AIRBUS HELICOPTERS

No. 3983-S-22

SAFETY INFORMATION NOTICE

SUBJECT: AUTO FLIGHT - AFCS (Automatic Flight Control System)

Use of AFCS to mitigate the risk of operation in brownout / whiteout conditions

For the attention of

AIRCRAFT CONCERNED	Version(s)	
	Civil	Military
AS365	N3	
AS565		MBe
EC155	B, B1	
EC225	LP	
EC725		AP
AS332	C, C1, L, L2	B, B1, F1, M, M1
AS532		A2, AC, AL, SC, UE, UL
EC175	B	
H160	B	
MBB-BK117	D-2, D-2m, D-3, D-3m	D-2m, D-3m
EC135	T3H, P3H, EC635 T3H, EC635 P3H	

Reason

With this Safety Information Notice, Airbus Helicopter would like to remind that helicopters equipped with AFCS upper modes can help to perform safe approach and landing.

Background

Airbus Helicopters was recently informed of several accidents where – without the use of the AFCS upper modes - the approach to an unprepared terrain was performed manually. In one of these cases, when the helicopter was close to the ground, the main rotor downwash lifted dust causing the pilot to lose visual references with the ground (brownout). The pilot was unable to maintain a level attitude causing the structure and main rotor blades to impact the ground. Fortunately, the crew and occupants were not injured in this event. However, other cases of brownout or whiteout have ended with more serious consequences.

Brownout or whiteout (when snow instead of dust is involved) can be extremely disorienting. Visual contact with the ground is lost and the swirling dust or snow particles can rapidly induce spatial disorientation and loss of situational awareness. At night, the risks are even higher.

Airbus Helicopters would like to emphasize the need to properly assess the landing site, prior to landing, for the potential risk of brownout or whiteout. In case of an unexpected capture in brownout or whiteout, the autopilot should be used to stabilize the aircraft.

No. 3983-S-22

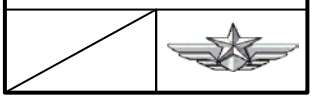
Airbus Helicopters would like to remind pilots that the best use of upper modes is described in the applicable Flight Operation Briefing Notes (FOBN, available in TIPI) or in the Flight Crew Operating Manual (FCOM). These documents also describe how automation (especially the automatic hover modes) can be used in case of unexpected loss of visual cues near the ground as in brownout or whiteout.

In order to become familiar with the use of the different AFCS upper modes, and facilitate their use in case of a sudden reduction in visibility, Airbus Helicopters recommends regular practicing of the use of these modes during training or standard missions.

Flight Operations Briefing Note

SUBJECT: AUTOPILOT

Description and recommended use of AS 365 N3+, in MFD255 / AFCS APM2010 configuration

For the attention of


AIRCRAFT CONCERNED	Version
	Civil
AS365N3+	N3+

Since the first Dauphin AS365N, avionics equipment in this helicopter includes autopilot system able to assist the cockpit crew in stabilizing flight parameters, managing a portion of flight in cruise, descent or approach. First generation was based on analog systems and the AS365N3+ innovates with a new AFCS: the APM2010. This autopilot system is derived from the H155B1 AFCS APM2000 digital autopilot, and continues to equip the Dauphin AS365N3+ with reliable, precise, last generation system with improved performance automation.

Associated with glass cockpit MFDs 255, the AS365N3+ “avionique nouvelle” will require from the pilots qualified in the model a deep knowledge of the normal and back-up AFCS operation and performance, a complete understanding of the various modes, how they are displayed, and all safety functions designed to protect from errors and keep as much as possible helicopter within a safe flight envelope.

This Flight Operations Briefing Note (FOBN) n° 09-22 is a document relative to the description and the recommended use of the AS365N3+ Automatic Flight Control System (AFCS) and is available to all Operators to be a base in developing Operations documents and Training Manuals.

Please take notice that this Flight Operations Briefing Note is neither a substitute nor a surrogate for the Flight Manual which is the primary reference source and the final authority for all information regarding your aircraft.

The material contained in this Briefing Note will also help trainers to identify additional training needs.

Nevertheless, pilots are responsible for learning and understanding all rules and regulations to be applied to their particular missions.

Issue	Issue date	Affected pages	Changes
Rev. 0	2017-01-25	All	New document

CONTENTS

LIST OF FIGURES

1. PRELIMINARY NOTES

1.1. ABBREVIATIONS

A/C	AirCraft
AC	Alternative Current
ADC	Air Data Computer
ADF	Automatic Direction Finder
ADI	Attitude Deviation Indicator
ADU	Air Data Unit
AEO	All Engines Operative
AFCS	Automatic Flight Control System
AGL	Above Ground Level
AHRS	Attitude and Heading Reference Sensor
ALT	AFCS Altitude hold mode
ALT.A	AFCS Altitude Acquisition mode
ANP	Actual Navigation Performance
AP	Autopilot
APM	AutoPilot Module
APMS	Autopilot Mode Selector
APP	AFCS Approach mode
ARA	Airborne Radar Approach
ATC	Air Traffic Control
ATT	Attitude long term retention
BIT	Built In Test
BITE	Built In Test Equipment
C	Collective axis
CAP	Caution Advisory Panel
CDFA	Continuous Descent Final Approach
COLL	Collective axis
CR.HT	AFCS Cruise Height mode
CPU	Central Processing Unit
DA	Decision Altitude
DC	Direct Current
DECU	Digital Engine Control Unit
DH	Decision Height
DME	Distance Measurement Equipment
DPIFR	Dual Pilot IFR
DSAS	Digital Stability Augmentation System
DVE	Degraded Visual Environment
FADEC	Full Authority Digital Engine Control
FAF	Final Approach Fix
FAP	Final Approach Point
FAT	Final Approach Track
FDS	Flight Display System
FFS	Feel Force System
FL	Flight Level
FMS	Flight Management System
FOG	Fiber Optic Gyrometer

ft	feet
FTR	Force Trim Release
GA	Go Around
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
GS	AFCS Glide Slope mode
GSTC	Ground Speed Turn Coordinated
h/c	Helicopter
HDG	AFCS Heading mode
HHT	AFCS Hover Height mode
HOV	AFCS Hover mode
HSI	Horizontal Situation Indicator
HUMS	Health and Usage Monitoring System
HW	Hardware
IAS	AFCS Airspeed mode **or** Indicated Air Speed
IF	Intermediate Fix
IFR	Instrument Flight Rules
IGE	In Ground Effect
ILS	Instrument Landing System
kt	Knot
KIAS	Knot of Indicated Air Speed
LH	Left Hand
LOC	AFCS Localizer mode
LRU	Line Replaceable Unit
LS	Low Speed
LVTO	Low Visibility Take Off
MAPt	Missed Approach Point
MDA	Minimum Descent Altitude
MEL	Minimum Equipment List
MFD	Multi-Function Display
MMEL	Master Minimum Equipment List
MP	Multi Pilot
MSA	Minimum Safety Altitude
NAV	Navigation
NDB	Non Directional Beacon
Ng	Engine Turbine Speed
Nm	Nautical Mile
NVM	Non Volatile Memory
OAT	Outside Air Temperature
OEI	One Engine Inoperative

OGE	Out of Ground Effect
OSS	Over Station Sensor
P	Pitch axis
Pb	Pushbutton
PF	Pilot Flying
PITCH	Pitch axis
PM	Pilot Monitoring
PNF	Pilot Not Flying = PM
QNH	Air Pressure on MSL
QFE	Air Pressure at Airfield level
R	Roll
RA	Radio-Altimeter
Radalt	Radio-Altimeter
RCU	Reconfiguration Unit
RF	Radius to Fix (leg)
RH	Right Hand
RNAV	Area navigation
RNP	Required Navigation Performance
RoC	Rate of Climb
RoD	Rate of Descent
ROLL	Roll axis
RVR	Runway Visual Range
SAR	Search And Rescue
SAS	Stability Augmentation System
SEMA	Smart Electro-Mechanical Actuator
SEMA NG	Smart Electro-Mechanical Actuator New Generation
SPIFR	Single Pilot IFR
SW	Software
TAS	True Air Speed
TCAS	Traffic and Collision Avoidance System
TEM	Threat and Error Management
VFR	Visual Flight Rules
VNAV	Vertical Navigation
VNE	Velocity Never Exceed
VOR	VHF Omnidirectional Range
VPT	Visual maneuvering with Prescribed Track
V/S	AFCS Vertical Speed mode
VSI	Vertical Speed Indicator
Vx	Longitudinal ground speed
Vy	Best Climb Speed **or** lateral ground speed
VTOSS	Take-Off Safety Speed
WoW	Weight on Wheel
Y	Yaw
YAW	Yaw axis

1.2. RECOMMENDED TERMS FOR UPPER MODES AND AFCS STATUS DESCRIPTION

1.2.1. UPPER MODES STATUS

To avoid misunderstanding or confusion between crewmembers when operating in Multi-Pilot (MP), it is recommended to describe the upper mode without ambiguity. So the following words will be preferably used instead of the usual generic terms “engaged” or disengaged”:

RECOMMENDED WORDING	GENERIC TERMS
Couple (Coupled – Coupling)	Engage (Engaged – Engagement)
Arm (Armed – Armament)	
Capture (Captured – Capture)	
Disarm (Disarmed – Disarmament)	Disengage (Disengaged – Disengagement)
Decouple (Decoupled – Decoupling)	

2. SYSTEM OVERVIEW

2.1. INTRODUCTION

The APM 2010 has replaced the CDV85 analog Autopilot installed in the early AS365N3 and older AS365N2 DAUPHIN. Based on the "Avionique Nouvelle" family concept, pilots will find similarities with other Airbus Helicopters regarding the Man-Machine Interface (controls and displays), normal procedures and usage of the AFCS modes.

The APM 2010 is a **digital 4-axis** autopilot based on one dual Autopilot Module (APM) architecture, redundant AHRSs, air data units (ADU). Command signals are provided to dual electro-mechanical Series actuators (SEMA) on each helicopter axis.

NOTE

Basically, the difference between analog and digital technologies is that in analog technology, information is translated into electric pulses of varying amplitude. In digital technology, translation of information is into binary format (zero or one) . Digital technology allows a greater number of precise information received, and faster exchange of data.

Design to decrease significantly the pilot workload, the APM2010 acquires data, then computes and transmits the correcting signals to the Smart actuators on the helicopter's four axis Pitch, Roll, Yaw and Collective in order to maintain or modify the flight path as managed by the pilot. AS365N3+ helicopter fitted with the APM2010 fullfill FAR 29 amendment 16 for Single Pilot IFR (SPIFR) and certified under the DGAC type certificate 86, and RFM modification 07-22B61 and 22B73.

2.1.1. FUNCTIONS

The APM 2010 has been designed to be "**fail passive**" **4 axis AFCS** thanks to a dual architecture providing:

- failure detection
- Commands freeze,

and offers a "**fail operative**" or in other words, system continues to provide assistance to the pilot when degraded status in the sensors or failure of the APM occurs and thanks the redundancy of resources as follow:

- reconfiguration / selection of the non-faulty sensor,
- Stabilization Augmentation System (SAS) piloting law as a back-up when attitude retention is lost,
- An actuator failure on an axis will degrade only that axis,
- Use of pitch and roll trims as back-up actuators.

The APM2010 AFCS offers functions such as **basic stabilization** and **upper modes** as follow:

2.2. AFCS SOFTWARE VERSION

2.2.1. GENERAL INFORMATION

The Hardware supplier of the "Avionique Nouvelle" AFCS is *SAGEM,* while *AIRBUS HELICOPTERS* is fully responsible for the system architecture design and the Software including flight control laws development and certification.

2.2.2. SOFTWARE VERSION CHECK

The AFCS software version can be checked on the aircraft by setting the AFCS in maintenance mode:

- Helicopter on ground, switch batteries 1 & 2 to “ON”.
- AP OFF, operator must press APMS CRHT pushbutton for 3 seconds,
- On the lower line AFCS strip appears for few seconds the type of helicopter and the software version:

Figure 1: Maintenance mode - AFCS Software.

2.3. AFCS ARCHITECTURE

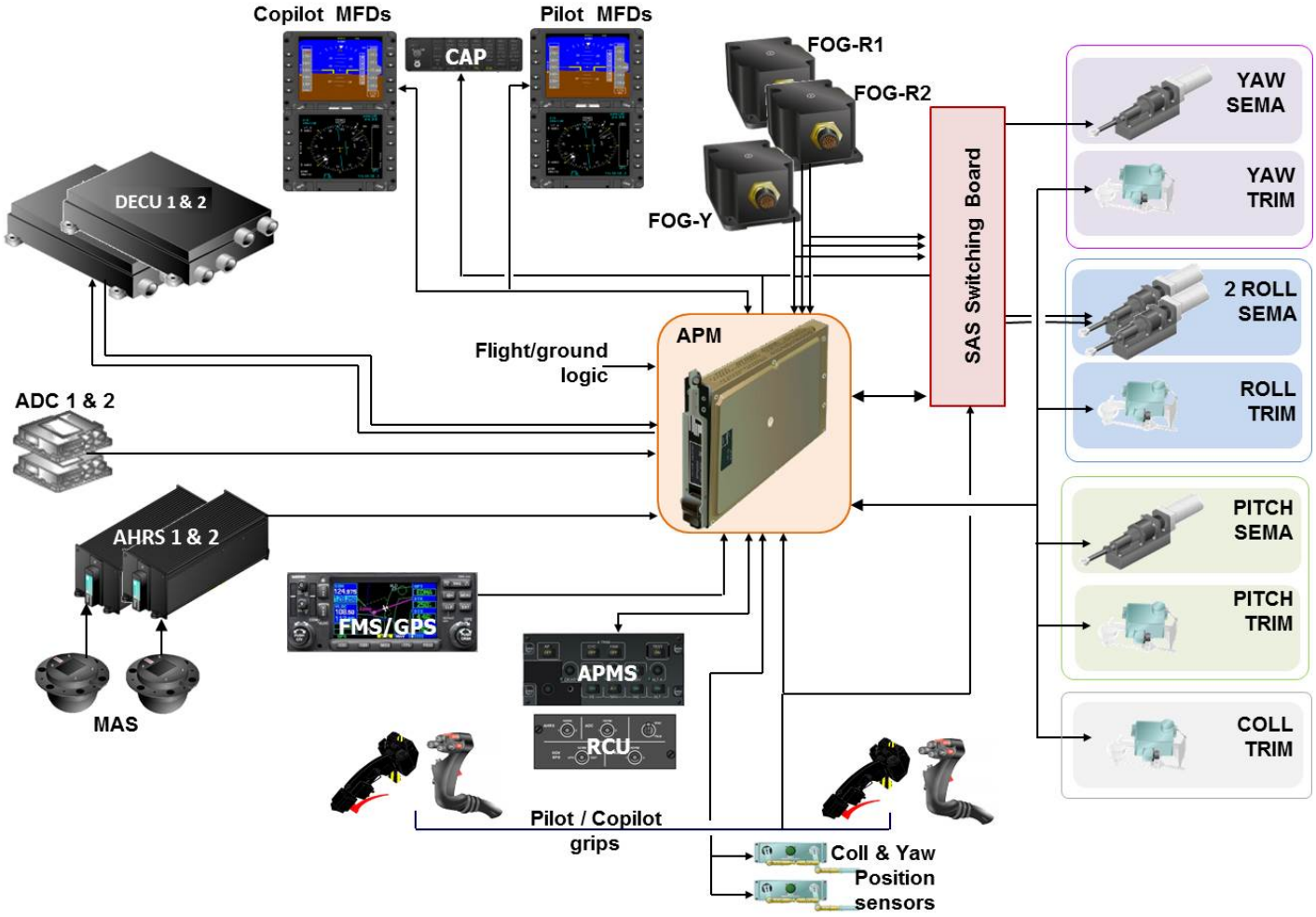


Figure 2: APM2010 General architecture

- **One dual electronic APM2010 Autopilot module** which receives helicopter angles and rates computes and transmits relevant orders to the actuators. The APM module is a 2-board module including 2 processing channels for flight control laws and monitoring. The APM module processes the basic stabilization (ATT) and upper modes functions.

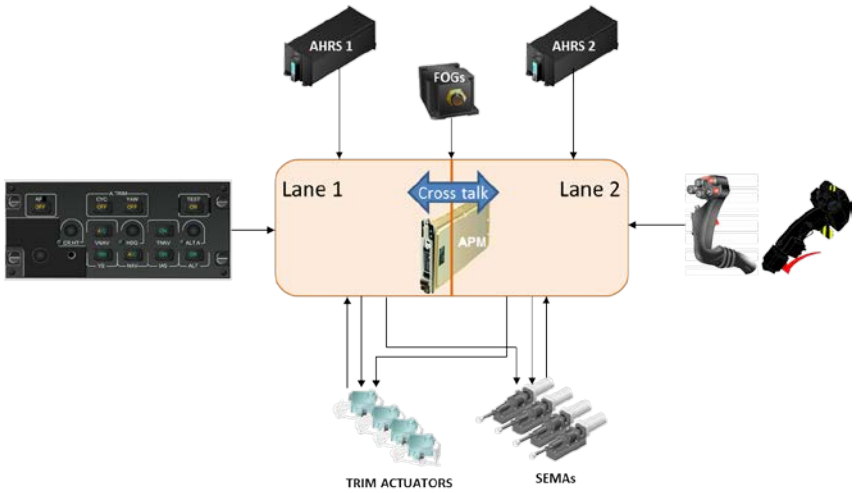


Figure 3: APM2010 detailed Dual architecture

The dual architecture of the APM allows the failure passivation as the two channels are linked together. They both acquire sensors data and cross-exchange information in order to compare and detect any discrepancy, and then compute, and send command to the actuators. APM channel discrepancy is detected at the actuator level, comparing the master signal used for actuator movement (channel 1) and a signal used for monitoring from channel 2.
APM receive DECUs signal for power limitation when collective upper modes are engaged.
APM can be disconnected manually by the crew (overhead panel Pb RST AP) or internally when the software detects an APM failure, or by the watchdog release.

- **Two independent sensors, Attitude and Heading Reference Systems (AHRS)**
  - The AHRS are a kind of mini Inertial Reference System, delivering attitudes, angular rates and acceleration.
  - The two AHRS are coupled with a Magnetic Aircraft Sensor (MAS) and become an Aircraft Piloting Inertial Reference System (**APIRS**) providing magnetic headings. Using air data from the ADUs, the AHRSs compute baro-inertial vertical speeds. Most sensors are shared with the FDS and are used as primary sensors for artificial horizon presentation, heading and radar stabilization purposes.

- **Two independent Air Data Units (ADU)**
  - Delivering altitudes, airspeeds, raw vertical speed and temperature data to the AFCS partitions, these sensors data are also shared with the FDS.

- **Four Smart Electro-Mechanical series Actuators (SEMA)**
  - Two SEMAs are installed on Roll,
  - One SEMA is installed on Pitch, and one SEMA on the Yaw
  - Collective is controlled by the Roll and Pitch SEMAs.

SEMAs are also designated as Series actuators. The actuator is able to receive piloting orders from APM via Arinc429 lines and send back validity signals to APM. Detection of any discrepancy between APM channels is performed by the SEMA as one channel signal is used as command and the other signal is used for monitoring.
When Back-Up SAS is selected, FOGs delivers commands to the SEMAs, in Roll two signals are provided, one FOG for control input and the other FOG for monitoring input, in Yaw only one FOG delivers control and monitoring inputs.
Why Smart? Because the SEMA actuator includes its own control for position slaving and position monitoring.

- **Four Parallel actuators (TRIM ACTUATOR)**

  One parallel actuator is installed on each axis and receive signals from APM and from flight controls pilot / copilot. They include an electrical motor receiving 28VDC pulses from APM for re-centering purposes.
  They are of different types:
  - On Pitch and Roll: they provide artificial force feel, and an anchoring point for cyclic's sticks. This anchoring point can be displaced by pilots using the cyclic grips beep trim or trim release. RVDT sensors provide stick position information and override information (i.e. pilot fly-through)
  - On Collective: provides artificial force feel, and an anchoring point. This anchoring point can be displaced by pilots using the collective grips beep trim or trim release, RVDT sensor provides stick position information only.
  - On Yaw: Trim Actuators are not controlled by FOGs when Back-Up SAS is selected, pilots cyclic can still be used for trim control inputs.

- **Collective position sensor – Yaw position sensor:**

Because there is no mechanical link between yaw and Collective control lines for coupling purpose, the APM software is designed to correct the collective inputs secondary effects using these sensors information.

  - Collective Sensor: this sensor sends collective pitch lever position changes to the APM, for the APM to compute signals to Trim Actuators Roll and Pitch for correction due to collective inputs.
  - Yaw Sensor: reports Yaw pedals position changes.

- **One Auto Pilot Modes Selector (APMS):**

  The APMS is the main interface between pilots and system. The mode selector box is installed on the console between the two pilots. The APMS is connected the APM2010 AP module.

  - The APMS allows AP and Back-up SAS engagement/disengagement, upper modes coupling/decoupling including navigation modes, modes references adjustment and auto trims engagement. The APMS may include SAR modes option.

- **Three Fiber Optic rate Gyros (FOG)**

FOGs are gyrometers, able to provide only angular rate in Roll and Yaw axis. FOGs compute a back-up SAS control law and command series actuators (Roll and Yaw) for short term stabilization.

  - There are 2 FOGs dedicated to the Roll axis for redundancy, and one FOG for the Yaw axis.

- **One SAS switching board**
  - It selects commands either from APM for basic stabilization with upper modes or FOGs for SAS Back-Up to be executed by the Roll and Yaw series actuators (SEMAs).

- **Flight / Ground logic**

Discret signals are send to APM both channels providing information on-ground or in-flight based on the main landing gears shock absorbers extension / compressed status. Ground logic will limit the use of the APM: i.e. pre-flight test is inhibited when in-flight.

2.4. AFCS DESCRIPTION

2.4.1. AFCS POWER SUPPLY

The AFCS basic and back-up SAS are both supplied with 2 sources of 28VDC Essential buses PP8 and PP9.

The AFCS is automatically supplied when helicopter is powered, after the power-up is identified by the APM, a self-test is executed with the initialization of the actuators.

The two reset switches cut off DC power when press. (see figure 13)

2.4.2. LOCATION OF THE MAIN COMPONENTS

The APM 2010 is installed in the baggage compartment, in rack called MASUF positioned against the RH side cabinet. A cooling system made of two fans is dedicated to the APM module.

The SAS switching unit is located inside this cabinet.

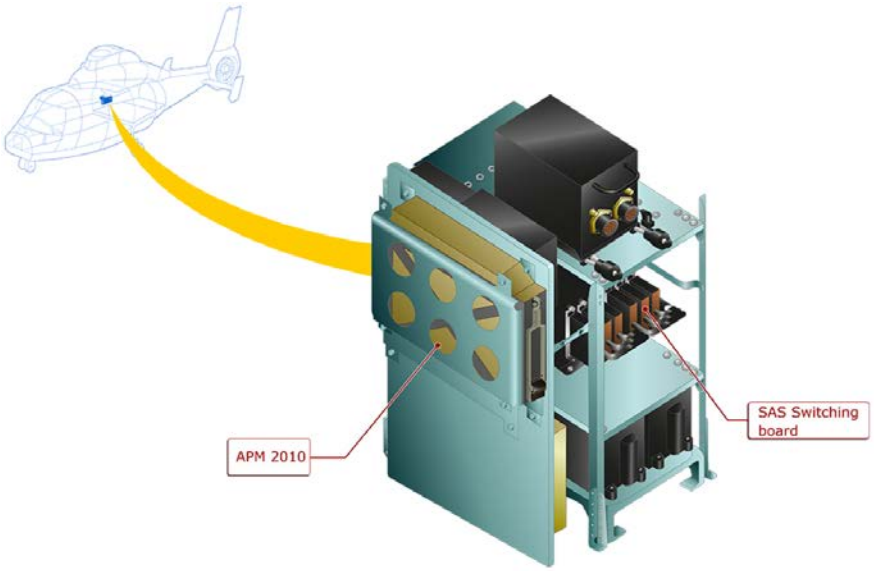


Figure 4: APM2010 & SAS switching unit location

SEMAs are positioned on the flight controls, two actuators on the Roll, one on the right and one on the left. The pitch SEMA is on the left side and the yaw SEMA is located near the tail servo control.

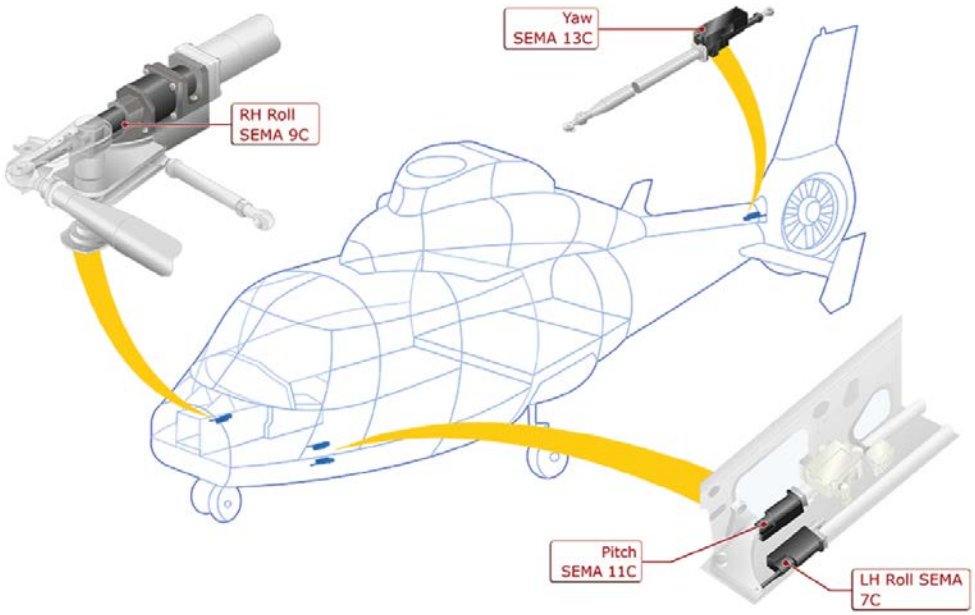


Figure 5: Roll, Pitch and Yaw SEMAs

FOGs are located in the tail boom. Collective pitch lever position is located under cockpit floor LH side, just behind the collective trim actuator. Yaw control pedals position detection unit is under the cabin floor, RH side in front of the Yaw trim actuator.

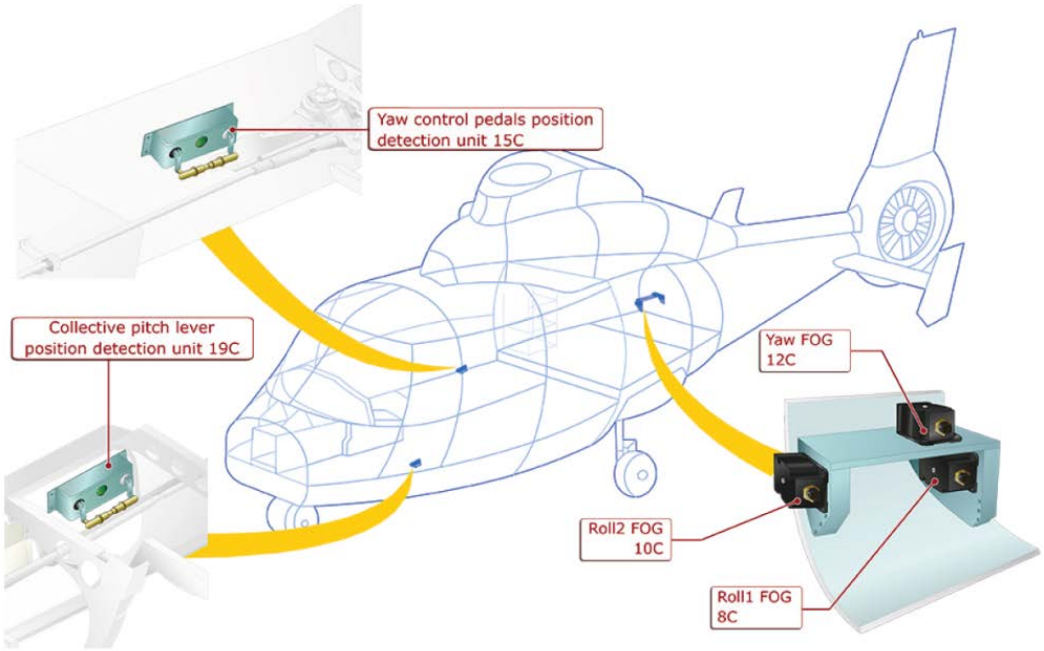


Figure 6: FOGs, Collective Pitch lever Position and Yaw control Pedals Position Detection.

Four parallel actuators installed as follow: Roll, Pitch and Collective actuators are under the cockpit floor LH side.

Yaw actuator is under the cabin floor RH side.

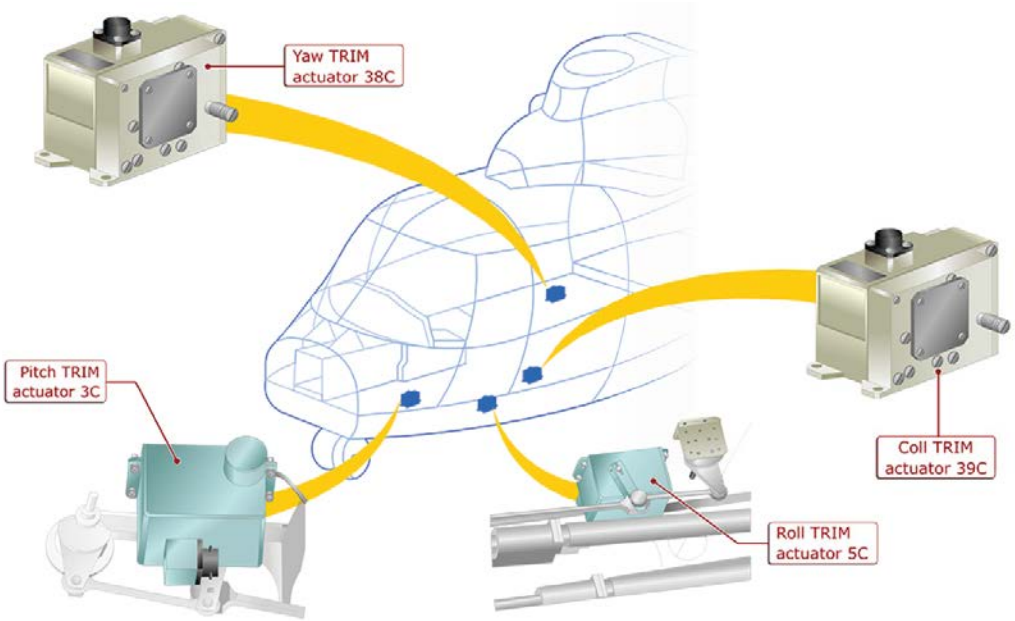


Figure 7: Parallel Actuators.

