

FMGS

User's Guide

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1. Foreword

A320 FMGS software is a freeware solution to replicate the real Airbus A320's Flight Management & Guidance System (FMGS) and main electronic instruments for Microsoft's Flight Simulator®. My aim with this software is to achieve the greatest realism possible, given the limitations of FS, my free time and my programming skills. As of this writing, the following systems are (partially) modeled:

- Primary Flight Display (PFD)
- Navigation Display (ND)
- Flight Control Unit (FCU)
- Multifunction Control & Display Unit
- Engine /Warning Display (E/WD)
- Status Display (SD)
- Overhead panel
- Brakes triple indicator

The present guide will depict every functions implemented in the software. To do so, I will first describe every instruments then we'll hop on-board an imaginary flight from Toulouse Blagnac (LFBO) to Nice Côte d'Azur (LFMN), to master the FMGS operations.

DISCLAIMER:

This software is by no means related to Airbus, EADS or any affiliated group. It is intended to use only as a recreational software together with Microsoft Flight Simulator. Do not use as a part of training toward any kind of aeronautical certification, be it private pilot or commercial pilot training.

This software should cause no harm to your computer. In the very unlikely event damage occurred to your system, I won't take any liability. Use at your own risk.

I started this project to fit my homecockpit hardware. The commercial alternatives are very expensive, even if more advanced, their price tag is prohibitive regarding the money I want to spend on a FS hobby.

All commands are interfaceable with hardware through FSUIPC.

If you have any questions, remarks or anything you want to say, you can do so either via e-mail (jeehell "at" jeehell.org) or through [MyCockpit.org forums](http://MyCockpit.org).

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2. Installation and customization

2.1. Requirements

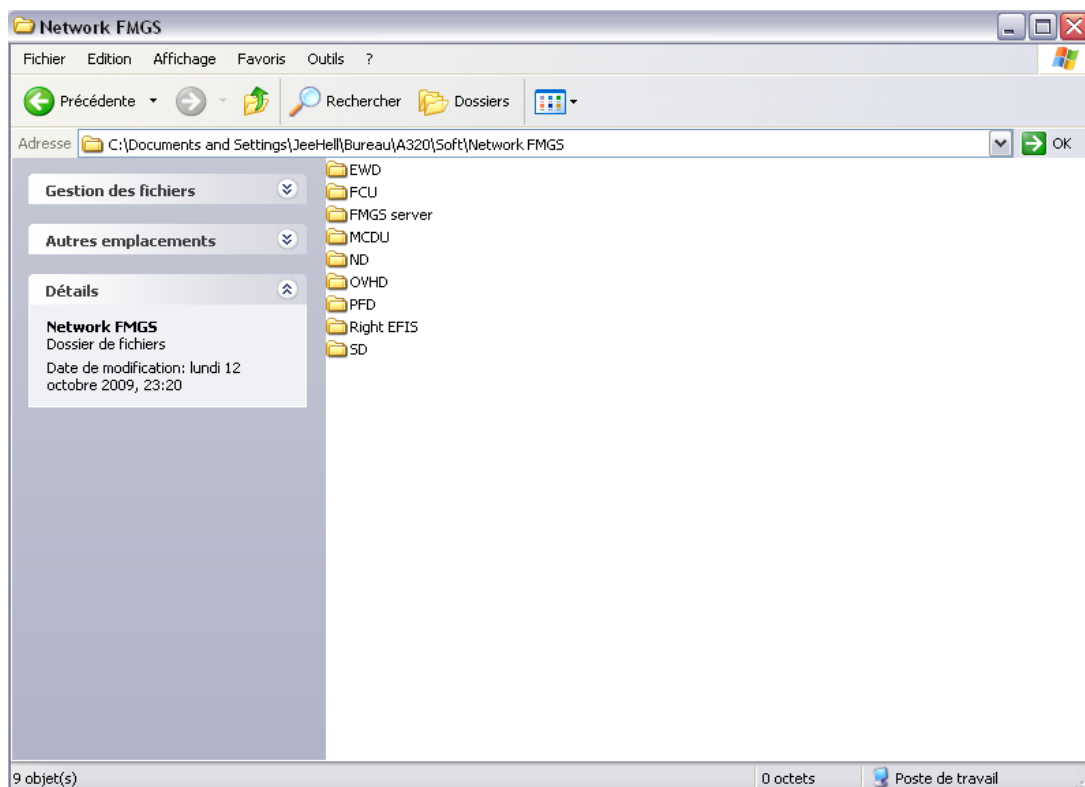
You need a PC with Windows XP running. It has not been tested with any other Microsoft OS (98, Vista, Seven), and won't work on any other (unless you use some kind of windows API emulation).

The communication with Flight Simulator is based on Peter Dowson's FSUIPC module. You'll need an up-to-date version. (At least V4.52).

Since I use some offsets only present in FSX, it is very unlikely it can work with FS9 or previous version of FS. Since I do not own FS9, I can not test.

2.2. Installation

It is plain simple. Just unzip the archive file containing the software to the folder of your choice (for example c:\games\FMGS), making sure to keep the same folder structure inside that folder. It should look like this:



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2.3. Networking

It is possible to deport all instruments/interfaces to computers over a network. To do so, you'll need WideFS from Pete Dowson installed and of course registered. As well as discussing with FSUIPC, the instruments need to share data so a little tweaking is required.

you've probably noticed a file called "network.cfg", present in each instrument subfolder, with the following structure:

```
IP=localhost
Port=8003
```

Assign to IP field the IP address or the Hostname of the **computer running the FMGS server**. If you run all instruments.interfaces on the same computer (even if deported from main FS computer), you can leave "localhost".

For the port number, I suggest you leave 8003, but you can freely change it (firewall/routing problems etc...), as long as **ALL instruments have the same port**.

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2.4. Aircraft.cfg

This file is located in the FMGS Server folder.

Use this file to adjust your FS model to the software. It should look like this after a fresh install:

```

EPR/N1=N1
TOGA_N1%=98.1
TOGA_EPR=
MCT_N1%=95.3
MCT_EPR=
CL_N1%=90.0
CL_EPR=
MAX_N1%=99
MAX_EPR=
Baro=mb
VFE_1=230
VFE_1+F=215
VFE_2=200
VFE_3=185
VFE_4=177
VLE=280
flaps_position.0=0
flaps_position.1=0
flaps_position.2=10
flaps_position.3=15
flaps_position.4=20
flaps_position.5=40
slats_position.0=0
slats_position.1=18
slats_position.2=18
slats_position.3=22
slats_position.4=22
slats_position.5=27

```

The EPR version is not operational yet, so you need to use N1 values if you want to take full advantage of the ATHR. To do so, the EPR/N1 field must be equal to "N1".

All other engine values are numeric and pretty straight forward. You may want to do some testing with your FS model to determine the right values.

The Baro value should be set to inhg or mb, depending if you want to use inches of mercury or millibars as default QNH unit.

VFE_1 to 4 correspond to the maximum indicated airspeed in knots when corresponding flaps/slats are extended.

VLE is the maximum indicated airspeed with landing gear extended.

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flaps_position.x and slats_position.x are the actual extension in degrees of the flaps/slats, in the selected position "x".

The aircraft you intend to use needs to have the same flaps/slats position declared as those. If you use default FSX A321, you'll need to tweak it's aircraft.cfg file. Here is how it should look like for proper operations:

```
[flaps.0]
type=1                                // 1 - tail, 2 - lead
span-outboard=0.8                     // 0.0 .. 1.0
extending-time=20                     // seconds
flaps-position.0=0                    // degrees
flaps-position.1=0                    // degrees
flaps-position.2=10                   // degrees
flaps-position.3=15                   // degrees
flaps-position.4=20                   // degrees
flaps-position.5=40                   // degrees
damaging-speed=250                    // KIAS
blowout-speed=300                     // KIAS
lift_scalar=0.7
drag_scalar=0.2
pitch_scalar=1.0
system_type=1                         //Hydraulic

[flaps.1]
type=2                                // 1 - tail, 2 - lead
span-outboard=0.8                     // 0.0 .. 1.0
extending-time=10                     // seconds
flaps-position.0=0                    // degrees
flaps-position.1=18.0                 // degrees
flaps-position.2=18.0                 // degrees
flaps-position.3=22.0                 // degrees
flaps-position.4=22.0                 // degrees
flaps-position.5=27.0                 // degrees
damaging-speed=250                    // KIAS
blowout-speed=300                     // KIAS
lift_scalar=0.3
drag_scalar=0.2
pitch_scalar=0.0
system_type=1                         //Hydraulic
```

Please note that as of now, only the default FSX A321 is tuned for the proprietary Auto Pilot, others models probably won't work.

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2.5. Navigation Data

To use the navigation planning feature of this software, you need to get an AIRAC cycle in the level-D B767 format. It is available for purchase on <http://www.navigraph.com>. Navigraph provides a test version of level-D B767 AIRAC cycle, it is outdated (from 2006) but it is free.

After downloading the navdata, you'll need to place the following files in the "navdata" subfolder of the FMGS Server and ND's :

- Airports.dat
- wpNavAID.txt
- wpNavAPT.txt
- wpNavFIX.txt
- wpNavRTE.txt

The FMGS software has its own format for SID, STAR and approach procedures. In the "navdata" subfolder, there is a little executable called "SID.STAR.manager.exe" which can allow you to easily create procedures. I won't go into detail as I hope it's quite intuitive, and you open the procedure for LFMN, which are included in the archive, to try your hands.

If you think it's no fun creating procedures, you can as well import them from Level-D B767 format thanks to "ProclImport.exe". Again I won't go into details. The LevelD files are available on www.navdata.at for free.

The data in the server and in the ND subfolders must be identical.

2.6. EGPWS terrain data

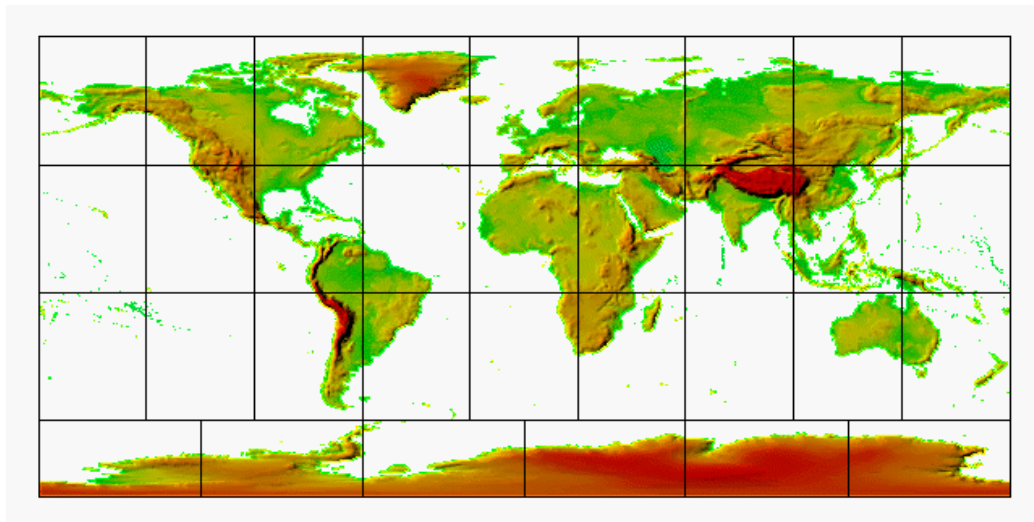
As in the real A320, the EGPWS needs a terrain elevation database to work. I use the free GTOPO30 data (from USGS) to create a compatible database. This database is not included in the zip file as it is quite big (around 1.44Go for the whole world).

However I included a little software in the "EGPWS data" subfolder to allow everyone to create its own database. Here is how it works:

- First, you need to download Data Elevation Model files from this website: <http://eros.usgs.gov/products/elevation/gtopo30/gtopo30.html>. On that page, there is the next map:

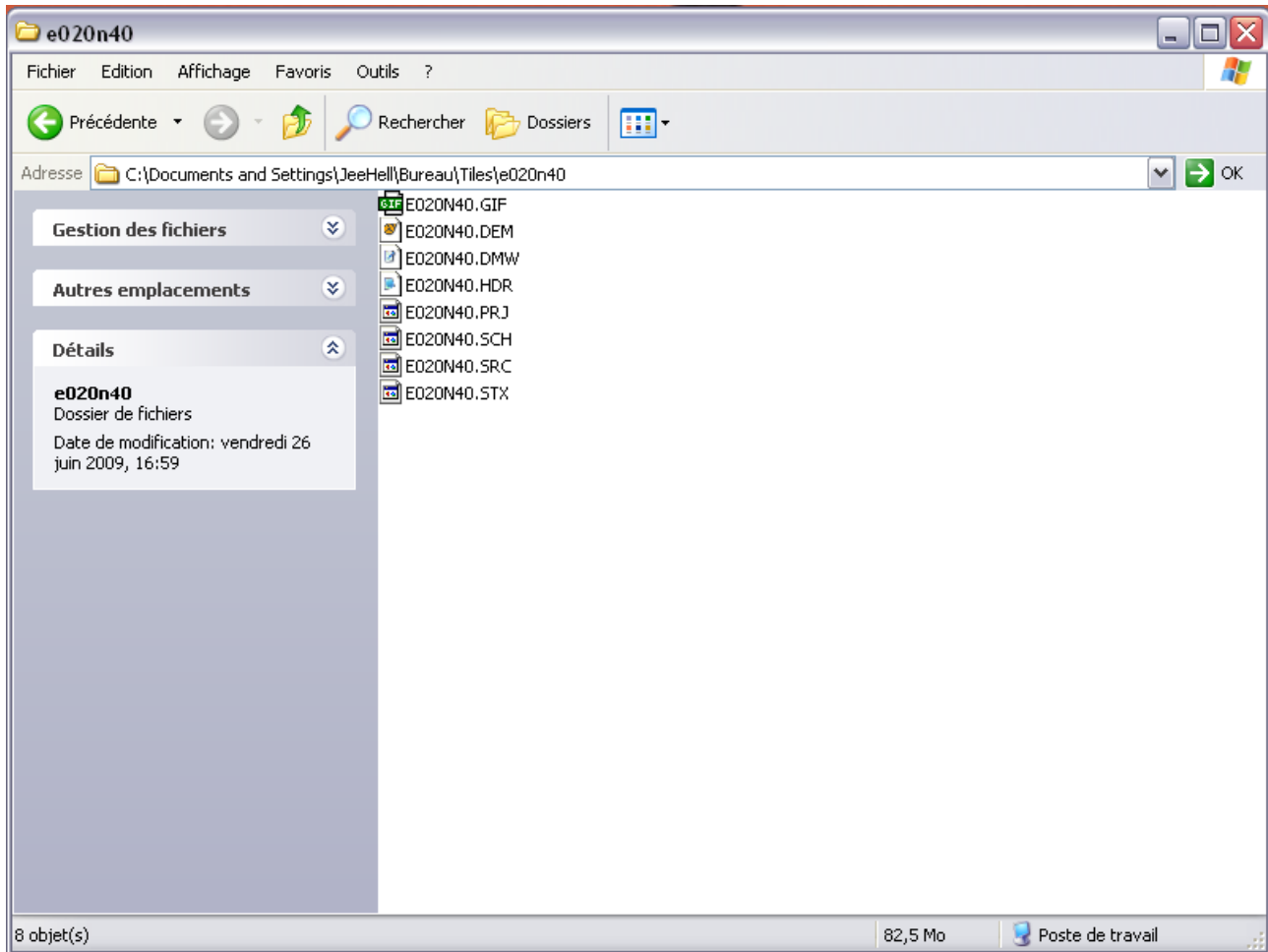
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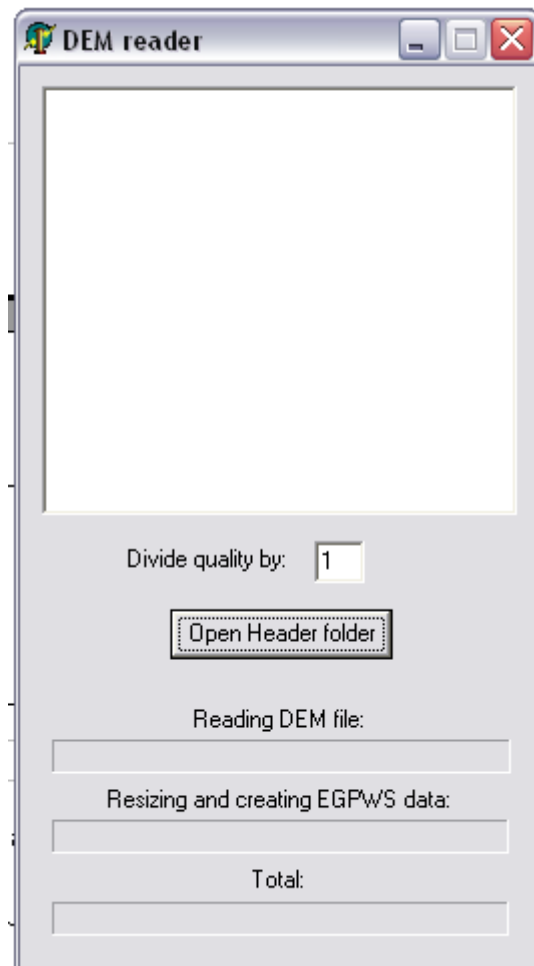
USGS copyrighted.

- Click on each rectangle you are likely to fly over to download the tiles you need. Do not download the Antarctica tiles, as they are not processed in the FMGS
- When you've downloaded every tiles you need, un-archive them twice (there is a.tar file zipped in a .gz file, use a software like 7-zip). You should get for each tiles 8 different files:



- Mix all the files from every tiles in the same folder.
- Launch "EGPWS data extractor.exe" located in "EGPWS data" subfolder of the ND folder.

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- Choose the quality you want (I think 2 or 3 is OK, 1 makes a pretty big database which slows down the EGPWS, 4 and above are too poor). Only integer numbers.
- Click "Open Header file", then browse to the location of all unzipped GTOPO files. Click on any .HDR file.
- **Wait. The whole process is quite long, around 10 minutes for one tile so don't be in a hurry if the window freezes. You can check if the software is still working if new folders appear periodically in the "EGPWS data" sub-folder.**
- Once the database has been created, you can launch "A320 FMGS.exe" as usual.
- Go in the "MCDU MENU" page and press 2nd RSK to activate "TERR on ND".
- To set TERR on ND via FSUIPC, set the bit n°5 of offset 66CA to 1.

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EGPWS represents an heavy load on the CPU. Even with a fast computer, you might notice the others instruments slowing down, and even lose control of the aircraft. If it happens, you'll have to fly without EGPWS.

2.7. Sounds

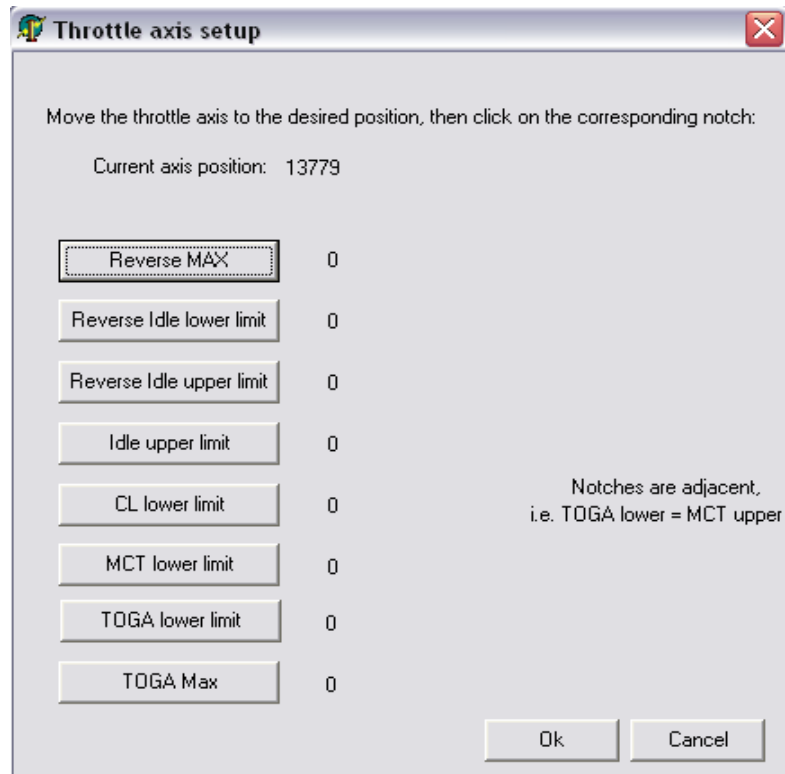
In the “Sounds” subfolder of the FMGS server, you'll find all the wave files used to playback GPWS and TCAS sounds. They were created with a free Text-To-Speech software. Feel free to replace them with your favorite sound package, but be sure to keep the same file names and the same number of files. If you don't want one particular sound to play, replace it with an empty wave file.

2.8. First start-up

Launch the “FMGS Server.exe” located in FMGS Server folder. Here is what you should get:



Click OK to this message, then click on “Show Throttle Setup”:



- To set the “notches” of the thrust lever, simply move your throttle to the desired position then click on the corresponding button to memorize that position. Repeat for each lever position, then click OK to save. Settings are stored in the “throttle.cfg” file. Do not try to modify it by hand. If everything gets messed up, simply delete that file and do the calibration process again.

We are now good to go!!

You'll have to launch each instrument separately.

On start-up, the screens will be black, as not powered through the OVHD electric power distribution. It doesn't mean they're not connected to the server. You can check the actual connection to the server through the “options” window available in each instrument.

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2.9. Resizing, rotating displays

You can freely move around any instrument/panel. Simply click on it and drag it where you want.

Each display, except the FCU and the MCDU in keyboard mode, can be resized and rotated. To resize, simply place the mouse cursor on the contour of the instrument until the usual resizing cursor appears. To rotate a display, right click on it then click on the direction you want to rotate (FCU, EFIS and overhead cannot be rotated).

When you close the software, it stores the position, size and rotation of each window in a file called "configXXX.cfg", where XXX is the name of the instrument. If you need to reset everything, just delete it.

2.10. Flight Simulator Aircraft

This software uses proprietary autopilot and FBW systems. As of beta 5 they are only tuned to the default FSX A321. You also need to disable FS pseudo FBW and flight control computers, by selecting off the corresponding buttons on the overhead panel:

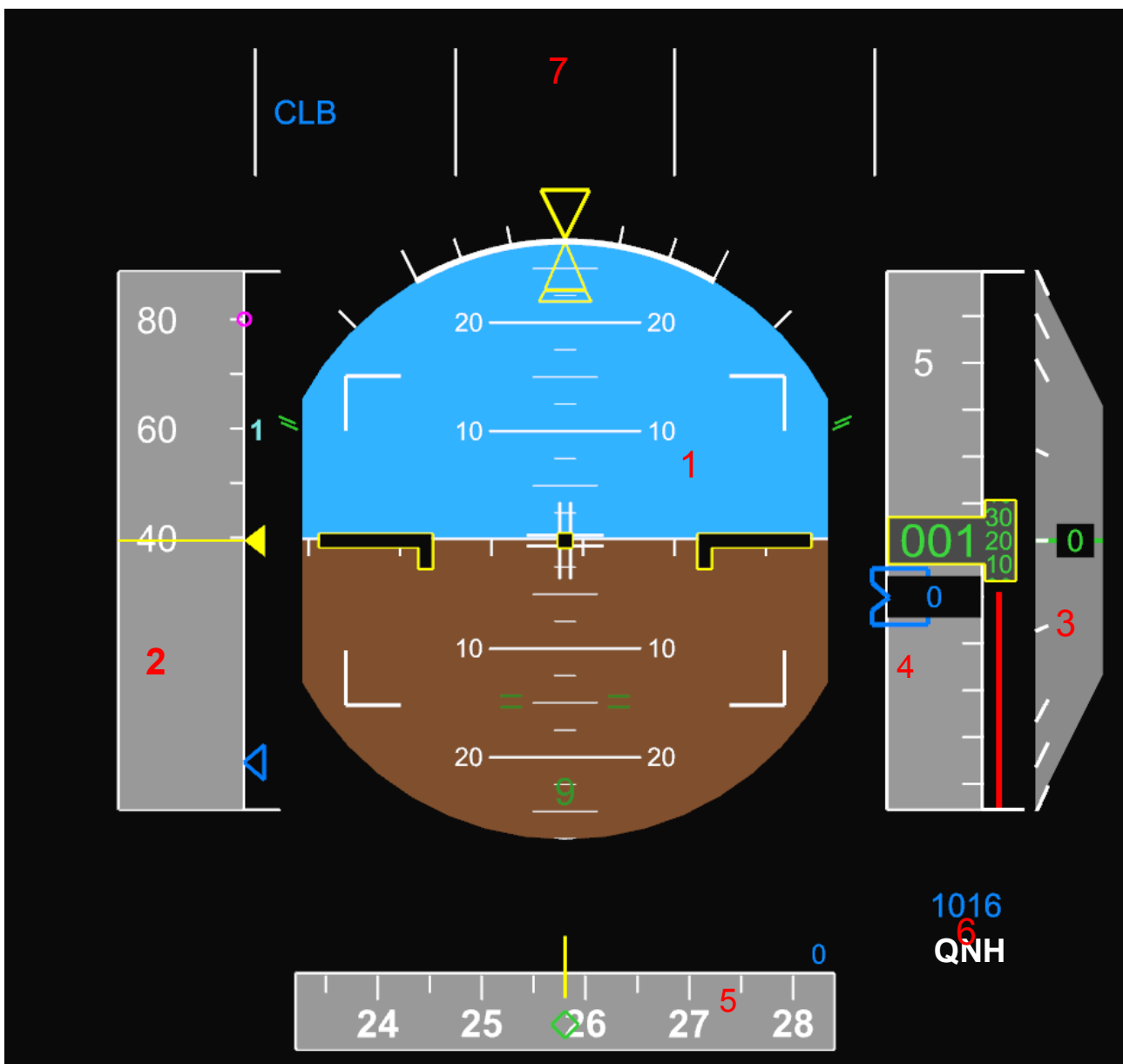


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3. The Primary Flight Display (PFD)

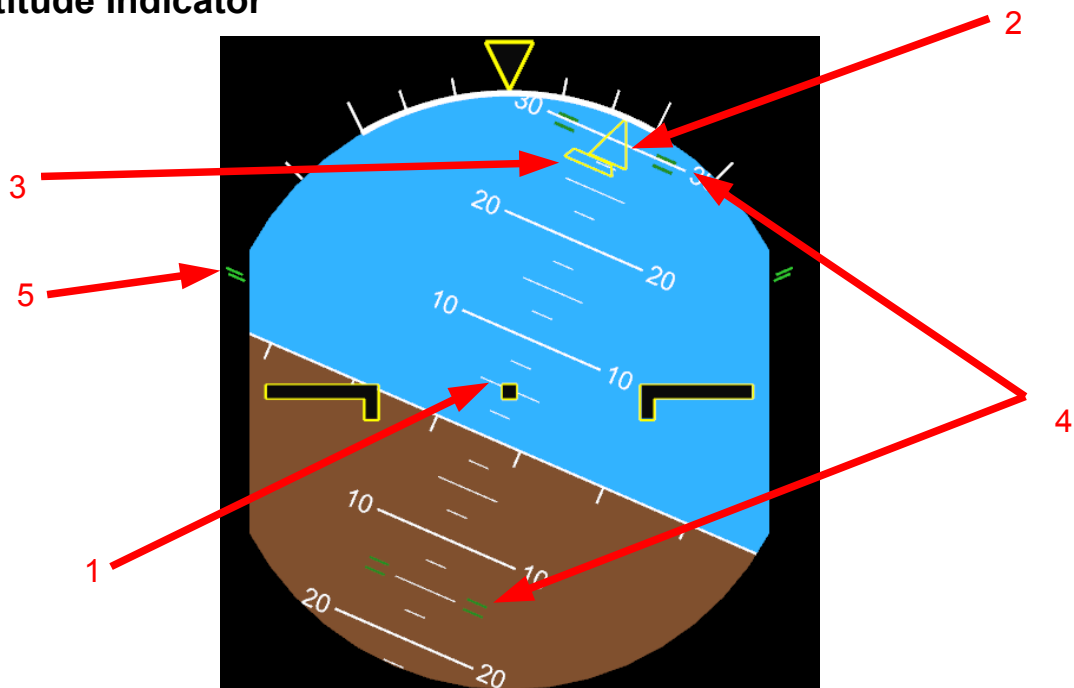
3.1. General View



- 1: Attitude Indicator (ADI)
- 2: Speed Tape

- 3: Vertical speed
- 4: Altitude Tape
- 5: Compass Tape
- 6: Barometric setting. “QNH” text appears along with numeric setting if set to QNH. “STD” text appears if set to standard pressure (1013,25 mb or 29,92 in.Hg) via a pull on baro setting knob on FCU.
- 7 : Flight Mode Annunciator

3.2. Attitude Indicator

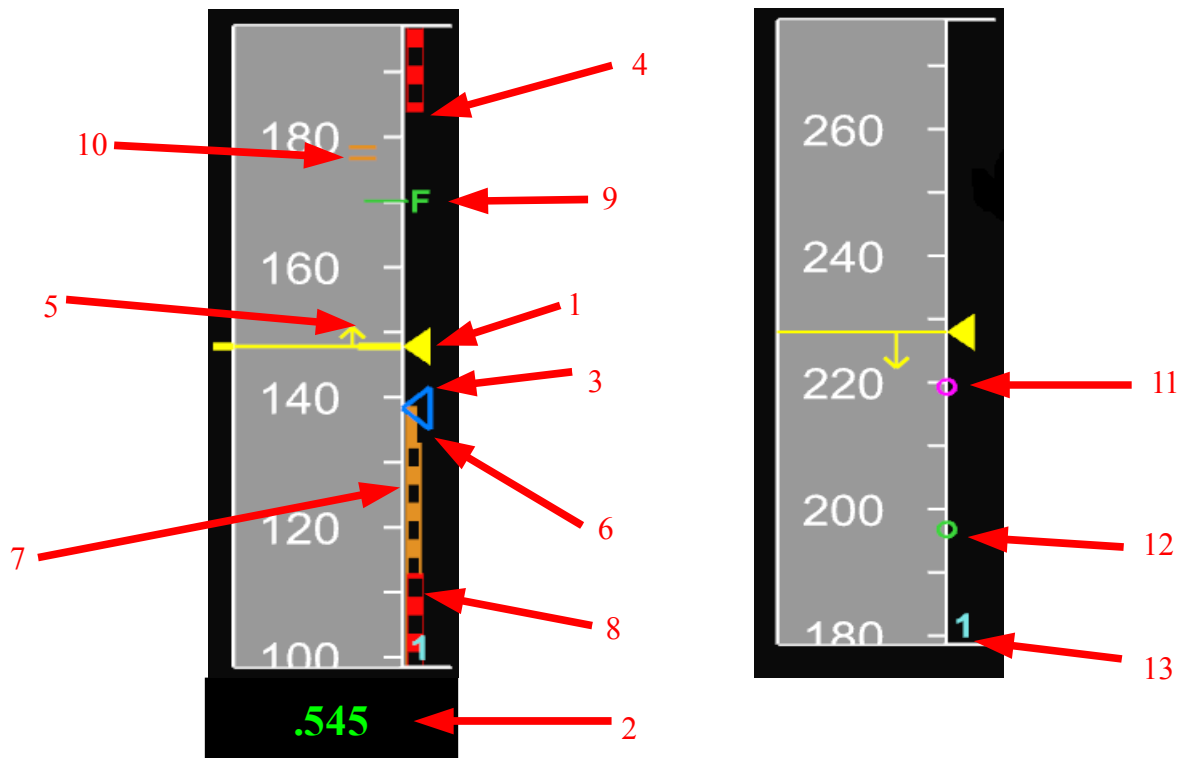


This is the heart of the PFD. It shows the ACFT attitude (pitch, bank, sideslip).

