DASSAULT FALCON 900EX EASY

SYSTEMS SUMMARY

Autoflight

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INTRODUCTION

The Falcon 900EX EASy Automatic Flight Control System (AFCS) is composed of:

- 2 Flight Director (FD) and 2 AutoPilot (AP) systems,
- 1 Thrust Director (TD) and 1 Auto-Throttle (AT) systems,
- 2 Yaw Damper (YD) and 2 Mach Trim (MT) systems

The AFCS elaborates orders in path and roll axis. These orders are displayed on the Attitude Director Indicator (ADI), on the Head-up Guidance System (HGS, optional), and identified as Flight Director (FD) orders.

The AFCS elaborates also a thrust order, displayed on the ADI, on the HGS (optional), and identified as Thrust Director order.

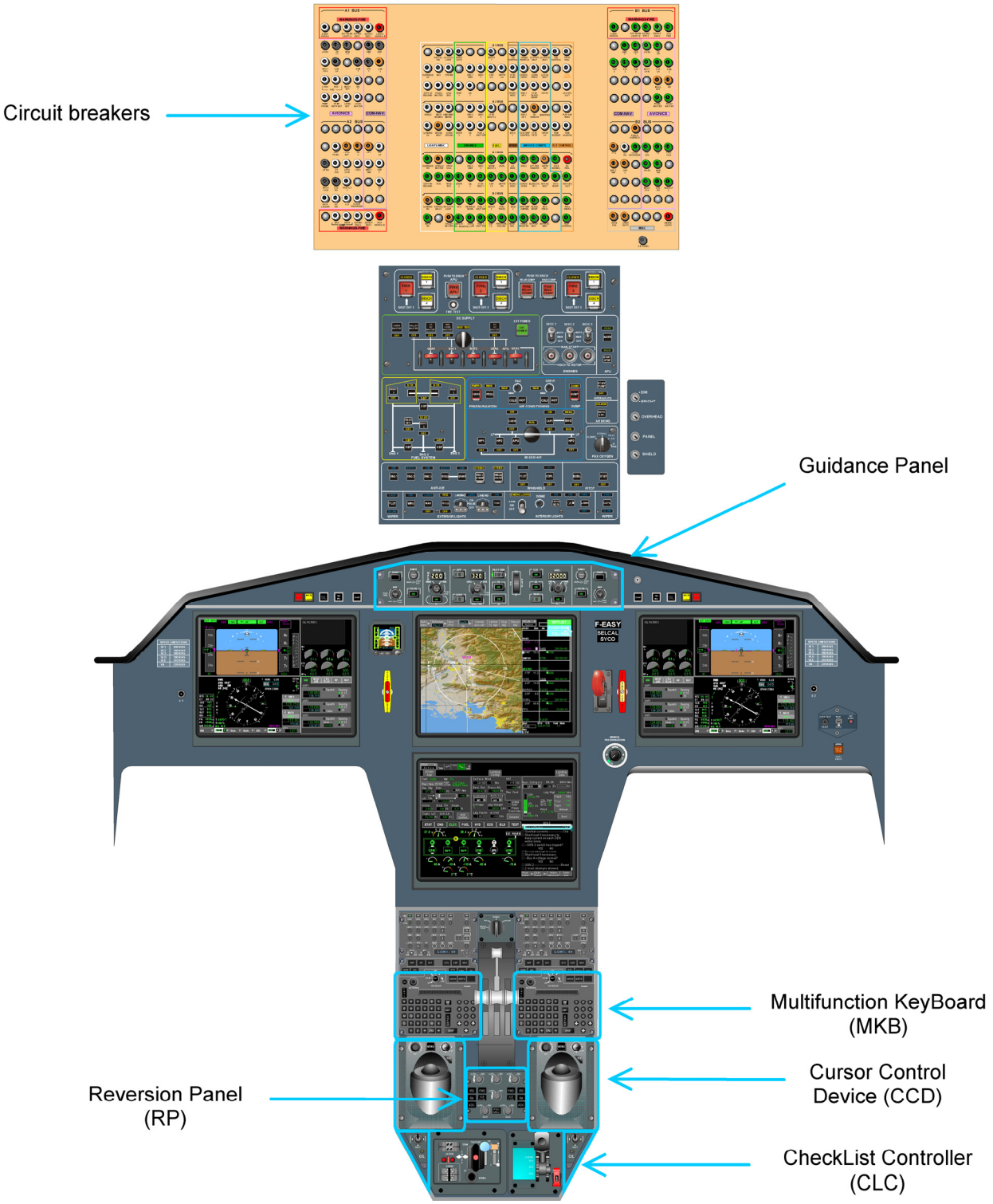
When AP and AT are engaged, electric servo-motors are connected to:

- the flight controls via a clutch, so that the airplane follows the FD orders,
- the power levers cables so that the engines follow the TD orders.

The AFCS also automatically trims the airplane in pitch and compensates for pitch variation during deployment of slats, flaps and airbrakes. Whatever vertical modes selected, when AP is engaged, pitch is automatically limited to +/- 20°.

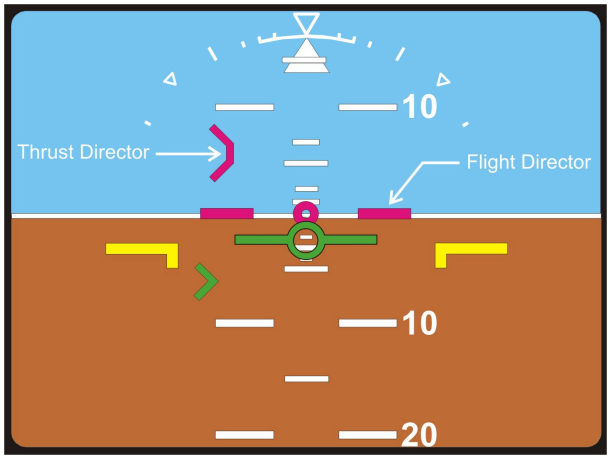
A Yaw Damper (YD) independent from the AP provides automatic stabilization in yaw during manual handling of the airplane, and turn coordination during AP operation.

The AFCS functions are hosted in the Modular Avionics Unit (MAU). The EASy installation contains two AFCS. The standard dual configuration can provide both manual and automatic reversion and interface capabilities sufficient to maintain full AFCS functionality, despite the absence of the other AFCS (due to failure). The fail operational design of the AFCS provides automatic reversion following in-flight failure of an MAU, except for the servo-motor failures: after a servo-motor failure, there is a transfer in priority AFCS, but the engagement of the 2nd AFCS is inhibited. The automatic reversion is annunciated to the crew via advisory CAS message (**AP .. FAIL**), but will result in no changes to the mode selection or engage status except for servo-motor failures.



FLIGHT DECK OVERVIEW

FLIGHT DIRECTOR AND THRUST DIRECTOR



THRUST DIRECTOR - FLIGHT DIRECTOR

Flight Director (FD) and AutoPilot (AP) can operate in:

- basic mode (ROLL and PATH),
- superior modes:
  - Lateral NAVigation (LNAV),
  - Heading / Track (HDG / TRK),
  - LOCalizer (LOC),
  - Back Course (B / C),
  - APProach (APP),
  - ALTitude (ALT),
  - Altitude SELection (ASEL),
  - CLimB (CLB),
  - Vertical Speed (VS),
  - Vertical NAVigation (VALT, VCLB, VPTH, VASEL, VGP),
  - Glide Slope (GS).

Thrust Director (TD) and Auto-Throttle (AT) can operate in:

- speed / Mach mode,
- thrust mode.

The FD can also operate in the following specific modes:

- Go-Around (GA),
- windshear (WSHR)

The TD is associated with the speed bug set through the GP in MAN mode or by the FMS in FMS mode.

FD and TD can be selected to be displayed or not on the ADI by pressing on the relevant FD/TD pushbuttons on the Guidance Panel (GP). When they are selected, a green ON symbol is lit on the pushbutton. When the FD and/or TD commands are invalid, a red flag is displayed on both ADI and FD and/or TD are dropped from displays.