2.4.3. THE PILOT – SYSTEM INTERFACE

2.4.3.1. Components location of the interface:

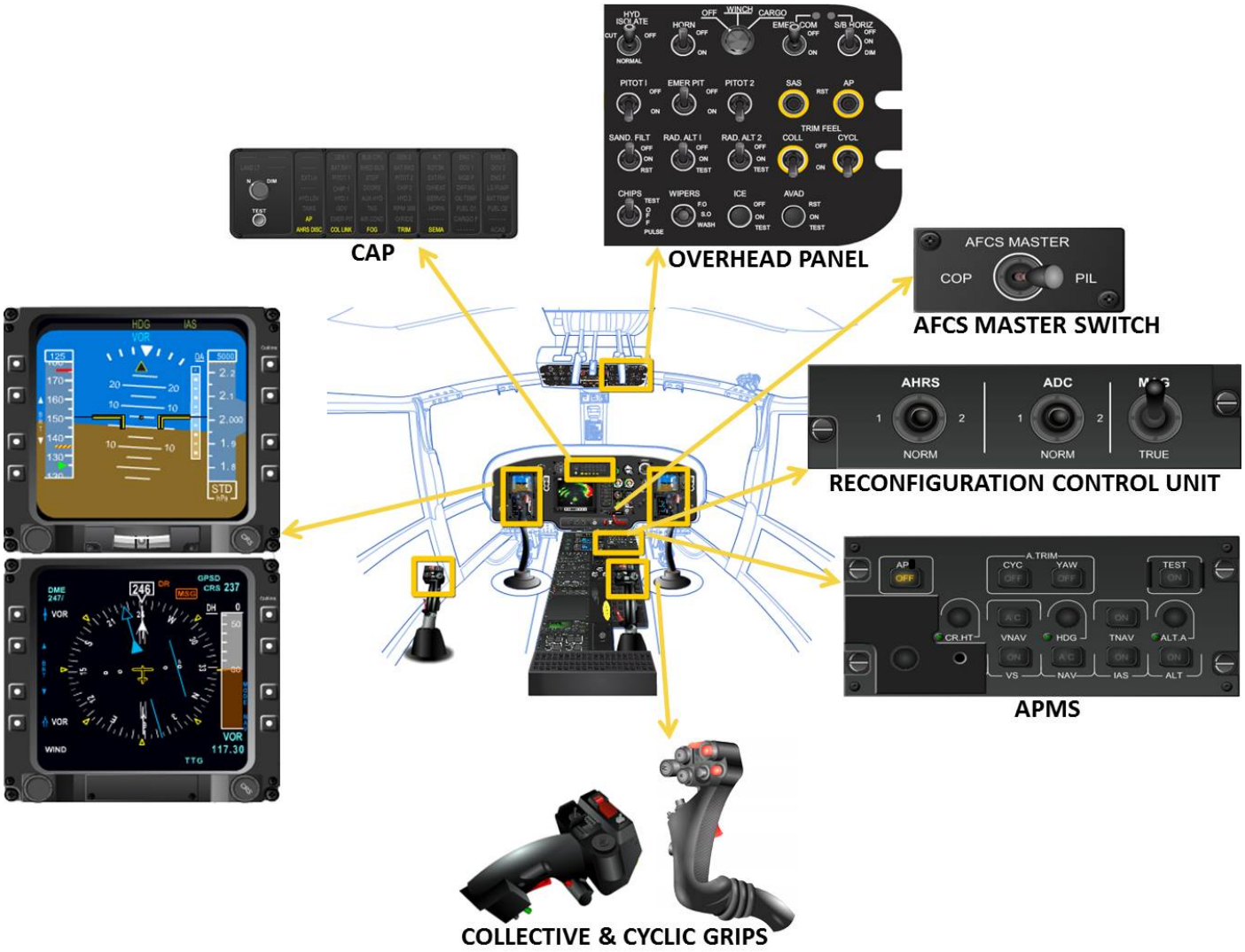


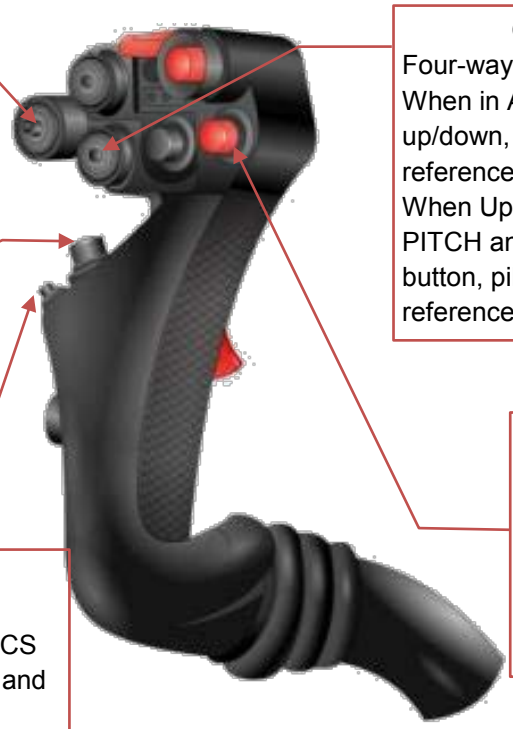
Figure 8: Pilot-system interface.

2.4.3.2. The cyclic grip

SAS pushbutton :
Small button, label: **SAS**
Pressing this button engages the Back-Up SAS when AFCS is OFF.
***** see GSPD para. For **GSTC/SAS** pb

Cyclic trim Release :
Push-button, label: **TRIM REL**
When this button is depressed, AFCS reference attitude is cancelled and Pitch and Roll parallel actuators clutches are open*: in result the anchoring point and the force feel are lost.*

CPL Release :
Push-button, label: **CPL REL**
In flight, pressing this button disengages all AFCS coupled Upper modes on PITCH, ROLL, YAW and COLL.
On ground, with AP ON pressing the button allows the Cyclic to return to a neutral centered position. Pressing more than 2 seconds clears all preselected upper modes parameters on ALT.A, CR.HT and HDG modes.



Cyclic beep trim :
Four-way switch with label: **TRIM**
When in ATT, trimming left/right or up/down, pilot changes the attitude reference in PITCH and ROLL.
When Upper Mode coupled on PITCH and/or ROLL, trimming the button, pilot changes the mode reference.

AFCS/SAS Cut-Off pushbutton :
Push-button label:**AFCS**
When AFCS or SAS is ON, depressing this button disengages the AFCS or SAS.

Figure 9: AS365N3+ Cyclic Grip.

2.4.3.3. The collective grip

Collective beep trim:
Two way rocker switch, label: **COLL BT** and **UP - DWN**
Trimming up or down, pilot raise (UP) or lower (DOWN) the collective lever position.
When Upper Mode coupled on COLLECTIVE, when trimming the button, pilot changes the mode reference.

Collective trim Release :
Trigger shape, label: **TRIM REL**
When pressing this button, collective parallel actuator clutch is open.
Collective lever can be moved freely. The AFCS commands can no longer drive the collective.

GO AROUND :
Black button, label: **G AROUND**
In flight, when AP ON, pressing this button engages or disengages Go-Around upper mode, it is the only way to select this Mode.
Disengagement can be made using the Cyclic CPL Release button.

Figure 10: AS365N3+ Collective Grip.

CAUTION

When in ATT, no upper mode couple on the COLLECTIVE, press the trigger TRIM REL prior to move collective up or down.

2.4.3.4. The AFCS master switch

two position switch **COP - PIL**:
PIL selected: pilot MFD datum references NAV source and datum, Heading reference and ADC pilot side are used by the APM

COP selected: copilot MFD datum references NAV source and datum, Heading reference and ADC co-pilot side are used by the APM

Figure 11: AFCS master switch.

2.4.3.5. The reconfiguration control unit (RCU)

Two-position switch **MAG**:
MAG selected: is the Normal position. Headings are displayed in magnetic on NDs.
TRUE selected: Headings are displayed in true on NDs.

Three-position switch **AHRS**:
1 selected: only AHRS #1 is used by the APM and is displayed on MFDs Pilot and CoPilot.
2 selected: only AHRS #2 is used by the APM and is displayed on MFDs Pilot and CoPilot.
NOTE: after reconfiguration to 1 or 2, **AHRS #** is displayed on the MFD-ND

NORM selected: APM receives and compares both AHRSs.

Three-position switch **ADC**:
1 selected: only ADC #1 is used by the APM and is displayed on MFDs Pilot and CoPilot.
2 selected: only ADC #2 is used by the APM and is displayed on MFDs Pilot and CoPilot.
NOTE: after reconfiguration to 1 or 2, **ADC #** is displayed on the MFD-ND

NORM selected: APM receives and compares both ADCs.

Figure 12: Reconfiguration Control Unit (RCU).

CAUTION

When position 1 or 2 is selected with AHRS or ADC switches, MFDs and APM cannot perform any cross data monitoring and no discrepancy is reported. Pilots are required to monitor MFDs and compare with Back-up instruments.

2.4.3.6. The Overhead control panel

Two reset pushbuttons: **RST** (reset) **:**
SAS: when press, cut-off the 28VDC to the FOGs Yaw and Roll, Yaw and Roll SEMA and SAS switching board.

AP: cut-off momentarily the 28VDC to the APM processors and Pitch SEMA

TRIM FEEL ON / OFF
COLL: disengagement of the trim Collective parallel actuator when OFF is selected.
Force trim is released; Collective lever can be moved without pressing the trigger,
The AFCS commands can no longer drive the collective: no upper mode can be coupled.

CYCL: cut-off the 28VDC to the Cyclic parallel actuator (PITCH & ROLL)
Cyclic can be moved freely with no anchoring point and no force feeling.
The AFCS commands can no longer drive the cyclic: no upper mode can be coupled on Pitch and Roll.

Figure 13: Overhead panel – Pilot side (RH).

NOTE

RESET pushbuttons (AP and SAS) can be used on ground after starting engines with a low battery voltage.

2.4.3.7. APMS

A single mode selector box (APMS) located top right of the central console. The APMS allows to manage and test the basic upper mode, and to couple, arm and decouple the AFCS upper modes.

The control panel includes different types of push-buttons and knobs with labels of amber or green colors. Top line includes AP, A.TRIM CYC & YAW, TEST for basic APM management. The two lower lines are used to manage the AFCS Upper modes, with rotary knobs for presetting references, and push-buttons for coupling or decoupling.

Two modes are currently not used: VNAV and TNAV on this version of software.

AP push-button with two stable positions:
Pressing this PB engages AP or disengage if previously ON.
This PB is the only command to switch ON the autopilot.

OFF AP is disengaged,

AP is engaged.

A.TRIM push-buttons with two stable positions:
Pressing this PBs engage auto-trims Pitch & Roll (CYC) or yaw (YAW), or disengage if previously ON.
Disengagement of the A.TRIM when upper modes are engaged leads to loss of upper mode function.

OFF A.TRIMs are disengaged,

A.TRIMs are engaged.

TEST push-button with two stable positions:
Pressing this PB engages AP Pre-Flight Test or disengage if previously ON. This PB is inhibited in flight.

ON Flashing, Pre-Flight test is running.

Pre-Flight test is OFF

CR.HT HDG ALT.A
knobs, with a pushbutton function for coupling / decoupling the upper mode and rotating 360° for reference datum preset and modification for the three modes.

indicates upper mode couple when green triangle is illuminated.

NAV
Pushbutton with three different statuses: Upper mode not coupled neither armed,

A Upper mode has been selected but armed,

C Upper mode is captured
Transition from Armed to Captured is managed by the AFCS.

VS IAS ALT
Pushbuttons with 2 statuses:

Upper mode not coupled,

ON Upper mode is coupled.

Figure 14: AP Modes Selector box (APMS) standard configuration (no SAR modes).

2.4.3.8. The Caution Advisory Panel (CAP)

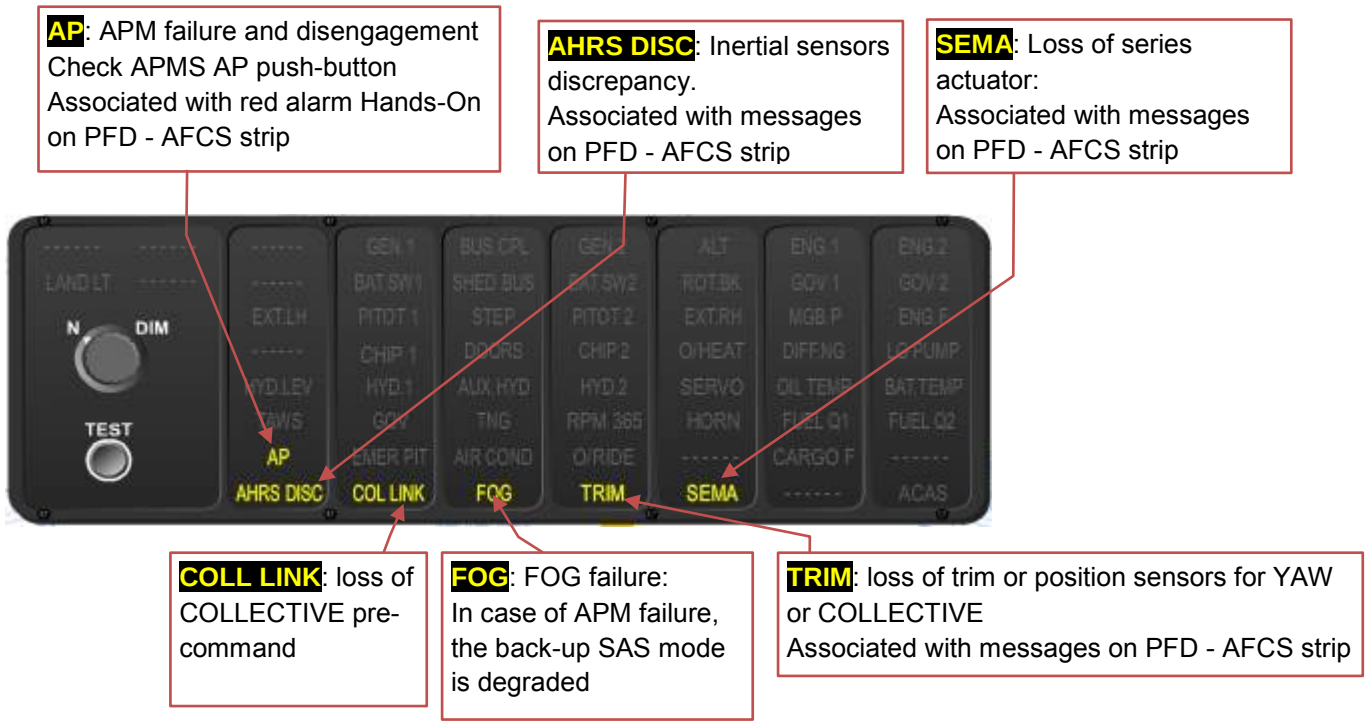


Figure 15: Caution and Warning Panel (CWP).

NOTE

AP , **AHRS** , **COLL LINK** , **FOG** , **TRIM** , **SEMA** , illuminate and then extinguish during pre-flight test.

2.4.3.9. Understanding the AFCS displays: PFD and ND

MFD 255 system is a smart multifunction display including 4 screens, and generating two upper screens PFD format, two lower screens as ND format in normal configuration. The system is structured in two channels, one RH side for pilot and LH side for co-pilot, every channel being made of two screens PFD and ND, one Display Control Panel (DCP) and one Main Control Panel (MCP).

Reconfiguration by the pilots can be made using MCPs when left or right system degrade.

A MASTER side is selected in order to provide the Master navigation source to the AFCS NAV guidance, either radio navigation (VORs & ILSs) or autonomous navigation (GPSs & FMS)

Figure 15: MFD 255 components.

The MFDs (PFDs and NDs) receive all data from all sensors via a dispatching unit:

- Flight parameters from AHRS 1 & 2, Air Data Units 1 & 2, Reconfiguration Control Unit allowing the crew to reconfigure the displays when sensors fail.
- Navigation data from GPS(s), VOR-ILS & Mkr, DME, ADF, Radio Altimeter(s), Weather Radar, TCAS and HTAWS,
- AFCS data from APM 2010.

AFCS data including AFCS status, modes engagement status and degradations, and immediate manual recovery alarm are continuously forwarded to MFDs through Arinc 429 line. These data are looped back to APM computer to perform a crosscheck. In result APM triggers an “autorisation” signal to the screens for display.

It is essential for pilots to have a clear understanding of the messages displayed on MFDs and color code has a major importance, as important as the text written.

In general, the main colors signification is:

RED: loss of function, immediate HANDS-ON required

AMBER: mode or function degradation, no immediate pilot action,

GREEN: normal operation, or Go.

For more detailed description, the table below gives the complete overview of colors assigned to MFD messages:

RED	Failure flags VNE limitation
AMBER	Abnormal source selection ILS cross-side navigation source Cautions and warnings
WHITE	Scale and associated figures Navigation parameters associated to primary navigation source on master side Wind Bearing needles and associated parameters Range ring and data value
CYAN	Track indication Default color for PFD/ND selected modes, bugs, pointers, readouts Armed AFCS Upper Modes
MAGENTA	ILS navigation source and deviation pointers
GREEN	Coupled AFCS Upper modes Navigation parameters associated to primary navigation source on master side, Coupled bugs, pointers, readouts on master side
BROWN	Ground
SKY BLUE	Sky
YELLOW	Aircraft mockup Scale indexes Trend vector
GREY/ TRANSLUCENT	Scales background

Figure 16: MFDs symbols & messages color code.

2.4.3.10. Description of the AFCS strip on the PFDs

Pilot and co-pilot PFD format include the AFCS strip at the top of the screen, just above the attitude indicator in order to communicate to the pilot the status of the APM, and the operating AFCS modes.

Figure 4: MFDs PFD format: AFCS strip.

The AFCS strip is made of two rows, and three columns, associated from left to right with:

COLLECTIVE – ROLL & YAW – PITCH

The two rows are associated with ATT (basic stabilization), and coupled modes for the upper row, armed modes associated with lower row.

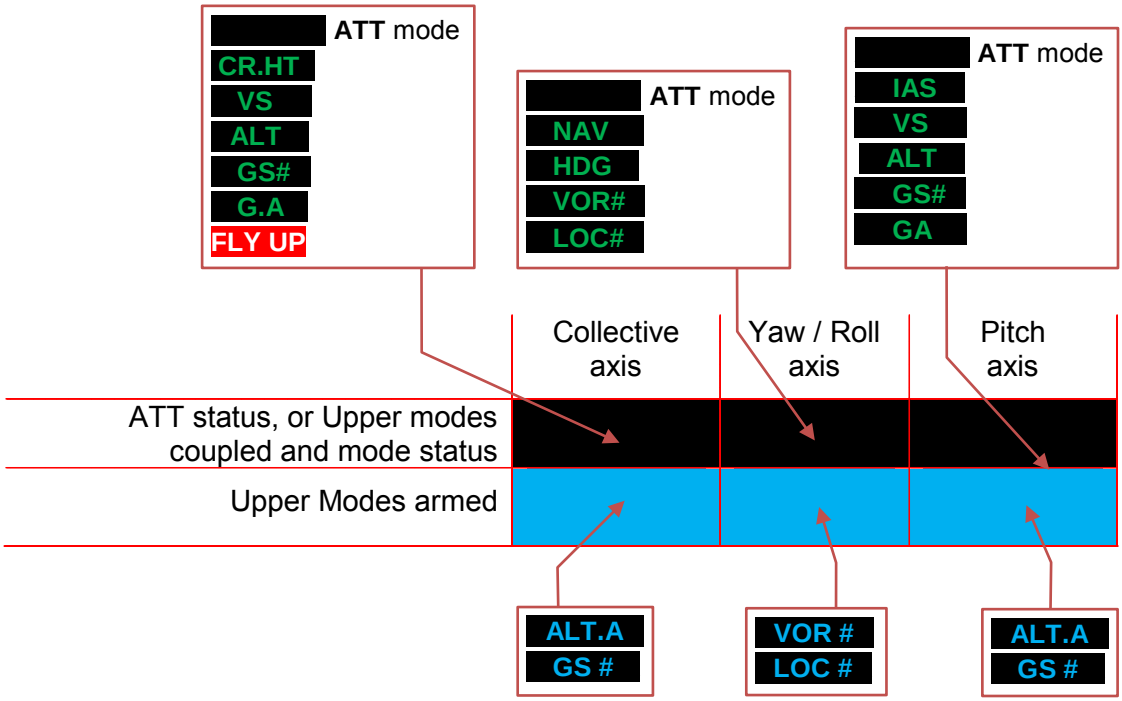
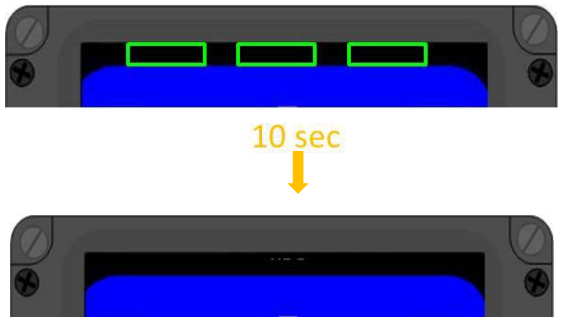
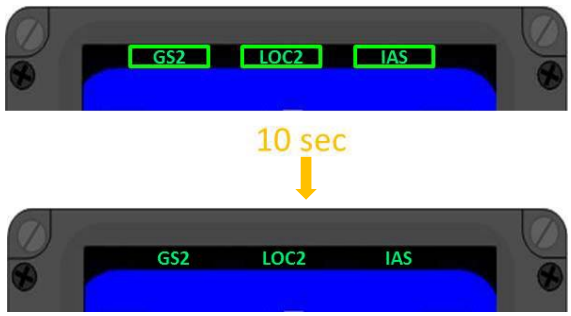
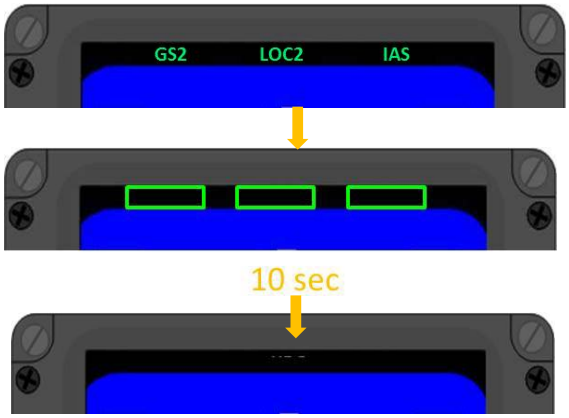
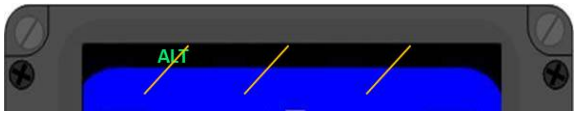
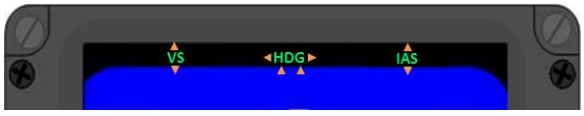


Figure 5: AFCS strip Upper modes assignement.

In addition, several messages will be addressed to the pilot, by color changes, symbols flashing or steady, and for good usage of the APM 2010, pilots must know perfectly all this messages and consequences, as soon have to immediately take manual control and recovery of the helicopter.

PFD	comment
	Basic stabilization ATT mode is operating, when AFCS is switched ON
	Upper modes coupling or status changing from Armed to Captured when AFCS basic stabilization is ON. Pilot can “Fly Through” or change datum reference for each mode using the beep trims.

<table>
<tr><td> 
</td><td>Flashing amber and green, illuminates when pilot is overriding the upper mode against the spring loads.</td></tr>
<tr><td> 
</td><td>When AFCS is ON: Upper mode(s) is (are) decoupled by the pilot. The AFCS reverts to Basic Stabilization (ATT mode) and pilot can use beep trims to change Attitudes on cyclic and power on the collective.
In ATT, power monitoring is active and maximum power is limited when pilots uses collective beep trim for collective changes.</td></tr>
<tr><td> 
</td><td>Excessive Deviations: the APM does not match the required datum reference on the mode concerned. Excessive deviation does not require to take immediate manual control but the concerned mode require attention, monitor the actual flight parameter compared to the datum set.</td></tr>
<tr><td> 
</td><td>Upper modes reference datum changes.
In example the white underline is visible when pilot is applying beep trim or changing reference with APMS switches.</td></tr>
<tr><td> 
</td><td>This malfunction indication is also called BANPA (Boolean annunciator signal) and is the consequence of loss of data transmission between MFDs and APM.
AFCS references displayed on PFD is no more reliable.
Upper mode coupled prior to the malfunction can only be decoupled, and pilot cannot change datum on this mode. Other modes not previously coupled cannot be coupled.
Significant drift in datum may appears, pilot shall monitor the references on the coupled modes.</td></tr>
<tr><td> 
</td><td>Amber arrows indicate one or more series actuators out of trim. These arrows show the correction to be applied for re-centering the actuator. Pilot has to move gently the controls as follow and stop correction when the arrow goes off.
<table>
<tr><td>VS</td><td>▼ Move collective down</td><td>▲ Move collective up</td></tr>
<tr><td rowspan="2">HDG</td><td colspan="2">▲ ▲ Move Left or Right pedal forward</td></tr>
<tr><td>◀ Move cyclic to the Left</td><td>▶ Move cyclic to the Right</td></tr>
<tr><td>IAS</td><td>▼ Move cyclic forward</td><td>▲ Move cyclic backward</td></tr>
</table></td></tr>
</table>

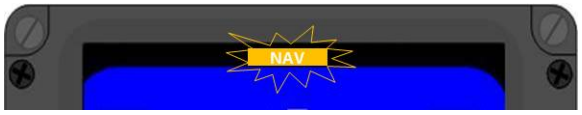
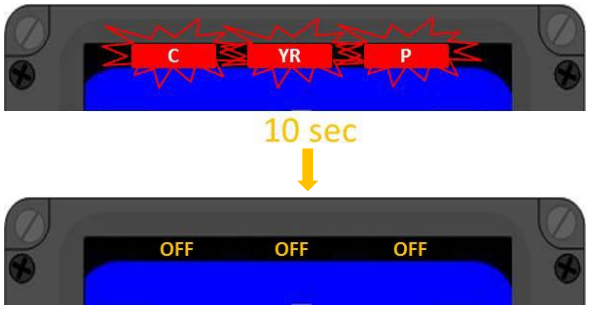
	When a fault occurs on an upper mode, pilot attention will be alerted by a flashing amber frame on the concerned upper mode. After 10 sec. the frame disappears and upper mode is displayed in amber showing that more attention should be payed on this degraded coupled upper mode.
	Upper mode flashing in inverse video, decoupling within 30 seconds. Occurs, or loss of signal in radio navigation. Pilot must be ready to engage another lateral mode like HDG or prepare for controlling in ATT.
	Actuator degradation on relevant axis when basic stabilization is selected (ATT)
	A major failure causing the illumination of a MANDATORY “Hands On” red manual recovery. AP Caution light illuminates on CAP, OFF Comes on the APMS. Pilot shall immediately take controls, stabilize the flight parameters in the flight envelope, and apply the published Emergency procedure.
	While flying CR.HT coupled, APM detect a deviation of more than 30 ft below CR.HT reference datum, or below 200 ft whichever is higher.when such deviation is detected, APM applies power
	AFCS pre-flight test result : OK: no failure is detected. Note that APMS Test pushbutton ON light is Off.
	FAIL : when FAIL illuminates the pre-flight test has detected a failure: Pilot shall check the ON light at the APMS to determine either a major or minor failure.

Figure 6: AFCS strip messages.

