

 A330 <small>SIMULATOR</small> FLIGHT CREW OPERATING MANUAL	FLIGHT CONTROLS		1.27.00	P 1
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GENERAL

- R The fly-by-wire system was designed and certified to render the new generation of aircraft
 R even more safe, cost effective, and pleasant to fly.

BASIC PRINCIPLE

The flight control surfaces are all :

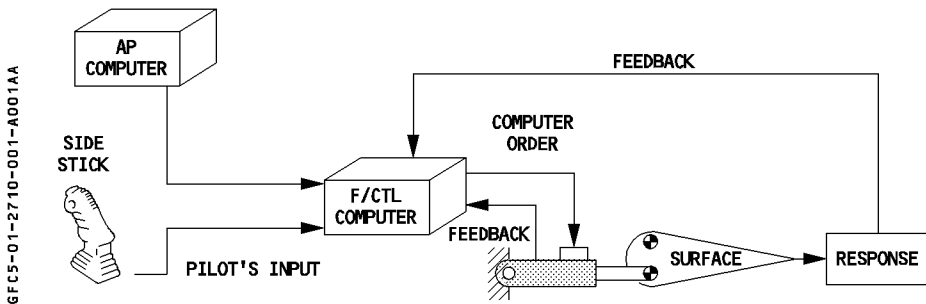
- Electrically-controlled, and
- Hydraulically-activated

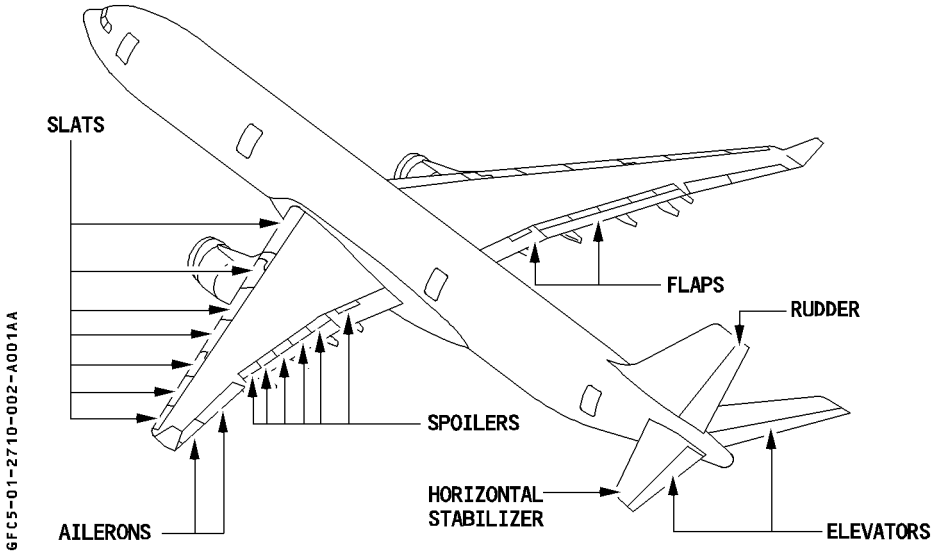
The stabilizer and rudder can be mechanically-controlled.

Pilots use sidesticks to fly the aircraft in pitch and roll (and in yaw indirectly, through turn coordination).

Computers interpret pilot input and move the flight control surfaces, as necessary, to follow their orders.

- R However, when in normal law, regardless of the pilot's input, the computers will prevent
 R excessive maneuvers and exceedance of the safe envelope in pitch and roll axis.
 R However, as on conventional aircraft, the rudder has no such protection.



CONTROL SURFACES

R The flight controls are electrically or mechanically controlled as follows:

Pitch axis

Elevator control = Electrical

Stabilizer control = Electrical for normal or alternate control. Mechanical for manual trim control

Roll axis

Aileron control = Electrical

Spoiler control = Electrical

Yaw axis

Rudder control = Mechanical, however control for yaw damping, turn coordination and trim is electrical.

Other controls

Speed brakes = Electrical

Note : All surfaces are hydraulically actuated.

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COCKPIT CONTROLS

- Two side stick controllers are used for pitch and roll manual control. One is on the CAPT's lateral console, the other is on the F/O's lateral console.
The two controllers are springloaded to neutral, and are not mechanically coupled. Each controller independently sends electrical signals to the flight control computers.
- Two pairs of rigidly interconnected pedals ensure mechanical control of the rudder.
- A speed brake control lever is provided in the center pedestal.
- Two handwheels, on the center pedestal, are used to mechanically control the THS.
- A switch, installed on the center pedestal, ensures the rudder trim control.
- No manual aileron trim switch is provided.

COMPUTERS

Five flight control computers process pilot and autopilot inputs according to normal, alternate or direct flight control laws.

The computers are :

3 PRIM computers

(Flight Control Primary Computer – FCPC) for :

- Normal, alternate, and direct control laws.
 - Speedbrake and ground spoiler control.
- R
- Protection speed computation.

2 SEC computers

(Flight Control Secondary Computer – FCSC) for :

- Direct control laws, including yaw damper function.
- Rudder trim, rudder travel limit, and pedal travel limit.

One computer of any type is capable of controlling the aircraft and of assuring safe flight and landing.

In normal operation, one PRIM computer is declared to be the master (P1). It processes the orders and sends them to the other computers (P1 / P2 / P3 / S1 / S2), which will then execute them on their related servo-control.

If one computer is unable to execute the orders sent by the master, another computer executes the task of the affected computer (except for spoiler control).

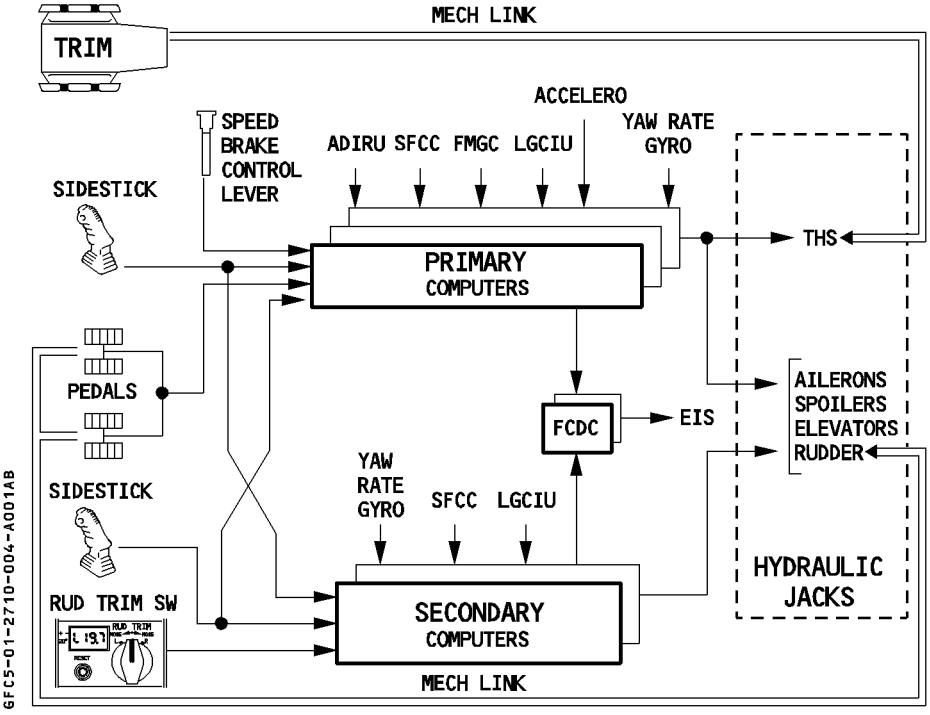
R If the master computer (P1) is not able to be the master (off or internal failure) than P2 (or P3 if P2 not available) will become the master.
 In case of loss of all PRIM computers each SEC is its own master and controls its associated servoloop in direct law.

Note : When green hydraulic system is lost, P2 replaces P1 as master computer.

A single SEC can provide complete aircraft control in direct law.

2 FCDC computers

(Flight Control Data Concentrators) acquire data from the PRIMs and SECs and send this data to EIS and CMC.

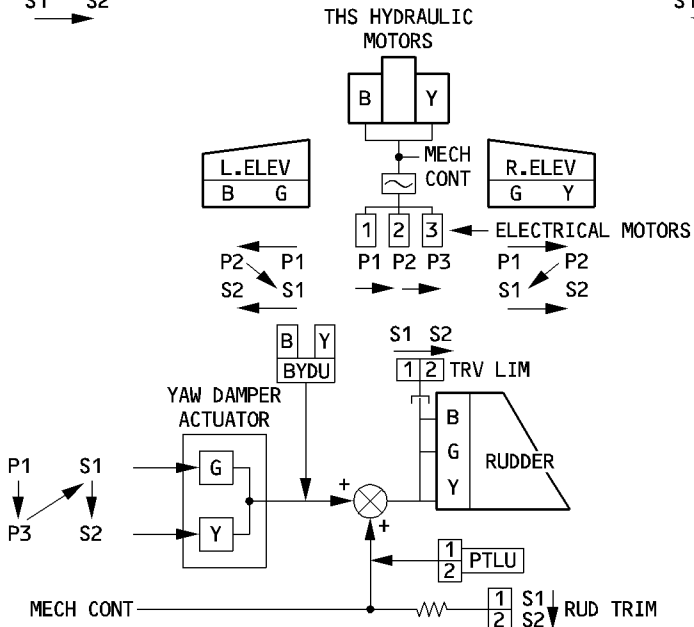
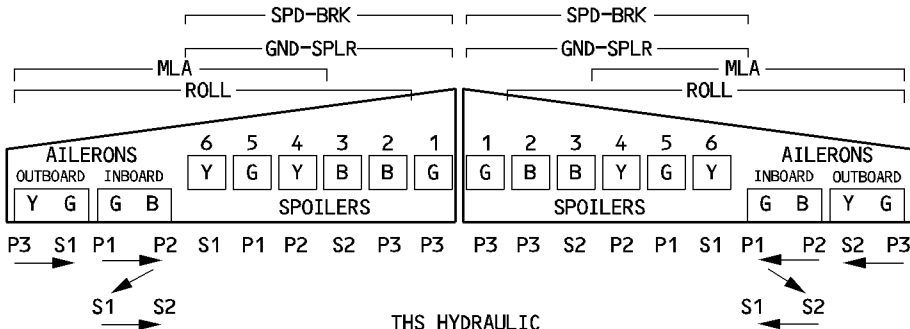


ARCHITECTURE

GENERAL ARCHITECTURE

FOR INFO

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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

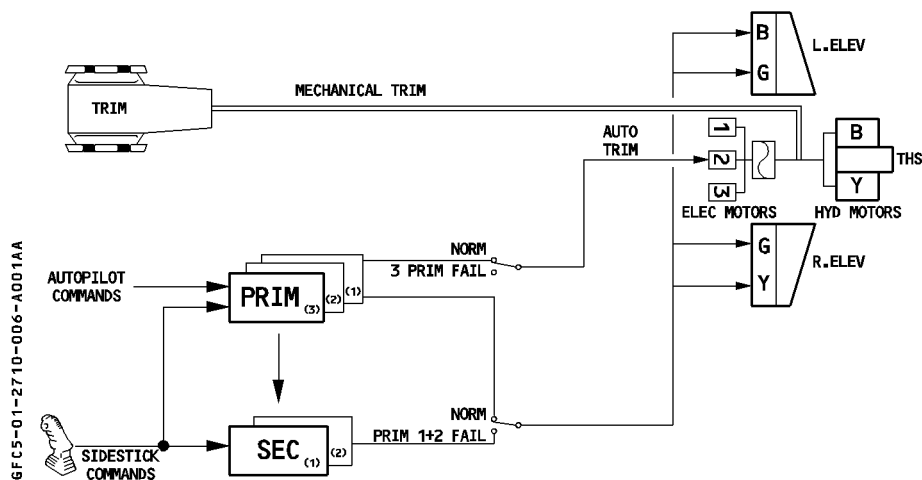
BYDU = Backup Yaw Damper Unit

PTLU = Pedal Travel Limit Unit

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PITCH CONTROL

R



Pitch control is achieved by two elevators and the Trimmable Horizontal Stabilizer (THS). Maximum elevator deflection is 30° nose up and 15° nose down. The maximum THS deflection is 14° nose up, and 2° nose down.

ELECTRICAL CONTROL

The elevators and the stabilizer are normally controlled from the PRIM 1 in which case the left and right elevator surfaces are driven by the green hydraulic jacks.

The THS is controlled by n°1 of the three electrical motors.

If a failure occurs in PRIM 1 or associated hydraulic systems or hydraulic jacks, the pitch control is transferred to PRIM 2. The PRIM 2 then controls the left and right elevators via the blue and yellow hydraulic jacks and the THS via THS motor 2.

If neither PRIM 1 nor PRIM 2 are available pitch control is transferred to SEC 1 for elevator control and to PRIM 3 for THS control via THS motor 3.

Refer to p. 8 for actuation reconfiguration.

In case of 3 PRIM failure the elevator is controlled by SEC 1.

Electrical control of THS is lost. THS actuation is still available through manual pitch trim wheel control.

