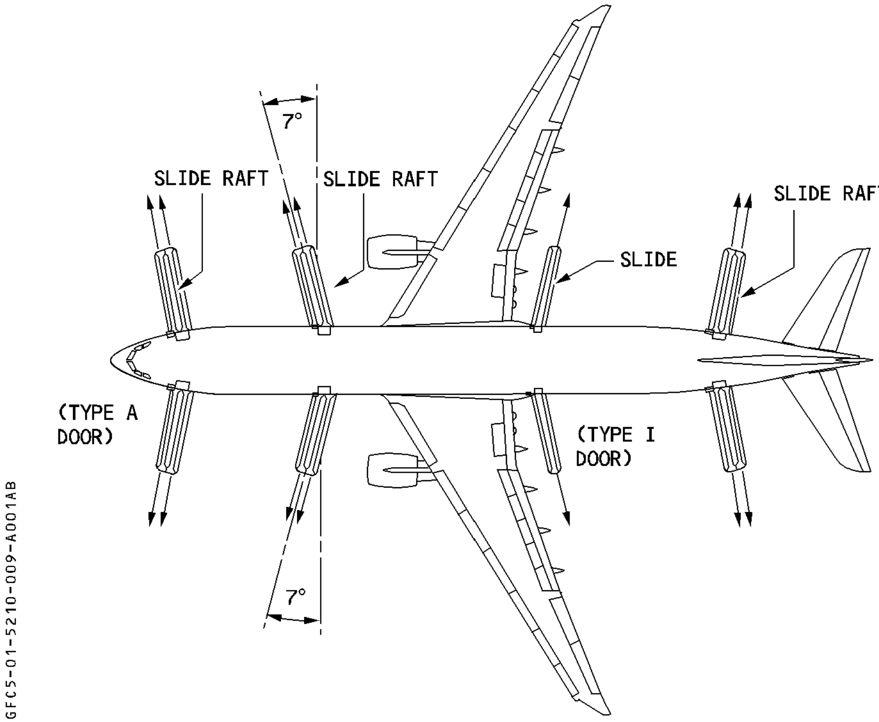
EMERGENCY EXIT SLIDES

Operation is identical to passenger door slides/rafts operation. Only slide mode is available.

ESCAPE SLIDE ARRANGEMENT

Passenger doors are equipped with dual lane escape slide rafts and emergency exits are equipped with single lane escape slides.

R



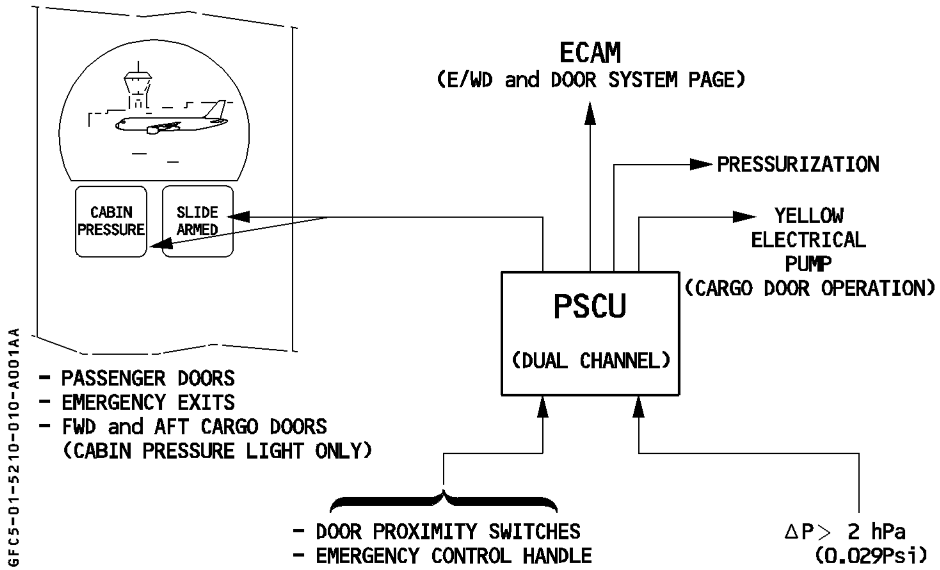
DOORS AND SLIDES CONTROL SYSTEM

The Doors and Slides Control System (DSCS) consists in :
- proximity switches installed on each door
- the Proximity Switch Control Unit (PSCU)
- a pressure switch (△P of the cabin)
- an autonomous standby power supply

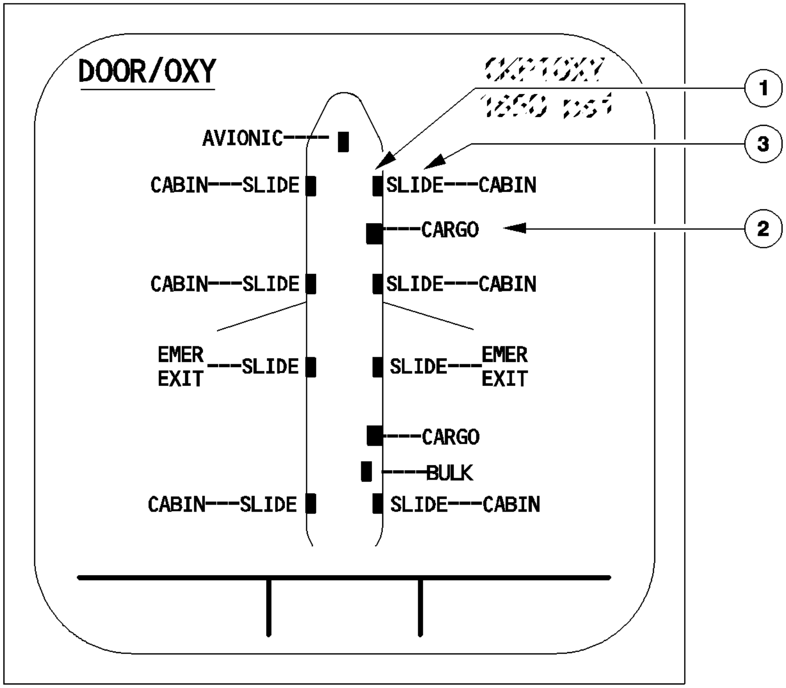
The Doors and Slide Control system performs the following functions:
- Door warning system: to indicate on the ECAM the state (LOCKED/UNLOCKED) of each door
- Escape slide warning system: to indicate on the ECAM and on the slide warning light the state (ARMED / DISARMED) of the slide.
- Overpressure warning system: to indicate an excessive residual differential cabin pressure to the passenger doors, the emergency exits and the FWD and AFT cargo doors.
- Electrical control of the FWD and AFT cargo doors.

The DSCS also prevents the aircraft pressurization with one engine running when a door (CAB, CARGO, BULK) is not fully closed and locked or if a sensor is defective. In this case the DSCS sends a signal to the cabin pressure system to keep the outflow valves open and to the Zone Controller to close the pack flow control valves.

ARCHITECTURE



ECAM DOOR / OXY PAGE



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① DOOR symbol

R Green (symbol outline) : the door is closed and locked.
R Amber (filled symbol) : the door is not locked

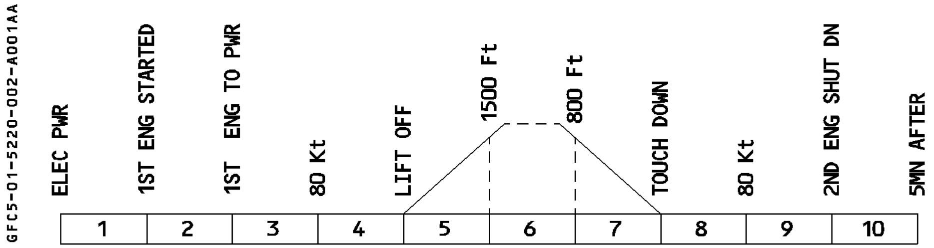
② DOOR indication

Appears amber when the door is not locked.
Appears white when the information is not valid.
Suppressed when the door is closed

③ SLIDE indication

R SLIDE appears white when the slide is not disarmed.
- - - appears amber when the slide is disarmed and the door is open.
Both suppressed when the slide is disarmed and the door is closed.

WARNINGS AND CAUTIONS



R

E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
L (R) FWD CABIN L (R) MID CABIN L (R) AFT CABIN L (R) EMER EXIT FWD (AFT) (BULK) CARGO AVIONIC	SINGLE CHIME	MASTER CAUT	DOOR	NIL	1, 4, 5, 7, 8, 10
POS DET 1 (2) (1 + 2) PSCU FAILURE					3, 4, 5, 7, 8

BUS EQUIPMENT LIST

FOR INFO

		NORM			EMER ELEC		
		AC	**DC**	**DC BAT**	**AC ESS**	**DC ESS**	**HOT**
DOORS and SLIDES CTL	NORMAL		GND/FLT				
	STBY			X (1)			
COCKPIT DOOR			DC2				

(1) If both busbars are inoperative, the system is supplied by an autonomous standby power supply (battery).

70.00 CONTENTS

GENERAL

R The GE engine is a high bypass ratio turbofan.

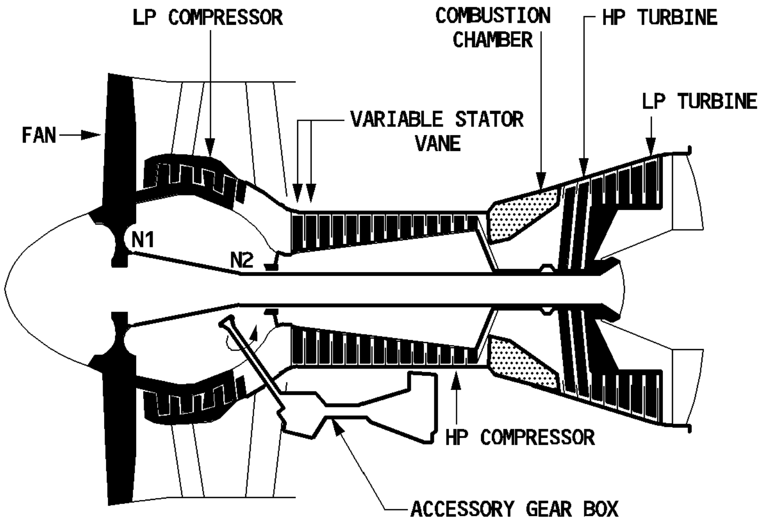
DESCRIPTION

– **Low-pressure (LP) compressor / turbine**
The low-speed rotor (N1) consists of a front fan (single stage) and a four-stage LP compressor connected to a five-stage LP turbine.

– **High-pressure (HP) compressor / turbine**
The high speed rotor (N2) consists of a fourteen-stage HP compressor connected to a dual-stage HP turbine.

– **Combustion chamber**
The annular combustion chamber is fitted with 30 fuel nozzles and 2 igniters.

– **Accessory gearbox**
The accessory gearbox, located at the bottom of the fan case, receives torque from horizontal HP rotor drive shaft and drives gearbox mounted accessories.



GENERAL

Each powerplant has a FADEC (Full Authority Digital Engine Control) system.
FADEC, also called the electronic control unit (ECU), is a digital control system that performs complete engine management.
FADEC has two-channel redundancy, with one channel active and one in standby.
If one channel fails, the other automatically takes control.
The system has a magnetic alternator for an internal power source.
FADEC is mounted on the fan case.
The engine interface unit (EIU) transmits to FADEC the data it uses for engine management.

