ATTACHMENT R

Excerpts from the Airbus A300-600 FCOM

Volume 1

(14 pages)

Errata:

The page of this document marked [1.09.14, Page 1, Rev 25, Seq 100], "Description Yaw Control", replaces the page originally provided under the same topic.
The original page was marked [1.09.50, Page 1, Rev 11, Seq 020] and was replaced May 8, 2003.

The control of the aircraft is achieved by:

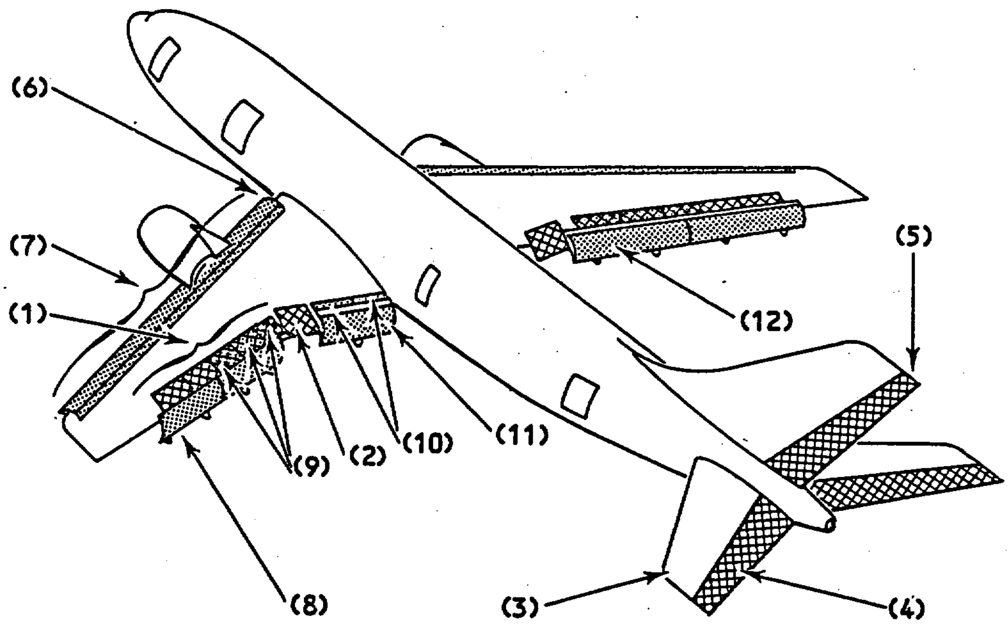
- the primary flight controls
- the secondary flight controls.

The primary flight controls ensure:

- ROLL CONTROL achieved on each wing by:
  . one aileron
  . five roll spoilers, upper wing surfaces n° 3 through 7.
- PITCH CONTROL achieved by two elevators hinged on the trimmable horizontal stabilizer.
- PITCH TRIM CONTROL achieved by the trimmable horizontal stabilizer hinged on the aircraft structure.
- YAW CONTROL achieved by one rudder.

The secondary flight controls ensure:

- FLAP CONTROL achieved on each wing by:
  . three single slotted flaps R
- LIFT AUGMENTING achieved on each wing by:
  . three slats
  . one kruger flap
  . one notch flap.
- SPEEDBRAKE CONTROL achieved on each wing by upper wing surfaces n° 1 through 5.
- GROUND SPOILER CONTROL achieved on each wing by all upper wing surfaces n° 1 through 7.



PRIMARY CONTROLS LOCATION

(1) ROLL SPOILERS

(2) AILERON

(3) TRIMMABLE HORIZONTAL STABILIZER

(4) ELEVATOR

(5) RUDDER

SECONDARY CONTROLS LOCATION

(6) KRUGER AND NOTCH FLAPS

(7) SLATS

(8) OUTER FLAP

(9) OUTER SPEEDBRAKES

(10) INNER SPEEDBRAKES

(11) INNER FLAP

(12) CENTRAL FLAP

All control surfaces are actuated by irreversible servo controls (in addition, on THS and slats/flaps motors there are pressure-off brakes).

Each one of them is supplied by one of the three independant hydraulic systems. The redundancy is such that with two systems failed, the remaining system provides safe aircraft control over the whole flight envelope.

The servo controls actuation is achieved by a mechanical linkage except for the roll spoilers, speedbrakes, yaw and roll trims, slats and flaps for which the control is made by electrical signalling.

The electrical autopilot orders are transmitted to the mechanical linkage by means of autopilot servo actuators. These orders can be overridden by the pilots.

Control Wheel Steering sensors permit the pilots to alter the autopilot pitch and roll commands.

In the event of control valve jamming in a servo control, an electrically controlled selector valve in the associated hydraulic system cuts off the hydraulic power supply to all the servo controls powered by this system.

