A330-200
TECHNICAL TRAINING MANUAL

MECHANICS / ELECTRICS & AVIONICS COURSE

34 NAVIGATION

GE Metric

Issued By SPL/GK March 2006

This document must be used for training purposes only.

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

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SYSTEM PRESENTATION

GENERAL

The objective of the module is to highlight the purpose of the various systems of the navigation system.

AIR DATA / INERTIAL REFERENCE SYSTEMS

The Air Data and Inertial Reference System (ADIRS) provides the main navigation parameters. The ADIRS comprises three Air Data Inertial Reference Units (ADIRU) which provide:

- air data: barometric altitude, airspeed, Mach, Angle Of Attack and Total Air Temperature,
- inertial reference: attitude, heading, position, groundspeed, inertial vertical speed, accelerations.

STANDBY NAVIGATION SYSTEMS

The standby navigation systems are a backup for the ADIRUs.
The standby navigation systems comprise:

- a compass,
- an altimeter,
- an airspeed indicator,
- an artificial horizon.

LANDING AIDS SYSTEMS

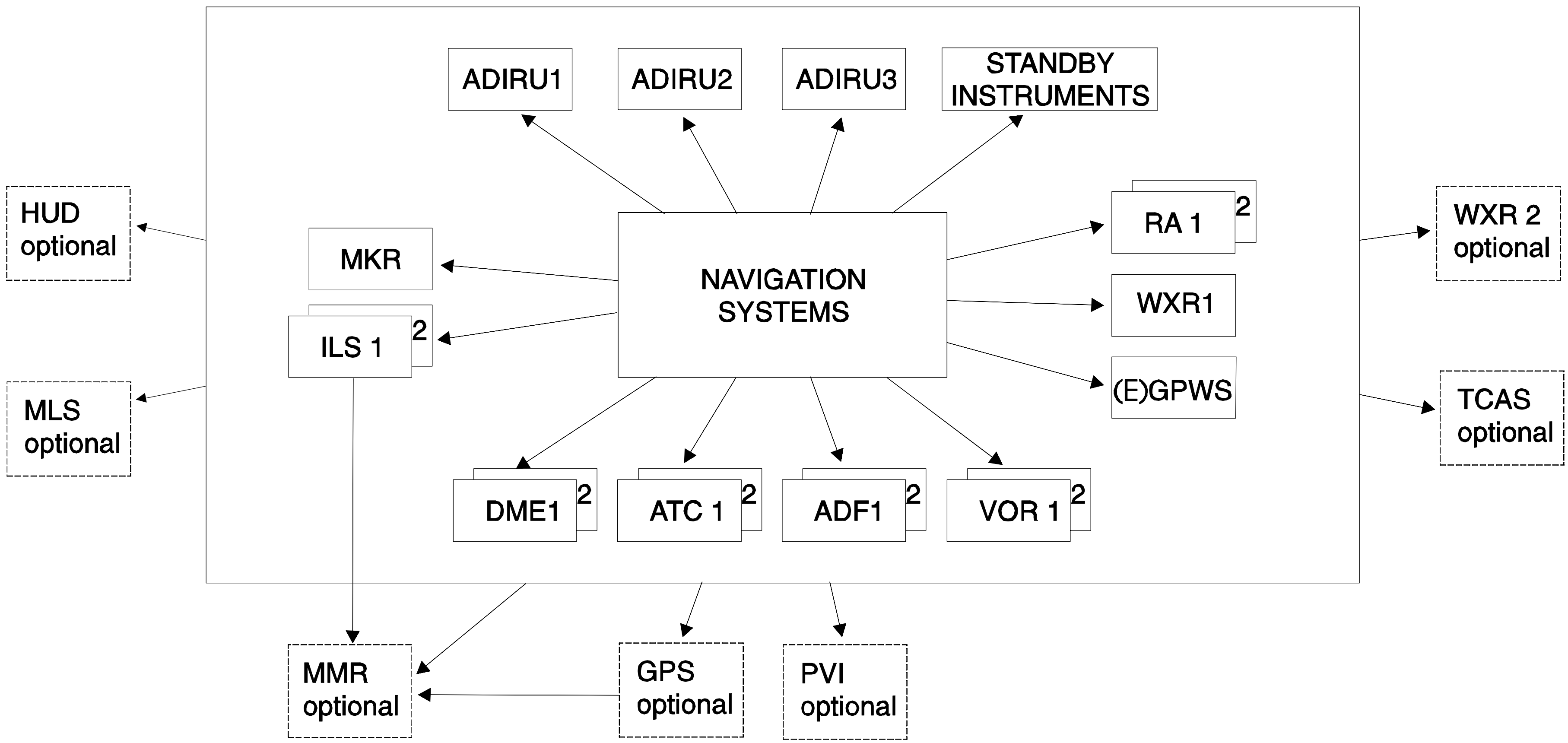
1- The Instrument Landing System (ILS) shows the aircraft position during approach and landing phases with respect to a predetermined path.
2- If installed, the Head Up Display (HUD) option provides an image above the glareshield, in front of the pilot.The image is transparent and allows the pilot to see through the windscreen. The HUD provides guidance information during take-off, landing or approach phases.
3- If installed, the Microwave Landing System (MLS) option shows the aircraft position during approach and landing phases with respect to a predetermined path.
The MLS is an ILS improvement.

DEPENDENT POSITION DETERMINING SYSTEMS

1- The Distance Measuring Equipment (DME) gives the slant distance between the aircraft and a distance measuring equipment ground station.
2- The Air Traffic Control system (ATC) allows the aircraft to be located and identified by ground operators or traffic collision avoidance system equipped aircraft.
3- The Automatic Direction Finder (ADF) system shows the bearing of an automatic direction finding ground station with respect to the aircraft heading.
4- The Very high frequency Omni-directional Range (VOR) shows the bearing of a ground station with respect to the aircraft heading. The VOR also indicates A/C course deviation with respect to preselected course.
5- The Marker is normally used with the instrument landing system during landing. The Marker provides aural and visual indications when overflying each of the three Marker transmitters positioned at known distances from the runway threshold.
6- If installed, the ParaVisual Indicating (PVI) system option provides a piloting aid during roll out on runway in reduced visibility. The PVI, on a LCD display, is located on the glareshield in front of the pilot.
7- If installed, the Global Positioning System (GPS) option provides an accurate position by processing signals provided by a satellite network.
8- The optional Multi Mode Receiver (MMR) is installed in place of the ILS system and G.P.S. system and ensures their functions.

INDEPENDENT POSITION DETERMINING SYSTEMS

1- The Weather Radar system (WXR) allows detection and localization of atmospheric disturbances and provides visual display of their intensity.
If activated, the optional Predictive Windshear function allows detection and localization of windshear events and provides the appropriate visual and aural annunciations.
2- The Radio Altimeter (RA) precisely and continually shows the aircraft height above the ground up to 2500 feet. The RA is independent of the atmospheric pressure.
3- The Ground Proximity Warning System (GPWS) or the optional Enhanced Ground Proximity Warning System (EGPWS), provides aural and visual warnings if the aircraft is in a hazardous configuration near the ground.
4- If installed, the Traffic Collision Avoidance System (TCAS) option provides aural and visual advisories if the aircraft is in a hazardous traffic configuration.



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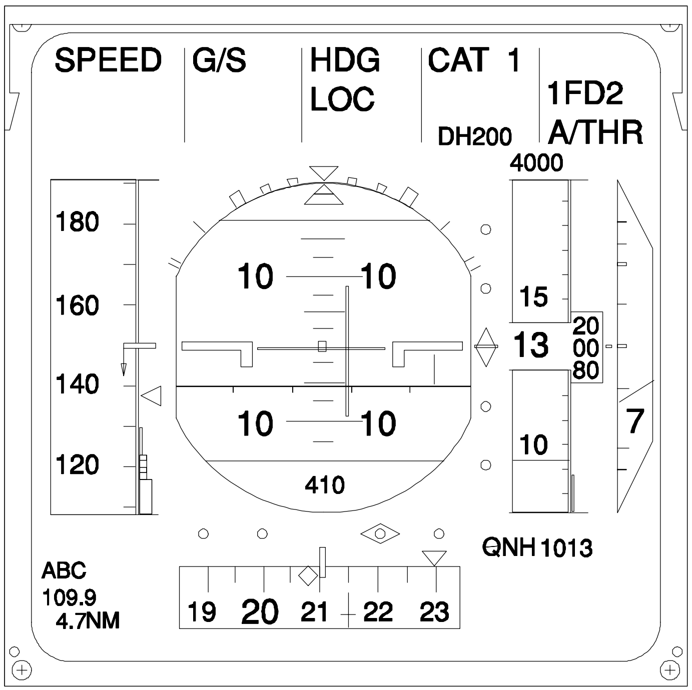
STUDENT NOTES

SYSTEM CONTROLS AND INDICATING

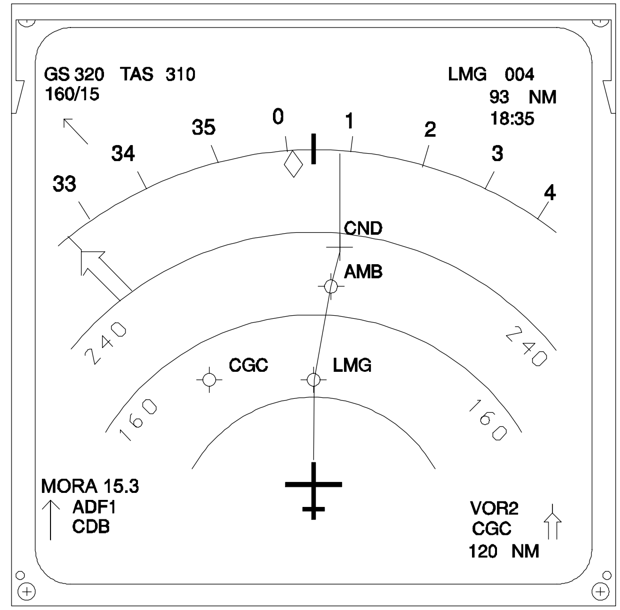
Displays
ADIRS
Standby Instruments
Radio Navigation
Weather Radar
ATC
GPWS
Options

DISPLAYS

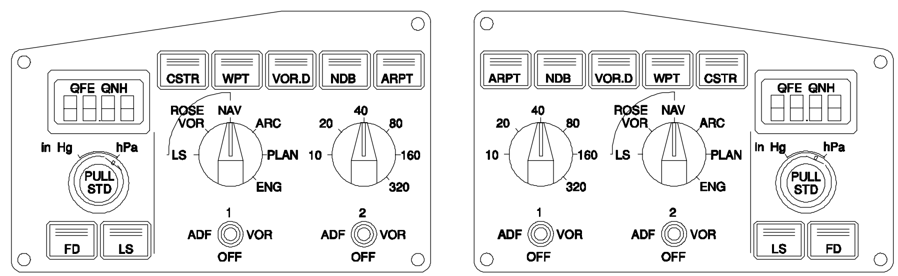
The Primary Flight Display (PFD) shows short range data for aircraft control.



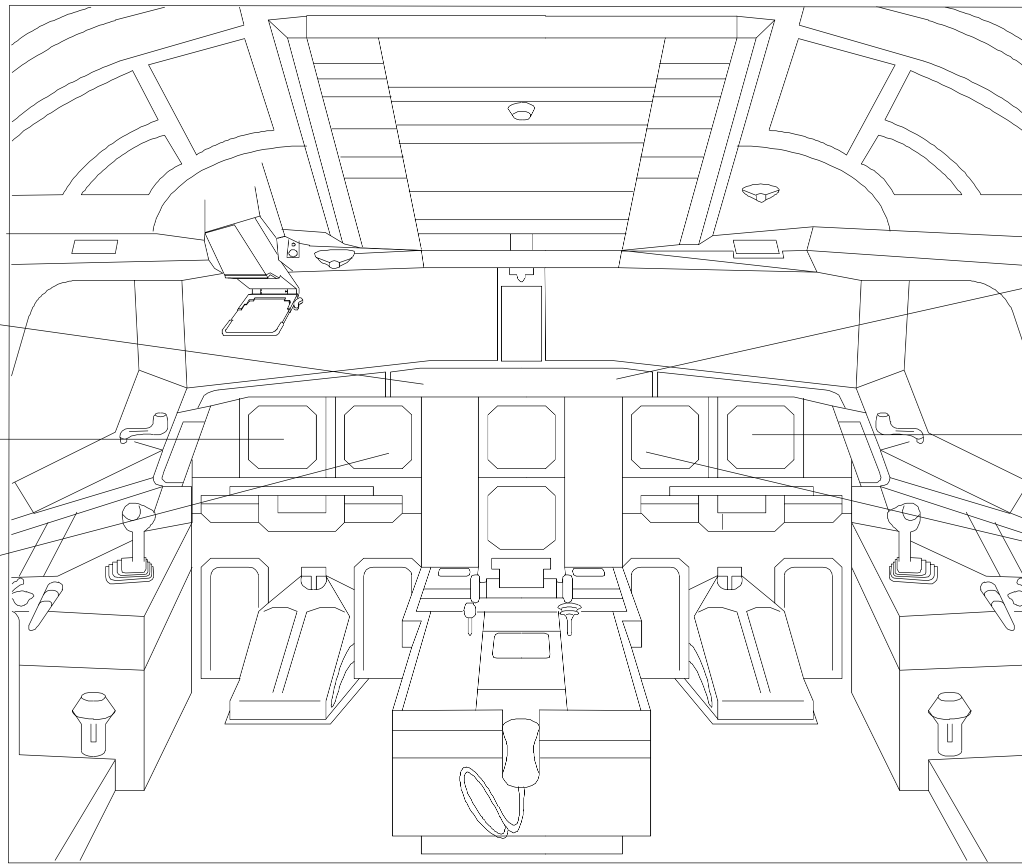
The Navigation Display (ND) shows long range data for navigation.



The Electronic Flight Instrument System (EFIS) control panel enables the crew to control PFD and ND.



Note: The EFIS control panel is a part of the Flight Control Unit (FCU).



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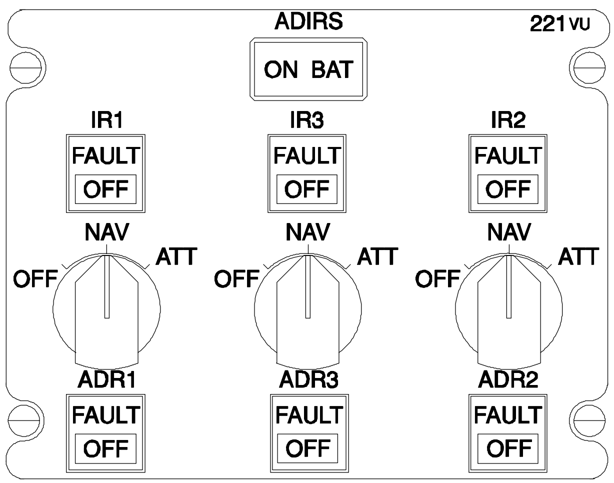
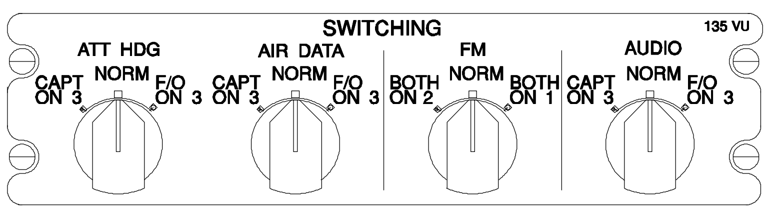
ADIRS

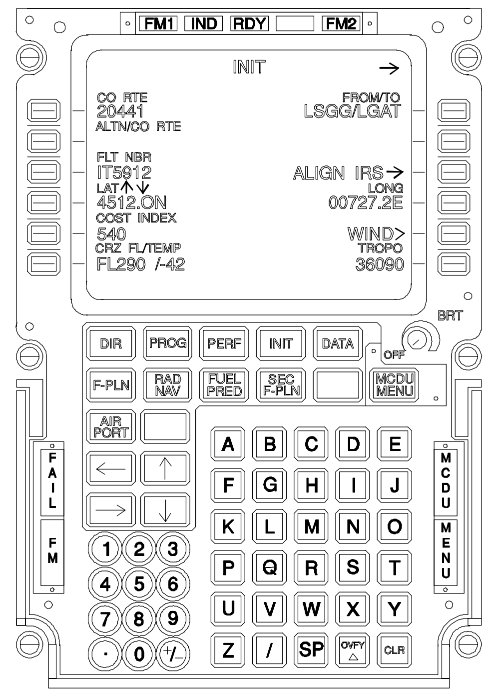
The Mode Selector Unit (MSU) enables the crew to energize the Air Data Inertial Reference Units (ADIRU) and to monitor their status and faults.



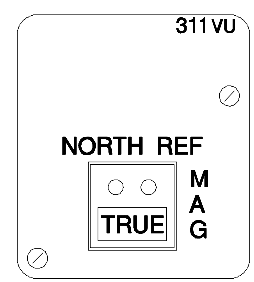
After a failure, part of the switching panel enables the display source to be selected from the three ADIRUs.
Note: the ATT HDG and AIR DATA switchings can be performed separately.



The ADIRS parameters can be initiated and displayed on the Multipurpose Control and Display Unit (MCDU).



The NORTH REF pushbutton serves to switch from magnetic to true north for polar navigation.



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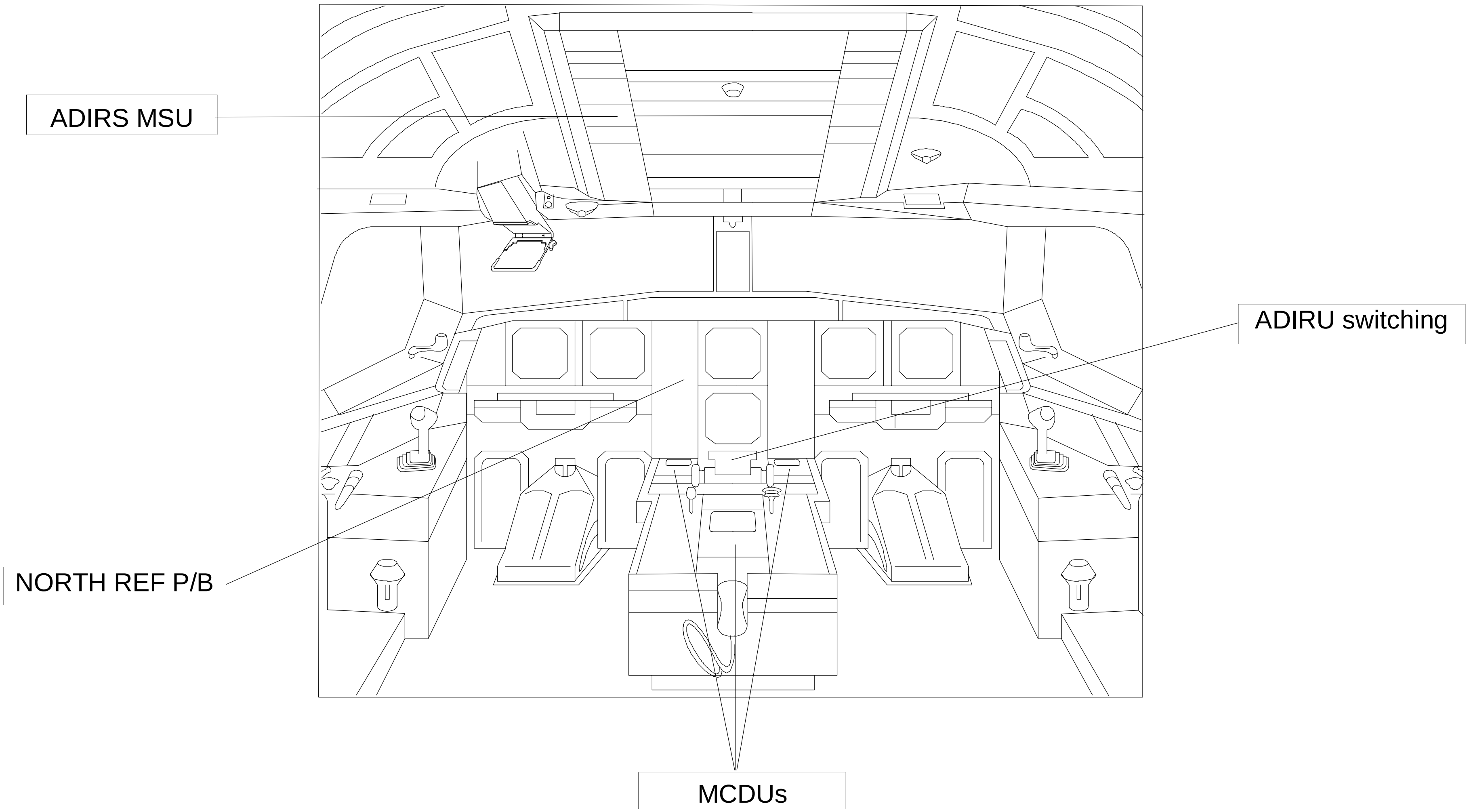

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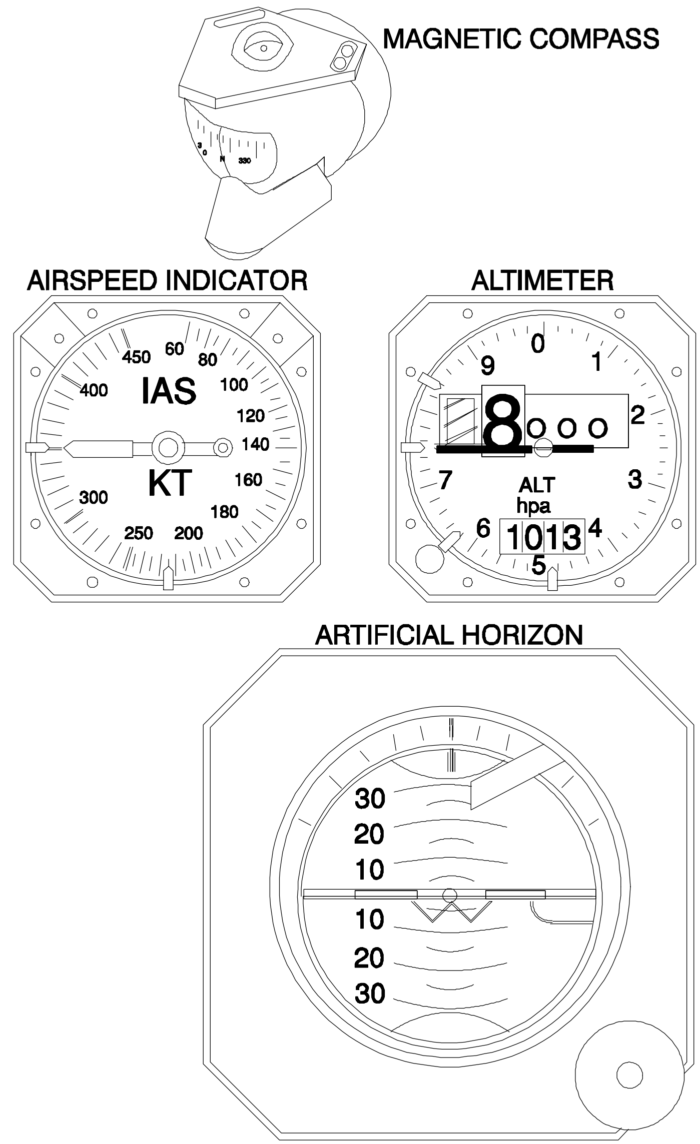
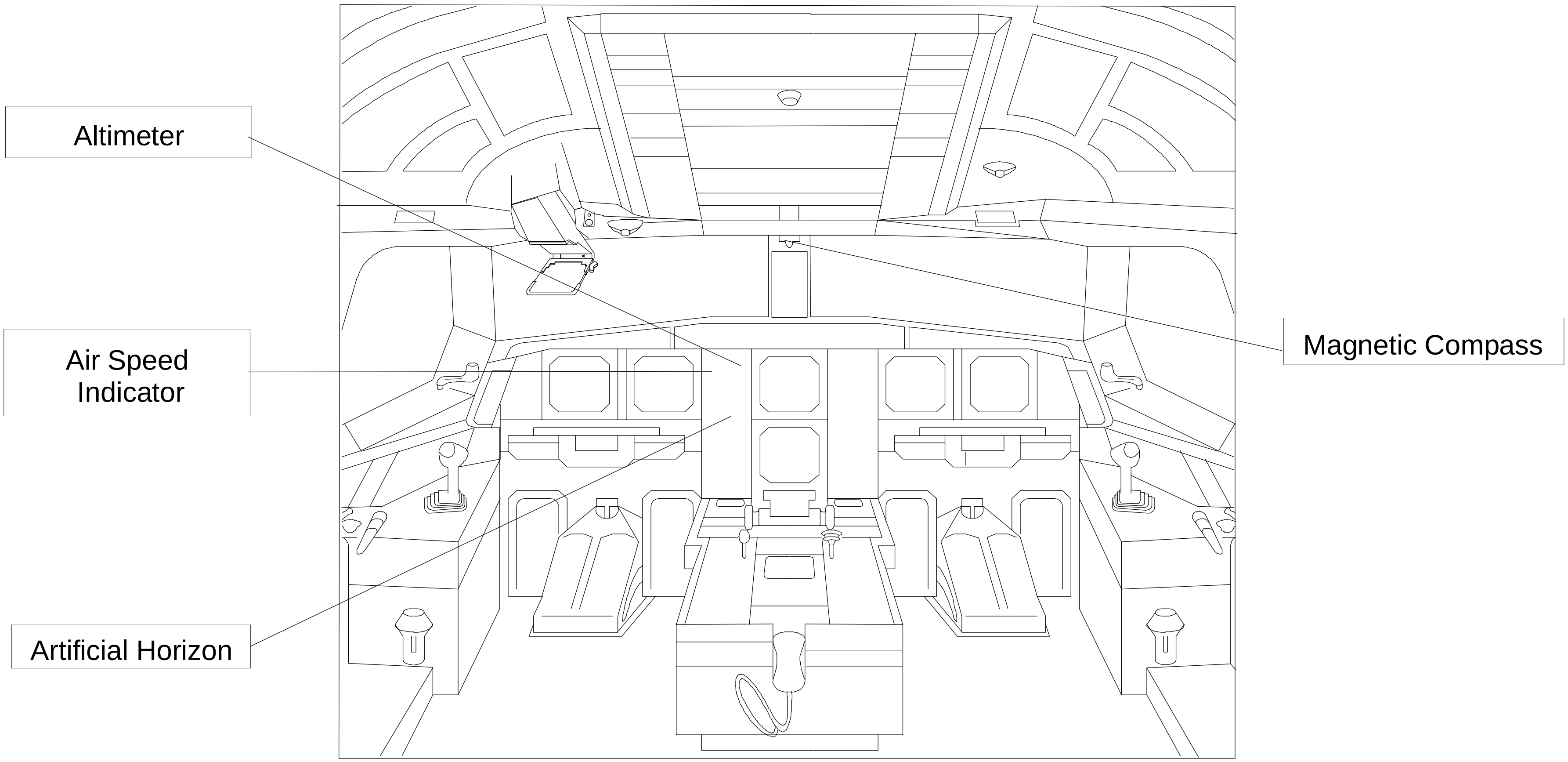
STANDBY INSTRUMENTS

The standby instruments comprise :
- a magnetic compass,
- an airspeed indicator,
- an altimeter,
- an artificial horizon.





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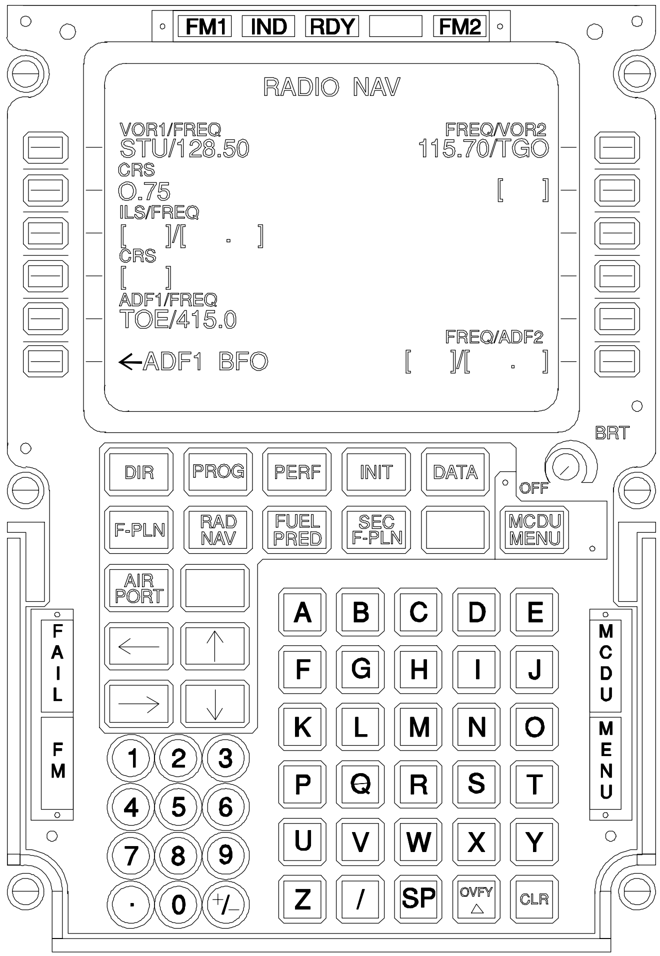
RADIO NAVIGATION

The radio navigation systems are controlled from an MCDU.



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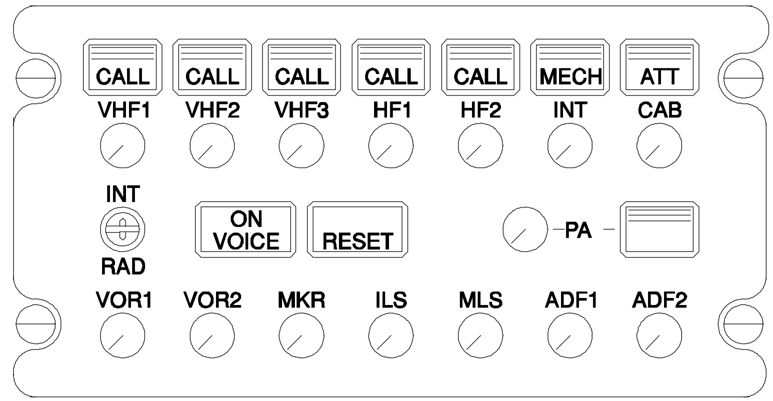
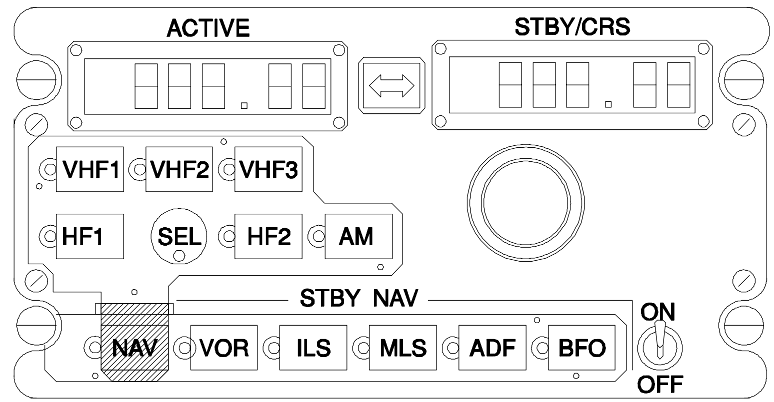
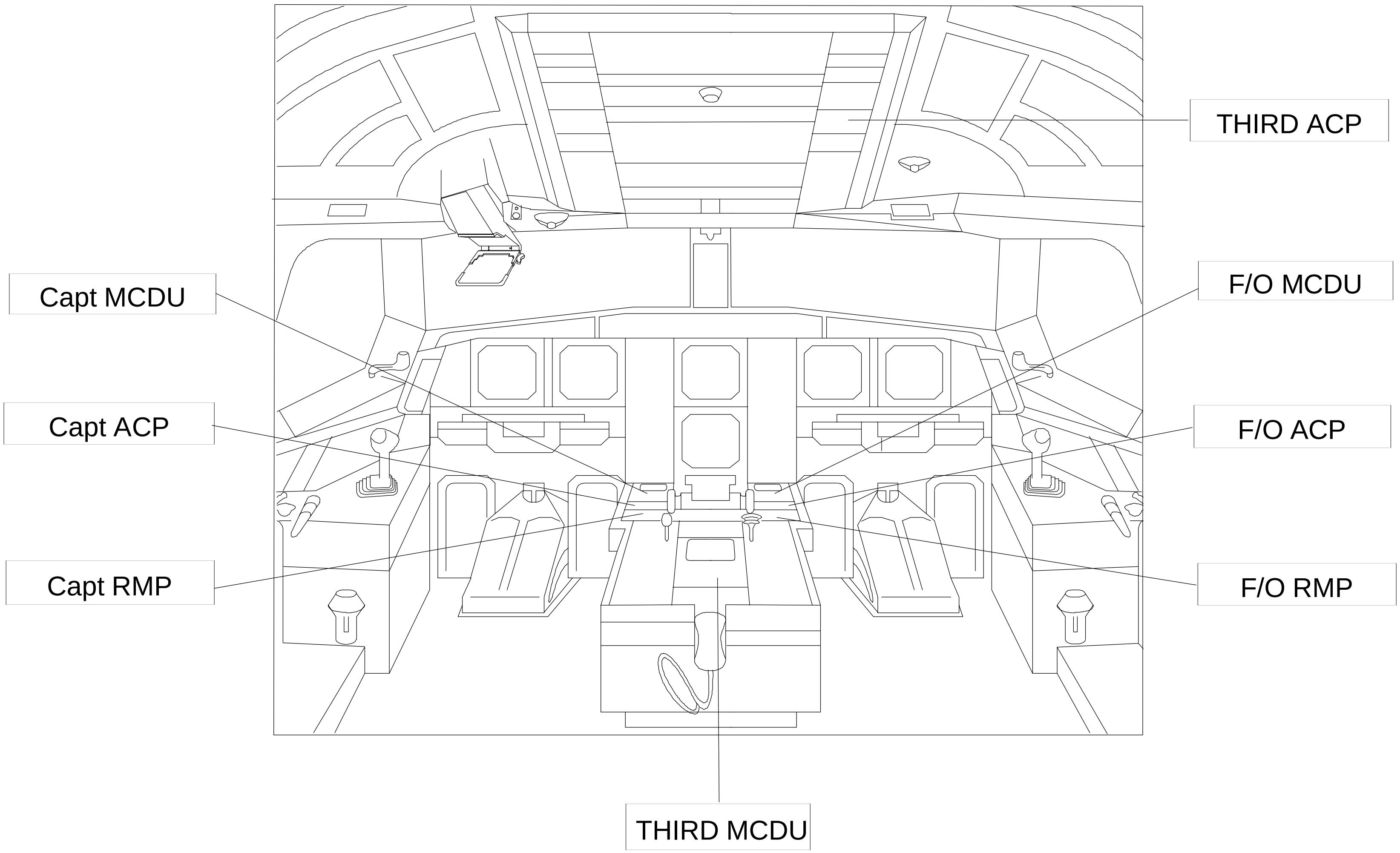
The Audio Control Panels (ACP) allow the control of audio and radio navigation signals.



The Captain and First Officer Radio Management Panels (RMP) allow back up radio navigation control.





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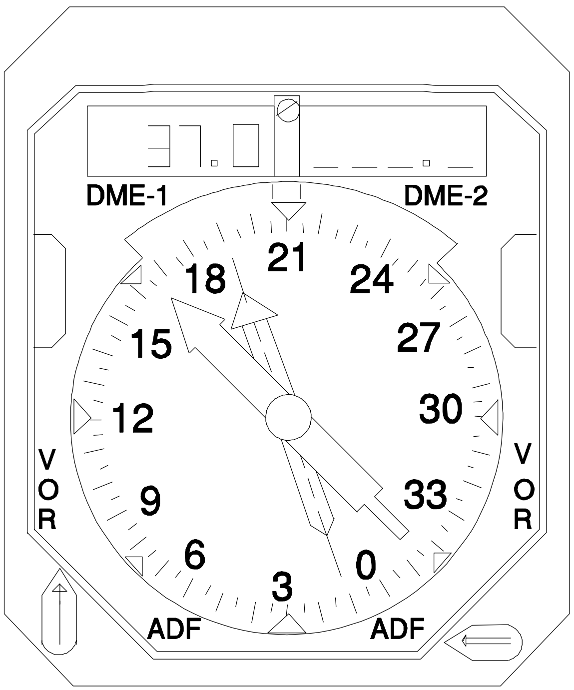
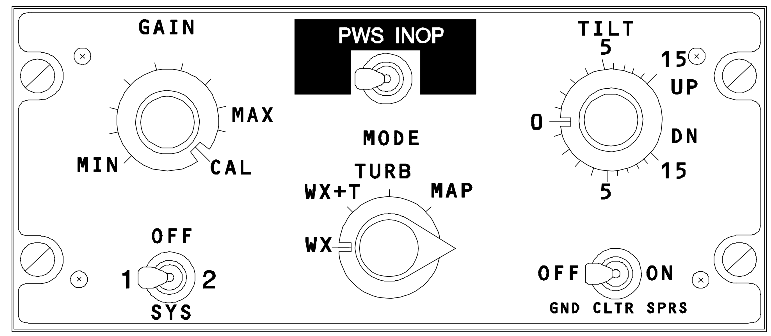
RADIO NAVIGATION (Continued)

The Very High Freqency Omni directional Range (VOR), Automatic Direction Finding (ADF) and Distance Measuring Equipment (DME) indications are shown on the Digital Distance Radio Magnetic Indicator (DDRMI).



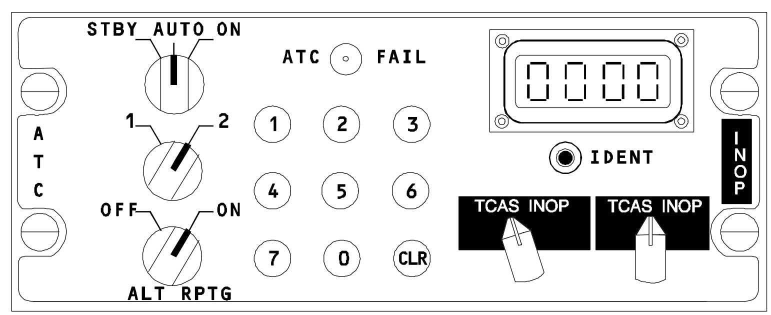
WEATHER RADAR

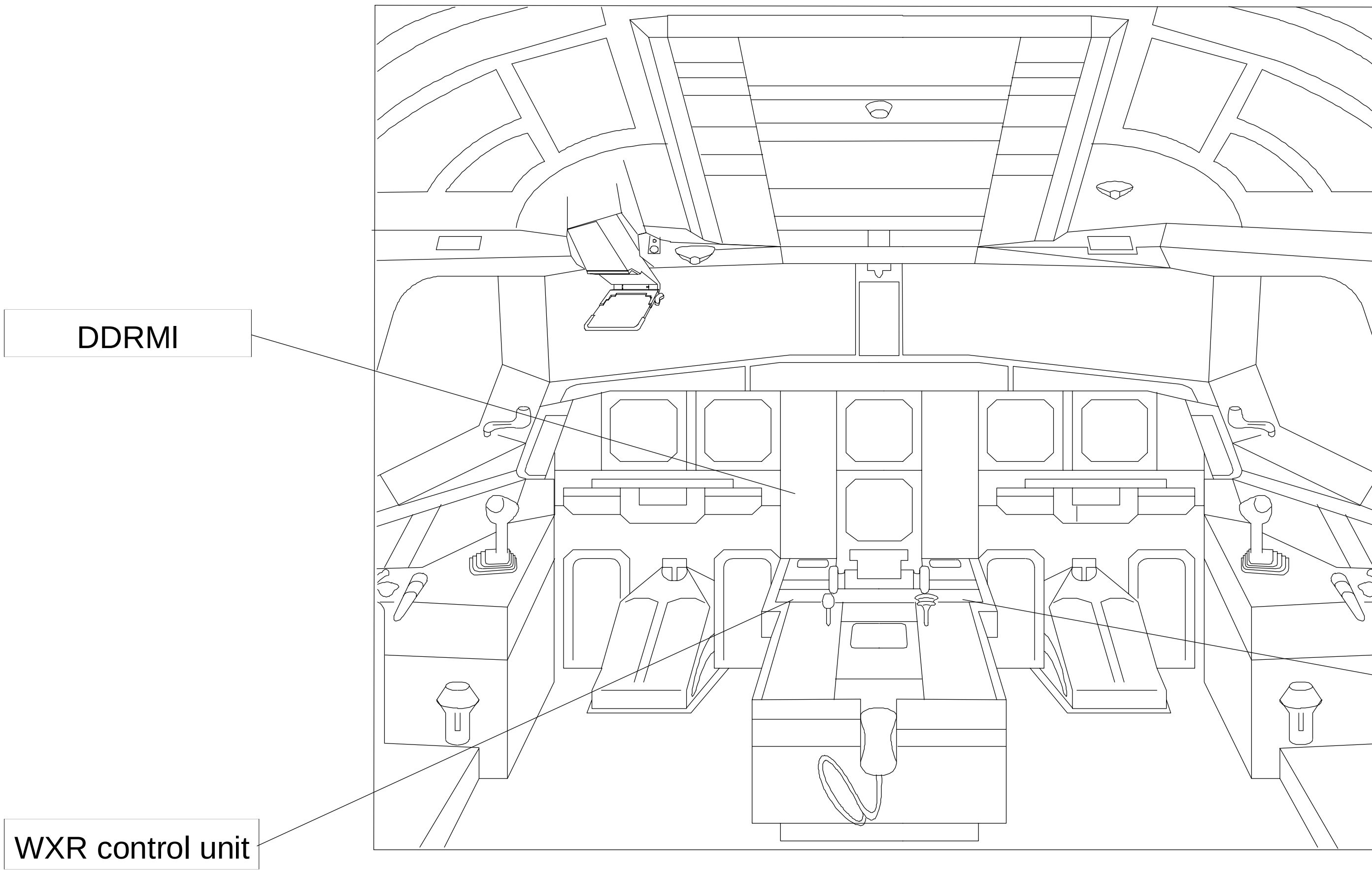
A control unit serves to control the Weather Radar system (WXR).



ATC

A control unit enables the crew to control the various operating modes of the Air Traffic Control (ATC).





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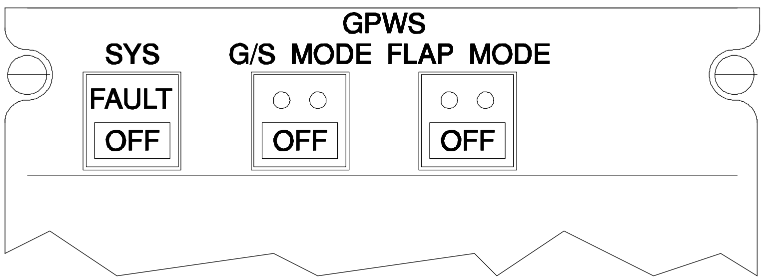
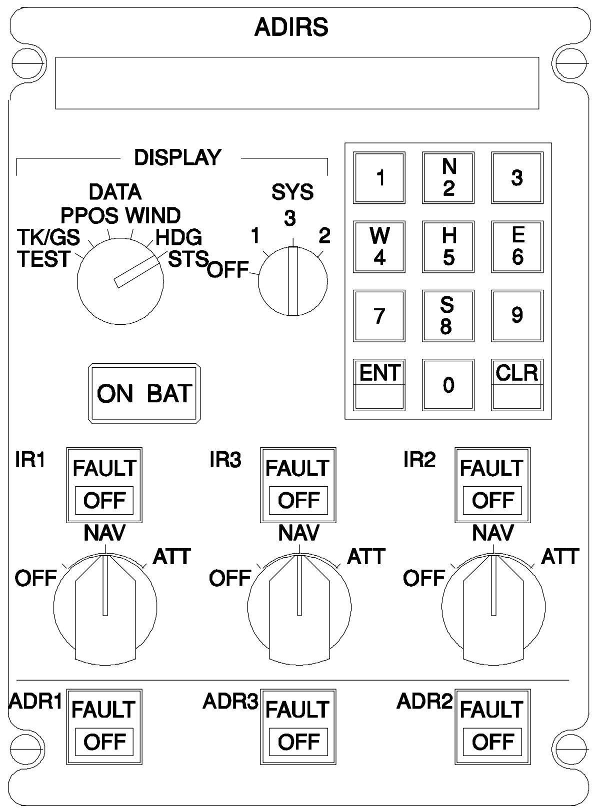
GPWS

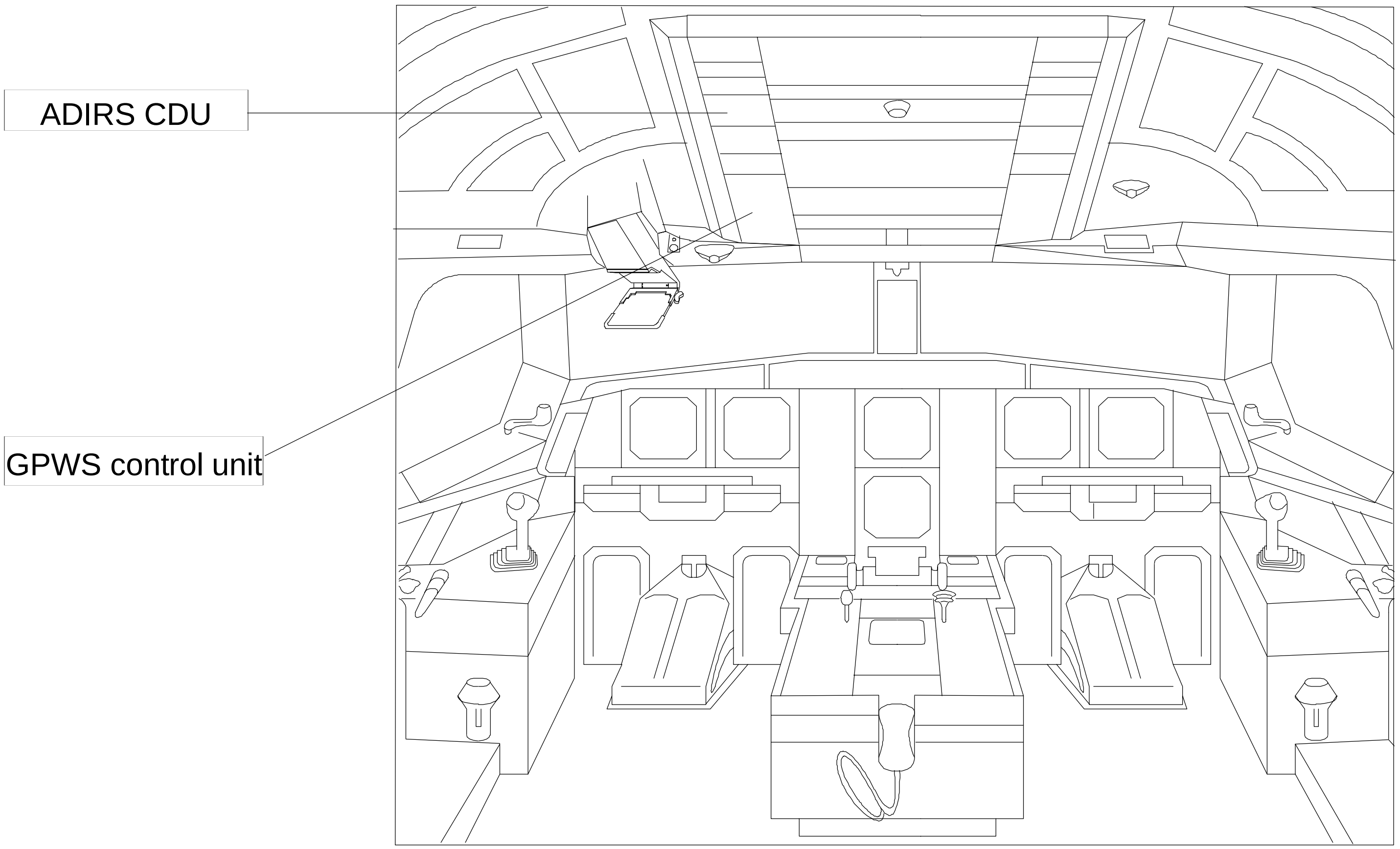
A control unit serves to control the Ground Proximity Warning System (GPWS).



OPTIONS

An optional Air Data Inertial Reference System (ADIRS) Control Display Unit (CDU)can be fitted to perform alignment and to indicate status and faults.





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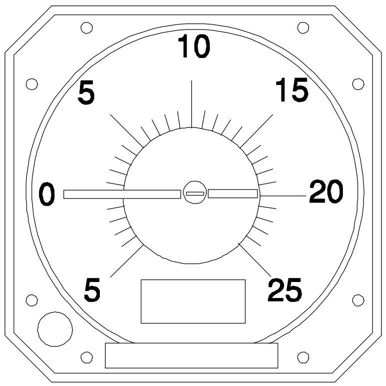
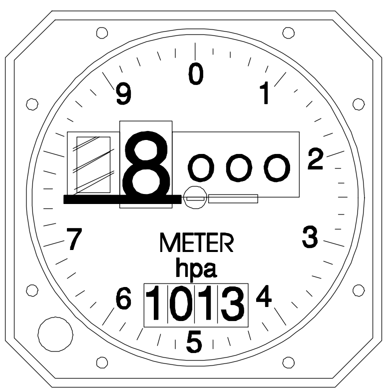
OPTIONS (Continued)

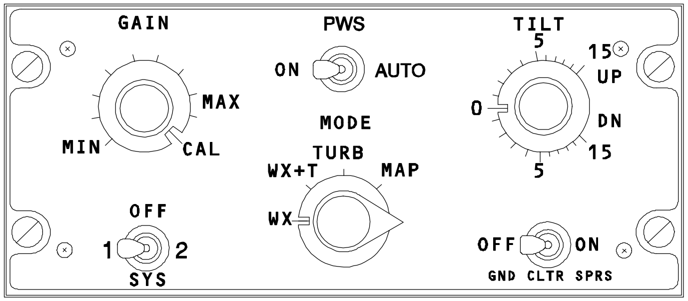
An optional Angle Of Attack (AOA) indicator can be fitted to show the angle of attack.



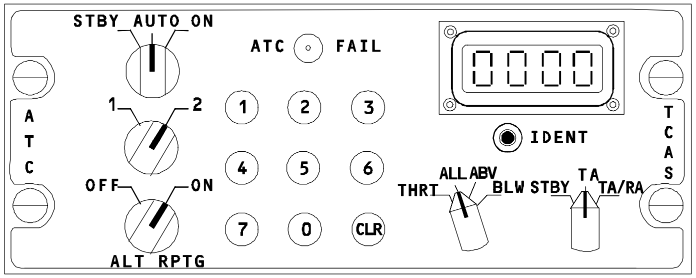
An optional metric altimeter can be fitted to show the altitude in meters.



An optional Weather Radar control unit can be fitted with a predictive windshear switch if the optional predictive windshear function is activated.



An optional Air Traffic Control (ATC) / Traffic Collision Avoidance System (TCAS) control panel serves to control both systems.



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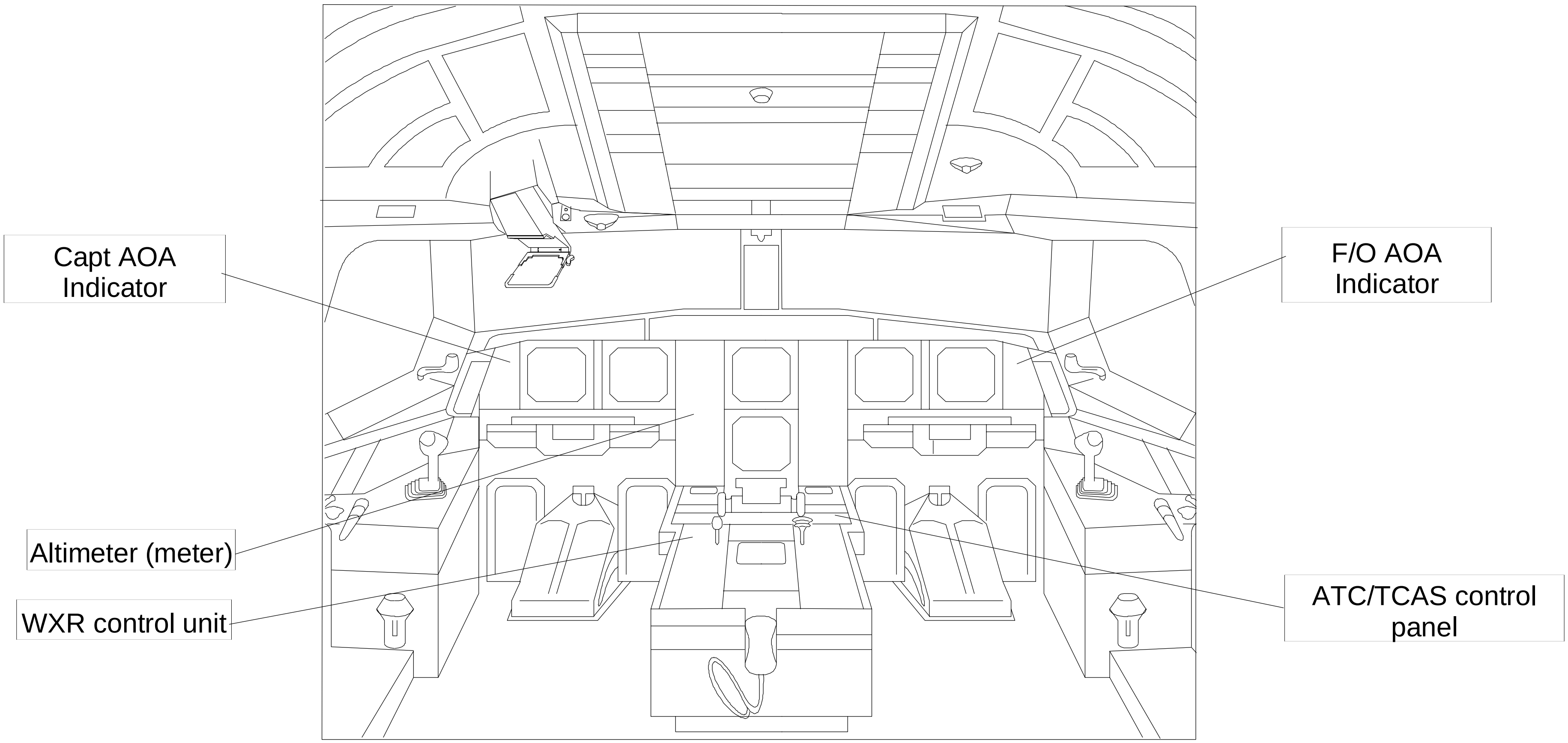

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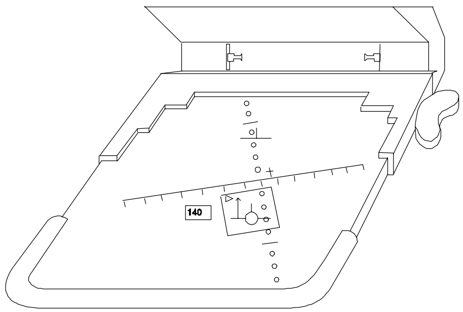
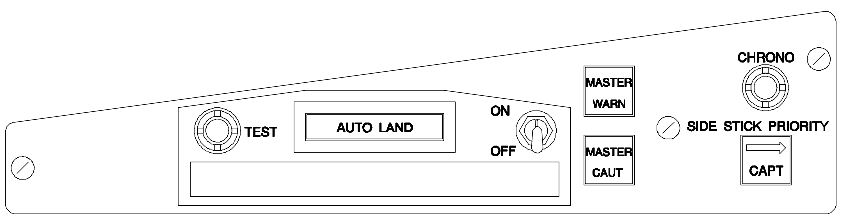
OPTIONS (Continued)

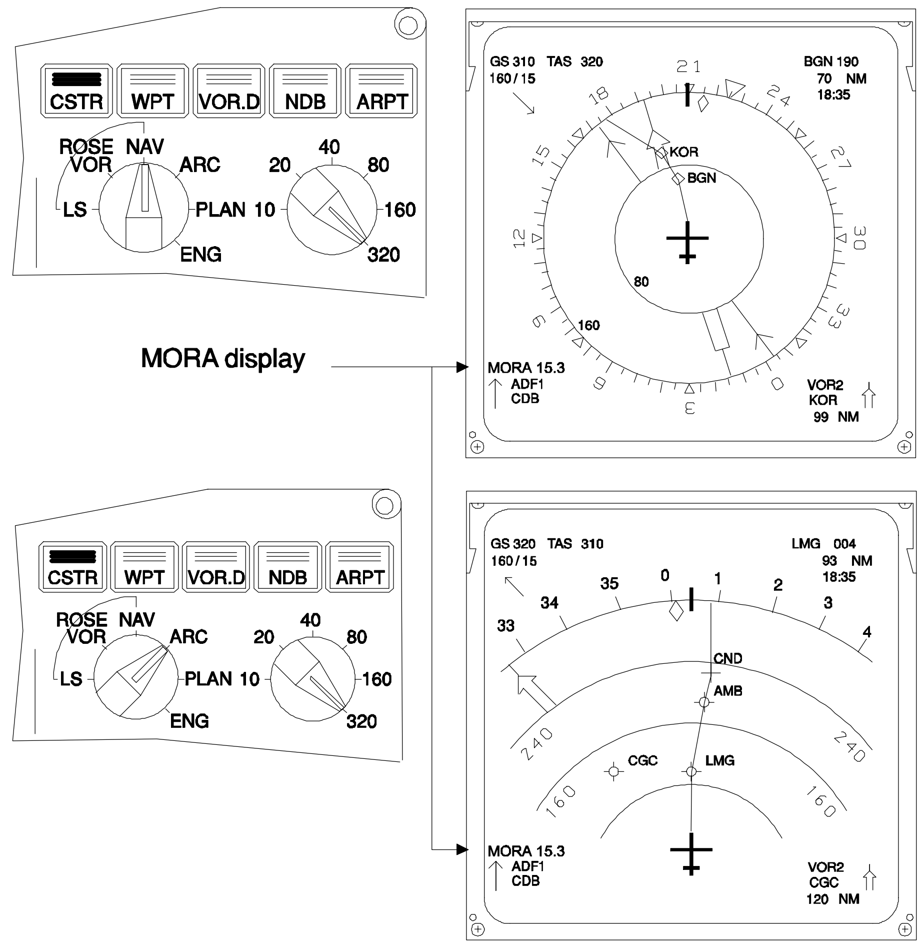
An optional Head Up Display (HUD) can be fitted to provide guidance information.

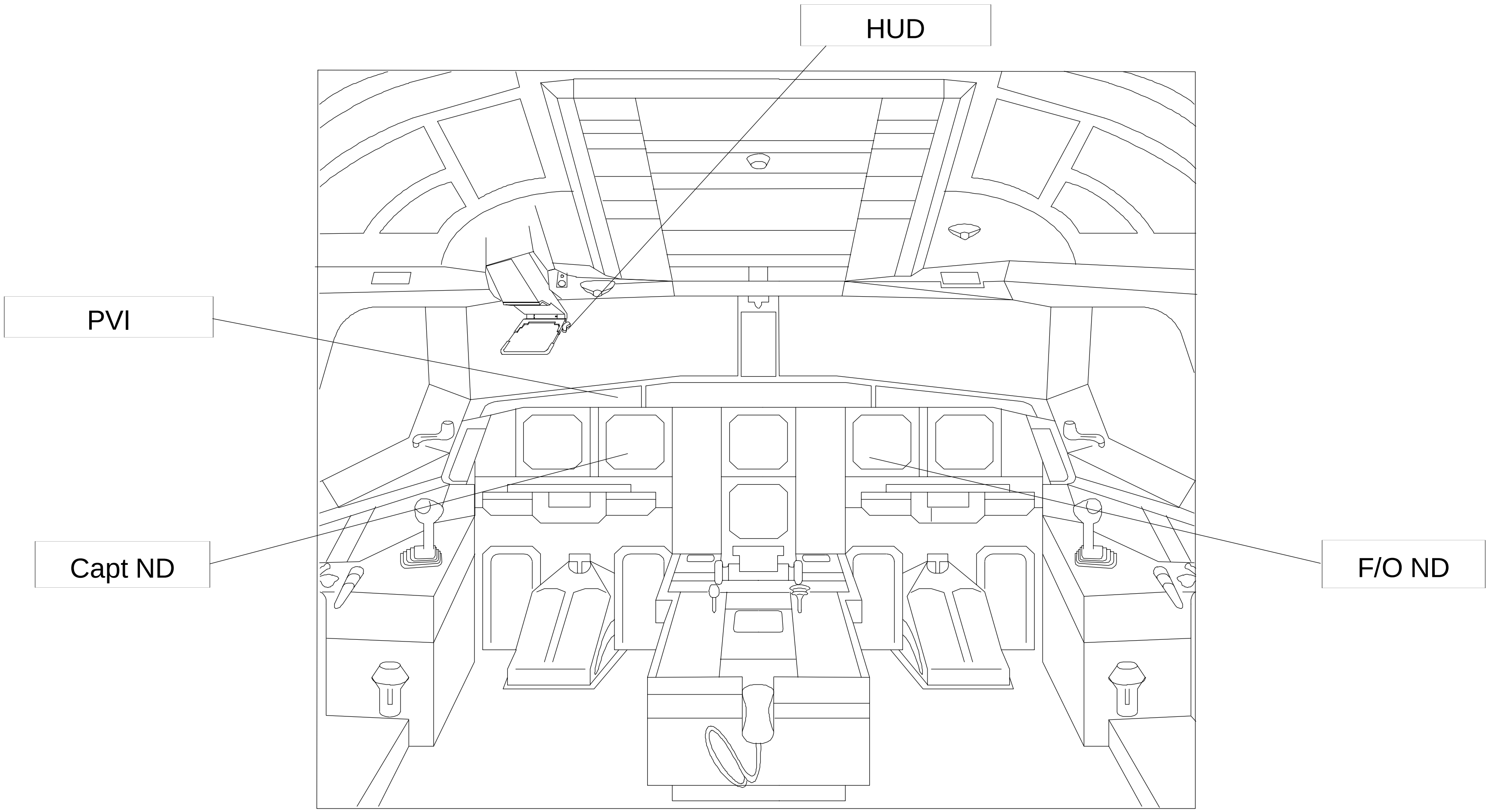


An optional Paravisual Indicating (PVI) system can be fitted to provide guidance information during roll out.



The optional MORA display provides the highest Minimum Off Route Altitude within 80 NM around the actual aircraft position. It is displayed in hundreds of feet on NDs (in ROSE-NAV and ARC modes) when the constraint option (CSTR) is selected on the EFIS control panel and the selected range is greater than 40 NM.





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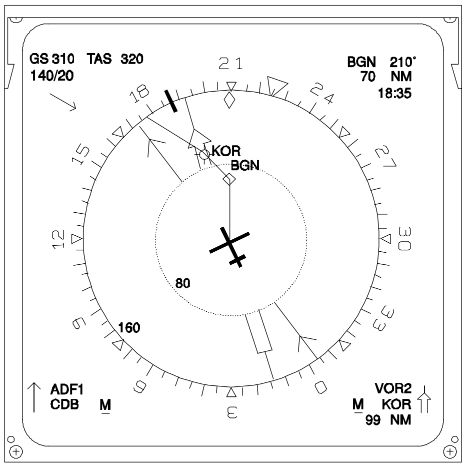
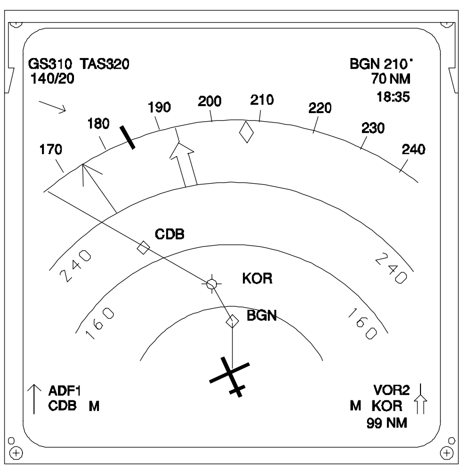
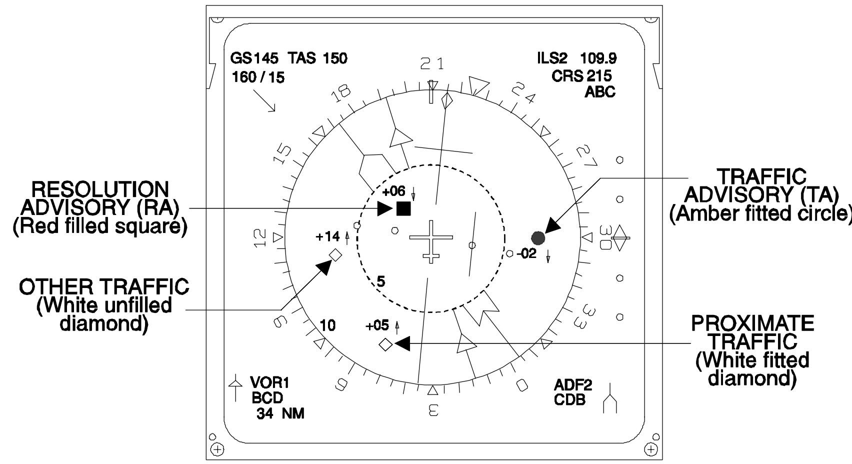
OPTIONS (Continued)

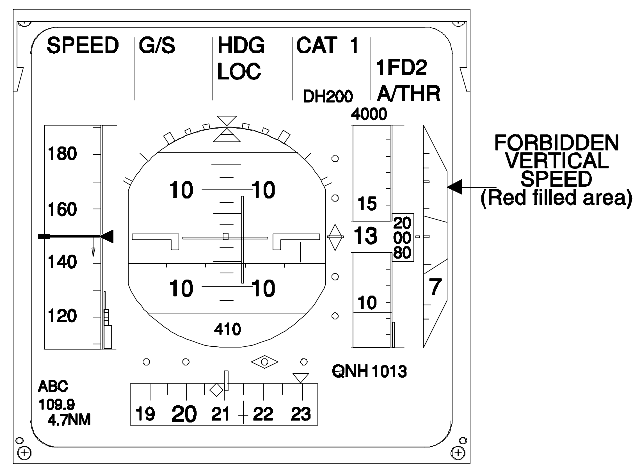
If activated, in ROSE-NAV and ARC modes, the heading dial takes its references from the track and not heading. In these modes, the aircraft model is fixed but rotates following the heading.

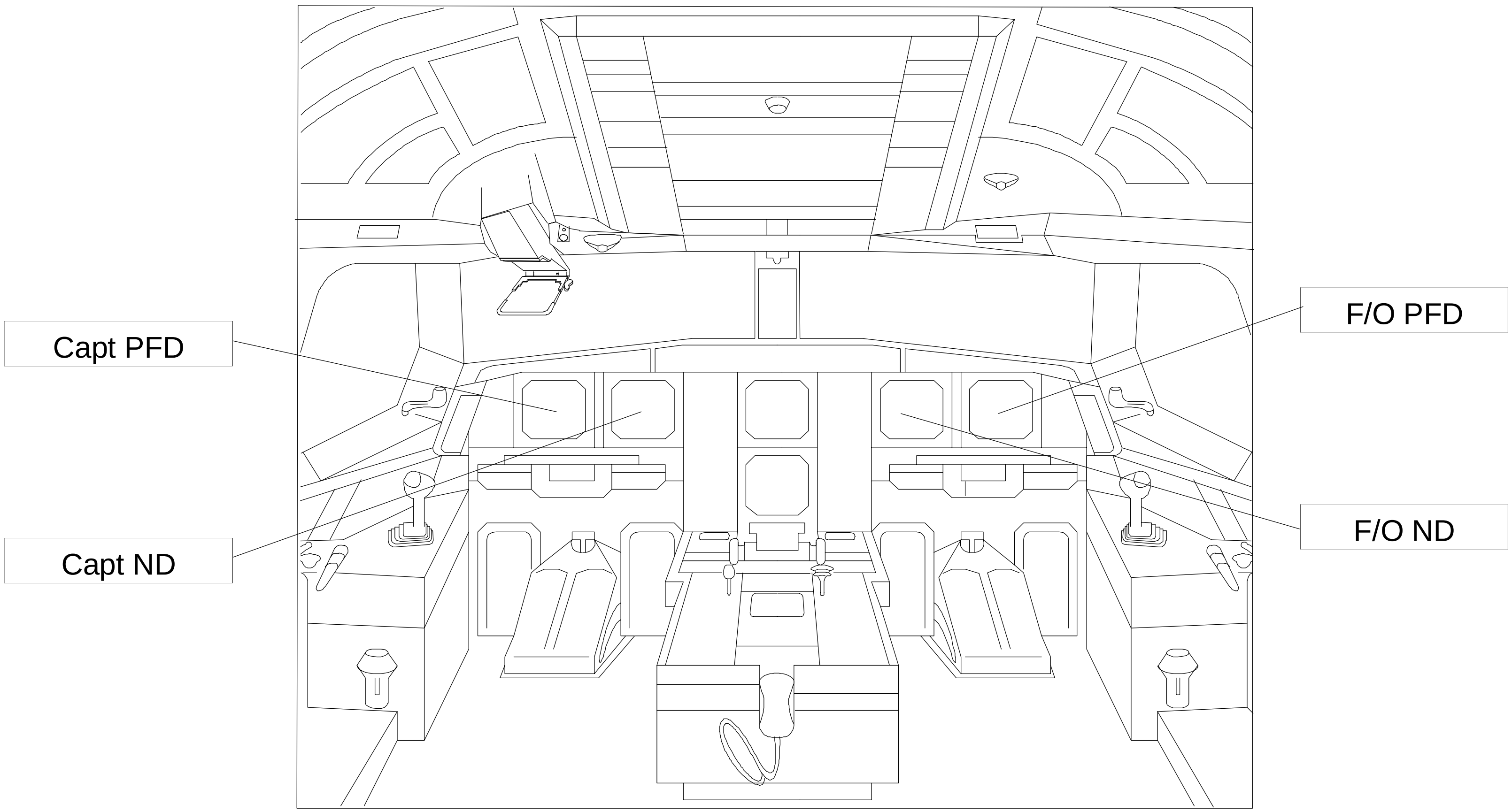
If fitted, the Traffic Collision Advoidance System (TCAS), detecting the ATC system or TCAS equipped aircraft, provides aural and visual information about intruders within a certain range.











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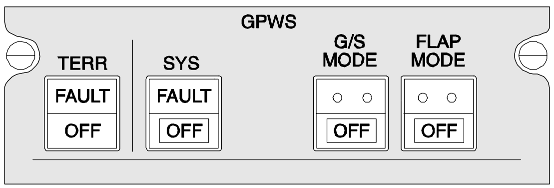
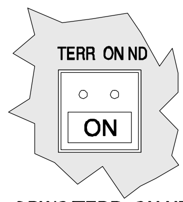
OPTIONS (Continued)

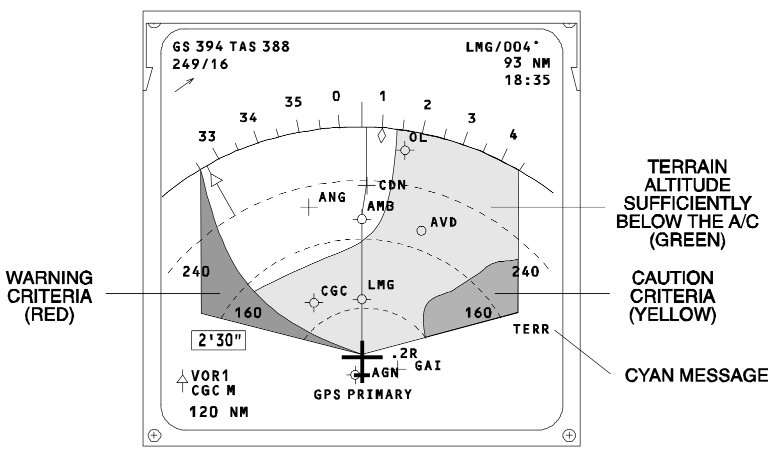
If the Enhanced GPWS (EGPWS) is installed in place of the GPWS and if the Enhanced functions are activated, it provides an increased terrain clearance envelope around the airport runway and displays any conflicting terrain around the flight path.



EGPWS CONTROL PANEL



GPWS/TERR ON ND
CAPT and F/O P/B SWITCHES



TERRAIN PICTURE

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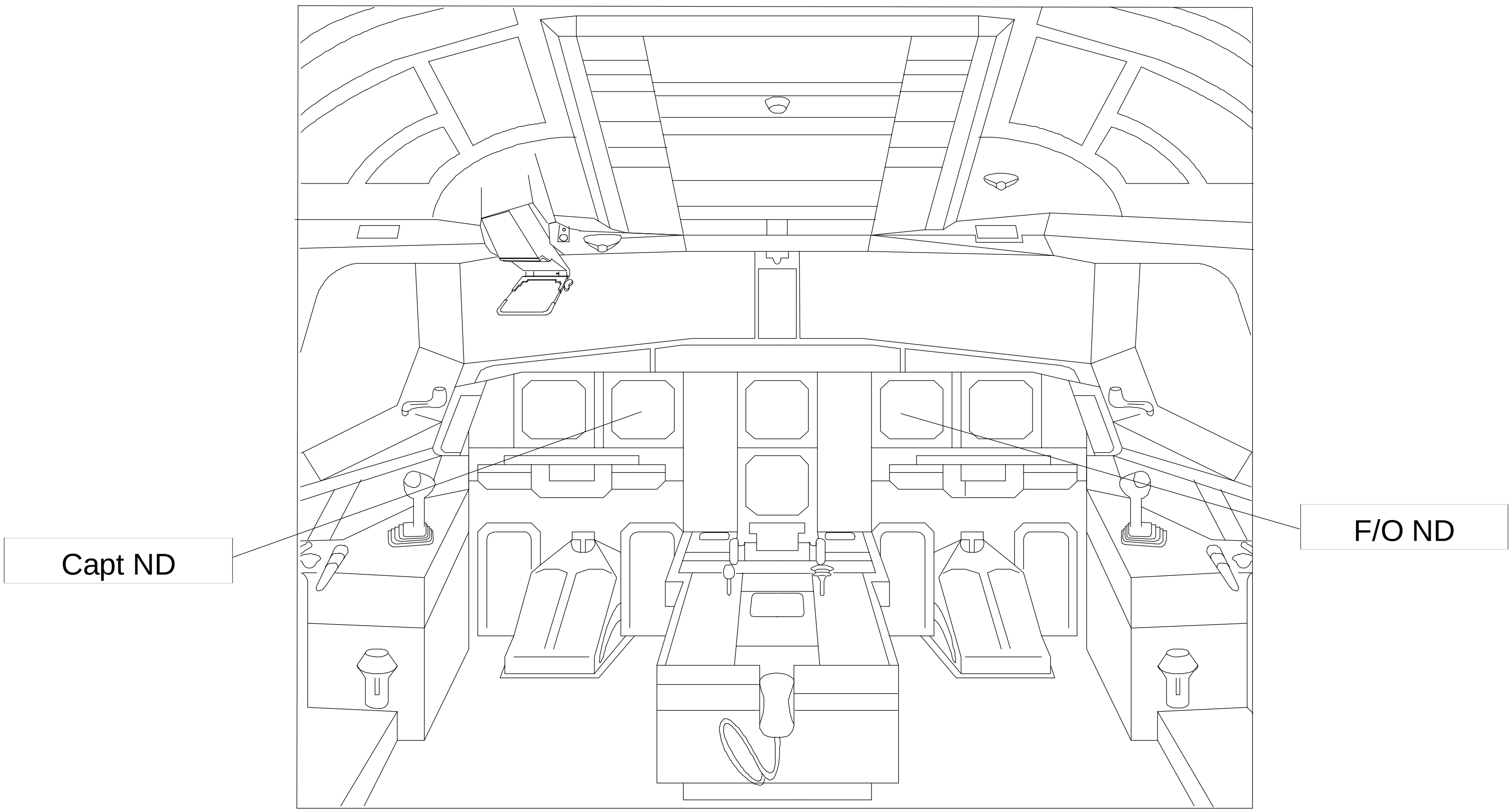

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STUDENT NOTES

RADIO NAVIGATION CONTROL PRESENTATION

Automatic Tuning
Manual Tuning
MCDU switching
FM switching
Backup Tuning

AUTOMATIC TUNING

In normal operation, each Flight Management Guidance and Envelope Computer (FMGEC) automatically controls its ownside receivers via the associated Radio Management Panel (RMP).
Without pilot action :

- FMGEC1 controls receivers 1,
- FMGEC2 controls receivers 2.

MANUAL TUNING

For manual tuning in normal operation, the crew uses the RADIO NAV page on the captain or first officer Multipurpose Control Display Unit (MCDU) and controls the receivers through the FMGECs.
When MCDU1 and 2 are ON, it is not possible to perform manual tuning from MCDU3.

MCDU SWITCHING

If the captain or first officer MCDU has failed and has been set to off, the third MCDU will operate with the complete functions.
If the CAPT and F/O MCDUs are set to OFF, MCDU3 operates as the CAPT MCDU.

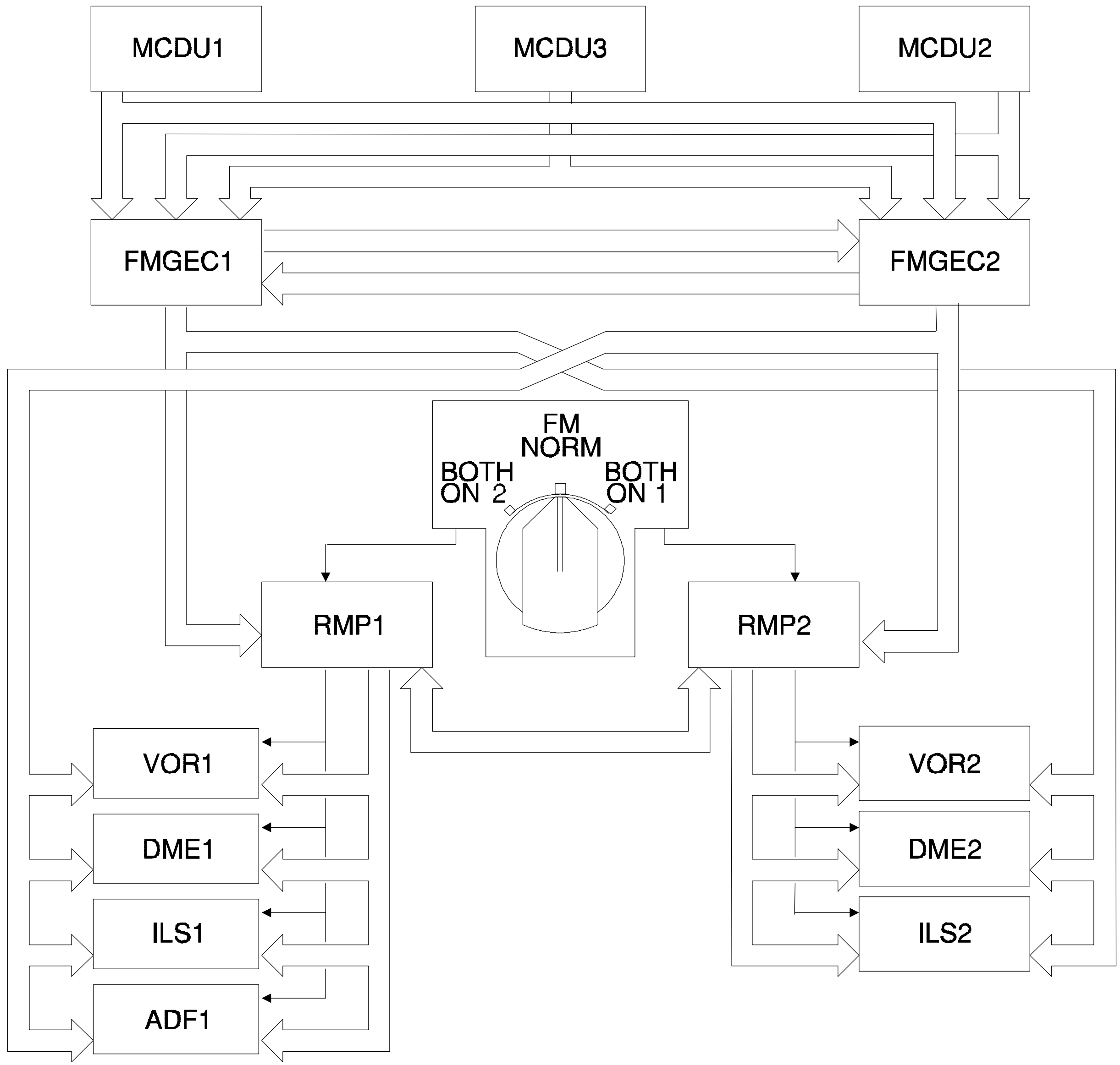
FM SWITCHING

If one FMGEC fails, a manual switching to the other one must be performed.
The remaining FMGEC controls:

- its ownside receivers, via its ownside RMP
- the opposite receivers, directly.

BACKUP TUNING

If the both FMGECs have failed, the captain and first officer use their RMPs to control their ownside receivers.The third RMP does not operate in radio nav back up mode.
The Instrument Landing System (ILS) course and frequency are the only radio navigation data exchanged (ILS1 and ILS2 data are identical).



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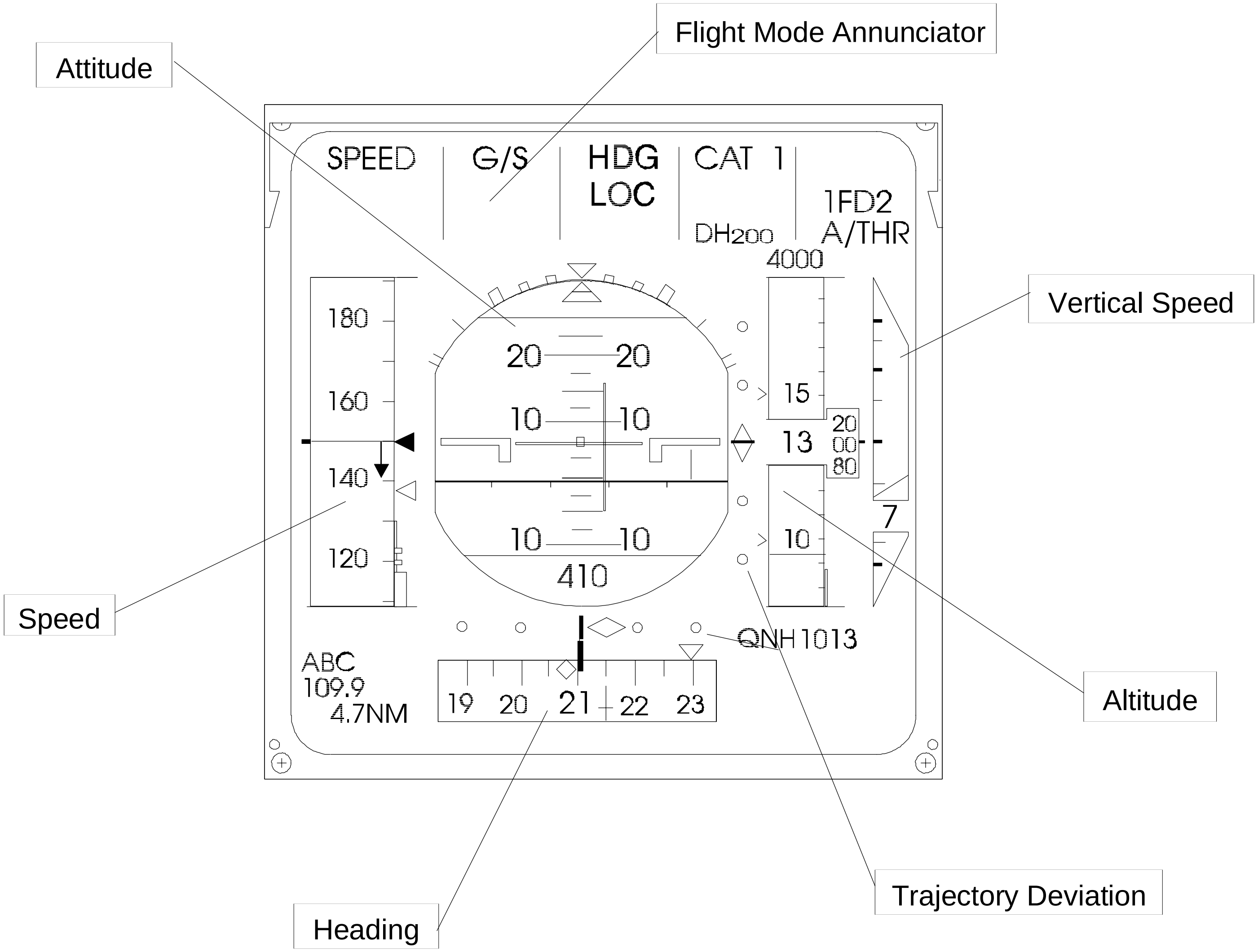
STUDENT NOTES:

PRIMARY FLIGHT DISPLAY PRESENTATION

Attitude
Speed
Altitude
Vertical Speed
Heading
Trajectory Deviation
Flight Mode Annunciator

GENERAL

The purpose of this module is to identify the main indications of the navigation system on the Primary Flight Display (PFD).



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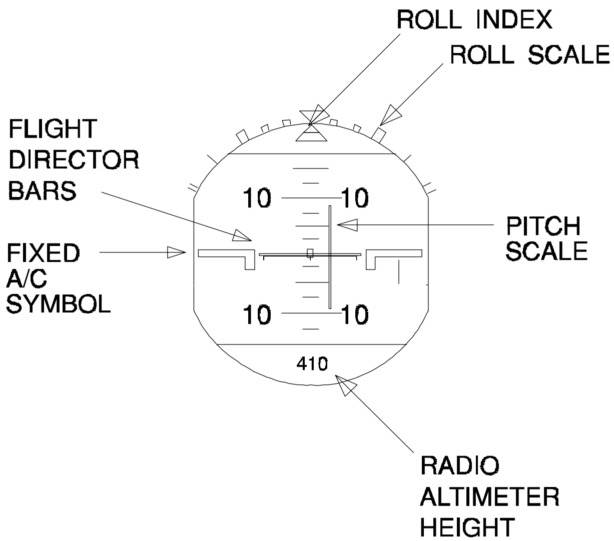
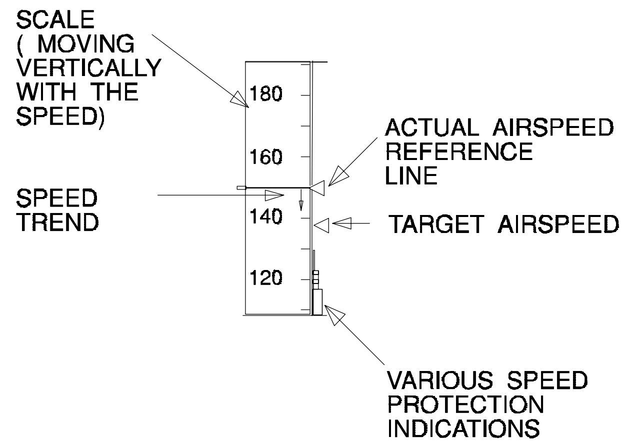
ATTITUDE

The attitude data is shown on the artificial horizon.



SPEED

The airspeed data is shown on the left hand moving scale.



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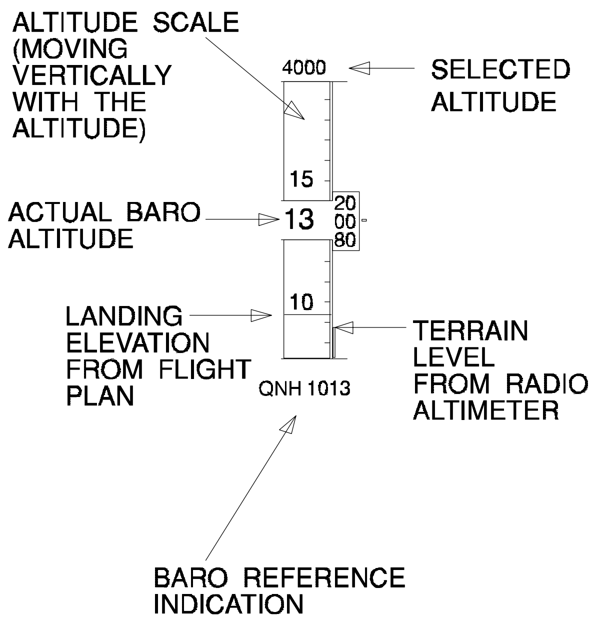
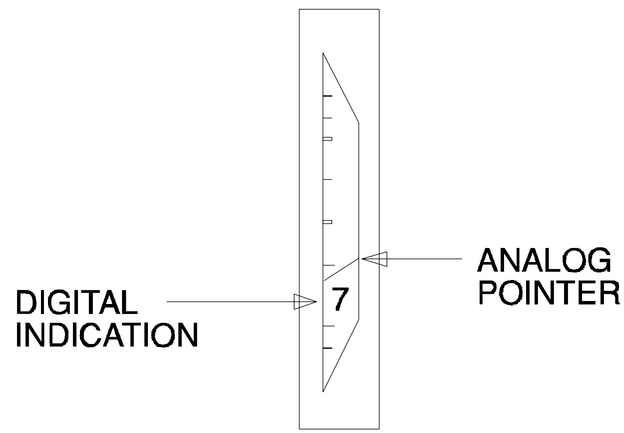
ALTITUDE

The altitude data is shown on the right hand moving scale.



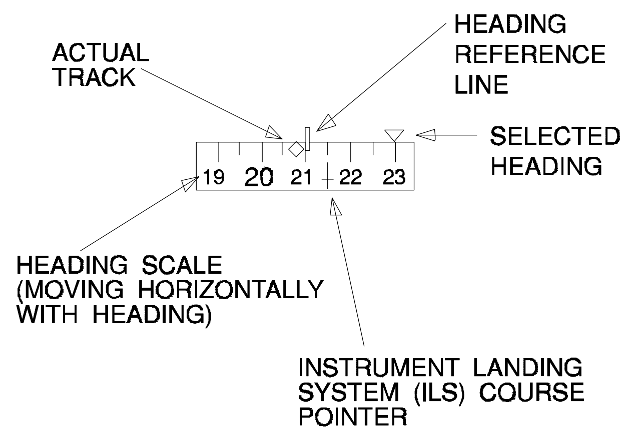
VERTICAL SPEED

The vertical speed data is shown on the right hand scale.



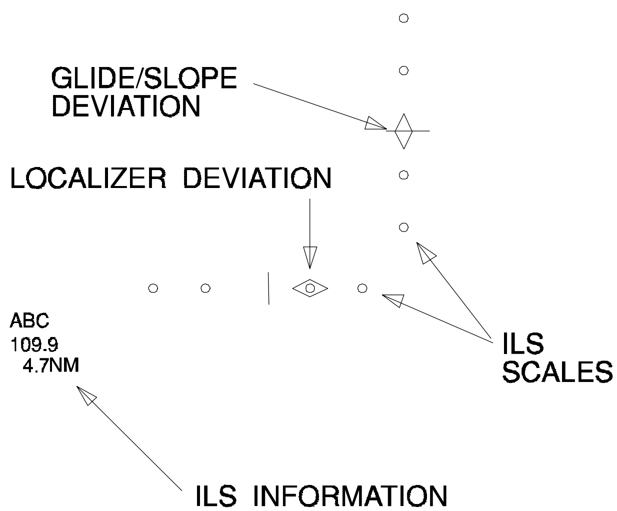
HEADING

The heading data is shown on the moving horizontal scale.



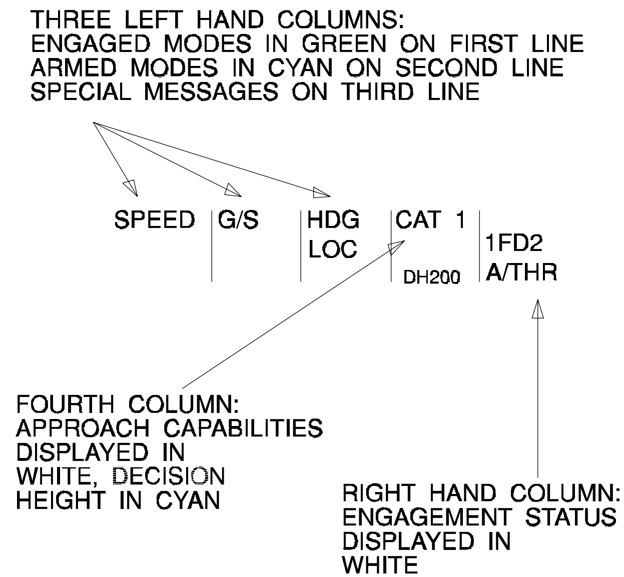
TRAJECTORY DEVIATION

The trajectory deviation scales provide guidance help for approach and landing phases.



FLIGHT MODE ANNUNCIATOR

The Flight Mode Annunciator (FMA) provides basic information concerning flight management, guidance and envelope system operation.



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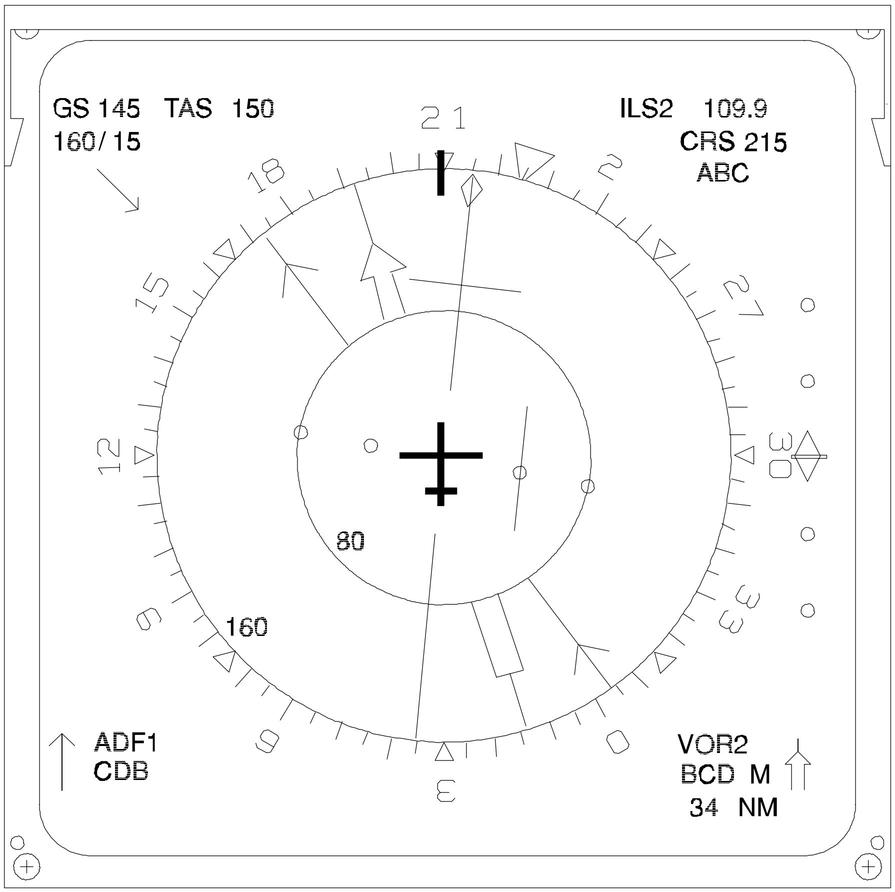
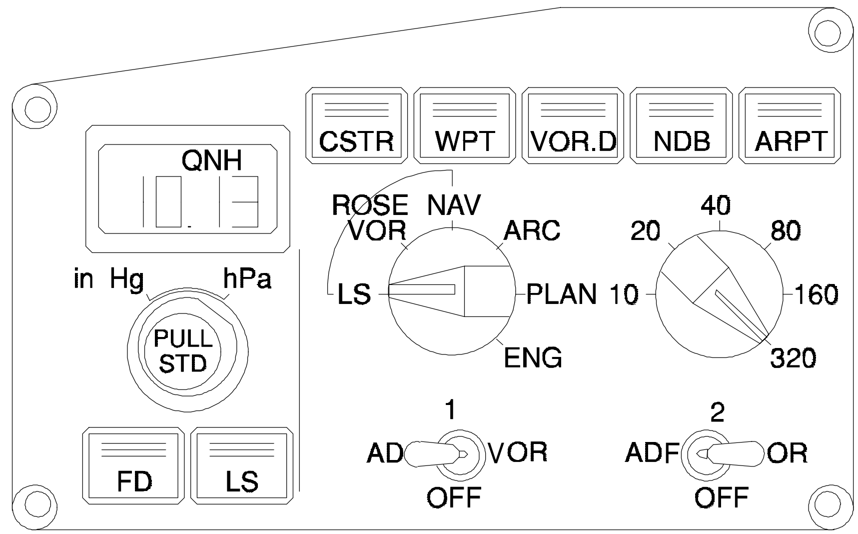
NAVIGATION DISPLAY PRESENTATION

GENERAL

The purpose of this module is to identify the main indications of the navigation system on the Navigation Display (ND) in the various modes.

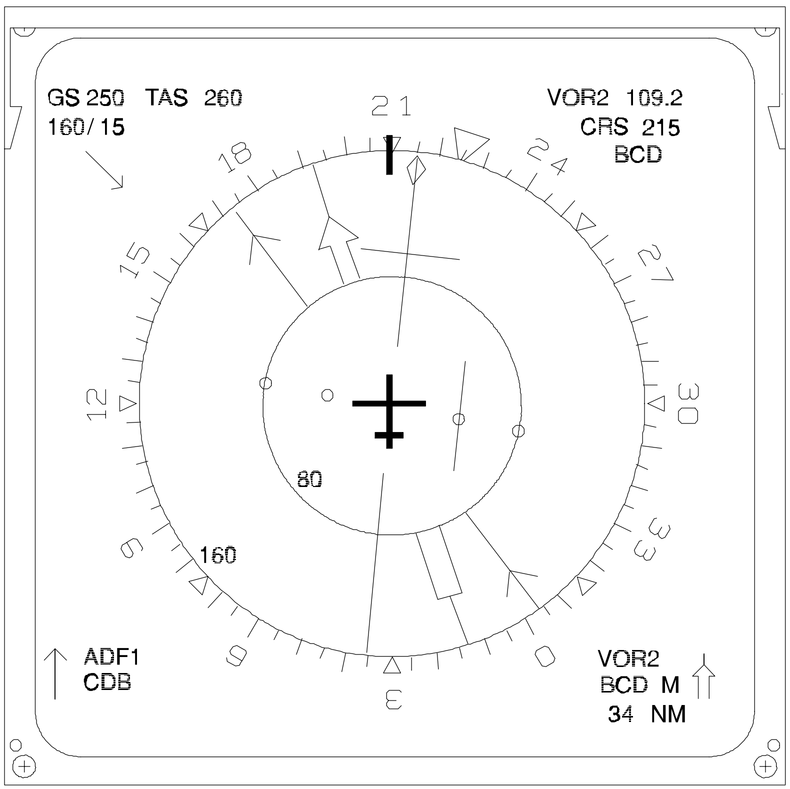




FQW4200 GE Metric

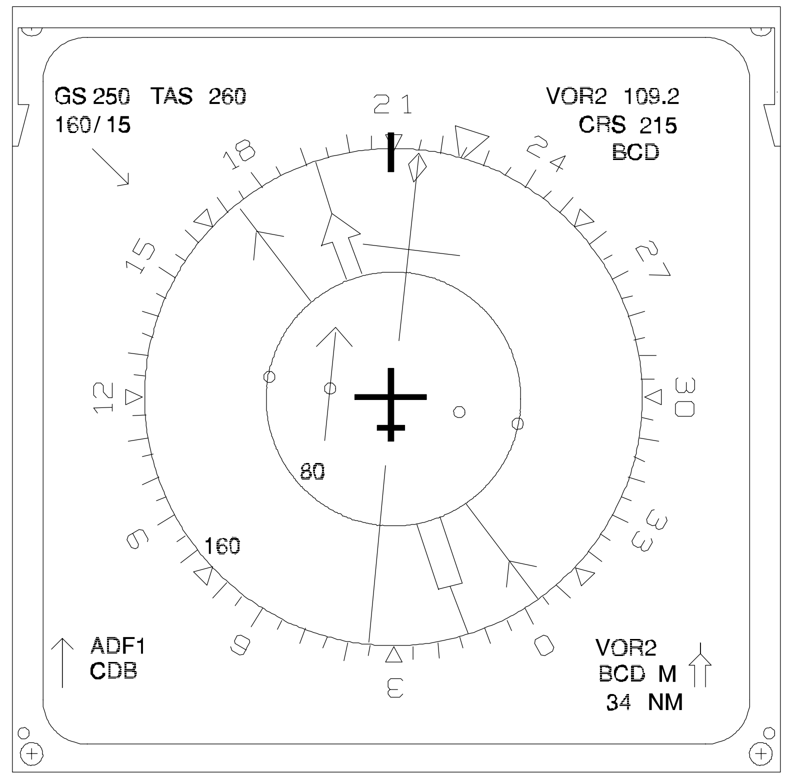
ROSE/LS

The rose LS (Landing System) display indicates the horizontal situation with the LS deviation indications.



ROSE/VOR

The rose VOR (Very high frequency Omni directional Range) display indicates the horizontal situation showing the VOR course and deviation.



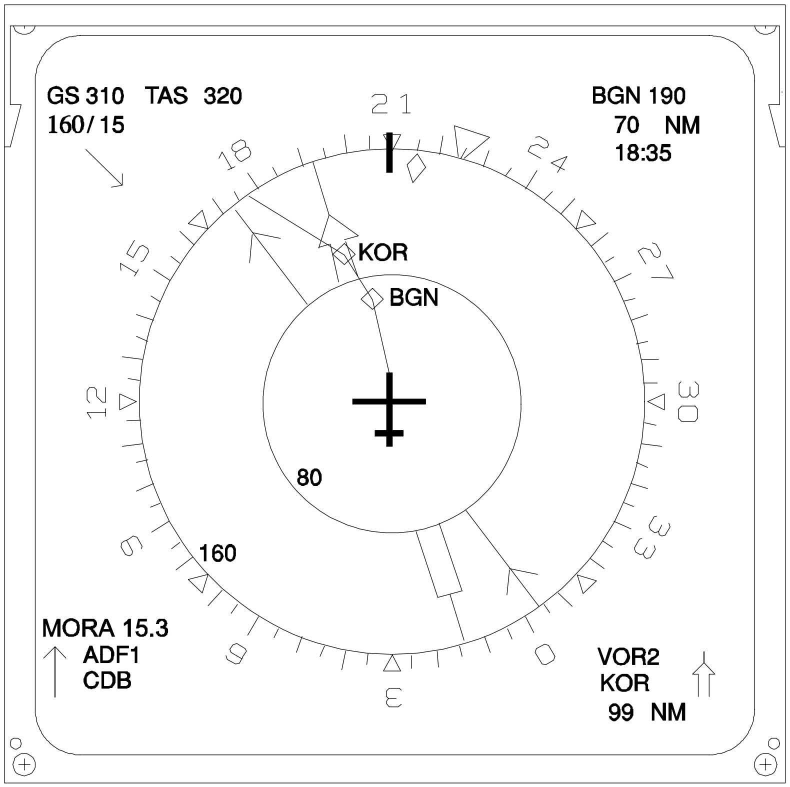
FQW4200 GE Metric

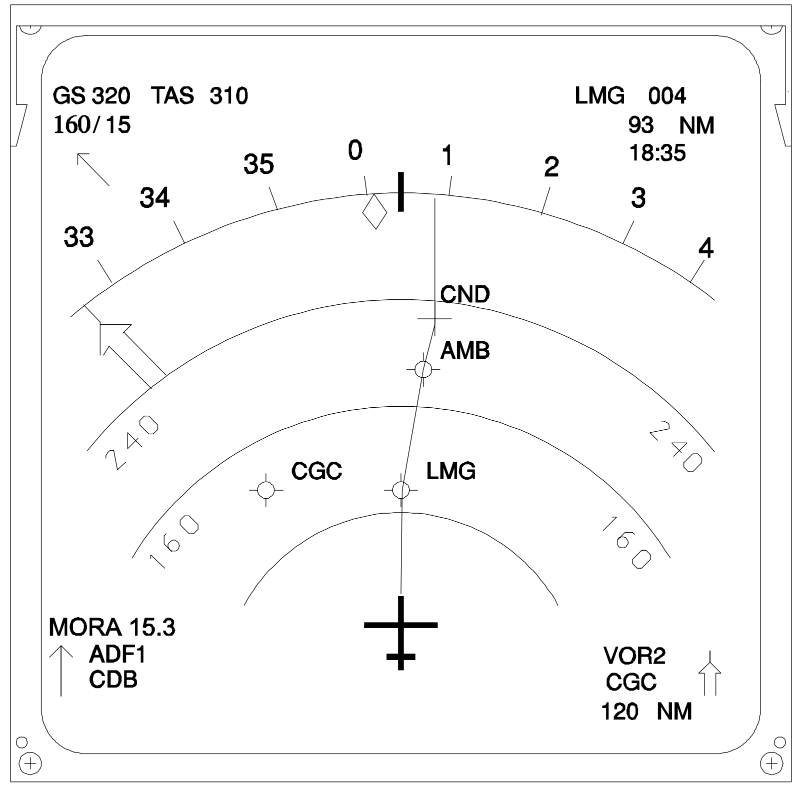
ROSE/NAV

The rose NAV mode displays a 360 degree dynamic pattern which provides the aircraft position with respect to the flight plan.

ARC MODE

The ARC mode displays a 90 degree dynamic pattern which provides the aircraft position with respect to the flight plan. This ARC mode display is the same as ROSE NAV with 90. for 360.

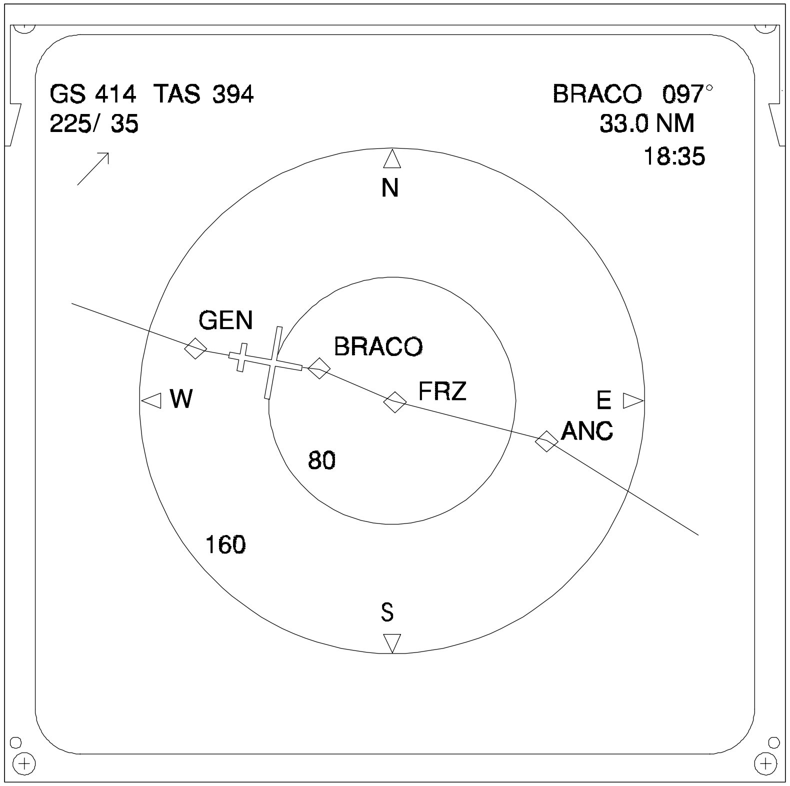




FQW4200 GE Metric

PLAN

The PLAN mode displays a static map oriented with respect to true north.The map is centered on one of the flight plan waypoints chosen by the pilot through the Multipurpose Control Display Unit (MCDU). This mode allows the flight plan to be checked.



FQW4200 GE Metric

ENGINE

Engine parameters can be displayed on crew request.

STUDENT NOTES:

STUDENT NOTES

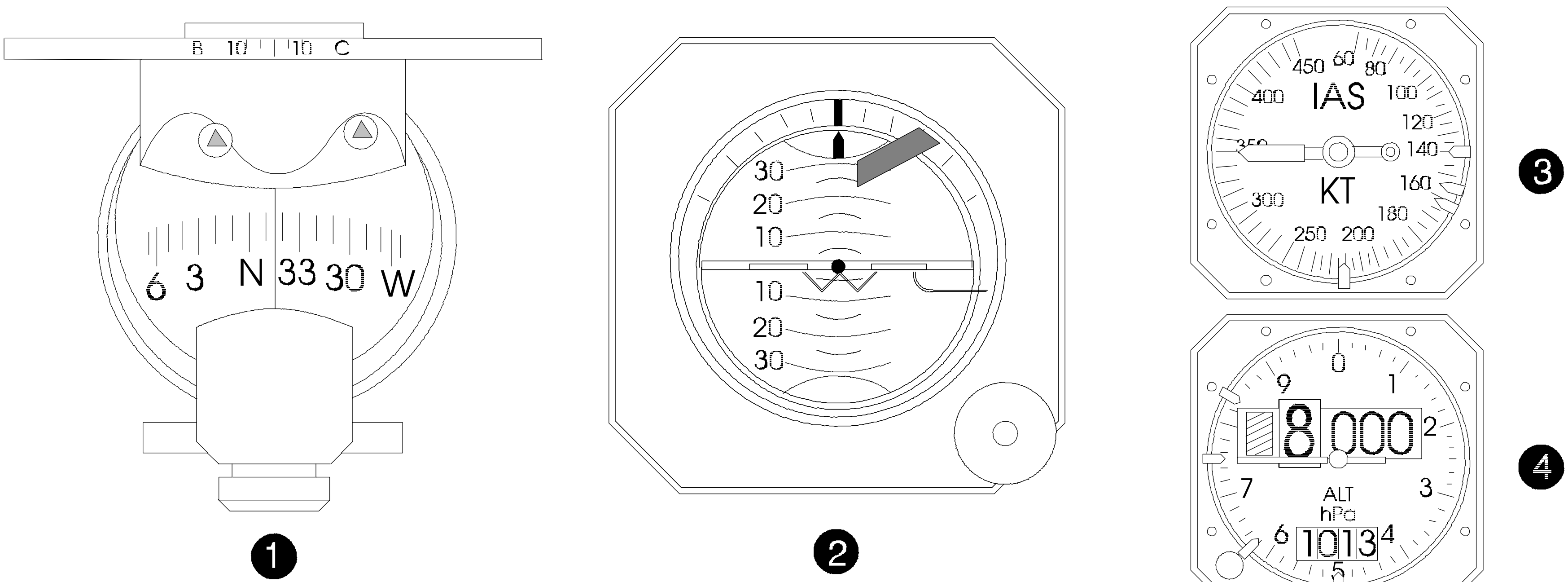
STANDBY INSTRUMENTS PRESENTATION

Compass
Horizon Indicator
Airspeed Indicator
Altimeter

The standby navigation system enables the flight crew to check the navigation data provided by the Air Data Inertial Reference System (ADIRS).

The standby navigation system comprises four instruments each providing different indications :

1. Standby Compass for magnetic heading,
2. Standby Horizon indicator for attitude,
3. Standby Airspeed indicator (IAS) for airspeed,
4. Standby Altimeter for altitude.



FQW4200 GE Metric

COMPASS

The Standby Compass consists of a magnetic element rotating freely inside a compass bowl and provides the pilot with a magnetic heading.

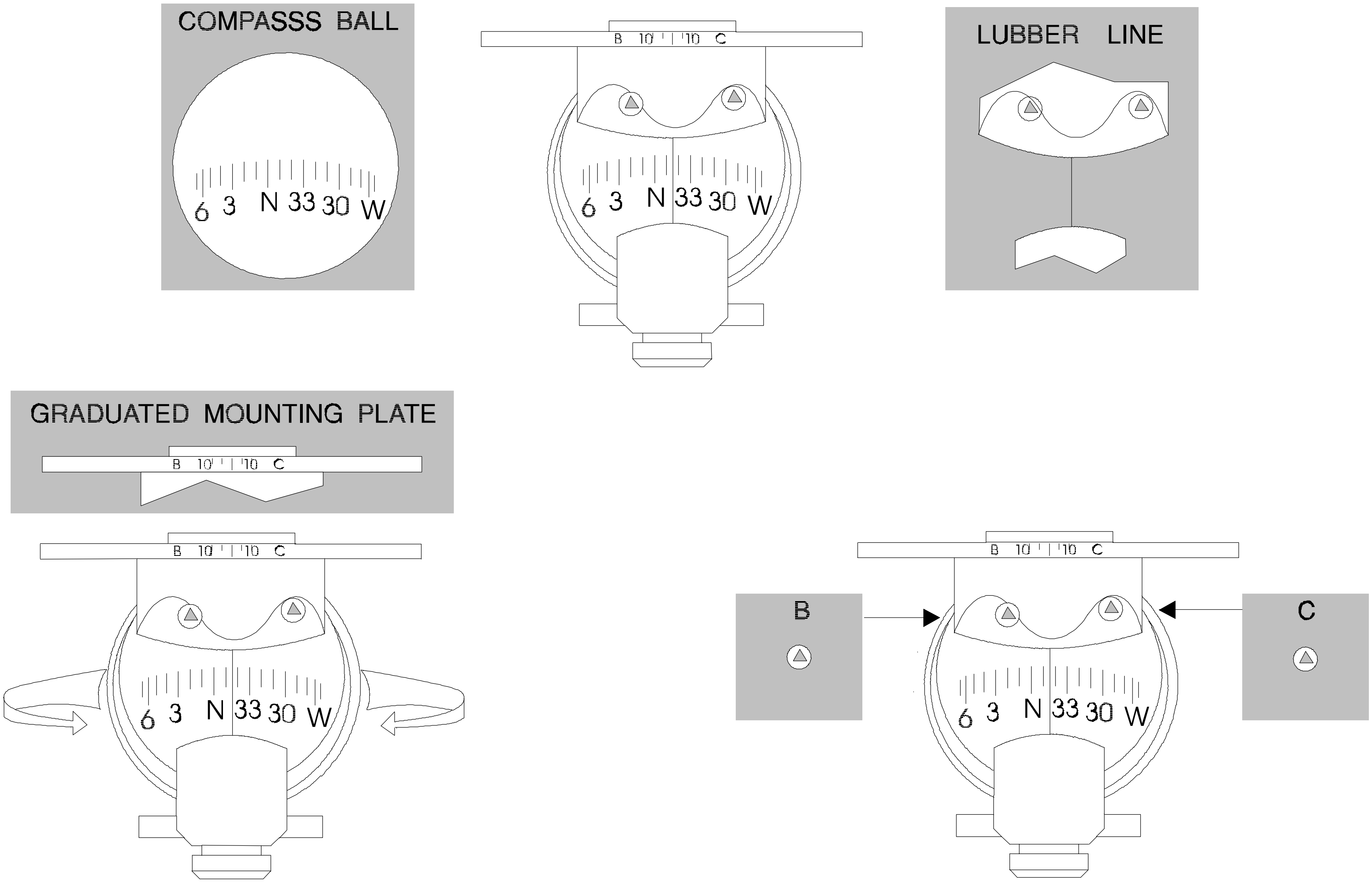
The compass ball is immersed in a damping liquid.
A compass card, drawn on the compass ball, moves behind a lubber line and gives the magnetic heading.

A correction of deviation is made by rotating the Standby Compass on its mounting screws.

The upper mounting plate is provided with graduations which indicate the number of degrees of deviation.

Compensation is achieved by inserting a special key in two holes, marked B and C, located below the graduated mounting plate.

By means of a special key, these holes enable two small magnetized bars (E-W axis and N-S axis) to be positioned.

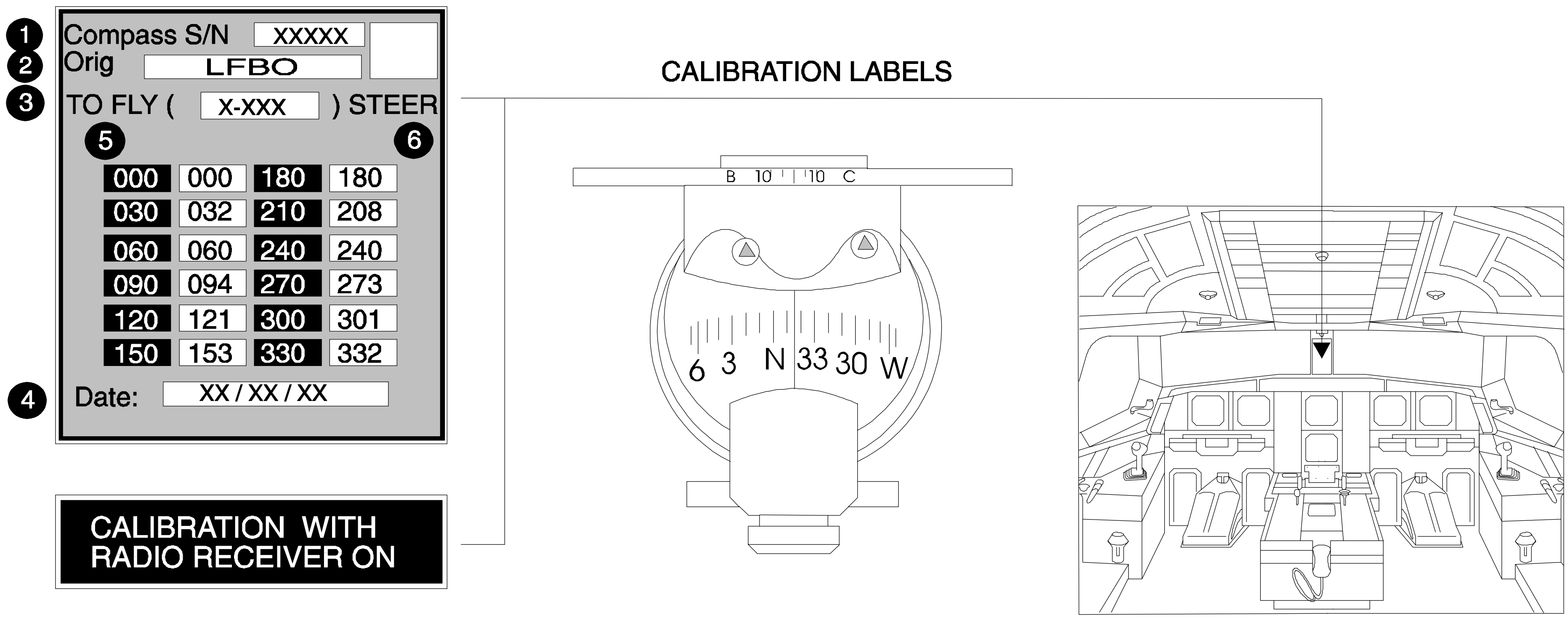


FQW4200 GE Metric

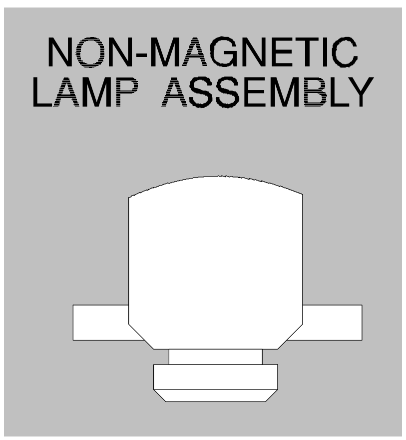
In the cockpit, on the center vertical member, a label is installed and provides information on the last calibration of the standby compass.

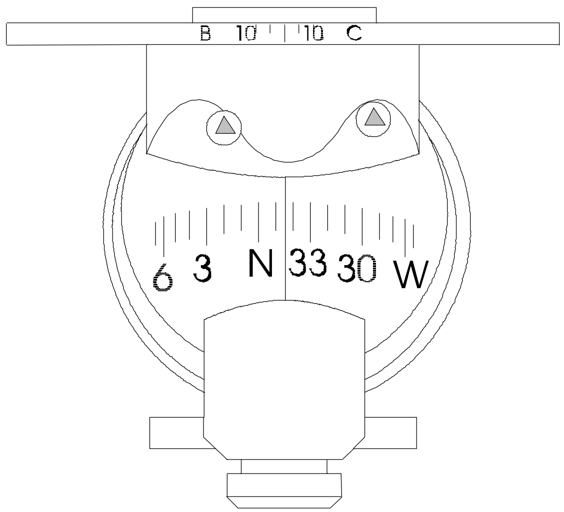
1 Compass serial number.
2 Place of the calibration.
3 Aircracft registration.
4 Date of calibration.
5 030 ADIRS 3 magnetic heading (rounded value).
6 032 Balanced STBY Compass heading.
It is the result of :
Compass heading + (rounded value - ADIRS 3 heading)
Sample : 030 + (030 - 028) = 032

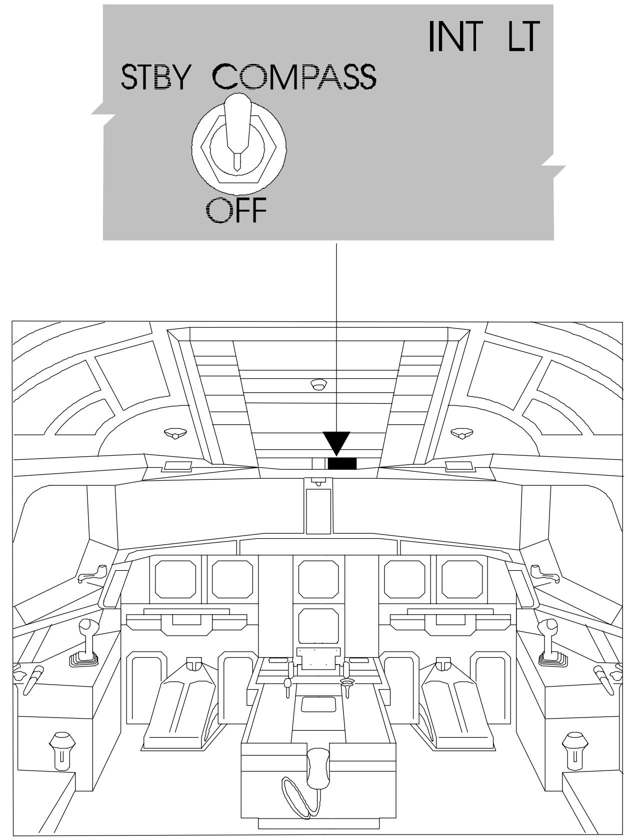
FQW4200 GE Metric


1 Compass S/N XXXXX
2 Orig LFBO
3 TO FLY (X-XXX) STEER
5
6
000 000 180 180
030 032 210 208
060 060 240 240
090 094 270 273
120 121 300 301
150 153 330 332
4 Date: XX / XX / XX
CALIBRATION WITH
RADIO RECEIVER ON
CALIBRATION LABELS
B 10 10 C
6 3 N 33 30 W

A non-magnetized lamp assembly provides illumination of the heading dial and is controlled from the standby compass switch.







FQW4200 GE Metric

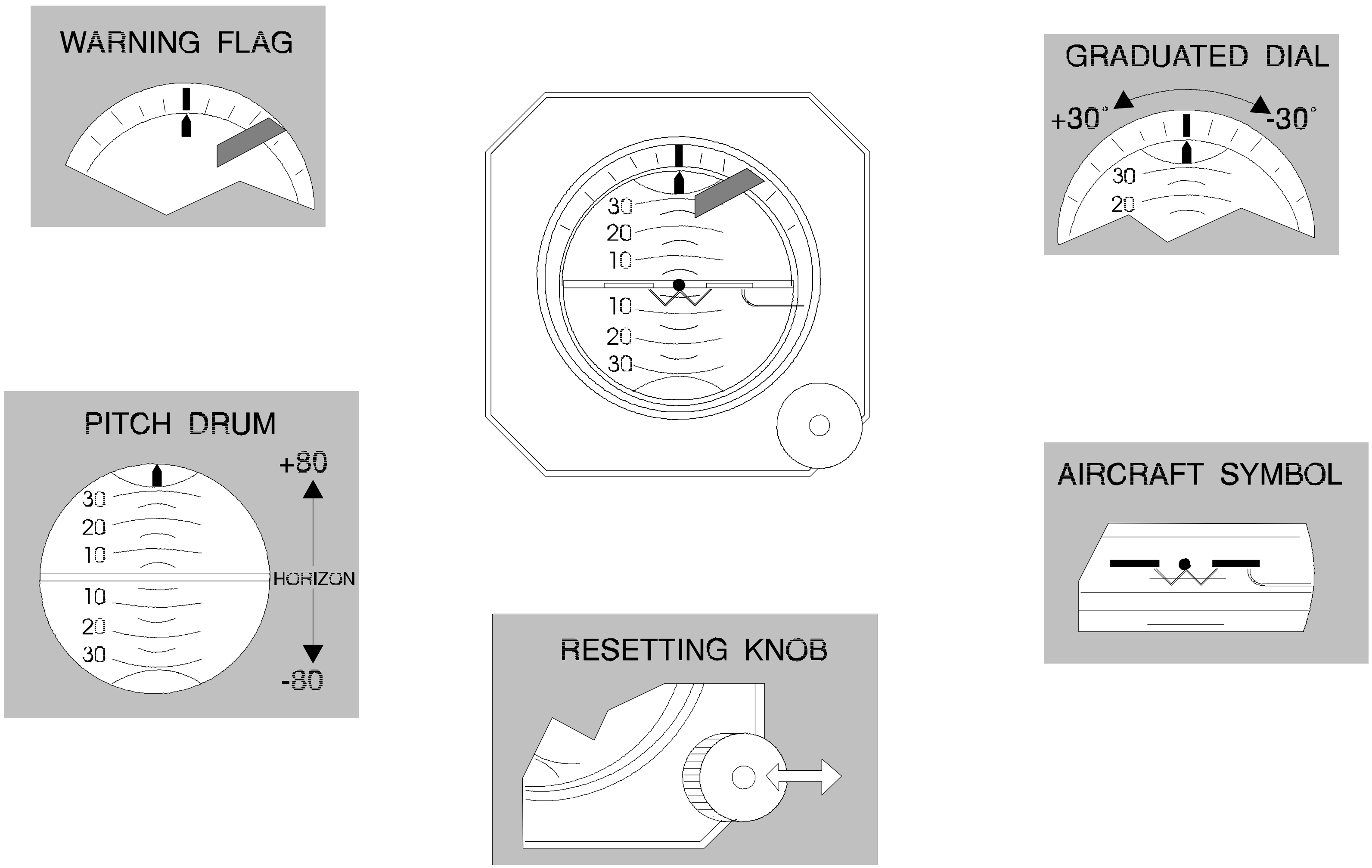
HORIZON INDICATOR

The instrument function is to provide the pilot with a true vertical stable reference by means of gyroscopic system.

The pitch information is given by the graduated pitch drum which moves behind the fixed aircraft symbol.
The roll information is given by a pointer which moves in front of a graduated dial.

The instrument is provided with warning flag and resetting system.

By pulling the resetting knob, the gyroscopic horizon is immediately reset. The warning flag appears if an electrical failure is detected or if the gyroscopic rotor speed drops below 18.000 RPM.

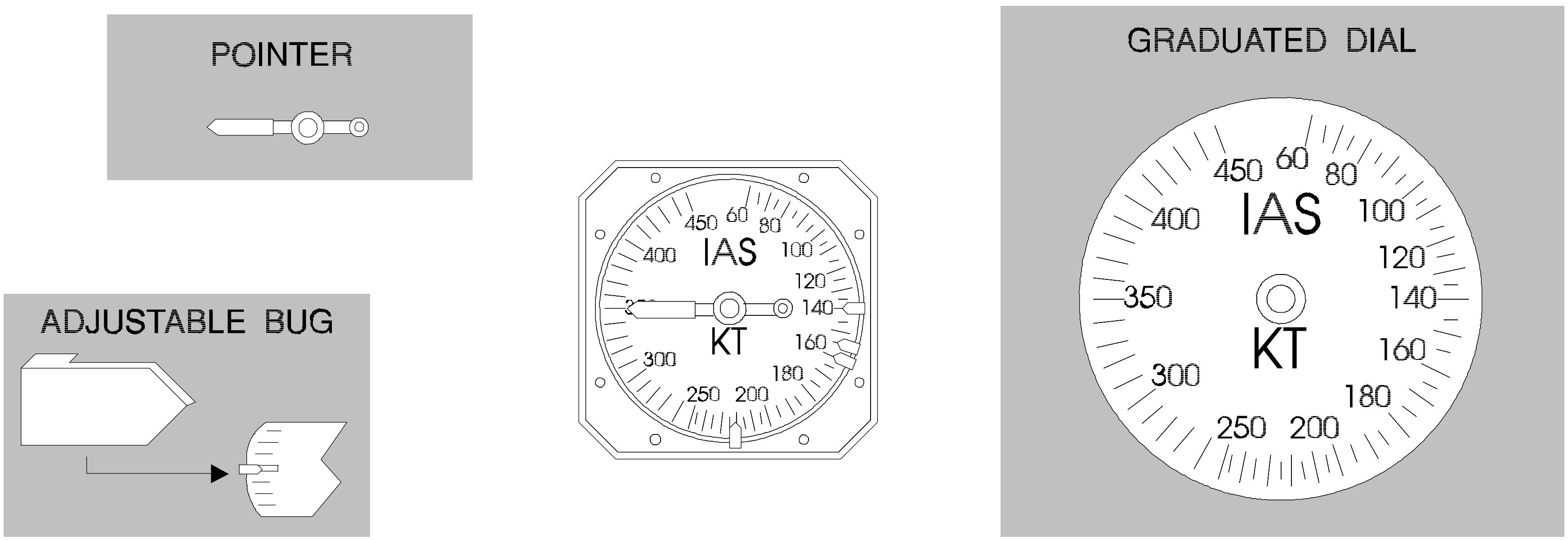

WARNING FLAG
GRADUATED DIAL
+30°
-30°
30
20
10
10
20
30
PITCH DRUM
+80
HORIZON
-80
AIRCRAFT SYMBOL
RESETTING KNOB

AIRSPEED INDICATOR

The standby Airspeed Indicator provides airspeed indication by means of a capsule operated mechanism which measures the difference between the Pitot and static pressure.

The Airspeed Indication is displayed by means of :

- A pointer which moves on a dial graduated every 5 kts from 60 kts to 250 kts and every 10 kts from 250 kts to 450 kts.
- Four manually adjustable bugs are provided for speed setting.


POINTER
ADJUSTABLE BUG
IAS
KT
450
60
80
100
120
140
160
180
200
250
300
350
400
GRADUATED DIAL

ALTIMETER

The standby Altimeter which is supplied with static pressure by the standby air data system, indicates the barometric altitude of the aircraft.

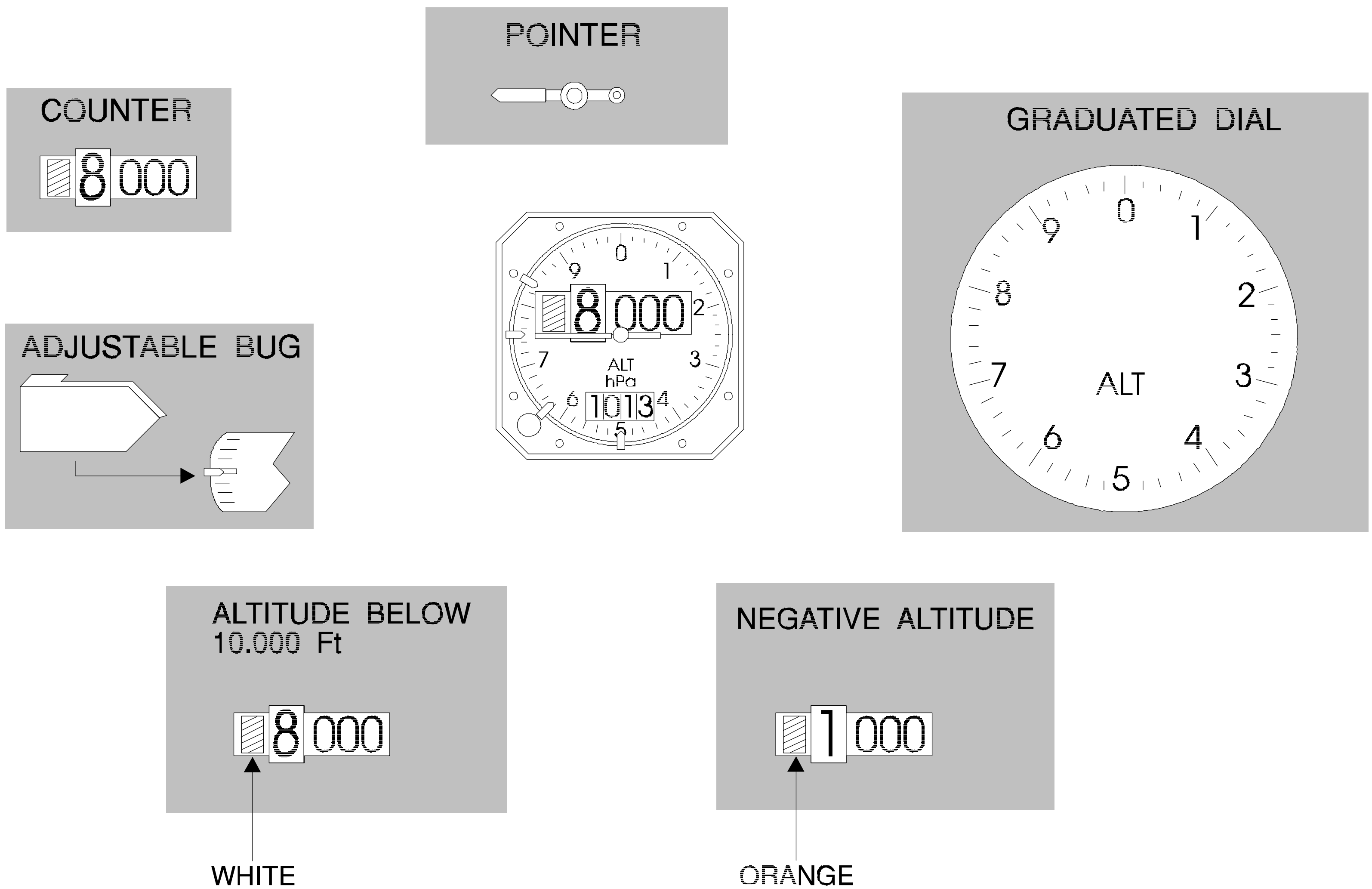
The barometric altitude is displayed by means of :

- A pointer performing one revolution of dial for 1000 ft,
- A total altitude counter,
- Manually adjustable bugs for altitude setting.

When the altitude is above 1000 feet, a counter composed of two drums, respectivly displays the tens of thousands and the thousands of feet.

In particular, the left drum is replaced by :

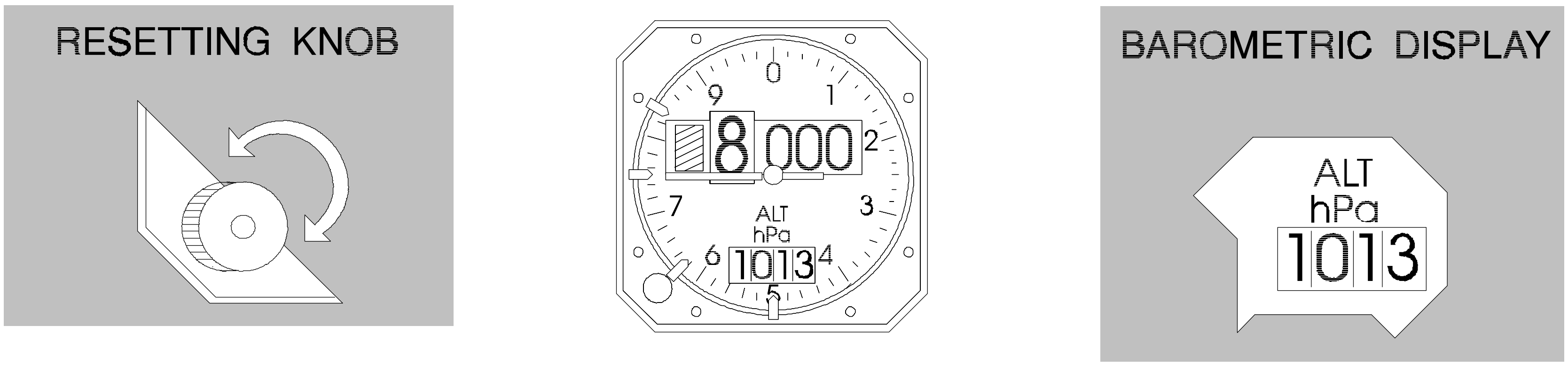
- A white and black striped zone when the altitude is below 10.000 ft,
- An orange fire and black striped zone when the altitude is negative.



FQW4200 GE Metric

The barometric correction is displayed on a counter graduated in hecto Pascals.

The setting knob enables the display of the reference barometric correction in the range of 750 to 1050 hPa.


RESETTING KNOB
0
1
2
3
4
5
6
7
9
8 000
ALT
hPa
1013
BAROMETRIC DISPLAY
ALT
hPa
1013

STUDENT NOTES

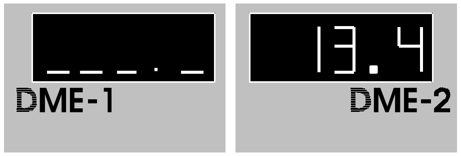
DDRMI PRESENTATION

DME Windows
Compass Card
ADF/VOR Switch
Bearing Pointers
Failure

DME WINDOWS

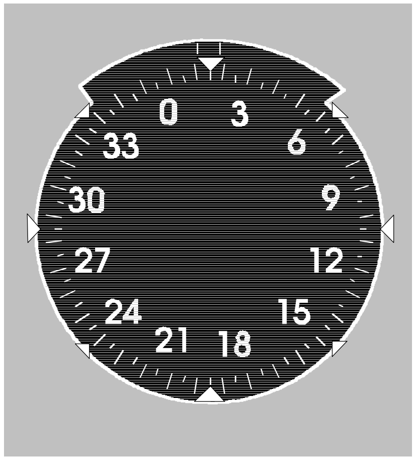
The Distance Measuring Equipment (DME) windows show the distances processed by system 1 and 2 in nautical miles.

Dashes appear in case of no computed data.



COMPASS CARD

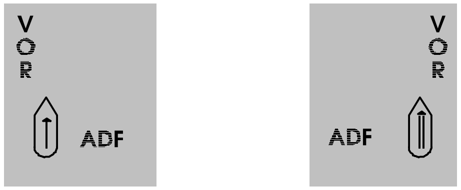
The Compass Card is controlled by Air Data Inertial Reference Unit (ADIRU) 1 or 3 depending on the selection made by the crew.



ADF/VOR SWITCH

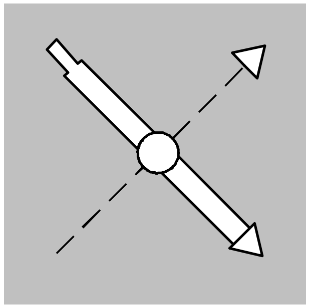
Two ADF/VOR selectors allow switching between ADF1 and VOR1 bearing or ADF2 and VOR2 bearing.

- Automatic Direction Finding (ADF).
- Very High Frequency Omni Directional Range (VOR).

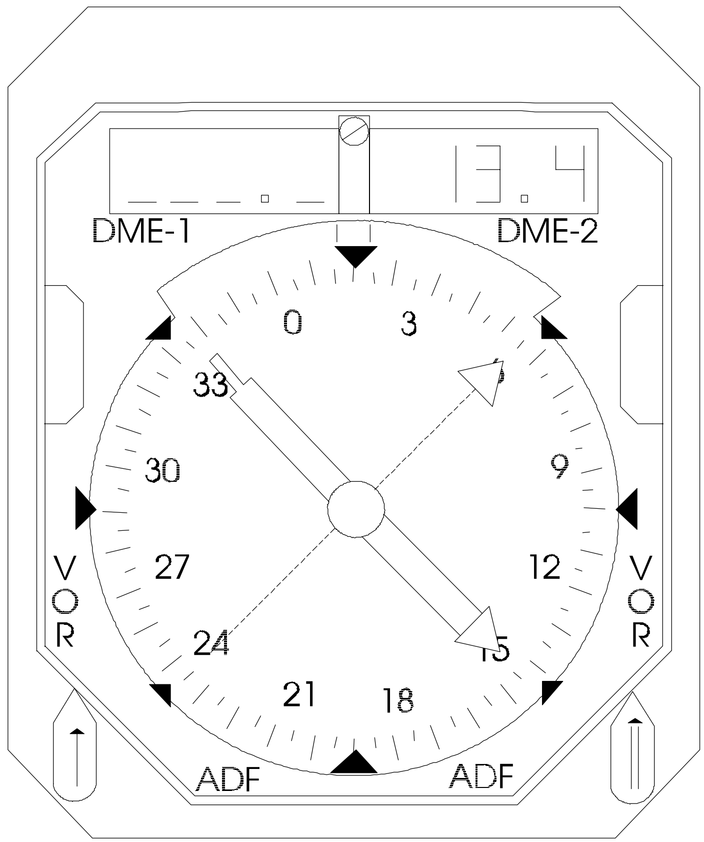


BEARING POINTERS

The Dashed Pointer indicates the magnetic Bearing of the station received by VOR1 or ADF1; the Double Pointer indicates that received by VOR2 or ADF2.



