Reference to Figure 72 ADIRS System Schematic

ATA 34 NAVIGATION

34–10 ADIRS

SYSTEM DESCRIPTION

GENERAL

The Air Data/Inertial Reference System (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 Control and Display Unit (CDU).

The ADIRS is a three channel system. Each channel is isolated from the others and provides independent information.

Each ADIRU contains:

- an Air Data Reference (ADR) portion.
- an Inertial Reference (IR) portion.

AIR DATA REFERENCE

The Air Data Reference (ADR) portion of the Air Data/Inertial Reference Unit (ADIRU) provides main data sources which are air data references for the aircraft avionics systems.

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

ADR Control

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

- the pushbutton switch is used to disable the ADR output buses. It is a momentary action pushbutton switch
- when the ADR output buses are disabled, the ADR controls the activation of the ADR OFF legend by its output discrete: ADR OFF status
- when an ADR failure is detected, the ADR controls the activation of the ADR FAULT legend by its output discrete: ADR FAULT
- each ADR is de–energized 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.

ADR Indicating

Altitude (ALT), Computed Airspeed (CAS), Mach number (M) and Vertical Speed (V/S) are computed by the ADIRU (ADR portion), processed by the associated DMC and displayed on the PFDs. True Airspeed (TAS) is supplied in the same way but is displayed on the NDs. In normal 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. Static Air Temperature (SAT) and Total Air Temperature (TAT) are also supplied in the same way but are permanently displayed on the lower part of the lower ECAM DU.

INERTIAL REFERENCE

The Inertial Reference (IR) part of the Air Data/Inertial Reference Unit (ADIRU) supplies the primary data that follows to the aircraft avionic systems:

- Precision attitude
- Magnetic heading references
- Navigation data.

  The IR part also supplies data from the selected Global Positioning System (GPS) and the accurate GPIR hybrid position.

  The attitude, heading and navigation data is shown on the displays of the EFIS.

IR Control

Operation interface with the IR is performed through the MCDU or the CDU. The MCDU is used for entering initialization data and 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. 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. The power supply of the ADMs is switched off. 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.

IR Indicating

The ADIRU (IR part) calculates the attitude and heading data. Then the related DMC processes this data. The attitude data is shown on the PFD and the heading data is shown on the PFD and ND..

The vertical speed (V/S) is shown on the PFD and the ground speed and wind indications on the ND.

In normal configuration, with the ATT/HDG selector switch in the NORM position, the IR1 data is shown on the CAPT PFD and ND, and the DDRMI if installed.

The IR2 data is shown on the F/O PFD and ND.

PFD 1

ND 1

DDRMI

System Display

PFD 1

ND 1

DMC 1

DMC 3

DMC 2

ADIRS

N 4337.6 W 07325.6

DISPLAY

DATA

SYS

PPOS

WIND

TK/GS

HDG

TEST

STS

OFF

ON BAT

IR1

IR3

IR2

FAULT

ALIGN

OFF NAV ATT

ADR1

ADR3

ADR2

FAULT

OFF

ADIRS CONTROL AND DISPLAY UNIT

ADIRU 1

IR1

ADR1

ADIRU 3

IR 3

ADR 3

ADIRU 2

IR 2

ADR2

SYS 1 USER

SYS 2 USER

ADM

STBY ASI

STBY ALTM

WATER DRAIN

STBY PITOT PROBE

CAPT PITOT PROBE

F/O PITOT PROBE

STBY STATIC PORT

F/O STATIC PORT

CAPT STATIC PORT

AOA 1 SENSOR

AOA 3 SENSOR

AOA 2 SENSOR

TAT 1 SENSOR

TAT 2 SENSOR

SWITCHING

ATT HDG

AIR DATA

EIS DMC

ECAM / ND XFR

NORM

CAPT

F/O

SWITCHING PANEL

Figure 72 ADIRS System Schematic

Reference to Figure 73 Radio Navigation System Schematic (1 of 2)

34–00 NAV-GENERAL

ILS, VOR/MKR, DME & ADF SYSTEM DESCRIPTION

Schematic Legend

PFD: Primary Flight Display

ND: Navigation Display

ISIS: Integrated Standby Instrument System

DDRMI: Digital Distance and Radio Magnetic Indicator

DMC: Diplay Management Computer

MMR: Multi Mode Receiver

ILS: Instrument Landing System

- LOC: Localizer
- G/S: Glideslope

VOR: VHF Omnidirectional Range

MKR: Marker

- OM: Outer MKR
- MM: Middle MKR
- AWY: Airway MKR

DME: Distance Measuring Equipment

ADF: Automatic Direction Finder

ANT: Antenna

General

The aircraft navigation systems provide the crew with the data required for flight within the most appropriate safety requirements.

