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Airbus
A318/A319/A320/A321

ATA 34
Navigation

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EASA Part-66
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Training Manual

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- The LTT production process ensures that the Training Manual contains a complete set of all necessary pages in the latest finalized revision.

ATA 34 NAVIGATION

34–10 AIR DATA INERTIAL REFERENCE SYSTEM

ADIRS INTRODUCTION

General

Each ADIRU contains:

- an ADR (**A**ir **D**ata **R**eference) portion.
- an IR (**I**nertial **R**eference) portion.

Power supply is common for ADR and IR.

The ADIRU is interfaced with the ADIRS CDU **(C**ontrol and **D**isplay **U**nit) for mode control and status annunciation.

ADR

The Air Data Reference portion of the ADIRU provides main data sources which are air data references for the aircraft avionics systems.

The ADR receives and processes the outputs of the.

- **ADM**, Air Data Module,
- **TAT Probe**, Total Air Temperature Probe,
- **AOA Sensor**, Angle Of Attack sensor,

It computes the aerodynamic parameters in the form of ARINC 429 low speed buses.

IR

The Inertial Reference portion of the ADIRU (**A**ir **D**ata **I**nertial **R**eference **U**nit) provides main data sources which are precision attitude, magnetic heading references and navigation data to the aircraft avionics systems.

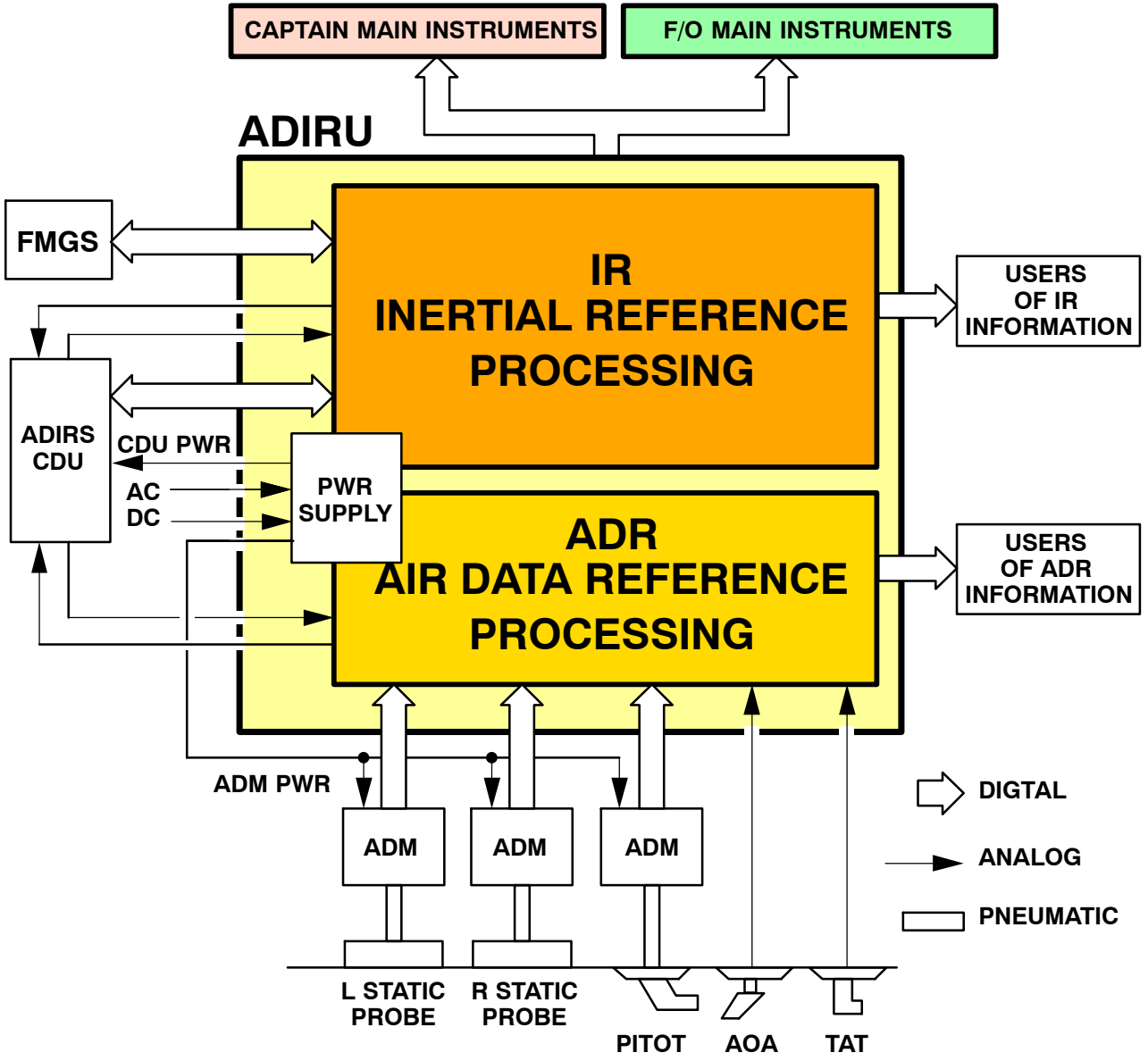


Figure 1 ADIRU Block Diagram

ADIRU GENERAL DESCRIPTION

GENERAL

This part of the navigation system comprises:

- three ADIRU (**A**ir **D**ata/**I**nertial **R**eference **U**nits)
- standby systems.

Each ADIRU performs:

- the air data function through its ADR (**A**ir **D**ata **R**eference) portion.
- the attitude, heading and position function through its IR (**I**nertial **R**eference) portion.

Air Data Function

Air data are provided by four independent sources:

- **Three main systems**

  Each of the three main systems includes static probes, pitot probes and their associated ADM (**A**ir **D**ata **M**odules), TAT (**T**otal **A**ir **T**emperature) sensors and AOA (**A**ngle **o**f **A**ttack) sensors.

  They provide the ADR portion of the ADIRU with the necessary data for the generation of parameters which are transmitted to the PFD (**P**rimary **F**light **D**isplays) and ND (**N**avigation **D**isplays) and the Angle of Attack indicator (optional) and to the various aircraft systems.

- **A standby system**

  1 The standby system includes a standby altimeter, a standby airspeed indicator and a metric altimeter (optional) or to the optional system ISIS. They are provided with pressure by static probes and pitot probe linked to the ADIRU 3 via an Air Data Module (ADM).

Attitude, Heading and Position Function

Attitude, heading and position data are provided by four independent sources:

- **Three main systems**
  - The three main systems are made up of the following components:
    - three IR portions
    - a CDU (**C**ontrol and **D**isplay **U**nit).

    They provide inertial reference information, attitude (pitch, roll and yaw), heading, ground speed and present position.

    The primary information of rotation rates and linear acceleration measured by the IR portions are directly used by the AFS (**A**uto **F**light **S**ystem), by the FAC (**F**light **A**ugmentation **C**omputer) and the FMGC (**F**light **M**anagement and **G**uidance **C**omputer).

    The IR data are transmitted to the indicators (PFD, ND and RMI) and to the various aircraft systems.

- **A standby system**

  1 The standby system includes a standby horizon indicator and a standby compass.

NOTE: The standby systems will be explained in detail in chapter 34–20.

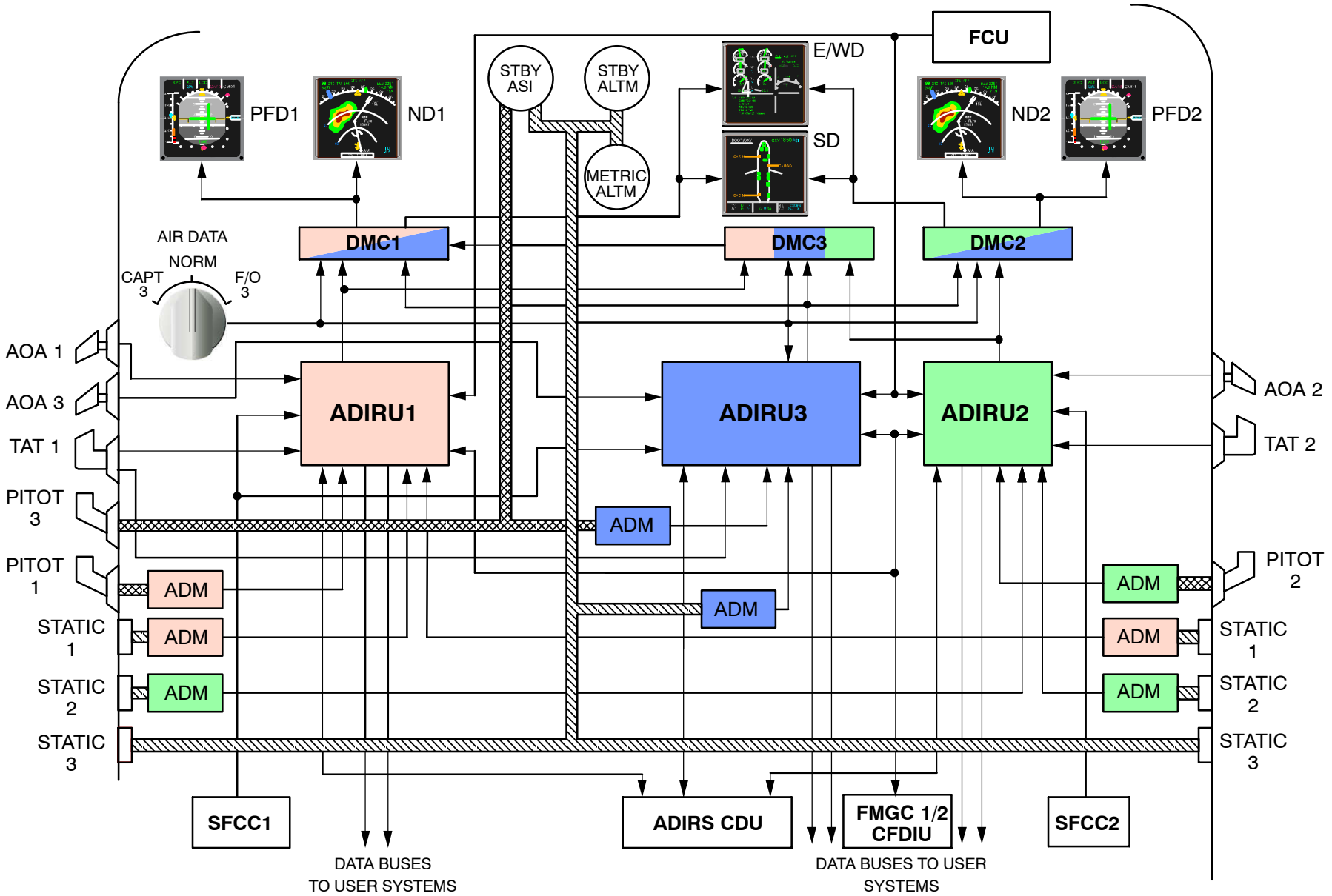


Figure 2 ADIRS General Layout

ADIRS SYSTEM GENERAL DESCRIPTION

ADIRS SYSTEM

The ADIRS is composed of three ADIRU (**A**ir **D**ata **I**nertial **R**eference **U**nits), each having their own set of probes and sensors and a common CDU (**C**ontrol **D**isplay **U**nit).

The main air data and heading/attitude data are provided by the ADIRS.

This configuration provides for triple redundant information for all inertial and air data functions.

Each channel is isolated from the others and provides independent information.

The ADIRS provides the main air data and heading/attitude/navigation data to the aircraft systems.

The main computers of the ADIRS are the three ADIRUs which are controlled by the ADIRS CDU.

Attitude, heading and navigation data are displayed on the EFIS (**E**lectronic **F**light **I**nstrument **S**ystem) displays (PFD and ND) and on the optional DDRMI (Digital Distance Radio Magnetic Indicator) which recopies the heading data.

MCDU

The **M**ultipurpose MCDUs (**C**ontrol and **D**isplay **U**nits) are normally used to align the Inertial References, to initiate the ADIRU tests and to display ADIRU information.

ADIRS CDU

The ADIRS Control Display Unit is used as a back–up for Inertial Reference alignment. It is also used for mode selection, information display and status indication.

PROBES

The Air Data input parameters, such as total and static pressures, AOA (**A**ngle **O**f **A**ttack) and TAT (**T**otal **A**ir **T**emperature) are sent, from the related probes and sensors, to the three ADIRUs.

NOTE: Static and total pressure are sent to the ADIRUs via the ADMs.

FCU

The ADIRUs receive, from the FCU (**F**light **C**ontrol **U**nit), the Baro correction set by the crew.

GPS

The GPS (**G**lobal **P**ositioning **S**ystem) provides data to the ADIRS, mainly A/C position and speed. The ADIRUs process the GPS data and provides pure GPS data, pure IR data and hybrid GPS/ADIRS data to users.

DMC

The DMCs (**D**isplay **M**anagement **C**omputers) 1 and 2 receive their data from their related ADIRU and from ADIRU3.

The DMC3 receives information from all three ADIRUs, to operate as a back–up in case of DMC1 or 2 failure.

DMC/PFD & ND

ADIRU 1 and 2 display information via DMC 1 and 2, on the corresponding PFD and ND. ADIRU3 operates as a back–up in case of ADIRU1 or 2 failure.

ADIRS SWITCHING

Basically, ADIRU1 is associated to the captain instruments, ADIRU2 to the first officer instruments and ADIRU3 is in standby.

In case of failure of the ADR (**A**ir **D**ata **R**eference) or IR (**I**nertial **R**eference) function of ADIRU1 or 2, the affected instruments and displays may be manually switched independently to ADIRU3 by means of selector switches.

USERS

The ADIRUs are directly connected to many other user systems.

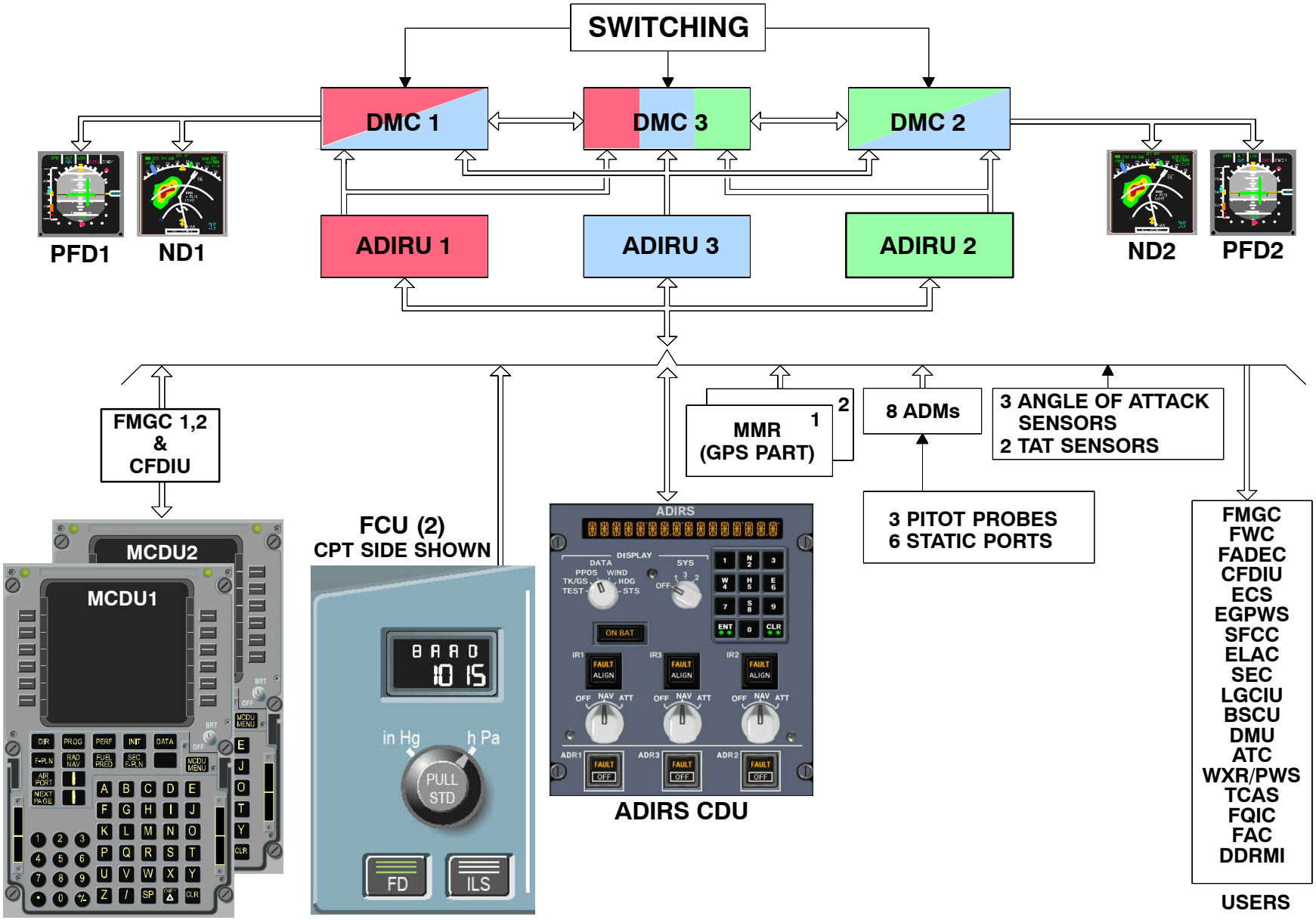


Figure 3 ADIRS System General

ADIRS SYSTEM OPERATION

Description

The main air data and heading/attitude data are provided by the ADIRS.

This configuration provides for triple redundant information for all inertial and air data functions.

Each channel is isolated from the others and provides independent information.

The ADIRS provides the main air data and heading/attitude/navigation data to the aircraft systems.

The main computers of the ADIRS are the three ADIRUs which are controlled by the ADIRS CDU.

Attitude, heading and navigation data are displayed on the EFIS displays Primary Flight Display, Navigation Display and on the VOR/DME RMI (DDRMI) which recopies the heading data.

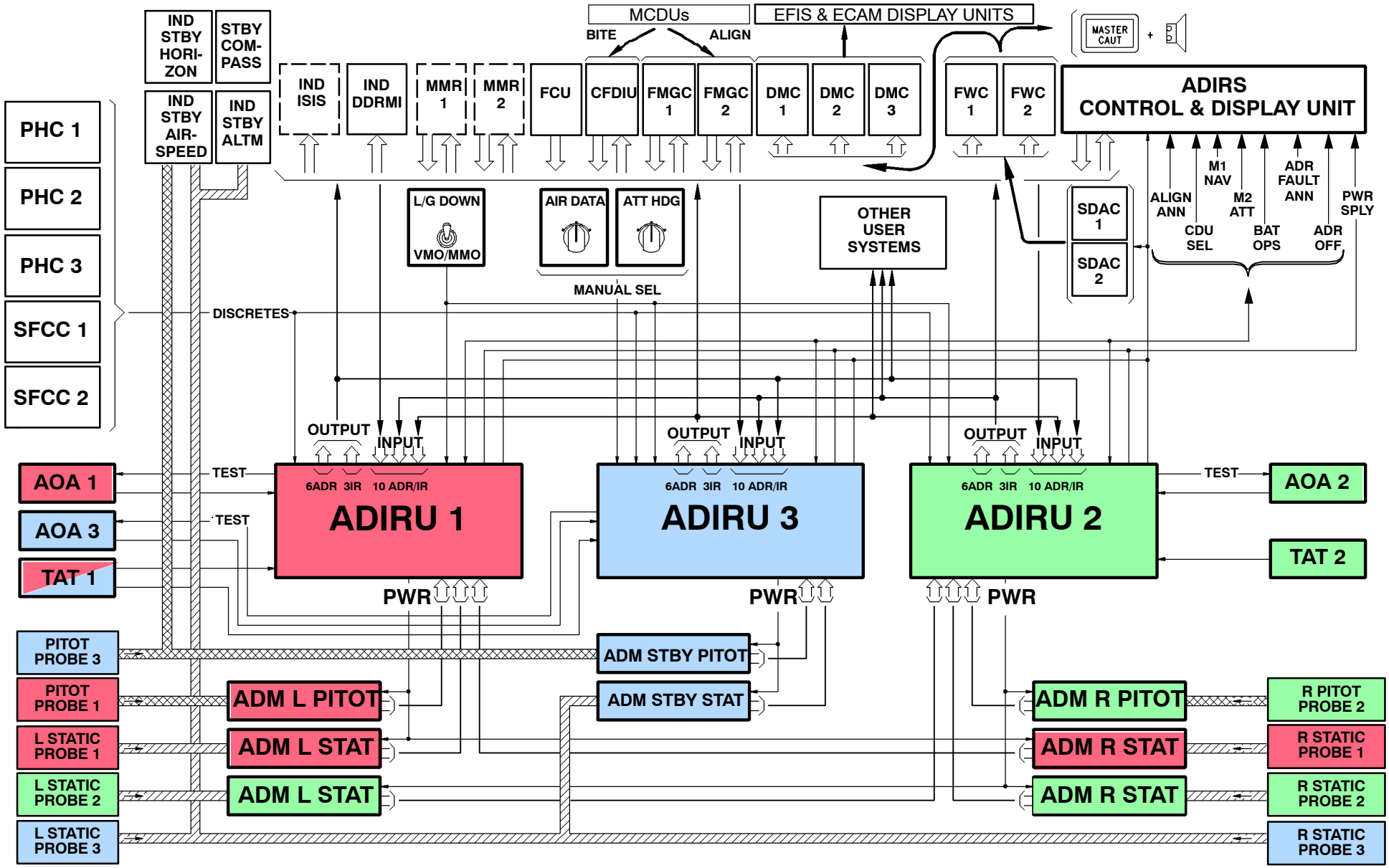


Figure 4 ADIRS System Schematic

ADIRS CDU PRESENTATION

Description

The ADIRS CDU located on the overhead panel provides the controls and indicators to permit:

- selection of power supplies to the ADR and IR systems
- selection and display of navigation data
- manual initialization (normally performed through the FMGC)
- status and fault indication of IRs or ADRs.

1 IR 1(2)(3) Mode Rotary Selector

- OFF:

  The ADIRU is not energized. ADR and IR data are not available.
- NAV:

  Normal mode of operation. Supplies full inertial data to aircraft systems.
- ATT:

  IR mode supplies only attitude and heading information, if the system loses its ability to navigate. The heading must be entered through the CDU keyboard and has to be reset frequently (about every 10 minutes)

2 IR 1 (2) (3) Light

- FAULT:

  Comes on amber associated with an ECAM caution when a fault affects the respective IR.
- Steady:

  The respective IR is lost.
- Flashing:

  The attitude and heading information may be recovered in ATT mode.
- ALIGN:

  When steady the respective IR is operating normally in align mode. Flashing if case of IR alignment fault, or no present position entry after 10 min, or difference between position at shutdown and entered position exceeds 1DEG of latitude or longitude.

  Extinguished when alignment has been completed.

3 ON BAT Light

Comes on amber when one or more IRs is supplied only by the a/c battery. It also comes on for a few sec at the beginning of the alignment, but not for a fast realignment.

NOTE: If at least one ADIRU is supplied by aircraft batteries on ground an external horn sounds and the ADIRU and AVNCS light comes on amber on the EXTERNAL POWER panel.

4 DATA Selector Knob

This knob selects the information to be displayed in the ADIRS display window.

- TEST:

  The ENT and CLR buttons on the keyboard come on, and in the display all segments illuminate.
- TK/GS:

  The display shows true track and ground speed.
- PPOS:

  The display shows present latitude and longitude
- WIND:

  The display shows true wind direction and speed.
- HDG:

  The display shows true heading and the minutes remaining until alignment is completed.
- STS:

  The display shows an action code.

5 SYS Selector Knob

- OFF:

  The CDU display is not energized. ADIRS are still energized if the associated IR mode rotary selectors are not at OFF.
- 1.2.3:

  System selected for data display.

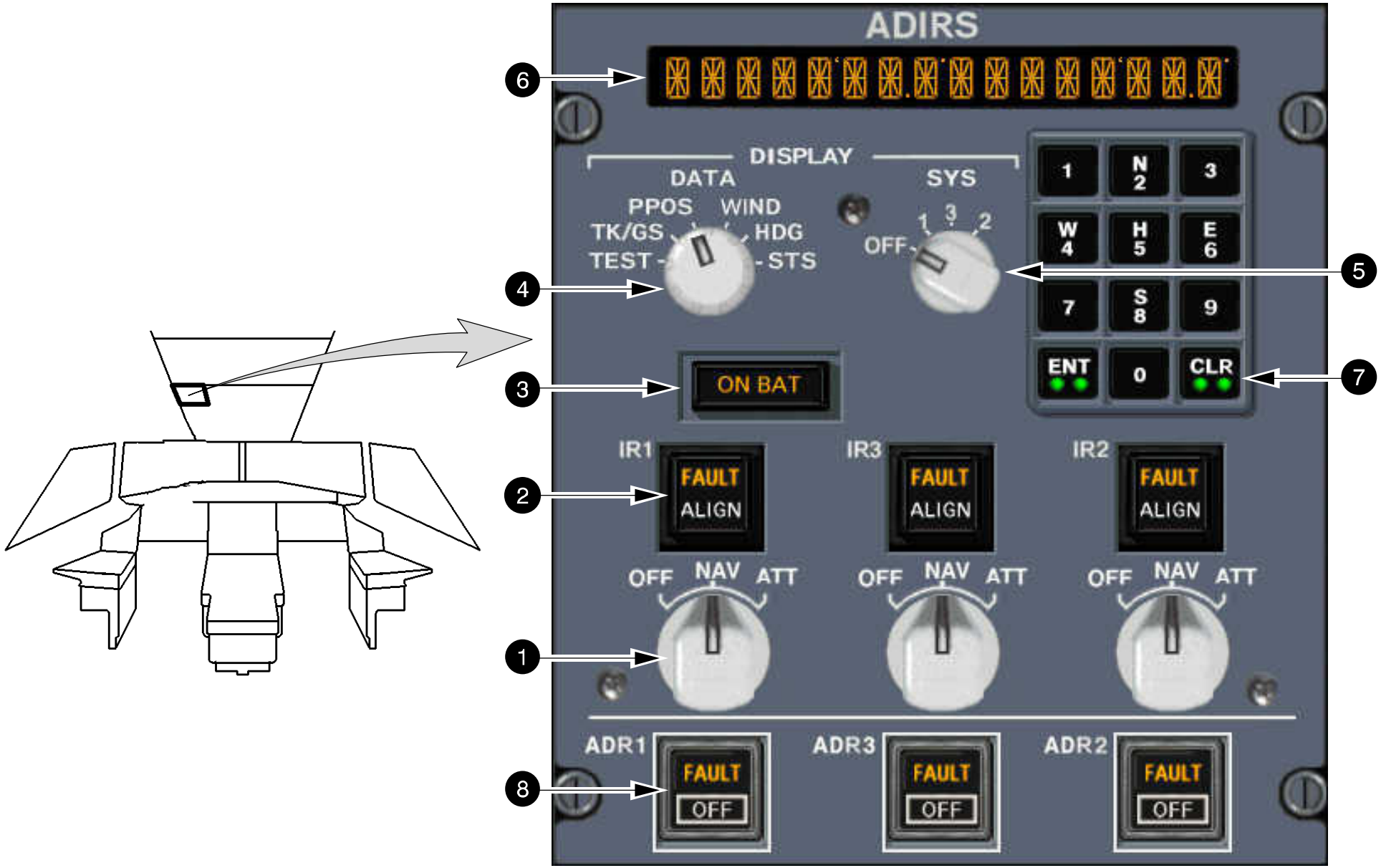


Figure 5 ADIRS Control and Display Unit

6 Display

The display presents the data selected by the DATA selector. A keyboard entry overrides the selected display.

7 Keyboard

The flight crew can use the keyboard to enter the present position, or the heading in ATT mode, into the selected system.

- **Letter Keys:**

  Used to enter N, S, E, or W for position, or entering H for heading (ATT mode).
- **Number keys:**

  Used to enter the present position (or the present magnetic heading in ATT mode).
- **CLR key:**

  The integral cue light comes on after an entry operation, if the data has an unreasonable value. Pressing this key clears the data display, that has been keyed in but not yet entered.
- **ENT Key:**

  The integral cue light comes on when a crew member has keyed in a number for N, S, W, E or H. Pressing the key enters data into the ADIRS.

8 ADR 1 (2) (3) P/BSW (Momentary Action)

- **OFF:**

  Air data output disconnected.
- **FAULT:**

  This amber light comes on with an ECAM caution, if a fault is detected in the air data reference part.

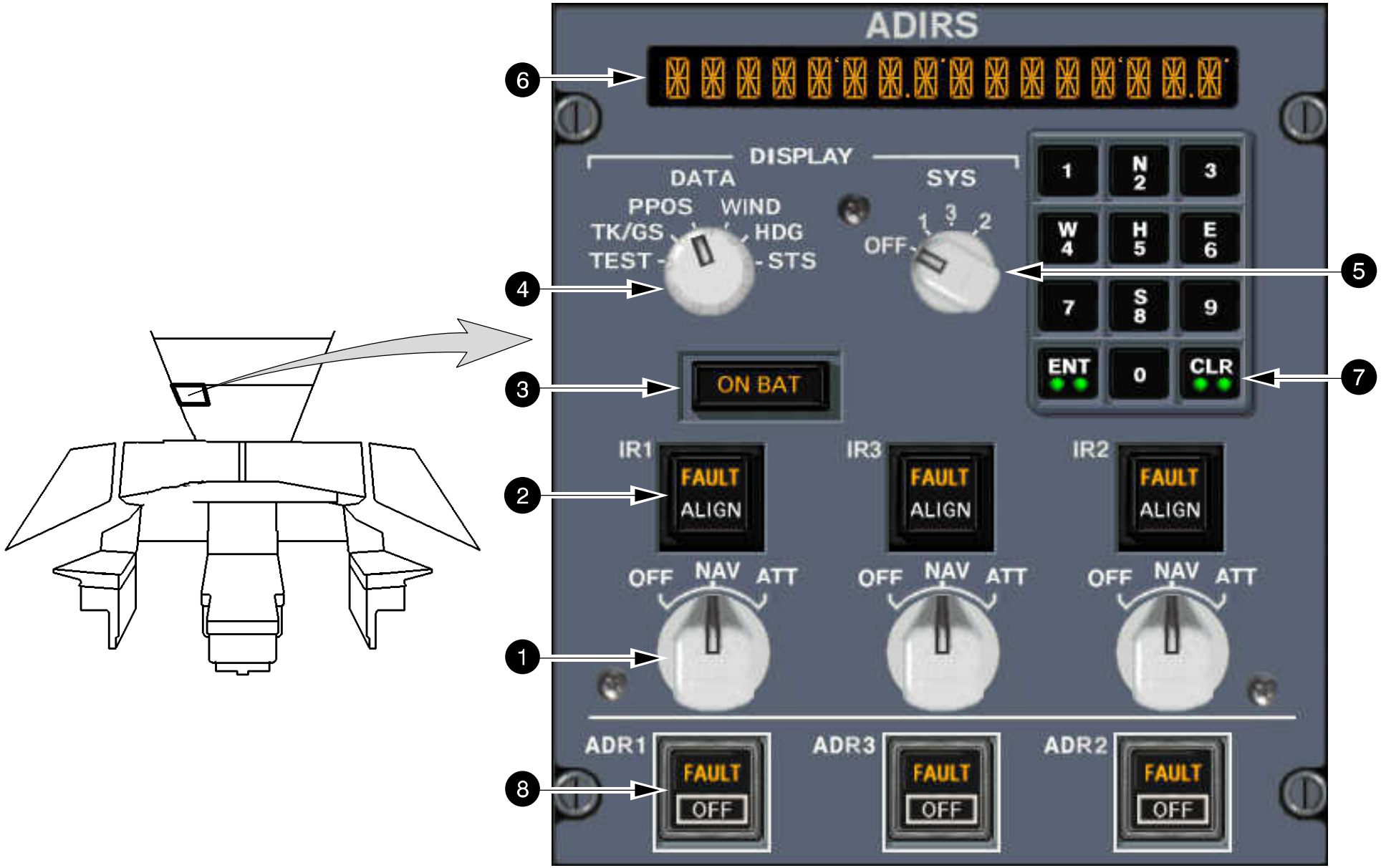


Figure 6 ADIRS Control and Display Unit

ADIRS MODE SELECTOR UNIT (MSU)

1 ON BAT LIGHT

Comes on amber when one or more IRS is supplied only by the aircraft battery. It also comes on for a few seconds at the beginning of the alignment but not for a fast realignment.

NOTE: If, when the aircraft is on the ground, at least one ADIRU is supplied by aircraft batteries :
An external horn sounds. The ADIRU light comes on amber on the EXT PWR panel.

2 IR 1, (2), (3) P/B SWITCH

- **OFF (released out)**

  Inertial data output disconnected.
- **FAULT LIGHT**

  This amber light comes on with an ECAM caution when a fault affects the respective IR.
  Steady: The respective IR is lost.
  Flashing: The attitude and heading information may be recovered in ATT mode.

3 IR 1, (2), (3) MODE ROTARY SELECTOR

- **OFF**

  The ADIRU is not energized.
  ADR and IR data are not available.
- **NAV**

  Normal mode of operation.
  Supplies full inertial data to aircraft systems.
- **ATT**

  IR mode supplying only attitude and heading information if the system loses its ability to navigate.
  The heading must be entered through the MCDU and has to be reset frequently (about every 10 minutes).

4 ADR 1, (2), (3) P/B SWITCH

- **OFF (released out)**

  Air data output disconnected.
- **FAULT LIGHT**

  This amber light comes on with an ECAM caution if a fault is detected in the air data reference part.

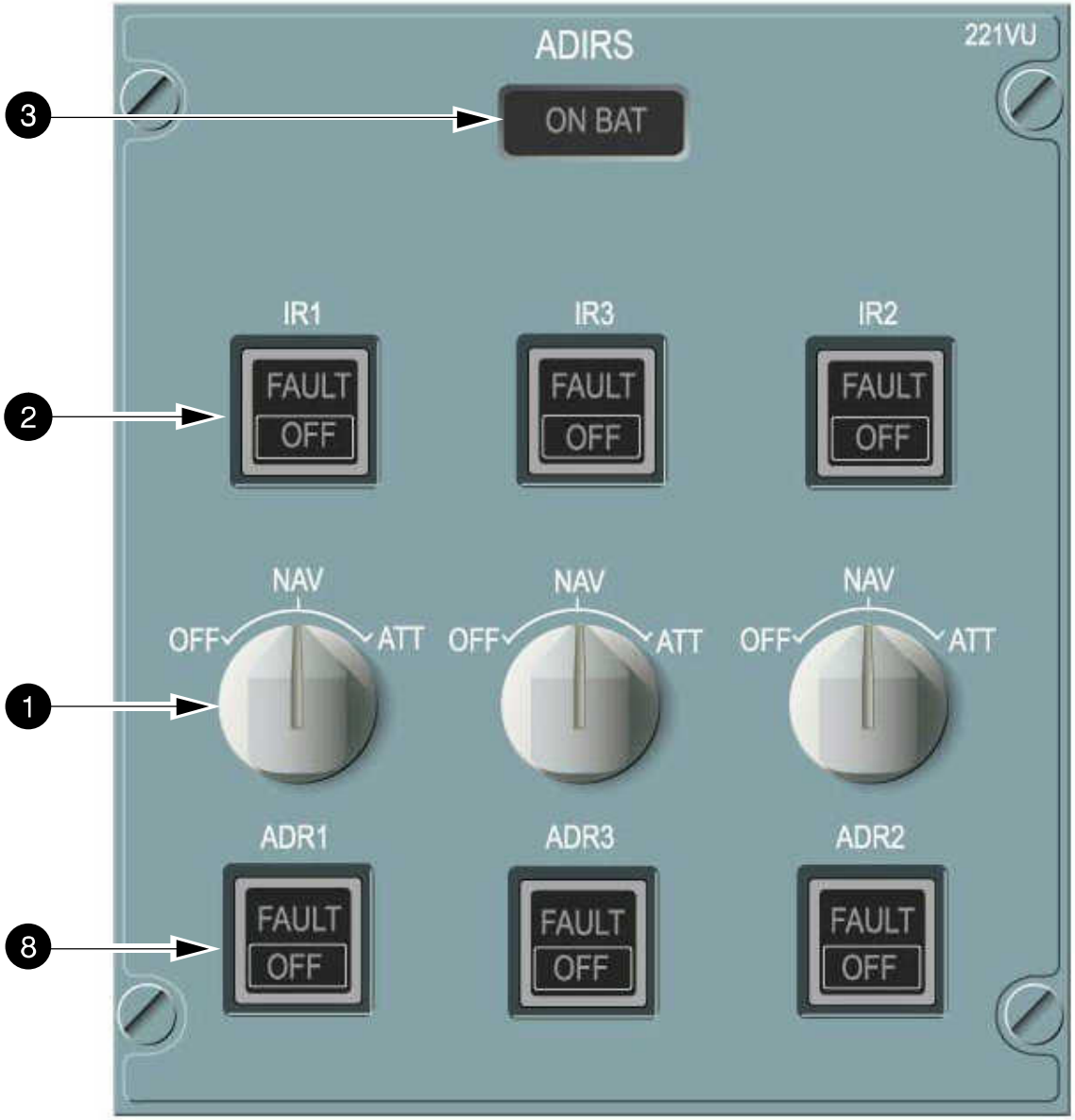


Figure 7 ADIRS Mode Selector Unit (MSU)

SWITCHING PANEL FUNCTION

The two selector switches AIR DATA and ATT HDG are rotary selector switches with 3 positions:

- CAPT/3, NORM and F/O/3.

  These selector switches are used for the functions listed below.

ATT HDG AND AIR DATA SEL

NORM:

- ADIRU 1 supplies data to PFD 1, ND 1, RMI and VOR/DME.

  ADIRU 2 supplies data to PFD 2, and ND 2.

CAPT 3:

- ADR 3 or IR 3 replaces ADR 1 or IR 1.

F/0 3:

- ADR 3 or IR 3 replaces ADR 2 or IR 2.

  AIR DATA SEL SW 1:

  - 34–14–00 Selection of the ADR used by IR3
  - 34–52–00 ATC mode S
  - 31–68–00 DMC
  - 22–85–00 FMGC

  ATT HDG SEL SW:

  - 34–11–00 Power Supply
  - 34–14–00 Selection of the ADR used by IR3
  - 34–41–00 Weather Radar
  - 34–57–00 VOR/DME RMI
  - 31–68–00 DMC
  - 22–85–00 FMGC
  - 34–15–00 GPS

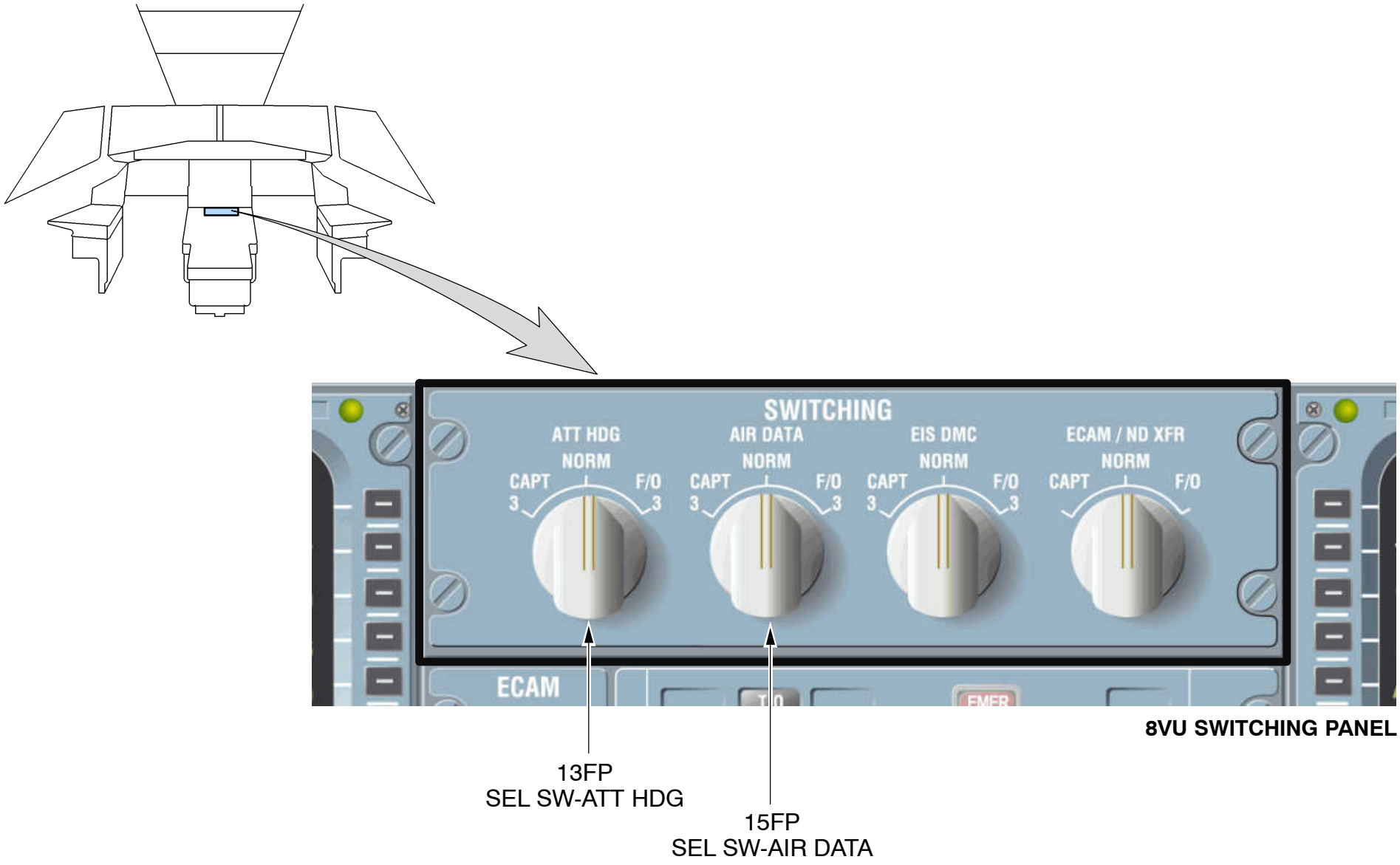


Figure 8 Switching Panel

ADIRS COMPONENT LOCATION

The 3 ADIRUs are installed in the Avionic Compartment.

The ADIRS CDU is installed in the Cockpit.

Two different types of ADIRUs may be installed in the aircraft, one is the Honeywell System, the other the Litton System.

