DASSAULT FALCON 7X

SYSTEMS SUMMARY

Aircraft Introduction

This material is to be used for training purpose only

Do not use it for flight!

PERFORMANCE

The Falcon 7X is a business jet certified for transporting up to 19 passengers and three crew members.

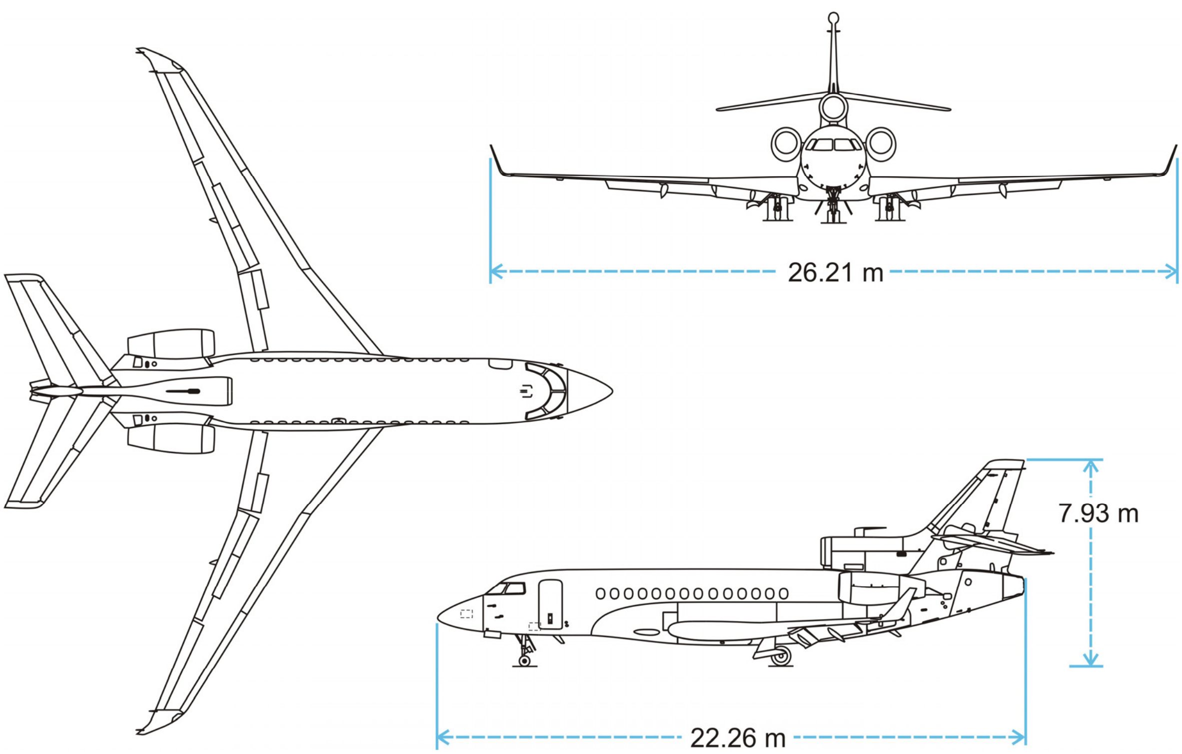
Because it is capable of long range flights, the Falcon 7X can be equipped with a crew rest area.

It is capable of the following type of operations:

- Approach RNP 0.3,
- BRNAV,
- MNPS,
- PRNAV,
- RVSM.

STRUCTURAL CHARACTERISTICS

Main structural characteristics of the Falcon 7X are:



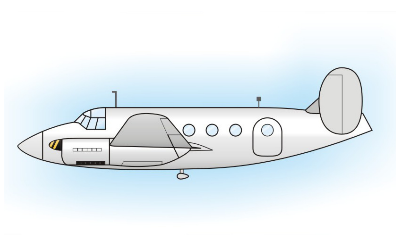
OVERALL DIMENSIONS

Winglets fitted on the wings are optimizing performance in cruise conditions.

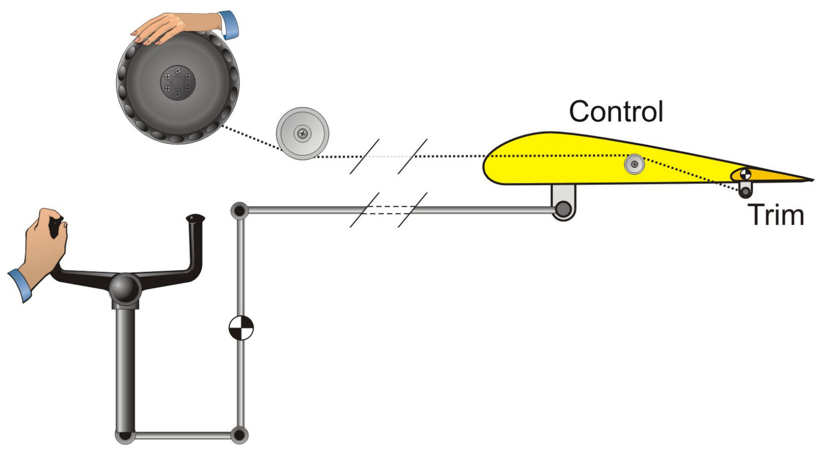
FLY BY WIRE TECHNOLOGY

Flight controls technology has been evolving for years in order to enable better airplane performance.

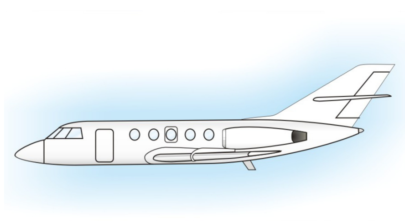
Slow airplanes only required conventional controls, with direct actuation of the control surfaces by the pilot through bell cranks and pulley.



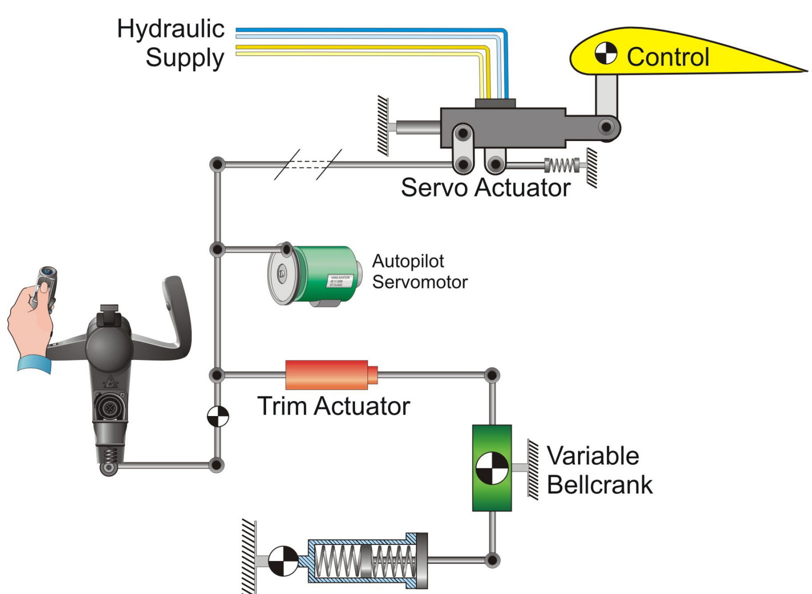
MD 315
First Flight: 1947



As airplane speed increased, Hydraulic assistance was required to actuate the flight control surfaces.



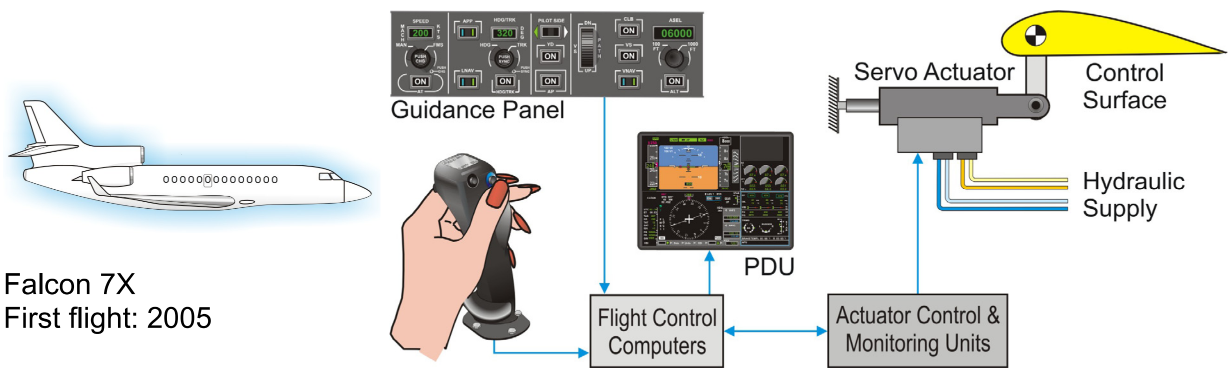
Mystère / Falcon 20
First Flight: 1963



As of today, bell cranks and pulley have been replaced by digital links between the pilot controls and the servo actuators.

This technology, also referred to as digital Fly By Wire technology, not only allows increased airplane speed, but it mainly allows safety improvement.

The Flight controls of the Falcon 7X were therefore designed with digital FBW technology.



The digital FBW (Fly By Wire) technology allows:

- Improved safety by :
  - Preventing the airplane from exceeding the safe flight envelope while reaching maximum airplane performance,
  - Allowing instinctive reaction in emergency situation,
- Reduced pilot workload by:
  - Simplifying airplane handling characteristics,
  - Enhancing airplane stability,
- Improved performance.

SYSTEMS

The Falcon 7X is fitted with three Pratt and Whitney engines of type 307A, thrust rated 6405 lbs at sea level, up to ISA+18.4°C. These engines are controlled by a FADEC, and air-started.

The fuel system is comprised of three tank grouping, each supplying fuel to its respective engine. The system is designed to provide:

- Fast fuelling capability,
- Automated fuel management,
- Precise fuel gauging,
- Maximum transfer capability in abnormal conditions.

The engines, APU, baggage compartment, and rear compartment are protected against fire while the main landing gear bay is monitored by a brake overheat sensor against brake overheat.

The primary flight controls are of Fly By Wire (FBW) as described in previous paragraph.

To improve passenger comfort, variable spoilers can be progressively controlled through the airbrake function.

Hydraulic and electrical systems are designed specifically to take into account FBW technology. Therefore, the 7X is fitted with:

- Electrical Ram Air Turbine (RAT) which provides non time-limited electrical power in case of total engine failure,
- Three hydraulic systems.

Main Landing Gear are the trailing link type which improve stability and passengers comfort.

The avionics is based on the EASy concept and incorporate a new Air Data System (ADS) based on four Smart Probes.

Engine bleed air extraction is automatically managed based on the needs of engine start, environmental control and anti-ice systems.

Environmental Control System (ECS) and air distribution systems allow air circulation and automatic regulation of temperature in the cockpit and two parts of the cabin.

The anti-ice system is provided for wings, engines, S-duct and brakes (optional). The wings anti-ice has been designed to give maximum anti-ice protection through the efficient use of bleed air extracting thereby minimizing fuel consumption.

Pressurization system is totally independent from other air systems. Air extraction is electrically regulated by two smart valves in order to maintain a Cabin altitude of 6,000 ft in cruise.

Oxygen system is designed to optimize crew oxygen consumption in normal flight conditions. At any time during a flight, the oxygen system will supply oxygen to all passengers in case of high cabin altitude, or first aid if required by a passenger.

ACRONYMS

ADF	Automatic Direction Finder
ADI	Attitude Director Indicator
AFCS	Automatic Flight Control System
AGM	Advance Graphic Module
AP	AutoPilot
AT	Auto-Throttle
ATA	Air Transport Association
ATC	Air Traffic Control
CAS	Crew Alerting System
CCD	Cursor Control Device
CDI	Course Deviation Indicator
CLC	Check List Controller
CRS	CouRSe
DAU	Data Acquisition Unit
EASy	Enhanced Avionics System
FBW	Fly By Wire
FD	Flight Director
FMA	Flight Management Annunciator
FMS	Flight Management System
FMW	Flight Management Window
FPS	Flight Path Symbol
GP	Guidance Panel
HSI	Horizontal Situation Indicator
I-NAV	Interactive NAVigation
I/O	Input/Output
LH	Left Hand
MAU	Modular Avionics Unit
MDU	Multi function Display Unit
MKB	Multi function Key Board
NWS	Nose Wheel Steering
OP	Overhead Panel
PDU	Primary Display Unit
PF	Pilot Flying
PNF	Pilot No Flying
PRB	Permanent Radio Bar
RAT	Ram Air Turbine
RH	Right Hand

RNP	Required Navigation Performance
RP	Reversion Panel
SFD	Secondary Flight Display
TAWS	Traffic Awareness Warning System
TCAS	Traffic Collision Avoidance System
TD	Thrust Director
VHF	Very High Frequency
VOR	Very high frequency Omni Range
WPT LIST	WayPoinT LIST

The Falcon 7X cockpit, mainly based on EASy (Enhanced Avionics System) cockpit, was developed to ensure the maximum level of safety and comfort, during Normal and Abnormal / Emergency situations, for performing:

- Piloting actions,
- Communication,
- Navigation,
- System monitoring and control,
- Emergency / Abnormal situations management.

Utilization of controls and indications of the flight deck in accordance with Dassault recommended operational methodology provided in CODDE 2 will guaranty the maximum efficiency of the crew actions in terms of safety and operational capabilities.

FLIGHT DECK OVERVIEW

CONTROLS

Controls dedicated to piloting actions:
- Main controls are the sidesticks and rudder pedals,
- On ground, Nose Wheel Steering (NWS) control can be performed by either pilot through the rudder pedals,
- Slats, flaps and airbrake controls as well as manual trims are located on the pedestal,
- Power management is performed with power levers located between both pilots.

Systems' control is performed via the overhead panel pushbuttons, accessible by both pilots, and through specific controls for Ram Air Turbine (RAT) manual extension, landing gear, and oxygen system.

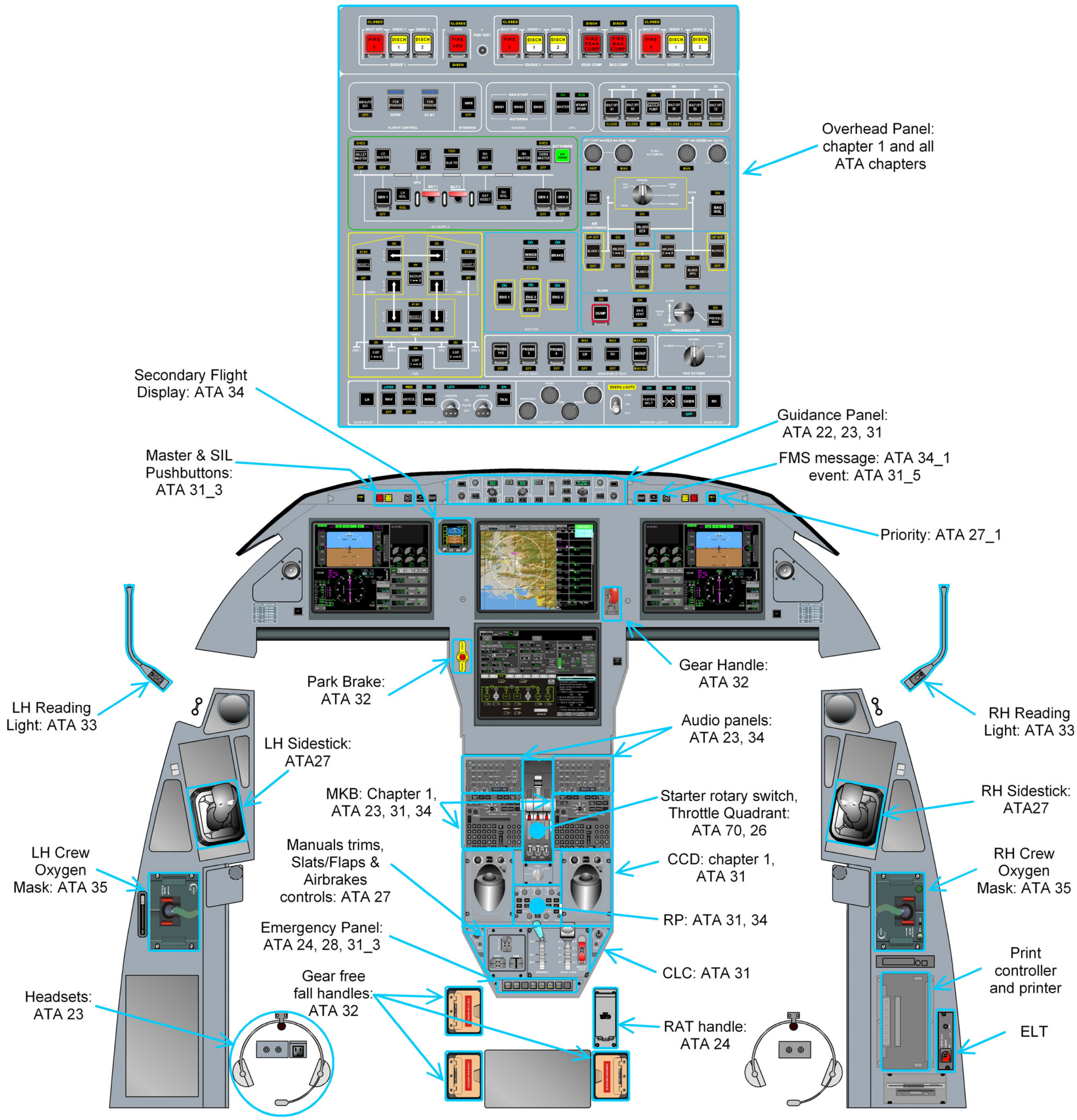
All other functions: communication, navigation, system's monitoring and part of Emergency/Abnormal situations management are performed through the EASy system.