MECHANICAL CONTROL

Mechanical control by cable of the THS is available from the pitch trim wheel at any time, provided B or Y hydraulic is available.

Mechanical control from the pitch trim wheel has priority over electrical control.

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ACTUATION

Elevators

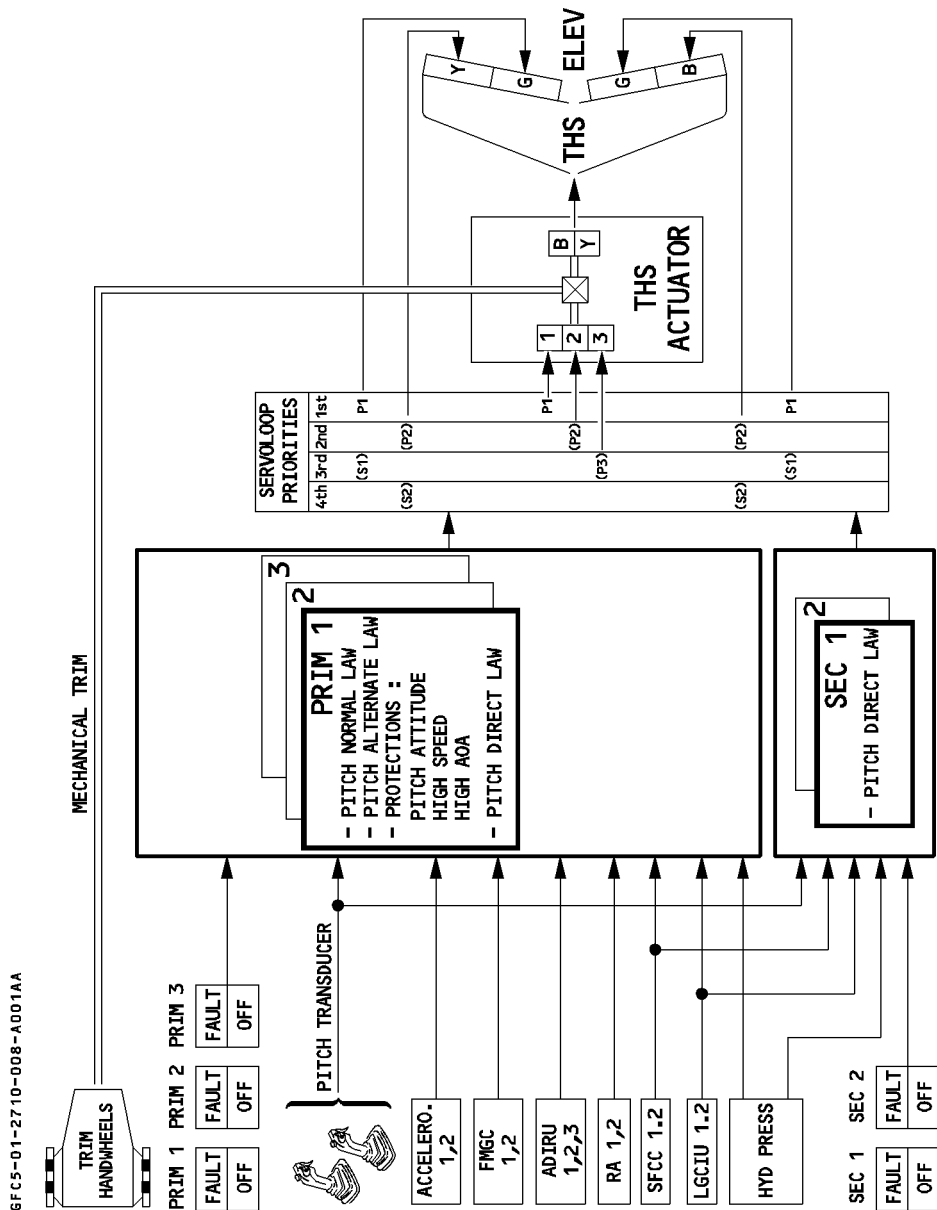
- Two electrically controlled hydraulic servojacks are fitted on each elevator.
- R Each servojack has 3 control modes.
 - Active : Jack position is electrically controlled.
 - Damping : Jack follows surface movement.
 - Centering : Jack is hydraulically maintained in neutral position.
- In normal operation:
 - One jack is in active mode.
 - The other one is in damping mode.
 - Some maneuvers cause the second jack to become active.
- In case of failure of the active servo jack the damped one becomes active and the failed jack is automatically switched to the damping mode.
- R – If both servojacks are not electrically or hydraulically controlled they are automatically switched to the damping mode.
- R – If the four elevator servojacks are not electrically controlled they are automatically
- R switched to the centering mode.

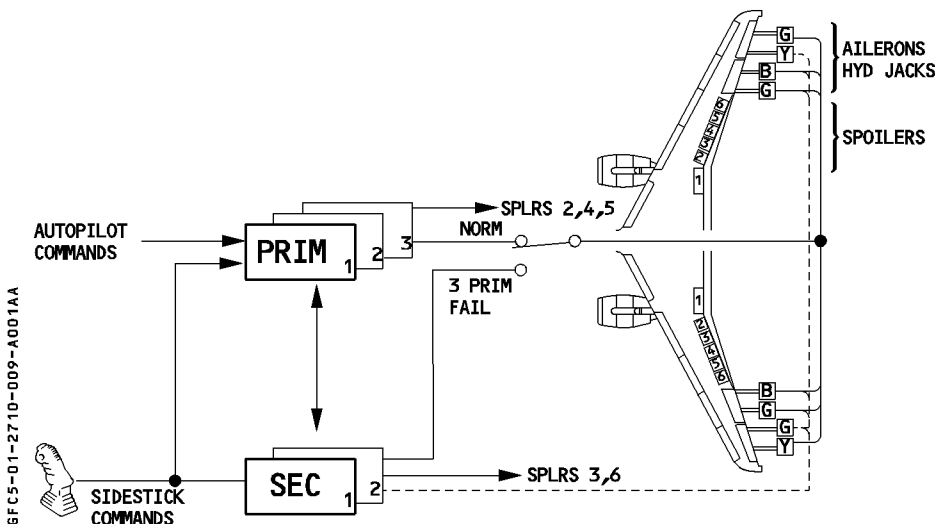
Stabilizer

- Actuated by a screw jack driven by two hydraulic motors.
- These two hydraulic motors are in turn controlled by:
 - one of three electric motors or
 - mechanical trim wheel.

PITCH CONTROL – SCHEMATIC

FOR INFO



ROLL CONTROL

Roll control is achieved by two ailerons and five spoilers on each wing. Ailerons max deflection is 25° and spoilers max deflection is 35°. Ailerons are deflected down when flaps are extended (aileron droop).

ELECTRICAL CONTROL

- The inboard ailerons are normally controlled by the PRIM 1 (LH) and the PRIM 2 (RH) with each of these computers being capable of controlling both sides.
- R The SEC 1 and 2 provide back up control in case of failure of PRIM 1 and 2. (see p. 13 for reconfiguration).
- R The outboard ailerons are normally controlled by the PRIM 3.
- R The SEC 1 and 2 provide back up control in case of PRIM 3 failure (see p. 13 for reconfiguration).
- R Spoilers control is provided by the PRIM (spoilers 2, 4, 5) and by the SEC (spoilers 3, 6).

ACTUATION– **Ailerons**

Each aileron has two electrically controlled hydraulic servojacks.

Each servojack has two control modes :

- Active : Jack position is electrically controlled.
- Damping : Jack follows surface movement.

The system automatically selects damping mode, in the event of green and yellow or blue and green low pressure, or if the respective computer fails.

At high speed (above 190 knots, in CONF 0), the outboard ailerons are controlled to zero deflection.

In autopilot mode, or in some failure cases, the outboard ailerons are used up to 300 knots.

When the emergency generator is supplied by the RAT only, the outboard ailerons are controlled in damping mode to reduce hydraulic power consumption.

– **Spoilers**

A servojack positions each spoiler. Each servojack receives hydraulic power from either the green, yellow, or blue hydraulic system, controlled by the PRIM or SEC (as shown in the diagram on Page 13).

The system automatically retracts the spoilers to their zero position, if it detects a fault or loses electrical control.

If the system loses hydraulic pressure, the spoiler retains the deflection it had at the time of the loss, or a lesser deflection if aerodynamic forces push it down.

When a spoiler surface on one wing fails, the symmetric one on the other wing is inhibited (except for spoilers 4 and 6).

R
R

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SPEEDBRAKE AND GROUND SPOILER CONTROL

SPEEDBRAKE CONTROL

The pilot controls the speedbrakes with the speedbrake lever. The speedbrakes involve spoilers 1 to 6. Speedbrake extension is inhibited, if :

- Maneuver Load Alleviation (MLA) is activated.
- Angle-of-attack protection is active.
- Low speed stability is active.
- Flaps are in Conf FULL.
- At least one thrust lever is above MCT.
- Alpha floor activation.

If an inhibition occurs when the speedbrakes are extended, they automatically retract and stay retracted until the inhibition condition disappears, and the pilots reset the lever. (The speedbrakes can be extended again, 5 seconds after the lever is reset). When a speedbrake surface on one wing fails, the symmetric one on the other wing is inhibited.

FOR INFO

*Maximum deflection : 25° for spoiler 1
 30° for spoilers 2 to 6
 Reduced in Conf 2 and 3*

For surfaces 2 to 6 (which perform roll and speedbrake functions), the roll function has priority : When the sum of a roll order and a simultaneous speedbrake order on one surface is greater than the maximum deflection achievable in flight, the symmetrical one is retracted until the difference between the two surfaces is equal to the roll order.

GROUND SPOILER CONTROL

Spoilers 1 to 6 act as ground spoilers.

When a ground spoiler surface on one wing fails, the symmetric one on the other wing is inhibited.

Arming :

The pilot arms the ground spoilers by pulling the speedbrake control lever up into the armed position.

Extension :

– Full extension

The ground spoilers automatically extend during rejected takeoff (at a speed greater than 72 knots) or at landing, when both main landing gear have touched down, and :

- All thrust levers are set to idle, provided ground spoilers are armed, or
- Reverse is selected on at least one engine (other engine at idle).

R The spoiler roll function is inhibited when spoilers are used for the ground spoiler
 R function.

Partial extension

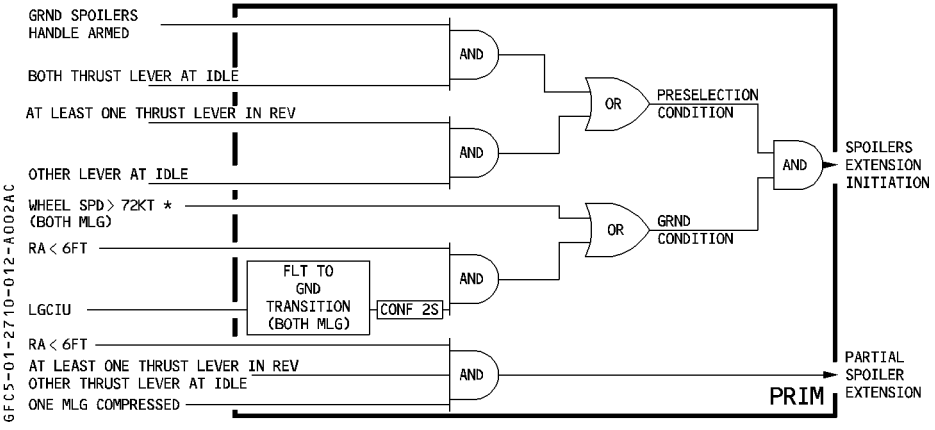
R The ground spoilers partially extend when reverse is selected on at least one engine (other engine at idle) and one main landing gear is compressed.
 This partial extension, by decreasing the lift, will ease the compression of the second main landing gear, and consequently will lead to the normal ground spoiler extension.

Retraction :

The ground spoilers retract when :
 – one thrust lever is above idle
 – or, both thrust levers are at forward idle and the speedbrakes control lever is pushed down.