These data can be divided into four groups :

- Air Data/Inertial Reference System (ADIRS),
- Landing and taxing aids,
- Independent position determining
- Dependent position determining.

Instrument Landing System (ILS)

The A320 Family is equipped either with an pure ILS receiver or an MMR which is a combined GPS and ILS receiver.

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

The localizer operates in a frequency band which ranges from 108.1 MHz to 111.95 MHz and the glide uses the band from 329.15 MHz to 335 MHz.

VOR/Marker System

The VOR/MARKER comprises two independent systems in a same receiver:

- a VOR system for the radio navigation phase,
- a MKR system for the landing approach phase.

The two VOR/MKR receivers are interchangeable but only in the VOR/MKR receiver 1 the MKR function is active. The VOR system is a radio aid to medium–range navigation. The aircraft is equipped with two VOR systems which can accept ground station signals in the frequency range of 108 MHz to 117.95 MHz.
These signals are processed and conditioned to provide the crew with:

identification of a selected ground station,

indication of the aircraft position with respect to the station (bearing information),

indication of the aircraft angular deviation from a selected course.

Distance Measuring Equipment

The Distance Measuring Equipment (DME) is a radio aid to medium range navigation which provides the crew with:

- a digital readout of the slant range distance of the aircraft from a selected ground station
- audio signals which identify the selected ground station.

The DME uses the frequency band from 962 MHz to 1213 MHz for reception and transmission. The principle of the DME navigation is based on the measurement of the transmission time. Paired interrogation pulses go from an onboard interrogator to a selected ground station. After 50 microseconds, the station transmits the reply pulses to the aircraft. The measurement of time between transmitting the interrogation pulses and receiving the reply pulses is a function of the slant range distance of the aircraft to the ground station. The measurement value is converted into nautical miles and shown to the crew.

Automatic Direction Finder

The Automatic Direction Finder (ADF) is a radio navigation aid which provides:

- an indication of the relative bearing of the aircraft to a selected ground station (150 to 1799 KHz)
- aural identification of the ground station.

The frequency range includes :

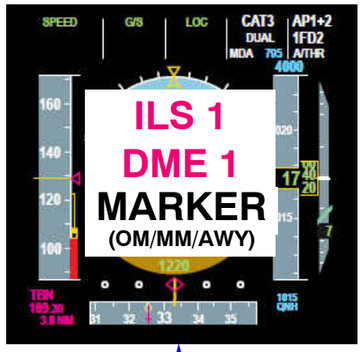
- the standard commercial broadcast AM stations (550 to 1610 KHz) located at known co–ordinates around the world
- the Non–Directional Beacons (NDB) (190 to 550 KHz).

The principle of the ADF navigation is to sense the relative bearing of a selected ground station.

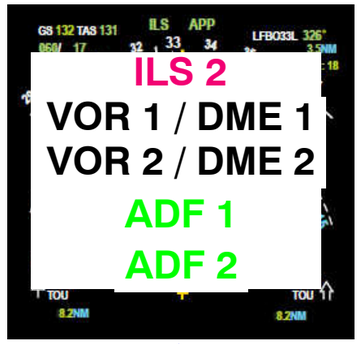
ACTION

Tune the discussed systems with the CMOS simulator and explore their indications.

