AIRBUS A318/A319

Volume **4**

Systems Guide

Version 01-03-001

RECORD OF REVISIONS

revision n°	Issue date	Release	Description
001	Aug 20, 2104	1.00	completion
002	Sept 2, 214	1.00	Avionics door changes

CONTENTS

INTRODUCTION

It is very easy to find actual manuals for the A320 range of aircraft on the internet. For obvious reasons we cannot include them but even a quick source will lead you to a treasure-trove of information. Start your search with *'A320 FCOM'* to find complete operation manuals. Almost all you find in there is applicable to this product.

AIRCRAFT GENERAL

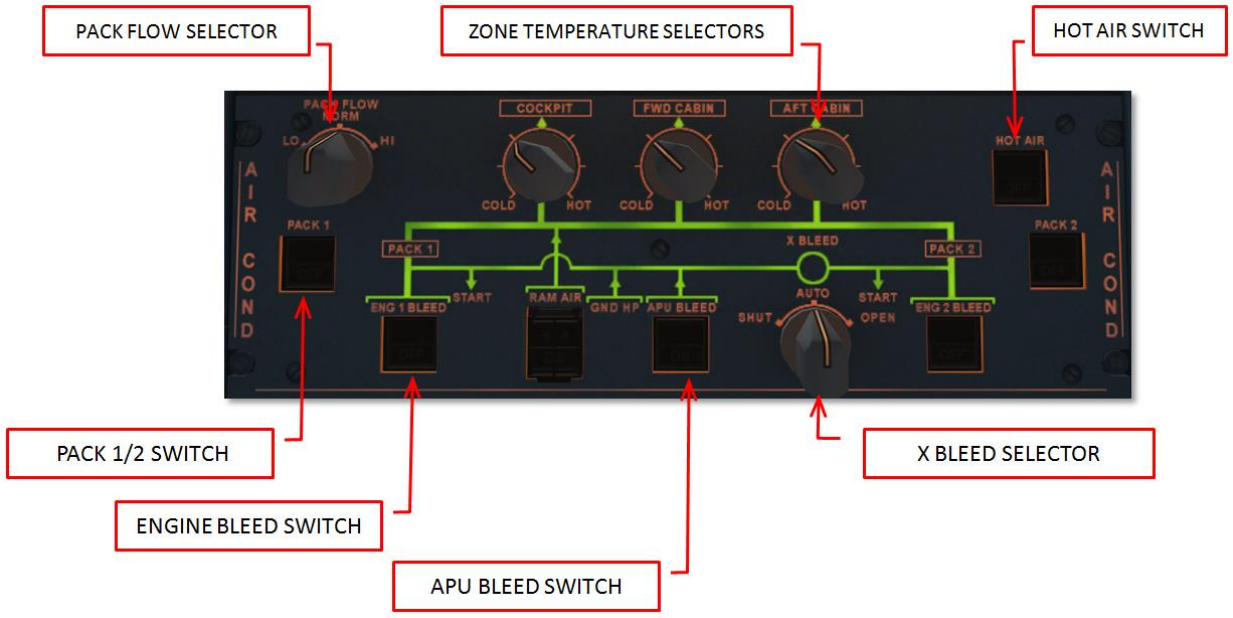
The Airbus A320 family includes the A318, A319, A320, and A321, all medium range, subsonic narrow body civil aviation aircraft. Powered by two high-powered by-pass turbofan engines they seat up to 220 passengers.

AIR CONDITIONING & PNEUMATICS

The air conditioning system is fully automatic and provides continuous renewal of conditioned air in three zones: COCKPIT, FWD CABIN and AFT CABIN. Temperatures in these three zones can be regulated independently. The air is supplied via the pneumatic systems using:

- two pack flow control valves
- two packs
- the mixing unit that combines air from the packs and the cabin

The cold air from the PACKs is mixed with the hot bleed air (taken from the engines or APU) by a mixing unit that is controlled by the zone regulator.



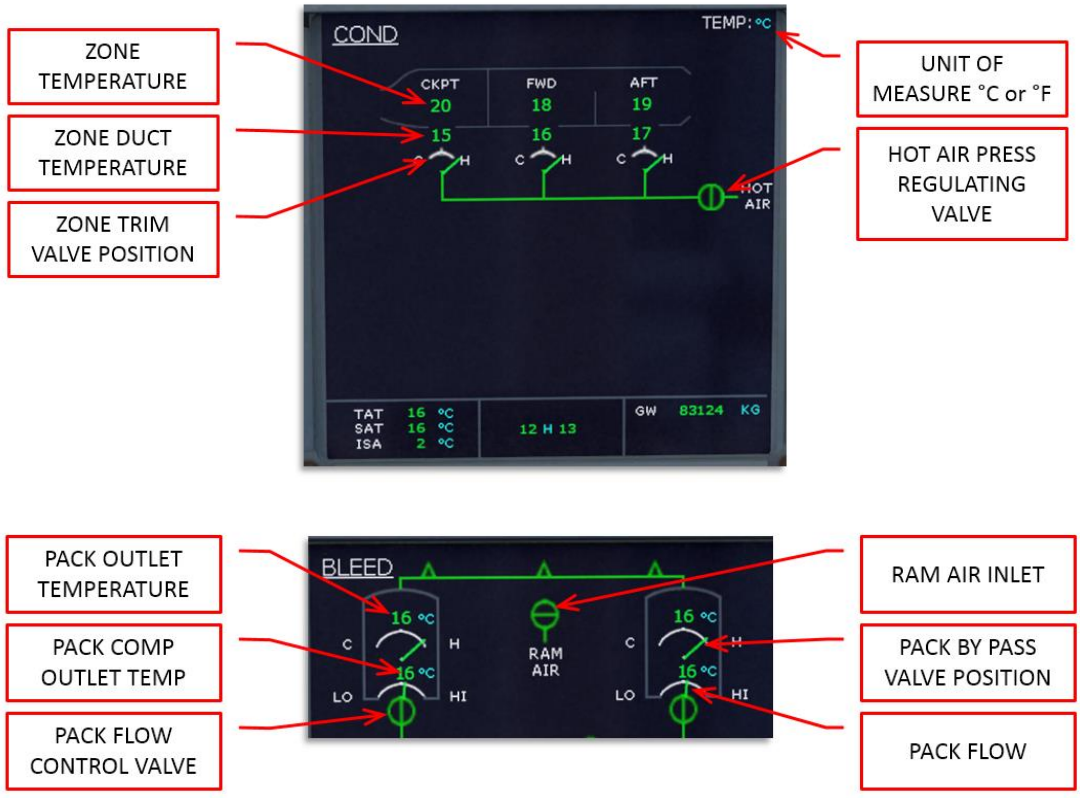
All control is done via the AIR COND panel on the overhead panel.

- Zone temperature control selectors
  - COLD = 18 °C
  - CENTER = 24 °C
  - HOT = 30° C
- HOT AIR pb switch
  - ON: hot air pressure is regulated

- OFF: valve closes + trim air valve closes and cabin temperature will drop to external temperature
- FAULT: (plus ECAM caution) when duct temperature is above 80°C, resets when temperature is below 70°C

- PACK pb switch
  - ON: pack flow control is automatically controlled (note the pack flow valve is closed during certain conditions like engine start etc.)
  - OFF: pack flow control valves close
  - FAULT: (plus ECAM caution) when valve position does not match the selected position
- PACK FLOW
  - LO: to be used with little or no passengers
  - NORM: to be used with (near to) maximum amount of passengers
  - HI: to be used to clear smoke or contaminants or in extreme temperatures (only available if both engines are running)
- ENG x BLEED pb
  - ON
  - OFF
  - FAULT

Feedback on the air conditioning system is given on the ECAM COND page and on the ECAM BLEED page.



PRESSURIZATION

Under normal operation conditions the complete pressurization is fully automatic. The system consists of:

- two Cabin Pressure Controllers
- outflow valve
- control panel
- two safety valves

In automatic operation pressurization is divided in 6 different modes

- **Ground**: before take-off and 1 minute after landing the outflow valve is fully open to equalize pressure with outside pressure.
- **Take-off**: just before take-off the system prepresurizes the cabin to avoid a sudden pressure increase
- **Climb**: cabin altitude is decreased to cruise level using input from vertical speed and other sensors
- **Cruise**: cabin pressure is maintained
- **Descent**: cabin altitude is increased to cruise level using input from vertical speed and other sensors
- **Abort**: in case of an aborted take-off the system will prevent the triggered climb mode from starting to decrease the pressure.

VENTILATION

The ventilation of avionics is controlled by the Avionics Equipment Ventilation Controller (AEVC). It provides cooling of the avionics compartments using two fans, a heat exchanger that uses the outside skin of the aircraft to cool the air and an inlet and outlet valve. Only the automated mode is simulated and you can see the ventilation valve position on the CAB PRESS ECAM page. Battery, galley and toilet ventilation is provided by fans that draws air from the cabin and vents it overboard via a vent in the aircraft skin.

Do note that the AEVC is very loud and other sounds from the aircraft systems that are heard on other aircraft types are not heard on the Airbus A320 series.

APU

GENERAL

The Auxiliary Power Unit provides:

- Bleed air for engine starting
- Bleed air for air conditioning
- Electrical power for all the buses

The APU can be used on the ground and in flight with the following limitations:

- 100% generator load up to 25,000 feet
- Full pneumatic and hydraulic pressure up to 20,000 feet
- Can be started using the battery up to 25,000 feet.

SYSTEM COMPONENTS

The APU consists of a gas turbine engine with an APU computer that manages the system. The air intake uses a electrically operated inlet flap and the exhaust vents in the tail cone. The electrical starter will start the engine when the inlet flap is fully opened. The fuel is taken from the left wing tank using a separate fuel pump.

AIR BLEED SYSTEM

Bleed air from the APU is selectable from the overhead panel and has priority over main engine bleed air as long as the APU BLEED pb is ON. The bleed air can start engines and provide the air condition system.

CONTROLS AND DISPLAYS

The APU ECAM page displays the parameters of the APU. For the gas turbine engine N (in %) and EGT (in °C) are available. The APU generator shows load (in %), voltage (in V) and frequency (in HZ) plus the connection to the bus (arrow when connected, nothing when not connected). Bleed air shows pressure (in PSI) plus the position of the valve (open or closed). All system messages are shown in green while within correct parameters, or amber when outside correct parameters.

The APU MASTER SW pb on the overhead APU panel is pressed (ON will show) to power up the APU computer, the fuel pump is activated and the air inlet is opened. When ON is shown the APU is ready to start.

The APU START pb starts the APU. When pressed it will show ON and the APU computer will command and control the startup. Aircraft batteries must be selected ON, even when the engine generators are online. When

the APU is running and bleed air and electrical power are available a green AVAIL will show and the ON will not be shown. Note the APU needs a 3 minute cool down period after it has shut down.

On the ELEC panel the APU GEN pb will be dark when the APU generator is ON, and when pressed it will show OFF as the APU generator is taken of line. When there is any problem an amber FAULT will show and the ECAM will show more information.

On the AIR COND panel the APU BLEED pb will show ON when APU N speed is sufficient. When pushed the pb will be dark and the bleed air valve will close. When there is any problem an amber FAULT will show and the ECAM will show more information.

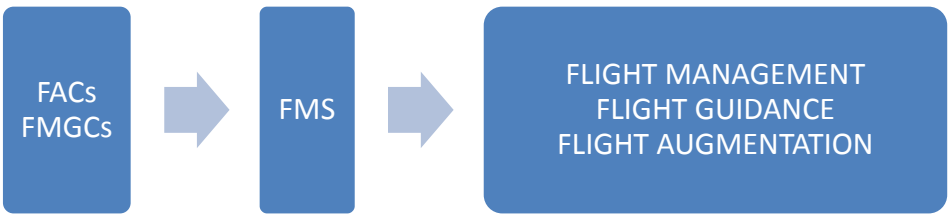
AUTOFLIGHT

OVERVIEW

The following components are used by the pilot to interact with the autoflight system:

- Flight Control Unit (FCU)
- Multifunction Control and Display Units (MCDUs)
- Sidesticks
- Thrust levers
- Primary Flight Display (PFD)
- Navigation Display (ND)

The autoflight system is part of the Flight Management System (FMS). The FMS (including autopilots and autothrust system) is made up by two Flight Management Guidance Computers (FMGCs) and two Flight Augmentation Computers (FACs).



- Flight Management provides navigation, performance optimization and display management.
- Flight Guidance provides autopilot commands (sent to the flight control computers), flight director commands (sent to the PFD) and thrust commands (sent to the autothrust systems).
- Flight Augmentation provides flight envelope calculations, turn coordination and yaw damping.

PILOT INTERFACES

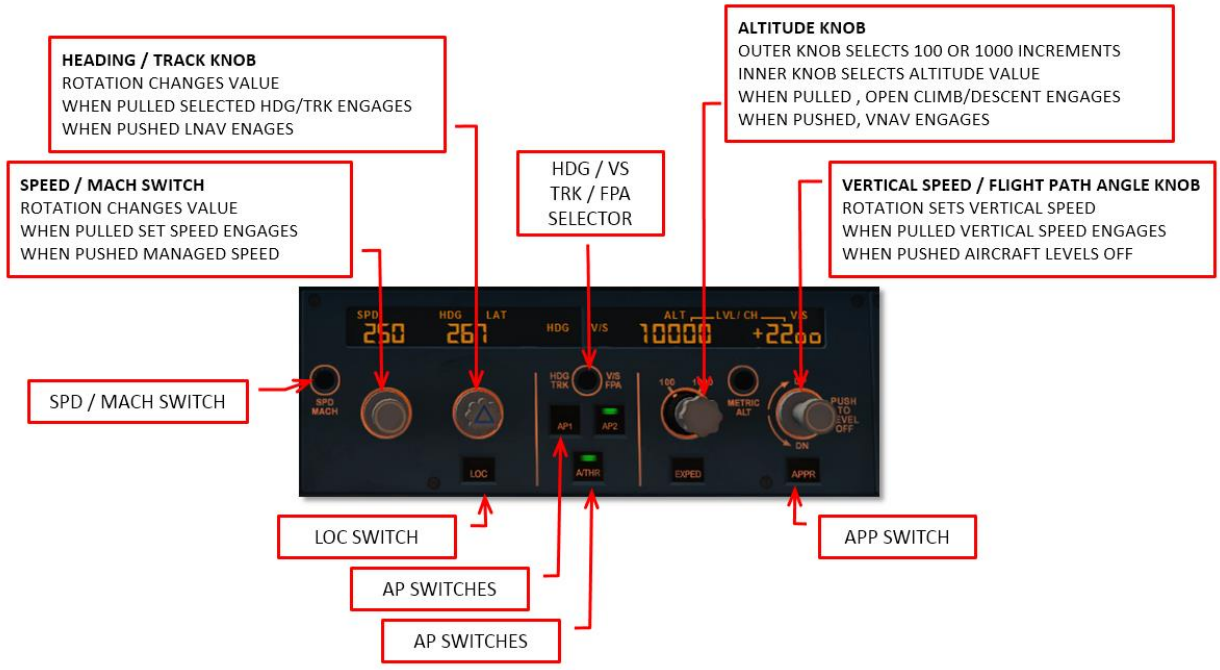
FLIGHT CONTROL UNIT

The FCU is located in the center of the glareshield and four knobs provide control for:

- Airspeed
- Heading (or track) or navigation modes
- Climb or descent modes and/or
- Vertical speed (or flight path angle)

There are two modes possible for airspeed, heading and vertical speed. Switching between modes is done by pulling (right click) the knob.

- Selected Functions
  - In selected mode the pilot controls speed and lateral/vertical navigation. After pulling the knob the pilot can rotate the knob to set the desired value. When the knob is pushed (left click) the current value for that function is inserted.
- Managed Functions
  - In managed mode the displays are dashed (note the FCU altitude windows is never dashed) and the control of speed and lateral/vertical navigation is managed by the FMS.