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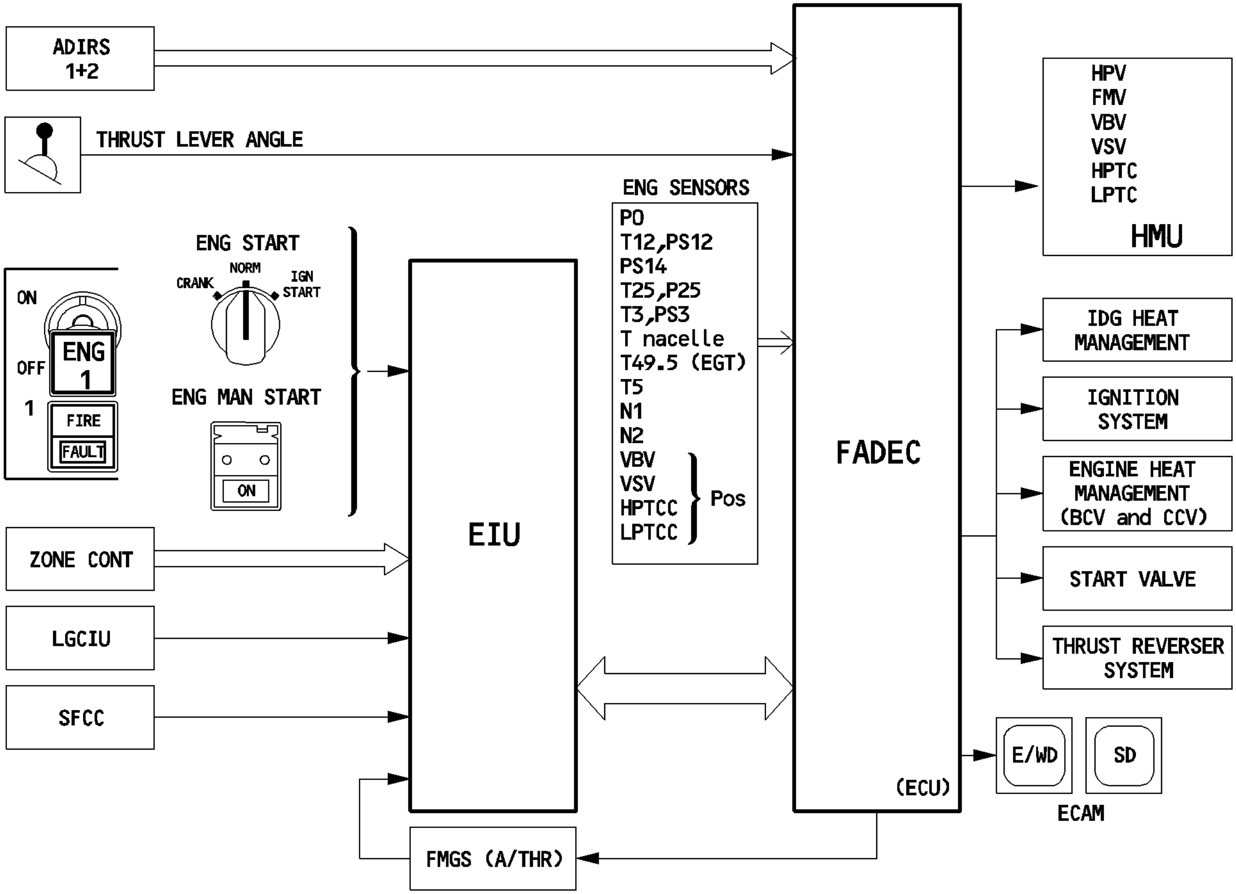

FUNCTIONS

The FADEC system performs the following functions:

Control of gas generation
— control of fuel flow
— acceleration and deceleration schedules
— variable bleed valve and variable stator vane schedules
— control of turbine clearance
— idle setting

Protection against engine exceeding limits
— protection against N1 and N2 overspeed
— monitoring of EGT during engine start

Power management
— automatic control of engine thrust rating
— computation of thrust parameter limits
— manual management of power as a function of thrust lever position
— automatic management of power (A/THR demand).

Automatic engine starting sequence
— control of :
 · the start valve
 · the HP fuel valve
 · the fuel flow
 · the ignition
— monitoring of N1, N2, FF and EGT
— initiation of abort and recycle (on the ground only)

Manual engine starting sequence
— passive monitoring of the engine
— active protection (on the ground only) against high EGT and for starter reengagement speed
— control of:
 · the start valve
 · the HP fuel valve
 · the ignition

Thrust reverser control
- actuation of the blocker cowls.
- engine setting during reverser operation

Transmission of engine parameters and engine monitoring information to cockpit indicators
- the primary engine parameters
- the starting system status
- the thrust reverser system status
- the FADEC system status
- secondary engine parameters (oil temperature, nacelle temperature, oil filter clogging and fuel filter clogging)

Computation of fuel used
- integration of fuel flow.

Management of engine heat
- control of the core compartment cooling valve.
- control of the bore compartment cooling valves.

Management of IDG heat
- control of the IDG air/oil heat exchanger air valve

Detection, isolation and recording of failures

POWER SUPPLY

The FADEC system is :
— powered by the aircraft electrical circuit below 15 % N2
— self-powered above 12 % N2.
— both supplies are connected between 12 and 15 %.

FADEC ELECTRICAL SUPPLY LOGIC

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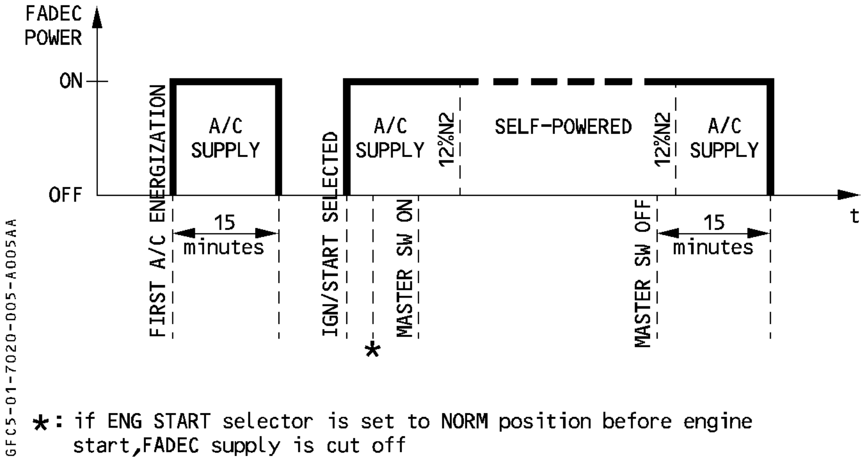
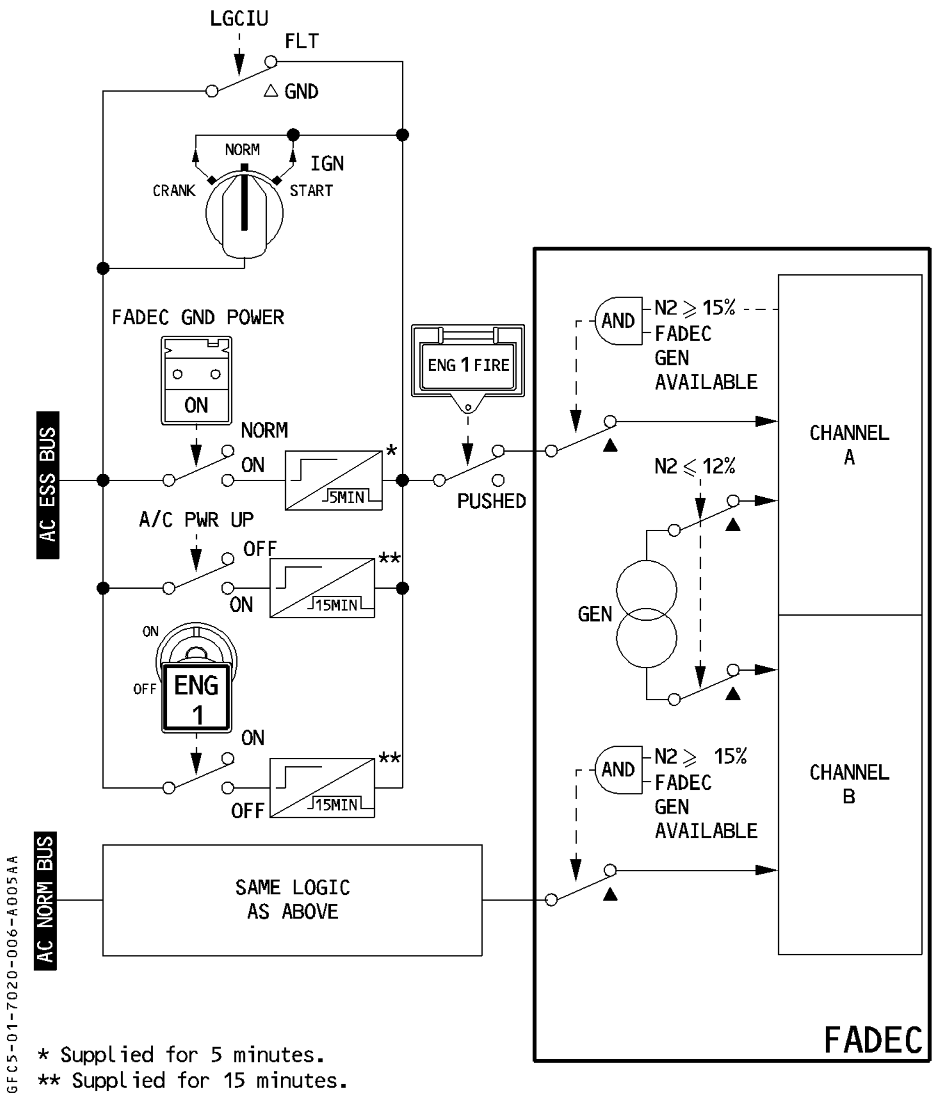


*: if ENG START selector is set to NORM position before engine start,FADEC supply is cut off

FADEC POWER SUPPLY

FOR INFO

R

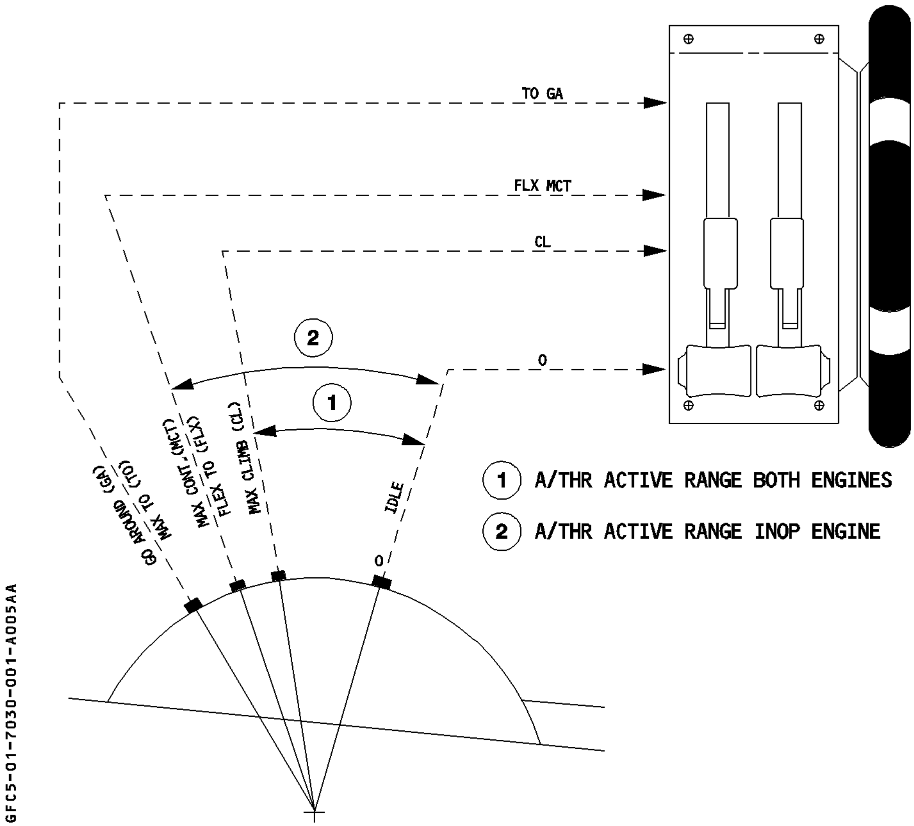


* Supplied for 5 minutes.
** Supplied for 15 minutes.

GENERAL

A FADEC dedicated to each engine controls thrust.
The pilot uses the thrust levers to set the thrust in manual mode, and the FMGS sets the thrust in automatic mode.
The FADEC prevents the thrust from exceeding the limit for the thrust lever position in both manual and automatic modes.

THRUST LEVERS

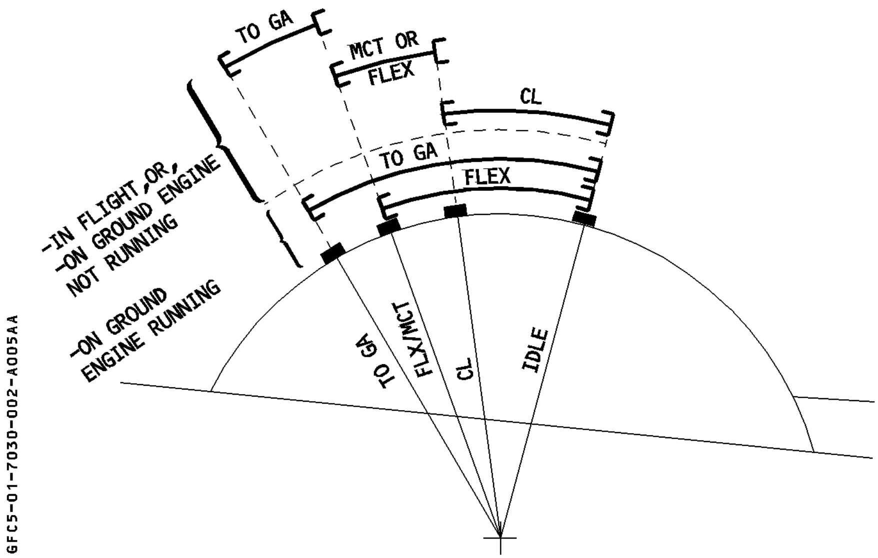


The thrust levers can only be moved manually.
They move over a sector that is divided into 3 operating segments.
The sector has 4 positions defined by detents or stops.
Thrust lever position is transmitted to the FADEC which computes and displays the thrust rating limit and the N1 for that Thrust Lever Angle (TLA).