- 1: ACFT reference symbol.
- 2: Roll index.
- 3: Sideslip index
- 4: Pitch limits of Fly-By-Wire (FBW)
- 5: Bank limits of FBW

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3.3. Speed Tape



- 1: IAS index
- 2: Actual Mach number, shown if greater than 0.5.
- 3: IAS target. If speed target is out of scale range, then the numeric value is shown either above or below the scale in the same color as the index.
- 4: Maximum IAS, red and black ribbon moving according to aircraft maximum speeds (VFEs, VLE, MMO, VMO)
- 5: IAS trend. Shows the IAS to be reached in 10s if acceleration is constant.
- 6: VLS speed: this amber ribbon starts at the α -protection speed and stops at the VLS speed (lowest selectable speed)
- 7: α -protection ribbon. Ranges from V_{stall} to $V_{\alpha\text{-protection}}$. If IAS drops inside this ribbon, α -protection automatically engage and TOGA is applied.
- 8: Stall speed ribbon.
- 9: Flaps retraction speed
- 10: Next flap setting VFE
- 11: Rotation Speed V_R (not the real value shown)

- 1: Actual altitude (in respect to the barometric setting)
- 2: Altitude target. If altitude target is out of scale range, then the numeric value is shown either above or below the scale in the same color as the index.
- 3: Ground altitude ribbon
- 4: Radio altimeter value.

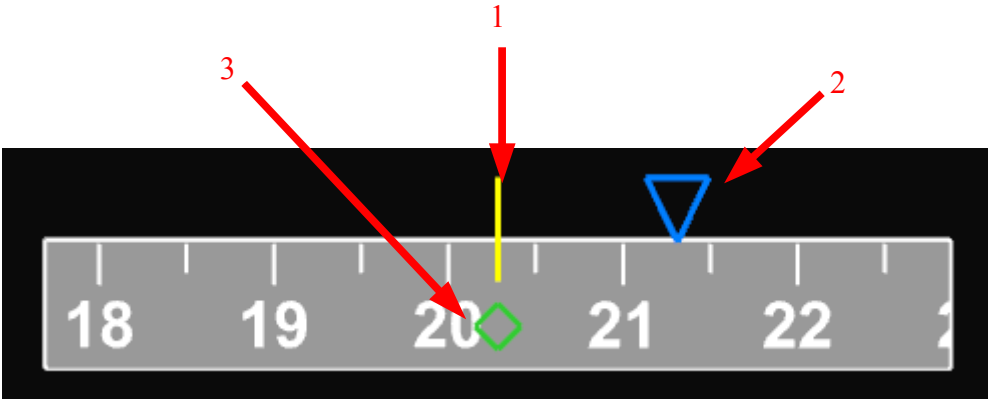
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3.5. Vertical Speed



The green line is an analog indicator and moves along the V/S scale . Limits are ± 2000 ft/min. The green number is the V/S in hundreds of ft/min (here V/S is then -1400 ft/min)

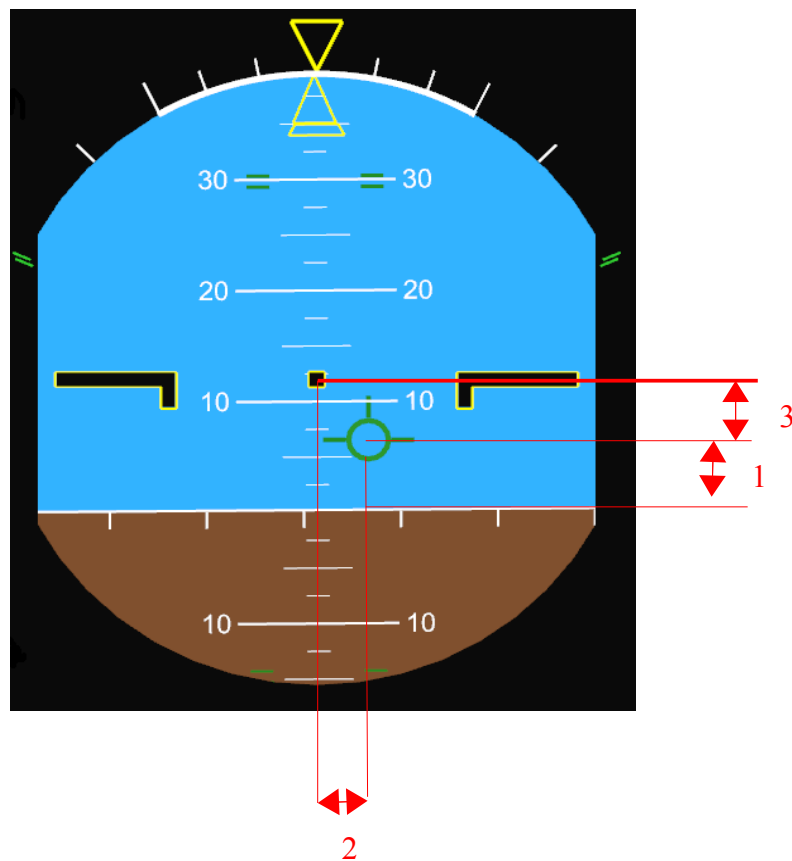
3.6. Heading Tape



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- 1: Magnetic heading index
- 2: Magnetic heading target. If target is out of scale range, then the numeric value is shown either left or right of the scale in the same color as the index.
- 3: Actual magnetic track

3.7. Flight Path Vector



The Flight Path Vector (FPV) is only shown when in Track/FPA mode (see FCU section)

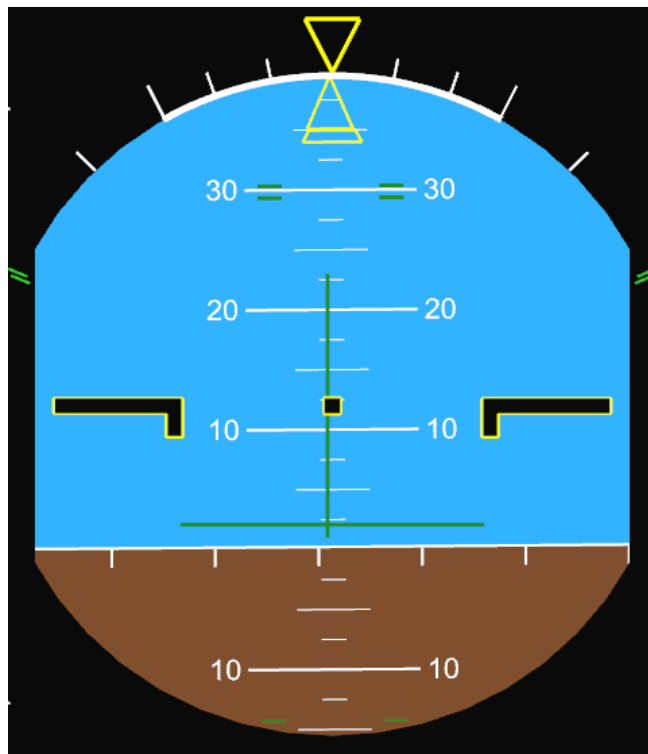
- 1: Flight Path Angle
- 2: Drift angle
- 3: Angle of attack

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3.8. Flight Director

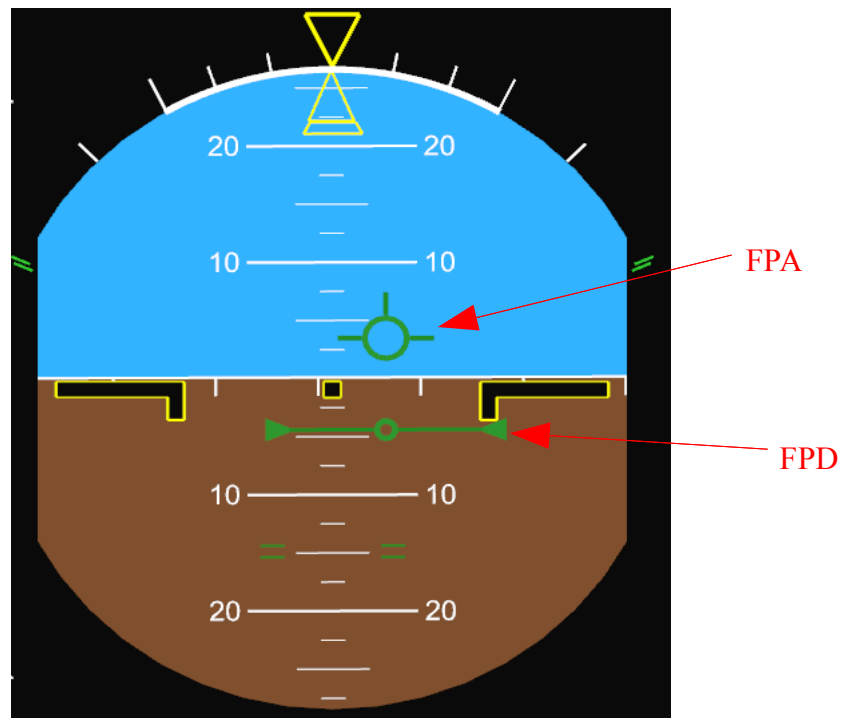
As of Beta 5, the Flight Director is not working properly. It shows the right direction but the deviation is most of the times greater than it should be.

3.8.1. HDG – V/S mode



In HDG-V/S mode, the FD shows two green bars: pitch and roll. To follow the FD guidance, centers the ACFT symbol on both bars.

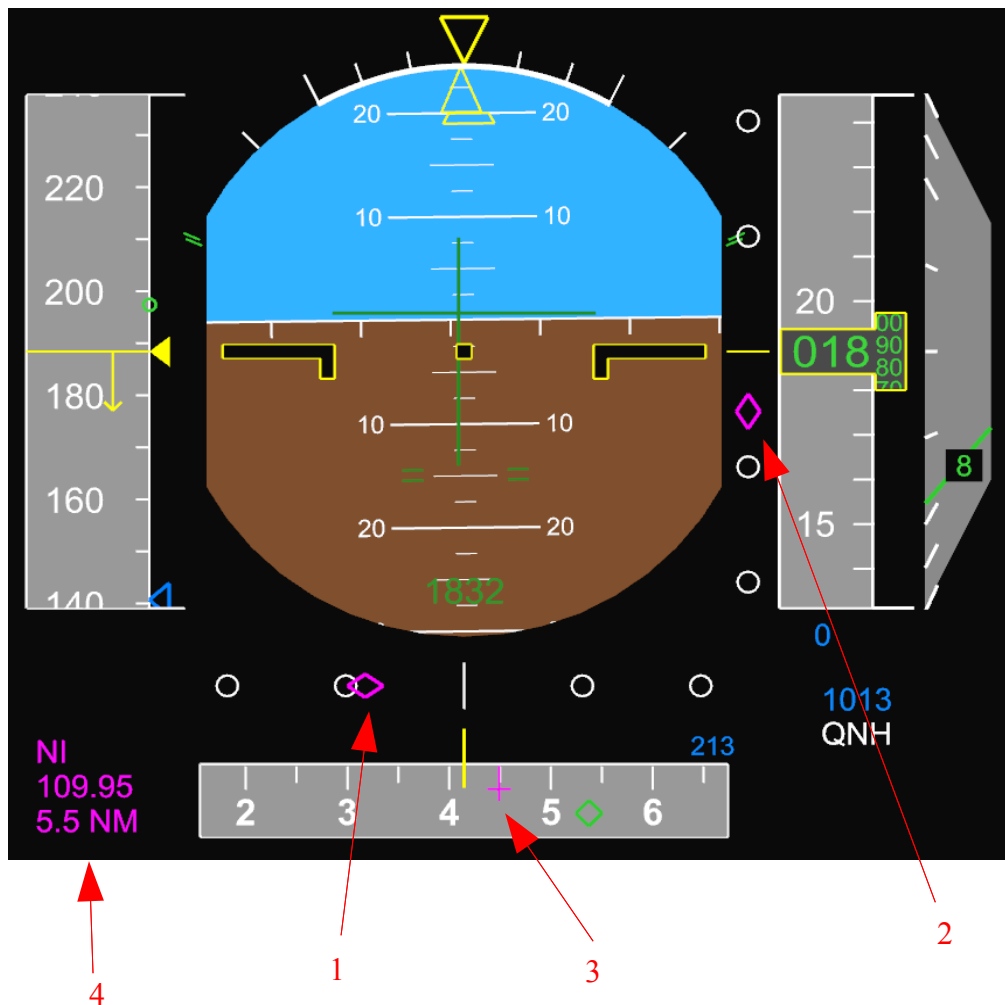
3.9. Track-FPA mode



In TK/FPA mode, the FD shows the Flight Path Director (aka the “Bird”). You need to center the FPD on the FPA to achieve the correct pitch attitude, and roll in order to get the FPD horizontal (as in the picture above).

3.10. ILS and V/DEV deviation scales

3.10.1. ILS trajectory deviation

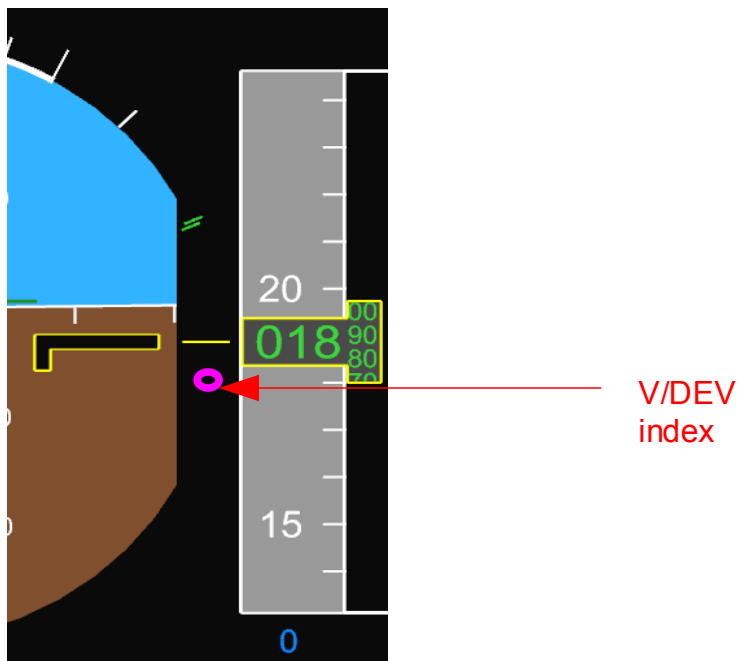


The ILS scales appear when an ILS frequency is entered, either via the MCDU or the Radio Management Panel (RMP), and the signal is received.

- 1: Localiser Course Deviation Indicator index and scale
- 2: Glidepath Deviation Indicator index and scale
- 3: Localiser magnetic course
- 4: ILS data : ID, frequency and DME distance if there is a DME co-implanted with the GP.

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3.10.2. V/DEV



The V/DEV index appears at the engagement of descent (at TOD or on manual activation of DES mode).

During a non precision approach, the V/DEV symbol should be a rectangle, but it's not yet implemented.

3.11. Flight Mode Annunciator (FMA)

The FMA is a summary of FMGS mode status and will be discussed later on in the [AP/FD and A/THR section](#)

3.12. Flags and messages

They are not yet implemented.

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4. The Navigation Display (ND)

4.1. General

The ND has five modes, each representing different data:

- ILS rose mode
- VOR rose mode
- NAV rose mode
- NAV arc mode
- Plan mode

NAV arc and rose mode display the same data, but arc only shows the 90° forward sector whereas rose modes show a 360° sector.

There are six range modes: 10NM, 20NM, 40NM, 80NM, 160NM and 320NM. They do not affect the way data is displayed.

ND modes and range can be selected via the EFIS panel, next to the FCU.

- 1: Active flight plan track.
- 2: Active Point. The magenta number is a constraint (here FL100)
- 3: Non active point.
- 4: Secondary Flight Plan track (if MCDU page is a SEC page)
- 5: Active point data block. It shows the name, the magnetic bearing and the distance to the point.
- 6: Range mark.



- 1: Bearing pointer 1 and NAV1 data block.
- 2: Bearing pointer 2 and NAV2 data block.
- 3: Cross track error. 0.6L means the ACFT is 0,6 NM left of the FPLN track. R would be right...

The bearing pointers appear in all modes except Plan mode. The color is green for ADFs and white for VORs. You can select to display them or not via the EFIS.

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4.5. Plan mode



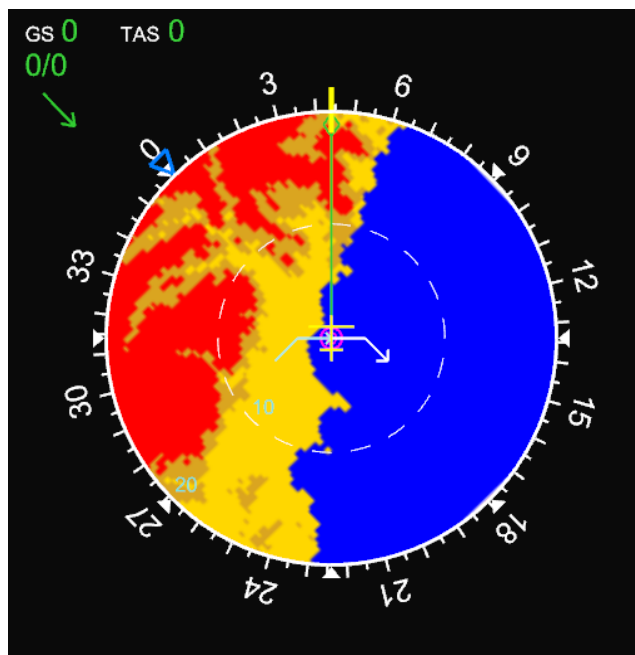
The PLAN mode shows a map centered on the 2nd line point in the MCDU FPLN page. It is oriented relatively to the true north.

- 1: ACFT symbol
- 2: Map reference point and data block.
- 3: Cross track error

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4.6. EGPWS

When Terrain On ND is selected, the ND display (in all modes) the terrain elevation according to the aircraft reference altitude in colors. The aircraft reference altitude is the ACFT altitude or the altitude expected in 30s if descending more than 1000 ft/minute.



Color code:

- Deep blue: sea or ocean
- Black: 2000ft below reference altitude
- Light green: 2000 to 1000 ft below reference altitude
- dark green:
 - *500 to 1000 ft below reference altitude if gear is up
 - *250 to 1000 ft below reference altitude if gear is up
- Dark yellow: 500ft or 250ft (according to gear) below reference altitude to 1000ft above reference altitude.
- Yellow: 1000ft to 2000ft above reference altitude
- Red: higher than 2000ft above reference altitude

You can switch ON/OFF the EGPWS via the MCDU MENU (TERR ON ND button on the main panel in the real ACFT), or with the corresponding FSUIPC offset (see offsets table at the end of the guide).

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4.7. TCAS

The Traffic Collision Avoidance System (TCAS) use the transponders of all aircraft in the vicinity to detect risks of collision. It represents on the ND the position of other traffic to help acquire a situation awareness.

It can detect traffic 40NM from ACFT position and ± 9900 ft from ACFT altitude. There are four levels of risk, each represented by a different symbol on ND:

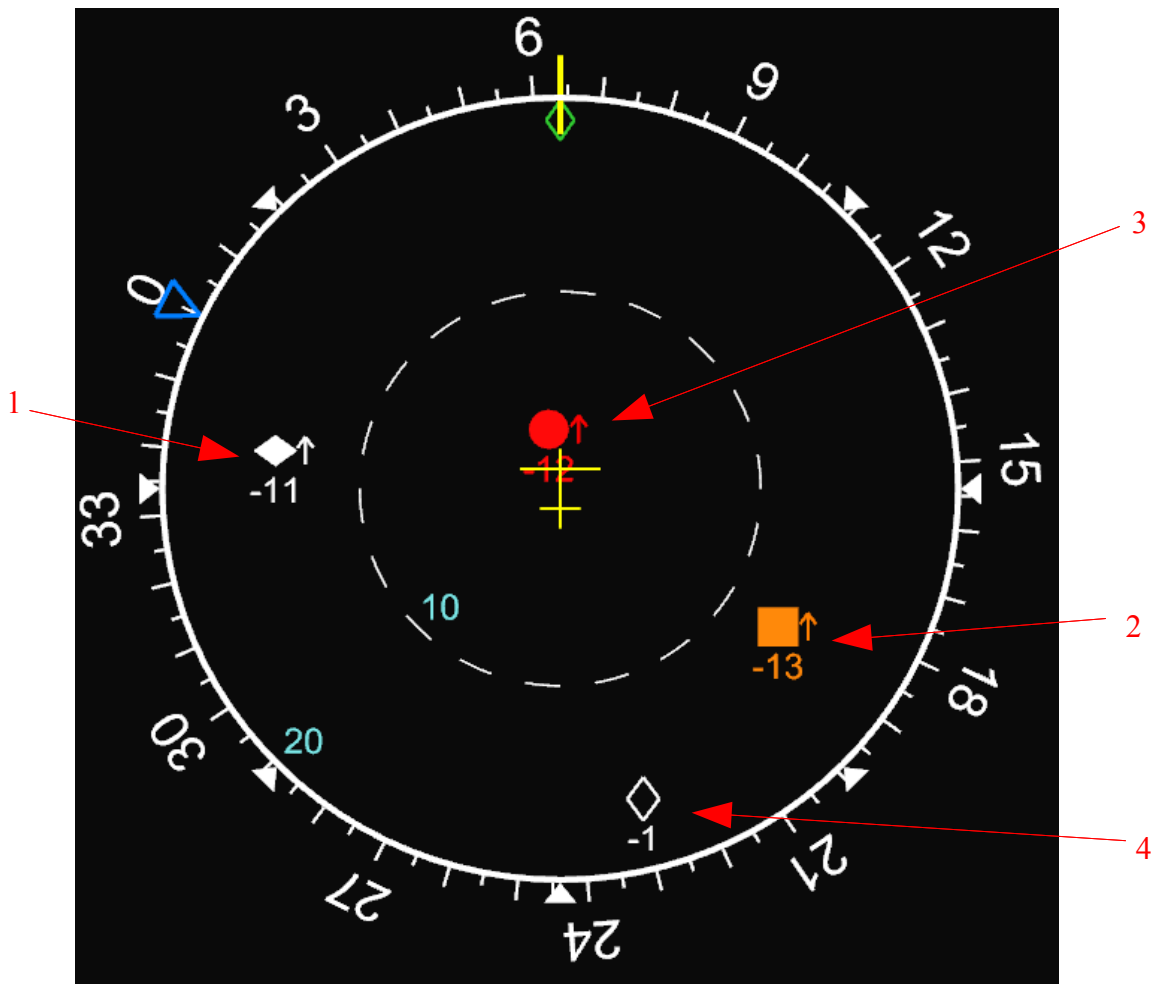
- 1: Proximate: No collision risk. Intruder within 6NM laterally and ± 12000 ft vertically
- 2: Traffic Advisory (TA): Potential collision risk. Estimated time of closest position ≤ 40 s.
- 3: Resolution Advisory (RA): real collision risk, Estimated time of closest position ≤ 25 s
- 4: Other intruder: no risks of collision.

For each type of symbol, the number below is the altitude difference in hundred of feet, and the arrow is the vertical trend (the difference between the two aircraft vertical speed).

For TA alerts there is an aural warning 'TRAFFIC TRAFFIC', and if the ND range or mode is not adequate, an amber flag appears on the ND.

For RA alerts there is an aural warning 'CLIMB CLIMB' or 'DESCEND DESCEND' and a visual aid on the PFD vertical speed indicator. If the ND range or mode is not adequate, a red flag appears on the ND.

When an RA or TA is over, an aural message 'Clear of conflict' is played.



In order for the TCAS to function, you need to set your transponder on mode C, and the TCAS on any mode besides STBY. You can do so via the MCDU MENU page.

TCAS modes are:

- STBY: TCAS doesn't provide any traffic information.
- TA: only TA alerts are provided (RA's are treated as TA's). Can be useful in some cases such close runways, or emergency situation.
- TA/RA: all intruders displayed.

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It is possible to inhibit proximates and other intruders via the MCDU MENU page (on the real aircraft via the transponder panel). TA's and RA's are always shown.

- ALL: Proximates and intruders are shown at all time if within ± 2700 ft
- THRT: Proximates and intruders are shown only if within ± 2700 ft AND a TA or RA is present.
- ABV: Proximates and intruders are shown at all time if within +9900ft and -2700ft
- BLW: Proximates and intruders are shown at all time if within -9900ft and +2700ft

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5. Engine / Warning Display E/WD

5.1. General

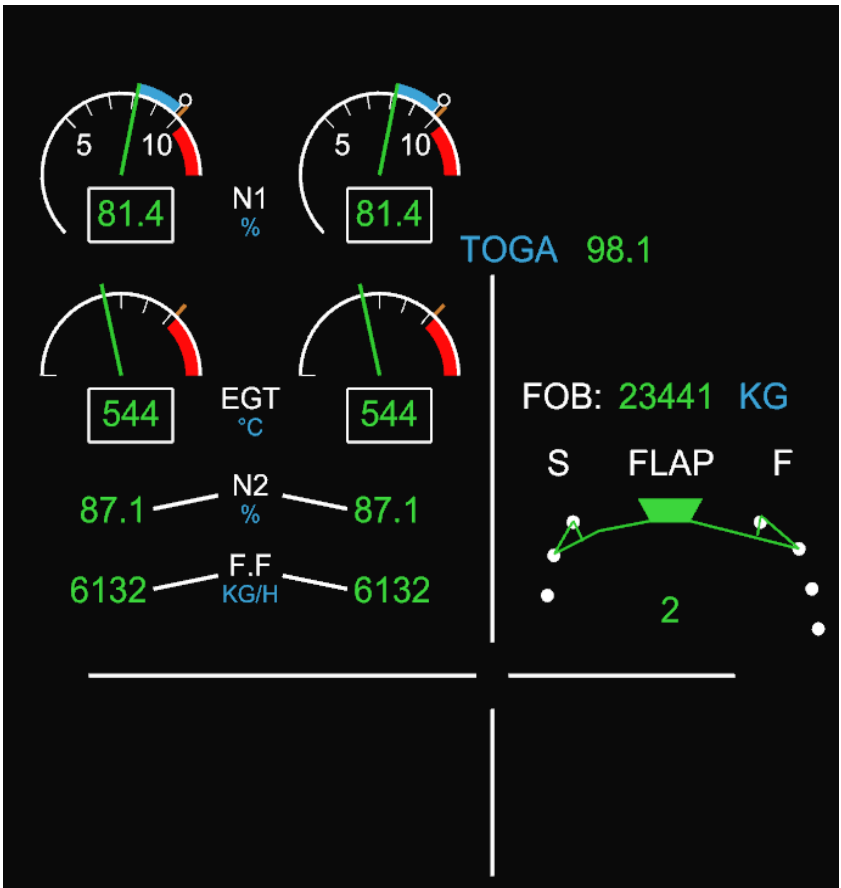
The E/WD, usually displayed on the upper ECAM, presents various important information on the ACFT system.

It is divided into four parts. The upper left part part is reserved for engine parameters. The upper right part is for fuel and flaps.

The lower two parts are for ECAM failure, warning and memo messages. For the time being, only a few messages are displayed.

There are 2 different display for the E/WD, depending on the type of engines used. If you use CFM, set the E/WD display to N1 aircraft configuration file.

The EPR version is just eye candy, in the sense the ATHR will still be working with N1 values instead of EPR, but the displays should be OK. I won't detail this version until it's more advanced.



- 1: Analog pointer
- 2: Numeric value
- 3: Small white circle: position of Thrust lever.
- 4: Amber line: Max N1.
- 5: transient N1: difference between commanded N1 and actual N1. Only displayed with A/THR on.
- 6: Max permissible N1: starts at 104%, it's the prohibited area of N1.

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5.2.2. EGT

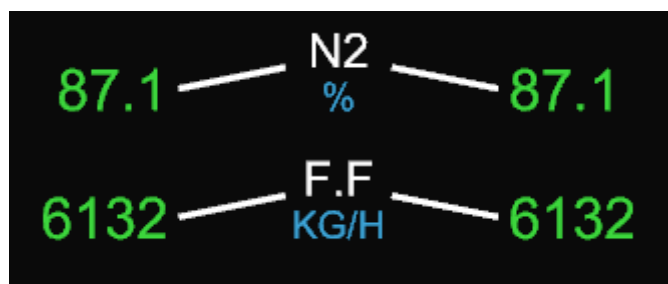
This indicator show the Exhaust Gas Temperature in Celsius degrees.



- 1: Analog pointer
- 2: Numeric value
- 3: Max permissible EGT (starts at 950°C)
- 4: Max EGT (915°C)

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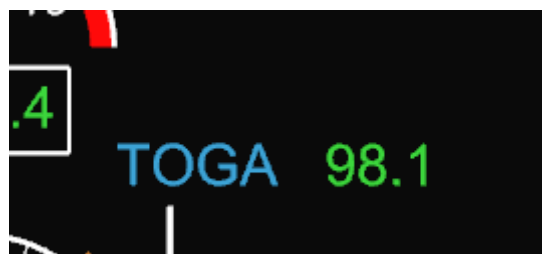
5.2.3. N2 and Fuel Flow



N2 is in percentage of maximum N2.

Fuel flow is in kg/hour.

5.2.4. Lever Setting



It shows the Thrust levers position, and the maximum %N1 value A/THR can deliver when in that position. If the levers are not in a defined notch, only the numerical value appears.

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5.2.5.FOB and Flaps



The FOB (Fuel On Board) shows the total fuel on-board in kg.

The Flap indicator shows the flaps (F) and slats (S) settings. The green triangles show the actual position. The blue ones the selected position (via pedestal lever), they disappear when selected and actual positions match.

The text below the indicator is the selected flaps position. It's green when selected and actual positions match, and blue when flaps/slats are in transit.

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6. System/Status Display – SD

6.1. General

The SD is usually displayed on the lower ECAM, on the main panel. It displays information on most aircraft system, through a set of system pages, in a total of 12 pages. Here is a list of the pages, with the corresponding keypress to access it (with SD page focused):

- Engine (E)
- Bleed (B)
- Cabin pressure (P)
- Electric power (L)
- Hydraulic (H)
- Fuel (F)
- APU (A)
- Air conditioning (O)
- Doors (D)
- Wheels/landing gear (W)
- Flight controls (G)
- Cruise (C)

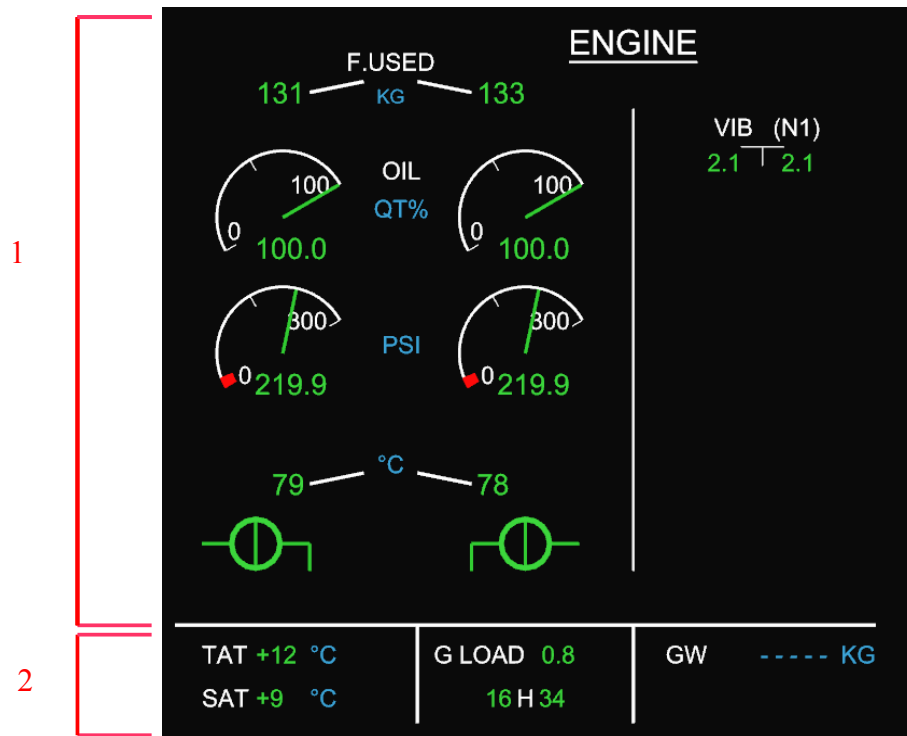
There are additional keypresses for this window: Y and U respectively arms and disarms the ground spoilers, T is the TO configuration Button on the ECAM control panel (located on the pedestal).