FOR INFO

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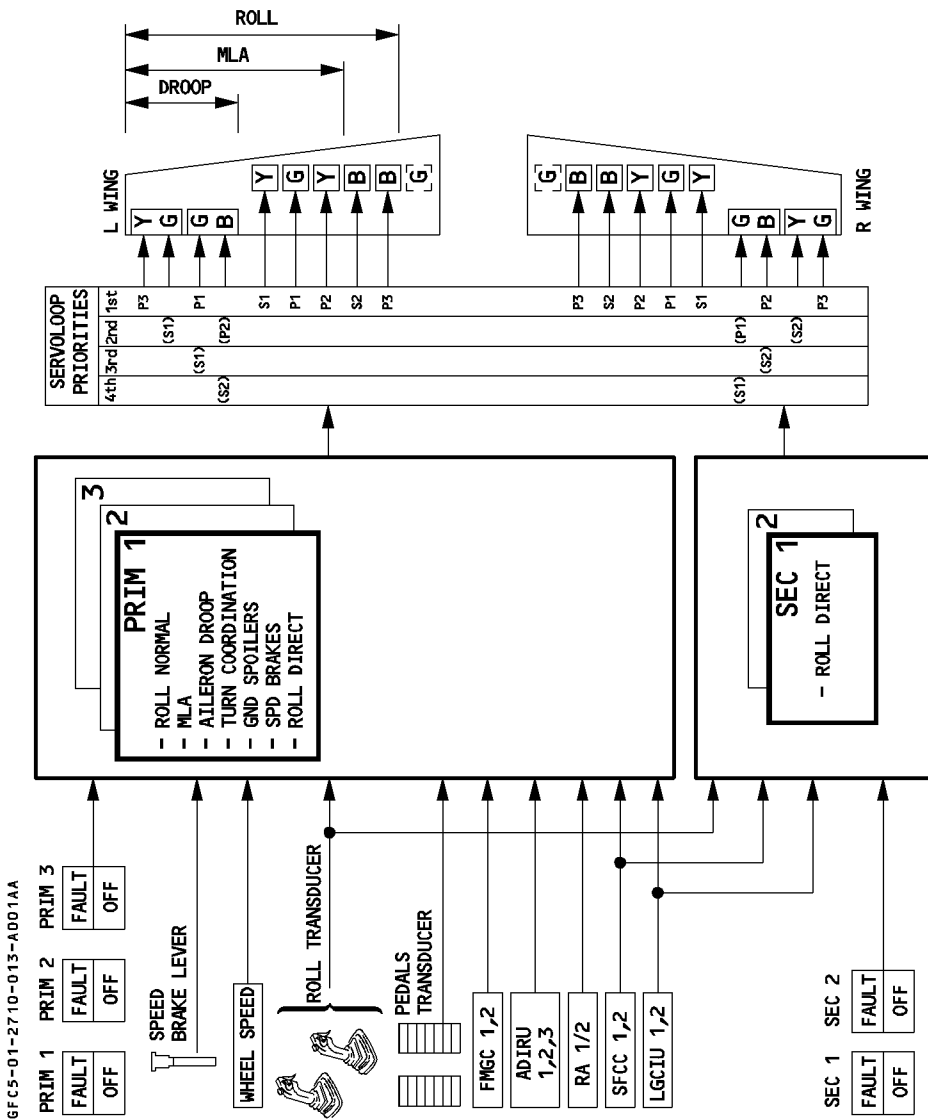


* Condition on wheel speed is inhibited after GND/FLT transition.
 The condition is rearmed if wheel rotation stops.
 Consequently after an aircraft bounce (aircraft airborne) if the spoilers are extended :
 – They remain extended with thrust lever at idle
 – They retract if thrust is increased above idle (go around), and extend again after the next touch down
 The thrust levers are considered idle when they are below 4.7° when the RA is above 6 feet and below 32° when the RA is below 6 feet.
 Surfaces extend partially/fully to 14°/35° for spoiler 1, 20°/50° for spoilers 2 to 6

ROLL CONTROL – SCHEMATIC

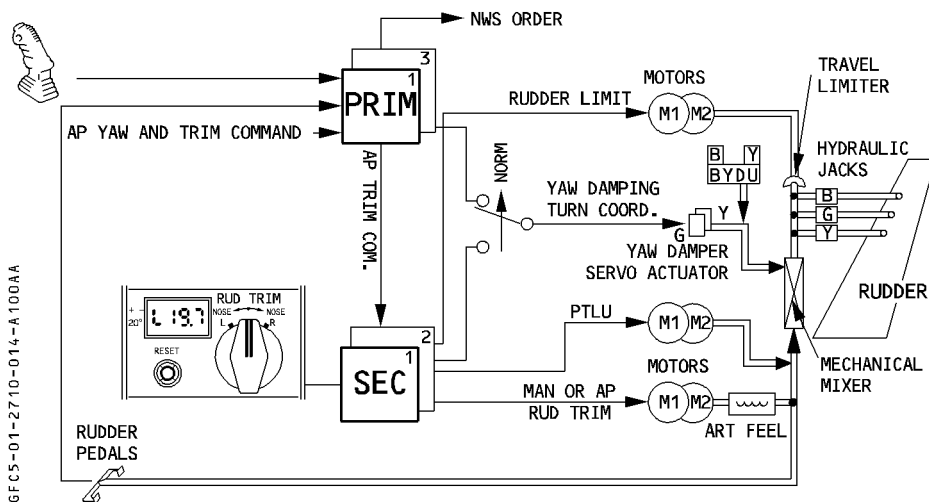
FOR INFO

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YAW CONTROL

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Yaw control is achieved by one rudder surface (maximum rudder deflection $\pm 35^\circ$).

ELECTRICAL RUDDER CONTROL

In flight, yaw damping and turn coordination functions are automatic, and are controlled by the PRIMs and SECs. (Refer to the yaw control schematic).

MECHANICAL RUDDER CONTROL

Conventional mechanical rudder control is available from the pilot's rudder pedals.

RUDDER ACTUATION

The rudder is actuated by 3 independent hydraulic jacks, which operate in parallel.

YAW DAMPING, TURN COORDINATION

The three hydraulic servo-jacks are actuated by a green hydraulic servo-actuator. A yellow servo-actuator remains synchronized and will take over in case of failure.

There is no feedback to the rudder pedals from the yaw damping and turn coordination functions.

In case of a total loss of electrical power, or a total loss of flight control computers, the Backup Yaw Damper Unit (BYDU) becomes active for the yaw damping function only.

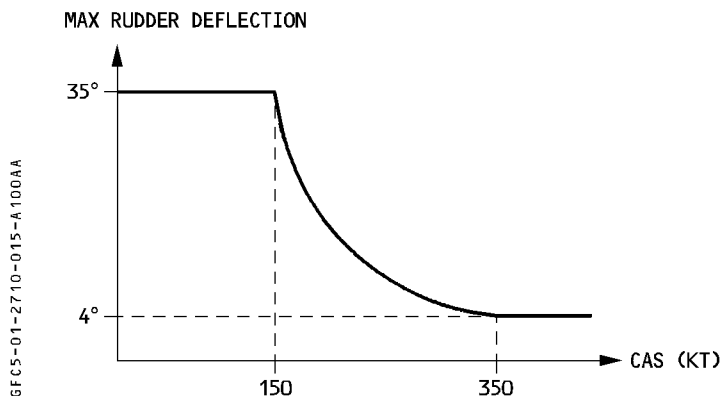
The BYDU consists of an electro-mechanical actuator, in parallel with the two normal yaw dampers, and incorporates one gyrometer and associated electronics. Independent electric supply is provided by two dedicated electrical generators, one is driven by the blue hydraulic system, the other by the yellow hydraulic system.

RUDDER TRAVEL LIMIT AND PTLU

Rudder and pedal deflection is limited as a function of the speed.

Each limiter channel is controlled and monitored by its associated SEC.

In case of a double SEC failure, the max rudder deflection remains at the value reached before the failure ; then, a max deflection is available when the slats are extended.



RUDDER TRIM

Rudder trim is achieved by two electric motors which position the artificial feel unit. In normal operation SEC 1 / MOTOR 1 are driving with SEC 2 / MOTOR 2 remaining synchronized as back up.

The pilot can apply in manual flight, rudder trim from the RUD TRIM rotary switch located on the pedestal.

– Authority : 85 % of max rudder deflection limited to 25°

R – Rudder trim speed : 1°/second in clean configuration, in case slats/flaps extended 1°/second for input up to 1.5 second and 3°/second above.

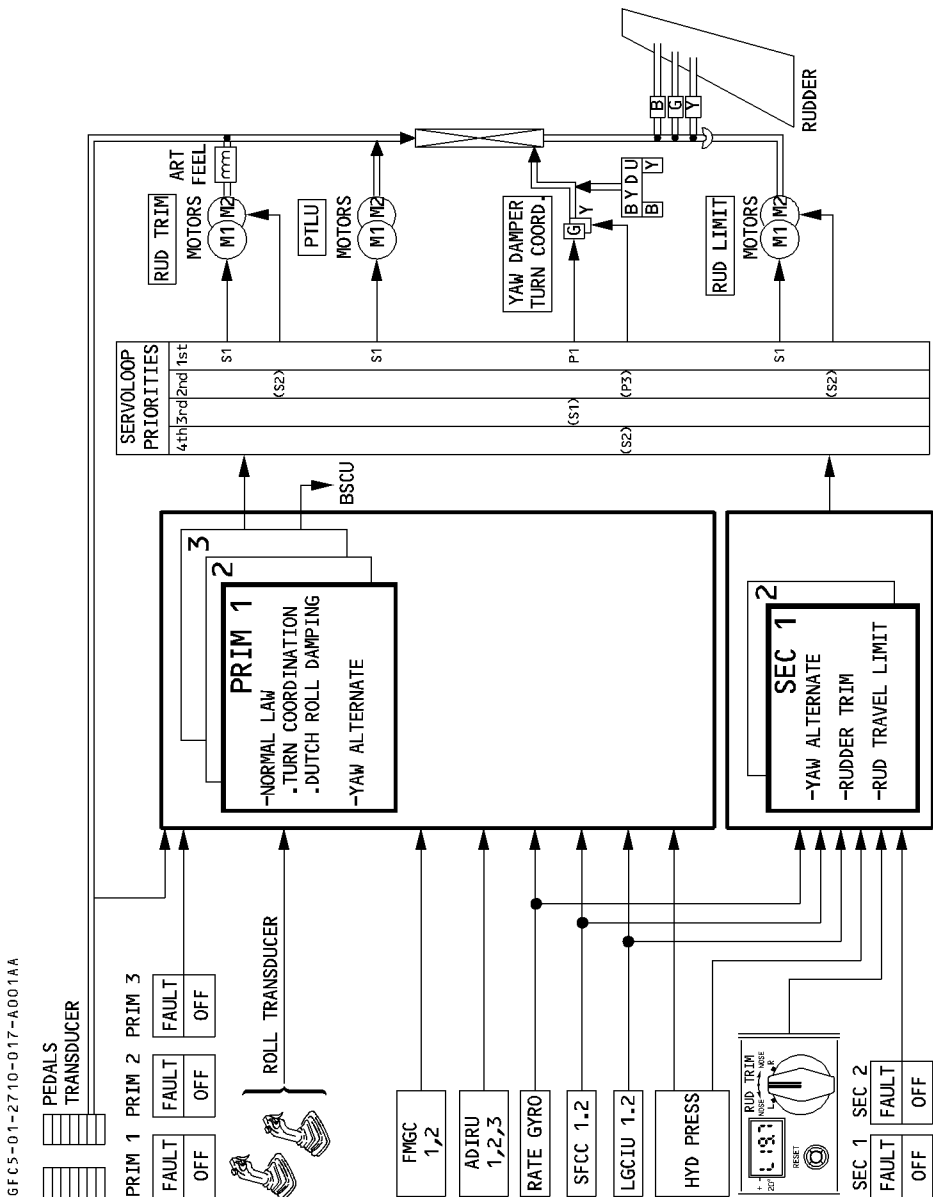
A button is provided on the RUD TRIM panel to reset the rudder trim to zero.

R Note : With autopilot engaged, rudder trim orders are computed by FMGC. Rudder trim rotary switch is not active.

YAW CONTROL – SCHEMATIC

FOR INFO

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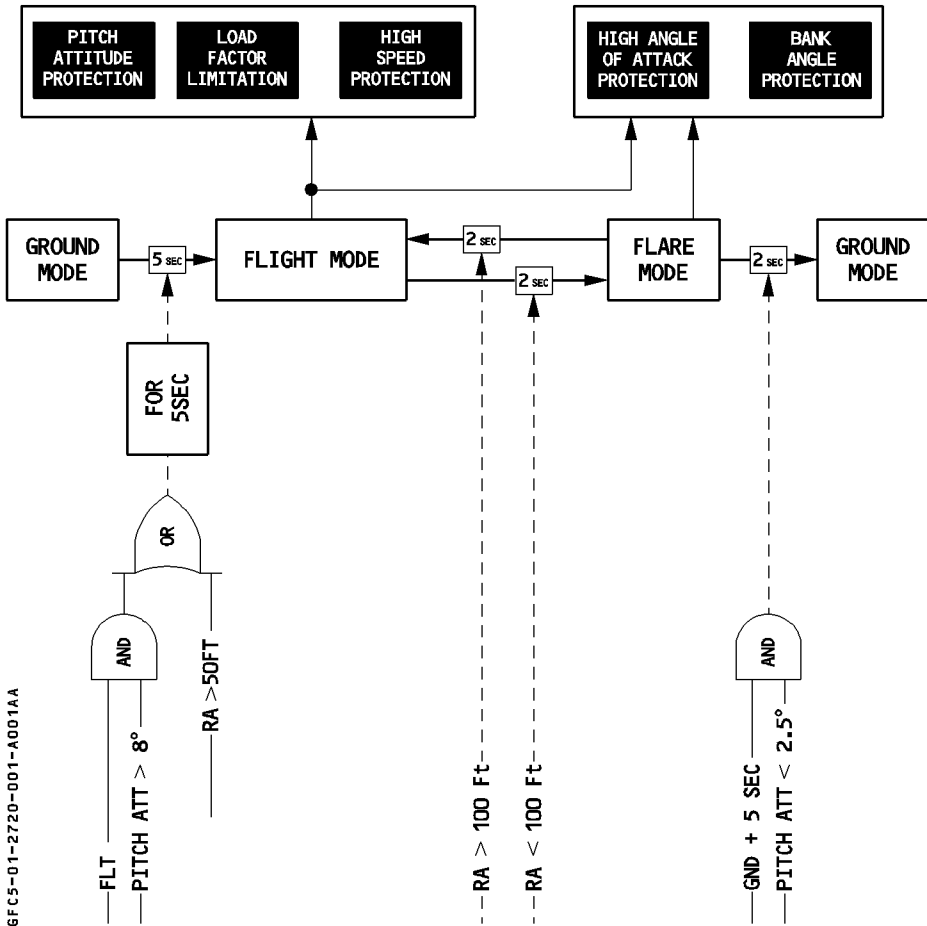
GENERAL

Flight control normal law provides:

- 3 Axis control
- Flight envelope protection
- Maneuver load alleviation

FOR INFO

R



PITCH CONTROL**GROUND MODE**

Ground mode is active on ground. It is a direct relationship between sidestick deflection and elevator deflection without auto trim.

