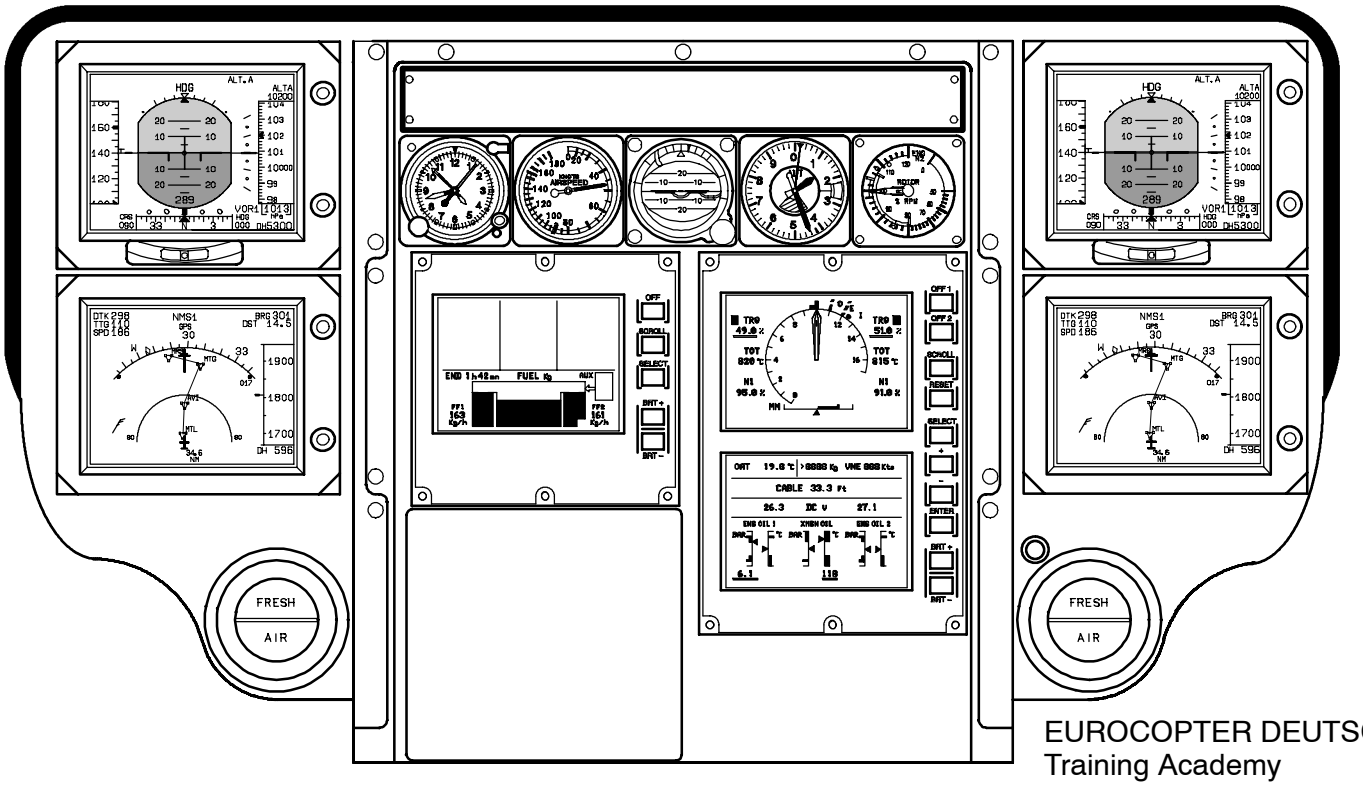
EC 135 / BK117 C-2
Training Manual FCDS



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This training document comprises the following ATA chapters:

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Introduction

About this Training Document

The purpose of this training document is to provide an overall picture of the Flight Control Display System with which the EC 135 and BK117 C-2 helicopters can be equipped. It has been prepared with the aid of the information contained in the the respective flight manuals and maintenance manuals.

The information contained in this training document represents the technical status of March 2006.

It is expressly emphasized that this training document is of a pure informational nature and is not subject to any revision service.

The authors

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Revision 3, March 2006

Please direct any inquiries you may have to the Training Academy.

Abbreviations

A

ADC . . . . . Air Data Computer
ADF . . . . . Automatic Direction Finder
ADU . . . . . Air Data Unit
AHRS . . . . . Attitude and Heading Reference System
A/C . . . . . Aircraft
AMLCD . . . . . Active Matrix Liquid Crystal Display
ARINC . . . . . Digital Bus (Aeronautical Radio Inc.)
ATT . . . . . Attitude

B

BIT . . . . . Built In Test
BRG . . . . . Bearing

C

CAD . . . . . Caution and Advisory Display
CPDS . . . . . Central Panel Display System
CPIL . . . . . Copilot
CRS . . . . . Course

D

DH . . . . . Decision Height
DME . . . . . Distance Measurerment Equipment
DST . . . . . Distance to go (waypoint to waypoint)

F

FBL . . . . . Functional Base Line
FCDM . . . . . Flight Control Display Module
FCDS . . . . . Flight Control Display System
FLIR . . . . . Forward Looking Infra Red

G

GPS . . . . . Global Positioning System

H

HC . . . . . Helicopter
HDG . . . . . Heading
HSI . . . . . Horizontal Situation Indicator

I

IAS . . . . . Indicated Airspeed
ICP . . . . . Instrument Control Panel
IGE . . . . . In Ground Effect
ILS . . . . . Instrument Landing System

J

JAA . . . . . Joint Aviation Authorities

L

LCD . . . . . Liquid Crystal Display

LH . . . . . Left Hand

LOC . . . . . Localizer

N

NAV . . . . . Navigation System

ND . . . . . Navigation Display

NMS . . . . . Navigation Management System

P

P . . . . . Pitch

PELICAN . . . . . Packing Equipment Line for Integrated Concept of Avionique Nouvelle

PIL . . . . . Pilot

PFD . . . . . Primary Flight Display

R

R . . . . . Roll

RA . . . . . Radio Altimeter

RCU . . . . . Reconfiguration Control Unit

RH . . . . . Right Hand

RMM . . . . . Removeable Memory Module

S

SMD . . . . . Smart Multifunktion Display

SMD 68H . . . . . SMD 6 inches x 8 inches for HC

SMD 45H . . . . . SMD 4 inches x 5 inches for HC

SPIFR . . . . . Single Pilot Instrument Flight Rules

STD . . . . . Standard

T

TST . . . . . Test

TTG . . . . . Time to Go

U

UL . . . . . Upper Limit

V

VEMD . . . . . Vehicle & Engine Multifunction Display

VNE . . . . . Velocity Never Exeed

VOR . . . . . Very High Frequency Omnidirectional Radio Ranging

VRU . . . . . Video and Radar Range Unit

VS . . . . . Vertical Speed

W

WXR . . . . . Weather Radar

Y

Y . . . . . Yaw

Flight Control Display System FCDS

General

The modular layout of the Flight Control Display System (FCDS) with the four displays, Primary Flight Display (PFD) and Navigation Display (ND) for pilot and copilot, fullfills the requirements for IFR with regards to redundancy and fail-save requirements. The digital system enables flexibility and reconfiguration. In case of module failure the indication of important flight parameters is still possible in a limited operation mode (Composite Mode). A double redundancy is achieved by installation of back-up instruments in conventional design.

The system architecture is based on two separate symmetrical channels (no. 1 for copilot and no. 2 for pilot). Each channel is composed of one Flight Control Display Module (FCDM), an Instrument Control Panel (ICP) and two displays (SMD 45H).

Normal Operation

During normal operation the values of systems 1 are displayed LH and those of the systems 2 RH side at the instrument panel. The selection for the display mode, for the displayed sensors and the indicated distances is done through the Instrument Control Panel (ICP), which is installed separately for each pilot in the slant console. Additionally there is a data exchange between the two FCDMs for comparison of the sensor data. If there is a discrepancy detected, an automatic failure indication will be shown on the display.

Components

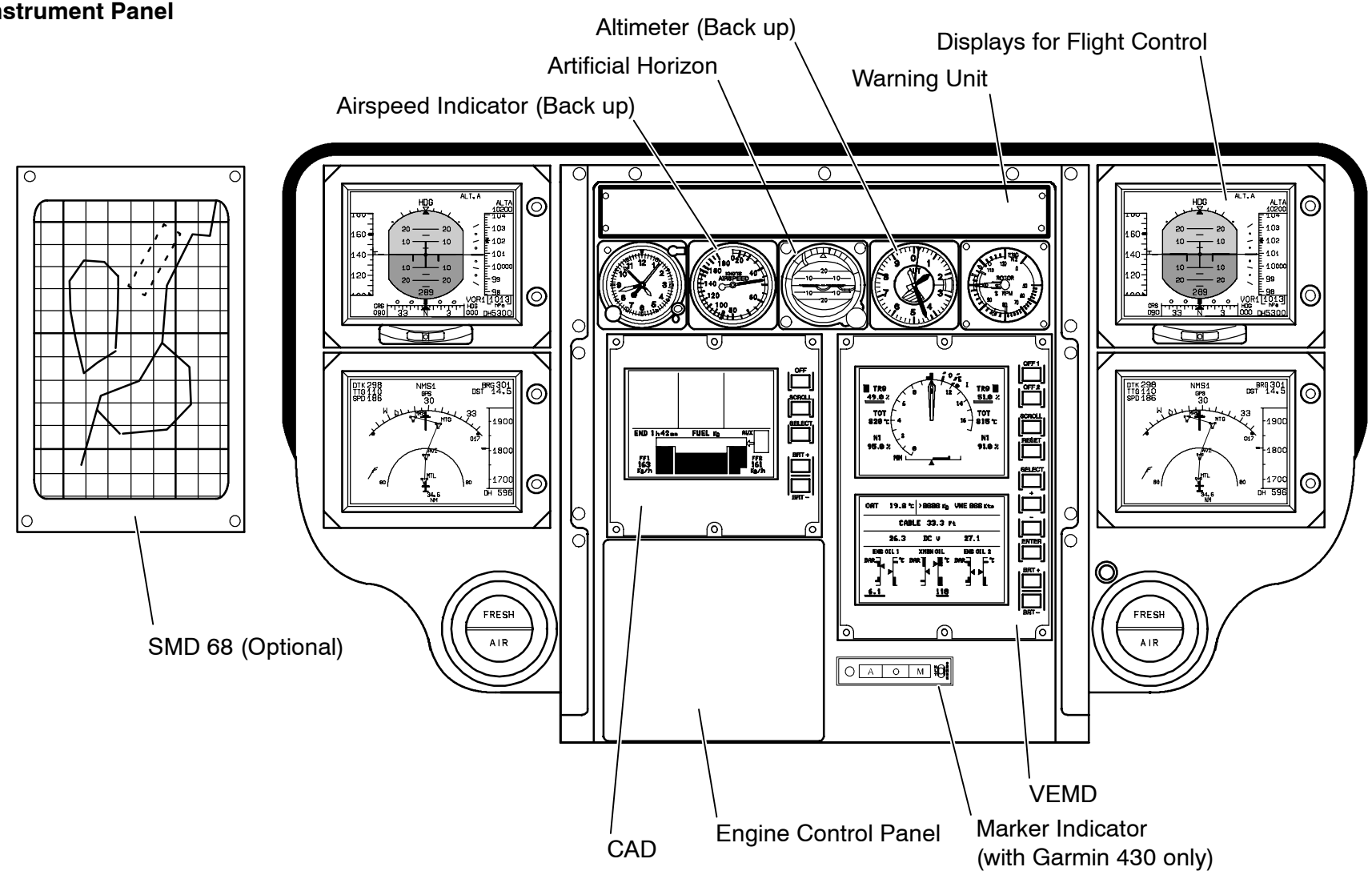
The following additional components are necessary for operation of the FCDS:

- Power supply (overhead panel)
- 4x SMD 45H displays
- Backup instruments (airspeed, altimeter, artificial horizon)
- 2x ICP (Instrument Control Panel)
- RCU (Reconfiguration Unit)
- 2x ADC (Air Data Computer)
- 2x FCDM (Flight Control Display Module)
- 2x AHRS
- 2x magnetometer
- Avionics: NAV 1, NAV 2, ADF, DF (option), GPS (NMS)
- Optional equipment: radar altimeter, weather radar, FLIR, moving map, autopilot, terrain avoidance system (Hellas)

◆ **NOTE** **The autopilot symbology is not shown in this manual.**

◆ **NOTE** **Before starting engines, make sure that no power is applied to the FCDS (avionics master switches in OFF position) in order to prevent influence of transient voltage.**

Instrument Panel



SMD 45H

The SMD 45H is an Active Matrix Liquid Crystal Display with an excellent legibility under all illumination conditions. Two displays per side are mounted in the instrument panel. Normally the upper monitor is used as Primary Flight Display (PFD) and the lower one as Navigation Display (ND).

Instrument Control Panel

They are used to control the different display modes of the SMD 45H monitors.

The two Instrument Control Panels (ICP) are mounted in the slant console.

Reconfiguration Unit

With the Reconfiguration Unit (RCU) each sensor can be allocated individually to both system sides.

The RCU is installed in the aft center console.

Attitude and Heading Reference System

The Attitude and Heading Reference System (AHRS) is a glass fiber optic aided heading and reference system of high accuracy. It measures the flight attitude, turning- and acceleration rates of the helicopter for viewing on the flight displays (and for further processing in the autopilot computer). The inertial unit compensates all external influences such as drift, temperature etc. and calculates by means of the measured turning rates the helicopter attitude.

The AHRS are installed RH side below the cabin floor.

Air Data Computer

The Air Data Computer provides the FCDS with the data of the barometric flight altitude and with the horizontal and vertical speed. The data from the ADC are transmitted digitally to the AHRS and to the Primary Flight Display.

Location EC 135: The ADCs are installed respectively in the LH and RH side channels of the helicopter.

Location BK117 C-2: The ADC 1 is located in the FWD avioncs bay LH side. The ADC 2 is installed in the RH side channel of the helicopter.

PELICAN Rack including two FCDM

The PELICAN rack consists of two compartments respectively cooled by a fan. In each compartment are two plug-ins for modules integrated. In each compartment one FCDM is implemented, secured by a locking device.

Location EC 135: The PELICAN rack is attached on the avionics deck, aft of the passenger cabin.

Location BK117 C-2: The PELICAN rack is mounted below the aft cabin floor board and is vented via a separate air intake.

