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
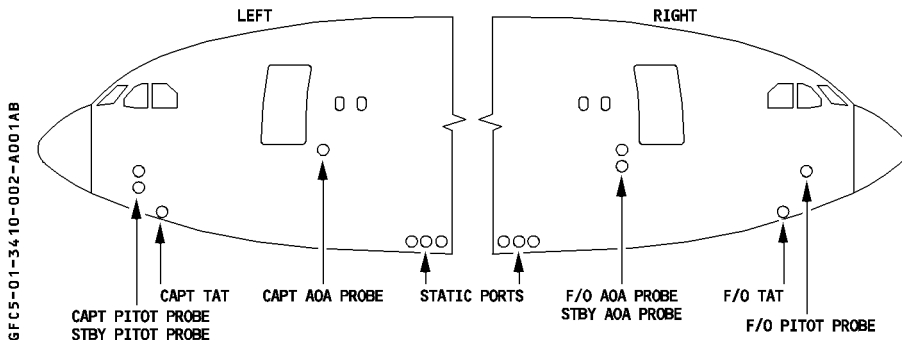
PROBES SCHEMATIC
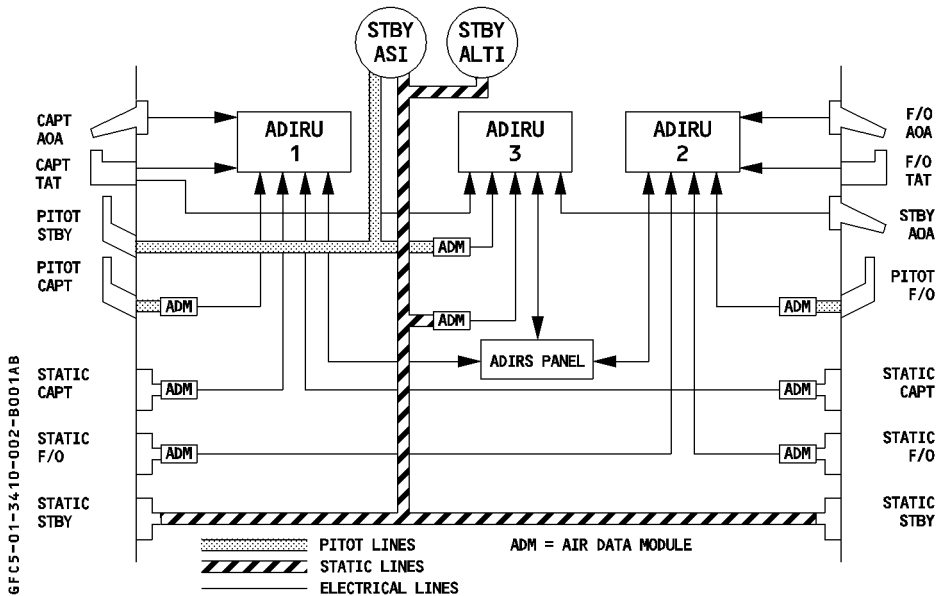
Note : ADIRU
ADIRU 1 is supplied by CAPT probes,
ADIRU 2 is supplied by F/O probes
ADIRU 3 is supplied by STBY probes and CAPT TAT

ADIRS SCHEMATIC

R
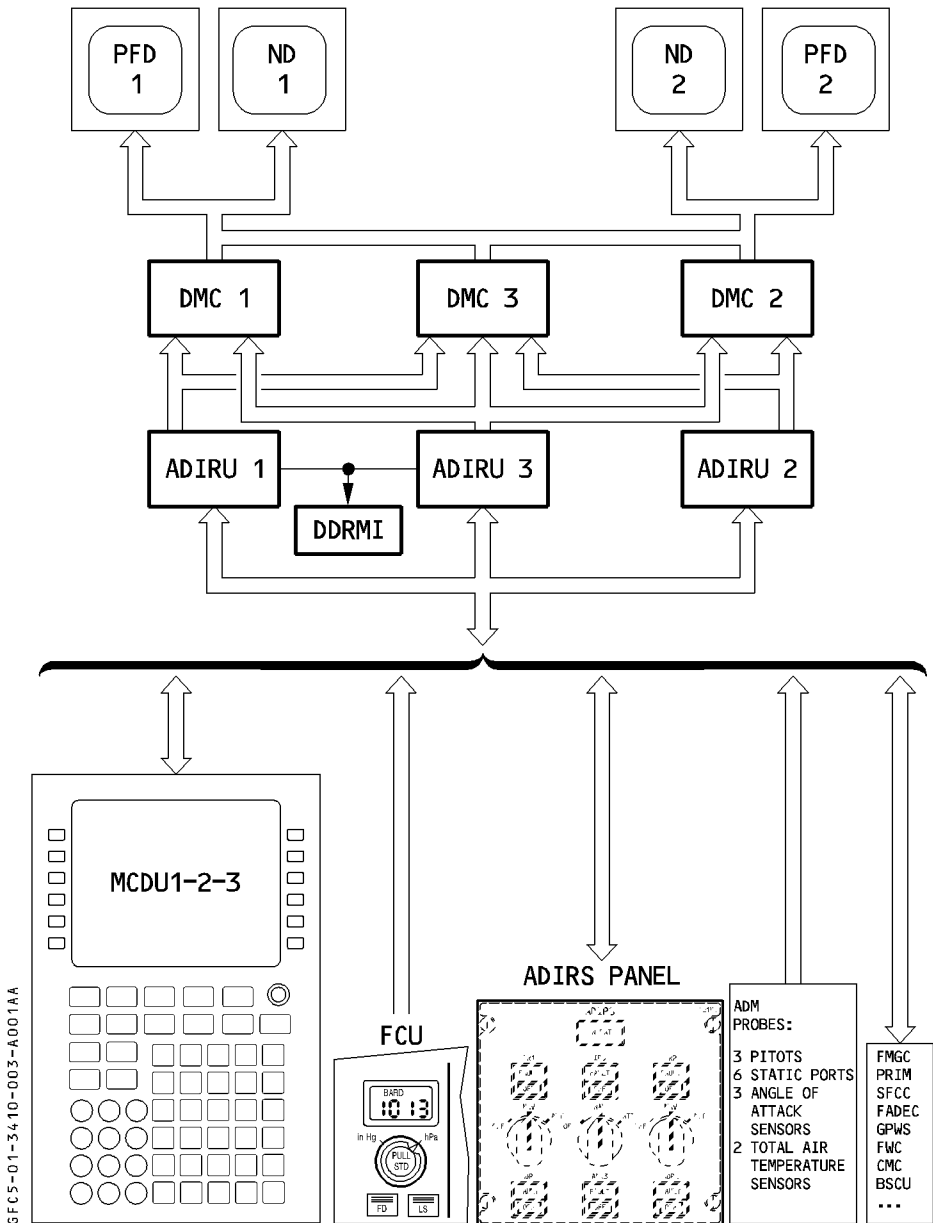
CONTROLS AND INDICATORS

OVERHEAD PANEL
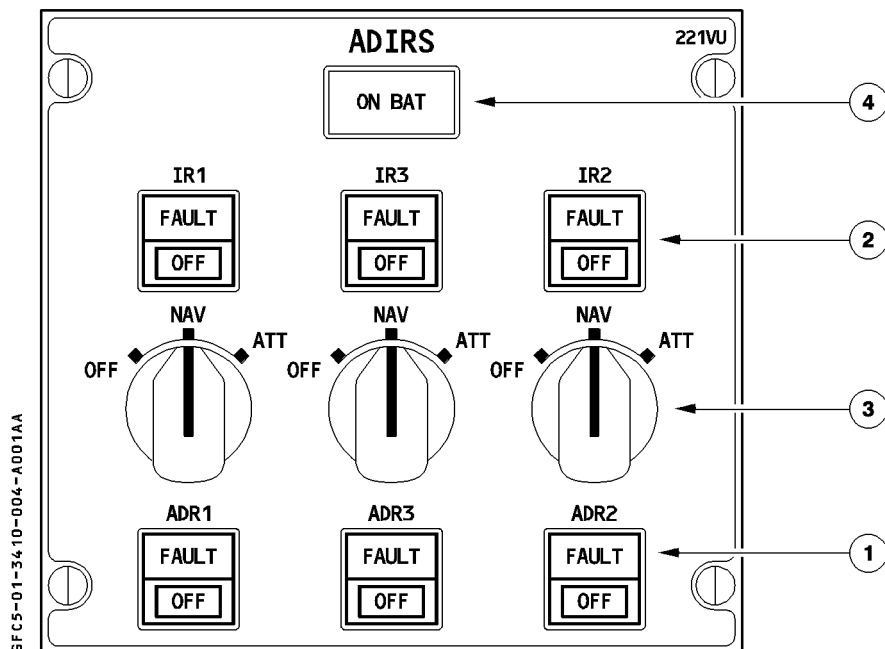
(1) **ADR pb sw**

    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.

ADIRU LIGHT

SERVICE INTERPHONE BAY PANEL
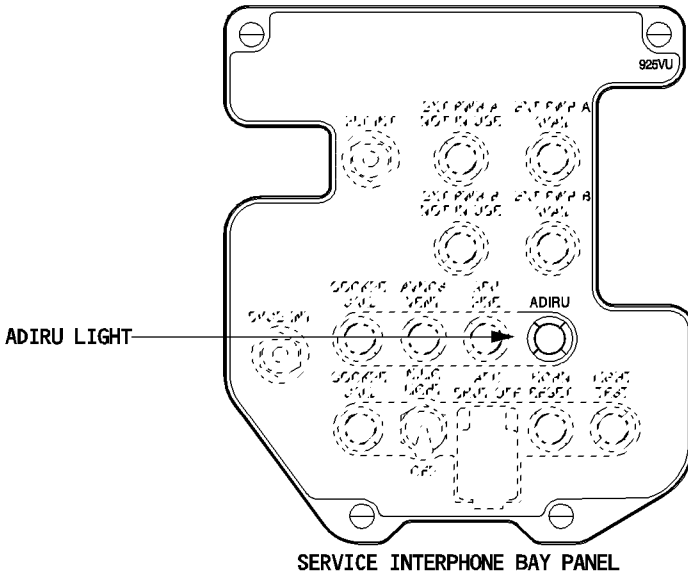
GFC5-01-3410-005-A001AA