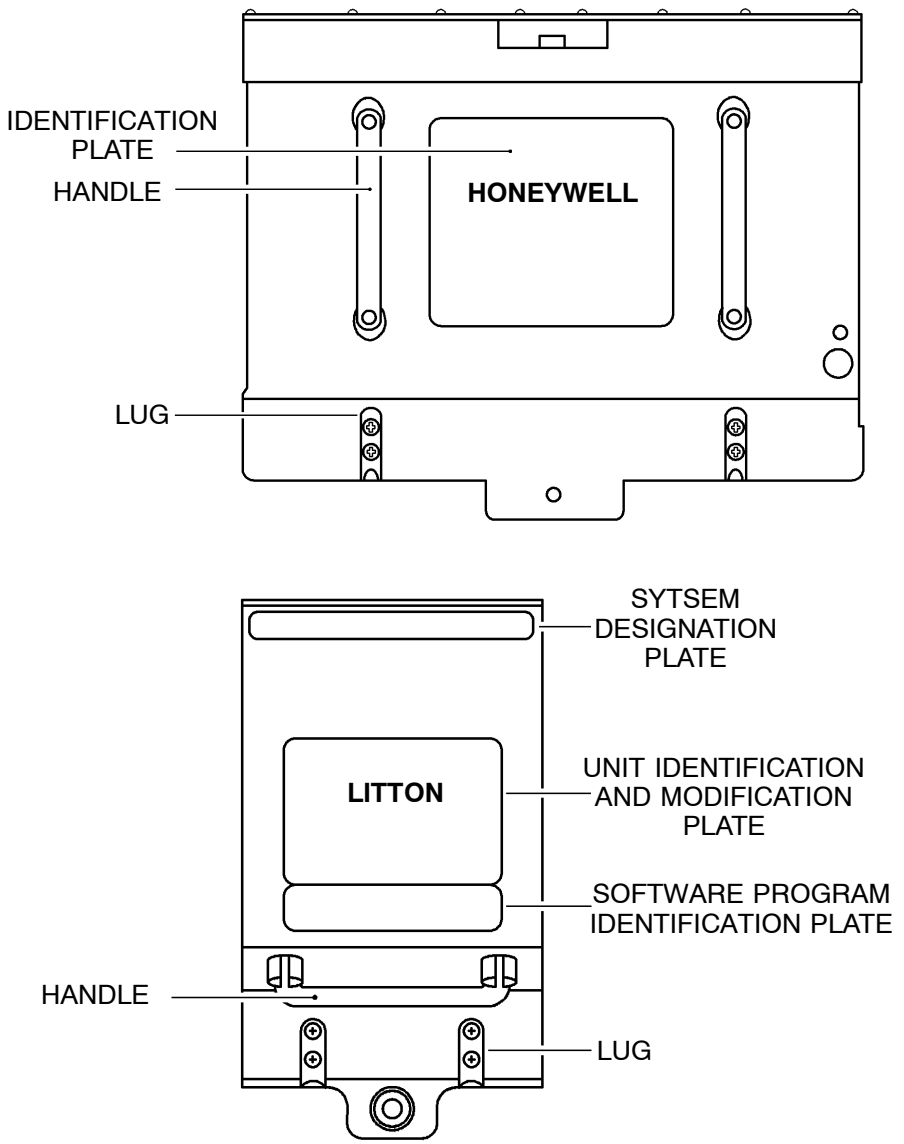


Figure 9 ADIRS Component Presentation

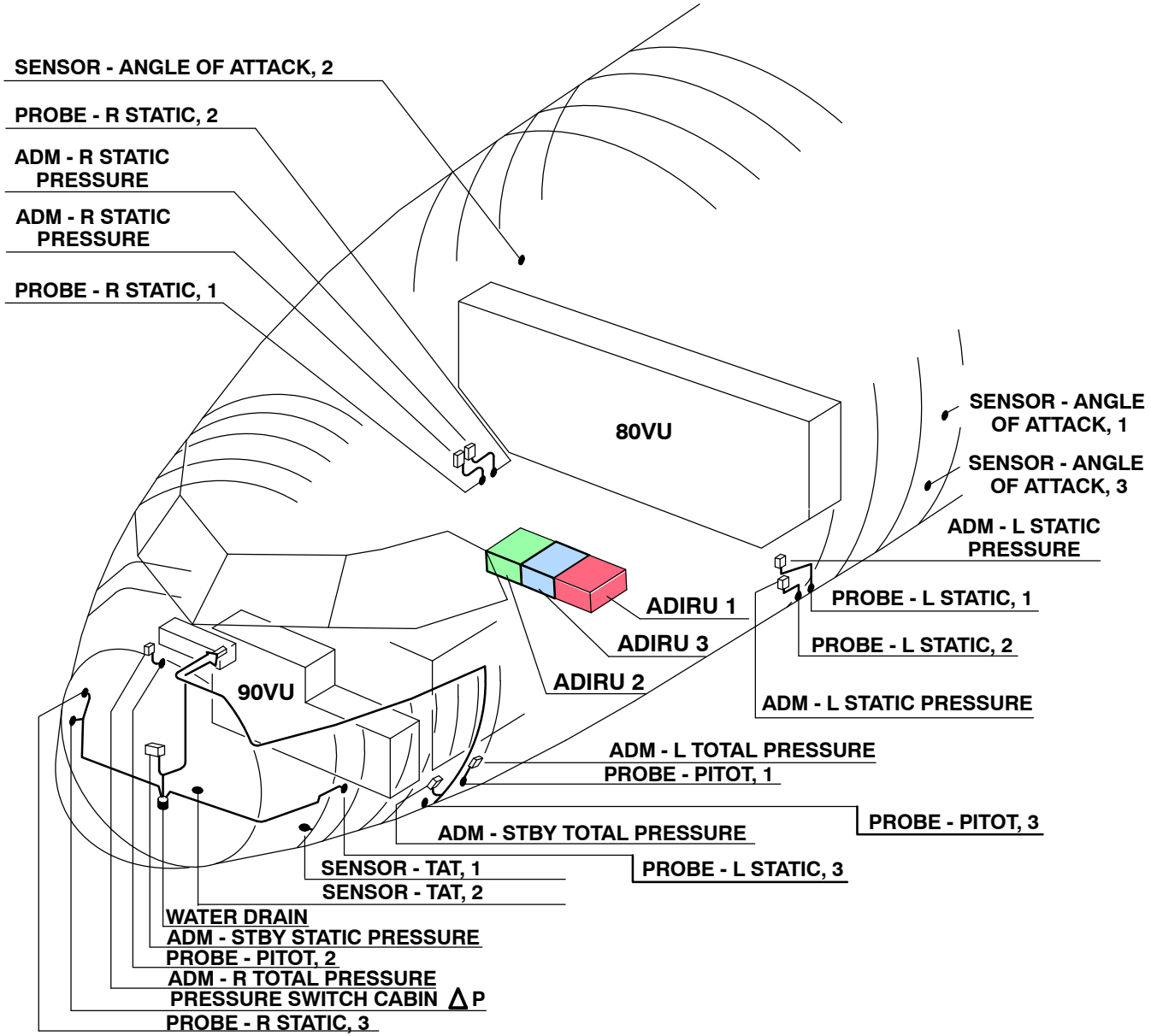


Figure 10 ADIRS Component Location

IR COMPONENTS GENERAL

IR STRAPDOWN

In a strapdown IRS (**I**nertial **R**eference **S**ystem) the gyros and the accelerometers are solidly attached to the aircraft structure.

The strapdownlaser gyro supplies directly accelerations and angular speeds

RING LASER GYRO

The three ring LASER (**L**ight **A**mplification **S**timulated **E**mission of **R**adiation) gyros, one for each rotation axis, give inertial rotation data and are composed of two opposite LASER beams in a ring.

At rest, the two beams get to the sensor with the same frequency. An aircraft rotation creates a difference of frequencies between the two beams.

The frequency difference is measured by optical means providing an analog output, which is sent to an analog/digital converter. After computation this output will provide rotation information.

NOTE: The schematic below describes very briefly the function of a laser gyro.

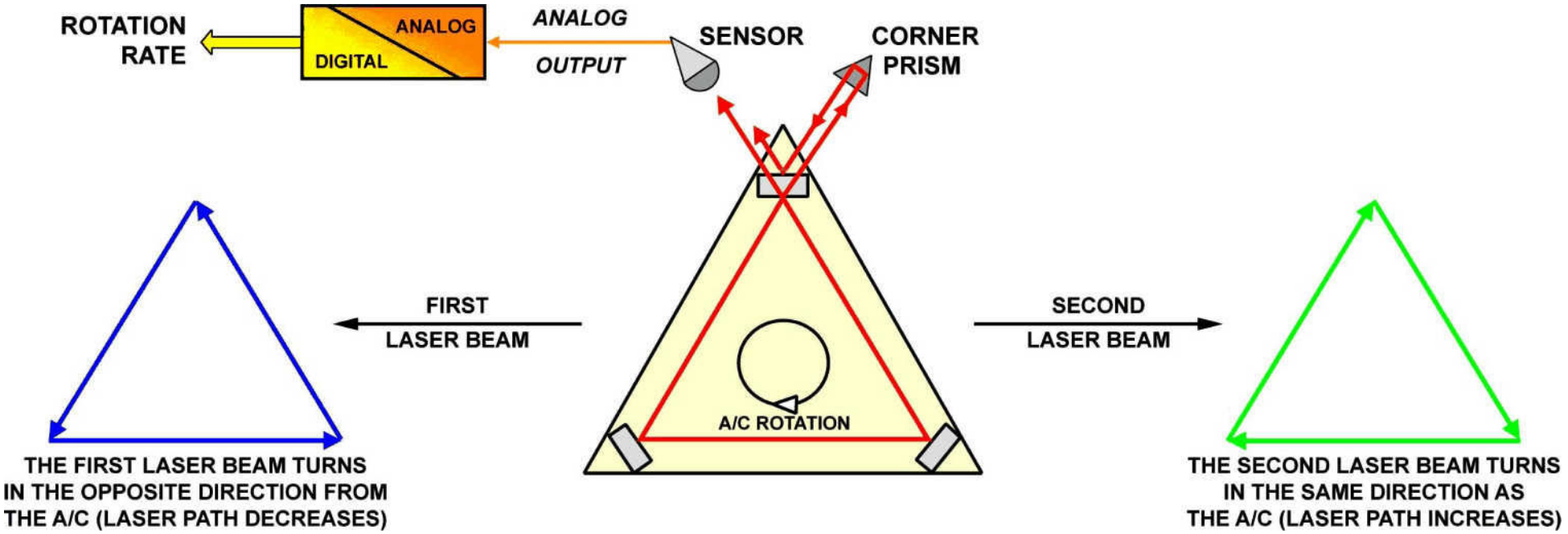


Figure 11 Ring Laser Gyro

ACCELEROMETERS

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

The acceleration signal is sent to an analog/digital converter.

The digitized signal is then sent to a processor, which uses this signal to compute the velocity and the position.

IR COMPUTATION

Each ADIRU computes the LASER gyro and the accelerometer outputs to provide IR data to users.

NOTE: The three LASER gyros and the three accelerometers are installed in the IR Part inside the ADIRU.

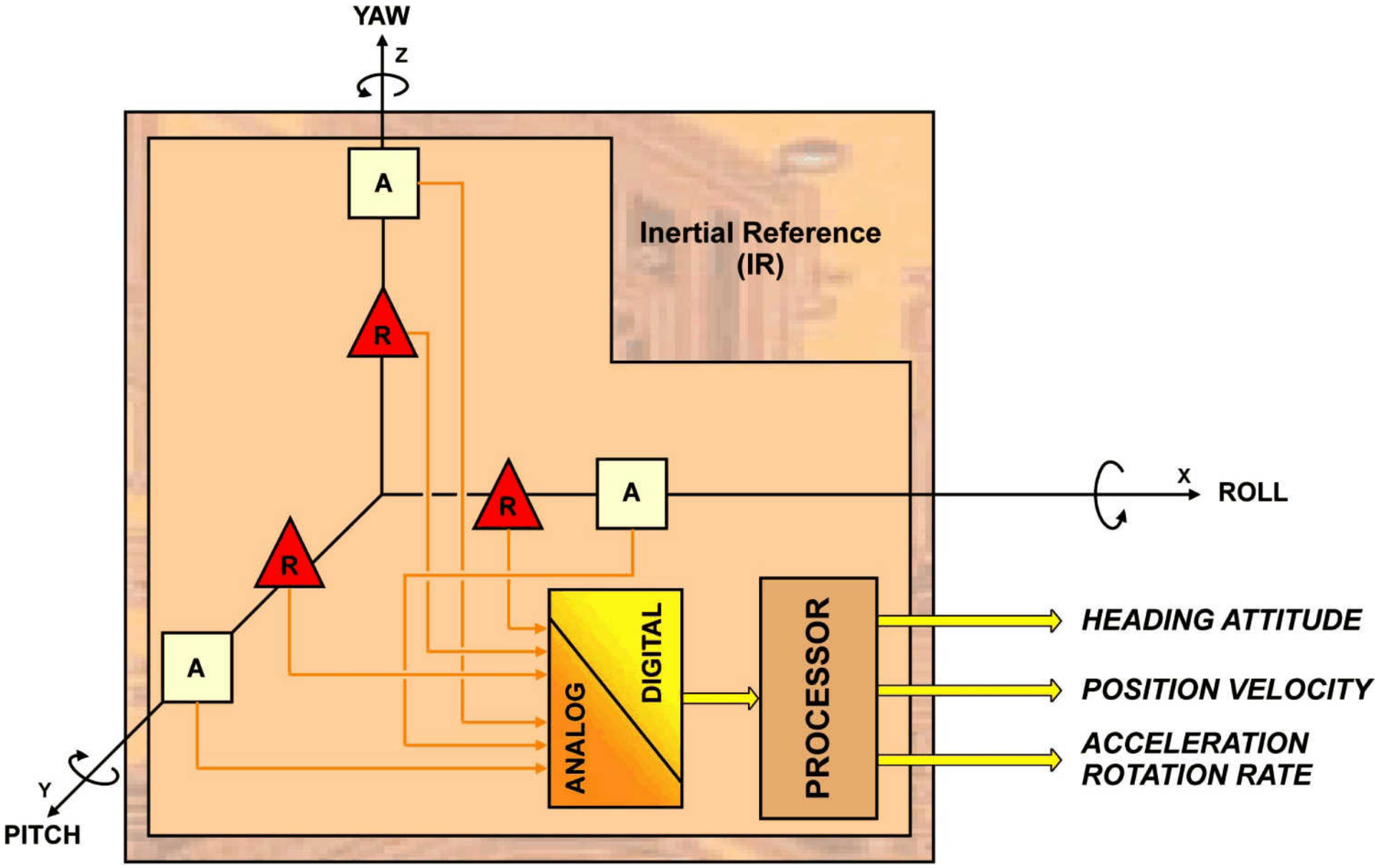


Figure 12 Accelerometers and IR Computation

AIR DATA INDICATION ON PFD, ND & ECAM

ALT, CAS, Mach number, V/S & TAS

ALT (**ALT**itude), CAS (**C**omputed **A**ir **S**peed), M (**M**ach number) and BARO V/S (**V**ertical/**S**peed) are computed by the ADIRU (ADR portion), processed by the associated DMC and displayed on the PFDs.

TAS (True Air Speed) is supplied in the same way but is displayed on the NDs.
In normal EIS configuration, with the AIR DATA selector switch in NORM position,

- the ADR1 displays information on CAPT PFD and ND.
- the ADR2 displays information on F/O PFD and ND.

SAT and TAT

SAT (**S**tatic **A**ir **T**emperature) and TAT (**T**otal **A**ir **T**emperature) are also supplied in the same way but are permanently displayed on the lower part of the lower ECAM DU.

These items of information are displayed by:

- the ADR 2 on the classic EIS 1
- and from ADR 1 on the enhanced EIS 2.

ISA (OPTION)

TAT (Total Air Temperature) and SAT (Static Air Temperature) are displayed in green. ISA (International Standard Atmosphere temperature) is displayed in GREEN, in standard altitude mode and when SAT is valid.

PFD DISPLAY

Computed Airspeed

The CAS indication is displayed in analog form by means of a white tape with graduations every 10 knts and digital values every 20 knts.

This tape moves up and down so as to indicate the A/C actual speed value in front of a fixed yellow reference line. The displayed part of the scale represents an **84 kts range**. The scale is graduated from 30 kts to 520 kts and the digital values from 40 to 520 kts.

CAS can never be displayed lower than 30 kts.

In case of computed airspeed failure, the speed scale goes out of view and is replaced by a red SPD flag.

Mach

When the Mach number is above 0.5, it is displayed just below the speed scale.

In case of failure, a red MACH flag is presented.

Altitude

The baro altitude indication is provided by means of a tape which moves up and down behind a window within which the A/C actual altitude is displayed. The tape of the scale is graduated every 100 ft and digital values are displayed every 500 ft in hundreds.

The A/C actual altitude is provided by a counter located at the middle of the scale in which the actual value is displayed in green digits.

The hundreds of feet are written in a large size whereas the tens and units are displayed by a drum operating as a classical mechanical altimeter.

Small white marks are positioned in front of each number on the tape.
If the altitude is negative, a NEG white indication is added at the left of the digital value. The digital value is limited to minus 1500 ft .

Different displays are presented depending on the baro setting reference (standard or baro corrected).

In case of baro altitude failure, the scale goes out of view and a red ALT flag flashes for a few seconds in the altitude window then remains steady.

In case of discrepancy between the altitude given by the CAPT air data source and the altitude given by the F/O air data source, a CHECK ALT amber flag is presented on the right side of the altitude scale.

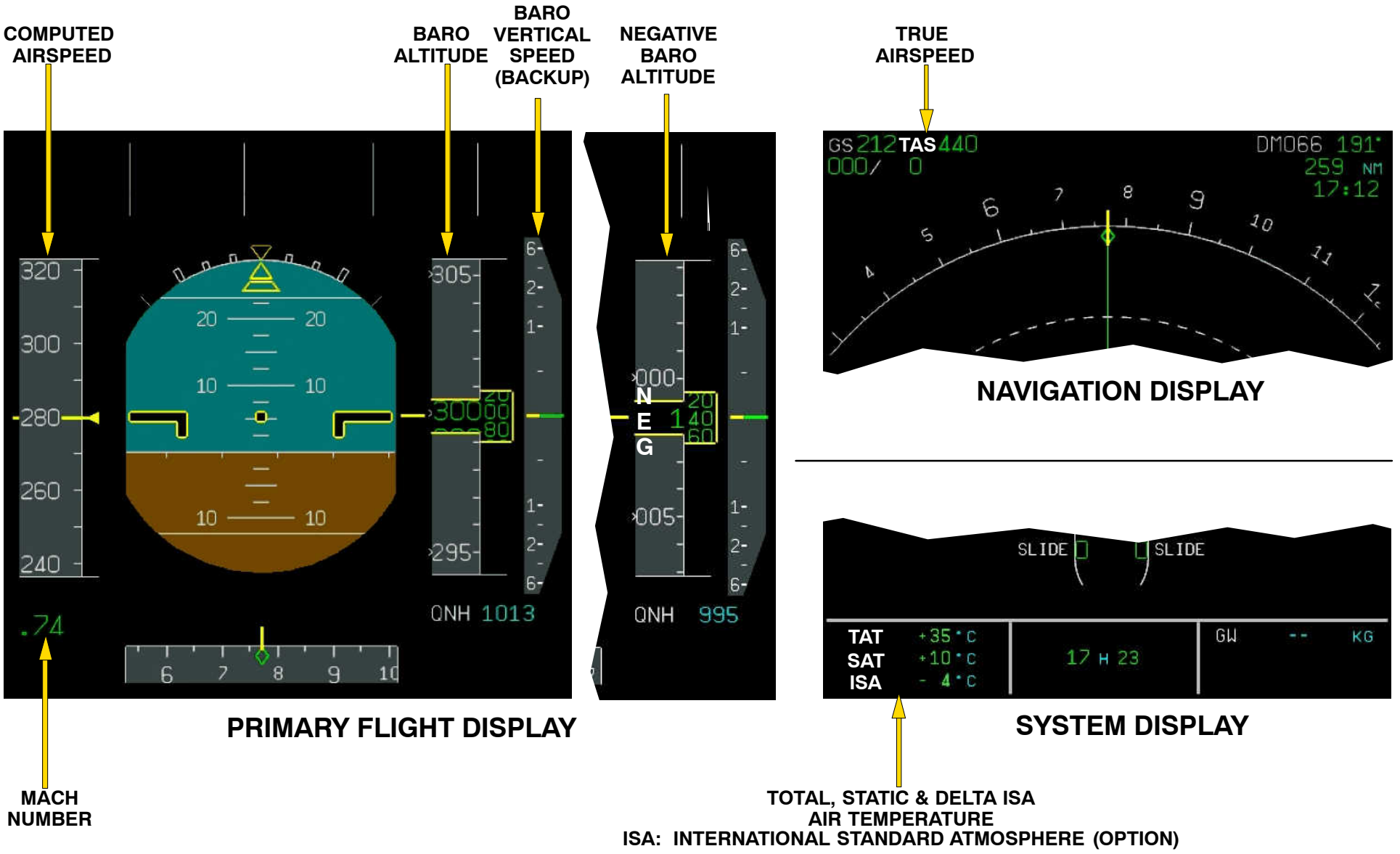


Figure 13 Air Data Indication (1)

Vertical Speed

The baro vertical speed is automatically displayed in the right side of the PFD when the inertial vertical speed is not available.

NOTE: This is a *degraded* mode**.**

The vertical speed scale consists of:

- a trapezoidal grey background colored surface
- a fixed white scale with 500 ft/min. spaced marks from –2000 ft/Min to +2000 ft/mn
- a needle giving in analog form the actual vertical speed value
- a number in a moving amber window.

  This window accompanies the needle (above the needle if V/S > 0, below if V/S < 0).

  The number gives the V/S value in hundreds of ft/mn.

  Between –200 ft/mn and +200 ft/mn, both the window and the number disappear.
- above +6000 ft/mn (or below –6000 ft/mn), the needle remains stopped where it is.

  When the vertical speed exceeds +6000 ft/mn or –6000 ft/mn, the digital indication and the analog needle change from green to amber.

  In addition, those indications change to amber in approach, in the following cases:
  - V/S less than –2000 ft/mn below 2500 ft RA
  - V/S less than –1200 ft/mn below 1000 ft RA.

  In case of a failure warning, the vertical speed scale is removed and replaced by a red V/S flag which flashes for a few seconds then remains steady.

ND DISPLAY

The TAS is displayed on the ND in ROSE, ARC and PLAN Mode.

The TAS information is displayed by a numerical indication of 3 digits preceded by TAS indication. This information is displayed in the left upper corner of the ND for speed higher than 100 kts.

Below this value TAS indication remains visible but is followed by three dashes.

ECAM SD DISPLAY

The SAT (Static Air Temperature) and the TAT (Total Air Temperature) are permanently displayed on the lower part of the lower ECAM DU by a numerical indication of two digits preceded by the plus or minus sign.

The DELTA ISA (International Standard Atmosphere) temperature indication is optional. It is the difference between the measured SAT and the temperature which should be normally at this altitude according to the International Standard Atmosphere calculation.

On aircraft equipped with EIS 1 these data are delivered by the ADR 2.

When they are equipped with EIS 2 (enhanced) these data are provided by ADR 1. For details refer to ATA 31–60.

In case of failure or when NCD (No Computed Data) information is received from the ADR, these data are replaced by crosses.

RECONFIGURATION DISPLAY

In case of loss of AIR DATA parameters on CAPT or F/O PFD and ND the ADR 3 can be used as a back up source by placing the AIR DATA selector switch in CAPT-3 position for EFIS 1 and F/O-3 position for EFIS 2.

In case of loss of TAT/SAT parameters on the lower ECAM DU the ADR 3 can be used as a back up source by placing the AIR DATA selector switch in F/O-3 position on EIS 1 or CAPT-3 on EIS 2 (enhanced).

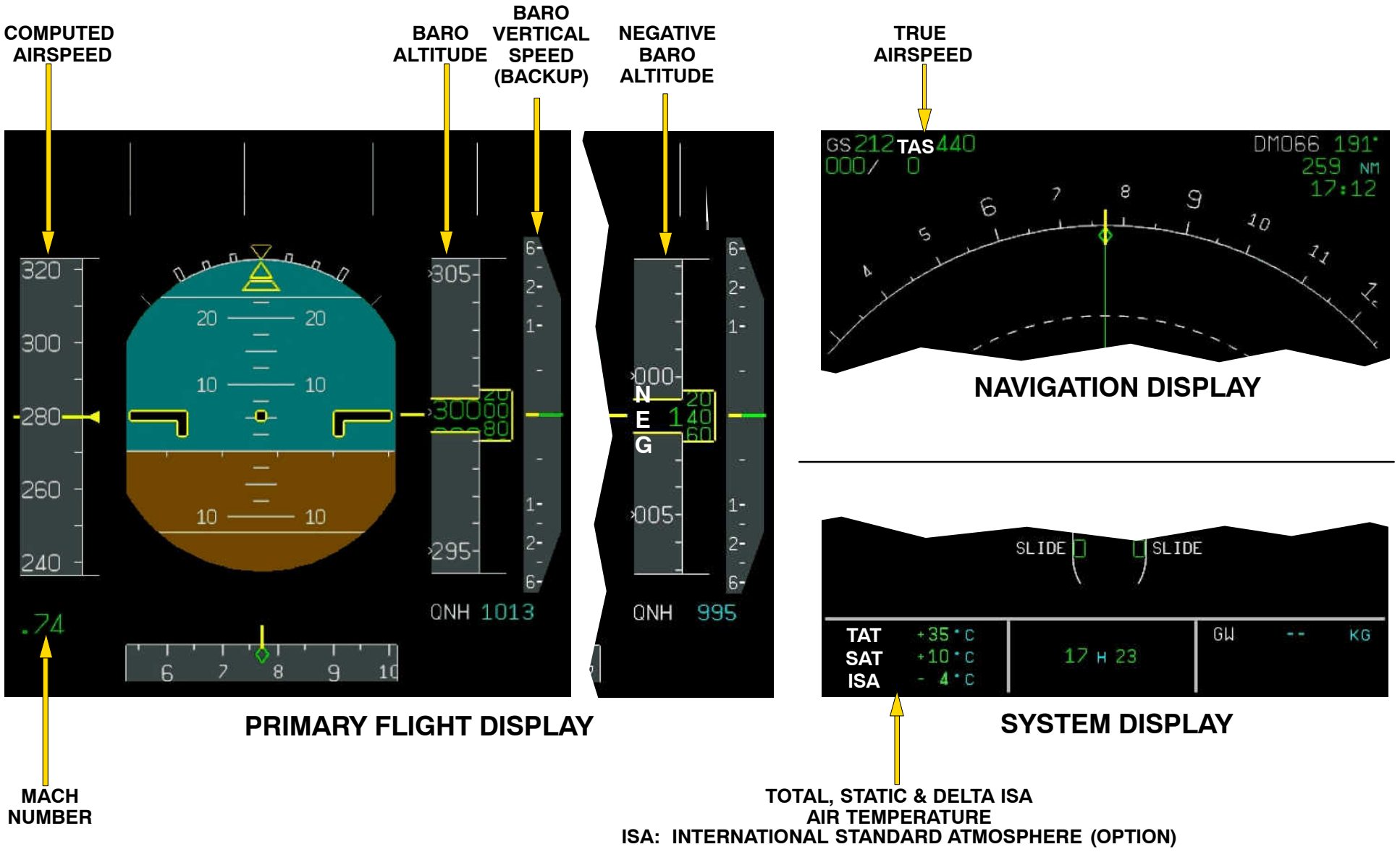


Figure 14 Air Data Indication (2)

AIR DATA FLAGS

ALT (**ALT**itude), CAS (**C**omputed **A**ir**S**peed), M **(M**ach number) and BARO V/S (**V**ertical **S**peed) are computed by the ADIRUs (ADR portion), processed by the associated DMCs and displayed on the PFDs.

TAS (**T**rue **A**ir **S**peed) is supplied in the same way but is displayed on the NDs. In normal EIS 1 configuration, with the AIR DATA selector switch in NORM position, the ADR 1 displays information on CAPT PFD and ND.

The ADR 2 displays information on F/O PFD and ND.

SAT (**S**tatic **A**ir **T**emperature) and TAT (**T**otal **A**ir **T**emperature) are also supplied in the same way but are permanently displayed on the lower part of the lower ECAM DU.

These items of information are displayed by the ADR 2.

PRIMARY FLIGHT DISPLAY

Computed Airspeed

In case of computed airspeed failure, the speed scale goes out of view and is replaced by a red SPD flag.

Mach

In case of failure, a red MACH flag is presented.

Altitude

In case of baro altitude failure, the scale goes out of view and a red ALT flag flashes for a few seconds in the altitude window then remains steady.

In case of discrepancy between the altitude given by the CAPT air data source and the altitude given by the F/O air data source, a CHECK ALT amber flag is presented on the right side of the altitude scale.

NAVIGATION DISPLAY

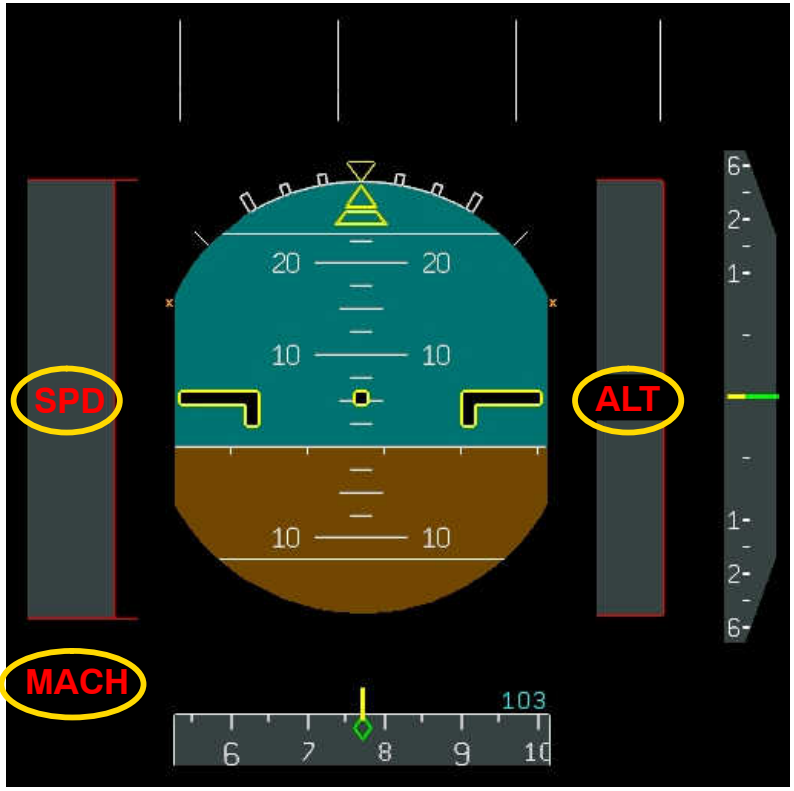
TAS

In case of true airspeed failure, the value goes out of view.

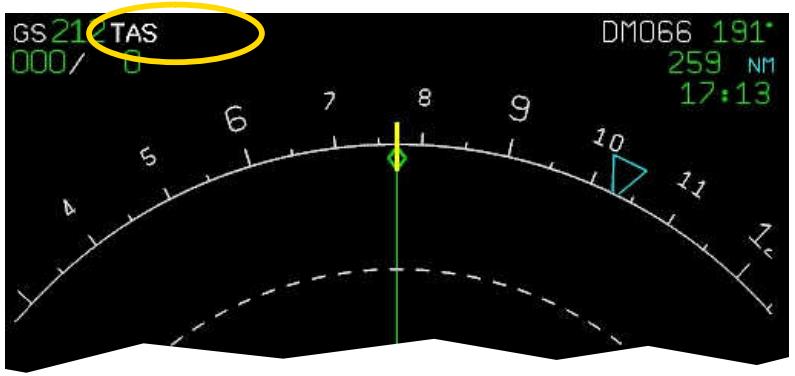
NOTE: There is no red TAS flag.

SYSTEM DISPLAY

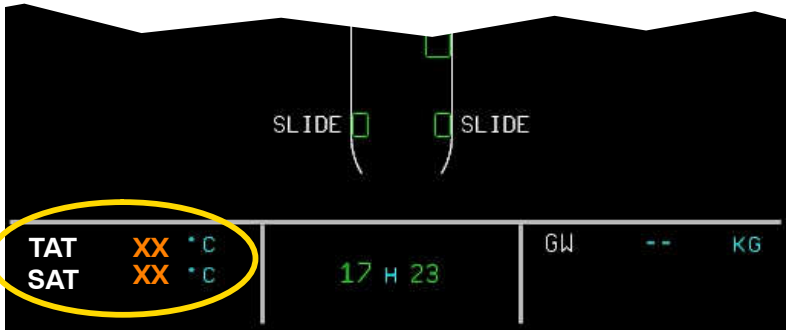
In case of TAT & SAT failure, the indication shows amber crosses.



PRIMARY FLIGHT DISPLAY



NAVIGATION DISPLAY



SYSTEM DISPLAY

Figure 15 ADR Flags

BACK UP SPEED SCALE (BUSS), (OPTIONAL)

GENERAL

In order to decrease the crew workload in case of unreliable speed, Airbus has developed the Back–UP Speed Scale (BUSS) that replaces the pitch and thrust table. The BUSS is optional on A320.

This indication is based on angle of attack (AOA) sensor information, and is therefore not affected by erroneous pressure measurements.

The BUSS comes with a **new ADIRU standard** (among other new system standards), where the AOA information is provided through the IR‘s and nor through the ADR‘s. This enables selecting all ADR‘s off without loosing the STALL WARNING PROTECTION.

The AOA information provides a guidance area in place of the speed scale.

When the crew selects all ADR‘s OFF, then:

- The Back–Up Speed Scale replaces the PFD speed scale on both PFD‘s,
- GPS Altitude replaces the Altitude Scale on both PFD‘s.

INDICATION

The Back–Up Speed Scale then enables to fly at a safe speed, i. e. above stall speeds, by adjusting thrust and pitch.

The BUSS will be displayed once all ADR‘s are switched OFF.

Therefore, on aircraft that have the BUSS, when the flight crew cannot identify the faulty ADR(s) when performing the troubleshooting, or when all ADR‘s are affected, the flight crew will switch OFF ADR‘s, and will fly the green area of the BUSS.

However, if the safe conduct of the flight is affected, the memory items must still be applied before troubleshooting.

As the BUSS is associated to the ADR monitoring functions, some unreliable speed situations can be automatically detected (e. g. new ECAM warning ”NAV ADR 1+2+3 FAULT”), and some ECAM procedures will lead to the BUSS activation by requesting to switch OFF all ADR‘s.

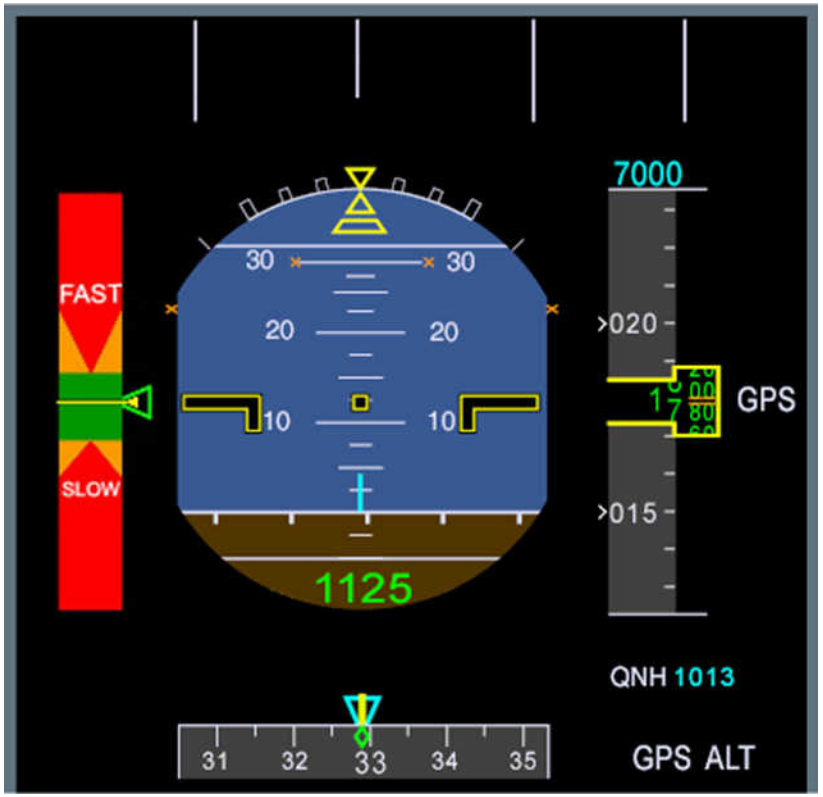
Conclusion

An unreliable speed situation may be difficult to identify, due to the multiple scenarios that can lead to it. Therefore, training is a key element: indeed the flight crew’s ability to rapid detected the abnormal situation, and to correctly handle it, is critical.

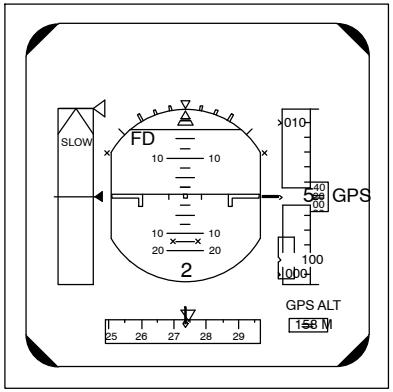
In case of any doubt, the pilot should apply the pitch/thrust memory items, and then refer to the QRH to safely fly the aircraft, and to positively determine the faulty source(s) before eliminating it (them).

In addition, to further assist the pilot in detecting the failure and safely fly the aircraft, Airbus has developed the BUSS, which provides a safe flying range indication.

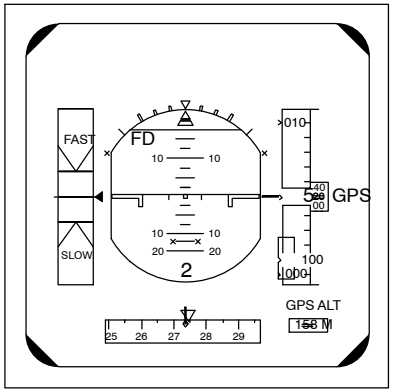
Finally, to reduce the probably of experiencing unreliable speed situations, on–ground actions, such as comprehensive maintenance and through pre–flight exterior inspection, should be stressed.



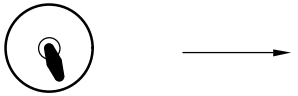
IF A MINIMUM OF TWO AOA SENSORS ARE IN UP POSITION



IF THE THREE AOA SENSORS ARE IN THE MIDDLE POSITION



IF A MINIMUM OF TWO AOA SENSORS ARE IN THE DOWN OOSITION



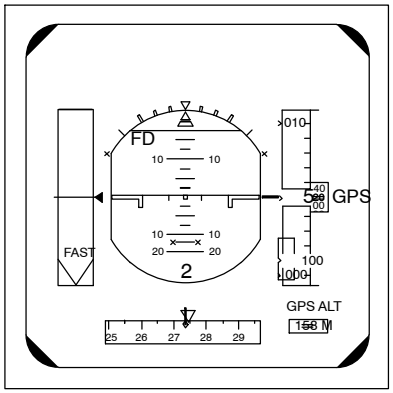


Figure 16 BACKUP SPEED SCALE

ADR PROBES AND SENSORS COMPONENT DESCRIPTION

STATIC PROBES

Each of the three systems CAPT (1), F/O (2), STBY (3) comprises two static probes which are linked to each ADR portion of the ADIRUs through five ADMs.

The probe is protected from icing with a 28VDC heater circuit.

The static probes linked to ADIRU 1 and ADIRU 2 are set at 48.64° below the fuselage datum line (Z=0). The static probes linked to ADIRU 3 are set at 29.5° below the fuselage datum line.

PITOT PROBES

Each system comprises one pitot probe CAPT (1), F/O (2), STBY (3) which is linked to each ADR portion of the ADIRUs through one ADM.

The probes are protected from icing with a 115V AC – 400 Hz heater circuit.
The pitot probes 1 and 2 are set at 40.08° below the fuselage datum line (Z=0).
The pitot probe 3 is set at 59.56° below the fuselage datum line (Z=0).

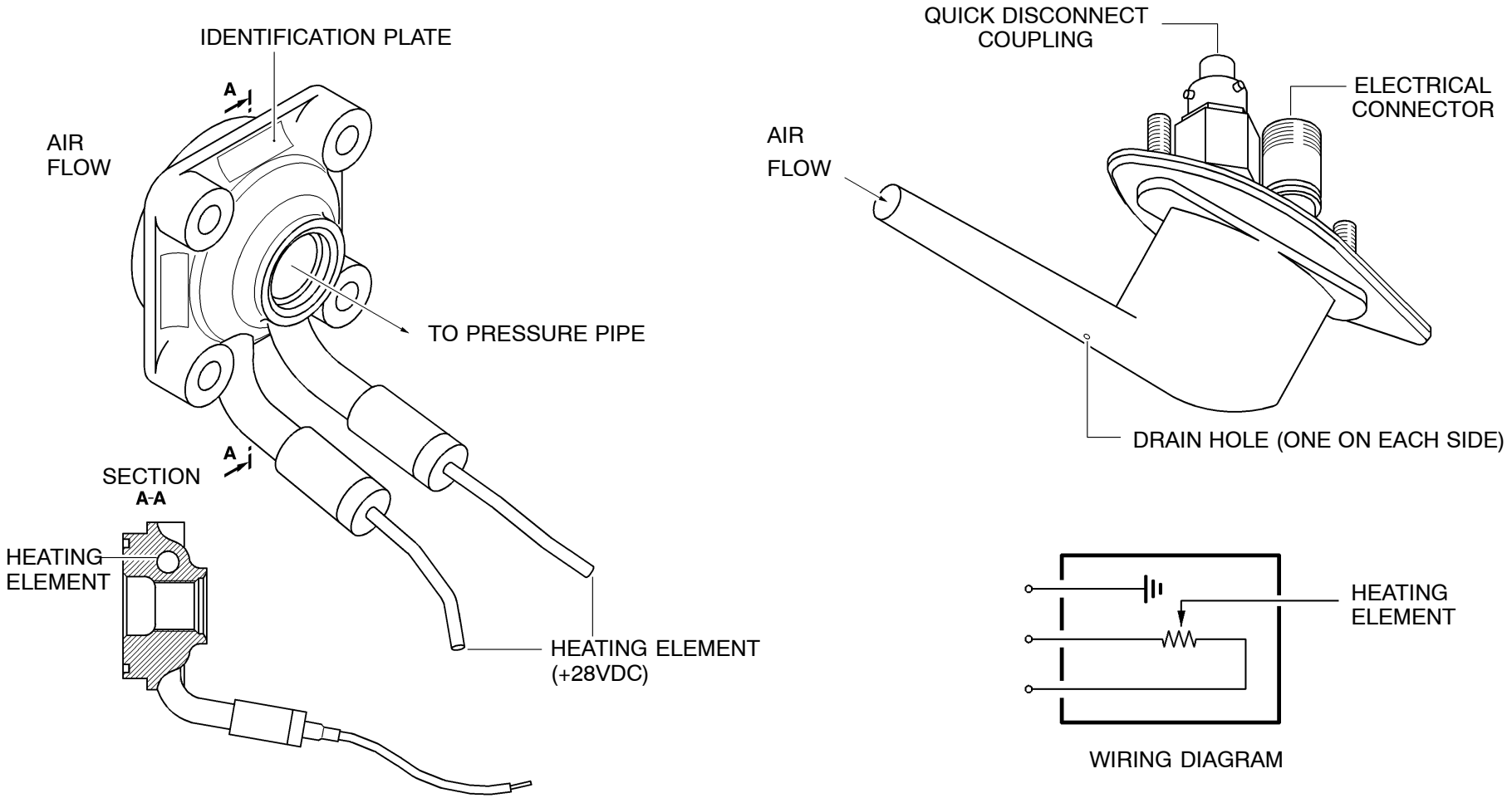


Figure 17 Pitot/Static Probes

AIR DATA MODULE

The term Air Data Module refers to any remotely located LRU which senses pressure information and transmits it to the ADIRU in ARINC 429 format.