The selection of a page can be either manual or automatic. By default, it's automatic, and the page displayed depends on the flight phase, and aircraft configuration.

To manually select a page, push the key as in the list above. To get back to automatic selection, push the same key again.

The description of the pages in this chapter is intended to remain brief. Almost every indicators and labels are modeled. For an in-depth description of SD pages and aircraft systems, I suggest you read material such as FCOMs (see www.smartcockpit.com).

The display is usually organized like in this picture:

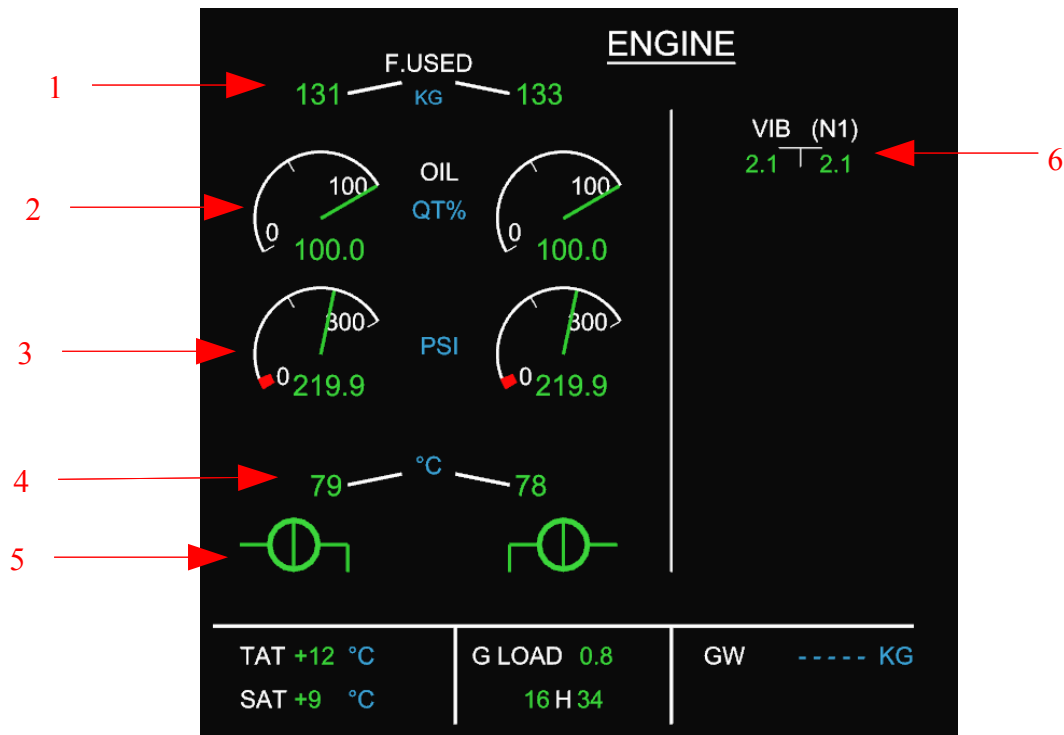


- 1: System Page: varies according to the selected page (either automatically or manually)
- 2: Permanent data. Shows the Total and Static Air Temperatures (TAT & SAT), the G-load, UTC time, and the Gross Weight (GW) if weight data has been entered in the MCDU.

Now let's see each page independently.

6.2. Engine

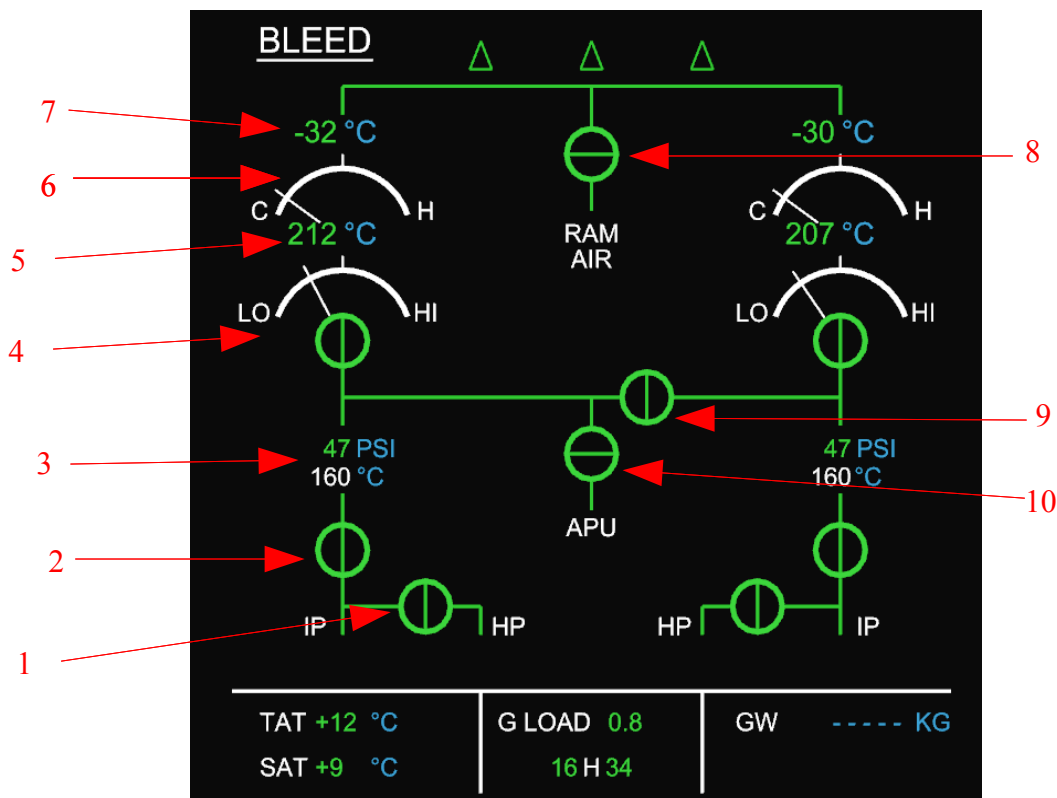
This page show various information for each engine, in addition to the EWD.



- 1: Fuel used in kilograms
- 2: Oil quantity, in %, for each engine
- 3: Oil pressure in PSI
- 4: Oil temperature in Celsius degrees
- 5: Start valve position (here closed)
- 6: N1 fan vibrations.

6.3. Bleed

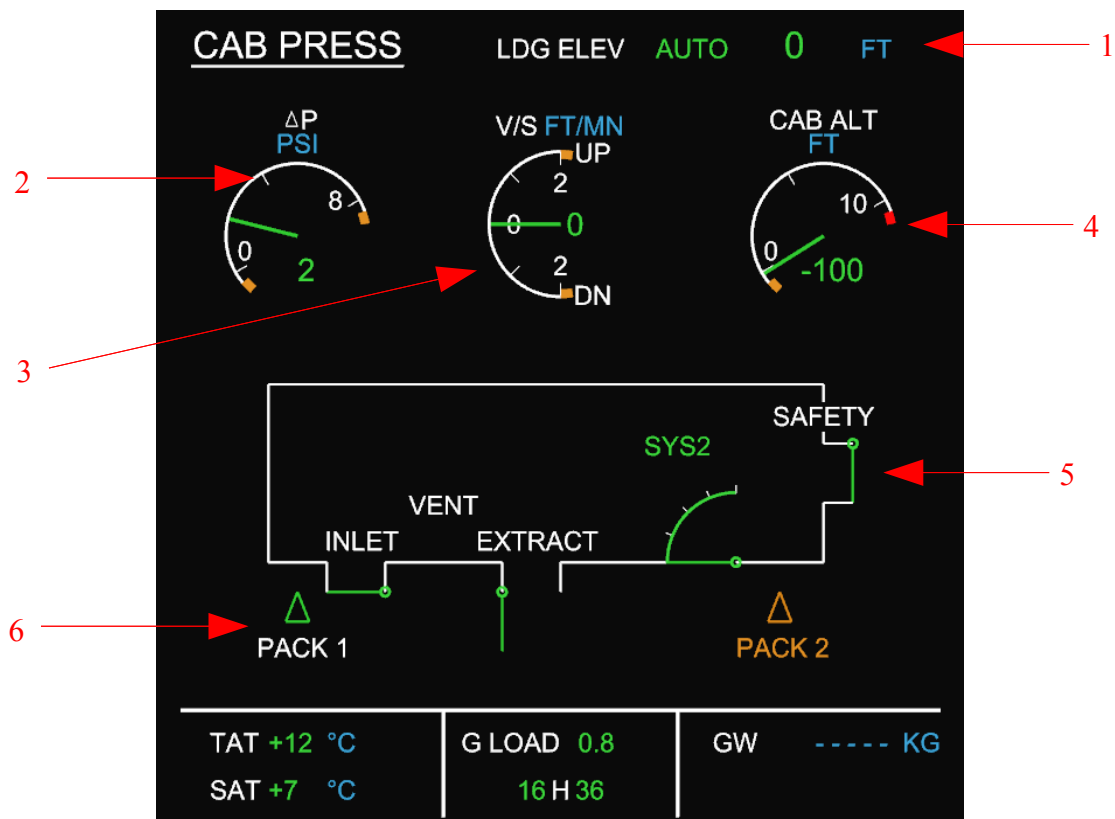
It displays the status of the air bleed system.



- 1: High Pressure valve
- 2: Engine Bleed valve
- 3: Engine bleed pressure and temperature
- 4: Pack flow control valve, and flow indicator
- 5: Pack compressor outflow temperature
- 6: Pack By-pass valve
- 7: Pack outlet temperature
- 8: RAM air valve
- 9: X-Bleed valve
- 10: APU bleed valve

6.4. Cabin Pressure

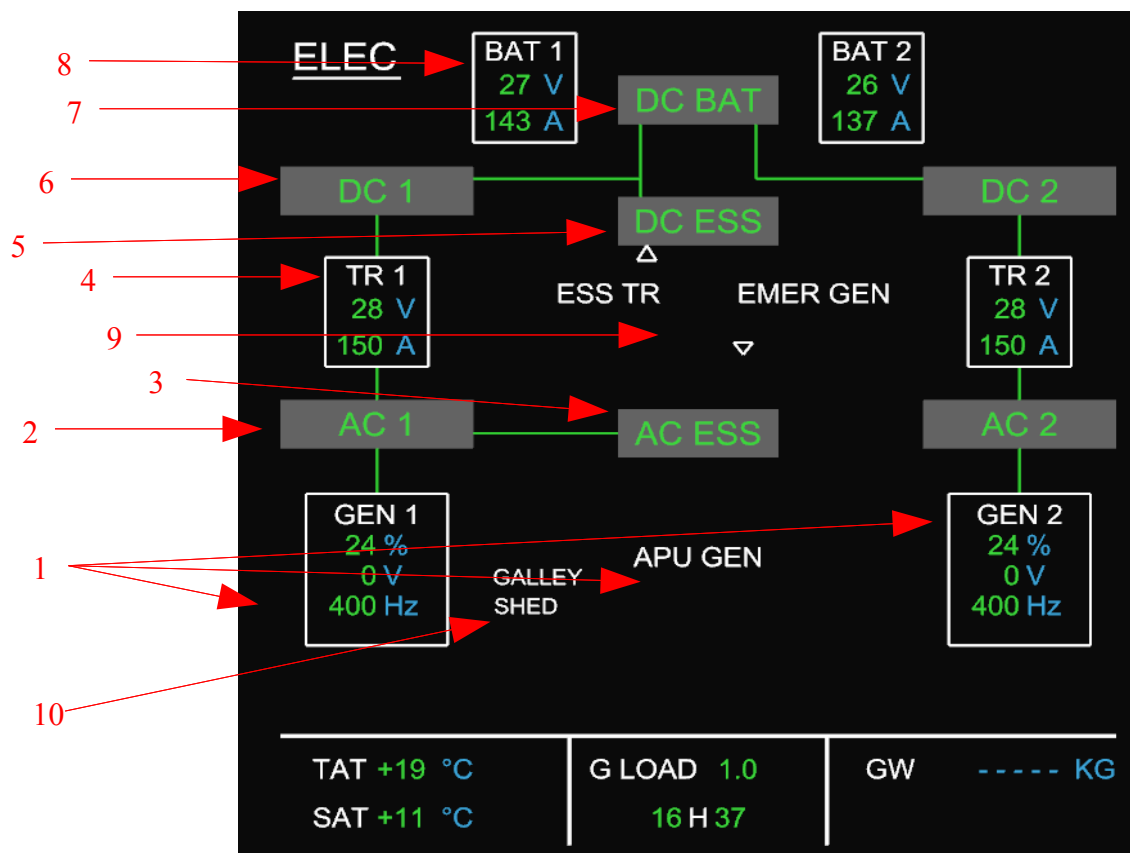
It displays the cabin pressurization system status.



- 1: Landing runway elevation, either selected manually or automatically (cf overhead)
- 2: Pressure ΔP (PSI)
- 3: Cabin vertical speed in ft/min
- 4: Cabin altitude (feet)
- 5: Safety valve
- 6: Packs status

6.5. Electrical System

This page shows the electric power generation and distribution to the different buses.



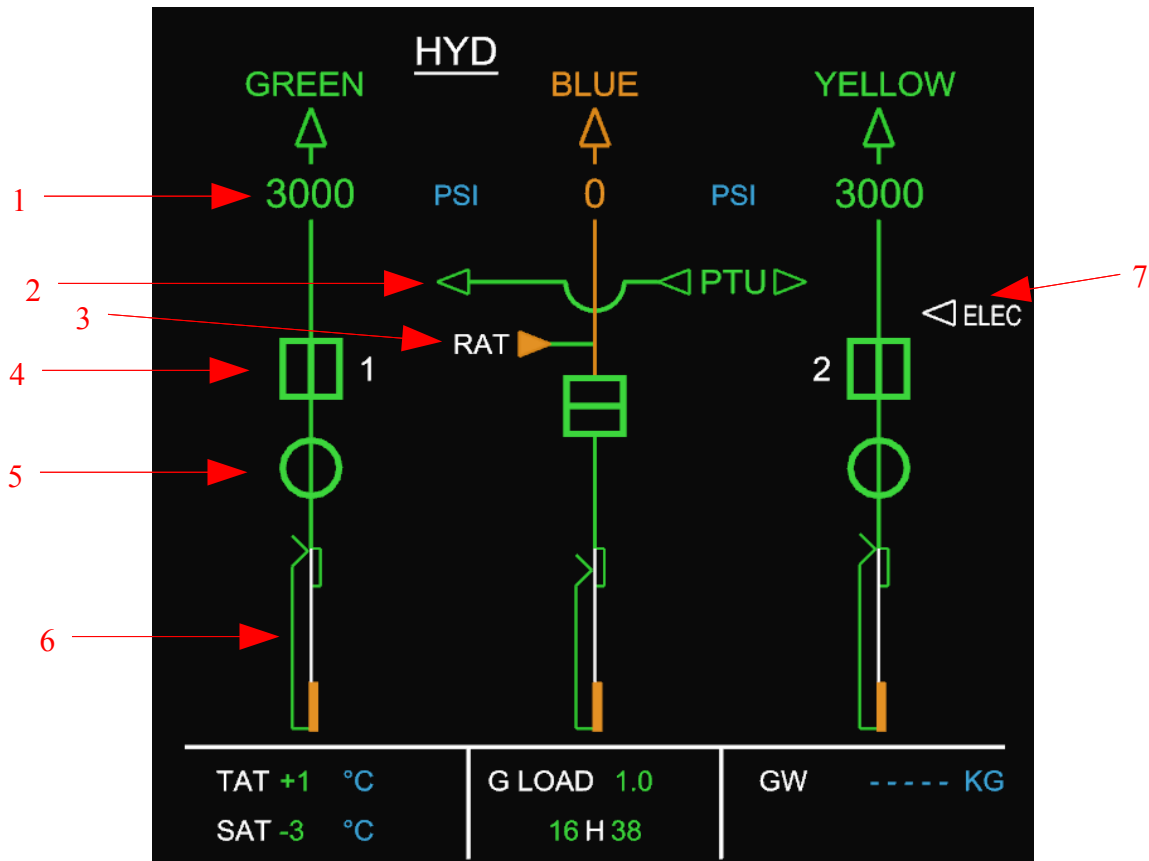
- 1: Normal electric generation status (Voltage, load and frequency). Engine1 &2 generators, APU electric generator and ground power.
- 2: AC buses 1 & 2
- 3: AC essential bus
- 4: Transformer Rectifier 1 & 2
- 5: DC essential bus
- 6: DC buses 1 & 2
- 7: DC battery bus
- 8: Batteries 1 & 2 voltage and current

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- 9: Essential TR and Emergency Generator
- 10: Galley Shed, if a part of the commercial equipment is shed to save electric power.

6.6. Hydraulic

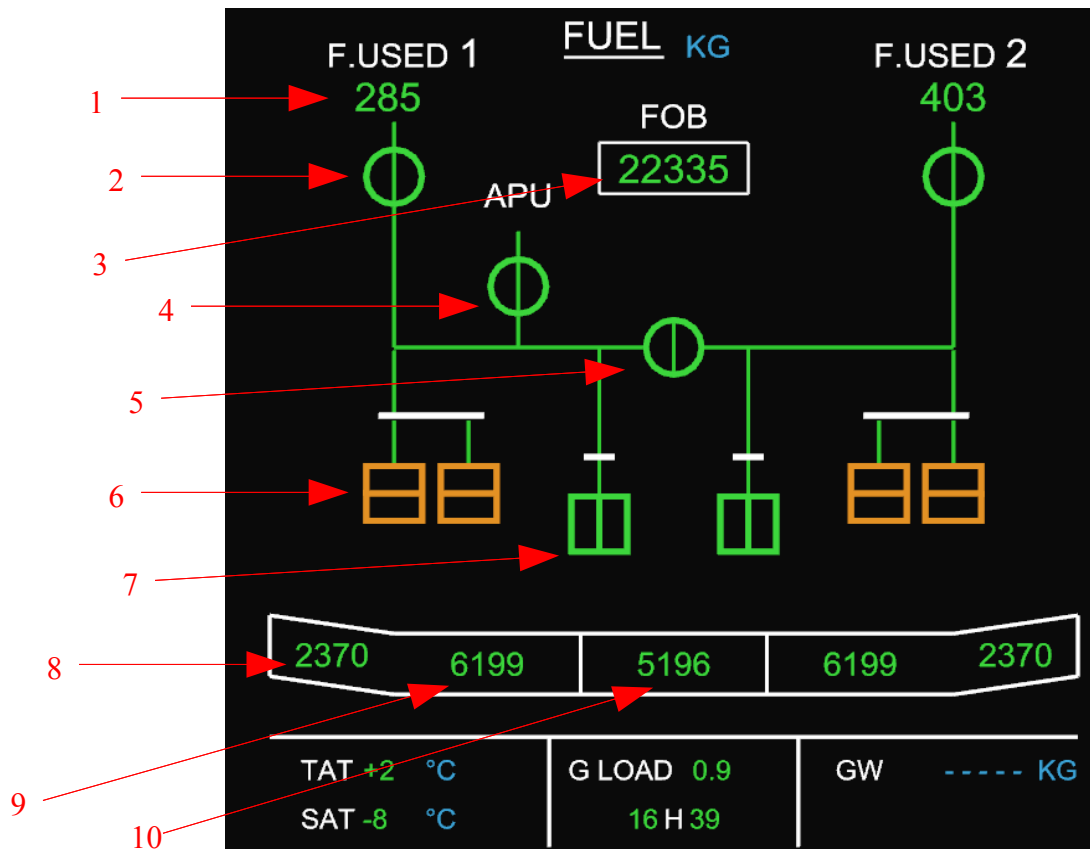
This page shows the hydraulic system status.



- 1: Hydraulic fluid pressure in G, B & Y circuits
- 2: Power Transfer Unit (PTU)
- 3: RAT driven electric pump
- 4: Hydraulic pumps
- 5: Fire valve
- 6: Hydraulic fluid quantity
- 7: Yellow electric pump

6.7. Fuel

This page displays the fuel system status.

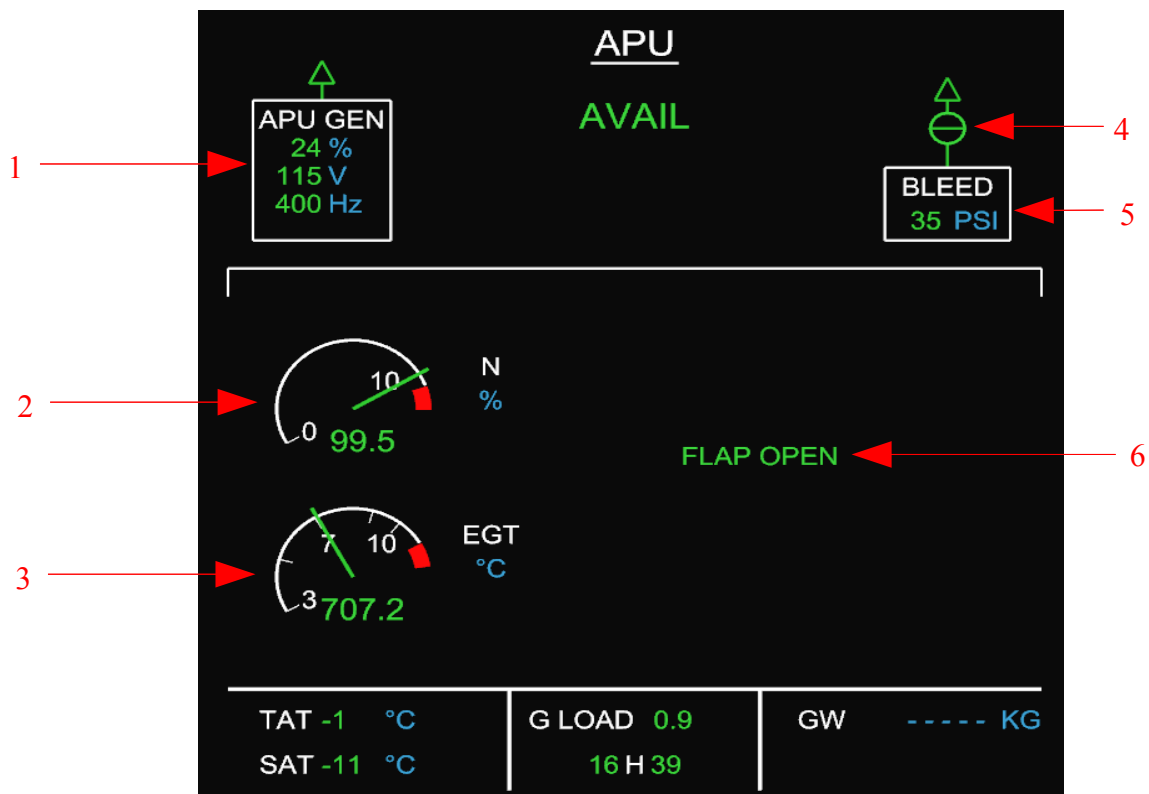


- 1: Fuel used in kilograms
- 2: Engine LP fuel valves
- 3: Fuel On Board in kilograms
- 4: APU LP fuel valve
- 5: Fuel X-feed valve
- 6: Wing tanks fuel pumps
- 7: Center tank fuel pumps
- 8: Outer wing tanks fuel quantity
- 9: Inner wing tanks fuel quantity
- 10: Center tank fuel quantity

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6.8. APU

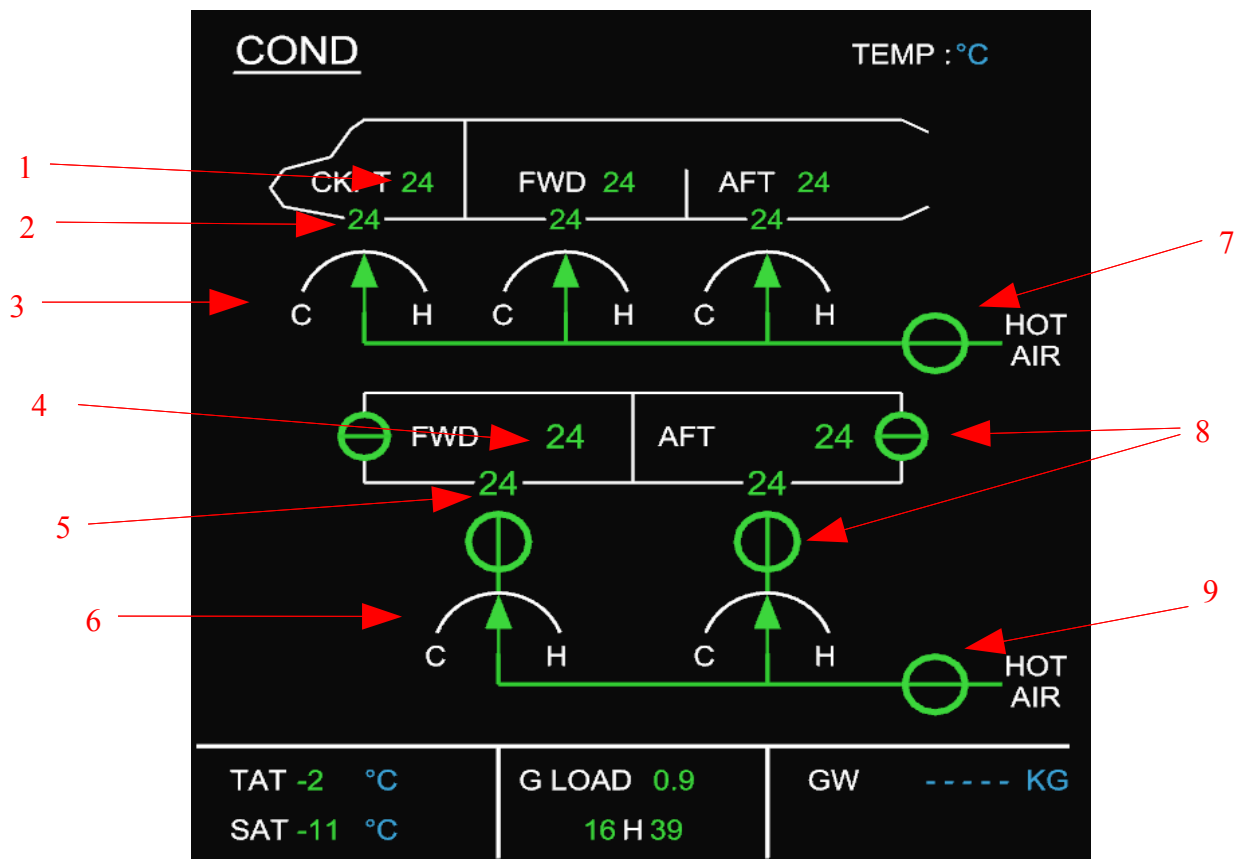
This page shows the Auxiliary Power Unit status.



- 1: APU electric generator status
- 2: APU fan N in percentage of maximum N
- 3: APU Exhaust Gas Temperature in Celsius degrees
- 4: APU bleed valve
- 5: APU bleed air pressure in PSI
- 6: APU flap indication (appears if flap open only)

6.9. Air conditioning

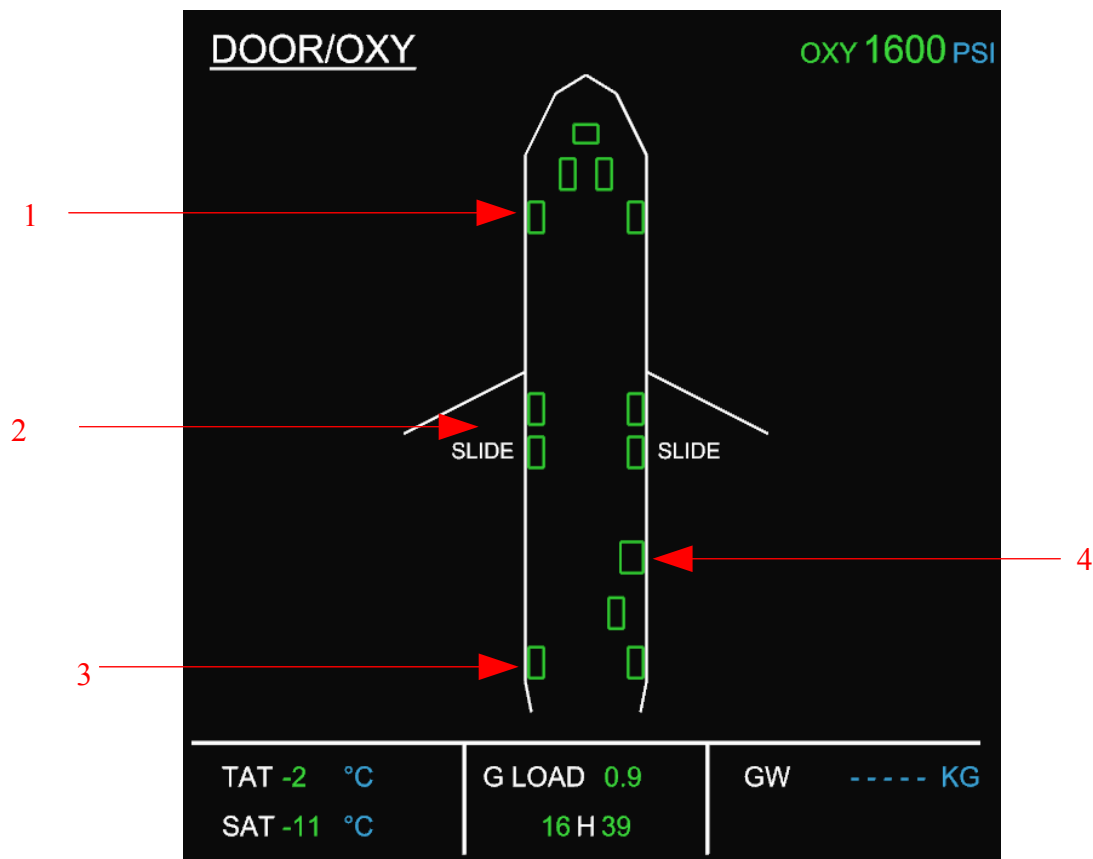
This page shows the air conditioning status.



- 1: Cockpit, forward & aft compartments actual temperature (°C)
- 2: Cockpit, forward & aft compartments desired temperature (°C)
- 3: Trim air valves position
- 4: Forward & aft cargo compartments actual temperature (°C)
- 5: Forward & aft cargo compartments desired temperature (°C)
- 6: Cargo trim air valves
- 7: Cabin hot air valve
- 8: Cargo isolation valves
- 9: Cargo hot air valve

6.10. Door

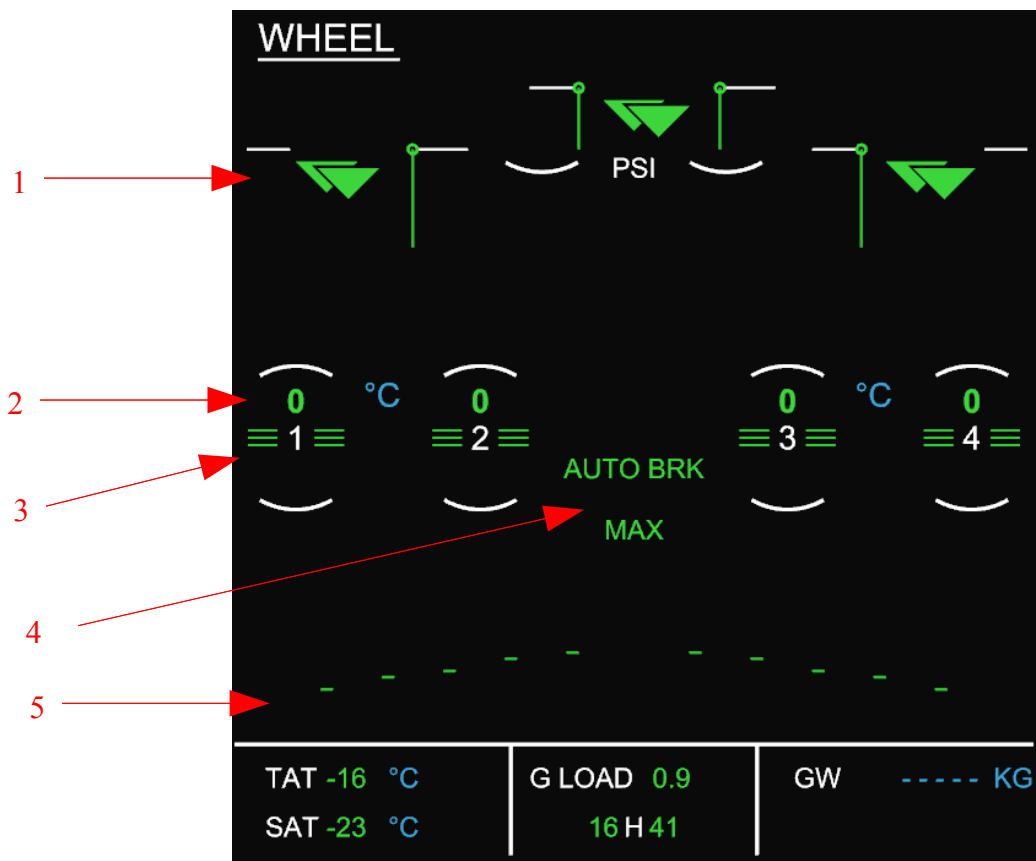
This page shows the status of cabin & cargo doors.