IND ON PFD 1

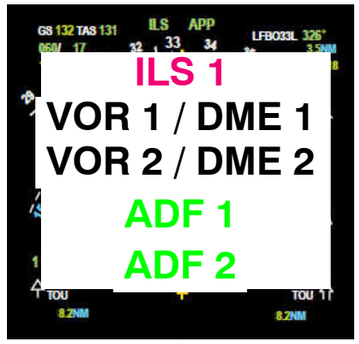


IND ON ND 1

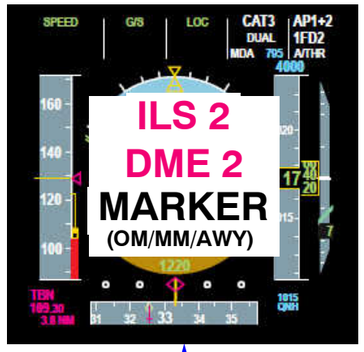


IND ON ISIS

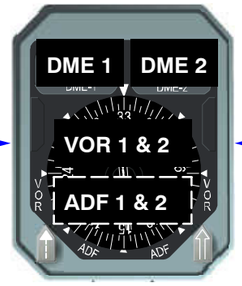
IND ON ND 2



IND ON PFD 2



DDRMI



CAPT EFIS CTRL PNL

F/O EFIS CTRL PNL

DMC 1 OR 3

DMC 2 OR 3

INPUT SELECT
NORM TUNING

INPUT SELECT
NORM TUNING

RECEIVERS #1

MMR 1
(ILS PART)

VOR 1
MKR

DME 1

ADF 1

INPUT A

INPUT B

PWR SPLY

RMP 1

RMP 2

FAULT

FAULT

FMGC 1

FMGC 2

BACKUP TUNING

RECEIVERS #2

INPUT A

INPUT B

ADF 2

DME 2

VOR 2
(MKR DEACT)

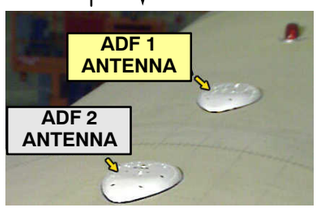
MMR 2
(ILS PART)

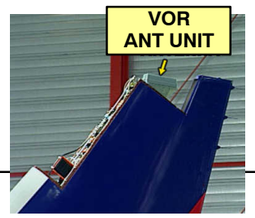
PWR SPLY

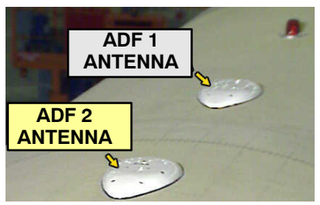
4

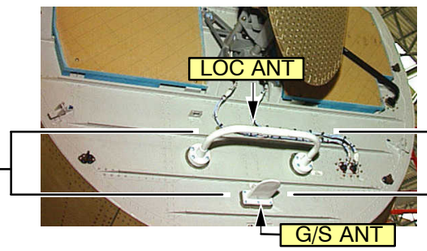
2

2









ANALOG
DIGITAL

Figure 73 Radio Navigation System Schematic (1 of 2)

Reference to Figure 74 Radio Navigation System Schematic (2 of 2)

RA, WXR, ATC, TCAS & EGPWS SYSTEM DESCRIPTION

Schematic Legend

ANT: Antenna

ATC: Air Traffic Control Transponder

DMC: DisplayManagement Computer

EFIS: Electronic Flight Instrument System

EGPWC: Enhanced Ground Proximity Computer

FWC: Flight Warning Computer

IND: Indication

RA: Radio Altimeter

TCAS: Traffic Collision Avoidance System

- TA : Traffic Advisory
- RA: Resolution Advisory

WXR: Weather Radar Transceiver

PWS: Predictive Windshear System

WG: Wave Guide

Radio Altimeter

The RA provides vertical distance to the terrain. The RA transmit a Frequency Modulated Continuous Wave signal to the terrain, via the transmit antenna, and receives the reflection of that signal via the receive antenna. It independently computes an altitude by measuring and processing the characteristics of the transmitted and received signal.

The principle of the radio altimeter is to :

- transmit a frequency modulated signal from the aircraft to the ground,
- receive the ground reflected signal after a certain delay.

The time between the transmitted frequency and the received frequency is proportional to the aircraft height.