The damps are identical. Each ADM has one pressure input and several discrete inputs. The discrete inputs determine the ADM location and the type of pressure.

On the data bus it provides:

- digital pressure information
- type of pressure,
- ADM identification,
- BITE status.

The ADMs are remotely mounted near and above the level of the pitot and static probes, this in order to make the ADM pneumatic plumbing self draining when the aircraft is stationary on the ground.

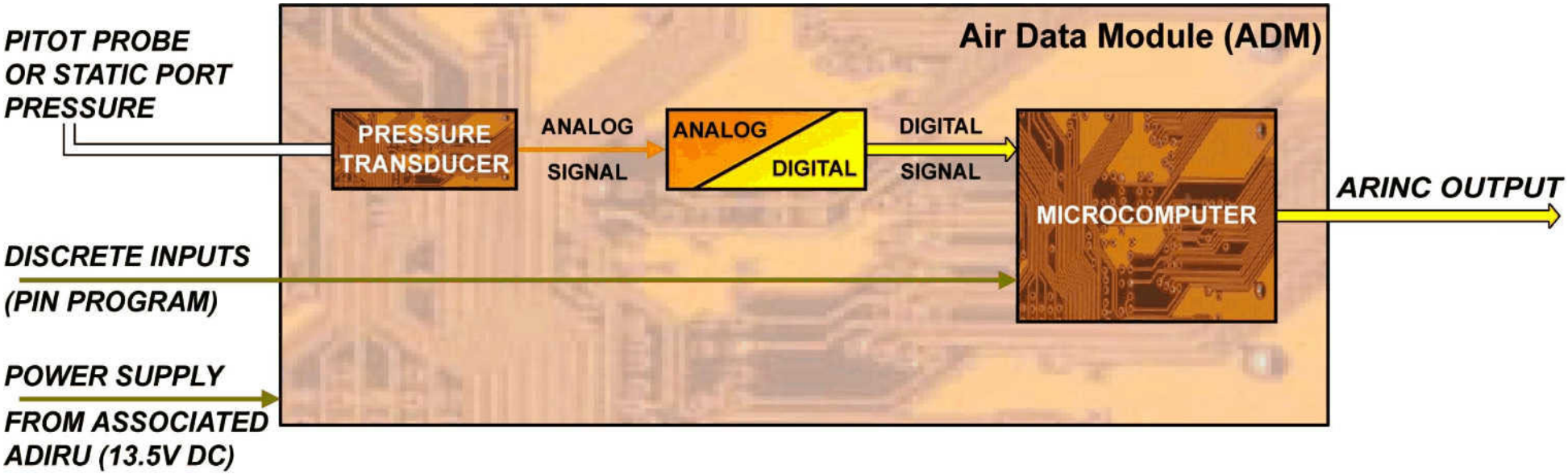


Figure 18 Air Data Module

TAT SENSOR

The aircraft is equipped with two total air temperature sensors, with two sensing elements each. The sensing elements of the sensor have variable resistances.

The TAT sensor 1 is linked to the ADR portion of ADIRUs 1 and 3, the TAT sensor 2 is linked to the ADR portion of ADIRU 2.

The TAT sensors are set at 2.33 m from the nose and at 0.60 m of the aircraft axis below the fuselage. The TAT sensor 1 is located on the left side and the TAT sensor 2 on the right side.

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.

Sensor

The ADR portion is designed to operate with 500 ohms (at 0°C) temperature sensor unit corresponding to the basic Callender/Van Dusen equation. To improve the accuracy of the sensor, a network of precision resistors is used.

This technique is identified by the term PCI (**P**recision **C**alibration **I**nterchangeability).

Heat

These sensors are heated with 115V AC through the probe heating system. The heating element is normally not energized on the ground (see ATA 30–30).

The heating element is implanted in the scoop and strut and keeps the probe free of ice under the most severe icing conditions.

NOTE: Optionally the aircraft may be equipped with an TAT sensor supplied by pressurized air from the bleed system.

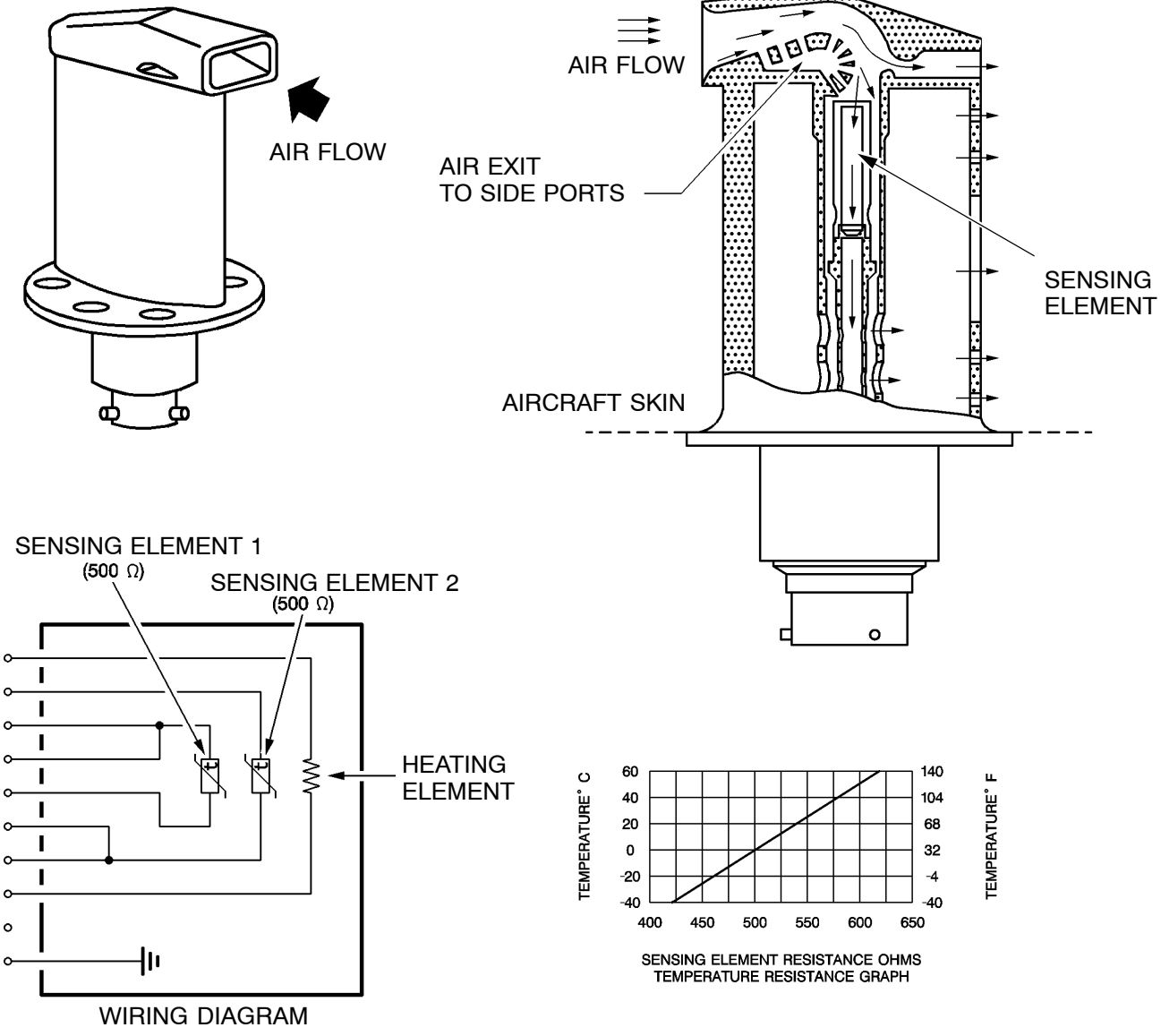


Figure 19 TAT Sensor

AOA SENSOR

General

The aircraft is equipped with three AOA sensors. Two are located on the left side and one on the right side of the fuselage.

Each of these AOA sensors is respectively linked to each ADR portion of the ADIRUs.

The AOA sensors 1 and 3 are set at 6.08 deg. and 31 deg. below the fuselage datum line (Z = 0) on the left side. The AOA sensor 2 is set at 6.08 deg. below the fuselage datum line (Z = 0) on the right side.

Vane Type

The angle of attack sensor is of the wind vane type. Its sensing element is a small wing which is positioned in the direction of airflow.

The small wing is mechanically linked to a free turn–shaft which drives the devices transmitting the local angle of attack signal. These transmitting devices are made up of resolver transformers which convert the angular information into proportional electrical information (angle sine and cosine).

The resolvers are supplied with a 26VAC signal. The same signal is also received by the ADIRU as a reference for the decoding of AOA values.

Each sensor has 3 resolver outputs but only two are wired to the ADIRU.

The characteristics of the resolvers are as follows:

- scale factor: 1°/Degree of AOA
- index reference: 0° resolver input = 25° AOA

The whole mechanism is stabilized around the rotation axis.

In addition, a damping device enables a satisfactory dynamic response to be obtained (filtering of mechanical oscillation).

Heating

A self regulated heating element (PTC resistances: positive coefficient of temperature) inserted into the vane eliminates or avoids icing.

It is supplied with 115VAC through the PHC.

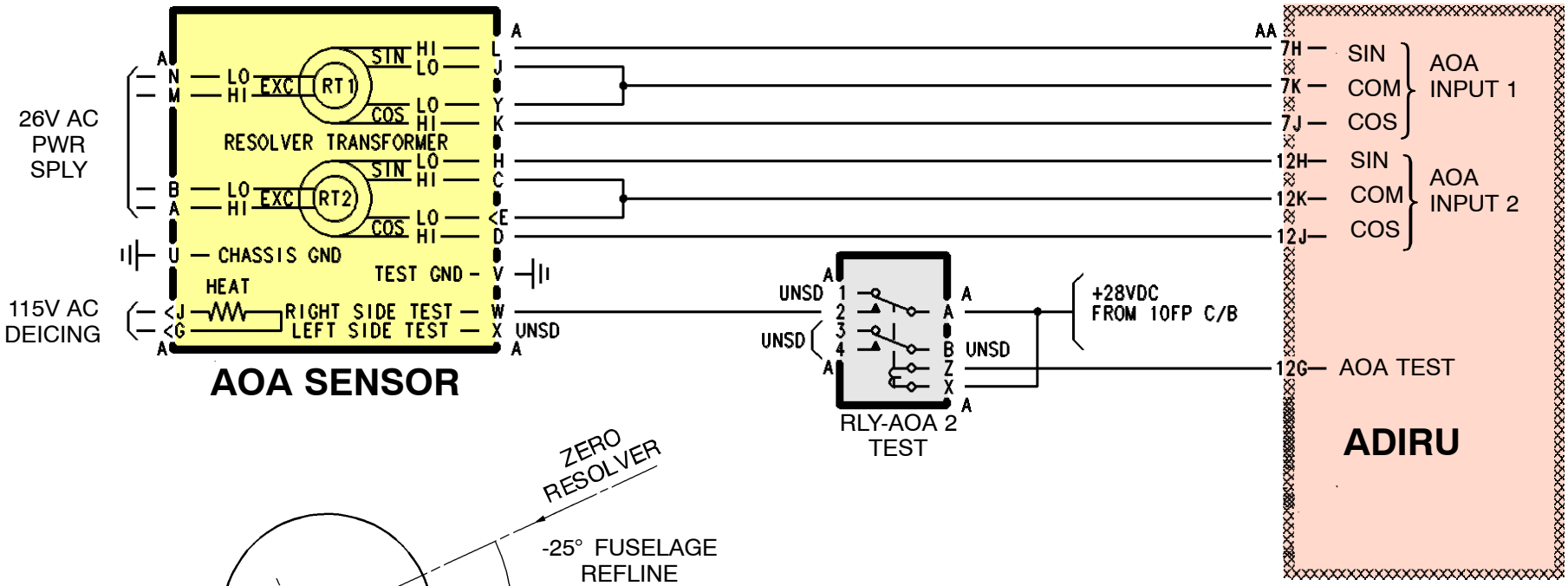
Test

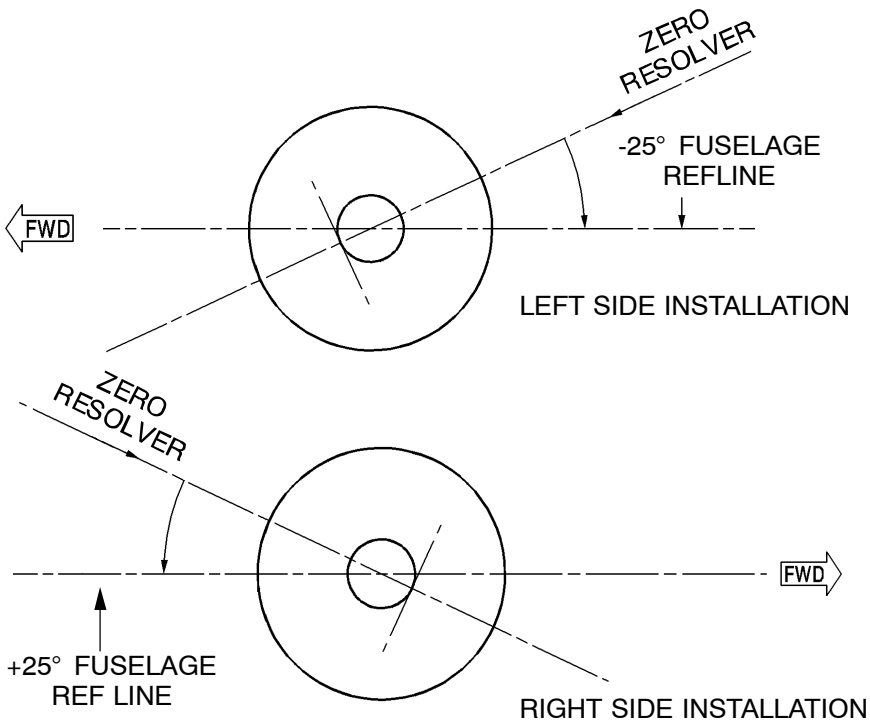
The AOA sensor is equipped with a self test device which is activated by a 28VDC signal, from the ADR when the test is entered via the maintenance system (CFDIU and MCDU).

The self test positions the vane at a resolver angle of +15 deg. (left side test) or –15 deg. (right side test).

The mounting and wing of AOA resolvers determine the relationship between the measured resolver angle and indicated angle of attack.

The ADRs receive the same 26VAC, 400 Hz reference as the AOA resolvers. This reference is common to both AOA resolver inputs 1 and 2.





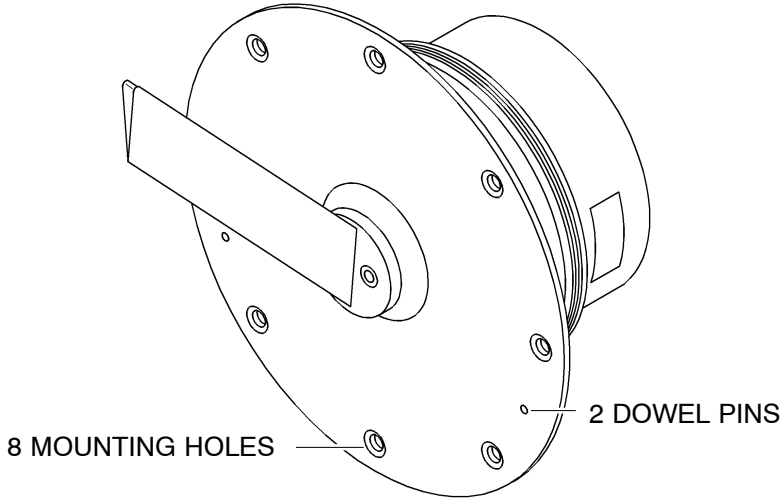


Figure 20 AOA Sensor

INERTIAL REFERENCE INDICATING (PFD)

Attitude and heading information is computed by the ADIRU (IR portion) and processed by the associated DMC. The attitude data are displayed on the PFD and the heading data are displayed on the PFD, the ND and the VOR/DME RMI.

In addition, V/S (**V**ertical/**S**peed) is displayed on the PFD and Ground Speed and wind indications are displayed on the ND.

In normal configuration, with the ATT/HDG selector switch in NORM position, the IR 1 data are displayed on the CAPT PFD, ND and the VOR/DME RMI. The IR 2 data are displayed on the F/O PFD and ND.

ATTITUDE INFORMATION

The aircraft roll and pitch attitude is indicated in the center part of the PFD by a sphere representing a conventional ADI (**A**ttitude **D**irector **I**ndicator) drum.

1. **Fixed Aircraft Symbol** (black, yellow boxed)

   The airplane symbol represents the longitudinal- and lateral axis of the A/C.

2. **Roll Scale** (white)

   This fixed roll scale comprises white marks for the 10 degrees, 20 degrees, 30 degrees and 45 degrees significant values, on either side of the zero position (horizontal wings) which is indicated by a small fixed triangle.

3. **Roll Index** (yellow)

   A yellow triangle which remains on the line going through the center of the A/C reference and which is perpendicular to the horizon line, moves against the fixed roll scale on the upper contour of the attitude sphere.

4. **Pitch Scale** (white)

   The scale moves behind the cut–sphere shaped window, limited by the lines of an upper and a lower sector. The scale rotates around the center of the A/C reference in accordance with the A/C present roll angle.

   The lines are given every 2.5 degrees from 0 to 30 degrees, then for the 50 degrees and 80 degrees values for positive pitch angles.

5. **Side Slip Index** (yellow)

   Represents on GROUND the A/C-acceleration in the latitude axis and during FLIGHT the side slip.

6. **Heading Reference Line** (yellow) and **Heading Scale** (white)

(see next page)

7. **Actual Track Symbol** (green)

   The actual Track Symbol represents the A/C-movement in relation to True North.

HDG on the PFD

A blank heading scale (with 10 deg. spaced marks without any indicated value) is provided on the horizon line. The marks are just under this line.

This scale moves as the aircraft heading varies. For important nose up or nose down the heading graduations remain at the lower or upper sector limit. Below the sphere, a heading scale provides the pilot with the aircraft actual track and relative selection. This heading scale is graduated every 5 deg.

Pitch Angle Information

The A/C present pitch angle is given by the vertical displacements of the pitch attitude scale with respect to the center of the A/C reference. Beyond 30 degrees, red large arrow heads (V–shaped) indicate an excessive attitude and the direction to follow in order to reduce it.

Attitude Discrepancy Detection

In case of discrepancy detected by the FWC between the pitch or roll attitude information presented on the CAPT and F/O PFDs, a CHECK ATT amber message flashes for a few seconds on both PFDs, then remains steady (refer ATA31–50 CWS).

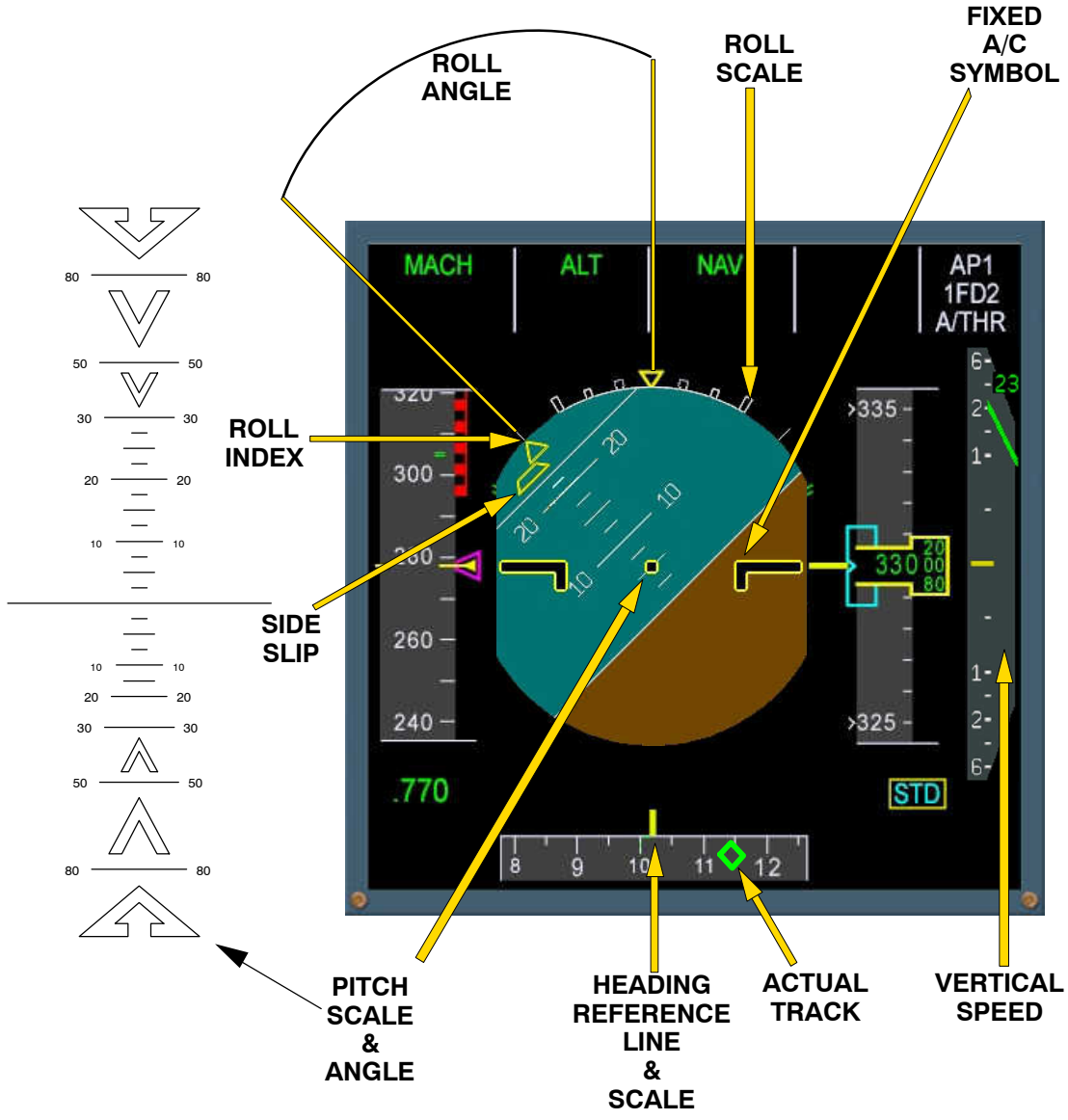


Figure 21 IR Indication on PFD

INERTIAL REFERENCE INDICATING (ND)

HDG on the ND

The heading data is displayed on the ND in the three following operating modes: ROSE, ARC and PLAN.

The ROSE mode and the ARC mode are oriented with respect to the aircraft heading, while the PLAN mode is oriented with respect to the true north.

- **True heading display**

  In ROSE or ARC mode, when true heading is displayed, a cyan TRUE message appears at the top of the ND.

- **ROSE mode**

  In this mode each pilot has 3 different sub–modes of presentation of his ND such as ROSE–ILS/ROSE–VOR/ROSE–NAV.

  In the three ROSE sub–modes, the ND provides a display which is similar to that of a conventional HSI (**H**orizontal **S**ituation **I**ndicator), i. e. a rotating heading dial orientated to the North and giving to the pilot the aircraft actual magnetic or true heading with as reference the fixed yellow lubber line at the top of the dial.

- **ARC mode**

  In this mode the ND displays a 90 deg. heading sector ahead of the aircraft giving the aircraft actual magnetic or true heading with respect to the fixed yellow lubber line at the top of the scale.

- **PLAN mode**

  The ND displays a static map orientated with respect to the true North.

GROUND SPEED

The ground speed is displayed in the left upper corner of the ND for ROSE, ARC or PLAN mode.

The GS title is displayed in white color and the ground speed value in green.

In case of NCD, the ground speed value is replaced by three dashed lines.

The ground speed can also be displayed on the CDU if the DATA DISPLAY selector switch is placed in the TK/GS position.

WIND INDICATIONS

The wind origin, force and direction is displayed in the left upper corner of the ND, for ROSE, ARC and PLAN mode:

- the wind origin is displayed in green color in degrees with respect to the *true North*
- the wind force is displayed in green color in knots
- the wind direction, in analog form,

  is represented by means of a green arrow orientated with respect to the north reference in use. This arrow is displayed only if the wind force is greater than 2 knots.

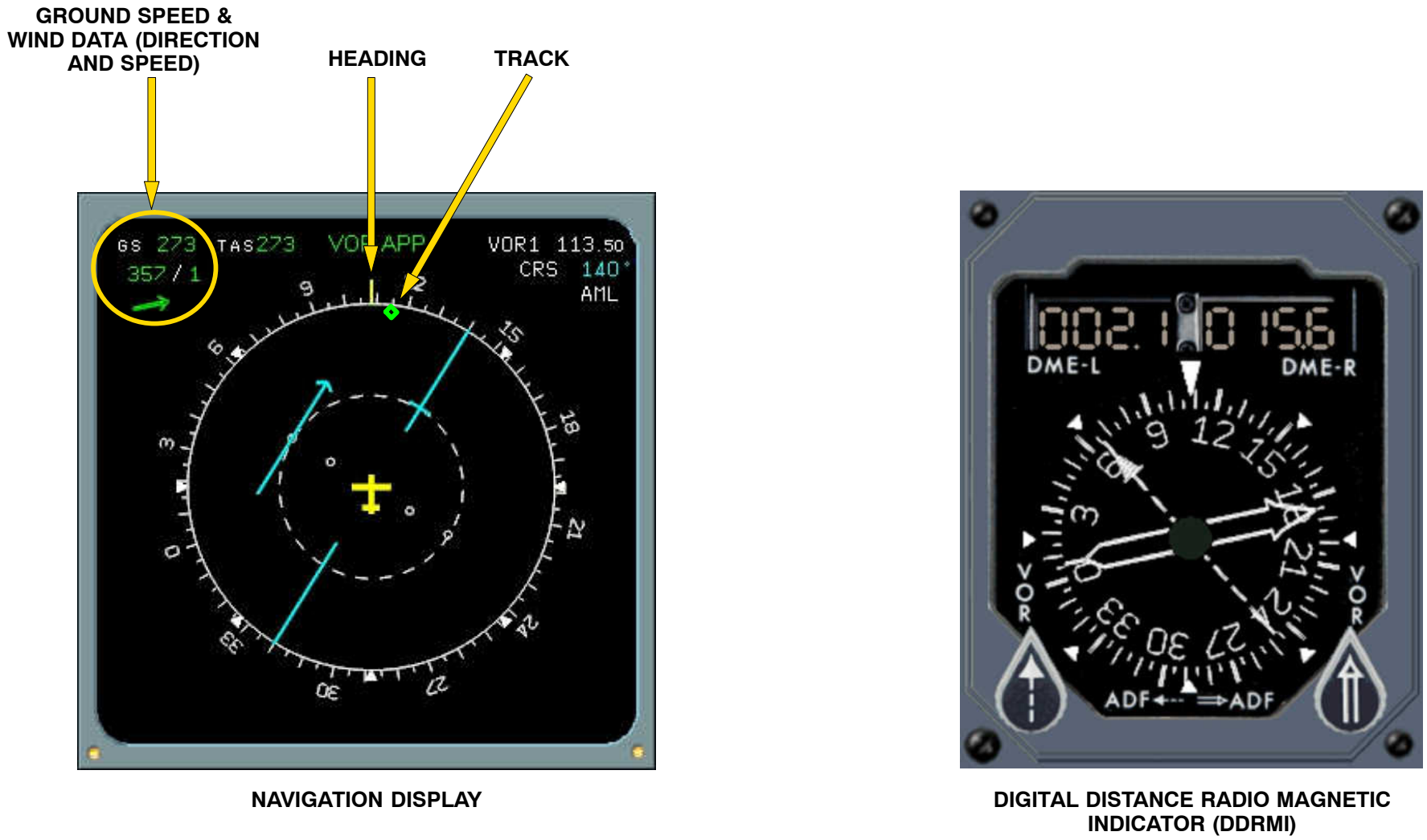
  In case of failure or NCD (**N**o **C**omputed **D**ata), the digital data are replaced by three dashed lines and the wind direction arrow disappears.

  The wind indications can also be displayed on the CDU if the DATA DISPLAY selector switch is placed in the WIND position.

HDG on the Digital Distance Radio Magnetic Indicator

The heading indication is given by a dial which rotates in front of a fixed index.

In case of heading failure, the red warning flag with the black HDG inscription comes into view at the top of the compass rose.



NAVIGATION DISPLAY

DIGITAL DISTANCE RADIO MAGNETIC INDICATOR (DDRMI)

Figure 22 IR Indication on ND & DDRMI

HEADING INFORMATION

The aircraft magnetic or true heading is displayed on the PFD, the ND and the DDRMI (**D**igital **D**istance **R**adio **M**agnetic **I**ndicator).

The heading can be also displayed on the ADIRS CDU (**C**ontrol & **D**isplay **U**nit) if the display selector switch is placed in the HDG position.

TRUE HDG on the PFD

A blank heading scale (with 10 deg. spaced marks without any indicated value) is provided on the horizon line. The marks are just under this line.

“TRUE“ appears automatically when the display is showing true heading instead of magnetic heading under this conditions:

- **above 82 DEG North**
- **above 73 DEG North between 90 and 120 DEG West** (magnetic polar region)
- **above 60 DEG South**

Depending on ADIRU vendor & version instead of “TRUE“ the indication “TRU“ appears. Also the values for true heading indication may deviate.

Heading Discrepancy Detection (PFD)

In case of discrepancy detected by the FWC between CAPT and F/O heading indications, with the heading signal valid, a CHECK HDG amber message is displayed at the center of the heading scale (refer ATA 31–50 CWS).

In case of failure, the heading graduation disappears on the two scales and a red HDG flag appears on the lower heading scale. It flashes for a few seconds then remains steady.

HDG on the ND

The heading data is displayed on the ND in the three following operating modes: ROSE, ARC and PLAN.

Heading Discrepancy Detection (ND)

If a discrepancy between CAPT and F/O sides is detected by the comparison inside the FWCs, with the heading signal valid, the CHECK HDG message is displayed in amber on both NDs (refer ATA 31–50 CWS).

In case of heading failure the scale and all symbols positioned on the ROSE and ARC scales go out of view; a red HDG flag comes into view below the scale after flashing for a few seconds, when the DMC has detected an anomaly concerning the heading parameter.

G LOAD indication on the SD

G LOAD is displayed in amber:

- for **flight phases 4 to 10**, when G Load is **less than 0.7 G or more than 1.4 G for more than 2 s.**

Information remains displayed 5 s after excessive G Load condition has disappeared.

G LOAD is not displayed in the other cases or when no valid data are available from the ADIRUs.

G Load digital value is amber, while the indication G LOAD is shown in white. The value is shown with 0.1 G resolution. The sign is displayed for negative values only.

The display can vary from –9.9G to 0.7G, and from 1.4G to 9.9G.

If ALT SEL is selected through the flight control unit, and the selected altitude is shown in metric units on the SD the G Load function is not displayed.

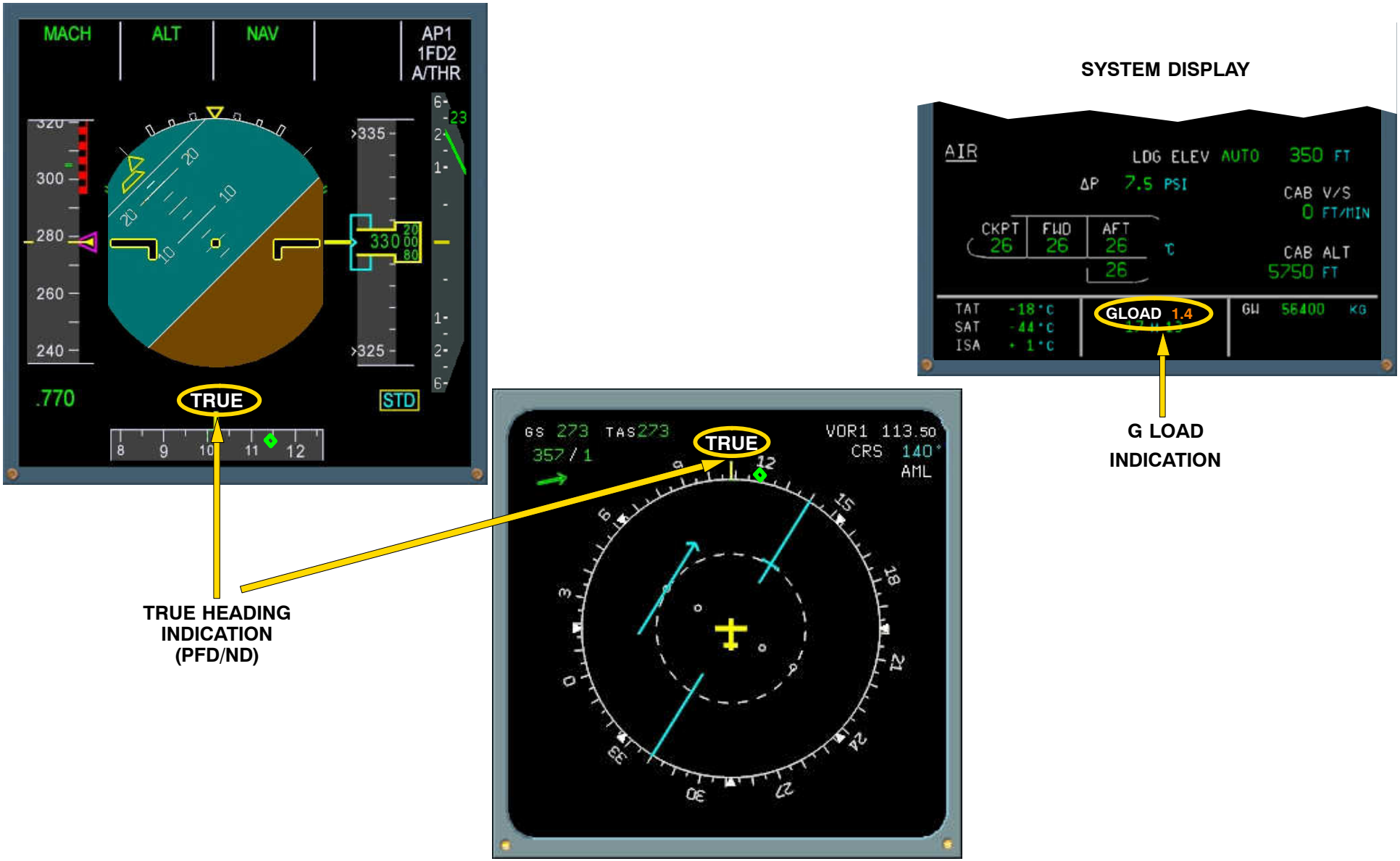


Figure 23 TRUE Heading & G LOAD Indication

INERTIAL REFERENCE FLAGS

PFD DISPLAY

ATT Flag (red)

If the PFD loses all attitude data, its entire sphere is cleared to display the ATT flag.

HDG Flag (red)

If the heading information fails, the HDG flag replaces the heading scale.

V/S Flag (red)

The V/S flag appears only when **IR and ADR V/S** information fails. In case of IR V/S fail ADR V/S is indicated.

ND DISPLAY

HDG Flag (red)

If the heading data fails, the rose, arc and associated symbols disappear.

Ground Speed & Wind Data

In case of GS & Wind Data failure, the values goes out of view.

NOTE: There is no red GS or Wind Data flag.

DIGITAL DISTANCE RADIO MAGNETIC INDICATOR

HDG Flag (red)

The HDG flag appears, when the HDG signal from the IR 1 or 3 fails.

VOR Flag (red)

The indicators display these flags if :

- the VOR receiver fails
- the RMI has an internal failure
- the heading signal from ADIRS is not valid
- the power supply fails.

As long as the flag shows, the relevant pointer remains at the last valid position.

Figure 24 Flags on DDRMI

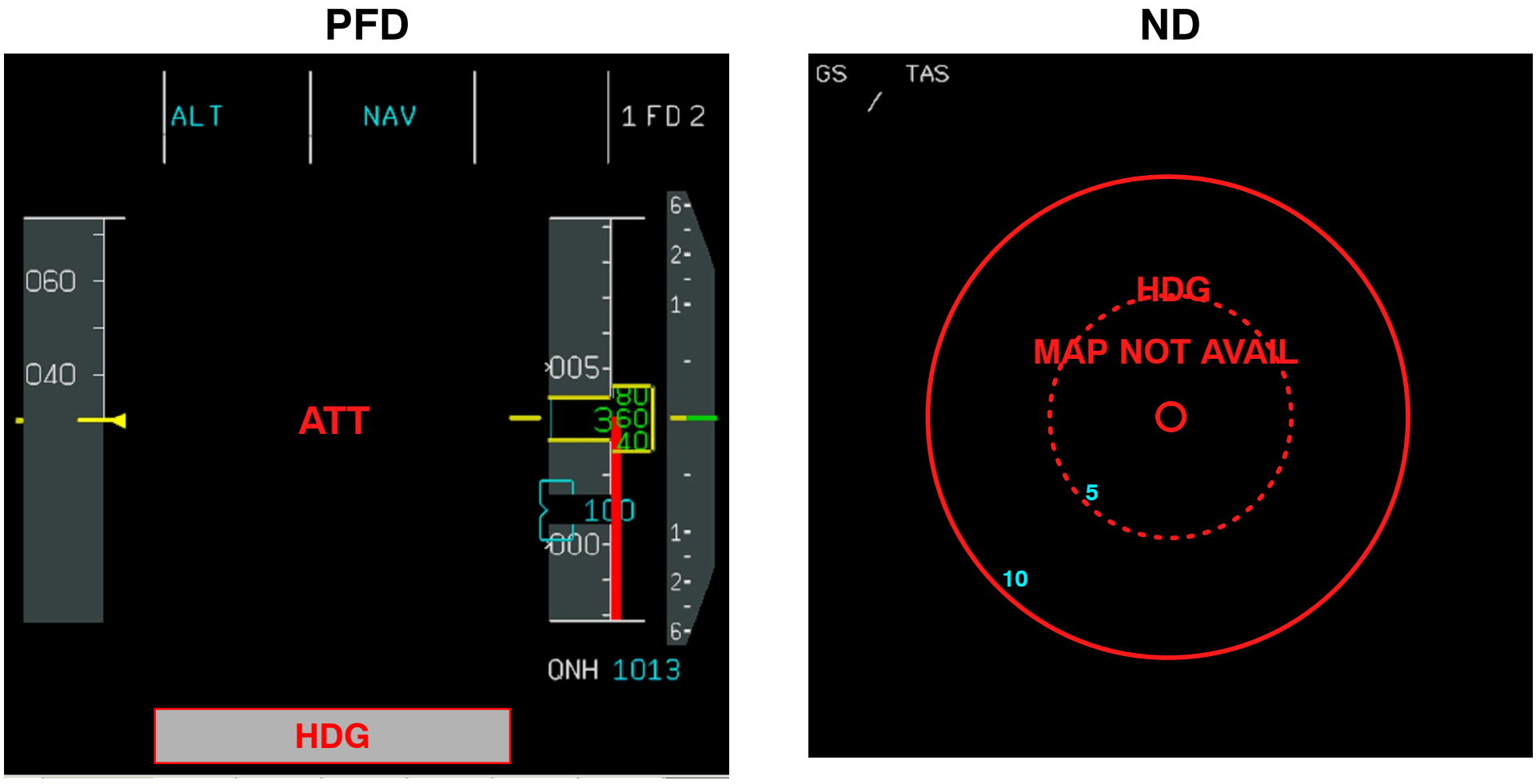


Figure 25 IR Flags on EFIS

ALIGNMENT PRESENTATION

General

The alignment is the initialization mode for the IR. Its primary function is to initialize the attitude, velocity and position integration functions implemented in the navigation mode. This mode operates on the ground only.

The Alignment initialisation may be done from the MCDU via the FMGC (recommended) or from the ADIRS CDU (backup).

IR ALIGNMENT MODE IS DIVIDED INTO THREE PARTS

Coarse Level Processing

The coarse level processing is engaged during the first 30 seconds of the IR alignment mode. This processing estimates the local vertical using the three accelerometers and the measured gravity. During coarse level processing of the alignment mode, the software computes the level coordinate frame, pitch and roll, and associated rates and accelerations.

Gyro–Compass (or Azimuth) and Level Processing

Gyro–compass processing is engaged after the 30 seconds of the IR alignment mode (coarse level complete) and run for a minimum of 5 minutes. The ADIRU alignment time will be reduced from 10 minutes fixed alignment time to a variable time based on aircraft latitude.

Gyro–compass processing is used to orient body frame to North (using earth rotation detection by gyros). During this alignment submode, an estimated latitude is computed using local vertical component of the earth rotation. During this submode, the results of the coarse level processing are sharpened to have a better knowledge of the coordinate frame.

