AIRBUS

A340
Flight Deck and Systems Briefing for Pilots

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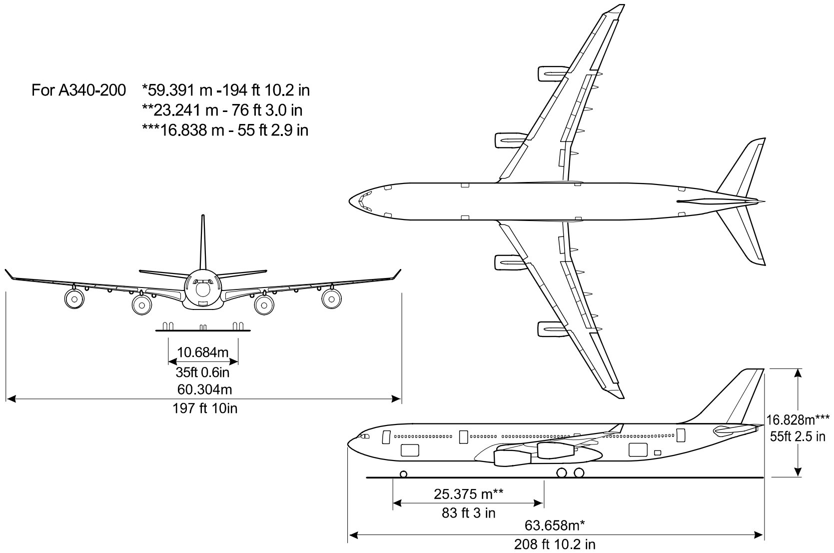
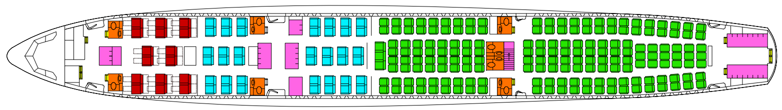
A340 General

General arrangement



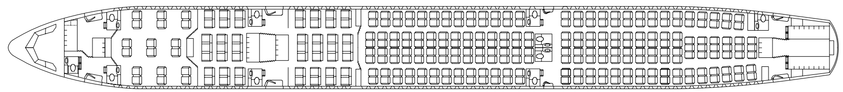
Typical cabin layout

A340-200 239 seats



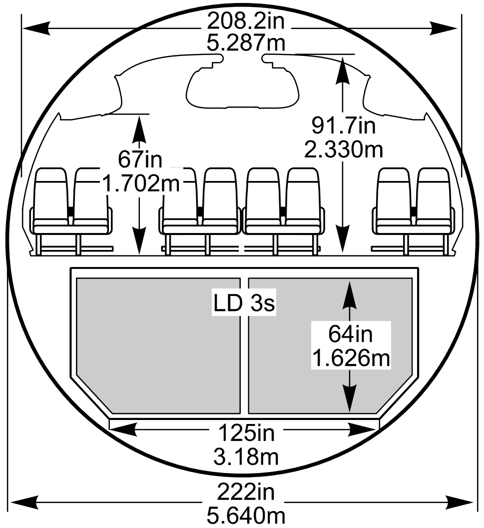
16 sleeperette (62 in pitch) | 42 Business class (40 in pitch) | 181 Economy (32 in pitch)

A340-300 295 seats



18 sleeperette (62 in pitch) | 49 Business class (40 in pitch) | 228 Economy (32 in pitch)

Fuselage cross-section



Passenger cabin

- True wide-body spaciousness and adaptability

Lower cargo holds

- Large, efficient, fully compatible with existing worldwide air cargo system.

A340 General

Introduction

- The ultra-long-range A340 is an all-new, wide-body, four-engine, twin-aisle aircraft. It is offered in two models, the -200 and -300 whose length is increased by two four-frame fuselage plugs.

- The design combines the high technology, developed for the A320, with the vast experience gained from the A300 and A310 aircraft currently in worldwide service.

  As with the A320, A321 and A330, it incorporates all of the following features :
  - Two-man crew operation with CRT displays;
  - Electrically signalled flight controls;
  - Sidestick controllers;
  - Full Authority Digital Engine Control **(FADEC)**;
  - Centralized Maintenance System **(CMS)**.

- Since its introduction in early 1993, the aircraft has been the most advanced long-range airliner offering a major stride forward in airline profitability.

- Certification basis includes :
  - JAR 25 at Change 13,
  - JAR AWO at Change 1 for CAT II and CAT III and autoland,
  - ICAO Annex 16 (Chapter 3) for noise.

Basic data

	A340-200	**A340-300**
MTOW* MLW MZFW	275 000 kg 185 000 kg 173 000 kg	275 000 kg 190 000 kg 178 000 kg
Max fuel capacity	155 040 L	147 840 L
Max operating altitude	41 100 ft	41 100 ft
Powerplants	CFM56-5C2 31 200 lb CFM56-5C3 32 500 lb CFM56-5C4 34 000 lb	CFM56-5C2 31 200 lb CFM56-5C3 32 500 lb CFM56-5C4 34 000 lb
Design speeds Vmo/Mmo	330 kt CAS/0.86	330 kt CAS/0.86
Underfloor cargo	26LD3 +9 pallets + bulk 19.7 m^3	32LD3/9 pallets + bulk 19.7 m^3

* Max ramp weight 900 kg higher than MTOW

A340 General

Aircraft design specifications

1. Design weights (see page 1.3)

2. Design speeds

V_{MO} = 330 kt CAS
M_{MO} = 0.86
V_D = 365 kt CAS
M_D = 0.93
V_B = 270 kt CAS
M_B = 0.78
$V_{LO,LE}$ = 250 kt CAS

3. Slat and flap design speeds

Lever position	Function	Config. No.	Design speed V_{FE} kt (CAS)
0	Climb/cruise/holding	0	-
1	Holding	1	240
1	Takeoff	1 + F	215
2	Takeoff	2	196
3	Takeoff/approach	3	186
Full	Landing	Full	180

4. Structural life (design aims)

The objectives for primary structure fatigue life are based on the average block time of 4 hours, as follows :

- Design life goal …………………………. 20000 flights
- Threshold for initial inspection ……….. 8 750 flights

5. Landing gear

The design aim is 25000 cycles safe life operation in accordance with FAR and JAR.

6. Cabin pressure

Max nominal operational differential pressure	593 hPa ±7	8.60 psi ± 0.1 psi
Actuating cabin pressure of discharge valve	610 hPa ± 7	8.85 psi ± 0.1 psi
Max relief valve overpressure	638 hPa	9.25 psi
Max negative differential pressure	- 70 hPa	1.00 psi

A340 General

Aircraft design specifications

7. Fuel capacity

	Litres	US gallons
Center tank	41 560	10 979
Inner tank LH	42 775	11 301
Inner tank RH	42 775	11 301
Outer tank LH	3 650	964
Outer tank RH	3 650	964
Trim tank	6 230	1 640
ACTS	7 200 x 2	1 902 x 2
Total	155 040	40 959

8. Pavement strength

Max ramp weight and max aft CG.

A340 model	ACN							
	Flexible pavement				Rigid pavement			
	Cat A	Cat B	Cat C	Cat D	Cat A	Cat B	Cat C	Cat D
A340-200	56	60	70	96	47	54	65	76
A340-300	57	61	71	97	47	54	65	76

Tire radials - 1400 mm x 530 mm x R23

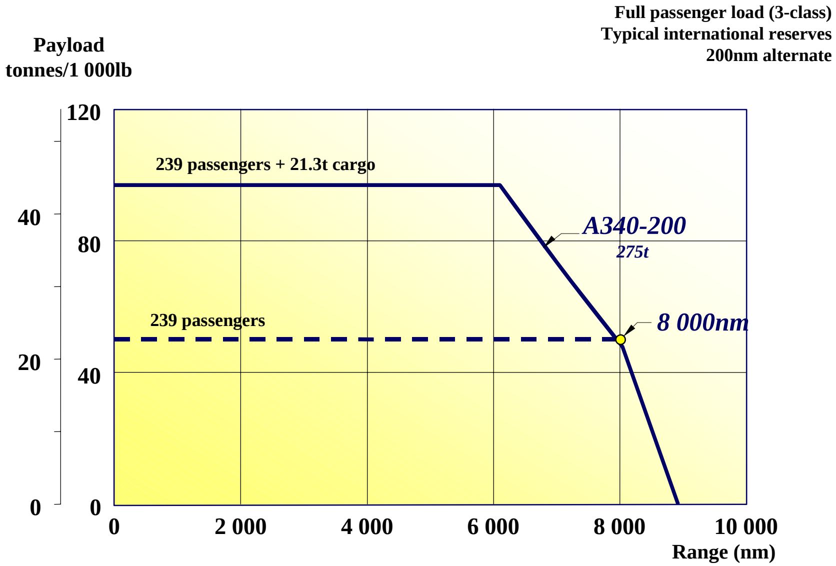
A340 General

Performance - payload range

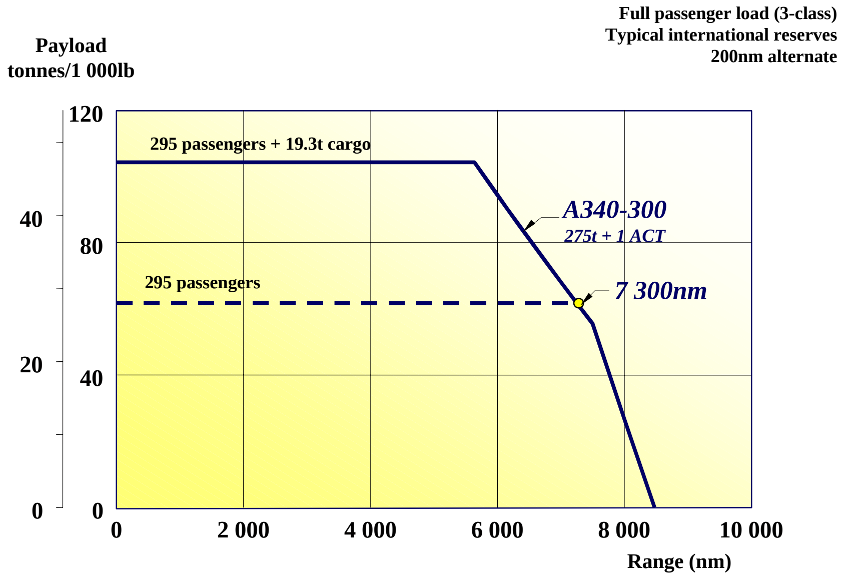
In typical airline long-range configuration, with typical international reserves and 200 nm alternate, the range is as follows :

- A340-200 three-class : 239 passengers + baggage
  8 000nm nominal
- A340-300 three-class : 295 passengers + baggage
  7 300nm nominal

A340-200 payload/range diagram



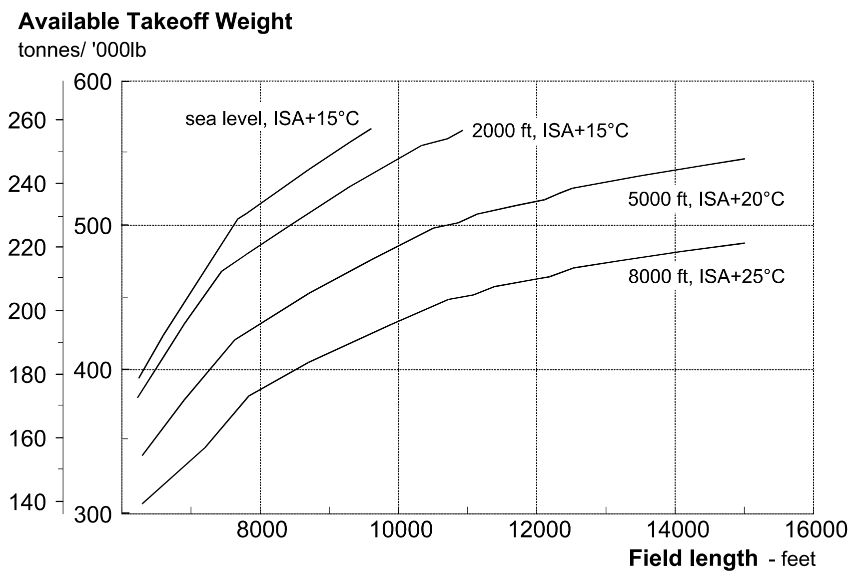
A340-300 payload/range diagram



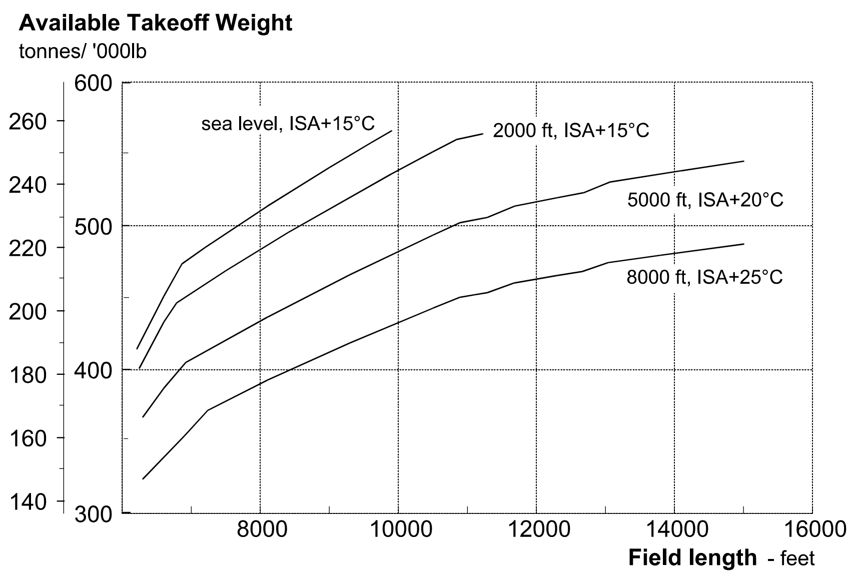
A340 General

Performance with CFM56-5C2 powerplants, rated at 31 200lb slst

A340-200 takeoff

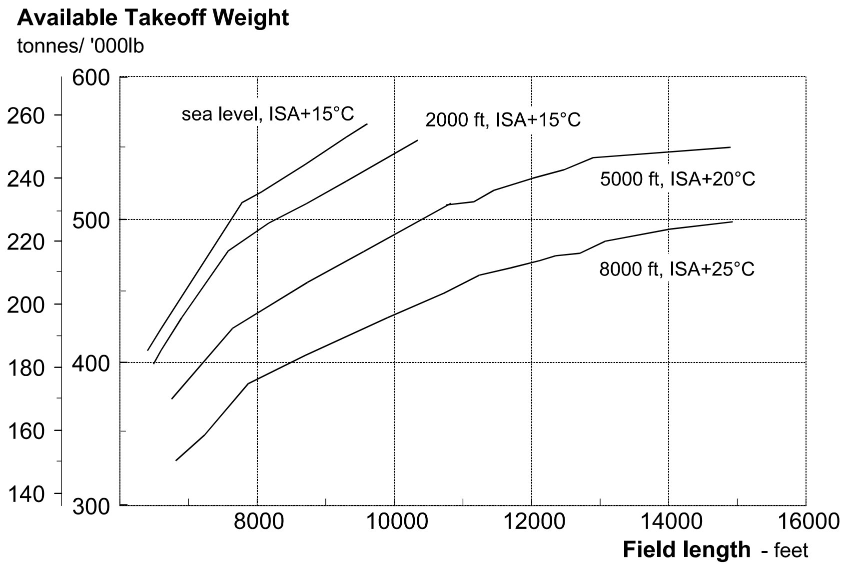


A340-300 takeoff

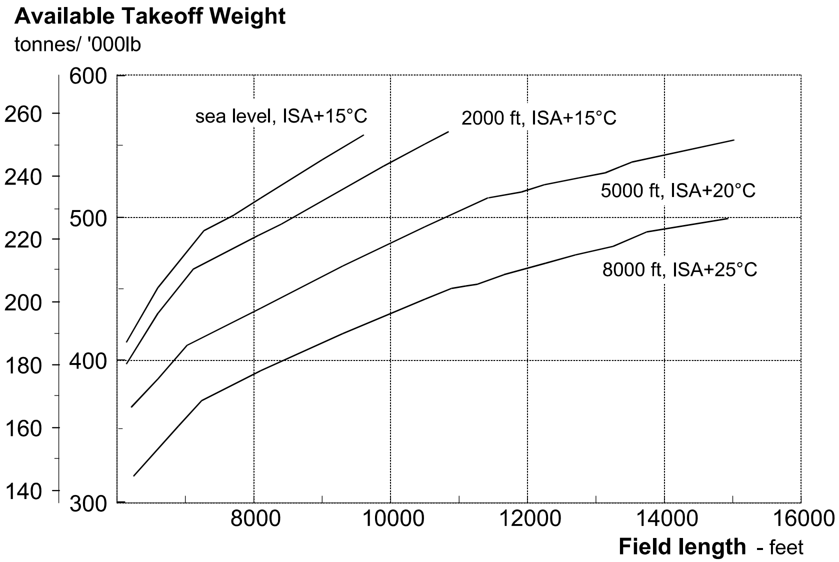


Performance with CFM56-C3 powerplants, rated at 32 500lb slst

A340-200 takeoff



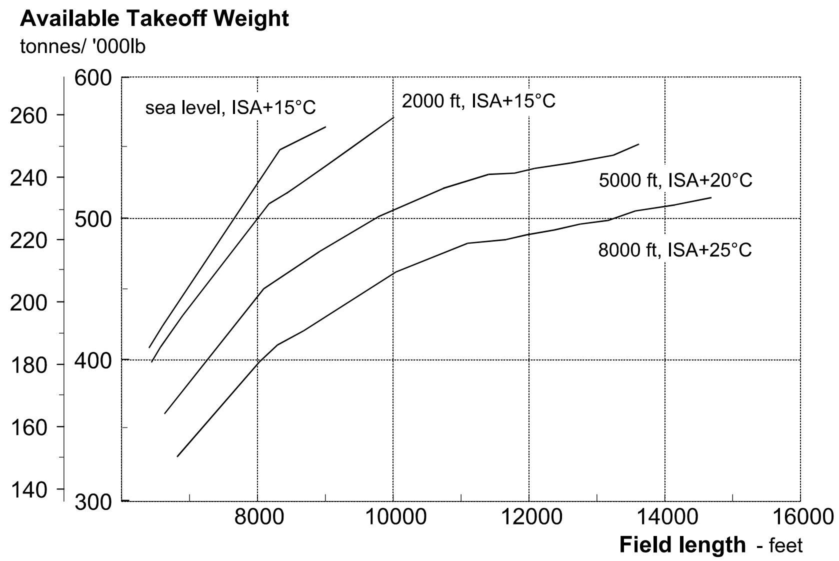
A340-300 takeoff



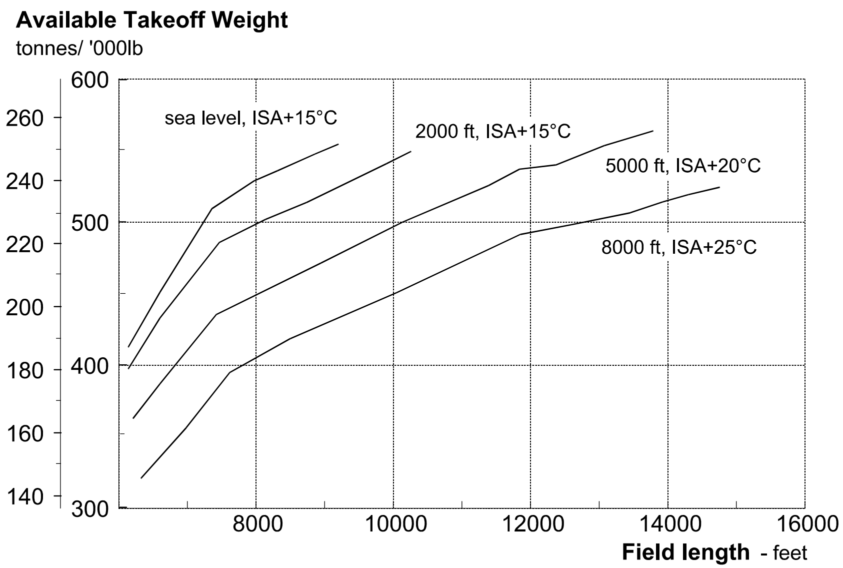
A340 General

Performance with CFM56-5C4 powerplants, rated at 34 000lb slst

A340-200 takeoff

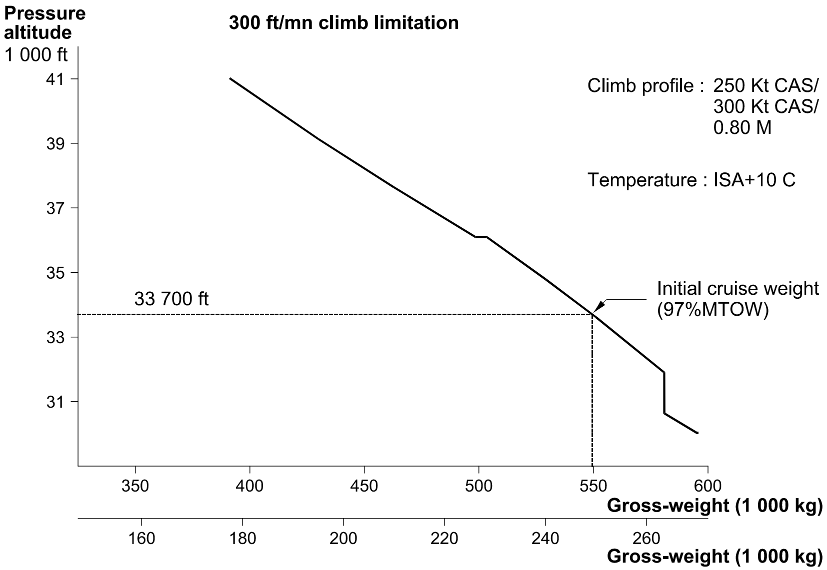


A340-300 takeoff

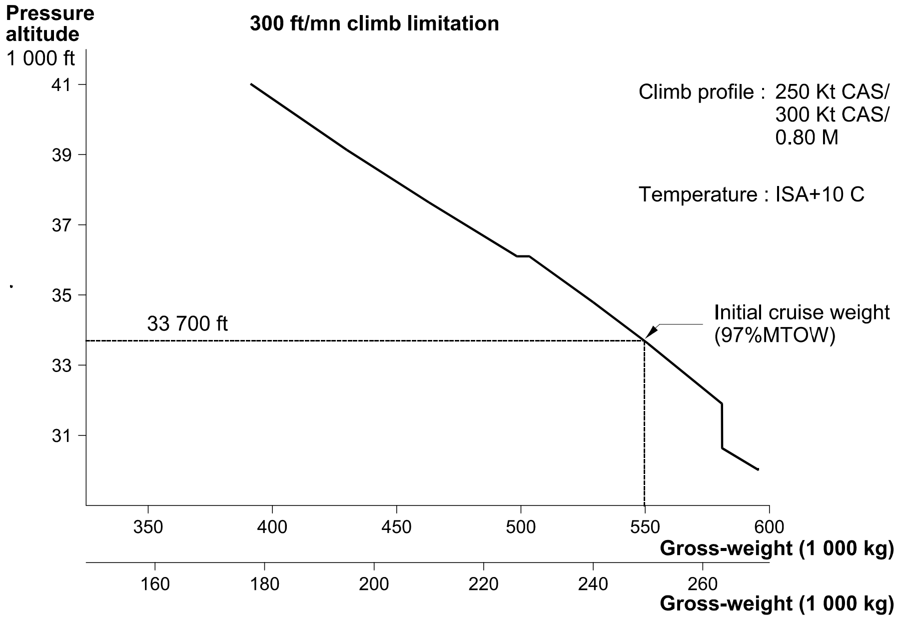


Performance with CFM56-5C2/5C3

A340-200 initial cruise altitude

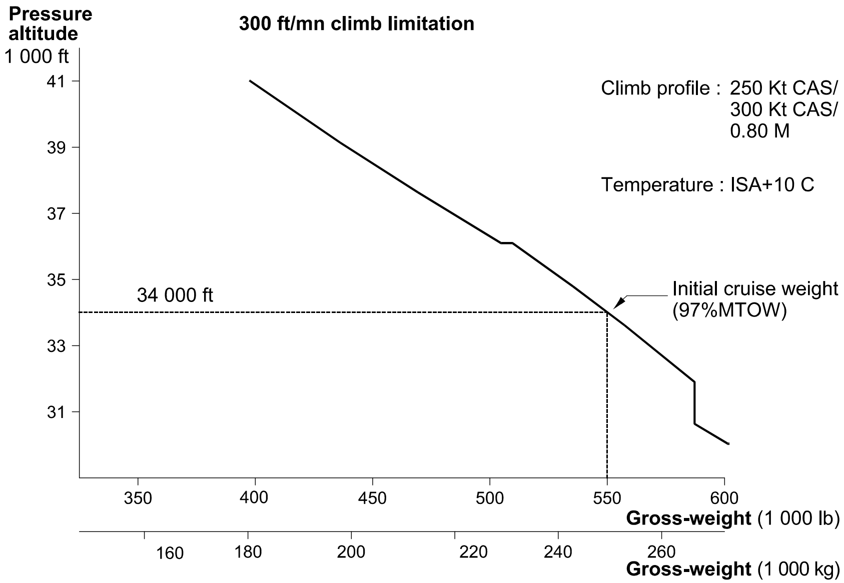


A340-300 initial cruise altitude

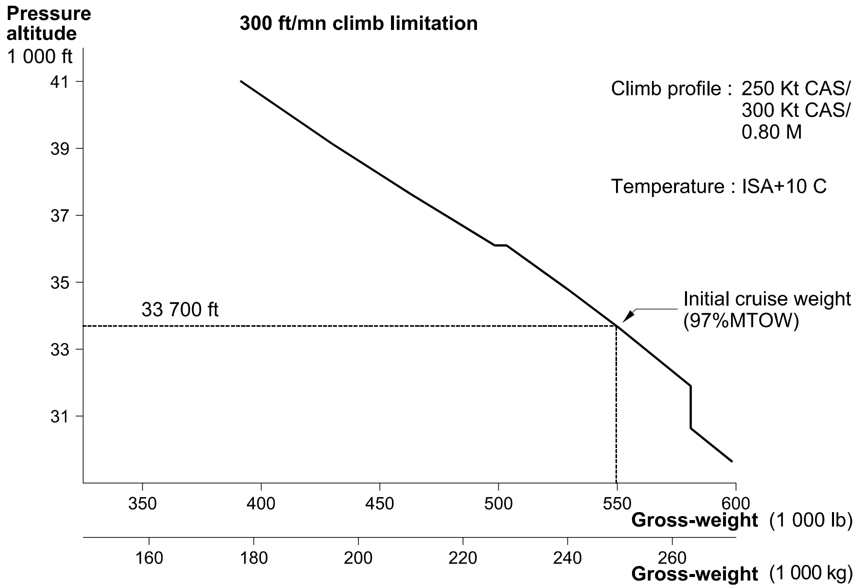


Performance with CFM56-5C4

A340-200 initial cruise altitude

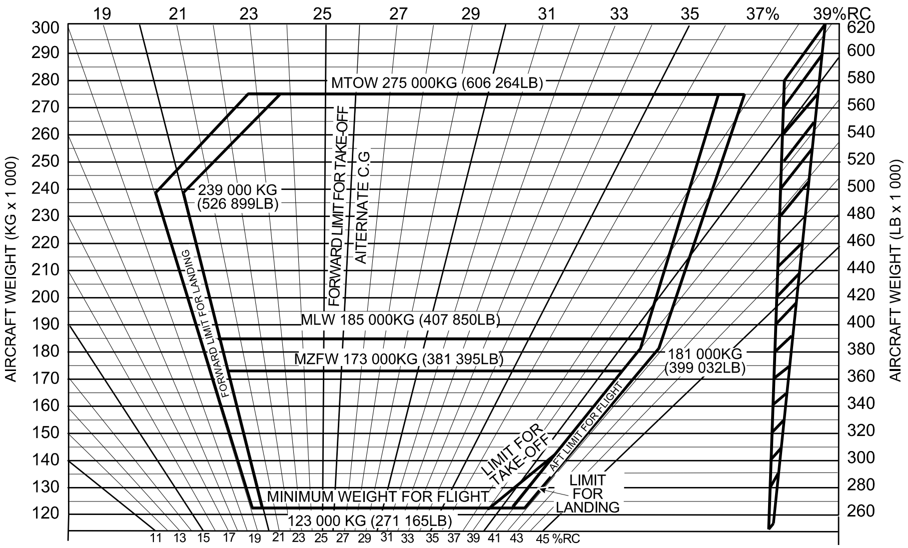


A340-300 initial cruise altitude

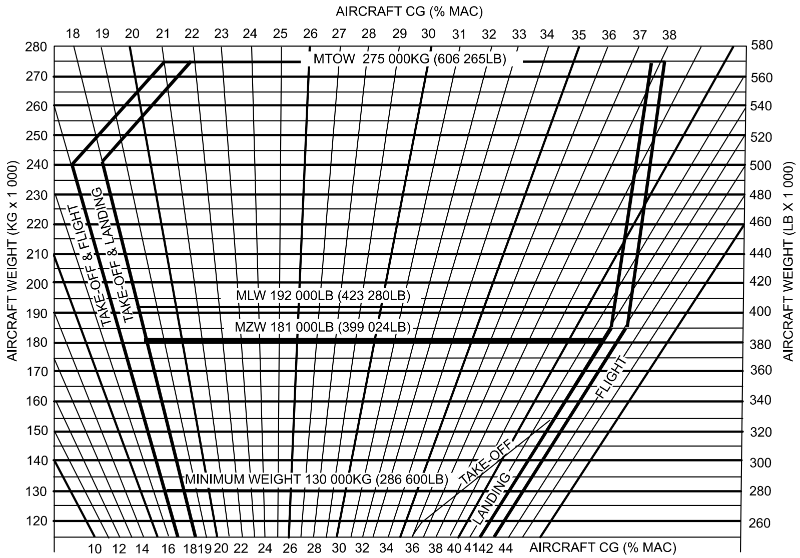


Weight and balance

A340-200 CG limits



A340-300 CG limits



Ground maneuver capability

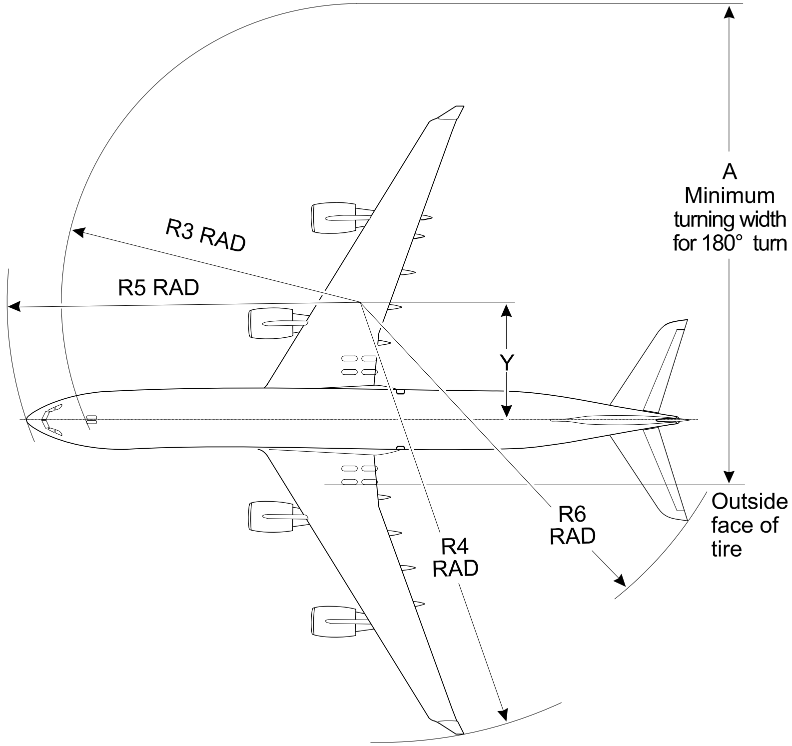
Minimum turning radius

Towing

The A340 can be towed or pushed to a nosewheel angle of up to 78° from the aircraft center line, at all weights up to maximum ramp weight without disconnecting the steering.

Taxiing

Minimum turning radii (with tire slip) and minimum pavement width for a 180° turn are as illustrated.



A340-200

	Type of turn 1 Effective turn angle 77.95°		Type of turn 2 Effective turn angle 61.5°	
	Meter	(Feet)	Meter	(Feet)
Y	5.34	17.53	12.66	41.54
A	35.16	115.41	45.23	148.23
R3	24.48	80.32	27.23	89.34
R4	36.20	118.78	43.22	141.22
R5	30.33	99.51	32.65	107.11
R6	35.07	115.06	38.61	126.69

A430-300

	Type of turn 1 Effective turn angle 77.95°		Type of turn 2 Effective turn angle 62°	
	Meter	(Feet)	Meter	(Feet)
Y	5.34	17.53	13.53	44.39
A	38.22	125.41	48.43	158.89
R3	26.58	87.19	29.59	96.98
R4	36.20	118.78	44.06	144.57
R5	32.49	106.59	34.95	114.66
R6	35.07	115.06	39.12	128.36

Type of turn 1 : Asymmetric thrust differential braking (pivoting on one main gear)
Type of turn 2 : Symmetric thrust no braking

2. Flight Deck Layout

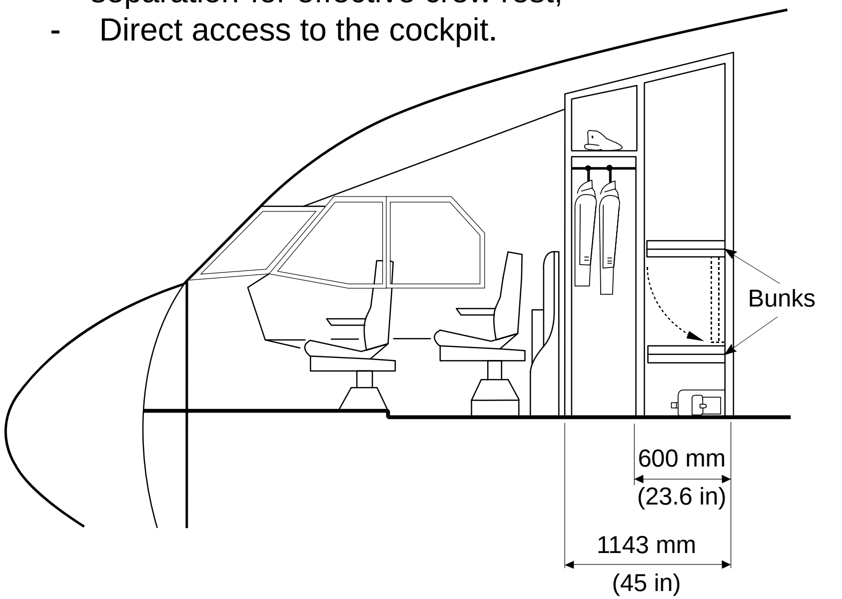
A340 Flight Deck Layout

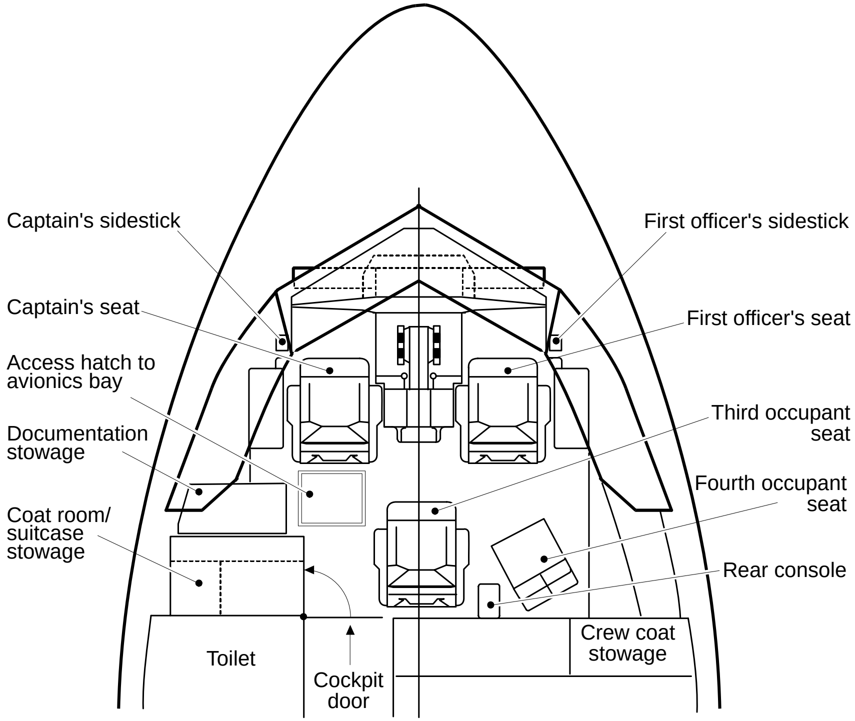
General provisions

- As the A340 is a long-range aircraft the cockpit fully provides for a 3rd occupant seat, and a folding 4th occupant seat.
- In addition, an optional crew rest compartment, adjacent to the cockpit, is available in place of a galley.

  This proposed rest compartment features :

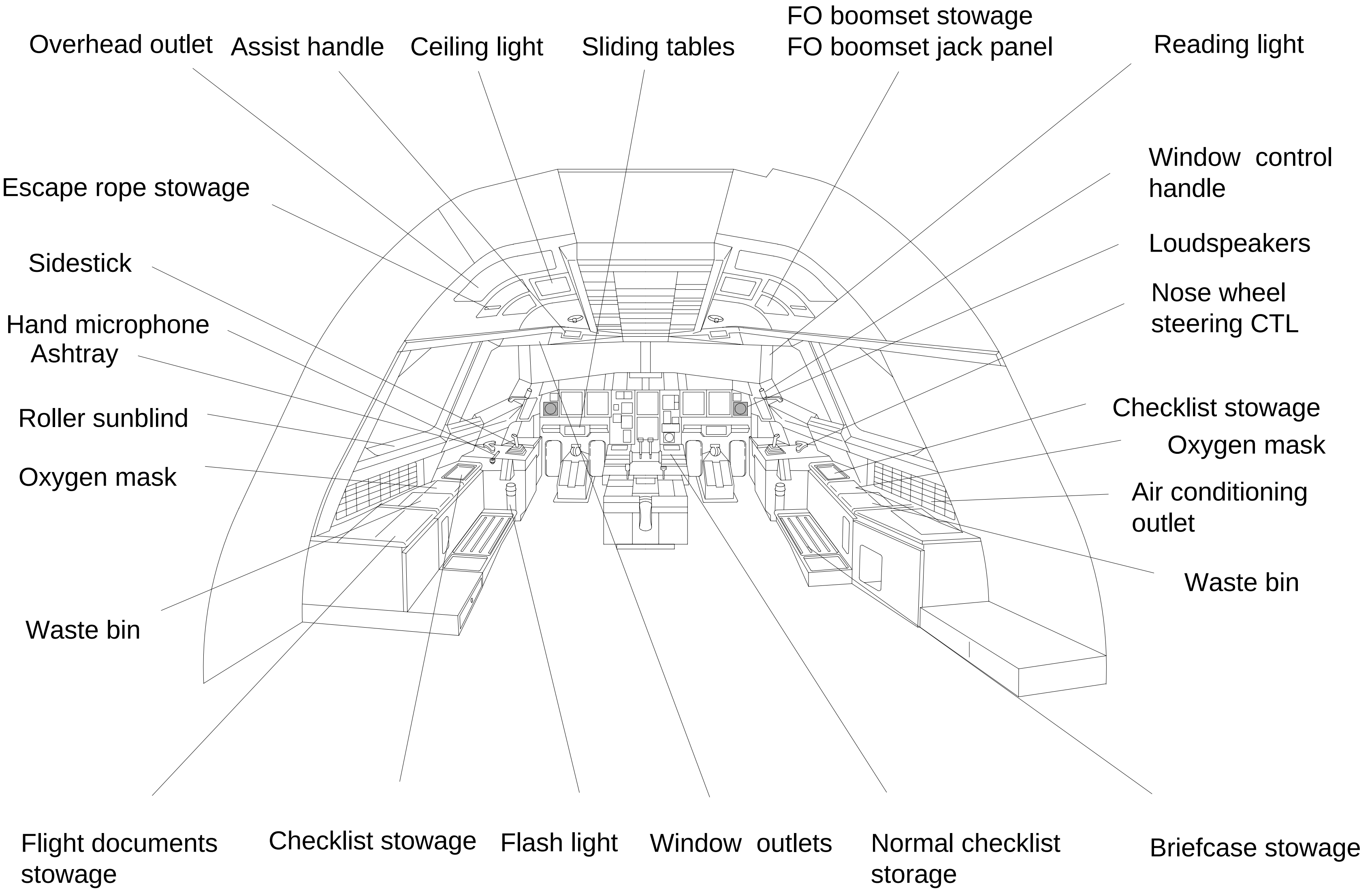
  - Two crew bunks,
  - Two folding tables/dining places,
  - A wardrobe and baggage stowage area
  - Direct view into the cockpit yet complete separation for effective crew rest,
  - Direct access to the cockpit.





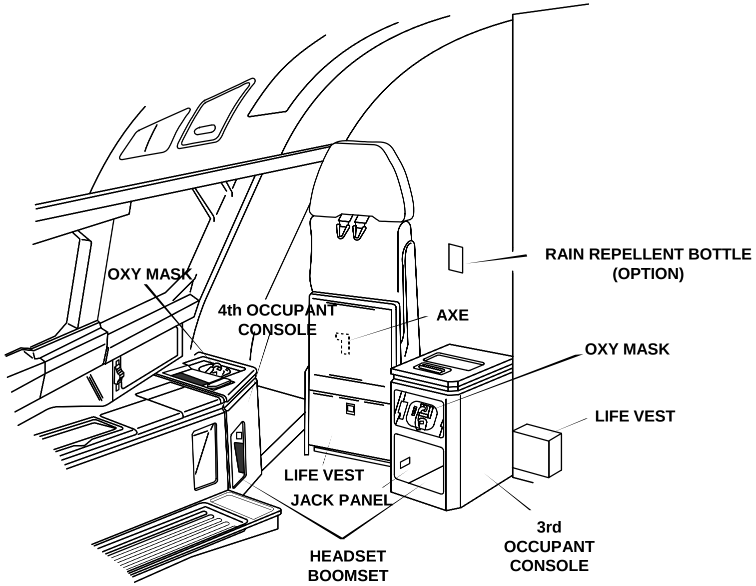
A340 Flight Deck Layout

Forward view

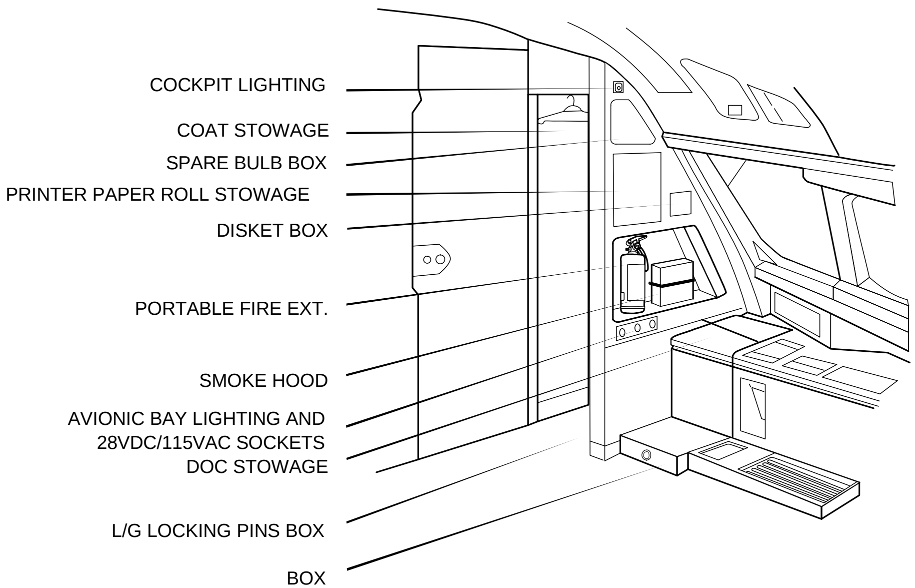


A340 Flight Deck Layout

Rear view : Right aft corner



Rear view : left aft corner



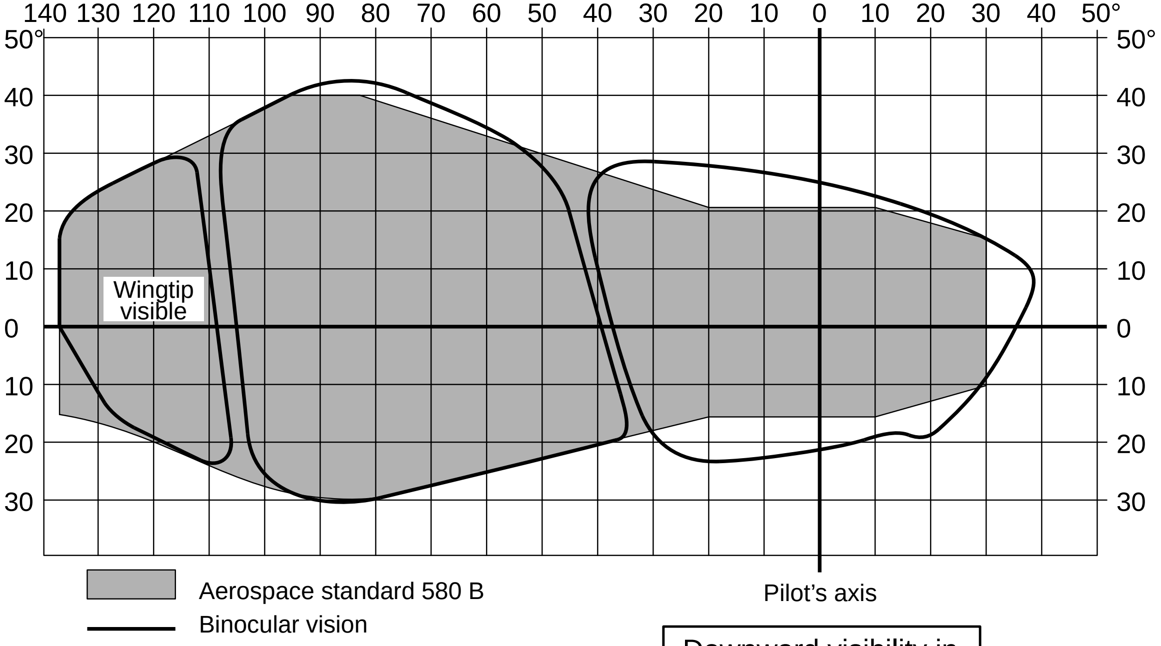
Pilots’ field of vision

Visibility

- Windows are designed to meet or exceed the Aerospace standard.

- Geometry :
  - Windshield panels : flat glass
  - Lateral windows : curved acrylic

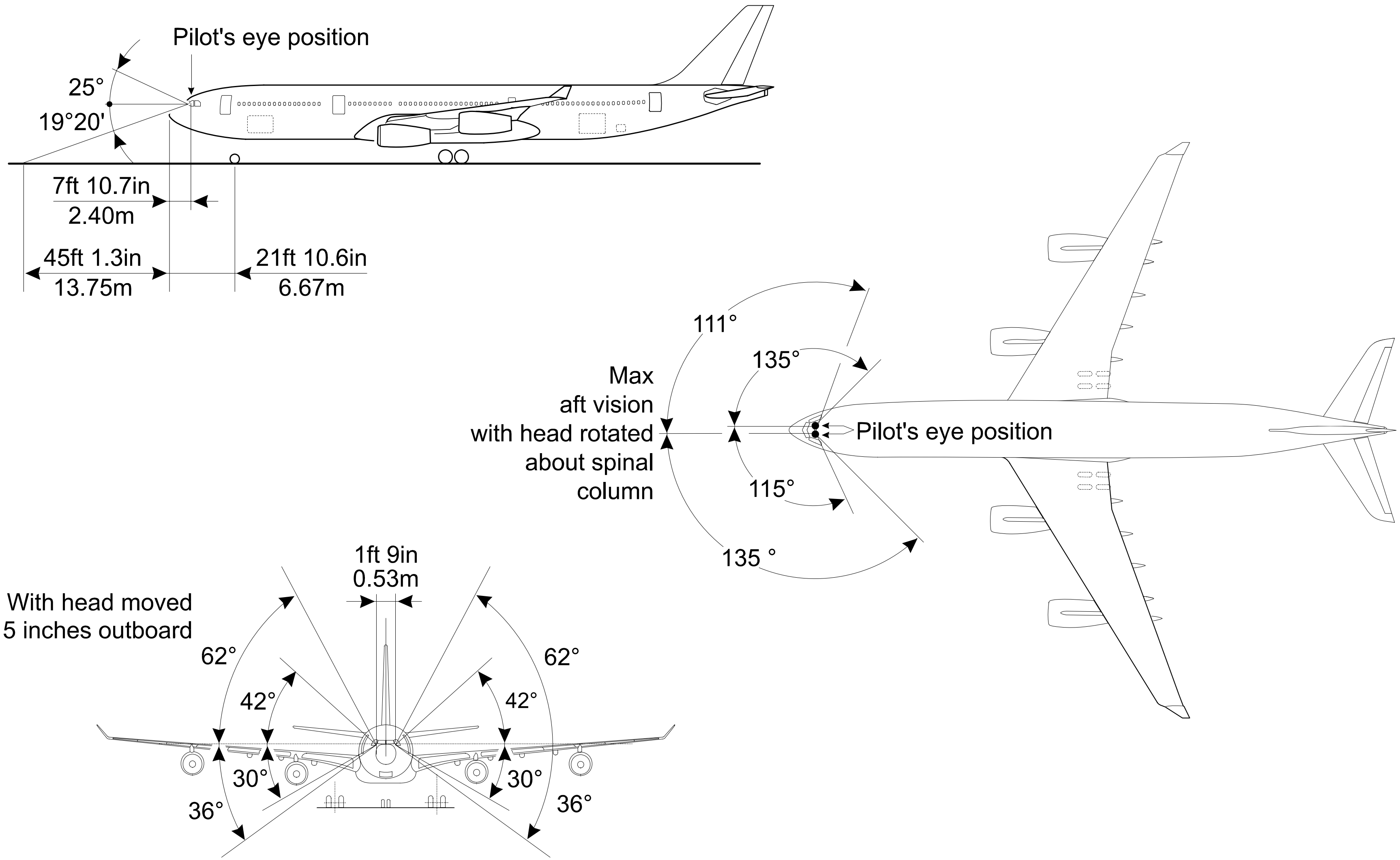
Pilots’ vision envelope



Downward visibility in the pilot axis : 20°

A340 Flight Deck Layout

Pilots' field of vision

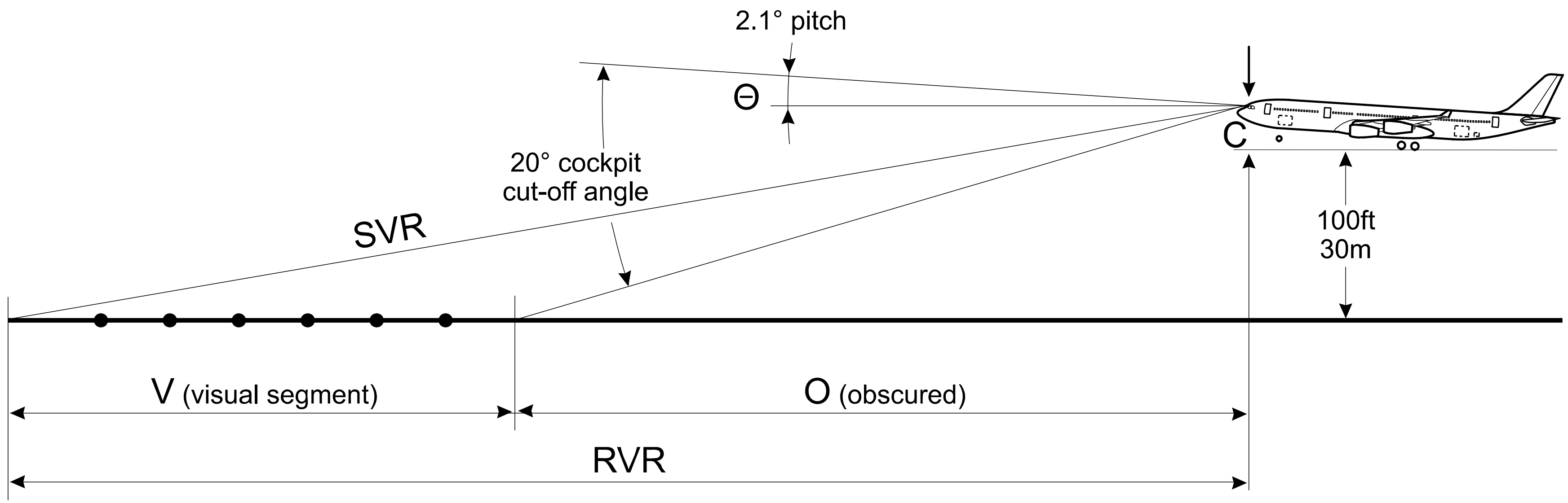


A340 Flight Deck Layout

Pilots' field of vision - landing configuration CAT II (DH = 100 ft)

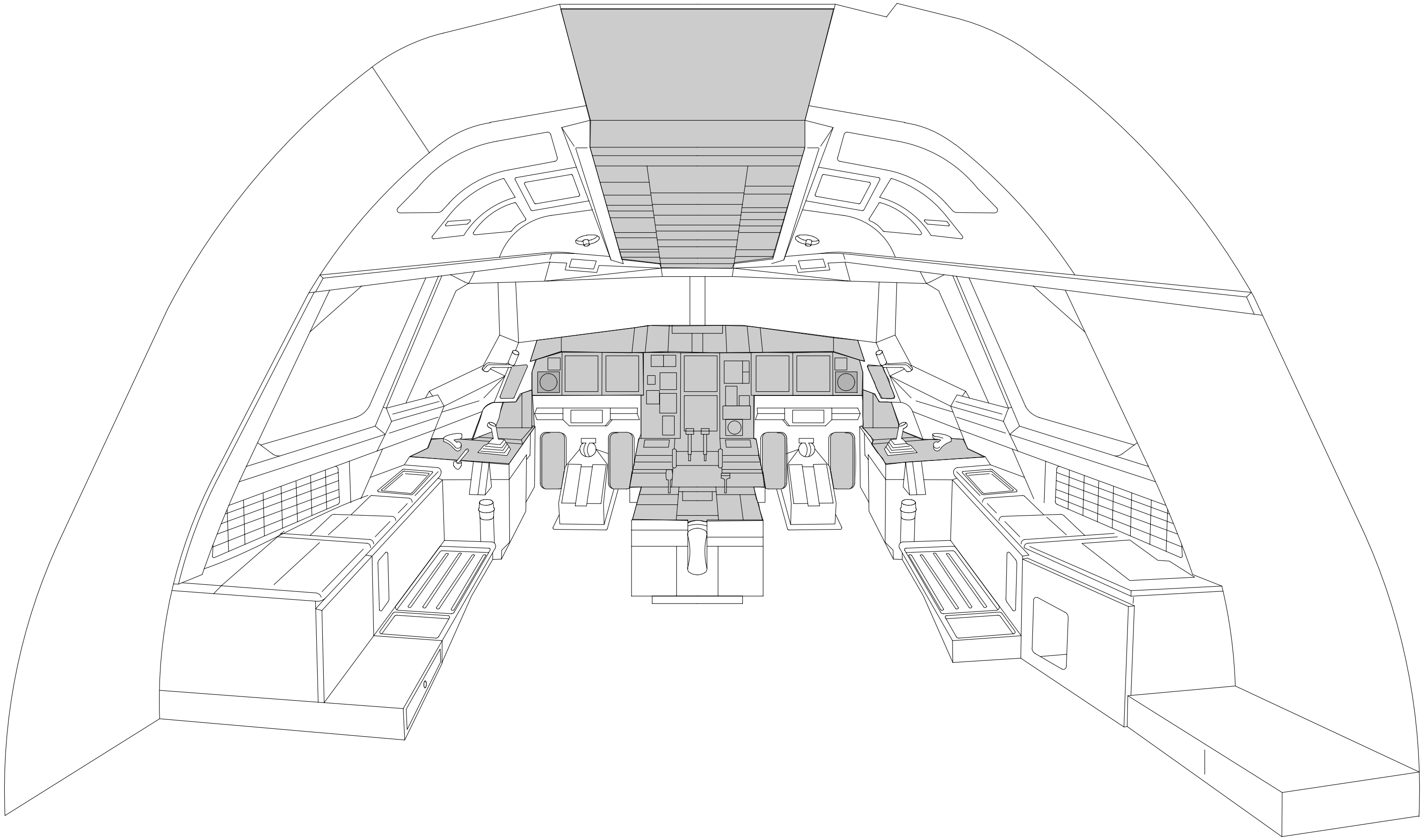
- This geometry improves external aircraft monitoring, thereby increasing safety standards.
  - Downward visibility in the pilot axis is 20°.
  - Wing tips visible from respective pilot seats.

