

Title: 34 A320 T1

Summary: EGYPTAIR

EGYPTAIR TRAINING ACADEMY Airbus A318/A319/A320/A321 (CFM56) Technical
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34 NAVIGATIONS (LEVEL 2)

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Automatic Tuning: FMGC controls VOR/
DME, ILS, and ADF; FMGC1 for
Receivers 1, FMGC2 for Receivers 2. In
case of FMGC failure, the remaining
FMGC controls all receivers.

Manual Tuning: Pilot selects frequency
via MCDU; must clear manual tuning to
return to auto mode.

Back-Up Tuning: RMPs provide backup
if both FMGCs fail or during emergency
power. Only ILS data exchanged;
identical settings for ILS1 and ILS2.

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Multipurpose Control Display Unit (MCDU)
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The MCDU allows the crew to:

- View radio navigation frequencies on the RAD/NAV page.
- Align Inertial Reference systems via the INIT page.
- Conduct navigation system tests and troubleshooting via the CFDIU.

SYSTEM CONTROLS PRESENTATION - MCDU

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ADIRS CDU Functions

Switch ADR and IR on/off via NAV control.

Disconnect ADR output using a pushbutton.

Check ADIRU operation.

Align IR directly via ADIRS CDU or INIT page in FMGC.

Perform navigation system tests/troubleshooting via CFDIU.

Note: In ATT mode, IR operates in downgraded mode but remains powered.

SYSTEM CONTROLS PRESENTATION - ADIRS CDU

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Radio Management Panel (RMP) Notes
Controls communication frequencies and
standby Radio/NAV frequencies.
Standby mode activates during dual FMGC
failure with NAV pushbutton pressed.
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AUDIO CONTROL PANEL (ACP) - Notes
Controls reception of audio signals for
beacons and stations.
DME IDs are selected via the colocated
VOR/ILS knob.
SYSTEM CONTROLS PRESENTATION - ACP
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Location: Top windshield center post, stowed
in normal configuration.

Correction Card: Glued to the compass
assembly.

Non-Magnetic Lamp: Lights the compass
card, controlled by STBY COMPASS switch
on the INT LT panel.

Graduated Compass: Rotates freely inside a
damping liquid, attached to a magnetic
element.

Lubber Line: Indicates magnetic heading.

Compensation Holes: NS and EW holes for STANDBY INSTRUMENT PRESENTATION -
COMPASS

adjustments using compensator magnets.

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Roll Pointer: Indicates roll movement on a graduated scale.

Roll Scale: Graduated in 10° increments (-30° to +30°) and 15° up to 60°.

Flag: Appears with power supply failure or gyro rotor speed <18,000 RPM.

Pitch Drum: Displays pitch from -80° to +80°, divided by the horizon.

Aircraft Symbol: Fixed position.

Resetting Knob: Used for fast resetting

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and gyro protection during shipping.

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Location: Center instrument panel.

Features:

Adjustable Bugs: Four manual bugs for reference altitude.

Altitude Counter: Two drums display altitude in thousands and tens of thousands of feet; below 10,000 feet shows black/white, negative altitude shows orange/white.

Altitude Pointer: Indicates hundreds of feet (20 ft increments); includes a flight-supplied internal vibrator.

Altitude Dial: Calibrated 0–1000 feet

(20 ft graduations).

STANDBY INSTRUMENT PRESENTATION - ALTIMETER

Baro Correction: Displayed in hecto

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Pascals (750–1050 range) adjustable EFFECTIVITY

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via a knob.

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Location: Center instrument panel.

Adjustable Bugs: Four manually adjustable
bugs for reference speed.

Speed Pointer: Moves on a graduated dial.

Speed Dial:

One scale: 60kt to 250kt (5kt increments).

Second scale: 250kt to 450kt (10kt
increments).

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ISIS Display Overview

Displayed Information:

Airspeed, Mach number, Pitch & Roll angles, Altitude (ft & metric), ILS/MMR deviations (G/S,
LOC), Barometric
pressure, Magnetic heading.

Initialization: Displays "ATT", "SPD", "ALT", "INIT 90s" for 90 seconds.

Standby Indicators:

Airspeed: Black tape, linear scale, with speed indicator (red SPD flag on failure).

Mach: Green below speed scale (red M flag on failure).

Altitude: Black tape with white indications, digital readout every 500 ft (red ALT flag on failure).

Barometric Pressure: Selectable between STD (cyan) and QNH (hPa), corrected range (745-1100
hPa) or in.inHg
(22-32.48 in.Hg).

Standby Horizon:

Aircraft symbol for pitch/roll reference; red arrows for excessive pitch.