Position Entry Data Processing

This position initialization can take place in coarse level processing or gyro–compass processing.

The latitude and longitude pair processed for position initialization is received from the same source (FMGC 1, FMGC 2, CDU,[GPSSU1/MMR1 or GPSSU2/MMR2 only with GPS POS ALIGN]).

As soon as a valid position initialization pair is received, the software performs three BITE tests to check if the entered latitude and longitude are within the following limits versus the position recorded at the end of the last power–up cycle:

- 3+3T test: the entered position and the position from the previous navigation mode must not differ by more than 3NM + (3NM/HR)*T, where T is the duration in hours of the previous navigation mode.
- Abs val(lat entered–lat recorded) less than or equal to 1 deg.
- Abs val(long entered–long recorded) less than or equal to 1 deg/cos (latitude)

A third BITE test is performed on the entered latitude when an estimated latitude is available during the gyro–compass processing:

- Abs val(lat est)–(lat ent) less than or equal to 0.5 .

The alignment is completed after 10 minutes if a valid position data has been received and verified by the IR.

If not, the automatic sequencing to the NAV mode will be delayed after position data is received.

ATTENTION: New functions are active with the new Honeywell ADIRU

A. If a GPS position data is available and if there is no pilot entry, the GPS data is used to perform the alignment.

B. If a GPS position data is available and if there is a pilot entry, the pilot entry is compared with the GPS position.

Rapid Realign

The IR also offers the possibility to enter into a variant of the alignment mode called ”rapid realign” or ”30–second realign”. This mode is selected by moving the CDU selector switch from NAV to OFF, then to NAV within five seconds, when the aircraft is on the ground (ground speed less than 20 knots). Valid position data must be received. During the ”rapid realign” mode, all computed velocities are set to zero and a fine tuning of the alignment is performed using the attitude reference vertical and the heading data available from the last NAV phase as initial conditions.

During the alignment mode, the IR outputs on the ARINC 429 bus may not be available.

NOTE: The alignment mode process may differ between the vendors and the generation of the ADIRU.

EXAMPLE A

STEP 1

STEP 2

EXAMPLE B

STEP 1

STEP 2

Figure 26 Alignment via FMGC/INIT Page on MCDU

ADIRS START PROCEDURE DESCRIPTION

ATTENTION: The following example is for information only and without obligation!

MODES OF OPERATION

Operation interface with the IR is performed through the MCDU 1 (2) or the CDU. The MCDU 1 (2) is used for entering initialization data and for displaying IR data.

The CDU is used for mode selection, IR annunciation (FAULT, ALIGN), for entering initialization data and displaying IR data.

The IR has three selectable modes: OFF, NAV and ATT.

The relation between the mode selection and system response is described later in the IR-part.

OFF Mode

When the OFF/NAV/ATT selector switch on the CDU is in the OFF position, all circuitry in ADIRU is de–energized, except for any logic associated with the power off function. When the ADIRU has turned off, it consumes less than 10 milliamps (needed for power supply turn–on control). The power supply of the ADMs is switched off. A period is required between switching to OFF and actual power off (Honeywell ADIRU: 15 seconds). During this sequence, the last position computed is stored.

NAV Mode

After selection of the NAV mode on ground, the IR automatically enters the NAV mode, if a self–determined satisfactory alignment has been completed.

The **ON BAT** Light comes on and extinguishes after some seconds.
If alignment is not completed, the IR remains in the Align submode.

No updating of the IR present position latitude and longitude is allowed once the IR has completed the Align submode. The IR latitude and longitude entered during alignment is the starting point for its computation.

The following logical processes are mechanized:

- OFF to NAV provides automatic alignment in 10 minutes for latitudes between 73° N and 60° S, with automatic entry to NAV mode. Requires initial position data to be entered.

NOTE: The automatic alignment requires 15 min. delay for latitudes between 73° N and 82° N.

For high latitudes the alignment (high latitude alignment) is provided by an operational procedure which delays the entering of the initial position by the crew. Accuracies of the system are slightly degraded.

Procedure

1. On the ADIRS CDU, set the 3 OFF/NAV/ATT selector switch to NAV.
2. Make sure that the ON BAT light comes on for 5 seconds and the related ALIGN legend comes on.
3. Make sure that the ADR FAULT/OFF legends are off.
4. On the CPT and F/O PFDs:
5. Make sure that the CAS, ALT, V/S data are shown.
6. Make sure that the attitude data is shown 40 seconds after start up.
7. Set the SYS DISPLAY selector switch to 1 and the DATA DISPLAY selector switch to PPOS, and make sure that dashes are shown on the CDU Display.

Figure 27 ADIRS Start Procedure

IR ALIGNMENT PROCEDURE

ATTENTION: The following example is for information only and without obligation!

The Inertial Reference part of the ADIRU needs on ground a 10 minute alignment period. During this time the aircraft must stay unmoved and the initial **P**resent **POS**ition inserted. The present position entry may be done via the ADIRS CDU or the MCDU.

Preparation

1. Prior to this procedure several circuit breakers of the systems autoflight, landing gear, probes, ADIRS and hydraulics has to be closed.
2. Do the EIS start procedure.
3. **On the overhead panel:**
   - on the FLT CTL panels make sure that the FAC, ELAC and SEC pushbutton switches are not pushed (in). The OFF legends are on.
   - on the ADIRS CDU, on the panel make sure that the 3 OFF/NAV/ATT selector switches are at OFF.
4. **On the panel 13VU**, on the EFIS control section of the FCU, on CPT and F/O side,
   - set the ROSE-NAV mode.

NOTE: During the alignment phase until the NAV mode is achieved, the aircraft must not move.

NOTE: On the ADIRS CDU, if the ALIGN legend flashes (maintenance indication: ENTER P POS), make sure that the airport latitude and/or longitude are correct.

Enter again the latitude and/or longitude. Do the procedure again until the ALIGN legend stops flashing.

NOTE: During the alignment phase necessary to get the NAV mode, the time for alignment is shown:

–in the right part of the display window of the ADIRS CDU if the

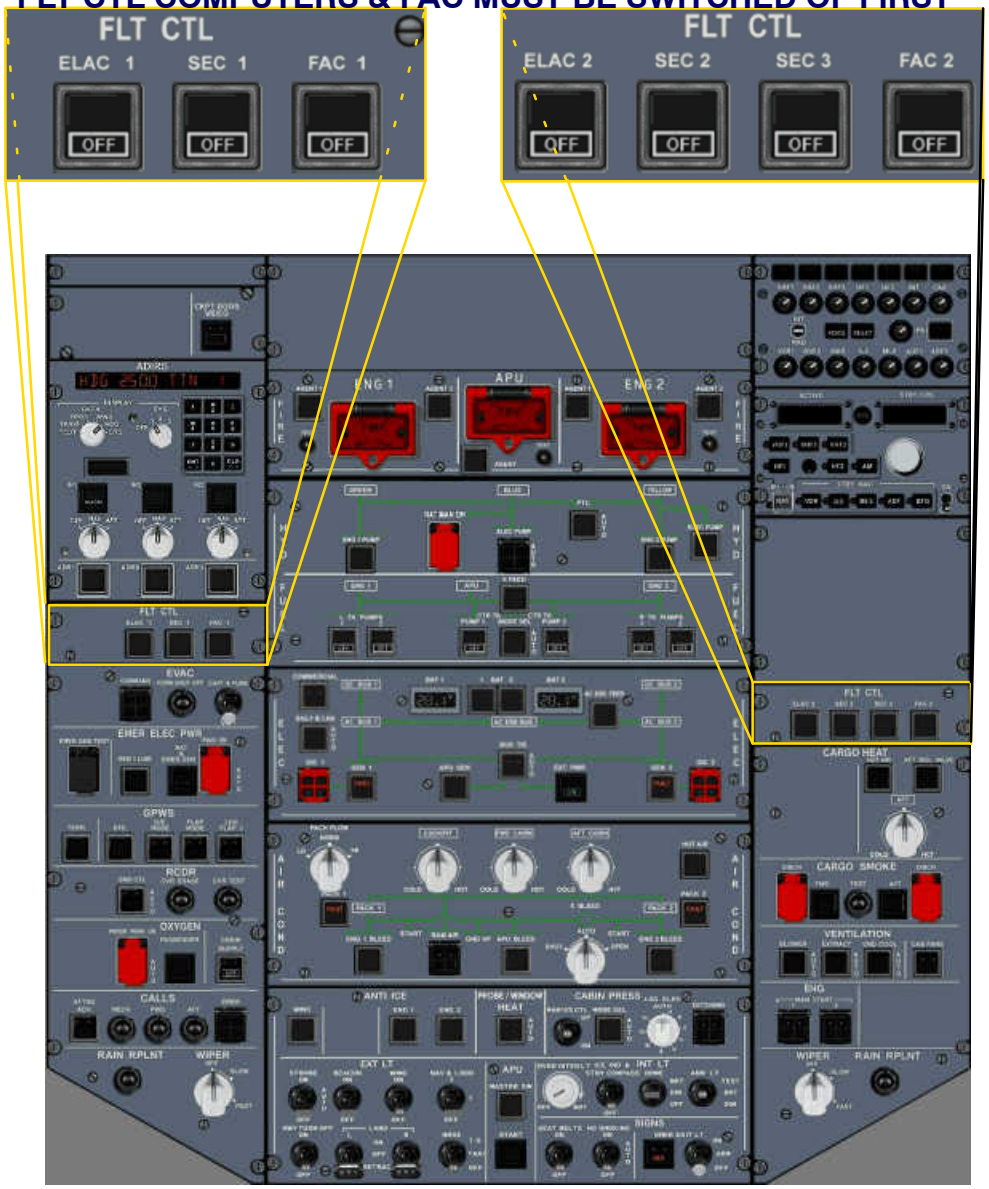
DATA DISPLAY selector switch is at HDG.

It is shown in this form:TTN 5

–on the upper ECAM DU, minute after minute

(from 6 MN to 1 MN) in this form: IRS IN ALIGN 6 MN.

FLT CTL COMPUTERS & FAC MUST BE SWITCHED OF FIRST



ADIRS CONTROL & DISPLAY UNIT

Figure 28 Alignment Preparation Procedure

IR ALIGNMENT FROM THE ADIRS CDU

On the ADIRS CDU:

1. Set the 3 OFF/NAV/ATT switch to NAV.
2. Make sure that the OFF legend of the ADR1, ADR2, ADR3 pushbutton switches are off.
3. Set the DATA DISPLAY selector switch to PPOS.
4. Set the SYS DISPLAY selector to 1:
   - Result on the ADIRS CDU
     - the OFF legend of the ADR pushbutton switches stays off.
     - the ON BAT light stays on for 5 seconds.
     - the ALIGN legends come on and after approximately 30 seconds:
   - Result on the CAPT and F/O PFD:
     - the ATT warning flag are no more shown
     - the ATT indications are available
     - on upper ECAM display unit, the MEMO page shows this indication:

       IRS IN ALIGN 7-10 MN.
5. On the CDU keyboard, enter the present position (example for FRA) :

   N 50024 then push the ENT key, E 8352 then push the ENT key.

   NOTE: If you entered incorrect coordinates, push the CLR key and enter new data as above.

   Now the ADIRS CDU shows the coordinates N 50° 02,4’ and E 8° 35,2’ (in the left/right part of the display window).
6. Set the SYS DISPLAY selector switch successively to 2 and 3 to make sure that the coordinates come into view in these 2 positions.
   - Result after a time delay of approximately 5 minutes:
     - on the CPT and F/O ND,

       the HDG warning flags are no more shown. The rose is available.
   - after a time delay of approximately 10 minutes:
     - on the ADIRS CDU, the 3 ALIGN legends go off,
     - on the upper ECAM display unit,

   The IRS ALIGN 1 MN indication is no more shown. The IRS ALIGNED indication is shown (the ADIRU is in the NAV mode).

Alignment Time (Example Honeywell)

The typical alignment time will be calculated for a given latitude as follows:

- ABS (5.0 minutes/cosine (latitude)) for latitudes between 60S and 60N
- 10.0 minutes at a latitude more than or equal to 73.0S and less than 60S
- 10.0 minutes at a latitude more than 60N and less than or equal to 73.0N
- 17 minutes at latitude less than 73.0S
- 17 minutes at latitude more than 73.0N

ABS= ABSOLUTE (math.)

PPOS ENTRY VIA KEYPAD ON ADIRS CDU

HDG VALUE IS DISPLAYED SOONEST 5 MIN BEFORE THE END OF ALIGNMENT

Figure 29 ADIRS CDU PPOS Entry

IR ALIGNMENT FROM THE MCDU

On the ADIRS CDU:

1. Set the 3 OFF/NAV/ATT selector switches to NAV.
2. Make sure that the OFF legend of the ADR1, ADR2, ADR3 pushbutton switches are off.

   Result:
   - the ON BAT light comes on for 5 seconds
   - the ALIGN legend comes on
   - on the upper ECAM display unit, the MEMO page shows this indication: IRS IN ALIGN > 7 MN
   - on the CPT and F/O PFD:
     - CAS, V/S and ALT data are shown
     - after approximately 40 seconds, the ATT warning flags are no more shown and the attitude data comes into view.
3. Set the SYSTEM DISPLAY selector switch to 1 (2 or 3) and the DATA DISPLAY selector to PPOS.

On the MCDU 1 or 2:

1. Make sure that the MCDU MENU page is in view and check brightness.
2. Push the line key adjacent to FMGC indication

   Result:
   - the A/C STATUS page comes into view.
3. Push the INIT mode key

   Result:
   - the INIT page comes into view.
4. Enter either FROM/TO, or a COMPANY ROUTE, or the LAT and the LONG position

   Result:
   - the chosen FROM/TO, or COMPANY ROUTE or LAT and LONG is shown on the scratchpad line (lower part of the MCDU).
5. Push the LSK adjacent to either FROM/TO, or CO RTE, or LAT and LONG indication

   Result:
   - the place latitude and longitude are shown below the LAT and LONG indication.
   - the slew prompts (arrow up and arrow down) adjacent to the LAT indication are shown.
   - the ALIGN IRS indication is shown on the line above the LONG coordinates.

NOTE: The LAT or /and LONG magnitude (regardless of N, S, E or W) can be incremented or decremented as follows

For the LAT /LONG change:

1. **On the MCDU keyboard**, push one of the two slew keys.

   Result:
   - -the LAT /LONG coordinates increment or decrement by 1 minute per key press or 1 minute per second if the slew key is pushed (in) and held in this position.
2. **On the MCDU**, push the line key adjacent to the ALIGN IRS indication.

   Result:
   - on the MCDU, the ALIGN IRS indication is no more shown.
3. **On the ADIRS CDU,**

   successively set the SYS DISPLAY selector switch to 2 and 3 to make sure that the coordinates are shown for the 3 ADIRU.

   Result:
   - the coordinates which are in view on the ADIRS CDU are the same as the coordinates shown on the MCDU
   - - after a time delay of approximately 5 minutes:
     - on CPT and F/O ND, the HDG warning flags are no longer shown.
     - The rose is available.
   - after a time delay of approximately 10 minutes:
     - on the ADIRS CDU, the 3 ALIGN legends go off
     - on the upper ECAM display unit, the IRS IN ALIGN 1 MN indication is no more shown. The IRS ALIGNED indication is shown (the ADIRU is in the NAV mode).

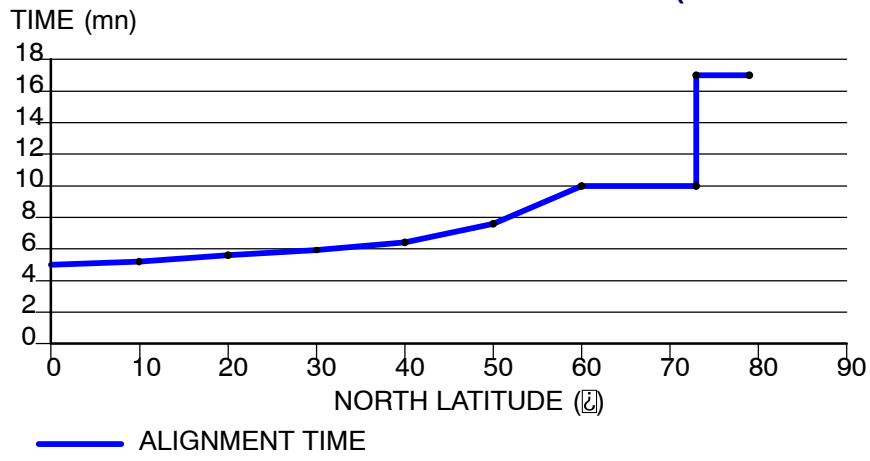
MCDU INIT PAGE

FMGC1/2 SENDS POSITION TO IR 1,2 & 3

ALIGN LIGHT OFF WHEN IRS ALIGNED

INDICATION ON LOWER EWD

ALIGNMENT TIME IN NORTH HEMISPHERE (HONEYWELL)



ATTENTION: For new ADIRS (Honeywell), if there is no Pilot entry, the GPS data is used for Alignment if available. (Not installed on DLH)

Figure 30 MCDU PPOS Entry

ALIGNMENT PROCESS DESCRITPION

Initialization Data

IR alignment is carried out on ground before takeoff and after the entry of the current aircraft coordinates on the INIT page of the MCDU1 (2) or on the CDU (DATA DISPLAY selector switch in PPOS position).

Valid initial position data must be received and verified by the IR during the 10–minute alignment or automatic sequencing to the NAV mode will be delayed after position data is received.

Initial position data are verified by the IR.

If a miscompare exists then:

- on the ADIRS CDU, the **ALIGN light flashes**.
- a message ENTER PPOS is displayed on the CDU (DATA DISPLAY selector switch in STS position)

If a miscompare exists then:

- a message is displayed on the upper ECAM DU:

  NAV IR1 (2) (3) NOT ALIGN

  - POSITION MISMATCH

  - PRESENT POS–––––INSERT
- a message ENTER PPOS is displayed on the ADIRS CDU (DATA DISPLAY selector switch in STS position)

The miscompare is removed and the position data verified by the IR when:

- the last two Set Latitudes received by the IR are identical and the last two Set Longitudes received by the IR are identical, or
- the last Set Latitude and Set Longitude received by the IR compare within one degree of the latitude and longitude from the previous flight.

Latitude Comparison

The IR compares Set Latitude with a self–computed gyro–compass latitude after 10.0 minutes into alignment or any subsequent time when a valid Set Latitude is available.

In case of discrepancy on the ADIRS CDU the ALIGN light flashes.

The message ENTER PPOS is displayed on the CDU (DATA DISPLAY selector switch in STS position).

A discrepancy exists when the entered latitude differs from the computed latitude by greater than 0.5°.

The miscompare is removed if a subsequent entry of Set Latitude passes the test.

If latitude test fails two times with identical set latitude inputs then:

- the IR FAULT legend flashes on the CDU
- the message IR FAULT appears on the CDU liquid crystal display (DATADISPLAY selector switch in STS position)
- A warning message appears on the upper ECAM DU:

  NAV IR1 (2) (3) FAULT.

Excessive Motion

The IR performs an excessive motion test during the Align submode.

If taxiing or towing causes a step input which exceeds 0.2 ft/s, in the X or Y velocity then:

- the EXCESS MOTION message is displayed on the ADIRS CDU (DATA DISPLAY selector switch in STS position)
- the following message is displayed on the upper ECAM DU:

  NAV IR1 (2) (3) NOT ALIGN

  EXCESS MOTION

  IR1 (2) (3) IN ALIGN
- the attitude information is flagged on the PFD.

Thirty seconds after motion detection, the system reverts to a full alignment (time to the end of alignment will revert to 9 min 30 s). It is not necessary to re–enter the position.

30–Second Realignment

A thirty–second rapid realignment is provided by moving the OFF/NAV/ATT selector switch on the CDU from NAV to OFF and back to NAV within five seconds.

A subsequent switching on the selector switch from NAV to OFF and back to NAV within 5 seconds during the 30–second realignment causes the system to start the 30–second realignment again.

The realignment is initialized with existing attitude and heading angles. Velocities are zeroed. Valid position data must be received and verified by the IR during the 30–second realignment.

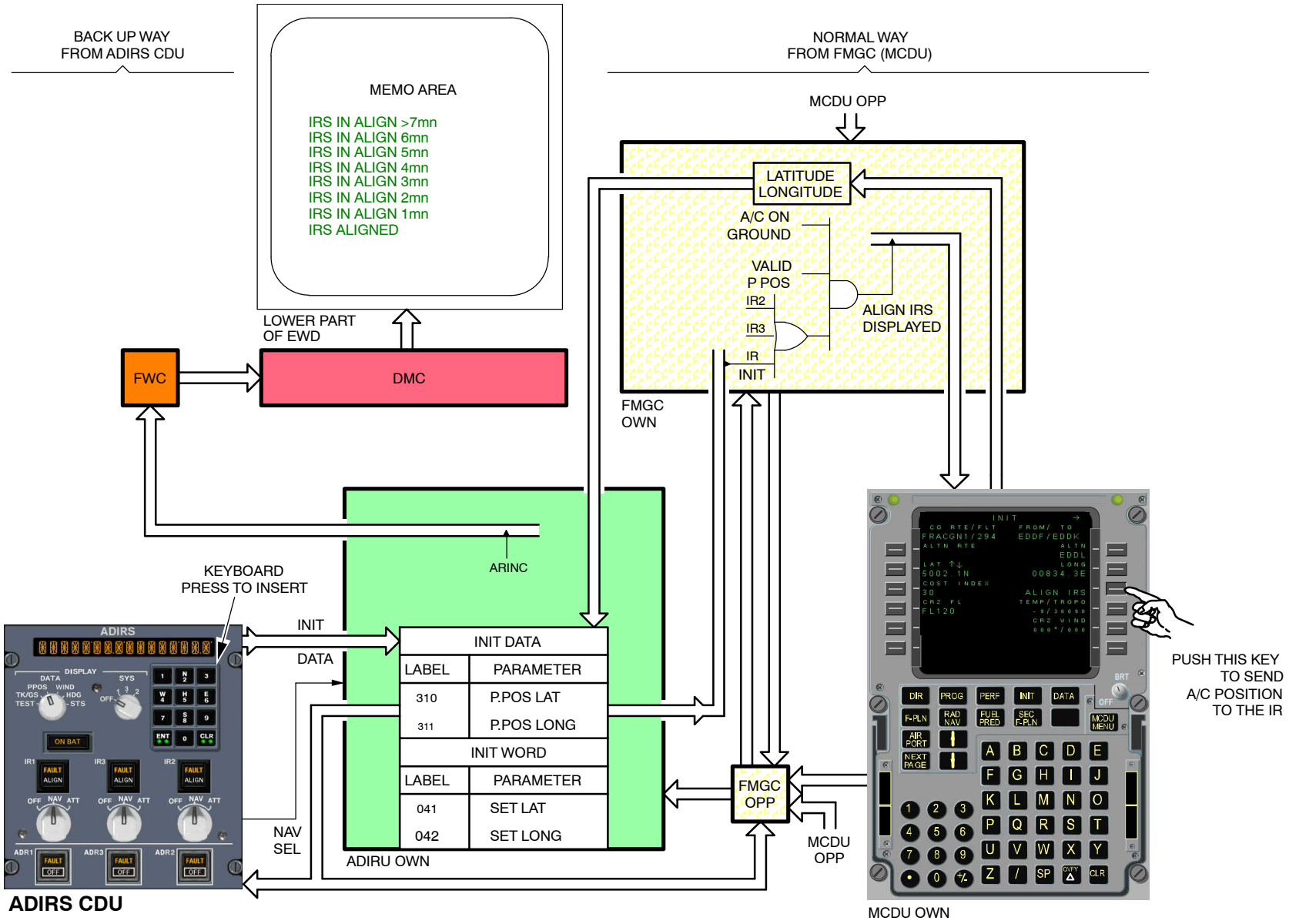


Figure 31 Alignment Process

ADIRU PERFORMANCE CRITERIA (TROUBLE SHOOTING)

History

The inertial parameters to be considered to evaluate the level of performance of an inertial system after flight completion are:

- the radial position error (in NM)
- the residual ground speed error (in kts).

Depending on their magnitude noticed at the end of the flight, the concerned inertial system (s) shall or shall not be removed from the aircraft.

Radial Position Error

In order to address the statistical term of this requirement with the most relevant approximation, the removal criteria use a limit based on the recording of the radial position error on two consecutive flights.

On the MCDU the message “CHECK A/C POSITION“ may come into view when the discrepancy is greater than 12NM.

The use of a two–strike method presents the advantage to decrease the removal rate of healthy units that have shown, by chance, or by an inaccurate position entry at alignment, a radial position error beyond the specified criterion. The removal boundaries described on the figure present three different areas:

- Area 1:

  ADIRU OK all the time.
- Area 2:

  ADIRU to be checked after second flight.
- Area 3:
- ADIRU to be replaced.

Residual Ground Speed Error

The residual ground speed for each IR is determined at the end of the flight when the aircraft has come to a complete stop.

- Check of the residual ground speed can be made:
  - On the CAPT (IR1) and F/O (IR 2) ND (Navigation Displays) :

    The residual ground speed of the IR 3 can be read on the CAPT ND by setting the ATT HDG selector switch to CAPT/3.
  - On the ADIRS CDU:
    - set the DATA DISPLAY selector switch to TK/GS
    - set the SYS DISPLAY selector switch to 1, 2, 3
    - read the respective ground speed in the CDU display.
- Compare the recorded ground speed values with the following limits:
  - If the residual ground speed error is 15 kts or greater after each of two consecutive flights, replace the ADIRU.
  - If the residual ground speed error is 21 kts or greater at the end of any one flight, replace the ADIRU.

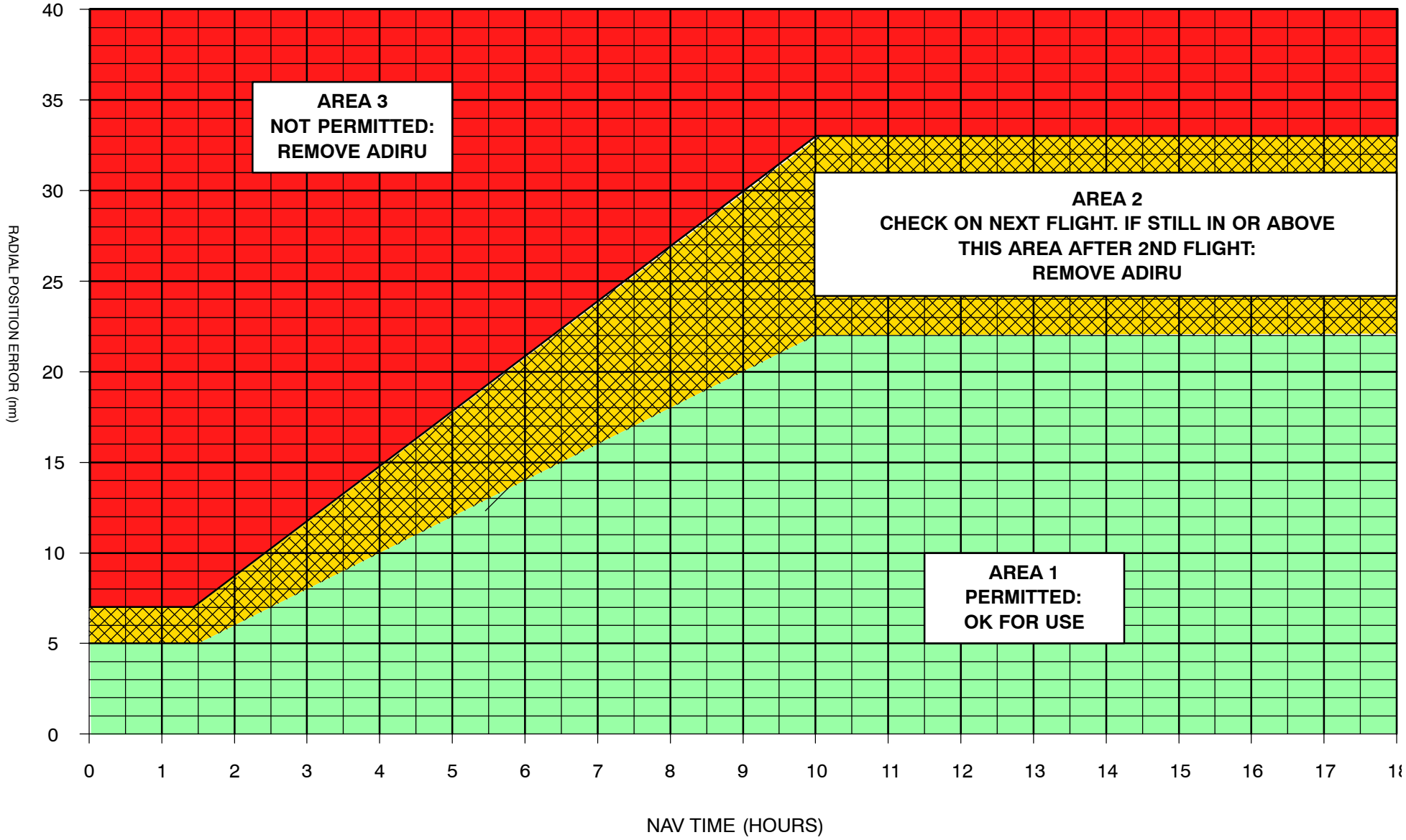


Figure 32 Radial Position Error - Removal Criteria

RAPID REALIGNMENT OPERATION

The IR also offers the possibility to enter into a variant of the alignment mode called ”rapid realign” or ”30–second realign”.

This mode is selected by moving the CDU selector switch from NAV to OFF then to NAV within five seconds, when the aircraft is on ground (ground speed less than 20 knots). Valid position data must be received.

During the ”rapid realign” mode all computed velocities are set to zero and a fine tuning of the alignment is performed using the attitude reference vertical and the heading data available from the last NAV phase as initial conditions.

NOTE: A rapid realignment is only possible when the related IRS was in ALIGN condition before!

STEP 1: SELECT OFF POSITION

STEP 2:
RESELECT NAV POSITION WITHIN 5 SECONDS

STEP 3:
SEND PPOS TO REALIGN THE IRS

Figure 33 Rapid Realignment

ATT MODE OPERATION

The IR has a reversionary mode which can be activated only by manual selection of ATT mode on the CDU.

The mode can be activated on the ground or in the air and is intended to provide a rapid attitude/heading restart capability in the event that the IR has experienced a total power shutdown or a failure has occurred resulting in the following:

- “IR FAULT“ legend flashes on the CDU.
- “SELECT ATT“ message displayed on the CDU (DATA DISPLAY selector switch in STS position).
- On ECAM the following messages appear:
  - IR 1 (2) (3) FAULT message displayed on the upper ECAM DU
  - IR x MODE SEL...ATT

The IR is designed so that the ATT mode can be used after BITE has detected failures which will cause excessive NAV mode data errors but does not disable the ATT mode mechanization. However, it is recommended to stay in NAV mode even with excessive navigation errors because of higher accuracy of attitude signals and a more complete signal processing.

ATT mode must always be used after loss of power or a similar situation in the air where a new alignment /leveling is required.

The “ENTER HEADING“ message is displayed on the CDU (DATA DISPLAY selector switch in STS position) when ATT mode is selected until valid heading initialization is received from the MCDU or the CDU.

The ATT mode is normally engaged with the aircraft in level flight. A 30–second period (Honeywell ADIRU: 20 second) is needed with the aircraft in level flight to perform an attitude erection to initialize a ”level” attitude. During this period, the data normally computed in ATT mode, have SSMs set to NCD.

NOTE: In ATT Mode the ADIRU is a ”Free Azimuth System“.

That means, the HDG-value drifts and must be updated about every 10 minutes.

FURTHER STATUS MESSAGES ON ADIRS CDU

INDICATION ON CDU	DESCRIPTION (AMM)
STS - IRU FAULT	CRITICAL FAILURE. REMOVE THE IRU FOR MAINTENANCE.
STS – DELAYED MAINT	NON CRITICAL FAILURE. REMOVE THE IRU IF NECESSARY.
STS – ENTER P POS	ENTER THE PRESENT POSITION.
STS – SELECT ATT	NON CRITICAL FAILURE. SET THE ATT MODE
STS - XCESS MOTION	EXCESSIVE MOVEMENTS OF THE AIRCRAFT DURING THE ALIGN-MENT
STS - ADR FAULT	ADR NON VALID
STS - CHECK CK/BK	DO THE CHECK OF THE CIRCUIT BREAKER
STS - CDU FAULT	REMOVE THE CDU FOR MAINTE-NANCE
STS - ENT MAG HDG	ENTER THE MAGNETIC HEADING IN ATTITUDE MODE

Figure 34 Attitude Mode

MODE SELECTION

OFF:

The ADIRU is not energized. ADR and IR data are not available.

When the OFF/NAV/ATT selector switch on the CDU is in the OFF position, all circuitry in the ADIRU is de–energized except for any logic associated with the power–off function.

When the ADIRU has turned off, it consumes less than 10 milliamps (needed for power supply turn–on control). The power supply of the ADMs is switched off.

A period of 15 seconds is required between switching to OFF and actual power– off. During this sequence, the last position computed is stored in NVM.

NAV:

Normal mode of operation. Supplies full inertial data to aircraft systems.

After selection of the NAV mode on the ground, the IR automatically enters the NAV mode if a self–determined satisfactory alignment has been completed. If alignment is not completed, the IR remains in the Align submode.

Updating of the IR present position latitude and longitude is allowed once the IR has completed the Align submode.

The IR latitude and longitude entered during alignment is the starting point for its computation.

ATT:

IR mode supplies only attitude and heading information, if the system loses its ability to navigate.
The heading must be entered through the CDU keyboard and has to be reset frequently (about every 10 minutes)

Selection

The relation between the mode selection and system response is shown in the following 'Mode State Diagram'.

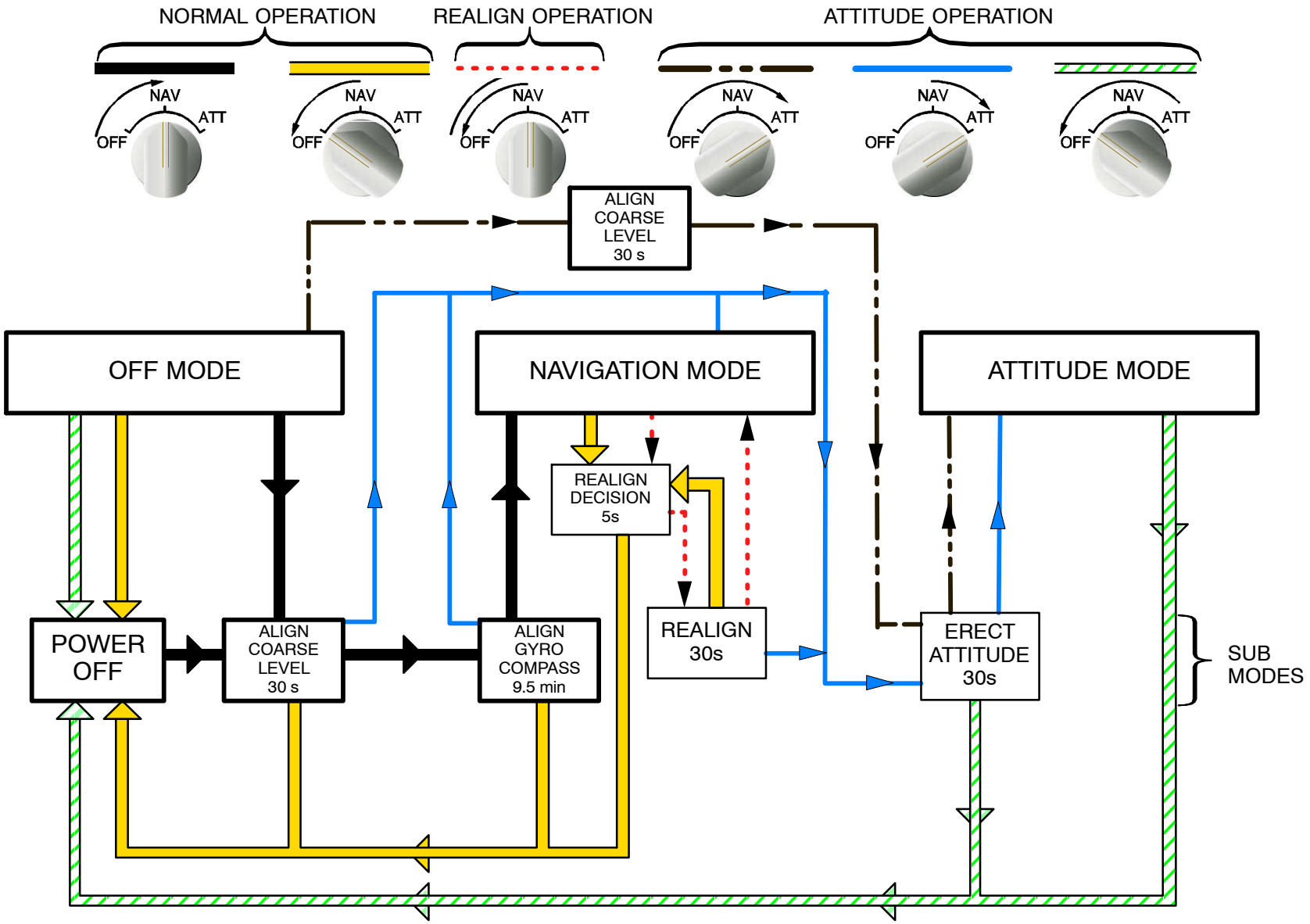


Figure 35 Mode State Diagram

ADIRS CDU & ADIRU COMPONENT DESCRIPTION

ADIRS CDU COMPONENT DESCRIPTION

The CDU is a three–channel unit. Each CDU channel is dedicated to one separate ADIRU and includes the following features:

- a three–position mode selector switch.
  The modes are:
  - power off **(OFF)**
  - navigation **(NAV)**
  - reversionary attitude **(ATT)**
- an indicator announcing when the IR is in align
  (ALIGN legend of IR annunciator)
- an IR fault indicator
  (FAULT legend of IR annunciator)
- a pushbutton switch to disable ADR output buses.
  It is a momentary action pushbutton switch
- an indicator announcing when the ADR output buses are turned off
  (OFF legend of ADR pushbutton switch)
- an ADR fault indicator
  (FAULT legend of ADR pushbutton switch).

The following items of equipment are shaped between the three channels:

- **a keyboard**
  To enter the initial position in degrees, minutes and tenth of minutes or magnetic heading in the attitude mode.
- Two **data pushbutton switches**
  (ENT and CLR) with cue lights.
- A l**iquid crystal display**
  For selected parameters. The LCD has 16 digits and each digit has 14 segments.
- A **DATA DISPLAY selector switch**
  To select parameters for display on the LCD:
  - wind (WIND)
  - PPOS (**P**resent **POS**ition)
  - true HDG (**H**ea**D**in**G**)
  - STS (**ST**atu**S**) of selected system conditions
  - TK/GS (**T**rac**K** and **G**round **S**peed)
  - test values (TEST).
- A **SYS DISPLAY** selector switch
  It has four positions: OFF, 1, 2, 3.
  The OFF Position disables the display of the CDU but the mode control of the ADIRUs remains active.
- An **ON BAT** annunciator.

The CDU contains three identical connectors.

No cooling air is provided to the CDU.

The CDU receives 28V DC power from the selected ADIRU to drive internal circuits and the data display. The 28V DC inputs are isolated from each other. The aircraft supplies 5V AC power for panel lighting/LCD backlight and for annunciator lighting.

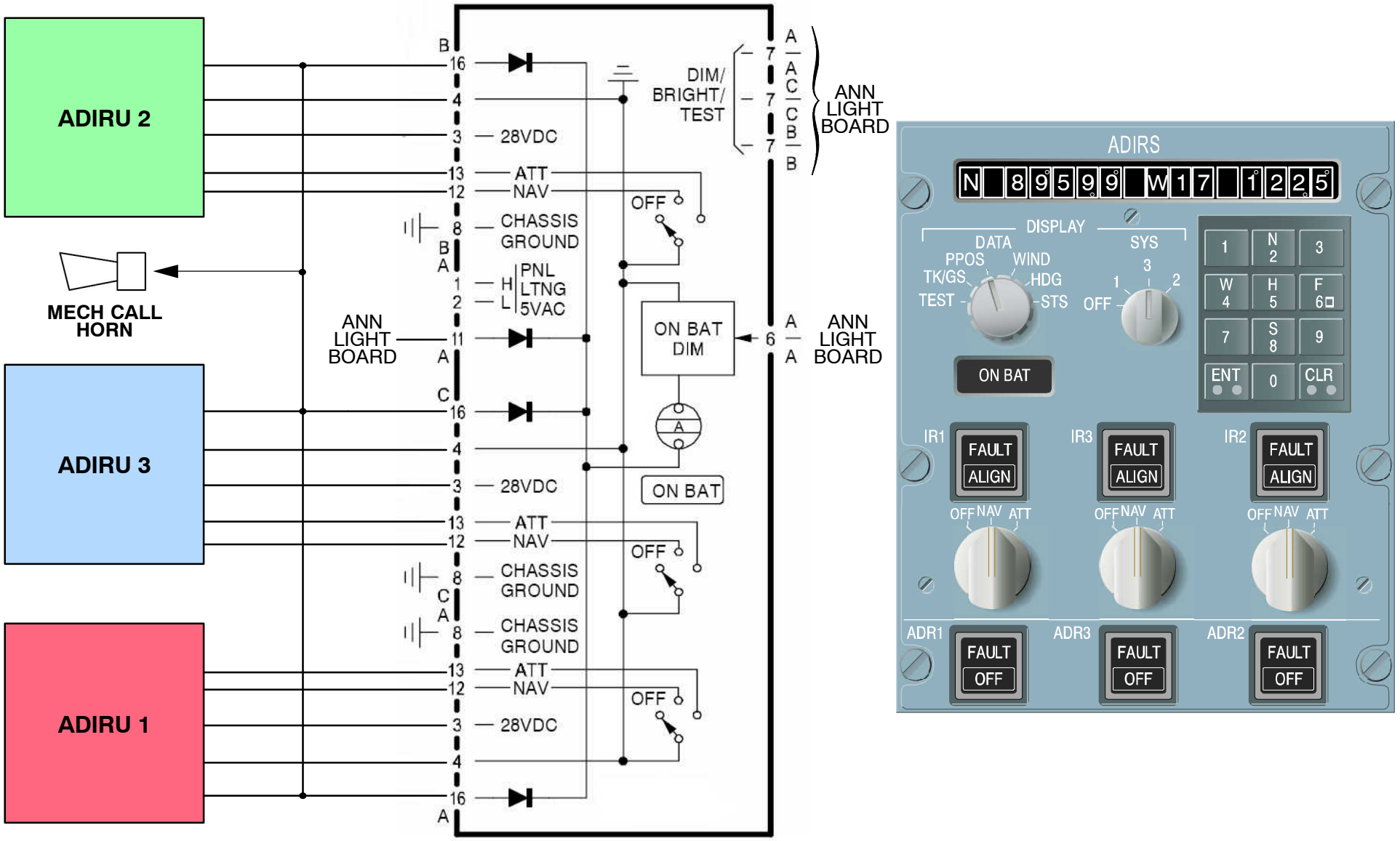


Figure 36 ADIRS CDU Description

ADIRU COMPONENT DESCRIPTION

Two different ADIRUs are possible. A (Honeywell or Litton). Their size and internal function may differ marginally.