Priority valves are installed upstream of the following components :

- blue system : slat power control unit (PCU) motor
- green system : flap and slat PCU motors
- yellow system : flap PCU and THS motors

in order to avoid supply pressure of the main flight controls components dropping (below approximately 1885 psi) when various hydraulic user systems are operated simultaneously.

To preserve the green system, safety valves are installed upstream of the following components :
- Kruger valve block (in case of engine burst)
- Rudder servo control (in case of flight collision).

The roll control surfaces on each wing are:

- one aileron powered by 3 servo controls
- 5 roll spoilers, each one powered by 1 servo control.

The spoiler system is supplied from two normal bus bars (28 V DC and 26 V AC). When the normal buses have been cut off, before landing, power is supplied again to three spoiler groups by pressing the LAND RECOVERY P/B switch on the overhead panel.

From the two interconnected control wheels, the roll inputs are transmitted to the ailerons by dual cable runs providing fail safe operation. In each wing the inputs are transmitted to a differential unit receiving additional inputs from:

- artificial feel unit
- aileron droop unit
- trim screw jack

In case of jamming in one control run, the interconnected spring strut can be compressed to permit operation of the other control run to the other wing. The pilot efforts required on the wheel is between 16 daN (34 lbs) and 40 daN (90 lbs). Spoilers control is still available but downgraded.

Each servo control linkage on the aileron includes a spring rod to protect it against a runaway if an input lever on one jack remains in the open position.

The artificial feel is provided by a spring loaded rod. The trim actuator is electrically signalled by a control on the center pedestal.

In order to improve the aerodynamic characteristics, a droop signal coming from the slats control system moves the ailerons downwards of 9.2° maximum when the slats are extended. During cruise, the operational limits for aileron trim are ± 2°. R R R

The roll spoilers and speedbrakes are electrically signalled by two identical computers (EFCU-Electrical Flight Control Units) that elaborate the roll orders by processing the signals coming from the control wheel position transducers units.

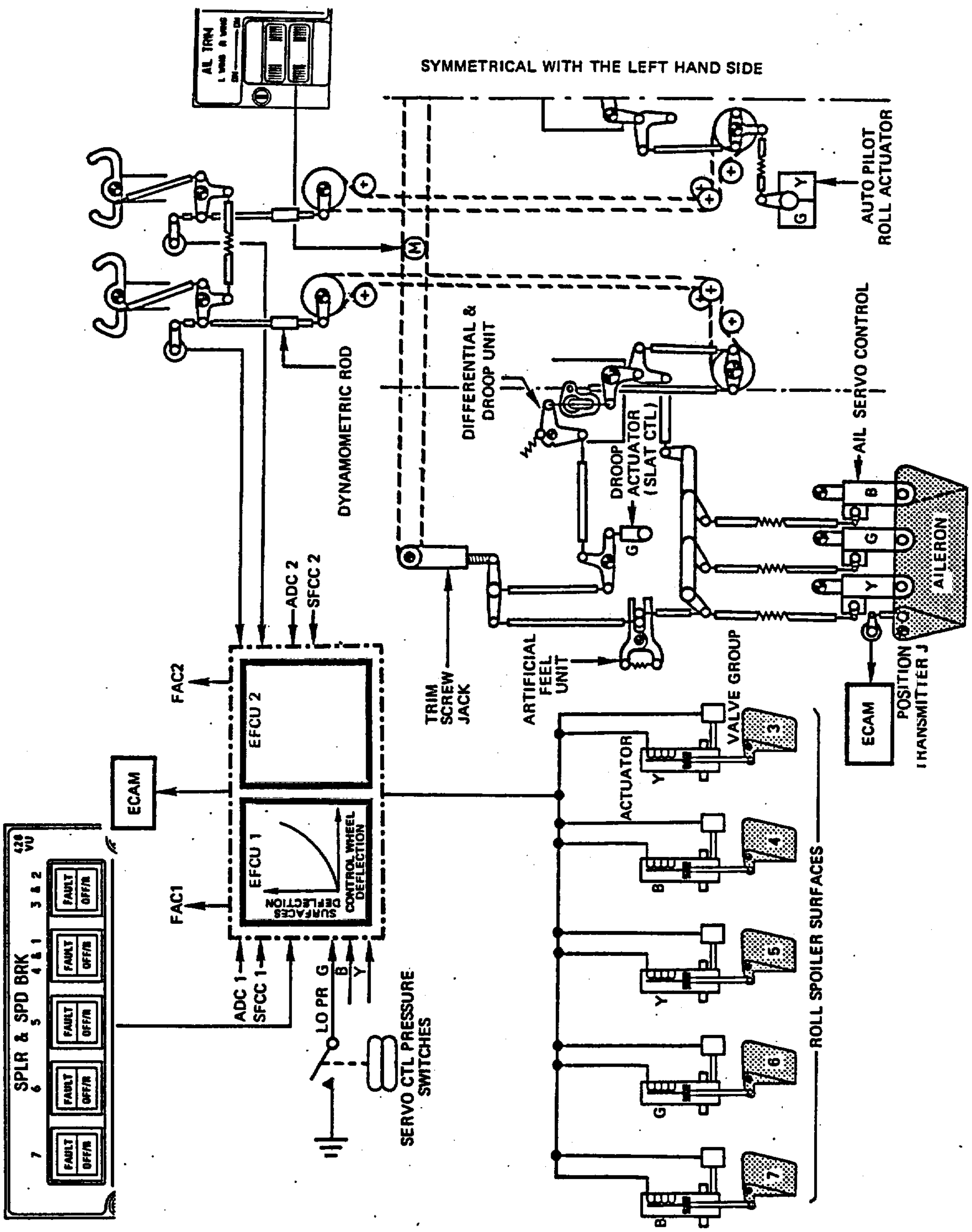
Each computer is composed of two control units and two monitoring units. Each unit controls or monitors one group of surfaces. Each group is made of one or two pairs of servo controls (spoilers 2-3, spoilers 4-1, spoilers 5-7, spoilers 6).