To manage the EASy system, only few controls are used. These controls are fitted in front of each station, and on the pedestal. Both crew members have access to all functions, which allow the Pilot Flying (PF) and Pilot Non Flying (PNF) functions to be handled by either of the two pilots (repartition of tasks between PF and PNF is described in CODDE 2).

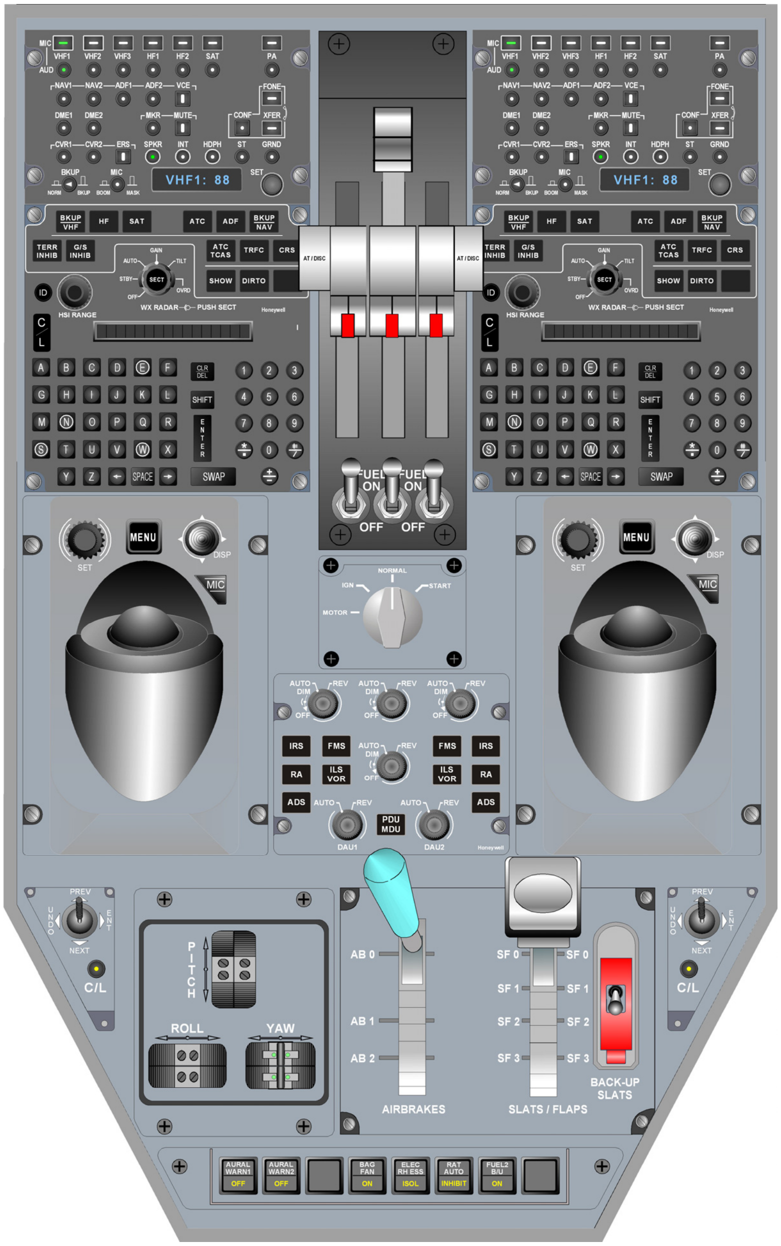
Some controls are dedicated to specific functions while other functions are accessed through a graphical interface:
- On the flight deck, only functions that require a frequent action, a direct independent access, or that would need to interrupt another task are given dedicated controls (AutoPilot, Auto-Throttle, AP/AT management, VHF tuning, weather radar management, Check List management,…),
- Others functions that do not need quick access are managed through a graphical user interface: a trackball on the pedestal, called the Cursor Control Device (CCD), is the main control to set and select functions through the display units.

The specific EASy controls are:
- Two Cursor Control Devices (CCD) which drive a cursor and provide pushbuttons and a knob for acting directly on the displays,
- Two Check List Controllers (CLC) which drives the cursor through the Electronic Check List,
- Two Multi-function Key Boards (MKB) which provide alphanumeric keyboard and dedicated controls for flight management, TAWS, and weather radar as well as functions shortcuts,
- One Reversion Panel (RP) which gathers all reversion controls and displays dimming knobs,
- One Guidance Panel (GP) which comprises all the controls dedicated to the Automatic Flight Control System (AFCS) and the VHF quick tuning knob,
- Three AUDIO panels which gather all communication and audio selection for each crew members,
- Controls dedicated to the Secondary Flight Display (SFD), which are located on the Secondary Flight Display unit.

The following figure shows the cockpit controls, as well as the ATA chapters in which the controls description can be found.



FLIGHT DECK OVERVIEW - CONTROLS


VHF1: 88
MENU
MIC
SET
DISP
NORMAL
IGN
START
MOTOR
IRS
FMS
RA
ILS VOR
ADS
PDU MDU
DAU1
DAU2
PITCH
ROLL
YAW
AB 0
AB 1
AB 2
SF 0
SF 1
SF 2
SF 3
AIRBRAKES
SLATS / FLAPS
BACK-UP SLATS
C/L
PREV
NEXT
OFF

PEDESTAL

DISPLAYS

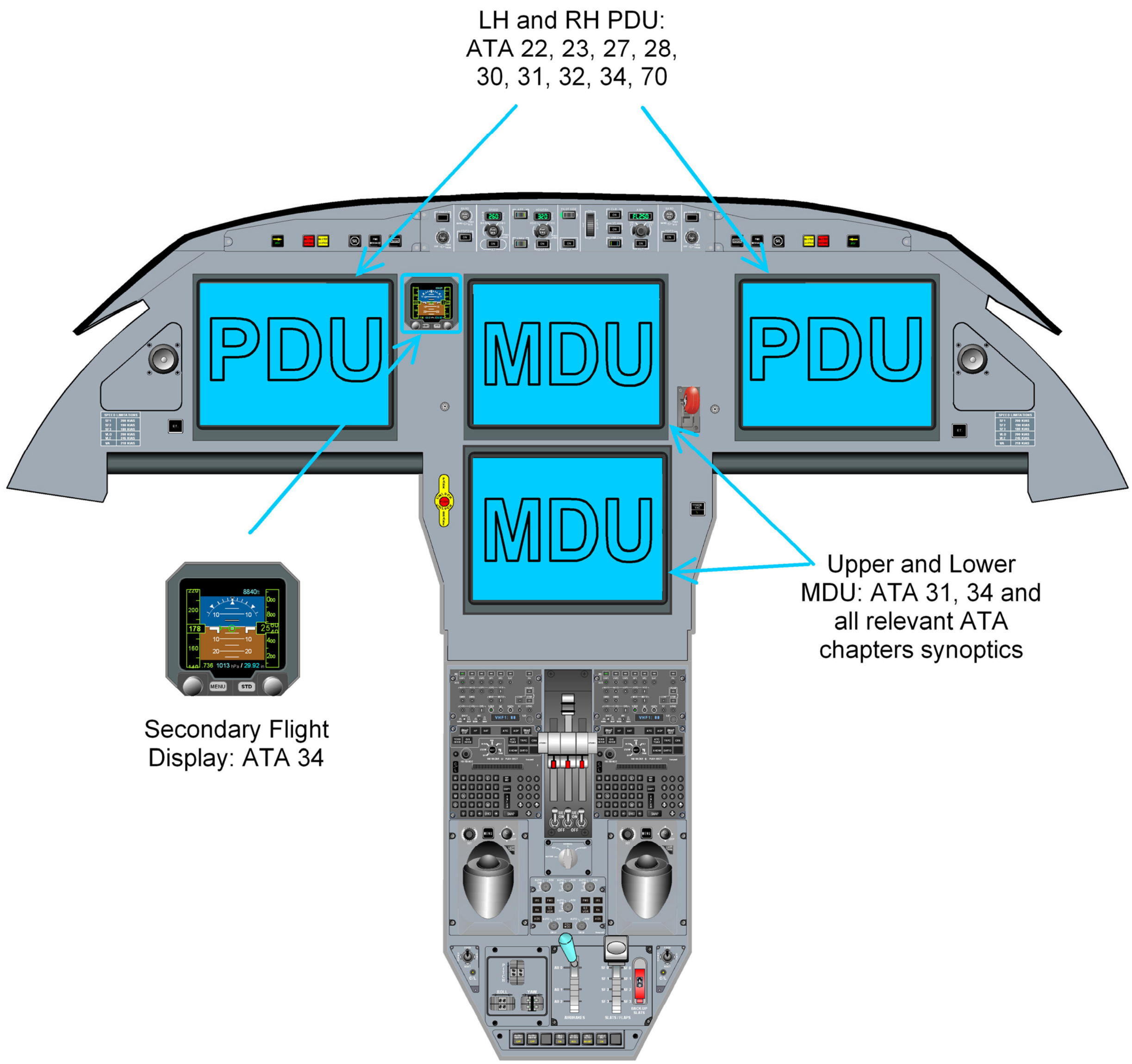
All flight information such as communication, navigation, or flight management, as well as system status or Electronic CheckList are displayed into four 14.1 inches digital display units:

- Two Primary Display Units (PDU) (external displays), which provide:
  - All necessary information for piloting (Flight Path, Air data, Heading),
  - Primary navigation information (VOR, DME, ILS Glideslope/localizer, radio…),
  - Primary aircraft systems parameters (engines parameters, trims…)
  - The CAS messages window
- Two Multifunction Display Units (MDU) (central displays), which provide:
  - Navigation data,
  - System synoptics providing systems and Circuit Breaker status.

Because different types of information are needed depending on the flight phase or operating conditions, the system is characterized by a great versatility and can be modulated at will. All the functions can be accessed by using a cursor, just like on a computer.

Essential flight information is also provided in a SFD, in case of failure of PDU.

The following figure shows the different cockpit displays, as well as the ATA chapters in which their description can be found.



FLIGHT DECK OVERVIEW – DISPLAYS

The Falcon 7X flight deck was designed considering the following design principles:

- With regard to technology:
  - Sidesticks have been selected with the Fly By Wire (FBW) system, in a technology well proven on other airplanes,
  - For slats/ flaps/ airbrakes and manual trim controls, interface used on previous Falcons is implemented on the 7X,
  - EASy interface, which was implemented on previous Falcons has demonstrated to be efficient from a man machine Interface point of view, and therefore implemented on the 7X.
- With regard to installation in the cockpit:
  - All controls are accessible by both crew members which permits the Pilot Flying – Pilot Non Flying functions to be handled on the RH or LH side,
  - Control position is homogeneous with indications layout in the displays,
  - Types and position of controls were selected to ensure comfort while using the different controls and maximise space available for the crew.
- With regard to design:
  - Generic rules (color coding, labeling, organization of vertical versus horizontal data, etc..) were applied consistently through the cockpit to ensure a rapid familiarization by the crews with the cockpit, and clear situational awareness.
- With regard to architecture:
  - Sufficient redundancy in piloting controls and EASy avionics components to be resistant to failure, even in case of dispatch.

As a summary, the Falcon 7X flight deck was designed around three fundamental principles:

- Safety in all operations,
- System availability,
- Crew comfort.

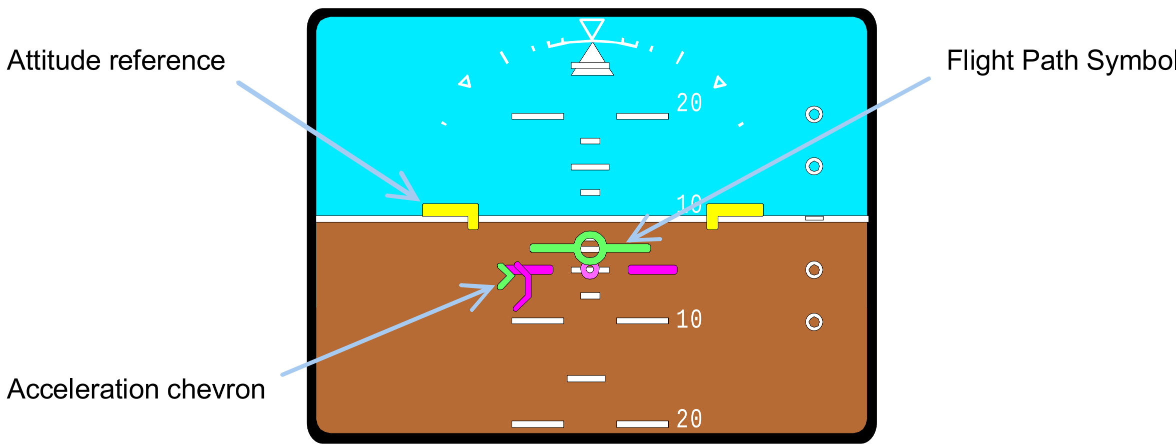
SAFETY IN ALL OPERATIONS

AIRPLANE TRAJECTORY AND ENERGY STATE AWARENESS

“Where is the airplane exactly going? What performance can be achieved with current engine power and airplane configuration?"

The EASy Attitude Director Indicator (ADI) provides in a very accurate and HUD-like picture, all necessary information about airplane trajectory and energy state:

- The Flight Path Symbol (FPS):
  - Provides airplane trajectory indication,
  - Is now a primary flight parameter. The basic Flight Director (FD) mode is the PATH mode, instead of pitch on classical Falcons,
- The acceleration chevron provides the potential acceleration along airplane flight path,
- The attitude reference symbol:
  - Gives airplane attitude (pitch and roll),
  - Is still displayed in the ADI, but is no longer considered basic information to fly the airplane.



ATTITUDE DIRECTOR INDICATOR

Just below the ADI, the Horizontal Situation Indicator (HSI) provides all the information concerning the horizontal situation and short term navigation information.

Just beside the ADI, a window called ENG-CAS displays the primary engine parameters and CAS messages.

AIRPLANE AUTOMATION AWARENESS

"What are the AutoPilot and Auto-Throttle doing now? What will they do next? What if?"

The Flight Mode Annunciator (FMA), at the top of the ADI has been designed with a consistent color code. The crew can immediately understand:

- The current or active AutoPilot / Auto-Throttle modes and targets,
- The next or armed AutoPilot / Auto-Throttle modes.

The number of AutoPilot modes has been reduced. Thus, the Guidance Panel has been simplified to provide, with the same layout as the FMA, a clear picture of active modes with a single set of references.

The navigation sources used by the AutoPilot / Auto-Throttle are reduced now to FMS and LOC for precision approaches.

The pending flight plan displayed in the I-NAV and WayPoinT LIST (WPT LIST) allows the crew to identify the repercussions of any changes in the flight plan activation.

AIRPLANE POSITION AWARENESS

"Where is the airplane, relative to the flight plan, surrounding terrain, airplane, airports, airways, and restricted airspace?"

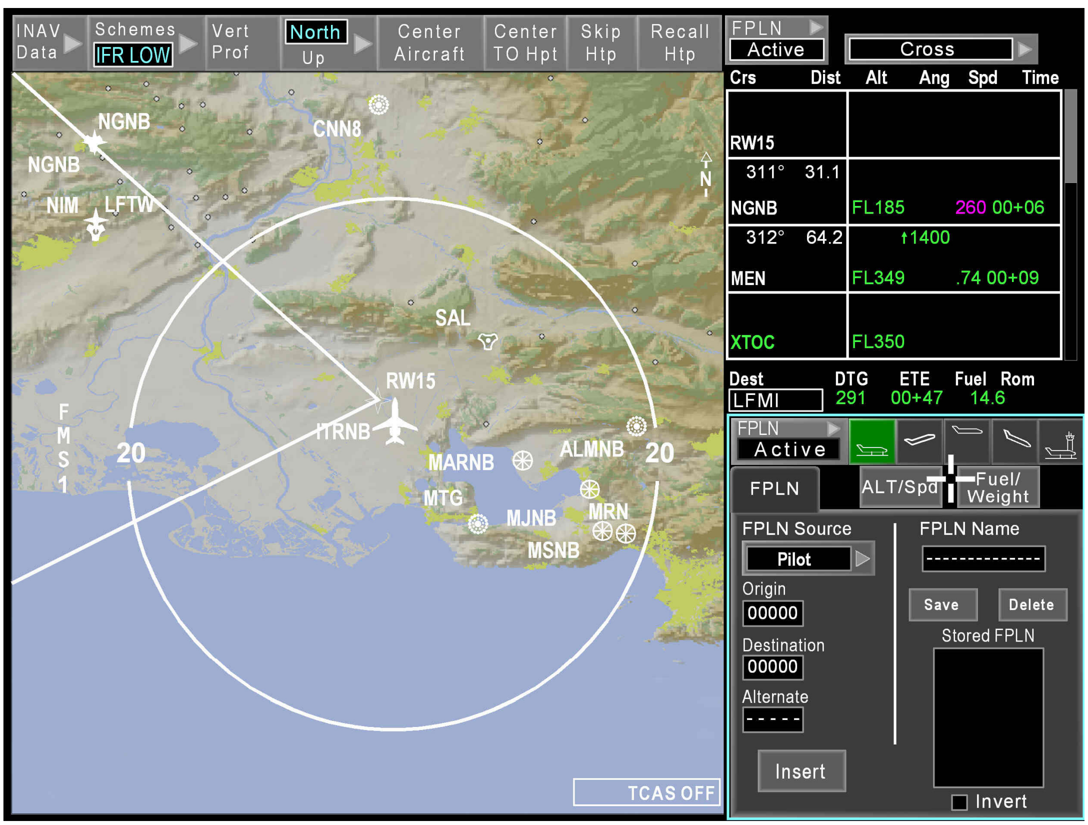
The I-NAV map display provides a horizontal display of the terrain by merging, at pilot request, information which is:

- Gathered by on-board sensors (traffic, weather, terrain threat),
- Retrieved from airplane worldwide data bases for aeronautical data, terrain and main geopolitical elements.

