

DASSAULT FALCON 7X

SYSTEMS SUMMARY



Automatic Flight Control System

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Do not use it for flight!

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Falcon 7X [Automatic Flight Control System Summary]

ACRONYMS	
AAE	Automatic Auto-throttle Engagement
ADI	Attitude Director Indicator
ADS	Air Data System
AFCS	Automatic Flight Control System
ALT	Altitude mode
AOA	Angle Of Attack
AP	Auto Pilot
APP	Approach
ASEL	Altitude preSElect
ASP	Autothrottle Speed Protection
AT	Auto Throttle
B/C	Back Course
CAS	Crew Alerting System
CDI	Course Deviation Indicator
CLB	Climb mode
CRU	CRUise mode
FADEC	Full Authority Digital Engine Control
FD	Flight Director
FMA	Flight Management Annunciator
FMS	Flight Management System
GA	Go Around
G/S	Glide Slope
HDG	HeadinG
HGS	Head up Guidance System
HSI	Horizontal Situation Indicator
HUD	Head Up Display
I-NAV	Interactive NAVigation window
LNAV	Lateral NAVigation
LOC	Localizer
LSC	Low Speed Cue
MAU	Modular Avionics System
PDU	Primary Display Unit
PFCS	Primary Flight Controls System
PROT	speed PROTection
PSP	Pitch Speed Protection
RA	Radar Altimeter
ROS	ROtation Symbol

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RTR	Retard mode or Thrust Reduction mode
SPD	Speed mode
SPS	Speed Protection System
TCS	Touch Control Steering
TD	Thrust Director
TQA	Throttle Quadrant Assembly
TLA	Thrust Lever Angle
TOGA	Take-Off Go Around
TRK	TRack
VALT	Vertical ALTitude
VFT	Final Take-off speed (velocity)
VGP	VNAV Glide Path
VNAV	Vertical NAVigation
VPTH	Vertical PaTH
VS	Vertical Speed

Falcon 7X [Automatic Flight Control System Summary]

INTRODUCTION

The Falcon 7X EASy Automatic Flight Control System (AFCS) is composed of:

- A Flight Director (FD) and an AutoPilot (AP) systems,
- A Thrust Director (TD) and an Auto-Throttle (AT) systems.

The Flight Director provides Flight Guidance on Path and Roll axes. This guidance can be displayed on ADI or HUD upon crew request. It can be either manually followed, or automatically followed by the Flight Control System if the crew engages the Auto Pilot.

In the same manner the Thrust Director provides Thrust Guidance. This guidance can be displayed on ADI or HUD upon crew request. It can be either manually followed, or automatically followed by the Throttle if the crew engages the Auto Throttle.

The Automatic Flight Control System is split into:

- ATA 22-1: Auto Pilot and Flight Director,
- ATA 22-2: Auto Throttle and Thrust Director.
- ATA 22-3: Speed and stall protections.

Speed protections provided by the Primary Flight Control System (PFCS), the Automatic Flight Control System (AFCS) and the Air Data System (ADS) as well as protections provided by the PFCS are provided in ATA 22-3.

INTRODUCTION TO AUTOPILOT & FLIGHT DIRECTOR

NORMAL OPERATION

The Flight Director (FD) provides flight guidance on path and roll axes. This guidance can be displayed upon crew request on the Attitude Director Indicator (ADI) and the Head-Up Display (HUD). It can be either manually followed, or automatically followed if the crew engages the AutoPilot (AP).

The Flight Director function is performed within the MAU (Modular Avionics Unit).

The Auto Pilot function is performed by the Primary Flight Control System (PFCS): there is no specific module dedicated only to this function. When AP is engaged, PFCS controls the Flight Control Surfaces in order to follow FD orders. In that case, the side sticks are locked and do not move.

On the following figures, the "switches" show a possible selection:

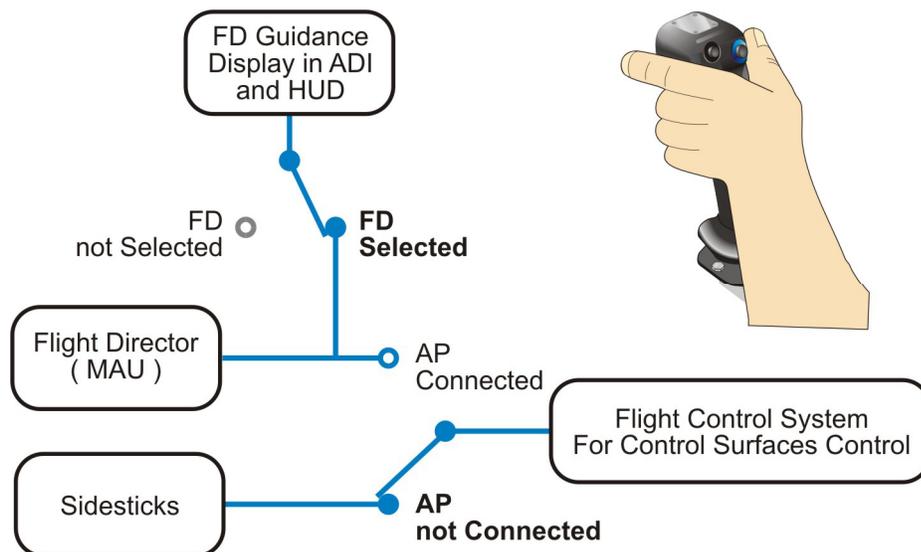
- FD selected or not on Guidance Panel,
- AP connected or not.

The chosen selection for each example is identified in bold letters and determines the position of the switch.

AP Not Connected and FD Selected

If the FD is selected on Guidance Panel, the FD guidance bars will be displayed on the ADI and the HUD.

If the AP is not connected, the pilot will have to use the sidestick to manually follow the displayed FD orders.



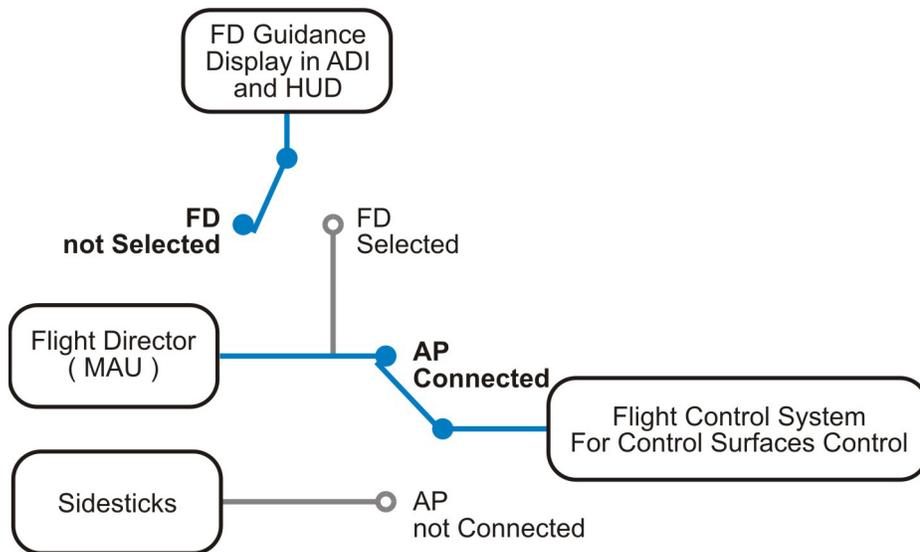
FD SELECTED AND AP NOT CONNECTED

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AP connected and FD not selected

If the FD is not selected, the FD guidance bars will not be displayed on the ADI or the HUD.

If the AP is connected, the Flight Control System will automatically follow the FD orders. This example is shown only to confirm that the AP would follow FD guidance even if the FD is not displayed. This configuration is not recommended, as the crew must, at all times, be aware of the target trajectory.



FD NOT SELECTED AND AP CONNECTED

SPEED PROTECTION

When the AutoPilot is engaged, a Speed Protection System (SPS) may be activated in addition to the Primary Flight Control System protections. This additional protection is composed of:

- An Auto-Throttle Speed Protection (ASP),
- A Pitch Speed Protection (PSP) leading to the change of path command by the Flight Director and AutoPilot.

FLIGHT DECK OVERVIEW

CONTROLS

Crew control of the AutoPilot and Flight Director is performed via:

- The Guidance Panel,
- The FMS interfaces,
- Pushbuttons on the sidesticks and Throttles Control,
- The Soft key on the AFCS tab of the Avionics window, to select bank angle,
- The HSI menu for Altitude unit selection,
- The Landing data tab of the Flight Management Window for selection of the approach category and approach speeds,
- The Take Off data tab of the Flight Management Window for speeds selection to use TOGA mode.

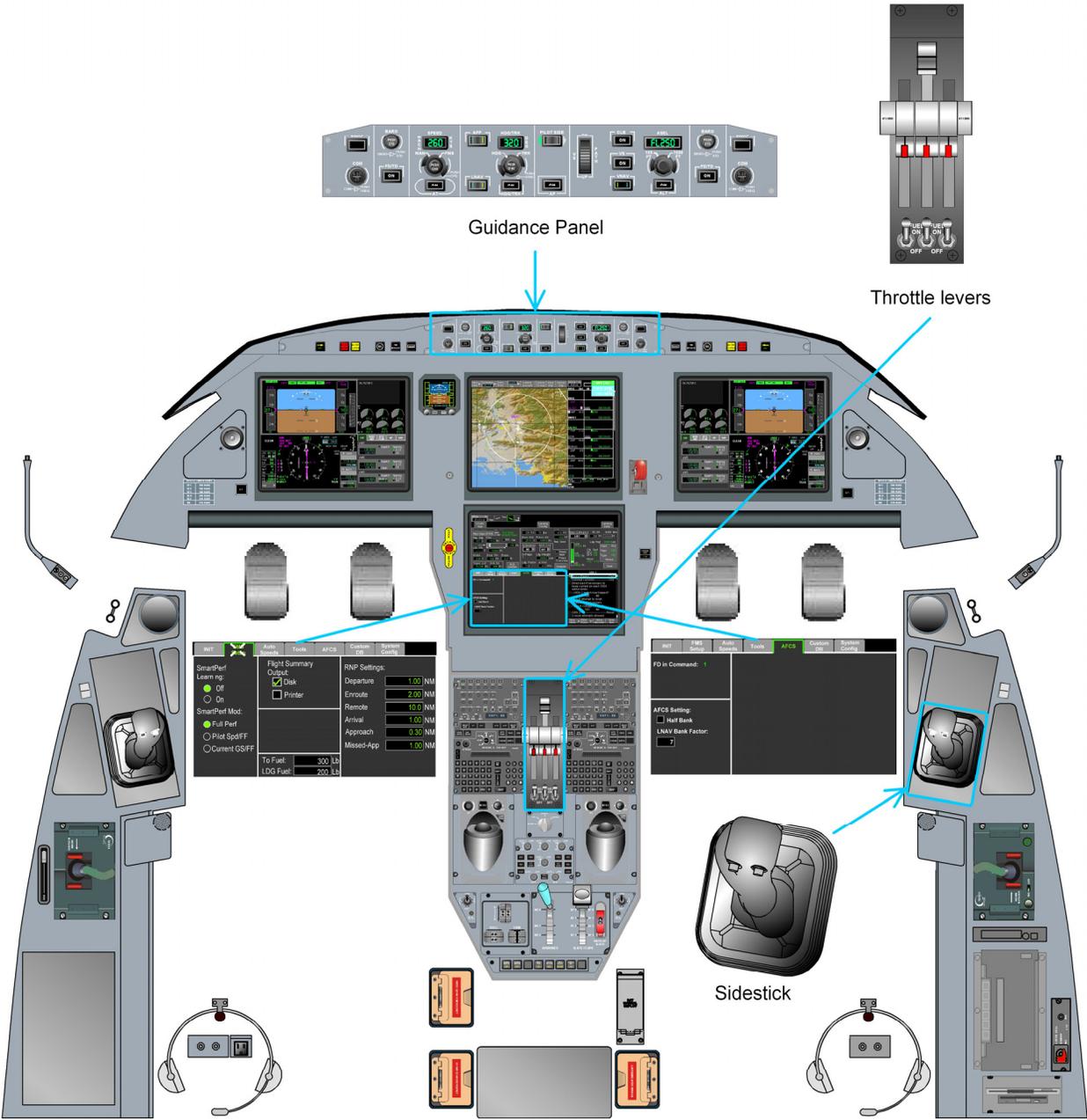
INDICATIONS

Cockpit indications related to AutoPilot and Flight Director are displayed:

- On the Guidance Panel for target data,
- On the ADI and the HUD,
- On the AFCS tab of the Avionics window,
- On the ENG-CAS window for CAS messages,
- On the STATus synoptic / FAULT tab for fault messages.

Additionally, an aural alert "AUTOPILOT" is triggered upon AP disconnection.

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FLIGHT DECK OVERVIEW

Falcon 7X [Automatic Flight Control System Summary]

GENERAL

The Flight Director is dual channels (FD 1 and FD 2), but only one channel is in control at a time.

The crew has no possible selection of the FD channel in control.

The FD channel in control alternates at each power up.

In case one FD channel is invalid, the Flight Control System will revert to the other FD channel without disconnection of the AutoPilot (AP).

There is no specific module dedicated to the AP function: the AutoPilot function is performed by the Flight Control System (FCS). The Flight Control System manages the control surface according to FD orders.

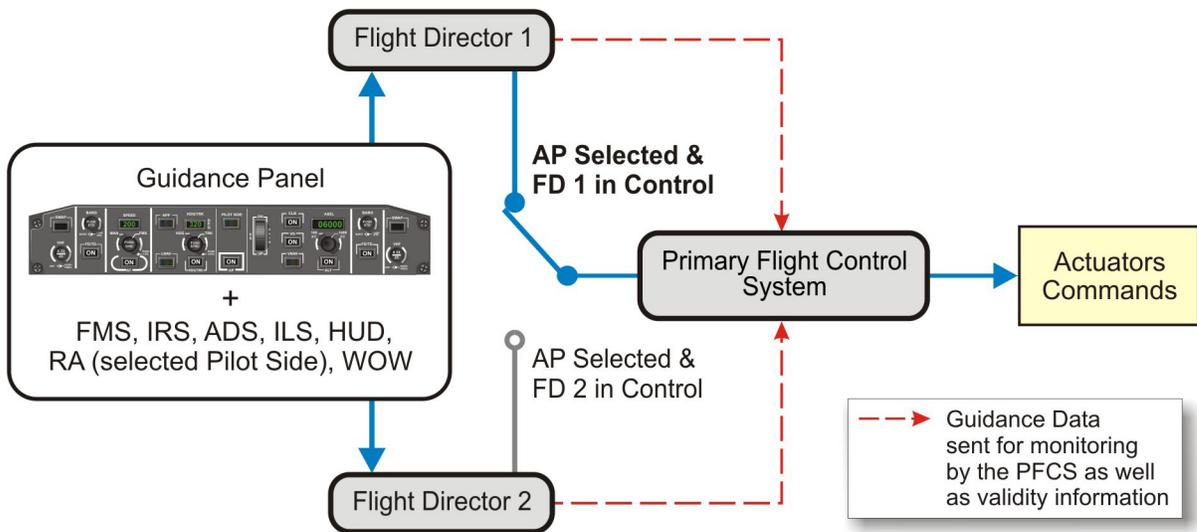
When the AP is selected,

- If the FD1 is in control, the AP is referred to as "FD1" in the AFCS sub page,
- If the FD2 is in control, the AP is referred to as "FD2" in the AFCS sub page.

Both FD use sensors of the selected PILOT SIDE for elaborating guidance information - IRS, ADS, RA, FMS.

NOTE

Presently, for CAT 2 HUD approach, the FD follows guidance provided by the AFCS.
This is a Manual Approach only.



FD1 IN CONTROL, AP CONNECTED

FLIGHT DIRECTOR MODES - GENERAL DESCRIPTION

PRINCIPLES

The FD (Flight Director) can provide:

- Lateral guidance modes,
- Vertical guidance modes,
- Specific flight phases modes.

Only one vertical FD guidance mode and one lateral FD guidance mode may be active at the same time.

For lateral modes (respectively vertical modes), one of the modes is referred to as basic mode and other modes than the basic modes are referred to as upper modes.

The basic mode is the default mode when:

- No other lateral mode (respectively vertical mode) is selected, or
- PILOT SIDE selection is modified, or
- After some sensors failures.