MULTIFUNCTION CONTROL AND DISPLAY UNIT

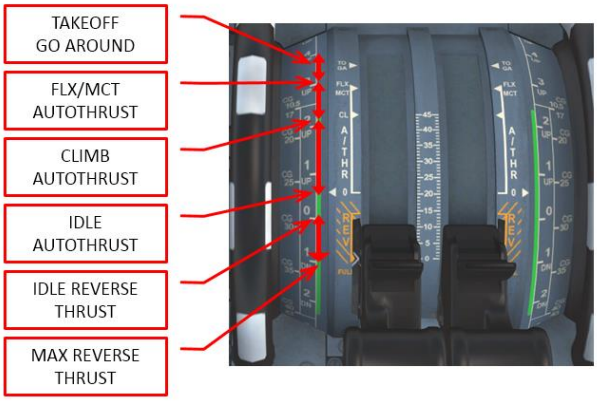
The MCDUs is the primary interface between pilot and FMS (and in our simulation it is also used to access some simulation functions.

SIDESTICK CONTROLLER

The sidestick controllers are used to fly the aircraft manually. Any strong input with these will deactivate the autopilot.

THRUST LEVERS

The thrust levers are used to manually control thrust or to select the desired autothrust mode. With both engines operating the autothrust range is between the idle and the FLX/MCT detents. With autothrust active the position of the thrust lever determines the maximum thrust level.



Normally the thrust levers are positioned in the climb (CL) detent at the thrust reduction altitude after takeoff and left there until the landing flare.

FLIGHT PHASES

The FMGC divides the complete flight into phases that normally will automatically switch to the next phase when certain conditions are met.

Flight Phase	Optimum Speed Profile	Switching conditions to next phase
Preflight	-	SRS take off mode engaged + N1 > 85% or Ground Speed > 90 kts
Take Off	V_2 followed by V_2 +10	At ACC ALT (or manually)
Climb	ECON CLB SPD/MACH	At reaching Cruise Flight Level
Cruise	ECON CRZ MACH	At reaching ToD
Descent	ECON DES MACH/SPD	Overflying Decel waypoint with NAV (or LOC/LOC*) engaged Manually activating APPR phase
Approach	VAPP (GS Min)	To Go Around: thrust levers to TOGA To Done: automatic 30 seconds after landing To Climb: inserting new CRZ FL
Go Around	VAPP or Current Speed	To Approach: manually select APPR phase To Climb: manually select CLMB phase
Done		At depressing INIT or PERF to Preflight

PERFORMANCE

The FMGC will minimize the flight cost through speed optimization. Depending on the Cost Index setting it will compute optimal targets for the following items:

- Take off, approach and go around speed are calculated as a function of the TOW and performance model. Note that V1, V2 and Vr have to be manually entered (in our aircraft these speeds are calculated but can be overwritten.
- CLB and DES speeds are computed as a function of the GW, Cost Index, environment (temperature, wind) and Cruise level. The speeds are NOT recalculated when the mode is active.
- Cruise Mach is computed as the optimal speed and is updated continuously update to the current weather condition and F-PLN modifications.
- Optimum Flight Level is calculated assuming a 5 minute minimum cruise flight. It is continuously update in flight.

AUTOPILOTS

ENGAGEMENT

The autopilot (two identical systems) are engaged by the AP1 and AP2 pb on the FCU. When engaged a green bar will show on the pb and the appropriate FMA annunciation is displayed. When a flight director is on when the autopilot is engaged, the autopilot engages in appropriate mode (OP CLMB and NAV) otherwise it will engage in the default guidance modes (HDG and V/S or TRK-FPA).

Either autopilot can be engaged seconds after takeoff.

DISENGAGEMENT

Disengage the autopilot by depressing the AP1 or AP1 button.

- The autopilot is automatically disengaged by moving the side stick (or rudder pedals) a certain amount. This will trigger a master warning.
- The autopilot is automatically disengaged when the throttles are set above FLX/MCT on ground.
- The autopilot is automatically disengaged when a normal law is exceeded or pitch or bank angle are excessive.
- The autopilot is automatically disengaged during a non-precision approach when the aircraft reaches MDA minus 50 feet .

AUTOPILOT & SPEED BRAKES

With the autopilot engaged the speed brakes are limited to ½ deflection. When autopilot is engaged with speed brakes extended beyond ½ they will retract to ½. Note this will cause a sudden pitch up.

AUTOTHRUST

The autothrust system reduces workload for the pilot, provides additional comfort for the passengers and reduces fuel use. Two main modes are included:

- Fixed Thrust Modes
    - Uses constant thrust; airspeed is controlled with pitch. Normally used for level changes when no specific vertical speed is required.
- Variable Thrust Modes
    - In variable thrust mode the airspeed remains constant by changing the amount of thrust. Normally used for level flight or when a certain airspeed is required during level change.

AUTOTHRUST ARMING STATUS

When autothrust is OFF the thrust is controlled manually and corresponds to the position of the trust levers. When autothrust is ARMED and the thrust levers are moved into the A/THR active the autothrust status changes to ACTIVE. The status is shown on the FMA (blue indicates armed mode and white indicates active mode). Autothrust is automatically armed during takeoff when thrust levers are in the TOGA or FLX detent.

AUTOTHRUST ACTIVE STATUS

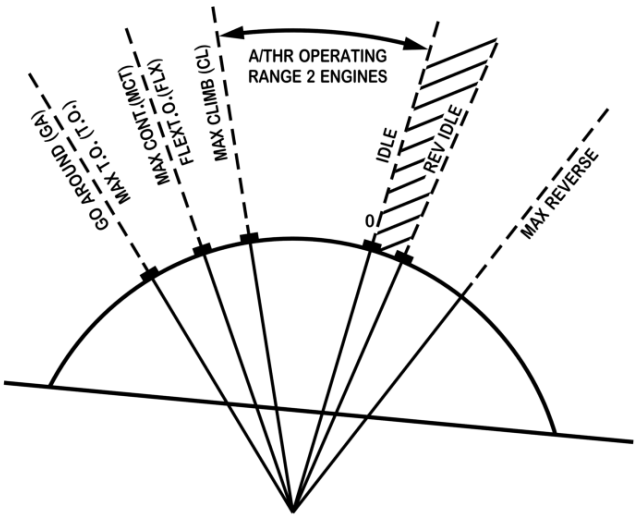
The autothrust system controls thrust only in active status. Both fixed (MCT, CLB, IDLE, THR) and variable thrust (SPEED, MACH) modes are available in active status.

AUTOTHRUST DEACTIVATION

The autothrust system can be disabled by depressing the FCU A/THR pb or by retarding the throttles to the idle detent. A single chime and a short amber master caution illumination alerts the pilot.

AUTOTHRUST MODES

FIXED THRUST MODES



- TOGO: Provides fixed maximum thrust and is only available when autothrust status is armed.
- FLX: Flex thrust is used for reduced thrust takeoffs. Thrust is calculated using the assumed temperature as set in the MCDU.
- MCT: Provides Maximum Continuous Thrust at the current ambient conditions.
- CLB: Provides fixed thrust equal to the climb thrust rating at current ambient conditions.
- IDLE: Provides fixed idle thrust.
  Only available in active autothrust status. Note the thrust levers can be anywhere in the autothrust range!
- THR: When the thrust is not TOGA, FLX, MCT or CLB the fixed thrust is called THR.

VARIABLE THRUST MODES

- SPEED: The autothrust system will provide variable thrust to maintain a set speed or a managed speed in level flight or when the aircraft follows a programmed flight path. Only available when autothrust is active.
- MACH: Identical to speed mode but not available at low altitudes. The speed mode is automatically switched to Mach mode (and vice versa) at a preset altitude.

AUTOTHRUST/FLIGHT DIRECTOR/AUTOPILOT

The vertical guidance modes use pitch to maintain a target speed or a specific vertical path. If vertical guidance modes are used to control a target speed, autothrust uses a fixed thrust mode. If vertical guidance modes are

used to control a specific vertical path, autothrust uses variable thrust to maintain target speed. When manually flown in fixed autothrust mode the flight director's pitch command bar indicates the pitch needed to fly the desired speed.

ALPHA FLOOR

The alpha floor protection assists the pilot in recovering from dangerous low speed and high angle of attack by automatically setting TOGA thrust when:

- Excessive angle of attack (alpha)
- Excessive high nose up attitude
- Windshear is detected

When the alpha floor conditions are no longer detected the autothrust system will stay in TOGA lock until the pilot disables auto throttle. It is recommended the pilot moves the throttle to the TOGA detent before depressing the FCU A/THR pb to avoid a power surge. After that the pilot can pull the throttle to the CL indent and engage the autothrust.

FLIGHT AUGMENTATION COMPUTERS

The FACs handle:

- Yaw damping and turn coordination
- Rudder trim
- Flight envelope and maneuvering speed computations
- Alpha floor protection
- Windshear detection
- Low energy detection

FLIGHT ENVELOPE

Many different speeds are calculated by the FACs are used by the autoflight system. These speeds include the minimum safe speed, maximum speed and never exceed speed. They also calculate the alpha floor speed. Most of these speeds are shown on the PFD airspeed indicator.

WINDSHEAR

The FACs will try to detect windshear and will warn the pilot of this dangerous condition. Windshear detection is only active below 1300 feet AGL in configuration 1 or greater. When detected the flight director will show an optimal pitch attitude and the aural warning "WINDSHEAR" will be heard.

LOW ENERGY WARNING

Between 2000 and 100 feet AGL the FACs will detect a low energy state (based on airspeed, descent angle and angle of attack) and will warn the pilot with an aural "SPEED SPEED SPEED" warning. Normally this warning will precede an alpha floor condition.

FLIGHT GUIDANCE

Flight guidance is provided for speed control, lateral navigation and (limited in this project) vertical navigation. There are two types:

- Selected Guidance: In this mode the aircraft will fly on autopilot using the settings on the FCU. You switch from managed mode to selected mode by pulling (right mouse click) the SPD, HDG and ALT knobs.
- Managed Guidance: In this mode the airspeed is calculated by the FMS and differs per flight phase. The FMS also provides managed lateral and vertical flight plan guidance following the flight plan that has been inserted in the MCDU. The FCU will show dashes in managed guidance. You switch from selected guidance to managed mode by pushing (left mouse click) the SPD, HDG or ALT knobs.
  Please note the FCU altitude window will never be dashed.

When the autopilot is engaged or the flight director is activated the Flight Mode Annunciator (FMA) (at the top of the PFD) will also display the activated settings.

LATERAL GUIDANCE MODES

The lateral guidance modes keep the aircraft course to its destination.

SELECTED HEADING (OR TRACK) MODE

The heading (or track) mode will guide the aircraft on a heading (HDG) or track (TRK) and is the default lateral mode. The pilot activates it by pulling (right mouse click) the HDG button on the FCU. A digital display of the heading (track) will be shown on the FCU and HDG will be displayed on the FMA. Note this mode cannot be activated when LAND mode is activated.

- If the knob is turned to the desired HDG (TRK) and pulled the aircraft will make the shortest turn to the selected HDG (TRK)
- If the HDG knob is pulled but not turned the current HDG (TRK) is selected.
- If the HDG knob is pulled first and turned the aircraft will turn in the direction of the turn.
- If the HDG knob is turned but not pulled the selected value is cleared after a period that depends on the flight mode.

MANAGED NAVIGATION MODE

When a flight plan is available and activated the managed nav mode will guide the aircraft along the path stored in the FMS. It is activated by the pilot by pushing (left mouse click) the FCU HDG knob. The display will show dashes and the FMA will display NAV.

LOCALIZER LATERAL MODE

When the FCU LOC pb is pushed the loc lateral guidance mode is armed and the FGS will only use the localizer signal for lateral guidance. In the FMA LOC will be displayed and the LOC pb will illuminate. It can be used to intercept and track a localizer while maintaining a selected altitude. Note that a ILS frequency must be tuned and TAKEOFF and GO-AROUND mode are not selected. To disarm press the LOC pb again.

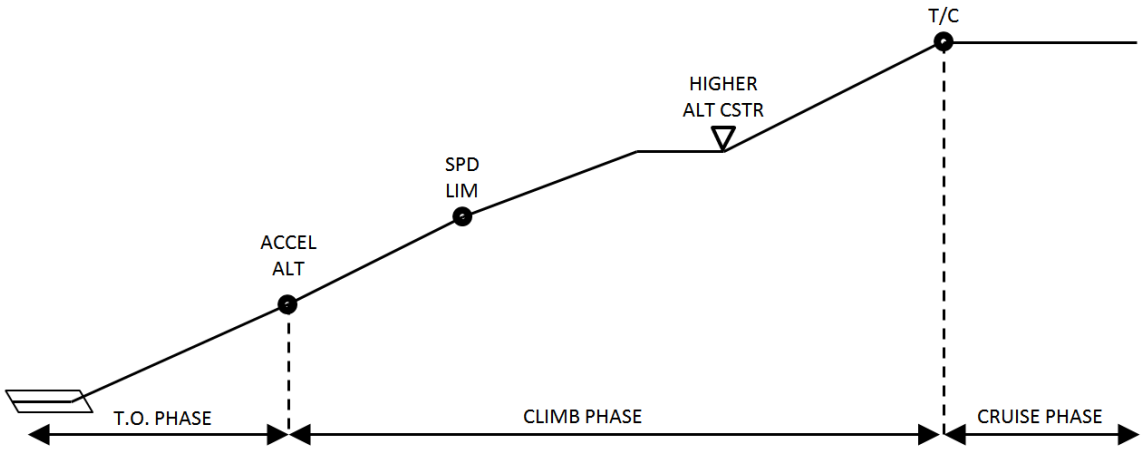
VERTICAL MODES

The vertical guidance modes will make the aircraft change altitude. To leave a FCU selected altitude a dual action sequence is needed:

- Turn the ALT selector to set the new altitude
- Pull the ALT selector to select OPEN CLB/DES mode or
  Push the ALT selector to engage CLB/DES mode or
  Select a target V/S and pull the V/S selector knob to engage V/S mode

CLIMB

CLB mode manages the vertical guidance towards the FCU selected altitude taking altitude and speed constraints into account.



ARMING CONDITIONS

- On ground or when TAKE OFF or GA modea are engaged as long as no other vertical modes are selected.
- In flight when lateral NAV mode is engaged, FCU selected altitude is higher than aircraft altitude or when aircraft meets a ALT CSTR

DISARMING CONDITIONS

- Engagement of any other vertical mode
- FCU selected mode lower then aircraft altitude
- Switching to DES or APP phase
- Loss of vertical flight path validity or loss of ANV mode

ENGAGEMENT CONDITIONS

- Aircraft more than 5 seconds in flight
- FCU selected altitude above current altitude
- Not in descent or approach mode
- NAV mode engaged
- Not in G/S mode
- CLB mode is automatically selected when

  - ACC ALT is reached
  - ALT CSTR is reached with CLB mode armed
- CLB mode can be manually selected by pushing the ALT selector knob.

DISENGAGEMENT CONDITIONS

- NAV mode lost or disengaged
- Selecting another vertical mode
- Setting a lower altitude in FCU than current altitude

GUIDANCE

In standard CLB mode the engine stay at max climb thrust, the speed will be the one calculated by the FMGS and pitch will vary to keep that speed.

OPEN CLIMB

ENGAGEMENT CONDITIONS

- The aircraft must be in flight more than 5 seconds
- LAND mode is not engaged
- FCU selected altitude is higher than current altitude

OPEN CLIMB is engaged by:

- Pulling the ALT selector knob
- Acceleration altitude reached with armed CLM mode and NAV not engaged
- When an overspeed condition is detected (the aircraft will pitch up to loose speed)

DISENGAGEMENT CONDITIONS

- Selecting any other vertical mode
- Selecting a lower altitude then the current altitude

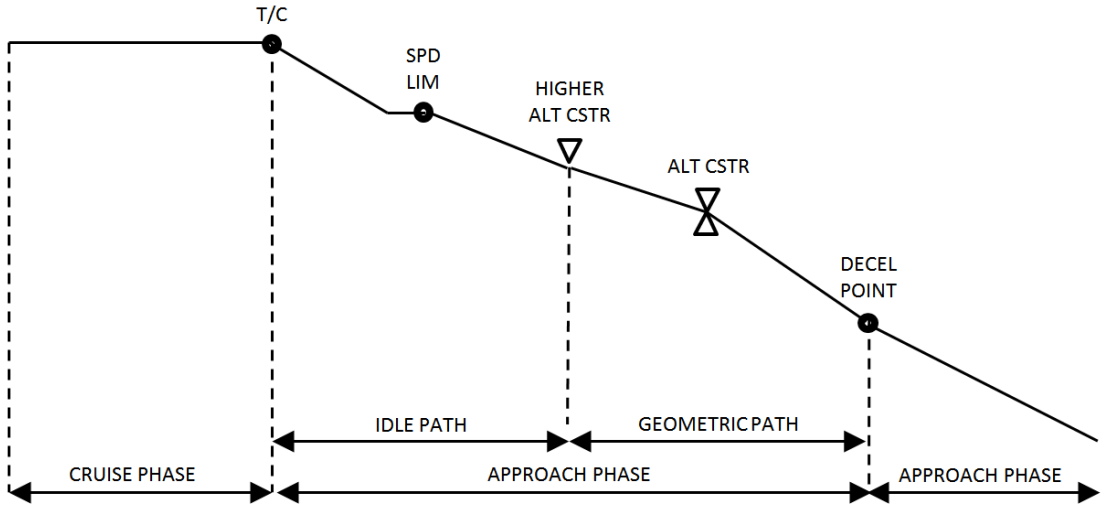
GUIDANCE

In OPEN CLB the target Speed / Mach is kept by varying the pitch, thrust is managed by the A / THR or manually, speed target can be selected or managed. All ALT CSTR are ignored in OPEN CLB.