Roll angle with white scale marks, coordinated with lateral acceleration (red ATT flag on failure).

Optional magnetic heading display with yellow triangle (red HDG flag on failure).

LS & Bugs Function:

LS: Displays G/S and LOC scales, replaced by red flags on failure.

BUGS: Program speed and altitude bugs; use the BARO knob to set/reset. The RST switch resets
attitude values
during stabilized flight.

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DDRMI Presentation

General: Located on the center panel, combines VOR/ADF/DME RMI. Some models lack ADF capability.

Normal Operation:

DME 1 Distance: Displayed in the left window.

DME 2 Distance: Displayed in the right window.

Single Pointer: Indicates VOR 1 or ADF 1 bearing.

DDRMI gets Heading information from ADIRU 1 or

Double Pointer: Indicates VOR 2 or ADIRU 3

ADF 2 bearing.

Selection: VOR/ADF for each pointer is selectable via a switch.

DDRMI PRESENTATION - NORMAL OPERATION

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DME/RMI Failures:

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DME failure: Display window blanked.

NCD (e.g., out-of-range station): White dashed lines.

Heading:

Normally from ADIRU 1; switches to ADIRU 3 if ADIRU 1 fails.

Receiver Failures:

VOR/ADF 1 or 2 failure: Red flag and pointer at 3 o'clock.

NCD: No flag, pointer at 3 o'clock.

Display:

DME 1 on the left, DME 2 on the right.

Single pointer for VOR 1/ADF 1, double pointer for VOR 2/ADF 2.

DDRMI PRESENTATION - FAILURE AND NON COMPUTED DATA (NCD)

VOR/ADF selection via a switch for

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each pointer.

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MMR System: Navigation sensor with 2 internal receivers (ILS + GPS).

ILS Principle:

Provides signals from a ground station to assist with landing.

Descent axis determined by intersection of Localizer (LOC) and Glide Slope (G/S) beams.

Measures angular deviations and receives Morse audio signals.

ILS Frequency Range:

LOC: 108.1 to 111.95 MHz.

MMR SYSTEM PRESENTATION - ILS PRINCIPLE

G/S: 329.15 to 335 MHz.

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NAV.S.T.A.R. GPS: A global navigation system using
satellite signals for accurate navigation.

System Segments:

Spatial Segment: 24 satellites in 6 orbital planes, 4
satellites per plane.

Characteristics: 55° inclination, 20,200 km altitude, 12-

hour orbital period.

Provides satellite position (Ephemeris), constellation data (Almanach), and atmospheric corrections.

Control Segment

User Segment:

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4 monitor stations: Kwajalein, Hawaii, Ascension Island, Diego Garcia

1 master control station: Colorado Springs.

Functions: Track satellites, compute ephemeris, clock corrections, and control navigation parameters. Transmit data to GPS users.

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GPS Position Computation: Based on signal transmission time from at least 4 satellites.

Functions:

Signal acquisition

Distance calculation

Navigation computation (satellite choice, positioning, corrections)

Detection and isolation of failed satellites (GPS Primary)

Note: When GPS mode is active, VOR/DME/ADF data is not used for navigation.

MMR SYSTEM PRESENTATION - GPS PRINCIPLE - USER SEGMENT

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The components are two ILS antennas, 2 GPS antennas
and two MMR units in Avionics Compartment

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The ILS1 information is displayed on PFD1 and ND2.

The ILS2 information is displayed on PFD2 and ND1.

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Function: Measures aircraft height above terrain during climb, approach, and landing, including non-flat surfaces.

Principle: Transmits a frequency-modulated signal to the ground and receives the reflected signal.

Operation: The time delay between transmission and reception is proportional to the aircraft's height.

RADIO ALTIMETER SYSTEM PRESENTATION - PRINCIPLE

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The components are two transceivers in the aft cargo compartment, two fans, two transmission antennae and two reception antennae.

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

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Responds to radar pulses from ground stations with coded replies for
identification (Mode A) and altitude reporting (Mode C).

Allows controllers to distinguish and track aircraft on radar.
Also responds to interrogations from aircraft with (TCAS) (Mode S).

ATC SYSTEM PRESENTATION - PRINCIPLE

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The components are two transponders, four antennae,
and one ATC/TCAS control panel.

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The TCAS components are two antennae, one TCAS computer
and one TCAS/ATC control panel.

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The TCAS indications appear on the PFD and the ND.

The visual resolution and traffic advisory indications
are associated with aural indications such as "TRAFFIC,
TRAFFIC", "CLIMB, CLIMB"...