LEFT INTENTIONALLY BLANK

PEDESTAL

(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.
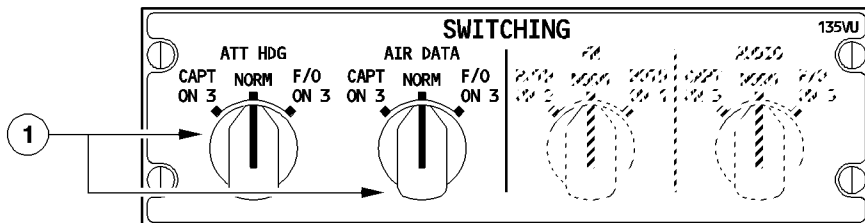CAPT ON 3 : ADR 3 or IR 3 replaces ADR 1 or IR 1
F/O ON 3 : ADR 3 or IR 3 replaces ADR 2 or IR 2

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.
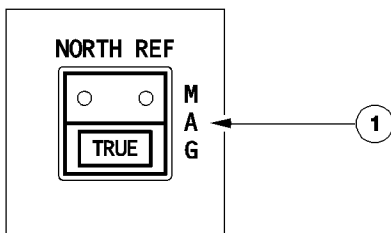
(1) NORTH REF pb sw

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

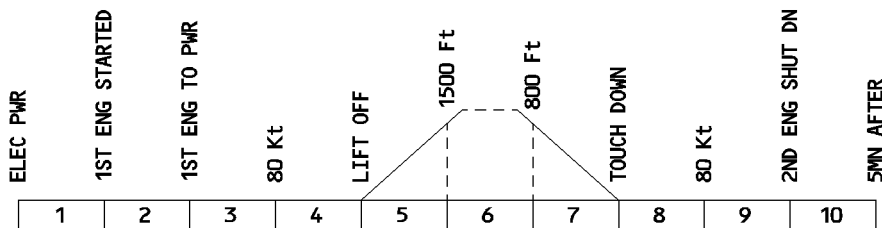GFC5-01-3410-008-A001AA

ELEC PWR	1ST ENG STARTED	1ST ENG TO PWR	80 Kt	LIFT OFF	1500 Ft	800 Ft	TOUCH DOWN	80 Kt	2ND ENG SHUT DN / 5MN AFTER
1	2	3	4	5	6	7	8	9	10

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
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)	Cricket + STALL (synthetic voice)	MASTER WARN		NIL	NIL
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.	CRC				
ADR 1(2)(3) FAULT			NIL	ADR FAULT lt	1, 4, 8, 10
ADR 1+2 (1+3)(2+3) FAULT					
IR 1(2)(3) FAULT				IR FAULT lt	1, 4, 5, 7, 8, 10
IR 1+2 (1+3)(2+3) FAULT					1, 4, 8, 10
HDG DISCREPANCY difference between heading on CAPT and F / O displays greater than 5° in TRUE or than 7° in MAG	SINGLE CHIME	MASTER CAUT		CHECK HDG (on ND and PFD)	
ATT DISCREPANCY difference between roll or pitch angle displayed on CAPT and F / O PFD greater than 5°				CHECK ATT (on PFD)	4, 8
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				CHECK ALT (on PFD)	

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
EXTREME LATITUDE A / C enters in polar area, the crew must select true reference	SINGLE CHIME	MASTER CAUT	NIL	NIL	4, 5, 7, 8
IR NOT ALIGNED Problem detected during IR alignment					NIL
FM/IR POS DISAGREE discrepancy between a/c position computed by FMS and position given by IRs					1, 2, 3, 4, 5, 7, 8, 9, 10
BARO REF DISCREPANCY discrepancy between F/O and captain baro ref.					3, 4, 8

MEMO DISPLAY

- "IRS IN ALIGN XXX" and "IR XXX IN ATT ALIGN" appear in green, during an IR alignment.
- "IRS IN ALIGN" :
  · Becomes amber, if engines are running
  · Flashes in 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 the AIR DATA or the 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).
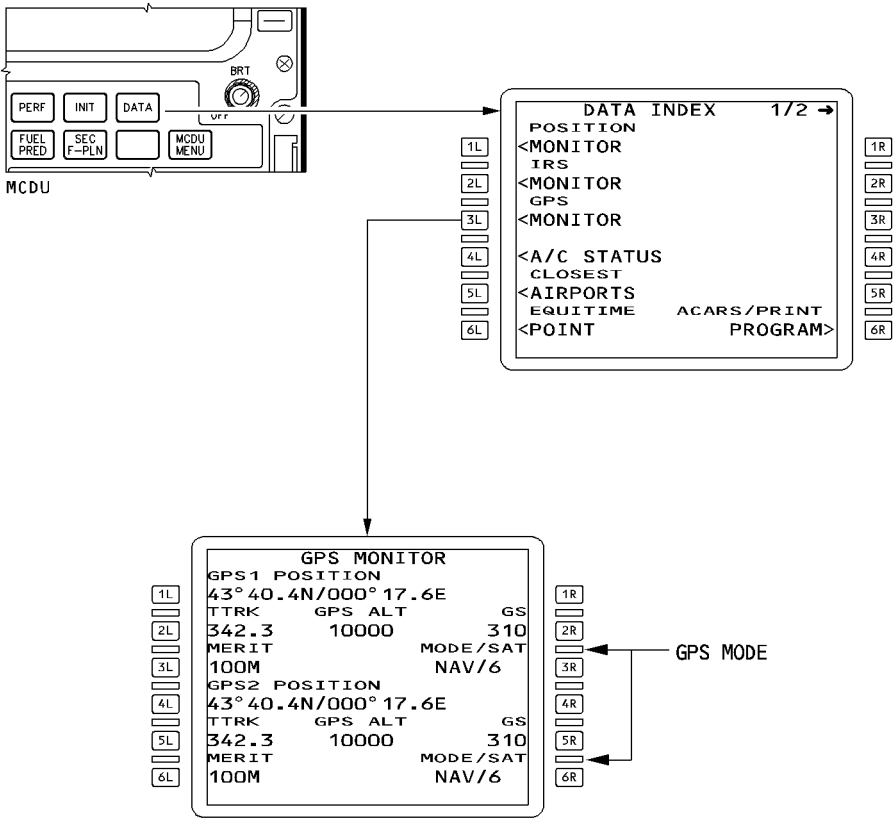
R
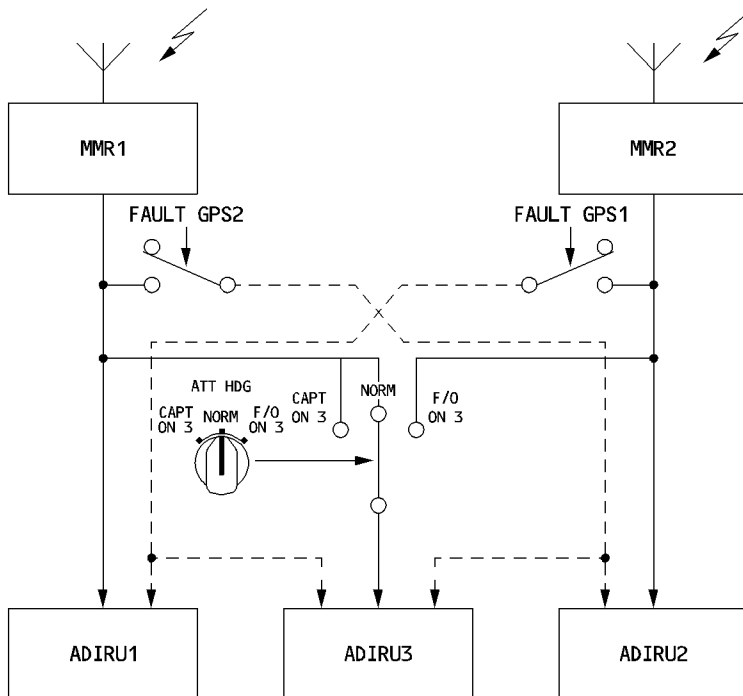
NORMAL OPERATION

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.
R   If the number of satellites drops to three, the altitude bias is frozen and the MMR enters ALTAID mode, using the IR altitude (corrected with the altitude bias).
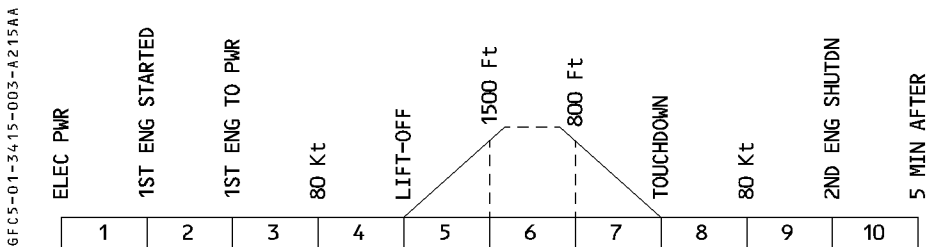
— **Fault Mode (FAULT)**
The fault mode is entered when a failure, which may prevent the MMR from transmitting valid data has been detected.

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

GFC5-01-3415-003-A215AA

ELEC PWR	1ST ENG STARTED	1ST ENG TO PWR	80 Kt	LIFT-OFF	1500 Ft	800 Ft	TOUCHDOWN	80 Kt	2ND ENG SHUTDN · 5 MIN AFTER
1	2	3	4	5	6	7	8	9	10

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					1, 3, 4, 10
GPS PRIMARY LOST (No ECAM Warning)	TRIPLE CLICK During non ILS approach only	NIL		ND/MCDU Message	2, 3, 4, 5 8, 9, 10

COMPASS

There is a compass located on top of the windshield center post.
The deviation card is located above the compass.
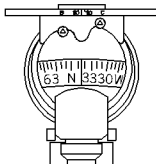
HORIZON

The electric standby horizon normally obtain current from the DC ESS BUS. In the case of a total electrical failure the indication remains usable for 5 minutes.

R
R   *Note : When leveling the wings, after performing a small turn of a small bank angle, the displayed roll attitude may temporarily be incorrect by a few degrees.*
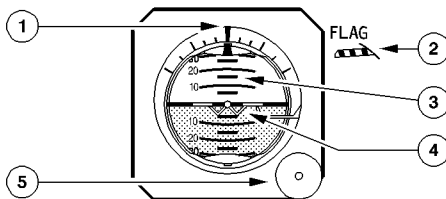
(1) Roll scale

The roll scale indicates the bank angle. It has bank angle graduations up to 60°. There is no rotation limit.

(2) Flag

The flag appears if the instrument fails or it power supply fails.