Magnetometer

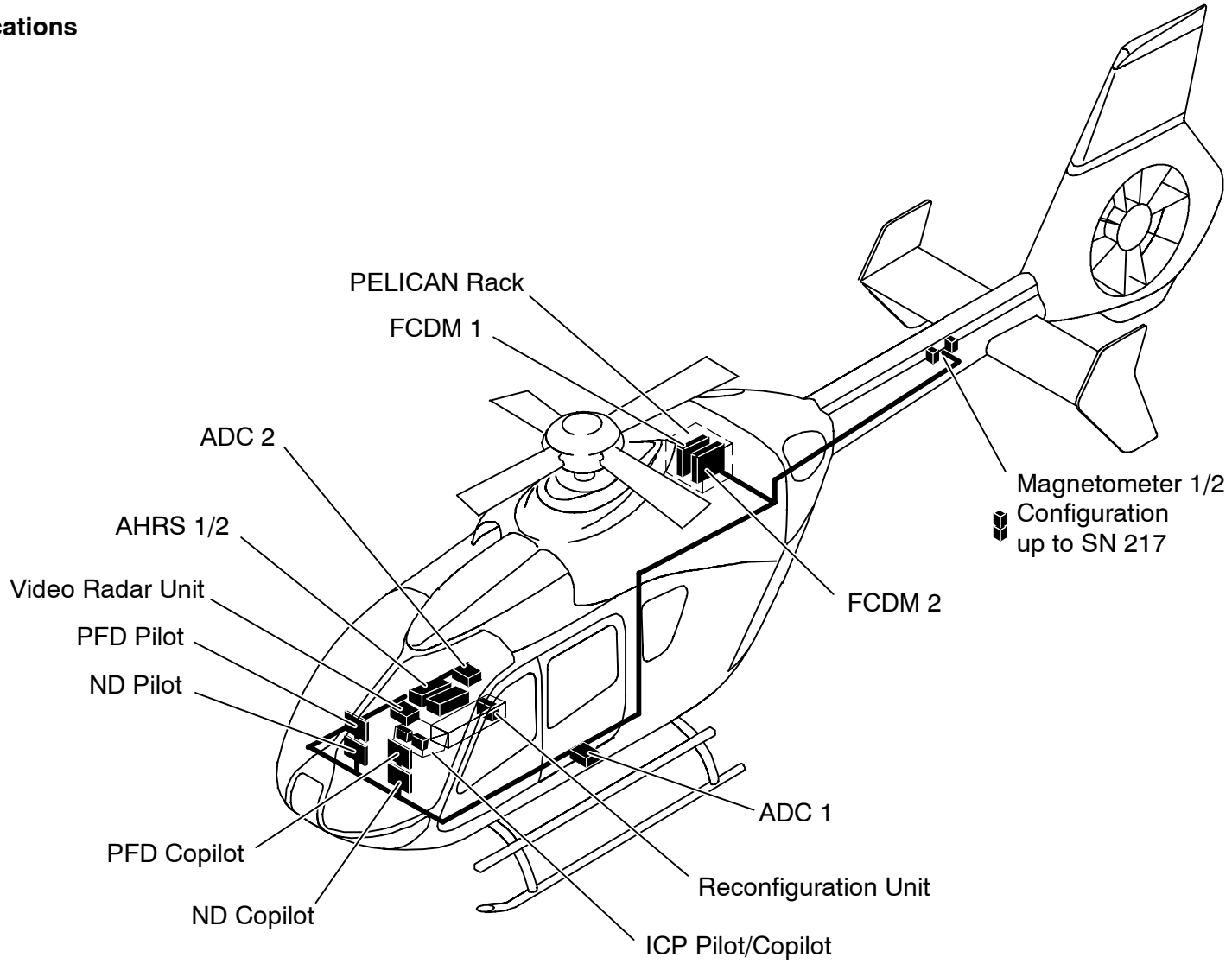
The direction of the earth's magnetic field is measured by the magnetometer. This data are sent to the inertial unit of the AHRS for calculation of the actual heading.

They are installed in the middle of the tail boom.

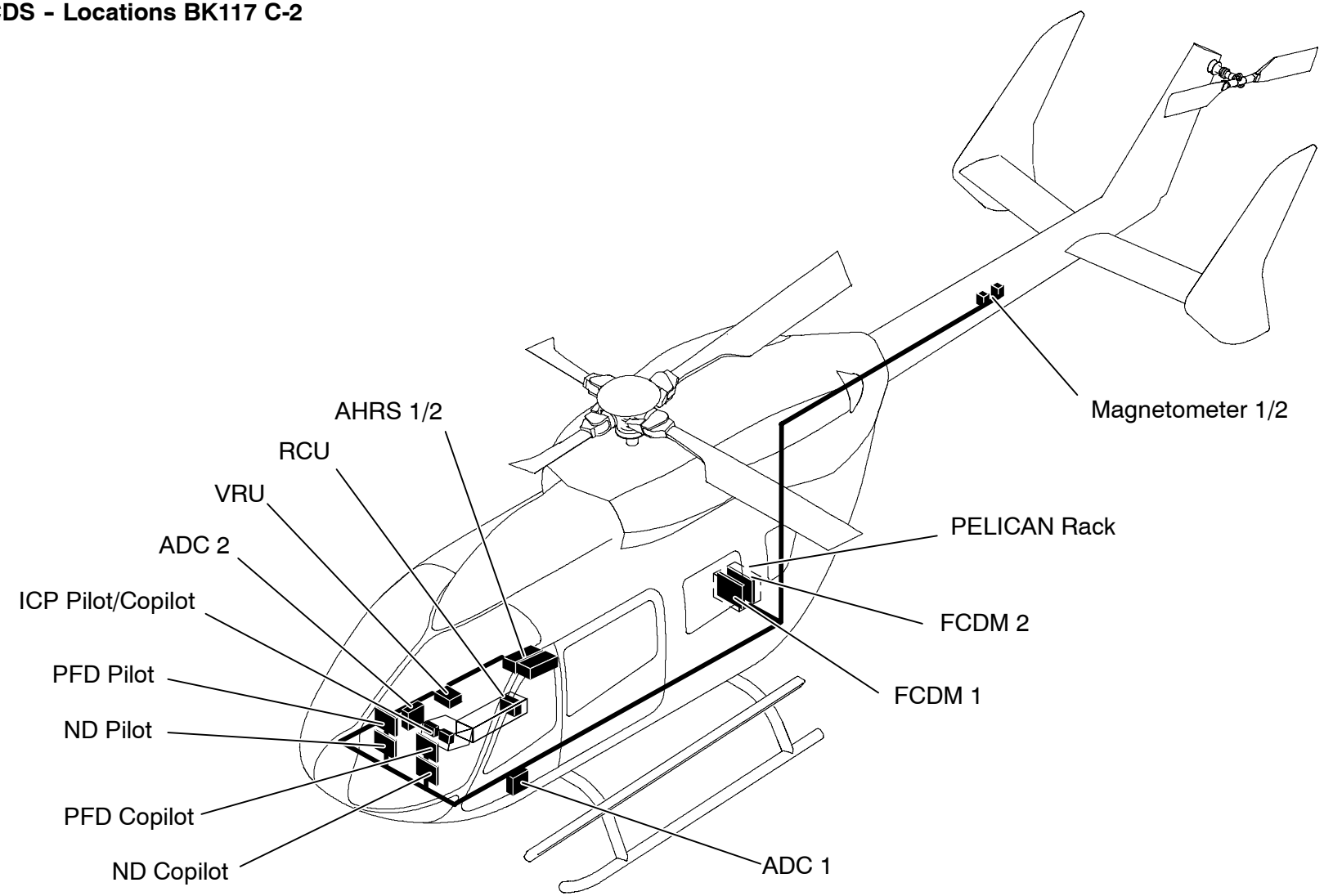
Back-up Instruments

Additionally, analog instruments serve as back-up instruments in case of display failure or sensor malfunctions.

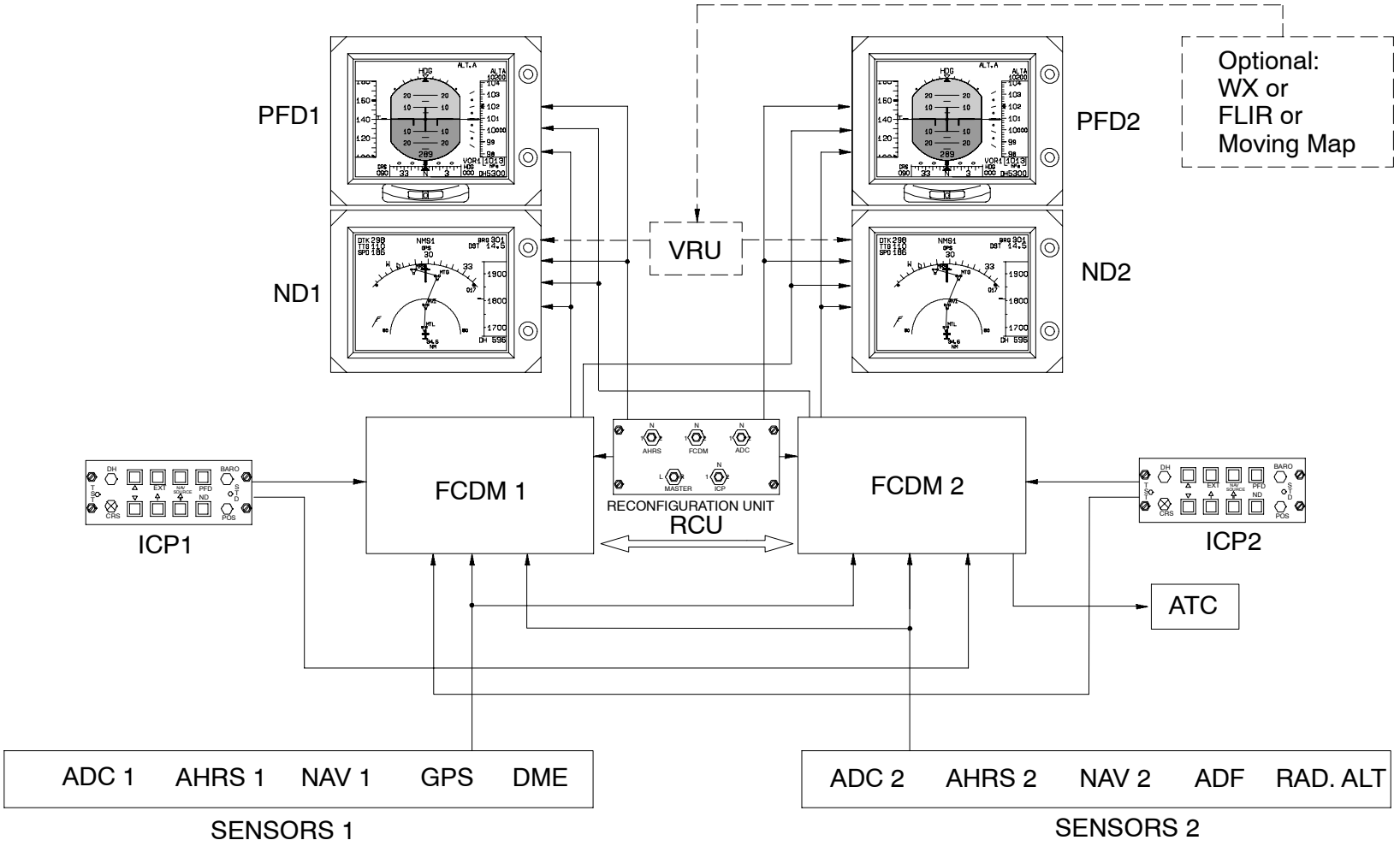
FCDS - Locations



FCDS - Locations BK117 C-2



FCDS Block Diagram



Instrument Control Panel Copilot/Pilot

The ICP is used to operate the PFD and ND. Under normal conditions, the left ICP is used for the copilot's displays and the right ICP is used for the pilot's display.

The following controls are provided:

(1) DH

Press: Selects between DH and UL (optional)
Rotate: Adjusts DH or UL value
Fast rotation = 8 ft steps
Slow rotation = 1 ft steps

(2) (Range up)

Press: Increases the range settings of the ND sectors or EXT systems up to 500 NM half range (depending on configuration).

(3) EXT

Press: Sequentially selects: WX, Moving Map, FLIR

(4) NAV SOURCE

Press: Sequentially selects VOR/ILS1, VOR/ILS2, GPS (NMS) for NAV source on ND.

(5) PFD

Press: Selects between normal PFD and PFD Composite Page

(6) BARO

Rotate: Adjusts the pressure setting

(7) STD (may be covered at helicopters with older software versions)

Press: Standard pressure (1013.25 hPa) or manually set value.

(8) POS

Press: Resets the pitch reference value (aircraft symbol) on ADI to 0°.
Rotate: Adjusts the POS value between -2° and +7°.

(9) ND

Press: Selects between ND HSI and ND Sector Mode

(10) Double Bar Pointer

Press: Sequentially selects for ADF (DF optional), VOR2 & NMS (GPS).

(11) Single Bar Pointer

Press: Sequentially selects for ADF, VOR1 & NMS (GPS).

(12) (Range down)

Press: Decreases the range settings of the ND sectors or EXT systems down to 0.25 NM half range (depending on configuration).

(13) CRS

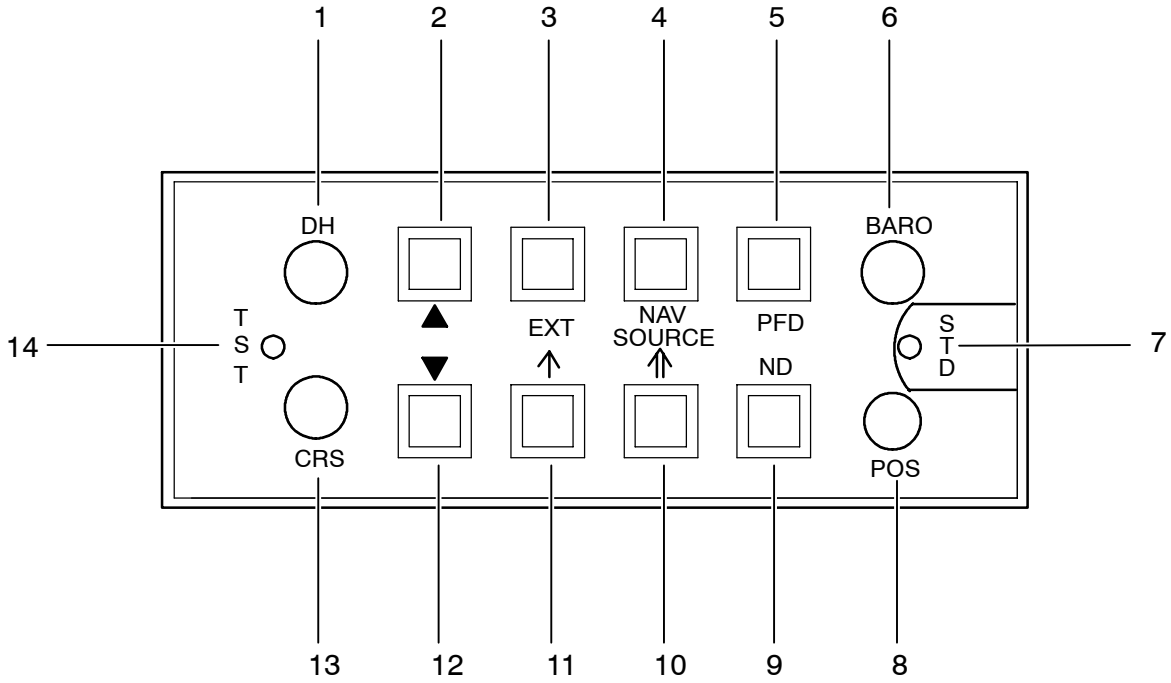
Rotate: Adjusts CRS value (course pointer) manually (VOR)
Press: With NAV (VOR) engagement automatically rotation to the station and centering the CDI.

(14) TST

Press: Initiates test function of the fans of the PELICAN rack and test function of the radar altimeter 50 ft test.

The TST button should not be operated in flight.

Instrument Control Panel ICP



PELICAN Rack

The PELICAN rack serves as a mounting for the individual modules of the FCDMs and for the autopilot computer (optional). It has an integrated cooling system and comprises four 19” computer slots. Each of the two chambers of the rack are cooled by one blower.

In the left chamber the FCDM 2 and in the right chamber the FCDM 1 is located. All the modules are secured by a locking device.