THRUST RATING LIMIT

The FADEC computes the thrust rating limit for each thrust lever position, as shown below.
If the thrust lever is set in a detent, the FADEC selects the rating limit corresponding to this detent.
If the thrust lever is set between two detents, the FADEC selects the rating limit corresponding to the higher detent.

N1 RATING LIMITS :

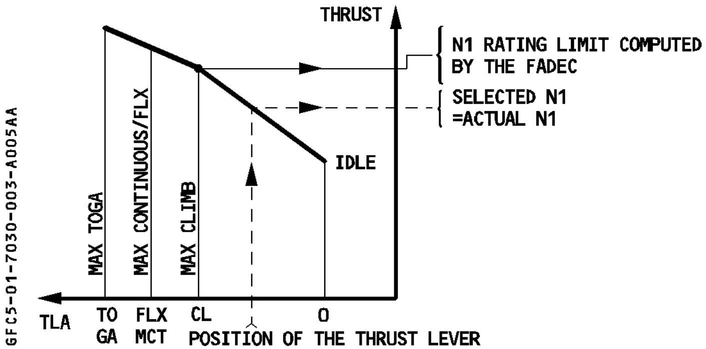


THRUST CONTROL

MANUAL MODE

The engines are in the manual mode provided the A/THR function is:
- not armed or
- armed and not active (thrust lever not in the A/THR operating range and no alpha floor).

In these conditions, each engine is controlled by the position of its thrust lever.
The pilot controls the thrust by moving the thrust lever from IDLE to TOGA positions. Each position of the thrust lever within these limits corresponds to an N1.
When the thrust lever is in a detent, the corresponding N1 is equal to the N1 rating limit computed by the FADEC for this engine.



When the thrust lever is set in FLX MCT detent :

- **On the ground :**
  The engine runs at the flex takeoff thrust rating if the MCDU has selected a flex takeoff temperature that is higher than the current total air temperature (TAT).
  Otherwise the engine produces maximum continuous thrust (MCT).

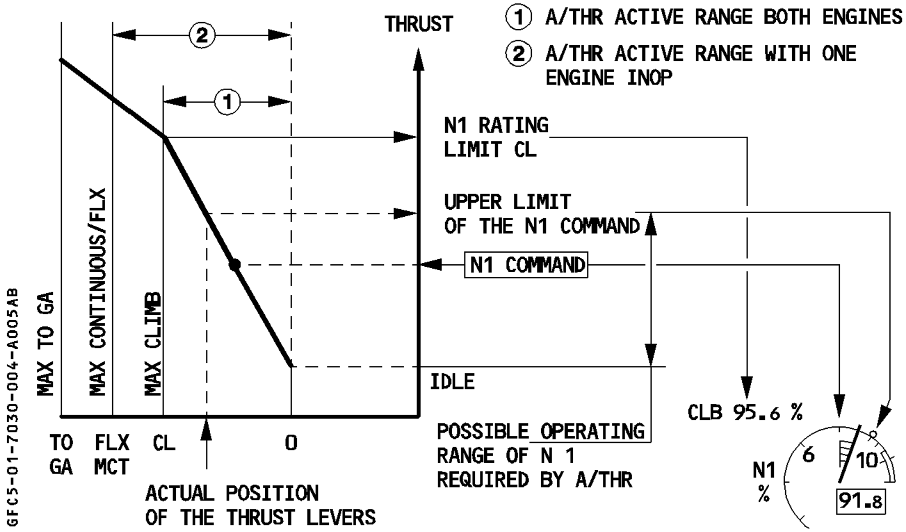
  Note : A change in FLEX TEMP during the takeoff has no effect on the thrust.

- **After takeoff:**
  The pilot can change from FLX to MCT by moving the thrust lever to TOGA or CL, then back to MCT. After that, he cannot use the FLX rating.
  The pilot can always get MAX TO thrust by pushing the thrust lever all the way forward.

  Note : Setting the thrust lever out of FLX MCT detent without reaching TOGA or CL detent has no effect.

AUTOMATIC MODE

In the autothrust mode (A/THR function active), the FMGC computes the thrust, which is limited to the value corresponding to the thrust lever position (unless the alpha-floor mode is activated).



INDICATIONS ON FMA

The FADECs monitor the positions of the thrust levers and trigger appropriate indications on the FMA :

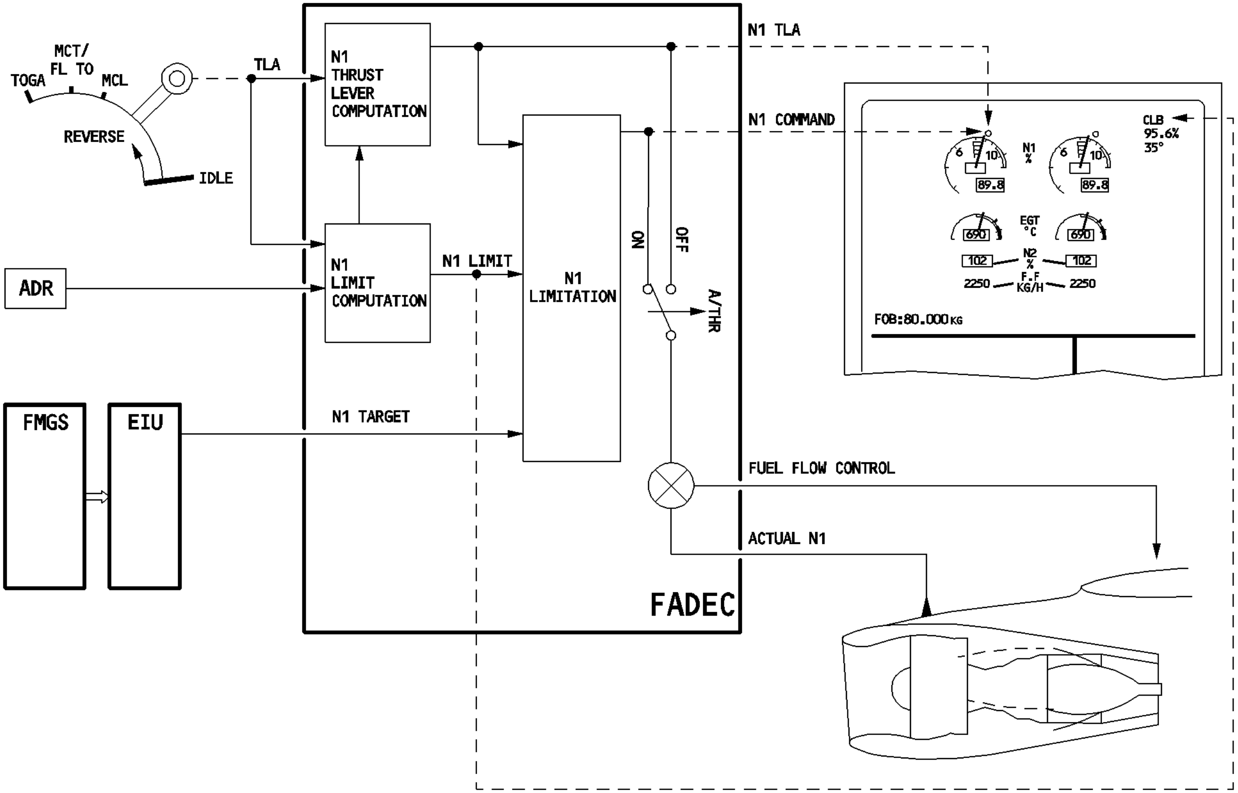
LVR ASYM : appears in amber (third line on the FMA) if, with A/THR active and both engines running, one thrust lever is set out of the CLB detent

LVR CLB : flashes white (3rd line on the FMA) if the thrust levers are not in CL position while the aircraft is above the altitude of thrust reduction with both engines running.

LVR MCT : flashes white (3rd line on the FMA) if the thrust levers are not in MCT position after an engine failure (with speed above green dot).

THRUST CONTROL

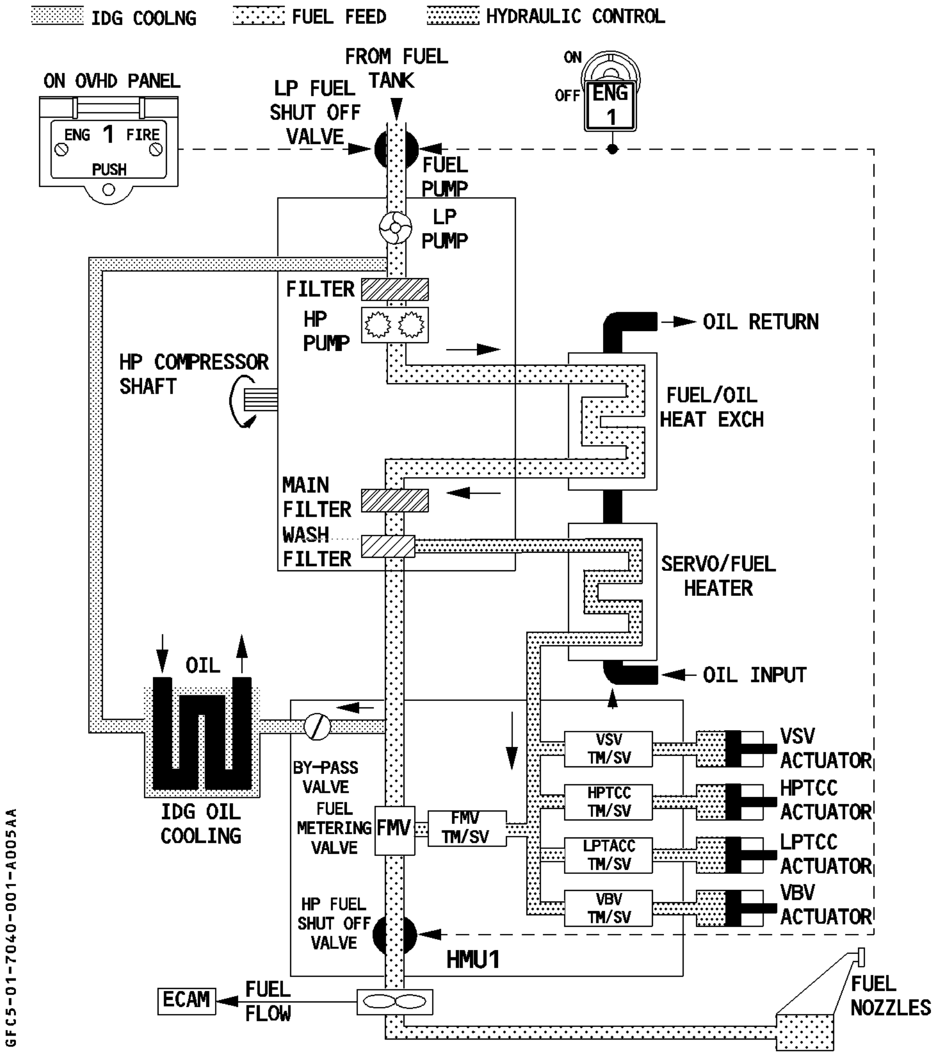
GFC5-01-7030-005-A005AA



GENERAL

The fuel system supplies fuel to the combustion chamber at the required flow rate, pressure and temperature.
The fuel flows from the tank, via the fuel pump unit and the fuel/oil heat exhanger, to the Hydromechanical Unit (HMU) and to the fuel nozzles.

FOR INFO



FUEL PUMP UNIT

The HP compressor shaft drives the HP fuel pump assembly. Fuel flows through the LP pump, a filter (debris screen), and the HP pump (gear pump), then through the fuel/oil heat exchanger and the main filter. Fuel then divides into two filtered flows, one for the servo-fuel heater and servo-valves of the HMU, and one for the metering valve of the HMU.

SHUTOFF VALVES

Moving the ENG1 (ENG2) MASTER switch to OFF directly commands the closing of the LP and HP fuel shutoff valves for that engine fuel system.