NOTE

FD and/or TD orders can also be flown manually (AP and/or AT disengaged, lateral and vertical modes remain active).

MACH TRIM FUNCTION

When AP is not engaged, an automatic Mach trim increases manual longitudinal stability of the airplane at high Mach numbers (above 0.77) by adjusting the horizontal stabilizer position as Mach number is changing.

Mach trim is automatically engaged at airplane power up and cannot be manually disengaged. With the Mach trim system engaged, the normal trim can be used at any time to adjust the stabilizer position. Once the normal pitch trim switch is released, the Mach trim system resumes its operation.

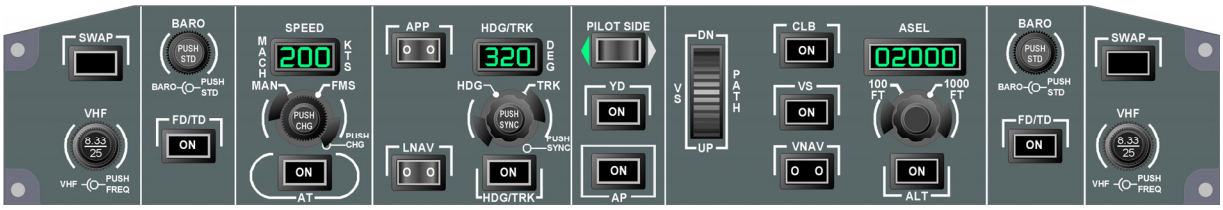
When AP is engaged, an auto-trim is provided by the AFCS.

AUTOMATIC FLIGHT CONTROL SYSTEM INTERFACE

AFCS (AutoPilot and Auto-Throttle) is managed:

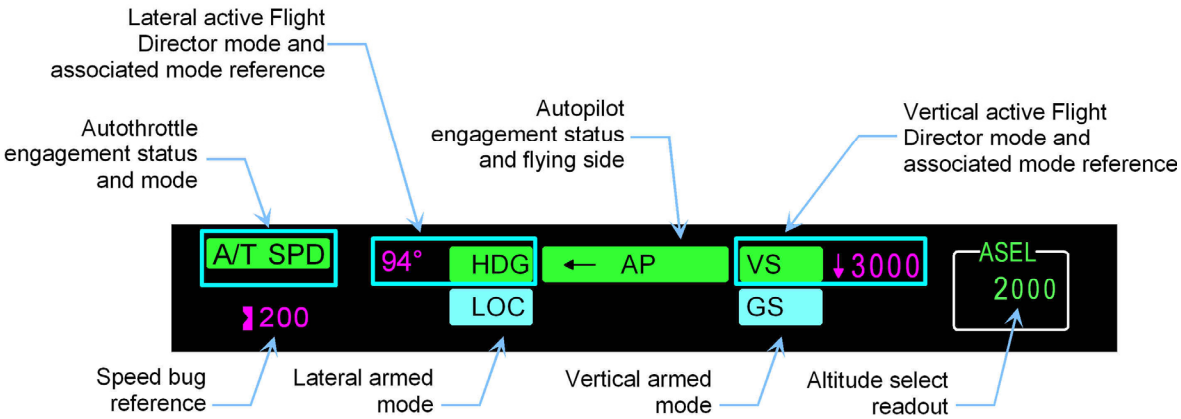
- on the instrument panel,
  - the Guidance Panel (A) gathering all AFCS mode controls and indications,
  - the Flight Mode Annunciator (B) providing status of AFCS mode operation,
- on the yoke (D),
  - the AutoPilot (AP) quick disconnect pad,
  - the Go Around (GA) pushbutton,
  - the Touch Control Steering (TCS) pushbutton,
- on the throttles of engines No 1 and 3,
  - the AT (E) quick disconnect pushbuttons.

AFCS CONTROLS



GUIDANCE PANEL

FLIGHT MODE ANNUNCIATOR

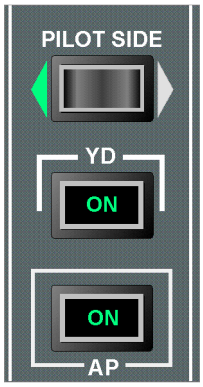


FMA AREA

AP and AT modes status (armed, engaged) and their references are displayed on the Flight Mode Annunciator (FMA) on each ADI, according to the EASy color code. Only one vertical AP mode and one lateral AP mode may be active at the same time. However, one vertical armed and one lateral armed modes can be simultaneously selected, for example when APP (approach mode) is armed, LOC and GS are armed.

AUTOMATIC FLIGHT CONTROL SYSTEM OPERATION

PILOT FLYING (PF) SIDE SELECTION



AP / YD / PF AREA

PILOT SIDE (PF) pushbutton (on the GP). The selected side is indicated by a green light on the left or right side of the pushbutton, and by an horizontal arrow in the middle of each Flight Mode Annunciator (FMA) of each ADI.

NOTE

At power on, LH side is selected by default.

The following sensors and equipment selected on the PF side are used by the AFCS for computations:

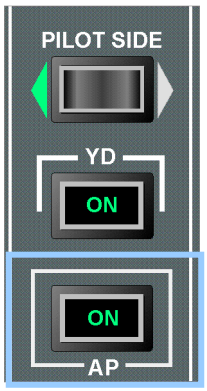
- Air Data System (ADS),
- Inertial Reference System (IRS),
- Flight Management System (FMS).

During the PILOT SIDE selection change, AP/FD modes are automatically de-selected and they must be selected again.

NOTE

We can observe that after a PILOT SIDE change, non-engaging of LNAV, VNAV modes. In this case, it is recommended to respect a waiting period (about 30 sec) before a new selection of these modes.

AP ENGAGEMENT

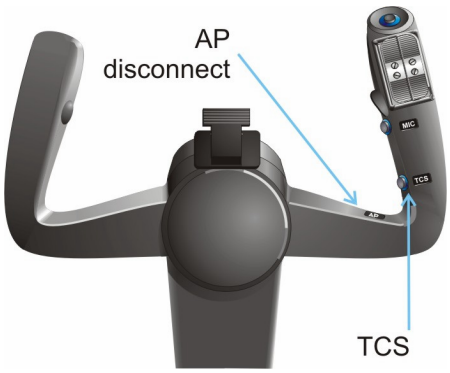


AP PUSHBUTTON

Engagement of the AP is achieved through depression of the AP pushbutton on the GP. When engaged, ON is illuminated in green on the AP pushbutton and a green AP caption is displayed at the top center of each FMA.

When AP is engaged, the horizontal and vertical modes are displayed in reverse video on the FMA. With this symbology, pilots are immediately warned about the status of the AutoPilot.

AP DISENGAGEMENT



AUTOPILOT DISENGAGEMENT (RH)

Normal AP disconnect

- Quick disconnect pad on the yoke (one push),
- Go-Around pushbutton (one push),
- TCS (push and maintain),
- Guidance Panel.

TCS pushbutton (push and maintain): when the TCS pushbutton (on the yoke) is depressed, the AP servomotors are disengaged but the AP is not properly speaking disconnected.

Activation of the Touch Control Steering (TCS) function allows the crew to manually set a new reference attitude and path without disengaging the AP. Release of the TCS button re-engages the AP servomotors. The FD synchronizes on the new reference values or return to its previous target, depending on previous active modes.

Abnormal AP disconnect

- Normal or emergency stabilizer trim command,
- Overriding action on the yoke (force disconnection),
- AP 1 and 2 failure,
- Stall warning.

NOTE

When triggered, continuous aural AutoPilot warning and AP red symbol flashing on the FMA remains active as long as there is no push on the quick disconnect pad.

YD ENGAGEMENT / DISENGAGEMENT

The Yaw Damper is automatically engaged on the ground after successful completion of the AFCS power up test or in-flight upon AP engagement, or by pressing the YD pushbutton (the ON caption on the pushbutton illuminates in green).

YD disengagement disengages AP, but AP disengagement does not disengage the YD.

YD failure does not disengage the AP.