FQW4200 GE Metric

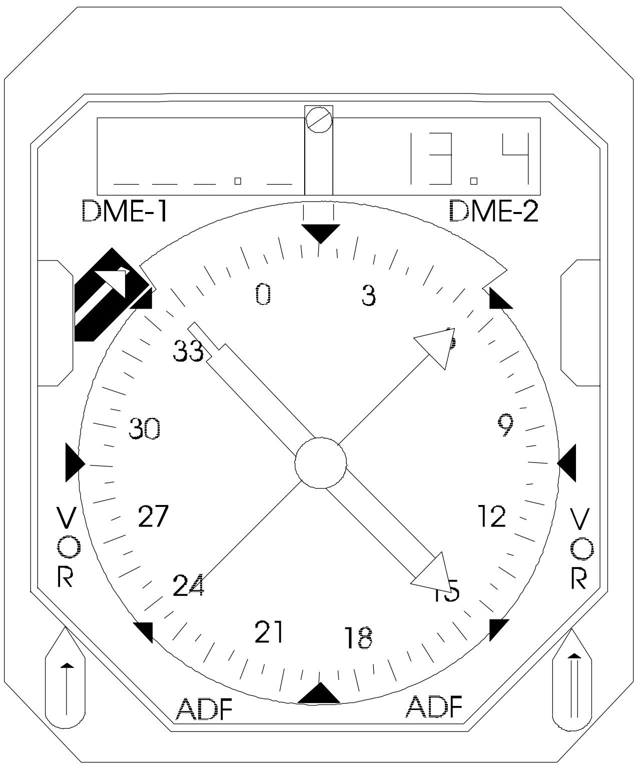


FQW4200 GE Metric

FAILURE

When a VOR or an ADF fails : a failure flag comes into view on the associated side and the related pointer is set to the the three o’clock position.

When a DME fails, the corresponding window becomes blank.



FQW4200 GE Metric

STUDENT NOTES:

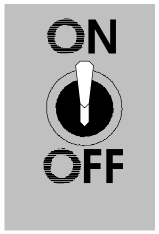
STUDENT NOTES

RADIO MANAGEMENT PANEL PRESENTATION

ON/OFF Switch
Navigation Key
Standby Navigation Keys
Rotating Knob
Transfer Key
STBY/CRS Window
Active Window
BFO Key

ON/OFF SWITCH

The ON/OFF Switch controls the power supply to each Radio Management Panel (RMP).



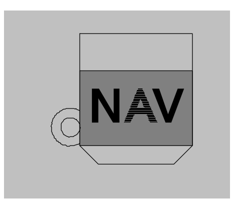
NAVIGATION KEY

When the navigation key is pressed IN on any RMP, the Flight Management Guidance and Envelope system is no longer used for Navigation frequency selection.

On the relevant RMP :

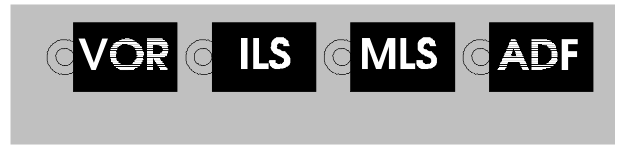
- CAPT RMP controls NAV1 receivers.
- F/O RMP controls NAV2 receivers.
- Does not operate on RMP3.

Note : the NAV key is a guarded P/B.



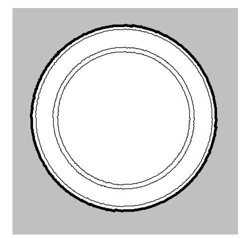
STANDBY NAVIGATION KEYS

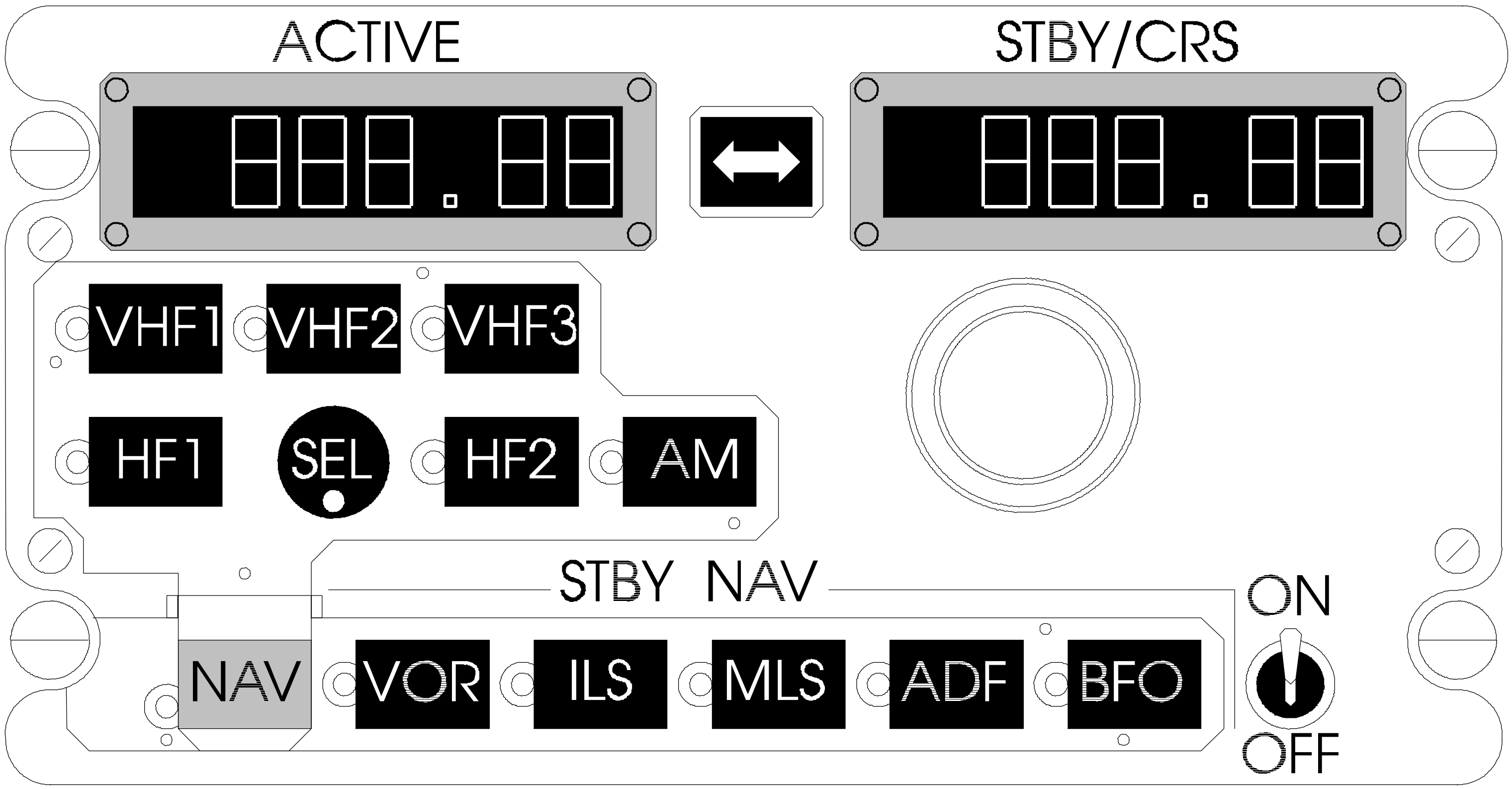
The standby navigation keys enable the pilot to select the associated radio navigation aid.



ROTATING KNOB

The two concentric rotating knobs allow preselection of frequency and course for radio navigation aid.



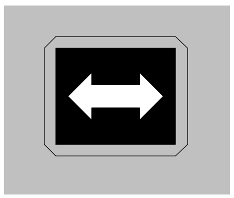


FQW4200 GE Metric

TRANSFER KEY

When the transfer key is pressed IN, the active and the standby frequencies are interchanged.

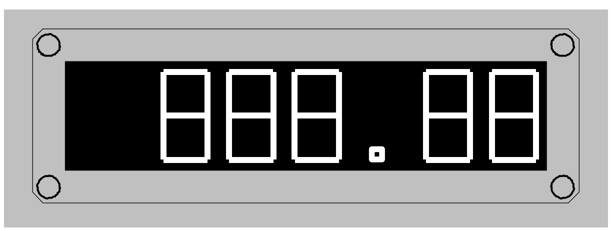
If a course is displayed on the STBY/CRS window, when the transfer key is pressed IN, the active frequency will be displayed on both windows.



STBY/CRS WINDOW

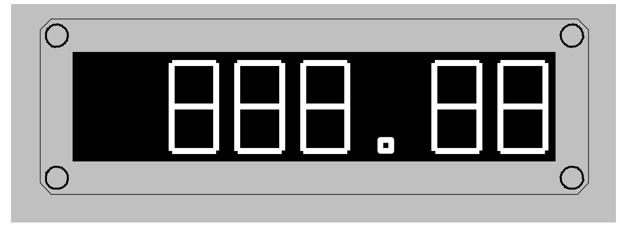
The Standby/Course window displays a standby frequency.

If a course is displayed, the associated frequency is displayed on the active window.



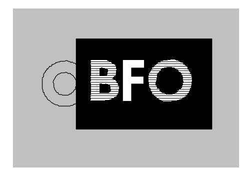
ACTIVE WINDOW

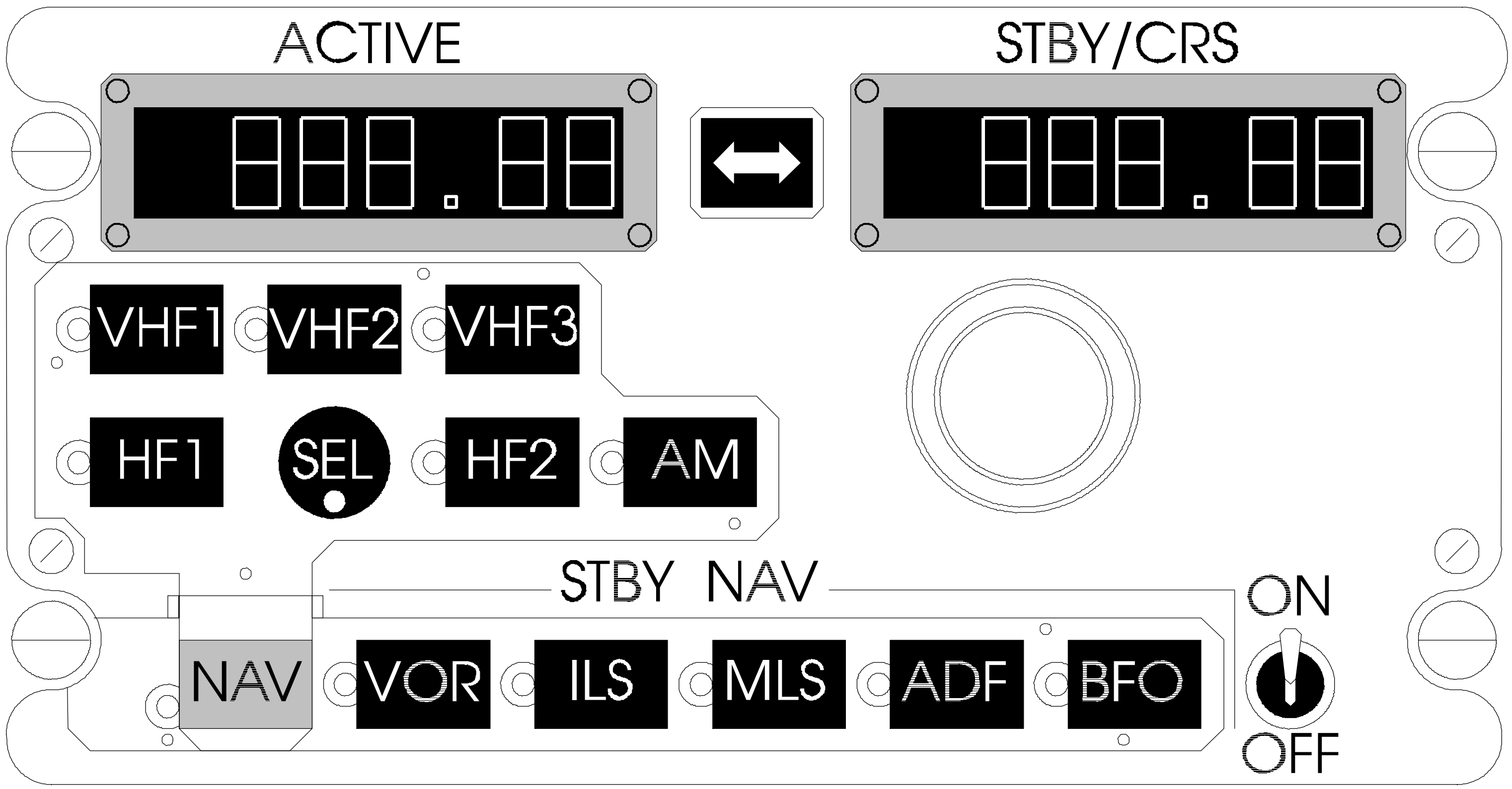
The active window shows the frequency in use.



BFO KEY

The BFO key enables the pilot to select the Beat Frequency Oscillator (BFO) when required.





FQW4200 GE Metric

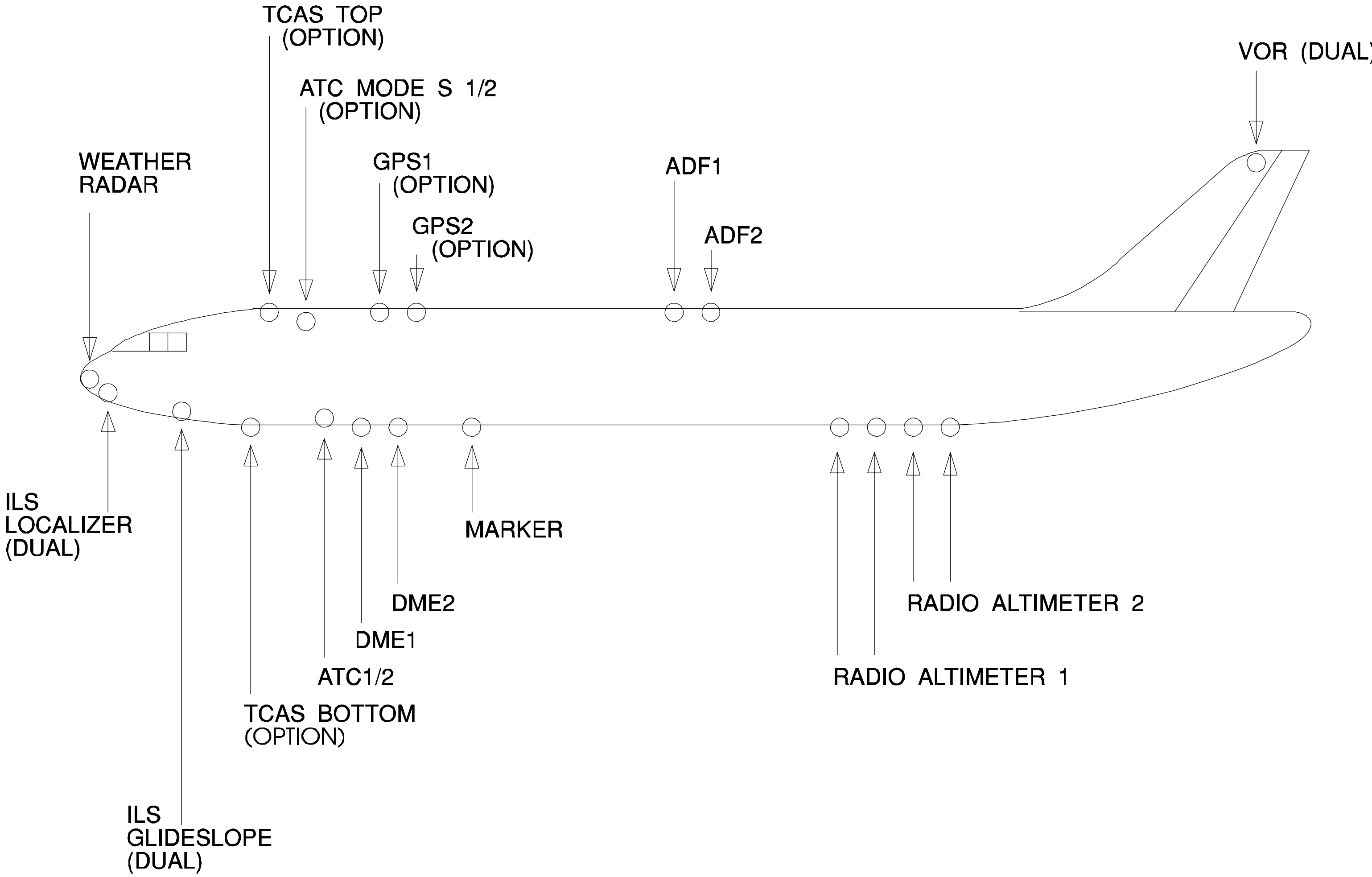
STUDENT NOTES:

NAVIGATION ANTENNAE LOCATION

The purpose of this module is to locate the various radio-nav antennae

GLOSSARY

ADF - Automatic Direction Finder
ATC - Air Traffic Control
GPS - Global Positionning System
ILS - Instrument Landing System
TCAS - Traffic Collision Advoidance System
VOR - Very hight frequency Omni-directionnal Range



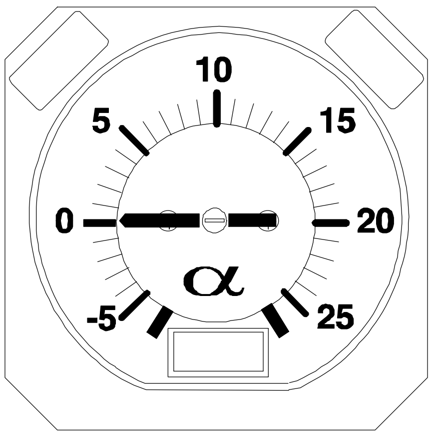
FQW4200 GE Metric

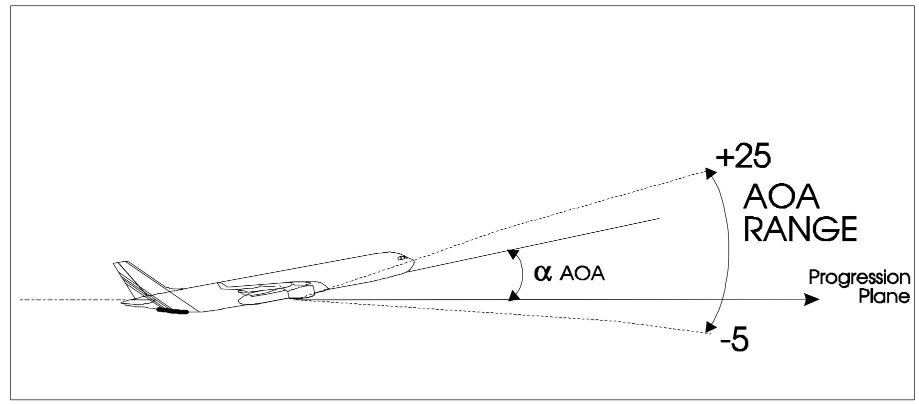
STUDENT NOTES:

ANGLE OF ATTACK INDICATOR

AOA PRINCIPLE

The Angle Of Attack (AOA) is the angle between the longitudinal progression plane of the aircraft and its vertical attitude position.





Angle Of Attack (AOA) indicator

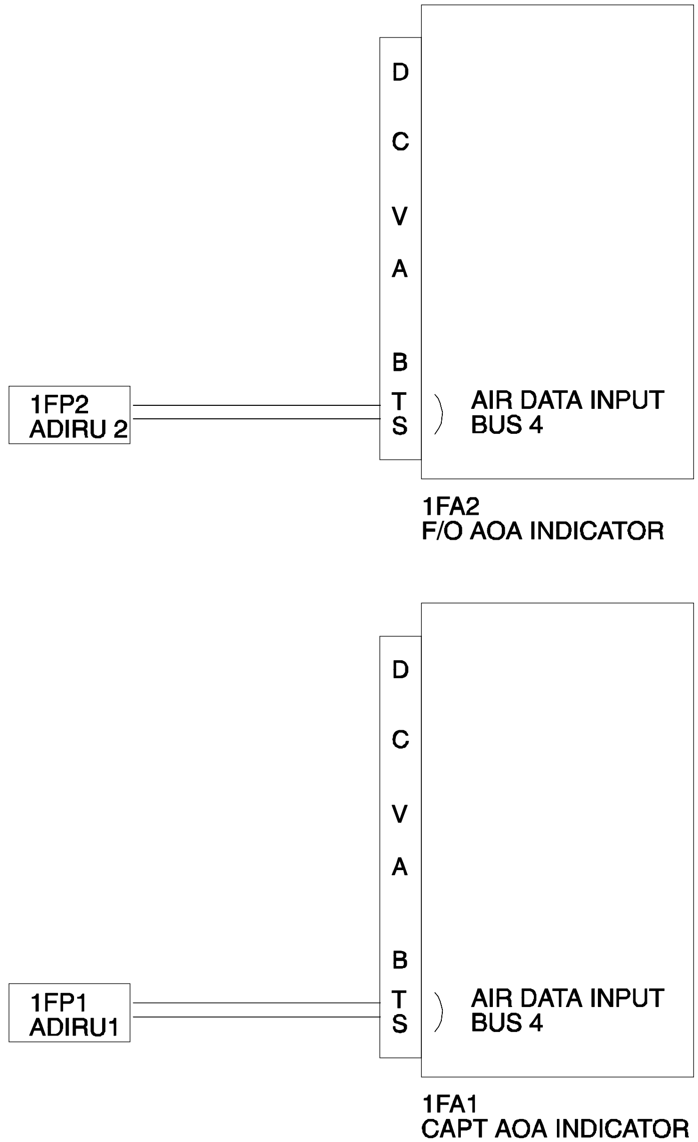
The AOA indicator provides the crew with the angle value (α) in the maximum range between -5 and +25 degrees.

INDICATOR D/O

The AOA indicator receives a digital signal complying with the ARINC specification 429.

This signal is directly issued from ADIRU 1 (CAPT indicator) and ADIRU 2 (F/O indicator).

No system reconfiguration is possible on ADIRU 3. So in case of loss of the imput signal validity, the AOA indication is completely lost on the corresponding indicator.



FQW4200 GE Metric

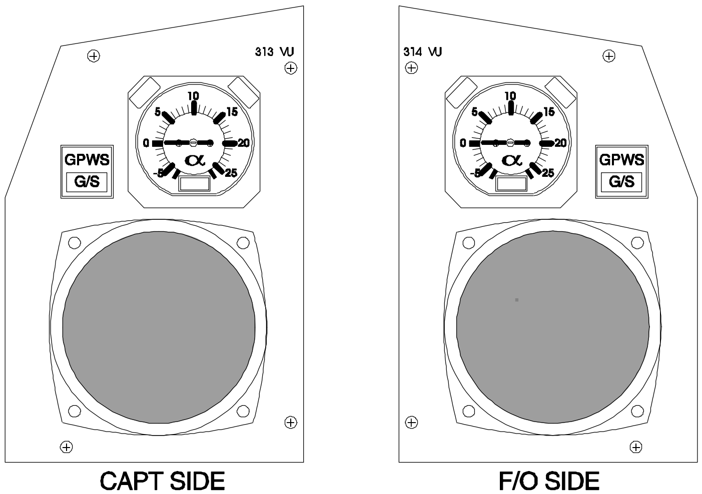
INDICATOR COMPONENT

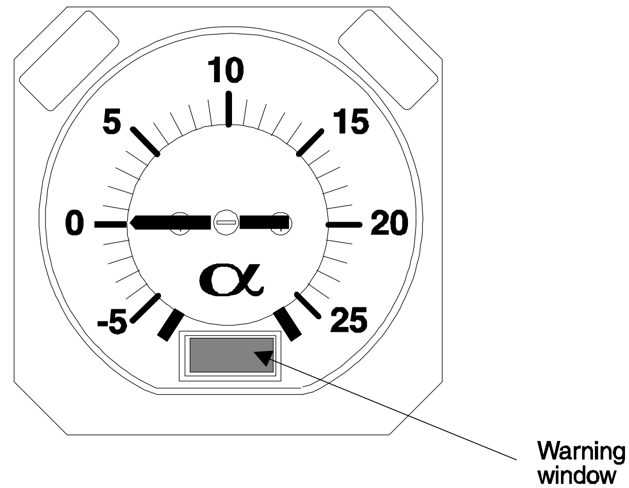
Each AOA indicator is contained in a case above the loudspeaker on the loudspeaker panel.

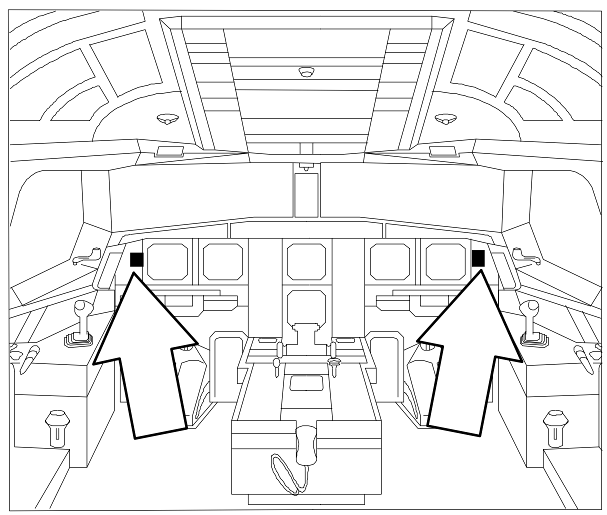
The indication is ensured by a servo motor. The processing operations are performed under the control of a microprocessor which enables:

- data acquisition through an ARINC receiver
- data digital processing and digital analog conversion for driving the servo motor.

In some failure cases, an amber warning flag comes into view below the deviation scale.







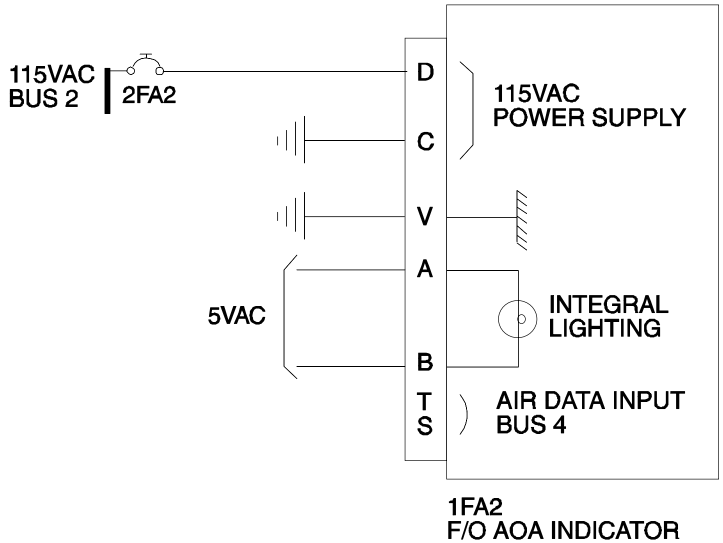
FQW4200 GE Metric

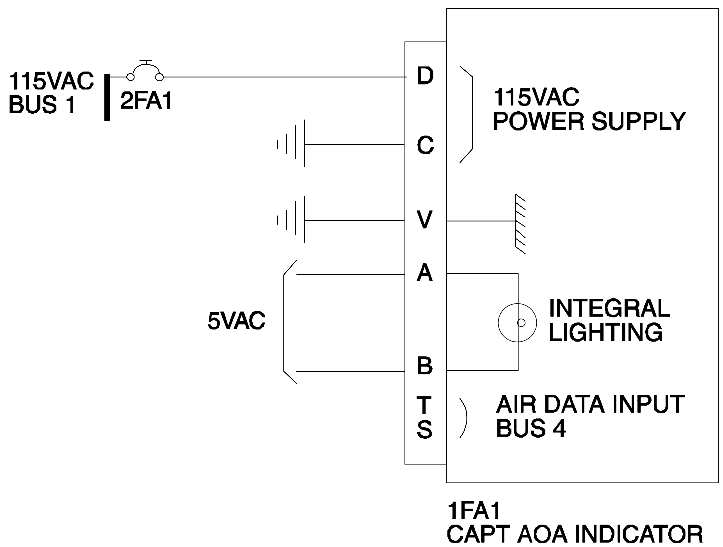
INDICATOR POWER SUPPLY

The system is electrically supplied with two different voltages.

The CAPT AOA indicator is supplied from the 115 VAC Bus 1 via the circuit breaker 2FA1 and the F/O AOA indicator from the 115 VAC Bus 2 via the circuit breaker 2FA2.

The integral lighting of the indicator is supplied with 5 VAC / 400 Hz.





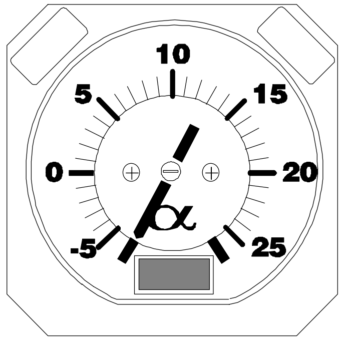
FQW4200 GE Metric

INDICATOR TEST

The operational test of the AOA indicator is made through the interface test of the corresponding ADIRU.

Following the test values sent by the ADIRU, the indications displayed by the indicator are :

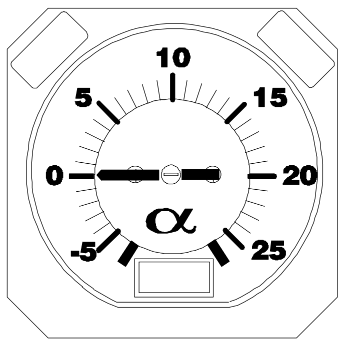
FQW4200 GE Metric



From 0 second to 5 seconds

Failure Warning (FW word):

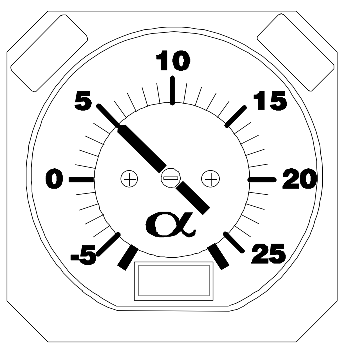
- warning falg comes into view.
- pointer moves to the down position.



From 5 seconds to 10 seconds

Fonctional Test (FT word)

- warning falg goes out of view.
- pointer moves to the 0° position.



After 10 seconds

Fonctional Test (FT word)

- pointer moves to the 5° position.

FQW4200 GE Metric

STUDENT NOTES

ADIRS PRESENTATION

ADIRU
MCDU
MSU
Probes
FCU
ADIRS Switching
Interface

ADIRU

The main components of the Air Data Inertial Reference System (ADIRS) are the three Air Data Inertial Reference Units (ADIRU) which provide attitude and navigation data to the crew according to various inputs and controls.
Each ADIRU is a combination of an air data reference and an inertial reference inside a single unit.
The ADIRUs provide signals to the primary flight displays and navigation displays via the display management computers.
ADIRU1 and ADIRU3 provide data to the digital data radio magnetic indicator.
Depending on the setting of the true / magnetic pushbutton, the heading data, displayed on PFD/ND, is referenced to true or magnetic north.

MCDU

The Multipurpose Control Display Units (MCDU) enable the crew to perform alignment, to control and to display ADIRS parameters.

MSU

The Mode Selector Unit (MSU) serves to control the mode of operation and to indicate faults, if any, for all three ADIRUs.

PROBES

A set of probes and sensors provides air data.
Pitot probes and static ports are linked to remote Air Data Module (ADM) which comprise pressure transducers for sending the total or static pressure data to the ADIRUs on an ARINC bus.

FCU

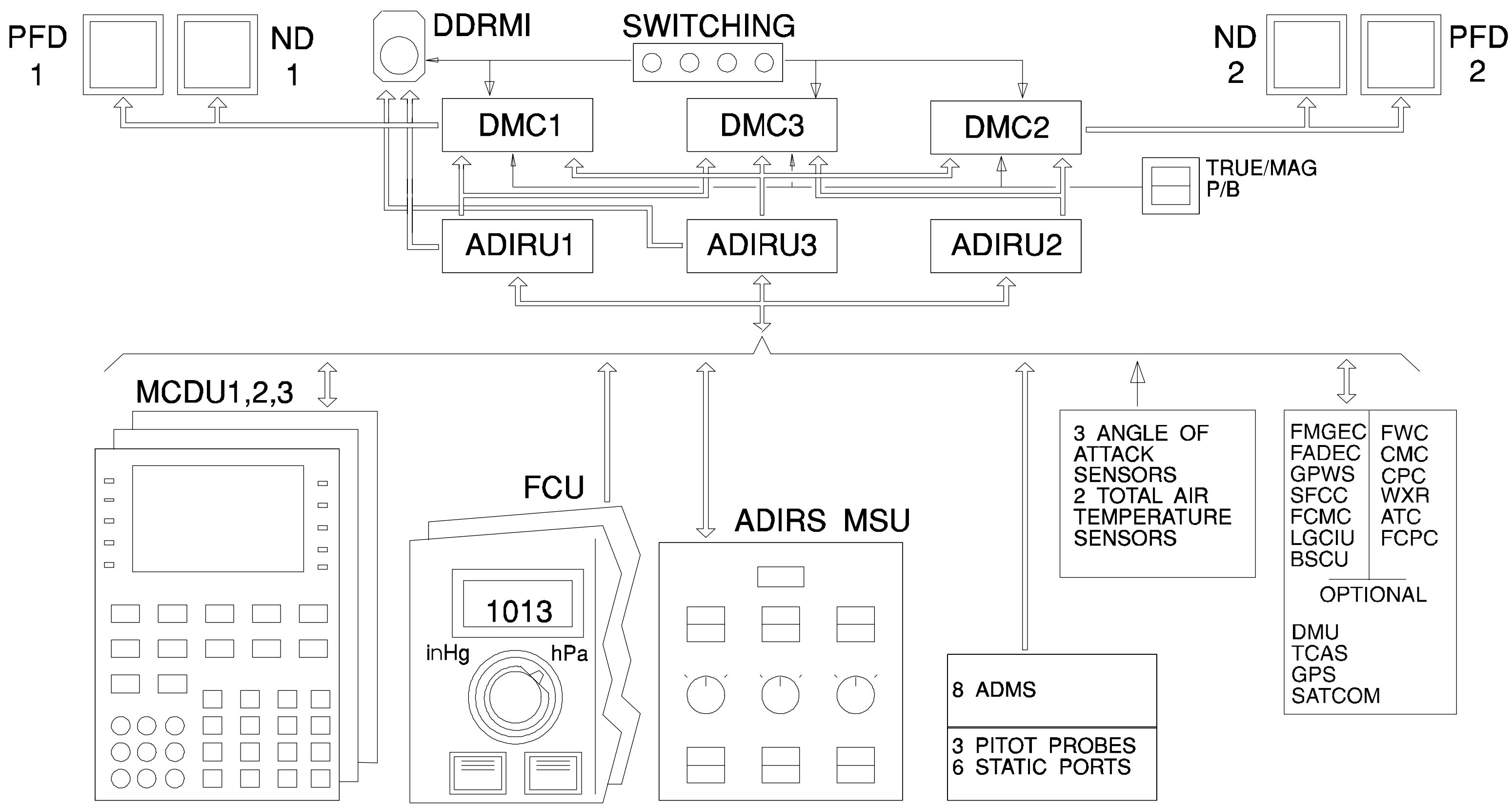
On the Flight Control Unit (FCU), two independent baro setting knobs are used to provide baro corrections to the associated ADIRUs.

ADIRS SWITCHING

In the basic configuration, ADIRU1 is associated to the captain instruments, ADIRU2 to the first officer instruments and ADIRU3 is in standby.There are two selector switches for air data reference and inertial reference so that data can be displayed after an ADIRU failure.
In case of failure of the Air Data Reference (ADR) function of ADIRU 1 or 2, the affected instruments and displays may be manually switched to ADIRU3 (one side at a time only). The same possibility also exists for the inertial reference function.

INTERFACE

The ADIRUs are directly connected to some user systems.



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STUDENT NOTES:

ADIRS NEW TECHNOLOGY

ADIRU PRINCIPLE

The Air Data/Inertial Reference Unit (ADIRU) comprises an Air Data Reference Unit and an Inertial Reference Unit, both included in a single unit.

The static and pitot probes are connected with the ADIRU through the Air Data Modules (ADM).

ADM INPUTS

The ADM Inputs are one pressure input and several discrete inputs.

The ADMs are identical.
The discrete inputs determine the ADM location and the type of pressure data (Pitot or Static) to provide to the ADR. The ADIRU provides 13.5 VDC to supply each associated ADM.

ADM FUNCTIONAL DESCRIPTION

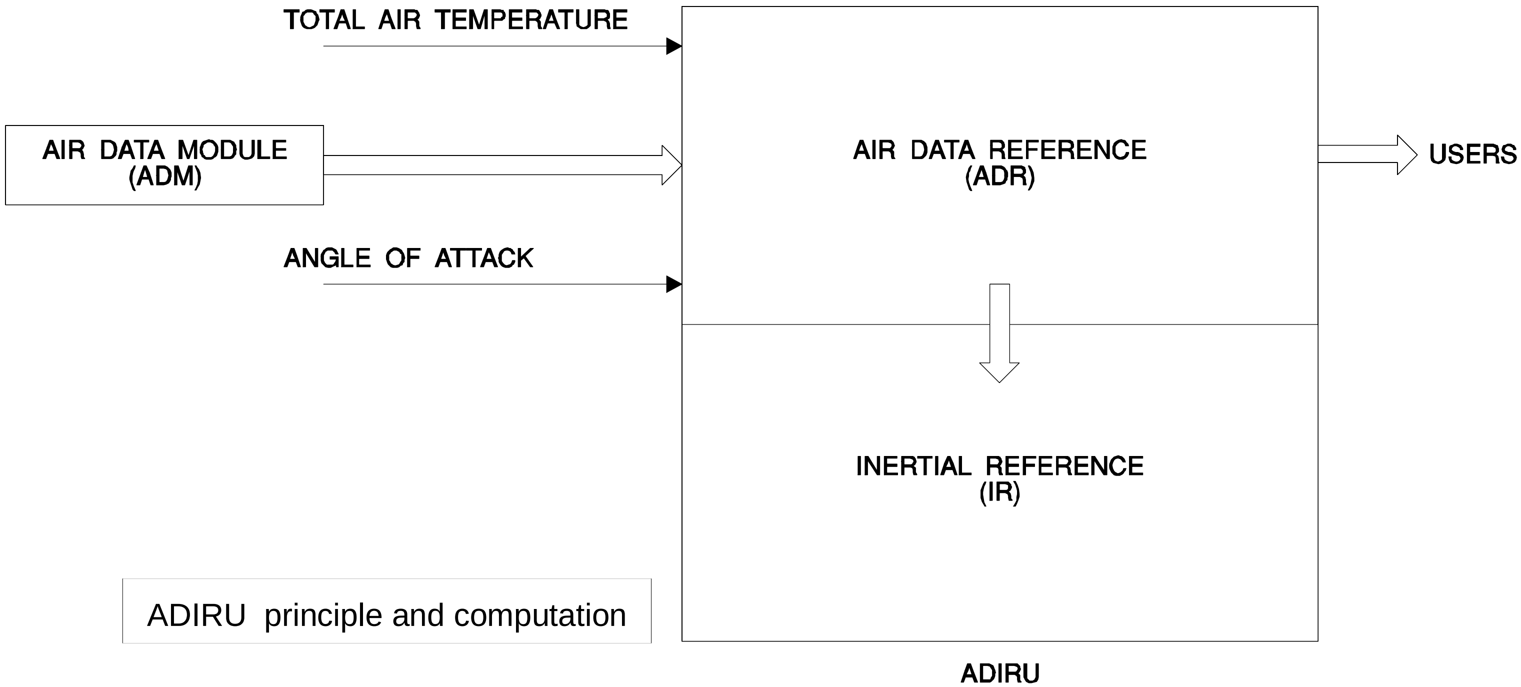
A microcomputer processes an ARINC signal according to the discrete inputs and to the digitized pressure.

ADM OUTPUT

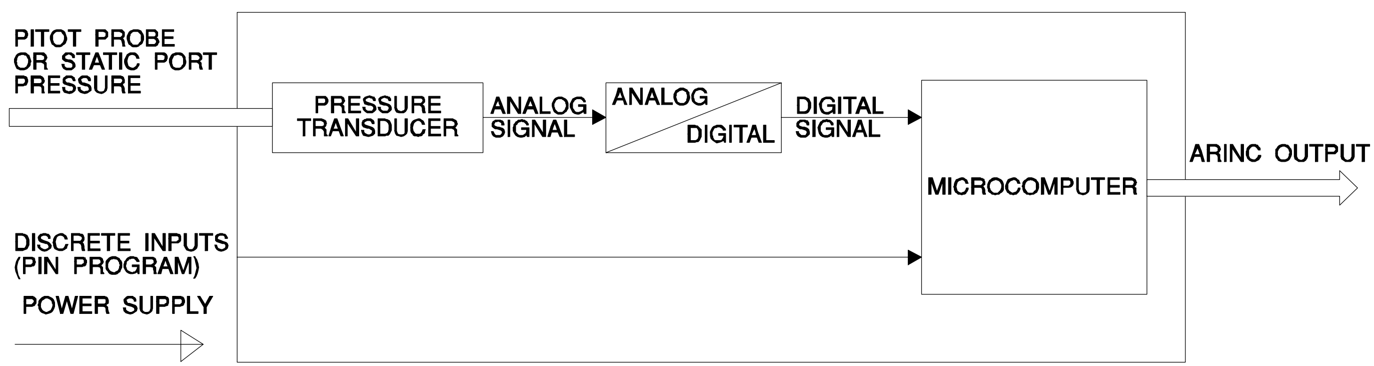
The ADM output is an ARINC bus which provides digital pressure information, type of pressure, ADM identification and BITE status to the ADIRU.

ADR COMPUTATION

The ADR processes sensor and ADM inputs in order to provide air data to users.



ADIRU principle and computation



Air Data Module

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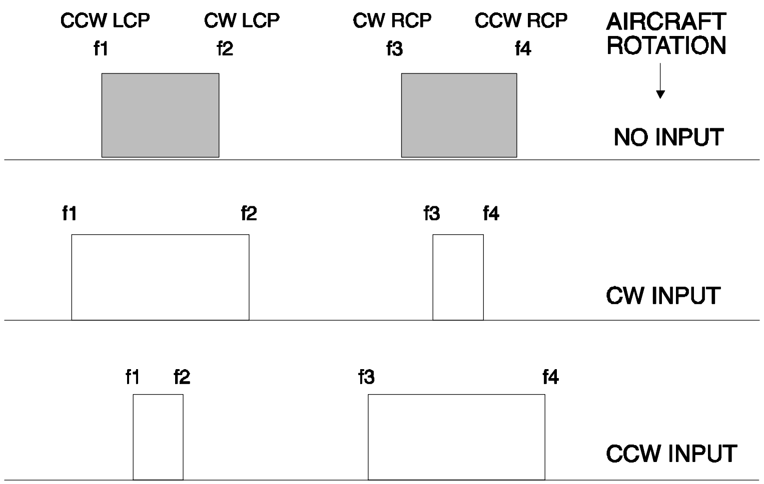
RING LASER GYRO

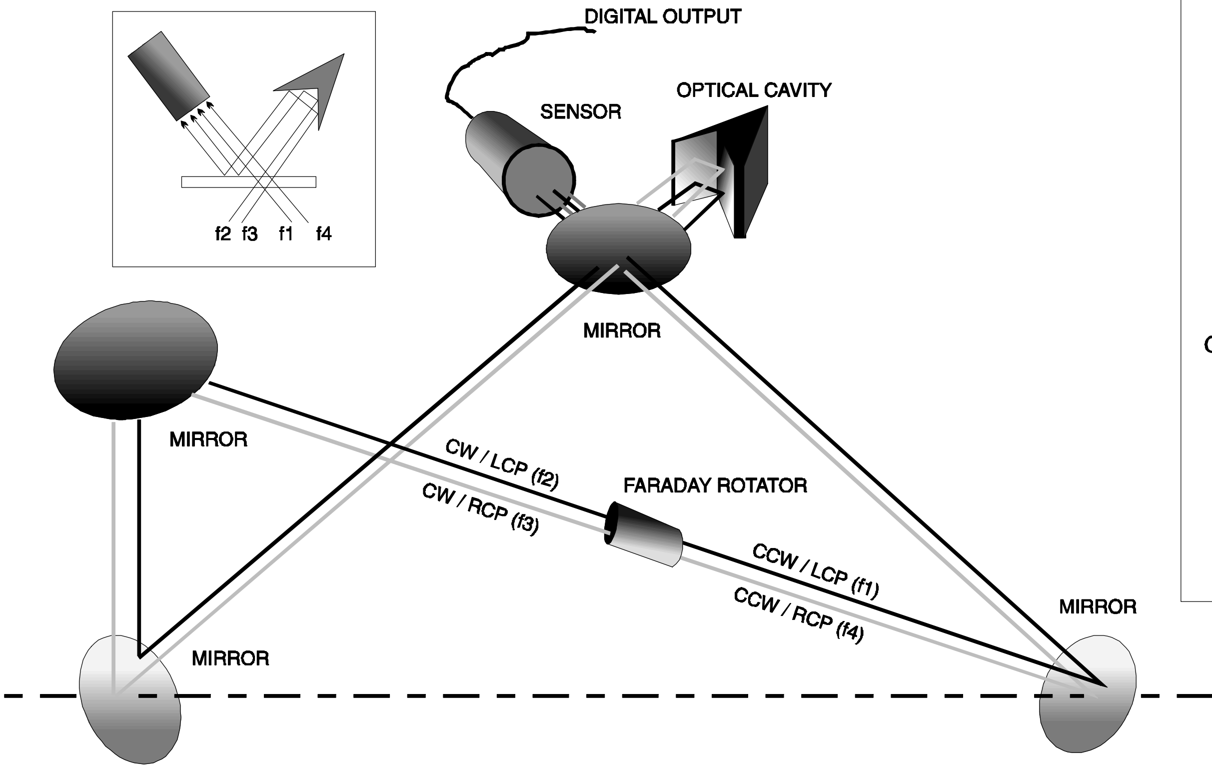
The three ring laser gyros, one for each rotation axis, provide inertial rotation data and are composed of two laser beams in a ring.

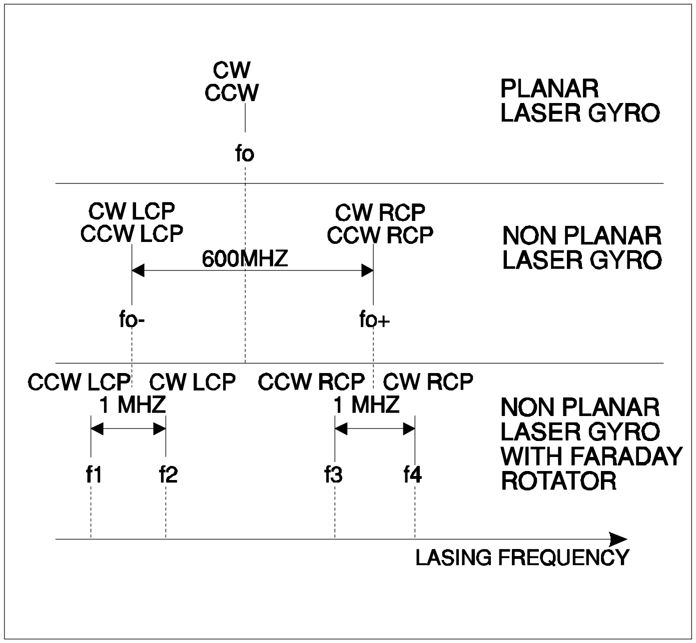
A non-planar quadrilateral optical path causes lasing to be in right and left circular polarization (RCP and LCP) frequencies. A Faraday phase rotator switches frequencies of clockwise (CW) and counterclockwise (CCW) beams.

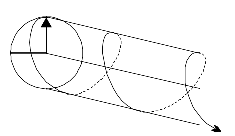
An optical cavity sustains lasing mode at four separate frequencies f1, f2 for LCP mode and f3, f4 for RCP mode. An aicraft rotation generates an increase or decrease of each mode frequency difference.

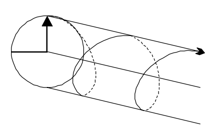


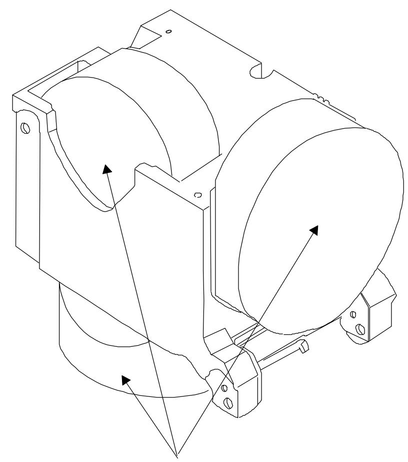
These frequency differences are measured by optical means providing a digital output which, after computation, will provide rotation information.






Right Circular Polarization (RCP)


Left Circular Polarization (LCP)



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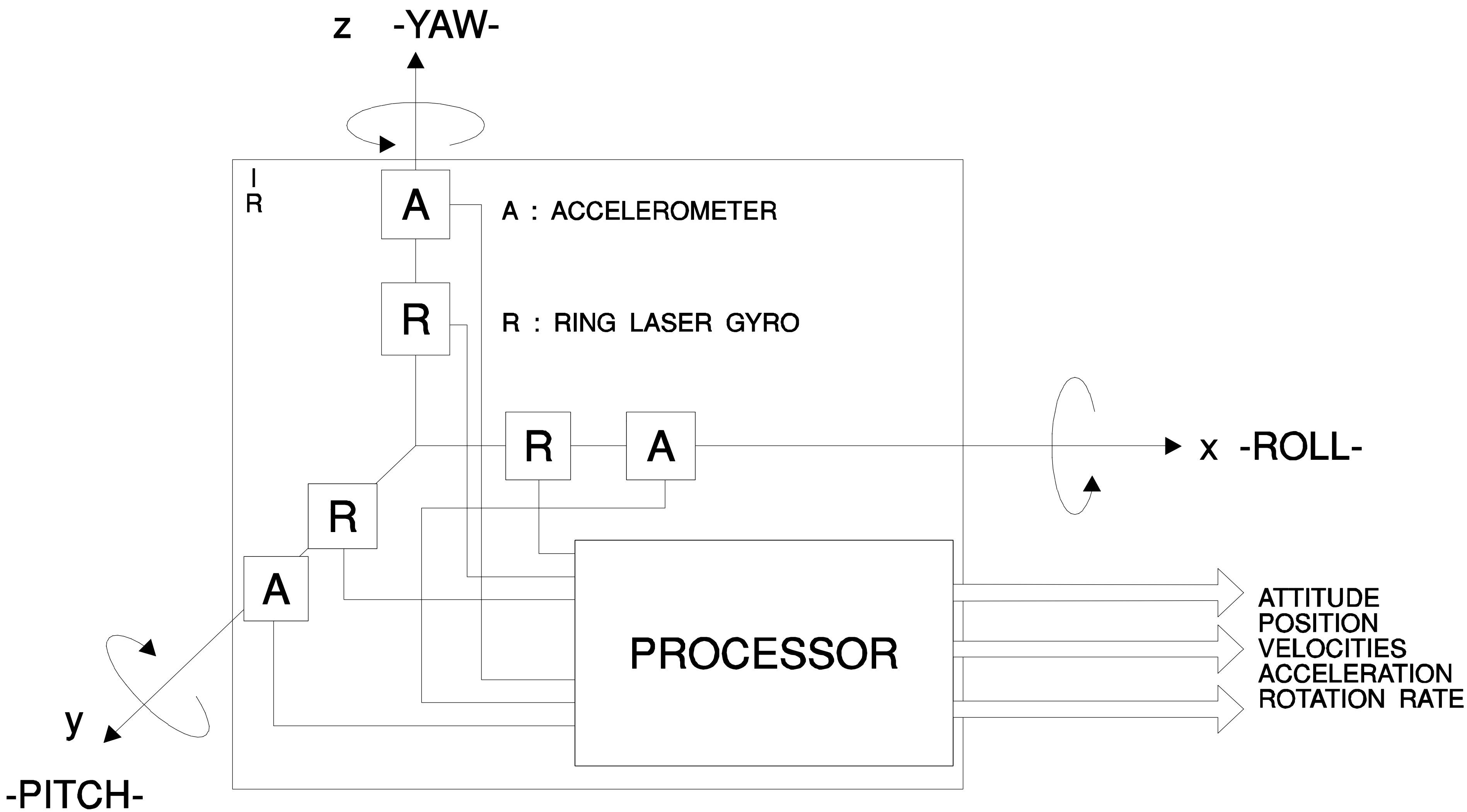
ACCELEROMETER

Three accelerometers, one for each axis, provide linear accelerations.

IR COMPUTATION

By computing the laser gyro and the accelerometer outputs, each ADIRU provides Inertial Reference data to users.



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STUDENT NOTES

ADIRS MODE SELECTOR UNIT PRESENTATION

ADIRU Mode Rotary Selector
ADR P/B
IR P/B
ON BAT Indicator

ADIRU MODE ROTARY SELECTOR

When an Air Data Inertial Reference Unit (ADIRU) mode rotary selector is on OFF:

- the associated ADIRU is not energized ,
- the Air Data Reference (ADR) and Inertial Reference (IR) parts are OFF.

The Navigation (NAV) mode is the normal mode of operation. It provides full inertial and air data to aircraft systems after alignment.The Attitude (ATT) mode is a backup mode which provides only attitude and heading when navigation capability is lost.

ADR P/B

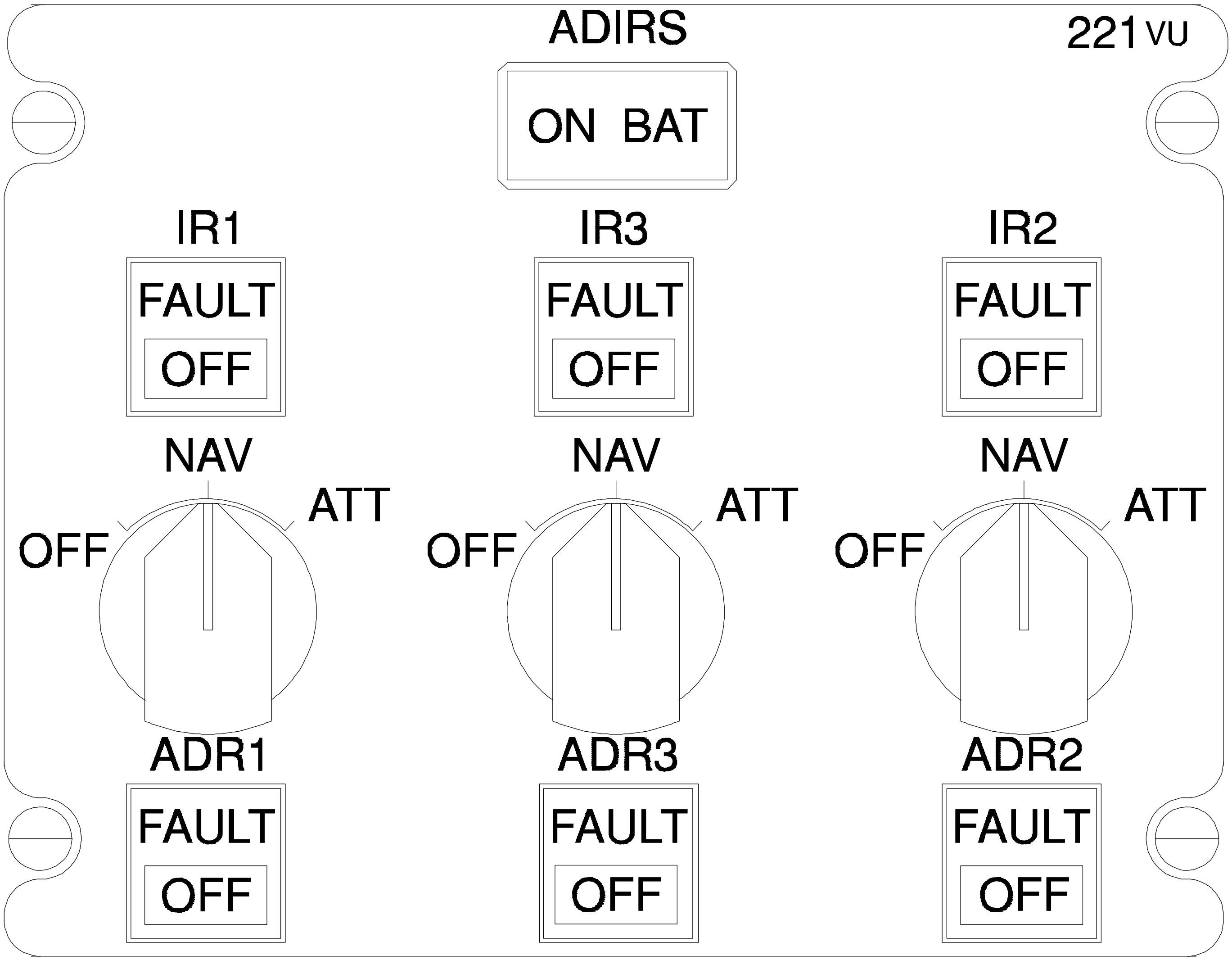
The ADR fault light comes on when a fault is detected in the associated ADR. When the ADR pushbutton is released out, the associated air data reference output is disconnected but the air data reference system remains energized.

IR P/B

The IR fault light comes on when a fault is detected in the associated IR. When the IR pushbutton is released out, the associated inertial reference output is disconnected but the inertial reference system remains energized.

ON BAT INDICATOR

The ON BAT indicator comes on when one or more air data inertial reference units are supplied by the aircraft batteries.
Note: the ON BAT indicator comes on for five seconds during the power up test.



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STUDENT NOTES:

ADIRS SWITCHING

Principle

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Air Data Inertial Reference System (ADIRS) is composed of three Air Data Inertial Reference Units (ADIRU).

PRINCIPLE

Various instruments and systems receive data from the ADIRS.
The Primary Flight Display (PFD), the Navigation Display (ND) and the Digital Distance and Radio Magnetic Indicator (DDRMI) for inertial and air data display.

The ADIRS provides barometric altitude to the mode S Air Traffic Control (ATC) system.

The ADIRS provides data to the Flight Management Guidance and Envelope Computer (FMGEC) for aircraft position computation and computation of various characteristic speeds.

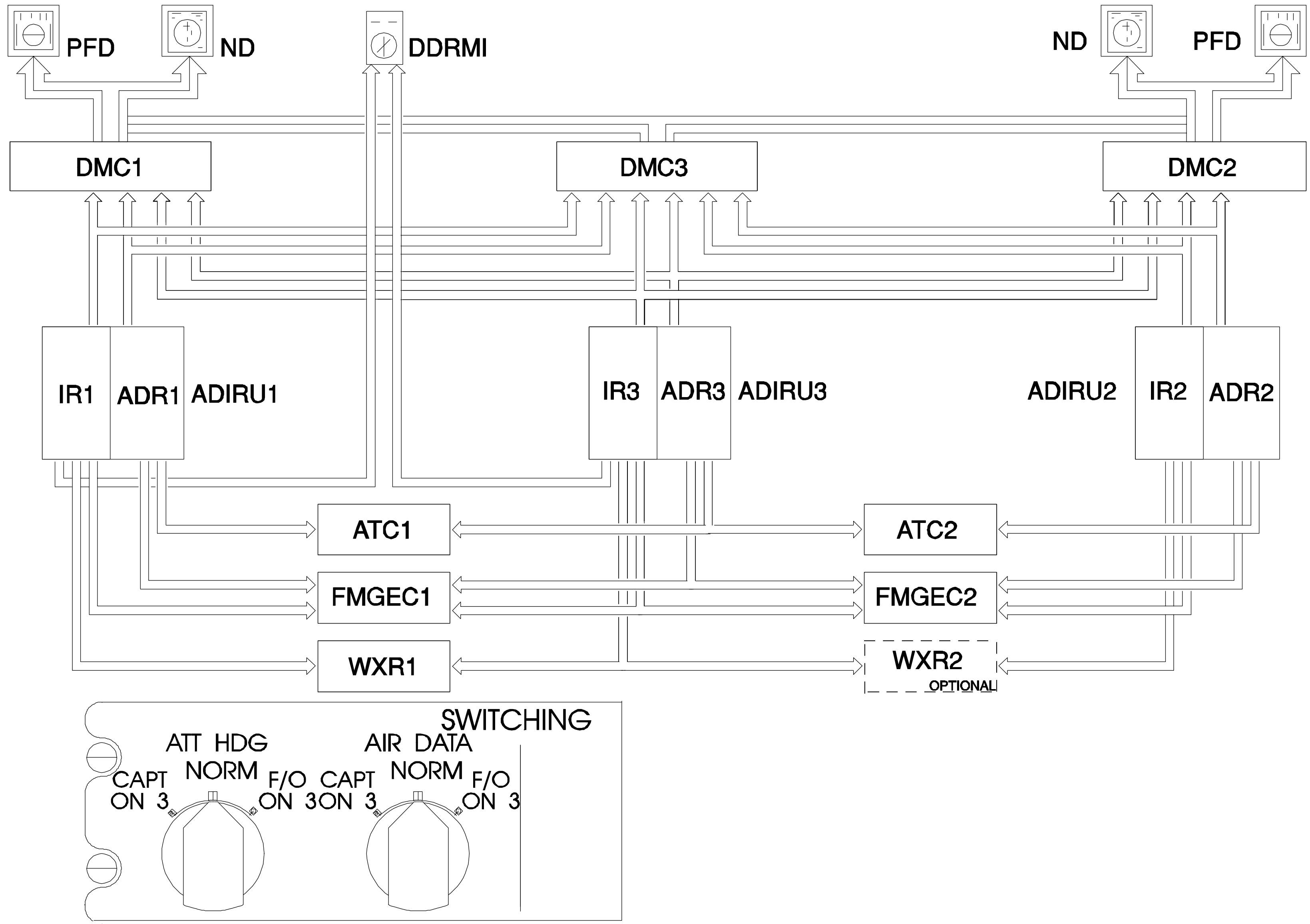
The ADIRS provides data to the Weather Radar (WXR) system for antenna attitude stabilization.

Basically, ADIRU1 is associated with systems 1 and the DDRMI, ADIRU2 with systems 2, ADIRU3 is in standby.

If an Air Data Reference (ADR) or an Inertial Reference (IR) fails, the AIR DATA or ATT HDG selector enable the crew to use ADR3 or IR3.

The manual switching is mainly performed to recover displays.
The computers select their inputs according to the switching for consistency of computation and display.

Note : each FMGEC receives data from the 3 ADIRUs.
The switching only concerns characteristic speeds.



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STUDENT NOTES

AIR DATA PROBES SYSTEM D/O

Static Ports
Pitot Probes
Angle Of Attack Sensors
Total Air Temperature Sensors
Water Drain and Heating

The probes are connected to the Air Data Reference (ADR) of the Air Data Inertial Reference Unit (ADIRU).

STATIC PORTS

Captain and First Officer static ports directly provide static pressure to 4 Air Data Modules (ADM) which convert this pressure into digital format.

ADR1 and ADR2 compute the average static pressure value from the left and right ADMs.

Standby static ports provide an average pressure directly to the standby instruments and to a single ADM connected to ADR3.

PITOT PROBES

The three pitot probes directly provide the total pressure to three ADMs.

The standby pitot probe also supplies the standby airspeed indicator.

ANGLE OF ATTACK SENSOR

Each Angle Of Attack (AOA) sensor provides a primary and a backup signal to each ADIRU.
In case of failure, the selection is automatically made by the ADIRU.

The AOA sensor is equipped with a self test device which is activated from the MCDU through the ADIRU.
The AOA sensors are also called Alpha probes.

TOTAL AIR TEMPERATURE SENSORS

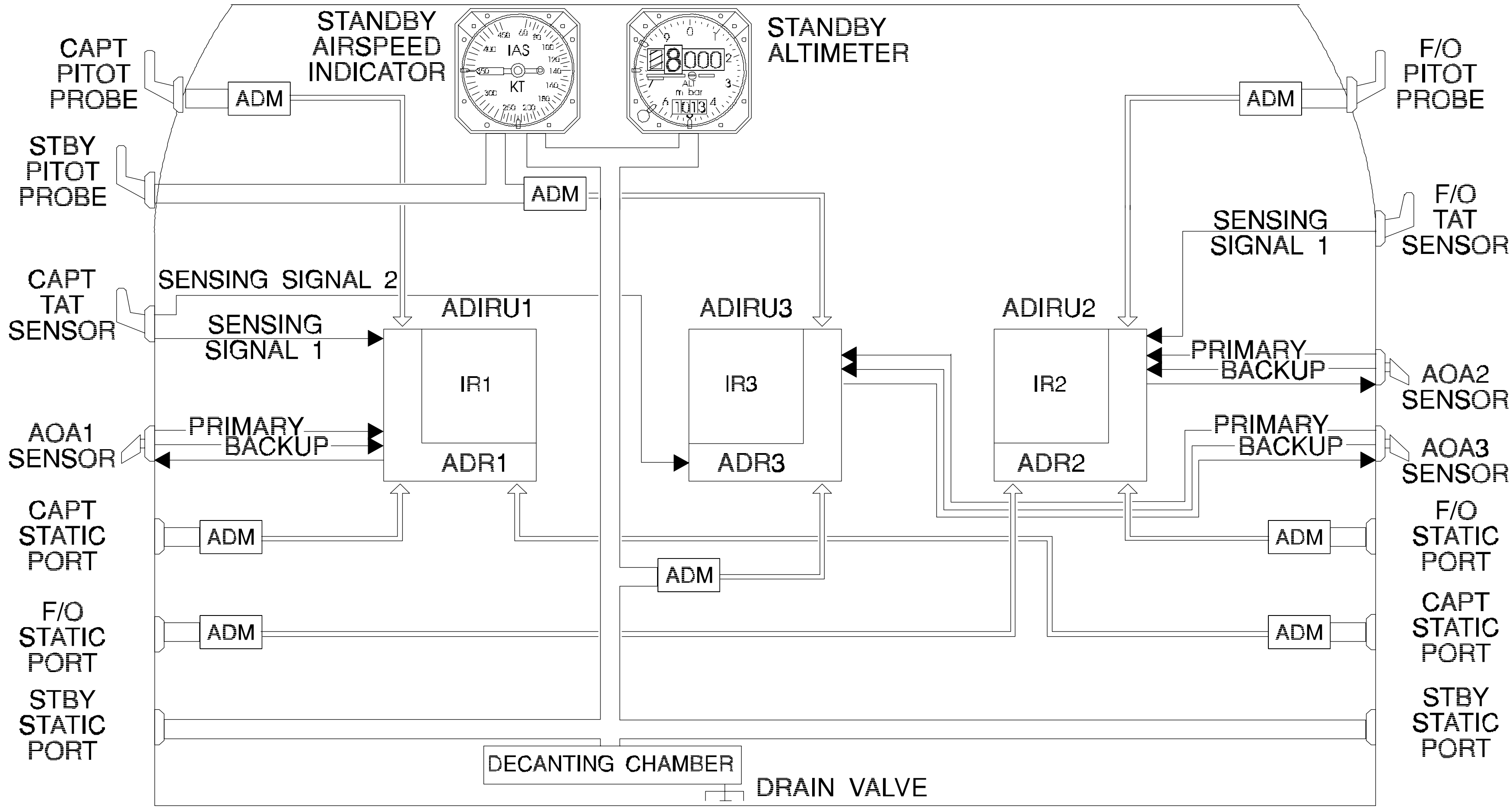
Each Total Air Temperature (TAT) sensor has two independent sensing elements.

For F/O TAT sensor, only one sensing element is connected.

WATER DRAIN AND HEATING

The probes are installed in such a way that their pressure lines do not require a water drain except for that of the static port.

The probe and sensor heating is achieved through the probe heating system.



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STUDENT NOTES:

INTERRUPTION DURING ALIGNMENT

Excessive Motion
Test On Stored Position
Test On Computed Latitude

These tests will trigger messages on the MCDU and EWD.
They are associated with warnings as soon as the first engine starts.

EXCESSIVE MOTION

If taxing or towing causes a step input exceeding a threshold, alignment or rapid realignment is stopped and then the ADIRUs revert to the beginning of a 10 minutes alignment.

Step input threshold : 0.5ft/s.

30 seconds after motion has been detected, and no other motion has occured, a 10 minutes alignment begins.
It is not neccessary to re-initialize the position if already entered.

TEST ON STORED POSITION

When the initial position is entered, the ADIRUs check if it is within a threshold of the computed position which has been stored at the last ADIRU shutdown.
If not, a message is displayed requiring insertion of the Present Position.

Test threshold : 1° for latitude and for longitude during alignment, 0.5° during rapid realignment.

If the new position entry does not pass the test, the system waits for another position entry.
If the same position (out of the threshold) is entered twice, the ADIRUs accept it as a deliberate choice (example: the ADIRUs have been set to the ATT mode during last flight leg, so last computed position is invalid).

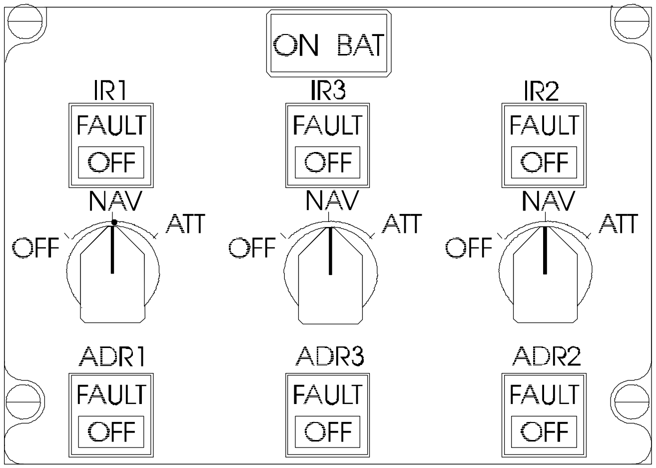
TEST ON COMPUTED LATITUDE

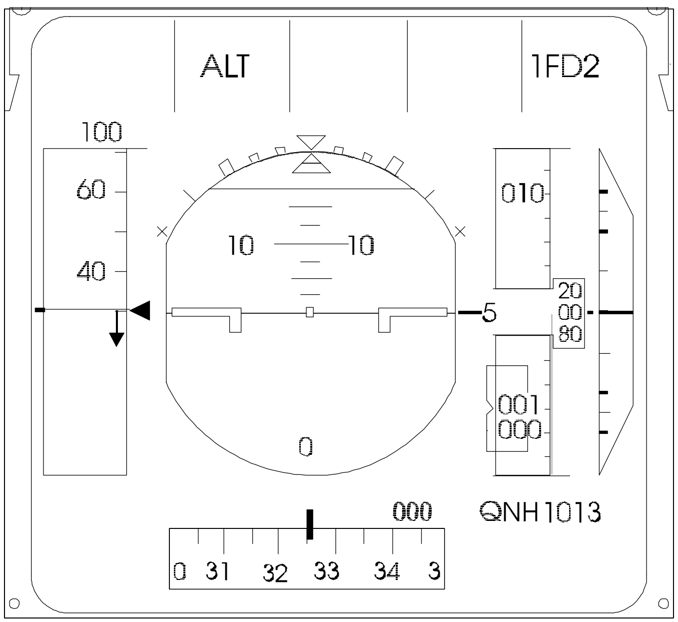
At the end of the alignment, the ADIRUs check if the entered latitude is within a threshold of the self computed latitude.
If not, a message is displayed requiring insertion of the Present Position.

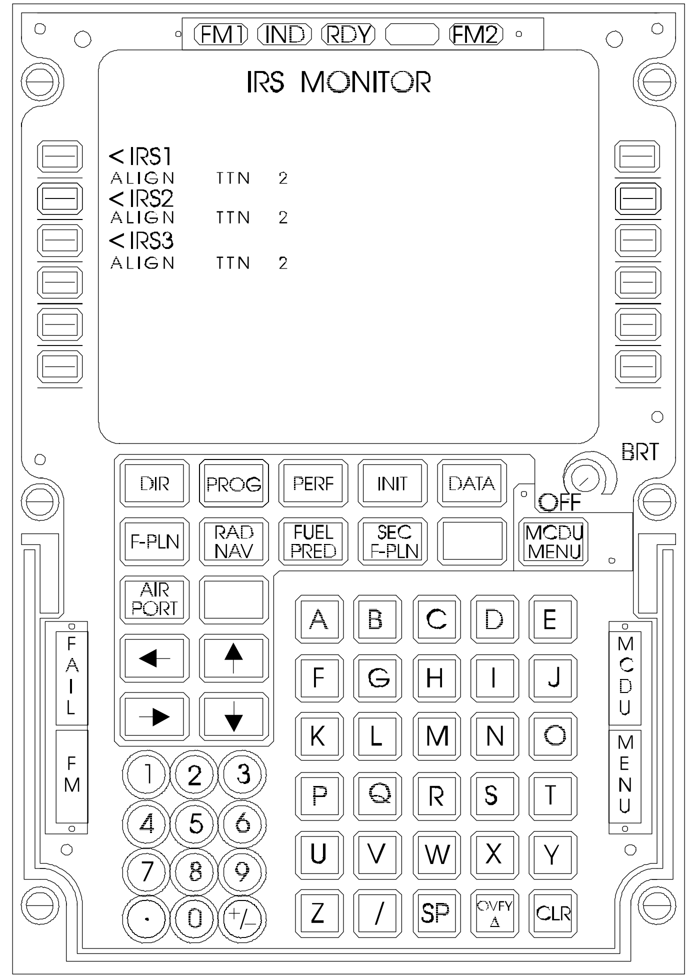
Test threshold: cosine (or sine) of entered latitude differs from cosine (or sine) of computed latitude by more than 0.01234.

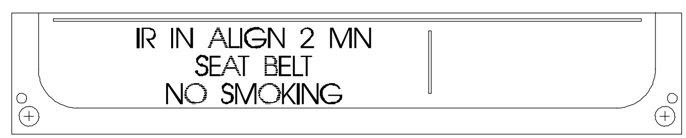
A new position entry, then IRS alignment is required.
If this position passes the test, the alignment is completed.

If the test failed twice, the IRs detect a fault situation (indications on MSU and EWD).
You need to switch them to OFF.
You can try to wait 20 seconds for ADIRUs reset, and try a complete new alignment.









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STUDENT NOTES

ADIRS INDICATIONS ON PFD

ATTITUDE

- Pitch Scale
- Roll Scale
- Roll Index
- Flight Path Vector
- Discrepancy
- Failure

HEADING

- Heading Scales
- Heading Reference Line
- Actual Track Symbol
- True Heading
- Discrepancy
- Failure

AIRSPEED

- Airspeed Scale
- Airspeed Reference Line
- Failure

VERTICAL SPEED

- V/S Scale
- V/S Pointer
- Numerical Value
- Excessive V/S
- Degraded Data
- Failure

ALTITUDE

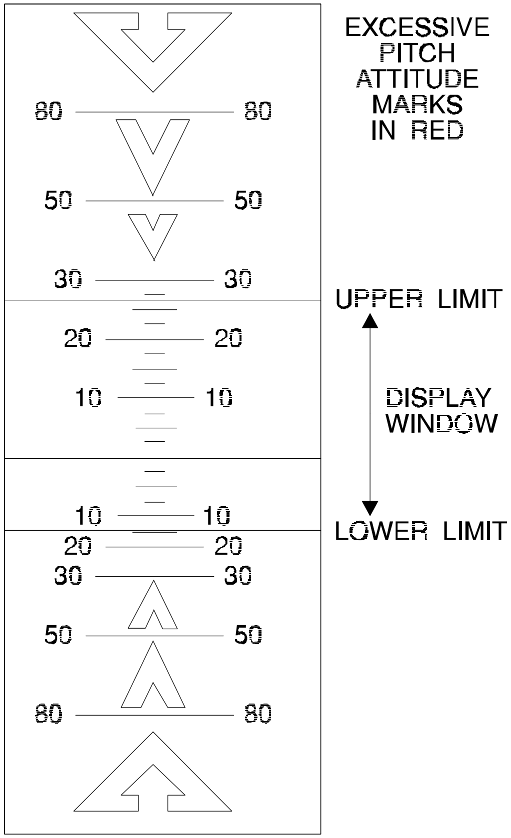
- Altitude Scale
- Altitude Indication
- Baro Reference
- Discrepancy
- Failure

Air Data Inertial Reference System (ADIRS).
Primary Flight Display (PFD).

ATTITUDE

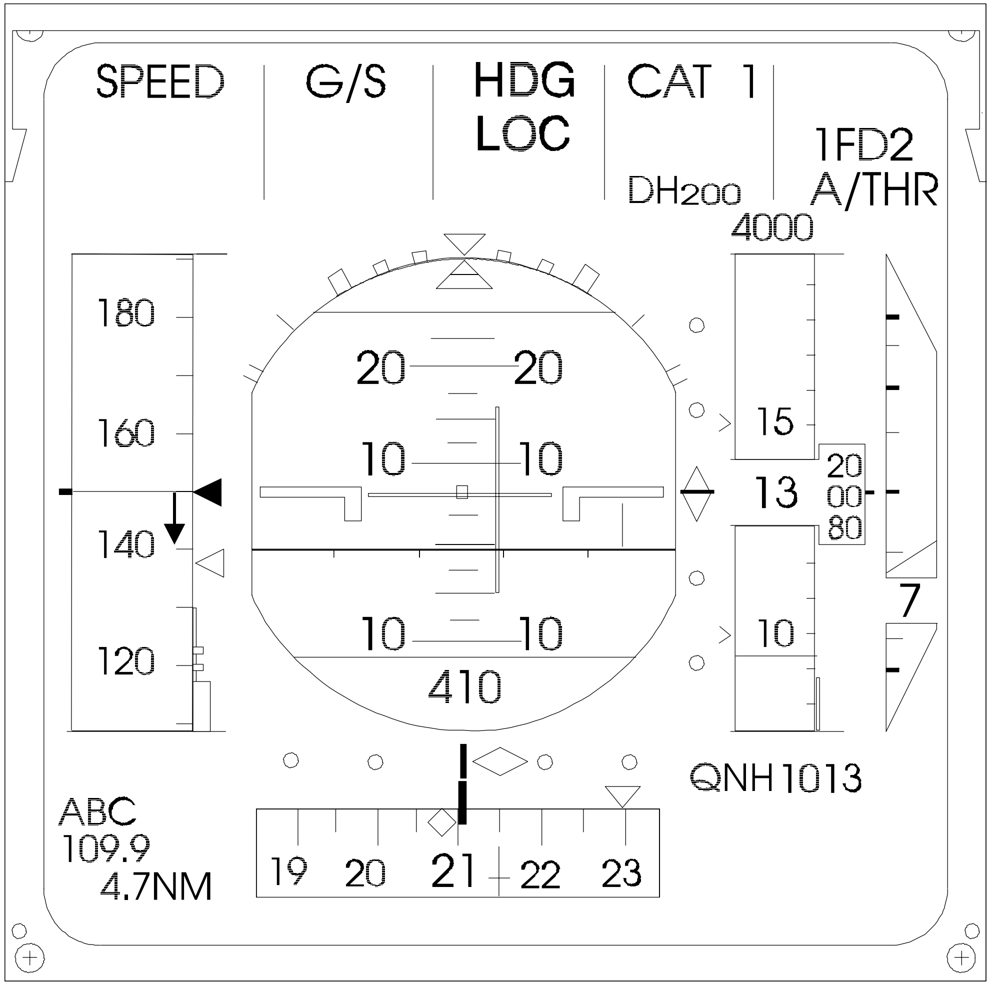
The inertial attitude data is displayed in the middle of the Primary Flight Display (PFD).

PITCH SCALE



The aircraft pitch angle is given by the displacement of the pitch attitude scale through a display window.

For pitch angles of more than 25° or less than -13°, the guidance symbols and the Flight Mode Annunciator (FMA) are removed.



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ROLL SCALE

The fixed roll scale comprises roll graduations.

For roll angles of more than 45° the guidance symbols and the Flight Mode Annunciator (FMA) are removed.

ROLL INDEX

The roll index moves along the fixed roll scale and provides the roll data.

FLIGHT PATH VECTOR

The flight path vector indicates the actual aircraft inertial trajectory.

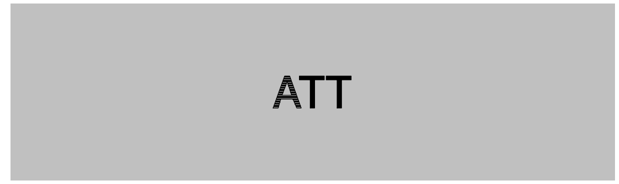
The flight path vector is used as a reference when the Flight Director (FD) is engaged in TRACK/FLIGHT PATH angle mode.

DISCREPANCY

When an attitude discrepancy is detected between the Captain display and the First Officer display, a CHECK ATT message is displayed.

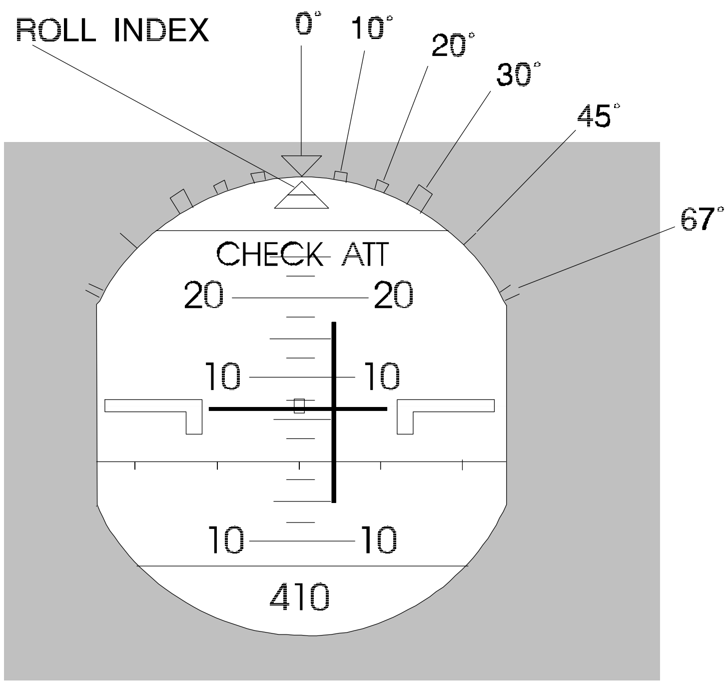
The attitude discrepancy threshold is 5°.
The attitude discrepancy is detected by an external comparison by the Flight Warning Computer (FWC).

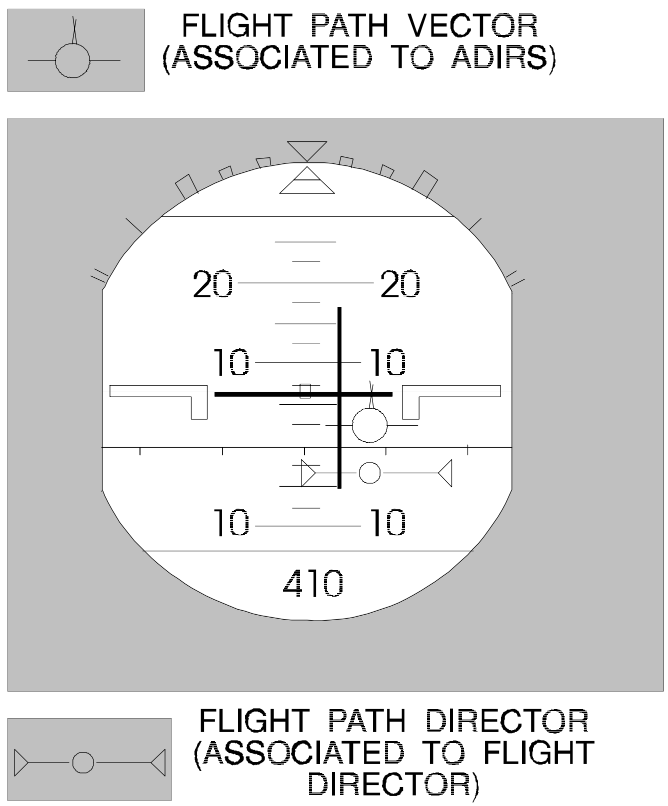
FAILURE



In case of attitude failure, the attitude scale is replaced by an attitude flag.

The failure is detected by the Air Data Inertial Reference Unit (ADIRU).





FQW4200 GE Metric

HEADING

The inertial heading data is displayed in the lower section of the primary flight display and on the horizon line.

HEADING SCALES

Two moving heading scales provide the crew with heading data.

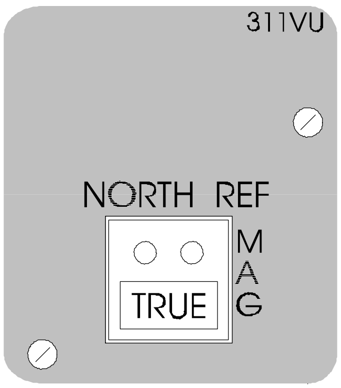
HEADING REFERENCE LINE

A fixed heading reference Line shows the actual heading on the lower heading scale.

ACTUAL TRACK SYMBOL

An actual track symbol is displayed.

TRUE HEADING



When true heading is displayed, a true message is displayed.

The true heading is displayed :

- Manually when the TRUE/MAG P/B is selected,
- Automatically above 82° north or below 60° south for polar navigation.

DISCREPANCY

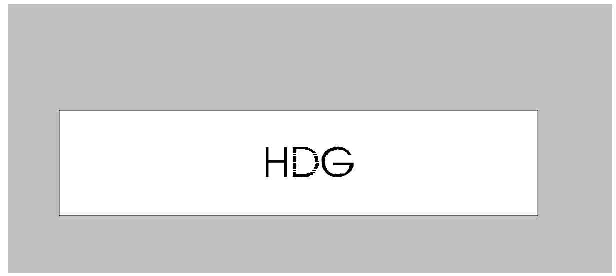
When a heading discrepancy is detected between the Captain display and the First Officer display, a CHECK HEADING message is displayed.

Heading discrepancy threshold :

- 7° (magnetic reference),
- 5° (true reference).

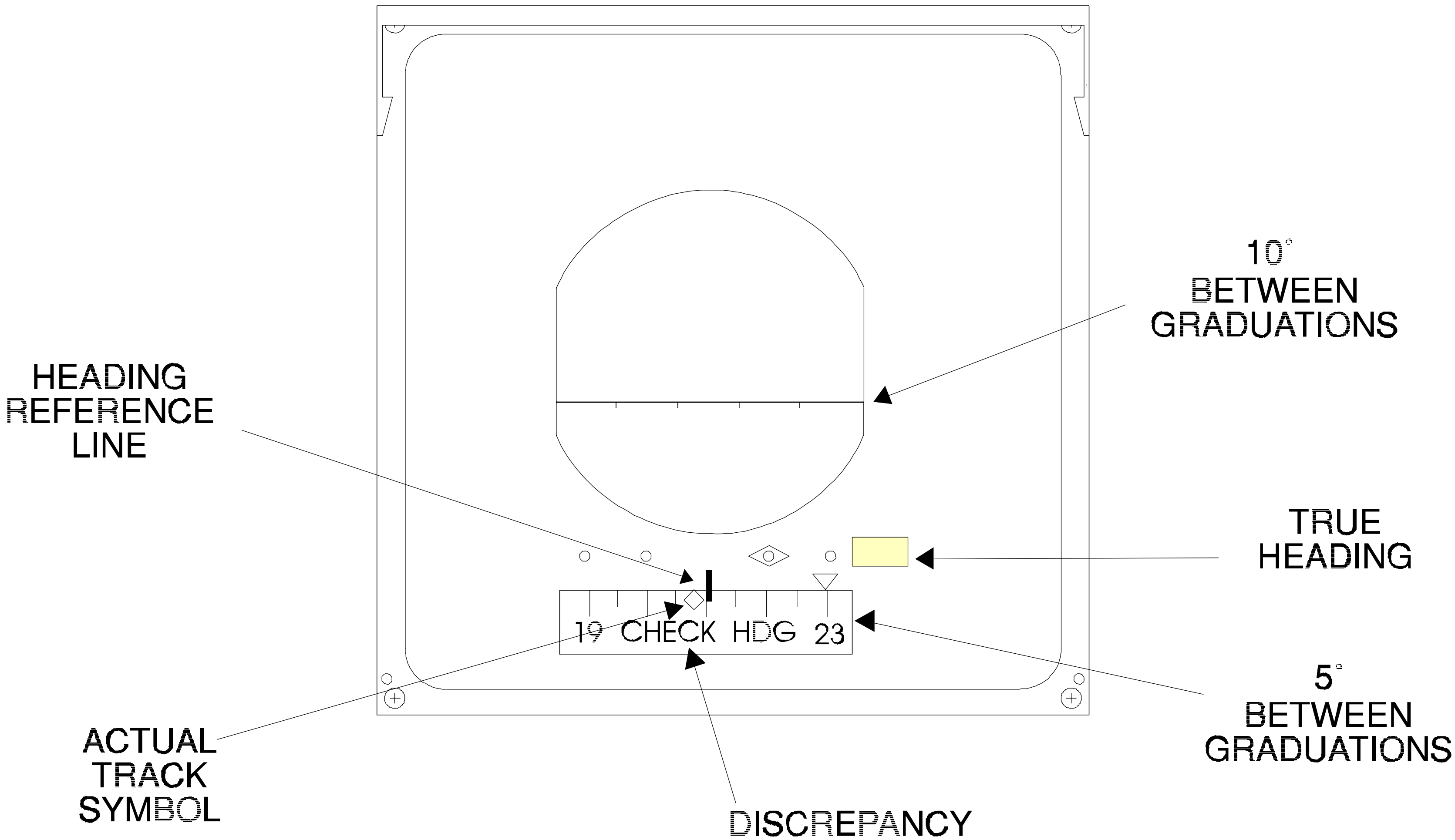
Note : the discrepancy is detected by an external comparison by the Flight Warning Computers (FWC).

FAILURE



In case of heading failure, the heading scale is replaced by a heading flag.

The failure is detected by the associated ADIRU.



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AIRSPEED

The air data Computed Airspeed (CAS) is displayed on the left hand side of the primary flight display.

ARSPEED SCALE

A moving airspeed scale with graduations in knots provides the crew with airspeed information.

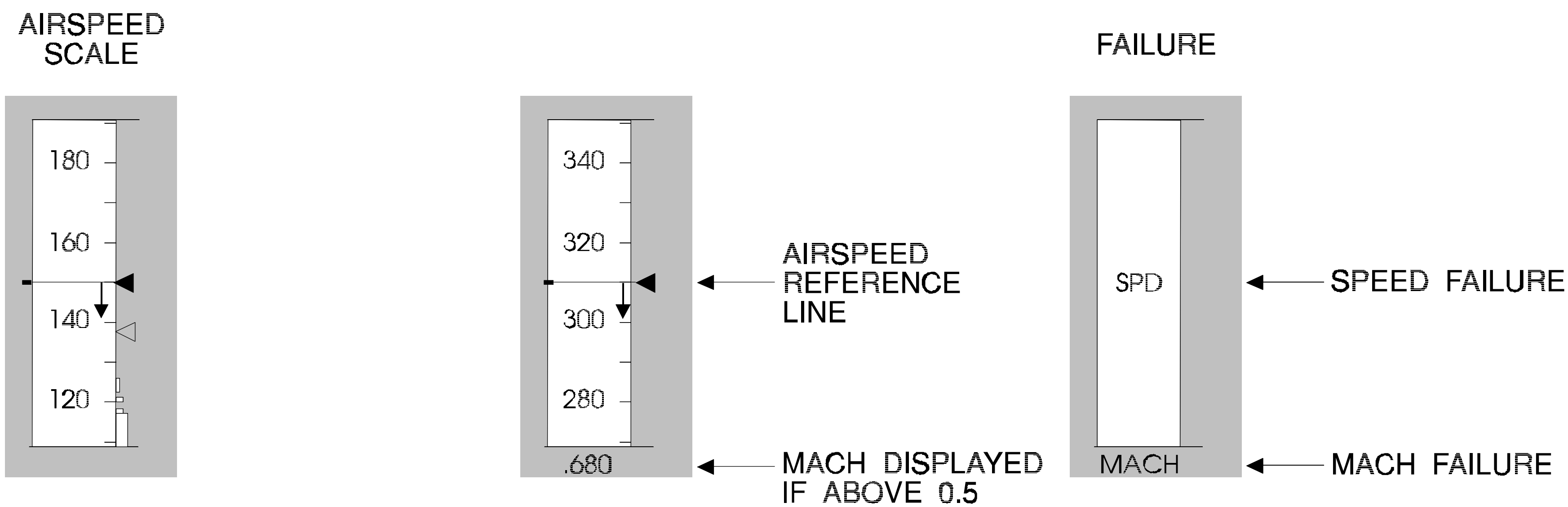
The speed scale is graduated from 30 to 520 kts.
In no case can the displayed airspeed be lower than 30 kts.

AIRSPEED REFERENCE LINE

A fixed airspeed reference line shows the actual airspeed on the airspeed scale.

FAILURE

In case of airspeed failure, the airspeed scale is replaced by a speed flag.



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VERTICAL SPEED

The inertial Vertical Speed (V/S) is displayed on the right hand side of the Primary Flight Display.

Note : a baro inertial loop is integrated in the inertial V/S computation to bring the stability in time of the air data (no drift like inertial data).

V/S SCALE

A vertical speed scale with graduations in feet per minute, provides the crew with vertical speed information.

V/S POINTER

A pointer provides the vertical speed in analog form.

The pointer rotates around a point outside the V/S scale.
Only the portion of the needle inside the scale is displayed.

NUMERICAL VALUE

Above a threshold, a numerical value in hundreds of feet per minute comes into view and follows the pointer.

EXCESSIVE V/S

In case of excessive vertical speed, the digital and analog indications become amber.

Excessive V/S when :

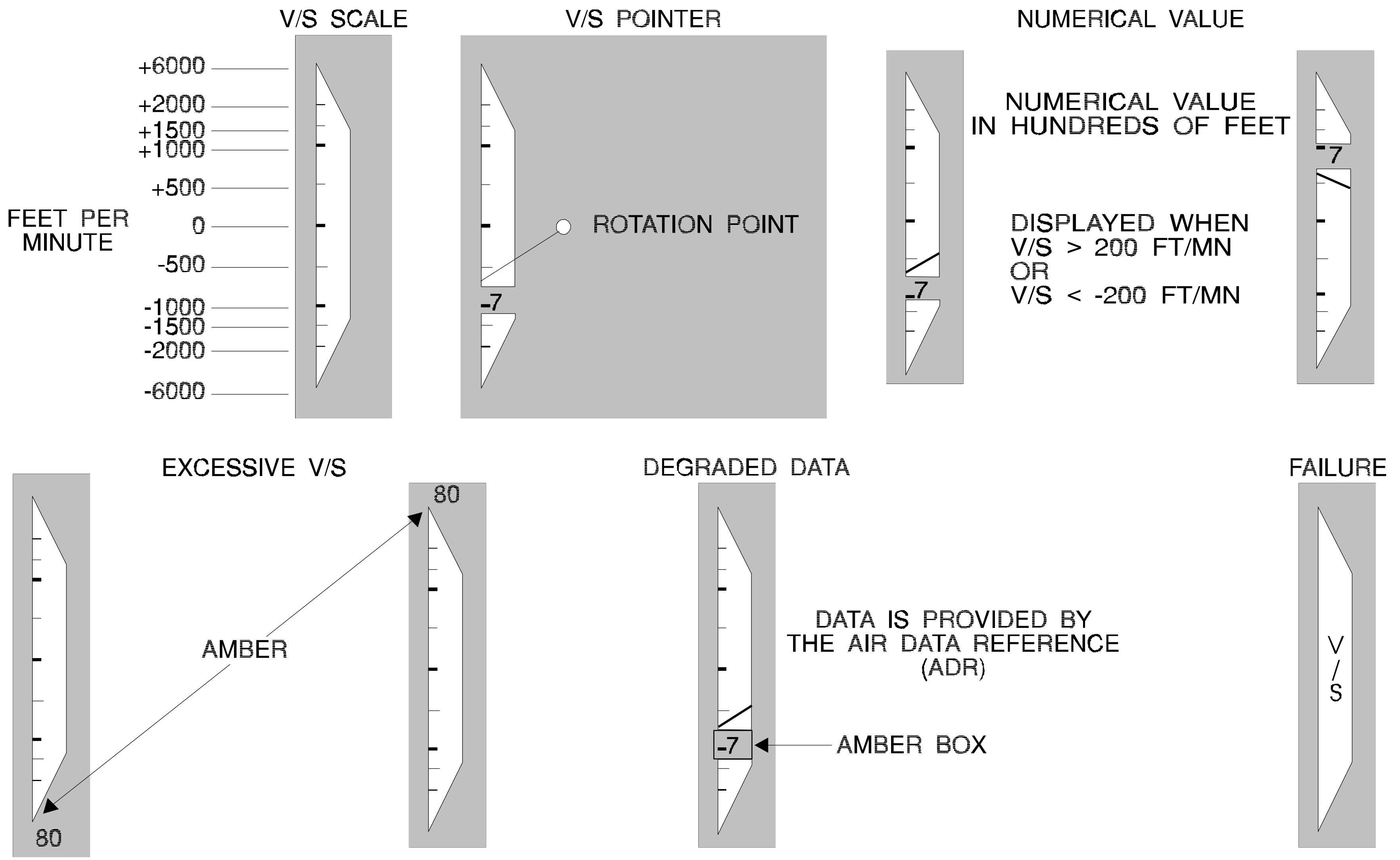
- V/S > 6000 ft/mn or V/S < - 6000 ft/mn,
- V/S < -2000 ft/mn below 2500 ft Radio Altimeter,
- V/S < -1200 ft/mn below 1000 ft Radio Altimeter.

DEGRADED DATA

When the inertial vertical speed is not available, the baro vertical speed is automatically displayed.

FAILURE

In case of vertical speed failure, the scale is replaced by a vertical speed flag.



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ALTITUDE

The Air Data Altitude is displayed on the right hand side of the Primary Flight Display.

ALTITUDE SCALE

A moving altitude scale with graduations every hundred feet provides the crew with altitude information.

ALTITUDE INDICATION

The aircraft altitude is shown by a counter on the left and a drum on the right.

BARO REFERENCE

The baro reference can be standard, QNH or QFE according to the selection made on the EFIS control panel.

DISCREPANCY

When an altitude discrepancy is detected between the Captain display and the First Officer display, a CHECK ALT message is displayed.

Altitude discrepancy threshold :

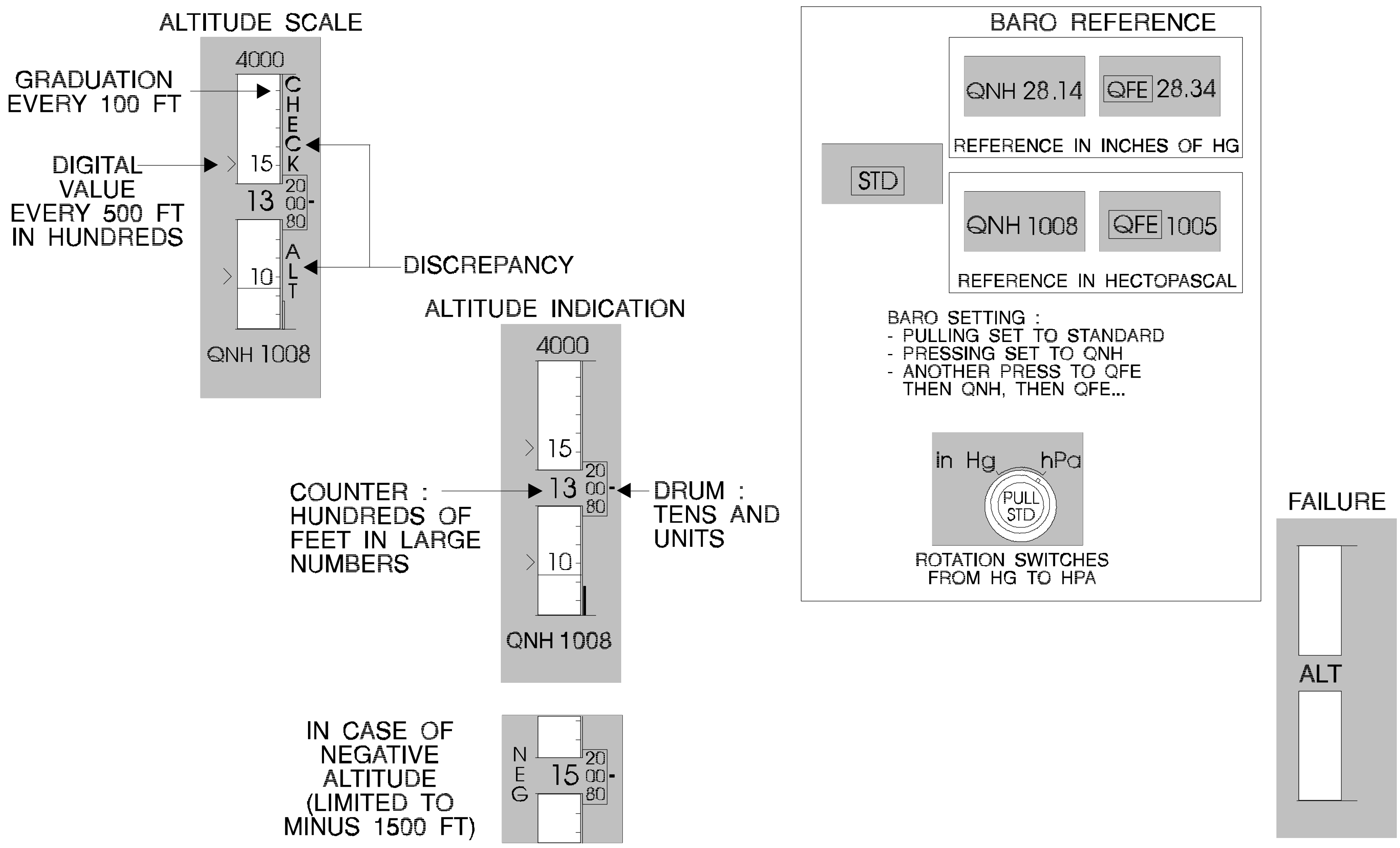
250 ft with baro selected or 500 ft with STD selected.

Note : the discrepancy is detected by an external comparison by the Flight Warning Computers (FWC).

FAILURE

In case of altitude failure, the altitude scale is replaced by an altitude flag.

The failure is detected by the associated ADIRU.


ALTITUDE SCALE
GRADUATION EVERY 100 FT
DIGITAL VALUE EVERY 500 FT IN HUNDREDS
4000
15
13
20
00
80
10
CHECK
ALT
QNH 1008
DISCREPANCY
ALTITUDE INDICATION
4000
15
13
20
00
80
10
QNH 1008
COUNTER : HUNDREDS OF FEET IN LARGE NUMBERS
DRUM : TENS AND UNITS
IN CASE OF NEGATIVE ALTITUDE (LIMITED TO MINUS 1500 FT)
NEG
15
20
00
80
BARO REFERENCE
QNH 28.14
QFE 28.34
REFERENCE IN INCHES OF HG
STD
QNH 1008
QFE 1005
REFERENCE IN HECTOPASCAL
BARO SETTING :
- PULLING SET TO STANDARD
- PRESSING SET TO QNH
- ANOTHER PRESS TO QFE THEN QNH, THEN QFE...
in Hg
hPa
PULL STD
ROTATION SWITCHES FROM HG TO HPA
FAILURE
ALT

STUDENT NOTES:

ADIRS INDICATIONS ON ND

ROSE MODE

- Speed
- Wind
- Heading
- Discrepancy
- Failure

ARC MODE

- Speed
- Wind
- Heading
- Discrepancy
- Failure

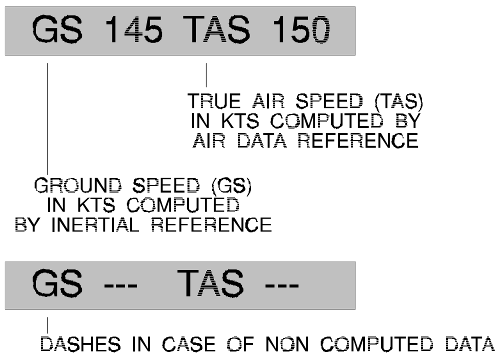
PLAN MODE

- Speed
- Wind
- Heading

ROSE MODE

The rose mode provides a 360 degree sector around the aircraft.

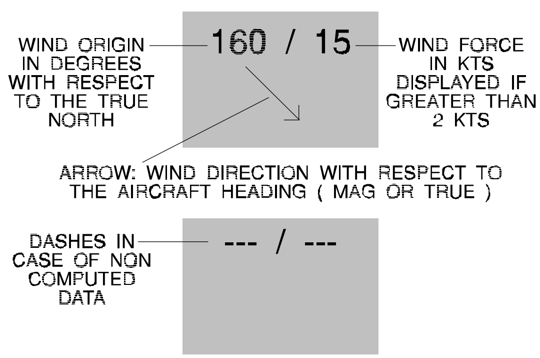
SPEED



The speed information is displayed in the left upper corner.

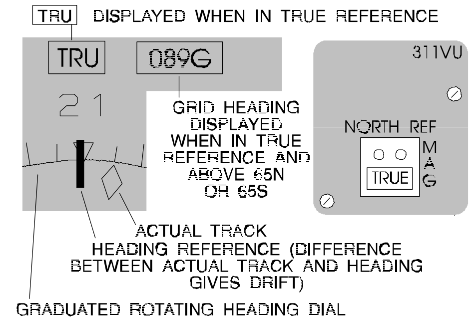
The True Airspeed (TAS) is displayed for speeds higher than 100 KTS.

WIND



The wind information is displayed in the left upper corner.

HEADING



The heading data is shown on a full rotating dial.
A True message is displayed when true heading has been selected in polar areas.

DISCREPANCY

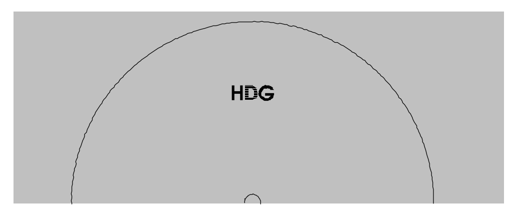
When a heading discrepancy occurs between the Captain and First Officer Navigation Displays (NDs), a check heading message is displayed on both NDs.

Heading discrepancy treshold :

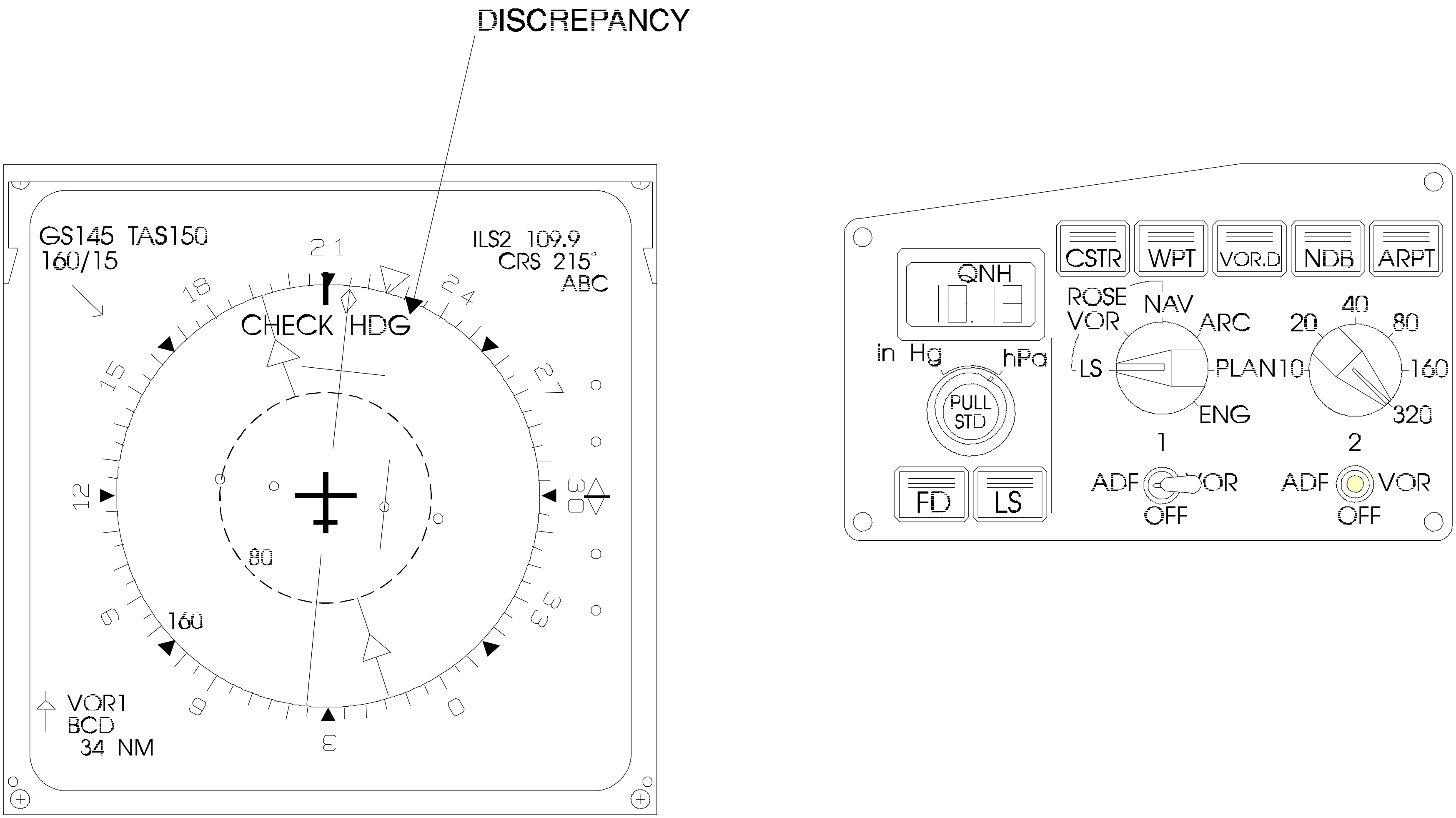
- 7° in magnetic reference,
- 5° in true reference.

Note: the discrepancy is detected by an external comparison by the Flight Warning Computer (FWC).

FAILURE



When a heading failure is detected, a heading flag is displayed.



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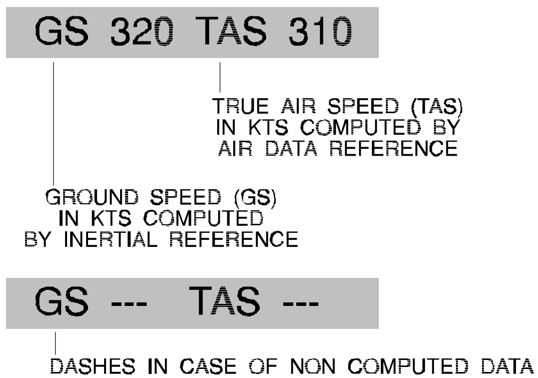
ARC MODE

The ARC mode provides a 90 degree sector ahead of the aircraft.

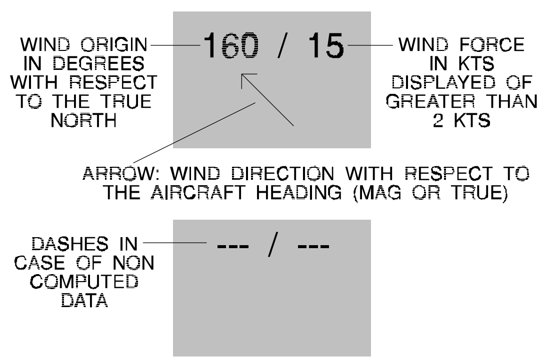
SPEED



The speed information is displayed in the left upper corner.

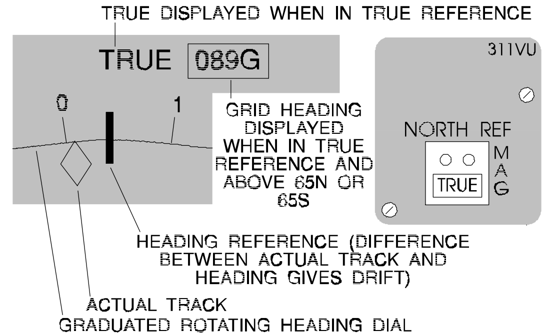
The True Airspeed (TAS) is displayed for speeds higher than 100 KTS.

WIND



The wind information is displayed in the left upper corner.

HEADING



The heading data is shown on a partial rotating dial.
A True message can be displayed when true heading has been selected in polar areas.

DISCREPANCY

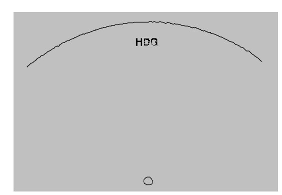
When a heading discrepancy occurs between the Captain and First Officer Navigation Displays (NDs), a check heading message is displayed on both NDs.

Heading discrepancy treshold :

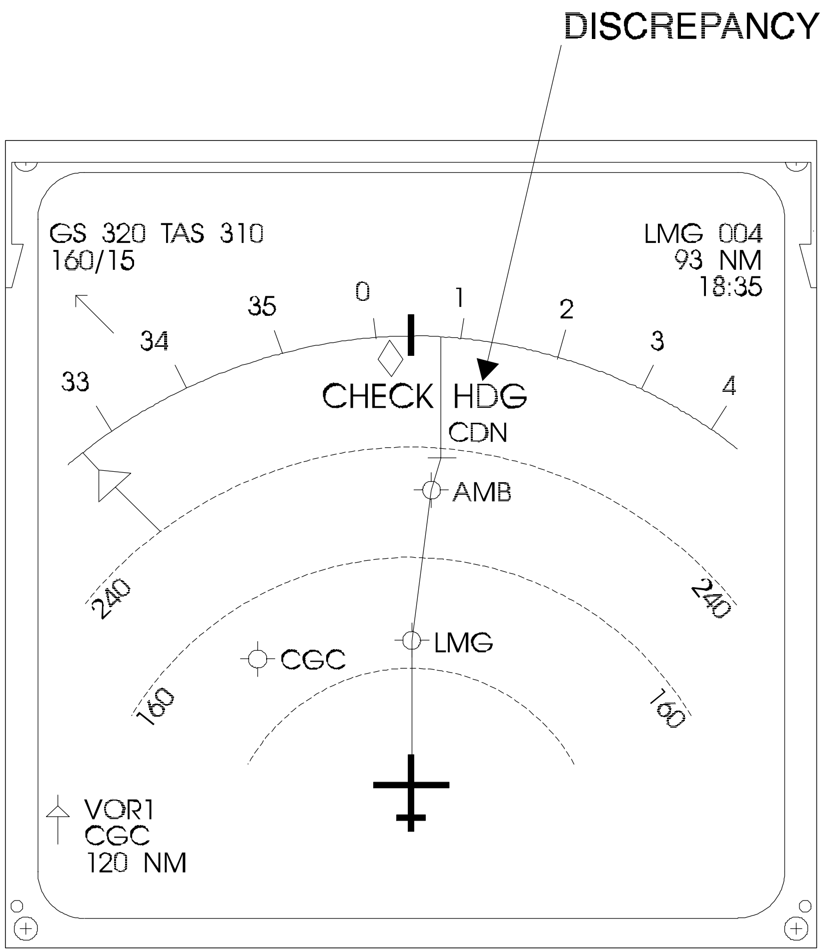
- 7° in magnetic reference,
- 5° in true reference.

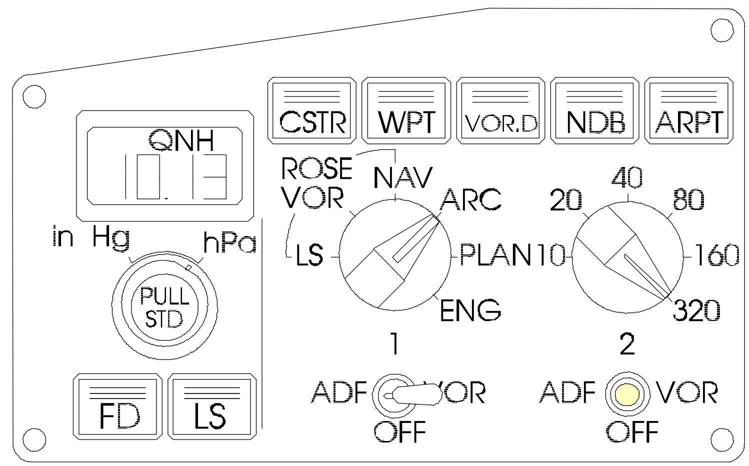
Note: the discrepancy is detected by an external comparison by the Flight Warning Computer (FWC).

FAILURE



When a heading failure is detected, a heading flag is displayed.





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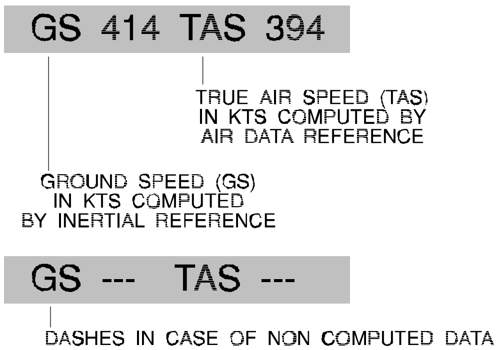
PLAN MODE

The plan mode provides a map display centered on the next or selected waypoint.

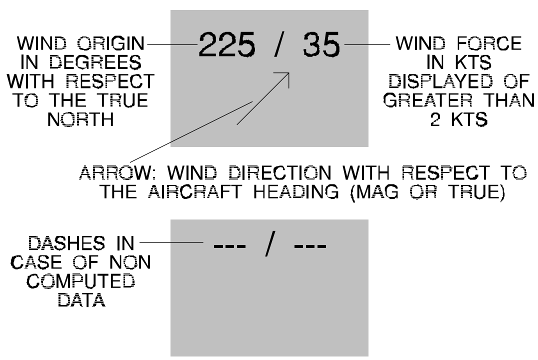
SPEED



The speed information is displayed in the left upper corner.

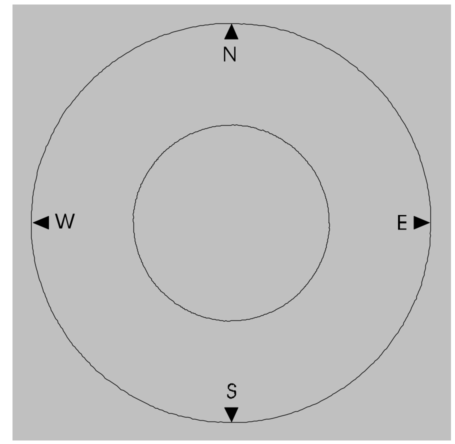
The True Airspeed (TAS) is displayed for speeds higher than 100 KTS.

WIND

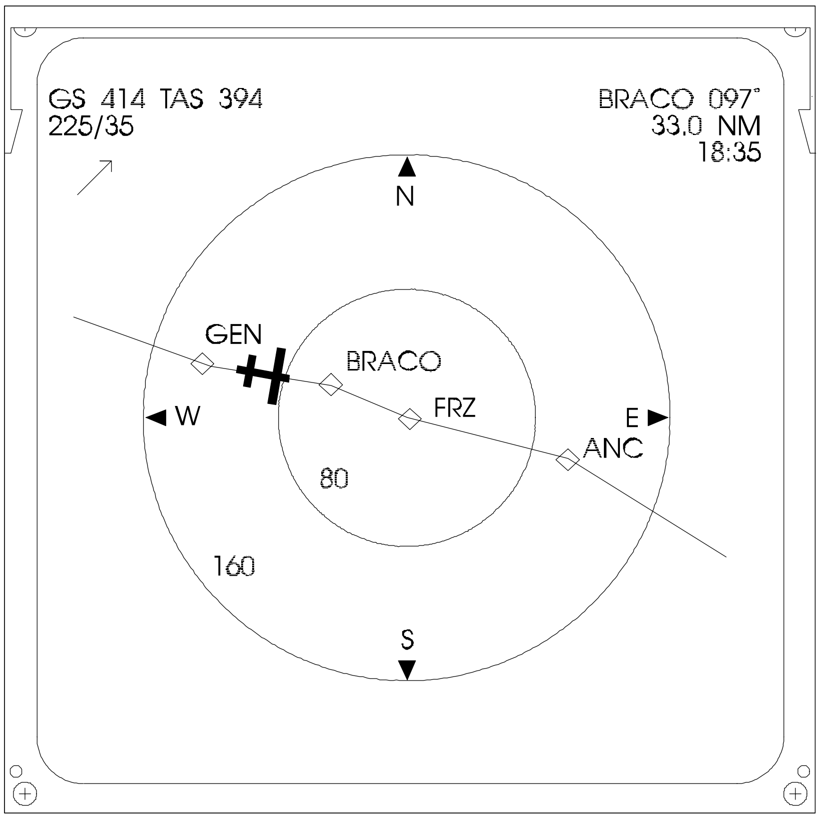


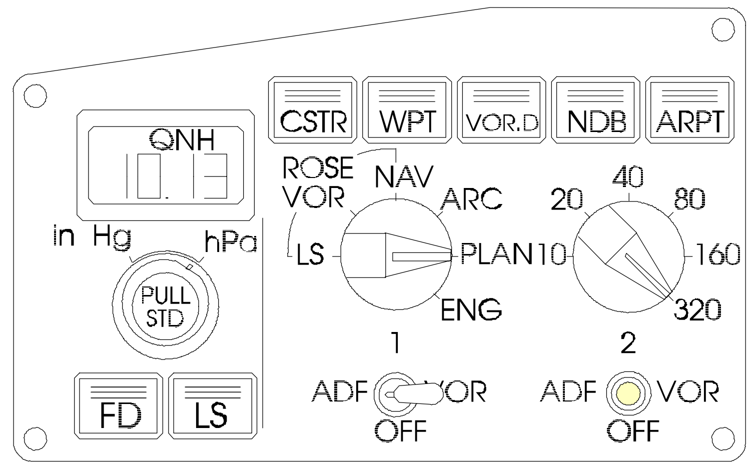
The wind information is displayed in the left upper corner.

HEADING



The map displayed is referenced to the true north.





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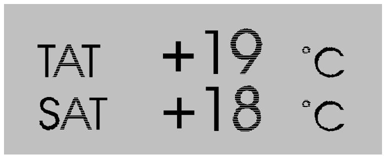
STUDENT NOTES:

ADIRS INDICATIONS ON ECAM DISPLAY UNIT

Total Air Temperature/Static Air Temperature
Failure
Switching

Air Data / Inertial Reference System (ADIRS).

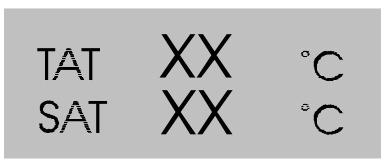
TOTAL AIR TEMPERATURE/STATIC AIR TEMPERATURE



The Total Air Temperature and Static Air Temperature are permanently displayed.

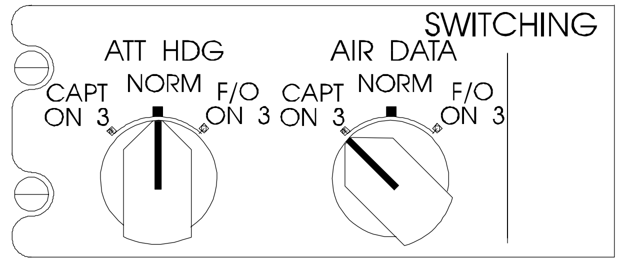
Total Air Temperature (TAT) (range: -60°C / +99°C),
Static Air Temperature (SAT) (range: -99°C / +80°C).

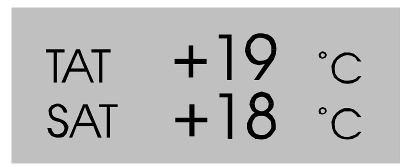
FAILURE



In case of failure or when no computed data information is received, the data is replaced by crosses.

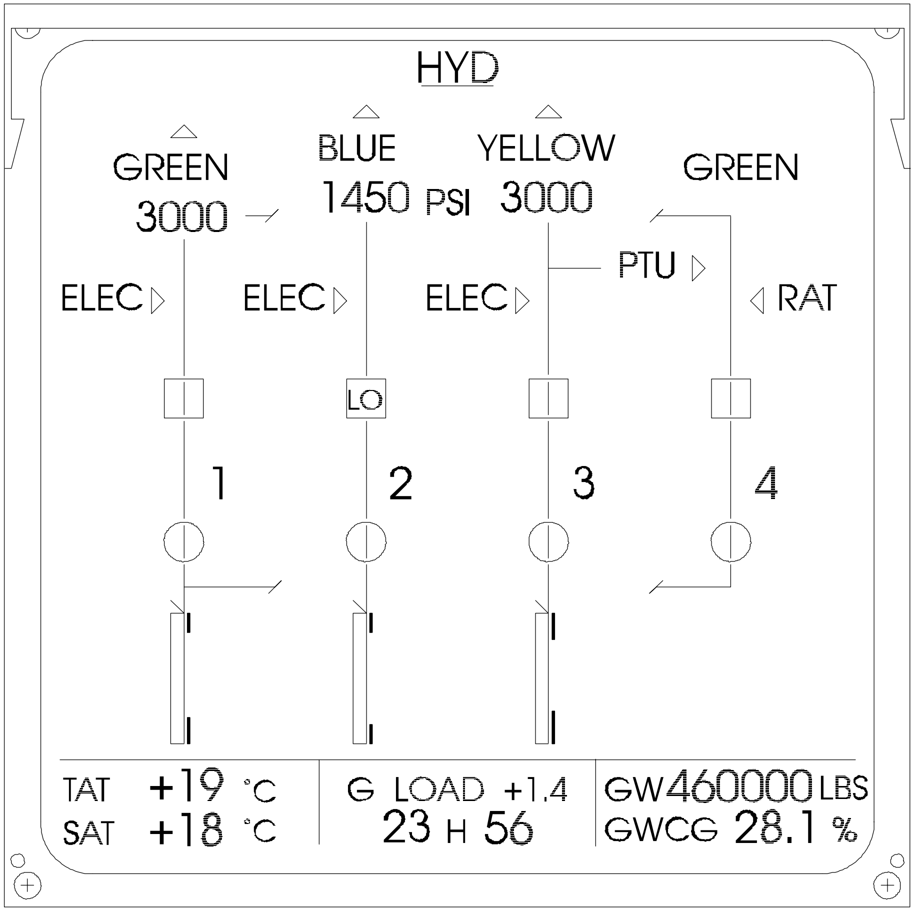
SWITCHING





Basically, ADR1 provides data.

Back up data is provided by setting the AIR DATA switch to the CAPT ON 3 position.



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SSTUDENT NOTES:

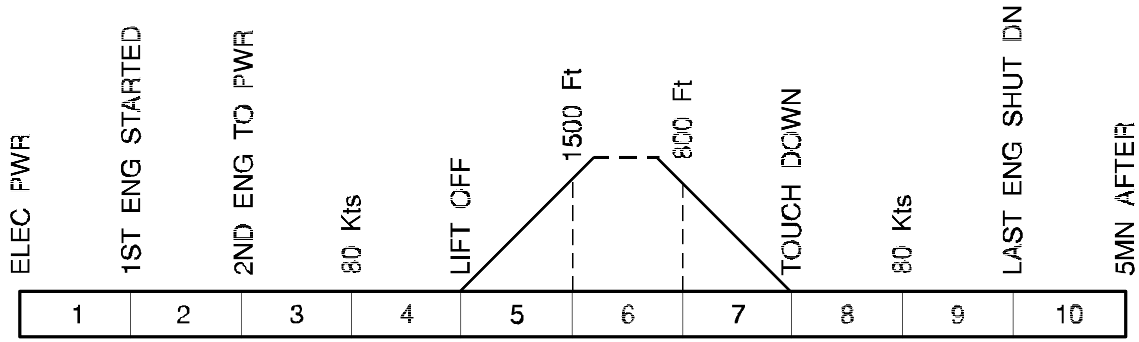
FQW4200 GE Metric

ADIRS WARNINGS

Overspeed
VLE
VFE
ADR 1 (2) (3) Fault
ADR 1+2 (1+3) (2+3) Fault
IR 1 (2) (3) Fault
IR 1+2 (1+3) (2+3) Fault
HDG Discrepancy
ATT Discrepancy
ALTI Discrepancy
Extreme Latitude
IR Align Fault

OVERSPEED AND STALL WARNING

Note the red "OVERSPEED" message on the ECAM display. The ADIRS provide speed and acceleration data to the Flight Warning Computer (FWC) which will generate a warning in case of hazardous flight configuration. Please refer to FLIGHT CONTROLS chapter for more explanations.



E/WD : FAILURE TITLE	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
OVERSPEED -VMO/MMO aircraft speed/mach greater than VMO + 4 KB/MMO + 0.006 -VLE aircraft speed greater than VLE + 4Kts with L/G not uplocked or L/G doors not closed. -VFE aircraft speed greater than VFE + 4Kts with slats or/and flaps extended.	CRC	MASTER WARNING	NIL	NIL	NIL

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ADR 1 (2)(3) FAULT

This warning will appear if one ADR fails. Note the amber "FAULT" light on the control panel below the ADR failed.
In this case, you should :
- select the backup source (ADR 3) on the AIR DATA selector. No switching if ADR 3 faulty.
- set the corresponding ADR switch to OFF. CAT 3 DUAL not available anymore.

ADR 1+2 (1+3) (2+3) FAULT

This warning will appear if two ADRs fail at the same time.Note the amber "FAULT" lights on the control panel below the ADRs failed.
In this case, you should :
- select the backup source (ADR 3) on the AIR DATA selector. No switching if ADR 3 faulty.
- set the corresponding ADR switches to OFF. CAT 1 not available anymore.

IR 1 (2) (3) FAULT

This warning will appear if one IR fails. Note the amber "FAULT" light on the control panel below the IR failed.
In this case, you should :
- select the backup source (IR 3) on the ATT HDG selector. No switching if IR 3 faulty.
- try to recover part of the IR function by using the IR mode selector. CAT 3 DUAL not available anymore.

IR 1+2 (1+3) (2+3) FAULT

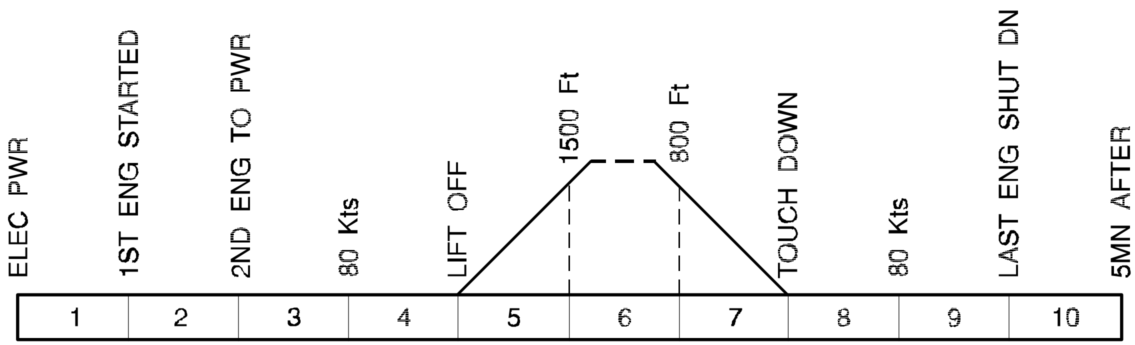
This warning will appear if two IRs fail at the same time. Note the amber "FAULT" lights on the control panel below the IRs failed.
In this case, you should :
- select the backup source (IR 3) on the AIR DATA selector. No switching if IR 3 faulty.
- try to recover part of the IR function by using the IR mode selectors. CAT 1 not available anymore.

HDG DISCREPANCY FAULT

Note the flashing amber "CHECK HDG" message on the PFD and ND, as well as an amber "NAV HDG DISCREPANCY" message on the ECAM display. This warning is triggered if there is a difference between heading on CAPT and F/O displays. The crew will have to cross-check heading information by using the standby compass and then selecting the backup heading source.

ATTITUDE DISCREPANCY FAULT

Note the flashing amber "CHECK ATT" message on the PFD , as well as an amber "NAV ATT DISCREPANCY" message on the ECAM display. This warning is triggered if there is a difference between roll or pitch angle displayed on both PDFs. The crew will have to cross-check attitude information by using the standby horizon and then selecting the backup heading source.



E/WD : FAILURE TITLE	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
ADR 1 (2) (3) FAULT	SINGLE CHIME	MASTER CAUTION	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°				CHECK HDG (on ND and PFD)	4, 8
ATT DISCREPANCY difference between roll and pitch angle displayed on CAPT and F/O PFD greater than 5°				CHECK ATT (on PFD)	

ALTITUDE DISCREPANCY FAULT

Note the flashing amber "CHECK ALT" message vertically shown on the altitude scale on the PFD , as well as an amber "NAV ALT DISCREPANCY" message on the ECAM display. This warning is triggered if there is a difference between altitude displayed on both PDFs. The crew will have to cross-check altitude information by using the standby altimeter and then selecting the backup ADR source.

EXTREME LATITUDE

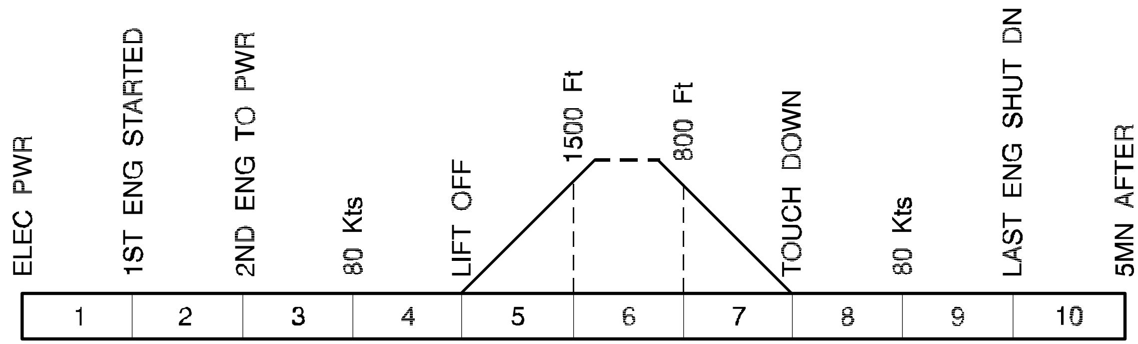
Note the amber "NAV EXTREME LATITUDE" message on the ECAM display. This warning is triggered when the Aircraft enters a polar area. The crew has to select true reference through the NORTH REF push-button switch.

IR ALIGN. FAULT

This warning will appear in case of :

- aircraft motion during an alignement
- no position data entered
- invalid position data.

Note the amber "NAV IR NOT ALIGNED" message on the ECAM display



<table>
<tr><th>E/WD : FAILURE TITLE</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>ALTI DISCREPANCY
difference between

altitude displayed on CAPT and F/O greater than:
- 500lt if baro ref STD is selected
- 250ft if QMH is selected</td><td rowspan="3">SINGLE CHIME</td><td rowspan="3">MASTER CAUTION</td><td rowspan="3">NIL</td><td>CHECK ALT (on PFD)</td><td>4, 8</td></tr>
<tr><td>EXTREME LATITUDE
A/C centers in polar area, the crew must select true reference</td><td rowspan="2">NIL</td><td>3, 4, 5
7, 8</td></tr>
<tr><td>IR ALIGN FAULT
problem selected during IR alignement</td><td>NIL</td></tr>
</table>

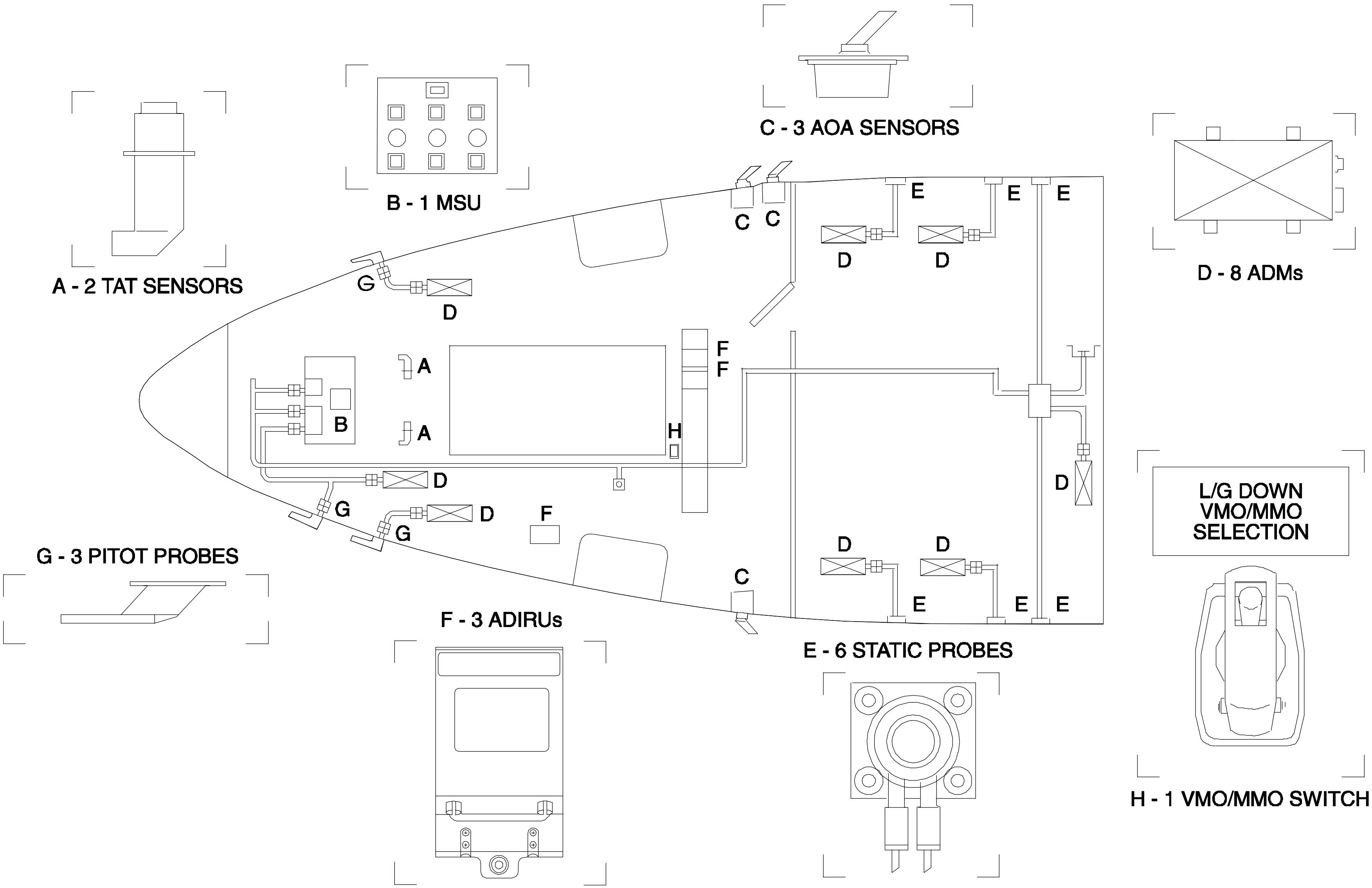
OPERATIONAL LIMITATIONS

Alignement must be performed on ground, aircraft stopped. It can last up to 10 mn.
True Reference must be selected above 82° North or below 60° South.
When aligned, the IRS are released and navigate. Thus, for flight out of VOR/DME areas (Trans-oceanic flights), you should delay the alignement in order to decrease the navigation error before Take Off.