Transition of mode is performed by:

- Manual selection of an other mode, or
- Manual de-selection of the currently active upper mode leading back to the basic mode, or
- Automatic AFCS transition due to the capture of an other mode,
- Automatic AFCS transition due to a failure.

Depending on the selected mode, the FD is providing guidance based on:

- The manually selected targets (Heading, Track, Speed, Altitude,..) ,
- The current value of target parameters at the moment of selection of the mode, (Altitude..)
- The flight plan elaborated by the Flight Management System (FMS).

Whatever lateral and vertical modes are selected, the FD pitch is automatically limited to $\pm 20^\circ$ and roll to $\pm 35^\circ$.

LATERAL GUIDANCE MODES

The available lateral modes are:

LATERAL BASIC MODE	LATERAL UPPER MODES
ROLL	HDG / TRK (heading / track)
	LNAV: FMS Lateral Navigation

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VERTICAL GUIDANCE MODES

The available vertical modes are:

VERTICAL BASIC MODE	VERTICAL UPPER MODES
PATH	CLB: Climb
	ASEL: Altitude Selection
	ALT: Altitude Hold
	VS: Vertical Speed
	VNAV: FMS Vertical Navigation: including following modes: VCLB, VALT, VASL, VPTH, VGP

SPECIFIC FLIGHT PHASE MODES

The following modes are dedicated to specific flight phases:

- APP: Approach,
- HUD CAT 2 Approach,
- TO: Take Off (Manual mode only),
- GA: Go Around (Manual mode only).

AUTOPILOT ENGAGEMENT / DISENGAGEMENT

AP ENGAGEMENT

AP engagement is manual, through the AP pushbutton on Guidance Panel. AP can be engaged for any FD mode, except for Take Off or Go Around.

There is no automatic engagement of Auto Pilot, even for Speed Protections.

NOTE

Limitations for AP engagement are:

Roll angle $< +/- 75^\circ$

Path angle $< +/- 50^\circ$

Indications

- AP green symbol is displayed on the top center of both FMA,
- ON pushbutton is green lighted on Guidance Panel.

NOTE

When AP is engaged, both side sticks are restrained in neutral position.

AP DISENGAGEMENT

AP disengagement is either manual or automatic.

Manual AP Disconnection

The AP may be disengaged by the

- Quick Disconnect pushbutton on the side-stick (one push),
- AP pushbutton on the GP.

Automatic AP Disconnection

An automatic AP disengagement will occur:

- When TOGA pushbutton on the throttles is depressed,
- With an overriding action on the side-stick,
- After AP failure,
- By the PFCS in case of low speed,
- By the PFCS in case of high speed,
- With excessive attitudes: bank angle outside $\pm 80^\circ$ or flight path angle outside $\pm 60^\circ$.

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Indications

When the AP is disengaged manually or automatically:

- AP red symbol continuously flashing on the top center of both Flight Management Annunciator (FMA),
- Repeated aural warning "AUTOPILOT".

NOTE

When AP disengages, the repeated aural warning and AP red flashing symbol remains active as long as there is no push on the Quick Disconnect pushbutton or on the SIL button or no AP re-engagement.

FLIGHT DIRECTOR - LATERAL MODES - DETAILED DESCRIPTION

The FD lateral modes are:

- ROLL: Basic Roll mode,
- HDG / TRK: Heading or Track modes,
- LNAV: Lateral Navigation mode (FMS guidance).

BASIC ROLL MODE

As the Roll mode is the lateral basic mode, it is the default lateral mode (no specific activation pushbutton).

The ROLL guidance will depend on the bank angle at the time of engagement of the ROLL mode.

AIRPLANE BANK ANGLE (ROLL ATTITUDE) AT ROLL MODE ENGAGEMENT	GUIDANCE PROVIDED
Lower than 3° for 10s	Heading Hold
$3^\circ \leq \text{Bank angle} \leq 6^\circ$	Wings level order
$6^\circ < \text{Bank angle} < 35^\circ$	Bank angle Hold
Bank angle > 35°	Back to bank angle hold of 35°

Pressing the TCS pushbutton synchronizes target bank angle and path to the current bank angle and path of the airplane (FD is limited to $\pm 17^\circ$ of path in PDU).

HEADING / TRACK MODES

The Heading / Track mode captures and holds the Heading or Track corresponding to the Heading / Track bug on the HSI.

Turn will be initiated in the same direction as the Heading bug has been turned to for a heading change up to 360°.

By default the associated bank angle is:

- 28° (high bank) below 30,000 ft,
- 15° (low bank) above 30,000 ft.

Manual selection of low or high bank angle is available in the AFCS tab of the Avionics window.

NOTE

TRK mode is not available when the pilot flying IRS parameters are not valid.

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Pressing the PUSH SYNC rotary pushbutton on the GP synchronizes the selected heading or track value to the current Heading or track of the airplane.

LATERAL NAVIGATION MODE

The LNAV mode provides lateral command to capture and hold the active leg of the Flight Plan.

The LNAV mode engagement is performed in two steps:

- Mode is armed upon pilot LNAV selection (Cyan indications)
- Mode is automatically activated once the required conditions are met (Green indications).

FLIGHT DIRECTOR - VERTICAL MODES - DETAILED DESCRIPTION

The FD vertical modes are:

- PATH: Basic Path mode ,
- CLB: Climb mode,
- VS: Vertical Speed mode,
- ASEL: Altitude Preset mode,
- ALT: Altitude mode,
- Vertical Navigation modes (VALT, VCLB, VPTH, VASL, VGP) (FMS guidance).

BASIC PATH MODE

As the Path mode is the vertical basic mode, it is the default vertical mode (no specific activation pushbutton).

PATH guidance:

- Holds the current path at the time of engagement,
- Change the path command (up or down) based on PATH / VS thumb wheel on the guidance panel.

NOTE

Path target selection is limited to $\pm 17^\circ$.

Pressing the TCS pushbutton synchronizes target bank angle and path to the current bank angle and path of the airplane (FD is limited to $\pm 17^\circ$ of path in PDU).

CLIMB MODE

The Climb (CLB) mode sets and adjusts a climb path in order to follow the reference climb speed / Mach profile set manually by the crew (SPEED knob) or automatically by Flight Management System (if ASEL target is above the current altitude).

The reference speed value is displayed on the readout above the SPEED setting knob and on the FMA in manual speed mode. The readout is dashed in FMS speed mode

The CLB mode might result constant altitude or descend depending on speed target.

When CLB mode is selected, any other vertical mode can be armed. When this other mode becomes active, the CLB mode will be deselected.

VERTICAL SPEED MODE

The Vertical Speed (VS) mode sets and adjusts a climb path in order to follow the reference vertical speed set by the crew through the use of the VS / PATH wheel on the guidance panel.

The target Vertical Speed is displayed on the FMA.

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The maximum values of the Vertical Speed command are - 8,000 ft/min and + 6,000 ft/min. When VS mode is selected, any other vertical mode can be armed. When this other mode becomes active, the VS mode will be deselected.

PRESET ALTITUDE MODE

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

- A pre-selected altitude of Flight Level has been set manually,
- The airplane is climbing / descending toward the pre-selected altitude with a minimum altitude difference.

The reference pre-selected altitude value is displayed on the readout above the ASEL setting knob and on the FMA.

ASEL is selected in association with one of the other Vertical modes except for VGP and GS modes.

NOTE

With active VGP or GS modes, ASEL is ignored.

The ASEL mode will provide guidance to capture and hold the target Altitude with a minimization of the overshoot, depending on Aircraft climb or descent rate:

- 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.

Once the target altitude is reached, the guidance will automatically change from ASEL to ALT mode.

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.

ALTITUDE MODE

Altitude mode (ALT) is selected:

- Manually by pressing the ALT pushbutton on the GP, or
- Automatically after capture of a pre-selected Altitude (ASEL).

This mode adjusts the path to capture and hold the altitude of the airplane at the current time of mode selection.

Selection of the ALT mode could lead to a small overshoot or undershoot of the target altitude before the target altitude is actually captured.

Airplane response in ALT mode is limited to $\pm 20^\circ$ pitch angle.

VERTICAL NAVIGATION MODE

Vertical Navigation mode (VNAV) is selected by pressing the VNAV pushbutton on the GP. The FMS will then send target values to the FD to be used.

NOTE

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

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

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.

VASL

This mode is armed as the ASEL mode when capturing an altitude in VNAV mode (either a constraint on a waypoint or a pre-selected altitude). It operates like ASEL mode.

VASL mode operation status is displayed in the FMA only during capture phases.

In case of VASL, the target altitude on the PDU is still indicated as "ASEL".

NOTE

With active VGP or GS modes, ASEL is ignored.

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.

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VPTH

It is selected by pressing the VNAV pushbutton on the GP.

VPTH is only active during descent and operates 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.

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. This mode is then armed via the APP pushbutton on the GP.

NOTE

With active VGP mode, ASEL is ignored.

FLIGHT PHASE SPECIFIC MODES

APPROACH MODE

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

Lateral and Vertical guidance will be:

- LOC and GS for a precision approach (ILS),
- B/C (Back Course) and manually selected PATH or VS, if Back Course is selected for an ILS approach,
- LNAV and VGP for a non precision approach.

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

LOC mode

When engaged, the APP mode allows the airplane to capture and follow a LOC beam.

The LOC can be captured from ROL, HDG / TRK, LNAV lateral modes.

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.

NOTE

With active GS mode, ASEL is ignored.

AP CAT II approach

For AutoPilot CAT II approach, the approach CAT 2 must be selected in the Landing data tab of the Flight Management Window.

After this selection is performed, the AFCS will enter dual sensor mode, below 800ft RA, 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 altitude information.

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, but CAT 2 capability is lost.

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Back Course mode

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

NOTE

When Back Course has been selected, it remains active until de-selection in FMW window (ARRIVAL phase, STAR App tab).

For a Back Course approach, the front course must be selected on the CDI.

HUD CAT II APPROACH MODE

Presently, functionality is not available. To be described in the next issue.

TAKE-OFF MODE (FD MODE ONLY)

Take Off (TO) mode provides a specific vertical flight guidance, and basic lateral guidance as a default lateral Guidance.

The TO mode is available:

- When the airplane is on ground,
- By pressing TOGA pushbutton on the throttles of N°1 or N°3 engine.

Take Off speeds are setting in the Takeoff Data tab of the Flight Management Window (FMW).

Take Off mode provides vertical guidance as follow:

- Take off configuration
 - o Speed guidance target: $V_2 + 10$,
 - o Pitch limitation 20° ,
- Clean configuration
 - o Speed guidance target :VFT.

The crew can modify the following values in the FMW:

- The pitch attitude,
- Take off speed values (V_2 and VFT).

If take off data are not entered, then pressing TOGA pushbutton causes the display of **AFCS: FD TO MODE INHIBITED** advisory CAS message.

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

NOTE

The Auto-Throttle is inhibited during Take Off mode.

GO-AROUND MODE (FD MODE ONLY)

The Go-Around mode (GA) is available when the airplane is airborne (Weight Off Wheels) by pressing the TOGA pushbutton on the throttles of N°1 or N°3 engine.

This automatically disengages the AP and displays ROL and GA on the FMA.

Go Around mode provides vertical guidance as follow:

- Take off configuration
 - o Speed guidance target: Vref +20,
 - o Pitch limitation 20°,
- Clean configuration
 - o Speed guidance target :VFT.

When Go Around is degraded the GA mode provides guidance to a fixed pitch of 12°.

If Go Around data are not entered, then pressing TOGA pushbutton causes display of **AFCS: FD GA DEGRADED MODE** advisory CAS message.

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

NOTE

GA mode will automatically disconnect and inhibit the Auto Throttle.

AUTOPILOT SPEED PROTECTIONS

When the AutoPilot is engaged, the AFCS provides active speed protections. When the AutoPilot is not engaged the FD and TD guidance are not provided for speed protection, but the PFCS speed protections are still active.

DESIGN PRINCIPLES

The following design principles were applied in the design:

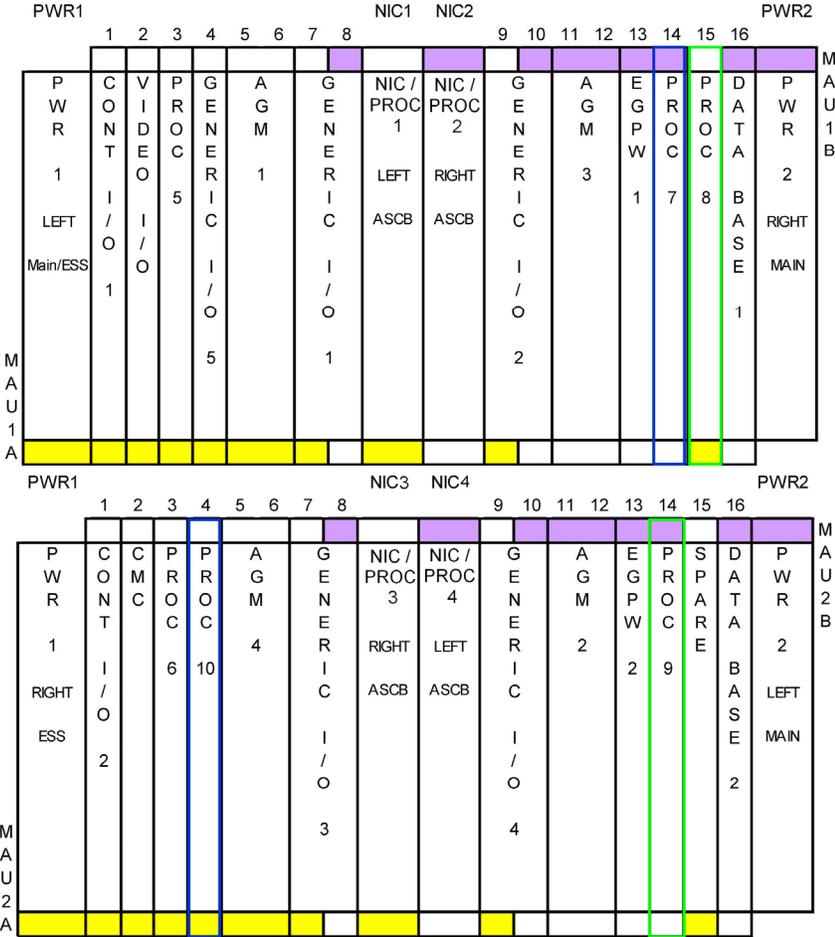
- With regard to architecture:

The dual Flight Director configuration provides automatic reversion and interface capabilities sufficient to maintain full AFCS functionality in case of failure of one FD.

EQUIPMENT LOCATION

The Flight Director function is implemented:

- FD1 channel A within MAU 1A: in PROC 8 module,
- FD1 channel B within MAU 2B: in PROC 9 module,
- FD2 channel A within MAU 2A: in PROC 10 module,
- FD2 channel B within MAU 1B: in PROC 7 module.



IMPLEMENTATION OF FD FUNCTION

AP AUTHORITY

Nominal authorities for the Auto Pilot for aircraft control are:

- Load factor: 0.7 g / 1.3 g,
- Roll rate: $\pm 9^\circ/\text{s}$,
- Pitch angle: $\pm 20^\circ$,
- Bank angle: $\pm 35^\circ$.

AP CAT II APPROACH

Approach Category must be selected in the Landing Data tab of the Flight Management Window (FMW).

The AFCS enters dual sensor mode 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 altitude information,
- Radar Altitude below 800 ft.
- CAT 2 is selected in FMW Landing Data tab.

While operating in this dual sensor mode, the AFCS utilizes approach navigation data as follows:

- The AFCS uses averaged deviation data as long as both sources are unflagged and tracking (no miscompare detected),
- The AFCS reverts to single PDU status using the unflagged source, if one PDU or the radio data is invalid,
- The AFCS reverts to single PDU status using the most reasonable source if both are unflagged, but not tracking (miscompare detected).

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.

The AFCS receives Radar Altimeter information displayed on both PDU. The AFCS uses averaged radar altitude data as long as both Radar Altimeters (RA) are unflagged and tracking (no miscompare detected).

AP DISENGAGEMENT CUE

AP DISENGAGEMENT CUE AT LOW SPEED (AMBER/BLACK)

The amber / black cue indicates, on the speed tape of the ADI window, the speed at which maximum AOA for AP operation is reached.