2.4.3.11. Understanding the MFDs

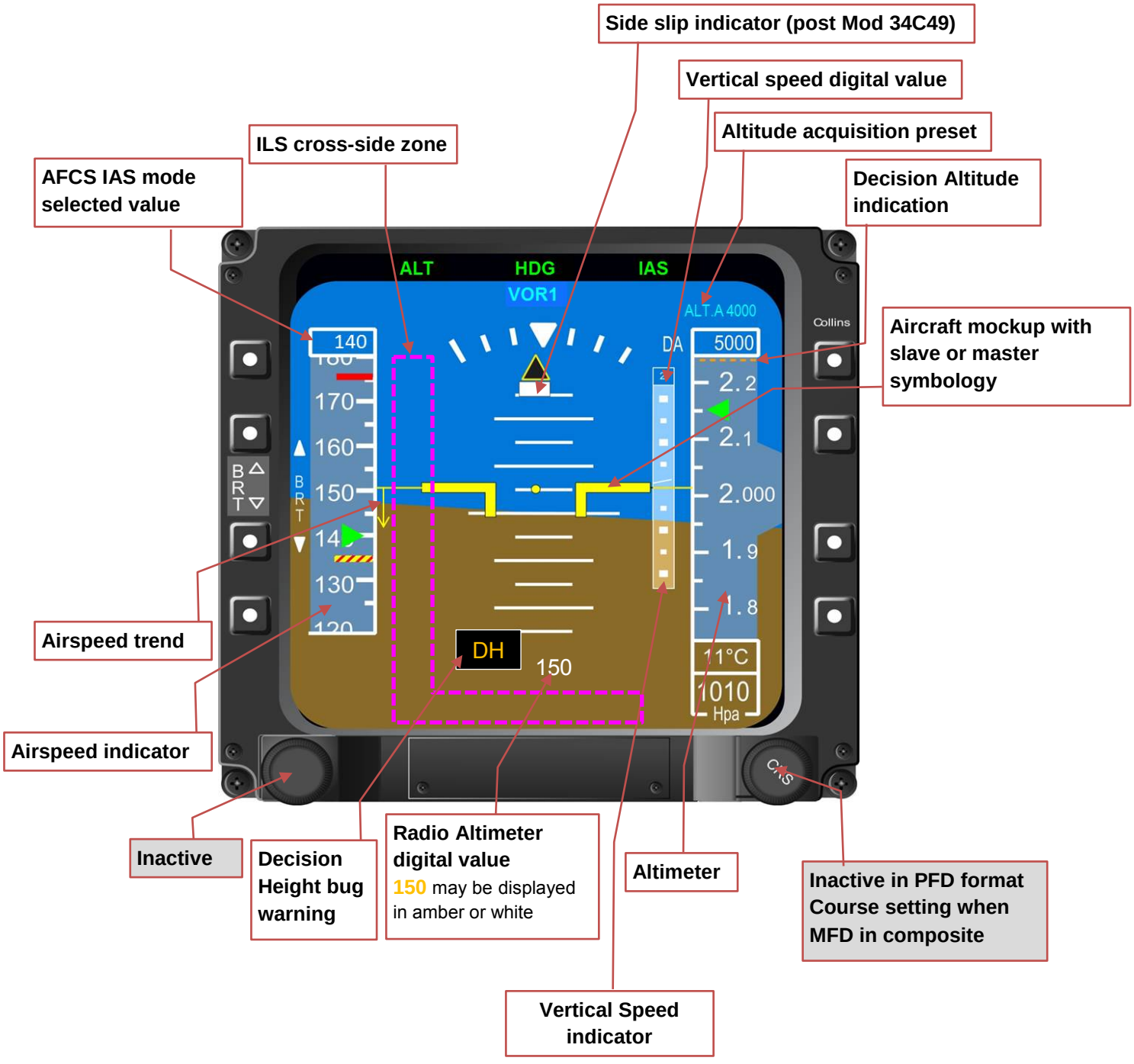
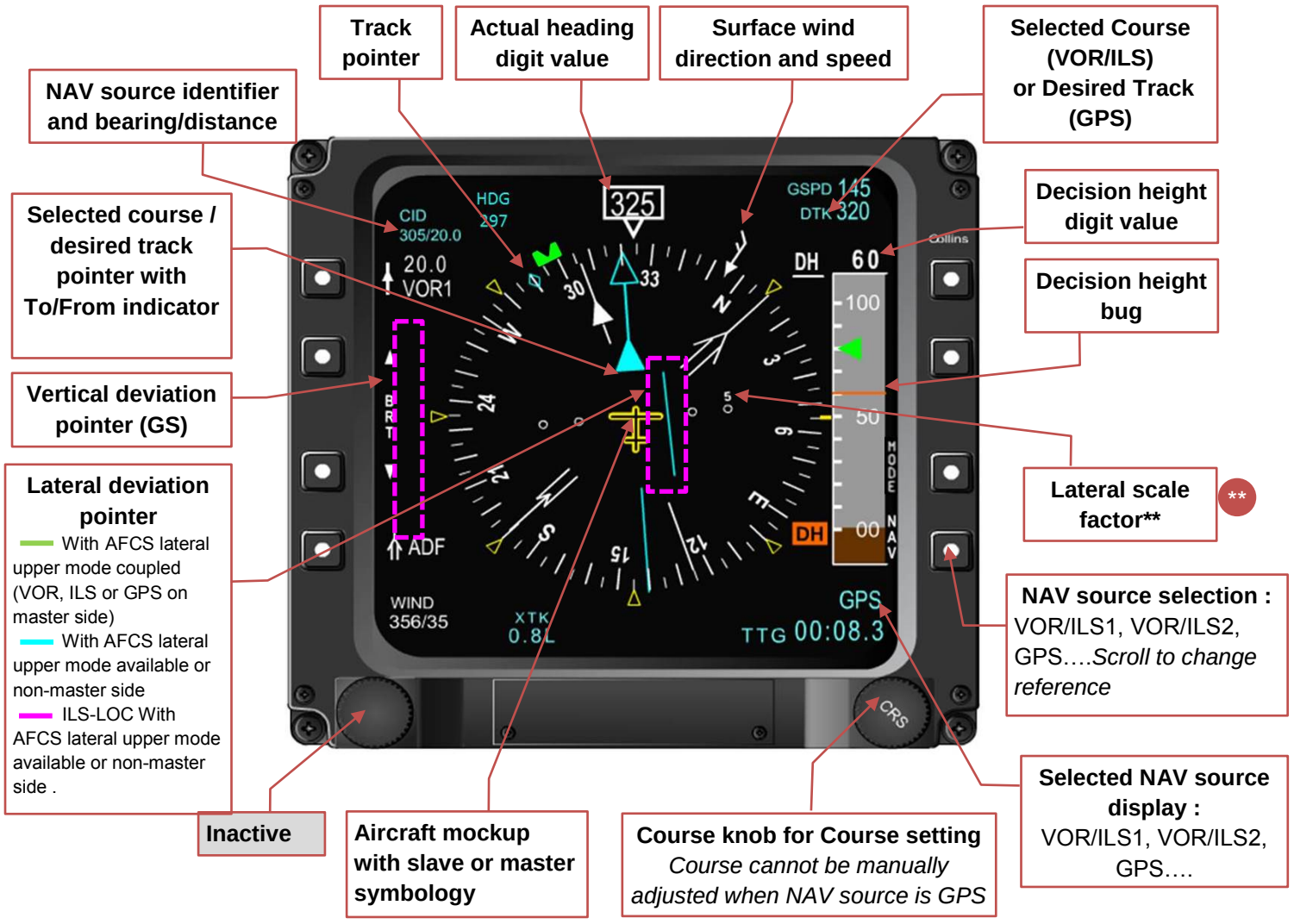


Figure 7: MFD PFD format (post Mod 34C49).



** Lateral scale factor: indicate full length in Nautical Mile (NM) of the deviation bar. available only when FMS or GPS selected as NAV Source. Three values can be red: 5NM, 1NM, or 0,3NM

Figure 8: MFD ND format.

2.4.3.12. Master and Slave status displays on PFDs & NDs

The Master switch allows selection of the MFDs1 (COPilot) or MFDs2 (PILot) to be used by the APM for guidance purpose when NAV mode is coupled and the Barometric reference side.

It is important for pilots to understand the purpose of that switch, for crew coordination when flying multi-pilots or avoiding confusion and errors when single pilot.

- **Barometric altitude reference**

The Air Data Computer (ADC) of the Master side altimeter will supply the barometric altitude information to the APM when both ADC are valid (ADC1 to PFD1, ADC2 to PFD2) and ALT mode is coupled on that altitude. Degradation on the ALT mode could be a difference of valid signal between ADC1 and 2.

- **Navigation source**

Displays of the helicopter mockup on PFDs and NDs allow identifying the Master side and the Slave side selection. If a change of Master is made while the NAV is coupled, automatically NAV shift to the navigation source selected on the master selection.

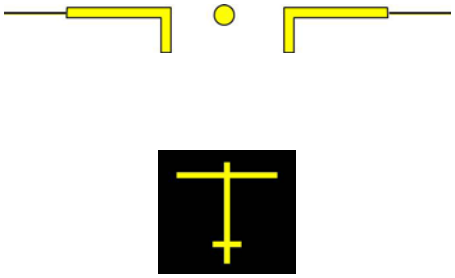
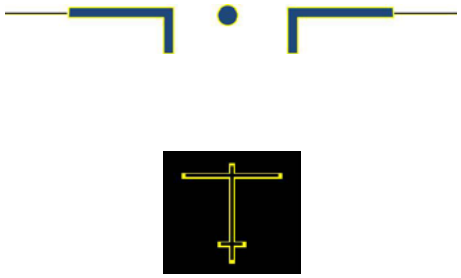
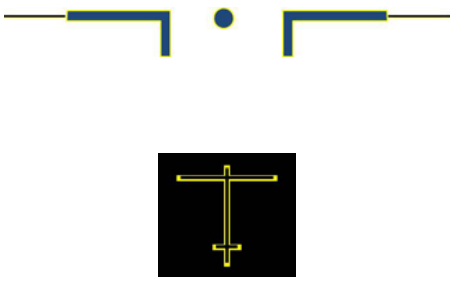
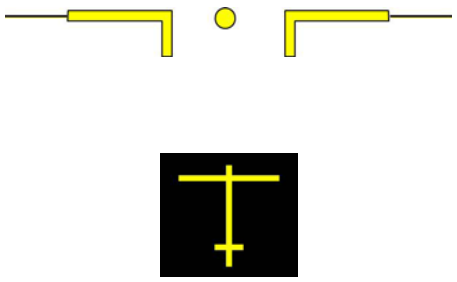
<table>
<tr><td rowspan="2">PILOT side (RH side) is Master,
 
</td><td colspan="2">PFDs and NDs</td></tr>
<tr><td>COP
  </td><td>PIL MASTER
 
Pilot’s ND selected NAV source used for NAV guidance</td></tr>
<tr><td rowspan="2">COPILOT side (LH side) is Master,
 
</td><td colspan="2">PFDs and NDs</td></tr>
<tr><td>COPILOT MASTER
 
Copilot NAV source used for NAV guidance</td><td>PILOT
  </td></tr>
</table>

Figure 9: AFCS Master select switch and displays.

2.4.3.13. IAS, V/S, ALT.A, & ALT upper modes PFD displays

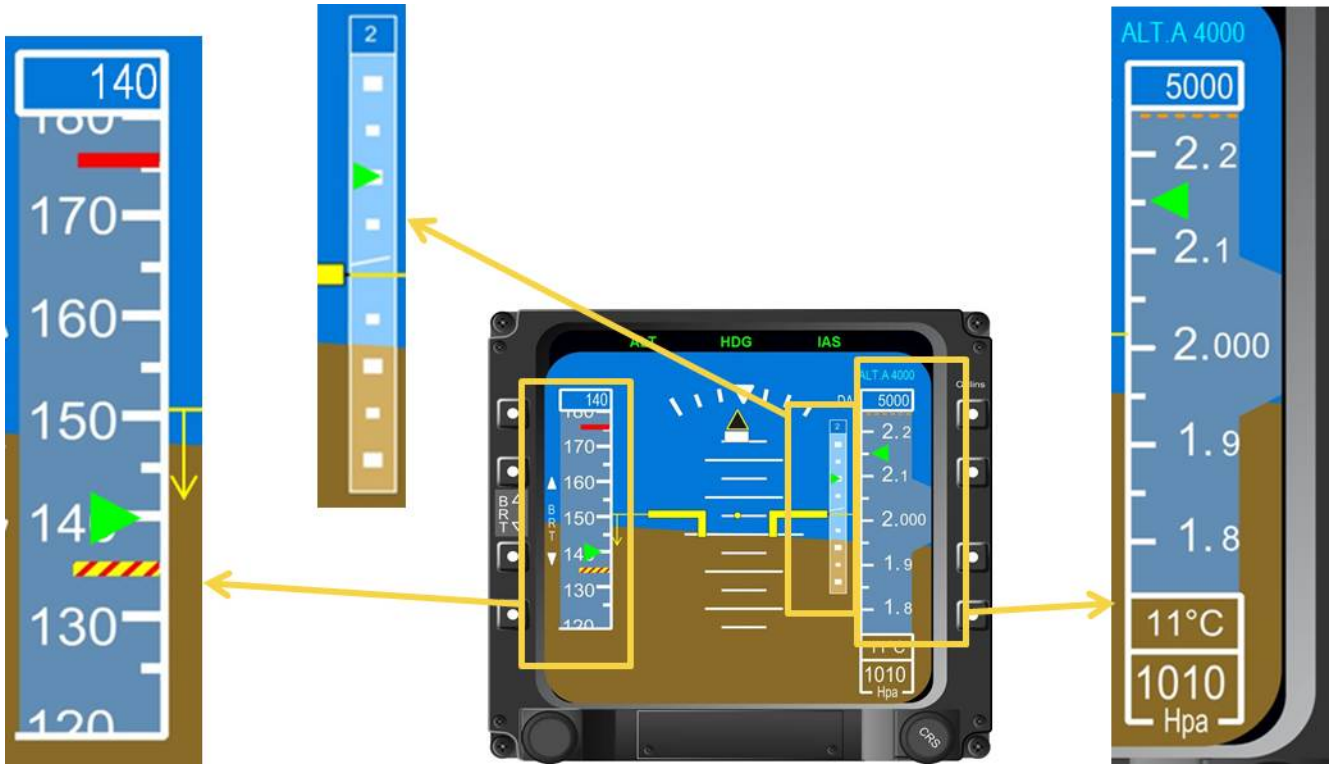


Figure 10: PFD AFCS modes display.

IAS: Indicated Airspeed upper mode

- **IAS** mode coupled: the **IAS** reference bug ▶ and the **IAS** numerical value XXX at the top of the airspeed band indicator.
- -half of the triangle in green ◤ or ◣ are displayed when the reference selected is out of the band.

NOTE

The airspeed scale includes Vy and Vtoss marking in blue.

V/S vertical speed hold

- **V/S** mode coupled: the **V/S** reference bug ▶ is green.

ALT: Altitude hold upper mode

- Upon coupling the **ALT** mode is set on the current baro-altitude value.
- The **ALT** reference bug ◀ is displayed in green on the altitude scale.
- The Altitude can be preset using the ALT.A mode.

ALT.A: barometric Altitude Acquisition mode

- **ALT.A** mode pre-selected: the barometric altitude target is displayed above the altitude scale with an "ALTA" and XXXX (in feet) digital value in cyan.
- When the preset value is inside the current altitude window: an additional cyan **ALT.A** reference bug ◀ is displayed on the altitude scale.
- When **ALT.A** is preset but not armed and the current altitude is at less than 300 ft of the preset **ALT.A** value: "ALTA" and digital value XXXX are displayed (cyan inverse video)

2.4.3.14. HDG, NAV & CR.HT upper modes ND displays

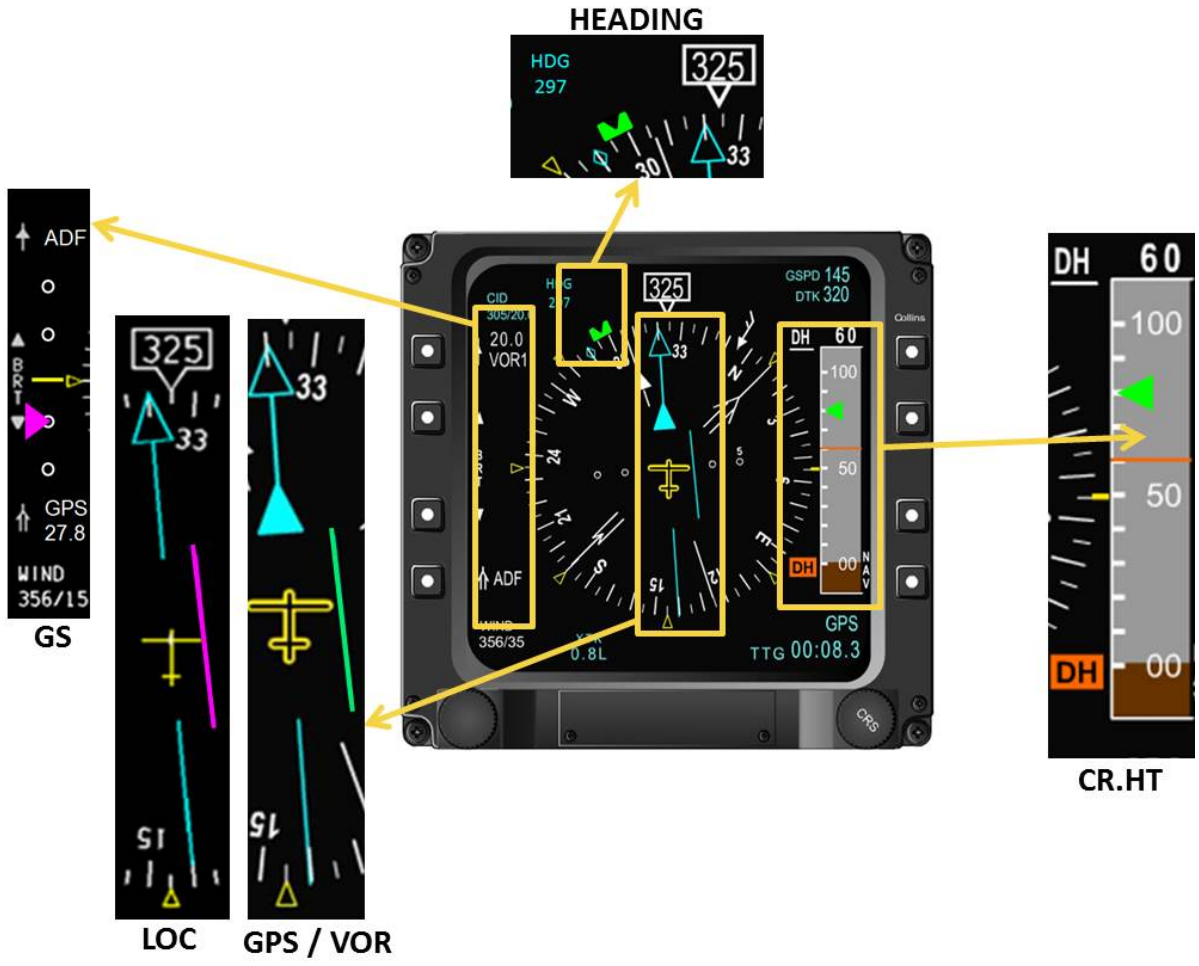


Figure 11: ND AFCS modes display.

CR.HT: Cruise Height upper mode

- **CR.HT** mode pre-selected: the radio-altimeter (radalt) height target is displayed above the radalt scale with a "CRHT" cyan prefix and a cyan digital value XXXX (in feet).
- When the preset value is inside the current radalt window: an additional cyan reference bug ▶ is displayed on the radalt scale.
- If preset value is outside of the scale, cyan half triangle ◣ or ◤ are displayed.
- **CR.HT** mode coupled: the "CRHT" prefix on AFCS strip (PFDs) the radalt target digital value XXXX and the **CR.HT** reference bug ▶ in green. When outside of the scale, bug is displayed in a half triangle in green color: ◣ or ◤

HDG: Heading upper mode

- **HDG** mode pre-selected: a cyan ▼ (**HDG** reference bug) is displayed on the heading rose (or arc) and a numerical value HDG XXX top left of the screen is displayed allowing fine setting of the heading bug then disappears after 5 seconds.
- Using a sector display, when the **HDG** reference is out of the heading arc the **HDG** reference numerical value XXX (in degrees) and half of the triangle are displayed in cyan at the end of the heading arc.
- **HDG** mode coupled: the **HDG** reference bug ▼ is green. If no change has been applied, numerical value is not displayed.
-

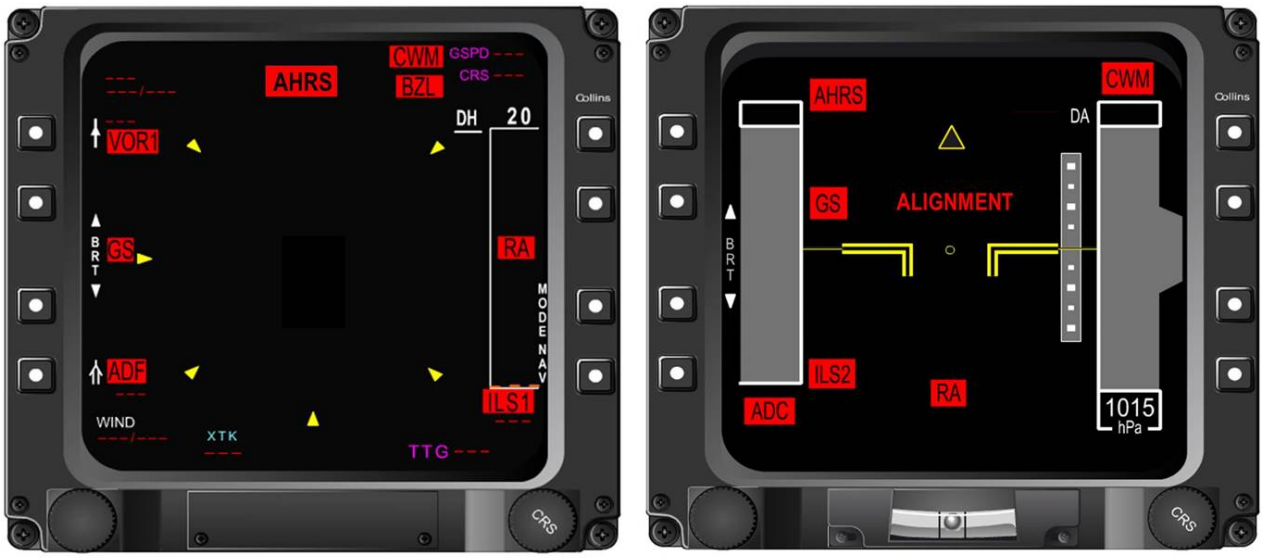
AFCS Navigation coupling or armament:

The NAV mode coupling requires first the Navigation source to be selected by the pilot on the ND Master (see “Master & Slave paragraph above)

- The crew selects the type of navigation VOR/ILS1 or 2, FMS or GPS by scrolling with the right/down bezel key of the master ND. Information on the NAV source is displayed in the right lower corner of the screen.
- For VOR and ILS pilot shall set the appropriate course using the CRS knob, before pressing the NAV mode to be either coupled or armed.
- Colors code on the NDs depends on MASTER side selection, NAV mode status “Armed” or “Captured” and type of navigation. (Refer Fig.16)

2.4.3.15. MFDs alarms AFCS related

- Failures displayed on PFD and ND:



ND **PFD**

Procedures to be applied are detailed in the Rotorcraft Flight Manuals.

3. AFCS OPERATING MODES

3.1. WHAT AFCS PROVIDES?

As soon as the helicopter is powered-up with 28V, AFCS and SEMAs processing units are supplied and perform internal self-tests and initialization of the actuators.

After completing this automatic power-up build-in test the APM is ready to be engaged. On ground, with hydraulic power, the pre-flight test shall be performed once a day , before first flight. Test result is showing the condition of the system.

Before taxiing and takeoff, pilot engages AP and the stabilization mode is ATT available as soon as the helicopter is off the ground. The ATT mode is the default mode and the highest handling quality processed: ATT is a long term attitude retention monitoring helicopter attitudes with AHRS information and the APM maintains the reference attitude trimmed by the pilot. These attitudes references can be modified with different techniques or Upper modes can be couple to acquire or hold a precise flight parameter.

From ATT, pilot can couple upper modes, on Pitch, Roll / Yaw and Collective axis, enabling acquisition and hold of pilot selected values such as altitude or height, airspeed, heading, enroute navigation and approaches.

When degradation occurs, AFCS displays degraded status on the AFCS strip, or Hands On if severe degradation. In this case pilot has to keep hands on the controls and select the SAS back-up mode, giving only short term stabilization, with no upper mode available.

3.1.1. PRE FLIGHT TEST

After engines start and before first flight of the day, the full Pre Flight Test has to be performed. The Pre-flight test is conducted in two phases, AFCS APM test followed by the back-up SAS p re-flight test. Duration of the pre-flight test is approximately 25 sec.

Purpose: to make sure that no failure regarding safety (mainly dormant failure) as well as operational aspects is present before the flight.

The Pre-flight test will cover:

- The test of APM processing unit hardware and safety devices,
- The check of cyclic and collective grips,
- The APMS controls,
- The actuators (trim, SEMAs) operation,
- The “freeze” signal of SEMA when APM or sensors failure,
- The back-up SAS operation,
- Alarms and Hands On signal,

Prerequisites: to be able to engage the TEST, the following conditions shall be met:

- Helicopter is “on ground” received by both APM lanes from dual “wheels-on-ground” signals,
- AP disengaged,
- Collective stick unlocked and full low Pitch position,
- Cyclic sticks and pedals free,
- Hands and feet off,
- Hydraulic system pressurized,
- Radio-altimeter(s) to “ON” position,

In addition, the power-up test should have been successful.

Starting the Pre-Flight Test

Launching the pre-flight test is performed with the AP OFF by pressing the TEST pushbutton on the APMS.

The test pushbutton ON light is blinking all during the test sequence. Flight controls cyclic, collective and pedals must be free and pilot(s) must not interfere as pre-flight test includes flight controls movements.

While the test is running, pilot checks as indicated below the illumination of warnings and annunciation lights and verify without interfering with the movement of flight controls:

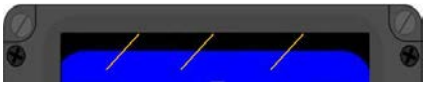
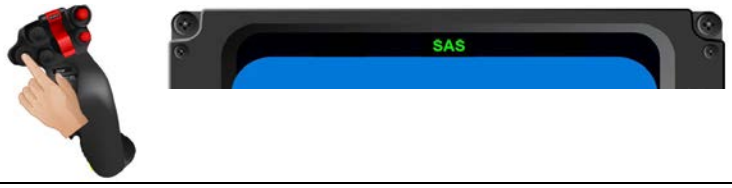
On APMS	
On PFDs	 then 
On CAP	
FLIGHT CONTROLS	 **CAUTION** collective pitch lever must be unlocked before starting pre-flight test
After APM test result, and test disengagement, test back-up SAS	

Figure 12: AP pre-flight test procedure.

At the end of the pre-flight test a message reporting the APM test result is displayed on the PFD AFCS strip, the message shows the condition of the APM, and 3 different displays may be observe as follow:

	Test ON light Off, and AFCS strip AP TST OK: No failure is detected, pilot can continu with the back-up SAS pre-flight test
	Test ON light continues blinking, and AFCS strip AP TST FAIL: A minor failure is detected; pilot can engage the AP and use basic stabilization only.
	Test ON light illuminated steady, and AFCS strip AP TST FAIL: A major failure is detected, pilot cannot engage the AFCS,

CAUTION

TAKEOFF WITH AUTOPILOT INOPERATIVE IS FORBIDDEN

Figure 13: AP pre-flight test results table.

After checking the AFCS TEST strip message, pilot switches ON the AFCS with APMS to erase AP TEST message and then select AFCS OFF using the cyclic AP/SAS CUT OFF pushbutton.

When AP is off, pilot select SAS Back-up with cyclic SAS pushbutton

3.1.2. IN FLIGHT MONITORING

During operation, SEMAs and AFCS processing units perform continuous internal tests.

AFCS processing units also perform continuous AFCS system monitoring (cross-checks between AFCS Chanel A & Chanel B, cross-checks between AFCS Chanel A & Chanel B orders inside each SEMA).

3.1.3. BASIC STABILIZATION

Performed by the AFCS on pitch and roll, and either heading hold or turn coordination on yaw through series and parallel actuators.

It includes a nor mal operation mode **ATT**itude with **long term attitude retention** and correction of natural cross coupling between helicopter axis, A Stability Augmentation Sub-mode also called Digital SAS when system degrade.

When AP fails, pilot reverts to a Stability Augmentation mode SAS providing stability augmentation on Roll and Yaw using FOGs only.

3.1.3.1. How to engage the AFCS?

AFCS is engaged after satisfactory completion of the Pre-Flight Test, and prior to taxi. Engaging the AP is on the APMS AP pushbutton, crosschecked with PFD AFCS strip where OFF disappears and three green frames flash for 10 seconds.

The AFCS is now in ATT basic stabilization and AFCS strip is empty.

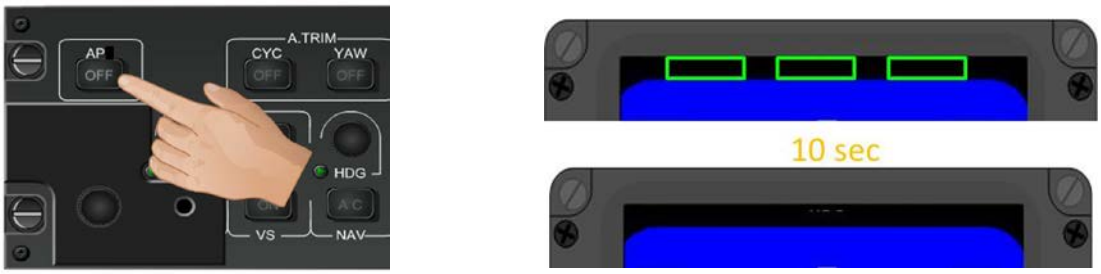


Figure 14: AP engagement.

3.1.3.2. Cyclic automatic centering function:

Helicopter on-ground and AFCS selected ON, pilot can any time reposition the cyclic in the neutral centered position by pressing 1-second the CPL Release push button.

The re-centering movement can be stopped by a pilot input on the cyclic, or pressing trim release, or stopped automatically if a delay of more than 7 seconds occurs.

NOTE

When pressing the CPL Release pushbutton for more than 2-seconds, all AFCS mode pre-selected references are removed.

3.1.3.3. Long Term Attitude Hold ATT

The ATT mode is the selected mode by default, as soon as AP is engaged in normal operation providing a current attitude hold on Pitch and Roll axis, with either a heading hold or turn coordination on yaw axis whether hover or cruise flight. The ATT mode is the mode required to couple Upper modes, and when upper modes are decoupled, the AP remains in ATT mode.

ATT mode includes protections in pitch and Roll to limit the beep trim authority to the following:

Cyclic beep trim: maximum nose up and down = 24 deg., maximum angle of bank = 45 deg left / right.

When in ATT, the AP offers to the pilot different techniques to **fly-through**:

- **Hover follow-up**: when in hover and below 30 KIAS and up to 40 KIAS, longitudinal and / or lateral pilot inputs on cyclic against the spring induces an attitude reference synchronization to the current attitude together with a follow-up trim command.

NOTE

The follow-up trim is momentarily stopped when maneuvers in Hover exceed 2 deg/sec.

- **Beep-trim**: using the cyclic grips 4-way switch, pilots can change attitude reference on pitch with a 2 deg/sec beep speed, and reference in roll with a 4 deg/sec beep speed.

Cyclic beep trim use includes protections in pitch and roll inhibiting the beep trim beyond the following values: Pitch =24 deg of nose up or down, Roll = 45 deg. left and right.

When using the collective grips 2-way switch or beep, the pilot can change the collective lever position with protection regarding the power limits, either twin or single engine.
Beep trim is used for small and precise changes of attitude, pitch and roll on cyclic and precise power changes with collective beep.

CAUTION

Using beep trim simultaneously on pilot and copilot cyclic grips, in opposite direction, the APM will not follow any trim and will inhibit the beep trims functions.

Beep trims functions can be reactivated by disengaging then re-engaging the AP.