This moving map provides a full interactivity to the crew:

- For direct flight plan modification on the map (using the trackball and the cursor),
- For displaying Vertical Situation Display (VSD),
- For faster and more intuitive access to data base information.

The crew has full authority to manage the size (up a full screen size), orientation, content and location of the I-NAV maps in the flight deck.



I-NAV

AIRPLANE SYSTEMS CONTROL AND AWARENESS

The Overhead Panel (OP) gathers in a single area the controls to manage most airplane systems.

The Crew Alerting System (CAS) is permanently displayed in front of both crew members.

It is the sole means for indicating all system malfunctions and system messages. The wording of each failure message conveys the maximum of information about the nature of the failure.

Any message that does not require a pilot action in flight is not presented.

The SYNOPTICS window provides a clear and concise illustrated view of the status for each airplane system synoptic. The system is represented graphically with most elements that can be controlled by the crew, and uses a consistent color code to provide an instantaneous awareness of the system status.

The STATUS page of the system window represents the status of the airplane, by displaying current limitations associated with the failures displayed in the CAS.

IMPROVING CREW RESOURCE MANAGEMENT

The flight deck has been designed to provide in its center part a common work area for both crew members. Starting from the top to the bottom:

- The Overhead Panel (OP) gives access to most airplane systems,
- The Guidance Panel (GP) provides Flight Director (FD), AutoPilot, Thrust Director (TD) and Auto Throttle status, as well as the active modes and their targets,
- The two central displays, called Multifunction Display Units (MDU), provide all necessary information to allow the crew to make his decisions,
- The pedestal provides all controls to manage the flight.

In case of a display failure, the windowing helps the crew to reconfigure displays with adequate information.

MINIMIZING THE CREW WORKLOAD

The crew workload is reduced by simplifying the way the system is operated:

- The Electronic Check List (ECL) integrates all normal/abnormal/emergency checklists. It can be entirely and easily managed using its dedicated controller (Check List Controller),
- The Flight Management system Window (FMW)
  - Provides the most common FMS tasks in only five simple graphical pages.
  - Each page is dedicated to a flight phase and prompts the pilot along all flight management tasks that must be accomplished for this phase of flight: trajectory, performances and airplane configuration,
- Basic flight plan modification (Direct To, …) or even complex route modification can intuitively be achieved “head-level” on the displays, graphically and directly on the I-NAV map or the WayPoinT LIST just by pointing and clicking:
  - By clicking on an object, the pilot has access to all available functions for that object,
  - Complex tasks such as defining a holding pattern are made easy, by presenting in real time a drawing of the corresponding pattern based on pilot inputs,
- The SENSORS window gathers in a single window all controls and information about on-board sensors. The primary page provides graphical position uncertainty compared to Required Navigation Performance (RNP), secondary pages provide detailed information for each sensors. They are used only if the RNP cannot be maintained or if there are sensor malfunctions.

Due to the windowing architecture and the design of each window, loss of one or two displays does not result in loss of functionality and more importantly does not change the place where the information is displayed.

Windows that were previously displayed in an extended format are then available in their basic reduced format without changing their layout and content.

MINIMIZING THE LIKELIHOOD OF CREW ERROR

The likelihood of crew errors is reduced by adopting the following solutions:

- Controls have been simplified and gathered in a more logical way especially when they induce effects on trajectory,
- The loss of one or two displays does not affect the way the system is operated, and where the crew can find the information,
- Standardization of flight deck eases transition within FALCON family.

AVAILABILITY

The new solutions adopted to achieve maximum availability are:

- Integrate airplane systems and engine maintenance in the avionics system,
- Make the maintenance more understandable to the crew by supplying precise instructions and a clear language,
- Offer the possibility to dispatch, most of the time, with one module or piece of equipment failed.

PILOT COMFORT

The solutions retained to provide maximum pilot comfort are:

- Use of lateral sidesticks
- Gather controls in front (Guidance Panel) or beside pilots (pedestal and Overhead Panel) and avoid controls not in direct field of view of the crew,
- Improve access to the seats due to a shorter pedestal.

INTRODUCTION TO MULTISYSTEM CONTROLS

This paragraph provides a general description of flight deck controls related to the systems:

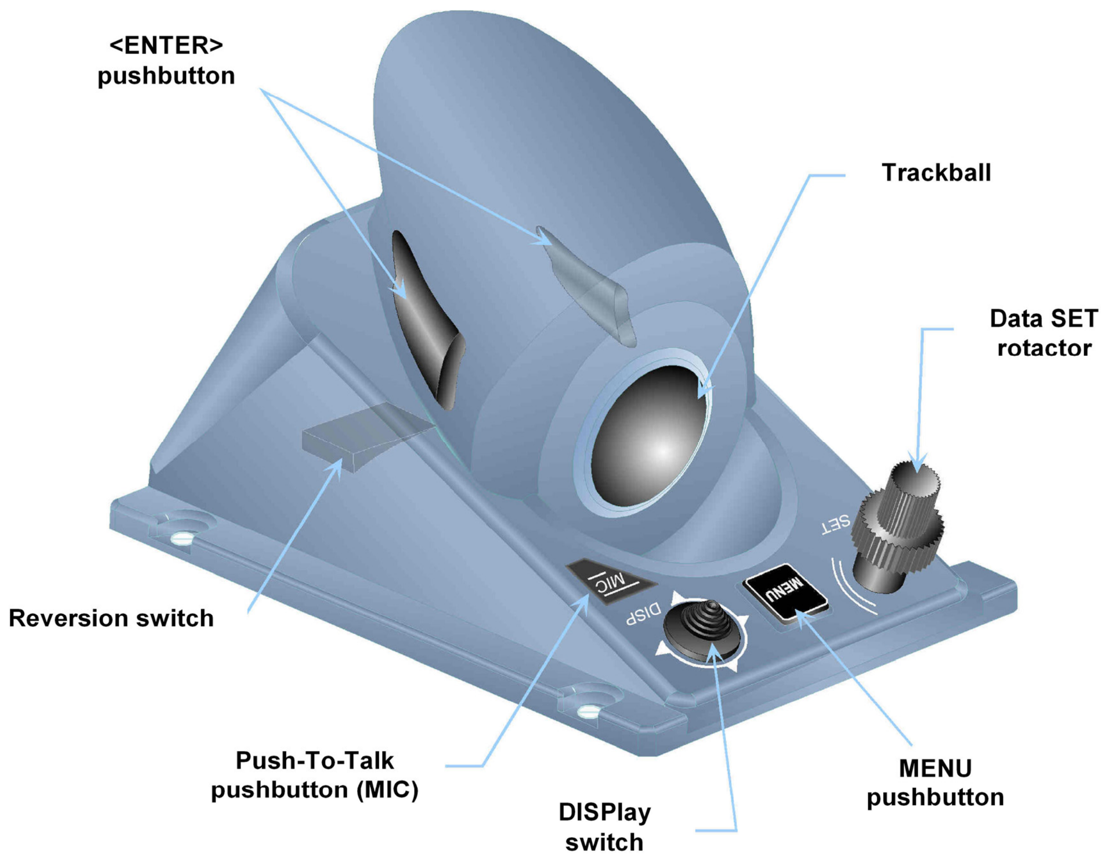
- Two Cursor Control Devices (CCD) which drive a cursor and permit to access to all functions available in the displays,
- Two Multifunction Key Boards (MKB) to enter data and access through short cuts to certain functions available in the displays,
- One Reversion Panel (RP) dedicated to display dimming and reversions, as well as sensors and FMS reversions,
- The Guidance Panel (GP) which gathers controls for the Automatic Flight Control System as well as short cuts for the VHF and baro correction setting knobs,
- The Overhead Panel (OP) which gathers most systems' controls

CURSOR CONTROL DEVICE

The Cursor Control Device (CCD) is the pilot primary interface. It is the virtual finger of the crew members on the displays to access to all functions available in the displays.

The CCD has been designed to provide the most comfortable and the most accurate pointing device, regardless of the flight conditions:

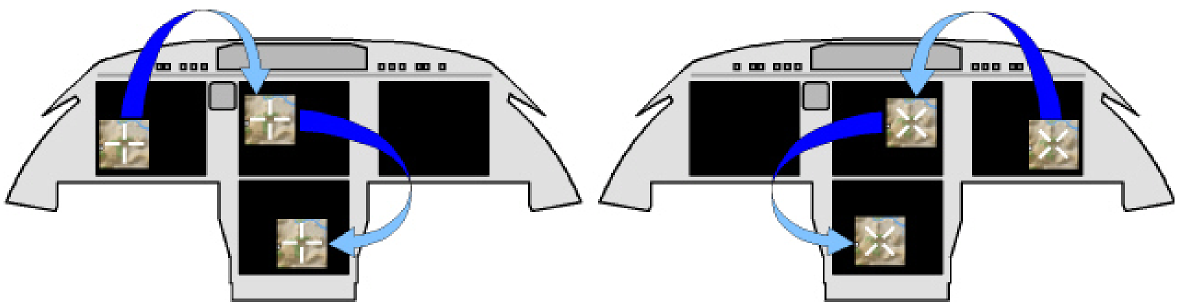
- It is a one-hand operated device. Moving the ball only requires finger movement while the palm comfortably lays on the palm-rest,
- Due to the ergonomically modified armrest and the location of the CCD on the pedestal, operating the CCD is natural and comfortable,
- The tilted palm-rest allows a good grip on the CCD, and allows good operation, accuracy and comfort even in turbulent conditions,
- Friction avoids any cursor movement in case of vibration or unintentional action,
- Identical CCD are installed on both sides.



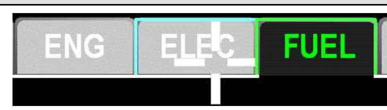
CCD CONTROLS

The main function of the CCD is to move the cursor through the various display units and through the different windows of a given display unit, in order to select/modify a page or an item.

However, a crew member will not be able to move his/her cursor on the PDU of the other crew member.



MOVING THE CURSOR THROUGH THE DISPLAYS

FUNCTIONS PERFORMED WITH THE CCD	EXAMPLE
Selection of a tab	
Selection in a pull down menu	
Data entry	

EXAMPLE OF FUNCTIONS OF THE CCD

MULTIFUNCTION KEYBOARD

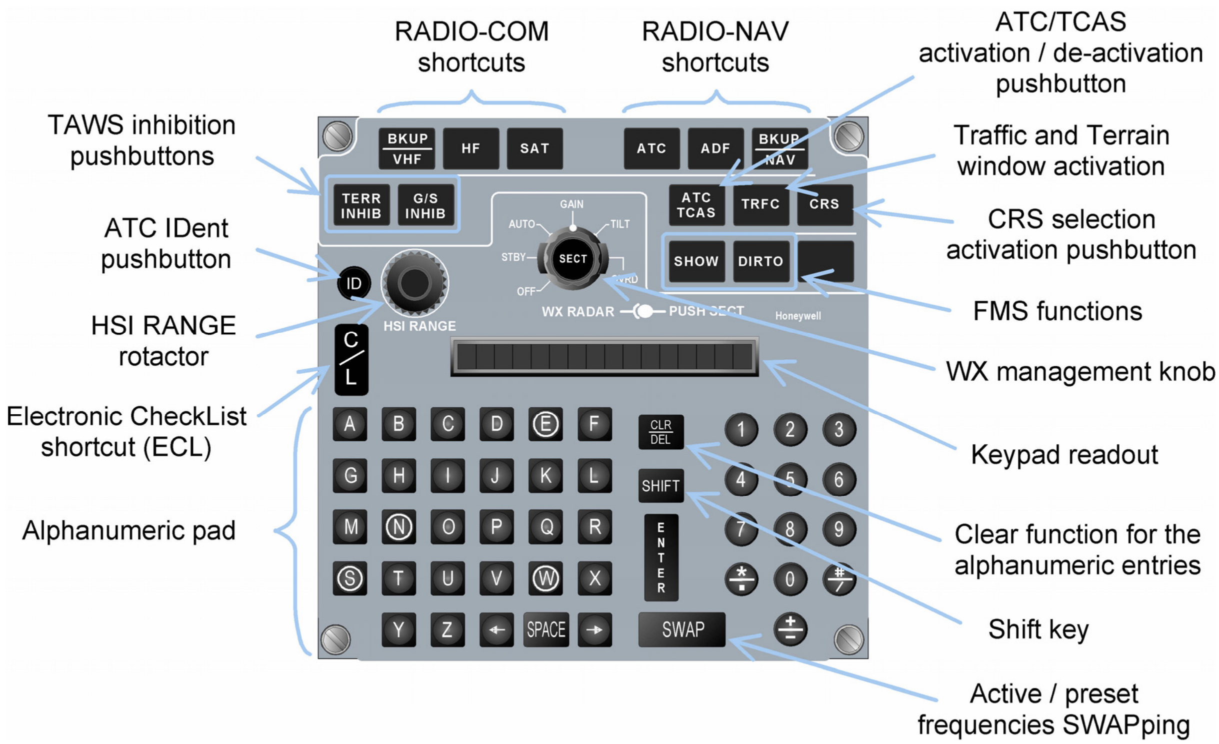
INTRODUCTION

The Multi-function Key Board (MKB) is a single interface, providing alphabetic and numeric entries available on the flight deck. It is no longer dedicated only to FMS. It gathers shortcuts to frequently used windows, and thus gives the pilot a fast access to many functions.

DESCRIPTION

The MKB integrates:

- An alphanumeric pad which provides characters and numbers input into the system,
- A digital keypad readout window, which provides instant feedback of what the pilot is typing on the keyboard (16 digits),
- Fast-access shortcuts, instantaneously moving the CCD cursor to the corresponding page in the displays,
  - Radio-communication: VHF, HF and SATCOM setting,
  - Radio-navigation: ATC code, ADF and NAV tuning,
- Functions activation and de-activation pushbuttons:
  - CRS activates the VOR/LOC Course Direction Indicator (CDI) and moves the cursor to the CRS entry location,
  - FMS SHOW and DIRECT TO functions,
  - ATC/TCAS operating mode activation,
  - Traffic and Terrain window pop-up,
  - Inhibition of the TERR and G/S modes alerts of the terrain awareness system,
  - Electronic CheckList,
- WX RADAR knob, gathering all primary functions to manage weather radar,
- Dedicated HSI range knob, which allows each crew members to adjust independently his/her on-side HSI range when in ARC format and when the WX is selected,
- A SWAP pushbutton, for switching between active and preset frequencies of the radios,
- An IDENT pushbutton for the TCAS.