- 1: Forward doors
- 2: Emergency escape doors and slides arming indication
- 3: Aft doors
- 4: Cargo door

6.11. Wheels

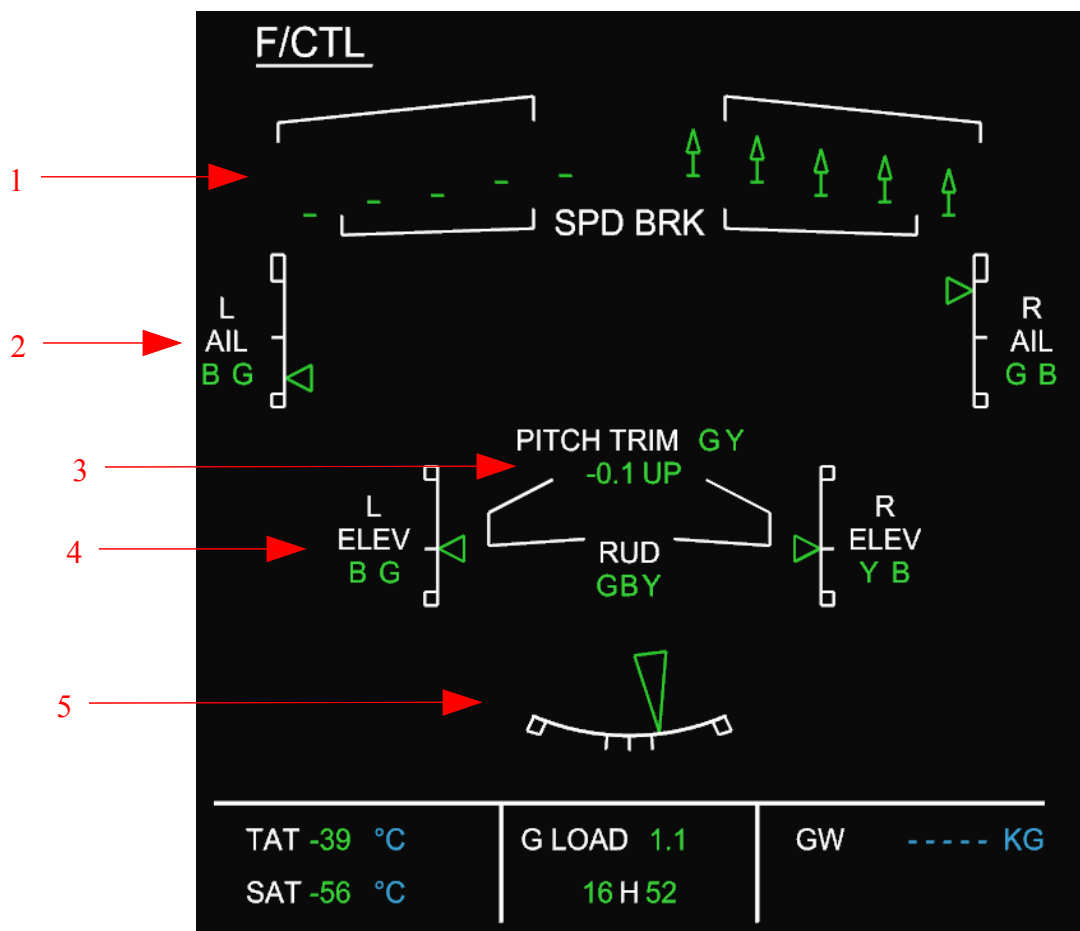
This page shows the status of the landing gear, the brakes and the spoilers.



- 1: Landing gear & gear bay doors status
- 2: Brake temperature
- 3: Autobrake Ready indication
- 4: Autobrake status
- 5: Spoilers indication. Here fully retracted.

6.12. Flight Controls

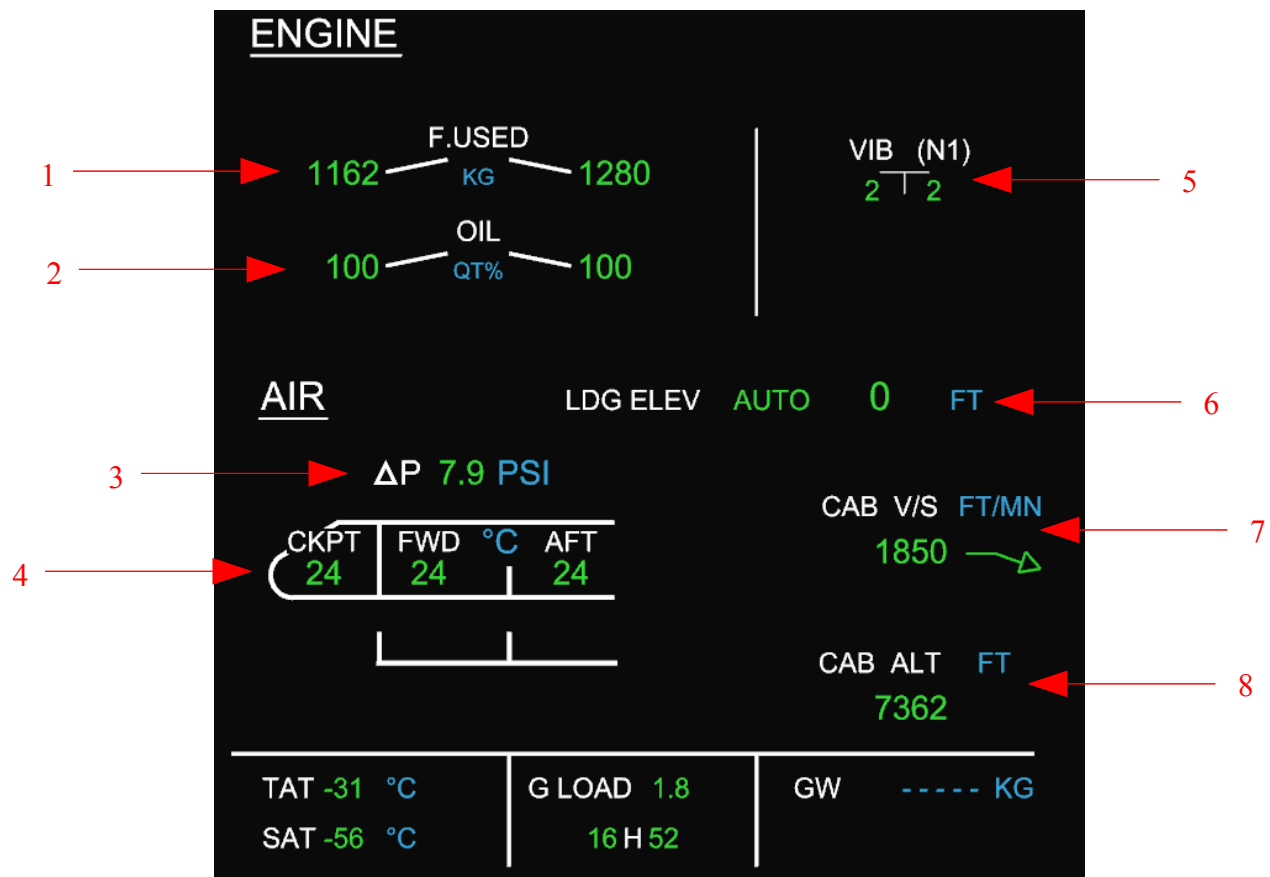
This page shows the position of the flight controls, as well as the functioning of relevant hydraulic circuits.



- 1: Speed brakes. Here, left SBs are retracted and right SBs are extended.
- 2: L & R Ailerons and corresponding hydraulic circuit (Blue and Green)
- 3: Pitch Trim and hydraulic circuits (Green and Yellow)
- 4: Elevators and hydraulic circuits (Green, Blue and Yellow)
- 5: Rudder and hydraulic circuits (Green, Blue and Yellow)

6.13. Cruise

This page shows a summary of engine, air conditioning and pressurization status.

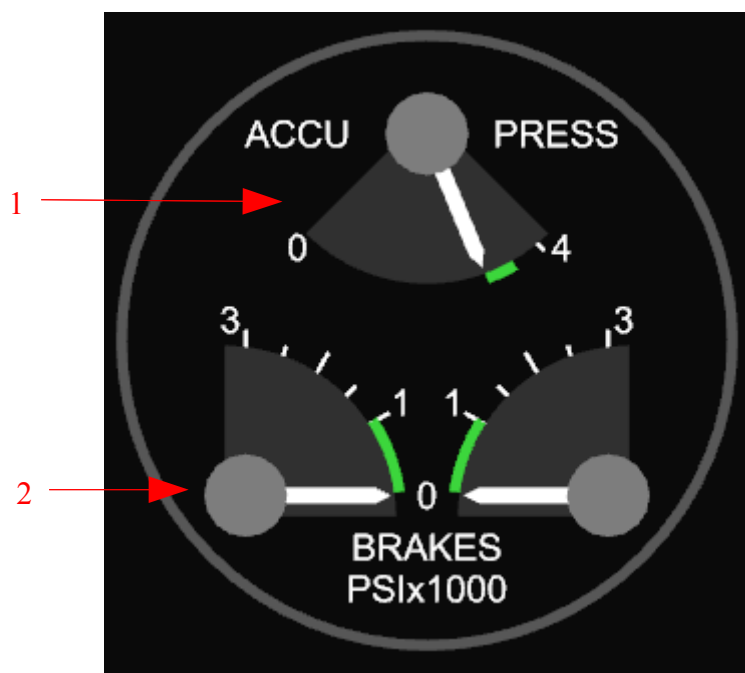


- 1: Fuel used in kilograms
- 2: Oil quantity in percentage
- 3: ΔP in PSI
- 4: Cabin compartments temperature
- 5: Engine N1 vibrations
- 6: Landing elevation in feet
- 7: Cabin vertical speed Ft/min
- 8: Cabin altitude in Ft

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6.14. Brakes Triple Indicator

This is not so to speak part of the SD, but since it's located near the lower ECAM, I decided to implement it in the same executable. You can open it via a right click on the SD, then “Show Brakes”.



- 1: Brakes accumulator pressure.
- 2: Brakes pressure applied. They'll show the pressure only if the brakes are powered by the yellow hydraulic circuit (in case of G failure, or ALTN braking law).

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7. Flight Control Unit (FCU)

7.1. General

The FCU is located on the glareshield. It is one of the main interface between the pilots and the FMGS, along with the MCDU. The real unit has 3 panels: 2 EFIS on each side (CPT and F/O) and the autoflight control.

You can launch the FO EFIS separately, it's logic is the same as the captain one. The two EFIS are independent, they act on the corresponding PFD and ND. QNH values are independent as well.



EFIS

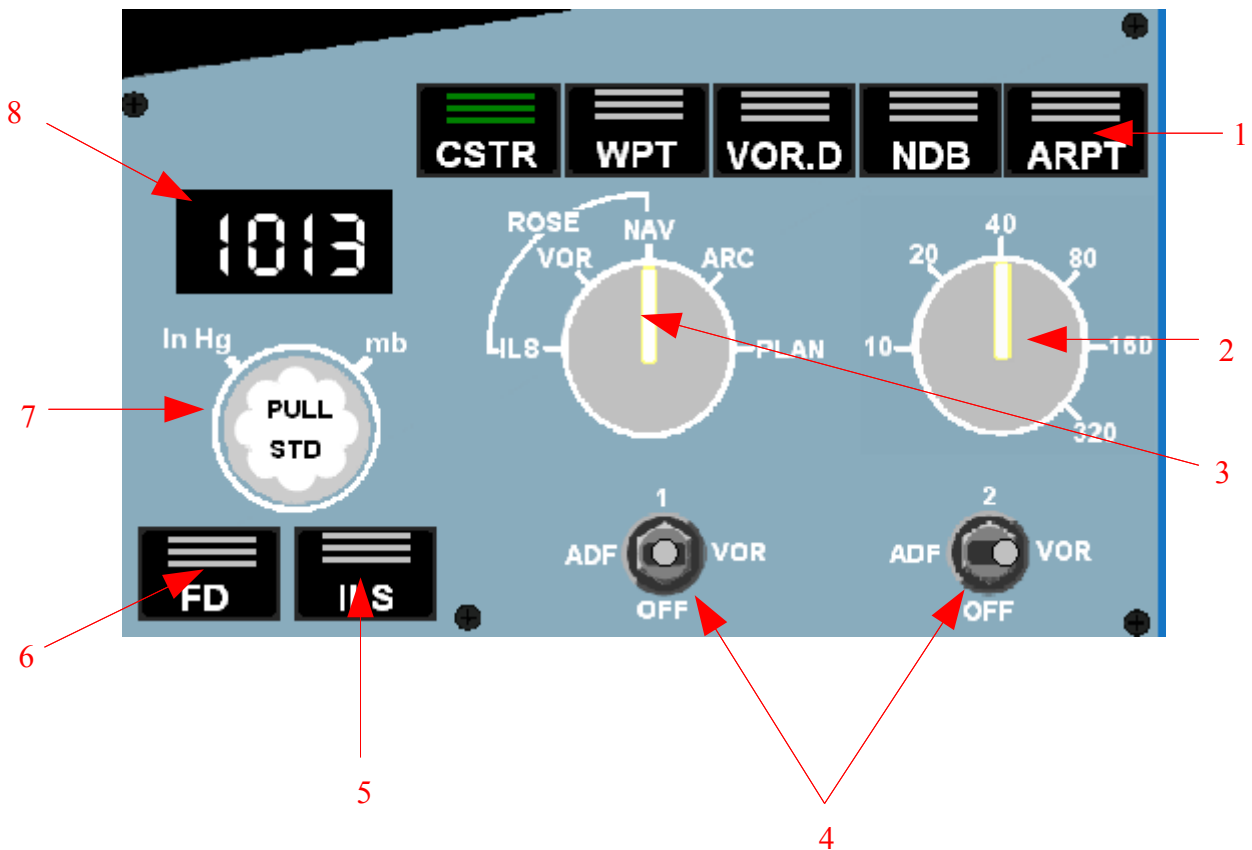
AutoFlight Control

The software logic implemented regarding switches and selectors is quite intuitive:

- Simple switches are pushed with a single click (left or right).
- Rotary encoders (HDG, SPD, ALT, VS and QNH) :
 - turn with the mouse-wheel.
 - Push with left click
 - Pull with right click
- Rotary switch (ND modes and range): Turn with left (clockwise) and right (anti clockwise) click.
- You can click the text next to rotaries or NAV selectors to select what you want directly (i.e. click on 'ARC' to set ND in ARC mode, on 'inHG' to set QNH in inHG, or on 'ADF' to set nav pointers to ADF.)

Response is not necessarily immediate (network and FSUIPC delays issue), so don't triple or quadruple click...

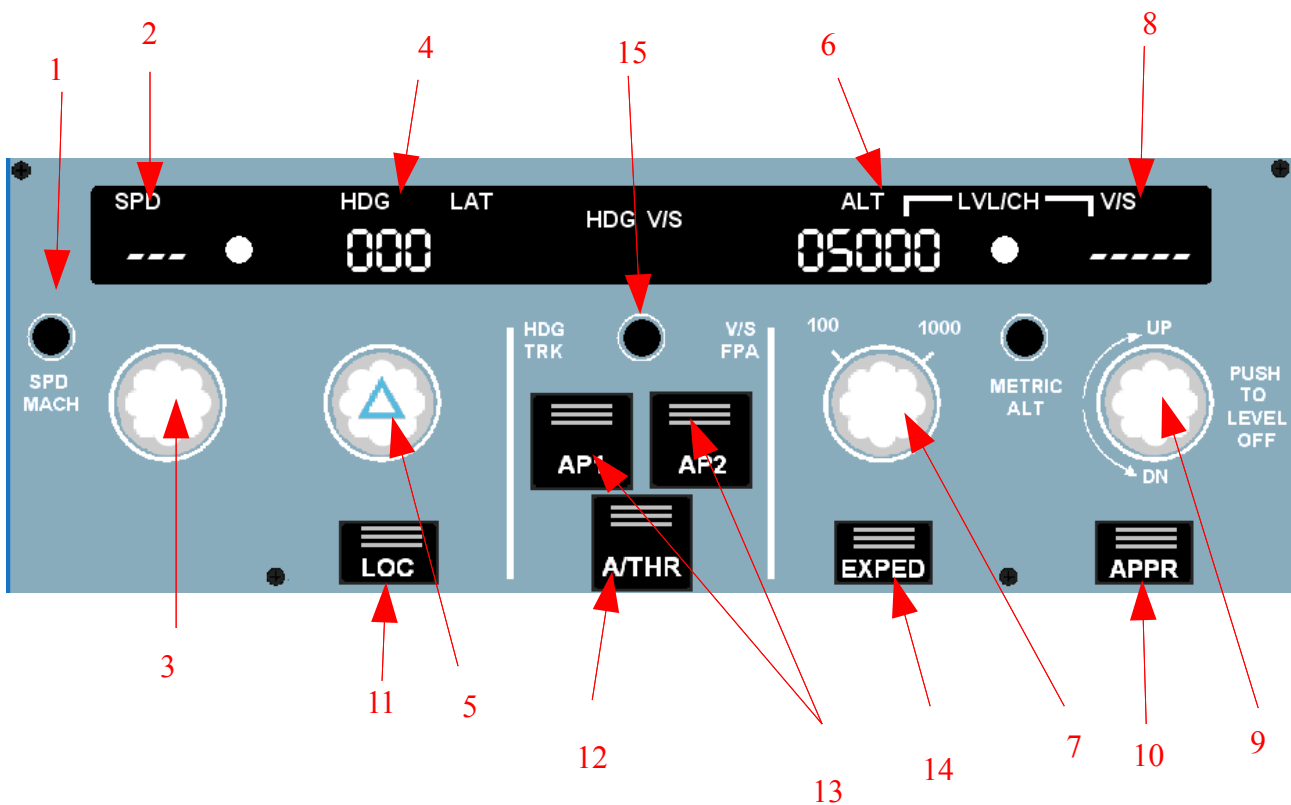
7.1.1.EFIS panel



- 1: Additional ND data display: (only one can be engaged)
 - CSTR: shows constraints in magenta next to flight plan points
 - WPT: shows fixes that are not in the FPLN
 - NDB: shows NDBs that are not in the FPLN
 - VOR: shows VORs that are not in the FPLN
 - ARPT: shows airports
- 2: ND range selection
- 3: ND mode selection
- 4: ND bearing pointers selection
- 5: ILS scales on PFD

- 6: FD bars or FPD on PFD
- 7: Switch barometric pressure between standard (pull) and QNH (push) setting
- 8: QNH displays, in mb or in.Hg. If set to standard, it reads “STD”

7.1.2. Auto-Flight Control



- 1: SPD/MACH switch: click to switch between SPD and Mach mode
- 2: Speed display: shows selected speed or mach number if in selected mode, otherwise shows dashes '---' and white dot next to it shows up.
- 3: Speed controls:
 - Pull to enter selected speed modes
 - Push to enter managed speed modes
 - Mouse-wheel change value by 1 knot or 0,01 mach number

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- 4: Heading display: shows selected heading or track if in selected mode, otherwise shows dashes '---' and white dot next to it shows up.
- 5: HDG controls:
 - Pull to enter selected lateral modes
 - Push to enter managed lateral modes
 - Mouse-wheel to change value by 1°
- 6: Altitude Display: displays altitude selected. Even in managed mode, you need to select an altitude, the managed mode will only manage the vertical profile up(or down) to the selected altitude (which should always be the ATC cleared altitude).
When in managed mode, the white dot shows up.
- 7: Altitude controls:
 - Pull to enter selected vertical modes
 - Push to enter managed vertical modes
 - Mouse-wheel change value by 100ft or 1000 ft.
- 8: Vertical speed display: Shows the selected vertical speed or dashes '-----' if vertical mode is either managed or OP CLB/DES
- 9: V/S controls:
 - Level off: push
 - VS: pull to enter V/S mode
 - Mouse-wheel change value by 100 ft/min
- 10: APPR button: click to engage the approaches modes (LOC or G/S if ILS approach entered in FPLN, APP-NAV / FINAL modes if non precision approach selected).
- 11: LOC pushbutton: not effective yet, use APPR instead
- 12: A/THR pushbutton: arms/disarms A/THR
- 13: AP1 & AP2 pushbuttons: engage/disengage auto pilot. If you click AP2, AP1 will engage, there is no difference yet.
- 14: EXPED pushbutton: not effective yet
- 15: HDG / TRK selector: click to switch between HDG-V/S and TRK-FPA lateral modes. The corresponding modes show up above HDG and VS displays.

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7.2. Airbus FCU philosophy

The FMGS Guidance part is controlled via the Auto Flight Control panel.

Selected mode means the pilots decide of the trajectory of the ACFT whereas Managed means the FMGS computes the trajectory according to the FPLN entered via the MCDU.

On the real airbuses, the selectors for SPD, HDG and ALT are push/pull rotating knobs. To enter selected modes, you'd pull toward you to be in control. To enter managed modes, you'd push toward the FCU to give the ACFT control.

You can read more about selected/managed, guidance & management in the [AP/FD and A/THR](#) section.

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8. Overhead Panel

8.1. General

The overhead panel is the main pilot/aircraft interface concerning the aircraft systems such as bleed air, electric power or hydraulic circuits. It is divided in smaller groups of switches, push-buttons, indicators, etc, according to the concerned system.

For the sake of readability over a computer screen, I decided to divide the overhead panel in two, which we'll call the lower & upper overhead panels (please note the upper OVHD here has nothing to do with the circuit breakers panel on the real A320).

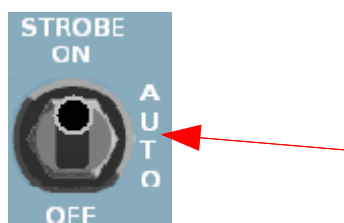
The lower panel is launched whenever you launch the overhead software. If you close this panel, the software will close as well. You can fire up the upper panel with a right click on the panel then "Show upper OVHD". Both panels are resizeable, and position/size will be stores for next start-up.

The main type of switch is the "korry". It's a pushbutton with one or two leds built-in. Usually, the lower part is the state of a function. Depending on the korry, the light will come up only if it's ON (in blue) or OFF (in white). The upper part indicates if the function is faulty (amber or red LED) or available (green LED). The upper part is not always present.



Korry

There are 2 or 3 positions switches such as this one for the strobe light:



You can choose the position you want by clicking on the label directly. So for example, if you want to set the strobe light to automatic mode, just click the "AUTO" label to its right (red arrow).

The same principle goes for the rotary buttons, only you can as well directly click left or right on it, to respectively turn clockwise and counter-clockwise the button.

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Click the labels

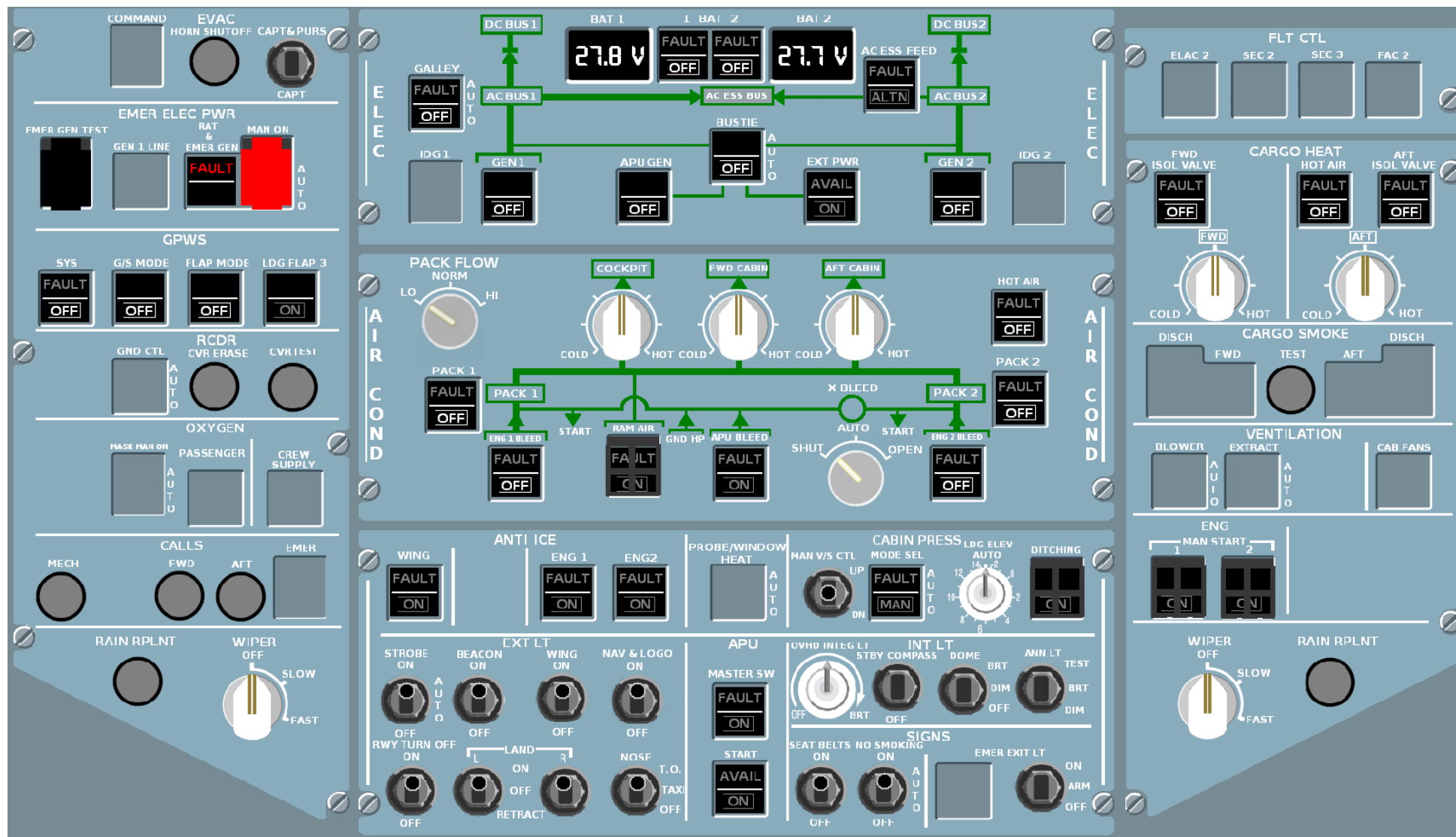
Or left/right click
the rotary

Some of the rotaries (such as cabin temperature or landing levation), won't move even if clicked. To see the value selected, just move the mouse cursor over the rotary and a small label with the value will appear.

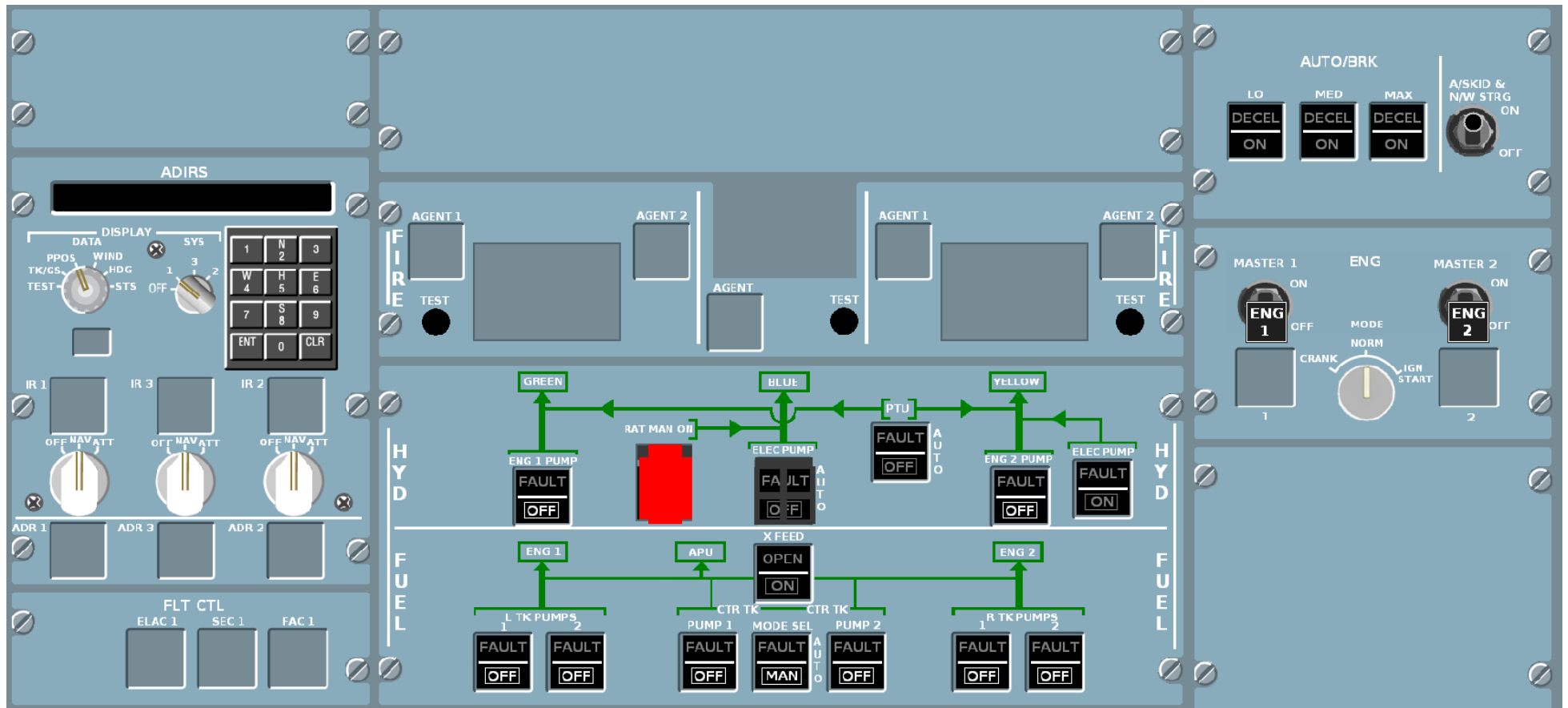
On the upper OVHD, you can show two additional panel, which are not placed on the OVHD on the actual aircraft. They are the AutoBrake panel and the Engine start panel. Since my software simulates the real operations of engine start and autobrake, it seemed necessary to have those controls in handy. However, if you prefer to only use the FSUIPC offsets, you can hide them via the options window of the overhead panel (accessible via a right click on the lower OVHD).

Some switches are guarded, you can only operate them when unguarded. To do so, simply click on the cover. To guard the switch back, simply click on the remaining visible part. If you use the FSUIPC offsets, guarded/unguarded state is ignored.

The gray spots where you can imagine there is a korry will maybe be filed later on...