- **Override against the spring loads (Indicated Airspeed > 40kt)**:

  On the cyclic, after 40 kt IAS the APM is no more in follow-up trim mode, the pilot can override the attitude hold function by flying through in pitch and/or roll. The AFCS automatically switches to a Hands-On status called CSAS (Command and Stability Augmentation System) on the relevant axis. When fly-through terminates, the helicopter is returned to the previously trimmed attitude.

  On the collective, do not to fly-through and override spring loads as releasing the effort will reposition immediately the collective lever in the initial position. Only in case of immediate power modification for safety reason it may be possible to fly-through. It is possible to fly-through for minor power modification around the reference position.

- **Fly-Through - Stick + beep**: the pilot fly-through and simultaneously uses in the same direction the 4-way switch on the cyclic grips: the trim is commanded to follow up the stick; the attitude reference slowly joins the current attitude. This mode can be used after a significant change of attitude with the cyclic stick, and pilot decide to keep stable this new attitude.

- **Trim release**: when pressing cyclic trim release Pb all cyclic trim actuators are declutched and efforts are suppressed, the AFCS switches to CSAS mode. Then, if a cyclic position has been changed, the AFCS holds the new position as soon as the trim release Pb is released.
  Pilots should pay attention when flying through while the Cyclic trim release Pb is depressed as the feeling and anchoring point are lost.
  On the collective, it is necessary to press the collective trim release for collective / power changes.

3.1.3.4. Stability Augmentation Sub-mode (Digital SAS):

From ATT, when the auto-trim function is deactivated - i.e. for training purposes by pressing the CYC A.TRIM on APMS, AFCS control law is still managed by APM with handling qualities lower than ATT. Digital SAS provides only stability augmentation on roll and pitch axis using series actuators while the Yaw remains unaffected. The Digital SAS reduces natural instability of the helicopter helping the pilot in controlling the aircraft, but it does not hold attitude and upper modes are not available. Pilot workload increase has to be considered.

CAUTION

When AP control law is Digital SAS, The pilot has to fly Hands-On.

3.1.3.5. Backup SAS mode

The SAS stabilization is available in case of APM computer total loss. Stability augmentation is provided on roll and yaw using series actuators only. This mode is not processed by the APM computer but by FOGs. Back-up SAS does not hold attitude and upper modes are not available. Pilot workload is increased and has to be considered.

Procedure:

Back-up SAS does not engage automatically upon AP failure. The SAS engagement is a pilot action following a total loss of APM:

AP .....on CWP

C YR P *10sec*..... Hands-On collective, cyclic and feet on pedals: pilot takes controls

OFF OFF OFF AFCS strip.....check

APMS AP ..... OFF

Identify cyclic SAS Pb..... press SAS 

SAS ..... check on AFCS strip

CAUTION

The pilot has to fly hands on cyclic and collective, feet on pedals for heading stabilization and coordinated turns

3.1.3.6. Power protection in basic stabilization

In ATT, power protection is active only when power changes applied by the pilot are made using the collective beeper trim.

In AEO, APM applies power rating limits as function of the indicated airspeeds. the reference powers will be MTOP and MCP according to the chart in fig 14

When flying single engine OEI the references are limited at the selected OEI rating: CT, LO or HI.

Any application of beep trim higher than the limit will be inhibited automatically by the APM.

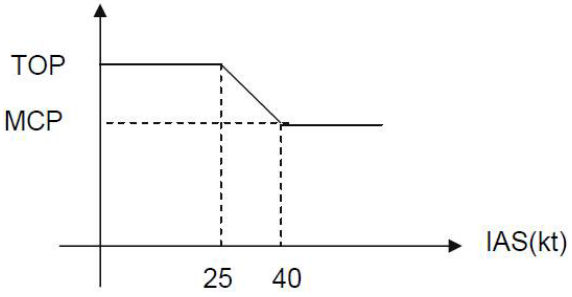


Figure 15: ATT power limits vs IAS

When power changes in ATT are made pressing the collective trigger, pilot is fully responsible for power limitations.

3.1.3.7. Good practices using basic stabilization (ATT mode)

Cyclic stick

- Beep trim the roll at zero angle of bank, and for turning, apply the appropriate angle of bank through cyclic stick load (override against the springs) in order to recover zero bank angle reference when releasing cyclic stick.
- When adequate cyclic stick position is found to follow desired flight path, use:
  - Beep trim for small adjustments,
  - Trim release for significant flight path change. Trim release should be a one-press, and not a continuous application as trim release application cancel artificial effort (feeling) and anchoring point is lost. In IMC pitch attitude has to be changed with cyclic pitch beep trim.
- In ATT mode, pilot can fly cyclic hands-off temporarily after canceling cyclic stick forces.

CAUTION

In degraded basic stabilization (DSAS or back up SAS mode), pilot must be hands-on on cyclic stick.

Collective lever

- Collective trigger (Collective trim release) shall be pressed to change collective lever position (4-axis autopilot).
- In ATT mode the collective lever can be hands-off: for power adjustment, use:
  - Collective beep trim ,
  - if important change or continuous control (final, landing) is required, press the trigger and control the collective lever manually.

NOTE

For collective changes, use of the collective beep trim in ATT allows a power automatic limitation from the APM.

Yaw pedals

In cruise flight, free pedals allow AFCS to maintain ball centered (drift cancelled).

During takeoff, acceleration to VTOSS pilot should be Feet-On during transition from hover logic to cruise logic, where the yaw control changes from heading-control to Yaw / Roll coordinated turn.

Maximum bank angle protection: the Roll beep trim is inhibited above 45° of bank angle.

3.1.4. AFCS UPPER MODES:

As soon as Basic stabilization ATT mode is active the AFCS provides a large set of upper modes on longitudinal, vertical and lateral axis:
Longitudinal mode: Indicated Air Speed mode (**IAS**),
Vertical modes: Altitude hold (**ALT**), Altitude Acquisition (**ALT.A**), Vertical Speed mode (**VS**), Cruise Height (**CR.HT**),
Lateral modes: Heading mode (**HDG**),
Combined modes: Go Around (**GA**),
Navigation and approach modes: VOR navigation (**VOR**), ILS approaches (**LOC** & **G/S**), FMS / GPS navigation (**NAV**),
Search And Rescue modes: for SAR option helicopters: TBD.

Thanks to the 4 axes control, multiple combinations of these modes are possible. Flying-through the modes is still available while an upper mode is coupled (beep trim, effort against spring loads & trim release),
The AFCS has a full capability to provide necessary information (i.e. “immediate recovery” alarm, state change, mode coupling, reference, degradation or excessive deviation and out of trim) to the Primary Flight Display System (PFD).

The pilot can fly “hands-off” on the flight control axes (Collective, Pitch, Roll or Yaw) when managed by an active upper mode. Pilot has to monitor the AFCS status and be ready to fly “Hands-On” in case of upper mode loss or AP severe degradation.

3.1.4.1. Generalities - CRM and automation

In highly automated aircraft such as the AS365N3+ it is important to ensure that the automation (upper modes) have been set up and coupled correctly.

Pilot must follow the 3 principles (*anticipate, execute & confirm*) in 6 steps:

1. Pre-setting the parameter
2. Verifying the setting
3. Coupling or arming the mode(s)
4. Checking the correct modes are coupled / armed on the AFCS strip
5. Note and confirm when the armed mode changes to coupled
6. Monitoring that aircraft response is as expected

Remember the coupling of mode when axis is already coupled does not require decoupling the previous mode: coupling the mode will automatically decouple the previous one.

3.1.4.2. Managing automation

The AS365N3+ with APM2010 is designed to be flown using the autopilot’s upper modes coupled on the 4 axes, Collective, Yaw/Roll and Pitch to enhance safety and reduce pilot workload. When fully coupled, AFCS protections improve error management from the crew.

3.1.4.3. Automation level

The appropriate level of automation is the one adapted for the task or prevailing condition. If a crew does not use automation, it significantly reduces safety protections.

Coupling or decoupling AFCS upper modes may occur automatically, without intervention from the pilot. Automatic engagements are part of the AFCS design and will provide pilots with enhanced safety protection. These advanced functions will reinforce pilot attention in high workload flight phases as long as system knowledge and mode management is understood. When lack of knowledge or management, doubt installed and lead to confusion in the cockpit.

In confusing situations, do not shift to an immediate hand flying, consider reverting first to more direct upper modes (HDG, G/A, etc.).

Except at night or in poor visual references conditions where the highest level of automation should be used, operators should define when automations are to be used, taking into account the need to maintain aircrew manual flying skills.

3.1.4.4. Fly through and mixed flying mode

The following remarks are based on techniques to be applied to an h/c with an operating AFCS ATT mode and one or more AFCS upper mode coupled.

- **Fly Through** is a situation in which AFCS upper modes are coupled but the pilot overrides the autopilot modes, without disengaging AFCS modes nor changing their reference to ensure the desired flight path.

  After the pilot overriding action (mode(s) no more flashing green / amber), the aircraft is commanded to return back to the attitude reference and the flight path is stabilized. The upper mode resumes command to bring the aircraft back to the mode's reference, with the desired trajectory but after applying a 2-seconds delay without further pilot overrides. During this 2 sec the AFCS strip displays Hands-On symbology (modes toggle green / amber)

  NOTE

  Overriding an AFCS mode shall not be considered as "Helping the AFCS mode". When such action is performed, it is a "high priority" manoeuvre performed by the pilot for safety purposes for example traffic/obstacle avoidance.

- **Mixed Flying mode** is a situation in which the aircraft is AFCS coupled in two or three axes and the pilots flies at least one axes manually.

  NOTE

  The risk of involuntary interference with the AFCS controlled axes is significant, and may lead to a mode override with the consequences described above.

  Both situations (fly through & mixed flying mode) shall be used only for short term (limited time).

- **Hands-On Flying mode** is a situation in which the aircraft is flown manually using AFCS ATT stabilization.
- Transition from Fly Through, Mixed Flying or Hands-On mode to AFCS upper modes guidance:

  Before reverting to upper modes guidance, in order to avoid high residual forces are still felt; it is highly recommended to first reduce those forces by:

  - A short trim release action or
  - A stick-plus-beep trim action or
  - A beep trim action.

3.1.5. APM2010 UPPER MODES PROTECTIONS

3.1.5.1. Power protections with upper modes

When a vertical upper mode is coupled on the Collective axis (4-axis operation), the power and power limits are automatically managed by the autopilot when flying AEO and OEI.

All engine operative (AEO)

- Airspeed < 25 kt: the power limit is set to the Maximum Take-Off Power (MTOP),
- 25 kt < Airspeed < 40 kt: gradually the power limit decreases from TOP to MCP,
- Airspeed > 40 kt: the power limit is set to the Maximum Continuous Power (MCP).

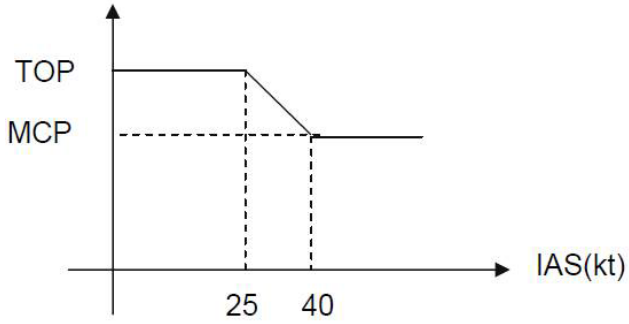


Figure 16: AFCS vertical upper modes power limits

Single engine operation (OEI)

- On OEI, the vertical modes coupled on the pitch axis (3-axis) are immediately transferred to the Collective axis and IAS is coupled on Pitch, forcing to 4-axis operation and optimizing OEI power limits automatic management combined with vertical mode versus longitudinal mode management.
- The AFCS applies up to the selected OEI rating limit. As the OEI 30'' (OEI HI) rating is automatically selected, by the FADEC in case of engine loss, it will be managed by the AFCS until the pilot switches to a lower limit (OEI LO or CT).

CAUTION

In strong turbulence, if IAS value is not stable with ALT coupled, disengaging IAS will allow ALT to be maintained on the Pitch axis with a fixed collective pilot setting.
When the AFCS Collective axis is not operative (forced 3-axis operation), the pilot has to manage the collective lever manually and must respect the power limitations.

Minimum torque protection

- to avoid rotor / free turbines desynchronization during descent or speed reduction with an upper mode coupled on the Collective axis, AFCS does not lower the torque below the following values:
  - 2 x 5 % (AEO)
  - 1 x 10 % (OEI).

3.1.5.2. Flight envelope protections (upper modes coupled)

With upper modes coupled the AFCS prevent exceedance of limitations. The active limitations listed below will be activated.
When overriding one or more upper modes, pilot is responsible of exceeding limitations, and shall monitor the parameters.

Airspeed envelope protections

- IAS envelope limitations: an airspeed protection is introduced to limit the IAS reference value in the range 30 kt and the computed VNE for a 3000 kg helicopter, 175 kt reduced by 3 kt per 1000 ft.

AFCS is able to manage the Vy for optimum rate of climb speed particularly useful in OEI critical phase of flight.

Moreover the AFCS provides the pilot with VTOSS set by default at 55 kt and adjustable on ground between 30 kt and Vy: this speed called “pseudo VTOSS” reference will be used when upper modes are coupled during takeoff and departure following an OEI procedure.

NOTE

Vy and VTOSS are displayed in cyan on PFD airspeed scale

- 3-axis to 4-axis automatic reversion: in 3-axis operation with a vertical mode coupled (vertical mode on the Pitch axis), if speed decreases and airspeed trend vector reaches 60 kt, there is an automatic reversion to 4-axis operation by coupling IAS and vertical mode switching on the Collective axis. IAS mode stops the airspeed reduction and the collective mode readjusts the power, increasing to avoid descent, if necessary up to the authorized maximum power. This safety feature will protect the helicopter to drop in the back side of the “power required in level flight” curve.
- Vortex protection: in order to prevent exposure to Vortex and settling with power at low air speed / high rate of descent, a reduction in rate of descent for the modes coupled is automatically applied following an airspeed reduction in descent. (see VS and ALT.A modes)
- Modes priority according to airspeed: reaching the maximum power in 4-axis operation, **IAS** coupled together with a vertical mode, the AFCS will give :
  - vertical mode priority above Vy: **IAS** bug is unchanged, the current airspeed may decrease but without excessive deviation chevron display,
  - **IAS** hold priority at or below Vy: the vertical mode bug is unchanged, the current vertical mode value may decrease with excessive deviation chevron display.

3.1.5.3. Ground proximity protection

- Automatic **ALT** coupling close to the ground:
  - When descending with **VS** or **VS** with **ALT.A** coupled, the **ALT** mode is immediately coupled near 150 ft to terminate level-off at 150ft above the ground. This 150 ft information is provided by radio-altimeter.
  - When descending on an ILS, with **GS** mode coupled, **ALT** is automatically coupled to level-off at 80ft above the ground using radio-height information.

NOTE

The equivalent baro-altitude corresponding to 80 ft above terrain is evaluated throughout the descent.
If the runway is located in an elevated position, the ALT mode target baro-altitude may be too low and require pilot manual upward correction.

  - If **IAS** is coupled without any vertical mode (3-axis operations), **ALT** is automatically coupled when descending towards the ground to stabilize the aircraft at 150 ft above the ground using radio-height information.

3.1.5.4. Attitude limitations

- -12° < commanded Pitch attitude < +14° when IAS, VS, ALT, GS, ALT.A, and GSPD modes are coupled on Pitch.
- With LOC armed: -30° < commanded Roll attitude < +30°,
- With HDG, VOR, NAV = +22 deg left or right.
- With GSPD, = the commanded roll attitude is limited (+6.75° to +30°) depending on airspeed.

3.1.6. GOOD PRACTICES TO USE APM2010 UPPER MODES

Whenever it is possible, it is highly recommended to couple the upper modes in order to decrease the pilot's workload. APM functions are very helpful particularly in critical situation and increase flight safety. You will find hereafter definitions and good practices of the APM 2010:

3.1.6.1. 3-axis / 4-axis definition

In normal conditions (AP engaged, Collective, Yaw, Roll & Pitch axes operative):

- When the upper modes command only the cyclic and the yaw control (Pitch, Roll and Yaw axes can be used, no upper mode coupled on the Collective axis, no upper mode label displayed on the left side of AFCS strip): it is called **"3-axis operation"**. The collective lever must be controlled manually (hands-on controls) but power limitation can still be with the APM if using the collective beep trim. If not, pilot must apply collective within the applicable power limits.
- When the upper modes command the collective lever (4^{th} axis), the cyclic and the yaw: it is called **"4-axis operation"**. The pilot can hence fly completely hands off, however pilot attention is still required near the ground.

3.1.6.2. General recommendations

IAS mode coupled

- It is recommended to use a vertical mode while using the **IAS** mode otherwise the pilot has to manage collective power closely to stabilize vertical flight path.

Vertical mode coupled

- It is recommended to use the **IAS** mode while using a vertical mode otherwise the pilot has to manage collective power closely to maintain airspeed.
- When climbing or descending to an as signed level-off altitude, it is preferable to use **ALT.A** armed instead of directely **VS** mode.

Lateral mode coupled

- It is recommended to couple the **IAS** mode while using a lateral mode otherwise the input on the cyclic stick may disrupt the lateral mode stabilization.
- It is also recommended to use a vertical mode while using a lateral mode otherwise the pilot has to manage collective power to stabilize vertical flight path.

3.1.6.3. Recommended minimum usage heights

When using upper modes, pilots should continue to monitor flight parameters and understand corrections when upper modes are coupled, armed and captured.
Below 500 ft AGL, pilot must be ready and keeps hands and feet in a position allowing an immediate and precise manual control in order to correct any unexpected change in flight parameters. Below 200 ft AGL, pilots shall be fully attentive with hands on or close to cyclic and collective grips without interfering with the AFCS coupled upper modes.
On coupled ILS approach pilot shall be ready to fly Hands-On below 130 ft and revert to ATT not later than the stabilization at 80 ft.

When using CR.HT mode minimum height is:

300 ft AGL when QNH is available and selected,

500 ft otherwise

3.1.6.4. Upper modes reference change

CR.HT, and **HDG** mode references can be modified either by rotating the rotary knobs on APMS or by action on the beep-trims located on cyclic or collective grips.
ALT.A can only be preset and armed on the APMS. When armed, the reference can be changed using the same ALT.A knob at the APMS.

Small corrections

- When the new desired value is inside the current display window, pilot's action on the 4-ways beep trims on the cyclic or on the collective grip is recommended for small corrections.

Large corrections

- Rotation of the corresponding knob is recommended for large corrections ("out of the display window").

ALT mode specificity

- The Collective beep trim is used for the small corrections within the altimeter scale; otherwise the **ALT.A** mode must be used for large changes.

3.2. ALT: ALTITUDE HOLD MODE

3.2.1. HOW ALT WORKS?

The Altitude (ALT) mode maintains the current barometric altitude upon engagement. For this purpose, ALT may be installed either on Pitch (3-axis) or Collective (4-axis).
The ALT mode cannot be preset, and for altitude change planning another mode has to be used: altitude Acquisition (ALT.A). Nevertheless, small altitudes variations of less than 300 ft can be applied with the ALT mode coupled.
ALT is using the Master side barometric information. When ALT is coupled, a barometric setting change does not decouple the mode, but pilot must readjust the reference.
For safety purposes ALT includes a power limitation in AEO and OEI when installed on collective axis, and airspeed limits high and low, associated with nose attitudes limits, when applied on pitch axis.

3.2.2. HOW TO USE ALT?

3.2.2.1. Envelope

Speed envelope: with ALT installed on pitch, when speed drops below 60 KIAS the ALT changes to be controlled through the collective axis,
When ALT mode is on the collective, with no IAS mode on the pitch, ALT shift to pitch when airspeed is above 65 KIAS for at least 5 sec.
Altitude limit: the bottom altitude of the ALT mode is 30ft,

3.2.2.2. Pilot coupling and decoupling ALT

ALT mode is coupled and decoupled by pressing ALT on the APMS.

To decouple ALT pilot has to press ALT on the APMS or use either pilot or copilot cyclic CPL Release pushbutton.

NOTE

When pressing CPL Release all coupled upper modes are immediately decoupled.

When coupling ALT.A, the ALT mode couples automatically 300 ft before reaching the datum.

3.2.2.3. Automatic decoupling of ALT

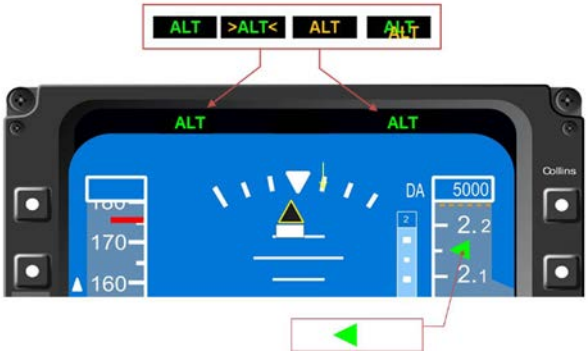
When ALT is coupled on pitch, coupling IAS mode on the pitch will force ALT to shift to the collective when available.
ALT is decoupled automatically when pilot couples CRHT, VS, ALT.A and GA or GS status change from armed to coupled.

ALT mode will also decouple when either:

- a discrepancy between AHRS 1 and 2 occurs,
- AFCS is disengaged (loss of ATT basic stabilization)
- Loss of pitch axis: cyclic Auto Trim loss, or cyclic trim Feel permanently released and loss of collective axis: collective trim failure or collective trim feel permanent release.
- Complete loss of barometric altitude valid signal for more than 10 seconds'
- complete loss of airspeed signal for at least 10 sec the ALT mode flashes amber and shift to the collective, but when collective axis already failed the ALT is decoupled.

3.2.2.4. Displays

When coupling the ALT mode, a green ALT is displayed on the AFCS strip LH side (4-axis) when ALT is controlled through the collective axis, on RH side when controlled through the pitch axis (3-axis) and a green triangle . ALT label colour changes defining the status of the mode, as follow:



ND	PFD		Remarks
	COLL	PITCH	
N/A			ALT not coupled APM is ON and when in-flight, ALT is ready to be coupled on collective or pitch according to the airspeed.
N/A	ALT	**If airspeed <60kt, or** IAS	ALT mode coupled in normal operation. Engagement and disengagement is indicated with a green rectangle to highlight the concerned upper mode. ALT underline with white line when altitude reference is modified Green bug is displayed on both LH and RH MFD's altimeters. **NOTE** **ALT illuminates amber on the pitch when airspeed drops below 60 kt, and ALT is shifting to collective axis.**
			
N/A		**ALT airspeed >65kt for 5 sec.**	ALT mode coupled in normal operation. Engagement and disengagement is indicated with a green rectangle to highlight the concerned upper mode. ALT underline with white line when altitude reference is modified. Green bug is displayed on both LH and RH MFD's altimeters.
			
N/A	>ALT< or >ALT<		Excessive deviation on the ALT mode. Difference of more than 82ft detected between ALT reference and actual helicopter altitude.
			
	ALT ALT or ALT ALT		When ALT AFCS strip message toggles between amber and green: pilot is overriding the mode and applying inputs in roll. ***Stop overriding the ALT mode to recover a ALT green mode.***

		ALT degraded when: • An altitude information difference between both ADCs reach 60ft when below 8000ft and up to 100ft when at 20000ft, if difference exceeds 120 ft between two valid altitudes information the mode is decoupled. ADC DISC may be displayed on PFDs, or • Airspeed difference of more than 12kt, ALT flashes amber then shift to collective axis if available, or • Loss of redundancy in altitude signals: ADC1 or ADC2 is displayed on PFDs • only one ADC selected on RCU **APM is calling for pilot attention: the ALT mode may flash for 10 sec. in amber before to disconnect in case of total altitude information loss.**

Figure 17: ALT upper mode displays

3.2.2.5. How to manage ALT mode?

As soon as pilot depresses the ALT APMS push-button, the **ALT** mode is coupled and its reference is set at the current helicopter barometric altitude. Depending of airspeed, or IAS mode coupled, ALT mode is installed on pitch or collective.

NOTE

It is recommended to select IAS with ALT, and in result flying in 4-axis coupled.

To change the ALT reference, whatever the 3-axis or 4-axis option, control of the ALT bug is made using the collective beep trim. Pressing forward will reduce the ALT reference, pressing aftward increase it. When reference has been changed, the APM2010 will apply a maximum of 500 Feet per minute rate of climb or descent.

CAUTION

WHEN CHANGING ALT BUG TO DESCENT IN 3-AXIS, PILOT SHALL MONITOR THE AIRSPEED AND REDUCE SLIGHTLY POWER IN ORDER TO NOT EXCEED THE ACTUAL VNE.

In normal conditions, pilots must use ALT on the collective, with IAS on pitch and a lateral mode in Roll / yaw. Nevertheless, flying with 3-axis option can be required in particular situations: turbulences, were the collective pitch hit the MCP limit to control altitude, or during Engine Power Margin recording were a stabilized level flight shall be performed with no power changes.

3.2.2.6. Safety devices & Automatic coupling of ALT

ALT includes a power limitation when installed on collective axis, with a collective law fully available, limiting power as follow:

- When AEO: power is limited at MTOP when below 30KIAS, reducing to MCP when above 45KIAS.
- At low power, a safety feature does not authorize the ALT collective mode to reduce power less than 2x5% torque in AEO, or 10% torque in OEI to avoid free turbine and rotor desynchronization.
- When OEI: power is limited to the selected stop (HI, LO or CT).

- When FADEC is in manual or failed: power changes are limited, it is recommended to not use ALT on collective axis.

If ALT is coupled on pitch axis, power is controlled manually by the pilot and inappropriate power application may be observed:

- if lack of power application make the airspeed decreasing below the 60 KIAS automatically IAS is coupled with a 60 KIAS bug, and ALT is coupled on collective allowing power application.
- if excessive power is manually applied, the ALT mode does not exceed the VNE computed at 175 KIAS minus 3 kt / 1000ft @ 3000 kg gross weight.
- in addition, ALT on pitch cannot exceed nose up / down limits of 12 deg. nose down and 14 nose up attitudes.

CAUTION

WHEN ALT COUPLED ON PITCH (3-AXIS), VNE SAFETY LIMIT APPLIED MAY NOT PREVENT VNE EXCEEDANCE WHEN HELICOPTER ALL-UP WEIGHT IS ABOVE 3000KG. PILOTS MUST PAY ATTENTION AND CALCULATE THE VNE ACCORDING TO THE HELICOPTER WEIGHT.

Low altitude protection at ALT coupling: a minimum altitude of 150 ft height equivalent above the ground is automatically set and ALT mode will not go below this value when a “descent” command is selected on ALT. this value is forced to 80 ft when transition from Glide Slope mode to ALT at the end of the ILS approach.
ALT is automatically coupled when VS, ALT.A, IAS mode are coupled and helicopter approaching 150 ft on descent, or GS mode coupled reaching 80 ft.

NOTE

The equivalent baro-altitude corresponding to 80 ft above terrain is evaluated throughout the descent.
If the runway is located in an elevated position, the ALT mode target baro-altitude may be too low and require pilot manual upward correction.

3.3. ALT.A: ALTITUDE ACQUISITION MODE

3.3.1. HOW ALT.A WORKS?

The Altitude acquisition (ALT.A) allows the pilot to preset an altitude reference and acquire it using VS mode. ALT.A mode has an armed status only, and when descending or climbing the ALT.A / VS modes change to ALT mode approximately 300 ft prior the reference.
For this purpose, ALT.A may be installed either on Pitch (3-axis) or Collective (4-axis) depending on the helicopter airspeed.
ALT.A is using the Master side barometric information. When armed, an altimeter barometric setting change does not decouple the mode, but pilot must readjust the reference.
For safety purposes ALT.A is limited in rate of climb and descent, and includes power limiting function.

3.3.2. HOW TO USE ALT.A?

3.3.2.1. Envelope

Speed envelope: with ALT.A installed on pitch, when speed drops below 60 KIAS the ALT.A and VS changes to be controlled through the collective axis, When ALT.A with VS modes are on the collective, with no IAS mode on the pitch, ALT.A and VS shift to pitch when airspeed exceeds 65 KIAS for at least 5 sec.

NOTE

It is recommended to select IAS with ALT.A, and in result flying in 4-axis coupled.

When approaching the ground, the mode reverts immediately to ALT mode in order to hold the altitude corresponding to 150 ft height from radio altimeter.

Rate of climb are limited according to the airspeed and rate of descent are reduced at low speed in order to avoid the risk of vortex and settling with power.

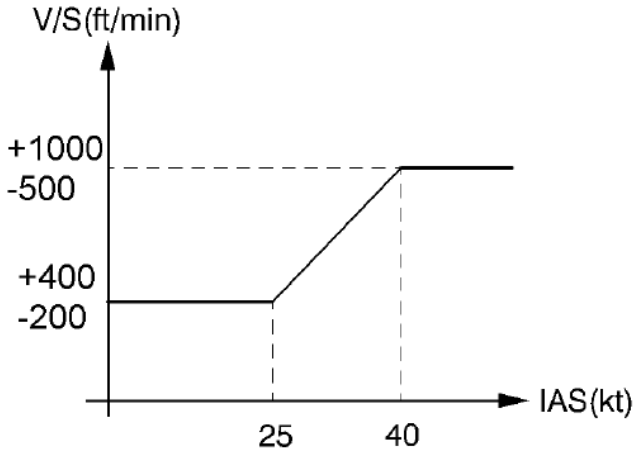


Figure 18: ALT.A mode limits function of airspeed

3.3.2.2. Pilot coupling and decoupling ALT.A

ALT.A must be preset prior to be coupled. By turning the ALT.A rotary knob. Setting must be checked on PFDs top of the barometric altimeter.

Turning ALT.A rotary knob changes step by step the altitude to acquire: step value is 100 ft when above 5000 ft and 50 ft when below.

ALT.A can be coupled by pressing the ALT.A rotary knob on the APMS. When ALT.A button is pressed, ALT.A and VS mode are displayed on AFCS strip and VS ON illuminates on t he APMS, VS ON pushbutton illuminates on the APMS.

To decouple ALT.A pilot has to press ALT.A on the APMS or use either pilot or copilot cyclic CPL Release pushbutton.

NOTE

When pressing CPL Release all coupled upper modes are immediately decoupled.

When climbing or descending with ALT.A, the ALT mode couples automatically 300 ft before ALT.A reference.