Aircraft	θ	C	V	0	RVR	SVR
A340-200 m (ft)	3.7°	9.1 (30)	120 (394)	135 (445)	255 (825)	258 (846)
A340-300 m (ft)	2.1°	8.2 (27)	120 (394)	120 (394)	240 (788)	243 (798)



A340 Flight Deck Layout

Control and indication panels (shaded)



A340 Flight Deck Layout

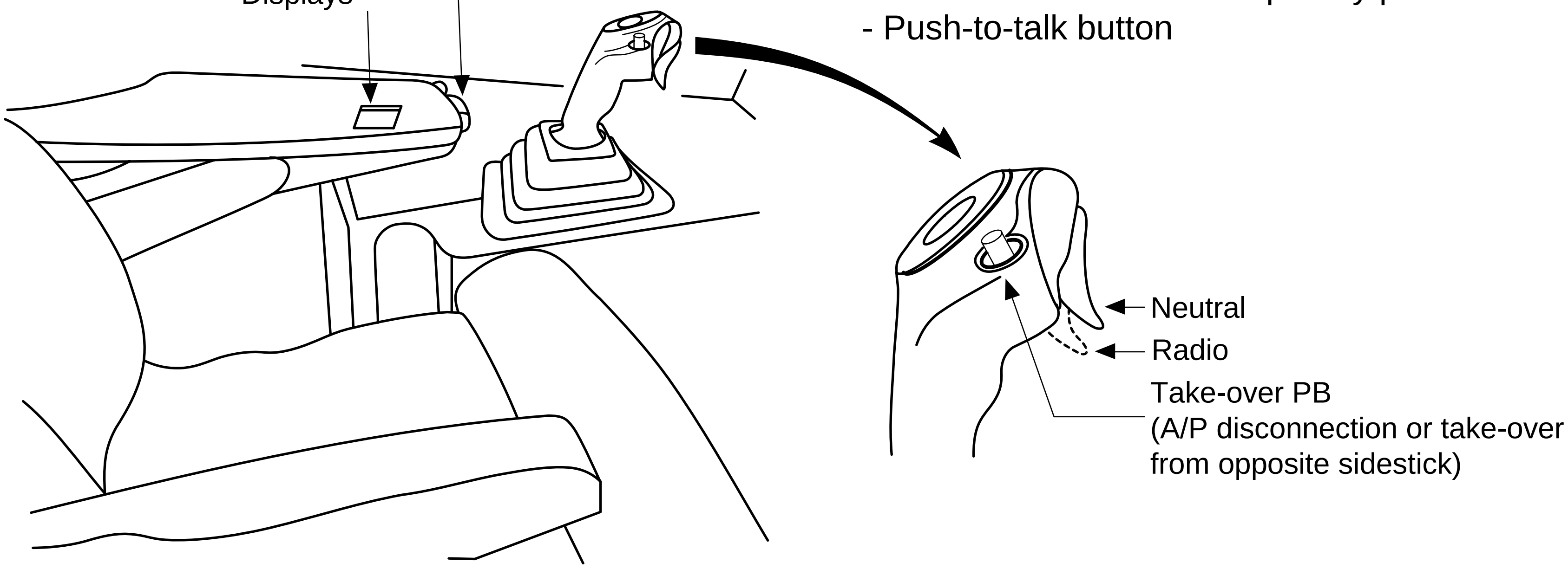
Main features

- The main features, shared with those developed for the A320/A321/A330 family are:
  - Sidestick controllers which leave the main instrument panel unobstructed.
  - Six interchangeable and switchable display units **(DU)** which are integrated into the same system architecture (EFIS/ECAM).
- Other features evolve directly from the concepts introduced with the A300/A310 family, including the :
  - Ergonomic layout of panels, synoptically arranged according to frequency of use (normal, abnormal, emergency) and located within easy reach and visibility for both crew members.
  - Philosophy of panels (e.g., “lights out” philosophy for overhead panel).
  - Principles of information presentation (“need to know” concept).
  - Monitoring of systems through an Electronic Centralized Aircraft Monitor **(ECAM).**
  - Coherent system of color coding for EFIS, ECAM and panel lights.

Sidestick arrangement

- Sidesicks are installed on the Captain's and First Officer's forward lateral consoles.
- To facilitate control, a dual pivot adjustable armrest with position indicators is fitted on each seat behind the sidestick.

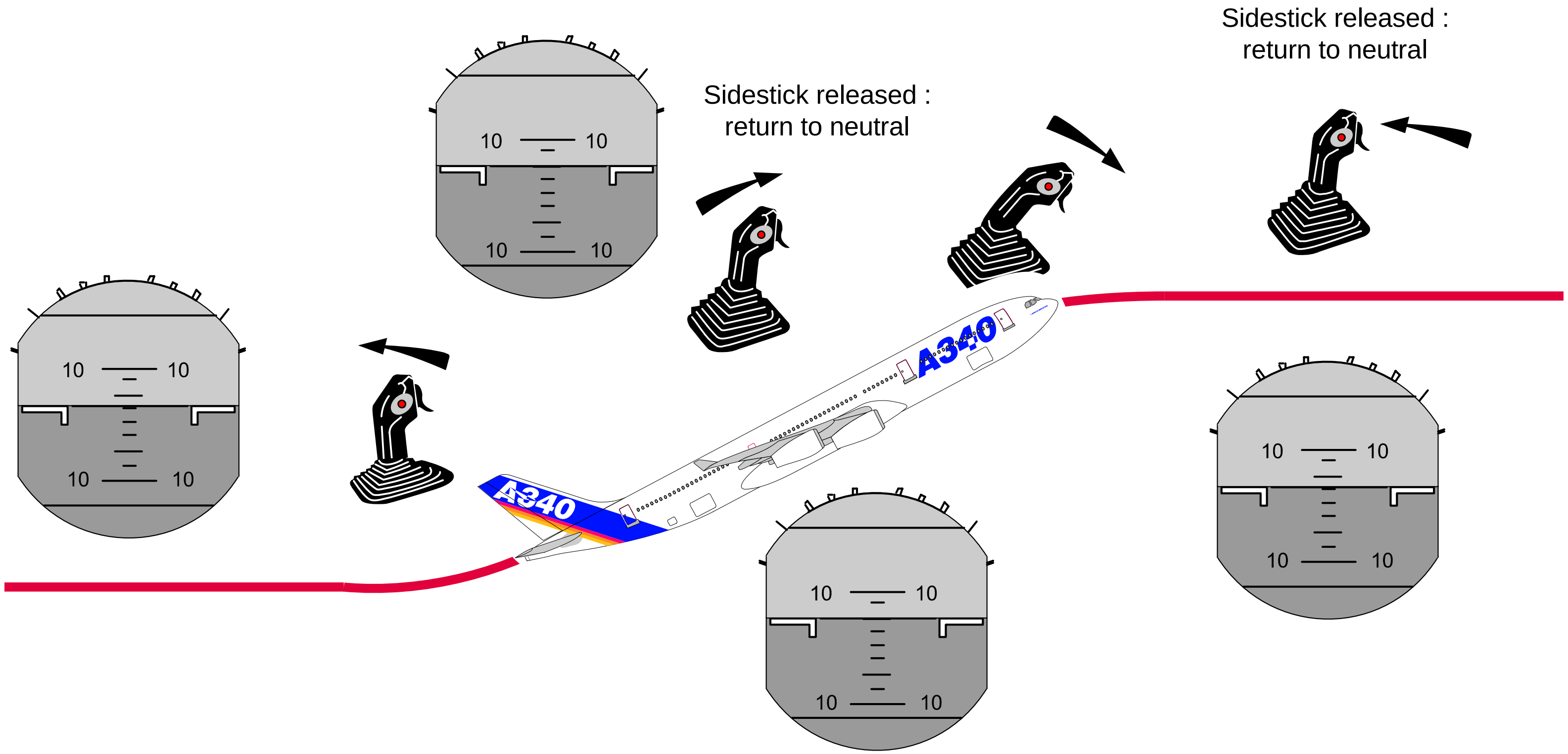
The handgrip includes two switches :
- A/P disconnect/sidestick priority pushbutton
- Push-to-talk button



A340 Flight Deck Layout

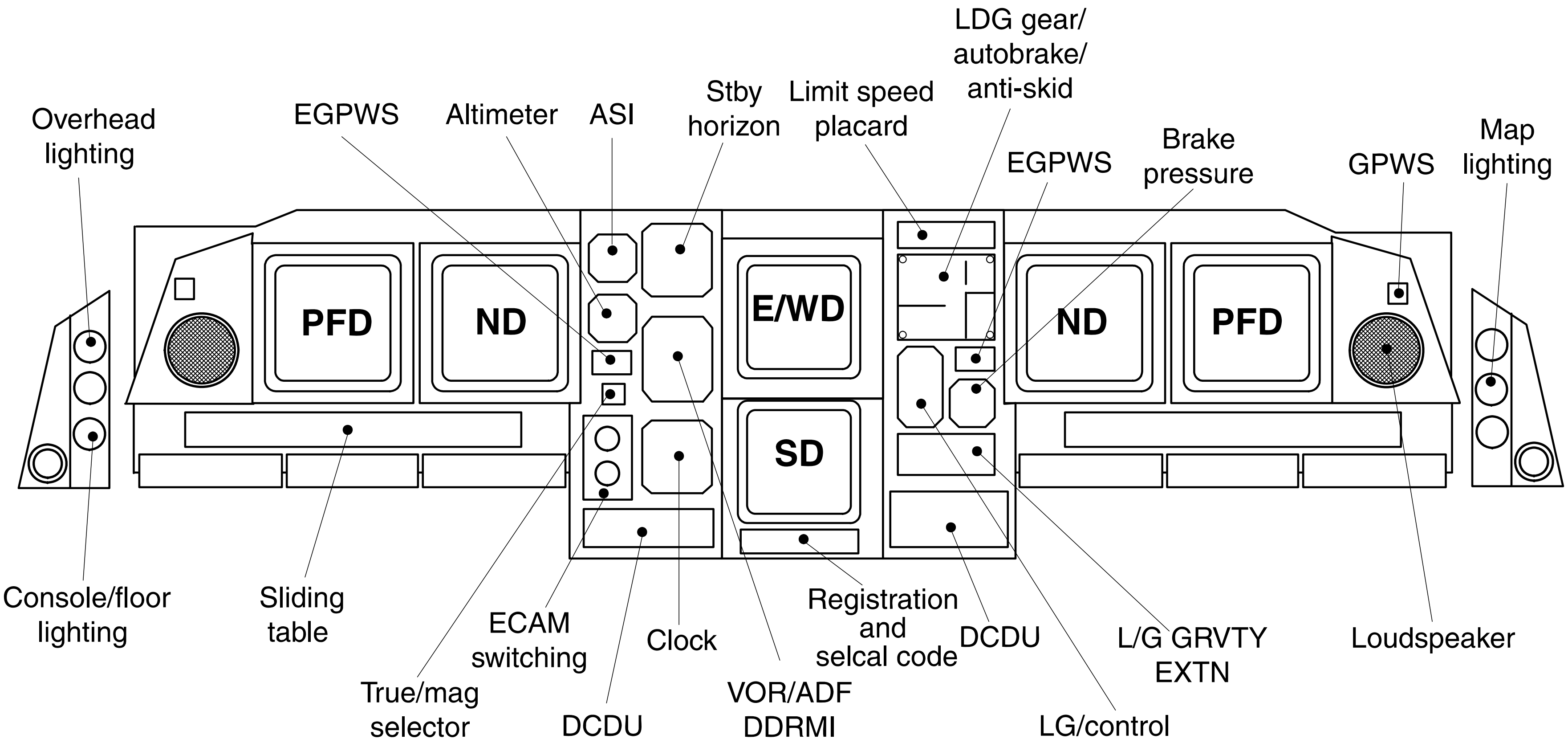
Sidestick operation

- Moving the sidestick results in “setting the aircraft trajectory” with a certain level of “g” for the requested maneuver, depending on the amount of sidestick movement.
- Accuracy of movements is very precise since backlash and friction are negligible.
- Control of the flight path is performed by the Electronic Flight Control System **(EFCS)** which links the trajectory order with aerodynamic data to stabilize the aircraft and protect it from prohibited attitudes.



A340 Flight Deck Layout

Main instrument panels



A340 Flight Deck Layout

Captain and First Officer panels

- The CAPT and F/O panels are mirror images of each other :
  Both incorporate two side-by-side Display Units (DUs) (7.25 in x 7.25 in) :
  . A Primary Flight Display **(PFD)**
  . A Navigation Display **(ND)**.

- This arrangement provides :
  - Better visibility on all DUs in normal configuration and in case of reconfiguration (PFD ND or ECAM ND)
  - A sliding table and a footrest in front of each pilot.

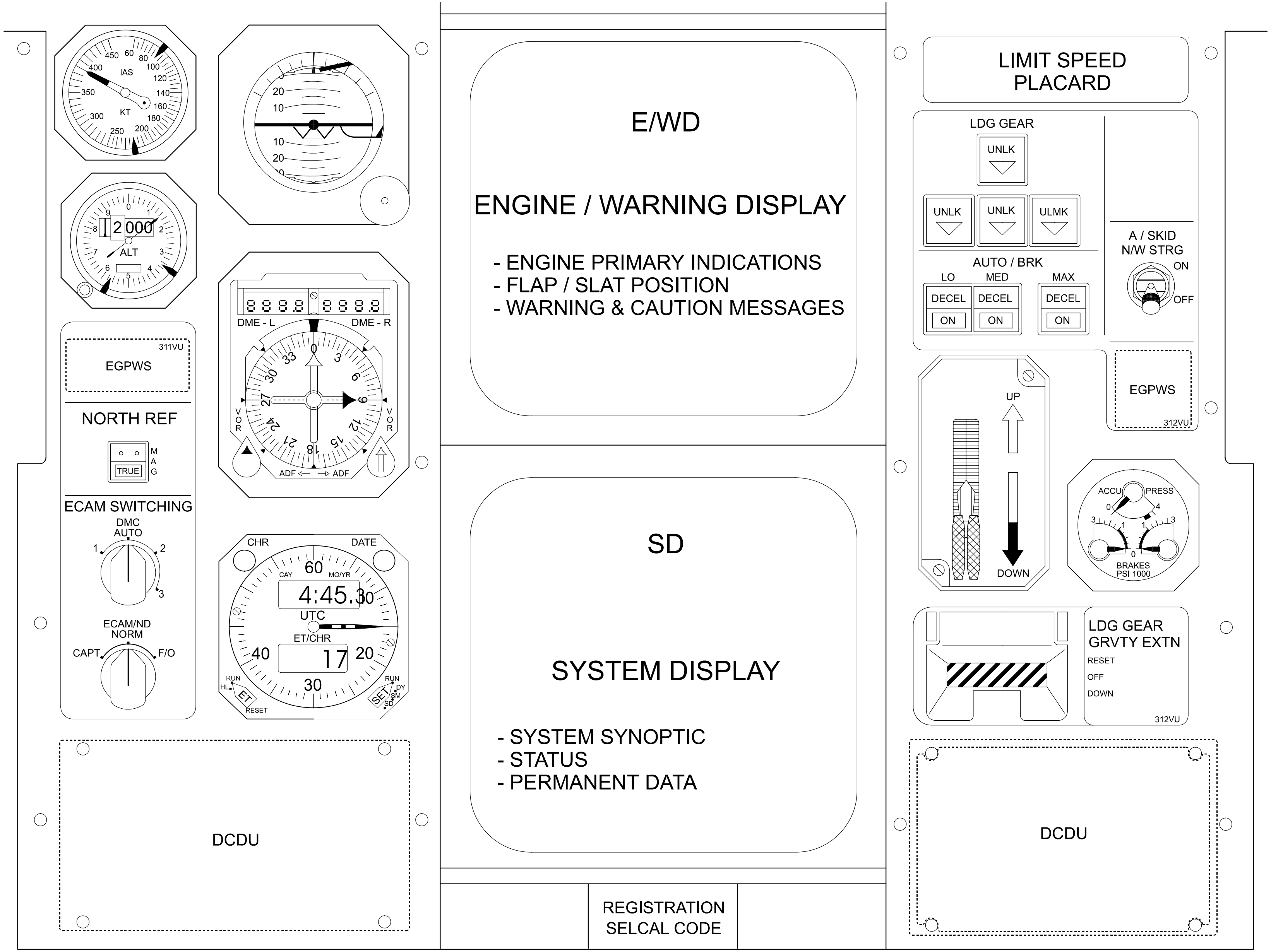
- **The PFD** includes the complete Basic T with :
  - Attitude
  - Airspeed/Mach (with all upper and lower limits)
  - Altitude/vertical speed
  - Heading
  - AFS status
  - ILS deviation/marker
  - Radio altitude.

- **The ND** offers up to three modes :
  - **ROSE** mode (ILS, VOR or NAV) : Aircraft symbol in screen center, with radar availability
  - **ARC** mode : Heading up, horizon limited to a 90° forward sector, with radar availability
  - **PLAN** mode : North up, display centered on selected waypoint.

- **Engine display** : in case of an all DMC/ECAM failure, each pilot may display the ENG STBY page on his ND.

Note : In ROSE-NAV, ARC, and PLAN modes, F-plan data from FMS is presented.

A340 Flight Deck Layout



Main center panel

The center panel includes :

- Two DUs, one above the other, which are interchangeable with the CAPT and F/O DUs :

  - **Engine Display** (DU 1), showing the:
    - Main engine parameters (N1, EGT, N2)
    - N1 limit, N1 command
    - Total fuel
    - Flaps and slats position
    - Memo and warning.

  - **System Display** (DU 2) showing :
    - An aircraft system synoptic diagrams page, or
    - The aircraft status (list of all operationally significant items)

  - Standby instruments
  - Landing gear control and indications (including brakes)
  - Clock.

A340 Flight Deck Layout

Glareshield

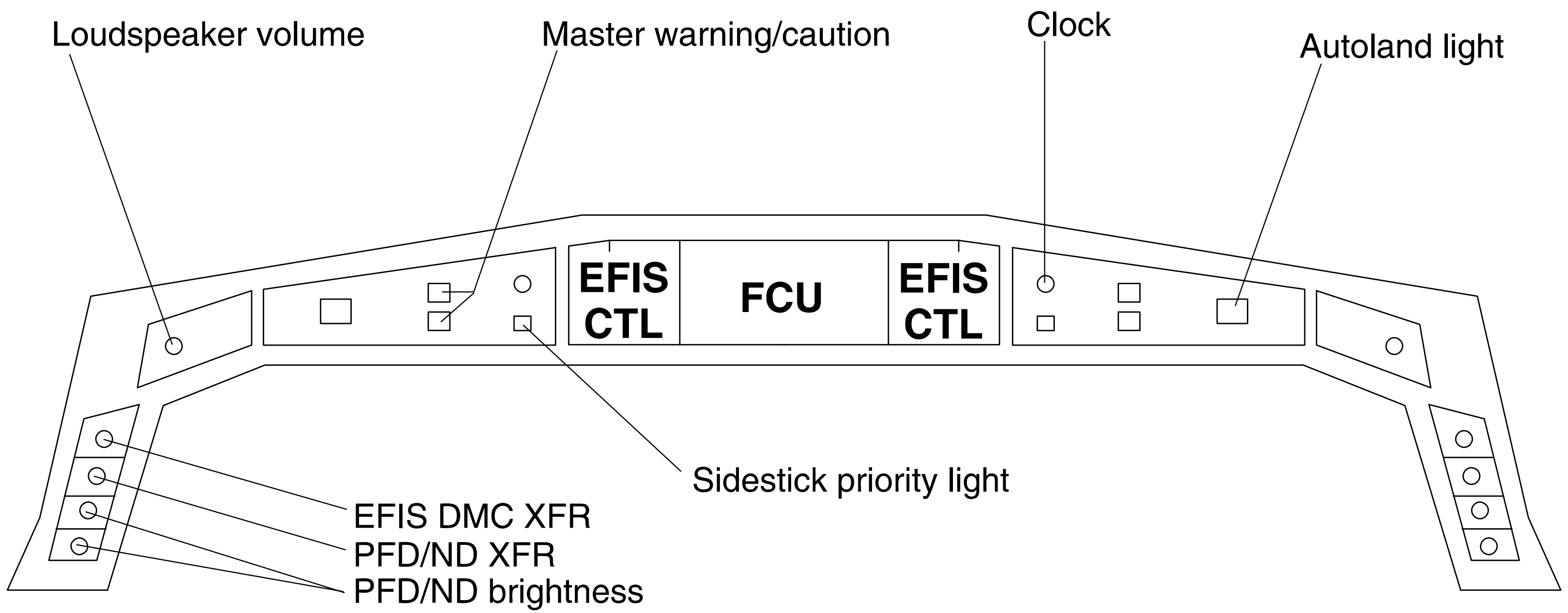
- The Flight Control Unit (FCU) provides short-term interface between the Flight Management and Guidance Computer **(FMGC)** and crew for the:

  - Engagement of A/P, A/THR
  - Selection of required guidance modes
  - Manual selection of flight parameters SPD, MACH, ALT, V/SPD, HDG or track.

- The EFIS control panels designed for the:

  - Selection of desired ND modes (ROSE-ILS, -VOR,
  - NAV, ARC, PLAN, ENG) and ranges
  - Selection of baro settings.

- The master warning, master caution, autoland and sidestick priority lights.



A340 Flight Deck Layout

Central pedestal

In addition to the thrust levers and the engine control functions, the main features on the pedestal are the:

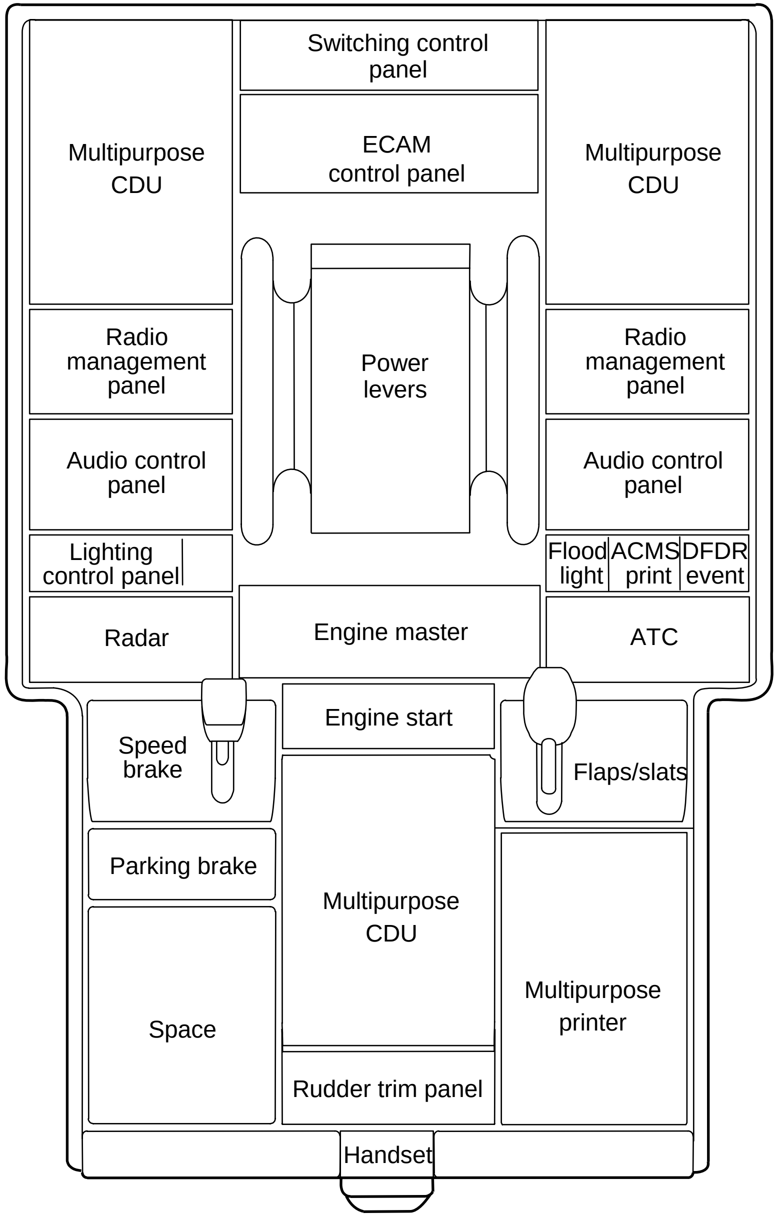
- Multipurpose Control and Display Units **(MCDU)** for flight management functions and various other functions such as data link, maintenance, etc.

- Radio Management Panels **(RMP)** for tuning all radio communications and the radio navigation as a back-up to the normal operation through the Flight Management and Guidance Computers **(FMGC)**,

- Electrical rudder trim,

- Parking brake control,

- Speedbrake and flap/slat control levers.



A340 Flight Deck Layout

Overhead panel

- The overhead panel has a “single slope”.

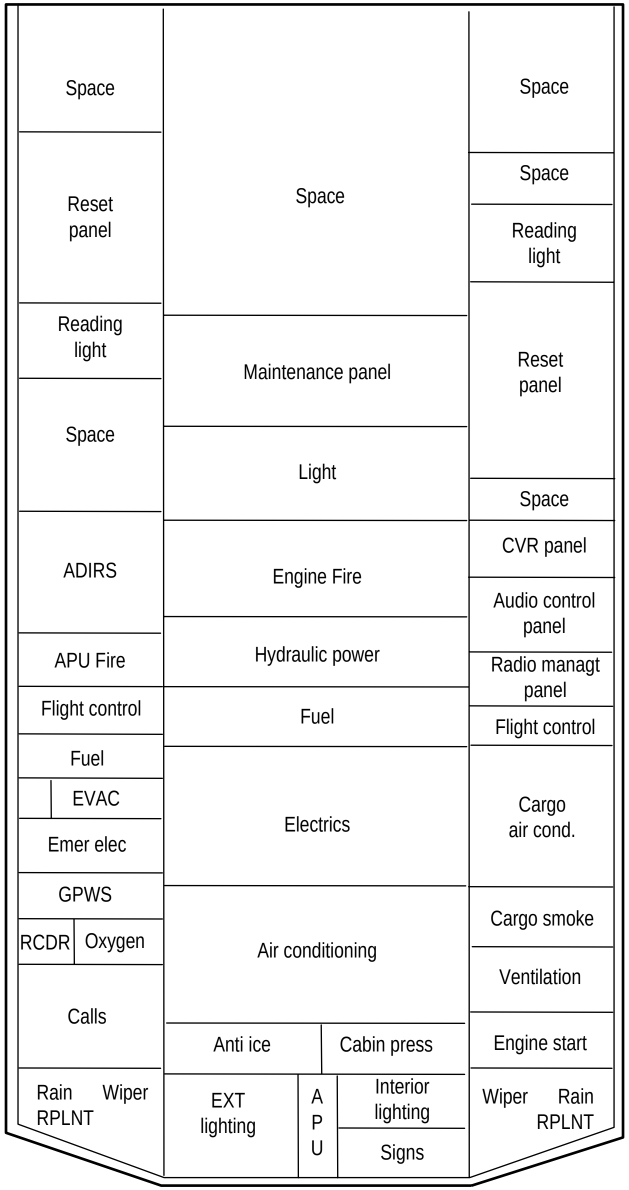
- All controls on the overhead panel can be reached by either pilot.

- The following two main zones are separated by protective padding :

- **Forward zone for :**
  - Most frequently used functions,
  - System controls, arranged in three main rows :
    - center row for engine-related systems, arranged in a logical way.
    - lateral rows for other systems.

- **Aft zone,** not used in flight, is mainly for a small maintenance panel corresponding to some maintenance controls.

- The pushbutton philosophy is identical to that already applied on previously existing Airbus aircraft.



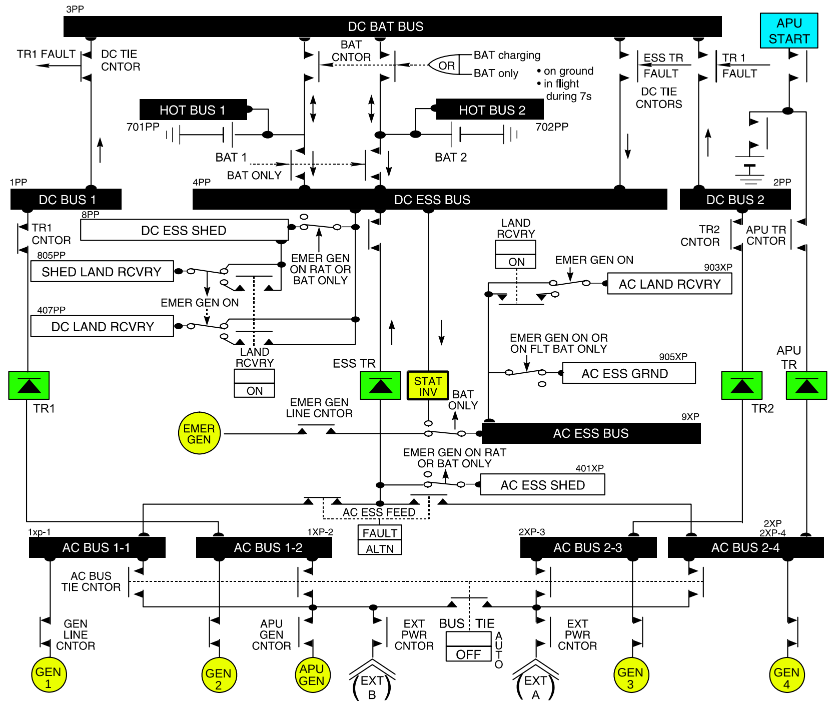
3. Electrical System

Electrical power generation

The electrical power generation is comprised of :

- Four engine-driven AC generators, nominal power 75 kVA.
- One auxiliary power unit (APU) AC generator nominal 115 kVA.
- One emergency generator Constant Speed Motor /Generator) (CSM/G), nominal power 5.5 kVA, hydraulically driven by the Green system.
- One static inverter fed by two batteries and working either on ground or when CSM/G inoperative.
- Two ground connectors, power 90 kVA.
- DC network supplied via two main Transformer Rectifier Units (TR) (200 A) and one essential TR (100 A).

  A fourth TR (200 A) is dedicated to APU start or to APU battery charging.
- Two batteries nominal capacity 37 Ah, 28 V each and one APU battery :
  - On ground : To provide an autonomous source mainly for APU starting.
  - In emergency configuration : To feed some equipment during RAT deployment or when CSM/G not operating (BAT 1+2).



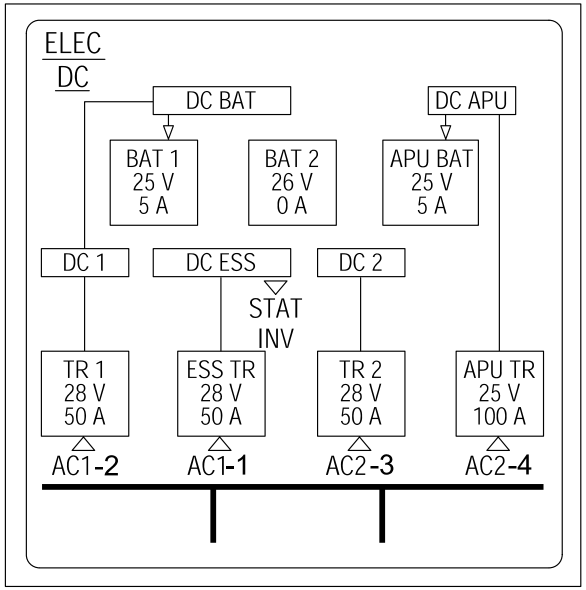
Distribution - normal configuration

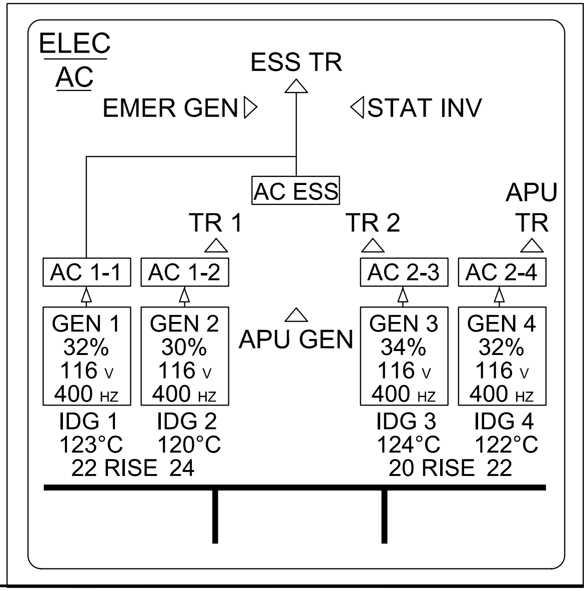
AC distribution network

- In normal configuration, each engine-driven generator supplies its associated AC BUS.
- The AC ESS BUS is normally supplied from AC BUS 1-1.

DC distribution network

- In normal configuration, normal DC systems are split into two networks : DC BUS 1 in parallel with DC BAT BUS and DC BUS 2.
- Each DC network is supplied by its own TR.
- More specifically, ESS TR systematically feeds DC ESS BUS, which allows a better segregation between DC 1 and DC 2.
- Two batteries are connected to the DC BAT BUS via the Battery Charge Limiter **(BCL)**.
- Each battery has its own HOT BUS bar (engine/APU fire squib, ADIRS, CIDS, PRIM and SEC computers, slide warnings, parking brake, etc).
- The third battery is dedicated to APU starting.





Distribution - abnormal configurations

Generator failure

If one generator fails, another will automatically take over :

- If APU is operative, APU generator will take over.
- If APU generator is not available, the same side, external generator will take over.
- If same side generator is not available, the opposite side external generator will take over.

In case of a total loss of all main generators :

- The EMER GEN will deliver 5.5 kVA since the Green hydraulic system is still powered by engine-driven pumps

  or

In case of loss of all engines :

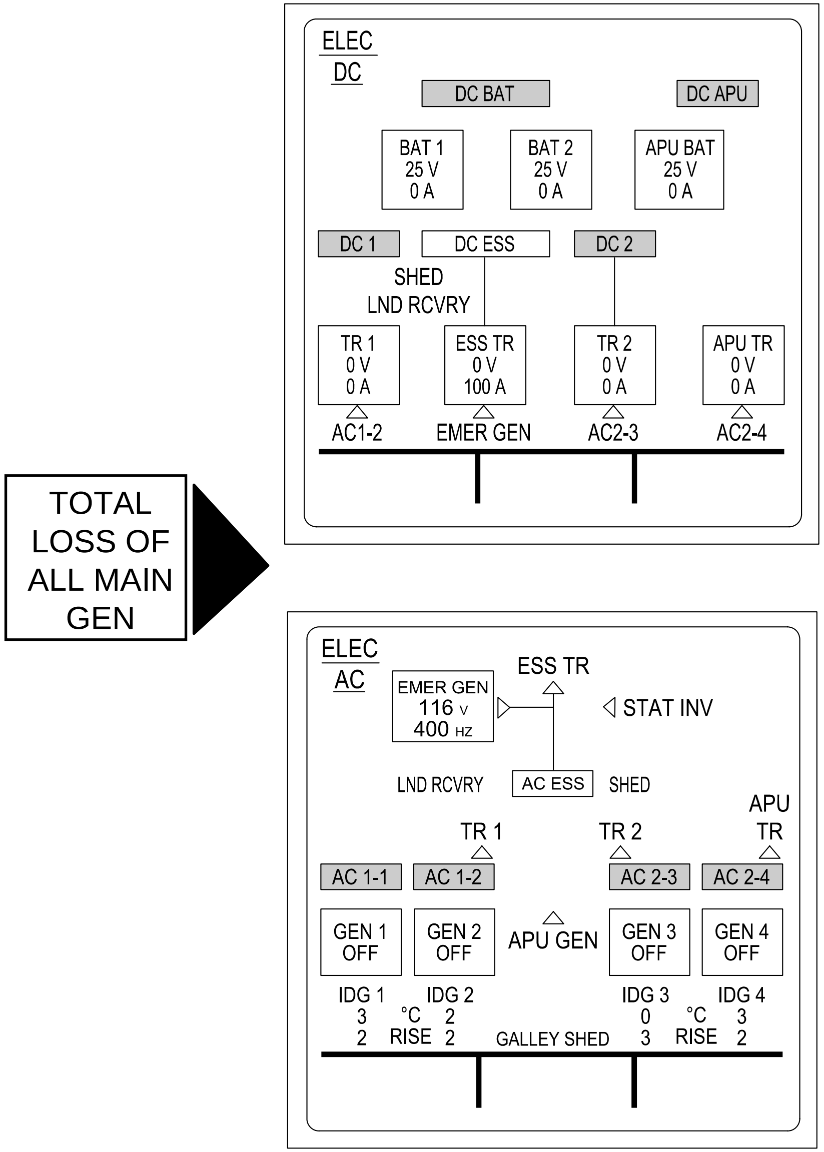
- The EMER GEN will deliver 3.5 kVA since the Green hydraulic system is then powered by the RAT ; in this case, the batteries take over when slats are extended.

TR failure

If one TR fails, the other will automatically take over its corresponding DC network via DC BAT BUS,

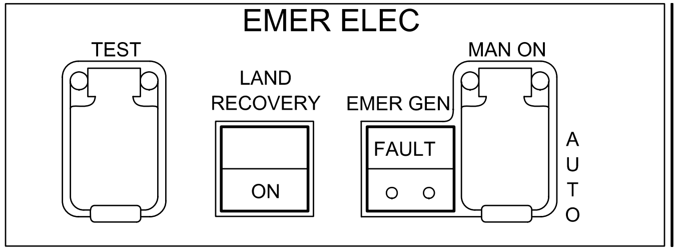
In case of double TR failure :

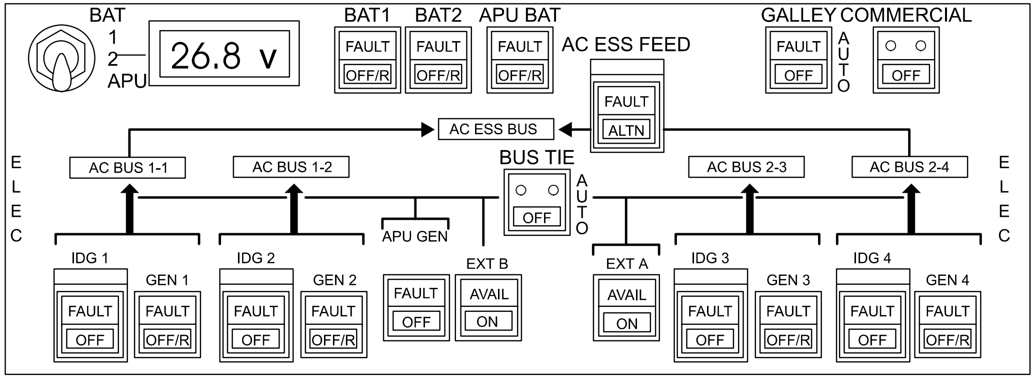
- TR 1 and 2 : DC BUS 1 and DC BUS 2 are lost
- TR 1 (or 2) and ESS TR : The remaining TR supplies DC BUS 1 + 2 and DC BAT BUS ; the DC ESS BUS is lost.



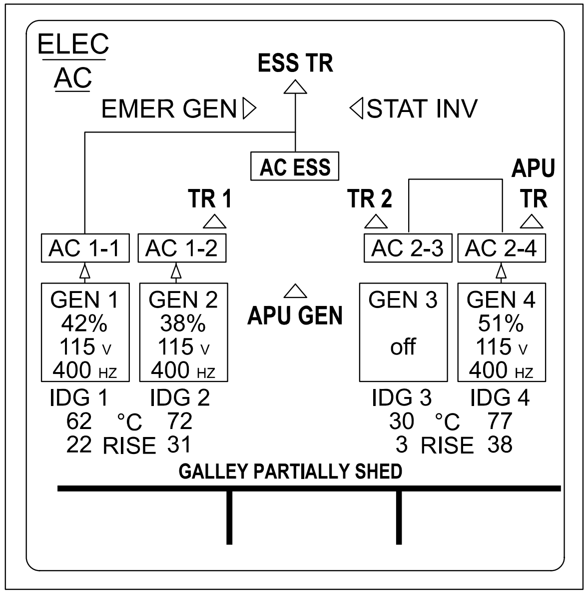
Control and display

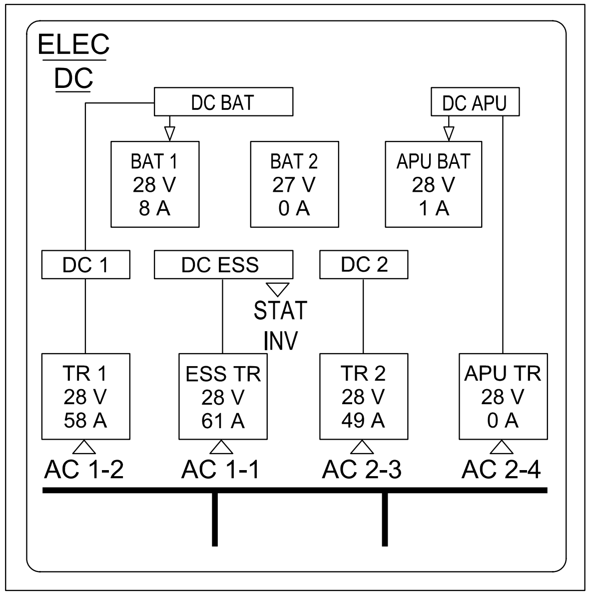
Overhead panel





ECAM





Circuit - breaker monitoring

- Circuit-breakers are installed in the avionics bay area below the cockpit.
- Circuit-breakers are monitored by the CBMU (Circuit-Breaker Monitoring Units) which output the identification and status of each circuit-breaker.
- A specific C/B page is provided on the ECAM.
- Computer resets can be performed via system controls.

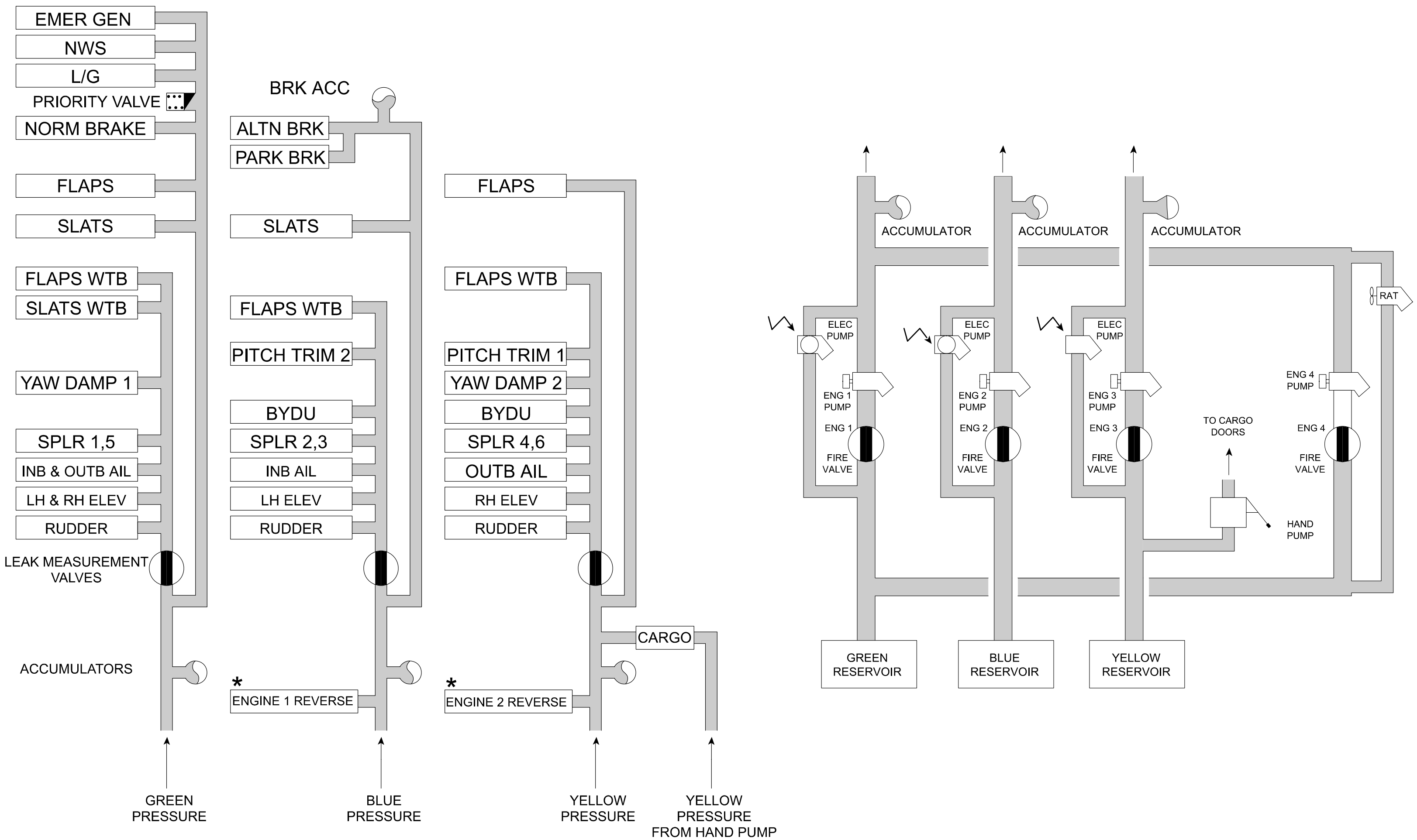
C/B

ECMU1 VOLT SNSG …………………	X1	4XM
SFCC1 NORM DCBUS AVAI ………..	X3	10CW
HYD PUMP G ENG2 ………………….	X44	4JG2
ANTI ICE ENG2 ………………………..	W2	2DN2
DU SWTG CAPT ND ………………….	S2	9WK1
HYD PUMP B ENG2 …………………..	U15	1JB
ADIRU1 155VAC ……………………..	C8	4FP1
ANTI ICE PITOT 1 OR 3 …………….	D10	4DA1
303PP …………………………………..	715VU	9PB
BUS 1/3 TIE CNTOR …………………	X12	10PC1
ANTI ICE 1 OR 3 PHC ……………….	N21	2DA3
EXTRACT FAN AVNCS ………………	J21	1HQ
ADIRU1 AOA1 26VAC ……………….	M80	5FP1
APU TR ………………………………….	5000VU	3PU3
SWTG FUEL BUS ……………………..	W15	8PR
AUDIO ACP CAPT …………………….	A50	4RN1
AIR BLEED VLV ENG2 ……………….	D12	3HA2
XFEED VLV ENG1 MOT1-2 ………….	C15	40E1

4. Hydraulic System

A340 Hydraulic System

Architecture



* PW and RR engines only

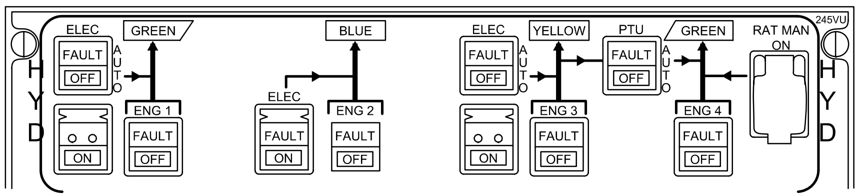
A340 Hydraulic System

General

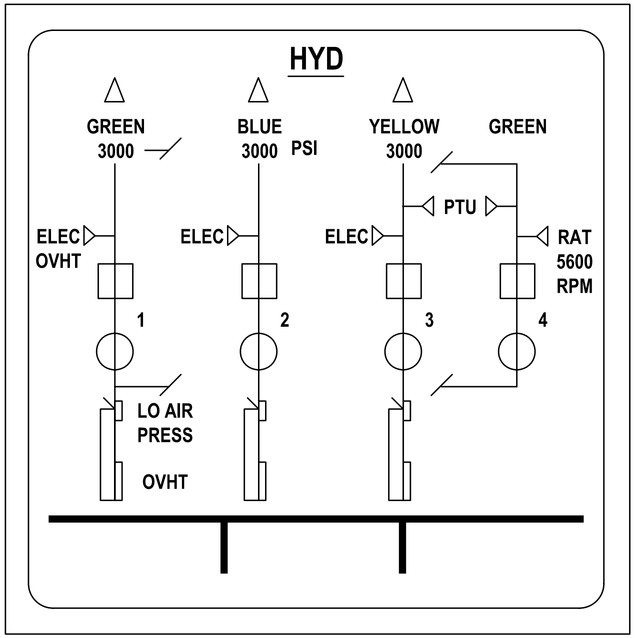
- Three fully independent systems : **Green, Blue, Yellow** (nominal pressure at 3000 psi).
- Normal operation :
  - Four engine-driven pumps, two of which are for the Green system.
  - Three electrical pumps that can act automatically as back-up.

  They are managed by the **HSMU** (Hydraulic System Monitoring Unit) which ensures all autofunctions (electrical pumps, RAT, monitoring, etc) ; manual override is available on the overhead panel.

  - one handpump on the Yellow system for cargo doors operation when no electrical power is available.



- Abnormal operation :
  - In the event of engine 1 or 4 failure, the Green electrical pump runs automatically for 25 seconds, when landing gear lever is selected up.
  - In the event of engine 3 failure, the Yellow electrical pump runs automatically when flaps are not retracted.
  - In the event of four engine failure, RAT deployment will be automatically controlled by the HSMU to pressurize the Green system.

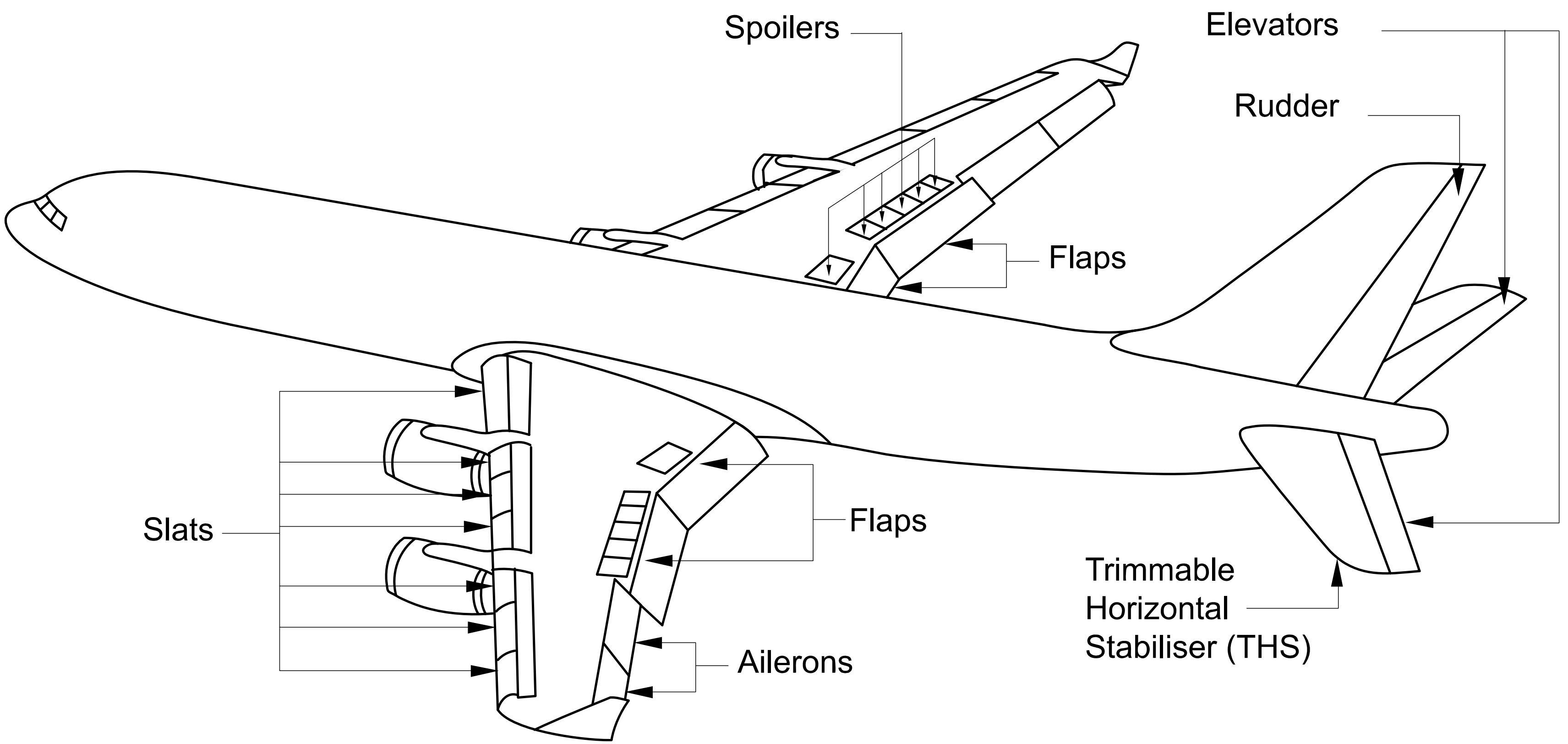


5. Flight Controls - EFCS

Electronic Flight Control System (EFCS)

Surfaces :

- All hydraulically activated
- All electrically controlled
- Mechanical back-up control :
  - Rudder
  - Trimmable Horizontal Stabilizer (THS).



A340 Flight Controls - EFCS

General

The A340 fly-by-wire system was designed and certificated to make this new aircraft more cost effective, more pleasant to fly, and more comfortable than conventional aircraft.

Basic principles

- A340 flight control surfaces are all :
  - Electrically controlled
  - Hydraulically activated.

- Stabilizer and rudder can be mechanically controlled.

- Sidesticks are used to fly the aircraft in pitch and roll (and indirectly through turn coordination, in yaw).

- Pilot inputs are interpreted by the **EFCS** computers for moving flight controls, as necessary to achieve the desired pilot commands.

- The computers prevent from :
  - Excessive maneuvers
  - Exceedance of the safe flight envelope.

Computers

Electrical control of the main surfaces is achieved by two types of computers :

- **Three** Flight Control Primary Computers **(PRIM)** which can process all three types of control laws (Normal, Alternate, Direct)
- **Two** Flight Control Secondary Computers **(SEC)** which can process the Direct Control Law.

These computers perform additional functions including :

- Speedbrakes and ground spoiler command
- Characteristic speed computation **(PRIM** only**)**.

High-lift devices are commanded by two Slat/Flap Control Computers **(SFCC)**.

The **SFCCs** also command the aileron droop via **PRIM** or **SEC**.

In order to provide all required monitoring information to the crew and to the Central Maintenance System **(CMS)**, two Flight Control Data Concentrators **(FCDC)** acquire the outputs from the various computers to be sent to the ECAM and Flight Data Interface Unit **(FDIU)**. These two FCDCs ensure the electrical isolation of the flight control computers from the other systems.

Cockpit controls

Each pilot has a sidestick controller to exercise control of pitch and roll.

The two sidestick controllers are not coupled mechanically, and they send separate sets of signals to the flight control computers.

Two pairs of pedals, which are rigidly interconnected, give the pilots mechanical control of the rudder. The pilots control speedbrakes with a lever on the center pedestal.