AUTO-THROTTLE ENGAGEMENT / DISENGAGEMENT

AT PUSHBUTTON

Engagement / disengagement of the AT is achieved through depression of the AT pushbutton on the GP, only authorized when the airplane is flying above 400 ft above runway altitude on take-off. When AT is engaged, the ON caption on the AT pushbutton illuminates in green and a green A/T caption displayed at the top left corner of each FMA. When AT is engaged, the AT modes are displayed in reverse video on the FMA.

AT can also be disengaged by:

- overriding the throttles (force disconnection),
- pressing the AT quick disconnect on engine #1 and/or #3 throttles,
- DEEC malfunction,
- pushing AT pushbutton on GP.

Whenever the AT is normally disconnected, the A/T caption on the FMA turns amber and flash for 10 seconds and one aural "AUTO-THROTTLE" is heard.

Upon abnormal disengagement (manual override, failure, or drop to manual mode) an aural "AUTO-THROTTLE" warning is triggered and the amber A/T caption flash. The warnings will stop when one of the AT Quick disconnect buttons is pressed.

When engaged, the AT generate the appropriate synchronized power settings on the three engines, with respect of engine and airplane flight envelope limitations (max / min N1, VMO / MMO) or specific speed references.

NOTE

AP and AT must be disengaged at minimum used height.

FLIGHT DIRECTOR MODES

LATERAL MODES

LATERAL MODES CONTROLS

The AFCS lateral modes are:
- Basic Roll mode (ROL),
- Heading or Track modes (HDG / TRK),
- Lateral Navigation mode (LNAV),
- Localizer (LOC),
- Back Course (B / C)

Basic Roll mode

ROLL mode is active when no other lateral mode is active.

Depending on the roll condition at the activation of the mode:
- roll hold when the airplane roll attitude exceeds 6°, up to 28° max above 20,000 ft, 35° max below 20,000 ft,
- roll return to 0° when the roll attitude is between 6° and 3°,
- heading hold when the roll attitude has remained lower than 3° for 10 seconds.

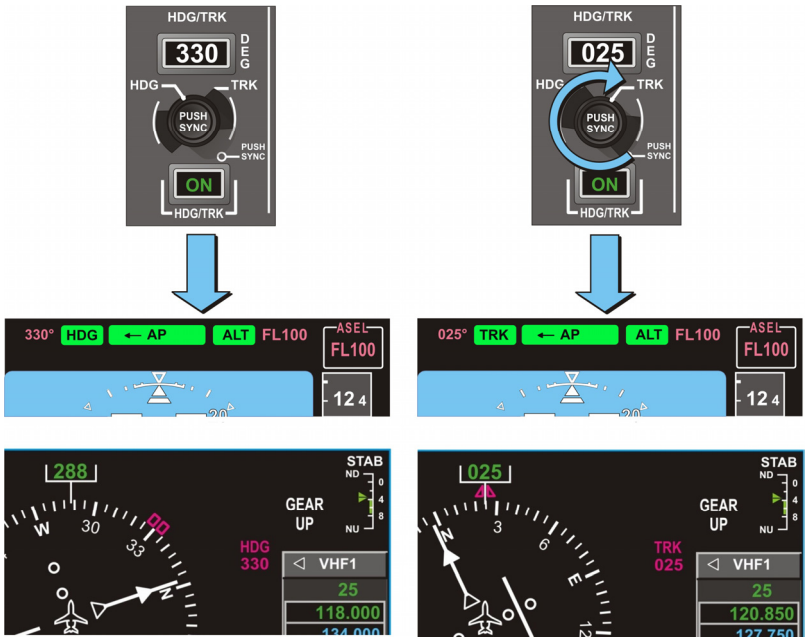
The FMA displays the green ROL.

Roll angle can be modified through TCS function: up to 28° (above 20,000 ft) or 35° max below 20,000 ft.

Heading / Track modes

Heading (HDG) or Track (TRK) mode is selected with the outer rotary switch (outer ring) on the GP. Heading or Track value is set with the inner rotary knob (inner ring), then mode is engaged by pressing the HDG / TRK pushbutton.

When engaged a green ON symbol is displayed onthe GP. Heading or Track value is displayed on the FMA and on the HSI.



HEADING OR TRACK MODE

When engaged, the HDG/TRK mode captures and hold the heading or track corresponding to the bug position.

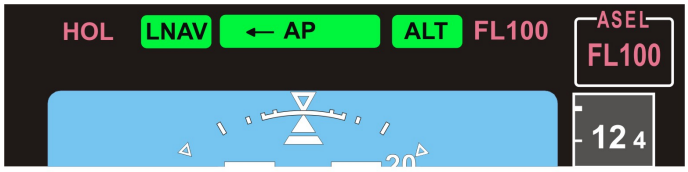
Turn is initiated in the direction the heading bug was turned to (even for changes of more than 180° but less than 360°).
The maximum bank angle can be manually selected on the AVIONICS window (AFCS Tab) or can be automatically selected according to current airplane altitude (High bank 28° below 30,000 ft, Low bank 15° above). Low bank symbol is displayed on the roll scale at the top of the ADI.

Pressing the PUSH SYNC rotary knob synchronizes selected heading or track value to the current heading or track of the airplane.

When activated, HDG or TRK mode can be disengaged automatically by AFCS logic (e.g. if LOC mode is armed, there is an automatic transition from HDG / TRK mode to LOC mode) or manually by pressing again on the HDG / TRK pushbutton (return to ROLL mode).

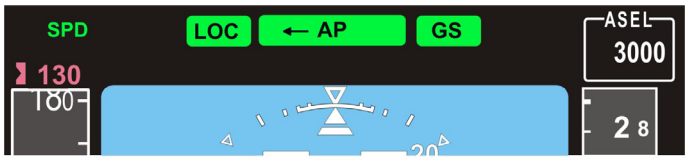
Lateral navigation mode

Lateral navigation mode (LNAV) is selected by pressing the LNAV pushbutton, which displays a cyan dot (LNAV armed) or a green dot (LNAV engaged), and accordingly the FMA displays a cyan/green LNAV symbol. When LNAV is active, the FD provides lateral command to capture and hold the active leg of the flight plan. When engaged, the AP follows this FD lateral command and the roll is automatically limited to 28°.
LNAV can be automatically activated after a DIRECT TO a waypoint selection and after a transition from ROLL / HDG / TRK to LNAV (for these last cases, the airplane trajectory must be convergent to the considered flight plan leg).
When active, LNAV mode can be disengaged automatically by AFCS logic (e.g. commutation from LNAV to LOC if APP was previously armed) or manually by pressing the LNAV pushbutton or by selection of HDG or TRK mode.



LNAV AND ALT MODES

LOC



LOC AND GLIDE CAPTURED

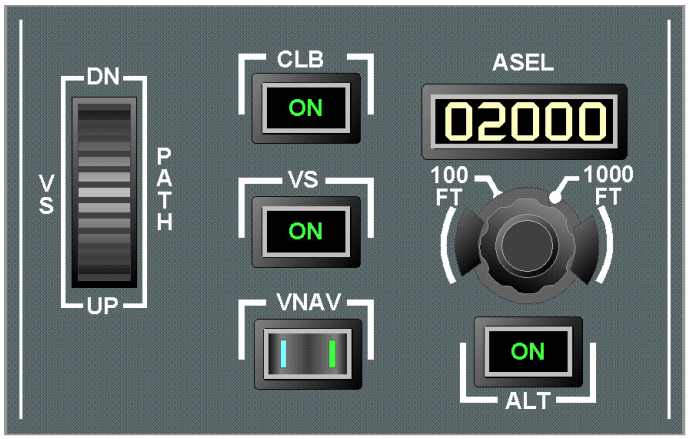
When engaged, the APP mode allows the airplane to capture and follow a LOC beam. This mode is similar to the LNAV mode but provides more accurate track monitoring. The LOC can also be captured from ROL, HDG / TRK, LNAV lateral modes.

The lateral deviation scale is displayed in white at the bottom of the attitude display. The Loc pointer deviation is displayed in white, cyan or magenta according to the approach mode status.