Lower overhead

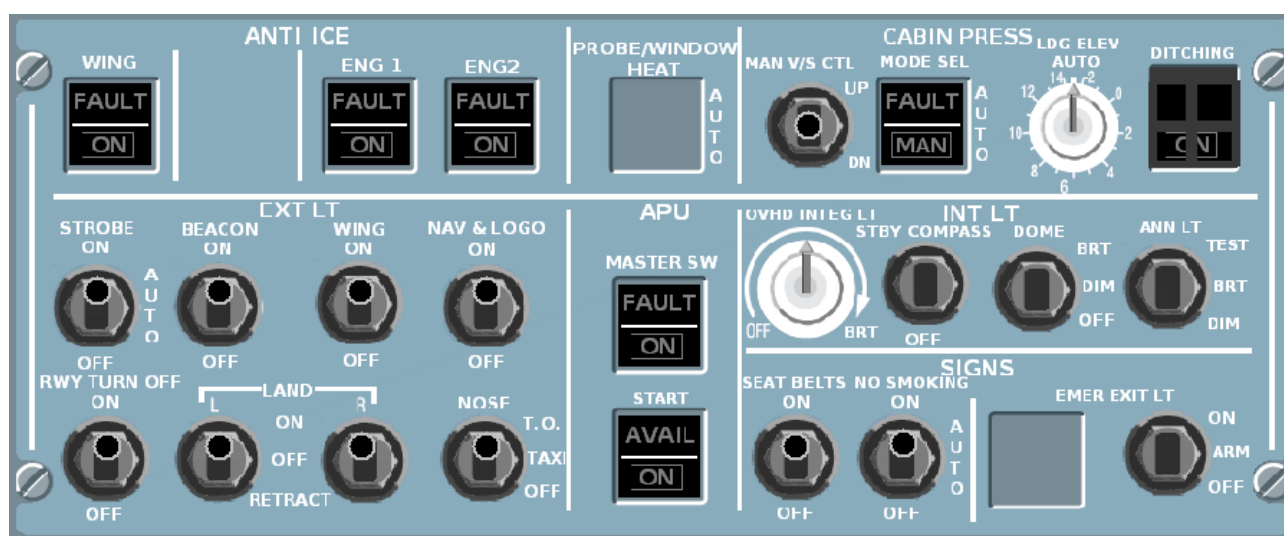


Upper Overhead

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8.2. Anti-ice, Lights, APU, Cabin Pressure,...

All those functions are located on the same sub-panel:



To operate the wing or engine anti-ice systems, simply click on the corresponding korry. The blue light will illuminate.

The exterior lights and interior signs are quite simply operated, click the labels. For the right side landing light, you have to click on invisible spots, placed in the same way as for the left side one.

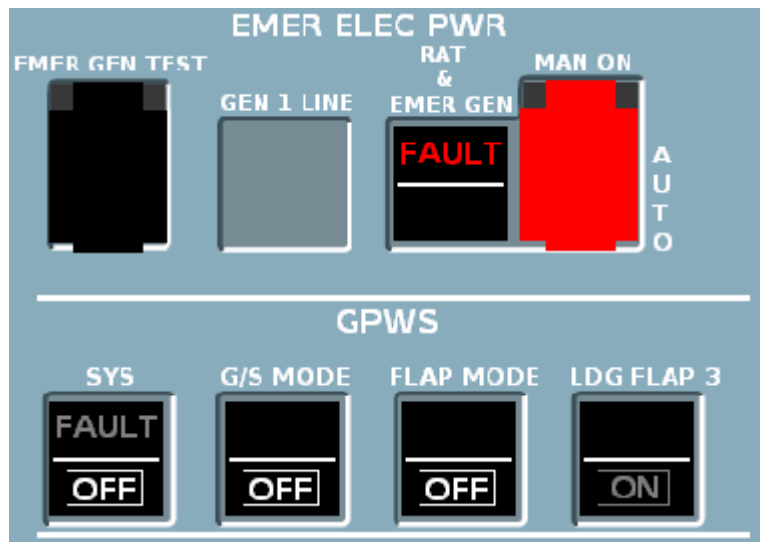
To operate APU, if starting condition are met, you first have to turn ON the master switch, then push the start korry. When APU power is available, the green AVAIL label comes up.

Cabin pressure is managed either automatically, or manually. If you want to use automatic mode, make sure MODE SEL korry is not illuminated. You can select the landing elevation with the rotary (eihter automatic by clicking AUTO label, or manually with left/right clicks). If you want to control pressure manually, make sure MAN is illuminated, then select the cabin climb rate by clicking and maintaining mouse button down on the up or right label of MAN V/S CTL. This switch is spring-loaded to neutral position. There are two different calculators managing pressurization, you can switch by maintaing MODE SEL button pushed down 10 seconds.

Other functions are not yet modeled.

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8.3. Emergency Electric Power, GPWS

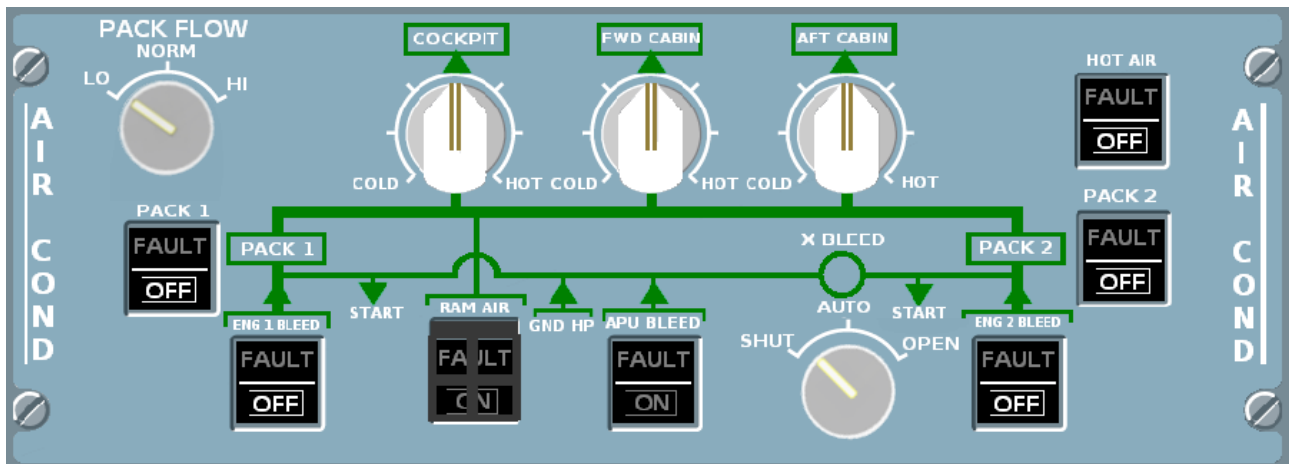


The emergency electric power is produced by a generator driven by the Ram Air Turbine (RAT). The RAT automatically deploys in flight when all other generators are lost. To manually extend it, unguard the red switch and push the korry. The RAT cannot be stowed in flight, it needs maintenance actions on the ground. The korry to the left is not pushable, it simply shows the status of the emergency generator. EMER GEN TEST is not operational.

The GPWS korrys arm/disarm the following system (from left to right):

- SYS: Overall GPWS
- G/S MODE: “glideslope” announcement
- FLAP MODE: “too low flaps” announcement
- LDG FLAP 3 : if landing configuration is flap 3 and not flaps full, then arm this korry to avoid unnecessary warnings on final approach.

8.4. Air conditioning



This panel allows the management of bleed air, used for air conditioning and engine starting.

Bleed air can be obtained from different sources:

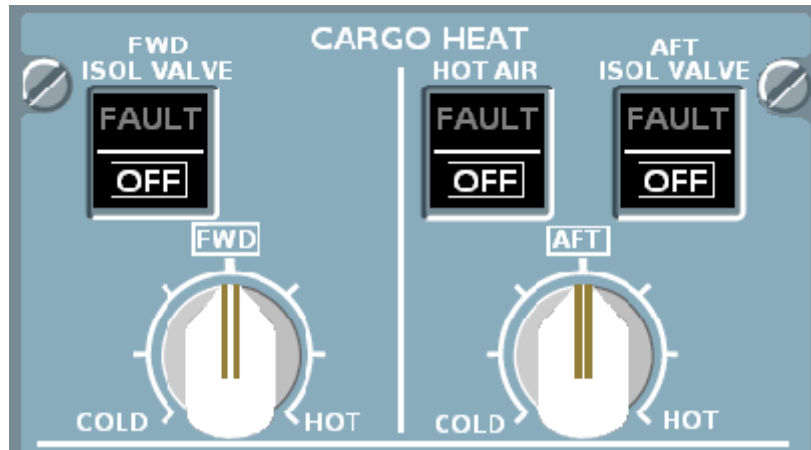
- GND HP: if on the ground, and engine bleeds are not available (click GND HP label to activate)
- APU bleed: if APU is running
- ENG1 & 2 bleed, if corresponding engine is running.

The bleed air is then used either to feed the start valves, or the PACKs, which are compressors to cool air, then thus regulating cabin temperature.

The X-Bleed valve is used to provide bleed air to one side if not available on the other (example: APU bleed to feed engine 2 start valve). Three positions: Shut, Auto or open.

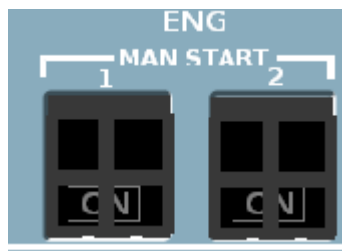
You can select the flow of the PACKs with the PACK FLOW rotary. You can select target temperature in the cabin with the three rotaries labeled COCKPIT, FWD CABIN and AFT CABIN. They are not animated. To select the temperature, you can click on the cold (18°C) or hot labels (30°C), or the green arrow (24°C). To select intermediate temperatures, left or right click to respectively increase/decrease temperature by 1°C.

HOT AIR opens/closes the hot air valve, used to regulate the cold air coming from the PACKs.



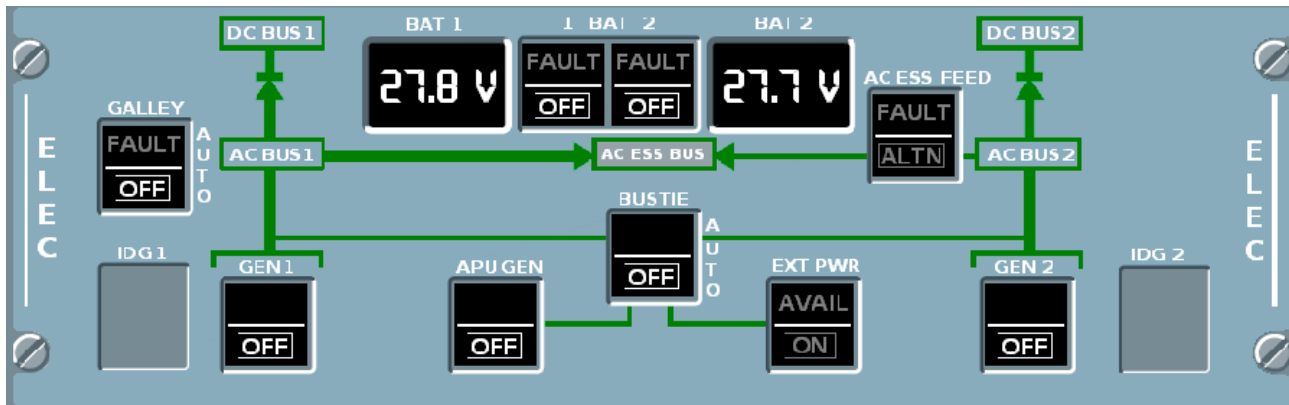
This panel controls the temperature in the cargo hold compartments. Temperature is selected in the same way as the cabin compartments. The korrays control the cargo hot air valve and the isolation valves.

8.5. Engine Manual Start



These guarded korrays are used to start the engines manually, see later on.

8.6. Electric Power



This panel is used to manage electric generation and distribution. Use the GEN1&2, APU GEN to produce electricity with engines or APU running. Use EXT PWT to use electricity coming from a ground generator plugged in, possible only on ground (...) if AVAIL light is on (simulated when both engines are not running).

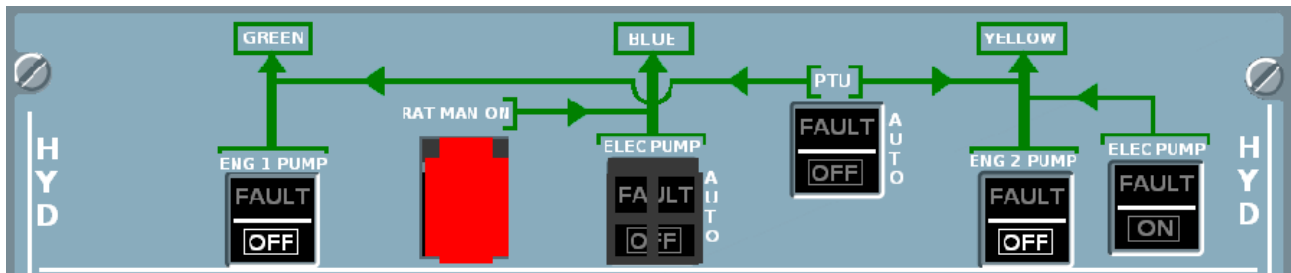
BUS TIE and AC ESS FEED are used to modify distribution of power between generators and AC buses.

GALLEY is used to shed commercial equipment when the generators cannot provide enough power to meet the load of essential aircraft equipment.

BAT 1 & 2 are used to connect the batteries to the DC BAT BUS. Batteries remain connected to DC ESS BUS or the static inverter even if selected OFF. The LCD windows show batteries voltage.

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8.7. Hydraulic system



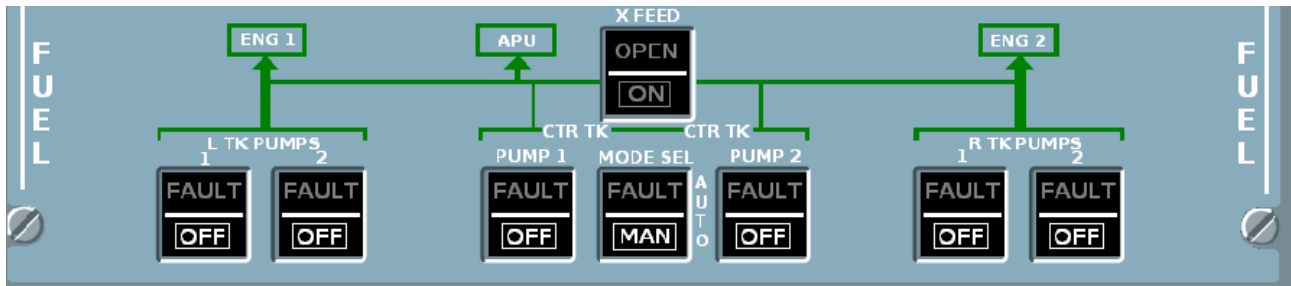
There are 3 hydraulic circuits on the A320 family:

- Green: pressurized thanks to the ENG 1 Pump
- Blue: pressurized by an electric pump, or an emergency pump, powered by the RAT
- Yellow: pressurized thanks to the ENG 2 Pump, or an electric pump

In case of low pressure in green or yellow circuit, the Power Transfer Unit (PTU) can pressurize the two simultaneously (on ground with one or no engine running or pump failure in flight).

You can extend the RAT, here as well, via the red guarded switch.

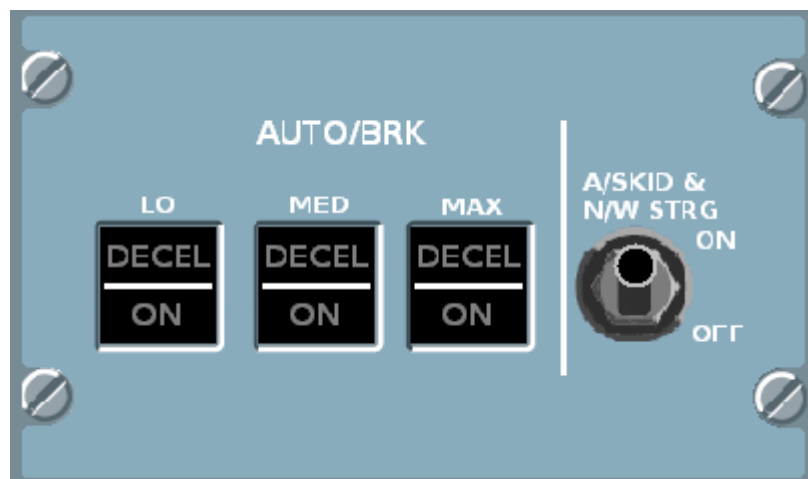
8.8. Fuel



This panel manages the fuel pumps and the fuel X-bleed. If all pumps are ON and MODE SEL is not MAN, then pumps are operated automatically by the aircraft. Otherwise, the center pumps are operated.

X-Bleed allows fuel from one side to feed the opposite engine.

8.9. Auto-Brake

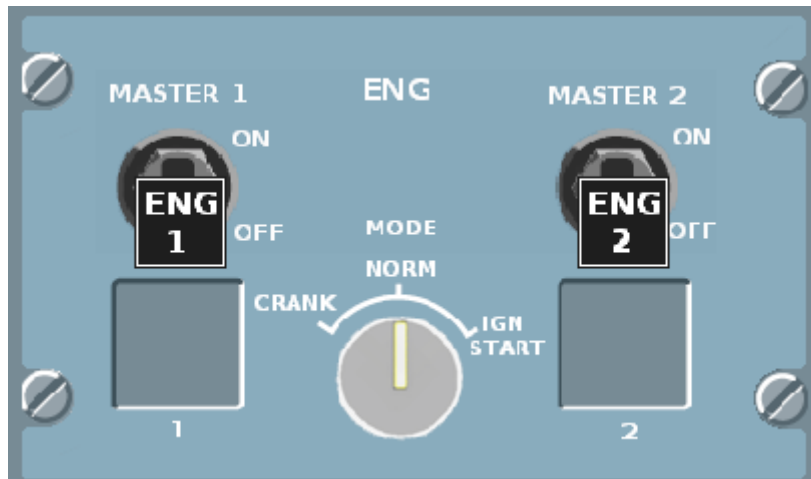


Located on the main instrument panel on the actual aircraft, it controls the auto-brake and anti-skid systems.

Click the korrys to select the level of autobrake desired (push twice to deactivate autobrake). The A/SKID switch is straight forward...

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8.10. Engine Start



To start an engine automatically:

- Make sure start valve has pressure
- Select MODE IGN/START
- Select MASTER switch ON

To start an engine manually:

- Make sure start valve has pressure
- Select MODE IGN/START
- Select ENG MAN START ON on lower OVHD
- Select MASTER switch ON when $N_2 > 20\%$

The fuel LP and HP valves are operated automatically. To abort start or stop an engine, select MASTER switch off.

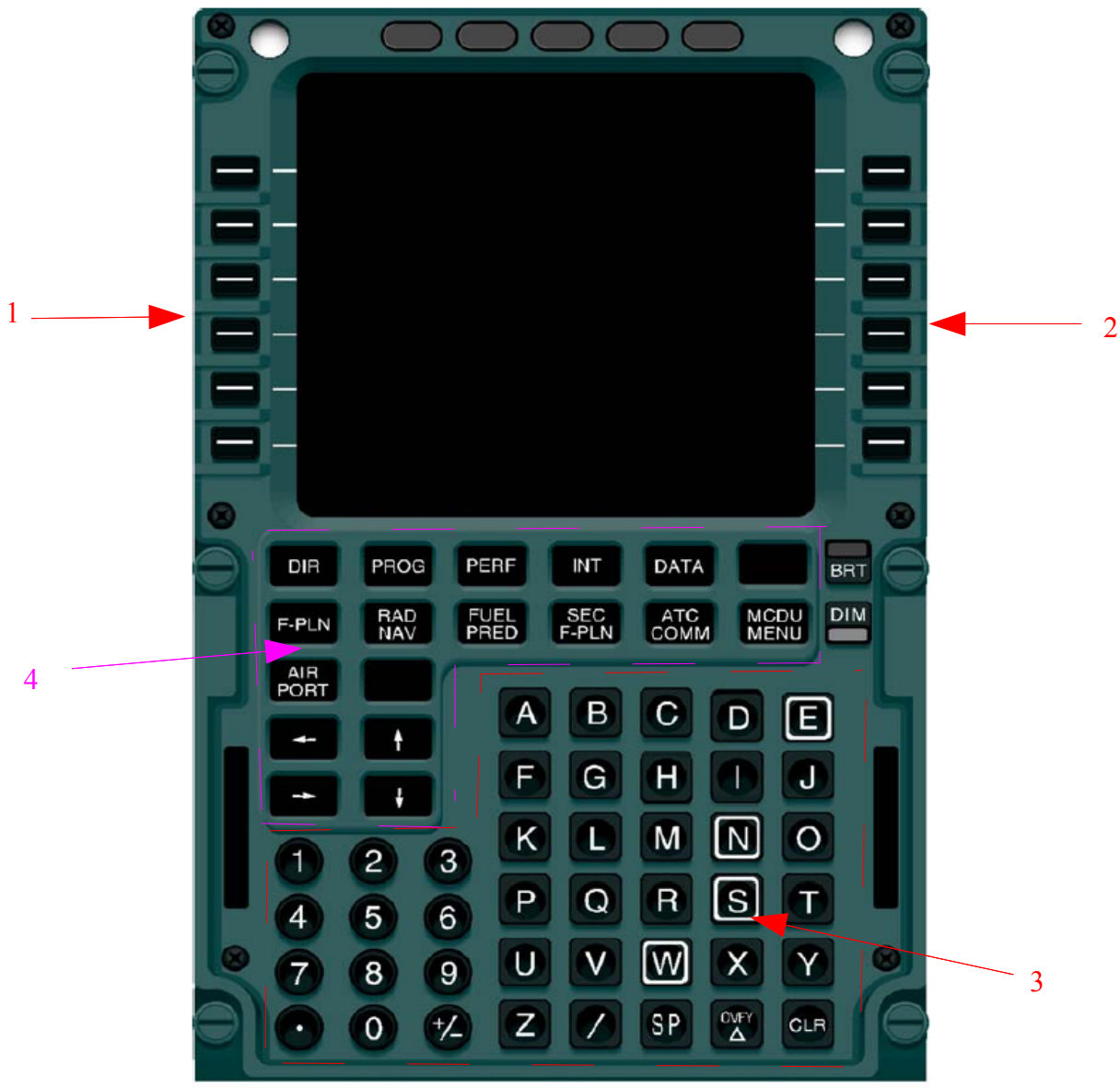
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9. MCDU

9.1. General

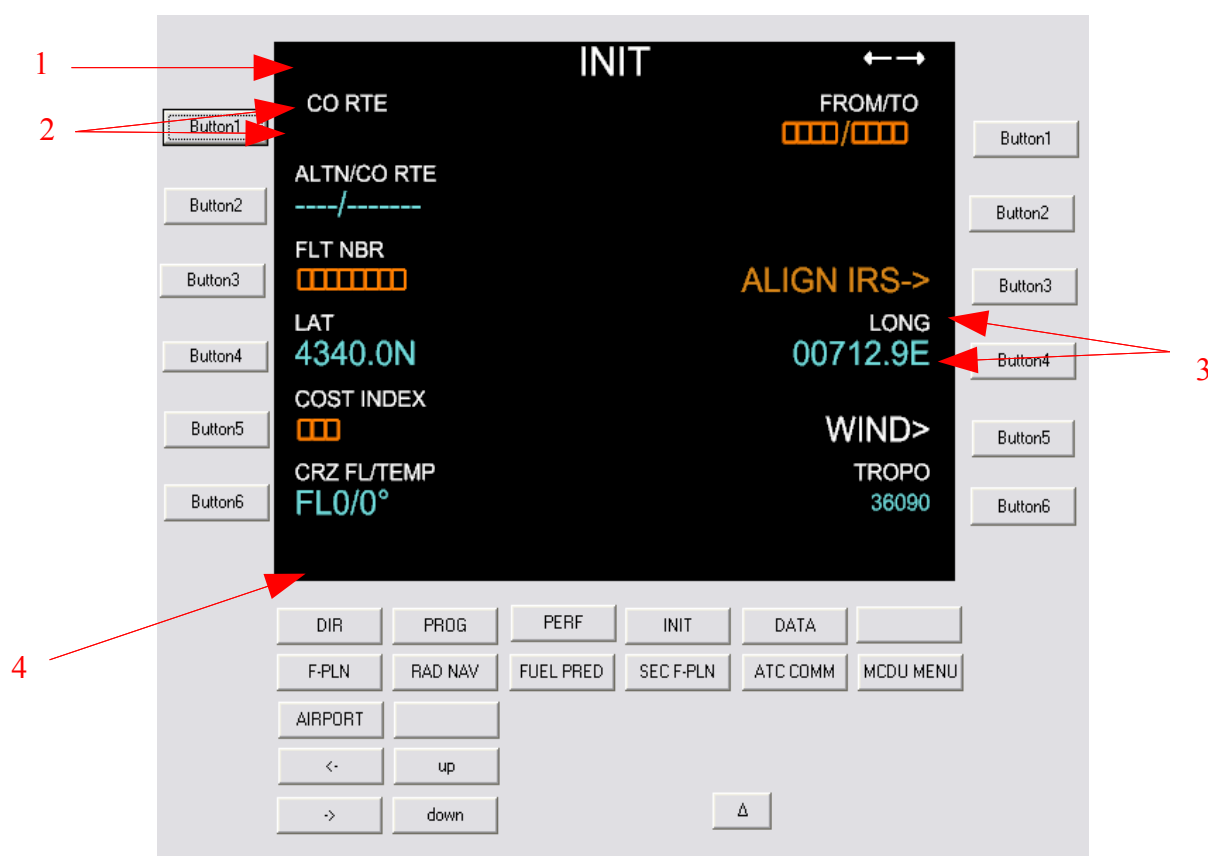
The Multifunction Control & Display Unit (MCDU) is the heart of the Management part of the FMGS. The original unit looks like this:



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- 1: Left Selection Keys: LSK
- 2: Right Selection Keys: RSK
- 3: Keyboard
- 4: MCDU pages selection

The MCDU as currently modeled:



Besides the ugly face, you can note the keyboard is the only part left out. You can simply use your own keyboard, while making sure the MCDU window is focused (i.e. click on it...). You can as well use FSUIPC offsets, which are available for every buttons on the MCDU (see offsets table).

The following buttons have no effect yet: DATA, FUEL PRED, ATC COMM, AIRPORT. All other buttons (LSK, RSK, arrows, DIR, PROG,) are working according to the situation, as in the real airbus.

You can hide the keyboard to only display the screen via a right click then “Display only option”

The MCDU programming consist in filling a succession of different pages, each

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representing different aspects of the flight we want to conduct. Let's see every pages individually.

- As long as we talk about the MCDU, the line corresponding to number 1 on previous picture will be the Title Line. Number 2 points at left Caption1(CO RTE) and left line1 (empty line) which we'll name LC1 and L1. Incidentally, number 3 points to RC4 and R4.

Number 4 is the line below L6 and is called "Srcatchpad". Every data you want to enter will be written here before you assign it to a line via the LSK or RSK.

- The orange squares are fields that need to be filled for a correct setup of the flight plan.
- Blue text usually is data that can be modified to fit the actual conditions of the flight. Green text is calculated and cannot be changed.

9.2. INIT A Page

This is the first page to show up when you launch the software. You can bring it up by pressing the INIT key on the MCDU. It asks for the basic information about the FPLN.

```

INIT
CO RTE                                FROM/TO
                                     [ ]/[ ]
ALTN/CO RTE                          [ ]/[ ]
----/-----
FLT NBR                              [ ][ ][ ][ ][ ][ ]
                                     ALIGN IRS->
LAT                                  LONG
4340.0N                             00712.9E
COST INDEX                          WIND>
[ ][ ]                              TROPO
CRZ FL/TEMP                         36090
FL0/0°

```

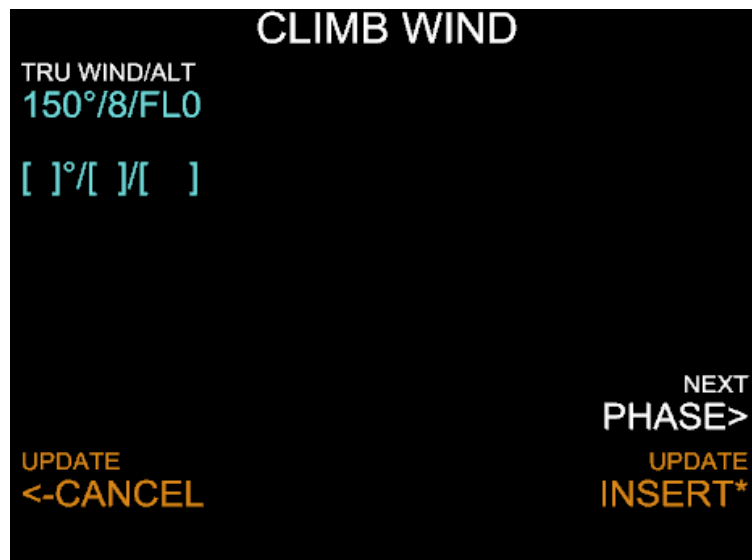
- R1 is where you enter departure and arrival airports. Syntax is ABCD/WXYZ where ABCD is the departure ICAO code and WXYZ is the arrival ICAO code.

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- L1: CO RTE: in the real ACFT, you have a route database which can provide the routing between ARR and DEP airport. Not yet implemented, so you'll have to input the FPLN route manually.
- R2: empty.
- L2: ALTN/CO RTE: Not yet implemented.
- R3: ALIGN IRS: push the RSK3 to align the IRS and display all attitude and position data on PFD and ND.
- L3: FLT NBR: input here your flight number (ex BAW31CE, or AF905HI).
- R4 and L4: longitude and latitude (cannot be changed)
- R5: push RS5 to prompt the winds page.
- L5: Cost index input. The value entered here doesn't have an effect on vertical profile yet.
- R6: Tropopause altitude. By default 36090fr, you can change it but no effect on flight profile.
- L6: Cruise flight level has to input here. The number after the “/” automatically updates to predict temperature at cruising altitude, according to tropopause altitude.

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9.3. Wind Page



Only the climb wind page is modeled for the moment and it is pure eyecandy: it doesn't have any effect on flight profile. This page is accessed via INIT A page.

- L1 to L5: enter different winds for different altitudes. Syntax: XXX/YY/ZZZ where XXX is true wind direction, YY is wind speed in knots and ZZZ is a flight level (1000ft is thus FL10)
- R5: no effect.
- L6: cancel any new value entered and back to INIT A page.
- R6: Accepts new values entered and back to INIT A page.

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9.4. INIT B

```

INIT FUEL PREDICTION  ←→
TAXI                    ZFWCG/ZFW
0.2                     24.6/49.0
TRIP/TIME              BLOCK
1.8/0023               23.6
RTE RSV/%             FUEL DATA
0.1/5.0               UPLINK>
ALTN/TIME              TOW
---./---              72.4
FINAL/TIME             LW
2.4/0030              70.6
EXTRA/TIME
19.1/0356

```

Also called INIT Fuel Prediction. Once a route has been entered, you need to enter here fuels values in order to initialize fuel calculations. INIT B is accessed on ground via Right or Left arrow when INIT A is shown. (the arrows in title line indicate you can switch pages).

- L1: Input Taxi time in tons.
- R1: input here the ZFWCG (Zero Fuel Weight Center of Gravity) and the ZFW (Zero Fuel Weight in tons). Syntax:
 - ZFWCG/ZFW if you want to change both
 - ZFWCG or /ZFW if you only want to change one.
 - You can get them from “ground handling” if you click RSK3.
- L2: flight plan fuel in tons and in time. 1.8/0023 means the flight plan route will need 1.8 tons of fuel and will last 00h23min, without any reserve.
- R2: Total fuel before start-up, in tons. You can uplink it via RSK3
- L3: Route fuel reserve: input a percentage of route fuel to consider as reserve fuel. You can only input a percentage, but the MCDU calculates the equivalent in tons. Here, reserve is 0.1 ton, which is equivalent to 5% of route fuel.
- R3: Use RSK3 to get ZFWCG, ZFW and block fuel via datalink.
- L4: not implemented.
- R4: Take Off Weight as calculated the following way: $TOW = ZFW + \text{block} - \text{taxi}$

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- L5: Final reserve. Input syntax: XXYY where XX is hours and YY minutes. Even if there are zeroes, input four number (ex: 0030 for 30 minutes). The number shown before reserve time is weight equivalent in tons (here 2.4 tons for 30 minutes reserve).
- R6: Landing Weight as calculated following way: $LW = TOW - RTE$
- L7: Extra fuel in tons and time (here 19.1 tons, 03 hours 56 minutes).
Extra = block – taxi – trip – RTE – RSV

9.5. FPLN page

This page is where the flight plan route is entered, including SID, STAR and approach procedure. It can be accessed via FPLN key on MCDU.