The pilots use mechanically interconnected handwheels on each side of the center pedestal to control the trimmable horizontal stabilizer.

The pilots use a single switch on the center pedestal to set the rudder trim.

There is no manual switch for trimming the ailerons.

Power sources

Electrical power supply

The flight control computers **PRIM, SEC** and **FCDC** are fed by various DC busbars. This ensures that at least two flight control computers are powered, in the event of major electrical power losses such as :

- Failure of two main systems, or
- Electrical emergency configuration (CSM/G), or
- Battery-only supply.

	Normal		**Emergency**		
	AC	DC	AC ESS	DC ESS	HOT
PRIM 1				X	X (BACK UP)
PRIM 2		X			
PRIM 3		X			
SEC 1				X	X (BACK UP)
SEC 2		X			
FCDC 1				X (SHED)	
FCDC 2		X			

Power sources

Hydraulic power supply

Three hydraulic circuits (Green, Yellow, Blue) power the flight controls.

System circuit	Power source
Green	2 engine (N° 1 and 4) - driven pumps 1 electropump 1 RAT
Yellow	1 engine (N° 3) - driven pump 1 electropump
Blue	1 engine (N° 2) - driven pump 1 electropump

Note :

The distribution to the various control surfaces is designed to cover multiple failure cases.

Safety objectives

Safeguards were designed to protect against :

Loss of pitch control	- extremely improbable ($<10^{-9}$)
Loss of elevators	- extremely remote ($< 10^{-7}$)
Loss of roll control	- extremely improbable
Permanent loss of THS	- extremely improbable
Rudder loss or runaway	- extremely improbable

To satisfy these objectives, the following architecture applies:

- Electrical signalling for spoilers, elevators and ailerons
- Electrical and mechanical signalling in parallel for rudder and THS.

Dispatch objectives

The basic objective is to allow aircraft dispatch with a peripheral or computer failure, in order to increase dispatch reliability without impairing flight safety.

Systems	Dispatch situation
3 IRS 2 yaw rate gyros 3 PRIM 2 SEC	Maximum 1 inoperative or “off”
3 ADR	Maximum 1 inoperative or “off”
3 IR - 2 N_z accelerometers	Maximum 1 inoperative or “off”
2 FCDC	Maximum 1 inoperative or “off”
3 PRIM/2 SEC Electro hydraulic and electro actuators	Maximum 1 inoperative or “off” Maximum 1 inoperative if it is not connected to 2 computers No-go items are inboard aileron, elevator and yaw damper actuators.

Design principles

Two types of flight control computers :

- **PRIM** (two channels with different software for control/monitoring).

  SEC (two channels with different software for control/monitoring).
- Each one of these computers can perform two tasks :
  - Process orders to be sent to other computers as a function of various inputs (sidestick, autopilot…)
  - Execute orders received from other computers so as to control their own servo-loop.

The three primary or main computers **(PRIM)** :

- Process all control laws (Normal, Alternate, Direct) as the flight control orders.
- One of the three PRIM is selected to be the master ; it processes the orders and outputs them to the other computers (PRIM 1, 2 and 3, SEC 1 and 2) which will then execute them on their related servo-loop.
- The master checks that its orders are fulfilled by comparing them with feedback received ; this allows self-monitoring of the master which can detect a malfunction and cascade control to the next computer.
- Each **PRIM** is able to control up to eight servo-loops simultaneously ; each can provide complete aircraft control under normal laws.

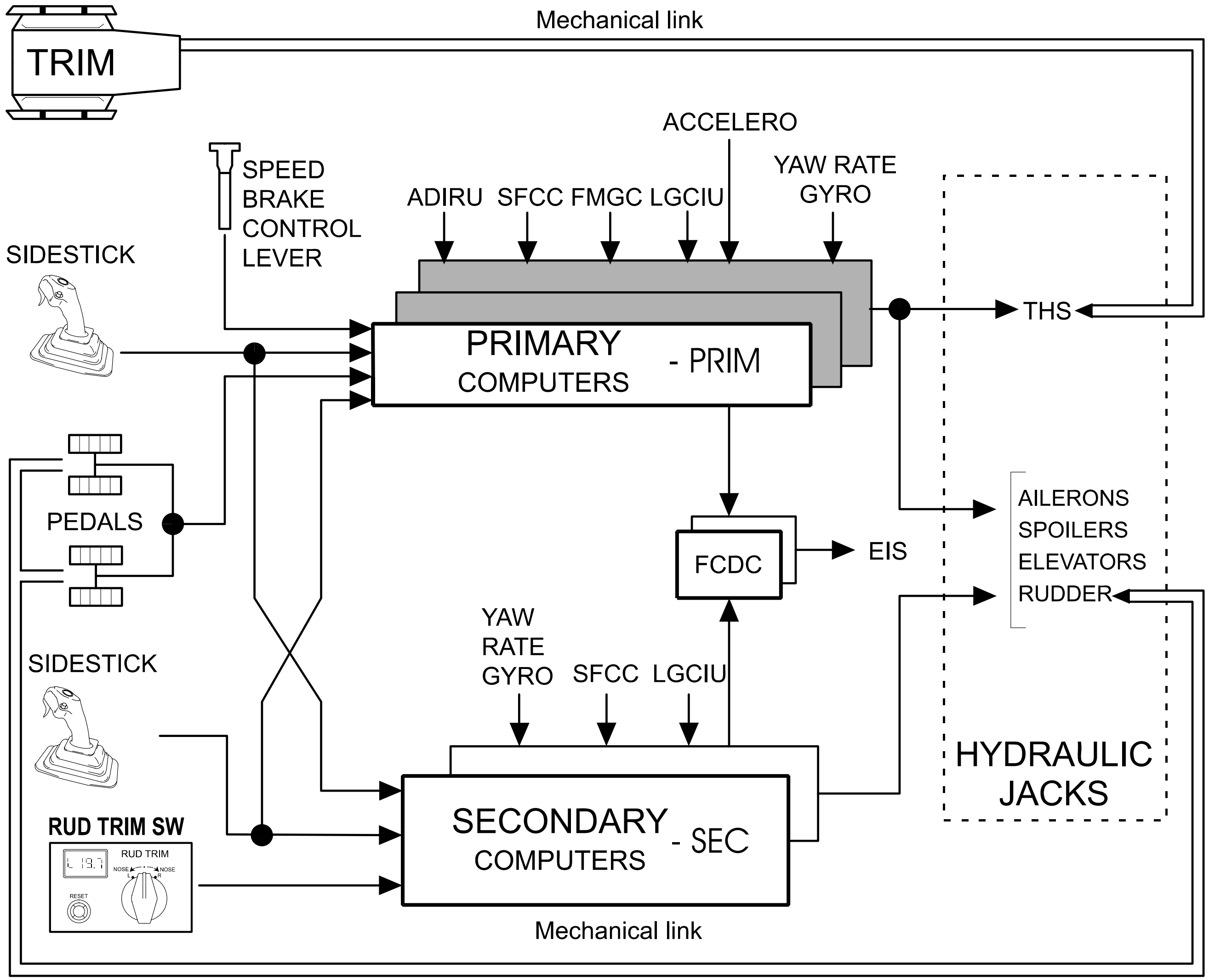
The two secondary computers **(SEC)** :

- Are able to process direct laws only
- Either SEC can be the master, in case of loss of all primary computers
- Each SEC can control up to 10 servo-loops simultaneously ; each can provide complete aircraft control.

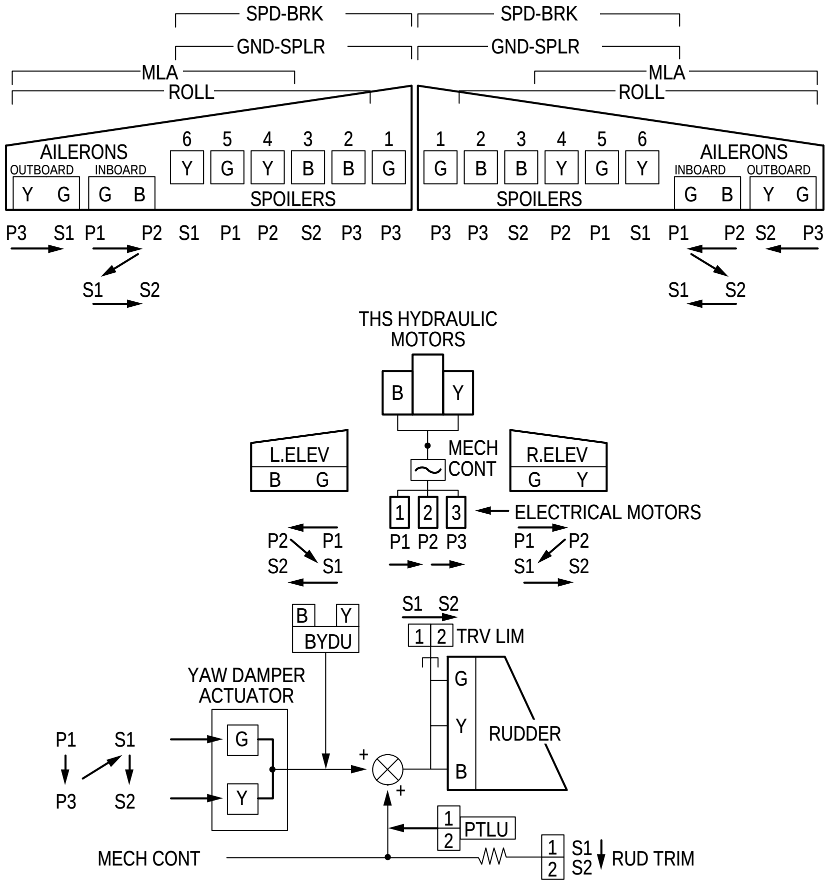
  Electrically controlled hydraulic servo-jacks can operate in one of three control modes depending upon computer status and type of control surface :
- Active : The servo-jack position is electrically controlled.
- Damping : The servo-jack position follows the surface movement.
- Centering : The servo-jack position is maintained neutral.

A340 Flight Controls - EFCS

Schematic diagram



EFCS - Computers and actuators



P = PRIM computers S = SEC computers

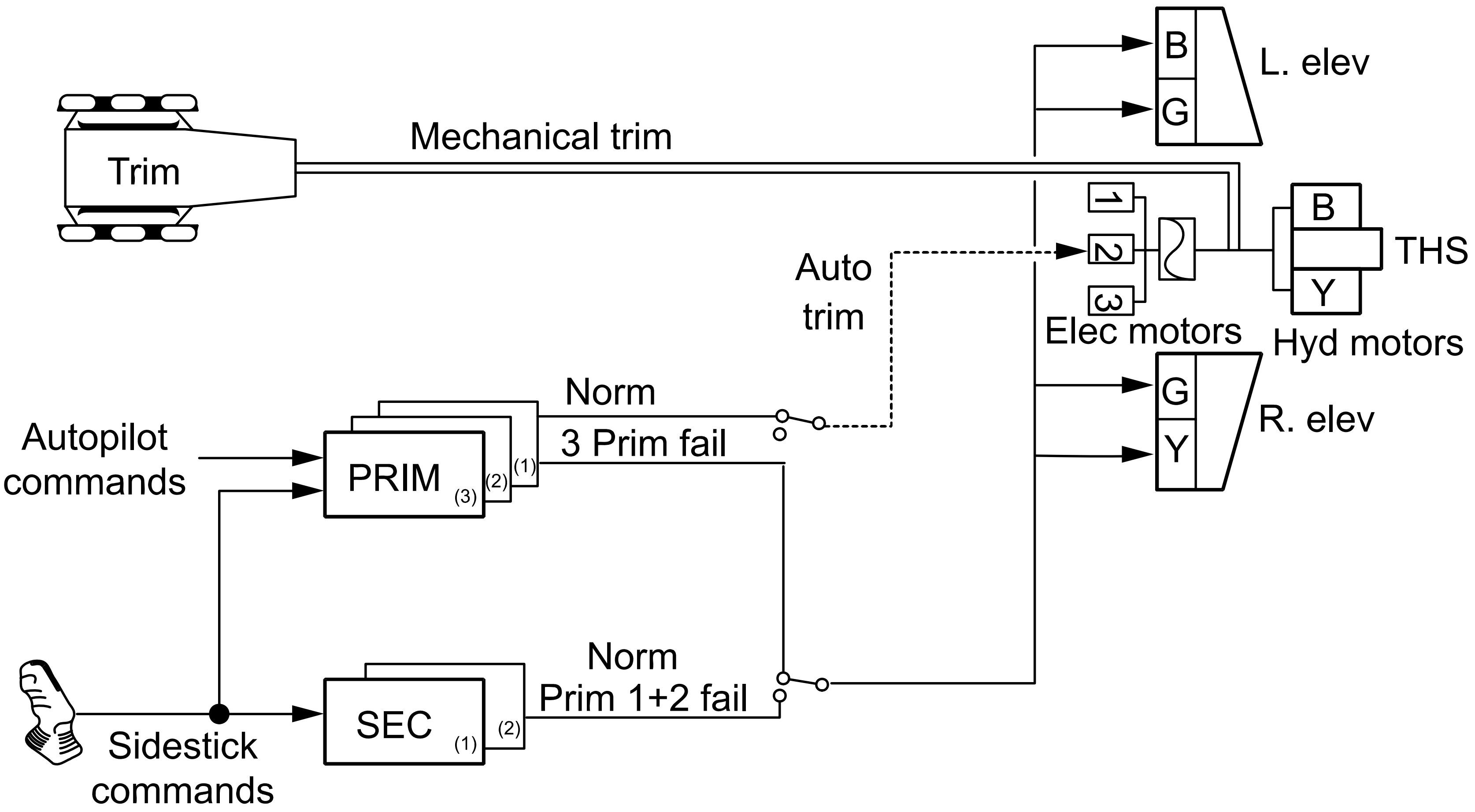
Arrows indicate the control reconfiguration priorities

G B Y indicates the hydraulic power source for each servo control

MLA = Maneuver Load Alleviation
BYDU = Back Up Yaw Damper Unit
PTLU = Pedal Travel Limit Unit

A340 Flight Controls - EFCS

Pitch control



Pitch control

Pitch control is provided by two elevators and the THS :

- Elevator deflections 30° nose up - 15° nose down
- THS deflections 14° nose up - 2° nose down.

Each elevator is actuated by two independent hydraulic servo control units :

- L. ELEV is driven by Green and Blue hydraulic jacks;

- R. ELEV is driven by Green and Yellow hydraulic jacks.

One servo control is in active mode, while the other is in damping mode.

In case of a failure on the active servo-jack, it reverts to damping mode, while the other becomes active.

In case of electrical supply failure to both servo-jacks of one elevator, these revert to centering mode which commands a 0° position of the related elevator.

Autoflight orders are processed by one of the primary computers.

Sidestick signals, in manual flight, are processed by either one of PRIM 1 and 2, or SEC 1 and 2.

The THS is driven by two hydraulic motors supplied by Blue and Yellow systems ; these motors are controlled either :

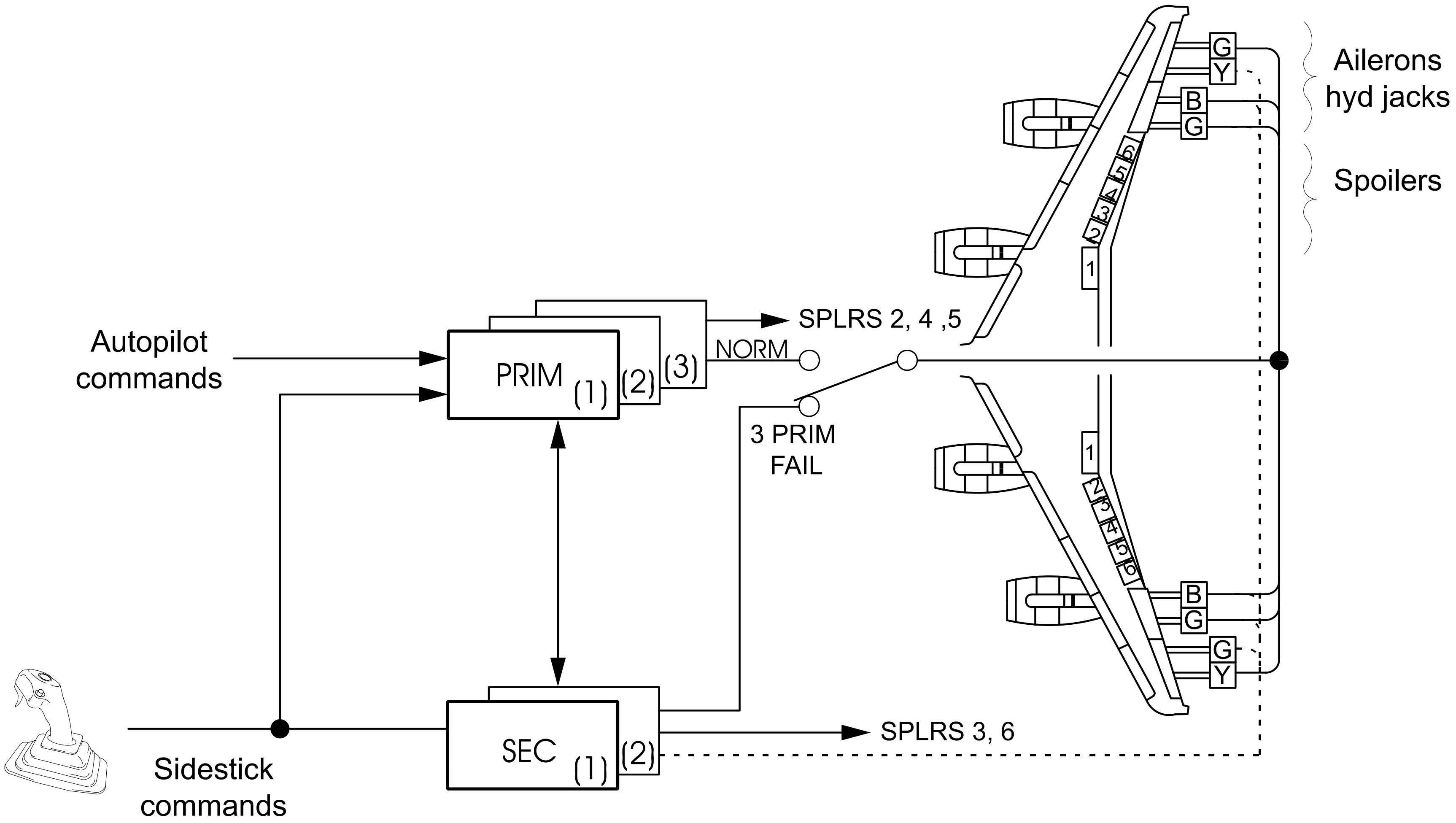
- By three electrical motors with their associated electronics controlled by one PRIM each, or

- By mechanical command from control wheels located on the central pedestal.

The control wheels are used in case of major failure (Direct Law or mechanical back-up) and have priority over any other command.

A340 Flight Controls - EFCS

Roll control



Roll control

Roll control is provided by two ailerons and five spoilers (2 to 6) per wing :

- Aileron deflection is ± 25°
- Spoiler max deflection is -35°.

Each aileron is driven by two electrically-signalled servo-controls which are connected to :

- Two computers for the inboard ailerons (PRIM 1 or 2 and SEC 1 or 2),
- One computer for the outboard ailerons (PRIM 3, SEC 1 or 2),
- One servo-control is in active mode while the other is in damping mode.

Above 300 kt, in autopilot mode and in some failure cases, the outboard aileron is centered to prevent any twisting moment. In manual mode (above 190 KT, in CONF 0) the outboard ailerons are centered.

Each spoiler is driven by one electro-hydraulic servo control which is connected to one specific computer.

In the event of a failure being detected on one spoiler, the opposite spoiler is retracted and maintained in a retracted position.

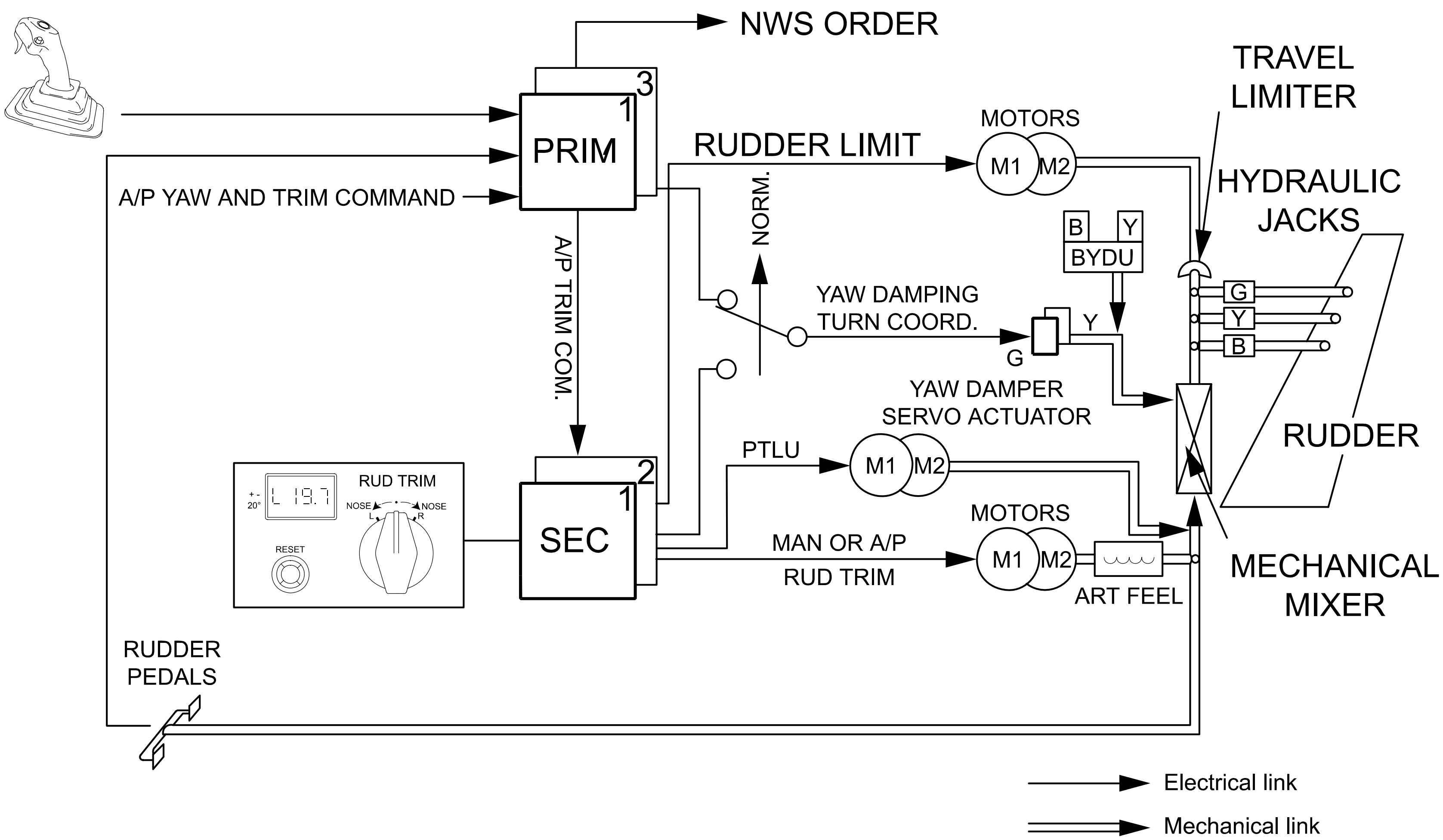
Autopilot orders are processed by one of the primary computers.

Sidestick signals, in manual flight, are processed by either one of the primary or secondary computers.

Note : If the RAT is deployed to provide Green hydraulic power, the outboard ailerons servo-controls revert to damping mode in order to minimize hydraulic demands.

A340 Flight Controls - EFCS

Yaw control



Yaw control

Yaw control is provided by one rudder surface :
- Rudder deflection ± 31.6°.

The rudder is operated by three independent hydraulic servo-controls, with a common mechanical input. This mechanical input receives three commands :
- Rudder pedal input limited by the Pedal Travel Limitation Unit **(PTLU)** ;
- Rudder trim actuator electrical input ;
- Yaw damper electrical input.

The mechanical input is limited by the Travel Limitation Unit **(TLU)** as a function of airspeed in order to avoid excessive load transmission to the aircraft. This function is achieved by the secondary computers.

The rudder trim controls the rudder pedal zero load position, as a function of pilot manual command on a switch located on the pedestal (artificial feel neutral position variation). This function is achieved by the secondary computers.

Yaw damper commands are computed by the primary or secondary computers.

In case of total loss of electrical power or total loss of flight controls computers, the Back Up Yaw Damper Unit **(BYDU)** becomes active.

Autoflight orders are processed by the primary computers and are transmitted to the rudder via the yaw damper servo-actuator and the rudder trim actuator.

Note : In the event of loss of both yaw damper actuators, the yaw damping function is achieved through roll control surfaces, in which case at least one spoiler pair is required.

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Additional functions devoted to ailerons and spoilers

Ailerons

Ailerons receive commands for the following additional functions :

- **Maneuver Load Alleviation (MLA)** : Two pairs of ailerons are deflected upwards 11° max. (added to roll demand, if any) to reduce wing loads in case of high "g" maneuver.
- **Lift Augmentation** (aileron droop) : Two pairs of ailerons are deflected downwards to increase lift when flaps are extended.

Spoilers

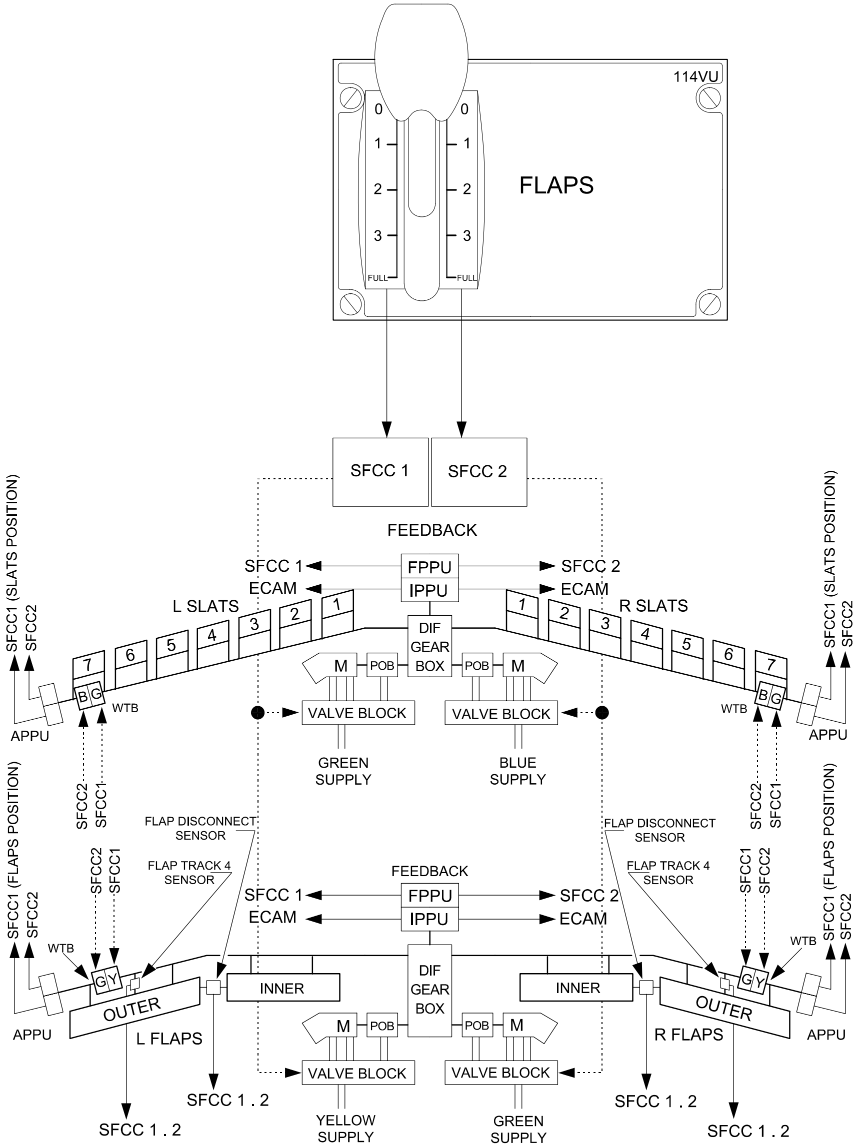
Spoilers receive commands for the following additional functions :

- **Maneuver Load Alleviation** : Spoilers 4, 5 and 6 (max 9° deflection symmetrically)
- **Ground spoiler functions** : Spoilers 1 to 6
    - - 35° max for spoiler 1
    - - 50° max for spoilers 2 to 6
- **Speedbrake functions** : Spoilers 1 to 6
    - - 25° max for spoiler 1
    - - 30° max for spoilers 2 to 6

Six spoilers and two pairs of ailerons perform these functions in the following **priority** order :

- The roll demand has priority over the speedbrake function.
- The Maneuver Load Alleviation **(MLA)** function has priority over the speedbrake function.
- If one spoiler surface fails to extend, the symmetrical surface on the other wing is inhibited.
- Speedbrakes are inhibited when AOA protection is active, when MLA is active, or when in CONF3 or CONF FULL.

Slats/flaps controls



Slats/flaps

- High lift control is achieved on each wing by :
  - Seven leading edge slats,
  - Two trailing edge flaps,
  - Two ailerons (ailerons droop function).

- Slat and flaps are driven through similar hydromechanical systems consisting of :

  - Power Control Units **(PCU)**,
  - Differential gearboxes and transverse torque shafts,
  - Rotary actuators.

- Slats and flaps are electrically-signalled through the SFCCs :

  - Control lever position is obtained from the Command Sensor Unit **(CSU)** by the two SFCCs.
  - Each SFCC controls one hydraulic motor in both of the flap and slat PCUs.

- Aileron droop is achieved through the primary computers, depending on flap position data received from the **SFCC**.

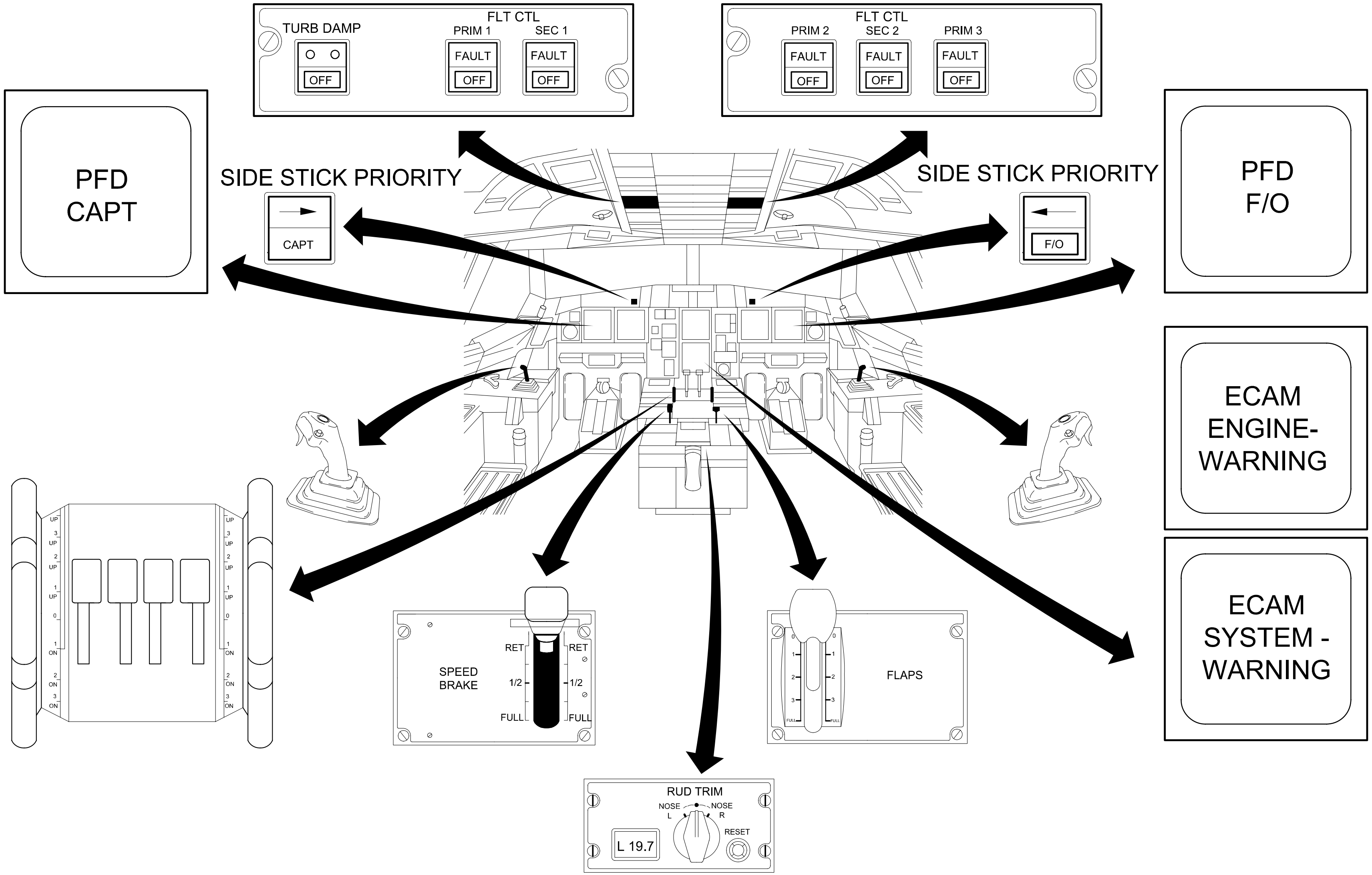
- The SFCC monitors the slats and flaps drive system through Feedback Position Pick-off Units **(FPPU)** located at the PCUs and at the outer end of the transmission torque shafts.

- Wing Tip Brakes, **(WTB)** installed within the torque shaft system and controlled by the SFCC, prevent asymmetric operation, blow back, or runaway.

- A pressure-off brake, provided between each hydraulic motor of the PCU and the differential gearboxes, locks the slat or flap position when there is no drive command from the SFCC.

- Flight Warning Computers **(FWC)** receive slat and flap position data through dedicated Instrumentation Position Pick-off Units **(IPPU)** for warnings and position indication on ECAM display units.

Slats/flaps control



Controls and displays

- **Overhead panel**
  Pushbutton switches on the overhead panel allow disconnection or reset of the primary and secondary computers. They provide local warnings. Side 1 computer switches on the left-hand side are separated from those of side 2 computers on the right-hand side.

- **Glareshield**
  Captain and First Officer priority lights, located in the glareshield, provide indication if either has taken the priority for his sidestick orders.

- **Lateral consoles**
  Captain and First Officer sidesticks, located on the lateral consoles, provide the EFCS computers with pitch and roll orders. They are not mechanically coupled. They incorporate a take-over pushbutton switch.

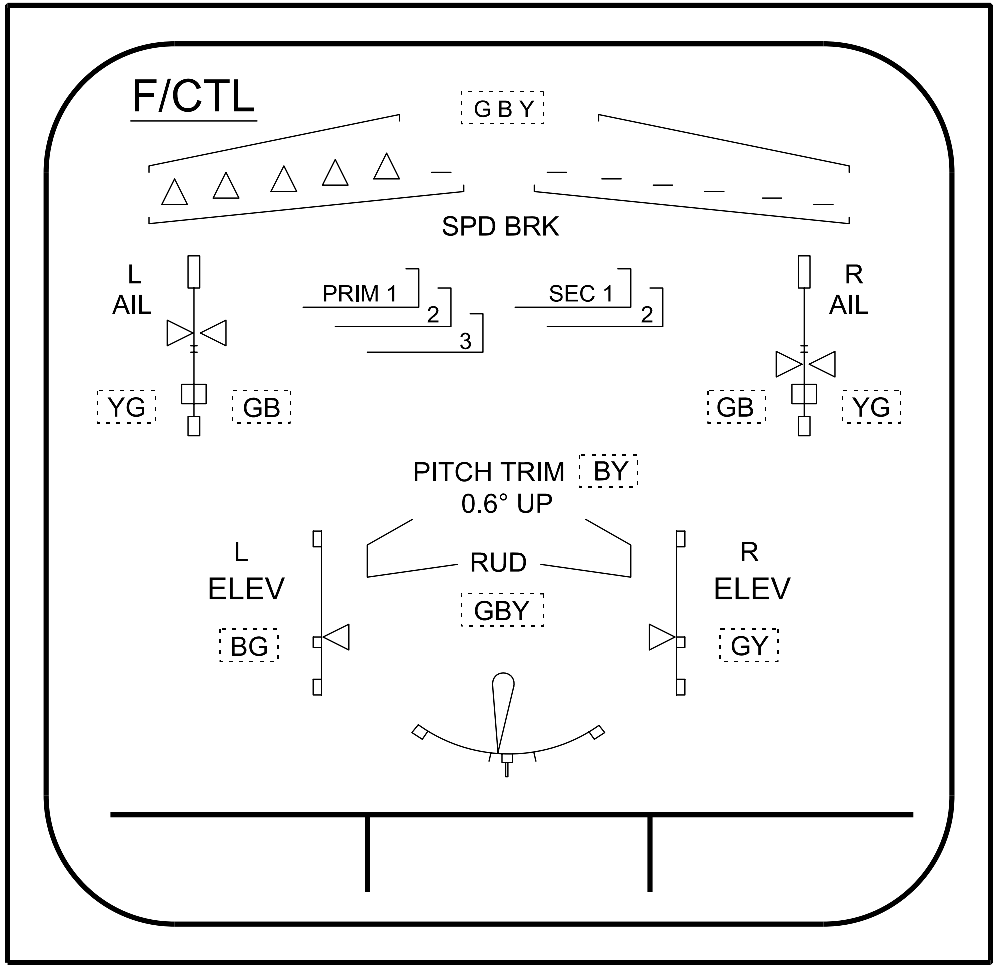
- **Central pedestal**
  - Speedbrake control lever position is processed by the primary computers for speedbrake control. A "ground spoiler" position commands ground deceleration.
  - Rudder trim switch and reset pushbutton switch are processed by the secondary computers. The local rudder trim position indication is repeated on the ECAM FLT/CTL system page.
  - Flap control lever position is processed by the SFCC. It allows selection of high-lift configurations for slats and flaps. Lever position indication is repeated in the "flap section" of the ECAM engine and warning display.
  - Pitch trim wheels allow the setting of the THS position for takeoff. They permit manual pitch trim control.

- **Main instrument panel**
  ECAM display units and PFDs present warnings and status information of the Flight control system. Permanent indication of slat and flap positions are given on the ECAM engine/warning display. Remaining flight control surface positions are given on the FLT/CTL system page, which is presented on the ECAM system/status display.

- **Rudder pedals**
  Interconnected pedals on each crewmember's side allow mechanical yaw control through the rudder.

A340 Flight Controls - EFCS

ECAM system page



Control law introduction

- **Flight through computers**

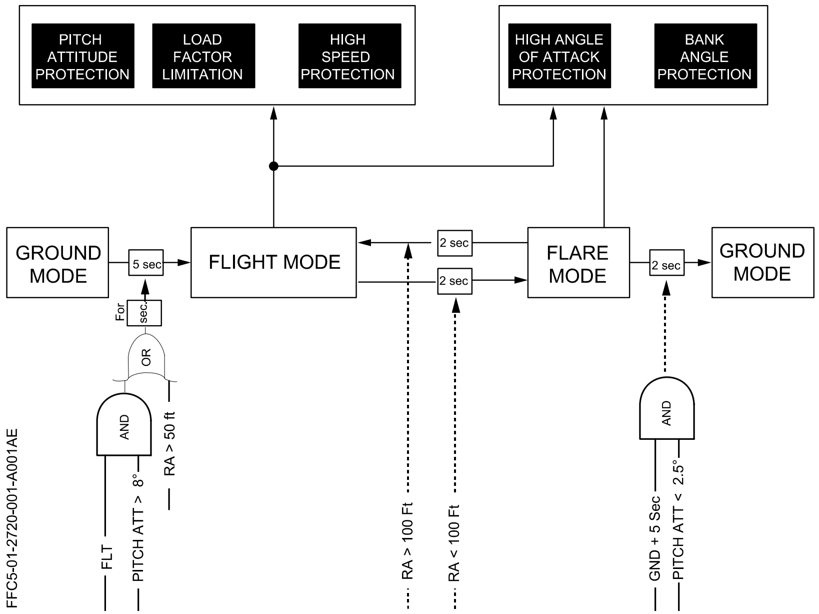
  Depending upon the EFCS status, the control law is :

  - **Normal Law** (normal conditions even after single failure of sensors, electrical system, hydraulic system or flight control computer).

    According to the number and nature of subsequent failures, it automatically reverts to :
    - **Alternate Law**, or
    - **Direct Law**.

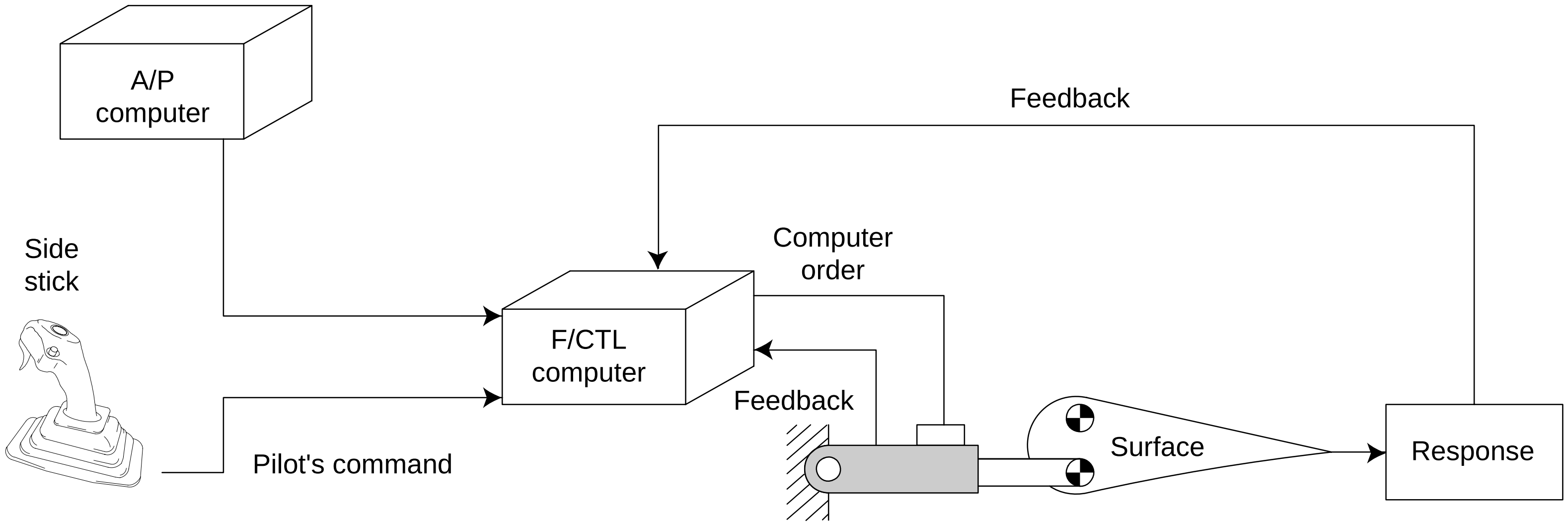
- **Mechanical back-up**
  During a complete loss of electrical power, the aircraft is controlled by :
  - Longitudinal control through trim wheel,
  - Lateral control from pedals.

Overall Normal Law Schematic



Normal Law - flight mode

Basic principle



- **Highlights**
  - No direct relationship between sidestick and control surface deflection.
  - The sidestick serves to provide overall command objectives in all three axes.
  - Computers command surface deflections to achieve Normal Law objectives (if compatible with protections).

Normal Law - flight mode

Objectives

- **Pitch axis :**

  Sidestick deflection results in a change of vertical load factor.
  The Normal Law elaborates elevator and THS orders so that :
  - A stick movement leads to a flight path variation.
  - When the stick is released, flight path is maintained without any pilot action, the aircraft being **automatically trimmed**.

- **Lateral axis : Sidestick deflection results in initiating roll rate.**

  Roll rate demand is converted into a bank angle demand.
  The Normal Law signals roll and yaw surfaces to achieve bank angle demand and maintain it - if less than 33° - when the stick is released.

  Pedal deflection results in sideslip and bank angle (with a given relationship).

  Pedal input - stick free - results in stabilized sideslip and bank angle (facilitates de-crabbing in crosswind).

- **Adapting objectives to :**

  Ground phase : ground mode
  - Direct relationship between stick and elevator available before lift-off and after touch-down.
  - Direct relationship between stick and roll control surfaces.
  - Rudder : Mechanical from pedals + yaw damper function.
  - For smooth transition, blend of ground phase law and load factor (N_z) command law at takeoff.

  Flight phase : flight mode
  The pitch Normal Law flight mode is a load factor demand law with auto trim and full flight envelope protection. The roll Normal Law provides combined control of the ailerons, spoilers 2 to 6 and rudder.

  Landing phase : flare mode
  - To allow conventional flare.
  - Stick input commands a pitch attitude increment to a reference pitch attitude, adjusted as a function of radio altitude, to provide artificial ground effect.

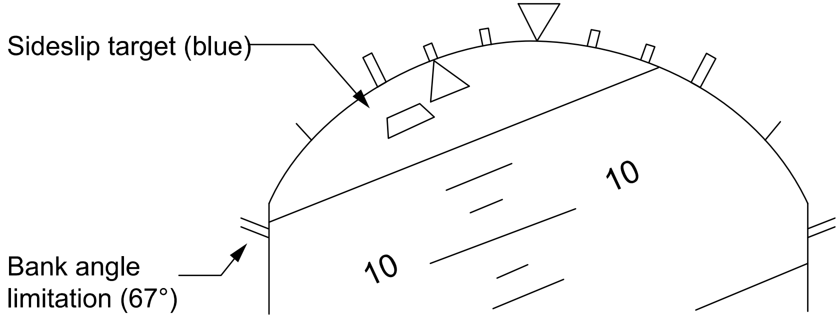
Normal Law - flight mode

Engine failure or aircraft asymmetry

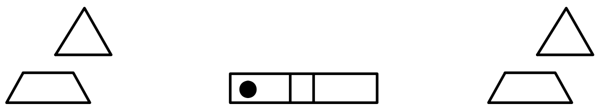
- By virtue of fly-by-wire controls and associated laws, handling characteristics are unique in the engine failure case :

  - With no corrective action :
    - Stabilized sideslip and bank angle
    - Slowly diverging heading
    - Safe flight

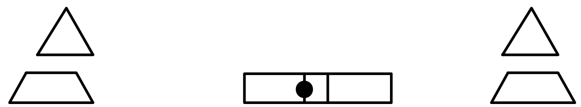
  - Short-term recommended action :
    - Zero sideslip or β **target** (take-off) with pedals
    - Then stabilize heading with stick input
    - Steady flight with stick free and no pedal force (rudder trim).



No corrective action



Corrective action



- This feature is made possible since roll controls can be fully deflected with sidestick neutral.

  The optimal pilot rudder application results in optimum climb performance.

Normal Law - flight mode

Main operational aspects and benefits

- Automatic pitch trim
- Automatic elevator to compensate turns up to 33° bank
- Aircraft response almost unaffected by speed, weight, or center of gravity location.
- Longitudinal flight path and bank angle resistance to disturbance stick free.
- Precise piloting
- Turn coordination
- Dutch roll damping
- Sideslip minimization
- Passenger comfort
- Reduced pilot workload
- **Increased safety**

Normal Law - protections

- Protection does not mean limitation of pilot authority. Full pilot authority prevails within the normal flight envelope.
- Whatever the sidestick deflection, computers have scheduled protections which overcome pilot inputs to prevent :
  - Excessive load factors (no structural overstressing) ;
  - Significant flight envelope exceedances :
  - Speed overshoot above operational limits
  - Stall
  - Extreme pitch attitude
  - Extreme bank angle.

Load factor protection

- **Design aim**
  To minimize the probability of hazardous events when high maneuverability is needed.

- **Load factor limitation at :**
  + 2.5 g, -1 g for clean configuration
  + 2 g, 0 g when slats or flaps are extended.

  Rapid pull-up to 2.5 g is immediately possible.

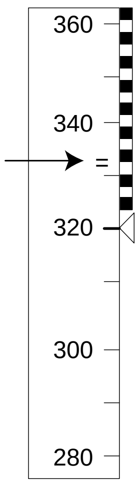
High speed protection

- **Design aims**
  To protect the aircraft against speed overshoot above V_{MO}/M_{MO}.
  Non-interference with flight at V_{MO}/M_{MO}.

- **Principle**
  When speed or Mach number is exceeded (V_{MO} + 6 kt/M_{MO} + 0.01) :
  - Automatic, progressive, up elevator is applied (.1 g max)
  - Pilot nose-down authority is reduced.

- **Results**
  Maximum stabilized speed, nose-down stick :
  V_{MO} + 15 kt
  M_{MO} + 0.04

Overspeed protection symbol :
Two green bars at V_{Mo} + 6



Note : OVERSPEED ECAM warning is provided at
V_{Mo} + 4 kt
M_{Mo} + 0.006

High angle-of-attack protection

- **Design aims**
  - Protection against stall
  - Ability to reach and hold a high CL angle (sidestick fully back), without exceeding stall angle (typically 3°/5° below stall angle) : good roll maneuverability and innocuous flight characteristics.
  - Elimination of stall risk in high dynamic maneuvers or gusts.
  - Non-interference with normal operating speeds and maneuvers.
  - Load factor limitation maintained.
  - Bank angle limited.
  - Available from lift-off to landing.

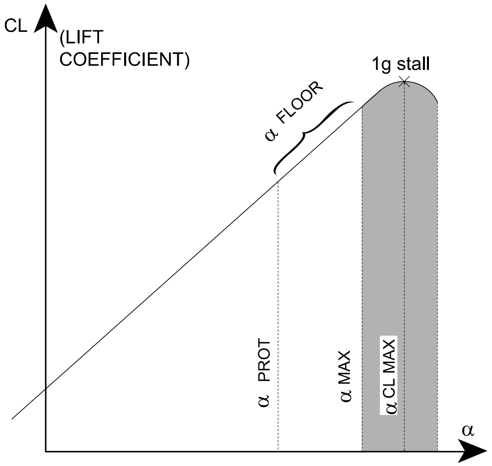
- **Windshear protection**
  Windshear protection is ensured by :
  - SRS mode
  - Speed trend indication
  - Wind indication (speed and direction)
  - Flight path vector
  - Windshear warning
  - “Predictive windshear” function of weather radar (optional).

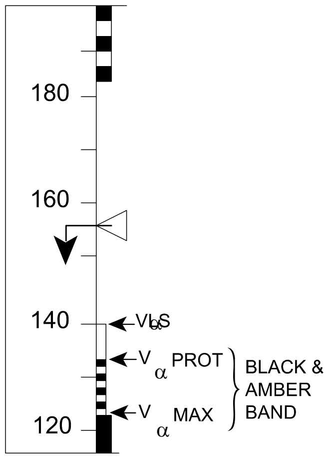
High angle-of-attack protection

- **Principle**
  When the AOA(*) is greater than AOA prot, the basic objective defined by sidestick input reverts from vertical load factor to AOA demand.

- **Result**
  - AOA protection is maintained, if sidestick is left neutral.
  - AOA floor results in GA power with an ensuing reduction of AOA.
  - AOA max is maintained if sidestick is deflected fully aft.

  Return to normal basic objective is achieved if the sidestick is pushed forward.





(*) AOA = α

Pitch attitude protection

- **Design aim**
  To enhance the effectiveness of AOA and high-speed protection in extreme conditions and in windshear encounter.
- **Principle**
  Pilot authority is reduced at extreme attitude.
- **Result**
  Pitch attitude limited :
  - Nose-down 15°
  - Nose-up 30°reduced to 25° at low speed

Bank angle protection

- When the stick is released above 33°, the aircraft automatically rolls back to 33°.
- If the stick is maintained, bank angle greater than 33° will be maintained but limited to 67°.
- When overspeed protection is triggered :
  . Zero bank angle is commanded with stick at neutral.
  . Max bank angle is limited to 45°.
- When angle-of-attack protection is triggered, max bank angle is limited to 45°.

Low energy warning

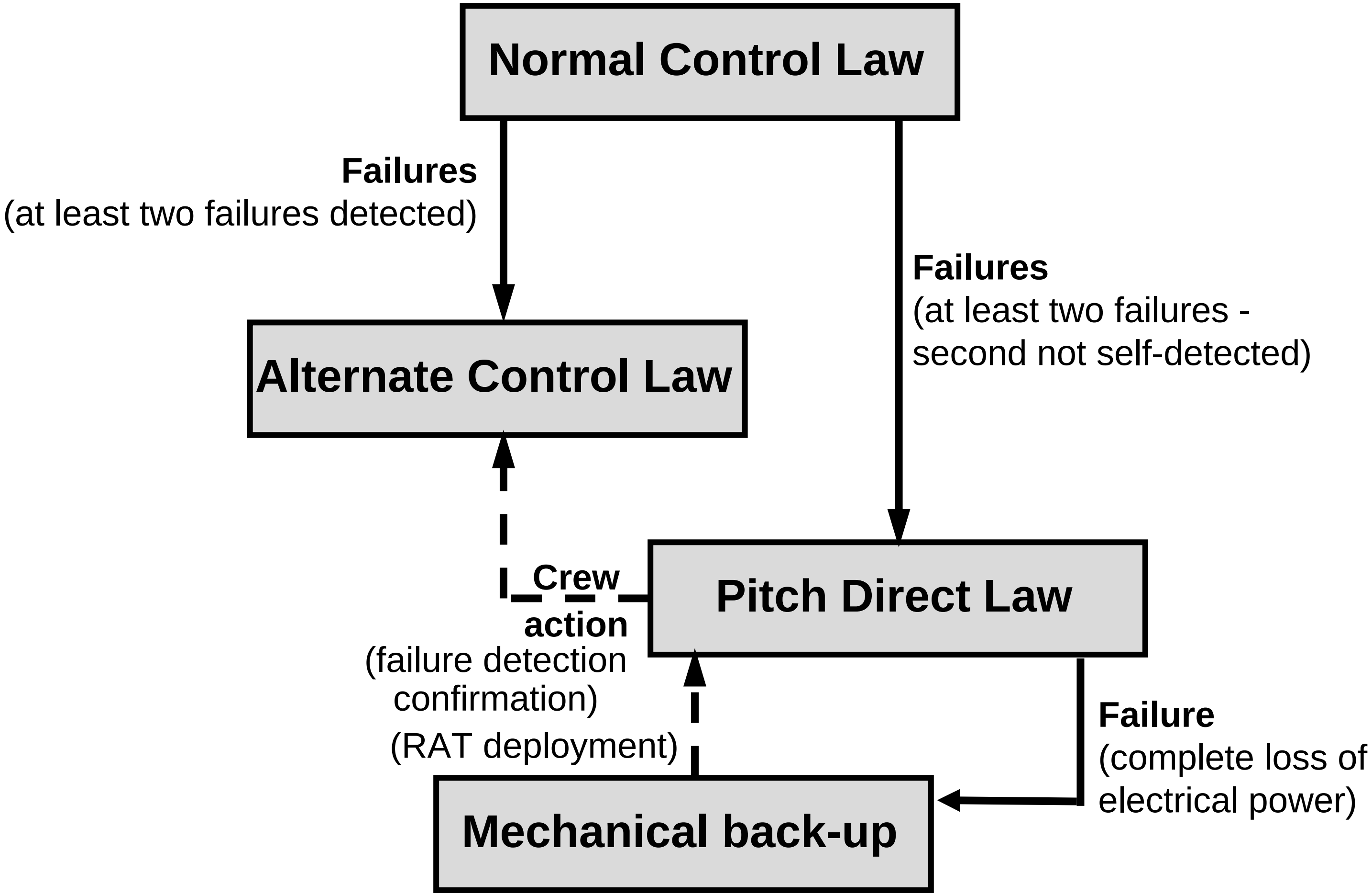
A low energy aural warning “SPEED, SPEED, SPEED” is triggered to inform the pilot that the aircraft energy becomes lower than a threshold under which, to recover a positive flight path angle through pitch control, and at which the thrust must be increased.