DESCENT

DES mode provides vertical guidance following a computed descent profile between Top of Descent to the Deceleration point. It uses the data in the F-PLN and the available WIND data. It is divided into three sections:

- Repressurization segment (ignored in our simulation)
- Idle Path segment where the engines are at idle and AP / FD controls SPD
- Geometric path when the AP / FD controls vertical path and the A /THR controls the SPD



ARMING CONDITIONS

- FCU selected altitude is below current altitude
- TAKE OFF, GO AROUND or LAND mode is not engaged

DISARMING CONDITIONS

- Selecting any other vertical mode
- FCU selected altitude is above current altitude
- Loss of NAV, LOC or vertical path validity
- Selecting GO AROUND mode

ENGAGEMENT CONDITIONS

- FCU selected level is below current altitude
- NAV, LOC* or LOC is active
- TAKE OFF, GO AROUND, LAND, FINAL not active
- DES mode is engaged automatically when an altitude constraint is met with DES mode armed.
- DES mode is manually engaged by pushing the ALT selector knob

DISENGAGEMENT CONDITIONS

- Engagement of any other vertical mode
- Selecting a FCU altitude above current altitude

GUIDANCE

In DES mode the aircraft is guided along the DES PATH. The SPD target can be selected or managed (with the speed to vary around the calculated optimal nominal descent speed. SPD CSTR is taken into account in the speed profile.

If the aircraft is above the DES PATH it will pitch down until the upper limit of the MANAGED SPD RANGE is reached. That speed will be kept and the aircraft will differentiate from the DES PATH. Extending ½ speed brakes will allow the aircraft to get back on the calculated path.

If the aircraft is below the DES PATH the aircraft will maintain the target speed until the DES PATH is reached.

OPEN DESCENT

In selected descend mode the autothrust system will be set to idle and the set speed will be kept using pitch. **This mode is not useful for final approaches.**

ENGAGEMENT CONDITIONS

- The aircraft must be in flight more than 5 seconds
- LAND mode is not engaged
- FCU selected altitude is lower than current altitude
- OPEN DESCENT is engaged by pulling the ALT selector knob

DISENGAGEMENT CONDITIONS

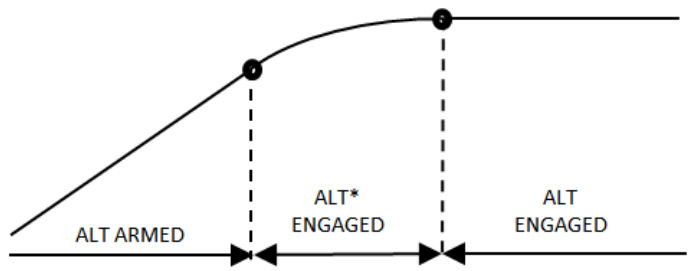
- Selecting any other vertical mode
- Selecting a higher altitude then the current altitude

GUIDANCE

In OPEN DES the target Speed / Mach is maintained by pitch controls and thrust is maintained by the A / THR or manually by the pilot. Speed target can be selected or managed.

ALTITUDE ACQUIRE

ALT* will guide the aircraft to the FCU selected altitude, ALT CST* guides the aircraft to an altitude constraint. Once the set altitude is reached the ALTITUDE HOLD (ALT or ALT CST) mode will engage.



GUIDANCE

In the ALT* and ALT CST* mode the vertical speed is managed to reduce vertical speed to ensure a smooth capture of the set FCU altitude.

ALTITUDE HOLD

ALT mode will keep the aircraft at a set altitude. The altitude can be a FCU set altitude (with ALT engaged) or an altitude constraint.

ARMING CONDITIONS

- ALT mode is automatically armed when the aircraft climbs or descents to a target altitude.

ENGAGEMENT CONDITIONS

- ALT or ALT CST is automatically engaged when the aircraft is 20 feet from the target altitude.

DISENGAGEMENT CONDITIONS

- ALT or ALT CST is disengaged when any other vertical mode is selected.

GUIDANCE

- The level kept is the level memorized at engagement of the mode.

VERTICAL SPEED – FLIGHT PATH ANGLE

V/S–FPA is a selected mode, it captures and keeps the vertical speed or the flight path displayed in the V/S – FPA FCU window.

ENGAGEMENT CONDITIONS

V/S-FPA is automatically selected:

- 5 seconds after liftoff with no other vertical mode selected
- Loss of G/S, G/S*, FINAL, LOC. LOC*, NAV (with DES engaged)
- Automatic reversions

V/S-FPA is manually selected by:

- V/S-FPA selection knob pulled
- V/S-FPA selection knob pushed (will engage an immediate level off and set VS=0)
- AP engagement with no other vertical mode set
- Selection of an different altitude (at least 250 ft from current altitude) in ALT*
- Selection of an higher altitude in DES or OP DES
- Selection of an lower altitude in CLB or OP CLB

DISENGAGEMENT CONDITIONS

- Engagement of other vertical mode
  - Manually by pulling altitude selection knob or performing a go around
  - Automatically by reaching FCU altitude or G/S* engagement

GUIDANCE

FMGS pitch mode will guide the aircraft to the target V/S (FPA). A/THR mode is SPD or MACH.
V/S-FPA guidance has priority over speed guidance and when reaching the limit of the flight envelope will change to OPEN mode.

COMMON MODES

COMMON modes are combinations of vertical and lateral modes.

COMMON MODE	VERTICAL	LATERAL
TAKE OFF	Mode: Pitch Take off FMA: SRS	Mode: Runway LOC or Runway Track FMA: RWY or RWY TRK
ILS APPROACH	Mode: G/S* or G/S FMA: LAND or FLARE or ROLL OUT	Mode: LOC* or LOC FMA: LAND or FLARE or ROLL OUT
NON ILS APPROACH	Mode: Final Descent FMA: FINAL	Mode: Nav FMA: APP NAV
GO AROUND	Mode: Pitch Go Around FMA: SRS	Mode: Go Around track FMA: GA TRACK

TAKE OFF: SRS

This mode is available during take off and the first 5 seconds of flight. In SRS mode the aircraft will follow pitch guidance at speeds defines by the speed reference guidance law.

ENGAGEMENT CONDITIONS

- V_2 is inserted in MCDU
- Slats are extended

DISENGAGEMENT CONDITIONS

- Manually by engaging any other vertical mode
- Automatically at acceleration altitude

GUIDANCE

- The aircraft will keep V_2 + 10 knots
- An attitude protection will prevent a too high nose up during take off
- Flight path angle of minimum climb rate of 120 ft/min

TAKE OFF: RUNWAY

The RUNWAY mode will provide lateral guidance during take off and immediately thereafter using the LOC signal (when it is available. The RUNWAY TRK mode will provide lateral guidance on an extended runway center line.

ENGAGEMENT CONDITIONS

- SRS engagement conditions
- LOC signal received
- Aircraft heading within 20 degrees of runway heading

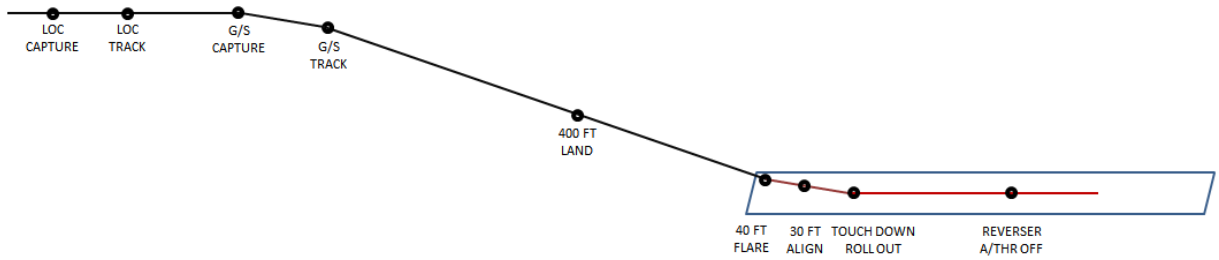
DISENGAGEMENT CONDITION

- Loss of LOC signal
- Any other lateral mode selected

GUIDANCE

The RWY mode will guide the aircraft as close as possible to the center runway line and on an extended runway line in flight in the RWY TRK mode.

APPROACH: ILS APPROACH



ARMING CONDITIONS

- Aircraft over 400 ft AGL
- ILS approach is selected
- ILS and RA are available
- GA or FINAL mode not selected

DISARMING CONDITIONS

- Depressing the APPR pb (both LOC and G/S mode will disarm)
- Depressing the LOC pb (only G/S will disarm)
- Go AROUND mode selected
- Disengaging AP

ENGAGEMENT CONDITIONS

- Radio Altimeter active
- LOC* and G/S* mode engage

DISENGAGEMENT CONDITIONS

- Depressing the APPR pb (both LOC and G/S mode will disarm)
- Depressing the LOC pb (only G/S will disarm)
- Pull action on the V/S/FPA button
- Pull action on the HDG/TRK button
- Go AROUND mode selected

LAND MODE

LAND mode engages automatically when the LOC and G/S modes are engaged and aircraft is below 400 AGL.

FLARE MODE

At 40 ft RA the FLARE mode automatically engages. At 30 ft AGL the aircraft will align with the runway, will pitch up and when A/THR is active the trust reduction (RETARD) will activate.

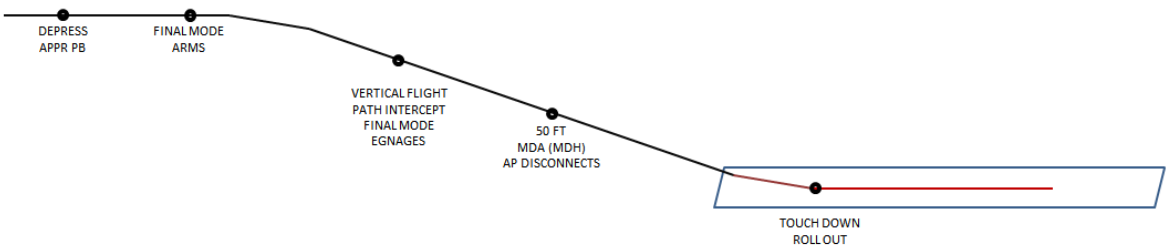
ROLL OUT MODE

When load is detected on the main gear the ROLL OUT mode will automatically be activated and centerline guidance is provided.

SPEED CONTROL

A/THR will provide speed control during and ILS approach when speed can be managed or selected.

APPROACH: NON ILS APPROACH



ARMING CONDITIONS

- Aircraft over 400 ft AGL
- NON ILS approach is selected
- GA or FINAL mode not selected

DISARMING CONDITIONS

- Depressing the APPR pb (both LOC and G/S mode will disarm)
- Depressing the LOC pbn (only G/S will disarm)
- Go AROUND mode selected
- Disengaging AP

ENGAGEMENT CONDITIONS

- Radio Altimeter active
- APP phase is active
- APP NAV mode engaged
- FINAL is armed

DISENGAGEMENT CONDITIONS

- Depressing the APPR pb
- Depressing the LOC pb
- Automatically at MDA (MDH)
- Go AROUND mode selected

GUIDANCE

The aircraft is guide down to MDA/MDH where AP is automatically disconnected.

GO AROUND

This mode is a combination of the SRS vertical and the GA TRK lateral mode.

ENGAGEMENT CONDITIONS

Thrust levers in TOGA detent will engage SRS/GA TRK as long as slats/flaps lever is in position 1 and the aircraft is in flight.

DISENGAGEMENT CONDITIONS

- Manually engaging another mode
- Automatically at GA ACC ALT

GUIDANCE

SRS is similar to SRS take off. Speed will be kept on speed on engagement or V_{APP} if that is higher. GA TRK guides the aircraft along the track the aircraft was at engagement.

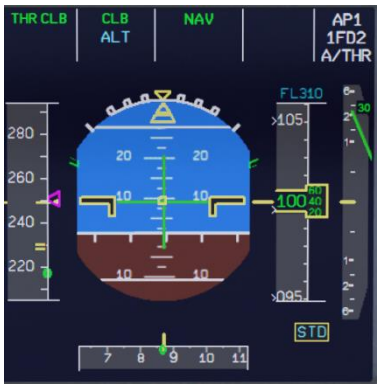
MANAGES MODE VERSUS SELECTED MODE

In Managed modes the Flight Management Guidance Computer sends information to the Autopilot systems so that it follows the programmed route. This route can include headings, altitudes and even speeds. The pilot selects this mode by pushing (left click) the appropriate selector knob on the Flight Control Unit (FCU).

In Selected modes the pilot inserts the information and the aircraft will follow his manual input. The pilot selects this mode by pulling (right click) the appropriate selector knob on the Flight Control Unit and turning it the required setting.

MANAGED SPEED

- On PFD the Target Airspeed shows in magenta
- On the FCU the Speed/Mach will show dashes and a white dot
- On the MCDU (PERF page) Managed mode is displayed with the target value



SELECTED SPEED

- On PFD the Target Airspeed shows in blue
- On the FCU the Speed/Mach will display the Target Airspeed

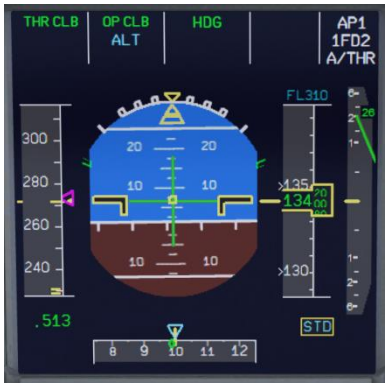
MANAGED LATERAL GUIDANCE

- On the PFD the FMA will display NAV
- On the FCU the Heading/Track window will show dashes and a white dot
- On the PFD/ND the actual (not selected) heading and actual track is displayed
- On the ND the flight plan track is displayed as a continuous green line

SELECTED LATERAL GUIDANCE HEADING OR TRACK

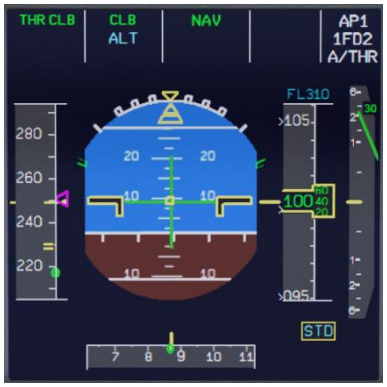
- On the PFD the FMA will display HDG (or TRK)
- On the PFD/ND the selected heading or Track Index (blue)
- On the ND the flight plan track is displayed as a dashed green line and the actual track by a continuous green line
- On the FCU the Heading/Track window will show the Target Heading (Track)

(NOTE: In HDG, if in a climb or descent, VNAV will change to OP CLB or OP DES. To reselect NAV and managed CLB/DES, push HDG FCU knob in [left click], then push in [left click] the FCU ALT knob)



MANAGED CLIMB

- On the PFD the FMA will display a green CLB, with a blue ALT beneath it
- On the FCU the altitude will show the dialed value with a white dot to the right of it
- On the MCDU (PERF page) will be displayed as the CLB page



OPEN CLIMB

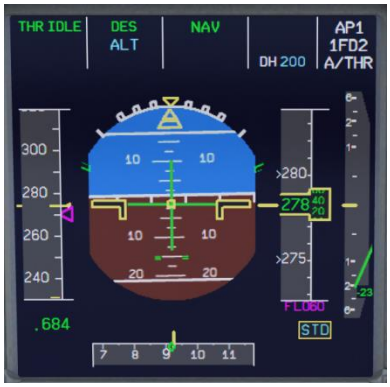
- To activate OP CLB, pull (right click) the FCU ALT knob after dialing in a higher altitude. In OP CLB, the FMGS will disregard any altitude constraints and climb straight to the altitude in the FCU.
- On the PFD the FMA will show OP CLB
- On the FCU the selected altitude will show without a white dot next to it

SELECTED CLIMB

- For selected V/S climb, pull (right click) the FCU V/S knob.
- On the PFD the FMA will show in green VS and in blue the selected vertical speed, with a blue ALT beneath it.
- On the FCU you will read the selected V/S with a + sign to the left of it, and the dialed altitude without a white dot to the right of it.