The THS is automatically set at 4° UP (inside the green band). Manual setting according to CG has priority for take off.

The rotation maneuver is flown in direct law with full authority.

Immediately after the aircraft becomes airborne the flight mode is progressively blended in.

The reverse process occurs after touch down.

FLIGHT MODE

The normal law flight mode is a load factor demand law with auto trim and full flight envelope protection.

It provides control of elevator and THS from the side stick controllers to achieve a load factor proportional to stick deflection, independent of speed.

With the side stick at neutral, wings level, the system maintains 1 G in pitch corrected for pitch attitude, and there is no need for the pilot to trim with speed or configuration changes.

R Pitch trim is automatic in both manual mode and when the autopilot is engaged.

In normal turns (up to 33° of bank) no pitch correction is required once the turn is established.

The flight mode is active from TO to landing according to the logic (page 1).

Automatic pitch trim is frozen in the following cases:

- Manual trim order
- Radio altitude below 100 ft for flare
- Load factor lower than 0.5 g
- In high speed protection

When angle of attack protection is active, THS is limited between setting at entry in protection and 2° nose down (i.e. further nose up trim cannot be applied).

Similarly when the load factor is higher than 1.3 g, or when the bank angle gets outside ± 33°, the THS is limited between the actual setting and 2° nose down.

R **Control with autopilot engaged**

R – The autopilot orders are limited by the PRIM

R – A force must be overcome to move the sidestick with the autopilot engaged. If the pilot moves the side stick to overcome this force the autopilot will disconnect.

R – All protections remain effective.

FLARE MODE

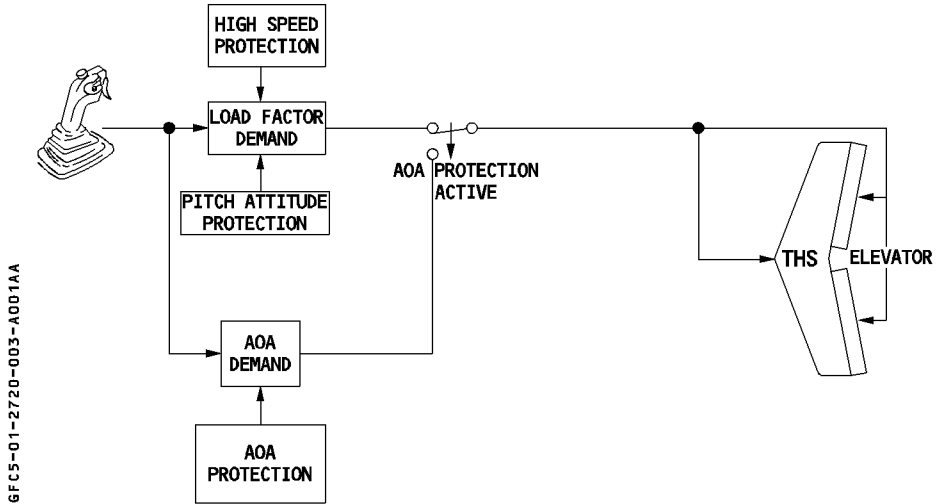
The flight mode changes to flare mode at landing, when passing 100 feet.

- R Flare mode is a direct stick-to-elevator relationship (with some damping provided by load
- R factor and pitch rate feedbacks). In addition, at 50 feet, a slight pitch down elevator order
- R is applied, so that the pilot has to move the stick rearwards to maintain a constant path,
- R so as to reproduce conventional aircraft aerodynamic characteristics.

PROTECTIONS

Normal law provides complete flight envelope protection as follows :

- Load factor limitation
- Pitch attitude protection
- High angle-of-attack (AOA) protection
- High speed protection



LOAD FACTOR LIMITATION

The load factor is automatically limited to:

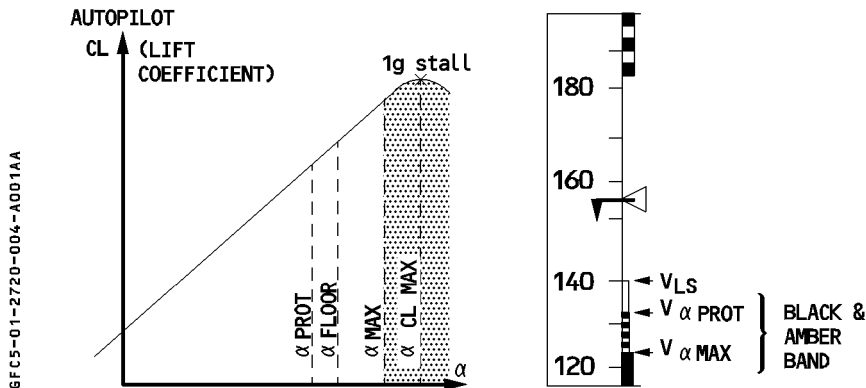
- + 2.5 g to – 1 g, slats retracted
- + 2 g to 0, slats extended

PITCH ATTITUDE PROTECTION

Pitch attitude is limited to 30° nose up (progressively reduced to 25° at low speed), and to 15° nose down (indicated by green symbols “=” on the PFD pitch scale (Refer to 1.31.40)).

HIGH ANGLE OF ATTACK PROTECTION

R Under normal law, when angle of attack becomes greater than α prot, the system switches
 R the elevator control from normal mode to a protection mode in which the angle of attack
 R is proportional to the sidestick deflection. That is, in the α prot range, from α prot to α max,
 R the side stick commands α directly. However the angle of attack will not exceed α max,
 R even if the pilot gently pulls the sidestick all the way back. If the pilot releases the sidestick
 R the angle of attack returns to α prot and stays there.
 R This protection, against stall and windshear, has priority over all other protections.
 R The autopilot will disconnect if the protection is active.



- V_{α} prot, V_{α} max and V_{α} floor conditions vary according to the weight and the configuration
- V_{α} prot and V_{α} max displayed on the PFD are computed by the PRIM.
- α floor activation logic is provided by the PRIM.

Note : 1. At takeoff α prot is equal to α max for 5 seconds.

2. α FLOOR is activated through autothrust system when :

- α is greater than a threshold depending on the aircraft configuration, the ground speed variation, and the difference between ground speed and air speed or,
- Sidestick deflection above 14° and:
 - pitch altitude greater than 25° , or
 - AOA protection active

3. α FLOOR inhibition: (Refer to 1.22.30).

To leave the angle of attack protection the sidestick must be pushed :

- More than 8° forward, or,
- More than 0° forward for at least 1 second when $\alpha < \alpha$ max.

HIGH SPEED PROTECTION

The aircraft automatically recovers following a high speed upset. Depending on the flight conditions (high acceleration, low pitch attitude), the High Speed Protection is activated at/or above VMO/MMO.

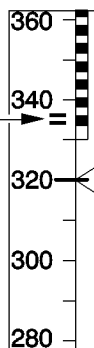
- R When it is activated, the pitch trim is frozen. Positive spiral static stability is introduced to
 - R 0° bank angle (instead of 33° in normal law), so that with the sidestick released, the aircraft
 - R always returns to a bank angle of 0°. The bank angle limit is reduced from 67° to 45°.
- As the speed increases above VMO/MMO, the sidestick nose-down authority is progressively reduced, and a permanent nose-up order is applied to aid recovery to normal flight conditions.

The High Speed Protection is deactivated when the aircraft speed decreases below VMO/MMO, where the usual normal control laws are recovered.

The autopilot disconnects when high speed protection goes active.

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High speed protection symbol: }
 Two green bars at VMO + 4



Note : *OVER SPEED ECAM warning is provided at:*

- VMO + 4 kt
- MMO + 0.006

LOW ENERGY WARNING

R A low energy aural warning “SPEED SPEED SPEED” repeated every 5 seconds indicates to the pilot that the aircraft energy becomes lower than a threshold under which to recover a positive flight path angle through pitch control, the thrust must be increased. It is available in configuration 2, 3 and full between 100 and 2000 ft. The low energy warning is computed by the PRIM’s from the following inputs:

- R – Aircraft configuration
 – Air speed deceleration rate
 – Flight path angle

It is inhibited when:

- R – TOGA is selected
 – Below 100 ft RA
 – Above 2 000 ft RA
 – Alpha floor or GPWS alert is triggered
 R – In alternate or direct law
 – If both RA are failed.

The low energy warning is triggered during deceleration before alpha floor (unless alpha floor is triggered by stick deflection), the delay between the two warnings depends on deceleration rate.

LATERAL CONTROL**LATERAL NORMAL LAW**

When the aircraft is on the ground (in "on ground" mode), the sidestick commands the aileron and roll spoiler surface deflection. The amount of control surface deflection that results from a given amount of sidestick deflection depends upon aircraft speed. The pedals control rudder deflection through a direct mechanical linkage.

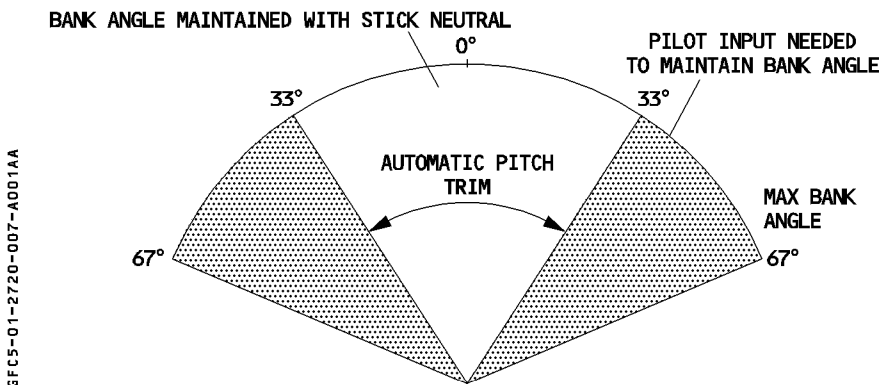
When the aircraft is in the "in flight" mode, normal law combines control of the ailerons, spoilers (except N° 1 spoilers), and rudder (for turn coordination) in the sidestick. While the system thereby gives the pilot control of the roll and heading, it also limits the roll rate and bank angle, coordinates the turns, and damps the dutch roll.

The roll rate requested by the pilot during flight is proportional to the sidestick deflection, with a maximum rate of 15° per second when the sidestick is at the stop.

When the aircraft is in "flare" mode, the lateral control is the same as in "in flight" mode.

BANK ANGLE PROTECTION

- R Inside the normal flight envelope, the system maintains positive spiral static stability for bank angles above 33°. If the pilot releases the sidestick at a bank angle greater than 33°, the bank angle automatically reduces to 33°. Up to 33°, the system holds the roll attitude constant when the sidestick is at neutral. If the pilot holds full lateral sidestick deflection, the bank angle goes to 67° (indicated by a pair of green bar lines "=" on the PFD) and no further.



If the angle-of-attack protection or high speed protection is operative, the bank angle goes to 45° and no further, if the pilot holds full lateral sidestick deflection. If high speed protection is operative, the system maintains positive spiral static stability from a bank angle of 0°, so that with the sidestick released, the aircraft always returns to a bank angle of 0°.

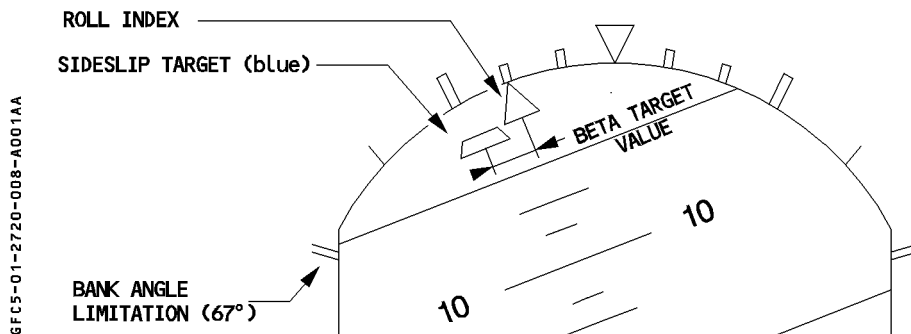
When bank angle protection is active, auto trim is inoperative.