TCAS PRESENTATION - INDICATING

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34 NAVIGATIONS (LEVEL 2)

EGPWS = GPWS + Enhanced functions.

Purpose: Prevents accidents caused by Controlled Flight Into Terrain (CFIT).

Alerts: Aural, visual warnings, and displays when alert boundaries are exceeded.

Enhanced Features:

Terrain Clearance Floor (TCF):

Terrain Awareness Alerting and Display (TAD).

ENHANCED GROUND PROXIMITY WARNING SYSTEM PRESENTATION - PRINCIPLE

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34 NAVIGATIONS (LEVEL 2)

The system comprises an EGPWC, a control panel, two
warning lights and two TERRAIN ON ND mode pushbuttons .

ENHANCED GROUND PROXIMITY WARNING SYSTEM PRESENTATION - COMPONENTS

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The basic GPWS modes generate visual warnings through associated lights and synthetic warnings through the loudspeakers.

The "ENHANCED" GPWS functions allow the terrain hazards to be displayed on the Navigation Display (ND).

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Function: ADF provides the relative bearing to a selected NDB (Non-Directional Beacon).

Features:

Identifies the relative bearing (angle between aircraft heading and aircraft/ground station axis).

Provides aural identification of the ground station.

ADF SYSTEM PRESENTATION - PRINCIPLE

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Signal Combination: Received from two loop antennas and one omni-directional sense antenna for bearing

information.

Frequency Range: Ground stations operate between 190 to 1750 kHz.

Morse Signal: Used to identify the selected ground station.

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The Automatic Direction Finder system is composed of two receivers and two antennae.

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Navigation Displays (ND):

ADF 1: Single pointer.

ADF 2: Double pointer.

DDRMI:

ADF 1: Single pointer.

ADF 2: Double pointer.

Note: Some DDRMIs lack ADF capability.

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34-55-00 VOR/MARKER SYSTEMS PRESENTATION

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34 NAVIGATIONS (LEVEL 2)

VOR: Medium-range radio navigation

aid (108-117.95 MHz).

Function: Receives, decodes, and processes bearing information from a ground station.

Signal: Ground station generates a reference and variable phase signal; phase difference represents the bearing.

Bearing: Angle between Magnetic North and the aircraft/ground station axis.

Morse Identification: Each VOR station provides a unique Morse code identifier.

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The MARKER (MKR) system is a radio navigation aid which indicates the distance between the aircraft and the runway threshold.

The MARKER (MKR) system is normally used together with the ILS system during an ILS approach

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

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

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34-51-00 DME SYSTEM PRESENTATION

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Function: Provides aircraft slant range distance to a selected ground station.

Operation:

Aircraft interrogator sends pulses to the ground station.

Ground station replies after 50 microseconds.

Distance is calculated in Nautical Miles (NM).

Identification: Interrogator detects Morse audio signal identifying the ground station.

DME SYSTEM PRESENTATION - PRINCIPLE

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The components are two antennae and two interrogators.

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The DME distance is shown on the Primary Flight Display
(PFD) (if ILS/DME) and on the Navigation Display (ND)
(if VOR/DME).

The DME distance is also shown on the two windows of the Digital Distance Radio Magnetic Indicator (DDRMI).

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The system detects atmospheric disturbances and windshear events in the scanned area. PWS is optional.

Weather Radar (WR): Helps pilots avoid turbulence by determining the range and bearing of disturbances. Also used for ground mapping.

Principle: The radar emits microwave pulses;

distance is determined by echo return time, and azimuth is based on antenna position when the echo is received.

WR/PWS SYSTEM PRESENTATION - WEATHER RADAR (WR) PRINCIPLE

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A windshear event is a sudden change of wind speed and/or direction over a small distance due to downwards and/or upwards movement of the air.

The most critical moment for the aircraft is near the ground level during the approach or in take-off.

WR/PWS SYSTEM PRESENTATION - PREDICTIVE WINDSHEAR (PWS) PRINCIPLE

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The main components are an antenna, a wave guide, a transceiver and a control unit.

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WR INDICATING

The Weather Radar image is shown on Navigation Displays.

Radar image and radar information status (TILT, GAIN,

failure) are displayed in the different EFIS modes

(ARC and ROSE) except in PLAN mode.

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34 NAVIGATIONS (LEVEL 2)

In a strapdown Inertial Reference System the gyros
and

the accelerometers are solidly attached to the aircraft
structure.

The strapdown laser gyro provides directly
accelerations and angular speeds.

ADIRS PRINCIPLE - IR

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

opposite laser beams in a ring.