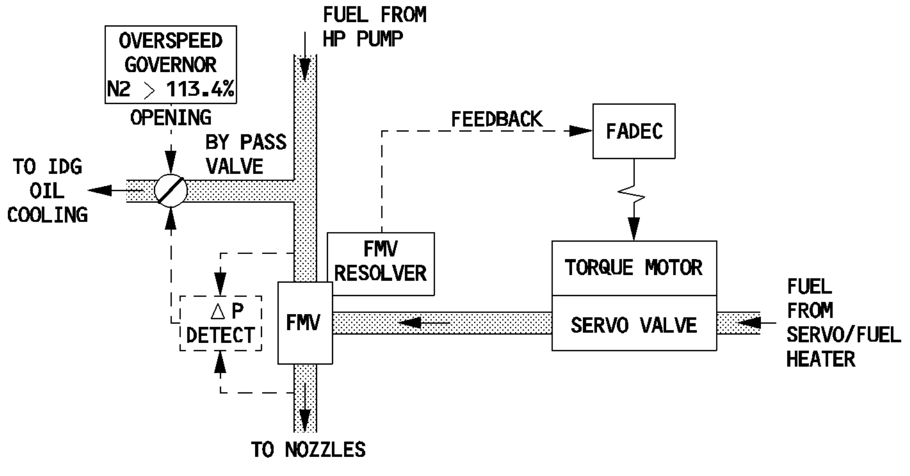
HYDROMECHANICAL UNIT

The FADEC controls the HMU which :
– controls fuel flow to engine combustion chamber
– controls fuel hydraulic signals to actuators
– protects against overspeeding

FUEL FLOW

FOR INFO

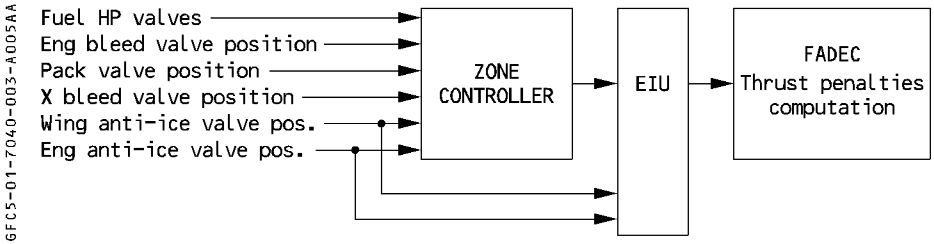
The fuel metering valve (FMV) transforms FADEC orders through a torque motor and servo valve into fuel flow to the engine fuel nozzles.
The FMV resolver generates a feedback signal proportional to the FMV position.
The bypass valve maintains a constant pressure drop across the FMV to ensure that the metered fuel flow is proportional to the FMV position.



GFC5-01-7040-002-A005AA

The FADEC computes the fuel flow that will maintain the target N1.
As the FADEC maintains this N1, it allows N2 to vary while remaining between N2 minimum and N2 maximum. The FADEC also controls the engine parameters to :
- Limit acceleration and deceleration ;
- Avoid engine stall or flameout ;
- Limit maximum N1 and N2 ;
- Maintain the air bleed pressure requirement.

The FADEC computes the N2 correction according to the bleed configuration.



OVERSPEED GOVERNOR SYSTEM

Independent of the FADEC, the overspeed governor limits the N2 by opening the fuel bypass valve, in the event of a malfunction that could lead to an overspeed condition.

IDLE CONTROL

The FADEC has the following three idle modes :

Modulated idle

R - Is regulated according to :
  - Bleed system demand
  - Oil temperature
  - Mach number
- Is selected :
  - In flight, when the flaps are retracted and the gear is up.
  - On ground, provided reverse is not selected.

Approach idle

R - Is regulated according to aircraft altitude, regardless of bleed system demand.
- Selected in flight, when the flaps are extended to FLAP 2, FLAP 3, or FULL, or when the landing gear is down.
- Allows the engine to rapidly accelerate from idle to go-around thrust.

Reverse idle

- Selected on ground, when reverse thrust is selected.
- Slightly higher than forward idle thrust.

FUEL HYDRAULIC SIGNALS

FOR INFO

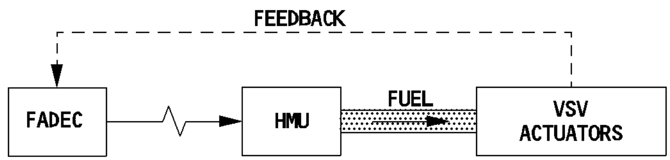
Fuel hydraulic signals go to :

- ***Low Pressure Turbine Clearance Control (LPTCC) valves.***
  (Refer to 1.70.60)

- ***High Pressure Turbine Clearance Control (HPTCC) valves.***
  (Refer to 1.70.60)

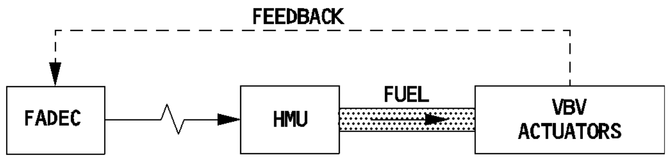
- ***Variable Stator Vanes (VSVs)***
  The VSVs system positions the compressor variable vanes
  The FADEC maintains optimum compressor efficiency at a steady state and an adequate stall margin for transient engine operation.
  VSVs are fully closed at low engine power and are fully open at high thrust.

GFC5-01-7040-004-A005AA



- ***Variable Bleed Valves (VBVs)***
  The FADEC controls the VBVs, upstream of the HP compressor. Their setting depends on compressor inlet temperature and on N2. It varies between full open (start, low thrust, and during fast deceleration) and full closed (high thrust) positions.

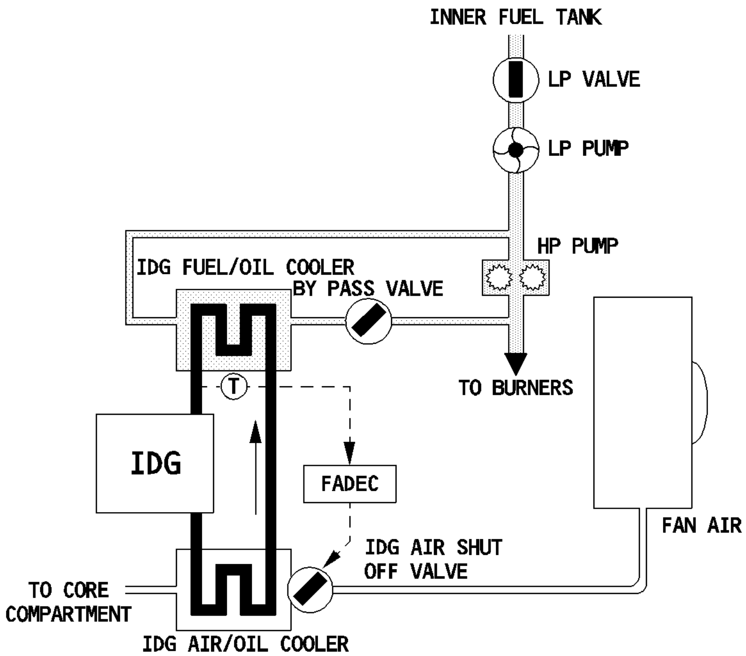
GFC5-01-7040-004-B005AA



IDG OIL COOLING SYSTEM

IDG oil cooling is ensured by the IDG fuel/oil heat exchanger using fuel flow from the HMU.
At low fuel flows the IDG oil is cooled with fan discharge air thru an air/oil cooler.
The air is extracted from the fan by opening the air/oil cooler valve controlled by the FADEC.

FOR INFO

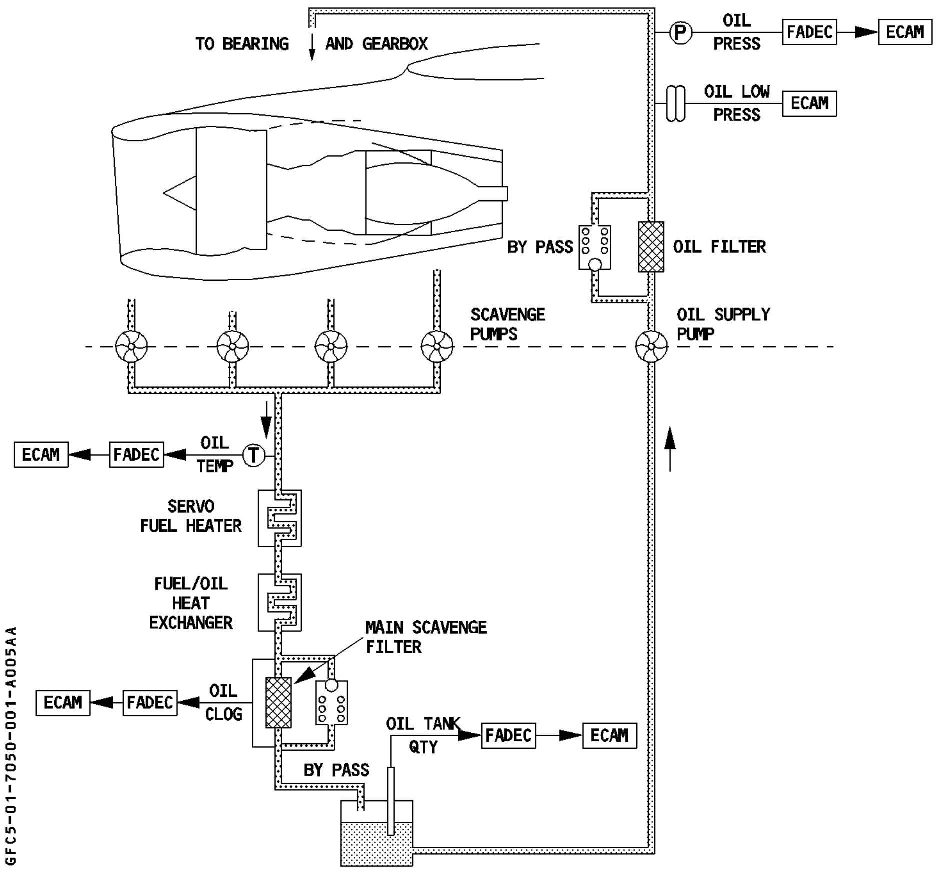


GFC5-01-7040-005-A005AA

GENERAL

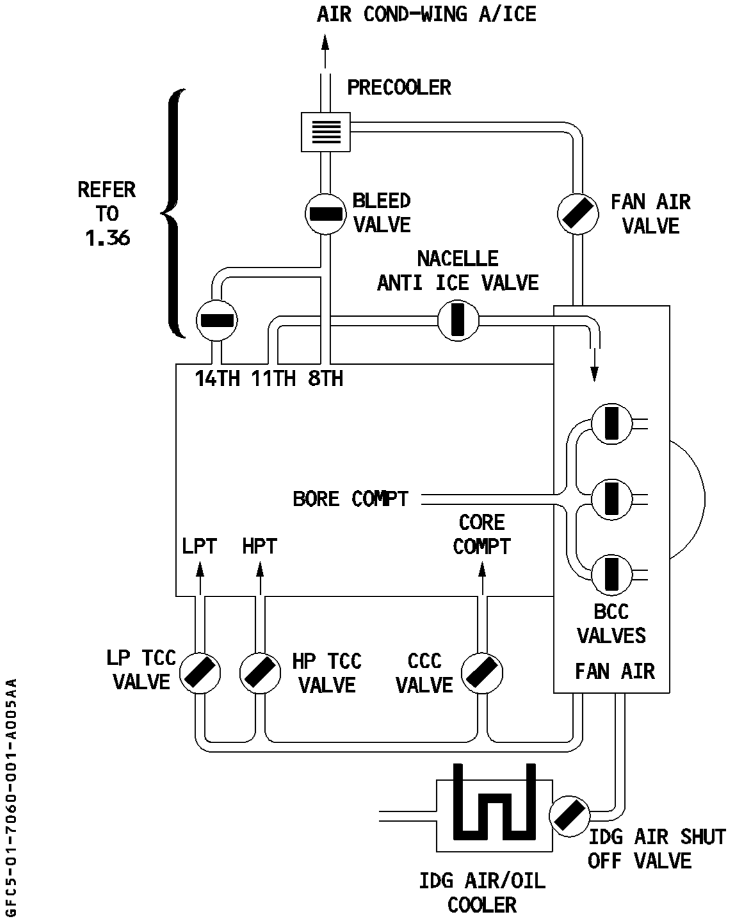
The oil system lubricates the engine components.
It contains :
– the oil tank
– the lube and scavenge pump modules
– the fuel/oil heat exchangers
– the filter, pressure relief and bypass valves.

FOR INFO



GENERAL

The air bleed system is provided for various aircraft uses.
It is used for :
– pneumatic system (Refer to 1.36)
– cooling the engine compartment and the turbine
– cooling the IDG oil



COOLING

HIGH PRESSURE TURBINE CLEARANCE CONTROL (HPTCC) SYSTEM

The HPTCC system is controlled by the FADEC through the HMU and controls the high pressure turbine clearance. The FADEC modulates the fan air flow for the high pressure turbine case cooling.
It provides optimization of high pressure turbine performance and EGT reduction.

LOW PRESSURE TURBINE CLEARANCE CONTROL (LPTCC) SYSTEM

The LPTCC system is controlled by the FADEC through the HMU and controls low pressure turbine clearance.
The FADEC modulates the fan bleed air flow for the low pressure turbine case cooling.