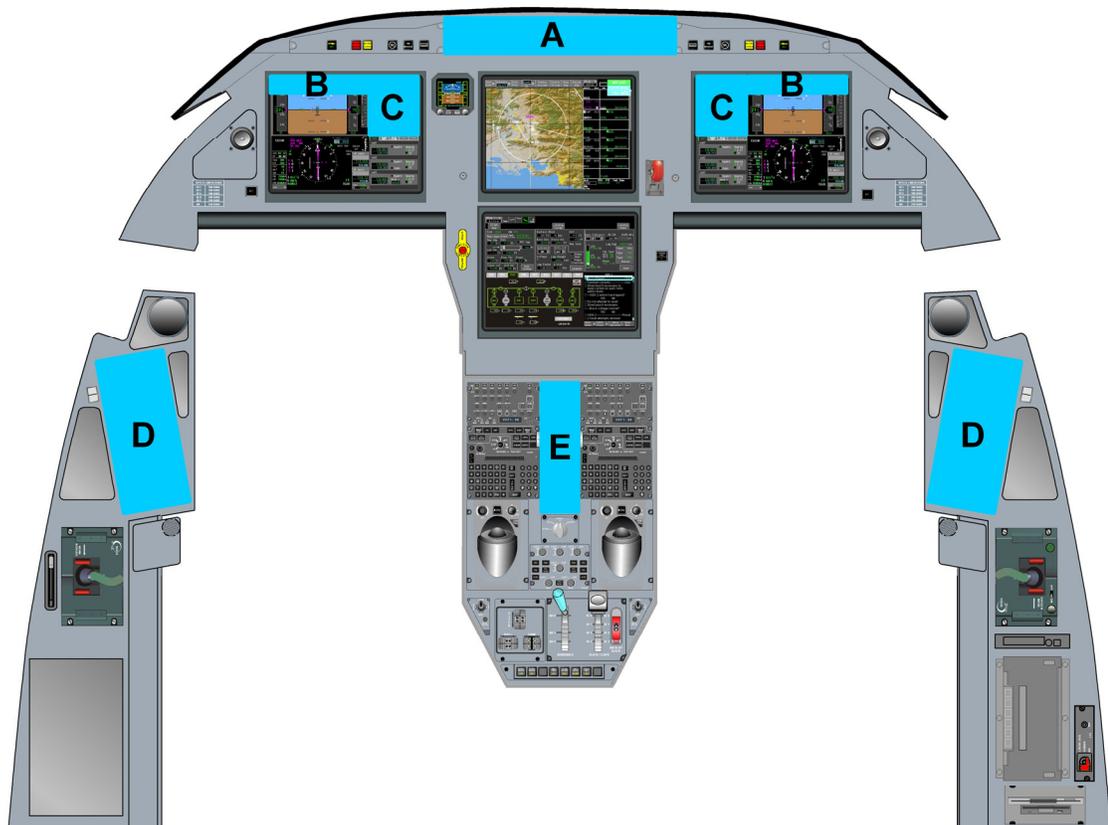
Below that speed, the AP is automatically disengaged and the low speed protection is performed by the PFCS.

The upper limit varies with Slats-Flaps and Airbrakes configuration. It is not corrected for load factor, meaning that the upper limit will move on the speed scale if load factor is increased.

GENERAL

The Flight Director and Auto Pilot can be managed:

- On the instrument panel, through:
 - o A: the Guidance Panel gathering all AFCS mode controls,
 - o The PDU:
 - B: the FMA (Flight Mode Annunciator) providing status of AFCS mode operation,
 - C: the CAS window providing CAS messages,
 - o The MDU:
 - AFCS tab of the Avionics window,
 - FAULT tab of the STATus synoptic for fault messages,
- On the side-stick,
 - o D: the AP/PTY (AutoPilot / PrioRiTY) and TCS (Touch Control Steering) pushbuttons,
- On the throttles of engines No 1 and 3,
 - o E: TO / GA (Take Off / Go Around) FD mode pushbuttons.



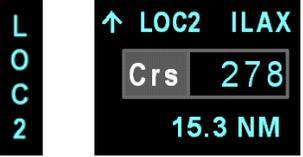
FD AND AP CONTROLS AND INDICATIONS

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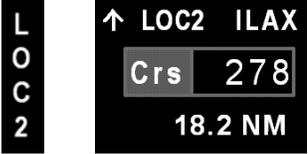
COLOR CODE

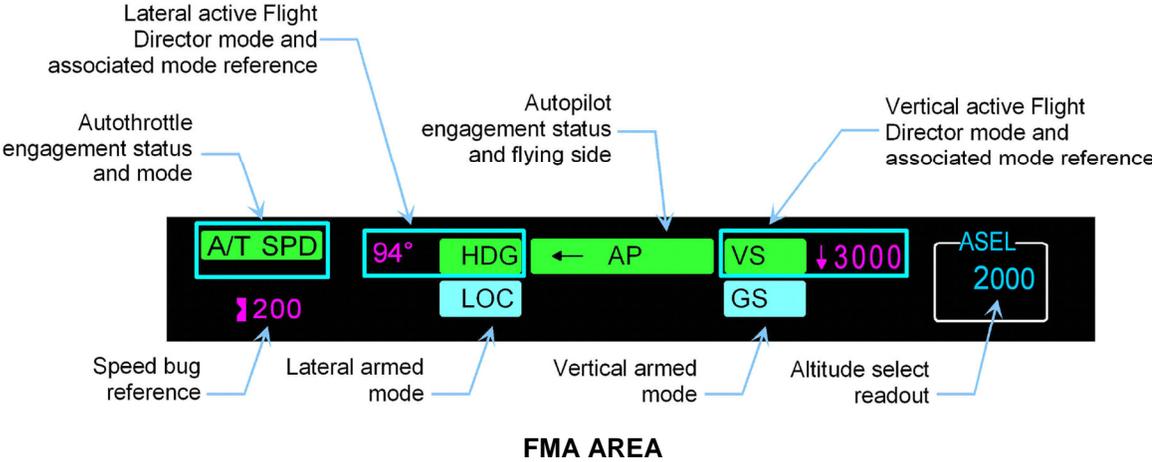
A specific set of colors has been defined to depict the status of the automated systems:

- **GREEN** defines an active mode,
- **MAGENTA** represents the active target: what the system is aiming for now,
- **CYAN** corresponds to what is about to happen. As such, it means armed mode, pending modification: what the system will do next,
- **WHITE** defines an inactive target.

COLOR		TARGET STATUS	MEANING	EXAMPLES
GREEN	On the FMA or Guidance Panel		Active mode	Active lateral mode 
MAGENTA		Active target for FD or FMS	What the system is aiming for NOW	FMS CDI and FMS TO leg on HSI and MDU when LNAV mode engaged: 
CYAN	On FMA or Guidance Panel	Armed target	What the system will follow NEXT (when capture conditions will be satisfied)	Armed lateral mode on FMA and on GP: 
	On HSI	Armed target	What the system will follow NEXT (when capture conditions will be satisfied)	LOC CDI on HSI when LOC mode armed: 
	On I-NAV	PENDING Flight Plan modification	What the Flight Plan will be after ACCEPTING the modification	Modified flight plan in I-NAV and WPT LIST while in pending mode

Falcon 7X [Automatic Flight Control System Summary]

COLOR	TARGET STATUS	MEANING	EXAMPLES
WHITE	Inactive target	Ignored by the active mode	<p>LOC CDI when LOC is neither active nor armed:</p> 

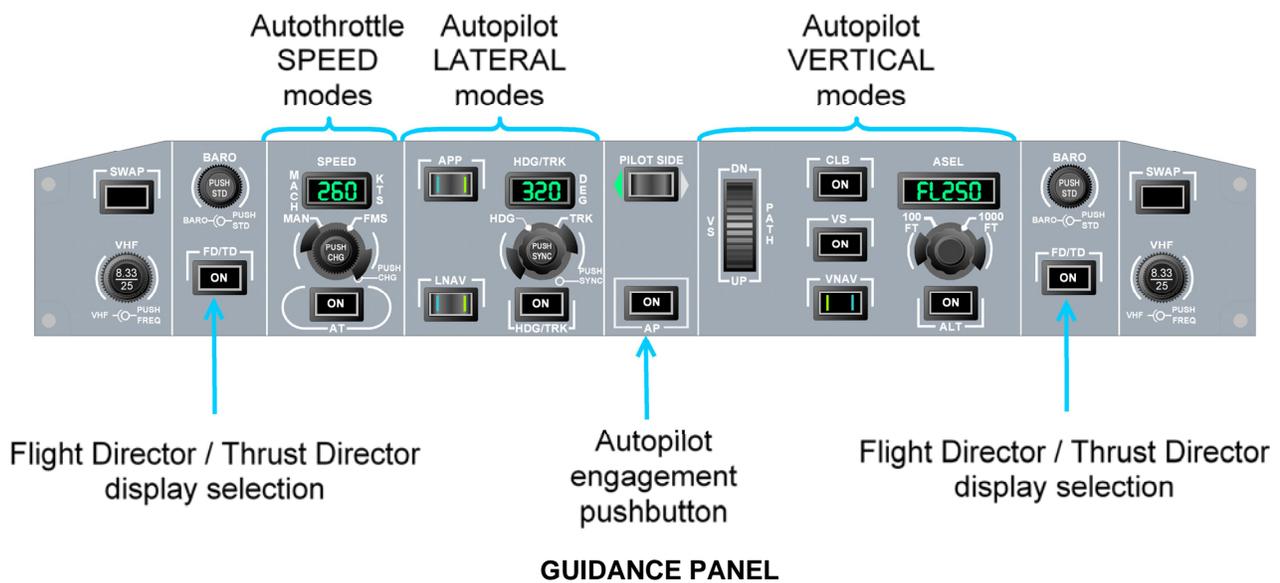


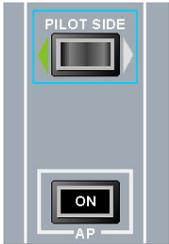
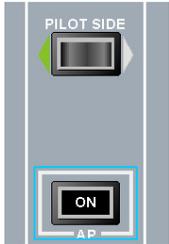
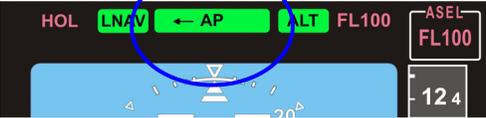
CONTROLS

Crew control of the AutoPilot and Flight Director is performed via:

- The Guidance Panel,
- The FMS interfaces, (Landing phase for Approach CAT 2 selection)
- Pushbuttons on the sidesticks and throttles controls,
- Soft key on the AFCS tab of the Avionics window, to select bank angle,
- The HSI menu for Altitude unit selection,

GUIDANCE PANEL

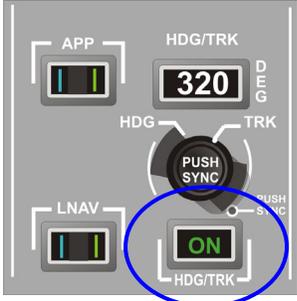
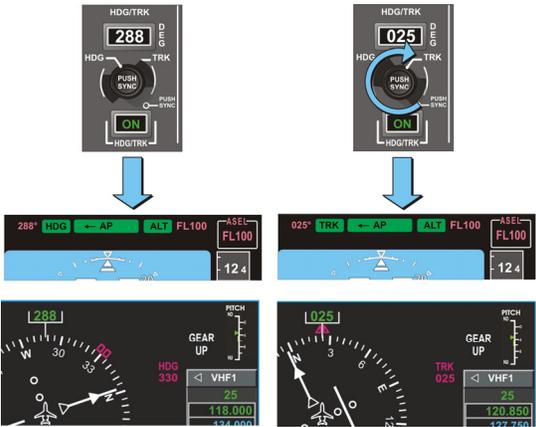
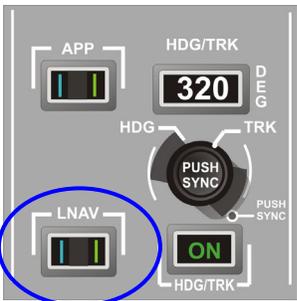


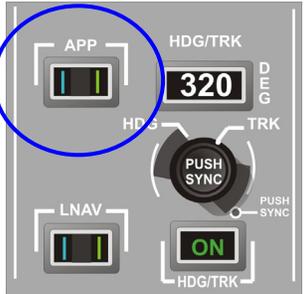
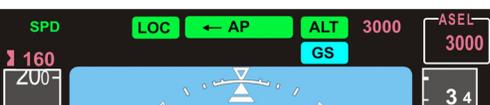
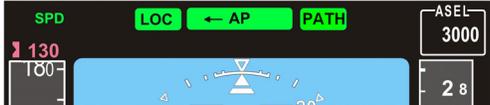
CONTROL	FUNCTIONS	LOCAL INDICATIONS
<p>Pilot FLYING Flying SIDE</p> 	<p>Selects the source data (ADS, IRS, FMS) from selected side for FD Guidance computations.</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p style="text-align: center;">NOTE</p> <p>During the PILOT SIDE selection change, FD automatically reverts to basic modes and AP remains engaged.</p> </div>	<ul style="list-style-type: none"> - GP: Directional green arrow on the left or right side of the pushbutton - FMA: Directional horizontal arrow in the middle of FMA of both ADI 
<p>AP Engagement Disengagement</p> 	<p>Allows engagement or disengagement of the AP</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p style="text-align: center;">NOTE</p> <p>When AP is engaged, both sidesticks are restrained in neutral position</p> </div>	<p>AP connection</p> <ul style="list-style-type: none"> - GP: Green ON is illuminated on the AP pushbutton - FMA: Green AP caption is displayed at the top center of both FMA - Lateral and vertical modes are displayed in reverse video on the FMA  <p>AP disconnection</p> <ul style="list-style-type: none"> - AP red symbol flashing on the top center of both FMA continuously - Continuous Aural alert “autopilot” 

Falcon 7X [Automatic Flight Control System Summary]

CONTROL	FUNCTIONS	LOCAL INDICATIONS
		<div style="border: 1px solid black; padding: 10px; text-align: center;"> <p>NOTE</p> <p>When AP disengages, the repeated aural alert and AP red symbol flashing remain active as long as there is no push on the quick disconnect pushbutton or the SIL button or until AP is re-engaged.</p> </div>
 <p>The image shows a rectangular pushbutton with a grey background. At the top, the text 'FD/TD' is displayed in white. Below it is a black square containing the word 'ON' in white, indicating the button is active.</p>	<p>Pilot can select FD and/or TD information by pressing the FD/TD pushbutton on the Guidance Panel</p> <p>In the following sequence</p> <ul style="list-style-type: none"> - FD and TD display - FD display - TD display <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p style="text-align: center;">NOTE</p> <p>FD/TD selection is not operative while in TO or GA modes, or if ASP or PSP protection is active.</p> </div>	<ul style="list-style-type: none"> - GP: Green ON is displayed on the FD/TD pushbutton

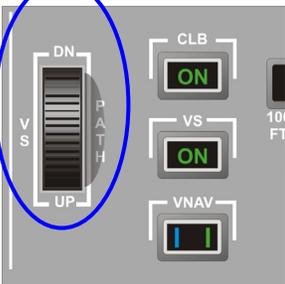
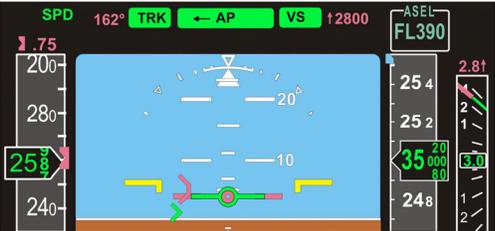
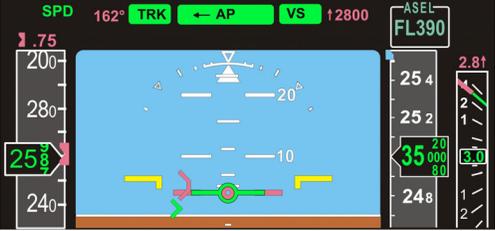
CONTROL	FUNCTIONS	LOCAL INDICATIONS
<p>HDG/TRK selection</p> 	<ul style="list-style-type: none"> - The outer ring allows selection between HDG mode and TRK mode. - The inner rotary knob allows selection of the targeted value of HDG or TRK. Direction of the setting will determine the direction of the turn. - Pushing on the inner knob allows synchronizing target HDG or TRK to current HDG or TRK. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p style="text-align: center;">NOTE</p> <p>TRK mode is not available if the Pilot Flying IRS is not valid.</p> </div>	<ul style="list-style-type: none"> - GP: Target value is displayed in degrees on the digital readout just above the knob. - FMA: Target Value is displayed in Magenta