Thus, for a group of servo controls, the corresponding control unit is in one computer and the monitoring unit is in the other one.

For the roll spoilers the control laws are such that they are not usually used unless the control wheel is moved enough.

An autopilot servo actuator is mounted adjacent to the RH wing rear cable quadrant. It drives the complete control via a detent lever which can be overridden by the pilots.

ROLL CONTROL



The pitch control is achieved by two elevators hinged on the horizontal stabilizer, each actuated by three servo controls controlled by a dual mechanical linkage through dynamometric rods, cable runs, an artificial feel system linked to the cable run of the LH control column and load limiting rods.

In normal operation, the two elevators are controlled together.

In case of jamming in one control linkage during flight (take off excluded) pitch control is provided by THS (Trimmable Horizontal Stabilizer).

If jamming occurs at take off, two uncoupling bellcranks enable the elevator on the other side to be controlled by one or both pilots :

- first bellcrank installed downstream of the captain's control column which can be overridden by a pilot force of approximately 50 daN (112 lbs)
- second bellcrank installed between the two elevators.

A pitch uncoupling unit (locking rod plus solenoid) prevents accidental assymetrical deflection of the elevators during flight and allows uncoupling of the RH and LH control systems during take off (locked at speeds lower than 30 kt or higher than 195 Kt).

The artificial feel is provided by the associated action of :

- a double action spring loaded rod.
- a torsion bar driven by a variable gain mechanism which generates a variable stiffness in the control. The variable gain mechanism is actuated by either of two electrohydraulic actuators. Each actuator is controlled by an independant PITCH FEEL channel, each one included in a FLC (Feel and Limitation Computer).

  PITCH FEEL systems are operating above 165 kt.

  Inputs are function of stabilizer position, airspeed, and mach number. In case of failure of two systems, the mechanism returns to the low speed position.

R At high angle of attack, the system causes an increase
R in load at the control column.

In each run, downstream of the artificial feel system, a load limiting spring rod limits the efforts in the elevators control linkage.

A spring loaded rod on each servo control input avoids a runaway of the elevator in case of jamming of one input lever in the open position.

An autopilot actuator is mounted adjacent to the LH elevator. It drives the control via a detent lever which can be overridden by the pilots.

Pitch trim is provided by adjustment of the horizontal stabilizer from + 3° (nose down) to - 14° (nose up). It is actuated by a fail safe ball screw jack driven by two independent hydraulic motors supplied respectively by green and yellow systems and coupled by a differential gear through pressure-off brakes.

Horizontal stabilizer adjustment may be initiated :