MKB (MULTIFUNCTION KEYBOARD) CONTROLS

REVERSION PANEL

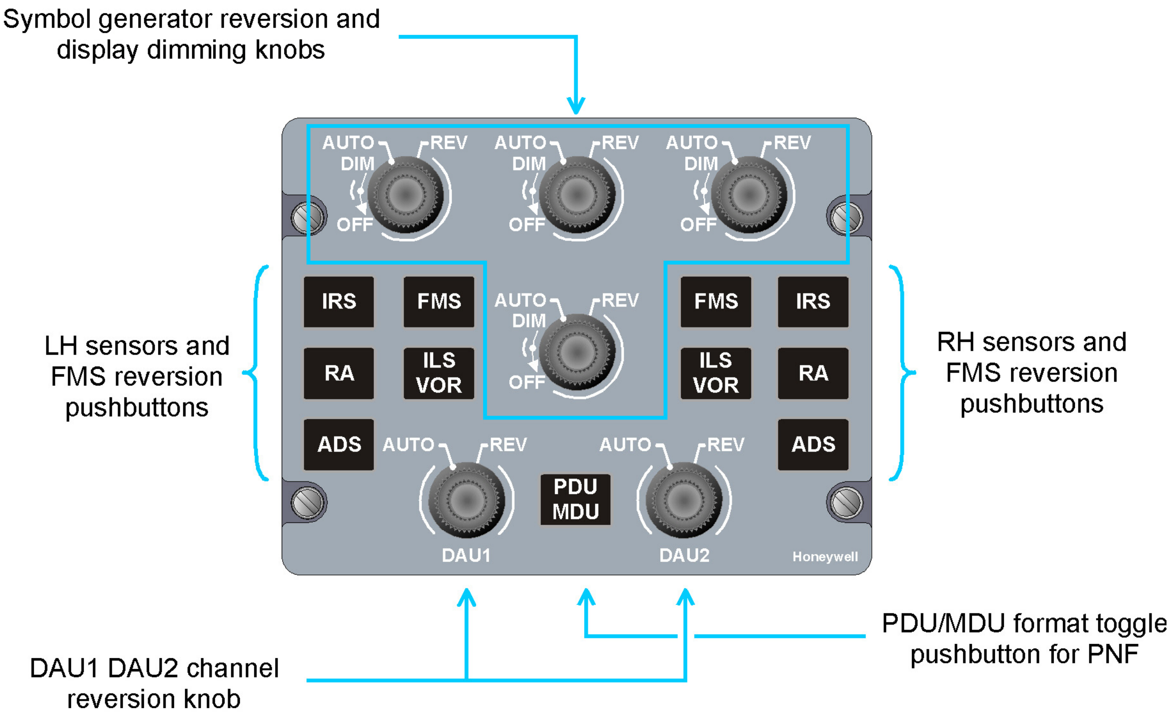
INTRODUCTION

The Reversion Panel (RP) is located in the middle of the pedestal, behind the throttles. It gathers in one place the reversion controls for avionics, for both crew members.

DESCRIPTION

The RP houses:

- Four concentric dual knobs corresponding to each display:
  - The inner knob controls the display dimming,
  - The outer knob controls the Advance Graphic Module (AGM, symbol generator) reversion,
- Two knobs for the Data Acquisition Unit (DAU) channel reversion, (the DAU corresponds to generic I/O modules within the MAU),
- One MDU PDU pushbutton (to be used only in a two-display configuration failure),
- 2 x 5 pushbuttons dedicated to the sensors and FMS reversions (LH and RH).



REVERSION PANEL CONTROLS

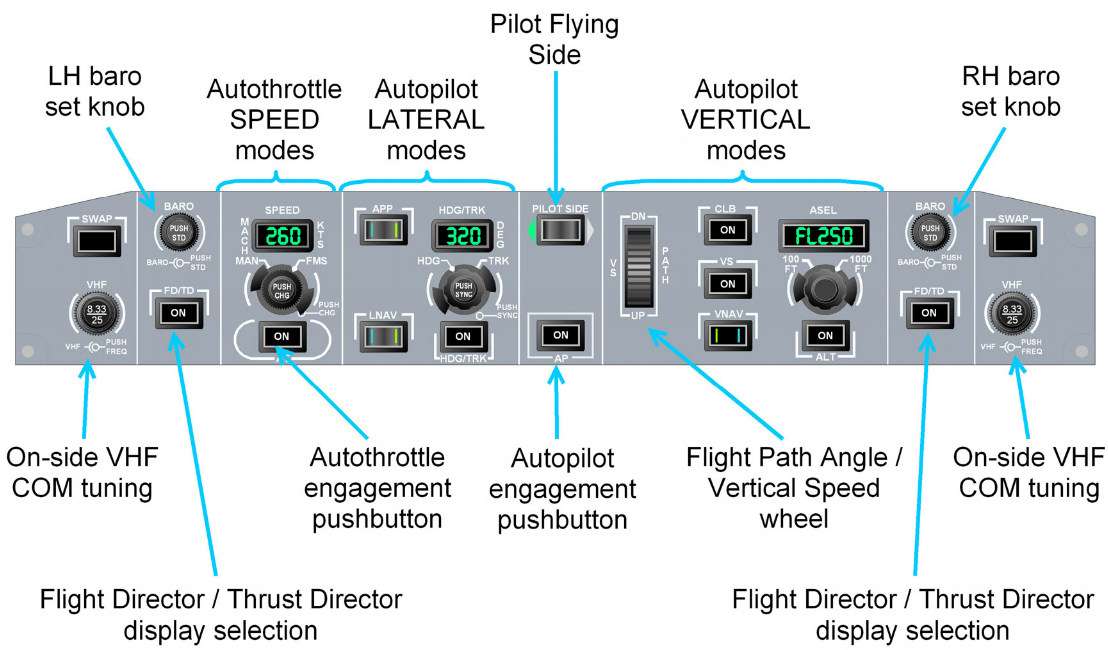
➢

GUIDANCE PANEL

The Guidance Panel (GP) gathers in one place accessible from both pilots:

- The center of the GP:
  - o Control and indications for Automatic Flight Control System,
  - o AutoPilot modes are layed out in the same order as the FMA or the ADI:
    - Lateral Modes on the left,
    - Vertical Modes on the right
- On each side of the Guidance Panel:
  - o Baro correction setting knobs for each PDU,
  - o A fast access to the on-side VHF COM tuning in the Permanent Radio Bar (PRB) of each PDU.

The GP comprises the following functions:



GUIDANCE PANEL

OVERHEAD PANEL

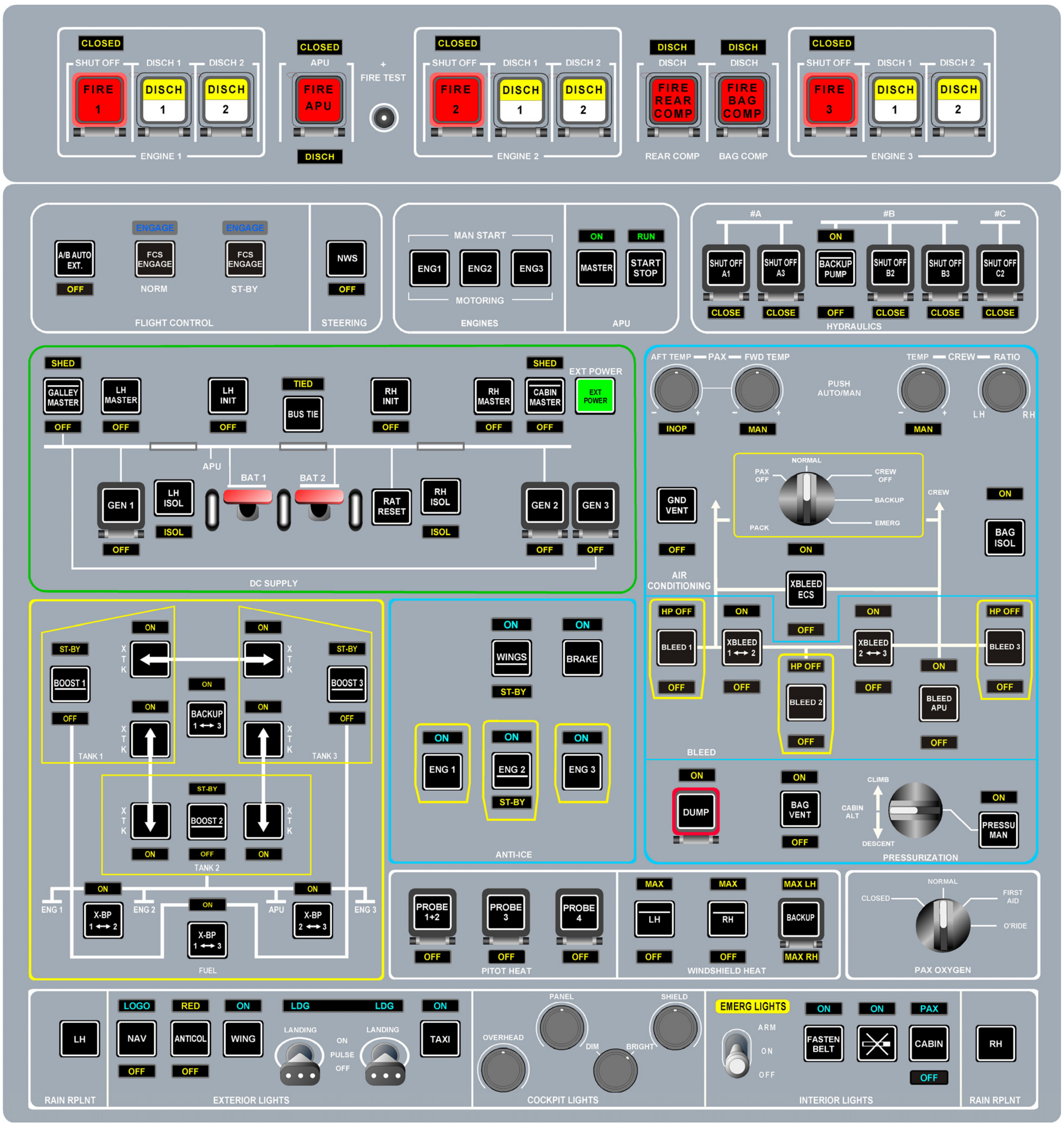
GENERAL

The Overhead Panel (OP) gathers in a single area the controls to manage most airplane systems and provides a direct pilot action feedback on those controls.

This panel features flush technology pushbutton with electronics logic (to drive relay) and LED based lighting.

The electronic technology allows:

- Automatic configuration of all Overhead Panel controls at airplane power-up (auto set up) whatever the last system state before shutdown,
- Implementation of automation for some features: automatic activation of probe heat at take-off, automatic activation of booster pump at engine start…The crew can override these automatic functions, if necessary.



PRINCIPLES

Overhead Panel Layout

Layout of the Overhead Panel is such that:

- Systems are separated by colored lines
- For the electrical, fuel and bleed air systems, controls layout on the overhead panel is similar to the layout of the synoptic of the system.

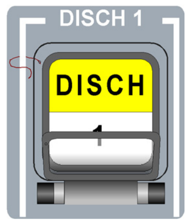
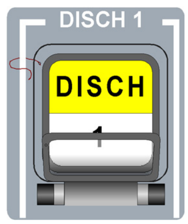
Dark cockpit philosophy and Overhead Panel color code

Main principle applicable to the Overhead Panel is the DARK COCKPIT philosophy: in normal in-flight operation, the overhead panel is black. Nevertheless, for a few systems a permanent blue status indication will be displayed for temporary use of the systems.

During normal operation of the systems, the color code will be the following:

	EXAMPLE	TYPE OF SITUATION	TYPE OF INDICATION
Green switch (Ground only)	External Power (GPU) On: EXT POWER / EXT POWER Off: EXT POWER / EXT POWER	Normal use on ground (GPU only)	System feedback
Green Indicator (Ground only)	APU RUN ON	Normal use on ground (APU only)	System feedback
Blue Indicator	Anti ice ON Landing lights LDG	Temporary use of a system	Pilot Command feedback (system feedback is provided in the synoptic only)
White Indicator (dedicated to electrical system)	Between Main and Essential bus on each side	Essential and Main buses on each side are tied	System feedback

During abnormal situations, the color code will be the following:

	EXAMPLE	TYPE OF SITUATION	TYPE OF INDICATION
Red Switch (Fire protection only)		Fire Detected	System Feedback
Amber Switch (Only for DISCH switch for Fire protection)		Indicates that the extinguisher was discharged following pilots command	System feedback
White Switch (Only for DISCH switch for Fire Protection)		Indicates that the extinguisher is available after the crew has acknowledged a fire on the Fire Control Panel	System feedback
Amber Indicator	Fuel Booster pumps, Nose Wheel Steering OFF Bag Vent, XBLEED ON	Abnormal configuration of a system	Pilot command Feedback (system feedback is provided in the synoptic only) Exception: "OFF" for Electrical generator provides system feedback
White Indicator (dedicated to electrical system)	Between both Essential buses 	Both Essential buses are tied	System feedback

Status of indicators

The status of indicators is labeled based on following rules:

- OFF or unlighted off: the pilot has commanded the "disengagement" of the system,
- ON or unlighted on: the pilot has commanded the "engagement" of the system. In most cases, the functioning of the system will contain some automation,
- AUTO or unlighted auto: the pilot sets the system engagement to be automatic when required,
- INOP: command is inoperative,
- STBY: the pilot sets the system to be commanded by a secondary system which has the same functionality as the normal system,
- BACKUP: the pilot sets the system to be commanded by a secondary system which has degraded functionality compared to the normal system.

Position of indicators

Position of indicators is based on following rules:

- OFF indicators are located below the related switch,
- ON indicators are always located above the related switch.

Types of controls

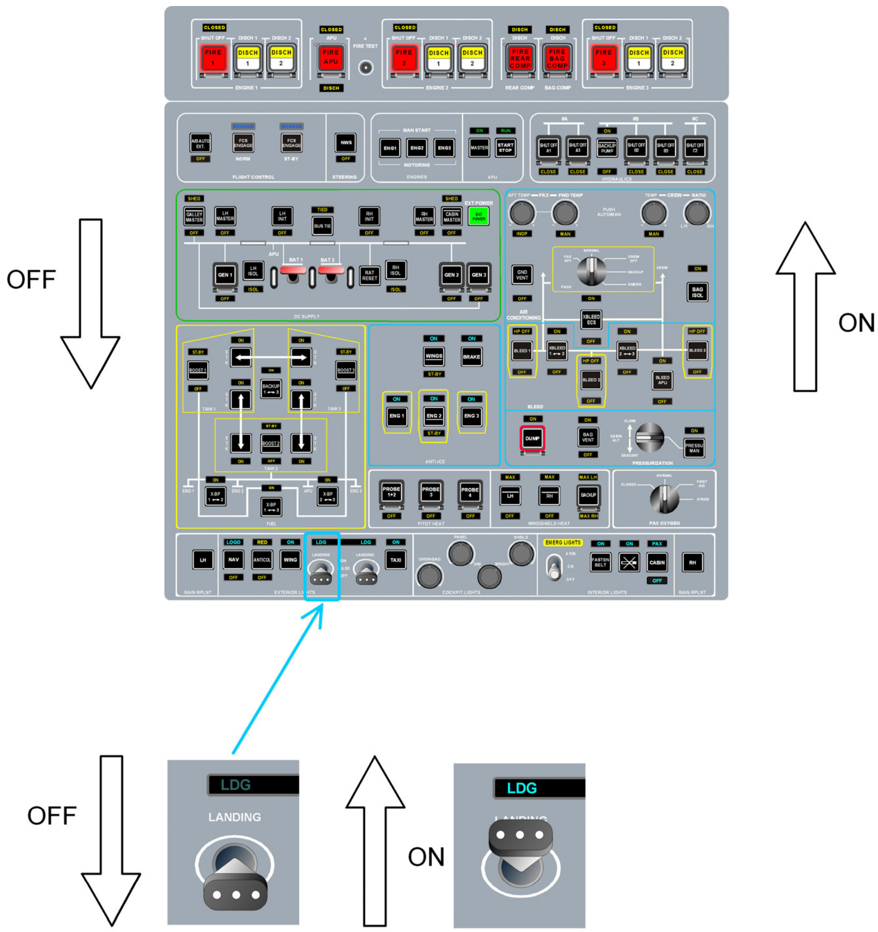
The different types of controls on the Overhead Panel are:

- Two status pushbuttons,
- Three status pushbuttons,
- Three status pushbuttons with long push:
  - The long push allows alternating between two of the three status without any transition to the third status unless the pushbutton is depressed during more than two seconds:
  - This type of pushbutton is used when transition between two modes must be rapid, and/or when one status requires particular attention,
- Some of these pushbuttons can be guarded:
  - This type of switch is used when the use of this switch requires mutual control or could have non reversible effect.
  - Switches related to fire extinction are also safety wired to avoid unwanted discharge of the extinguishers,
- Rotary switches,
- Rotary knob,
- Trip magnetic switch,
- Mechanical switch.

Position of trip or mechanical switches

The on / off position of switches is not written on the Overhead Panel as the convention is the same for all switches:

- Forward to aft (or upward): the switch is off,
- Aft to forward (or downward): the switch is on.



TRIP OR MECHANICAL SWITCH

EXAMPLES OF CONTROLS ON THE OVERHEAD PANEL

Two status pushbutton

- 1st push: 1st status (ON for example),
- 2nd push: 2nd status (Off for example),
- 3rd push: 1st status (ON for example),

ENGINE 1 ANTI-ICE PUSHBUTTON

Three status pushbutton

Different sequences are implemented through “three status pushbuttons”.