ADIRS COMPONENTS

A - 2 TAT Sensors
B - 1 MSU
C - 3 AOA Sensors
D - 8 ADMs
E - 6 Static Probes
F - 3 ADIRUs
G - 3 Pitot Probes
H - 1 VMO/MMO Switch

STUDENT NOTES



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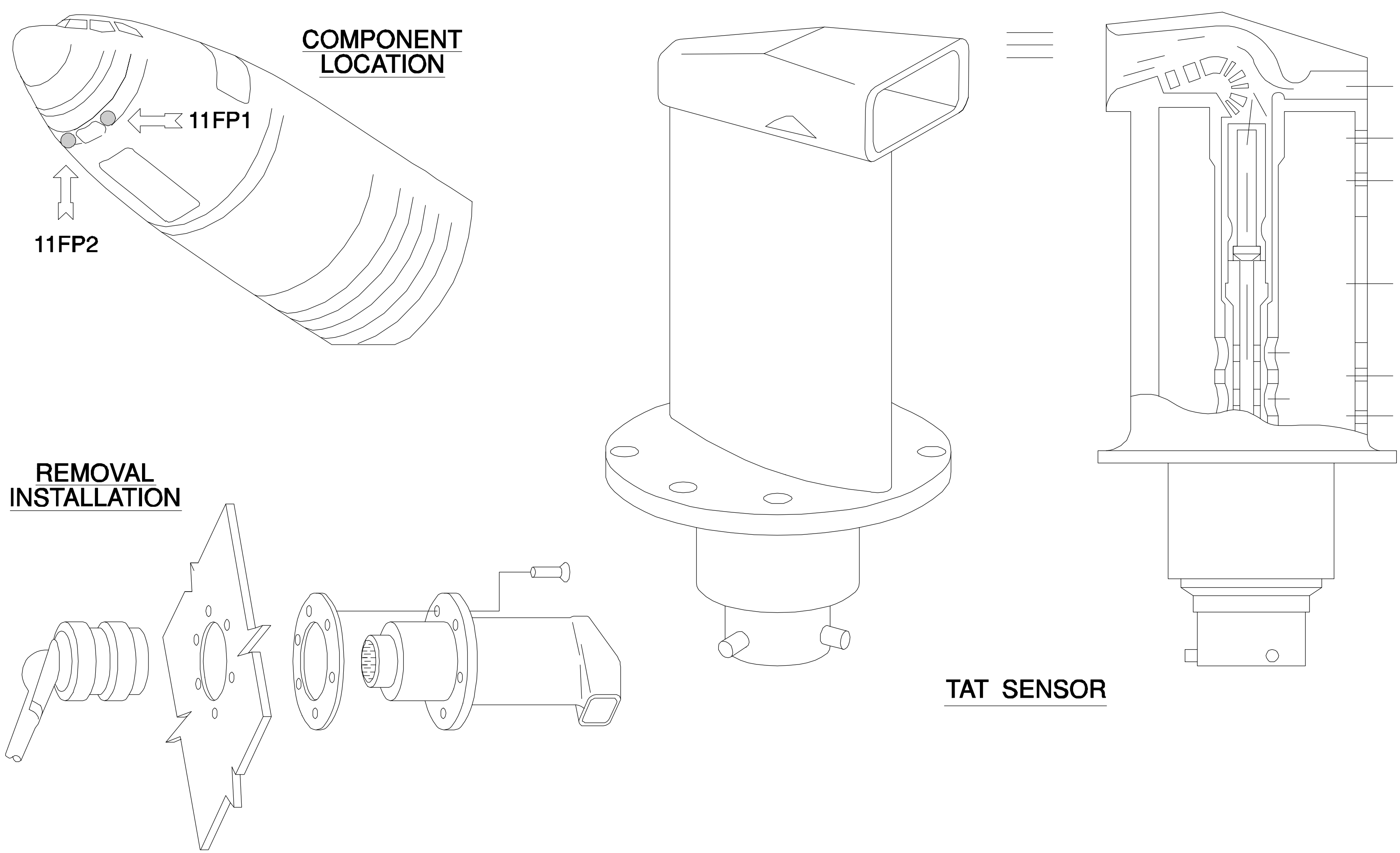
A - 2 TAT SENSORS

FIN : 11FP1, 11FP2

ZONE : 121, 122

COMPONENT DESCRIPTION

The air flow enters the scoop of the sensor, goes through a calibrated choke and flows over the hermetically sealed platinum resistance sensing element where the temperature is measured.
The speed of the flow over the element is controlled by the choke in the element tube.
These sensors are heated with 115VAC through the probe heating system. The heating element must not be energized on the ground.



FQW4200 GE Metric

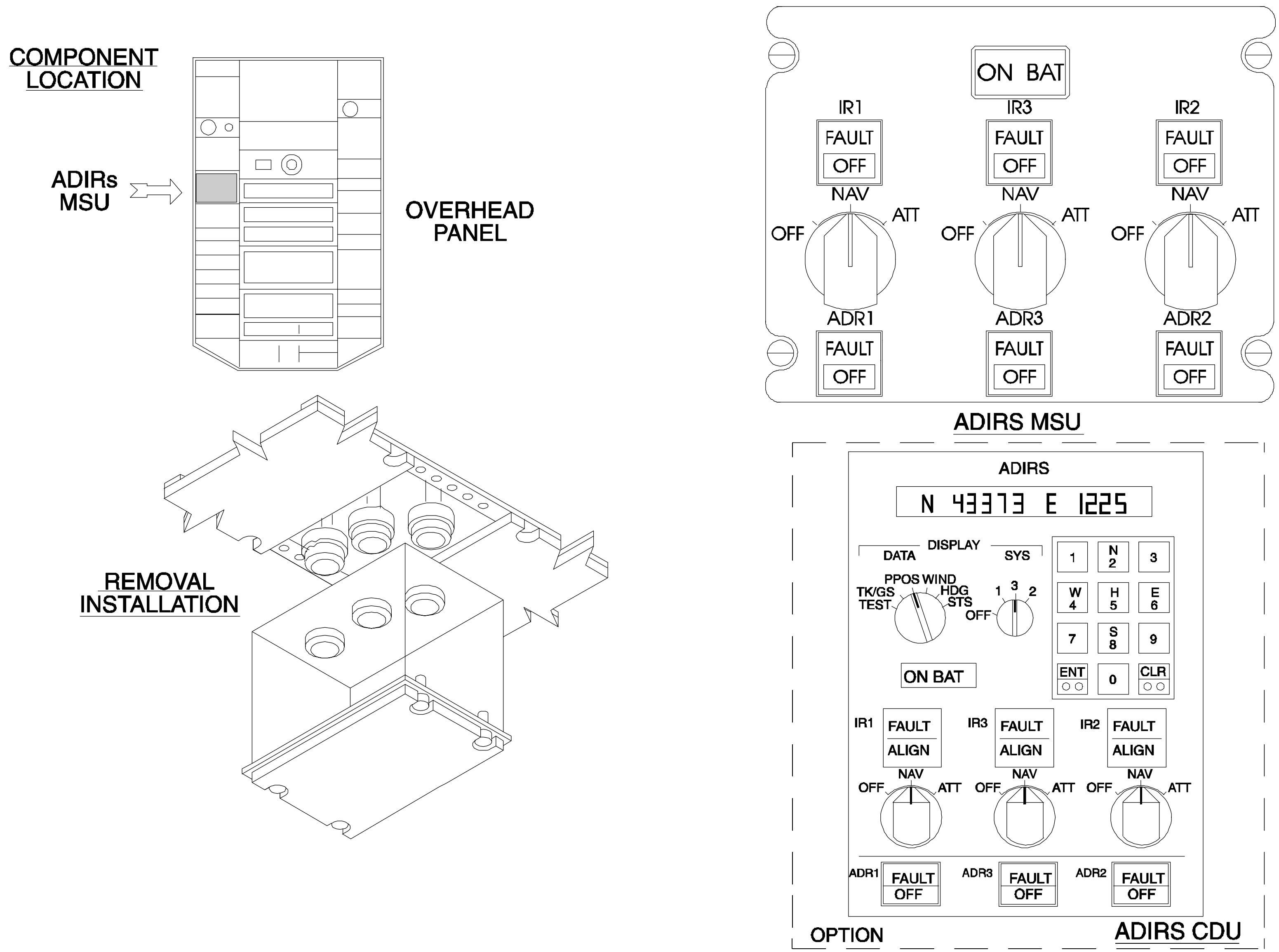
B - 1 MSU

FIN : - - -

ZONE : 211

COMPONENT DESCRIPTION

The ADIRS MSU (or ADIRS CDU if installed) contains three identical connectors.
Each connector is linked to one ADIRU.
The electronic module is supplied with 28VDC and the brightness control voltage is provided from the aircraft 5VAC.



FQW4200 GE Metric

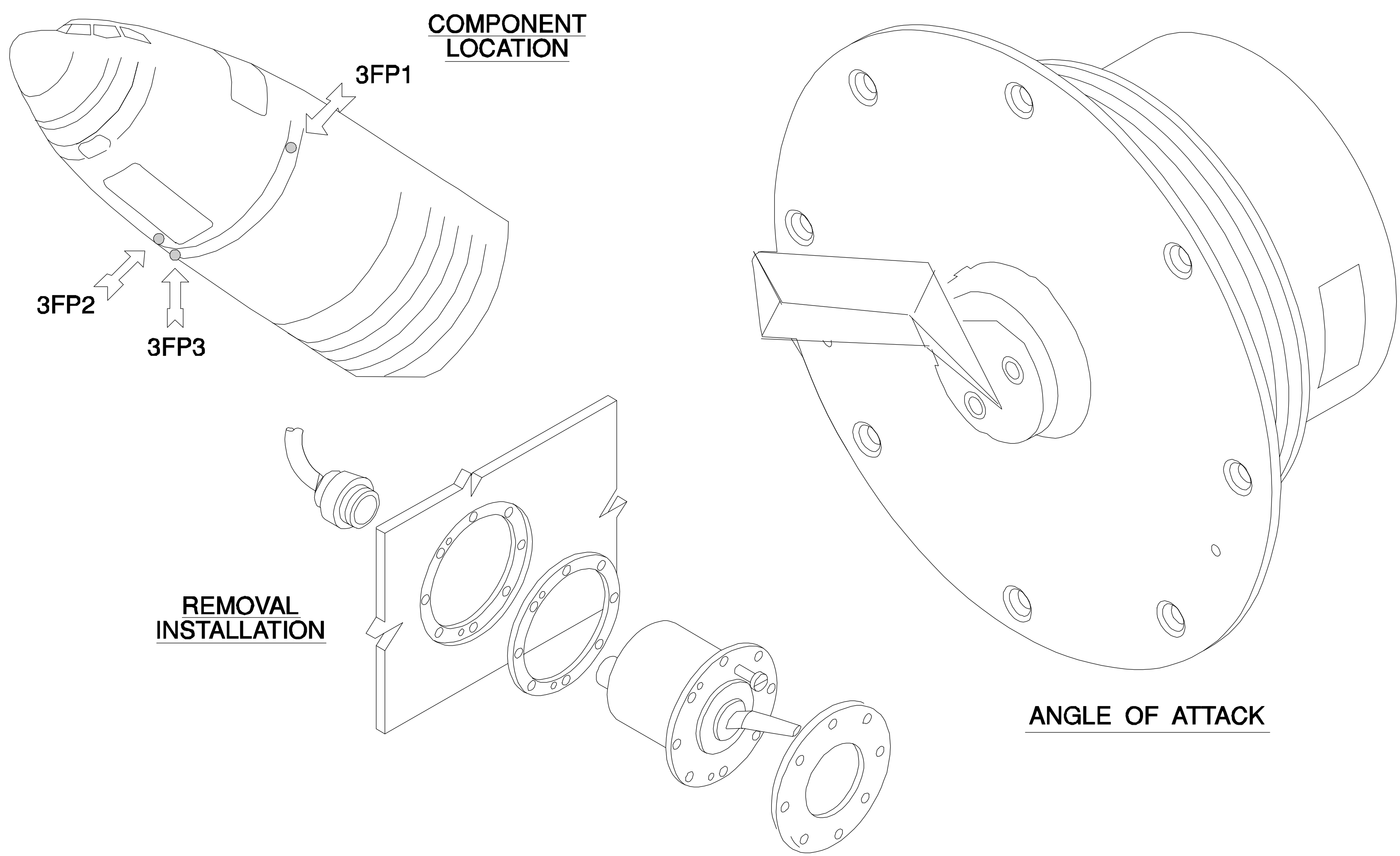
C - 3 AOA SENSORS

FIN : 3FP1, 3FP2, 3FP3

ZONE : 121, 122, 121

COMPONENT DESCRIPTION

The angle of attack (AOA) sensor is of the wind vane type.
The small wing mechanism is stabilized around the rotation axis.
In addition, a damping device enables a satisfactory dynamic response to be obtained (filtering and mechanical oscillation).
A self regulated heating element inserted into the vane eliminates or avoids icing.
It is supplied with 115VAC.



FQW4200 GE Metric

D - 8 ADMS

FIN : 19FP1, 19FP2, 19FP3, 19FP4, 19FP5, 19FP6, 19FP7, 19FP8.

ZONE : 121, 122, 121, 132, 131, 132, 131, 132

COMPONENT DESCRIPTION

The ADM comprises :

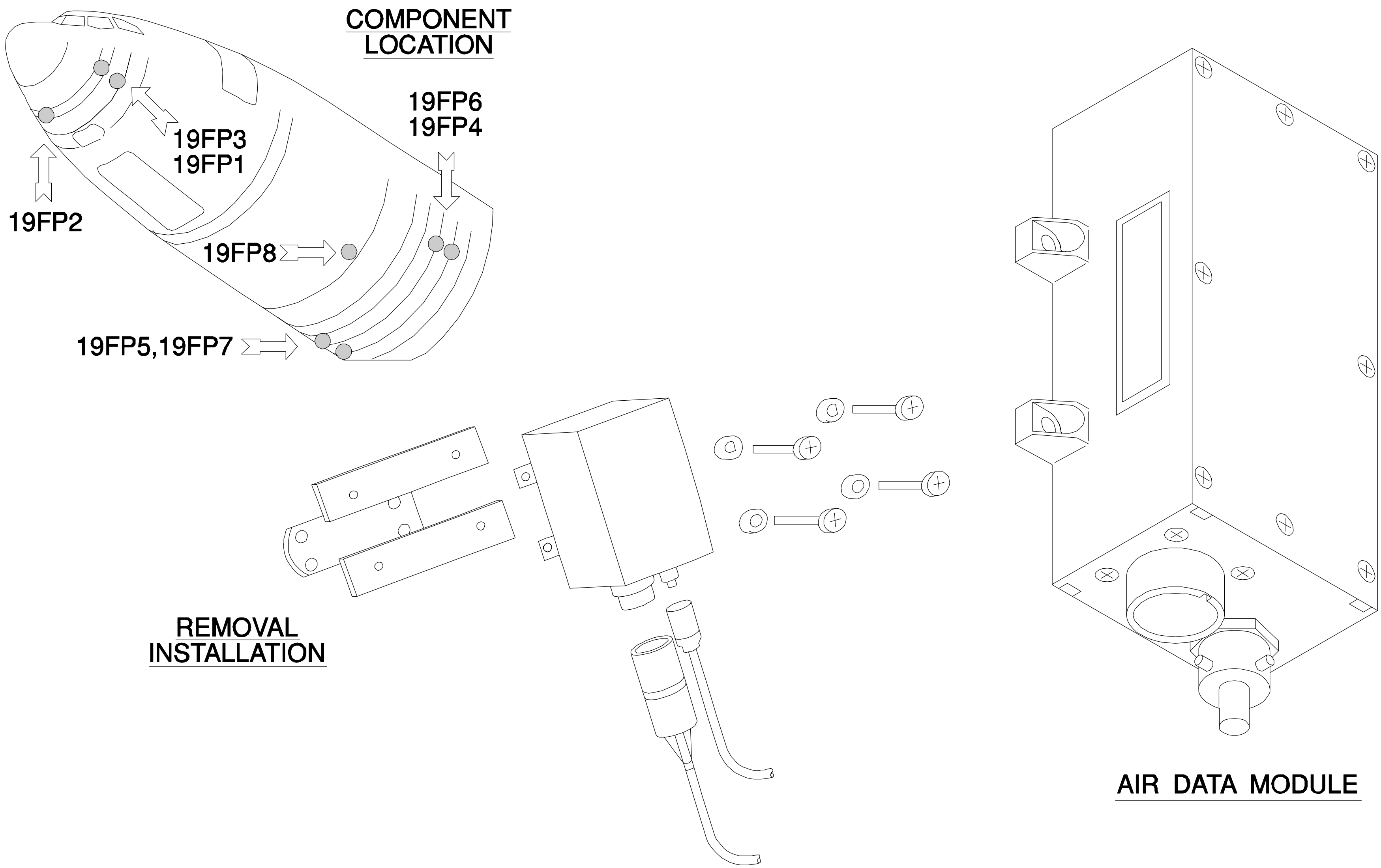
1) one Transducer board providing :

- Pressure Time Pulse (PTP) signal;
- Temperature Time Pulse (TTP) signal.

2) one Processor board using the PTP and TTP signals to compute the pressure.

3) one EMI/Lightning board comprising :

- Power supply (+-13,5VAC) ;
- EMI (Electromagnetic Interference) filter;
- Lightning protection ;
- Input discretes filtering.



FQW4200 GE Metric

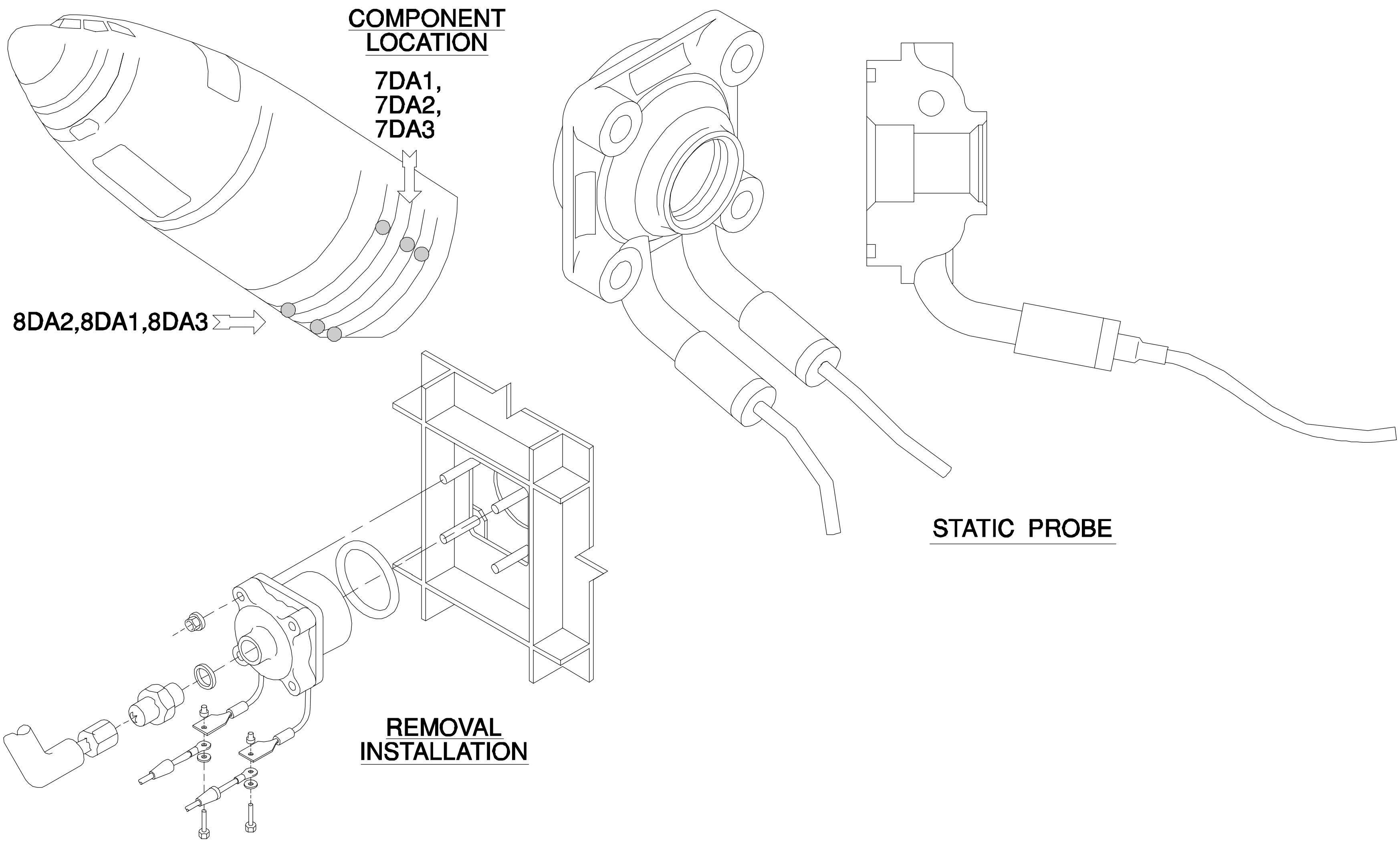
E - 6 STATIC PROBES

FIN : 7DA1, 7DA2, 7DA3, 8DA1, 8DA2, 8DA3

ZONE : 131, 131, 131, 132, 132, 132

COMPONENT DESCRIPTION

Each of the three systems (CAPT,F/O,STBY) comprises two static probes which are linked to each ADR portion of the ADIRUs through five ADMs (the two static STBY probes are linked to only one ADM). The probe is protected from icing with a 28VDC heater circuit.



FQW4200 GE Metric

F - 3 ADIRUS

FIN : 1FP1, 1FP2, 1FP3

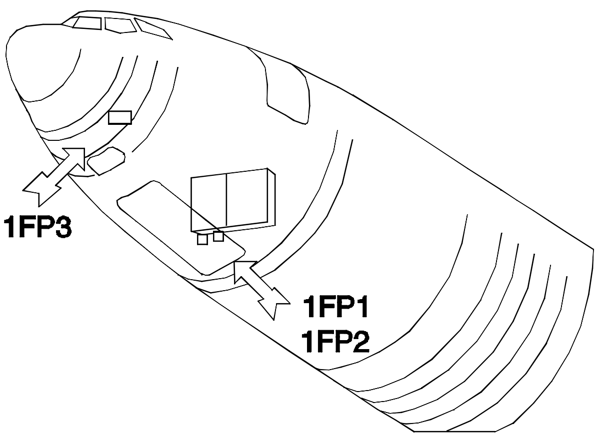
ZONE : 122, 122, 121

COMPONENT DESCRIPTION

The ADIRU has to be aligned on a special shelf in the avionics compartement in the accordance with the installation design described in ARINC 738.

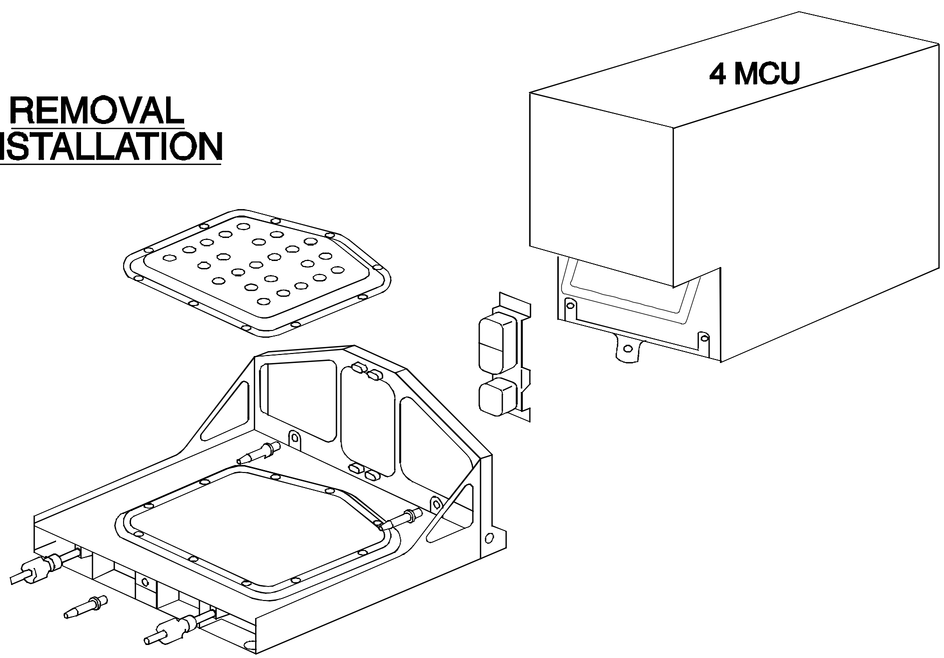
This installation involves modification of the ARINC 600 standard to include 3 alignment pins and a floating connector.

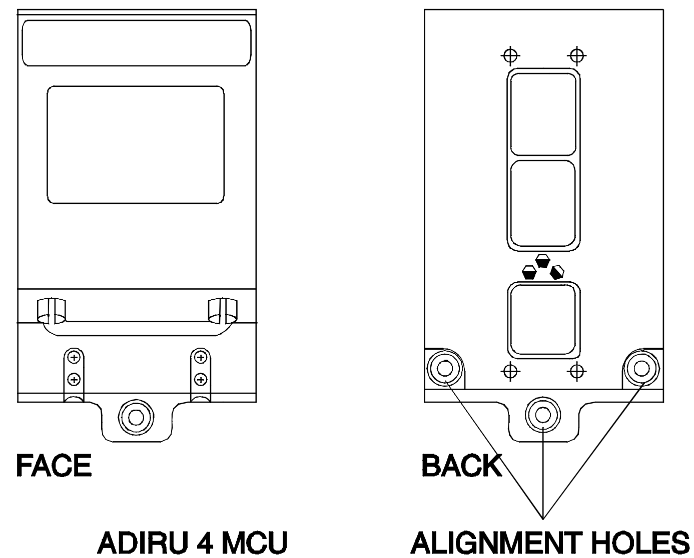
The ADIRU contains an ADR and an IR portion supplied by a common power source (115VAC, 28VDC).



COMPONENT LOCATION

REMOVAL INSTALLATION





ADIRU 4 MCU

FQW4200 GE Metric

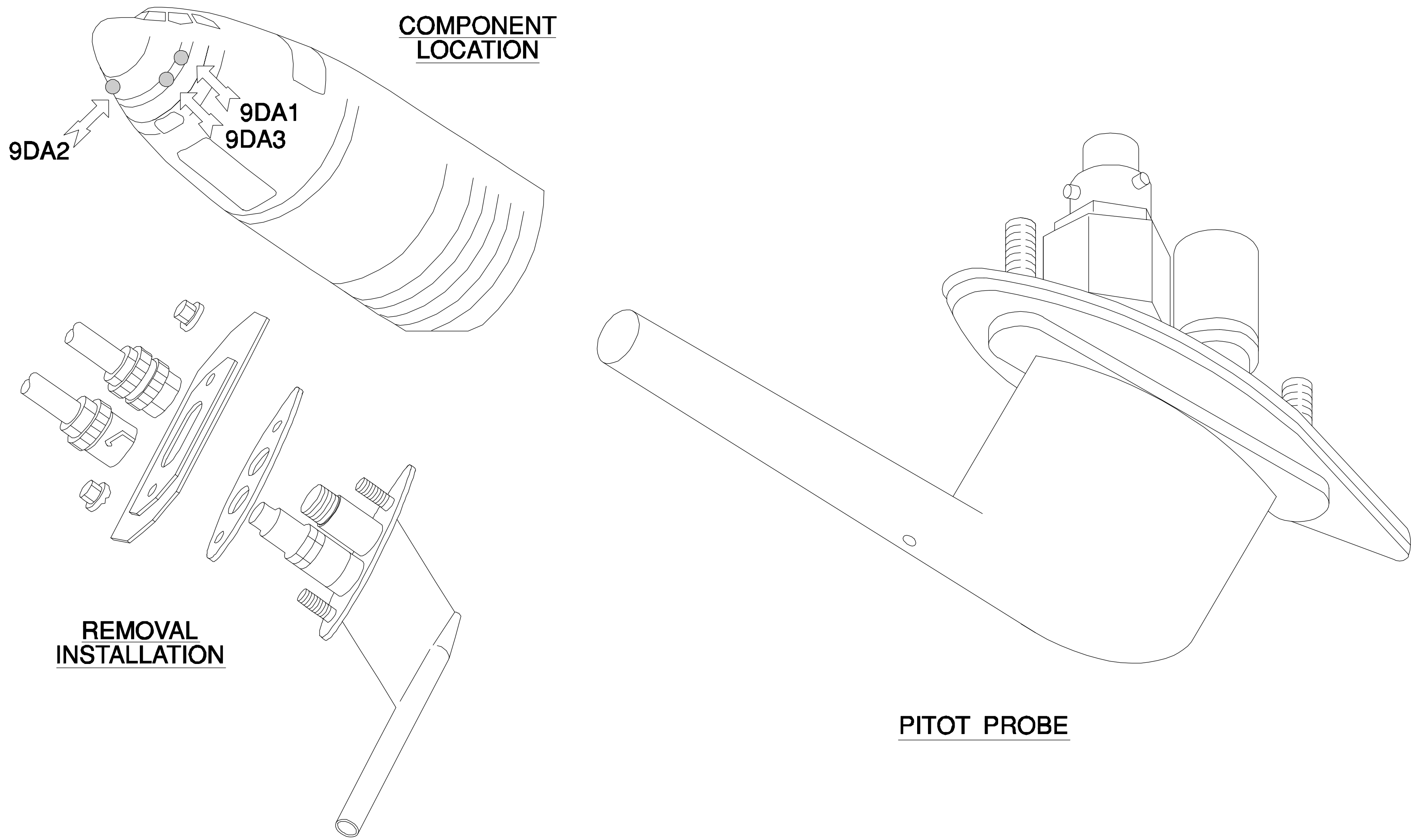
G - 3 PITOT PROBES

FIN : 9DA1, 9DA3, 9DA2

ZONE : 121, 122, 121

COMPONENT DESCRIPTION

Each system comprises one pitot probe (CAPT,F/O,STBY) which is linked to each ADR portion of the ADIRUs through one ADM.
The pitot probe is protected from icing with a 115VAC heater circuit.
The pitot probe comprises a three-pin connector.



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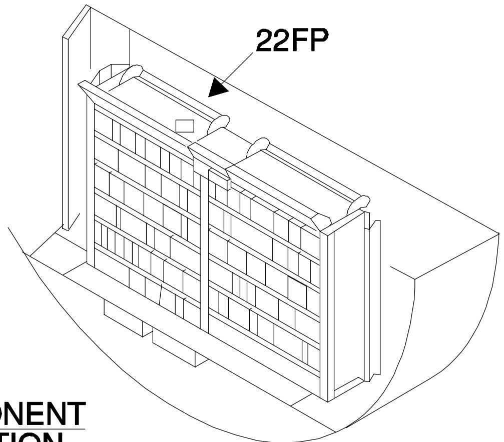
H - 1 VMO/MMO SWITCH

FIN : 22FP

ZONE : 122

COMPONENT DESCRIPTION

This switch is selected for particular flights with the landing gear down, ferry flights for example.
It allows the ADR software to determine the normal or alternate VMO/MMO law.

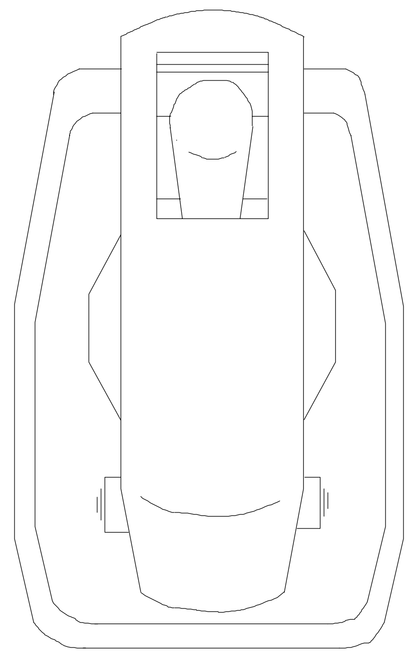


COMPONENT LOCATION

L/G DOWN VMO/MMO SELECTION

VMO :
Maximun Operating Speed

MMO :
Maximun Operating Mach



FQW4200 GE Metric

STUDENT NOTES

GLOBAL POSITIONING SYSTEM PRESENTATION

GENERALITIES

The Global Positioning System (GPS) is a radio aid to world wide navigation which uses signals broadcast by satellites.
The architecture of the system is composed of 3 segments.

INERTIAL SEGMENT

It is composed of a constellation of 24 satellites (21 always available).

CHARACTERISTICS

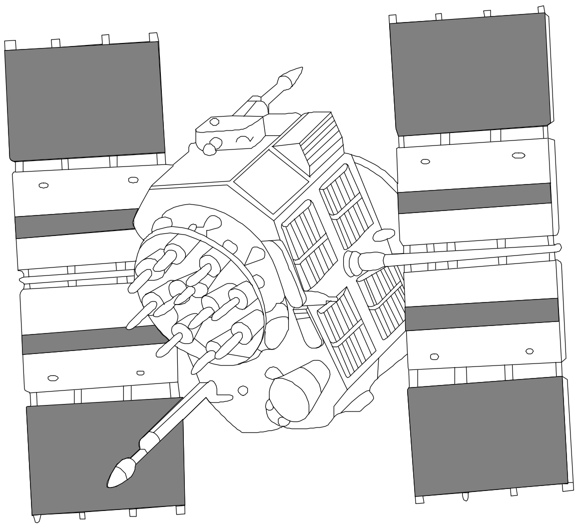
Time of life : 7.5 years
Mass : 815 Kgs
Boarded Power : 700 watts at the end of life.
Operation frequency : 1515.42 Mhz
Operating clock : 2 cesium and 2 rubidium clocks.

The satellites are dispatched on 6 circular orbits of 4 satellites each.

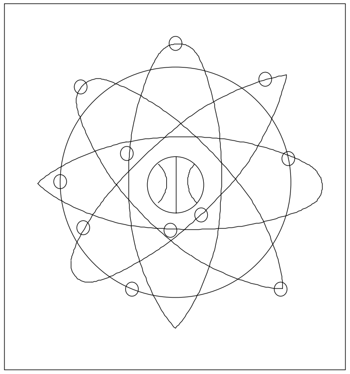
CONSTELLATION DESCRIPTION

- orbit altitude : 20231 Km
- orbit plan pos. : 550 /equa.
- orbit reccurence : 12 sideral hour

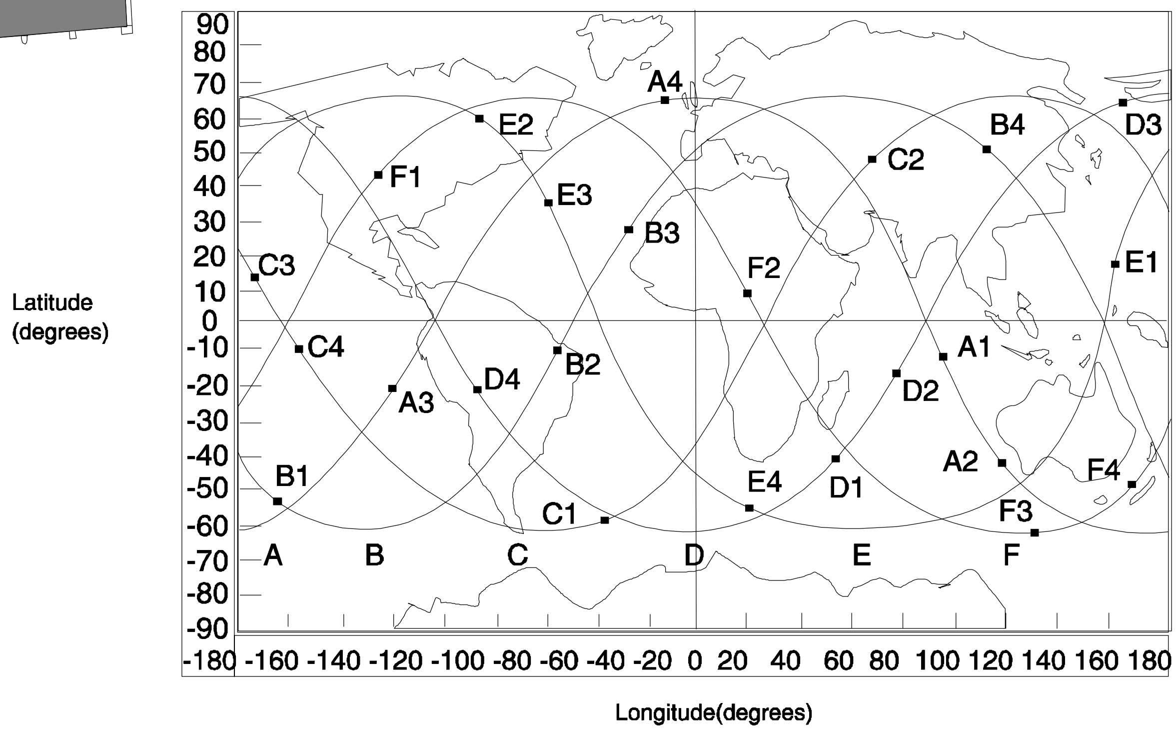
NOTE: 1 sideral day equals 23 hours 56 mn 4s and 1/10.



CIRCULAR ORBITS



ORBIT PLANES



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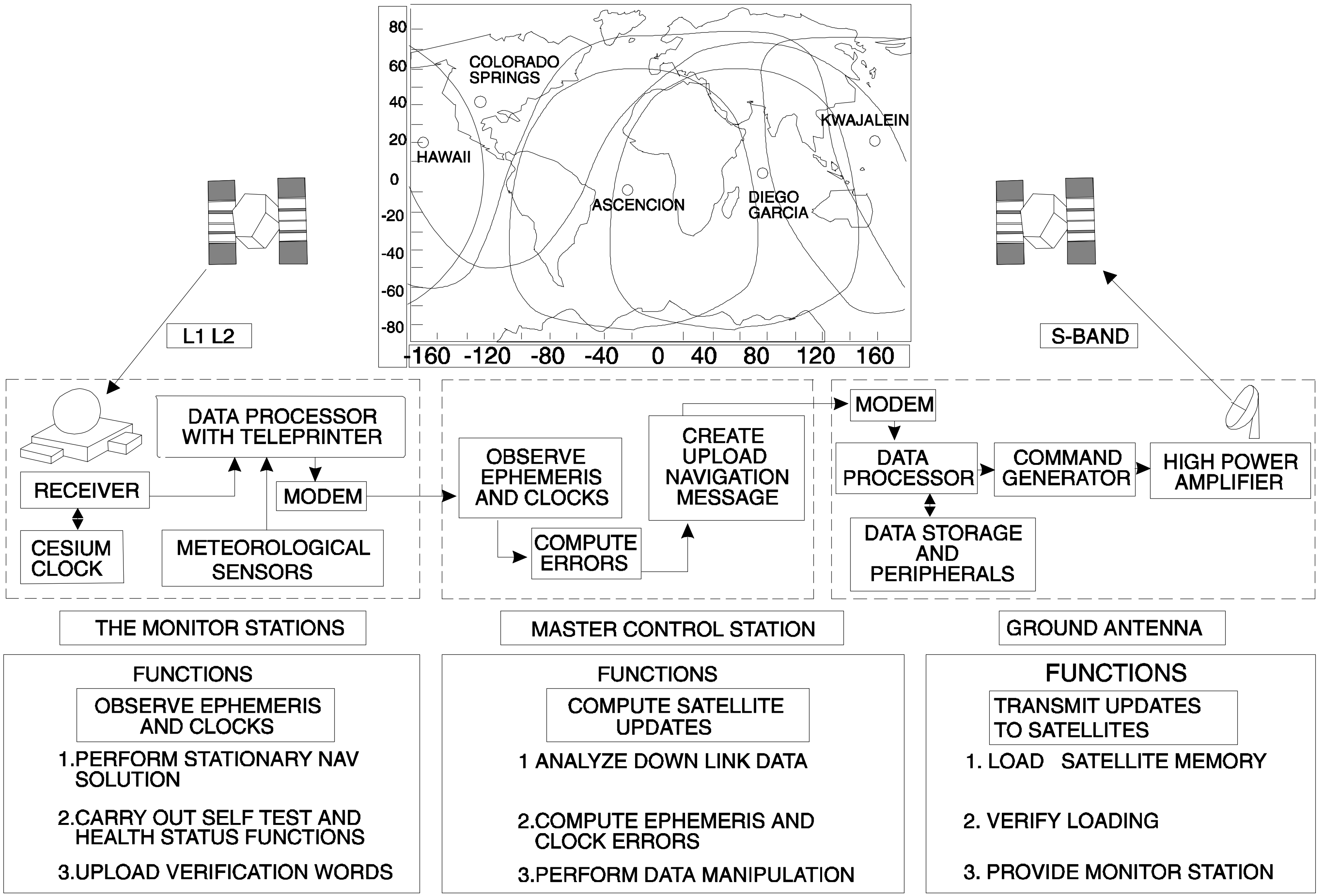
CONTROL SEGMENT

The control segment is composed of 4 monitor stations and 1 master control station which pursue the satellites, compute the ephemerides and clock corrections, and transmit at regular intervals an information message for the GPS users.
The 4 monitor stations are located at:

- KWAJALEIN
- HAWAII
- ASCENCION ISLAND
- DIEGO GARCIA

The master control station is located at:

- COLORADO SPRINGS.

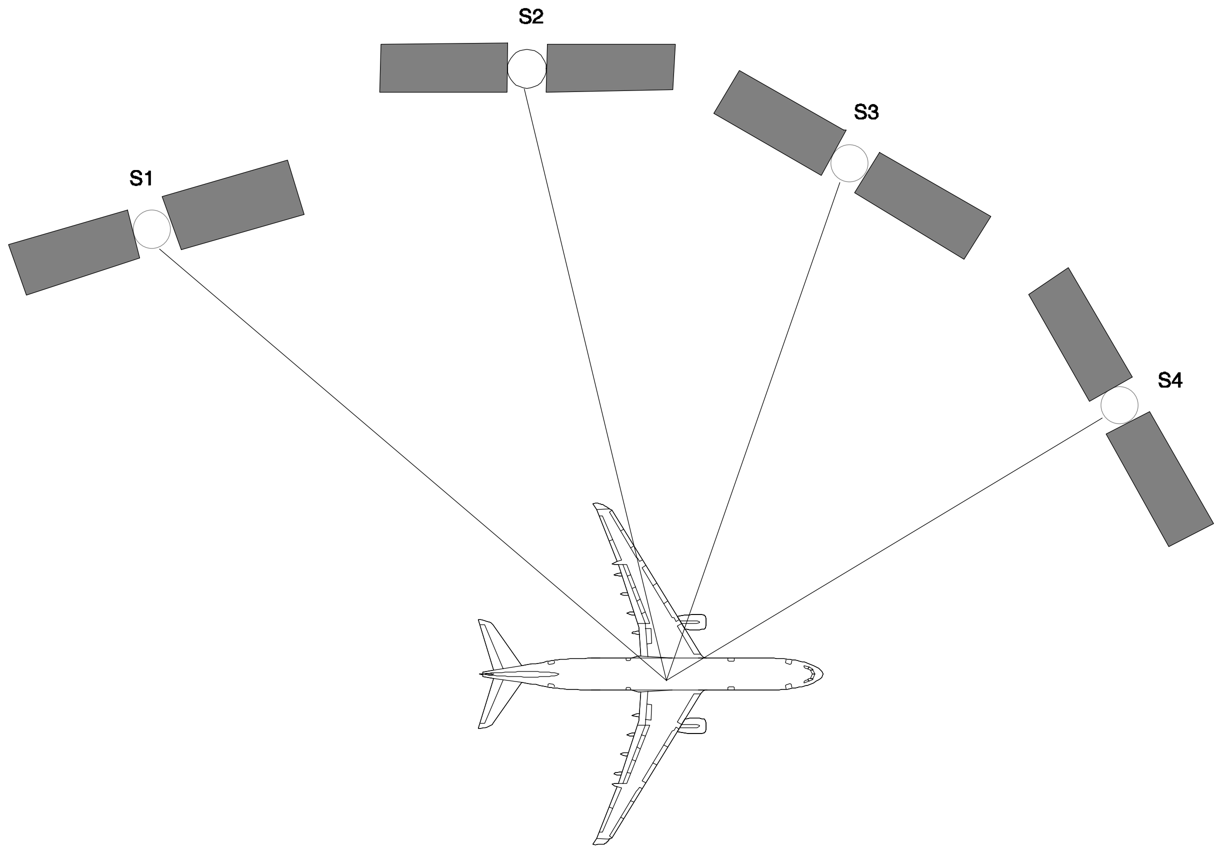


FQW4200 GE Metric

USER SEGMENT

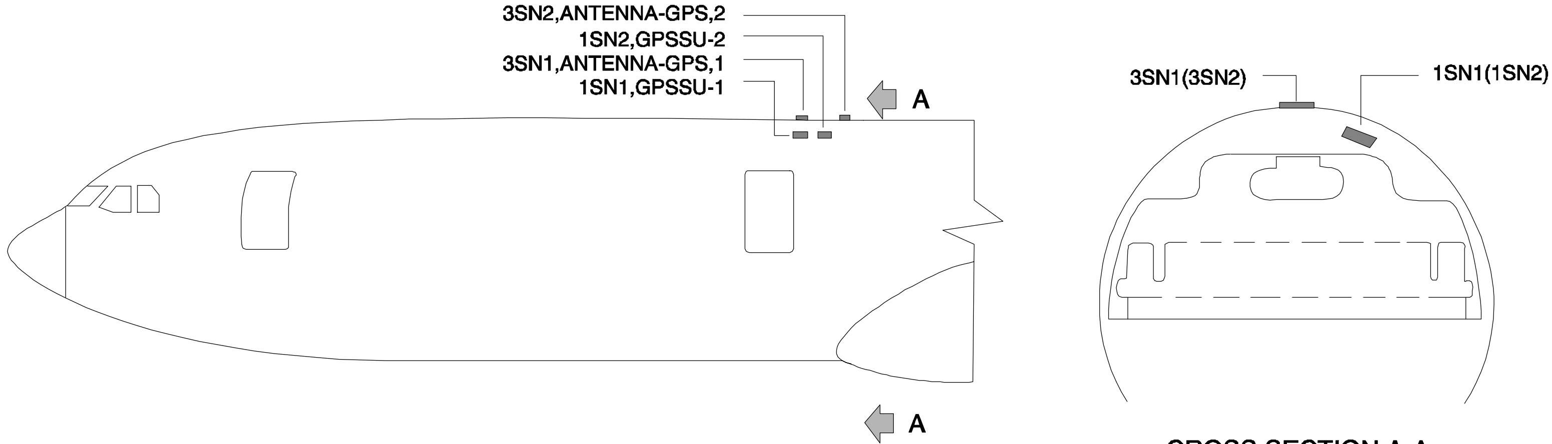
The principle of GPS position computation is based on the measurement of transmission time of the GPS signals broadcast by 4 satellites.
For a boat, only 3 satellites would be enough to obtain its position, while, for a user on the move, a fourth satellite is necessary to synchronize the aircraft and satellite clocks.
The user equipment is generally defined by 3 principal functions which are :

- UHF Reception : antenna, amplification and filtering.
- Signal processing : pseudo distance obtaining.
- Navigation computation : constellation choice, propagation corrections, positioning and navigation data computation.


S1
S2
S3
S4

COMPONENTS

The GPS components are located in the aircraft at the top of the fuselage.
In normal operation the GPS Sensor Unit (GPSSU)1 data is used by ADIRU 1 and 3.
The GPSSU 2 data is used by ADIRU 2.



CROSS SECTION A-A

FQW4200 GE Metric

GPS AIRCRAFT ARCHITECTURE

It is possible to find two different GPS aircraft architectures, depending on whether the GPS is used as a supplemental or primary means of navigation.

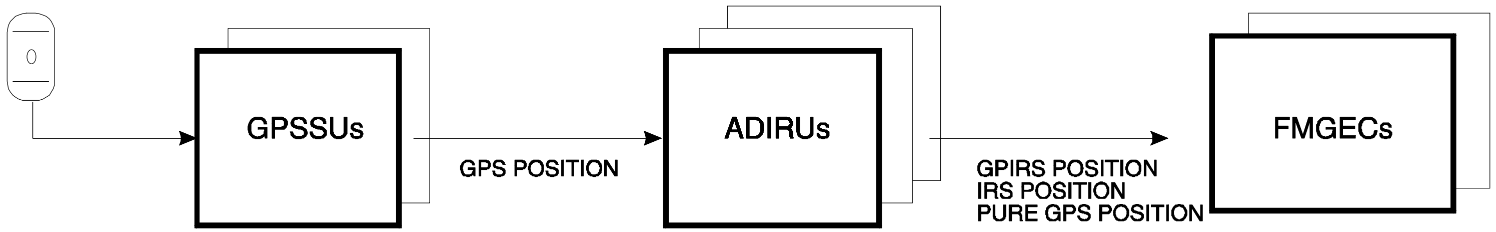
HYBRID :

The GPSSU sends the GPS position to the associated ADIRU which mixes it with the IR position. This hybrid GPIRS position is sent by the ADIRU to the Flight Management System (FMS).

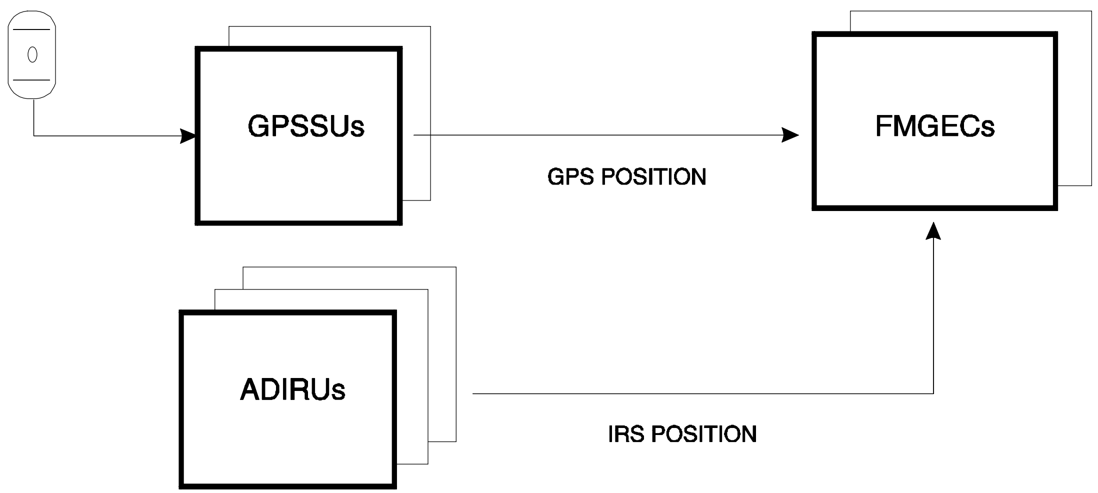
AUTONOMOUS:

The GPSSU directly sends the GPS position to the FMS which directly receives the IR position from the ADIRU. The GPIRS position is computed by the FMS.

HYBRID :



AUTONOMOUS :



FQW4200 GE Metric

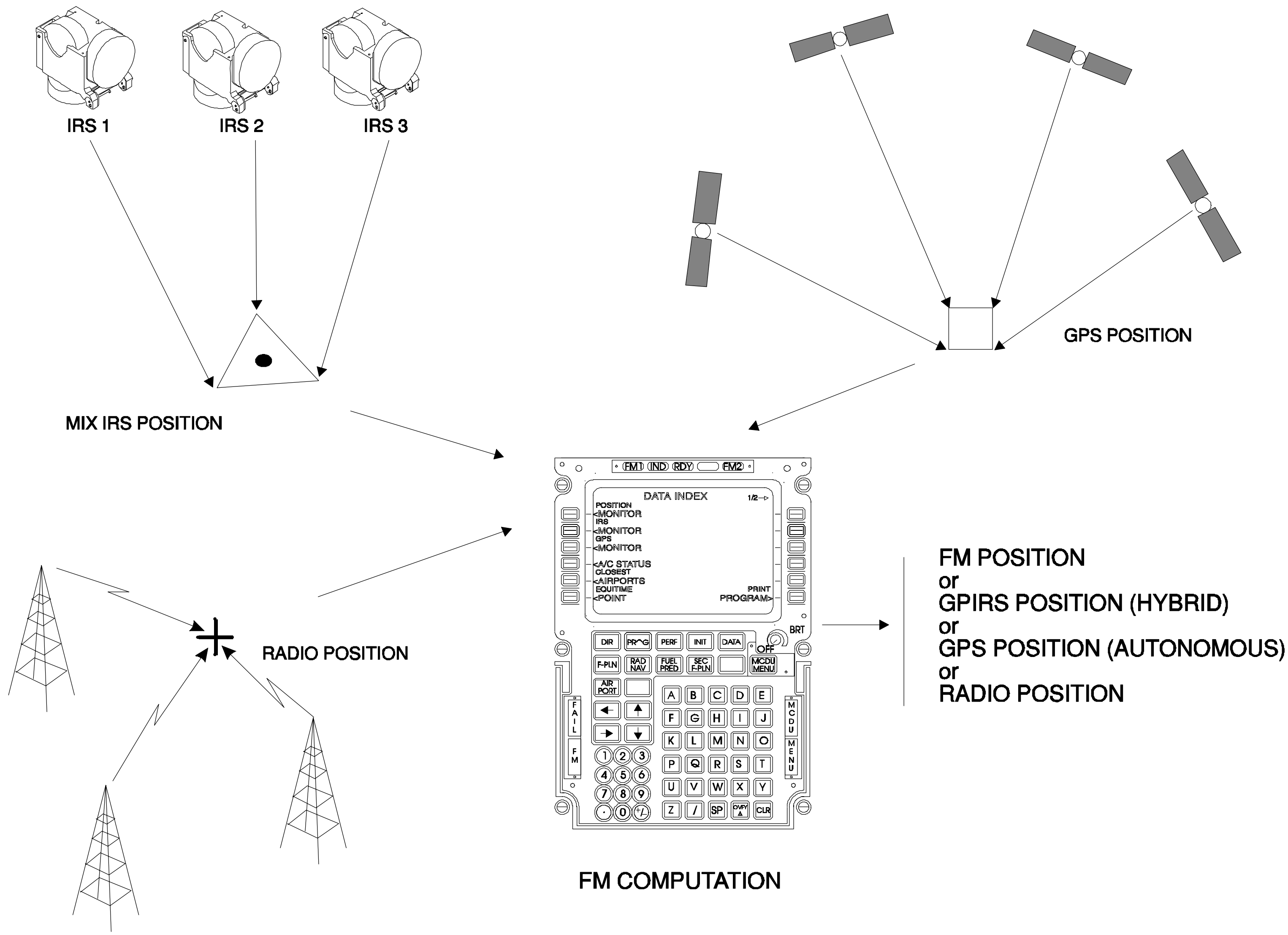
PRINCIPLE

SUPPLEMENTAL MEANS OF NAVIGATON

The GPS position shall be used in conjunction with the IRS position.

The current navigation modes in priority order are :

- IRS / GPS (GPIRS)
- IRS / DME / DME
- IRS / VOR / DME
- IRS ONLY



FQW4200 GE Metric

PRIMARY MEANS OF NAVIGATION

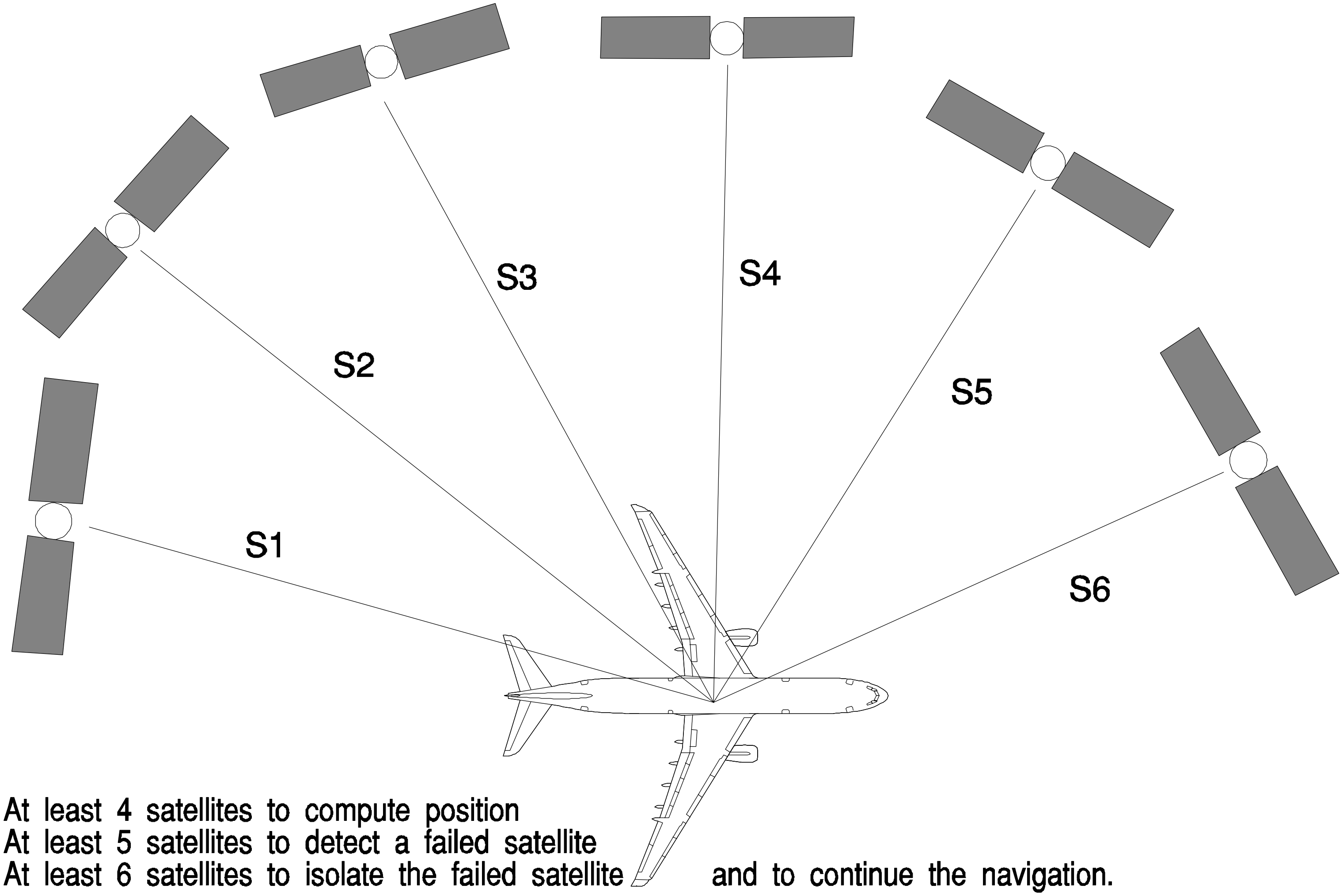
As long as the GPS is considered to be the primary means of navigation, the GPS/FMS position can be used as the position reference without navigation accuracy check.
For that purpose the GPS PRIMARY shall meet certain requirements:

- Navigation accuracy:
- provided data integrity;
- System availability;
- Service continuity;
- Display and annunciation capability (status, navigation accuracy and warning).

To match these requirements, solutions have been developed.

RAIM (Receiver Autonomous Integrity Monitoring):

The purpose of the RAIM function is to provide an instantaneous integrity estimation of the computed GPIRS / GPS position. For that purpose, the GPSSU uses all satellites that are tracked except those currently declared as failed.



At least 4 satellites to compute position
At least 5 satellites to detect a failed satellite
At least 6 satellites to isolate the failed satellite and to continue the navigation.

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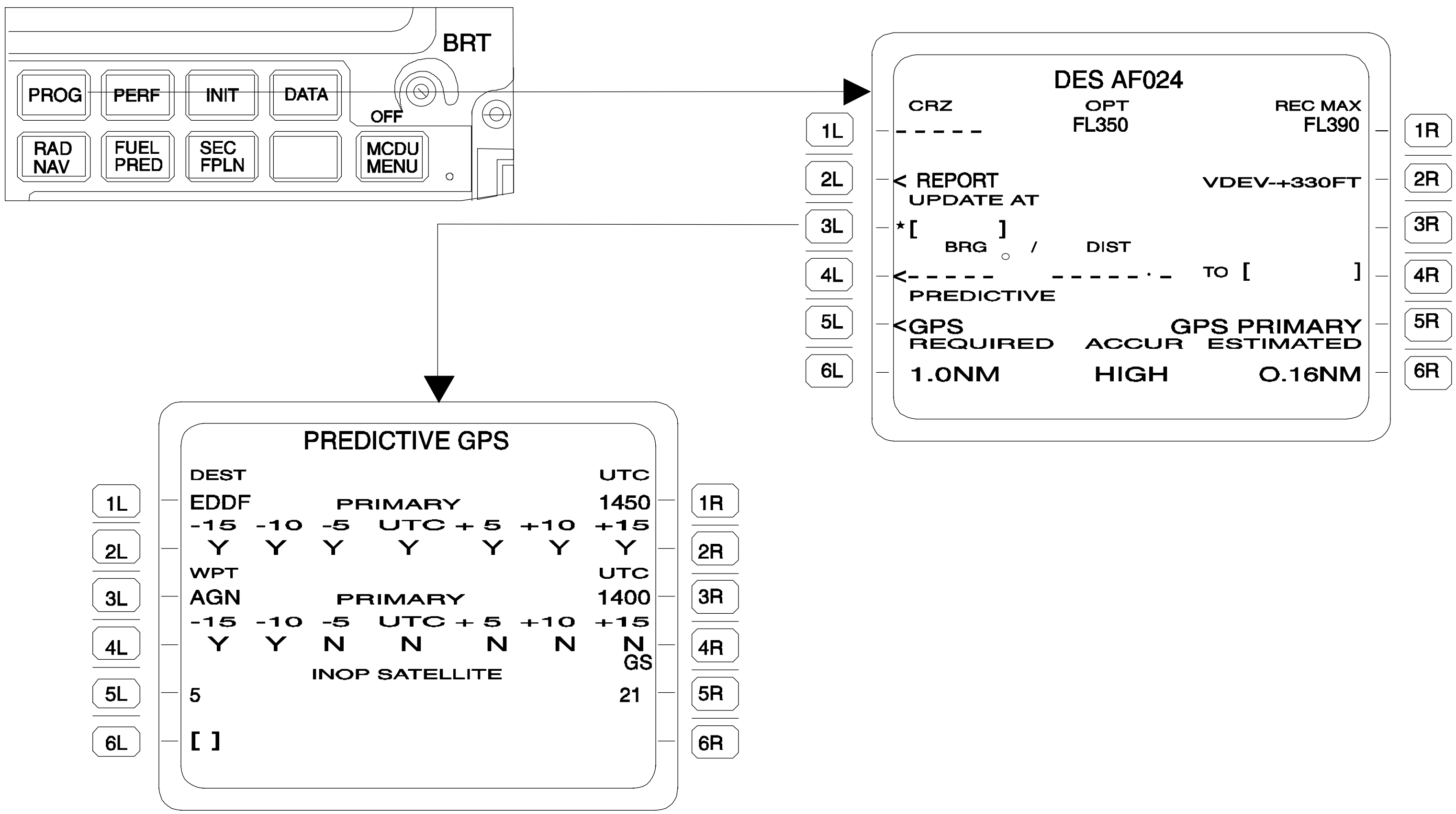
PRAIM (PRedictive Autonomous Integrity Monitoring):

The PRAIM is used to predict the GPS constellation integrity, at a certain time and position, requested by the user through the PREDICTIVE GPS MCDU page. The GPS almanac database is used to predict which satellites will be visible at the requested time and position. It is possible to manually deselect up to 4 satellites through the PREDICTIVE GPS MCDU page.



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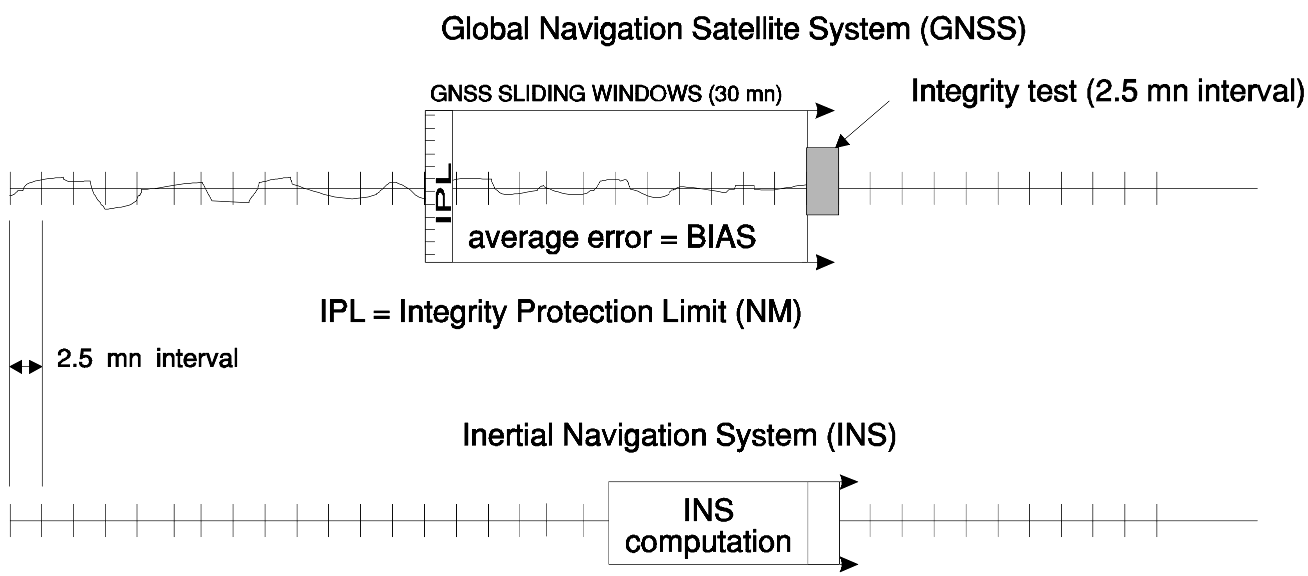
AIME (Autonomous Integrity Monitoring Extrapolation):

The AIME function uses the history of GPS measurements over the last 30 minutes to ensure GPIRS integrity (it estimates satellite errors that occurred during the last 30 mn). AIME updates GPIRS position every 2.5 mn when the integrity is verified.



GNSS integrity established = updating of the INS and advancing of sliding windows

GNSS integrity not established = using of BIAS to maintain accuracy and integrity of the basic INS computation.

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INDICATION

There are two categories of GPS information : those permanently needed and those occasionaly used.

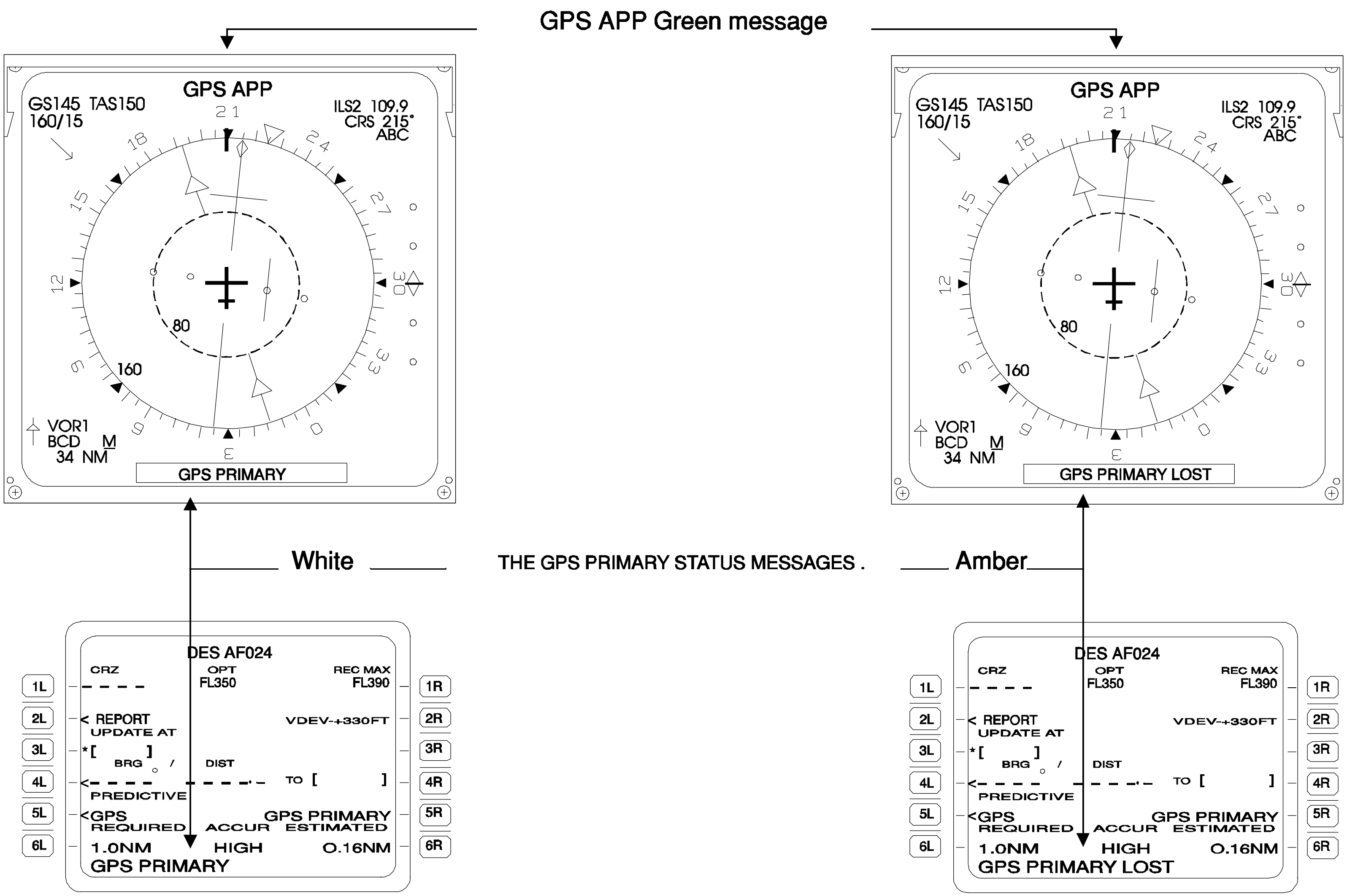
PERMANENTLY NEEDED GPS INFORMATION

This information is only displayed if the GPS is fitted with primary means of navigation capability.

GPS PRIMARY white message.
This message is displayed in all modes (except engine standby mode) when the GPS becomes primary. This message can be cleared from the MCDU.

GPS PRIMARY LOST amber message.
This message is displayed in all modes (except engine standby mode) when the GPS primary availability is lost. However, in function of the required accuracy and integrity required for the intended operation, the GPS can be used as an alternate navigation means. The message displayed on the MCDU can be cleared from the MCDU while the one displayed on ND stays in view.
An aural alert is generated in case of a non-precision approach.

GPS APP green message.
This message is displayed in all modes (except engine standby mode) when a GPS approach is selected in the flight plan.



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OCCASIONALY NEEDED GPS INFORMATION

PREDICTIVE RAIM (Optional)

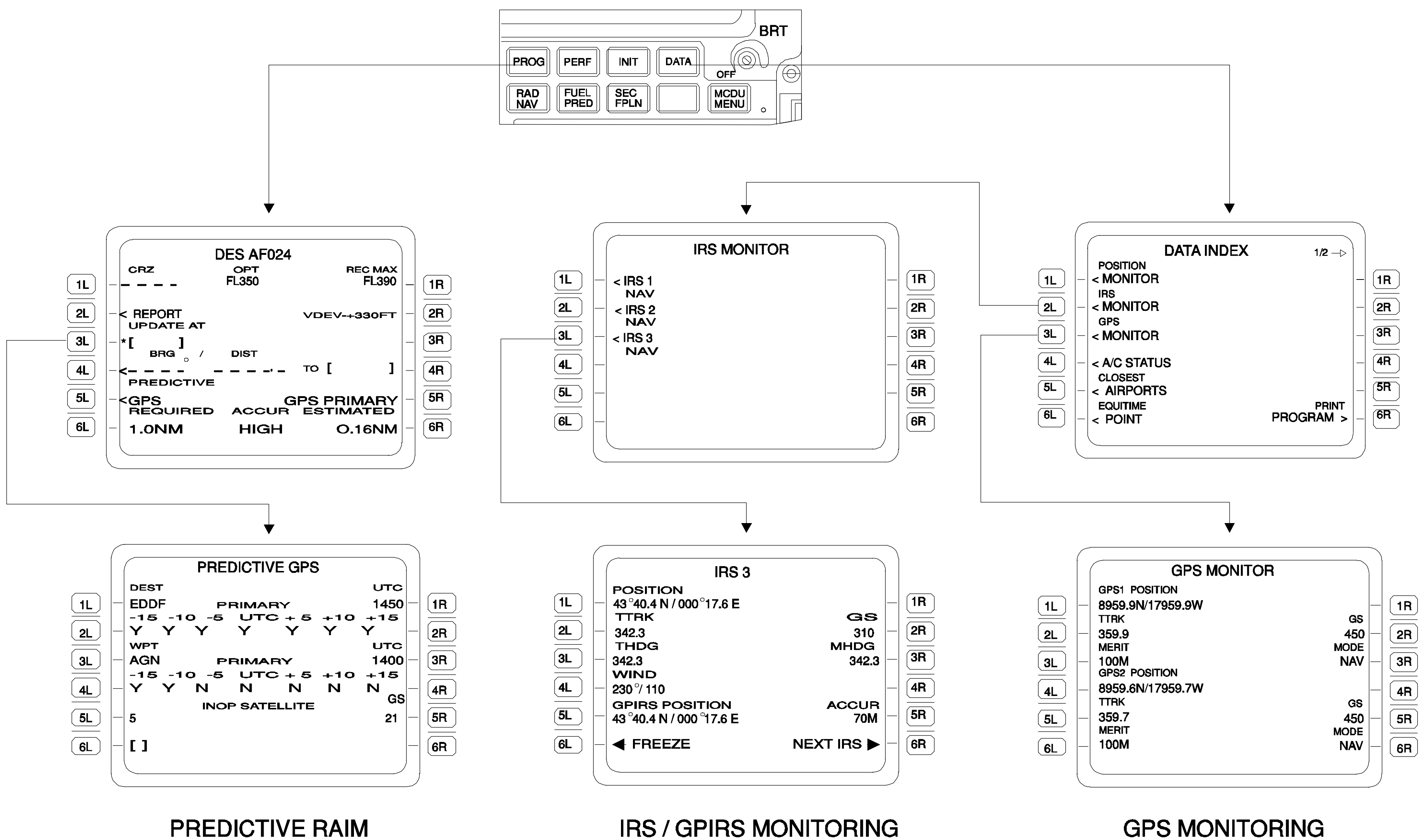
Enables prediction of the RAIM computation availability at destination, from - 15 to +15 mn around the pilot modifiable ETA (Estimated Time of Arrival) and location.

GPS MONITOR PAGE

The displayed data are:
- GPS position (lat/long)
- True Track
- Figure of merit (meter)
- Ground Speed
- Mode.

IRS/GPIRS MONITORING

Provides the raw data of the selected IRS, the hybrid GPIRS position and estimated accuracy.



FQW4200 GE Metric

STUDENT NOTES

GPS D/O

- GPS Sensor Unit
- ADIRU
  - FMGEC
  - ATT/HDG Switching
  - DMC/FWC
  - Indicating
- Antennae
- CMC
- LGCIU

GPSSU

The Global Positioning System Sensor Unit (GPSSU) is a stand-alone satellite navigation sensor utilizing the course acquisition code of the MAUSTAR GPS satellites.
The GPSSU primary function is to track the R.F. signal received from the antenna, determine the signal code phase and carrier phase, compute the antenna position and output the navigation data to the three ADIRUs.
The GPSSU has twelve channels, each capable of tracking NAVSTAR GPS satellite signals.

ADIRU

In normal operation, the GPSSU 1 data is used by ADIRU 1 and 3; the GPSSU 2 data by ADIRU 2.
In order to reduce GPSSU initialization time, ADIRU1 and 2 respectively send data to GPSSU1 and 2 (IR position, Altitude, Date, UTC).

FMGEC

The Inertial Reference portions of ADIRU 1 and 2 respectively provide Flight Management Guidance and Envelope Computer (FMGEC) 1 and 2 with pure inertial reference data, hybrid GP inertial reference data used by the FMGEC for position fixing purposes and pure GPS data which is displayed on MCDU; in this case the ADIRU operates as a relay.
In case of failure of one GPS : the two ADIRUs automatically select the only operative GPS to compute hybrid GPIR data.

ATT/HDG Switching

In case of failure of ADIRU 1, FMGEC 1 uses ADIRU 3 / GPS 1 data and in case of failure ADIRU 2 , FMGEC 2 uses ADIRU 3 / GPS 2 data.
The primary source of ADIRU 3 being GPS 1, it is necessary to select the secondary input part of ADIRU 3 (GPS2) by means of the SWITCHING ATT/HDG selector switch to preserve side 1 /side 2 segregation (GPS1/ADIRU1/FMGEC1 and GPS2/ADIRU3/FMGEC2 architecture).

DMC/FWC

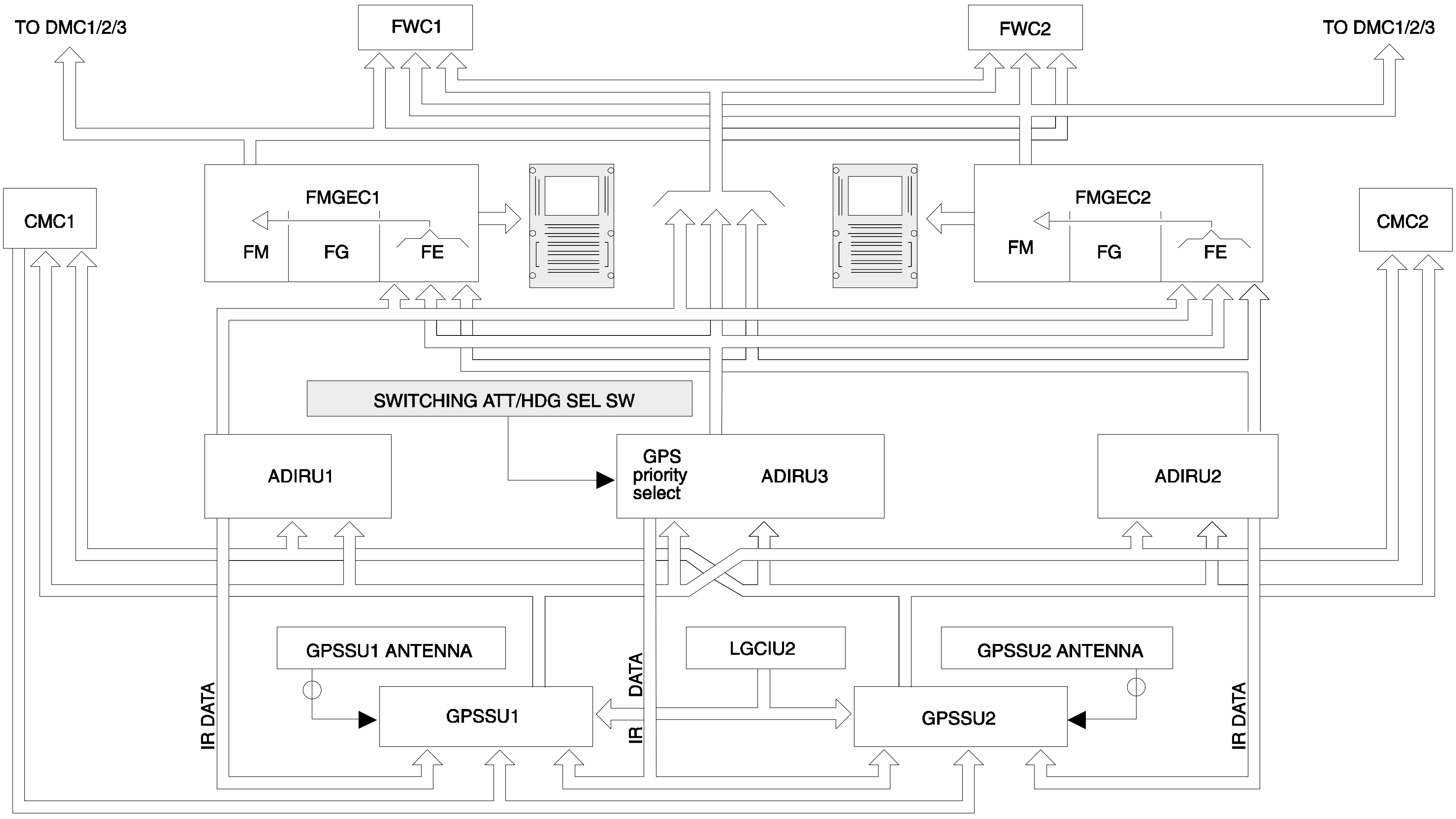
The GPSSUs are monitored by the three ADIRUs using the status word send by each GPSSU and the BITE. of the inertial reference portion.
In case of GPS failure, the NAVGPS 1(2) FAULT message is displayed on the lower part of the Engine/Warning Display (EWD).
This message is accompanied by :

- activation of the MASTER CAUTION lights on the glareshield,
- aural warning : Single Chime (SC).

Indicating

The GPS data is displayed on the GPS Monitor Page of the MCDU through the FMGEC.
The displayed data are :

- GPS position (Lat/Long)
- true track
- figure of merit (in meters)
- ground speed
- mode.



FQW4200 GE Metric

ANTENNAE

The GPS antenna is a L-band non preamplified antenna.
The GPS antenna is designed to operate at 1575.42 Mhz with a right hand circular polarization and to provide an omnidirectional upper hemispheric coverage.

CMC

The BITE. of the GPSSU is connected to the Central Maintenance Computer (CMC).
The units tested are the GPSSU, GPS antenna and coaxial cable.

LGCIU

Landing Gear Control Interface Unit (LGCIU)
This ground/flight information is used by the receiver BITE module to count the flight legs.

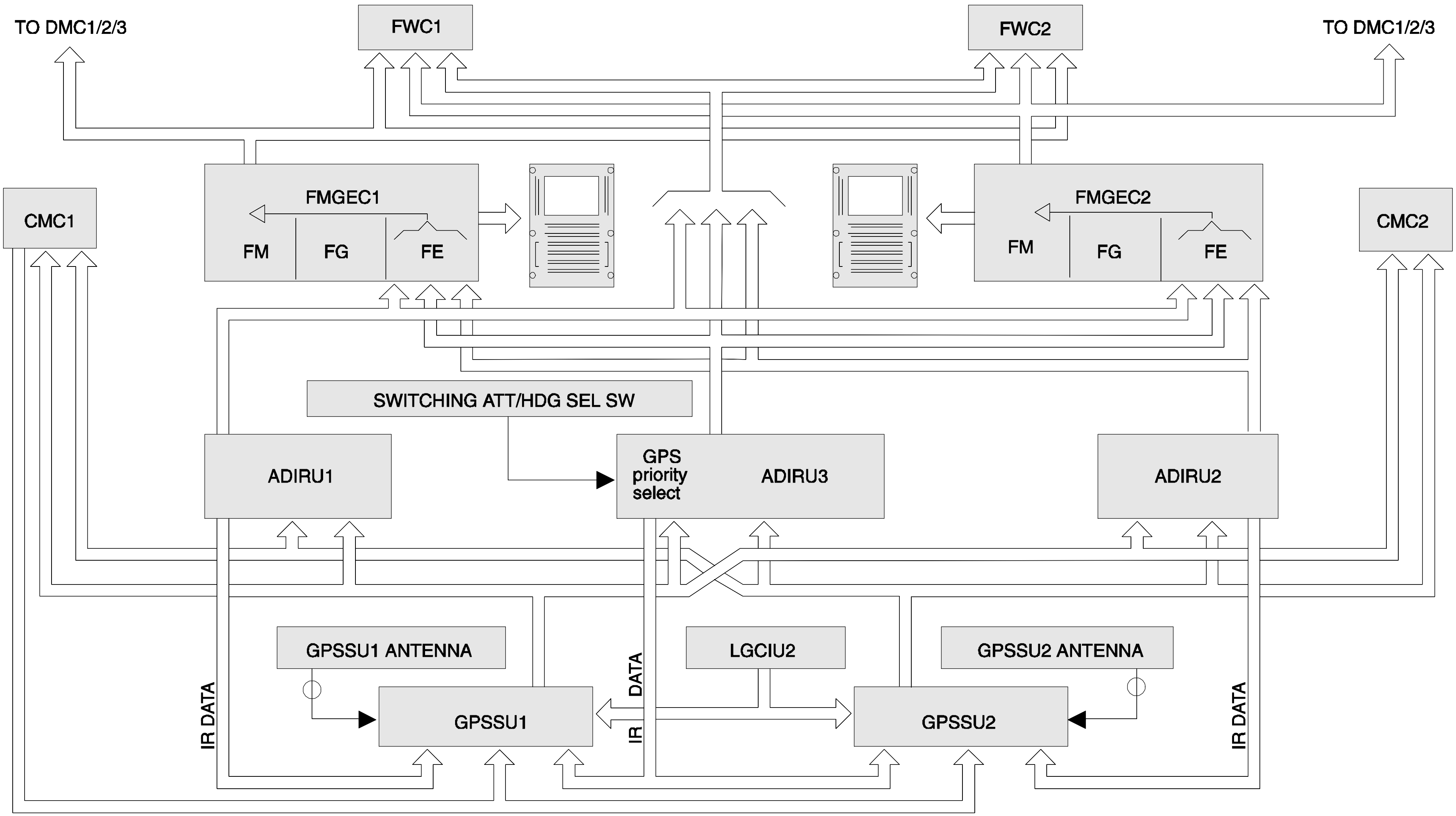
STUDENT NOTES:

STUDENT NOTES

GPS COMPONENTS

GPS Sensor Units 1/2
GPS Antennae 1/2

STUDENT NOTES



FQW4200 GE Metric

GPSSU 1/2

FIN/ZONE:

FIN : GPSSU1 - 1SN1
GPSSU2 - 1SN2

ZONE: GPSSU1 - 252
GPSSU2 - 252

COMPONENT DESCRIPTION

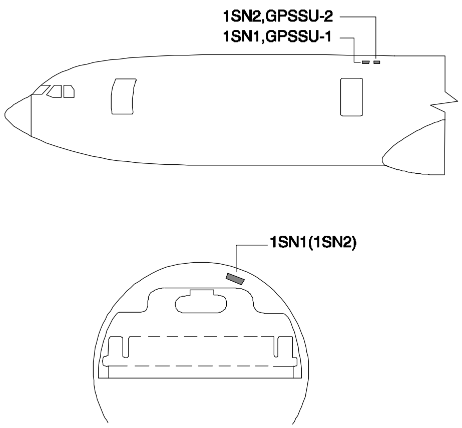
The face of the GPSSU is fitted with two connectors:

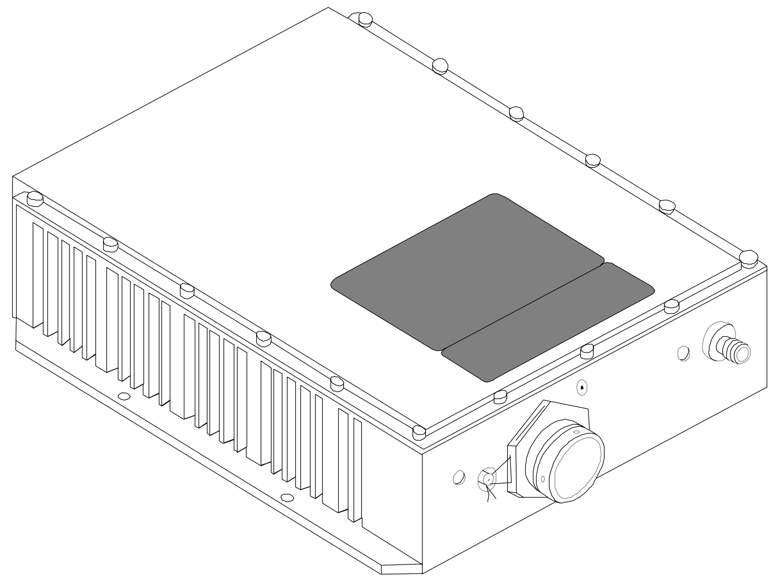
- a 41 pin circular connector for connection with the peripherical circuits and the power supply circuit,
- a Thread Nut Coupling (TNC) connector for connection with the antenna.

IN SITU TEST

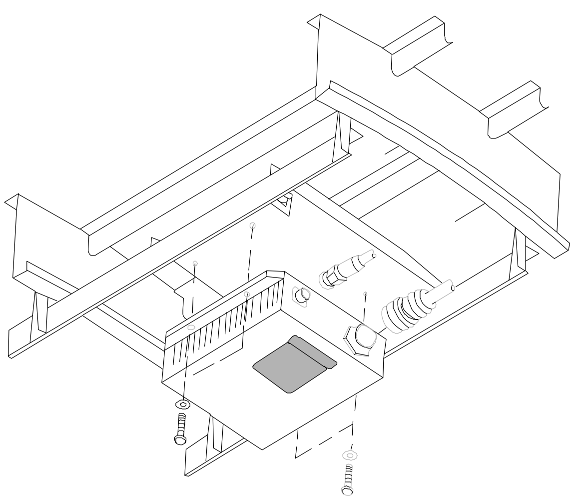
No in situ test is available for the GPSSU.

COMPONENT LOCATION





REMOVAL /INSTALLATION



FQW4200 GE Metric

GPS ANTENNAE 1/2

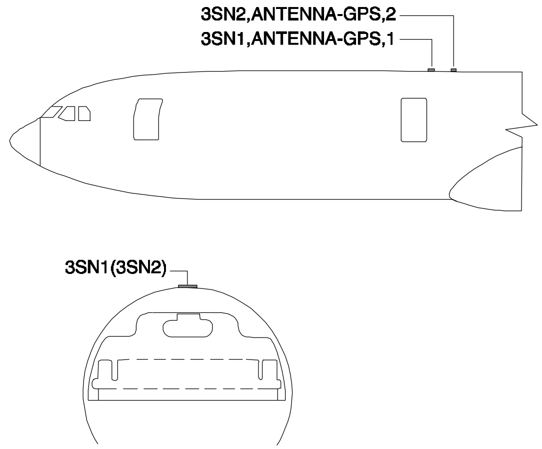
FINE/ZONE:

FIN :	GPS1 - 3SN1
	GPS2 - 3SN2
ZONE:	GPS1 - 252
	GPS2 - 252

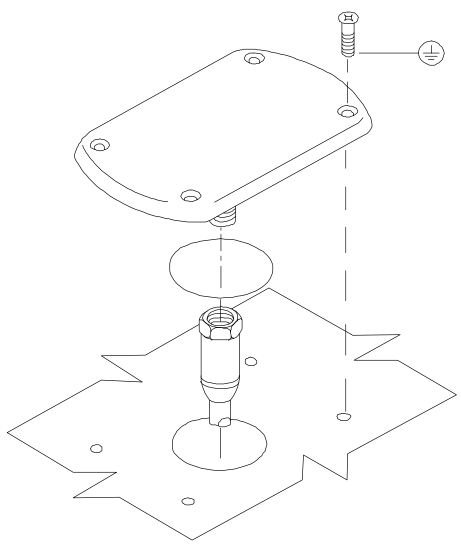
COMPONENT DESCRIPTION

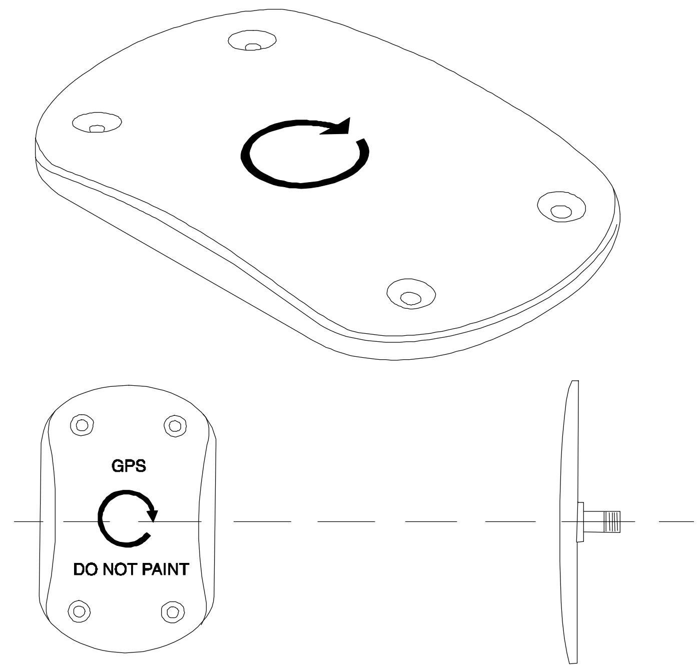
This antenna is low profile type mounted on top of the fuselage at the centerline.
It is a passive antenna designed to operate at 1575,42 Mhz.

COMPONENT LOCATION



REMOVAL/INSTALLATION





FQW4200 GE Metric

STUDENT NOTES.

ILS PRESENTATION

Principle
Components
Indicating

PRINCIPLE

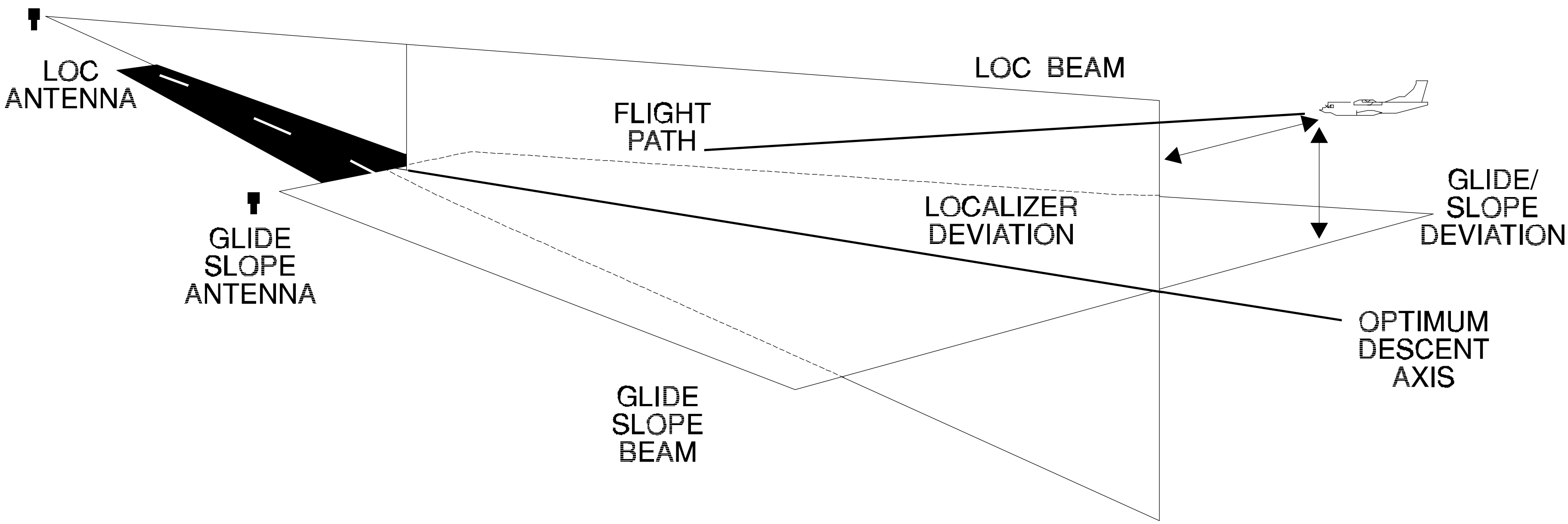
The Instrument Landing System (ILS) allows the aircraft to follow an optimum descent.

The descent axis is determined by the intersection of a localizer beam and a glide slope beam.

The beams are created by ground stations at known frequencies.

The ILS allows measurement and display of angular deviations.

The ILS also detects the Morse audio signal which identifies the ILS ground station.



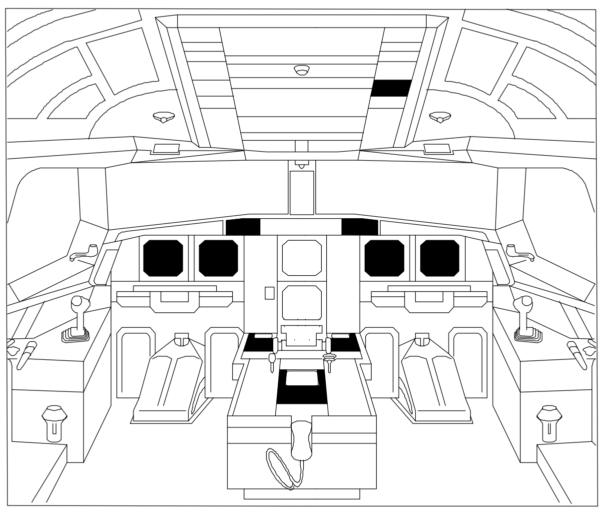
FQW4200 GE Metric

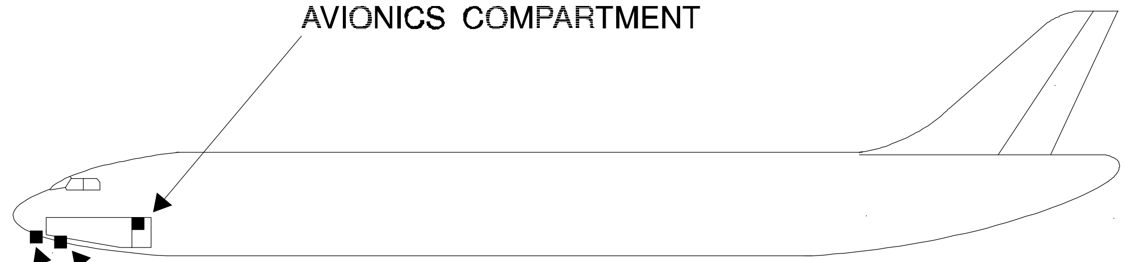
COMPONENTS

The Components are two antennae and two receivers.

The ILS system is also connected to :

- Primary Flight Display (PFD) and Navigation Display (ND) for display.
- Electronic Flight Instrument System (EFIS) control unit for display control.
- Flight Management Guidance and Envelope Computer (FMGEC) for auto-tuning.
- Multipurpose Control Display Units (MCDU) for manual tuning.
- Captain and First Officer Radio Management Panels (RMP) for back-up tuning.
- Audio Control Panels for ILS audio signal.



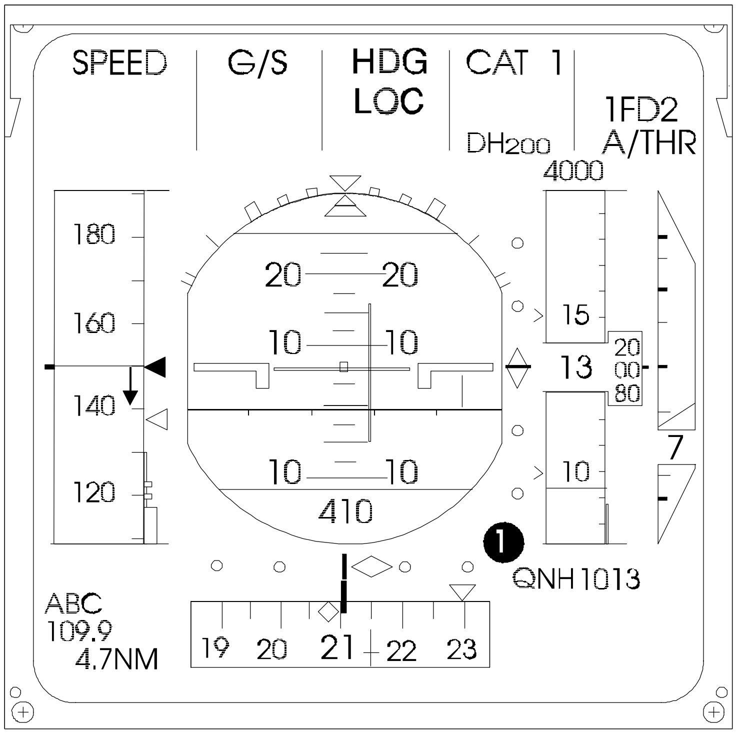


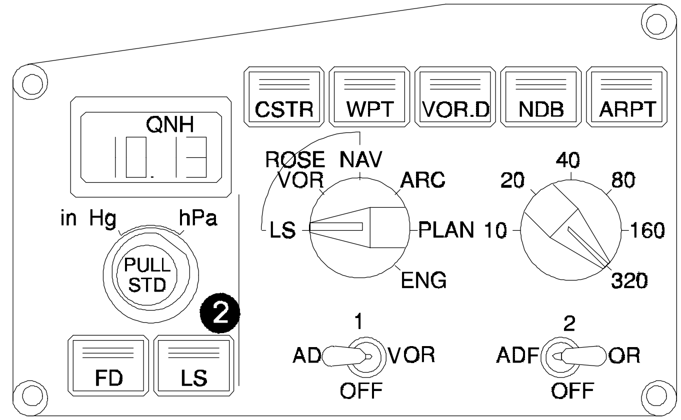
FQW4200 GE Metric

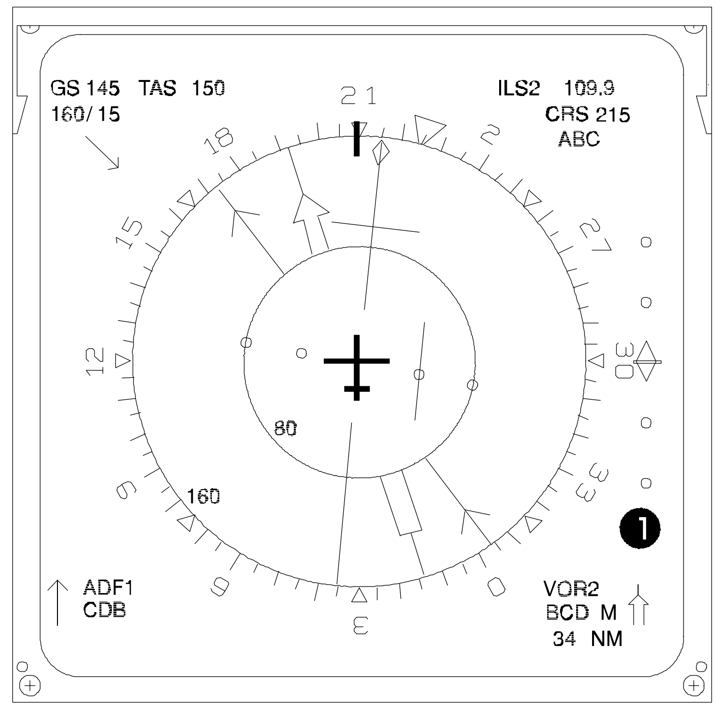
INDICATING

The glide slope and localizer scales appear as soon as the Landing System (LS) pushbutton is pressed.

ILS information is displayed in magenta.







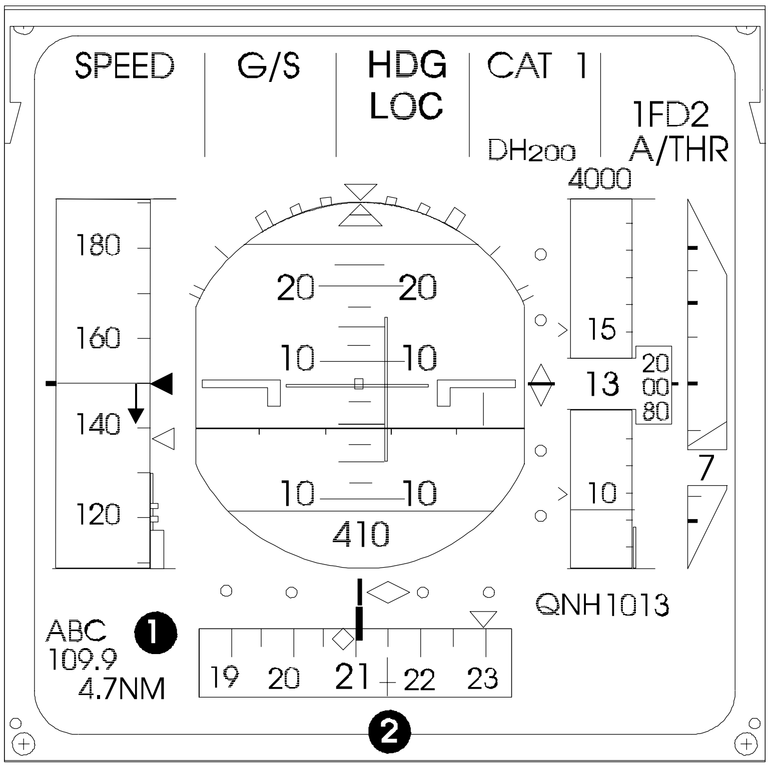
1 ILS SCALES

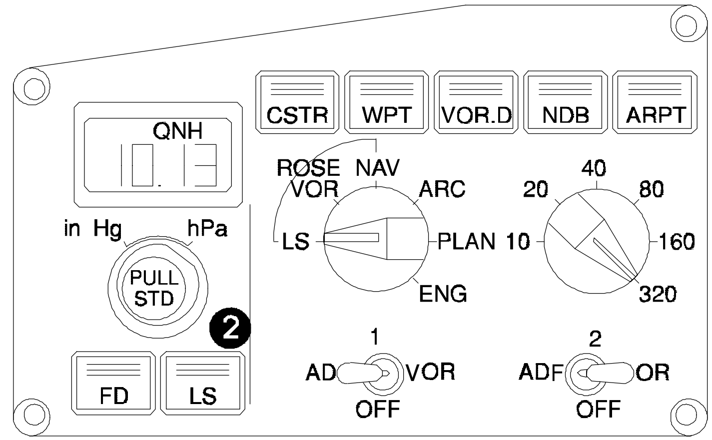
2 LS P/B

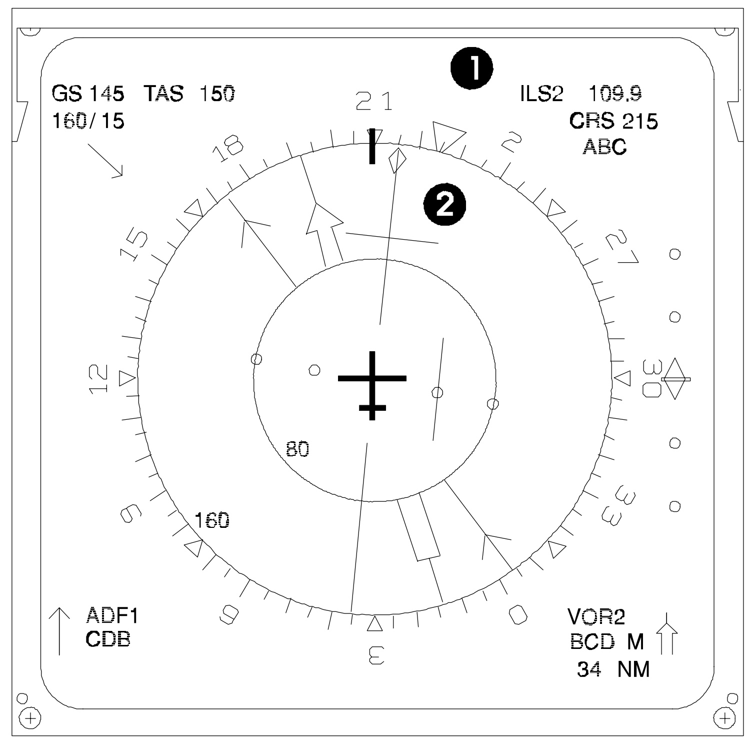
FQW4200 GE Metric

The ILS information and course pointer appear when ILS frequency and course have been selected and LS pushbutton pressed in.

ILS1 information is displayed on PFD1 and ND2.
ILS2 information is displayed on PFD2 and ND1.







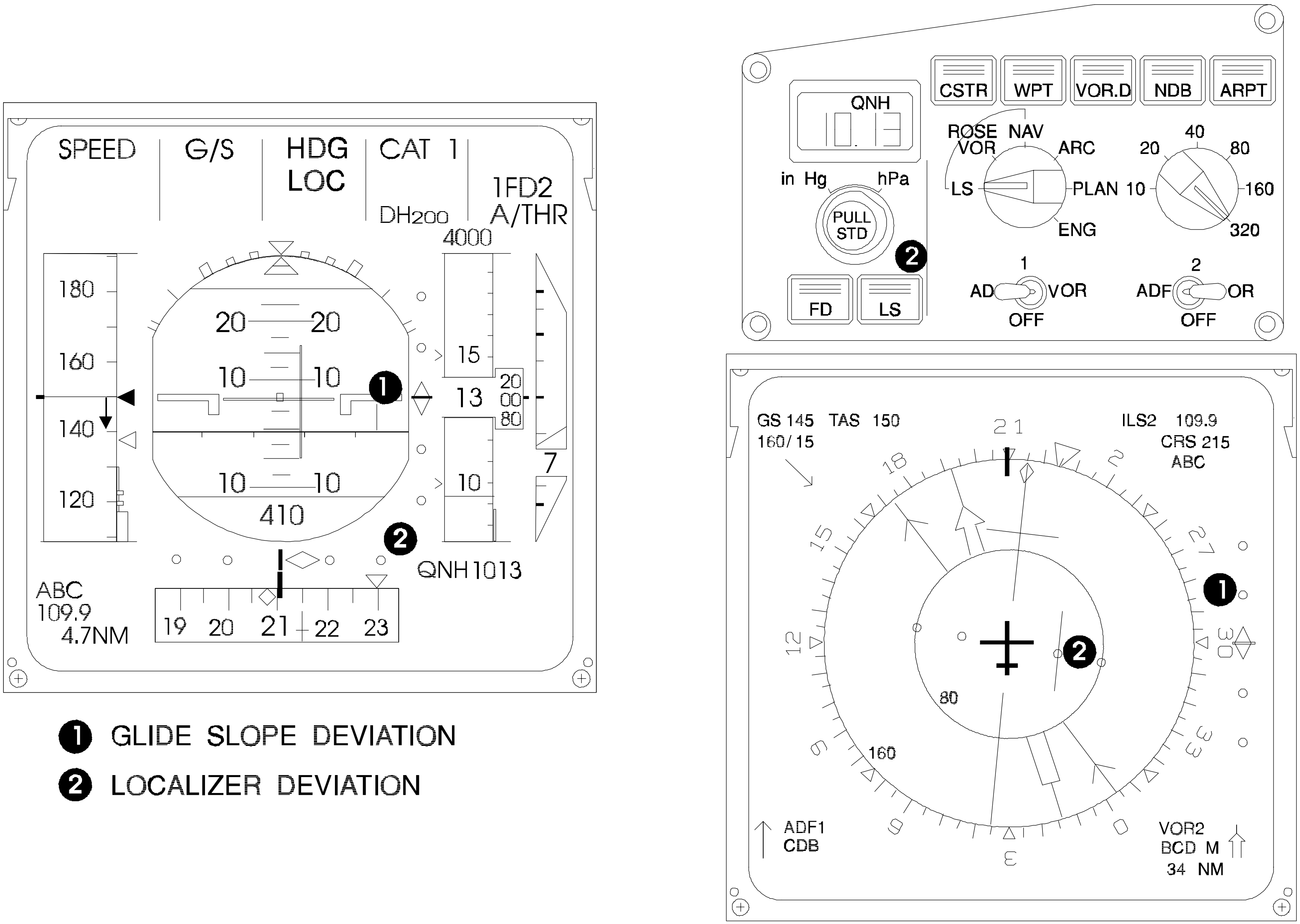
❶ ILS INFORMATION

❷ ILS COURSE POINTER

FQW4200 GE Metric

The Glide/Slope and Localizer deviation indexes appear as soon as the ILS signal is captured.

Glide/Slope and Localizer deviations are displayed in ROSE ILS mode.



❶ GLIDE SLOPE DEVIATION

❷ LOCALIZER DEVIATION

FQW4200 GE Metric

STUDENT NOTES

ILS D/O

Auto Tuning
Manual Tuning
FM Switch
Back Up Tuning
Antennae
LGCIU
Indicating
Users
CMC

AUTO TUNING

In normal operation each Flight Management Guidance and Envelope Computer (FMGEC) automatically tunes its ownside Instrument Landing System (ILS) receiver through its ownside Radio Management Panel (RMP).

MANUAL TUNING

Each Multipurpose Control and Display Unit (MCDU) allows the ownside ILS receiver to be manually tuned through the ownside FMGEC and the opposite ILS receiver to be tuned through the opposite FMGEC.

FM SWITCH

If a FMGEC failure occurs, a discrete, generated by the Flight Management (FM) switching, changes the tuning port of the associated ILS receiver, so that it can be directly tuned by the opposite FMGEC.

BACK UP TUNING

If both FMGECs fail, each RMP allows its ownside receiver to be directly tuned.
A discrete inhibits the radionav MCDU page, via the FMGEC.

The ILS data is exchanged between the RMPs if both are in NAV configuration.

ANTENNAE

The Glide Slope (G/S) and Localizer (LOC) antennae are common to both receivers. Each antenna has two independent connectors, used for feeding the two ILS receivers.

The G/S antenna operates in the 329-335 Mhz range.
The LOC antenna operates in the 108-112 Mhz range.

LGCIU

Each Landing Gear Control Interface Unit (LGCIU) sends discrete signals to the associated ILS receiver.
This Ground/Flight information is used by the receiver BITE module to count the flight legs.

INDICATING

The ILS 1 data is sent to the Captain Primary Flight Display (PFD) and First Officer Navigation Display (ND), while the ILS 2 data is sent to the F/O PFD and CAPT ND.

The ILS data is sent through the Display Management Computers (DMC).
The ILS audio signal is processed by the receivers and sent to the Audio Management Unit (AMU) and can be heard by the crew.

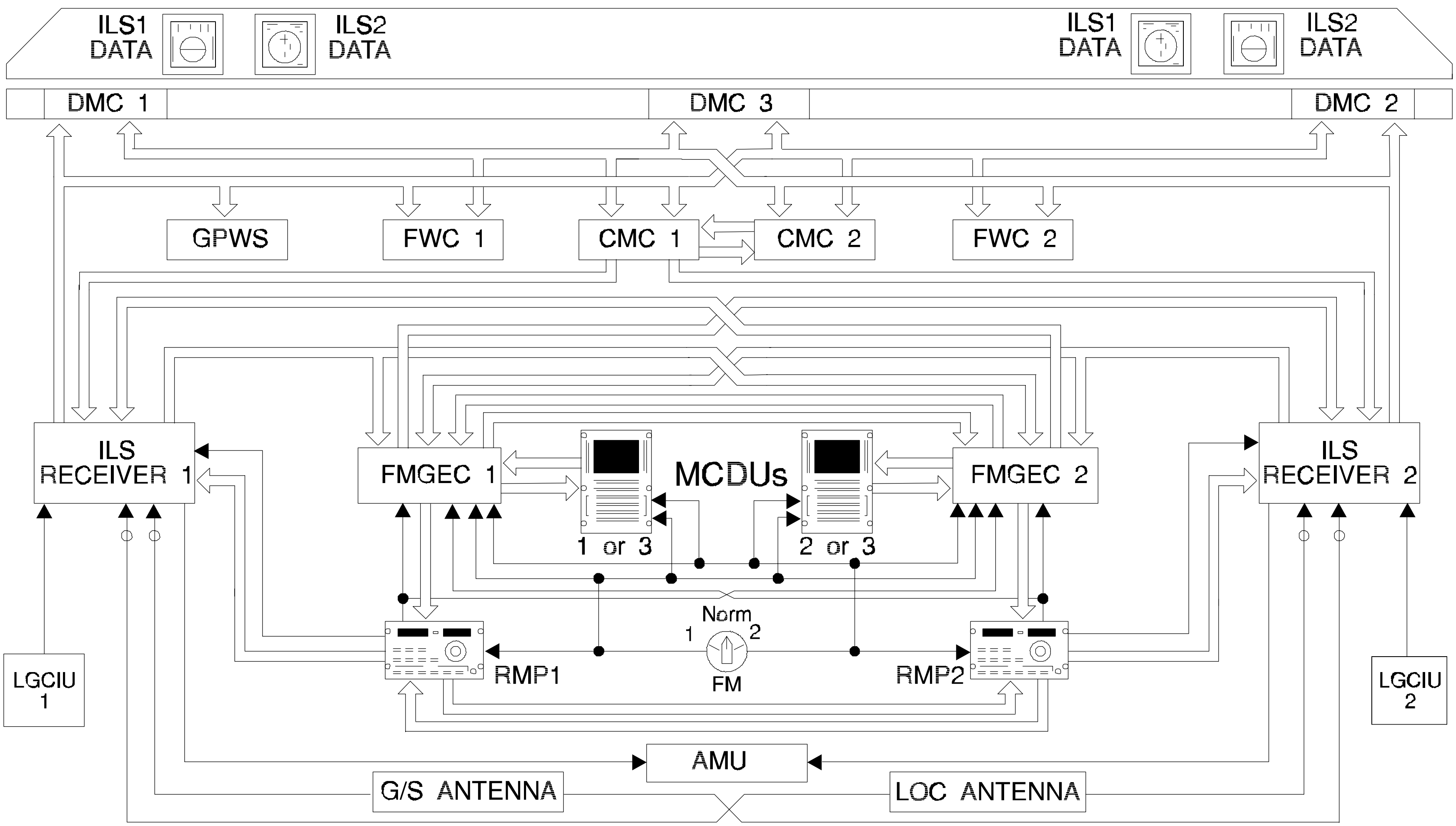
USERS

The ILS data is sent to the FMGEC for aircraft guidance during take off, approach and landing phases.

The ILS data is sent to the Electronic Centralized Aircraft Monitoring (ECAM) via the Flight Warning Computers (FWC).
The ILS1 data is sent to the Ground Proximity Warning System (GPWS).

CMC

The MCDUs allow the systems to be tested via the Central Maintenance Computers (CMC).
The tests are only available on ground.



FQW4200 GE Metric

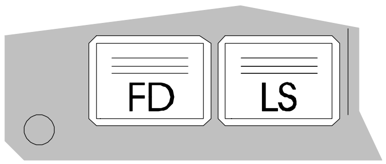
STUDENT NOTES:

ILS INDICATIONS ON PFD

Instrument Landing System (ILS).
Primary Flight Display (PFD).
Distance Measuring Equipment (DME).

LS PUSHBUTTON

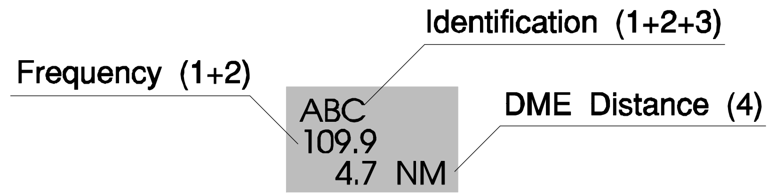
LANDING SYSTEM (LS) PUSHBUTTON



The ILS data is displayed on the PFD if the Landing System pushbutton is switched on on the Electronic Flight Instrument System (EFIS) control panel.

ILS CHARACTERISTICS

CONDITIONS OF DISPLAY



1 - LOCALIZER FUNCTION VALID

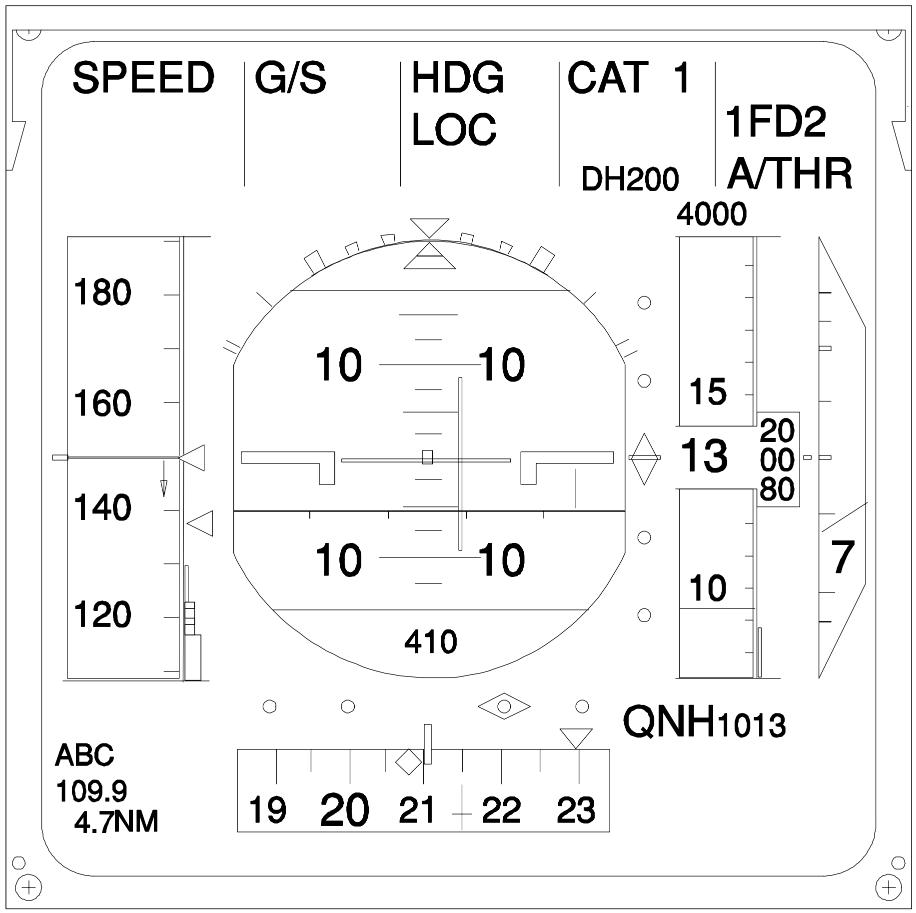
2 - GLIDE/SLOPE FUNCTION VALID

3 - ILS IDENTIFICATION SIGNALS VALID

4 - ILS-DME DISTANCE AVAILABLE

The ILS characteristics are displayed in magenta in the bottom left corner of the PFD.

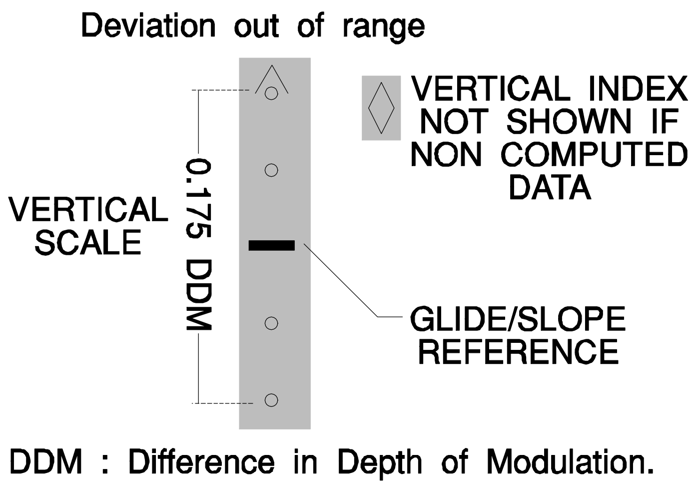
The ILS identification is displayed after decoding by the ILS receiver.



FQW4200 GE Metric

VERTICAL DEVIATION

CONDITIONS OF DISPLAY



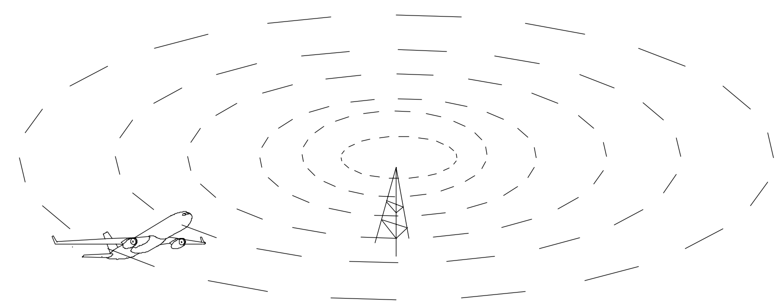
The vertical deviation is associated with the Glide/Slope beam reception.

The vertical scale and the vertical index flash when the deviation is excessive.

When the deviation is out of range the vertical index is against one stop and only its outer half remains in view.

LATERAL DEVIATION

CONDITIONS OF DISPLAY

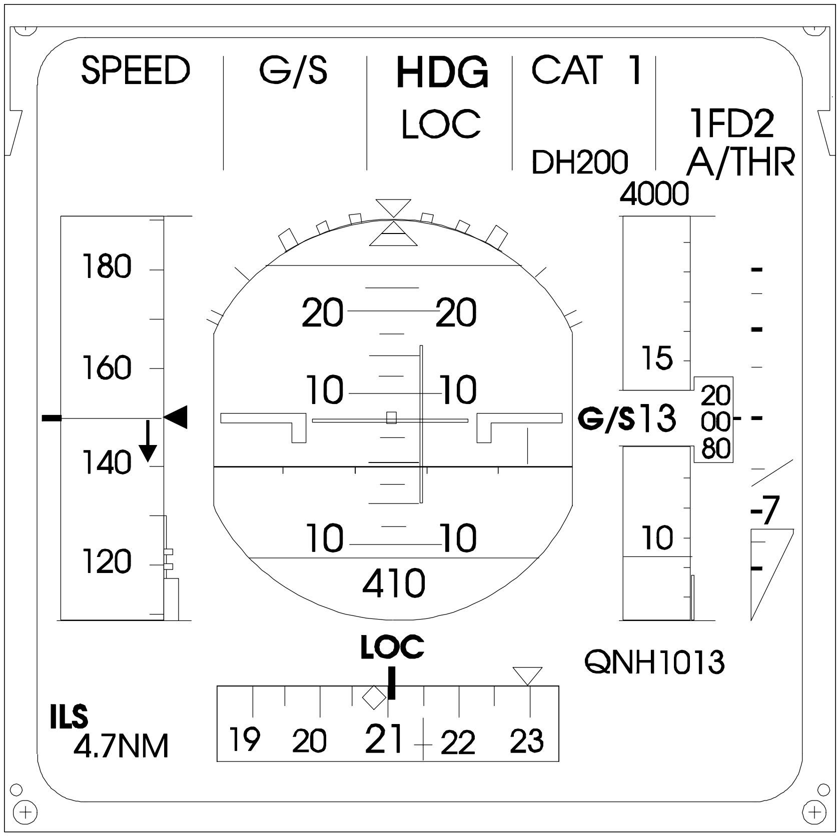


The lateral deviation is associated with the Localizer beam reception.

The lateral scale and the lateral index flash when the deviation is excessive.

When the deviation is out of range the lateral index is against one stop and only its outer half remains in view.

FLAGS

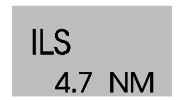


CONDITIONS OF DISPLAY

GLIDE/SLOPE

G/S SYMBOL FLASHES FOR 9 SECONDS THEN STEADY.

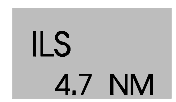
THE ILS CHARACTERISTICS ARE REPLACED BY A FLAG



LOCALIZER

LOC SYMBOL FLASHES FOR 9 SECONDS THEN STEADY.

THE ILS CHARACTERISTICS ARE REPLACED BY A FLAG.



When a failure occurs, a corresponding flag is shown in red.

FQW4200 GE Metric

STUDENT NOTES:

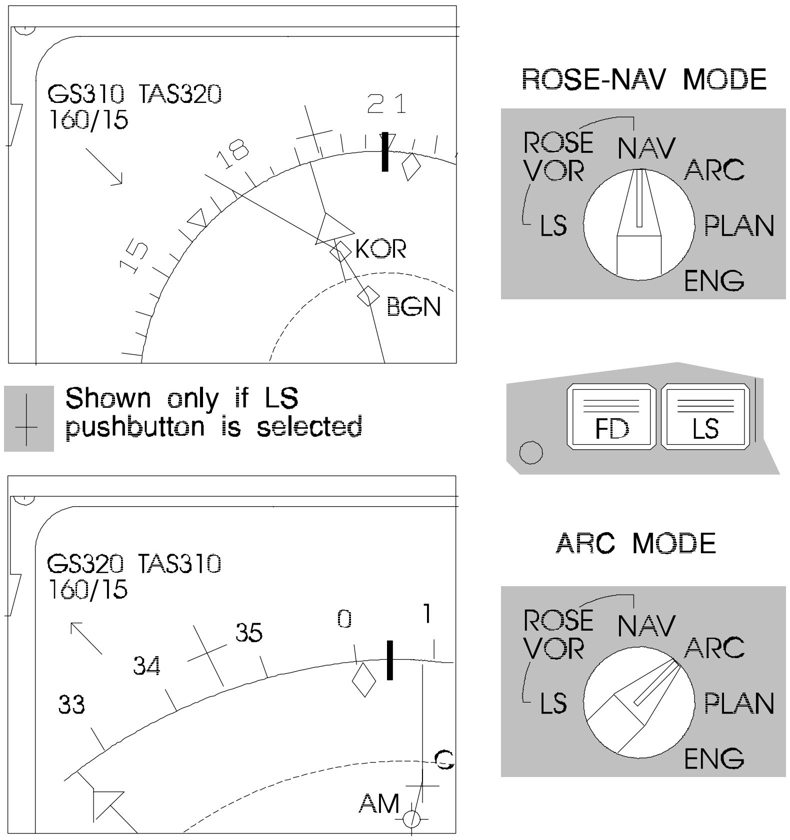
ILS INDICATIONS ON ND

Data Display
ILS Characteristics
Vertical Deviation
Lateral Deviation
Flags

Instrument Landing System (ILS).
Navigation Display (ND).

DATA DISPLAY

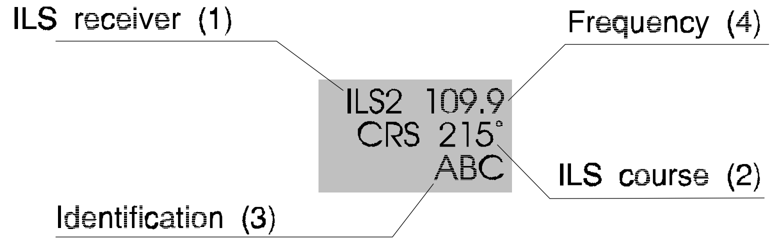
LANDING SYSTEM (LS) PUSHBUTTON



All the indications are displayed in ROSE-LS mode while the only ILS dagger course is displayed in ARC or NAV mode if the Landing System pushbutton is selected.

ILS CHARACTERISTICS

CONDITIONS OF DISPLAY



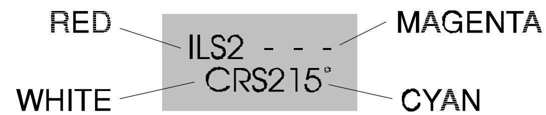
1 - BEARING IS VALID

2 - COURSE RECEIVED IS VALID

3 - ILS IDENTIFICATION SIGNAL IS VALID

4 - ILS FREQUENCY SIGNAL IS VALID

NON COMPUTED DATA

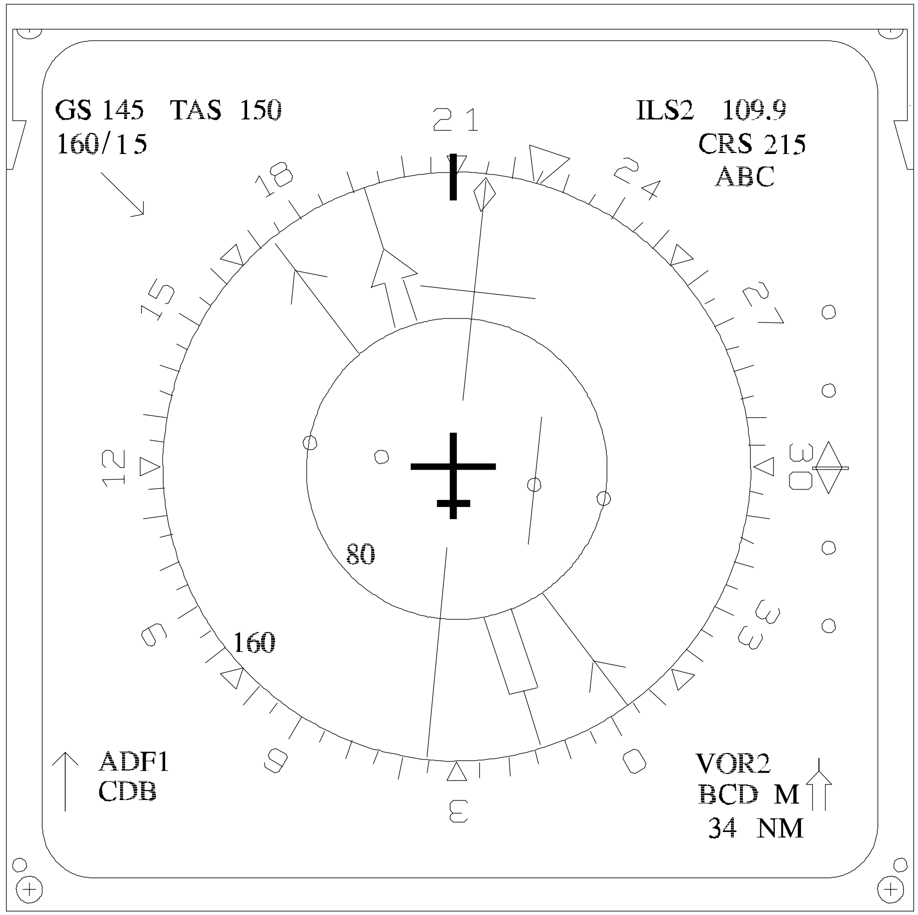


Identification is removed.

In ROSE-LS mode, the ILS characteristics are displayed in magenta, in the top right corner of the ND.

The ILS identification is displayed after decoding by the ILS receiver.

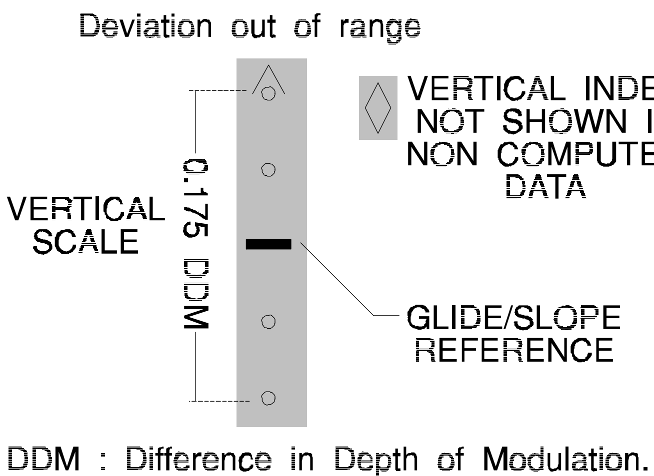
FQW4200 GE Metric



FQW4200 GE Metric

VERTICAL DEVIATION

CONDITIONS OF DISPLAY



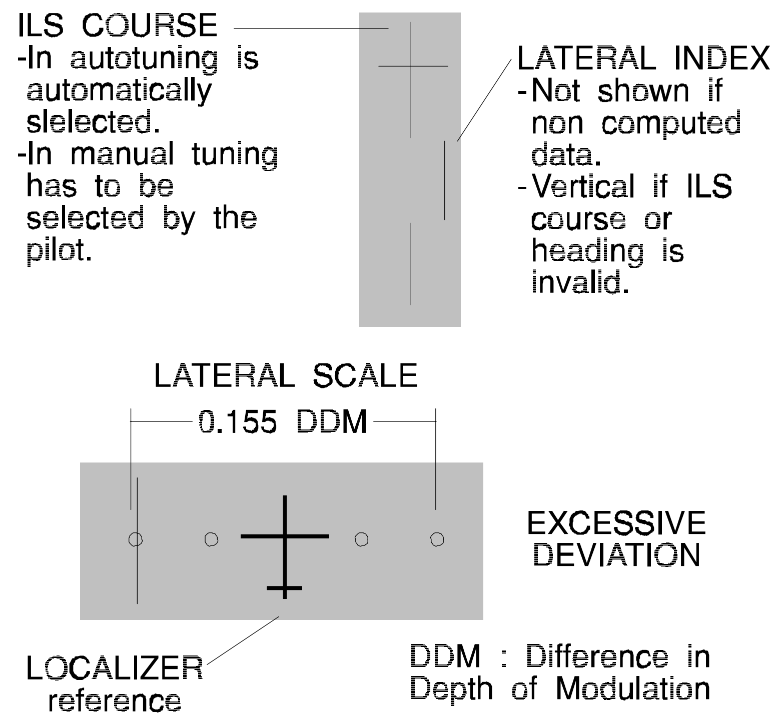
The vertical deviation is associated with the Glide/Slope beam reception.

The vertical scale and the vertical index flash when the deviation is excessive.

When the deviation is out of range the vertical index is against one stop and only its outer half remains on view.

LATERAL DEVIATION

CONDITIONS OF DISPLAY

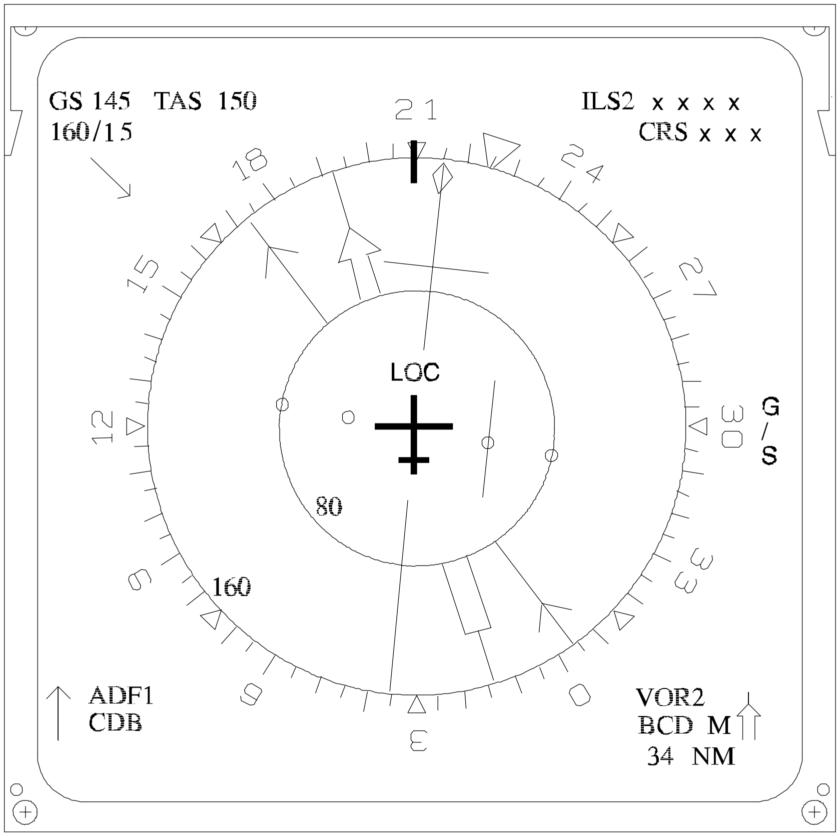


The lateral deviation is associated with the Localizer beam reception.

The lateral scale and the lateral index flash if the deviation is excessive.

The lateral index, corresponding to the center part of the ILS course dagger, can move on the deviation scale and gives the Localizer deviation.

FLAGS



CONDITIONS OF DISPLAY

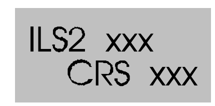
GLIDE/SLOPE

G/S SYMBOL FLASHES FOR 9 SECONDS THEN STEADY.

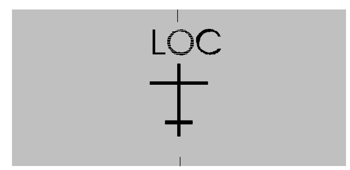
THE ILS CHARACTERISTICS ARE REPLACED BY A FLAG.

LOCALIZER

LOC SYMBOL FLASHES FOR 9 SECONDS THEN STEADY



THE ILS CHARACTERISTICS ARE REPLACED BY A FLAG.



In ROSE-LS mode, when a failure occurs, a corresponding flag is displayed in red.