A340 Flight Controls - EFCS

Reconfiguration control laws

No loss of Normal Law after a single failure.

Automatic reversion from **Normal Law** to **Alternate** or **Direct Law** according to the number and nature of subsequent failures.



A340 Flight Controls - EFCS

Alternate Law

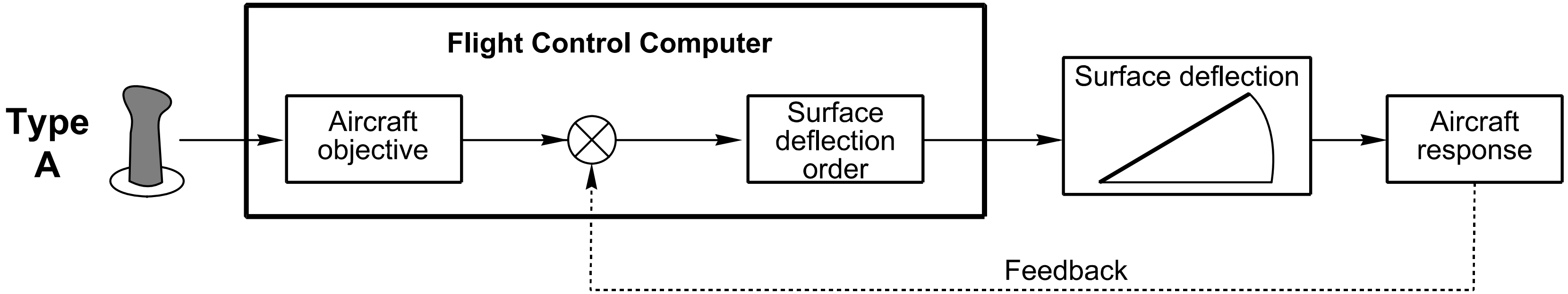
- **Probability objective :** 10^{-5}/flight hour (10^{-3} under MMEL).
- No change for **ground, takeoff** and **flare** mode compared to Normal Law.
- **Flight mode :**
  - **Pitch axis :** As per Normal Law with limited pitch rate and gains, depending on speed and configuration.
  - **Roll/yaw axes : Depending on failure :**
    - The lateral control is similar to Normal Law (no positive spiral stability is introduced).
    - Characterized by a direct stick-to-roll surface relationship which is configuration dependent.
- **Protections :**
  - Pitch attitude : lost
  - High speed : replaced by static stability
  - High angle of attack : replaced by static stability (Vc prot. law) + aural stall warning when $\alpha > \alpha_{sw*}$
  - Low energy : lost

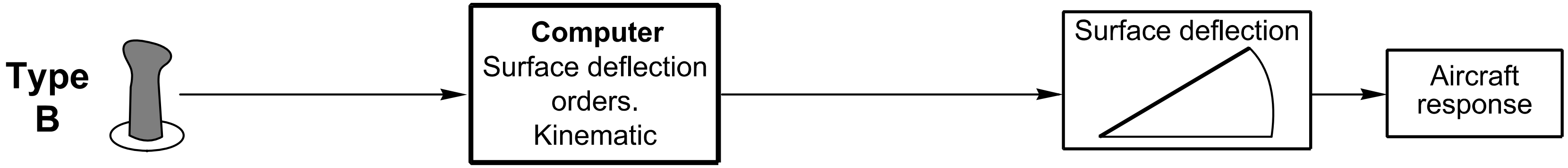
Direct Law

- **Probability objective :** 10^{-7}/flight hour (10^{-5} under MMEL).
- No change for **ground mode** and **takeoff mode** compared to Normal Law.
- **Flight mode :** Maintained down to the ground
  - In all three axes, direct relationship between stick and elevator/roll control surfaces which is center of gravity and configuration dependent.
- **All protections are lost**
  Conventional aural stall and overspeed warnings are provided as for Alternate Law.
- Main operational aspect :
  - **Manual trimming** through trim wheel.

A340 Flight Controls - EFCS

Control law reconfiguration summary

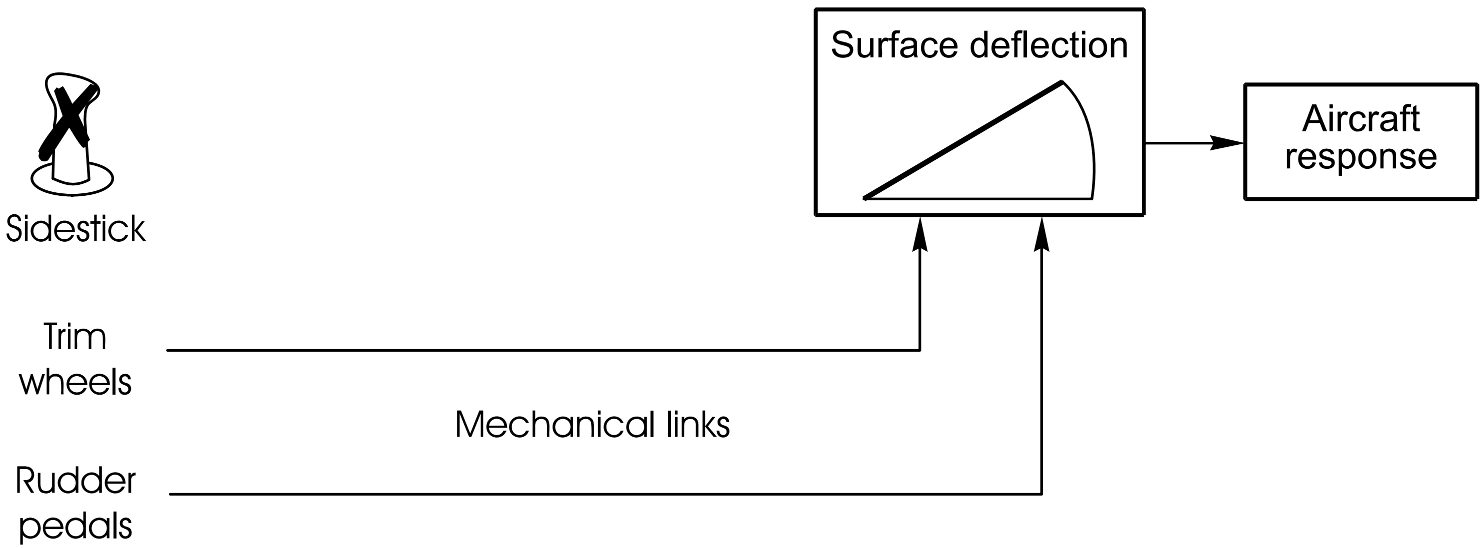




Control law	Pitch	Lateral
Normal	Type A	Type A
Alternate	Type A	Type A/B
Direct	Type B	Type B

Mechanical back-up

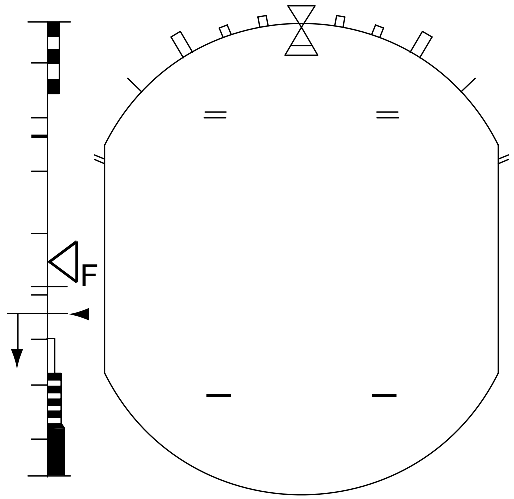
- To sustain the aircraft during a temporary complete loss of electrical power.
- Longitudinal control of the aircraft through trim wheel. Elevators kept at zero deflection.
- Lateral control from pedals. Roll damping is provided by the Back up Yaw Damper Unit (BYDU).
- Message on PFD **MAN PITCH TRIM ONLY** (red).



Control law status information

Besides ECAM messages, the pilot is permanently informed of control law status on PFD.

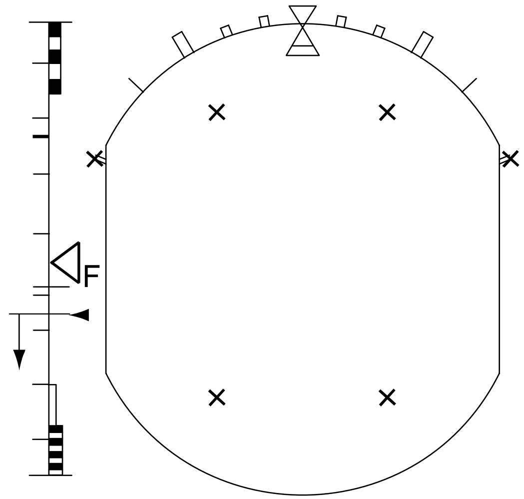
Normal Law
Normal FMA indications



Pitch attitude protection

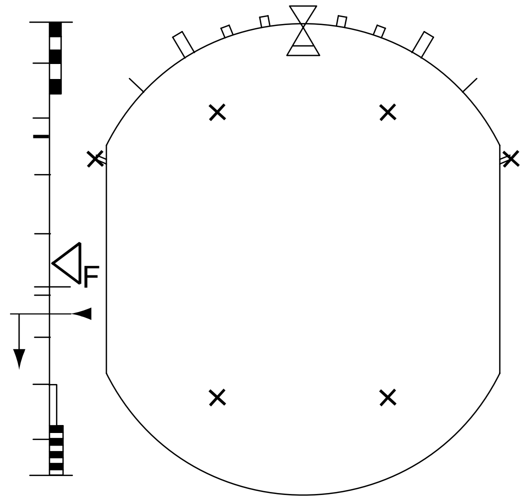
Bank angle protection

Alternate Law
Normal FMA indications



+ Audio warning
+ ECAM messages
with
limitations, if any

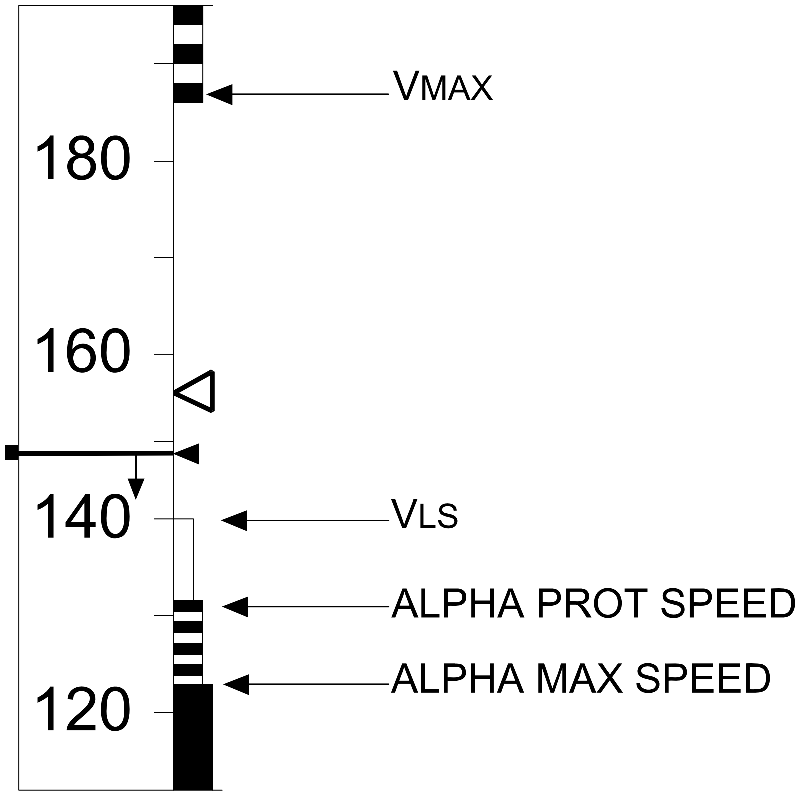
Direct Law
Normal FMA indications +
USE MAN PITCH TRIM



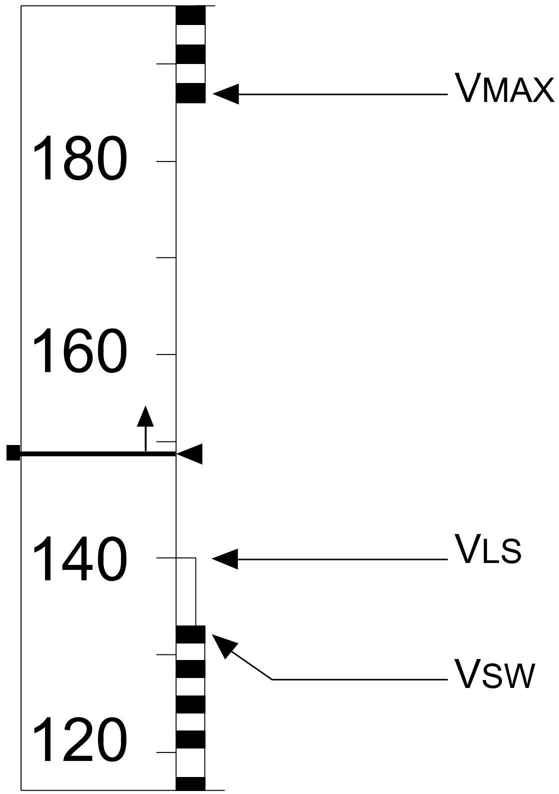
+ Audio warning
+ ECAM messages
with
limitations, if any

Control law status information

Crew information : PFD speed scale



F / CTL IN PITCH
NORMAL LAW



F / CTL IN PITCH
ALTN & DIRECT LAW

Priority logic

- Normal operation : Captain and First Officer inputs are algebraically summed up to applicable limits.

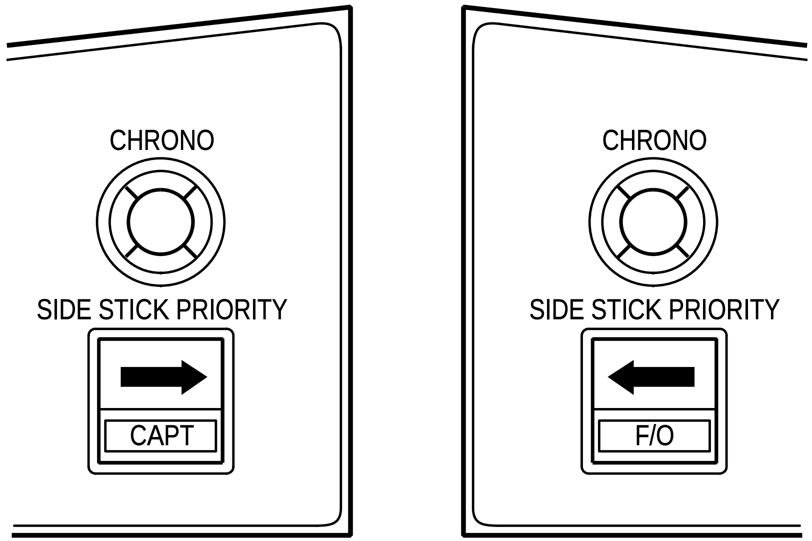
- Autopilot disconnect pushbutton is used as priority take-over button.

- Last pilot who depresses and holds priority take-over button has priority ; other pilot's inputs ignored.

- Priority annunciation :
  - In front of each pilot on glareshield
  - ECAM message
  - Audio warning.

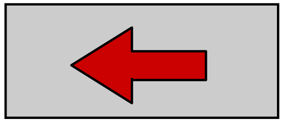
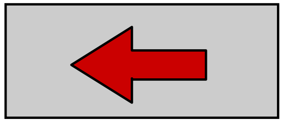
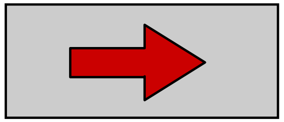
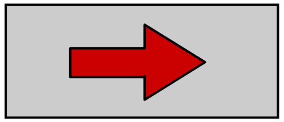
- Normal control restored when both buttons are released.

- Jammed sidestick :
  - Priority automatically latched after 40 seconds
  - Priority reset by depressing take-over button on previously jammed sidestick.



A340 Flight Controls - EFCS

Priority display logic

Captain's side		First Officer's side	
Sidestick	**Annunciation**	**Annunciation**	**Sidestick**
Take-over button depressed	CAPT **Green**	 **Red**	Sidestick deflected
Take-over button depressed	**“Light off”**	 **Red**	Sidestick in neutral
Sidestick deflected	 **Red**	F/O **Green**	Take-over button depressed
Sidestick in neutral	 **Red**	**“Light off”**	Take-over button depressed

6. Landing Gear

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A340 Landing Gear

Main features

- Conventional landing gear with single bogie nose gear, an outer gear and a double bogie main landing gear, with direct-action shock absorbers.

- The main landing gear is also provided with a shock absorber extension/retraction system.

- The main gear retracts laterally ; nose and center gears retract forward into the fuselage.

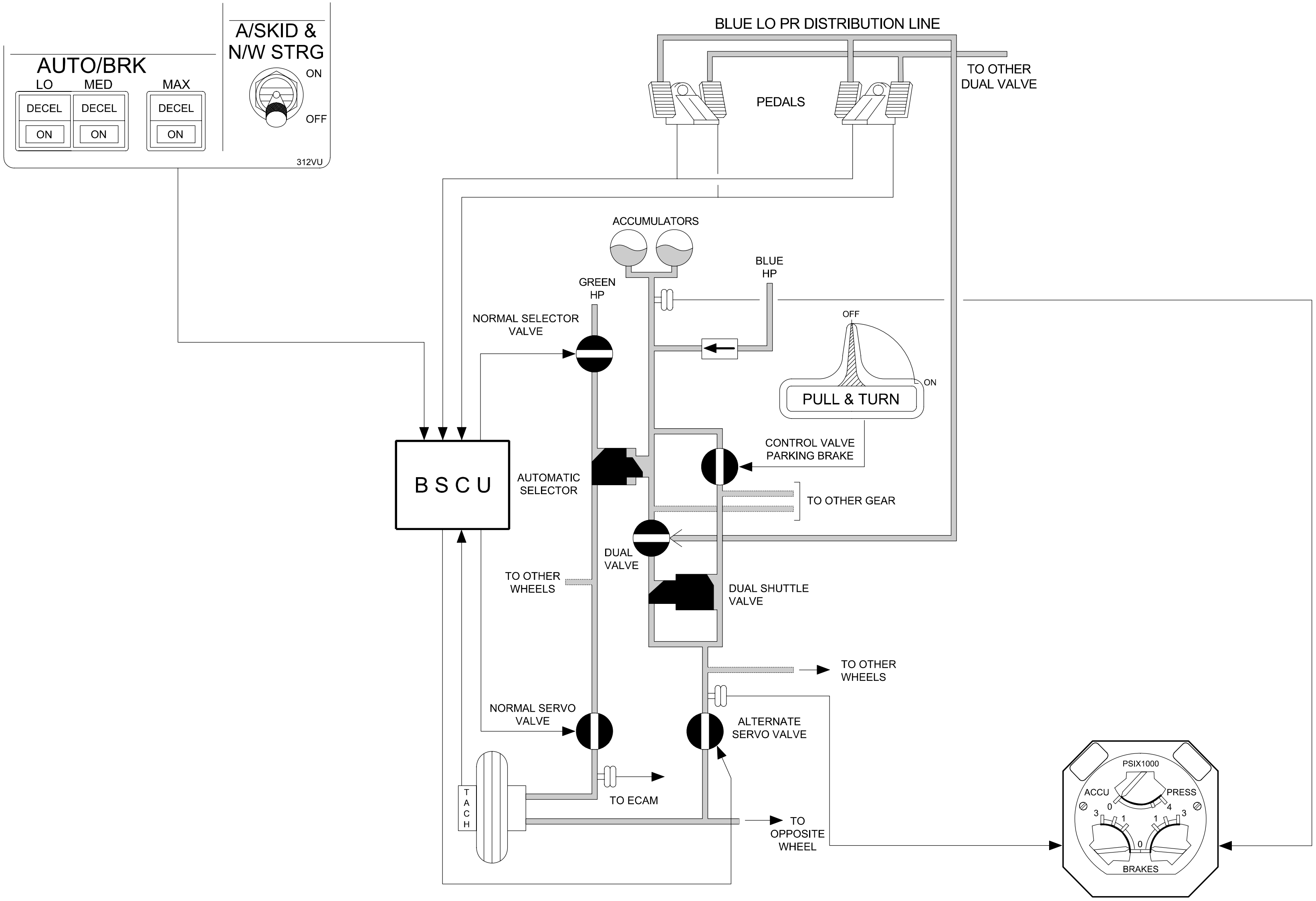
- Electrically controlled by two Landing Gear Control/Interface Units **(LGCIU)**.

- Hydraulically actuated (Green system) with alternative free-fall/spring downlock mode.

- Alternating use of both LGCIUs for each retraction/extension cycle. Resetting the landing gear control lever results in transition to the other LGCIU.

- Elimination of gear lever neutral position through automatic depressurization of landing gear hydraulic supply at speeds above 280 kt.

- Elimitation of microswitches by use of trouble-free proximity detectors for position sensing.


AUTO/BRK
LO
MED
MAX
DECEL
ON
A/SKID &
N/W STRG
ON
OFF
312VU
BLUE LO PR DISTRIBUTION LINE
TO OTHER
DUAL VALVE
PEDALS
ACCUMULATORS
BLUE
HP
GREEN
HP
NORMAL SELECTOR
VALVE
OFF
ON
PULL & TURN
CONTROL VALVE
PARKING BRAKE
B S C U
AUTOMATIC
SELECTOR
TO OTHER GEAR
DUAL
VALVE
TO OTHER
WHEELS
DUAL SHUTTLE
VALVE
TO OTHER
WHEELS
NORMAL SERVO
VALVE
ALTERNATE
SERVO VALVE
TO ECAM
T
A
C
H
TO
OPPOSITE
WHEEL
PSIX1000
ACCU
PRESS
BRAKES

Braking system

- Carbon disc brakes are standard.

- Normal system (Green hydraulic system supply) :
  - Electrically signalled through antiskid valves ;
  - Individual wheel antiskid control ;
  - Autobrake function ;
  - Automatic switchover to alternate system, in event of Green hydraulic supply failure.

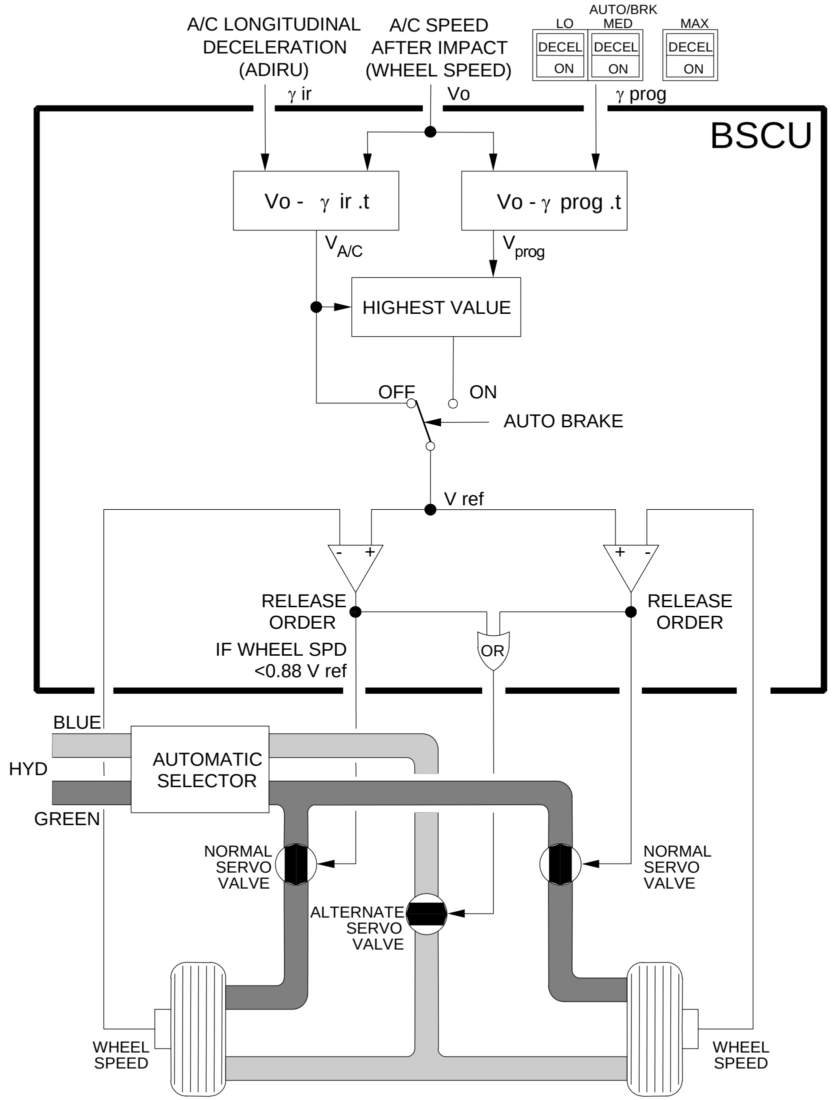
- Alternate braking system with antiskid (Blue hydraulic system supply) :
  - Electrically signalled through alternate servovalves,
  - Hydraulically controlled through dual valve,
  - Individual wheel antiskid control,
  - No autobrake function.

- Alternate braking system without antiskid (Blue hydraulic system-supply or Blue brake power accumulator) :
  - Hydraulically controlled by pedals through dual valve;
  - Brake pressure has to be limited by the pilot referring to the gauges ;
  - No autobrake function ;
  - No antiskid system.

- Parking brake (Blue hydraulic system supply or Blue brake power accumulator :
  - Electrically signaled ;
  - Hydraulically controlled with brake pressure indication on gauges.

- The Braking and Steering Control Unit **(BSCU)** is a digital dual-channel double system (control and monitoring) computer controlling the following functions:
  - Normal braking system control ;
  - Antiskid control (normal and alternate) ;
  - Autobrake function with LO, MED, MAX ;
  - Nosewheel steering command processing ;
  - Brake temperature signal processing ;
  - Monitoring of all these functions.

Antiskid system schematic



Braking principle

Antiskid system

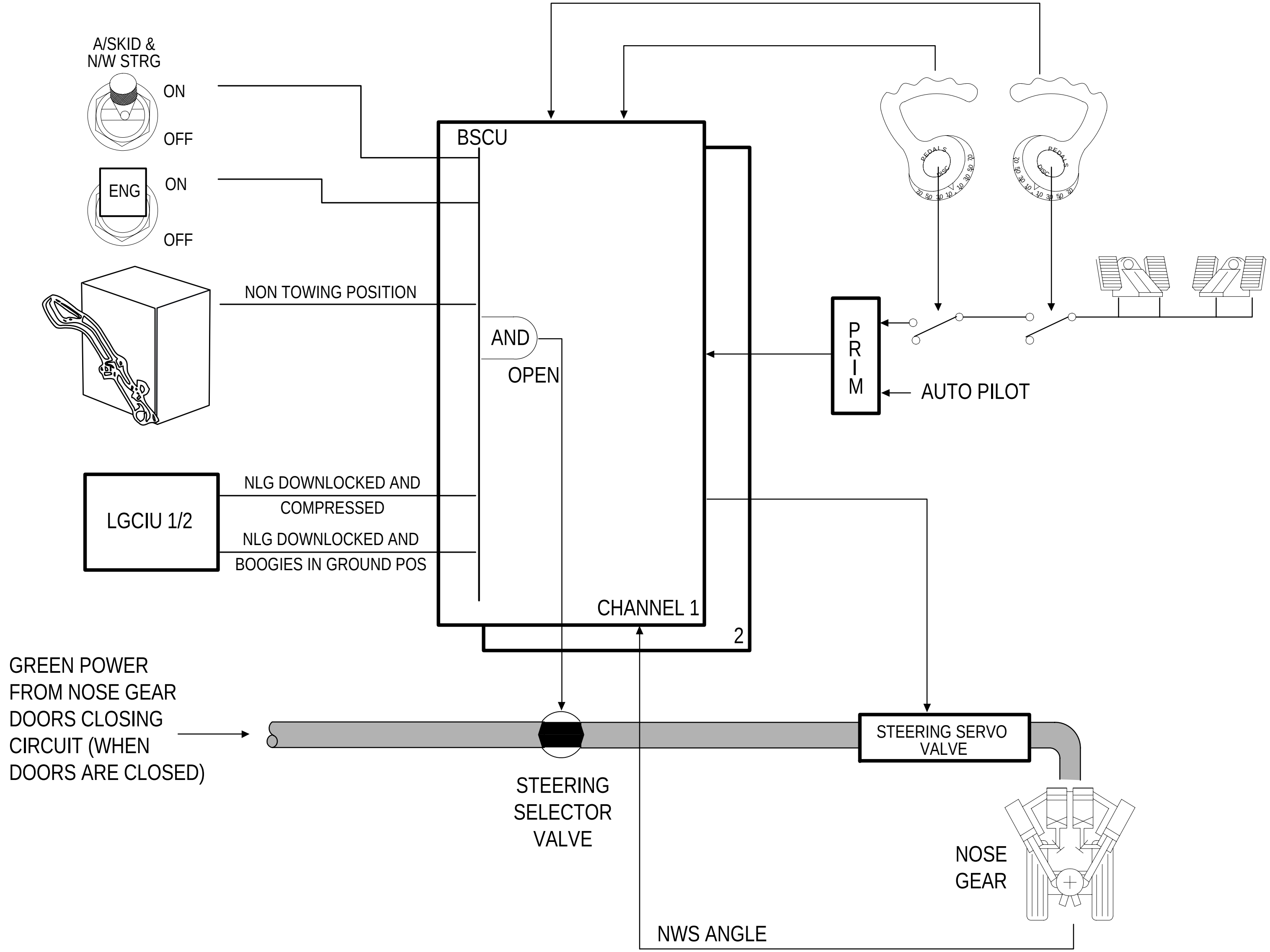
- From touchdown, aircraft speed is computed based on touchdown speed (wheels) and integrated deceleration (ADIRS). This reference speed is compared with each wheel speed to generate a release order for closing the normal servovalve in case of skid exceeding 16%.
- Brake pedal orders open this servovalve which is also modulated by antiskid closing signals.

Autobrake system

- From touchdown, a specific speed is computed, based on touchdown speed (wheels) and programmed deceleration (low, medium, max). This programmed speed is compared with each wheel speed to generate a release order for closing the normal servovalve to meet selected deceleration.
- If the reference speed exceeds programmed speed (contaminated or iced runways), the former will take over for the antiskid to modulate the normal servovalve.

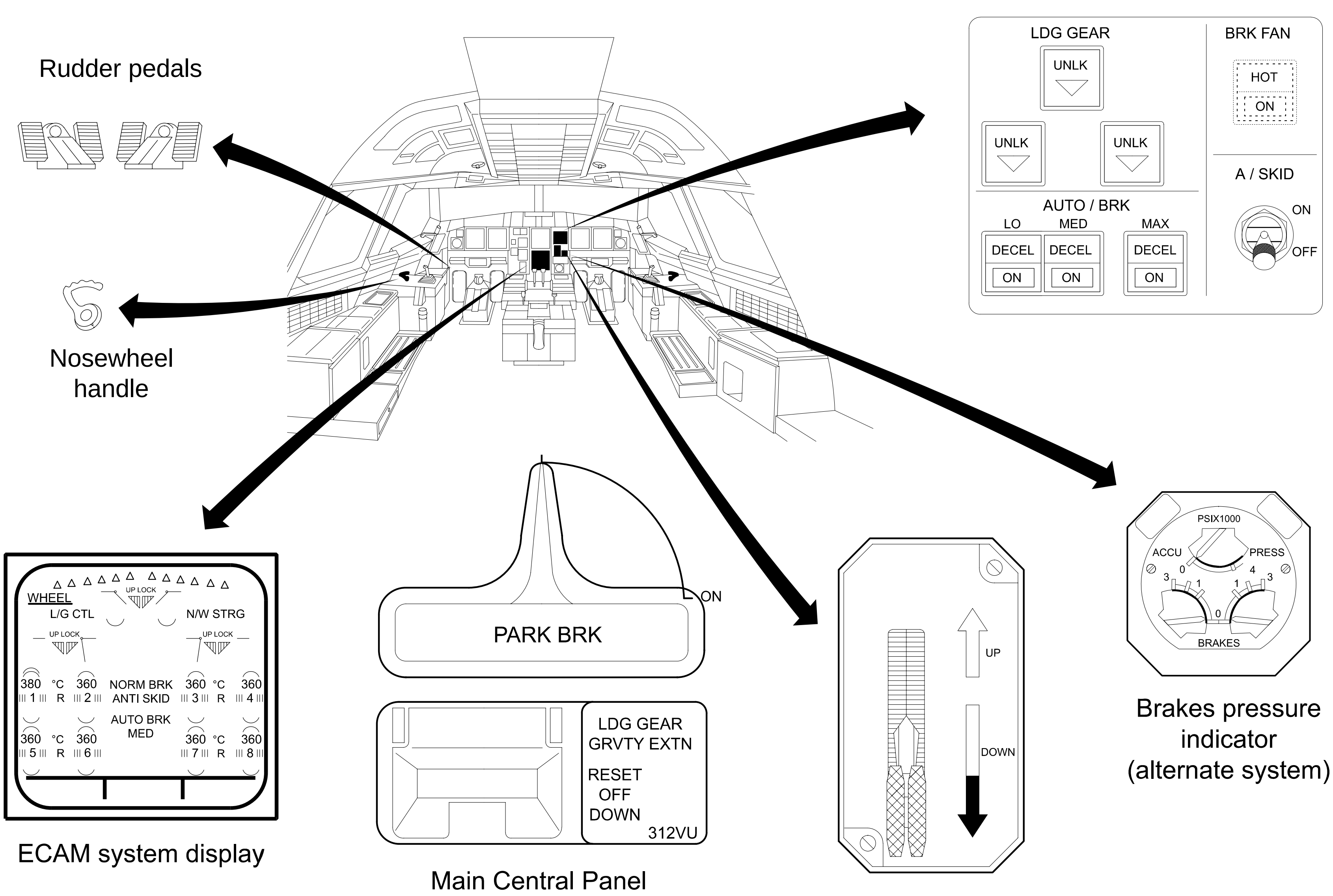
A340 Landing Gear

Nose gear steering principle

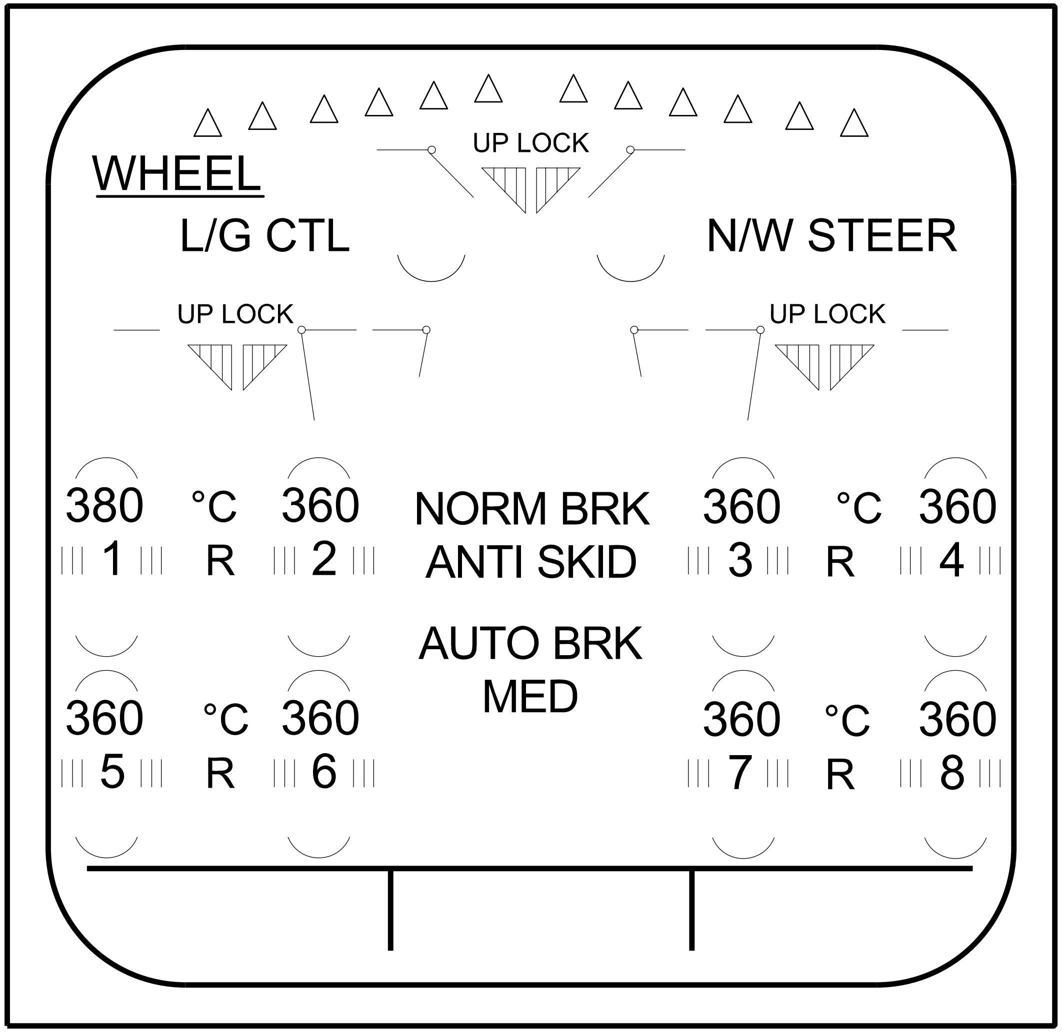


A340 Landing Gear

Controls and displays



ECAM system page



7. Fuel System

A340 Fuel System

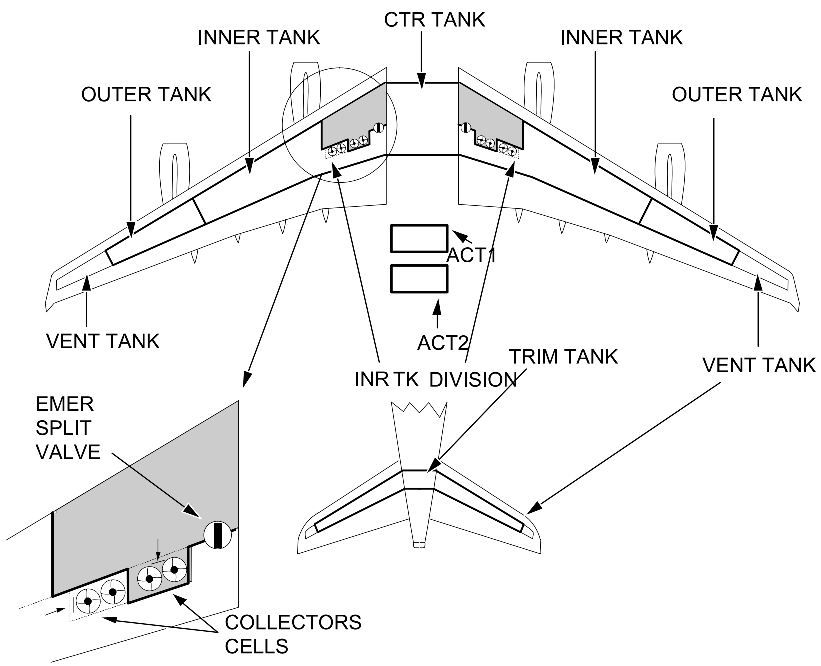
Basic layout

- **Total fuel capacity**

USABLE FUEL								
		Outer tanks	Inner tanks	Center tanks	ACTs	TRIM TANK	Total without ACTs	Total witht ACTs
VOLUME	(liters)	3650x2	42775x2	41560	7200x2	6230	140640	155040
	(US gallons)	964x2	11301x2	10979	1902x2	1646	37155	40959
WEIGHT*	(KG)	2865x2	33578x2	32625	5652x2	4890	110399	121703
	(LB)	6315x2	74033x2	71923	12460x2	10782	243401	268321

- **Ventilation**
  - Each wing tank and the tail tank is separately vented though its associated vent tank.
  - The center tank is ventilated via the LH vent tank.
  - These vent tanks are open to the atmosphere via flame arrestors and NACA inlets.
  - Location of ducts and float valves is designed to ensure free venting over appropriate attitude ranges during refueling and normal ground and flight maneuvers.
  - Pressure relief outlets protect the inner and center tanks from over- or under-pressure in case of failure or blockage of the vent system or pressure refueling gallery.

Tank arrangement



(*) : Fuel specific gravity : 0.785 kg/l or 6.551 lb/US gal.

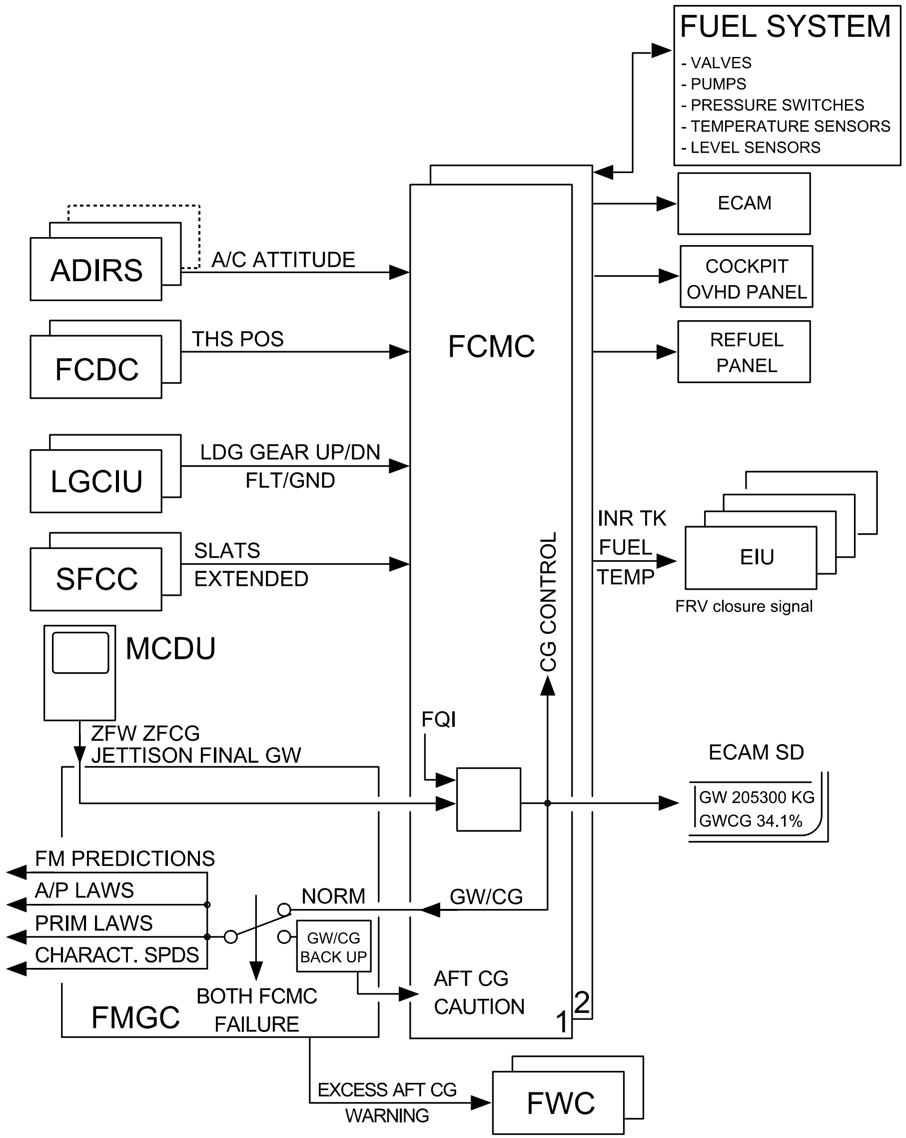
Control and monitoring

The Fuel System is automatically controlled by the Fuel Control and Monitoring System **(FCMS)**.

The FCMS operates in a fully automatic mode.

Two identical Fuel Control and Monitoring Computers (FCMC) provide :

- Fuel quantity measurement and indication ;
- Fuel transfer control ;
- Center of gravity control ;
- Level sensing ;
- Fuel temperature indication ;
- Refuel control ;
- Aircraft gross weight and center of gravity calculation based on zero fuel weight and zero fuel center of gravity entered by the crew ;
- Signals to FADEC for IDG cooling control.



Engine feed

- In normal operation, each engine is independently supplied by a continuously operating booster pump, located in a dedicated collector box.

  In the event of a pump failure, each engine is automatically fed by a standby pump.

  Collector boxes are maintained full by a jet pump transfer action using booster pump pressure.

  In cruise conditions, a single booster pump is able to supply flow to all four engines.

- A crossfeed valve is associated with each engine. It connects the engine and its associated pumps to the X-FEED line. This allows any pump to supply any engine.

  All crossfeed valves open automatically in electrical emergency configuration and during jettison operation.

- Supply of fuel to each engine may be shut off by an engine LP valve driven by a double motor actuator. It is controlled by either the ENG FIRE pushbutton or the ENG master lever.

- Automatic control of transfer from center to inner tanks is initiated, provided either center tank pump pushbutton is selected on.

  With fuel in the center tank and CTR TK pumps running, both inner inlet valves are used independently to cycle the inner tank contents between underful and high level. (Underful is set at approximately 2000 kg below high level).

  When the center tank is empty, the pumps are automatically controlled off, and both inner inlet valves lose.

- Automatic transfer of fuel from the outer tanks is performed by gravity. This occurs when center and trim tanks have been emptied and when either inner tank reaches 4000 kg.

  Outer tank fuel transfer valves are used to cycle the inner tanks contents between 4000 and 4500 kg. These valves are closed when outer tanks are empty for 5 minutes.

- Transfer to inner tanks can be manually selected through the OUTR TK XFR pushbutton.

  When selected ON, all inner tank fuel transfer, outer inlet and inner inlet valves are controlled OPEN.

- Automatic control of transfer from ACT to center tank occurs after takeoff slats restriction, provided the center tank contains less than 23000 kg.

Jettison system

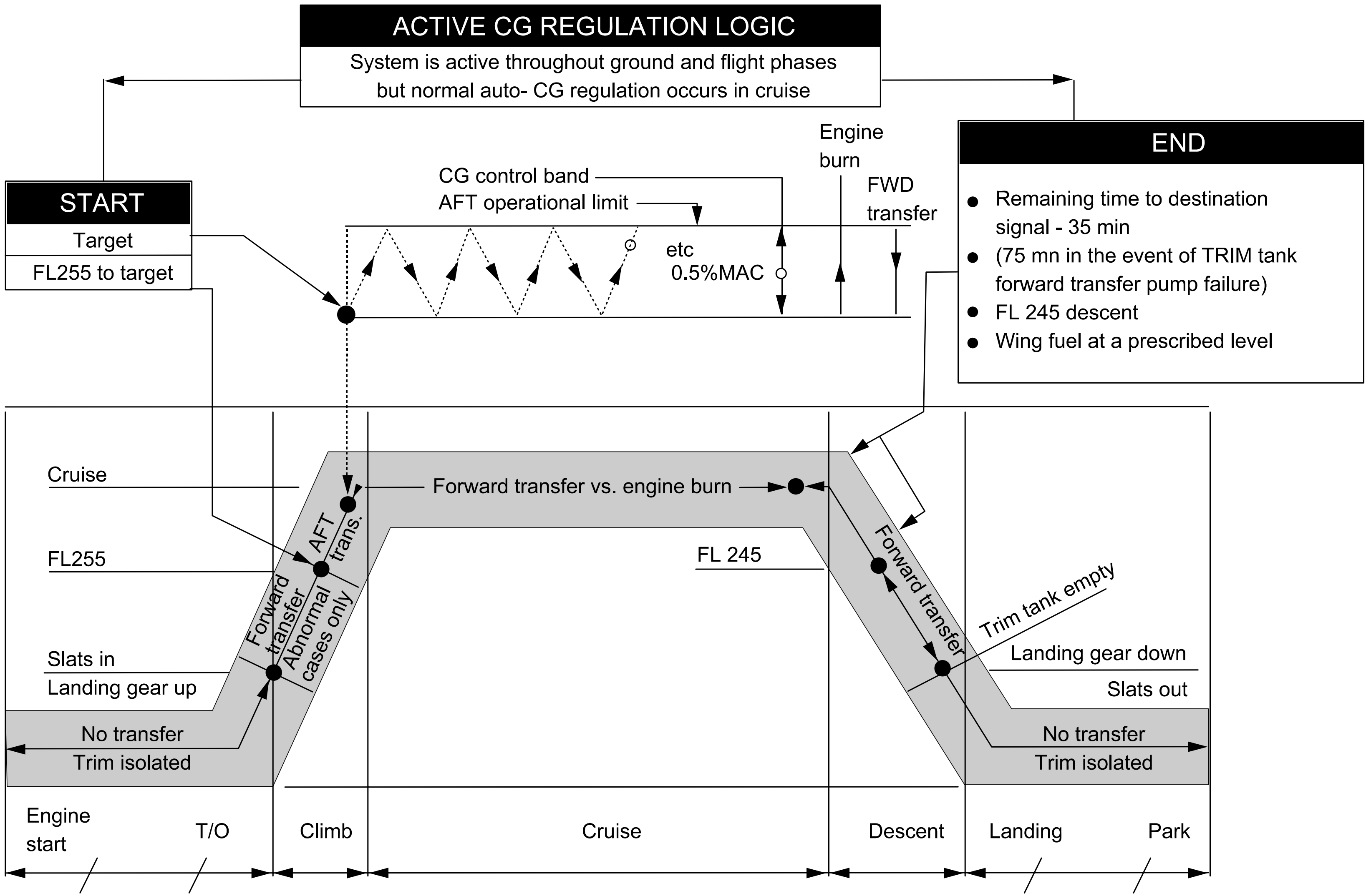
- The jettison pipe is connected to the refuel gallery in each wing. A dual actuator jettison valve is fitted.

- Fuel is simultaneously jettisoned from the center and inner tanks. All cross-feed valves open automatically. All normal and STBY pumps are running and a forward transfer into center tank is initiated.

- The aircraft weight will be reduced at a rate approximately 1000 kg per minute (excluded fuel burn).

- Jettison is stopped when :
  - The crew deselects the jettison pushbutton ;
  - Any inner tank low level sensor becomes dry ;
  - A signal from the FCMC indicates that the remaining fuel on board reaches a value previously defined by the crew via the FMGS MCDU (Option : Preselection of gross weight after jettison).

Center of Gravity control band relative to operational flight envelope



CG Control

- Automatic control CG begins when climbing through FL255 and is terminated when descending through FL 245 or when FMGS time to destination is below 75 minutes.

- **Aft transfer**

  - If the center tank is not empty, fuel is transferred from the center tank to the trim tank through the trim pipe isolation valve and the trim tank inlet valve, using the CTR TK pumps.

  - If the center tank is empty, fuel is transferred from the inner tanks to the trim tank through the aft transfer valves, the trim pipe isolation valve and the trim tank inlet valve, using engine feed pumps. In this case, cross-feed valves 2 and 3 are open.

  - Aft transfer is terminated when :
    Computed CG = target CG -0.5%, or
    When an inner tank reaches the low level.

- **Forward transfer :**

  - Forward transfer is required when :
    Computed CG = target CG.

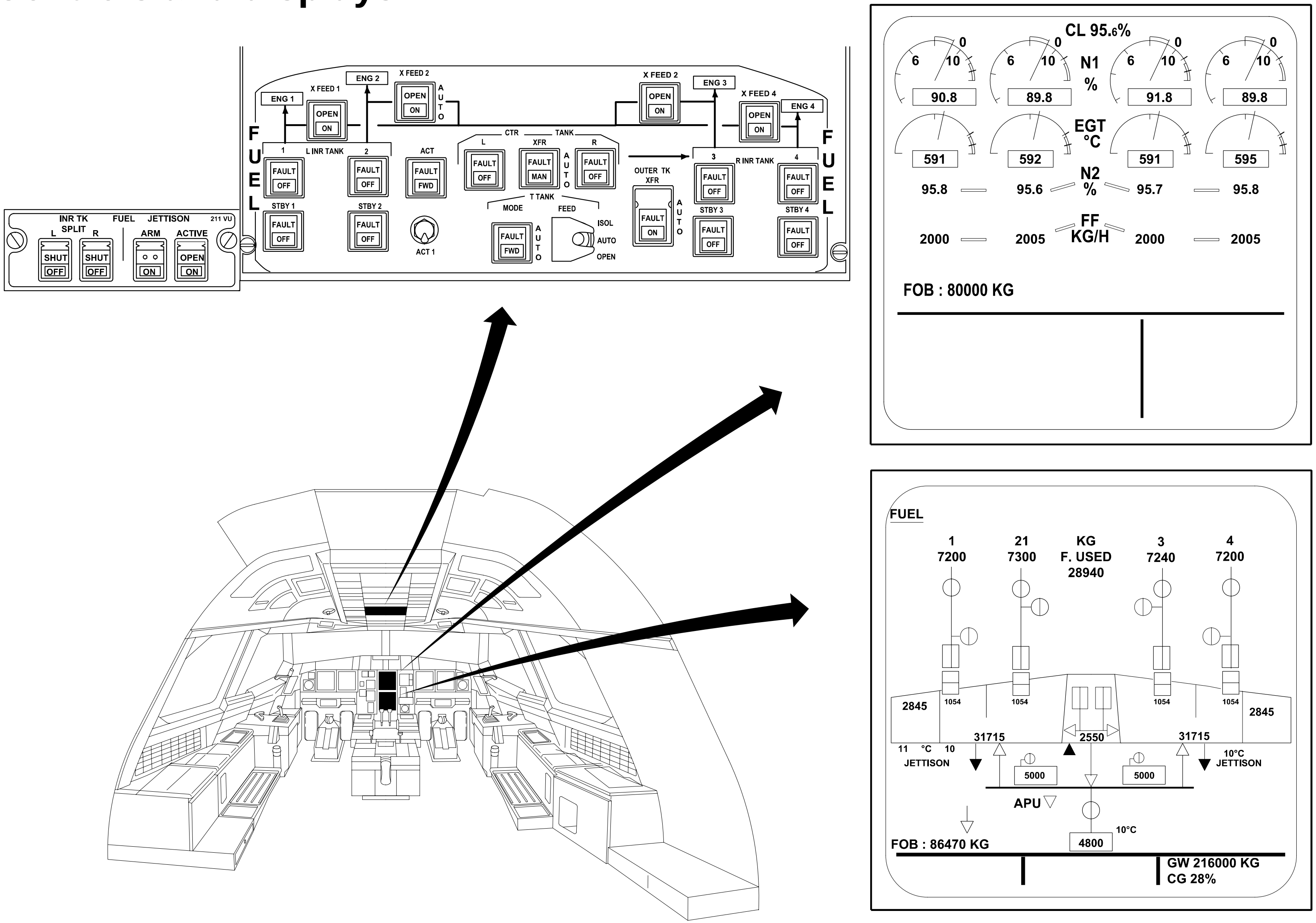
  - If the center tank is not empty, fuel is transferred by the trim tank forward transfer pump from the trim tank to the center tanks through the auxiliary forward transfer valve.

  - If the center tank is empty, fuel is transferred by the trim tank forward transfer pump from the trim tank to the inner tanks through the trim pipe isolation valve.

  - Forward transfer is terminated when :
    Computer CG = target CG -0.5%

    In descent below FL 245 (see diagram on page 7.6), or by an FMGS time-to-destination signal, or at jettison operation, a forward transfer is initiated.

Controls and displays



Control and indication

- No crew action is required for normal operation except initiation and termination.