- **sequence 1 ⇒ 2 ⇒ 3 ⇒ 2 ⇒ 1 …**
  - 1st push: 1st status (MAX for example),
  - 2nd push: 2nd status (Auto for example),
  - 3rd push: 3rd status (OFF for example),
  - 4th push: 2nd status (Auto for example),
  - 5th push: 1st status (MAX for example), …

LH WINDSHIELD HEATING PUSHBUTTON

- **sequence 1 ⇒ 2 ⇒ 3 ⇒ 1 ⇒ 2 ⇒ 3, …:**
  - 1st push: 1st status (ON for example),
  - 2nd push: 2nd status (OFF for example),
  - 3rd push: 3rd status (Auto for example),
  - 4th push: 1st status (ON for example),
  - 5th push: 2nd status (OFF for example),…

ENGINE 1 BLEED PUSHBUTTON

- **Three status pushbutton with long push**

The pushbuttons with long push are identified with a white horizontal line at the top or the lower part of the title’s button:

The functioning of these pushbuttons is:
- A long push allows to select the display command on the side of the dash,
- A short push allows to select the others display command

Examples of three status Pushbuttons with long push:

Short pushes allow transition between the " unlighted on" status and the "OFF" status

A long push allows to select the "SHED" status

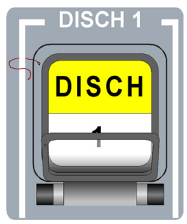
Short pushes allow transition between the " unlighted auto" status and the "ON" status

A long push allows to select the "ST-BY" status

Example of Guarded pushbutton

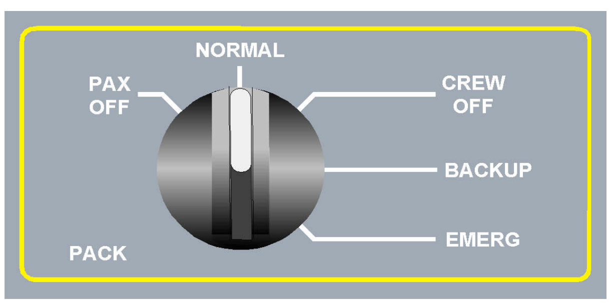
FIRE 1 GUARDED PUSHBUTTON

Example of Safety guarded pushbutton



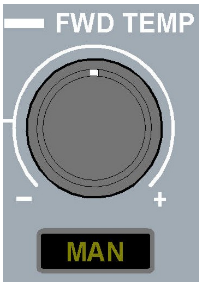
DISCHARGE 1 SAFETY GUARDED PUSHBUTTON

Rotary switch



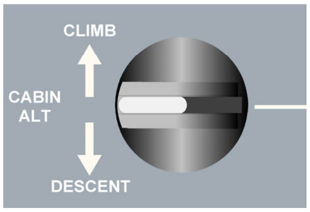
ECS PACK ROTARY SWITCH

Rotary knob



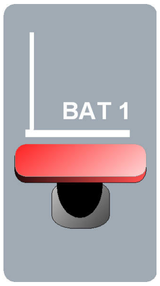
AIR CONDITIONING ROTARY KNOB

Spring knob



PRESSURIZATION SPRING KNOB

Trip magnetic switch



BATTERY 1 TRIP MAGNETIC SWITCH

Mechanical Switch:

LANDING LIGHT SWITCH

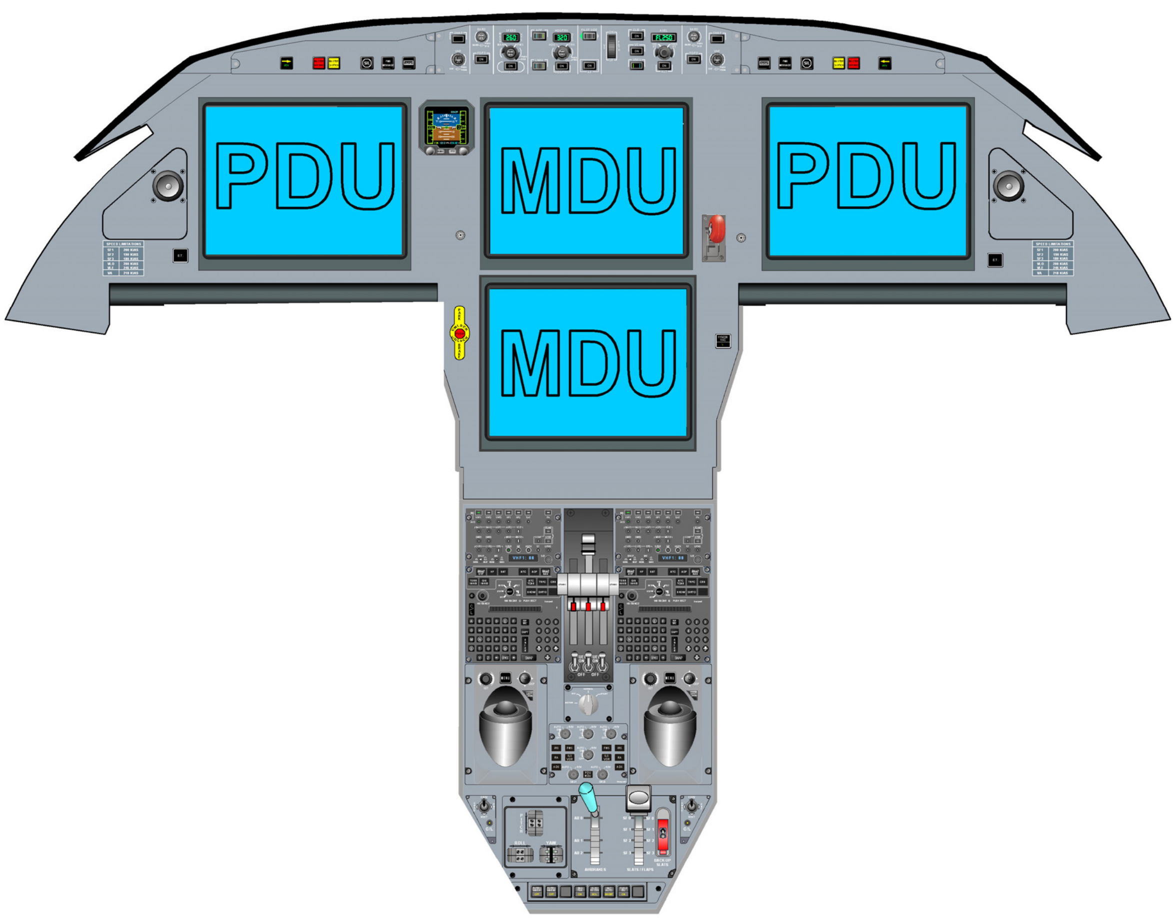
INTRODUCTION TO DISPLAYS

The EASy system is characterized by its versatility. It gathers all the flight and management information into four display units, which can be modulated at will. Depending on the flight phase or on the operating configuration, most areas can be customized by the crew. Additionally, a Secondary Flight Display provides primary information in case of failure of primary displays.

The EASy displays are set on the flight deck as follows:

- Two outboard displays, fitted in front of each pilot station, called PDU (Primary Display Unit). Each screen is a private area: the crew members can manage their PDU independently,
- Two central displays, called MDU (Multifunction Display Unit). These screens are considered shared areas, as both of the crewmembers can access them with their own controls.

➢ *Refer to ATA 31 for detailed description of displays, cursor control and windowing.*



EASY DISPLAYS

PRIMARY DISPLAY UNIT

Each Primary Display Unit (PDU) is fitted in front of each pilot station (LH Primary Display Unit and RH Primary Display Unit) in a normal display units configuration. It basically gathers the indications usually displayed in a classic flight deck such as ADI (Attitude Director Indicator), HSI (Horizontal Situation Indicator).

Each PDU contains therefore:

- An ADI (Attitude Director Indicator),
- An HSI (Horizontal Situation Indicator),
- An ENG-CAS window, comprising permanent engine parameters information and the CAS messages display area,
- A window, which can be filled as desired with:
    - o ENG-TRM,
    - o RADIOS,
    - o SENSORS,
    - o TRAFFIC (TCAS plots and Terrain layer).

In a normal configuration, the ADI, the HSI and the ENG-CAS window are fixed and cannot be changed to another window. The last window can be modulated depending on the number of display units available.

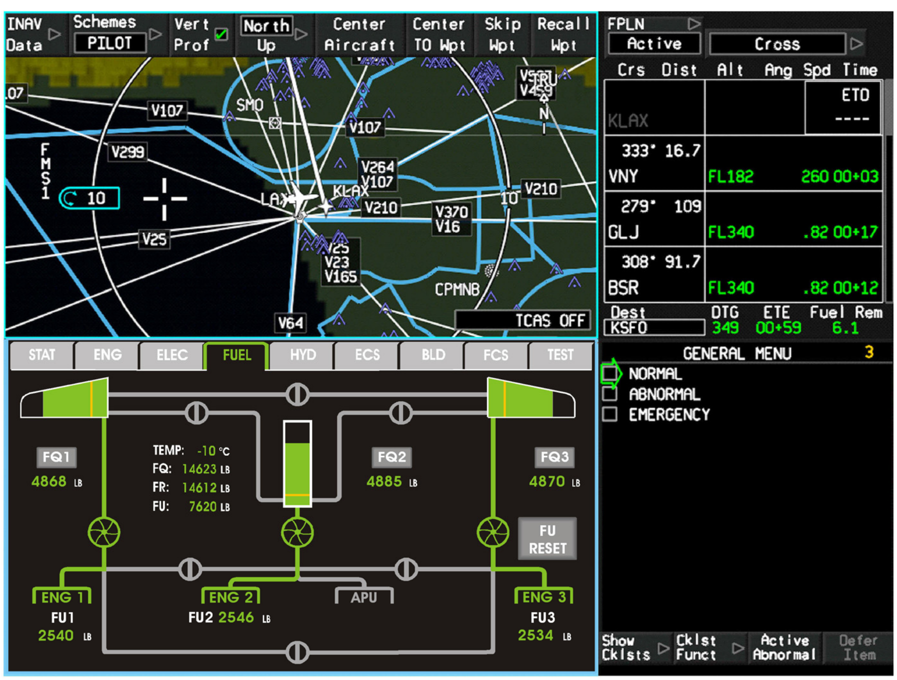
RIGHT HAND PRIMARY DISPLAY UNIT

MULTI FUNCTION DISPLAY UNIT

The Multi Function Display unit (MDU) offers more freedom in the display configuration, as no window is permanent in normal situations.

The available pages are the following:

- An AVIONICS page,
- An I-NAV (Interactive NAVigation) page,
- A WPT LIST (WayPoinT LIST) page,
- A FLIGHT MGMT (flight management) page,
- A SYNOPTICS page, containing the synoptics of all the airplane systems,
- A CHECKLIST (for Electronic Check List) page,
- A CMF (Communication Management Function) page (optional),
- A CHARTS page (optional),
- A VIDEO page (optional)
- A MAINT (MAINTenance) page:
  - o This page is only available when the airplane is on ground, for maintenance purposes.
  - o It can be activated from either the lower or the upper 1/3 windows of each MDU.



LOWER MULTIFUNCTION DISPLAY UNIT

INTRODUCTION TO COLOR CODES

To facilitate the understanding of information in the flight deck interface, a color code has been defined, applicable to:

- Displays, readouts and lighted pushbuttons,
- Labelling and placards when located in the flight deck.

The color code aims at:

- Alerting the crew on abnormal situations with required level of attention and rapidity of action,
- Helping the crew members in their operations, as the color code makes obvious what input is possible or not, and puts forward information in abnormal situation.

The color code can be defined as follows:

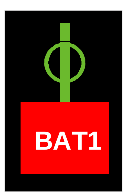
- Color code for Emergency and Abnormal situations. General rules for Emergency and Abnormal situations are provided in the following paragraph. More detailed information can be found in:
  - In CODDE 1 - ATA 31 for the Crew Alerting System,
  - In each relevant CODDE 1 - Chapter 02 - ATA sub-sections for the synoptics.
- Color code for Overhead Panel -provided in CODDE 1 - section 01-15,
- Color code for Automatic Flight Control System (Guidance Panel and FMA) and FMS,
- Color code for other displays.

COLOR CODE FOR EMERGENCY & ABNORMAL SITUATIONS

WARNING ALERTS

RED is associated with short term danger or emergency situation. This includes fire, loss of such basic parameters as attitude, airspeed and altitude loss of guidance cues. Red is also used for some events like AutoPilot disconnection and is relevant to out of normal range conditions.

The following table shows some examples of red indications:

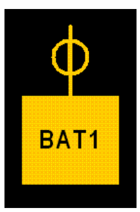
INDICATION	LOCATION	MEANING
	Glareshield	Informs the crew of a MASTER WARNING alert
FIRE: ENG 2	CAS messages area on each PDU	Engine 2 on fire
FD	Attitude Director Indicator (ADI)	Flight Director invalid
	Synoptics window (on MDU)	Battery 1 overheat

WARNING

IN THESE CASES, AN IMMEDIATE CREW ACTION IS REQUIREDSINCE THE PHYSICAL INTEGRITY OF THE AIRPLANE CAN BE JEOPARDIZED IN SHORT TERM.

CAUTION ALERTS

AMBER is associated with abnormal conditions and aims at alerting the crew.
The following table shows some examples of amber indications:

INDICATION	LOCATION	MEANING
	Glareshield	Informs the crew of a MASTER CAUTION alert
FUEL: TK 1 LO LVL	CAS messages area on each PDU	Less than 200 lb of fuel remaining in the tank group 1
TCAS	Attitude Director Indicator (ADI)	TCAS fail indication
	Synoptics window (on MDU)	Battery 1 failure

WARNING

IN THESE CASES, CREW ATTENTION IS REQUIRED EVEN IF NO IMMEDIATE ACTION IS EXPECTED. NEVERTHELESS, FLIGHT CONTINUATION MAY BE COMPROMISED.

WHITE MESSAGES

WHITE MESSAGES are associated with abnormal configuration or condition requiring no crew action.

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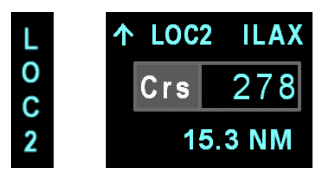
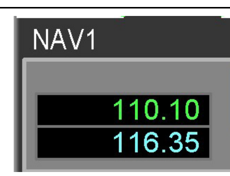
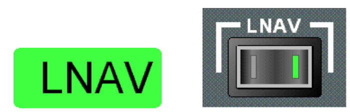
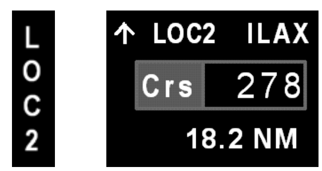
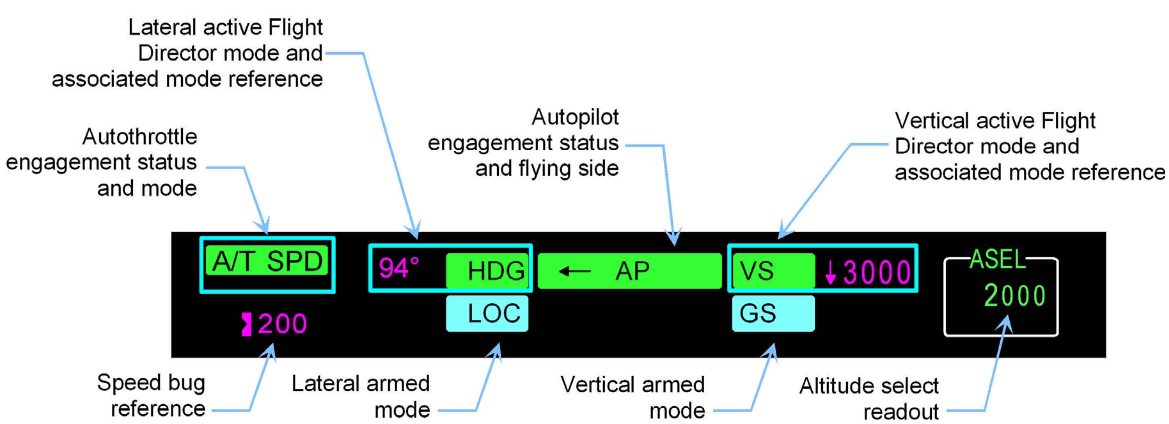
COLOR CODE FOR AFCS AND FMS

A specific color has been defined in order to depict the status of the automated systems:

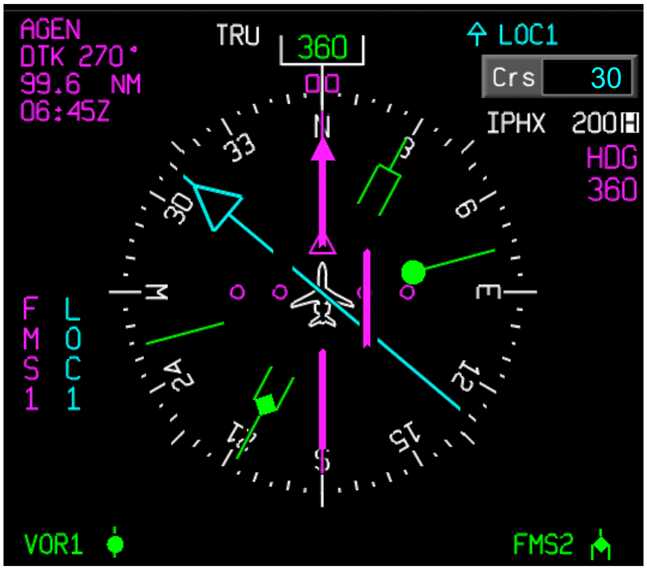
- MAGENTA represents the active target: what the system is aiming for now,
- CYAN corresponds to what is about to happen. As such, it means armed mode, pending modification: what the system will do next,
- WHITE defines an inactive target,
- GREEN defines an active mode or target,

COLOR		TARGET STATUS	MEANING	EXAMPLES
MAGENTA		Active target for FMS or FD	What the system is aiming for NOW	FMS CDI and FMS TO leg on HSI and MDU when LNAV mode engaged: 
CYAN	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 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 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
	Radio setting	Preset radio frequency		

COLOR		TARGET STATUS	MEANING	EXAMPLES
GREEN	On the FMA or Guidance Panel		Active / selected state	Active lateral mode 
	Radio setting		Active radio frequency	
WHITE		Inactive target	Ignored by the active mode	LOC CDI when LOC is neither active nor armed: 



FMA AREA



HSI COLOR CODE

COLOR CODE FOR OTHER INDICATIONS

BACKGROUNDS

Gray

Gray is a neutral background color and is used to show areas or sectors which cannot be acted upon by the crew members, e.g.: labels, units, scales.