The use of the slots for the FCDMs are in both helicopters the same. The other two slots are of a different use.

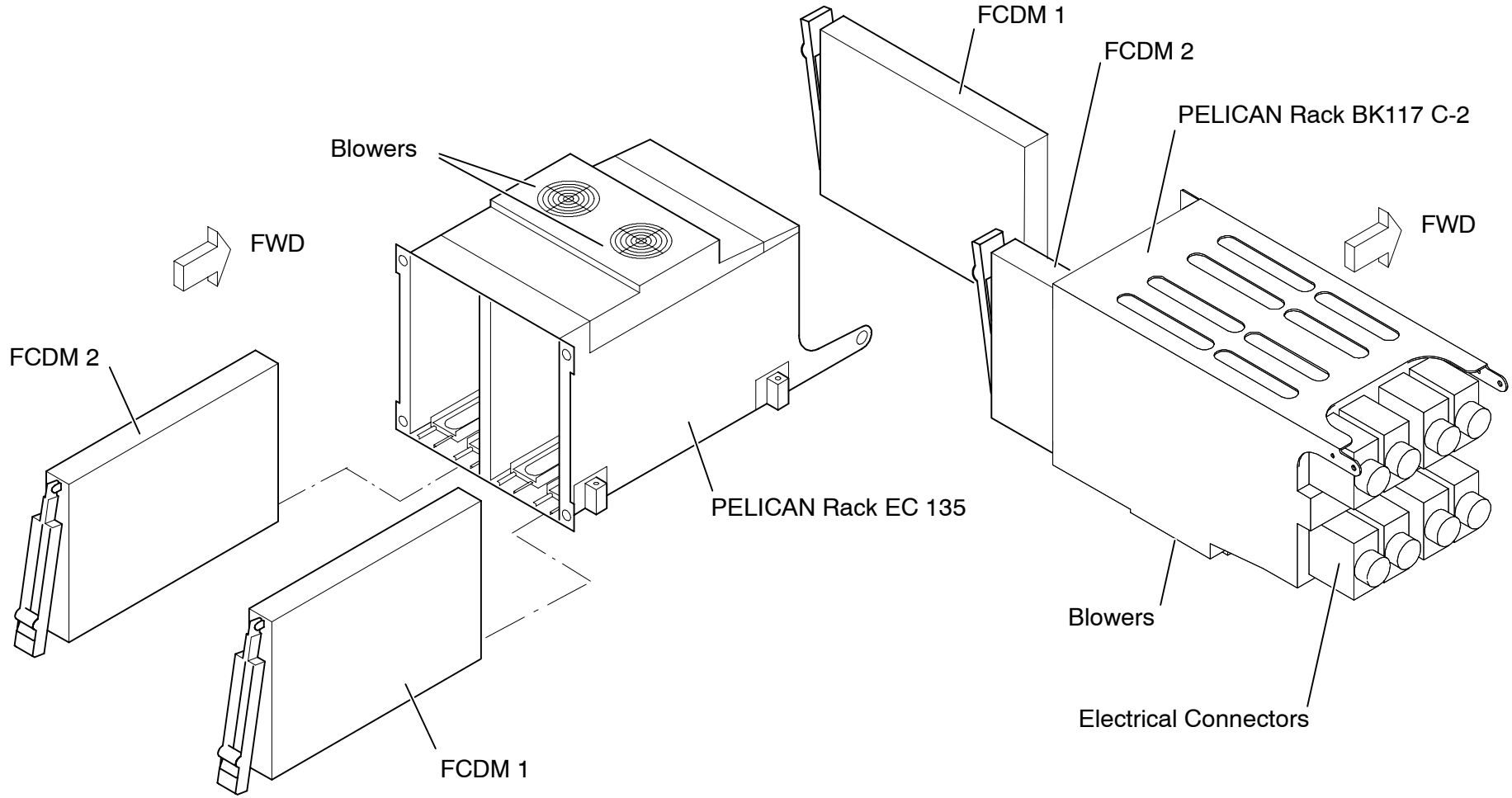
Installation Location EC 135

The PELICAN rack is attached on the avionics deck, aft of the passenger cabin.

Installation Location BK117 C-2

The PELICAN rack is mounted below the aft cabin floor board and is vented via a separate air intake.

PELICAN Rack



SMD 45H

The SMD 45 H is a “smart” multifunctional color display that was purpose-designed for helicopters. By means of its high resolution 4” x 5”-Active Matrix Liquid Crystal Display (AMLCD) there is an excellent legibility under all illumination conditions. Additionally a switch-over to a NVG mode is possible.

The SMD 45 H comprises in a line replacement unit all the functions as an interface, the data processing and the generation of graphics. If the weather radar is displayed an overlay with symbols is possible.

SMD 68H

The SMD 68 display unit is an Active Matrix Liquid Crystal Display (AMLCD) too. It has the dimension of 6” x 8”.

The embedded generation of graphics allows the display of PFD and ND on the same screen. This display can be switched-over to a NVG mode, too.

A course indication in the PFD (Composite Mode) is not possible.

The SMD 68 is able to display several formats of pictures. This allows the display of a digital map in the full-size screen. A provision for a terrain avoidance system is built-in (without overlay of pictures).

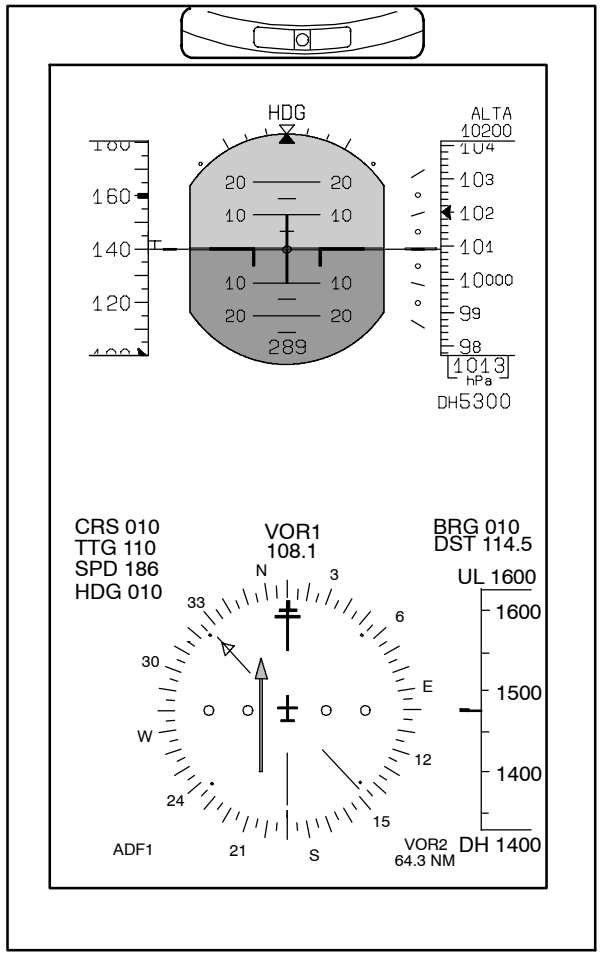
FCDS Color Logic

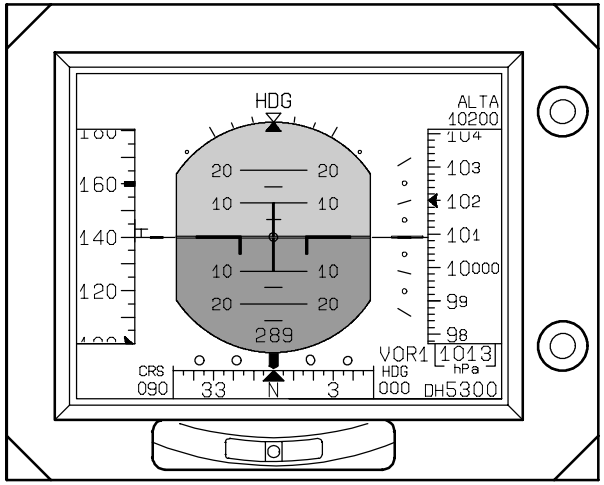
The following color logic is used for the FCDS:

- Yellow: References, markers for reading
- White: Lines, speed, altitude, numbers of degree
- Cyan: Nav data (CRS included)
- Green: Nav data with autopilot engaged
- Amber: Cautions
- Red: Warnings
- Magenta: Correct ILS mode
- Brown: DH, UL bars; 500 ft before DH line

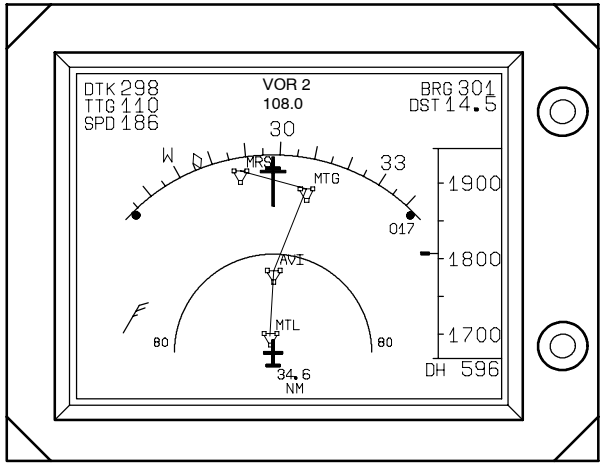
SMD 68 H, SMD 45 H

SMD 68 H





SMD 45 H
Primary
Flight Display



SMD 45 H
Navigation
Display

Primary Flight Display

PFD Symbolism

The PFD displays the following parameter:

- Attitude
- Airspeed
- Airspeed tendency
- Altitude
- Pressure setting
- Vertical speed
- AFCS informations (option)

Attitude

Each line in the roll axis means 10° bank, the dot symbolises 45°. In the pitch axis, each line symbolises 5° nose up or down, digital number is displayed.

Airspeed

The airspeed is displayed in knots with a graduation every 5 knots. The yellow lubber line shows 150 knots in this example, the V_{NE} is symbolised by a red bar.

Airspeed Tendency

This indicator gives the airspeed predicted to be reached after 5 seconds if the acceleration remains constant.

Altitude

Barometric altitude, data comes from the ADCs.

Pressure Setting

Baro pressure setting is done with a separate knob on the ICP (example 1010 hPa).

Vertical Speed

An analog scale with a white bar is given between +/-2000 ft/min with a mark every 500 ft/min, together with a digital value. The display figure is associated to 100 ft/min, e.g. “3” equals 300 ft/min.

Above +/-2300 ft/min only thr digital numbers will change.

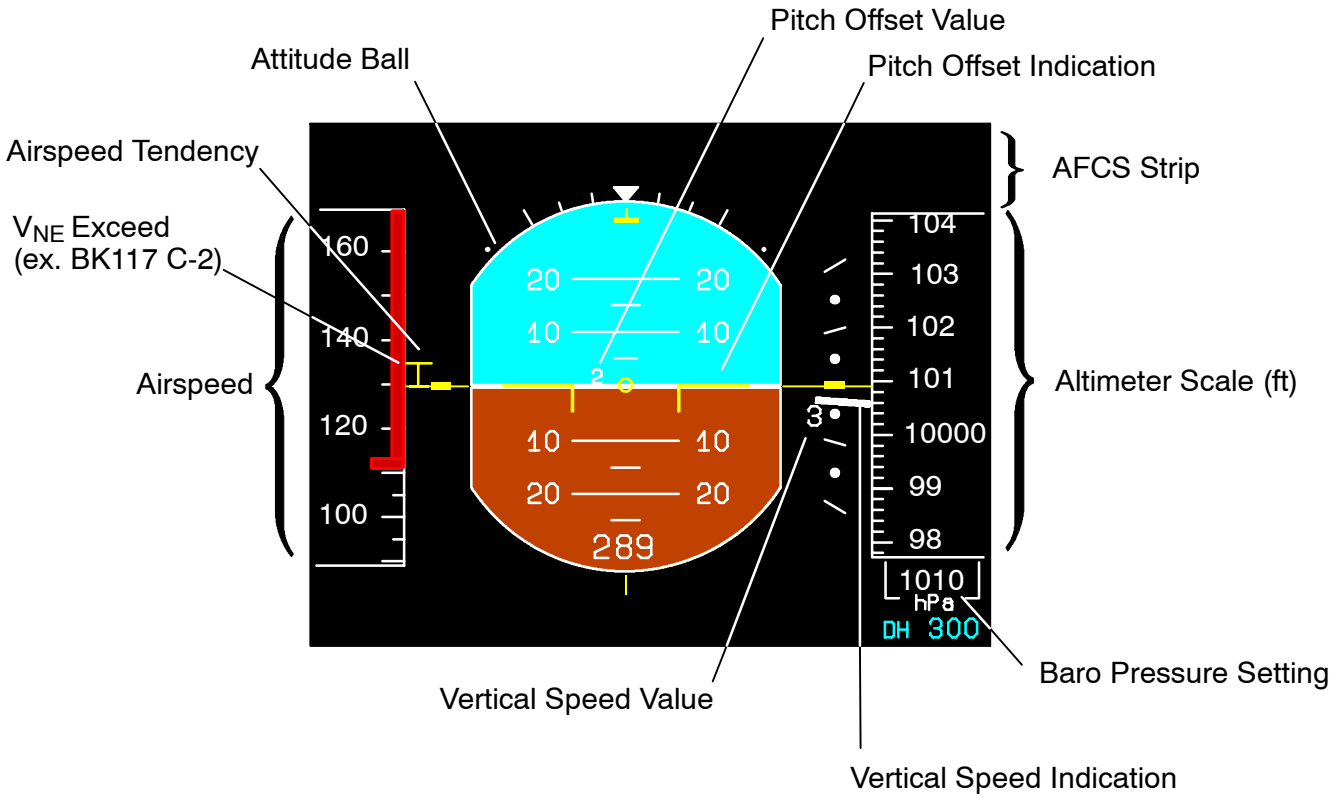
AFCS Informations

If an autopilot system is installed, information about the selected or pre-selected upper modes are displayed on the PFD (e.g. IAS, HDG, LOC...)

Radar Height Indication on PFD

The radar altimeter information will be shown automatically at the PFD in the bottom part of the artificial horizon. The time of appearance depends on a control law which is described at the chapter Navigation Display.

PFD - Normal Mode



Composite Mode

In case the ND is used to display WX/FLIR/Moving Map pictures or is switched off due to a failure the pilot/copilot has the possibility to display the navigation data by selecting a composite mode.

By pressing the PFD button on the ICP a part of the lower navigation display (ND) will be shown as a heading tape below the artificial horizon of the PFD.