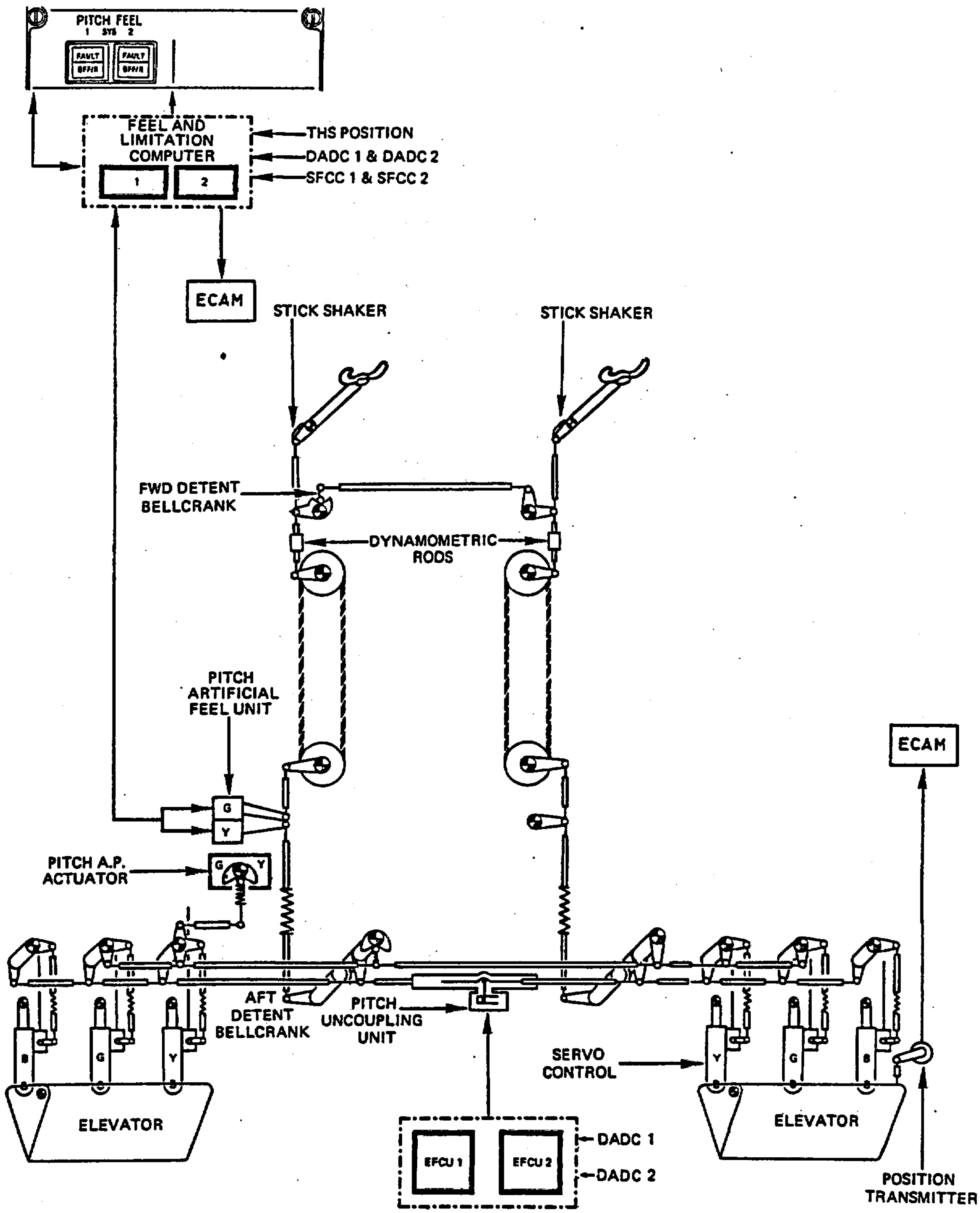
- manually (AP disengaged) by trim wheels operation (mechanical mode) or by action of the control wheel rocking levers (electrical mode).
- automatically by AP trim, mach trim or alpha (angle of attack) trim function.

Electrical and automatic trim signals are processed in two FAC (Flight Augmentation Computers) and control two electrical motors.
Trim speed and trim authority depend on trim mode and aircraft configuration.

The motors drive the control linkage to the hydraulic valves which control the hydraulic motors.
The manual trim wheel run is connected to the same linkage.

Stall warning is provided by a stick shaker (electrical motor) which is installed on each control column, and controlled by the FWC (Flight Warning Computer).