B / C

If Back Course has been selected on the Flight Management system window for the arrival phase of flight, the AP mode selection engages the B / C lateral mode. In B / C mode, the final descent to the runway can be performed in PATH or VS modes.

VERTICAL MODES



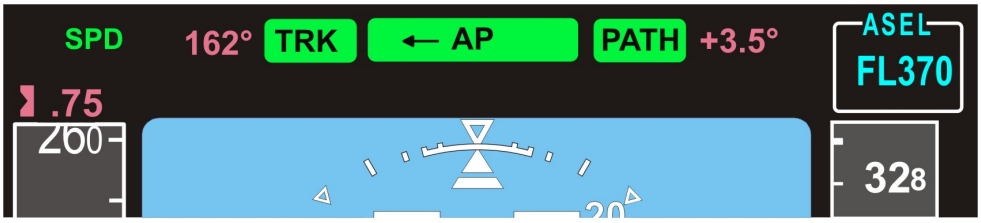
VERTICAL MODES CONTROLS

The AFCS vertical modes are:

- Basic Path mode (PATH),
- Altitude mode (ALT),
- Preset Altitude mode (ASEL),
- Climb mode (CLB),
- Vertical Speed mode (VS),
- Vertical Navigation mode (VALT, VCLB, VPTH, VASEL, VGP),
- Glide Slope mode (GS).

Basic Path mode

If no FD modes are displayed on the FMA, engaging the AutoPilot automatically selects basic modes (ROLL and PATH). The PATH limits when AP is engaged are +/- 17°. AP engagement outside of these limits will bring back the airplane to a commanded path at +/- 17°. Within these limits, the path angle can be changed through use of the PATH / VS thumb wheel, up and down (UP / DN), and also through TCS function.

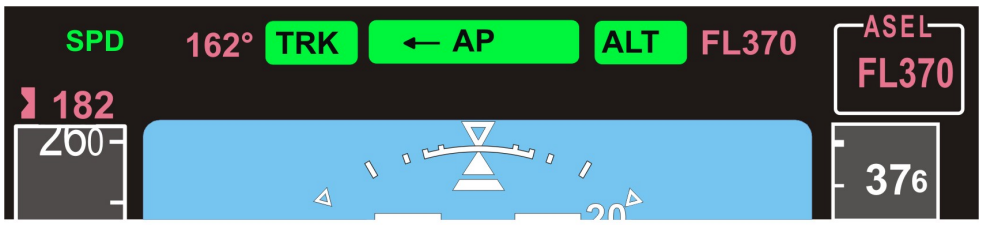


PATH MODE

Altitude hold mode

Altitude hold mode (ALT) is selected either manually by pressing the ALT pushbutton on the GP or automatically after capture of a Pre-selected Altitude (ASEL).

The ALT mode allows either to capture and hold the present altitude when ALT button is pressed or to hold the pre-selected altitude.
When ALT mode is active a green ON light is displayed on the GP and the FMA displays the green ALT indication and the reference altitude along with the corresponding bug on the altitude tape.
Airplane response in ALT mode is limited to +/- 0.1 g or +/- 20° pitch angle.



ALT MODE

When active, ALT mode can be disengaged automatically by AFCS logic (e.g. Glide Slope capture) or manually by pressing the ALT pushbutton.

Preset Altitude mode

Preset Altitude mode (ASEL) is automatically armed as soon as:

- a pre-selected altitude has been set, either manually (ASEL) or automatically through the FMS (VASEL) using a VNAV mode,
- the airplane is climbing / descending towards the pre-selected altitude.

The reference pre-selected altitude value (or FL value when BARO setting is STD) is displayed on the readout above the ASEL setting knob (1,000 feet or 100 feet increments). This reference value and associated bug are also displayed on the FMA, on top of the altitude tape. Depending on the selection made on the HSI menu, the ASEL unit can be either ft or m.

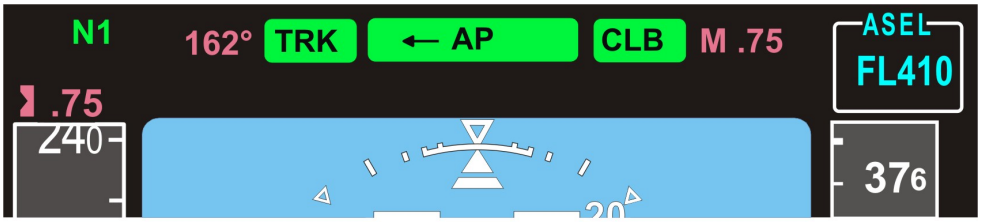
When the AP has been engaged in normal conditions (except with active VGP or G/S modes: in these cases, ASEL is ignored), it will capture and hold the reference with a minimization overshoot:

- during climb, the capture phase is initiated when the pre-selected altitude is within 2,000 ft (0.8 g max) of current airplane altitude,
- during descent, the capture phase is initiated when the pre-selected altitude is within 10,000 ft (1.2 g max) of current airplane altitude.

If the current flight path is diverging from the ASEL reference or if the selected mode is incompatible with ASEL logic, a CHECK ASEL message will be displayed on the FMA.

Climb mode

Climb mode (CLB) is selected by pressing the CLB pushbutton on the GP, and a green ON light is displayed on the pushbutton itself. When engaged, the CLB mode allows to capture and track a speed reference. The speed reference set manually by the crew (SPEED knob) in mach or speed, or automatically through the FMS. The FMA displays the green CLB indication and speed bug (FMS or manual) along the speed tape.

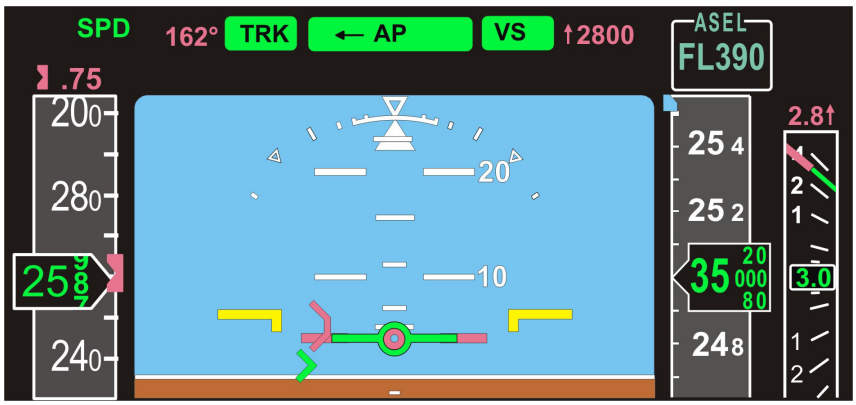


CLB MODE

When active, CLB mode can be disengaged automatically by AFCS logic (e.g. ASEL capture) or manually by pressing the CLB pushbutton.

Vertical Speed mode

Vertical Speed (VS) mode is selected by pressing the VS pushbutton on the GP and a green ON light is displayed on the pushbutton itself. When engaged, the VS mode allows to capture and track a vertical speed reference. This reference vertical speed can be adjusted through the use of the VS / PATH wheel on the GP. Each click on the wheel will change the vertical speed by +/- 100 ft/min. The maximum vertical speed commands are - 8,000 ft/min and + 6,000 ft/min. The FMA displays the VS indication in green and the value of the vertical speed target in magenta.



VS MODE

When active, VS mode can be disengaged automatically by AFCS logic or manually by pressing the VS pushbutton.

Vertical Navigation mode

Vertical Navigation mode (VNAV) is selected by pressing the VNAV pushbutton on the GP.

When VNAV is armed a cyan light is lighted on the GP, when the VNAV is active a green light is lighted on the GP. The FMA displays accordingly the corresponding cyan/green mode/sub mode indications.