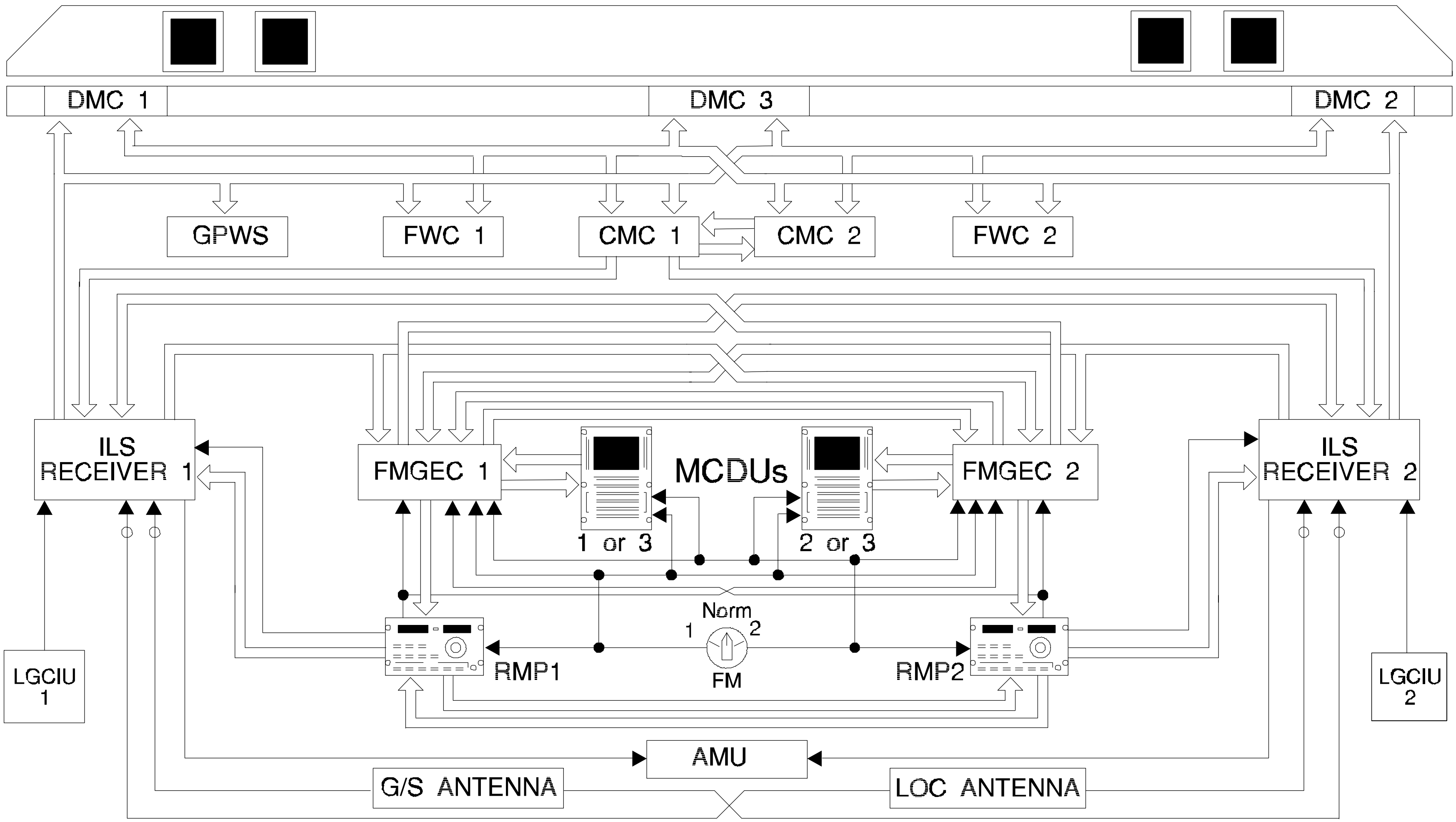
FQW4200 GE Metric

STUDENT NOTES:

ILS COMPONENTS

Ils Receiver 1/2
Glide and Slope Antenna
Localizer Antenna

STUDENT NOTES



FQW4200 GE Metric

ILS RECEIVER 1/2

FIN : 1RT1, 1RT2

ZONE : 120, 120

COMPONENT DESCRIPTION

The face of the receiver is fitted with a handle, two lugs, a test P/B and three LEDs.
The back is equipped with one ARINC 600 size one connector which includes three plugs :

- Top Plug (TP) :

  Connection with the automatic test circuit.

- Middle Plug (MP) :

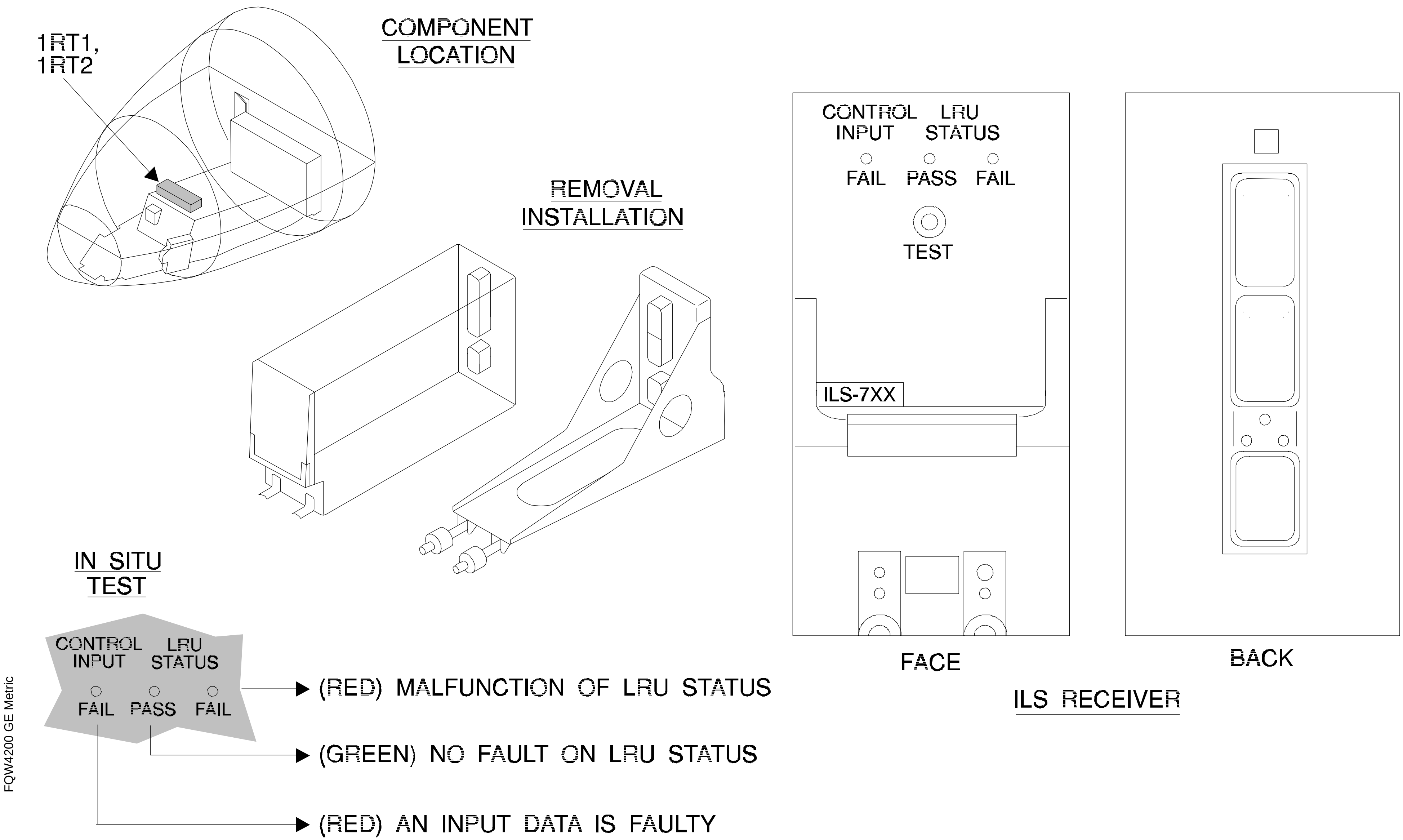
  Service interconnection.

- Bottom Plug (BP) :

  Connection with the power supply circuit (115vac-400Hz), and the LOC and G/S coaxial interconnections.

IN SITU TEST

The front panel test can be activated by pressing the TEST P/B on the face of the receiver.
However, FMGEC sends a discrete to inhibit this test during approach phase below 700 feet.


1RT1,
1RT2
COMPONENT
LOCATION
REMOVAL
INSTALLATION
CONTROL INPUT
LRU STATUS
FAIL
PASS
FAIL
TEST
ILS-7XX
FACE
BACK
ILS RECEIVER
IN SITU
TEST
CONTROL INPUT
LRU STATUS
FAIL
PASS
FAIL
(RED) MALFUNCTION OF LRU STATUS
(GREEN) NO FAULT ON LRU STATUS
(RED) AN INPUT DATA IS FAULTY
FQW4200 GE Metric

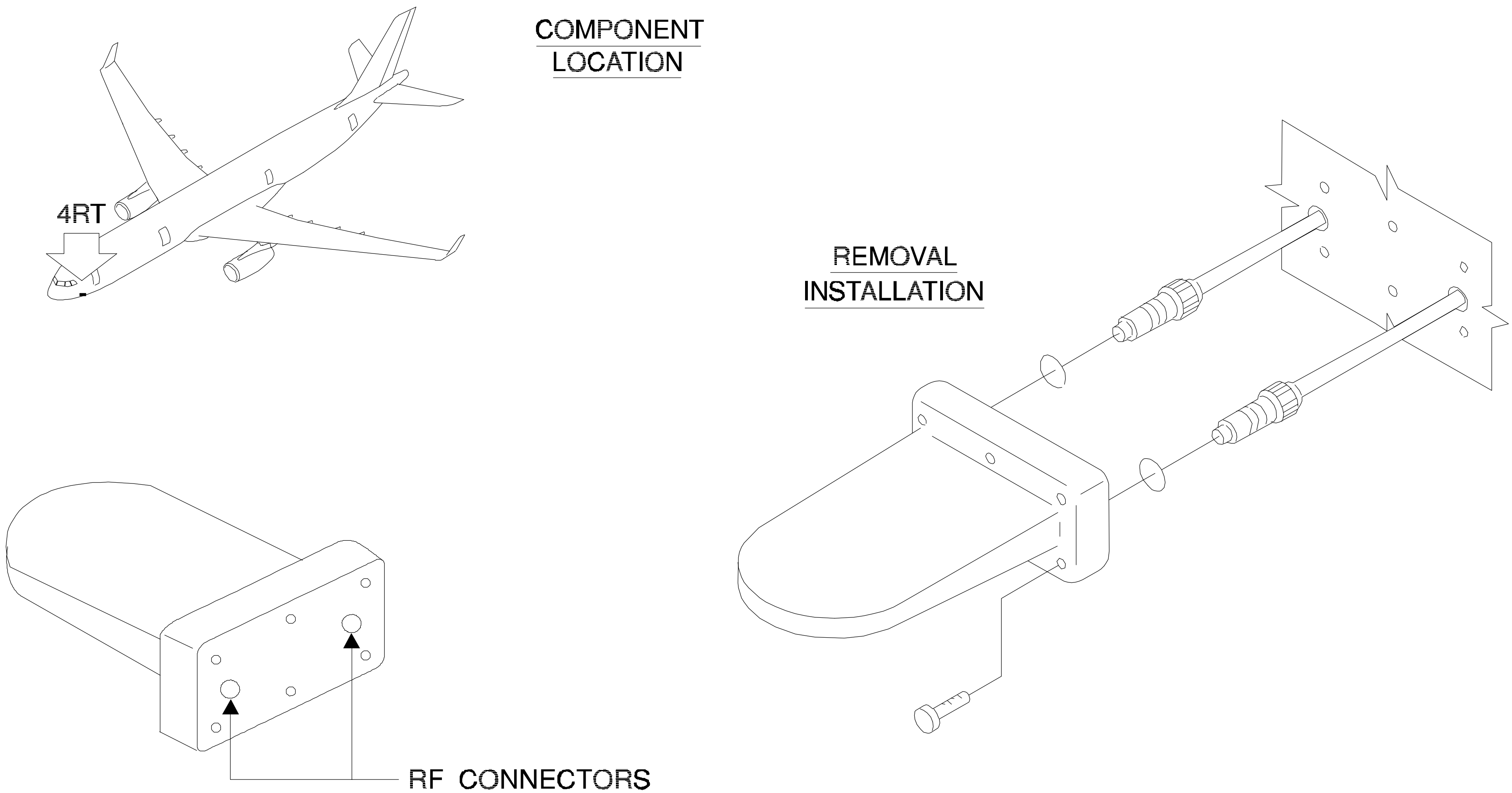
GLIDE AND SLOPE ANTENNA

FIN : 4RT

ZONE : 120

COMPONENT DESCRIPTION

The Glide/Slope antenna is an airborne antenna used to receive G/S signals in the 329-335 MHz range.
This antenna has two independent RF connectors used to feed two independent ILS receivers.



FQW4200 GE Metric

GLIDE/SLOPE ANTENNA

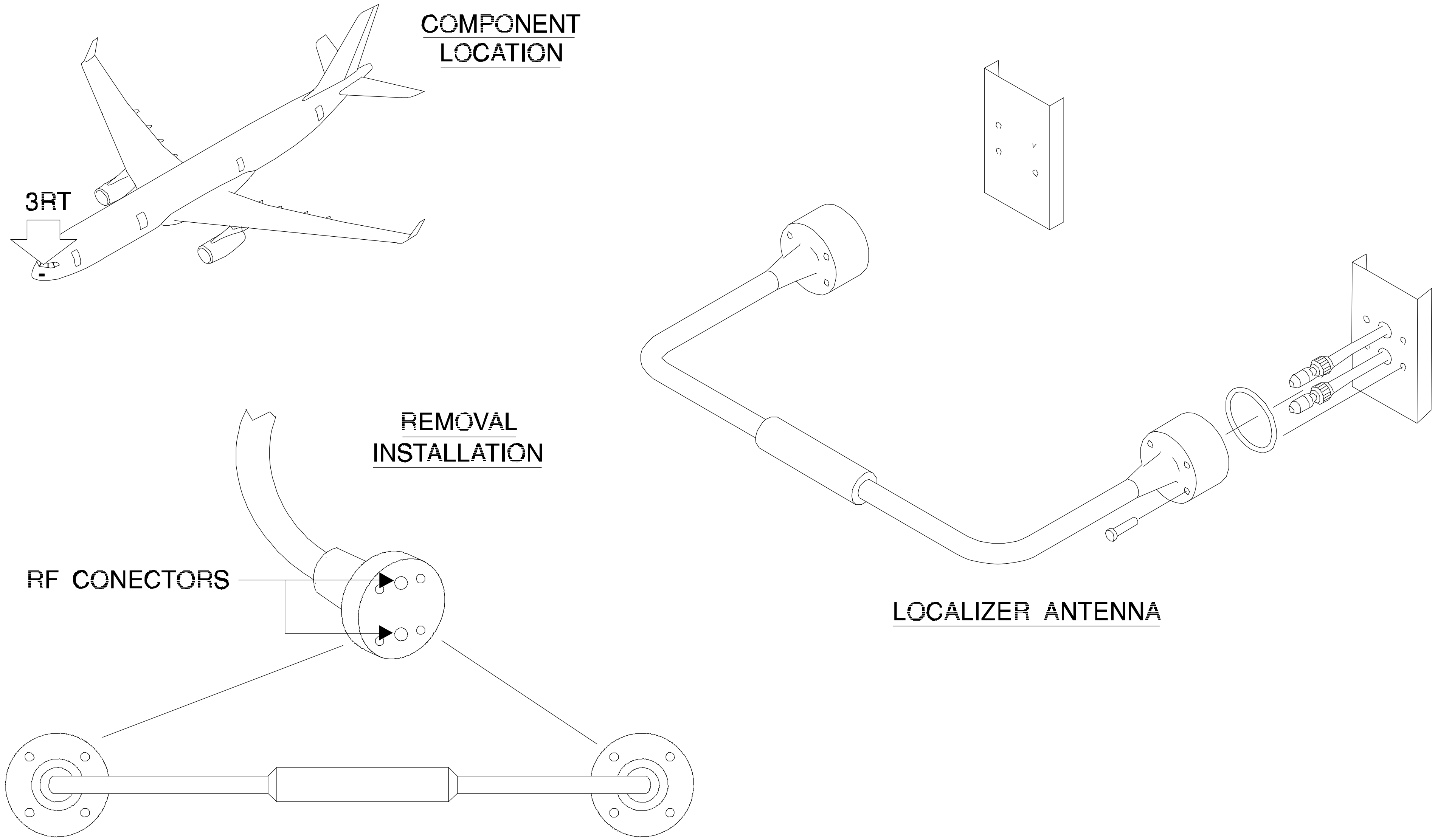
LOCALIZER ANTENNA

FIN : 3RT

ZONE : 110

COMPONENT DESCRIPTION

The Localizer antenna is an airbone antenna used to receive LOC signals in the 108-112 MHz range.
It is a folded half-loop type driven by capacitive coupling.
This antenna has two independent RF connectors used to feed two independent ILS receivers.



FQW4200 GE Metric

STUDENT NOTES

MULTI-MODE RECEIVER PRESENTATION

ILS PRINCIPLE

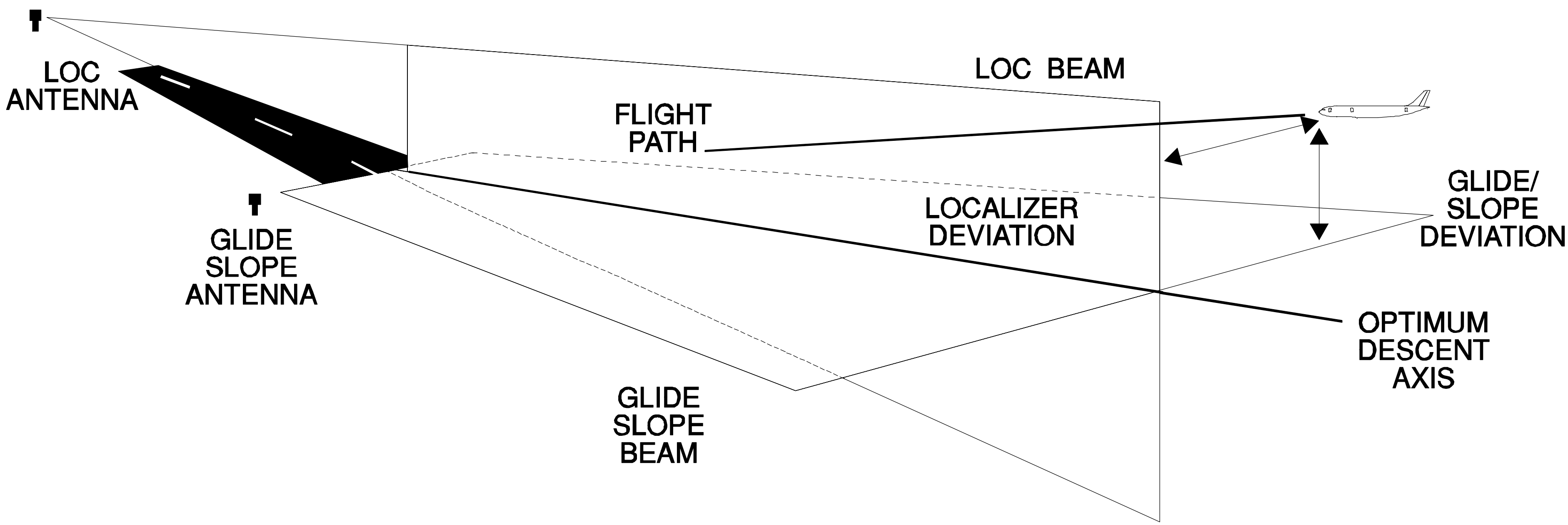
The Instrument Landing System (ILS) allows the aircraft to follow an optimum descent.

The descent axis is determined by the intersection of a localizer beam and a glide slope beam.

The beams are created by ground stations at known frequencies.

The ILS allows measurement and display of angular deviations.

The ILS also detects the Morse audio signal which identifies the ILS ground station.

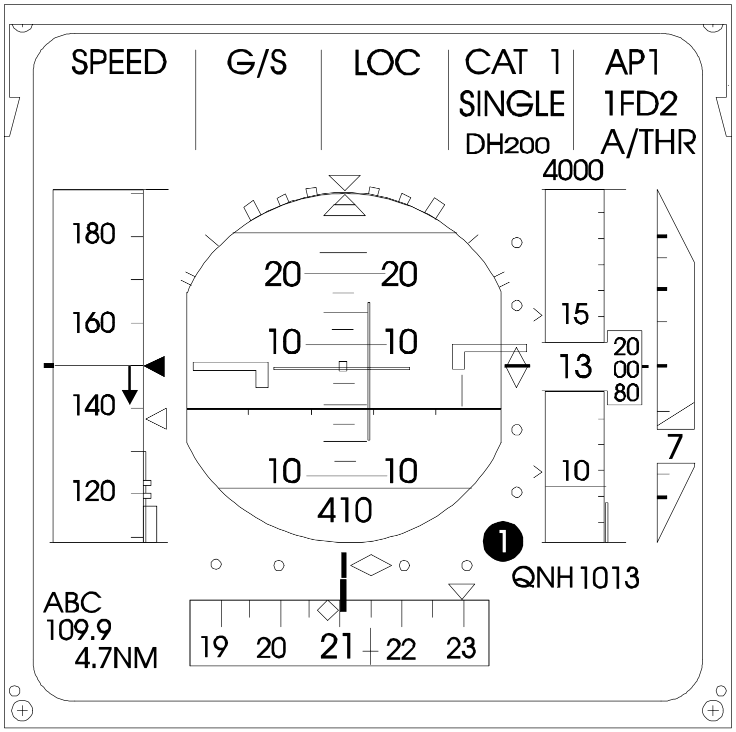


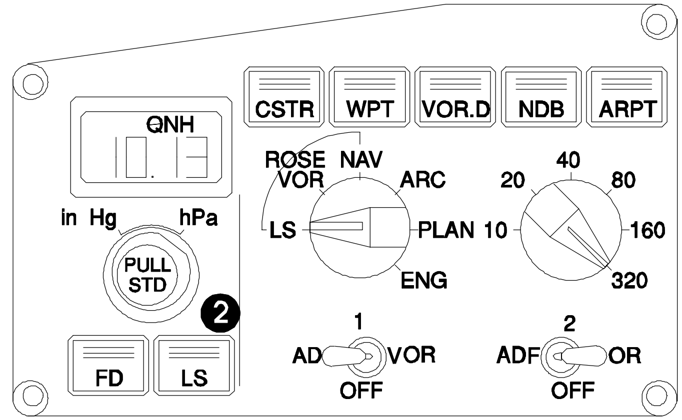
FQW4200 GE Metric

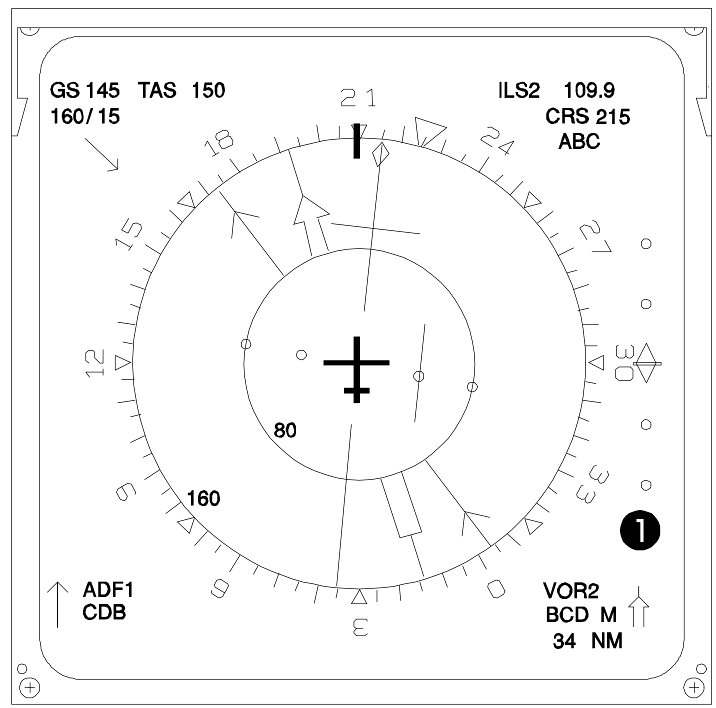
ILS INDICATING

The glide slope and localizer scales appear as soon as the Landing System (LS) pushbutton is pressed.

ILS information is displayed in magenta.







❶ ILS SCALES

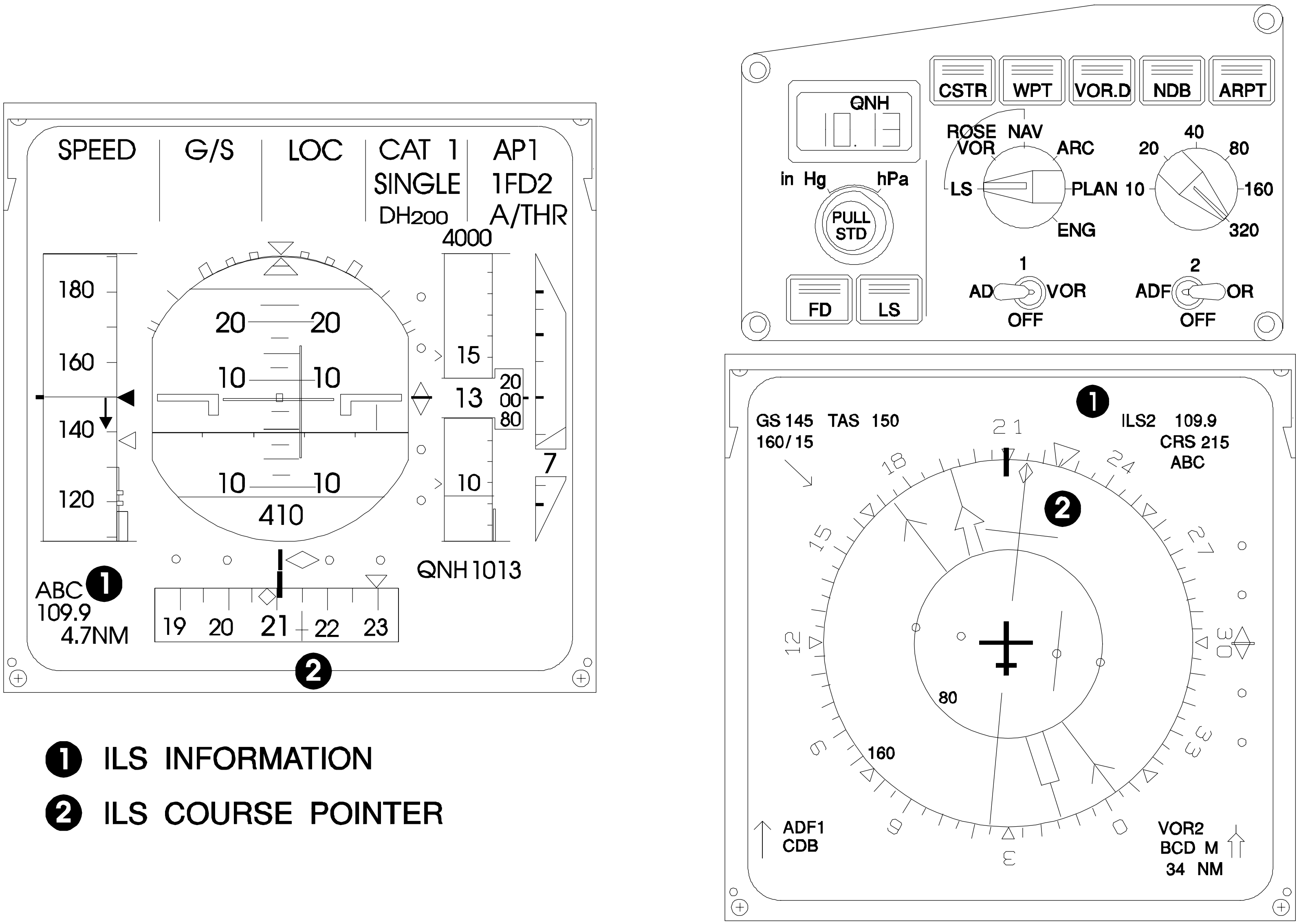
❷ LS P/B

FQW4200 GE Metric

ILS INDICATING (CONT'D)

The ILS information and course pointer appear when ILS frequency and course have been selected and LS pushbutton pressed in.

ILS1 information is displayed on PFD1 and ND2.
ILS2 information is displayed on PFD2 and ND1.



❶ ILS INFORMATION

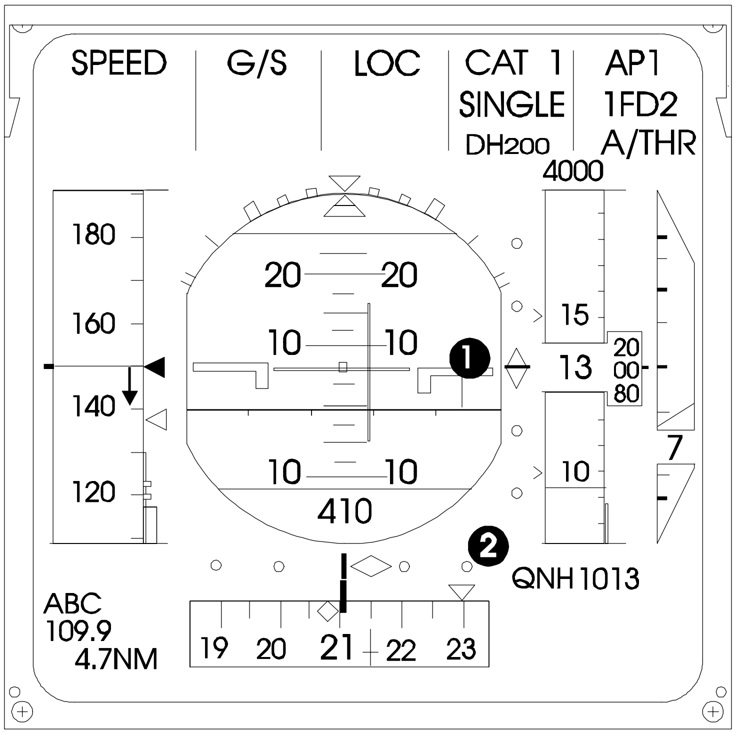
❷ ILS COURSE POINTER

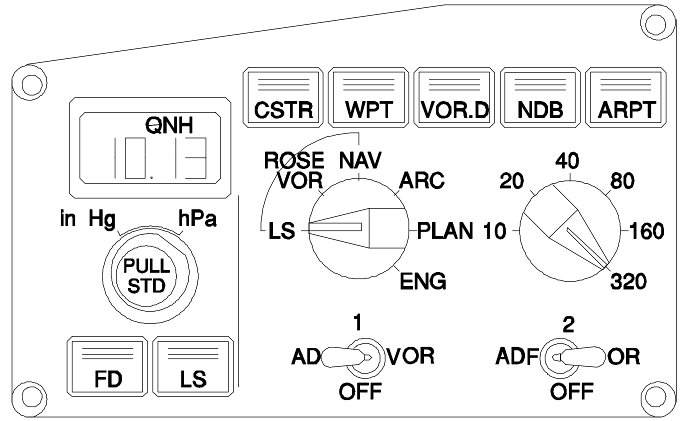
FQW4200 GE Metric

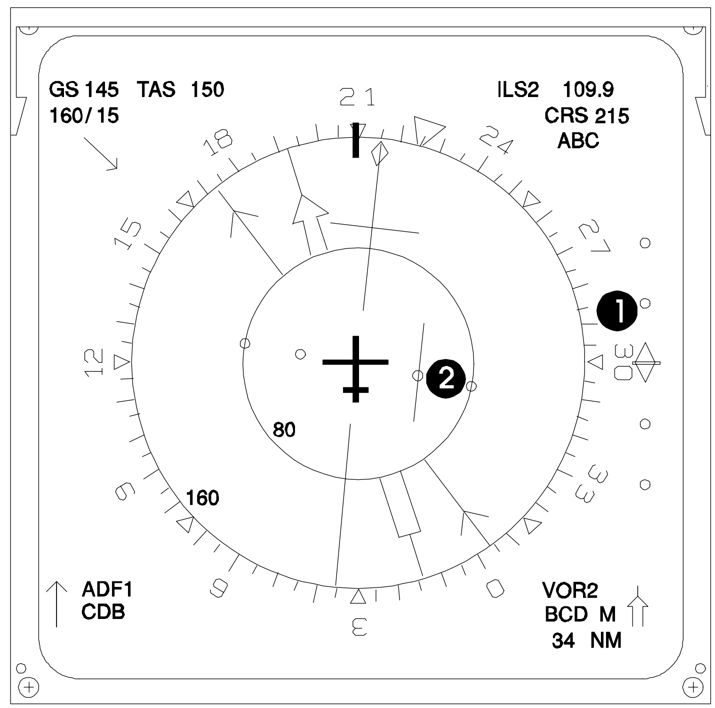
ILS INDICATING (CONT'D)

The Glide/Slope and Localizer deviation indexes appear as soon as the ILS signal is captured.

Glide/Slope and Localizer deviations are displayed in ROSE ILS mode.







❶ GLIDE SLOPE DEVIATION

❷ LOCALIZER DEVIATION

FQW4200 GE Metric

GPS GENERALITIES

The Global Positioning System (GPS) is a radio aid to world wide navigation which uses signals broadcast by satellites.
The architecture of the system is composed of 3 segments.

INERTIAL SEGMENT

It is composed of a constellation of 24 satellites (21 always available).

CHARACTERISTICS

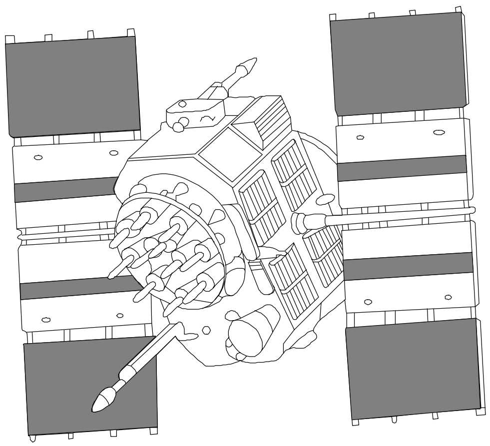
Time of life : 7.5 years
Mass : 815 Kgs
Boarded Power : 700 watts at the end of life.
Operation frequency : 1515.42 Mhz
Operating clock : 2 cesium and 2 rubidium clocks.

The satellites are dispatched on 6 circular orbits of 4 satellites each.

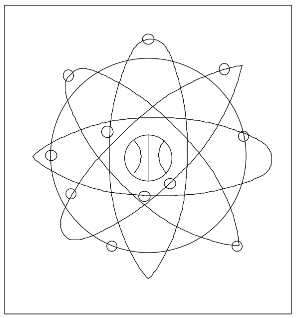
CONSTELLATION DESCRIPTION

- orbit altitude : 20231 Km
- orbit plan pos. : 550 /equa.
- orbit recurrence : 12 sidereal hour

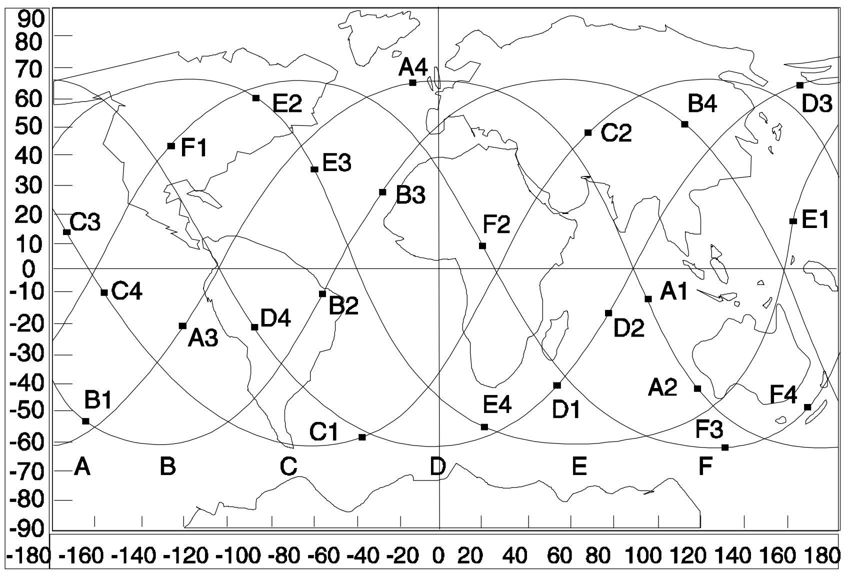
NOTE: 1 sidereal day equals 23 hours 56 mn 4s and 1/10.



CIRCULAR ORBITS



ORBIT PLANES



FQW4200 GE Metric

GPS GENERALITIES (CONT'D)

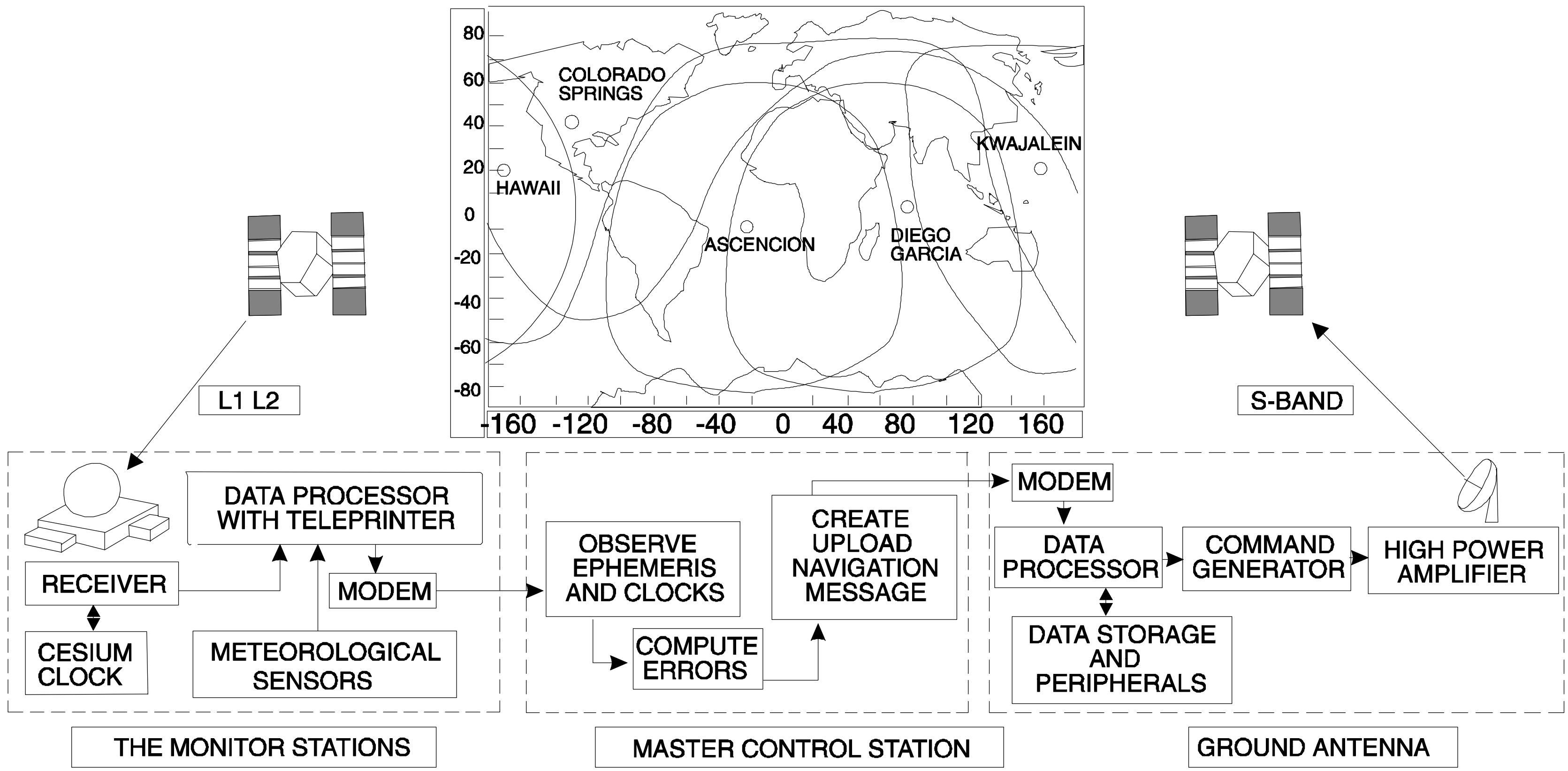
CONTROL SEGMENT

The control segment is composed of 4 monitor stations and 1 master control station which pursue the satellites, compute the ephemerides and clock corrections, and transmit at regular intervals an information message for the GPS users.
The 4 monitor stations are located at:

- KWAJALEIN
- HAWAII
- ASCENCION ISLAND
- DIEGO GARCIA

The master control station is located at:

- COLORADO SPRINGS.



THE MONITOR STATIONS

FUNCTIONS

OBSERVE EPHEMERIS AND CLOCKS

1.PERFORM STATIONARY NAV SOLUTION

2.CARRY OUT SELF TEST AND HEALTH STATUS FUNCTIONS

3.UPLOAD VERIFICATION WORDS

MASTER CONTROL STATION

FUNCTIONS

COMPUTE SATELLITE UPDATES

1 ANALYZE DOWN LINK DATA

2.COMPUTE EPHEMERIS AND CLOCK ERRORS

3.PERFORM DATA MANIPULATION

GROUND ANTENNA

FUNCTIONS

TRANSMIT UPDATES TO SATELLITES

1. LOAD SATELLITE MEMORY

2. VERIFY LOADING

3. PROVIDE MONITOR STATION

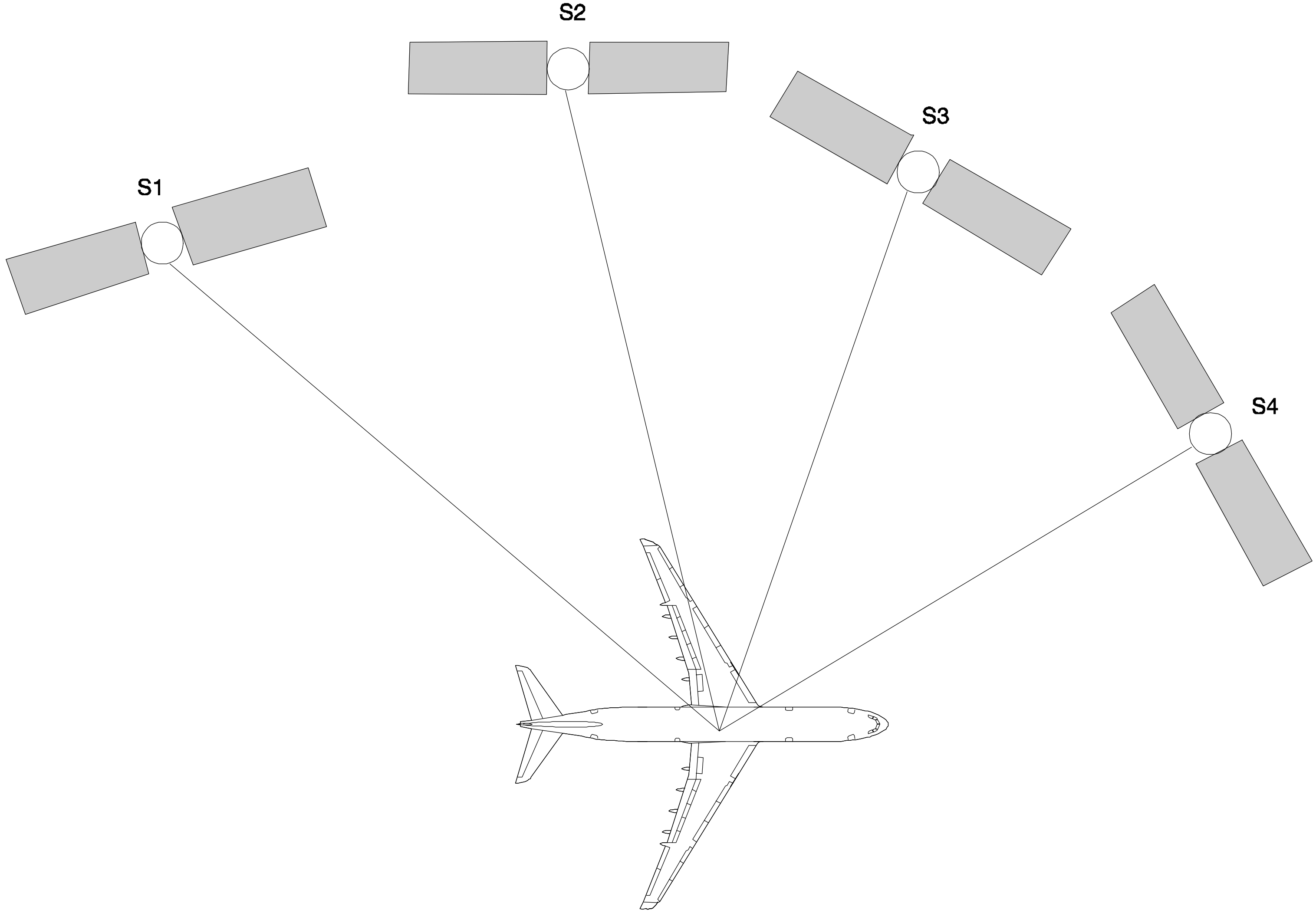
FQW4200 GE Metric

GPS GENERALITIES (CONT'D)

USER SEGMENT

The principle of GPS position computation is based on the measurement of transmission time of the GPS signals broadcast by 4 satellites.
For a boat, only 3 satellites would be enough to obtain its position, while, for a user on the move, a fourth satellite is necessary to synchronize the aircraft and satellite clocks.
The user equipment is generally defined by 3 principal functions which are :

- UHF Reception : antenna, amplification and filtering.
- Signal processing : pseudo distance obtaining.
- Navigation computation : constellation choice, propagation corrections, positioning and navigation data computation.



FQW4200 GE Metric

GPS AIRCRAFT ARCHITECTURE

It is possible to find two different GPS aircraft architectures, depending on whether the GPS is used as a supplemental or primary means of navigation.

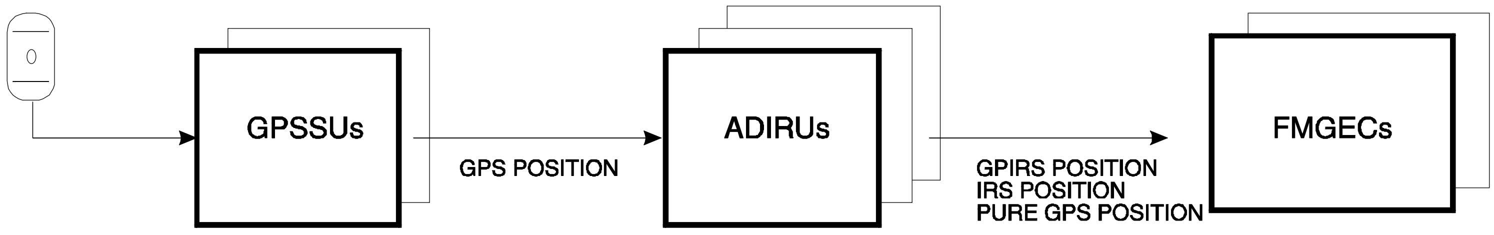
HYBRID:

The GPSSU sends the GPS position to the associated ADIRU which mixes it with the IR position. This hybrid GPIRS position is sent by the ADIRU to the Flight Management System (FMS).

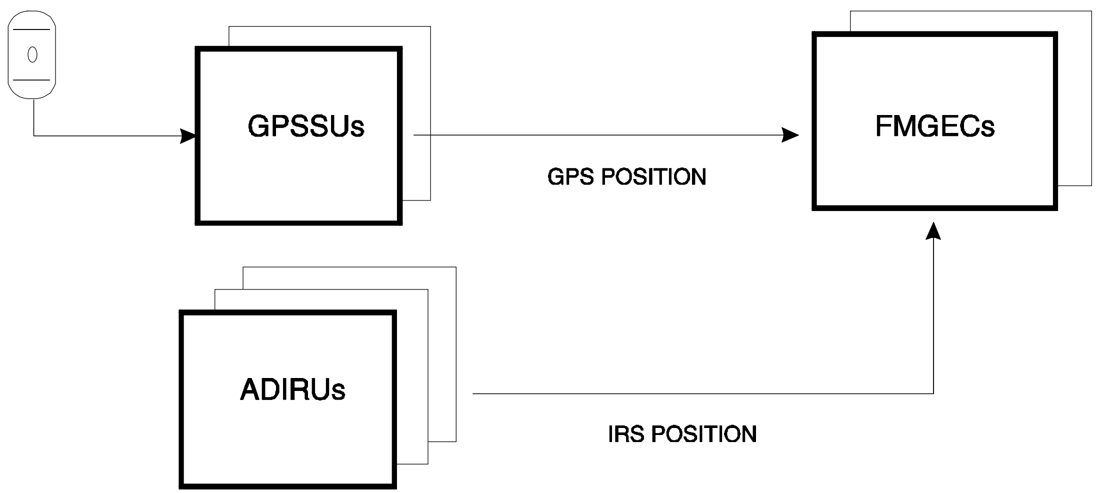
AUTONOMOUS:

The GPSSU directly sends the GPS position to the FMS which directly receives the IR position from the ADIRU. The GPIRS position is computed by the FMS.

HYBRID :



AUTONOMOUS :



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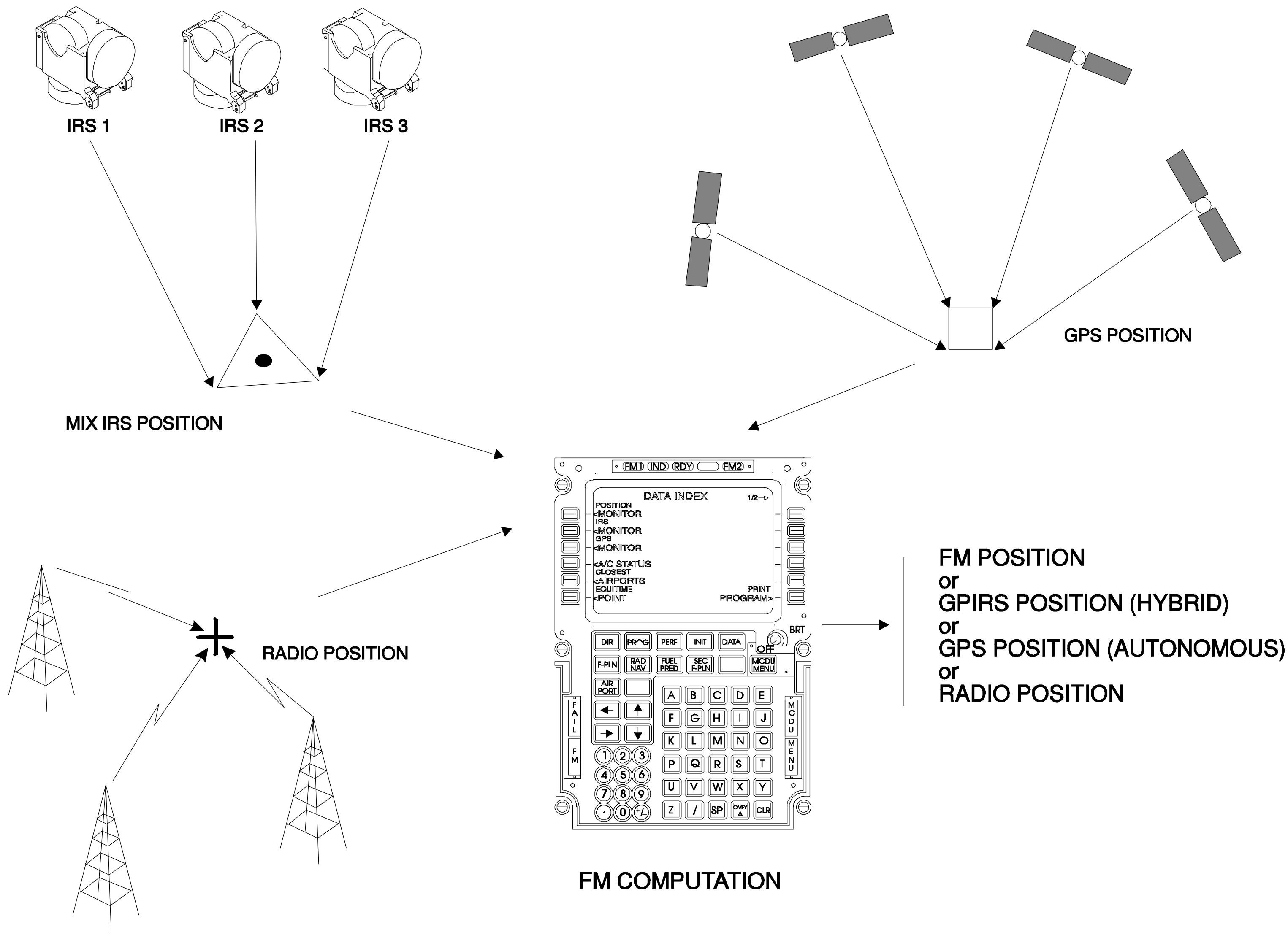
GPS PRINCIPLE

SUPPLEMENTAL MEANS OF NAVIGATION

The GPS position shall be used in conjunction with the IRS position.

The current navigation modes in priority order are :

- IRS / GPS (GPIRS)
- IRS / DME / DME
- IRS / VOR / DME
- IRS ONLY



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GPS PRINCIPLE (CONT'D)

PRIMARY MEANS OF NAVIGATION

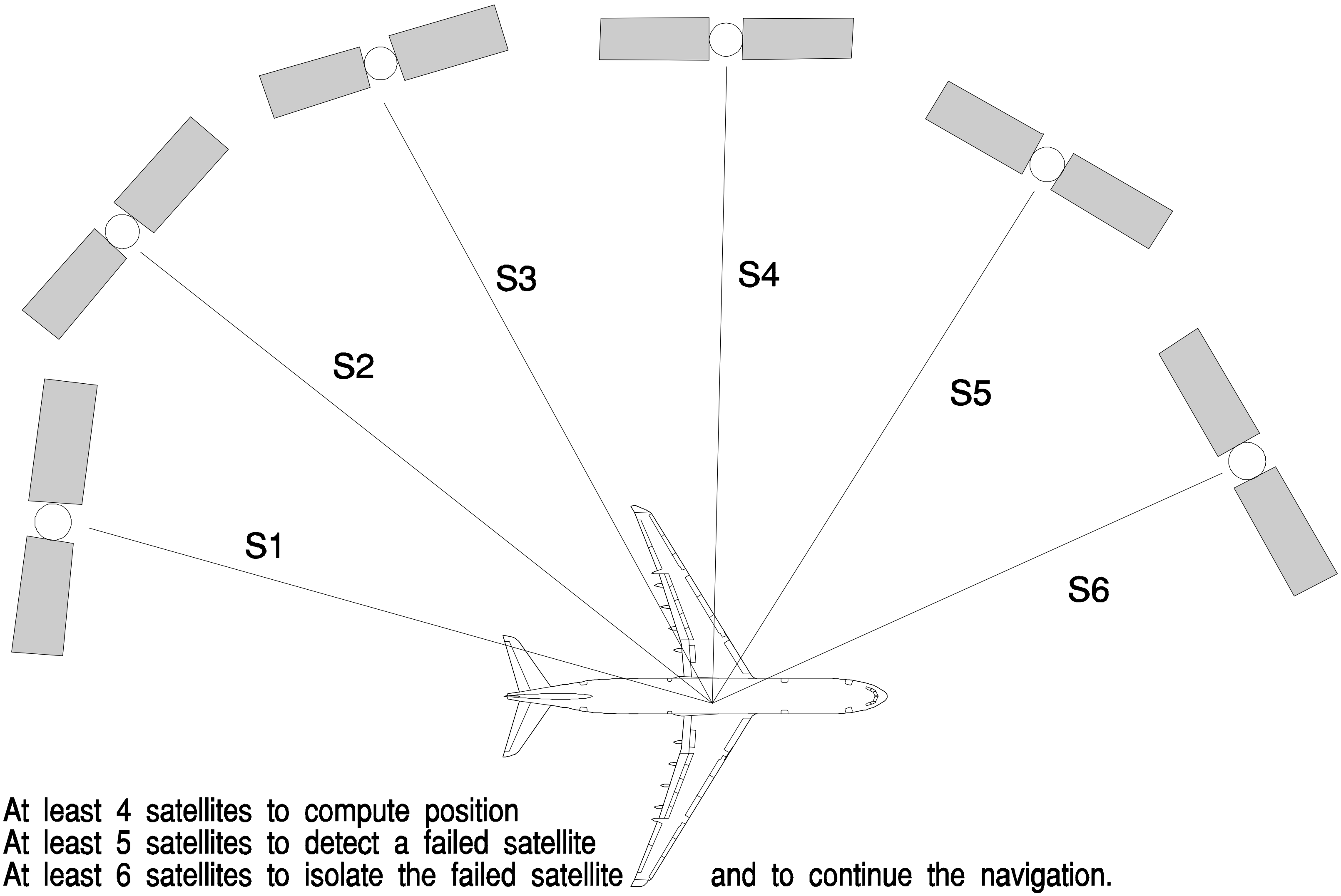
As long as the GPS is considered to be the primary means of navigation, the GPS/FMS position can be used as the position reference without navigation accuracy check.
For that purpose the GPS PRIMARY shall meet certain requirements:

- Navigation accuracy:
- provided data integrity;
- System availability;
- Service continuity;
- Display and annunciation capability (status, navigation accuracy and warning).

To match these requirements, solutions have been developed.

RAIM (Receiver Autonomous Integrity Monitoring):

The purpose of the RAIM function is to provide an instantaneous integrity estimation of the computed GPIRS / GPS position. For that purpose, the GPSSU uses all satellites that are tracked except those currently declared as failed.



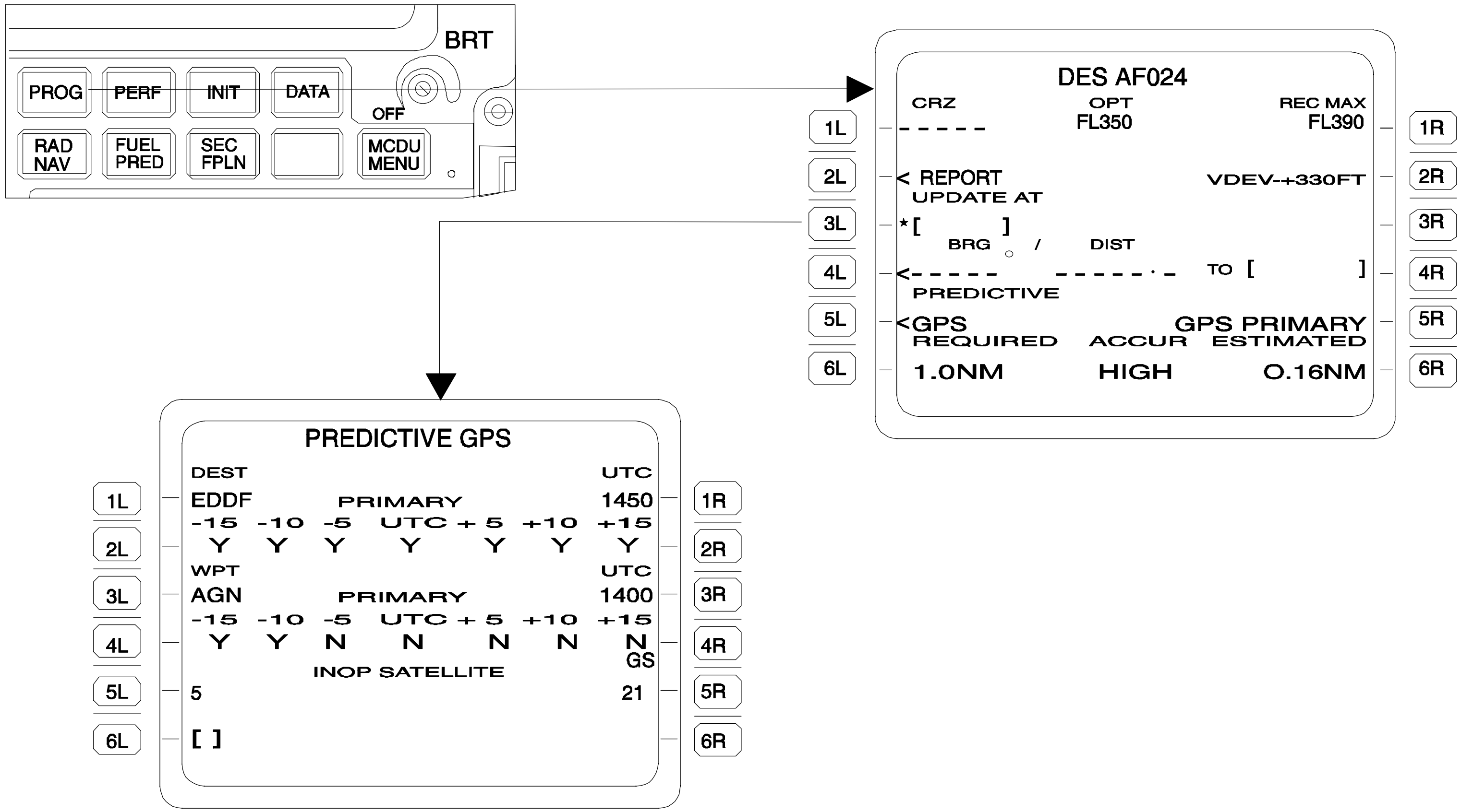
At least 4 satellites to compute position
At least 5 satellites to detect a failed satellite
At least 6 satellites to isolate the failed satellite and to continue the navigation.

FQW4200 GE Metric

GPS PRINCIPLE (CONT'D)

PRAIM (PRedictive Autonomous Integrity Monitoring):

The PRAIM is used to predict the GPS constellation integrity, at a certain time and position, requested by the user through the PREDICTIVE GPS MCDU page. The GPS almanac database is used to predict which satellites will be visible at the requested time and position. It is possible to manually deselect up to 4 satellites through the PREDICTIVE GPS MCDU page.

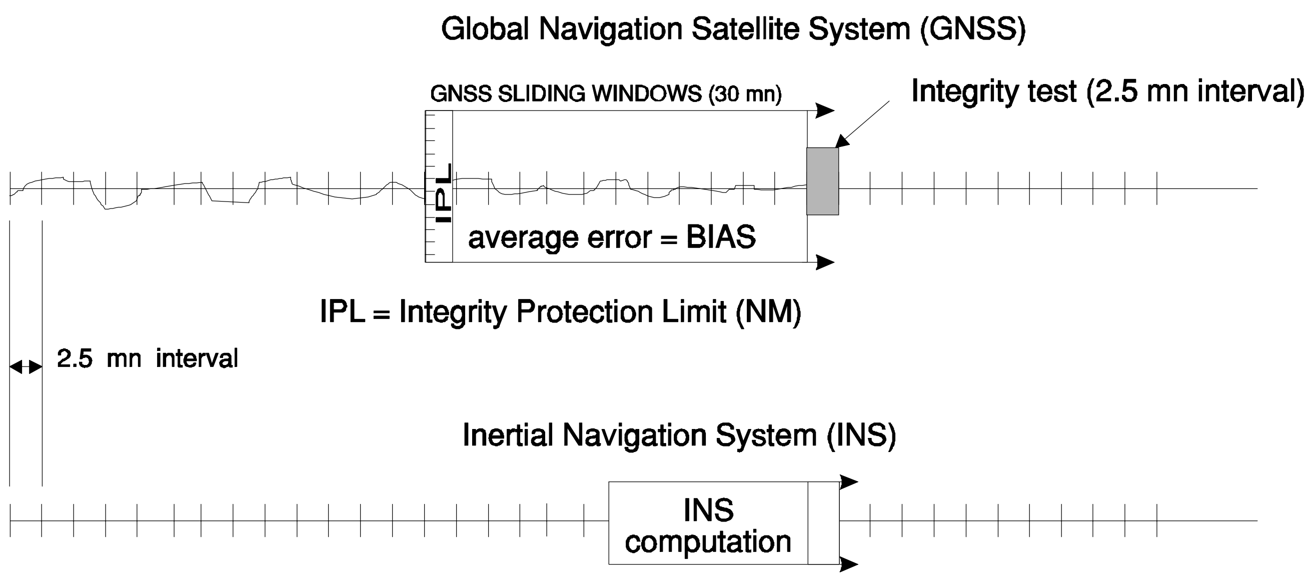


FQW4200 GE Metric

GPS PRINCIPLE (CONT'D)

AIME (Autonomous Integrity Monitoring Extrapolation):

The AIME function uses the history of GPS measurements over the last 30 minutes to ensure GPIRS integrity (it estimates satellite errors that occurred during the last 30 mn). AIME updates GPIRS position every 2.5 mn when the integrity is verified.



GNSS integrity established = updating of the INS and advancing of sliding windows

GNSS integrity not established = using of BIAS to maintain accuracy and integrity of the basic INS computation.

GPS INDICATING

There are two categories of GPS information : those permanently needed and those occasionally used.

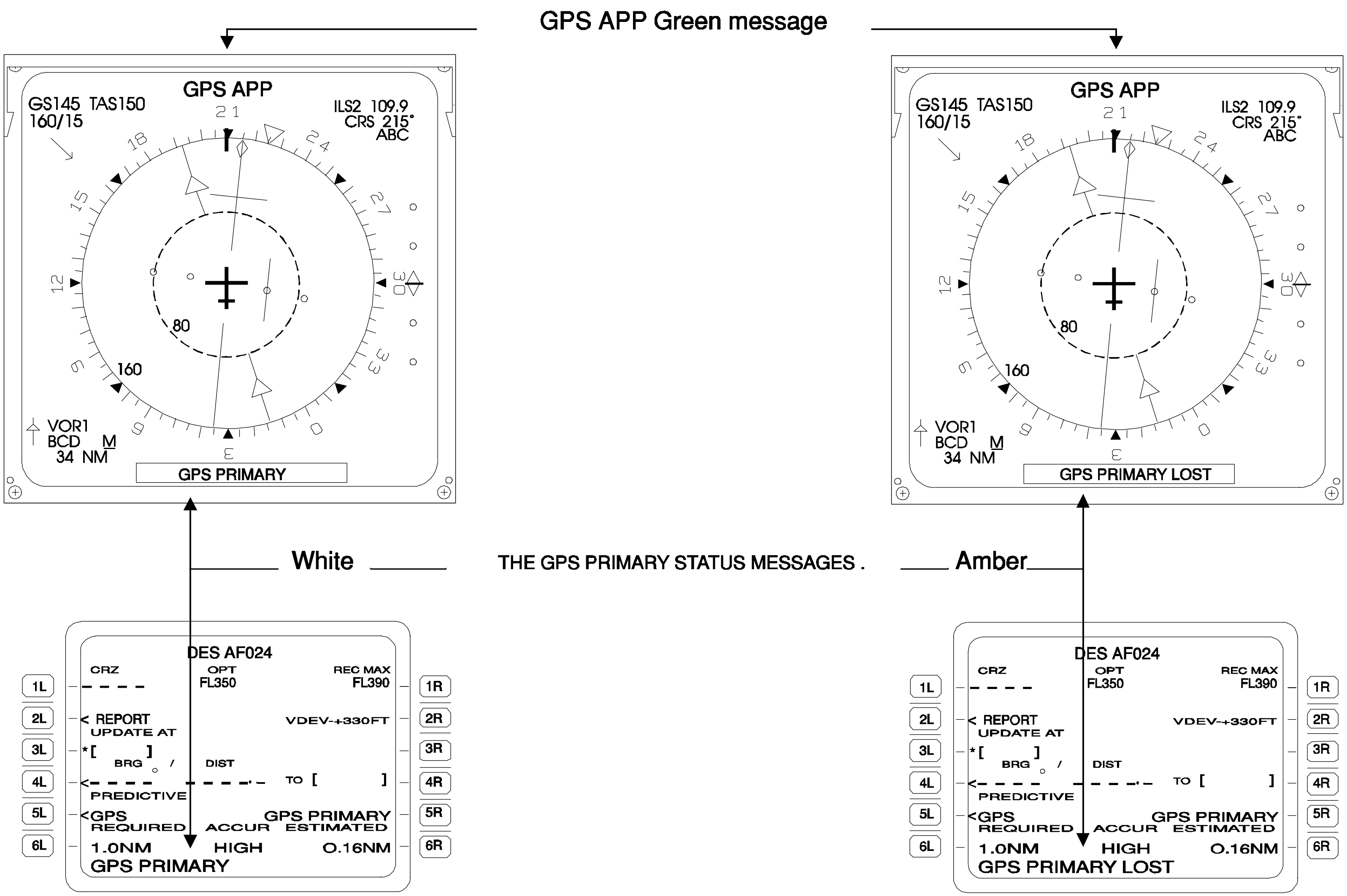
PERMANENTLY NEEDED GPS INFORMATION

This information is only displayed if the GPS is fitted with primary means of navigation capability.

GPS PRIMARY white message.
This message is displayed in all modes (except engine standby mode) when the GPS becomes primary. This message can be cleared from the MCDU.

GPS PRIMARY LOST amber message.
This message is displayed in all modes (except engine standby mode) when the GPS primary availability is lost. However, in function of the required accuracy and integrity required for the intended operation, the GPS can be used as an alternate navigation means. The message displayed on the MCDU can be cleared from the MCDU while the one displayed on ND stays in view.
An aural alert is generated in case of a non-precision approach.

GPS APP green message.
This message is displayed in all modes (except engine standby mode) when a GPS approach is selected in the flight plan.



FQW4200 GE Metric

GPS INDICATING (CONT'D)

OCCASIONALLY NEEDED GPS INFORMATION

PREDICTIVE RAIM (Optional)

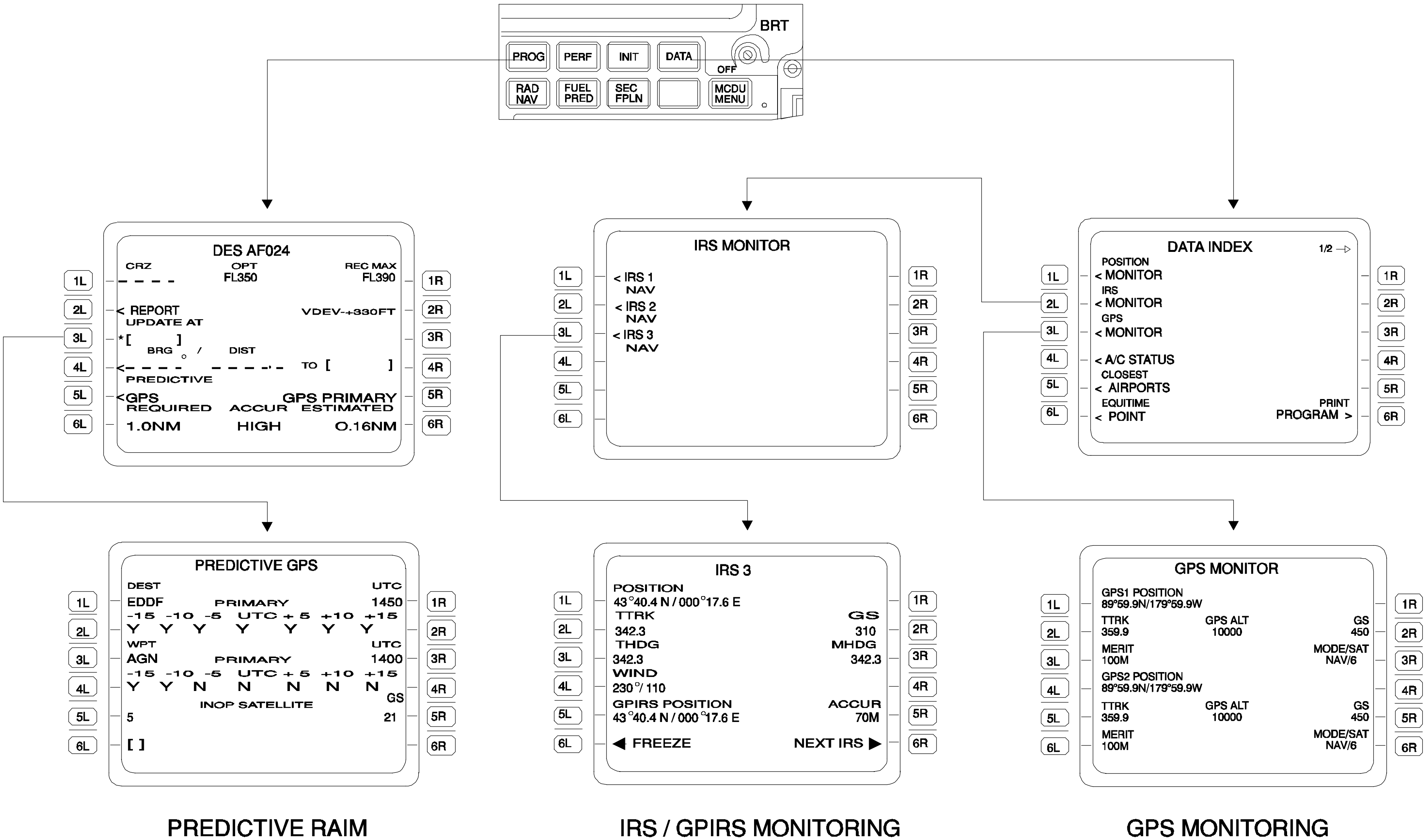
Enables prediction of the RAIM computation availability at destination, from - 15 to +15 mn around the pilot modifiable ETA (Estimated Time of Arrival) and location.

GPS MONITOR PAGE

The displayed data are:
- GPS position (lat/long)
- True Track
- Figure of merit (meter)
- Ground Speed
- Mode
- Number of satellites tracked
- GPS altitude.

IRS/GPIRS MONITORING

Provides the raw data of the selected IRS, the hybrid GPIRS position and estimated accuracy.



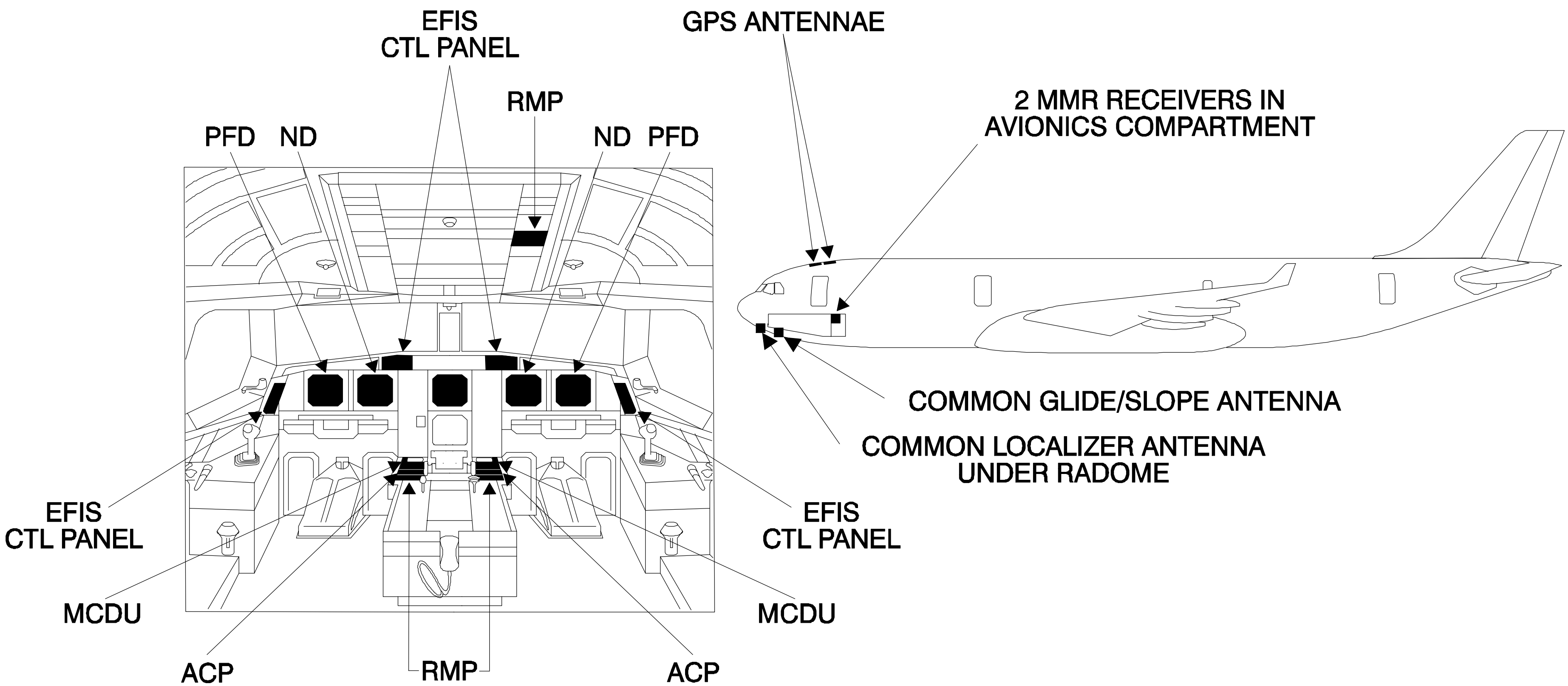
FQW4200 GE Metric

MMR COMPONENTS

The Components are 2 ILS antennae, 2 GPS antennae and 2 MMR units.

The ILS system is also connected to :

- Primary Flight Display (PFD) and Navigation Display (ND) for display.
- Electronic Flight Instrument System (EFIS) control unit for display control.
- Flight Management Guidance and Envelope Computer (FMGEC) for auto-tuning.
- Multipurpose Control Display Units (MCDU) for manual tuning.
- Captain and First Officer Radio Management Panels (RMP) for back-up tuning.
- Audio Control Panels for ILS audio signal.
- Air Data and Inertial Reference Unit for GPIR data.



FQW4200 GE Metric

STUDENT NOTES:

MMR D/O

- ILS Function
  - Auto Tuning
  - Manual Tuning
  - FM Switching
  - Backup Tuning

- GPS function
  - ADIRU
  - FMGEC
  - ATT/HDG Switching
  - Monitoring
- Antennae
- Indicating
- GMC
- LGCIU
- Users

The Multi Mode Receiver (MMR) system includes:

- 2 MMR units,
- 1 Glide Slope (G/S) antenna,
- 1 Localizer (LOC) antenna,
- 2 GPS antennae.

ILS FUNCTION

The ILS function is to provide the crew and airborne system users with lateral (LOC) and vertical (G/S) deviation signals, with respect to the approach ILS radio beam transmitted by a ground station.

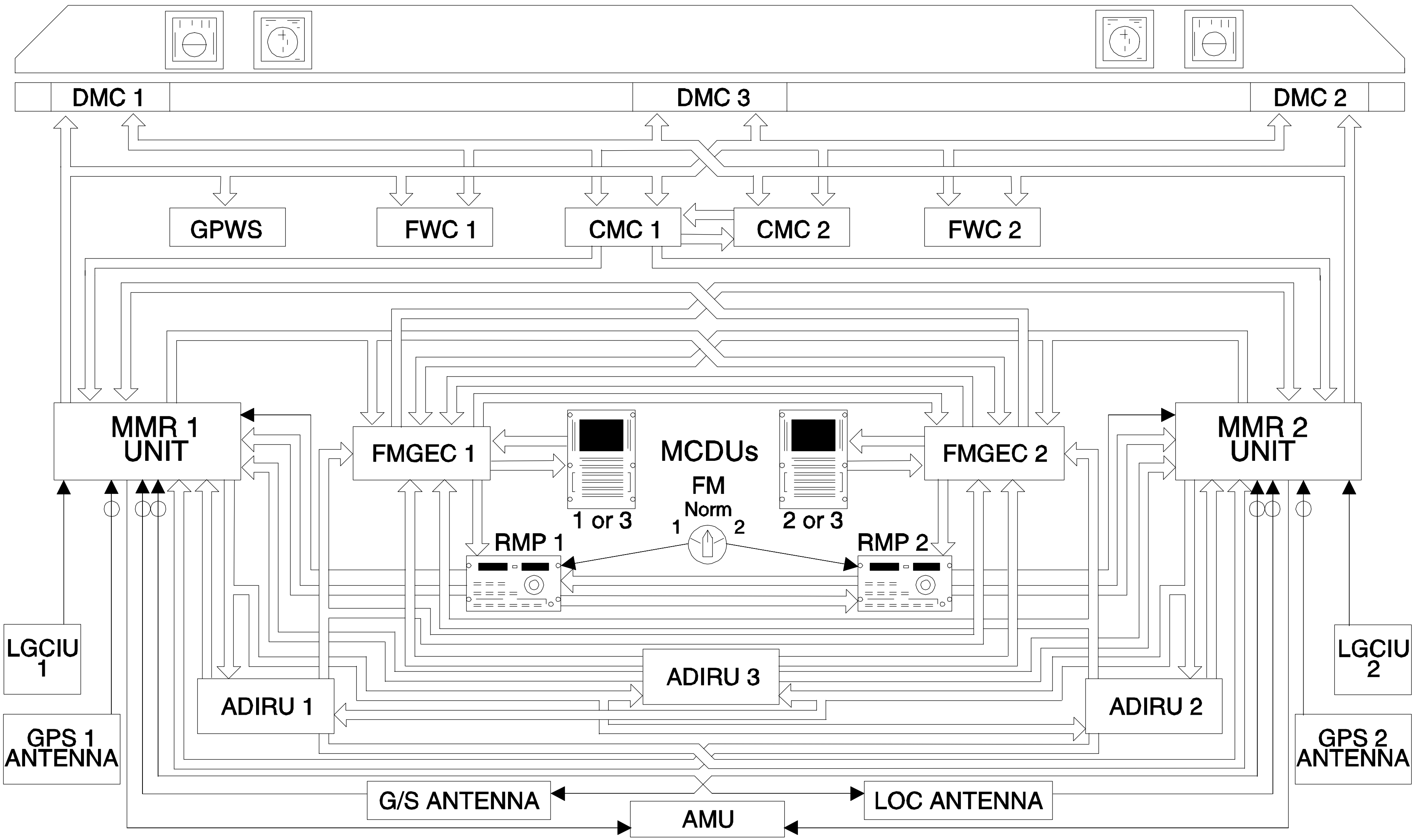
AUTO TUNING
In normal operation each Flight Management Guidance and Envelope Computer (FMGEC) automatically tunes its ownside Instrument Landing System (ILS) receiver through its ownside Radio Management Panel (RMP).

MANUAL TUNING
Each Multipurpose Control and Display Unit (MCDU) allows the ownside ILS receiver to be manually tuned through the ownside FMGEC and the opposite ILS receiver to be tuned through the opposite FMGEC.

FM SWITCHING
If an FMGEC failure occurs, a discrete, generated by the Flight Management (FM) switching, changes the tuning port of the associated ILS receiver, so that it can be directly tuned by the opposite FMGEC.

BACK UP TUNING
If both FMGECs fail, each RMP allows its ownside receiver to be directly tuned.
A discrete inhibits the radionav MCDU page, via the FMGEC.

The ILS data is exchanged between the RMPs if both are in NAV configuration.



FQW4200 GE Metric

GPS FUNCTION

The Global Positioning System (GPS) function is a stand-alone satellite navigation sensor utilizing the course acquisition code of the NAVSTAR GPS satellites.
The GPS primary function is to track the R.F. signal received from the antenna, determine the signal code phase and carrier phase, compute the antenna position and output the navigation data to the three ADIRUs.
The GPS has twelve channels, each capable of tracking NAVSTAR GPS satellite signals.

ADIRU

In normal operation, the GPS 1 data is used by ADIRU 1 and 3; the GPS 2 data by ADIRU 2.
In order to reduce GPS initialization time, ADIRU1 and 2 respectively send data to GPS 1 and 2 (IR position, Altitude, Date, UTC).

FMGEC

The Inertial Reference portions of ADIRU 1 and 2 respectively provide Flight Management Guidance and Envelope Computer (FMGEC) 1 and 2 with pure inertial reference data, hybrid GP inertial reference data used by the FMGEC for position fixing purposes and pure GPS data which is displayed on MCDU; in this case the ADIRU operates as a relay.
In case of failure of one GPS: the two ADIRUs automatically select the only operative GPS to compute hybrid GPIR data.

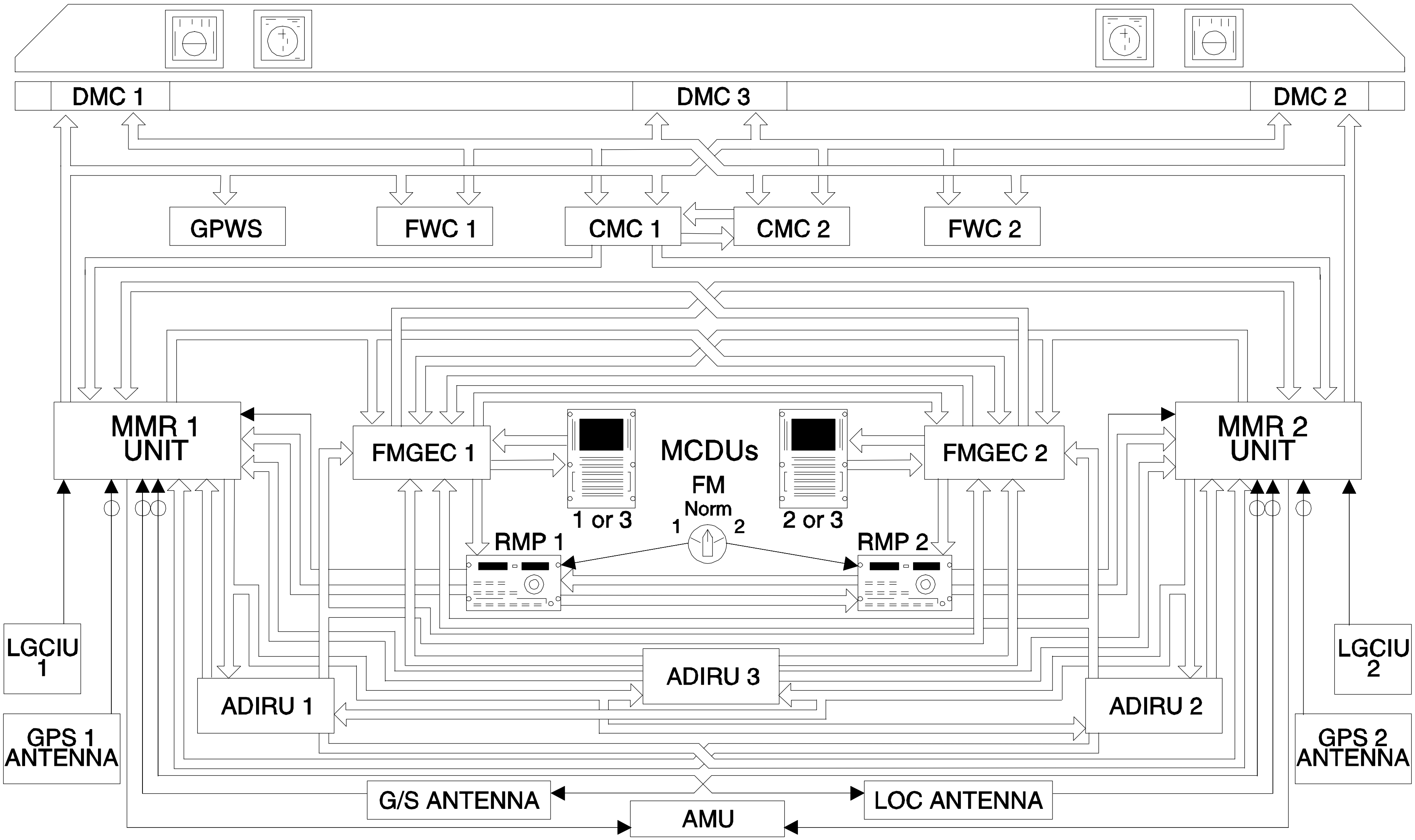
ATT/HDG SWITCHING

In case of failure of ADIRU 1, FMGEC 1 uses ADIRU 3 / GPS 1 data and in case of failure of ADIRU 2 , FMGEC 2 uses ADIRU 3 / GPS 2 data.
The primary source of ADIRU 3 being GPS 1, it is necessary to select the secondary input part of ADIRU 3 (GPS2) by means of the SWITCHING ATT/HDG selector switch to preserve side 1 /side 2 segregation (GPS1/ADIRU1/FMGEC1 and GPS2/ADIRU3/FMGEC2 architecture).

MONITORING

The GPSs are monitored by the three ADIRUs using the status word send by each GPS and the BITE of the inertial reference portion.
In case of GPS failure, the NAVGPS 1(2) FAULT message is displayed on the lower part of the Engine/Warning Display (EWD).
This message is accompanied by :

- activation of the MASTER CAUTION lights on the glareshield,
- aural warning: Single Chime (SC).



FQW4200 GE Metric

ANTENNAE

The Glide Slope (G/S) and Localizer (LOC) antennae are common to both receivers. Each antenna has two independent connectors, used for feeding the two ILS receivers.
The G/S antenna operates in the 329-335 Mhz range.
The LOC antenna operates in the 108-112 Mhz range.

The GPS antenna is an L-band active antenna.
The GPS antenna is designed to operate at 1575.42 Mhz with a right hand circular polarization and to provide an omnidirectional radiation pattern.

INDICATING

The ILS 1 data is sent to the Captain Primary Flight Display (PFD) and First Officer Navigation Display (ND), while the ILS 2 data is sent to the F/O PFD and CAPT ND.

The ILS data is sent through the Display Management Computers (DMC).
The ILS audio signal is processed by the receivers and sent to the Audio Management Unit (AMU) and can be heard by the crew.

The GPS data is displayed on the GPS Monitor Page of the MCDU through the FMGEC and operational messages may be displayed on the NDs.

The data displayed on MCDU is:
- GPS position (Lat/Long),
- true track,
- figure of merit (in meters),
- ground speed,
- mode,
- GPS altitude,
- number of satellites tracked.

CMC

The BITE of the MMR is connected to the Central Maintenance Computer (CMC).
The units tested are the MMR units, antennae and coaxial cable.
The tests are only available on ground.

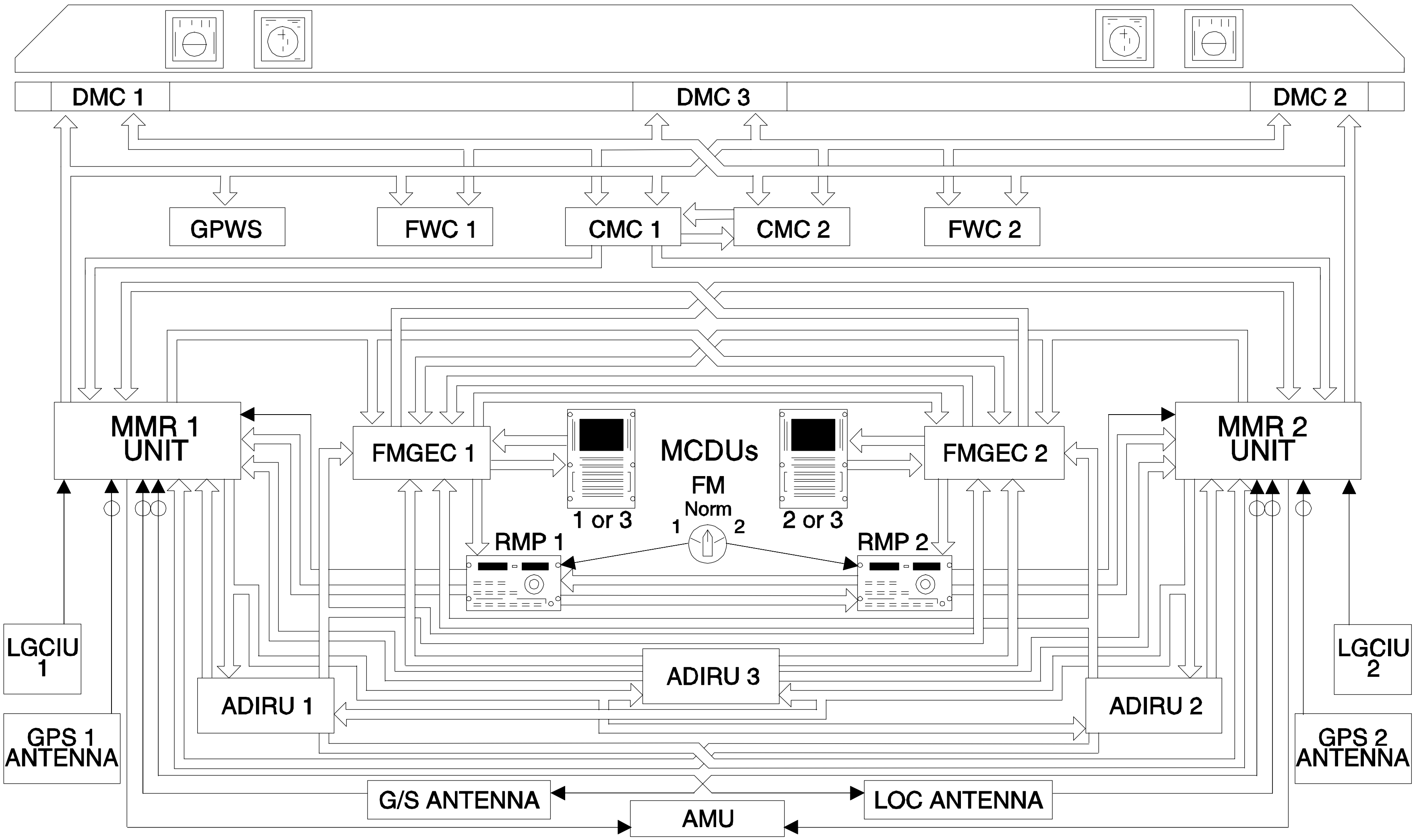
LGCIU

Each Landing Gear Control Interface Unit (LGCIU) sends discrete signals to the associated MMR unit.
This Ground/Flight information is used by the receiver BITE module to count the flight legs.

USERS

The MMR data is send to the FMGEC for aircraft guidance during take off, approach and landing phases.

The MMR data is send to the Electronic Centralized Aircraft Monitoring (ECAM) via the Flight Warning Computers (FWC).
The MMR1 data is sent to the (Enhanced) Ground Proximity Warning System ((E)GPWS).



FQW4200 GE Metric

STUDENT NOTES:

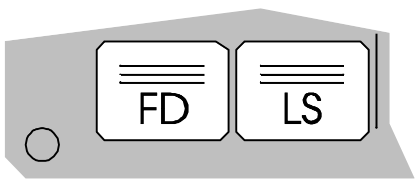
MMR INDICATIONS ON PFD AND ND

ILS INDICATIONS ON PFD

Instrument Landing System (ILS).
Primary Flight Display (PFD).
Distance Measuring Equipment (DME).

LS PUSHBUTTON

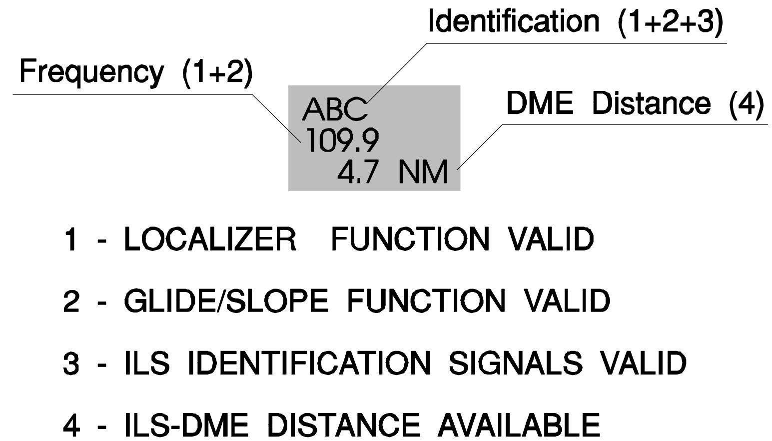
LANDING SYSTEM (LS) PUSHBUTTON



The ILS data is displayed on the PFD if the Landing System pushbutton is switched on on the Electronic Flight Instrument System (EFIS) control panel.

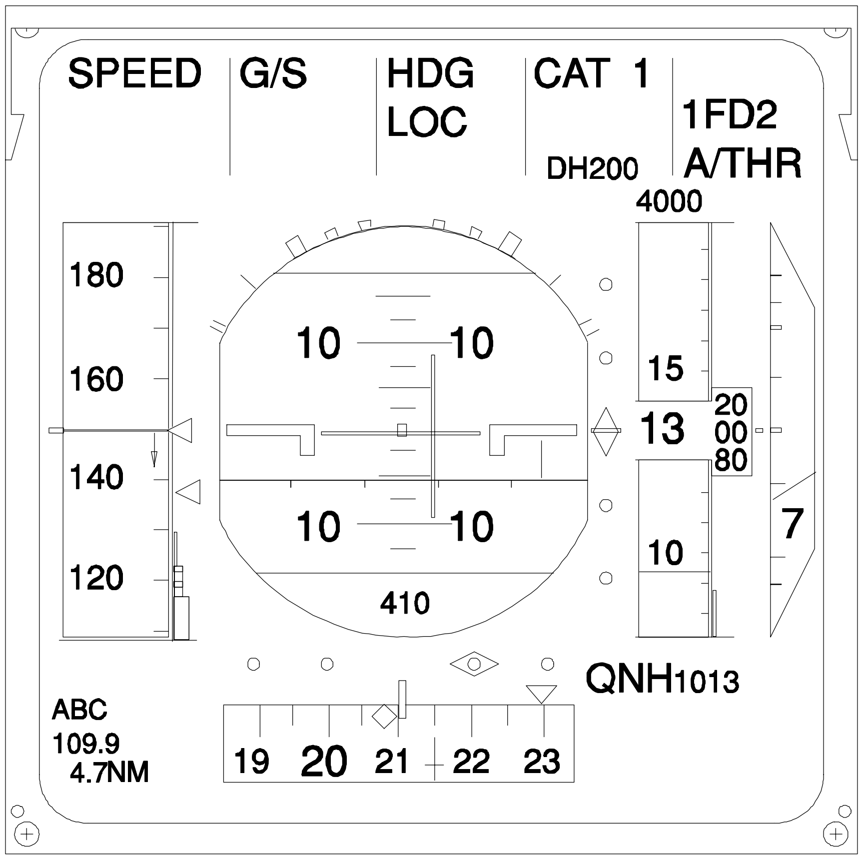
ILS CHARACTERISTICS

CONDITIONS OF DISPLAY



The ILS characteristics are displayed in magenta in the bottom left corner of the PFD.

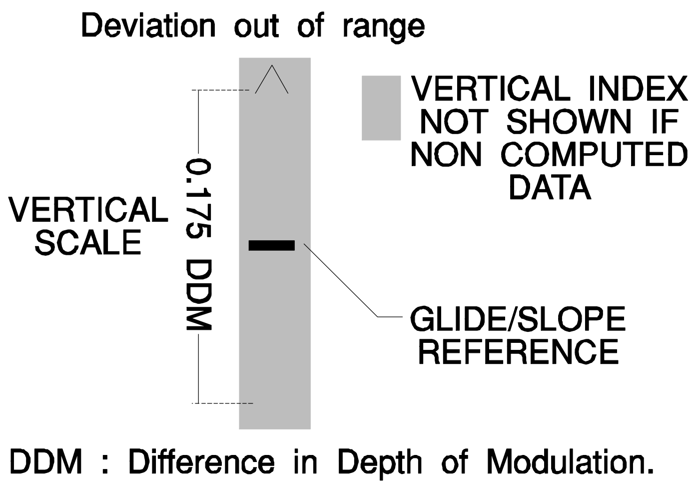
The ILS identification is displayed after decoding by the ILS receiver.



FQW4200 GE Metric

VERTICAL DEVIATION

CONDITIONS OF DISPLAY



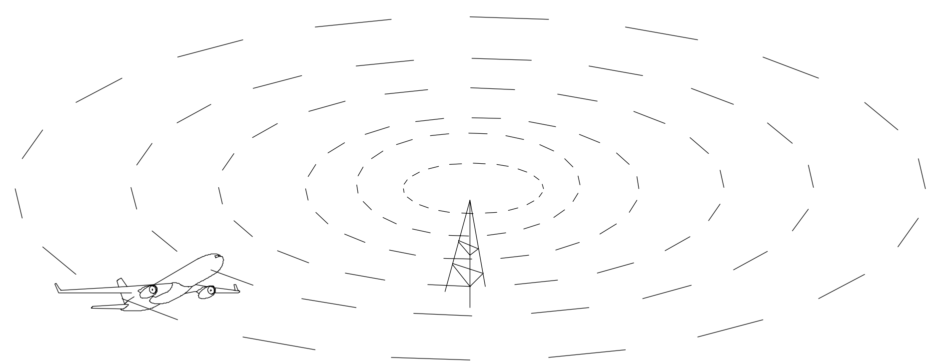
The vertical deviation is associated with the Glide/Slope beam reception.

The vertical scale and the vertical index flash when the deviation is excessive.

When the deviation is out of range the vertical index is against one stop and only its outer half remains in view.

LATERAL DEVIATION

CONDITIONS OF DISPLAY

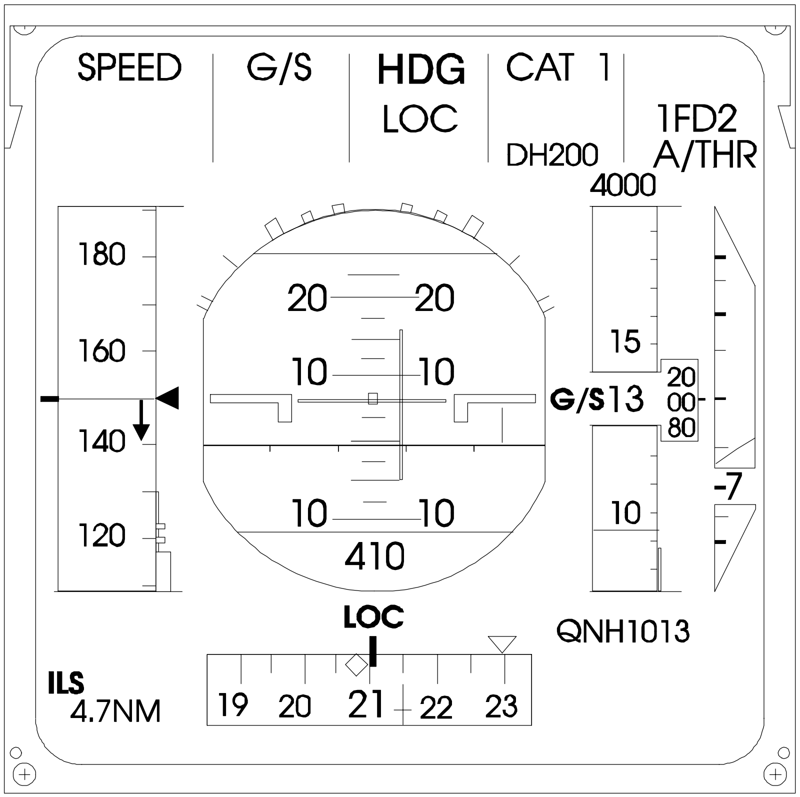


The lateral deviation is associated with the Localizer beam reception.

The lateral scale and the lateral index flash when the deviation is excessive.

When the deviation is out of range the lateral index is against one stop and only its outer half remains in view.

FLAGS

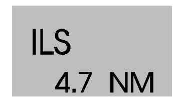


CONDITIONS OF DISPLAY

GLIDE/SLOPE

G/S SYMBOL FLASHES FOR 9 SECONDS THEN STEADY.

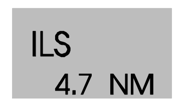
THE ILS CHARACTERISTICS ARE REPLACED BY A FLAG



LOCALIZER

LOC SYMBOL FLASHES FOR 9 SECONDS THEN STEADY.

THE ILS CHARACTERISTICS ARE REPLACED BY A FLAG.



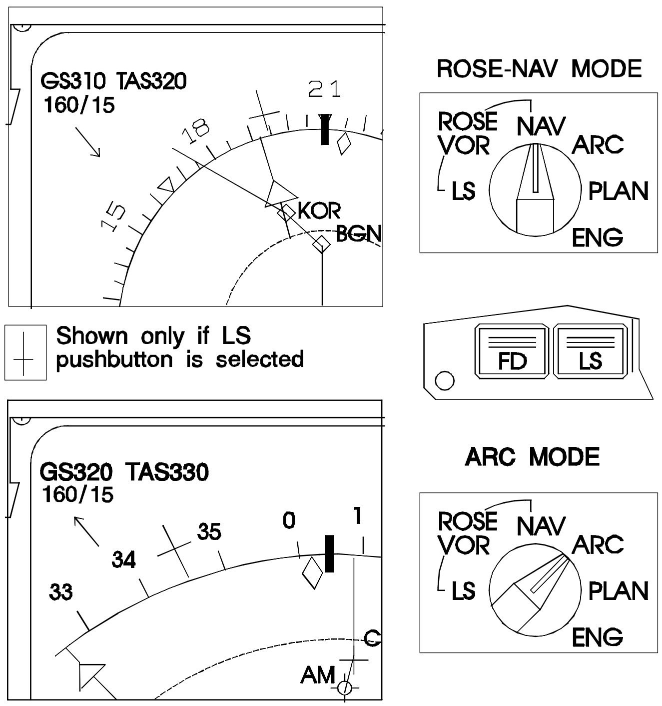
When a failure occurs, a corresponding flag is shown in red.

ILS INDICATIONS ON ND

Navigation Display (ND).

DATA DISPLAY

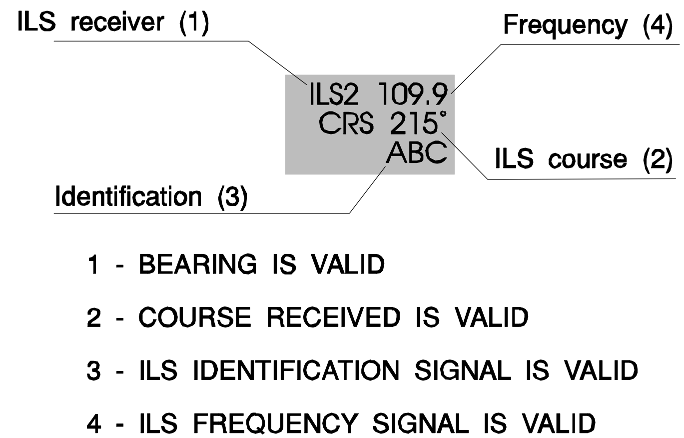
LANDING SYSTEM (LS) PUSHBUTTON



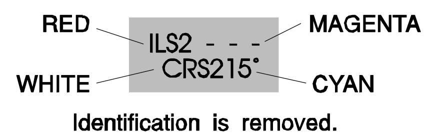
All the indications are displayed in ROSE-LS mode while only the ILS dagger course is displayed in ARC or NAV mode if the Landing System pushbutton is selected.

ILS CHARACTERISTICS

CONDITIONS OF DISPLAY

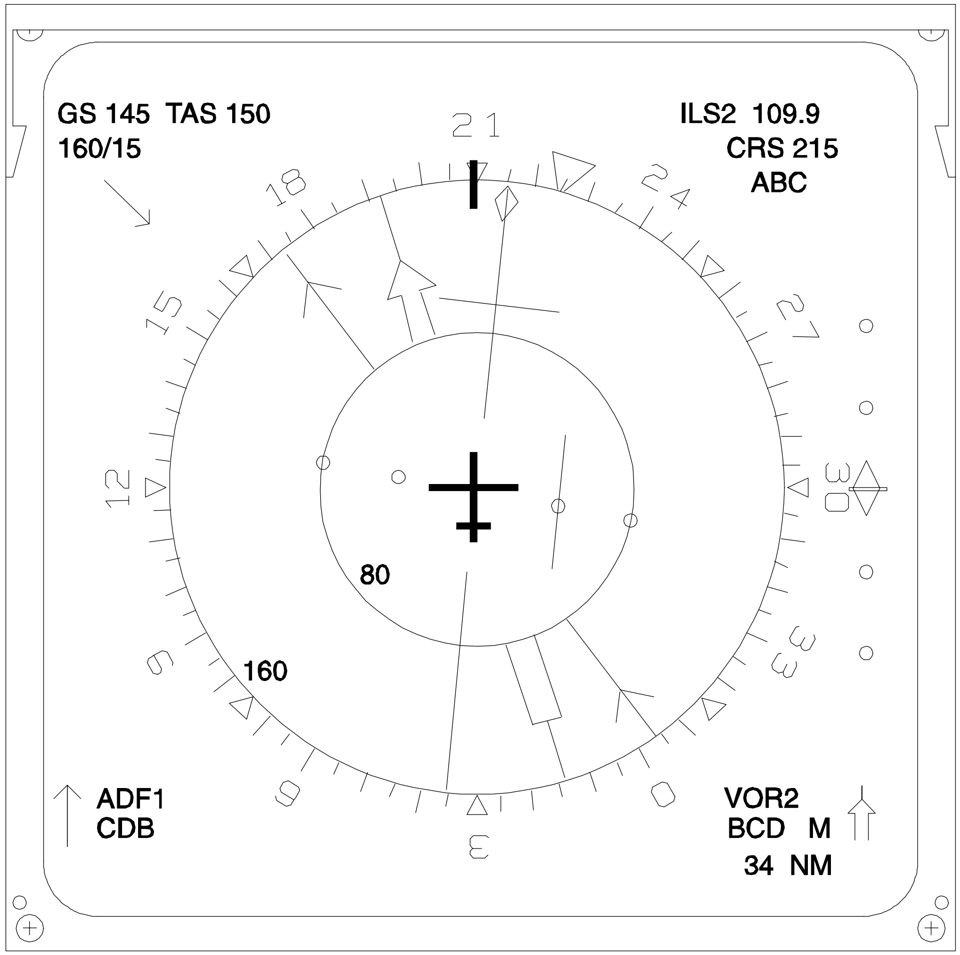


NON COMPUTED DATA



In ROSE-LS mode, the ILS characteristics are displayed in magenta, in the top right corner of the ND.

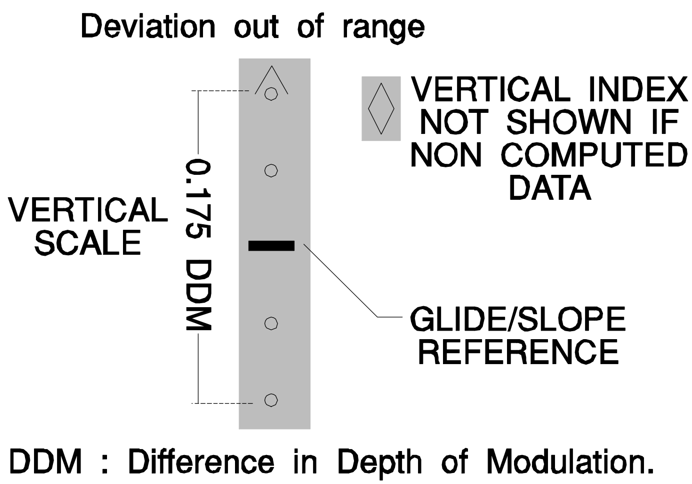
The ILS identification is displayed after decoding by the ILS receiver.



FQW4200 GE Metric

VERTICAL DEVIATION

CONDITIONS OF DISPLAY



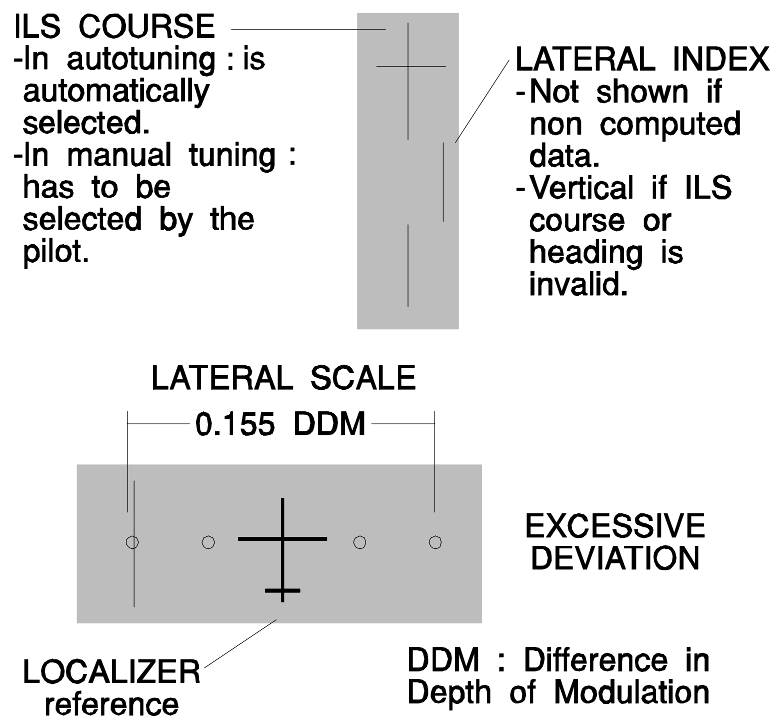
The vertical deviation is associated with the Glide/Slope beam reception.

The vertical scale and the vertical index flash when the deviation is excessive.

When the deviation is out of range the vertical index is against one stop and only its outer half remains in view.

LATERAL DEVIATION

CONDITIONS OF DISPLAY

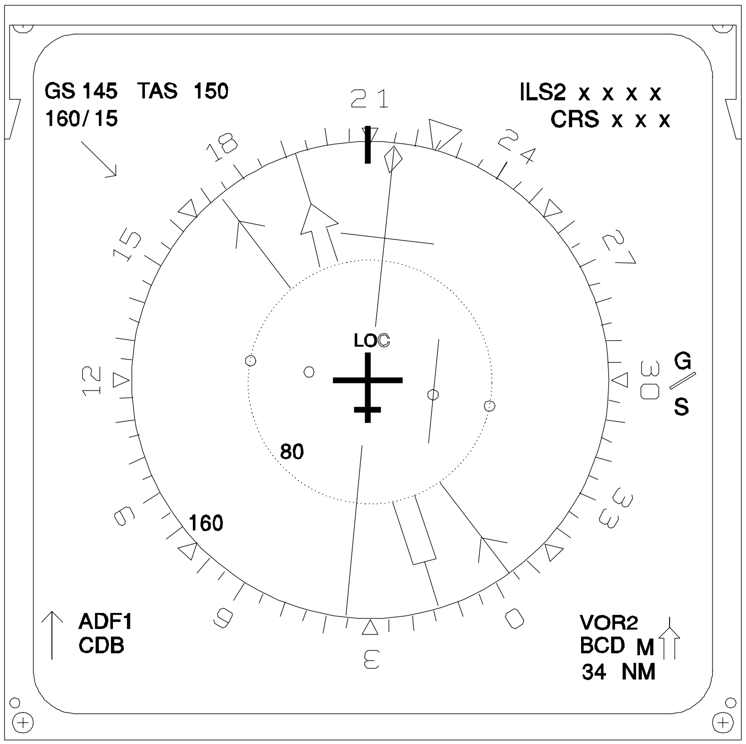


The lateral deviation is associated with the Localizer beam reception.

The lateral scale and the lateral index flash if the deviation is excessive.

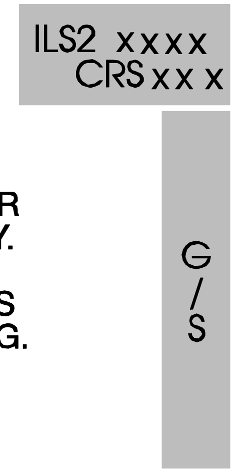
The lateral index, corresponding to the center part of the ILS course dagger, can move on the deviation scale and gives the Localizer deviation.

FLAGS



CONDITIONS OF DISPLAY

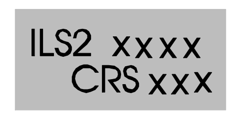
GLIDE/SLOPE



G/S SYMBOL FLASHES FOR 9 SECONDS THEN STEADY.

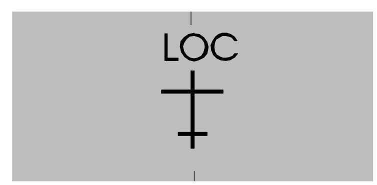
THE ILS CHARACTERISTICS ARE REPLACED BY A FLAG.

LOCALIZER



LOC SYMBOL FLASHES FOR 9 SECONDS THEN STEADY

THE ILS CHARACTERISTICS ARE REPLACED BY A FLAG.



In ROSE-LS mode, when a failure occurs, a corresponding flag is displayed in red.

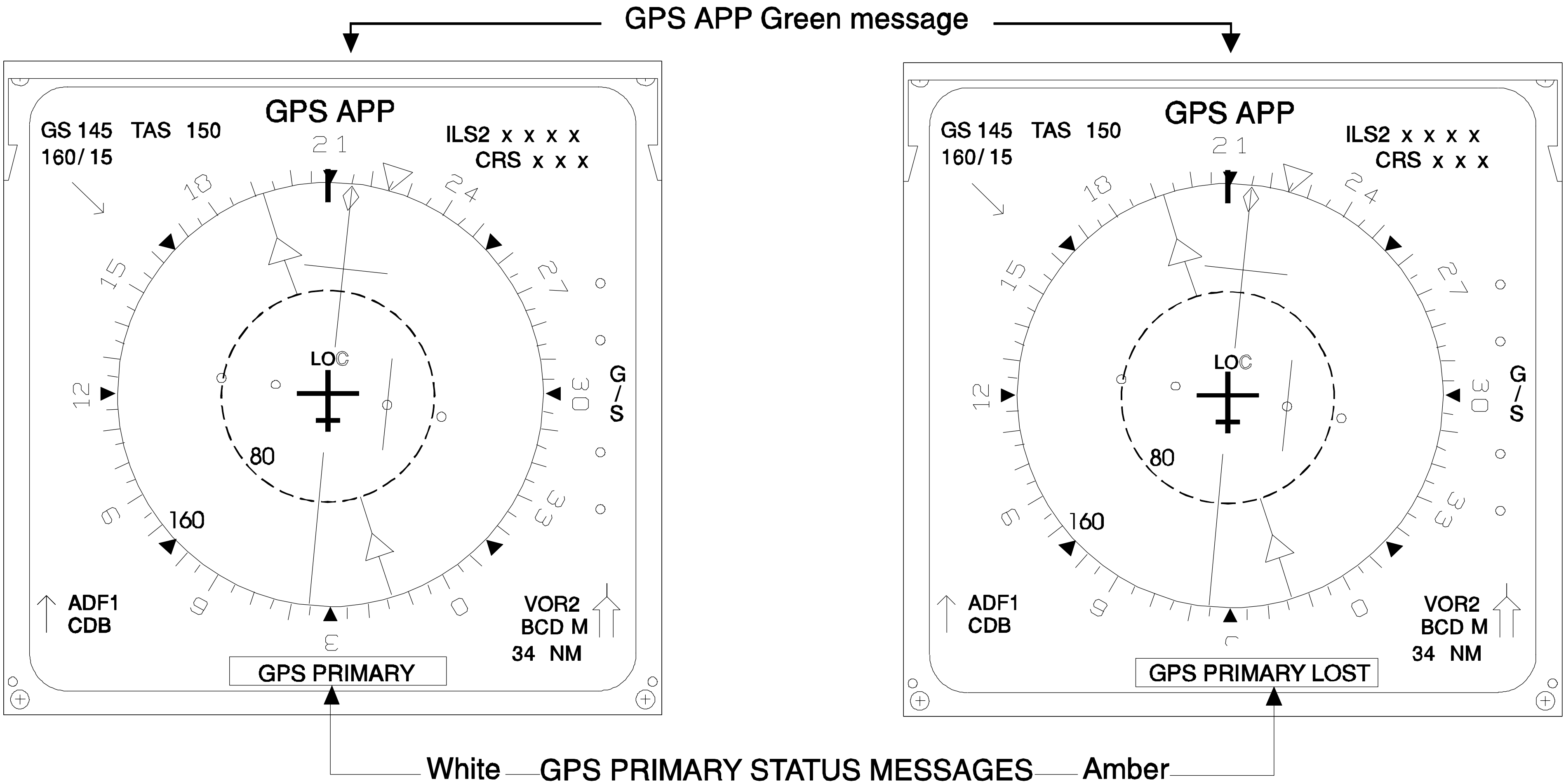
GPS INDICATIONS ON ND

This information is only displayed if the GPS is fitted with primary means of navigation.

GPS APP green message.
This message is displayed in all modes (except engine standby mode) when a GPS approach is selected in the flight plan.

GPS PRIMARY white message.
This message is displayed in all modes (except engine standby mode) when the GPS becomes primary. This message can be cleared from the MCDU.

GPS PRIMARY LOST amber message.
This message is displayed in all modes (except engine standby mode) when the GPS primary availability is lost. However, depending on the accuracy and integrity required for the intended operation, the GPS can be used as an alternate navigation means. This message cannot be cleared from the MCDU.



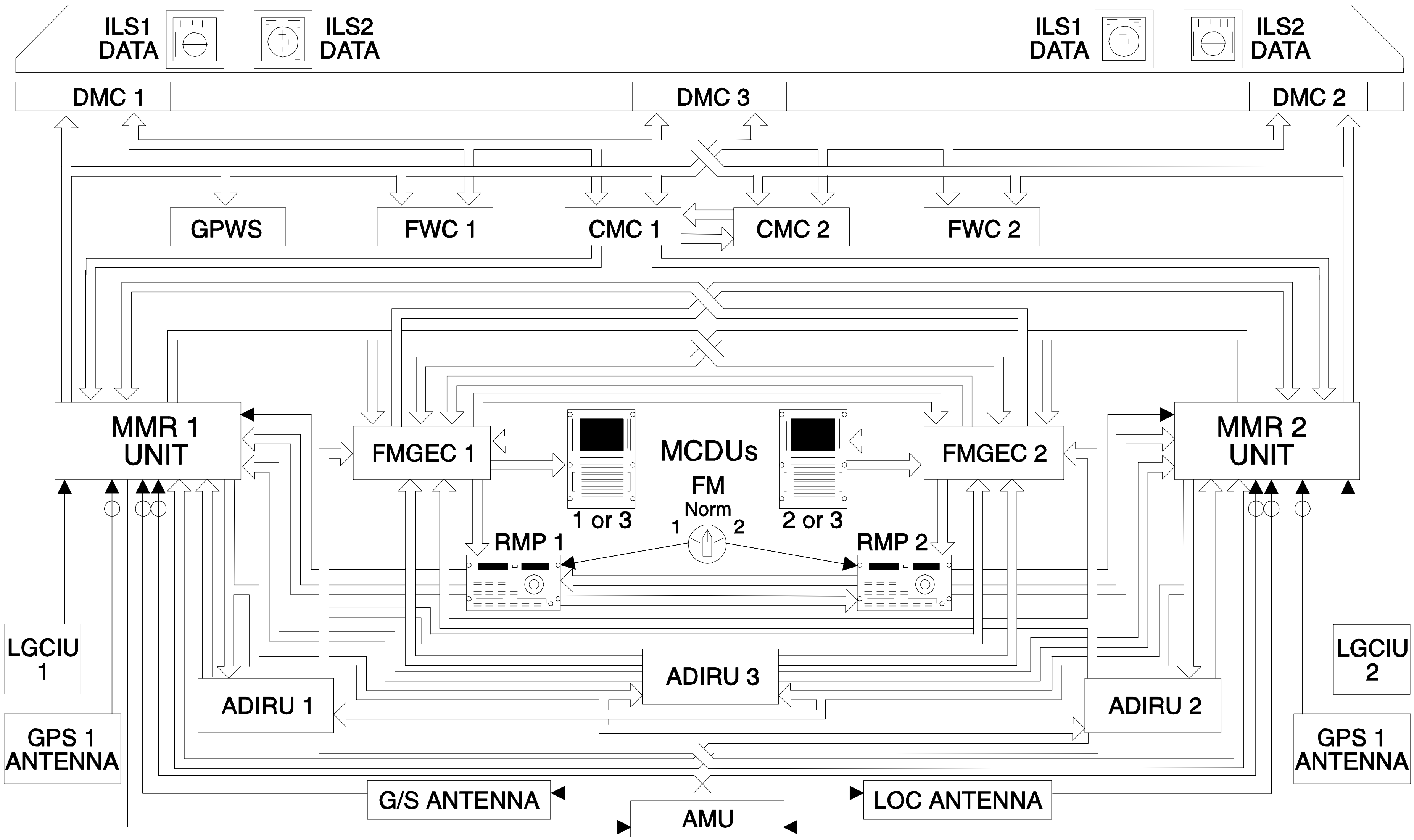
FQW4200 GE Metric

STUDENT NOTES:

MMR COMPONENTS

MMR Units 1/2
Glide/Slope Antenna
Localizer Antenna
GPS Antennae 1/2

STUDENT NOTES



FQW4200 GE Metric

MMR UNITS 1/2

FIN : 40RT1, 40RT2

ZONE : 120, 120

COMPONENT DESCRIPTION

The face of the receiver is fitted with a handle, two lugs, a test P/B and three LEDs.
The back is equipped with one ARINC 600 size one connector which includes three plugs :

- Top Plug (TP) :

  Connection with the GPS antenna.

- Middle Plug (MP) :

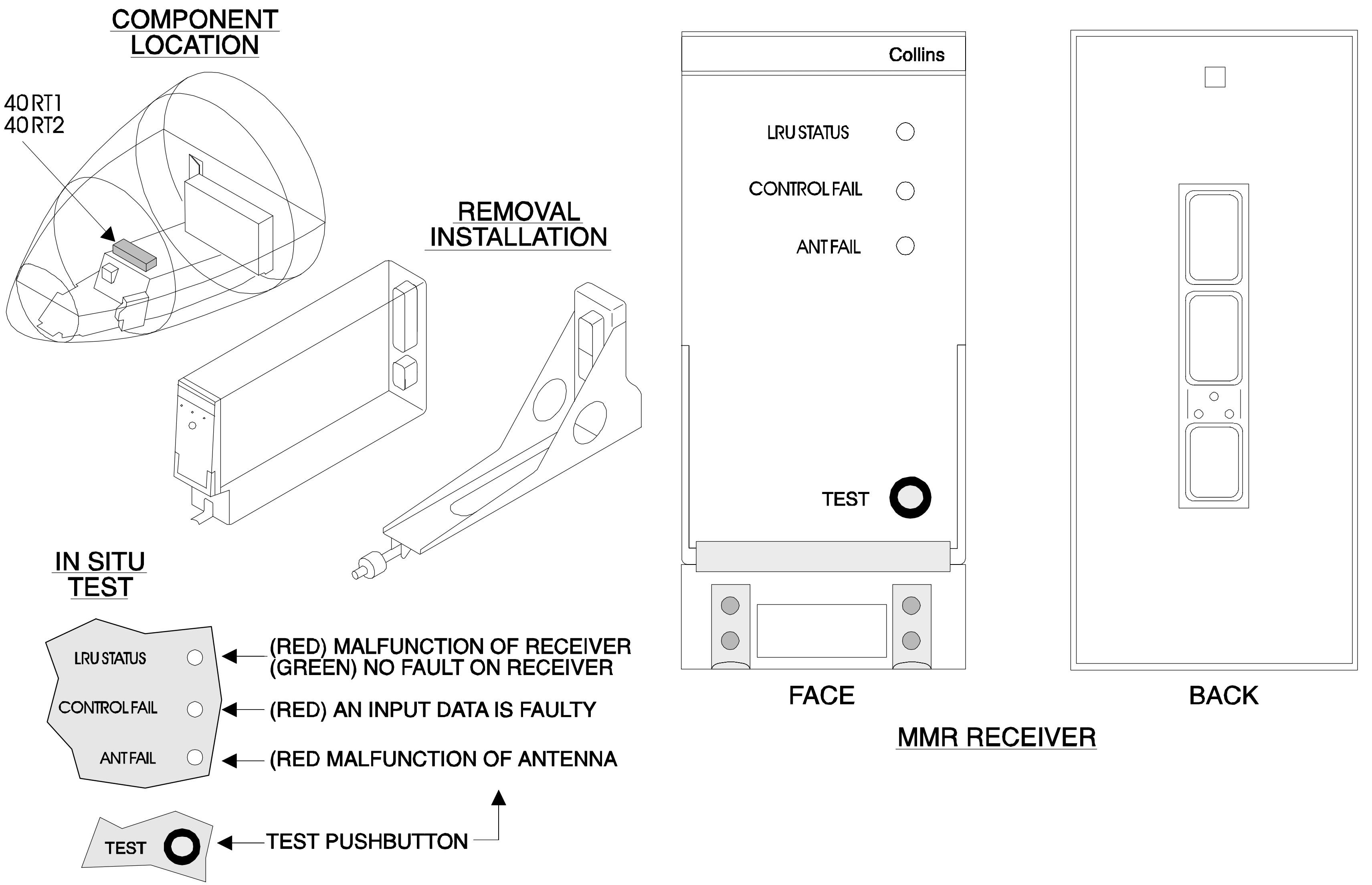
  Service interconnection.

- Bottom Plug (BP) :

  Connection with the power supply circuit (115vac-400Hz), and the LOC and G/S coaxial interconnections.

IN SITU TEST

The front panel test can be activated by pressing the TEST P/B on the face of the receiver.



FQW4200 GE Metric

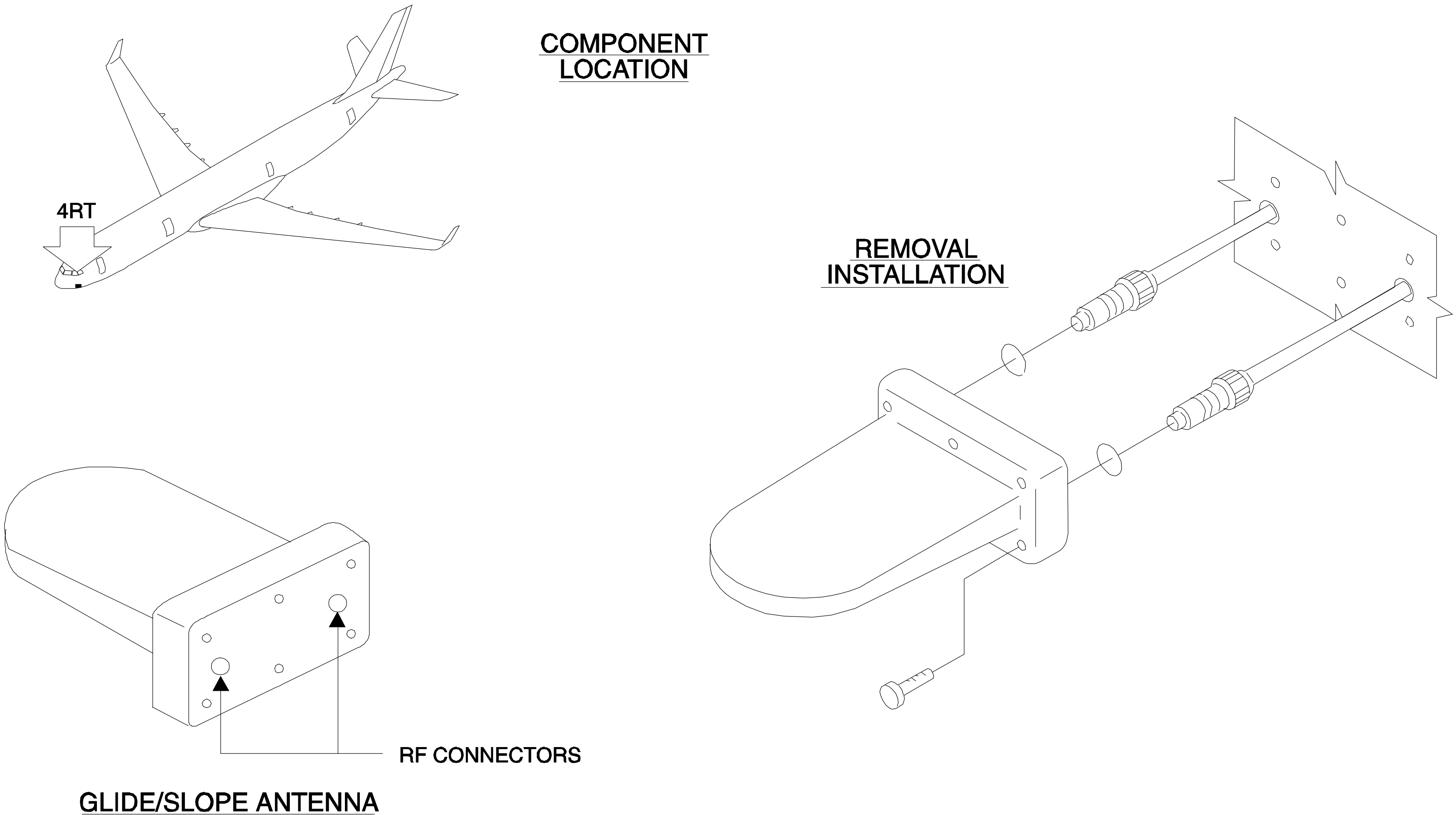
GLIDE/SLOPE ANTENNA

FIN : 4RT

ZONE : 120

COMPONENT DESCRIPTION

The Glide/Slope antenna is an airborne antenna used to receive G/S signals in the 329-335 MHz range.
This antenna has two independent RF connectors used to feed two independent ILS receivers.



FQW4200 GE Metric

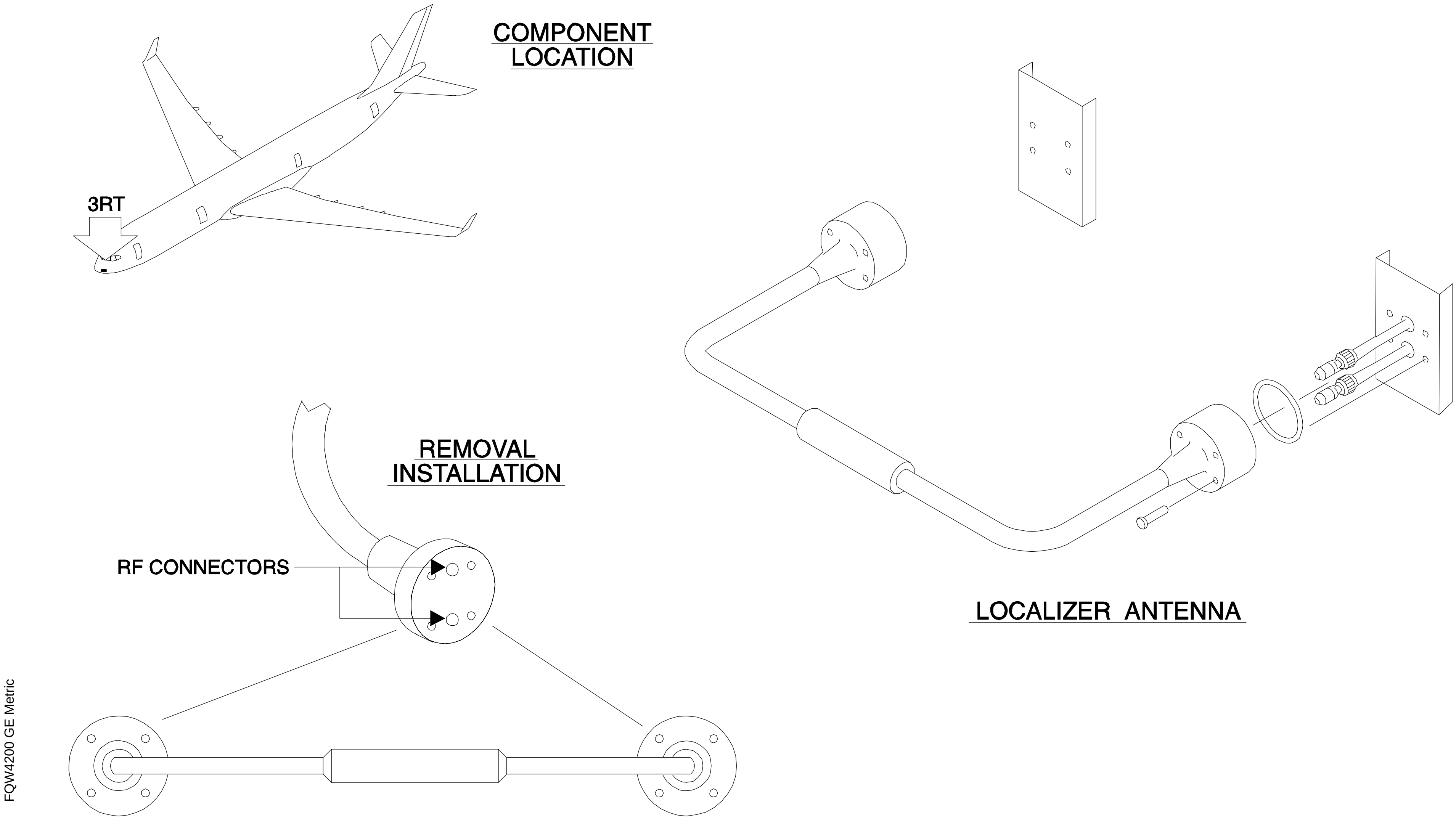
LOCALIZER ANTENNA

FIN : 3RT

ZONE : 110

COMPONENT DESCRIPTION

The Localizer antenna is an airbone antenna used to receive LOC signals in the 108-112 MHz range.
It is a folded half-loop type driven by capacitive coupling.
This antenna has two independent RF connectors used to feed two independent ILS receivers.


COMPONENT LOCATION
3RT
REMOVAL INSTALLATION
RF CONNECTORS
LOCALIZER ANTENNA
FQW4200 GE Metric

GPS ANTENNAE 1/2

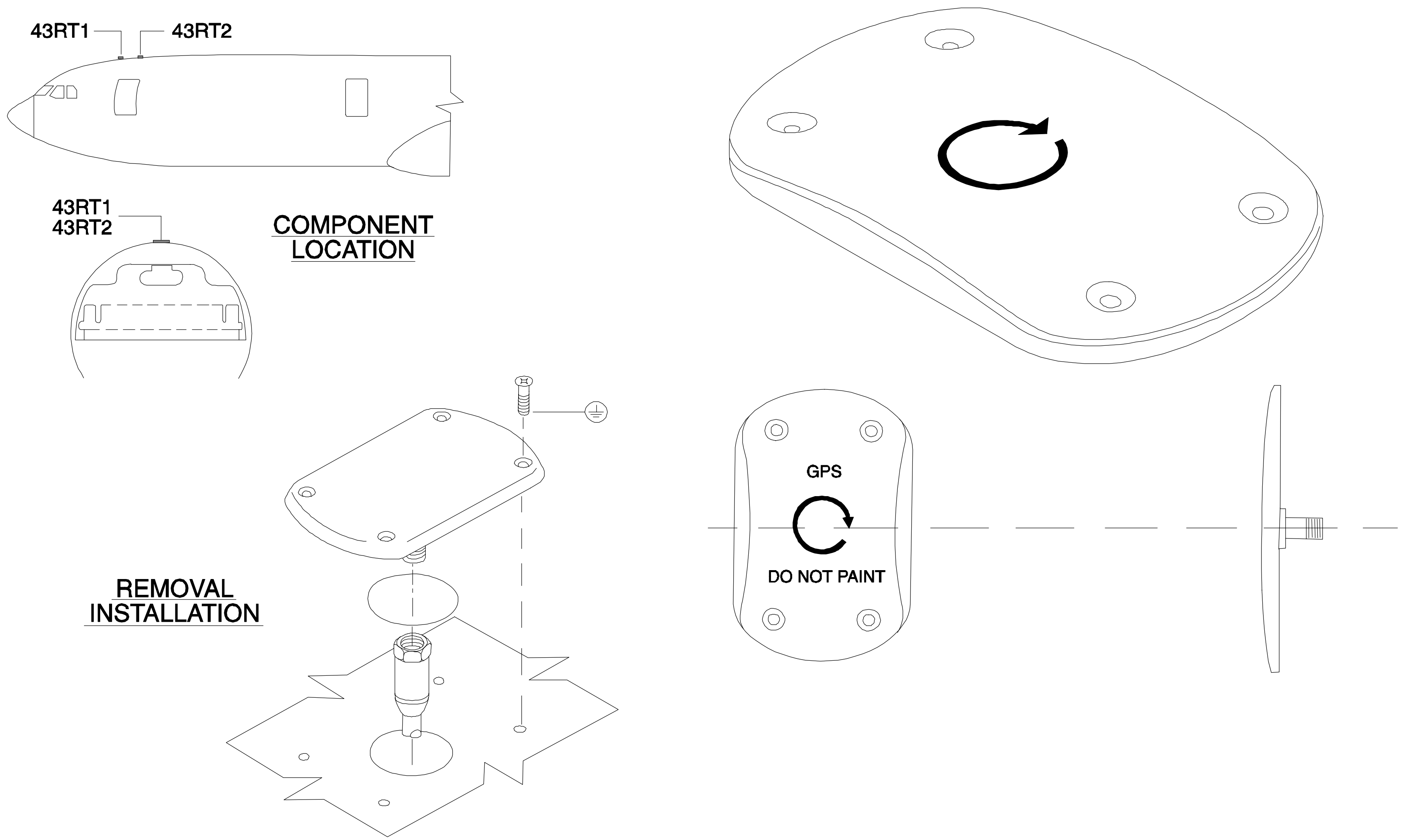
FIN/ZONE :

FIN : MMR1 - 43RT1
MMR2 - 43RT2

ZONE : MMR1 - 210
MMR2 - 210

COMPONENT DESCRIPTION

This antenna is low profile type mounted on top of the fuselage at the centerline.
It is an active antenna designed to operate at 1575,42 Mhz.