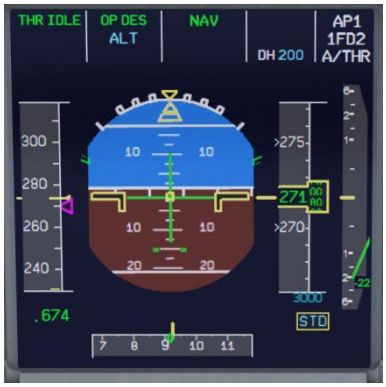
MANAGED DESCENT

- On the PFD the FMA will display a green DES, with a blue ALT beneath it
- On the FCU the altitude will show the dialed value with a white dot to the right of it
- On the MCDU (PERF page) will be displayed as the DES page



OPEN DESCENT

- To activate OP DES pull (right click) the FCU ALT knob after dialing in a lower altitude. OP DES acts similar to OP CLB, in that it will descend in an idle descent to the altitude dialed in the FCU disregarding any altitude constraints.
- On the PFD the FMA will show OP DES
- On the FCU the selected altitude will show without a white dot next to it



SELECTED DESCENT

- For selected V/S descent, pull (right click) the FCU V/S knob.
- On the PFD the FMA will show in green VS and in blue the selected vertical speed with a – sign in between, and a blue ALT beneath it
- On the FCU you will show the selected V/S with a – sign to the left of it, and the dialed altitude without a white dot to the right of it

VERTICAL GUIDANCE LEVEL OFF

- To immediately level off, push (left click) the FCU V/S knob.
- On the PFD the FMA will show in green VS and in blue 0, with a blue ALT beneath it.
- On the FCU you will read the selected V/S of 00oo, and the dialed altitude will remain at the altitude dialed previously, without a white dot to the right of it

COMMUNICATIONS

Unfortunately FSX is not very strong with radios and we really wanted to stick to the default commands of FSX because a lot of people have hardware for these parts. So we went for practicality more than for getting the simulation exactly as the real aircraft. It's a small price to pay for compatibility and usability.

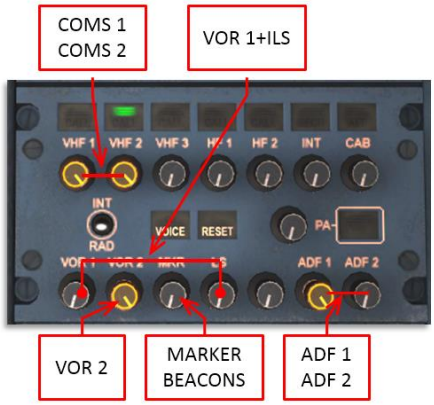
COMMUNICATION RADIOS

Communication radios (VHF) are set using the Radio Management Panel on the pedestal while Navigation radios are set on the MCDU system. The backup Radio navigation option on the RMP is not implemented. The communication radios VHF1 and VHF2 (*FSX calls that COMS 1 and COMS* 2) are set on the Radio Management Panel on the center console. VHF1 is set on the Captain side (left), VHF2 is set on the First Officer side (right).

1. ON / OFF sw: Toggles power to the panel
2. NAV key: Not implemented
3. STBY NAV keys: Not implemented
4. ROTATING KNOB: Outer wheel sets most significant digits, inner wheel sets least significant digits. When a frequency has a COURSE attached to it the inner wheel sets the COURSE
5. TRANSFER KEY: When pressed the ACTIVE and STBY frequencies are interchanged.
6. STBY / CRS window: Shows STBY frequency or COURSE
7. ACTVIVE window: Shows the active frequency of the selected radio system
8. BFO key: Not implemented

AUDIO MANAGEMENT SYSTEM

The Audio Management System determines which sources you will hear. With the button depressed the source is not heard, with the button depressed and lit the corresponding source is heard. Please note that FSX does not have a separate ILS receiver and that is always linked to VOR 1.

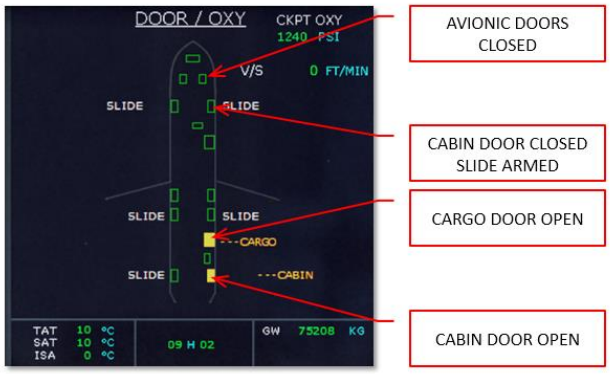


DOORS AND WINDOWS

The external doors and cargo hatches can be opened using a simulated page in the right MCD under the ACFT DOORS page. When the aircraft is stopped, engines are off and the parking brakes (or chocks) are set, you can open the doors via this menu. The door identifier will blink when the door is being opened or closed. This menu is not available when the aircraft is not stationary, with engines off and on parking brakes (or with wheel chocks activated).

All external doors in the Airbus A32x are conventional in design and operation and all door operation can be monitored on the ECAM DOORS page. The ECAM DOOR/OXY page will appear automatically:

- as the default ECAM system display page with the engines shut down
- when any door is not closed and an engine is running.



It may also be selected by depressing the DOOR pb on the ECAM panel.

During taxying it is allowed to open the cockpit windows.

The cargo doors should never be open with the right engine running. The cockpit door should stay locked in flight and a small video camera (with a display mounted above the door) allows the crew to see who is behind the door.

The windshields consist of multi layered glass and are electrically heated to prevent icing. Two of the windows have sliding mechanisms. To open the windows left mouse click on the handle. The window will be opened by a rattle mechanism. To close the window, right mouse click on the handle. Make sure the red ring underneath the release button is shown to indicate the window is locked. The status of the windows is also shown in the ECAM DOORS page.

ELECTRICAL

GENERAL

In normal operation the generation and distribution of electrical power is fully automated and does not need any interaction. Even when there are failures the systems will almost always be able to correct or activate alternate systems when needed. As with all overhead panels a dark panel with all lights off indicates systems without fault and in automatic mode.

AC GENERATION

AC power is distributed via the two AS buses. Each engine generator supplies one of the two buses but a tie connection allows one of the generators to provide both buses. The APU generator can be used as the sole source for all systems, excluding the galleys. Note that at high altitude the APU generator load capacity is decreased. When available, Ground Power is able to provide all buses with electricity. The two batteries are connected to the buses via a static converter. An automated bus tie system interconnects all systems.

AC BUSES

There are 5 buses for AC power:

1. AC1 Bus
2. AC2 Bus
3. AC ESS Bus
4. AC ESS SHED Bus
5. AC Ground/Flight (the latter is ignored)

DC GENERATION

The DC system powers the DC components, and is needed to start the APU when no EXT PWR is available. The DC electrical system is the first backup for the AC system and will power essential components when all AC generators are offline. In normal operation three transformer rectifiers (TRs) convert AC to DC and AC1 is the first source for DC power.

Two NICAD batteries connect to their own hot battery bus that is always active. The batteries are charged using the DC BAT bus and disconnected from all buses when they are not needed and fully charged. The batteries use proprietary code so they will not lose power as fast as standard FSX batteries. Depending on your use you should be able to run the systems on battery for up to half an hour. Of course it is advised to either connect external power of power up the APU to avoid your aircraft going cold and dead unexpected.

PRIORITY LOGIC

The priority logic determines which source is used. When that source is lost the system will automatically switch to the next available source.

1. Engine Generators
2. External Power
3. APU Generator
4. Ram Air Turbine (not simulated)
5. Batteries

For example, if the aircraft is run from APU generator and EXT PWR comes online the system will automatically switch to EXT POWER but when engine generators come online they will be used.

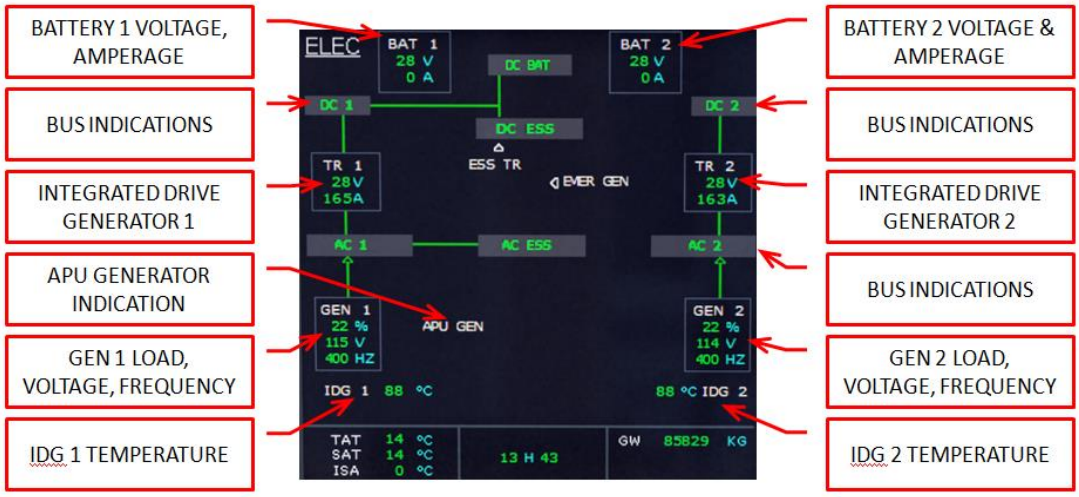
GROUND POWER

Using the GROUND SERVICES menu on the right MCDU it is possible to display a Ground Power Unit and to actually let it supply the electrical power.

- EXT. POWER GPU: will activate ground power and will show a Ground Power Unit
- EXT. POWER: will activate ground power but will not show the Ground Power Unit (use this one in combination with AES)

ECAM ELEC SYSTEM DISPLAYS

The ECAM ELEC pages show the configuration of the electrical system and the relevant values of all systems.

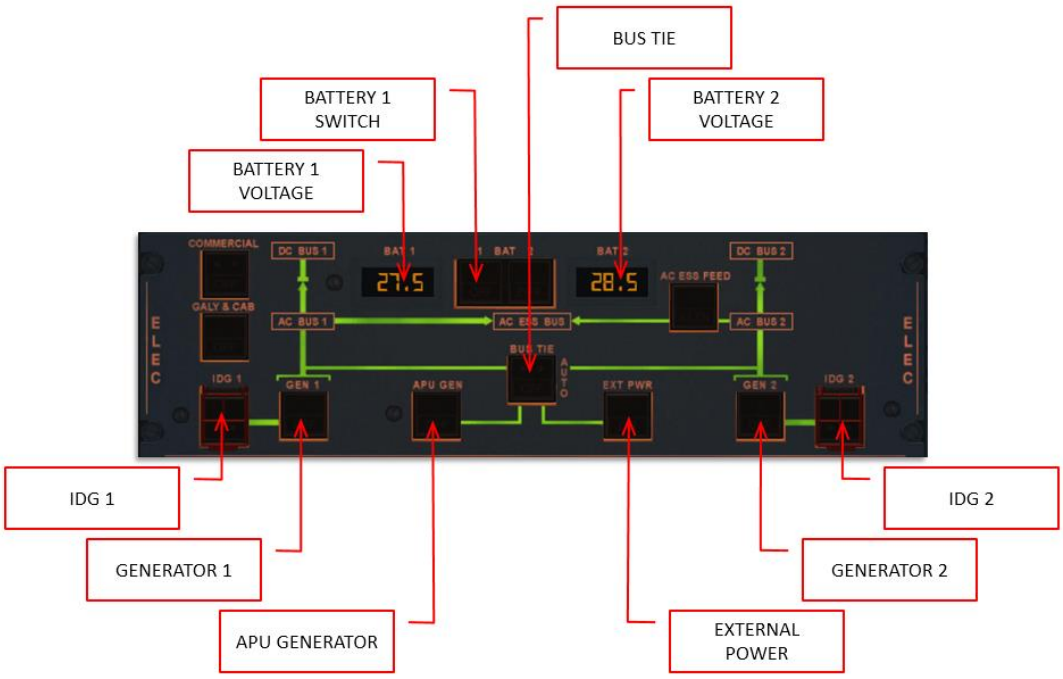


- The battery indications (BAT 1 & BAT 2) normally appear white but will show in amber if voltage drops below 25 volt. Voltage and Amperage is shown. Connection lines or arrows between the battery and the DC BUS icon show if the batteries are connected, discharging or charging.
- The TR indications (TR 1 & TR 2) display in green when the values are within normal limits and in amber when these are exceeded. Output voltage (V) and amperage (A) are shown.

- The generator indications (GEN 1 & GEN 2) show the load (%), voltage (V) and frequency (HZ) normally in green, for any abnormal value the same is shown in amber. Connection lines will show if the generator is online.
- The External Power indication will show voltage (V) and frequency (HZ) and connecting lines but only when external power is available.

ELEC OVERHEAD PANEL

All the normal operations for the electrical system are done via pushbuttons on the overhead ELEC panel.



- The battery voltage for both batteries is shown in the two small LCDs. These displays will always be on when the battery is installed.
- The BAT pbs (BAT 1 & BAT 2) are off when in AUTO mode. The batteries will automatically connect when the APU is started without EXT PWR, when voltage drops below 26.5 (to charge) or when the aircraft is on ground and no other electrical sources are available. They will show FAULT when the batteries are disconnected because of a fault. When the pb is clicked OFF will show and the battery will be disconnected.
- The IDG pb (IDG 1 & IDG 2) will disconnect the generator from the engine, only ground maintenance can reset this. The switch is protected by a switch guard.
- The EXT PWR pb will be off when no external power is available. It will show AVAIL when power is available. When pushed ON will show and the external power will be connected to the aircraft buses. It is recommended to deselect EXT PWR before the ground crew disconnects.
- The ACC ESS pb makes it possible to select a different source for the aircraft essential bus. When pushed ALTN will show and AC2 will be selected instead of AC1.Commercial and Galley are not simulated. They connect the cabin systems (galleys, toilets, entertainment system etc) to the buses.
-
- The GEN pbs (GEN 1 & GEN 2) are dark in AUTO mode. FAULT will show when the generator is inoperative or the engine is not running. When pushed OFF will show and the generator will be disconnected from the AC bus.

- The APU GEN pb is normally in the ON position (lights off) and the generator will be available when the APU is running. When there is a problem FAULT will show. When pushed OFF will show and the APU generator will be taken offline.
- The BUS TIE pb is normally in the AUTO position (lights off) and will activate when needed. When pushed OFF will show and the buses will NOT interconnect.

EQUIPMENT

Most functions and systems are controlled by push-button switches with integrated (light) indications that follow the 'light out' principle:

- No light: system functioning normal
- Green: normal operation
- Blue: normal operation of temporary used system
- White: abnormal operation / test
- Red: failure, needs immediate action
- Amber: failure, needs attention

During normal operation only green lights can be illuminated permanently, blue lights are possible if not permanently lit.

Button positions:

- PRESSED IN: on, automatic, normal, open
- RELEASED OUT: off, manual, alternate, shut down

A push button that shows two dots is only partially used.

FLIGHT CONTROLS

GENERAL

The Sidesticks are used to control pitch and roll. The input from the pilot is interpreted by the flight computers and these move the flight controls. The flight computers however will ignore any input that would cause excessive maneuvers or would put the aircraft outside the safe flight envelope.

The flight control surfaces are electrically controlled and hydraulically activated.