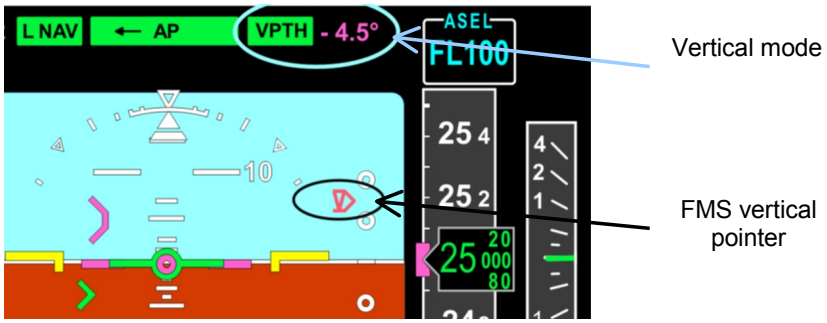
In this mode, the FD guidance is computed by FMS.

FD modes for VNAV are VALT, VCLB, VPTH, VASEL, VGP:

- VALT: Transition to VALT automatically occurs upon VNAV mode capture of the FMS pre-selected altitude or computed altitude (whichever is closer), or if the FMS requests a direct transition to altitude hold. The reference altitude may also be manually selected and in such case will have priority over the FMS computed altitude.
- VCLB : when CLimB mode is operating, VCLB is selected by pressing the VNAV pushbutton on the GP. It operates like the CLB mode except that guidance commands are referenced to the FMS altitude and IAS/Mach values. Manually selected speed reference can also be used in this mode. If a pre-selected altitude has been manually set, this selection will override the FMS computed altitude if this selected altitude value is below the FMS constraint.
- VPTH : it is selected by pressing the VNAV pushbutton on the GP. VPTH is only active during descent and operate like VS mode. It is automatically engaged at the TOD (Top Of Descent) if the ASEL is lower than the current altitude of the airplane. To obtain a VPTH mode on a waypoint, it is necessary to have an altitude constraint attached to this waypoint. If the ASEL is lower than the airplane current altitude, it is possible to engage VPTH by performing a vertical DIRECT TO this waypoint.
- VASEL: this mode is armed as the ASEL mode is when the altitude constraint attached to the waypoint is closer to the airplane current altitude than the ASEL. VASEL mode operation status is displayed in the FMA only during capture phases. It operates like PRESEL altitude mode.
- VGP: This mode is similar to VPTH mode but the altitude preselector is ignored. The FD shall transition to VGP mode based on the set-up of an FMS approach, being in the terminal area, and the arming of the mode via the APP pushbutton on the GP.

NOTE

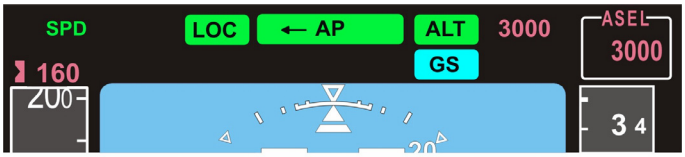
Below transition altitude or level, altimeter setting must be set to QNH for the use of VNAV.



VPTH MODE

Glide Slope mode

Transition to Glide Slope mode (GS) from a VNAV mode occurs when the airplane gets within the GS deviation limits with LOC captured. In the FMA the GS caption turns green.



LOC CAPTURED AND GLIDE ARMED

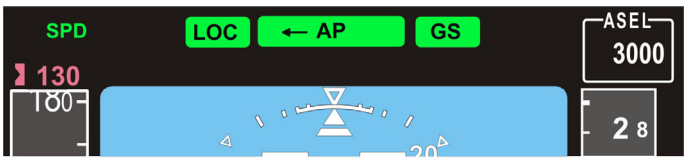
APPROACH MODE

Approach mode (APP) is selected by pressing the APP pushbutton on the GP. A cyan light (APP armed) or a green light (APP engaged) is then displayed on the pushbutton itself.

The type of approach must be selected in the FMW page before pressing the APP pushbutton (Refer to Chapter 02 / ATA 34 / windows and associated tab - flight management window).

When active, APP mode can be disengaged automatically by AFCS logic (e.g. loss of sensors) or manually by pressing the APP pushbutton.

Accordingly the FMA displays armed mode in cyan and active mode in green.



LOC AND GLIDE CAPTURED

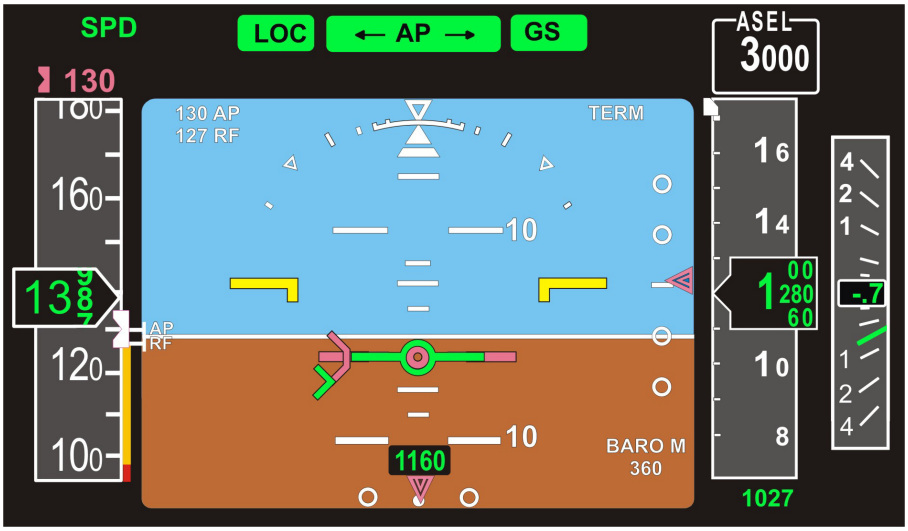
The dual couple mode is activated if the following conditions are met:

- both PDU display the same approach guidance source (ILS),
- both navigation sources are valid,
- both PDU indicate they are receiving the same radio frequency from the NAV receivers,
- both PDU receive radio information from independent radios.

When in dual couple mode the AFCS use for FD computation the average deviation data.

If during the dual approach track mode, the displayed data on one of the two PDU become invalid, the AFCS continues the approach using the valid data from the remaining PDU.

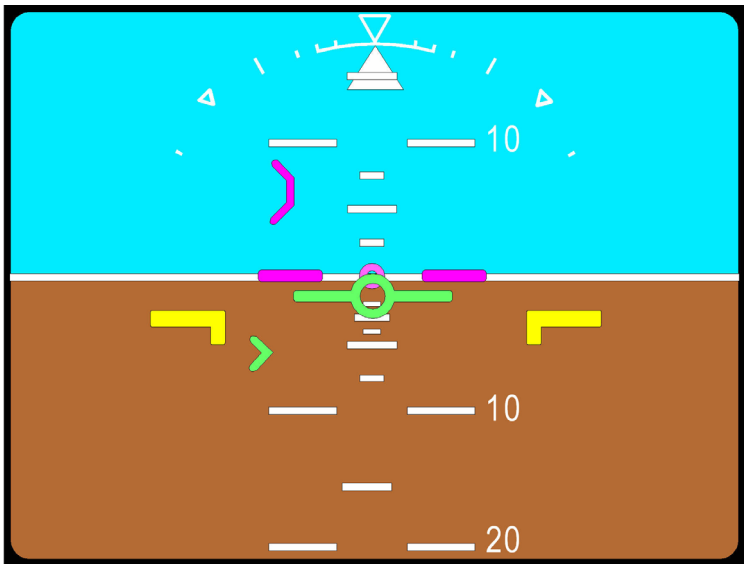
After a transition from dual approach track status, the AFCS reverts to the selected single PDU status (couple) in effect prior to acquisition of dual PDU status.



APP LOC AND GLIDE CAPTURED-DUAL COUPLED

GO-AROUND MODE

The Go-Around mode (GA) is available when the airplane is airborne (weight off wheels) or when airspeed is above 60 kt, by pressing the GA pushbutton on the yoke. This disengages the AP and displays ROL and GA on the FMA.



GA REFERENCE

On the ADI:

- in the lateral axis lateral mode, the FD commands wings level until 140 kt are reached, and then transition to heading hold,
- in the vertical axis, the FD commands a fixed pitch (14°).

GA mode is de-selected when a new vertical mode is selected (PATH, VS, CLB or VCLB).