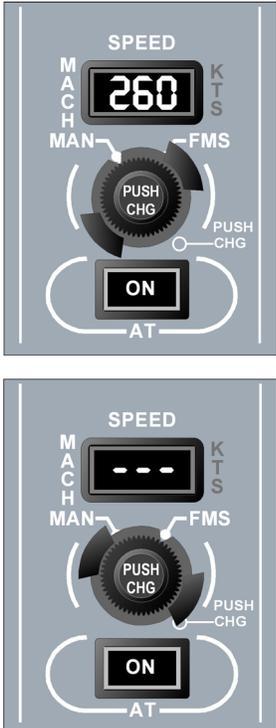
CONTROL	FUNCTIONS	LOCAL INDICATIONS
<p>HDG/TRK pushbutton</p> 	<ul style="list-style-type: none"> - Once target HDG or TRK is selected, HDG/TRK pushbutton engages HDG/TRK mode and disengages the previous lateral mode, - Pushbutton also allows disengagement of the HDG/TRK mode and reversion to basic ROLL mode. 	<ul style="list-style-type: none"> - GP: Green "ON" on the pushbutton - FMA: HDG or TRK mode displayed in Green when active 
<p>LNAV pushbutton</p> 	<ul style="list-style-type: none"> - Selects LNAV mode, - Pushbutton also allows disengagement of the LNAV mode and reversion to basic ROLL mode. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p align="center">NOTE</p> <p>Lateral mode which was active prior to LNAV selection will remain active until LNAV lateral mode is captured.</p> </div>	<ul style="list-style-type: none"> - On GP, LNAV pushbutton is: <ul style="list-style-type: none"> o Cyan when LNAV is armed, o Green when LNAV is engaged. - On FMA, LNAV symbol is: <ul style="list-style-type: none"> o Cyan when LNAV is armed, o Green when LNAV is engaged.  <p align="center">LNAV ENGAGED</p>

CONTROL	FUNCTIONS	LOCAL INDICATIONS
<p style="text-align: center;">APP pushbutton</p> 	<p>Selects APP mode:</p> <ul style="list-style-type: none"> - LOC and G/S for a precision approach (ILS), - B/C and manually selected PATH or VS, if Back Course is selected for an ILS approach, - LNAV and VGP for a non precision approach. - Pushbutton also allows disengagement of the APP mode and reversion to basic ROLL and PATH modes. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p style="text-align: center;">NOTE</p> <p>Lateral (respectively vertical) mode which was active prior to APP selection will remain active until APP lateral (respectively vertical) mode is captured.</p> </div>	<ul style="list-style-type: none"> - On GP, APP pushbutton is: <ul style="list-style-type: none"> o Cyan when APP is armed, o Green when APP is engaged. - On FMA, LOC, GS, BC, LNAV symbols are: <ul style="list-style-type: none"> o Cyan when related mode is armed, o Green when related mode is engaged. <div style="margin-top: 10px;">  <p style="text-align: center;">LOC AND GLIDE ARMED</p> </div> <div style="margin-top: 10px;">  <p style="text-align: center;">LOC CAPTURED AND GLIDE ARMED</p> </div> <div style="margin-top: 10px;">  <p style="text-align: center;">LOC AND GLIDE CAPTURED</p> </div> <div style="margin-top: 10px;">  <p style="text-align: center;">BC CAPTURED</p> </div>

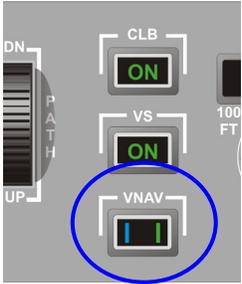
Falcon 7X [Automatic Flight Control System Summary]

CONTROL	FUNCTIONS	LOCAL INDICATIONS
		 <p data-bbox="906 646 1349 711">LOC AND GLIDE CAPTURED IN APP CAT2</p>

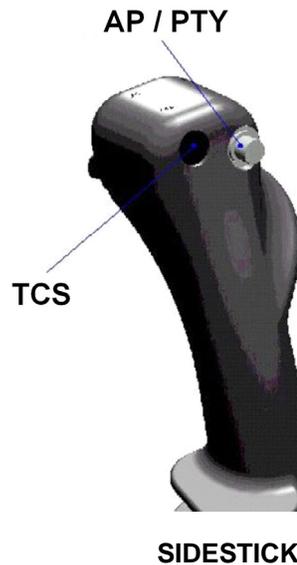
CONTROL	FUNCTIONS	LOCAL INDICATIONS
<p>VS / PATH thumb wheel</p> 	<ul style="list-style-type: none"> - Allows modifying the PATH angle, UP or DOWN (within $\pm 17^\circ$) in PATH mode: each click on the wheel will change the PATH angle by $\pm 1^\circ$ - Allows modifying the target vertical speed in VS mode: each click on the wheel will change the Vertical Speed by $\pm 100\text{ft}/\text{min}$ (within $-8000\text{ft}/\text{min}$ and $+6000\text{ft}/\text{min}$) 	<p>On the FMA if PATH mode is active: Magenta PATH angle target</p>  <p>PATH MODE ACTIVE WITH TARGET OF 3.5° PATH ANGLE</p> <p>On the FMA if VS mode is active: Magenta Vertical Speed target, with Up or Down arrow. Additionally, the target Vertical Speed is displayed above the Vertical Speed scale (in 1000ft/min).</p>  <p>VS MODE ACTIVE WITH TARGET OF 2800 FT/MIN CLIMB RATE</p>
<p>VS pushbutton</p> 	<ul style="list-style-type: none"> - VS pushbutton engages VS mode with target speed selected with the thumb wheel, and disengages previous Vertical mode, - Pushbutton also allows disengagement of the VS mode and reversion to basic PATH mode. 	 <p>VS MODE ACTIVE WITH TARGET OF 2800 FT/MIN CLIMB RATE</p>

CONTROL	FUNCTIONS	LOCAL INDICATIONS
<p>SPEED selection</p> 	<ul style="list-style-type: none"> - The outer ring allows selection between MANual or FMS speed selection - The inner knob allows selection of the targeted value of SPEED when MAN is selected. - Pushing on the inner knob alternately selects between Mach and kt. 	<ul style="list-style-type: none"> - GP: Target value is displayed in kt or Mach on the digital readout just above the knob. Speed target is replaced by "dashes" when outer ring is on FMS selection. - FMA: Target Value is displayed in Magenta next to CLB symbol if Climb mode is selected.
<p>CLB pushbutton</p> 	<ul style="list-style-type: none"> - Once the target SPEED is selected with an ASEL target above the current altitude, CLB pushbutton engages Climb mode and disengages previous vertical mode, - Pushbutton also allows disengagement of the CLB mode and reversion to basic PATH mode. 	 <p>CLB MODE ACTIVE WITH TARGET M=0.75</p>

CONTROL	FUNCTIONS	LOCAL INDICATIONS
<p>ASEL Setting knob</p> 	<ul style="list-style-type: none"> - ASEL setting knob allows selecting the target Altitude, - Outer ring sets the increments to 1,000 ft or 100 ft. - ASEL is selected in association with any other vertical modes except VGP and GS. - When ASEL is being captured, ASEL mode becomes the active mode, - Once the target altitude is captured, the guidance will revert to ALT mode, which becomes the active mode, disconnecting at the same time the active previous vertical mode. 	<ul style="list-style-type: none"> - GP: target value is displayed in ft - FMA: target value is displayed above the speed tape, in FL or meters depending on selection in the HSI menu. - Color is cyan when capture phase has not yet started.  <p style="text-align: center;">CLB MODE</p> <ul style="list-style-type: none"> - Color is magenta during altitude capture phase.  <p style="text-align: center;">ALT MODE AT PRESELECTED ALTITUDE CAPTURE</p>  <p style="text-align: center;">ASEL MODE ACTIVE</p> <ul style="list-style-type: none"> - Color is white otherwise.
<p>ALT Pushbutton</p> 	<ul style="list-style-type: none"> - ALT pushbutton engages ALT mode and disengages previous vertical mode, - Pushbutton also allows disengagement of the ALT mode and reversion to basic PATH mode. 	

CONTROL	FUNCTIONS	LOCAL INDICATIONS
<p>VNAV Pushbutton</p> 	<p>Selects VNAV mode:</p> <ul style="list-style-type: none"> - VCLB if in Climb mode, - VPTH if in descent, - VASL, - VALT, - or VGP. - Pushbutton also allows disengagement of the VNAV mode and reversion to basic PATH mode. <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p style="text-align: center;">NOTE 1</p> <p style="text-align: center;">Below transition altitude or level, altimeter setting must be set to QNH for the use of VNAV.</p> </div> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p style="text-align: center;">NOTE 2</p> <p style="text-align: center;">Vertical mode which was active prior to VNAV selection will remain active until VNAV vertical mode is captured.</p> </div>	<ul style="list-style-type: none"> - On GP, VNAV pushbutton is: <ul style="list-style-type: none"> o Cyan when VNAV is armed, o Green when VNAV is active. - On FMA, VCLB, VPTH, VASL, VALT or VGP symbol is: <ul style="list-style-type: none"> o Cyan when related mode is armed, o Green when related mode is active.

SIDESTICK CONTROLS



AP Quick Disconnect

If AP is connected, a first push on AP/PTY pushbutton will lead to:

- AP disconnection,
- AP red symbol flashing on the top center of both FMA continuously,
- Continuous Aural alert "AUTOPILOT".

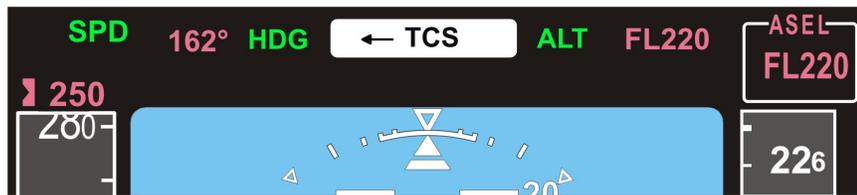
When AP is being disconnected, acknowledgment is required to remove the flashing AP symbol of the FMA and stop the aural alert. This can be performed via a second push on AP/PTY pushbutton or on pushing the SIL pushbutton.

Touch control steering

When the TCS pushbutton is depressed:

- The AP is deactivated but not disconnected,
- The bank angle and path of the FD are synchronized to the current bank angle and path of the airplane (for path angles lower than 17°),
- A white TCS indication is displayed at the top of the FMA.

Falcon 7X [Automatic Flight Control System Summary]



TCS

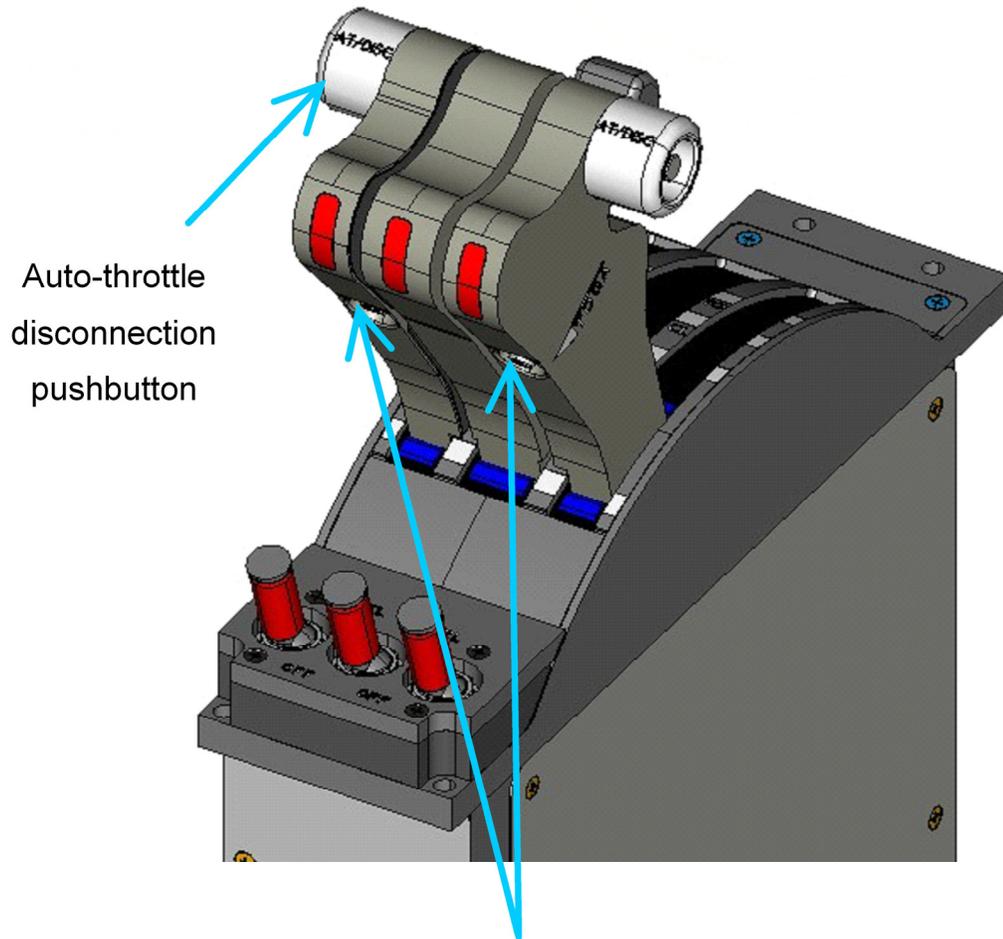
When the TCS pushbutton is released:

- The AP will re-activate,
- The FD will synchronize on the new reference values or return to its previous target, depending on previous active modes.

NOTE

If the previous active mode was a basic mode, VS, CLB or ALT: target values after releasing the TCS will be set to the current values instead of the initial targets.
All target values should be carefully verified after using the TCS.

THROTTLE CONTROL



Take-Off Go Around pushbuttons

TAKE OFF - GO AROUND PUSHBUTTONS

On ground, pushing on the TOGA pushbutton will lead to engage Take Off mode.

In flight, pushing on the TOGA pushbutton will lead to:

- Engage Go Around mode,
- Disengage the AutoPilot if engaged,
- Disconnect the Auto-Throttle.

AFCS TAB OF THE AVIONICS WINDOW

Bank angle can be selected within the AFCS tab of the Avionics window.

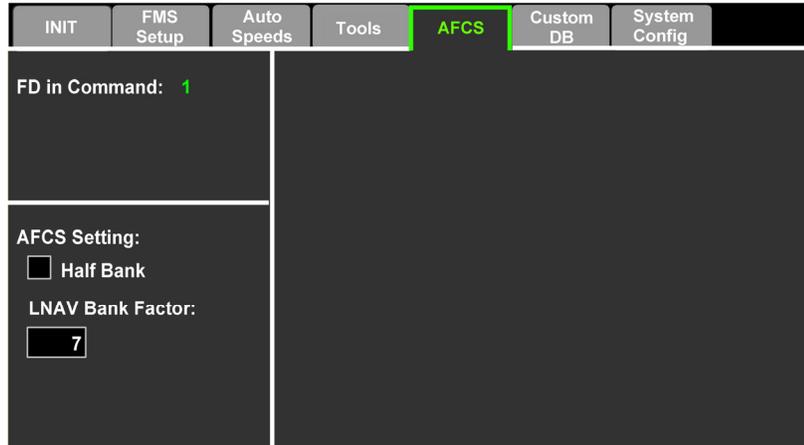


FIGURE02- 02-22_1-20-06 - AFCS TAB OF AVIONICS WINDOW

AFCS Setting: has the following selections:

- **Half Bank** limits bank to 15° (available only in HDG / TRK mode),
- **LNAV Bank Factor** is a crew input value from 0 to 15. The default value is 7. LNAV bank factor is used in computation of turn radii for nominal turns (fly-by transitions) in LNAV mode. Low LNAV bank factors require greater turn radii and high LNAV bank factors require smaller turn radii. While turn radius computations by the FMS always comply with airway lateral deviation limits, if airway limits are not the limiting item determining turn radius, LNAV bank factor allows the crew to increase or decrease nominal bank angle during fly-by transitions.