Figure 19: ALT.A mode coupling / decoupling on APMS

3.3.2.3. Automatic decoupling of ALT.A

When ALT.A / VS are coupled on pitch, coupling IAS mode on the pitch will force ALT.A and VS to shift to the collective when available.
ALT.A is decoupled automatically when pilot couples CRHT, VS, ALT and GA or GS status change from armed to coupled.

ALT.A mode will also decouple when either:

- a discrepancy between AHRS 1 and 2 occurs,
- AFCS is disengaged (loss of ATT basic stabilization)
- Loss of pitch axis: cyclic Auto Trim loss, or cyclic trim Feel permanently released and loss of collective axis: collective trim failure or collective trim feel permanent release.
- Complete loss of barometric altitude valid signal for more than 10 seconds'
- complete loss of airspeed signal for at least 10 sec the ALT mode flashes amber and shift to the collective, but when collective axis already failed the ALT is decoupled.

3.3.2.4. Displays

ND	PFD		remarks
	COLL	PITCH	
N/A	[redacted]	[redacted]	APM is ON and when in-flight, ALT.A is ready to be coupled on collective or pitch according to the airspeed.
	 (cyan)		ALT.A mode is not coupled green arrow not illuminated on APMS. ALT.A reference zone displays altitude to acquire in cyan.
N/A	VS ALT.A	**If airspeed <60kt, or** IAS	ALT.A mode coupled on collective (4-axis) in normal operation and with  on APMS. Engagement

	 (green) and	and disengagement is indicated with a green rectangle to highlight the concerned upper mode. **VS** underline with white line when altitude reference is modified. ALT.A XXXX reference has changed to green upon ALT.A coupling. Green bug is displayed on both LH and RH MFD's Vertical speed indicators.
N/A	**VS** **ALT.A** **airspeed >65kt for 5 sec.**	ALT.A modes coupled on pitch (3-axis) in normal operation and  with on APMS. Engagement and disengagement is indicated with a green rectangle to highlight the concerned upper mode. **VS** underline with white line when altitude reference is modified. ALT.A xxxx reference has changed to green upon ALT.A coupling. Green bug is displayed on both LH and RH MFD's Vertical speed indicators. **NOTE** **VS illuminates amber on the pitch when airspeed drops below 60 kt, and VS / ALT.A are shifting to collective axis.**
	 (green) and	
N/A	**>VS<** **ALT.A** **or** **>VS<** **ALT.A**	ALT.A and VS does not fulfill the theorical performances of the APM. If pilot "Hands Off" or "Fly Through" : error in vertical speed in excess of 300 ft/min. ***Do not take controls, monitor sharply the climb or descent parameters and be ready to takeover.***
	VS **VS** **or** **VS** **VS**	When VS AFCS strip message toggles between amber and green: pilot is overriding the mode and applying inputs in roll. ***Stop overriding the collective or cyclic axis modes to recover a ALT.A / VS green display.***
		The last phase of altitude acquisition is when entering within the 300 ft from the ALT.A target: **VS** **ALT.A** is replaced by **ALT**, ALT.A XXXX green display disappears when less than 150 ft, allowing preset of another altitude acquisition. Bug appears on the altimeter showing the acquisition target. VS bug disappears.

		ALT.A XXXX info is flashing in inverse video when the helicopter is flying at less than ±350 ft of the ALT.A reference
		ALT.A degradation is similar to ALT and VS degradations, it occurs when: • An altitude information difference between both ADCs reach 60ft when below 8000ft and up to 100ft when at 20000ft, if difference exceeds 120 ft between two valid altitudes information the mode is decoupled. **ADC DISC** may be displayed on PFDs, or • Airspeed difference of more than 12kt, ALT flashes amber then shift to collective axis if available, or • Loss of redundancy in altitude signals: **ADC1** or **ADC2** is displayed on PFDs • only one ADC selected on RCU **APM is calling for pilot attention: the VS mode may flash for 10 sec. in amber before to disconnect in case of total information loss. Monitor altitudes information on PFDs altimeter , VS indicator and Back-up instruments. Be ready for Hands-On.**

Figure 20: ALT.Aupper mode displays.

3.3.2.5. How to manage ALT.A mode?

Use of ALT.A mode shall be preferred when altitudes changes are to be applied with a more than 300 ft difference.

- Pilot shall verify the altimeter setting reference, then preset the ALT.A reference to acquire, and confirm the reference value before to couple.
- As flying 4-axis is preferable, couple IAS mode prior to press ALT.A.
- Coupling ALT.A is carried out by pressing on ALT.A push-button, on the APMS the ALT.A green arrow is displayed, and VS mode is ON .
- Pilot shall check that ALT.A is displayed in cyan under VS mode displayed in green at the AFCS strip. On the PFDs ALT.A reference zone, above the altimeter, the ALT.A value changes from cyan to green until the altitude is capture. Depending on airspeed, or IAS mode coupling, ALT mode is installed on pitch or collective.

NOTE

It is recommended to select IAS with ALT.A, and in result flying in 4-axis coupled.

- When ALT.A mode is coupled the vertical speed reference is set to fixed values of climbing at +1000 ft/min maximum or descending at -500 ft/min minimum (with airspeed above 40 kt). If vertical speed at the ALT.A coupling was greater than +1000 ft/min, VS will keep the actual vertical speed.
- VS reference bug can be changed by using the collective whatever the 3-axis or 4-axis option. Control of the VS bug is made using the collective beep trim. Pressing forward will reduce the VS reference, pressing aft ward increase it.

NOTE

VS reference cannot be adjusted in the opposite direction than ALT.A objective: the minimum VS reference value is +50 ft/min when climbing, or -50 ft/min when descending.

- To change the altitude to acquire (ALT.A XXXX) reference can be made by using the rotary knob and reading the ALT.A XXXX window on PFDs.

CAUTION

WHEN CHANGING ALT.A REFERENCE OR VS BUG TO DESCENT IN 3-AXIS, PILOT SHALL MONITOR THE AIRSPEED AND REDUCE SLIGHTLY POWER IN ORDER TO NOT EXCEED THE ACTUAL VNE.

- Pilot must monitor the climb / descent until the aircraft is stable at the desired altitude and check when reaching the required altitude at **ALT** engagement.

Summary

When	how	reminder
• Small altitudes changes: Within the altimeter indicator scale ≈ 300 ft	• With ALT mode coupled, do not couple ALT.A and use collective beep trim for ALT reference adjustment. NOTE **Couple upper modes (ALT - IAS) and use collective beep trim to take advantage of the power limitation and altitude protection.**	
• Important altitudes changes: more than 300 ft • preset ALT.A reference • when flying multi-crew: PM can preset, PF couples	Use APMS ALT.A rotary switch: • Turn L / R to change ALT.A reference on PFD, • Press to couple the ALT.A mode, verify coupling of VS and ALT.A NOTE **Presetting ALT.A reference can be anticipated, prepare the en-route altitude before takeoff.** **On ground, recentering cyclic (long press) will reset to 0 all preset upper modes references.**	 check PFDs  then 

ALT.A coupled, change rate of climb or descent	• With ALT.A mode coupled, use collective beep trim for VS mode reference adjustment. **NOTE** **VS reference cannot be adjusted in the opposite direction than ALT.A objective: the minimum VS reference value is +50 ft/min when climbing, or -50 ft/min when descending.**	 forward: descent backward: climb
ALT.A coupled, change the target altitude	Use APMS ALT.A rotary switch: • Turn L / R to change ALT.A reference on PFD,	 check PFDs new altitude ALT.A 2100
Decoupling ALT.A	• Decoupling ALT.A is on t he APMS. • If intention is to replace ALT.A by ALT mode while crossing an altitude, there is no need to decouple ALT.A before coupling the ALT mode.	

Figure 21: use of ALT.A summary.

3.3.2.6. Safety features with ALT.A

o **Rate of climb and descent limitation:**

ALT.A is the best aid to avoid altitude busts. Crosschecking altimeter setting and ALT.A reference prior to couple the mode is essential for an efficient use.
ALT.A XXXX is flashing in inverse video when the helicopter is flying at less than ±350 ft of the ALT.A reference, showing the pilot the proximity of the target altitude, even if ALT.A mode was not coupled.
ALT.A mode vertical speed climbing or descending are more restrictive than using VS to prevent power limit or excessive rates of descent. Rate of climb and descent of the mode are designed to provide standard and smooth altitude change rates with an anticipated level off.

Regarding these ALT.A safety features, the mode can be us ed in AEO and OEI operations, must be preferred to climb or descent, and for the taking the best advantages, to couple IAS in order to fly 4-axis.

o **Power limitation:**

ALT.A includes a power limitation when installed on collective axis, with a collective law fully available, limiting power as follow:

- When AEO: power is limited at MTOP when below 30KIAS, reducing to MCP when above 45KIAS.
- When OEI: power is limited to the selected stop (HI, LO or CT).
- When FADEC is in manual or failed: power changes are limited.
- At low power, a s afety feature does not authorize the ALT.A with VS installed on collective to reduce power less than 2x5% torque in AEO, or 10% torque in OEI to avoid free turbine and rotor desynchronization.

o **ALT.A in 3-axis (ALT.A installed on pitch)**

If ALT.A with VS are coupled on pitch axis, power is controlled manually by the pilot and inappropriate power application may be observed:

- if lack of power application make the airspeed decreasing below the 60 KIAS automatically IAS is coupled with a 60 KIAS bug, and ALT.A is coupled on collective allowing power application.
- if excessive power is manually applied, the ALT.A mode does not exceed the VNE computed at 175 KIAS minus 3 kt / 1000ft @ 3000 kg gross weight.
- in addition, ALT.A on pitch cannot exceed nose up / down limits of 12 deg., nose down and 14 nose up attitudes.

CAUTION

When ALT coupled on pitch (3-axis), VNE safety limit applied may not prevent VNE exceedance when helicopter all-up weight is above 3000kg. pilots must pay attention and calculate the VNE according to the helicopter weight.

o **Altitude limitation**

If ALT.A reference is set below a minimum altitude of 150 ft height equivalent above the ground and the mode is coupled, APM stops automatically descent coupling ALT mode and level off at 150 ft.

3.4. HDG: HEADING MODE

3.4.1. HOW HDG WORKS?

The heading mode maintains the current heading upon engagement or acquires and holds a heading reference preset by the pilot.
When coupled HDG controls the roll and yaw as long as heading reference is not reached. When the difference is less than 0,6° HDG holds heading with yaw. When difference increases above 4° then HDG activates the roll.
HDG in cruise flight is coordinating turn, with ball centered. Heading change rate is near the Standard rate at 3°/sec – 360°/2min. the angle of bank is limited to 0.16 times the airspeed in knot (e.g. 16° at 100kt, 22° at 140kt) with a maximum commanded angle-of-bank of 22°. The Roll angular rate is limited to 5°/sec.

Turns are performed in the direction of knob rotation or beeper side even if change exceeds 180°.

3.4.2. HOW TO USE HDG?

3.4.2.1. Envelope

HDG can be coupled in flight, with a minimum airspeed coupling at 26 KIAS, with the AFCS basic attitude (ATT) available,

control pushbutton on the APMS INSTALLED ONLY ON Roll/Yaw axis

3.4.2.2. Pilot coupling and decoupling HDG:

HDG can be coupled by pressing the HDG rotary knob on the APMS. When no preset has been made, coupling **HDG** set reference at the current heading. **HDG** can be preset, by using the HDG rotary switch.

To decouple HDG pilot has to press HDG on the APMS or use either pilot or copilot cyclic CPL Release pushbutton.

NOTE

When pressing CPL Release all coupled upper modes are immediately decoupled.

Figure 22: HDG coupling / decoupling on APMS

3.4.2.3. Automatic decoupling of HDG

Coupling other modes on the roll will force HDG to decouple: these modes are LOC, NAV, VOR.

HDG mode will also decouple when:

- a discrepancy between AHRS 1 and 2 occurs,
- AFCS is disengaged (loss of ATT basic stabilization)
- Loss of roll axis: cyclic Auto Trim loss, or cyclic trim Feel permanently released.
- Complete loss of heading valid signal for more than 30 seconds.

NOTE

When HDG mode is couple, pressing GA will maintain the HDG mode coupled.

3.4.2.4. Displays

When coupling the HDG mode, a green HDG is displayed on the AFCS strip. The heading bug is displayed on the compass card in the ND, in cyan when preset and green when mode is active. A heading readout is displayed during heading setting and is cleared 10sec. after bug is stable. The HDG label and symbols color may change, defining the status of the mode, as follow:

ND	PFD	remark
 for 10 sec.		HDG bug preset but not coupled HDG XXX readout flashing during knob adjustment by the pilot. The digit numbers are matching the position of the HDG bug allowing precise setting. Triangle on the APMS HDG zone does not illuminates: 
	HDG	HDG mode coupled in normal operation. XXXXX displayed for 10 sec. at engagement and disengagement. HDG underline with white line when heading reference is modified. Bug is displayed on both sides master and slave. A green triangle illuminates at the APMS HDG zone: 
	>HDG<	Excessive deviation on the HDG mode. A difference of more than 10° detected between reference and actual helicopter heading.
	HDG HDG	When HDG AFCS strip message toggles between amber and green: pilot is overriding the mode and applying inputs in roll. ***Stop overriding the HDG mode to recover a HDG green mode.***
		HDG degraded : • a difference between both headings information reach 5°, or • loss of redundancy in headings information. • When AHRS1 or AHRS2 only is selected on RCU **APM is calling for pilot attention: the HDG mode may flash for 30 sec. in amber before to disconnect in case of total heading information loss. Monitor heading information on HSI and be ready for Hands-On on roll.**

Figure 23: HDG displays

3.4.2.5. How to manage HDG mode?

Coupling the HDG mode is done via the APMS HDG rotary knob. Pilot may anticipate a heading selection, by presetting the heading using the APMS rotary switch and positioning the cyan bug, then pressing the switch to couple the HDG mode. The helicopter will be controlled to turn in the shortest direction to the bug.

Another method of using HDG, is to press first the HDG APMS switch: the HDG mode is immediately coupled, and bug is positioned on the helicopter actual heading.

When HDG mode is coupled, changing the heading reference can be performed either using the APMS HDG rotary switch, or using the cyclic beep trims. In both cases, the helicopter will turn following the bug or beep trim side in the direction of rotation even if reference change exceeds 180 deg.

The APM2010 will apply a variable angle-of-bank computed with the airspeed, limited to x 0,16 times the airspeed, without exceeding the 22 deg. Left or right maximum limits. APM2010 anticipate the roll-out to stop turn at designated heading with 0 angle-of-banks.

In addition, when HDG is coupled, anytime an urgent situation is developing – i.e. avoiding traffic, bird, obstacles – pilots can fly-through, applying manually roll inputs. HDG bug and reference will not be changed; the reference is maintained, even if pressing trim release on cyclic. When stopping fly-through, the helicopter will be returned to the bug reference.

NOTE

When HDG is coupled, GA coupling does not decouple HDG mode.

Summary:

When	how	reminder
• Small corrections(less than 30 deg), or • flying below 500 ft • precise adjustment after important correction,	• Couple HDG on the APMS • Use the cyclics beep trims for reference change:	 then 
• Important change (more than 30 deg.) • preset heading reference followed by HDG couple • when flying hands-Off • when flying multi-crew: PM can preset, PF couples	Use APMS HDG rotary switch: • Turn L / R: reference change, every clic on the knob is 1 deg • Press to couple the mode	 then 
Decoupling HDG	Decoupling only HDG is on t he APMS. If intention is to replace HDG by another lateral mode (NAV, VOR, LOC) there is no need to decouple HDG before coupling the next mode.	

Figure 24: how to manage HDG?

3.4.2.6. Safety features with HDG

The HDG mode includes safety features on the angle-of-bank limitation according to the airspeed and limited to a m aximum of 22 deg . except when HDG coupled with a LOC mode armed where the maximum angle-of-bank can reach a maximum of 30 deg. for accurate final approach interception.

3.5. VOR: NAVIGATION MODE

3.5.1. HOW VOR WORKS?

VOR mode is design to intercept and track course on a VOR station selected on the Master ND. VOR mode is controlled through the Roll axis and can have different statuses; it can be armed, captured and "over-the-station".

- ARMED STATUS: VOR is received, and deviation from the radial to intercept is great, pilot has to couple HDG mode in order to set an interception heading and arm VOR mode. It is recommended to intercept the course with a difference of less than 90 deg.
  - If course deviation is greater than 45 deg, VOR changes from armed to captured within 0,9 dot, approximately 4,5 deg.
  - If course deviation is below 45 deg. VOR changes from armed to Capture at 0,25 dot ≈ 1,25 deg.

- CAPTURED STATUS: HDG mode is disconnected and VOR is active. The APM computes heading to intercept the radial inbound or outbound as set in the CRS (course). From this phase, the interception and l ater tracking the radial is automatic, managed by the APM as long as the VOR signal is valid.
  - If course deviation is greater than 45 deg: the helicopter heading is computed to maintain a 45 deg intercept until reaching 0,25 dot ≈ 1,25 deg. at 0,25 dot helicopter turn and start tracking phase.
  - If course deviation is below 45 deg: armed status was maintained up to 0,25 dot ≈ 1,25 deg. at this point helicopter tur and start tracking.

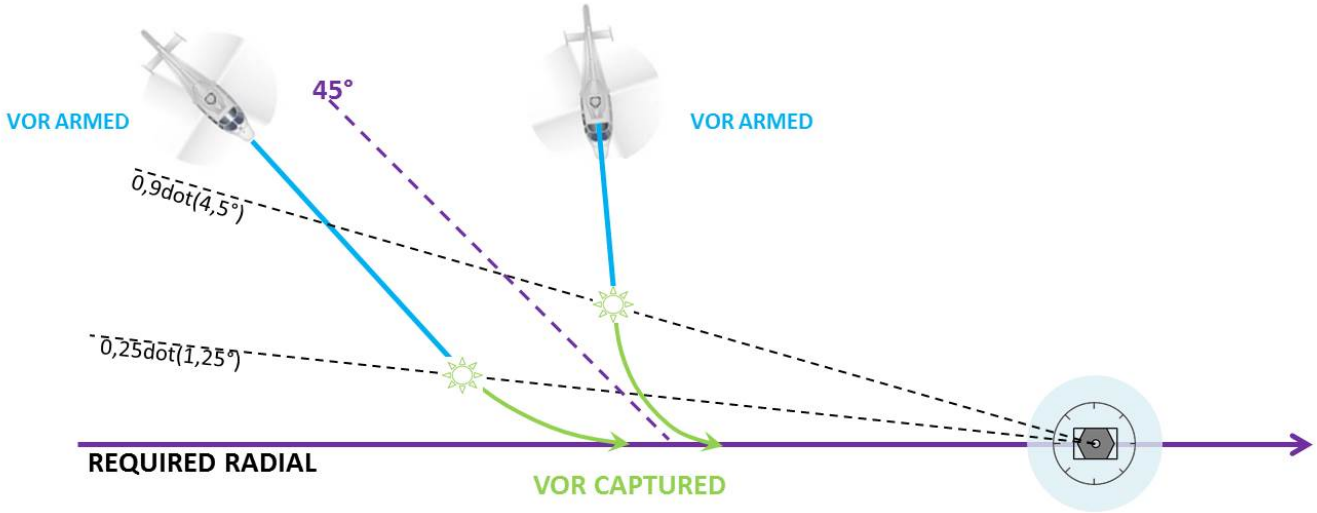


Figure 25: NAV VOR interception.

LOSS OF BEARING / RAPID DEVIATION CHANGE / OVER THE STATION STATUS: when VOR signal validity is lost for a significant period of time, as well when flying over the station where needle is flickering and signal is lost, and based on this receiving condition, for at least 10 sec. the VOR mode is flashing in amber, and flies a heading-like until the VOR signal is steady for a minimum of 10 sec.
Therefore, during station passage pilot does not have to shift to HDG before to select another course: as soon as VOR flashing amber, pilot can change course on ND master – CRS. The selected course will be used as a heading as long as VOR is amber flashing. When VOR become green, APM enters in the interception phase followed by tracking phase on the new CRS;

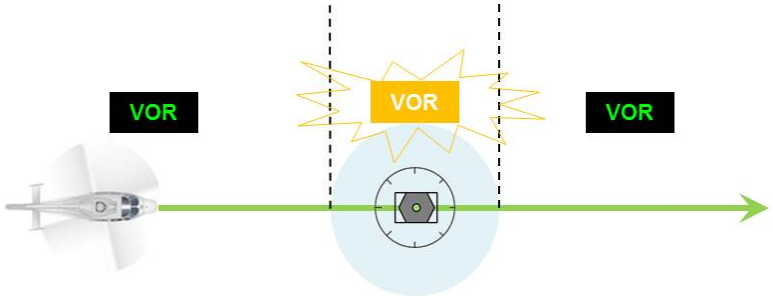


Figure 26: Over Station status

3.5.2. HOW TO USE VOR?

3.5.2.1. Envelope

For the VOR mode to be coupled, airspeed must be above 35 kt, and the AFCS basic attitude (ATT) available,
When VOR is coupled, the angle of bank is limited depending on the airspeed, with a factor of 0,16 (example airspeed 100 Kt x 0,16 = 16 deg Angle-Of-Bank)
CRS (course) can be modified, if changes are under 8 deg. the mode uses a reduced rate of turn limit at 0,25 deg/sec. otherwise, a the limit is 5 deg/sec is used.
It is recommended to arm the mode and intercept radials with less than 90 deg. angle of interception, and arming VOR too close to the station

3.5.2.2. Pilot arming / coupling and decoupling VOR:

AFCS VOR is activated by pressing the NAV push-button on the APMS and is controlled through the Roll axis.

Prior to press NAV, Pilots shall first select VOR station frequency on the receivers and select VOR as navigation source, use the CRS knob to adjust the course to or from VOR station and then press NAV. When 2 VOR equipment are installed, pilot uses VOR2, co-pilot uses VOR1 , NAV sources are selected accordingly and Master is set on PILOT.

NOTE

When a VHF ILS frequency is tuned, system automatically changes to ILS approach mode.

When coupling VOR navigation, pilot must check the status of the mode: it may be immediately captured with mode displayed green VOR (1 or 2 when dual VOR receivers) and C on APMS with helicopter immediately tracking inbound or outbound the station.

When mode is Armed and **VOR** mode displayed cyan VOR (1 or 2 when dual VOR receivers) on AFCS strip, with A on the APMS. As long as the mode is in armed status, pilot must manage heading either using the roll ATT basic stabilization mode or couple HDG. When armed or coupled, CRS can be modified by the pilot on master ND without disconnecting the mode.

At station passage, pilot maintain VOR mode coupled, and when VOR is flashing amber pilot changes the course without keeping the VOR mode couple. The mode controls the helicopter trajectory with a stable heading based on the course value, as long as VOR flashes amber. When VOR is back in green, the mode resumes the radio navigation and intercepts the radial.

To disarm or decouple VOR pilot has to press NAV on the APMS or use either pilot or copilot cyclic CPL Release pushbutton.

NOTE

When pressing CPL Release all coupled upper modes are immediately decoupled.

3.5.2.3. Automatic decoupling of VOR

Coupling **HDG** mode, or pressing **GA**, or selecting another NAVAID force **VOR** to decouple.

Other issues forcing VOR to decouple:

- AFCS is disengaged (loss of ATT basic stabilization)
- a discrepancy between AHRS 1 and 2 occurs,
- loss of roll axis cyclic auto-trim, or cyclic trim feel,
- 30 second after navigation source change on Master ND (VOR shing for 30 sec)
- Complete loss of valid heading information at the APM,

NOTE

Following a loss of VOR signal validity VOR is flashing for 60 sec. before VOR mode decouples.

In case of heading invalid signal, VOR is flashing for 30 sec. before VOR mode decouples.

3.5.2.4. Displays

When coupling the NAV VOR mode, the mode is either in armed or captured status. A VOR is displayed in cyan (armed) or green (captured)

The VOR label color may change, defining the status of the mode, as follow:

ND		PFD	remark
MASTER	SLAVE		
		HDG VOR	Navigation source on VOR, preselect course to/from VOR station. armed Navigation is based on VOR navigation source selected on ND master. On APMS: 
		VOR	VOR mode coupled and captured normal operation. VOR underline with white line when heading reference is modified using the beep trim or the APMS HDG rotary switch. On APMS: 
		VOR VOR	When HDG AFCS strip message toggles between amber and green: pilot is overriding the mode applying inputs in roll. ***Stop overriding the VOR mode to recover a VOR green mode.***
		VOR **or** VOR	Flashing on pilot and copilot PFDs, APM calls for pilot attention and various situations may be developing: • VOR station passage, loss of signal, pilot maintains VOR mode coupled and correct CRS to resume radio-navigation. VOR message is underlined in white when CRS changes. • VOR signal invalid, VOR decouple after 60 seconds.
			**APM is calling for pilot attention: the VOR mode may flash for 60, 30 sec. in amber before to disconnect in case of total information loss. Monitor VOR sensors and heading information on HSI and be ready to engage HDG mode or Hands-On and refer to VOR raw data if available.**

Figure 27: NAV VOR mode displays.

NOTE

There is no excessive deviation alert on the VOR mode.

3.5.2.5. Safety features with VOR

The VOR mode includes safety features mainly on the angle-of-bank limitation according to the airspeed and limited to a maximum of 22 deg. maintaining the standard turn rate of 3 deg. per second.

3.6. NAV : LONG RANGE NAVIGATION MODE

3.6.1. HOW NAV WORKS?

NAV mode is design to intercept and track course controlled via GPS / FMS. **NAV** mode is controlled through the Roll / Yaw axis.

3.6.2. HOW TO USE NAV?

3.6.2.1. Envelope

For the **NAV** mode to be coupled, airspeed must be above 35 kt, and the helicopter in-flight with the AFCS basic attitude ATT available,
When NAV is coupled, the angle of bank is limited depending on the airspeed, with a factor of 0,16 (example airspeed 100 Kt x 0,16 = 16 deg Angle-Of-Bank)
CRS (course) cannot be modified when GPS navigation guidance is selected in NAV source. The only way to modify the NAV guidance is to change navigation calculation in GPS or FMS, in this case, pilot shall re-couple the NAV mode as changing parameters in the GPS clears the previous GPS guidance.

3.6.2.2. Pilot coupling and decoupling NAV:

AFCS NAV is activated by pressing the NAV push-button on the APMS and is controlled through the Roll axis above 35 Kt indicated airspeed.

Prior to press NAV, Pilots shall first select GPS or FMS as navigation source, on the master ND and then press NAV.
When dual navigation equipment are installed (GPS / FMS), pilot select NAV2 or NAV1 source on ND and Master is set on PILOT side by default.

Figure 28: APMS NAV mode.

When coupling NAV navigation, the mode is be immediately captured with mode displayed green **NAV** (**1** or **2** when dual navigation system installed) on the AFCS strip and **C** on APMS with helicopter tracking to the waypoint.

to decouple the **NAV** mode pilot should either press cyclics CPL release or the APMS NAV push-button.

NOTE

When pressing CPL Release all coupled upper modes are immediately decoupled.

3.6.2.3. Automatic decoupling of NAV

Coupling of HDG, or pressing GA, or selecting another force NAV to decouple.

Other issues forcing NAV to decouple:

- AFCS is disengaged (loss of ATT basic stabilization)
- a discrepancy between AHRS 1 and 2 occurs,
- loss of roll axis cyclic auto-trim, or cyclic trim feel,
- loss of a command in roll for at least 30 sec.
- 30 second after navigation source change on Master ND (NAV flashing for 30 sec)

3.6.2.4. Displays

NAV mode status is display on PFD – AFCS strip – on NDs formats and the APMS. When in NAV GPS or FMS, there is no armed status.

ND		PFD	remark
MASTER	SLAVE		
		NAV	NAVigation (GPS, FMS) coupled in normal operation. On APMS: 
		NAV NAV	When NAV AFCS strip message toggles between amber and green: pilot is overriding the mode applying inputs in roll. ***Stop overriding the VOR mode to recover a VOR green mode.***
			Flashing on pilot and copilot PFDs, APM calls for pilot attention, NAV mode is going to decouple after 30 sec.: • NAV route or guidance near to terminate: pilots must prepare another guidance either VOR, or GPS / FMS or revert to HDG mode, • AHRS discrepancy, • Loss of roll axis, • Navigation source deselected for at least 30 sec.
			APM is calling for pilot attention: the NAV mode in amber is associated with rectangle in amber flashing for 10 sec. Before to disconnect in case of total information loss. Monitor VOR sensors and heading information on HSI and be ready to engage HDG mode or Hands-On .

Figure 29: NAV mode displays.

NOTE

There is no excessive deviation (> <) alert on the NAV mode.

3.6.2.5. How to manage NAV mode?

Coupling the NAV mode is done via the APMS NAV pushbutton. Prior to couple NAV, pilot must select the GPS / FMS navigation source on the ND designated as Master. After coupling, pilots must crosscheck that the APM NAV turn to the selected route point, and wind correction is automatically applied. There is no vertical guidance; pilots are responsible for terrain clearance and obstacle avoidance. For this purpose, pilot can apply inputs in roll “flying-through” the mode: when cyclic is released the NAV mode returns to the GPS navigation. When NAV is coupled, the cyclic beep trim is inoperative in roll.

NOTE

The GPS reception must be at least in PRNAV for navigation overlay.

Pilots must anticipate the end-of-navigation by preparing next navigation or pre-select a heading. An amber flashing NAV message is displayed to call pilot attention, 30 sec. later NAV mode decouples. When decoupling, APM automatically set a zero angle of bank.

NOTE

When NAV is coupled, coupling GA decouples NAV mode.

3.6.2.6. Safety features with NAV

The NAV mode includes safety features mainly on the angle-of-bank limitation according to the airspeed and limited to a maximum of 22 deg. maintaining the standard turn rate of 3 deg. per second, with a minimum speed of 35 kt.

- In case of NAV mode inadvertent decoupling, the APM revert to ATT mode (basic stabilization) with a zero angle of bank roll attitude.

3.7. ILS APPROACH

ILS approach can be flown fully coupled from final approach course intercept, glide slope intercept with level off at 80 ft over the runway. To carry out this automatic approach pilot has to set VOR / ILS receiver(s) tuned to ILS frequency, automatically the APM NAV mode is in ILS mode as soon as the navigation source is selected on the master ND, and the final approach course set before the LOC is captured. The ND must be in HSI format to allow the Glide slope and Localizer display.
Coupling the ILS approach is on the APMS with NAV push-button.
Lateral mode is LOC, and vertical mode is G/S. LOC is controlled through the Roll and G/S can be on the pitch or the collective. In normal condition (no collective mode degradation) the ILS is performed with LOC on the Yaw/Roll, IAS on the pitch axis and G/S on the collective.
ILS modes LOC and G/S are detailed below.