WINDSHEAR MODE

WindShear (WS) escape mode can be selected each time a Windshear condition is detected by the Terrain Awareness and Warning System (TAWS) by pressing the GA pushbutton on the yoke. If GA is already activated at the moment of the windsher condition is detected, the windshear mode is automatically activated.

This action disconnects the AutoPilot and changes the FD / TD commands. ROL and WSHR modes are displayed in the FMA.

FD and TD will thus provide vertical and thrust guidance to achieve the best escape path. FD command, when followed, will maintain the IAS close to the stall speed. TD command, when followed, will maintain the maximum take-off power.

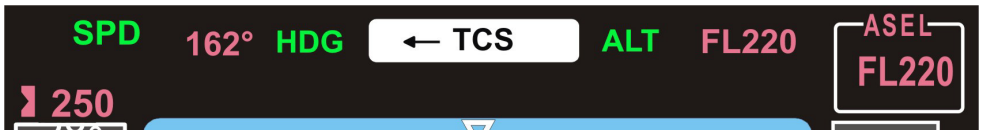
Windshear mode is de-selected upon selection of any other vertical mode.

TOUCH CONTROL STEERING (TCS) RELEASE

Depressing the TCS pushbutton on the yoke activates the TCS mode.
When the push button is released the previous modes are active again. The FD synchronizes on the new reference values or return to its previous target, depending on previous active modes:

FD MODES BEFORE TCS ACTIVATION	FD MODES AFTER TCS ACTIVATION
LNAV	LNAV
HDG (XXX°)	HDG (XXX°)
TRK (XYZ°)	TRK (XYZ°)
ROL (X°)	ROL at TCS release (*)
LOC	LOC
ALT (XXX ft)	ALT at TCS release (XXX ft)
VS (XXX ft/min)	VS at TCS release (YYY ft/min)
PATH (XX°)	PATH at TCS release (YY°)
ASEL	ASEL
CLB (XXX kt) manual speed	Speed at TCS release (YYY kt)
CLB (XXX kt) FMS speed	CLB (XXX kt)
G/S	G/S
VGP	VGP
VPTH	VPTH

(*) refer to basic ROL mode



THRUST DIRECTOR MODES

When engaged the Auto-Throttle moves the throttle to achieve TD guidance.

NOTE

When AT is engaged and in speed capture phase (target speed is significantly different from the current speed), TD progressively coincide with acceleration chevrons.

The TD is working in two different modes:

- speed mode,
- thrust mode.

SPEED MODE

In this mode, throttle positions are adjusted to maintain the selected speed / Mach number.

Associated AP vertical modes are: ALT, VALT, VS, PATH, VPTH, GS, VGP, ASP.

In MAN speed, the reference target speed / Mach number (selected through action on the PUSH CHG toggle button) is displayed in the speed digital readout on the GP. On FMS speed modes, dashes are displayed in the speed digital readout on the GP. The FMA displays a green A/T SPD indication, the reference speed value and the associated bug.

A speed reference bug can be:

- : MAN,
- : FMS,
- : tear-drop display when MAN / FMS speed < Low Speed Cue + 5 kts.

The TD provides a thrust command to capture and hold the reference speed / Mach number. If reaching the reference speed / Mach number takes too long or is impossible, a LIM amber indication is displayed on the FMA (in the AT status area): to achieve the target capture, PF action will be necessary (extend or retract airbrakes, change flaps configuration, …).

THRUST MODE

This mode is active when the speed is hold by the FD or when the throttle positions are maintained constant.

Associated modes are CLB, VCLB, WS, GA, Pitch Speed Protection (PSP), throttle retard mode, and thrust reduction mode.

CLB, VCLB

In these modes, the TD indicates the throttle position to complete the climb.

N1 is displayed in green in the autothrottle FMA.

The maximum possible engine power setting is MAX CLIMB or FLXCLB (flex climb) or CRU (cruise). The FLXCLB or CRU is selected on the ENG synoptic.

➢ *For more information, refer to CODDE 1 / ATA 70.*

Windshear, GA

The engine power setting is MAX TAKE-OFF power.

Pitch Speed Protection (PSP)

This mode provides over speed protection and when activated engine power is set at the appropriate position to correct the speed violation.

➢ *For more information, refer to CODDE 1 / ATA 22 / Speed protection mode.*

Throttle retard mode (CAT III approaches only)

When the AT is engaged and the airplane descending through 20 ft radio altitude, the AT will retard throttles to IDLE, then disengage after touch down (WOW). The FMA displays a green RTR symbol as the active N1 limit, until AT disengagement.

Thrust reduction mode (optional HUD3)

This mode is initiated by a HGS order entailing automatic throttles reduction during flare out. AT displays and operation in this mode is the same as in the throttle retard mode described above.

AUTO-THROTTLE LIMITS

N1 limit

The FMA displays a green N1 indication, and just below the active N1 limit:

- FLXCLB, when the upper N1 limit is a flex climb value set by the pilot,
- CRU, if the N1 upper limit is MAX CRUISE.

Speed limit

The upper speed limit is VMO / MMO and the lower speed limit is low speed cue.

NOTE
Automatic protection is not provided for VFE.

AUTOPILOT CAT II APPROACH

CAT II Approach must be selected in the Landing database of the Flight Management Window.

Aproach mode (APP) is selected by pressing the APP pushbutton on the GP.

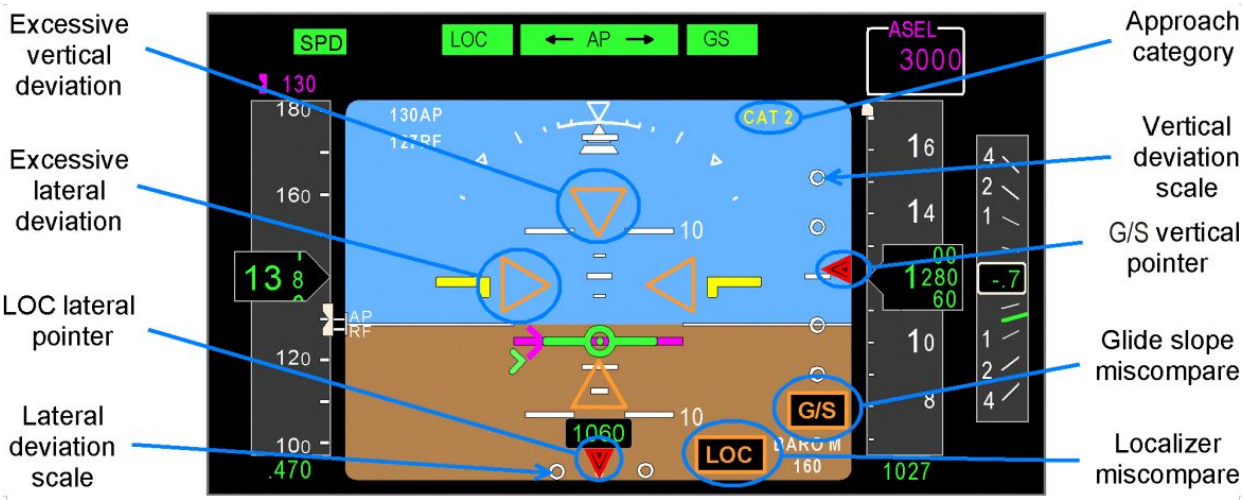
GUIDANCE PANEL CONTROL

The following condition must be met to enter in CAT II:

- dual couple mode active,
- independant sources for IRS and ADS,
- same barosetting for LH and RH side,
- one RA is operational;
- auto-pilot is engaged.

➢ *For more CAT II conditions of operation, see AFM (DGT84972) / ANNEX 2 and CODDE 2 (DGT84973) / Chapter 02 / SPECIAL NORMAL OPERATION / Operations.*

Each condition required for CATII that is not met is indicated by an appropriated advisory CAS message.



CAT II APPROACH SYMBOLS

The CAT2 annunciation is displayed in the ADI when approach CATII is selected and the vertical G/S deviation is captured.

This annunciaion is displayed in green if the CATII conditions are valid.