PITCH CONTROL



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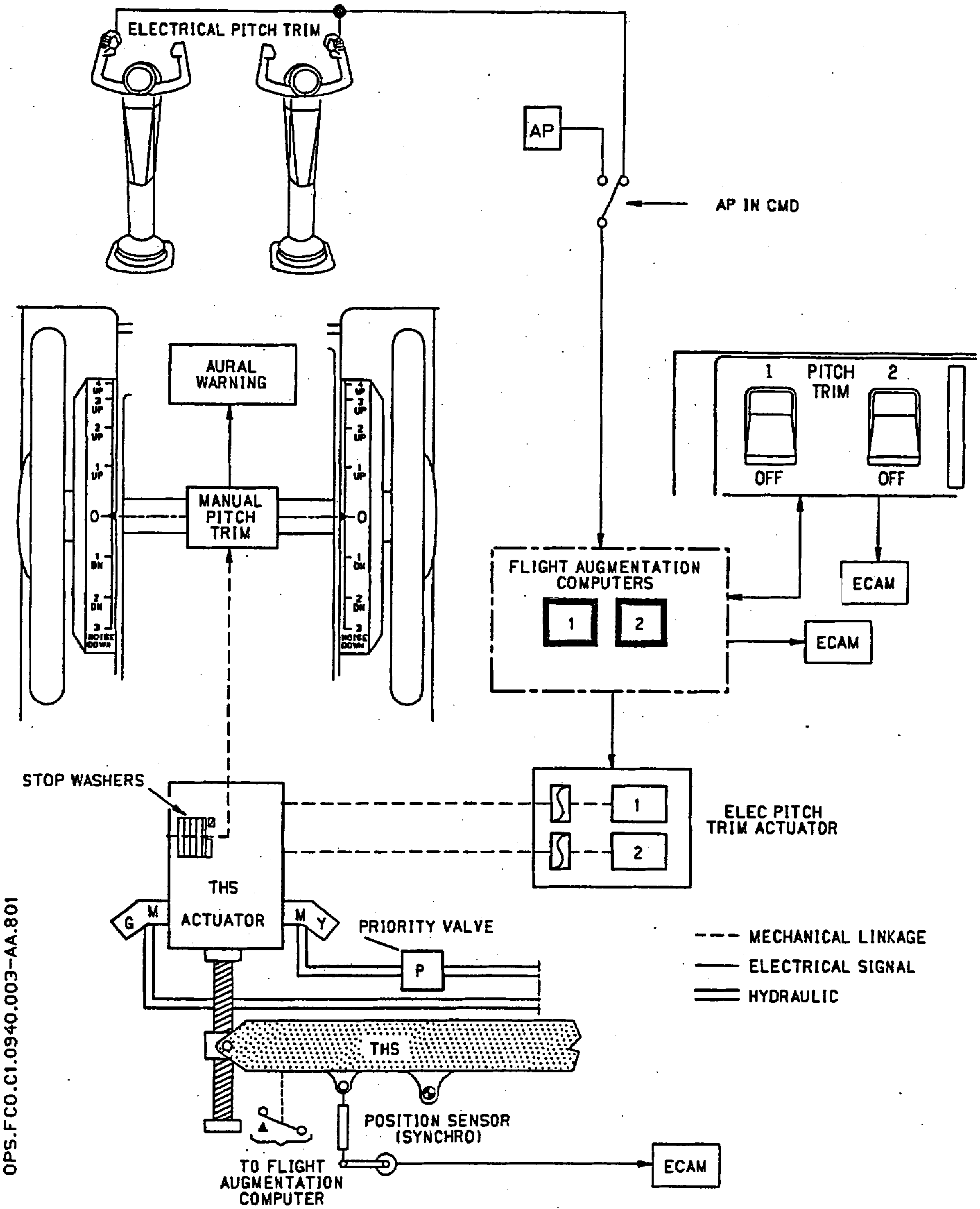
Vers. : All   Eng. : All

PITCH TRIM CONTROL



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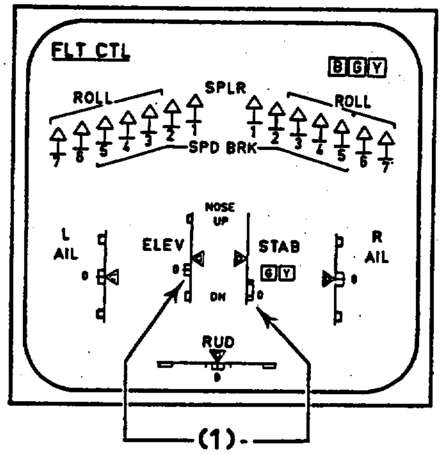
SYSTEM DISPLAY - FLT CTL PAGE



(1) ELEV and STAB Position Indication

A white scale covering the full travel range is provided for elevator and trimmable horizontal stabilizer position.

An index indicating the actual position of the surfaces moves along each scale.

In addition each available hydraulic system on the THS is indicated by a green symbol (G, Y).

In case of servo control low pressure detection, the corresponding symbol becomes amber.

RUDDER CONTROL

- The rudder is controlled by 3 actuators, which are commanded by a single cable run from the rudder pedals.

  Rudder artificial feel is provided by a spring-loaded rod.

- Additional inputs to the rudder come from:
  - the rudder trim, and
  - the 2 yaw dampers.

- Rudder trim is operated by an electric motor.

- During cruise, it is recommended to trim the aircraft to achieve a Zero Control Wheel deflection.

  The resulting rudder trim deflection should not exceed 1.5 unit NOSE L or NOSE R.

- 2 independent Rudder Travel Limiting Systems (RUD TRAVEL), controlled by the Feel and Limitation Computers (FLC), progressively decrease the maximum rudder travel from ± 30° below 165 kt (low speed range) to ± 3.5° above 310 kt (high speed range).