In the SYNOPTICS page, gray is used to depict an element which is not active.

Black

Black is the default background color or string color for inverse video. When used as the background color of a parameter, it means that this parameter can be selected or modified by the crew members.

GRAY AND BLACK BACKGROUND COLORS

OTHER COLORS

White

White is a default color. Every other indication or parameter that does not pertain to the color code described before is displayed in white. It is used for all labels on controllers and in windows, as well as for pilot selected inputs or overridden data in order to differentiate them from system data.

WHITE COLOR IN A PAGE

Blue

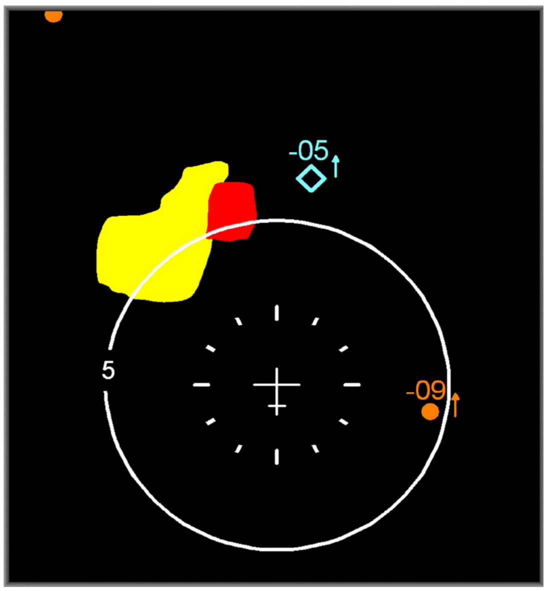
Blue is the control feedback color code after a normal crew selection in the overhead panel. It is also used in the flight plan WPT LIST to highlight the row where the CCD cursor lies.

Brown

Brown depicts the earth in the ADI (as well as on the standby instrument), in the altitude tape and in the I-NAV regular terrain representation.

Yellow

Yellow is used for airplane symbol on the ADI, WX symbology and terrain alerts in the I-NAV and TRAFFIC windows.



YELLOW COLOR FOR TERRAIN ON TRAFFIC WINDOW

ADDITIONAL GRAPHIC FEATURES

The color code does not only include the use of colors but also usage of different backgrounds, different fonts, videos and flashing:

- The fonts of the flight deck can be of three sizes: large, medium and small,
- An inverse video is also available for alphanumeric strings. The definition of an inverse video for a string color is:
  - In normal video, the string is displayed in a color and the background is black,
  - In inverse video, the string is black and the background is displayed in the previous string color: for example, the modes displayed in the Flight Mode Annunciator (FMA) appear in normal video when AutoPilot is off and in inverse video when AP is on,
- Flashing alerts the crew members that an action is required.

INTRODUCTION TO TECHNICAL INFORMATION PAGES

Falcon airplanes fitted with EASy feature primary means of information that had never been used before in corporate aviation. Based on basic flight mechanics principles, all these primary means work toward providing the pilot with direct, immediate, intuitive assessment and control of the airplane trajectory.

Targeting pilots with a large variety of experiences, Dassault Aviation has created Technical Information Pages for educational purpose. Reviewing them allows for pilots to remember the basics of flight mechanics before any initial type-rating training and checking.

In order to emphasize the acquisition of key principles rather than in-depth theory, all schematics, drawings, symbols or equations have been voluntarily simplified. As a result, although they may depict an approximate theoretical situation, they provide pilots with an easy-to-review and an easy-to-remember tool.

The Technical Information Pages section has been organized to support a progressive learning process. Consequently, Dassault Aviation recommends reviewing them in the following sequence:

REVIEW SEQUENCE	AIRPLANE TRAJECTORY
1	Flight Path Symbol - General
2	Flight Path Symbol - Detailed
3	Acceleration Chevron, Trend Vector and Thrust Director
4	Rotation Symbol

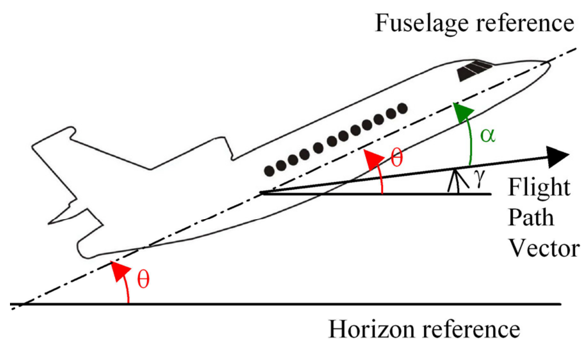
Most given examples correspond to normal situations where pilot inputs cause a progressive and smooth change in flight characteristics, except where otherwise mentioned. Consequently, any deviations to this assumption may result in different interpretation or visualization. Detailed information is provided in CODDE 1 - Chapter 02.

FLIGHT PATH SYMBOL - GENERAL

GENERAL PRINCIPLES

In the vertical plane, 3 angles can have a direct or indirect influence on the flight path of an airplane. These angles characterize the Flight Path Vector, which is the instantaneous actual airplane trajectory:

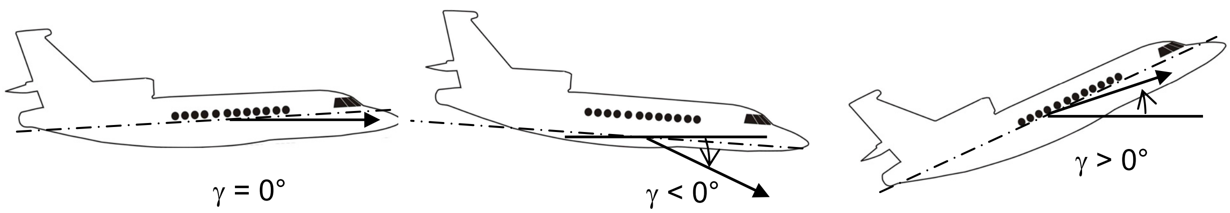
- The pitch angle (θ), angle between the horizon reference and the fuselage reference,
- The path angle (γ) (also called slope), angle between the horizon reference and the airplane flight path vector,
- The angle of attack (α), angle between the airplane flight path vector and the fuselage reference.



GENERAL PRINCIPLES

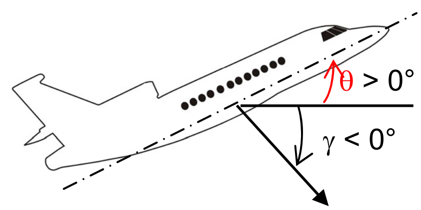
Piloting an airplane consists of controlling its trajectory, in particular in the vertical plane. Usually, the pilot will set a reference pitch attitude and then adjust it by acting on the yoke and / or the engine power, in order to:

- Have the airplane level off,
- Have the airplane descend,
- Have the airplane climb.



AIRPLANE LEVELLING OFF **AIRPLANE DESCENDING** **AIRPLANE CLIMBING**

Flying the pitch angle does not offer the most intuitive mean to control the airplane trajectory, as pitch and flight path angles can be opposite in some flight conditions. For instance, the pitch angle can be positive or equal to zero while the airplane is descending, or worse, stalling.

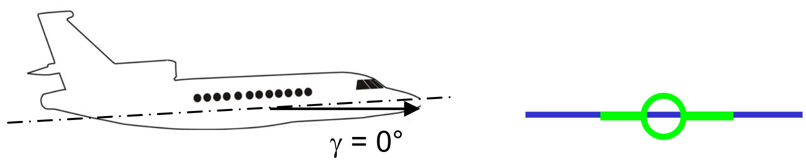


To understand the airplane actual flight path or to maintain a defined slope (ex: descent at a constant – 3° slope), the pilot has to interpret the pitch symbol position on the Attitude Display Indicator (ADI) in relation to other information (airspeed, vertical speed, altitude,...).

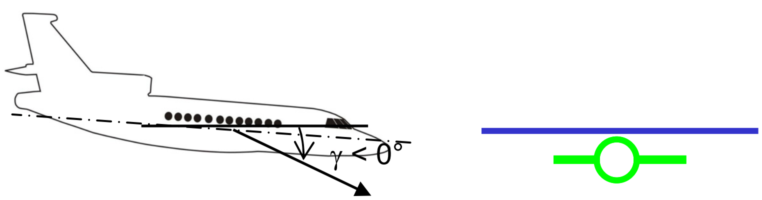
In order to help pilots control accurately or be aware of the airplane trajectory actually flown, Dassault Aviation has decided to provide crews flying EASy Falcons with a direct and intuitive primary mean of control and awareness: the Flight Path Symbol (FPS), displayed on the ADI(s) and the SFD (Secondary Flight Display).

OPERATIONAL BENEFITS

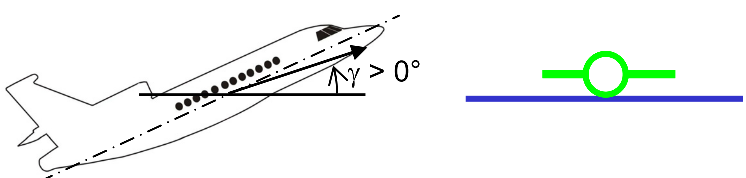
The position of the FPS  with respect to the horizon reference line gives an instant indication of the actual airplane vertical trajectory, as follows:



AIRPLANE LEVELLING OFF



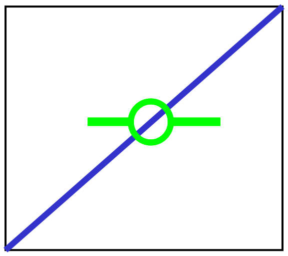
AIRPLANE DESCENDING



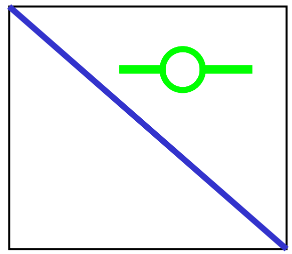
AIRPLANE CLIMBING

In addition to the FPS position, the position of the little "wings" on both sides of the FPS circle with respect to the horizon reference line gives also instant indication of the actual airplane horizontal trajectory and roll attitude, as follows:

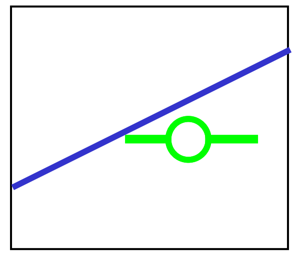
The airplane is performing a right turn at a 45° bank angle and is level



The airplane is performing a left turn at 45° bank angle and is climbing



The airplane is performing a right turn and is descending



CONCLUSION

Using the FPS results in reduced pilot workload and awareness of actual trajectory since the pilot has now the capability of:

- Instantly visualizing and controlling the actual airplane trajectory,
- Managing the airplane flight path in a better and easier way, regardless of aircraft configuration, airspeed variations, wind velocity and direction, turbulence, …

FLIGHT PATH SYMBOL - DETAILED DESCRIPTION

GENERAL PRINCIPLES

The Flight Path Vector (FPV) can be described with respect to two different reference systems:

- The ground reference system,
- The air mass reference system associated to the air mass in which the airplane is flying.

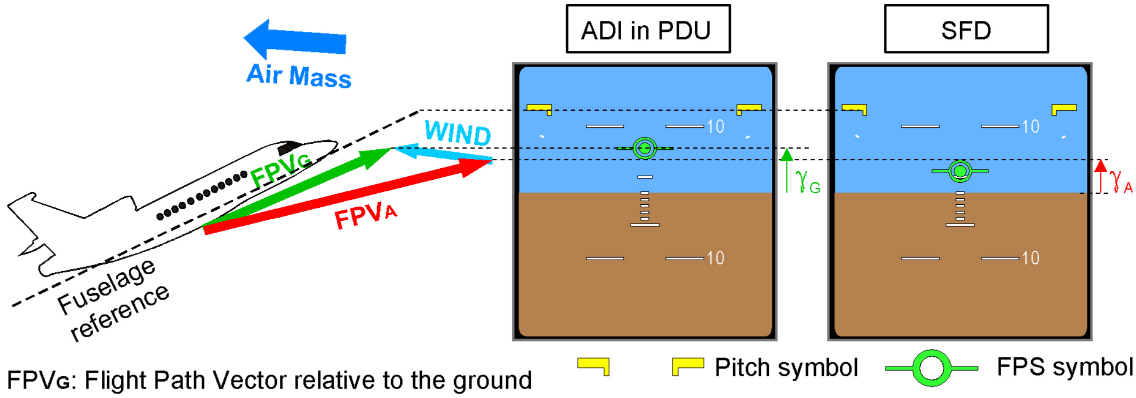
As shown on the figure thereafter, the difference between ground and air mass reference systems is wind dependent.

For given flight conditions (speed, thrust setting) and when observed from the ground, both FPV direction and magnitude (FPVG) will be affected by variations of wind force and direction. Whereas, in the same flight conditions and when observed from the air mass, FPV direction and magnitude (FPVA) will not be affected by wind variations.

Currently, pilots use pitch attitude as the primary parameter to control flight path.

On EASy Falcons, the combination of modern technology equipment such as the IRS (Inertial Reference System) and computers offers both measurement capability and computing power to calculate FPVG and FPVA. The two flight path vectors are presented to the pilot, in addition to the Pitch Symbol:

- The FPS displayed in the ADI (Attitude Director Indicator) shows the FPV direction observed from the ground (FPVG) and provides the flight path angle relative to the ground (□G),
- Whereas the FPS displayed in the SFD (Secondary Flight Display) shows the FPV direction observed from the air mass (FPVA) and provides the flight path angle relative to the air mass (□A).



FPVG: Flight Path Vector relative to the ground

FPVA: Flight Path Vector relative to air mass

FLIGHT PATH ANGLE VALUES

Consequently, one pitch angle setting may correspond to two different flight path angles displayed in the ADI and the SFD, depending on wind force and direction.

OPERATIONAL BENEFITS

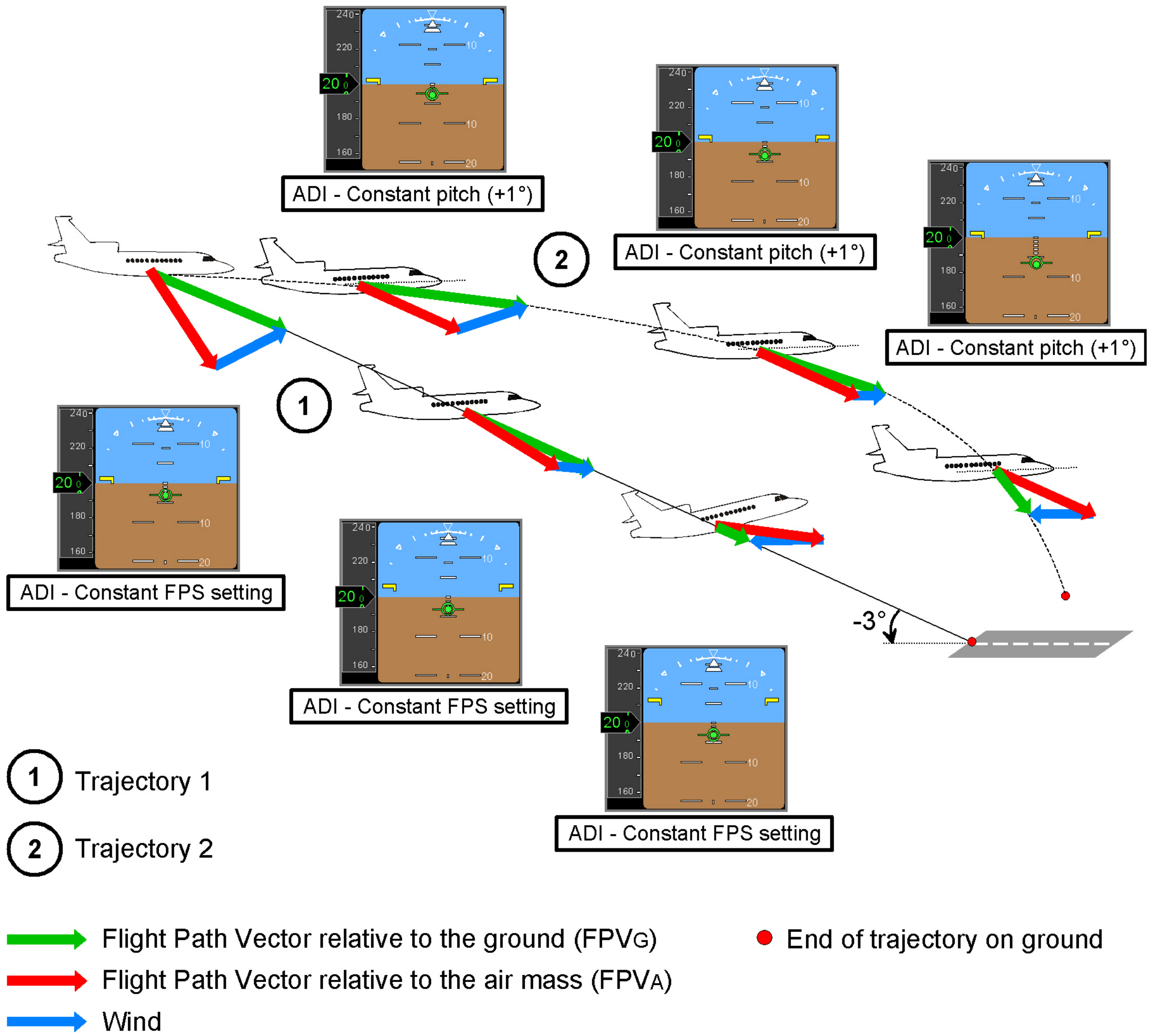
See examples on the following page.

