

	POWER PLANT THRUST CONTROL SYSTEM		1.70.35	P 1
			SEQ 150	REV 17

GENERAL

A FADEC dedicated to each engine controls thrust.

The pilot uses the thrust levers to set the thrust in manual mode, and the FMGS sets the thrust in automatic mode.

The FADEC prevents the thrust from exceeding the limit for the thrust lever position in both manual and automatic modes.

The engine thrust setting is made through control of the Engine Pressure Ratio (EPR).

EPR = low pressure turbine exhaust pressure (P5)/ Engine air inlet pressure (P2).

ENGINE POWER SETTING

Two modes of power setting, EPR and N1 modes are used for engine control depending on the availability of air data inputs to the FADEC which are used for rating computation.

Two sources of air data are used by the FADEC :

- either engine data
 - : P0 static pressure
 - P2 total air pressure
 - T2 total air temperature
- or ADIRS 1 or 2 data
 - : Ps equivalent to engine P0
 - Pt equivalent to engine P2
 - Tt equivalent to engine T2

Thrust computation for both engines is mainly based on one ADIRS data. This ensures engine thrust symmetry.

A comparison between ADIRS 1, ADIRS 2 and engine data is made by the FADEC to determine the source to be validated and the mode to be used.

EPR MODE

EPR mode is the normal mode to control the thrust.

The required EPR is set by controlling the fuel flow.

The FADEC computes the command EPR as a function of :

- Thrust Lever Angle (TLA)
- Altitude
- Mach number
- Air data (static pressure, total air pressure/temperature)
- Service bleed.

Note : During reverse operation, the thrust is controlled as a function of N1.

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N1 MODE

If no EPR is available (either sensed or computed), the affected FADEC will automatically revert to N1 mode.

Upon reversion to N1 mode, a thrust equivalent to that achieved in EPR mode is provided, until a change in thrust lever position.

Depending on the failure case leading to EPR mode loss, the FADEC will revert to either rated or unrated N1 mode.

Autothrust control disengages. However, it can be re-engaged if no more than one engine is in unrated N1 mode. ALPHA FLOOR protection remains available if no more than one engine is in unrated N1 mode.

RATED N1 MODE

An automatic reversion to rated N1 mode occurs, when :

- Engine P2 and/or P5 are not available, or
- Engine P2 is lower than ADIRS Pt.

The FADEC will compute an EPR COMMAND, depending on the TLA, then convert it to a N1 COMMAND as a function of Mach.

The rated N1 mode can also be manually-selected via the ENG N1 MODE pushbutton on the overhead panel.

UNRATED N1 MODE

An automatic reversion to unrated N1 mode occurs, when :

- Engine P2 and ADIRS 1 + 2 Pt are not available, or
- Engine T2 and ADIRS 1 + 2 Tt are not available, or
- Engine P0 and ADIRS 1 + 2 Ps are not available.