3.7.1. DISPLAYS

When coupling the ILS mode pressing the NAV pushbutton, , the mode is either in armed or captured status. LOC and GS are displayed in cyan (armed) in the lower AFCS strip row if signal is valid (within the station range), or green (captured) at the top . automatically the armed to capture change occurs when the signals are valid and t he interception phase is completed.

Figure 31: LOC and GS modes display on ND.

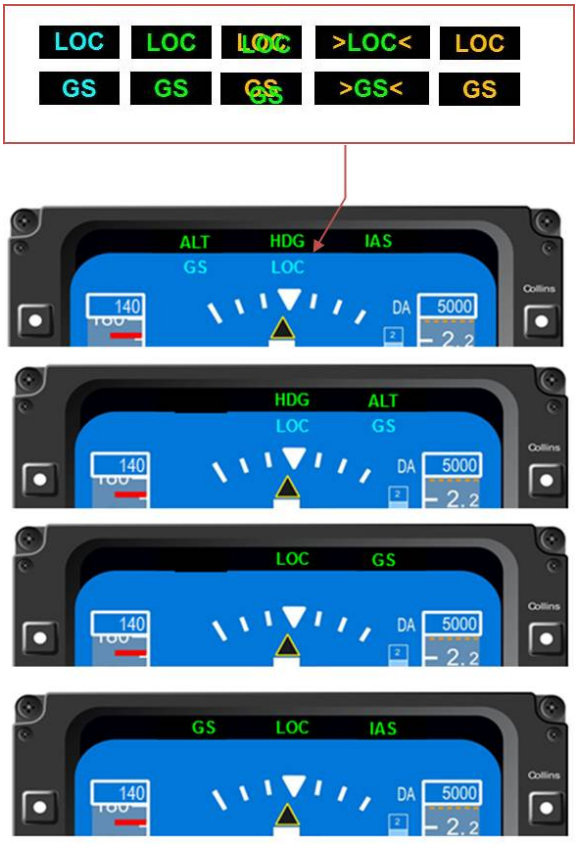


Figure 30: ILS PFDs 3 and 4 axis displays.

NOTE

In normal operation, when no degradation occurs and both LOC and GS reception is correct , the recommended LOC and GS mode armed and captured is with IAS mode coupled for the AFCS to be operative on the 4 axis.

3.8. LOC: APPROACH MODE

3.8.1. HOW LOC WORKS?

LOC mode is designed to intercept and track the localizer course of the ILS approach selected on the Master ND. LOC mode is controlled through the Roll / Yaw axis and can have different statuses; it can be armed, or captured.

o ARMED STATUS: LOCaliser is received, but the deviation is great, pilot has to couple HDG mode in order to set an interception heading and arm **LOC** mode. It is recommended to intercept the localizer final approach course with a difference of less than 90 deg.

- If course deviation is greater than 25 deg, LOC changes from armed to captured within 2,1 dot,
- If course deviation is below 25 deg. LOC changes from armed to Capture at 1 dot.

o CAPTURED STATUS: when the Localizer signal is received and valid for at least 2 second, HDG mode is disconnected and LOC (localizer) become active, **LOC** is displayed on PFD AFCS strips. Localizer deviation displayed on PFD in magenta on slave side.

NOTE

For small interception angles, less than 25 deg., capture condition is 1 dot. However a 30 s econd maximum limit in armed status below 2,1 dot has been set . after the 30 second the LOC will change automatically to Capture even if deviation is still above 1 dot.

NOTE

Arming LOC mode automatically arm G/S mode and LOC must be captured for G/S to be captured.

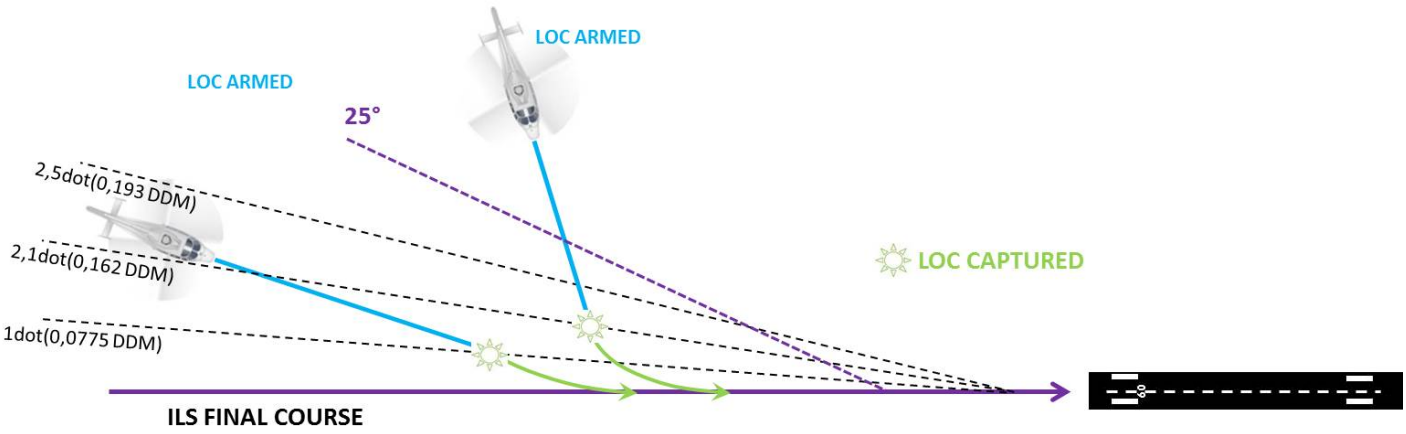


Figure 32: Localizer mode.

3.8.2. HOW TO USE LOC?

3.8.2.1. Envelope

For the LOC mode to be coupled the helicopter must be in-flight, the AFCS basic attitude available, airspeed must be above 35 kt and ILS system on ground available.
LOC mode is limited in roll to 0,225 times the airspeed, without exceeding 30 deg, the angular speed being limited to 5 deg / sec.
It is recommended to arm the mode and i ntercept final course with less than 90 deg. angle of interception.

3.8.2.2. Pilot arming / coupling and decoupling LOC:

AFCS LOC is activated by pressing the NAV push-button on the APMS and is controlled through the Roll axis.

Prior to press NAV, Pilots shall first select ILS frequency on the VOR / ILS receivers and select ILS as navigation source, use the CRS knob to adjust the final approach course and then press NAV: the LOC and G/S if available is armed or catured on the master nav source..
When 2 VOR / ILS equipment are installed, pilot uses VOR2 / ILS2, co-pilot uses VOR1 / ILS1 , NAV sources are selected accordingly and Master is set on PILOT side.

NOTE

When a VHF ILS frequency is tuned, system automatically changes to ILS approach mode.

When coupling LOC pressing NAV, pilot must check the status of the mode: it may be i mmediately captured with mode displayed green **LOC** (**1** or **2** when dual VOR/ILS receivers) and **C** on APMS with helicopter immediately tracking inbound on the final approach course.

Figure 33: APMS NAV ILS

When the mode is Armed LOC mode is displayed cyan **LOC** (**1** or **2** when dual VOR/ILS receivers) on AFCS strip, with **A** on the APMS. As long as the mode is in armed status, pilot must manage heading either using the roll ATT basic stabilization mode or couple **HDG**. When armed or coupled, CRS can be modified by the pilot on master ND without disconnecting the mode.

To disarm or decouple LOC pilot has to press NAV on the APMS or use either pilot or copilot cyclic CPL Release pushbutton. Decoupling LOC automatically decouples G/S.

CAUTION

WHEN PRESSING CPL RELEASE ALL COUPLED UPPER MODES ARE IMMEDIATELY DECOUPLED.

3.8.2.3. Automatic decoupling of LOC

Coupling of HDG, or pressing GA, force LOC to decouple.

Other issues forcing NAV to decouple:

- AFCS is disengaged (loss of ATT basic stabilization)
- a discrepancy between AHRS 1 and 2 occurs,
- loss of roll axis cyclic auto-trim, or cyclic trim feel,
- loss of a command in roll for at least 30 sec.
- 30 second after navigation source change on Master ND
- ILS frequency change on master ND for at least 30 sec.
- Loss of LOC valid signal for at least 30 sec.
- Total loss of heading valid signals for at least 30 sec.

3.8.2.4. Displays

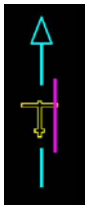
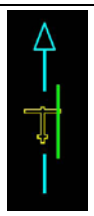
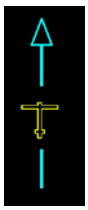
ND		PFD	remark
LH Copilot 	RH Pilot 		Standard settings for multi-receivers cockpit : ND : RH receiver #2, LH receiver #1, with identical ILS frequency.
MASTER	SLAVE		
		HDG LOC And GS	Navigation source on VOR / ILS, select course on final approach course. Armed Navigation is based on ILS navigation source selected on ND master. On APMS: 
		LOC And GS or GS	LOC mode coupled and captured normal operation. On APMS: 
		>LOC<	Excessive deviation is displayed as soon as : Deviation in excess of 2,2 dots if during the first 1 min. after LOC is captured. Then after the first minute, deviation in excess of 1/3 of dot during more than 0,6 sec
		LOC LOC	When LOC AFCS strip message toggles between amber and green: pilot is overriding the mode applying inputs in roll. ***Stop overriding the LOC mode to recover a LOC green mode.***
		LOC	• Helicopters with two VOR/ILS receivers : difference between valid signals LOC1 and LOC2 is more than 0,02ddm. • Helicopters with two VOR/ILS receivers : pilot / copilot receiver selection inappropriate • Helicopters with two VOR/ILS receivers : ILS frequencies are different between receivers.
			**APM is calling for pilot attention:** Flashing on pilot and copilot PFDs, various situations may be developing: • LOC signal invalid: last valid LOC information frozen and LOC mode decouple after 10 seconds. • Heading information is invalid: LOC mode decouple after 10 seconds. **ILS # appear on PFD / NDs, check Flight Manual procedure, Be ready to engage HDG mode or Hands-On**

Figure 34: NAV LOC mode displays.

3.8.2.5. How to manage LOC mode?

Arming / Coupling the LOC mode is done via the APMS NAV pushbutton. Prior to arm LOC, pilot shall tune the proper ILS frequencies on VOR/ILS receiver or both receivers with identical frequencies. He must select an MFD side as master, and receiver 2 on RH side, receiver 1 on LH.

NDs must be in HSI format, and ILS final course shall be tuned, on both NDs.

Flying the ILS arrival with NAV or HDG modes, LOC can be armed, for the APM to intercept the final course. The reference will be provided by the master ND, and pilot monitor the interception, and can modify the helicopter trajectory using HDG mode. When LOC is armed GS automatically arms.

When within the dots limits, the LOC status changes to capture, check the wind direction and correction applied by the APM. Pilot monitors the GS status and checks beginning of descent.

Pilot may anticipate a heading selection, by presetting a heading on APMS rotary switch and positioning the cyan bug.

The APM2010 applies a variable angle-of-bank computed with the airspeed, limited to x 0,225 times the airspeed, limited to a maximum of 30 deg. APM2010 anticipates the roll-out to stop turn when the helicopter is established on the localizer. Overshooting localizer course may be observed when angle of interception is near 90 dg with high airspeed and wind: pilot shall monitor the interception and verify the localizer is correctly captured.

In addition, when LOC is coupled, anytime an urgent situation is developing – i.e. avoiding bird, obstacles – pilots can fly-through, applying manually roll inputs. LOC reference will not be changed, even if pressing trim release on cyclic. When stopping fly-through, the helicopter will automatically be returned on the LOC reference.

If a missed approach is required, GA mode must be used disconnecting LOC mode automatically.

NOTE

When LOC is coupled, GA coupling decouple the LOC mode.

3.8.2.6. Safety features with LOC

The LOC and G/S modes are both armed; G/S cannot be capture as long as LOC is armed only. Helicopter is clear to descent with G/S captured as soon as LOC is captured.

For precise interception and avoid overshooting final course when at the final approach turn, HDG mode with LOC armed is limited to 30 degrees Angle-Of-Bank before to capture the LOC.

When pressing GA for a missed approach, LOC is automatically disengaged allowing HDG coupling for missed approach procedure.

Pilots shall be attentive all along the approach with LOC, and pay attention at an amber status of the mode: pilot shall anticipate and brief the possible degradation.

3.9. GS: APPROACH MODE

3.9.1. HOW GS WORKS?

G/S mode is designed to intercept then control the helicopter on a descent following glide slope signal of the ground ILS station. Descent with G/S mode is controlled through the pitch or the collective axis and can have different statuses; being armed, or captured. G/S is always coupled together with LOC armed or captured. The system requires a valid ILS frequency tuned on VOR/ILS receiver and selected as master for Navigation source.
For safety purposes, GS mode will stop descending and is replaced by ALT mode at 80 ft and requires a barometric altitude signal, consolidated with a radio altimeter information; loss of these two sensors degrade G/S mode.

- COLLECTIVE OR PITCH AXIS: selection is based on helicopter airspeed and the coupling of IAS mode at the GS arming.

G/S is on Collective: the helicopter airspeed is below 60 kt, or the IAS mode was previously coupled on pitch.
GS is on pitch: the helicopter airspeed is more than 65 kt, with no upper mode previously selected on the pitch axis.

NOTE

Performing a complete ILS shall be performed in 4-axis, with IAS mode on pitch, G/S mode armed or capture on collective, and LOC mode on Yaw/Roll.

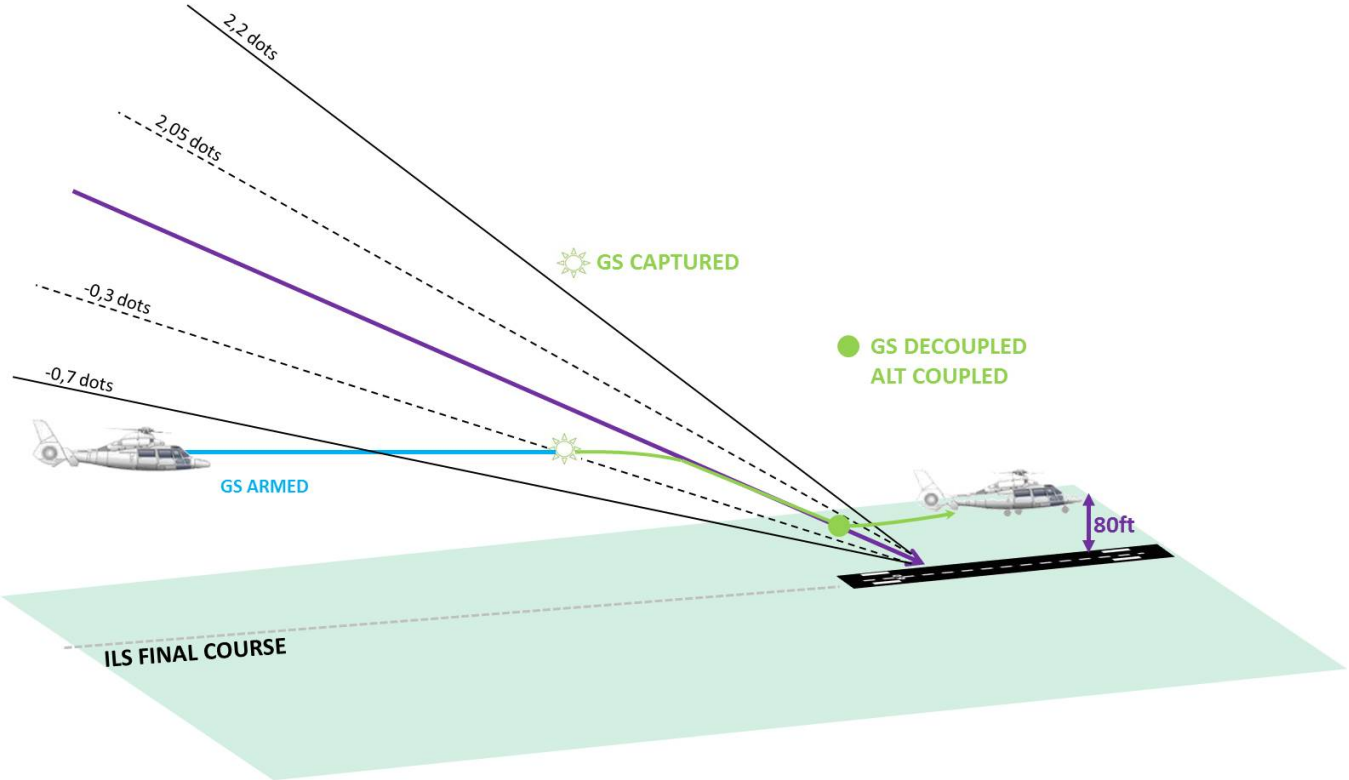


Figure 35: Glide Slope mode.

- ARMED STATUS: G/S is armed (GS) when LOC mode is armed or captured but conditions for the G/S to be captured are not met. If a mode was coupled (ALT, ALT.A, VS) and active this mode will not decouple until G/S is captured.

It is recommended to intercept the glide slope from below and arm G/S on the collective: couple IAS before coupling GS.

- CAPTURED STATUS: **GS** mode will be captured (GS) only if the LOC mode is already captured and with a **GS** valid signal, the vertical position of the helicopter is within less than 2,2 dots during at least 1sec., and more than -0,7 dot for at least 3 sec. the capture status is effective when between 2.05 dots and -0.3 dots.

3.9.2. HOW TO USE GS?

This option for the **GS** mode to be on pitch or collective shall remind the pilot to manage wisely the axis to be used by **GS**. in normal operation condition, pilot shall select **GS** mode on the collective, coupling IAS prior flying the ILS approach.

3.9.2.1. Envelope

For the G/S mode to be coupled the helicopter must be in-flight, the AFCS basic attitude available, airspeed must be above 35 kt and ILS system on ground available.
LOC mode must be previously armed or captured, it is recommended to intercept final descent on glide slope from below.
G/S mode is limited in altitude and decouples automatically at 80 ft height-above-ground given by a radio altimeter, and ALT mode is coupled at 80 ft. when GS decouples, pilots shall crosscheck ALT mode coupled and confirm the height above ground and baro-altitude.

NOTE

If the airport is at altitude, presence of rough terrain on long final, ALT mode reference may be low and requires pilot attention and power application to stabilize level flight.

3.9.2.2. Pilot arming / coupling and decoupling GS:

AFCS GS mode is activated by pressing the NAV push-button on the APMS if LOC mode is available, and is controlled through the Collective or the Yaw/Roll axis.
Prior to press NAV, Pilots shall first select ILS frequency on the VOR / ILS receivers and select ILS as navigation source, the LOC and G/S if available is armed or captured on the master nav source..
When 2 VOR / ILS equipment are installed, pilot uses VOR2 / ILS2, co-pilot uses VOR1 / ILS1 , NAV sources are selected accordingly and Master is set on PILOT side.

When coupling NAV GS, pilot must check the status of the mode: it may be immediately captured GS with mode displayed green (1 or 2 when dual VOR/ILS receivers). LOC mode must already be captured with LOC and C on APMS and helicopter starting descent on the glide slope.

When mode is Armed GS is displayed cyan GS on AFCS strip (1 or 2 when dual VOR/ILS receivers), The LOC may be either captured LOC or armed LOC . GS does not capture as long as LOC is armed only. Do not decouple LOC as GS will be immediately be decoupled.

Figure 36: APMS NAV mode LOC

As long as the mode is in armed status, depending on collective or pitch axis, pilot can either use the collective or pitch, or couple a vertical mode as ALT, VS. When armed or coupled, altitudes can be modified by the pilot on master PFD without disconnecting the mode.

NOTE

When Go Around mode is coupled, GS cannot be armed. Pilots shall decouple GA before to couple GS.

To disarm or decouple GS pilot has to press NAV on the APMS or use either pilot or copilot cyclic CPL Release pushbutton. Decoupling LOC automatically decouples GS.

CAUTION

WHEN PRESSING CPL RELEASE ALL COUPLED UPPER MODES ARE IMMEDIATELY DECOUPLED.

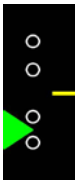
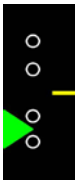
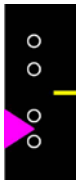
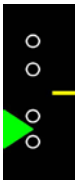
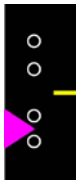
3.9.2.3. Automatic decoupling of GS

Coupling of ALT, VS, ALT.A, or pressing GA, force GS to decouple.

Other issues forcing GS to decouple:

- AFCS is disengaged (loss of ATT basic stabilization)
- a discrepancy between AHRS 1 and 2 occurs,
- loss of pitch axis (cyclic auto-trim, or cyclic trim feel) and collective axis (cyclic series actuator or collective trim failure, or collective trim feel are lost),
- Loss of airspeed and groundspeed signal at least 30 sec. with an armed LOC, 10 sec. with a captured LOC.
- Total loss of barometric altitude valid signals at least 30 sec. with an armed LOC, 10 sec. with a captured LOC.
- 10 second after navigation source change on Master ND, at least 30 sec. when LOC is armed, 10 sec. when LOC is captured,
- ILS frequency change on master ND for more than 10 sec.
- Loss of GS valid signal at least 30 sec. with an armed LOC, 10 sec. with a captured LOC.
- Decoupling LOC from armed or captured will decouples GS after 10 sec.,

3.9.2.4. Displays

ND		PFD	remark
Multi VOR/ILS receivers			
LH Copilot 	RH Pilot 		Standard settings for multi-receivers cockpit : ND : RH receiver #2, LH receiver #1, selected with identical ILS frequency and course.
MASTER	SLAVE		
		GS With LOC	Navigation source on VOR / ILS, select course on final approach course. Armed Navigation is based on ILS navigation source selected on ND master. On APMS:  **NOTE** **LOC may be captured with a GS mode still armed. The APMS "C" comes on as soon as LOC is green.**
		GS with LOC	LOC & GS modes coupled and captured normal operation. On APMS:  **NOTE** **Flying with upper modes must be preferably in 4-axis, and descending on an ILS approach must be performed LOC, GS and IAS coupled.** **NOTE** **GS illuminates amber on the pitch when airspeed drops below 60 kt, and GS are shifting to collective axis.**
		>GS<	Excessive deviation is displayed as soon as : Deviation in excess of 2,2 dots for more than 0.6 sec. during the first 30 sec. following mode coupling the deviation of more than 0.7 dot.
		GS GS	When GS AFCS strip message toggles between amber and green: pilot is overriding the mode applying inputs in collective and cyclic (pitch). ***Stop overriding the GS mode to recover a green GS mode.***

			• Radio Altimeter is unserviceable: loss of stabilization function at 80 ft. • Helicopters with two VOR/ILS receivers : difference between valid signals LOC1 and LOC2 is more than 0,02ddm. • Helicopters with two VOR/ILS receivers : pilot / copilot receiver selection inappropriate • Helicopters with two VOR/ILS receivers: ILS frequencies are different between receivers.
			**APM is calling for pilot attention:** Flashing on pilot and copilot PFDs, various situations may be developing: • GS signal invalid: last valid GS information frozen and LOC mode decouple after 10 seconds. • LOC signal decouples GS flashes amber then decouples. **ILS # appear on PFD / NDs, check Flight Manual procedure,**

Figure 37: NAV - GS modes displays.

3.9.2.5. How to manage GS mode?

Arming / Coupling the **GS** mode is done via the APMS NAV pushbutton. Pressing NAV will arm or capture first the LOC mode, and then GS mode. Prior to arm LOC, pilot shall tune the proper ILS frequencies on VOR/ILS receiver or both receivers with identical frequencies. He must select an MFD side as master, and receiver #2 on RH side, receiver #1 on LH. NDs must be in HSI format. When LOC is armed GS automatically arms.

NOTE

It is recommended to fly an ILS approach with LOC and GS mode and IAS mode to be in a 4-axis configuration.

Flying the ILS arrival with NAV or HDG modes, LOC must be armed, for the APM to intercept the final course therefore GS can automatically be armed too: pilot has to check and confirm **LOC** and **GS** armed status. Reference will be provided by the master ND, and pilot monitors the interception, and can modify the helicopter trajectory using HDG mode.

When within the dots limits, the **LOC** status changes to capture: check the wind direction and correction applied by the APM. Pilot monitors the **GS** status and checks beginning of descent.

In addition, when **GS** is coupled, anytime an urgent situation is developing – i.e. avoiding bird, obstacles – pilots can fly-through, applying manually collective inputs. **GS** is not lost, even if pressing trim release on cyclic. When stopping fly-through, the helicopter will automatically be returned on the GS.

If a missed approach is required, GA mode must be used disconnecting **GS** mode automatically.

3.9.2.6. Safety features with GS

Similar safety features as ALT mode, when installed on pitch or collective:
GS includes a power limitation when installed on collective axis, with a collective law fully available, limiting power as follow:

- When AEO: power is limited at MTOP when below 30KIAS, reducing to MCP when above 45KIAS.
- When OEI: power is limited to the selected stop (HI, LO or CT).
- When FADEC is in manual or failed: power changes are limited, it is recommended to not use ALT on collective axis.
- At low power, a safety feature does not authorize the GS collective mode to reduce power less than 2x5% torque in AEO, or 10% torque in OEI to avoid free turbine and rotor desynchronization.

If GS is coupled on pitch axis, power is controlled manually by the pilot and inappropriate power application may be observed:

- If lack of power application makes the airspeed decreasing below the 60 KIAS automatically IAS is coupled with a 60 KIAS bug, and GS is coupled on collective allowing power application.
- if excessive power is manually applied, the GS mode does not exceed the VNE computed at 175 KIAS minus 3 kt / 1000ft with a theorical gross weight of 3000 kg.

CAUTION

WHEN GS COUPLED ON PITCH (3-AXIS), VNE SAFETY LIMIT APPLIED MAY NOT PREVENT VNE EXCEEDANCE WHEN HELICOPTER ALL-UP WEIGHT IS ABOVE 3000KG. PILOTS MUST PAY ATTENTION AND CALCULATE THE VNE ACCORDING TO THE HELICOPTER WEIGHT.

- in addition, **GS** on pitch cannot exceed nose up / down limits of 12 deg. nose down and 14 nose up attitudes.

Low altitude protection: at ALT coupling: GS includes a level of at 80 ft above the ground, and disconnect to immediately and automatically couple ALT mode at an equivalent of 80 ft AGL.

NOTE

The equivalent baro-altitude corresponding to 80 ft above terrain is evaluated throughout the descent.
If the runway is located in an elevated position, the ALT mode target baro-altitude may be too low and require pilot manual upward correction.

CAUTION

WHEN DESCENDING WITH 3-AXIS ONLY, NO IAS MODE COUPLED, GS ON PITCH WILL BE DECOUPLE AND ALT COUPLES AT 80 FT ON PITCH AXIS. PILOT SHALL ANTICIPATE AND INCREASE THE POWER WITH COLLECTIVE TO ALLOW THE AIRSPEED TO BE MAINTAINED.

3.10. IAS: AIRSPEED MODE

3.10.1. HOW IT WORKS (IAS)

The Airspeed (IAS) mode purpose is to acquire and maintain airspeed. . The **IAS** mode cannot be manually preset and coupling IAS mode is only on Pitch axis.

Using information provided by ADC1 & 2, airspeed is displayed on the MFDs, and send to the APM 2010, to allow AFCS IAS upper mode based on indicated airspeed.

When coupling the mode by pressing the APMS IAS pushbutton the IAS mode reference is synchronized to the current indicated airspeed, if within the limits of the system. Pilot can then modify the IAS reference.
IAS mode has the priority over **ALT, ALT.A, VS, GS** when installed on the Pitch axis, when pilot is overriding – flying through with trim release or against the spring there is no modification of the **IAS** mode reference.

Coupling of IAS mode is automatic 15 or 25 seconds after pressing GA or following an engine failure when a vertical mode only was coupled on pitch axis (3-axis)

3.10.2. HOW TO USE IAS?

3.10.2.1. Envelope

- From basic stabilization, in flight, **IAS** mode couples on the Pitch axis, and is available within speed limits of 30 kt to absolute VNE (175 kt) minus 3 kt per 1000 ft , corresponding to a light aircraft (less than 3000 kg). Outside limits, IAS mode can be coupled but the mode will automatically accelerate or reduce speed to the closest speed limit.
- For helicopters equipped with an FMS, where the exact helicopter gross-weight is manually entered and computed with fuel consumption, the VNE calculation consider the FMS weight for IAS mode maximum limit.
- When coupled, Pilot can modify IAS reference by using the cyclic beep trim moving the IAS bug at a speed of 8 kt per second. Another option to change the IAS bug is beep + override and take advantage of a follow-up stick.
- When increasing or decreasing IAS speed reference, the **IAS** mode is limited 12 deg. nose down, and 14 deg. nose up.

NOTE

when indicated airspeed below 30 kt the APM 2010 is in “hover follow-up” with automatic trim follow-up in lateral and longitudinal attitudes.

CAUTION

The IMC operating speeds envelope start at 30 kt if IAS mode coupled (4-axis), otherwise minimum indicated airspeed shall be 70 kt. (RFM limitations)

3.10.2.2. Pilot coupling and decoupling IAS

Pilot can couple or decouple the IAS mode only using the APMS IAS push button. Using the cyclic grips CPL release push buttons pilot decouple IAS mode and all other coupled modes.

An **ON** green light illuminates when push button is pressed in, ON green is not illuminated if mode is not coupled.

3.10.2.3. Automatic coupling of IAS

- **IAS** mode couples automatically following coupling of GA (Go-Around) mode after a delay of 15 sec. or 25 sec. when GA is coupled in hover (zero speed)
- When flying 3-axis, with vertical mode set on pitch, pilots are responsible of power application. APM controls vertical modes with pitch attitude and If power required is not applied, helicopter airspeed drops to compensate. When passing 60 kt, automatically IAS mode is coupled, and vertical mode is forced to the collective axis, to stabilize airspeed at 60 kt, and control vertical mode with power.
- For safety purposes, the **IAS** mode is immediately coupled by APM following an engine failure while flying with a vertical mode (**ALT, ALT.A, VS, or GS**) on the pitch (3-axis)
- When **IAS** mode is forced to couple the **ON** light illuminates on APMS IAS.