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

ADR Part

Five resolvers can be used for the analog baro–correction and the AOA inputs. The ADR provides 6 ARINC 429 low–speed output buses. Each bus can drive 20 ARINC bus loads.

The ADR portion of the ADIRU provides main data sources which are air data references for the aircraft avionic systems.

The ADR receives and processes the outputs of the Air Data Modules (ADM) and other sensors. It computes the aerodynamic parameters in the form of digital outputs.

The ADR software performs five basic computational elements which are under the air data calculations as follows:

- pressure altitude functions (ALT/ALT-rate)
- Mach calculation (M)
- airspeed calculation (CAS/TAS)
- temperature calculation (SAT/TAT)
- output signal processing.

Aircraft-dependent calculations are also included in the operational software:

- static source error correction
- AOA (**A**ngel **O**f **A**ttack)
- maximum operating speed (VMO/MMO).

The ADR data outputs are transmitted digital by 6 ARINC 429 low speed busses and by discretes.

The system tests includes continuous in-flight monitoring and manually-activated test modes.

The continuous monitoring detects and annunciates faults in the ADR during normal operation.

Faults are stored in NVM (**N**on **V**olatile **M**emory) BITE and sent to the CFDS (**C**entralized **F**ault **D**isplay **S**ystem) via digital words.

IR Part

The gyros/accel sensors block contains three accels and three gyros mounted along each axis. This sensor block is supplied by a high voltage power supply provided by the IR portion. The IR provides 3 (4 when GPS equipped) ARINC 429 high–speed output buses. Each bus can drive 20 loads.

The Inertial Reference portion of the ADIRU (**A**ir **D**ata/**I**nertial **R**eference **U**nit) provides main data sources which are precision attitude, magnetic heading references and navigation data to the aircraft avionics systems.

Attitude, heading and navigation data are displayed on the EFIS displays (PFD and ND) and on the VOR/DME RMI which recopies the heading data.

The IR portion is a strapdown inertial system which provides a quality reference for attitude, heading (true and magnetic), angular rates and accelerations.

The IR software also computes:

- the inertial position,
- the ground velocities,
- the baro inertial vertical speed,
- the drift angle,
- the wind data,
- the flight path data.

The IR processing unit are linked to its own ADR portion of the ADIRU via an internal data bus and additionally it provides two digital data input ports for receiving data from the other ADIRUs in case of an internal ADR-Failure.

The incoming data are in ARINC 429 LS format and include altitude and true airspeed. With this inputs the IR processor is able to calculate Inertial Vertical Speed (IVS) and the WIND-Components (speed and direction).

The IR data outputs are transmitted digital by 3 ARINC 429 high speed buses (4 buses, if GPS is installed) and by discretes.

The IR software operates in one of three basic modes: alignment, navigation, or a reversionary attitude mode. These modes include various portions of the major functions. The real–time executive and built–in test functions interface with each function in each mode.

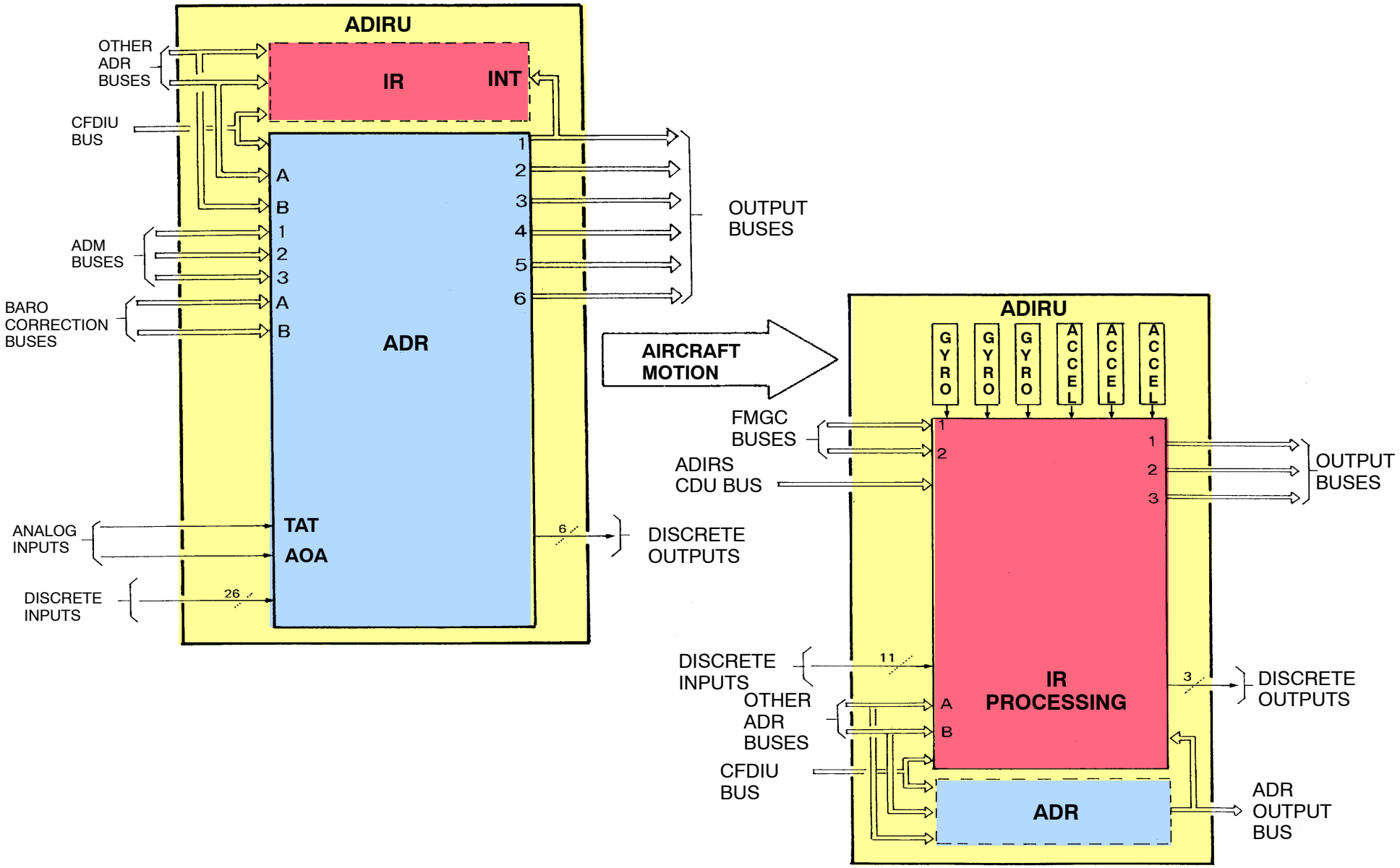


Figure 37 ADR and IR Description

ELECTRICAL INTERFACE/POWER SUPPLY

The ADIRS CDU contains three identical connectors. Each connector is linked to one ADIRU.

The four annunciator discretes ADR OFF, ADR FAULT, IR ALIGN, IR FAULT are linked to the ADIRS CDU from the ADIRU, through the annunciator light test and interface boards.

The CDU panel lighting and LCD backlight are provided by bulbs supplied with 5V AC.

ADIRS CDU

The CDU is a three–channel unit.

Each CDU channel includes the following features:

- a three–position mode selector switch. The modes are:
  - power off (OFF)
  - navigation (NAV)
  - reversionary attitude (ATT)
- an indicator announcing when the IR is aligning (ALIGN legend of IR annunciator)
- an IR fault indicator (FAULT legend of IR annunciator)
- a pushbutton switch to disable ADR output buses. It is a momentary action pushbutton switch
- an indicator announcing when the ADR output buses are turned off (OFF legend of ADR pushbutton switch)
- an ADR fault indicator (FAULT legend of ADR pushbutton switch).

The following items of equipment are shaped between the three channels:

- a keyboard to enter the initial position in degrees, minutes and tenth of minutes or magnetic heading in the attitude mode.
- two data pushbutton switches (ENT and CLR) with cue lights.
- a liquid crystal display for selected parameters. The LCD has 16 digits and each digit has 14 segments.
- a DATA DISPLAY selector switch to select parameters for display on the LCD:
  - wind (WIND)
  - present position (PPOS)
  - true heading (HDG)
  - status of selected system (STS)
  - track and ground speed (TK/GS)
  - test values (TEST)
- a SYS DISPLAY selector switch with four positions: OFF, 1, 2, 3. The OFF position disables the display of the CDU but the mode control of the ADIRUs remains active
- an ON BAT annunciator.

This LRU uses an Intel 8031 microprocessor. The CDU receives an IR bus from each ADIRU to display navigation data.

It provides one bus per ADIRU to permit IR initialization.

No cooling air is provided to the CDU.

The CDU is supplied with 28V DC from the selected ADIRU to drive internal circuits and the data display.

The 28V DC inputs are isolated from each other. The aircraft supplies 5V AC power for panel lighting/LCD backlight and for annunciator lighting.

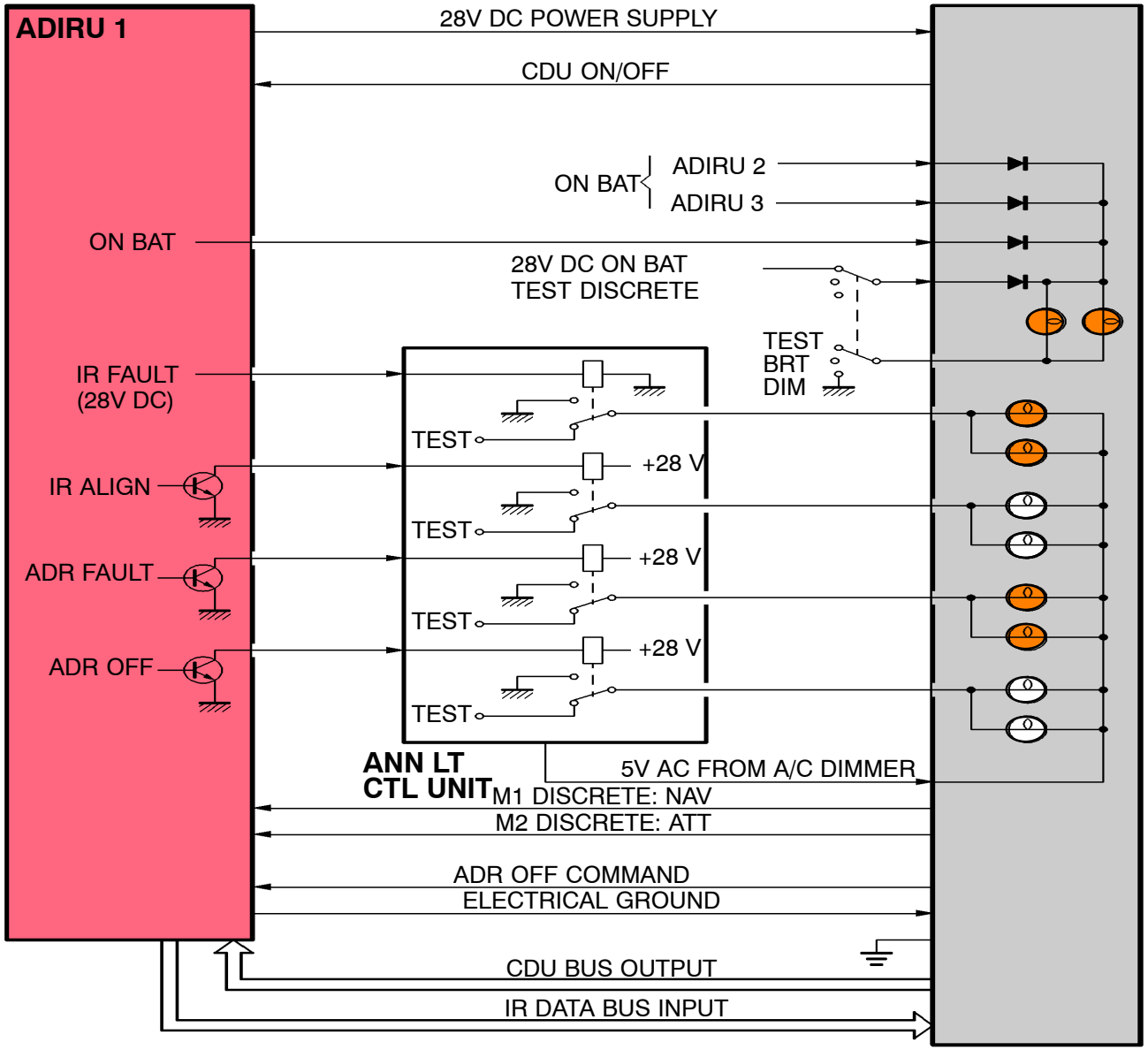


Figure 38 Electrical Interface

ADR CONTROL FUNCTION

The ADIRS CDU provides the control and warning of the three ADRs by means of three ADR illuminated pushbutton switches:

- The ADR pushbutton switch

  Is used to disable the ADR output buses. It is a momentary action pushbutton switch.
- ADR output buses

  When they are disabled the ADR controls the activation of the ADR OFF legend by its output discrete (ADR OFF status).
- ADR fault light

  When an ADR failure is detected, the ADR controls the activation of the ADR FAULT legend by its output discrete (ADR FAULT).
- OFF/NAV/ATT selector switch
  - Each ADR is deenergized when the associated OFF/NAV/ATT selector switch is set to OFF.
  - When the associated OFF/NAV/ATT selector switch is set to NAV or ATT, each ADR is switched on independently of the previous selection on the ADR pushbutton switch.

POWER SUPPLY

The sensors, the probes, the ADMs and the ADIRUs are power supplied as follows:

EQUIPMENT	**28V DC**	**115V AC**	**26V AC**
ADIRU	X	X	X
AOA SENSOR		X	X
PITOT PROBE		X	
STATIC PROBE	X		
TAT SENSOR		X	
ADM	13,5V AC from ADIRU		

The ADIRU is normally supplied with 115V AC, 400 Hz power for the ADR and IR functions. However the AOA resolver converter module is supplied with 26V AC, 400 Hz.

The 28V DC backup generation is provided by batteries and is automatically used when the main power exceeds its normal limits.

At the beginning of each power cycle the ADIRU switches from the main to the back–up power to test the electrical generation.

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ADIRS POWER SUPPLY AFTER LOSS OF MAIN ELECTRICAL GENERATION

Loss of Main generation and ATT HDG Selector Switch in NORM Position

- **Captain side:**

  The **ADIRU 1** is supplied as in **normal configuration**.

- **First Officer side:**

  The **ADIRU 2** is no more supplied with 115V AC and 26V AC.

  When the 26VAC is lost, the ADR detects a fault and flags the output parameters.

  The ADIRU is still powered with 28V DC from the 28V DC HOT BUS 702PP but the TDO (**T**ime **D**elay **O**pening) relay 17FP **will cut this supply after 5 minutes in emergency configuration.**

  – The ADR 2 function is lost immediately.

  – The IR 2 function is lost after 5 minutes.

- **Standby side:**

  The **ADIRU 3** is no more supplied with 115V AC and 26V AC.

  When the 26VAC is lost, the ADR detects a fault and flags the output parameters.

  The ADIRU is still powered with 28VDC from the 28VDC HOT BUS 701PP but the TDO relay 14FP **will cut this supply after 5 minutes in emergency configuration.**

  – The ADR3 function is lost immediately.

  – The IR 3 function is lost after 5 minutes.

Loss of Main generation and ATT HDG Selector Switch in CAPT/3 Position

The CAPT/3 position of the ATT HDG selector switch corresponds to the selection of the IR 3 in place of the IR 1. The power supply distribution must then be modified to keep the IR 3 in emergency configuration.

- **Captain side:**

  The ADIRU 1 is supplied as in normal configuration.

- **First Officer side:**

  ADIRU 2 supply: Ref. Para. (NORM pos., F/O side)

- **Standby side:**

  ADIRU 3 is no more supplied with 115VAC. The ADIRU 3 is still powered with 28VDC from the 28VDC HOT BUS 701PP.

  – The ADR 3 function is lost immediately.

  – The IR 3 function is available.

GROUND WARNING

If one of the 3 ADIRUs looses 115 VAC power (the ON BAT light on the ADIRS illuminates), the 'HORN MECH CALL' sounds with a time delay of 15 seconds, if the A/C is on GROUND.

Parallel to this the ADIRU & AVIONICS VENT light in the nose well illuminates.

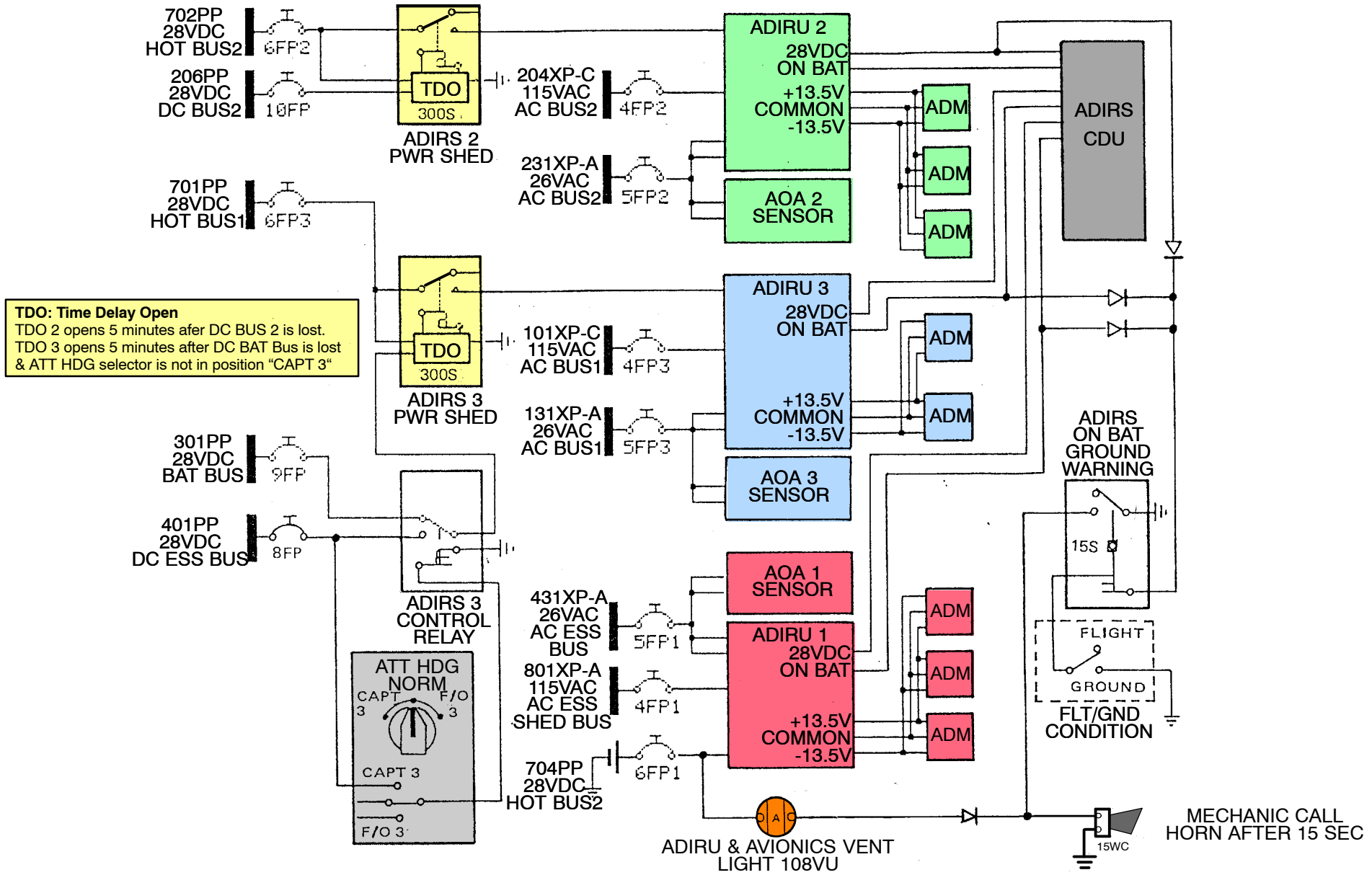


Figure 39 ADIRS Power Supply

AIR DATA REFERENCE INTERFACE

INPUTS

Digital Inputs

- ADM (**A**ir **D**ata **M**odule) inputs

  Three of five possible inputs are used to receive air mass data from remotely mounted ADM.

  For the ADIRU 3, only two ADM input buses are used: one for the total pressure data and the other for the averaged static pressure data.
- FCU (**F**light **C**ontrol **U**nit) inputs

  The ADR receives two input buses from the FCU, for digital baro corrections, but uses only one at a time.
- CFDS (**C**entralized **F**ault **D**isplay **S**ystem) input

  For maintenance purposes, the ADR receives one input bus from the CFDIU.
- ADR (**A**ir **D**ata **R**eference) input

  Each ADR receives two intercommunication buses from the other ADRs for cross channel comparison purpose.

Analog Inputs

- TAT (**T**otal **A**ir **T**emperature) input

  The ADR measures the resistance of the sensing element of the TAT sensor.
- AOA (**A**ngle **O**f **A**ttack) inputs

  The ADR receives two resolver inputs for angle of attack computation.

Discrete Inputs

The ADR is provided with the following input discretes:

- Heat discrete come from the associated PHC (**P**robe **H**eat **C**omputer).
- AOA average/unique

  The ADR portion receives the AOA on two resolvers. This discrete indicates wether the computation must use an average value from the two resolvers, or the value of resolver 1 in priority, with the second as a back-up in case of failure. This last solution is chosen on the A/C.
- VMO/MMO discrete

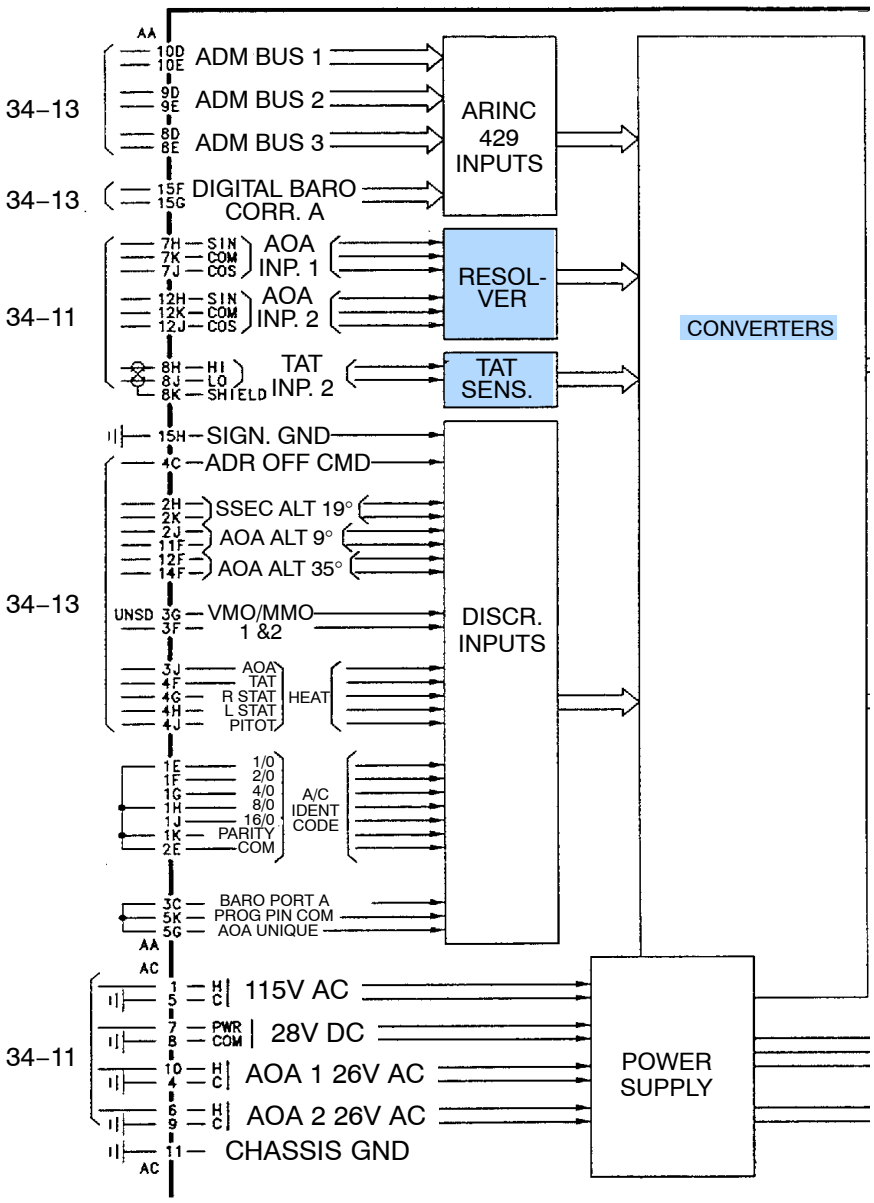
  Provides the position of the L/G DOWN VMO/MMO SELECTION Switch.
- SSEC (**S**tatic **S**ource **E**rror **C**orrection) and AOA correction and selection discretes

  Sent from the SFCC (**S**lat and **F**lap **C**ontrol **C**omputers). They are linked to the flap position.
- A/C identification:

  7 discretes provides the ADIRU with the identification of the aircraft. They are used to select the appropriate SSEC and AOA correction laws.
- ADR OFF

  Indicates to the ADIRU, that the crew has pushed the ADR pushbutton switch on the ADIRS CDU. This commands the ADIRU to stop the transmission of the ADR output busses.
- Baro-correction source selection provides the ADIRU with the following:
  - the form (digital or analog) in which the baro-correction transmission is made
  - the number of sources (2 or 3)
  - the type of transmission used by the digital sources (single bus or various buses).

    On the A/C the FCU transmits the CPT and F/O baro-correction in digital form on separate buses.



INPUT SIGNAL	INPUT	INPUT DEFINITION
ADR ARINC Filter Select	Open/GND	Type A/Type B
CMC/CFDS Message Select	Open/GND	CFDS/CMC
SDI LSB (Middle Insert)	Open/GND	0/1
SDI MSB (Middle Insert)	Open/GND	0/1
Pitot Probe Ht Disc	Open/GND	No Fault/Fault
Right Static Ht Disc	Open/GND	No Fault/Fault
Left Static Ht Disc	Open/GND	No Fault/Fault
TAT Ht Disc	Open/GND	Off/On
AOA 1 Ht Disc	Open/GND	No Fault/Fault
AOA Average/Unique	Open/GND	Average/Unique
VMO/MMO Disc 1	Open/GND	No/Yes
VMO/MMO Disc 2	Open/GND	No/Yes
VMO/MMO Disc 3	Open/GND	No/Yes
VMO/MMO Disc 4	Open/GND	No/Yes
SSEC Alternate Disc A	Open/GND	No/Yes
SSEC Alternate Disc B	Open/GND	NO/Yes
AOA Alternate Disc 1A	Open/GND	Off/On
AOA Alternate Disc 1B	Open/GND	Off/On
AOA Alternate Disc 2A	Open/GND	Off/On
AOA Alternate Disc 2B	Open/GND	Off/On
Baro Port "A"	Open/GND	Port B/Port A
Zero MACH SSEC	Open/GND	Use SSEC/Ignore SSEC
Zero AOA SSEC	Open/GND	Use SSEC/Ignore SSEC
AIR FRM ID Code 1/0	Open/A.I.Com	No/Yes
AIR FRM ID Code 2/0	Open/A.I.Com	No/Yes
AIR FRM ID Code 4/0	Open/A.I.Com	No/Yes
AIR FRM ID Code 8/0	Open/A.I.Com	No/Yes
AIR FRM ID Code 16/0	Open/A.I.Com	No/Yes
AIR FRM ID Code Parity	Open/A.I.Com	No/Yes
ADR Remote Test	Open/GND	No Test/Test
ADR OFF DISCR Input	Open/GND	Released/Pressed
Dual Baro	Open/GND	Sgl Port/Dual Port
Baro Analog/Digital Sel.	Open/GND	Digital/Analog
Baro Corr. 3 Active	Open/GND	Not Active/Active

Figure 40 ADR Digital and Discrete Inputs

VMO/MMO Switch

Discretes are used to select alternate VMO/MMO (**V**elocity **M**aximum **O**peration/**M**ach **M**aximum **O**peration) levels.

With no VMO/MMO discretes in the ground state (yes) the ADR defaults to the BASIC LAW values for VMO/MMO.

Only one of the four VMO/MMO program discretes can be in the ground state at any one time.

If more than one VMO/MMO program discrete is in the ground state at any one time, the ADR defaults to the lowest available alternate condition (e. g. Flaps Full and L/G down).

On the A/C only the VMO/MMO DISC 2 is available and is provided by the L/G DOWN VMO/MMO SELECTION switch.

The normal position of this switch is open and it is grounded after crew action for particular flights (e. g. ferry flight with Landing Gear down).

The list below defines VMO/MMO state according to the switch 22FP.

VMO/MMO Switch open (basic):

- VMO = 350kts
- Mach = 0,82

VMO/MMO Switch closed (ground):

- VMO = 235kts
- Mach = 0,60

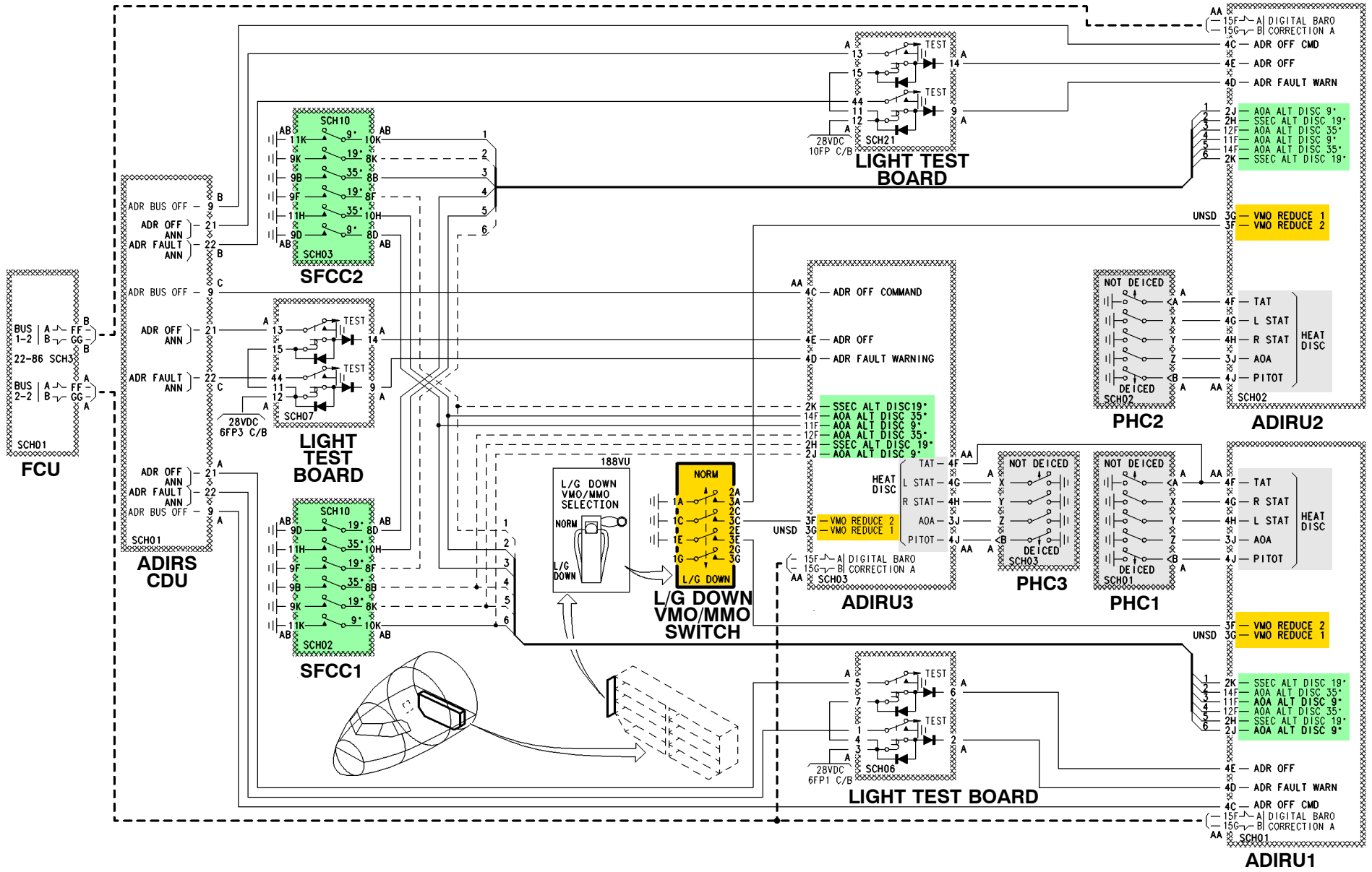


Figure 41 VMO/MMO Switch Schematic

OUTPUTS

The ADR data outputs are transmitted in two forms:

- digital (ARINC 429 LS bus)
- and discrete.

Digital Outputs

Calculated ADR parameter are transmitted on 6 data buses.

The parameters on each data bus are coded in different form:

- BNR: binary data word
- BCD: binary coded decimal data word
- ISO: data word coded in ISO5 code
- DIS: discrete data word
- HEX: hexadecimal code
- HYB: mixed code.

Discrete Outputs

The ADR provides seven standard OPEN /GROUND output discretes:

- ADR OFF light
- ADR FAULT
- Low Speed Warning Discretes 1, 2, 3 and 4
- AOA Special Test.

The AOA self test is commanded via the CFDIU interface bus. When the AOA test is active, the AOA sensor is offset to +15° C.

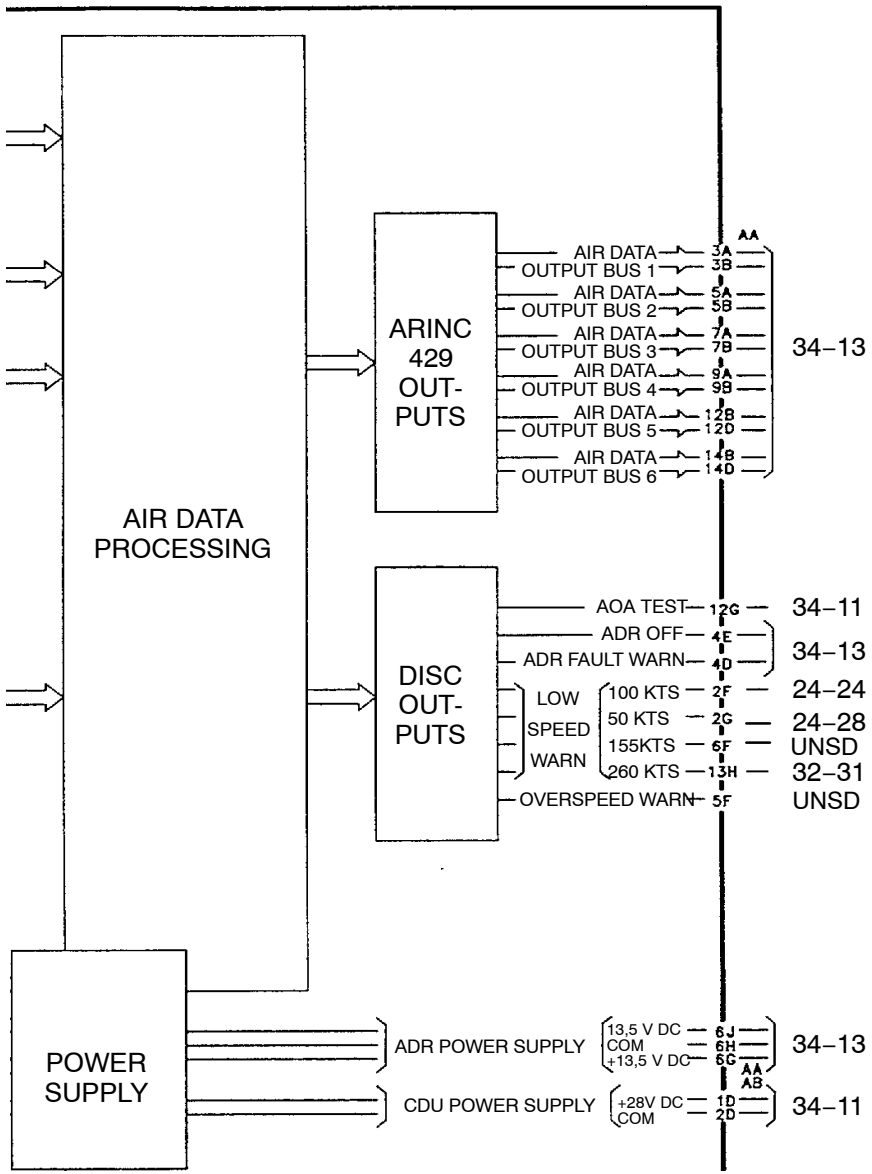


Figure 42 ADIRU (ADR) Outputs

USERS	ADR 1 BUS						ADR 2 BUS						ADR 3 BUS					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
ADIRU 1									*						*			
ADIRU 2		*												*				
ADIRU 3			*							*								
FMGC 1			*						*						*			
FMGC 2		*						*						*				
DMC 1	*														*			
DMC 2							*							*				
DMC 3			*						*				*					
ATC 1				*												*		
ATC 2								*						*				
FWC 1			*						*						*			
FWC 2		*						*						*				
CFDIU				*						*						*		
ECU ENG 1					*						*							
ECU ENG 2						*						*						
SFCC 1			*						*									
SFCC 2		*						*										
FAC 1			*						*						*			

USERS	ADR 1 BUS						ADR 2 BUS						ADR 3 BUS					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
FAC 2		*						*						*				
ELAC 1			*						*						*			
ELAC 2		*						*						*				
SEC 1			*												*			
SEC 2		*						*										
SEC 3								*						*				
GPWC				*														
DMU		*																
CABIN PRESSURE CONTROLLER1			*							*						*		
CABIN PRESSURE CONTROLLER2				*				*									*	
ZONE TEMPERATURE CONTROLLER																	*	
TEST 1 CONNECTORS				*						*						*		

Figure 43 ADR Data Users

INERTIAL REFERENCE INTERFACE

DIGITAL INPUTS

- **FMGC inputs**

  The IR portion is provided with two ARINC 429 LSU buses from the two FMGCs.

  These buses transmits the following data:

  – Set Latitude
  – Set Longitude
  – Set Magnetic Heading
  – FMGC Discretes.

- **CDU inputs**

  The IR portion is provided with one ARINC 429 LSU bus from the ADIRS CDU.

  This bus transmits the following data:

  – Set Latitude
  – Set Longitude
  – Set Magnetic Heading
  – CDU Test.

- **ADR inputs**

  The IR portion is provided with two ARINC 429 LSU buses from the two other ADIRUs (ADR portion) and with one bus from its associated ADR.

  These buses transmit the following data:

  – Altitude
  – True Airspeed.

- **CFDS inputs**

  The IR portion is provided with one ARINC 429 LSU bus from the CFDS.

  This bus transmits the following data:

  – UTC, Flight Phase
  – A/C Config, CFDS Command
  – Date, Flight Number and A/C Tail Number

Discrete Inputs

The IR portion is provided with the following discrete inputs:

INPUT SIGNAL	INPUT	INPUT DEFINITION
Mounting Position 1	Open/GND	-/-
Mounting Position 2	Open/GND	-/-
SDI MSB (Middle insert)	Open/GND	0/1
SDI LSB (Middle insert)	Open/GND	0/1
CDU ON/OFF	Open/GND	Not displayed/displayed
IR mode select M1	Open/GND	-/-
IR mode select M2	Open/GND	-/-
Auto ADR DADS select	Open/GND	-/-
Manual ADR DADS select	Open/GND	-/-
A/C Ident Code 1/0	Open/A. I. Com	0/1
A/C Ident Code 2/0	Open/A. I. Com	0/1
A/C Ident Code 4/0	Open/A. I. Com	0/1
A/C Ident Code 8/0	Open/A. I. Com	0/1
A/C Ident Code 16/0	Open/A. I. Com	0/1
A/C Ident Code 32/0	Open/A. I. Com	0/1
A/C Ident Code 64/0	Open/A. I. Com	0/1
A/C Ident Code Parity	Open/A. I. Com	0/1
IR remote test	Open/GND	No test/test
MAGVAR select	Open/GND	Standard/expended model
GPS sensor 1 present	Open/GND	GND = present
GPS sensor 2 present	Open/GND	GND = present
GPS priority select	Open/GND	Normal priority/ Reserved priority

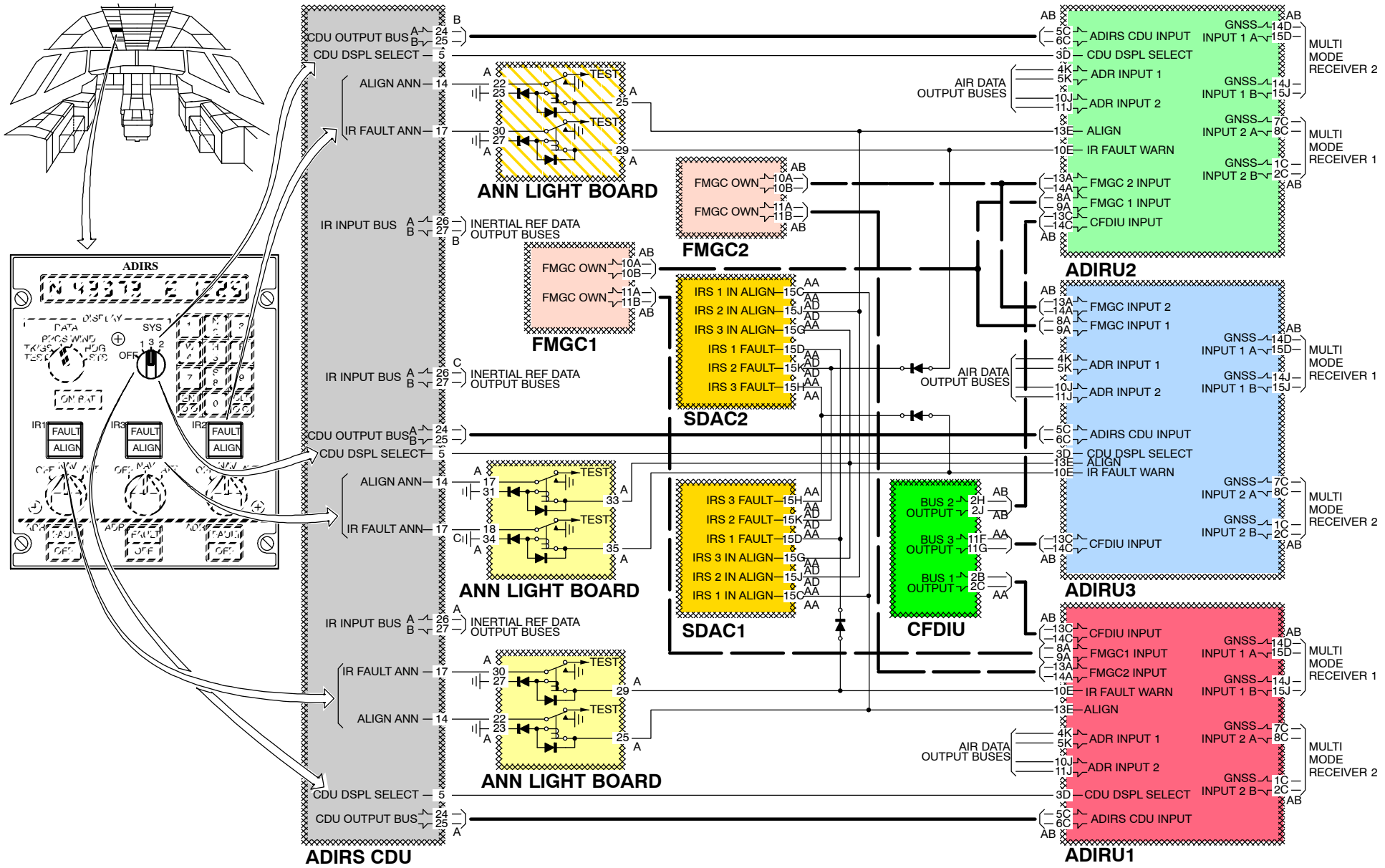


Figure 44 IR Inputs Schematic

OUTPUTS

The IR data outputs are transmitted in to forms, digital (ARINC 429 HS bus) and discrete.