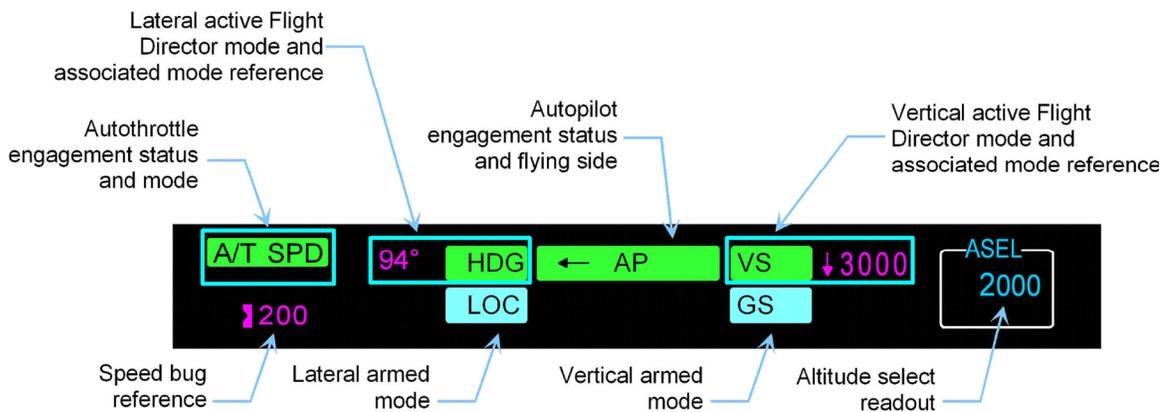
INDICATIONS

Cockpit indications related to AutoPilot and Flight Director are displayed:

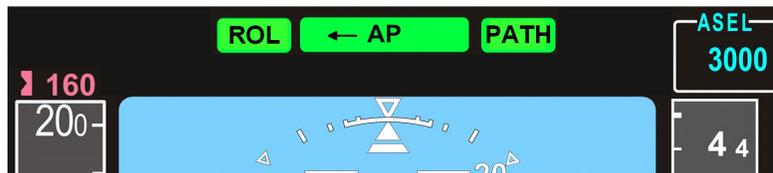
- On the Guidance Panel for target data, (described in previous paragraph),
- On the FMA for mode selection, status and associated target,
- On the ADI and HUD for FD guidance, and Flags associated with FD/AP,
- On the AFCS tab of the avionics window, for the active FD channel,
- On the ENG-CAS window for CAS messages,
- On the STATus synoptic / FAULT tab for fault messages.

FLIGHT MANAGEMENT ANNUNCIATOR

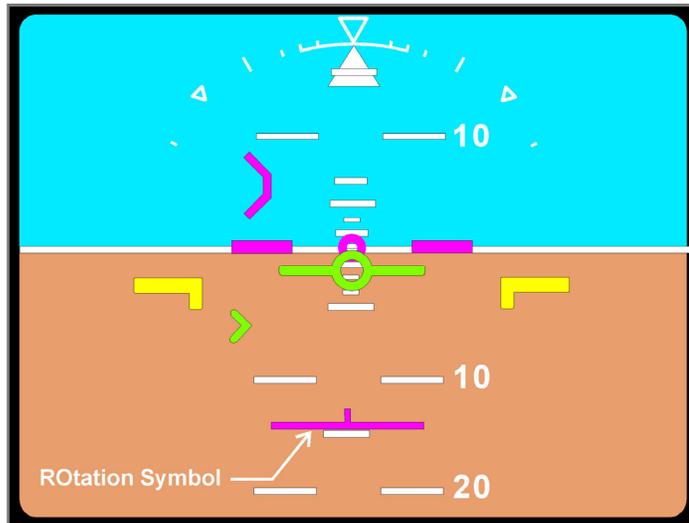
The FMA is displayed in the upper part of each PDU.



FLIGHT MODE ANNUNCIATOR AREA



FLIGHT MODE ANNUNCIATOR AREA IN BASIC MODE

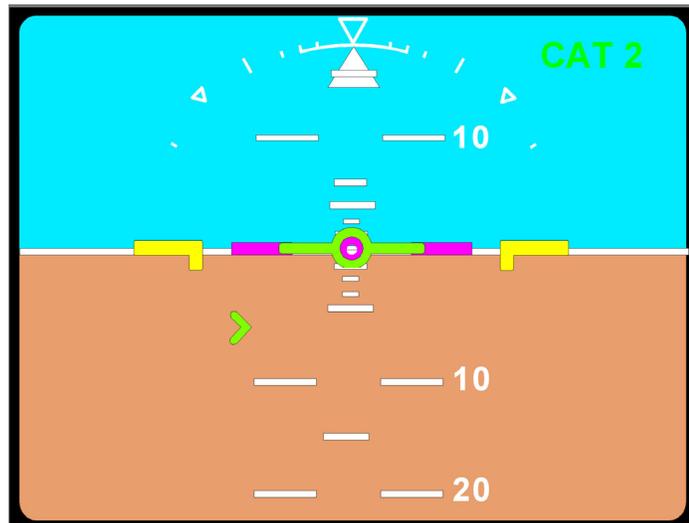


ROTATION SYMBOL

CAT2 approach

CAT 2 annunciation is displayed in the upper right corner of the ADI:

- In green if the checklist passes,
- In amber if the checklist is failed and radio altitude is above 200 ft,
- In red if the checklist is failed and the radio altitude is below 200 ft.

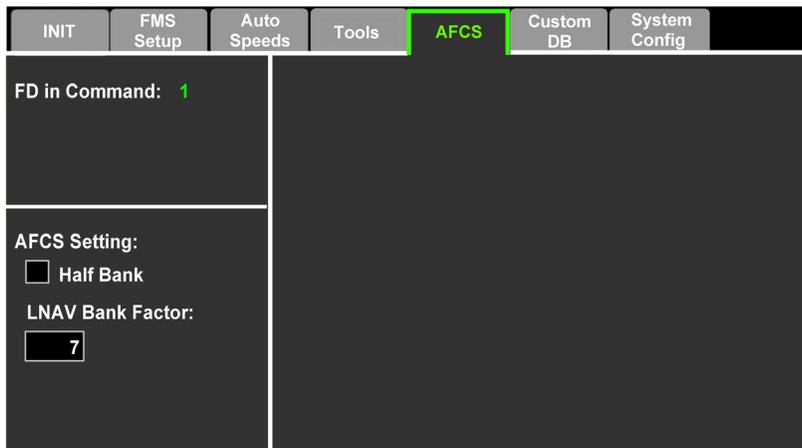


CAT 2 ANNUNCIATION

AFCS TAB OF THE AVIONICS WINDOW

The FD1 or FD2 is selected alternatively at each power-up. It cannot be directly selected by the crew.

The FD selected by AFCS is displayed in the AFCS tab of the Avionics window.



AFCS TAB OF AVIONICS WINDOW

In case of failure of the active FD, the FD originally selected by the AFCS is automatically changed and the indicating changes also.

If no FD is in command (i.e. both flight directors are invalid), the FD in command field displays an amber dash.

Falcon 7X [Automatic Flight Control System Summary]

TOUCH CONTROL STEERING

When TCS is released, the FD will synchronize on the new reference values or return to its previous target, depending on the previous active modes, as described in the following table.

FD mode	AFTER TCS RELEASE	
	Mode returns to initial target	Mode maintains current reference as a new target
ROL (X°)		Yes
HDG (XXX°)	Yes	
TRK (XYZ°)	Yes	
LNAV	Yes	
PATH (XX°)		Yes
VS (XXX ft/min)		Yes
CLB (XXX kt)		Yes
ASEL / VASL	Yes	
ALT (XXX ft)		Yes
VPTH	Yes	
VGP	Yes	
LOC	Yes	
G/S	Yes	

SYSTEM MONITORING

Monitoring of the following parameters is provided by the system:

- Integrity of both FD channels,
- Consistency between both lanes of each FD channel,
- Validity of input data.

ACTIVE PROTECTIONS

In case of invalidity of an FD channel, the system will automatically revert to the other channel, if valid, without any crew action and no AP disengagement.

INTRODUCTION TO AUTO-THROTTLE / THRUST DIRECTOR

The Thrust Director (TD) provides thrust guidance. This guidance is displayed upon crew request. It can be either manually followed or automatically followed by the throttle if the crew engages the Auto-Throttle.

The Thrust Director and Auto-Throttle functions are performed within the MAU (Modular Avionics Unit).

The Auto-Throttle function sends the TD orders to electric servo motors within the Throttle Quadrant Assembly (TQA) in order to move the throttles automatically.

On the following figures, the "switches" show a possible selection:

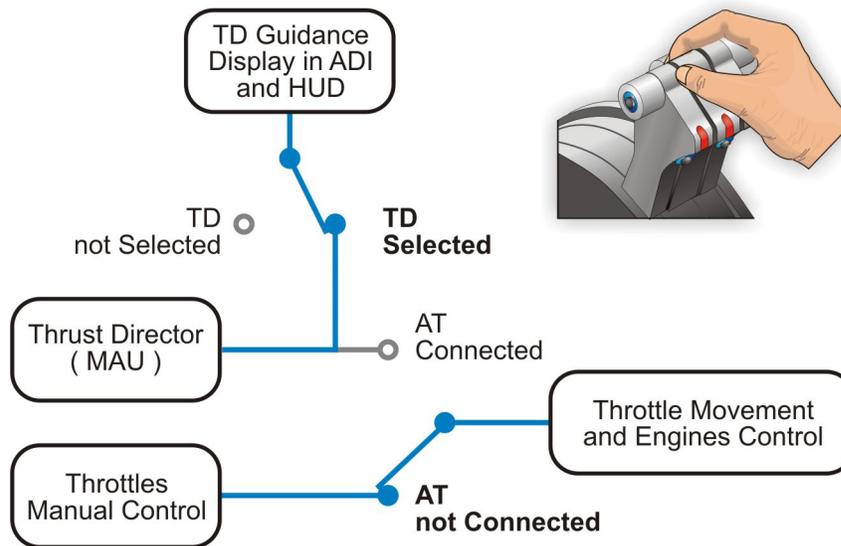
- TD selected or not,
- AT connected or not.

The chosen selection for each example is identified in bold letters and determines the position of the switch.

EXAMPLE 1: AT NOT CONNECTED AND TD SELECTED

If the TD is selected, the guidance will be displayed on the ADI and the HUD.

If the AT is not connected, the pilot will have to move manually the throttles to follow the displayed TD guidance.

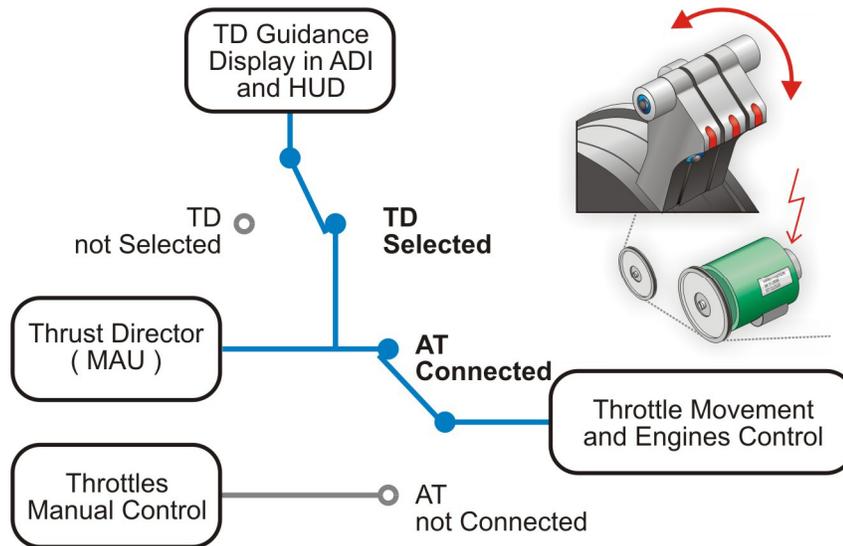


TD SELECTED AND AT NOT CONNECTED

EXAMPLE 2: AT CONNECTED AND TD SELECTED

If the TD is selected, the guidance will be displayed on the ADI or the HUD.

If the AT is connected, the throttles will automatically follow the TD orders.



TD SELECTED AND AT CONNECTED

FLIGHT DECK OVERVIEW

CONTROLS

Crew control of the Auto Throttle and Thrust Director is performed via:

- The Guidance Panel,
- Pushbuttons on the throttles,
- A soft key on the ENG synoptic page.

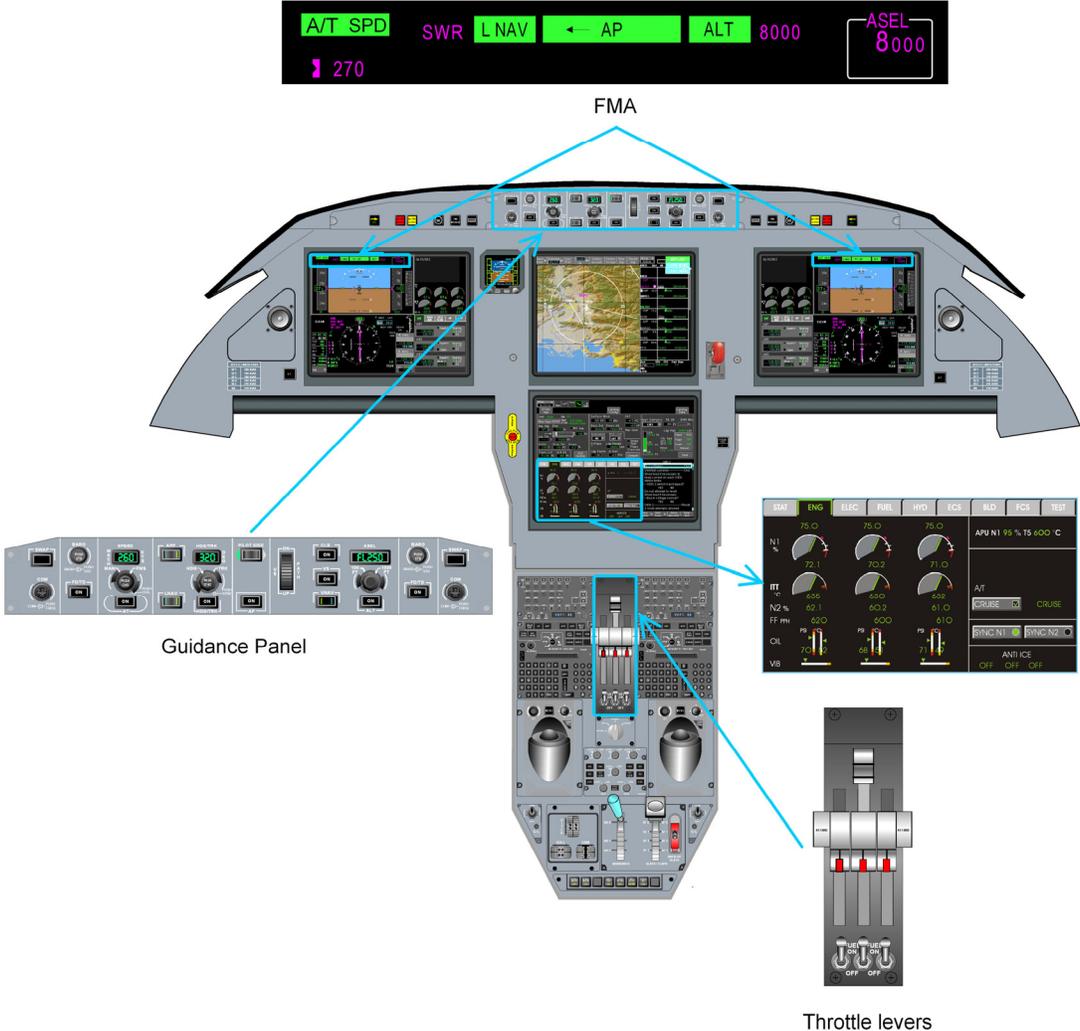
INDICATIONS

Cockpit indications related to Auto-Throttle and Thrust Director are displayed:

- On the Guidance Panel,
- On the FMA for active mode and speed target,
- On the ADI and HUD for FD guidance, and Flags associated with TD / AT,
- On the ENG-CAS window for CAS messages,
- On the STATus synoptic / FAULT tab for fault messages.

Additionally, an aural alert "AUTOTHROTTLE" is triggered upon AT disconnection.

Falcon 7X [Automatic Flight Control System Summary]



FLIGHT DECK OVERVIEW

GENERAL

When AT is engaged, TD orders are sent to the Full Authority Digital Electronic Computer (FADEC) and to three servomotors within the Throttle Quadrant Assembly.

With regard to the Thrust Director (TD) architecture:

- The TD has a single channel (TD1),
- TD1 is dual lane (TD1A and TD1B), both lanes being required at all time.

With regard to Auto Throttle (AT) architecture:

- The AT has a single channel and dual lane, like the TD,
- The AT command is computed within the same modules as the TD.