If the bank angle exceeds 45°, the autopilot disconnects and the FD bars disappear. The FD bars return when the bank angle decreases to less than 40°.

SIDESLIP TARGET

Should an engine failure occur, the sideslip indication is slightly modified to ensure that optimum pilot rudder application is made to achieve optimum climb performance (ailerons to neutral and spoilers retracted).

In takeoff configuration, when asymmetrical thrust is detected (30 % N1 (GE) or 0.25 EPR (PW/RR)), and at least one engine is above 80 % N1 (GE) or 1.3 EPR (PW/RR), the sideslip indication will change from yellow to blue.



Crew response is normal and instinctive:

- Zero, beta target value for optimum performance with appropriate rudder application.
- Accelerate if beta target cannot be zeroed with full rudder.

The computation is made by the PRIM.



MANEUVER LOAD ALLEVIATION (MLA)

The purpose of MLA is to redistribute the lift over the wing to relieve structural loads on the outer wing surfaces (bending moment).

The demanded load factor is maintained.

MLA utilises spoilers 4, 5, and 6 and the ailerons.

R The MLA becomes active when the sidestick is pulled more than 8°, and the load factor is more than 2g, in which case :

- The ailerons are deflected symmetrically upwards :
 - Maximum 11° added to roll demand, if any.
 - Spoilers 4, 5, 6 are symmetrically deflected :
 - Maximum 9° added to roll demand if any.
 - Deflection is proportional to load factor in excess of 2 g.
- An elevator demand is simultaneously applied to compensate for the pitching moment induced by spoilers and ailerons.

The load alleviation is only available when :

- The aircraft speed is above 250 knots.
 - The FLAPS lever is in the 0 position.
 - In normal or alternate law flight mode.
- The MLA has priority over the speedbrakes.

TURBULENCE DAMPING FUNCTION

The purpose of the turbulence damping function is to damp the structural modes induced by atmosphere turbulence.

The function uses the Nz accelerometer and two dedicated Ny accelerometers. The PRIMs compute a turbulence damping command, which is added to the normal law command for the elevator and the yaw damper.

This function is automatically monitored and becomes inoperative for the remainder of the flight, when a failure is detected. In addition, it may be manually inhibited by switching off the TURB DAMP pushbutton on the overhead panel, when it is considered that comfort is degraded instead of being improved, and no failure is detected.

It is only available if the following conditions are met :

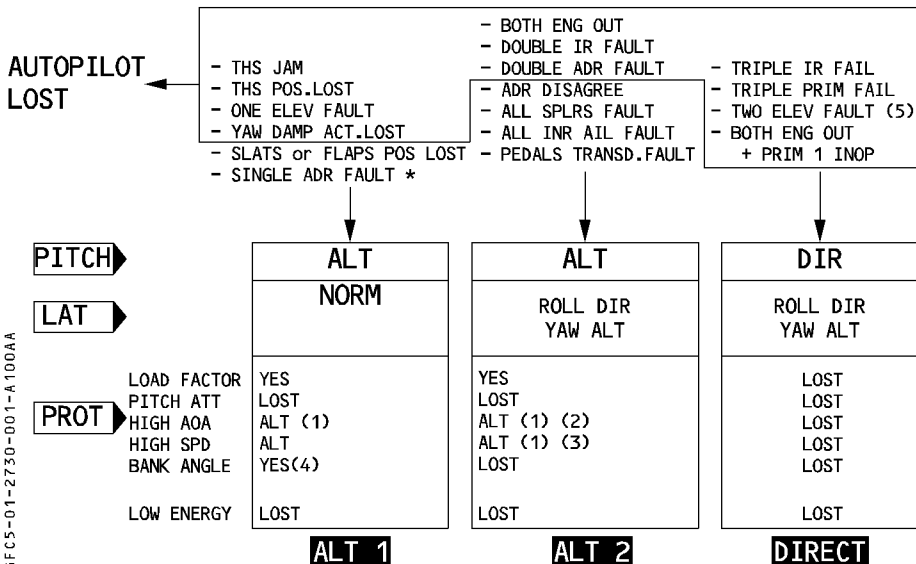
- Aircraft in flight.
- Aircraft speed greater than 200 knots.
- Autopilot engaged or normal law active.
- Aircraft within the normal flight envelope.

GENERAL

Depending on the type of failures affecting the flight control system, or peripherals, there are 3 possible reconfiguration levels :

- Alternate law (ALT 1 or ALT 2)
- Direct law, or
- Mechanical.

R



- * Only in case the AOA, of the remaining ADRs, disagrees with the AOA (as computed by the PRIMs).
- (1) Protection is totally lost, in case of VS1g computation failure (loss of weight, or slat/flap position).
 - (2) Protection is lost, in case of a dual ADR failure (or ADR DISAGREE).
 - (3) Protection is lost, in case of a triple ADR failure (or ADR DISAGREE).
 - (4) Bank angle limitation remains effective in ALT 1, which uses roll normal.
However, since ALT 1 is in generally an unprotected law, all protection marks on the PFD are in amber for simplicity.
 - (5) When both elevators have failed, only pitch mechanical backup is available, by using the manual pitch trim control (THS). "MAN PITCH TRIM ONLY" is displayed in red on the PFDs.

R
R
R

Note : 1. In case of a dual RA failure, flare law is introduced when the landing gear is extended and both autopilots are disengaged. The specific normal law pitch down effect at 50 feet no longer applies.

2. In case of flight controls computer reconfiguration (due to hydraulic failure, computer failure, electrical transient...), a jerk may be noticed.

ALTERNATE LAW

ALT 1

PITCH CONTROL

Ground mode

Identical to normal law ground mode.

Flight mode

Flight law is a load factor demand law, similar to normal law, with limited pitch rate feedback and gains, depending on speed and configuration.

Note : When the yaw damper actuators are not available (Hydraulic G + Y failure for example), the yaw damping function is achieved via the ailerons and the BYDU.

Flare mode

Flare law is identical to normal flare law.

LATERAL CONTROL

Lateral control is similar to normal law, except that alterations of positive spiral static stability will not occur due to the loss of high AOA and high speed protection.

PROTECTIONS

Low speed stability

At low speed, a nose down demand is introduced in reference to IAS, instead of angle of attack, and alternate law changes to direct law.

It is available, whatever the slats/flaps configuration, and it is active from about 5 knots up to about 10 knots above the stall warning speed, depending on the aircraft's weight and slats/flaps configuration.

A gentle progressive nose down signal is introduced, which tends to keep the speed from falling below these values. The pilot can override this demand.

Bank angle compensation is provided.

In addition, audio stall warning (crickets + "STALL" synthetic voice message) is activated at an appropriate margin from the stall condition.

The PFD speed scale is modified to show a black/red barber pole below the stall warning. V_{α} prot and V_{α} max are replaced by V_{sw} (stall warning speed).

The α floor protection is inoperative.

 AIRBUS TRAINING A330 SIMULATOR FLIGHT CREW OPERATING MANUAL	FLIGHT CONTROLS	1.27.30	P 3
	RECONFIGURATION CONTROL LAWS	SEQ 100	REV 12

- R **High speed stability**
 Above VMO/MMO a nose up demand is introduced to avoid an excessive increase in speed.
 The pilot can override this demand.
 The high speed protection symbol (VMO + 4) disappears.
 In addition, the overspeed warning (VMO + 4 or MMO + 0.006) remains available.

Pitch attitude protection

Lost.

ALT 2

PITCH CONTROL

Identical to ALT 1 law.

LATERAL CONTROL

Roll direct law

Provides a direct stick-to-surface position relationship. The gains are automatically set according to the slats/flaps configuration.

The maximum roll rate is approximately 20 to 25° / second, depending on the speed and configuration.

Spoilers 2, 3 and 6 are inhibited, except in case of some additional failures affecting the lateral control.

Yaw alternate law

The dutch roll damping function is available, and damper authority is limited to $\pm 4^\circ$ rudder (CONF 0) and $\pm 15^\circ$ (other configuration).

Turn coordination is also provided, except in CONF 0.

PROTECTIONS

Identical to protections in ALT 1, except that :

1. There is no bank angle protection in ALT 2 law.
- R 2. In case of failure of 2 ADRs, there is no low speed stability.
- R 3. In case of failure of 3 ADRs, there is no high speed stability.

DIRECT LAW

The pitch direct law is a direct stick to elevator relationship (elevator deflection is proportional to stick deflection).

In all configurations the maximum elevator deflection is varied as a function of CG.

It provides a compromise between adequate controllability at forward CG and not too sensitive control at aft CG.

There is no automatic trim and the pilot has to use manual trim.

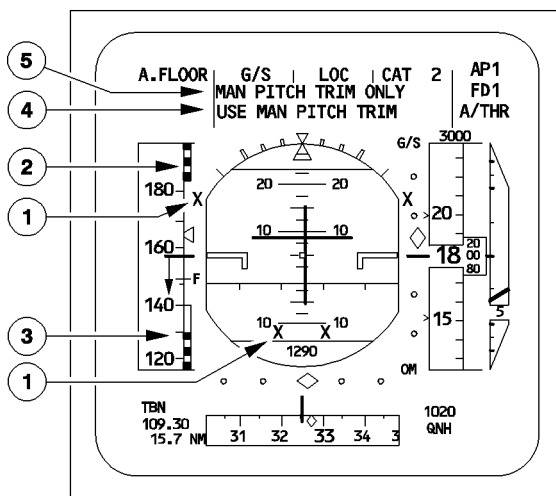
«USE MAN PITCH TRIM» amber message is displayed on the PFD.

All protections are inoperative

R The α floor function is inoperative.

Overspeed and stall warnings are available as for alternate law.

RECONFIGURATION CONTROL LAWS – PFD DISPLAY



GFC5-01-2730-004-A001AA

① Bank angle and pitch limitation replaced by amber X

② Overspeed protection symbol (=) disappears.

③ V_{α} prot and V_{α} max are replaced by V_{sw}

R ④ USE MAN PITCH TRIM (amber) displayed in direct law, or, in flare law without RA

R ⑤ MAN PITCH TRIM ONLY (red) displayed if L + R elevators fault detected

 AIRBUS TRAINING A330 SIMULATOR FLIGHT CREW OPERATING MANUAL	FLIGHT CONTROLS		1.27.30	P 5
	RECONFIGURATION CONTROL LAWS		SEQ 001	REV 03

ABNORMAL ATTITUDE LAWS

- R An abnormal attitude law in pitch and roll is provided if the aircraft is in flight and in any
- R of these conditions :
- R – Pitch attitude > 50° nose up or 30° nose down
- R – Bank angle > 125 °
- R – Angle of attack > 30° or < – 10°
- R – Speed > 440 kt or < 60 kt
- R – Mach > 0.96 or < 0.1

The law in pitch is the alternate law without protection (except load factor protection) and without auto trim. In roll it is a full authority direct law with yaw alternate.

After recovery, the flight controls laws are:

in pitch : alternate law

in roll : direct law with yaw alternate law

MECHANICAL BACK UP

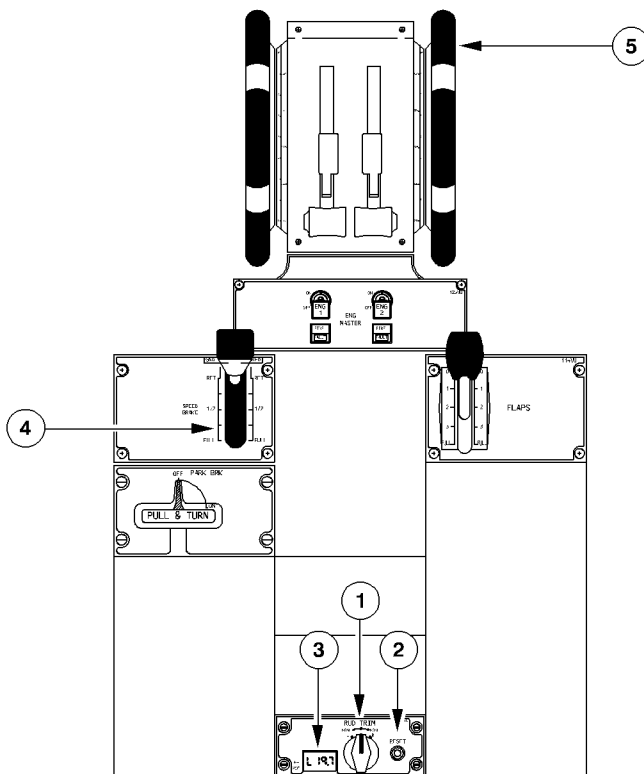
To control the aircraft during a temporary complete loss of electrical power.

PITCH

Pitch mechanical control is achieved through the THS using manual trim control. «MAN PITCH TRIM ONLY» is displayed in red on the PFDS.

LATERAL

Lateral mechanical control is achieved through the rudder using pedals. Dutch roll damping is provided by the back up yaw damper unit (BYDU).

PEDESTAL

GFC5-01-2740-001-A001AA

① RUD TRIM selector

Controls the rudder trim actuator which moves the neutral point of the artificial feel by the equivalent of :

In clean configuration : 1° / second of rudder travel

Slats/flaps extended : 1° / second of rudder travel for quick inputs

3° / second for inputs longer than 1.5 seconds

② RESET pushbutton

By pushing the RESET pushbutton, the zero trim position is ordered at 3° / second.