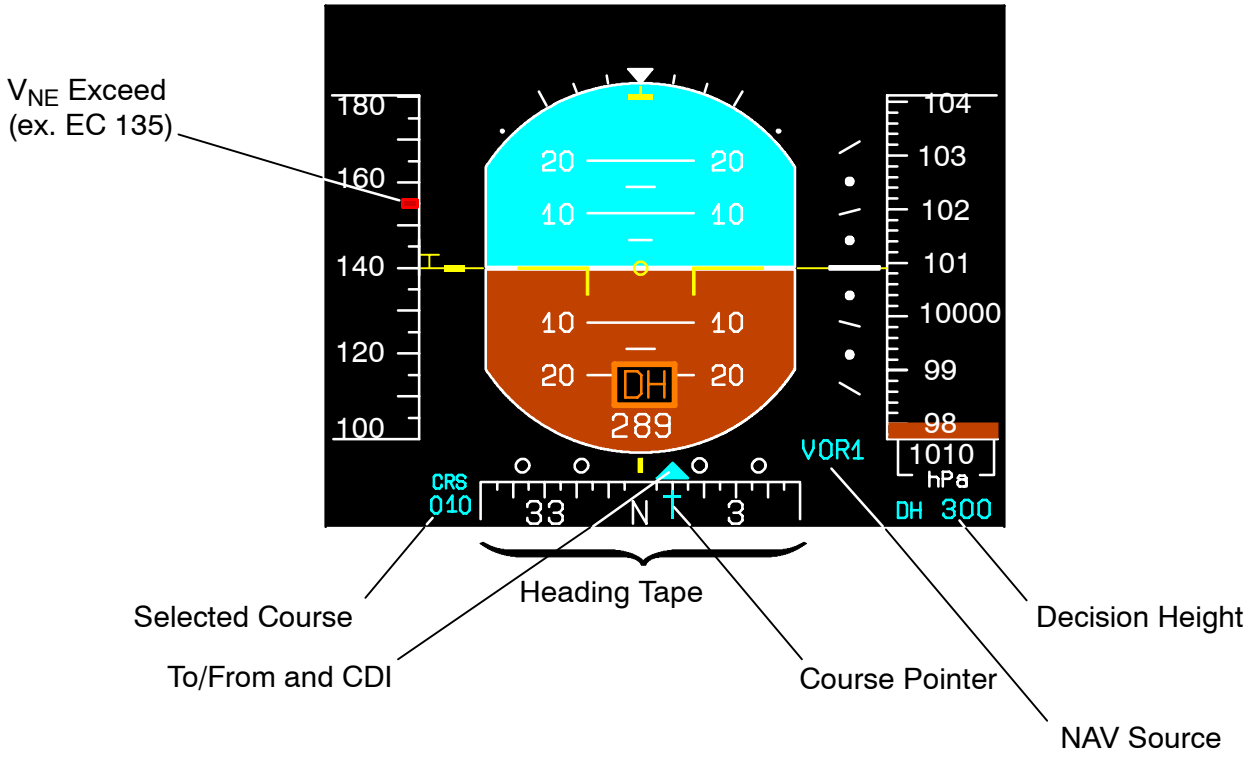
The heading tape comprises a section of 90° from the ND. This section is marked by yellow dots in the ND.

In this mode the following is displayed additionally to the PFD:

- Heading
- ILS
- Course
- Deviation
- NAV-Source

◆ **NOTE** **With a SMD 68 display, there is no VOR composite mode available.**

PFD Composite - VOR Symbolism



Page ILS (Normal ILS Philosophy)

The page ILS appears after the selection ILS. The following informations are displayed:

- Glide slope
- Localizer
- Cross side heading tape
- Marker indication
- ILS source

The page ILS will appear on the PFD as a backup information from the opposite navigation source after the selection of an ILS frequency.

If the NAV source ILS is selected, the information is automatically transferred to the PFD of the other system via a cross line talk. It is displayed on the part below the artificial horizon and is called Cross Side Heading Tape.

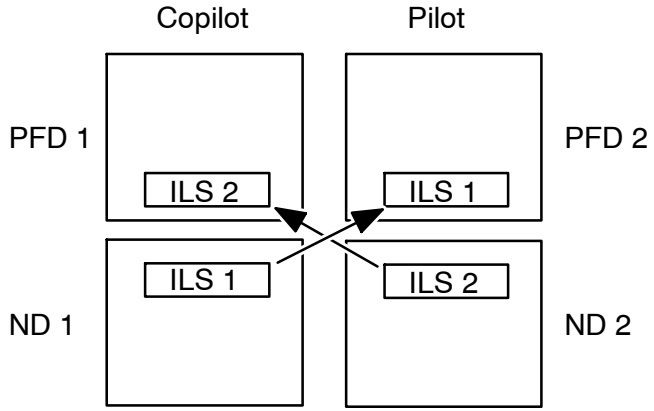
This is helpful especially for SPIFR, because the pilot is able to see the informations of both ILS systems on one single screen (PFD).

Marker indication (OM= Outer Marker, MM= Middle Marker).

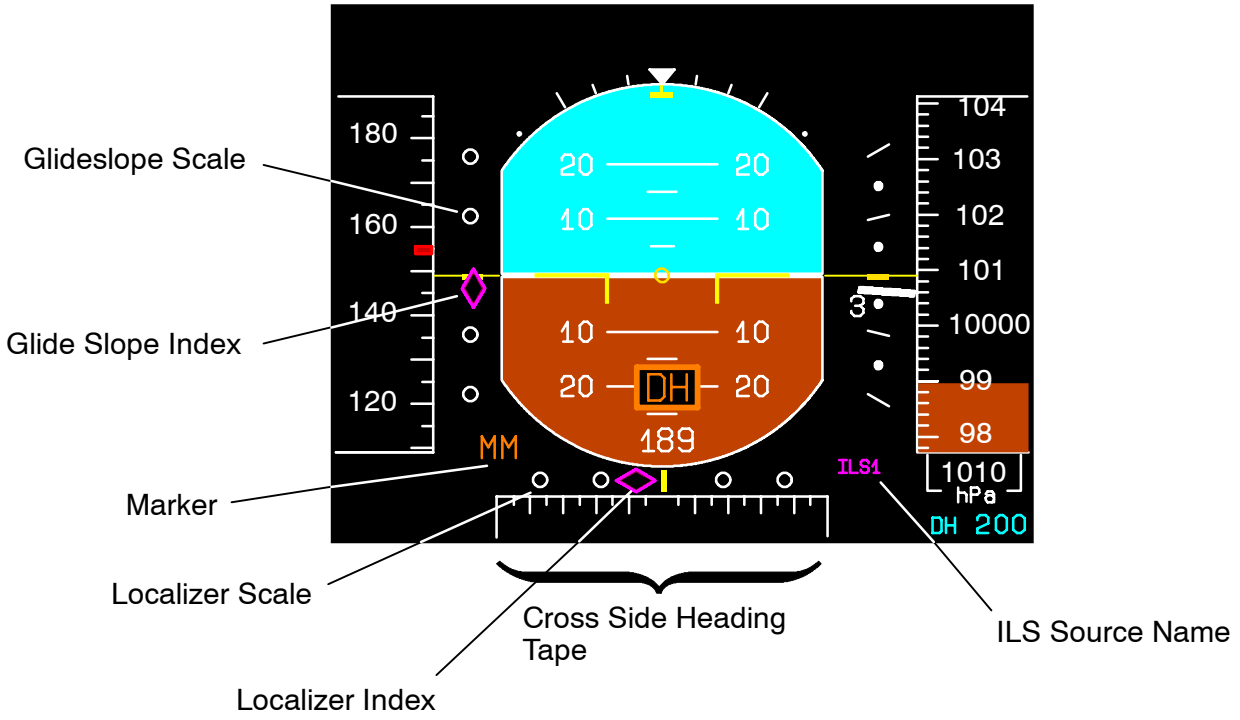
◆ **NOTE** **Marker indication on the PFD will only be possible if an ILS frequency is selected.**

◆ **NOTE** **A separate marker receiver, which contains the indicator, is installed in combination with Garmin 430 only.**

Cross Side Heading Tape



PFD Composite - ILS Symbology



Navigation Display

NAV Symbology

The ND shows all the information necessary for navigation:

- Compass rose
- Course pointer (cyan)
- Single and double pointer (white)
- Navigation source (e.g. VOR 2 108.0 MHz)
- DME information (time to go, ground speed, distance)
- Digital values of course
- Heading and bearing.
- GPS track
- Wind indication (with GPS only)
- Radar height
- Decision height
- Upper limit (option)

The radar height is shown on the right side together with the RA decision height (DH) and the upper limit (UL) (which may be found on the PFD, working then with barometric pressure). These limits are also marked by a brown bar from the respective side. Additionally 500 feet before DH, a horizontal line appears.

With GPS installed also a wind indication and the actual track is displayed.

In case of a GPS System Garmin 430, the wind indication will only be displayed if “direct to” or an active flight plan is selected.

Decision Height (DH)

The selected decision height value is shown below the radar altimeter scale. The decision height is connected to the radar altimeter. A brown bar indicates the selected DH graphically. If the helicopter drops below the decision height, the letters DH appear on the PFD (brown part of the artificial horizon), together with an audio- tone.

Additionally, a “pre-warning” appears 500 ft before the selected decision height.

Upper Limit (UL)

Optionally, the system can be equipped with an upper limit, which indicates that the helicopter has passed a selected altitude from below. The upper limit is typically connected to the barometric pressure and is indicated at the PFD. Optional, the UL may be connected to the radar altimeter system and can operate up to radar altimeter range 2500 ft.

Radar Altimeter Indication

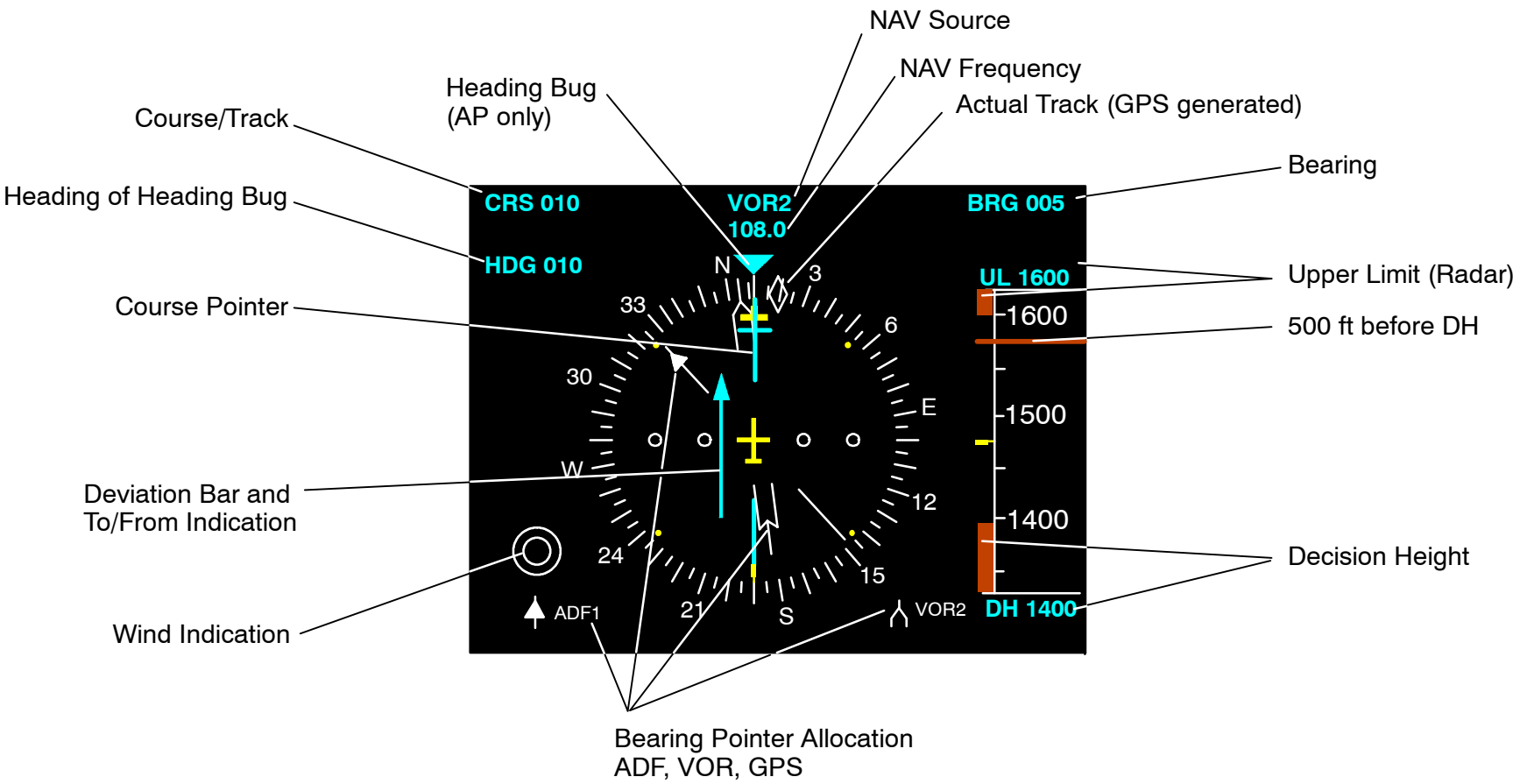
The radar height is displayed at the right side of the ND with a range up to 2500 ft. Above this altitude, the numeric scale disappears.

Additionally the radar height is indicated digitally at the PFD at the bottom part of the artificial horizon.

The following condition (simplified) triggers the digital indication of the radar altitude:

Radar altitude indication at PFD= decision height + 500 ft.

NAV Symbology



ND NAV Symbology DME Hold

The DME transceiver calculates the distance, the speed ("DME-speed"), the time to go (TTG) and the distance (DST). All this information is shown in cyan.

As soon as the DME hold button is depressed, the NAV receiver can be switched to a different frequency and the HOLD information is shown in white colour.

The picture shows a 112.15 MHz DME frequency set to hold, indicated by a white "H" in front of the frequency, the TTG, SPD, and DST. The new VOR frequency 108.80 MHz is shown in cyan, together with the BRG.