- Indications :

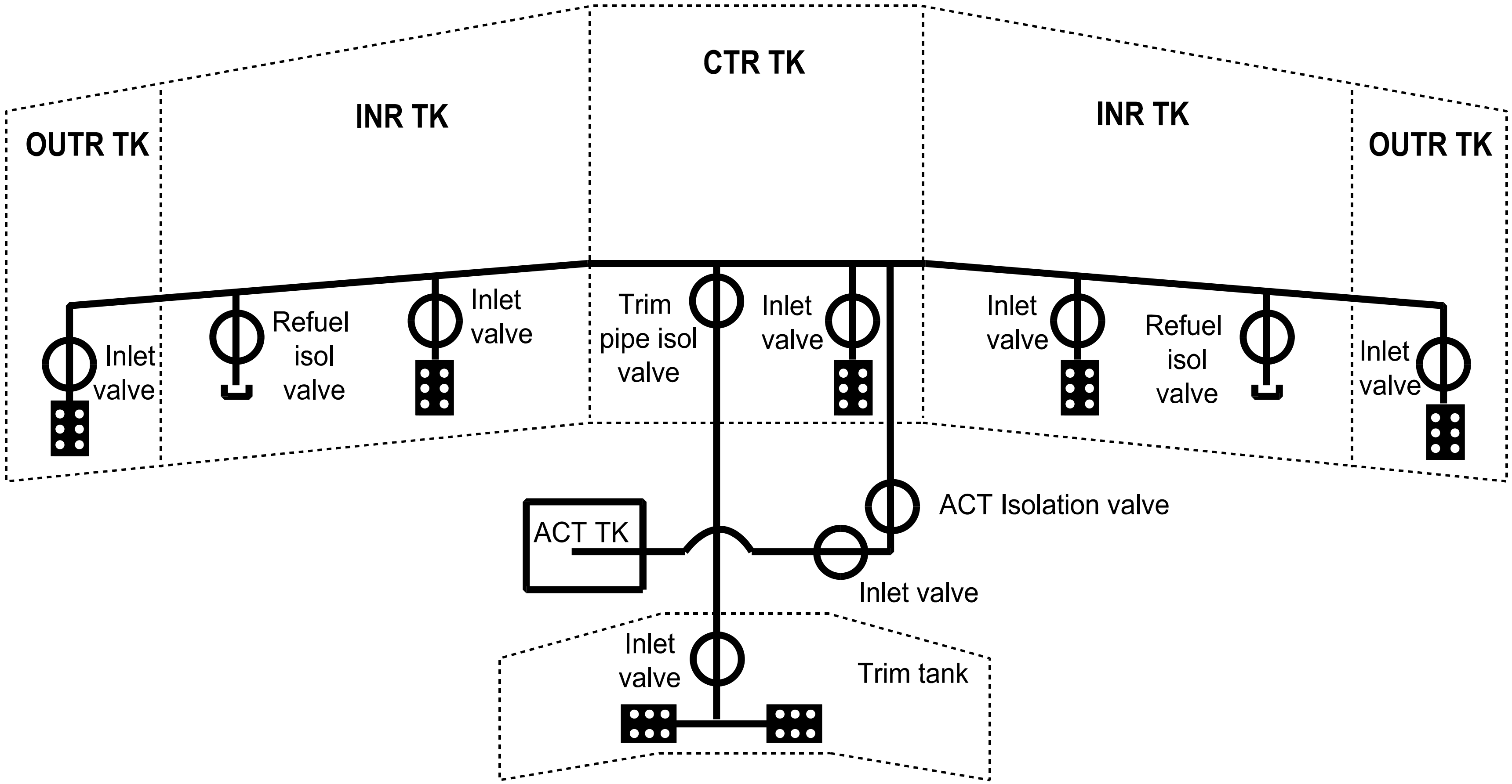
  - Fuel data (quantity, temperature) are available from a Fuel Quantity Indication **(FQI)** system.
  - Fuel On Board **(FOB)** is permanently displayed on upper ECAM DU.
  - Fuel system synoptic on lower ECAM DU is displayed according to ECAM logic.
  - Low level warning is totally independent from FQI.

- Abnormal operations :

  - Fuel feed sequence may be operated manually.
  - Crossfeed valves may be operated manually (which allows crossfeed between any combination of engine and collector cells).
  - Forward and (some) inter tank transfers may be initiated manually.
  - Engine gravity feed is possible.
  - Split valves (operated manually) isolate fuel forward of inner wing tank center spar from fuel aft of spar (see page 7.2).

A340 Fuel System

Refueling system



Refueling

- Two standard 2.5 inch couplings are installed under the each wing. When both couplings are used, refueling time at nominal pressure (50psi) is approximately 33 minutes.
- An isolation valve is provided between each pair of couplings and the refueling gallery.
- A refueling inlet valve is provided for each tank, allowing distribution to a diffuser to reduce turbulence and avoid electrostatic build-up.
- An automatic refueling system controls the refuel valves to give preselected fuel load and correct distribution.
- Refueling/defueling is controlled from an external panel, located in the fuselage fairing under the RH belly fairing and can be carried out with battery power only.

  Optional : Auto-Refueling can be controlled from the cockpit.
- Gravity refueling can be achieved by overwing refueling points.
- Defueling is accomplished by means of fuel pumps and, for the outer and trim tanks, via transfer valves.

8. Engine Controls

A340 Engine Controls

FADEC

- Thrust control is operated through Full Authority Digital Engine Control **(FADEC**) computers which :

  - Command the engines to provide the power best-suited to each flight phase ;
  - Automatically provide all the associated protection that is required :

    - Either in manual mode (thrust levers), or
    - In automatic mode (autothrust) with fixed thrust levers.

- Engine performance and safety improvement over current hydro-mechanical control systems :

  - Simplification of engine/aircraft communication architecture.

  - Reduction of crew workload by means of automatic functions (starting, power management).

  - Facilitate on-wing maintenance.

- The system design is fault-tolerant and fully duplicated, with 'graceful degradation' for minor failures (i.e. sensor failures may lose functions but not the total system).

  The engine shut-down rate, resulting from FADEC failures, will be at least as good as today's latest hydro-mechanical systems with supervisory override.

- FADEC also called Engine Control Unit **(ECU)** is a fully redundant digital control system which provides complete engine management.

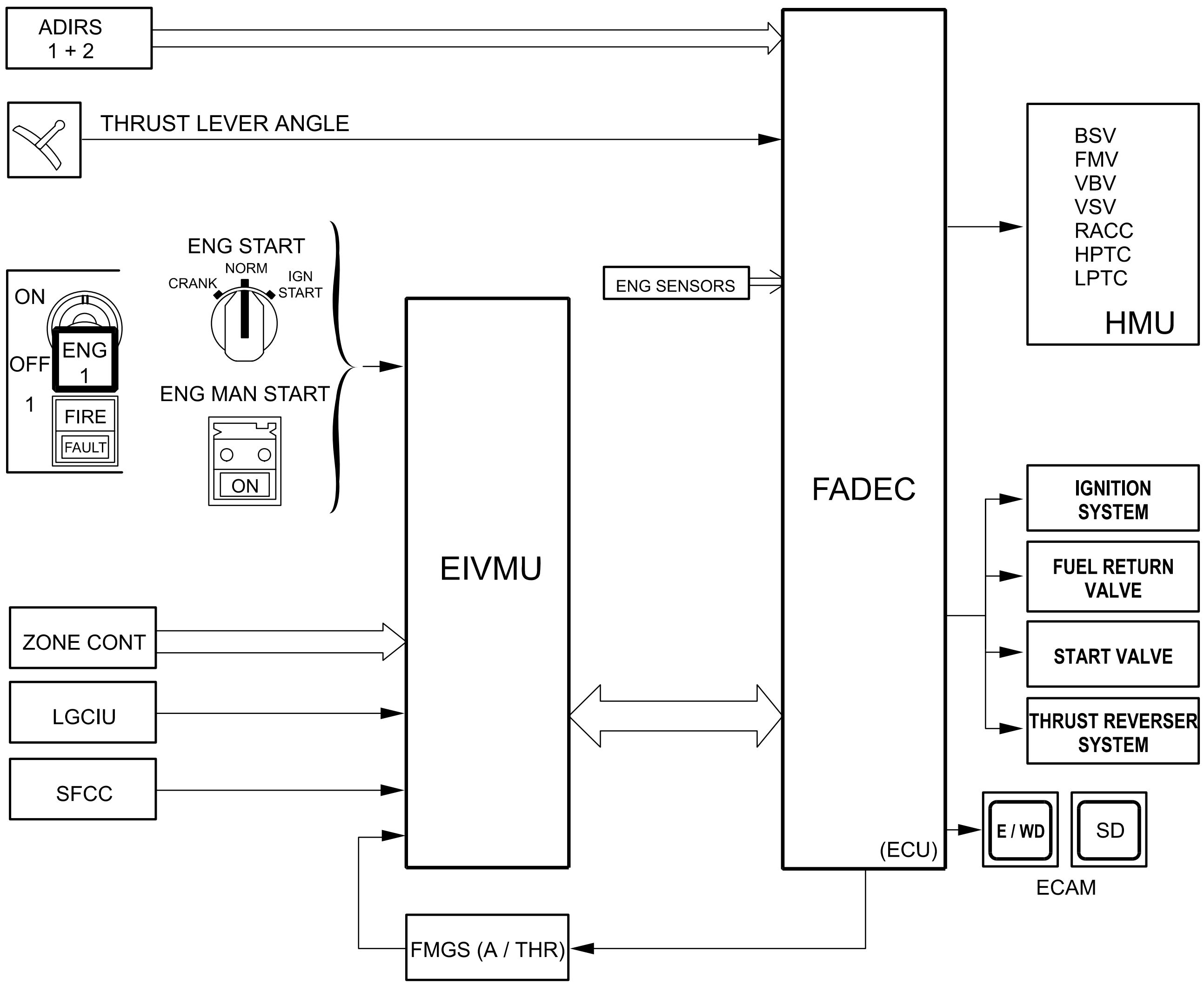
  Aircraft data used for engine management is transmitted to the FADEC by the Engine Interface Unit (EIU).

  Each engine is equipped with a fan-case-mounted FADEC supporting the following functions :

  - Gas generator control ;
  - Engine limit protection ;
  - Engine automatic starting ;
  - Engine manual starting ;
  - Power management ;
  - Engine data for cockpit indication ;
  - Engine condition parameters ;
  - Reverser control and feedback ;
  - Fuel recirculation control / fluids temperature management ;
  - Fuel used computation ;
  - Integrated PMUX function.

A340 Engine Controls - CFM56

FADEC architecture



FADEC and EIU

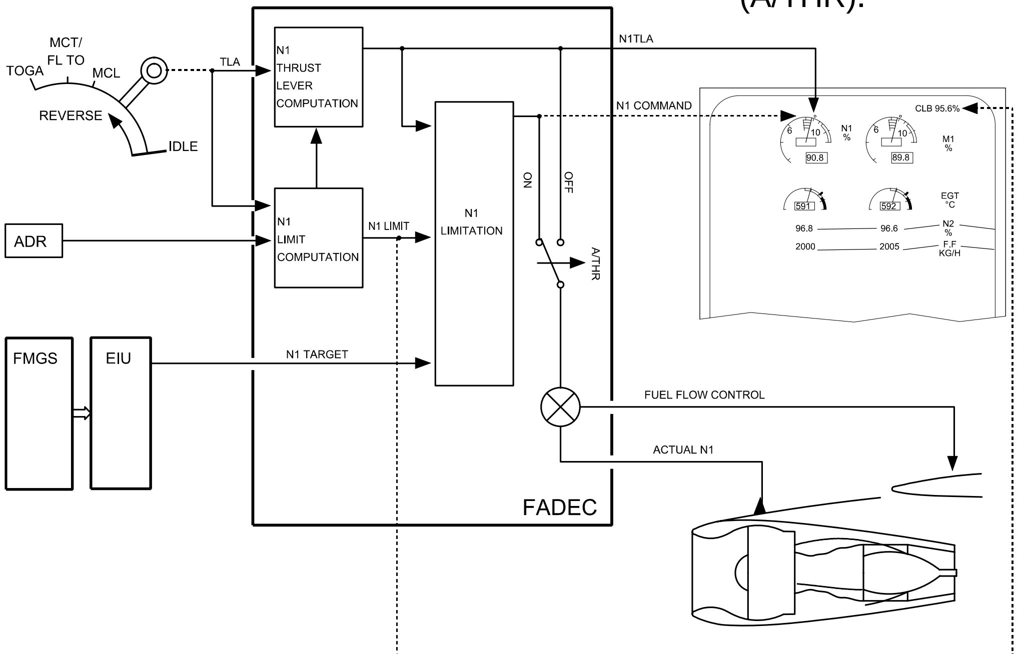
One FADEC is located on the engine with dual redundant channels (active and standby), each having separate 115 VAC aircraft power sources to provide engine starting on ground and in flight.

Additional features :

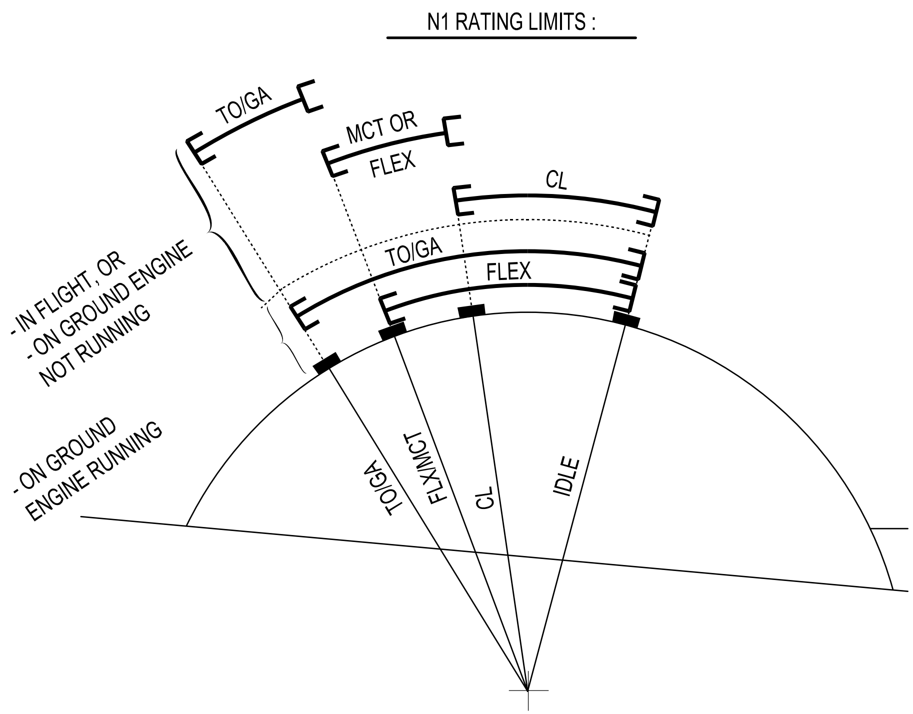
- Dedicated FADEC alternator provides self power above 12% N2 for CFM56.
- Dual redundancy for electrical input devices (ADIRS 1 + 2, TLAs, engine parameters).
- Dual redundancy for electrical part of control actuator.
- Simplex system for hydro-mechanical parts of the control.
- Fault tolerance and fail-operational capability.
- High level of protection against electromagnetic disturbance.
- Interface between the FADEC system and the other aircraft system mainly performed by the EIU through digital data buses.
- One EIU per engine located in the avionics bay.
- Care taken to preserve system segregation for safety and integrity.

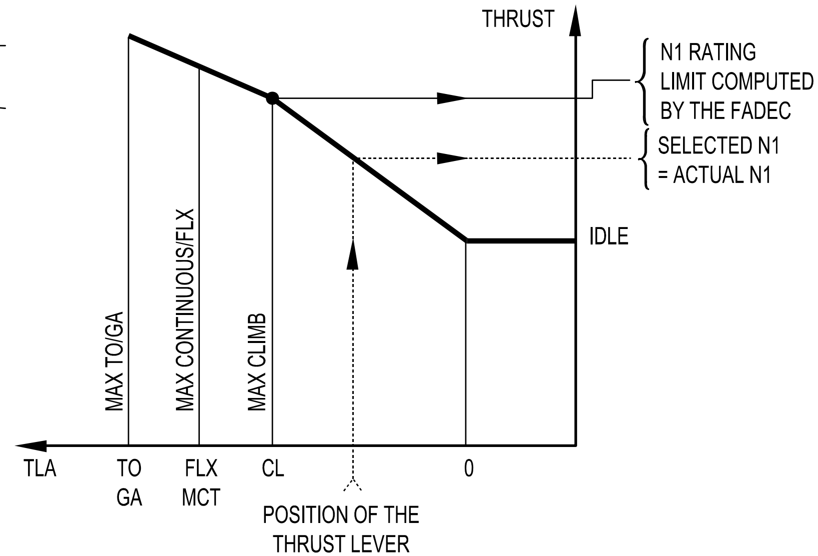
Thrust control system

- Engine thrust control is provided by the FADEC 1, 2, 3 and 4, controlling engines 1, 2, 3 and 4 respectively.
- Thrust selection is performed by means of :
  - Thrust levers, when in manual mode;
  - A/THR function of the FMGS, when in automatic mode, but limited to the value corresponding to the thrust levers' position.
- Limit thrust parameters are computed by the FADEC.
- Since there is no mechanization of the thrust levers (no servomotor) any thrust lever displacement must be performed manually.
- Depending on the thrust lever position, the FADEC computes :
  - Thrust rating limit,
  - N1when in manual mode,
  - N1which can be achieved in automatic mode (A/THR).



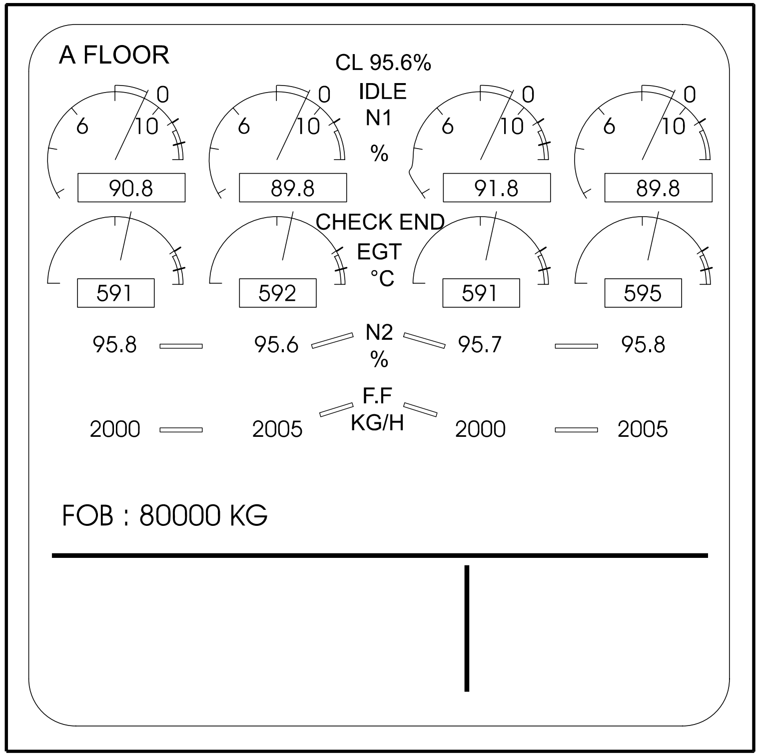
Thrust control operations





A340 Engine Controls

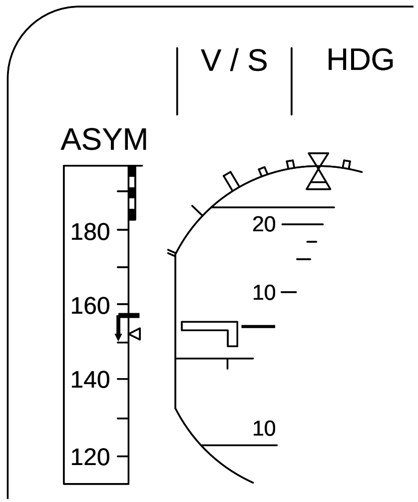
Indications on ECAM upper DU



Indications on PFD : FMA

- The following indications may appear in the upper left corner of the PFD flight mode annunciator, (examples) :

- ASYM : One thrust lever not in CL detent.
- CLB : Flashing, when aircraft is above thrust reduction altitude and thrust levers are not retarded to CL.
- MCT : Flashing, in the case of engine failure, if the non-affected thrust levers are not set at MCT.
- A-FLOOR : When thrust is at MTO and an alpha-floor condition is encountered.



Thrust reverser

- Reverser deployment selection is performed through conventional reverser controls.

- If an outer engine reverser is inoperative, an interlock system prevents the deployment of the opposite thrust reverser.

- At full aft throttle position, maximum reverse power is automatically limited, depending on ambient conditions.

- Reverser status is displayed on ECAM upper DU.

9. Auxiliary Power Unit (APU)

A340 Auxiliary Power Unit

General principles

- **On ground**, the APU renders the aircraft independent by:

  - Providing bleed air for starting engines and for the air conditioning system,

  - Providing electrical power to supply the electrical system.

- **In flight**, provision of back-up power for the electrical system, the air conditioning system and for engine start.

- The APU can be started either by using the aircraft battery, external power, or normal aircraft supply.

  The normal flight envelope does not impose any limitations for starting, except when batteries are supplying starting power.

- The APU is controlled by the Electronic Control Box **(ECB)** which acts as a FADEC for monitoring start and shut-down sequences, bleed air and speed/temperature regulation.

- Controls and displays are located :

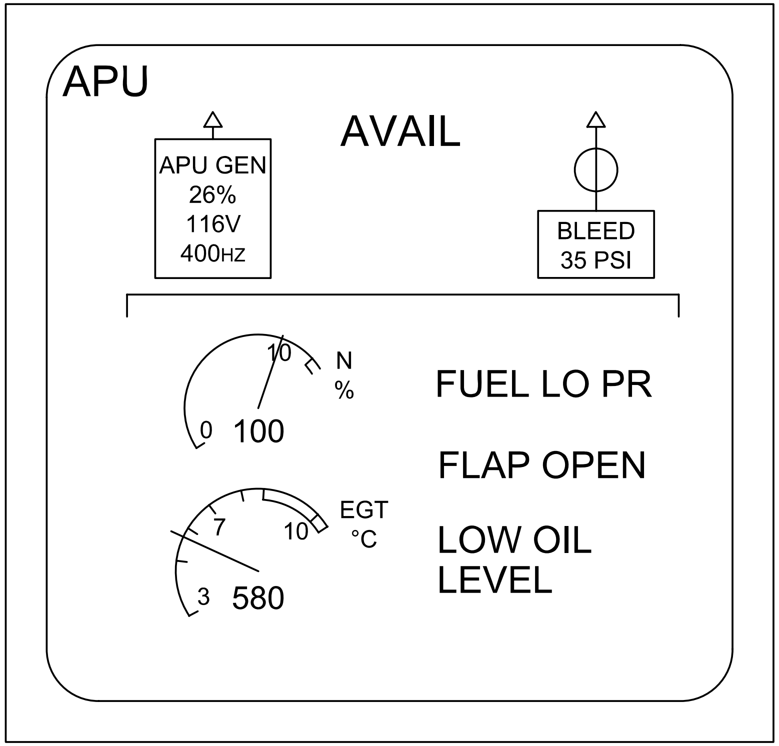
  - On the overhead panel for APU normal operation and fire protection,

  - On the ECAM for APU parameter display,

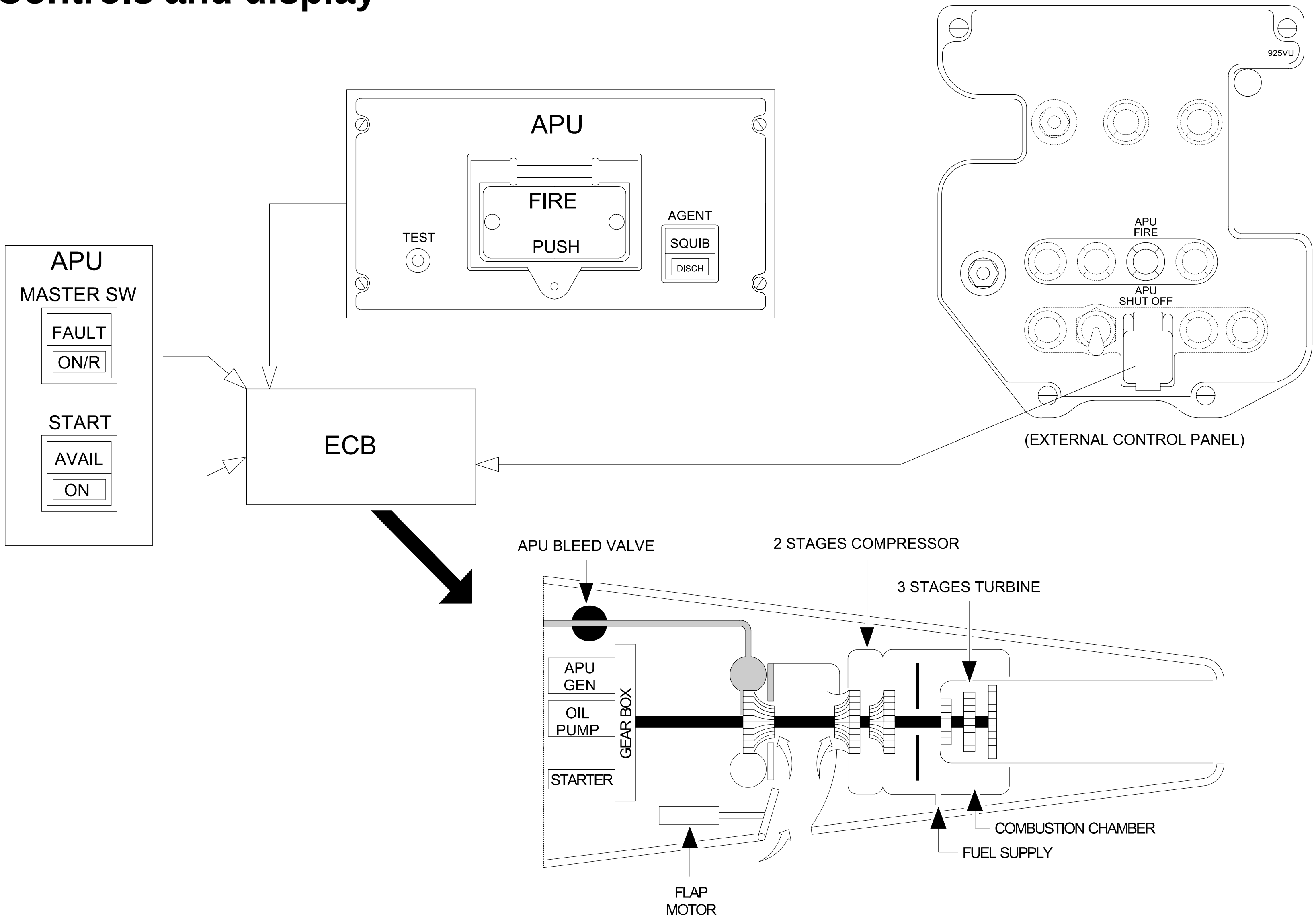
  - On the external power control panel, next to the nose landing gear,

  - On the REFUEL/DEFUEL panel for APU shut-down.

System display



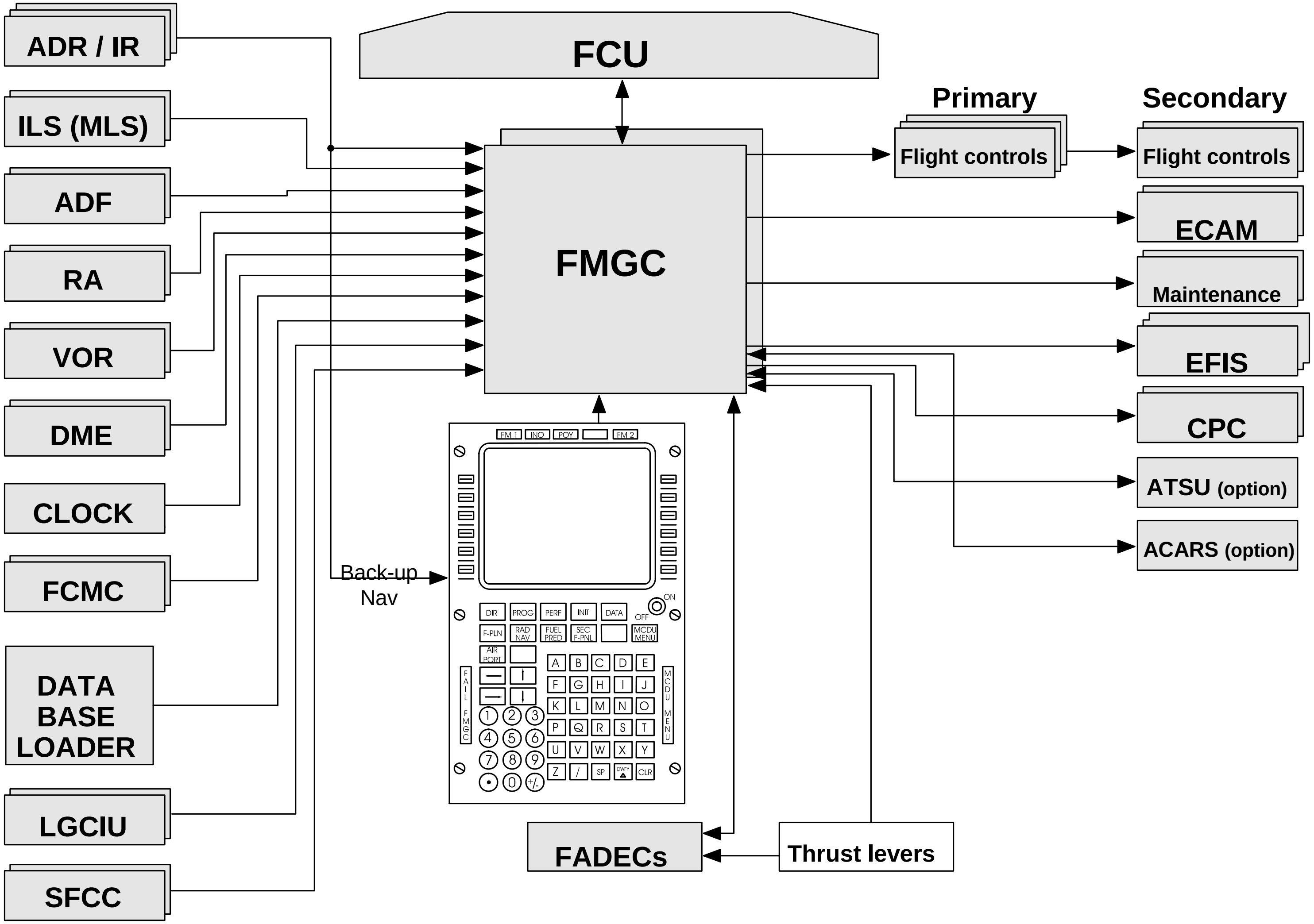
Controls and display



10. Automatic Flight System

A340 Automatic Flight System

Architecture block diagram



A340 Automatic Flight System

Architecture components

Unit	Number per aircraft	Comments
FMGC	2	FMGEC 1 includes AFS/FIDS*
FCU	1	Includes three independent channels
MCDU	3	Color display
A/THR instinctive disconnect switches	2	One for CM 1 and one for CM 2
AP take-over switches	2	One for CM 1 and one for CM 2
North reference switches	1	For EIS and MCDU display
FM source switch	1	For EIS display

* Fault isolation and Detection System

OBRM (On-Board Replaceable Modules) :

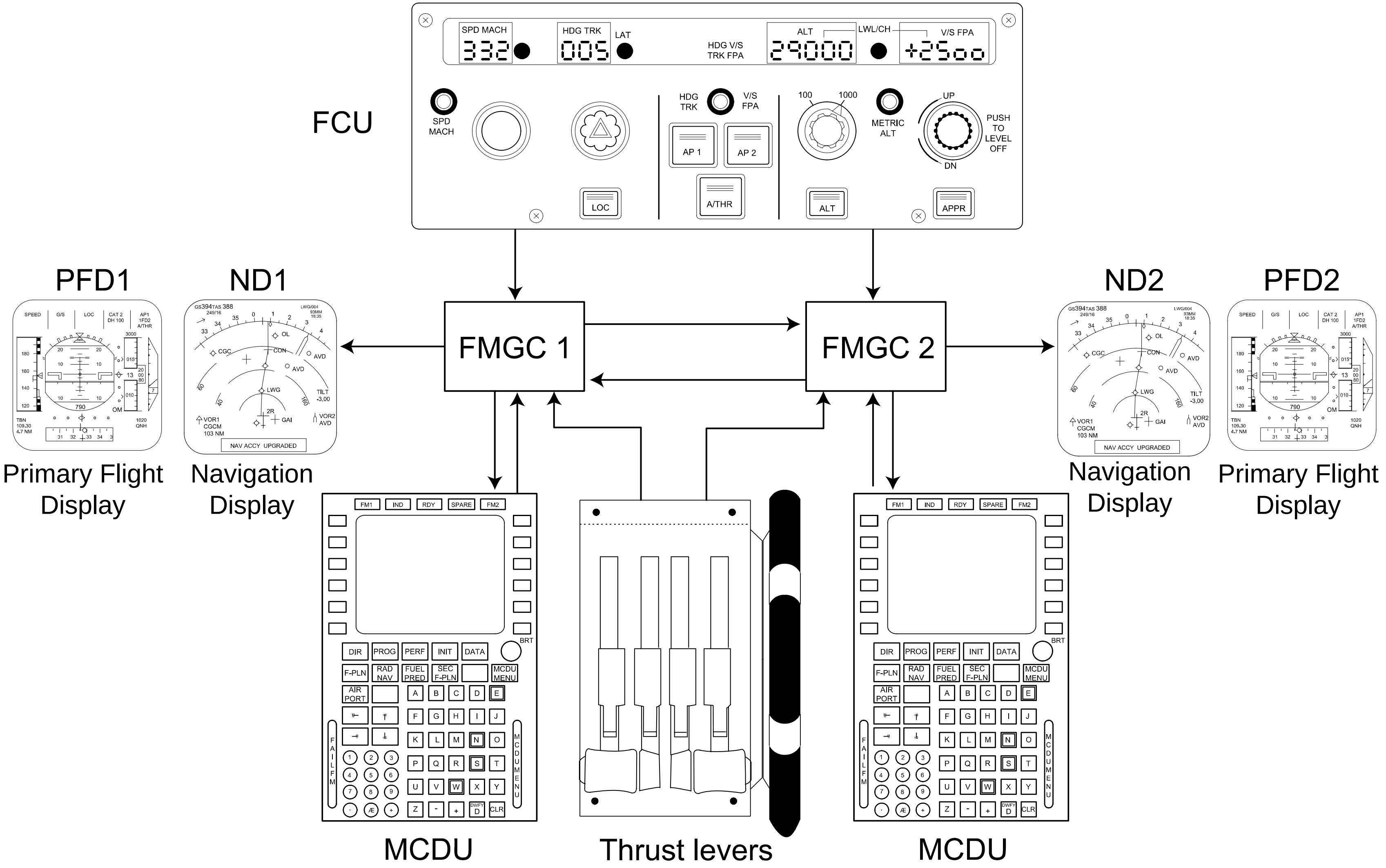
- Solid-state memory modules plugged into the front face of the computer.

- Cost and logistic improvements for software changes.

- Software change can be achieved *in situ* using a common replaceable module reprogrammer.

A340 Automatic Flight System

Flight Management Guidance and Envelope System (FMGS) crew interface



FMGS - AFS/FMS integration

- The FMGS is made up of two computers **(FMGC)** including a management portion **(FM)**, a flight guidance portion **(FG)** and a flight envelope portion **(FE)**. This pilot interactive system provides :

  - Flight management for navigation, performance prediction and optimization, navigation radio aids tuning, and information display management,

  - Flight guidance for autopilot commands (to EFCS), flight director command bar inputs and thrust commands (to FADECs),

  - Flight envelope and speed computation.

- The FMGS offers two types of guidance which are obtained via the AP/FD :

  - **"Managed"** : Guidance targets are automatically provided by the FMGS, as a function of lateral and vertical flight plan data entered in the Multipurpose Control and Display Units **(MCDU)**.

  - **"Selected"** : Guidance targets are selected by the pilot on the glareshield Flight Control Unit **(FCU)**.

  Selected guidance modes always have priority over managed guidance modes.

FMGS crew interface

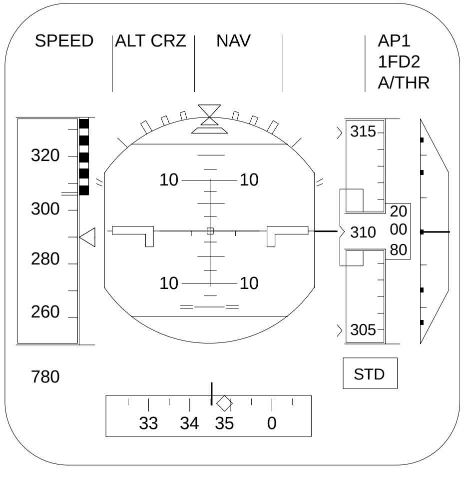
- **Three MCDUs** (only two at a time) on the central pedestal provide **a long-term interface** between the crew and the FMGECs, in terms of :
  - Flight plan definition and display,
  - Data insertion (speeds, weights, cruise level, etc.),
  - Selection of specific functions (direct to, offset, secondary flight plan).
- **One FCU** on the central glareshield provides a **short-term interface** between the crew and the FMGCs.
- **Four thrust levers** linked to the FMGCs and FADECs provide the crew with autothrust or manual thrust control.

- **Two PFDs** and **two NDs** provide visual interface with flight management and guidance-related data such as :

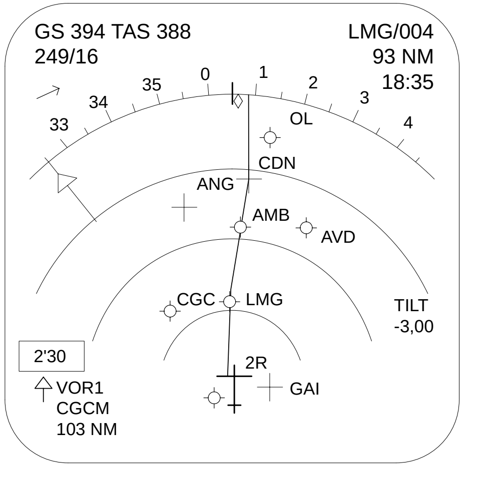
  On the PFD :
  - FMGS guidance targets,
  - Armed and active modes,
  - System engagement status.

  On the ND :
  - Flight plan presentation,
  - Aircraft position and flight path,
  - Navigation items (radio aids, wind).

PFD



ND



A340 Automatic Flight System

General functions

- **Guidance function**

  Fail operational architecture*
  Operation
  Modes

- **Autothrust**

  Operation
  Modes

AP/FD and A/THR mode relationship

- **Flight envelope**

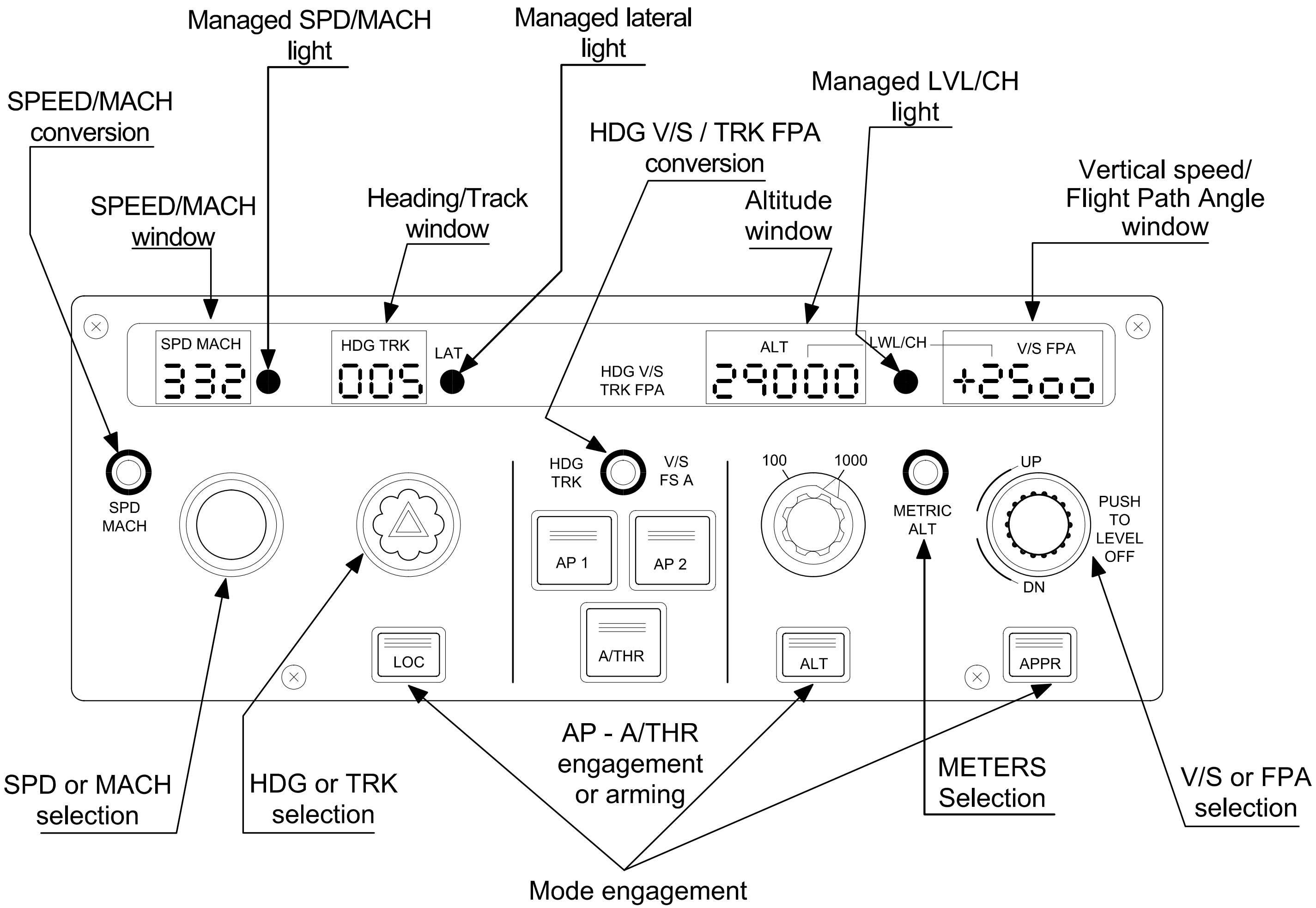
  Envelope protection (windshear, aft CG detection)
  Speed computation

- **Flight management**

  Functional architecture
  Navigation
  Flight planning functions (assembly, fuel management, lateral revision)
  Optimized performance (speed/altitude, prediction)
  Vertical profile

* “Fail Operational” refers to a single system failure which does not modify the aircraft’s flight path.

Flight Control Unit (FCU)



Control knob philosophy	Pull + rotate = selected guidance (pilot input via FCU) Push = return to managed guidance (via FMS)

AP/FD modes

Available modes

Guidance	Managed mode	Selected mode
Lateral	NAV B/C*, B/C, LOC*, LOC RWY RWY TRK GA TRK ROLL OUT	HDG - TRK
Vertical	SRS (TO and GA) CLB, DES ALT G/S*, G/S FINAL DES FLARE	OP CLB, OP DES V/S - FPA ALT*, ALT
Speed	FMGC reference ECON, Auto SPD, SPD LIM	FCU reference

Mode engagement (or arming as long as engagement conditions are not met) :

- By pushbutton action (located on the FCU) LOC - APPR - ALT, AP1 - AP2 - A/THR.

- By action on the thrust levers. On the ground, setting the thrust levers to the TO/GA or FLEX/TO detents leads to AP/FD mode engagement (SRS/RWY).
  During approach, setting the thrust levers to TO/GA engages go-around mode.

- By action on the FCU selection knobs (speed selection knob, HDG/TRK selection knob, altitude selection knob, V/S-FPA selection knob).

  • Push action engages managed mode.

  • Pull action engages selected mode (example : speed or Mach selected mode pushed in flight engages managed speed profile (usually ECON)).

AP/FD operation

- The aircraft can be operated in 'selected guidance' with flight references selected by the crew, or in 'managed guidance' with references computed by the system.

- If the AP/FD controls a vertical trajectory, the A/THR controls the target SPEED/MACH.
  If the AP/FD controls a target speed, the A/THR controls the thrust.

- Selected guidance always has priority over managed guidance, which means that the PF may select a speed, lateral or vertical path at any time; actions are acknowledged on the FCU itself and on the FMA (Flight Mode Annunciator).

- Selected guidance or managed guidance is available for SPEED/MACH control, LATERAL guidance, and LEVEL CHANGE execution.

Lateral modes

NAV : Lateral navigation

- Lateral track is defined by the FMGC, according to the flight plan introduced in the system.

LOC : LOC axis capture and track

- LOC is armed if LOC pushbutton is pressed; LOC capture replaces NAV.

HDG/TRK

- Selection of HDG/TRK references is obtained by turning the dedicated switch located on the FCU.

- HDG/TRK is engaged by pulling on lateral selector; HDG/TRK value can be selected before or after pull action.

- Heading track preselection is possible on ground before takeoff, and in flight starting from a height of 30ft.

Vertical modes

Level changes [managed guidance (CLB, DES), selected guidance (OP CLB, OP DES)].

- In CLB/DES modes vertical path is maintained as defined by the FMGC, taking into account the flight plan constraints inserted in the system and the clearance altitude selected on the FCU.

- OP CLB (OP DES) mode allows uninterrupted aircraft climb or descent towards the FCU selected altitude, maintaining a TARGET SPEED (managed or selected) with a fixed given thrust. ALT constraints are ignored.

Altitude hold
The altitude mode is active :
- when the aircraft reaches the FCU altitude, or
- when the ALT pushbutton is pressed, or
- when V/S is set at zero, or
- when in DES or CLB mode, the aircraft reaches a flight plan altitude constraint.

V/S FPA

- V/S FPA is engaged by pulling on V/S FPA selector. V/S or FPA value can be selected before or after a pull action.

- Level off by pushing the V/S / FPA selector (equivalent to a zero V/S / FA selection + mode engagement).

Common modes

Approach
- ILS available :
  - GLIDE capture and track,
  - FLARE,
  - LAND,
  - ROLL-OUT.

- ILS not available, RNAV approach selected on MCDU :

  - LATERAL guidance on the F-PLN
  - VERTICAL guidance and descent allowed down to MDA.

Takeoff
- SRS :
  - With engines running V2 + 10 holding ;
  - With one engine out
    VA (1) holding if VA>V2,
    V2 holding if VA<V2.

  (1) VA = Aircraft speed when engine failure occurs.

- RWY :
  - Track hold or LOC centerline hold.

Go-around
- SRS (as for takeoff) ;

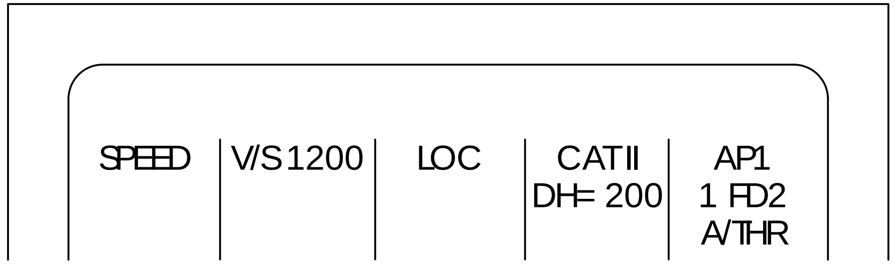
- GA TRK hold.

A340 Automatic Flight System - Autothrust Function

AP/FD and A/THR mode interaction

1st case :

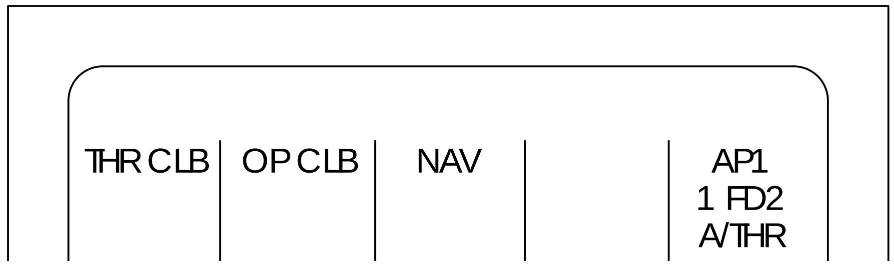
AP/FD pitch mode controls a vertical flight path (V/S or G/S or FINAL,) then A/THR mode controls the target speed/Mach.
e.g. If AP/FD V/S mode is selected, then
A/THR is in SPEED mode.



2nd case :

AP/FD pitch mode controls the target speed/Mach, then A/THR mode controls the thrust.

e.g. If AP/FD open CLB mode is selected, then
A//THR is in THR CLB mode



AP/FD and A/THR SPD/MACH modes

SPD/MACH managed mode :

- Is engaged by pushing the FCU SPD selector knob.
- AP/FD or A/THR holds the SPEED/MACH, as provided by the FMS.
- Speed preset for next flight phase is available by entering preset value on the MCDU; speed preset becomes active at flight phase change.
- Crossover altitude is automatically provided.

SPD/MACH selected mode :

- Is engaged by pulling the FCU SPD selector knob.
- Crossover altitude is automatically provided.
- Manual SPD/MACH selection is available to the pilot via the SPD/MACH conversion pushbutton.

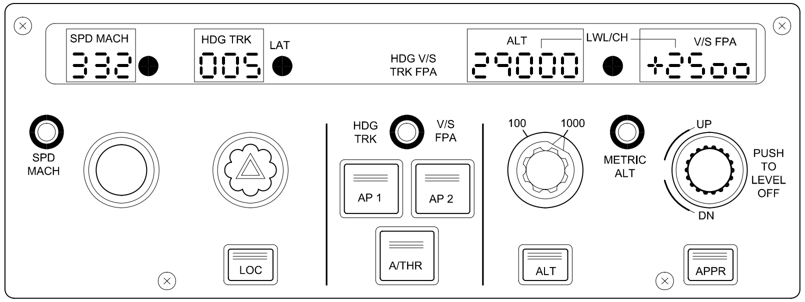
AP/FD and A/THR SPD/MACH modes :

SPEED/MACH managed or **selected** may either be controlled by AP/FD pitch mode or A/THR mode.
The reasons for this are as follows :

- An AP/FD pitch mode may control a flight path or an indicated airspeed - but not both at the same time.
- Thus, if the pitch mode (elevator) controls a flight path, (G/S of V/S) the A/THR controls the IAS, but if the pitch mode controls a speed (OPEN CLB/OPEN DES), then the A/THR will control a thrust.

  Consequently, AP/FD pitch mode and A/THR are linked so that, if no AP/FD is engaged, A/THR can be active in SPD/MACH mode.

A/THR operation - A/THR can be armed, active or de-activated



By pressing A/THR pushbutton switch

By moving TLA in TO/GA or FLEX TO gates

Alpha floor activation

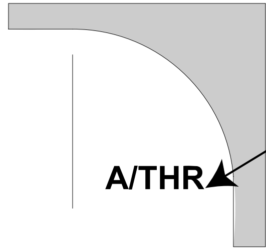
AUTOTHRUST ARMED

A/THR ACTIVE

ARMED

ACTIVE

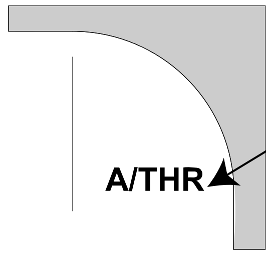
PFD



Blue

At least one TLA above MCT :
Thrust = f (TLA pos.)

PFD



White

No TLA above MCT :
Max thrust = f (TLA pos.)

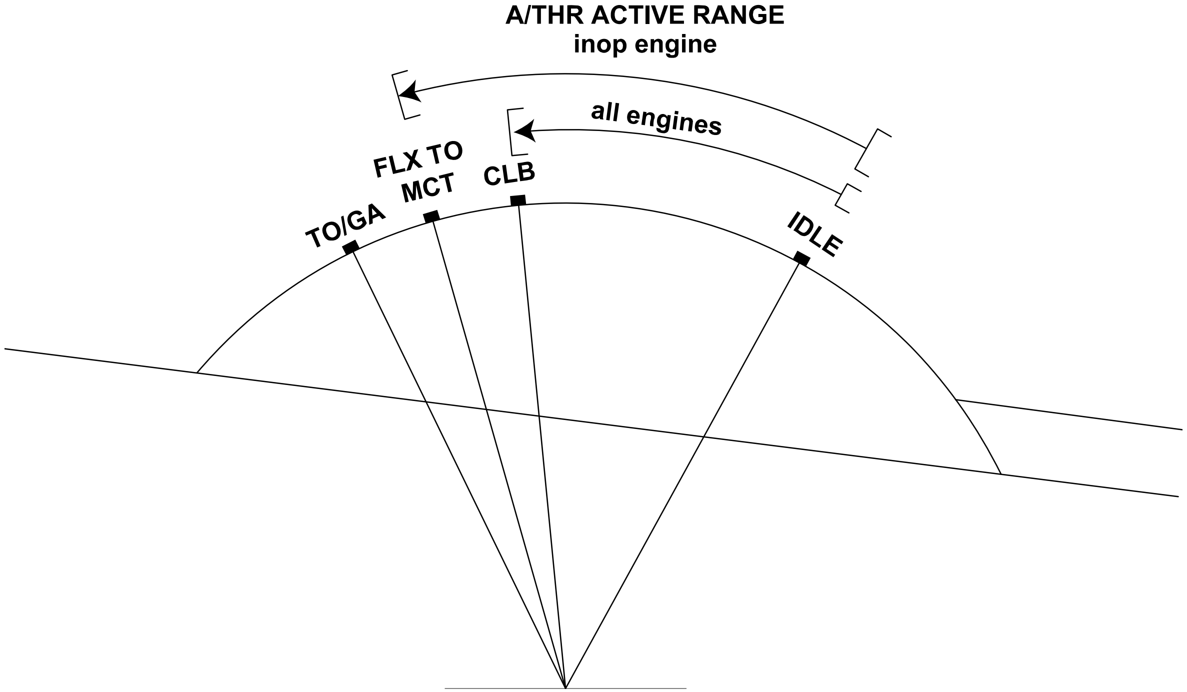
A/THR main features

Each engine thrust is electrically controlled by the associated FADEC (Full Authority Digital Engine Control) which is fully integrated in the autothrust system.

The A/THR function is computed in the FMGC.

The FADECs receive A/THR commands directly from the AFS via an ARINC 429 bus.

Selection of thrust limit mode is obtained from the Thrust Lever Angle (TLA).



A/THR mechanization

The thrust levers can only be moved manually by the pilot.

Takeoff

Thrust mode selection :

- On ground TO limit mode is automatically selected at power up.
- FLX/TO limit mode is selected by setting a FLX/TO temperature on the MCDU (TO page).

Takeoff is performed :

- In limit mode, by manually setting the thrust lever to TO/GA detent.
- In FLX/TO limit mode, by manually setting to FLX/TO/MCT detent.

Notes :

- In both cases, this maneuver also engages FD TO mode (SRS RWY if ILS selected).
- The lowest FLX/TO thrust is limited to CL thrust.

Cruise

Thrust levers must be set :

- To be CLB detent
- To the MCT detent (engine failure case).
- The A/THR modes become active according to AP/FD mode selection.

Approach

Thrust levers must be set to CLB (or MCT engine failure case) detent :

- ATS SPD mode is active

Go Around

GA mode engagement is achieved by setting the thrust levers to TO/GA detent ;

(A/THR armed ; GA thrust is applied via the FADEC).

This maneuver also engages AP/FD GA mode.