CORE COMPARTMENT COOLING (CCC) SYSTEM

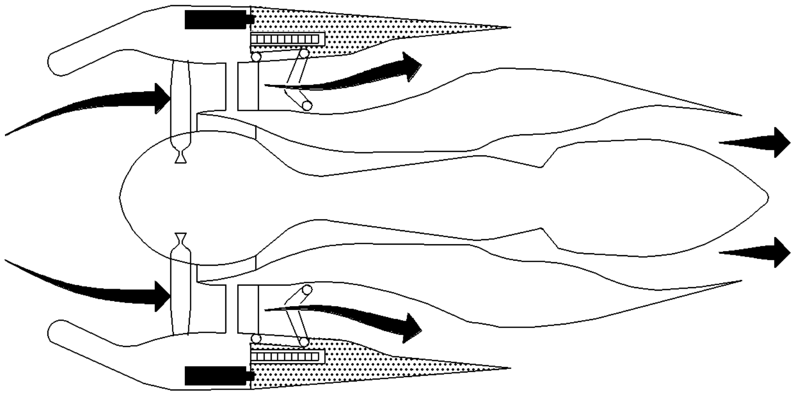
The CCC system is controlled by the FADEC. The core compartment is cooled and ventilated by fan air thru the CCC valve pneumatically actuated.
The FADEC controls the valve to a low flow position during cruise at normal cruise power settings.

BORE COMPARTMENT COOLING (BCC) SYSTEM

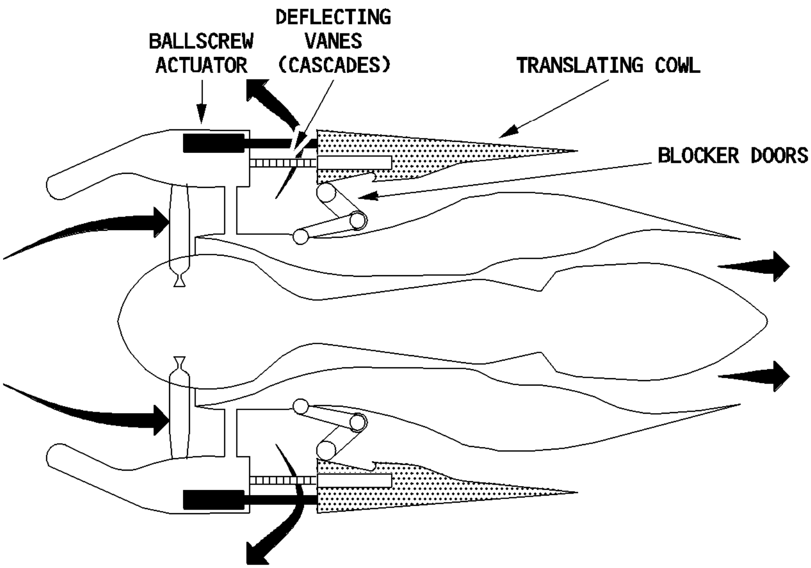
The BCC system is controlled by the FADEC. The bore compartment is cooled and ventilated by fan air thru the three BCC solenoid valves.
FADEC reduces the cooling during cruise.

GENERAL

The reverse thrust is obtained by deflecting the fan airstream. This is done when the translating cowls are fully deployed rearward, thus enabling the pivoting blocker doors to forward divert the fan flow through the cascades.



STOWED THRUST REVERSER



DEPLOYED THRUST REVERSER

GFC5-01-7070-001-A005AA

The thrust reverser system is independently controlled for each engine by the associated FADEC. It is controlled and monitored by each FADEC channel.
The translating cowls are pneumatically actuated.
The thrust reverser system on each engine includes :
- 2 translating cowls each activated by three ballscrews operated by a single pneumatic motor actuator.
- an autonomous air supply valve which automatically selects one of the air pneumatic source depending on delivered pressure.
- a pressure regulator and shutoff valve to regulate down stream pressure to 90 psi maximum
- a directional control valve which actuates the pneumatic motor in the deployed/stowed position
- 2 stow switches (one per cowl) and 2 deploy switches (one per cowl) to monitor whether the translating cowls are deployed or stowed.
- R R One thrust reverser brake which is spring loaded in the lock position. During engine reverse thrust operation, a solenoid allows to overcome the spring.

ACTUATION LOGIC

Deployment requires :
- one FADEC channel operating with its associated thrust lever reverse signal
- aircraft on ground signal from at least one LGCIU
- TLA reverse signal from the flight control primary computer 1 or 3 (PRIM 1 or PRIM 3).

Before the transit completion the FADEC sets reverse idle thrust.

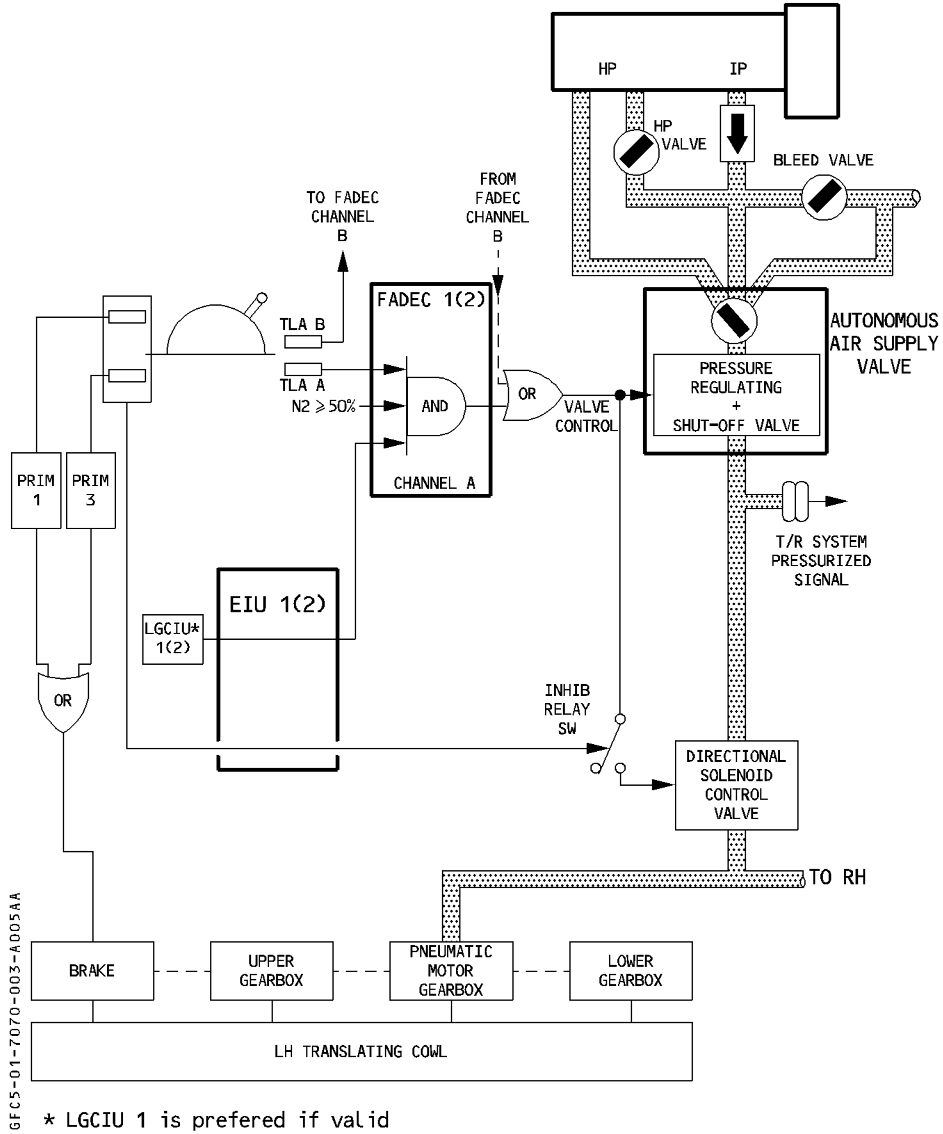
PROTECTION

- AUTO RESTOW FUNCTION
  The FADEC will automatically command the reverser to stow if at least one door is unstowed and reverse thrust is not selected while engine is running.
- IDLE PROTECTION
  The FADEC will automatically select idle thrust if the reverse thrust is not selected and one translating cowl is unstowed by more than 30 % or both cowls are unstowed by more than 15 %.

SCHEMATIC

FOR INFO

R



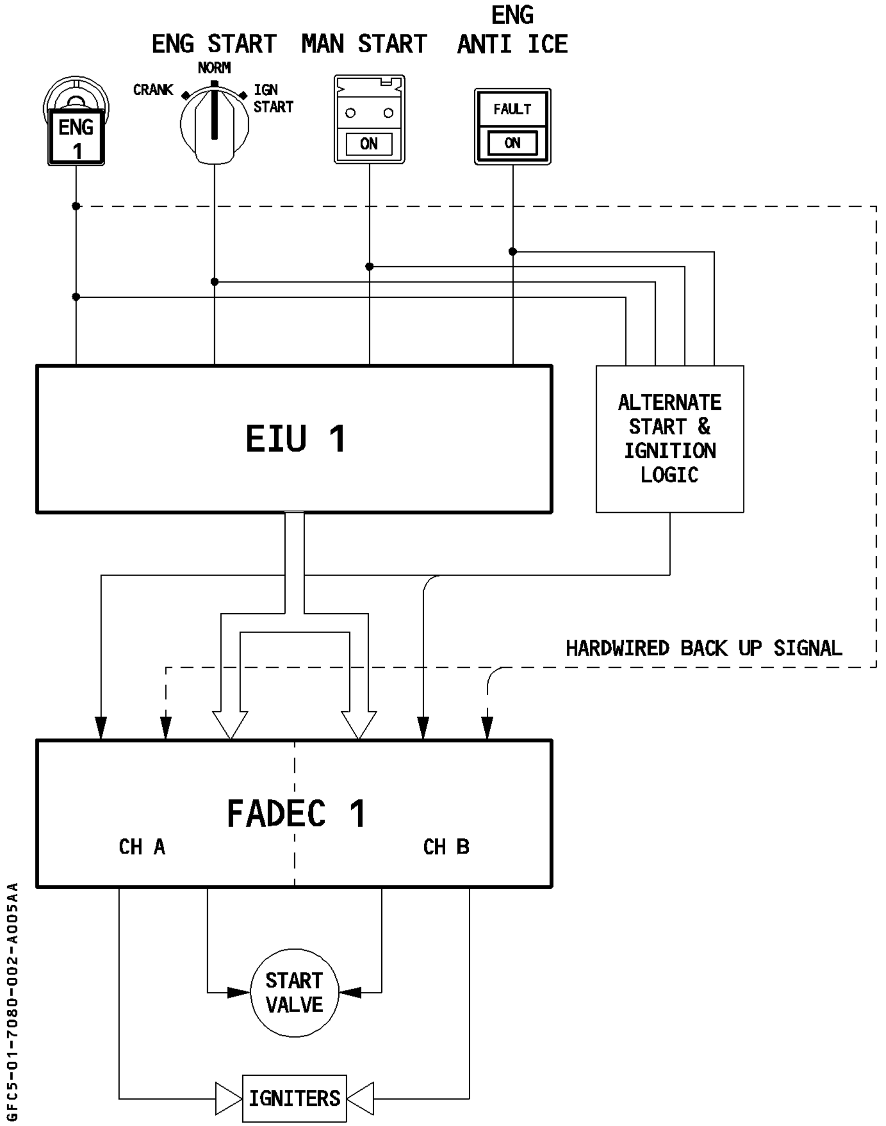
* LGCIU 1 is prefered if valid

GENERAL

The ignition and starting system is controlled by the FADEC according to :
- engine start selector position
- engine master switch position
- ENG MAN START pushbutton position
- ENG ANTI ICE pushbutton position
- flight/ground aircraft condition.

In normal operation, the FADEC receives its inputs from the EIU.
In the event of EIU signal loss, all the functions, except man start and wet crank, will remain available by using both a back up signal from the engine master switch, and the alternate start/ignition signal.

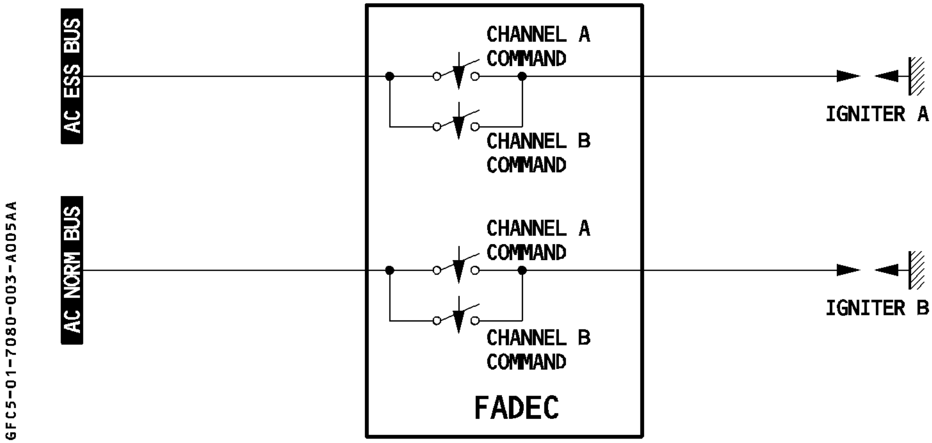
ARCHITECTURE



IGNITION SYSTEM

The ignition system is for engine starting on the ground and restart in flight.
It consists of two identical independent circuits for each engine, normally controlled by the FADEC channel A with the channel B in standby. Each FADEC channel can control both igniters.