FQW4200 GE Metric

STUDENT NOTES

RADIO ALTIMETER SYSTEM PRESENTATION

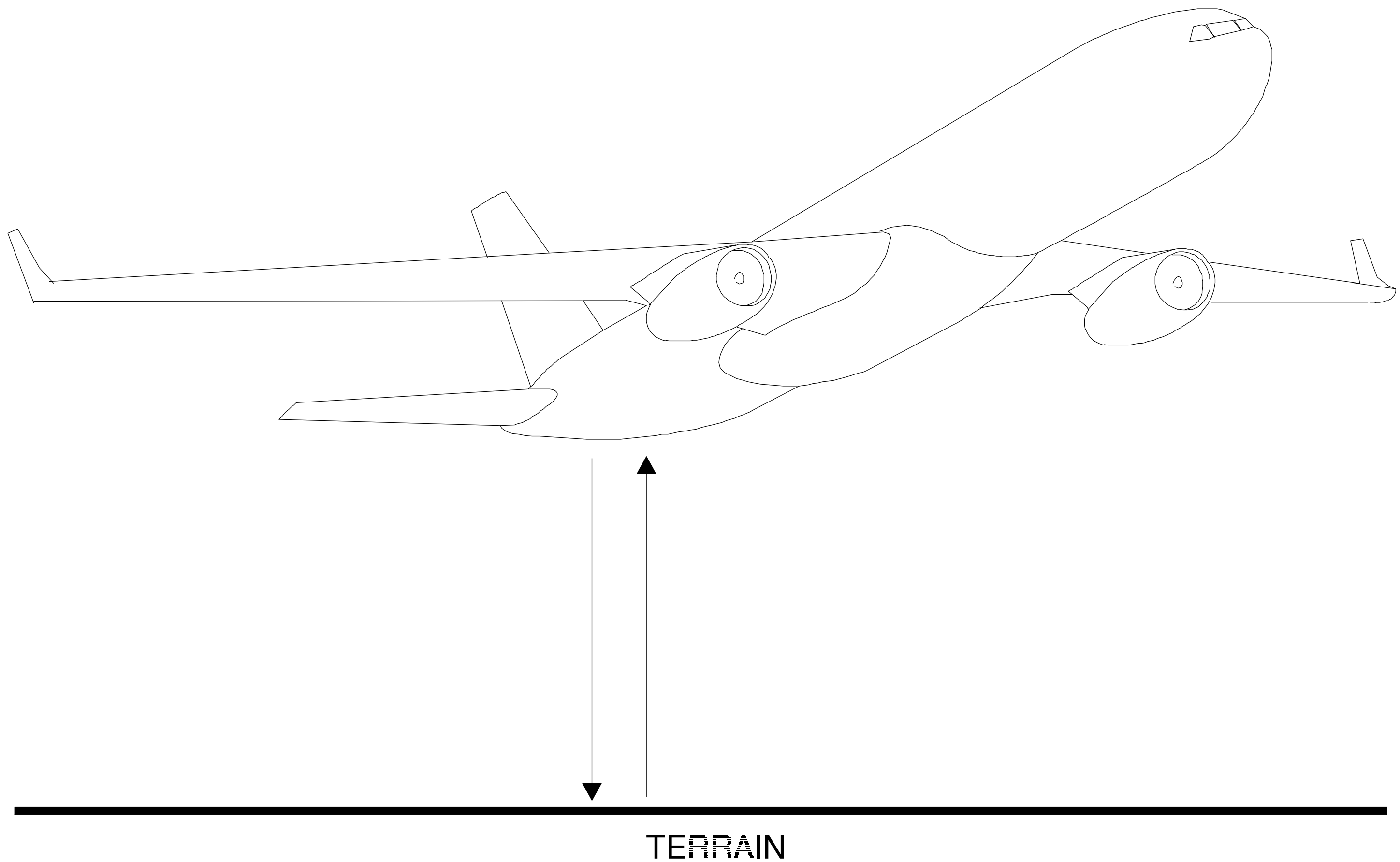
Principle
Components
Indicating

PRINCIPLE

The Radio Altimeter (RA) System determines the height of the aircraft above the terrain during initial climb, approach and landing phases.

The principle of the radio altimeter is to transmit a frequency modulated signal, from the aircraft to the ground, and to receive the ground reflected signal after a certain delay.

The time between the transmission and the reception of the RA signal is proportional to the A/C height.

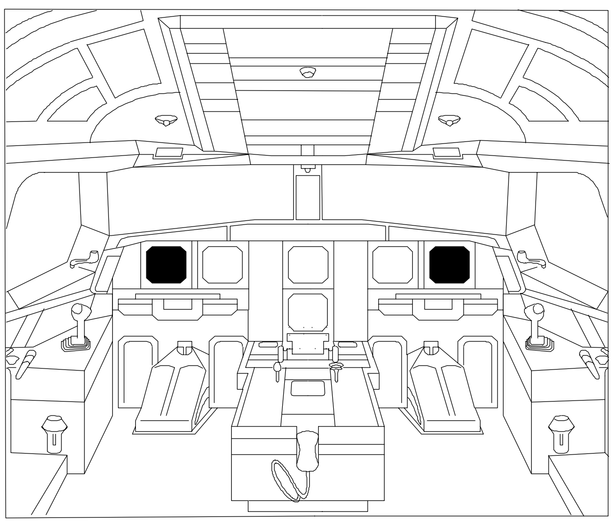


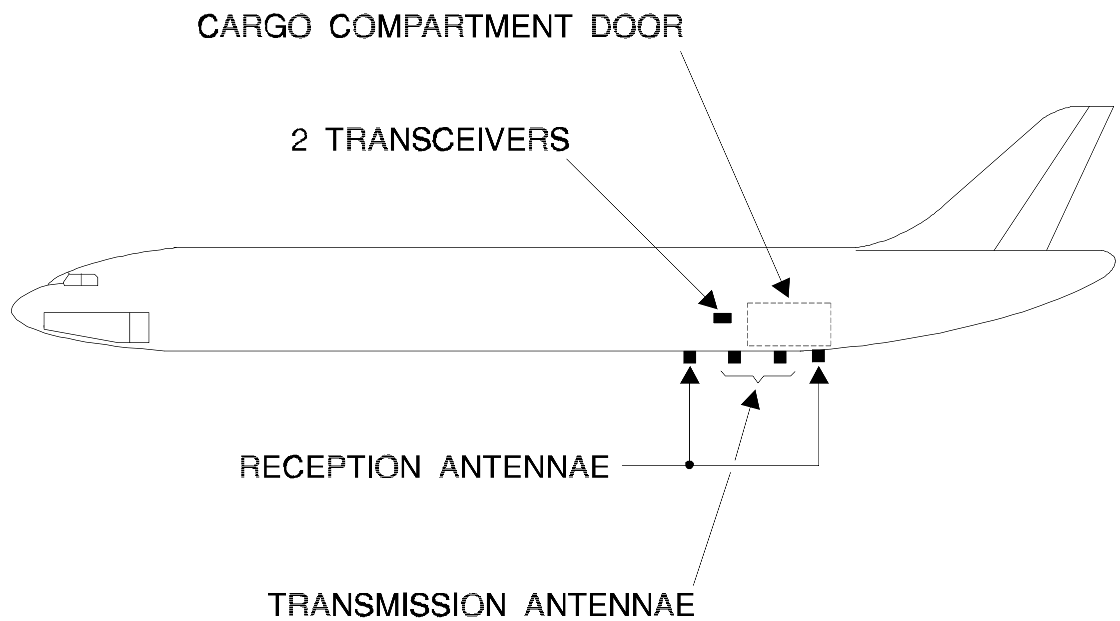
FQW4200 GE Metric

COMPONENTS

The components are two transceivers, two transmission antennae and two reception antennae.

The RA system is also connected to the Primary Flight Display (PFD) for display.



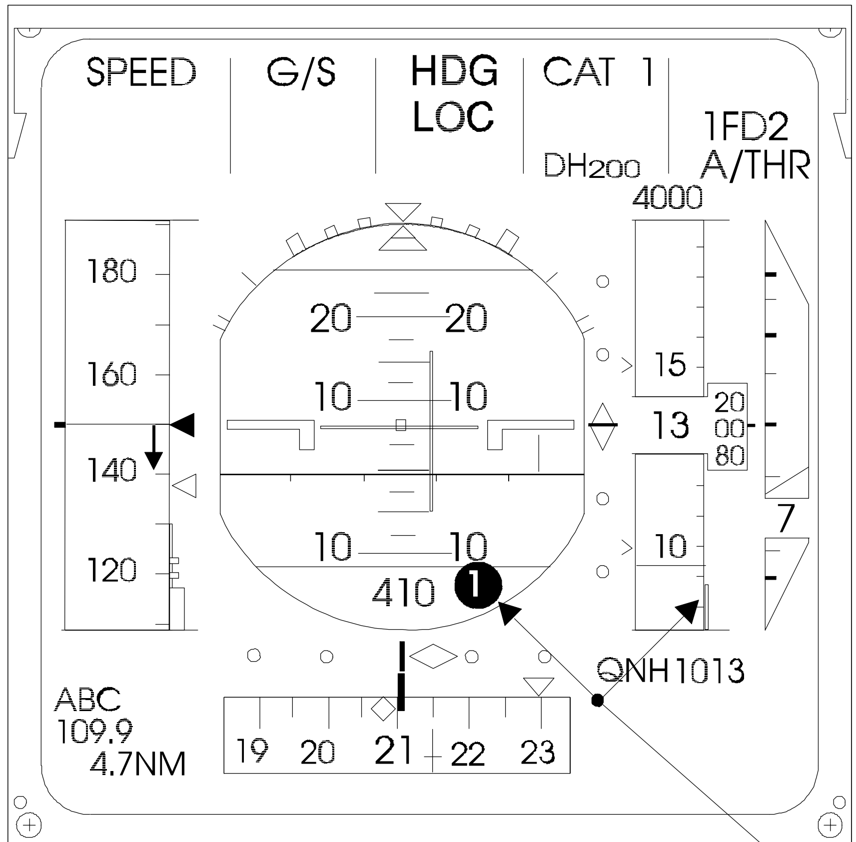


FQW4200 GE Metric

INDICATING

The aircraft height data is shown on the Primary Flight Display for heights less than or equal to 2500 ft.

The altitude is also shown by two indications.
The first on the sphere, the second on the altitude scale.



❶ AIRCRAFT DIGITAL HEIGHT

INDICATES TERRAIN

FQW4200 GE Metric

STUDENT NOTES

RADIO ALTIMETER D/O

Antennae
LGCIU
Indicating
Fan
Users
CMC

ANTENNAE

The transmission and reception Antennae are identical.

The frequency range that is used from 4200 Mhz to 4400 Mhz.
The operating range of the antenna is limited to +30° or -30° for aircraft roll and pitch attitude.

LGCIU

The Landing Gear Control Interface Unit (LGCIU) provides the flight/ground information which is used by the receiver BITE module to count the flight legs.

INDICATING

In normal operation, system 1 provides the height data, up to 2500 feet, for the Captain Primary Flight Display (PFD), and system 2 for the First Officer PFD, through Display Management Computers (DMC) 1 and 2.

When a failure of one transceiver occurs, the DMC automatically switch over to the other transceiver.

FAN

Each transceiver is cooled by an associated fan.

The fan is installed under the transceiver and receives its power (115 VAC) from the transceiver.

USERS

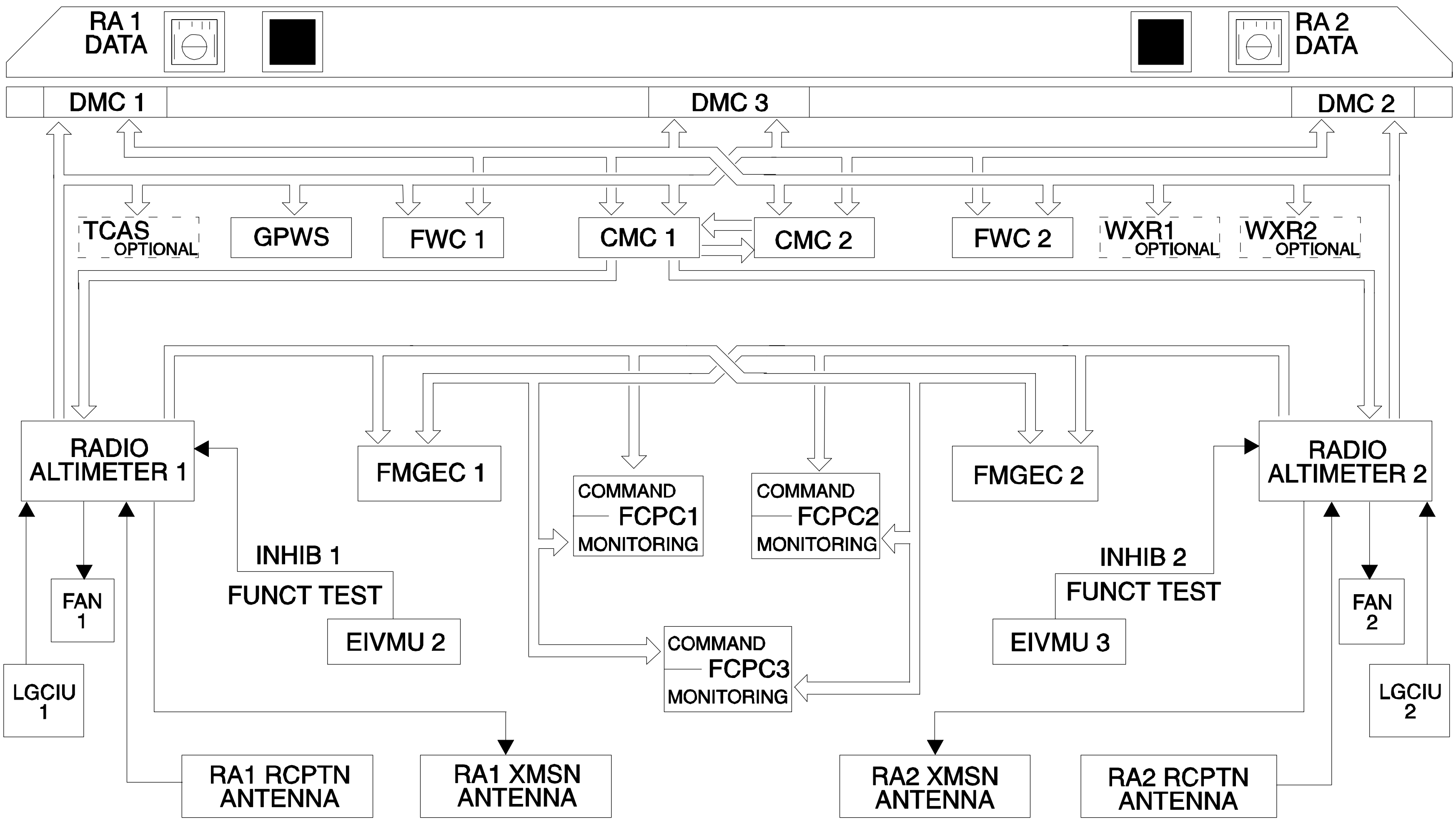
The Radio Altimeter (RA) information is sent to the Ground Proximity Warning Computer (GPWS) for different warnings, to the Flight Management Guidance and Envelope Computers (FMGEC) for processing data, to the Flight Warning Computers (FWC) for call out indications and warnings, and to the Flight Control Primary Computers (FCPC) for integration into various flight parameters.
OPTION:

To the Traffic Advoidance System (TCAS) for, in the 0 to 2500 ft range, triggering of inhibit orders and for the system sensitivity, and to the Weather Radar Transceivers (WXR) for automatic activation of the windshear function if it is activated.

CMC

The Multipurpose Control and Display Units (MCDU) allow the systems to be tested via the Central Maintenance Computer (CMC).
The tests are only available on ground.

Some tests are inhibited on ground by signals coming from the Engine Interface and Vibration Monitoring Unit (EIVMU) when the associated engine is operating.



FQW4200 GE Metric

STUDENT NOTES:

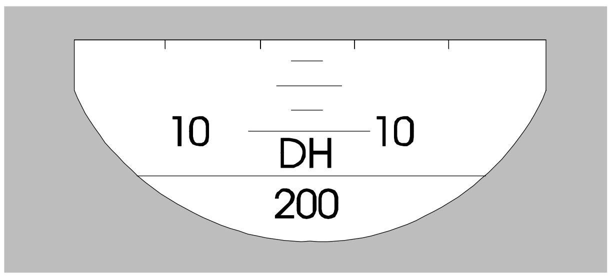
RA INDICATIONS ON PFD AND AUTOMATIC CALL OUT

Decision Height
Radio Altitude
Rising Runway Indicating
Analog Indication
Automtic Call Out
Flag

DECISION HEIGHT

SELECTED DH

AMBER MESSAGE



When the radio altitude reaches the DH.

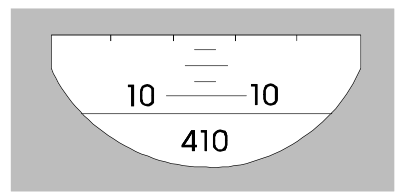
After the selection made by the pilot on the Multipurpose Control Display Unit (MCDU), the Decision Height (DH) data is displayed in the fourth column of the Flight Mode Annunciator (FMA) if the Radio Altimeters (RA) are not faulty.

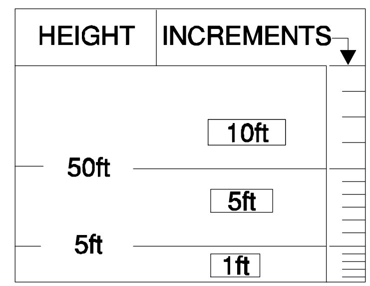
RADIO ALTITUDE

CONDITIONS OF DISPLAY

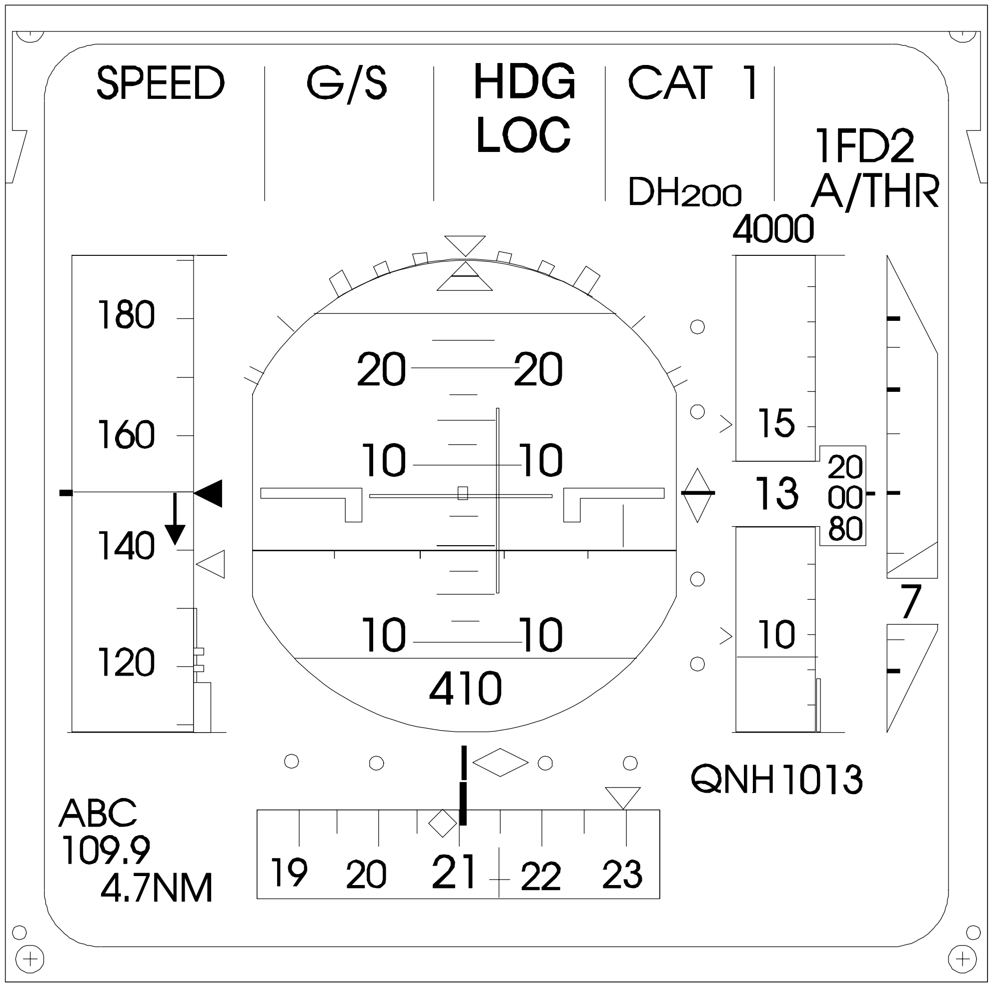
DIGIT COLOR \ DH	SELECTED	NOT SELECTED
GREEN	RA > DH+100ft and RA < 2500ft	RA > 400ft and RA < 2500ft
AMBER	RA <= DH+100ft	RA <= 400ft

The indication accuracy is in function of the height.





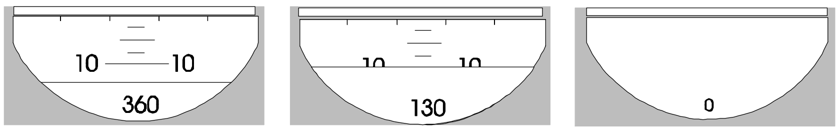
The radio height is displayed at the bottom of the attitude sphere for heights less than 2500 feet.



FQW4200 GE Metric

RISING RUNWAY INDICATING

MOVING LOWER LIMIT



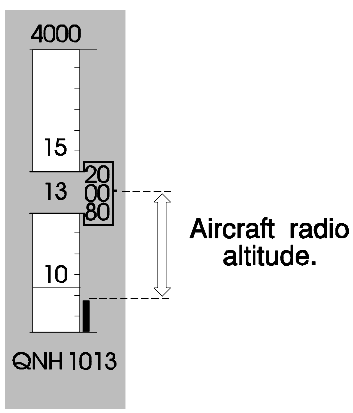
Final phase of approach | Final phase of approach below 150ft | On ground

In the final phase of an approach, below 150 feet, the white lower limit of the attitude sphere moves up as the aircraft approaches the ground.

The distance between the moving lower limit and the horizon line is proportional to the aircraft height (accuracy 5ft/mm).

ANALOG INDICATION

RED RIBBON INDICATION



When the height is less than 570 feet, a red ribbon is displayed on the altitude scale.

AUTOMATIC CALL OUT

CALL OUT CONDITION

The altitude call out corresponds to predetermined thresholds:

TRESHOLD IN FT	CALL OUT
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 + 100	HUNDRED ABOVE
DH	MINIMUM

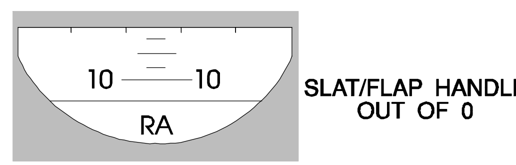
Pin programmings allow selection of the call outs.

Below 400 feet, the radio altitude is announced by a synthetic voice, generated by the Flight Warning Computer.

If the time between two consecutive predetermined call outs exceeds 11 seconds above 50ft and 4 seconds below 50ft the present altitude is repeated at regular interval of 4 seconds.

FLAG

RA FLAG DISPLAY



The message flashes during 9 seconds then is steady.

If both Radio Altimeters fail and the aircraft altitude is below the transition altitude, a red RA flag is shown in place of the radio height information.

Independently of slat/flap position, with failure of both Radio Altimeters, the red ribbon indication disappears and the lower limit remains at its position.

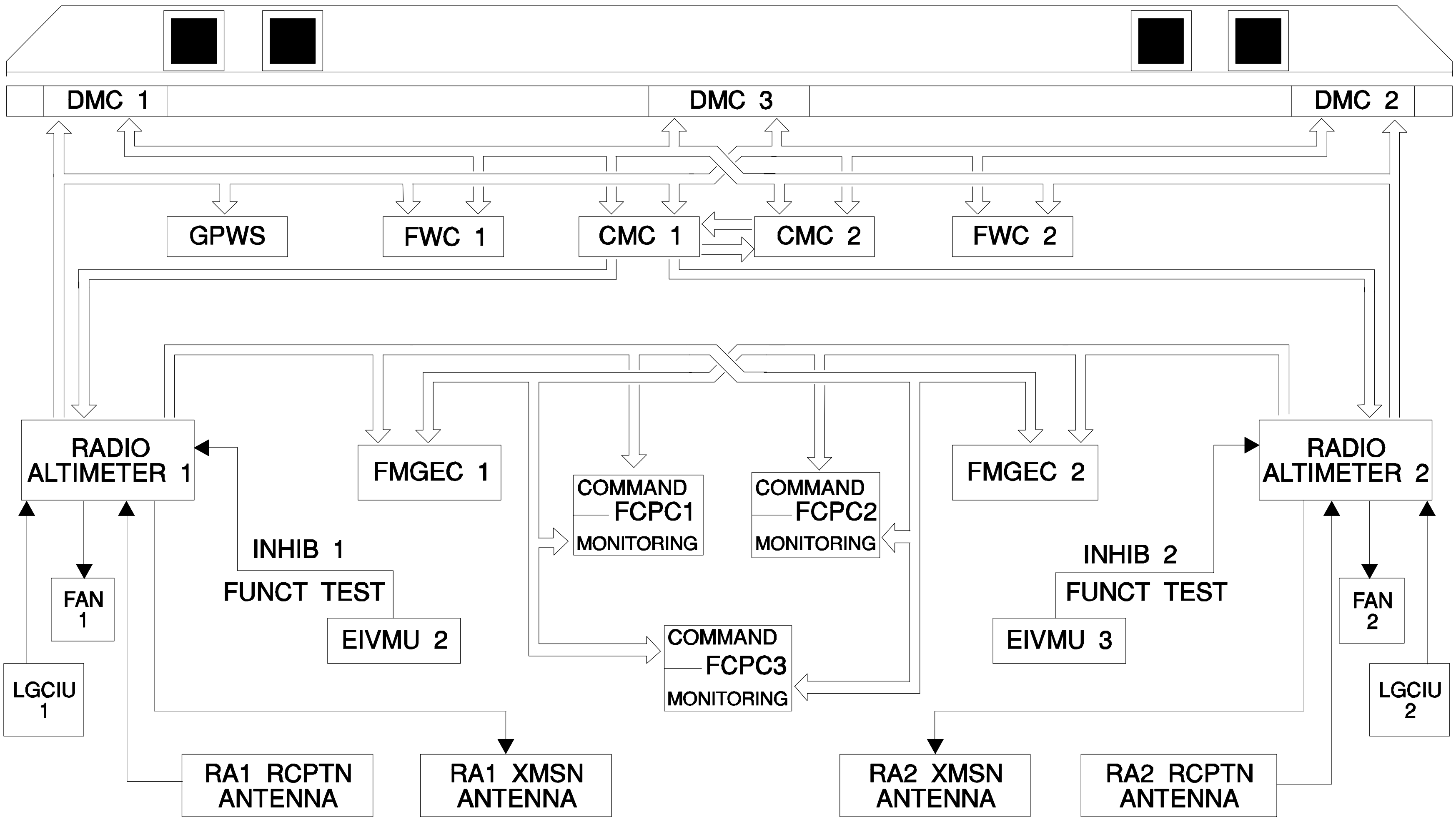
STUDENT NOTES:

STUDENT NOTES

RA COMPONENTS

Radio Altimeter 1/2
FAN 1/2
RA 1/2 Reception/Transmission Antennae

STUDENT NOTES



FQW4200 GE Metric

RADIO ALTIMETER 1/2

FIN : 1SA1, 1SA2

ZONE : 152, 152

COMPONENT DESCRIPTION

The face of the transceiver is fitted with a handle, two lugs, a test P/B, four LEDs and a test set connector.
The back is equipped with one ARINC 600 size two connector which includes three plugs :

- Top Plug (TP) :

  Connection with the automatic test circuit and reception coaxial.

- Middle Plug (MP) :

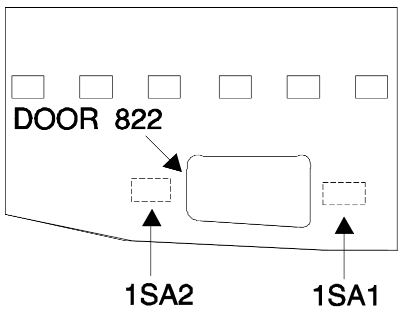
  Connection with the service interconnection and transmission coaxial.

- Bottom Plug (BP) :

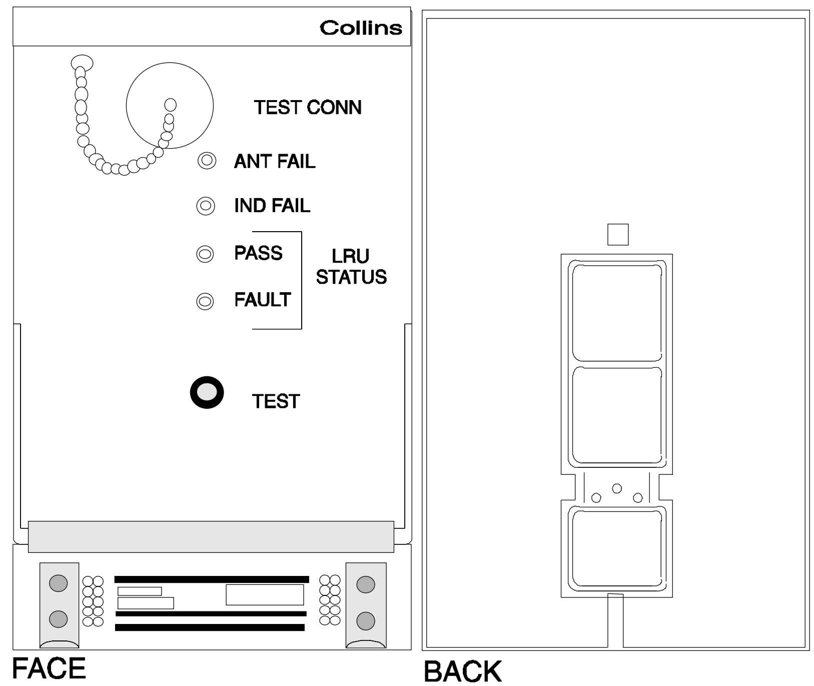
  Connection with the power supply circuit (115vac-400Hz).

IN SITU TEST

The front panel test can be activated by pressing the TEST P/B on the face of the transceiver. EIVMU1 and EIVMU2 (Engine Interface and Vibration Unit) send discrete signals to inhibit this test when the aircraft engine is operating.

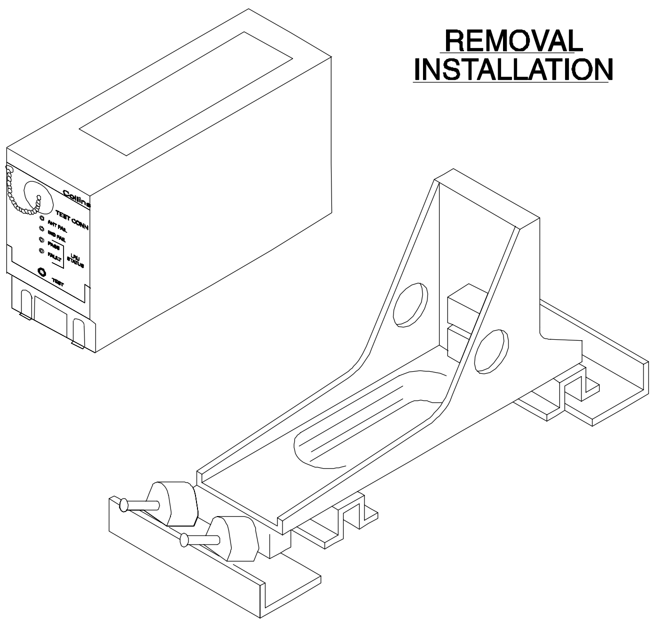


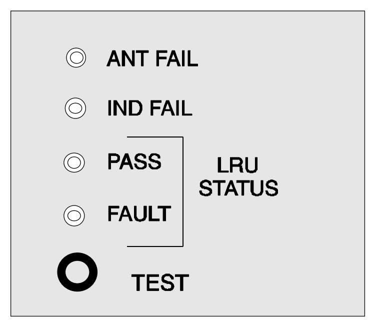
COMPONENT LOCATION



RA TRANSCEIVER

REMOVAL INSTALLATION





STATUS OF SYSTEM DURING THE TEST

(Red) ANTENNAE MALFUNCTION

(Red) INDICATOR MALFUNCTION

(Green) NO FAULT
(Red) MALFUNCTION
TRANSCEIVER

FQW4200 GE Metric

FAN 1/2

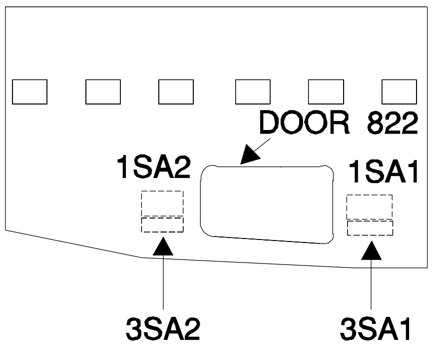
FIN : 3SA1, 3SA2

ZONE : 152, 152

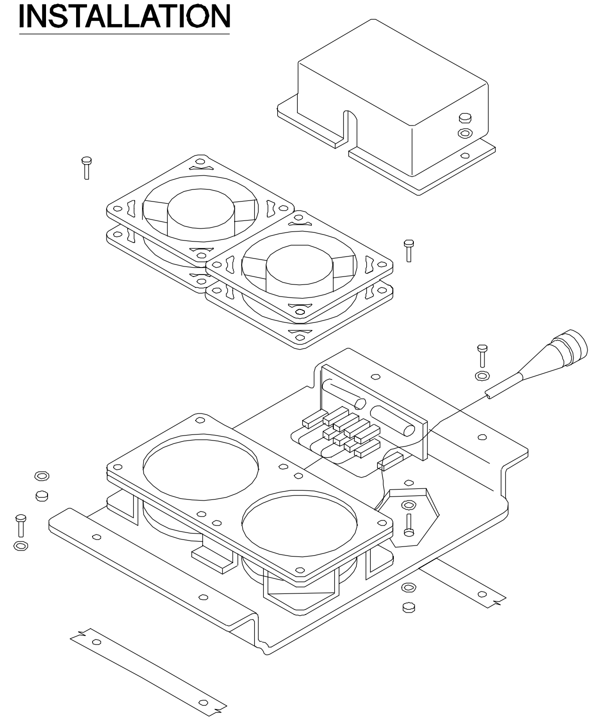
COMPONENT DESCRIPTION

The six-blade fan is integral with a removal base plate attached under the transceiver mount. It is contained in a square aluminium alloy case.
It is supplied with 115VAC through the electrical circuit of the associated transceiver.
Parasites are suppressed by a capacitor mounted on the fan.

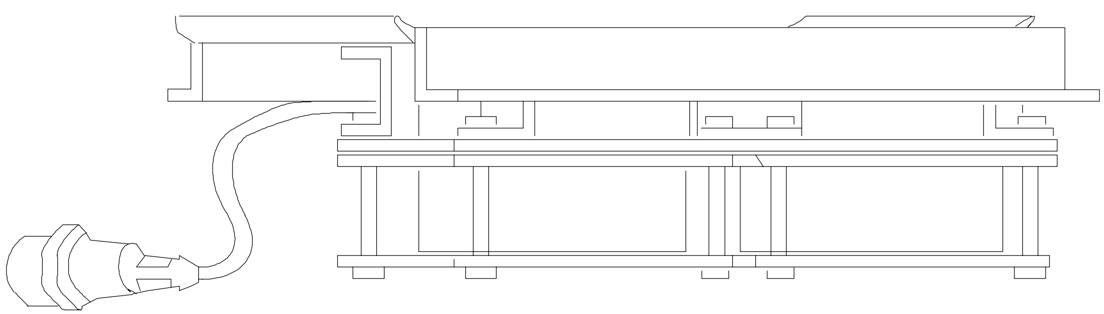
COMPONENT LOCATION



REMOVAL INSTALLATION



RA FAN



FQW4200 GE Metric

RA1/2 RECEPTION/TRANSMISSION ANTENNAE

FIN :

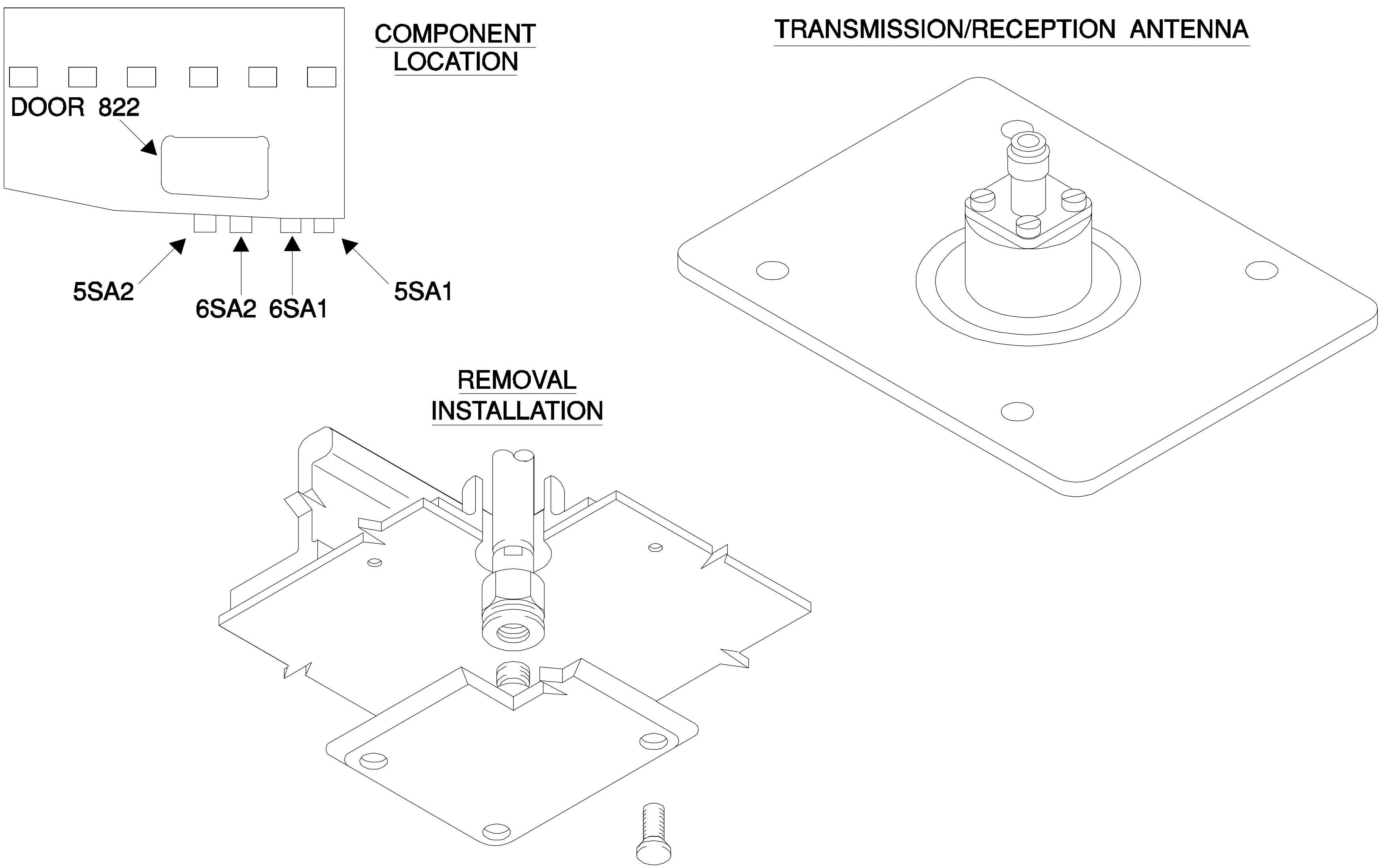
Reception : 5SA1, 5SA2

Transmission : 6SA1, 6SA2

ZONE : 150

COMPONENT DESCRIPTION

The transmission and reception antennae are identical. Each antenna is supplied through a coaxial connector linked to the transceiver. The operating range of the antenna according to the attitude of the aircraft is limited to +/- 30° for roll and pitch angles.



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STUDENT NOTES

(ENHANCED) GROUND PROXIMITY WARNING SYSTEM PRESENTATION

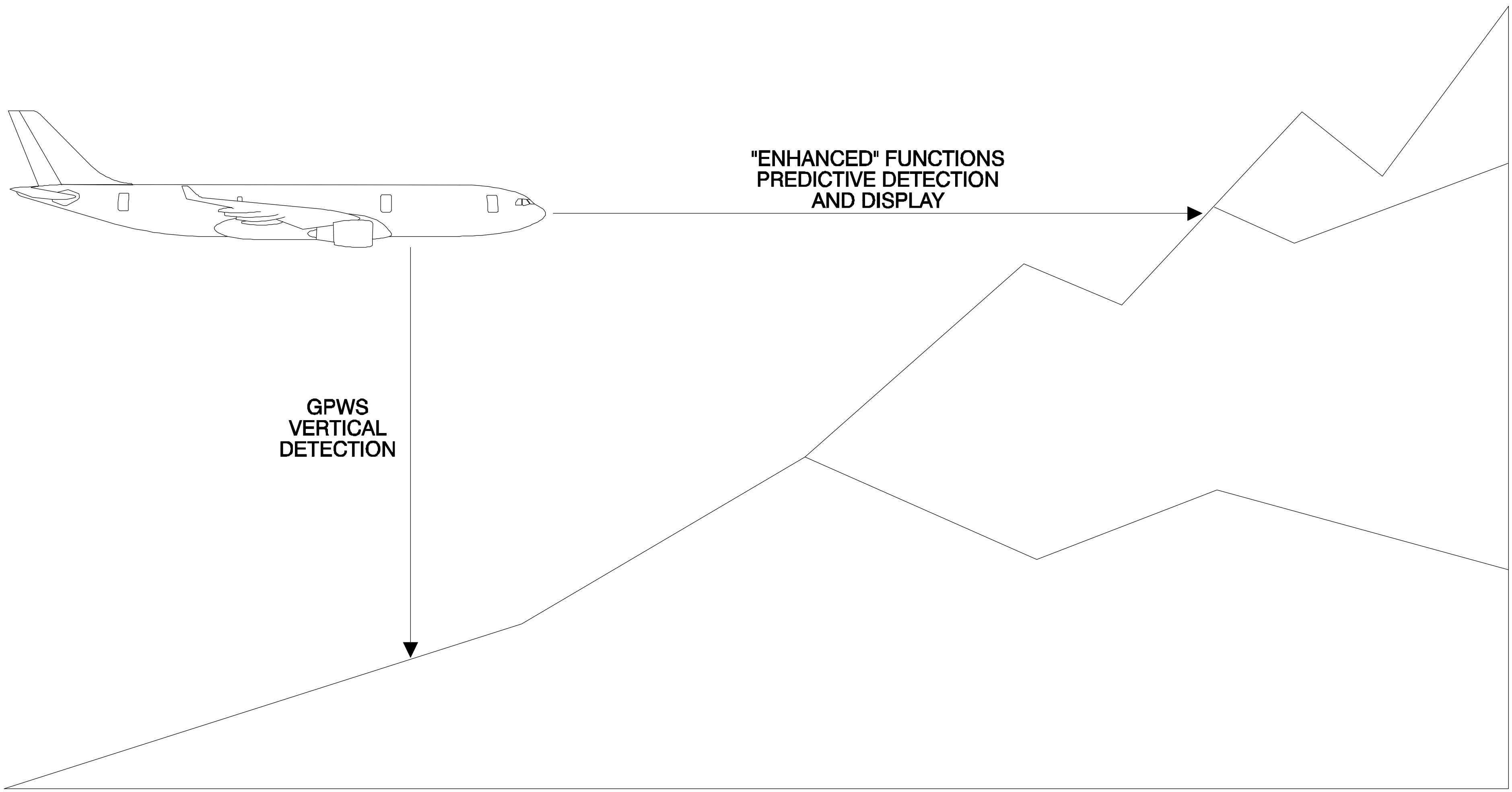
Principle
Components
Indicating

PRINCIPLE

The Ground Proximity Warning System (GPWS) generates aural and visual warnings if the aircraft adopts a potentially hazardous configuration because of ground proximity.
The GPWS is connected to various systems (radio altimeter system, instrument landing system...). It processes their navigation data and generates alarms.

If the EGPWS ("ENHANCED" functions + GPWS = EGPWS) is built over the GPWS and if the ENHANCED functions are activated, the following ENHANCED features complete the basic GPWS modes:

- Terrain Clearance Floor (TCF): Increases the terrain clearance envelope around the airport runway.
- Terrain Awareness alerting and Display (TAD): Incorporation of a terrain database to predict conflict between flight path and terrain and to display the conflicting terrain.



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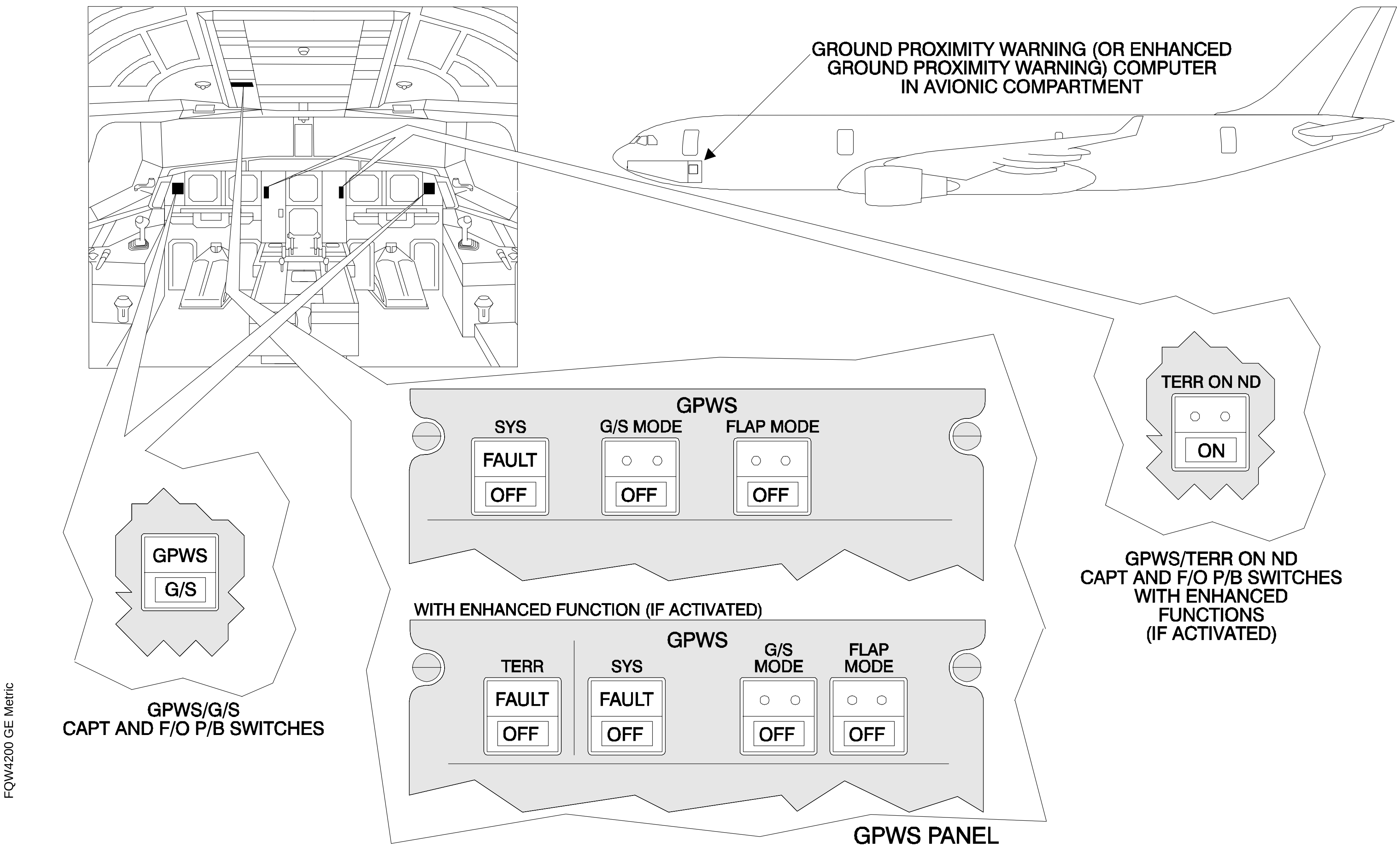
COMPONENTS

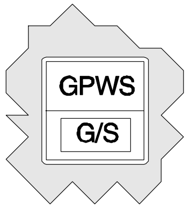
The components are a Ground Proximity Warning Computer, or an Enhanced Ground Proximity Warning Computer, an appropriate control panel, two warning lights and, if the Enhanced functions are activated, two TERRAIN ON ND mode pushbutton switches.


GROUND PROXIMITY WARNING (OR ENHANCED GROUND PROXIMITY WARNING) COMPUTER IN AVIONIC COMPARTMENT
TERR ON ND
ON
GPWS/TERR ON ND CAPT AND F/O P/B SWITCHES WITH ENHANCED FUNCTIONS (IF ACTIVATED)
GPWS
SYS
G/S MODE
FLAP MODE
FAULT
OFF
OFF
OFF
WITH ENHANCED FUNCTION (IF ACTIVATED)
GPWS
TERR
SYS
G/S MODE
FLAP MODE
FAULT
OFF
FAULT
OFF
OFF
OFF
GPWS
G/S
GPWS/G/S CAPT AND F/O P/B SWITCHES
FQW4200 GE Metric

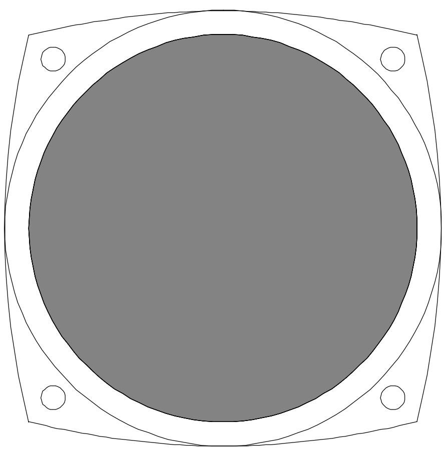
GPWS PANEL

INDICATING

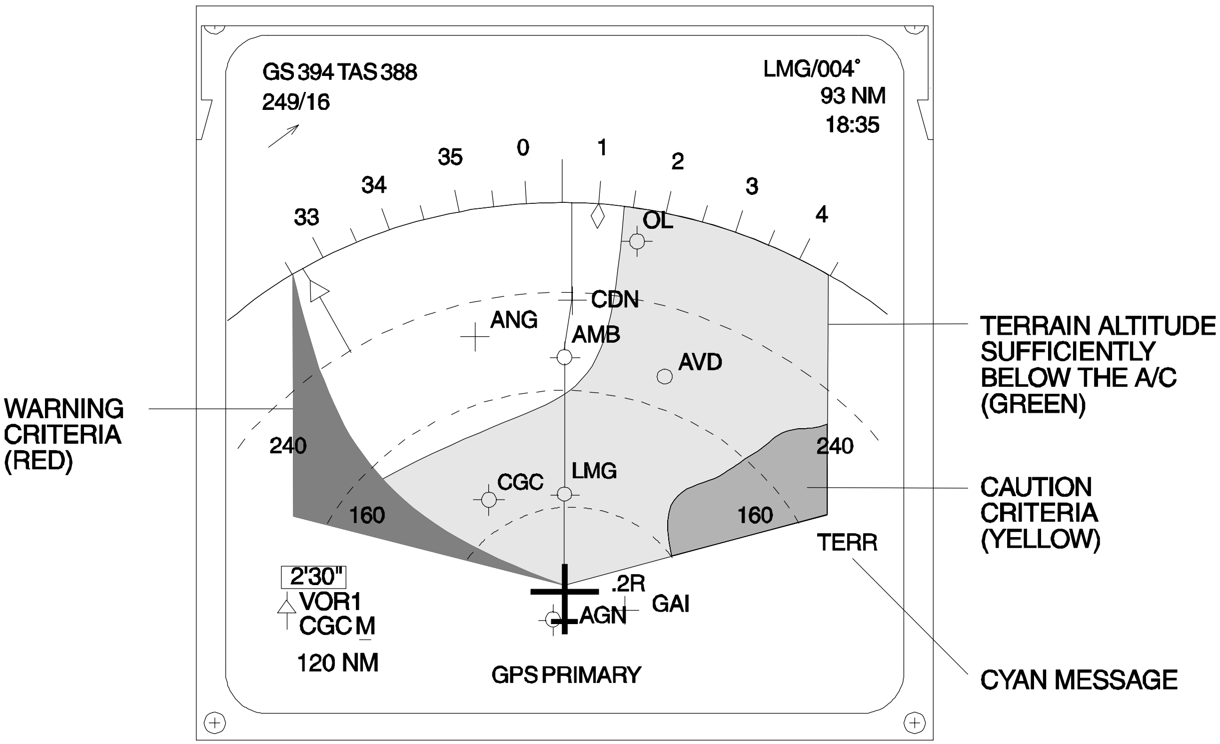
The GPWS generates visual warnings through associated lights and synthetic voice warnings through the loudspeakers.
The "ENHANCED" functions, if activated, allow the terrain hazards to be displayed on the Navigation Displays (NDs).



CAPT / F/O



CAPT / F/O LOUDSPEAKER



TERRAIN PICTURE

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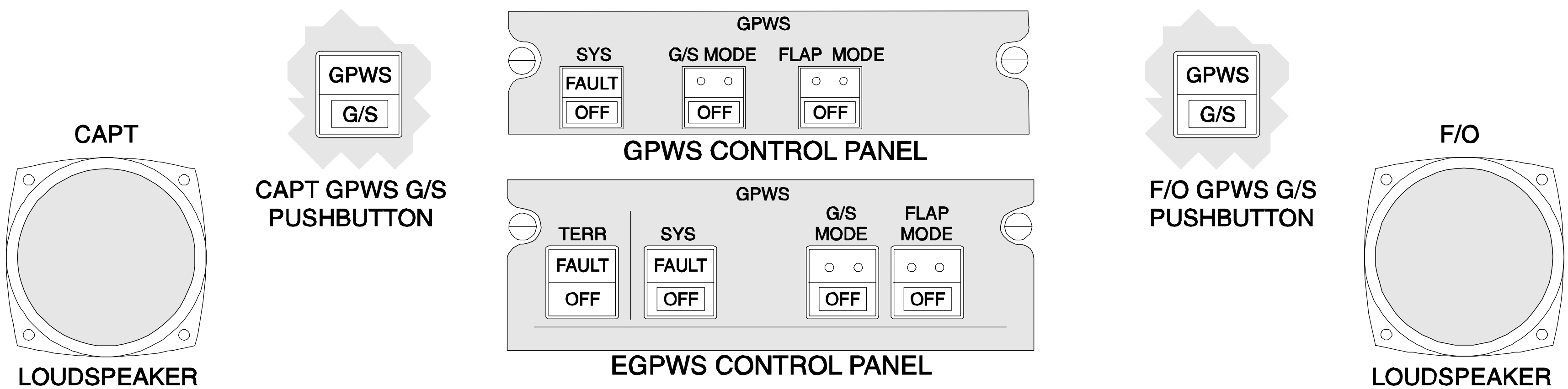
STUDENT NOTES

(E)GPWS MODES

WARNING MODES

The digital and discrete data inputs are used in different combinations to monitor aircraft vertical path.

If the warning envelope is penetrated, visual and aural warnings are generated.
The aural messages are broadcast and visual warnings are indicated by the Ground Proximity Warning System (GPWS) lights.



- WARNING MODES -

MODE 1: EXCESSIVE RATE OF DESCENT.

MODE 2: EXCESSIVE CLOSURE RATE WITH TERRAIN.

MODE 3: DESCENT AFTER TAKE OFF AND MINIMUM TERRAIN CLEARANCE.

MODE 4: UNSAFE TERRAIN CLEARANCE.

MODE 5: DESCENT BELOW GLIDE/SLOPE.

TERRAIN AWARNESS AND DISPLAY (TAD) (ENHANCED MODE).

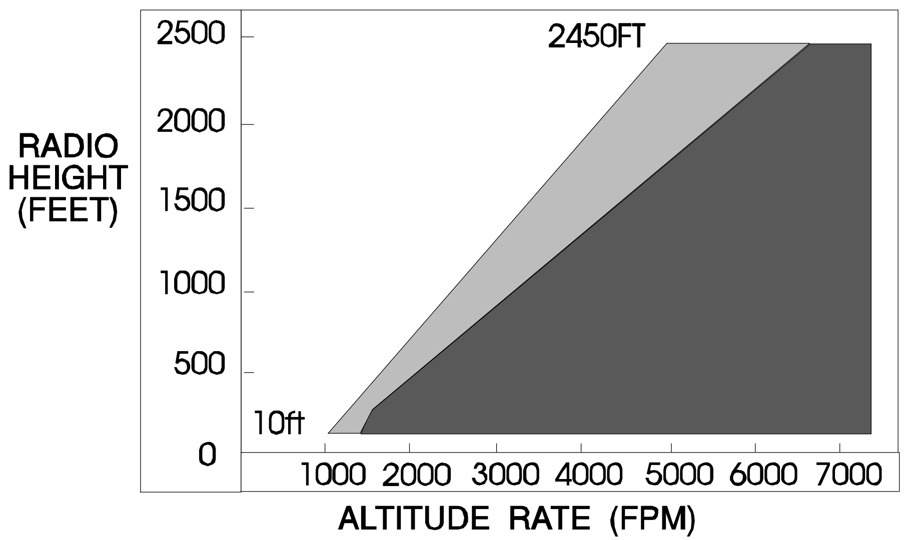
TERRAIN CLEARANCE FLOOR (TCF) (ENHANCED MODE).

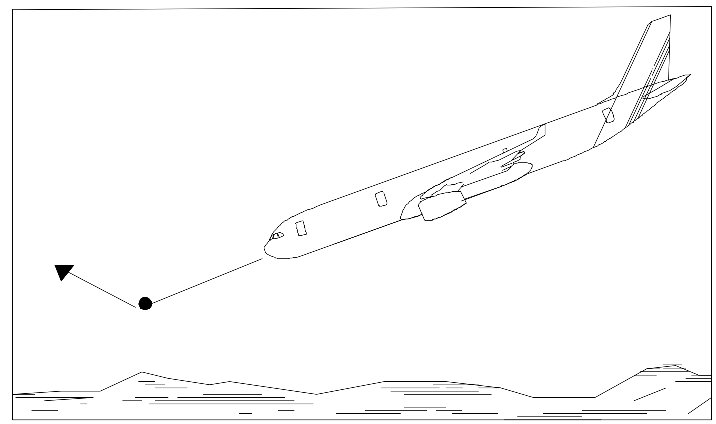
FQW4200 GE Metric

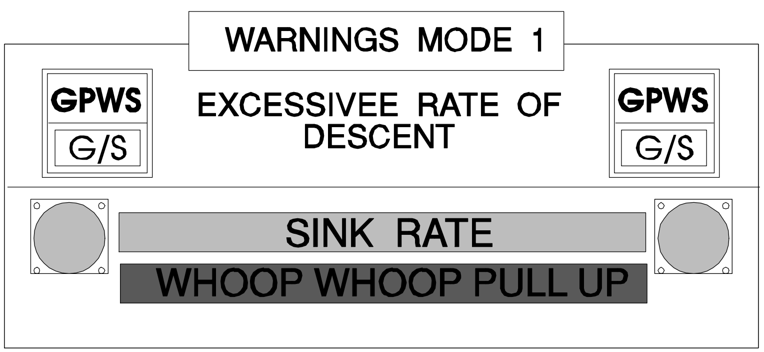
MODE 1

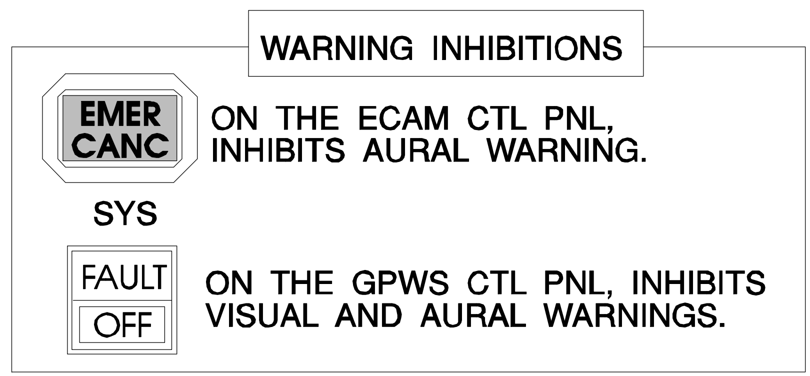
Mode 1 provides an alert warning for high descent rate into terrain and for rapidly increasing sink rates near the runway when landing.

These alerts will continue until the boundary penetration is corrected.









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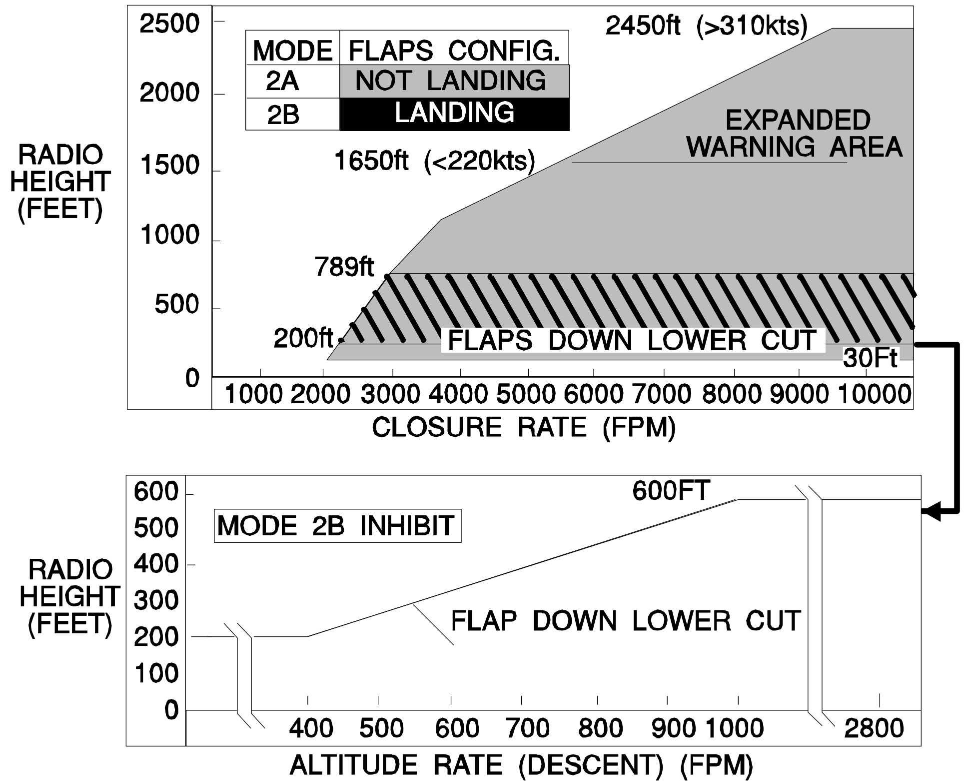
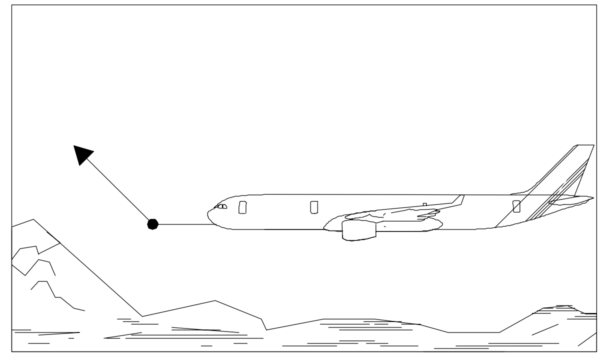
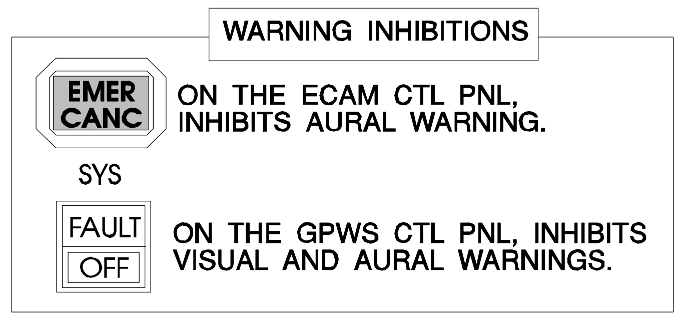
MODE 2

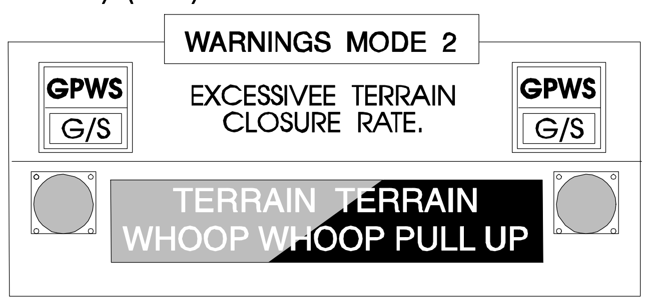
Mode 2 provides a warning based on the radio height and on how rapidly the radio height decreases.

Mode 2B requires the FLAPS to be in landing configuration or the aircraft to be in Glide/Slope beam within +/- 2 dots of deviation during an ILS approach.
After leaving the warning area, the repeated TERRAIN message will persist until an increase of baro altitude of 300 Ft is obtained.


RADIO HEIGHT (FEET)
2500
2000
1500
1000
500
0
MODE | FLAPS CONFIG.
2A | NOT LANDING
2B | LANDING
2450ft (>310kts)
1650ft (<220kts)
EXPANDED WARNING AREA
789ft
200ft
FLAPS DOWN LOWER CUT
30Ft
1000 2000 3000 4000 5000 6000 7000 8000 9000 10000
CLOSURE RATE (FPM)
RADIO HEIGHT (FEET)
600
500
400
300
200
100
0
MODE 2B INHIBIT
600FT
FLAP DOWN LOWER CUT
400 500 600 700 800 900 1000 2800
ALTITUDE RATE (DESCENT) (FPM)

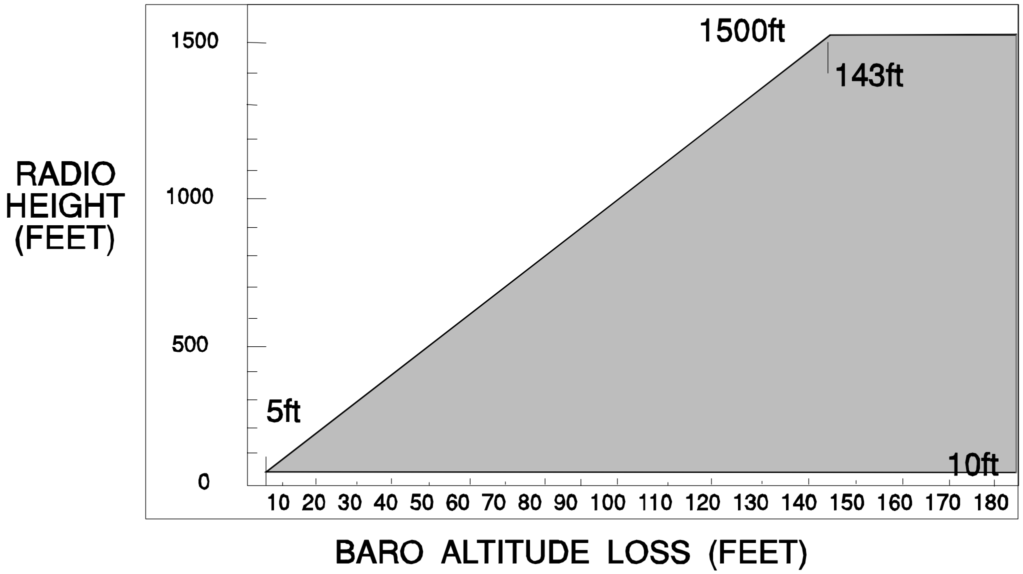


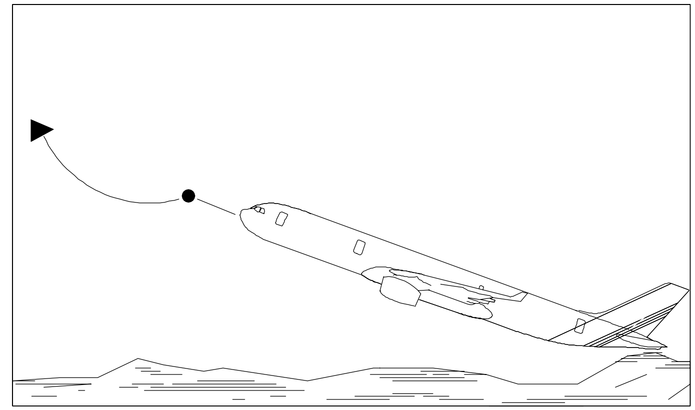

WARNING INHIBITIONS
EMER CANC
ON THE ECAM CTL PNL, INHIBITS AURAL WARNING.
SYS
FAULT
OFF
ON THE GPWS CTL PNL, INHIBITS VISUAL AND AURAL WARNINGS.

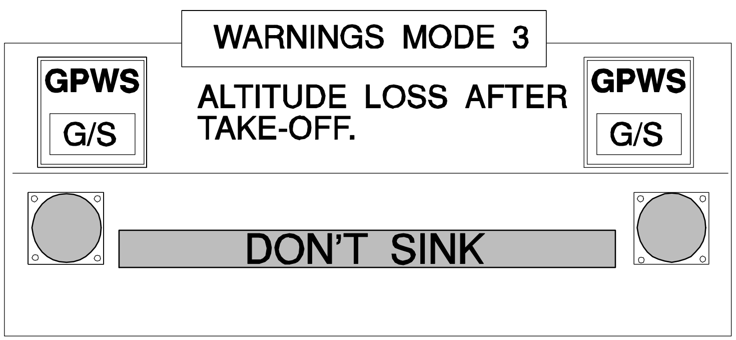

WARNINGS MODE 2
GPWS
G/S
EXCESSIVEE TERRAIN CLOSURE RATE.
GPWS
G/S
TERRAIN TERRAIN
WHOOP WHOOP PULL UP

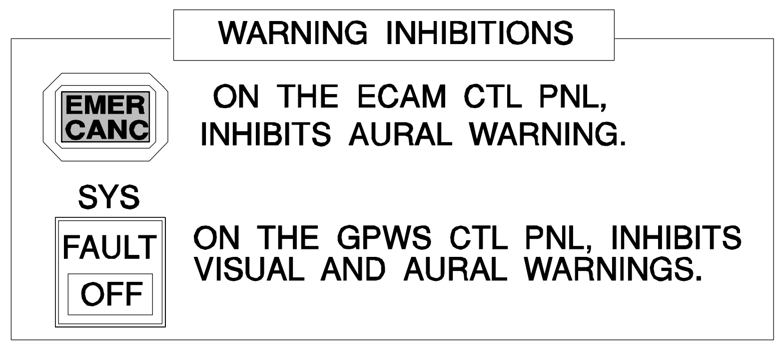
MODE 3

Mode 3 provides a warning for excessive altitude loss after take-off.







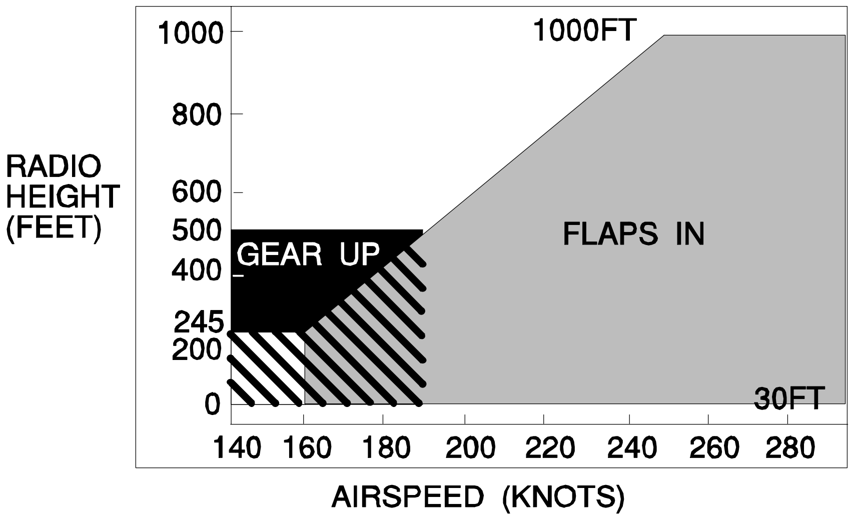


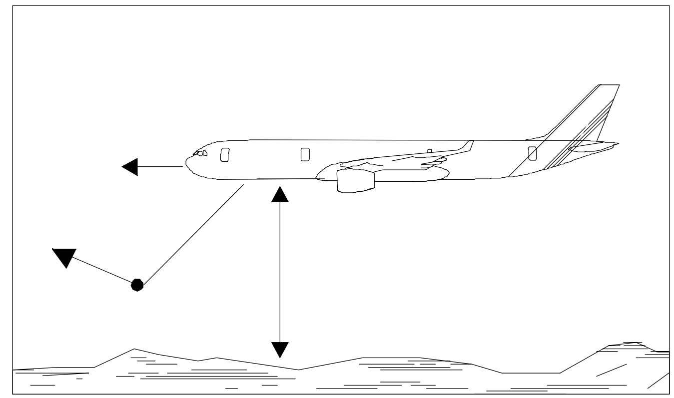
FQW4200 GE Metric

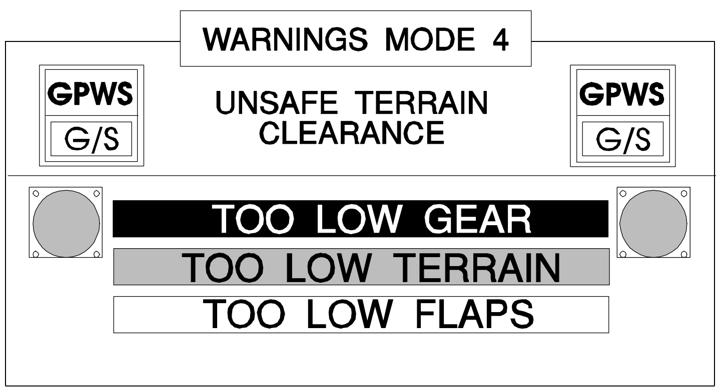
MODE 4

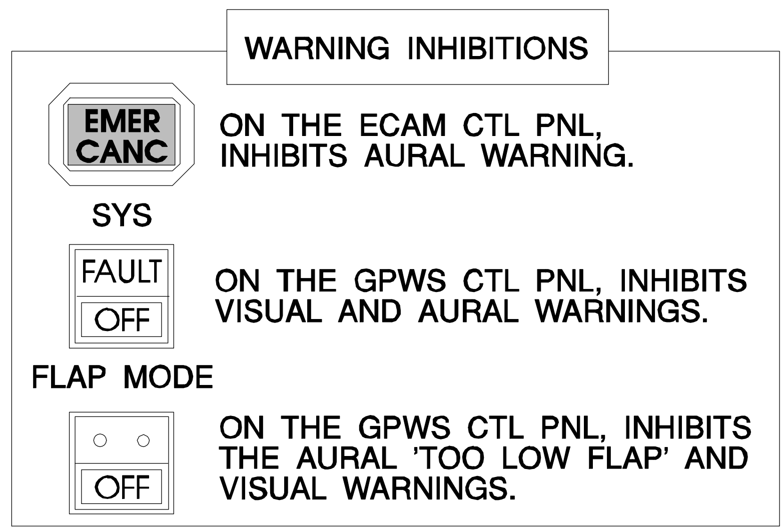
Mode 4 generates three types of voice warning based on the radio height, computed airspeed, and aircraft configuration.

The TOO LOW GEAR message warning has priority over the two other messages.


RADIO HEIGHT (FEET)
1000
800
600
500
400
245
200
0
1000FT
GEAR UP
FLAPS IN
30FT
140 160 180 200 220 240 260 280
AIRSPEED (KNOTS)

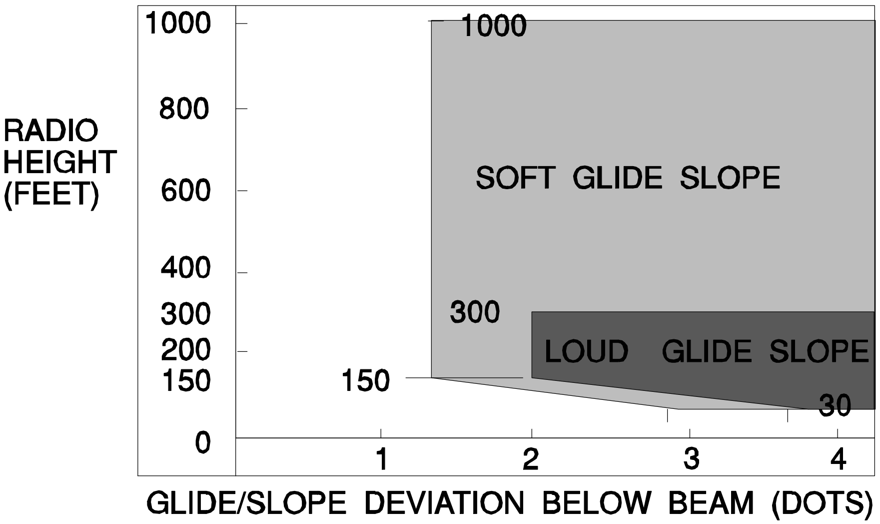


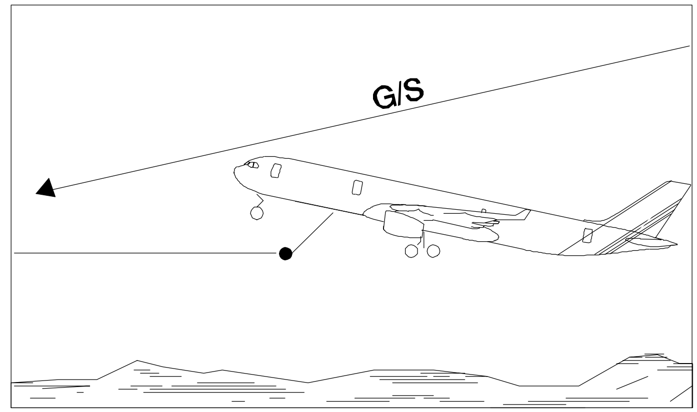

WARNINGS MODE 4
GPWS
G/S
UNSAFE TERRAIN CLEARANCE
GPWS
G/S
TOO LOW GEAR
TOO LOW TERRAIN
TOO LOW FLAPS

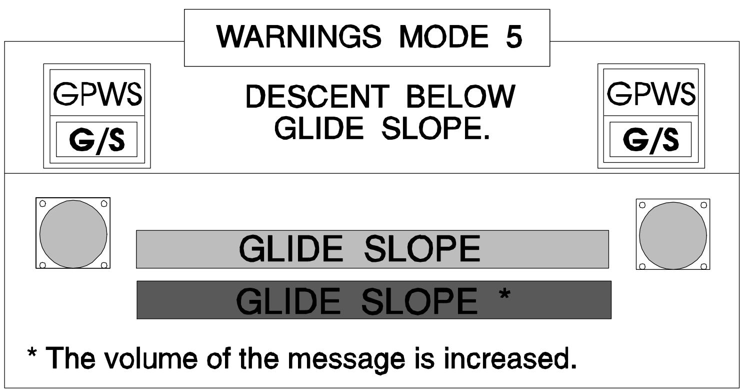

WARNING INHIBITIONS
EMER CANC
ON THE ECAM CTL PNL, INHIBITS AURAL WARNING.
SYS
FAULT
OFF
ON THE GPWS CTL PNL, INHIBITS VISUAL AND AURAL WARNINGS.
FLAP MODE
OFF
ON THE GPWS CTL PNL, INHIBITS THE AURAL 'TOO LOW FLAP' AND VISUAL WARNINGS.

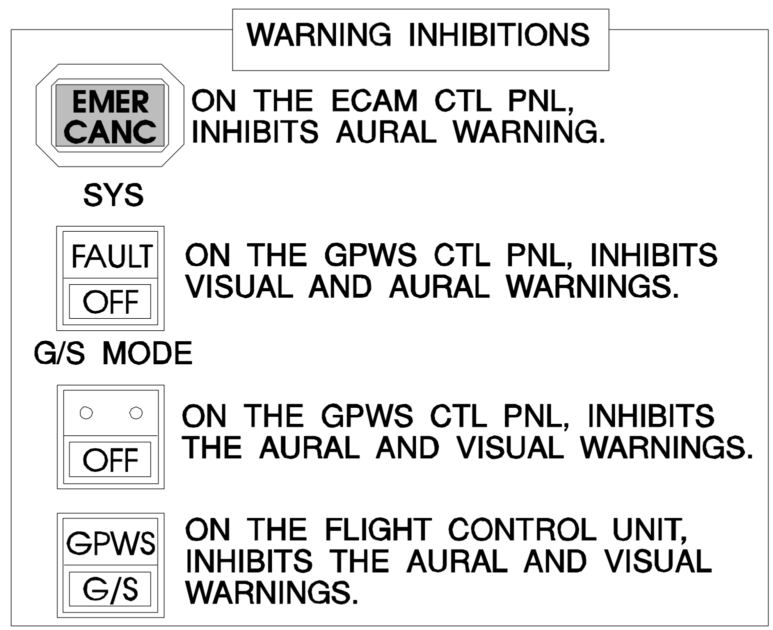
MODE 5

Mode 5 provides two levels of warning when the aircraft flight path descends below the Glide/Slope beam during ILS approaches.


RADIO
HEIGHT
(FEET)
1000
800
600
400
300
200
150
0
1000
SOFT GLIDE SLOPE
300
LOUD GLIDE SLOPE
150
30
1
2
3
4
GLIDE/SLOPE DEVIATION BELOW BEAM (DOTS)


G/S


WARNINGS MODE 5
GPWS
G/S
DESCENT BELOW
GLIDE SLOPE.
GPWS
G/S
GLIDE SLOPE
GLIDE SLOPE *
* The volume of the message is increased.


WARNING INHIBITIONS
EMER
CANC
ON THE ECAM CTL PNL,
INHIBITS AURAL WARNING.
SYS
FAULT
OFF
ON THE GPWS CTL PNL, INHIBITS
VISUAL AND AURAL WARNINGS.
G/S MODE
OFF
ON THE GPWS CTL PNL, INHIBITS
THE AURAL AND VISUAL WARNINGS.
GPWS
G/S
ON THE FLIGHT CONTROL UNIT,
INHIBITS THE AURAL AND VISUAL
WARNINGS.

TERRAIN AWARNESS AND DISPLAY (TAD) (ENHANCED MODE)

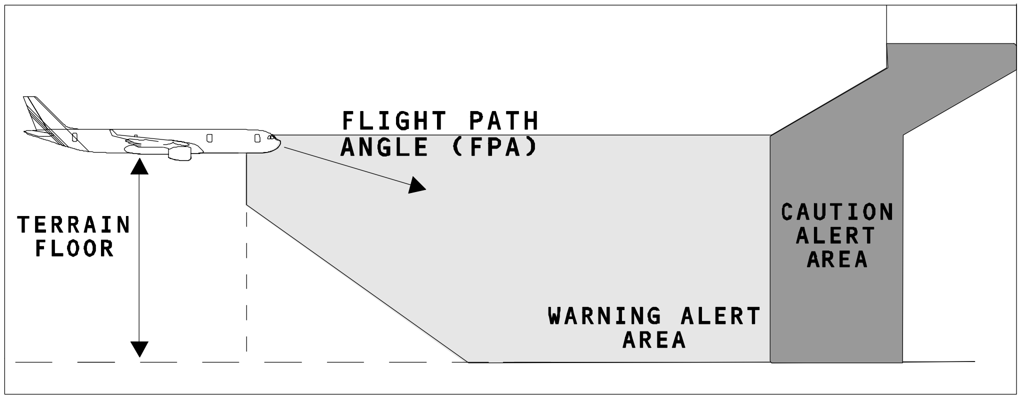
When a terrain threat forward of the aircraft path is detected, with respect to the aircraft position and the local terrain database, caution and warning alerts are triggered.

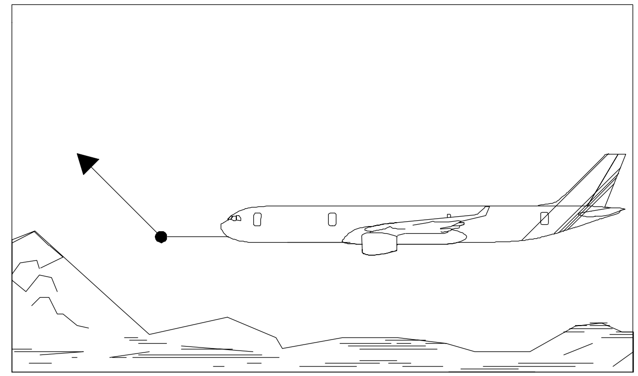
When the envelope boundaries are met, the following alerts are generated:

- Terrain Caution Alert: "TERRAIN AHEAD" (JAA),
  "CAUTION TERRAIN" (FAA).
- Terrain Warning Alert: "TERRAIN AHEAD, PULL UP" (JAA),
  "TERRAIN, TERRAIN, PULL UP" (FAA).

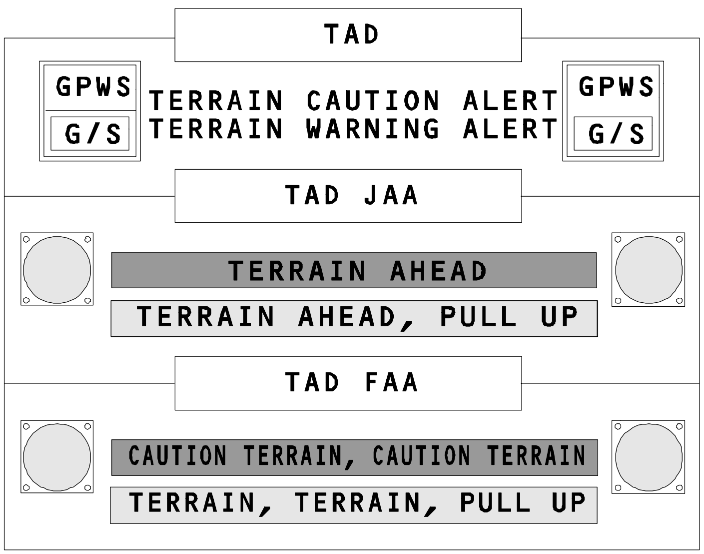
These alerts are completed by a terrain image on the NDs:

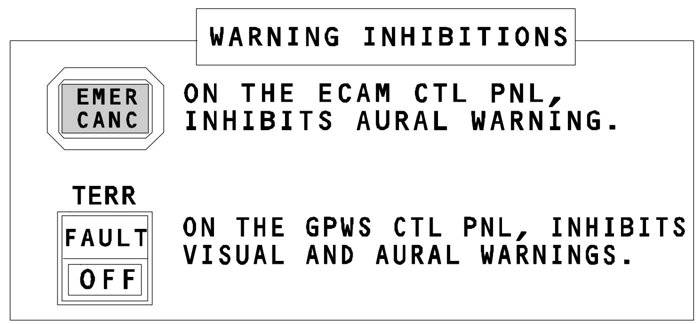
- Red area for warnings.
- Yellow area for cautions.





ENVELOPE BOUNDARIES



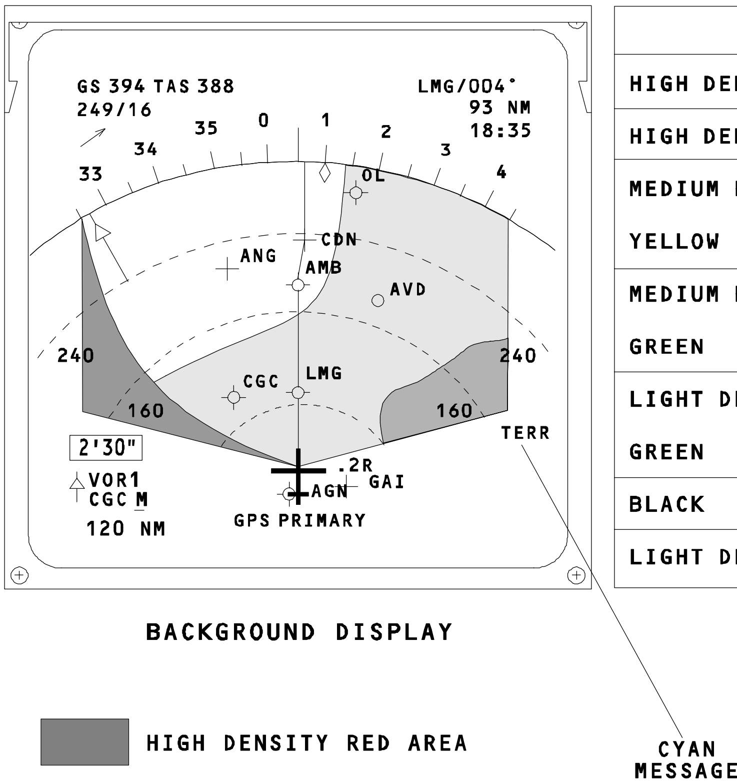


The Terrain Awarness Alerting and Display (TAD) function displays the background terrain and terrain alerts, forward of the aircraft, in the ROSE and ARC modes on navigation displays.

BACKGROUND DISPLAY

The background terrain display is depicted as variable density dot patterns in green, yellow or red depending on how close the terrain is relative to the aircraft altitude.

Note: terrain is not shown if more than 2000 ft below the aircraft altitude and if the terrain elevation is within 400 ft of the runway elevation nearest the aircraft.



BACKGROUND DISPLAY

HIGH DENSITY RED AREA

HIGH DENSITY YELLOW AREA

MEDIUM DENSITY GREEN AREA

COLOR	THREAT
HIGH DENSITY RED	TERRAIN > 2000 ft ABOVE A/C ALTITUDE
HIGH DENSITY YELLOW	1000 ft < TERRAIN < 2000 ft ABOVE A/C ALT.
MEDIUM DENSITY YELLOW	TERRAIN THAT IS 500 ft (250 ft GEAR DOWN) BELOW TO 1000 ft ABOVE AIRCRAFT ALTITUDE
MEDIUM DENSITY GREEN	TERRAIN THAT IS 500 ft (250 ft GEAR DOWN) BELOW TO 1000 ft BELOW A/C ALTITUDE
LIGHT DENSITY GREEN	TERRAIN THAT IS 1000 TO 2000 ft BELOW A/C ALTITUDE
BLACK	NO CLOSE TERRAIN
LIGHT DENSITY MAGENTA	UNKNOWN TERRAIN

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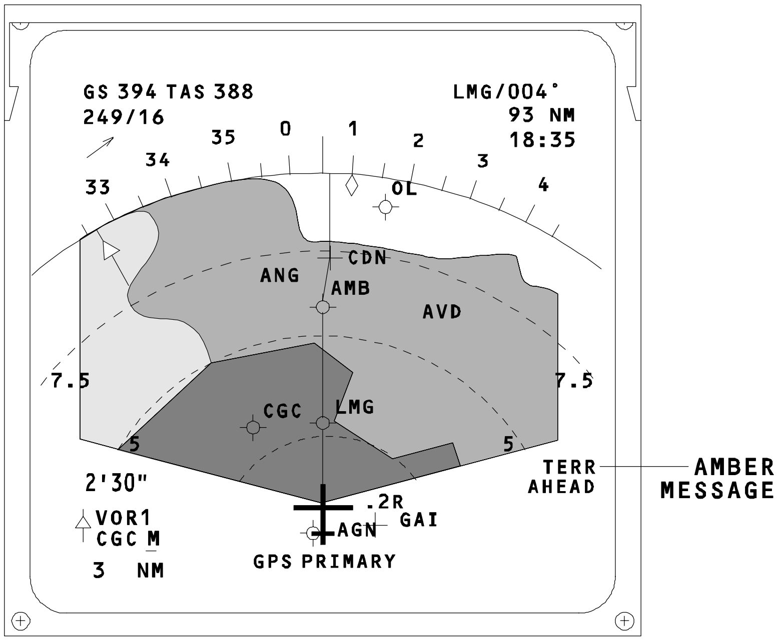
Depending on the conditions of terrain alert, the background image is enhanced to highlight the terrain threats by coloring them in solid yellow for the terrain caution alert and in solid red for the terrain warning alert.

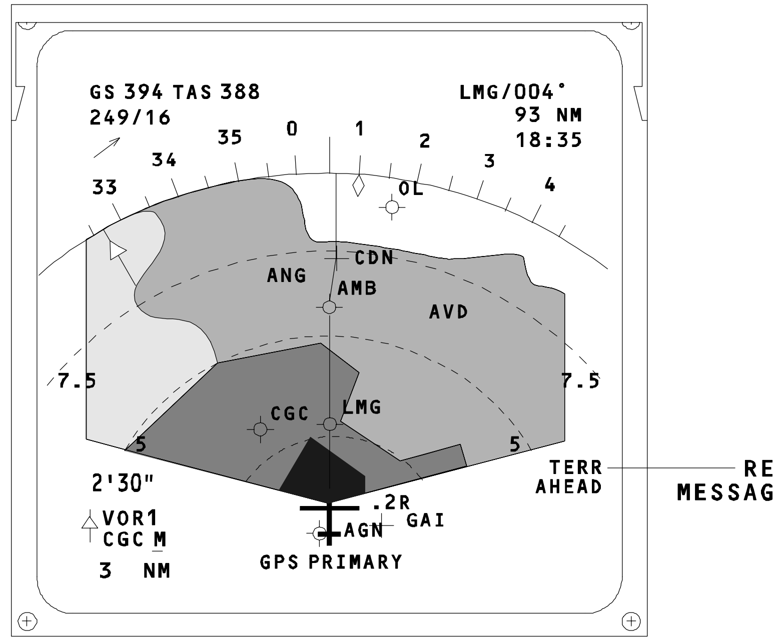


TERRAIN CAUTION ALERT (60 S FROM IMPACT)=
"TERRAIN AHEAD" AUDIO ALERT (REPEATED AFTER 7 S IF STILL IN THE CAUTION ENVELOPE)
+ GPWS RED WARNING
+ AMBER TERR AHEAD MESSAGE ON ND.

YELLOW AREA

HIGH DENSITY YELLOW AREA

MEDIUM DENSITY YELLOW



TERRAIN WARNING ALERT (30 S FROM IMPACT)=
"TERRAIN AHEAD PULL UP" AUDIO ALERT (REPEATED CONTINUOUSLY WHILE IN THE WARNING ENVELOPE)
+ GPWS RED WARNING
+ RED TERR AHEAD MESSAGE ON ND.

RED AREA

YELLOW AREA

HIGH DENSITY YELLOW AREA

MEDIUM DENSITY YELLOW

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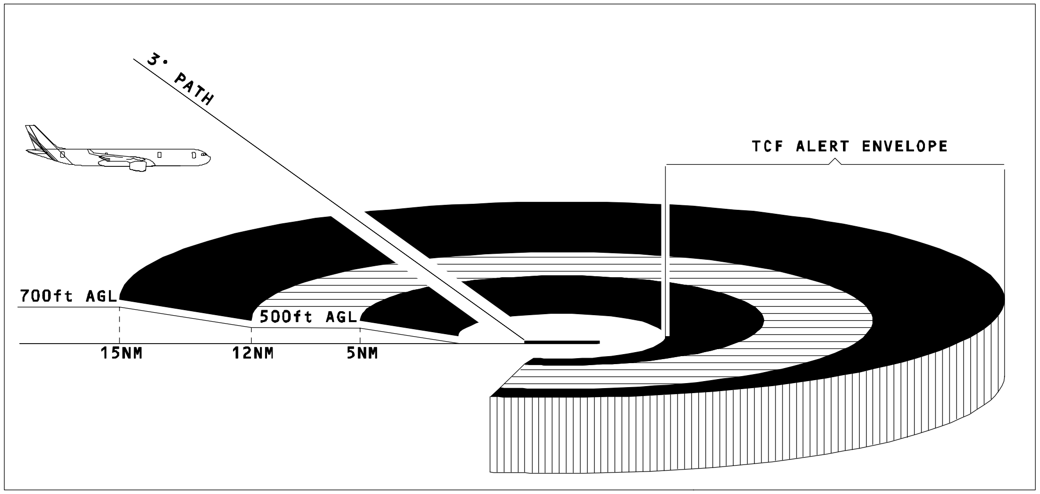
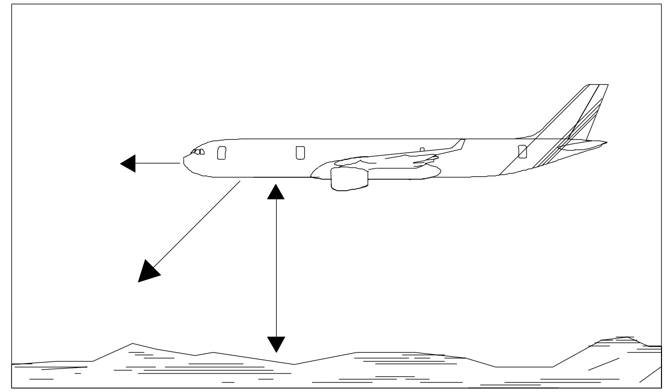
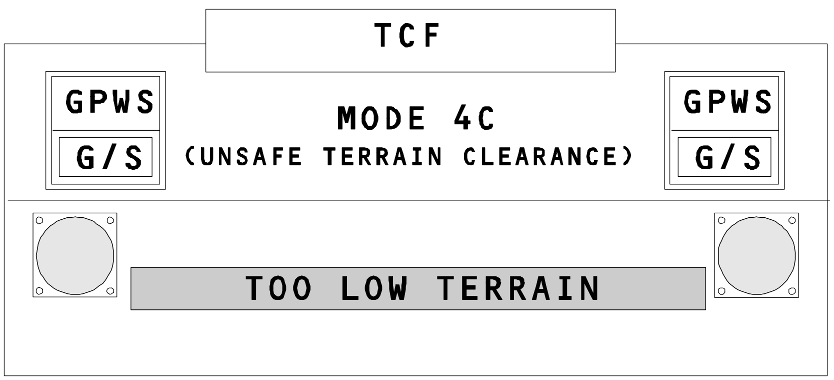
TERRAIN CLEARANCE FLOOR (TCF) (ENHANCED MODE)

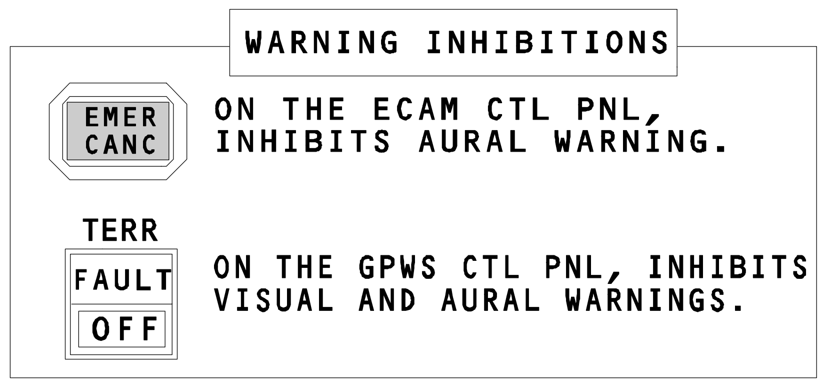
The Terrain Clearance Floor is an increasing terrain clearance enveloppe around the airport runway to provide protection against Controlled Flight Into Terrain (CFIT).
The TCF alert function complements the existing Mode 4. When TCF alert envelope is penetrated "TOO LOW TERRAIN" is broadcast.
It is based on current aircraft position, nearest runway center point position and Radio Altitude.





TCF ALERT ENVELOPE





STUDENT NOTES:

(E)GPWS D/O

Data Inputs
Visual Warnings
Aural Warnings
GPWS Control
MCDU Control
Other Outputs
FWC
LGCIU
CMC
Enhanced GPWS

Ground Proximity Warning System (GPWS).

DATA INPUTS

The Ground Proximity Warning Computer (GPWC) receives ARINC 429 data inputs from other systems.

VISUAL WARNINGS

Different light warnings enable system failures on hazardous flight configurations to be detected.

Three discretes control the warning legends :

- one for red GPWS legends, for ground proximity warning (mode 1 to 4),
- one for amber G/S legends, for Glide/Slope advisory alert (mode 5),
- one monitor output for the amber FAULT legend and the 'GPWS FAULT' ECAM message via the System Data Acquisition Concentrator (SDAC).

AURAL WARNINGS

The cockpit loudspeakers use the audio output via the Audio Management Unit (AMU) for transmission of aural warning messages.

The GPWC receives a discrete signal from the ECAM control panel which allows the crew to suppress the audio transmission.

GPWS CONTROL

Different pushbuttons allow the crew to control the actions of the GPWS.

When pressed in, the SYS P/B inhibits all the GPWS warnings, the G/S P/B inhibits the Glide/Slope mode and the FLAP P/B inhibits flap abnormal condition input and generates the 'GPWS FLAP MODE OFF' ECAM message.

When pressed in, the CAPT or F/O GPWS G/S P/B cancels the G/S mode or initiates the test sequence.

MCDU CONTROL

To avoid nuisance warnings during approach, the GPWC needs to know at which flap position the crew intends to land.

If the FLAP 3 position is selected from one MCDU, the FMGEC 1 or 2 activates a relay which selects the ground signal from the Slat and Flap Control Computer (SFCC) 1.

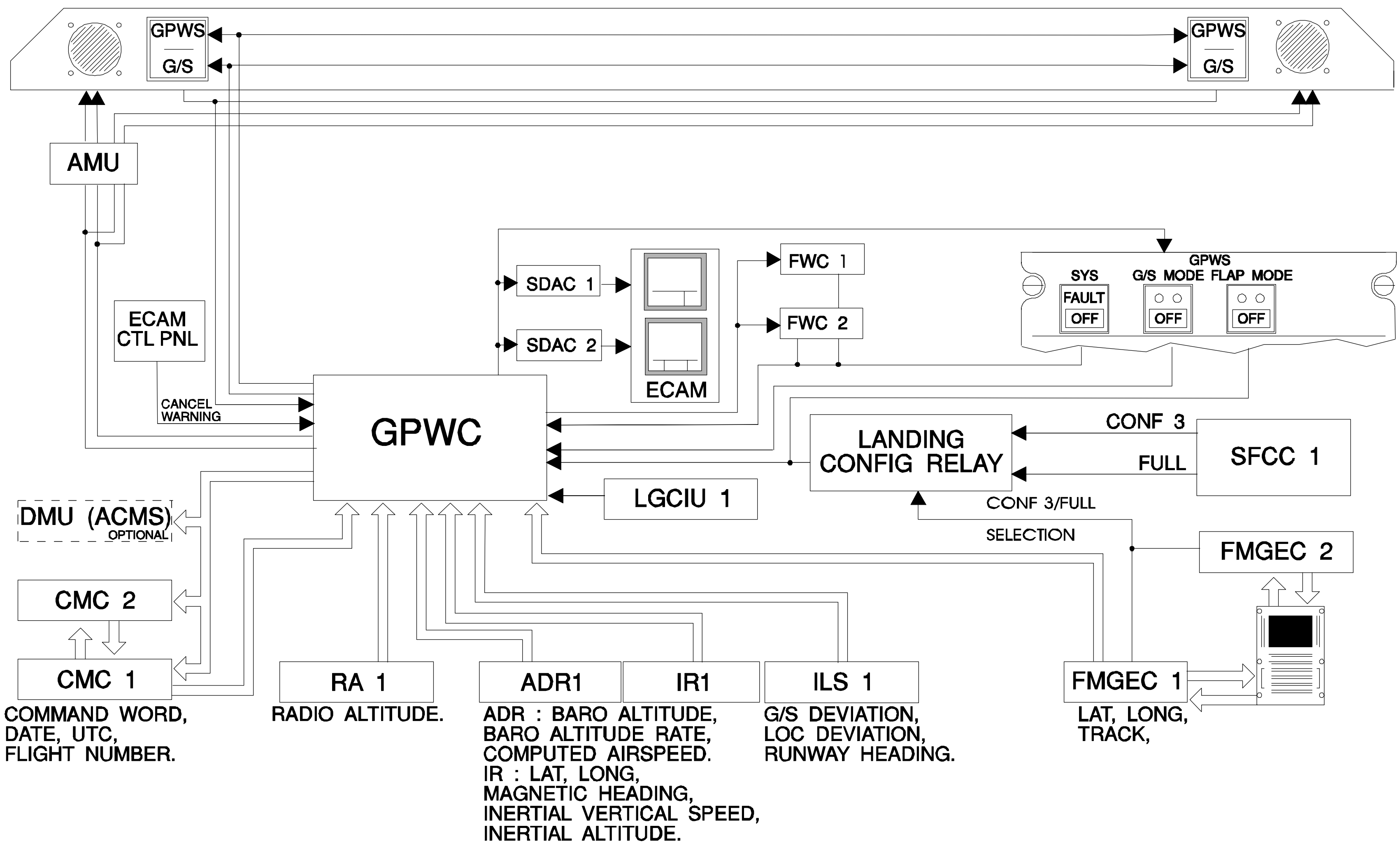
OTHER OUTPUTS

Different output signals are sent from GPWC to other systems.

One bus output is used by the Aircraft Condition Monitoring System (ACMS) through the Data Management Unit (DMU) if these options are installed.

One discrete output is used for the Digital Flight Data Recorder (DFDR) via the Flight Warning Computers (FWC) 1 and 2.

Two discrete outputs are used to inhibit TCAS (if fitted) and automatic call out when the GPWS or G/S warnings are in progress.



FQW4200 GE Metric

FWC

The Flight Warning Computers (FWC) send a discrete to the GPWC to inhibit all warnings when a stall or windshear warning is triggered.

LGCIU

The Landing Gear Control Interface Unit (LGCIU) sends a discrete signal to the GPWC.

The Ground/Flight information, sent by the Landing Gear Control Interface Unit, is used by the GPWC BITE module to count the flight legs.

CMC

The Central Management Computers (CMC) receive, during the concerned flight, the status of the GPWS from the BITE module.

The MCDUs allow the systems to be tested via the Central Maintenance Computers.
The tests are only available on ground.

ENHANCED GPWS

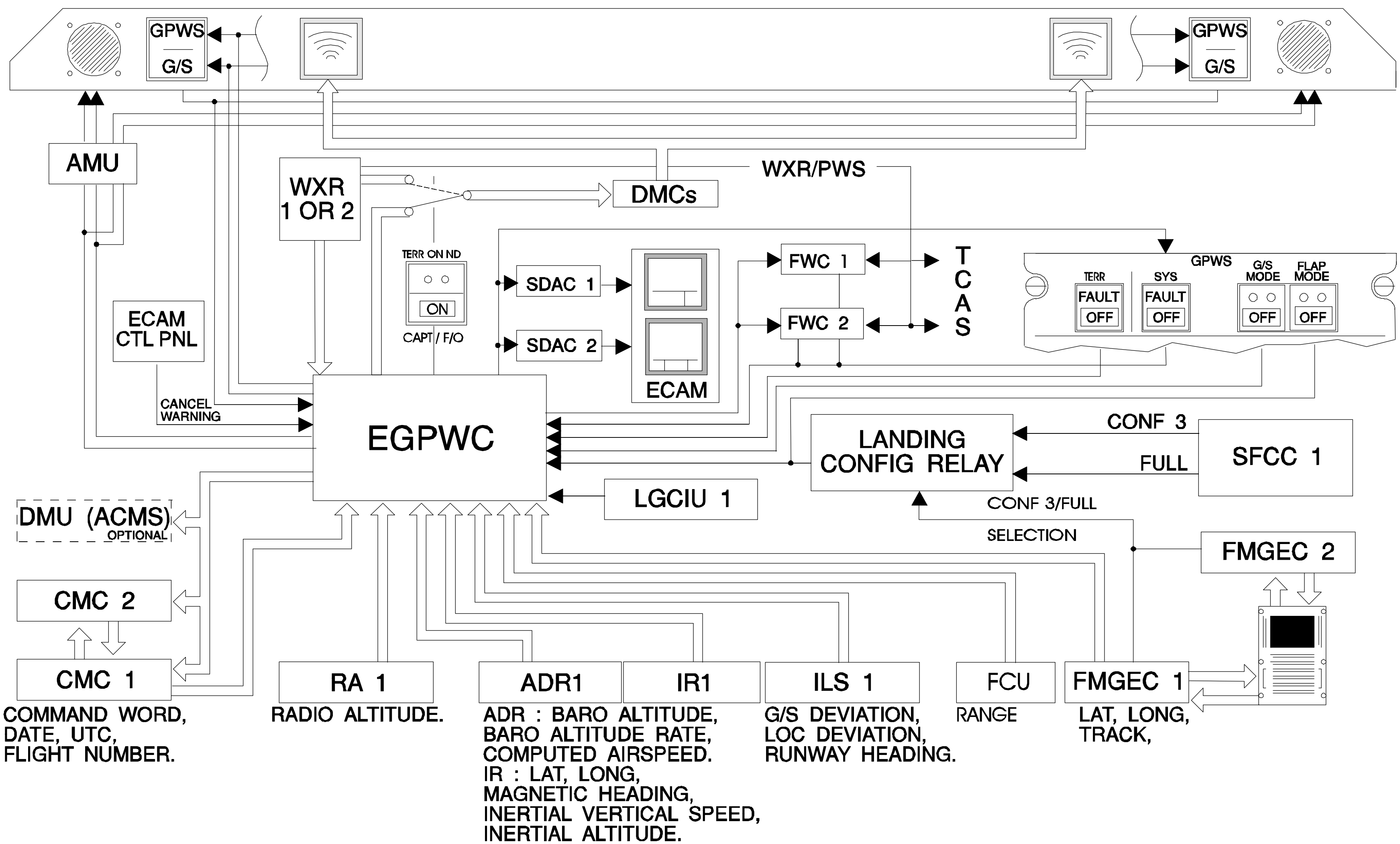
The Enhanced functions are GPWS added functions which automatically display, on the NDs, the terrain data, in place of the radar image, when a Terrain Caution or Warning is detected or at any time by using the TERR ON ND p/b.
Notes: If the optimal Predictive Windshear (PWS) is activated, the PWS alerts have priority over EGPWS modes.

Enhanced functions added controls:

When pressed in, on the GPWS panel, the TERR p/b (white legend) inhibits the terrain awarness.
When the TERR ON ND p/b is pressed in, on the center instrument panel, the green ON legend comes on to indicate that terrain data is displayed on the ND.

Enhanced functions warning:

TERR monitor output controls the amber FAULT legend of the GPWS/TERR p/b to indicate an Enhanced function failure and generate the "GPWS TERR DET FAULT" ECAM warning message.



FQW4200 GE Metric

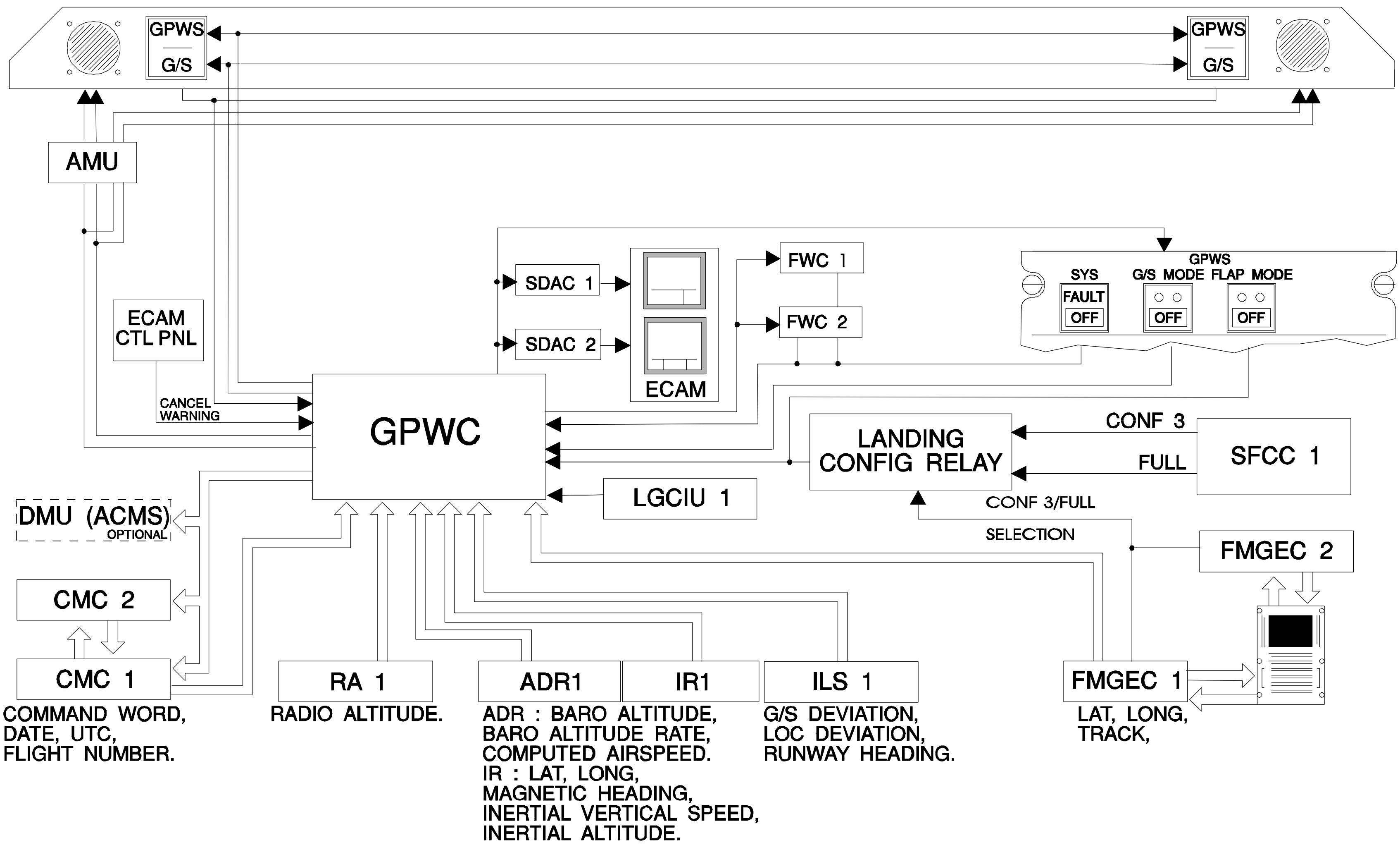
STUDENT NOTES:

STUDENT NOTES

(E)GPWS COMPONENTS

GPWS
EGPWS

STUDENT NOTES



FQW4200 GE Metric

GPWC

FIN : 1WZ

ZONE : 121

COMPONENT DESCRIPTION

The face of the GPWC is fitted with a handle, one lug, a STATUS/HISTORY test switch and an 8-character alpha-numeric BITE display.
The back is equipped with one ARINC 600 size one connector which includes three plugs :

- Top Plug (TP) :

Connection with the automatic test circuit.

- Middle Plug (MP) :

Interconnections with systems.

- Bottom Plug (BP) :

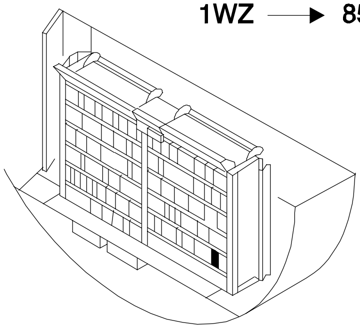
Connection with the power supply circuit (115vac-400Hz).

IN SITU TEST

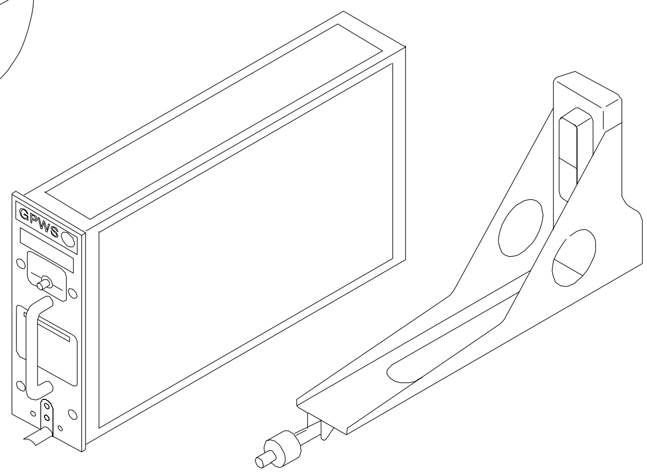
The test is controlled by the STATUS/HISTORY switch on the GPWC.
The status of system is displayed by means of an 8-character BITE display.

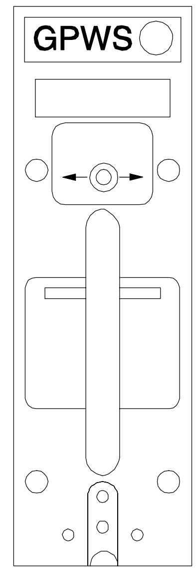
COMPONENT LOCATION

1WZ ⟶ 851 VU

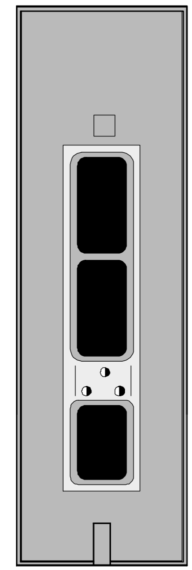


REMOVAL INSTALLATION





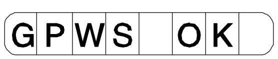
FACE



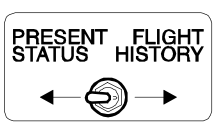
BACK

GPWC

IN SITU TEST



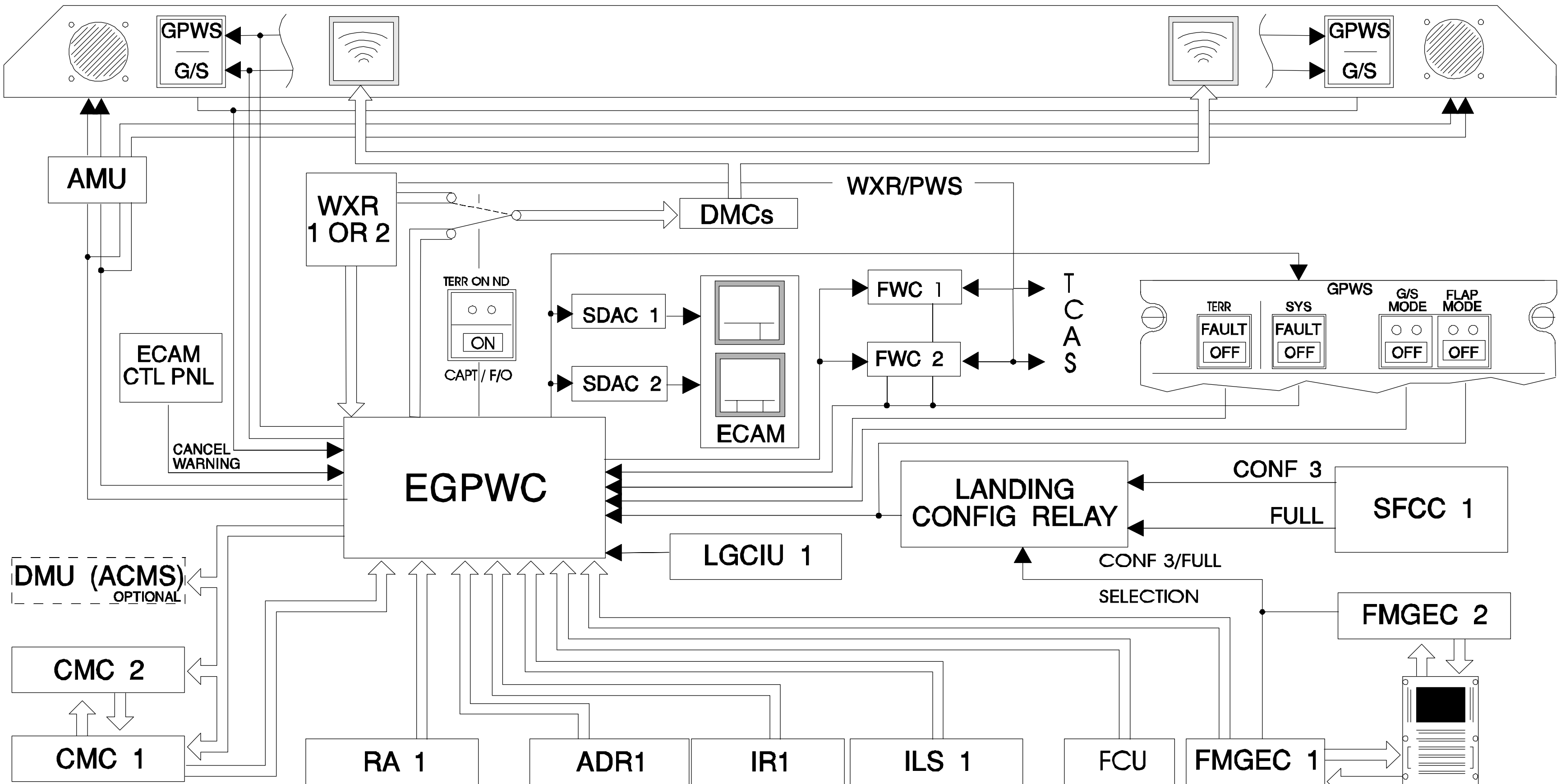
PRESENT STATUS:
The STATUS page will display the status of the last flight.



FLIGHT HISTORY:
The HISTORY page will display the status related to the ten previous flights.

FQW4200 GE Metric

STUDENT NOTES



COMMAND WORD,
DATE, UTC,
FLIGHT NUMBER.

RADIO ALTITUDE.

ADR : BARO ALTITUDE,
BARO ALTITUDE RATE,
COMPUTED AIRSPEED.
IR : LAT, LONG,
MAGNETIC HEADING,
INERTIAL VERTICAL SPEED,
INERTIAL ALTITUDE.

G/S DEVIATION,
LOC DEVIATION,
RUNWAY HEADING.

RANGE

LAT, LONG,
TRACK,

FQW4200 GE Metric

EGPWC

FIN : 1WZ

ZONE : 121

COMPONENT DESCRIPTION

The face of the EGPWC is fitted with a handle, 3 status leds and a latched door behind which are located:

- a self-test switch,
- a headphone jack,
- an RS232 test connector for CRT or a PC,
- a Personal Computing Memory Card Interface Adapter (PCMCIA) for uploading or downloading internal EGPWC information.

The back is equipped with one ARINC 600 size one connector which includes three plugs :

- Top Plug (TP) :

Connection with the automatic test circuit.

- Middle Plug (MP) :

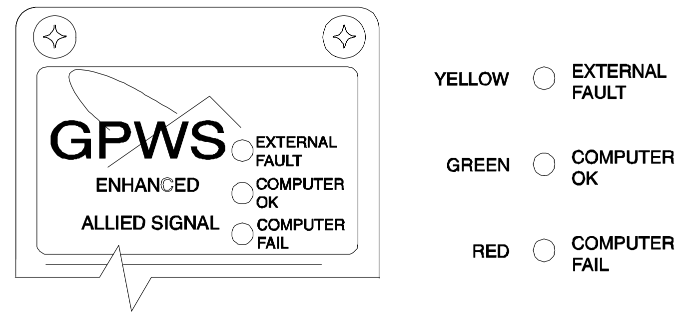
Interconnections with systems.

- Bottom Plug (BP) :

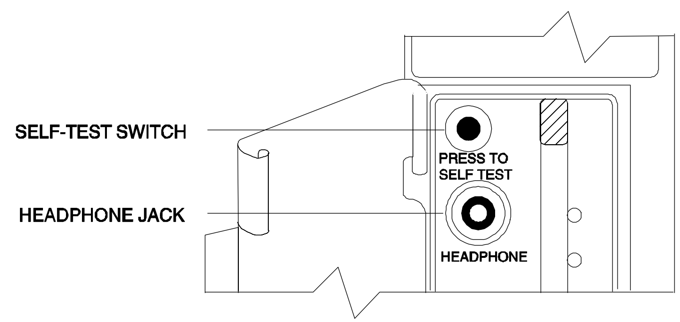
Connection with the power supply circuit (115vac-400Hz).

IN SITU TEST

The EGPWC front panel status leds consist of 3 leds which indicate the stations of the system.



The EGPWC front panel Self-Test interface consists of a self-test switch and a headphone jack which can be used to activate all of the self-test features defined for the system.



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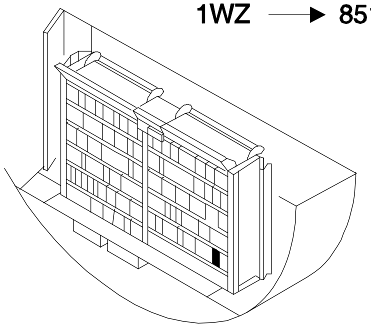
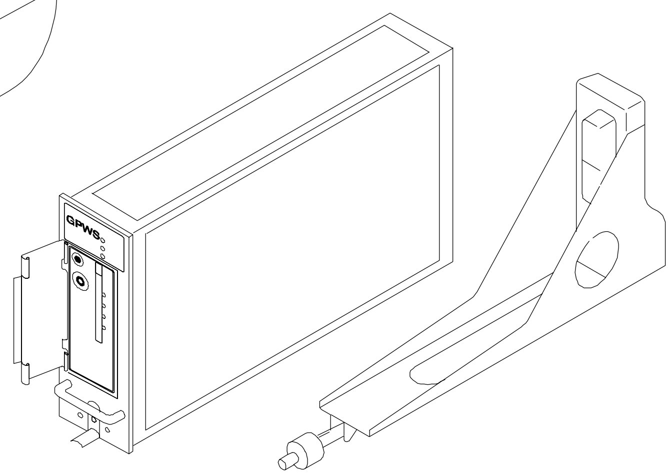
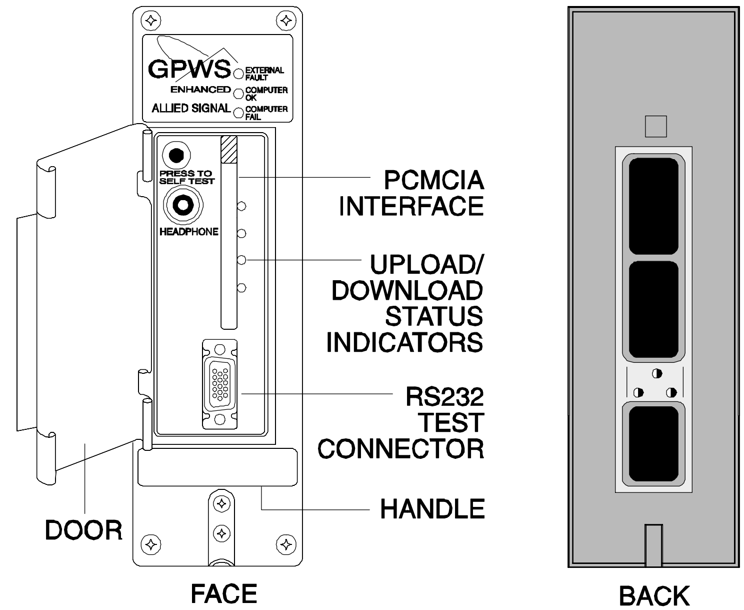
COMPONENT LOCATION

1WZ → 851VU



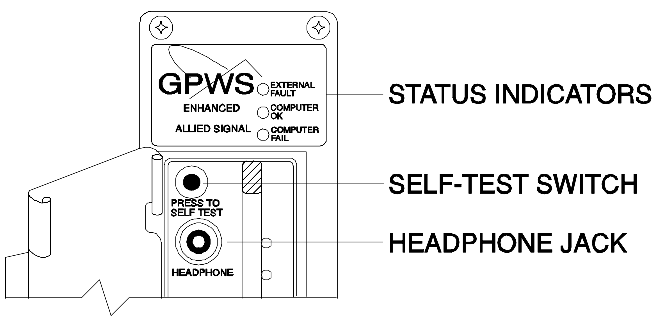
REMOVAL INSTALLATION





EGPWC

IN SITU TEST



FQW4200 GE Metric

STUDENT NOTES

DME SYSTEM PRESENTATION

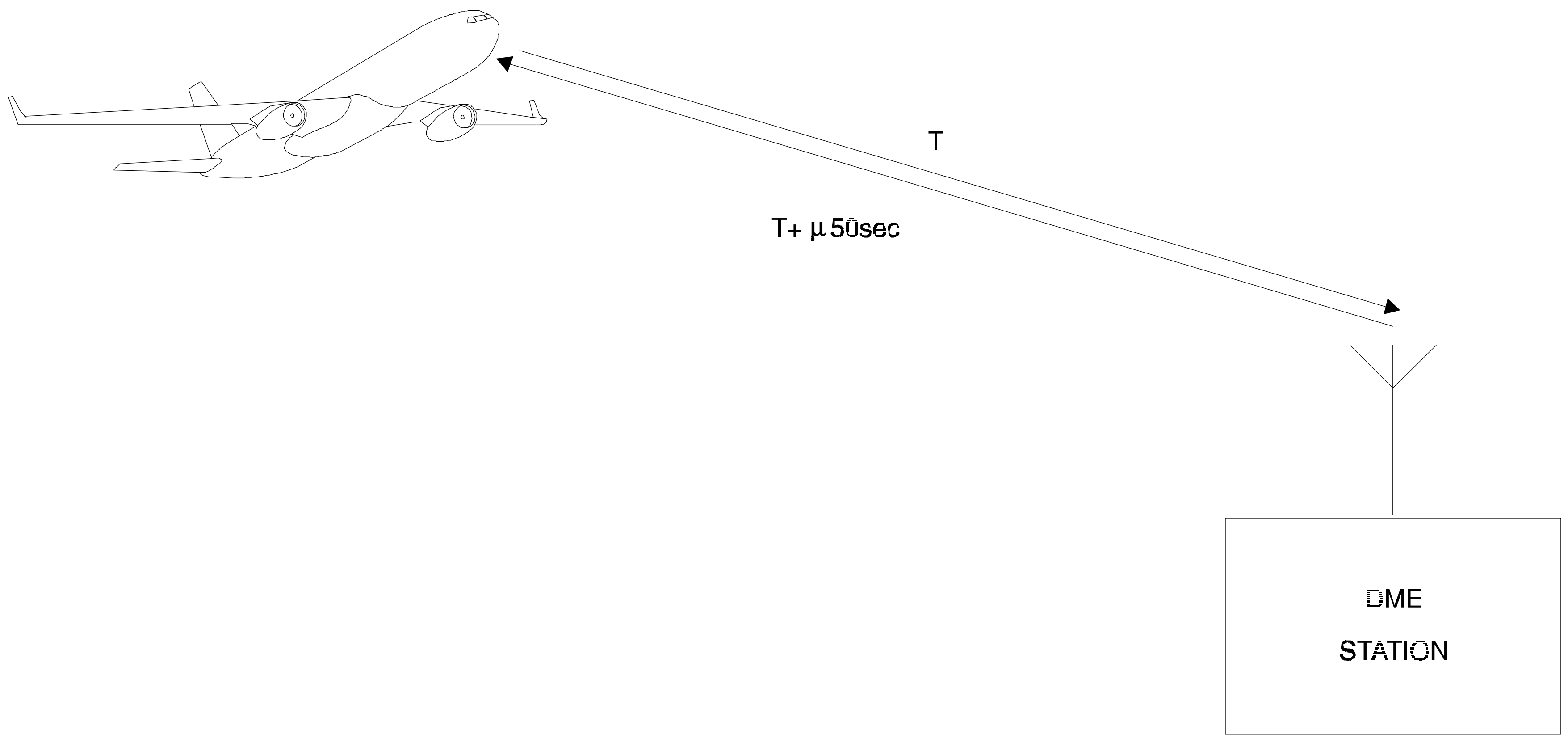
Principle
Components
Indicating

PRINCIPLE

The Distance Measuring Equipment (DME) provides digital readout of the aircraft slant range distance from a selected ground station.

The system generates interrogation pulses from an onboard interrogator and sends them to a selected ground station.
After 50 micro seconds the ground station replies.

The interrogator determines the distance in Nautical Mile (NM) between the station and the aircraft.
The interrogator detects the Morse audio signal which identifies the ground station.



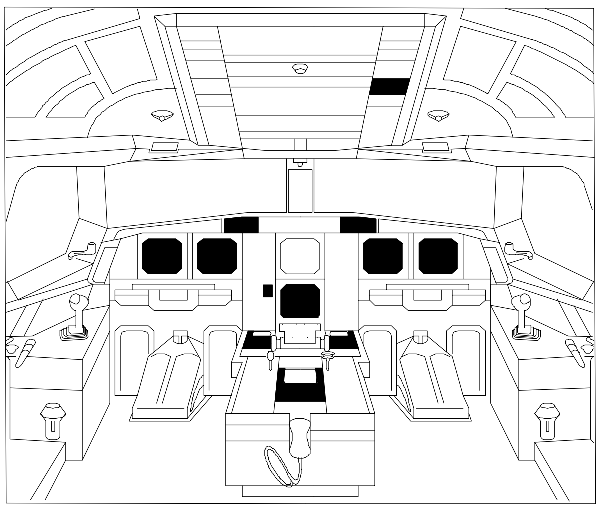
FQW4200 GE Metric

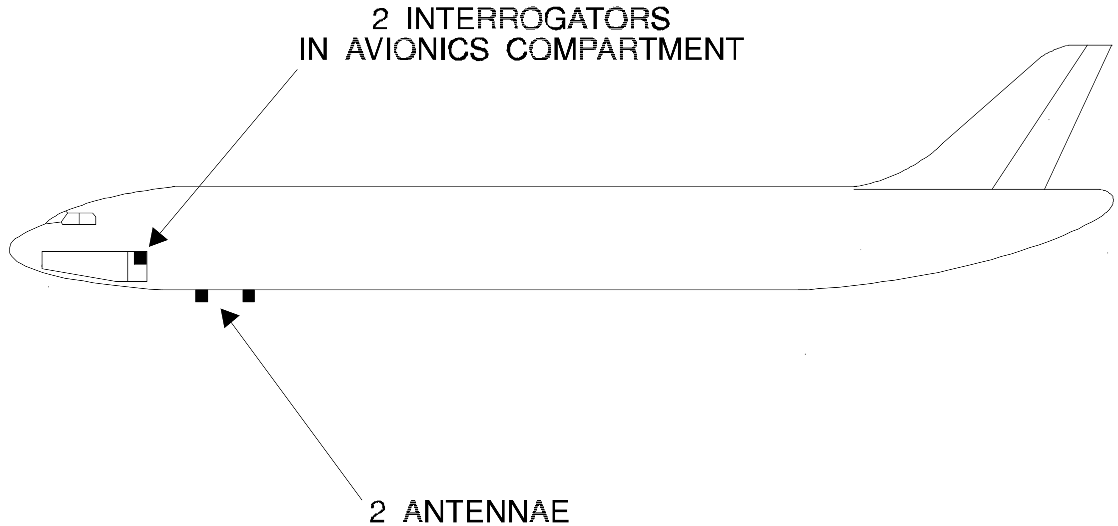
COMPONENTS

The components are two antennae and two interrogators.

The DME system is also connected to :

- Primary Flight Display (PFD), Navigation Display (ND) and Digital Distance and Radio Magnetic Indicator (DDRMI) for display.
- Electronic Flight Instrument System (EFIS) control unit for display control.
- Flight Management Guidance and Envelope Computer (FMGEC) for auto-tuning.
- Multipurpose Control Display Unit (MCDU) for manual tuning,
- Captain and F/O Radio Management Panels (RMP) for back-up tuning,
- Audio Control Panels for broadcast Morse identification audio signals.



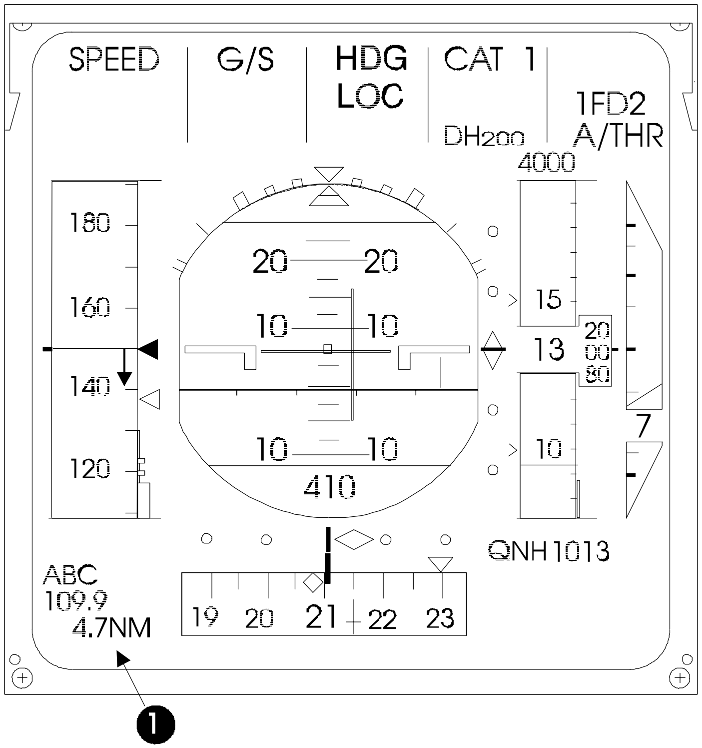


FQW4200 GE Metric

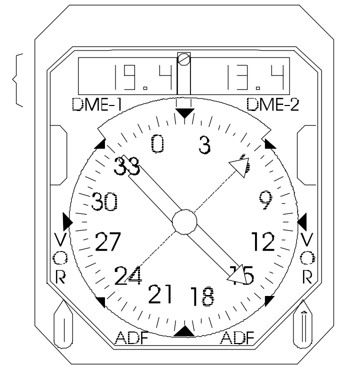
INDICATING

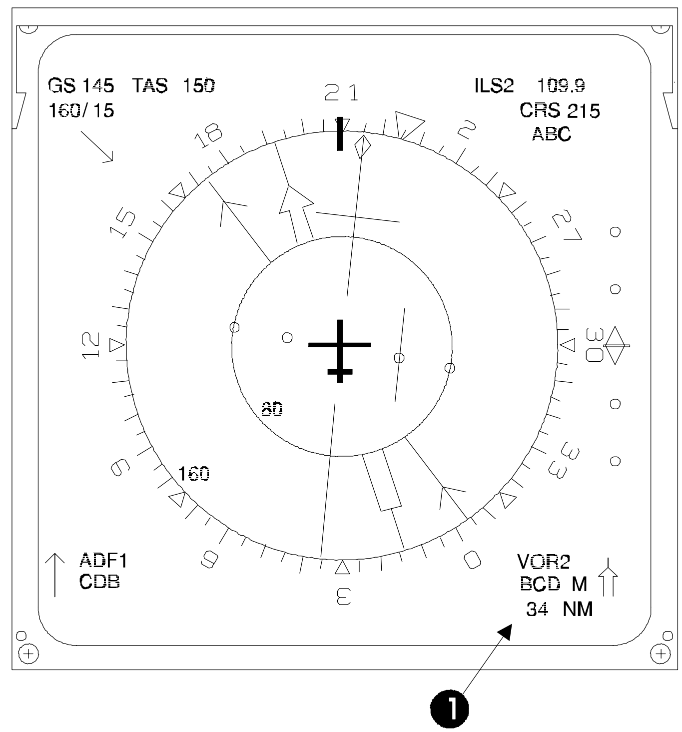
The DME distance is shown on the Primary Flight Display and on the Navigation Display.

The DME distance is also shown on the two windows of the Digital Data Radio Magnetic Indicator.



DME INDICATION





❶ DME INDICATIONS

FQW4200 GE Metric

STUDENT NOTES

DME D/O

Auto Tuning
Manual Tuning
FM Switch
Back Up Tuning
Antennae
Suppressor
LGCIU
Indicating
Users
CMC

AUTO TUNING

In normal operation each Flight Management Guidance and Envelope Computer (FMGEC) automatically tunes its ownside Distance Measuring Equipment (DME) interrogator through its ownside Radio Management Panel (RMP).

MANUAL TUNING

Each Multipurpose Control and Display Unit (MCDU) allows the ownside DME interrogator to be manually tuned through the ownside FMGEC and the opposite DME interrogator to be tuned though the opposite FMGEC.

FM SWITCH

If a FMGEC failure occurs, a discrete, generated by the Flight Management (FM) switching, changes the tuning port of the associated DME interrogator, so that it can be directly tuned by the opposite FMGEC.