Weather Radar

WXR is installed to detect precipitation. The displayed returns are shown on the ND. The weather radar also performs PWS detection. A wind shear event is a sudden change of wind speed and/or direction over a short distance with a downwards and/or upwards movement of the air very dangerous during take off and approach phases.

Two antenna scans are performed, each scan is optimized for a particular region in front of the aircraft.

The upper beam detects medium–range weather and the lower beam detects short and long–range weather by automatically adjusting tilt and gain (Multiscan Radar Only).

The principles of the weather radar is:

- generation of the very short intense pulses of microwave energy via an X–band wave guide to the antenna, and the processing of their echoes (radio frequency signals) to obtain the desired information,
- the receiver signal is formatted into 1600–bit ARINC 453 words and sent to the Display Management Computers (DMCs),
- windshear event detection and generation of the appropriate signal.

ATC/TCAS

The ATC transponders respond to the ground ATC secondary surveillance radar and TCAS interrogations.

The Air Data Reference (ADR) of the ADIRU supplies barometric information to the ATC transponders. The ATC transponder is an integral part of the ATC radar beacon system. The transponder is interrogated by the ground station and replies with a series of pulses.

These reply pulses are coded to supply identification MODE A and altitude reporting MODE C, and selective call and flight data MODE S on the ground controllers radar scope.

This information enables the controller to distinguish the A/C and to maintain effective ground surveillance of the air traffic.

The TCAS gives traffic information and warnings of potential conflicts to the crew, with vertical avoidance instructions. TCAS can only detect and indicate intruders that have at least one operative ATC transponder.

Enhanced Ground Proximity Warning System

The purpose of the EGPWS is to generate aural and visual warnings if the A/C adopts a potentially hazardous configuration of Controlled Flight Into Terrain (CFIT).
The functions of the EGPWS are:

- the basic Ground Proximity Warning System (GPWS) (Modes 1 to 5)
- the Terrain Clearance Floor (TCF) function
- the Terrain Awareness and Display (TAD) function including the peaks and obstacle function,
- the Runway Awareness and Advisory System (RAAS) function.

Action

Do the BITE tests of the discussed systems with the CMOS simulator and explore their indications and warnings.

IND ON PFD 1

PWS WARN
TCAS RA
RA 1 (2)

IND ON ND 1

TCAS INTRUDERS
&
WXR/PWS IMAGE
OR
EGPWS TERRAIN

AUDIO MANAGEMENT UNIT

LOUDSPEAKER

IND ON ND 2

TCAS INTRUDERS
&
WXR/PWS IMAGE
OR
EGPWS TERRAIN

IND ON PFD 2

PWS WARN
TCAS RA
RA 2 (1)

FWC

CAUT & WARN

CAPT

F/O

CAPT EFIS CTRL PNL

DMC 1 OR 3

TO WXR 1 & 2

6 ARINC 429
4 ARINC 453
DATA BUSES

TA/RA WARN

TEST

20RK

CVR TEST ON GND

AUDIO MIXING BOX

DMC 2 OR 3

6 ARINC 429
4 ARINC 453
DATA BUSES

F/O EFIS CTRL PNL

TO WXR 1 & 2

1 ARINC 429

2 ARINC 429

2 ARINC 429

2 ARINC 453

PWS CAUT & WARN

PWS CAUT & WARN

2 ARINC 453

1 ARINC 429

WXR CP

FAN

PWR SPLY

RA 1

XMS ANT

ATC 1

TOP ANT

BOT ANT

TCAS

TOP ANT

BOT ANT

ATC 2

TOP ANT

BOT ANT

ATC/TCAS CP

EGPWC

PULL UP GPWS

P/BSW PULL UP/GPWS

ON

P/BSW TERR ON ND

EGPWS CONTROL PANEL

TERR FAULT OFF

SYS FAULT OFF

G/S MODE OFF

FLAP MODE OFF

LDG FLAP 3 ON

WXR 1

WXR 2 (OPTION)

WG SWITCH

WXR ANT

ANT DRIVE

RA 2

PWR SPLY

FAN

RCP ANT

XMS ANT

AUDIO
ANALOG
DIGITAL
ANALOG & DIGITAL

Figure 74 Radio Navigation System Schematic (2 of 2)