Alpha floor

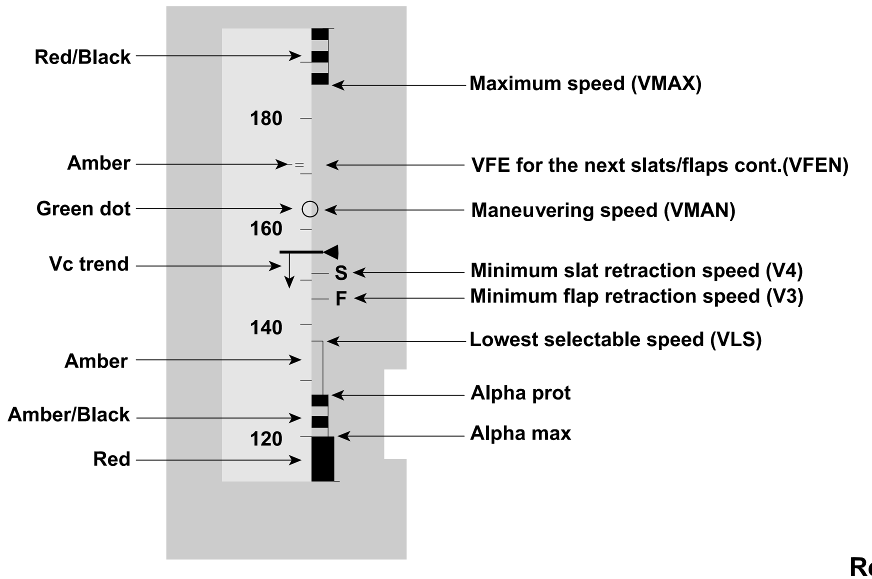
If the alpha floor function is activated, A/THR increases the thrust to the GA thrust limit.

Flight envelope protection

Flight envelope protection is achieved by generating maximum and minimum selectable speeds, windshear warning and aft CG warning. Also computed as part of this protection are the maneuvering speed and the flap and slat retraction speeds.

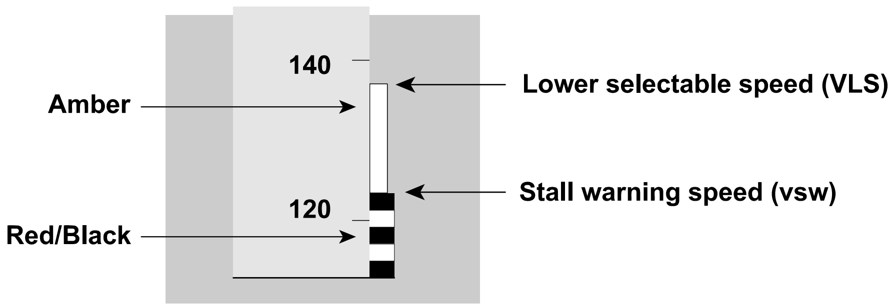
The alpha-floor signal is computed by the flight control computers.

Speed computation (PFD scale)



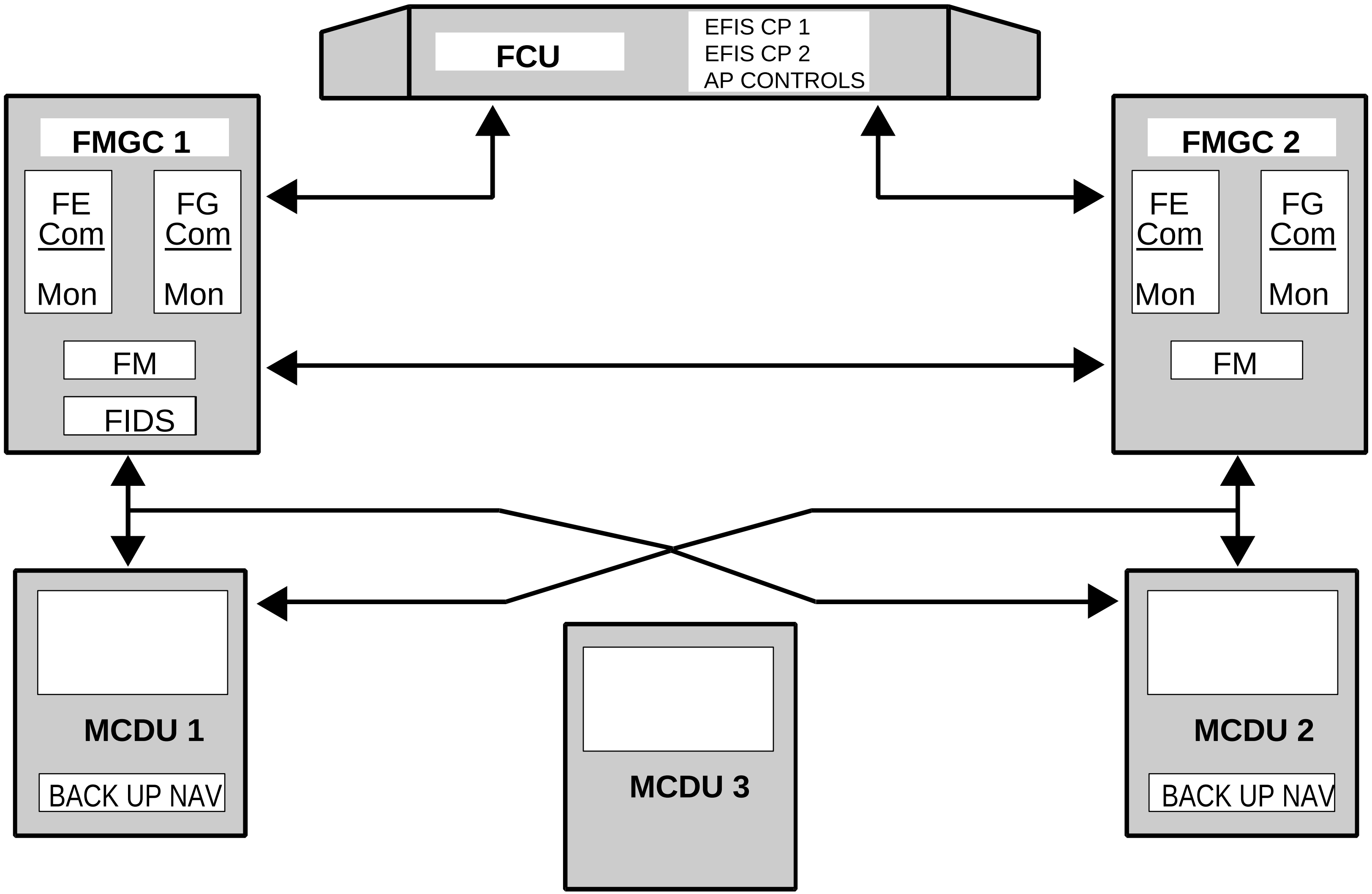
* Only one symbol is displayed, except in TO configuration where all are shown.

In case of loss of normal pitch law



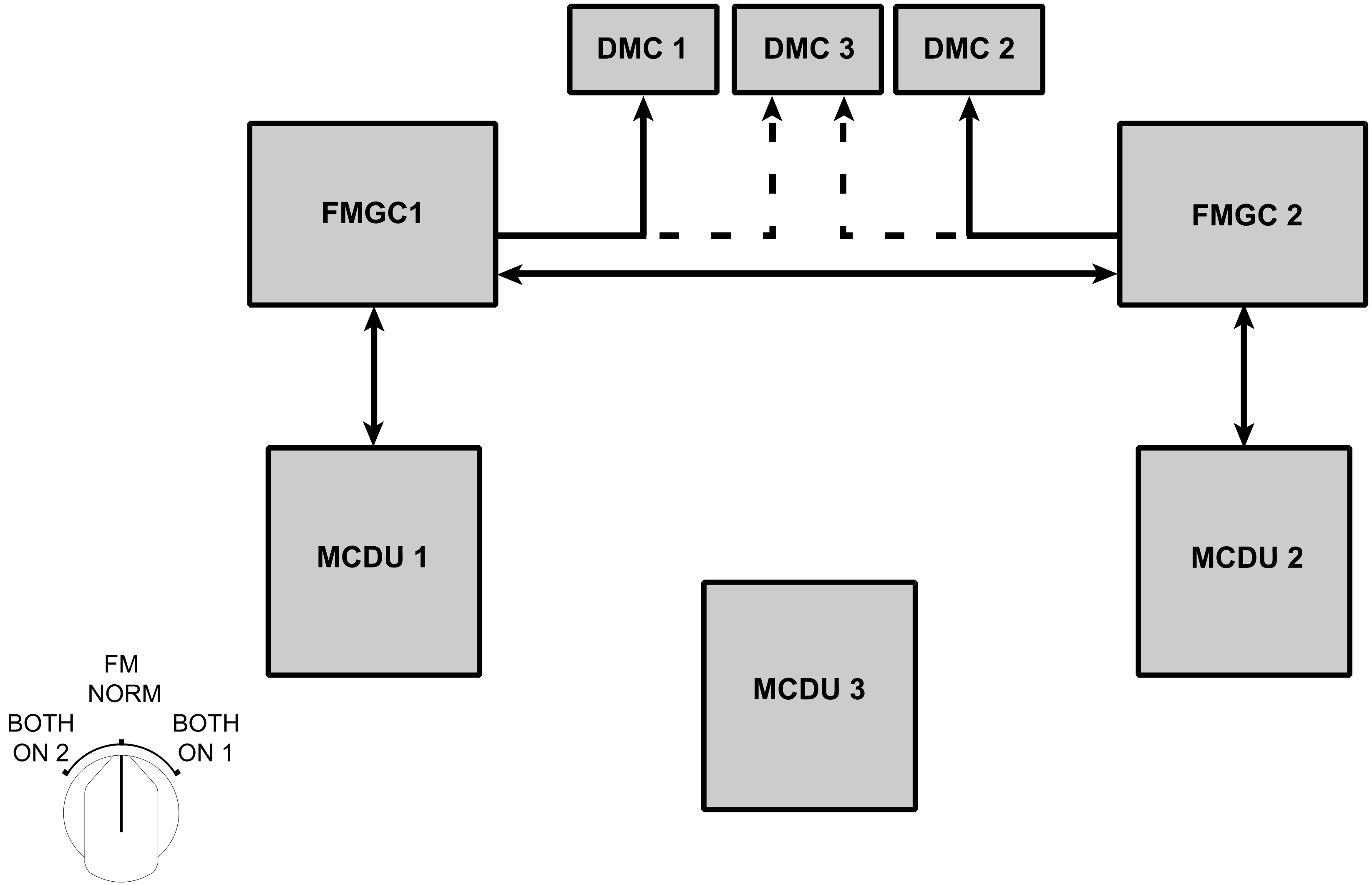
A340 Automatic Flight System - Flight Management

General architecture



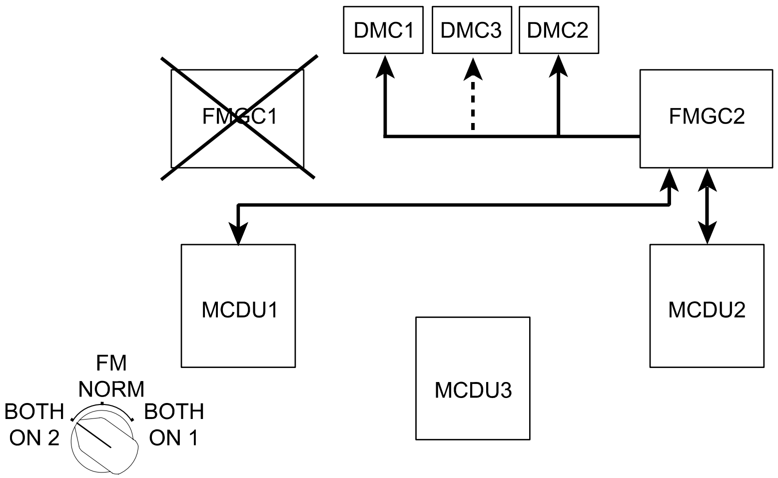
MCDU 3 switchable for FM function, in case of MCDU 1 or 2 failure

Functional architecture - Normal configuration

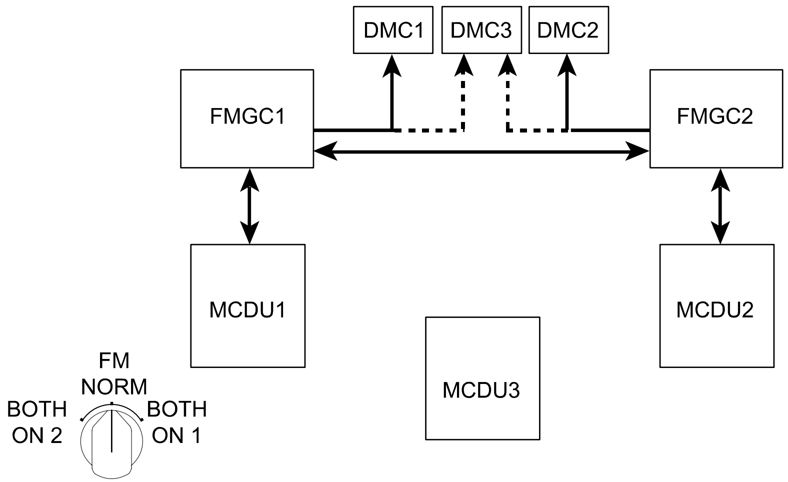


A340 Automatic Flight System - Flight Management

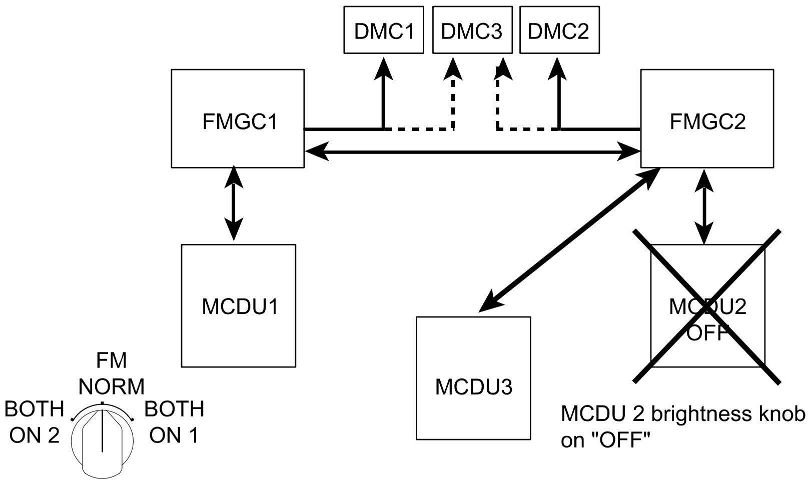
Functional architecture - One FMGC failed



Functional architecture - Normal configuration



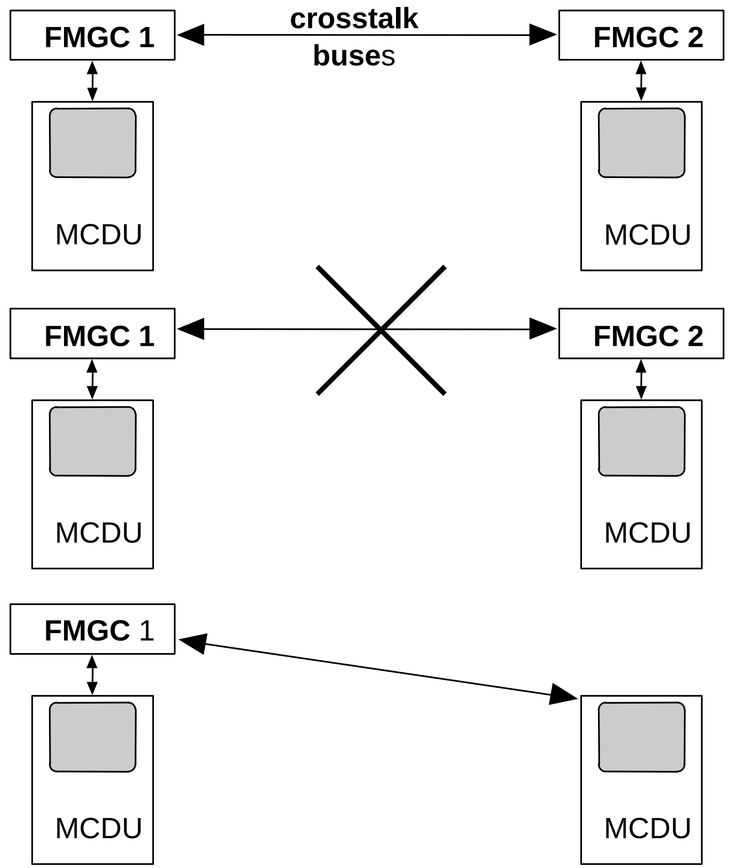
Functional architecture - One MCDU failed



A340 Automatic Flight System - Flight Management

Two FMGCs associated to two MCDUs provide a redundant configuration.

- **Normal mode operation : dual mode**
  - Each FMGC makes its own computation.
  - One FMGC is **master** - the other one is **slave**.
  - Both FMGCs are synchronized.
  - Both MCDUs act independently (entries are automatically transmitted on the other MCDU and applied to both FMGCs).
- **Independent mode**
  - Automatically operative if mismatch occurs between the FMGCs.
  - Independent operation of FMGCs with associated MCDUs.
    (Data insertion and display related to the side concerned.
  - One FMGC remains master.
- **Single mode**
  - One FMGC fails.
  - Either MCDU can be used to enter or display data related to the remaining FMGC.



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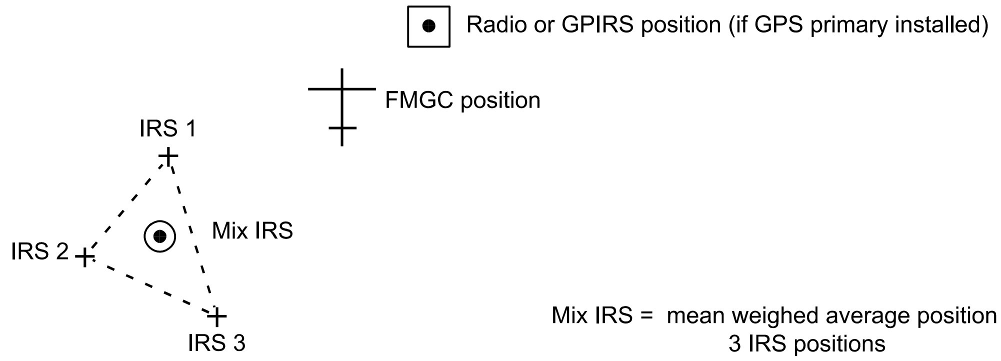
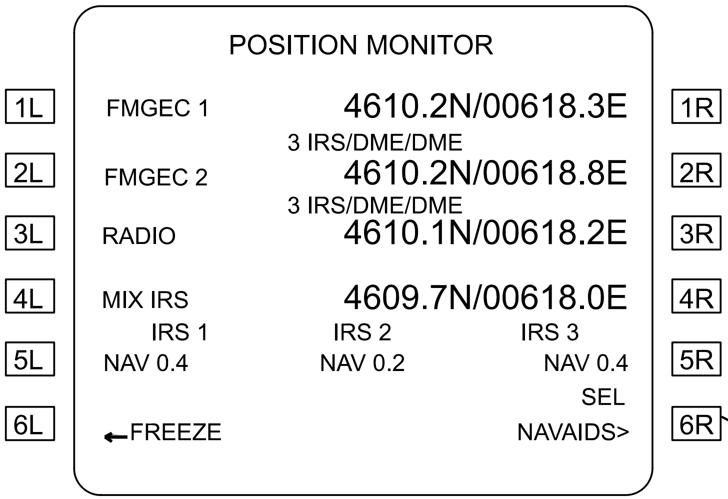
Position indication

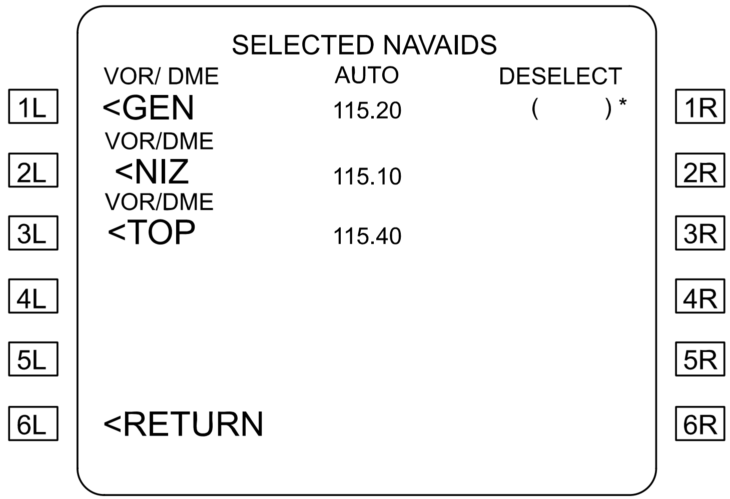


Mix IRS = mean weighed average position of the 3 IRS positions

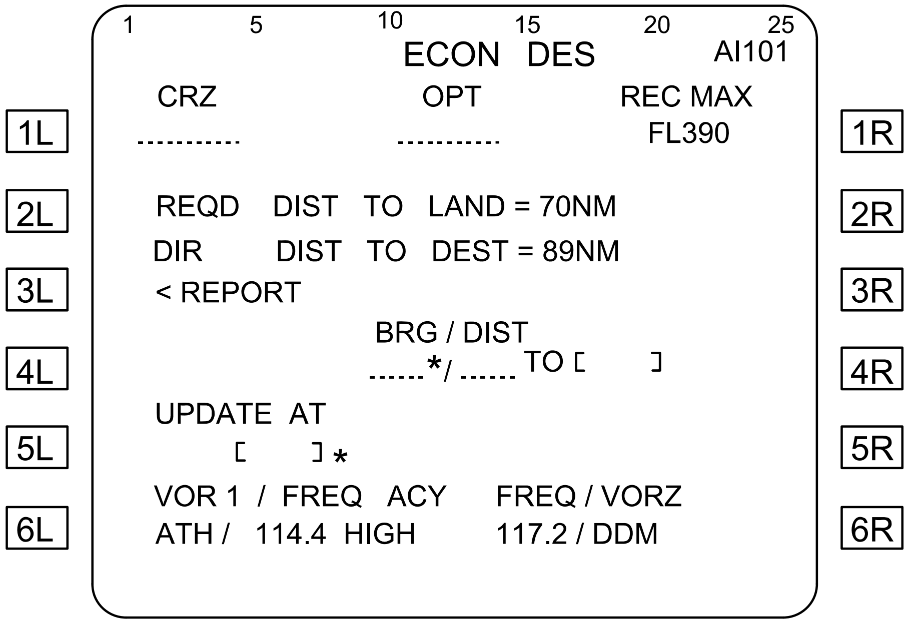
GPIRS = GPS position integrity verified against IRS position



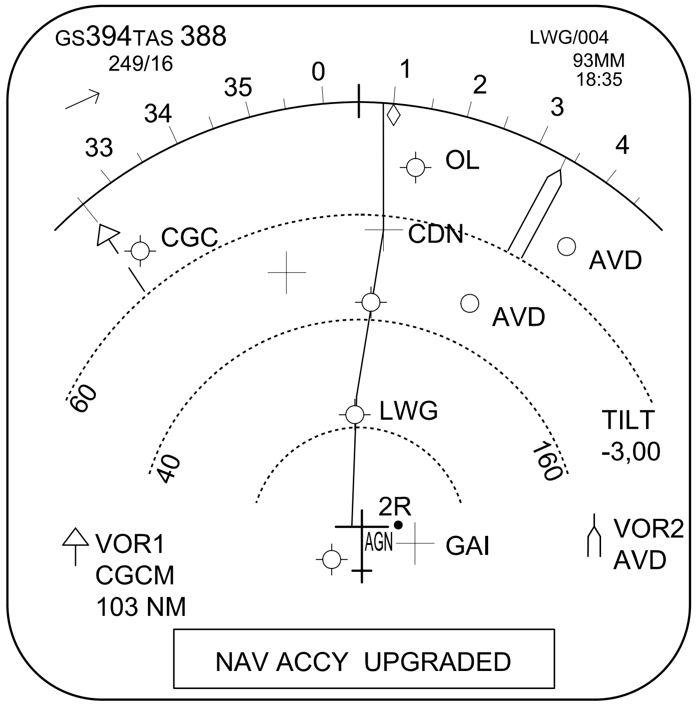
To see the navaids used for radio position



MCDU


1 5 10 15 20 25
ECON DES
AI101
CRZ
OPT
REC MAX
FL390
REQD DIST TO LAND = 70NM
DIR DIST TO DEST = 89NM
< REPORT
BRG / DIST
------*/ ------ TO [ ]
UPDATE AT
[ ]*
VOR 1 / FREQ ACY
FREQ / VORZ
ATH / 114.4 HIGH
117.2 / DDM
1L
2L
3L
4L
5L
6L
1R
2R
3R
4R
5R
6R

ND


GS394TAS 388
249/16
LWG/004
93MM
18:35
33
34
35
0
1
2
3
4
OL
CGC
CDN
AVD
AVD
LWG
60
40
160
TILT
-3,00
2R
AGN
GAI
VOR1
CGCM
103 NM
VOR2
AVD
NAV ACCY UPGRADED

Lateral navigation

- **Position computation :**

  - Before flight, the three IRSs are aligned on airfield or gate position (manually or via database).
  - At takeoff, the position is automatically updated to the runway threshold.
  - In flight, position updating is computed using radio navaids (DME, VOR, ILS and GPS when available).

  The FMGC position is a blend of IRS and radio position. On a medium-term basis, the FM position will tend towards the radio position, if any drift occurs.

- **Navigation mode selection :**

  - If the aircraft is equipped with GPS primary, the FMGC uses the GPIRS position in priority (IRS-GPS mode).
  - If the GPIRS position is not available, or if the aircraft is not equipped with GPS primary, depending upon the availability of navaids and sensors, FMGC automatically uses the best navigation means to compute the most accurate position :

  - IRS - DME/DME
  - IRS - VOR/DME
  - IRS - ILS/DME
  - IRS only.

- The FMGC position is associated with a high or low criterion, which is based on an Estimated Position Error **(EPE)**.

  This EPE depends upon the flying area (en route, terminal, approach) and is permanently compared to Airworthiness Authorities Accuracy Requirements (AAAR).

  - If EPE > AAAR, then LOW is displayed on MCDU and the position must be cross-checked with raw data (ADF/VOR needles, DME reading).

  - Each time HIGH (or LOW) reverts to LOW (or HIGH) the message NAV ACCUR DOWNGRAD (or UPGRAD) is displayed on NDs and MCDUs.

Radio navigation

Each FMGC tunes its own side radio navaids, except when in single operation :

- One VOR, one ILS, one ADF (if belonging to the F-PLN) and five DMEs may be autotuned at the same time.
- Manual tuning always has priority over autotuning.
- Autotune priority rules are according to FMGS logic ;

  For example :

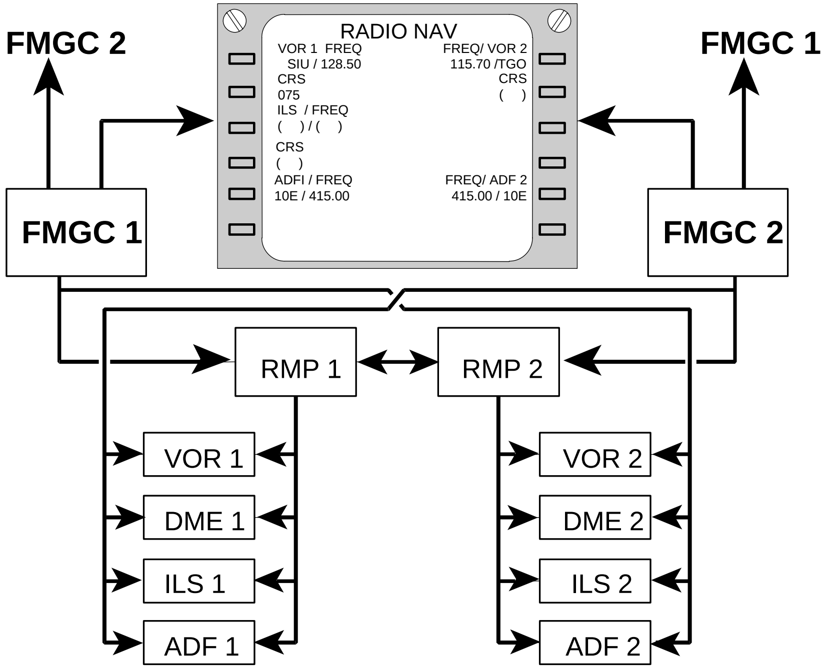
  • VOR autotune (frequency course) priority is :

    - Manual tune,
    - Specified navaid for approach,
    - Radio position computation,
    - Display purpose logic.

  • Five DMEs can be scanned simultaneously

    - One DME for display purposes ;
    - Two DMEs for radio position computation when in DME/DME mode ;
    - One DME for VOR/DME position computation when in VOR/DME mode ;
    - One DME is linked to ILS/DME.

Radio navigation architecture



Navigation and flight planning

Navigation :

- Aircraft position determination.
- Aircraft position referenced to the flight plan.
- Automatic VOR/DME/ILS/ADF selection.
- Automatic guidance along flight plan from takeoff to approach.
- IRS alignment.
- Ground speed and wind computation.
- Polar navigation.
- Optimum radio and inertial sensor mixing.
- Provision for GPS and MLS.

Flight plan stringing :

- Flight plan definition by company route or city pair.
- Departure and arrival procedures, including associated speed/altitude/time constraints.
- Standard flight plan revision (offset, DIR TO, holding pattern, alternate flight plan activation, etc.).
- Additional flight plan revisions linked to long-range flights (DIR TO mechanization, AWY stringing).
- Secondary flight plan creation, similar to primary flight plan.
- Definition of five cruising levels on the flight plan.
- Extension of the database capacity.

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Back-up NAV function

- A back-up source of navigation is available in the MCDU 1 and the MCDU 2, to cover FMS failure cases.

- No database is available in the MCDUs. The FM F-PLN is permanently downloaded in the MCDUs (from the FMS to which the MCDU is linked) and the back-up NAV is selectable on MCDU menu page, if FM source is on ’normal’ position.

- The following features are provided :

  - Lateral revision using :

    . ‘Direct to’ (DIR TO) modification ;
    . Clearing of discontinuity ;
    . Waypoint deletion ;
    . Waypoint lat/long definition and insertion.

  - F-PLN automatic sequencing.

  - Track and distance computation between waypoints.

  - IRS position using one ADIRS (onside or ADIRS 3, according to pilot selection).

  - F-PLN display on ND with crosstrack error.

Flight plan aspects

- Flight plan optimization through the performance database :

  - Optimum speeds ;.
  - Optimum and maximum recommended altitudes ;
  - Optimum step climb.

  The computations are based on :

  - Flight conditions (multiple cruise levels, weights, center of gravity, meteorological data) ;
  - Cost index, given by the airline ;
  - Speed entered on the FCU or given in the flight plan.

- Performance predictions :

  - Time, altitude, speed at all waypoints ;
  - Estimated time of arrival, distance to destination ;
  - Estimated fuel on board (EFOB) at destination ;
  - Energy circle.

- Advisory functions :

  - Fuel planning ;
  - Optimum altitude and step climb ;
  - Ttime/distance/EFOB to enroute diversion airfields.

- Fuel vertical guidance related to flight plan predictions, from initial climb to approach.

Vertical profile

- **Takeoff**
  SRS control law maintains V2 + 10 up to thrust reduction altitude where max climb thrust is applied. V2 + 10 is held up to acceleration altitude (ACC ALT).

- **Climb**
  Energy sharing is applied for acceleration (70% thrust) and for altitude (30% thrust) from ACC ALT up to first climb speed. Max climb thrust is kept - altitude and speed constraints are taken into account.

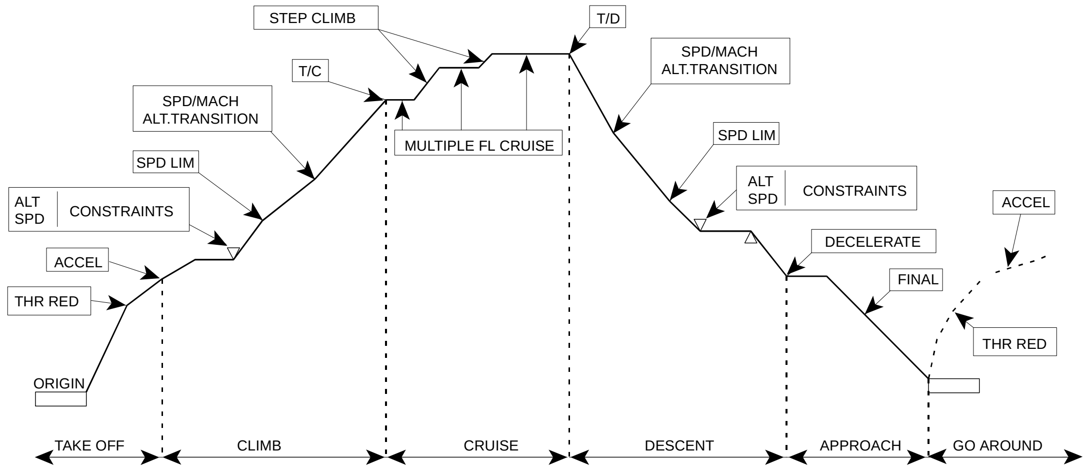
- **CRZ**
  Steps may exist and/or may be inserted.

- **Descent**
  Top of Descent (T/D) is provided on ND.
  From T/D down to the highest altitude constraint, ECON descent speed is held by the elevator and IDLE thrust by the A/THR. If this status can no longer be held or maintained, geometric segments will be followed between the constraints.

- **Approach**
  From DECEL point, a deceleration allows configuration changes in level flight.

  Approach phase is planned to reach approach speed at 1000 ft above ground level.

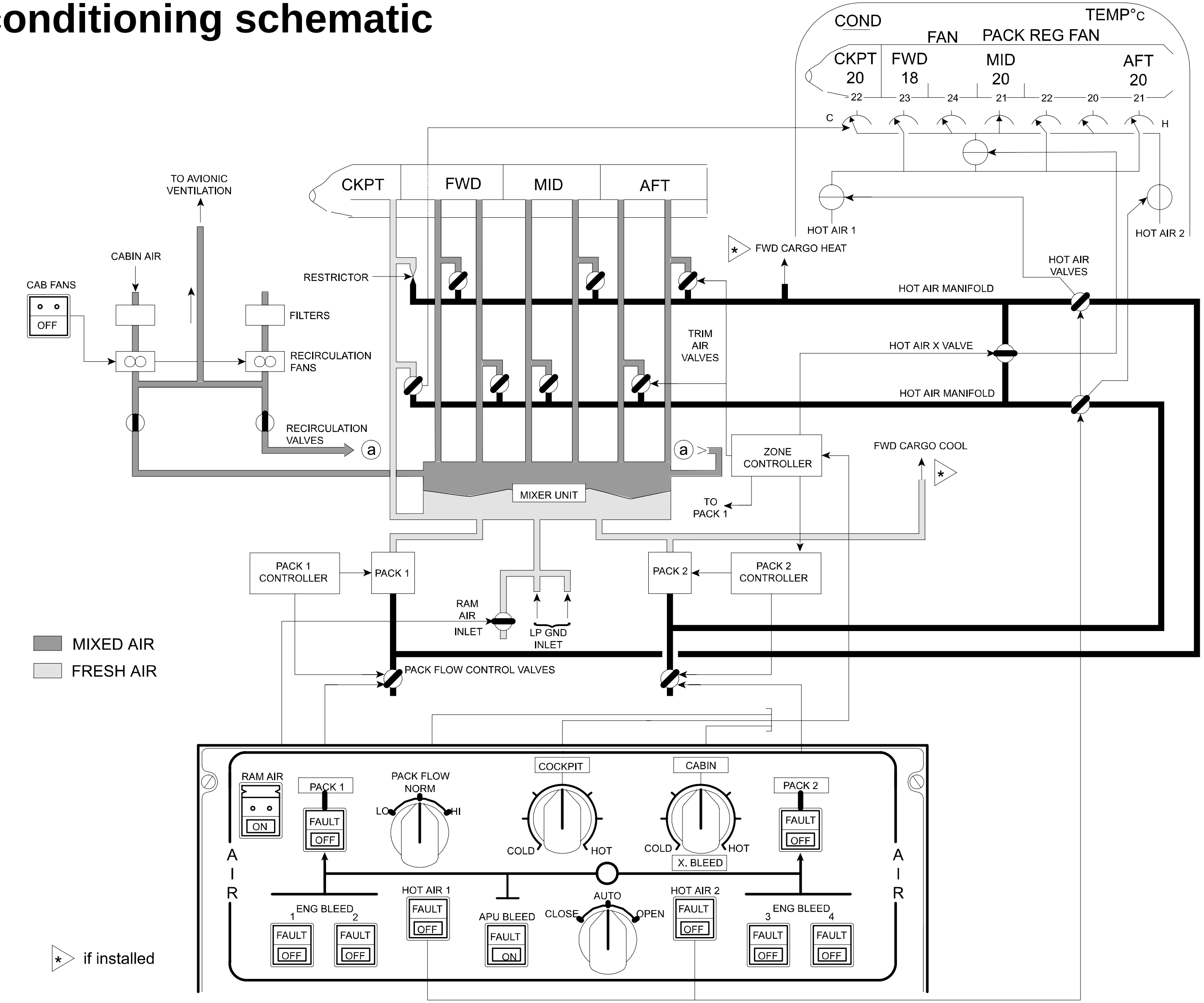
Flight plan - vertical definition



11. Environmental Control System

A340 Environmental Control System

Air conditioning schematic



Air conditioning

The hot compressed air is cooled, conditioned and delivered to the fuselage compartments and then discharged overboard through two outflow valves.

Fresh air can also be supplied to the distribution system through two low-pressure ground connections. A ram air inlet supplies emergency air to the fuselage, if there is a complete failure of the air generation system during flight. A mixing manifold, mixes fresh air with cabin air.

The cabin air that enters the underfloor area, is drawn through recirculation filters by fans. The recirculation fans then blow the air through check valves to the mixing manifold. The flight deck is supplied by fresh air only.

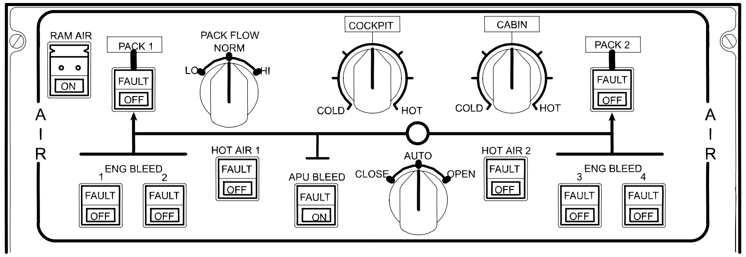
Hot bleed air is tapped downstream of the pack valves. The air flows through two hot air valves which control the pressure of the hot trim air going into two hot air manifolds.

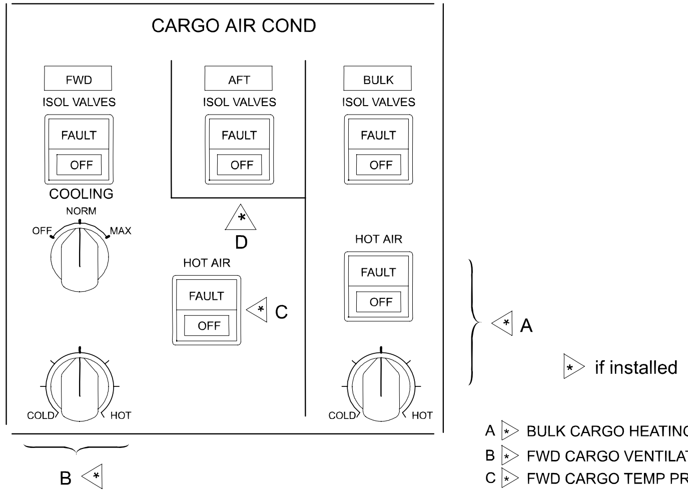
To control the temperature in the different upper deck zones, the quantity of trim air added is controlled through the cockpit and cabin temperature control system. Hot air is delivered to the air supply ducts through the related zone trim air valves. The trim air valves are controlled through the temperature requirements of each zone and duplicated for cabin zone flexibility.

The trim air system has several features to ensure that no substantial comfort degradation occurs in case of trim air valve or hot air valve failure; a hot cross-bleed valve is installed between the two hot air manifolds and will open to maintain trim air supply to all riser ducts, in the event of hot air failure (blocked closed). Moreover, in the event of trim air valve failure (blocked open) and/or duct overheat, as the shut-off valve is normally closed and there are two riser ducts per cabin zone, only half of each zone will lose its trim air supply. The flight deck is permanently supplied by a constant restricted trim air flow, in addition to the normal controlled trim air supply.

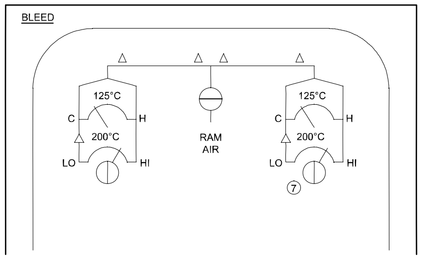
In addition, all packs and zone temperature control systems are duplicated or have back-up modes, a simple failure has no influence on flight deck and cabin comfort. All computers have a segregated two-line concept. Packs have built-in flow and temperature back-up regulation modes to overcome any failure case, including air cycle machine seizure.

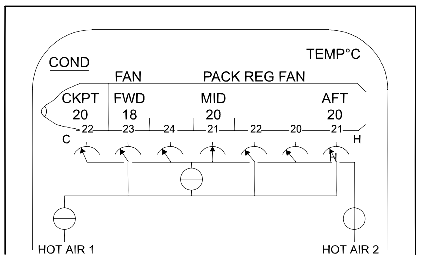
Air conditioning - Air bleed

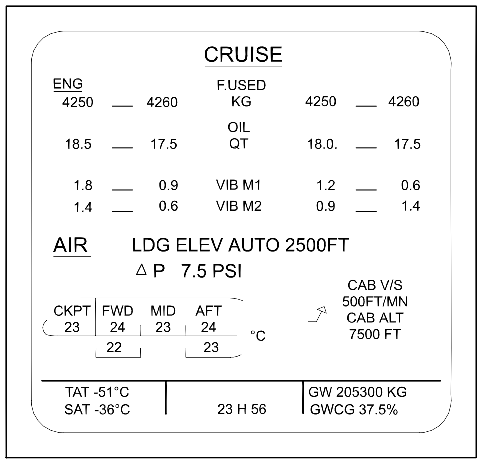




A BULK CARGO HEATING
B FWD CARGO VENTILATION AND HEATING
C FWD CARGO TEMP PRESELECTION
D AFT CARGO VENTILATION





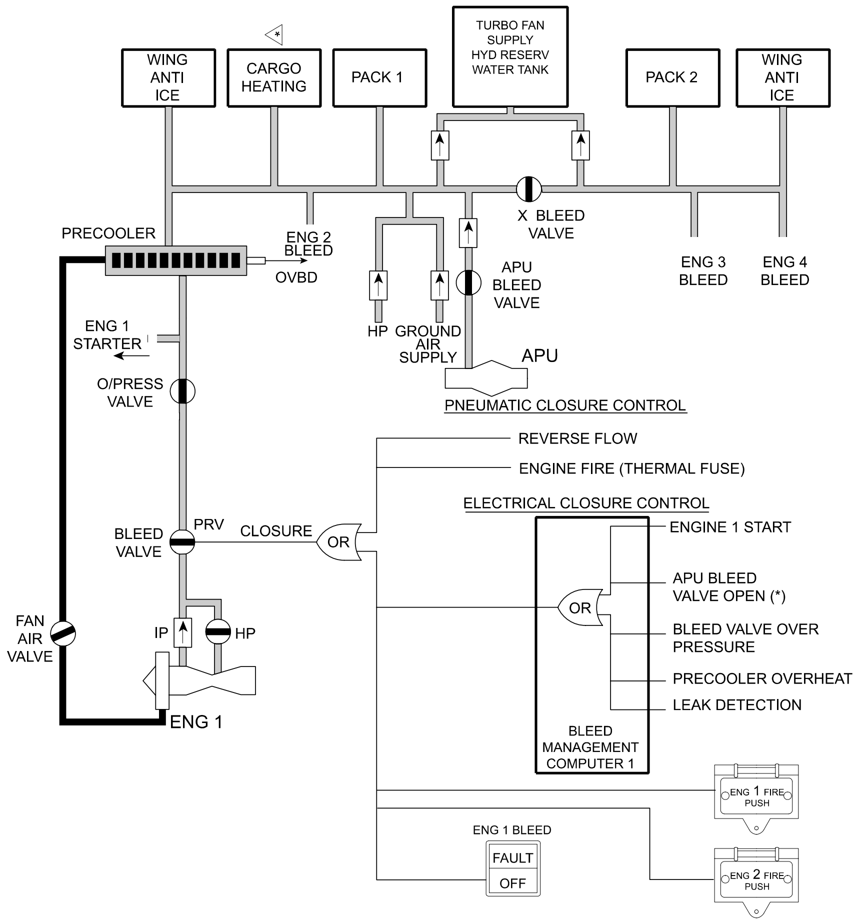


Pneumatic

- Pressurized air is supplied for air conditioning, air starting, wing anti-ice, water pressurization and hydraulic reservoir pressurization.

- System operation is electrically monitored by Bleed Monitoring Computers **(BMC)**, and is pneumatically controlled.

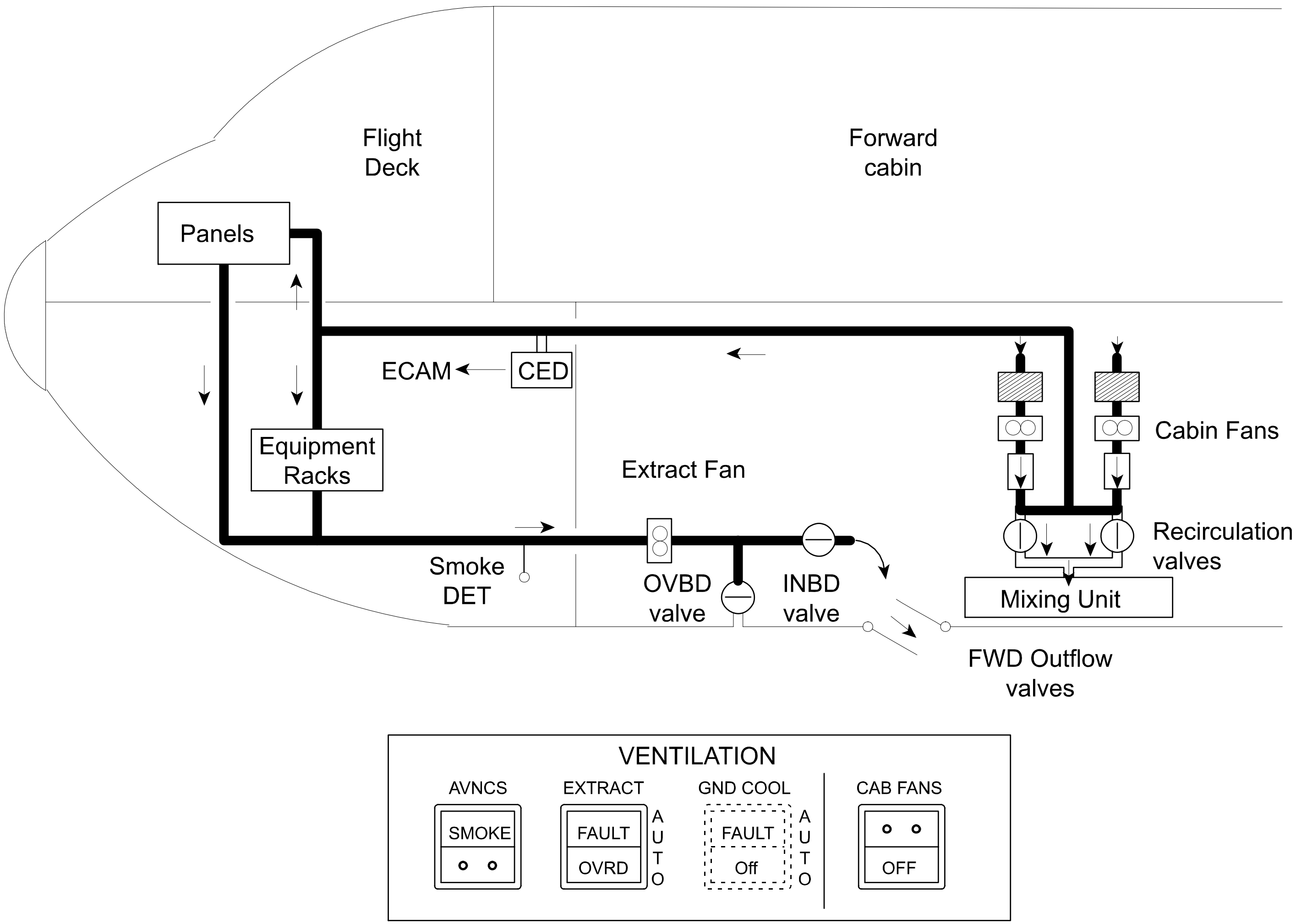
- A leak detection system is provided to detect any overheating in the vicinity of the hot air ducts.



(*) For engine 3 and 4, the bleed valve closure due to APU bleed valve open will occur only if the X.BLEED valve is not selected CLOSE.

* as installed

Avionics ventilation



Ventilation

- **Avionics ventilation**

  Provides ventilation and cooling of avionics and electronic equipment under digital control (without any crew intervention) by the Avionic Equipment Ventilation Controller **(AEVC)**.

  - Cabin fans (or packs as a back-up) provide blown air to the avionics compartment.
  - Extract fan (continuously on) blows air through the overboard valve (on ground), or the under-floor valve (in flight).
  - Manual control partially opens the overboard valve (fan failure or cockpit smoke removal).

- **Pack bay ventilation**

  Maintains a mean temperature compatible with the structure constraints. In flight, air is fed from outside through a NACA air inlet. On ground, air is blown by a turbofan which is driven by the air bleed system.

- **Battery ventilation**

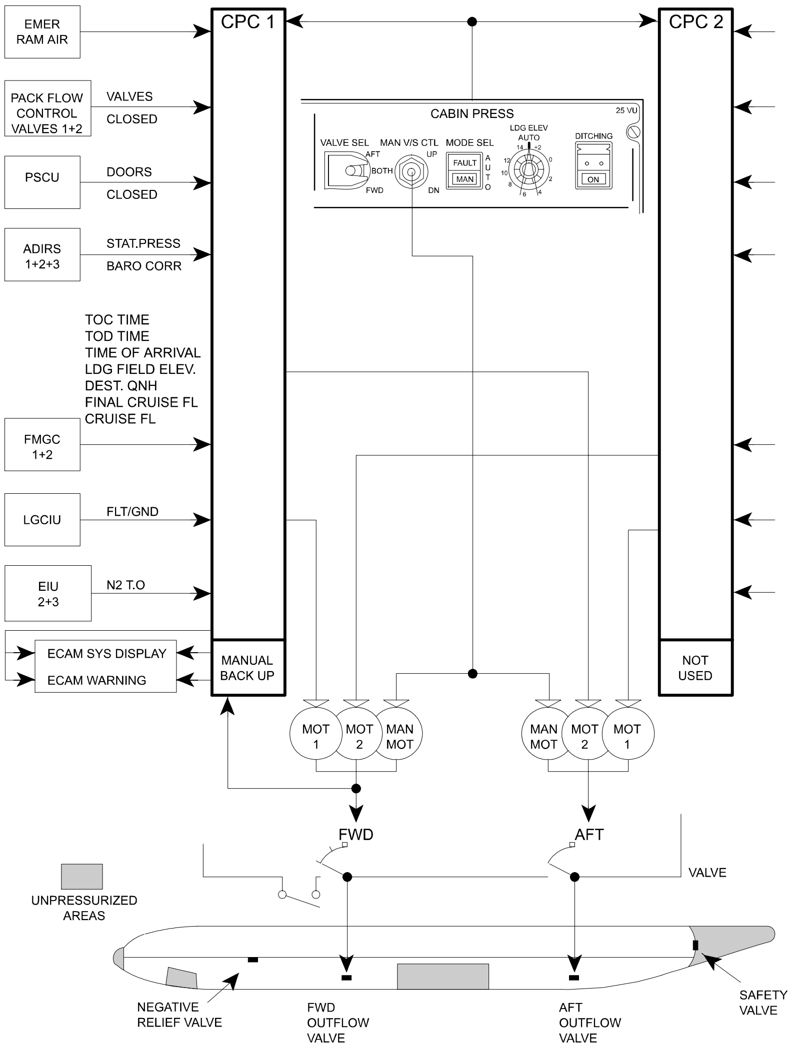
  Provided by ambient air being drawn around the batteries and then vented directly outboard via a venturi.

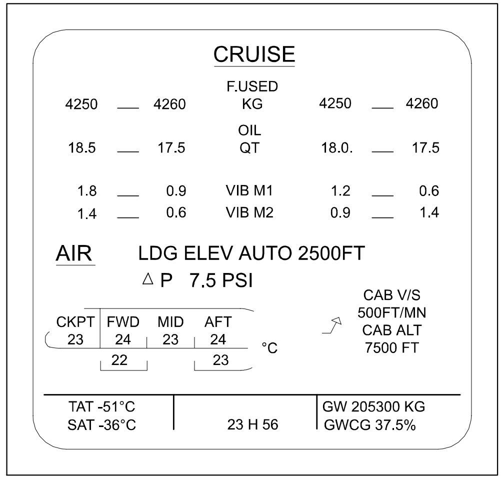
- **Lavatory and galley ventilation**

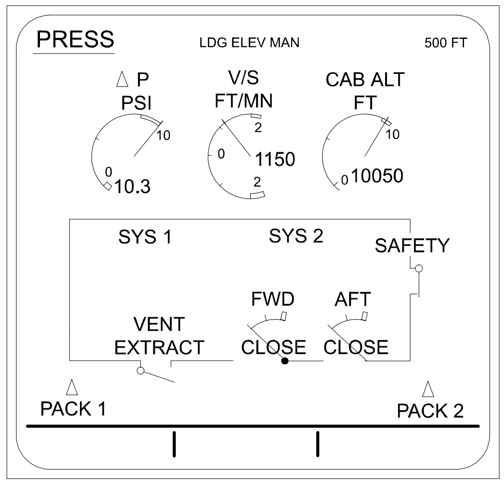
  Provided by ambient cabin air, extracted by a fan and exhausted through a venturi at the aft of the aircraft near the outflow valves.

A340 Environmental Control System

Cabin pressure control







Pressurization

- The pressurization control system is fully automatic.

- It is a dual system, with automatic switchover after failure. Each system is alternatively used from one flight to the other. Two outflow valves are operated by any of three independent electric motors. These two valves are associated with the automatic controllers.

- In normal operation, cabin altitude and rate of change are automatically controlled from FMGC flight plan data :

  - Cruise flight level, landing field elevation, QNH ;
  - Time to top of climb, time to landing.