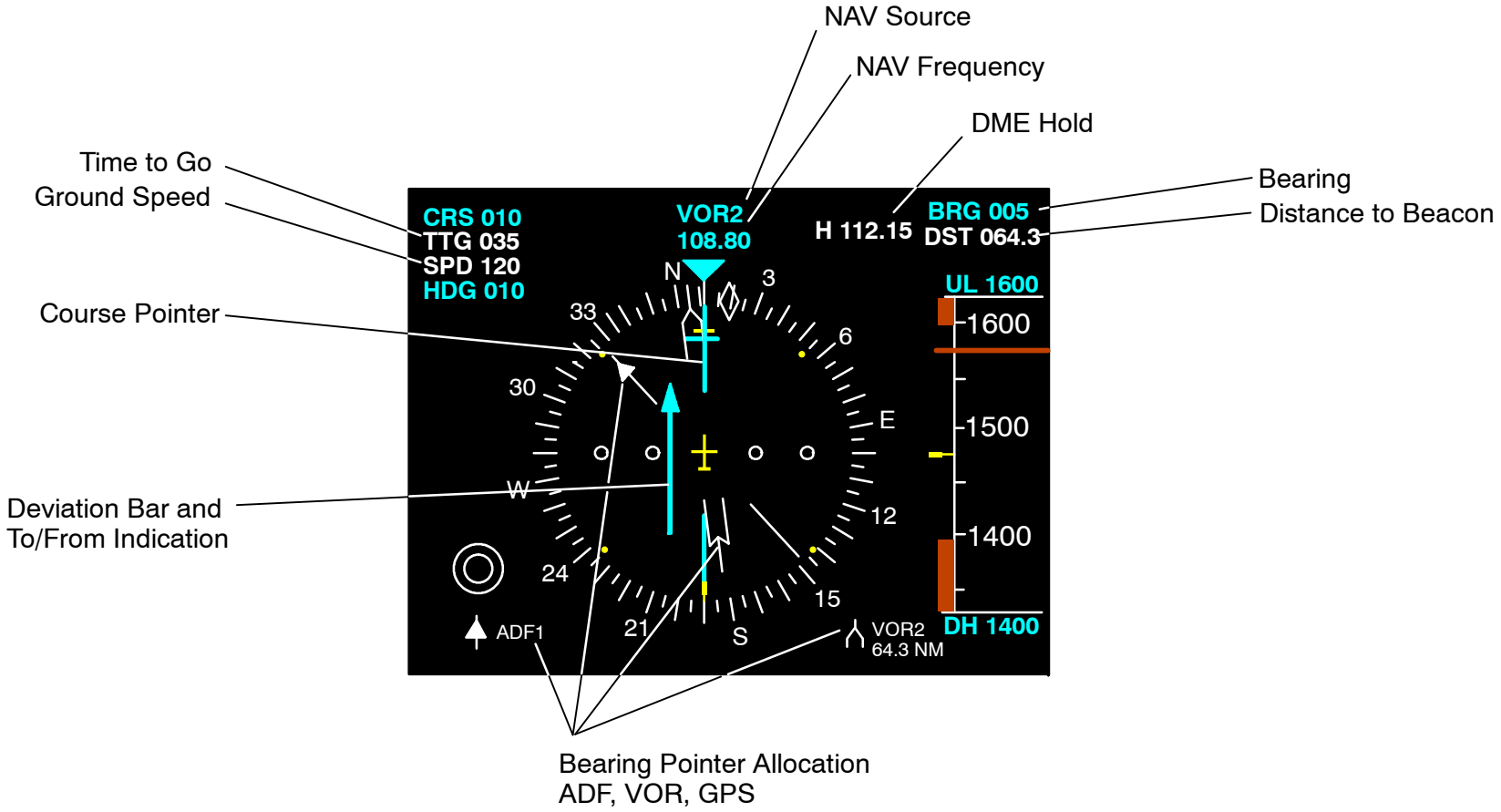
Depending on the helicopters equipment, DME HOLD is additionally indicated

- at the instrument panel (DME HOLD ON)
- on the NMS (NAV page)

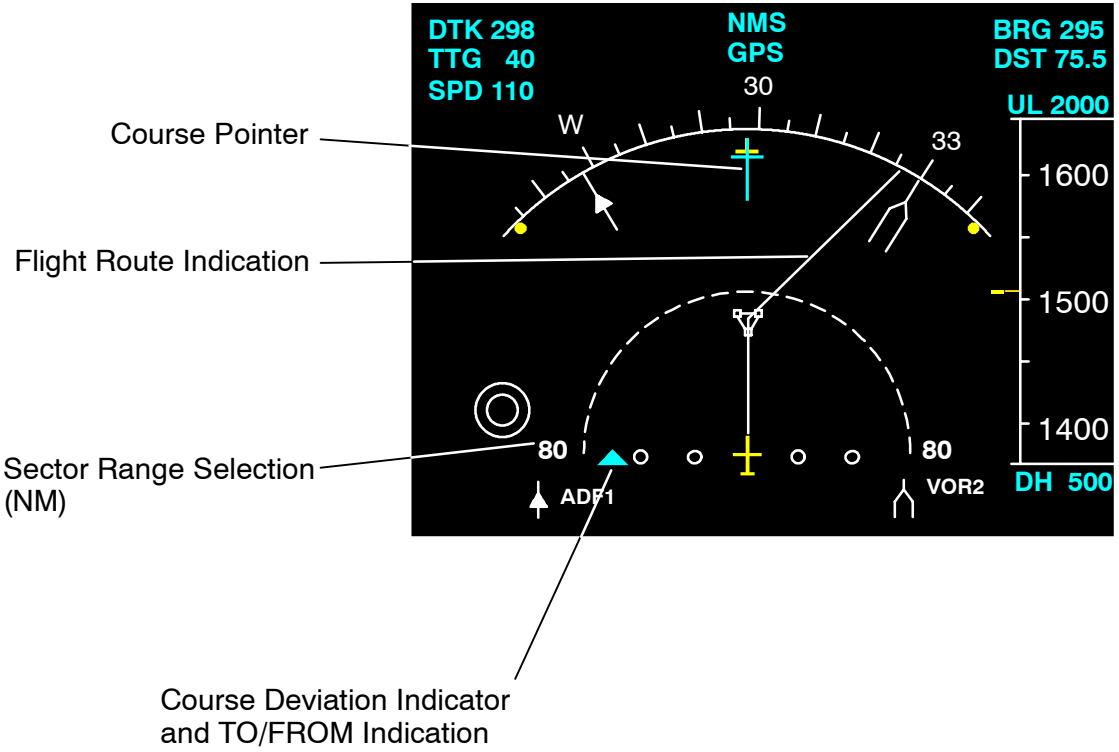
Pilot and copilot may select DME HOLD on NAV2 and on NAV1 with different frequencies for navigation purposes.

◆ **NOTE** **If NMS is selected as NAV SOURCE, no DME indication is displayed at the ND.**

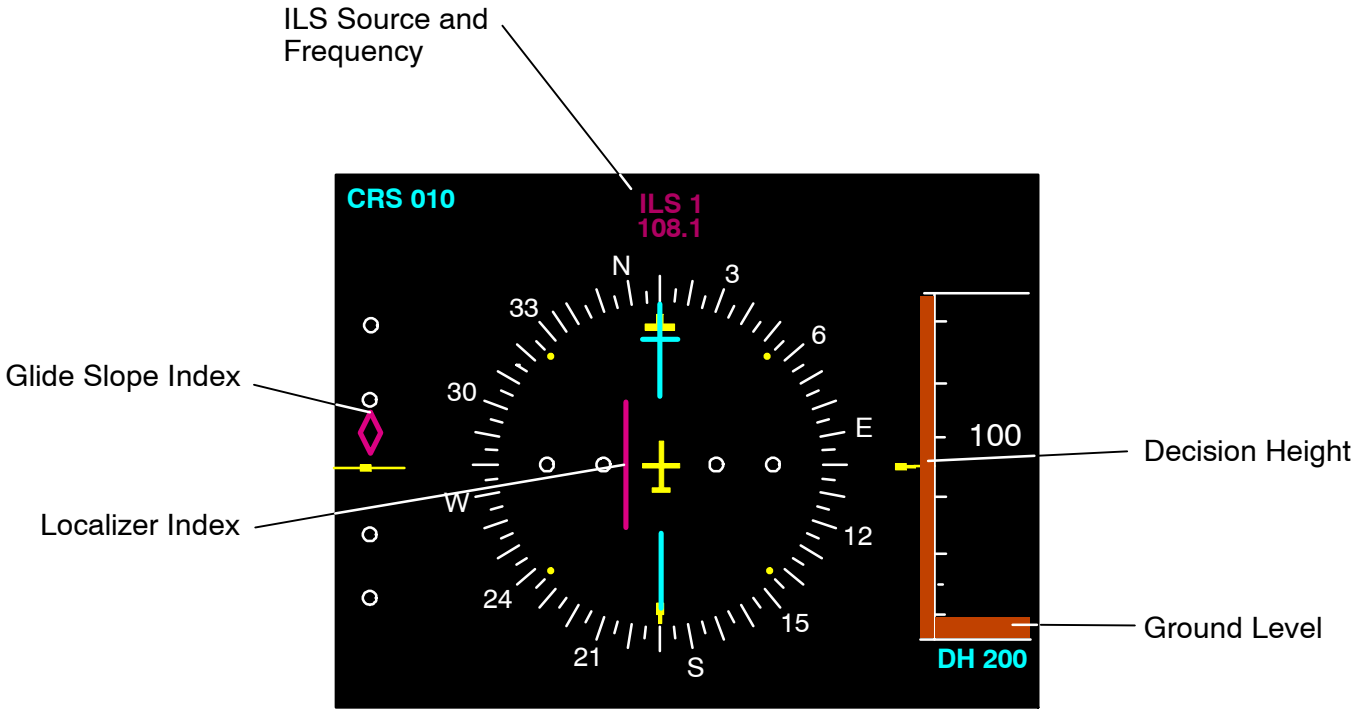
ND NAV Symbology DME Hold



ND - Sector Symbology



ND - ILS Symbology



NAV Color-Logic

Copilot Side (ND1)	Pilot Side (ND2)
ILS1 (amber, because same ILS selected)	ILS1 (amber)
ILS1 (magenta, normal ILS approach)	ILS2 (magenta)
ILS2 (amber, because wrong ILS)	ILS1 (amber)
ILS2 (amber, because same ILS selected)	ILS2 (amber)
ILS2 (amber, because one ILS is missing and wrong VOR)	VOR1 (amber)
ILS1 (amber, because one ILS is missing, VOR 2 is considered normal)	VOR2 (cyan)
VOR1 (cyan, because one ILS is missing, VOR 1 is considered normal)	ILS2 (amber)
VOR1 (amber, because same VOR selected)	VOR1 (amber)
VOR1 (cyan, normal VOR use)	VOR2 (cyan)
VOR2 (amber, because one ILS is missing and wrong VOR)	ILS1 (amber)
VOR2 (amber, because wrong VOR)	VOR1 (amber)
VOR2 (amber, because same VOR selected)	VOR2 (amber)

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Reconfiguration Unit

Reconfiguration of the Main Components

In case of a sensor/module malfunction of one system, the defect sensor/module can be deselected by means of the RCU and the sensor of the other system is used as information source for both systems now. A reconfiguration message in amber appears after the reconfiguration, alerting the pilot which sensor was deselected.

Sensors are AHRS and ADC, modules are FCDM and ICP. MASTER is used for the autopilot.

RCU Functions

The RCU includes the following controls:

- AHRS
  Allows to select which AHRS has to be used for the display on pilot and copilot sides.

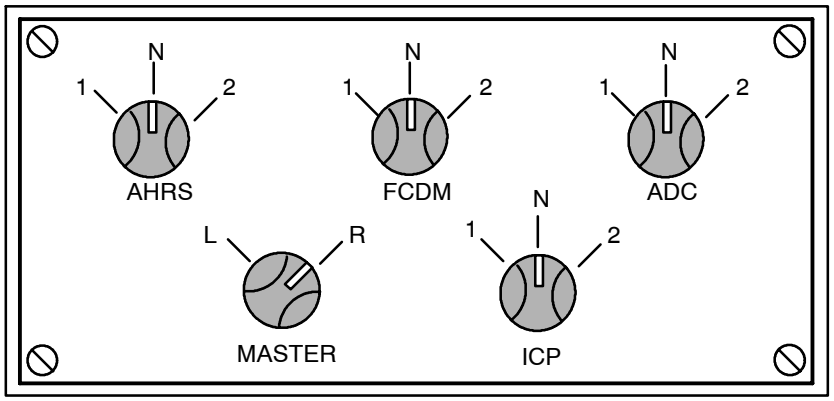
  Position N: Pilot for AHRS 2, copilot for AHRS 1.
  Position 1: Pilot and copilot for AHRS 1.
  Position 2: Pilot and copilot for AHRS 2.
- FCDM
  Allows to select which FCDM has to be used for the display on pilot and copilot sides.

  Position N: Pilot for FCDM 2, copilot for FCDM 1.
  Position 1: Pilot and copilot for FCDM 1.
  Position 2: Pilot and copilot for FCDM 2.
- ADC
  Allows to select which ADC has to be used for the display on pilot and copilot sides.

  Position N: Pilot for ADC 2, copilot for ADC 1.
  Position 1: Pilot and copilot for ADC 1.
  Position 2: Pilot and copilot for ADC 2.
- ICP
  Allows to select which ICP has to be used for the display on pilot and copilot sides.

  Position N: Pilot for ICP 2, copilot for ICP 1.
  Position 1: Pilot and copilot for ICP 1.
  Position 2: Pilot and copilot for ICP 2.
- MASTER
  Allows to select the NAV source for the autopilot. It is indicated with a box on the ND2 (Pilot's side, default) or ND1 (Copilot's side).
  Position L: Copilot for Master Side.
  Position R: Pilot for Master Side.

Reconfiguration Unit (RCU)



PFD/ND - Warnings

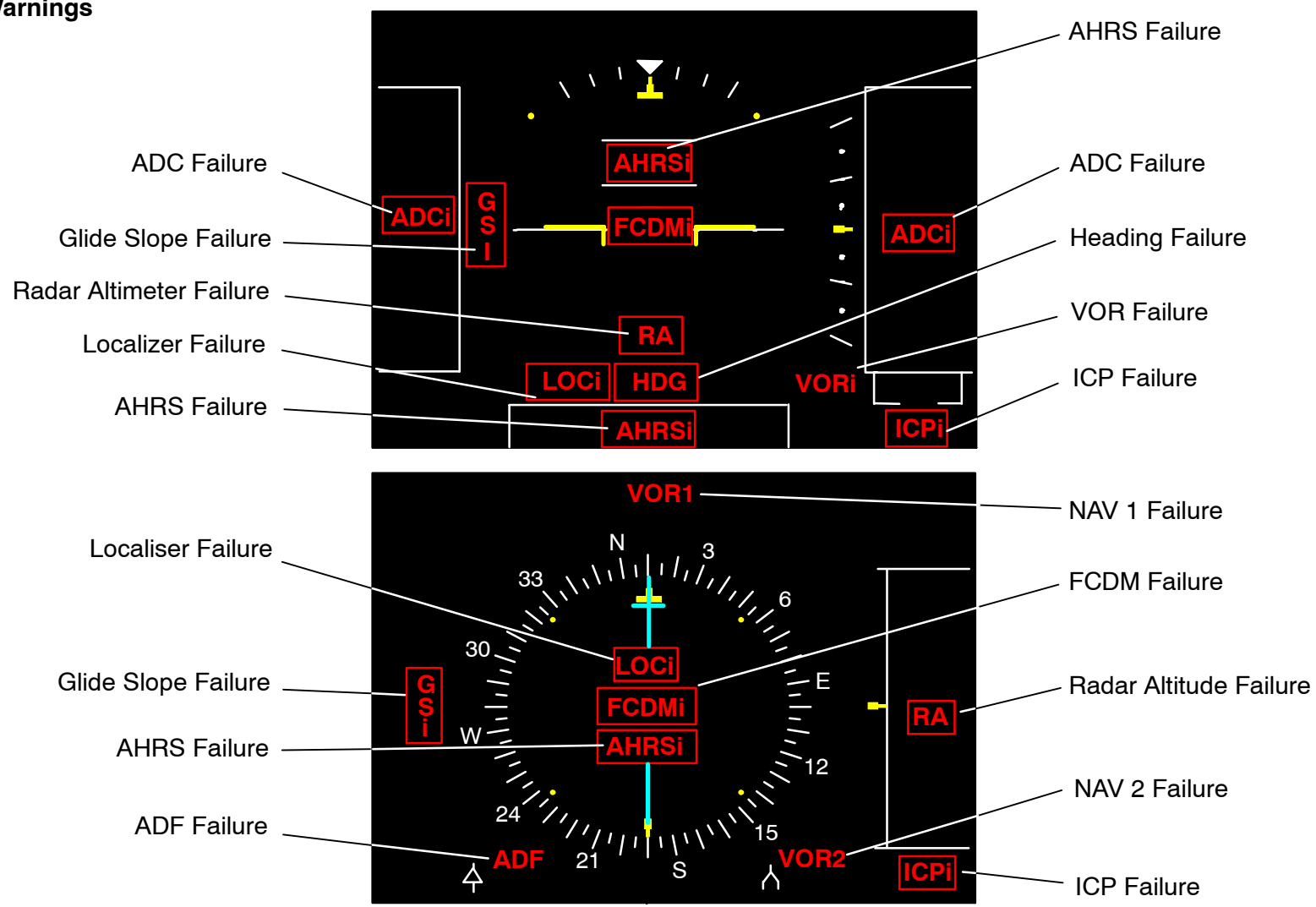
If there is a failure of the equipment or missing data a red warning box appears with a reference to the failed system.