FROM	AF905HI		
	UTC		SPD/ALT
04L			0/0
	TRK044°	2NM	
400FT			210/400
	TRK045°	0NM	
INT			210/0
	TRK120°	4NM	
MN042			210/0
	TRK088°	6NM	
MN052			0/0
DEST	UTC	DIST	EFOB
LFMN			
↑			

Lines 1 to 5 show points. A normal flight plan has more than 5 points, so you can scroll through all points via vertical arrows if the corresponding arrow is displayed at the end of the scratchpad:



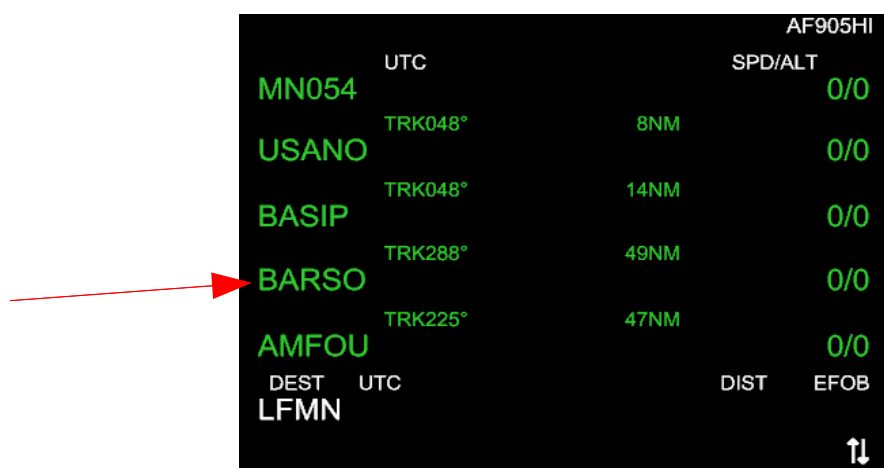
L6 is reserved for destination airport. When on the ground, and FPLN hasn't been scrolled down, L1 shows departure airport.

To add a waypoint, enter the name of the waypoint (VOR, NDB, fix) in the scratchpad, then push the LSK adjacent to the point you want to insert the waypoint before:



If you push LSK next to AMFOU, here is what will happen:

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		AF905HI	
	UTC		SPD/ALT
MN054			0/0
	TRK048°	8NM	
USANO			0/0
	TRK048°	14NM	
BASIP			0/0
	TRK288°	49NM	
BARSO			0/0
	TRK225°	47NM	
AMFOU			0/0
DEST	UTC	DIST	EFOB
LFMN			

The line labels between two points show the magnetic track and the distance in nautical miles between the two points.

The numbers on the right are the speed and altitude constraints at each point, in knots and feet.

If nothing is entered in the scratchpad, pushing a LSK will prompt the Lateral Revision page, and a RSK will prompt the Vertical Revision page. If an airport is displayed on the corresponding line, RSK won't have any effect.

- **To delete a waypoint, push CLR button then the adjacent LSK.**
- You can as well add a waypoint with latitude and longitude, place/bearing/distance or place-bearing/place-bearing. Syntax is:
 - ✓ LAT/LON where:
 - LAT starts with the letter N or S (North or South) then one or two digits for degrees of arc then two digits for minutes of arc, and eventually a decimal part for minutes of arc.
 - LAT starts with the letter E or W (East or West) then one to three digits for degrees of arc then two digits for minutes of arc, and eventually a decimal part for minutes of arc.

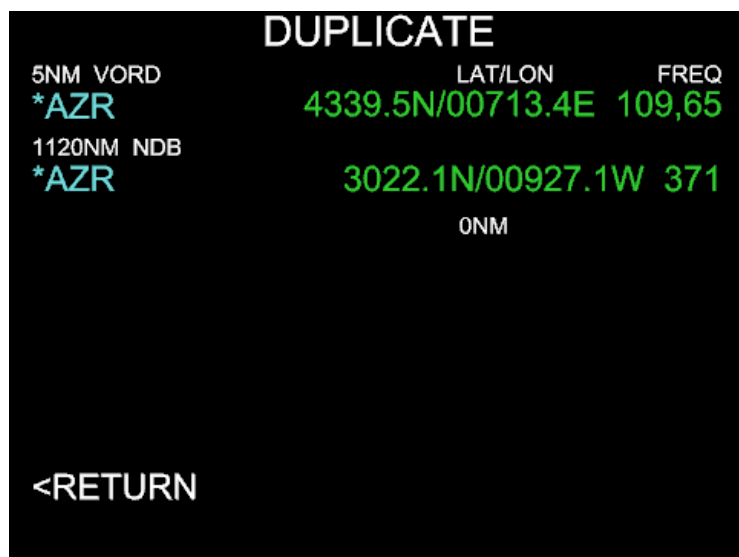
Example: N4401.8/E00715 stands for 44°0.8' North and 007°15' East
 - ✓ Place/bearing/Distance: where :
 - Place is the ID of a VOR, NDB or FIX
 - bearing is the bearing in degrees

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- distance is the distance in nautical miles
Example: AZR/090/5 is the point 5NM east of AZR VOR.
- ✓ place1-bearing1/place2-bearing2 where:
 - place1 is the ID of a VOR, NDB or fix number1
 - bearing1 is the bearing from place1
 - place2 is the ID of a VOR, NDB or fix number2
 - bearing2 is the bearing from place2
Example: CGS-090/AZR-180 is the the crossing between the 090° radial from CGS and the 180° radial of AZR.

9.6. Duplicate page

If you insert a waypoint ID (VOR, NDB or fix) which corresponds to several points worldwide, the next page is prompted:



It lists the five nearest points, in increasing distance from ACFT. To select the desired waypoint, push the adjacent LSK.

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9.7. Lateral Revision page

9.7.1. Normal waypoint



Accessed via LSK 1 to 5 in FPLN page. This page allows you to modify the lateral trajectory from the selected point.

- L3: Push LSK3 to add an holding circuit at the selected point.
- R3: enter a new waypoint in the scratchpad then push RSK3 to add that waypoint AFTER the selected point.
- L4 and R4 are not implemented yet.
- R5: click RSK5 to enter the airways page, to follow airways to another point.
- LSK6 to go back to FPL page.

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9.7.2. Hold page

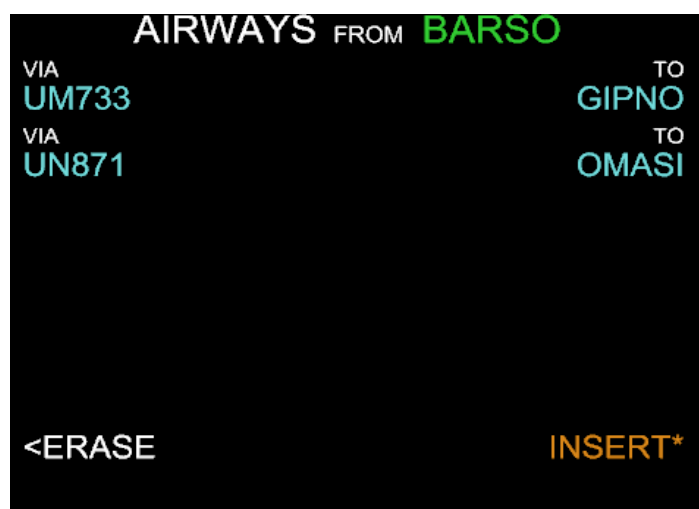


Accessed via preceding page. It allows you to add an holding pattern at a point with desired characteristics.

- L1: inbound magnetic course toward holding fix.
- L2: direction of turns. R for right and L for left.
- L3: outbound track length, either in time or distance:
 - input XX.X for time in decimal minutes
 - input /YY.Y for decimal nautical miles.
- Press RSK6 to insert the holding pattern, or LSK6 to cancel.

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9.7.3. Airways page



This page is accessed via lateral revision page. It allows you to add to the flight plan several waypoints from airways easily.

- First, enter an airway which connects at the selected revision point, and push LSK1.
- Then, you can successively enter airways which connect with the preceding one, via LSK 2 to 5. The connecting point between two AWY is automatically entered in R1 to 4.
- Once you have selected all the AWYs you need, enter the last waypoint of the last AWY via the RSKs1 to 5 (according to the number of AWYs used).

In the screenshot above, AWY UM733 was entered, then UN871. Those two connect at GIPNO point. We wanted to exit UN871 at OMASI, so we entered it in R2 line.

When you are happy with the AWYs entered, push RSK6 to accept the route, or LSK6 to get back to lateral revision page.

All the points along the selected AWYs to the last point are automatically entered in the FPLN (in our example, all points between BARSO and OMASI, on UM733 then UN871):

DEPARTURE from		LFMN
RWY	SID	TRANS
-----	-----	-----
AVAILABLE RUNWAYS		
<- 04L 2570M		CRS44
	ILS	109.95
<- 04R 2960M		CRS42
	ILS	110.70
<- 22L 2960M		
<- 22R 2570M		
<RETURN		

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The first line shows dashes if it's the first time this pages is accessed during preflight. The lines 2 to 5 show the available runways at departure APT, with length in meters, ILS frequency and course if available.

If a RWY and SID had previously been selected, the next page shows up instead with green characters in line1:



To select a RWY simply push the LSK adjacent to it. If more than 4 RWYs are available, you can scroll with vertical arrows. When selecting a runway, it prompts you automatically to the SID selection page:



In the same way, you can select the desired SID via LSK 2 to 5 and scroll with vertical arrows if more than 4 are available. When selected, the arrow before the SID name disappears (here BODRU 4E SID was selected):

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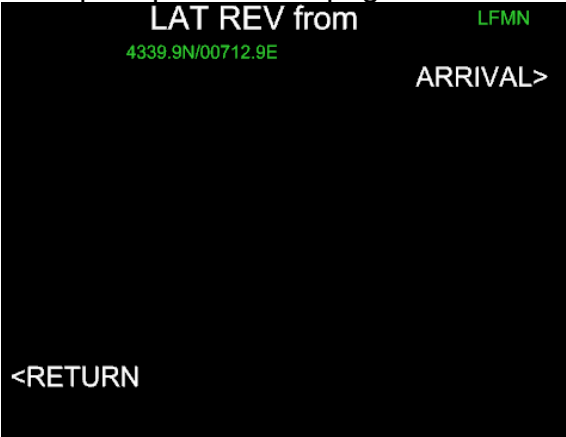


The line 1 updates, and if for that particular SID transitions are available, you can select one with the RSK1 to 5 (here none are available). Once everything is selected and verified, push RSK6 to insert the SID in the FPLN.

- **Note that if you want to revise a previously entered SID, you would only have to modify it this way in the real ACFT. But in my software, revision is not yet effective and you'll have to manually delete all SID points before actually entering the new one.**

9.7.5. Arrival Lateral Revision

In FPLN, pushing LSK6 prompts the next page:



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From that page you can access the STAR and approach selection pages. Pushing RSK1 prompts the approach selection page:



Select the desired approach with LSK 3 to 5. You can scroll if more than 3 are available, using the vertical arrows keys. Each procedure is for ONE RWY only, and the length in meters, as well as ILS data (if available) are displayed. Clicking the desired LSK prompts the STAR selection page:



The available STARs are selectable with LSK 3 to 5. To connect a STAR to the approach procedure, you may need to add a "VIA". To do so push the LSK2:

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```

      APPROACH VIAS
APPR      VIA
RIVIERA04L  MUS      -----
APPR VIAS
<-NO VIA      -----

MUS

<-NERAS

<RETURN

```

Note: The VIAs available depend on the approach procedure selected, and in fact connect the IAF to the final segments of the approach procedure. The STARs connect the en-route phase to the IAF.

Select the VIA you need via LSK 2 to 5. Doing so will prompt you back to STARs selection page. You can chose 'NO VIA' if you don't need any VIA. Some approach procedures can come without any via.

```

      ARRIVAL TO
APPR      VIA      LFMN      STAR
RIVIERA04L  MUS      AMFOU5R
APPR      TRANS
<VIAS      NONE
STAR      AVAILABLE  TRANS
AMFOU5R

<-BORDI5C

<-BORDI5R

<RETURN      INSERT*

```

Once you've selected your VIA (or no VIA) and your STAR, you might have to chose between STAR transitions, in the same way as SID transition, using the RSK3 to 5.

Once you're don, push RSK6 to insert the terminal procedures in the FPLN.

- Note that once you've inserted the terminal routing, you can revise that routing only by manually deleting all the necessary points in the FPLN, then going over that process again, as for SID revision.

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9.8. Vertical Revision page

In FPLN page, pushing RSK1 to 5 prompts this page if scratchpad is empty.



- L3: input speed constraint at point (only exact constraints can be input that way).
- R3: input altitude constraint at point (only exact constraints can be input that way).

If no value is entered, blue brackets appear (like ALT CSTR above). Otherwise the numeric value appears in magenta (like SPD CSTR above).

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9.9. DIR TO page

Push DIR key on MCDU to access DIR TO page. This page allows you to go directly to any point you want, either in the FPLN or not.



You can either scroll through the FPLN points in lines 2 to 5 or directly enter any point name in L1. Then you need to select a DIR TO mode with RSK 2 to 5:

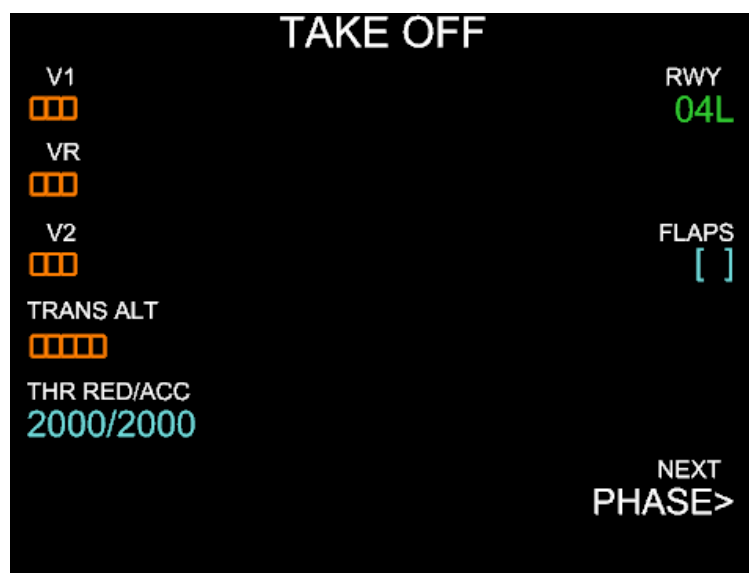
- DIRECT TO either deletes all points between ACFT position and selected FPLN point (if in FPLN), or insert the new point instead of current active FPLN followed by a FPLN discontinuity (if not a FPLN point).
- ABEAM PTS do the same as DIRECT TO but insert reference points on the new track, abeam the old FPLN points.
- RADIAL IN allows you to join the waypoint after intercepting a specified radial to it. The ACFT will fly in HDG/TRK mode until the radial is intercepted and NAV mode engaged. It's up to the pilot to select a valid heading to intercept the radial.
- RADIAL OUT allows you to intercept a radial outbound the specified point. The ACFT will fly in HDG/TRK mode until the radial is intercepted and NAV mode engaged. It's up to the pilot to select a valid heading to intercept the radial;

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9.10. PERF pages

Those pages are accessed via the PERF key on the MCDU. According to the actual phase of flight, the prompted page will differ. They are still only partially modeled, especially the CLB, CRS and DES ones.

9.10.1. PERF Take-Off



This page can be accessed only during preflight. It allows you to input reference speeds V1, VR, V2 (LSK1 to 3), the transition altitude (LSK4), the thrust reduction altitude and the acceleration altitude (LSK 5).

Speed syntax is simply the value in knots ex: 110

Transition altitude is in feet ex: 5000

Thrust reduction and acceleration altitudes are defined with the following syntax:

XXXX/YYYY where XXX and YYYY are the altitude value of respectively THR RED and ACC altitude. Ex: 1000/1000.

ACC altitude shouldn't be inferior to THR RED altitude.

R1 shows the departure runway if it has already been entered via departure lateral revision page.

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R3 asks for take off flaps settings. Not yet of any use.

Pushing RSK6 will prompt the next phase of flight PERF page, PERF CLB

9.10.2. *PERF CLB*



This page is directly accessible when in CLB mode. It is no longer accessible once cruise phase is reached.

- L1 shows the speed mode that will automatically engage after setting the thrust levers at the CLB notch on initial climb (for more details see the FMGS section).
- L2 shows the cost index that is input from INIT A page.
- L3 is the managed speed law. As of beta 5, cost index has no influence on climb laws. Default law is 250 IAS until reaching Mach 0.79, then constant 0.79 Mach becomes the speed target.
- L4: input here an indicated airspeed if you want to fly with selected speed first (to follow ATC clearance for example). Due to a bug, when you input a speed here, it won't show up at L4, but the FMGS will take it into account when transitioning from Take-off to Climb phases.

If there is an asterisk (*) before the IAS in lines 3 or 4 means that the corresponding mode is not active (in picture above, managed mode is active, and there is an asterisk at L4).

9.10.3. *PERF CRZ and DES*

Those pages resemble PERF climb, and thus won't be detailed here.

9.10.4. *PERF APPR*

APPR

QNH

[]

TEMP

[]

MAG WIND

[]°/[]

TRANS ALT

[]

VAPP

[]

PREV

<PHASE

FINAL

MDA

[]

DH

[]

This page allows you to input approach data.

- L1: arrival airport QNH
- L2: arrival airport temperature (Celsius degrees)
- L3: arrival airport surface wind. Syntax: XXX/YY where XXX is direction in degrees and YY speed in knots
- L4: arrival airport transition altitude in feet
- L5: Approach Speed
- R2: Minimum descent height (if non precision approach selected) in feet.
- R3: Descent height (if precision approach selected) in feet.

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9.11. PROG pages



This set of pages is accessed via PROG key on MCDU. It is very partially modeled.

- L1 shows the CRZ level chose in INIT A page
- L4 shows the bearing and distance to the point selected in R4 (VOR, NDB or fix)
- Lines 5 and Lines 6 are dummy for the moment.

During DES phase, it also displays in R2 the V/DEV numerical values:



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9.12. RAD NAV page



This page is accessed via the RAD NAV key on MCDU. Use it to tune the radio-electric nav aids (VORs, ILS and NDBs). Nav aids can also be tuned via the RMP on the pedestal.

- L1: VOR1 ID/frequency.
- R1: VOR2 ID/frequency.
- L2: VOR1 course selector.
- R2: VOR2 course selector.
- L3: ILS ID/frequency.
- L4: ILS course.
- L5: NDB1 ID/frequency
- L6: NDB2 ID/frequency

To tune a nav aid, either input the ID or the frequency in the ID/frequency line. If you input the ID and several nav aids have the same ID throughout the world, the nearest one will be tuned.

If you input a frequency or an ID, and the nearest corresponding nav aid signal is not received, only the frequency will show up.

If an ILS is set and not received, it will be shown as a VOR until the signal is valid.

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9.13. SEC FPLN page

The SEC FPLN key on the MCDU prompts the SEC INDEX page. It allows the pilot to create a secondary FPLN, which is not followed by the auto pilot but can be activated any time to replace the active FPLN. When no SEC FPLN exists, the SEC INDEX page is like the picture below:



- Press LSK1 to copy the active FPLN in the SEC FPLN. The displays switch then to SEC FPLN page.
- Press RSK1 to access the secondary INIT A page. (SEC INIT A has the same layout as INIT A). The displays switch then to SEC FPLN page.
- Press LSK2 to access the SEC FPLN page (same layout as FPLN page, but all lines are white instead of green).

Once a SEC FPLN has been created, the SEC INDEX page becomes:



The INIT prompt at R1 disappears. To create a new SEC FPLN via INIT A page, you'd have to delete the existing one with LSK3 "DELETE SEC".

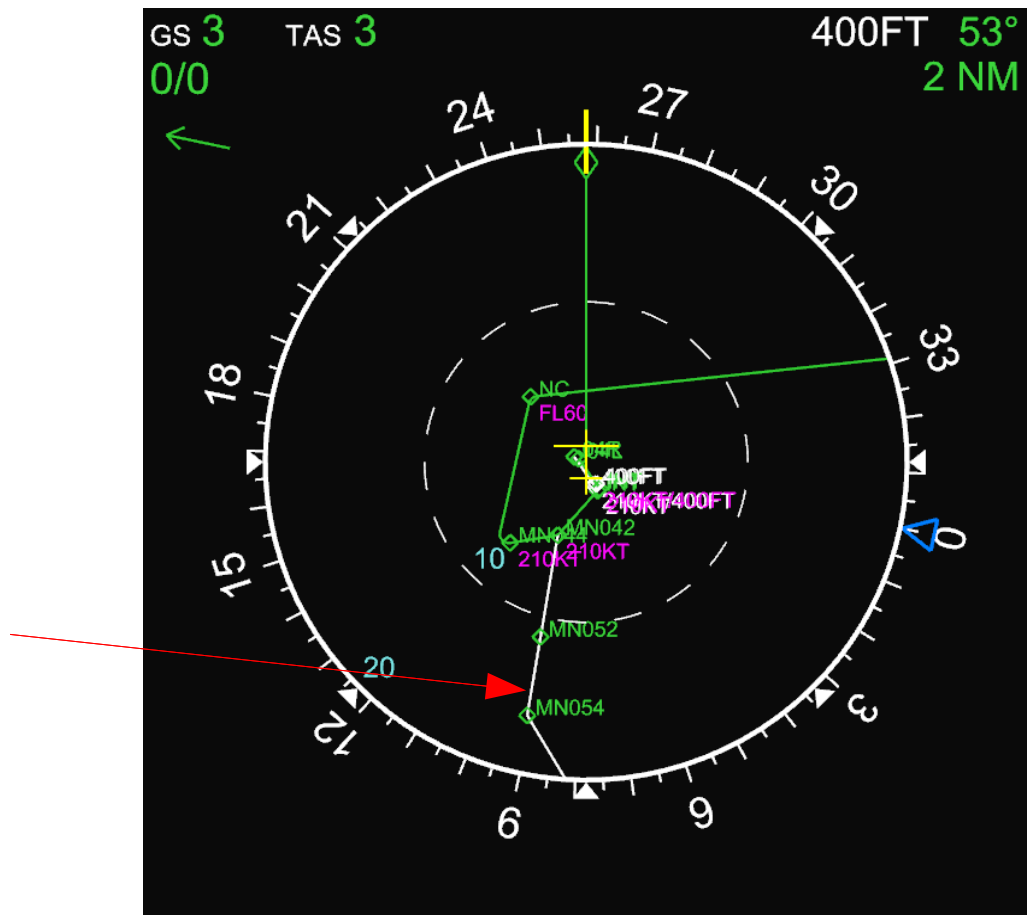
The LSK4 activates the SEC FPLN. The SEC FPLN becomes FPLN and FPLN becomes SEC FPLN.

The SEC FPLN page:



All FPLN sub-pages are available in the SEC FPLN (lateral and vertical revisions, SID, APPR, STAR selection).

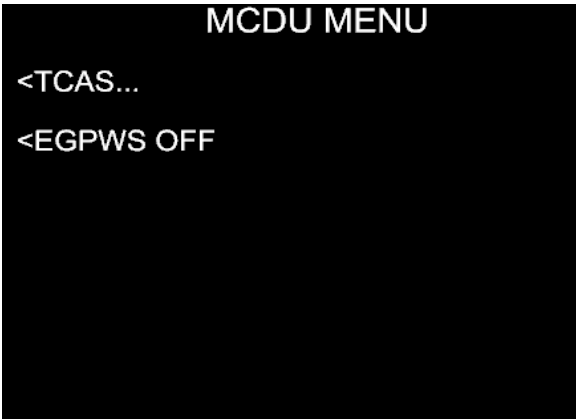
When the MCDU active page is any of SEC FPLN sub-pages, and the SEC FPLN isn't empty, the ND shows the SEC FPLN track in white:



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9.14. MCDU MENU page

This page is accessed via the MCDU MENU key on the MCDU.



For the moment, it is not as in the real ACFT. I'm using this page to access options that are not set via the FCU, but quite useful. As of now, only TCAS and EGPWS are settable here.

- LSK1 will prompt the TCAS page
- LSK2 will switch on/off EGPWS "Terrain On ND" feature.



The TCAS page is used to set transponder and TCAS modes. See TCAS description [page 33](#)

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10. AP/FD and A/THR logic

10.1. AP/FD modes

The Auto Pilot/Flight Director has different vertical and lateral modes, depending on flight phase and pilot selection through the FCU. To engage a mode, you need first to arm it and it'll engage by it's own when engagement conditions are met. Some modes work together with the A/THR.

Here is a list of all AP/FD modes with arming and engagement conditions.

10.1.1. *Lateral modes*

HDG or TRK mode: these modes allow to fly along the heading or track selected by the pilot in the FCU HDG/TRK window. You can switch between HDG or TRK with the HDG V/S – TRK FPA pushbutton on the FCU.

- Engagement conditions (one of the following):
 - pulling HDG selector knob on the FCU
 - NAV mode automatically disengaged
 - FINAL mode lost when in APP NAV mode
 - LOC or LOC* mode lost
- HDG or TRK mode is disengaged by the engagement of any other lateral mode.

NAV mode: This mode guides the aircraft along the lateral flight plan entered in the MCDU.

- Arming conditions (one of the following):
 - ACFT on the ground and no other lateral mode armed
 - Pushing the HDG selector knob on the FCU

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- Disarming conditions (one of the following):
 - pulling HDG selector knob on the FCU
 - LAND mode engages
- Engagement conditions (one of the following):
 - At 30ft RA if armed on the ground
 - With a DIR TO order
 - In-flight, when armed and near the FPLN track.
- Disengagement conditions (one of the following):
 - An other lateral mode is engaged

10.1.2. *Vertical modes*

CLB mode: this mode controls the aircraft pitch to fly at either a selected or managed speed, up to an altitude selected in the FCU altitude window. It takes into account the FPLN waypoint speed and altitude constraints, and thus require the NAV mode to be engaged.

- Arming conditions (one of the following):
 - on the ground or when SRS mode is engaged, no other vertical mode is engaged and ACCEL ALT is below FCU altitude
 - in-flight when FCU altitude is above current aircraft altitude
- Disarming conditions (one of the following):
 - Another vertical mode is engaged
 - FCU altitude lower than or equal to ACFT altitude
- Engagement conditions (all of the following):
 - NAV mode engaged
 - FCU altitude above ACFT current altitude

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- ACFT not flying an altitude constraint
- G/S mode is not active

CLB mode manually engaged when pilot pulls the altitude selector knob on the FCU and conditions above are met.

- Disengagement conditions (one of the following):
 - NAV mode disengages (vertical mode reverts to OP CLB)
 - Another vertical mode engages
 - Pilot selects an altitude lower than current ACFT altitude. (vertical mode reverts to V/S mode)

OP CLB mode: open climb mode controls the aircraft pitch to maintain the target speed (managed or selected), but disregards any FPLN altitude constraint.

- Engagement conditions (one of the following):
 - Pilot pulls the altitude selector knob
 - ACFT reaches ACC ALT with CLB armed and NAV not engaged
 - NAV mode lost when CLB is engaged

Also, the FCU altitude must be higher than actual ACFT altitude.

- Disengagement conditions (one of the following):
 - Any other vertical mode engaged

FCU altitude set lower than actual ACFT altitude. (vertical mode reverts to V/S mode)

DES mode: this mode controls the aircraft pitch to fly along a calculated vertical profile which takes into account the FPLN waypoint speed and altitude constraints, and thus require the NAV mode to be engaged. The aim of the profile is to maintain idle thrust to reduce fuel consumption. The target speed is maintained with a ± 20 knots error margin.

- Arming conditions (all of the following):
 - FCU altitude below current altitude
 - NAV engaged

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- Disarming conditions (one of the following):
 - Another vertical mode is engaged
 - FCU altitude higher than or equal to ACFT altitude
- Engagement conditions (all of the following):
 - NAV mode engaged
 - FCU altitude below ACFT current altitude
 - ACFT not flying an altitude constraint
 - TO, G/S, LAND, and FINAL mode not active

CLB mode manually engaged when pilot pulls the altitude selector knob on the FCU and conditions above are met.

- Disengagement conditions (one of the following):
 - NAV mode disengages (vertical mode reverts to OPDES)
 - Another vertical mode engages
 - Pilot selects an altitude higher than current ACFT altitude. (vertical mode reverts to V/S mode)

OP DES mode: open climb mode controls the aircraft pitch to maintain the target speed (managed or selected), but disregards any FPLN altitude constraint.

- Engagement conditions (one of the following):
 - Pilot pulls the altitude selector knob
 - NAV mode lost when DES is engaged

Also, the FCU altitude must be lower than actual ACFT altitude.

- Disengagement conditions (one of the following):
 - Any other vertical mode engaged
 - FCU altitude set higher than actual ACFT altitude. (vertical mode reverts to V/S mode)

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ALT*, ALT CSTR*: altitude and altitude constraint acquire modes.

- They engage automatically when in CLB, OP CLB, DES, OP DES or V/S modes and the ACFT is in the altitude capture zone around the FCU altitude target or constraint altitude (in DES or CLB modes only).
- They disengage if the FCU altitude is modified and ACFT is no longer in capture zone, or if ALT or ALT CSTR engage.

ALT, ALT CSTR: Altitude hold modes. They maintain either the FCU altitude or the constraint altitude if vertical profile is managed.

- Arming conditions: whenever target altitude is different than actual altitude.
- Engagement conditions: automatically if altitude is within ± 20 ft of target altitude.
- Disengagement conditions: any other vertical mode engages.

V/S – FPA: These modes maintain a constant V/S or a constant flight path angle. You can switch between the two with the HDG V/S – TRK FPA pushbutton on FCU.

- Engagement conditions (one of the following):
 - Pull V/S FPA selector knob or pull it (for immediate level off)
 - Select a higher altitude than current ACFT altitude in DES or OP DES modes.
 - Select a lower altitude than current ACFT altitude in CLB or OP CLB modes.
- Disengagement conditions (one of the following):
 - Pulling or pushing altitude selector knob
 - Reaching FCU altitude

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10.1.3. Common AP/FD modes

During certain phases of flight, vertical and lateral modes are linked. Here are all those common modes.

Take Off modes: Vertical SRS mode and lateral RWY mode. TO modes engage during the TO run. Currently, RWY mode is not modeled. SRS maintains V2+10knots bt adjusting pitch. It disengages when reaching ACC ALT.

ILS Approach modes: Vertical G/S or G/S* and lateral LOC or LOC* modes or LAND, FLARE and ROLL OUT common mode. Selected approach must be ILS.

LOC* engages when APPR has been pushed, and ACFT is in the localizer interception zone. It disengages when LOC engages, or ACFT loses localiser signal, or APPR pushbutton is pushed a second time to cancel approach mode.

LOC engages when ACFT is established on localiser beam. It then follows the localiser. It disengages when LAND mode engages, LOC signal is lost or APPR button pushed again.

G/S* engages when APPR has been pushed, and ACFT intercepts the glideslope signal. It disengages when G/S engages, or ACFT loses glidepath signal, or APPR pushbutton is pushed a second time to cancel approach mode.

G/S engages when ACFT is established on G/S beam. It then follows the glidepath. It disengages when LAND mode engages, GP signal is lost or APPR button pushed again.

LAND mode engages when ACFT established on GP and localiser and RA is inferior to 400ft.

FLARE mode engages when in LAND mode and RA <=40ft.

ROLL OUT mode engages on touch down.

Non Precision approach modes: FINAL vertical mode and APP NAV lateral mode. They arm by pressing APPR pushbutton. Selected approach is non-ILS.

APP NAV engage with same conditions as NAV mode.

FINAL engages if armed and APP NAV engaged.

They both disengage if APPR pushbutton is pushed again or another vertical mode is engaged.

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10.2. A/THR modes

Auto Thrust (A/THR) controls the engines %N1 setting. It is used either to maintain a constant N1 setting (THRUST mode) or to adjust speed/mach (SPEED/MACH mode).

When AP/FD is not engaged, A/THR always operates in SPEED/MACH mode.

When AP/FD is engaged, A/THR can operate either in SPEED/MACH or THRUST mode, according to the AP/FD modes engaged.

- A/THR arming conditions (one of the following):
 - A/THR pushbutton pushed on FCU
 - Setting thrust levers to TOGA notch
- A/THR engagement conditions (all of the following):
 - Thrust levers between idle and CL notches.
 - A/THR is armed
- A/THR disengagement conditions (any of the following):
 - FCU A/THR pushbutton
 - Thrust levers at idle notch

When disengaged, A/THR is not re-armed, you need to re-arm A/THR manually.

- A/THR operates in THRUST modes while AP/FD vertical modes is one of the following:
 - CLB, OP CLB, DES (when in idle path), OP DES, SRS*

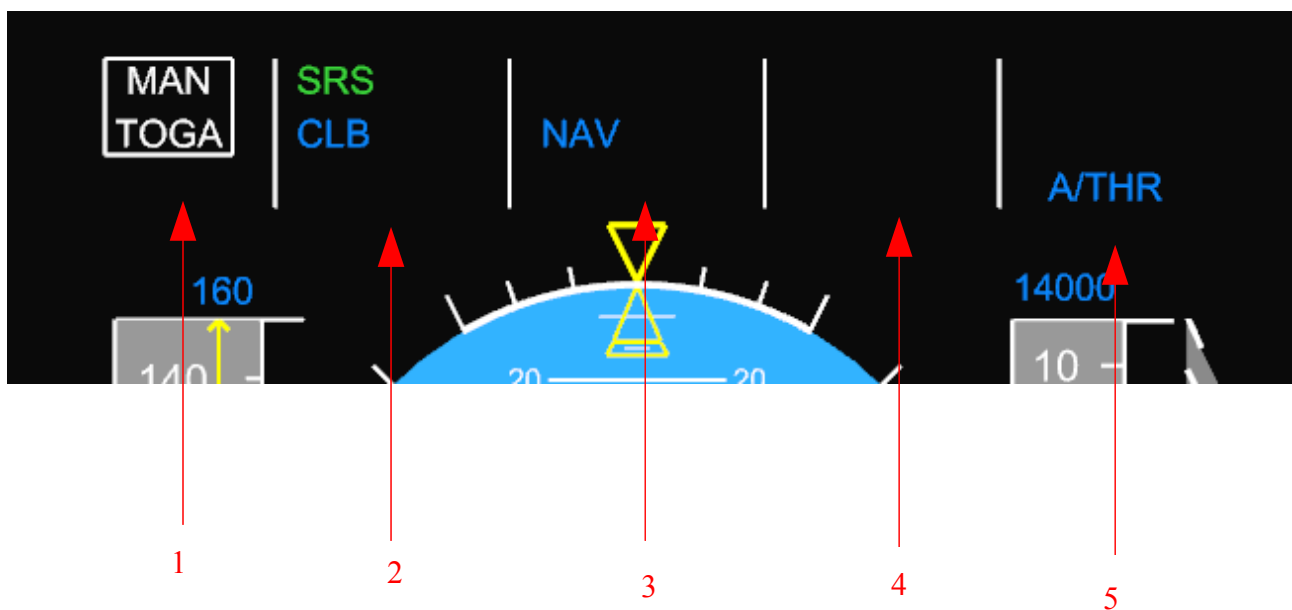
It delivers a thrust between idle power and the maximum thrust setting materialized by thrust levers position (CLB, MCT, TOGA,...).

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- A/THR operates in SPEED/MACH modes while AP/FD vertical modes is one of the following:
 - AP/FD not engaged
 - V/S – FPA, ALT, ALT CSTR, ALT*, ALT CSTR*, ALT CRZ, G/S*, G/S, FINAL, DES (when in geometric path)

10.3. FMA

The Flight Mode Annunciator displays the current armed and engaged AP/FD and A/THR modes:



- Column 1 to 3 (respectively A/THR, vertical and lateral modes)show in green the modes engaged and in blue the modes armed. White is used when A/THR armed but not engaged.
- Column 4 show Approach capabilities
- Column 5 shows AP/FD and A/THR status: in white if engaged, in blue if armed.

On the picture above taken during take off roll, we can see that thrust levers are set at TOGA, SRS is engaged, CLB, NAV and A/THR are armed.

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On this one, during climb, THRUST, CLB and NAV mode are engaged, as well as AP1, FDs 1 and 2 and A/THR. ALT mode is armed.

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11. FMGS operations – LFBO-LFMN example

11.1. General

In the chapter 8, we'll be flying an imaginary flight between Toulouse-Blagnac (LFBO), where the historical Airbus factory is located, to Nice Riviera (LFMN), where I live. I'll try to describe most of the FMGS functions throughout that flight.

11.2. Pre-flight

11.2.1. INIT A

So here we are, at the gate in LFBO. The PAX are slowly boarding the aircraft, and we now have to start setting the FMGS with today's flight.

First thing, will be to align the IRS so we can get a map on the ND. To do so, go to the INIT A page in the MCDU, then Push the RSK 3. Lucky us, it's not taking the 10 real minutes it should!

Now let's insert our flight plan details on the INIT A page. We're flying out of LFBO to LFMN, so let's input "LFBP/LFMN" in R1. Today flight number will be AF3002, let's write it down in L3.

Company cost index on this flight is 30, and cruising level is FL190, which is respectively input in L5 and L6. Today weather is standard and wind is calm, so we won't toy with R5 and R6.

INIT A should look like:

```

INIT
CO RTE
ALTN/CO RTE
FLT NBR
LAT
COST INDEX
CRZ FL/TEMP
FROM/TO
LONG
WIND>
TROPO

```

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11.2.2. *En-route routing*

Our Ops gave us the routing to Nice:

AFRIC - G39 - FJR - UY342 - SALIN - UY373 - ABILI - Q302 - AMFOU

Let's go to the FPLN page. For the moment it looks like:

FROM	AF3002		
UTC	SPD/ALT		
LFBO			
--- END OF F-PLN ---			
DEST	UTC	DIST	EFOB
LFMN			

Type AFRIC in the scratchpad then push LSK2 twice to enter lateral revision page at AFRIC. Enter then the airways page.

Enter G39 in L1 then FJR in R1, and RSK6 to insert in FPLN:

FROM	AF3002		
UTC	SPD/ALT		
LFBO			
AFRIC			0/0
TRK104°	7NM		0/0
BRUSC			0/0
TRK104°	43NM		0/0
FJR			0/0
----- F-PLN DISCONTINUITY -----			
DEST	UTC	DIST	EFOB
LFMN			
↑			

L5 shows “---FPLN DISCONTINUITY---”. This message appears every time the software cannot link the lateral revision with the FPLN, so it happens when the last point of a new leg is different that the point after it in the FPLN sequence. You can clear it with CLR button.

From FJR, we'll follow UTY342, then UY373 and finally Q302. We can add all those in a row, simply type the AWY names in the right order in L1 to L3 in FJR airway page, and

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then our last point AMFOU:



After entering AMFOU in R3 push RSK6. Clear any FPLN discontinuity.

11.2.3. *Departure routing*

By the time we're done, boarding is almost over, and it's time to call the delivery for our IFR clearance. Today the RWY in use is 32L (we listened to the ATIS), and the delivery controller answers: "AF3002, start up to Nice is approved, squawk 4436, AFRIC 5B departure, initial FL 140, report for push back".

Let's first enter the transponder code (via FS) then in the FCU set the altitude to 14000ft as initially cleared, and push to managed mode:



Since we'll be flying in vertical managed mode, the white dot next to the altitude window is on.

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Back to the MCDU, scroll all the way up to LFBO in the FPLN page, and click the LSK1 twice to enter RWY selection page. Chose RWY 32L then AFRIC 5B, and insert in FPLN.



(Before inserting you can note that our choice is summed up in line1)

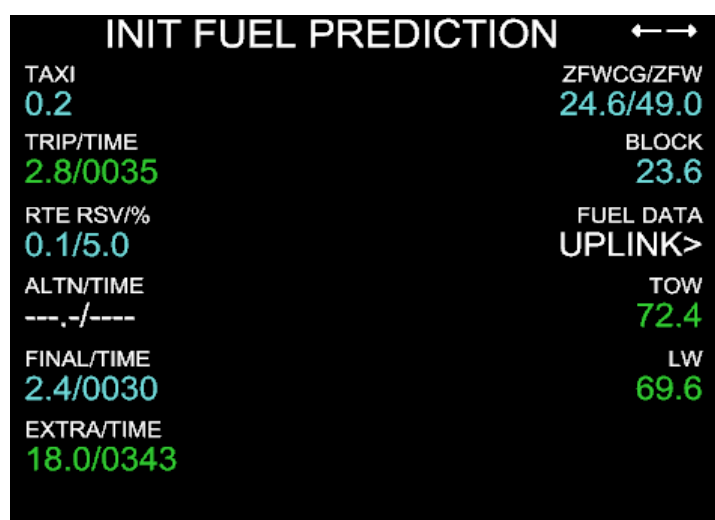


FPLN page is now quite full; And you'll note that there is no discontinuity before AFRIC point as it's the last point of the SID and the first point of the en-route phase.

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11.2.4. *INIT B – Fuel settings*

Go back to INIT A page then with one of the horizontal arrows, switch to INIT B. You can now either manually input the various center of gravity and mass settings if you have the load sheet, or use the data link function (RSK3).



Theses settings are just predictions and will probably be off by a few tons at our arrival.

11.2.5. *PERF pages*

Go to the PERF pages. If you have a precise speed references calculation tool, you can use it to fill the take off page. Otherwise use speed values which are plausible according to the stall speed of the aircraft. I usually set VR at 130 knots, V1 below VR, and V2 at 160 knots.

Transition altitude depends on the airfield. In Toulouse it's 5000 feet. As for thrust reduction and acceleration altitude I use around 1000ft AGL. In normal conditions, the two of them are equal. You can enter a take off flap setting, we'll use 2.

Press RSK6 to enter CLB page. If you looked at our SID map, you know that shortly after departure there is almost a 180° right turn. When there are tight turns, it can be a good idea to fly at a smaller airspeed than the climb law's 250 kts below FL100. We'll be using a 210kts limitations, by using a selected speed mode. Simply enter 210 in L4. The dashes in the FCU speed windows should be replaced by the V2 value, meaning we are in selected mode now. We the turn is complete, we'll resume the managed climb speed.

Next phases are not useful for the moment.

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11.2.6. *Last checks before start-up*

Almost there!! Usually, before copy the active flight plan in the secondary, in case they need to revert to the original FPLN (if they mess up with the FPLN for example). Do so by going to the SEC FPLN page and LSK1 to copy the active FPLN. INIT and FPLN pages as well as PERF ones are copied.

Now we need to tune the nav aids needed to follow our SID in case of IRS failure. We'll need TOU and GAI VORs, respective frequencies are 177.7 and 115.8. In the RAD NAV page, enter TOU in VOR1 (radial 324) and GAI in VOR2. In the real aircraft, the ILS receiver is different than the VOR1 receiver, and you would tune the active runway ILS in case of emergency landing, but it's not possible here due to FS limitation. You could tune ILS in VOR1 and TOU in VOR2, and wait to be high enough to change the tuning to GAI.

There is no auto-tuning facility yet.

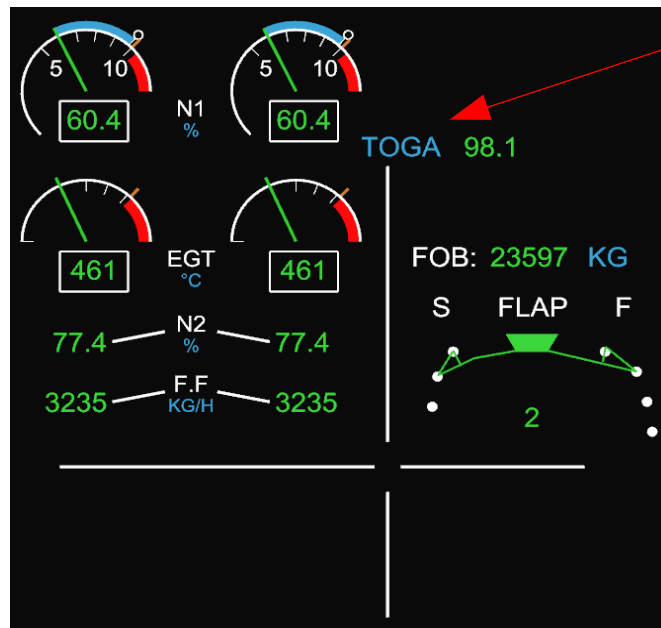


We're now good to go, ask for pushback and taxi clearance!!

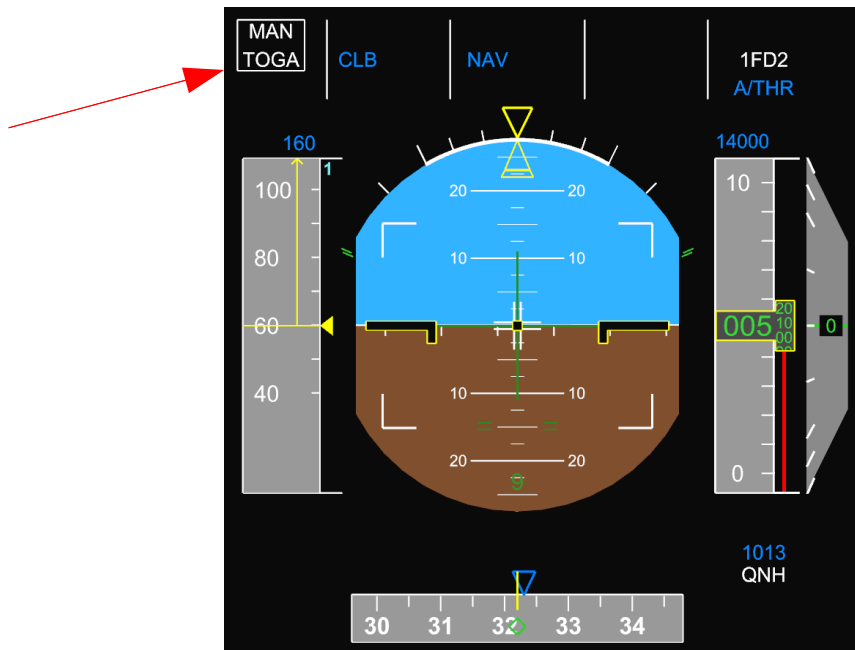
While taxiing, you can make sure everything is set. We'll be flying in lateral managed mode, so press the managed heading button (dashes in HDG window, and white dot). At the holding point, extend the flaps, transponder on mode C and TCAS on TA/RA. Line up when cleared to and wait for take off clearance.

11.3. Take Off

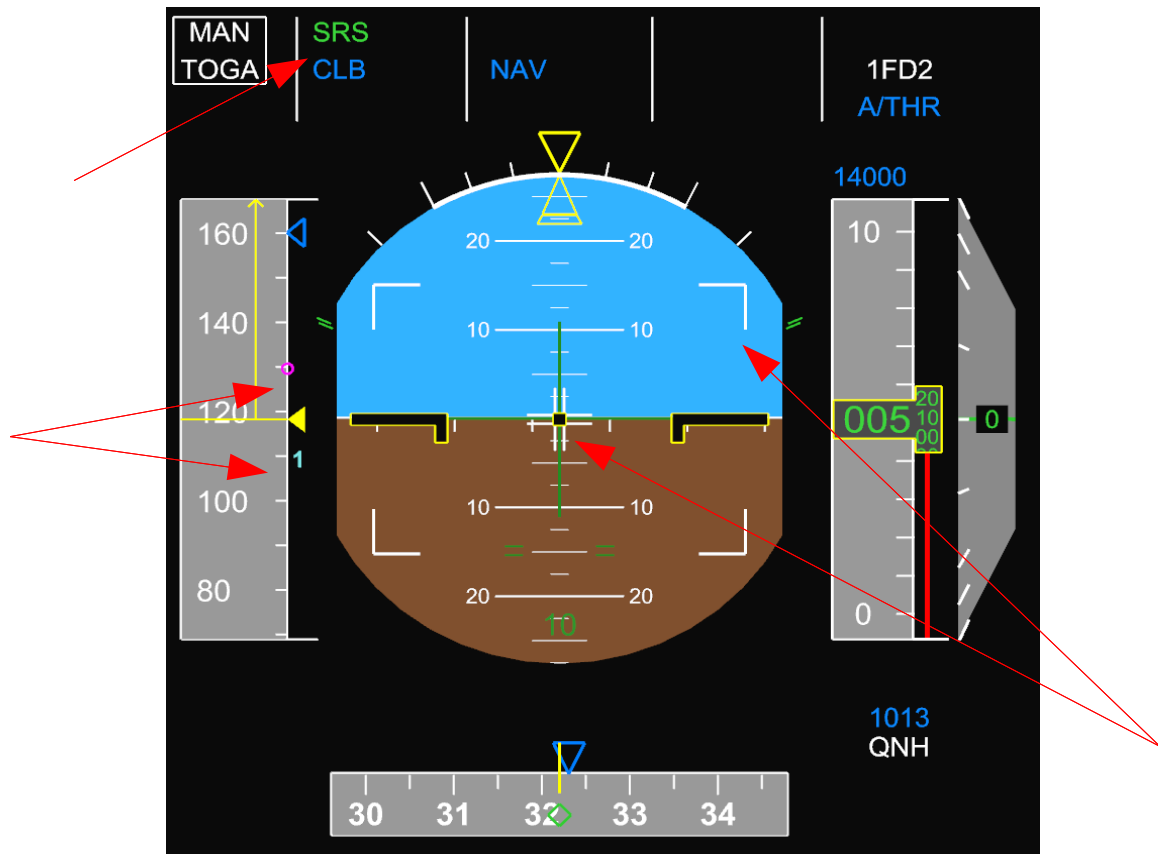
Once cleared for take off, slowly push the thrust levers to achieve 50% N1, then all the way to TOGA notch.



On the FMA, MAN TOGA should appear in a box in the first column:



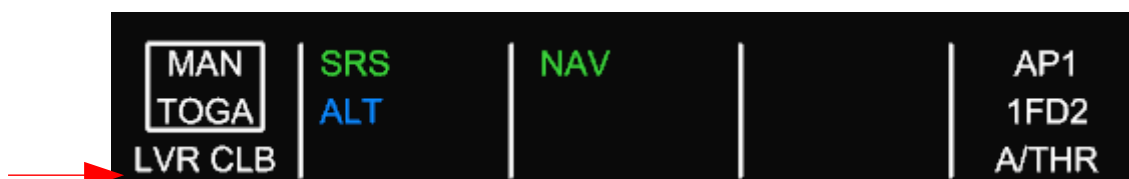
If you have a FO, he will call outs speed references such as 100kts, V1 and rotate. You can monitor the later two on the PFD speed scale. SRS vertical modes engages and CLB and NAV mode arm.



Note the white box and arrow on the PFD, they appear only on the ground and show the stick input (lateral and vertical). The box materializes the governs limits. When reaching VR, pull the stick full backward to raise the nose to around 7°.

When V/S is positive, raise the landing gear, and follow the speed target by adjusting pitch. You can now switch the AP on by pushing the FCU's AP1 button. The AP will maintain V2 +10 knots.

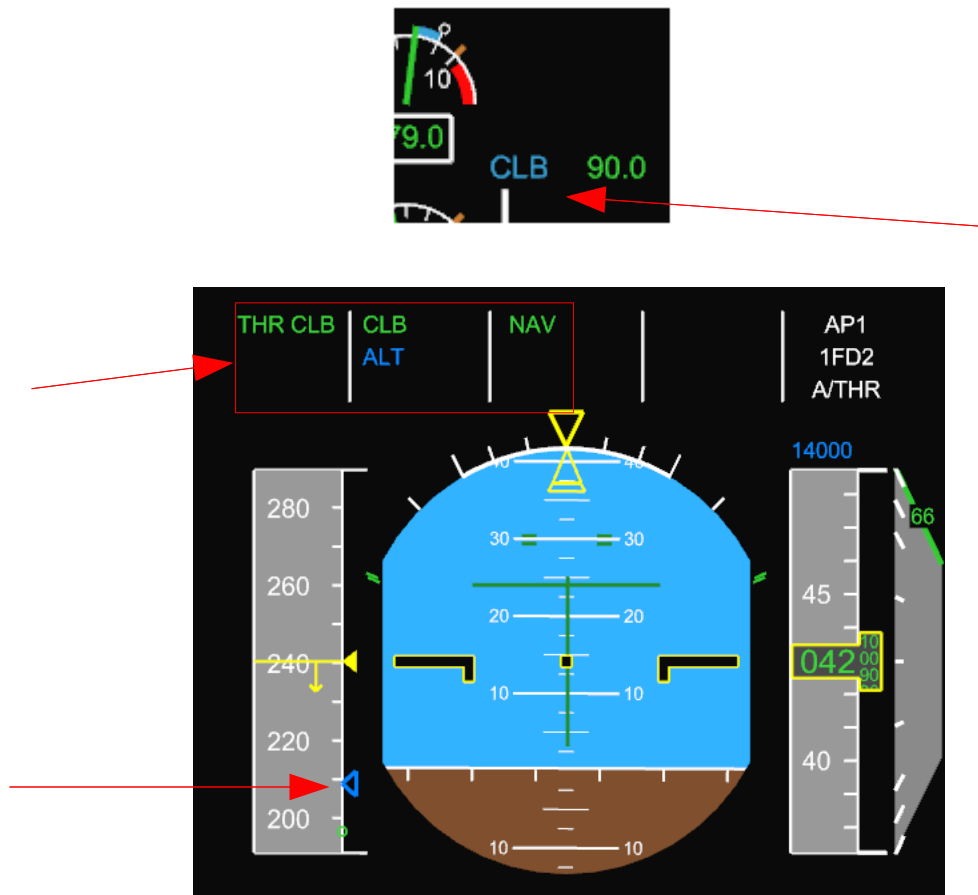
When reaching THR RED altitude, the message LVR CLB appears in FMA column1:



You need to put back the thrust levers to the Climb notch. The AP will automatically

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reduce N1% to climb N1 and maintain the first selected or managed speed. In our case, the selected 210 knots:



THR CLB mode engages, along with CLB and NAV modes.

11.4. Climb

Passing 5000ft, pull the QNH rotary below the QNH window on FCU to set barosetting at standard pressure.

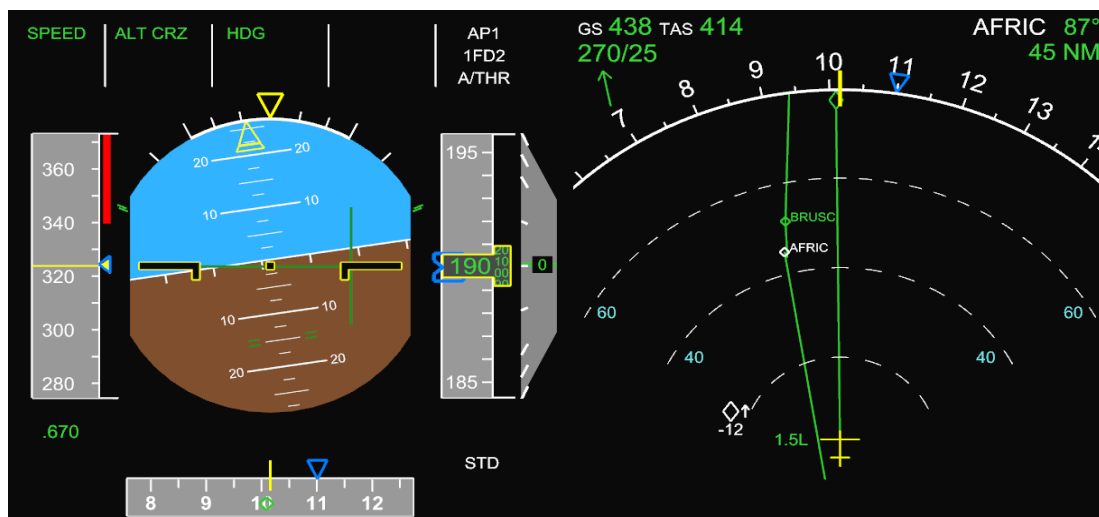
Approaching TOU, the controller gives us a direct to AFRIC point. Go to DIR TO page on the MCDU, scroll to AFRIC on the left, select DIRECT TO option then insert. The ND will change from that ugly bug in the OVFLY track display:



to:

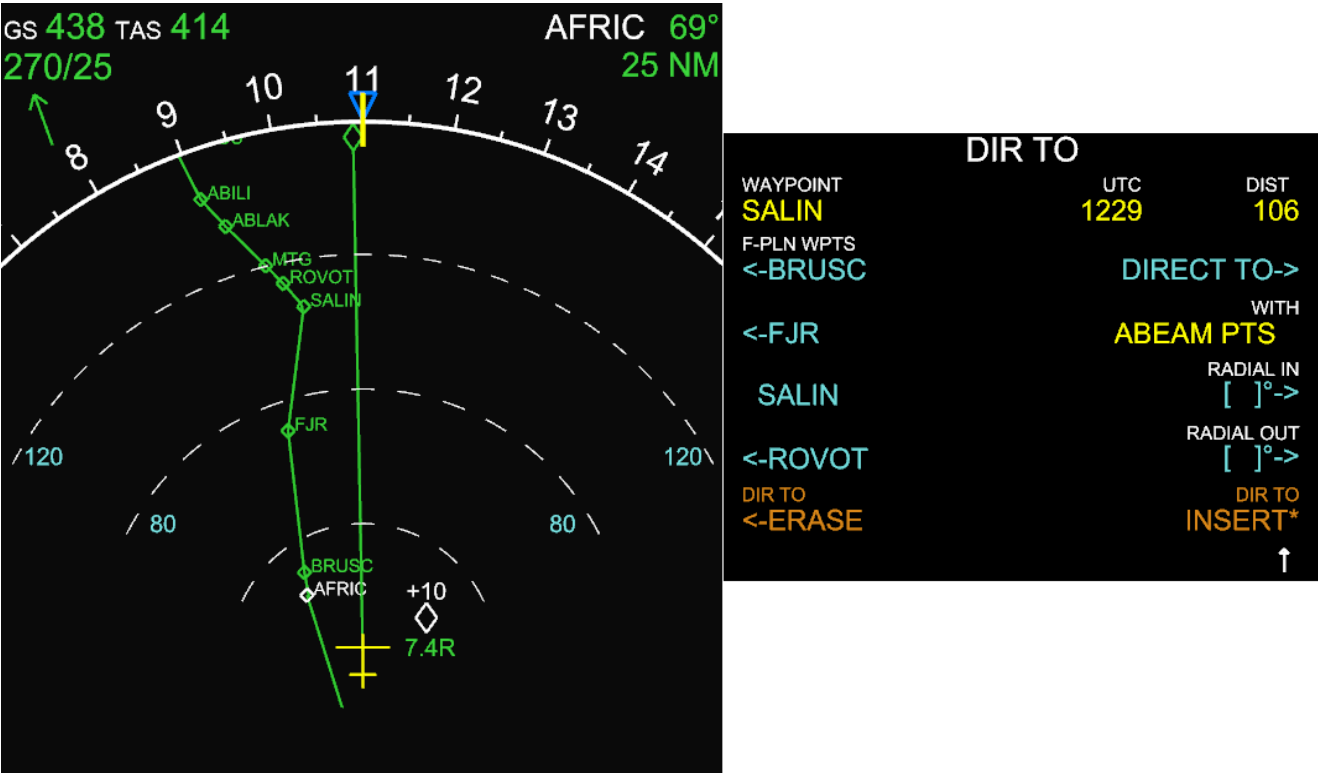


After contacting area control, we're cleared to climb to our CRZ level, FL190. Simply change the FCU value to 19000ft. Once established on track to AFRIC, don't forget to push managed speed button so that we accelerate to 250 while we're still under FL100. Dashes and dot appear on the FCU speed window.



HDG mode engages and the ACFT starts the right turn. We can maybe see the conflicting traffic, climbing through our level on the TCAS.

When clear of the conflict, we're given a direct to SALIN point as a reward of our cooperation. A320 operations recommends to use abeam points to keep track of the original FPLN. Let's do that:



ARRIVAL TO		LFMNN
APPR	VIA	STAR
-----	-----	-----
		TRANS

APPR AVAILABLE		
<-ILS04L	2570M	CRS044
		109.95
<-RIVIERA04L	2570M	
<-ILS04R	2960M	CRS042
		110.7
<RETURN		

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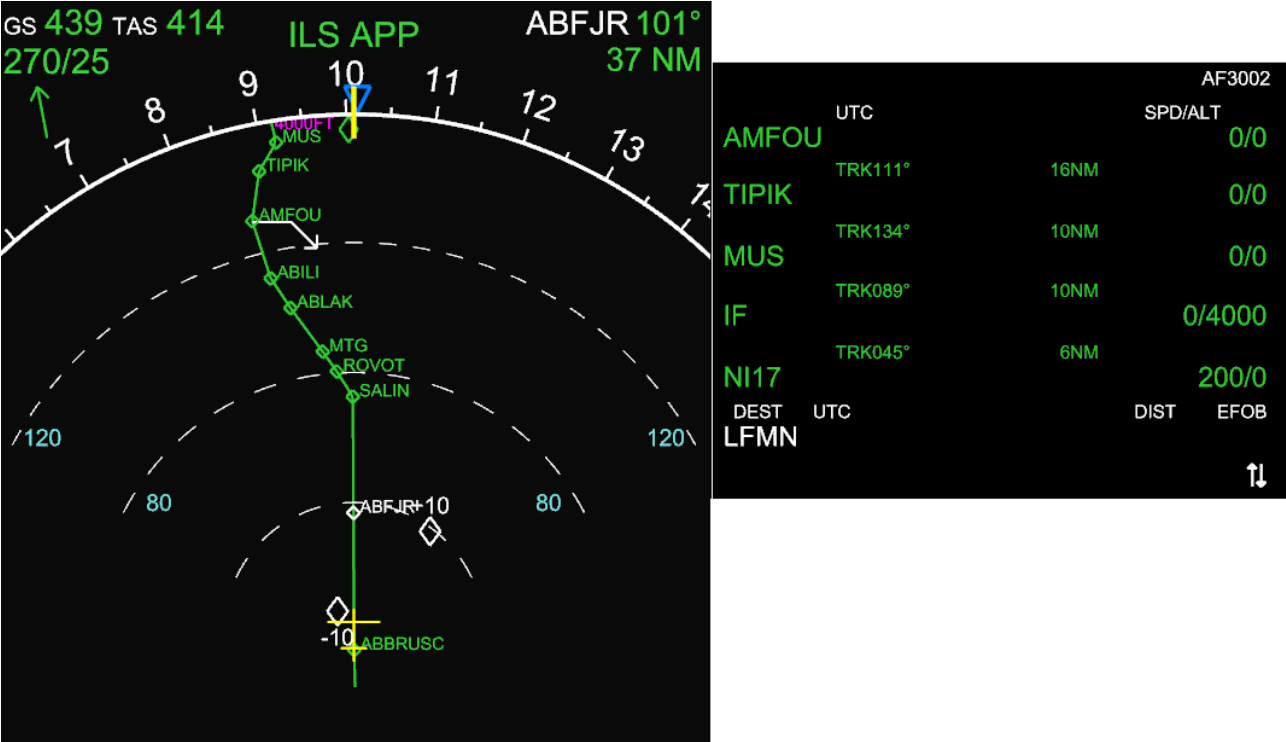
We'll execute the ILS approach RWY 04L, lucky us it's the first one, so click LSK3.



Our last en-route point is AMFOU, so we'll follow AMFOU 5R STAR. Again lucky us click LSK3. To connect our STAR to the approach, click on LSK2 to see the choice of VIASs available:



After looking on our paper chart, we know that AMFOU ends at MUS, so let's click on LSK3 again. Then insert the whole arrival routing via RSK6.



You can check the whole routing with ND map mode. Notice that the FMGS has calculated a TOD point, around AMFOU point, and that ILS APP appeared on the ND.

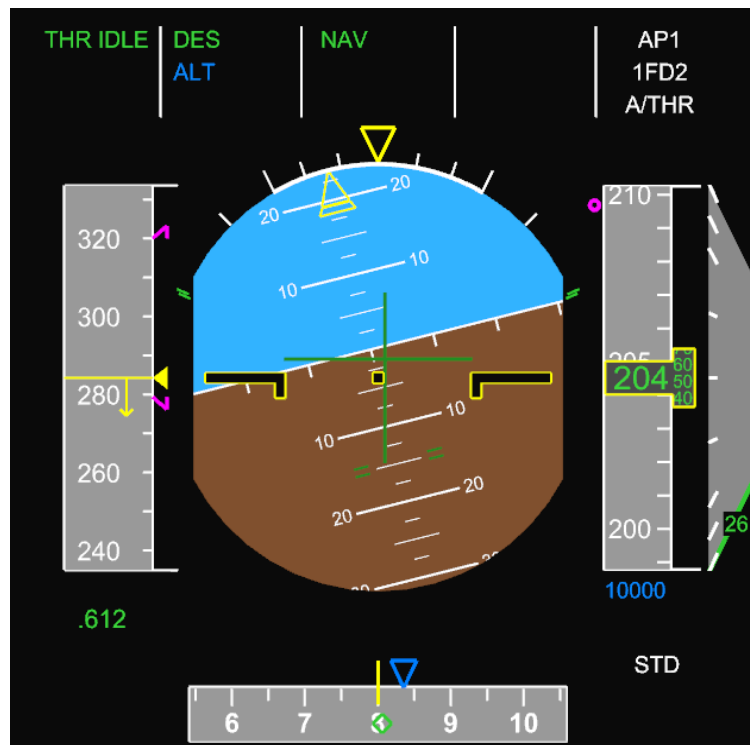
Well this time no luck, we encounter heavy turbulence at FL190, and we ask for FL210. The controller agrees, so let's set 21000ft in the FCU, and push managed button. Nothing happens yet, as this is bug in the software... You need to modify CRZ level via INIT A page, and the ACFT will start to climb again. Note that the TOD has changed a little bit to take the new CRZ level into account.

Approaching SALIN, we're cleared direct ABILI. You know the drill now.



11.6. Descent

Approaching now ABILI we get cleared to FL100. Set 10000ft in FCU and push managed. That way, we force the descent before the TOD. If we only selected 10000ft, the ACFT would have started descent at the TOD, and if we hadn't changed the altitude, it would have remained at FL 100.



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The speed target becomes an interval around managed descent speed, and FMGS can freely adjust pitch to maintain that interval and try to intercept calculated descent profile, symbolized by V/DEV symbol. All that with engines at idle power.

Let's tune the ATIS (129.6). QNH is 1013, temperature 15°C and wind is calm. Let's enter that data in the APPR PERF page, along with Nice transition altitude (5000ft), Decision altitude DA (200ft), and approach speed Vapp. We'll choose 147 kts today:



Note that you can activate approach phase via this screen and LSK6. It is as well activated automatically when passing deceleration point.

11.7. Approach and landing

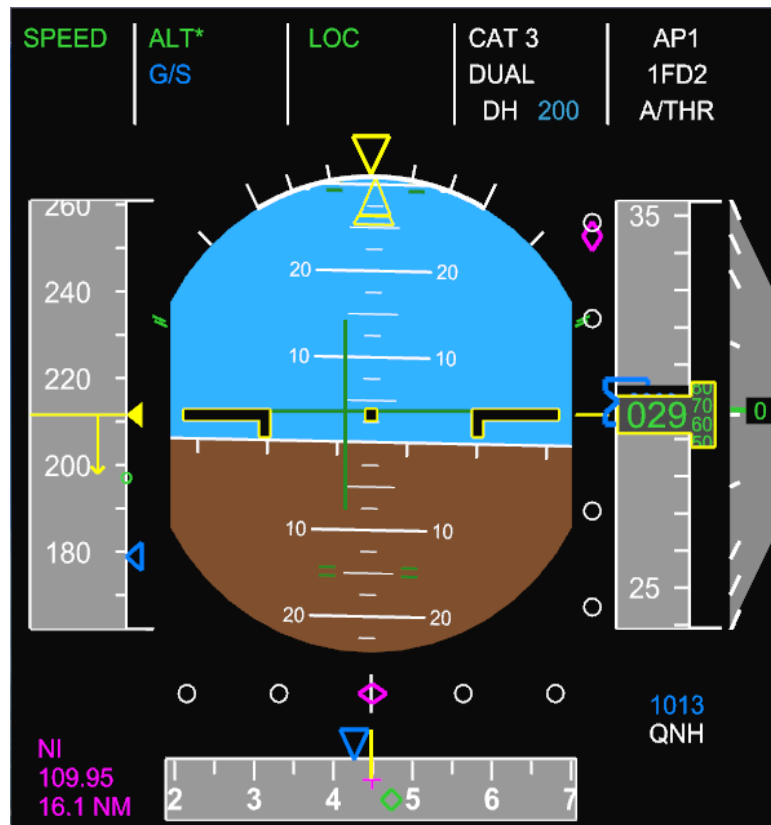
Nice approach controller clears us for a standard ILS approach, on our request as training purpose. Simply select 4000ft on the FCU (glideslope interception altitude), and the FMGS will do the rest!!! We'll stay on the track, reduce speed to 250 kts when below FL100, etc.... all automatically. Just don't forget to change the baro setting to QNH after passing the TA (5000ft).

You may want to manually reduce the speed by selecting an interception speed (<220knts), then the landing speed. The automatic way is not yet implemented.

Flaps extension and spoilers arm is done manually...

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After passing the IF point, make sure the ILS frequency is set in RAD NAV and push the APPR pushbutton once and watch the localiser then G/S capture. And display the ILS scale on the PFD with the FCU ILS pushbutton.



The AP/FD landing capabilities and approach minimums are displayed in the FMA's fourth column. During an ILS approach, it will for the moment always display CAT3 dual.

The ILS is correctly followed until at most 5 miles from the runway threshold. Sometimes the G/S is lost and you'll have to finish manually before reaching the minimums. Sometimes everything goes right and autoland is perfect...

On touchdown, if spoilers were armed they'll extend, remember to move back the thrust levers to idle position just before T/D, and to reverse max if you wish to use reverse thrust to slow down the aircraft.

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12. Offsets Table

This software is compatible with Peter Dowson's FSUIPC latest version (4.52 as of this writing). As some offsets change between versions, I won't support any other version. They are not yet official offsets, they may change in the future.

You need to know how to change particular bits of an offset to use some functions.

Offset	Length (in bytes)	Function																		
66C0	2	FCU speed window. Value is '999' if window shows dashes in managed mode. You can directly set the speed window through this offset.																		
66C2	2	FCU heading/track window. Value is '999' if window shows dashes in managed mode. You can directly set the heading/track window through this offset.																		
66C4	2	FCU altitude window. You can directly set the heading/track windows through this offset.																		
66C6	2	FCU Vertical speed window. Value is '9999' if window shows dashes in managed mode. You can directly set the VS/FPA window through this offset.																		
66C8	1	Various FCU indicators. Do not write here, only use for status indication.: <table><tr><th>Bit number</th><th>Function (ON = set to 1, OFF = set to 0)</th></tr><tr><td>0</td><td>Autopilot ON/OFF</td></tr><tr><td>1</td><td>A/THR ON/OFF</td></tr><tr><td>2</td><td>APPR pushbutton ON/OFF</td></tr><tr><td>3</td><td>HDG-TRK mode if set to 0, VS-FPA mode if set to 1</td></tr><tr><td>4</td><td>Barometric setting QNH if set to 0; STD if set to 1</td></tr><tr><td>5</td><td>Cpt ILS scales ON/OFF</td></tr><tr><td>6</td><td>Cpt FD ON/OFF</td></tr><tr><td>7</td><td>Speed mode SPD if set to 0, MACH if set to 1</td></tr></table>	Bit number	Function (ON = set to 1, OFF = set to 0)	0	Autopilot ON/OFF	1	A/THR ON/OFF	2	APPR pushbutton ON/OFF	3	HDG-TRK mode if set to 0, VS-FPA mode if set to 1	4	Barometric setting QNH if set to 0; STD if set to 1	5	Cpt ILS scales ON/OFF	6	Cpt FD ON/OFF	7	Speed mode SPD if set to 0, MACH if set to 1
Bit number	Function (ON = set to 1, OFF = set to 0)																			
0	Autopilot ON/OFF																			
1	A/THR ON/OFF																			
2	APPR pushbutton ON/OFF																			
3	HDG-TRK mode if set to 0, VS-FPA mode if set to 1																			
4	Barometric setting QNH if set to 0; STD if set to 1																			
5	Cpt ILS scales ON/OFF																			
6	Cpt FD ON/OFF																			
7	Speed mode SPD if set to 0, MACH if set to 1																			

Offset	Length (in bytes)	Function																																														
66C9	1	<div>MCDU keys control. Assign the value to the offset according to the table below:</div> <table><tr><th>Value</th><th>key</th></tr><tr><td>1 to 26</td><td>A to Z</td></tr><tr><td>27 to 36</td><td>0 to 9</td></tr><tr><td>38 to 43</td><td>LSK 1 to 6</td></tr><tr><td>44 to 49</td><td>RSK 1 to 6</td></tr><tr><td>50</td><td>CLR</td></tr><tr><td>51</td><td>OVFY</td></tr><tr><td>52</td><td>DIR</td></tr><tr><td>53</td><td>PROG</td></tr><tr><td>54</td><td>PERF</td></tr><tr><td>55</td><td>INIT</td></tr><tr><td>56</td><td>FPLN</td></tr><tr><td>57</td><td>RAD NAV</td></tr><tr><td>58</td><td>Left arrow</td></tr><tr><td>59</td><td>Right arrow</td></tr><tr><td>60</td><td>Up arrow</td></tr><tr><td>61</td><td>Down arrow</td></tr><tr><td>62</td><td>Space</td></tr><tr><td>63</td><td>/</td></tr><tr><td>64</td><td>+ (plus operator). If you push it twice, it'll output a -</td></tr><tr><td>65</td><td>- (minus operator)</td></tr><tr><td>66</td><td>. (decimal point)</td></tr><tr><td>67</td><td>SEC FPLN</td></tr></table>	Value	key	1 to 26	A to Z	27 to 36	0 to 9	38 to 43	LSK 1 to 6	44 to 49	RSK 1 to 6	50	CLR	51	OVFY	52	DIR	53	PROG	54	PERF	55	INIT	56	FPLN	57	RAD NAV	58	Left arrow	59	Right arrow	60	Up arrow	61	Down arrow	62	Space	63	/	64	+ (plus operator). If you push it twice, it'll output a -	65	- (minus operator)	66	. (decimal point)	67	SEC FPLN
Value	key																																															
1 to 26	A to Z																																															
27 to 36	0 to 9																																															
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50	CLR																																															
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52	DIR																																															
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54	PERF																																															
55	INIT																																															
56	FPLN																																															
57	RAD NAV																																															
58	Left arrow																																															
59	Right arrow																																															
60	Up arrow																																															
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65	- (minus operator)																																															
66	. (decimal point)																																															
67	SEC FPLN																																															

Offset	Length (in bytes)	Function	
66CA	1	Cpt EFIS pushbuttons (CSTR, WPT, etc...). Set the bit you want to 1 and the others to 0, except for bit n°5 which you can set separately:	
		Bit	Function
		0	CSTR
		1	WPT
		2	NDB
		3	VOR
		4	APT
		5	TERR on ND
66CB	1	FO ND modes. Set the corresponding value to set the mode:	
		Value	Function
		0	ILS
		1	VOR
		2	NAV rose
		3	NAV arc
		4	Plan
66CC	1	FO ND range. Set the corresponding value to set the ND mode:	
		Value	Range
		0	10 NM
		1	20 NM
		2	40 NM
		3	80 NM
		4	160 NM
5	320 NM		

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Offset	Length	Function												