(3) Pitch scale

The pitch scale indicates the pitch attitude. It can show pitch angle up to ± 85°
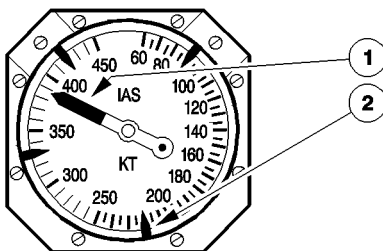
(4) Aircraft reference

It is a fixed symbol which represent the aircraft.

(5) Caging knob

Flight crew pulls it out to reinitialize the gyro, and level and center the horizon. The airplane should be level during this procedure.

R | **AIRSPEED INDICATOR** |

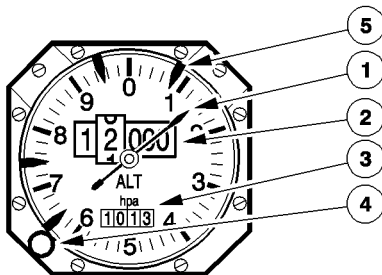
GFC5-01-3420-002-A001AB

(1) Airspeed pointer

(2) Airspeed bugs (4)

For marking of airspeed references.

R | **ALTIMETER** |

GFC5-01-3420-002-B001AB

(1) Altitude pointer

(2) Altitude counter (in feet)
The very left drum is replaced :
— for altitude below 10 000 feet by white/black stripes
— for altitude below 0 feet (reference altitude) amber/black stripes.

③ Altimeter setting

Display pressure setting in hPa.

④ Altimeter setting knob

⑤ Altitude bugs (4)

For marking of altitude references.

ALTIMETER (in meter)

GFC5-01-3420-003-A100AA

① Altitude pointer

② Altitude counter (meter)

The very left drum is replaced :
— for altitude below 10 000 m by white/black stripes
— for altitude below 0 m (reference altitude) by amber/black stripes
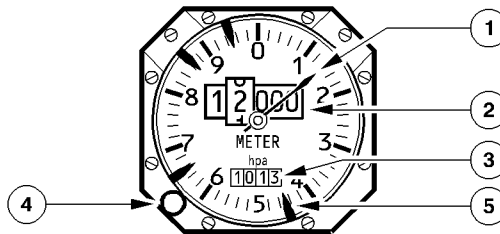
③ Altimeter setting

Display pressure setting in hPa.

④ Altimeter setting knob

⑤ Altitude bugs (4)

For marking of altitude references.

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
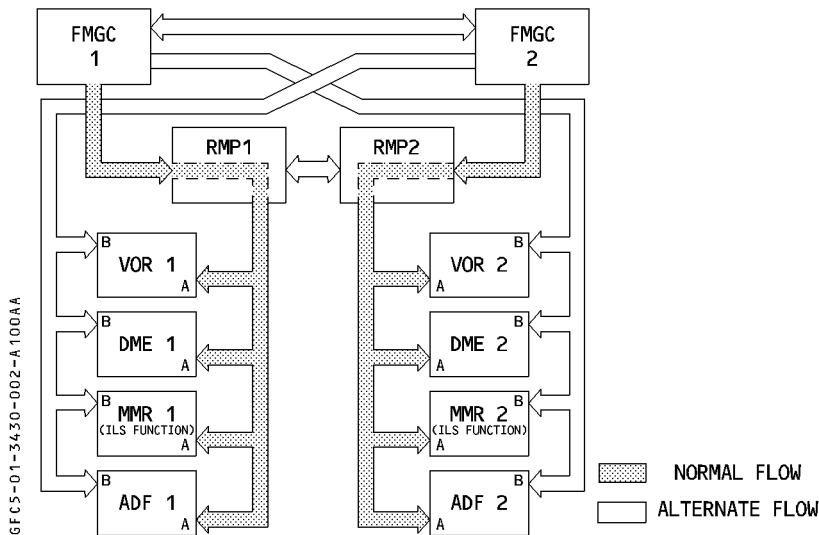The F/O RMP controls VOR 2 and ADF 2
Each RMP controls both ILSs (provided NAV back up is selected on RMP 1 and RMP 2)
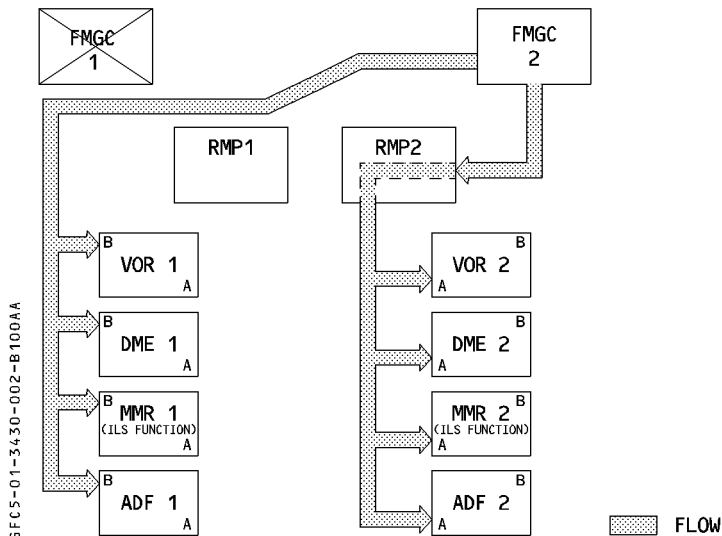RMP 3 is not used for navaids tuning.
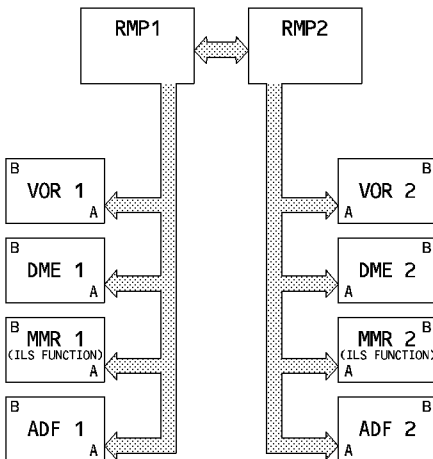
ARCHITECTURE

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
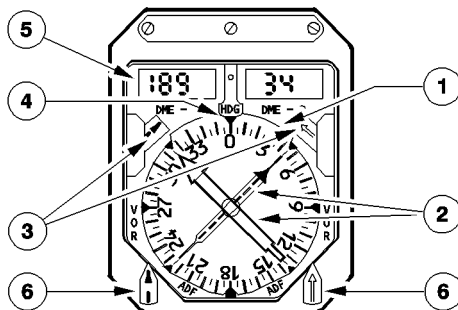R   the LS pushbutton on the EFIS control panel.

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
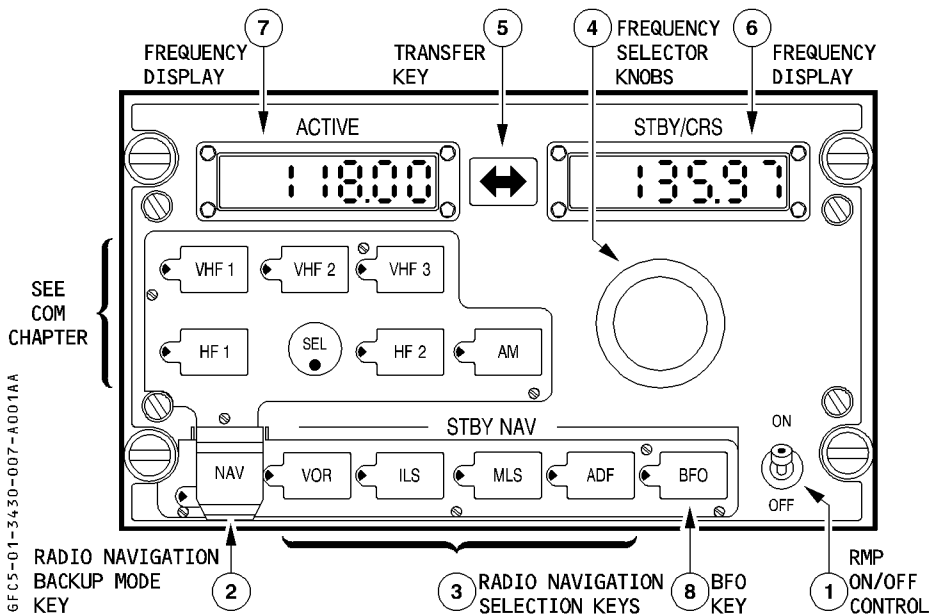— The RMI has an internal failure, or
— Power supply fails.

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.

FREQUENCY   COURSE

STBY/CRS   STBY/CRS

135.97   C-200

GFC55-01-3430-009-A001AA
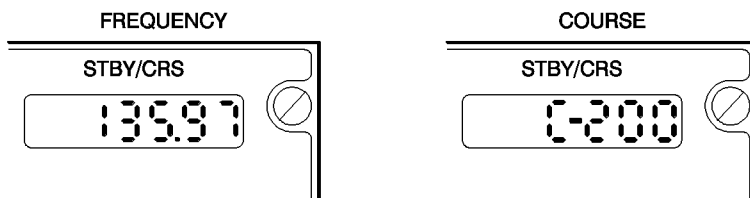
⑦ ACTIVE window

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

GFC5-01-3430-010-A001AB
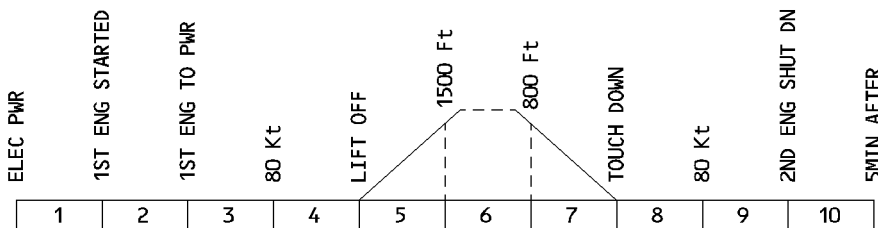
ELEC PWR	1ST ENG STARTED	1ST ENG TO PWR	80 Kt	LIFT OFF	1500 Ft	800 Ft	TOUCH DOWN	80 Kt	2ND ENG SHUT DN	5MIN AFTER
1	2	3	4	5	6	7	8	9	10	

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
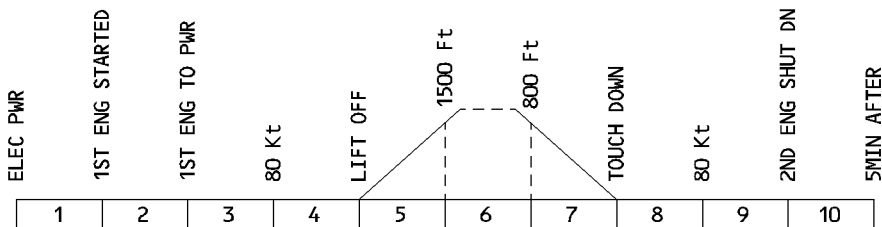
E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
RA 1 (2)(1+2) FAULT	SINGLE CHIME	MASTER CAUT	NIL	Flag on PFD	3, 4, 5, 8

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 ADR (1 for transponder 1, etc ...) supplies the altitude for altitude reporting.
In case of a failure, ADR 3 can do this when selected by the AIR DATA SWITCHING selector.