COCKPIT CONTROLS

- Two side stick controllers for pitch and roll (these are not mechanically connected)
- Two pairs of pedals (interconnected) that mechanically control the rudder
- A speed brake control lever
- Two hand wheels to mechanically control Trimmable Horizontal Stabilizer (THS)
- A switch to control rudder trim
- A tiller that is used to steer the aircraft at low speed on the ground (note this is animated but cannot be used to steer.)

Note there is no aileron trim control.

COMPUTERS

There seven flight control computers that process the pilot inputs:

- 2 ELAC's (Elevator Aileron Computer)
- 3 SEC's (Spoiler Elevator Computer)
- 2 FAC's (Flight Augmentation Computer)

PITCH CONTROL

The two elevators and THS control pitch. The pitch is normally controlled by ELAC 2 and uses the green and yellow hydraulic systems. The THS uses three electrical motors. Mechanical control using the THS always overrides the electrical controls, but has limited elevator travel.

ROLL CONTROL

One aileron and four spoilers on each wing control roll. Roll control is normally controlled by ELAC 1, using the blue and green hydraulic systems. Spoiler control uses SEC 3, using the green, yellow of blue hydraulic systems.

YAW CONTROL

In flight yaw control is fully automatic and the yaw orders are computed by the ELACs and handled by the FACs. One rudder surface is used. Mechanical control is always possible and overrides the electrical controls. The single rudder surface is moved by 3 hydraulic jacks using the green hydraulic system with a yellow hydraulic backup. Rudder deflection is limited as a function of speed.

Yaw trim is achieved by two electric motors. In automatic flight the FACs and FMCG controls the rudder. In manual mode the RUD TRIM rotary control on the pedestal can be used. The reset button will center the rudder. Rudder trim and reset is NOT active when A/P is used.

FLARE MODE

When passing 50 feet on landing the flight mode changes to flare mode and the attitude is maintained. At 30 feet the aircraft will start a pitch down maneuver to 2° nose down and gentle positive pilot action is required.

SPEED BRAKES AND GROUND SPOILER CONTROL

Spoiler 2, 3 and 4 are used as speed brakes and controlled by the speed brake lever. Speed brakes cannot be used in flaps configuration 3 and FULL or when angle of attack protection is active.

Ground spoilers are armed when the speed brakes control lever is pulled in to armed position. It uses spoiler 1 to 5. They will extend automatically:

- At landing when both main wheels touch down and throttle is at forward idle
- At take off when reverse is selected on at least one engine and speed is over 75 knots.

OVERHEAD PANEL CONTROLS

There are two FLT CTL panels on the overhead panel. When the corresponding system is ON and without fault the pb will be dark. When clicked OFF will show and the corresponding computer will be deactivated. When clicked again the computer will reset and restart. The two panels are mixed so each crew member will be able to control at least one ELAC, SEC and FAC.

ECAM F/CTL & WHEEL PAGE

The ECAM F/CTL page provides full feedback on all control surfaces. Please note the spoiler/speed brakes indication is also shown on the ECAM WHEEL page.

PROTECTIONS

The normal law provides complete flight envelope protection:

- Load Factor limitation
  - +2.5 g <-> -1.0 g flaps retracted
  - +2.0 <-> 0.0 g flaps extended
- Pitch Attitude protection
  - 30° nose up in configuration 0 to 3
  - 25° nose up in configuration full
  - 15° nose down
- Bank Angle protection
  - 33° bank angle
  - When the sidestick is kept full right or left the aircraft will bank to 67°, when sidestick is released it bank angle will go back to 30°
- High Angle of Attack protection
  - When angle of attack exceeds α protection the High Angle of Attach Protection kicks in. It will allow AoA to go to α max but not beyond. This protects against stall and windshear. A/P will disconnect in this mode.
- High speed protection
  - When the speed exceeds safe limits the engines will throttle down and when needed, speed brakes will be deployed.

FLAPS AND SLATS

Lift augmentation is achieved on each wing using:

- Two double-slotted flap surfaces
- Five slat surfaces

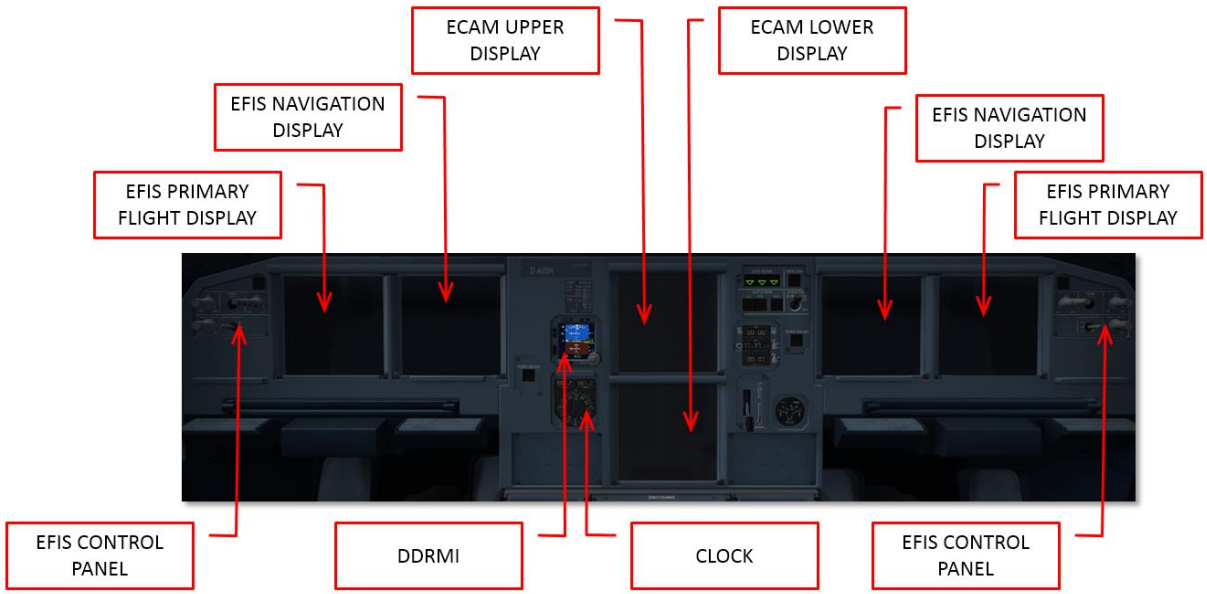
They are hydraulically moved and electrically signaled and operated using the FLAPS lever that has 5 positions. The upper ECAM always shows the flaps/slats position both in a small diagram and in position (with animation when the flaps/slats are moving).

If configuration 0 is not selected after takeoff, the flaps will automatically retract at 210 Kts.

Position	SLATS	FLAPS	ECAM			
0	0	0			CRUISE	HOLD
1	18	0	1			
		10	1 + F	TAKE OFF		
2	22	14	2			APPR
3	22	21	3		LDG	
FULL	27	25	FULL			

FLIGHT INSTRUMENTS

The flight instruments consist of the Electronic Instrument System (EIS) and several additional instruments. The EIS has six identical displays and is made up of two subsystem, the Electronics Flight Instrument System (EFIS) and the Centralized Aircraft Monitor System (ECAM).



ELECTRONIC FLIGHT INSTRUMENT SYSTEM

The EFIS has two displays on each side of the cockpit, Primary Flight Display (PFD) and Navigation Display (ND). The PFD consists of:

- Aircraft attitude
- Flight director command bars
- Aircraft heading and/or track
- Aircraft altitude both in MSL and AGL
- Aircraft vertical velocity and Vertical path indications
- Traffic Alert and Collision Avoidance System (TCAS)
- Indicated airspeed
- Flight Mode Annunciations (FMA)
- ILS information

The ND consists of:

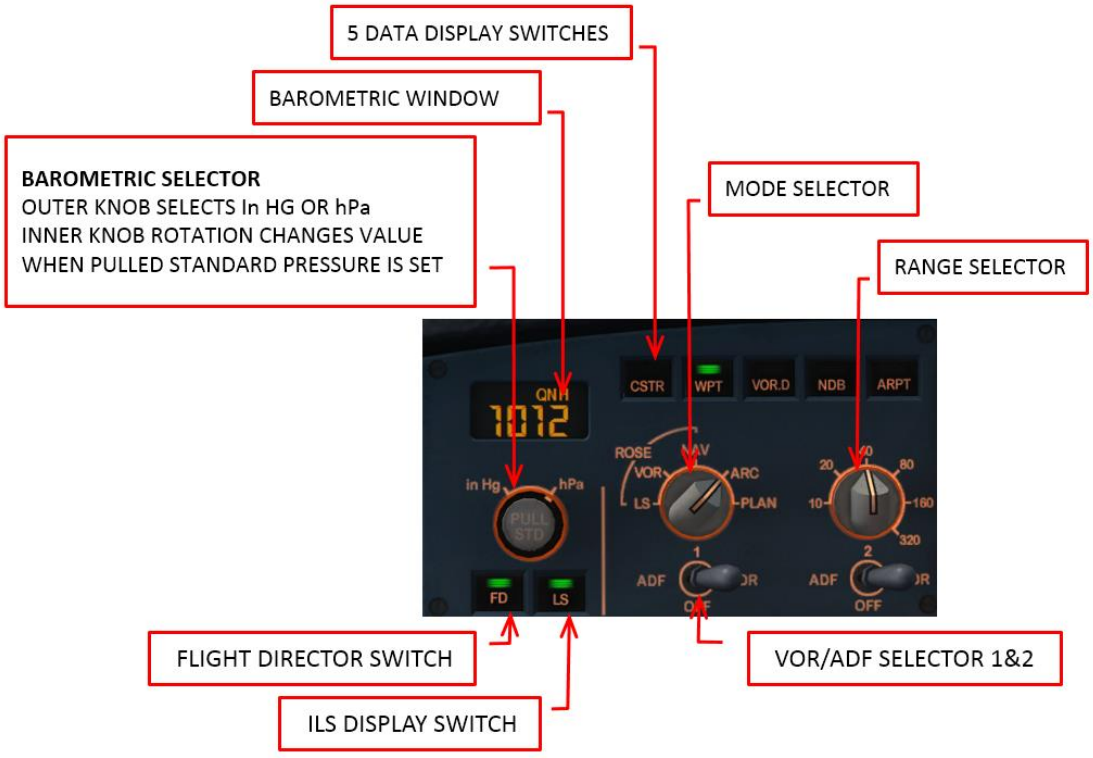
- Range markers
- Flight Plan
- Navigation Aids
- TCAS information
- Position
- Heading
- Speed

The colors on the EFIS show the importance of the information shown:

- RED: Failure requiring immediate action
- AMBER: Failure requiring action
- GREEN: Shows FMCG and NDB navigation information, flight director and engaged flight guidance modes
- WHITE: Used for titles, scales and VOR information
- BLUE: Used for armed flight modes, VOR, CDI and tuned navaids
- MAGENTA: Used for ILS navaids information.

EFIS CONTROL PANEL

The EFIS control panel is used to display or hide elements on the PFD and ND.



ELECTRONIC CENTRALIZED AIRCRAFT MONITOR

The ECAMs informs the pilot about aircraft systems and fault monitoring. The upper display shows engine and warning information while the lower display displays the System Display (SD) pages.

The colours on the ECAM show the relative importance of the information shown:

- RED: Failure requiring immediate action
- AMBER: Failure requiring action
- GREEN: For normal long time operation
- WHITE: Used for titles and remarks
- BLUE: Used for information about limitations
- MAGENTA: For additional information

When neither caution nor warnings are present the page shown is controlled by flight phase.

- On the ground and engines off -> Doors page
- On the ground and engines on -> Wheels page
- Take-off run and until reaching 1500 ft AGL -> Engines page
- Above 1500 AGL -> Cruise page

If a caution or warning is triggered the ECAM will show the page for the affected system and CLR button will be lit. Pressing CLR will show to next affected systems page (if any) otherwise it will return to the page relevant for the flight phase. Pressing RCL will recall any existing warnings and cautions and again show the page for the affected systems.

ECAM CONTROL PANEL

- T.O. CONFIG: when pressed the aircraft will simulate a take-off power application to trigger warnings or cautions that might prevent a take-off.
- EMER CANC: not simulated
- System pages: when pressed the selected page is shown on the lower ECAM
    - ENG: enginesBLEED: bleed air systems
    - PRESS: cabin pressure systems
    - ELEC: electrical systems
    - HYD: hydraulic systems
    - FUEL: fuel systems
    - APU: auxiliary power unit
    - COND: air conditioning systems
    - DOOR: door and cargo hatches
    - WHEEL: gear and brake systems
    - F/CTL: flight controls.
- ALL: when pressed all the system pages are shown at short intervals
- CLR: when lit it can be pressed to remove ECAM caution or warnings
- STS: when pressed the STATUS page is shown on the lower ECAM
- RCL: when pressed the warnings and cautions statuses that have been suppressed by other warnings or cautions (or new flight phase) are recalled,

STANDBY COMPASS

The standby compass is displayed when the access panel is pushed upwards shortly. It can be stored by pushing it upwards. The standby compass should not be used for normal operation.

STANDBY HORIZON

The standby horizon is a backup for the IRU and EFIS system and shows attitude, altitude, speed and barometric pressure. The standby horizon should not be used for normal operation.

DDRMI

The digital distance and radio magnetic indicator provides a backup for the flight displays but is also useful in normal operation.

CLOCK

The clock provides time related information

- CHR: chronometer, start and stop with the CHR button, reset with the RST button
- UTC: shows UTC time
- ET: shows flight time (triggered by flight mode START)

VOR/DME RECEIVERS

There are two VOR/DME receivers and the information is supplied on the Digital Distance Radio Magnetic Indicator (DDRMI) and the Navigation Display (ND).

FLIGHT MODE ANNUNCIATOR

The Flight Mode Annunciator is shown at the top of the Pilot Flight Display and it perhaps the most important display of the whole cockpit. It shows in detail in what mode the systems are operation and what the pilot can expect to happen. Understanding what is shown here means understanding what the aircraft is doing. If a pilot enters the cockpit after a sanitary break it is the first thing he will check. There are five columns with 3 lines each.