66CD	1	<div>FO EFIS. Read/write the bits according to the explanation below: Bits 0 to 3: NAV1 and NAV2 pointers:</div> <table><tr><td>NAV1: VOR1</td><td>Bits 0 and 1 set to 1</td></tr><tr><td>NAV1: ADF1</td><td>Bit 0 set to 0, bit 1 set to 1</td></tr><tr><td>NAV1: OFF</td><td>Bits 0 and 1 set to 0</td></tr></table> <table><tr><td>NAV2: VOR2</td><td>Bits 2 and 3 set to 1</td></tr><tr><td>NAV2: ADF2</td><td>Bit 2 set to 0, bit 3 set to 1</td></tr><tr><td>NAV2: OFF</td><td>Bits 2 and 3 set to 0</td></tr></table> <div>Bit 4: FD active if 1, inactive if 0. Bit 5: ILS scale active if 1, inactive if 0. Bit 6: QNH over 30.54 inHG if set to 1. Bit 7: STD barometric setting if set to 1, QNH otherwise.</div>	NAV1: VOR1	Bits 0 and 1 set to 1	NAV1: ADF1	Bit 0 set to 0, bit 1 set to 1	NAV1: OFF	Bits 0 and 1 set to 0	NAV2: VOR2	Bits 2 and 3 set to 1	NAV2: ADF2	Bit 2 set to 0, bit 3 set to 1	NAV2: OFF	Bits 2 and 3 set to 0
NAV1: VOR1	Bits 0 and 1 set to 1													
NAV1: ADF1	Bit 0 set to 0, bit 1 set to 1													
NAV1: OFF	Bits 0 and 1 set to 0													
NAV2: VOR2	Bits 2 and 3 set to 1													
NAV2: ADF2	Bit 2 set to 0, bit 3 set to 1													
NAV2: OFF	Bits 2 and 3 set to 0													
66CE	1	<div>FO QNH setting inHg. To calculate the QNH, you need to know the status of the bit 6 in offset 669CD. The formula is then: QNH = (offset66CE+2799)/100 + offset66CD₀*2.55</div> <div>To set the QNH via this offset use this: if under 30.54 : 66CE= 100*QNH – 2799 if over 30.54 : 66CE= 100*QNH – 3054 and 66CD bit6 =1</div>												
66CF	1	<div>FO EFIS pushbuttons (CSTR, WPT, etc...). Set the bit you want to 1 and the others to 0:</div> <table><tr><td>Bit</td><td>Function</td></tr><tr><td>0</td><td>CSTR</td></tr><tr><td>1</td><td>WPT</td></tr><tr><td>2</td><td>NDB</td></tr><tr><td>3</td><td>VOR</td></tr><tr><td>4</td><td>APT</td></tr></table>	Bit	Function	0	CSTR	1	WPT	2	NDB	3	VOR	4	APT
Bit	Function													
0	CSTR													
1	WPT													
2	NDB													
3	VOR													
4	APT													

Offset	Length	Function																															
66D0	1	Various controls. Assign the value to the offset here, but reading is useless.																															
		Value	Function	1	Arm ground spoilers	2	Disarm ground spoilers	3	TO config button (ECAM control panel)	4	SD DOOR page	5	SD ENGINE page	6	SD BLEED page	7	SD CAB PRESS page	8	SD ELEC page	9	SD HYDRAULIC page	10	SD FUEL page	11	SD APU page	12	SD COND page	13	SD WHEEL page	14	SD F/CTL page	15	SD CRUISE page
		Value	Function																														
		1	Arm ground spoilers																														
		2	Disarm ground spoilers																														
		3	TO config button (ECAM control panel)																														
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		10	SD FUEL page																														
		11	SD APU page																														
		12	SD COND page																														
		13	SD WHEEL page																														
		14	SD F/CTL page																														
15	SD CRUISE page																																
66D1	1	AutoBrake and Anti-Skid. Read & write.																															
		Bit	Function	0	Set this bit to override autobrake when manually braking.	1	Autobrake LO	2	Autobrake MED	3	Autobrake MAX	4	Autobrake DECEL	5	Anti-Skid & NWS																		
		Bit	Function																														
		0	Set this bit to override autobrake when manually braking.																														
		1	Autobrake LO																														
		2	Autobrake MED																														
		3	Autobrake MAX																														
		4	Autobrake DECEL																														
5	Anti-Skid & NWS																																
To change autobrake value for example from MAX to MED, you need to clear bit 3 and set bit 2 in the same process.																																	

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Offset	Length	Function																																																						
66D2	1	<div>Overhead controls. Write the numeric value corresponding to the korry/switch/rotary you want to use. Do not read here to get korrys or switch status.</div> <table><tr><th>Value</th><th>Function</th></tr><tr><td>1</td><td>Wing Anti-Ice</td></tr><tr><td>2</td><td>Engine 1 Anti-Ice</td></tr><tr><td>3</td><td>Engine 2 Anti-Ice</td></tr><tr><td>4</td><td>Strobe light ON</td></tr><tr><td>5</td><td>Strobe light OFF</td></tr><tr><td>6</td><td>Strobe light AUTO</td></tr><tr><td>7</td><td>Beacon light ON</td></tr><tr><td>8</td><td>Beacon light OFF</td></tr><tr><td>9</td><td>Wing light ON</td></tr><tr><td>10</td><td>Wing light OFF</td></tr><tr><td>11</td><td>Nav & Logo Light ON</td></tr><tr><td>12</td><td>Nav & Logo Light OFF</td></tr><tr><td>13</td><td>RWY turn off light ON</td></tr><tr><td>14</td><td>RWY turn off light OFF</td></tr><tr><td>15</td><td>Left LDG light ON</td></tr><tr><td>16</td><td>Left LDG light OFF</td></tr><tr><td>17</td><td>Left LDG light Retract</td></tr><tr><td>18</td><td>Right LDG light ON</td></tr><tr><td>19</td><td>Right LDG light OFF</td></tr><tr><td>20</td><td>Right LDG light Retract</td></tr><tr><td>21</td><td>Nose light TO</td></tr><tr><td>22</td><td>Nose light Taxi</td></tr><tr><td>23</td><td>Nose light OFF</td></tr><tr><td>24</td><td>APU Master Switch</td></tr><tr><td>25</td><td>APU Start</td></tr><tr><td>26</td><td>Cabin Pressure MAN V/S UP (see note at the end of table)</td></tr></table>	Value	Function	1	Wing Anti-Ice	2	Engine 1 Anti-Ice	3	Engine 2 Anti-Ice	4	Strobe light ON	5	Strobe light OFF	6	Strobe light AUTO	7	Beacon light ON	8	Beacon light OFF	9	Wing light ON	10	Wing light OFF	11	Nav & Logo Light ON	12	Nav & Logo Light OFF	13	RWY turn off light ON	14	RWY turn off light OFF	15	Left LDG light ON	16	Left LDG light OFF	17	Left LDG light Retract	18	Right LDG light ON	19	Right LDG light OFF	20	Right LDG light Retract	21	Nose light TO	22	Nose light Taxi	23	Nose light OFF	24	APU Master Switch	25	APU Start	26	Cabin Pressure MAN V/S UP (see note at the end of table)
Value	Function																																																							
1	Wing Anti-Ice																																																							
2	Engine 1 Anti-Ice																																																							
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4	Strobe light ON																																																							
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6	Strobe light AUTO																																																							
7	Beacon light ON																																																							
8	Beacon light OFF																																																							
9	Wing light ON																																																							
10	Wing light OFF																																																							
11	Nav & Logo Light ON																																																							
12	Nav & Logo Light OFF																																																							
13	RWY turn off light ON																																																							
14	RWY turn off light OFF																																																							
15	Left LDG light ON																																																							
16	Left LDG light OFF																																																							
17	Left LDG light Retract																																																							
18	Right LDG light ON																																																							
19	Right LDG light OFF																																																							
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		27	Cabin Pressure MAN V/S DN (see note at the end of table)
		28	Cabin Pressure MODE SEL (see note at the end of table)
		29	LDG elevation AUTO
		30	LDG elevation Increase
		31	LDG elevation Decrease
		32	Ditching
		33	Seat Belts Sign ON
		34	Seat Belts Sign OFF
		35	No Smoking Sign ON
		36	No Smoking Sign OFF
		37	No Smoking Sign AUTO
		38	RAT extension (works for both electric panel and EMER GEN panel)
		39	GPWS SYS
		40	GPWS Glideslope
		41	GPWS Flaps mode
		42	GPWS Landing Flaps 3
		43	PACK Flow LO
		44	PACK Flow NORM
		45	PACK Flow HI
		46	PACK 1
		47	PACK 2
		48	Engine 1 Bleed
		49	Engine 2 Bleed
		50	APU Bleed
		51	RAM Air
		52	Hot Air
		53	CKPT Temperature increase
		54	CKPT Temperature decrease
		55	CKPT Temperature 24°C

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		56	FWD cabin Temp. increase
		57	FWD cabin Temp. decrease
		58	FWD cabin Temp. 24°C
		59	AFT cabin Temp. increase
		60	AFT cabin Temp. decrease
		61	AFT cabin Temp. 24°C
		62	X-Bleed Shut
		63	X-Bleed AUTO
		64	X-Bleed Open
		65	FWD cargo ISOL. Valve
		66	AFT cargo ISOL. Valve
		67	Cargo Hot Air
		68	FWD cargo Temp. decrease
		69	FWD cargo Temp. increase
		70	AFT cargo Temp. decrease
		71	AFT cargo Temp. increase
		72	Engine 1 MAN start
		73	Engine 2 MAN start
		74	Galley Shed
		75	Electric generator 1
		76	Electric generator 2
		77	APU Elec. generator
		78	External Elec. PWR
		79	Bus Tie
		80	AC Essential Feed
		81	Battery 1
		82	Battery 2
		83	Engine 1 HYD pump
		84	Engine 2 HYD pump
		85	Blue HYD Elec. Pump
		86	Yellow HYD Elec. Pump

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		87	PTU
		88	Fuel X-Feed
		89	Left Fuel Tank Pump 1
		90	Left Fuel Tank Pump 2
		91	CTR Fuel Tank Pump 1
		92	CTR Fuel Tank Pump 2
		93	CTR TK MODE SEL
		94	Right Fuel Tank Pump 1
		95	Right Fuel Tank Pump 2
		96	Engine 1 Master Switch ON
		97	Engine 1 Master Switch OFF
		98	Engine 2 Master Switch ON
		99	Engine 2 Master Switch OFF
		100	ENG start Crank
		101	ENG start NORM
		102	ENG start IGN/START
		103	Cabin Pressure MAN V/S release (see note at the end of table)
		104	Cabin Pressure MODE SEL release (see note at the end of table)
		105	Ground HP bleed

Note for cabin pressure MAN V/S UP/DN and MODE SEL switches: those switch must/can be held down in order to achieve their primary or a secondary function. They need to know when they are pushed down and when they are released.

The “pushing down” action are the offset values 26, 27 & 28.

The “release action” are the offset values 103 & 104.

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Offset	Length	Function																																														
66D3	2	<p>Overhead korry Status. Read here to get korry status. Value format is: XYY where X is status indicator and YY the korry number.</p> <p>X=1: both LEDs off X=2: lower LED on / upper LED off X=3: lower LED off / upper LED on X=4: both LEDs on</p> <p>If X=5 then YY is battery 1 voltage*10 If X=6 then YY is battery 2 voltage*10</p> <table><tr><th>Korry Number</th><th>Corresponding Korry</th></tr><tr><td>1</td><td>GALLEY SHED</td></tr><tr><td>2</td><td>BAT1</td></tr><tr><td>3</td><td>BAT2</td></tr><tr><td>4</td><td>AC ESS FEED</td></tr><tr><td>5</td><td>ELEC GEN1</td></tr><tr><td>6</td><td>ELEC GEN2</td></tr><tr><td>7</td><td>ELEC APU GEN</td></tr><tr><td>8</td><td>BUS TIE</td></tr><tr><td>9</td><td>ELEC EXT PWR</td></tr><tr><td>10</td><td>RAT & EMER GEN</td></tr><tr><td>11</td><td>MAN ON RAT</td></tr><tr><td>12</td><td>GPWS SYS</td></tr><tr><td>13</td><td>GPWS G/S</td></tr><tr><td>14</td><td>GPWS FLAP</td></tr><tr><td>15</td><td>GPWS LDG FLAP 3</td></tr><tr><td>16</td><td>PACK1</td></tr><tr><td>17</td><td>PACK2</td></tr><tr><td>18</td><td>ENG1 BLEED</td></tr><tr><td>19</td><td>ENG2 BLEED</td></tr><tr><td>20</td><td>RAM AIR</td></tr><tr><td>21</td><td>APU BLEED</td></tr><tr><td>22</td><td><i>none</i></td></tr></table>	Korry Number	Corresponding Korry	1	GALLEY SHED	2	BAT1	3	BAT2	4	AC ESS FEED	5	ELEC GEN1	6	ELEC GEN2	7	ELEC APU GEN	8	BUS TIE	9	ELEC EXT PWR	10	RAT & EMER GEN	11	MAN ON RAT	12	GPWS SYS	13	GPWS G/S	14	GPWS FLAP	15	GPWS LDG FLAP 3	16	PACK1	17	PACK2	18	ENG1 BLEED	19	ENG2 BLEED	20	RAM AIR	21	APU BLEED	22	<i>none</i>
Korry Number	Corresponding Korry																																															
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22	<i>none</i>																																															

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		23	HOT AIR
		24	WING ANTI ICE
		25	ENG1 ANTI ICE
		26	ENG2 ANTI ICE
		27	CAB PRESS MODE SEL
		28	DITCHING
		29	APU MASTER SW
		30	APU START
		31	FWD ISOL VALVE
		32	AFT ISOL VALVE
		33	CARGO HOT AIR
		34	ENG1 MAN START
		35	ENG2 MAN START
		36	ENG1 HYD PUMP
		37	ENG2 HYD PUMP
		38	BLUE ELEC PUMP
		39	PTU
		40	YELLOW ELEC PUMP
		41	FUEL X-FEED
		42	L TK PUMP1
		43	L TK PUMP2
		44	R TK PUMP1
		45	R TK PUMP2
		46	CTR TK PUMP1
		47	CTR TK PUMP2
		48	FUEL MODE SEL

Offset	Length	Function																																								
78EB	1	<div>FCU buttons. Assign those values to have the corresponding FCU inputs (do not use this offset to get FMGS status):</div> <table><tr><th>Value</th><th>Action</th></tr><tr><td>1</td><td>Speed selected</td></tr><tr><td>2</td><td>Speed managed</td></tr><tr><td>3</td><td>HDG or TRK selected</td></tr><tr><td>4</td><td>HDG or TRK managed</td></tr><tr><td>5</td><td>Altitude selected</td></tr><tr><td>6</td><td>Altitude managed</td></tr><tr><td>7</td><td>Engage V/S mode</td></tr><tr><td>8</td><td>Level-Off</td></tr><tr><td>9</td><td>AP1 engage/disengage</td></tr><tr><td>10</td><td>A/THR engage/disengage</td></tr><tr><td>11</td><td>APPR engage/disengage</td></tr><tr><td>12</td><td>Cpt FD engage/disengage</td></tr><tr><td>13</td><td>Cpt ILS scales engage/disengage</td></tr><tr><td>14</td><td>Cpt Barometric setting STD</td></tr><tr><td>15</td><td>Cpt Barometric setting QNH</td></tr><tr><td>16</td><td>Cpt QNH shuffle between inHg and millibars</td></tr><tr><td>17</td><td>HDG-VS / TRK- FPA shuffle</td></tr><tr><td>18</td><td>FO QNH shuffle between inHg and millibars</td></tr><tr><td>19</td><td>SPD/MACH mode shuffle</td></tr></table>	Value	Action	1	Speed selected	2	Speed managed	3	HDG or TRK selected	4	HDG or TRK managed	5	Altitude selected	6	Altitude managed	7	Engage V/S mode	8	Level-Off	9	AP1 engage/disengage	10	A/THR engage/disengage	11	APPR engage/disengage	12	Cpt FD engage/disengage	13	Cpt ILS scales engage/disengage	14	Cpt Barometric setting STD	15	Cpt Barometric setting QNH	16	Cpt QNH shuffle between inHg and millibars	17	HDG-VS / TRK- FPA shuffle	18	FO QNH shuffle between inHg and millibars	19	SPD/MACH mode shuffle
Value	Action																																									
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Offset	Length	Function																				
78EC	1	Cpt ND modes. Set the corresponding value to set the ND mode: <table><tr><th>Value</th><th>Function</th></tr><tr><td>0</td><td>ILS</td></tr><tr><td>1</td><td>VOR</td></tr><tr><td>2</td><td>NAV rose</td></tr><tr><td>3</td><td>NAV arc</td></tr><tr><td>4</td><td>Plan</td></tr></table>	Value	Function	0	ILS	1	VOR	2	NAV rose	3	NAV arc	4	Plan								
Value	Function																					
0	ILS																					
1	VOR																					
2	NAV rose																					
3	NAV arc																					
4	Plan																					
78ED	1	Cpt ND range. Set the corresponding value to set the ND mode: <table><tr><th>Value</th><th>Range</th></tr><tr><td>0</td><td>10 NM</td></tr><tr><td>1</td><td>20 NM</td></tr><tr><td>2</td><td>40 NM</td></tr><tr><td>3</td><td>80 NM</td></tr><tr><td>4</td><td>160 NM</td></tr><tr><td>5</td><td>320 NM</td></tr></table>	Value	Range	0	10 NM	1	20 NM	2	40 NM	3	80 NM	4	160 NM	5	320 NM						
Value	Range																					
0	10 NM																					
1	20 NM																					
2	40 NM																					
3	80 NM																					
4	160 NM																					
5	320 NM																					
78EE	1	FCU, Cpt EFIS NAV1 and NAV2 selector and TCAS. Set the bits according to the explanation below: <table><tr><td>NAV1: VOR1</td><td>Bits 0 and 1 set to 1</td></tr><tr><td>NAV1: ADF1</td><td>Bit 0 set to 0, bit 1 set to 1</td></tr><tr><td>NAV1: OFF</td><td>Bits 0 and 1 set to 0</td></tr></table> <table><tr><td>NAV2: VOR2</td><td>Bits 2 and 3 set to 1</td></tr><tr><td>NAV2: ADF2</td><td>Bit 2 set to 0, bit 3 set to 1</td></tr><tr><td>NAV2: OFF</td><td>Bits 2 and 3 set to 0</td></tr></table> <table><tr><td>TCAS ALL</td><td>Bits 4 and 5 set to 0</td></tr><tr><td>TCAS THRT</td><td>Bits 4 and 5 set to 1</td></tr><tr><td>TCAS BLW</td><td>Bit 4 set to 1, bit 5 set to 0</td></tr><tr><td>TCAS ABV</td><td>Bit 4 set to 0, bit 5 set to 1</td></tr></table>	NAV1: VOR1	Bits 0 and 1 set to 1	NAV1: ADF1	Bit 0 set to 0, bit 1 set to 1	NAV1: OFF	Bits 0 and 1 set to 0	NAV2: VOR2	Bits 2 and 3 set to 1	NAV2: ADF2	Bit 2 set to 0, bit 3 set to 1	NAV2: OFF	Bits 2 and 3 set to 0	TCAS ALL	Bits 4 and 5 set to 0	TCAS THRT	Bits 4 and 5 set to 1	TCAS BLW	Bit 4 set to 1, bit 5 set to 0	TCAS ABV	Bit 4 set to 0, bit 5 set to 1
NAV1: VOR1	Bits 0 and 1 set to 1																					
NAV1: ADF1	Bit 0 set to 0, bit 1 set to 1																					
NAV1: OFF	Bits 0 and 1 set to 0																					
NAV2: VOR2	Bits 2 and 3 set to 1																					
NAV2: ADF2	Bit 2 set to 0, bit 3 set to 1																					
NAV2: OFF	Bits 2 and 3 set to 0																					
TCAS ALL	Bits 4 and 5 set to 0																					
TCAS THRT	Bits 4 and 5 set to 1																					
TCAS BLW	Bit 4 set to 1, bit 5 set to 0																					
TCAS ABV	Bit 4 set to 0, bit 5 set to 1																					

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Offset	Length	Function
7B91	1	Transponder offset, as in SquawkBox and IVAP: 0= Mode C 1= STBY