THRUST DIRECTOR AND AUTO-THROTTLE MODES - GENERAL DESCRIPTION

TD/AT MODES

In normal operation, the Thrust Director (TD) and Auto-Throttle (AT) can operate in two different modes:

- SPD mode: Speed / Mach mode,
- N1 mode: also referred to as "Thrust mode".

SPD and N1 modes contain different sub-modes:

SPD Mode

The only SPD specific sub mode is:

- LIM.

N1 Mode

The different N1 specific sub modes are:

- CLB: Climb,
- CRU: Cruise,
- RTR: Retard mode or Thrust Reduction mode,
- PROT: this mode is dedicated to Speed protection: if the Auto Pilot is engaged, the Auto-Throttle provides Low and High Speed protection by entering the PROT mode.

➤ *Refer to ATA 22_1 for a description of AFCS speed protections.*

MODE SELECTION

The crew has no control over selection of either SPD or N1 mode; the selection is made by the system, depending on:

- Which Flight Director Vertical mode is active,
- Selection of Flight Director Go Around mode,
- Radar Altitude.

The only possible selection by the crew is, when in N1 mode:

- CRU sub-mode selection via "Cruise" selection in the ENG synoptic.

Activation of PROT mode will be automatic in case of activation of Auto Throttle Automatic Engagement mode and/or Pitch Speed Protection mode.

TD / AT LIMITS

TD and AT respect engine and airplane flight envelope limitations depending on the active mode.

TD / AT limits in SPD mode

TD/AT authority is limited to:

- Upper limit: VMO/MMO,
- Lower limit: Low Speed Cue.

NOTE

There is no automatic limitation of the TD / AT for VFE: if flaps are extended and the target speed is set by the crew above VFE, the TD and AT will go over VFE.

TD / AT limits in N1 mode

TD / AT authority is limited to:

- Upper limit:
 - o MAX CLIMB in CLB mode, except in case of GA mode (TD mode only) or in PROT mode if the ASP is active: in these cases, the upper limit becomes "MAX TAKE OFF",
 - o MAX CRUISE in CRU mode,
- Lower N1 limit:
 - o IDLE,
 - o Anti-ice IDLE if wings anti-ice is selected.

AUTOTHROTTLE ENGAGEMENT / DISENGAGEMENT AND AUTHORITY

AT ENGAGEMENT

AT may be manually or automatically engaged.

Manual AT engagement is performed through AT pushbutton on Guidance Panel. AT can be engaged for any TD mode.

Automatic AT engagement is available only for Speed Protection if the AP is engaged.

NOTE

Limitations for AT engagement are:

- AT can be engaged 400 ft above runway
- AT is inhibited in Take Off and Go Around modes

Indications

- A/T green symbol is displayed on the top center of both FMA,
- A/T mode is displayed in reverse video on both FMA,
- ON pushbutton is green lighted on Guidance Panel.

AT DISCONNECTION

AT disconnection is either manual or automatic.

Manual AT Disconnection

A manual AT disconnection will occur when depressing:

- A Quick Disconnect pushbutton on the throttles of Engine 1 or Engine 3,
- The AT pushbutton on the GP.

Automatic AT Disconnection

An automatic AT disconnection will occur:

- At first push for a Take-off Go-Around TOGA pushbutton on the throttles (one push),
- By an overriding action on the throttles,
- After AT failure,
- After FADEC malfunction.

Falcon 7X [Automatic Flight Control System Summary]

Indications

- AT amber symbol continuously flashing during 10s on the top center of both FMA,
- Aural alert:
 - o One Auto-Throttle aural alert in case of manual disconnection,
 - o Repeated aural alert Auto-Throttle in case of automatic disconnection.

NOTE

When AT automatically disengages, the repeated aural alert remains active as long as there is no push on a AT Quick Disconnect pushbutton or until AT is re-engaged.

AUTO-THROTTLE AUTHORITY

By design, the AT authority has been limited when the Flight Level change is not significant: lower than 5,000 ft.

SPEED MODE - DETAILED DESCRIPTION

In the Speed mode (SPD), the TD will provide thrust guidance to capture and hold the target SPEED or MACH selected by the crew (SPEED knob set to MAN) or set by the FMS.

In case of MAN speed selection, the reference speed value is displayed on the readout above the SPEED setting knob. For MAN or FMS speed selection, the reference speed is recalled at the top of the speed tape, and is identified on the speed tape by a "speed reference bug".

NOTE

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

The TD will be in SPD mode if one of the following Flight Director modes is engaged:

- ALT, VALT,
- ASEL, VASL,
- VS,
- PATH, VPTH,
- GS, VGP.

LIM sub-mode

If reaching the reference Speed / Mach number takes too long or is impossible, a LIM amber indication will be displayed on the FMA: to achieve the target capture, a crew action will be necessary (extend or retract airbrakes, change flaps configuration, ...).

N1 MODE (THRUST MODE) - DETAILED DESCRIPTION

In N1 mode, throttle positions are maintained constant. The FD maintains the speed by adjusting the airplane Flight Path Angle.

The N1 mode sub-modes are:

- CLB: Climb,
- CRU: Cruise,
- RTR: Retard.

CLB (CLIMB)

This sub-mode is activated if:

- CLB or VCLB Vertical Flight Director mode is active.

In this mode, the engine power setting is set to a given thrust setting up to MAX CLIMB, and the Flight Path Angle is modified to reach the target SPEED. The thrust setting depends on the difference of altitude between the ASEL and the current altitude.

During Go Around operation, the TD is in thrust sub-mode, commands MAX TAKE-OFF and the AT is automatically disengaged and inhibited.

CRU (CRUISE)

This sub-mode is activated if:

- CLB or VCLB Vertical Flight Director mode is active,
- "Cruise" is selected on the ENG synoptic.

This sub-mode is similar to CLB mode, except that the upper thrust limit is MAX CRUISE rather than MAX CLIMB.

In this sub-mode, the engine power is set to a given thrust up to MAX CRUISE setting provided by the FADEC, and the Flight Path Angle is modified to reach the target SPEED. The thrust setting depends on the difference of altitude between the ASEL and the current altitude.

RTR (RETARD MODE AND THRUST REDUCTION)

The RTR sub-mode is engaged:

- When airplane descends through 20 ft Radar Altitude (Retard mode),
- Following an HGS order entailing automatic throttle reduction during flare out (Thrust reduction mode).

In the RTR sub-mode, if the AT is engaged, the AT will retard throttles to IDLE, and disengage after touch down (WOW). The FMA displays a green RTR symbol until AT disengagement.

AUTO THROTTLE CONTROL

The majority of the Auto-Throttle control and monitoring is performed in Auto-Throttle lane A.

Generic I/O modules in the MAU transmit the lane A AT rate commands to the Throttle Quadrant Assembly. These servo will provide full authority and can drive the throttles from Idle to Take Off in approximately 4s (40° travel, 12°/s max).

Generic I/O modules in the MAU transmit the lane A TLA trim commands to the FADEC via ARINC 429 buses. The TLA trim commands request limited authority thrust changes to enable the AT to accurately equalize the thrust setting for all engines (usual authority is ±2° TLA, and never more than ±4° TLA).

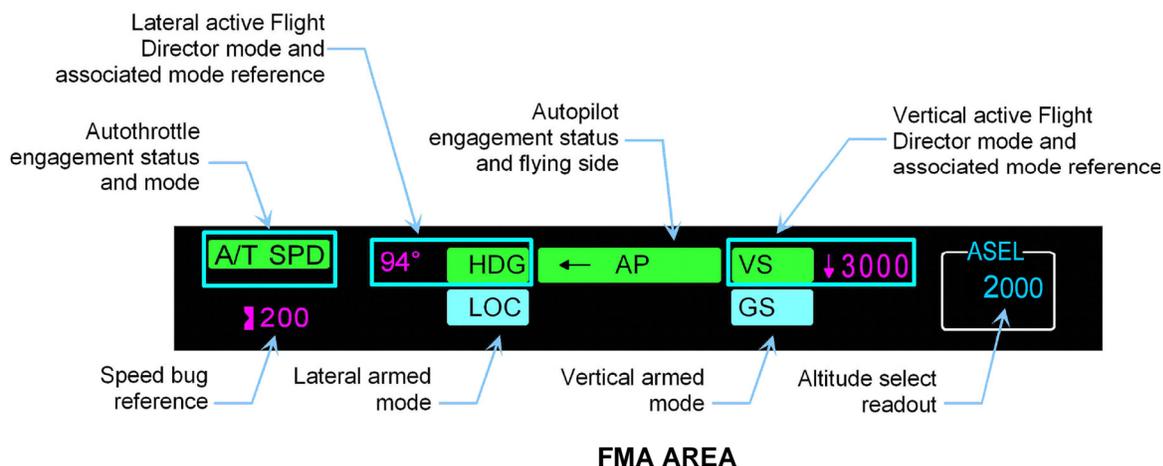
Lane B of the Auto Throttle performs a Take Off monitor function, to prevent engage requests from being applied to the Throttle Quadrant while the airplane is less than 400ft above Take Off altitude.

GENERAL

COLOR CODE

A specific set of colors has been defined to depict the status of the automated systems, as described in ATA 22_1. Only two colors are used for the TD/AT function:

- **GREEN** defines an active mode,
- **MAGENTA** represents the active target: what the system is aiming for now.

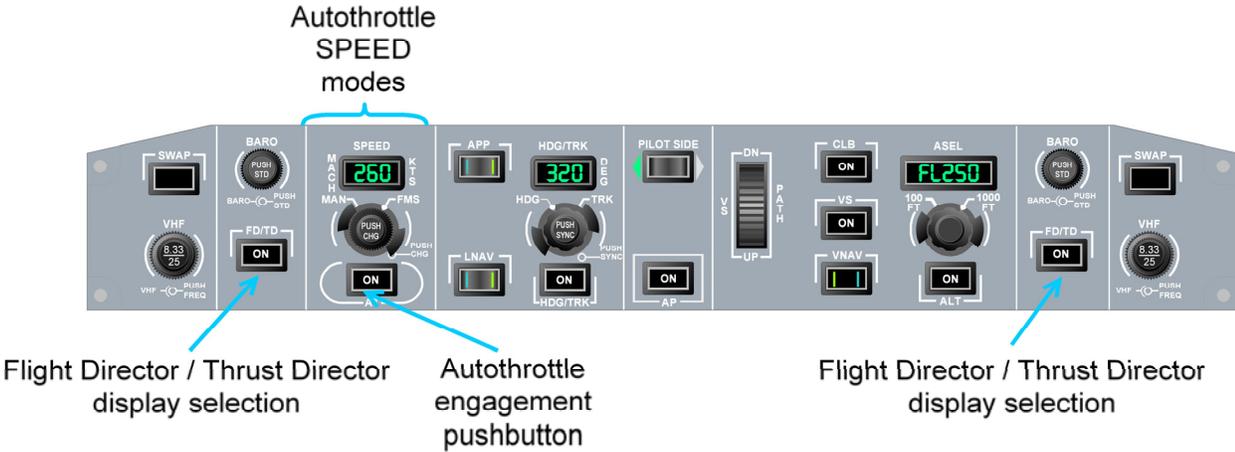


CONTROLS

Crew control of the Auto-Throttle and Thrust Director is performed via:

- The Guidance Panel,
- Pushbuttons on the Throttles,
- Soft key on the ENG synoptic page to select CRUise mode,

GUIDANCE PANEL

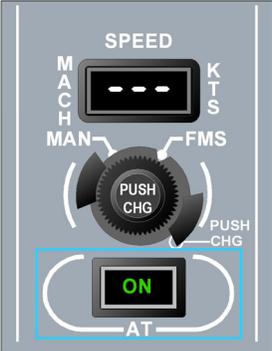


GUIDANCE PANEL

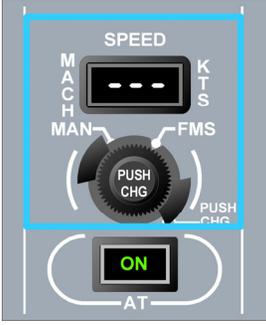
Falcon 7X [Automatic Flight Control System Summary]

CONTROL	FUNCTIONS	LOCAL INDICATIONS
<p style="text-align: center;">FD/TD Display Selection</p>  <p>The image shows a rectangular pushbutton with a grey background. At the top, the text 'FD/TD' is displayed in white. Below it is a black rectangular area containing the word 'ON' in white. The button is framed by a thin white border.</p>	<p>Pilot can select FD and TD information by pressing the FD/TD pushbutton on the guidance panel</p> <p>In the following cycling sequence</p> <ul style="list-style-type: none"> - FD and TD display - FD display - TD display <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p style="text-align: center;">NOTE</p> <p>FD/TD selection is not operative while in TO or GA modes, or if ASP or PSP protection is active.</p> </div>	<ul style="list-style-type: none"> - GP: Green ON is displayed on the FD/TD pushbutton - TD Mode is displayed in reverse video on the FMA

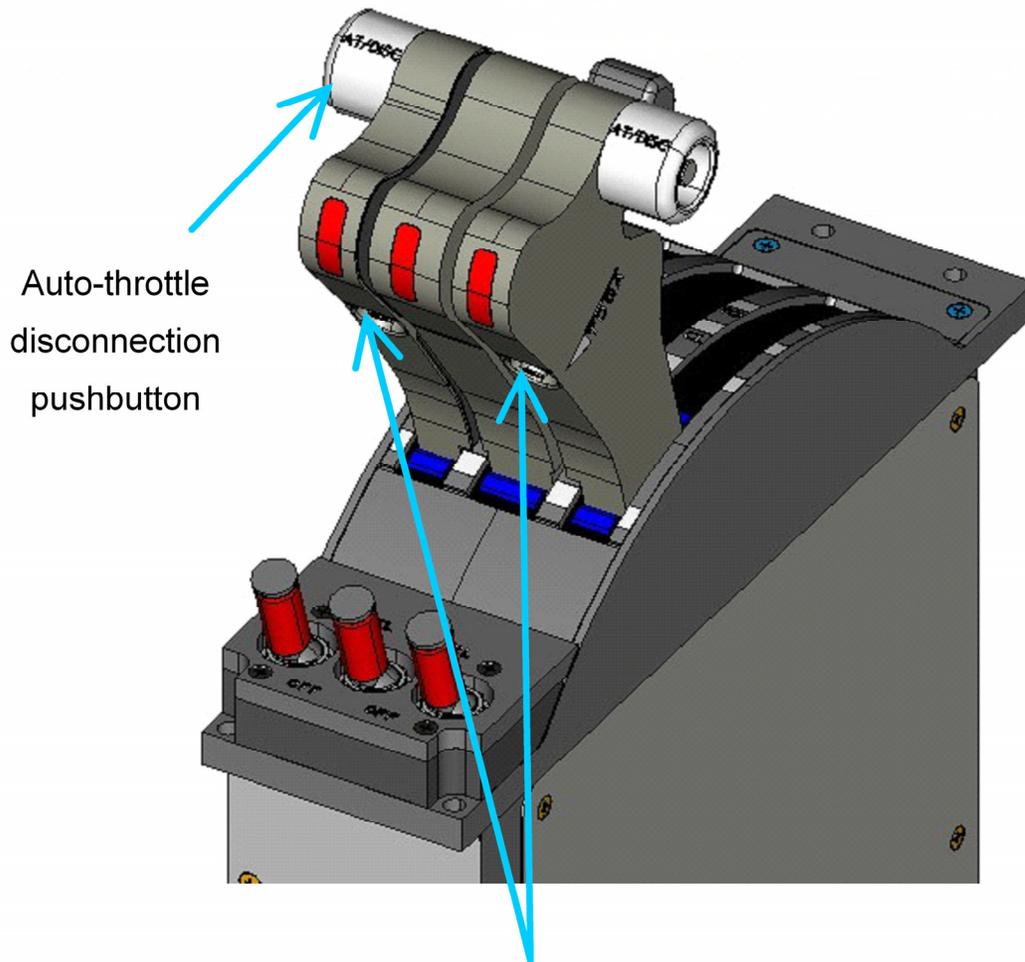
Falcon 7X [Automatic Flight Control System Summary]

CONTROL	FUNCTIONS	LOCAL INDICATIONS
<p>Auto Throttle selection</p> 	<p>Allows engagement or disengagement of the AT</p>	<p>AT CONNECTION</p> <ul style="list-style-type: none"> - GP: Green ON is illuminated on the AT pushbutton - FMA: Green AT caption is displayed at the LH side of both FMA  <p>AT CONNETED</p> <p>AT DISCONNECTION</p> <ul style="list-style-type: none"> - AT amber symbol flashing on the FMA 10 s for manual disconnection - Aural alert “AUTOTHROTTLE” repeatedly in case of automatic disconnection; one time only in case of manual disconnection.  <p>AT DISCONNECTION</p>

Falcon 7X [Automatic Flight Control System Summary]

CONTROL	FUNCTIONS	LOCAL INDICATIONS
<p style="text-align: center;">SPEED selection</p> 	<ul style="list-style-type: none"> - Outer ring allows selection between MANual or FMS speed selection - Inner knob allows selection of the targeted value of SPEED when MAN is selected. - Pushing on the inner knob alternates between Mach and kt. 	<ul style="list-style-type: none"> - GP: In MAN selection, target value is displayed in kt or Mach on the digital readout just above the knob. For FMS selection, dashes are included in the digital readout. - FMA: Target value is displayed in magenta at the top of the speed tape, next to a speed reference bug. The speed reference bug is also displayed on the speed tape. - The speed reference bug is: <ul style="list-style-type: none"> - : MAN, - : FMS, - : tear-drop display: <ul style="list-style-type: none"> o At low speed when MAN / FMS speed < Low Speed Cue + 3 kt, o At high speed when MAN / FMS speed > VMO - 5kt.