CONTROL PANEL
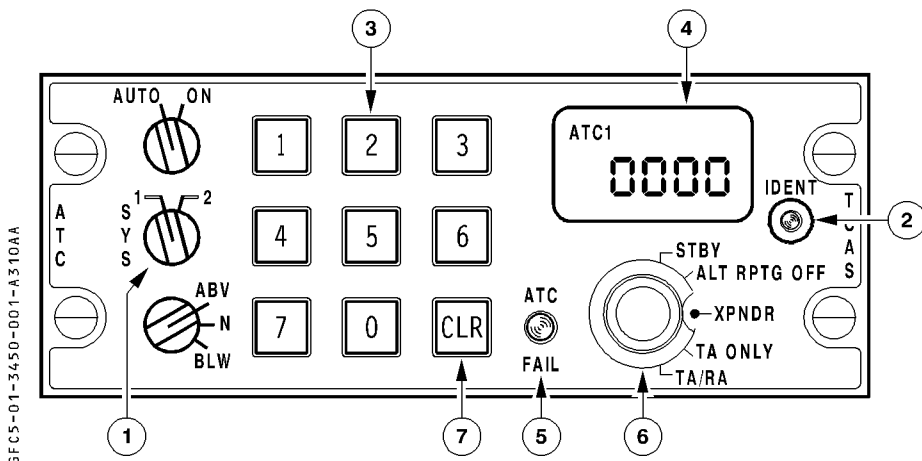
① XPNDR sel

This switch selects transponder 1 or 2.

② IDENT sw

The flight crew presses this button to send the aircraft identification signal.

③ Pushbutton(s)

Set(s) the code that is assigned by the ATC.

④ Code display

This window displays the selected code.

⑤ ATC FAIL light

This light comes on, if the selected Transponder fails.

⑥ Mode selector

STBY	: The two ATC Transponders and the TCAS are electrically-supplied, but are not operating.
ALT RPTG OFF	: No altitude data is transmitted.
XPNDR	: – On ground : The selected ATC Transponder only operates in the selective aircraft interrogation mode of Mode S.
	– In flight : The selected ATC Transponder operates.
	Baro altitude data is transmitted.
	ATC 1 uses ADR 1 or ADR 3. ATC 2 uses ADR 2 or ADR 3
	The TCAS is on standby.

R (marks on XPNDR lines)

⑦ CLR pushbutton

This pushbutton clears the code display.

Note : *The previous code remains, until a new four-digit code is entered.*
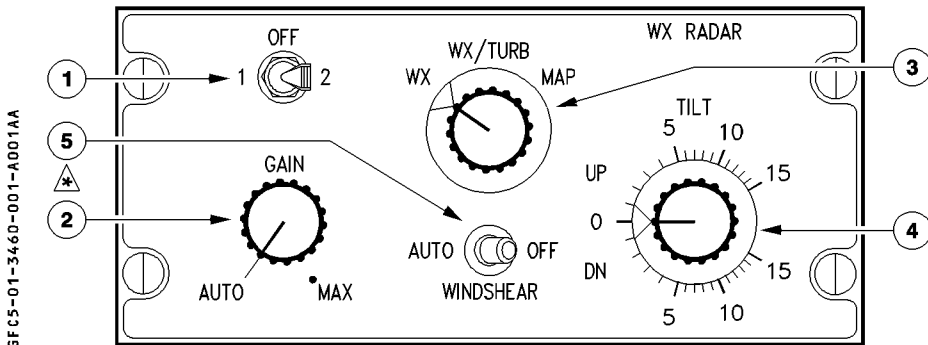
DESCRIPTION

The aircraft has two weather radar systems. Only one transceiver is active.
It can display the weather image on the ND in any 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).

CONTROL PANEL

GFC5-01-3460-001-A001AA

(1) Transceiver 1-2 sel

R   This switch allows to select the radar, and to turn both radars to OFF.

(2) GAIN knob

This knob adjusts the sensitivity of the receiver in all modes.
AUTO Automatically adjust the gain to optimum 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/TURB   : The screen shows turbulence areas (in precipitation areas) in magenta (within 40 NM).
MAP   : Radar operates in ground mapping mode : black indicates water, green ground and amber cities and mountains.

④ TILT knob

This knob controls antenna tilt.

R   Zero represents the horizon as the ADIRS 1 sees it (or ADIRS 3 if ATT HDG selector is at CAPT ON 3).

Note : Setting different scales on the ND reduces the sweep rate of each ND image. (8 seconds instead of 4 seconds)

⑤ WINDSHEAR sel ◁ (operative only if the windshear function is embodied)

AUTO : Windshear function is activated : windshear areas will be detected by the antenna scanning below 1500 ft RA, even if tranceiver selector (1) is set to off, and displayed on the ND.
OFF   : No windshear function.

WINDSHEAR PREDICTION FUNCTION

The weather radars have a Predictive Windshear System (PWS) that operates when :

R   — The PWS switch is in the AUTO position (Even if the weather radar is OFF), and
— The aircraft is below 2300 feet AGL, and
— The ATC is switched to the ON or AUTO position (or XPNDR ◁), and
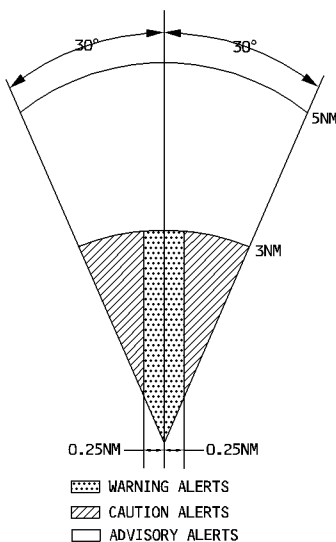— Either engine is running.

R   *Note : When two weather radars are installed, if the selected weather radar fails, the PWS*
R   *function is recovered by selecting the non-failed weather radar on the control panel.*

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 ALERTS during takeoff roll, up to 100 knots
R

During the takeoff roll, up to 100 knots, both warnings and cautions are available within a
range of 3 NM.

WINDSHEAR ALERTS above 50 feet
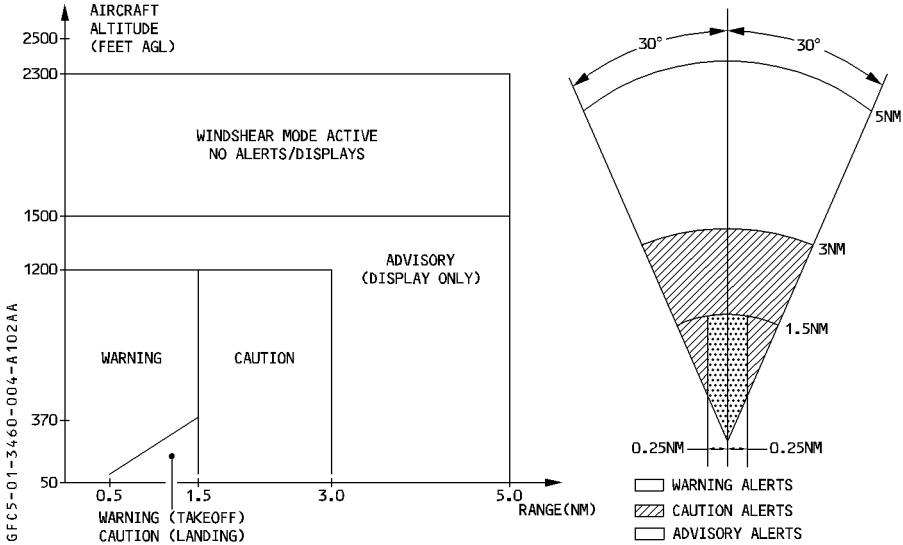
During final approach, the visual and aural warning alerts are downgraded to caution alerts between 370 feet AGL and 50 feet AGL, and range between 1.5 NM and 0.5 NM.

WINDSHEAR ALERTS inhibition

At takeoff, alerts are inhibited above 100 knots and up to 50 feet.
During landing, alerts are inhibited below 50 feet.

| 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

The aural alerts of the Predictive Windshear System (PWS) :
— Have priority over TCAS, GPWS and other FWC aural warnings.
— Are inhibited by windshear detection, by the FMGC, and stall warning aural messages.

WARNING AND CAUTIONS
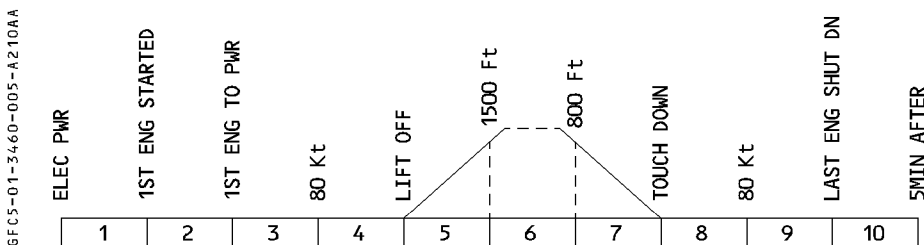
E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
PRED. W/S DET FAULT	SINGLE CHIME	MASTER CAUTION	NIL	NIL	3, 4, 5, 8

MEMO DISPLAY

The "PRED W/S OFF" message appears, when the windshear is set to OFF on the weather radar panel.
It appears in green, during in flight phases 2 and 6.
It appears in amber :
— In flight phases 3, 4, 5, 7, 8, 9.
— When the T.O. CONFIG pushbutton is pressed, during flight phase 2.

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 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 the volume adjustment for radio communication only).

R GPWS lights come on to give a visual warning for Modes 1 to 4, TAD, and TCF. For mode 5, the glideslope (G/S) lights on the Captain and First Officer instrument panels, come on.