The “i” symbolizes system 1 or 2. A loss of the Air Data Computer 1 will be displayed as ADC 1 (i=1). Consequently the pilot can reconfigure to the other system.

Example: If the AHRS 2 fails, the display will show a red box with AHRS 2 in red. Additionally the artificial horizon disappears due to the loss of its input source and a discrepancy message on the ND appears.

◆ **NOTE** **In case of a failure, the reconfiguration unit RCU is the appropriate means to switch to the other system.**

PFD/ND - Warnings



PFD/ND - Cautions and Discrepancies

Caution messages appear in amber e.g. ALIGNMENT for the AHRS run-up phase. An amber caution CHECK PFD or CHECK ND is displayed if the failed display is clearly identified. An amber caution CHECK SMD is displayed if the failed display cannot be identified.

I there is a discrepancy of the sensors an amber discrepancy arrow comes up on both sides.

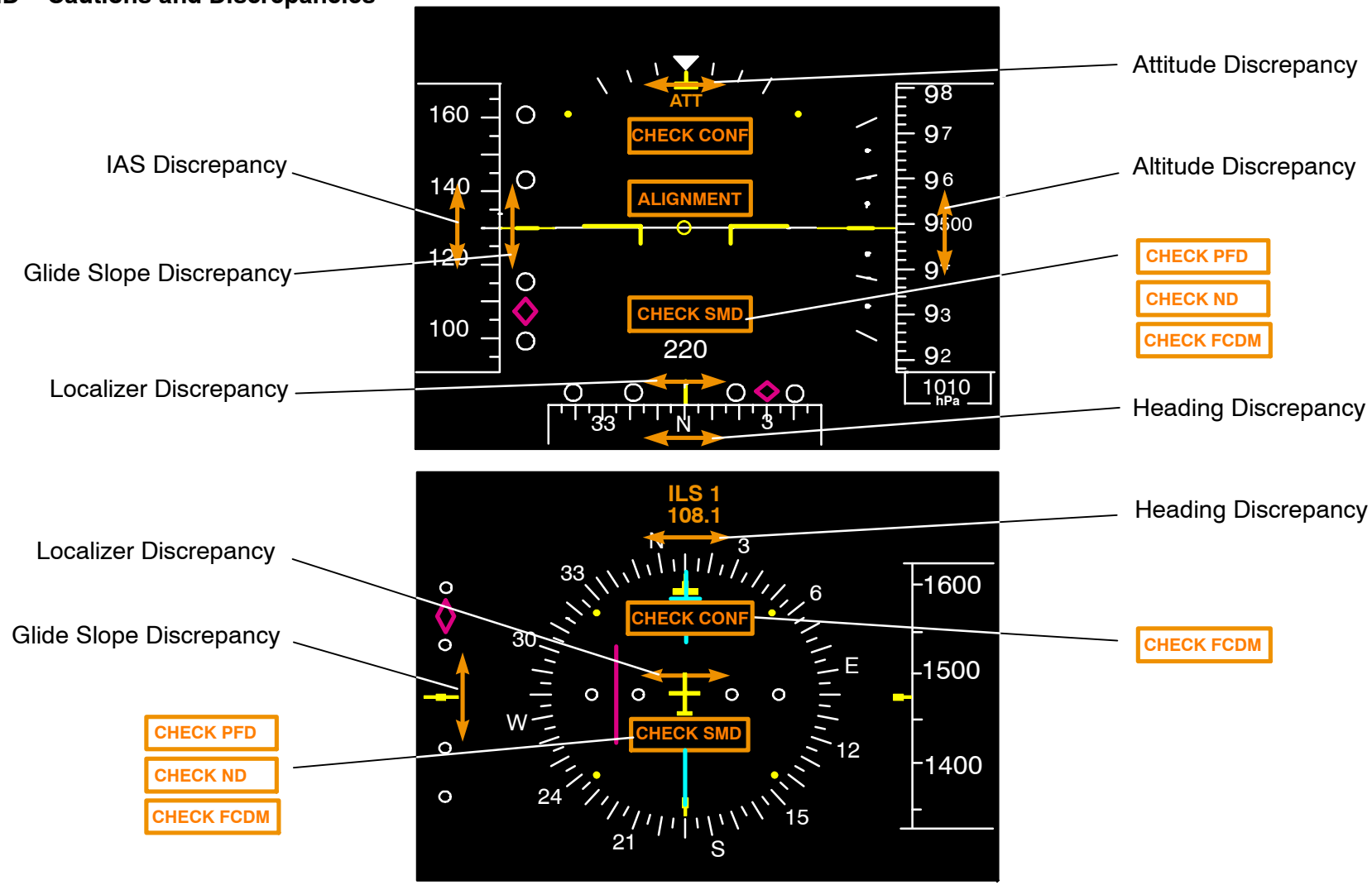
A discrepancy is indicated if the FCDMs detect different data from system 1 and system 2 sensors.

Additionally, a failure of one device (red warning) impliments a discrepancy on the other system.

Additional messages appear in amber: Decision height and upper limit.

◆ **NOTE** **In case of a discrepancy, the reconfiguration unit (RCU) is the appropriate means to switch to the other system.**

PFD/ND - Cautions and Discrepancies



PFD/ND Indication of Warnings and Discrepancies

If there is a failure of the equipment or missing data a red warning box appears with a reference to the failed system.

In case of a redundand system, an amber discrepancy is shown in addition to the red warning.

Example

A defect air data computer is shown in the manual as ADCi. It can be ADC1 or 2, the system determines the failure source automatically (system1 or 2).

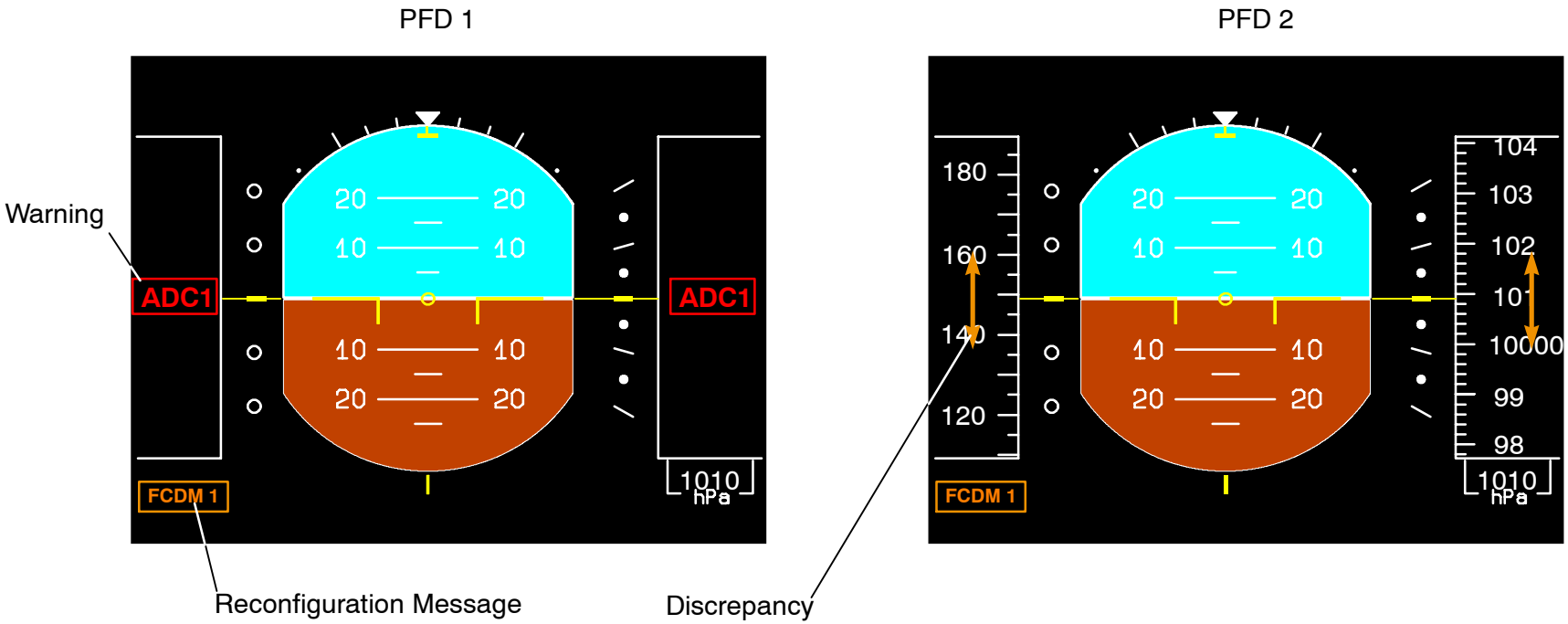
As a consequence, a discrepancy is indicated at the pilot's side (and vice versa) to alert the flight crew. Consequently the pilot can reconfigure to the other system.

If there is (only) a discrepancy of the sensors an amber discrepancy arrow comes up on both sides.

In case of a total black display (e.g. pilot's side) with the red warning FCDM2, a reconfiguration to FCDM1 enables to display all previous information without any limitation.

After the reconfiguration only the deselected sensor is shown in amber and the value of the remaining sensor is shown on both sides.

PFD Warnings and Discrepancies



Reconfiguration

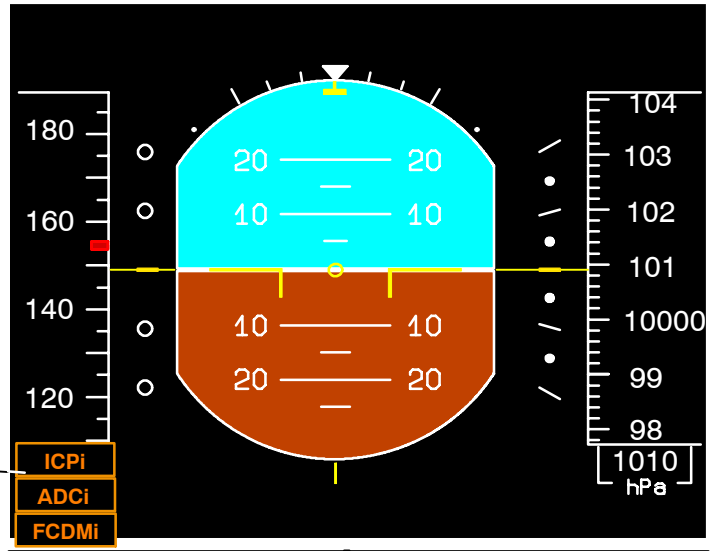
On all displays a message for the reconfiguration appears. This message is in amber and “i” stands for system 1 or 2.

Example: ADC 1 means that ADC 1 is defect (or de- selected) and the information is taken from ADC 2 now.

The message is not the new switch position of the selector on the RCU. It indicates which system is switched off or defect.

The respective warnings and discrepancies disappear and only the reconfiguration message is visible.

PFD/ND - Reconfiguration Messages



Reconfiguration Messages

Reconfiguration Messages

Reconfiguration Messages

Additional Equipment

Attitude and Heading Reference System AHRS

General

The AHRS is a glass fiber optic aided attitude and heading reference system of high accuracy. It measures the attitude, turning rates and acceleration of the helicopter. The attitude detectors have no moving parts and are very precise in their measurements.

Supplement

When the AHRU is removed, the compensation memory module is fixed to the fuselage with a security cord. The module remains to the helicopter until the new AHRU is mounted and takes over the compensation data.

Installation Location

The AHRS are installed under the RH side of the helicopter cabin floor.

Function

Two AHRSs measure the flight attitude for further processing in the autopilot computer and for viewing on the flight displays.

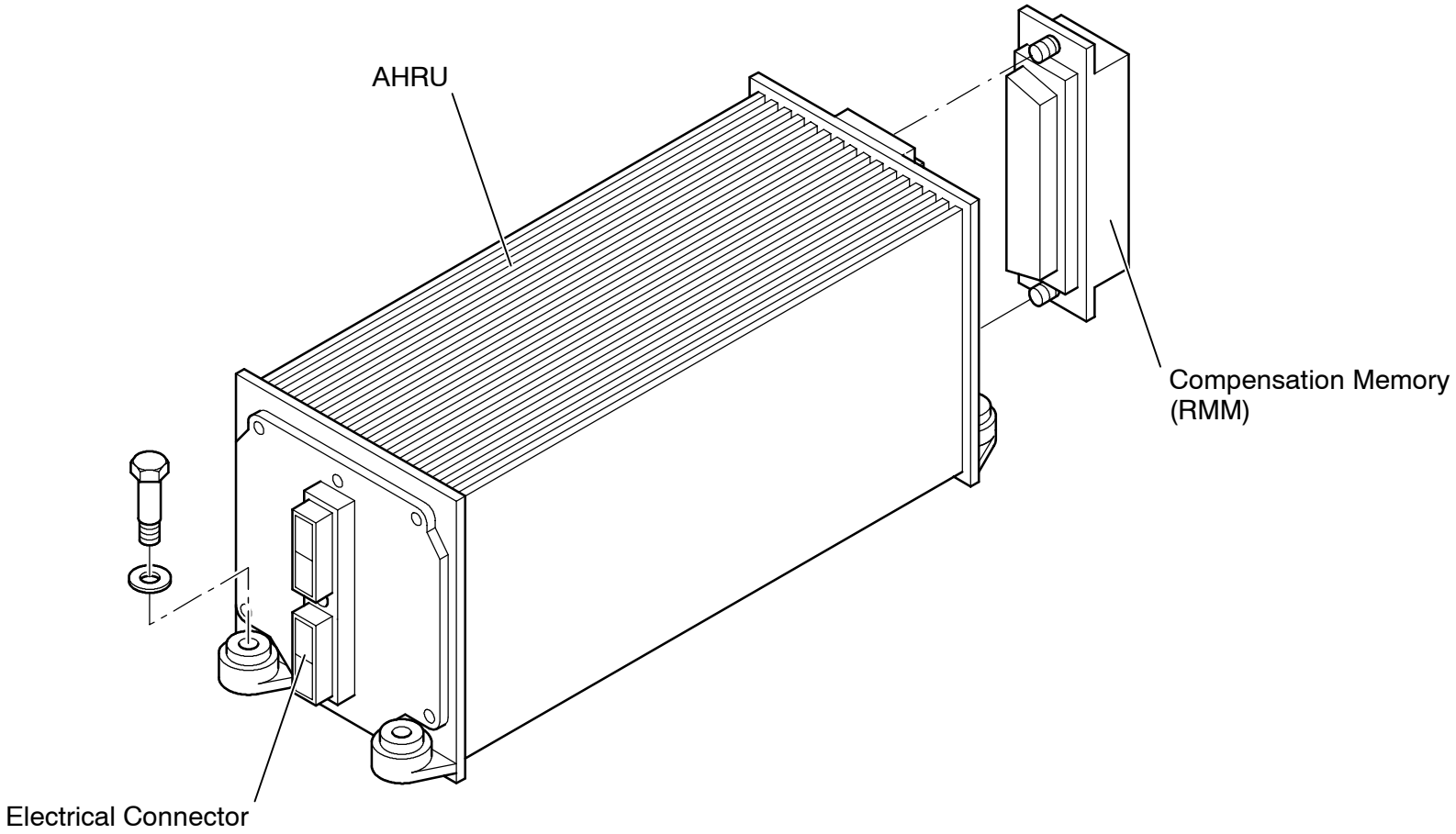
The direction of the earth's magnetic field is measured by the magnetometer and this data is sent to the AHRS inertial unit for calculation of the actual heading. The inertial unit compensates for external influences such as drift and, from the measured turning rates, calculates the helicopter attitude.