Example No 1 hereafter gives 2 graphical representations of trajectories flown at a constant True Air Speed (TAS) in identical wind conditions, but obtained by setting and keeping constant 2 different primary attitude flight parameters:

- On trajectory 1, the pilot has set the Flight Path Symbol in the ADI for a constant descent at -3°. The result is:
    - On the trajectory, a constant straight slope relative to the ground unaffected by significant wind variations; reaching the expected trajectory end on the ground is ensured whatever wind variation in force or direction during descent,
    - Necessary pilot actions on the yoke dictated by wind effect in order to maintain the FPS set at -3°; in this example, it results in significant pitch attitude variations all along the flight path,
- On trajectory 2, the pilot has set the Pitch Symbol in the ADI at +1° and maintained it constant during the descent. The result is:
    - On the trajectory, variation of the slope relative to the ground as wind varies during descent; if no pitch correction is applied, reaching the expected trajectory end on the ground will depend on the magnitude of wind variation in force or direction along the flight path,
    - With no pilot action, a constant position and magnitude of the FPV relative to the air (FPVA) during descent, and affection of the FPV position relative to the ground (FPVG) directly caused by wind variations.

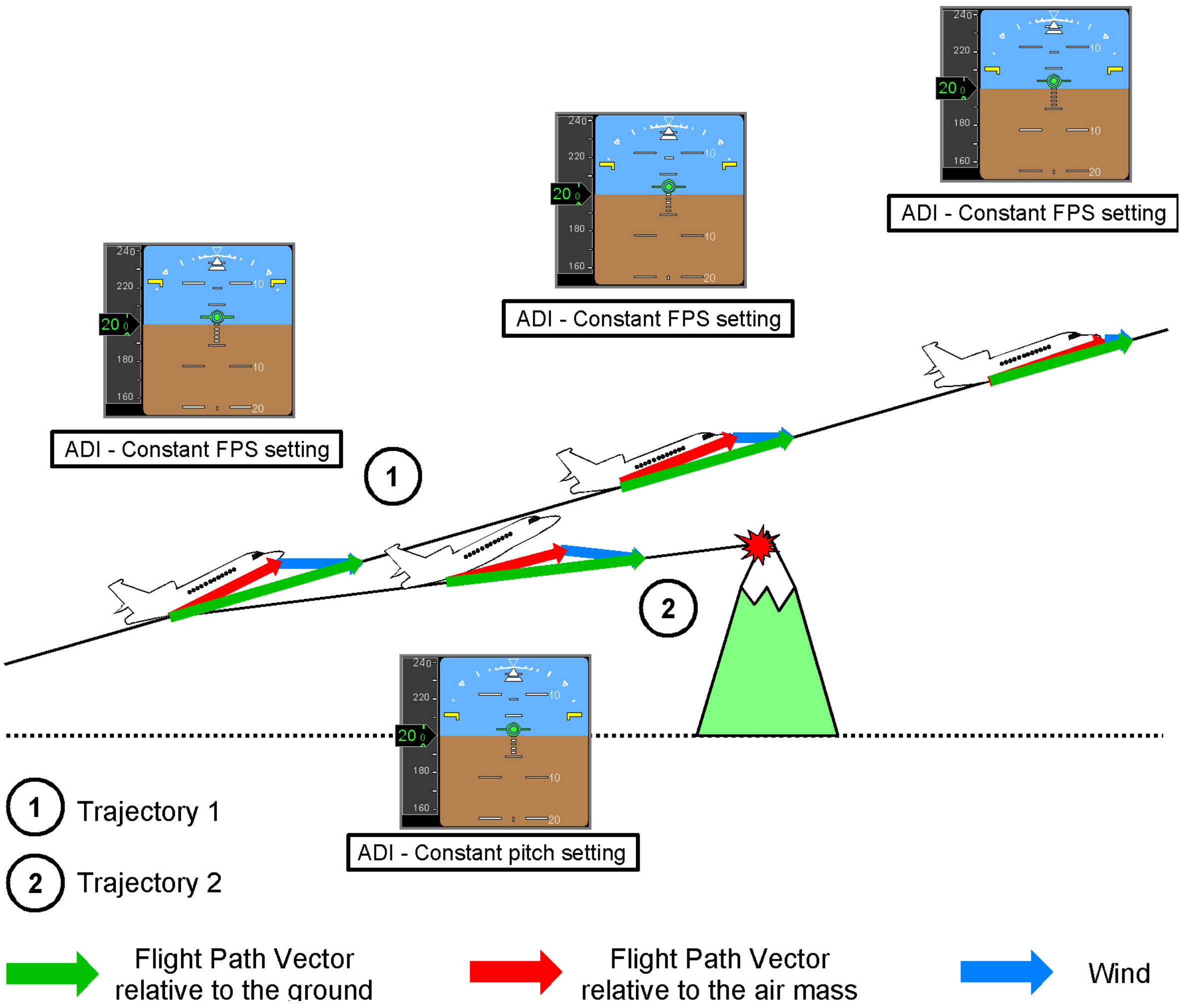
NOTE

Along both trajectories 1 and 2, the FPVA magnitude has remained constant, meaning that the True Air Speed (TAS) has also remained constant. Wind changes along the flight path result in Ground Speed (GS) variations shown by FPVG magnitude variations in the figure shown.


ADI - Constant pitch (+1°)
ADI - Constant pitch (+1°)
ADI - Constant pitch (+1°)
2
1
ADI - Constant FPS setting
ADI - Constant FPS setting
ADI - Constant FPS setting
-3°
1 Trajectory 1
2 Trajectory 2
Flight Path Vector relative to the ground (FPVG)
Flight Path Vector relative to the air mass (FPVA)
Wind
End of trajectory on ground

EXAMPLE NO 1

Example No 2 shows another situation where flying a constant flight path angle relative to the ground contributes directly and obviously to safety enhancement (constant FPS setting on the ADI along trajectory 1 instead of constant pitch angle setting along trajectory 2):



EXAMPLE NO 2

CONCLUSION

The benefit for pilots of knowing the aircraft flight path angle through the FPS position in the ADI and using it as the primary mean of flight path control is the most accurate method of controlling the airplane. The FPS is the unique tool to control the airplane trajectory with respect to the ground, which is a safety requirement particularly during descent, approach and obstacle clearance.

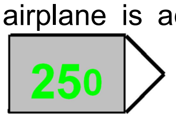
ACCELERATION CHEVRON, TREND VECTOR AND THRUST DIRECTOR

WHAT IS THE ACCELERATION CHEVRON (AC)?

The Acceleration Chevron (AC) is the green V-marker symbol displayed in the ADI (Attitude Director Indicator). When used in relation with the Flight Path Symbol (FPS), it gives an immediate and intuitive indication about the airplane ability to stabilize and maintain speed, accelerate or decelerate.

When used in relation with the FPS scale in the ADI, and for smooth maneuvers, it gives an immediate and intuitive indication about the maximum flight path angle that can be instantaneously flown at steady speed, which is a valuable information for a pilot in an engine failure situation for instance.

WHAT IS THE TREND VECTOR (TV) ?

The Trend Vector (TV) is a green double-line bar which is displayed above (when the airplane is accelerating) or below (when the airplane is decelerating) the speed pointer 

in the ADI. On Falcon fitted with EASy, this green double-line bar can be topped by a horizontal line when the acceleration is above the scale limit ( ).

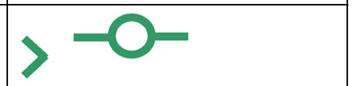
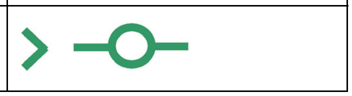
WHAT IS THE THRUST DIRECTOR (TD) ?

The Thrust Director (TD) is the magenta open box displayed in the ADI. It represents the box inside which the AC must be to fly the pre-selected target speed displayed in magenta on the speed scale and on the Flight Guidance Panel (FGP).

GENERAL PRINCIPLES

Acceleration Chevron and Trend Vector

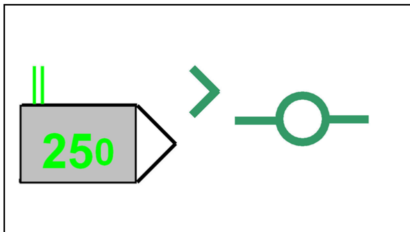
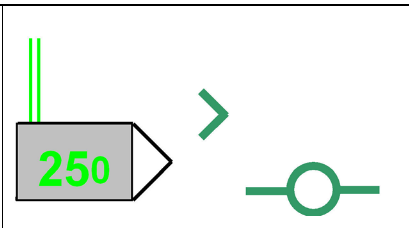
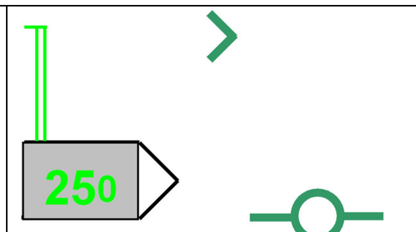
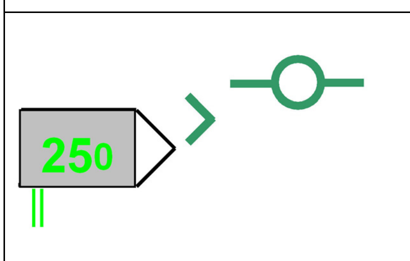
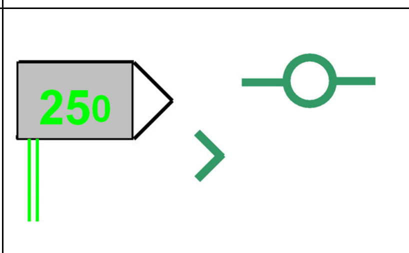
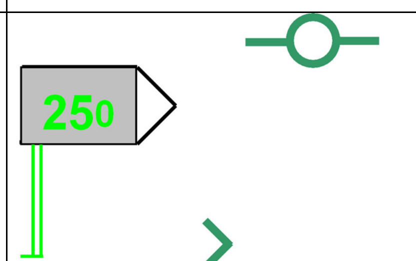
The relative position of the AC with respect to the FPS provides the pilot with an immediate, direct and intuitive mean to assess and precisely control the acceleration along any given flight path, whatever the instantaneous airplane trajectory (straight level flight, descent, climb):

- When the AC is above the FPS, the airplane is accelerating	
- When the AC is below the FPS, the airplane is decelerating	
- When the AC is aligned with the FPS, the airplane is maintaining speed.	

The pilot will control the AC position and consequently the speed, are controlled by the pilot through the power levers that command thrust. The AC position can also vary upon landing gear, airbrakes or slats / flaps activation, due to the consequent variation in drag.

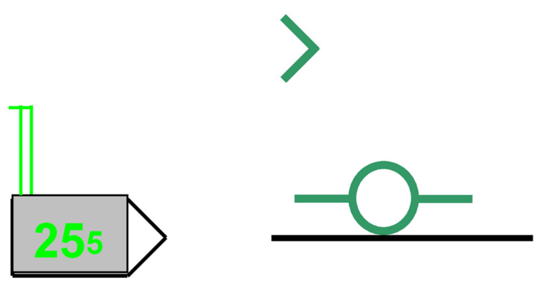
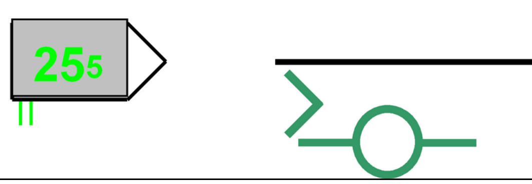
The airplane acceleration or deceleration along the flight path can be cross-checked through the TV position with respect to the speed pointer.

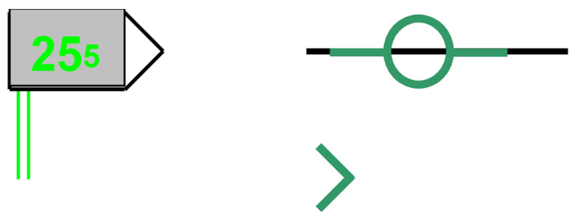
Additionally, the length of the TV, as well as the distance between the AC and the FPS, are proportional to the acceleration (when AC is above FPS) or deceleration (when AC is below FPS):

		
Low acceleration	Medium acceleration without exceeding scale limit	High acceleration exceeding scale limit
		
Low deceleration	Medium deceleration without exceeding scale limit	High deceleration exceeding scale limit

As a result, three main situations may occur:

SITUATIONS	VISUALIZATION	COMMENTS
Maintaining the current speed	Airplane straight level flying and maintaining speed  Airplane climbing and maintaining speed  Airplane descending and maintaining speed  	The AC is aligned with the FPS: speed is steady and no TV is displayed

SITUATIONS	VISUALIZATION	COMMENTS
Acceleration	Airplane straight level flying and accelerating  Airplane climbing and accelerating  Airplane descending and accelerating  	The AC is above the FPS: speed is increasing and TV is displayed above the speed pointer In addition, the more distant the AC and the FPS are, the longer the TV is, the higher the acceleration is, the faster the speed is increasing

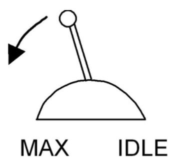
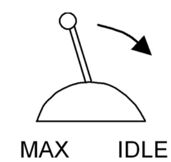
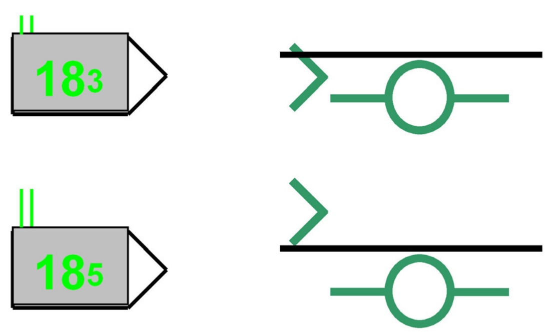
SITUATIONS	VISUALIZATION	COMMENTS
Deceleration	Airplane straight level flying and decelerating  Airplane climbing and decelerating  Airplane descending and decelerating 	The AC is below the FPS: speed is decreasing and TV is displayed below the speed pointer In addition, the more distant the AC and the FPS are, the longer the TV is, the higher the deceleration is, the quicker the speed is decreasing

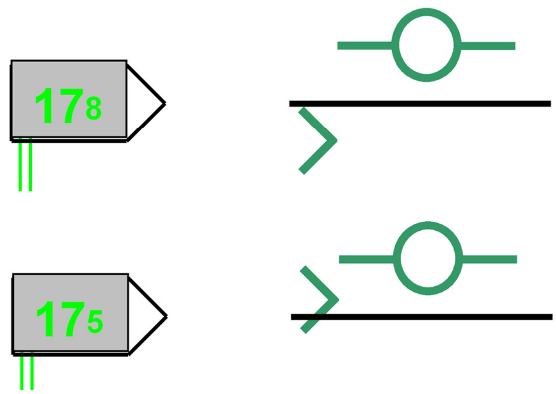
HOW TO USE THE ACCELERATION CHEVRON (AC)

Acceleration Chevron uses without Thrust Director

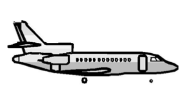
The following gives examples of how to use the AC, the FPS and the TV without using the TD.

- **Initial Situation: airplane in level flight steady at 180 kt:**

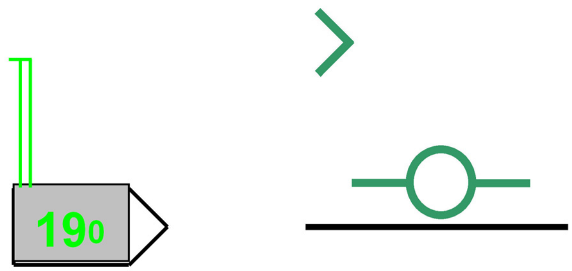
EVENT	NEW SITUATION
Power is slightly increased and flight path kept level 	 Speed is slowly increasing, as confirmed by the TV position and AC position above the FPS
Power is slightly decreased and flight path is kept level 	 Speed is slowly decreasing, as confirmed by the TV position and AC position below the FPS
Flight path is set to descent and power kept unchanged 	Two examples of resulting situations:  Speed is slowly increasing, as confirmed by the TV position and AC position above the FPS. Depending on how low or high the flight path value set by the pilot is, the AC can be more or less close to the FPS, indicating the airplane is more or less accelerating

EVENT	NEW SITUATION
Flight path is set to climb and power kept unchanged 	Two examples of resulting situations:  Speed is slowly decreasing, as confirmed by the TV position and AC position below the FPS. Depending on how low or high the flight path value set by the pilot is, the AC can be more or less close to the FPS, indicating the airplane is more or less decelerating

- **Initial Situation: airplane in descent on a – 3° flight path steady at 180 kt**

EVENT	NEW SITUATION
Change in configuration: (example: landing gear and slats / flaps are extended) 	 Speed is slowly decreasing, as confirmed by the TV position and AC position below the FPS. Therefore, increase power to maintain airspeed on the same flight path.