THROTTLE CONTROL



Take-Off Go Around pushbuttons

AT QUICK DISCONNECT AND TOGA PUSHBUTTONS

The AT Quick Disconnect switches allow manual disconnection of the AT. On ground, pushing on the TOGA pushbutton will engage Take Off mode.

In flight, pushing on the TOGA pushbutton will:

- Engage Go Around mode,
- Disconnect automatically the Auto Throttle,
- Disengage AP if engaged.

ENG SYNOPTIC

"CRU" mode can be selected via the ENG synoptic page.



ENGINE SYNOPTIC

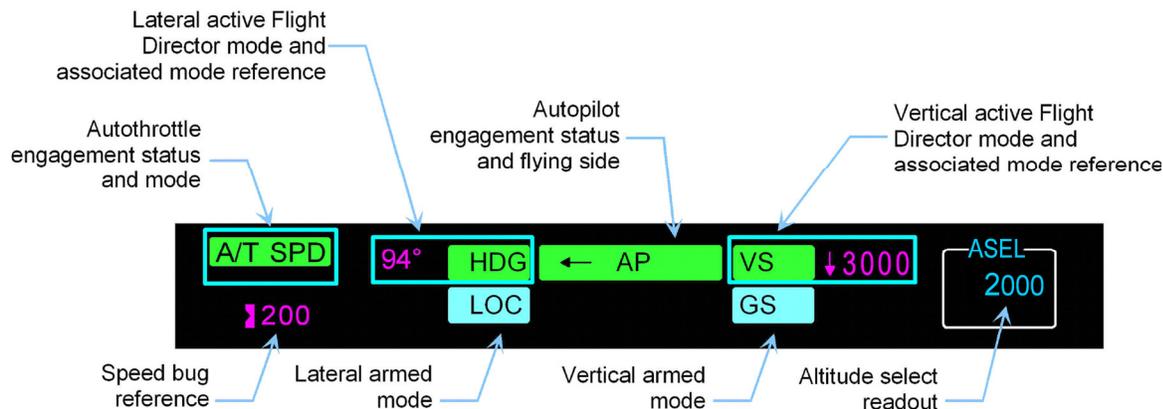
INDICATIONS

Cockpit indications related to Auto-Throttle and Thrust Director are displayed:

- On the Guidance Panel for SPEED MAN target data, (described in previous paragraph),
- On the FMA for active mode and speed target,
- On the ADI and HUD for FD guidance, and Flags associated with TD/AT,
- On the ENG-CAS window for CAS messages,
- On the STATus synoptic / FAULT tab for fault messages.

FLIGHT MANAGEMENT ANNUNCIATOR

FMA is displayed in each upper part of the PDU.



FLIGHT MODE ANNUNCIATOR AREA

Mode display

Depending on the active mode, the following will be displayed:

- SPD: TD is selected, and speed mode was selected by the system,
- A/T SPD: same as above with AT selected,
 - o Sub mode "LIM" would be displayed below A/T SPD if LIM mode is reached.



A/T SPD ACTIVE MOD WITH LIM SUB MODE

- N1: TD is selected, and N1 mode (Thrust mode) was selected by the system,

Falcon 7X [Automatic Flight Control System Summary]

- A/T N1: same as above with AT selected,
 - o Sub modes "CRU, RTR" would be displayed below A/T N1.



A/T N1 ACTIVE MOD WITH CRUISE SUB MODE

- PROT is displayed below A/T



PROT DISPLAY

Speed reference bug

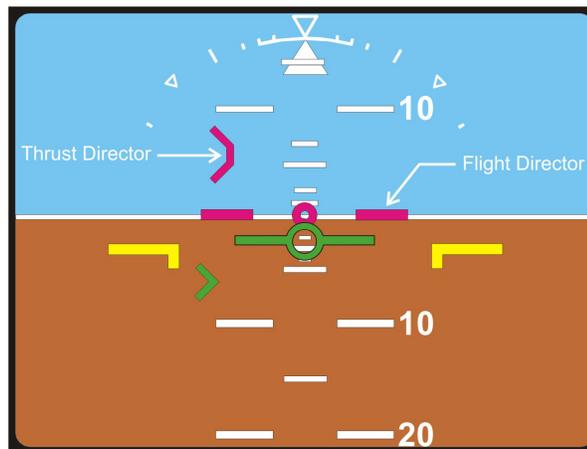
A speed reference bug can be:

- : MAN,
- : FMS,
- : tear-drop display when MAN / FMS speed < Low Speed limit + 3 or MAN / FMS speed > VMO- 5kt.

ATTITUDE AND DIRECTION INDICATOR

Similar indications are provided in the ADI and in the HUD:

- TD guidance,
- Flags,



THRUST DIRECTOR AND FLIGHT DIRECTOR ORDERS

When the TD command is invalid, a red **TD** flag is displayed on both ADI and TD is dropped from displays.

SYSTEM MONITORING

Monitoring of the following parameters is provided by the system:

- Integrity of both lanes of the TD and AT,
- Validity of input data from RA.

ACTIVE PROTECTIONS

Lane B of the TD is used to prevent unwanted engagement of AT during Take Off.

INTRODUCTION TO SPEED & STALL PROTECTION

Speed and stall protections consist in:

- Low Speed protection,
- High Angle Of Attack protection,
- High Speed protection.

Several systems are involved in the elaboration of these:

- The Primary Flight Control System (PFCS),
- The Automatic Flight Control System (AFCS),
- The Air Data System (ADS),
- The EASy avionics.

The protections can be classified under six categories:

- Airplane configuration adaptation (automatic control of slats and airbrakes by the PFCS),
- Pitch up or pitch down orders provided by the PFCS and potentially by the Auto Pilot (AP),
- Wing level order,
- Auto-Throttle (AT) automatic control,
- Aural alerts,
- Indications.

Among the categories of protections listed above, the protections associated to the AP or AT will only be available if the AP was connected prior to entering the speed protection zone.

FLIGHT DECK OVERVIEW

CONTROLS

No controls are dedicated to speed and stall protections. All protections are active at all times in PFCS normal laws if the AP is connected. If the AP is not connected, the PFCS protections are still available, as well as the aural alerts and indications.

INDICATIONS

Cockpit indications related to speed and stall protections are displayed on the PDU and HUD:

- On the speed scale of the ADI,
- On the FMA for AT or AP speed protection mode activation.

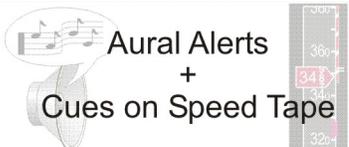
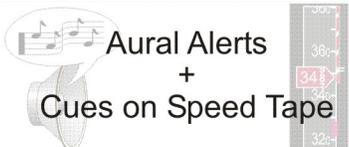
Additionally, aural alerts are provided in case of low or excessive speed or Mach.

Falcon 7X [Automatic Flight Control System Summary]

GENERAL

In normal operation (no PFCS failure), the speed protections available only depend on the activation status of the Auto Pilot and FD mode:

- If the AP is not connected prior to entering a speed protection zone, protections available are:
 - o Airplane configuration adaptation (automatic control of slats and airbrakes by the PFCS),
 - o Progressive pitch up and wing level orders provided by the PFCS (High Speed),
 - o Progressive pitch down orders provided by the PFCS (Low Speed),
 - o Aural alerts,
 - o Indications on the speed tape, referred to as "cues".
- If the AP is connected prior to entering a speed protection zone, an depending on the FD mode, protections available are:
 - o All of the above listed protections,
 - o AT automatic engagement and control,
 - o Pitch up or pitch down orders provided by the AP.

	Autopilot OFF	Autopilot ON
A F C S	 None	 AP Pitch Speed AT Speed Protection with Automatic AT Engagement
P F C S	 Aerodynamic Configuration Pitch Protection Wings Level	 Aerodynamic Configuration Pitch Protection Wings Level
W a r n	 Aural Alerts + Cues on Speed Tape	 Aural Alerts + Cues on Speed Tape

**SPEED AND STALL PROTECTIONS AVAILABLE
DEPENDING ON AP STATUS**

Falcon 7X [Automatic Flight Control System Summary]

After some PFCS failures, the PFCS speed protections will not be available anymore, and the authorized flight domain will be reduced.

NOTE

In the remaining of this chapter, unless specified, the PFCS will be considered as fully operative with regard to speed protections.

STALL AND SPEED PROTECTIONS FROM THE PFCS

GENERAL

The PFCS provides:

- Stall and low speed protection, which consists in:
 - o Airplane configuration adaptation (automatic orders of slats and airbrakes at high AOA or automatic Airbrakes order for low speed protection),
 - o High AOA limitation (automatic pitch down order),
- Overspeed protection, which consists in:
 - o Pitch up and wing level orders at high speed.

AIRPLANE CONFIGURATION ADAPTATION

Slats automatic control

For stall protection, the PFCS commands:

- In clean configuration: the extension of the middle and outboard slats at $AOA=9^\circ$,
- If inboard slats were extended, inboard slats are retracted at very high AOA ($AOA=26^\circ$) to increase deep stall margin.

Airbrakes Automatic control

The middle airbrake panels authority for airbrake function is progressively reduced for an AOA between 10° and 16° .

The PFCS commands the airbrakes retraction at $AOA=16^\circ$. This command is sent to:

- The inboard and outboard airbrakes panels,
- The middle airbrakes panels, which can still be used as spoilers (e.g. for roll function).

For low speed protection, the PFCS will command the airbrakes retraction if maximum Take Off power is commanded.

NOTE

Once the airbrakes have been automatically retracted, the airbrake handle needs to be reset before the airbrakes can be extended again.

HIGH ANGLE OF ATTACK PROTECTION

In order to maintain a safe maximum AOA (17° in flaps extended configuration and around 14° in clean configuration), the PFCS will command a pitch down order to descend and maintain sufficient speed if thrust power is not increased.

NOTE

The PFCS will NOT command an automatic thrust increase in case maximum AOA is reached.

OVERSPEED PROTECTION

The PFCS will initiate wing level and pitch up commands above VMO (VMO + 6kt) or above MMO (MMO + 0.012).

HIGH SPEED AND LOW SPEED INDICATIONS AND AURAL ALERTS

GENERAL

Aural alerts as well as changes of color on the speed tape are provided in order to increase crew awareness in case of overspeed or excessive AOA.

It is recommended to review chapter 02-22_1-15 which describes the cues in details before reviewing the reminder of this section.

HIGH SPEED INDICATIONS AND AURAL ALERT

The speed tape is colored in red with white stripes above VMO or MMO.

This red cue with white stripes is referred to as "High speed cue" or "VMO/MMO Cue".

A continuous aural alert is triggered slightly above VMO or MMO.

NOTE 1

In Slats Flaps extended configuration and in some failure cases, a red cue (V constraint) will be displayed on the upper part of the speed tape. This V constraint indicates to the crew the maximum speed allowed considering the configuration or failure.

NOTE 2

There is no automatic protection associated with this V constraint.

LOW SPEED INDICATIONS AND AURAL ALERTS

At low speed or high AOA, the speed tape is colored in:

- Amber: the top of the cue is:
 - o In SF3: Vref - a certain margin ,
 - o In SF1 or SF2: V2 - a certain margin,
 - o The margin depends on CG position, but will be of about 5kt minimum,
- Red at the minimum speed Vmin which can be achieved with sidestick fully aft (corresponding to the maximum AOA allowed by the PFCS).

The amber and red cues at low speed are referred to as "Low Speed Cues".

A continuous aural alert "INCREASE SPEED" is triggered if the speed is below the amber zone for 1s (or in case of AT speed protection engagement, as described below).

A continuous aural alert "STALL" would be triggered below the red zone.

The "STALL" aural alert would not be heard in Normal PFCS laws unless a turbulence would lead to increase the AOA and therefore decrease the speed below Vmin (top of the red zone).

AUTOPILOT SPEED PROTECTIONS

GENERAL RULES FOR AUTOPILOT SPEED PROTECTIONS

If the AutoPilot is not engaged, there is no AFCS speed protection in addition to the protections described above (PFCS protections, aural alerts and indications).

If the AutoPilot is engaged, speed protections are provided by the AFCS in addition to protections described above. The AFCS protections consist in:

- Automatic pitch inputs from the AP (pitch inputs), referred to as Pitch Speed Protection (PSP),
- And automatic thrust management by the AT, referred to as AT Speed Protection (ASP).

The speed protection engagement will depend on the status of the AutoPilot and Auto-Throttle:

- If the AP and the AT are engaged, the system is configured to stay within the normal speed flight envelope,
- If the AP is engaged but the AT is not engaged, the AT will automatically be engaged when the AT speed protection conditions are triggered (ASP mode).

If a predetermined speed is reached while the Pitch Speed Protection and the AT Speed Protections are active, the PFCS will automatically disengage the Auto Pilot (the Auto-Throttle will remain connected) in order to activate the PFCS speed or stall protections. This predetermined value is indicated on the speed tape as a "disengagement cue".

➤ Refer to "Controls and Indications" section for a description of the disengagement cues.

AUTO-THROTTLE SPEED PROTECTION (ASP)

ASP Engagement

Initial condition: the AP is engaged but the AT is not engaged.

In this case, the Auto-throttle Speed Protection (ASP) is activated to prevent the airplane to fly outside of the normal speed flight envelope as follows:

- Low speed ASP is engaged at the top of the amber Low Speed Cue (LSC),
- High speed ASP is engaged at VMO / MMO (bottom of the red High speed cue in most conditions),
- The deceleration or acceleration rate of the airplane can lead to an earlier engagement of the protection.

Falcon 7X [Automatic Flight Control System Summary]

NOTE 1

Between 25,000 ft and 35,000 ft, the ASP could be engaged before reaching the LSC (at the maximum, ASP will engage at LSC+15 kt). Activation of ASP will also trigger the "INCREASE SPEED" aural alert.

NOTE 2

There is no Auto-throttle Speed Protection (ASP) when:

- In Take-Off (TO), Go-Around (GA),
- Flying manually (AP off).

Upon ASP activation, the Auto-Throttle mode is changed to protection mode "PROT", as indicated in the FMA.

Target of the ASP

When the ASP is activated, the Auto-Throttle engages and follows the TD (Thrust Director) orders calculated by the system in order to reach and maintain the reference speed.

At low speed, the reference speed is the greater of:

- MAN / FMS selected speed or
- The tear-drop speed (top of Low Speed Cue + 3 kt).

At high speed, the reference speed is:

- MAN / FMS selected speed or
- The tear-drop speed (slightly below MMO, or slightly below VMO - 5 kt).

ASP mode disengagement

Once out of violation, AT remains engaged in SPD mode and follows the reference speed.

NOTE

The tear-drop symbol will remain displayed on the speed scale until the speed bug setting is changed on the guidance panel for a speed above LSC +3.

PITCH SPEED PROTECTION (PSP)

PSP engagement

The Pitch Speed Protection mode is automatically activated when the ASP alone is not able to make the airplane re-enter within the limits of the normal speed flight envelope.

NOTE

In ALT below 20,000 ft, VALT below 20,000 ft, 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 activation. In that case, the vertical AP mode is automatically changed (PROT indication in the Flight Mode Annunciator FMA in addition to the PROT indication for the ASP).