Function of the FOG

The functional principle of the FOG is an application of the Sagnac effect, which illustrates a relative phenomenon on the basis of the constant speed of light.

When light is sent into a closed, circularly coiled and rotating light guide, a difference arises between the circulation times against and in the circulation direction. This difference in circulation time is proportional to the rotating speed of the light guide.The closed circuit of the light guide is formed by a fibreglass coil, the dimensions and windings of which are selected in accordance with the required characteristics. A light source with an LED is positioned outside the coils of the light guide.

AHRS (AHRU, RMM)



ADC

The ADU 3000 air data system consists of a temperature sensor TPU and an air data computer. The air data computer provides data of the barometric flight altitude (ALT, QNH/QFE, FL) and the horizontal and vertical speed (IAS, VS). The data from the ADC are transmitted digitally to the AHRS, (AFCS optional) and to the flight display system (FCDM) and are displayed on the PFD. The VS signal is provided by the ADC but computed by the AHRS. That means that you will loose VS indication in case of an AHRS failure.

Location EC 135

The ADC are installed respectively in the LH and RH side channels of the helicopter.

Location BK117 C-2

The ADC 1 is located in the FWD avioncs bay LH side. The ADC 2 is installed in the RH side channel of the helicopter.

Temperature Sensor for ADC

General

Mounted on the forward underside of the EC 135 / BK117 C-2, there is an air temperature sensor for each ADC. The sensors have the effect of compensating the displays for speed, altitude and vertical speed.

The temperature probe contains a platinum sensor covered by a glass tube and is sensitive against mechanical strain. The platinum sensor changes its resistor proportional to the air temperature. Each ADC is equipped with one temperature sensor. The temperature information is used by the ADC and- depending on the helicopter's CPDS-configuration- by the CPDS.

With the help of the ADC temperature sensor, the ADC can calculate true airspeed, computed airspeed (CAS=IAS), baro corrected altitude and vertical speed.

The temperature sensor information from ADC2 is used for the true air speed calculation which is sent to the GPS for calculation of the wind direction.

The correct function of the ADC- temperature sensor can be checked with an ARINC429 test device (e.g. ARINC LABEL 211 and 213, as described in the maintenance manual) or by measuring the resistor over temperature given by a calibration table.

Magnetometer

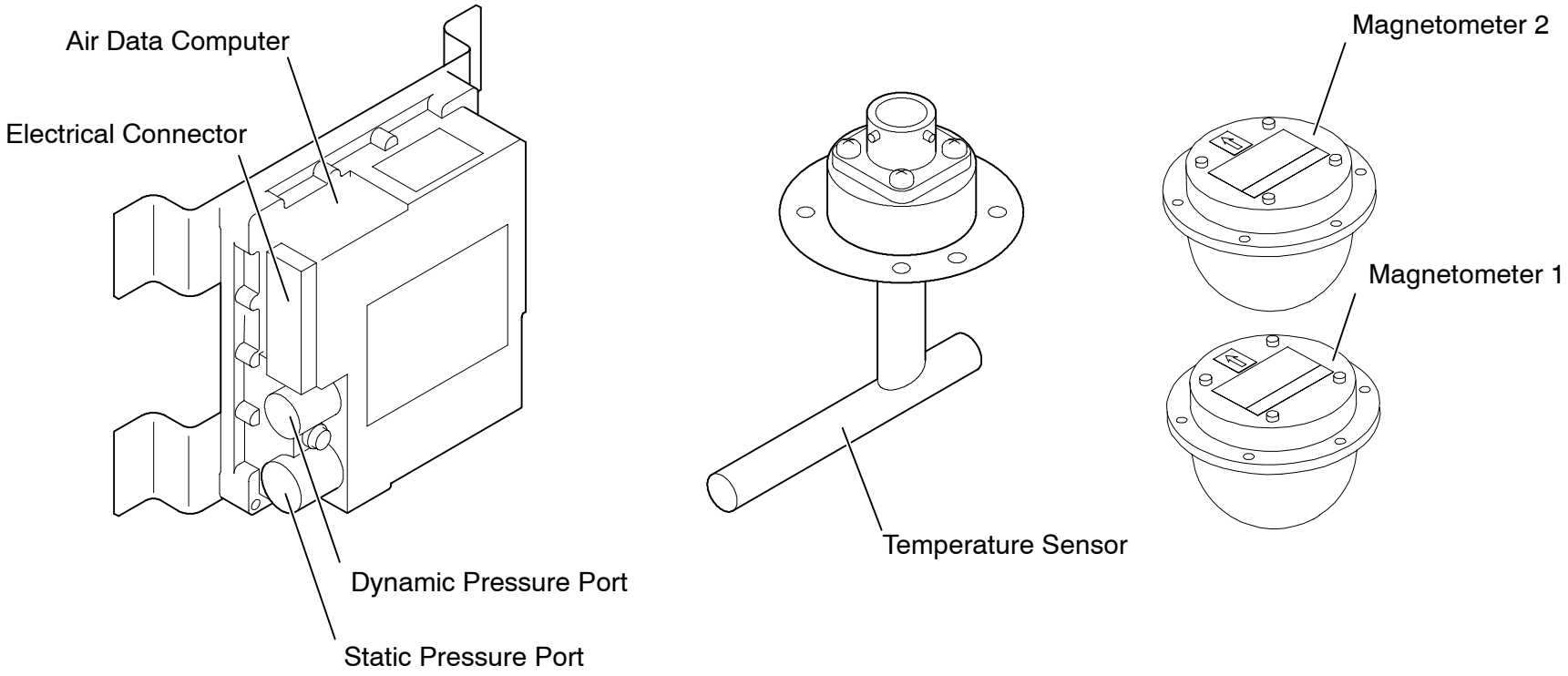
General

The direction of the earth's magnetic field is measured by the two magnetometers and this data are sent to the respective AHRS inertial units for calculation of the actual heading. The inertial unit compensates for external influences such as drift and, from measured turning rates, calculates the helicopter attitude.

Location

Both the magnetometers are installed inside in the middle of the tail boom.

ADC, Temperature Sensor, Magnetometer



Calibration

General

The calibration must be performed e.g. after a change of a major component of the aircraft (main gearbox, engine, horiz. stabilizer, because the influence of the helicopter on the earth's magnetic field has been changed) or of a magnetic sensor.

For this procedure a calibration box is connected to the helicopter and a special test flight has to be performed. Further a fine tuning can be performed on demand (annual check).

Purpose

The AHRS sends signals to the FCDS to display the compass rose and course. To ensure that an angle deviation of the helicopter's course corresponds to the correct value [°], the output signals have to be calibrated. A 360° turn clockwise and counterclockwise must result in the same value. Therefore a ground and flight calibration of the AHRS is necessary. The AHRU uses the RMM to store calibration data.

Location EC 135

To connect the calibration box to the helicopter, there are two sockets installed. They are located at the copilots side in the lower part of the side cover of the slanted console.

The sockets are allocated the following:

AHRS 1	Socket 73 FDA
AHRS 2	Socket 83 FDA

Location BK117 C-2

The two sockets are located at the LH side of the cargo compartment on the connector panel.

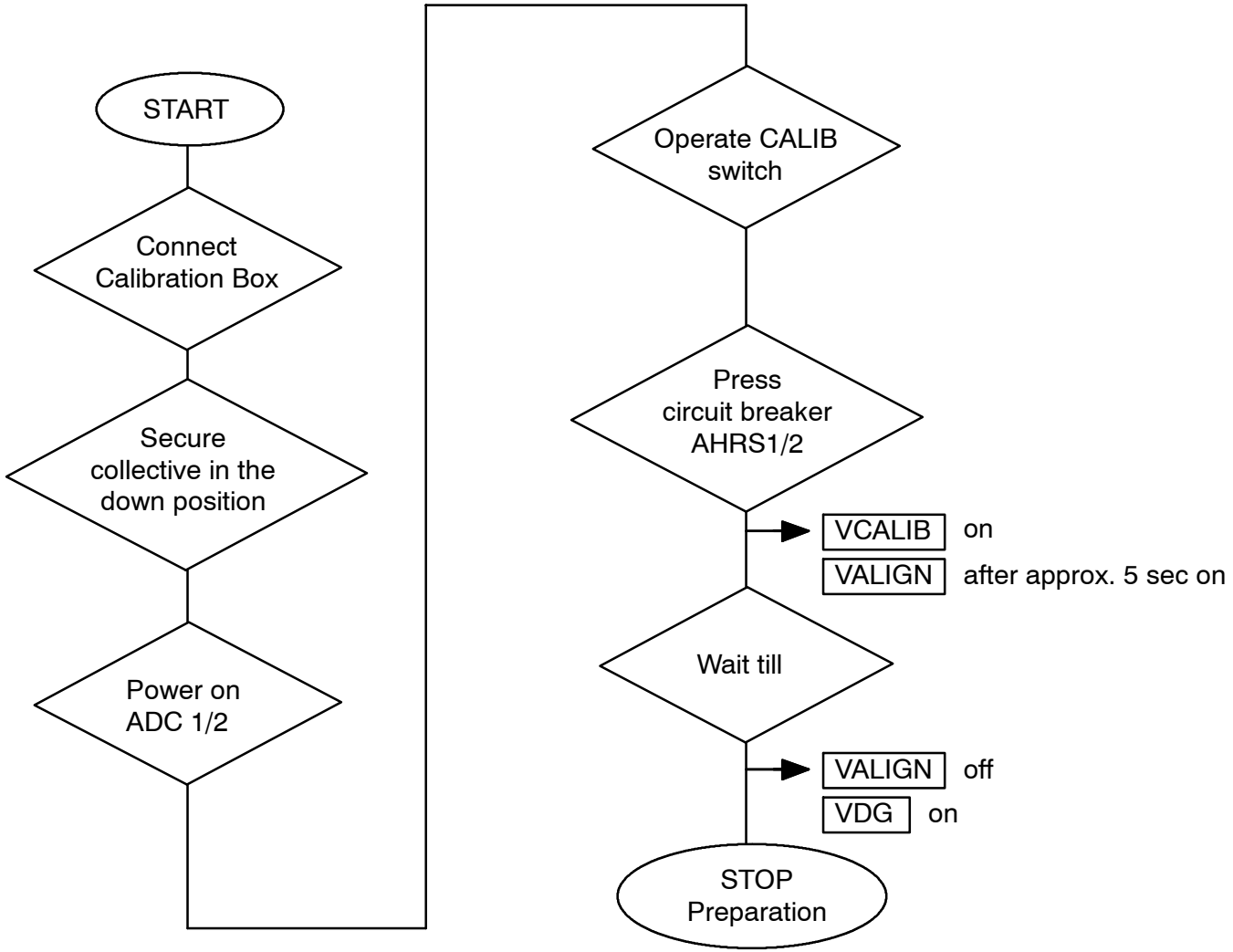
The sockets are allocated the following:

AHRS 1	Socket J75007
AHRS 2	Socket J75107

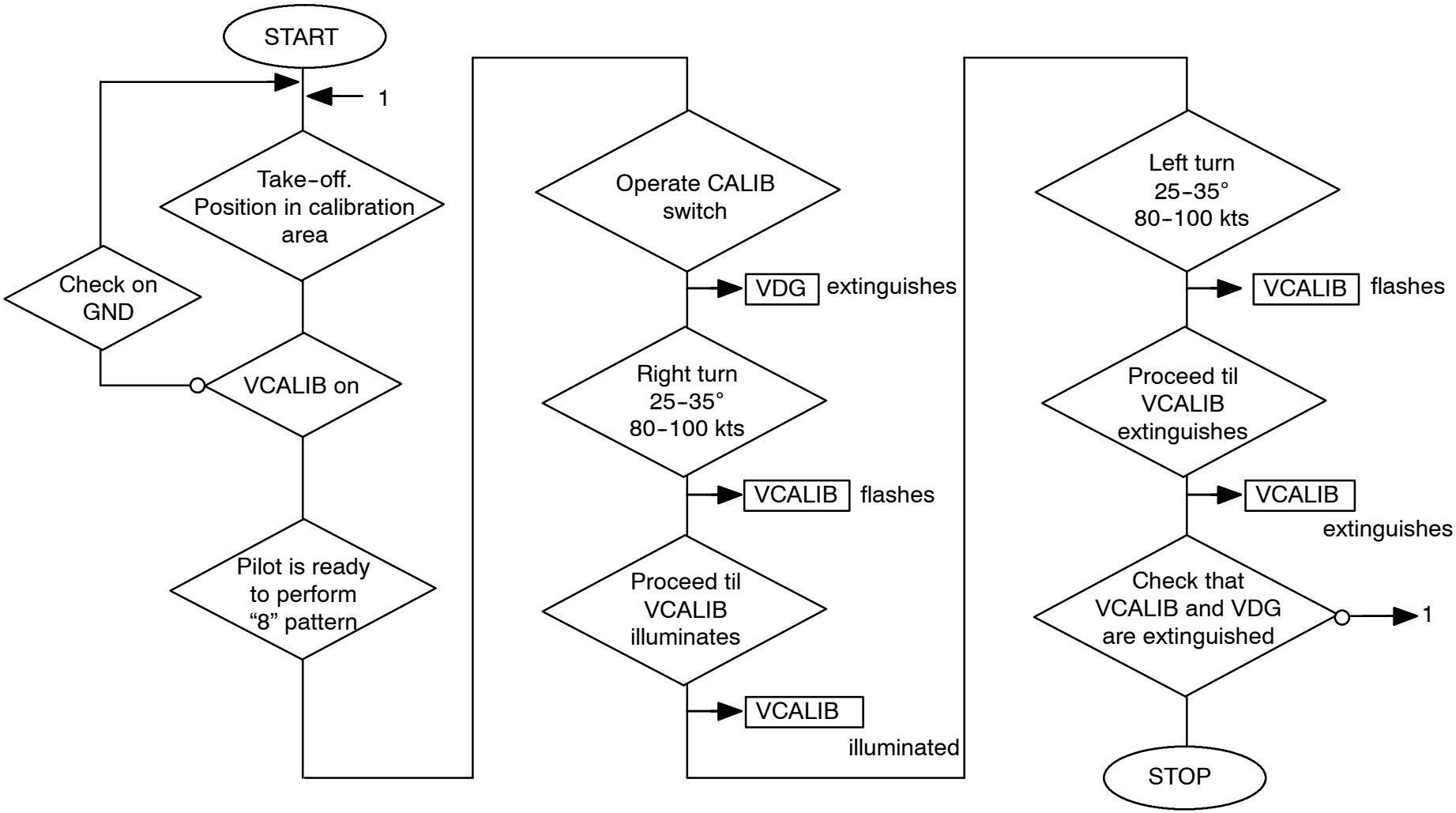
◆ **NOTE** **Start flying the "8" pattern with a right turn.**

◆ **NOTE** **The calibration procedure is aborted when:**
-Collective securing is removed (on ground)
-ADC failure in flight
-Magnetic sensor unit failure
-Flying the "8" pattern takes longer than 4 minutes.