AUTO THRUST OPERATIONS --	AP/FD VERTICAL MODES --	AP/FD LATERAL MODES --	APPROACH CAPABILITIES DH/MDA	AP, FD. ENGAGEMENT STATUS

AUTO THRUST OPERATIONS ANNUNCIATIONS

MAN TOGA	A/THR is armed, at least one thrust lever is in TOGA detent
MAN FLEX XX	A/THR is armed; at least one thrust lever is in MCT/FLX detent, with FLX TO temp set at XX°. The other thrust lever is at, or below, the MCT/FLX detent
MAN MCT	A/THR is armed; at least one thrust lever is in the MCT/FLX detent, the other is at, or below, this detent
MAN THR	A/THR is armed and the most advanced thrust lever is above CL detent (2 engines operative, or one above MCT/FLX (engine-out) and not in a detent
THR MCT	A/THR is active in thrust mode and the most advanced thrust lever is in the MCT/FLX detent (engine-out).
THR CLB	A/THR is active in thrust mode
THR IDLE	A/THR is active in thrust mode and commands idle thrust
THR LVR	A/THR is active in thrust mode with both thrust levers below CL detent
SPEED or MACH	A/THR active in SPEED or MACH mode
FLOOR	A/THR active and commands TOGA thrust, in alpha FLOOR condition
TOGA LK	A/THR active and TOGA thrust locked (not in alpha FLOOR condition)

Flashing White	Set the thrust levers in CL detent
Flashing White	Set the thrust levers in MCT/FLEX DETENT
LVR ASYM	Only one thrust lever is in CL or MCT/FLX detent

AP/FD VERTICAL MODE ANNUNCIATIONS

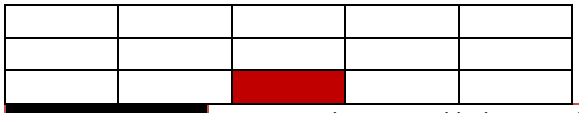
SRS	Takeoff or go around mode engaged
CLB	Climb mode engaged, FMGS target above, ALT CSTR used
OP CLB	Open Climb mode engaged FCU target above, ALT CSTR disregarded
ALT *	Altitude Capture engaged, FCU selected altitude
ALT CSTR *	Altitude Capture engaged, ALT CSTR set altitude
ALT	Altitude Hold mode engaged, FCU selected altitude
ALT CSTR	Altitude Hold mode engaged, CSTR set altitude
ALT CRZ	Altitude Hold mode engaged, CRS FL is held
DES	Descent mode engaged, FMGS target below, ALT CSTR used
OP DES	Descent mode engaged, FMGS target below
G/S *	Glide Slope Capture mode engaged
G/S	Glide Slope mode engaged
V/S	Vertical Speed Mode engaged, ALT RSTR disregarded
FPA	Flight Path Mode engaged, ALT RSTR disregarded

CLB	Climb mode armed
ALT	Altitude mode armed, FCU target
ALT	Altitude mode armed, ALT CSTR target
DES	Descent mode armed
G/S	Glide slope mode armed
ALT G/S	ALT and G/S mode armed
ALT G/S	ALT CSTRT and G/S mode armed
ALT FINAL	ALT CSTR and FINAL mode armed

AP/FD A/THR ENGAGEMENT ANNUNCIATIONS

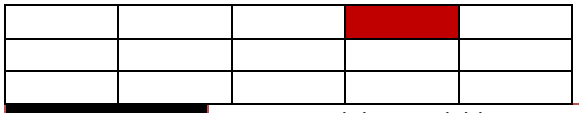
RWY	RWY mode engaged
HDG	HDG mode engaged
NAV	NAV mode engaged
LOC *	LOC capture mode engaged
LOC	LOC track mode engaged
APP NAV	NAV mode engaged for non ILS approach

NAV	NAV mode armed
LOC	LOC mode armed
APP NAV	NAV mode armed for non ILS approach

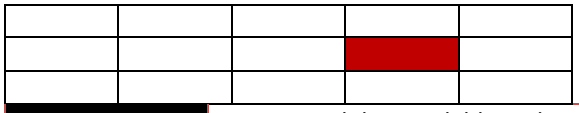


LAND	LAND mode engaged below 400 feet RA
FLARE	FLARE mode engaged
ROLL OUT	ROLL OUT mode engaged
FINAL APP	APP NAV and FINAL APP mode engaged during RNAV approach

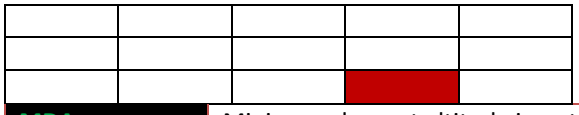
APROACH CAPABILITIES ANNUNCIATIONS



CAT 1	CAT 1 capability available
CAT 2	CAT 3 capability available
CAT 3	CAT 3 capability available

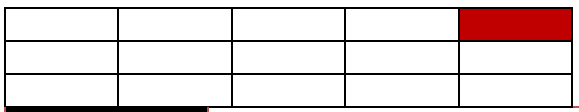


SINGLE	CAT 3 capability available with FAIL PASSIVE condition
DUAL	CAT 3 capability available with FAIL OPERATIONAL condition



MDA xxxx	Minimum descent altitude inserted
DH xxxx	Decision height inserted
NO DH	No Decision height inserted

APPROACH CAPABILITIES ANNUNCIATIONS



AP 1+2	Autopilot 1 and 2 engaged (LOC/GS, Roll-out or Go-around mode armed or engaged
AP 1	Autopilot 1 engaged

AP 2	Autopilot 2 engaged

XFDY	1FD2 indicates FD is activated on both PFD -FD- indicates FD is not activated on both PFD

A/THR	A/THR is activated by: - Setting thrust levers between CL and IDLE, assuming previously armed - Setting thrust levers between MCT and IDLE, assuming previously armed - Depressing A/TRH pb on FCU with thrust levers in active range - With ALPAH FLOOR active
A/THR	A/THR is armed - On ground by setting thrust levers at FLX or TOGA detent In flight by pushing A/THR pb with thrust levers out of active range or by engaging GA

FUEL

GENERAL

The fuel system has the follow functions

- Store fuel in the tanks
- Supply the engines (and APU) with fuel
- Transfers fuel between tanks
- And, not simulated, cool the integrated drive generator and control the refueling operations.
- Note there is no fuel dumping possible on A320/321

TANKS

Two wing tanks and one center tank store the fuel, with a vent surge tank in each wing tip.

USABLE FUEL			
	WING TANKS	**CENTRE TANK**	**TOTAL**
VOLUME	2 X 7750 LITERS 2 X 2047 US GALLONS	8800 LITERS 2166 US GALLONS	23700 LITERS 6260 US GALLONS
WEIGHT	2 X 6048 KG 2 X 13,140 LB	6437 KG 14,190 LB	18605 KG 41,010 LB

ENGINE FEED

The main fuel pumps feed fuel from the wing tanks to the engines using two fuel pumps in each wing tank.

MAIN COMPONENTS

- **Tank pumps**, two in each wing tank, normally both activated.
- **Cross feed valve**, allows the left and right systems to be connected and to feed both engines from one wing tank, normally closed.
- **Engine low pressure valves**, when closed (by using the engine master switch or the ENG FIRE PUSH button) they cut the fuel flow to the engine, normally open.
- **Suction valves**, when open they allow the engines to be gravity-fed from the wing tanks. Normally the fuel pump action will close these valves.

FUEL FEED SEQUENCE

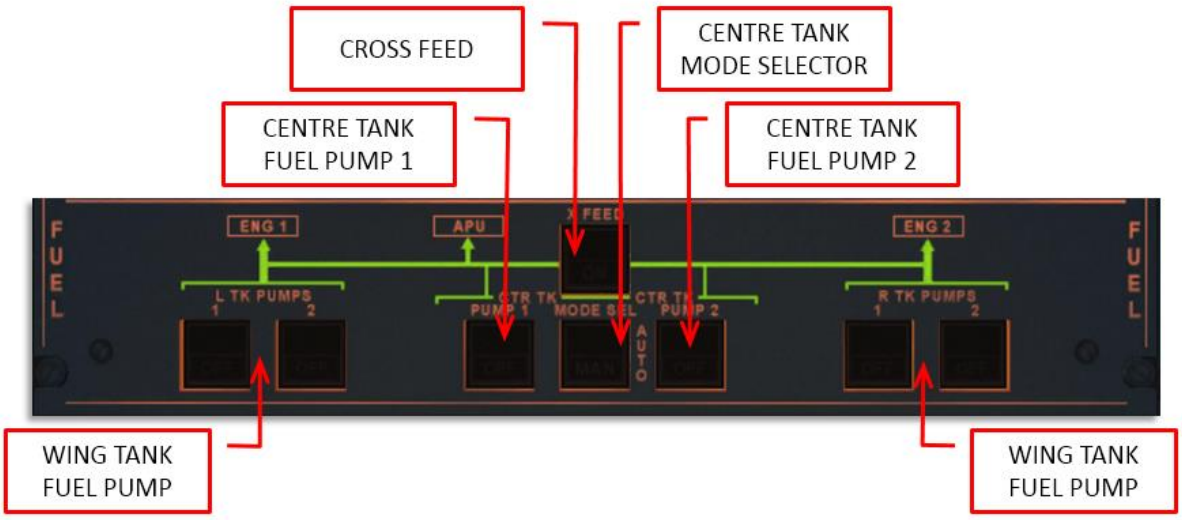
- During engine start (and for 2 minutes after engine start) engines are fueled from the wing tanks.
- When slats are extended engines are fueled from the wing tanks.
- When wing tanks are full engines are fueled from the wing tanks (to allow fuel expansion) until an ‘under level’ sensor is triggered. While engines are fueled from the wing tanks, fuel is transferred from the center tank to the wing tanks. When the inner wing tank reaches 750 kg of fuel, the outer wing tank fuel content will be transferred to the inner tanks.

CENTRE FUEL TANK TRANSFER

The Fuel Level Sensing Control Unit (FLSCU) controls the transfer of fuel from the centre tank to the wing tanks. When 500 KG of fuel has been used (from a wing tank) the FLSCU will start the transfer of fuel from the centre tank to the wing tank. When the FLSCU senses the wing tank is full the transfer is stopped. This system ensures that the wing tanks are always as full as possible and that the wing tanks fuel levels are always as equal as possible.

> NOTE: to avoid an incorrect fuel load, always fill the wing tanks complete before adding fuel to the center tank. If you see the MODE SEL button light up with a amber FAULT the most obvious cause is that the center contains too much fuel and the wing tanks too little.

OVERHEAD PANEL



TK PUMPS (push button switch), pump the fuel from the wing tanks to the engines.

- ON Pump is energized
- OFF Pump is deactivated
- FAULT When the delivery pressure drops FAULT will be lit in amber, suppressed when OFF setting is selected

CTR TK XFR (push button switch), pump the fuel from the center tank to the wing tanks

- ON XFR valve is open when MODE selector is in MANual mode
- OFF XFR valve is closed
- FAULT Lit in amber in case of wing tank overflow

MODE SEL (push button switch),

- AUTO Center tank XFR is automatic, open when wing tanks are not full, closed when centre tank is empty
- MAN Center tank XFR is manually controlled with CTR TK XFRpush button switches
- FAULT Lit in amber when:

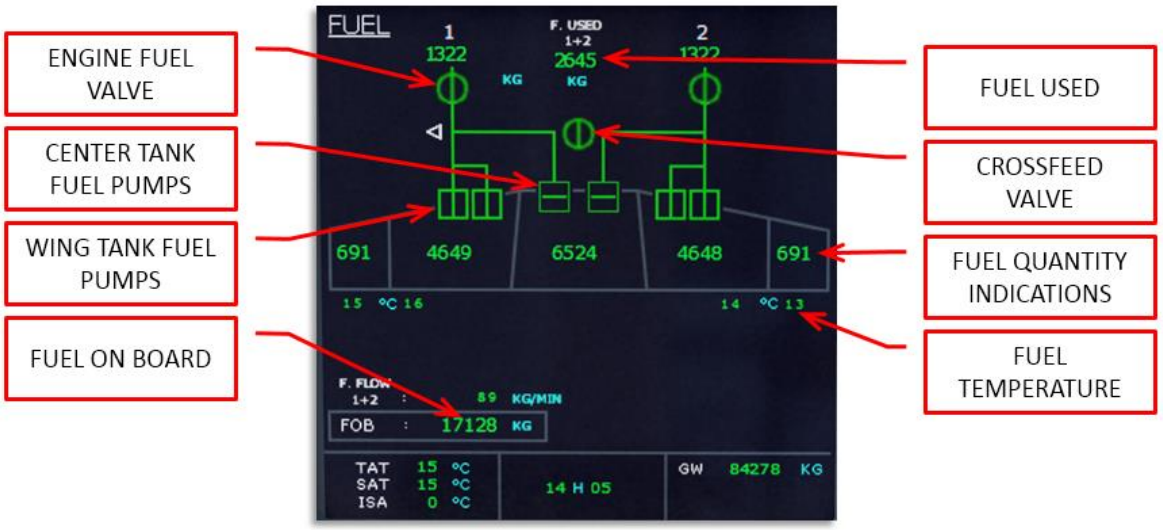
- Centre tank has more than 250 KG (550 LB) of fuel and the right or left wing tanks less than 5000 KG (11000LB). The fault indicates a problem with the fuel transfer or an incorrect fuel loading
- The MODE selector has been set to MANual

X FEED (push button switch)

- OFF Valve closed, no light
- ON Valve opens, white ON illuminated
- OPEN Green OPEN illuminated

ECAM FUEL SYSTEM DISPLAY

The ECAM FUEL page is opened by depressing the ECAM FUEL button. This page is automatically opened if any of the fuel systems is abnormal.



HYDRAULIC SYSTEM

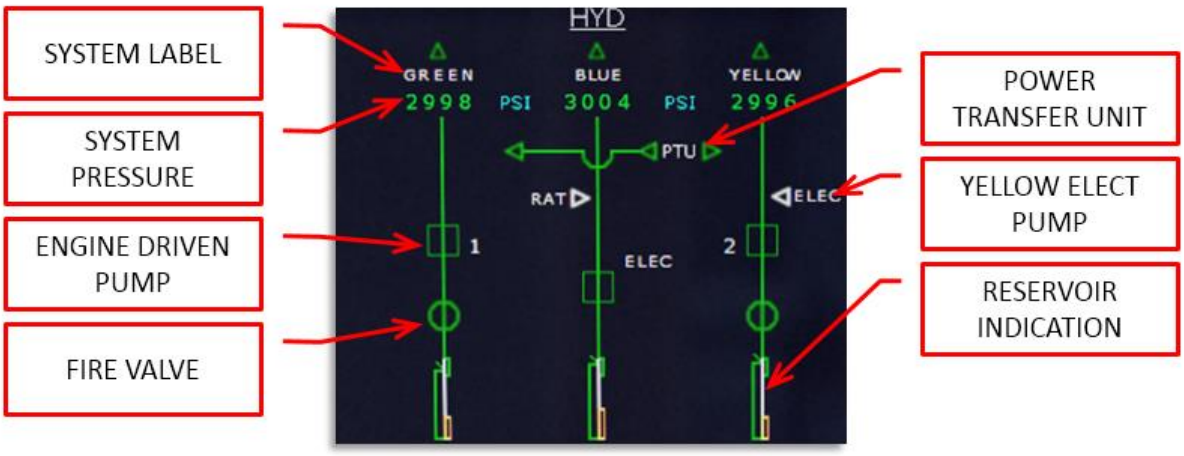
GENERAL

There are three separate and fully independent hydraulic systems, Green, Blue and Yellow, each with its own pump(s), reservoir and accumulator. In normal operation the system is fully automated and does not need any interaction.

- The Green system can be pressurized by an engine-driven pump and can use the Yellow system via the connection Power Transfer Unit (PTU).
- The Yellow system can be can be pressurized by an engine-driven pump and can use the Green system via the connecting PTU. Additionally an electric and a hand pump (not simulated) can be used.
- The Blue system is powered by an electric pump or the Ram Air Turbine (not simulated) and is mainly intended as a backup emergency system.
- The Power Transfer Unit is used to transfer pressure between the Green and Yellow systems when differential pressure exceeds a set limit.

ECAM HYD PAGE

All pumps are indicated by triangles on the ECAM. When the pump is off it is a white open triangle, when the pump is ON and pressure is normal a green triangle is shown. An amber triangle means the pump is on but pressure too low.

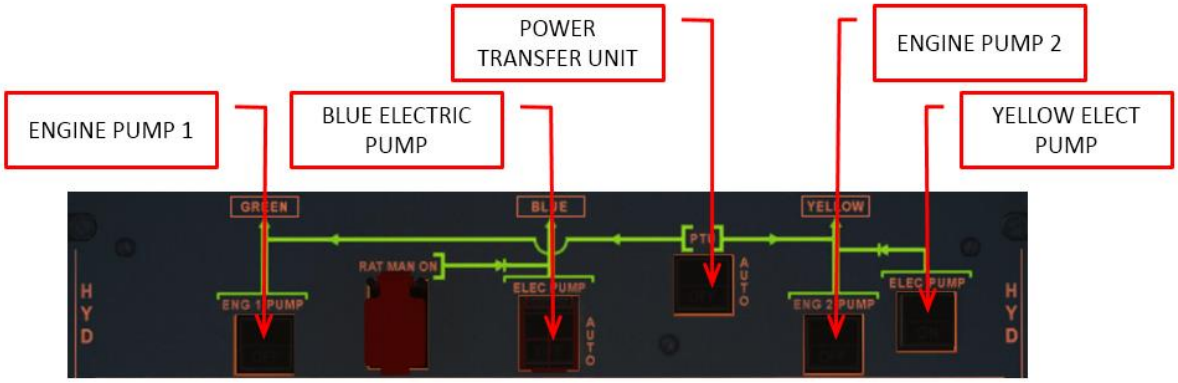


HYD OVERHEAD PANEL

The Hydraulic panel on the overhead panel allows the crew to interact with the system in case of failures. As with all overhead panels a completely dark panel indicates is in AUTO mode and there are no problems.

- The ENG PUMP pb (ENG 1 PUMP & ENG 2 PUMP) are dark in AUTO mode (ON and pressure within limits). When there is a problem FAULT will show. When pushed OFF will show and the pump will be offline and the system depressurize.
- The Blue Electric Pump pb (ELEC PUMP) is always active when one of the AC buses has power. When pushed (after lifting the switch guard) OFF will show and the system will depressurize. When the pump is on but pressure too low FAULT will show. The ECAM will show more details on that.