FOR INFO



IGNITION FOR STARTING

ON THE GROUND

During an automatic start only one igniter is supplied. The FADEC automatically alternates
R the use of igniters every second start.
The ignition is automatically selected when N2 reaches 10 %.
It is automatically cut off when N2 reaches 54 % N2.
During a manual start both igniters are supplied, when the engine MASTER switch is at ON.
Both stop firing when N2 reaches 50 % N2.

IN FLIGHT

Both igniters are supplied when the engine MASTER switch is at ON.

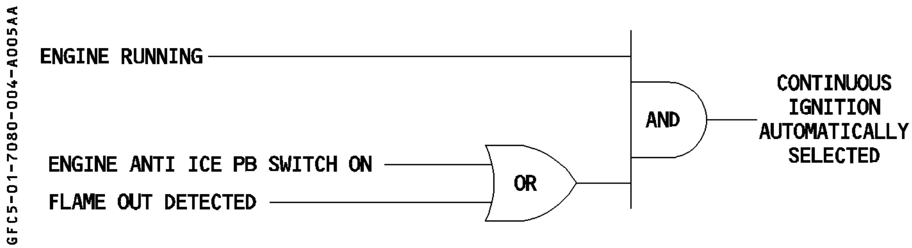
CONTINUOUS IGNITION

Continuous ignition is either selected manually or automatically to protect engine combustion.

MANUAL SELECTION

In flight, continuous ignition is selected when the ENG START selector is on IGN/START provided the related engine is running.
On ground, after starting, since ignition is automatically cut off, it is necessary to cycle the ENG START selector to NORM, then back to IGN/START, to select the continuous ignition.

AUTOMATIC SELECTION



ENGINE STARTING SYSTEM

GENERAL

The engine starting system consists of an air turbine starter and a start valve.
The start valve admits air supplied by the pneumatic system to operate the starter.
The FADEC controls the start valve electrically. On the ground, in the event of electrical control failure the start valve can be manually operated by a handle.

AUTOMATIC STARTING

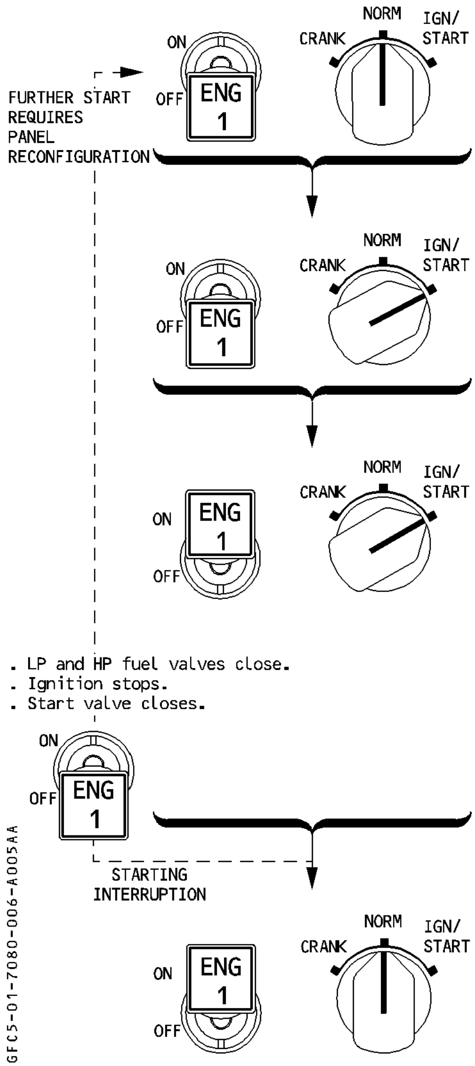
This sequence is under the full authority of the FADEC which controls :
- the start valve
- the igniter(s)
- the fuel HP valves.

It provides:
- detection of hot start, hung start, stall or no light up, and protection for starter reengagement speed and time.
- FAULT announcement with specific ECAM message.
- start abort on ground (high pressure valve closure, start valve closure, ignition stopped) and automatic engine crank after start abort and control of any additional start attempts.

In flight, the FADEC identifies the windmilling or starter assisted airstart conditions according to engine parameters and the flight environmental parameters.
This sequence may be interrupted by selecting the engine master switch to OFF.

AUTOMATIC STARTING SEQUENCE

R



INITIAL CONFIGURATION OF CONTROLS (engine not running).

ENG MAN START
Pushbutton OFF

- START IDENTIFICATION :
  ECAM ENG page is displayed. (**)
- PACK VALVES close. (*)

- LP fuel valve opens.
- START VALVE opens.
- Ignition starts when N2 ⩾ 10% :
  . On ground : Using ignition A or B
  . In flight : Using ignition A + B
- HP fuel valve open when N2 ⩾ 15%
- When N2 ⩾ 50% :
  . START VALVE closes.
  . PACK VALVES reopen, if the other engine is not started within 30 seconds.
- When N2 ⩾ 54% :
  . IGNITER off, if on ground.

- ECAM ENG page disappears. (***)
- If after engine start, the MODE Sel is set at NORM and back to IGN/START, continuous relight is activated on the running engine(s).

R *Note :* *(*) If after 30 seconds the engine master switch is not ON, the pack valves will*
R *reopen.*
(**) At first engine start, if after IGN/START selection no further action is applied, the ECAM ENG page will automatically disappear after 30 seconds.
(***) If ENG START selector is not switched to NORM, the ENG page is automatically replaced by the WHEEL page 15 seconds after 2nd engine start.

MANUAL STARTING

Manual starting is under limited authority by the FADEC which controls :
- start valve opening when the ENG START selector is set to IGN/START and the MAN START pushbutton is depressed
- high pressure fuel valve and operation of both igniters when the engine master switch is set to ON.
- start valve closure at 50 % N2, and, on ground, ignition cut off at 54 % N2.

The FADEC provides a passive survey of the engine during the starting sequence.
R On the ground, it will automatically abort the starting sequence in case of starter reengagement speed exceedance.
The sequence may be interrupted :
- before engine master switch set to on by selecting MAN START pushbutton to OFF.
- after engine master switch set to on by selecting it back to OFF. In this case a dry crank shall be selected by the crew.

Note : *When the engine master switch is set to on, selecting the MAN START pushbutton to off has no effect.*

In flight, the FADEC always commands a starter assisted airstart.

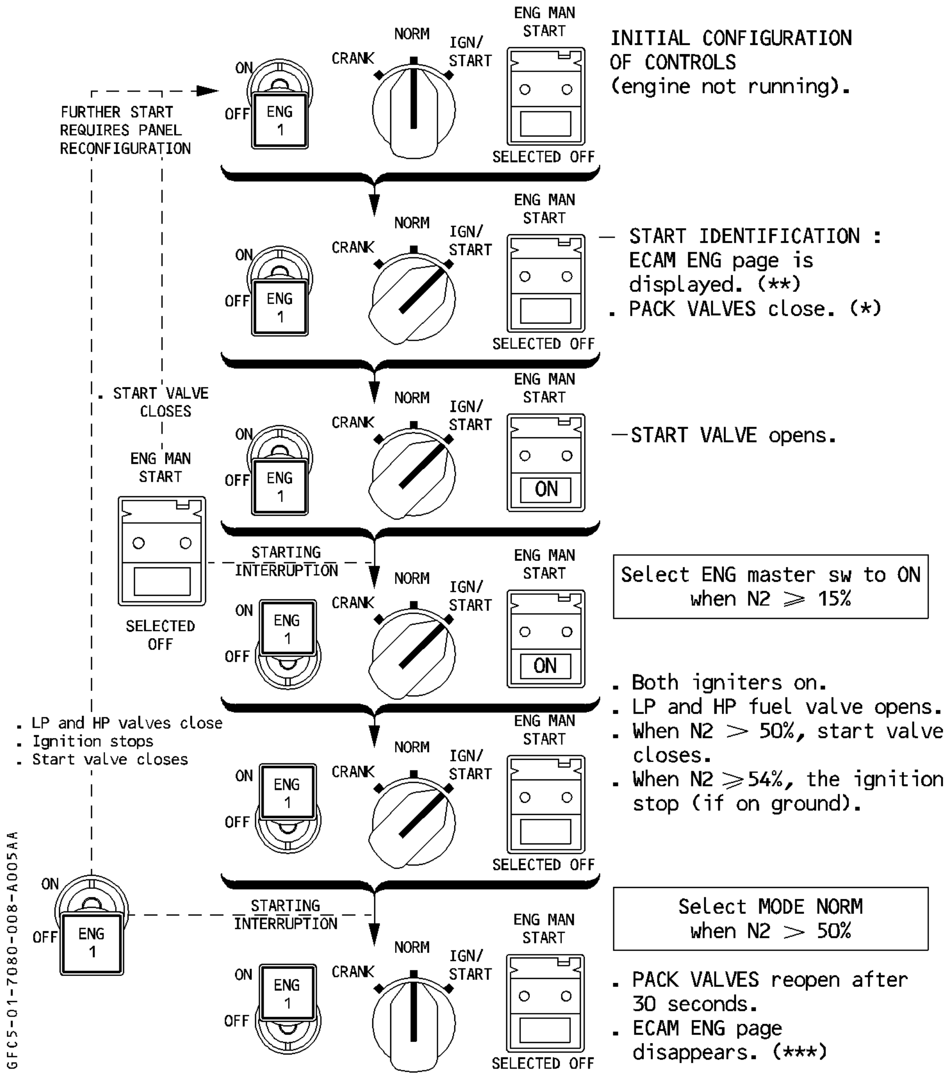
ENGINE VENTILATION (Dry cranking)

A dry cranking cycle enables the engine to be ventilated to remove fuel vapors after an unsuccessfull start attempt on the ground.
Cranking can be manually selected by setting the ENG START selector to CRANK and the MAN START pushbutton to ON (engine master switch OFF). It is stopped by setting the MAN START pushbutton to off.

CAUTION
Selecting the ENG START selector to NORM would not stop the cranking.

R

MANUAL STARTING SEQUENCE

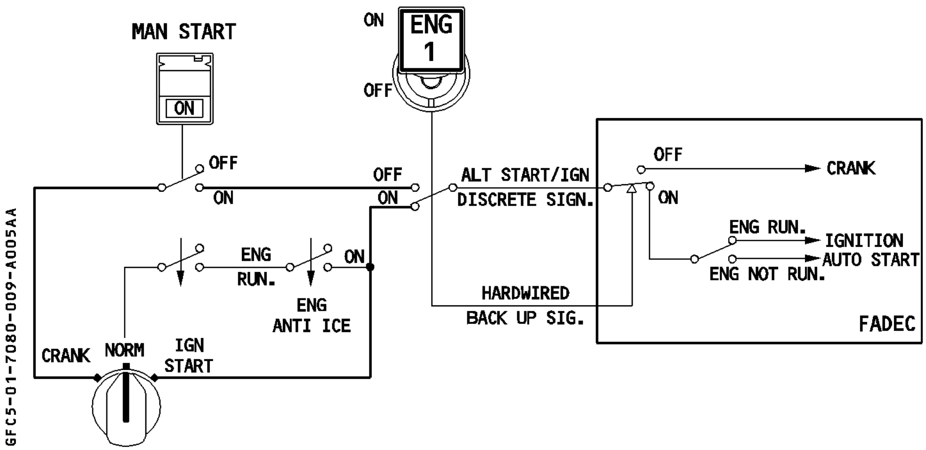


R R *Note : (*) If after 30 seconds the ENG MAN START pushbutton is not switched ON, the pack valves will reopen.*
(**) At first engine start, if after IGN/START selection no further action is applied, the ECAM ENG page will automatically disappear after 30 seconds.
(***) If ENG START selector is not switched to NORM, the ENG page is automatically replaced by the WHEEL page 15 seconds after 2nd engine start.

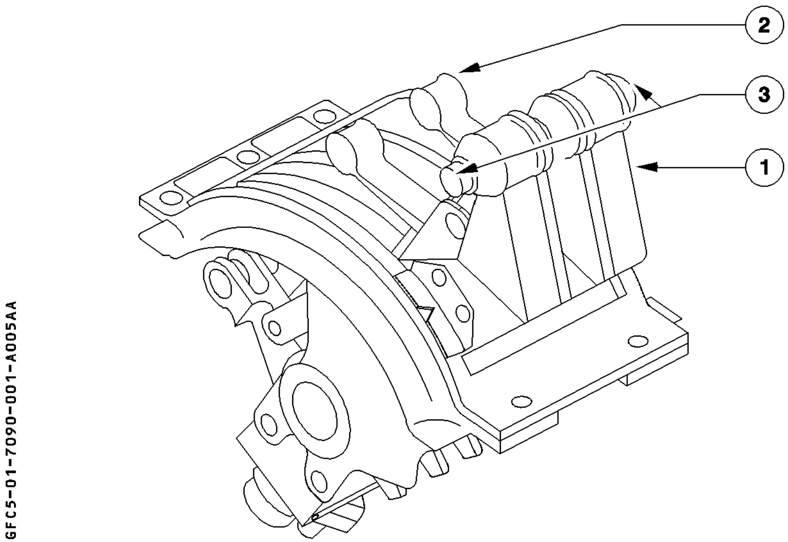
ALTERNATE START / IGNITION INFORMATION

In case of EIU failure, the FADEC uses a backup signal from the engine master switch and the alternate start/ignition signal to control :
— an automatic starting,
— a dry crank or
— the continuous ignition
Manual starting is no longer available.