At rest, the two beams arrive at 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 a digital output which, after computation, will

provide rotation information.

ADIRS PRINCIPLE - GYRO

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Three accelerometers, one for each axis, provide linear

accelerations.

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

ADIRS PRINCIPLE - ACCELEROMETER

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ADIRS Components:

3 (ADIRUs) with separate probes and sensors, sharing a common (CDU).

MCDU: Used for Inertial Reference alignment, ADIRU tests, and displaying ADIRU data.

ADIRS CDU: Backup for alignment, mode selection, and status display.

Probes: Measure total/static pressures, (AOA), and (TAT), sending data to ADIRUs via ADMs.

FCU: Sends barometric correction data to ADIRUs.

GPS: Provides aircraft position and speed data to ADIRUs for pure GPS, IR, or hybrid data outputs.

DMCs: DMC1 and DMC2 receive data from their related ADIRUs; DMC3 serves as backup, receiving data from all three ADIRUs.

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Pitot Probes: Three probes send total pressure to Air Data Modules (ADMs), which convert it to ARINC 429 digital

format. Data is sent to the ADIRUs. Standby probe supplies the standby ASI and ADR3.

Static Ports: Six static ports provide static pressure to five ADMs. Standby static ports supply average pressure to standby instruments and ADR3.

AOA Sensors: ADIRUs receive angle of attack data from corresponding AOA (Alpha) probes.

TAT Sensors: Two sensors provide Total Air Temperature to the ADIRUs. ADIRU3 gets data from TAT 1 sensor with two elements.

Water Drain: Pressure lines are designed without a water drain, except for the standby static ports.

AIR DATA PROBES PRESENTATION

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Data Selector

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

If an Air Data Reference (ADR) or an Inertial Reference (IR) fails, the AIR DATA or ATT HDG selectors enable the crew to use ADR 3 or IR 3.

The manual switching is mainly performed to recover ADIRS SWITCHING displays.

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ADR to IR: ADR sends data to IR for computation. Each IR receives data from 3 ADRs, using its own for calculation.
ADR to ADR: Each ADR crosschecks its data with the other two ADRs for 4 parameters: static pressure, total pressure, AOA, TAT.
ADR Switching: If Captain or FO ADR fails, the AIR DATA switch manually switches to ADR3 to

restore data display.

IR Switching: If Captain or FO IR fails, the attitude heading switch manually switches to IR3. The associated ADR switches to IR3 automatically for display continuity.

Switching Control: IR1 and IR2 always use AUTO mode; IR3 is selected via AUTO or MANUAL depending on switch position. If ADR fails, IR switches to ADR3 for computation continuity until manual switching occurs.

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34-12-00 ADIRS BACK-UP OPERATION (ATT
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Purpose: Backup mode for attitude and magnetic heading data during navigation failure (e.g., IR2 fault).

Fault Indication:

Single chime, MASTER CAUT light, FAULT light on ADIRS CDU, HDG flag on PFD/ND.

ECAM DU shows "NAV IR2 FAULT" and instructs switching to IR3.

ADIRS CDU shows "STS-SELECT ATT".

Mode Engagement:

Select ATT mode; FAULT light off, ALIGN light on (then off after 20s).

"ATT MOD" displayed on ADIRS CDU, showing Pitch and Roll on EFIS.

Mode must be engaged in level flight.

Magnetic Heading Insertion:

Set DATA selector to HDG, SYS selector to position 2.

Enter heading via keyboard (e.g., 353.9°), press ENT to send to IR2.

Heading displayed on instruments.

Post-Engagement:

ADIRS BACK-UP OPERATION (ATT MODE)

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34 NAVIGATIONS (LEVEL 2)

34 - NAVIGATION

34-10-00 ADIRS INDICATIONS ON PFD

CONTENTS:

Attitude

Heading

Airspeed

Vertical Speed

Altitude

Self Examination

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ADIRS INDICATIONS ON PFD - ATTITUDE (SHEET 1/2)

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When an attitude discrepancy is detected between the

Captain display and the First Officer display, an amber

In case of attitude

CHECK ATT message is displayed on both PFDs associated failure, the attitude
with aural and visual ECAM cautions. sphere is

The attitude discrepancy threshold is 5°. cleared and replaced by

This discrepancy is detected by comparison of the 2 IRSs an attitude flag (ATT

in use within the Flight Warning Computer (FWC).

red).

The red ATT flag first

flashes then remains

steady.

ADIRS INDICATIONS ON PFD - ATTITUDE (SHEET 2/2)

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34 NAVIGATIONS (LEVEL 2)

When a heading discrepancy

is detected between the

Captain display and the First

Officer display, an amber

CHECK HDG message is

displayed on both PFDs

associated

with aural and visual ECAM

cautions.