  If both systems fail, whatever the aircraft speed, the mechanism automatically returns to the low speed position (± 30° rudder travel available).

  If the system does not return to the low speed position, an ECAM warning (indicating that the rudder travel limiting system is jammed in the high speed range) is activated when flaps are at 20° or more.

  In normal operation, RUD TRAVEL SYS 1 is active and SYS 2 is in standby.

- On the ground, the rudder pedals are linked to the nose wheel steering.

- The AP yaw actuator is connected to the rudder mechanical control system. When one or both AP are engaged and provided slats are extended, the AP actuator drives the rudder. The AP rudder deflection is transmitted back to the rudder pedals.

YAW DAMPER

- The yaw damper ensures the following functions:
  - dutch roll damping,
  - turn coordination which becomes active if sufficient control wheel deflection is applied except if :
    - AP is engaged in CMD, or
    - flaps are extended to 40°, or
    - a stall warning is detected.
  - yaw compensation in case of engine failure, provided the AP is engaged in CMD with SRS (takeoff) or GO AROUND mode annunciated on FMA. R

- Yaw damper command is transmitted to the rudder but there is no deflection feedback sent to the rudder pedals.

- There are two yaw damper systems. In normal operation, yaw damper 1 is operative and yaw damper 2 is in stand-by.

- Each system is engaged by its respective yaw damper lever on the overhead panel.

- If both EFCU fail, both yaw dampers remain engaged but turn coordination is inhibited.

Yaw damper engagement :

- YAW DAMPER lever can be engaged if :
  - power supply is available,
  - associated FAC is operative,
  - associated ADC is operative (condition required only if flaps are retracted),
  - IRS 1 and (2 or 3) is operative for YD 1,
  - IRS 2 and (1 or 3) is operative for YD 2,
  - blue hydraulic system is pressurized, for YD 1,
  - yellow hydraulic system is pressurized, for YD 2.

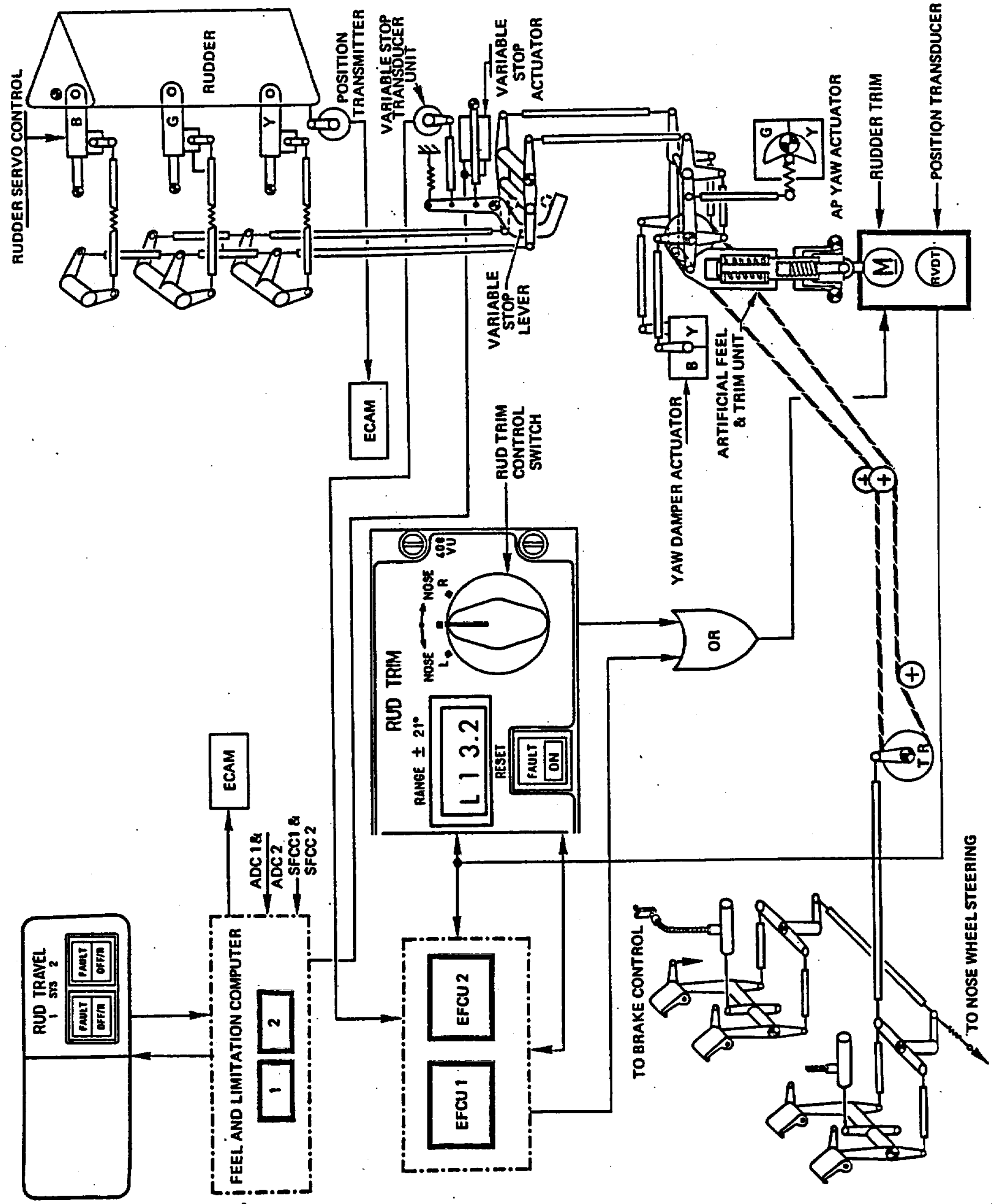
Note : on ground, hydraulic power is not necessary for yaw damper engagement.