Digital Outputs

Calculated IR parameter are transmitted on 3 data buses (4 buses, if GPS is installed). The parameters on each data bus are coded in different forms.

On aircraft with GPS

The IR portion also provides selected GPS (**G**lobal **P**ositioning **S**ystem) data and accurate GPIR hybrid position.

The GPIR (**G**lobal **P**ositioning **I**nertial **R**eference) function computes a hybrid GPS/IRS solution utilizing inputs received from the IR function and GPSSUs. The GPIR function has two operating modes: GPIR NAV mode and GPIR ATT mode, as indicated by IR mode command. In GPIR NAV mode, all the system state transitions are slaved to the IR function (Align, NAV).

ATTENTION: Only for GPS-ADIRUs: When the GPS PRESENT programming pins input discretes are grounded (indicating GPS present), both the GPSSU outputs and the GPIRS integrated navigation solution outputs are transmitted on the IR output buses with the IR output data.

Discrete Outputs

The IR provides 3 discrete outputs:

- ON BAT

  When the IR is powered with batteries, this discrete sets the ON BAT light to on.
- IR FAULT

  when a failure is detected by the IR, this discrete sets the FAULT legend to on.
- IR ALIGN

  When the IR is aligning, this discrete sets the ALIGN legend to on.

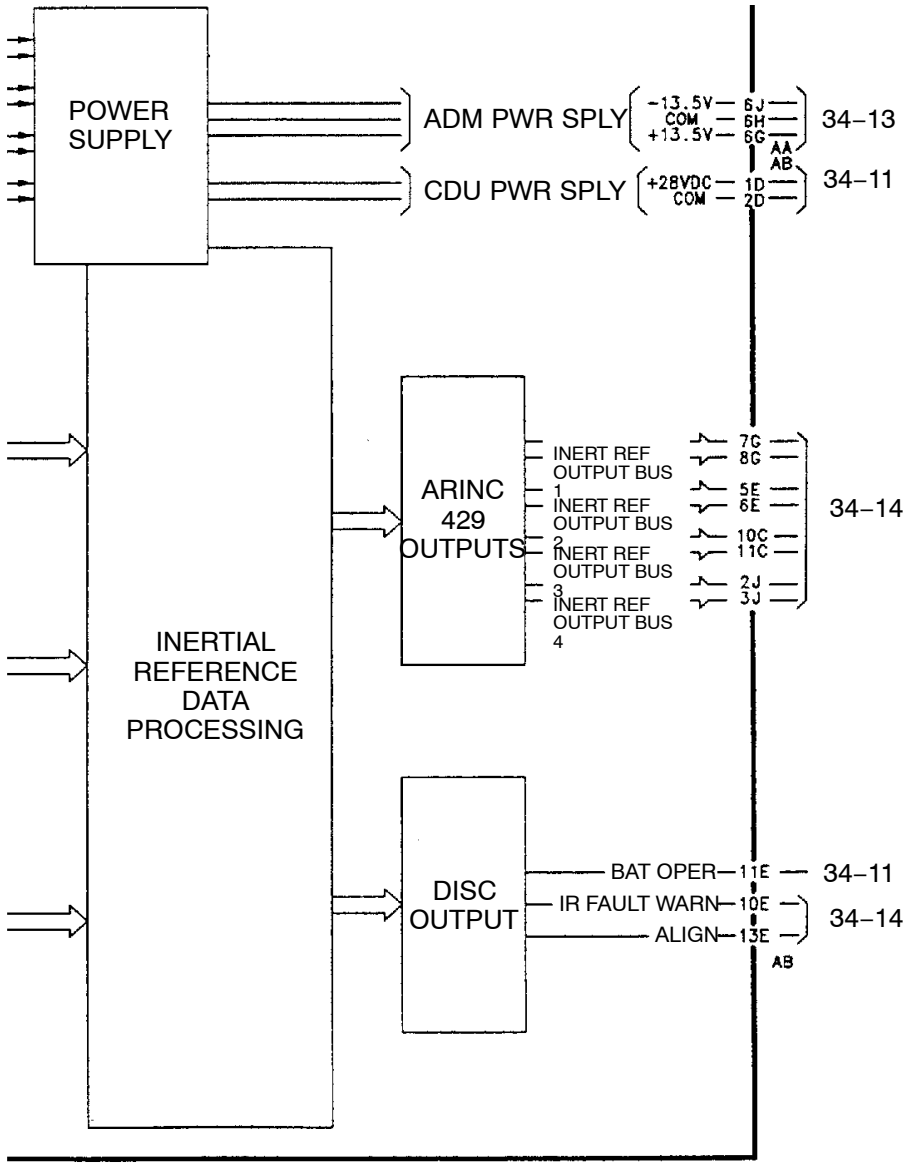


Figure 45 ADIRU Outputs (IR)

USERS	IR 1 BUS				IR 2 BUS				IR 3 BUS			
	1	2	3	4	1	2	3	4	1	2	3	4
FAC 1			*				*				*	
FAC 2		*				*				*		
ELAC 1			*				*				*	
ELAC 2		*				*				*		
SEC 1			*								*	
SEC 2		*				*						
SEC 3						*				*		
DMC 1	*										*	
DMC 2						*				*		
DMC 3			*				*		*			
CDU		*				*				*		
FMGC 1			*				*				*	
FMGC 2		*				*				*		
FQIC		*				*						
BSCU		*					*			*		
CFDIU			*				*				*	
GPWC			*									
WR 1			*								*	
DMU		*					*					
RMI-VOR/DME		*								*		
TEST PLUG			*			*					*	

IR Data Users

SYS.	LABEL	SDI	PARAMETER DEFINITION	RANGE ACCURACY	UNIT	SIG BIT	DATA BITS	UPD/ MSEC	CODE	ALPHA CODE	SOURCE ORIGIN BUS No. ATA REF CONV
	010		PPOS LAT	W 90S-90N 0.1	Deg & mn		6	500	BCD	LATP	
	011		PPOS LONG	W 180E-180W 0.1	Deg & mn		6	500	BCD		
	012		GROUND SPEED	W 0 to 2000 0 to 1000 R 1 +/- 8	Kts		4	500	BCD	GS	
	013		TRK ANGLE TRUE	W 0 to 359.9 R 0.1 +/- 2.3	Deg		4	500	BCD		
	014		MAG HDG	W 0 to 359.9 R 0.1 +/- 3	Deg		4	500	BCD	MH	
	015		WIND SPEED	W 0 to 256 R 1 +/- 9	Kts		3	500	BCD	WS	
	016		WIND DIR TRUE	W 0 to 359 R 1 +/- 10	Deg		3	500	BCD	WD	
	041		SET LAT	W +/- 180 90S-90N R 0.1	Deg & mn		6	500	BCD		
	042		SET LONG	W +/- 180 R 0.1	Deg & mn		6	500	BCD		
	043		SET MAG HDG	W 0 to 359.9 R 0.1	Deg		4	500	BCD		
	356		FAULT STAT						ISO		
	377		EQUIP IDENT					1000	HEX		
	076		GPS ALT - MSL	W +/- 131072 R 0.125	ft		20	1000			
	101		HDOP	W 0 to 1024 R 0.031			15	1000			
	102		VDOP	W 0 to 1024 R 0.031			15	1000			
	103		GPS TRACK ANGLE TRUE	W +/- 180 R 0.005493	DEG		15	1000			
	110		GPS PRES POS - LAT	W +/- 180 R 0.000172	DEG		20	1000			

IR Dig Output Characteristics

Figure 46 IR Outputs Chart

ADIRS ECAM WARNINGS OPERATION

GENERAL

The ADIRS (**A**ir **D**ata **I**nertial **R**eference **S**ystem) warning messages are shown on the lower part of the upper ECAM display unit.

NOTE: Although the ADIRS warnings are amber, they are directly computed by the FWC (**F**light **W**arning **C**omputer) from ADIRU (**A**ir **D**ata **I**nertial **R**eference **U**nit) data.

STALL WARNING

The MASTER WARNing flashes, the cricket sounds associated with a STALL synthetic voice if the aircraft is in stall configuration the AOA (**A**ngle–**O**f–**A**ttack) is greater than a predetermined angle.

The AOA depends on:

- the slats/flaps position,
- the speed/mach and,
- the flight/control law (normal, alternate/direct).

The stall warnings are also activated when the AOA test is carried out.

OVERSPEED WARNING

The MASTER WARN flashes and the CRC (**C**ontinuous **R**epetitive **C**hime) sounds.

This warning appears when:

- aircraft speed/mach is greater than Maximum Operating Speed (VMO) + 4 kts/Maximum Operating Mach (MMO) + 0.006, in clean configuration. The VMO/MMO value is influenced by the LDG GEAR DOWN switch.
- aircraft speed is greater than Maximum Landing Gear Extended Speed (VLE) + 4 kts with the landing gear not uplocked or landing gear doors not closed,
- aircraft speed is greater than Maximum Flap Extended Speed (VFE) + 4 kts with slats and/or flaps extended.

HDG DISCREPANCY

The MASTER CAUTion comes on, and the SC (**S**ingle **C**hime) sounds in case of heading discrepancy between the CAPT and the F/O NDs and PFDs. The comparison is performed by the FWC with a threshold of 5 degrees on heading.

ATT DISCREPANCY

The MASTER CAUT comes on, and the SC sounds in case of attitude discrepancy between the CAPT and the F/O PFDs. The comparison is performed by the FWC with a threshold of 5 degrees on pitch and roll channels.

ALT DISCREPANCY

The MASTER CAUT comes on, and the SC sounds in case of altitude discrepancy between the CAPT and the F/O PFDs. This warning appears when the difference between altitude displayed on CAPT and F/O is greater than:

- 500 ft if BAROmetric reference STanDard is selected,
- 250 ft if QNH or QFE (optional) is selected.

ADR FAULT

The MASTER CAUT comes on, and the SC sounds in case of ADR 1 or 2 fault. The faulty ADR should be switched off. ADR 3 has to be selected.

The MASTER CAUT comes on, and the SC sounds in case of ADR 3 fault.

If the ADR 3 was not in use at the time of failure, it has to be switched off. If it was in use when the failure occurred, then the AIR DATA switching selector on the SWITCHING panel has to be set back to NORMal position.

NOTE: In electrical emergency configuration, the warnings associated with an ADR 3 fault are inhibited.

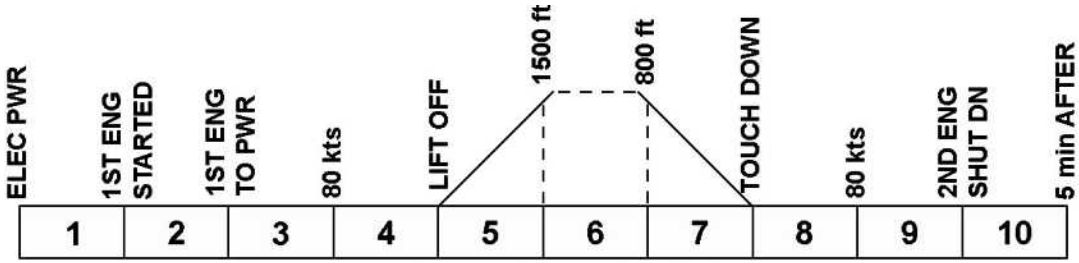
IR FAULT

The MASTER CAUT comes on, and the SC sounds in case of IR (**I**nertial **R**eference) 1 or 2 fault. IR 3 has to be selected.

The MASTER CAUT comes on, and the SC sounds in case of IR 3 fault.

IR 3 has to be selected. If IR 3 was not in use at the time of failure, it has to be switched off.

NOTE: In electrical emergency configuration, the warnings associated with an IR 3 fault are inhibited.



FLIGHT PHASE INHIBITION

E/WD : FAILURE TITLE CONDITIONS	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLIGHT PHASE INHIB
STALL WARNING (NO ECAM MESSAGE) ANGLE OF ATTACK GREATER THAN A PREDETERMINED ANGLE, WHICH DEPENDS ON: - SLATS/FLAP POSITION - SPEED/MACH - F/CTL LAW (NORMAL, ALTERNATE/DIRECT)	CRICKET + SYNTHETIC VOICE "STALL"	MASTER WARN	NIL	NIL	1, 2, 3 4, 8, 9, 10
OVER SPEED - VMO/MMO: AIRCRAFT SPEED/MACH > VMO + 4 kts/MMO + 0.006 - VLE: AIRCRAFT SPEED > VLE + 4 kts - VFE: AIRCRAFT SPEED > VFE + 4 kts	CONTINUOUS REPETIVE CHIME				2, 3, 4 8, 9, 10
NAV HDG DISCREPANCY DIFFERENCE BETWEEN HDG ON CAPT AND F/O PFD > 5°	SINGLE CHIME	MASTER CAUT		CHECK HDG ON PFDs & NDs	4, 8
NAV ATT DISCREPANCY DIFFERENCE BETWEEN ROLL OR PITCH ANGLE ON CAPT AND F/O PFD > 5°				CHECK ATT ON PFDs	3, 4, 8
NAV ALTI DISCREPANCY DIFFERENCE BETWEEN ALTITUDE ON CAPT AND F/O PFD > 500 ft IF BARO REF STD SELECTED > 250 ft IF QNH OR QFE IS SELECTED				CHECK ALT ON PFDs	
NAV ADR 1(2) FAULT				ADR FAULT LIGHT	1, 4, 8, 10
NAV ADR 3 FAULT					1, 3*, 4 5, 7, 8, 10
NAV IR 1(2) FAULT				IR FAULT LIGHT	4, 5, 7, 8
NAV IR 3 FAULT					3*, 4, 5, 7, 8

* FLIGHT PHASE INHIBITED ONLY IF ADR 3 OR IR 3 IS USED WHEN THE FAILURE OCCURS.

Figure 47 ADIRS ECAM Warnings

ADIRS BITE

The BITE facilitates maintenance on in–service aircraft.

It detects and identifies faults related to the ADIRS (**A**ir **D**ata **I**nertial **R**eference **S**ystem) and reports them to the CFDIU (**C**entralized **F**ault **D**isplay **I**nterface **U**nit).

The BITE is included in the following LRUs:

- ADIRU (**A**ir **D**ata **I**nertial **R**eference **U**nit)
- ADM (**A**ir **D**ata **M**odule).
- CDU (**C**ontrol and **D**isplay **U**nit).

NOTE: The BITE menus of the ADR and IR can deviate depending on the vendor and generation of the ADIRU.

AIR DATA BITE

Air Data Module

The ADM performs various tests to detect its own faults and failed input signals (check of programming pins).

Faults are annunciated to the ADR by omission or labeling of a faulty output word (pressure label) and through the use of a discrete fault–code word output on the ARINC bus. Fault reports are also stored in a non–volatile memory inside the ADM.

It is linked to the CFDIU through the ADIRU (ADR and IR portions) which summarizes the BITE results for its own channel.

Air Data Part of ADIRU

The ADR BITE monitors certain internal functions, the functionality of other ADR internal hardware, the status of analog, digital and discrete inputs and cross–channel comparisons with the other ADRs.

These BITE tests are performed either at power up or continuously with the exception of cross–channel comparisons which are run once at takeoff.

Air Data Interactive function description

- Last Leg Report
- Previous Legs Reports
- LRU Ident:

  On page 1/2, the Part Numbers and the Serial Numbers of the ADIRU and the total pressure ADM are displayed. On page 2/2, the associated data to the remaining ADM are displayed.
- Ground Scanning

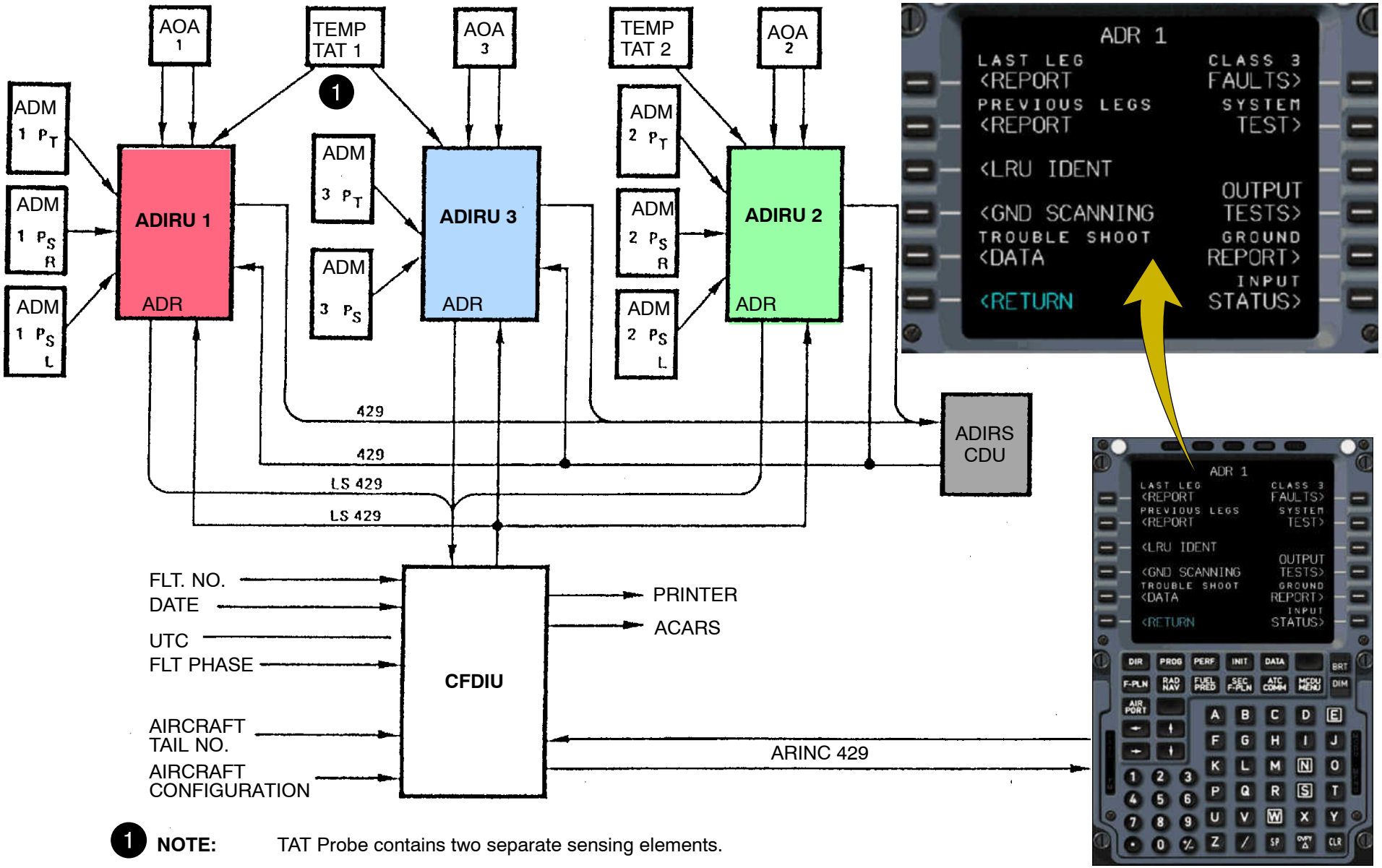
  The Ground Scanning function performs most of the continuous tests. All tests with an important time delay (e. g. temperature) are not performed within this function.
- Trouble Shooting Data

  A maximum of sixteen 16–bit words can be recorded for the Trouble Shooting Data.
- Class 3 Faults
- System Test

  The system test function performs power–up tests and various continuous tests to provide a complete status of the ADR part of the ADIRS. It is necessary to re–initialize the system for IR part because the navigation data are erased by the test of the RAM performed at the power–up.
- Output Tests

  The output tests are divided in three parts:
  - Slew tests
  - Interface test
  - AOA test
- Ground Report
- Current Status:

  The Current Status function displays on 8 pages the state (as read by the computer) of the discrete inputs, digital inputs (ADM and baro–correction), analog inputs and power condition.



1 **NOTE:** TAT Probe contains two separate sensing elements.

Figure 48 ADR/CFDS Block Diagram

INERTIAL REFERENCE BITE

The IR BITE monitors certain functions.

Some of them enable to monitor operation errors. These tests are:

- Align in air
- Excessive Motion
- Latitude comparison test.

They result in IR warnings but without fault message sent to the CFDIU.

Inertial Interactive function description

- Last Leg Report
- Previous Legs Report
- LRU Ident

  The Part Numbers and the Serial Numbers of the ADIRU are displayed.
- Ground Scanning:

  The Ground Scanning function performs most of the continuous tests. All tests with an important time delay (e. g. temperature) are not performed within this function.
- Trouble Shooting Data

  A maximum of sixteen 16 bit words can be recorded for the Trouble Shooting Data.
- Class 3 Fault
- System Test

  The system test function performs power–up tests and various continuous tests to provide a complete status of the IR part of the ADIRS.

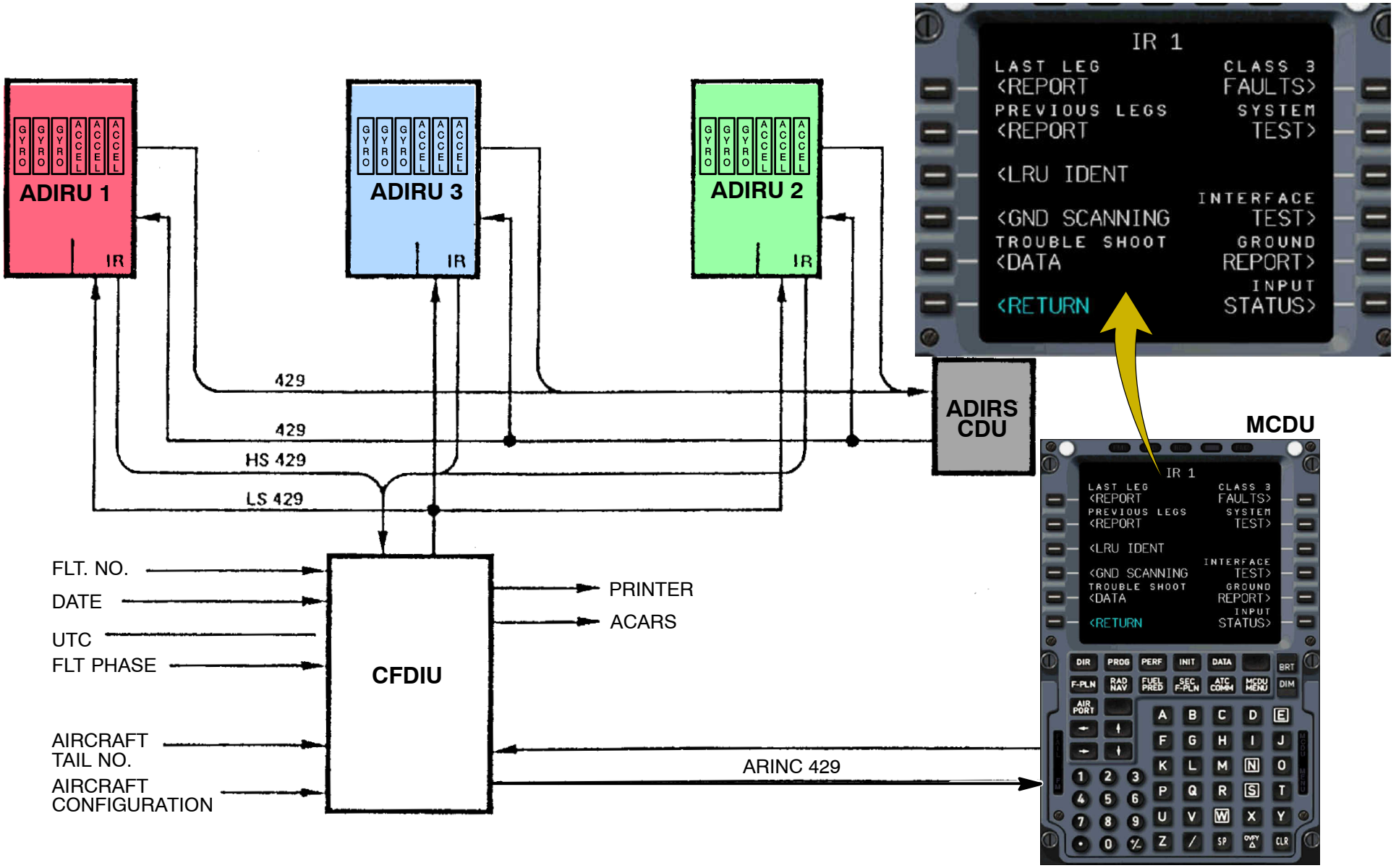


Figure 49 IR/CFDS Block Diagram

34–20 STANDBY NAVIGATION SYSTEMS

STANDBY INSTRUMENTS INTRODUCTION

The standby navigation system enables the flight crew to check the navigation data provided by the ADIRS.

The standby navigation system comprises four instruments. Each providing different indications:

- Standby Compass for magnetic heading,
- Standby Horizon Indicator for attitude,
- IAS (**S**tandby **A**irspeed **I**ndicator) for airspeed,
- Standby Altimeter for altitude.
- Optional Standby Metric Altimeter for metric altitude.

STBY ALTIMETER

STBY AIRSPEED INDICATOR

METRIC ALTIMETER (OPTION)

STBY COMPASS LIGHT SWITCH

STBY COMPASS

STBY HORIZON

Figure 50 Standby Instruments

STANDBY ALTITUDE AND AIRSPEED PRESENTATION

General

One standby airspeed indicator, one standby altimeter and one metric altimeter are directly connected to the standby pitot and static sources.

NOTE: The standby circuit can be drained by means of a water drain.

Standby Altimeter

The standby altimeter is supplied with static pressure by the standby air data system to indicate the barometric altitude of the aircraft in feet.

When the altitude is below 10.000 feet, the figure zero of the left drum is replaced by black and white stripes. The figure nine is replaced by a red stripped zone.

The baro correction is displayed on a counter graduated in hectopascal.

A knob, located at the left corner of the indicator, enables the display of the reference baro correction in the range of 750 to 1050 h Pa.

Four manually adjustable white bugs are provided for manual altitude setting.

The internal vibrator is supplied with 28VDC through a landing gear relay.

Standby Airspeed Indicator

The standby airspeed indicator contains a capsule–operated mechanism which measures the pitot /static pressure differential from the standby air data system and provides airspeed indication in terms of knots.

The airspeed indication is displayed by means of:

- A pointer which moves on a dial graduated between 60 kts and 450 kts. The scale is linear from 60 kts to 250 kts with 5 kts graduations and from 250 kts to 450 kts with 10 kts graduations.
- Four manually adjustable white bugs provided for manual speed setting.

Metric Altimeter (Optional)

The metric altimeter is supplied with static pressure by the standby air data system to indicate the barometric altitude of the aircraft in meters.

The barometric altitude is displayed by means of:

- a pointer performing one revolution of the dial for 1000 meters.
- a display counter made up of two drums displaying respectively the tens of thousands, and the thousands of meters.

  The altitude dial is calibrated from 0 to 1000 meters with 50 meters graduations.
- The baro correction is displayed on a counter graduated in hectopascal
- A knob located at the left corner of the indicator enables the display of the reference baro correction in the range of 870 to 1050 hPa.

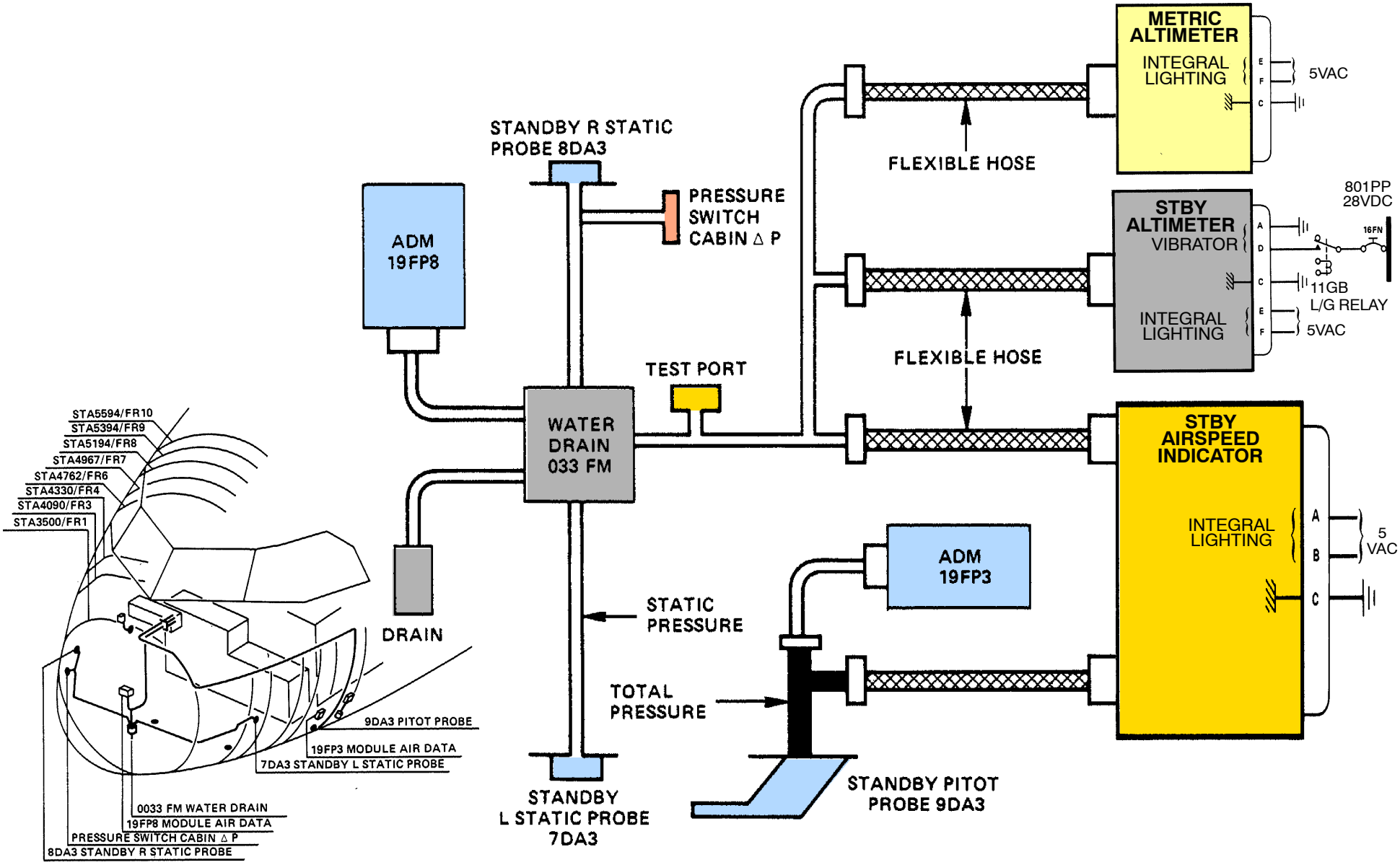


Figure 51 Standby Altitude and Airspeed

STANDBY ATTITUDE AND HEADING PRESENTATION

STANDBY ATTITUDE

The standby attitude is performed by a gyroscopic horizon that is an independent instrument which provides the flight crew, with a constant indication of the aircraft attitude.

It allows a check of the attitude provided by the main sources of attitude system. It acts in standby when these systems are inoperative.

The standby horizon indicator is supplied with 28V DC from essential bus.

A static inverter in the instrument converts this 28V DC into three phase alternate current to supply the gyroscopic motor.

The gyro rotor rotates at high speed (> 23,000 RPM) around its vertical axis and provides the vertical reference.

The fast resetting of the gyroscopic horizon can be activated by pulling the knob located in the lower right corner of the indicator.

The indicator provides the following information:

- roll angle,
- pitch angle,
- instrument failure (RED flag).

1. **Pitch information**

   The aircraft symbol (black and yellow) is fixed.

   The pitch drum, in the center of the instrument is divided into two zones (the upper part is blue, the lower part is brown) separated by the reference horizon (white).

   The pitch indications are displayed by means of a drum which is graduated between –80 and +80 degrees.

2. **Roll information**

   The roll information is given by a pointer which moves in front of a dial graduated in 10 degrees increments between –30 and +30 degrees.

3. **Failure warning**

   The flag comes into view if a failure is detected in the electrical power supply or if the gyro rotor speed drops below 18,000 RPM.

STANDBY HEADING

The standby heading is performed by a magnetic compass that is an independent instrument which provides the flight crew with the A/C magnetic heading.

It is installed on the top of the windshield center post and allows a check of the heading provided by the main sources of the heading system. It acts in standby when these systems are inoperative.

The standby compass consists of a magnetic element rotating inside a compass bowl, immersed in a damping liquid. The magnetic element is linked to a graduated compass card which moves against a lubber line and gives the magnetic heading.

Below the viewing window are two apertures marked N. S and E. W, allowing to achieve compensation by positioning the two small magnetized bars (compensator).

Above the viewing window is a non–magnetic lamp assembly which provides illumination of the compass card.

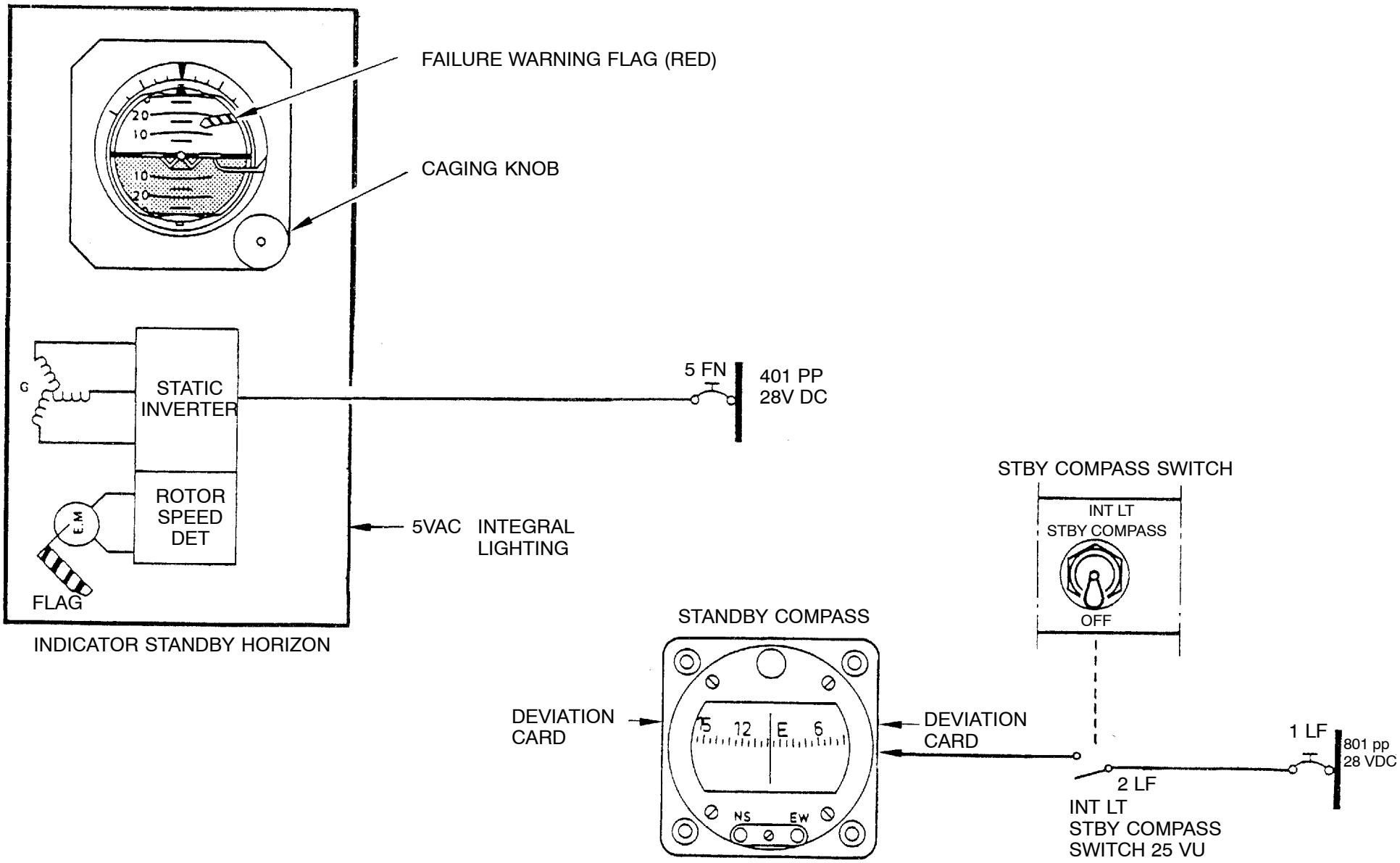


Figure 52 Standby Attitude and Heading

34–22 ISIS (INTEGRATED STANDBY INSTRUMENT SYSTEM)

GENERAL DESCRIPTION

CLASSIC

On the **A320** minimum three conventional standby instruments are located in the cockpit on the center instrument panel:

- Standby Airspeed Indicator
- Standby Altimeter
- Standby Horizon

The Standby Metric Altimeter is an option.

A standby compass is integrated in the lower part of the overhead panel.

General

The standby airspeed indicator, standby altimeter and the metric altimeter are directly connected to the standby pitot and static sources. The standby static circuit can be drained by means of a water drain.The standby airspeed indicator is also connected to the standby pitot circuit. The standby horizon is a gyro rotating with 23000 RPM, indicating the attitude of the aircraft.

Standby Altimeter

The standby altimeter is supplied with static pressure by the standby air data system to indicate the barometric altitude of the aircraft in feet.

The internal vibrator is supplied with 28VDC through a landing gear relay.

Standby Airspeed Indicator

The standby airspeed indicator contains a capsule–operated mechanism which measures the pitot /static pressure differential from the standby air data system and provides airspeed indication in terms of knots.

Four manually adjustable white bugs provided for manual speed setting.

Metric Altimeter (Option)

The metric altimeter is supplied with static pressure by the standby air data system to indicate the barometric altitude of the aircraft in meters.

ENHANCED

On the enhanced aircraft, the standby airspeed indicator and the standby altimeter are deleted and the standby horizon indicator is replaced by the

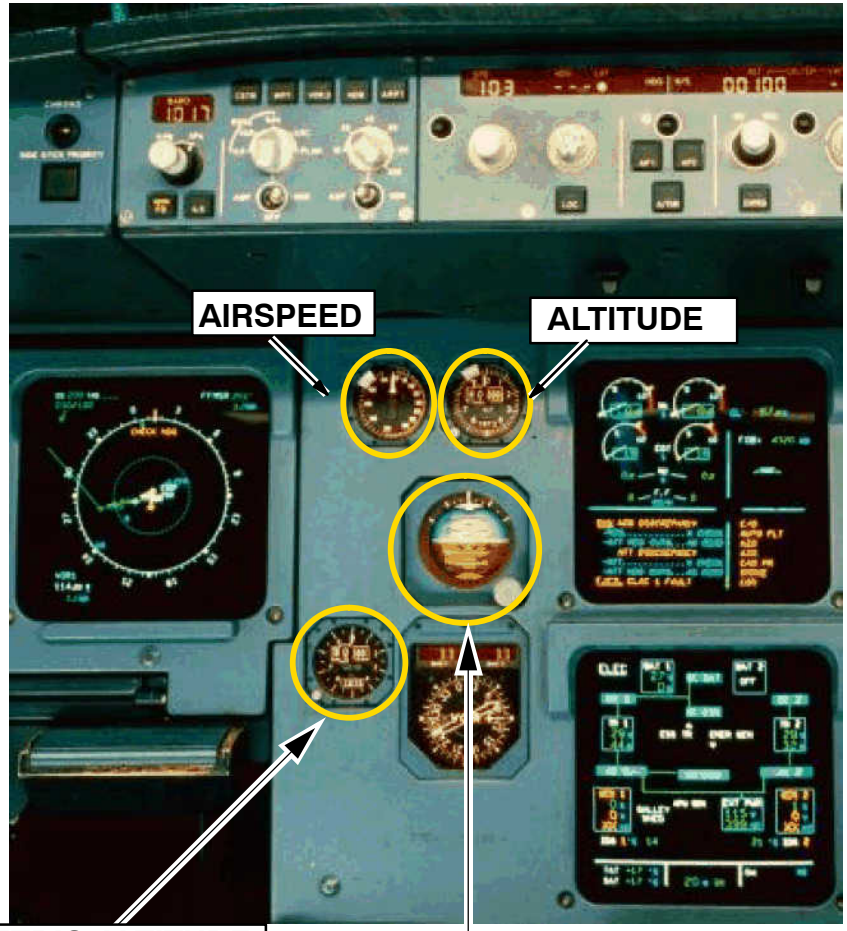
ISIS (Integrated Standby Instrument System).