Note : The rudder trim rotary switch, and the RESET pushbutton, are not active with the autopilot engaged.

③ Position Indicator

Displays the rudder trim direction (L or R) and value (0 to 25°).

④ SPEEDBRAKE lever

The lever controls:

- The position of the speedbrake surfaces.

To set speedbrake surfaces to a required position, the lever has to be pushed down and set to the required position. A "hardpoint" is provided at "½" SPEEDBRAKE position.

- The manual preselection of the ground spoilers.

To arm the ground spoilers, the lever must be pulled up when in the RET position.

When the lever is armed (or reverse thrust is selected), all spoilers' surfaces will automatically extend at landing, or in case of a rejected takeoff.

⑤ PITCH TRIM wheel

Both pitch trim wheels provide mechanical control of the THS and have priority over electrical control.

Note : Crew action on the pitch trim wheel does not disconnect the PRIMs (micro-switches, actuated by the override mechanism, ensure that the computers remain synchronized with the manually-selected position).

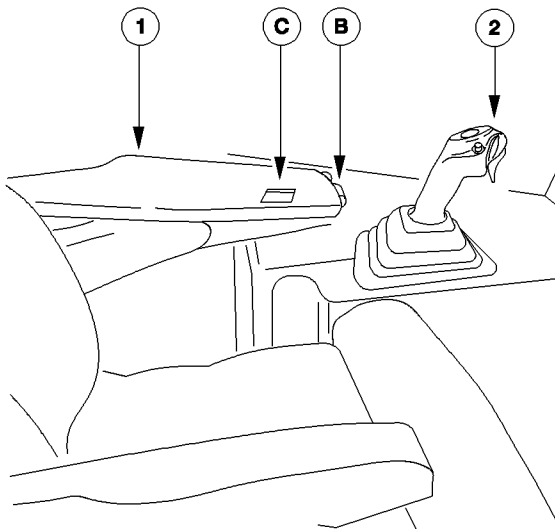
The THS is manually-controlled on ground for the THS setting, before takeoff and in flight, when in direct law :

- Before takeoff, the pilot sets the THS to the angular value, determined as a function of the aircraft CG, using the CG scale on the wheel. The relationship between the aircraft CG and the THS setting shown on the trim wheel is only applicable for takeoff. The limits of the THS normal setting range for takeoff are indicated by a green band on the pitch trim wheel
- In flight, when in direct law, the pilot uses the THS conventionally to fly in trim. In flight, the aircraft pitch trim setting depends on aircraft CG, weight, altitude 2nd speed. Consequently, the relation between the aircraft CG, and the THS setting displayed on the pitch trim wheel, does not apply in flight.

Following nosewheel touchdown, as the pitch attitude becomes less than 2.5° for more than 5 seconds, pitch trim is automatically reset to 4° up.

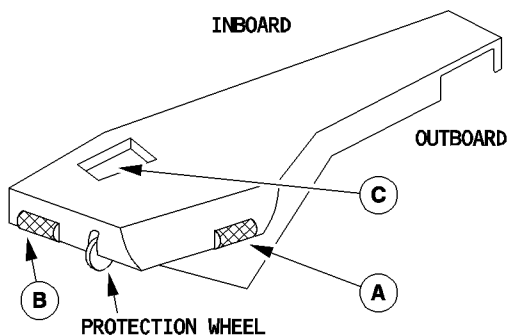


LATERAL CONSOLES



6FC5-01-2740-003-A001AA

① ARM REST



6FC5-01-2740-003-B001AA

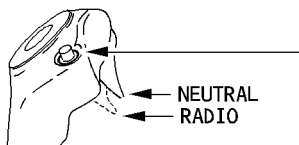
Arm rest is linked to the seat by means of a supporting arm.
The arm rest position is adjustable.
Following setting and indications are provided:

- ① A Height adjustment
- ① B Pitch adjustment
- ① C Armrest memory position display in pitch and in height.

② SIDESTICKS

Sidesticks, one on each lateral console, are used for manual pitch and roll control. They are springloaded to neutral. When the autopilot is engaged, a solenoid-operated detent locks both sidesticks in the neutral position. If the pilot applies a force above a given threshold (5daN in pitch, 3.5 daN in roll), the autopilot disengages and the sidestick unlocks and sends an input to the computers. The hand grip includes 2 pushbuttons :

- Autopilot disconnect/sidestick priority pushbutton.
- Push-to-talk button.



TAKE OVER PUSHBUTTON
 (AUTOPILOT DISCONNECTION OR TAKE OVER
 FROM OPPOSITE SIDESTICK)

NEUTRAL
 RADIO

8FES-01-2740-004-A20044

Sidestick priority logic

- When only one pilot operates the sidestick, his demand is sent to the computers.
- When the other pilot operates his sidestick, in the same or opposite direction, both pilot inputs are algebraically-added. The addition is limited to single-stick maximum deflection.

Note : In the event of simultaneous inputs on both sidesticks (2° deflection off the neutral position in any direction), the two green SIDE STICK PRIORITY lights, on the glareshield, come on and the "DUAL INPUT" voice message activates.

A pilot can deactivate the other sidestick, and take full control by pressing and keeping pressed his takeover pushbutton.

For latching the priority condition, it is recommended that the takeover pushbutton be pressed for more than 40 seconds. The takeover pushbutton can then be released without losing priority.

However, a deactivated sidestick can be reactivated at any time, by momentarily pressing either takeover pushbutton. If both pilots press their takeover pushbuttons, the last pilot to press their pushbutton will have priority.

Note : If an autopilot is engaged, any action on a takeover pushbutton will disengage it.

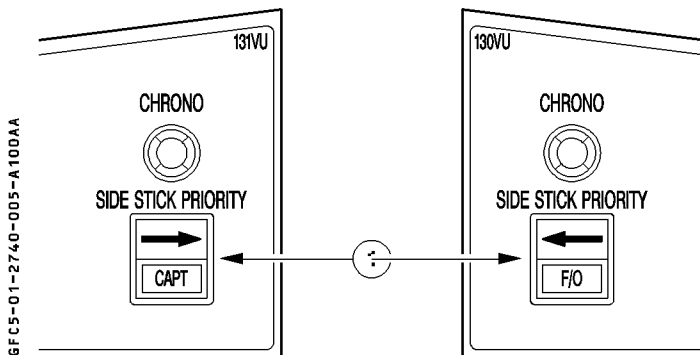
In a priority situation

- A red light will come on, in front of the pilot whose sidestick is deactivated.
- A green light will come on, in front of the pilot who has taken control, if the other sidestick is not in the neutral position (to indicate a potential and unwanted control demand).

Note : If one stick is deactivated on ground, at takeoff thrust application, the takeoff «CONFIG» warning is triggered.



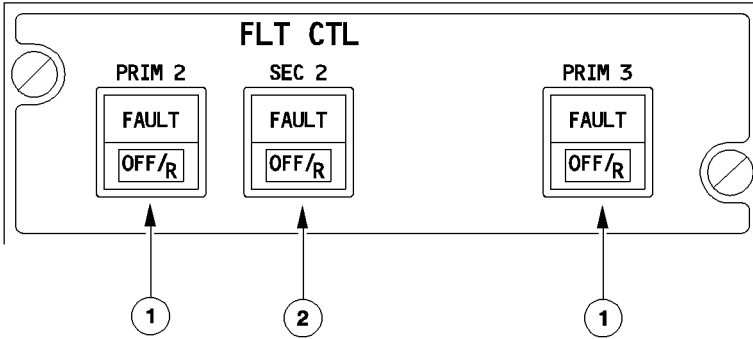
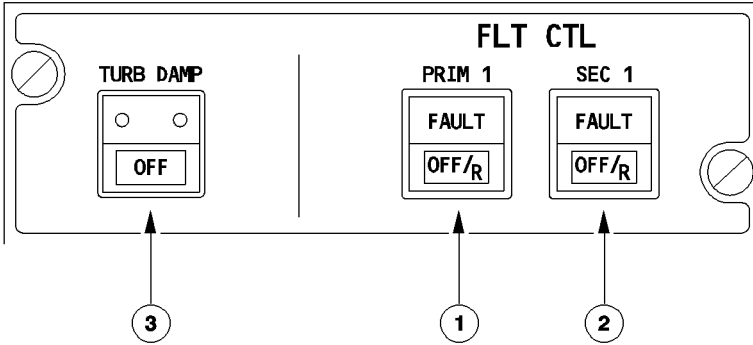
GLARESHIELD



① SIDE STICK PRIORITY It

- Arrow red It : – Illuminates in front of the pilot losing authority.
- Extinguishes if he has recovered his authority, ie:
 - If the other takeover pb is released prior priority condition is latched.
 - If he has used his takeover push button to cancel a latched priority situation.
- Sidestick priority audio: a «PRIORITY LEFT» or «PRIORITY RIGHT» audio voice message is given each time priority is taken.
- CAPT-F/O green It : – Illuminates in front of the pilot who has taken priority by pressing the takeover push button if the opposite stick is not at neutral.
- or
- CAPT and F/O light illuminate in case of simultaneous input on both sidesticks.
 - Extinguishes when the opposite stick is returned to the neutral position.

OVERHEAD PANEL



6FC5-01-2740-006-A001AA

 A330 <small>SIMULATOR</small> FLIGHT CREW OPERATING MANUAL	FLIGHT CONTROLS	1.27.40	P 7
	CONTROLS AND INDICATORS	SEQ 001	REV 03

① PRIM pb sw

Control the Flight Control Primary Computers (FCPC)

ON : The following functions are provided by each computer:

- Normal pitch
- Normal lateral
- MLA
- Speed brakes, ground spoilers control logic
- Pitch alternate
- Pitch direct
- Roll direct
- Yaw alternate
- Ailerons droop
- Abnormal attitude law
- Autopilot orders acquisition
- Characteristic speeds computation

R

OFF : The corresponding computer is not active. Switching OFF then on resets it.

FAULT It : Illuminates amber accompanied by ECAM caution activation when a failure is detected.

The FAULT It extinguishes when OFF selected, or at the end of PRIM power up test provided it is satisfactory.

② SEC pb sw

Control the Flight Control Secondary Computers (FCSC)

ON : The following functions are provided by each computer:

- Pitch direct
- Roll direct
- Yaw alternate
- Rudder trim
- Rudder travel

OFF : The corresponding computer is not active. Switching OFF then on resets it.

FAULT It : Illuminates amber accompanied by ECAM caution activation when a failure is detected.

The FAULT It extinguishes when OFF selected.

It flashes at the end of SEC power up test (at electrical power application).

③ TURB DAMP pb sw

R **on** : Command of Turbulence damping function is added to normal law elevator and yaw damper command.

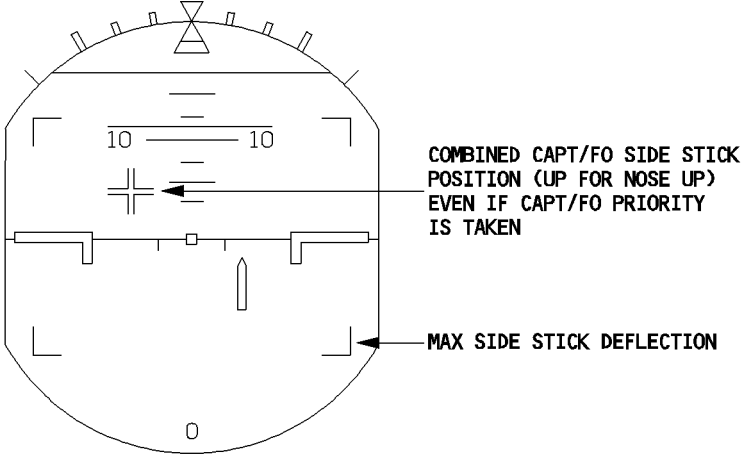
OFF : Turbulence damping function commands are inhibited.

SIDE STICK INDICATIONS ON PFD

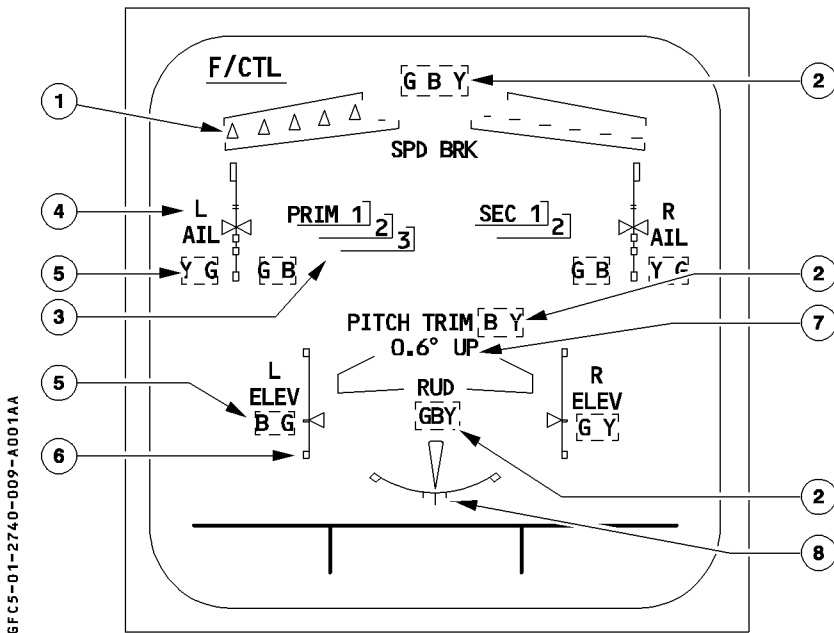
On ground, after first engine start, side stick position indications appear white on both PFDs.