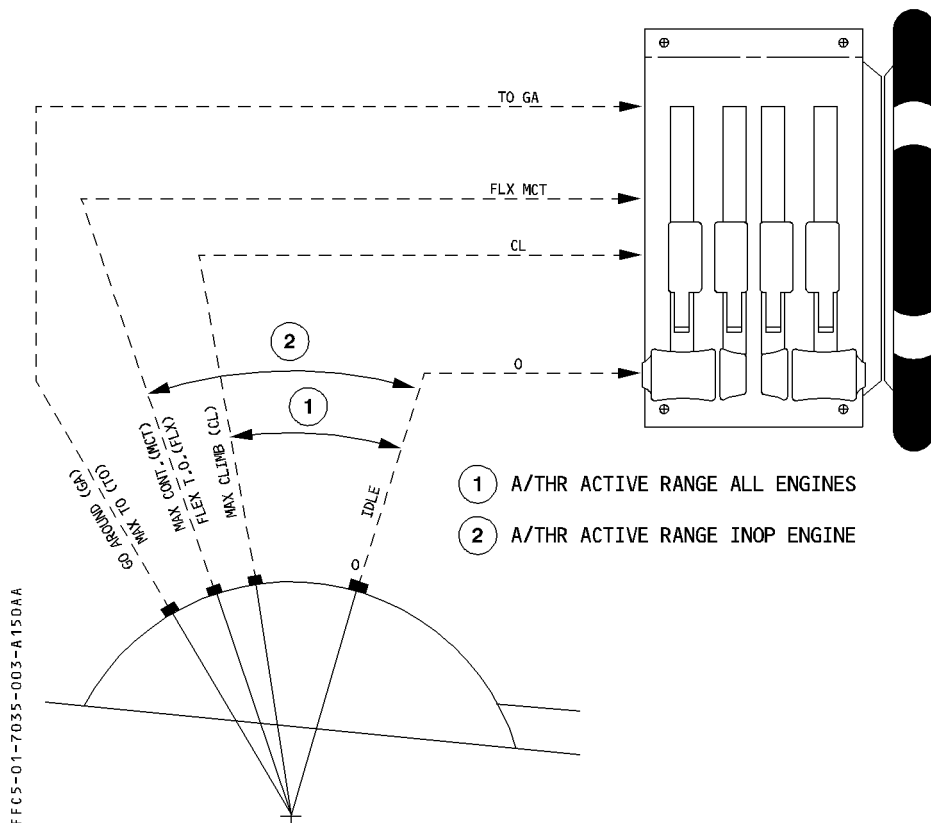
N1 is defined as a function of the TLA, and altitude and is limited by the FADEC to either the lesser of N1 max or N1 redline (if T2 is available), or N1 redline (if T2 is not available).

The N1 rating limit, N1 TLA, and N1 max indications on the ECAM E/WD are lost.

EPR RECOVERY LOGIC

With the FADEC in either rated or unrated N1 mode, switching OFF the ENG N1 MODE pushbutton on the overhead panel will permit to return to the EPR mode, if the failure has disappeared.

THRUST LEVERS



The thrust levers can only be moved manually.

The range of movement is divided into 3 operating segments.

Thrust lever position is transmitted to the FADEC which computes and displays the thrust rating limit and the EPR TLA.

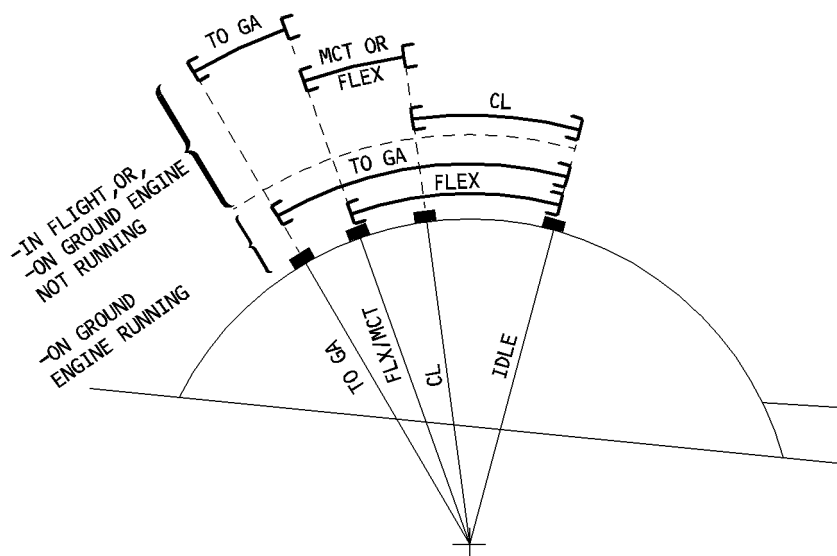
THRUST RATING LIMIT

The FADEC computes the thrust rating limit for each thrust lever position, as shown below.

If the thrust lever is set in a detent, the FADEC selects the rating limit corresponding to this detent.

If the thrust lever is set between two detents, the FADEC will select the rating limit corresponding to the higher detent.