- The Yellow Electric Pump pb (ELEC PUMP) is dark by default, indicating it is not active. When pushed ON will show and the pump will energize. FAULT will show if there are problems, check the ECAM for more details. Note the Yellow system will pressurize the flight controls (via the PTU) when the main engines are off!
- The Power Transfer Unit (PTU) is default dark and in AUTO mode. When differential pressure is detected it will pressurize the low pressure system. When clicked OFF will show and the Green and Yellow systems will not be connected. FAULT will show if there is a problem, the ECAM will display the problems.



ICE AND RAIN PROTECTION

Using the ice and rain protection systems allow the unrestricted use of the aircraft in severe icing conditions and heavy rain fall. Electrical heating is provide for flight compartment windows, probes, pitot tubes, static ports and waste water drains (though the latter is not simulated). Hot bleed air heating is provided for the engines nacelle leading edges and outboard leading edge of each wing.

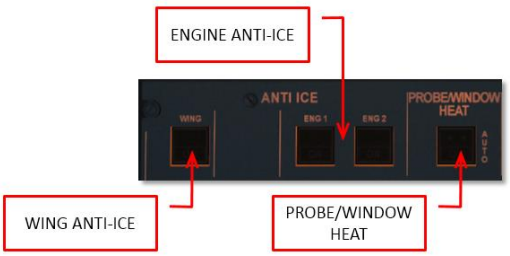
Rain protection comes in the form of wipers on the front windshields and an optional rain repellent system.

WING ANTI-ICE PROTECTION SYSTEM

To prevent ice buildup on the outboard wing slats, hot engine bleed air is sent into ducts on the wing leading edge. The WING pb on the ANTI ICE overhead panel controls the system and this is displayed by the wing anti-ice valve symbols on the ECAM BLEED system display.

PROBE / WINDOW ANTI-ICE PROTECTION SYSTEM

The probe heat computers provide automated protection using electrical heating coils against icing on the front windows, pitot tubes, static ports, TAT probe and AoA probes. It can be manually controlled (overriding the automated systems) using the PROBE/WINDOW HEAT pb. When the pb is not illuminated the system is running in automated mode.



ENGINE ANTI-ICE PROTECTION SYSTEM

To prevent ice buildup on the engine nacelle leading edges, hot engine bleed air is used. It is manually controlled by the PROBE/WINDOW HEAT pb. When engine anti-ice is selected engine idle speed will increase and continuous ignition is automatically selected.

RAIN REMOVAL

Both front windshields have individual windshield wipers controlled by three position switches on the overhead panel. Activating them on a dry windshield might cause damage to the windshield. Using the wipers at airspeed over 240 knots might result is not advised.

LANDING GEAR AND BRAKES

GENERAL

The landing gear consists of a steerable nose gear with two wheels and two main landing gears with two wheels. The nose gear retracts forward and does not have any brakes. The main gear retracts inboard and is equipped with carbon disk brakes. An auto brake system and anti-skid systems are available to assist the crew in halting the aircraft under less favorable conditions. An interlock system prevents gear retraction when the aircraft is on the ground. In case of total hydraulic failure the gear can be extended with a manual crank handle. On retraction the main gear is automatically braked using the normal brakes. The nose gear is braked with a friction band on retraction.

NOSEWHEEL STEERING

The nosewheel can be steered using the rudder pedals and the steering handwheels (not simulated). Nosewheel steering is available when:

- The A/SKID & N/W STRG controls are activated
- At least one engine is running
- Aircraft speed is under 130 knots
- Aircraft is on ground
- Green hydraulic pressure is available

MAIN WHEEL BRAKES

The brakes are operated by the brake pedals or the autobrake system via the Green hydraulic system. Temperature sensors in each main wheel display the temperature on the ECAM WHEELS page. Takeoff is not allowed before the brakes are below 300°C.

ANTI-SKID

The anti-skid system operates when wheel skid is detected and will provide maximum brake efficiency. The system is always active, when running from an alternate source it might not be available.

AUTOBRAKES

The autobrake system has three settings. LOW, MED or MAX selected by pbs. ON will show on the selected setting. When the aircraft is close to the selected rate a green DECEL will show. Pressing the illuminated pb deactivates the system. Green hydraulic pressure has to be available and the A/SKID & NW STRG needs to be active. The brakes are activated by spoiler extension.

BRAKE-FAN

The brake fans provide additional cooling when the brakes are overheating (amber temperature displayed). Activate them during taxi.

LANDING GEAR LEVER AND INDICATOR PANEL

The landing gear lever controls extension and retraction. The three indicator lights will be off when the gear is up and show red UNLK when the gear is in transit. Three green triangles will show the gear is down and locked. Next to the gear lever is a red arrow that will light when the gear is not extended and the aircraft is in landing configuration. When the two-position Gear Lever is moved and speed is below 260 knots

- Landing gear doors open,
- Gear will move to the new position
- All doors close

ECAM WHEEL PAGE

The ECAM WHEEL page shows indications for landing gear, brakes and anti-skid system. It is show automatic on the ground with engine running before takeoff and in flight when gear is commanded, in case of any abnormal indications.

ACCU-PRESS/BRAKE GAUGE

The ACCU PRESS gauge shows the Yellow accumulator pressure (top indication) and the Yellow hydraulic pressure applied to the brakes (two lower indications). When brakes are applied the pressure increase will be shown here.

PARKING BRAKE

The parking brake is commanded with the PARK BRK handle. Verify the parking brake is on by checking the ACCU-PRESS gauge. Normally the aircraft is not parked with the parking brakes applied, but with chocks to keep it in place. However during icing conditions, refueling or with high winds parking brakes are used.

LIGHTING

COCKPIT LIGHTING

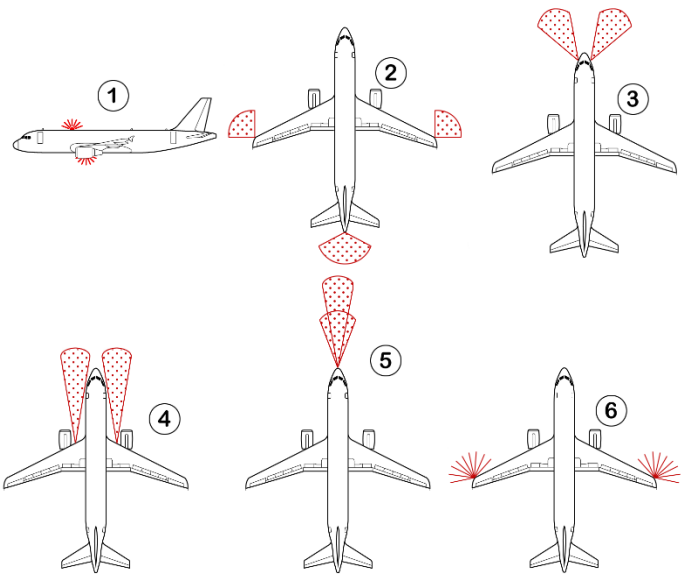
Compared to many other airliners the cockpit lighting is very simple and controlled by panels on the front console and overhead panel.

- INSTRUMENTS and PANEL LIGHTS: **ON** / **OFF (a**ll instruments and panels are integrally lit)
- ANNUNCIATOR LT TEST **BRT** / **TEST.**
  Switch to TEST to test the functionality of all annunciator lights. Switch back to BRT for standard operation. DIM setting is ignored.

EXTERNAL LIGHTS

The external lights are controlled by switches on the overhead panel. Please note that some of the lights (most noticeably landing lights) are not created using the standard FSX lights and do not react to the standard FSX light commands.

1. BEACON: **ON / OFF**
2. NAVIGATION: **ON / OFF**
3. RWY TURN: **ON / OFF**
4. LANDING: **ON** *(extended and on)***/OFF** (*extended and off*) **/ RETRACT**
5. NOSE: **T.O.** (*both lights on*) **/ TAXI** (*taxi light on*) **/ OFF**
6. STROBE: **ON / AUTO** (*off when gear on ground*) **/ OFF**



MASTER CAUTION, MASTER WARNING & AUTOLAND WARNING

The MASTER WARN pb and MASTER CAUT pb alert the pilot to a problem in one of the systems or an unsafe condition. The MASTER WARN pb is accompanied by a continuous chime while the MASTER CAUT pb only sounds a single chime. When pushed the caution and warning system is reset.

NAVIGATION

The navigation system has the following main components

- Navigation receivers
- Radar altimeter, transponders
- Two ADIRS
- Two FMGCs

Pilot interaction with these system uses:

- Multifunction Control and Display Units (MCDUs),
- Flight Control Unit (FCU)
- Transponder control panels
- ADIRS control panel
- Radio Management Panels (RMPs)

ADIRS

The Air Data Inertial Reference System supplies data such as baro altitude, speed, angle of attack, temperature, attitude, track, heading, acceleration and aircraft position. The Inertial Reference System uses three separate units to determine its position, and these have to be aligned before the aircraft is moved.

- The ON BAT light will be illuminated when one or more IRS is supplied only by the aircraft battery; it will also light up for a short while at the beginning of alignment.
- The IR pb sw will display OFF when the system is not connected to the other systems and FAULT when the when IRS alignment is lost.
- The three rotary mode selectors will switch between OFF, NAV (normal mode or operation) and ATT (not simulated).
- The ADR pb sw can be pushed to disconnect one or more of the systems (OFF) and will display FAULT when the ECAM systems detected a fault in the Air Data Reference data.

Note: There are differences in setup of ADIRS systems between Airbus models and even airlines, this also means there are slight differences in how the ADIRS is being used.

RADIO NAVIGATION

NAVIGATION RADIOS

The navigation radios are set in the MCDU on the RADIO NAV page. You enter this page by pressing the RADNAV key. Tuning to a station is as simple as entering the frequency (like 117.50) or the name (like SPA) on the scratchpad and then clicking the button next to the radio you want to tune. If there is more than one station with the same name or frequency the nearest is always selected.

GPWS

The Ground Proximity Warning System (GPWS) generates audio and visual warnings when the aircraft is in a dangerous condition;

- Mode 1: Excessive rate of descent
- Mode 2: Excessive ground closure rate
- Mode 3: Altitude loss after takeoff
- Mode 4: Unsafe terrain clearance
- Mode 5: Excessive deviation from glide path

Note that some airports have approaches that will trigger the GPWS warnings. Be prepared for this.

RUNWAY AWARENESS AND ADVISORY SYSTEM

The Runway Awareness and Advisory System (RAAS) is designed to provide to crews information about the aircraft's position relative to an airport's runway while operating at an airport. RAAS is a software upgrade to the later-model Enhanced Ground Proximity Warning Systems. It is designed to prevent runway incursion incidents. The RAAS is automatically triggered and does not have any user interface. See Vol1 for more information.

- Approaching Runway (on ground)
- Approaching Runway (in air)
- On Runway
- Runway End
- Taxiway Take-off
- Insufficient Runway Length

- Extended Holding on Runway
- Approaching Short Runway (in air)
- Taxiway Landing
- Flaps Setting (Take-off and Landing)
- Landing Distance Remaining
- Distance Remaining (Rejected Take-off)
- Excessive Approach Speed
- Excessive Approach Angle
- Unstable Approach
- Altimeter settings (above and below Transition)

RADIO ALTIMETER / TCAS

Two radio altimeters (one for each side of the cockpit provide the altitude above the ground and trigger the automatic call out in the final stages of the landing. The Traffic Collision and Avoidance System (TCAS) will warn of traffic that could cause danger to the aircraft. Transponder codes are set with the number keys.

TCAS / XPDR Selector:

- **OFF**: System deactivated
- **STBY**: TCAS and Transponder are in warm-up mode
- **ALT EPTG OFF**: Test mode
- **XPDR**: Transponder is ON, TCAS in warm-up mode
- **TA ONLY**: ATC/TCAS system is ON, advisories OFF
- **TA/RA**: ATC/TCAS system is ON, advisories ON

Above and Below Switch:

- Mode “N”: >= - 2700 ft and <= +2700 ft
- Mode “ABV: >= - 2700 ft and <= +7000 ft
- Mode “BLW”: >= - 7000 ft and <= +2700 ft

POWER PLANT

The Airbus A320 and A321 are powered by two CFM56 or IAE V2500 turbofan engines. Though these engines have slightly different characteristics, these differences are hard to notice for the crew as they are controlled by FADEC systems. The type rating of an Airbus pilot does not even mention the engine type.

FADEC

The Full Authority Digital Engine Control system (also called the Electronic Control Unit ECU) performs these functions:

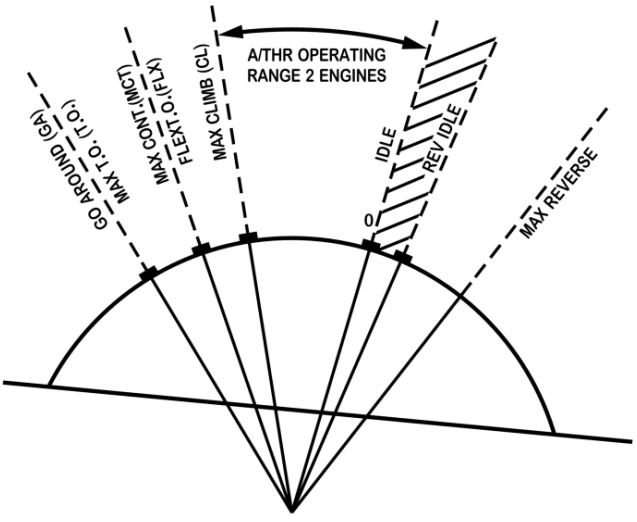
- Gas Generation Control (fuel flow, acceleration, idle settings)
- Engine Limit Protection (overspeed and EGT monitoring)
- Power Management (thrust rating)
- Automatic Starting Sequence
- Thrust Reverser Control
- Fuel Recirculation Control
- ECU Cooling
- Detection, Isolation and Recording of failures.

THRUST CONTROL SYSTEM

Thrust Control is managed by the FADEC on each engine. Thrust selection is done by means of the thrust levers when in manual mode or by the FMGS when in automatic mode. Thrust rating limit (maximum amount of power) is provided by the thrust lever position.

THRUST LEVERS

In automatic mode the trust levers should be seen as mode selectors and in many flights the throttles are not touched in the complete flight (from shortly after take-off to shortly before landing) and stay in CLIMB mode the whole flight.



The thrust levers can only be moved manually between 5 detents (stops) over 4 operating segments. Auto throttle is on only active in the range between idle and climb (including bit detents). Thrust Rating limit is computed from the thrust lever position, when between detents the FADEC will select the rating limit of the higher detent.

MANUAL MODE

The engines are in manual mode when the thrust levers are outside the operating range and the ATS is not activated. In manual mode the pilot operates the engines by moving the thrust levers between idle and T.O./G.A. The FADEC will calculate the optimal N1 rating for each position.

When on ground and the thrust levers are in the FLEX detent the FADEC will select a thrust rating based on flex T.O temperature (set in MCDU) greater than the current TAT. If no flex temperature is set MCT thrust will be used. MAX TO power is always available by pushing the levers full forward.

AUOMATIC MODE

In autothrust mode (A/THR activated) the thrust is calculated by the FMGC but limited to the mode setting of the thrust levers. When an alpha-floor condition is detected the FMCG will automatically select alpha-floor mode and full power is available.

The FMA will flash white LVR CLB to remind the pilot to select climb mode above the thrust reduction altitude.

RADIO NAVIGATION

Radio Navaids are used to display positional information and by the aircraft computer to calculate it's position. Tuning can be done automatically by the FMGC or manually using the MCDU RADNAV or PROG pages. When the FMGC fails the Radio Management Panel can be used. Manual tuning always has priority.

NAVAID SELECTION ON MCDU PAGES

The navaids that are tuned by the FMGC can be seen on three MCDU pages:

- RADIO NAV page
  Tuning can here be done by entering the frequency or name.
  The nearest navaid that matches will be used.
- PROG page
- SELECTED NAVAIDS page

AUTOTUNE VOR

The following priority rules are used for VOR tuning:

- Approach navaid
- Radio position computation
- Navaid specifically for the active leg

AUTOTUNE ADF/DME

The following priority rules are used for DME and ADF tuning:

- ADF in F-PLN and/or fix in the approach is a TO waypoint
- Radio position computation

AUTOTUNE ILS

An ILS is autotuned when the departure runway has a ILS (during PREFLIGHT AND TAKE OFF mode) and when the F-PLN approach mode has an ILS in all other modes.