BACK UP TUNING

If both FMGECs fail, each RMP allows its ownside DME interrogator to be directly tuned.
A discrete inhibits the radionav MCDU page, via the the FMGEC.

ANTENNAE

The DME antenna transmits the DME interrogation and receives the reply from the selected ground station.

The DME and Air Traffic Control (ATC) use identical and interchangeable blade antennae, designed for operation between 960 and 1250 Mhz.

SUPPRESSOR

The Distance Measuring Equipment, the Air Traffic Control (ATC) and Traffic Collision Avoidance System (TCAS) operate with Interrogation/Reply pulses in the same frequency range.

The suppressor signal is transmitted by the operating system during each pulse to inhibit the other systems and to prevent simultaneous transmission.

LGCIU

Each Landing Gear Control Interface Unit (LGCIU) sends discrete signals to the associated DME interrogator.
This Ground/Flight information is used by the receiver BITE module to count the flight legs.

INDICATING

The DME data is sent to the Primary Flight Display (PFD) and the Navigation Display (ND) through the Display Management Computers (DMC) and directly to the Digital Distance and Radio Magnetic Indicator (DDRMI).

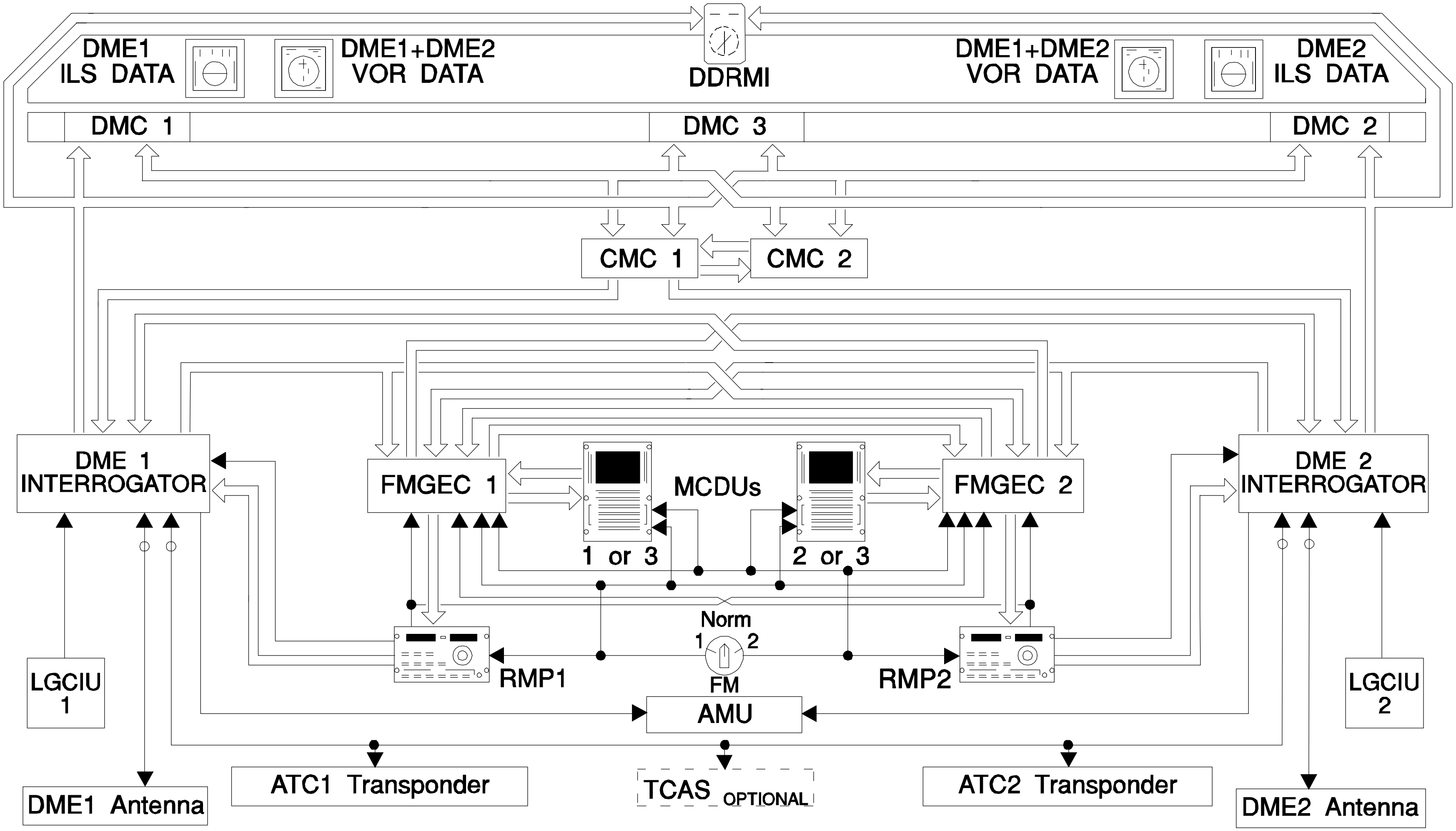
The DME audio signal is processed by the interrogators and sent to the Audio Management Unit (AMU) and can be heard by the crew.

USERS

The DME data is sent to the FMGEC for radio distance computation.

CMC

The MCDUs allow the systems to be tested via the Central Maintenance Computers (CMC).
The tests are only available on ground.



FQW4200 GE Metric

STUDENT NOTES:

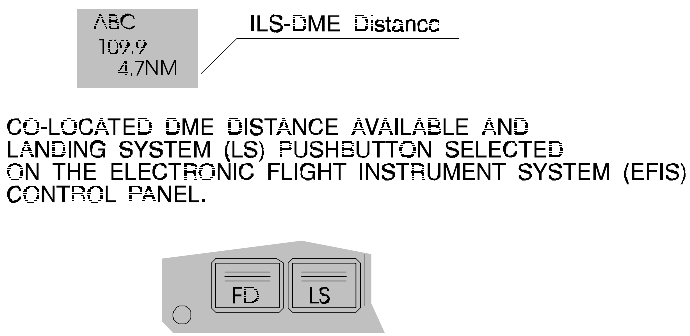
DME INDICATIONS ON PFD AND ND

On PFD
On ND
VOR-D Pushbutton
Failure

Distance Measuring Equipment (DME).
Navigation Display (ND).
Primary Flight Display (PFD).

ON PFD

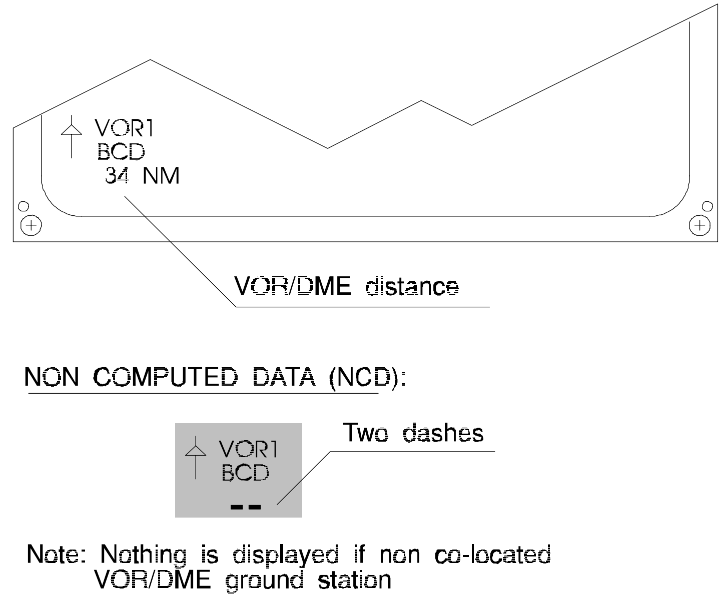
CONDITIONS OF DISPLAY



With Instrument Landing System (ILS) station co-located with a DME station, the ILS/DME distance is displayed in magenta on the left lower corner of the PFD.

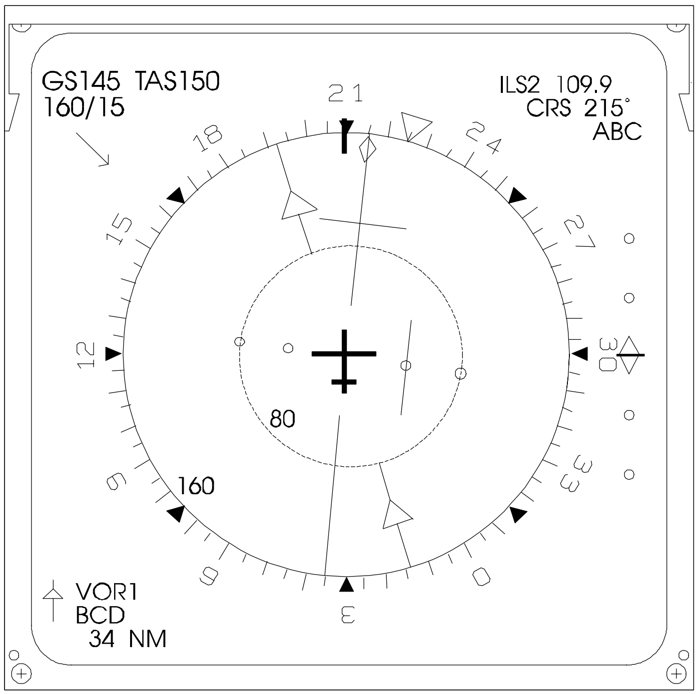
ON ND

DISPLAY IN ROSE OR ARC MODE

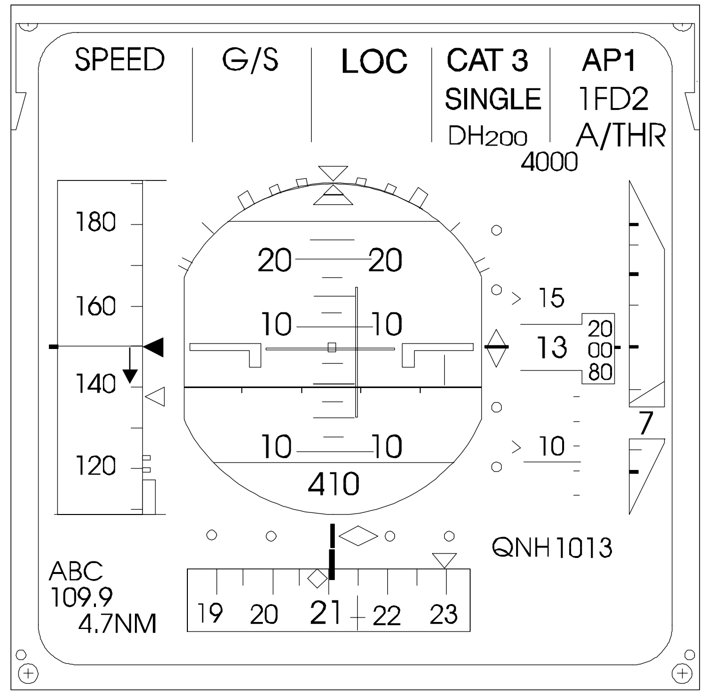


When the mode selector is set to ROSE or ARC mode, and the ADF/VOR selector is set to VOR, the DME distance is displayed in green in the left or right lower corner.

ND (ROSE-LS MODE)

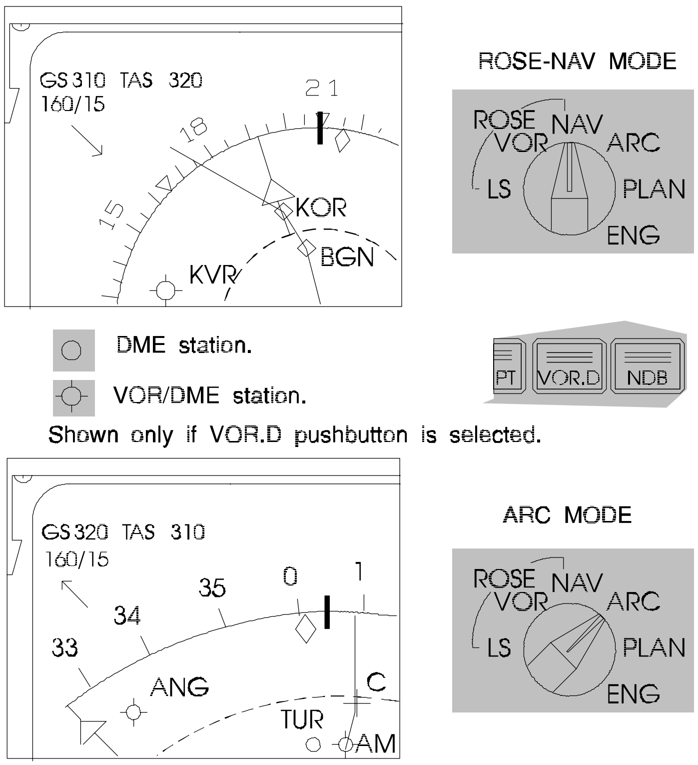


PFD



VOR-D PUSHBUTTON

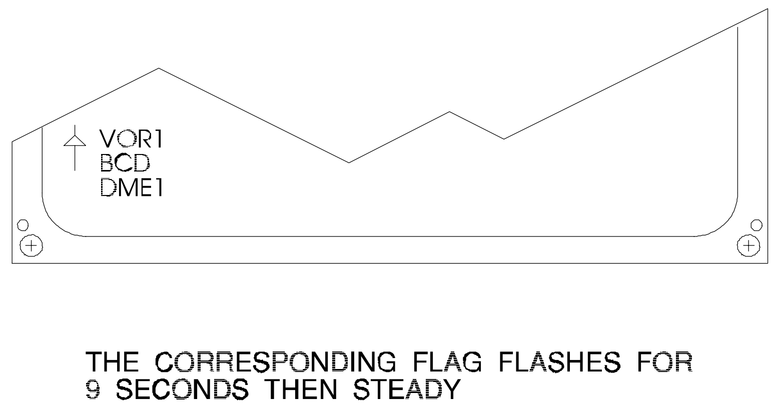
CONDITIONS OF DISPLAY



Additionaly, in ROSE-NAV and ARC position, it is possible to show the DME and VOR/DME ground stations which are included in the navigation data base.

FAILURE

DISPLAY IN ROSE OR ARC MODE



When a failure occurs, the corresponding red flag is displayed in the lower corner of the corresponding side.

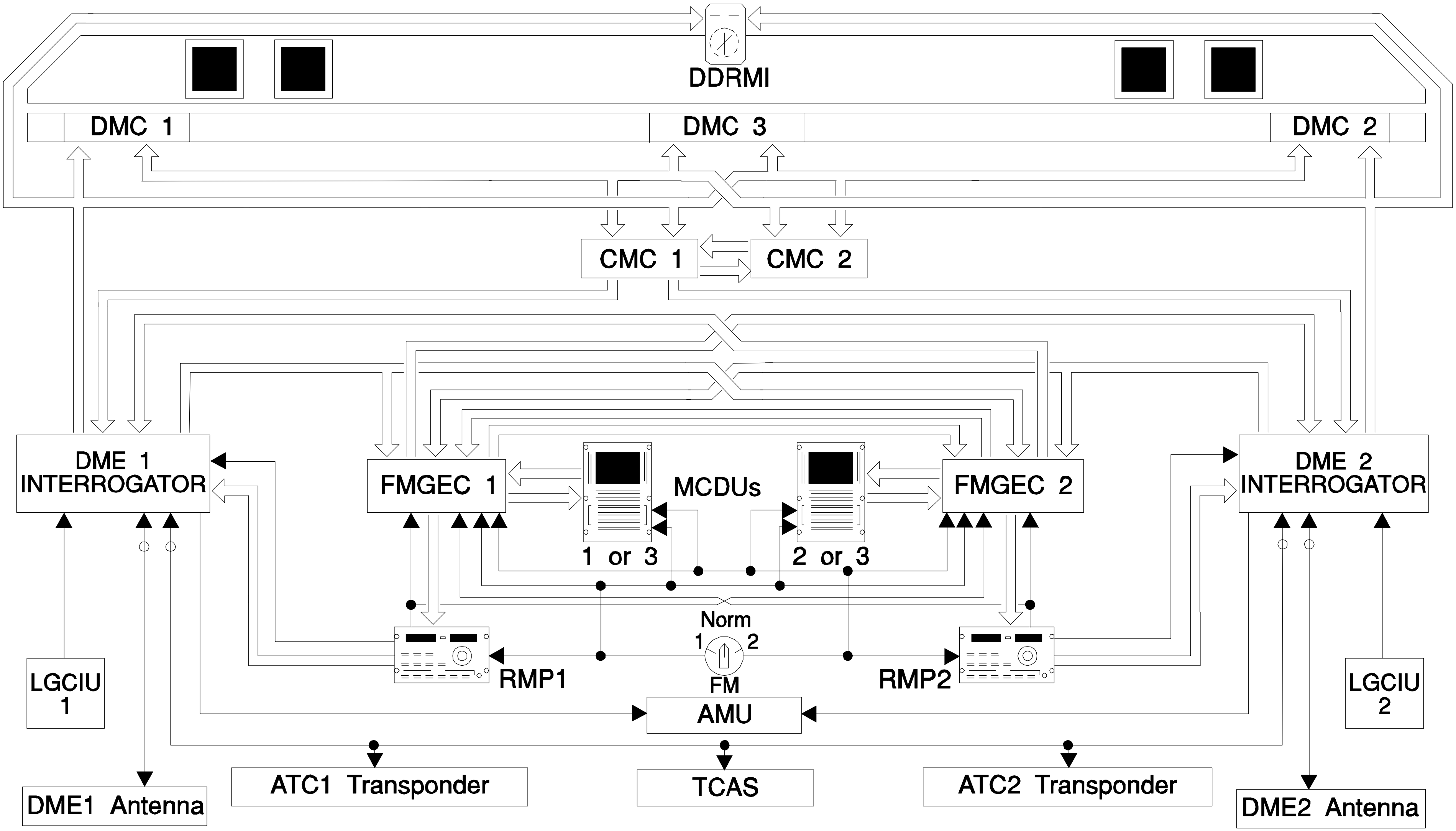
STUDENT NOTES:

STUDENT NOTES

DME COMPONENTS

DME 1/2 Interrogator
DME 1/2 Antenna

STUDENT NOTES



FQW4200 GE Metric

DME 1/2 INTERROGATOR

FIN : 1SD1, 1SD2

ZONE : 121, 122

COMPONENT DESCRIPTION

The face of the interrogator is fitted with a handle, two lugs, a test P/B and three LEDs.
The back is equipped with one ARINC 600 size one connector which includes three plugs :

- Top Plug (TP) :

  Connection with the automatic test circuit.

- Middle Plug (MP) :

  Connection with the antenna and peripheral circuits.

- Bottom Plug (BP) :

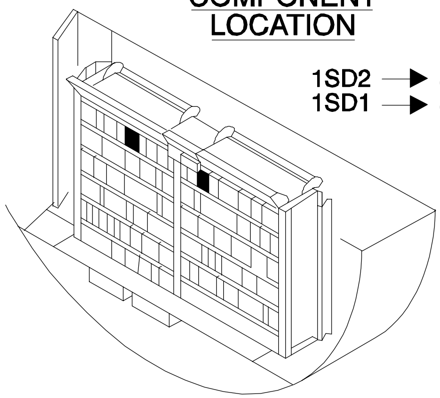
  Connection with the power supply circuit (115vac-400Hz).

IN SITU TEST

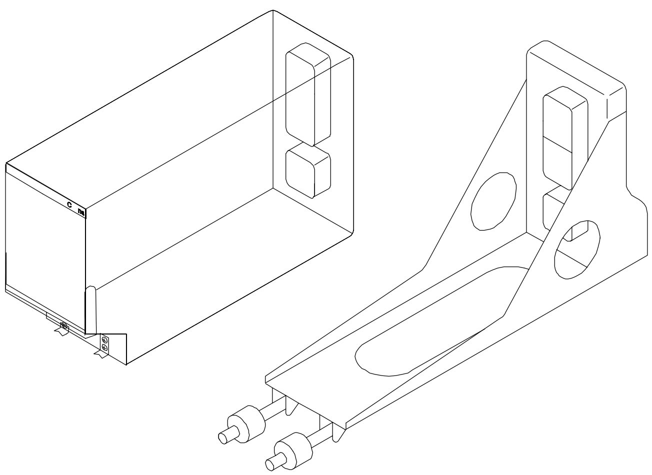
The DME test function can be activated in ground condition only by pressing the test P/B on the face of the interrogator.
The status of system is displayed by means of three LEDs.

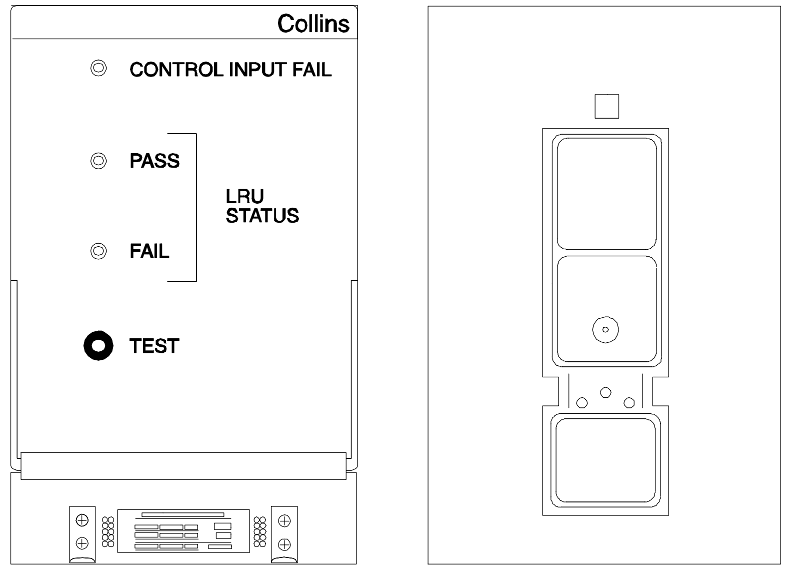
COMPONENT LOCATION

1SD2 → 812VU
1SD1 → 811VU



REMOVAL INSTALLATION



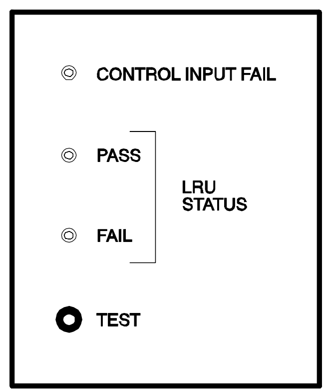


FACE

BACK

DME INTERROGATOR

IN SITU TEST



(RED) AN INPUT DATA IS FAULTY

(GREEN) NO FAULT ON RECEIVER

(RED) MALFUNCTION OF RECEIVER

FQW4200 GE Metric

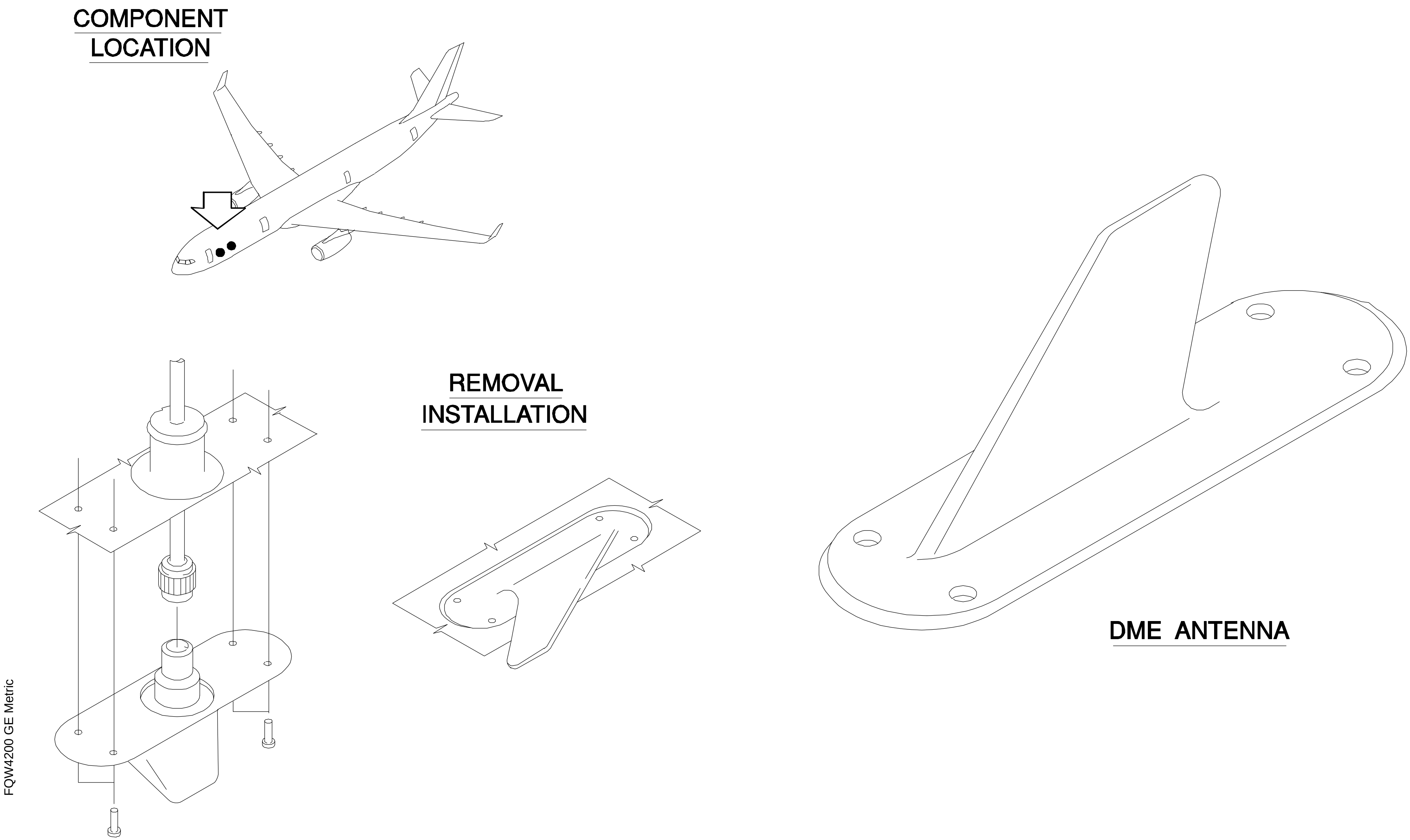
DME 1/2 ANTENNA

FIN : 3SD1, 3SD2

ZONE : 130

COMPONENT DESCRIPTION

This antenna is blade type with a radiating cavity driven by capacitive coupling.
It is an airborne antenna, designed for installation on fast aircraft and operation within the L-band from 960 to 1250 Mhz.


COMPONENT
LOCATION
REMOVAL
INSTALLATION
DME ANTENNA
FQW4200 GE Metric

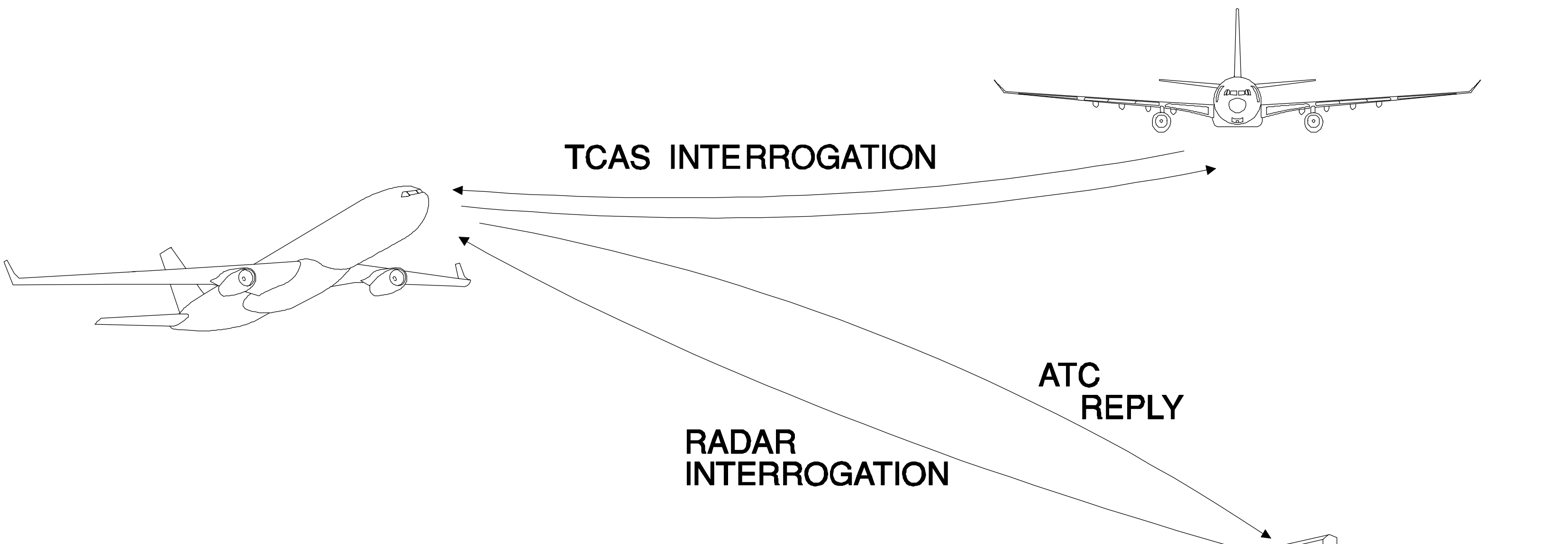
STUDENT NOTES

ATC SYSTEM PRESENTATION

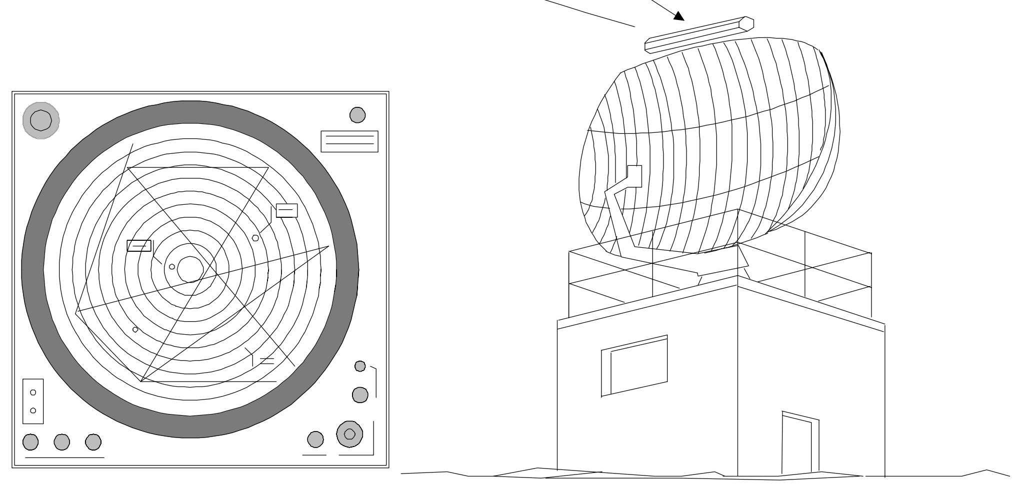
Principle
Components

PRINCIPLE

The Air Traffic Control (ATC) transponder is an integral part of the Air Traffic Control Radar Beacon System.
The transponder is interrogated by radar pulses received from the ground station. It automatically replies by a series of pulses.These reply pulses are coded to supply identification and automatic altitude reporting of the aircraft on the ground controller’s radar scope. These replies enable the controller to distinguish the aircraft and to maintain effective ground surveillance of the air traffic.
The ATC transponder also responses to interrogation from aircraft equipped with a Traffic Collision Avoidance System.
Note : mode S is optionnal.



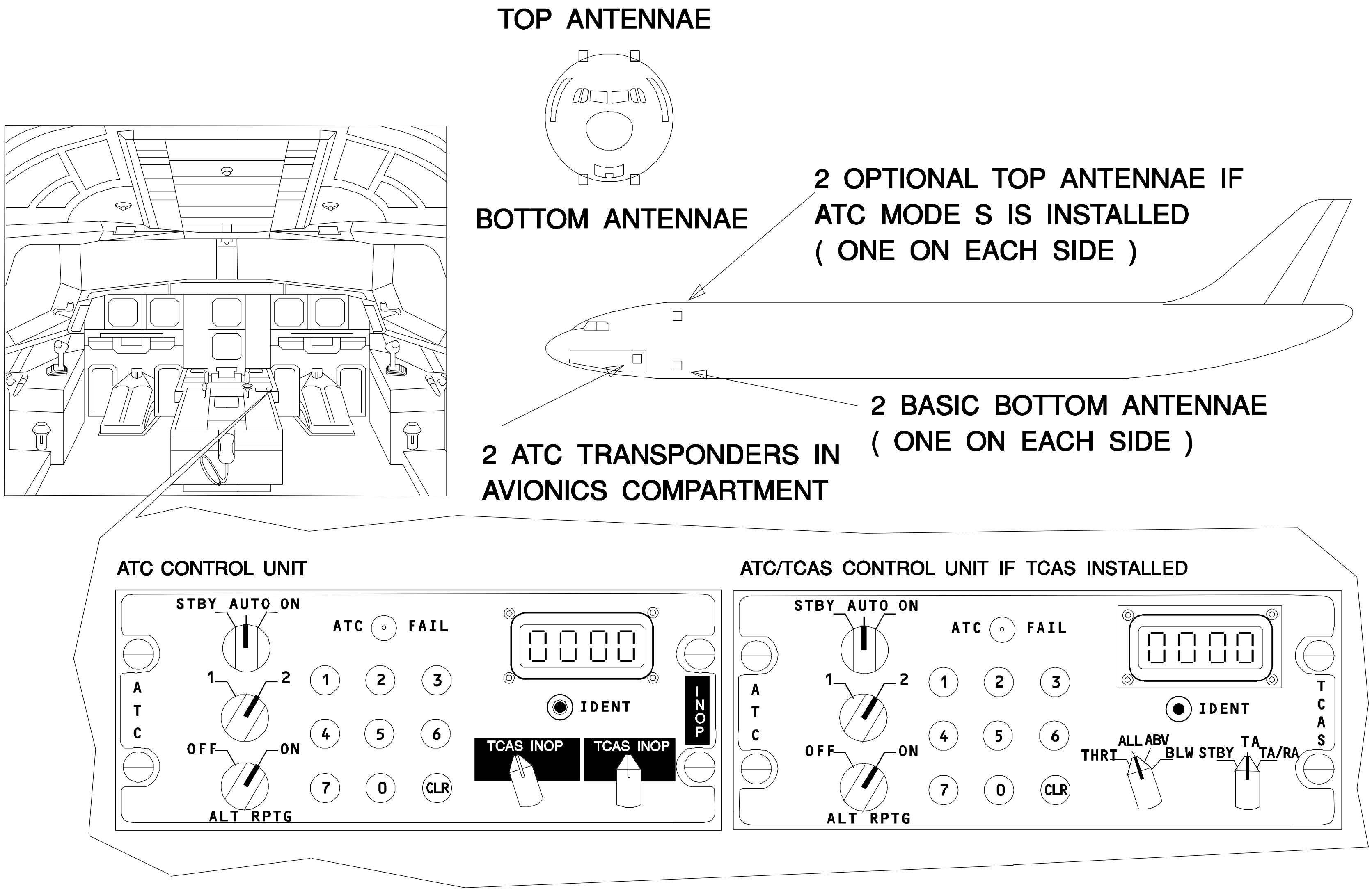
ATC mode	Information about the A/C
A	identification
C	altitude
S	communication link



CONTROLLER SCOPE

COMPONENTS

The components are two transponders, two antennae or four, if mode S is installed, and one ATC/TCAS control unit with " INOP " stickers on the TCAS control switches if the TCAS system is not installed.


TOP ANTENNAE
BOTTOM ANTENNAE
2 OPTIONAL TOP ANTENNAE IF ATC MODE S IS INSTALLED (ONE ON EACH SIDE)
2 BASIC BOTTOM ANTENNAE (ONE ON EACH SIDE)
2 ATC TRANSPONDERS IN AVIONICS COMPARTMENT
ATC CONTROL UNIT
ATC/TCAS CONTROL UNIT IF TCAS INSTALLED
STBY AUTO ON
ATC FAIL
1 2
OFF ON
ALT RPTG
IDENT
INOP
TCAS INOP
THRT ALL ABV BLW
STBY TA TA/RA
TCAS
CLR

STUDENT NOTES

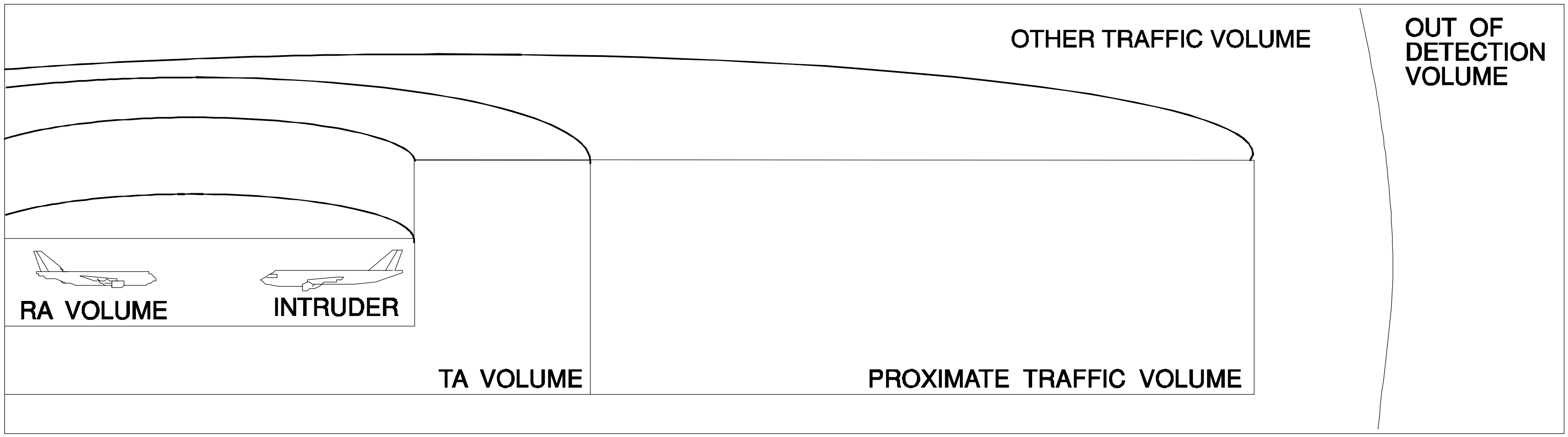
FQW4200 GE Metric

TRAFFIC COLLISION AVOIDANCE SYSTEM PRESENTATION

Principle
Components
Indicating

PRINCIPLE

The Traffic Collision Avoidance System (TCAS) function is to detect and display aircraft in the immediate vicinity and to provide the flight crew with indications to avoid these intruders.
The TCAS detects the air traffic control system or TCAS equipped aircraft and maintains surveillance within a range determined by its sensitivity.
When an intruder is detected within a certain range, the TCAS displays it on the navigation display for crew information.
Any transponder-replying traffic within the range of display and not included in the PROXIMATE, RA or TA categories is classified as OTHER.
When the intruder is relatively near but does not represent an immediate threat, the TCAS provides an aural and visual information known as traffic advisory.
When the intruder represents a collision threat, the TCAS triggers an aural and visual alarm known as resolution advisory.
The TCAS II indications for flight plan modifications are in the vertical plane only. The TCAS aural messages can be inhibited depending on higher priority aural messages.
The Resolution Advisory (RA) informs the crew about an available avoidance maneuver.

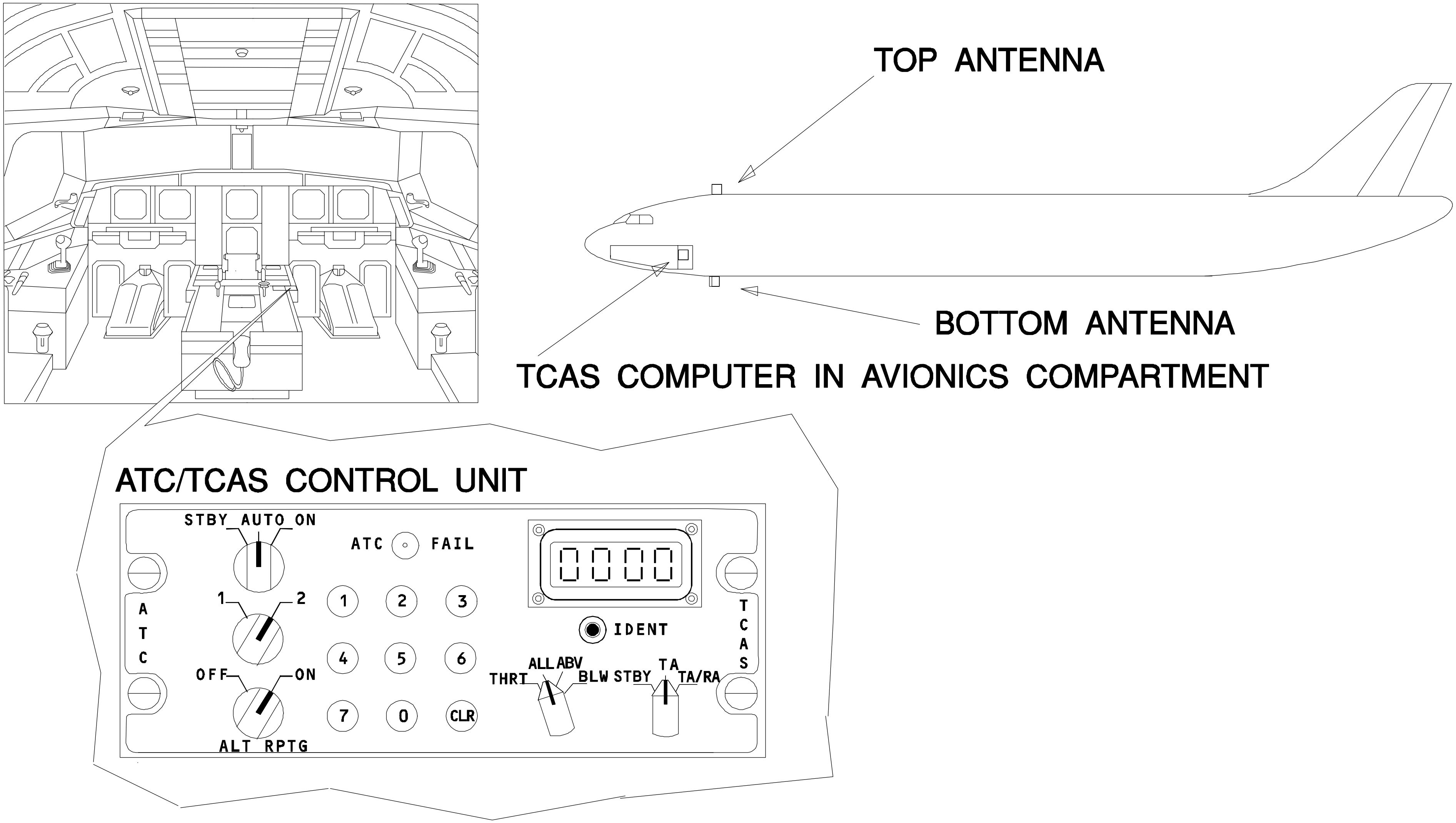


INTRUDER - LOCATION - EQUIPMENT	RESOLUTION ADVISORY (RA) VOLUME	TRAFFIC ADVISORY (TA) VOLUME	PROXIMATE TRAFFIC VOLUME	OTHER TRAFFIC VOLUME	OUT OF DETECTION
WITHOUT OPERATIVE ATC	NO DETECTION	NO DETECTION	NO DETECTION		NO DETECTION
WITH ATC MODE A	TA WITHOUT INTRUDER RELATIVE LEVEL	TA WITHOUT INTRUDER RELATIVE LEVEL	TRAFFIC INFORMATION WITHOUT INTRUDER RELATIVE LEVEL		
WITH ATC MODE C OR S	RA WITHOUT A/C MANEUVER COORDINATION	TA WITH INTRUDER RELATIVE LEVEL	TRAFFIC INFORMATION WITH INTRUDER RELATIVE LEVEL		
WITH TCAS II	RA WITH A/C MANEUVER COORDINATION				

FQW4200 GE Metric

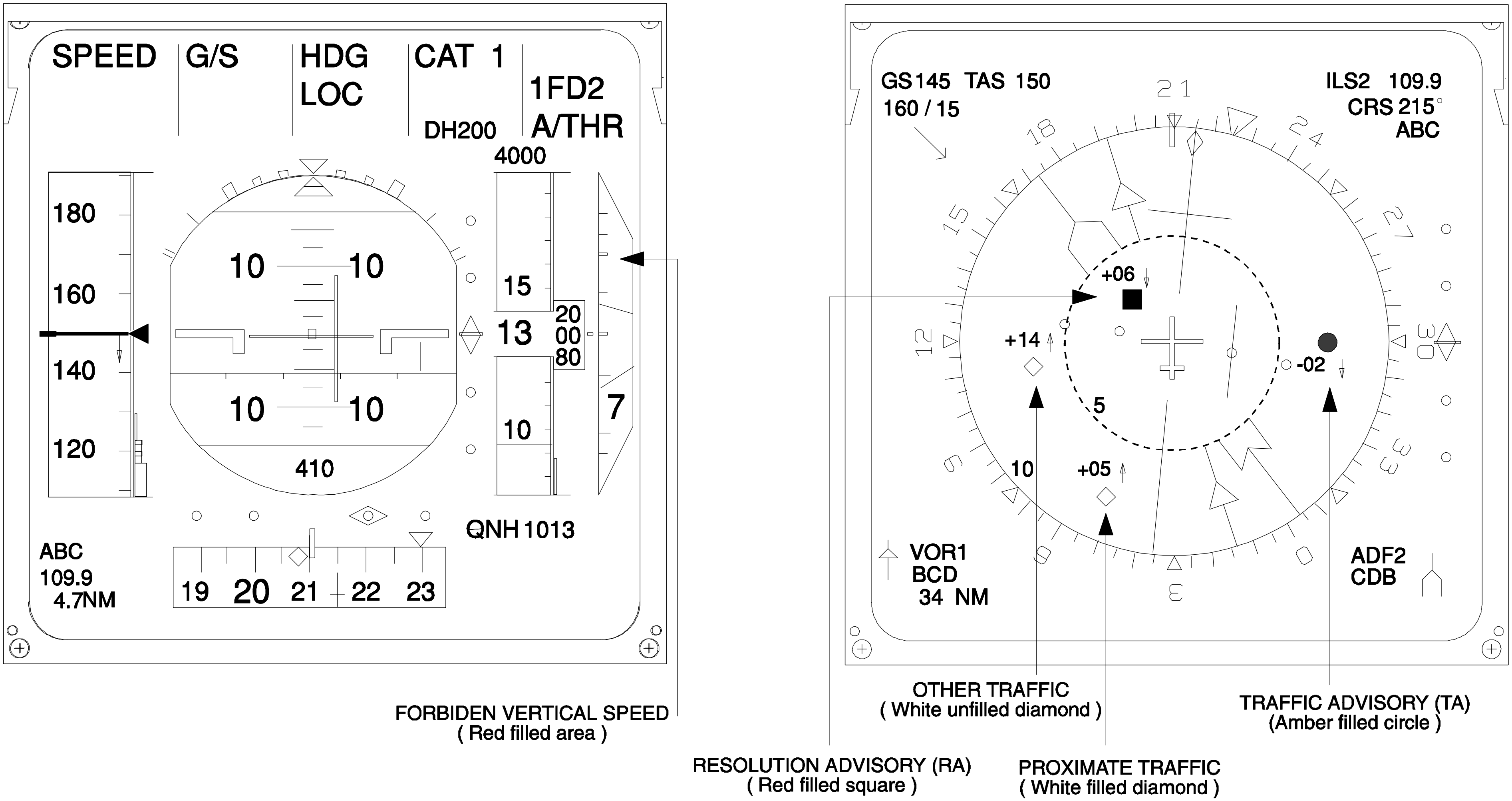
COMPONENTS

The TCAS components are two antennae, one TCAS computer and one ATC (Air Traffic Control)/TCAS control unit.


TOP ANTENNA
BOTTOM ANTENNA
TCAS COMPUTER IN AVIONICS COMPARTMENT
ATC/TCAS CONTROL UNIT
STBY AUTO ON
ATC FAIL
0000
1 2
A
T
C
OFF ON
ALT RPTG
1 2 3
4 5 6
7 0 CLR
IDENT
T
C
A
S
THRT ALL ABV BLW
STBY TA TA/RA

INDICATING

The TCAS indications appear on the primary flight display and the navigation display, they may be associated with synthetic voice indications.The visual resolution and traffic advisory indications are associated with aural indications such as "" TRAFFIC, TRAFFIC","CLIMB, CLIMB"... The TCAS displays only the most threatening intruders.



FQW4200 GE Metric

STUDENT NOTES:

ATC/TCAS CONTROL UNIT PRESENTATION

GENERAL

The purpose of this module is to understand the use of the various controls of the Air Traffic Control (ATC) control unit and the optional Air Traffic Control (ATC)/Traffic Collision Avoidance System (TCAS) control unit.

SYS 1/2 SWITCH

The system 1-2 switch allows the desired ATC transponder to be selected.

ATC MODE SELECTOR SWITCH

The mode selector switch allows the operating mode of the ATC system to be selected.

- ON: selected ATC transponder operates,
- AUTO: - selected ATC transponder operates in flight only,
  - selected ATC operates only in mode S on ground.
- STBY: ATC transponders energized but not operating.

ALT RPTG SWITCH

The altitude reporting (ALT RPTG) switch allows the altitude for ATC mode C to be transmitted.

FAULT LIGHT

The fault light comes on in case of ATC failure.

IDENT P/B

When the IDENT switch is pressed in, an ATC identification signal is transmitted.

CODE DISPLAY

The code display shows the selected ATC code.
Code exemples:

-7700 or 7777 for emergency configuration,
-7600 for total failure of radio communication system.

CONTROL KEYBOARD

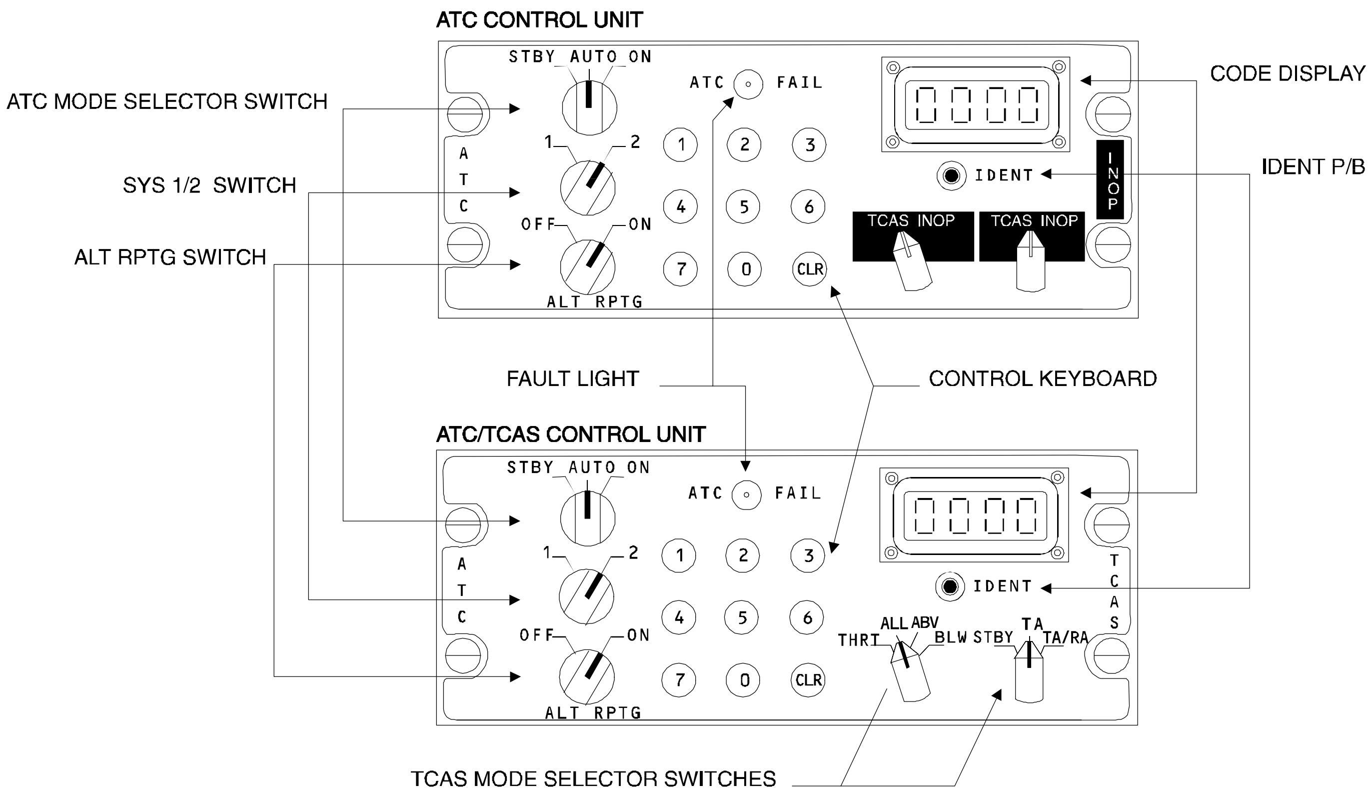
The control knobs allow the assigned ATC code to be selected.

TCAS MODE SELECTOR SWITCHES

The TCAS mode of operation is selected by means of two selector switches.

The first one is used for:
-TA/RA: Traffic Advisories (TA) and Resolution Advisories (RA) are performed,
- TA: only traffic advisories are performed,
- STBY: advisories are inhibited.

The second one is used for:
- THRT : TCAS intruders (proximate or/and other) are displayed if an TA or a RA is already displayed;
- ALL : all intruders are displayed without any condition when detected;
- ABV : altitude range is set to 9000 ft above the aircraft and 2700 ft below;
- ABV : altitude range is set to 9000 ft below the aircraft and 2700 ft above.



FQW4200 GE Metric

STUDENT NOTES:

ATC/TCAS PRINCIPLE

INTRUDER PARAMETERS
- Altitude
- Range
- Bearing
- Updating

ADVISORY
- Closest Point Of Approach
- Advisory
- Sensitivity
- Sensitivity Values

DETECTION
- Mode A Or C
- Mode S
- Squitter Message
- TCAS Broadcast Message

TRACKING
- Mode A Or C
- Mode S

COORDINATION

INTRUDER PARAMETERS

The TCAS needs to determine some intruder parameters in order to provide advisories.

Intruder parameters: relative altitude, range, bearing, altitude rate and range rate.
Surveillance area is 14NM minimum in range and + or - 2700 ft in altitude, but display is authorized up to 40 NM and + or - 1200 ft.
Note: A/C without operative ATC are not detected.

ALTITUDE

Mode C and S ATC equipped aircraft transmit their standard barometric altitude.
With its own altitude, the TCAS computes the relative altitude between the two aircraft.

Note: for mode A ATC equipped A/C, the altitude cannot be obtained. The TCAS considers these intruders at its altitude for further computation.

RANGE

The range is determined by measuring the elapsed time between a TCAS interrogation and an ATC reply.

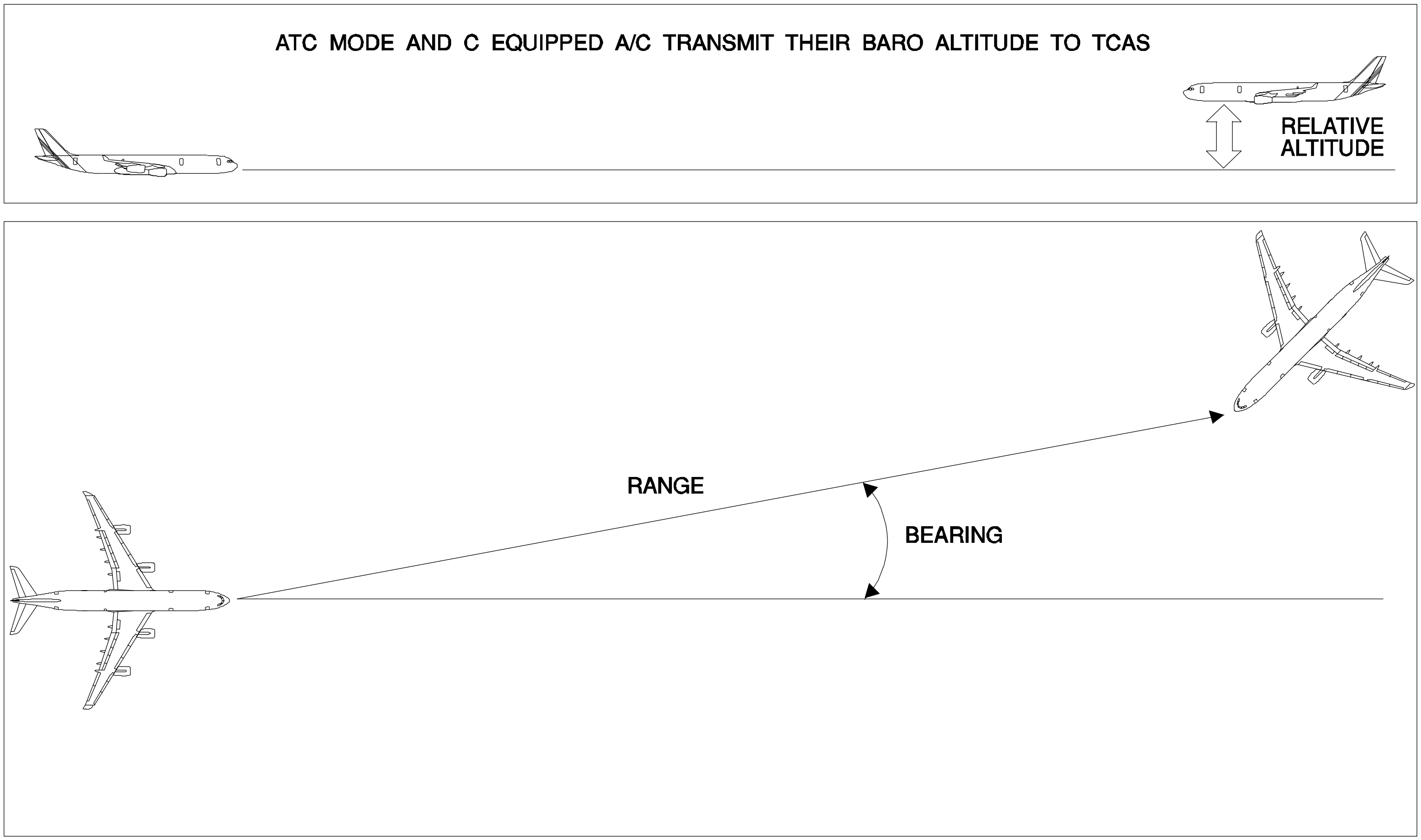
BEARING

The bearing is determined by interferometry on a comparison of ATC signal phases received by the four independent elements of the TCAS antenna.

UPDATING

Periodic updating allows the TCAS to compute range rate and altitude rate variations.

Updating occurs every second.



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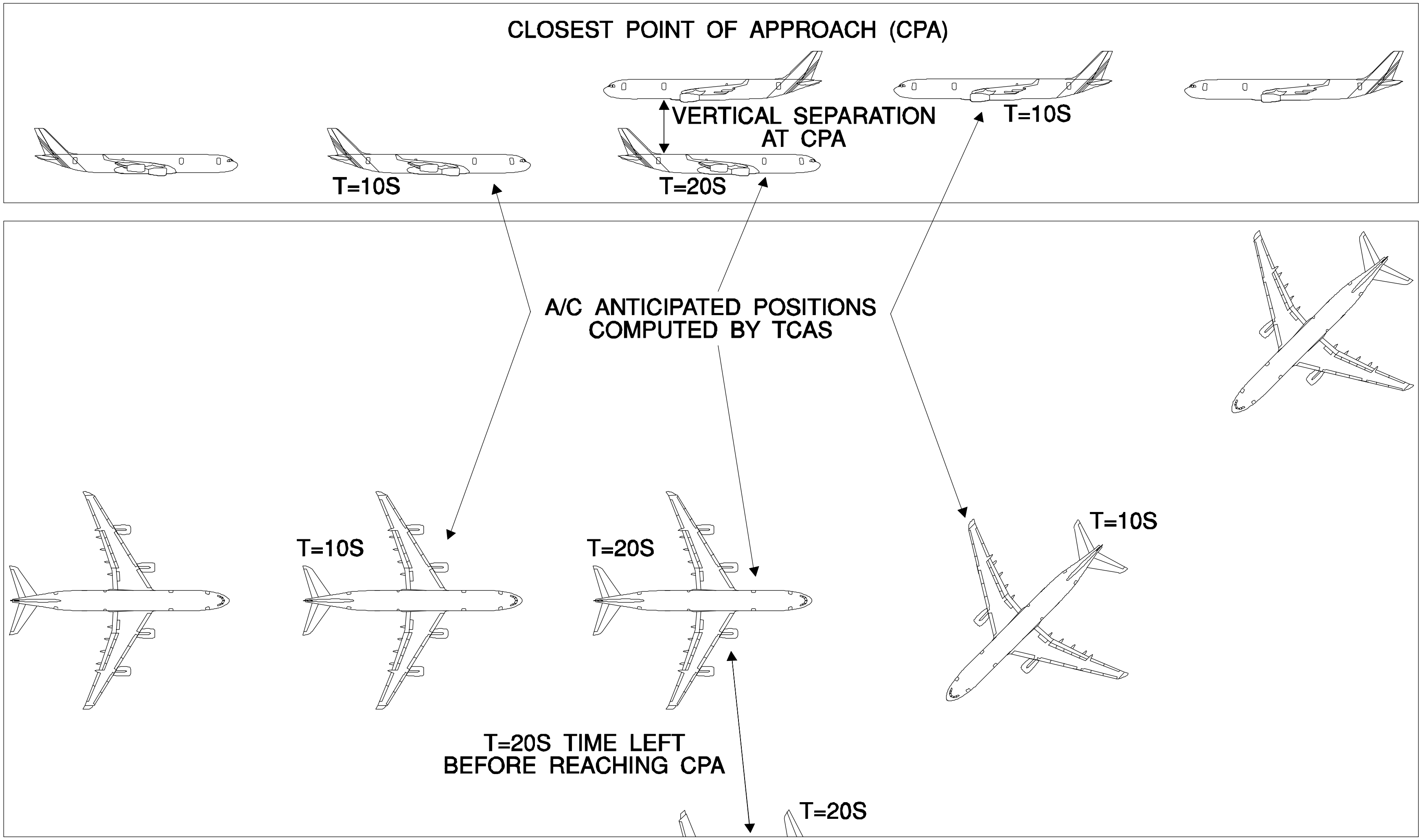
ADVISORY

The TCAS monitors intruder trajectories and can trigger advisories if any intruder becomes a threat.

CLOSEST POINT OF APPROACH

The TCAS permanently anticipates the Closest Point of Approach according to intruder parameters.
It also determines the vertical separation and the time left before reaching this point.

Up to 30 A/C may be followed by TCAS.



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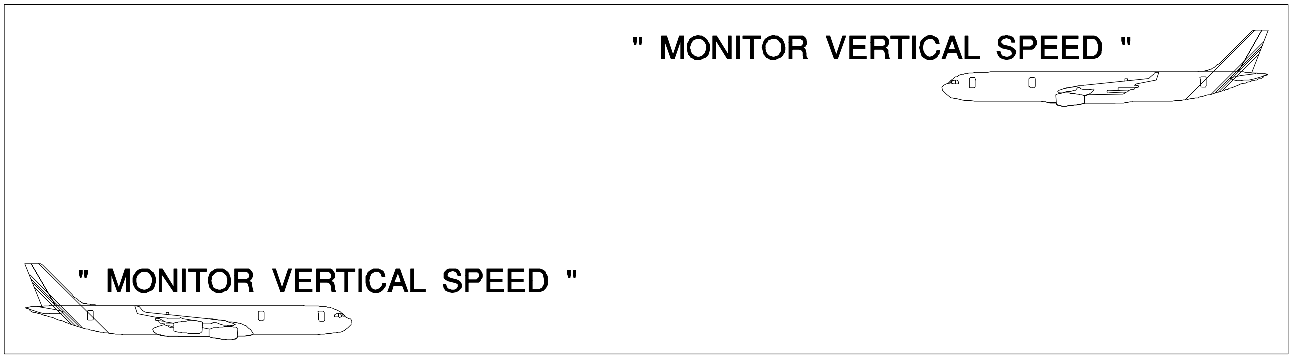
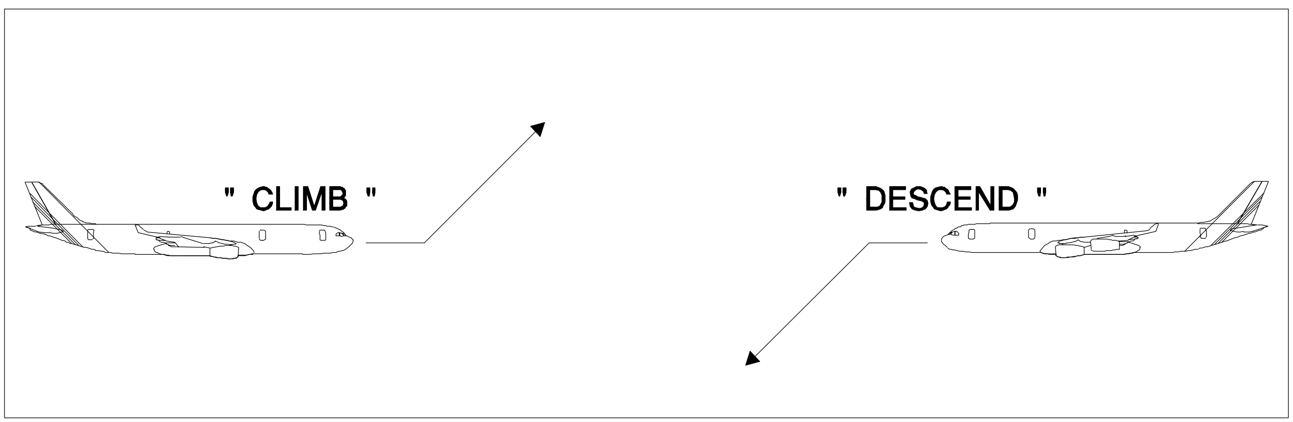
ADVISORY

When thresholds of vertical separation or time before reaching CPA are obtained, Traffic Advisories then Resolution Advisories can be triggered.

A RESOLUTION ADVISORY (RA) MAY BE PREVENTIVE , TO AVOID CERTAIN MANEUVER :



A RA MAY BE CORRECTIVE TO PERFORM A MANEUVER :



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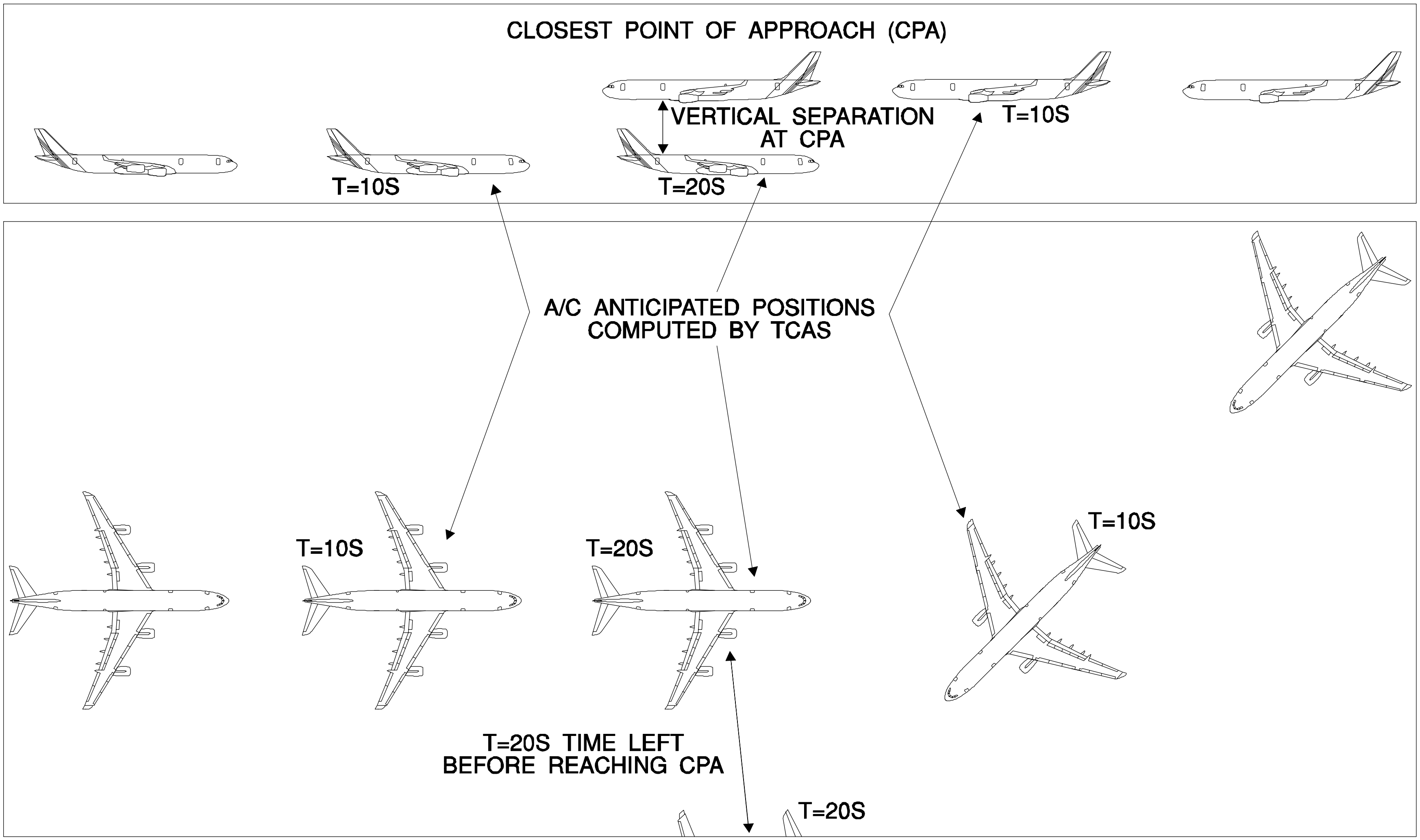
SENSITIVITY

The thresholds depend on the TCAS sensitivity level.
The sensitivity level is decreased at low altitude to prevent unnecessary advisories in high traffic densities such as terminal areas.

Note: certain advisories can be inhibited at low or high altitude.
Windshear/stall and GPWS warnings have higher priority than advisories.



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SENSITIVITY VALUES

The sensitivity level mainly depends on the selection made on ATC/TCAS control panel and on altitude.

STBY SELECTED ON ATC/TCAS CONTROL PANEL SET SENSITIVITY LEVEL (SL) TO 1 : NO ADVISORY GENERATED

TA SELECTED FORCES SL=2 (REFER TO ASSOCIATED CHART)

TA/RA SELECTED: SL DEPENDS ON ALTITUDE			TIME TO CPA THRESHOLD IN SECONDS		VERTICAL SEPARATION THRESHOLD IN FEET		
SOURCE ALTITUDE	ALTITUDE	SL	TA	RA	TA	RA PREV	RA CORR
RADIO ALTITUDE	LESS THAN 1000	2	20		850		
RADIO ALTITUDE	1000 - 2350	3	25	15	850	600	300
BARO ALTITUDE	2350 - 5000	4	30	20	850	600	300
BARO ALTITUDE	5000 - 10000	5	40	25	850	600	350
BARO ALTITUDE	10000 - 20000	6	45	30	850	600	400
BARO ALTITUDE	20000 - 30000	7	48	35	850	700	600
BARO ALTITUDE	MORE THAN 30000	7	48	35	1200	800	700

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DETECTION

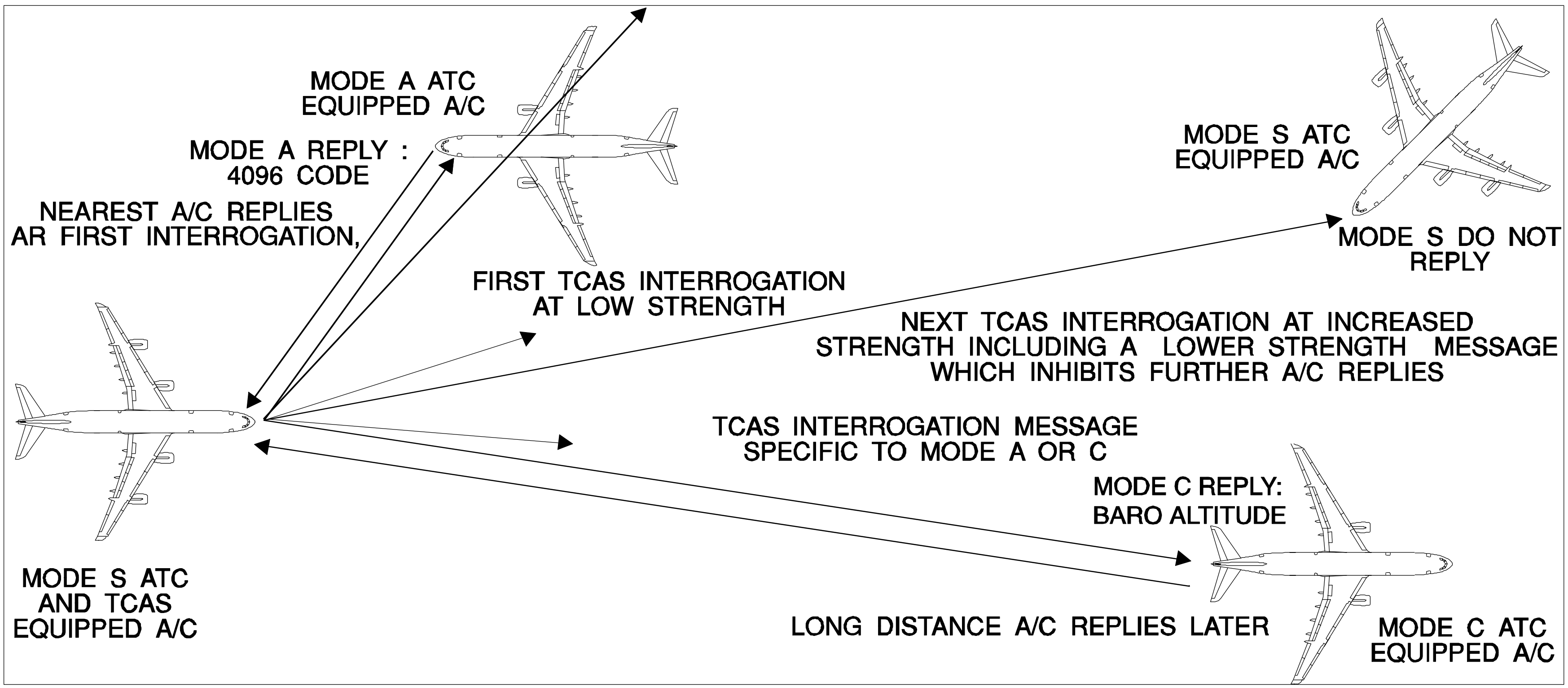
The TCAS uses different methods to detect intruders.

MODE A OR C

The TCAS must actively search for ATC mode A or C equipped aircraft.
It broadcasts a specific message every second and listens for replies.

The nominal time between interrogation is one second.
But to limit radio electric interference in dense traffic area, each interrogation consists of a series of increasing strength to reach more aircraft.

These series of interrogations are known as "WHISPER SHOUT" technique.



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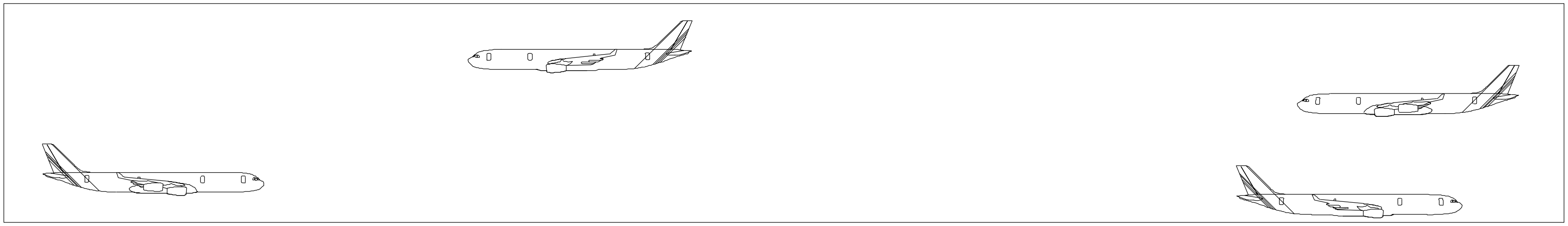
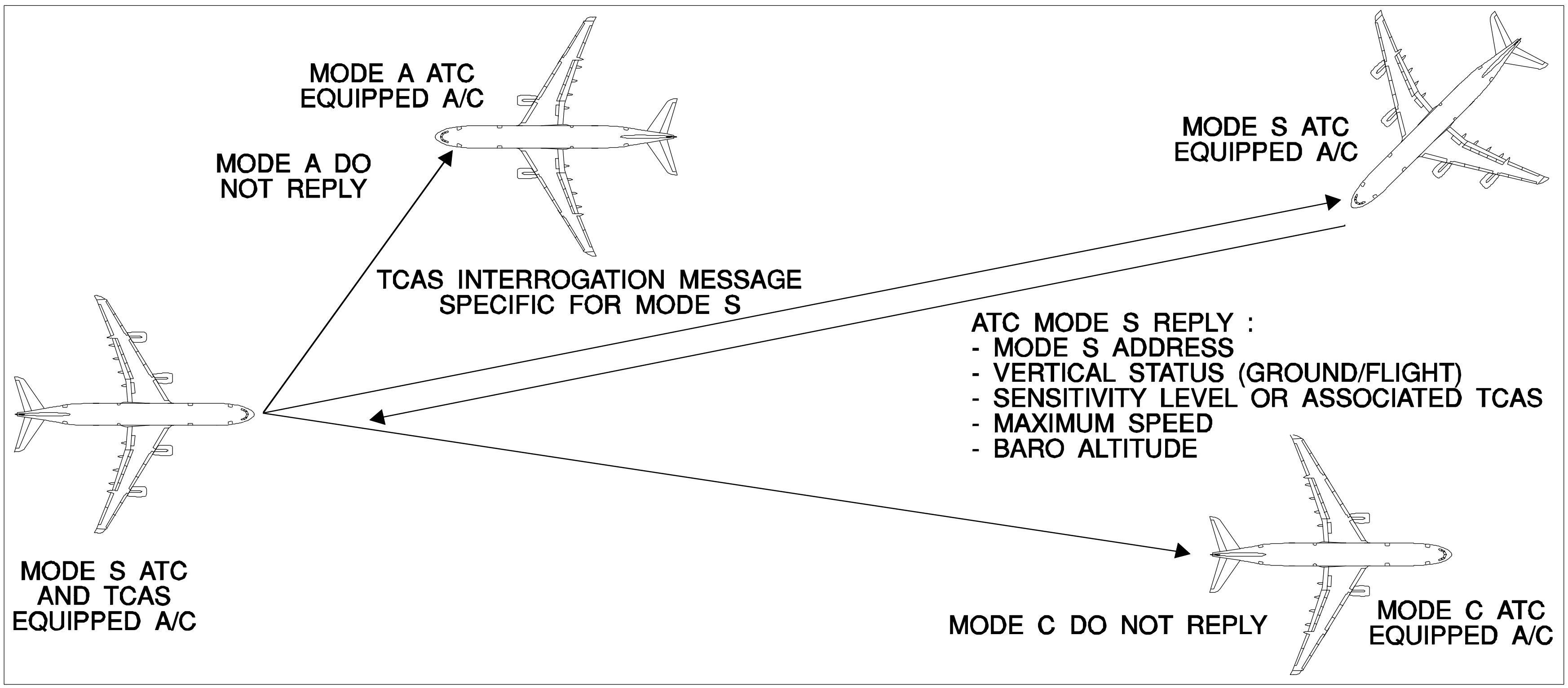
MODE S

The TCAS actively searchs for ATC mode S equipped aircraft.

The mode S address is a 24 bit address which is definitively assigned to each A/C by air traffic control.





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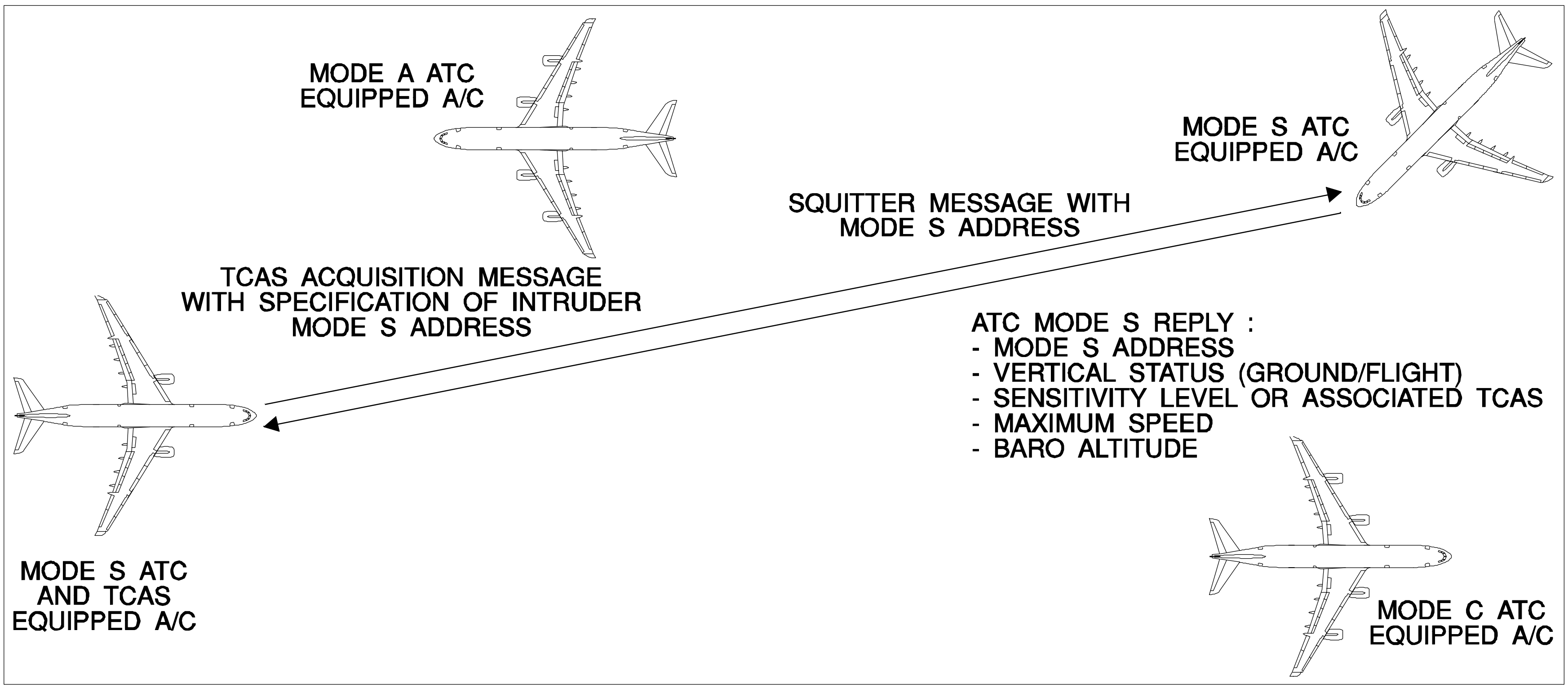
SQUITTER MESSAGE

The TCAS listens for squitter messages transmitted by mode S equipped aircraft every second.
A squitter message contains the specific mode S address of a transmitter and allows its detection.

The TCAS replies to a squitter message by an acquisition message which specifies the mode S address of interogated aircraft.
When the mode S intruder detects a reply with its address, it transmits data.



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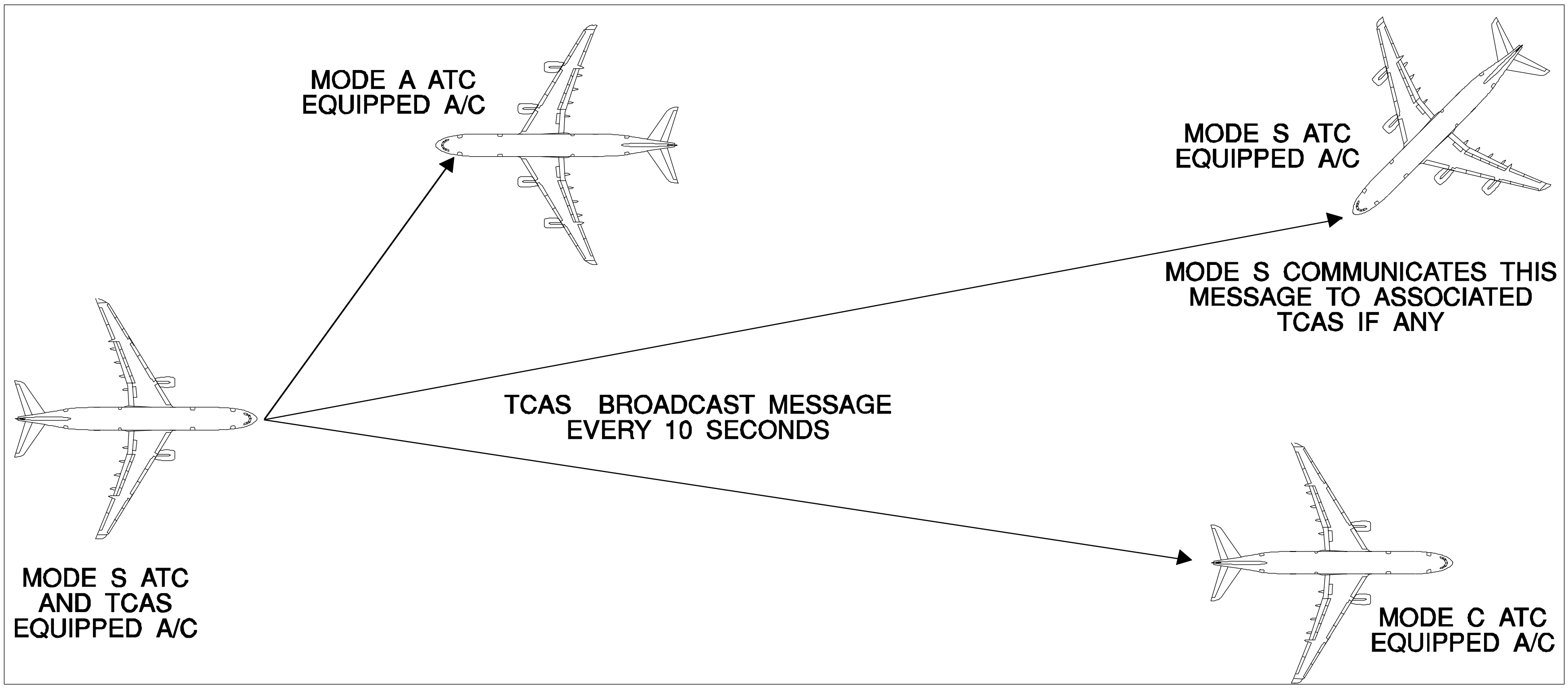
TCAS BROADCAST MESSAGE

Every 10 seconds the TCAS transmits a message intended to inform nearby aircraft, themselves equipped with a TCAS, of the presence of TCAS equipped aircraft.



FQW4200 GE Metric

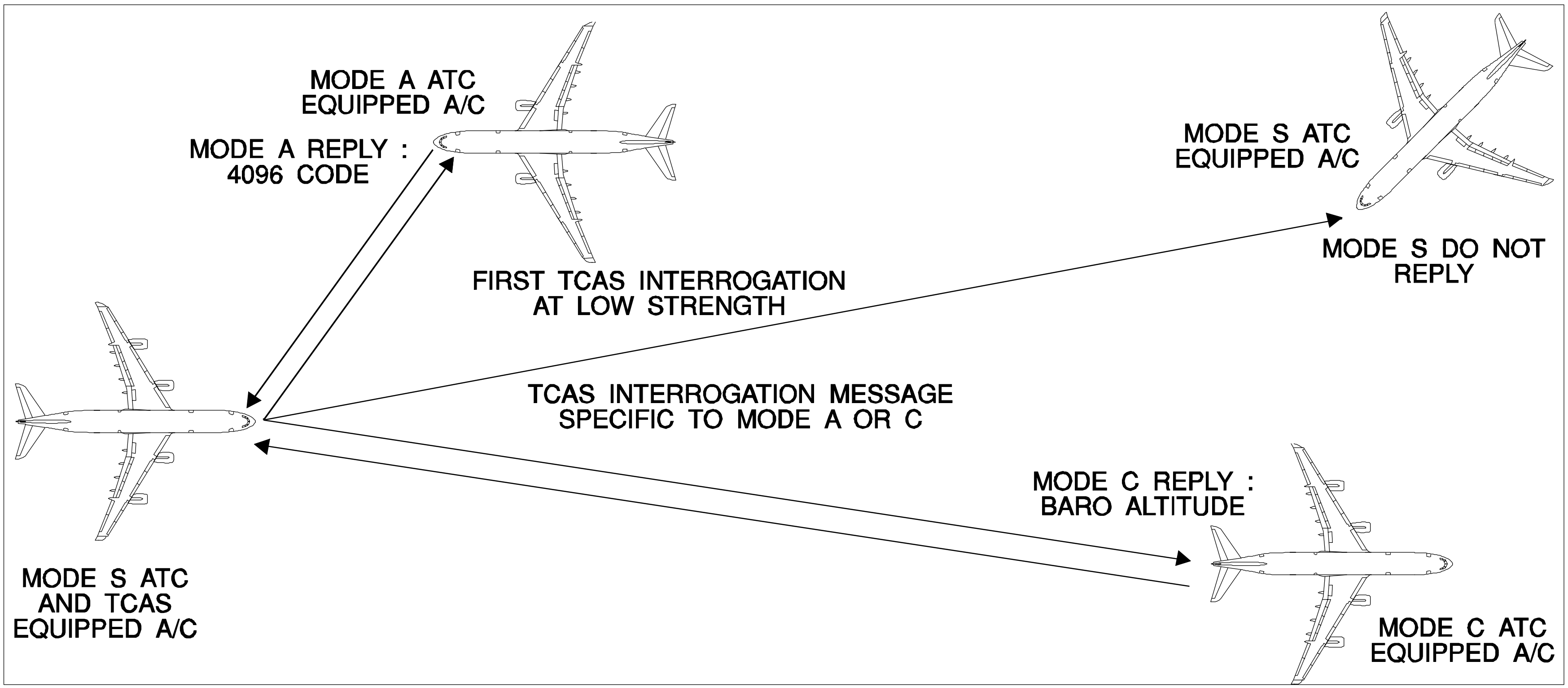
TRACKING

The TCAS must track the detected intruders to determine if they become a threat or not.

MODE A OR C

Each second the TCAS repeats a specific call message for mode A or C in order to detect new intruders and determine new parameters of detected intruders.

For mode A or C equipped A/C, tracking is equivalent to detection.



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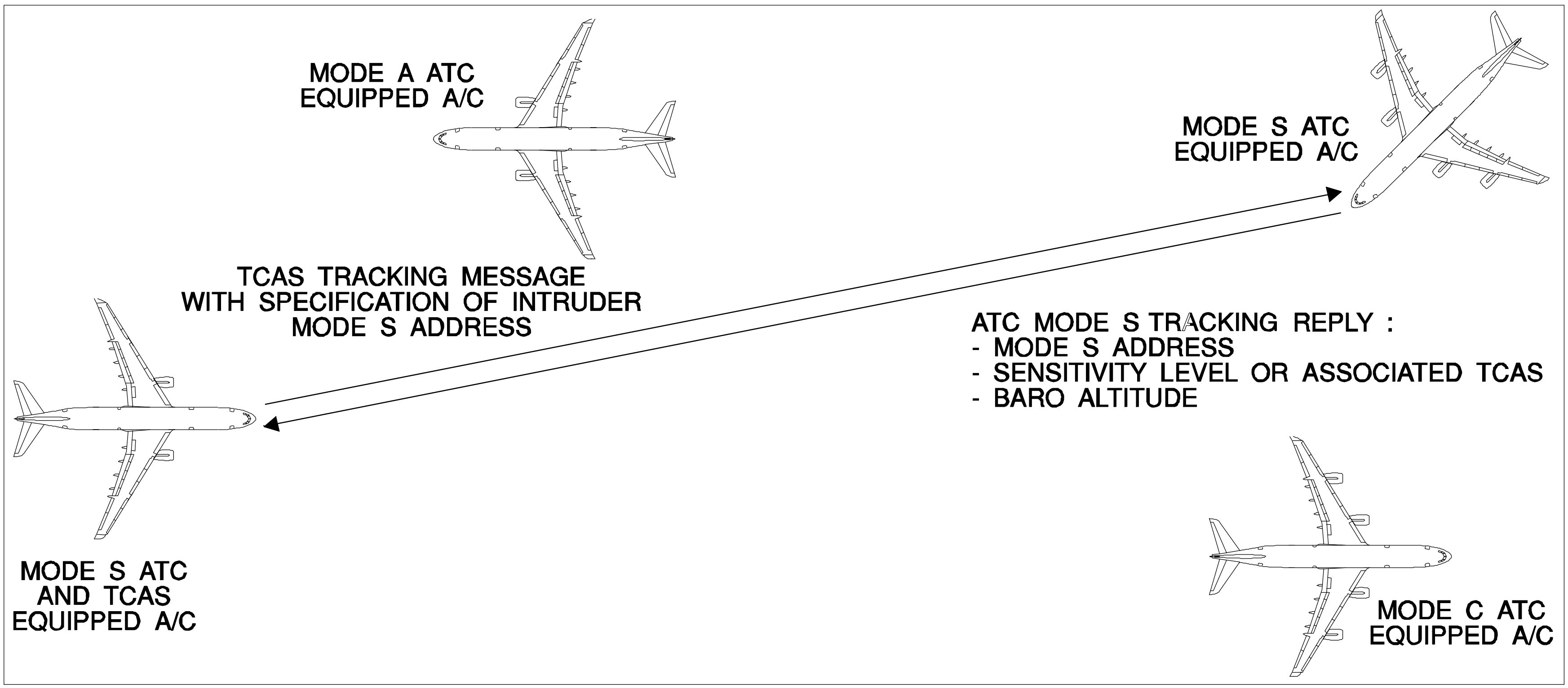
MODE S

The TCAS interrogates one by one the detected mode S intruders using their mode S address to determine their new parameters.



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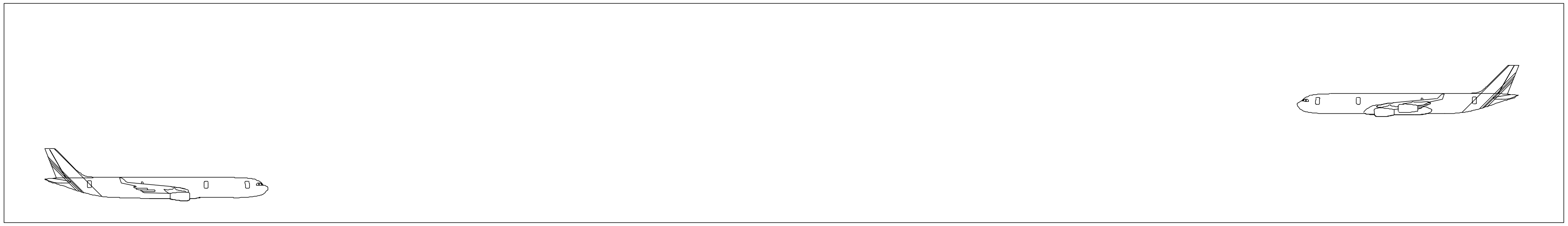
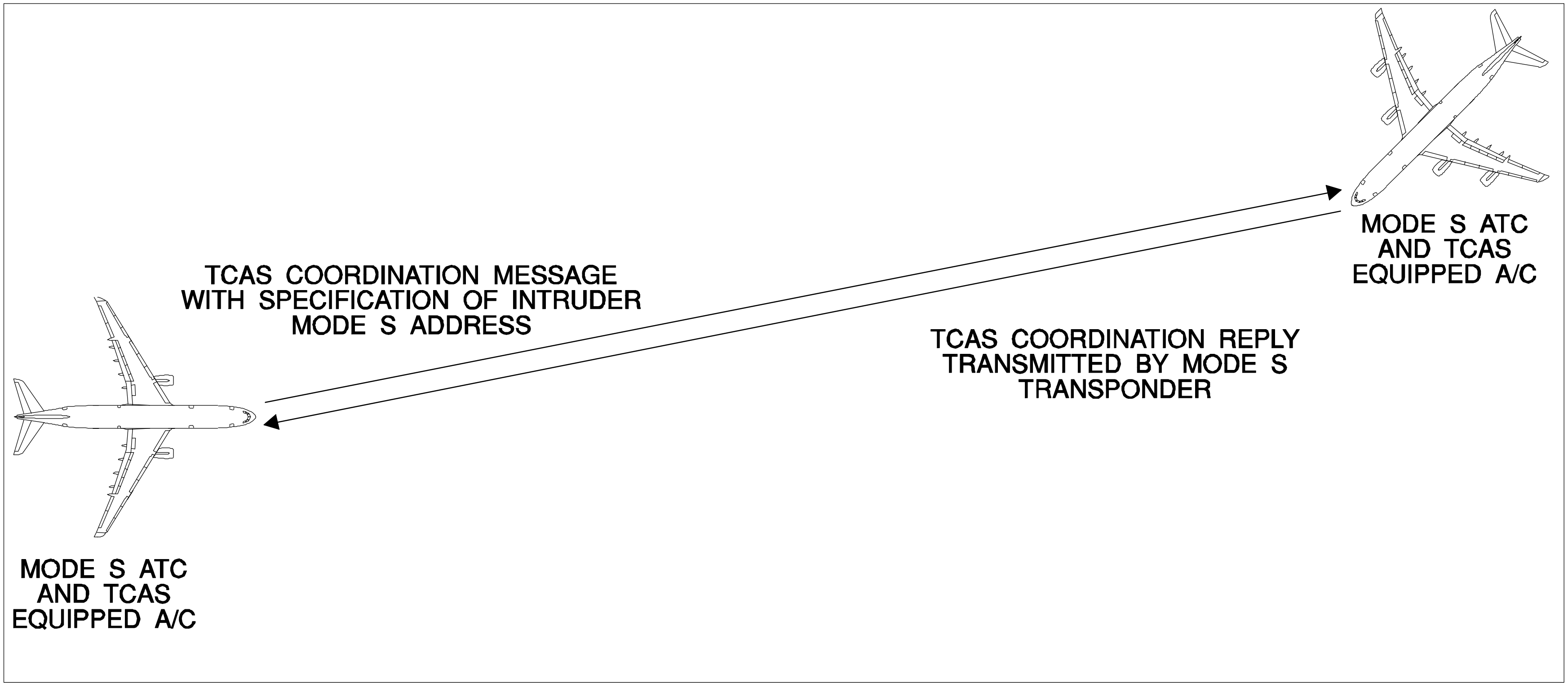
COORDINATION

When a resolution advisory occurs between two TCAS equipped aircraft, messages are exchanged to coordinate the maneuver.

The first detecting TCAS will decide the maneuver coordination.
If each TCAS detects the other one at the same time, the lowest mode S address has the priority.





FQW4200 GE Metric

STUDENT NOTES:

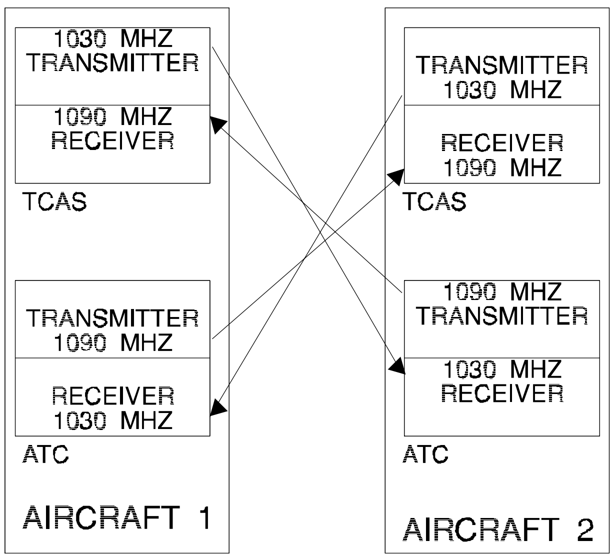
ATC/TCAS D/O

ATC ANTENNAE

The Air Traffic Control (ATC) antennae transmit replies to interrogations from ATC ground stations or Traffic Collision Avoidance System (TCAS) equipped aircraft.
The transponder switches between top and bottom antenna according to the characteristics of the received signals.

The ATC antennae receive at 1030 MHZ and transmit at 1090 MHZ. Each second a squitter message is transmitted alternatively by top and bottom antenna.

TCAS ANTENNAE



The TCAS has two antennae for transmission and reception. The TCAS switches reception and transmission circuits between the top and bottom antennae.

The TCAS antennae transmit at 1030 MHZ and receive at 1090 MHZ. Communications between two A/C are always crossed between transponders and TCAS : TCAS to ATC, then ATC to TCAS.

ATC/TCAS CTL PNL

A unique ATC/TCAS control panel controls both systems. The ATC transponder is directly controlled, and the TCAS computer is controlled through the ATC transponder.

Discrete inputs : monitor lamps from ATC transponder and AIR/GROUND from Landing Gear Control Interface Unit (LGCIU). Discrete outputs : AIR/GROUND and STBY/ON to ATC transponders.

ATC TRANSPONDER

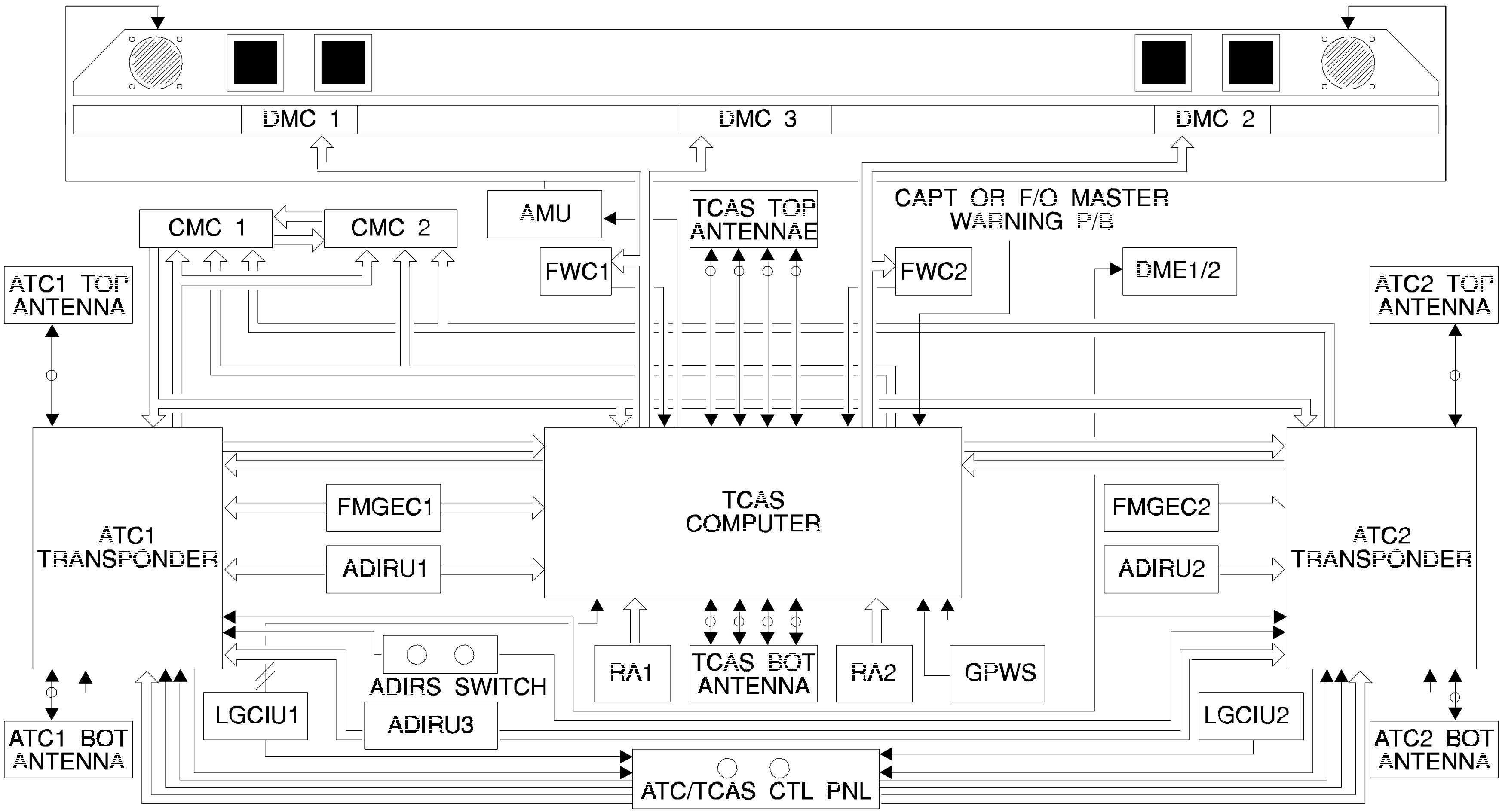
Various systems provide data to the transponder.
Air Data Inertial Reference Unit 1 (ADIRU1) and 2 provide baro altitude to associated transponders.
ADIRU3 is in standby and will be used according to the AIR DATA switch status.

In normal operation, one ATC transponder is operating as the other one is in standby.

The Flight Management Guidance and Envelope Computers (FMGEC) provide flight identification. This data will be transmitted to an ATC ground station after a mode S interrogation.

The Landing Gear Control Interface Units (LGCIU) provide ground/flight data to the ATC/TCAS control panel for AUTO mode of ATC transponder and BITE purposes.

As ATC, TCAS and DME operate in the same frequency range, a suppressor signal is transmitted by the operating system to inhibit the other systems and to prevent simultaneous transmission.



FQW4200 GE Metric

TCAS COMPUTER

Various systems provide data to the TCAS computer. ADIRU1 provides heading, pitch and roll data.

FMGEC1 provides aircraft performance limitations for Resolution Advisory computation.

The Radio Altimeters (RA) provide radio altitude which is mainly used in sensitivity level computation.

One RA signal is used as the other one is in stanby.

LGCIU1 provides ground/flight and landing gear extended data for TCAS operation and BITE purposes.

ATC/TCAS LINK

The operative ATC transponder transmits data to the TCAS such as baro altitude, TCAS controls from the control panel, TCAS BROADCAST MESSAGE received and coordination messages during a coordinated Resolution Advisory.

The TCAS transmits data to the ATC transponder to reply to a mode S interrogation and coordination messages during a coordinated Resolution Advisory.

TCAS INDICATING

The TCAS provides visual data on PFDs and NDs. The NDs provide indication on the location of intruders. The PFDs provide the flight crew with vertical speed correction data to avoid the intruders.

The Flight Warning Computers (FWC) check the signal validity.

A synthesized voice generator transmits messages from a Read Only Memory to generate aural advisories through the Audio Management Unit (AMU).

TCAS INHIBITION

Systems with higher priority than TCAS can inhibit advisories :
- windshear/stall warnings from FWCs,
- warnings from Ground Proximity Warning System (GPWS).

The MASTER WARNING P/B allows cancellation of TCAS audio advisory messages.

CMC

The MCDUs allow the ATC system and TCAS to be tested via the CMC. The tests are only available on ground.

PIN PROGRAMMING

Some pin programs define the operating mode of ATC transponders and TCAS computer.

ATC : mode S address, A/C maximum airspeed.
TCAS : audio level output (high or low), number of intruders displayed, A/C altitude limit, ground display mode (Traffic Advisory only), proximate A/C displayed only when TA or RA occurs.

STUDENT NOTES:

STUDENT NOTES

TCAS INDICATIONS ON PFD AND AURAL ALERTS

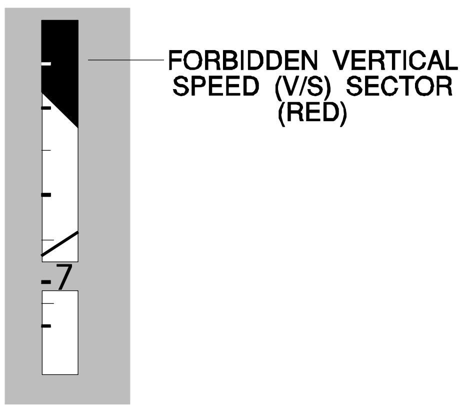
Preventive Resolution Advisory
Corrective Resolution Advisory
Aural Alerts
V/S Failure
TCAS Failure

Traffic Collision Avoidance System (TCAS).
Primary Flight Display (PFD).

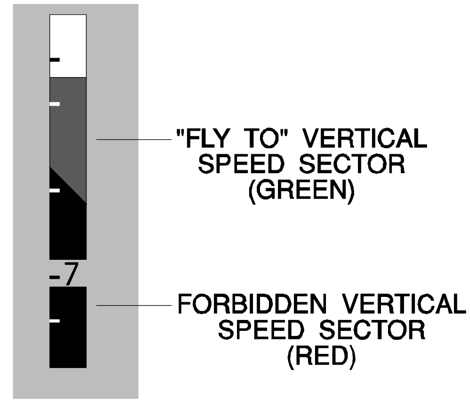
Only the Resolution Advisories (RA) are displayed on the PFD.
The TCAS indications, if any, are displayed on the vertical speed scale if the TCAS mode switch is set to TA/RA (Traffic Advisory/Resolution Advisory).

PREVENTIVE RESOLUTION ADVISORY

A preventive resolution advisory instructs the crew to avoid certain deviations from current vertical speed.

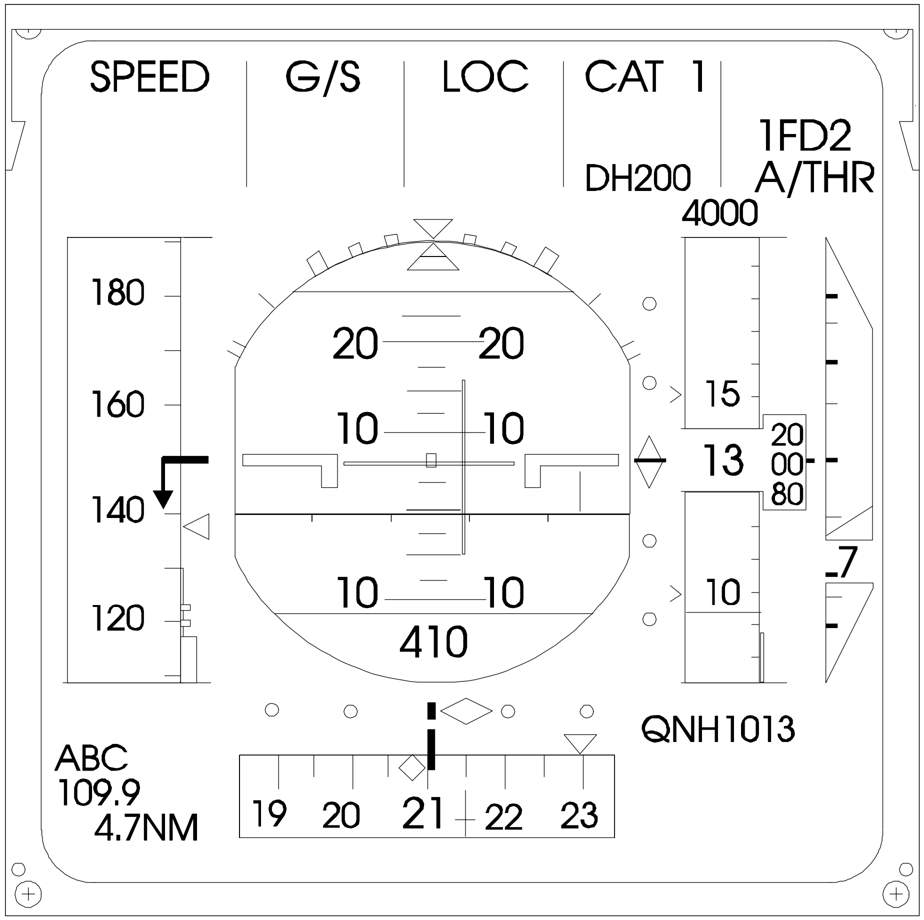


CORRECTIVE RESOLUTION ADVISORY



A corrective resolution advisory instructs the crew to perform a vertical avoidance manoeuver.

The vertical speed indications (digital value and needle) come on red.



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MODE SELECTOR SWITCH ON TA/RA POSITION

AURAL ALERTS

PREVENTIVE RESOLUTION ADVISORY :
"MONITOR VERTICAL SPEED, MONITOR VERTICAL SPEED"

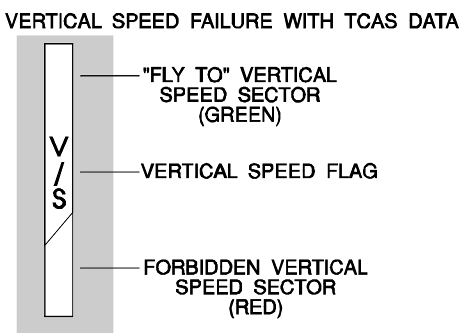
CORRECTIVE RESOLUTION ADVISORY :
"CLIMB, CLIMB, CLIMB"
"CLIMB, CROSSING CLIMB, CLIMB, CROSSING CLIMB"
"REDUCE CLIMB, REDUCE CLIMB"
"INCREASE CLIMB, INCREASE CLIMB"
"CLIMB, CLIMB NOW, CLIMB, CLIMB NOW"

"DESCEND, DESCEND, DESCEND"
"DESCEND, CROSSING DESCEND, DESCEND, CROSSING DESCEND"
"REDUCE DESCEND, REDUCE DESCEND"
"INCREASE DESCEND, INCREASE DESCEND"
"DESCEND, DESCEND NOW, DESCEND, DESCEND NOW"

AIRCRAFT SEPARATION HAS BEEN ACHIEVED :
"CLEAR OF CONFLICT"

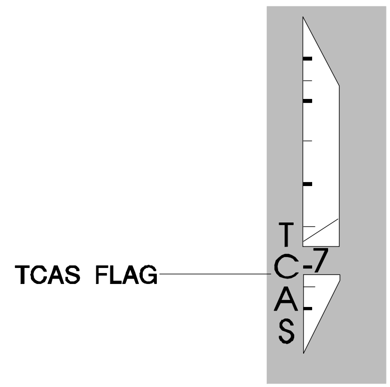
Synthesized voice announcements provide TCAS information to the crew. Voice level cannot be adjusted by the crew (pin program).

V/S FAILURE



In case of vertical speed failure, a vertical speed flag appears associated, if any, with TCAS information.

TCAS FAILURE



In case of TCAS failure, a red TCAS flag is displayed at the left side of the vertical speed scale.

STUDENT NOTES:

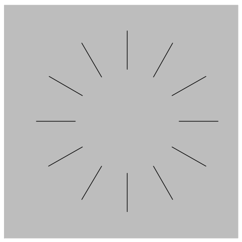
STUDENT NOTES

TCAS INDICATIONS ON ND

Display Conditions
Intruder
No Bearing Intruder
Message
Failure

Traffic Collision Avoidance System (TCAS).
Navigation Display (ND).

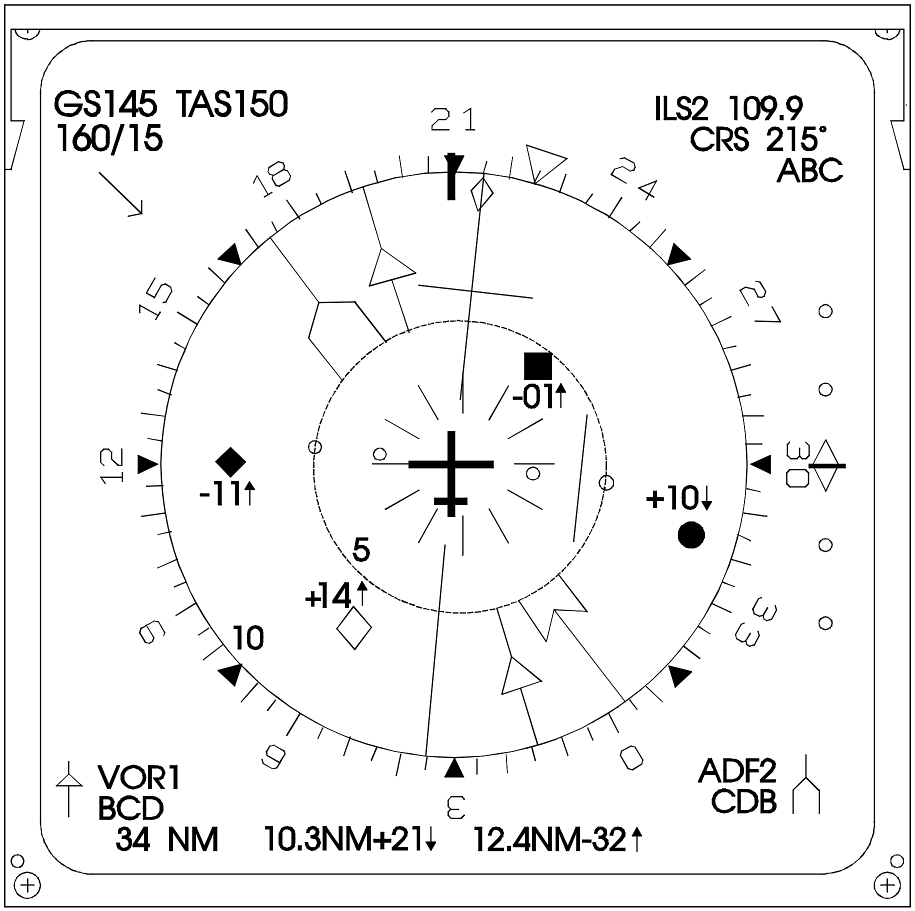
DISPLAY CONDITIONS



A RANGE RING IS PLACED AT 2.5NM WHEN 10NM OR 20NM RANGE IS SELECTED ON THE EFIS CONTROL PANEL.

The TCAS data is displayed in ROSE or ARC mode with a range lower or equal to 40 nautical miles.

Only the most threatening intruders are displayed.
The number of intruders is set by pin programming.



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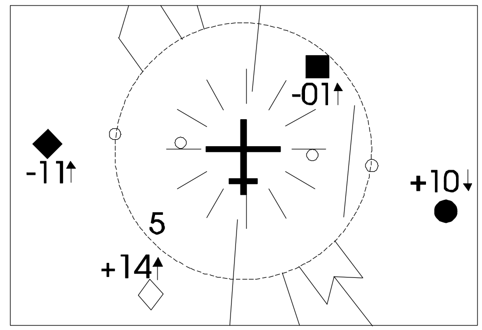
INTRUDER

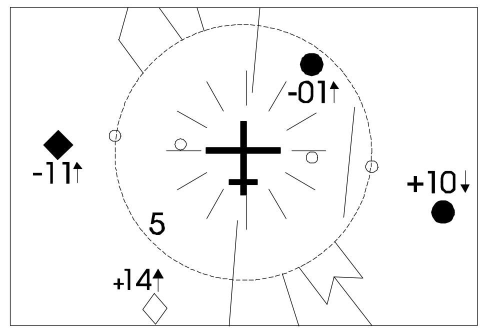
The intruders are displayed with range, bearing, relative level and vertical speed tendancy depending on the setting of the TA/RA switch.

(WHITE)	+14↑	OTHER TRAFFIC 1400FT ABOVE, CLIMBING
(WHITE)	-11↑	PROXIMATE TRAFFIC 1100FT BELOW, CLIMBING
(AMBER)	+10↓	TRAFFIC ADVISORY (TA) 1000FT ABOVE, DESCENDING
(RED)	-01↑	RESOLUTION ADVISORY (RA) 100FT BELOW, CLIMBING



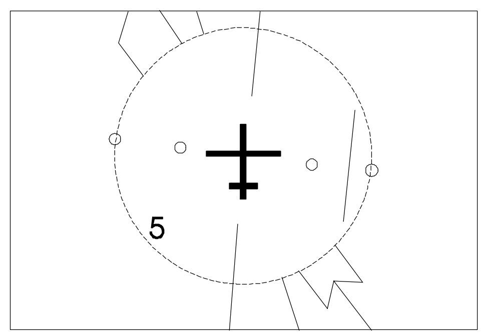
THRT AND TA/RA MODES SELECTED:

TA AND RA ARE DISPLAYED



THRT AND TA MODES SELECTED:

RA IS DISPLAYED AS TA

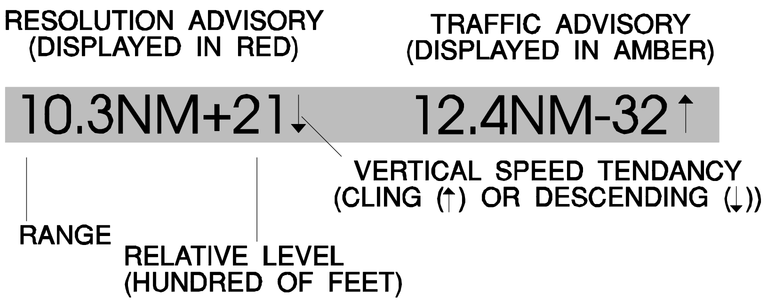


STBY SELECTED:

NO TCAS DATA DISPLAYED

Note: In the THRT mode, PROXIMATE or/and OTHER traffic are displayed if a TA or a RA is already displayed.

NO BEARING INTRUDER



Whithout bearing acquisition, the intruder characteristics are displayed at the lower side of the Navigation Display.

Only the two most threatening intruders are displayed.
The most dangerous is displayed on the left side.

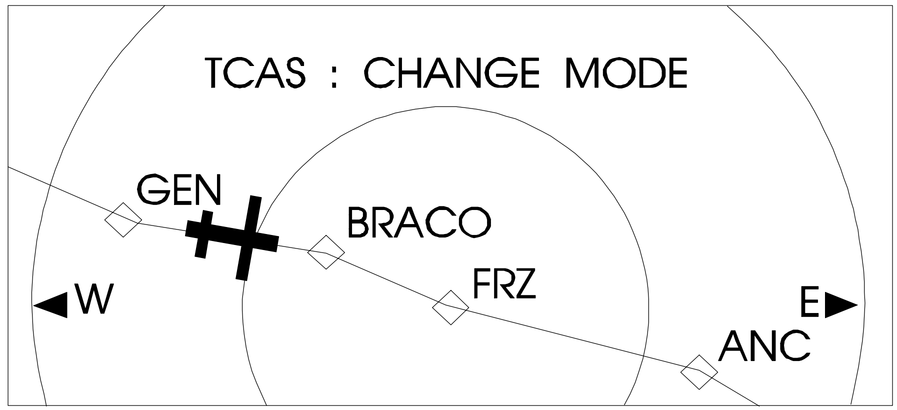
MESSAGE

Messages can be displayed to draw pilot's attention.

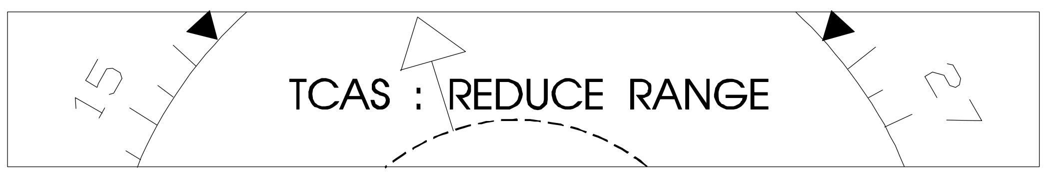
FAILURE

When a failure occurs, the TCAS indications are removed and a TCAS flag is displayed.

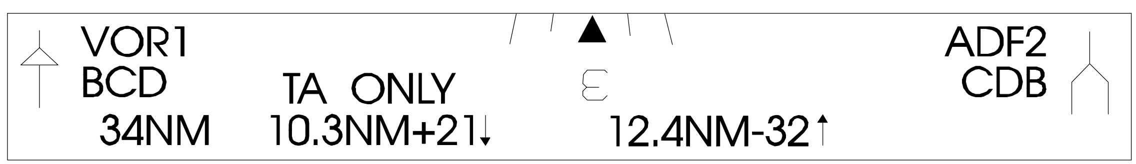
TCAS MESSAGES :



RA (RED) OR TA (AMBER) HAS BEEN DETECTED AND ND IS IN PLAN MODE



RA (RED) OR TA (AMBER) HAS BEEN DETECTED AND ND RANGE ABOVE 40NM (IN ARC OR ROSE MODE)



TCAS IN TA ONLY MODE (RA INTRUDER SYMBOLS CONVERTED INTO TA INTRUDER SYMBOLS)

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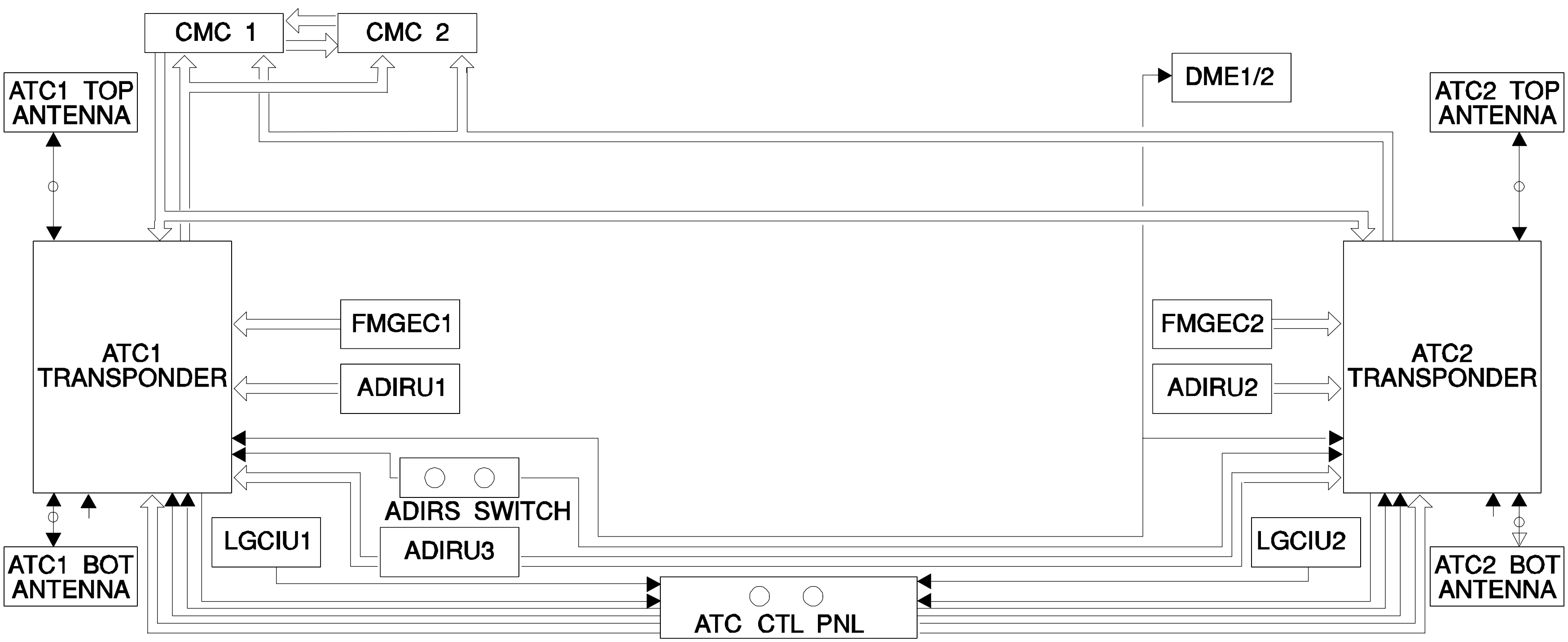
STUDENT NOTES:

ATC COMPONENTS

ATC1/2 Top/Bottom Antennae
ATC1/2 Tranponders
ATC CTL PNL

STUDENT NOTES



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ATC1/2 TOP/BOTTOM ANTENNAE

FIN :

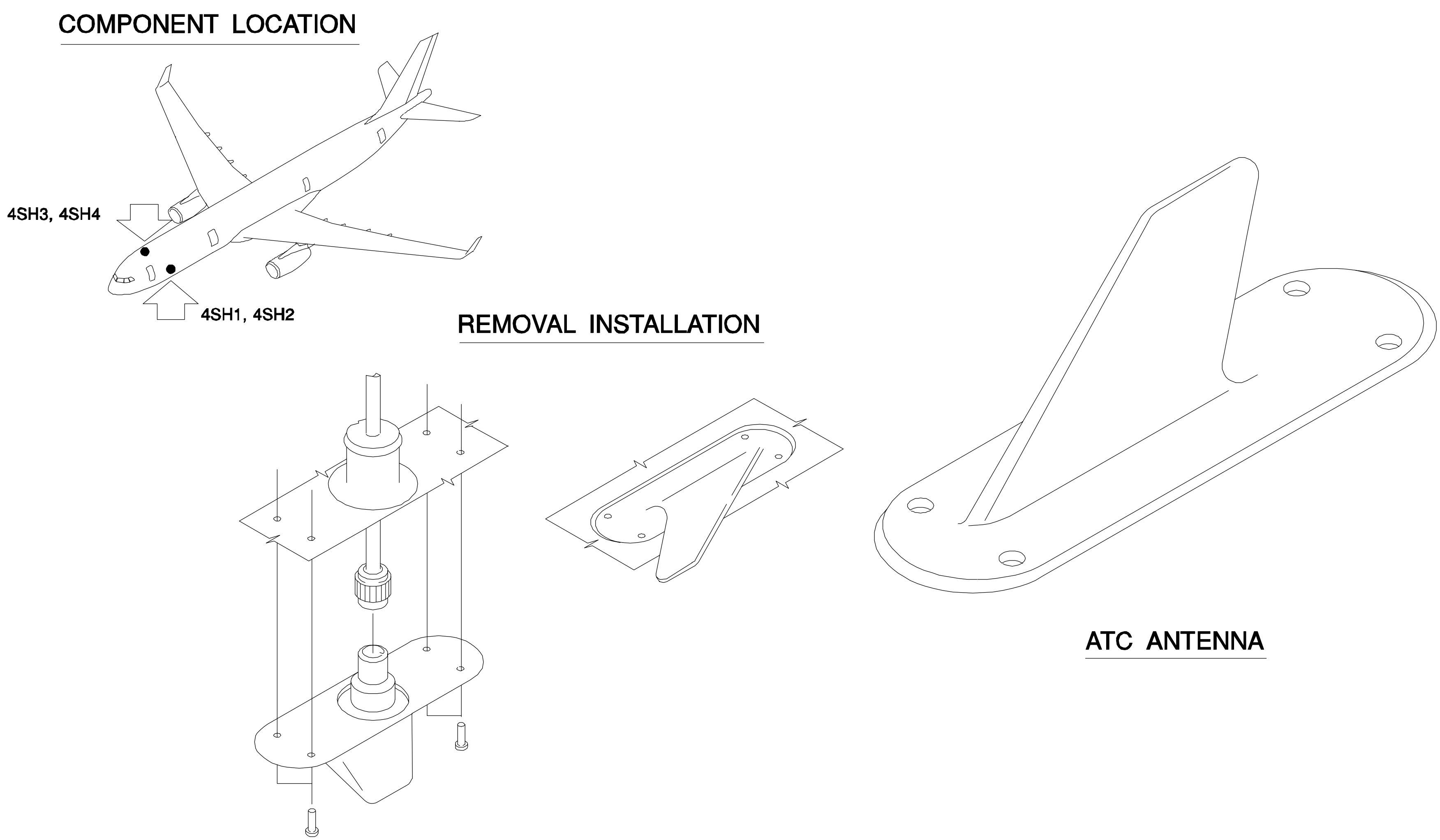
Bottom : 4SH1, 4SH2
Top : 4SH3, 4SH4

ZONE :

Bottom : 133, 134
Top : 233, 234

COMPONENT DESCRIPTION

This antenna is blade type with a radiating cavity driven by capacitive coupling.
It is an airborne antenna, designed for installation on fast aircraft and operation within the L-band from 960 to 1250 Mhz.
Lightning protection is provided to prevent damage to the antenna and the transponder.



FQW4200 GE Metric

ATC1/2 TRANSPONDERS

FIN : 1SH1, 1SH2

ZONE : 121, 122

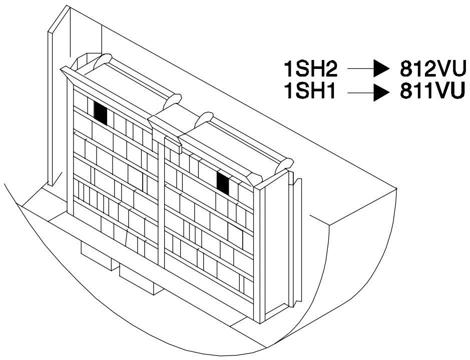
COMPONENT DESCRIPTION

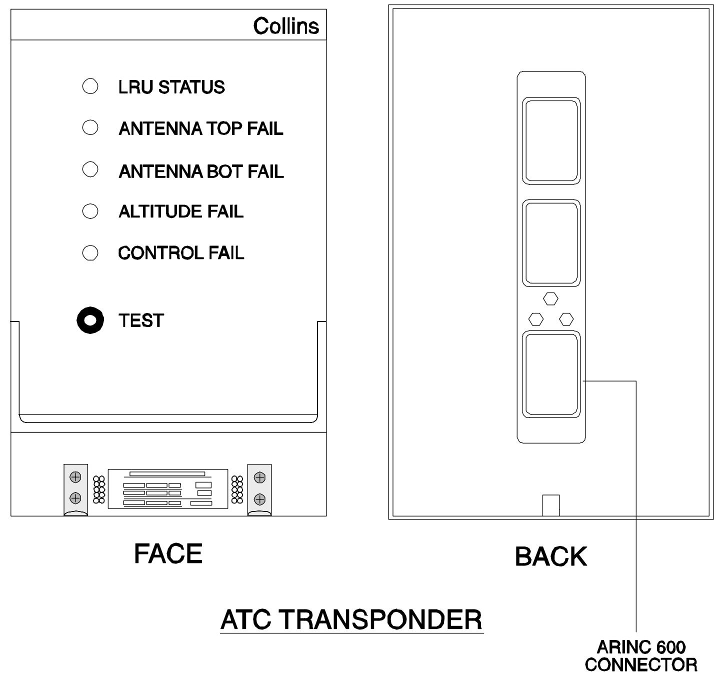
The face of the transponder is fitted with one handle, two lugs, a test P/B and five LEDs.
The back is equipped with one ARINC 600 size two connector.
Energization of each system is through 115VAC - 400Hz buses.

IN SITU TEST

When the TEST pushbutton is depressed, the five LEDs come on then go off, except the LED associated with the detected failure.
When the TEST pushbutton is depressed for more than five seconds, the unit reads Non-Volatile Memory Fault data for the last four flight legs and the applicable fault indicator lights come on.

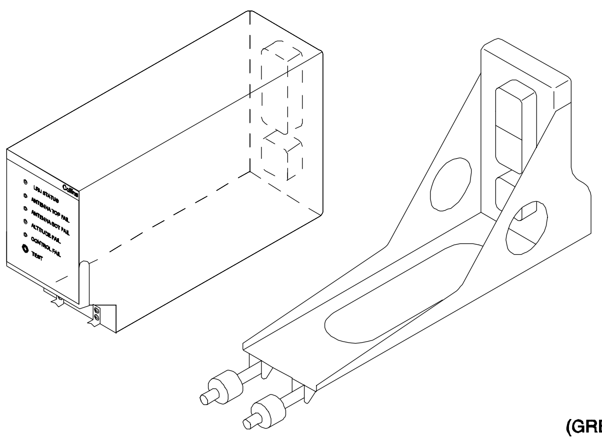
COMPONENT LOCATION



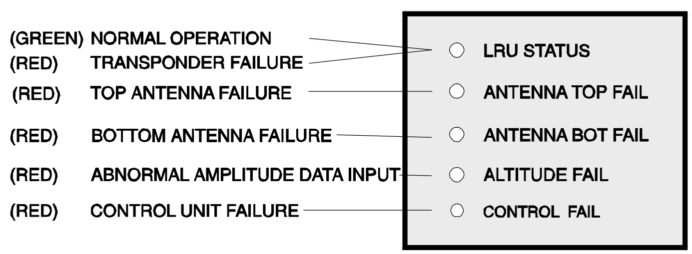


ATC TRANSPONDER

REMOVAL INSTALLATION



STATUS OF SYSTEM DURING THE TEST



FQW4200 GE Metric

ATC CTL PNL

(AND ATC/TCAS CTL PNL IF TCAS SYSTEM IS INSTALLED)

FIN : 2SH

ZONE : 210

COMPONENT DESCRIPTION

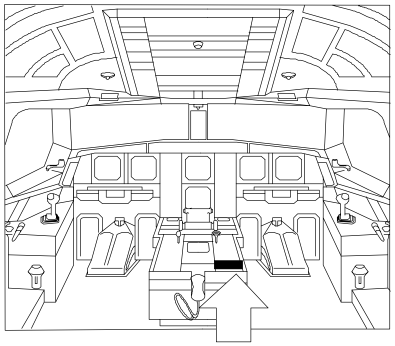
The front panel is integrally lit by clear 5 V lamps and features :

- a liquid crystal display window,
- one ATC failure indication light,
- an IDENT pushbutton,
- one keyboard to select the four-digit transmit code (0000 to 7777),
- an ATC toggle switch for ATC1 or ATC2 selection,
- a STBY/AUTO/ON selector.

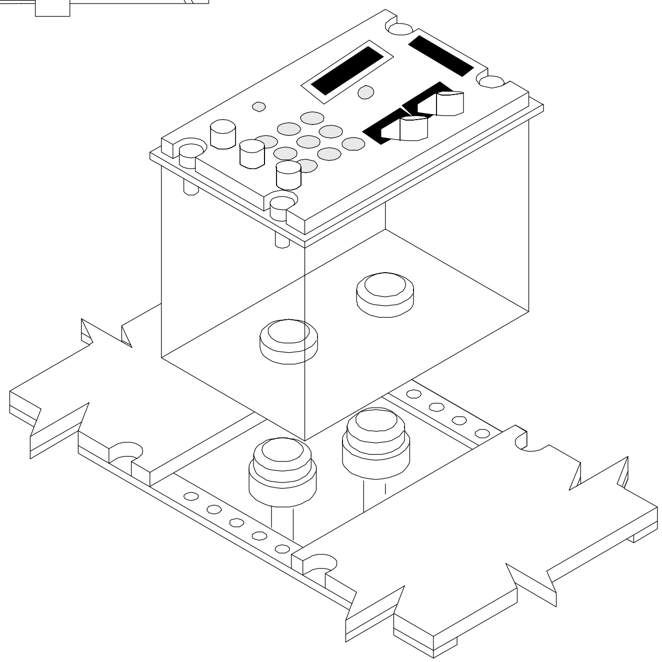
If a TCAS system is installed:

- a TA/RA/TA/STBY selector,
- an ALT RPTG ON/OFF selector.