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
R 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.
R This envelope uses the baro altitude in QNH or QFE reference, depending on a pin
R program (QFE is an option). If the QFE option is installed, the Enhanced GPWS uses
R (for GPWS basic modes) the QFE barometric reference altitude, independently of the selected barometric reference setting on the EFIS control panel.

FOR INFO

GFC5-01-3470-002-A110AA
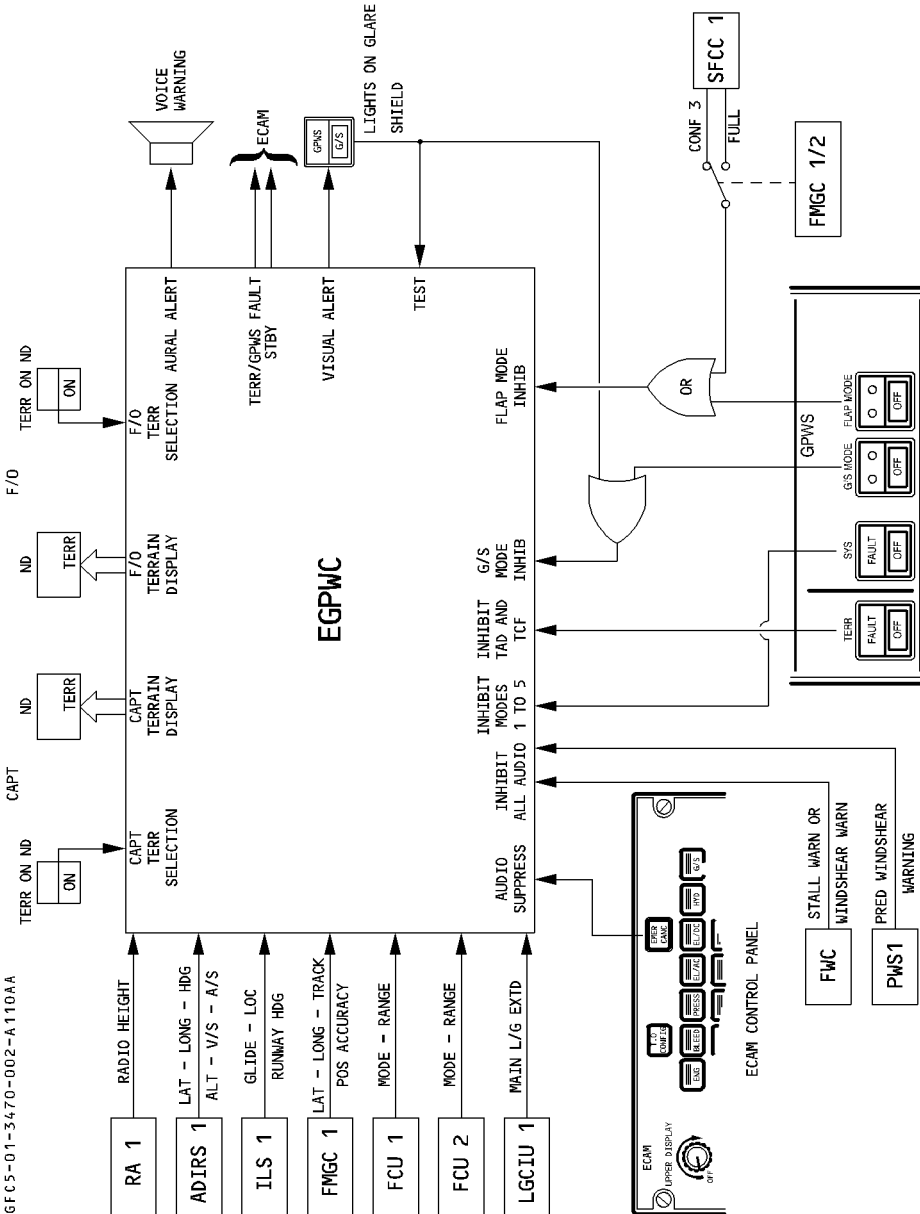
MODE 1: EXCESSIVE RATE OF DESCENT
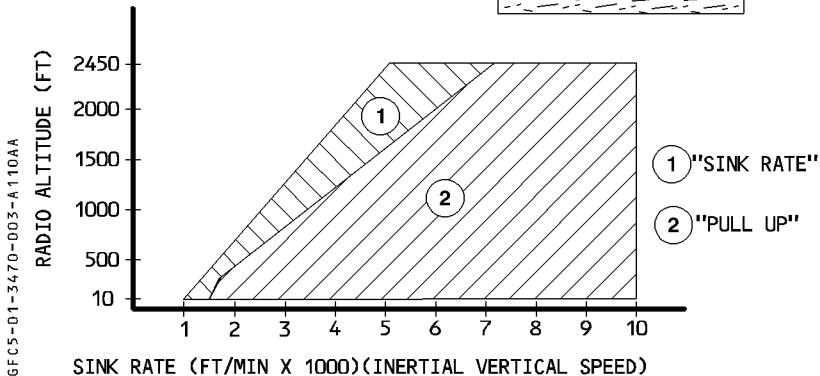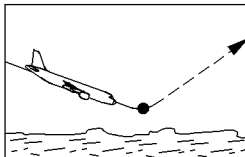
Mode 1 has two boundaries. Penetration of the first boundary generates the illumination of the GPWS lights and a repeated aural alert "SINK RATE". Penetration of the second boundary generates repetitive "PULL UP".

R The lower cut-off limit is 10 feet radio altitude.
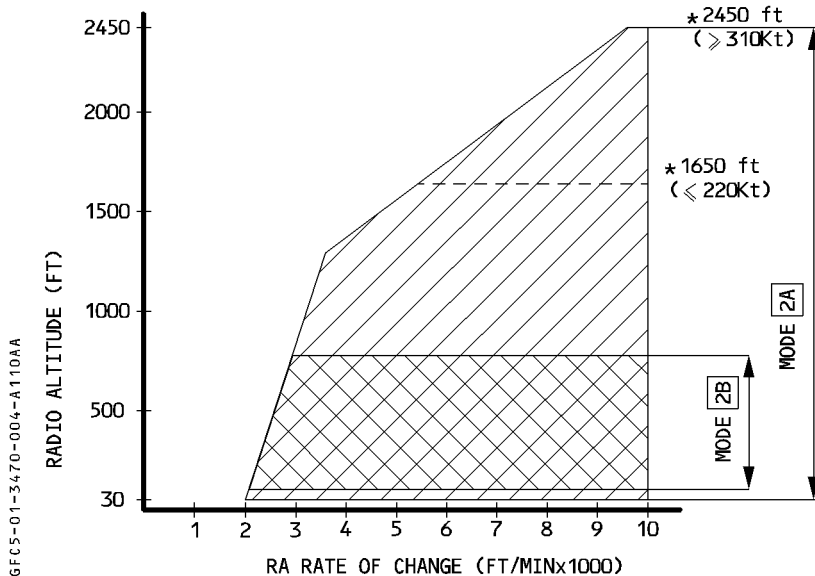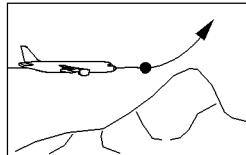The upper cut-off limit is 2450 feet radio altitude.

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", repeated continually until the aircraft leaves the warning envelope.
After the aircraft leaves the boundary, the GPWS lights stay on 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
R speed (between 220 to 310 knots). At certain airports, the upper boundary is limited to reduce the warning sensitivity and minimize nuisance warnings.

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
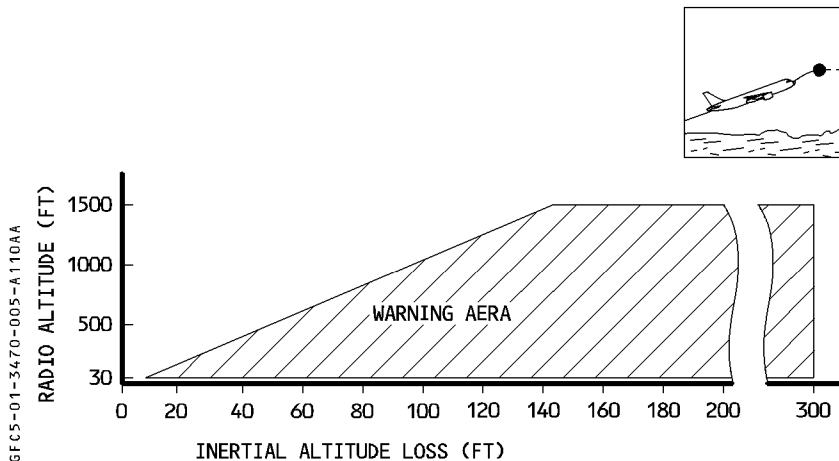
If the aircraft descents during the initial takeoff climb or during a go around, GPWS lights come on and the aural alert "DON'T SINK" sounds repeatedly.

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

R   4A - Landing gear up.
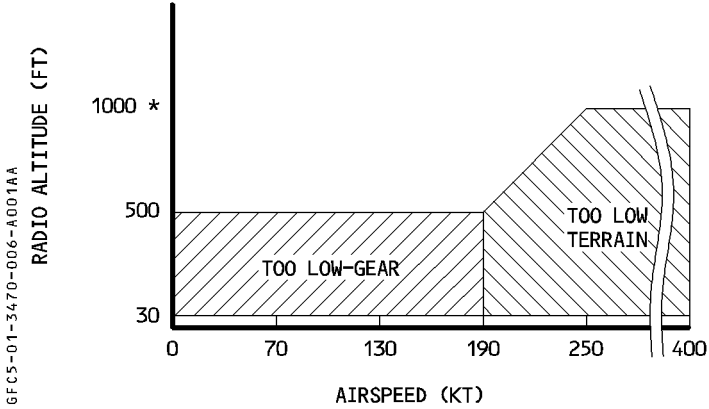
Two aural warnings may be triggered, depending on the area : "TOO LOW-GEAR" or "TOO
R   LOW-TERRAIN". In addition, the GPWS lights come on.
R   4B - Landing gear down, and flaps not in landing configuration.
R
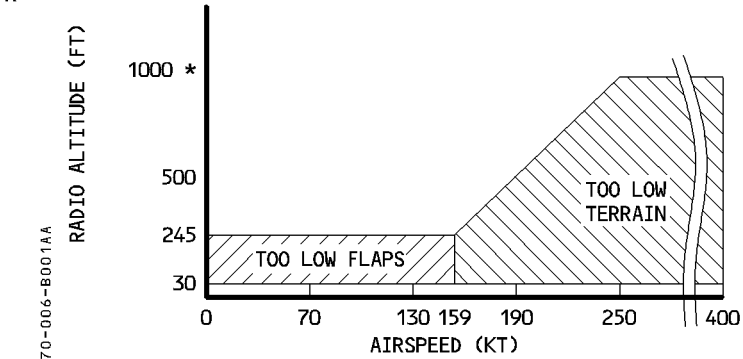

```
 * - OTHER MAXIMUMS ARE USED AT CERTAIN AIRPORTS TO MINIMIZE NUISANCE
     WARNINGS.
   - THIS MAXIMUM IS ALSO REDUCED TO 800feet WHEN AN OVERFLIGHT
     IS DETECTED.
```

Three aural warnings may be generated, depending on the area and the configuration :
R   "TOO LOW-GEAR", "TOO LOW-FLAPS" or "TOO LOW-TERRAIN". In addition, the GPWS
R   lights come on.