SEATBELT/NO SMOKING

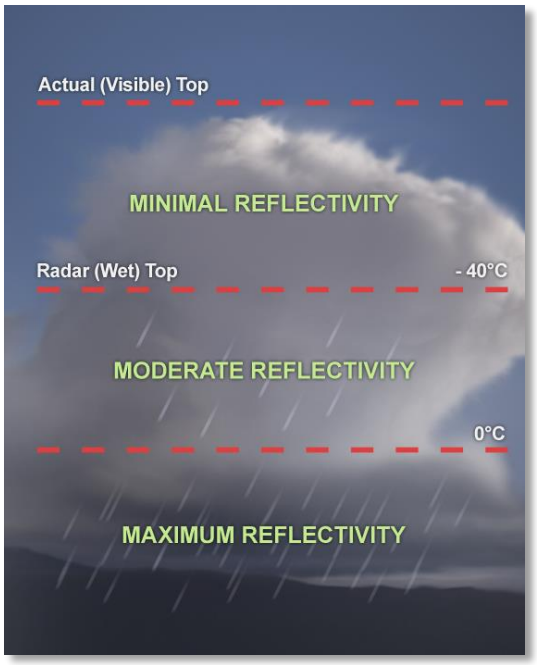
The no smoking signs should be left ON during all operational flights. The seatbelt sign behavior is semi-automated when in AUTO and the seatbelts sign will be lit when the aircraft is below 10,000 feet. Any time the indication for the passengers changes a chime is played in the cabin.

WEATHER RADAR

The Collins WXR (weather radar) detects precipitations by means of a high frequency radar. The radar beam reflects of rain drops or hail and is received by the system. The radar returns are then displayed in a calibrated gain color system. When the radar beam hits the ground (or other solid objects) it is also returned. The Collins WXR is able to eliminate ground clutter to provide a clearer image. However the Ground Mapping option does allow the user to scan the ground and pick up coastlines and other important ground features.

The fully automated multiscan mode sets the gain and tilt automatic to the ideal settings for each stage of the flight, reducing pilot workload. Multiscan operates the weather radar as a highly experienced would do manual.

The pilot is advised to keep in mind that at the cold top of clouds the water is mostly in ice crystals and super cooled water. These so not reflect the radar very effectively. Scanning a cloud from top to bottom using the manual scan will reflect that as reflections will increase near the bottom of the cloud where all the precipitation is in the form of liquid water and the density of droplets highest.



As radar beams travel in a straight line the curvature of the earth is important. Low clouds can be invisible at a distance because they are hidden by the curvature of the surface even though they are in range. In multiscan mode the radar is able to skim the radar horizon (tilting the beam so it remains just above the horizon). Keep in mind that over a distance of 320 NM the curvature of the earth causes the earth's surface to move down approximately 65,000 feet. So if the aircraft is at 25,000 feet the earth's surface is about 90,000 feet below the aircraft 320 NM in front of the aircraft. The antenna is stabilized up a 45 degree bank, meaning the radar sweep will be level with the horizon up to 45 degrees. It is also stabilized for pitch.

AUTO MULTISCAN MODE

In auto mode (MULTISCAN switch set to AUTO) the tilt is automatically controlled. Two beams (upper and lower) are merged together to become one picture representing weather in the possible vertical flight path of aircraft.

Also in MULTISCAN AUTO mode the GCS (ground clutter suspension) is usually in AUTO mode and so the ground clutter will be suppressed. Only when GCS switch is set to spring loaded OFF-Position the ground clutter would be visible but GCS is also only available in MULTISCAN AUTO mode, not in MAN mode!

MAN MULTISCAN MODE

In manual mode (MULTISCAN switch to MAN) the radar beam is controlled via the TILT rotary knob. The flight crew uses the following three features to operate the Collins WXR2100 Weather Radar in the Airbus A318/319 family (if MULTISCAN MAN is selected):

- Gain control, which adjusts the sensitivity of the receiver (and should usually be set to AUTO).
- Antenna tilt, that controls the angle between the center of the beam and the horizon
- Range control of the ND, that has an essential influence on the optimum tilt setting

The recommended TILT settings for the various FLIGHT PHASES based on ALTITUDE and ND-RANGE according to AIRBUS documentation (Flight Operations Briefing Notes) are:

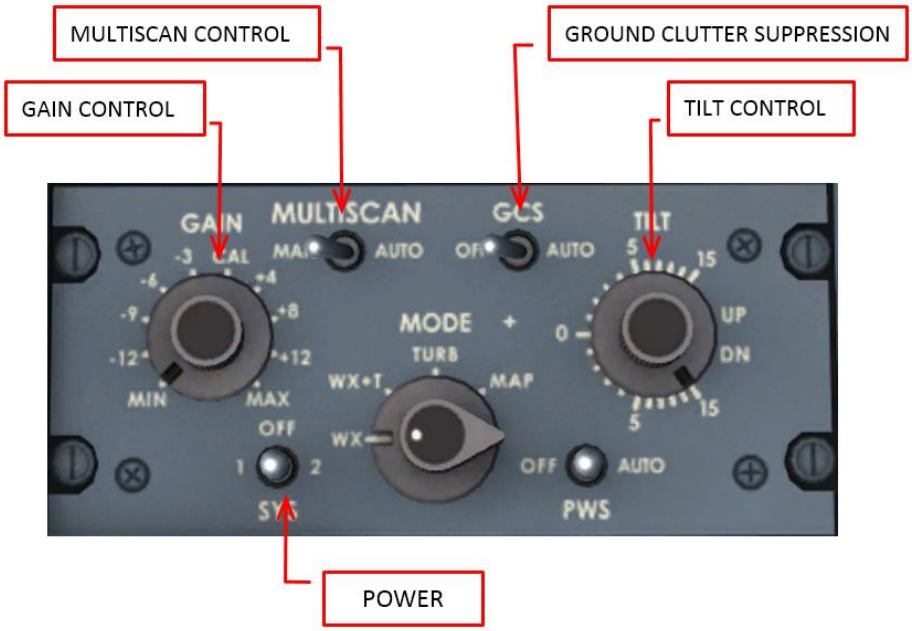
<table>
<tr><th>Flight Phase</th><th>Recommendations</th><th>Remarks</th></tr>
<tr><td>Taxi</td><td>Set ND to 10 NM range –
Tilt down, then up: Check appearance / disappearance of ground returns</td><td>Radar check must be performed away from people</td></tr>
<tr><td>Takeoff</td><td>Scan up to 15° UP for weather return, if significant weather is suspected- Select tilt at +4° UP for takeoff</td><td>Scan along the departure path</td></tr>
<tr><td>Climb</td><td>Select negative tilt, maintain ground returns on top of ND as the aircraft climbs (suggestions):
<table>
<tr><th rowspan="3">Flight Level</th><th colspan="5">ND-Range</th></tr>
<tr><th>10</th><th>20</th><th>40</th><th>80</th><th>160</th></tr>
<tr><th colspan="5">TILT SETTING</th></tr>
<tr><td>5.000</td><td></td><td>-0.9°DN</td><td>-0.1°DN</td><td></td><td></td></tr>
<tr><td>10.000</td><td></td><td>-2.7°DN</td><td>-0.8°DN</td><td>-0.5°DN</td><td>-0.4°DN</td></tr>
<tr><td>15.000</td><td></td><td>-4.5°DN</td><td>-1.4°DN</td><td>-1.0°DN</td><td>-0.9°DN</td></tr>
<tr><td>20.000</td><td></td><td>-6.3°DN</td><td>-2.8°DN</td><td>-1.6°DN</td><td>-1.5°DN</td></tr>
<tr><td>25.000</td><td></td><td>-8.8°DN</td><td>-4.3°DN</td><td>-2.4°DN</td><td>-2.1°DN</td></tr>
<tr><td>30.000</td><td></td><td>-10.8°DN</td><td>-5.4°DN</td><td>-2.8°DN</td><td>-2.4°DN</td></tr>
</table></td><td>Change TILT according to altitude and ND range</td></tr>
<tr><td>Cruise</td><td>Select negative tilt and maintain ground returns on top of ND. As a rule of thumb use the following suggestions:
<table>
<tr><th rowspan="3">Flight Level</th><th colspan="5">ND-Range</th></tr>
<tr><th>20</th><th>40</th><th>80</th><th>160</th><th>320</th></tr>
<tr><th colspan="5">TILT-Setting</th></tr>
<tr><td>31.000</td><td>-12.1°DN</td><td>-5.8°DN</td><td>-3.1°DN</td><td>-2.5°DN</td><td>-2.5°DN</td></tr>
</table></td><td>No ground returns beyond line of sight:
FL370 => 240 NM
FL250 => 200 NM</td></tr>
<tr><td>Descent</td><td>Adjust tilt to maintain ground returns on top of ND. As a rule of thumb:
<table>
<tr><th rowspan="3">Flight Level</th><th colspan="5">ND-Range</th></tr>
<tr><th>10</th><th>20</th><th>40</th><th>80</th><th>160</th></tr>
<tr><th colspan="5">TILT SETTING</th></tr>
<tr><td>30.000</td><td colspan="5">~ +3.0 °UP</td></tr>
<tr><td>25.000</td><td colspan="5">~ +2.5 °UP</td></tr>
<tr><td>20.000</td><td colspan="5">~ +2.0 °UP</td></tr>
<tr><td>15.000</td><td colspan="5">~ +3.0 °UP</td></tr>
<tr><td>10.000</td><td colspan="5">~ +2.0 °UP</td></tr>
<tr><td>5.000</td><td colspan="5">~ +1.0 °UP</td></tr>
<tr><td>3.000</td><td colspan="5">~ +0.5 °UP</td></tr>
</table></td><td></td></tr>
<tr><td>Approach</td><td>Select tilt: +4° UP</td><td>To avoid ground returns</td></tr>
</table>

CONTROLS

The following features are modeled respectively can be operated in the Aerosoft A318/319 Airbus:

- **GAIN** (-15<>+15): Sets the sensitivity of the receiver.
- **MULTISCAN** (MAN and AUTO): Multiscan mode is in Auto, off in Man.
- **GCS** (OFF and AUTO): Ground Clutter Suppression.
- **TILT** (-15° <> +15°): Controls the pitch of the radar transmitter.
- Range control: Range control is set by the standard Navigation Display Range setting.

Whereas the range control is handled on the EFIS for the other settings the WXR panel is used. To get the maximum range / display it is necessary to have set FSX SETTINGS / WEATHER / CLOUD DRAW DISTANCE to the maximum (if a weather tool is used apply the same settings to it).



WEATHER RADAR DISPLAY

The weather radar display is depicted on the ND in any mode except PLAN. The selected ND range scale will control the weather radar range.

The radar returns will appear in black, green, yellow, red or magenta depending on the precipitation intensity. The antenna tilt angle will be displayed in the lower right-hand corner of the ND and is the angle between the horizon and the radar beam axis. When MULTISCAN manual calibration mode is selected, MAN and the setting appear in blue whereas in AUTO mode the setting appears in green.

If the TERR ON ND is selected on, the ND displays the surrounding terrain from the stored database, and the weather radar display will be suppressed.

OPERATION

In standard operation the weather radar is kept in automatic multiscan mode and will always use the most suitable tilt angle for the current flight stage. These optimized settings are a good reference for manual mode.

Creating a mental image of the weather using the weather radar is a complex task where experience is very important. Areas to avoid are large areas with strong rain or smaller areas with tight color bands meaning there is only a small area where the rain increases in density.

Keep in mind that strong fronts hide whatever is behind them. Use the manual tilt and gain to look below the weather in front until ground clutter starts to appear. If the region directly behind the weather remains dark and ground clutter appears on either side it indicates a possible radar shadow.

A quick way to test operation of the weather radar on a clear day is to tilt it down and increase gain with Ground Clutter Suppression set to off. If you do not see ground returns the system is malfunctioning.

GLOSSARY

ABV	Above (TCAS)
ADF	Automatic Direction Finder
A/C	Aircraft
AGL	Above Ground Level
A.FLOOR	Alpha Floor
AMP	Audio Management Panel
ANN	Annunciator
A/THR	Autothrust
AC	Air Conditioning
ADIRS	Air Data Inertial Reference System
AIRAC	Aeronautical Information Circular
ALT	Altitude
AP	Autopilot
APPR	Approach (Key on FCU)
APU	Auxiliary Power Unit
ATC	Air Traffic Control
BLOCK	Fuel Weight (kg)
BLW	Below (TCAS)
BRG	Bearing
CFM	Engine Manufacturer GE + SNECMA
CL or CLB	Climb
CLR	CLEAR (Key on MCDU Keyboard)
CO RTE	Company Route
CRZ FL	Cruise Flight Level
DES	Descent
DH	Decision Height
DIR	Direct
DME	Distance Measuring Equipment
ECAM	Electronic Centralized Aircraft Monitoring
EFIS	Electronic Flight Instrument System
EFOB	Estimated Fuel On Board
ELAC	Elevator and Aileron Computer
ENG	Engine
ETD	Estimated Time of Departure
E/WD	Engine/Warning Display
EXPED	Expedite (FCU Key)
EXT PWR	External Power
EXT LT	External Lights
FAC	Flight Augmentation Computer
FADEC	Full Authority Digital Engine Control
FCU	Flight Control Unit
FD	Flight Director
FDR	Flight Data Recorder
FF	Fuel Flow
FL	Flight Level
FLEX	Flexible
FLX/MCT	Flexible/Maximum Continuous Thrust
FMA	Flight Mode Annunciator
FMGC	Flight Management and Guidance Computer
FO	First Officer
FOB	Fuel On Board
FPA	Flight Path Angle
F-PLAN	Flight Plan (MCDU Page)
FQ	Fuel Quantity

GPU	Ground Power Unit
GPWS	Ground Proximity Warning System
GS	Glide Slope
GW	Gross Weight
HDG	Heading
hPa	Air Pressure Unit of Measurement (hector Pascal)
IAE	Int. Aero Engines = Engine Manufacturer RR, P&E, MTU + JAEC
ILS	Instrument Landing System
In Hg	Air Pressure Unit of Measurement (Inch Mercury)
INIT	Initiation (MCDU Page)
KG	Kilogram
IRS	Inertial Reference System
L/G	Landing Gear
LK	Lock
LOC	ILS Localizer
LSK	Line Select Key
MCDU	Multifunction Control and Display Unit
MDA	Minimum Descent Altitude
MKR	Marker
N/W	Nose Wheel
ND	Navigation Display
NDB (ADF)	Nondirectional Beacon (Automatic Direction Finder)
NM	Nautical Miles
PB	Push Button
PERF	Performance (MCDU Page)
PFD	Primary Flight Display
PPU	Power Push Unit
PROG	Progress (MCDU Page)
QNH	Barometric Pressure Reported By A Station
PSI	Pounds Per Square Inch
PTU	Power Transfer Unit
RAD/NV	Radio/Navigation (MCDU Page)
RAAS	Runway Awareness and Advisory System
RMP	Radio Management Panel
RTO	Rejected Takeoff
RWY	Runway
SD	System Display
SEC	Spoiler and Elevator Computer
SID	Standard Instrument Departure
SRS	Speed Reference System
STAR	Standard Terminal Arrival Route
STDBY	Standby (TCAS)
SW	Switch
TA	Traffic Advisory (TCAS)
TA/RA	Traffic Advisory & Resolution Advisory
TAS	True Airspeed
T/C	Top of Climb
TCAS	Traffic Alert and Collision Avoidance System
T/D	Top of Descent
TERR	Terrain Proximity Alert (GPWS)
THR	Thrust
THR RED	Thrust Reduction
THRT	TCAS Threat
THS	Trimmable Horizontal Stabilizer
TOGA	Takeoff Go-Around
TOW	Takeoff Weight
TRANS	Transition

TRK	Track
UTC	Universal Coordinated Time
V1	Speed at which takeoff cannot be aborted
V2	Minimum Takeoff Safety Speed
V/S	Vertical Speed
Vfe	Maximum Flap Extended Speed
VHF	Very High Frequency
Vls	Minimum Safe Speed
Vmax	Maximum Operating Speed In Current Condition
Vmo/Mmo	Maximum Operating Limit Speed
VOR	Very High Frequency Omnirange Station
Vr	Rotation Speed
XFR	Transfer
ZFW	Zero Fuel Weight
ZFWCG	Zero Fuel Weight Centre of Gravity