3.10.2.4. Automatic decoupling of IAS

IAS is decoupled automatically when pilot couples **GA**. After 15 sec. with **GA**, **IAS** is re-coupled and replacing GA on pitch.

IAS mode will also decouple when either:

- a discrepancy between AHRS 1 and 2 occurs,
- AFCS is disengaged
- Loss of pitch axis: cyclic Auto Trim lost, or cyclic trim Feel permanently released.
- Complete loss of airspeed valid signal for more than 10 sec.
- complete loss of airspeed signal for at least 10 sec.

3.10.2.5. Displays

the **IAS** mode status and degradations are indicated in the PFDs AFCS strip, at the pitch position (right side)

On the airspeed indicator, and w hen **IAS** mode is coupled, a green bug triangle shape is pointing the IAS mode reference.

A blue window at the top of the airspeed indicator gives 3 digits precise value of the green bug position.

Figure 38: IAS mode PFDs display.

ND	PFD	remarks
	AFCS strip PITCH	
N/A		APM is ON and when in-flight in ATT, **IAS** is ready to be coupled on pitch. on APMS **IAS** mode light is not illuminated,  On Airspeed Indicator, no airspeed reference bug, neither digit at the top. .
N/A	IAS 	**IAS** mode coupled on cyclic in normal operation On APMS:  ON illuminated, On Airspeed indicator: green bug pointing airspeed reference. Green bug is displayed on both LH and RH MFD's airspeed indicators. This green bug is flashing green / white when pilots change reference. 163 above the airspeed indicator: 3-digit bug position on airspeed scale, in knots. IAS underline with white line when airspeed reference is modified.
N/A	>IAS<	Difference between **IAS** mode reference and actual airspeed exceeds 12 kt for more than 2 sec. or When airspeed drops below 65 kt for more than 2 sec. when flying Upper modes in 4-axis. If pilot "Fly Through" overriding the mode with an error of more than 12 kt. ***Do not take controls, monitor sharply the airspeed and nose attitude parameter and be ready to takeover.***
	IAS IAS	When IAS AFCS strip message toggles between amber and green: pilot is overriding the mode and countering efforts with inputs in pitch. ***Stop overriding the cyclic pitch axis to recover a IAS green display.***
	ALT at 150 ft IAS IAS	When descending with **IAS** only , **ALT** automatically couples near 150 ft, **ALT** mode level-off at 150 ft.
		• Flashing amber, until mode decoupling. • a difference of more than 12 kt between 2 valid ADCs • total loss of anemo barometric sensors: ADC1 and ADC2 is displayed on PFDs

	IAS	**IAS** degradation, it occurs when: • a difference of more than 6 kt between 2 valid ADCs signals or • Airspeed signals valid but a difference of more than 12kt, ALT flashes amber then shift to collective axis if available, or • Loss of redundancy ADC1 or ADC2 is displayed on PFDs, • After reconfiguration, only one ADC selected on RCU. **APM is calling for pilot attention: the mode may flash in amber for 10 sec. before to disconnect in case of total information loss. Monitor airspeed information on PFDs and Back-up instruments. Be ready for Hands-On.**

Figure 39: IAS mode displays.

3.10.2.6. How to manage IAS mode?

Pilot can couple the **IAS** mode directly pressing IAS on the APMS. However, during takeoff phase, **GA** mode can be used as this mode terminate after 15 sec. with the helicopter accelerating then coupling automatically **IAS**, and climbing coupling **VS** modes. In addition **GA** is offering a great airspeed management in case of OEI in takeoff phase.

The only way to change the airspeed reference is using beep trims on cyclic grips, reading the green bug on airspeed indicator band, and using the speed trend to control the nose attitudes and maximum speed.

For rapid reaction to avoid traffic, obstacle, pilot can override / flying through the mode without decoupling. When pilot is back Hands-off, **IAS** mode fly to the previously set airspeed reference.

any fly-through action (override or Force Trim Release) does not change the airspeed reference.

3.10.2.7. Safety features with IAS

- The **IAS** mode is designed to control the helicopter in the authorized envelope. A minimum and maximum airspeed reference can be set toward the VNE at sea level. Pilots must check VNE at altitude and helicopter gross weight to readjust airspeed limit.
- **IAS** mode has the role of forcing 4-axis mode coupling: at 60 kt automatically, shifting vertical modes on the collective for a safe control of altitude and speed, not entering in the bad side of the Power vs Speed chart. In single engine with only 3-axis, the **IAS** immediately couples for the same reason than before.

3.11. VS: VERTICAL SPEED MODE

3.11.1. HOW IT WORKS (VS)

3.11.1.1. Description

The vertical speed mode (**VS**) maintains the current vertical speed at coupling, and can be set for climbing / descending.
The AFCS uses the Master side for air data references.
It can be used directly or associated with altitude acquisition armament **ALT.A** mode for climb and descent or coupling **GA** mode for climbing only.

When **VS** mode is directely coupled the VS reference is the vertical speed at the time of coupling.

when pilot is overriding – flying through with trim release or against the spring there is no modification of the **VS** mode reference.

3.11.2. HOW TO USE VS?

3.11.2.1. Envelope

- Speed envelope: with **VS** installed on pitch, when speed drops below 60 KIAS the **VS** mode changes to be controlled through the collective axis,
  When **VS** mode is on the collective, with no IAS mode on the pitch, VS shift to pitch when airspeed is above 65 KIAS for at least 5 sec.
- Rate of climb / descent limits: the **VS** mode does not exceed 2200 ft / min, if the VS mode is coupled beyond these limits; the mode is designed to reduce rates to the limits.
- When **VS** mode couples with **ALT.A** armed the rate of climb is set at 1000 ft / min, or the current rate of climb if above, if **ALT.A** is armed for descent the rate of descent is – 500 ft / min.
- If **VS** couples following a **GA**, rate of climb is set at 1000 ft / min, and can be modified via the collective beep trim.
- Attitude is limited if VS mode is installed on pitch not to exceed the -12 to +14 deg nose attitudes.
- Power protection is applied when **VS** is on the collective, limited to TOP below 30 kt and MCP above. When flying OEI the crew selected rating applies (HI, LO, or CONT). When AP limit the power, airspeed is automatically reduced to not less than Vy, then Vs will be reduced according to power available.

3.11.2.2. Pilot coupling and decoupling VS

Pilot can directly couple or decouple the **VS** mode only using the APMS VS push button. Using the cyclic grips CPL release push buttons pilot decouple **VS** mode and all other coupled modes.

An **ON** green light illuminates when push button is pressed in, ON green is not illuminated if mode is not coupled.

3.11.2.3. Automatic coupling of VS

- **VS** mode couples automatically following coupling of **GA** (Go-Around) mode after a delay of 15 sec. or 25 sec. when **GA** is coupled in hover (zero speed),
- Another case of automatic coupling: **VS** mode couples when **ALT.A** is armed.

3.11.2.4. Automatic decoupling of VS

When **VS** is coupled on pitch, coupling **IAS** mode on the pitch will force **VS** to shift to the collective when available.
VS is decoupled automatically when pilot couples **CRHT, ALT or ALT.A** reach 300 ft from reference, or **GS** status change from armed to coupled.

VS mode will also decouple when either:

- a discrepancy between AHRS 1 and 2 occurs,
- AFCS is disengaged (loss of ATT basic stabilization)
- Loss of pitch axis: cyclic Auto Trim loss, or cyclic trim Feel permanently released and loss of collective axis: collective trim failure or collective trim feel permanent release.
- Complete loss of barometric altitude valid signal for more than 10 seconds'
- Complete loss of airspeed signal for at least 10 sec the **VS** mode flashes amber and shift to the collective, but when collective axis already failed the **VS** is decoupled.

3.11.2.5. Displays

The **VS** mode status and deg radations are indicated in the PFDs AFCS strip, at pitch (right side) or collective (left) positions.

On the vertical speed indicator, with **VS** mode coupled, a green bug triangle shape is pointing the **VS** mode reference.

Take note that the blue window at the top of the vertical speed indicator gives in digits the value of the actual rate of climb of descent in hundreds of ft / min, when above ±50 ft / min and not the value of the reference green bug position.

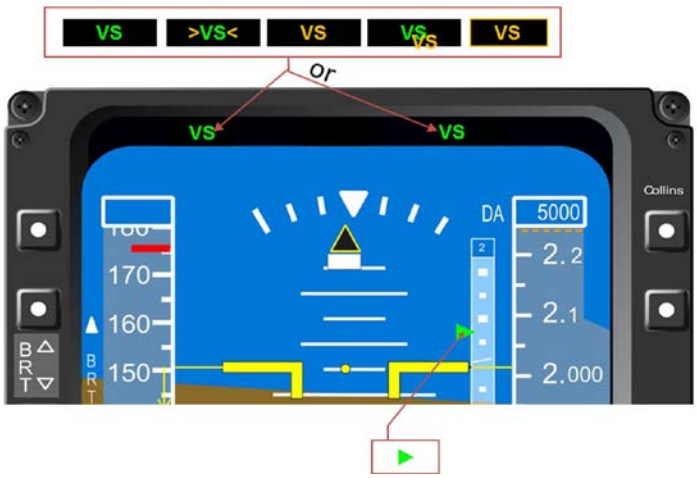


Figure 40: VS mode PFDs display.

ND	PFD		remarks
	COLL	PITCH	
N/A	[redacted]	[redacted]	**VS** not coupled, APM is ON and when in-flight, ALT is ready to be coupled on collective or pitch according to the airspeed.
N/A	VS	**If airspeed <60kt, or** IAS	**VS** mode coupled in normal operation. Engagement and disengagement is indicated with a green rectangle to highlight the concerned upper mode.

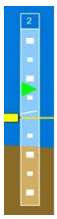
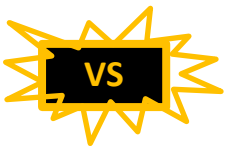
		VS underline with white line when altitude reference is modified using the collective beep trim and the bug toggles green and white. Green bug is displayed on both LH and RH MFD's altimeters.
N/A	VS **airspeed >65kt for 5 sec.** 	VS mode coupled in normal operation. Engagement and disengagement is indicated with a green rectangle to highlight the concerned upper mode. VS underline with white line when altitude reference is modified. Green bug is displayed on both LH and RH MFD's vertical speed indicators. **NOTE** **VS illuminates amber on the pitch when airspeed drops below 60 kt, and VS is shifting to collective axis.**
N/A	>VS< **or** >VS< 	Excessive deviation on the VS mode. Difference of more than 500ft / min detected between VS reference and actual helicopter altitude. **NOTE** **When VS is coupled with ALT.A mode, an excessive deviation is displayed as soon as a difference of 300 ft / min is detected.**
	VS VS **or** VS VS	When **VS** AFCS strip message toggles between amber and green: pilot is overriding the mode and applying inputs in pitch or collective. Above 40 kt airspeed, excessive deviation appears on collective as well, even if **VS** is installed on cyclic. ***Stop overriding the VS mode to recover a VS green mode.***
		Symbol flashing in amber before to disconnect **VS**, indicating either: A loss of barometric altitude, A loss of airspeed with a collective axis already not available. ***Pilot shall be ready to fly Hands On or revert to an available mode or configuration.***
	VS	**VS** degradation, it occurs when: Loss of confidence level between sensors, loss of redundancy, discrepancy between internal processing of control laws, ***Increase monitoring of this parameter, crosscheck instruments.***

Figure 41: VS mode displays.

3.11.2.6. How to manage VS mode?

As soon as pilot depresses the VS APMS push-button, the **VS** mode is coupled and it's reference is set at the current helicopter vertical speed if any. Depending of airspeed, or IAS mode coupled, VS mode is installed on pitch or collective.

NOTE

It is recommended to select IAS and ALT.A instead of solely VS, and flying in 4-axis coupled.

To change the **VS** reference, Whatever the 3-axis or 4-axis option, control of the **VS** bug is made using the collective beep trim. Pressing forward will reduce the VS reference, pressing aftward increase it.

CAUTION

WHEN CHANGING VS BUG TO DESCENT IN 3-AXIS, PILOT SHALL MONITOR THE AIRSPEED AND REDUCE SLIGHTLY POWER IN ORDER TO NOT EXCEED THE ACTUAL VNE.

In normal conditions, it is highly recommended to use **VS** and **ALT.A** on the collective, with **IAS** on pitch and a lateral mode in Roll / yaw. Nevertheless, flying with 3-axis option can be required in particular situations: turbulences, were the collective pitch hit the MCP limit to control rate of climb.

3.11.2.7. Safety devices of VS

VS includes a power limitation when installed on collective axis, with a collective law fully available, limiting power as follow:

- When AEO: power is limited at MTOP when below 30KIAS, reducing to MCP when above 45KIAS.
- At low power, a safety feature does not authorize the VS collective mode to reduce power less than 2x5% torque in AEO, or 10% torque in OEI to avoid free turbine and rotor desynchronization.
- When OEI: power is limited to the selected stop (HI, LO or CT).
- When FADEC is in manual or failed: power changes are limited, it is recommended to not use **VS** on collective axis.

If VS is coupled on pitch axis, power is controlled manually by the pilot and inappropriate power application may be observed:

- if lack of power application make the airspeed decreasing below the 60 KIAS automatically **IAS** is coupled with a 60 KIAS bug, and **VS** is coupled on collective allowing power application.
- If excessive power is manually applied, the VS mode does not exceed the VNE computed at 175 KIAS minus 3 kt / 1000ft @ 3000 kg gross weight.
- In addition, **VS** on pitch cannot exceed nose up / down limits of 12 deg . nose down and 14 nose up attitudes.

CAUTION

WHEN ALT COUPLED ON PITCH (3-AXIS), VNE SAFETY LIMIT APPLIED MAY NOT PREVENT VNE EXCEEDANCE WHEN HELICOPTER ALL-UP WEIGHT IS ABOVE 3000KG. PILOTS MUST PAY ATTENTION AND CALCULATE THE VNE ACCORDING TO THE HELICOPTER WEIGHT.

Low altitude protection: at **VS** coupling on descent: if a minimum altitude of 150 ft height equivalent above the ground detected **ALT** mode is automatically coupled and **ALT** mode will not go below this value even if a "descent" command is selected on ALT.
ALT is automatically coupled when VS, ALT.A, mode are coupled and helicopter approaching 150 ft on descent: RADALT shall be available.

3.12. GA: GO AROUND MODE

3.12.1. HOW IT WORKS (GA)

3.12.1.1. Description

The Go-Around mode (**GA)** is a combined mode designed to be used in demanding situations as missed approach procedure , departure from hover and during takeoff particularly in low visibility departure as the system is able to acquire and hold a pre-defined rate of climb using collective axis (+1000 ft / min or current ROC only if higher) and accelerate to Vy with the pitch axis (or maintain current airspeed if higher).
The **GA** mode works with several different logics depending on the engines power available (AEO / OEI power margin) and helicopter airspeed.

- **All engines operative (AEO)**
  - From the hover, it acquires and holds:
    - a vertical speed of +1000 ft/min,
    - an airspeed at Vy.
  - From a missed approach (or at any time), it acquires and holds:
    - a vertical speed of +1000 ft/min **or** the current vertical speed (whichever is the highest),
    - Vy **or** the current airspeed (whichever is the highest).
- **One engine off (actual OEI or Training mode)**
  - Airspeed ≤ V.TOSS: V.TOSS is acquired then a vertical speed is installed depending on the available power (OEI HI, LO, CT selection by the pilot).
  - V.TOSS < Airspeed < Vy: the current airspeed is held, a vertical speed is installed depending on the available power (OEI HI, LO, CT stops).
    The **IAS** reference shall be adjusted to Vy, using the cyclic beep trim.
  - Airspeed ≥ Vy: the current airspeed is held, a vertical speed is installed, depending on the available power (HI, LO, CT stops selection by the pilot). **IAS** reference can be reduced to Vy to increase power margin and optimize rate of climb.
- The **GA** mode automatically reverts to **V/S** mode and **IAS** mode after 15 seconds when it is coupled from a c ruise flight, or after 25 seconds when it is coupled from a hover flight condition.

REMEMBER
In AS365N3+ VTOSS (Takeoff Safety Speed) is 55 kt by default but can be adjusted between 30 kt and Vy manually on ground only by pressing IAS APMS button for more than 0,5 sec. And use cyclic pitch beep trim to modify it.
After crossing Vy, system reset automatically VTOSS to the default value of 55 kt.

When **GA** mode is coupled it does not couple any specific mode on the Roll axis. However, in case bank angle was applied at the moment of **GA** coupling, the Roll reference will be set to zero in order to allow the helicopter to climb wings level and bal l centered. When **HDG** mode is already coupled upon **GA** coupling, HDG is maintained coupled. **VOR, LOC, APP** are decoupled.

NOTE

The helicopters with the improvement ref. 07.22B73 and equipped with FMS have a GA mode including NAV coupling when GA is coupled at the condition of a NAV selected in the FMS.

When pilot is overriding – flying through with trim release or against the spring there is no modification of the VS mode reference.

3.12.2. HOW TO USE GA?

3.12.2.1. Envelope

- Rate of climb / descent limits: **GA** ends with a **VS** mode at 1000 ft / min, or current vertical speed. Once **VS** is coupled, pilot refer to VS envelope.

3.12.2.2. Pilot coupling and decoupling GA

Pilot can only couple the **GA** mode using the collective GA push button. Using the cyclic grips CPL release push buttons pilot decouple GA mode and all other coupled modes.

ON green light illuminate on APMS IAS and VS pushbuttons.

Decoupling manually **GA**, pilot can press GA button on collective grip, or switch OFF either **IAS** or **VS** mode on the APMS.

3.12.2.3. Automatic decoupling of GA

GA automatically decouples and replaced by **VS** at 1000 ft / min on the collective together with **IAS** set at Vy on the pitch. The roll / yaw is maintained at zero angle-of-bank or HDG mode remains coupled if it was coupled at the GA coupling.

GA is decoupled automatically when pilot couples **CRHT, ALT or ALT.A**.

NOTE

After GA coupling, and depending on the Hover or with forward speed, arm ALT.A mode after GA reverts to a VS and IAS coupling (after 15 or 25 sec.)

GA mode will also decouple when either:

- a discrepancy between AHRS 1 and 2 occurs,
- AFCS is disengaged,
- Loss of pitch axis: cyclic Auto Trim loss, or cyclic trim Feel permanently released,
- loss of collective axis: collective trim failure or collective trim feel permanent release, leading to a reversion of VS to the pitch axis,
- Complete loss of barometric altitude valid signal for more than 10 seconds,
- complete loss of airspeed signal for at least 10 sec the **VS** mode flashes amber and shift to the collective, but when collective axis already failed the **VS** is decoupled.
- In addition, **GA** is inhibited on ground,

3.12.2.4. Displays

on AFCS strip, as soon as **GA** coupled, GA green mode labels are displayed on the Collective and Pitch axis for 15 sec (from cruise flight) or 25 sec (from hover), followed by **V/S IAS** modes.

on APMS, **VS** and **IAS** **ON** illuminates,

on Airspeed indicator, with **GA GA** the airspeed green arrow ▶ appears at Vy (AEO) or following the OEI logic, but no bug indicates rate of climb on the vertical speed indicator.
All bugs are displayed when **GA** shift to **VS IAS**

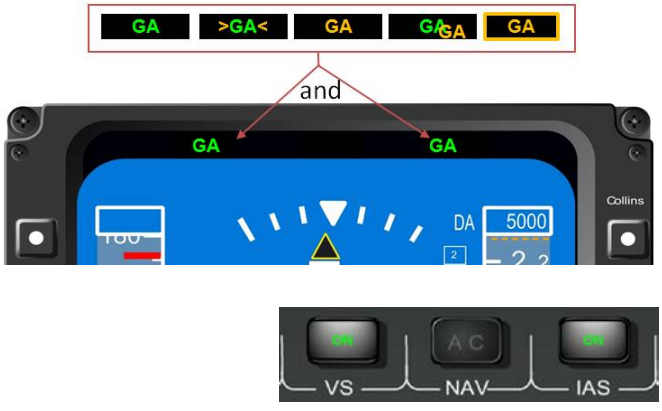


Figure 42: GA mode PFDs and APMS displays.

ND	PFD		remarks
	COLL	PITCH	
N/A			GA not coupled, APM is ON and when in-flight, GA is ready to be coupled on collective and pitch.
N/A	GA	GA	**GA** mode coupled in normal operation. Engagement and disengagement is indicated with a green rectangle to highlight the concerned upper mode. GA underline with white line when altitude reference is modified. Green bug is displayed on airspeed indicator but not on the vertical speed indicator.
N/A	>GA<	>GA<	Excessive deviation on the GA mode: APM has detected deviation in fulfilling the GA program parameters.
N/A	GA GA	GA GA	When GA AFCS strip message toggles between amber and green: pilot is overriding the mode and applying inputs in pitch or collective. ***Stop overriding the mode to recover a GA green mode.***
	GA	GA	Symbols flashing, loss of barometric altitude signal, flashing until mode decoupling.
	GA	GA	When APM detects loss of confidence in sensors, loss of confidence in flight control law computation, loss of confidence in actuators information.

Figure 43: GA mode displays.

3.12.2.5. How to manage GA mode?

The objective of GA mode is to combine coupling on collective and pitch, and control Roll / yaw at zero angle of bank or keep **HDG** coupled. It is recommended to use mode for missed approach after instrument approach, at takeoff after Vy or in any confusing situation with pilot spatial disorientation or loss of visual references, but not unusual attitude of the helicopter.
During clear area departure usually coupling **GA** is recommended at Vy as GA offers the optimum preset to initiate climb.

- Whether in AEO or OEI, as long as airspeed is above Vy, the vertical speed management by APM has the priority on the airspeed control. If the vertical speed reference is beeped close to the maximum rate, reducing the power margin, the **IAS** reference may not be followed and airspeed reduces to Vy with excessive deviation displayed.
- The **GA** coupling applies a zero roll, ball centered.
- During ILS approach, **LOC** and **G/S** captured, the activation of **GA** will cancel the ILS guidance.
- The commanded acceleration varies in accordance with:
  - the available power, and power margin,
  - the AEO or OEI conditions,
  - the current airspeed.
- According to the flight condition, the power is automatically stopped at the maximum authorized power.

3.12.2.6. Safety devices of GA

- The **GA** protections are the same as for the **IAS** and **VS** modes.

3.13. CRHT: CAPTURE AND RETENTION OF RADAR HEIGHT MODE

3.13.1. HOW IT WORKS (CR.HT)

The cruise height (**CR.HT**) mode is designed to fly low heights over flat areas as sea surface, referring to a radar altimeter height instead of barometric reference **ALT** mode is using.
as radar altimeter can detect false echoes or ships decks causing quick height variations, the APM includes a “filtering” system to maintain a smooth CR.HT control while transient height variations may occur.
CRHT references can be preset for the mode to acquire new datum selected on the radio altimeter scale of the NDs.

CR.HT mode is always coupled on the Collective axis.
CRHT includes a low height protection device called FLY-UP described below.

CAUTION
CR.HT must only be used over water or a flat surface.

3.13.2. HOW TO USE CRHT?

CR.HT mode is inhibited on ground, but can be prepared and preset. DHs can be prepared accordingly.

There is no airspeed condition.
Collective axis and radio-altimeter must be available.
When pilot is overriding – flying through with trim release or against the spring there is no modification of the **CR.HT** reference.

3.13.2.1. Envelope

- The CRHT mode maximum usable height is limited to 2450 ft because the radar altimeter instrument is limited at 2500 ft. the minimum height to be selected is limited by the highest DH, and when CR.HT coupled, the minimum height is defined as Safety Limit.
- Rate of climb / descent limits: +500 ft per min. is applied for climbing or descending.

3.13.2.2. Pilot coupling and decoupling CR.HT

- Pilot can directly couple or decouple the **CR.HT** mode only using the APMS CR.HT rotary knob.
- Rotating the knob before to couple the mode allows a preset of CRHT reference. Pressing the knob allows to couple and decouple the **CR.HT** mode.
  When **CR.HT** is coupled, a green arrow illuminates on the APMS, the light goes off when mode is decoupled.
- After coupling, pilot can use the rotary knob to modify the CR.HT reference.

Figure 44: APMS CR.HT mode.

- For preset or reference change after coupling, and if helicopter height is above DHs, the minimum CR.HT reference the pilot can select is limited to the highest DH value between pilot and copilot.
  If helicopter height is already below DHs alarms, there is no lower limit to the CR.HT setting.

NOTE

Pilots must include DH setting on pilot and copilot NDs radio altimeters before to change CR.HT reference.

CAUTION

DO NOT FLY LOW ALTITUDE BELOW DH BUGS WITH DH WARNING ILLUMINATED.

- Using the cyclic grips CPL release push buttons pilot decouple CR.HT mode and all other coupled modes.

3.13.2.3. Automatic coupling of CRHT

When flying below a safety limit – the lowest value between 200 ft and CR.HT reference minus 30 ft – the FLY-UP label function replaces CR.HT temporarily, the collective pitch increases until the helicopter is back on the reference CR.HT value.
As soon as the height is above the Safety Limit the **CR.HT** mode is automatically re-coupled.
Excessive deviation on >CR.HT< may appear during the acquisition to the previous helicopter height. (see figure 45)

3.13.2.4. Automatic decoupling of CRHT

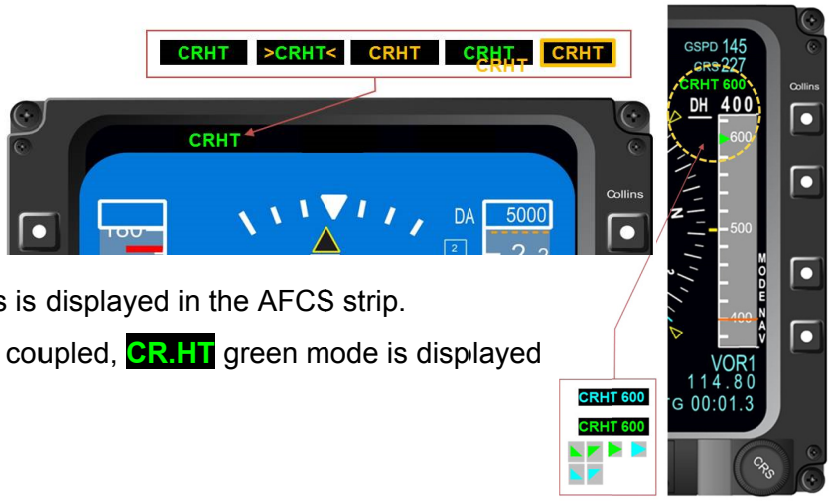
The mode is forced to decouple when pilot couples **ALT, VS, ALT.A, GS**, or after the following:

- AFCS disengagement,
- AHRS discrepancy,
- Loss of collective axis (loss of any cyclic series actuator or collective trim failure, or collective trim feel permanent release)

3.13.2.5. Displays

CRHT mode has two different statuses: it can be preset, or coupled.

When preset only, no display on the AFCS strip, only cyan indication of the CR.HT reference is displayed above the Radio altimeter, and bugs in cyan displayed in the instrument.



When CRHT mode is coupled, CRHT status is displayed in the AFCS strip.

- On AFCS strip, as soon as **CRHT** is coupled, CR.HT green mode is displayed on the Collective axis,
- on APMS, arrow illuminates,

Figure 45: CRHT PFDs & NDs displays.

NOTE

On NDs, DH value is displayed under the CR.HT reference for the pilot to not select or preset a CRHT reference according to the DH alarm. It is recommended to select different values for DH and CR.HT.

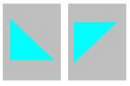
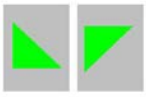
ND	PFD COLLECTIVE	remarks
	[redacted]	**CRHT** not coupled, APM is ON and when in-flight, **CRHT** is ready to be coupled on collective and pitch. **CR.HT** reference can be preset and displayed in cyan. **NOTE** **To couple CR.HT helicopter shall fly over flat area or water and below 2500 ft, the maximum selected CR.HT is 2450 ft.**
	[redacted]	CR.HT mode is preset, value can be red on NDs and displayed in cyan just above the DH setting. Bug appears on radio altimeter in cyan. If bug is out of the radio altimeter window, the bug reach the upper or lower stop and is displayed as follow: 
	CRHT	**CRHT** mode coupled in normal operation. coupling and decoupling indicated with a green rectangle to highlight the concerned upper mode. CRHT underline with white line when altitude reference is modified. Green bug is flashing white when CRHT reference is modified. If bug is out of the radio altimeter window, the bug reach the upper or lower stop and is displayed as follow: 
	>CRHT<	Excessive deviation on the **CRHT** mode: either the error between commanded trajectory and current estimated height exceed **15 ft for 2 sec.**, Or when height estimated and height measured are different, an additional condition of **40 ft** is applied, Finally, when Hands-On detected, the reference is replaced by the commanded height.
	CRHT CRHT	When **CRHT** AFCS strip message toggles between amber and green: pilot is overriding the mode and applying inputs in pitch or collective. ***Stop overriding the mode to recover a GA green mode.***
	CRHT	Loss of radio altitude information signal: flashing until mode decoupling.
	CRHT	When APM detects loss of confidence in sensors, loss of confidence in flight control law computation, loss of confidence in actuators information.

Figure 46: CRHT mode displays.

3.13.2.6. How to manage CR.HT mode?

Before to couple the **CR.HT** it is wise to preset a height value with APMS rotary knob: while presetting the height, check on NDs the DHs left and right. Once coupled, **CR.HT** is automatically acquired with a 500 ft / min rate of climb or descent. Rate of climb cannot be changed.

3.13.2.7. Protections and Safety devices of CR.HT

- **Power protection**

The **CR.HT** power protections are the same as for the **ALT** mode on collective.

- **FLY-UP height protection**

The **CR.HT** mode include a safety function based on a minimum height above flat area and named Safety Limit; this Safety Limit is define as the lowest value between 200 ft (when CR.HT reference is above 230 ft) and CR.HT reference minus 30 ft (when CR.HT reference is below 230 ft).

Figure 47: CR.HT Safety Limit: FLY-UP.

, When the helicopter is descending below the Safety Limit FLY-UP function is activated and the function increase power in order to stop the descent, and climb to a height above the safety limit, staying in the CR.HT power limits. If descent continues up to 30 ft, power is not limited.