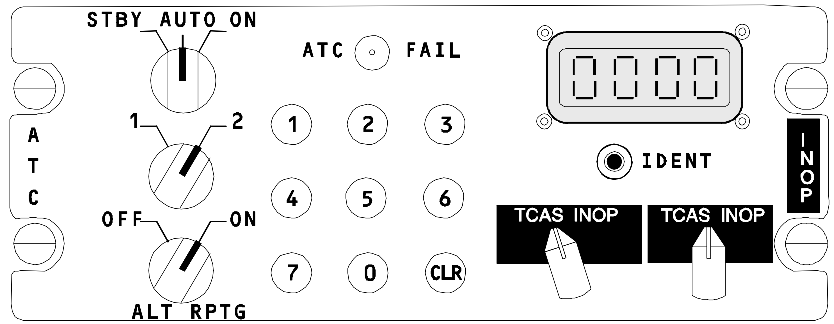
COMPONENT LOCATION



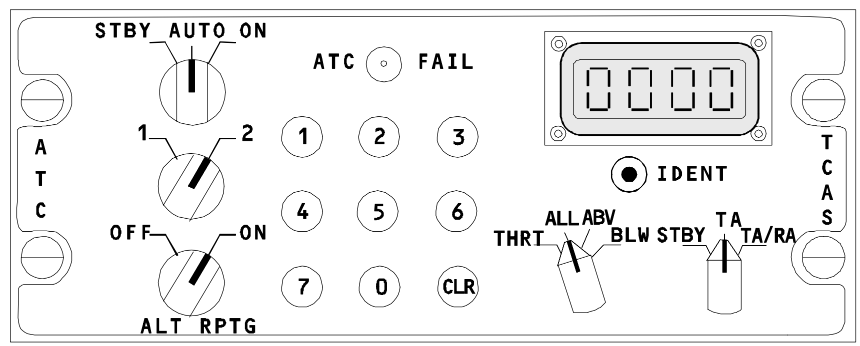
REMOVAL INSTALLATION



ATC CONTROL UNIT



ATC/TCAS CONTROL UNIT IF TCAS SYSTEM IS INSTALLED



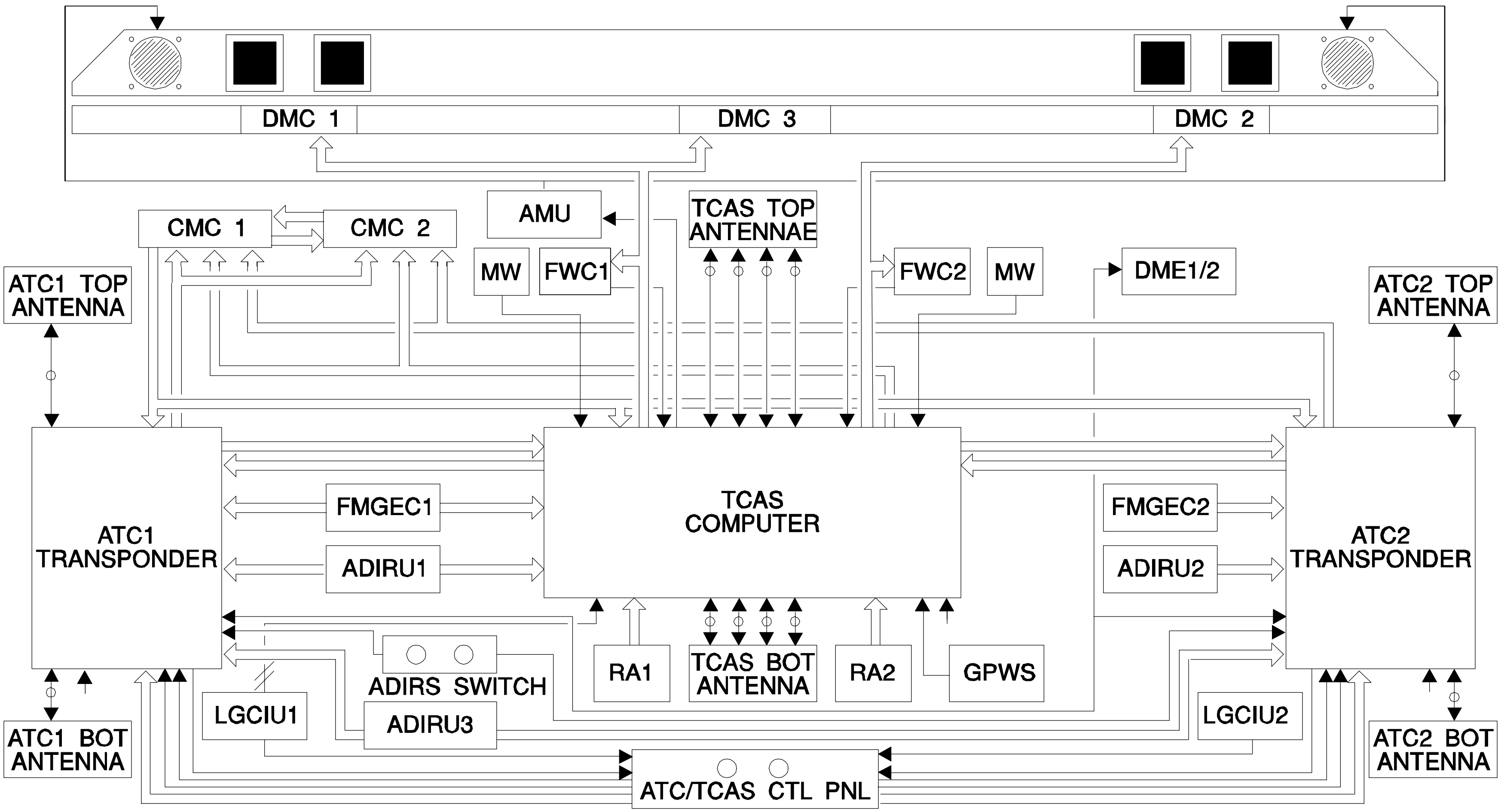
FQW4200 GE Metric

STUDENT NOTES

TCAS COMPONENTS

TCAS Top/Bottom Antennae
TCAS Computer
ATC/TCAS Control Panel

STUDENT NOTES



FQW4200 GE Metric

TCAS TOP/BOTTOM ANTENNAE

FIN :

Bottom : 7SG2

Top : 7SG1

ZONE :

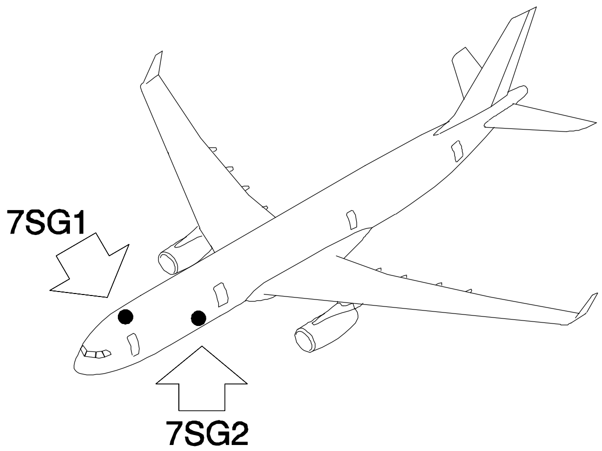
Bottom : 130

Top : 230

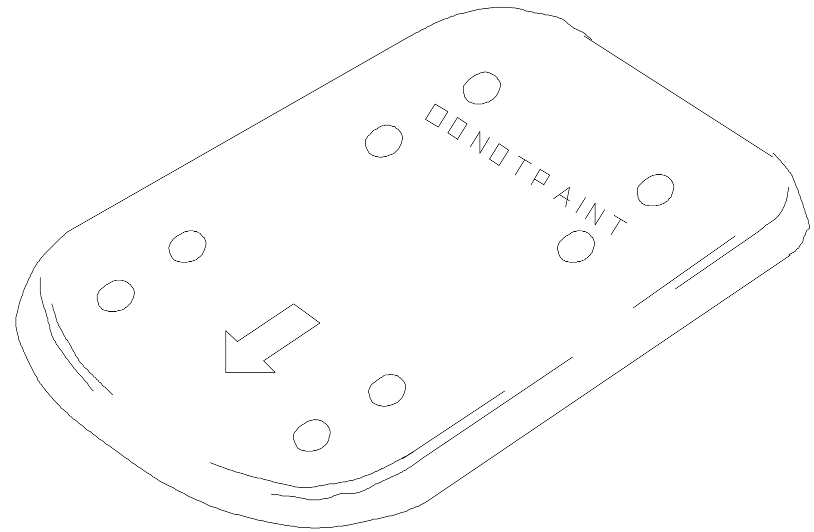
COMPONENT DESCRIPTION

The directional antenna is composed of four passive vertically-polarized elements. This high-strength composite antenna is provided with a plate base, eight fuselage mounting screws and four color-coded connectors used to coaxially connect the four antenna elements to the computer. An o-ring is provided to seal the antenna to the fuselage. A teflon gasket is located between the fuselage and the base of the antenna in order to facilitate the removal of the antenna. The antenna is used to receive and provide directional 1090 Mhz information. Proper phasing of the four antenna elements enables omni or directional transmission of transmission of 1030 Mhz brodcasts.

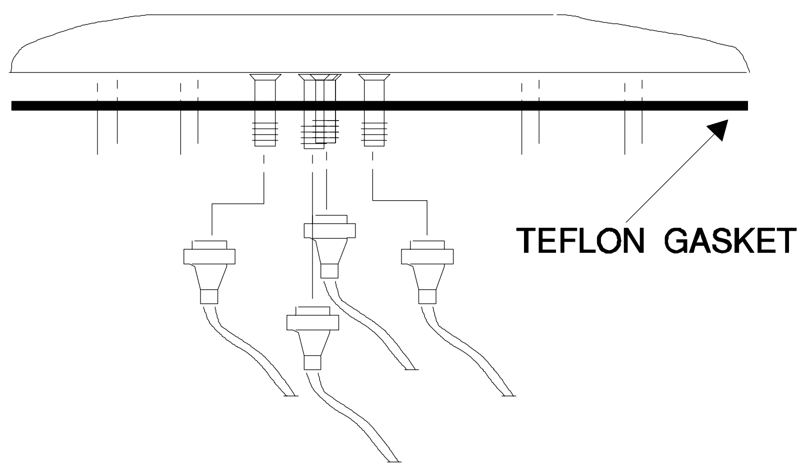
COMPONENT LOCATION



TCAS ANTENNA



REMOVAL INSTALLATION



TCAS COMPUTER

FIN : 1SG

ZONE : 121

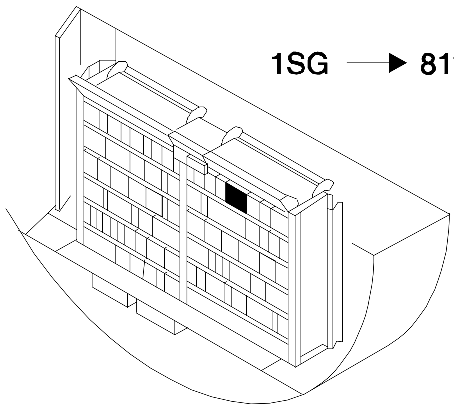
COMPONENT DESCRIPTION

The face of the computer is fitted with one handle, two lugs, a test P/B, eleven leds and one data loading connector.
The back is equipped with one ARINC 600 size three connector. The TCAS is supplied with 115VAC, 100 Watt power rating.

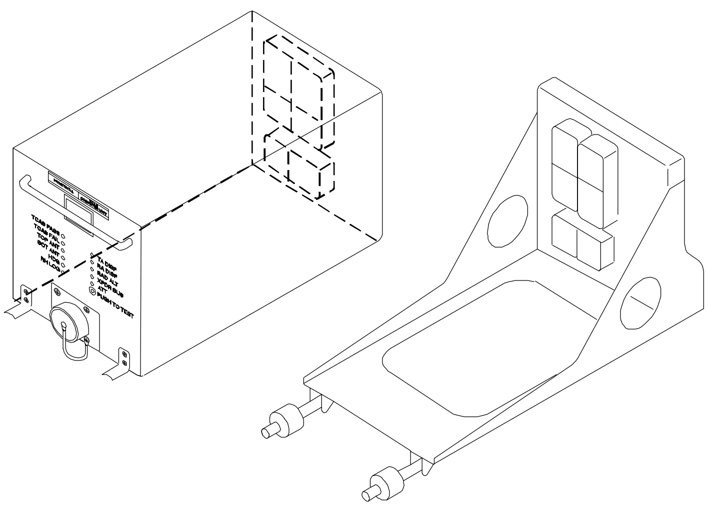
IN SITU TEST

When the TEST pushbutton is pressed in, and released, all of the indicators illuminate. Approximately 3 seconds later, the system status is displayed. If a system failure has been detected, the appropriate system failure indicator illuminates. If the test pushbutton is pressed in and held, the previously described sequence is displayed and the lamp test is repeated followed by the system status indication for the last previous 10 flight legs with a lamp test separating flight leg presentations.

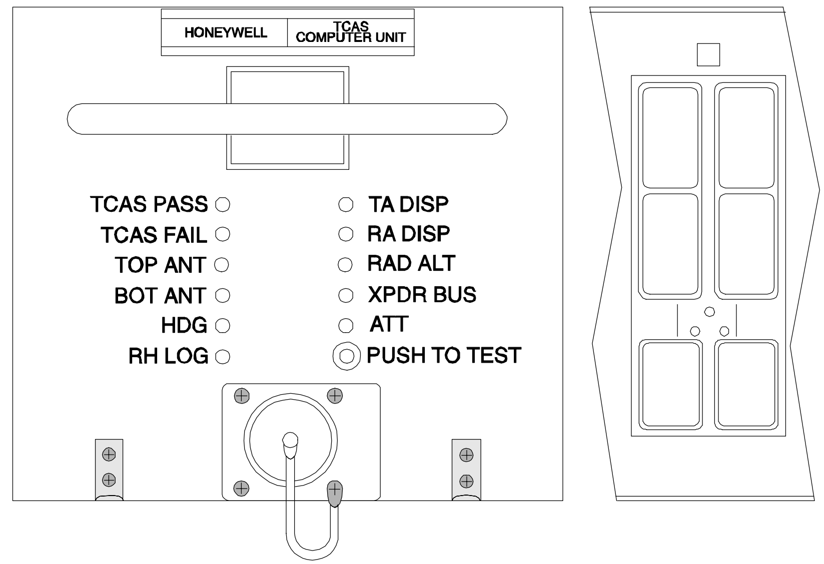
COMPONENT LOCATION



REMOVAL INSTALLATION



TCAS COMPUTER



STATUS OF SYSTEM DURING THE TEST

- TCAS PASS — No fault detected (green)
- TCAS FAIL — Any detected faults (red)
- TOP ANT — Top antenna failure (red)
- BOT ANT — Bottom antenna failure (red)
- HDG — Not applicable (red)
- RH LOG — Not applicable (red)
- TA DISP — Traffic advisory display failure (red)
- RA DISP — Resolution advisory display failure (red)
- RAD ALT — Radio altimeter failure (red)
- XPDR BUS — Update rate, data format or signal range failures (red)
- ATT — Not applicable (red)

ATC/TCAS CONTROL UNIT

FIN : 2SH

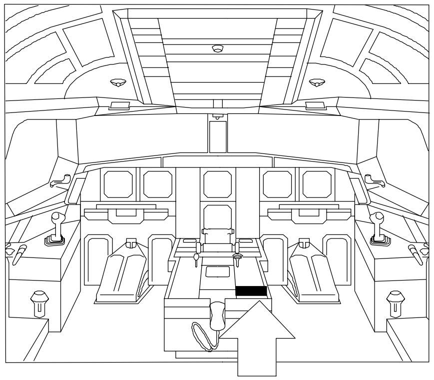
ZONE : 210

COMPONENT DESCRIPTION

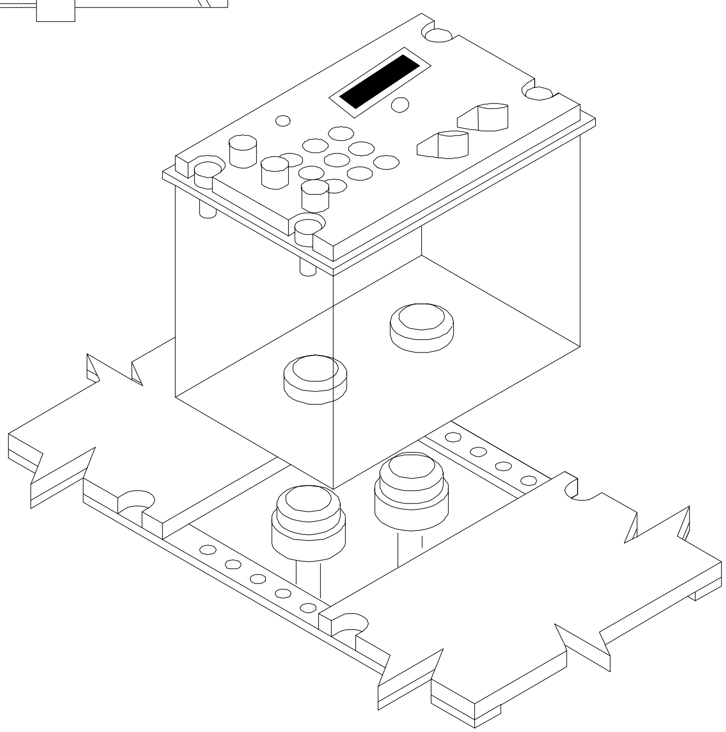
The front panel is integrally lit by clear 5 V lamps and features :

- a liquid crystal display window;
- one ATC failure indication light;
- an IDENT pushbutton;
- one keyboard to select the four-digit transmit code (0000 to 7777);
- an ATC selector for ATC1 or ATC2 selection;
- a STBY/AUTO/ON selector;
- a TA/RA/TA/STBY selector;
- an ALT RPTG ON/OFF selector;
- a THRT/ALL/ABV/BLW selector if the ABOVE/BELOW function is activated.

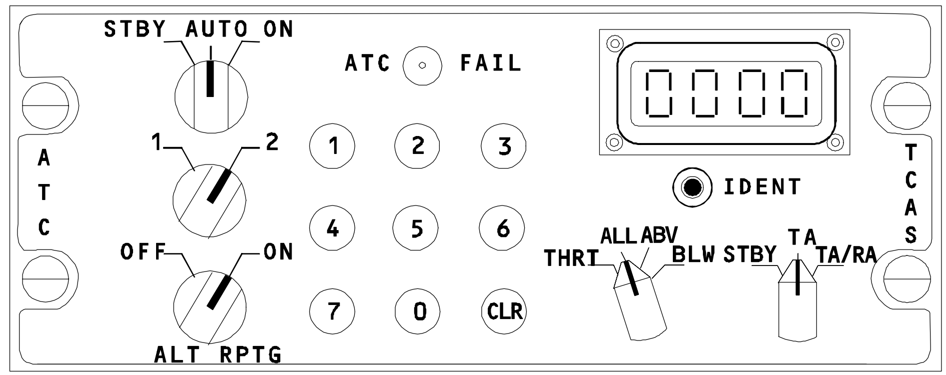
COMPONENT LOCATION



REMOVAL INSTALLATION



ATC/TCAS CONTROL UNIT



FQW4200 GE Metric

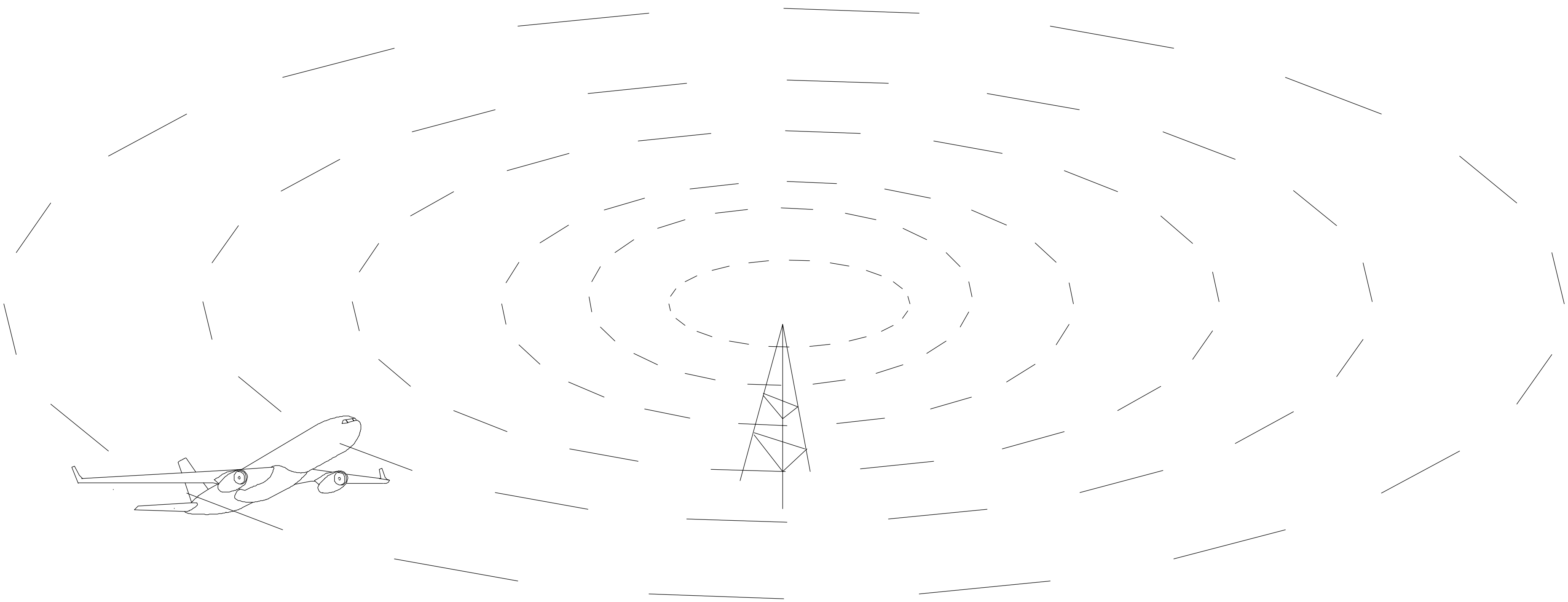
STUDENT NOTES

ADF SYSTEM PRESENTATION

Principle
Components
Indicating

PRINCIPLE

The Automatic Direction Finder (ADF) is a radio navigation aid which receives and interprets the signals provided by a non directional ground station.



FQW4200 GE Metric

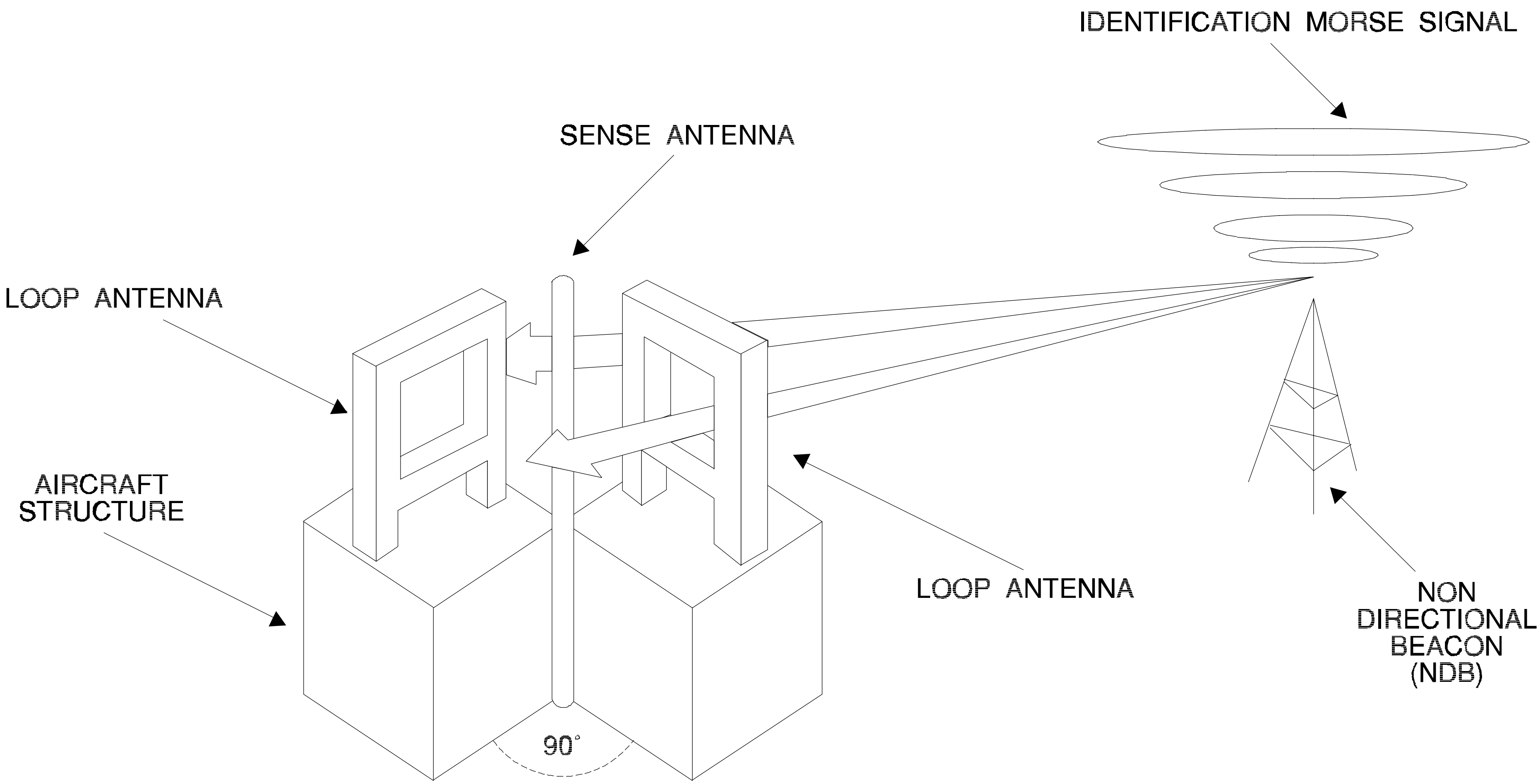
The combination of signals, received from two loop antennae and from one omni-directional sense antenna, provides bearing information.

The two loop antennae are positioned 90° apart on the aircraft structure. The signal from the omni-directional sense antenna is not affected by the relative bearing.

An additional Morse signal is provided to identify the selected ground station.

The ADF system also provides :

- Aural identification of the ground station.
- Decoding of the Morse identification which is received by the sense antenna.



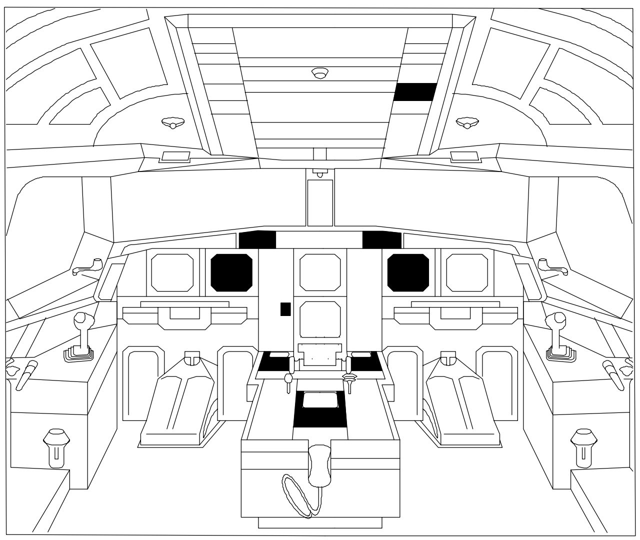
FQW4200 GE Metric

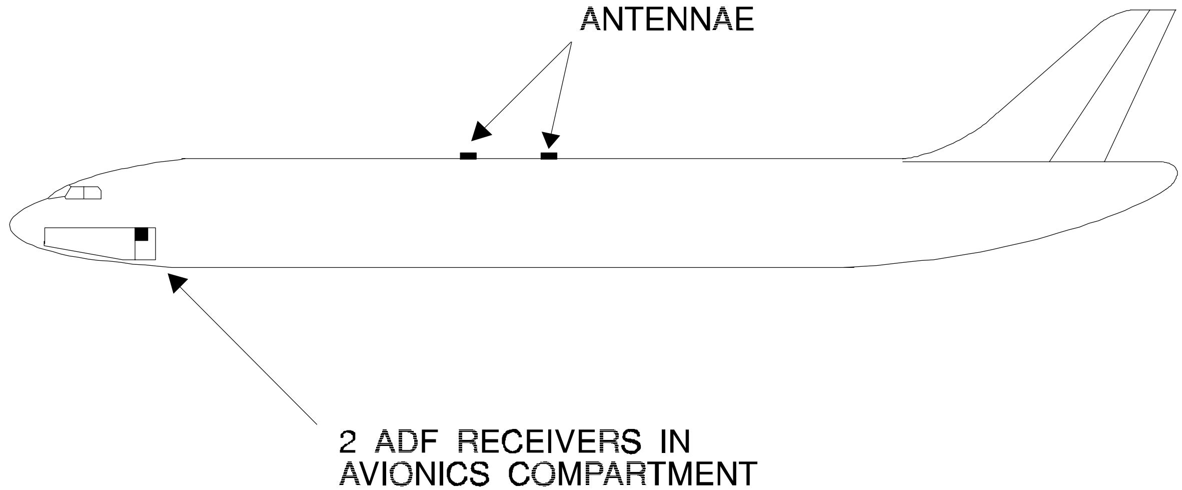
COMPONENTS

Each Automatic Direction Finder system is composed of one receiver and one antenna.

The ADF system is also connected to :

- Navigation Display (ND) and Digital Distance Radio Magnetic Indicator (DDRMI) for display.
- Electronic Flight Instrument System (EFIS) panels for control display.
- Flight Management Guidance and Envelope Computer (FMGEC) for auto-tuning.
- Multipurpose Control Display Units (MCDU) for manual tuning.
- Captain and First Officer Radio Management Panels (RMP) for back-up tuning.
- Audio Control Panels (ACP) for ADF audio signal.





FQW4200 GE Metric

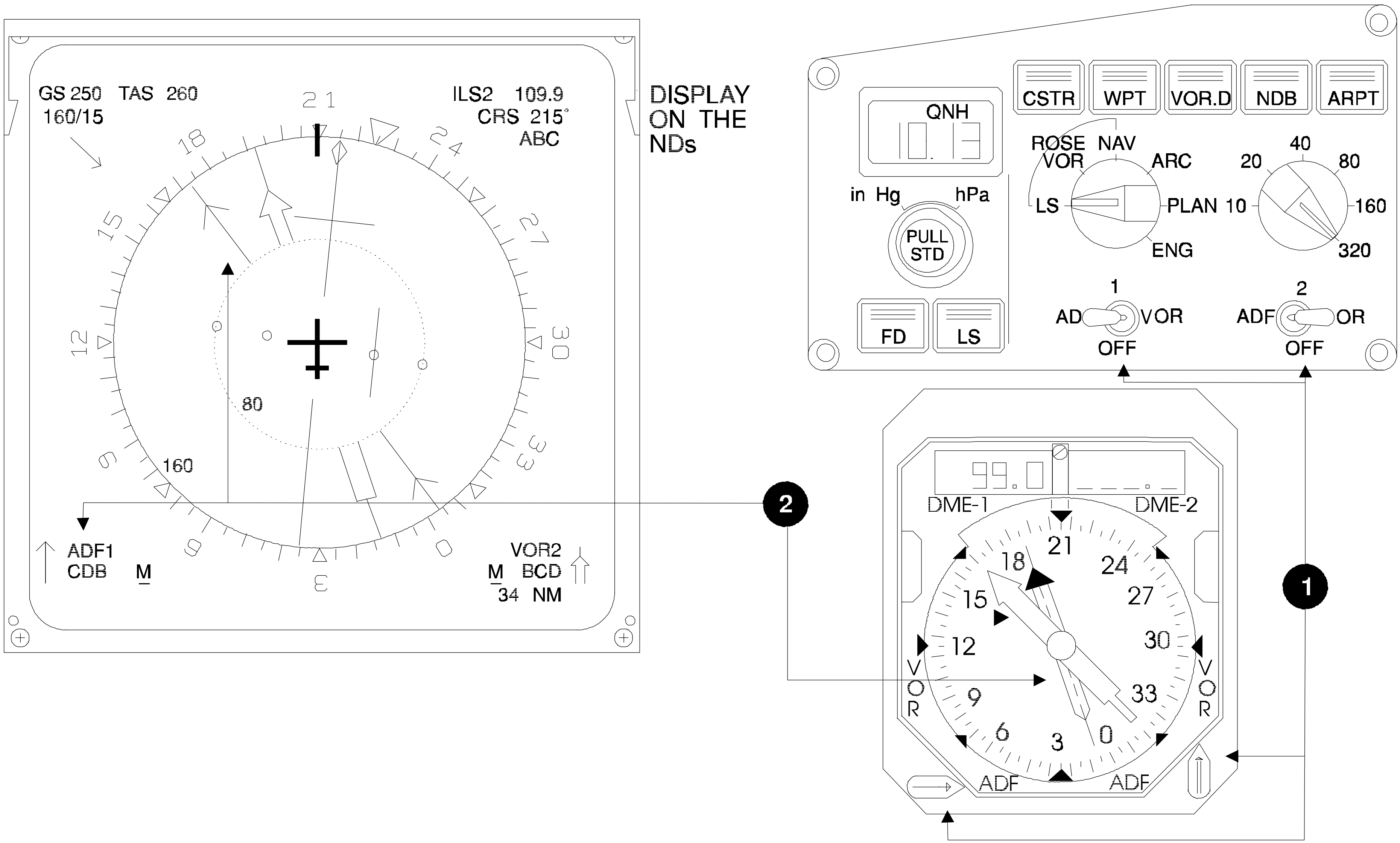
INDICATING

The Automatic Direction Finder system information can be displayed on the Navigation Display system and on the Digital Distance Radio Magnetic Indicator.

1. Selector switches set to ADF.

2. Pointers corresponding to selectors :

   - Always single pointer on ND;
   - Double or single pointer on DDRMI.



DISPLAY ON THE DDRMI.

FQW4200 GE Metric

STUDENT NOTES

ADF D/O

Auto Tuning
Manual Tuning
FM Switch
Back Up Tuning
Antennae
LGCIU
Indicating
CMC

AUTO TUNING

In normal operation each Flight Management Guidance and Envelope Computer (FMGEC) automatically tunes its ownside Automatic Direction Finder (ADF) transceiver through its ownside Radio Management Panel (RMP).

MANUAL TUNING

Each Multipurpose Control and Display Unit (MCDU) allows the ownside ADF transceiver to be manually tuned through the ownside FMGEC and the opposite ADF transceiver to be tuned though the opposite FMGEC.

FM SWITCH

If a FMGEC failure occurs, a discrete, generated by the Flight Management (FM) switching, changes the tuning port of the associated ADF transceiver, so that it can be directly tuned by the opposite FMGEC.

BACK UP TUNING

If both FMGECs fail, each RMP allows its ownside ADF transceiver to be tuned.
A discrete inhibits the radionav MCDU page, via the FMGEC.

ANTENNAE

The ADF antenna provides three signals and consists of one sense antenna and two loop antennae called longitudinal antenna and lateral antenna.

The ADF antenna operates between 190 and 1750 Khz and comprises :

- One pre-amplifer, for each antenna, energized by the ADF receiver.
- A test loop which enables a self test. (not used)

LGCIU

Each Landing Gear Control Interface Unit (LGCIU) sends discrete signals to the associated ADF transceiver.
This Ground/Flight information is used by the receiver BITE module to count the flight legs.

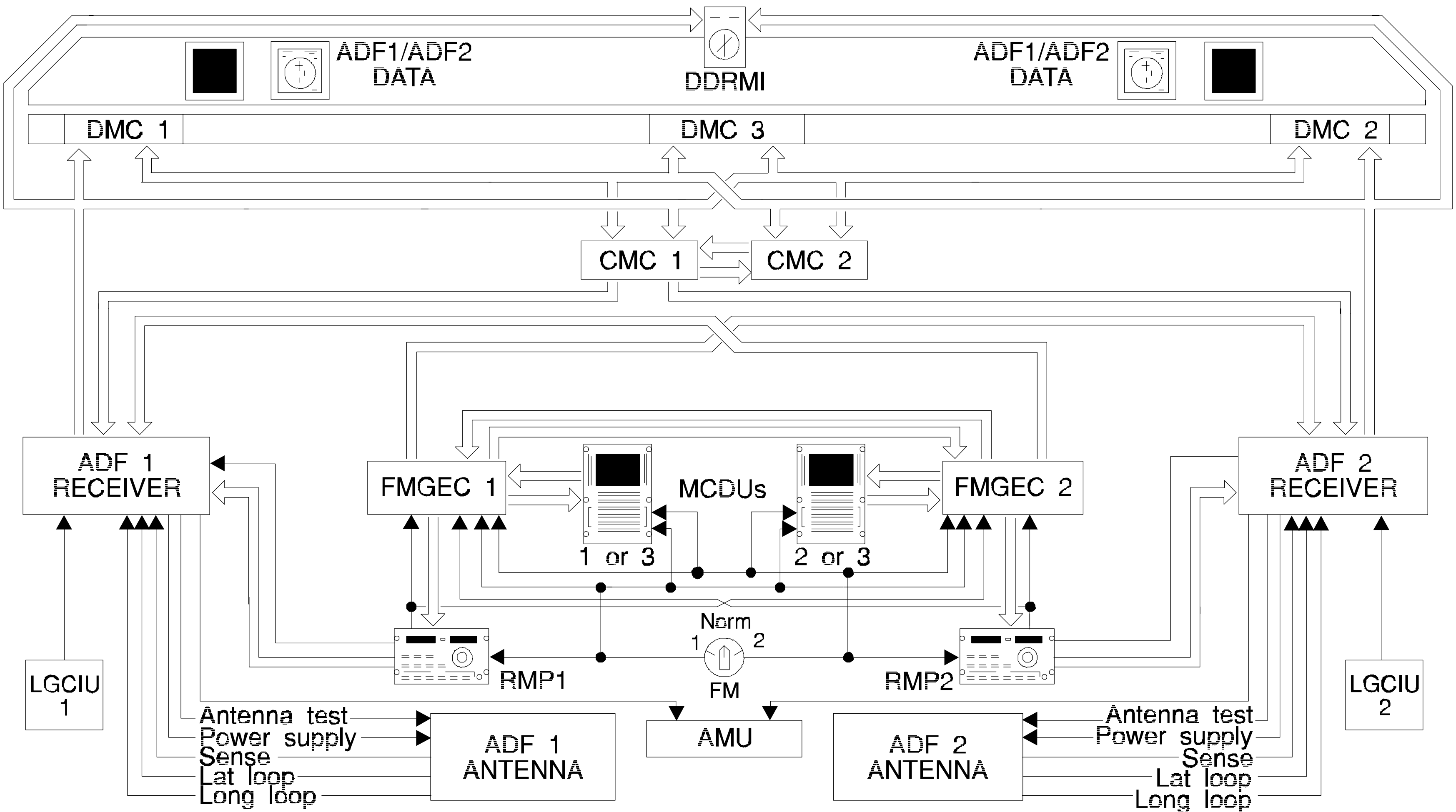
INDICATING

The ADF data is sent to the Navigation Display (ND) through the Display Management Computers (DMC) and directly to the Digital Distance and Radio Magnetic Indicator (DDRMI).

The ADF audio signal is processed by the receiver and sent to the Audio Management Unit (AMU) and can be heard by the crew.

CMC

The MCDUs allow the systems to be tested via the Central Maintenance Computers (CMC).
The tests are only available on ground.



FQW4200 GE Metric

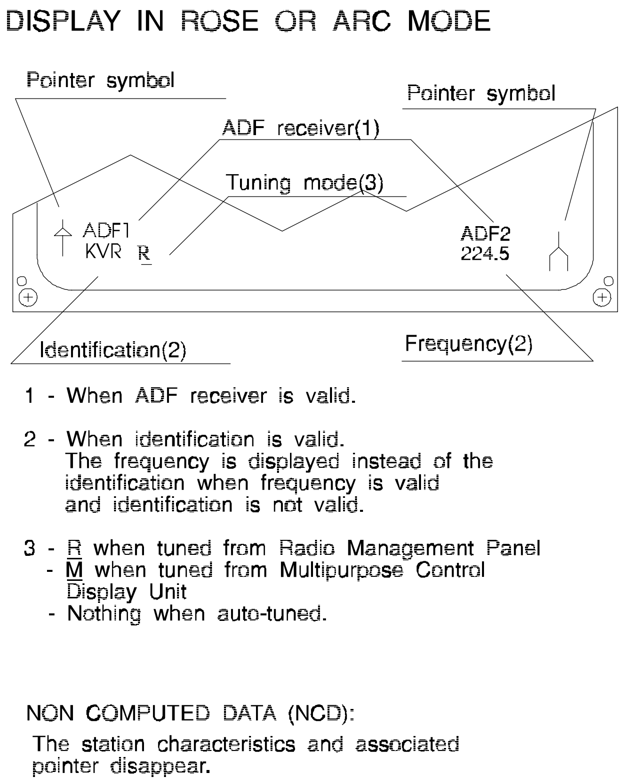
STUDENT NOTES:

ADF INDICATIONS ON ND

ADF Characteristics
ADF Pointers
NDB Pushbutton
Failures

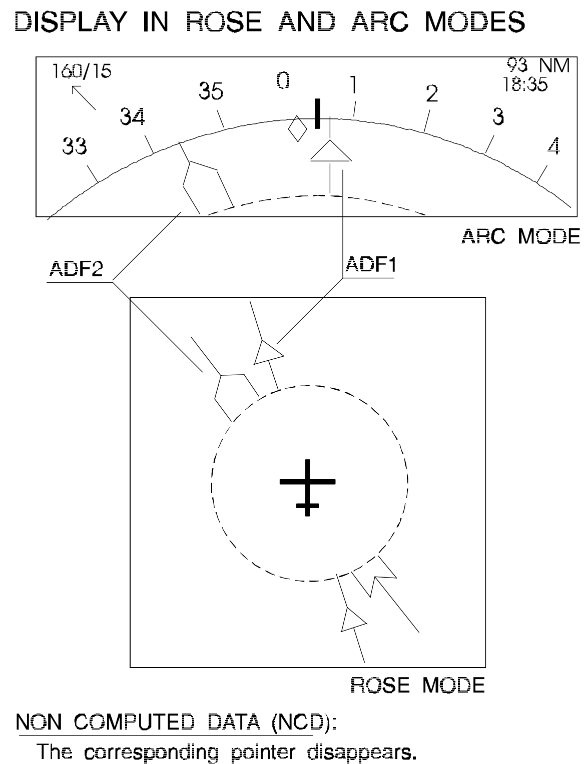
Automatic Direction Finder (ADF)
Navigation Display (ND)

ADF CHARACTERISTICS



When the mode selector is set to ROSE or ARC mode, and the ADF/VOR selector is set to ADF, the ADF station characteristics are displayed in green in the left or right lower corner.

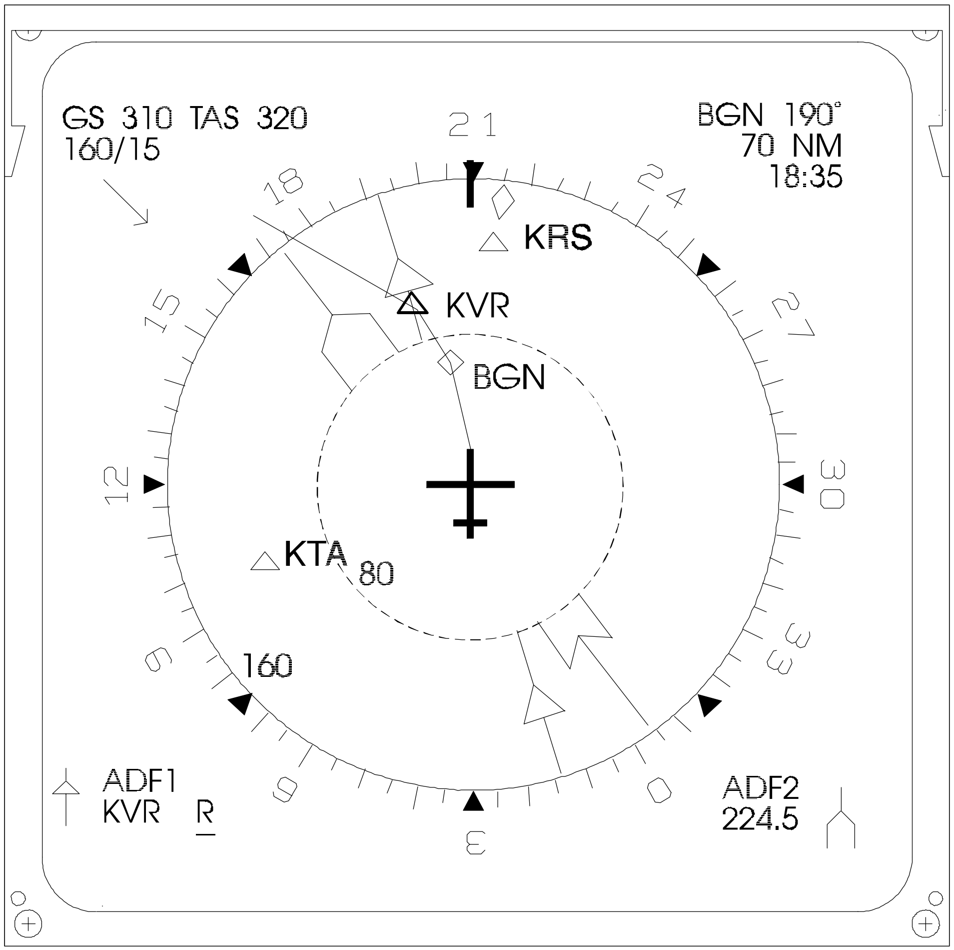
ADF POINTERS

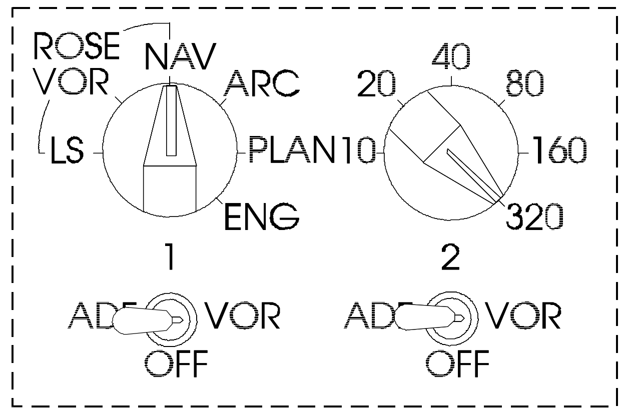


Two kinds of green pointer can show the ADF ground station bearing on the heading dial.

FQW4200 GE Metric

ROSE-NAV MODE



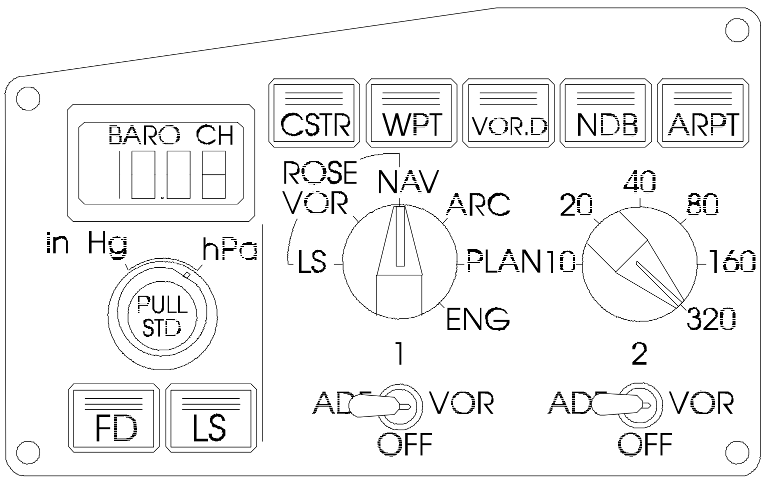


KTA and KRS are examples of ground station symbols displayed in magenta in ROSE-NAV or

FQW4200 GE Metric

NDB PUSHBUTTON

CONDITIONS OF DISPLAY



NDB PUSHBUTTON SELECTED

In ROSE-NAV and ARC modes, when the NDB (Non Directional Beacon) pushbutton is selected on the Electronic Flight Instrument System control panel, triangle symbols show the ADF ground stations.

FAILURES

DISPLAY IN ROSE OR ARC MODE

THE CORRESPONDING RED FLAG FLASHES
FOR 9 SECONDS THEN STEADY.(e.g. : ADF1)

When a failure occurs, a red flag is displayed in the left or right lower corner and the corresponding pointer disappears.

At the same time, the corresponding pointer goes out of view.

FQW4200 GE Metric

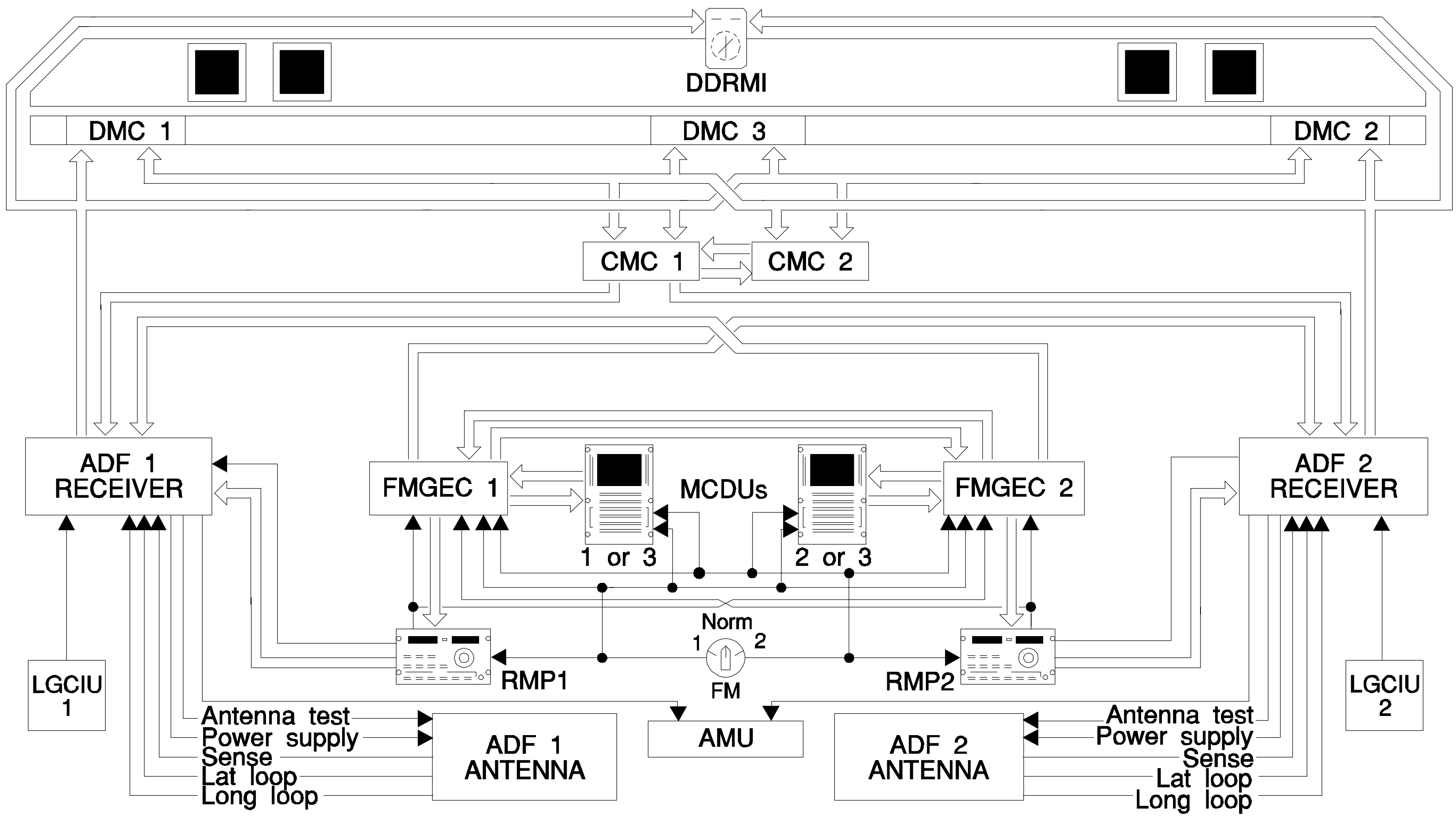
STUDENT NOTES:

STUDENT NOTES

ADF COMPONENTS

ADF 1/2 Receiver
ADF 1/2 Antenna

STUDENT NOTES



FQW4200 GE Metric

ADF 1/2 RECEIVER

FIN : 1RP1, 1RP2

ZONE : 121, 122

COMPONENT DESCRIPTION

The face of the receiver is fitted with a handle, one lug, a test P/B and three LEDs.
The back is equipped with one ARINC 600 size one connector which includes three plugs :

- Top Plug (TP) :

  Connection with the automatic test circuit,

- Middle Plug (MP) :

  Connection with the antenna and peripheral circuits,

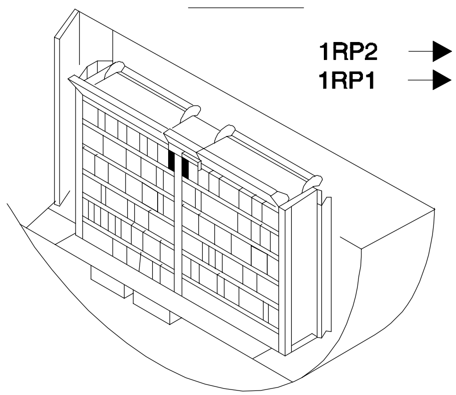
- Bottom Plug (BP) :

  Connection with the power supply circuit (115vac-400Hz).

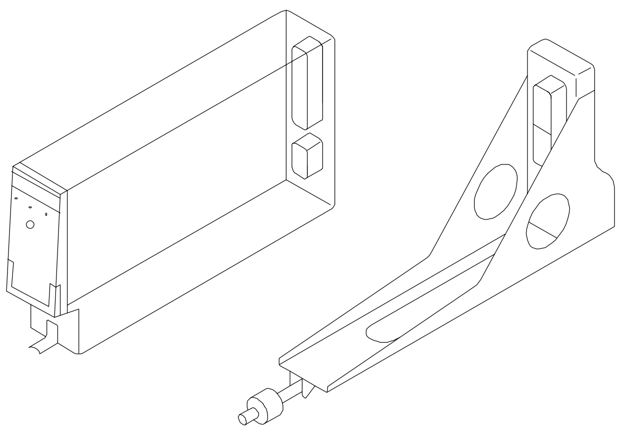
IN SITU TEST

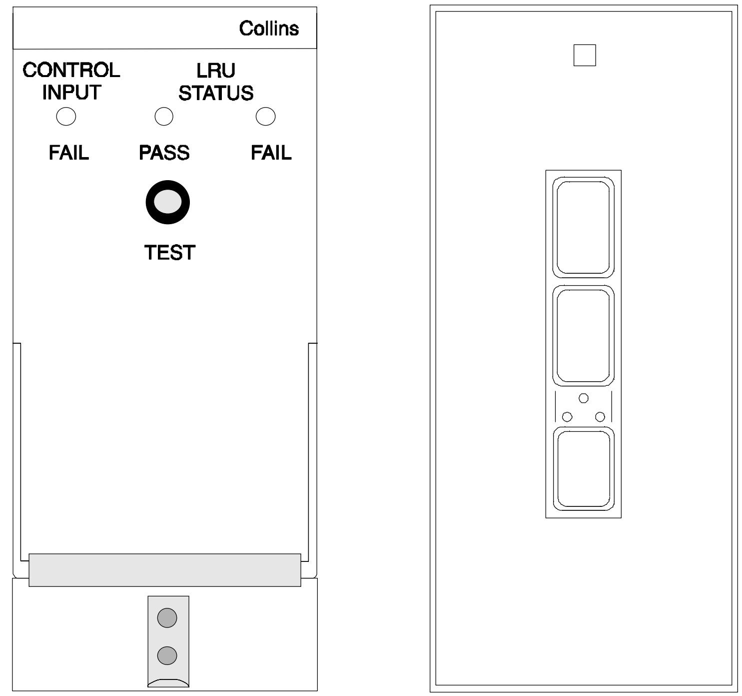
The ADF test function can be activated in ground condition only by pressing the test P/B on the face of the receiver.
The status of system is displayed by means of three LEDs.

COMPONENT LOCATION



REMOVAL INSTALLATION



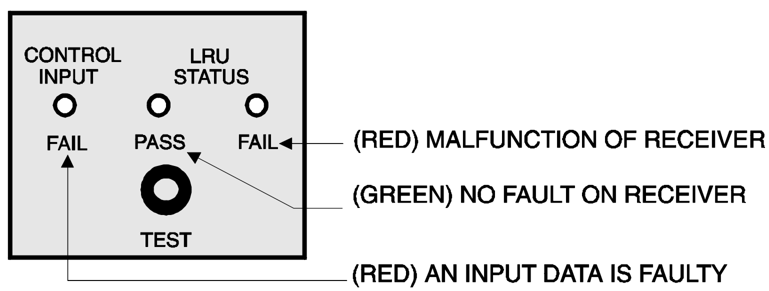


FACE

BACK

ADF INTERROGATOR

IN SITU TEST



FQW4200 GE Metric

ADF 1/2 ANTENNA

FIN : 2RP1, 2RP2

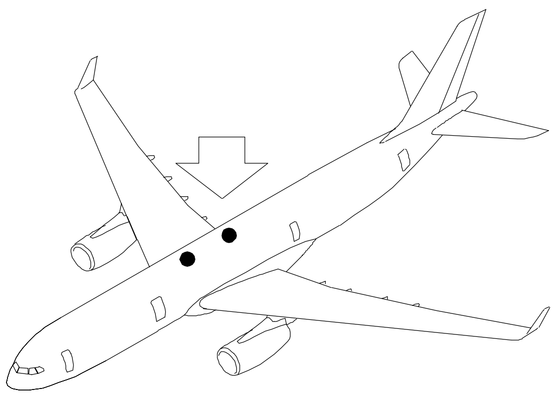
ZONE : 250

COMPONENT DESCRIPTION
The combined Loop and Sense antenna operates in the 190 to 1750 Khz frequency range and consists of the following components enclosed in a fiberglass housing.

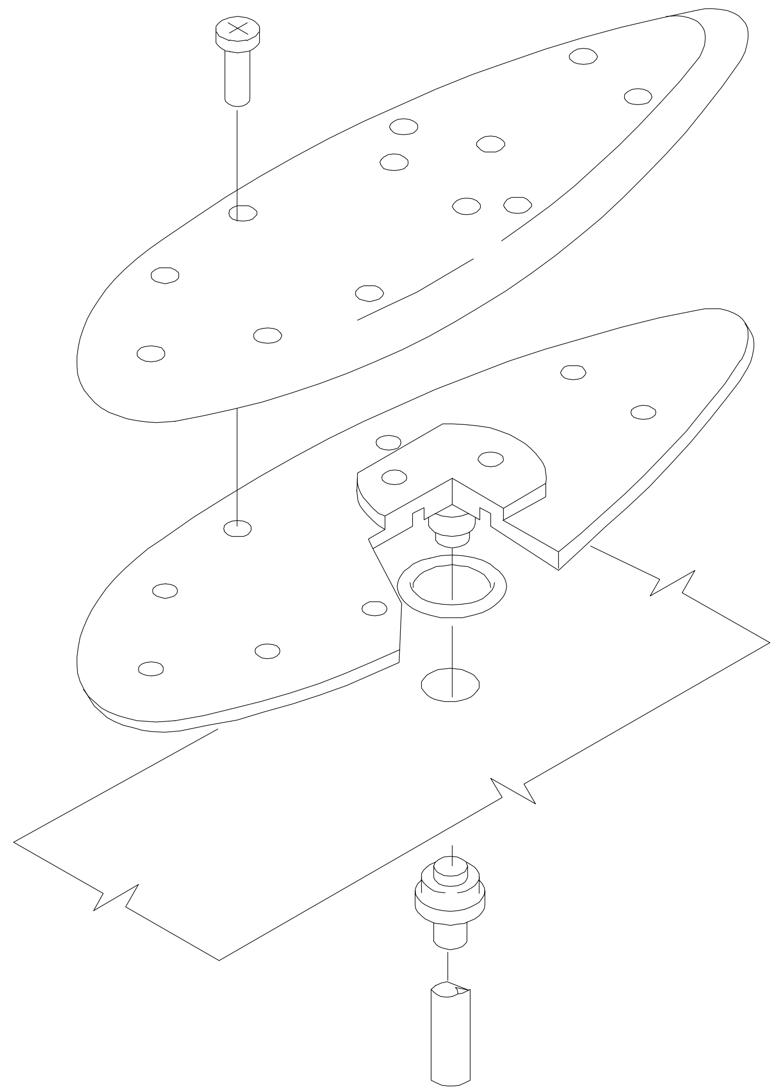
- one vertical Sense antenna,
- two horizontal Loop antennae,
- a printed circuit board which contains three pre-amplifiers used to amplify the Loop and sense signals.

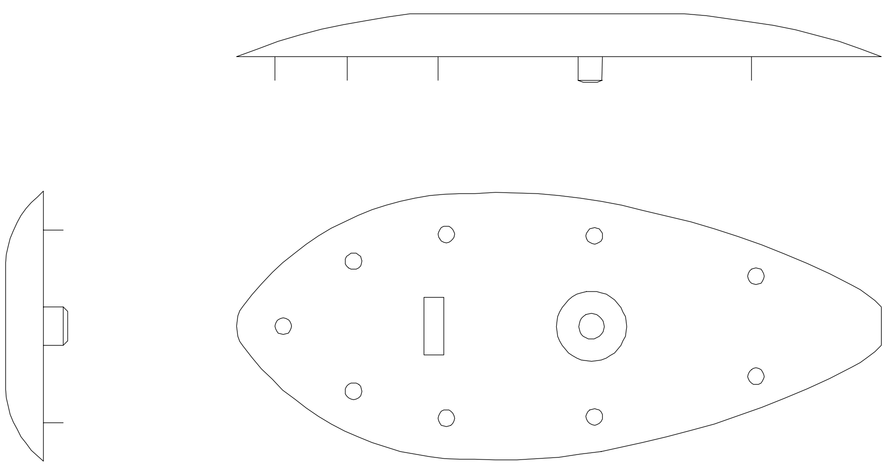
The pre-amplifiers are energized by +/- 12DVC from the ADF receivers.
The output impedance of the antenna is 78 Ohm.

COMPONENT LOCATION



REMOVAL INSTALLATION





ADF ANTENNA

FQW4200 GE Metric

STUDENT NOTES

VOR/MARKER SYSTEMS PRESENTATION

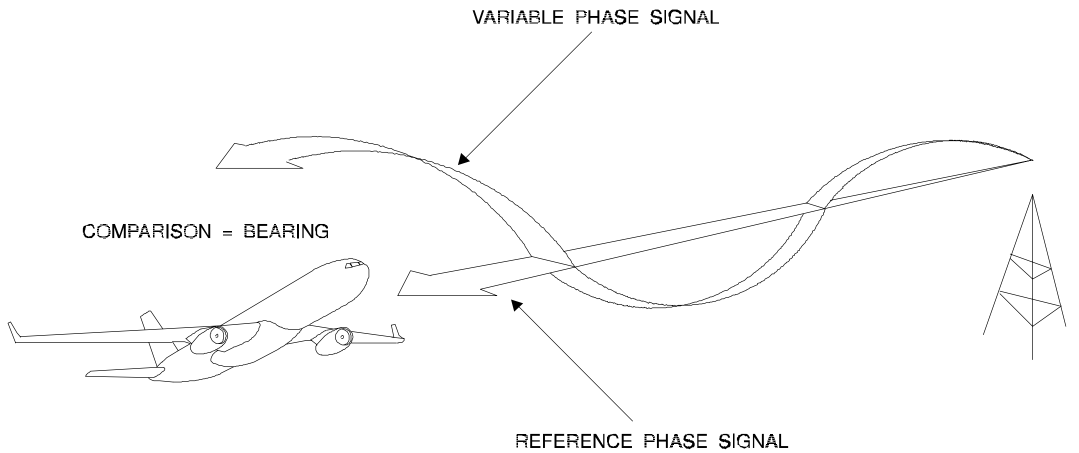
Very High Frequency Omni-directionnel Range (VOR) and MARKER radio beacon (MKR)

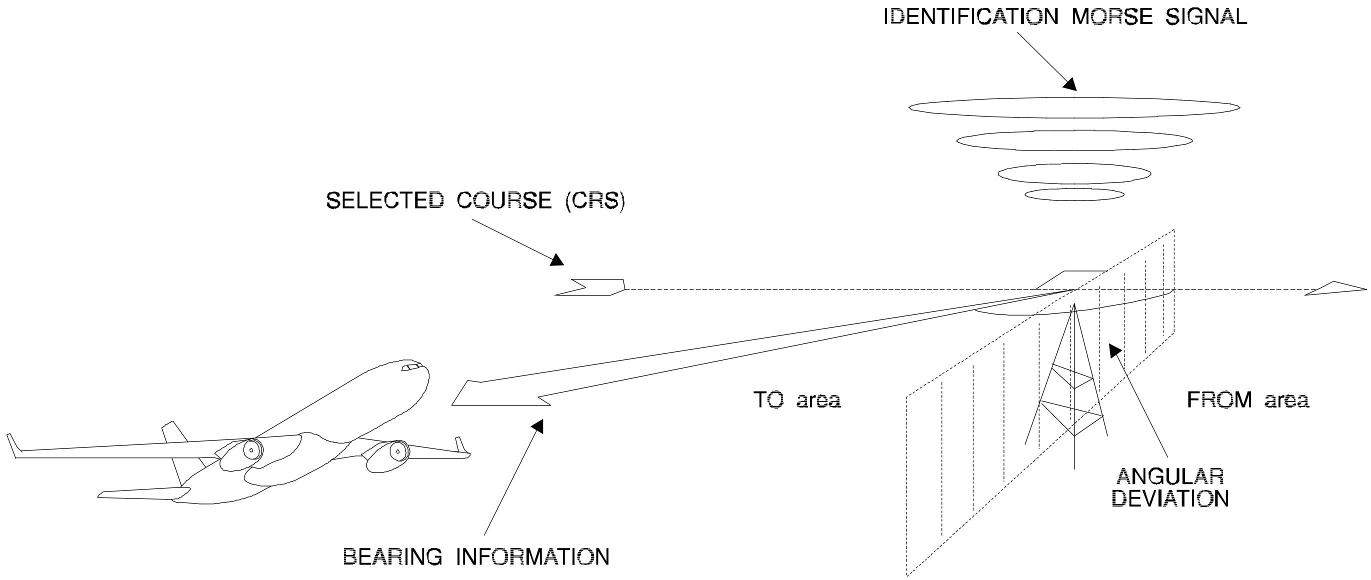
VOR PRINCIPLE

The VOR system is a navigation aid which receives, decodes and processes bearing information from the omni-directional ground station.

The phase difference between the reference and the variable phase is function of the aircraft position with respect to the ground station.

The VOR system provides the bearing information from the difference between two phases transmitted by a ground station.



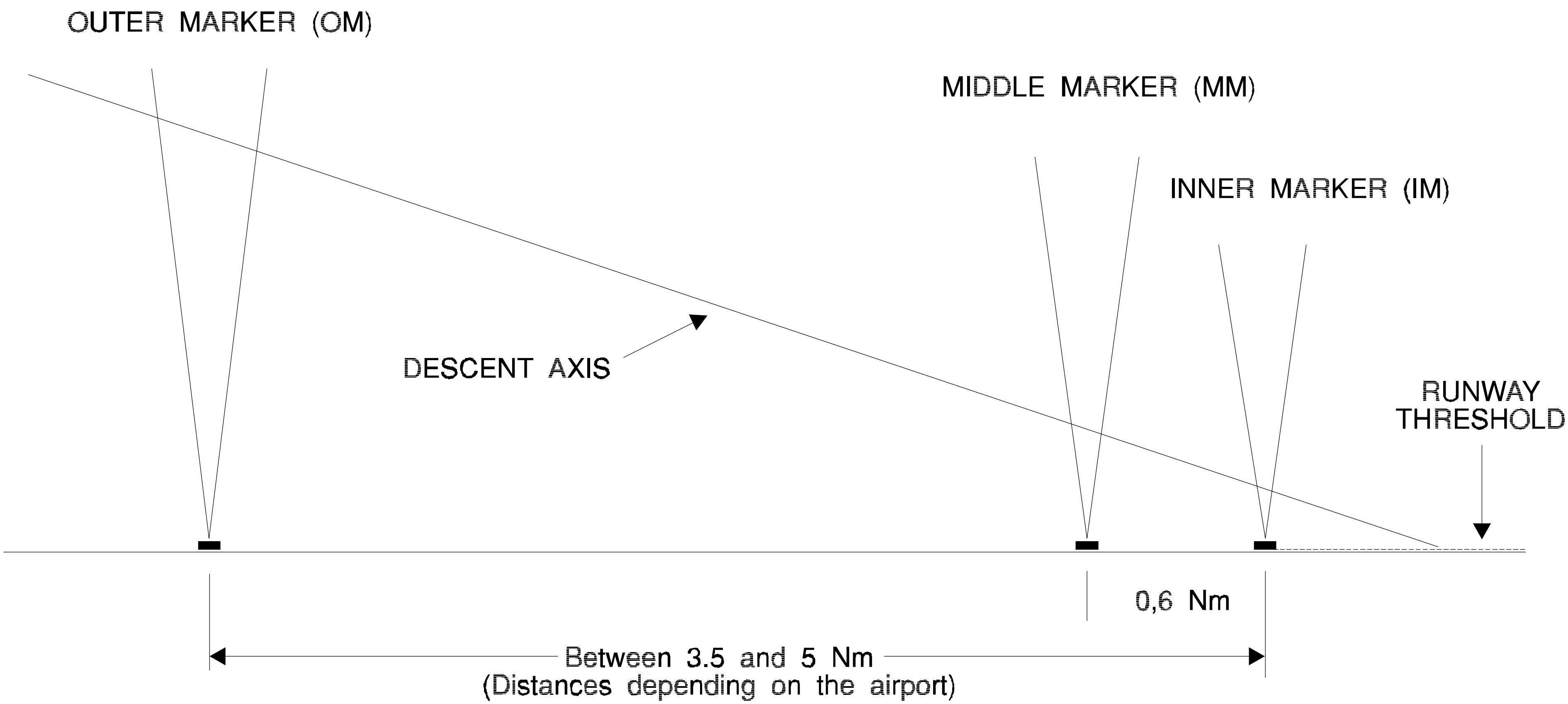


FQW4200 GE Metric

The VOR system is a medium-range radio aid.

The VOR system also provides :

- The aircraft angular and FROM/TO position with respect to a selected course.
- A Morse signal which identifies the station.

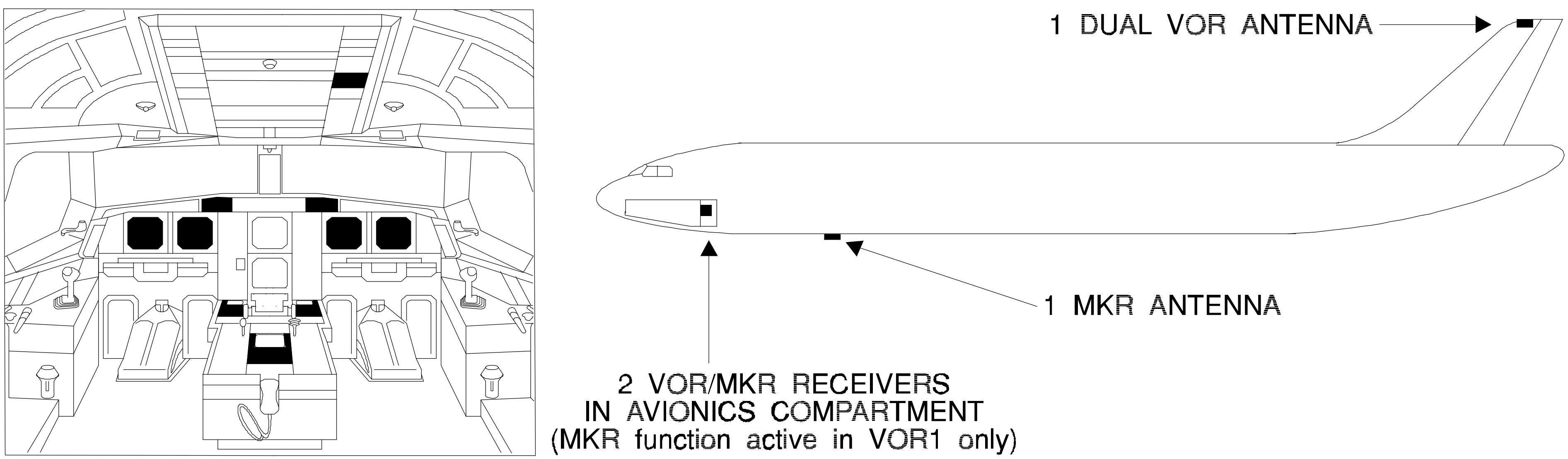


FQW4200 GE Metric

MKR PRINCIPLE

The Marker system is a radio navigation aid which determines the distance between the aircraft and the runway threshold.

When the aircraft overflies one of these Marker transmitters, the system provides aural and visual indications to the flight crew.


1 DUAL VOR ANTENNA
1 MKR ANTENNA
2 VOR/MKR RECEIVERS
IN AVIONICS COMPARTMENT
(MKR function active in VOR1 only)

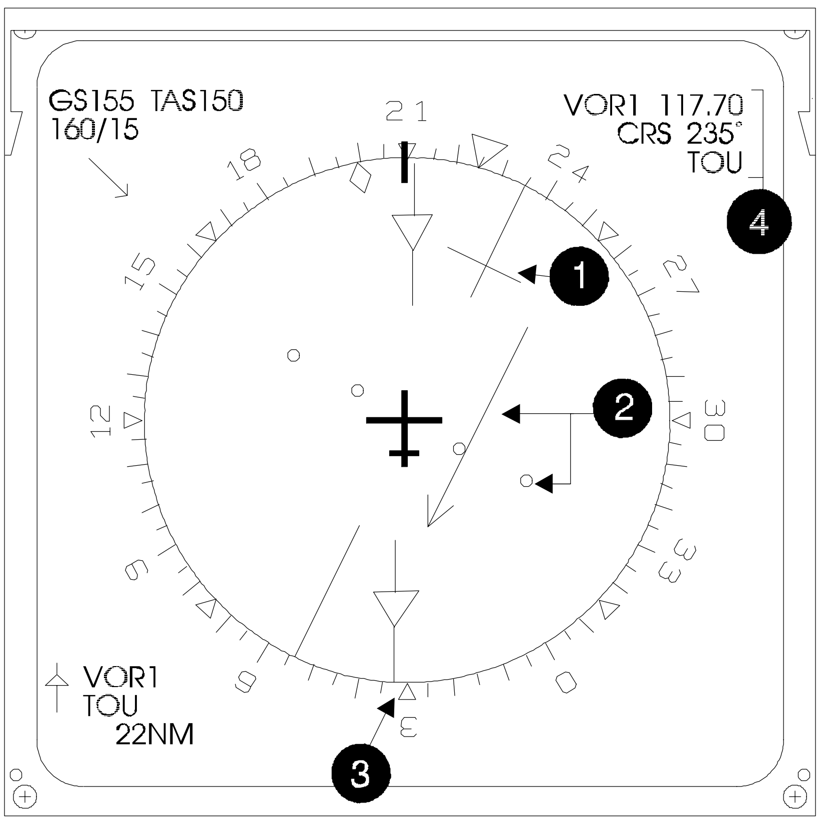
COMPONENTS

The VOR and Marker systems are composed of two receivers, one marker antenna and one dual VOR antenna.

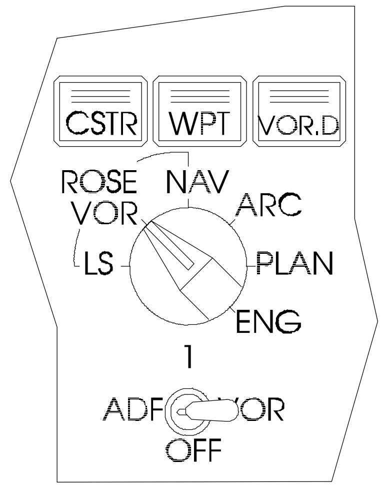
The VOR/MKR system is also connected to :

- Navigation Display (ND), Primary Flight Display (PFD) and Digital Distance Radio Magnetic Indicator (DDRMI) for display.
- Electronic Flight Instrument System (EFIS) panels for control display.
- Flight Management Guidance Envelope Computer (FMGEC) for auto-tuning.
- Multipurpose Control Display Units (MCDU) for manual tuning.
- Captain and First Officer Radio Management Panels (RMP) for back-up tuning.
- Audio Control Panels (ACP) for VOR/MKR audio signal.

ND

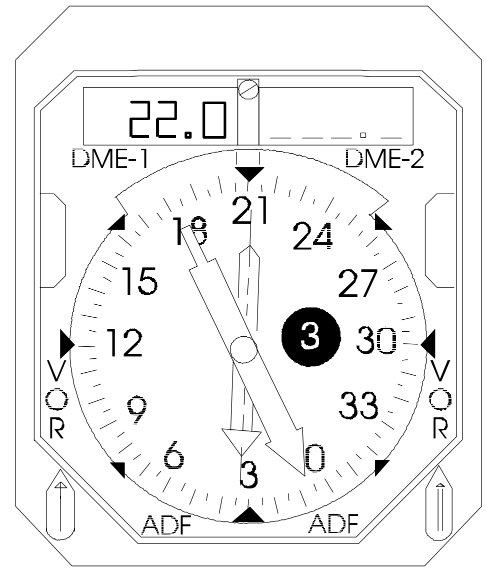


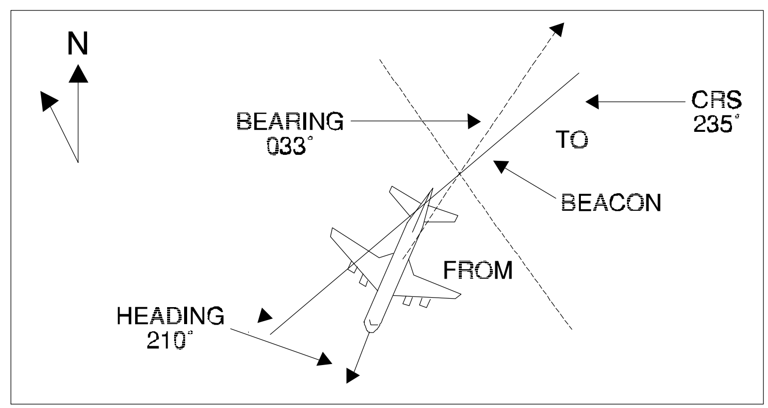
1. Selected course.
2. Lateral deviation and the arrow giving the TO/FROM indication.
3. Bearing pointers.
4. VOR information.



EFIS PANEL

DDRMI



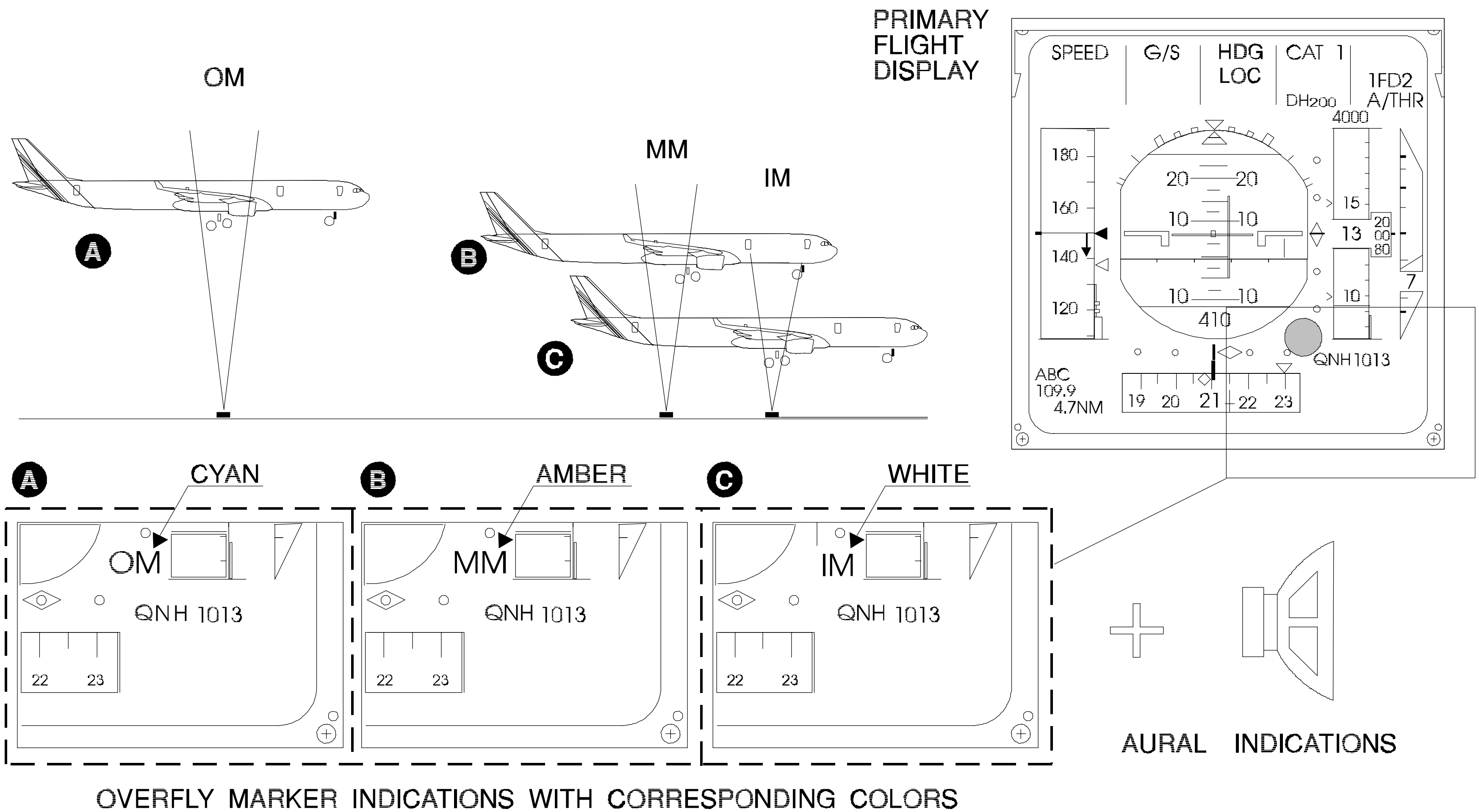


FLIGHT REPRESENTATION

FQW4200 GE Metric

VOR INDICATING

The indicators show that the aircraft is flying from the ground station and is on the left hand side of the course selected by the pilot.



FQW4200 GE Metric

MKR INDICATING

When the aircraft overflies the Marker, the type of Marker is displayed in different colors, and is indicated by an aural identification.

VOR/MARKER D/O

VOR Auto Tuning
VOR Manual Tuning
VOR FM Switching
VOR Back Up Tuning
VOR Antenna
VOR Users
Marker Control
Marker Antenna
LGCIU
Indicating
CMC

Very High Frequency Omni-Directional Range (VOR) and Marker (MKR).

VOR AUTO TUNING

In normal operation each Flight Management Guidance and Envelope Computer (FMGEC) automatically tunes its ownside VOR receiver through its ownside Radio Management Panel (RMP).

The transceiver start up system is ensured by a discrete signal.
No pre-heating time is necessary before the start up operation.

VOR MANUAL TUNING

Each Multipurpose Control and Display Unit (MCDU) allows the ownside VOR receiver to be manually tuned through the ownside FMGEC and the opposite VOR receiver to be tuned through the opposite FMGEC.

VOR FM SWITCHING

If a FMGEC failure occurs, a discrete, generated by the Flight Management (FM) switching, changes the tuning port of the associated VOR receiver, so that it can be directly tuned by the opposite FMGEC.

VOR BACK UP TUNING

If both FMGECs fail,each RMP allows its ownside VOR receiver to be directly tuned.
A discrete inhibits the radionav MCDU page, via the FMGEC.

VOR ANTENNA

The dual VOR antenna receives the signals coming from the ground stations.

The VOR Antenna has two independent connectors used to feed the two VOR systems.
The VOR Antenna operates in the 108 to 117.95 Mhz range.

VOR USERS

The VOR data is sent to the FMGECs for aircraft position computation.

MKR CONTROL

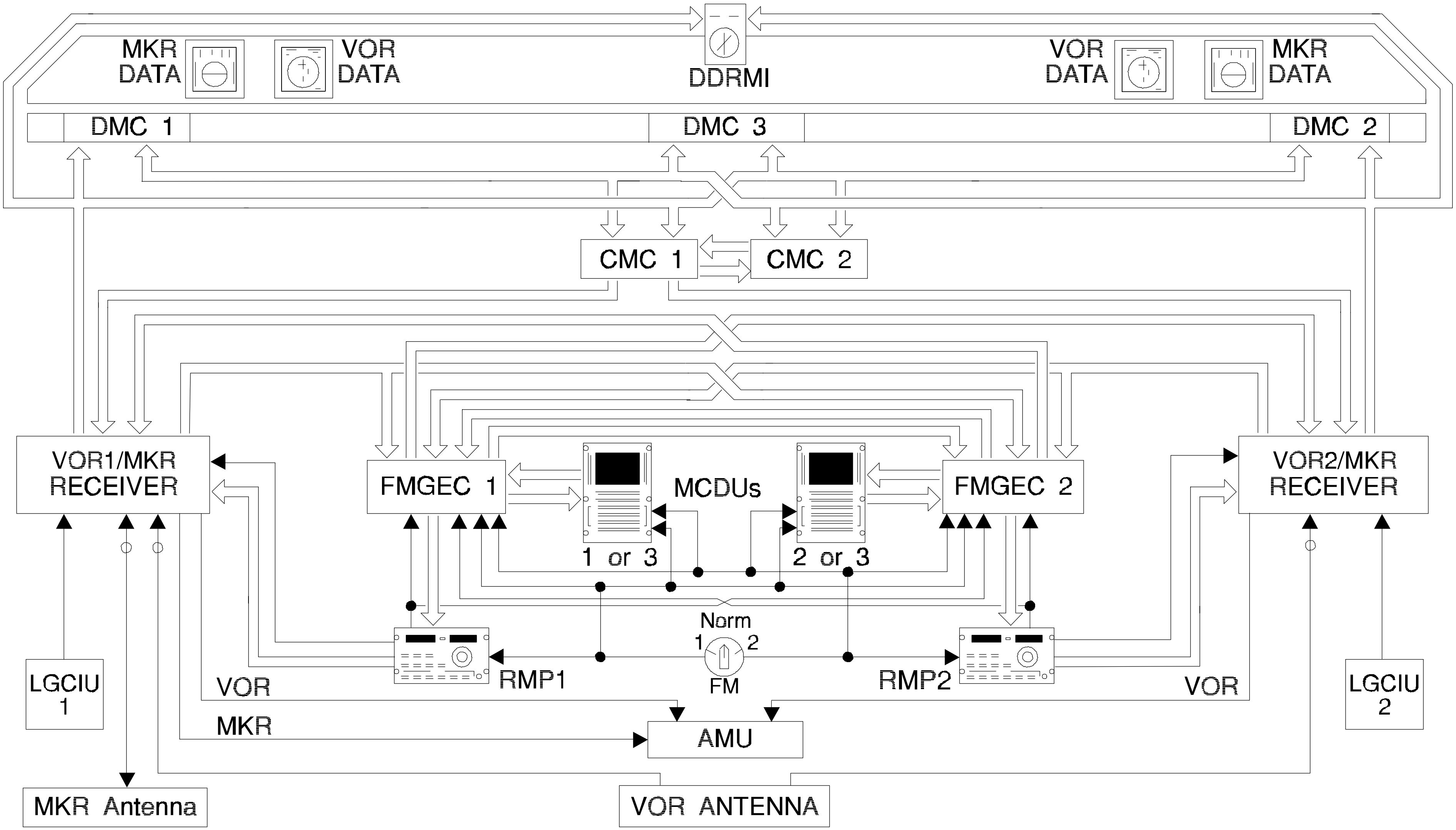
The system consists of two identical VOR/MKR receivers but only Marker (MKR) one is operative as connected to the MKR antenna.

The Marker system operates at a fixed frequency and does’nt need any control.

MKR ANTENNA

The Marker antenna receives Marker signals when the aircraft overflies the Marker beacons.

The Marker Antenna operates at 75 Mhz.



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LGCIU

Each Landing Gear Control Interface Unit (LGCIU) sends discrete signals to the associated VOR receiver.
This Ground/Flight information is used by the receiver BITE module to count the flight legs.

INDICATING

VOR data is sent to the Navigation Displays (ND) through the Display Management Computers (DMC) and to the Digital Distance and Radio Magnetic Indicator (DDRMI).
The Marker data is sent to the Primary Flight Displays (PFD) through the Display Management Computers.

VOR and Marker audio signals are processed by the receivers and sent to the Audio Management Unit (AMU) and can be heard by the crew.

CMC

The MCDUs allow the systems to be tested via the Central Maintenance Computers (CMC).
The tests are only available on ground.

STUDENT NOTES:

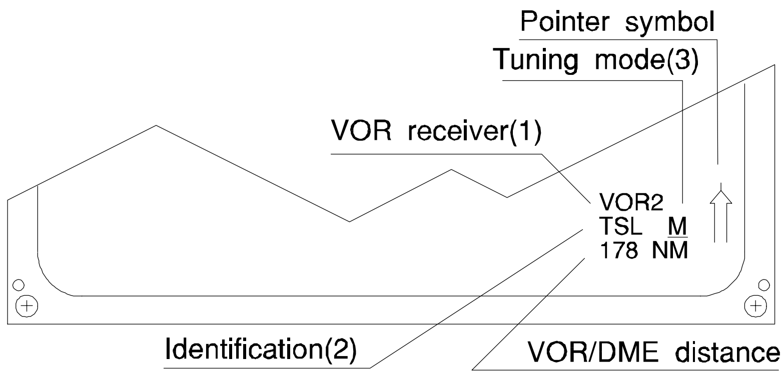
STUDENT NOTES

VOR INDICATIONS ON ND

VHF Omni directional Range (VOR).
Navigation Display (ND).

VOR CHARACTERISTICS

DISPLAY IN ROSE OR ARC MODE



1 - When VOR receiver is valid.

2 - When identification is valid.
The frequency is displayed instead of the identification when frequency is valid and identification is not valid.

3 - R when tuned from Radio Management Panel
- M when tuned from Multipurpose Control Display Unit
- Nothing when auto-tuned

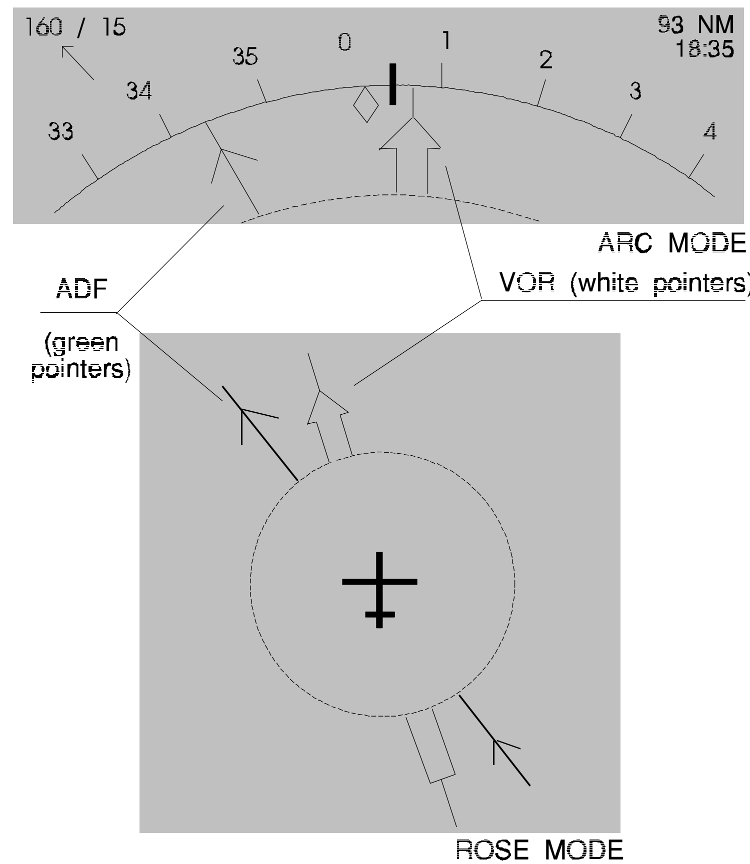
NON COMPUTED DATA (NCD):

The identification (or frequency) is replaced by ▭▭▭ and the corresponding pointer disappears.

When the mode selector is set to ROSE or ARC mode, and the ADF/VOR selector is switched to VOR, the VOR station characteristics are displayed in white in the left or right lower corner of the ND.

POINTERS

DISPLAY IN ROSE AND ARC MODES



NON COMPUTED DATA (NCD):

The corresponding pointer disappears.

Two types of white pointer can show the VOR ground station bearings on the heading dial.

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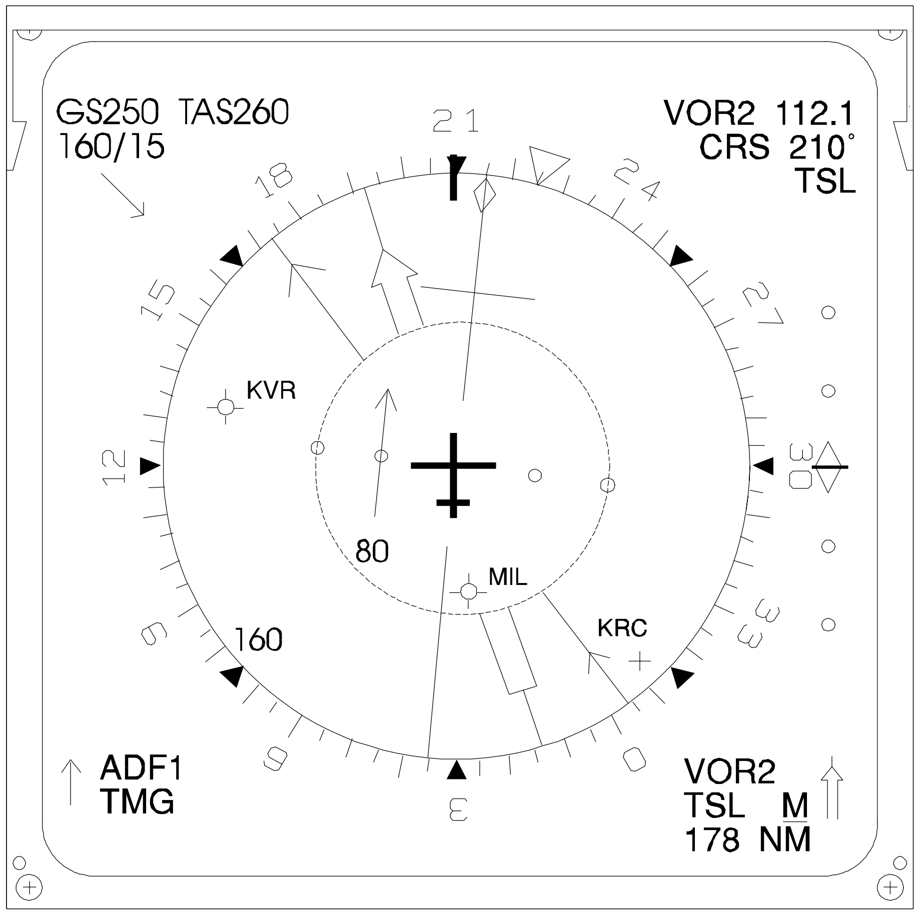

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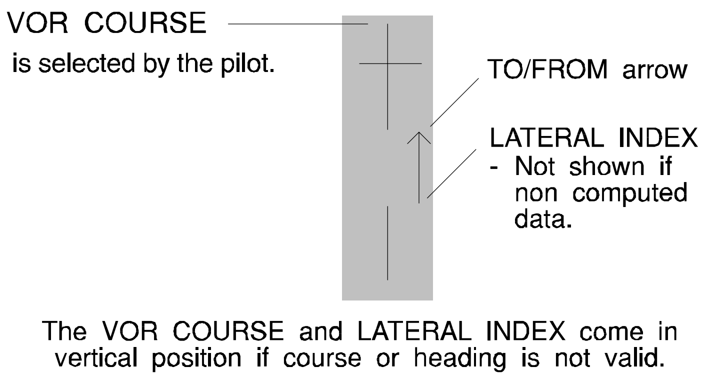
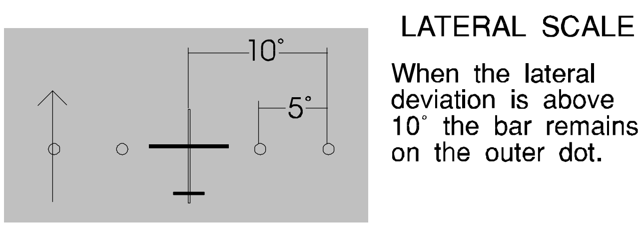
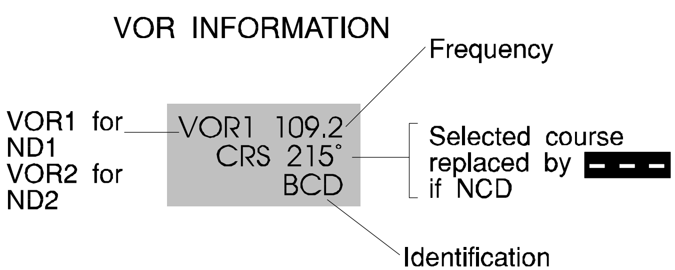
COURSE/LATERAL DEVIATION

CONDITIONS OF DISPLAY



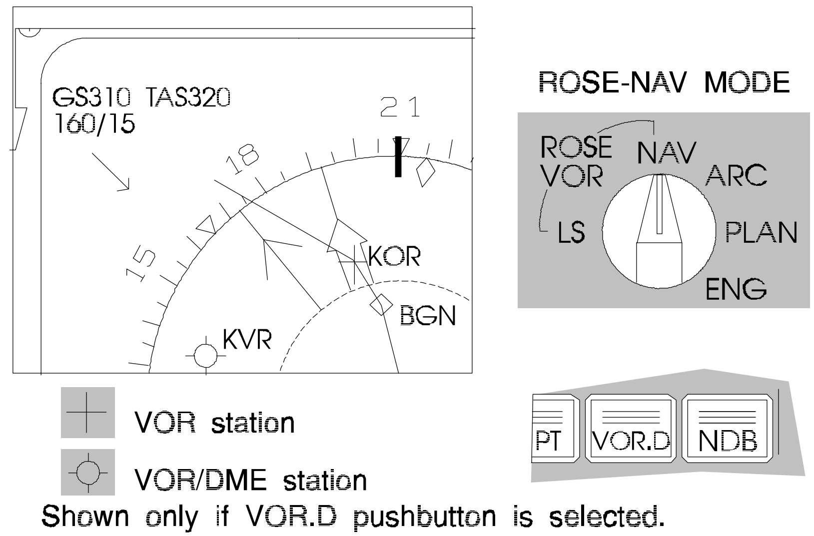


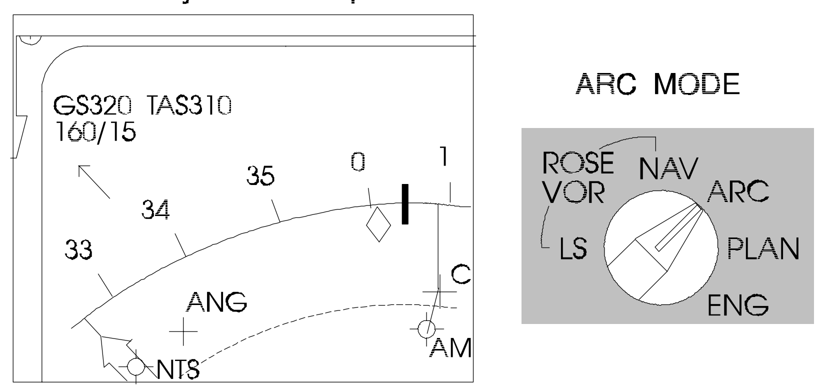


Additionally, in ROSE-VOR mode, other information is displayed on the ND.

VOR-D PUSHBUTTON

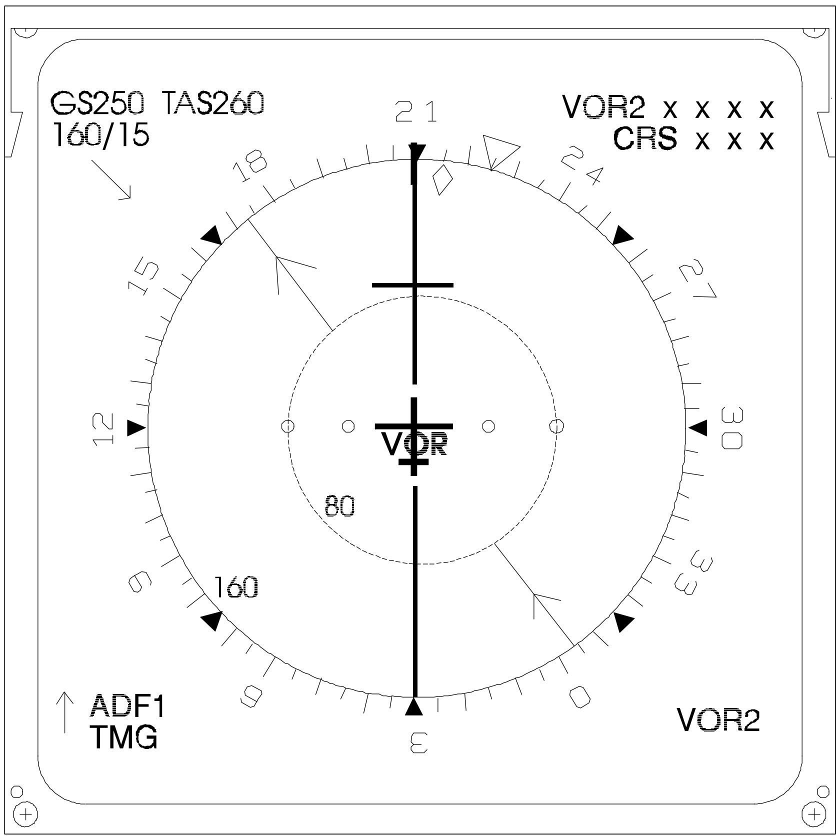
CONDITIONS OF DISPLAY



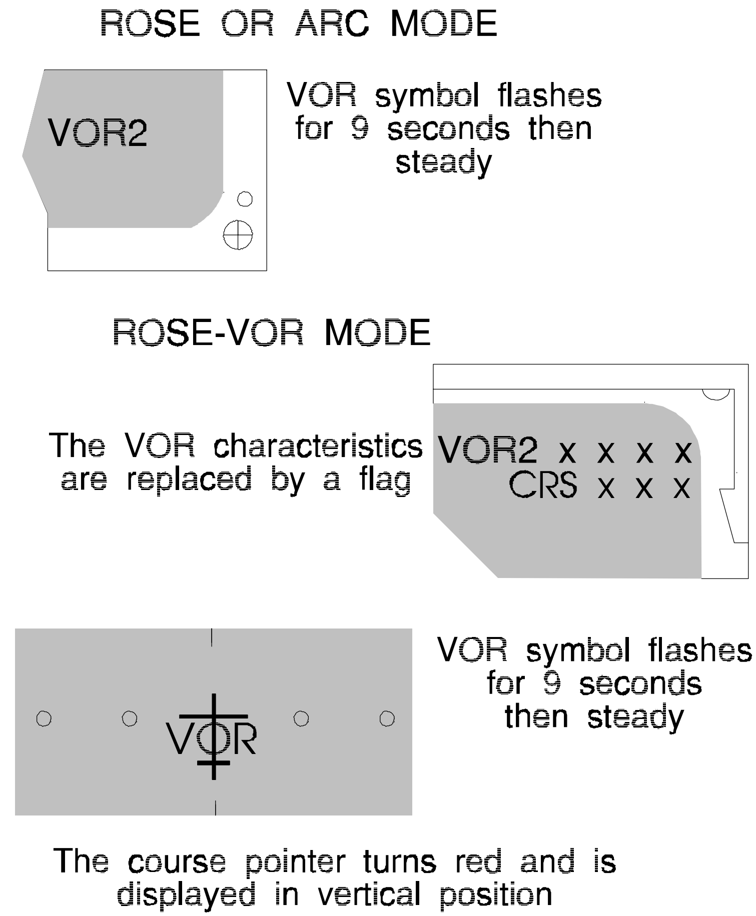


In ROSE-NAV and ARC positions, it is possible to show the VOR ground stations which are not already included in the flight plan.

FAILURES



CONDITIONS OF DISPLAY



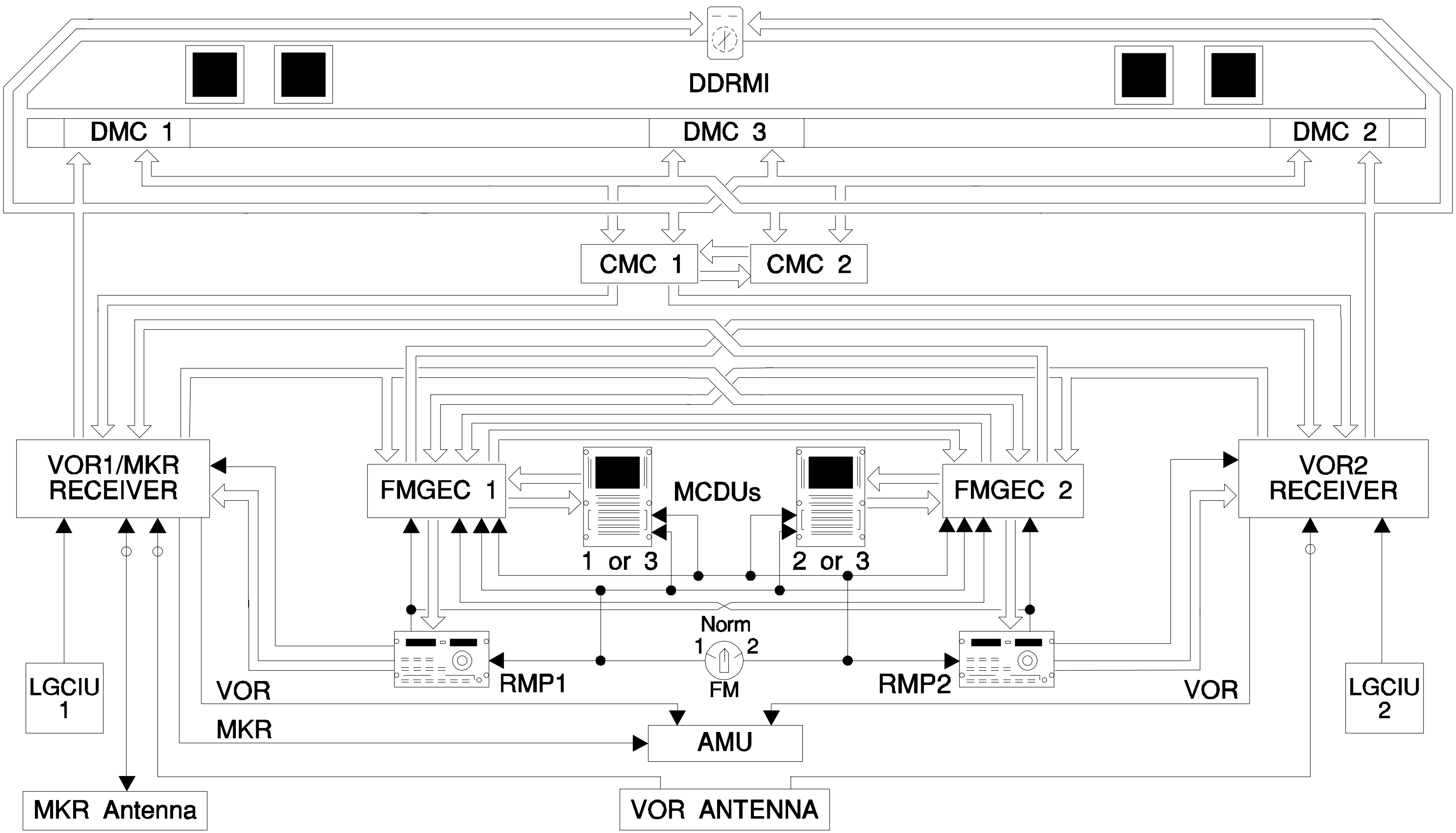
Depending on the mode selected on the EFIS control panel, red flags are displayed.

STUDENT NOTES:

VOR/MKR COMPONENTS

VOR/MKR 1/2 Receiver
MKR Antenna
VOR Antenna

STUDENT NOTES



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VOR /MKR 1/2 RECEIVER

FIN : 1RS1, 1RS2

ZONE : 121, 122

COMPONENT DESCRIPTION

The face of the receiver is fitted with a handle, two lugs, a test P/B and three LEDs.
The back is equipped with one ARINC 600 size one connector which includes three plugs :

- Top Plug (TP) :

  Connection with the automatic test circuit,

- Middle Plug (MP) :

  Connection with the peripheral circuits,

- Bottom Plug (BP) :

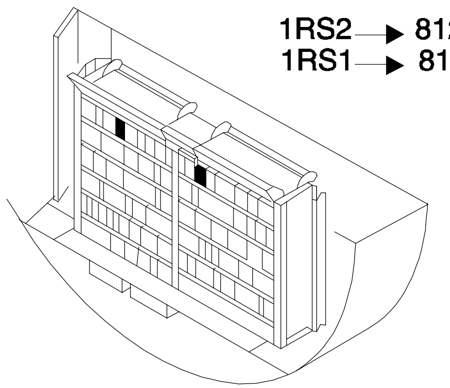
  Connection with the power supply circuit (115vac-400Hz), and the antennae.

IN SITU TEST

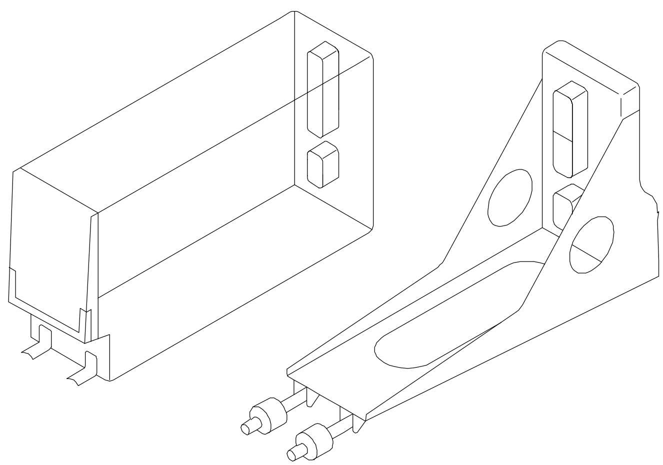
The VOR/MKR test function can be activated in ground condition only by pressing the TEST P/B on the face of the receiver.

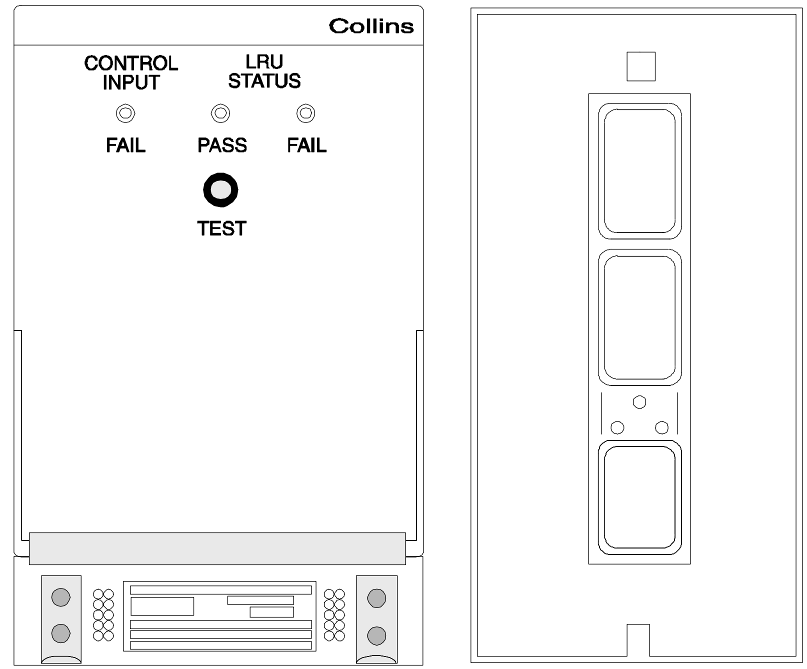
COMPONENT LOCATION

1RS2 ▶ 812VU
1RS1 ▶ 811VU



REMOVAL INSTALLATION



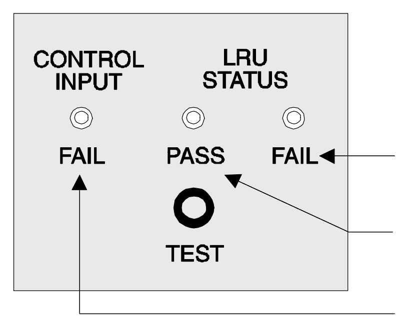


FACE

BACK

VOR/MKR RECEIVER

IN SITU TEST



(RED) MALFUNCNTION OF RECEIVER

(GREEN) NO FAULT ON RECEIVER

(RED) AN INPUT DATA IS FAULTY

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MKR ANTENNA

FIN : 3RS

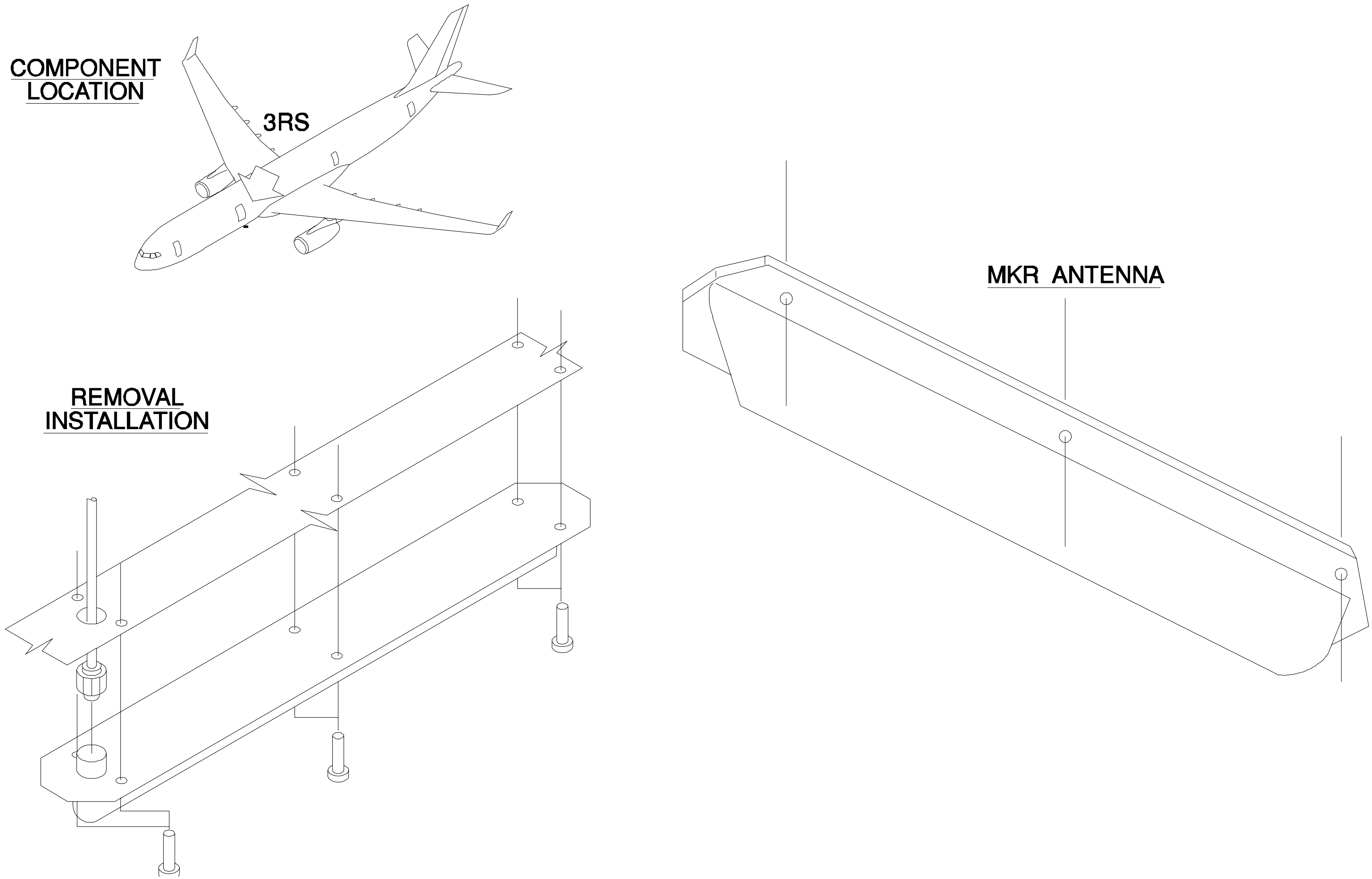
ZONE : 130

COMPONENT DESCRIPTION

This low-drag and light weight antenna, located in the longitudinal axis of the aircraft below the fuselage, is provided for the reception of 75 MHz marker signals.

The dielectric, foam-filled, white polyester fiberglass housing, fitted with a metal leading edge, protects against moisture and erosion.

The antenna is horizontally polarized and has an impedance of 50 Ohms.



FQW4200 GE Metric

VOR ANTENNA

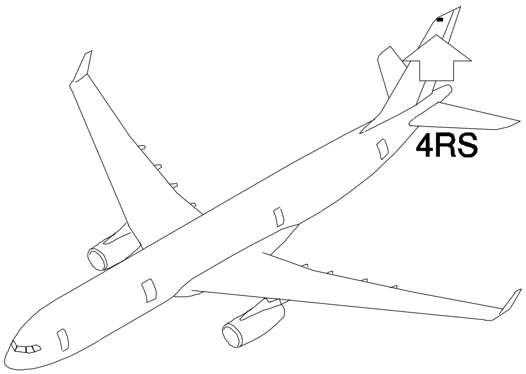
FIN : 4RS

ZONE : 324

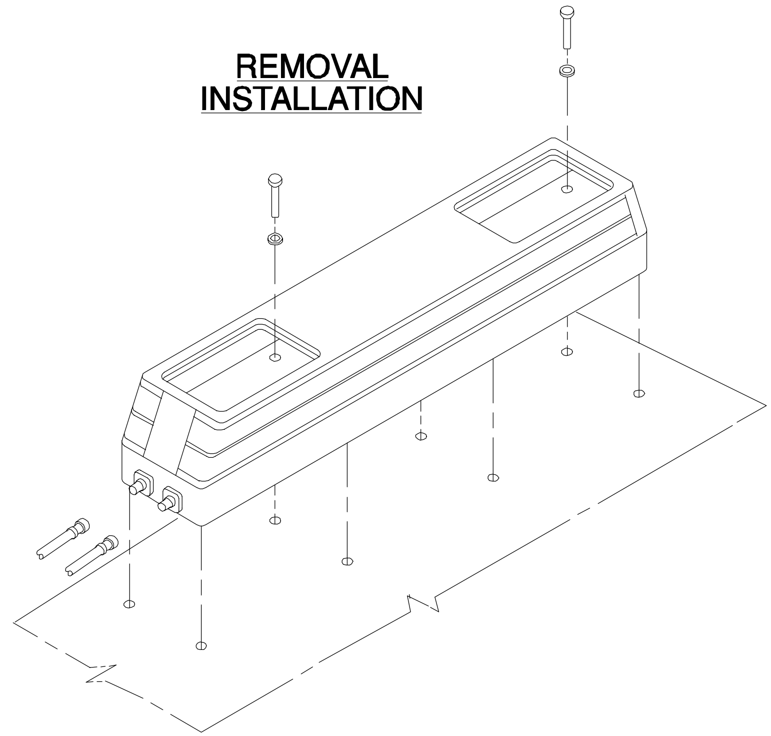
COMPONENT DESCRIPTION

The VOR antenna is an airborne antenna sunk into the vertical stabilizer and used to receive VOR signals in the 108-118 MHz range.
It is a small-sized half-wave folded dipole type.
This antenna has two independent RF connectors used to feed two items of equipment.
This antenna is horizontally polarized and has an impedance of 50 Ohms.

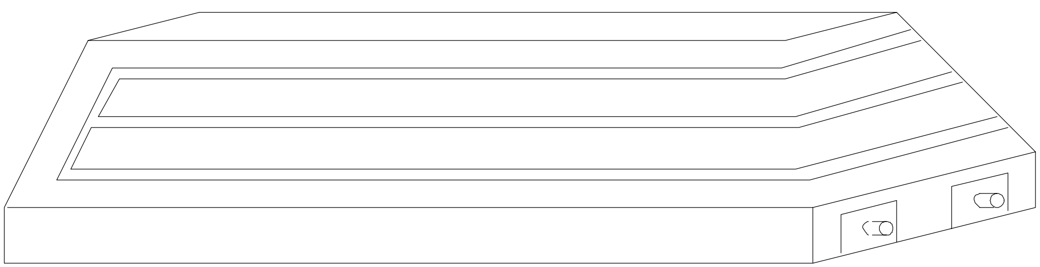
COMPONENT LOCATION



REMOVAL INSTALLATION



VOR ANTENNA



FQW4200 GE Metric

STUDENT NOTES

WEATHER RADAR SYSTEM PRESENTATION

Principle
Components
Indicating

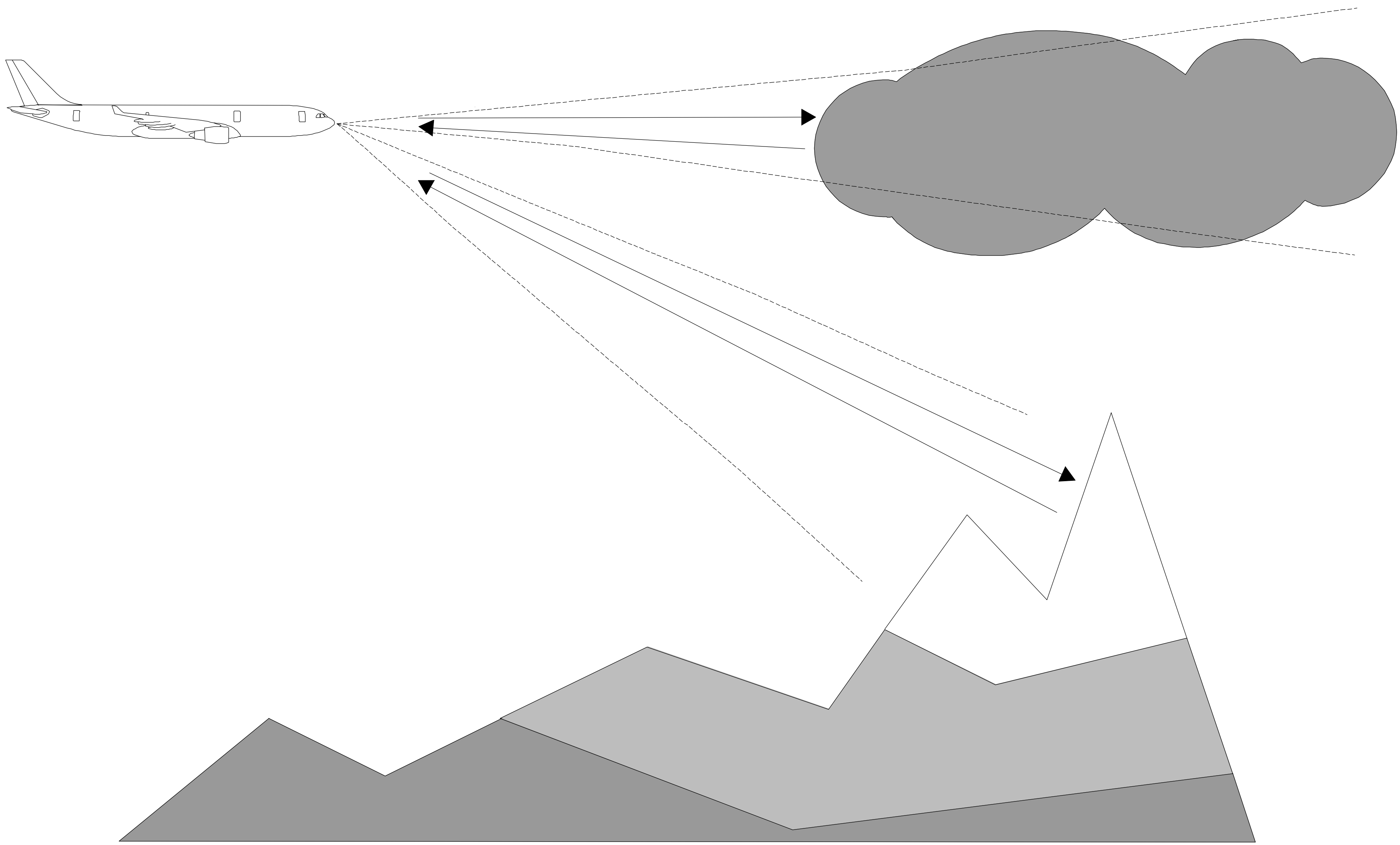
PRINCIPLE

The Airborne Weather Radar System (WXR) allows the detection and display of severe weather areas.

The WXR helps the pilot to avoid these areas and the associated turbulences by determining their range and bearing.
It also provides a ground mapping.

The radar emits microwave pulses through a directive antenna which picks up the return signals.

The range is determined by the time taken for the echo to return.
The azimuth is given by the antenna position when the echo is received.



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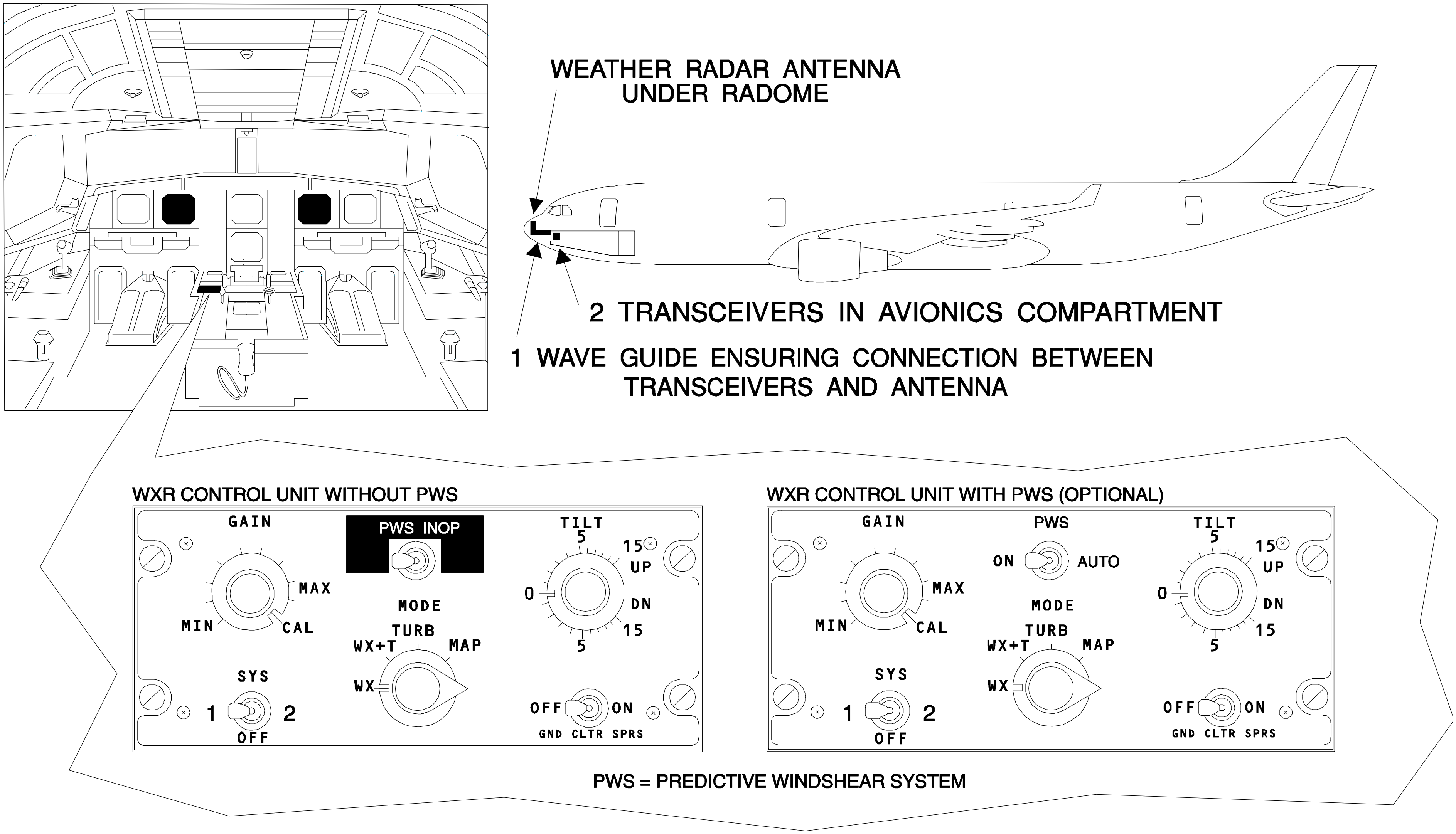
COMPONENTS

The main components are one antenna, one wave guide, two transceivers and one control unit.

The WXR system is also connected to the Navigation Display (ND) for display.



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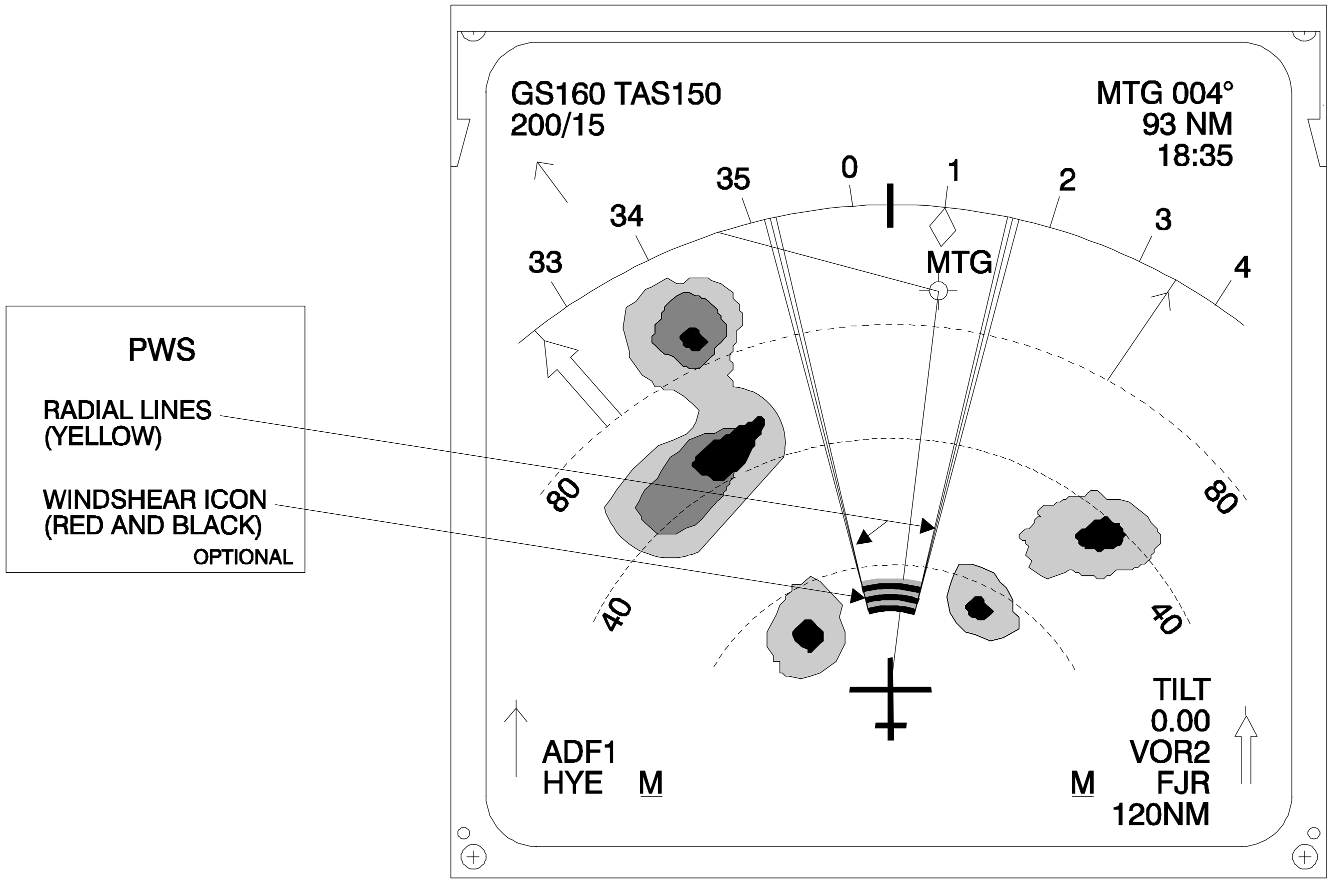
INDICATING

The Weather Radar image is shown on the Captain and First Officer Navigation Displays.



FQW4200 GE Metric

STUDENT NOTES

WEATHER RADAR CONTROL UNIT PRESENTATION

1/OFF/2 Selector
Gain Knob
Tilt Knob
Mode Selector
GND CLTR SPRS Switch
PWS/OFF/AUTO Switch (Optional)

1/OFF/2 SELECTOR

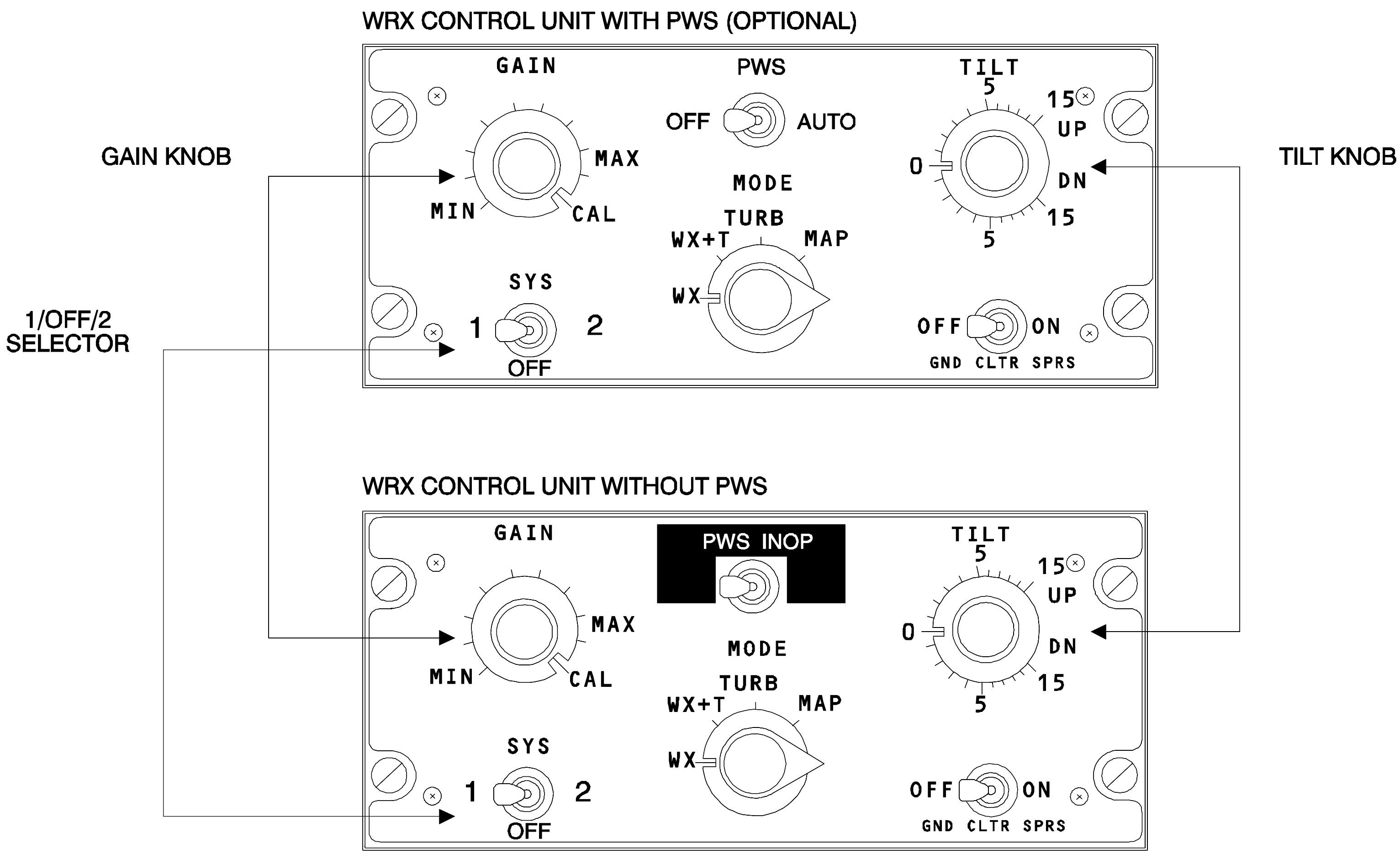
The 1/OFF/2 selector allows selection of transceiver1, no transceiver or transceiver 2.

GAIN KNOB

The gain knob provides receiver sensitivity adjustment.
In CAL position, it automatically adjusts to the optimum setting.

TILT KNOB

The TILT knob allows manual control of the antenna elevation.



PWS = PREDICTIVE WINDSHEAR SYSTEM

FQW4200 GE Metric

MODE SELECTOR

WX SELECTION

Weather is the normal position of the mode selector.
The colors displayed depend on the rain intensity.

WX + T SELECTION

In the Weather/Turbulence position, the turbulence areas are shown in magenta. Turbulence areas are shown up to 50 NM from the A/C.

TURB SELECTION

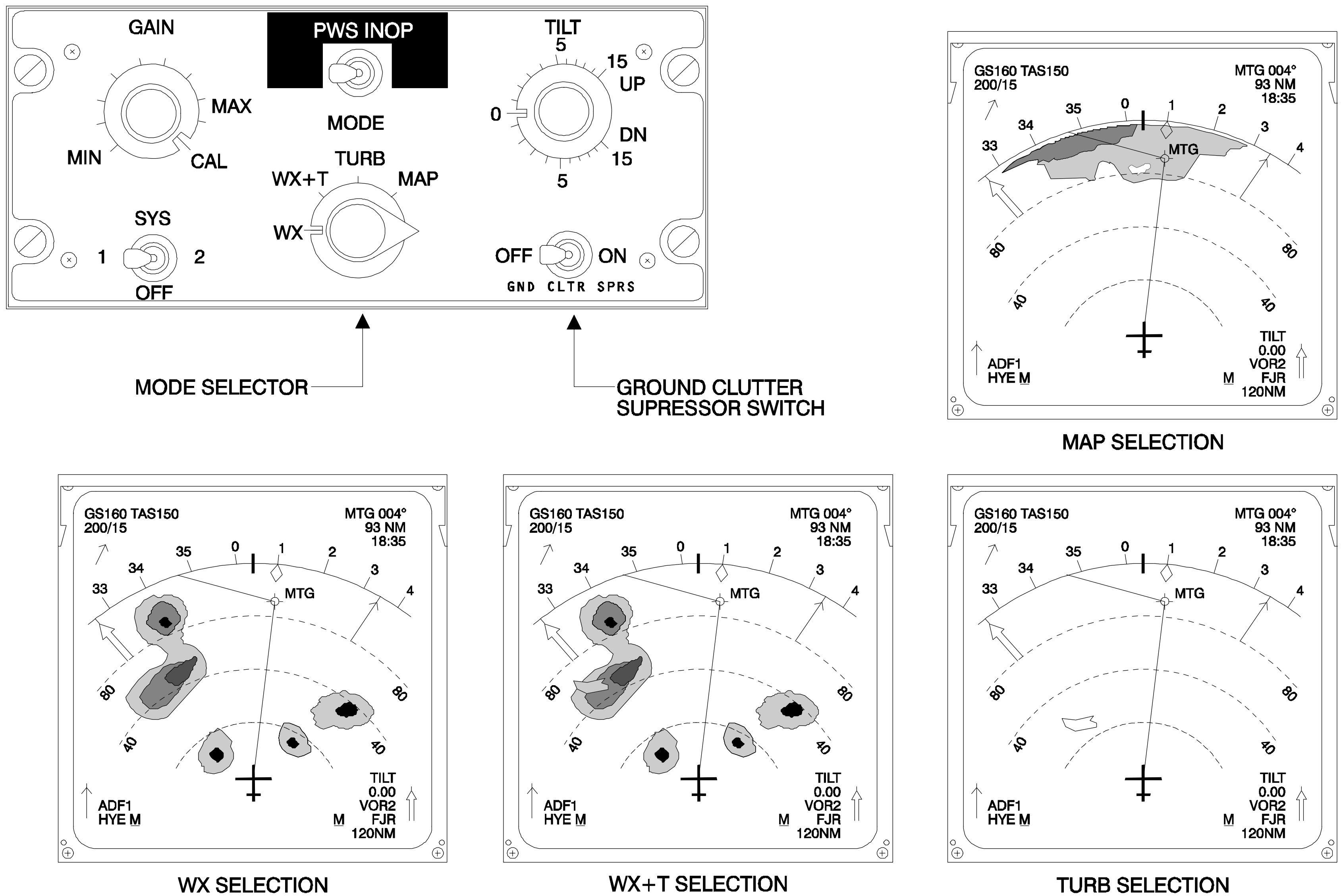
This mode corresponds to the operation in turbulence detection only and the turbulence areas are displayed in magenta.