4C − Landing gear up, or flaps not in landing configuration.

R

GFC5-01-3470-007-A001AA
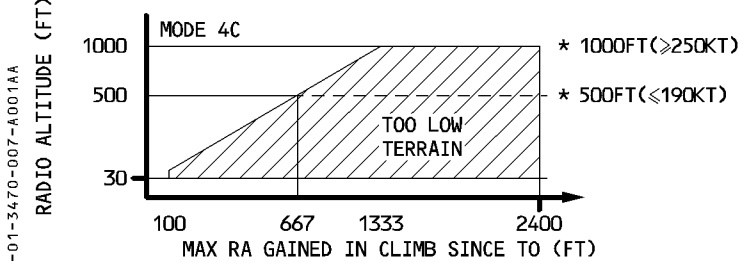
* THE UPPER OPERATIONAL LIMIT LINEARLY VARIES, DEPENDING ON THE AIRCRAFT SPEED.

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

GFC5-01-3470-007-B001AA
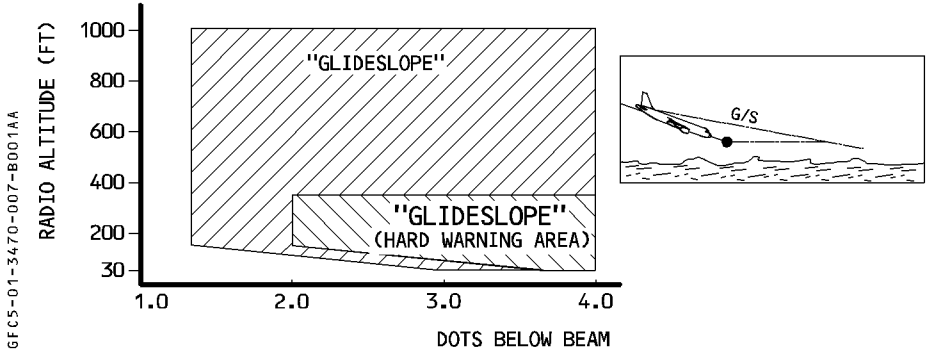
Note : Normally, the GLIDESLOPE alert is only triggered with the gear down. For a few airports, the gear down logic requirement is deleted, and other upper limits are used to increase the warning envelope.

In both areas, the alert is a repeated "GLIDESLOPE" aural message and both G/S 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 GPWS−G/S pushbutton 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 the aircraft, according to 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 memorized in the database, the system generates the relevant alert :

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)	The pb light comes on on each pilot's instrument panel
Caution	TERRAIN AHEAD	— Automatic terrain display * — Solid yellow areas — TERR AHEAD (amber)	

* When the TERR ON ND switch is selected ON, the ND displays the terrain memorized in the database according to 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). When an alert is generated (either caution or warning) and the 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.

R
R
R
R
R
R

2. The relative height of the aircraft is computed using the Captain's baro setting. Thus, the Terrain Awareness Display (TAD) does not protect against baro setting errors.

3. The TAD and Terrain Clearance Floor (TCF) functions operate using the FMS 1 position. Thus, in case of an FMS 1 position error, the system gives erroneous information.

TERRAIN CAUTION AND WARNING ENVELOPE

R

TERRAIN FROM THE TERRAIN DATABASE.

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

WARNING

TERRAIN
FLOOR

CAUTION

WARNING DISTANCE

CAUTION DISTANCE

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

3°

0.25 NM

3°

DURING TURNS, THE ENVELOPE IS DISPLACED
TO LOOK ALONG THE AIRCRAFT FLIGHT PATH.
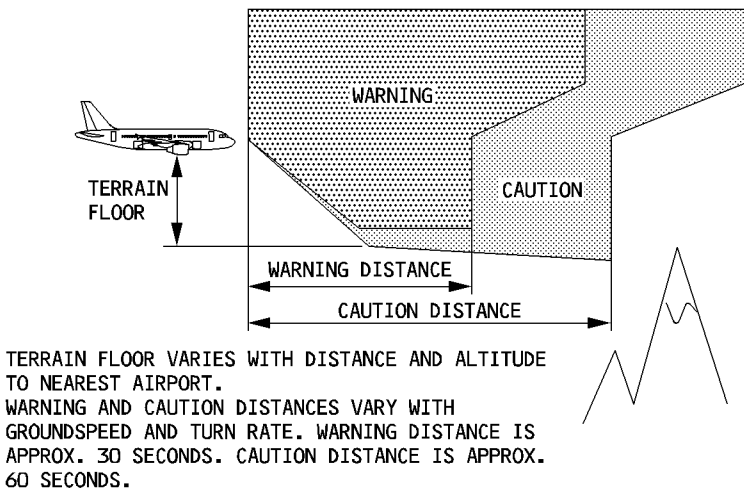
GFC5-01-3470-009-C110AB
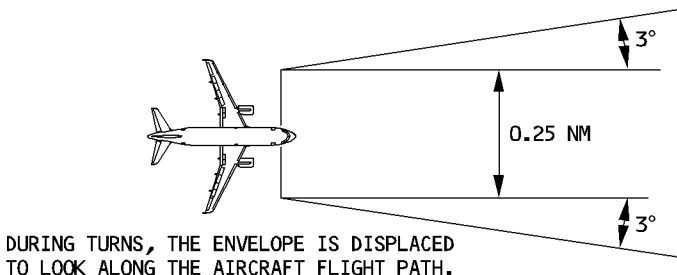
TERRAIN CLEARANCE FLOOR

A terrain clearance floor envelope is stored in the database for each runway for which terrain data exist. The Terrain Clearance Floor (TCF) function warns of a premature descent below this floor, regardless of the aircraft's configuration.
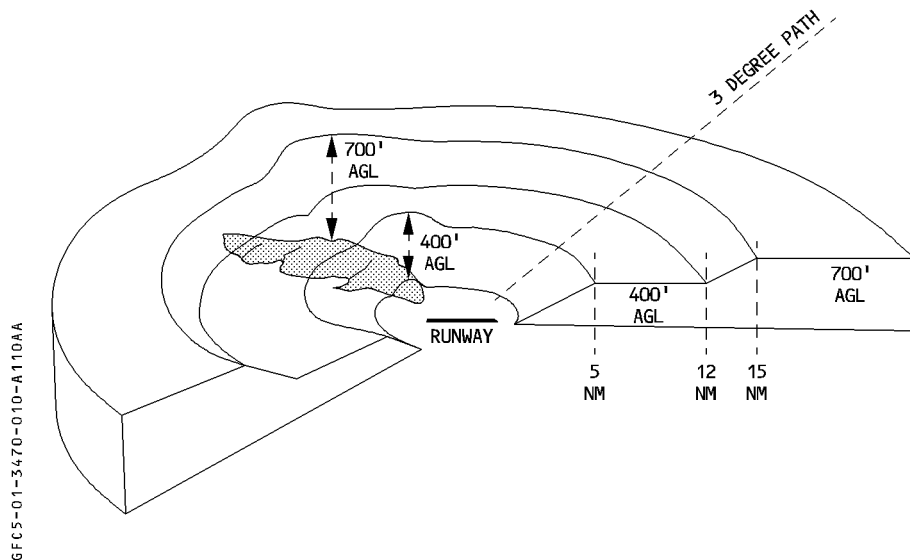
R If the airplane descends below this floor, a TOO LOW TERRAIN aural warning sounds, and
R the GPWS lights come on, on the glareshield.

CONTROLS AND INDICATORS

OVERHEAD PANEL

GFC5-01-3470-011-A110AA
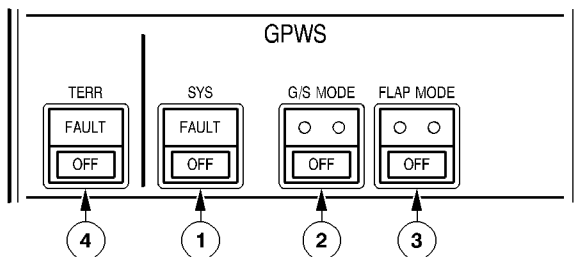
① SYS pb sw

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
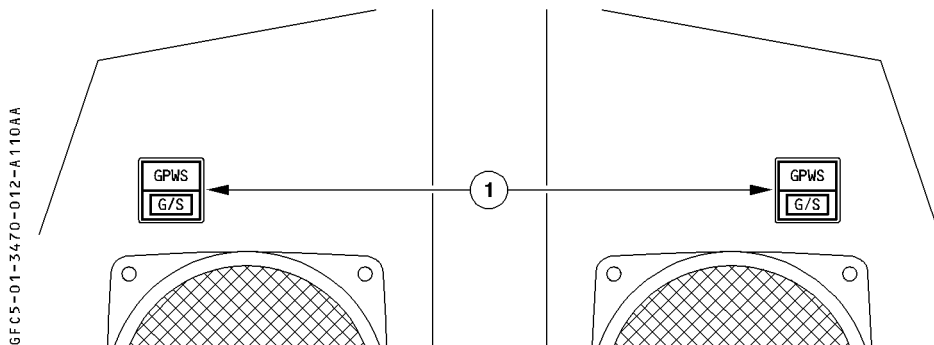
① GPWS – G/S pb

R GPWS : This red light comes on when any mode from 1 to 4 or any TAD or TCF
R alert is activated. The corresponding aural warning sounds.
R G/S : This amber light comes on when mode 5 is activated. The "GLIDE SLOPE"
R aural warning sounds.