If the CATII conditions are not valid and RA altitude is above 200 ft the annunciation is displayed in amber. If the CATII conditions are not valid and RA altitude is below 200 ft the annunciation is displayed in red.

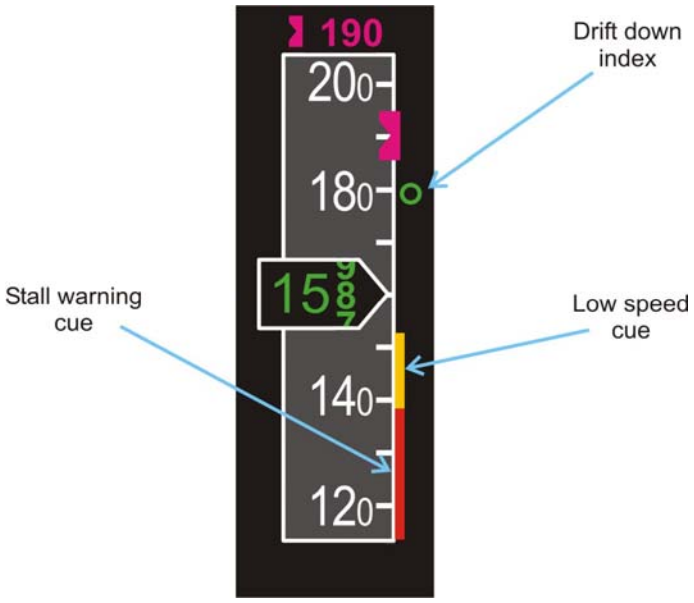
INTRODUCTION TO SPEED PROTECTION MODE

The EASy system provides speed protection devices and associated warnings, in order to the airplane stays within its normal flight envelope.

DEFINITIONS

LOW SPEED CUES (LSC)

At the bottom of the speed scale of the Attitude Director Indicator (ADI), two cues, one amber and one red, are displayed at low speed. They are also displayed on the HUD (optional).



LOW SPEED CUES ON ADI SPEED SCALE

Low speed cue (amber)

The amber low speed cue indicates an operational speed limit that includes preset stall margins. The length of the amber low speed cue will vary when the airplane configuration changes (SF1, SF2, SF3).

When the load factor is increased and autopilot is off, the upper edge of the amber cue will not move up.

Aural alert "Increase speed" is triggered at two knots below LSC or when speed protection is active. It can be muted by the SIL button available on the glareshield.

Stall warning cue

The upper edge of the red cue indicates the speed at and below which the stall warning is activated in any flight phase and airplane configuration. When the load factor is increased (e.g., during a turn), the upper edge of the red cue will move up. Therefore, at high load factors, the amber cue may be hidden by the red cue.

- *For more information, refer to CODDE1 / ATA 27*

Drift Down Index

The Drift Down Index (DDI) is only displayed in clean configuration. It indicates the speed corresponding to the best glide slope in clean configuration.

HIGH SPEED PROTECTIONS

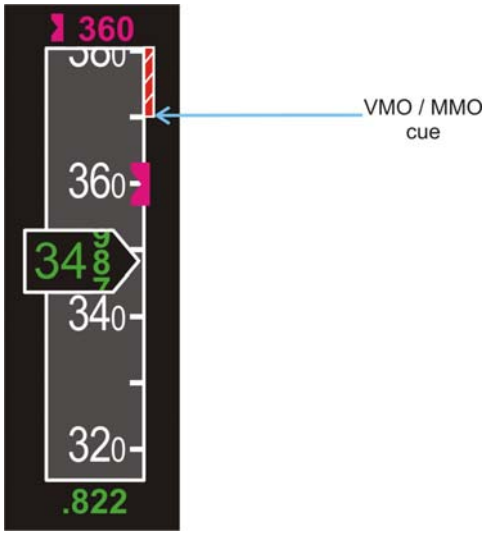
As for the Low Speed Cues, indications of overspeed are displayed at the top of the speed scale of the Attitude Director Indicator (ADI) and the HUD.

VMO / MMO

The VMO / MMO limitation is represented by a red cue with white stripes, displayed at the top of the speed scale.

The manual speed bug cannot be positioned above VMO / MMO.

Aural overspeed alert is triggered at VMO / MMO plus 2 knots.



VMO / MMO ON THE ADI SPEED SCALE

GENERAL RULES FOR SPEED PROTECTIONS

Automatic speed protections are available only if autopilot is engaged.

Speed protections aural and visual alerts are available independantly of the auto pilot engegement.

There is no speed protection:

- when flying above a Velocity Constraint (VFE, PITCH FEEL, AIL FEEL, ...),
- when flaps are extended; only a continuous FLAPS voice message is triggered when the airplane is flying above VFE,
- when Go Around or Windshear mode are active.

NOTE

Even when speed protection mode is active (AP ON, AT ON), if speed reaches the red low speed cue, a continuous "STALL" aural warning will be triggered and the Autopilot will automatically disengage. The crew will have to manually re-enter the normal speed flight envelope

SPEED PROTECTION MODES

AUTO-THROTTLE SPEED PROTECTION (ASP)

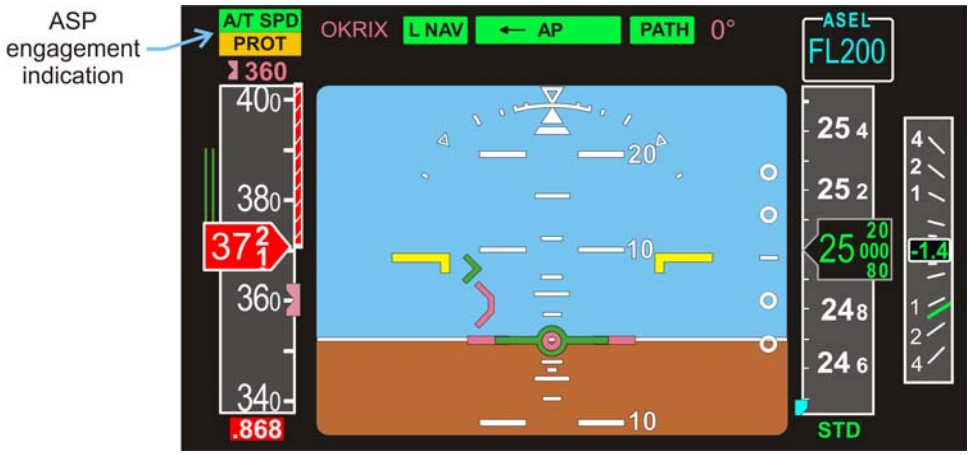
Engagement

The Auto-throttle Speed Protection (ASP) mode is automatically engaged each time that the airplane is flying outside of the normal speed flight envelope, when the AutoPilot is engaged and the Auto-Throttle is not engaged:

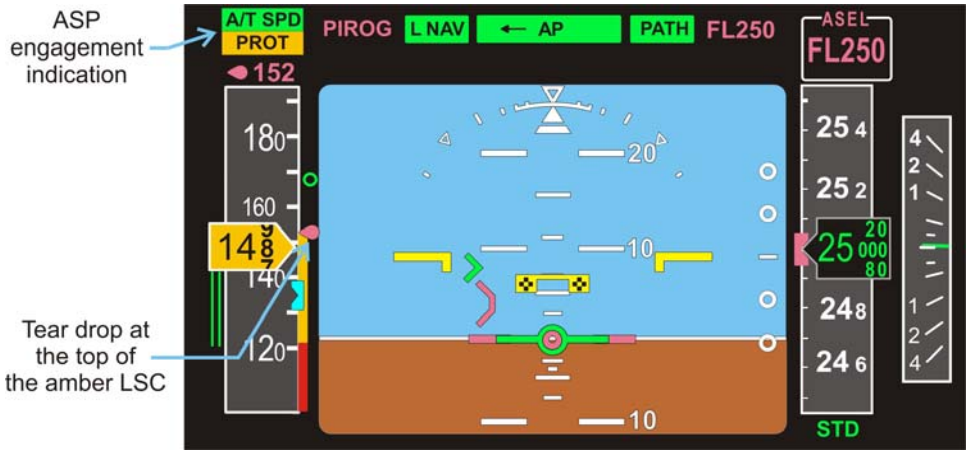
- low speed ASP is engaged when speed is below the amber Low Speed Cue (LSC) top edge value,
- high speed ASP is engaged when speed is above VMO / MMO.