MAP SELECTION

The MAP position provides the display of mountains, cities, coast lines and is useful for backup navigation.
Manual gain adjustment is recommended in the MAP mode.

GND CLTR SPRS SWITCH

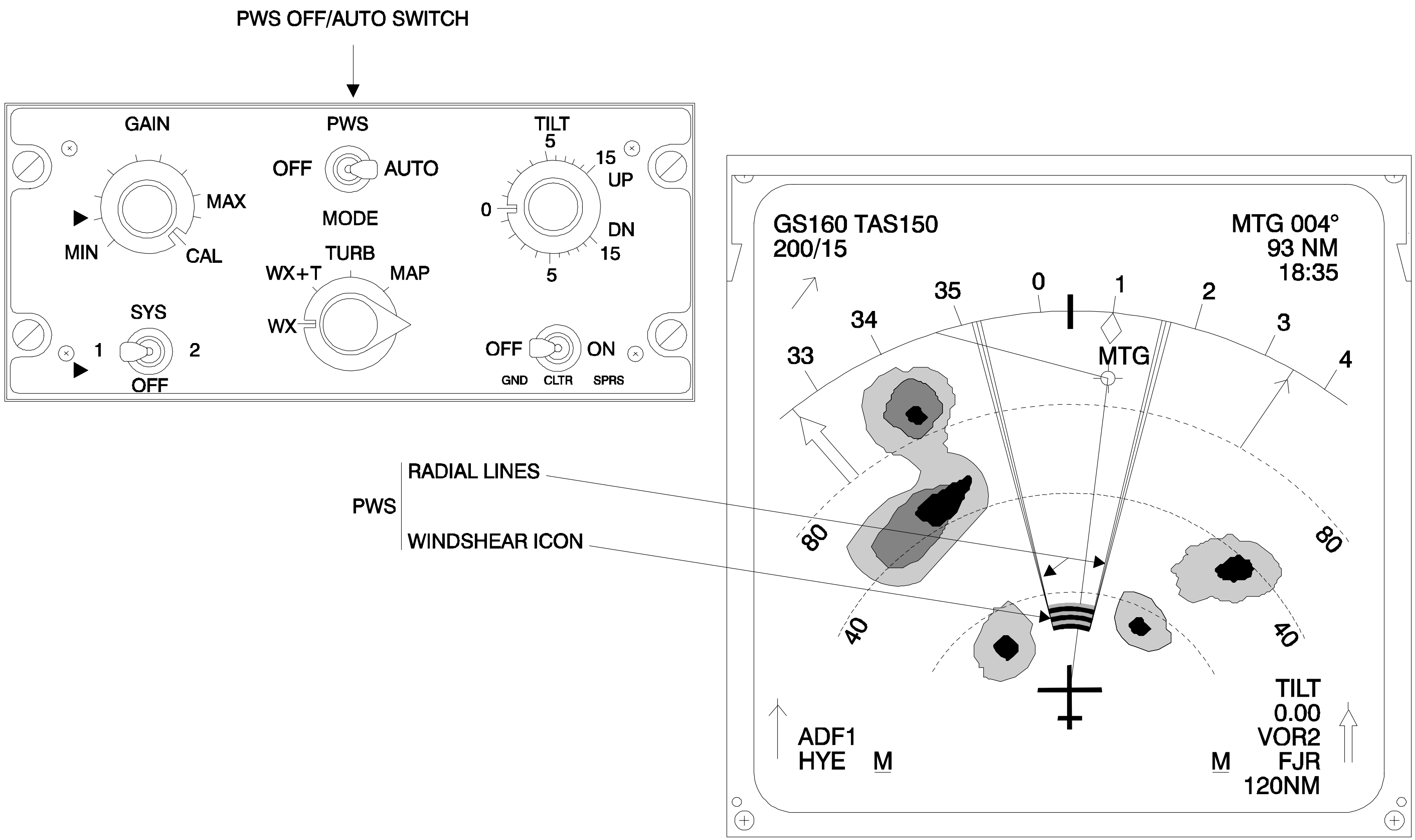
The activation of the Ground Clutter Suppressor (GND CLTR SPRS) switch, in the WX mode, reduces the intensity of the ground clutter. The Ground Clutter Suppressor function is only available in WX, WX+T modes and in TURB mode beyond 50 NM.



FQW4200 GE Metric

PWS/OFF/AUTO Switch (Optional)

In AUTO selection, the Windshear mode is transparent to the crew until a windshear event is detected. In this case, the Predictive Windshear System (PWS) generates the appropriate visual and aural annunciation.
In the Windshear mode, the TILT and GAIN are controlled automatically for the scanning; but the TILT displayed on the NDs is in accordance with the control unit tilt selection.



FQW4200 GE Metric

STUDENT NOTES:

WEATHER RADAR D/O

Control Unit
Transceiver
ADIRUs
Antenna
LGCIU
Indicating
CMC
PWS (OPTION)

CONTROL UNIT

The Control Unit provides mode of operation, antenna tilt and gain of the receiver digitalized information, via an ARINC 429 bus.

The transceiver start up system is ensured by a discrete signal.
No pre-heating time is necessary before the start up operation.

TRANSCEIVER

The Weather Radar uses the principle of radio echoing to detect the level of precipitation, and the principle of Doppler effect to detect the turbulence areas.

The transceiver operates in the X-band frequency (9345 Mhz).
It digitalizes the video signal for display on the Navigation Displays (ND).

ADIRUs

The three Air Data and Inertial Reference Units (ADIRUs) give the pitch and roll angles, to ensure antenna stabilization, and the ground speed for Doppler mode correction.

The ADIRU which provides data is selected by means of the Air Data Inertial Reference System (ADIRS) switching panel.

ANTENNA

The Weather Radar antenna is energized and controlled in azimuth and elevation by the transceiver in use.

The radio frequency signals are exchanged between the transceivers and the antenna, via a wave guide.
The antenna scans a 180° sector in azimuth and has a tilt coverage of + or - 15°.

An internal circuit of the transceiver ensures antenna stabilization.

The stabilization data is : pitch and roll angles, selected tilt, antenna azimuth and elevation angle.

LGCIU

The Landing Gear Control Interface Unit (LGCIU) sends a discrete signal to the transceiver.
This Ground/Flight information is used by the receiver BITE module to count the flight legs.

INDICATING

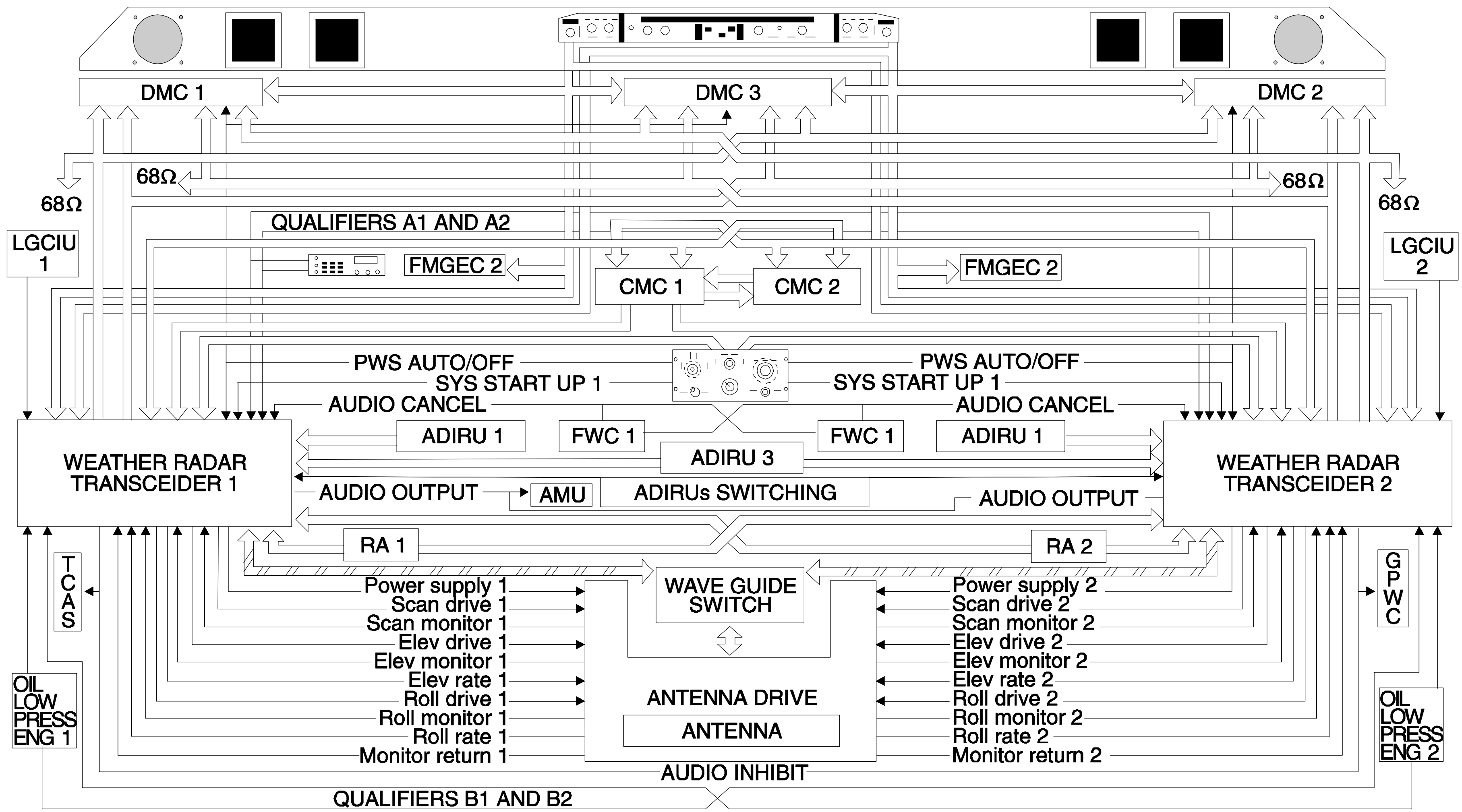
The Weather Radar image provided by the selected transceiver, is shown on Captain and First Officer Navigation Displays (ND).
The video signal is sent to the NDs via the Display Management Computers (DMC), by means of two ARINC 453 buses.
Each data cable is terminated at one end with a low inductance resistor (68 ohms) to avoid a signal return.
The various system controls are grouped on the weather radar control unit and on the Electronic Flight Instrument System (EFIS) control panels of the Flight Control Unit (FCU).

On either EFIS control panel of the FCU, the mode selector switch must be set to the ARC or ROSE position to obtain the image display on the corresponding ND.

CMC

The Multipurpose Control and Display Units (MCDUs) allow the systems to be tested via the Central Maintenance Computers (CMC).
The tests are only available on ground.

Only one transceiver provides information to the NDs at a time, but both transceivers are always supplied in order to achieve the maintenance function (continuous test).



FQW4200 GE Metric

PWS (OPTION)

A discrete input, provided by the weather radar control unit through the AUTO/OFF switch, enables the windshear function.

This discrete signal is also transmitted to the three DMCs which use it for the windshear message display logic.

Two types of qualifier inputs are required to prevent automatic activation of the windshear function:

- qualifiers A1 and A2, coming from the ATC TCAS control unit,
- and qualifiers B1 and B2, provided by the engine oil pressure sensors of engines 1 and 2.

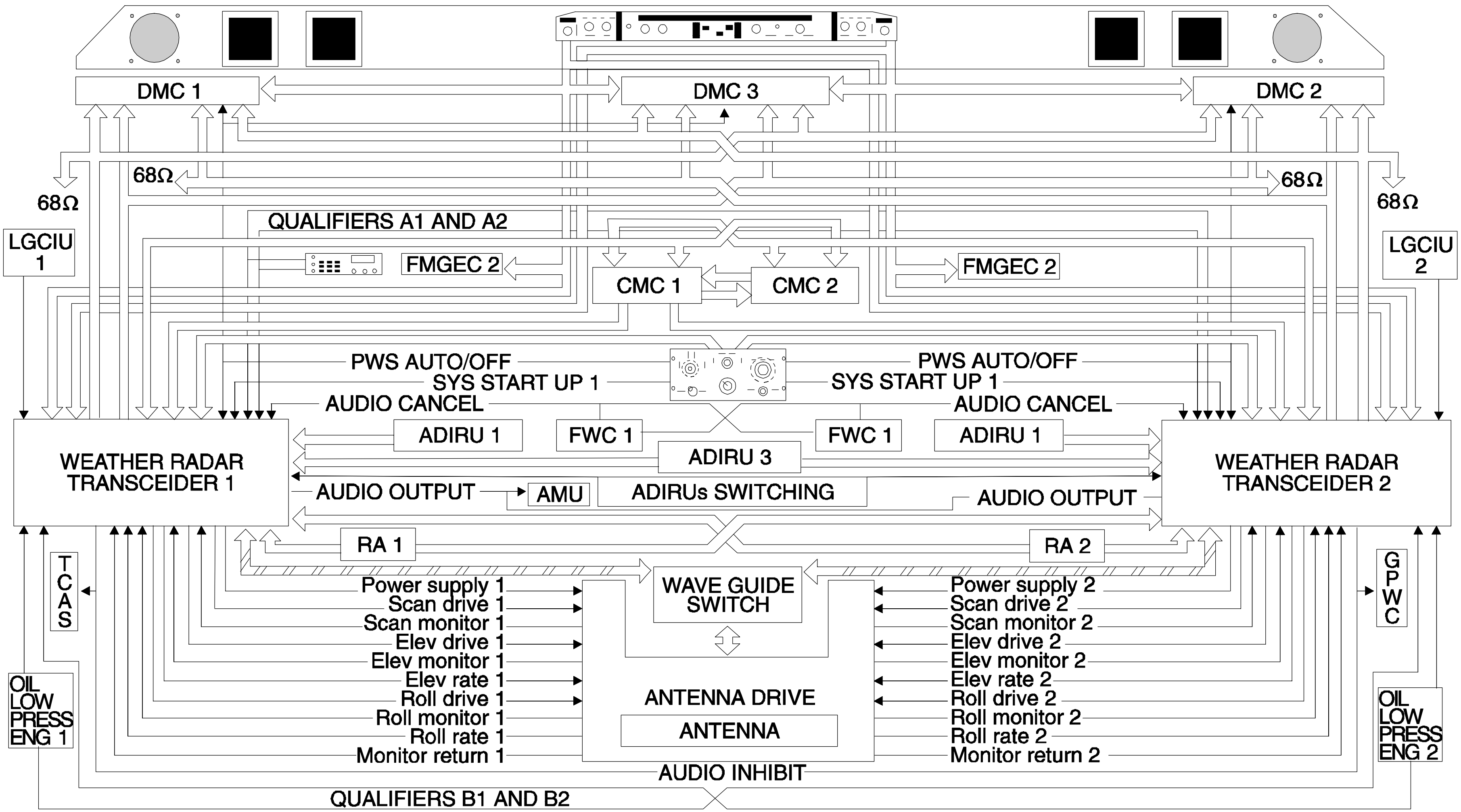
In order to automatically activate the windshear function, one qualifier A and one qualifier B have to be valid.

The radio altimeter provides the transceiver with altitude data which is used for the automatic activation of the windshear function.

An analog audio output transmits a synthetic voice alert message to the Audio Management Unit.

Audio inhibit discrete signals are used to indicate whether the aural alert output has to be active or not.

The audio input discretes are used to inhibit the predictive windshear alerts. The PWS audio inhibit discrete ouputs are used to inhibit other aural alerts generated by systems such as: TCAS or GPWS or other FWC warnings.



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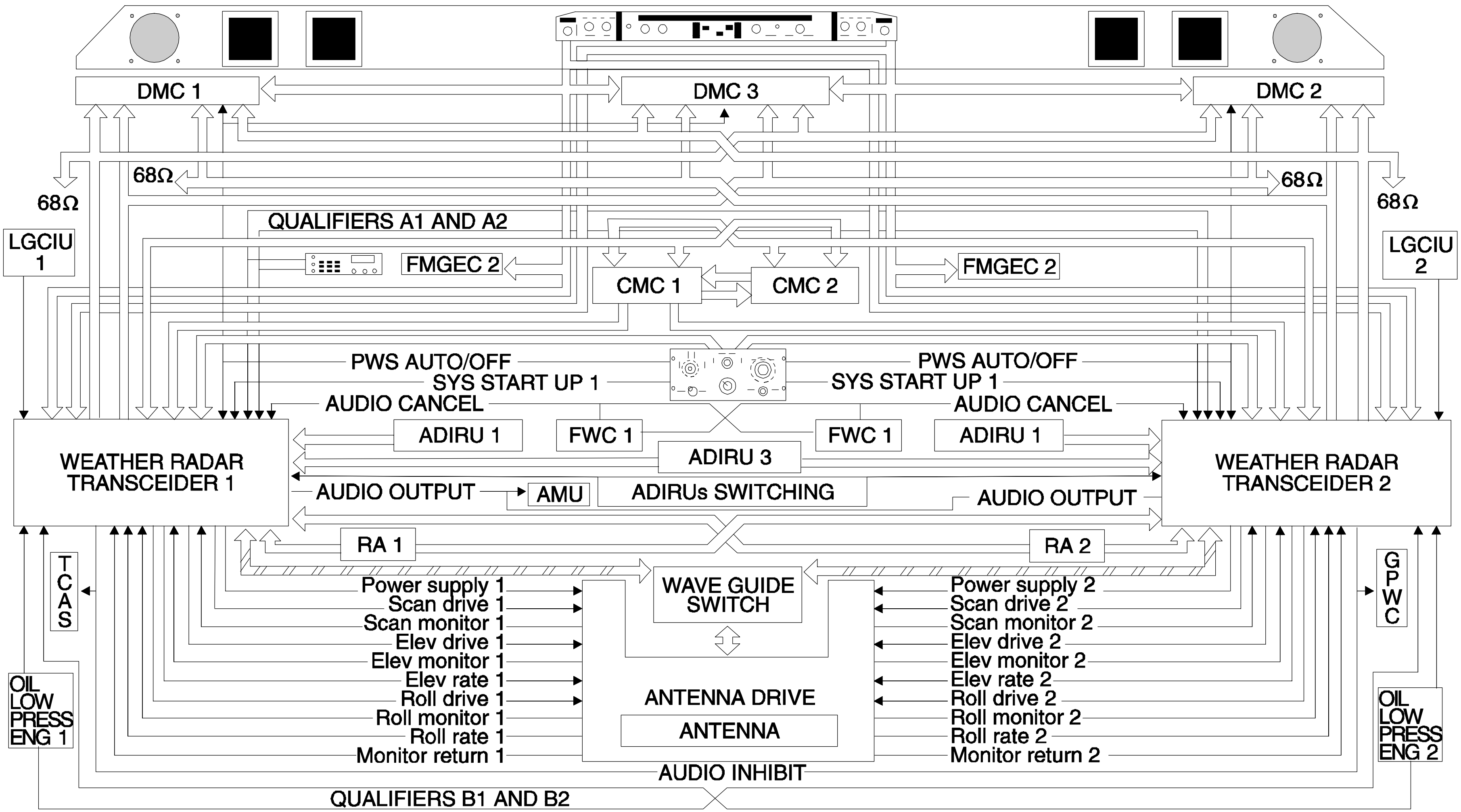
STUDENT NOTES:

WEATHER RADAR COMPONENTS

Weather Radar 1/2 Transceiver
Weather Radar Transceiver Control Unit
Weather Radar Transceiver Antenna

STUDENT NOTES



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WEATHER RADAR 1/2 TRANSCEIVER

FIN :

Transceiver: 1SQ1, 1SQ2

Dual mouting tray : 5SQ

ZONE : 121

COMPONENT DESCRIPTION

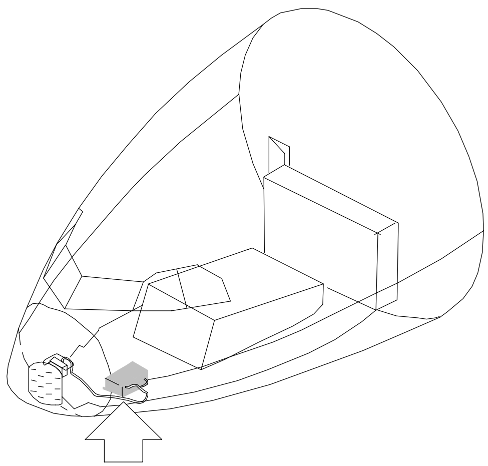
The face of the transceiver is fitted with one handle, two lugs, one RS 232 test connector and one BMC connector. The back is equipped with one ARINC 600 size two wave guide connector and two air connectors.

The transceivers are fixed on the mounting tray. The wave guide switch is integral with the mounting tray. It ensures switching of the RF signal from the antenna to each transceiver by means of a wave guide.

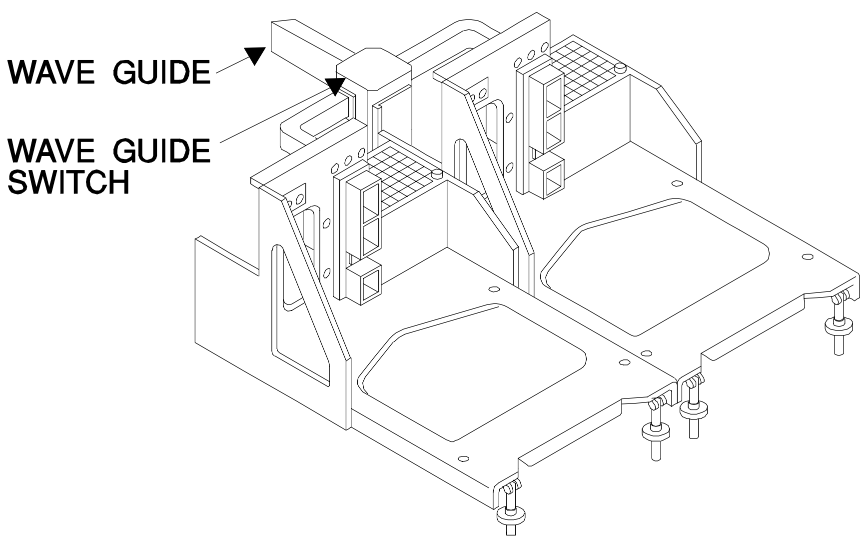
IN SITU TEST

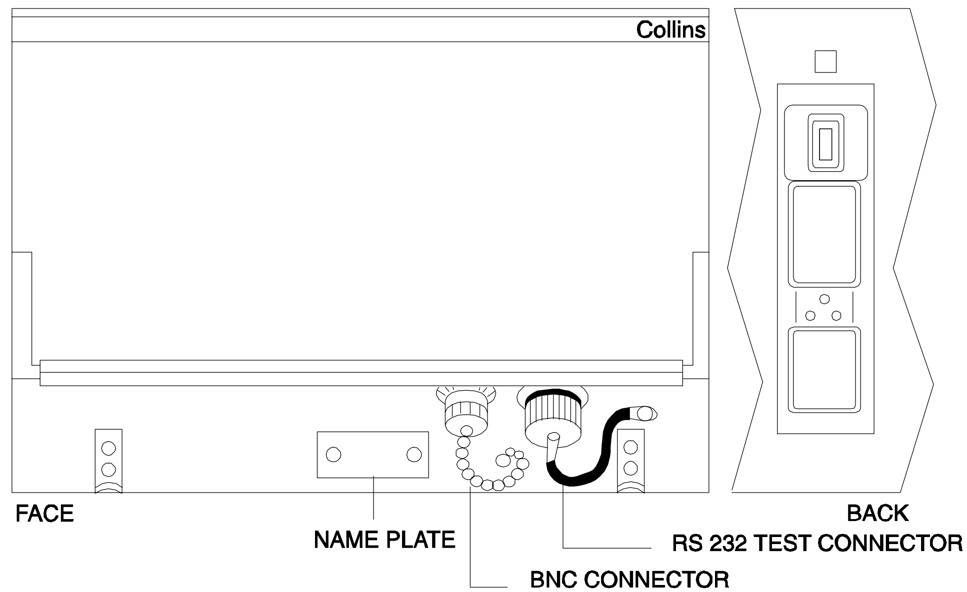
No test available.

COMPONENT LOCATION



REMOVAL INSTALLATION





WXR TRANCEIVER

WEATHER RADAR TRANSCEIVER CONTROL UNIT

FIN : 3SQ

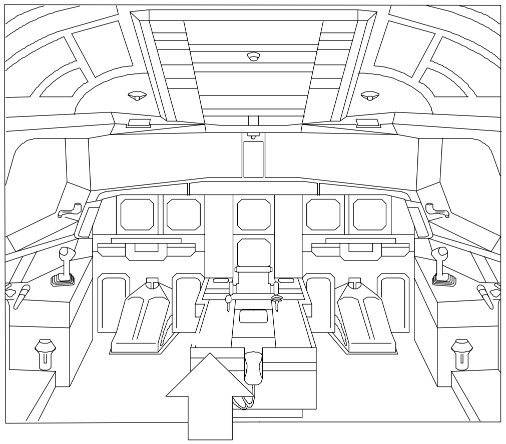
ZONE : 210

COMPONENT DESCRIPTION

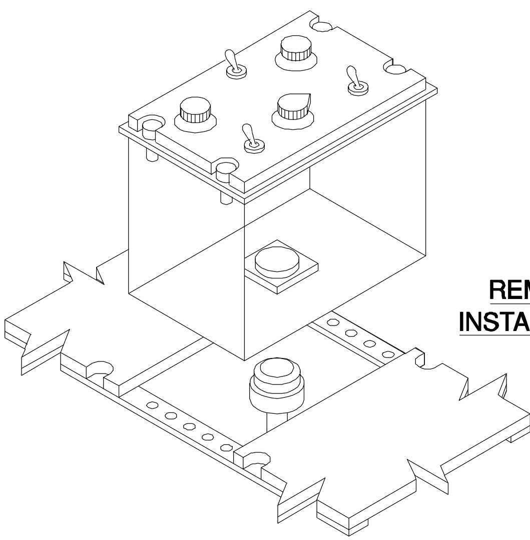
Part of weather radar control is grouped on the control unit:

1- Mode selector,
2- Tilt selector,
3- Gain selector,
4- 1/OFF/2 switch (transceiver 1 or 2 selector),
5- PWS/OFF/AUTO switch (If Predictive Function is activated) (OPTIONAL),
6- GND CLTR SPRS switch (Ground Clotter Suppressor).

These data (1,2,3) are digitized and monitored by a Central Processing Unit to generate a control word which is sent to the transceiver through a control bus line.

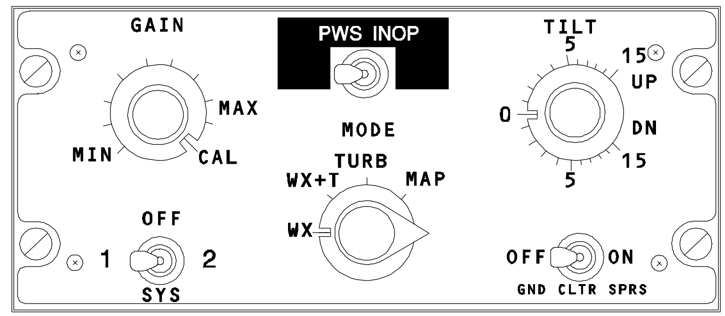


COMPONENT LOCATION

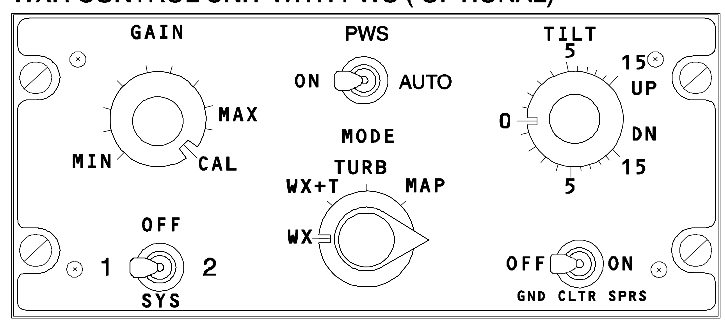


REMOVAL INSTALLATION

WXR CONTROL UNIT WITHOUT PWS



WXR CONTROL UNIT WITH PWS (OPTIONAL)



PWS = PREDICTIVE WINDSHEAR SYSTEM

FQW4200 GE Metric

WEATHER RADAR TRANSCEIVER ANTENNA

FIN :

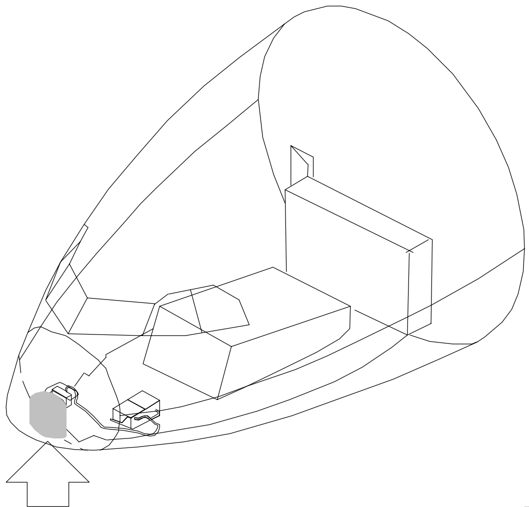
Antenna : 11SQ

Antenna drive : 7SQ

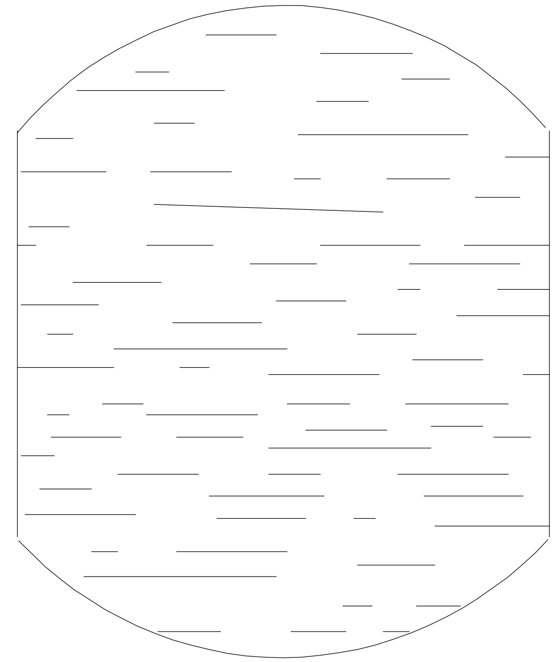
ZONE : 110

COMPONENT DESCRIPTION

The antenna is controlled in azimuth and elevation by the transceiver. The antenna movements are ensured by two DC (direct curent) motors and the angular positions are recopied by synchros.
Energization of the antenna is powered with 400hz 115VAC through the selected transceiver.

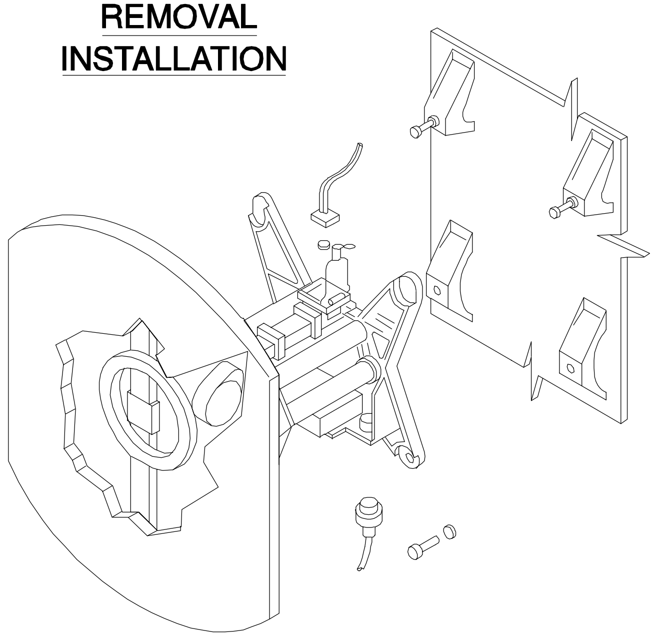


COMPONENT LOCATION



WXR ANTENNA

REMOVAL INSTALLATION



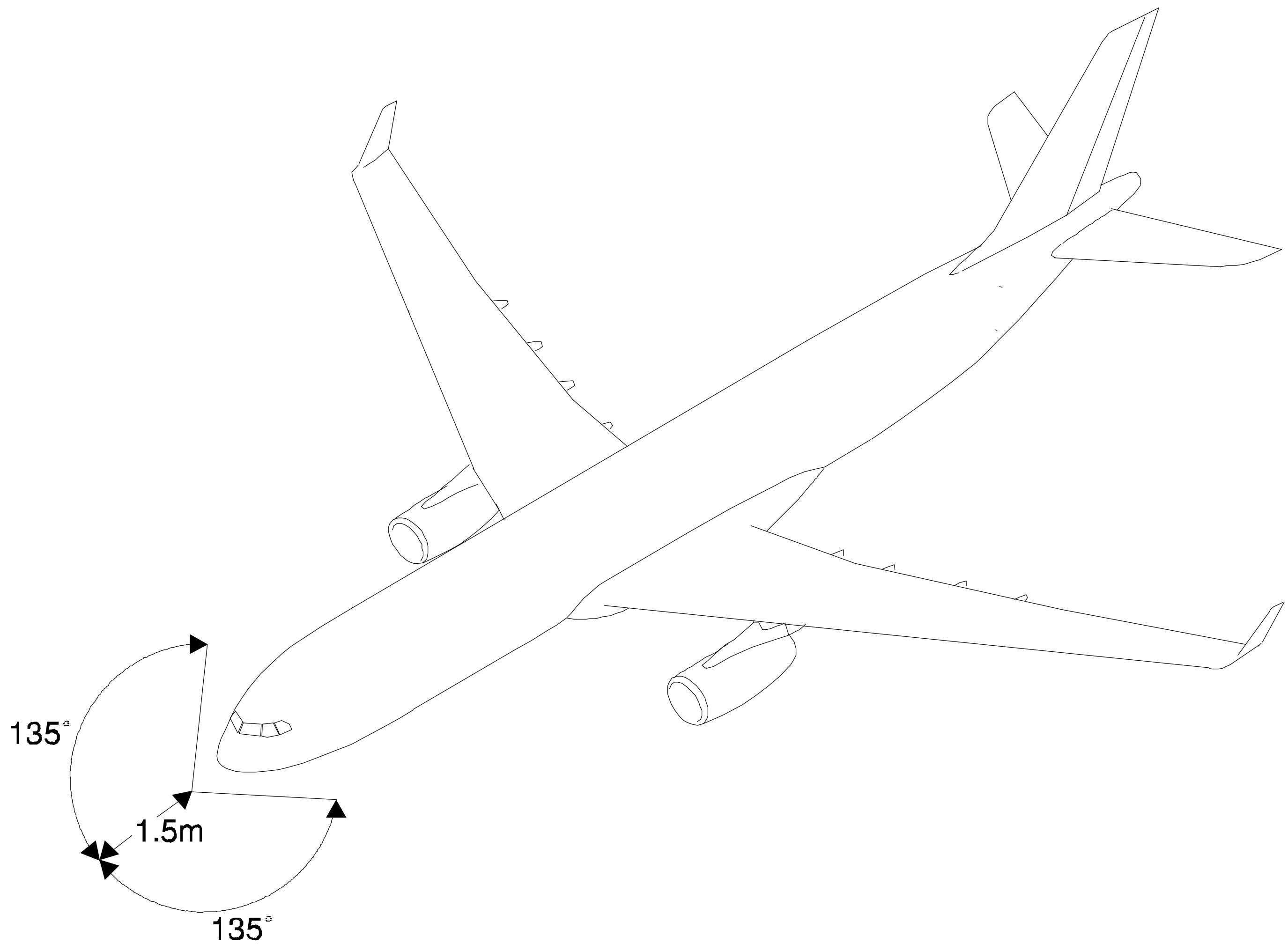
FQW4200 GE Metric

STUDENT NOTES

WEATHER RADAR OPERATIONAL PRECAUTIONS

FORBIDDEN AREA

Nobody within a distance of 1.5 meters from the antenna in an arc of +or - 135 degrees.



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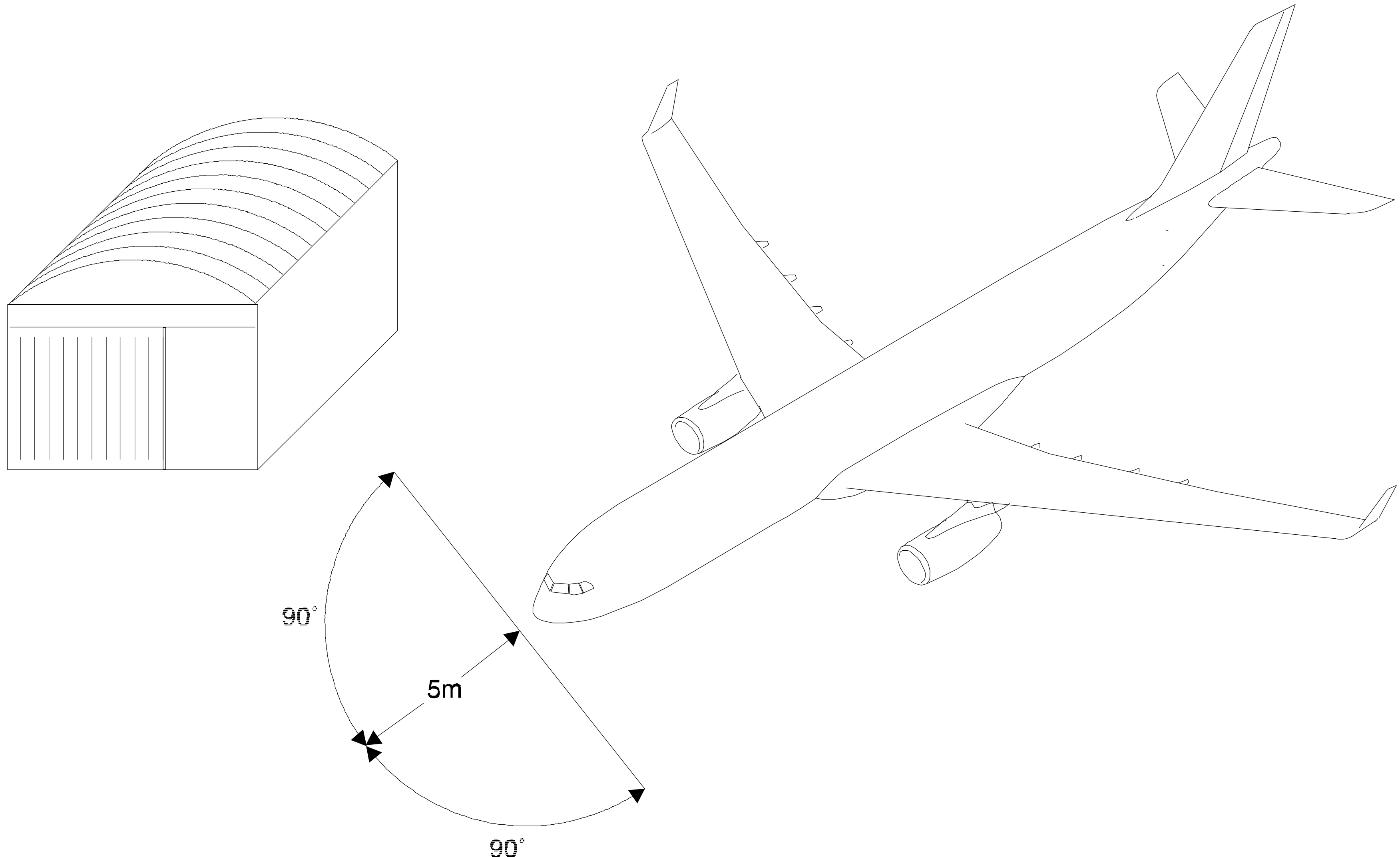
METALLIC OBSTACLES

The dangerous zone forward of the aircraft must be free of metallic obstacles such as hangars or aircraft within 5 meters in an arc of + or - 90 degrees.



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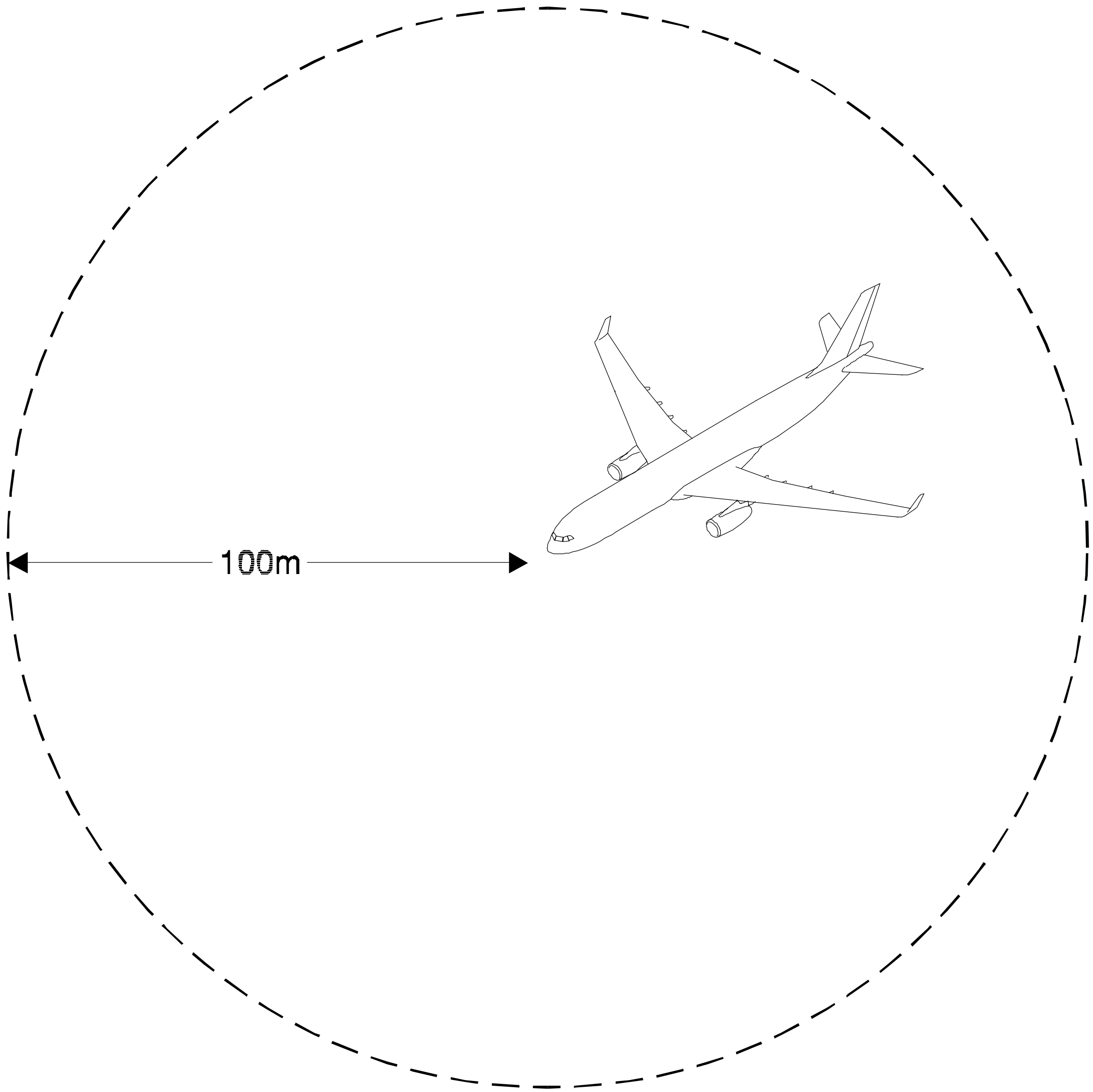
REFUELLING

The system must not be operated during the refuelling of the aircraft or during any refuelling operation within 100 meters.



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STUDENT NOTES

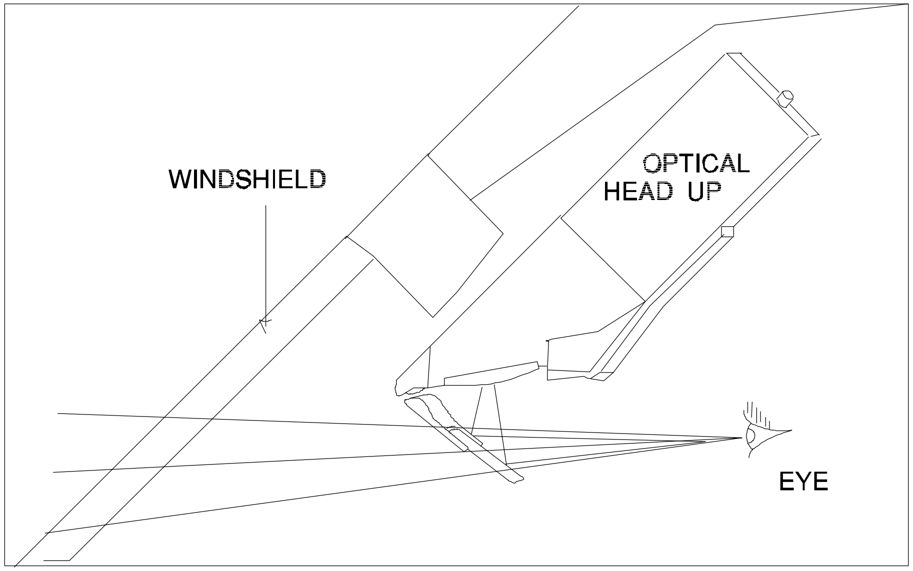
HUD SYSTEM PRESENTATION

Principle
Components
Indicating

PRINCIPLE

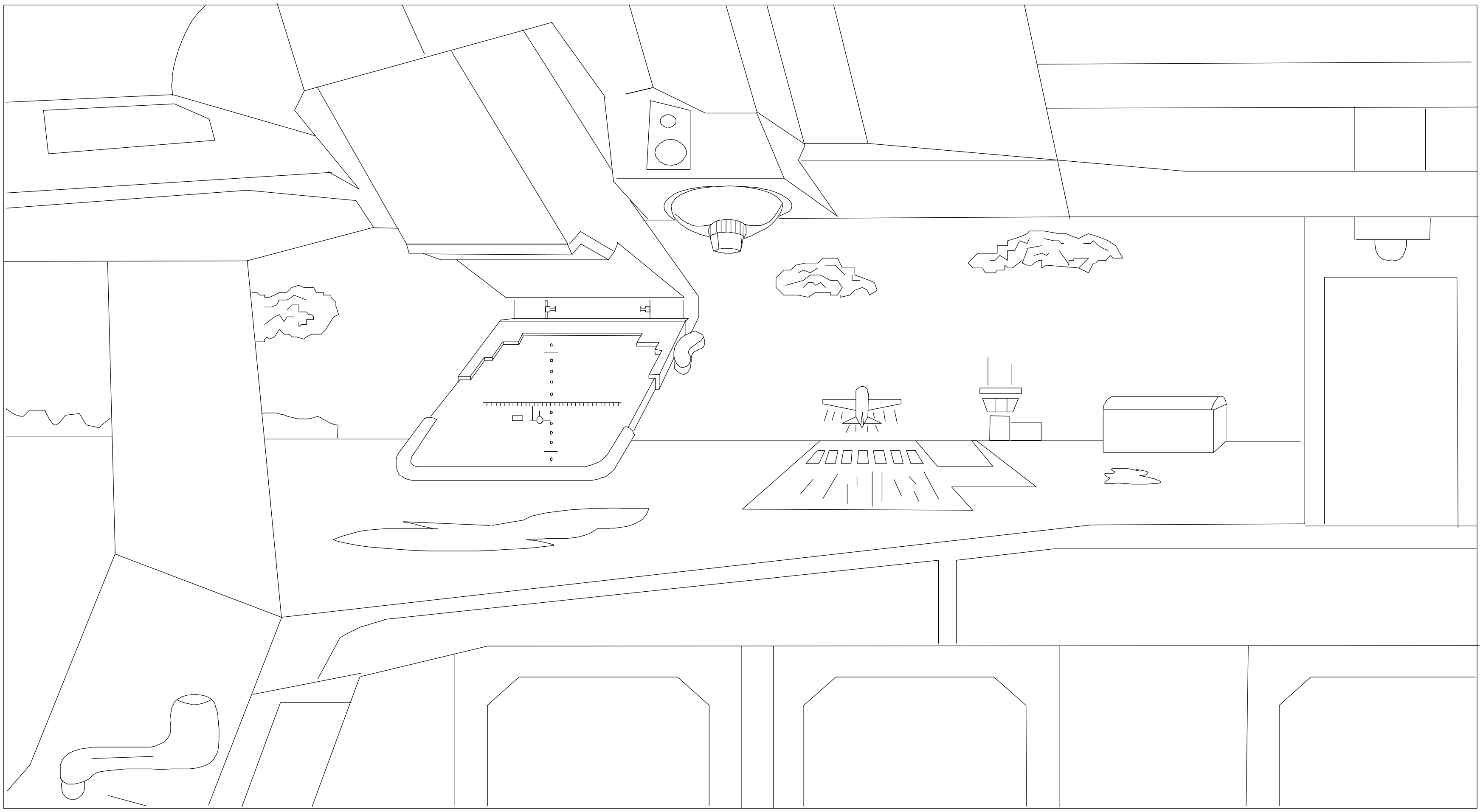
The HUD is a flying aid system which provides the pilot with an image superimposed on the outside world in his field of view.This aid is based on the principle of symbol projection on an external combiner, mainly composed of a flat sheet of glass.
A precise mechanism allows accurate positioning of this combiner.

When the Optical Head Up is located in the down operational position, it is automatically supplied. When it is in the retracted position, power is no longer supplied.



The objectives of HUD are :

- to supply guidance information on the ground, at take-off and landing in conditions of reduced visibility;
- to give information to the pilot for visual approach on airfields not equipped with Instrument Landing System (ILS);
- to monitor the automatic approach operations.



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COMPONENTS

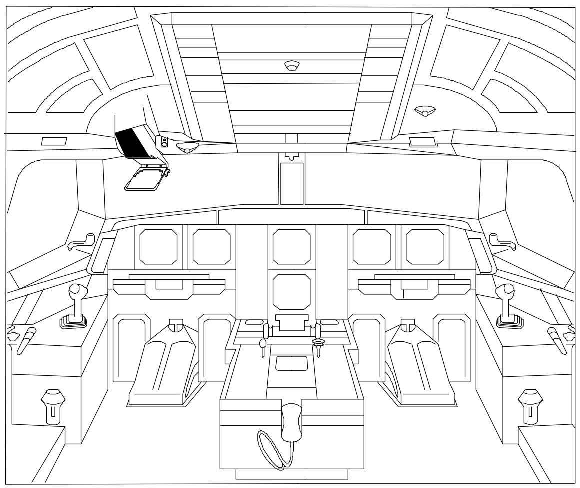
The HUD system is mainly composed of two separate units.

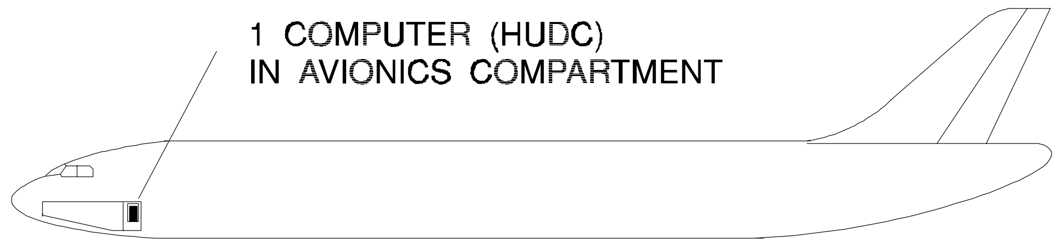
The HUD components are:

- the Head Up Display Computer (HUDC), which processes the input parameters received from the Display Management Computer (DMC) 1 or 3 and transforms them into deflection and bright-up signals;
- the Optical Head Up (OHU), above the pilot's head, on the cockpit ceiling, controlled by the HUDC and which supplies the pilot with a collimated synthetic image.

The OHU can take two positions (down or retracted) and the transfer operation between these positions can be performed by means of:

- a HUD ON/OFF switch, next to the OHU, for the motorized transfer;
- a declutching handle, below the ON/OFF switch, for the manual transfer.





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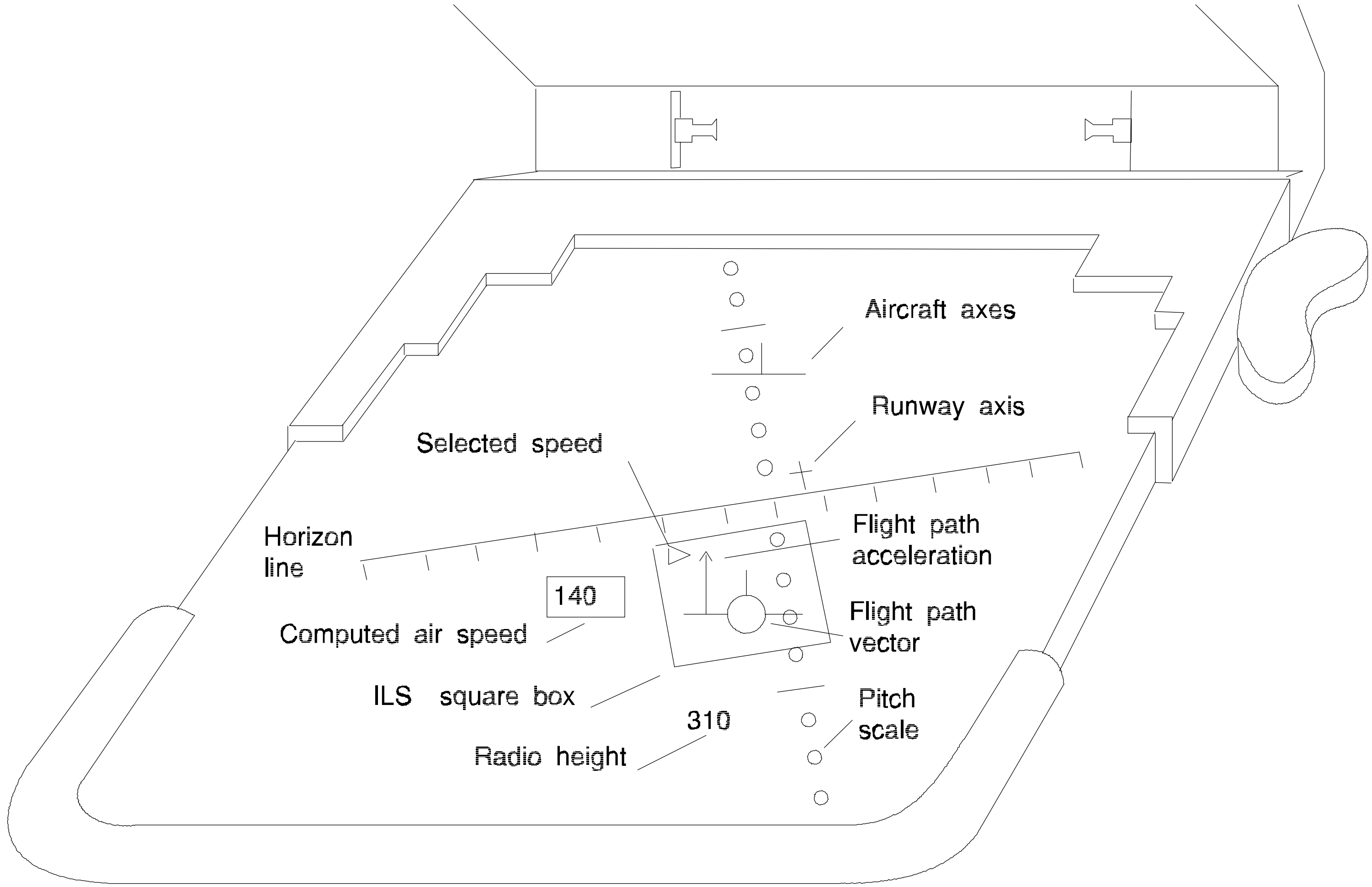
INDICATING

According to the flight configuration, different displays can be provided to the pilot and the symbology can be modified.



HUD DISPLAY DURING AN AUTOMATIC APPROACH

FQW4200 GE Metric

STUDENT NOTES:

HUD D/O

HUDC
OHU
ODU
DMC
CMC

Head Up display (HUD)

HUDC

The Head Up Display Computer (HUDC) processes the input parameters received from Data Management Computer (DMC) one or three.
The system architecture depends on captain DMC1/DMC3 switching possibility.

OHU

The Optical Head Up (OHU) is composed by the Optical Display Unit (ODU), which generates the image, and an electrical engine fixed on the Mounting Tray (MTR) which ensures the motorized interface to allow the different positionning of the Optical Display Unit (ODU).
The Optical Head Up (OHU) sends to the HUDC by means of two discrets:

- ON/OFF information (ON when the OHU is blocked in operational position);
- BITE information (when the OHU is faulty).

ODU

The HUDC sends to the ODU different analog signals to allow the image generation.
The analog signals are :

- deflection signals (x and y);
- bright-up signals (z);
- time reference signal (B0).

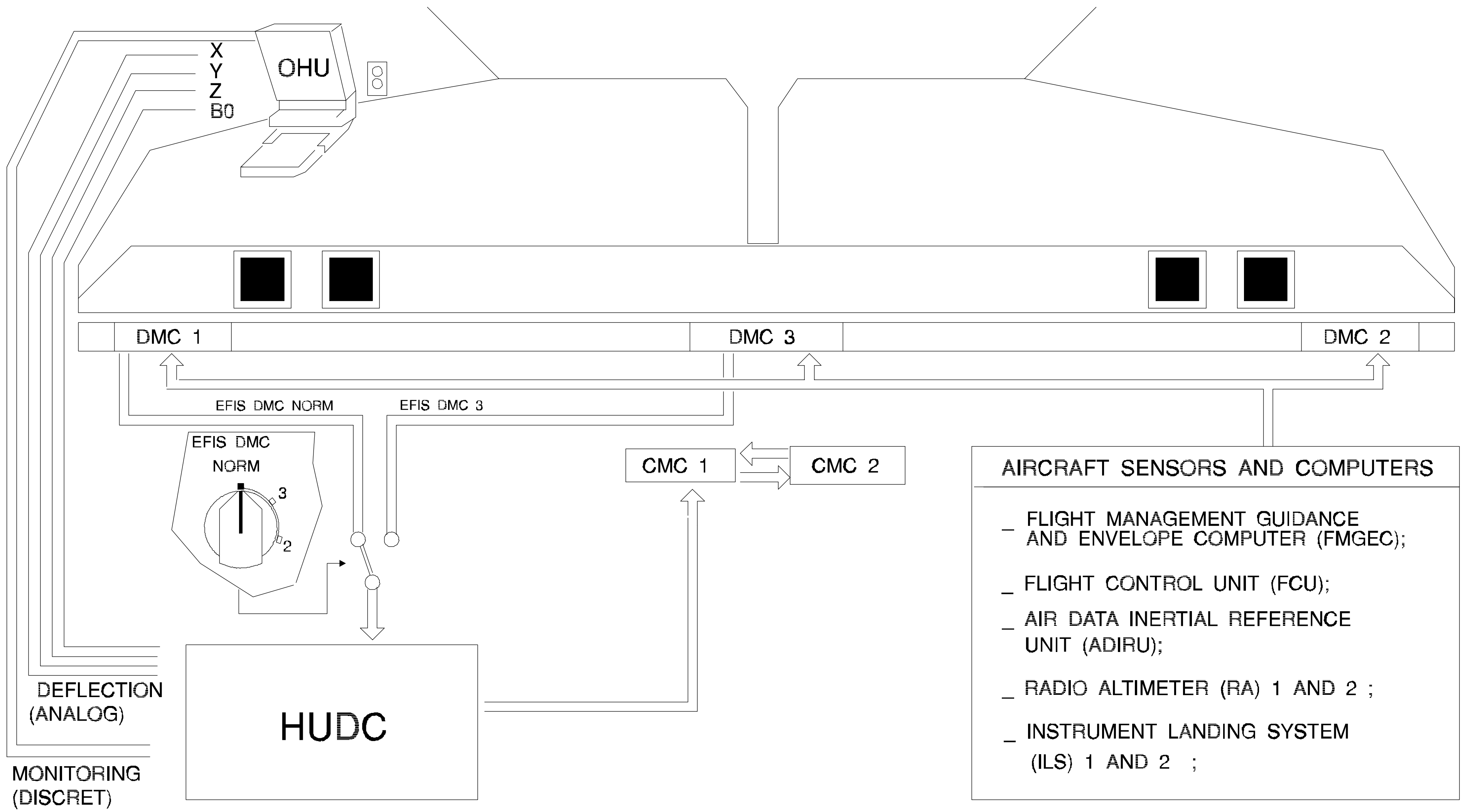
DMC

The DMC one or three sends to the HUDC the parameters provided by different aircraft sensors and computers.
For the RA and ILS information, the HUDC uses :

- RA1 in priority with automatic switchover on RA2;
- ILS2 in priority with automatic switchover on ILS1.

CMC

The Central Maintenance Computer (CMC) one is linked to the HUDC by an ARINC low speed bus for maintenance purpose.
There is no direct link between the HUDC and the Flight Warning Computer (FWC).



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STUDENT NOTES:

HUD INDICATIONS

GENERAL

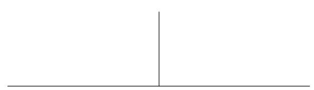
The purpose of this module is to explain in detail the symbology which composes the synthetic image provided to the pilot by the Head Up Display.

SYMBOLOGY

An image can be composed by means of 16 combinated symbols.

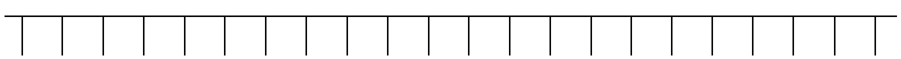
AIRCRAFT AXIS

The aircraft axis is the reference symbol.
All the other symbols are located with respect to this symbol.



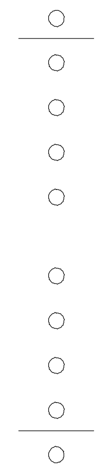
HEADING SCALE

The heading scale is indicated on the horizon line by means of dashes. The distance of the horizon line from the aircraft axis gives the pitch attitude. For excessive roll values, the horizon line flashes.

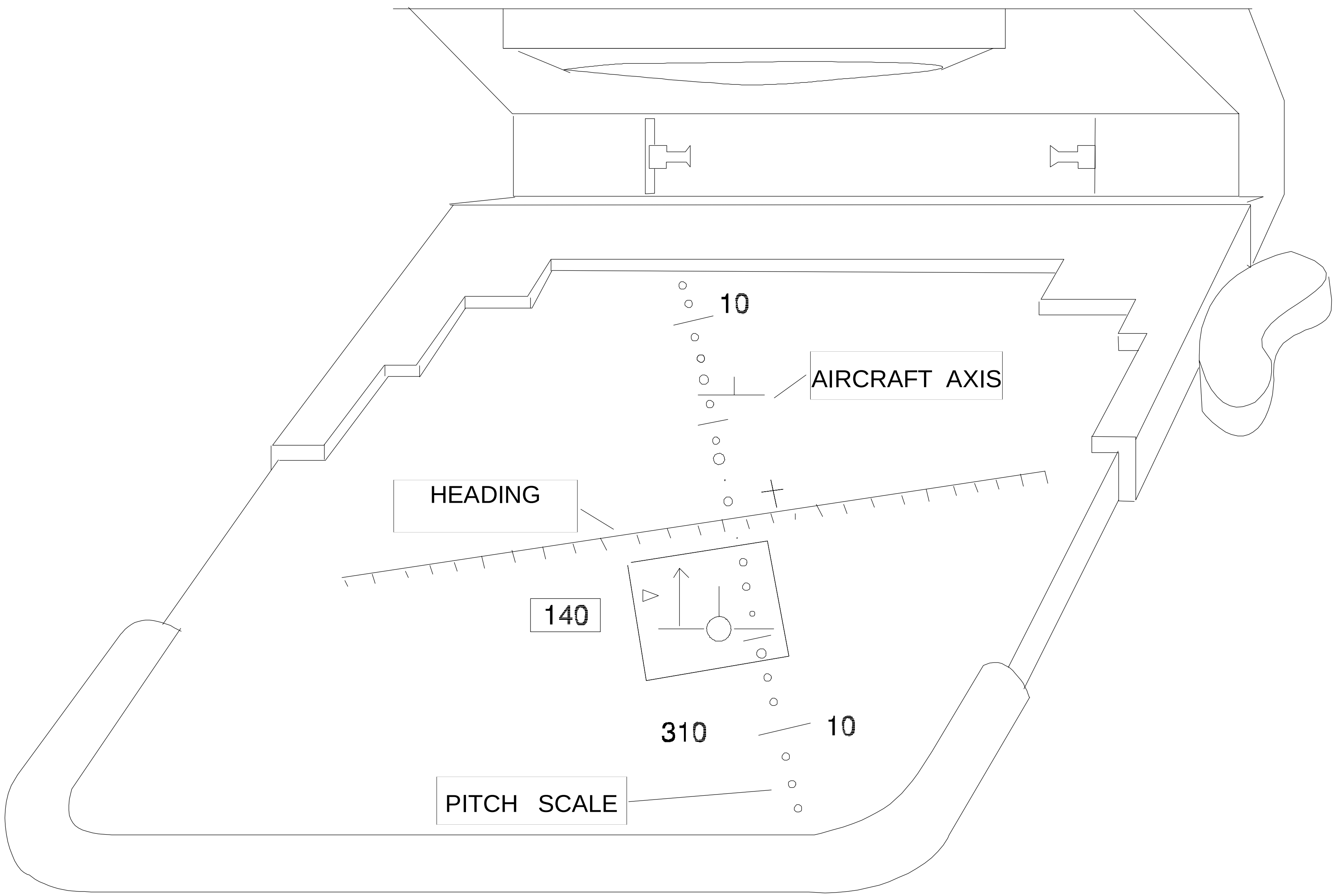


PITCH SCALE

The zero pitch attitude is fixed on the horizon line.



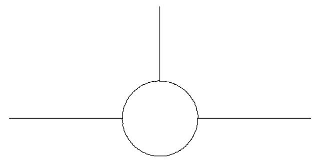
The indications are shown by :
- one dot for 1°;
- one short dash for 5°;
- one long dash with digital value for 10°.



FQW4200 GE Metric

FLIGHT PATH VECTOR (FPV)

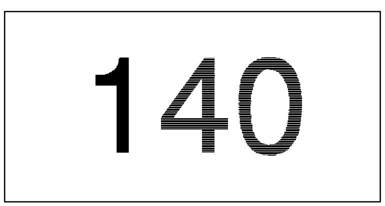
The flight path vector gives the aircraft slope with respect to the horizon line and the aircraft drift with respect to the pitch scale.



In the takeoff phase, only the positive pitch is shown. For high drift, when the symbol should be out of display it is held in limit position and it flashes.
The dimensions of total field of view are :
- 30° in azimuth;
- 20° in elevation.

COMPUTED AIRSPEED (CAS)

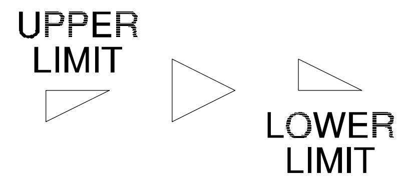
The Computed Air Speed is displayed in digital value and moves with respect to the Flight Path Vector.



Its square box flashes when the CAS is lower than VLS - 5 Kt.

SELECTED AIRSPEED

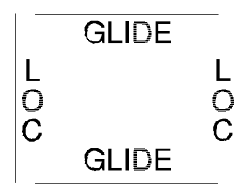
The selected airspeed moves along a virtual axis perpendicular to the left wing of the Flight Path Vector.



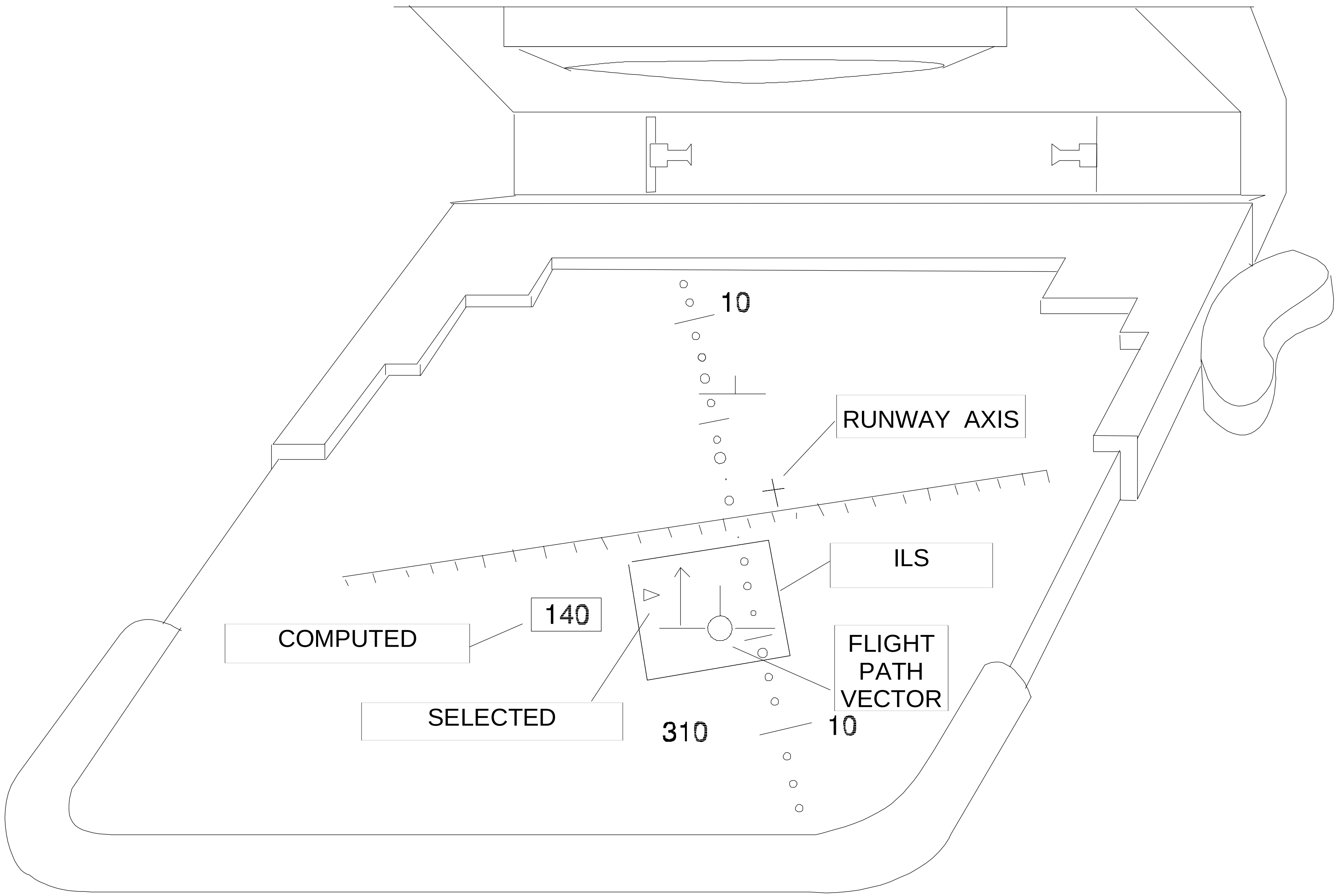
When the difference between the Computed Air Speed is greater than 15 Kt, this symbol is held in limit position and is only represented by a half triangle above or below the left wing of Flight Path Vector.

ILS DEVIATION

The upper and lower sides show Glide/Slope excessive deviation and the lateral sides show Localizer excessive deviation.
The distance from the center of the ILS square box to the center of



the Flight Path Vector enables the Localizer and Glide/Slope deviation to be evaluated.



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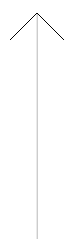
SELECTED FLIGHT PATH ANGLE

The Filght Path Angle symbol moves in parallel to the attitude scale.

The distance to the horizon line gives the selected Flight Path Angle.

FLIHGT PATH ACCELERATION (FPA)

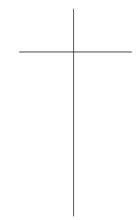
The Flight Path Acceleration shows increases or decreases in aircraft total energy.
Setting the top of the arrow at the level of the selected speed symbol



is performed by increasing or decreasing the engine thrust.

RUNWAY AXIS

The runway heading symbol shows the selected ILS runway axis on the horizon line.



SELECTED TRACK

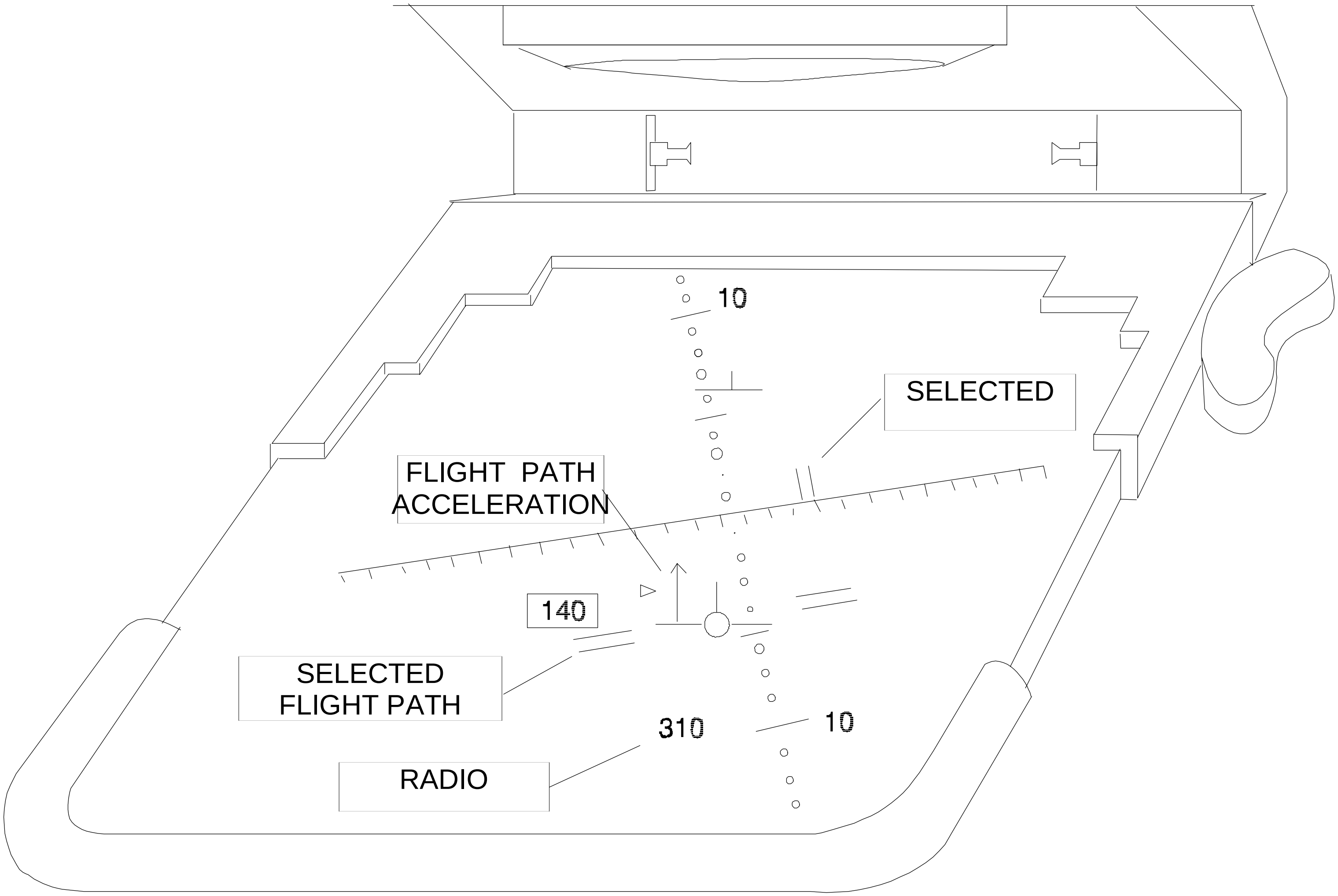
On the horizon line this symbol shows the track selected on the FCU.

RADIO HEIGHT

The radio height digital value is displayed in a fixed position with respect to the Flight Path Vector.

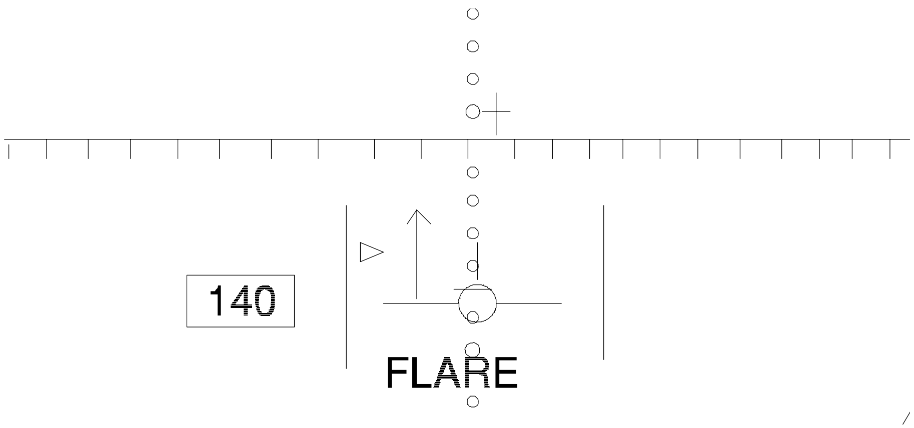
VARIOUS MESSAGES

1250



FQW4200 GE Metric

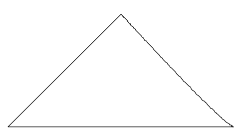
The position of this message is fixed with respect to the Flight Path Vector.
For example: The "FLARE" message appears at 50 feet when Auto



Pilot is engaged.

AIRCRAFT SYMBOL

During roll out, this fixed symbol represents the aircraft.

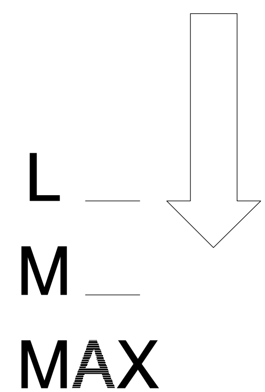


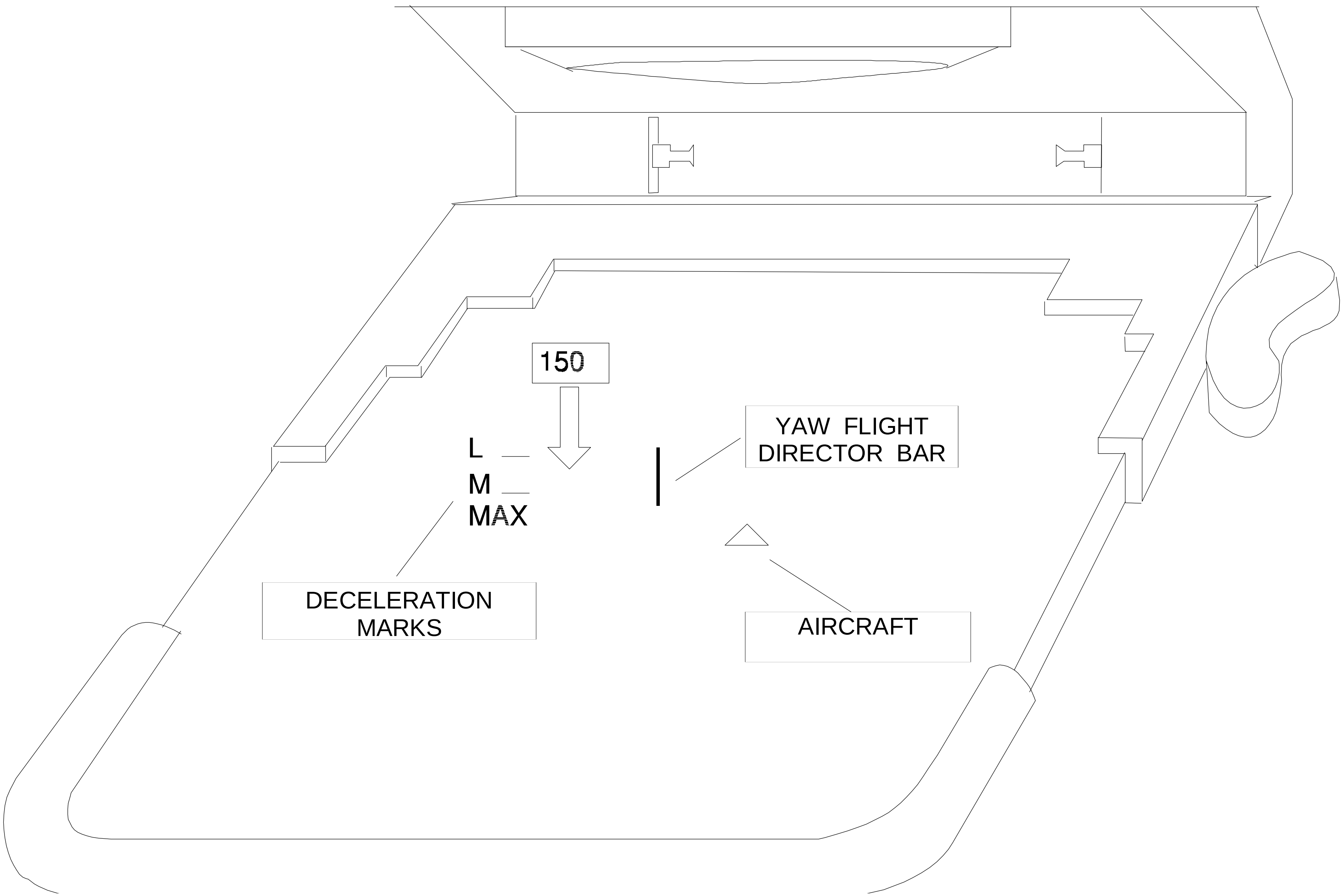
YAW FLIGHT DIRECTOR (FD) BAR

The position of the Yaw FD bar shows the necessary adjustment to keep the aircraft on the runway axis.

DECELERATION

The deceleration symbol appears during the deceleration phase on the ground and serves to quantify the aircraft deceleration. Marks L and M respectively correspond to the Low (3.4 Kt/s) and Medium (6 Kt/s) autobraking levels.





FQW4200 GE Metric

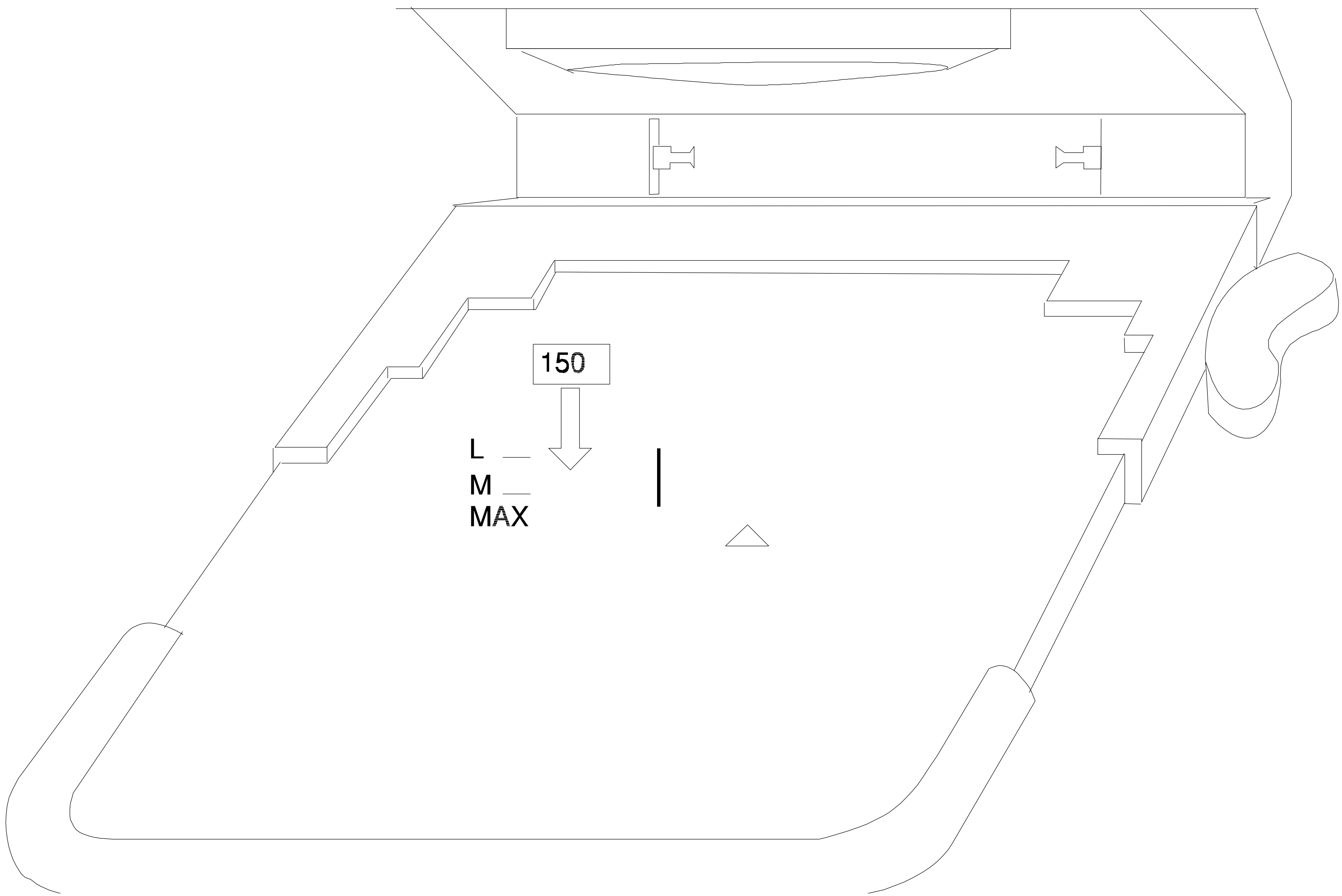
CONFIGURATION

There are 6 potential configurations of image.

ROLL OUT

This configuration is displayed when the pilot performs a Localizer guided roll out provided that auto pilot is disengaged.
It is activated when the following logic conditions are present:

- DMC, IR, ADR and FMGEC valid;
- FD and ROLL OUT mode engaged;
- AP not engaged.

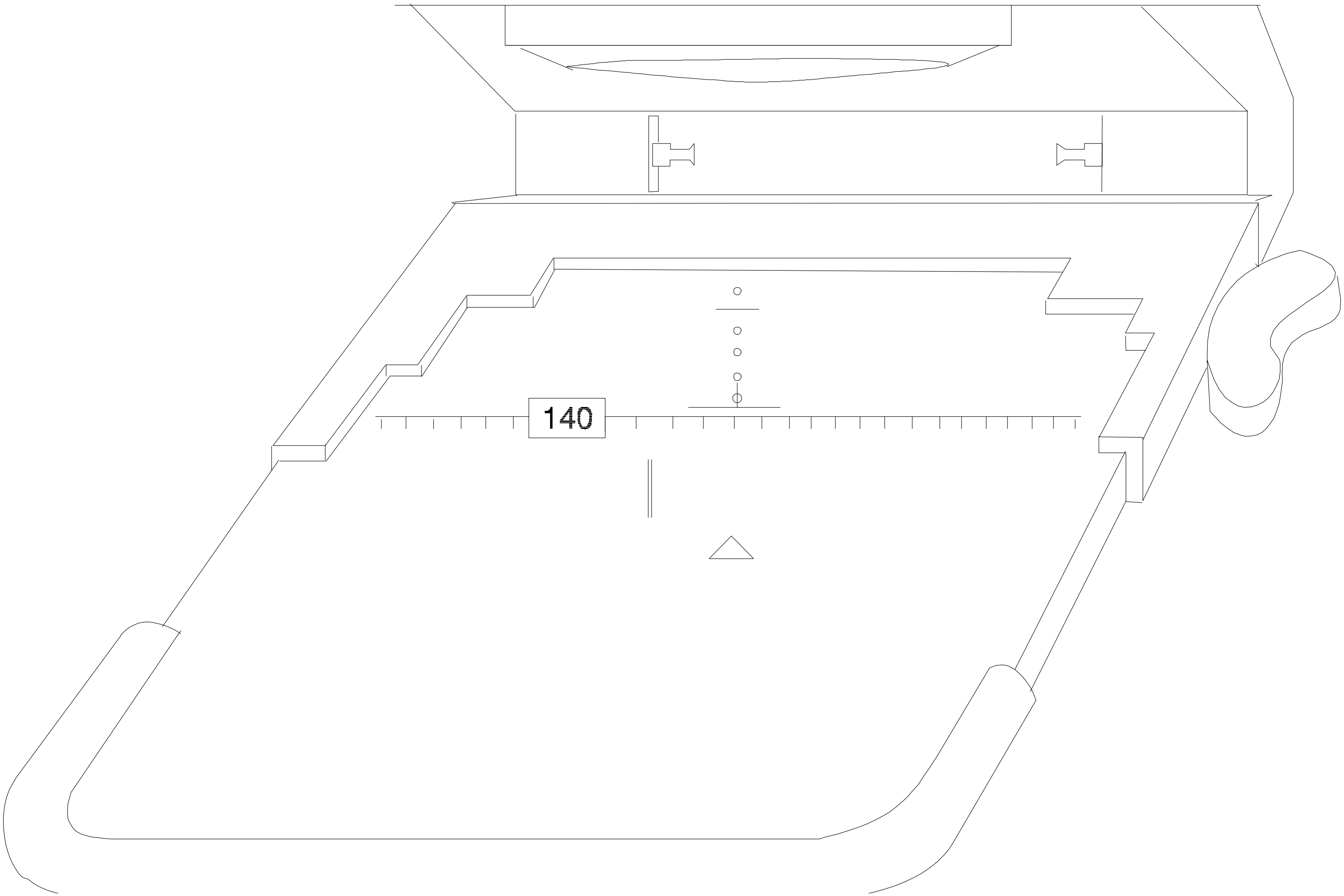


FQW4200 GE Metric

TAKEOFF RUN

This configuration is displayed when the pilot performs a Localizer guided takeoff.
It is activated when the following logic conditions are present:

- DMC, IR, ADR and FMGEC valid;
- AP and FD not engaged.
- RUNWAY LOC engaged.

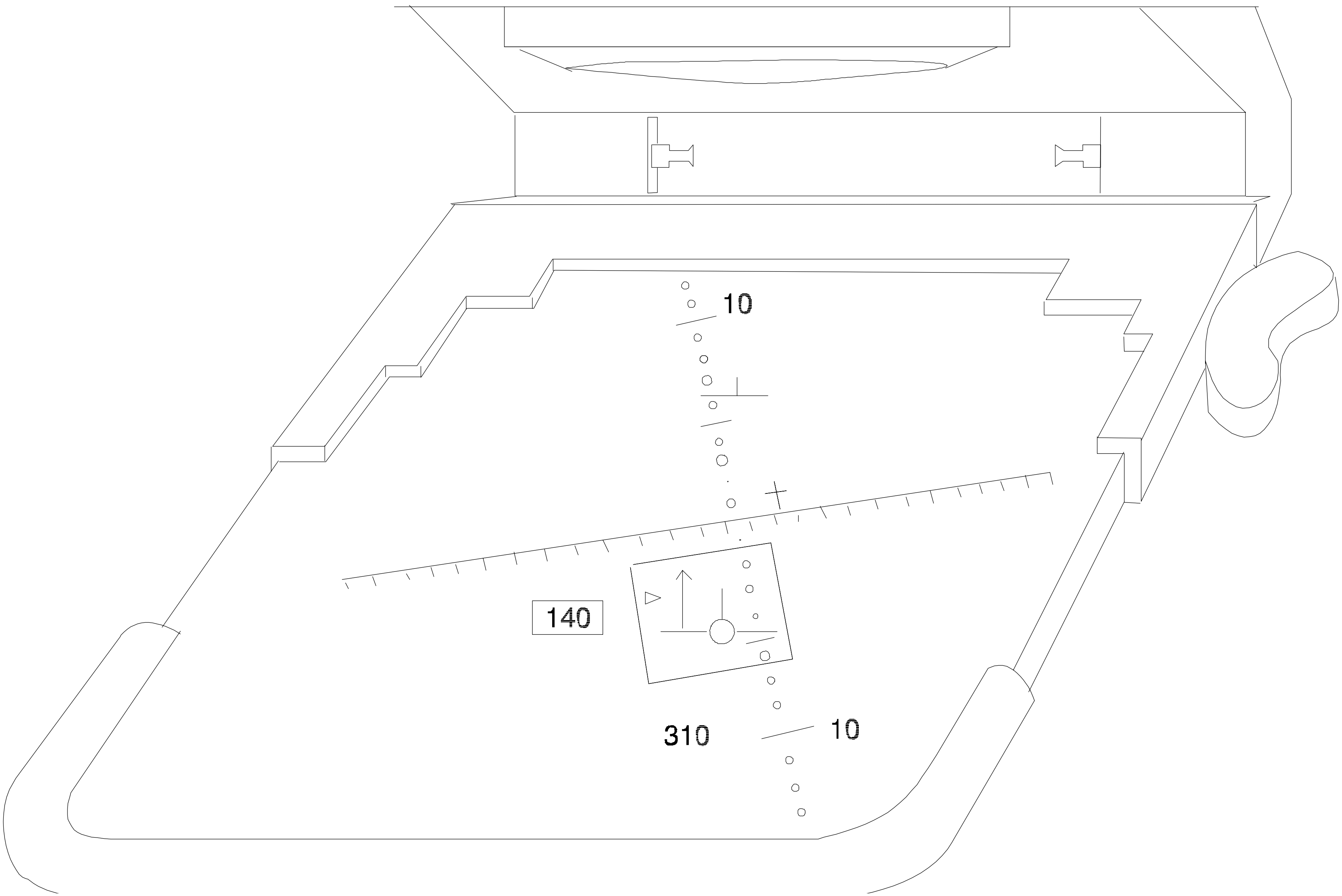


FQW4200 GE Metric

AUTOMATIC APPROACH

This configuration is displayed when the pilot performs an automatic ILS approach.
Note : G/S bars are cleared at 100 ft.
LOC bars are cleared at 15 ft.
It is activated when the following logic conditions are present:
- DMC, IR, ADR and FMGEC valid;
- at least one AP engaged ;
- G/S capture or G/S track engaged ;

or LAND TRACK mode engaged with ROLL OUT mode not engaged.



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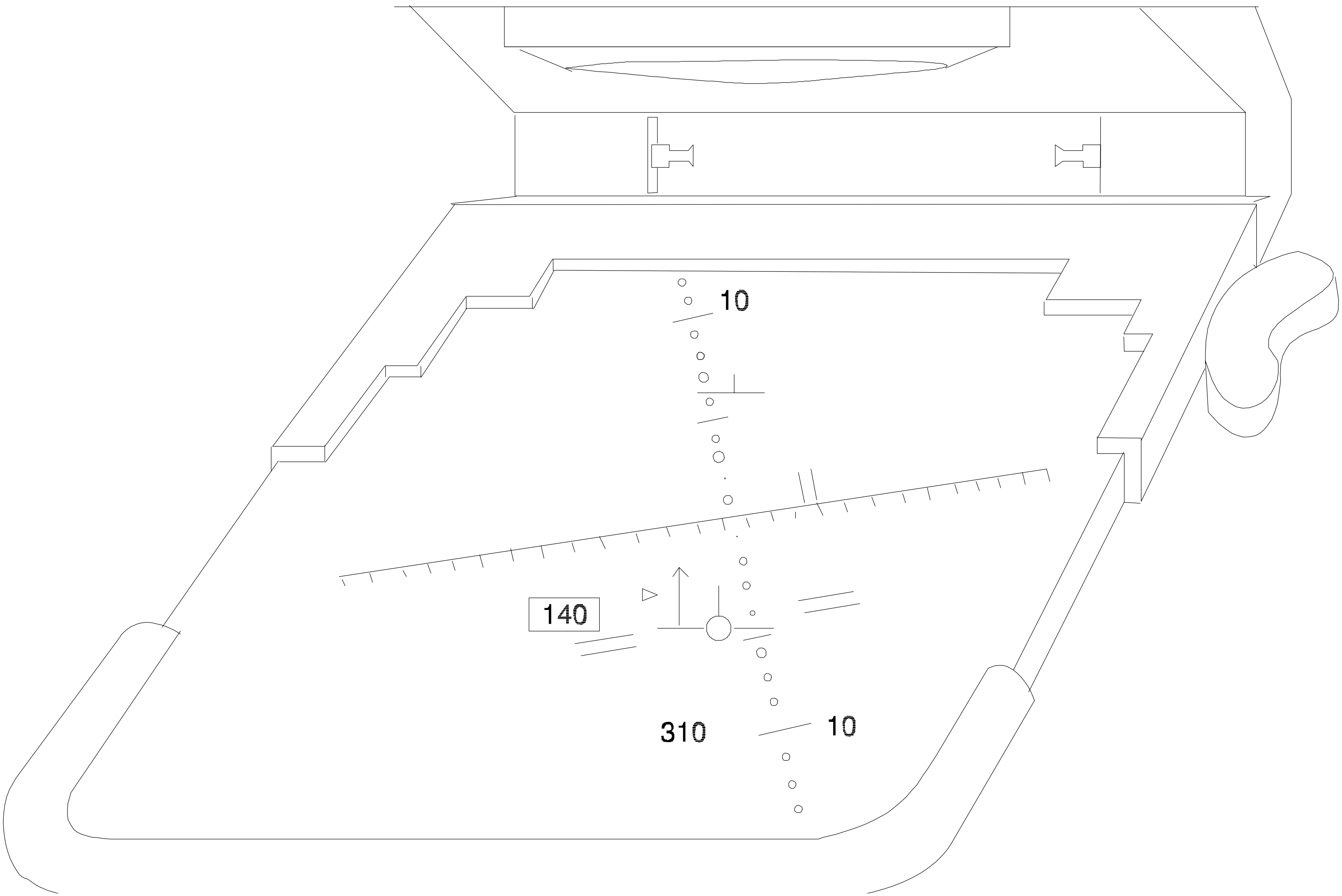
MANUAL APPROACH

This configuration is displayed when the pilot performs a visual approach, guided by a Flight Path Angle selected on the FCU.
It is activated when the following logic conditions are present:

- DMC, IR, ADR and FMGEC valid;
- at least one FD engaged with Flight Path Angle engaged.

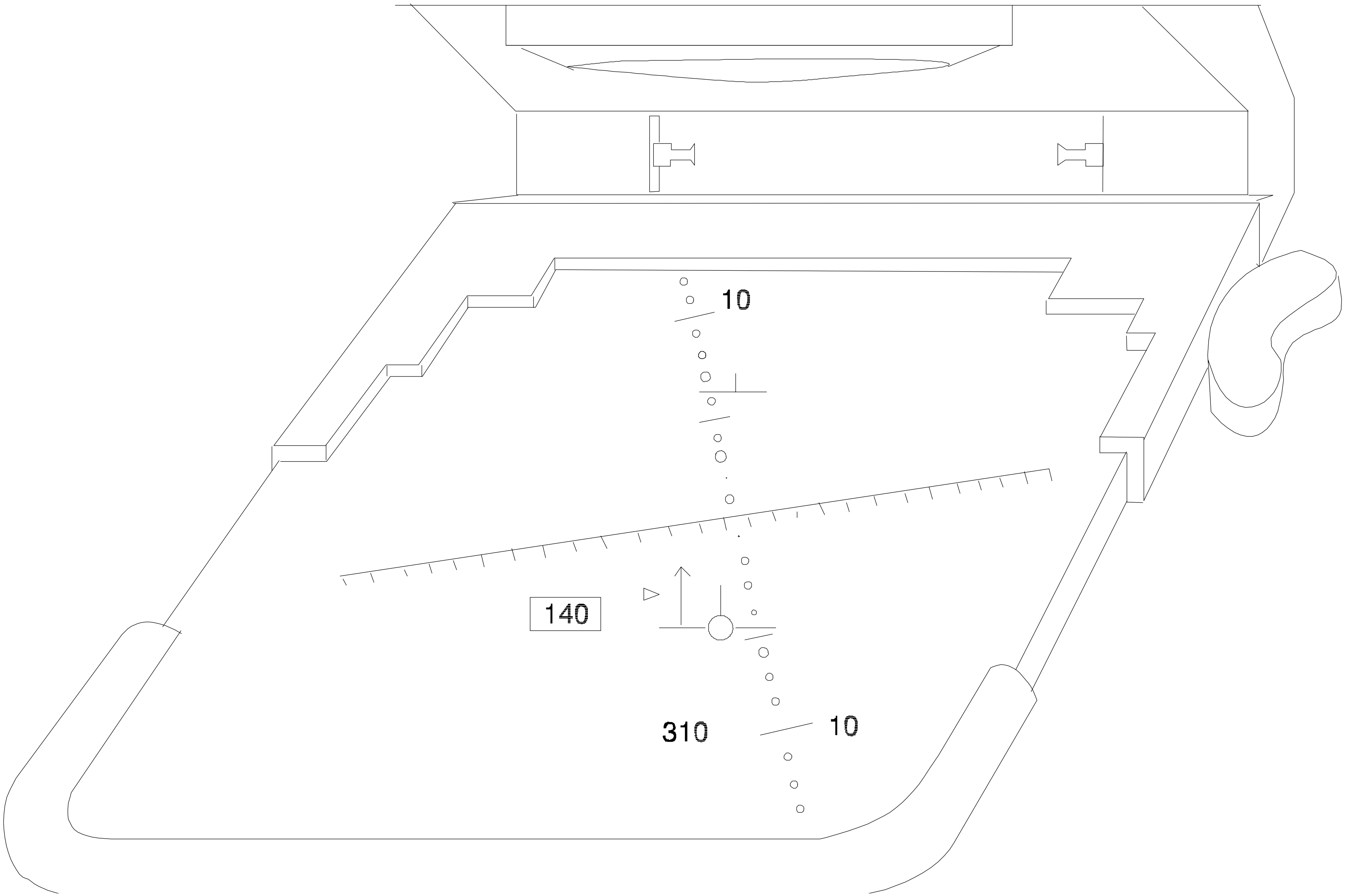


FQW4200 GE Metric

3º MANUAL APPROACH

This configuration is displayed when the pilot performs a visual approach with an FCU failure.
It is activated when the following logic conditions are present:
- DMC, IR, ADR valid;
- FCU FPA not valid;
- no AP or FD engaged;

or FMGEC failure.

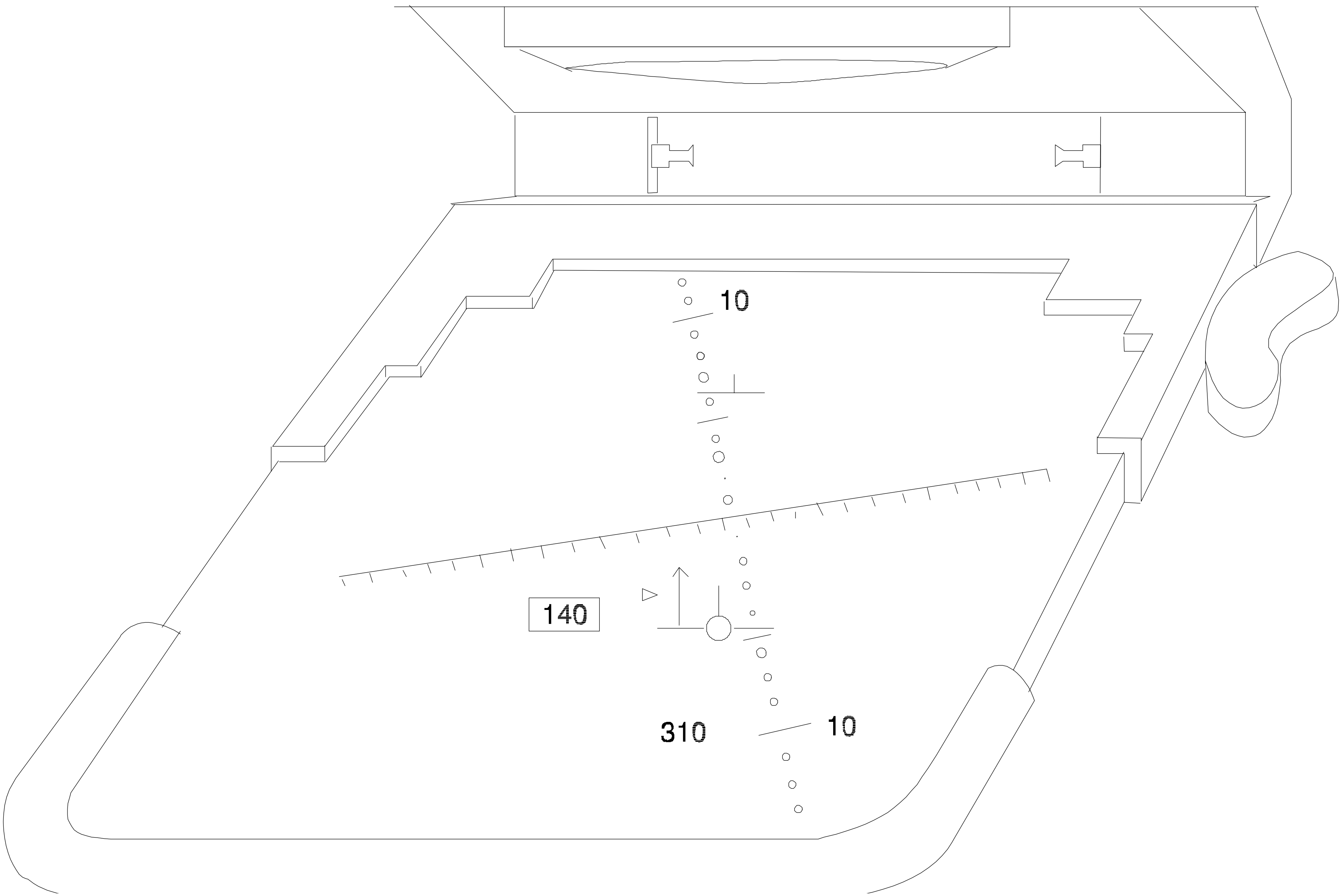


FQW4200 GE Metric

BASIC CONFIGURATION

This configuration shows the basic display.
It is activated when the following logic conditions are present:

- DMC, IR and ADR valid;
- not in automatic, manual or 3° manual approach configuration;
- not in roll out or takeoff run configuration.



FQW4200 GE Metric

FAILURES

The Head Up Display Computer and the Optical Display Unit have permanent test programs which can detect the following failures.

HEAD UP DISPLAY COMPUTER (HUDC) FAILURE

The energized Optical Display Unit shows a diagonal segment.

OPTICAL DISPLAY UNIT (ODU) FAILURE

The energized Optical Head Up is blank.

DISPLAY MANAGEMENT COMPUTER (DMC) FAILURE

If the HUDC detects label 276 not valid from DMC, the entire image disappears.

INERTIAL REFERENCE (IR) FAILURE

When the Display Management Computer delivers any of the IR parameters with the status matrix coded Failure Warning (FW) or not refreshed, the entire image disappears.

COMPUTED AIR SPEED (CAS) FAILURE

When the DMC delivers the Computed Air Speed with the status matrix coded Failure Warning (FW) or not refreshed, the entire image disappears.

ILS FAILURE

If data is lost on the two ILS receivers, or if transmission is coded Non Computed Data, it is no longer represented on the image. Each data (Glide/Slope, Localizer, runway heading) is independent and is separately shown.

RADIO ALTIMETER (RA) FAILURE

If the radio altitude information is completely lost, it will no longer be displayed.This discrepancy is detected by the Flight Warning Computer (FWC).

ATTITUDE DISCREPANCY

In case of attitude discrepancy, "CHECK A.T.T" message is displayed above the horizon line.

FMGEC FAILURE

When the DMC delivers any of the Flight Management Guidance and Envelope Computer (FMGEC) parameters either not refreshed or with the status matrix coded Failure Wwarning (FW), the speed information is no longer displayed.
The speed parameters (CAS, selected speed and potential Flight Path Acceleration) are dependent and are cleared simultaneously.

STUDENT NOTES:

STUDENT NOTES

PARAVISUAL INDICATING SYSTEM PRESENTATION

Principle
Components
Indicating

FQW4200 GE Metric

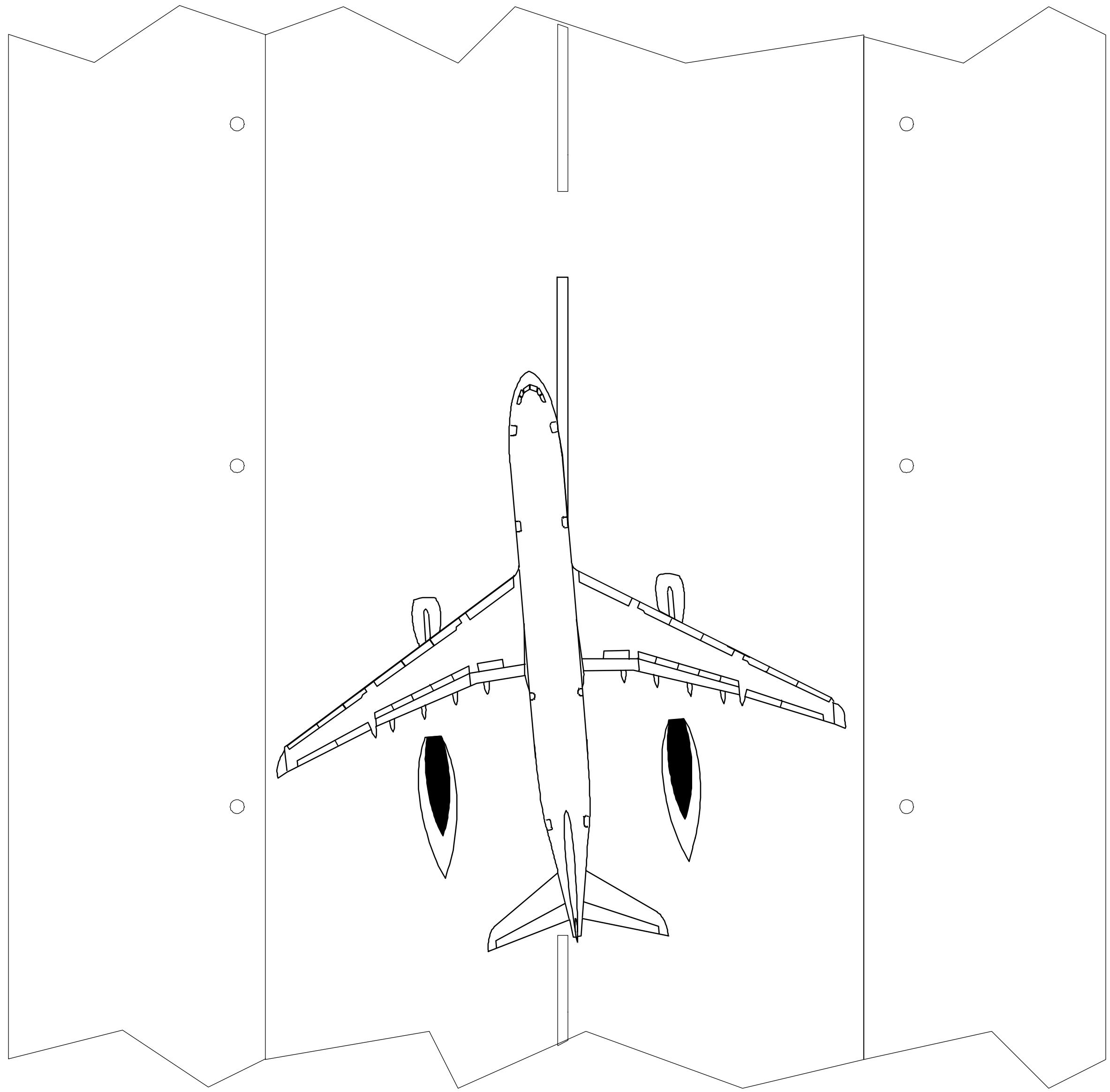
ParaVisual Indicating (PVI)

PRINCIPLE

The PVI is a roll out piloting aid system when on runway, during take-off and landing phases below 30 feet, in reduced visibility conditions.

The PVI is installed on the Captain side of the glareshield and generates a head up paravisual image for the Captain.

The Captain can correct the aircraft trajectory following the PVI indication.

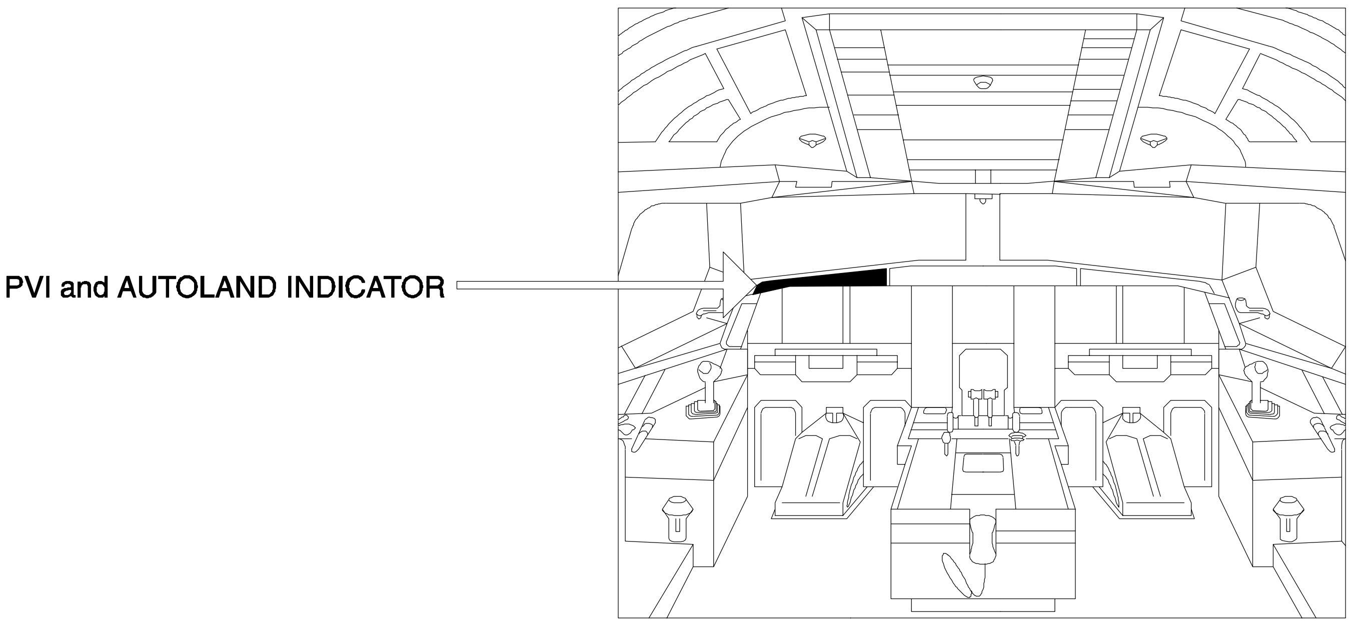


FQW4200 GE Metric

COMPONENTS

The PVI is provided for the Captain only.

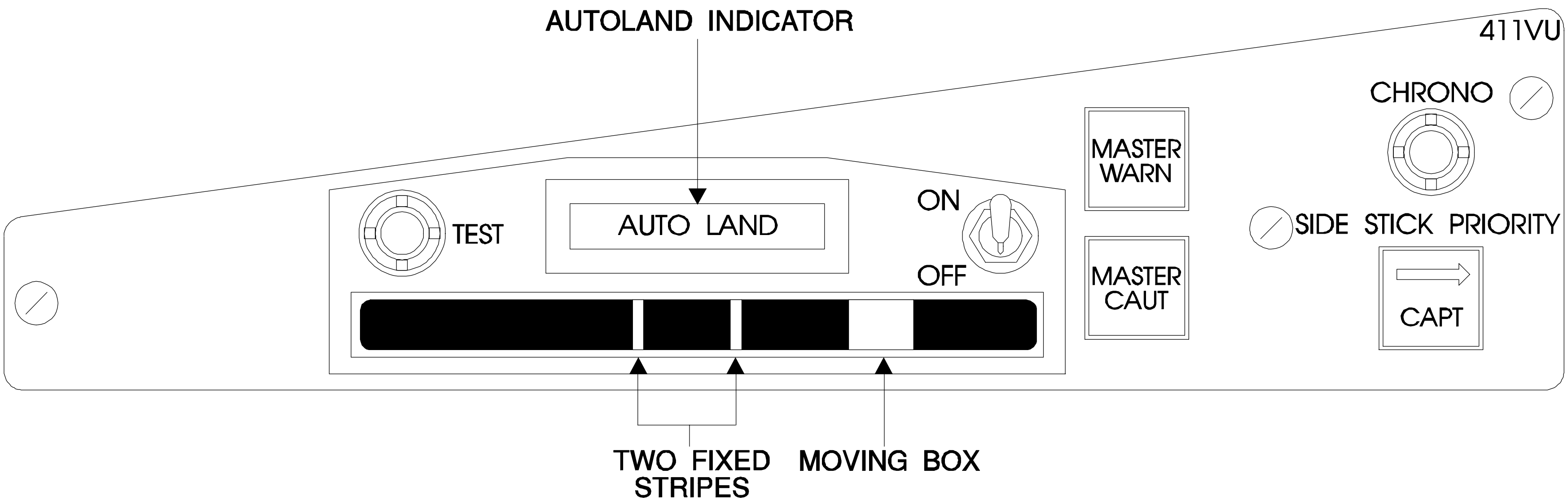
The electronic and display modules are integrated in a single unit.
The AUTOLAND indicator is also integrated in this unit.


PVI and AUTOLAND INDICATOR

INDICATING

The Liquid Cristal Display consists of two fixed stripes and a moving box.

e.g. : When moving box is to the right of the fixed stripes, the Captain must correct on the right.



FQW4200 GE Metric

STUDENT NOTES

PVI D/O

DMC
DMC Switching
Autoland
Test

DMC

The Display Management Computer (DMC) provides Flight Management Guidance and Envelope (FMGEC) Computer data to the ParaVisual Indicating system.

The DMC provides, to the PVI :

- Yaw Flight Director orders,
- Auto-Pilot engagement,
- Flight Director engagement,
- RUNWAY LOC mode or ROLL OUT mode

DMC SWITCHING

Basically DMC 1 provides data to the PVI.

By selecting 3 on the Captain EFIS DMC selector, DMC 3 will provide FMGEC data to the PVI.

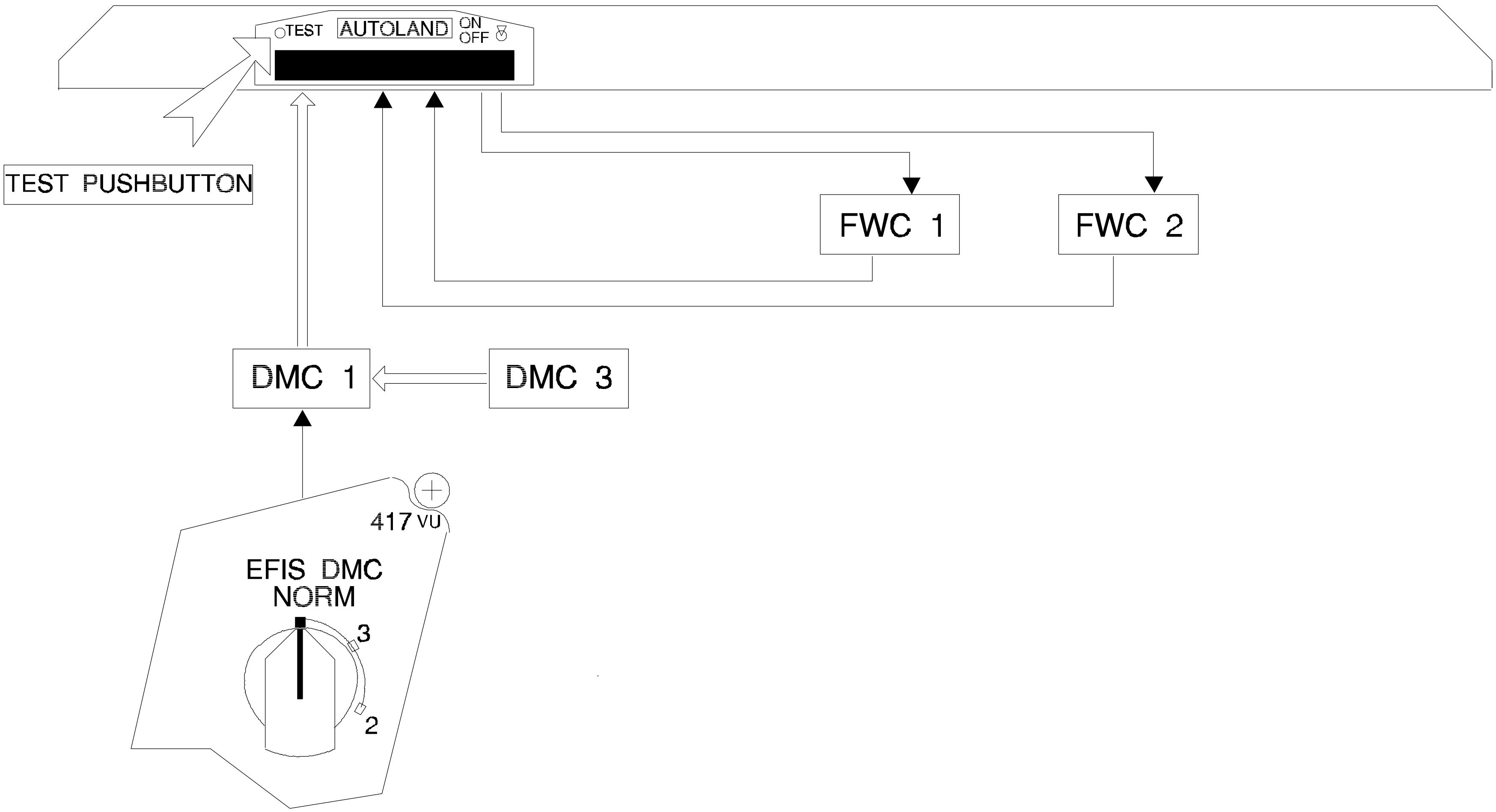
AUTOLAND

The AUTOLAND warning is controlled by the Flight Warning Computers (FWC) independently from the image generation system.

TEST

A self test controlled by a pushbutton is integrated in the PVI.

When the test pushbutton is pressed in, a discrete signal is transmitted to each Flight Warning Computer.



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STUDENT NOTES

PVI DISPLAY

ON/OFF Switch
PVI In Standby
PVI In Guidance Command Presentation
External Failure
Internal Failure
Autoland Light

ON/OFF SWITCH

An ON/OFF switch controls the PVI. When it is set to OFF the PVI display is black.

PVI IN STANDBY

When the PVI is ON and guidance command presentation conditions are not fullfilled, fixed marks are displayed.

The conditions of display are :

- PVI ON
- no PVI internal failure
- correct reception of Yaw Flight Director control
- AP/FD modes and engagement such as RUNWAY LOC mode or ROLL OUT mode.

PVI IN GUIDANCE COMMAND PRESENTATION

The PVI displays a moving symbol and a fixed mark.

When the moving symbol is on the right, the Captain has to correct on the right. Opposite for the left.

When the moving symbol is centered, no action is required.

EXTERNAL FAILURE

When a non valid signal input is detected, the PVI display is white.

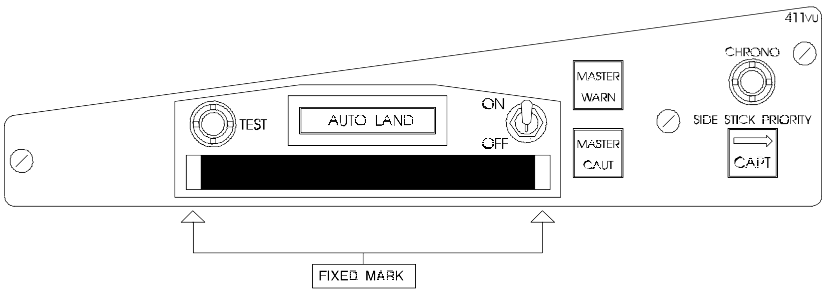
INTERNAL FAILURE

When the PVI integrated test detects a failure, a black display appears.

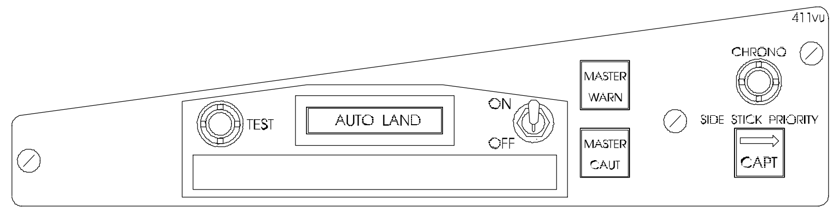
AUTOLAND LIGHT

The AUTOLAND warning light is integrated in the PVI indicator. It comes on when a failure occurs during automatic landing.

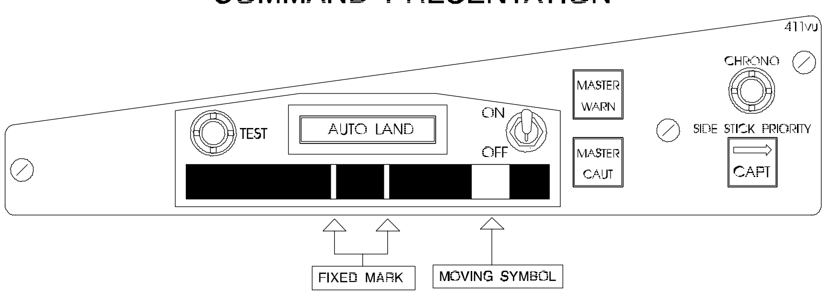
PVI IN STANDBY



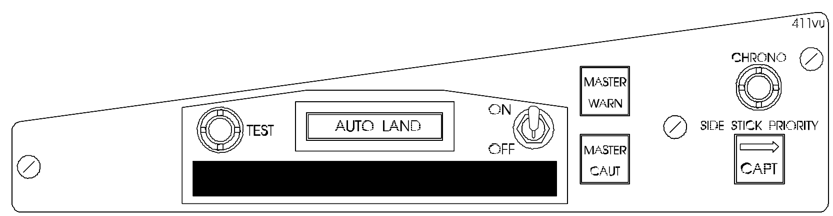
EXTERNAL FAILURE



PVI IN GUIDANCE
COMMAND PRESENTATION



INTERNAL FAILURE



FQW4200 GE Metric

STUDENT NOTES

SPECIFIC CMS PAGES PRESENTATION

General
Altitude
Altitude and Speed/Temp
Radio nav
Attitude

GENERAL

The purpose of this module is to present the specific CMS pages relative to the ATA 34 systems.

ALTITUDE

RA
The RA menus are standard.

ALTITUDE AND SPEED / TEMP

ADR
The same ADR menus are accessible from ALTITUDE and SPEED/TEMP key on the SYSTEM/REPORT TEST page.
The items are the same as on a standard menu except some tests that are available on the first ADR menu page:

- RAT TEST
- output TEST (Slew Tests, Interface Test, AOA SENSOR Test);

ALT DYNAMIC SLEW TEST

The ALT DYNAMIC SLEW TEST causes the ADR to output a simulated ramp of altitude. The altitude limits are tested to be within -2000 and +50000 ft. The altitude lower limit is tested to be less than the altitude upper limit. The altitude slew rate is tested to be within 1 to 20,000 ft/mn.

CAS DYNAMIC SLEW TEST

The CAS DYNAMIC SLEW TEST causes the ADR to output a simulated ramp of computed air speed. The CAS limit values are tested to be within 0 and +450 kts. The CAS lower limit is tested to be less than the CAS upper limit. The speed slew rate is tested to be within 1 to 100 kts/mn.

AOA SENSOR TEST

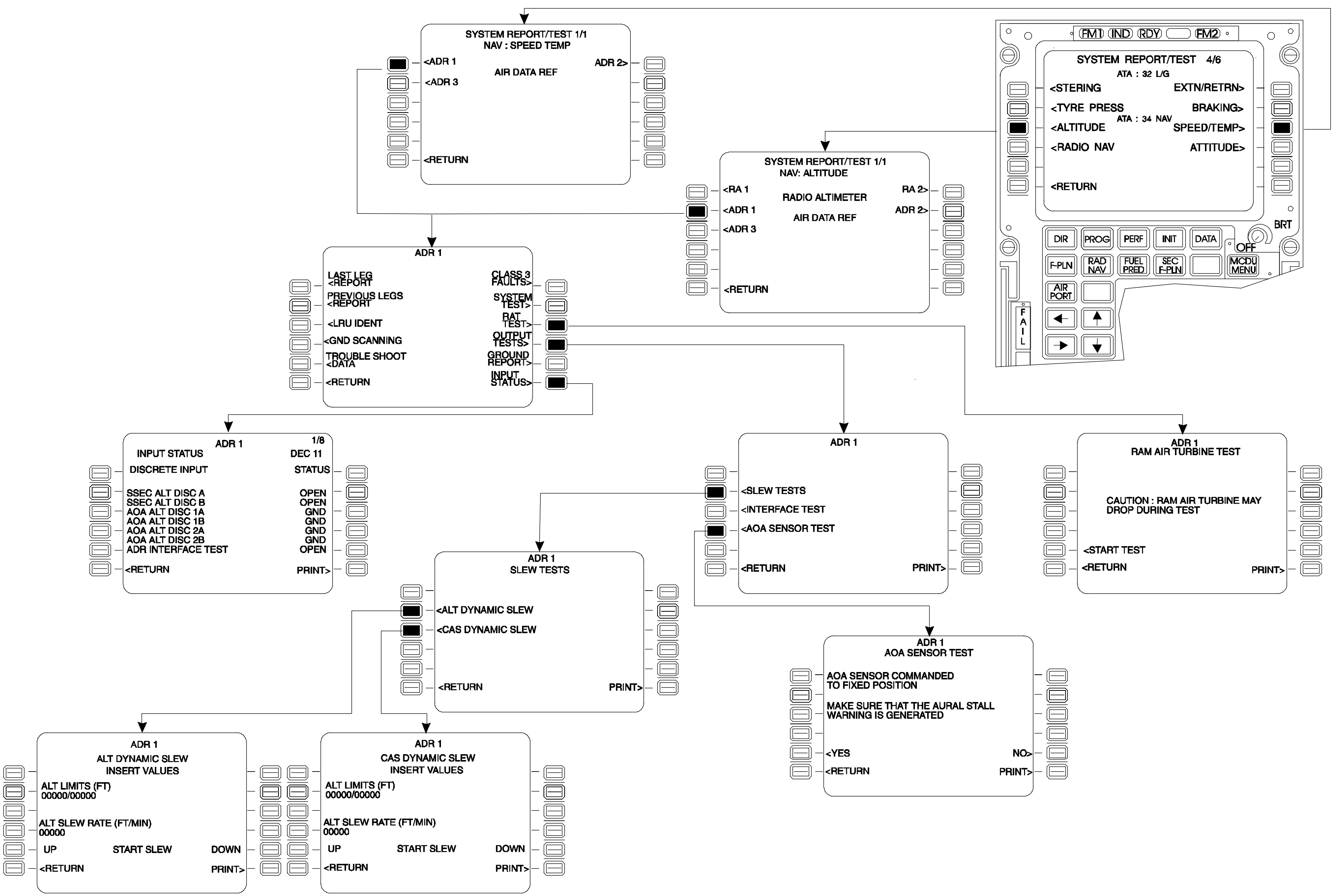
An AOA SENSOR TEST is available. The AOA SENSOR TEST causes the ADR to set the AOA special test discrete to ground state. Thus the AOA sensor is commanded to a fixed position greater than the stall warning threshold, so the FWC activates the aural stall warning.

RAM AIR TURBINE TEST

A RAM AIR TURBINE TEST is available.The RAM AIR TURBINE TEST sets the low speed warning 3 output discrete to simulate a CAS greater than 100 kts (logic condition used by the RAM AIR TURBINE). The discrete is reset at the end of the test.
CAUTION : RAM AIR TURBINE MAY DROP DURING TEST (amber).

INPUT STATUS

On the ADR main menu an INPUT STATUS key enables access to the current state/value of the selected ADR inputs (discrete, analog and binary inputs) (8 pages).



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RADIO NAV

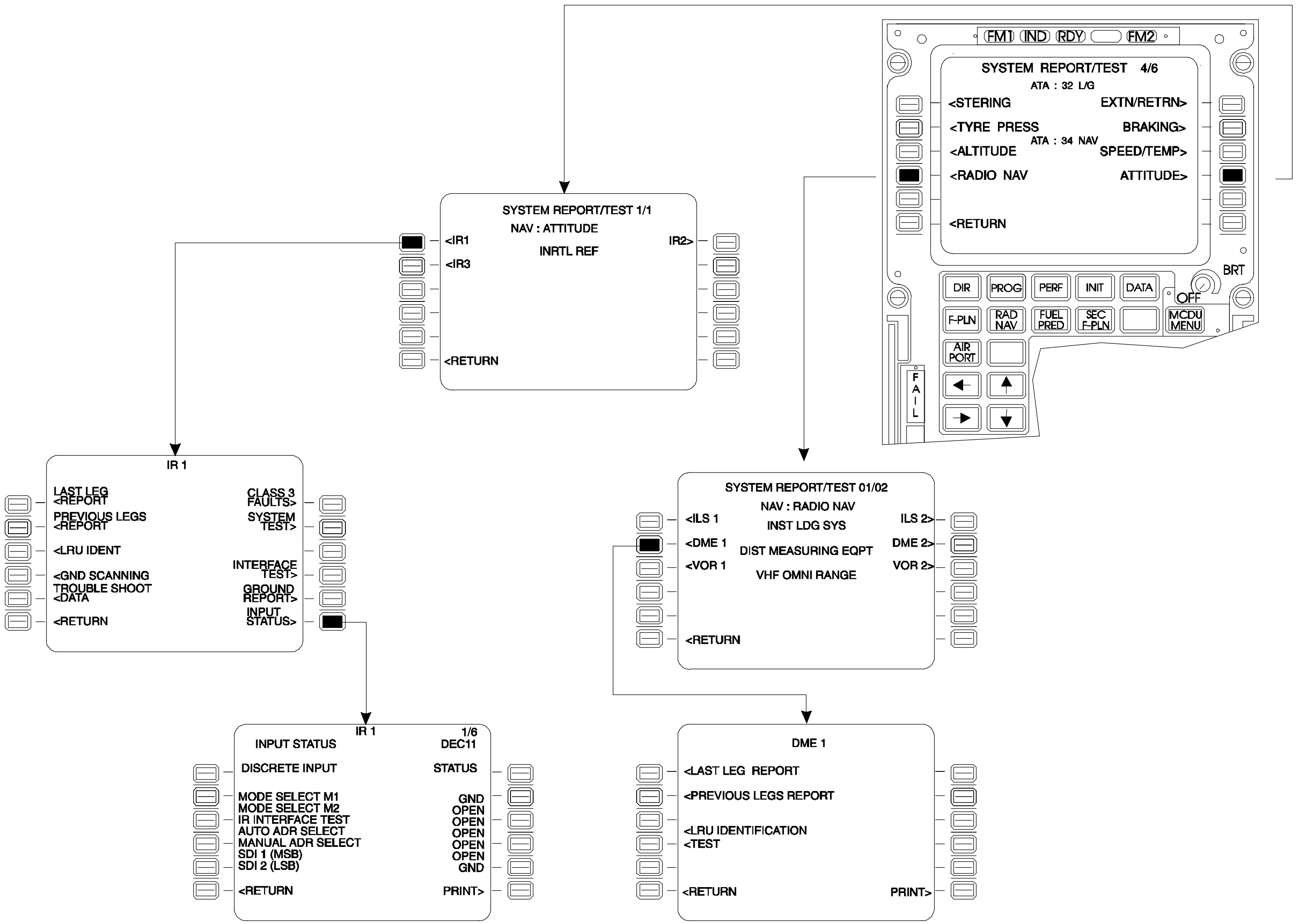
The radio nav menus are standard except for some systems. DME, VOR , ATC, ADF and WXR have the same type of specific menus.

ATTITTUDE

The IR menus are not standard.
The main items of a standard menu are available.

INPUT STATUS

On the IR main menu an INPUT STATUS Key enables to access top the current state/value of the selected IR inputs (discrete, analog and binary inputs) (6 pages).



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STUDENT NOTES

NAVIGATION SYSTEM WARNINGS (except ADIRS)

ILS 1 (2) (1+2) Fault
RA 1 (2) (1+2) Fault
GPWS Fault
GPS 1 (2) (1+2) Fault (OPTION)
TCAS Fault (OPTION)
PWS Fault (OPTION)

ILS FAULT (e.g.:ILS1 failed)

Notice the flashing red "LOC" and "G/S" message on PFD 1 and on ND 2, as well as an amber "NAV ILS 1 FAULT" message on the ECAM display. This warning is triggered in case of failure of an ILS receiver (LOC and G/S parts). In case of one ILS receiver failure, landing capability is limited to CAT1, in case of failure of both receivers, CAT1 is inoperative.

RA FAULT

Notice the flashing red "RA" message on the PFD, as well as an amber "NAV RA1+2 FAULT" message on the ECAM display.
This warning is triggered in case of failure of both RA transceivers. In this case, landing capability is limited to CAT1. In case of failure of one transceiver, no local warnings are shown but CAT3 is inoperative.

GPWS FAULT

Notice the amber "FAULT" SYS pushbutton light on the GPWS control panel, as well as an amber "NAV GPWS FAULT" message on the ECAM display. This warning is triggered in case of failure of the GPWS.

GPS FAULT (OPTION)

This warning is triggered in case of failure of the GPS.

TCAS FAULT (OPTION)

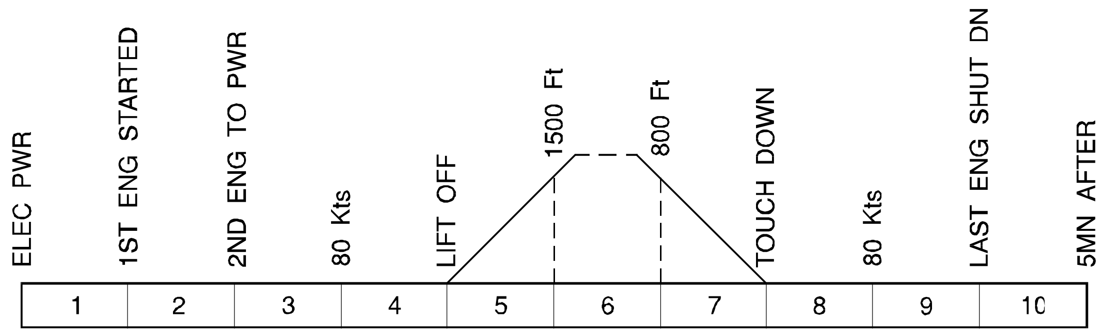
Notice the flashing red "TCAS" message on the PFD and on the ND, as well as an amber "NAV TCAS FAULT" on the ECAM display.
This warning is triggered in case of failure of the TCAS.

PWS FAULT (OPTION

Notice the amber "PRED W/S" message on the ND as well an amber " NAV PRED W/S DET FAULT" on the ECAM display.
This warning is triggered when the windshear AUTO/OFF switch (on the WXR conrol unit) is set to AUTO if either the aircraft is on the ground or the flat and slat lever position is different from 0. The fault message is not displayed if the AUTO/OFF switch is set to OFF.

NOTE :

There are no dedicated ECAM pages for the navigation system. In case of a NAV FAULT, there will be no system page called for the corresponding failure.



SYSTEM	E/WD : FAILURE TITLE	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
ILS	ILS 1 (2) (1+2) FAULT	SINGLE CHIME	MASTER CAUT	NIL	NIL	3, 4, 5,
RA	RA 1 (2) (1+2) FAULT	SINGLE CHIME	MASTER CAUT	NIL	NIL	3, 4, 5, 8
GPWS	GPWS FAULT	SINGLE CHIME	MASTER CAUT	NIL	GPWS SYS. FAULT lt	3, 4, 5 8, 9, 10
GPS (OPTION)	GPS 1 (2) (1+2) FAULT	SINGLE CHIME	MASTER CAUT	NIL	NIL	4, 5 7, 8
TCAS (OPTION)	TCAS FAULT	NIL	NIL	NIL	FLAG ON ND, PFD	3, 4, 5, 7, 8
PWS (OPTION)	PRED W/S FAULT	SINGLE CHIME	MASTER CAUT	NIL	FLAG ON ND	3, 4, 5, 8

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STUDENT NOTES