Yaw damper disengagement :

- If any of the engagement conditions are lost, the respective YAW DAMPER engagement lever trips to OFF accompanied by ECAM activation.

Mod : 5408

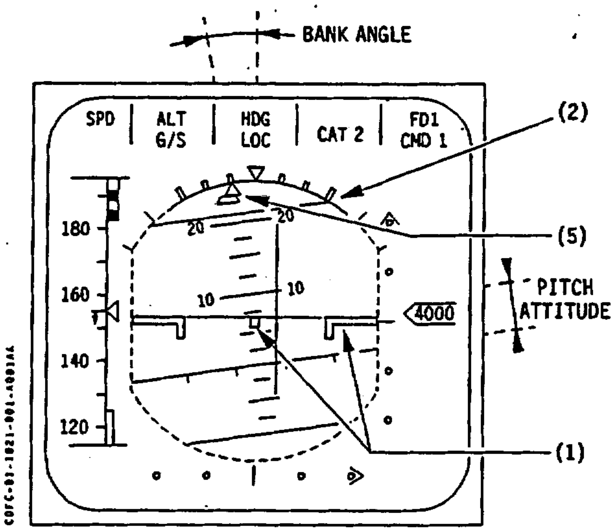
YAW CONTROL



Vers. : All

Eng. : All

ATTITUDE DATA DISPLAY



- The aircraft attitude is indicated in the center area of the PFD in a conventional Attitude Director Indicator (ADI) presentation..
  - The distance between the aircraft symbol and the horizon indicates the aircraft pitch attitude.
  - The angle between the aircraft symbol and the horizon indicates the aircraft bank angle.
  - The sky is colored blue, and the earth is brown.

(1) Fixed Aircraft Symbol

- Black, outlined in yellow.

(2) Bank Angle Scale

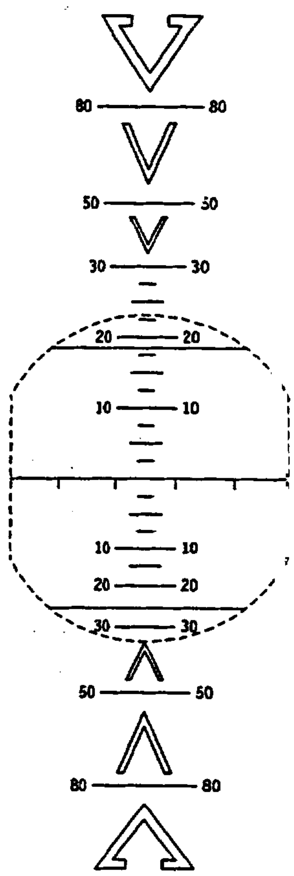
- White scale graduated at 0, 10, 20, 30, 45 and 60° of bank angle.
- The 0 position is marked by a yellow triangle (sky pointer).

(3) Roll Pointer

- A yellow pointer rolls with the aircraft and points at the bank angle on the bank angle scale.

(4) Pitch Scale

- The pitch scale is white, and is graduated in :
  - 2.5° increments between 0° and 30° nose up and between 0° and 10° nose down,
  - 5° increments between 10° and 20° nose down,
  - 10° increments between 20° and 30° nose down.
- In case of excessive nose up or nose down pitch attitude, red V's indicate the direction to the nearest horizon.
- On ground, the nose down scale is not displayed.