FOR INFO



PEDESTAL



(1) Thrust levers

(Refer to 1.70.30)

(2) Reverse control levers

When the thrust levers are not at idle, the reverse control levers are mechanically locked in the stowed position.
When the thrust levers are at idle, thrust reverser operation can be controlled by pulling backward the reverse control levers.
A detent indicates to the crew the reverse idle position.
For reverse thrust application the reverse control levers are pulled rearward as required.
For stowage of reversers the levers are moved forward then pushed down.

(3) Autothrust instinctive disconnect pb

(Refer to 1.22)

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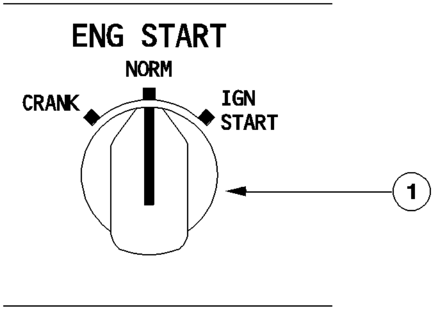


(1) ENG START selector

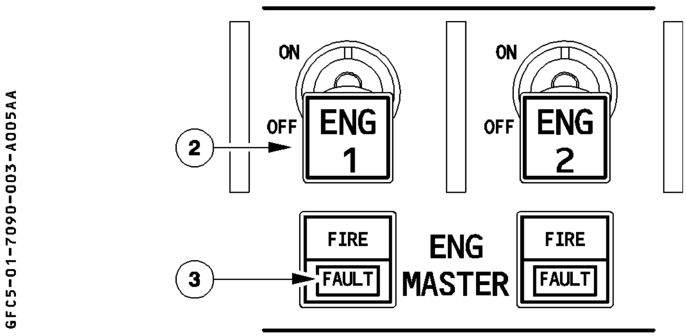
CRANK : The start valve opens, provided the MAN START pushbutton is ON.
R Ignition is not supplied. Both pack flow control valves close when
R CRANK is selected, provided the MAN START pushbutton is ON.

NORM : Continuous ignition A + B is selected, when the engine is running, and one of the following conditions is met :
- The ENG ANTI ICE pushbutton is ON.
- A flame-out is detected.

IGN START :
- If the engine master switch is ON, and N2 ≥ idle, continous ignition is selected.
- During an automatic start, the ignition will be selected :
  · On ground, when N2 ≥ 10 %
  · In flight, at start sequence initiation.
- During a manual start, the ignition is selected when the engine master switch is selected ON.

R Both pack flow control valves automatically close during the start sequence (Refer to 1.21.20). APU speed (if used) increases.

Note : On ground, the ignition is automatically cut off at the end of the start sequence (N2 ≥ 54 %)



(2) ENG MASTER sw 1 (2)

ON : Low pressure fuel valve will open (provided the ENG FIRE pushbutton is in).
- During an automatic start, the high pressure fuel valve opens provided :
  · the ENG START selector is at IGN / START
  · the N2 is above 15 %
- During a manual start, the high pressure fuel valve will open provided :
  · ENG START selector is at IGN / START
  · MAN START pushbutton is ON

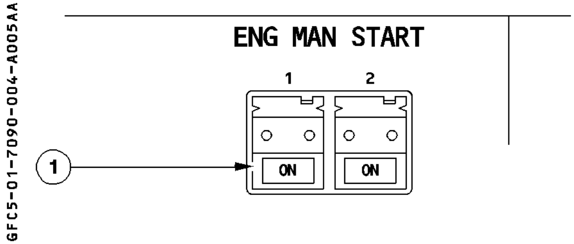
OFF : A Closure signal is sent directly to the high pressure fuel valve and the low pressure fuel valve.
Controls the reset of both channels of the FADEC.

Note : Releasing ENG FIRE pushbutton permits engine shutdown by closing the low pressure fuel valve. There is a time delay of about 40 seconds at ground idle (the time delay is due to fuel left between low pressure valve and nozzles)

(3) FIRE FAULT lt 1 (2)

FAULT lt : Illuminates amber associated with ECAM caution in case of:
- an automatic start abort
- a disagreement between the high pressure fuel valve position and its commanded position.

OVERHEAD PANEL



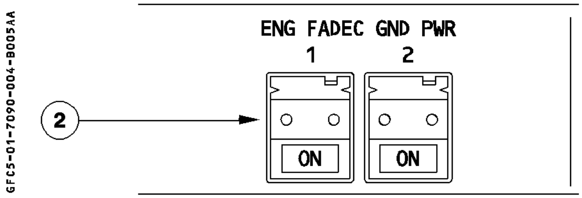
① ENG MAN START pb sw

ON : The start valve opens provided ENG START selector is set to CRANK or IGN/START.
Both pack valves close during the start sequence.

Note : The start valve closes automatically when N2 ≥ 50 %.

ON light illuminates blue.

Off : When the ENG MAN START pushbutton is set off during a manual engine start, the start valve closes provided the engine master switch is at OFF position.



② ENG FADEC GND PWR pb sw

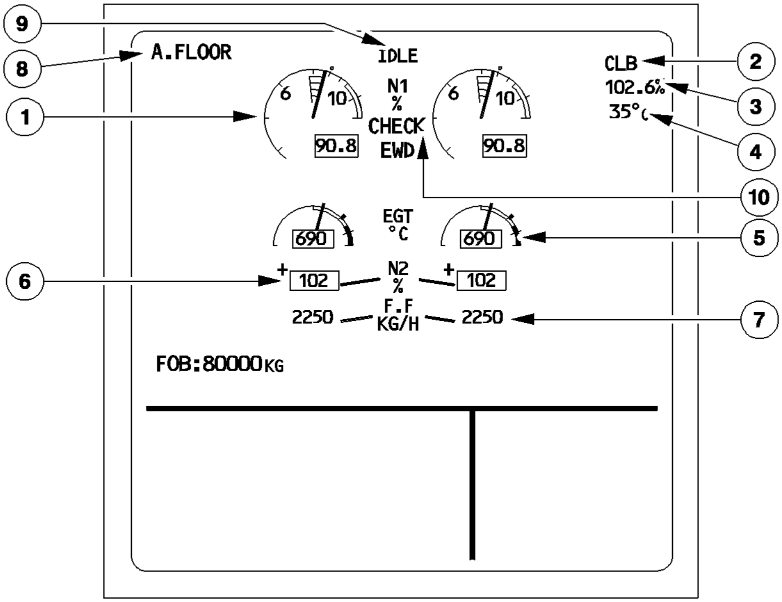
ON : The FADEC is supplied by the aircraft network for 5 minutes (except if the ENG FIRE pushbutton is released out, or if FADEC Generator is available). The ON light illuminates with a delay of 2 seconds.

ECAM

GENERAL

The engine primary parameters are permanently displayed on the upper ECAM E / WD.
The secondary parameters are displayed on the lower ECAM SD when selected automatically or manually.
In case of all DMC ECAM channel failure the engine primary parameters can be displayed on each ND using the ND selector on the EFIS control panel.

PRIMARY PARAMETER



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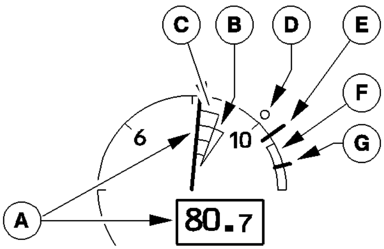
R ① LP rotor speed (N1)



GFC5-01-7090-005-B005AA

(A) Actual N1

The N1 needle and N1 digital indication are :
- normally green
- amber when the actual N1 is above the N1 MAX (see E)
- red when the actual N1 is above the N1 RED line (115.5 %).

When N1 is degraded (in case both N1 sensors fail), the last digit of the digital display is amber dashed.

(B) N1 Command (N1 tendency)

The green needle corresponds to N1 demanded by the FADEC. In addition next to the N1 trend needle a green triangle indicates the direction of N1 tendency. These symbols are displayed when A/THR is active.

(C) Transient N1

Symbolizes the difference between the N1 command and the actual N1. It is displayed only when A/THR is active.

(D) N1 TLA (blue circle)

N1 corresponding to the thrust lever position (predicted N1)

(E) N1 MAX

Amber index at the value corresponding to the N1 limit value of the TOGA or REV mode.

(F) Max permissible N1

N1 redline is represented by a red arc at the end of the scale beginning at 115.5 %

(G) N1 exceedance

If 115.5 % is exceeded, a red mark appears and remains at the maximum value achieved. It will disappear after a new start on ground or after maintenance action through the MCDU.

(I) REV indication

The REV indication appears in amber when at least one reverser cowl is unstowed or unlocked. It changes to green when the reversers cowls are fully deployed.
(If unlocked in flight the indication first flashes for 9 seconds and then remains steady).

(J) AVAIL indication

This is displayed in green to indicate a successful engine start on ground.
It is pulsing in green to indicate a successful engine relight in flight.
It is triggered when the engine is at or above idle.

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(2) Thrust limit mode

TOGA, FLX, CLB, MCT, limit mode selected by the thrust lever is displayed in blue. If FLX mode is selected, the flexible take-off temperature selected through the MCDUs is displayed in blue.
If a derated takeoff has been selected by the crew, D04, D08, D12, D16, D20 or D24 may be displayed. ⊲
DCLB1 or DCLB2 is displayed during the climb phase if the crew has selected a derated climb through the MCDU PERF CLB page. ⊲

(3) N1 rating limit

Is computed by the FADEC according to the thrust lever angle, and displayed in green.
The highest N1 mode and associated N1 limit value of the both engines is displayed.

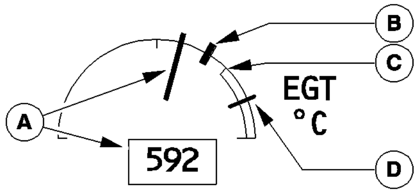
Note : – *On the ground with the engines running, the displayed N1 rating limit corresponds to the TOGA thrust limit whatever the thrust lever position is.*
– *On ground with engines running and if FLEX mode is selected, FLEX N1 is displayed whatever the thrust lever position is, between IDLE and FLX / MCT.*

(4) FLEX temperature

If a FLEX temperature has been entered through MCDU and validated by the FADEC, this temperature is displayed in blue.

(5) EGT indicator

GFC5-01-7090-008-A005AA



(A) Actual EGT
- Normally green
- Becomes amber above :
  - · 750°C during start sequence or,
  - · 940°C (except at takeoff)
- Becomes red above 975°C.

(B) EGT Max (amber)
R 750°C at engine start then 940°C. Not available when either take off thrust is applied
R or alpha floor is active or reversers are selected.

(C) Max permissible EGT
EGT red line is at 975°C. A red arc is displayed above 975°C to the end of the scale.

(D) EGT exceedance
If 975°C is exceeded, a red mark appears at the max value achieved. It will disappear after a new start on the ground or after a maintenance action through the MCDU.

(6) HP rotor speed N2

Digital indication normally green is displayed in double brightness during engine start and located in a grey background box.
When the N2 is above 113 % the indication becomes red and a red cross appears next to the digital indication. The red cross will disappear only after a new start on ground or after a maintenance action through the MCDU.
When the N2 value is degraded (in case of a dual N2 sensor failure), the last digit is amber dashed.

(7) Fuel flow

Green indication

(8) A FLOOR message

Is displayed amber when the ECUs receive the corresponding signal from FMGS.

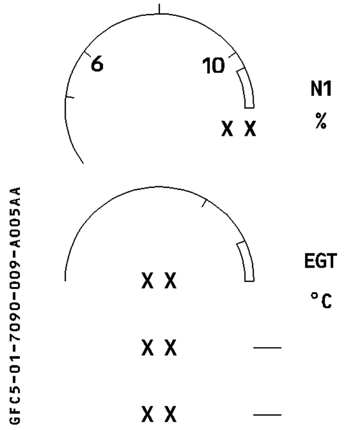
(9) IDLE message

This legend appears in green when both engines are at idle. It flashes for 10 seconds, then is steady.