Target of the PSP

When the PSP is activated, the AutoPilot will follow the FD commands calculated by the system. The FD commands are calculated such that:

- At high speed:
 - o A nose up command is calculated to maintain the speed at the tear drop bug (VMO - 5 kt),
 - o While the AT commands the engines at idle power,
- At low speed:
 - o A nose down command is calculated to maintain the speed at the tear drop bug (LSC +3 kt);
 - o While the AT commands the engines at max TO power.

PSP mode disengagement

The PSP is disengaged:

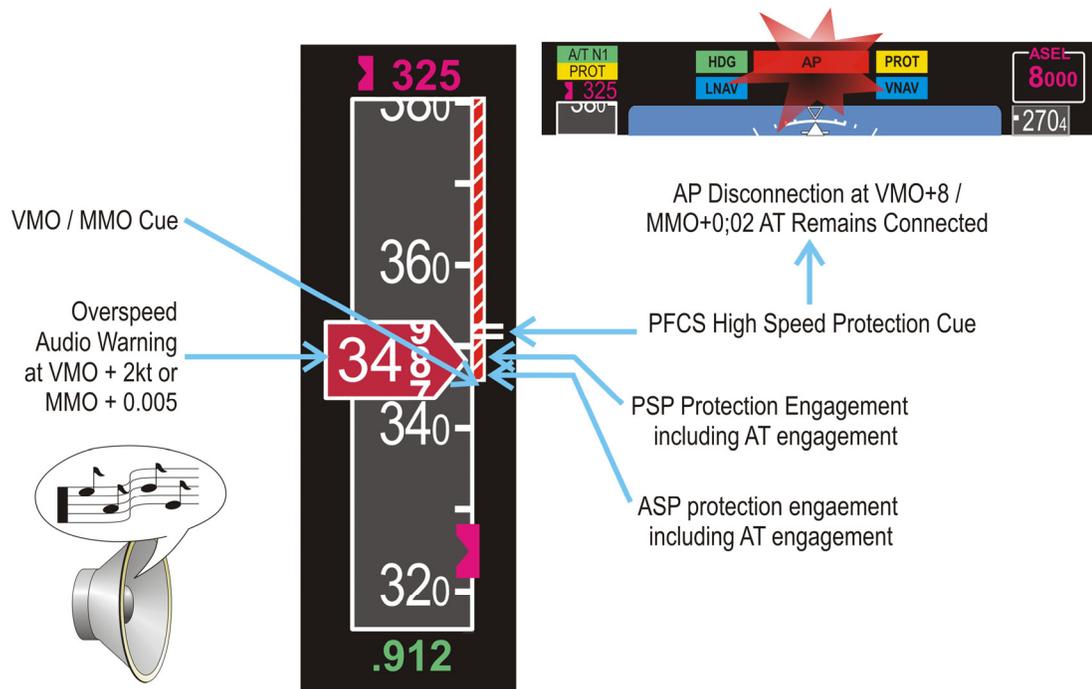
- When the normal speed flight envelope has been re-entered, and a FD vertical mode is selected (either PATH by moving the PATH wheel or other modes by pushbutton activation),
- Before the PFCS protections become active.

SEQUENCING OF PROTECTIONS

SEQUENCING OF PROTECTIONS AT HIGH SPEED

The sequencing of events for high speed protection could vary depending on conditions like speed, acceleration rate and FD mode. However, an example of sequencing is:

- Aural alert VMO/MMO is triggered,
- If the AP is engaged and ASP/PSP available:
 - o The ASP becomes active,
 - o The AP pitch protections will become active,
- If speed continues to increase above the disengagement cue, the AP is disengaged. The AT remains engaged if it was engaged,
- Pitch up and wing level orders are provided by the PFCS.

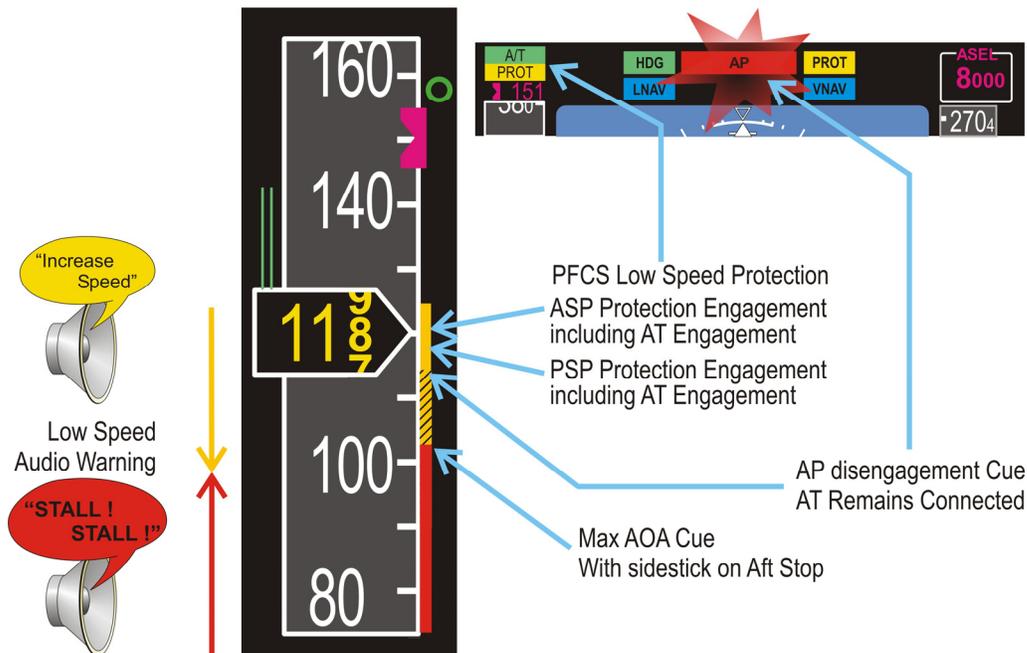


HIGH SPEED PROTECTIONS, CONSIDERING AP IS INITIALLY ENGAGED

SEQUENCING OF PROTECTIONS AT LOW SPEED

The sequencing of events for stall protection could vary depending on conditions like speed, acceleration rate, altitude and FD mode engaged. However, an example of sequencing is:

- Aural alert "INCREASE SPEED" is triggered (1s after entering amber LSC zone).
- If the AP is engaged and ASP/PSP available:
 - o The ASP becomes active,
 - o The AP pitch protections will become active,
- The airbrakes are retracted as soon as take off power is applied,
- Slats are extended if SF0 selected,
- If speed continues to decrease, the AP is disengaged. The AT remains engaged if it was engaged.
- Pitch down order is provided by the PFCS,
- The Airbrake are retracted when reaching high AOA if take off power was not applied,
- Aural alert "STALL" is triggered if the speed is decreased below the red LSC cue in Normal Laws. (The "STALL" aural alert is triggered at the top of the red LSC cue in Alternate and Direct Laws, since the protections are considered as lost).



LOW SPEED PROTECTIONS, CONSIDERING AP IS INITIALLY CONNECTED

CONTROLS

No controls are dedicated to speed and stall protections. All protections are active at all times in PFCS normal laws if the AP is connected. If the AP is not connected, the PFCS protections are still available, as well as the aural alerts and indications.

INDICATIONS

Cockpit indications related to speed and stall protections are displayed on the PDU and HUD:

- On the speed scale of the ADI for
 - o "Low Speed Cues" or "High Speed Cues",
 - o "AP Disengagement Cues",
 - o Airbrake indication,
- On the FMA for AT or AP speed protection mode activation.

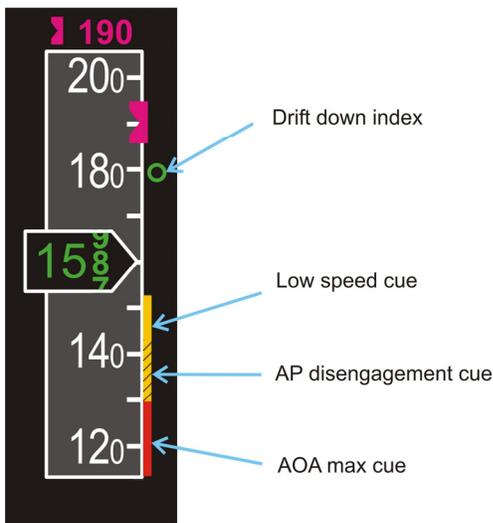
Additionally, aural alerts are provided in case of low or excessive speed or Mach.

➤ *Refer to "Controls and Indications - Supplementary information" for further information on the elaboration of aural alerts and indications.*

LOW SPEED CUES (LSC) AND AP DISENGAGEMENT CUE

Three types of colors are displayed at the bottom of the speed scale of the Attitude Director Indicator (ADI) of the PDU and HUD:

- The amber Cue:
 - o Indicates an operational limit that includes preset maximum reachable AOA margins,
 - o The upper limit varies with slats, flaps and airbrakes (in SF3 only).
- The amber with black stripes cue:
 - o Corresponds to protection zone by the Primary Flight Control System,
 - o The upper edge corresponds to disengagement speed of the AP.
- The red cue:
 - o In normal laws, the upper edge of this cue indicates maximum AOA with sidestick fully aft,
 - o In ALTERNATE or DIRECT laws this cue indicates STALL warning.



LOW SPEED CUES ON ADI SPEED SCALE

AURAL ALERTS AT LOW SPEED

Continuous aural alerts are triggered at low speed:

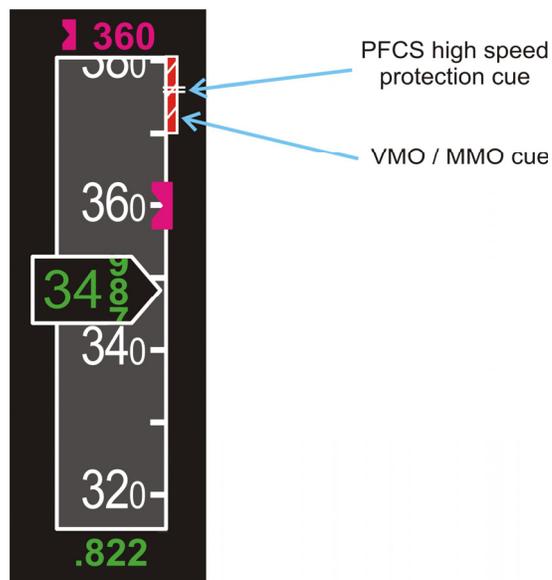
- "INCREASE SPEED" if the speed is below the top of the amber zone for 1s (or upon ASP engagement),
- "STALL" is triggered after or when entering the red AOA max cue depending on the PFCS flight control laws.

The "INCREASE SPEED" aural alert is not acknowledgeable and is inhibited at Take Off up to 500 ft, below 60 ft radar altitude or during windshear warning.

HIGH SPEED CUES AND AP DISENGAGEMENT CUE

Two indications of overspeed limits are displayed at the top of the speed scale of the Attitude Director Indicator (ADI) of the PDU and HUD:

- The red cue with white stripes:
 - o The lower edge of the cue indicates VMO/MMO,
 - o The manual speed bug cannot be positioned above VMO / MMO,
- The PFCS high speed protection cue represented by a double white line:
 - o Corresponds to protection zone by the Primary Flight Control System,
 - o Also corresponds to disengagement speed of the AP.



HIGH SPEED ANNUNCIATIONS ON THE ADI SPEED SCALE

AURAL ALERT AT HIGH SPEED

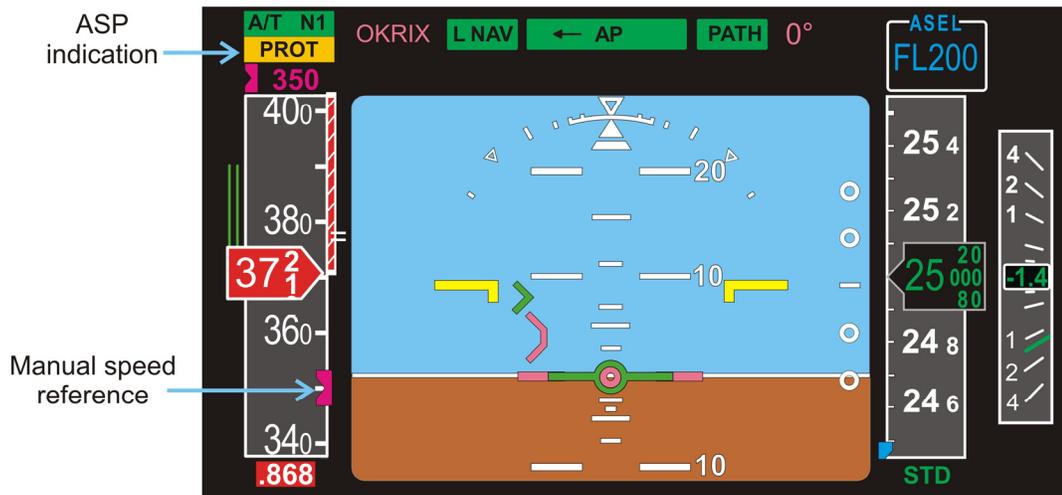
A continuous aural alert is triggered slightly above VMO (+2kt) and MMO (MMO + 0.005).

FMA INDICATIONS

ASP indication

Upon ASP activation:

- The Auto-Throttle mode is changed to protection mode
- A PROT indication appears on the Flight Mode Annunciator (FMA) in amber reverse video in the AT mode window and flashes for 10 seconds.



HIGH SPEED ASP ACTIVATION

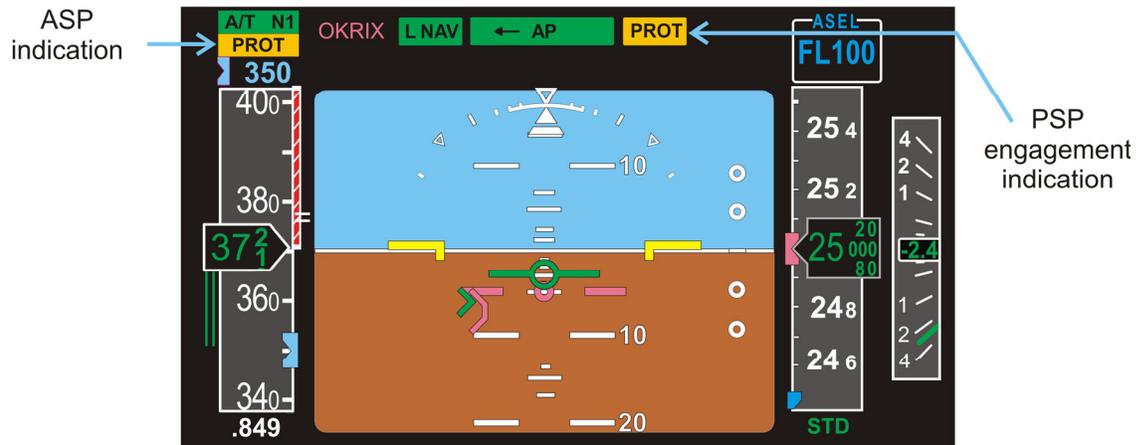


LOW SPEED ASP ACTIVATION

Falcon 7X [Automatic Flight Control System Summary]

PSP indication

Upon activation of the PSP a "PROT" indication is displayed in place of the vertical mode.



ASP ACTIVATED AND PSP MODE ENGAGED

AB INDICATION

The AB indication will be blinking upon ASP engagement.

SOURCES OF INDICATIONS AND AURAL ALERTS

AT LOW SPEED

The Low Speed Cues are elaborated by avionics based on data received from the Flight Director (FD) module.

The "INCREASE SPEED" and "STALL" aural alerts are generated by the avionics based on data elaborated by the PFCS, the MAU and the ADS.

AT HIGH SPEED

The High Speed Cue is elaborated by the avionics based on data received from the ADS.

The continuous aural alert at VMO/MMO is generated by the avionics based on data received from the ADS.

LOW SPEED CUES DETAILED DESCRIPTION

VARIATION WITH G'S

The top of the amber with black stripes cue and the amber Low Speed Cue will not vary with G's. When turns are performed at Vref, the pilot will not be disturbed by the amber cue.

The top of the red Low Speed Cue will vary with G's and could increase above amber with black stripes cue or above the amber cue.

LOW SPEED CUES (LSC) AND AP DISENGAGEMENT CUE

The top of the amber cue varies with the airplane weight above 20,000 ft.

NOTE

There will be no Low Speed Cue information if the FMS airplane weight is invalid above 20,000 ft.