On overhead panel (49 VU) the C/B for the standby altimeter is deleted and the C/B for the STBY/HORIZON is replaced by STBY/INST.

The ISIS indicator replaces these three conventional standby instruments:

- The standby altimeter.
- The standby horizon indicator.
- The standby airspeed indicator.

A320 CENTER INSTRUMENT PANEL



A318 CENTER INSTRUMENT PANEL (401 VU)

ISIS (22FN)

Figure 53 Standby Instrument Panel

ISIS LAYOUT

ISIS Indications

The ISIS displays the following information:

- Airspeed,
- Mach number,
- Pitch and Roll angles,
- Altitude in feet (ft),
- ILS (**I**nstrument **L**anding **S**ystem) or MM (**M**ulti–**M**ode **R**eceiver) deviations: G/S (**G**lide **S**lope), LOC (**LOC**alizer),
- BIRO (**BARO**metric) reference in hap (**hector Pa**scal),
- Metric altitude,
- Magnetic heading,
- BARO–correction in hap in addition to the BARO correction in inches of mercury (in. Hg)

A light Sensor automatically controls the display brightness.

As soon as the ISIS is energized, it shows the initialization display for 90 seconds. This display is four yellow boxes indicating ATT, SPD, ALT and INIT.

Initialization Function

This function corresponds to the initialization phase of the ISIS indicator.

As soon as the ISIS indicator is energized, the display shows these four yellow digital boxes for approximately 90 s:

- ATT for the standby horizon function,
- SPD for the airspeed indicator function,
- ALT for the altimeter function,
- INIT 90 S for the initialization function.

The ISIS performs an excessive motion test during the whole initialization phase.

At the end of the initialization phase pressing the RST (**R**e**S**e**T**) pushbutton switch more than 2 seconds restarts the initialization phase.

The display also shows the baro reference. Baro reference can be set during the initialization phase.

NOTE: If aircraft motion is detected during initialization the attitude information is flagged and the “**ATT-RST**“-message is displayed.

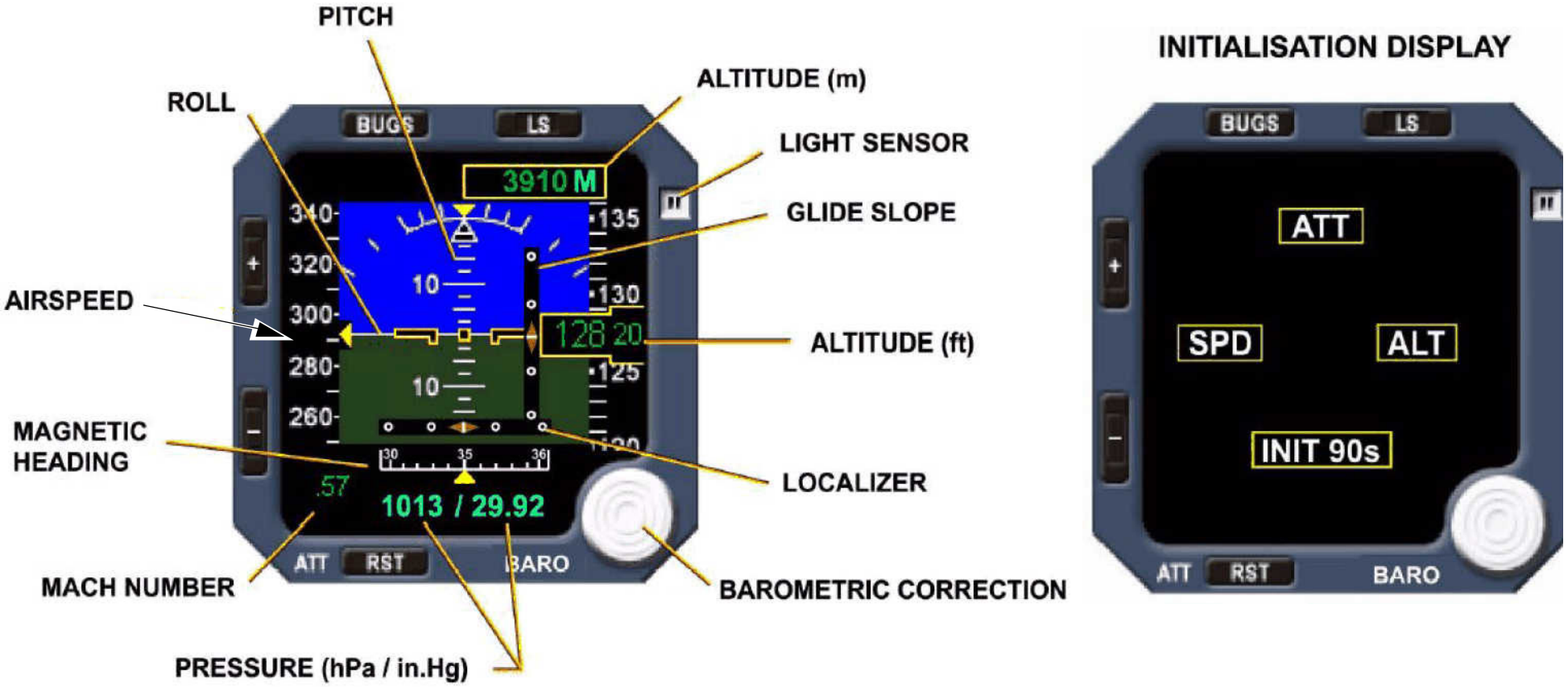


Figure 54 ISIS Display with Options

ISIS INDICATION

STANDBY AIRSPEED AND MACH NUMBER INDICATOR

The airspeed indicator is displayed by means of a black tape with white indications, positioned vertically in the left part of the display area. The airspeed scale is linear with five–knot graduations from 5 to 250 Kts, ten–knot graduations from 250 to 520 Kts and digital values every 20 Kts. This tape moves up and down to indicate the A/C actual speed value in front of a fixed yellow reference line.

When the airspeed data is not valid, a red SPD flag is displayed in place of the airspeed scale.

The Mach number is always computed. When the Mach number is above 0.5 (increasing sense) it is displayed in green in the left bottom part of the display area, just below the speed scale in green color. It is no more displayed when it becomes lower than 0.45.

In case of failure, a red M flag is displayed in place of the Mach number.

Figure 55 ISIS Speed and Mach Indication

STANDBY ALTIMETER

The standby altimeter indication is supplied with static pressure by the standby air data system to indicate the barometric altitude of the aircraft in feet.

The barometric altitude indication is displayed by means of a black tape with white indications, positioned vertically in the right part of the display area.

The altitude scale is linear from – 2000 to + 50,000 ft with 100 ft graduations, with digital indications every 500 ft. This tape moves up and down with respect to a window surrounded in yellow within which the A/C actual altitude value is displayed in green digits.

The window is surrounded in cyan when an altitude bug is hidden by this read–out. In this window, the hundreds of feet are written in a large size whereas the tens and units are displayed by a drum operating as a conventional mechanical altimeter.

When the altitude data is not valid, a red ALT flag is displayed in place of the altitude tape, but the selected pressure is always displayed.

Negative Altitude

If the altitude is negative, the NEG indication is displayed in white close to the digital read–out. The range is – 2000 to 0 ft.

Barometric Correction

By pushing the barometric reference (BARO) selector knob located in the right bottom corner of the indicator, the pilot can select the standard barometric pressure 1013.25 hPa (29.9211 in. Hg) or the barometric correction.

This value (without units) can be adjusted by turning the knob:

- First press STD, second press: baro correction.
- Push it again to select the QNH (sea level atmospheric pressure) barometric reference in hecto pascal (hPa).

The barometric correction is displayed in cyan, in the center bottom part of the display, in the range from 745 to 1100 hPa (22 to 32.48 in. Hg.), with a variation of 10 hPa per rotation of the knob.

In case of standard barometric pressure selection, a cyan STD flag is displayed in place of the barometric correction value.

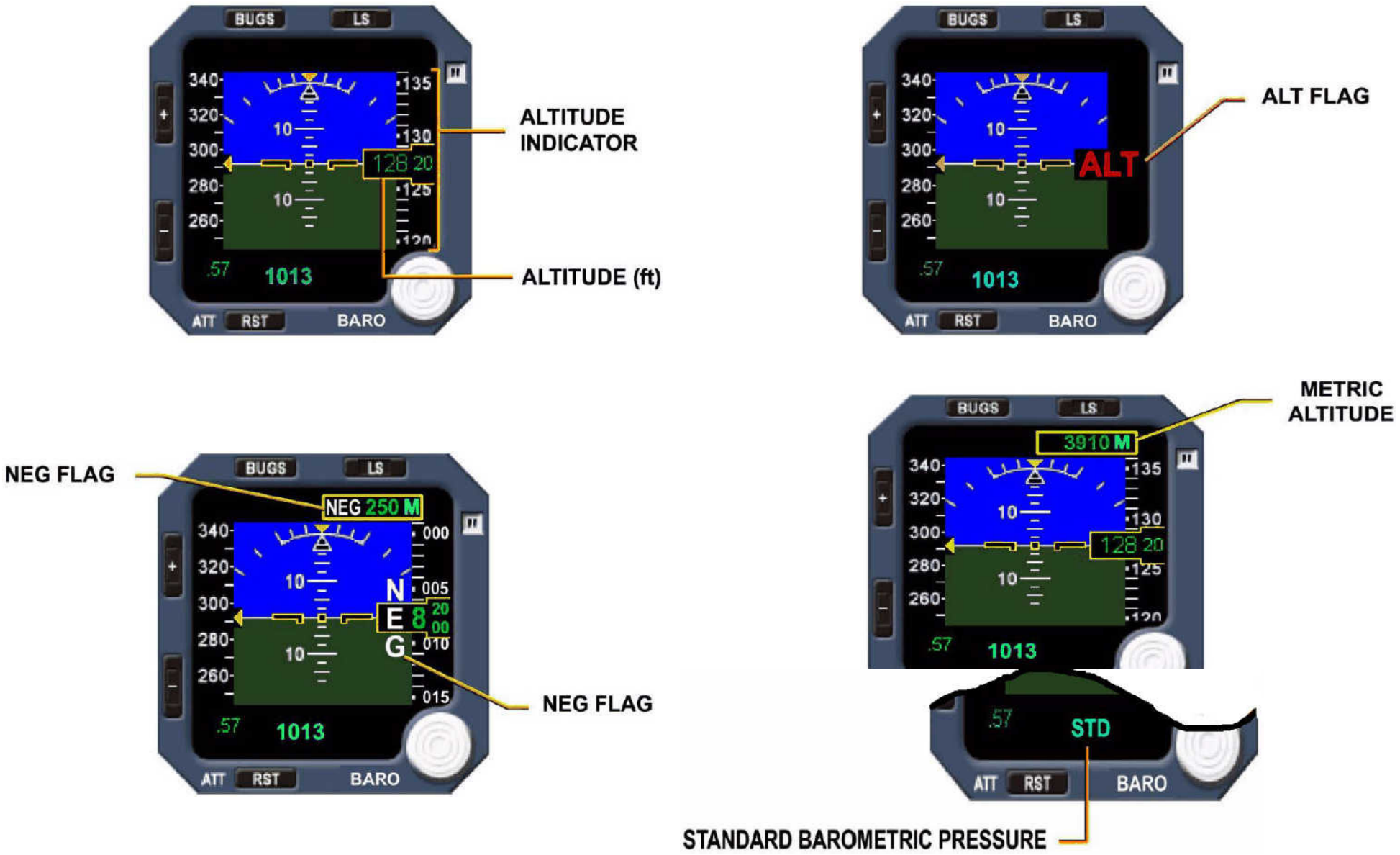


Figure 56 ISIS Altitude

STANDBY HORIZON

Reference

The yellow colored aircraft symbol provides a fixed reference for the moving scale pitch and roll indication. The basic A/C symbol can be replaced by the V–bar symbol when the corresponding pin–program discrete is grounded.

The fixed symbol is in yellow color, it comprises three parts:

Two simplified wing/landing gear parts plus a center part. It provides the pilot with a quick glance attitude information, both in pitch and roll with respect to the attitude sphere.

Pitch Angle

Pitch angles are shown with reference to the fixed aircraft symbol. The A/C present pitch angle is given by the vertical displacements of the pitch attitude scale with respect to the center of the A/C symbol. The scale moves behind the cut–sphere shaped window, limited by the lines of an upper (blue) and a lower (brown) sector. The scale rotates around the center of the A/C symbol in accordance with the A/C present roll angle. The pitch scale comprises white reference lines and associated pitch angle values. The lines are given every 2.5 degrees from – 30 to + 30 degrees. Beyond 30 degrees, red large arrow heads (V–shaped) indicate an excessive attitude and the direction to follow in order to reduce it.

Roll Angle

Roll angle is shown with reference to a fixed roll scale and index (yellow triangle). The scale has white scale marks at 10, 20, 30, 45 and 60 degrees. As the aircraft rolls left and right, a roll angle indicator (black triangle with white outline) moves across the fixed scale. The roll indicator is in two parts, which move together in a coordinated turn. However, if any lateral acceleration (sideslip) is detected, the lower part of the triangle moves with respect to the upper part. In case of failure of the pitch or roll information, the attitude display is replaced by a red ATT flag. The optional magnetic heading display is a moving scale (white) against a fixed reference (yellow triangle). In case of failure of the magnetic heading information, the magnetic heading display is replaced by a red HDG flag.

Lateral Acceleration

A black surrounded white trapezoidal index below the roll reference triangle represents the A/C lateral acceleration. Lateral acceleration is displayed in the range from –0,2 to +0,2 g. If the lateral acceleration exceeds this range, it is not displayed any more. When the lateral acceleration is null, the center of the symbol is in a neutral zone, the width of which corresponds to the middle of the base of the reference triangle. This can result on ISIS in a shifting up to one millimeter between this triangle and the symbol of lateral acceleration. This behavior comes from a compromise between the resolution of the sensors, the precision of the display and the mounting of the equipment on the instrument panel.

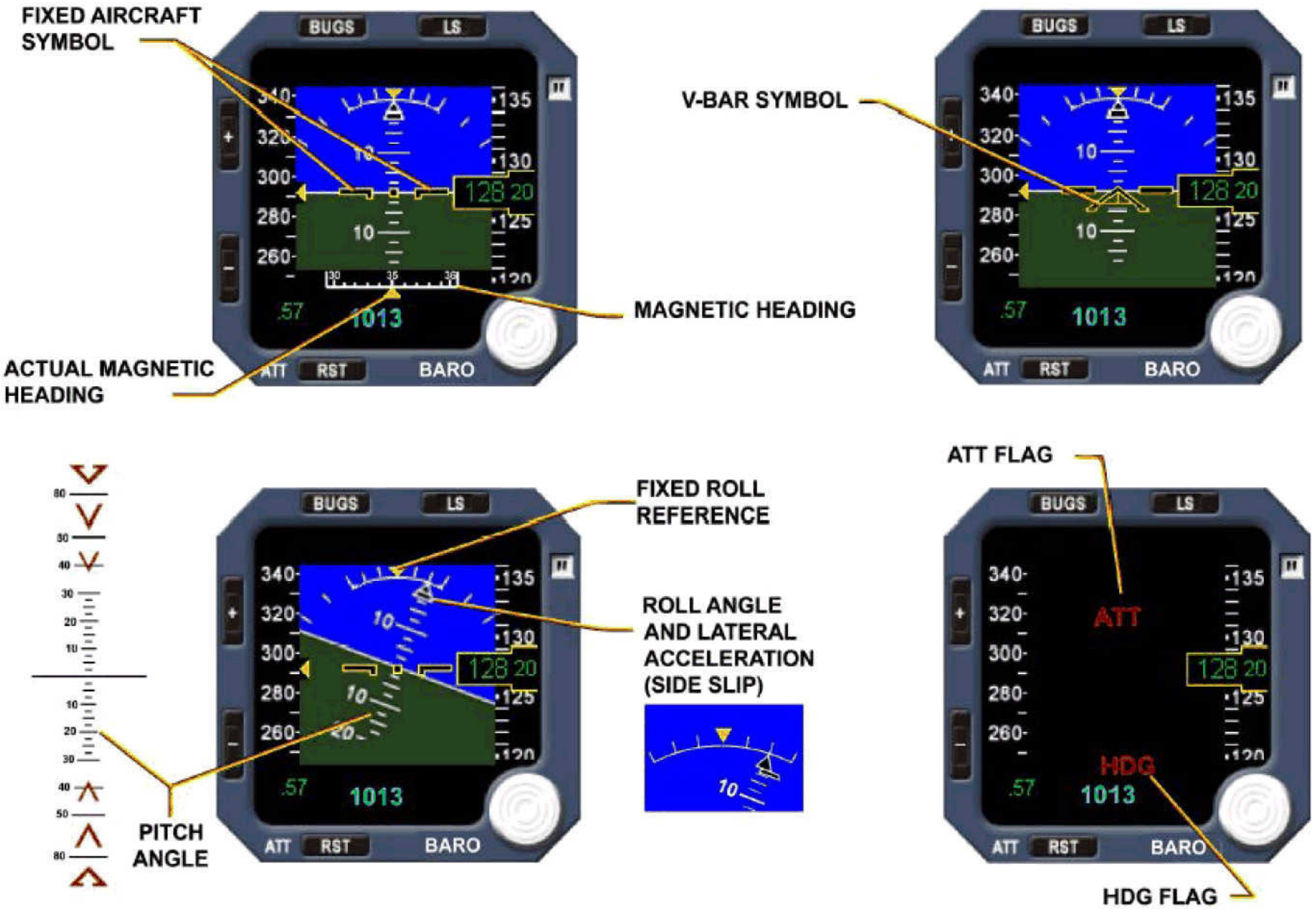


Figure 57 ISIS Pitch and Roll Indication

LS and BUGS

Landing System

When the LS pushbutton switch located on the right top part of the indicator is pushed, the G/S (**G**lide **S**lope) and LOC (**Loc**alizer) scales come into view. If the LOC and/or G/S signals are in Failure Warning condition or No Refresh, the relative scale disappears and the relative red flag LOC and/or G/S appears respectively in the left bottom corner and/or in the right top corner of the display area. If the LOC and/or G/S signals are in NCD condition, only the scales without diamond are displayed.

BUGS

Push the BUGS pushbutton, to show the BUGS display. This display is used to program up to four speed and four altitude bugs on the related speed and altitude scales.

The BUGS page has two columns positioned vertically:

- SPD column made of four boxes and
- ALT column made of two boxes.

Initially, the first box of the SPD column (left top) is flashing. The corresponding speed value has to be selected using the BARO selector knob (cyan SET/SELECT indication followed by an arrow in the right bottom part of the display). This value cannot be less than 30 kts and can only be selected or changed when ”OFF” function is deselected (true also with altitude bugs). When the correct value is displayed, access to the next box (below) is made by pushing the ”–” pushbutton switch. This box is then active and flashes. After the fourth box of the SPD column, access to the last box of the ALT column (right top) is made by using the BARO selector knob. The altitude values selected cannot be negative. The ”–” pushbutton switch is also used to select the last ALT box and then the first SPD box again. The ”+” pushbutton switch is used to return to the previous box.

The operational page is displayed again and the entered values are memorized by pushing the BUGS pushbutton switch or after 15 s without pilot action. These values are memorized until new values are entered, even in case of ISIS indicator power supply cutoff.

If one memorized bug has not to be displayed on speed or altitude scale, it is possible to hide it by pushing the BARO selector knob. The OFF indication is shown close to the selected box and the value is still displayed. By pushing the BARO selector knob again, the displayed and memorized bug is active. Initially, speed bugs are set to 30 and altitude bugs are set to 0.

All the bugs can be hidden using the OFF function.

Figure 58 ISIS LS and Bugs

ISIS INTERFACE

Connector

On the back of the ISIS there are two pressure connections and one electrical connector. To avoid ”cross connection” the pressure connectors are keyed and color–coded: red for Total pressure and yellow for Static pressure. The electrical connector is for Power supply, Pin programming and systems interface.

Power Supply

The ISIS indicator is supplied with 28VDC from the essential busbar 401PP. In case of loss of this busbar, the supply of the ISIS indicator is automatically switched over to the hot battery busbar 703PP by means of the relay 7XB when speed is greater than 50 kts.

ISIS SYSTEM INTERFACES

Inputs

- ILS or MMR (LOC and G/S signals),
- ADIRU 1 or 3 (Heading data –optional),
- ATT HDG SWITCHING (alternate ADIRU input – 1 normal, 3 alternate),
- PIN PROGRAM (options and parity check),
- STANDBY PITOT and STATIC (air data).

Outputs

- CFDIU (OPTIONAL)

  The ISIS is connected to the CFDIU via an ARINC 429 low speed bus for air data transmission and via an ARINC 429 high–speed bus for inertial data transmission.
- FDIMU

  All the data received and computed by the ISIS is sent to the Flight Data Interface and Management Unit (FDIMU) through one ARINC 429 high–speed bus for inertial data transmission and one low–speed bus for anemometric data transmission.

Out Of Order Page

One discrete output is used for fault/healthy indication. In case of a fatal failure of the ISIS the red message OUT OF ORDER associated with the related fault code is shown.

Meaning

A fatal error occurred and ISIS is unserviceable.

Action

If the fault message **OUT OF ORDER** with fault code 4xxx xxxx xxxx or 0000 0000 0100 are shown, it is not necessary to remove the ISIS indicator.

Open the NAV/STBY/HORIZON circuit breaker on the overhead panel 49VU for more than 5 seconds then close it. Otherwise replace the ISIS.

NOTE: After 145 hours of operating without any power supply interruption, the “OUT OF ORDER“ page is displayed with the 4000 0000 0000 code.

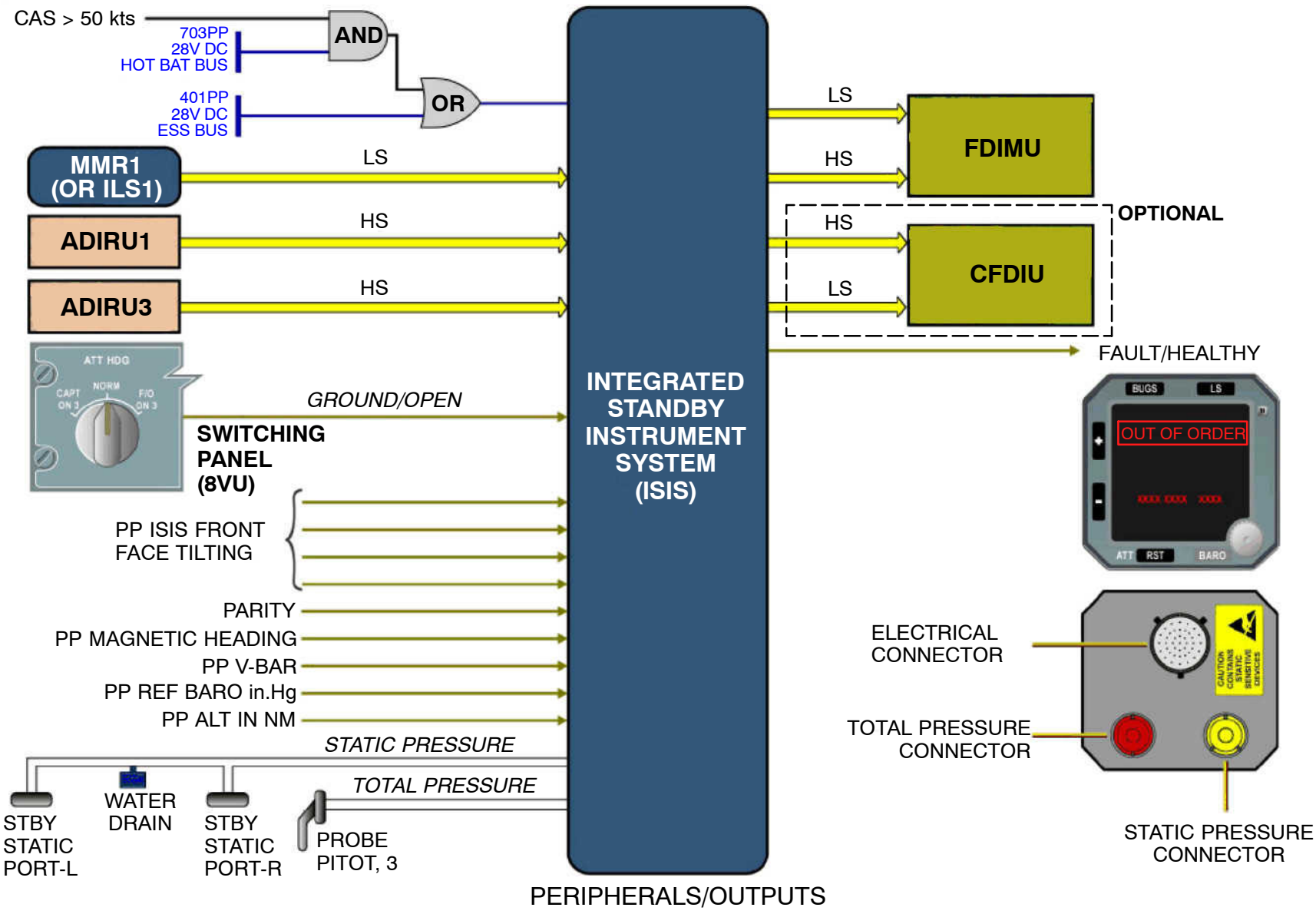


Figure 59 ISIS Interface Schematic

ISIS INTERNAL COMPONENT DESCRIPTION

ISIS INTERNAL COMPONENTS

The ISIS indicator contains the following subassemblies:

- a FIB (**Fi**ltering **B**oard),
- a PSU (**P**ower **S**upply **U**nit),
- an INB (**In**terface **B**oard),
- a PSM (**P**ressure **S**ensor **M**odule),
- an IMU (**I**nertial **M**easurement **U**nit),
- a CPGDM (**C**ontrol **P**rocessor and **G**raphic **D**isplay **M**odule),
- an OPM (**Op**tical **M**odule).

1. **Filtering Board**

   This board includes the rear plate with the two pressure unions for the static and the total pressures and the 41–pin external connector.

   It ensures protection against electromagnetic interference and lightning strikes.

2. **Power Supply unit**

   From the 28VDC, this unit supplies the voltages necessary for the operation of the indicator.

3. **Interface Board**

   This board makes the interface between part of the indicator inputs/outputs, the pressure sensors, the inertial sensors, the face, the light box and the CPGDM.

   It also supplies a clock signal at 20MHz.

4. **Pressure Sensor Module**

   This module contains for each system (static pressure and total pressure):

   - a pressure sensor with a cell (silicon detector),
   - a sensor memory with an electronic board that shapes the signals and stores the characterization parameters of the sensor.

5. **Inertial Measurement Unit**

   This unit includes three single–axis rate sensors (with analog outputs) and their temperature probes, two acceleration sensors and their temperature probes, and an electronic board.

   Its functions are as follows:

   – angular rate measurement,
   – temperature measurement,
   – absolute acceleration measurement,
   – storing of the IMU parameters (sensors, misalignment, identification),
   – generation of configuration data (IMU presence, two or three accelerometers),
   – generation of sensor healthy–operation discretes,
   – digitization of the sensor data (analog–to–digital converter).

6. **Control Processor and Graphic Display Module**

   This module performs the computing and graphics generation functions.

   The CPU (**C**ontrol **P**rocessing **U**nit) part of the CPGDM processes the data received through the INB and directly from the IMU to calculate the operational parameters (altitude, attitude and airspeed).

   The graphics part converts the data supplied by the CPU into smoothed symbology and drives the LCD (**L**iquid **C**rystal **D**isplay).

7. **Optical Module**

   This module includes a LCD matrix, backlight (light box with three tubes) and the control electronics for this lighting.

ISIS INDICATOR SUBASSEMBLIES

- PSM: PRESSURE SENSOR MODULE
- PSU: POWER SUPPLY UNIT
- FIB: FILTERING BOARD
- IMU: INERTIAL MEASUREMENT UNIT
- INB: INTERFACE BOARD
- OPM: OPTICAL MODULE
- CPGDM: CONTROL PROCESSOR AND GRAPHIC DISPLAY MODULE

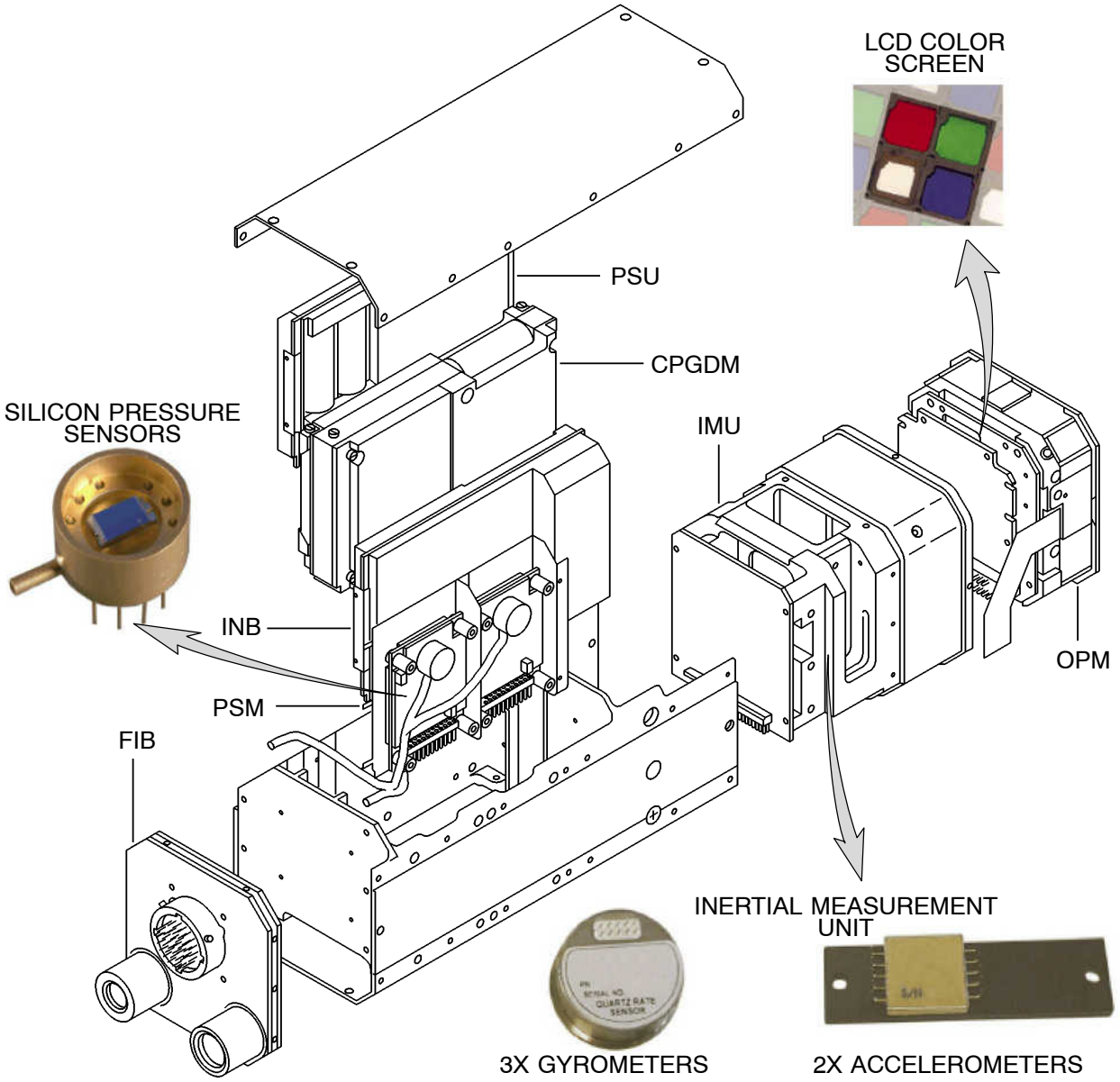


Figure 60 ISIS Internal Components

ISIS BITE AND TEST

An internal flight/ground logic manages the BITE function and prevents maintenance mode activation in flight. The test is inhibited when the CAS (**C**alibrated **A**ir **S**peed) is greater than 60 kts. The ISIS indicator is able to display maintenance data when the BUGS and LS pushbutton switches are pushed simultaneously, at least 2 seconds. In this case, a menu with two items is shown on screen: the TESTS menu and OTHER DATA menu.

OTHER DATA Menu

When the key adjacent to the OTHER DATA item (–) is pushed a menu made of two items is shown:

- Line Replaceable Unit Identification (LRU IDENT) and
- ENGINEERING DATA.

When the key next to the LRU IDENT item (+) is pushed, the display shows the:

- ISIS P/N (**P**art **N**umber) and the S/N (**S**erial **N**umber),
- A/C configuration (active options),
- Functional time counter (operating hours).

When the key next to ENGINEERING DATA (–) is pushed, the display shows the:

- ATA reference and time,
- Component identification and FIN,
- Failure code data.

If there is more than one data page, push the (+) or (–) pushbuttons to go to the Next/Previous data pages. Push the **RST** pushbutton to return to previous menu page. Repeat the **RST** push function until the operational display is restored.

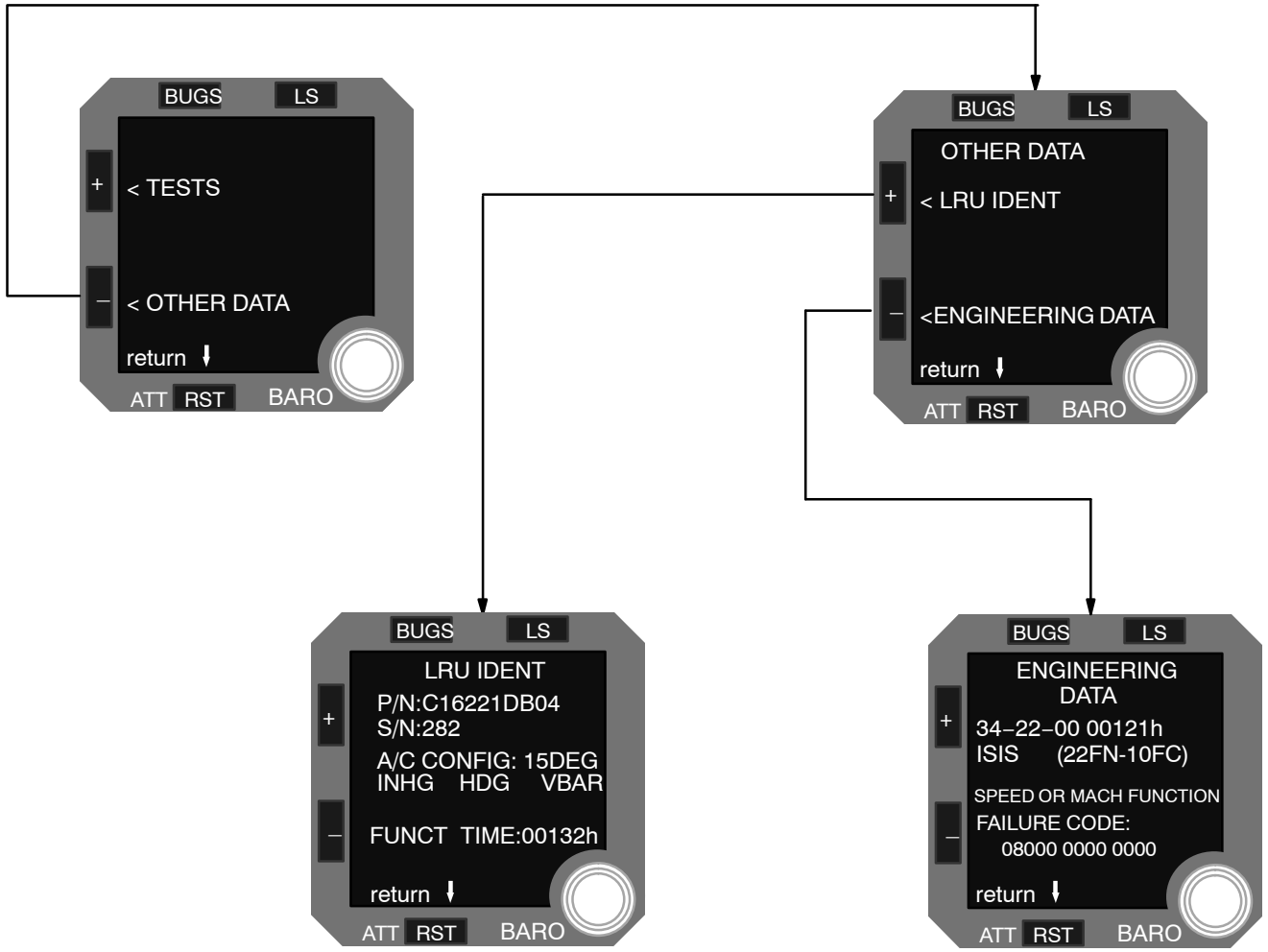


Figure 61 ISIS Other DATA

TESTS Menu

When the key adjacent to the TESTS item (+) is pushed, a specific menu made of two items is shown:

- FUNCTIONAL TEST (110s) and
- DISPLAY TEST.

Push the key next to DISPLAY TEST (–) and a white screen is displayed. Push the (–) key again and a black screen is displayed. Every time the (–) key is pushed, the display toggles between the black and white screen display.

When the key adjacent to the FUNCTIONAL TEST (110s) item (+) is pushed, the functional test is started and the message **„IN PROGRESS 110s“** is shown in the middle of the display area.

At the end of the test, the message „TEST OK“ is shown on the display area. In case of fault detection, the BITE displays the fault message (s). If there is more than one fault data page push the (+) or (–) pushbuttons to go the to the Next/Previous pages. Push the **RST** pushbutton to return to previous menu page. Repeat the **RST** push function until the operational display is restored.

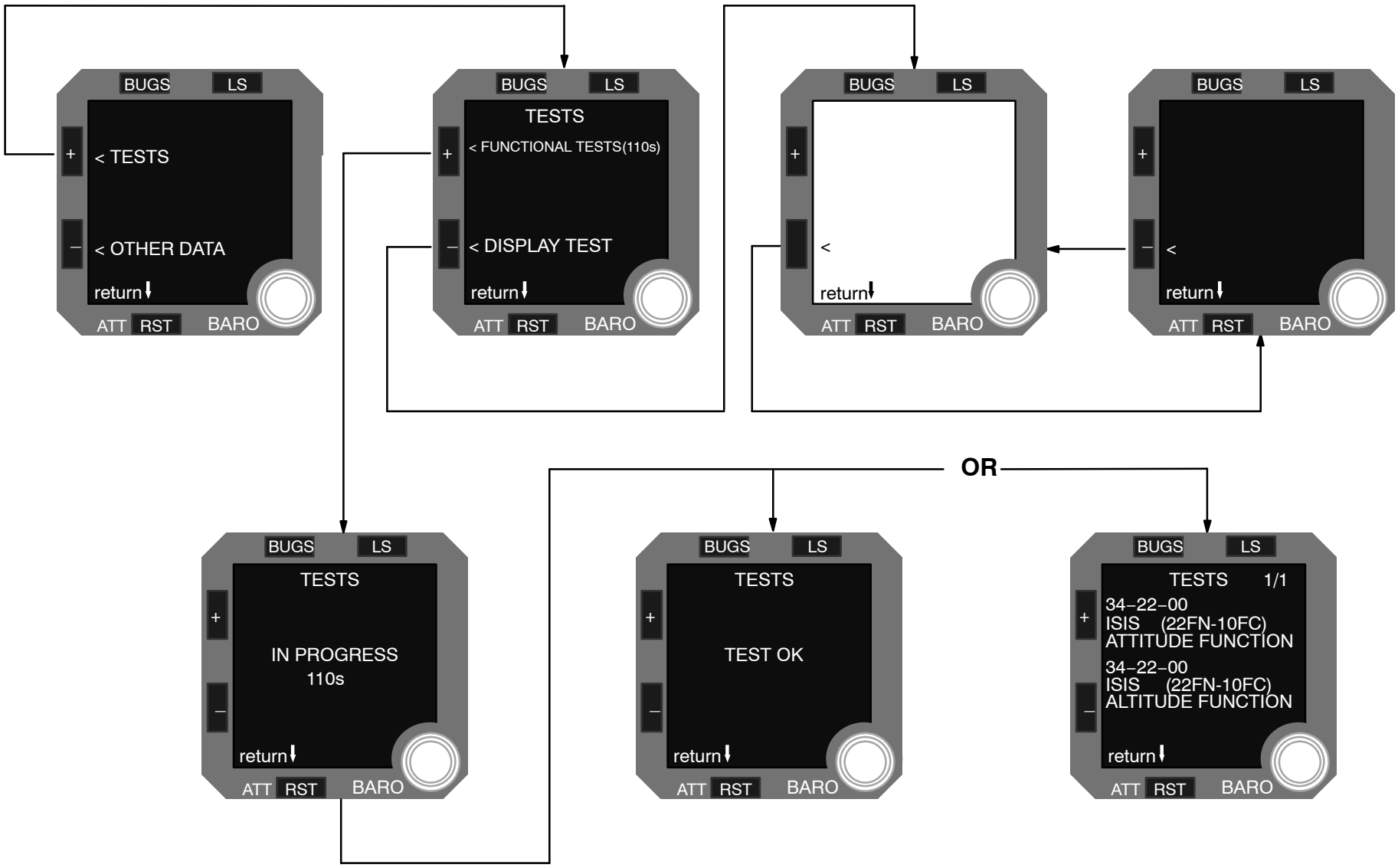


Figure 62 ISIS TESTS Menu

NEW MAINTENANCE MENU (NOT FOR ALL ISIS)

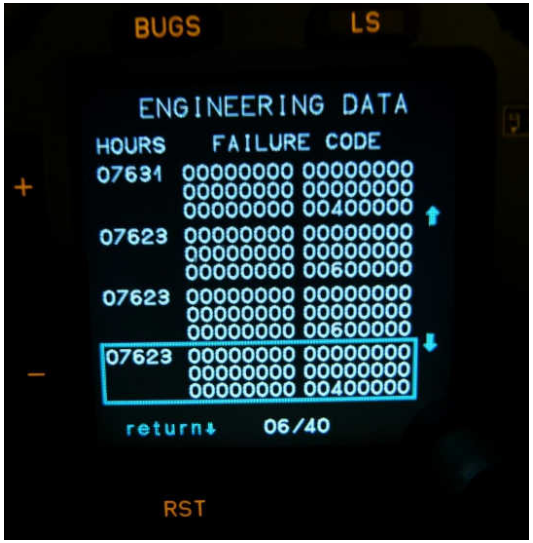


Figure 63 ISIS Maintenance Menu

Figure 64 ISIS Maintenance Menu 2

34–58 SATELLITE NAVIGATION

PRESENTATION

SYSTEM DESCRIPTION

Position Determining

To determine its position, the GPSSU (**G**lobal **P**ositioning **S**ystem **S**ensor **U**nit) uses signals broadcast at a frequency of 1575.42 MHz, by at least 4 satellites among 24 of the GPS constellation. Four satellites are necessary to solve 4 unknowns: the 3 user position coordinates and the user clock offset from the GPS reference time.