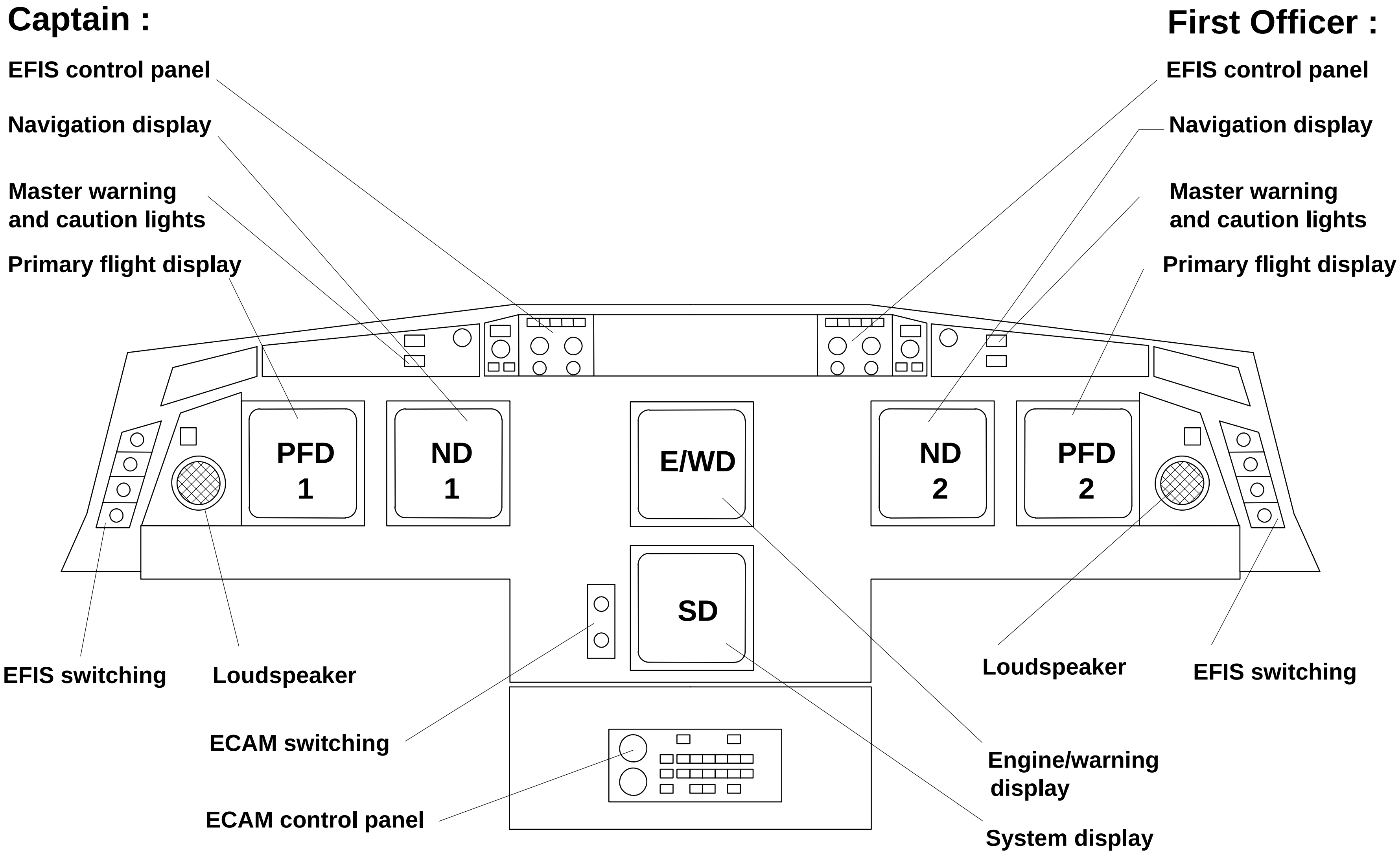
- In case of dual FMGC failure, the crew has to manually select the landing field elevation. The cabin altitude varies according to a pre-programmed law.

- In case of the failure of both pressurization system auto-controllers, the manual back-up mode is provided via the third outflow valve motor.

12. Electronic Instrument System (EIS)

A340 Electronic Instrument System

Cockpit arrangement



General

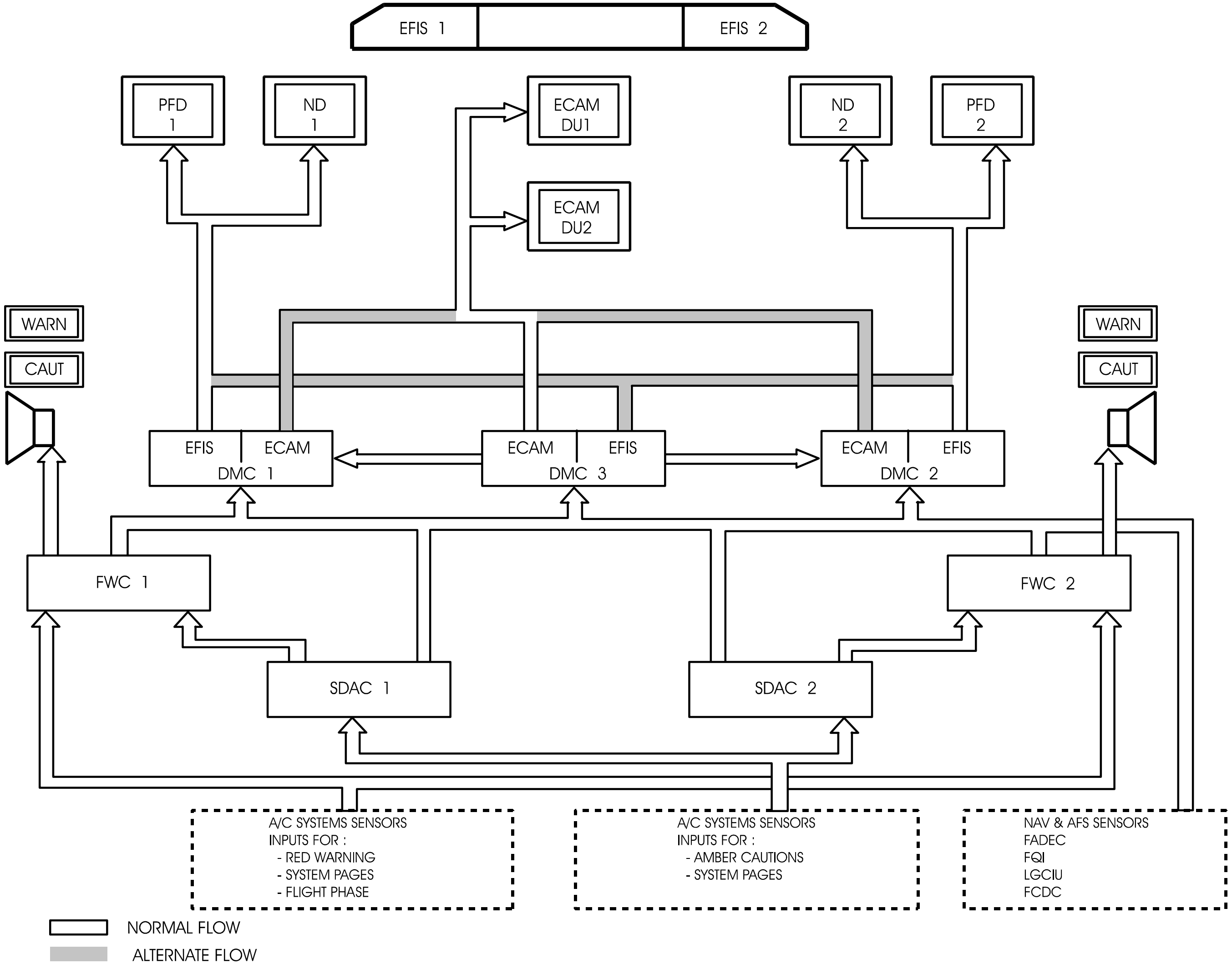
The Electronic Instrument System (EIS) performs a **display** function for :

- **Flight operation :** EFIS (Electronic Flight Instrument System located on each crewmember's instrument panel :
  - 1 PFD (Primary Flight Display)
  - 1 ND (Navigation Display)
- **System operation** : ECAM (Electronic Centralized Aircraft Monitor)

  On the center instrument panel for both crewmembers :
  - 1 E/WD (Engine/Warning Display)
  - 1 SD (System Display)

The crew remains in the INFORMATION/ACTION loop at all times and is able to CHECK and OVERRIDE the automation (if necessary).

EFIS / ECAM architecture



A340 Electronic Instrument System

Components

- **DU** (Display Unit) → **Display function**
  - Six identical full-color DUs
  - 7.25in x 7.25in case size
  - Symbol generator resident in DU
- **DMC** (Display Management Computer) → **Acquisition and processing functions**
  - Three identical DMCs
  - Each DMC has two independent channels : EFIS/ECAM
  - Each DMC is able to drive all six DUs with four independent formats : PFD ; ND ; E/WD ; SD.
- **SDAC** (System Data Acquisition Concentrator) → **Acquisition of system data for transmission to FWC and DMC**
  - Two identical SDACs
  - The SDACs are connected to the DMCs and FWCs
- **FWC** (Flight Warning Computer) → **Acquisition and processing of :**
  - Two identical FWCs
  - Each FWC is connected to all DMCs.

Acquisition and processing of :
- **Alert messages**
- **Memos**
- **Aural alerts**
- **Flight phases**
- **Auto callout**

A340 Electronic Instrument System

Architecture

- **Fully redundant EIS architecture :**

  Partitioned DMCs (3 EFIS functions/3 ECAM functions) to drive the 6 DUs :

  - Full reconfiguration capability ;
  - Independence between EFIS and ECAM switching.

- **Benefits :**

  - Dispatchability ;
  - No operational degradation when a DMC fails or some external computers fail (ADIRS, FWC, SDAC, etc.).

Availability objectives

- With one DMC and one DU failed, all functions remain available :

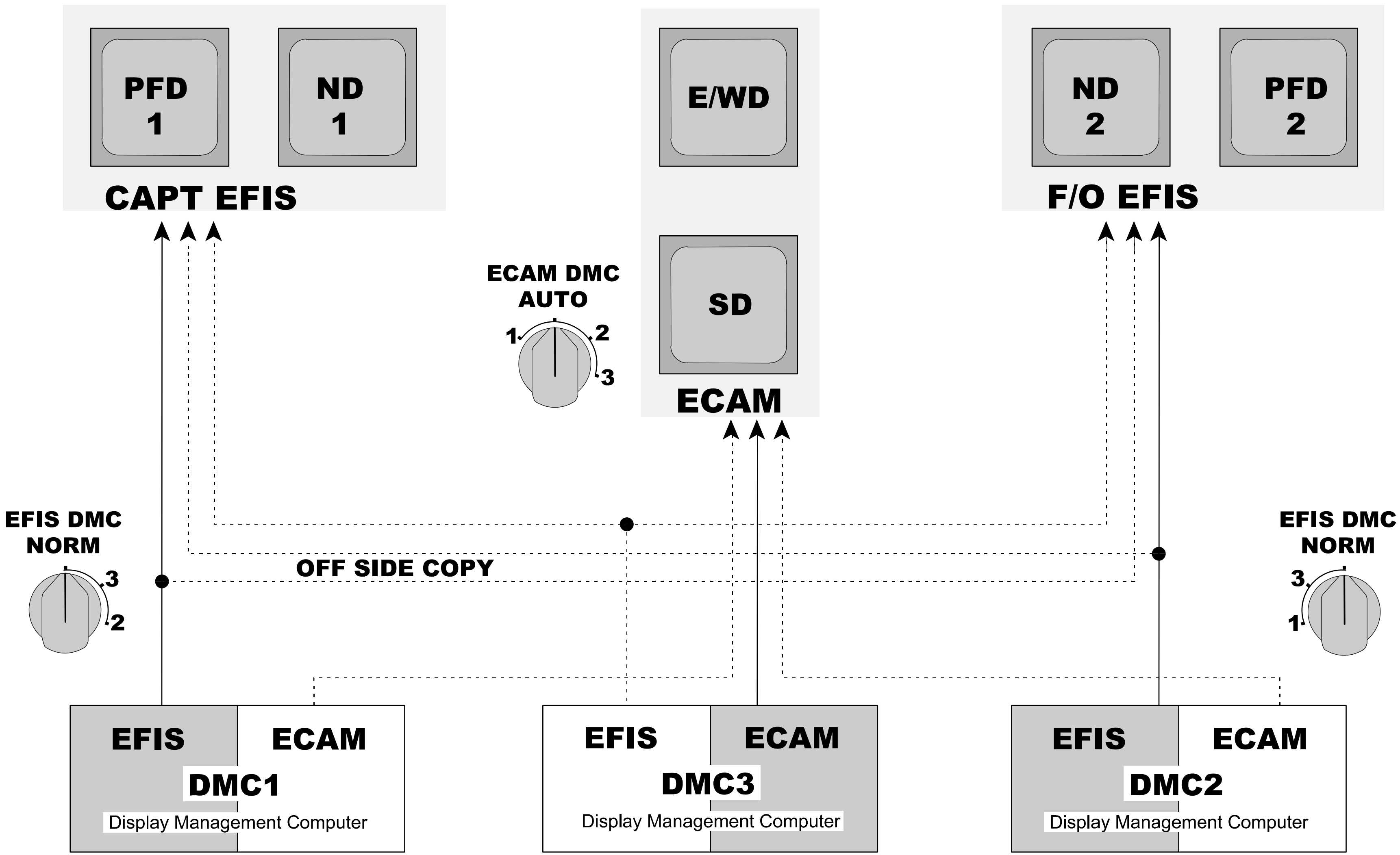
  - EFIS 1,
  - ECAM,
  - EFIS 2.

- After two failures (normal operation) or one failure (MEL operation) the following functions remain available :

  - EFIS 1 or 2,
  - ECAM,
  - Copy of remaining EFIS on the opposite side.

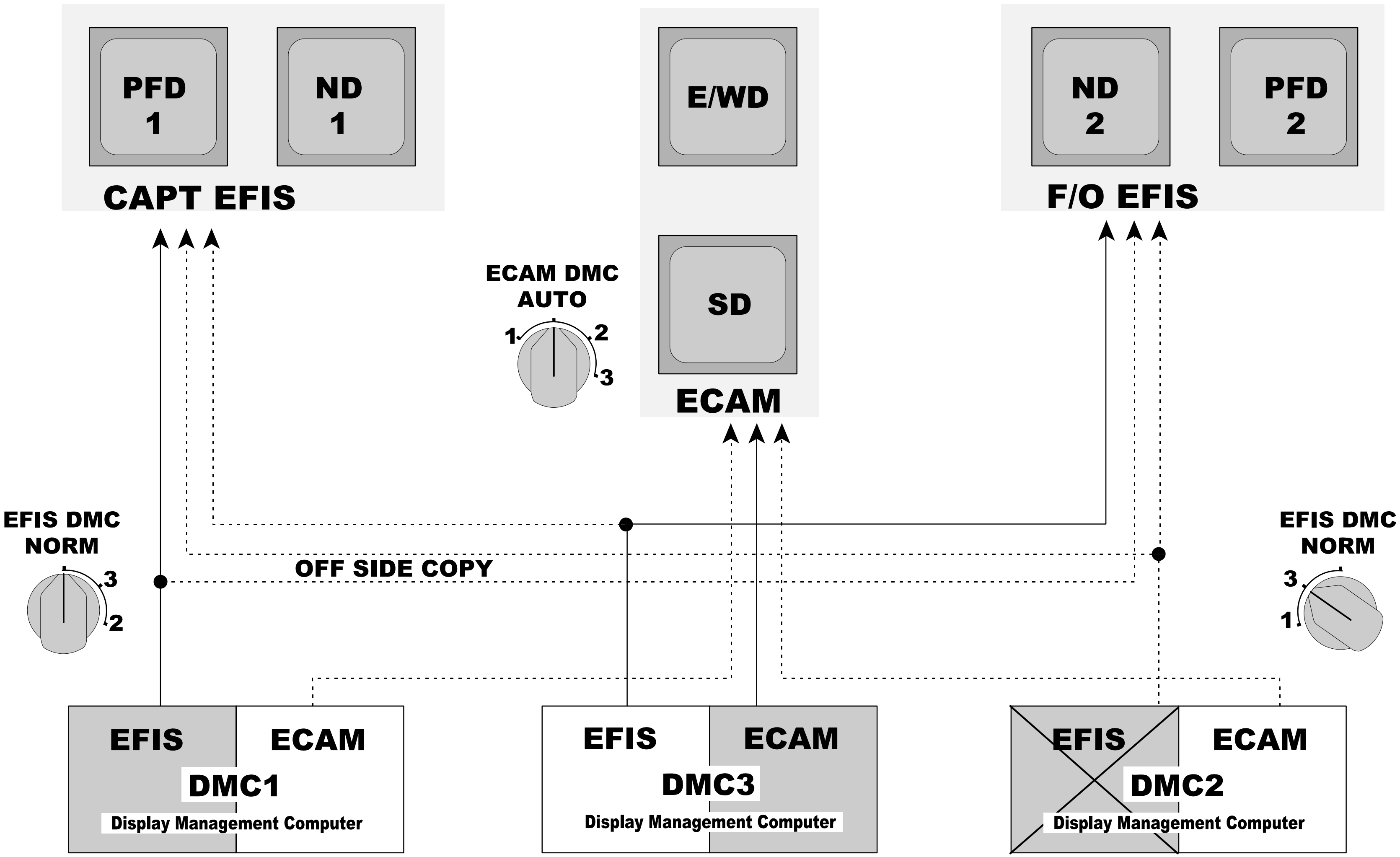
A340 Electronic Instrument System

Reconfiguration possibilities - Architecture



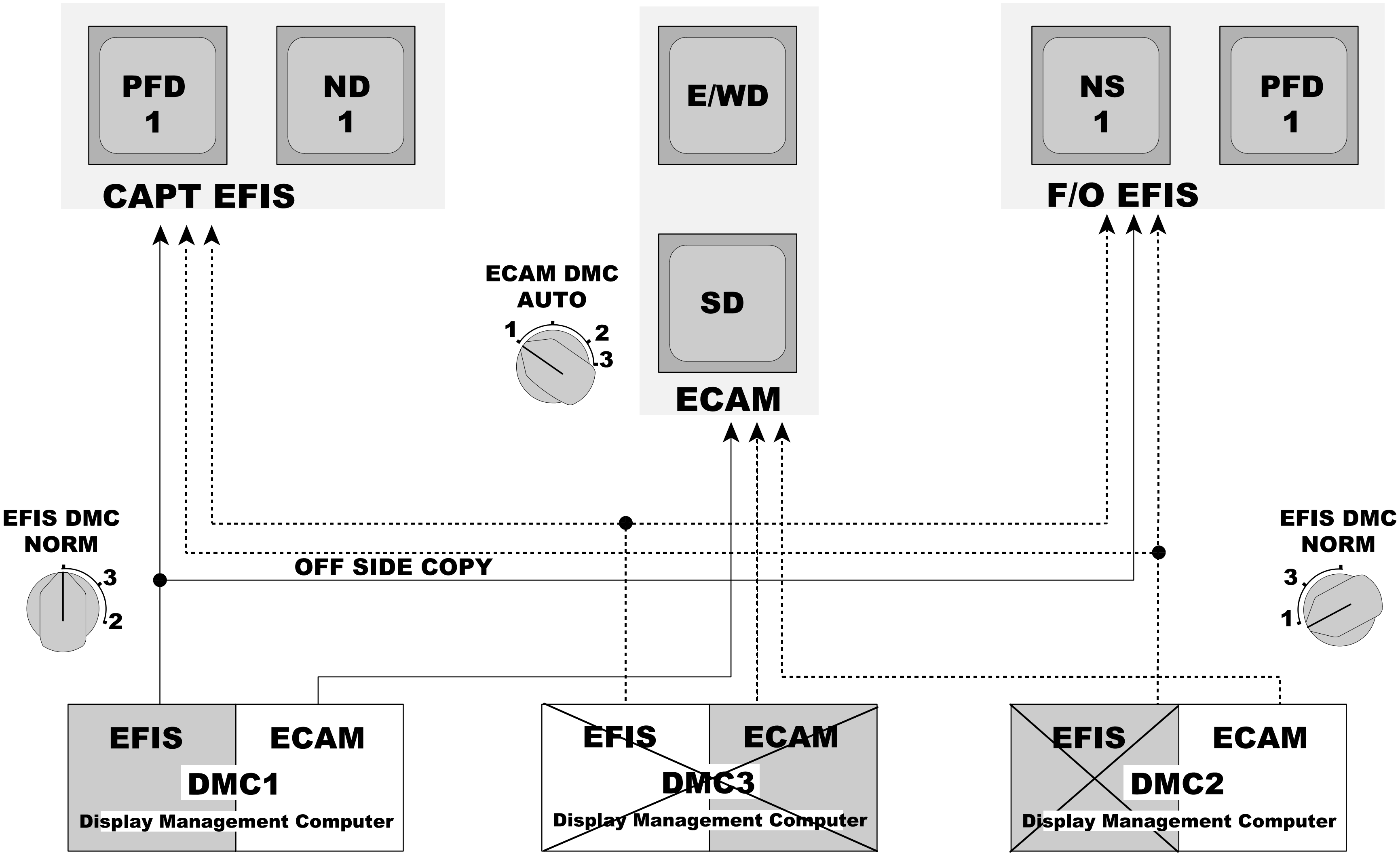
A340 Electronic Instrument System

Reconfiguration - F/O on EFIS DMC3

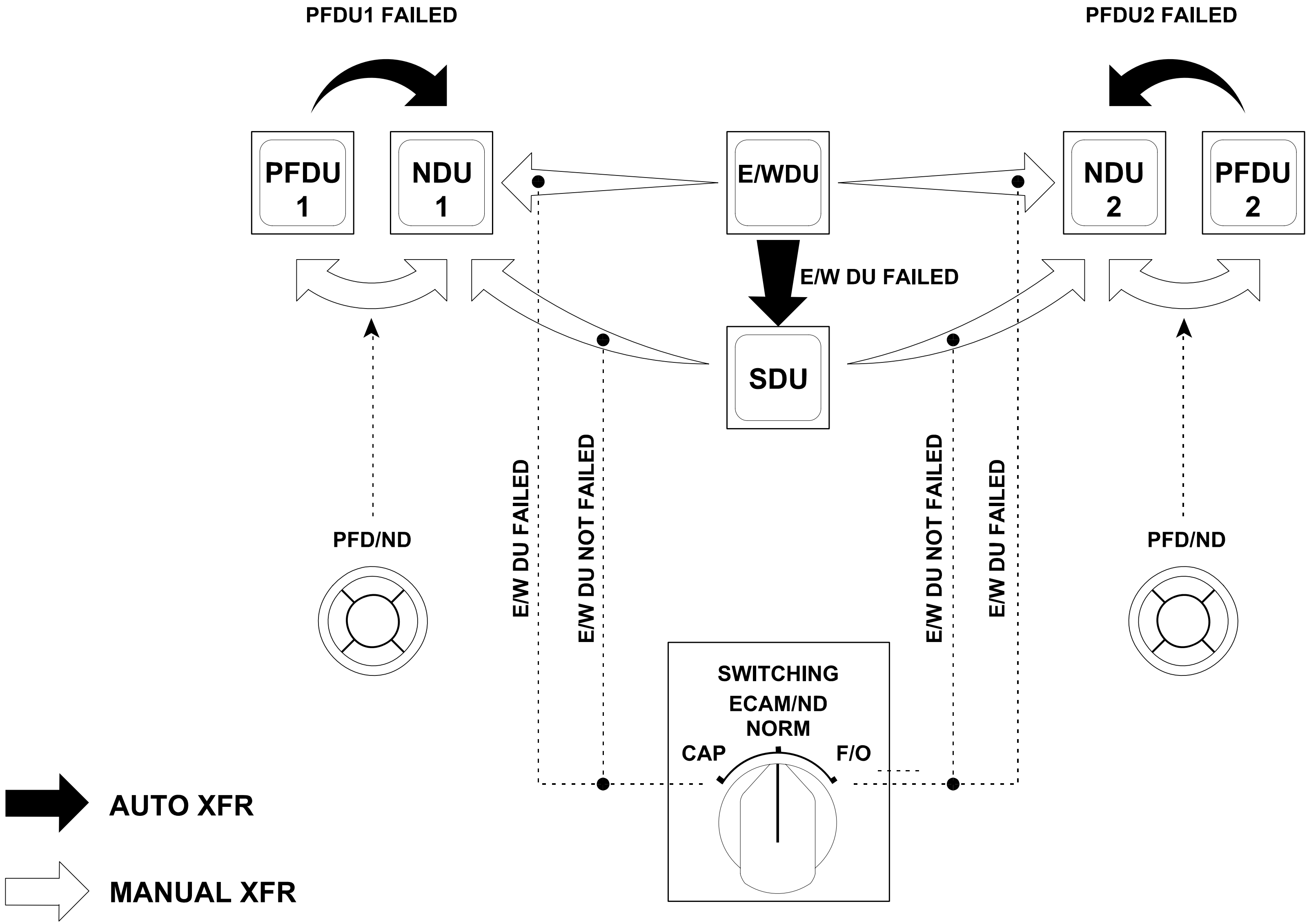


A340 Electronic Instrument System

Reconfiguration - ECAM on DMC1 + F/O on EFIS DMC1



DU reconfiguration



A340 Electronic Instrument System - EFIS

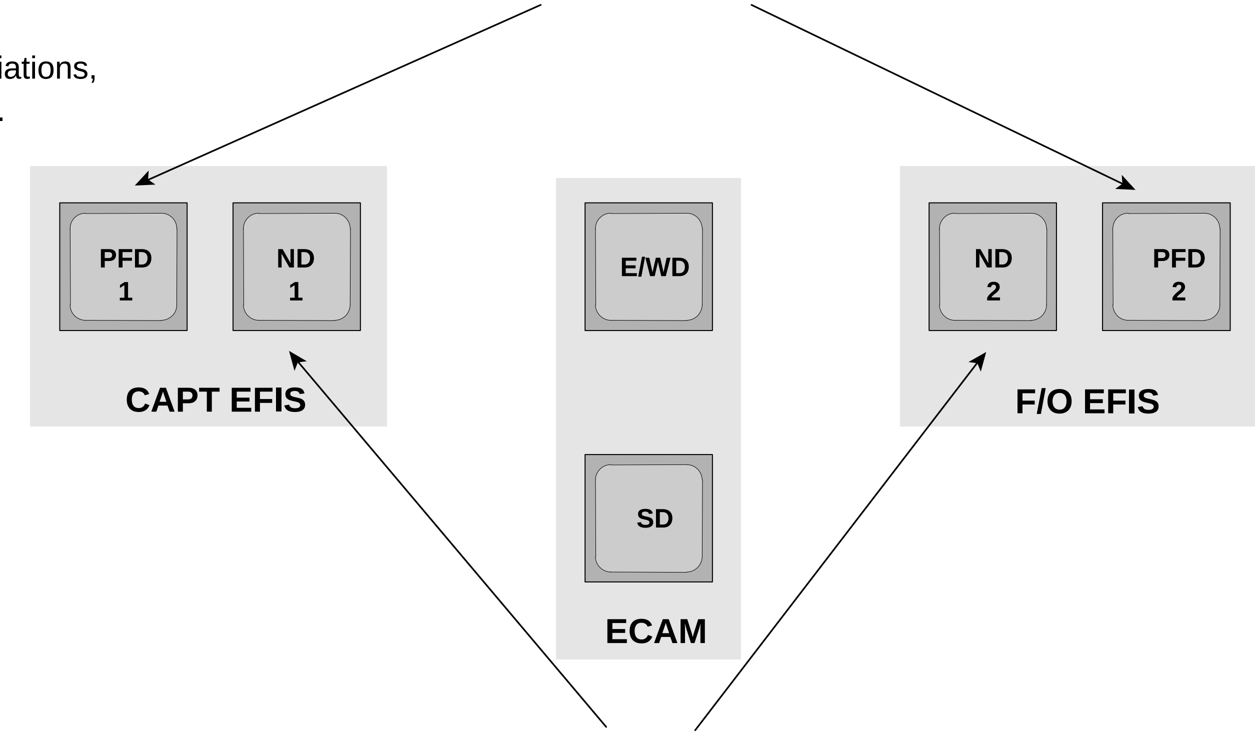
The **EFIS** (Electronic Flight Instrument System) is used for flight operations.

The two **PFDs** (Primary Flight Displays) provide **short-term flight information** :

- Aircraft attitude,
- Air speed,
- Altitude and vertical speed,
- Heading and track,
- Autoflight information,
- Vertical and lateral deviations,
- Radio NAV information.

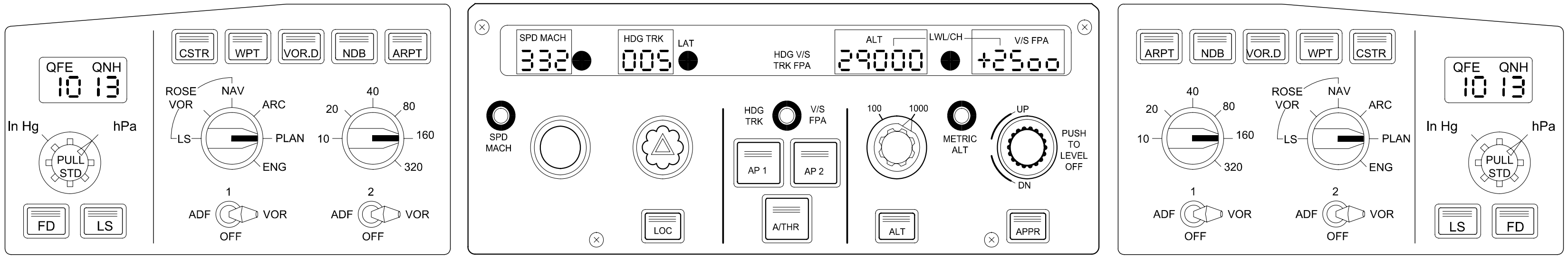
The two **NDs** (Navigation Displays) provide **medium-term flight information** :

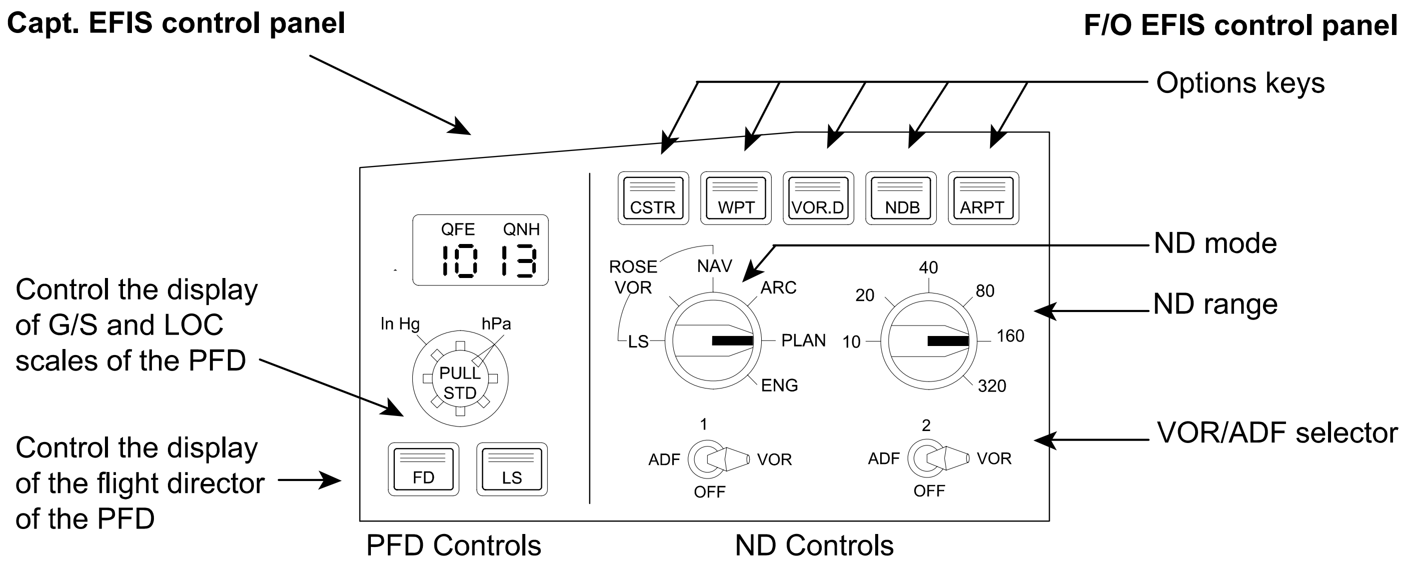
- Location of the aircraft with respect to navigation aids : FMS flight plan and map data ;
- Weather radar information ;
- TCAS (optional) ;
- EGPWS (optional).



Control panels

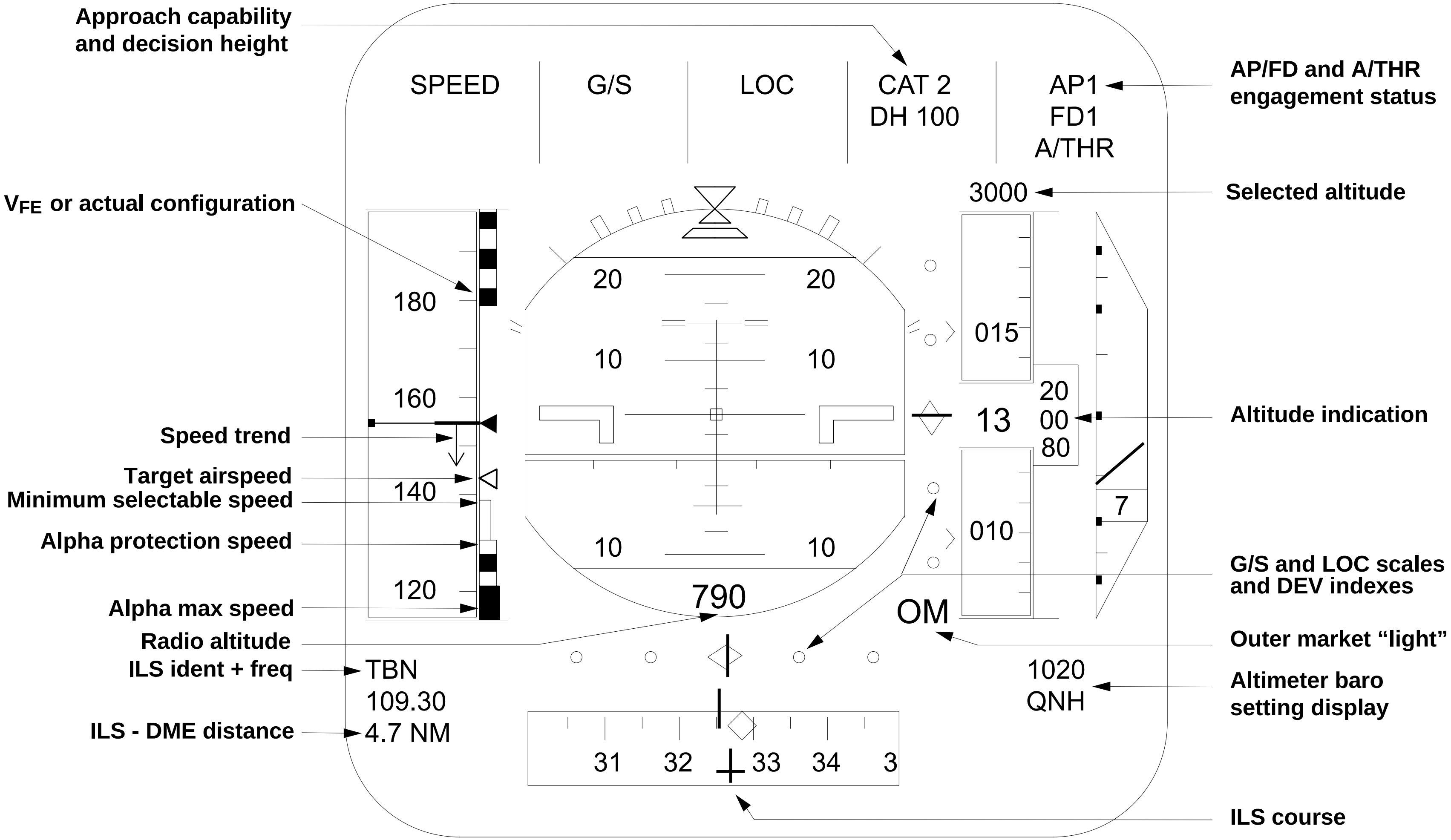
The capt and F/O control panels are part of the FCU (Flight Control Unit)





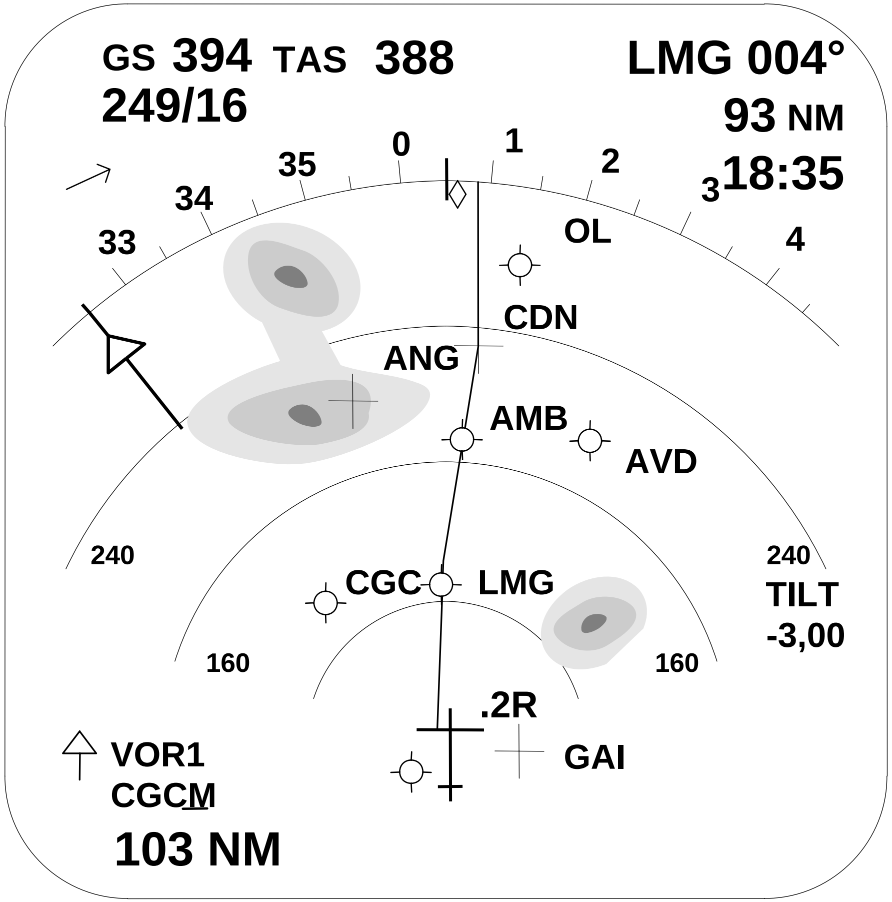
A340 Electronic Instrument System - EFIS

PFD - Approach



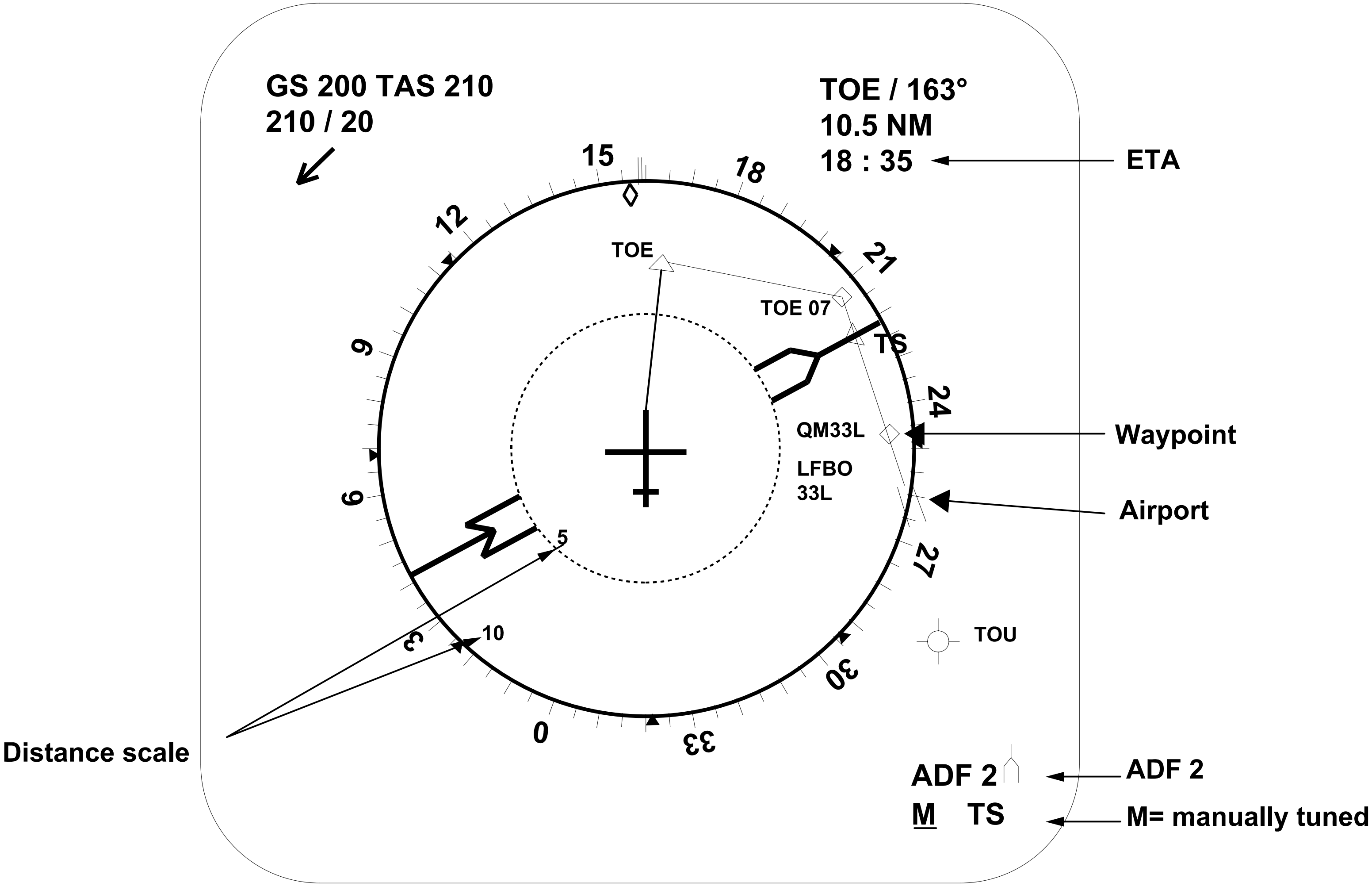
A340 Electronic Instrument System - EFIS

ND - ARC mode

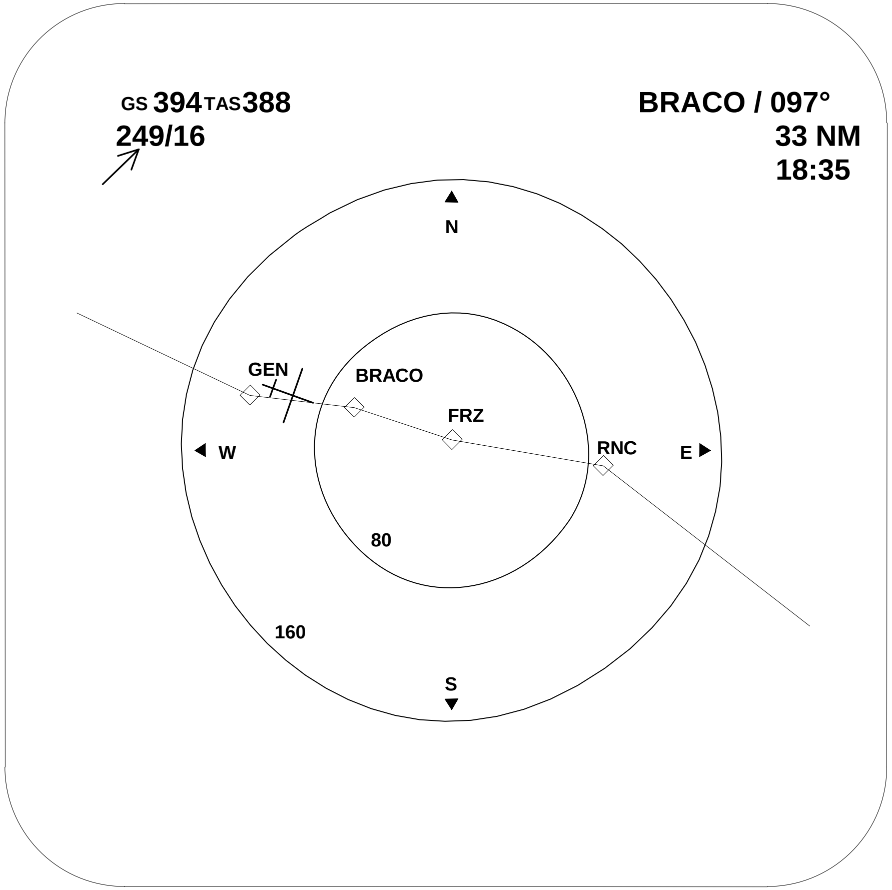


A340 Electronic Instrument System - EFIS

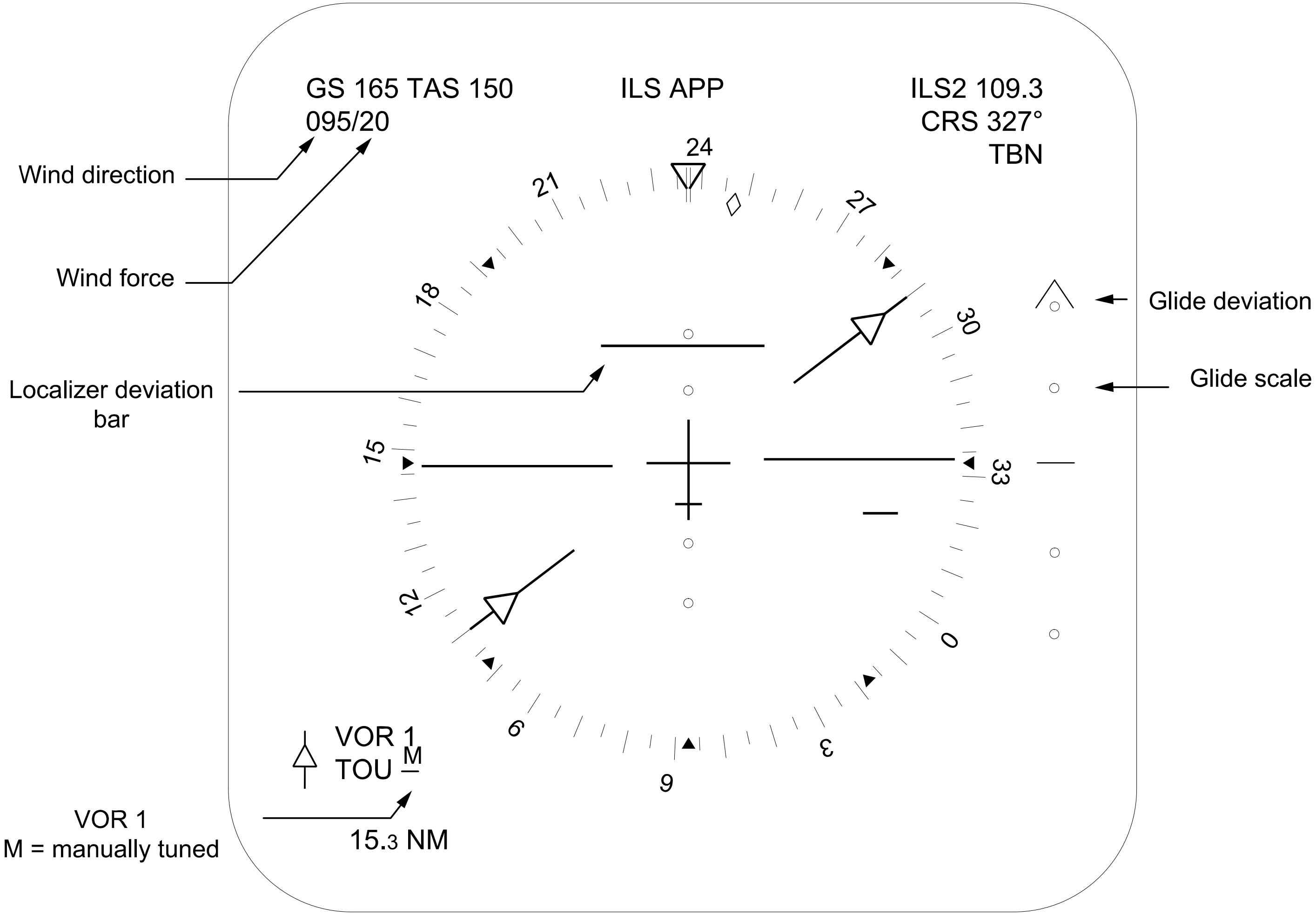
ND - ROSE/NAV mode



ND - PLAN mode

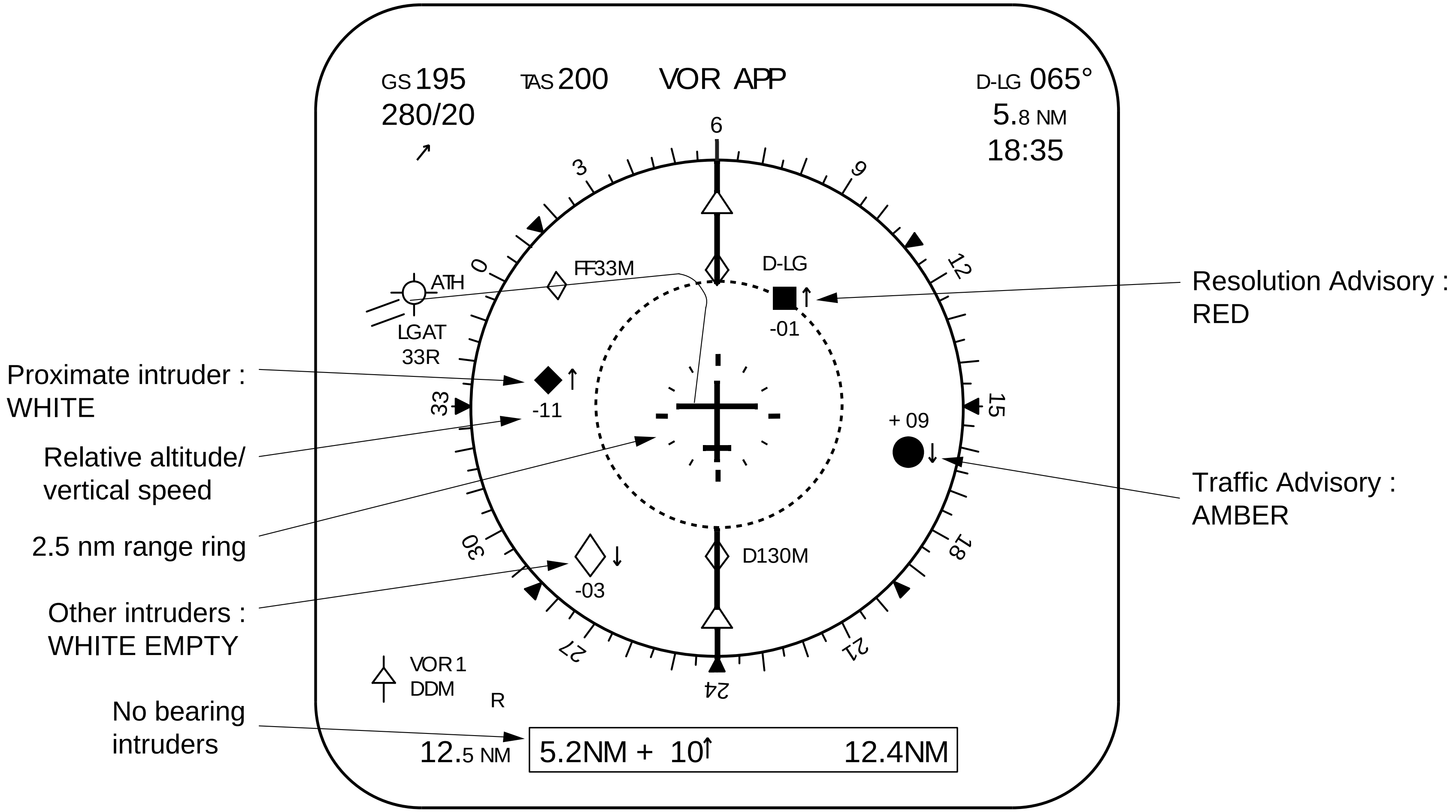

GS 394 TAS 388
249/16
BRACO / 097°
33 NM
18:35
N
W
E
S
GEN
BRACO
FRZ
RNC
80
160

ND - ROSE/ILS mode

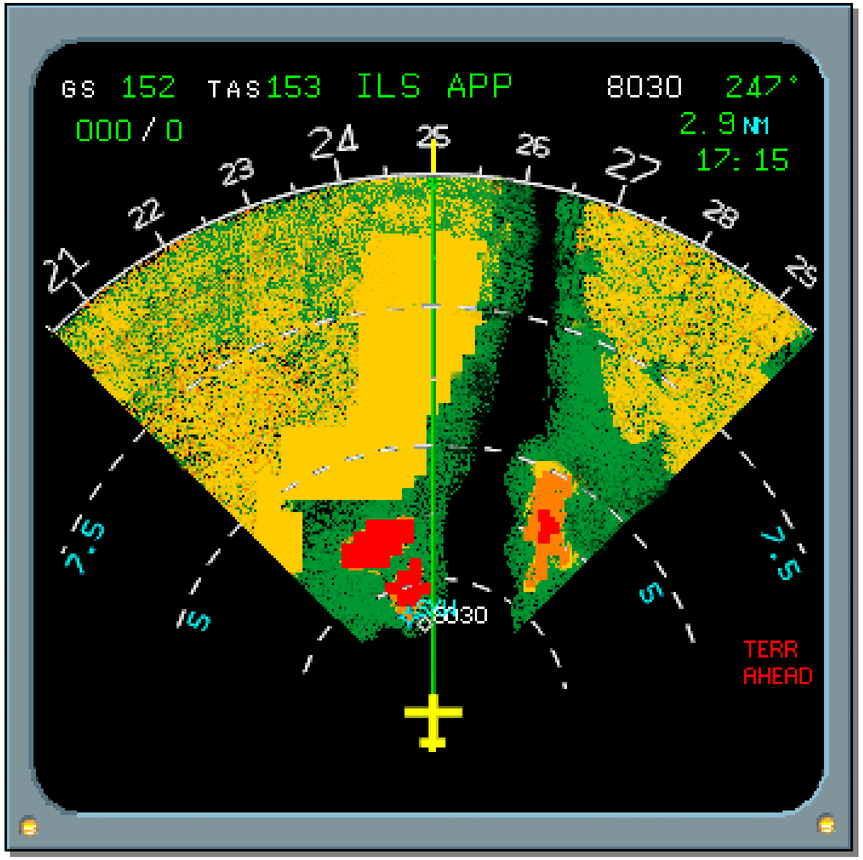


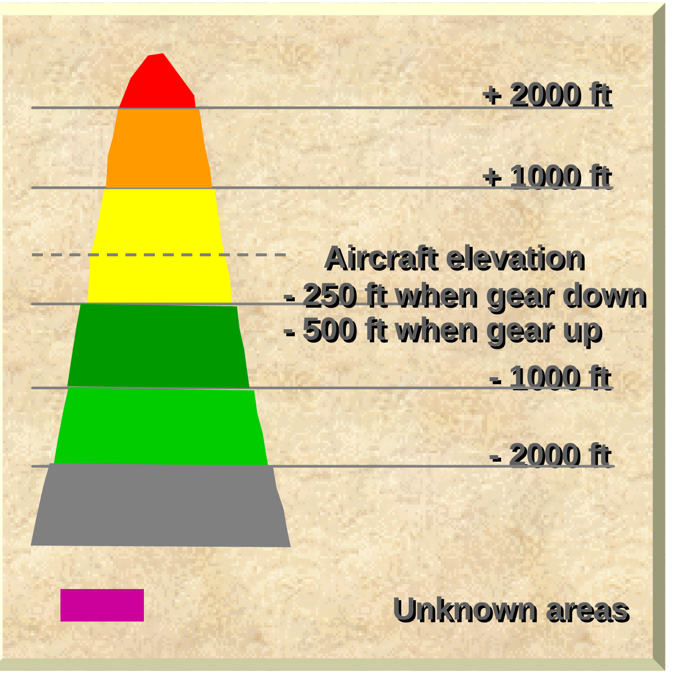
A340 Electronic Instrument System - EFIS

ND - TCAS (optional)



ND - EGPWS (optional)

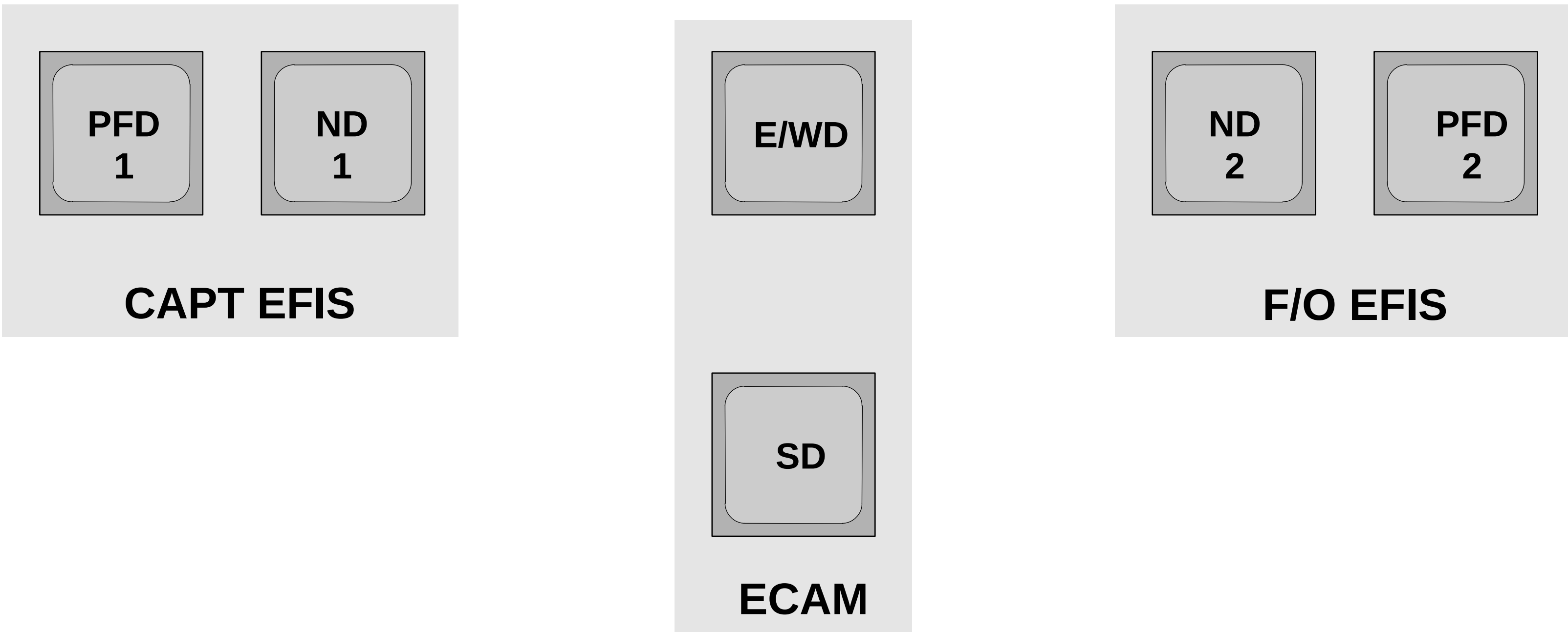




A340 Electronic Instrument System - ECAM

General

- The ECAM (Electronic Centralized Aircraft Monitor) is used for systems operation.
- ECAM is based on the “**need to know”** concept. System data is displayed only when required.
  - Data processing is fully automatic and, as such, does not require any additional crew action or selection.
  - Permanent display of engine control parameters : Total fuel, flaps/slats, TAT, SAT, aircraft weight and CG, time.