The indication disappears when the aircraft passes from ground to flight.

R



GFCS-01-2740-008-A001AA

ECAM F / CTL PAGE

GFC5-01-2740-009-A001AA

① Spoilers / speed brakes indication

- R
- △ : Spoiler not retracted (green)
 - : Spoiler retracted (green)
 - △ : Spoiler fault deflected (amber)
 - 1 2 3 ... : Spoiler fault retracted (amber)

Note : Same indications are displayed on WHEEL page.

② Hydraulic system pressure indication

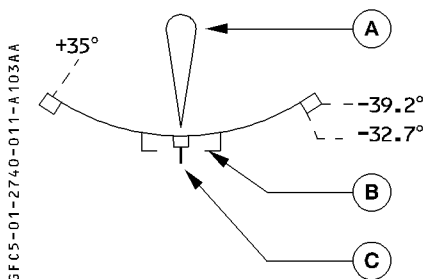
Normally green. Becomes amber in case of hydraulic system low pressure (downstream the leak valves).

③ PRIM / SEC indication

- PRIM, SEC labels are always displayed in white.
- Computer number is normally green boxed grey. Number and box become amber in case of computer failure.



8 Yaw control indications



(A) Rudder position indication

It is normally in green.

The rudder symbol becomes amber, in case of blue + green + yellow hydraulic low pressure.

(B) Rudder travel limiter or PTLU indication

It is normally in green.

It becomes amber, when Travel Limiters 1 and 2 are faulty.

(C) Rudder trim position

It is normally in blue.

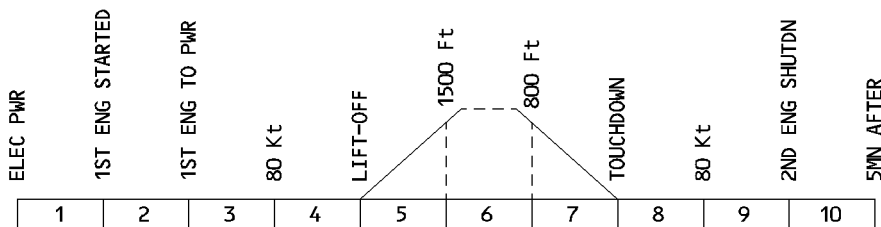
The position varies from -29.2 to $+29.2$ degrees.

It becomes amber, if rudder trim systems 1 and 2 are inoperative.



WARNINGS AND CAUTIONS

6FC5-01-2740-012-A 105AA



E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
CONFIG . SPD BRK NOT RETRACTED or . PITCH TRIM NOT IN TO RANGE (-7°, 0°) . RUD TRIM NOT IN TO RANGE (± 3°) Aircraft not in TO configuration, when thrust levers are set at TO or Flex TO, or when pressing the TO CONFIG. pb.	CRC	MASTER WARN	F/CTL	NIL	5, 6, 7, 8
CONFIG R (L) SIDESTICK FAULT (BY TAKE OVER) L or R sidestick is inoperative, deactivated by takeover pb, when thrust levers are set to TO or Flex TO, or when pressing the TO CONFIG. pb.			NIL	Red * SIDESTICK PRIORITY lt	4, 5, 6, 7, 8
L + R ELEV FAULT Loss of both elevators.				PFD message	NIL
L (R) SIDESTICK FAULT Transducers on pitch or roll axis are failed on one sidestick.	SINGLE CHIME	MASTER CAUT	F/CTL	NIL	NIL
PRIM 1 (2)(3) FAULT Failure of 1 primary computer.				FAULT lt on PRIM pb	3, 4, 5, 7, 8
SEC 1 (2) FAULT Failure of one secondary computer.				FAULT lt on SEC pb	3, 4, 5
FCDC 1 + 2 FAULT Failure of both FCDCs.				NIL	4, 5, 7
DIRECT LAW Direct laws are active.				PFD message	4, 5, 7, 8
ALTN LAW Alternate laws are active.				NIL	
IR DISAGREE Disagree between two IRs ; the third one failed.				PFD message	
ADR DISAGREE Disagree between two ADRs, the third one being failed or rejected by the PRIMs.	NIL	3, 4, 5, 7			
DUAL INPUT Both sidesticks are moved simultaneously.	Synthetic voice repeated every 5 seconds	NIL		SIDESTICK Priority light	NIL

* The red SIDESTICK PRIORITY light comes on, as soon as the sidestick is inoperative.




R

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB			
GND SPLR FAULT loss of ground spoiler function in all PRIM computers	SINGLE CHIME	MASTER CAUT	F/CTL	NIL	3, 4, 5			
SPD BRK DISAGREE position disagree between surfaces and handle pos								
SPD BRK FAULT spd brake lever transducers to all PRIM failed								
SPD BRK STILL OUT SPD BRK memo is amber for more than 30 seconds.			NIL		1 to 5 8 to 10			
STAB CTL FAULT Loss of the electrical control of the stabilizer			F/CTL		4, 5			
L (R) ELEV FAULT loss of both servojacks on one elevator								
L (R) OTR (INR) AIL FAULT loss of both servojacks on one aileron								
SPLR FAULT loss of one or more spoilers			F/CTL		3, 4, 5, 7			
YAW DAMPER FAULT Yaw damper 1+2 failure								
ELEV REDUND LOST loss of the elevator redundancy for which a subsequent failure would lead to a degraded pitch control or pitch mechanical back up								
SENSOR FAULT loss of any sensor of F/CTL sys			F/CTL		4, 5, 8			
RUD TRIM FAULT rudder trim 1+2 fault								
RUD TRV LIM FAULT travel limiter 1+2 fault								
ELEV SERVO FAULT loss of one servojack on one elevator			NIL		NIL	NIL	NIL	1, 4, 5, 7, 8, 10
AIL SERVO FAULT loss of one servojack on one aileron								
FCDC 1 (2) FAULT								
YAW DAMPER 1 (2) Travel limiter 1+2 failure	F/CTL	4, 5						
RUD TRIM 1 (2) FAULT								
RUD TRV LIM 1 (2)								
RUD G (Y) (B) SERVO JAM	NIL	3, 4, 5, 7, 8						
SEC 1(2) PITCH FAULT								
PRIM 1 (2)(3) PITCH FAULT								
TURB DAMP FAULT longitudinal or lateral turbulence damping lost due to accelerometer failure	NIL	3, 4, 5, 7,8						

**MEMO**

- SPEED BRK memo display logic :
 - When the speedbrakes are extended, in Flight Phases 2, 3, 4, and 5, the SPEED BRK memo flashes amber.
 - When the speedbrakes are extended, in Flight Phase 6 and 7, the SPEED BRK memo is displayed in green. It flashes amber, after 50 seconds, if at least one engine is above idle.
- The GND SPLRS ARMED message is displayed in green, when the ground spoilers are armed.
- The TURB DAMP OFF message is displayed in green, when the TURB DAMP pushbutton is selected OFF.

 AIRBUS TRAINING A330 SIMULATOR FLIGHT CREW OPERATING MANUAL	FLIGHT CONTROLS	1.27.50	P 1
	FLAPS AND SLATS	SEQ 001	REV 03

DESCRIPTION

GENERAL

Lift augmentation is achieved on each wing by:

- 2 flaps surfaces
- 7 slats surfaces
- 2 ailerons (aileron droop function)

These surfaces are electrically signalled and hydraulically operated.

Slats and flaps are selected by the «FLAPS» lever located on the center pedestal. It has 5 positions.

MAIN COMPONENTS

Slats and Flaps systems are similar, comprising:

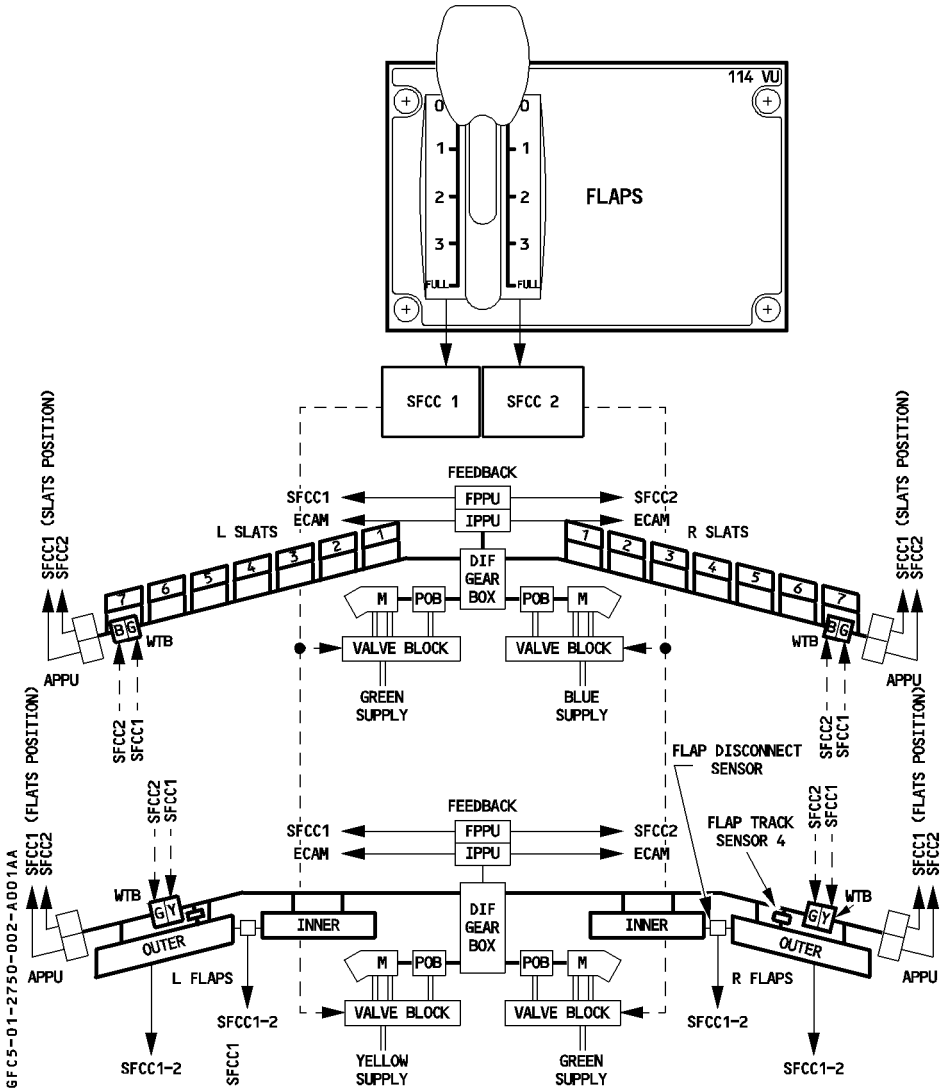
- Two Slats Flaps Control Computers (SFCC) each containing one flap channel and one slat channel.
- A Power Control Unit (PCU) consisting of 2 independent hydraulic motors coupled to a differential gearbox.
The motors driven by the related channel, are supplied by blue and green hydraulic power for the slats and green and yellow for the flaps.
Pressure-Off Brakes (POB) are installed to lock the transmission when the flaps or slats surfaces have reached the selected position or in case of hydraulic power failure.
- R – 7 Slats and 2 Flaps surfaces per wing.
- Two Asymmetry Position Pick Off Units (APPU) measuring the asymmetry between left and right wing.
- Flap disconnect detection system which detects attachment failure and inhibit flap operation in order to limit further damage. The failure is detected by a sensor measuring excessive differential movement between inner and outer flaps.
- R – Wing tip brakes (WTB), activated in case of asymmetry, overspeed or symmetrical runaway.
They cannot be released in flight.
They are supplied by blue and green power for the slats and by green and yellow for the flaps.
- Feedback Position Pick Off Units (FPPU) provide position feed back to SFCCs.
- Indication position pick off unit (IPPU) provide position data to the ECAM.


*Note : If flap wing tip brakes are activated, slat operation is still possible and vice-versa.
If one SFCC is inoperative both slats and flaps will operate at half speed.
If one hydraulic system is inoperative, the corresponding surfaces (slats or flaps) operate at half speed.*

ARCHITECTURE

FOR INFO

R



AIRBUS TRAINING  A330 SIMULATOR FLIGHT CREW OPERATING MANUAL	FLIGHT CONTROLS		1.27.50	P 3
	FLAPS AND SLATS		SEQ 001	REV 03

CONFIGURATIONS

FLAPS lever has 5 positions: 0, 1, 2, 3 and FULL.

Two configurations correspond to FLAPS lever position 1: CONF 1 or CONF 1+F. Selection is done as below.