(5) Turn Coordination Indicator (side-slip index)

- Below the roll pointer a yellow trapezoid-shaped box indicates the aircraft side-slip.
- The trapezoid replace the conventional side-slip ball :
  - When the trapezoid is centered under the roll pointer, the aircraft is in coordinated flight (no side-slip).
  - If the box is located to one side of the roll pointer, more rudder input is required on that side to cancel the side-slip.

UNUSUAL ATTITUDES

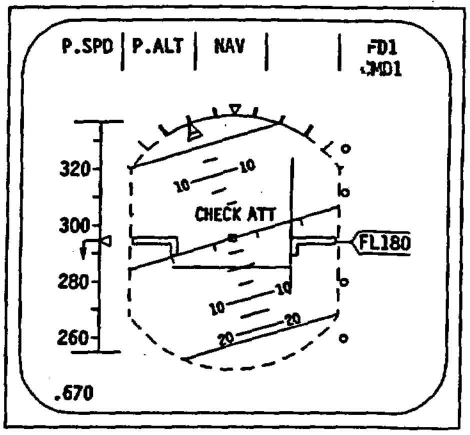
- In order to attract the flight crew attention in case off excessive pitch attitude or bank angle, the PFD display is decluterred in order to display only the information necessary for the recovery of a usual pitch and/or roll attitude.
- **Excessive bank angle :**
  - If the bank angle exceeds 45°, the following information only remain displayed :
    - pitch and roll attitudes,
    - speed,
    - heading,
    - FPV (if selected),

    all other information are cleared from display.
  - The PFD display returns to normal when the bank angle decreases below 40°.
- **Excessive pitch attitudes :**
  - If the pitch attitude exceeds 25° nose up or 13° nose down, the following information only remain displayed :
    - pitch and roll attitudes,
    - speed,
    - heading,
    - FPV (if selected),

    all other information are cleared from display.
  - The PFD display returns to normal when the pitch attitude decreases below 22° nose up or increases above 10° nose down.

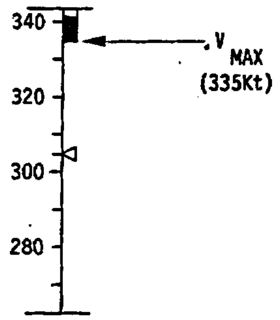
DISPLAY IN FAILURE CASES

- If IRS pitch or roll data is lost, the entire attitude sphere is erased and is replaced by a red "ATT" message (refer to section 1.10.71 – IRS SWITCHING.
- If there is a difference of more than 4° in pitch or roll between the two PFD a red "CHECK ATT" message is displayed on both PFD.



LIMIT SPEEDS (continued)

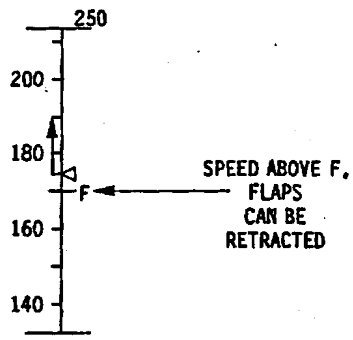
- **VMAX – Maximum Selectable Speed**



- The Maximum selectable speed is displayed as a red and black strip at top of speed scale.
- VMAX depends on aircraft configuration and represents the following :
  - MMO or VMO (Maximum Operating speeds) in clean configuration.
  - VFE (Maximum speed Flaps/slats Extended) when slats or flaps are extended.
  - VLE (Maximum speed Landing gear Extended), when landing gear is extended.

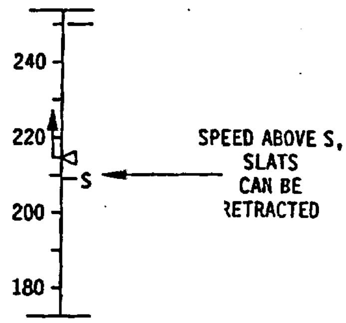
MANEUVERING SPEEDS

- **F – Minimum Flaps Retraction Speed :**



- The minimum Flaps retraction speed F is displayed as a green "-F" on the speed scale.
- F is displayed when the SLAT/FLAP lever is in the 15/15 or 15/20 positions.
- The flaps must only be retracted when the speed is above F-speed.
- F = 1.25 × stall speed of the slats 15 / flaps 0 configuration.
- F is also the approach maneuvering speed in Flaps 20 configuration (i.e. F = 1.4 to 1.5 × stal speed in 15/20 configuration).

- **S – Minimum Slats Retraction Speed :**



- The minimum Slats retraction speed is displayed as a green "-S" on the speed scale.
- S is displayed when the SLAT/FLAP lever is in the 15/0 position.
- The slats must only be retracted when the speed is above S-speed.
- S = 1.25 × Stall speed of the clean configuration.
- S is also the maneuvering speed in Slats 15 configuration (i.e. S = 1.4 to 1.5 × stall speed in 15/0 configuration).