R *Note : 1. If the flight crew briefly presses this button when a glide slope warning is on,*
the G/S light goes out and the "GLIDE SLOPE" aural warning (soft or loud)
stops.
R *2. The GPWS can be tested by pressing this pushbutton. If the pushbutton is*
R *pressed briefly, some of the aural warnings sound and pushbutton captions,*
R *related to the GPWS, come on. If the pushbutton is pressed continuously, then*
R *all the aural warnings sound.*

R
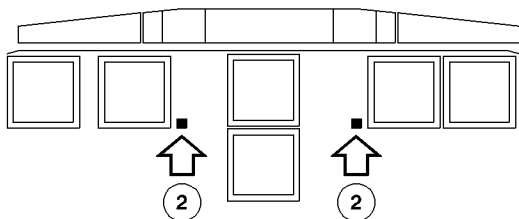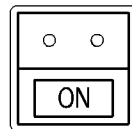
TERR ON ND

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
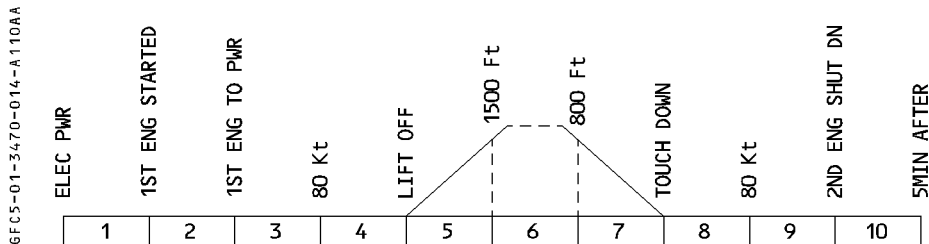
GFC5-01-3470-014-A110AA

	ELEC PWR	1ST ENG STARTED	1ST ENG TO PWR	80 Kt	LIFT OFF	1500 Ft	800 Ft	TOUCH DOWN	80 Kt	2ND ENG SHUT DN	5MIN AFTER
	1	2	3	4	5	6	7	8	9	10	

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 GPWS FLAP MODE pushbutton switch is OFF. Airborne, TERR STBY appears in green when the aircraft position accuracy (provided by the FMS) is not sufficient 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 ND is automatically deselected when the TERR STBY memo is triggered.

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

9900 ft

9900 ft

30-40NM

GFC5-01-3480-001-A100AA
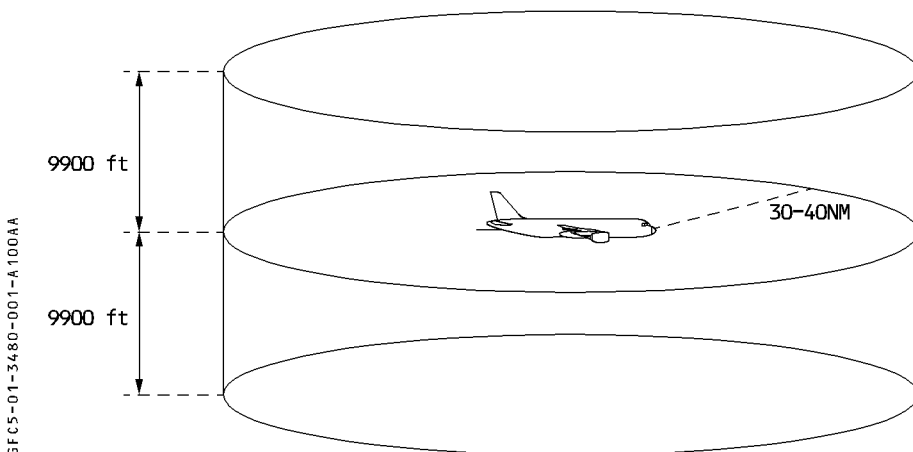
MAIN COMPONENTS

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

GFC5-01-3480-002-A100AA

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).
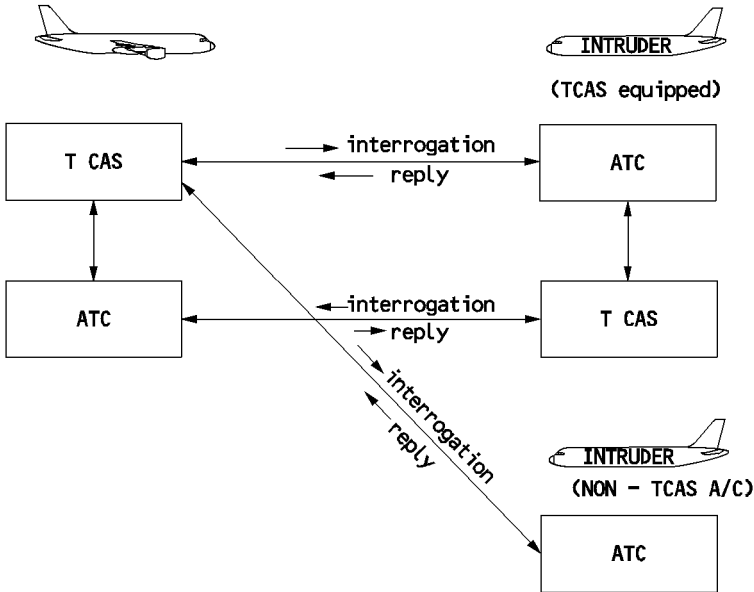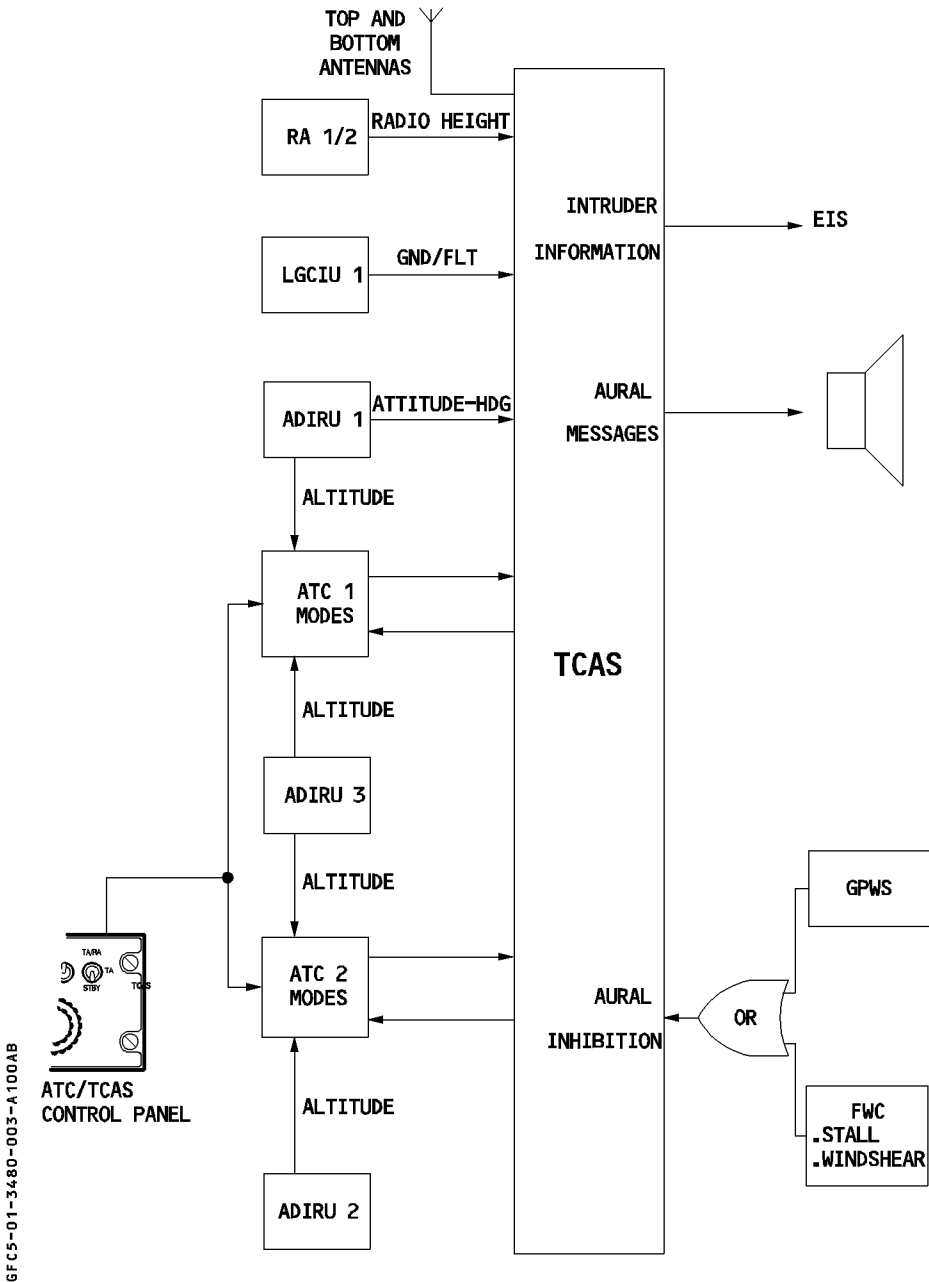Then the TCAS computes the intruder trajectory, the Closest Point of Approach (CPA) and the estimated time (TAU) before reaching the CPA.
Each time the relative position of the intruder presents a collision threat, aural and visual advisories are triggered.
TCAS optimizes vertical orders to ensure a sufficient trajectory separation and a minimal vertical speed variation considering all intruders.
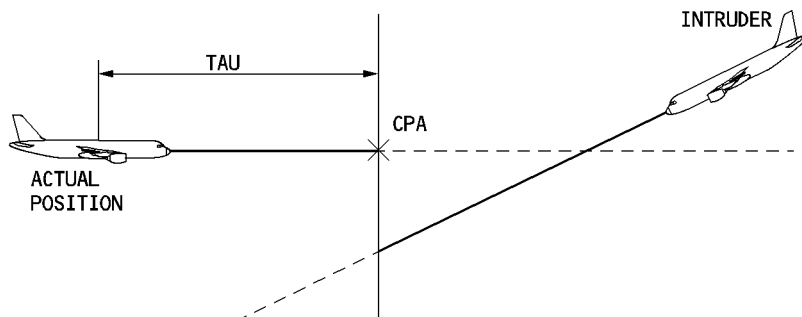
INTRUDER CLASSIFICATION