(10) CHECK EWD message

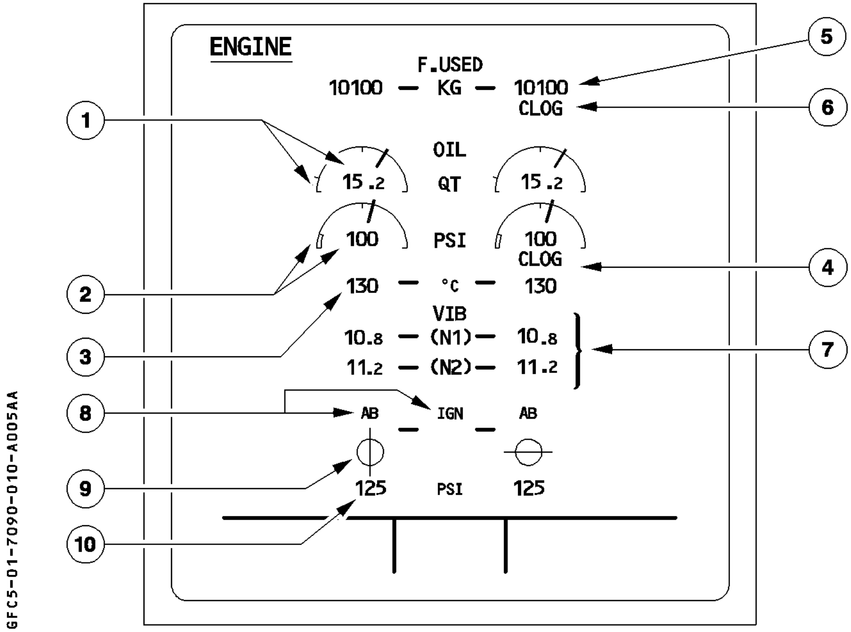
Is displayed amber on the EWD and on both NDs in case of discrepancy between N1, N2, EGT, FF values on FADEC-DMC bus and corresponding displayed information.

Note : *When one parameter becomes invalid, two amber crosses replace the associated digital indication. For N1 and EGT parameters, the needle and the box around the digital display disappear.*



SECONDARY PARAMETERS

START CONFIGURATION



(1) Oil quantity indication

The needle and the digital indication are normally green.
The digital indication pulses if the oil quantity drops below 2 quarts.
(Also displayed on ECAM CRUISE page).
Advisory is inhibited :
- at takeoff or go around
- when reversers are selected
- in alpha floor mode

(2) Oil pressure indication

The needle and the digital indication are normally green.
The needle and the digital indication are red if the oil pressure drops below 10 psi.

3 Oil temperature indication

Normally green
The indication pulses above 160° C
The indication becomes amber if temperature exceeds :
– 160° C for more than 15 minutes
– or, 175° C without delay.

4 Oil filter clog indication

CLOG message appears in amber in case of excessive pressure loss accross the oil main scavenge filter.

Note : This is not an indication that the bypass valve is open.

5 Fuel used indication

The fuel used value computed by the FADEC is displayed in green.
After a transmission interruption by the FADEC, if the displayed value is 100 kg less than the actual value it is crossed by 2 amber dashes.
It is reset at engine start on ground.
Also displayed on ECAM CRUISE page and ECAM FUEL page.

6 Fuel filter clog indication

CLOG message appears in amber in case of excessive pressure loss accross the fuel filter.

7 VIB indications

The indication is green.
R It pulses above 5.7 units for N1, 5.6 units for N2.
Also displayed on ECAM CRUISE page.

8 Ignition indication

IGN is displayed in white during the start sequence.
The selected ignitors "A" or "B" or "AB" are displayed in green when supplied.

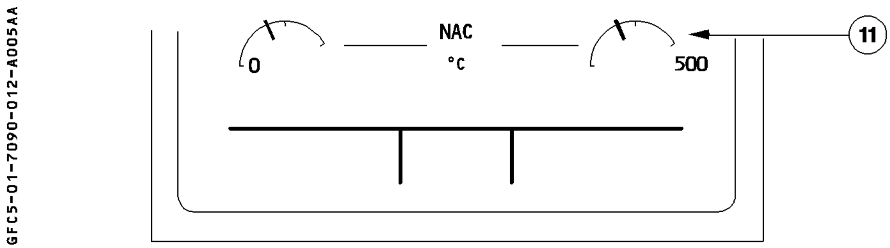
(9) Start valve position indication

In line - Green : The valve is fully open.
Crossline - Green : The valve is fully closed.
In line - Amber : The valve is abnormally fully open.
Crossline - Amber : The valve is abnormally fully closed.

(10) Engine bleed pressure

Bleed pressure, upstream of the precooler, is normally displayed in green.
It becomes amber below 21 psi, with N2 ≥ 10 %, or in case of overpressure.

AFTER START CONFIGURATION

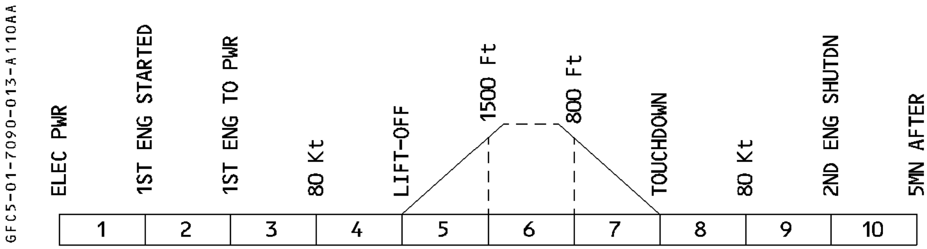


(11) Nacelle temperature indication

Nacelle temperature needles are displayed in green. They start pulsing, if the
R temperature exceeds 260°C.
The advisory threshold is indicated by a small mark on the arc.
The NAC is displayed in white.
Nacelle temperature indications are removed during engine start.

Note : In case of the invalidity of any parameter, the associated digital indication is replaced by two amber crosses.
For OIL QTY, OIL PR, and NAC TEMP the needle is removed.

WARNINGS AND CAUTIONS



<table>
<tr><th>E / WD: FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>ALL ENG FLAME OUT
Both engines flame out.</td><td rowspan="3">CRC</td><td rowspan="3">MASTER WARN</td><td>ENG</td><td rowspan="14">NIL</td><td>NIL</td></tr>
<tr><td>N1 OVERLIMIT
N1 above 115.5 %.</td><td rowspan="4">NIL</td><td rowspan="3">4, 8</td></tr>
<tr><td>N2 OVERLIMIT
N2 above 113 %.</td></tr>
<tr><td>EGT OVERLIMIT
EGT above 975°C.</td><td>SINGLE CHIME</td><td>MASTER CAUT</td></tr>
<tr><td>EGT EXCEEDED
Egt amber line exceedance during an air start of the previous flight.</td><td>NIL</td><td>NIL</td><td>3 to 10</td></tr>
<tr><td>OIL LO PR
Oil pressure low (< 10 psi).</td><td>CRC</td><td>MASTER WARN</td><td>ENG</td><td>1, 10</td></tr>
<tr><td>MINOR FAULT
Engine short time, limited dispatch.</td><td>NIL</td><td>NIL</td><td rowspan="4">NIL</td><td>1 to 8</td></tr>
<tr><td>CTL SYS FAULT
VBV or VSV failure or loss of parameters (PS3, T25, T3, N1, N2) or loss of FMV, VSV position.</td><td rowspan="2"></td><td rowspan="2"></td><td>4, 5, 7, 8</td></tr>
<tr><td>BLEED STATUS FAULT
Bleed status not received by active FADEC channel.</td><td>3, 4, 5, 7, 8</td></tr>
<tr><td>COOL VALVE FAULT
IDG valve closed.</td><td>NIL</td><td>NIL</td><td>3 to 8</td></tr>
<tr><td>ENG FAIL
Eng core speed below idle with MASTER sw ON, and fire pb not pushed.</td><td rowspan="4">SINGLE CHIME</td><td rowspan="4">MASTER CAUT</td><td>ENG</td><td rowspan="2">NIL</td></tr>
<tr><td>ENG SHUT DOWN
Eng master OFF in Phases 3 to 8, or eng fire pb pushed in phases 1, 2, 9 and 10.</td><td rowspan="3">NIL</td></tr>
<tr><td>THR LEVERS NOT SET
Throttle set between CLB and MCT at TO. Flex takeoff mode not selected by at least one FADEC.</td><td>1, 4 to 8, 10</td></tr>
<tr><td>ENG T.O. THRUST DISAGREE
One FADEC, at least, selects a different thrust takeoff mode on ground.</td><td>1, 4 to 10</td></tr>
</table>

<table>
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<tr><td>EIU FAULT
Data bus between EIU and FADEC failed. Engine vib indication is lost.</td><td rowspan="6">SINGLE CHIME</td><td>MASTER CAUT</td><td rowspan="2">NIL</td><td rowspan="19">NIL</td><td>3, 4, 5, 8</td></tr>
<tr><td>FADEC SYS FAULT
One NOGO failure affects one or both channels Channel failure, or alternate fault, or overspeed governor fault, or sensor failure.</td><td>NIL</td><td>4, 5, 6, 7, 8</td></tr>
<tr><td>FADEC FAULT
Data bus between FADEC and ECAM failed</td><td rowspan="4">MASTER CAUT</td><td rowspan="3">ENG</td><td>4, 5, 7, 8</td></tr>
<tr><td>FADEC OVHT</td><td rowspan="4">3, 4, 5, 7, 8</td></tr>
<tr><td>FUEL FILTER CLOG</td></tr>
<tr><td>IGN A+ B FAULT
Both ignition circuits are failed.</td><td rowspan="10">NIL</td></tr>
<tr><td>IGN A(B) FAULT
Ignition circuit A or B failed.</td><td>NIL</td><td>NIL</td></tr>
<tr><td>TYPE DISAGREE
Disagree between pin programming on FADEC and on FWC (engine rate).</td><td rowspan="5">SINGLE CHIME</td><td rowspan="5">MASTER CAUT</td><td>3 to 10</td></tr>
<tr><td>REV SET
Reverse thrust has been selected in flight</td><td>1 to 4, 8 to 10</td></tr>
<tr><td>REV FAULT
Loss of thrust reverser on one engine.</td><td>3, 4, 5</td></tr>
<tr><td>REV PRESSURIZED
Reverser system is pressurized, while rev cowls are stowed and locked, with no deploy order (on ground).</td><td>1, 8</td></tr>
<tr><td>REV UNLOCKED
One reverser cowl not locked in stowed position, with no deploy order.</td><td>8</td></tr>
<tr><td>REV INHIBITED
Reverser is inhibited by maintenance action.</td><td>NIL</td><td>NIL</td><td>3 to 8</td></tr>
<tr><td>THR LEVER FAULT
Both resolvers on one thrust lever failed.</td><td rowspan="6">SINGLE CHIME</td><td rowspan="6">MASTER CAUT</td><td>8</td></tr>
<tr><td>THR LEVER DISAGREE
Disagree between both resolvers of a thrust lever.</td><td>4, 5, 8</td></tr>
<tr><td>OIL LO TEMP
Engine oil temp < -10°C (on ground before takeoff)</td><td rowspan="2">ENG</td><td>3 to 9</td></tr>
<tr><td>OIL HI TEMP
Engine oil temp between 160°C and 175°C more than 15 minutes or above 175°C.</td><td>4, 5, 7, 8</td></tr>
<tr><td>OIL FILTER CLOG</td><td rowspan="2">NIL</td><td>3, 4, 5, 7, 8</td></tr>
<tr><td>THRUST LOCKED
The thrust is frozen on one or both engines, after an involuntary A/THR disconnection.
This caution is recalled every 5 seconds, until thrust levers are moved.</td><td>2, 3, 4, 8, 9</td></tr>
</table>

R

<table>
<tr><th>E / WD: FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>START VALVE FAULT
The start valve is either stuck closed, or stuck open, or no starter air pressure is available (valve disagree).</td><td rowspan="4">SINGLE CHIME</td><td rowspan="4">MASTER CAUT</td><td rowspan="3">ENG</td><td rowspan="3">Associated FAULT lt on ENG panel on pedestal (except in case of starter time exceeded)</td><td rowspan="3">3, 4, 5, 7, 8</td></tr>
<tr><td>START FAULT
Start fault due to :
. Starter time exceeded, or
. Stall, or
. EGT overlimit, or
. No light up, or
. Low N1, or
. Starter failure, or
. Hung start, or
. High tailwind start, or
. THR levers not at idle.</td></tr>
<tr><td>HP FUEL VALVE
Fuel valve failed closed, or open.</td></tr>
<tr><td>ENG THRUST LOSS
The actual bleed configuration is not in accordance with the bleed configuration requested by the crew.</td><td>NIL</td><td>NIL</td><td>1, 4 to 10</td></tr>
</table>

MEMO DISPLAY

The IGNITION message is displayed in green, either when selected automatically by the FADEC or manually by the crew.

BUS EQUIPMENT LIST

			NORM			EMER ELC		
			AC	**DC**	**DC BAT**	**AC ESS**	**DC ESS**	**HOT**
FADEC	CHANNEL A					X		
	CHANNEL B		AC2					
EIU (BOTH ENGINES)					X			
HP VALVES							X	
OIL PRESS		ENG 1		DC1				
		ENG 2		DC2				
IGNITION	A	Both ENG				X		
	B	ENG 1 ENG 2	AC1 AC2					