Arrangement

- ECAM (EFIS) color philosophy
  - Warnings : **RED** for configuration or failure requiring immediate action.
  - Cautions : **AMBER** for configuration or failure requiring awareness but not immediate action.
  - Indications : **GREEN** for normal long-term operations.

    WHITE for titling and guiding remarks.

    BLUE for actions to be carried out, or limitations.

    MAGENTA for particular messages, e.g. inhibitions.

- ECAM displays arrangement :

Upper DU

- Engine primary indication,
- Fuel quantity information,
- Slats/flaps position,
- Warning/Caution, or Memo messages.

Lower DU

- Aircraft system synoptic diagram or status messages.

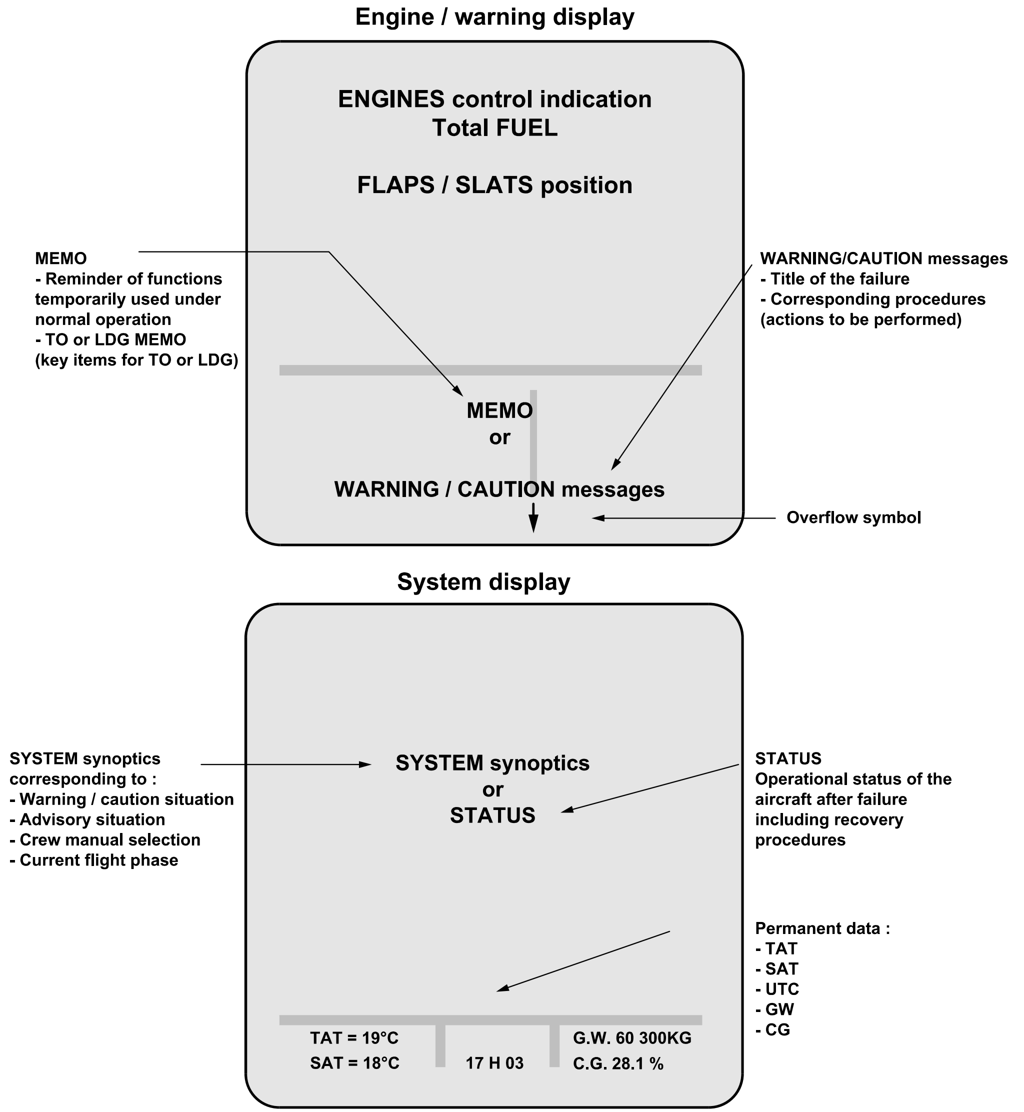
Audible warning definition

WARNING SIGNAL	CONDITION	DURATION	SILENCING
CONTINUOUS REPETITIVE CHIME	RED WARNINGS	PERMANENT	Depress* MASTER WARN lt
SINGLE CHIME	AMBER CAUTION	1/2 sec	
CAVALRY CHARGE	A/P DISCONNECTION BY TAKE OVER pb	1.5 sec	Second push on TAKEOVER pb
	A/P DISCONNECTION DUE TO FAILURE	PERMANENT	Depress MASTER WARN lt or TAKEOVER pb
CLICK	LANDING CAPABILITY CHANGE	1/2 sec (3 pulses)	
CRICKET + "STALL" message (synthetic voice)	STALL	PERMANENT	NIL
INTERMITTENT BUZZER	SELCAL CALL	PERMANENT	Depress RESET key on ACP
BUZZER	CABIN CALL	3s	NIL
	EMER CABIN CALL	3s REPEATED 3 TIMES	NIL
	MECH CALL	As long as outside pb pressed	NIL
	ACARS (*) CALL or ALERT	PERMANENT	Message reading on MCDU or Depress MASTER CAUT
C CHORD	ALTITUDE ALERT	1.5 sec or PERMANENT	new ALTITUDE selection or depress MASTER WARN pb
AUTO CALL OUT (synthetic voice)	HEIGHT ANNOUNCEMENT BELOW 400 FT	PERMANENT	NIL
GROUND PROXIMITY WARNING (synthetic voice)	UNSAFE TERRAIN CLEARANCE FORESEEN	PERMANENT	NIL
"WINDSHEAR" (synthetic voice)	WINDSHEAR	REPEATED 3 TIMES	NIL
"PRIORITY LEFT" "PRIORITY RIGHT" (synthetic voice)	A/P TAKEOVER pb	1 sec	NIL
"RETARD" (synthetic voice)	THRUST LEVER NOT IN IDLE POSITION FOR LANDING	PERMANENT	THRUST LEVER
TCAS (*) (synthetic voice)	TRAFFIC OR POTENTIAL COLLISION	PERMANENT	NIL

* All aural warnings may be cancelled by depressing the EMER CANC pb on the ECAM control panel or the MASTER WARN lt, except for some warnings like overspeed or L/G not down.

(*) If option is installed

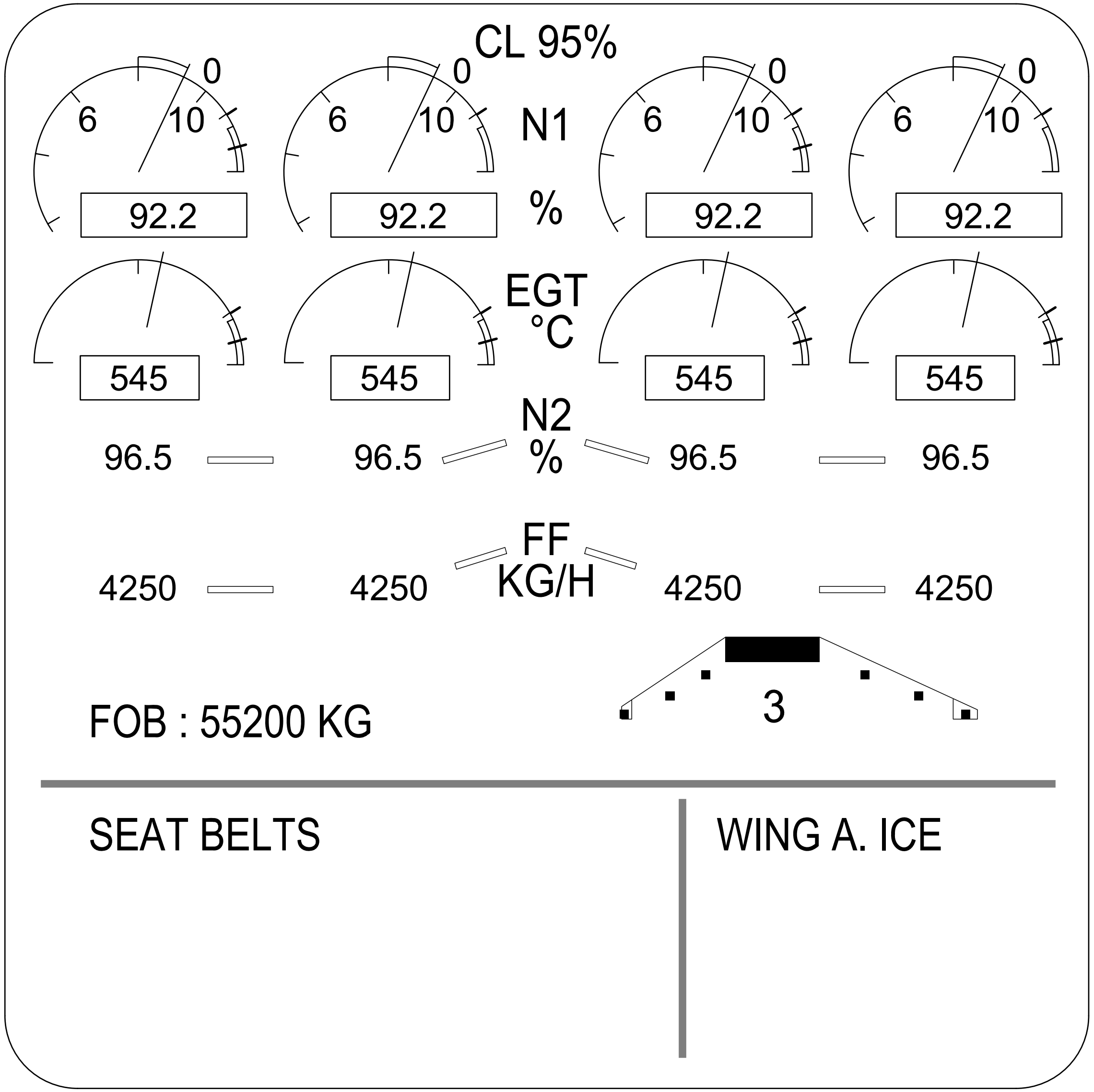
Display unit



A340 Electronic Instrument System - ECAM

E/WD

Typical



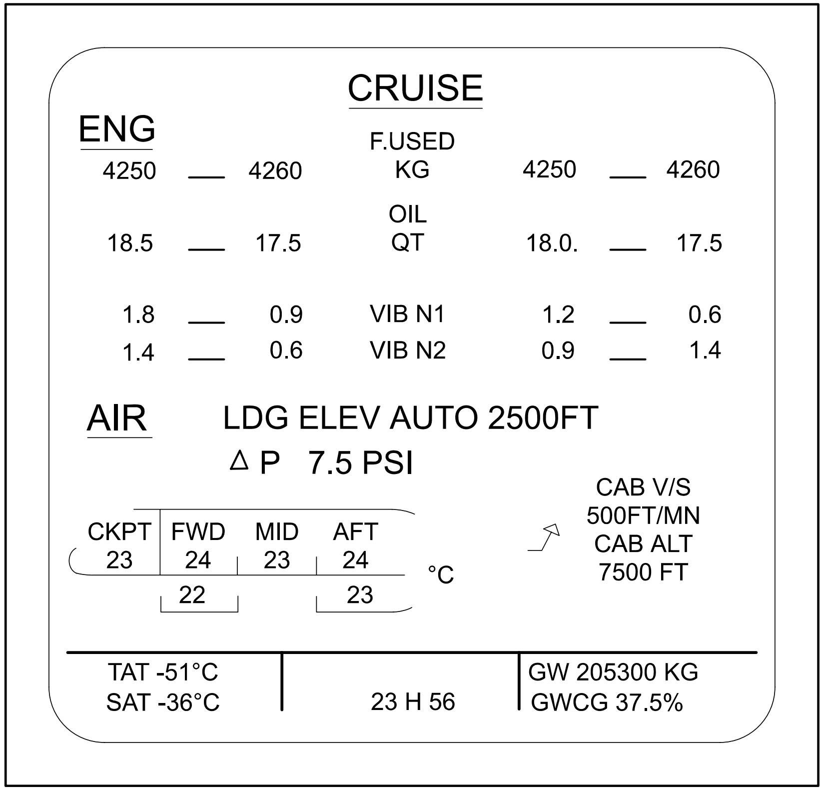
ECAM UPPER DISPLAY (E/WD)

- ENGINE CONTROL PARAMETERS
- FUEL QUANTITY INDICATION
- FLAPS/SLATS POSITION

- MEMO INFORMATION

S/D - A340 cruise page

ECAM LOWER DISPLAY (SD)

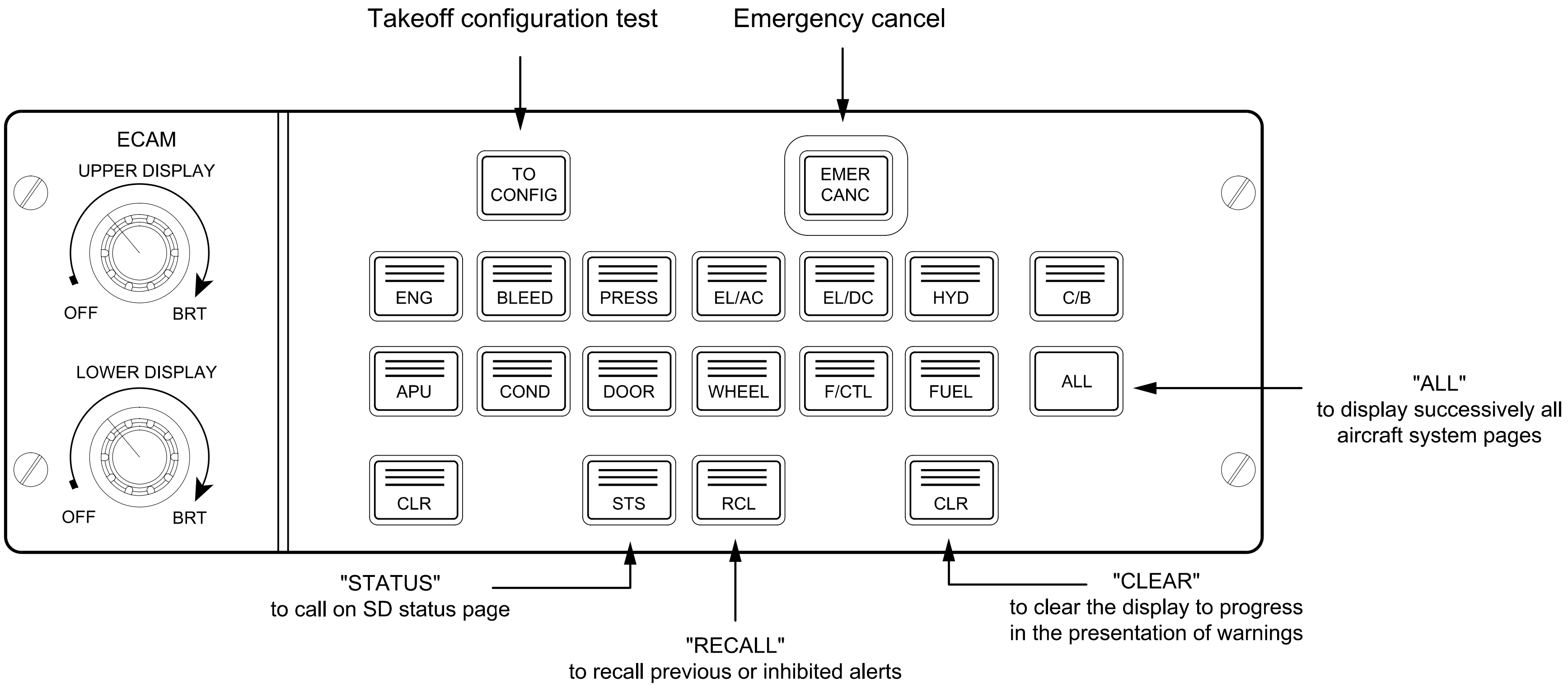


System pages

14 system pages can be displayed :

- BLEED (Air bleed)
- COND (Air conditioning)
- PRESS (Cabin pressurization)
- ELEC AC (AC electrical power)
- ELEC DC (DC electrical power)
- C / B (Circuit breakers)
- F / CTL (Flight controls)
- FUEL (Fuel)
- HYD (Hydraulic)
- APU (Auxiliary power unit)
- ENGINE (Secondary engine parameters)
- DOOR / OXY (Doors / oxygen)
- WHEEL (Landing gear, braking, ground spoilers, etc.)
- CRUISE (Cruise)

Control panel



Note : In the event of complete failure of the ECAM control panel electronics, the CLR, RCL, STS, EMER CANC and ALL remain operative since the contacts are directly wired to the FWCs/DMCs.

Operating modes

- **Four ECAM system page presentation modes:**

NORMAL mode : Automatic flight phase related mode :

- MEMO on E/WD
- Most suitable system page on SD.

MANUAL mode : use of the ECAM control panel

- Any of the system pages may be called up on SD by pressing the corresponding selector keys of the ECAM control panel.

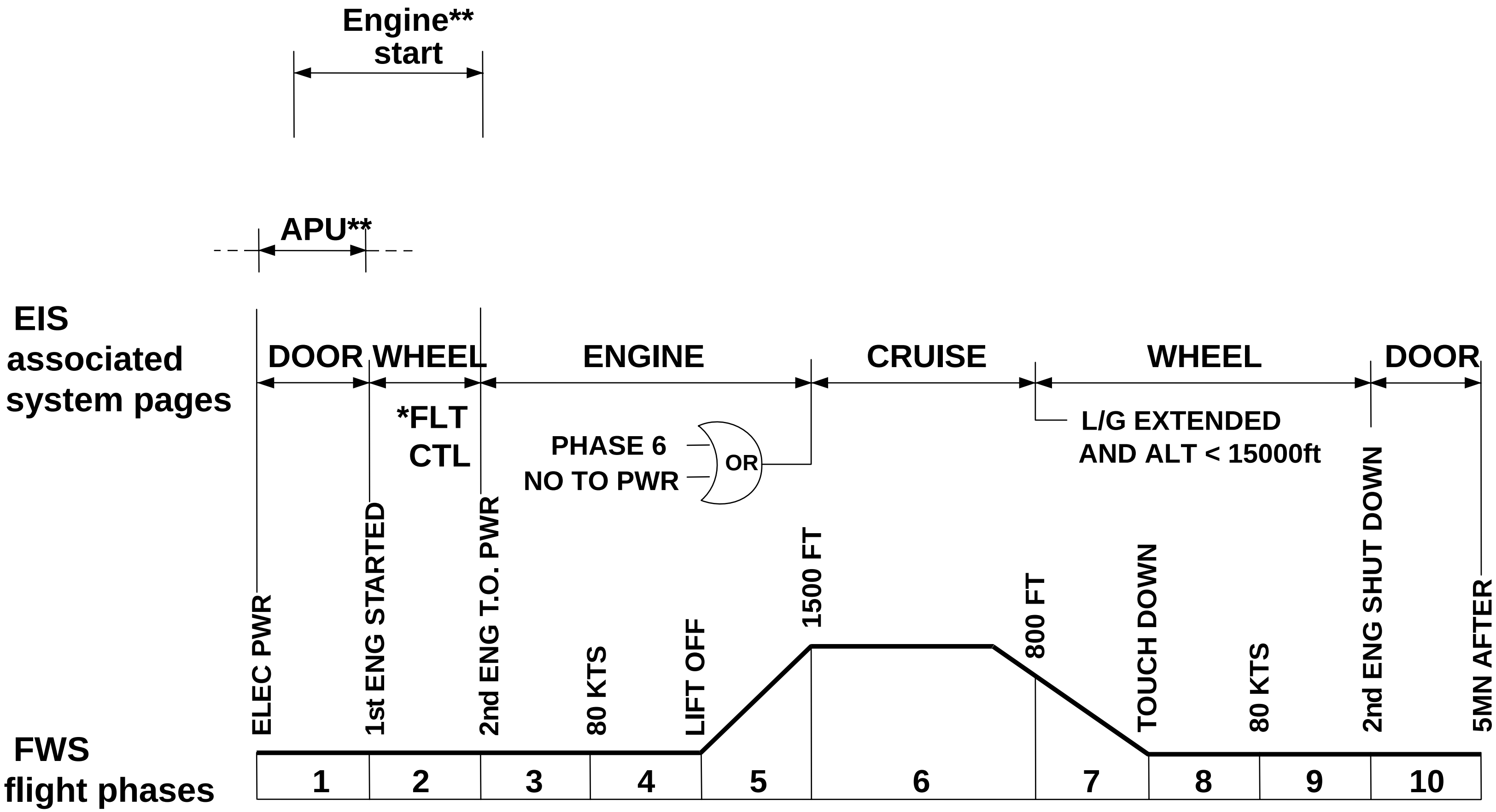
ADVISORY mode : parameter trend monitoring

- Corresponding system page on SD with affected parameter pulsing.

FAILURE RELATED mode :

- Failure indication and abnormal/emergency procedures on E/WD,
- Affected system synoptic on SD.

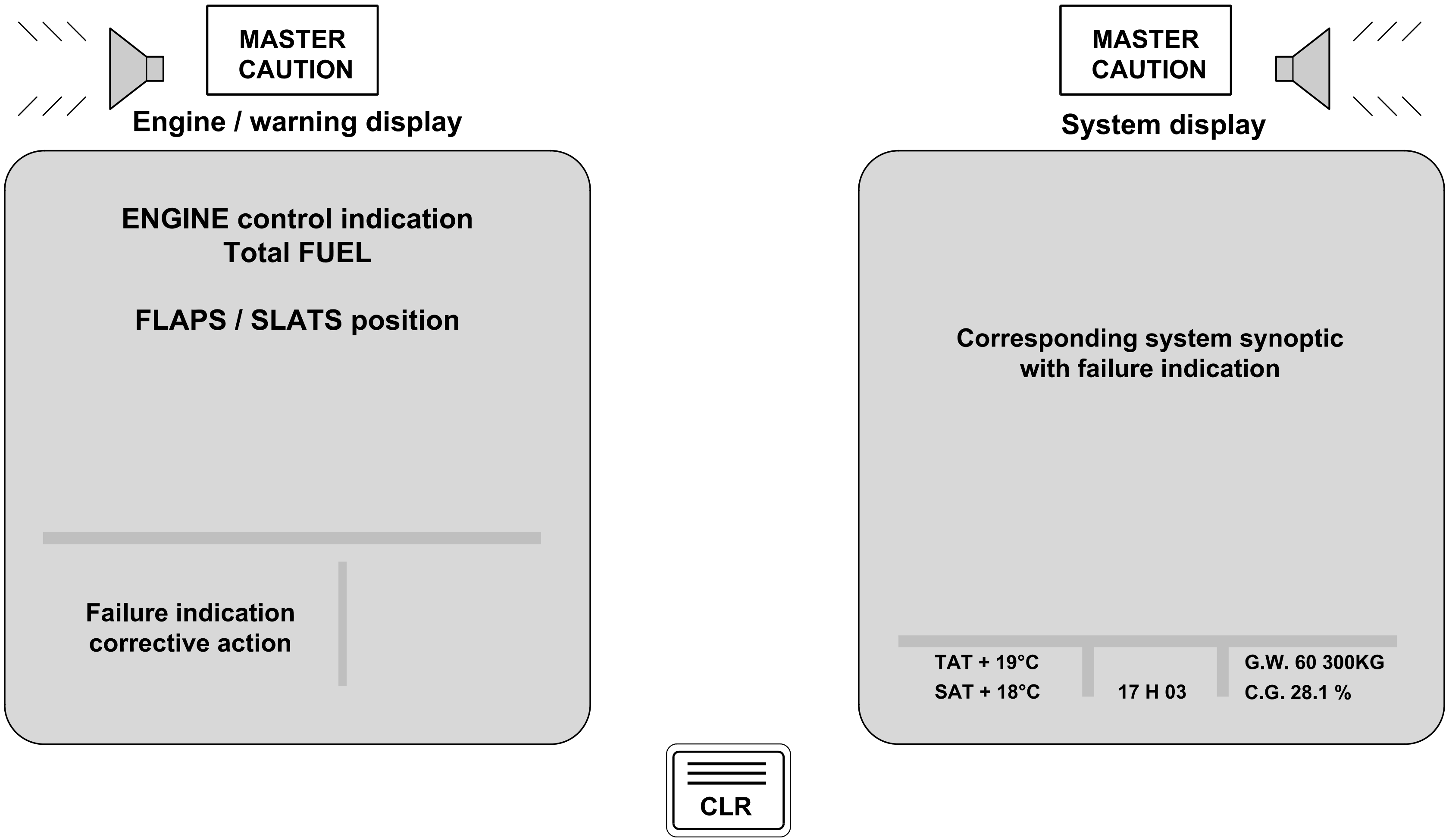
Automatic flight phase



* FLT CTL page replaces wheel page for 20 seconds when either sidestick is moved or when rudder deflection is above 22°.

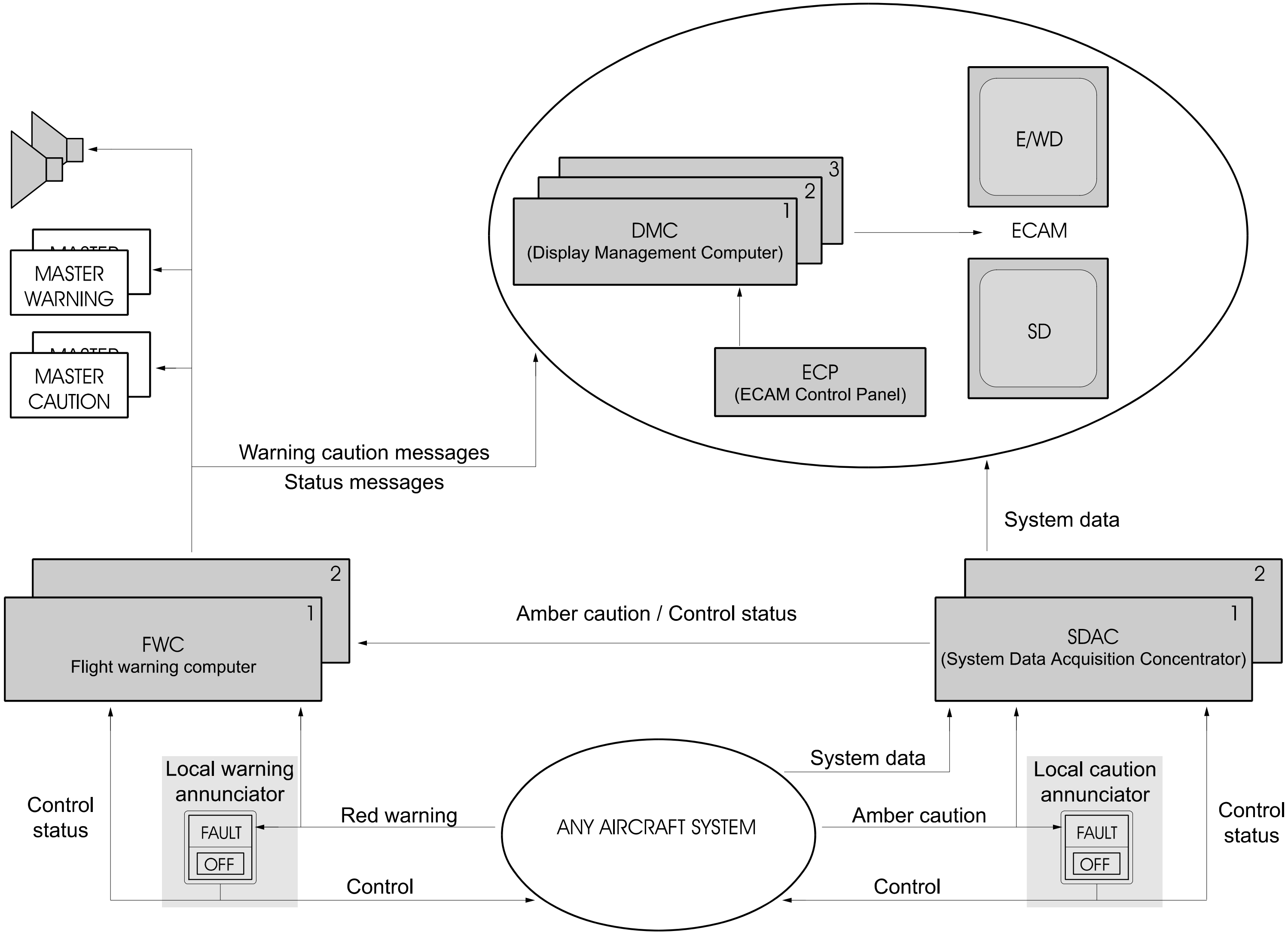
** APU page or ENG START page automatically displayed during start sequence.

Failure-related mode



A340 Electronic Instrument System

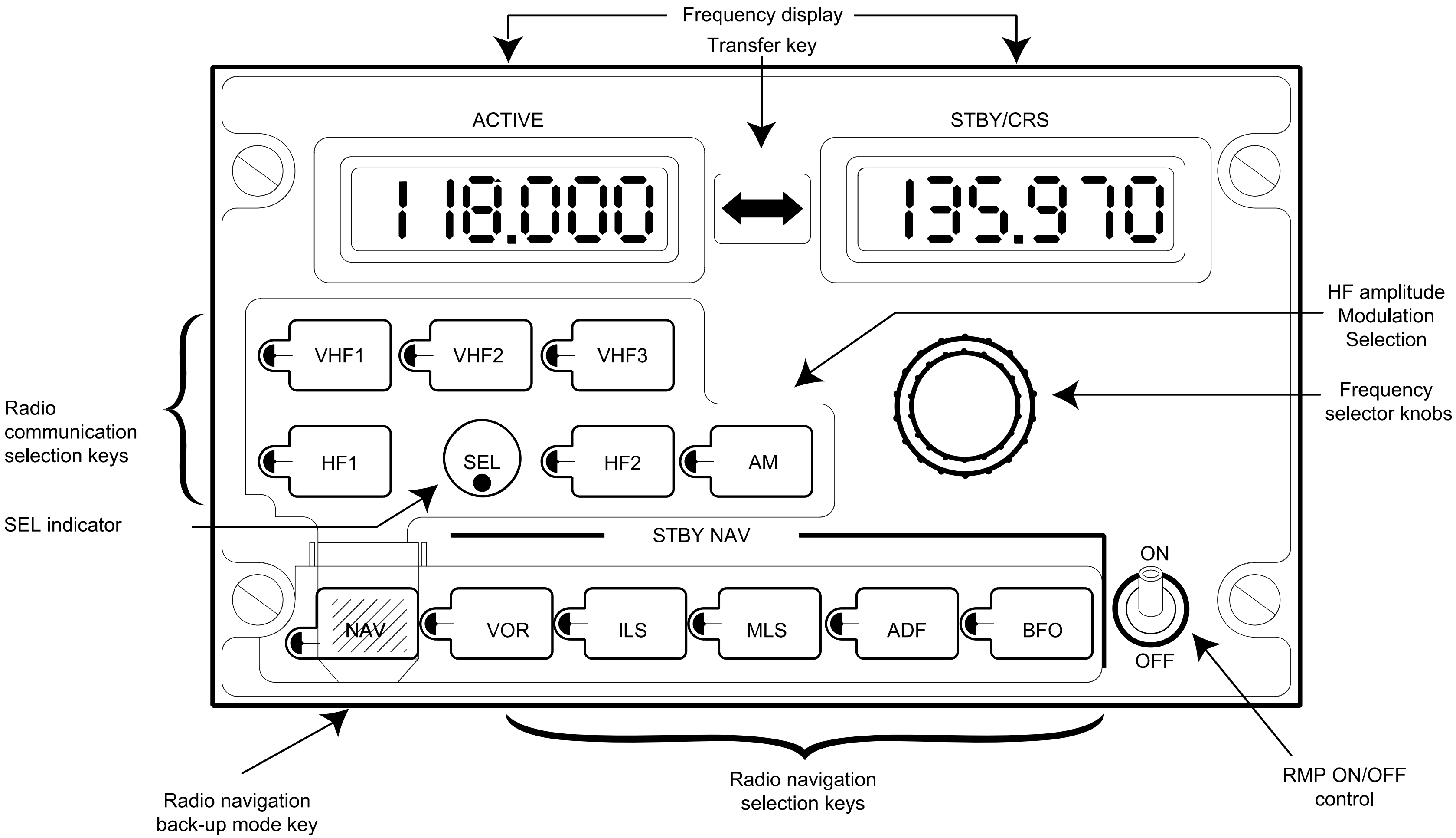
Architecture - Flight Warning System (FWS)



- The FWS performs **(in real time)** the **computation** and **management** of **central warnings and cautions :**
  - **Warning/caution hierarchical classification** (Level 3 : red warning, Level 2 : amber caution, Level 1 : simple caution) and **priority rules.**
  - **Warning/caution inhibitions.**
  - **Operational failure categorization** : Independent failure, primary failure, secondary failure.
- The FWS directly activates the crew attention-getters (aural and visual) and uses the EIS (ECAM : E/WD and SD) to display the warning/caution messages.
- The FWS also computes the MEMO information (presented on the E/WD) and performs an automatic radio height call-out function.

13. Radio Management and Communication

Radio Management Panel (RMP)



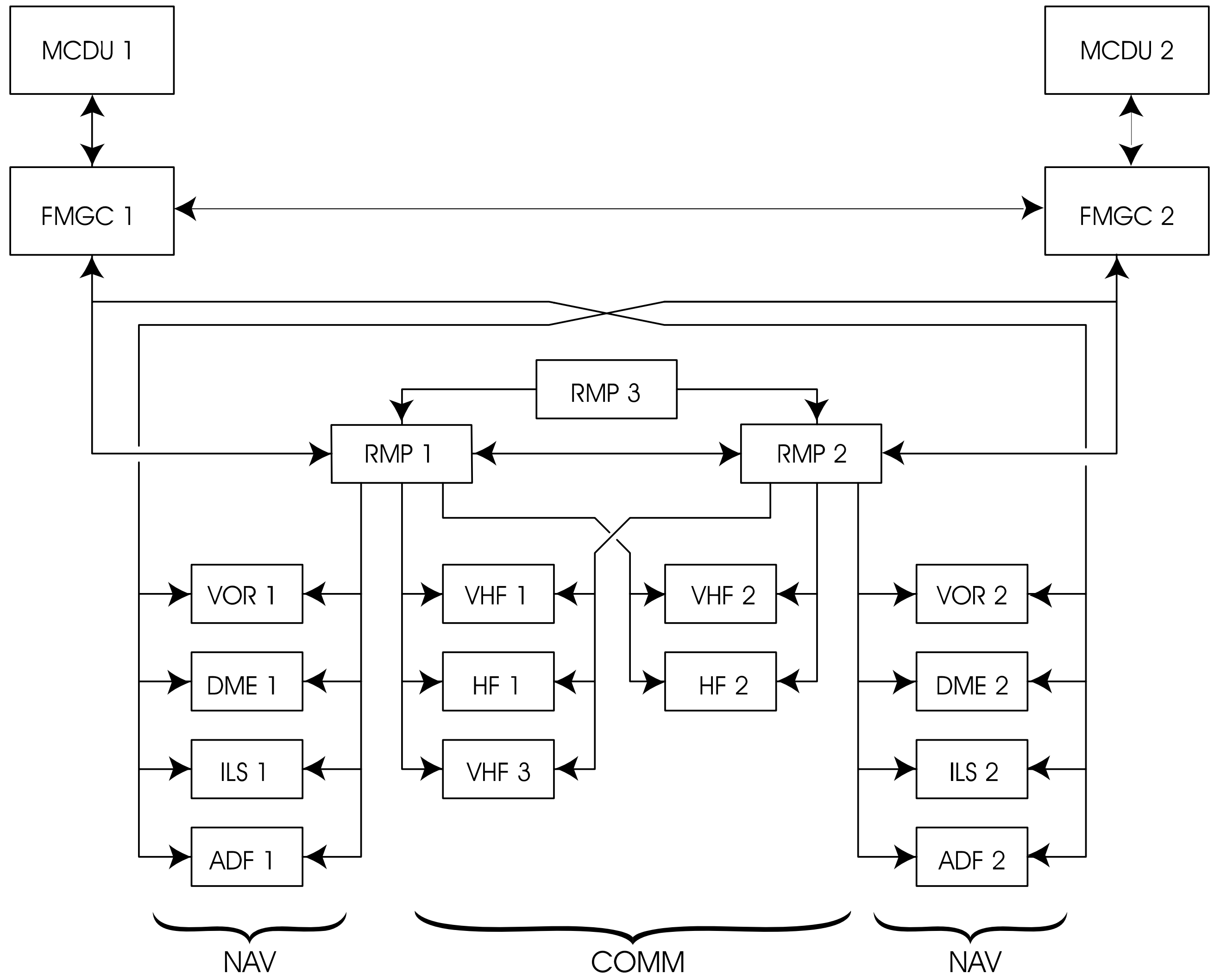
A340 Radio Management and Communication

Concept

- The Radio Management Panel **(RMP)** system provides :
  - Crew control of all radio communication systems ;
  - Back-up to the two FMGCs for controlling all radio navigation systems.
- Basic installation includes :
  - Two RMPs on pedestal ;
  - A third RMP on overhead panel (not available for NAV back up).
- The **ATC** transponder is tuned by a separate conventional control panel.

A340 Radio Management and Communication

RMP architecture



Concept architecture

Communications tuning

Any communication receiver can be tuned from either of the three RMPs. Either RMP can take over from the other, in the event of failure.

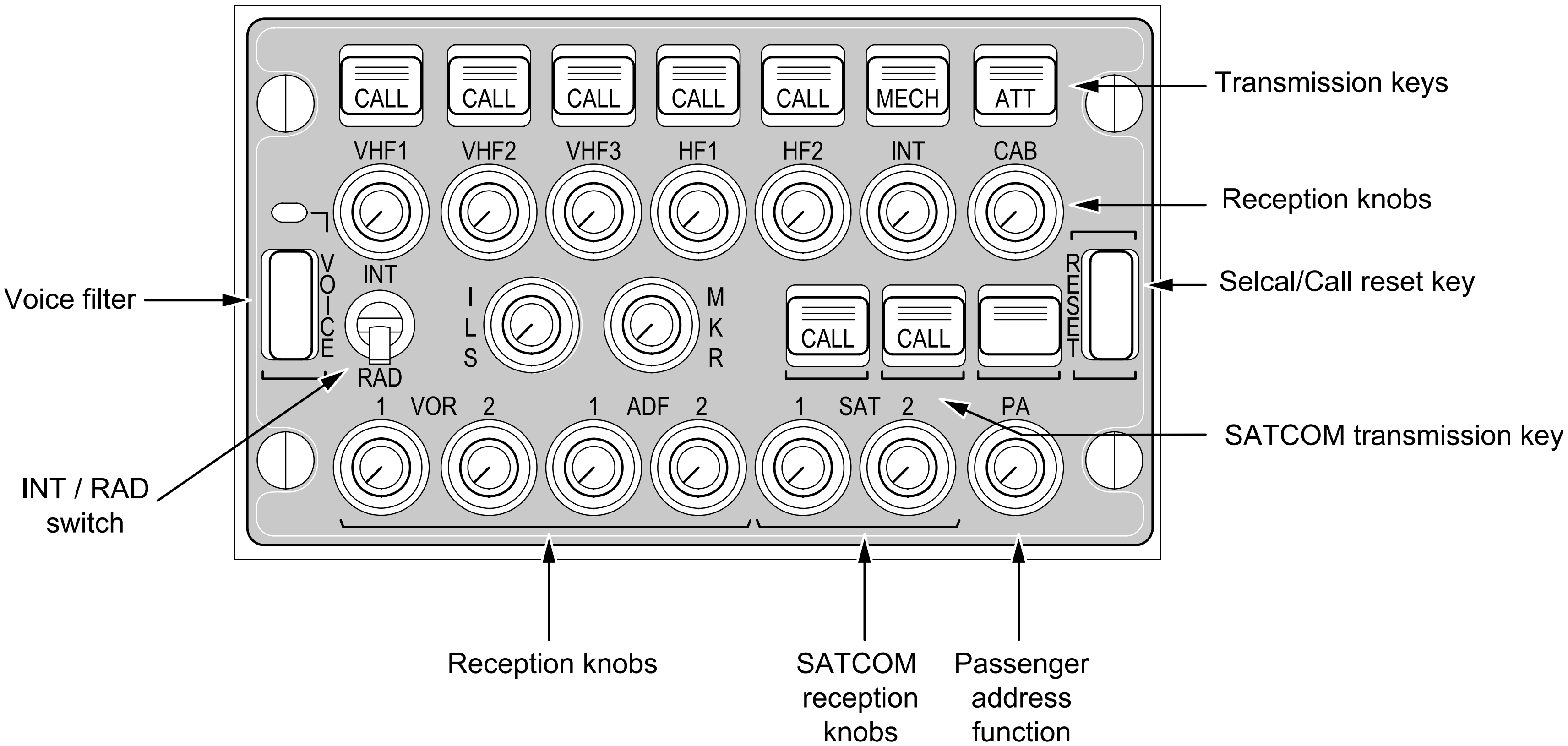
Navigation tuning

Three different operating modes exist :

- Automatic tuning : VOR/DME, ILS and ADF are automatically controlled by the FMGC.
- Manual tuning : To select a specific frequency through the FMGC MCDU which overrides the automatic function of the FMGC.
- Back-up tuning : When both FMGCs are inoperative, any NAV receiver may be tuned by the crew from RMP 1 or 2. Each RMP controls the on side receivers (except ILS is tuned by either RMP 1 or 2).

When one FMGC is inoperative, the remaining one controls all receivers.

COMM - Audio Control Panel (ACP)



COMM - Audio system

The audio integrating system provides the management of all audio signals produced, by feeding the radio communications, radio navigation and interphone systems :

- Basic installation includes :

  - Three Audio Control Panels **(ACP) :** Two on pedestal, one on overhead panel ;
  - One Audio Management Unit **(AMU)** in avionics bay ;
  - One **SELCAL** code selector in avionics bay.

- Provision exists for supplementary ACPs.

- All selections and volume adjustments are carried out by the crew through ACPs.

- All ACPs are fitted for maximum capacity (three VHF, two HF, public address, calls, two VOR, two ADF, ILS and provision for MLS).

- Each ACP and associated AMU electronic card are fully independent and microprocessor-controlled.

- Optional: The Satellite Communication (SATCOM) system allows the exchange of information between the ground station and the aircraft (technical information, voice transmission) via satellites.

14. A340 Central Maintenance System (CMS)

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A340 Central Maintenance System (CMS)

General

Line maintenance of the electronic systems is based on the use of a Central Maintenance System (CMS).

The purpose of the CMS is to give maintenance technicians a central maintenance aid to intervene at system or subsystem level from multipurpose CDUs located in the cockpit :

- To read the maintenance information ;
- To initiate various tests.

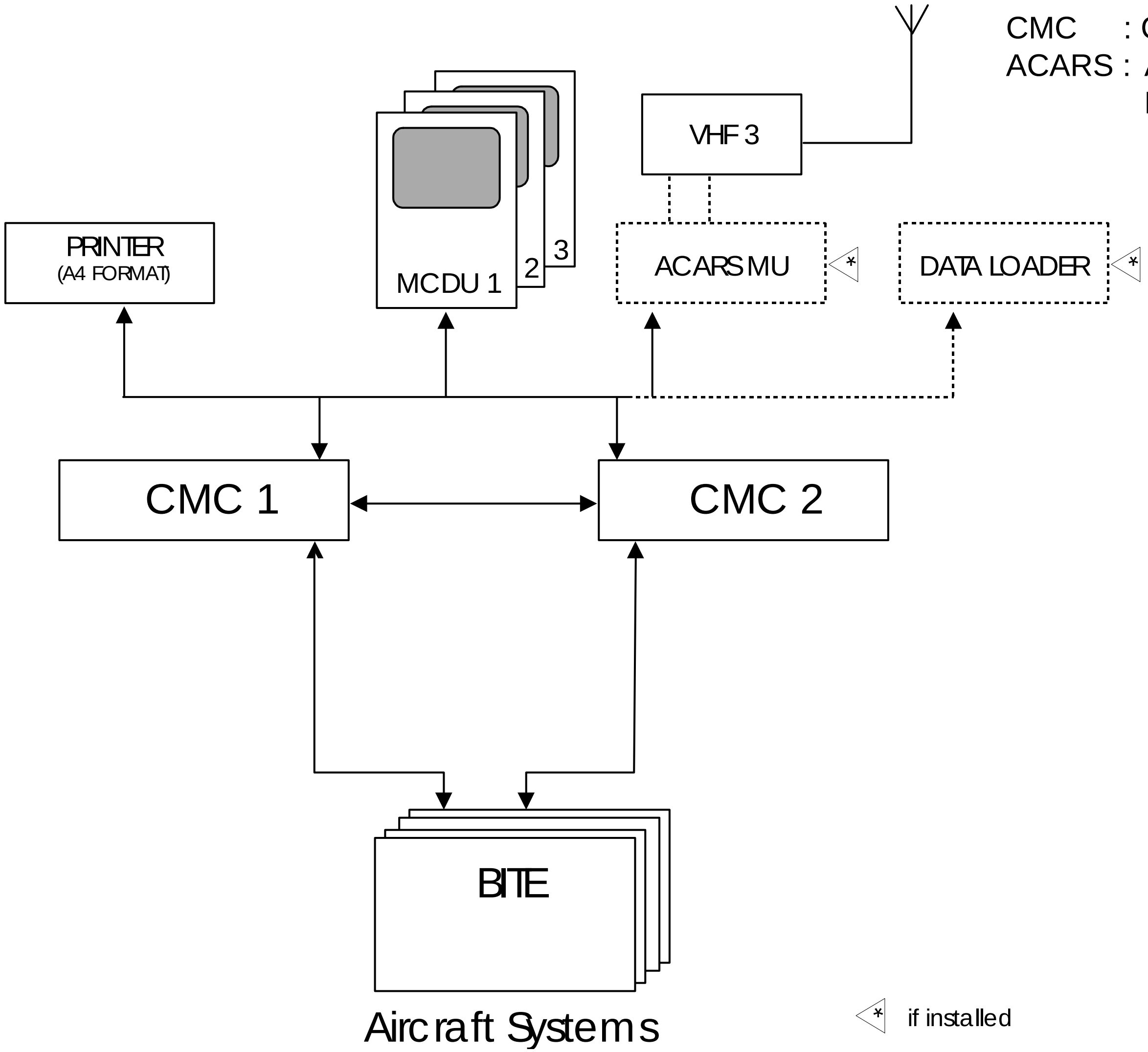
Two levels of maintenance should be possible using the CFDS :

- Maintenance at an out-station (LRU change) ;.
- Maintenance in the hangar or at the main base (troubleshooting).

A340 Central Maintenance System

Architecture

CMC : Central Maintenance Computer
ACARS : Aircraft Communication And Reporting System



A340 Central Maintenance System

Advantage of the CMS

A revised maintenance concept provides a :

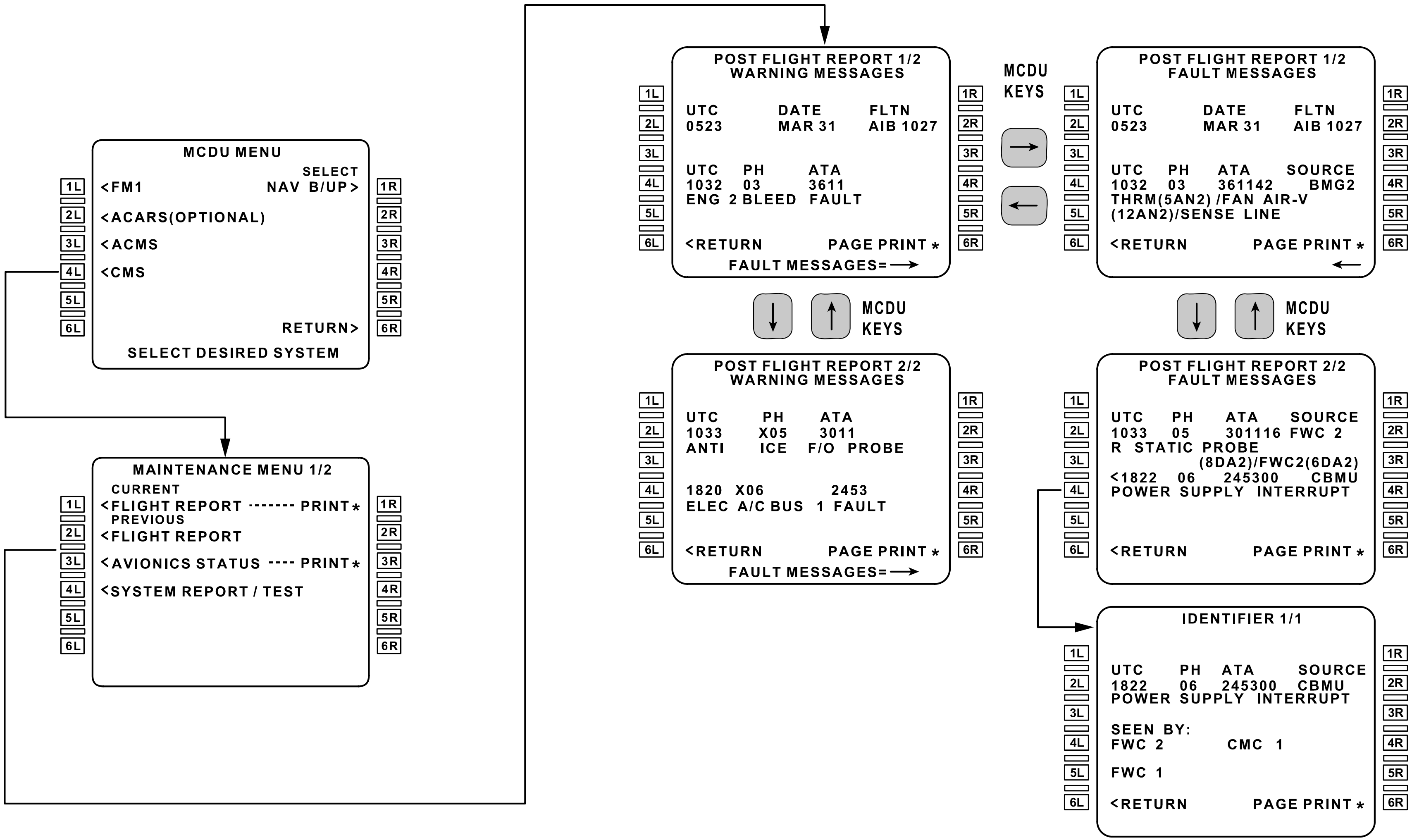
- Reduction in the duration of operations ;
- Reduction of maintenance crew training time ;
- Simplification of the technical documentation ;
- Equipment standardization ;
- Simplification of the computers which no longer display any BITE.

Integration of the CMS

The CMS includes :

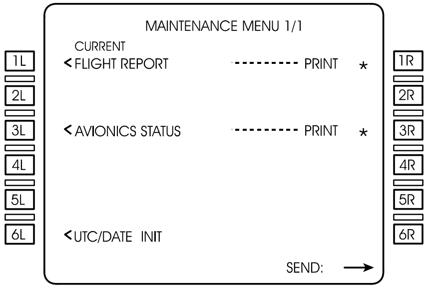
- **Basic equipment**
  - The BITE (Built-In Test Equipment) for each electronic system ;
  - Two fully redundant Central Maintenance Computers (CMCs) ;
  - Three MCDUs (Multipurpose Control Display Units) ;
  - One printer.
- **Optional equipment**
  - ACARS (Aircraft Communication And Reporting System) which dialogue with the CMC to display information or initiate tests.
  - Data Loader which allows the uploading of databases and operational software or the downloading of system reports from various onboard computers.

Examples of use



A340 Central Maintenance System

Examples of use (cont'd)



MAINTENANCE CURRENT FLIGHT REPORT LEG-00

AIRCRAFT IDENTIFICATION / F-GGEA
DATE / MAR31
ENGINE ON/ENGINE OFF / 1015/1720
FLIGHT NUMBER / AIB 1027
FROM/TO : LFBO/LFBT

PRINTING
DATE : APR02
TYC : 1406

COCKPIT EFFECTS		FAULTS		
ATA 36-11 MESSAGE DISPLAYED ENG 2 BLEED FAULT	UTC : 1032 FLIGHT PHASE : TAKEOFF ROLL	ATA 36-11-42 SOURCE : BMC3 MESSAGE : THRM (5HA3)/FAN AIR-V (12HA3)/SENSE LINE	INTERMITTENT	CLASS 1 IDENTIFIERS : CP1C CPC2
ATA 30-11 MESSAGE DISPLAYED ANTI-ICE F/O PROBE	UTC : 1033 FLIGHT PHASE : CLIMB	ATA 36-11-16 SOURCE : PHC2 MESSAGE : R STATIC PROBE (8DA2)/ PHC2 (6DA2)	HARD	CLASS 1 IDENTIFIERS : ADIRU1 ADIRU2 ADIRU3
ATA 24-53 MESSAGE DISPLAYED ELEC AC 1.1 BUS FAULT	UTC : 1822 FLIGHT PHASE : CRUISE	ATA 24-53-00 SOURCE : SDAC MESSAGES : POWER SUPPLY INTERRUPT	HARD	CLASS 1 IDENTIFIERS : CBMU

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