3.13.2.8. How to manage a FLY-UP

FLY-UP is triggered as soon as helicopter height reaches a safety limit: **the lowest value between 200 ft and CR.HT minus 30 ft.** Pilot is alerted with this red alarm on the AFCS strip Collective axis and must immediately pay attention and be prepared to climb. Automatically the function commands a climb with a combination of pitch and collective inputs. The objective of this safety function is to maintain helicopter height above the Safety Limit, using MCP or TOP according to the airspeed.
When proper margin is reached, FLY-UP disappears and CR.HT is displayed again, with the objective to readjust the pilot's selected height. Excessive deviations may appear during the transition to stabilized height. Pilots have to monitor heights above the surface, monitor the power margin reduce the speed near Vy if necessary and reconsider the vertical mode to be used if several FLY-UP are applied.

3.14. GSPD: GROUND SPEED MODE without SAR MODES and without CABIN JOYSTICK

This option can be installed on helicopters equipped with dual GNS430 or FMS.

GSPD mode holds current ground speed upon coupling (single click) or acquires and holds zero ground speed upon a double click. The best use of the **GSPD** is to automatically keep references on the lateral and longitudinal modes during hover in poor visibility, whiteout, brownout, dark night.

3.14.1. HOW IT WORKS (GSPD)

The APM2010 needs the AP software linked to the improvement Ref. 0722B73.
System uses 2 GPS signals, one used as a master, the other in slave. In case of loss of signal of the master, the other GPS become master.
The AFCS **GSPD** controls the pitch and the roll axes.
It can be associated with any vertical mode, **VS, ALT A., ALT** or **CR.HT**

3.14.2. HOW TO USE GSPD?

Prior to couple **GSPD** mode, set Pilot-Flying side ND with HOVER display to visualize the actual lateral and longitudinal groundspeeds (longitudinal GSpeed only is displayed on other-than-Hover ND displays)

NOTE

The use of GSPD mode is restricted to visual flight conditions in view of the ground or the water surface.

3.14.2.1. Envelope

- Attitudes: limited between -12° and +14° on Pitch axis, the commanded roll attitude is limited (+6.75° to +30°) depending on airspeed.
- Rates: Pitch rate is limited to ±5°/sec, the Roll rate is limited to ±7°/sec.
- Maximum Ground speeds are within: -10 kt and +50 kt on longitudinal axis and ± 20kt on lateral axis.
- Use of collective mode (CR.HT, VS, ALT.A) below 20 ft is not recommended,
- The recommended conditions for coupling **GSPD** are: lateral groundspeed less than 10 kt and stabilized attitudes or smooth variations.
- Coupling **GA** from GSPD should be performed with crosswind or tailwind no more than 10 kt.

3.14.2.2. Pilot coupling and decoupling GSPD

- **GSPD** mode is coupled only by pressing once the GSTC/SAS button on cyclic grips and **GSPD** maintains current groundspeed as a reference, if the ground speed is ≤ 50kt, above 50 kt, **GSPD** is coupled with a ground speed of 50kt.
- Another later click disengages the mode.
- Whether **GSPD** was coupled or not, a double click on GSTC button will activate the acquisition of a zero longitudinal and lateral speed,
- The GSPD reference is materialised by a green circle that appears on the NDs Hover page upon mode engagement.
- Using the cyclic grips CPL release push buttons pilot decouple **GSPD** mode and all other coupled modes.

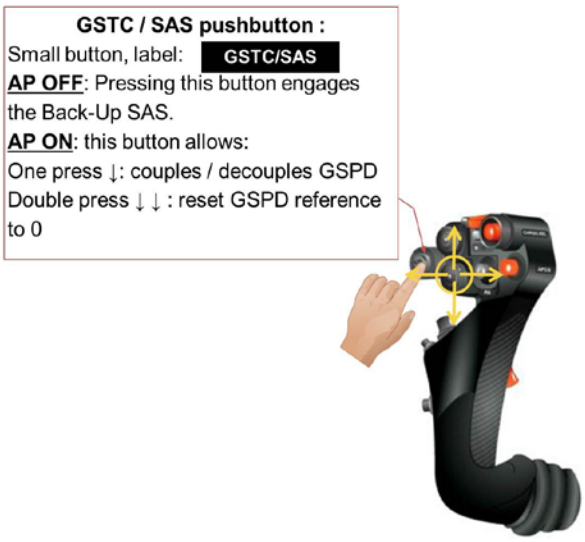


Figure 48: GSPD controls on cyclic grip.

3.14.2.3. Automatic decoupling of GSPD

The mode is forced to decouple when pilot couples **IAS, GA, HDG, NAV, VOR, LOC**, or after the following:

- AFCS disengagement,
- AHRS discrepancy,
- Loss of roll axis (loss of cyclic auto-trim or cyclic trim feel permanent release)
- Loss of pitch axis (loss of cyclic auto-trim or cyclic trim feel permanent release)
- Complete loss of ground speed for at least 30 sec.

3.14.2.4. Displays

- **NDs Hover format**

The Navigation Display (ND) can be set with an Hover format, showing information on 360 degrees compass rose.

The bars represent the lateral and longitudinal direction of the aircraft ground speed (computed by GPS) called Vx (longitudinal) and Vy (lateral), the resulting vector is ground speed of the helicopter.

The velocity bars are displayed in amber when the speed is above 34.5 kts and displayed in white when the speed drops below 34 knots.
When in Hover format, the selected course/desired track pointer, the To/From pointer, the bearing pointers/distances/labels, the lateral deviation scale/bar and the vertical deviation scale/pointer used for the ILS are not displayed.

Figure 49: ND HOVER format.

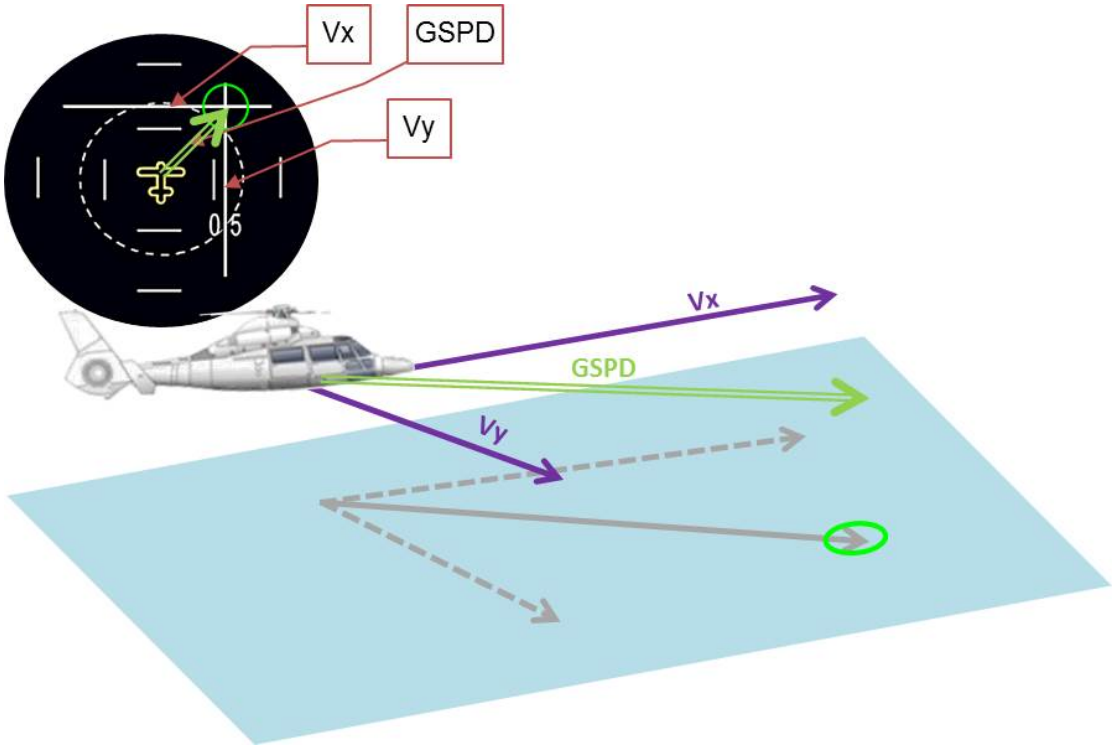


Figure 50: Hover Format: Vx and Vy.

3.14.2.5. Displays

Coupling GSPD is checked on PFDs AFCS strip with green **GSPD** in normal conditions. Label color change is showing the condition of the upper mode.

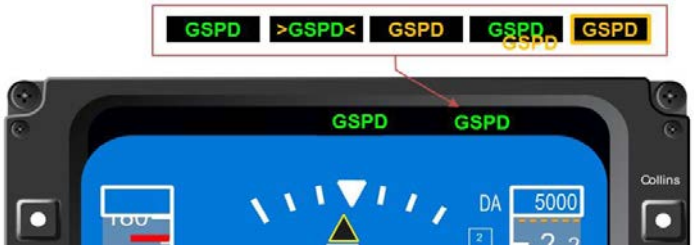


Figure 51:GSPD mode PFDs display.

ND	PFD	remarks
	ROLL & PITCH	
		GSPD not coupled, APM is ON and helicopter in-flight, **GSPD** is ready to be coupled on pitch and roll. Pilot must decide either current groundspeed or hover with zero groundspeed is to be used.
	GSPD	**GSPD** mode coupled in normal operation. Coupling and decoupling indicated with a green rectangle to highlight the concerned upper mode. **GSPD** underline with white line when altitude reference is modified the bug toggles green and white. Green bug is flashing white when CRHT reference is modified.

	>GSPD<	Excessive deviation on the GSPD may occur if mode is coupled in hover and set an alternative lateral wind over 25 kt.
	GSPD GSPD	When **GSPD** AFCS strip message toggles between amber and green: pilot is overriding the mode and applying inputs in pitch or collective. ***Stop overriding the mode.***
	GSPD	Flashing amber and inverse video, mode disconnect soon. Total loss of GPS data
	GSPD	When APM detects loss of confidence in sensors, loss of GPS redundancy, loss of confidence in flight control law computation, loss of confidence in actuators information.

Figure 52: GSPD modes displays.

3.14.2.6. How to manage GSPD mode?

Prior to couple **GSPD** mode, set Pilot flying ND with Hover display to visualize the actual lateral and longitudinal groundspeeds (longitudinal GSpeed only is displayed ND) and pilot has to check speed, rate of descent, lateral speeds to be in the envelope.

NOTE

The GSPD mode may be combined with ALT, ALT.A, VS or CR.HT modes.

GSPD mode reference can be adjusted with different techniques to fit pilot needs:
A smooth and precise change on lateral and/or longitudinal speeds: using cyclic beep trim, with this technique, the beep trim commands an acceleration in the beep direction, longitudinal or lateral. When beep is released, the acceleration stops and the new ground speed is held.

A change of lateral and / or longitudinal speeds using stick + beep technique will allow the pilot to manually set a new groundspeed using the cyclic, then when applying the beep trim on this modified groundspeed will immediately change the reference (green ellipse position).

3.15. AFCS UPPER MODES MATRIX :

Mode	Axis	Engagement condition	Operating Envelope	remarks	Excessive deviations
ALT	C or P	ATT Inhibit on ground On Collective below 60 KIAS On Pitch above 65 KIAS	Minimum height 30ft Altitudes acquisition at 500ft/min Power limitation at TOP below 45 KIAS, then MCP above 65 KIAS	Auto Coupled of ALT mode following 150 ft RA detection on IAS or VS Cannot exceed VNE when ALT is coupled on Pitch Power limiting in AEO and OEI	80ft for 2sec
VS	C or P	ATT Inhibit on ground On Collective below 60 KIAS On Pitch above 65 KIAS	+2200ft/min to -2200ft/min, above 55KIAS. Limited to 300ft/min at 25 KIAS and below. Power limitation at TOP below 45 KIAS, then MCP above 65 KIAS	- Auto Coupled with ALT.A. - Auto Coupled after 15sec on G.A (25sec if GA from hover) - Revert to ALT and level off at 150 ft RA - Cannot exceed VNE when VS is coupled on Pitch	500ft/min for 5sec
ALT.A	C or P	ATT On Collective below 60 KIAS On Pitch above 65 KIAS	Above 40 KIAS: +1000 ft/min for climbing. If above +1000ft/min at engagement, actual ROC is applied. -500 ft/min for descent.	- Maintained in armed status with VS coupled - Revert to ALT and level off at 150 ft RA - Below 40 KIAS rate of climb is reduced (power consideration) - Below 40 KIAS rate of descent is reduced (to anticipate risk of Vortex and settling-with-power)	300ft/min for 5sec
IAS	P	ATT Inhibit on ground	From 30 KIAS to VNE (175 kt minus 3kt/1000ft)	- Auto Coupled after 15sec on G.A (25sec if GA from hover) - Auto coupled when below 60 KIAS and ALT, ALTA, VS, GS modes shift to Collective pitch. - Auto coupled when loss of one engine with ALT, ALTA, VS, GS modes coupled in pitch axis. - Automatic Engagement of ALT following 150 ft RA detection with IAS only coupled	12 kt for 2 sec
GSPD	P and R	- ATT - Inhibit on ground	- Longitudinal speeds: - 50 kt FORWARD – 10 kt REARWARD - Lateral speeds:20 kt LEFT and RIGHT	**CAUTION**: use of standard GSPD and CR.HT modes is forbidden for airspeed below 30 KIAS	If alternative lateral wind over approx.. 25 kt.
HDG	R	- ATT - Inhibit on ground	- Minimum airspeed 26 KIAS - Rate of turn: rate 1= 3 °/sec - Angle of Bank (in deg.): 0.16 x airspeed (in KIAS) - Maximum angle of bank: 22°	- After engagement, helicopter turn on knob rotation side - Preset engagement: helicopter turns in the shortest direction.	10° for 2 sec.
NAV	R	- ATT - Inhibit on ground	- Minimum airspeed 35 KIAS	- GPS / FMS guidance - No excessive deviation displayed - At NAV disengagement returning to ATT, Angle of Bank is automatically set to cruise bank angle	N/A

Mode	Axis	Engagement condition	Operating Envelope	remarks	Excessive deviations
VOR	R	- ATT - Inhibit on ground - Can be armed or captured.	- Minimum airspeed 35 KIAS - Minimum intercept distance: 6NM - Maximum intercept angle: 90° - Angle of Bank (in deg.): 0.15 x airspeed (in KIAS) - Maximum angle of bank: 21°	- No excessive deviation computed by AFCS	N/A
LOC	R	- ATT - Inhibit on ground - Can be armed or captured.	- Minimum airspeed 35 KIAS - Maximum angle of bank is 30° during interception.	- LOC mode is decoupled when GA is coupled.	2.2 dots for 0.6s during the first 60s following mode's capture and then 1/3 dot for more than 0.6s
GS	P or C	- ATT - Inhibit on ground - LOC mode shall be armed / coupled - Can be armed or captured.	- Minimum airspeed 35 KIAS	- Disarming or decoupling LOC mode causes GS to disarm or decouple, - at 80 ft above ground, GS disengage, replaced by ALT to level off at 80 ft. - GS mode is decoupled when GA is coupled. -	2.2 dots for 0.6s during the first 30s following mode's capture and then 0.7dot for more than 0.6s
G.A	P and C	- ATT - On Ground, VTOSS can be set (VTOSS is reset to computed value in flight after 10 sec. above Vy)	- 1000ft/min or higher current value. - Vy or higher current value - If no HDG mode coupled, GA will set a zero angle Of Bank -	- Mode coupling available only on collective grips (no knob on APMS) - GS cannot be selected when GA is coupled, - Previously coupled HDG or NAV modes will not disengage when GA is selected, - If power loss below Vy, GA will set VTOSS of 55 KIAS or current speed if between VTOSS - Vy	500 ft /min for 5 sec.
CRHT	C	- ATT - Radio Altimeter must be available -	- Minimum height = highest DH - Maximum height = 2450 ft - Power limitation at TOP below 45 KIAS, then MCP above 65 KIAS	: an automatic power application on CRHT mode is triggered when either flying 30 ft below CRHT value, or below 200 ft if CRHT is above 230ft;	15 ft (5 m) for at least 2 s

4. BEST USE OF AUTOMATION

4.1. GENERALITIES

4.1.1. MANAGING AUTOMATION

The AS365N3+ with APM2010 is designed to be flown using the autopilot's upper modes coupled on the 4 axes to enhance safety and reduce pilot workload. When coupled, AFCS protections improve error management from the crew.

4.1.2. AUTOMATION LEVEL

The appropriate level of automation is the one adapted for the task or prevailing condition. If a crew does not use automation, it significantly reduces safety protections.

Coupling or decoupling AFCS upper modes may occur automatically, without intervention from the pilot. Automatic engagements are part of the AFCS design and will provide pilots with enhanced safety protection. These advanced functions will reinforce pilot attention in high workload flight phases as long as system knowledge and mode management is understood. When lack of knowledge or management, doubt installed and lead to confusion in the cockpit.

In confusing situations, do not shift to an immediate hand flying, consider reverting first to more direct upper modes (HDG, G/A, etc.).

Except at night or in poor visual references conditions where automation should be used, operators should define when automations are to be used, taking into account the need to maintain aircrew manual flying skills.

NOTE

The risk of involuntary interference with the AFCS controlled axes is significant, and may lead to a mode override with the consequences described above.

Both situations (fly through & mixed flying mode) shall be used only for short term (limited time).

4.1.3. PRE-SETTING OF AFCS COUPLED MODES ON GROUND AT DEPARTURE

There is no added value to preset HDG before takeoff. The only mode to be preset before takeoff is ALT.A. After takeoff, before engaging ALT.A, the setting shall be checked to ensure there has been no change to the pre-selection.

4.1.4. USE OF GPSS - FMS

FMS lateral navigation should be used to reduce workload during the en route phase and to reduce workload and risk of CFIT during departure, approach and go-around when applicable procedures are included in the FMS database.

Any action on the FMS keyboard should be confirmed by cross-checking the corresponding annunciation or data on the FMS display, FND and/or ND.

When in FMS Managed Guidance, if doubt exists regarding the aircraft flight path, the pilot should not try to reprogram the automated systems. The pilot should revert to aircrew selected guidance together with the use of navaids raw data, until time and conditions permit a reprogramming of the FMS.

Common error	Possible consequence	Recommendation
Pilot(s) occupied with the FMS in low workload phase (en route)	Loss of situation awareness	Anticipate and plan route and arrivals as much as possible. One head inside at one time if multi crew. Couple upper modes and control their normal operation frequently.
Preoccupation with FMS programming during critical phases,	Loss of situation awareness and degraded communication	Anticipate FMS programming. Cross check FMS inputs
Late FMS reconfiguration approaching IAF (e.g. following change of runway in use)	Reaching IAF with the inappropriate active FMS coupled navigation	Avoid late reconfiguration, fly the aircraft by reverting to an aircrew selected guidance together with the use of navaids raw data
Entering or selecting a wrong waypoint in the route	Confusion and CFIT	Confirm the navigation by cross-checking the corresponding annunciation or data on the FMS display, FND and/or NAVD.
Fuel reserve error management	Confusion and unprepared landing	Fuel reserve shall be checked and adjusted before flying

Monitoring of controls

When below 500 feet AGL, Pilot should keep hands and feet in a position to immediately take manual control if circumstances require it. Below 200 feet AGL, the helicopter shall be flown with Hands-On or close to cyclic / collective grips without interfering with the AFCS coupled modes.

4.1.5. MODES COMBINATIONS

A good knowledge of every upper mode is essential for best use, engagement, disengagement and parameters changes. This knowledge is crucial for an optimum and efficient combination of modes.

The following tables are non-exhaustive combinations to be avoided in all operation situations; or combinations being useful in case of collective mode degradation.

Collective mode	Lateral mode	Longitudinal mode	Comment
X	X	ALT or V/S or IAS	Not recommended
X	ANAV or HDG or VOR or LOC	X	Not recommended
ALT or V/S	X	X	Not recommended
X	ANAV or HDG	ALT or V/S	Not recommended except for maintenance check flight or in turbulence conditions
X	ANAV or HDG	IAS	Not recommended
X	VOR or LOC	IAS	Not recommended

*Figure 53: List of **inappropriate** level & combination of automation.*

Collective mode	Lateral mode	Longitudinal mode	Comment
X	LOC	GS recommended IAS possible**	ILS approach
X	LOC	ALT.A IAS possible**	ILS LOC only approach (GS out)
X	NAV or HDG or VOR	ALT.A IAS possible**	Non Precision Approach

**** use of IAS mode is an acceptable option on descent for non-precision or precision approach when collective axis upper modes are not available, particularly in turbulence where airspeed control using power changes is critical.**

*Figure 54: List of **appropriate** level & combination of automation in degraded situation.*

4.2. TAKEOFF & DEPARTURE

4.2.1. AUTOMATION MANAGEMENT

At takeoff and departure, whatever upper modes are preset, for modes engagement, the priority should be given to vertical and longitudinal modes using GA. Then, at the appropriate time, lateral mode should be coupled.

For engaging lateral and vertical modes after takeoff the recommended procedure is using the collective GA pushbutton rather than the FCP. It allows avoiding mistakes in mode selection

4.2.2. MFD CONFIGURATION FOR DEPARTURE

When the radios and navaids have been tested, the MFDs should be configured for departure. Pilot should normally select ND to ROSE then select ND to SECTOR with a suitable range to give best radar picture after takeoff.

4.2.3. POWER MANAGEMENT

Managing the power through the collective trim gives protection since the trim is inhibited when reaching the power limit (MTOP at takeoff). It prevents any transient power range incursion but shall only be used if there is no vertical upper mode coupled.

4.2.4. RUNWAY TAKEOFF CLASS 1 AND 2

- Before takeoff, at departure, preset **ALT.A**,
- Pilot engages **GA** at Vy and ensures GA are coupled on collective and cyclic pitch,
- Keeps hands near controls (below 200 feet), When established in climb,
- Pilot check **ALT.A** setting then couple **ALT.A**,
- Pilot couples lateral mode as required.

4.2.5. LOW VISIBILITY TAKEOFF (LVTO)

- Before takeoff, at departure, preset **ALT.A**,
- If power margin permits for taking off, from hover, apply power then cyclic forward to avoid descent,
- At Vy, Pilot presses **GA** and ensures GA are coupled on collective and pitch,
- Keeps hands near controls (below 200 feet),
- When established in climb,
  - Pilot presses **ALT.A**, and ensures **ALT.A** is armed,
  - Pilot couples the appropriate lateral mode (**HDG** or **NAV**).

4.2.6. GROUND HELIPAD TAKEOFF (CLASS 1)

- Before takeoff, at departure, preset **ALT.A**,
- At TDP (H1=130 feet), apply power then cyclic forward,
- At Vy, Pilot presses **GA** and ensures **GA** are coupled on collective and pitch,
- Keeps hands near controls (below 200 feet),
- When established in climb,
  - Pilot presses **ALT.A**, and ensures **ALT.A** is armed,
  - Pilot couples the appropriate lateral mode (**HDG** or **NAV**).

NOTE

In Degraded Visual Environment (DVE), including at night, from hover 10 feet, GSPD mode may be coupled.

4.2.7. HELIDECK TAKEOFF (CLASS 1)

- Before takeoff, at departure, preset **ALT.A**, and set ND(s) on HOV display as required,
- Establish in hover at 3 feet, rotor tips at the front edge of the helideck,
- Establish a vertical climb (without exceeding 200 feet per minute),
- At Rotation Point (RP) PF adopts a 10° nose down attitude change,
- At Vy Pilot couples **GA** and ensures **GA** is coupled on collective and pitch,
- Keeps hands near controls (below 200 feet) to ensure proper nose down attitude and power are attained as necessary,
  - o When established in climb, Pilot maintain Vy and presses **ALT.A**, and ensures **ALT.A** is armed,
  - o Pilot couples lateral mode (**HDG** or **NAV**) and ensures it is coupled,

NOTE

The nose down attitude change can be reduced according to the actual aircraft weight and wind conditions.

4.2.8. TAKEOFF FROM UNPREPARED AREA (OFF-AIRFIELD)

- At Vy, engage **GA** and ensure **GA** is coupled on collective and pitch.
- Keep Hands On controls (below 200 feet), flying collective through as necessary to ensure power required is attained.
- When established in climb,
  - o Pilot couples **ALT.A**, and ensure **ALT.A** is armed,
  - o engage lateral mode (**HDG** or **NAV**) and pilot ensures it is coupled,

4.3. CRUISE

The standard cruise power setting for the AS365N3+ with APM2010 is Maximum Continuous Power (MCP) flying coupled in 4 axes. This allows the system to control power so as to prevent over torque (for example in the event of icing).

In turbulent conditions, reduce IAS in order to avoid any power transient range incursion until the turbulence has subsided.

In turbulence, pilot may decouple IAS, and apply desired power. (in case of OEI, the system will revert automatically in 4-axis mode)

4.4. CLIMB AND DESCENT

For climb and descent, the preferred AFCS mode to manage altitude changes is **ALT A**.

4.5. APPROACHES

In non-degraded AFCS situation, the best recommended use of AFCS is to fly the aircraft 4-axes coupled. Except for AFCS degraded situations.

Mixed flying mode (e.g. flying lateral mode manually) should be avoided since it can be confusing for the crew. The flight path monitoring must be based on navaids raw data whatever AFCS modes in use.

4.5.1. MFDs CONFIGURATION

- FND(s)

The basic principle is to display short term objectives (attitude, navigation) on FNDs with HSI mode. For VOR or LOC approaches, set the inbound course on FNDs. For NDB approaches, select ADF on a pointer.

- ND(s)

The standard practice for pilot in RH seat is to set ND to display short/middle term objectives (final & missed approach).

NDs should be set on NAV showing the approach entered in the FMS if available, if not available, use other suitable waypoints to aid situational awareness.

4.5.2. ILS APPROACH

MFDs configuration

For ILS approaches, both NDs navigation sources shall be to ILS (ILS1 on LH, ILS2 on RH) associated with the relevant final approach course.

4.5.2.1. Use of AFCS vertical modes

Crews shall use **ALT.A** whenever descending to a cleared or previously announced altitude or flight level and both pilots shall cross-check that the correct settings have been made.

Use **ALT.A** to manage the descent to MSA then to the altitude required to intercept the ILS. If necessary, once **ALT** has been captured, the **ALT** datum may be adjusted by the Pilot with the collective beep for changes less than 300 ft.

During missed approaches or going around procedures, **GA** mode shall be coupled and **ALT.A** adjusted to the MISSED APCH. altitude and coupled when positive climb is established and after GA mode has been automatically replaced by VS / IAS.

4.5.2.2. Use of AFCS lateral modes

The arrival, holding pattern, navigation to IAF and missed approach should be flown **NAV** mode coupled to the VOR / ILS or FMS if installed. When radar vectored revert to **HDG** mode as necessary.

NOTE

Engaging GA while LOC mode is active will disengage LOC.

4.5.2.3. Use of AFCS longitudinal modes

The entire approach shall be flown with **IAS** coupled. For final approach, without any ATC request, the recommended IAS is 100 knots on a CAT A approach and 90 knots on a CAT H approach.

4.5.2.4. Use of AFCS after reaching DA for straight in landing

When reaching DA, active modes are **GS**, **LOC** and **IAS**. The aircraft is generally close to the ground and visual references are confirmed. Nevertheless, since the pertinent parameter is the RVR, a Degraded Visual Environment (DVE) is possible with associated poor situation awareness. Consequently, it is recommended to maintain modes coupled, reducing IAS to approximately 40 knots at 100 feet through cyclic beep trim while maintaining visual cues allowing a transition to manual flight for a safe landing.

In very poor visual environment (heavy rain, night, etc.), fly GS, LOC and IAS until approaching 80 feet. At a vertical speed dependent altitude above 80 feet the ALT mode engages automatically to reach level flight at 80 feet agl. Fly ALT, LOC and IAS, ALT mode can be managed to 30 feet agl (minimum ALT setting) using the collective beep trim. It is also possible to engage **GPSD**, to manage hover automatic acquisition.

CAUTION

AUTOMATIC LEVEL-OFF REQUIRES THE RADALT TO BE SERVICEABLE (IF RADALT IS NOT SERVICEABLE VERTICAL MODES ARE DISPLAYED IN AMBER).

4.5.2.5. Use of AFCS during circle to land

When tailwind conditions and traffic permit, a straight in landing should be preferred. Nevertheless, flying a circle-to-land shall be managed 4-axes coupled with **ALT-HDG-IAS**, adjusting ALT, HDG & IAS through beep trims while maintaining visual cues allowing transition to manual flight for a safe landing.

4.5.3. ON SHORE NON-PRECISION APPROACH

4.5.3.1. Use of AFCS vertical modes

Crews shall use **ALT.A** and adjust **VS** rate whenever descending to a cleared or previously announced altitude or flight level and both pilots shall cross-check that the correct settings have been made.

Crew shall use **ALT.A** to manage the descent to the MDA. If necessary, in order to manage a continuous descent (CDFA), **VS** should be adjusted using the collective trim.

The **ALT.A** shall be set to the MDA or rounded to the nearest 50 feet above (e.g. ALT.A set at 650 feet for MDA at 620 feet). If necessary, once **ALT** has been captured, pilot may adjust the **ALT** reference with the collective beep.

During missed approaches or going around procedures, power must be applied and nose down to accelerate to Vy, then **GA** mode shall be coupled and **ALT.A** adjusted to the missed approach altitude and coupled when positive climb is established.

4.5.3.2. Use of AFCS lateral modes

The arrival, holding pattern, approaches and missed approach shall be flown NAV coupled to the FMS database when available. When radar vectored revert to HDG mode as necessary.

4.5.3.3. Use of AFCS longitudinal modes

The entire approach shall be flown with **IAS** coupled. For final approach, without any ATC request, the recommended IAS is 100 knots on a CAT A approach and 90 knots on a CAT H approach.

4.5.3.4. Use of AFCS after reaching MDA for straight in landing

At this stage, active modes are **ALT**, **NAV** and **IAS**. The aircraft is generally close to the ground and visual references are confirmed. Nevertheless, since the pertinent parameter is the RVR, a Degraded Visual Environment (DVE) is possible with associated poor situation awareness. Consequently, it is recommended to maintain modes coupled, reducing IAS to approximately 40 knots at 100 feet through cyclic beep trim while maintaining visual cues allowing a transition to manual flight for a safe landing.

4.5.3.5. Use of AFCS during circle to land

When tailwind conditions and traffic permit a straight in landing should be preferred. Nevertheless, flying a circle-to-land shall be managed 4 axes coupled with **ALT-HDG-IAS**, adjusting ALT, HDG & IAS through beep trims while maintaining visual cues allowing transition to manual flight for a safe landing.