EPR RATING LIMITS :



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THRUST CONTROL

MANUAL MODE

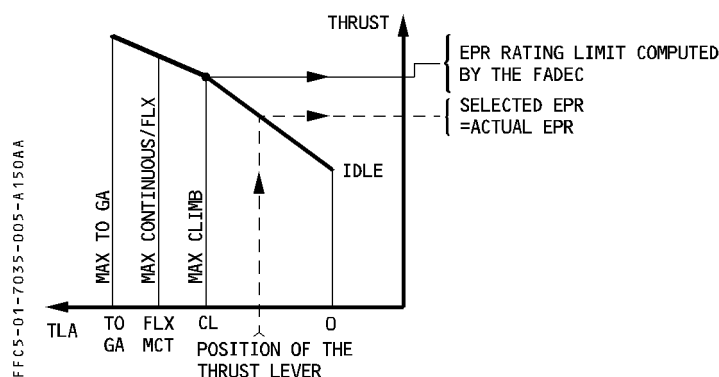
The engines are in the manual mode, provided the A/THR function is:

- not armed, or
- armed and not active (thrust lever not in the A/THR operating range and no alpha floor).

In these conditions, each engine is controlled by the position of its thrust lever.

The pilot controls the thrust by moving the thrust lever from IDLE to TOGA positions. Each position of the thrust lever within these limits corresponds to an EPR.

When the thrust lever is in a detent, the corresponding EPR is equal to the EPR rating limit computed by the FADEC for this engine.



When the thrust lever is set in FLX-MCT detent :

– On the ground :

The engine runs at the flex takeoff thrust rating, if the MCDU has selected a flex takeoff temperature that is higher than the current total air temperature (TAT).

Otherwise, the engine produces maximum continuous thrust (MCT).

Note : A change of FLEX TEMP during takeoff has no effect on the thrust.

– After takeoff:

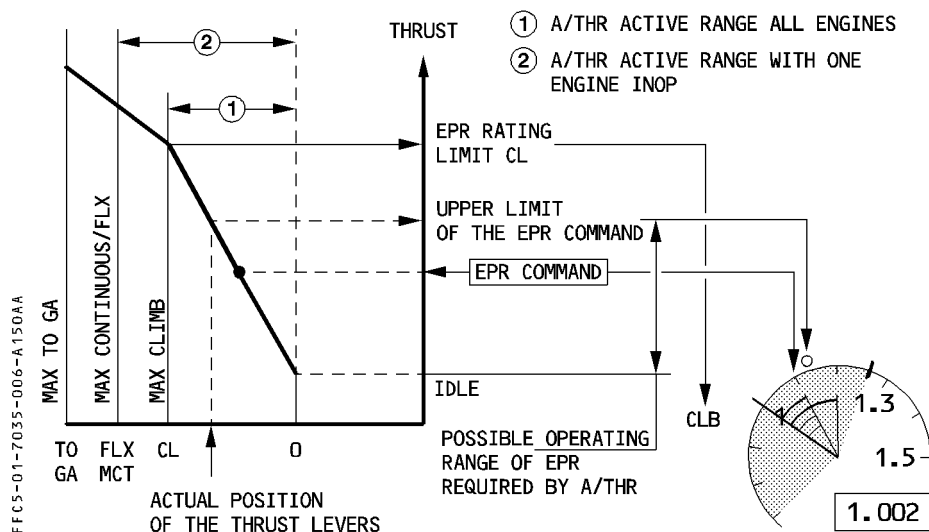
The pilot can change from FLX to MCT by moving the thrust lever to TOGA or CL, then back to MCT. After that, he cannot use the FLX rating.

The pilot can always get MAX TO thrust by pushing the thrust lever all the way forward.

Note : Setting the thrust lever out of the FLX MCT detent, without reaching TOGA or CL detent, has no effect.

AUTOMATIC MODE

In the autothrust mode (A/THR function active), the thrust is computed by the FMGC and is limited to the value corresponding to the thrust lever position (except if the alpha-floor mode is activated).



INDICATIONS ON FMA

The FADECs monitor the positions of the thrust levers, and trigger appropriate indications on the FMA :

- LVR ASYM : Appears in amber (third line on the FMA) if, with A/THR active and all engines running, one thrust lever is set out of CLB detent.
- LVR CLB : Flashes white (3rd line on the FMA), if the thrust levers are not in the CL position, while the aircraft is above the altitude of thrust reduction with all engines running.
- LVR MCT : Flashes white (3rd line on the FMA), if the thrust levers are not in the MCT position, after an engine failure (with speed above green dot).