AUTOMATIC RETRACTION SYSTEM (ARS)

When CONF1 + F is selected, auto retraction of flaps to 0 occurs at 200 kt (before VFE which is 215 kt).

FLAP LOAD RELIEF SYSTEM (FLRS)

Available only in CONF 2, 3 or FULL. When activated, the system retracts the flaps to the deflection corresponding to the next further retracted lever position.

Auto retraction of flaps occurs only in case of VFE exceedance (VFE + 2.5 kt).

If speed is reduced below VFE (VFE – 2.5 kt) flaps return to normal (selected) position.

In CONF 2, auto retraction results in CONF 1* (20 slats/8° flaps).

In CONF 3, auto retraction results in CONF 2* (23 slats/14° flaps).

These configurations can be obtained only by FLRS activation.

Note : 1. When FLAPS 1 is selected, VFE of CONF 1 or CONF 1 + F is displayed on PFD depending on actual configuration.

In approach VFE next is 205 kt (VFE of CONF 1)*

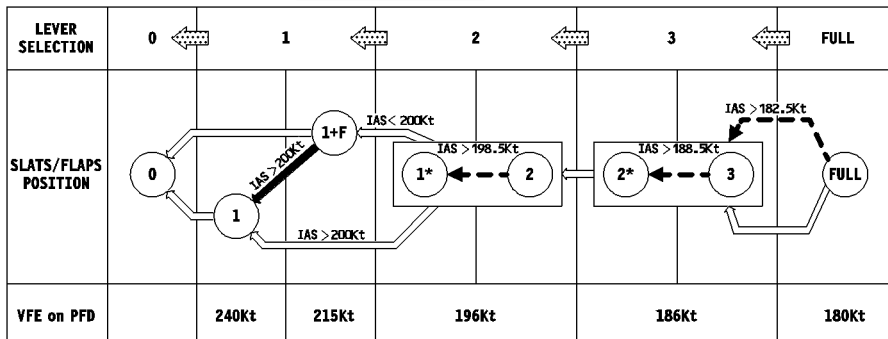
2. When FLAPS 2 is selected in approach, VFE of CONF 2 or CONF 1* is displayed on PFD depending on FLRS activation.

3. When FLAPS 3 is selected, only VFE of CONF 3 is displayed on PFD independently of FLRS activation.

In case of FLRS activation the ECAM upper display shows a flashing "RELIEF" message. If the speed is increased by 4 kt above the VFE corresponding to the actual flap/slat configuration, an overspeed warning is provided on ECAM.

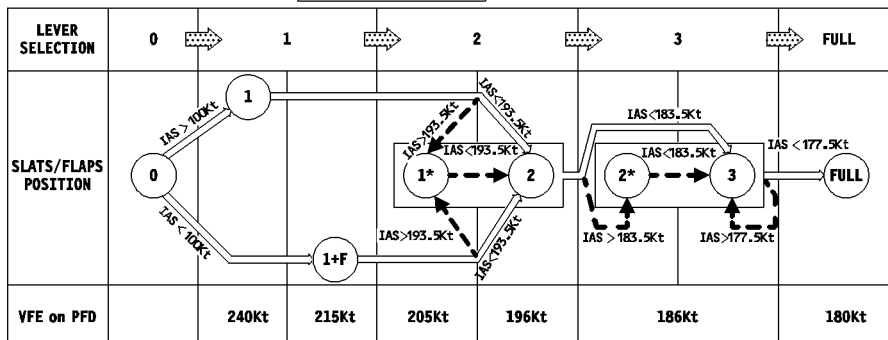
R

RETRACTION



- ➔ FLAP LOAD RELIEF SYSTEM
- ➔ AUTOMATIC RETRACTION SYSTEM
- ➔ MANUAL SELECTION

EXTENSION



- ➔ FLAP LOAD RELIEF SYSTEM
- ➔ AUTOMATIC RETRACTION SYSTEM
- ➔ MANUAL SELECTION

GFC5-01-2750-004-A001AA

 AIRBUS TRAINING A330 SIMULATOR FLIGHT CREW OPERATING MANUAL	FLIGHT CONTROLS	1.27.50	P 5
	FLAPS AND SLATS	SEQ 001	REV 03

SLATS ALPHA / SPEED LOCK FUNCTION

- This function inhibits slats retraction at high angle-of-attack and/or low speed.
- R The SFCC use corrected angle-of-attack (alpha) or air speed information from ADIRUs to inhibit slat retraction.
 - R If alpha exceeds 8.5 degrees or speed falls below 148 kt, the retraction from position 1 to 0 is inhibited.
 - R The inhibition is removed when alpha falls below 7.5 degrees or when the speed exceeds 154 kt. In this case the slats automatically retract to 0.
- The function is not active if:
- R – alpha exceeds 8.5 degrees or speed falls below 148 kt after the lever has been selected
 - R to 0
 - R – Aircraft on ground with speed below 60 kt.

SIGNALS TO OTHER SYSTEMS

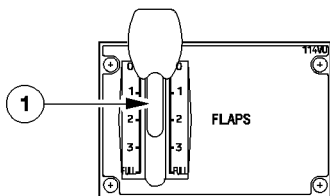
- R The SFCC transmit flap/slat position to the following systems:
 - PRIM and SEC
 - FMGC
 - ADIRU
 - EIU
 - CIDS
 - GPWS

Note: The ECAM system receives the position information directly from the IPPU (Instrumentation Position Pick Up Unit). This information is used for warnings and position indications on the E/WD.

CONTROLS AND INDICATORS

PEDESTAL

GFC5-01-2750-006-A001AA



① FLAPS lever

The FLAPS lever selects simultaneous operation of the slats and flaps.
 The five lever positions correspond to the following surface positions:

R

Lever Position	SLATS	FLAPS	AILERONS	Ind. on ECAM	FLIGHT PHASE	
0	0	0	0			CRUISE
				1		HOLD
1	16	0	0	1 + F	TAKEOFF	
		8	5			
2	20	8	10	2(a)	TAKEOFF	APPR
		14	10	2		
3	23	14	10	3(b)	LDG	
3	23	22	10	3		
FULL	23	32	10	FULL		
(a) This slats/flaps position corresponds to CONF 1*						
(b) This slats/flaps position corresponds to CONF 2*						

Before selection of any position, the lever must be pulled out of detent.
 Moreover, balks are provided at position 1 and 3 to avoid excessive flap / slat travel demand by a single pilot action.

Note : It is not possible to select an intermediate lever position.

Takeoff in CONF 1:

CONF 1 + F (16 / 8) is selected. The flaps automatically retract at 200 knots.

Takeoff or go-around in CONF 2 or 3:

At FLAPS 1 selection: CONF 1 + F (16 / 8) is selected if speed < 200 knots.
 Then, the flaps automatically retract at 200 knots.

0 to 1 above 100 Knots:

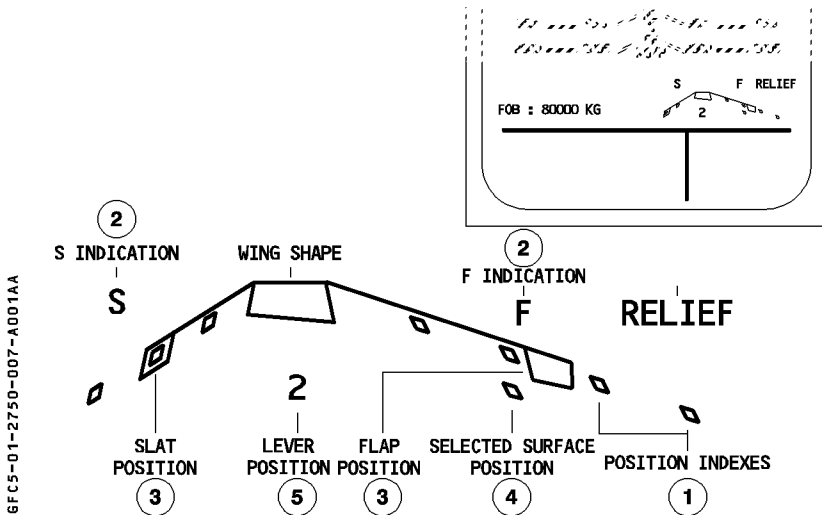
CONF 1 (16 / 0) is selected.

Note : After flaps retraction, CONF 1+F is no longer available until speed is 100 knots or less, except if CONF 2 or more has been previously selected.



ECAM UPPER DISPLAY

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① Position indexes:

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A fixed grey center part and three plus four white dots show all the flaps and slats positions. The white dots are not displayed in clean configuration.

② F and S

Normally white. Not displayed in clean configuration.

The F symbol is :

- replaced by amber F LOCKED message when wing tip brake is applied to flaps.
- replaced by green pulsing F RELIEF message when flap load relief system is activated.
- displayed in amber at flap system failure or at yellow and green hydraulic system low pressure.

The S symbol is :

R

- replaced by amber S LOCKED message when wing tip brake is applied to slats.
- replaced by green pulsing A LOCK message when alpha/speed LOCK function is activated.
- displayed in amber at slat system failure or at blue and green hydraulic system low pressure



③ Flaps/Slats actual position

The green boxes move independently when flaps/slats are retracted or extended. When fully retracted boxes are side by side with wing fixed part. Signal is acquired by separate sensors not used by the SFCC.

Symbols become amber at incidence of S (F) LOCKED. Slat box is green pulsing when alpha/speed lock function is active, flap box when flap load relief system is active.

④ Selected position

Blue when the surfaces are in transit.

Disappears when the selected position has been reached.

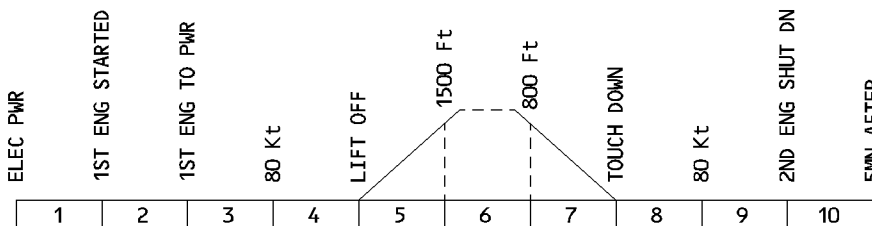
Provided by the SFCC.

R ⑤ Lever position

R Numbers and letters indicate the flaps/slats position. Green when actual position agree with selected position. Blue when surfaces in transit. Not displayed in clean configuration. Provided by the SFCC.

WARNINGS AND CAUTIONS

6FC5-01-2750-009-A110AA



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E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
CONFIG SLATS (FLAPS) NOT IN TO CONFIG Slats or flaps are not in takeoff configuration when thrust levers are set at TO or FLEX TO, or when pressing TO CONFIG pb.	CRC	MASTER WARN	NIL	NIL	5, 6, 7, 8
SLATS (FLAPS) FAULT Failure of both slat or flap channels	SINGLE CHIME	MASTER CAUT			4, 5, 8
SLATS (FLAPS) LOCKED Slats or flaps wing tip brakes applied.					1, 2, 4 5, 6, 7 8, 9 10
FLAP/MCDU DISAGREE Discrepancy between real TO flaps position and value entered into MCDU PERF TO page.					NIL
LVR OUT OF DETENT The flap/slat lever is between two detents.	NIL	NIL			NIL
SLATS SYS 1 (2) FAULT Failure of slat channel in one SFCC.					3, 4, 5, 7, 8
FLAP SYS 1 (2) FAULT Failure of flap channel in one SFCC.					
SLAT (FLAP) TIP BRK FAULT Failure of one wing tip brake on slats or flaps.	CRC	MASTER WARN			1 to 5, 7 to 10
FLAP LVR NOT ZERO Slat/flap lever is not in the zero position, and altitude is above 22 000 feet.					



BUS EQUIPMENT LIST

FOR INFO

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		NORM			EMER ELEC		
		AC	DC	DC BAT	AC ESS	DC ESS	HOT
MAIN FLT CTL COMPUTERS	PRIM 1					X	X (1)
	PRIM 2		DC2				
	PRIM 3		DC2 (3)				
	SEC 1					X	X (1)
	SEC 2		DC2			X (2)	
	FCDC1					X	
	FCDC2		DC2				
FLAP SLAT COMPUTERS	SFCC 1 slats					LAND REC	
	SFCC 1 flaps					SHED (LAND REC)	
	SFCC2 slats		DC2				
	SFCC2 flaps		DC2				
SENSORS	RATE GYRO 1					X	X (1)
	RATE GYRO 2					X	X (1)
	ACCELRM 1					X	X (1)
	ACCELRM 2		DC2				
PITCH TRIM	ACTUATOR 1					SHED	
	ACTUATOR 2		DC2				
	ACTUATOR 3		DC2				
RUDDER TRIM	ACTUATOR 1					SHED	
	ACTUATOR 2		DC2			SHED (2)	
RUDDER TRAVEL	ACTUATOR 1					X	
	ACTUATOR 2		DC2			X (2)	

(1) Hot bus supplies, when DC ESS BUS fails.

(2) Normal supply is from DC BUS 2. DC ESS BUS supplies, in case of a DC BUS 2 failure.

(3) Normal supply is from DC BUS 2. DC BUS 1 supplies, in case of a DC BUS 2 failure.