- **Initial Situation: airplane in climb at 190 kt, accelerating, with a high acceleration rate**

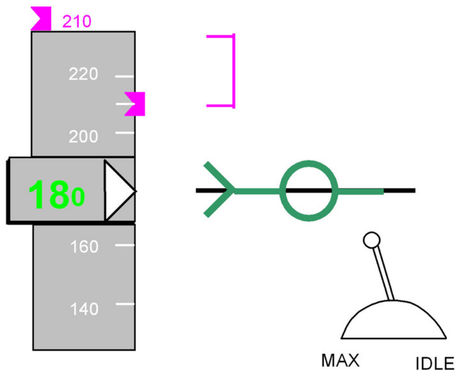


EVENT	NEW SITUATION
One engine fails and positions of the remaining engines power levers are unchanged	 The engine failure results in a lower AC position. In this particular case, the airplane is still accelerating but at a lower rate. The new AC position indicates the maximum instantaneous flight path angle that can be flown at a constant speed for smooth maneuvers

Acceleration Chevron uses with Thrust Director

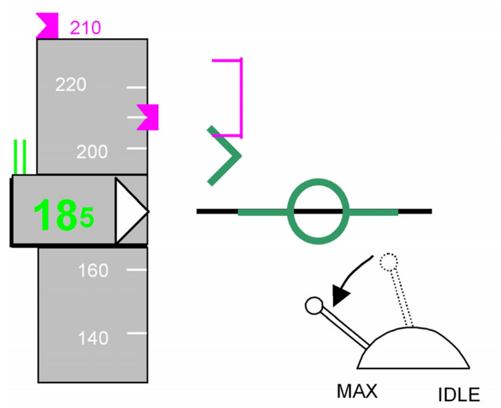
TD tells the pilot where the AC must be positioned in the ADI to capture and hold a pre-selected target speed. Consequently, two main situations may occur:

- Example No 1: a 210 kt target speed is commanded which triggers and positions the TD, while, initially, the airplane is in straight level flight and the thrust is adjusted to maintain a 180 kt steady speed.



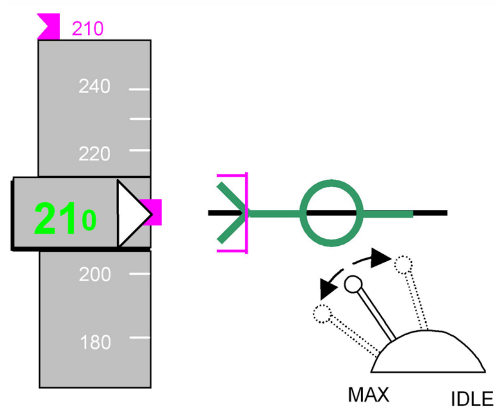
TRANSITION

The pilot increases the thrust to accelerate and bring the AC into the TD, without changing the flight path. While thrust is increased, the airplane accelerates, and speed increases. AC and TD close up toward each other

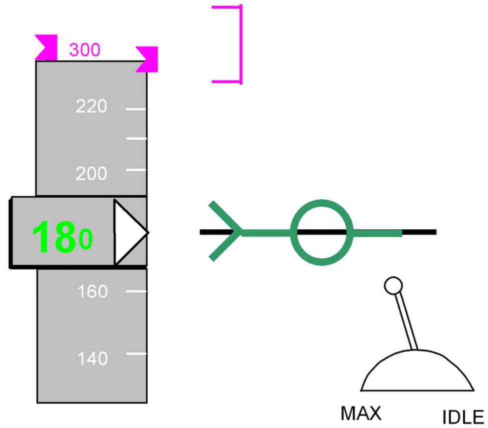


NEW SITUATION AND COMMENTS

In this example, there was enough available thrust to achieve the required increase in speed. The pilot has reached the target speed (AC inside TD) by using thrust only, and he can now adjust throttles to hold a 210 kt steady speed (no TV) without changing the flight path

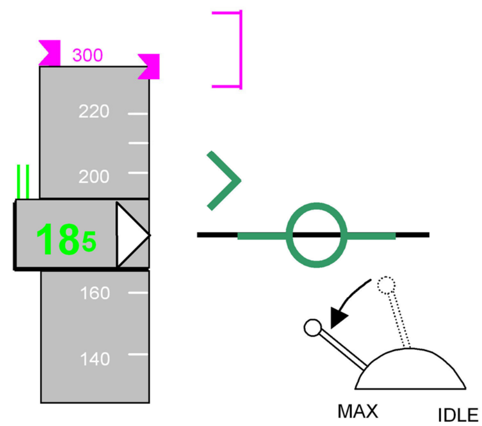


- A 300 kt target speed is commanded which triggers the TD at the appropriate location while, initially, the airplane is in straight level flight and the thrust is adjusted to maintain a 180 kt steady speed.



TRANSITION STEP 1

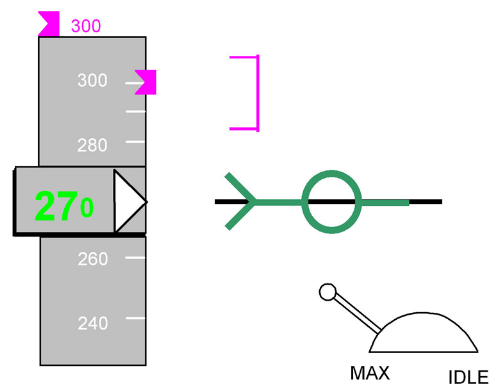
The pilot has commanded full authorized thrust to accelerate and bring the AC into the TD, without changing the flight path. While thrust is increased, the airplane accelerates, and speed increases.



TRANSITION STEP 2

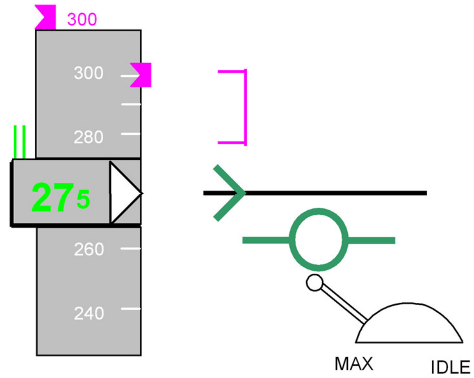
In this example, full available thrust is not enough to increase speed up to the pre-selected value.

Consequently, speed stabilizes below 300 kt although full available thrust has been set, in level flight.



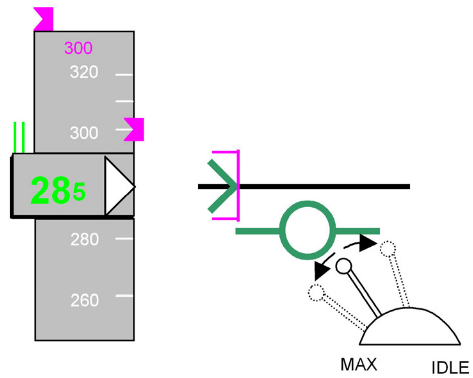
TRANSITION STEP 3

Therefore, to reach 300 kt, the pilot has to set a descent flight path that makes the airplane accelerate



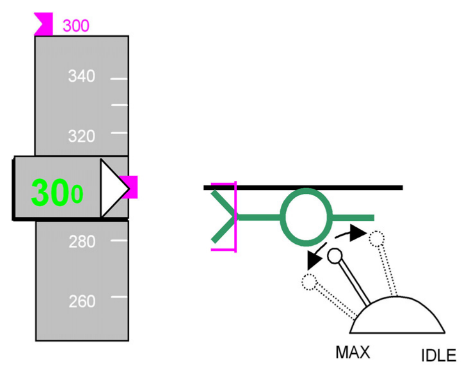
TRANSITION STEP 4

The AC meets the TD and the pilot can now adjust the throttles to keep the AC inside the TD



NEW SITUATION AND COMMENTS

Once speed has reached 300 kt, the AC, TD and FPS are aligned. To maintain 300 kt, the pilot will have to regulate the thrust setting while maintaining the flight path angle constant



CONCLUSION

The Acceleration Chevron (AC) is the complementary primary mean to assess the airplane energy along with the Flight Path Symbol (FPS) for flying EASy Falcon. When the AC and the FPS are used together with the Thrust Director (TD), they provide the pilot with a direct, intuitive and immediate mean to capture, track or control simultaneously the airspeed or the airspeed variation along the airplane flight path.

ROTATION SYMBOL

WHAT IS THE ROTATION SYMBOL (ROS) ?

The ROtation Symbol (ROS) is the magenta inverted-T symbol displayed in the ADI (Attitude Director Indicator) during take-off, from brake release to 3 seconds after lift-off. It is located at the bottom of the ADI at brake release, and on the horizon reference line at the end of the rotation. It provides the pilot with an easy-to-follow vertical mean to control the rotation phase of the airplane.

GENERAL PRINCIPLES

The rotation is a particular phase of the take-off where the combined increase of speed and angle of attack increase provides the necessary lift to get the airplane airborne and eventually climb.

The rotation phase can be divided into two consecutive parts:

- The first part starts with the rotation initiation created by the pilot pulling on the yoke. During this part, the lift increases but does not compensate for the weight of the airplane
- The second part starts as soon as the lift, created by the pilot still pulling on the yoke, exceeds the airplane weight. As a result, the airplane lifts off and starts climbing.

EASY FITTED AIRCRAFT

On Falcons fitted with EASy, pilots are provided with both flight path and pitch information, by the way of the FPS and the Pitch Symbol .

However, it has been decided not to use the FPS during the rotation phase because:

- During the first part of the rotation phase, the FPS remains aligned with the horizon reference line whereas it is necessary to have a cue to set the appropriate take-off attitude,
- During the second part of the rotation phase, the FPS position permanently changes with the speed.

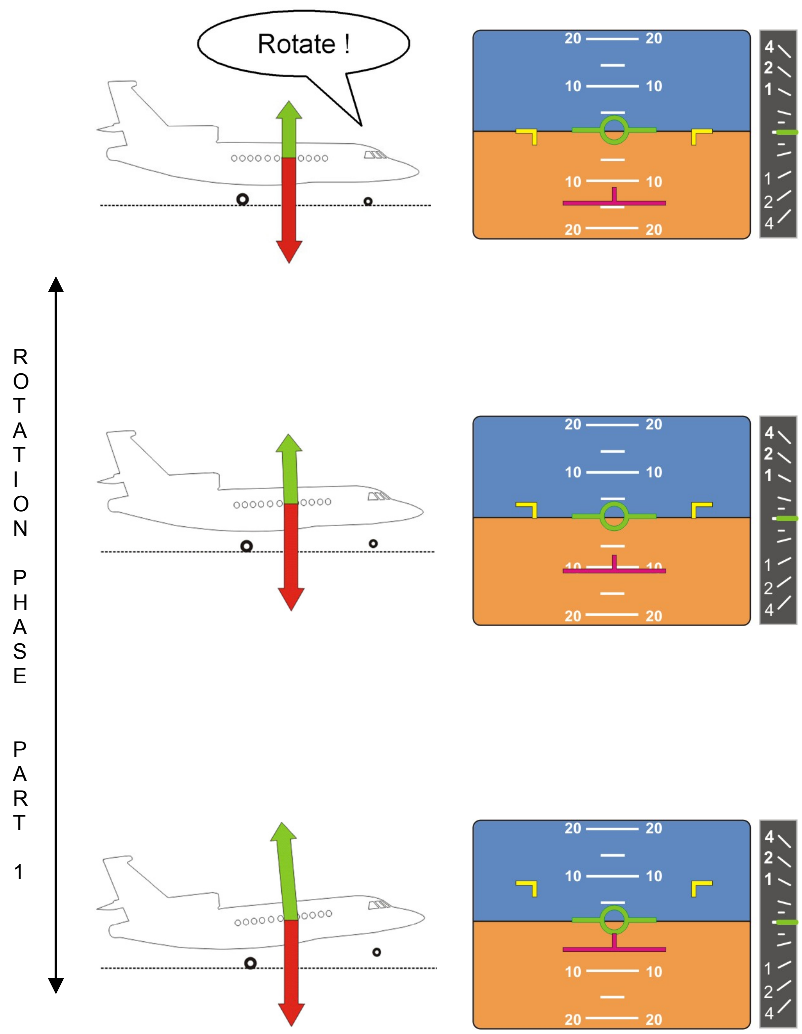
In addition, flying both FPS and Pitch Symbol simultaneously was perceived as possible but not comfortable for the pilot. This would imply non-intuitive and repeated eye pattern in the ADI between the horizon reference line (where the FPS is located) and the top of the ADI (where the Pitch Symbol is ultimately located) and this during a heavy work-loaded flight phase.

That is the reason why the ROS ( ) was created to provide the pilot with a valid, easy-to-use pitch reference to control the two parts of the rotation phase. When the pilot brings the ROS from the bottom of the ADI up to the horizon reference line, he / she actually sets the appropriate pitch value for take-off. Moreover, being initially located at the bottom of the ADI, the ROS will move upward as the FPS will do when "pushed by the ROS" once the airplane is airborne. This results in a smooth, linear eye pattern from the bottom to the top of the ADI, significantly decreasing the pilot workload.

HOW TO USE THE ROTATION SYMBOL (ROS)

As soon as <Rotate> is called out, the pilot initiates the rotation by pulling on the yoke. This causes the ROS to rise up from the bottom of the ADI. Then the pilot controls the rotation by bringing the ROS to the horizon reference line in the ADI. By doing that, the pilot gives the airplane the appropriate angle of attack to generate the necessary lift to lift up and climb.

As soon as the airplane is airborne, the FPS rises off from the horizon reference line where it was stuck during the rolling and rotation phases. Three seconds after lift up, the ROS disappears and FPS naturally becomes the primary mean of flight path control for the pilot.



- The airplane is rolling on the ground (pitch and flight path angle are null)
- Lift (created by speed only) does not compensate for the airplane weight yet
- ROS is at the bottom of the ADI

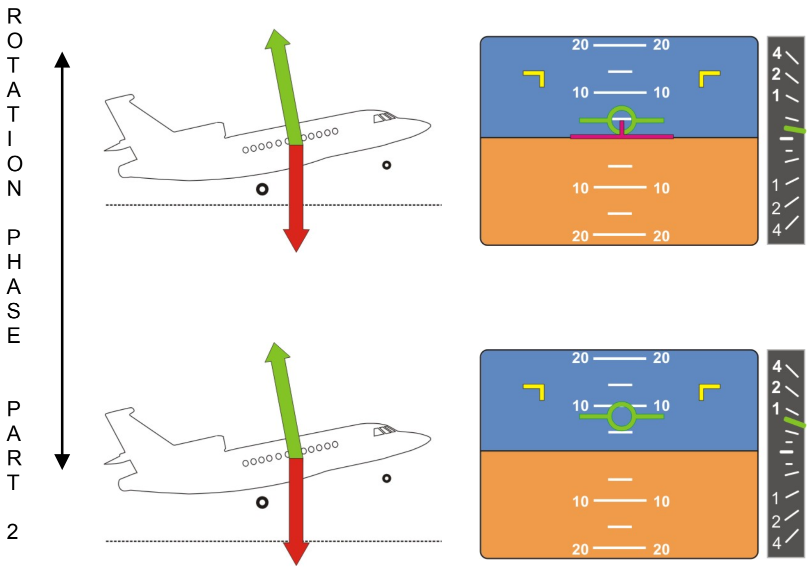
<Rotate> is called out

- The pilot is pulling on the yoke to set the ROS on the horizon reference line, which causes the pitch symbol to rise up too, but not the FPS

The airplane rotates while still rolling on the ground. However, the combination of speed and angle of attack does not create lift enough for lift up

- The pilot keeps on pulling on the yoke to set the ROS on the horizon reference line, which causes the pitch symbol to rise up too, but not the FPS

The airplane keeps on rotating while rolling on the ground. However, the combination of speed and angle of attack does not create lift enough for lift off



- The pilot has set the take-off attitude by keeping the ROS on the horizon reference line until it disappears, which causes the FPS to climb above the horizon line reference

The combination of speed and angle of attack now creates lift enough to lift off the airplane

- 3 seconds after lift off, the ROS disappears and the pilot flies the FPS to climb

CONCLUSION

The ROtation Symbol (ROS) is a symbol providing the pilot with valid flight information to control the rotation phase up to three seconds after lift off. It helps the pilot to measure out how much input he / she must give to the yoke to perform the rotation by reaching the appropriate angle of attack, in safe and comfortable conditions.