The heading discrepancy

threshold is 5°.

This discrepancy is detected

by a comparison of the 2 IRs

in use within the (FWC).

ADIRS INDICATIONS ON PFD - HEADING

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The speed scale is graduated from 30 to 520 kts.

The MACH number (green) is displayed if above 0.5 M

and no ILS selection. It disappears at 0.45 M.

ADIRS INDICATIONS ON PFD - AIRSPEED

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DEGRADED DATA

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

An amber box surrounds the numerical value.

ADIRS INDICATIONS ON PFD - VERTICAL SPEED

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The Altitude discrepancy threshold is:

- 250 ft with baro selected (QNH or QFE),
- 500 ft with STD selected.

ADIRS INDICATIONS ON PFD - ALTITUDE

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34 - NAVIGATION

34-10-00 ADIRS INDICATIONS ON ND

CONTENTS:

ROSE Mode
ARC Mode
PLAN Mode
Self Examination
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1. SPEED
The speed information (green) is displayed in the left

upper corner.

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

2. WIND

The wind information (green) is displayed in the left upper corner.

3. HEADING

ADIRS INDICATIONS ON ND - PLAN

The map displayed (white) is referenced to north up.

MODE

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34 - NAVIGATION

34-10-00 ADIRS INDICATIONS ON ECAM

DISPLAY UNIT

CONTENTS:

Total Air Temperature/Static Air Temperature

Failure

Switching

Self Examination

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Basically, ADR2 provides data.

ADR3 provides data when the AIR DATA switch is set to

First Officer 3 (F/O 3).

Back up data is provided by setting the AIR DATA switch to the F/O 3 position.

ADIRS INDICATIONS ON ECAM DISPLAY UNIT

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34 NAVIGATIONS (LEVEL 2)

34 - NAVIGATION

34-10-00 ADIRS COMPONENTS

CONTENTS:

Air Data Module

AOA Sensors

Static Probes

TAT Sensors

Pitot Probes

ADIRS CDU

ADIRUs

VMO/MMO Switch

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ADIRS COMPONENTS - ADMs AND AOAS

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** ON A/C 301-350

A. ADR Operation

(1) General

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
- Angle Of Attack (AOA)
- maximum operating speed (MMO/VMO).

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

monitoring includes test of:

- input signal integrity
- input interface integrity
- memory integrity
- computational integrity
- output signal integrity.

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

Faults are stored in BITE history in Non Volatile Memory (NVM) and sent to the Centralized Fault Display System (CFDS) via digital words.

** ON A/C 301-350

PRE SB 22-1739 for A/C 301-308

(2) Back-up speed and altitude scales

(Ref. Fig. Back-Up Speed and Altitude Scales SHEET 1)

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34 NAVIGATIONS (LEVEL 2)

SELECTED ALTITUDE IN METERS

TARGET SPEED

LOC

G/S

900 M

>030 SELECTED ALTITUDE

GREEN AREA

028

FAST

80

60 GPS

> 22

40

SPEED/AOA INDICATOR

SLOW

DOUBLE DASH ON LAST

DIGITS (LOSS OF PRECISION)

>010

BUSS

GPS ALT

GPS ALTITUDE SCALE

688 M

TBN

109 . 30

27 28 29 30 326

GPS METRIC ALTITUDE

PFD TYPICAL

DOUBLE DASH ON LAST

DIGITS (LOSS OF PRECISION)

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34 NAVIGATION (LEVEL 3)

34 NAVIGATIONS (LEVEL 2)

B
C
A
PUPULLLL UP UP
PUPULLLL UPUP
GGPWPWSS
GGPWPWSS
ND
PFD PFD/ND
ND
PFD/ND PFD
XFR
XFR
OFF BRT OFF BRT
OFF BRT OFF BRT
TRAFFIC
TRAFFIC
LOUD SPEAKER CONSOLE/FLOOR
SELECTOR
CONSOLE/FLOOR LOUD SPEAKER
SELECTOR
BRT
BRT
DIM
DIM
OFF
OFF MAX
OFF
OFF MAX
BKUP
BKUP
FOOT WARMER SPD/ALT
SPD/ALT FOOT WARMER
ON
ON
ONON
ONON
OFF 39WT2
OFF
39WT1
CAPT LIGHTING/LOUD TYPICAL
F/O LIGHTING/LOUD TYPICAL

SPEAKER CTL PNL

SPEAKER CTL PNL

B

C

301VU

500VU

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