When the ASP is activated, the Auto-Throttle engages and adjusts engine power to follow Thrust Director (TD) orders calculated by the system in order to maintain speed at the active speed target (manual or FMS speed bug or tear drop).

The Auto-Throttle mode is changed to protection mode and a PROT indication appears on the Flight Mode Annunciator (FMA).



HIGH SPEED ASP MODE ENGAGED



LOW SPEED ASP MODE ENGAGED

Disengagement

The ASP is disengaged when the normal speed flight envelope has been re-entered or when the AT is disengaged

PITCH SPEED PROTECTION (PSP)

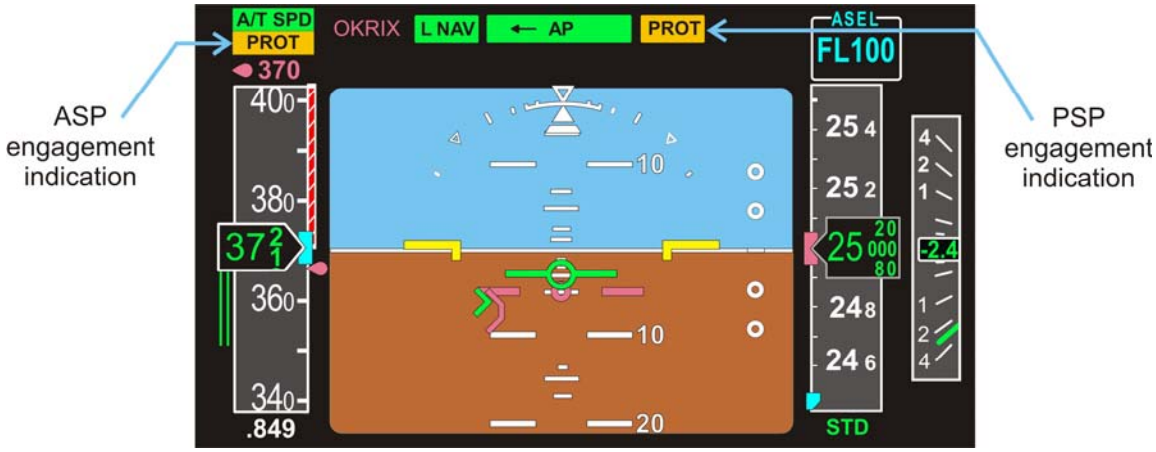
Engagement

The Pitch Speed Protection (PSP) mode can be activated in every vertical mode other than ASEL, ALT (below 20000 ft), VALT (below 20000 ft), G/S, GA, WS and VGP and it protects the airplane from overspeed only. It is automatically activated when the ASP is not able to make the airplane re-enter within the limits of the normal speed flight envelope.

> **NOTE**
>
> In ASEL, ALT, VALT, G/S, VGP modes, holding the path is considered more important than speed control so PSP is not available in these modes.

The PSP is always activated after ASP engagement. In that case, the vertical AutoPilot mode is automatically changed (PROT indication in the Flight Mode Annunciator FMA). Then, when the PSP is activated, two PROT modes is displayed in the FMA (one for ASP as AT mode and one for PSP as vertical AP mode).

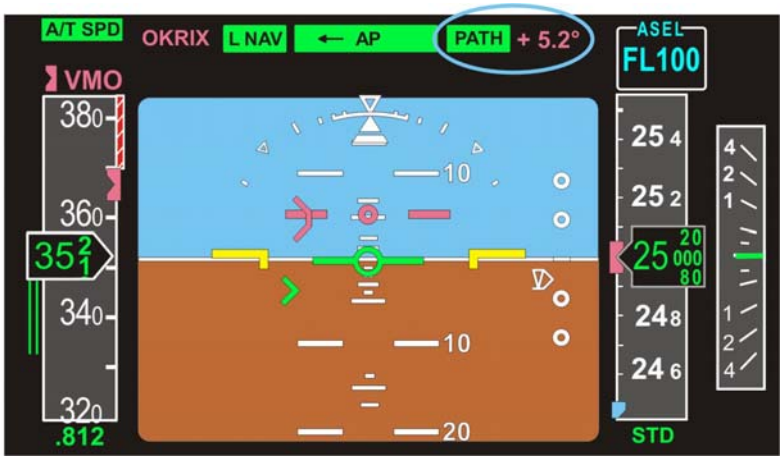
When the PSP is activated, the AutoPilot tracks Flight Director (FD) command, calculated by the system. The AutoPilot maintains speed at the tear drop bug level. The tear drop is set at VMO /MMO minus 5 knts in case of overspeed, or LSC plus X knts in case of low speed (X depends of the altitude).



ASP AND PSP MODE ENGAGED

Disengagement

The PSP is disengaged when the normal speed flight envelope has been re-entered. At the disengagement the PATH mode is activated.



DISENGAGEMENT OF THE PSP MODE

CAS MESSAGES

CAS MESSAGES	DEFINITION
AP .. FAIL	On ground, indication of AP (1/2) failure
MACH TRIM FAIL	Failure of Mach trim function
PITCH MISTRIM	Pitch mistrim is detected with AP engaged
RETRIM LEFT WING DOWN	AP engaged, detection of left lateral or direction mistrim
RETRIM RIGHT WING DOWN	AP engaged, detection of right lateral or direction mistrim
YD .. FAIL	On ground, YD function (1/2) is failed
AFCS - ADS ALL MISC	All ADS miscompare detected by AFCS
AFCS - IRS ALL MISC	All IRS units miscompare detected by AFCS
AFC - IRS ..+.. MISC	Miscompare of the IRS unit (1/2/3) with respect the other IRS units.
AFCS IRS .. FAIL	IRS (1/2/3) not available for AFCS
AP CONTROL WHEEL OVRD	AutoPilot has been disconnected due to pressure on control wheel
AP-ON GROUND INHIBITED	AP engagement is inhibited on ground
AP-SW ACTIVE INHIBITED	AP engagement is inhibited due to AP switch stucked
AP-TCS INHIBITED	AP engagement is inhibited due to AP being Touch Control Steering (TCS) switch stucked
AP-TOGA INHIBITED	AP engagement is inhibited due to AP being Go-Around (GA) switch stucked
AP TRIM INHIBITED	Pressure limit on control wheel has been reached and AP trim is inhibited
AP .. FAIL	In-flight, indication of AP (1/2) failure
AT FAIL	Auto-Throttle failure
CAT 2 NOT AVAILABLE	Approach CAT 2 not available
CHECK ADS SOURCE	The same ADS is displayed on both PDU
CHECK BARO SETTING	Difference between LH and RH barosetting is greater than ± 0.06 in.Hg (± 2 hPa)

CAS MESSAGES	DEFINITION
CHECK COPILOT NAV	RH NAV source in not LOC 2
CHECK FGC SETUP	The FD is not in dual couple mode below 800 ft
CHECK ILS FREQ	ILS frequencies are different between LH and RH
CHECK IRS SOURCE	The same IRS is displayed on both PDU
CHECK PILOT NAV	LH NAV source in not LOC 1
ENGAGE AP	RADH is set below 200 ft and AP is not engaged
G/S NOT CAPTURED	The active vertical mode is not GS
G/S NOT RECEIVED	One GS deviation pilot or copilot is invalid
LOC NOT RECEIVED	LH LOC deviation or RH LOC deviation is invalid
PITCH TRIM FAIL	Pitch trim is failed
RA NOT RECEIVED	Radio Altimeter is invalid (Second RA is optional)
REVERT IRS	One IRS data on LH or RH is invalid
REVERT RAD ALT	In dual RA configuration, a displayed RA is invalid
STAB EMERGENCY	Horizontal stabilizer control in emergency mode
YD .. FAIL	In flight, Yaw Damper (1/2) is failed