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

A/C ALT (ft)

```
42000 ┤
       │ //////////////////////
30000 ┤ /// RA if TAU ≤ 35s ///        TA if TAU ≤ 48s
       │ //////////////////////
       │ /// RA if TAU ≤ 35s ///      TA if
20000 ┤ //////////////////////       TAU ≤ 45s
       │ /// RA if TAU ≤ 30s ///   TA if TAU ≤ 45s
10000 ┤ //////////////////////
       │ /// RA if TAU ≤ 25s ///   TA if TAU ≤ 40s
 5000 ┤ //////////////////////
       │ /// RA if TAU ≤ 20s ///   TA if TAU ≤ 30s
 2350 ┤ //////////////////////
 1000 ┤ /// RA if TAU ≤ 15s ///   TA if TAU ≤ 25s
       │      TA if TAU ≤ 20s              Relative
       │                                   altitude
    0 └─────────────────────────────────► at CPA (ft)
         600  700  800 850      1200
```

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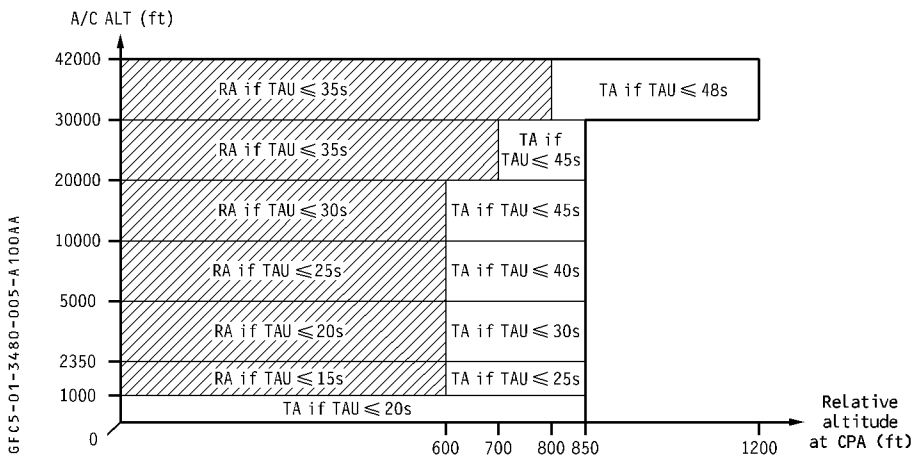
TCAS MODES

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.

Consequently :
- · All RAs are inhibited and converted into TA
- · TA threshold is set to TAU ≤ 20 seconds independent of aircraft altitude.
- · No vertical speed advisories on PFD
- · "TA ONLY" is displayed on the NDs.

In case of priority messages triggering, all the TCAS aural messages are suppressed.

R

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 TA aural messages and all RAs 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.
- "Increase Descent" RA below 1450 feet.

CONTROLS AND INDICATORS

ATC/TCAS PANEL
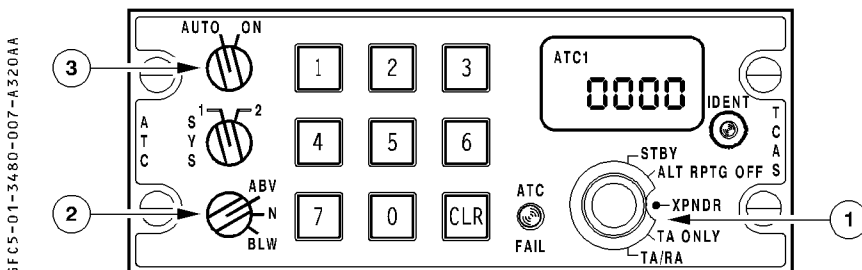
(1) Mode selector

TA/RA   : Normal position.
            TAs, and RAs, proximate and other intruders are displayed.
TA ONLY : This mode should be used, in case of degraded aircraft performance
            (engine failure, landing gear extended, or approach on parallel runways).
            All RAs are converted into TAs. TAs, proximate and other intruders, are
            displayed.
XPNDR   : – The TCAS is on standby.
R   – On ground : The selected ATC Transponder only operates in the
R   selective aircraft interrogation mode of Mode S.
R   – In flight   : The selected ATC Transponder operates.

(2) TRAFFIC selector

Sets the altitude range, within which other intruders will be displayed on the NDs.
ABV   : The altitude range is set to + 7000 feet above the aircraft, and – 2700 feet
        below the aircraft.
N   : The altitude range is set to – 2700 feet below the aircraft, and + 2700 feet
        above the aircraft.
BLW   : The altitude range is set to – 9000 feet below the aircraft, and + 2700 feet
        above the aircraft.

(3) AUTO/ON selector or THRT/ALL selector

ON (or ALL)   : All intruders are displayed.
AUTO (or THRT) : Proximate and other intruders are only displayed, if a TA or RA is
                    already presented.

Note : Some TCAS panels are equipped with a THRT/ALL selector, instead of
AUTO/ON. The associated functions remain unchanged.

ND INDICATIONS

The traffic is displayed in all ROSE modes and ARC mode when 10, 20 or 40 NM range is selected. Only the eight most threatening intruders are displayed.
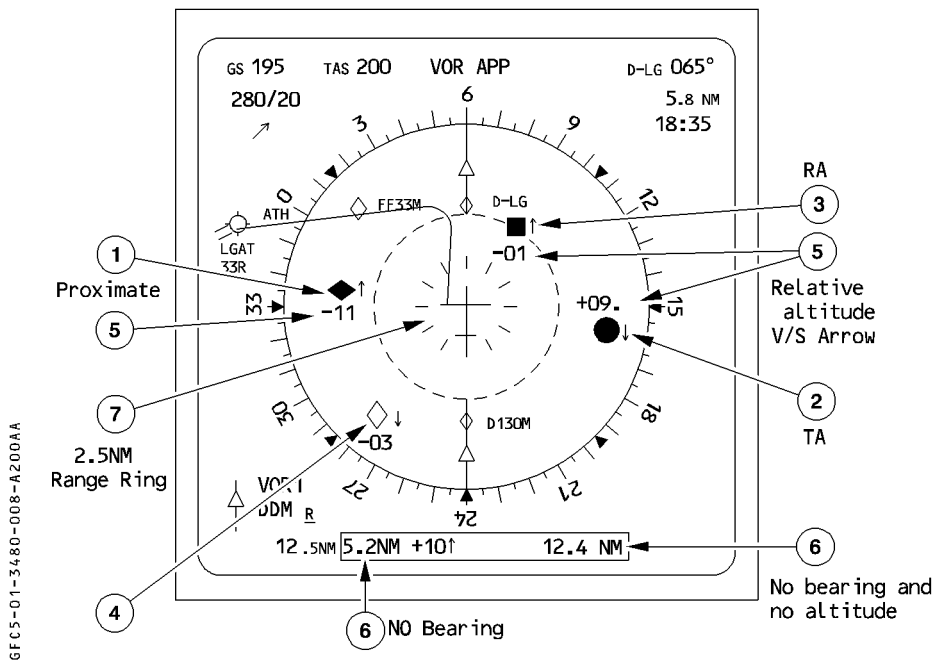
(1) Proximate intruder

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
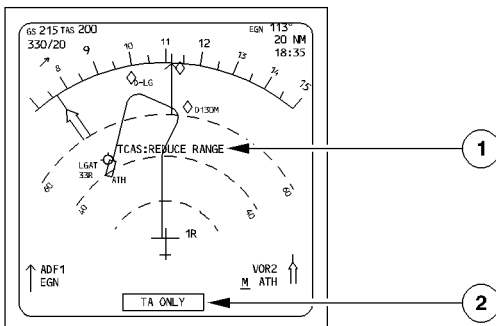
① Mode and range messages

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 red, 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.

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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.
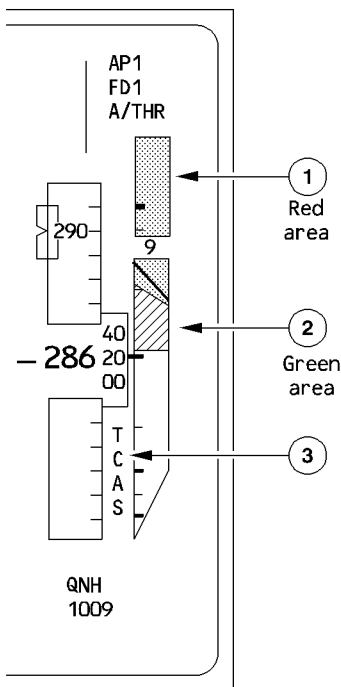
(1) Red area

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

R Appears in red, when the TCAS cannot deliver RA data, or in case of TCAS internal
R failure.

Note : When within the red area, the color of 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
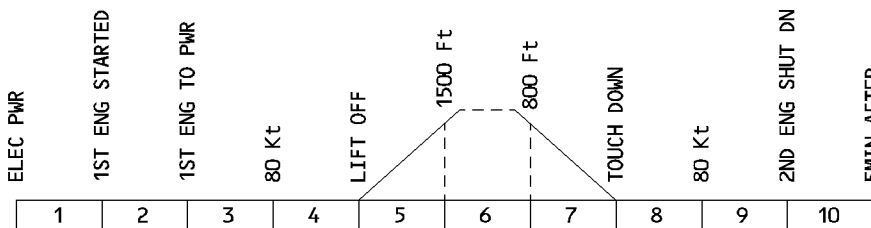
TA / RA detection is associated with the following messages:

TRAFFIC TRAFFIC	: Only in case of TA detection.
CLIMB CLIMB CLIMB	: 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 CLIMB message, if vertical speed is insufficient to achieve safe vertical separation.
REDUCE CLIMB (twice)	: Reduce vertical speed to that indicated by the green area on the PFD.
DESCEND 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 vertical speed is insufficient to achieve safe vertical separation.
REDUCE DESCEND (twice)	: Reduce vertical speed to that indicated by the green area on the PFD.
CLIMB, CLIMB NOW (twice)	: Triggered after DESCEND message, if the intruder trajectory has changed.
DESCEND, DESCEND NOW (twice)	: Triggered after CLIMB message, if the intruder trajectory has changed.
MONITOR VERTICAL SPEED (twice)	: Ensure that vertical speed remains outside the red area. Triggered only when leaving a RA.
CLEAR OF CONFLICT	: Range is increasing and separation is adequate. Return to assigned clearance.

WARNINGS AND CAUTIONS

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| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

ELEC PWR · 1ST ENG STARTED · 1ST ENG TO PWR · 80 Kt · LIFT OFF · 1500 Ft · 800 Ft · TOUCH DOWN · 80 Kt · 2ND ENG SHUT DN · 5MIN AFTER

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

R

		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)		
STBY INST	HORIZON					X	
	ALTIMETER					SHED	
	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.