The position computation is based on a triangulation principle through distance measurements to satellites whose position is perfectly known (satellite position data are included in the broadcast signal).

Each distance value is obtained from measurement of the in–space signal propagation delay. For this, the GPSSU generates internally a replica of the received satellite identification code. Then, the GPSSU shifts the replica code until concordance with the received one by correlation techniques, to determine their phase offset which is directly proportional to the in–space GPS signal propagation time.

Speed Determination

Speed is determined from a phase Doppler shift measurement of each GPS signal already used for localization purposes.

GPS Primary Function Definition

The purpose of the GPS Primary navigation function is to use the GPS position as the primary means of navigation to compute the aircraft position in the FMS (**F**light **M**anagement **S**ystem).

The GPS Primary function is an upgrade of the initial aircraft navigation function which was based on the use of the GPS as a supplementary means of navigation.

In this initial function, the integrity of the GPS position was computed in the FMS using comparisons with radio and inertial positions.

In the GPS Primary case, the GPS is capable of delivering an integrity information associated with the position data (through RAIM (**R**eceiver **A**utonomous **I**ntegrity **M**onitor) algorithm). Therefore these position data can be used directly by the FMS with an improved availability and integrity.

SYSTEM ARCHITECTURE

The GPS comprises two independent systems. Each system consists of:

- a Global Positioning System Sensor Unit
- a GPS antenna

Normal operation

In normal operation, the GPSSU1 data are used by the ADIRU1 and 3; the GPSSU2 data by the ADIRU2.

NOTE: In order to reduce GPSSU initialization time, the GPSSU receives data from the ADIRU.

The IR portion of the ADIRU provides the FMGC with:

- pure IR data
- pure GPS data (in this case the ADIRU operates as a relay)

  NOTE: The pure GPS data are only used for display on the MCDU1 and 2.

- hybrid GPIR data.

The hybrid GPIR data are used by the FMGC for position fixing purposes.

Operation in case of failure

In case of one GPS failure, the three ADIRUs automatically select the only operative GPS to compute hybrid GPIR data.

In case of ADIRU1 failure, the FMGC1 uses ADIRU3/GPS1 data.

In case of ADIRU2 failure, the FMGC2 uses ADIRU3/GPS2 data.

The primary source of the ADIRU3 being the GPS1, it is necessary to select the secondary input port of the ADIRU3 (GPS2) by means of the ATT HDG selector switch to preserve side 1/side 2 segregation (GPS1/ADIRU1/FMGC1 and GPS2/ADIRU3/FMGC2 architecture). This ensures that in this case both GPSSUs are still used for position calculation.

In case of failure of two ADIRUs, the two FMGCs use only the operative ADIRU.

This ADIRU receives data from its own side GPS (e. g. ADIRU1–GPS1).

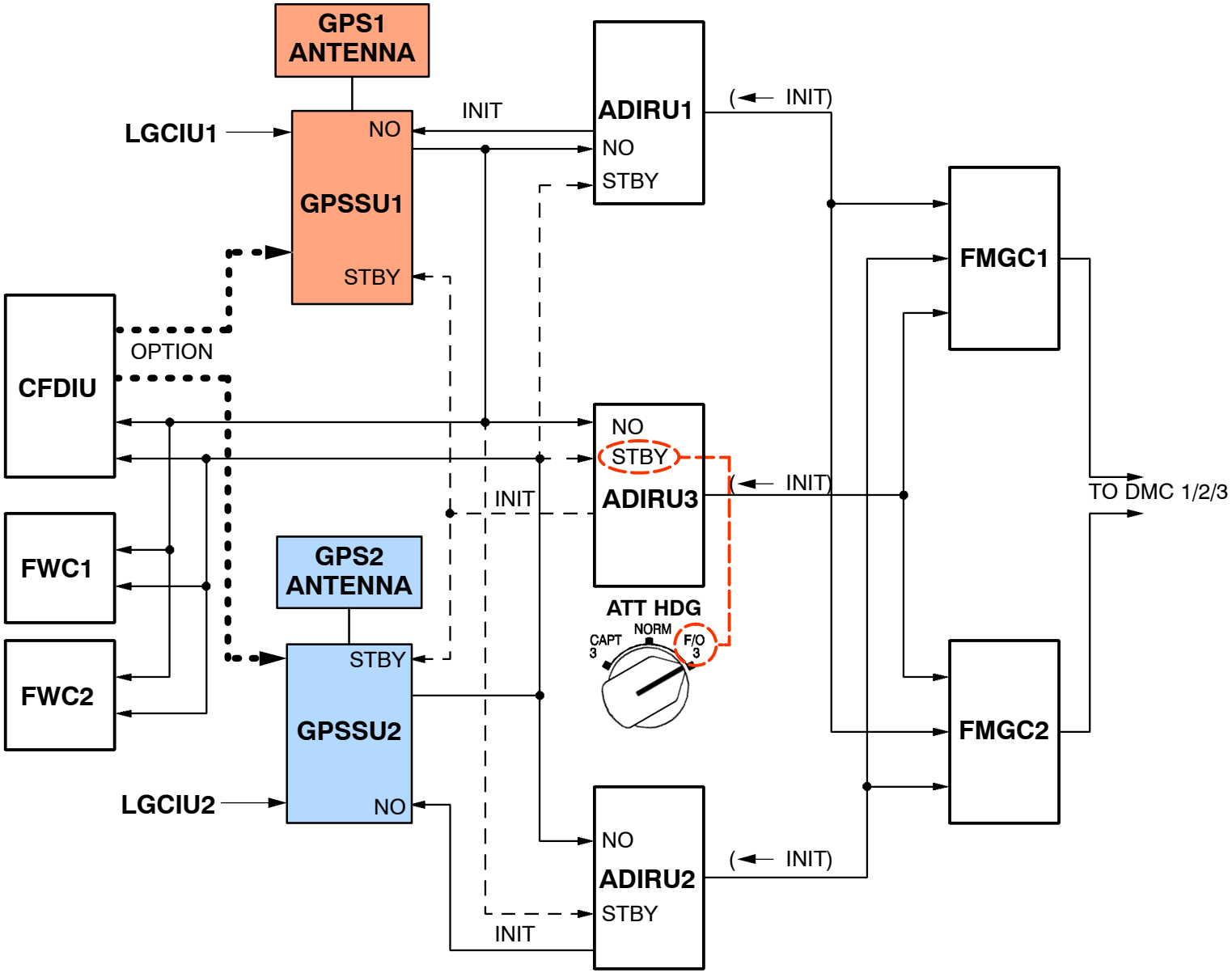


Figure 65 GPSSU Basic Schematic

SYSTEM OPERATION

The GPSSU (**G**lobal **P**ositioning **S**ensor **U**nit) initializes itself at power–on process. It organizes its internal computer, initializes its I/O operation and performs its turn–on self test.

Then the GPSSU activates its receivers in order to initiate communication with the IR/FMGC and monitors the receivers for five seconds. When valid initial position, time, altitude and date are transferred from the IR to the GPSSU, normal acquisition of GPS satellites begins. Even if there are no valid initial parameters, the GPSSU enters the Search the Sky mode and tries to locate any satellite. The GPSSU is an eight–channel C/A (**C**oarse/**A**cquisition) –code receiver capable of tracking up to eight satellites simultaneously.

GPSSU OPERATING MODES

Initialization mode

At power–on, the GPSSU initiates a Power–On Reset signal. This provides a means for properly initializing the hardware of the GPSSU to a known initial state. At turn on, the processor contained within the GPSSU conducts an assessment of its operational status. Tests include (but are not limited to) ROM CRC, RAM read/write comparison tests, and basic operation code tests.

If the processor is operational, a status indication is placed on the ARINC 429 data bus for use by the IR.

If the internal computer has failed or there is question as to the validity of the operation of the ARINC 429 bus, the GPS processor indicates a fault in the status word. The GPSSU FAULT discrete also indicates that it has failed. During initialization, the GPSSU fault discrete is turned on briefly.

Upon acceptance of the initialization parameters from the input buses, the GPSSU indicates that it is in the acquisition mode and indicates the source of the initialization in its status word.

If no initialization data are available from the input buses and last valid position and velocity are available, the GPSSU utilizes the last valid data as initialization data. Acceptance of the initial parameters transfers the GPSSU into the acquisition mode.

No valid initialization data and/or valid almanac transfer the GPSSU into the Search the Sky mode.

Acquisition mode

The acquisition mode is utilized to transfer the GPSSU from the initialization mode or from long satellite signal outages to the navigation mode. The GPSSU status word is updated as required throughout the acquisition mode. When the selected satellites have been acquired (four to eight), the GPSSU transfers into the navigation mode with the appropriate indication contained in the status word. The IR may or may not be transmitting data into the GPSSU during the acquisition mode dependent on their current state. The GPSSU may use the data if they are valid.

Navigation mode

In navigation mode, the GPSSU tracks up to eight available satellites in view and maintains a current status of each for transmission to the IR.

The raw measurement data are coherent and uncorrupted by previous GPS updating.

- Altitude aiding

  Label 361 (IR Altitude), if present, is utilized for altitude aiding.

  An altitude bias is computed between the received altitude and the computed GPS ellipsoid altitude and filtered with a five–minute time constant. This is continuously done while a correct GPS altitude is available. When the number of satellites drops to three and the altitude bias is available, the GPSSU uses the input altitude (361) for altitude aiding for up to one minute. During this period all velocity and speed outputs are set to NCD (**N**on **C**omputed **D**ata).

- Clock coasting

  In the event that the number of available satellites drops to three and the GPSSU cannot use the altitude aiding function, the GPSSU clock coasts. This is accomplished by freezing the measurement updating of the clock bias and rate. The GPSSU clock coasts for up to one minute. During this period all velocity and speed outputs are set to NCD.

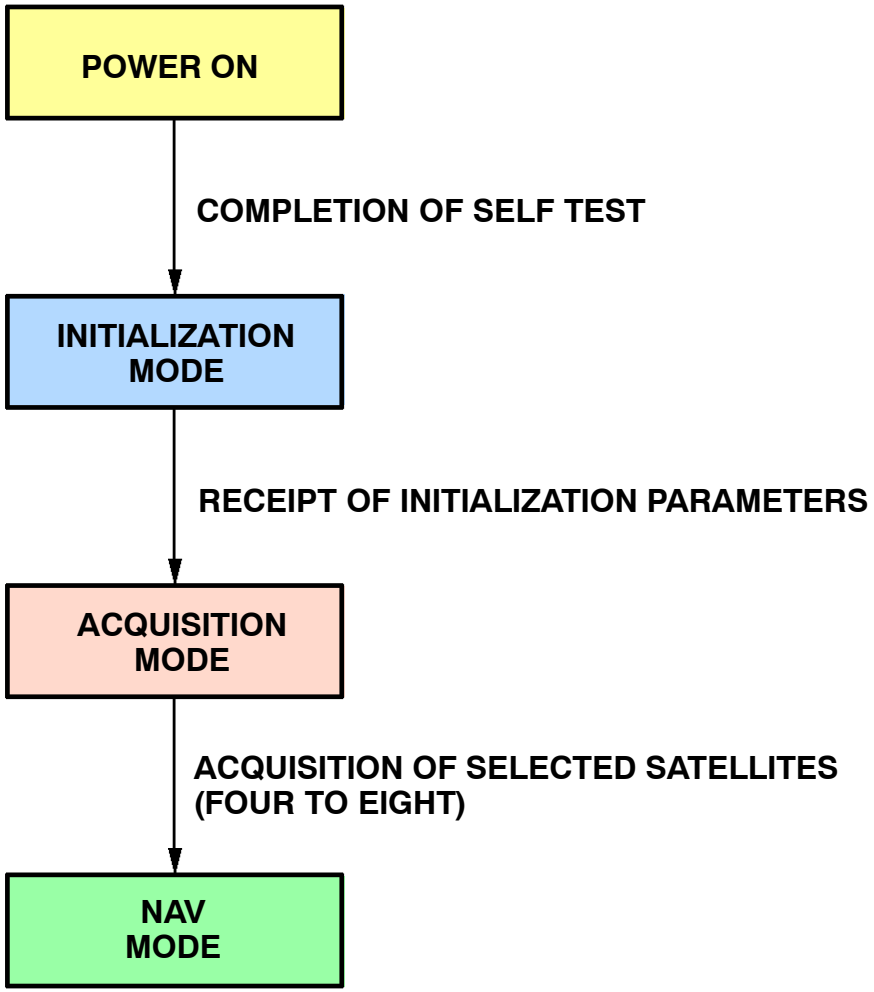


Figure 66 GPSSU Modes

GPS MONITOR PAGE INDICATION

General

On the MCDU, the GPS monitor page displays GPS data.

Access Procedure

The procedure to call the GPS monitor page is:

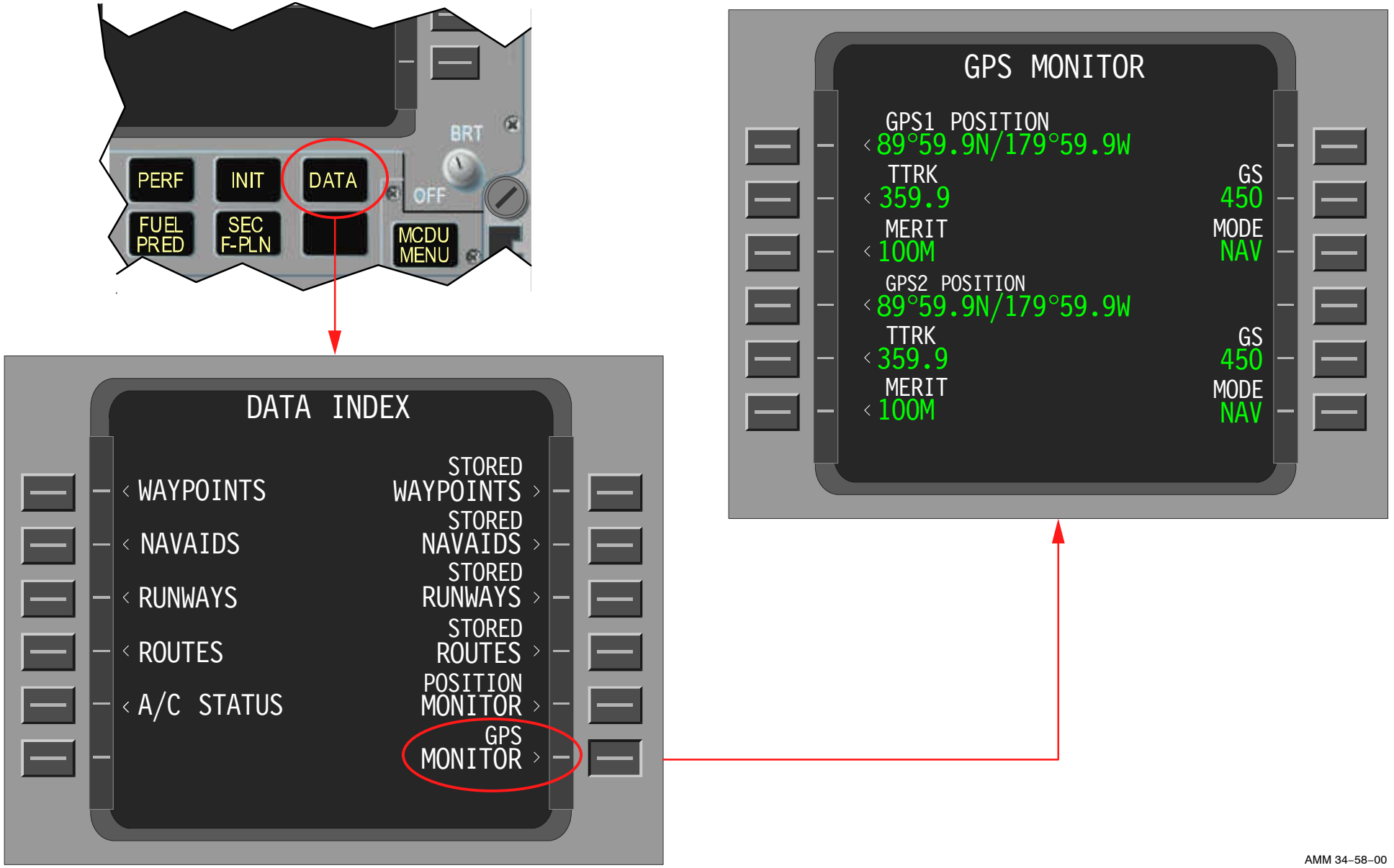
1. Push the key for DATA on the MCDU.
   The DATA INDEX appears.
2. Push LSK 3L for GPS MONITOR.
   The GPS monitor page appears.

GPS Data

On the GPS monitor page the following data are displayed:

- Present Position
- True Track
  (Track referred to geographic north)
- Figure of Merit
  (Accuracy in meters)
- Ground Speed
- Mode
  (Acquisition Mode ACQ or nav mode NAV).

NOTE: During poor receiving conditions (e. g. aircraft in the hangar) no data are displayed.



AMM 34–58–00

Figure 67 GPS Monitor Page

MANUAL GPS DESELECTING OPERATION

When the FMGCs are supplied with hybrid GPIR data, they use this data for navigation and no DME/DME or VOR/DME radio updating is made.

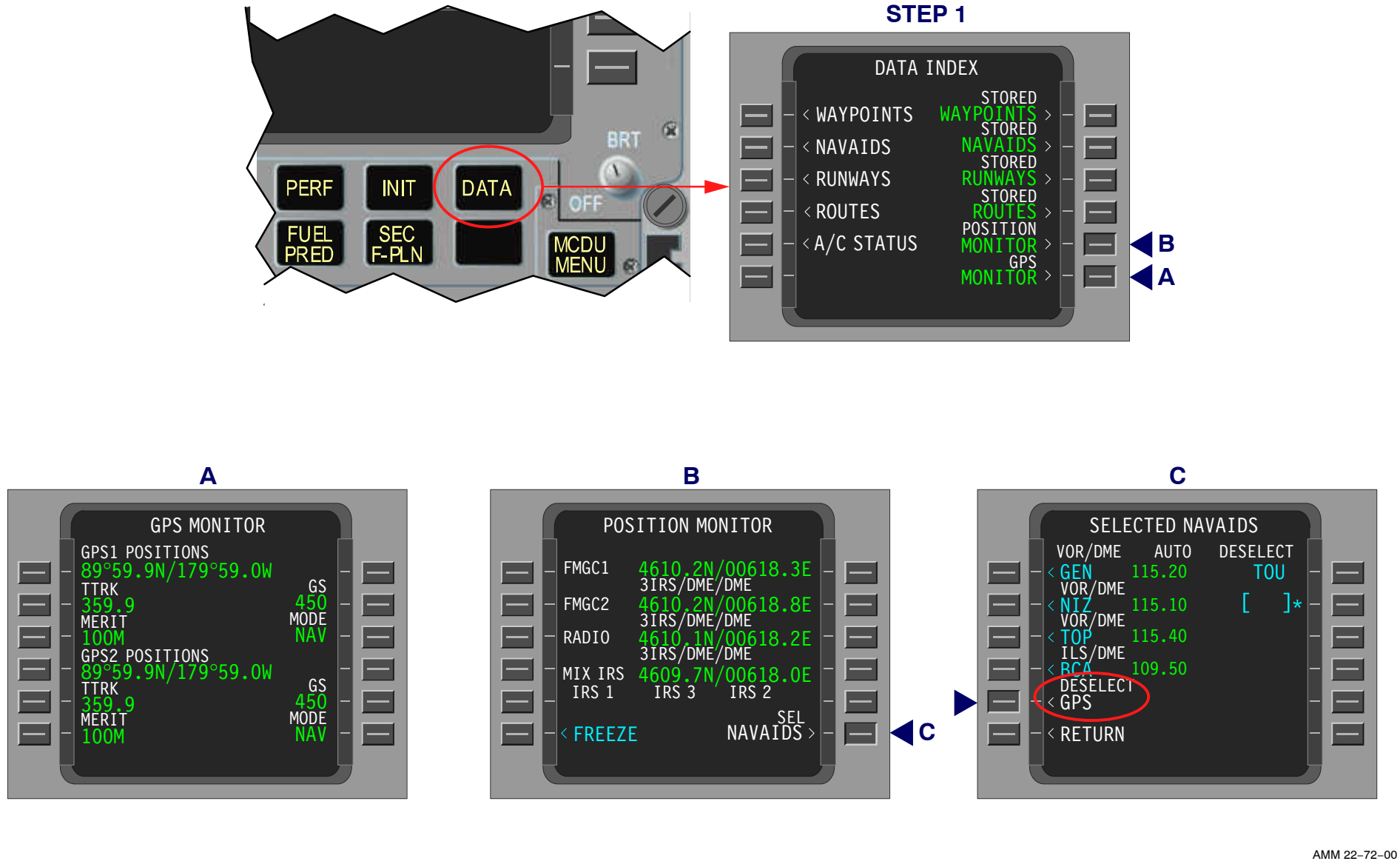
This FMGC mode is called GPS/inertial mode.

There is no pushbutton switch in the cockpit to switch off the GPS. However the GPS may be deselected via the MCDU in case of failure.

The procedure to deselect the GPS/inertial mode manually is:

1. Push the key for DATA on the MCDU.
   The DATA INDEX appears.
2. Push the LSK 5R for POSITION MONITOR.
   The POSITION MONITOR page appears.
3. Push the LSK 6R for SEL NAVAIDS.
   The SELECTED NAVAIDS page appears.
4. Push the LSK 5L for DESELECT GPS.
   GPS will not be used by the FMGCs any longer. Instead of DESELECT GPS now SELECT GPS is offered.

The procedure to re–select GPS is the same.



AMM 22–72–00

Figure 68 Manual GPS Deselecting

GPS MESSAGES (ND) AND FAILURE DESCRIPTION

Display of GPS PRIMARY LOST amber Message

This message is displayed at the bottom of the image in all the ND modes (except engine standby modes) when the GPS primary is lost (this message cannot be cleared from the MCDU). In this case, the GPS is not used for navigation (accuracy and integrity for the intended operation can still be met by the use of alternate navigation means).

Display of GPS PRIMARY white Message

This message is displayed at the bottom of the image in all the ND modes (except engine standby modes) when the GPS becomes primary (this message can be cleared from the MCDU).

Display of GPS APP green message

This approach message is displayed at the top of the image in all the ND modes (except engine standby modes) when a GPS approach is selected in the flight plan.

GPS Failure

The GPSs are monitored by the both FWCs using a status word sent by each GPS.

In case of GPS failure, the NAV GPS1 (2) FAULT message is displayed in the lower part of the upper ECAM DU.

This message is accompanied by:

- activation of the MASTER CAUT lights on the glareshield
- aural warning: SC (**S**ingle **C**hime).

The failure is reminded on the INOP SYSTEM page of the lower ECAM DU The message displayed is GPS1 (2).

Loss of the GPS Primary Navigation

When the GPS navigation is lost for any reason, the navigation function is degraded and reverts to the traditional navigation function with IRS positions and radio positions if available. In this case the RNP (**R**equired **N**avigation **P**erformance) features are still available.

Warnings are generated to indicate the loss of GPS PRIMARY navigation:

- GPS PRIMARY LOST message on the NDs (cannot be cleared) and MCDU (can be cleared)
- in case of GPS non–precision approach, an aural alert is generated (Triple Click)

GPS/FMS Position Disagreement

When GPS Primary is active and either FMGC1 or FMGC2 latitude (resp. longitude) deviates from either GPSSU1 or GPSSU2 latitude (longitude) from more than 0.5 Nm, the

- NAV FMS/GPS POS DISAGREE in amber and
- A/C POS.....CHECK in cyan

are displayed on the lower ECAM DU.

These messages are accompanied by:

- activation of the MASTER CAUT lights on the glareshield
- aural warning:
  - Single Chime.

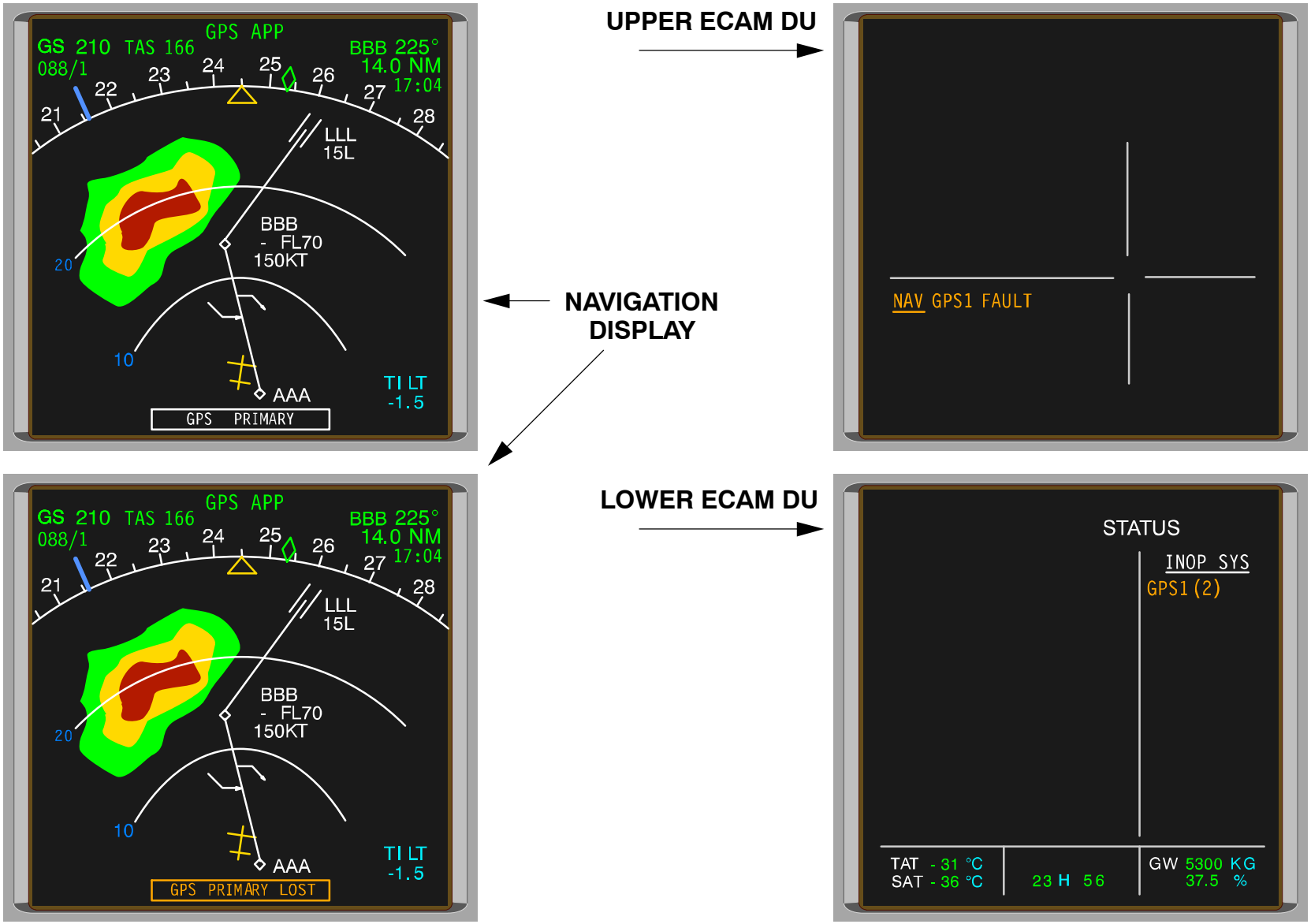


Figure 69 GPS Indications on ND

GPSSU BITE

BITE Description

NOTE: The BITE implementation of the GPSSU is an option!

The BITE facilitates maintenance on in–service aircraft. It detects and identifies faults related to the GPS.

The BITE of the GPSSU is connected to the CFDIU (**C**entralized **F**ault **D**isplay **I**nterface **U**nit).

The units tested are the GPSSU, GPS antenna and coaxial cable.

The BITE:

- transmits permanently GPS status and its identification message to the CFDIU
- memorizes the faults which occurred during the last 63 flight segments
- monitors data inputs from the various peripherals (ADIRU and CFDIU)
- transmits to the CFDIU the result of the tests performed and self–tests
- can communicate with the CFDIU through the menus.
- can operate in two modes:
  - the normal mode
  - the menu mode.

Aircraft without BITE implementation

When no BITE is implemented; when performing CFDS test, a message ”GPSSU 1+2 NOT INSTALLED” appears.

However, the ADIRU BITE:

- permanently transmits the GPSSU status
- memorizes the GPSSU failures which occurred during the last 63 flights
- monitors the input data from each GPSSU

Normal Mode

During the normal mode, the BITE monitors cyclically the status of the GPS. It transmits its information to the CFDIU during the concerned flight. In case of fault detection, the BITE stores the information in the fault memories.

These items of information are transmitted to the CFDIU every 100 ms by an ARINC 429 message.

Menu Mode

The menu mode can only be activated on the ground.

This mode enables communication between the CFDIU and the GPSSU BITE by means of the MCDU.

The GPS menu mode is composed of:

- LAST LEG REPORT
- PREVIOUS LEGS REPORT
- GROUND SCANNING
- TROUBLE SHOOTING DATA
- CLASS 3 FAULTS
- SYSTEM TEST
- GROUND REPORT
- LRU IDENTIFICATION

All the information displayed on the MCDU during the BITE test configuration can be printed.

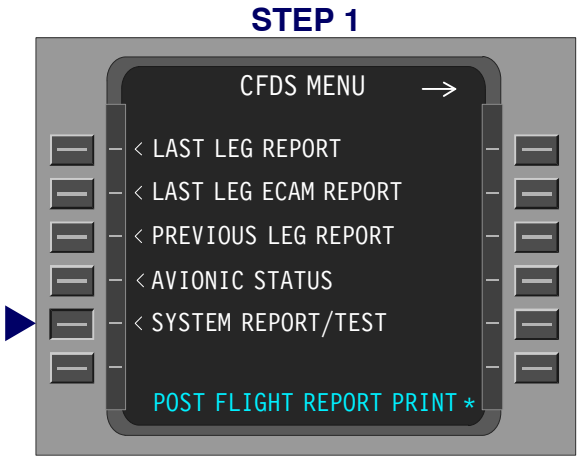


Figure 70 GPS BITE Menu Start

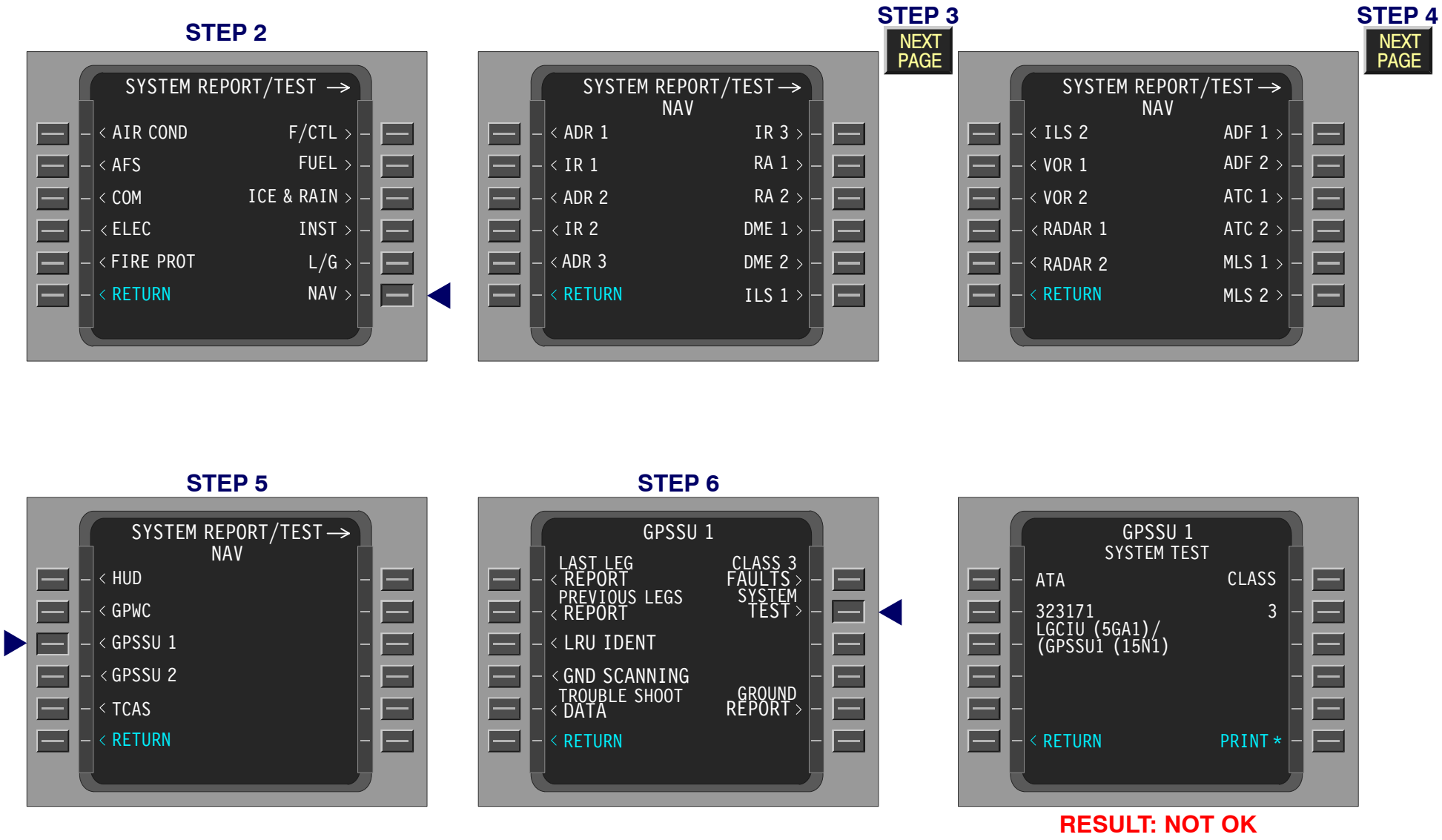


Figure 71 GPSSU BITE (Option) CFDS Menu

COMPONENT LOCATION

Antenna Location

Both GPS antennas are mounted in 12 o'clock position.

GPSSU Location

The GPSSUs are mounted close to the GPS antennas behind the ceiling in 1 o'clock position.

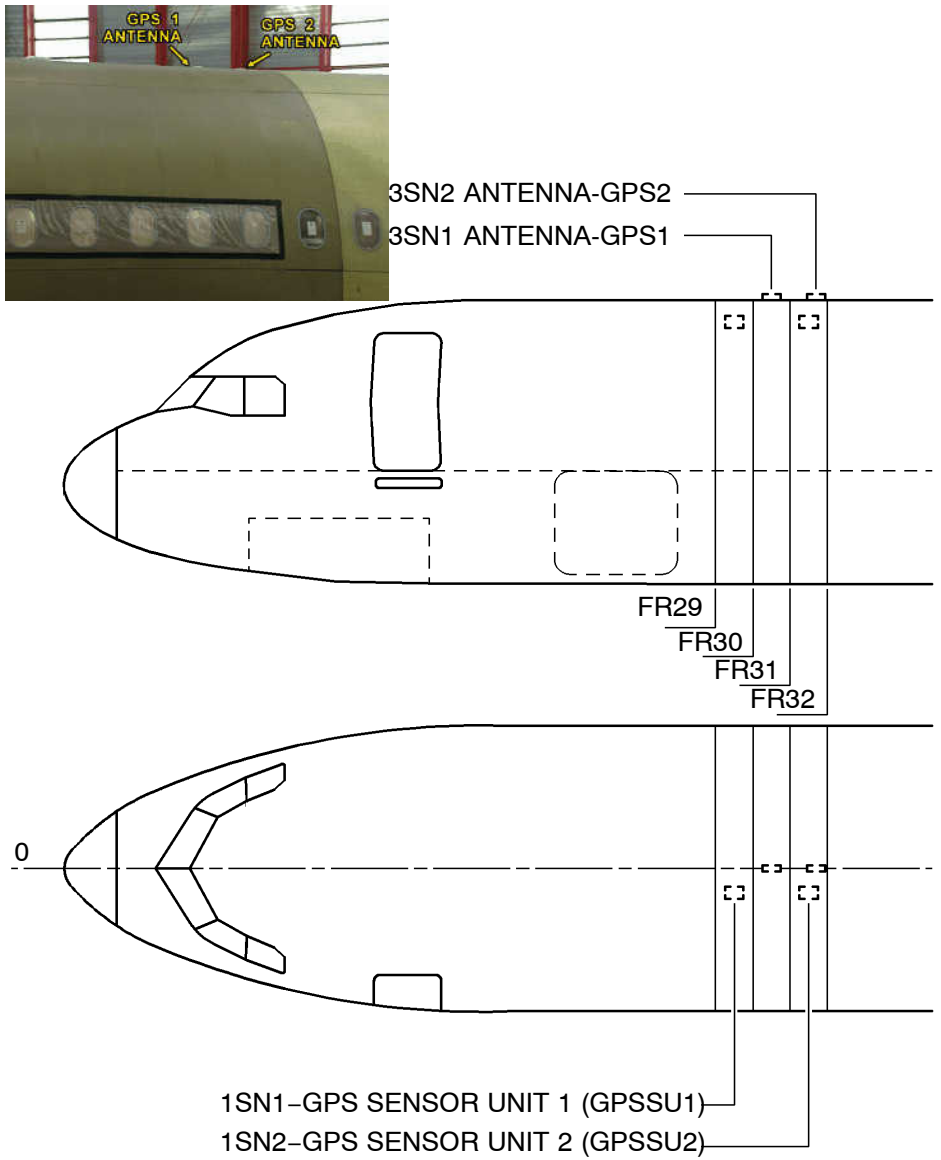


Figure 72 GPSSU & Antenna Location

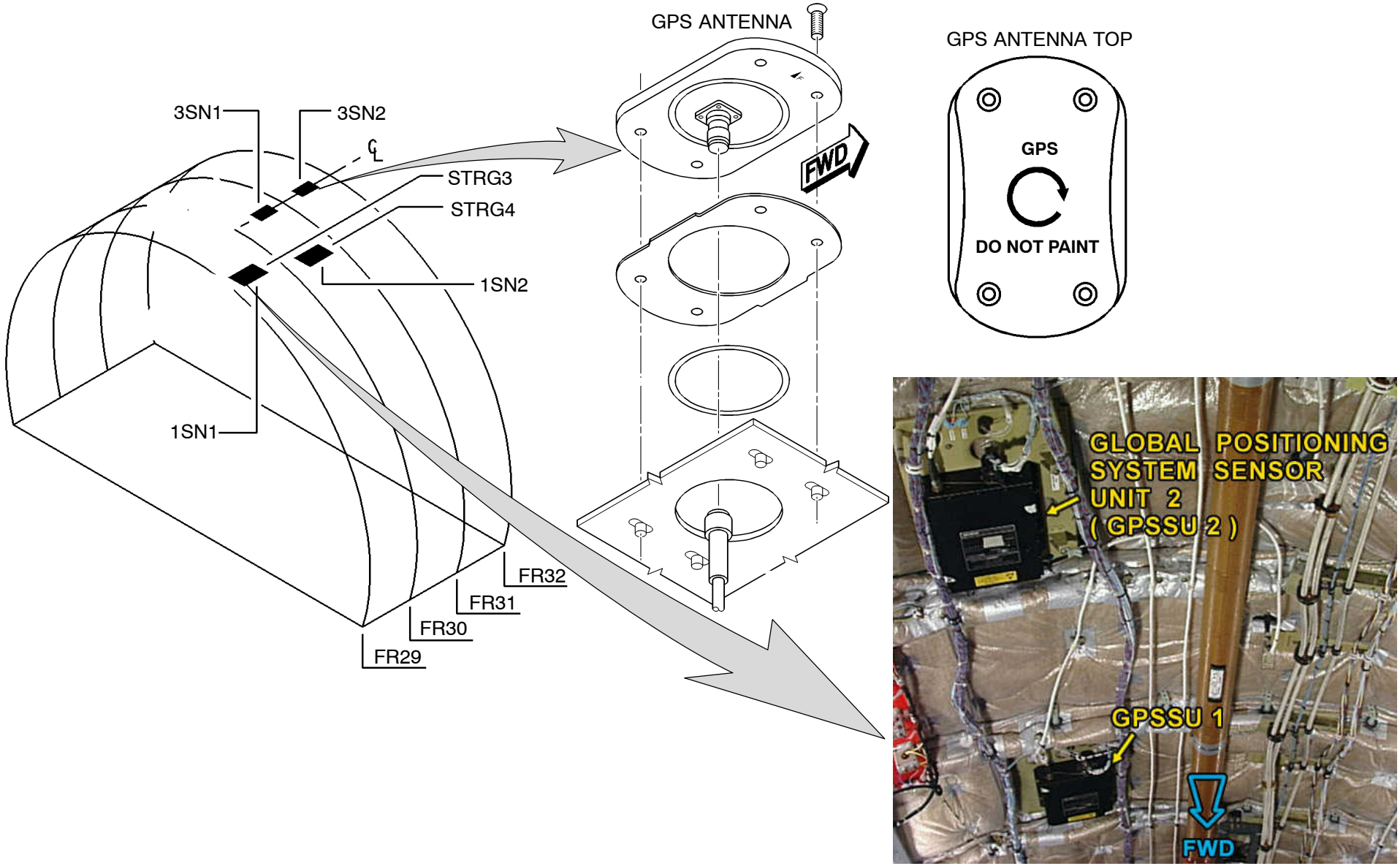


Figure 73 Component Location

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