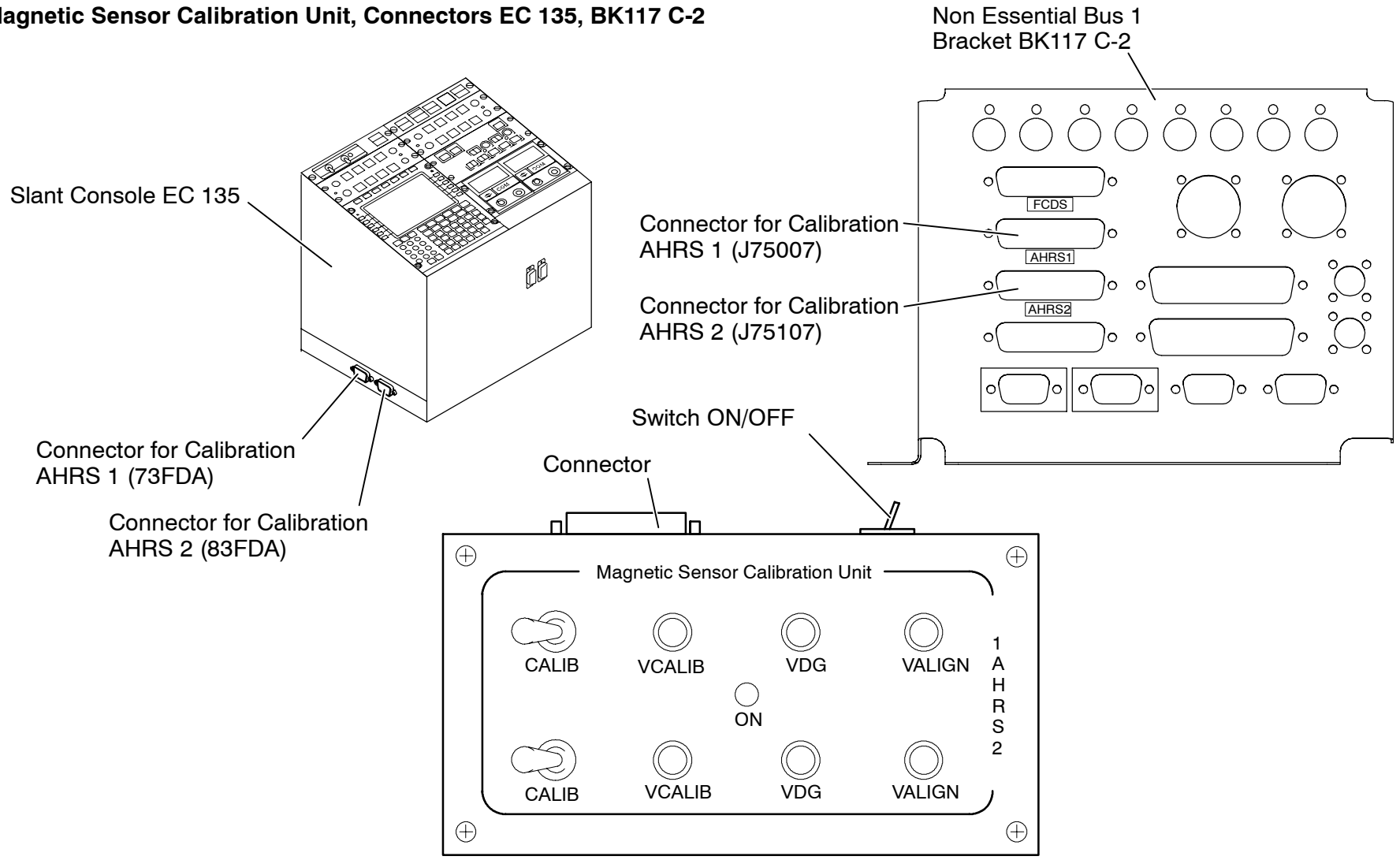
Preparing Calibration Mode of AHRS (On Ground)



Calibration AHRS In Flight



Magnetic Sensor Calibration Unit, Connectors EC 135, BK117 C-2



FCDS Data Transfer Configuration

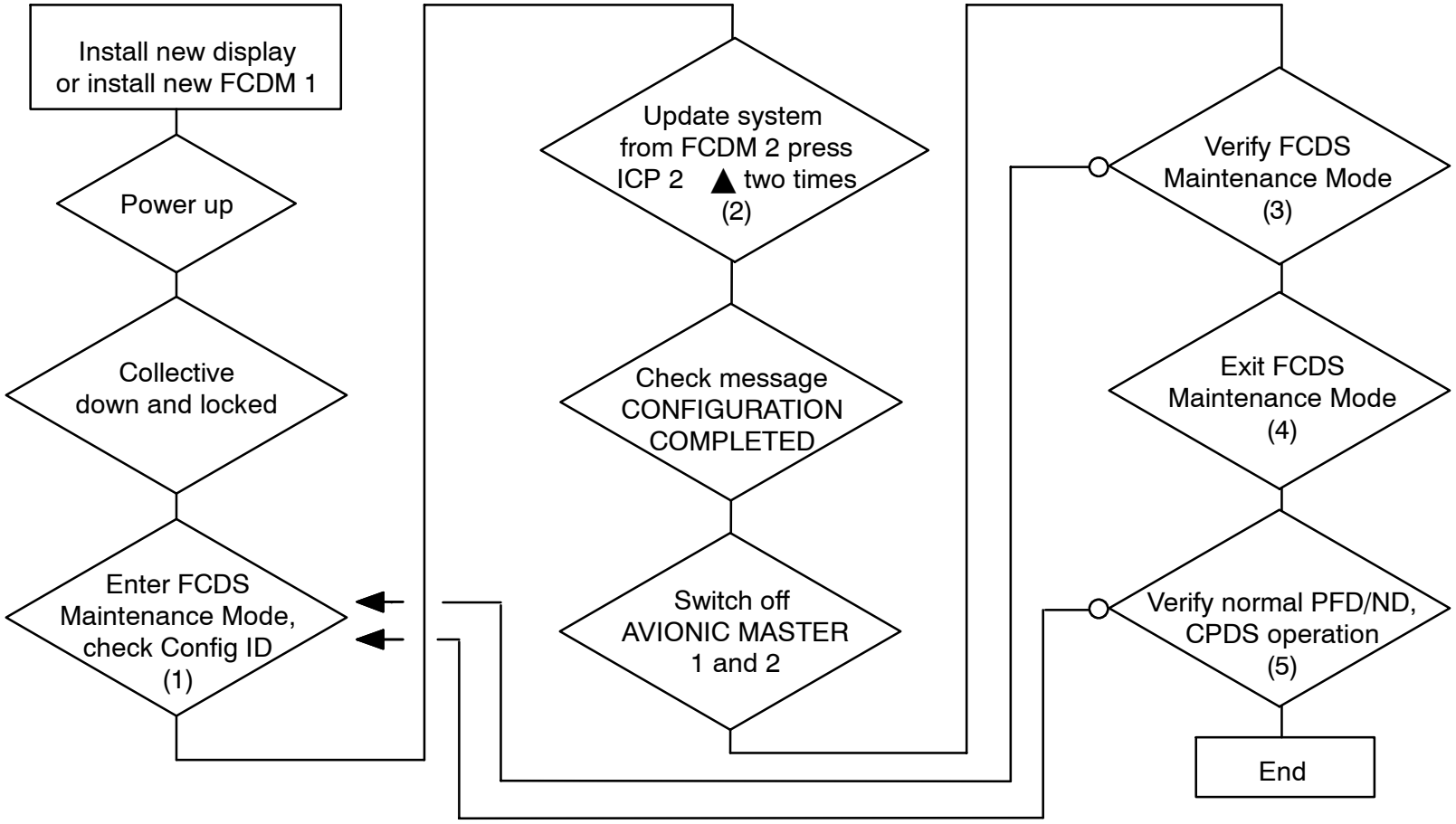
Procedure after "new FCDM installed" or "new display installed"

- RCU: all switches in norm position, MASTER to R
- Install new FCDM on FCDM 1 slot and/ or install new display, see note.
- Power up helicopter and collective lever down and locked.
- Switch ON avionic master 1 and 2 (=activate FCDMs).
- Enter CPDS maintenance mode (4 buttons).
- Check message INCONSISTENT CONFIGURATION
  UPDATE SYSTEM FROM FCDM 2
  WITH ID xxxxxxx
  Y/N PRESS UP/DOWN ON ICP 2
  EXIT: SYSTEM POWER OFF
- Carefully check the configuration ID you are going to upload. If o.k. press UP on ICP 2 (only there!).
- Check message CONFIRM UPDATE, Y/N: PRESS UP/DOWN ON ICP 2.
- Press UP on ICP 2 (only there!) a second time.
- Check message CONFIGURATION IN PROGRESS.
- Wait for data transfer (up to 2min).
- Check message CONFIGURATION COMPLETED.
- Exit FCDS by switching off avionics master 1 and 2.
- Verify successful completion: switch ON avionics master 1 and 2 again and check message CONSISTENT CONFIGURATION.
- Verify display's normal operation mode:
  switch off avionics master 1 and 2, switch VEMD OFF 1 OFF 2;
  switch on VEMD 1 and 2 again, switch on avionics master 1 and 2:
  check the correct display of the operational pages on PFDs and NDs.

◆ **NOTE** **Data transfer is only possible from FCDM 2 to FCDM 1 and/or the displays (PFD, ND).**
If FCDM 2 (master) has to be replaced and the helicopter's installed configuration is still valid, insert the "old" FCDM 1 (which "knows" the correct configuration) on FCDM 2-slot and the new dummy loaded FCDM card on the FCDM 1 slot.

◆ **NOTE** **If a computer is connected to the FCDM maintenance connector and the connection via RS485 is valid, the FCDS displays shows the message SYSTEM SLAVED.**

FCDS Data Transfer Configuration



(1) Enter FCDS Maintenance Mode:

- Switch OFF avionic masters 1 and 2.
- Enter CPDS Maintenance Mode:
  Press OFF 1, OFF 2.
  Press SCROLL and RESET simultaneously, hold.
  Press OFF 1 and OFF 2 simultaneously
  Release keys after message RELEASE KEYS appears.
- switch ON avionics master 1 and 2.

◆ **NOTE** **FCDS Maintenance Mode is an automatic result of the previous selected**
CPDS Maintenance Mode in Ground Mode (=collective down and locked).

(2) Update System from FCDM 2

Follow the instructions of the screen:

- press UP on ICP 2 (only!), the message CONFIRM UPDATE appears [as long as the same identifier reference (=FBLx-software version) is detected], then press UP on ICP 2 a second time:
  CONFIGURATION IN PROCESS appears until it changes to CONFIGURATION COMPLETED (appr. 1-2 min).

This is done automatically if a PC is connected: all data will be transferred to all devices automatically. Check message on PC UPLOAD SUCCESSFUL.

(3) Verification of FCDS Maintenance Mode

- Enter FCDS maintenance mode and check message CONSISTENT CONFIGURATION and COMMON ID XXX.

(4) Exit FCDS Maintenance Mode

Exit FCDS Maintenance Page

- Switch OFF avionic master 1 and 2
  (message: EXIT: SYSTEM POWER OFF).

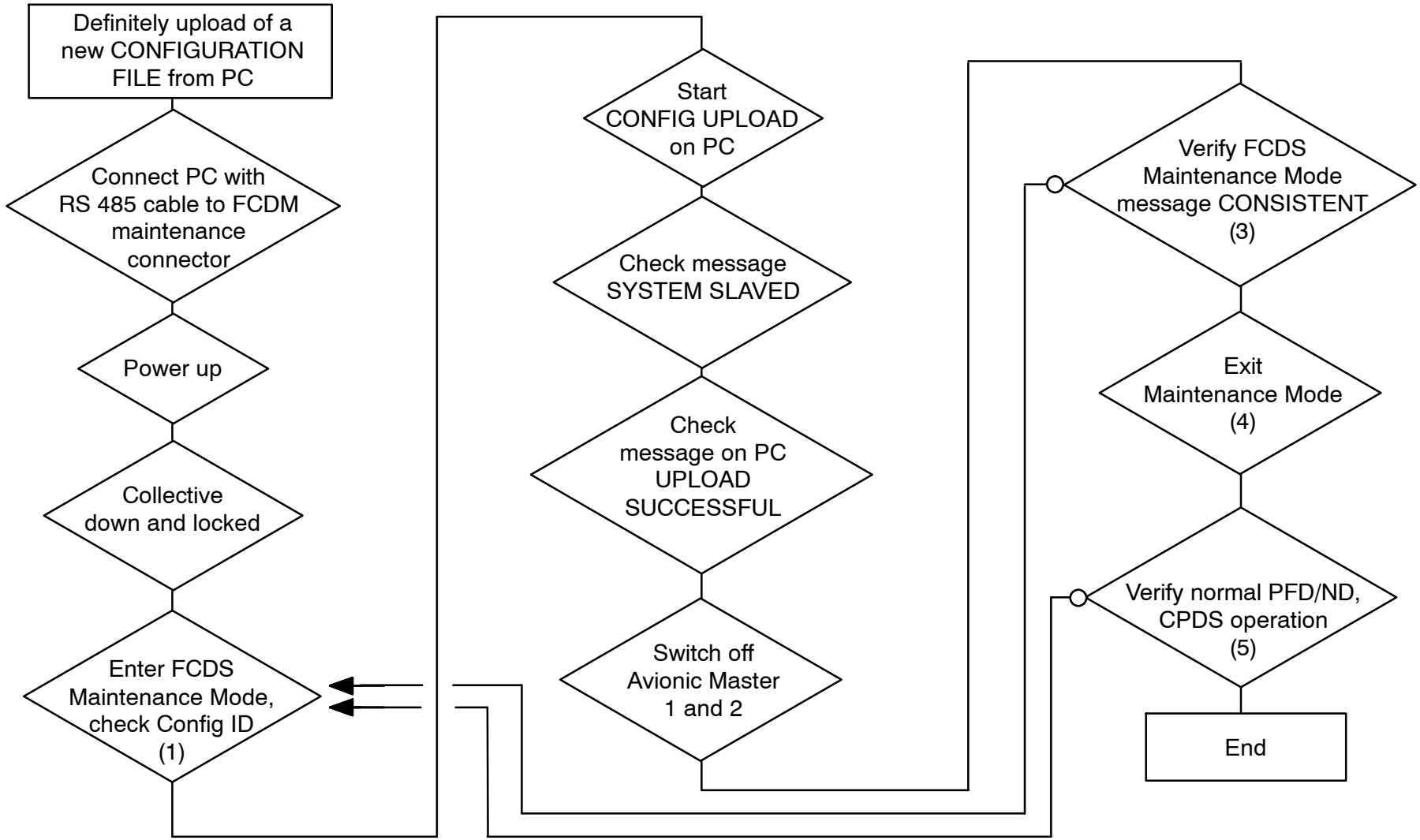
Exit CPDS Maintenance Mode

- switch OFF VEMD 1 and 2.

(5) Verification of Normal Mode

- Check the correct display of the operational pages on PFDs and NDs (CPDS in normal mode, avionics master 1 and 2 ON).

FCDS Data Transfer Configuration



FCDS Possible Failure Messages

MISMATCH	Inconsistent configuration file on the displays/FCDMs	Match configuration on-board (without PC) EC 135: L316xxxx BK117 C-2: B316xxxx
CHECK CONF	Wrong Software Version/ PN (not wrong configuration-file)	Exchange Parts, Install correct PN (e.g. FBL3 and FBL4)
PIN PROG	Hardware Pin Coding not correct. Or first power up not in GROUND MODE	Check pin coding Ensure collective down and locked and restart FCDS.